The Shift of Precipitation Maxima on the Annual Maximum Series using Regional Climate Model Precipitation Data

by

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ABSTRACT

Ten regional climate models (RCMs) and atmosphere-ocean generalized model parings from the North America Regional Climate Change Assessment Program were used to estimate the shift of extreme precipitation due to climate change using present-day and future-day climate scenarios. RCMs emulate winter storms and one-day duration events at the sub-regional level. Annual maximum series were derived for each model pairing, each modeling period; and for annual and winter seasons. The reliability ensemble average (REA) method was used to qualify each RCM annual maximum series to reproduce historical records and approximate average predictions, because there are no future records. These series determined (a) shifts in extreme precipitation frequencies and magnitudes, and (b) shifts in parameters during modeling periods.

The REA method demonstrated that the winter season had lower REA factors than the annual season. For the winter season the RCM pairing of the Hadley regional Model 3 and the Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model had the lowest REA factors. However, in replicating present-day climate, the pairing of the Abdus Salam International Center for Theoretical Physics' Regional Climate Model Version 3 with the Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model was superior.

Shifts of extreme precipitation in the 24-hour event were measured using precipitation magnitude for each frequency in the annual maximum series, and the difference frequency curve in the generalized extreme-value-function parameters. The average trend of all RCM pairings implied no significant shift in the winter annual maximum series, however the REA-selected models showed an increase in annual-season

precipitation extremes: 0.37 inches for the 100-year return period and for the winter season suggested approximately 0.57 inches for the same return period.

Shifts of extreme precipitation were estimated using predictions 70 years into the future based on RCMs. Although these models do not provide climate information for the intervening 70 year period, the models provide an assertion on the behavior of future climate. The shift in extreme precipitation may be significant in the frequency distribution function, and will vary depending on each model-pairing condition. The proposed methodology addresses the many uncertainties associated with the current methodologies dealing with extreme precipitation.

DEDICATION

The contributions of this work are dedicated to :

My wife, Anamaria, always inspired me to pursue my dreams with her patience and love.

My parents, Octavio and Rosalba, have always been there to lift up my spirits with their encouragement and support.

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INTRODUCTION

Background

Climate change is one of the most studied subjects of the 21st century. Major policy decisions are being driven as a response to the expectancy of greater changes in climate behavior resulting from anthropogenic activities and climate-system responses. Climatologists have been studying climate systems at the global scale and regional scale to reproduce plausible climate-change scenarios that reflect changes due to the combination of natural forces and anthropogenic forces. The Intergovernmental Panel on Climate Change (IPCC; Bernstein et al., 2007) reported that climate changes would result in extreme weather events such as longer droughts, lower rainfall frequency, and severe flooding, due to higher intensity rainfall, especially in the southwestern United States. The North American Regional Climate Change Assessment Program (NARCCAP, 2013) developed regional climate models (RCMs) that are paired with global climate models to provide better resolution and reduce levels of uncertainty in global climate models. Consequently these models can be used to assess the future outcomes of climate change. (see Appendix A for a complete glossary of terms.)

Currently, NARCCAP provides an archive of RCM realizations of various climatic variables for present-day and future-day climate scenarios, including rainfall precipitation. These RCMs downscale general ocean-atmosphere circulation models to a more discrete grid resolution that covers the entire North American continent. A number of studies have evaluated rainfall precipitation patterns for the entire region, but few have considered extreme variations at the subregional level. Mishra, Dominguez, and

Lettenmaier (2012) studied the ability of RCM models to reproduce urban precipitation extremes; Moise and Hudson (2008) studied probabilistic predictions of climate change in Australia and Southern Africa; and Mailhot et al. (2012) assessed future changes in intense precipitation over Canada. These studies covered large areas and used statistical methods to evaluate the performance of the models over large regions as a whole. Dominguez, Cañon, and Valdes (2009) studied the IPCC—fourth-assessment report (IPCC-AR4, 2005) climate simulations in the southwestern US and suggested that the aridity of the region would be amplified during La Niña conditions, however the study did not evaluate precipitation extremes. Studies assessing climate changes at a subregional level are important so communities can make educated decisions about the implementation and development of policies to address the effects of climate change.

Studying precipitation extremes for short-duration events is not appropriate, as RCMs provide only a coarse grid that does not represent well the physics of local climate systems, despite being more discrete than general ocean-atmospheric-circulation models. Mishra et al. (2012) found that RCMs were unsuccessful in reproducing 3-hour events, but also found that the seasonality of 24-hour events were satisfactorily simulated by the RCM from NARCCAP. The 24-hour event is used by various communities in the United States and abroad for hydrologic design.

Predictions on climate change in the southwestern United States indicate an exacerbation of current stresses on water resources in the region. However, no studies have evaluated the shift in precipitation extremes as a result of climate change at the subregional level. The study of the shift in precipitation extremes serves as a tool for policymakers and practitioner engineers to determine the impact of these changes on their regions. Determining whether the change in the extremes is significant is also important because it affects the cost of designing and building infrastructure and providing adequate protection and services for those communities that are affected by it. Furthermore, studying the shift in precipitation extremes helps identify the level of protection and service provided by existing infrastructure. Evaluating shifts in precipitation extremes due to climate change serves as an additional evaluation tool to quantify the level of exacerbation of the current stresses on water resources.

Problem Statement

This paper addresses the shift of extreme precipitation due to climate change. The shift of extreme precipitation is interpreted as the differences in frequency and magnitude of extreme precipitation during the modeling periods of the RCMs. The models, provided by NARCCAP, cover the present-day climate period of 1968–2001, and future-day climate period of 2038–2071. Finding the shift in extreme precipitation requires developing annual maximum series (AMS) for both modeling periods because these series allow scientists to relate frequency and magnitude of extreme precipitation events. Furthermore, these AMS can be used to determine the magnitude of precipitation for given return periods through the use of frequency analysis. The shift is the difference in magnitude among present-day and future-day climates for each given return period.

Each NARCCAP model has a different set of assumptions and settings, resulting in different realizations of present-day and future-day climate scenarios. This particularity of each model requires using an evaluation technique to assert the model or models that better represent a given region. Giorgi and Mearns (2002) proposed the reliability ensemble averaging (REA) method. The basis of the REA method combines two criteria: (a) how well a particular general circulation model (GCM) represents historical records; and (b) how closely it approximates the average predictions of GCMs, because there are no future records. Moise and Hudson (2008) applied the REA method to climate-change projections for Australia and southern Africa. Rodriguez-Iturbe and Valdes (2011) recommended the use of the REA approach to evaluate GCMs output in resource-limited projects. The REA method serves as a technique to qualify the results of each RCM in a given subregion.

Contributions

Contribution 1

Qualifying RCM AMS at a subregional level using the REA method. was first proposed by Giorgi and Mearns (2002), then modified by Dominguez et al. (2009) to account for additional climate variables and address algorithms in the original REA calculations. Originally, the REA methodology was used to qualify general-circulation models at the regional level. In this case, the REA method is applied to evaluate the AMS attained from each RCM. Although this application has not been performed previously, this methodology can be used to evaluate AMS given the simplicity of its calculations. The REA method is used to evaluate (a) how well a particular RCM represents historical records of extreme precipitation; and (b) how closely it approximates the average extreme precipitation predictions of the RCMs. As a result, this method indicates which AMS better represents a given subregion.

Contribution 2

The second contribution is the application of a method to estimate the magnitude of the shift in extreme precipitation due to climate change at the subregional level using

RCM results. The method consists of developing spatial relationships among RCM grid systems and observed sensor networks, developing AMS for the two modeling periods and performing a frequency analysis for each series. Then, the resulting curves are used to compare present-day with future-day climate extremes and estimate the shifts of the precipitation maxima for given return periods.

Contribution 3

The third contribution is the evaluation of the applicability of the stationarity and homogeneity assumptions, despite the variation of extremes over the modeling period. Milly et al. (2008) referred to the stationary assumption as the idea that natural systems fluctuate in an unchanging envelope of variability. The premise here is that as climate changes, the envelope of variability changes with it as well. Homogeneity is interpreted as the group of events generated by the same phenomena. These two assumptions are fundamental parts of the frequency analysis and are essential to interpret the resulting frequency and magnitude curves.

Organization

I used the following procedures to better understand the shifts of the 24-hour extreme precipitation maxima in the Phoenix metropolitan area (see Figure 1):

1. Develop the grid for the study area.
2. Attain observed precipitation data and regional-climate-model precipitation data contained in the grid.
3. Process climate data and develop an annual-maximum series and a winter seasonal-maximum series for observed regional climate data. This includes

present-day and future-day precipitation from the RCMs. Determine differences between the present-day and future-day maximum series.

4. Apply the REA methodology to qualify models using observed and regional climate data. Determine the most appropriate model for the area of study.
5. Fit the generalized Extreme Value (GEV) to the maximum series from RCMs only by the use of the maximum-likelihood method. Determine GEV parameters and compare present-day and future-day climate distributions.
6. Perform a sensitivity analysis to evaluate the fit of GEV parameters and how they compare with the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 model. Also, perform an additional sensitivity analysis on the GEV parameters to relate the magnitude in the precipitation change with respect to each individual GEV parameter.

Chapter Overview

This chapter is composed of sections that summarize relevant scholarly articles, government policies and reports, and current approaches to the analysis of regional-climate-model results. It begins with a brief overview of climatological science and its relationship to the study of climate change. I present a synopsis of the assessment of predicted changes in the global climate by the IPCC. Additionally, I discuss the assumptions of rainfall-frequency analysis and its relationship to this study. This is followed by a review of scholarly articles that address the use of the GEV distribution on frequency analysis and climate change. In this chapter, I conclude the climate-change discussion by identifying the REA method as the procedure to compare RCM present-day climate with observed records.

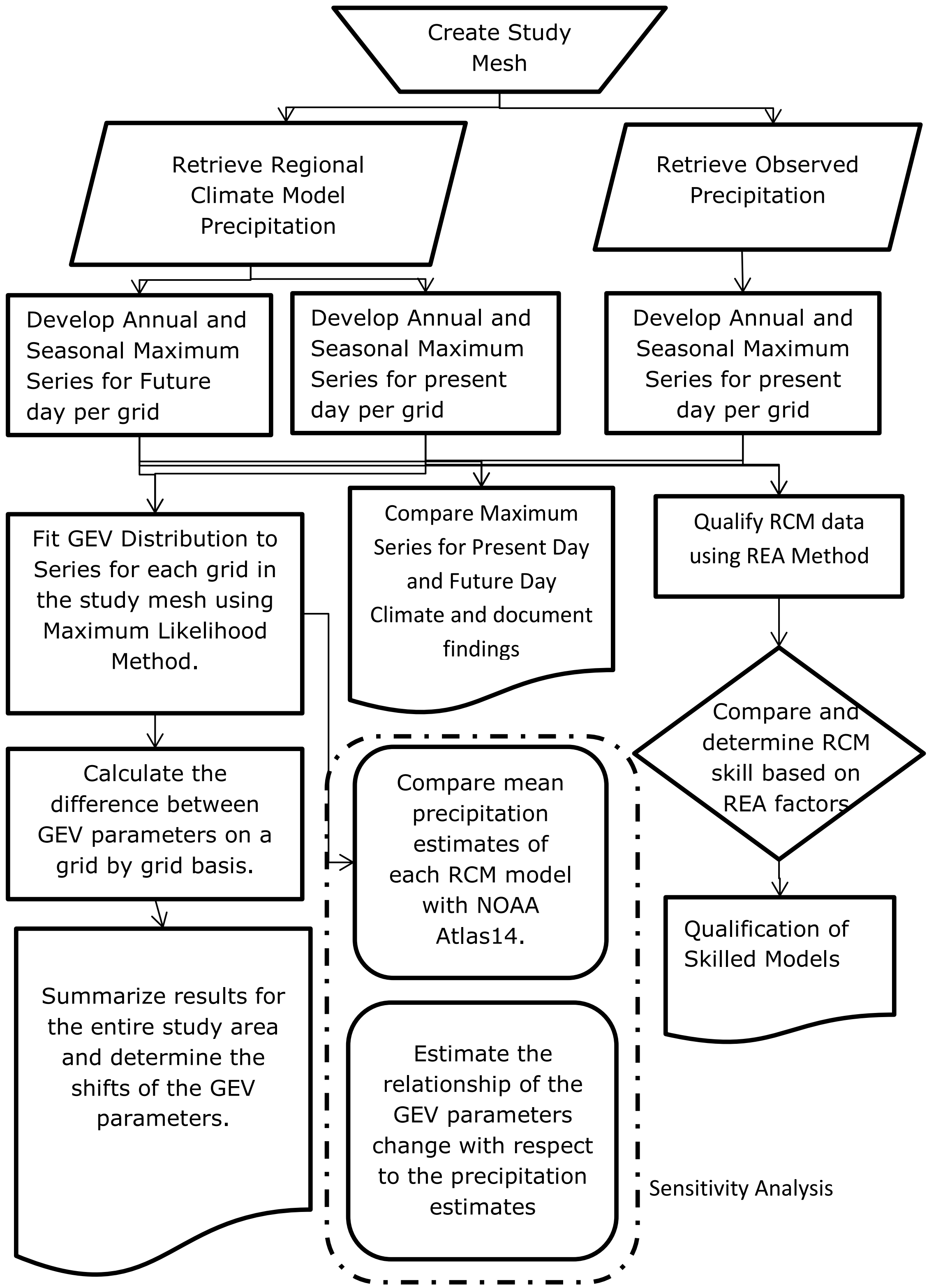

Figure 1. Flowchart of the estimation of the shift in precipitation maxima.

Climatology and the Study of Climate Change

Climatology and Climate Models

Climatology is a science that studies the dynamics of the climate state and its variability. Originally climatology started as a subdiscipline of geography with the main purpose to describe the "normals" or "normal deviation" of climatic variables, typically illustrated in climatic maps. The advent of digital modeling and simulation spurred the development of atmospheric-circulation models. These computer models served to simulate the climate state and its variability, fulfilling the original purpose of climatologists. Climate dynamics are influenced by a large number of factors ranging from the macroscale, such as earth topography, to those at the microscale, like the molecular composition of the earth's atmosphere. These large numbers of variables make it impossible to develop an exact map of the state of the atmosphere. Although these atmospheric-circulation models can generate realizations of climate with a small portion of factors, these have been proven to be nondeterministic in a practical sense (Von Storch & Zwiers, 1999). The models are sensitive to insignificant changes in the initial conditions, which can affect how the models generate divergent realizations. These divergences lead climatologists to rely on statistical tools to describe the state of the climate. Hence, climatology is a science that uses deterministic models along with statistical tools to best describe the state of the climate (Von Storch & Zwiers, 1999).

Intergovernmental Panel of Climate Change and Climate Models

The IPCC has relied on atmospheric-ocean general-circulation model realizations to analyze plausible future scenarios of climatic conditions based on the knowledge of the current climate. The context and assumptions of these climatic scenarios were developed and proposed in the IPCC Special Report on Emission Scenarios (SRES) by the IPCC Work Group III (Nakicenovic, Alcamo, & Davis, 2000). The total cumulative emissions resulting from the storylines is presented in Figure 2. In particular, scenario SRES A2 has been further studied because it is at the higher end of the SRES scenarios and one of the most conservative, as illustrated in the IPCC report. Hence, the analysis performed in this thesis is based on and limited to the assumptions of SRES Scenario A2.

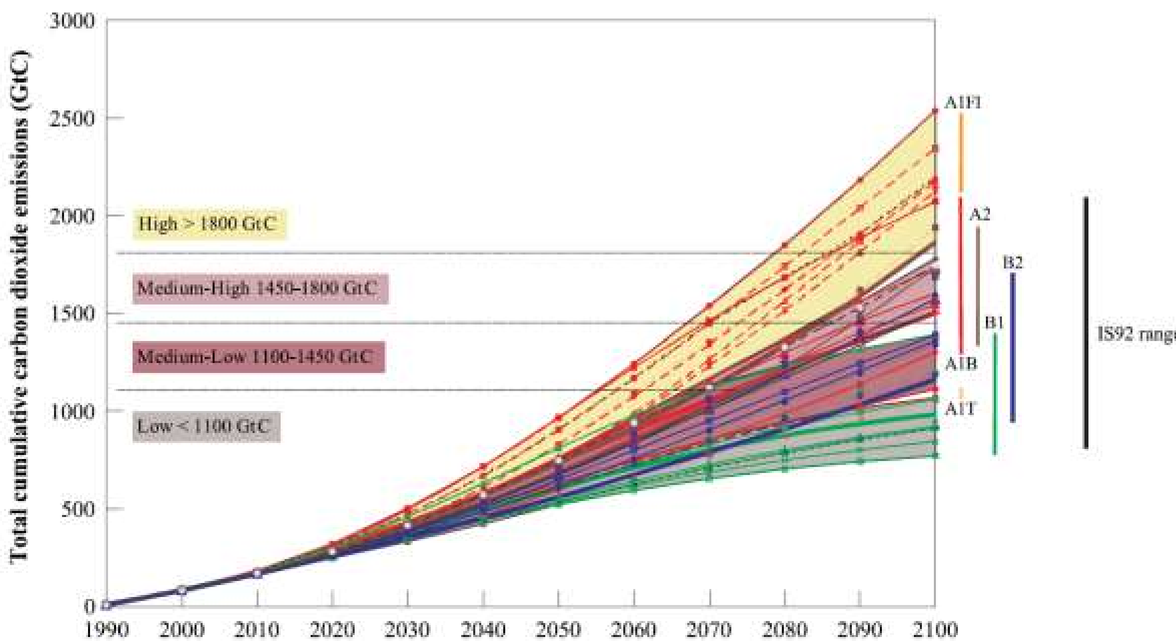

Figure 2. Total cumulative carbon dioxide emissions with respect of time, resulting from the various families of Special Report Emissions Scenarios storylines.
Source: *IPCC 2000: Special Report on Emissions Scenarios.* Prepared by Working Group III of the Intergovernmental Panel on Climate Change, Figure SPM-4 (a). Cambridge University Press with permission.

The storyline of the SRES A2 scenario and family is based on a theme of self - reliance and preservation of local identities. This world has continuous population growth and its economic development is primarily regionally oriented. Per capita economic growth and technological change are fragmented and slower than in other storylines.

SRES storylines served as the foundational work used by the IPCC to develop a framework for climate-change studies. In the IPCC-AR4 (Bernstein et al., 2007), the IPCC (a) established their definition of climate change, (b) provided evidence of observed effects of climate change, and (c) performed forecasts of the effects climate change will have in the next century.

Climate Change is defined by the IPCC as follows:

> Climate change in IPCC usage refers to a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods. (Bernstein et al., 2007, p. 30)

As to observational evidence, the IPCC stated that "observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases" (Bernstein et al., 2007, p. 31). The report's authors also suggested that climate change will be expected to exacerbate current stresses in water resources due to population growth, economics, and urbanization. Consequently, water-resources systems would be susceptible to longer droughts, lower rainfall frequency, and severe flooding, due to higher intensity rainfall. Regions like the western United States would have adverse impacts on multiple sectors such as agriculture, water supply, energy production, and health. These effects would, hence, result in unsustainable development. Therefore, the understanding and implementation of climate-modeling realizations is paramount for decision makers and water-resource engineers (Bernstein et al., 2007)

A shortcoming of this report is that its assessments and analysis are based on large and coarse datasets, limiting its applicability to a global framework. In addition, much interpretation went into the assessments made in the IPCC-AR4. The panel envisioned and addressed this level of analysis and in 2005, posted “Guidance Notes for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties.” The framework of uncertainty is directed at members of various disciplines and backgrounds to make a major effort to evaluate the uncertainty drawn from the literature. For example, Work Group I focused on the nature of data, indicators, and analyses used in the natural sciences generally, which is different from the focus of Work Group III, to assess technology development in the social sciences. Work Group II covers aspects of both (Bernstein et al., 2007). Consequently a substantial level of uncertainty is associated with the assessments made by the IPCC-AR4. The study of the effects of climate change on regional or local environments should be conducted with a different set of tools and assumptions.

This lack shores up the importance of NARCCAP (Mearns et al., 2009), which is an international panel that systematically investigates the uncertainties associated with future climate projections for the North American region. NARCCAP closes this breach in uncertainty by closely matching RCMs with multiple atmosphere-ocean general circulation models (AOGCMs).

North America Regional Climate Change Assessment Program and Uncertainties

The basic tenet of this thesis embraces NARCCAP's RCM realizations. The purpose of the NARCCAP is to investigate uncertainties in regional scale projections of future climate. NARCCAP is an international program that takes advantage of the various AOGCMs by the Hadley Centre (HadCM3), National Center for Atmospheric Research (NCAR) community climate system model (CCSM), the Canadian Coupled Global Climate Model 3 (CGCM3), and the Geophysical Fluid Dynamics Laboratory model (GFDL). They closely match AOGCM with RCMs based on the SRES A2 scenario over an area covering most of North America, including Canada, the United States, and Mexico. NARCCAP is supported by various governmental organizations like the NCAR, NOAA, the National Science Foundation, the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the Canadian Ouranos Consortium. The basic spatial resolution for all RCMs is 50 kilometers and the rainfall events in NARCCAP models are represented by a temporal resolution of 3 hours (Mearns et al., 2009).

Rainfall Frequency-Analysis Assumptions

Frequency analysis of hydrologic data helps hydrologists relate the magnitude of extreme hydrologic events with the frequency of occurrences through the use of probability distributions. Hydrologists assume data is independent and identically distributed and the system producing them is considered to be stochastic, space independent, and time independent (Chow, Maidment, & Mays, 1988). Frequency analysis has been of particular importance because it has been the foundation for hydrosystems design. This methodology has allowed engineers and hydrologists to study the frequency of extreme events such as floods, droughts, and design rainfall. Scientists using one of the most comprehensive frequency-analysis applications, the NOAA Atlas 14 (Bonnin et al., 2011), developed rainfall-intensity duration frequency curves and maps based on the frequency analysis of regional and local historical precipitation data. Here, intensity refers to the average rainfall intensity for a given duration. Duration is a length of time ranging from a 5-minute interval to a 60-hour interval. Frequency refers to the expected annual recurrence of an event with a determined duration. The concept of duration is used to homogenize the property that defines a "storm event."

The U.S. Army Corps of Engineers suggested that a hydrologic data set used for frequency analysis ideally must be homogeneous with respect to some specified property. Each element of the population must be independent of the others, its magnitude should be the result of random occurrence, and its statistical properties must be time-invariant or stationary (Beard & Fredrich, 1975). Milly et al. (2008) referred to the stationary assumption as the idea that natural systems fluctuate in an unchanging envelope of variability. They suggested that stationarity is no longer a valid assumption applicable to hydrologic data because there is a continuously changing climate that is affecting the behavior of hydrological systems as a result of human activities. Hydrologic-system response to small variations in the climate averages results in increasing variations in climate extremes. As a consequence, hydrologic-system response does not meet the qualification of time-invariant statistical properties for multidecadal climate. For the present analysis, it would be fair to assume time-invariant stationarity for each of the 30-year intervals of the present-day and future-day climates in the NARCCAP dataset.

The homogeneity assumption in frequency analysis implies that in any given extreme series, elements have been produced by the same type of phenomena. However, in the range of rainfall events of any given year, events are the result of different types of atmospheric drivers, such as convective and frontal types. The partial-duration series and the annual-maximum series were used to develop intensity-duration frequency curves for the NOAA Atlas 14 (Bonnin et al., 2011) This series includes the subset of extreme events for a given historical period of record and for the calendar year. The U.S. Geological Survey (USGS, 2013) definition of the water year is a 12-month period bounded by October 1st and September 30th of a given year. The USGS (2013) definition is appropriate because it allows improved capturing of the seasonality and continuity of precipitation events. Also, it is important to continue to explore the homogeneity assumption by performing a separate analysis for the winter season. The summer season is limited to short-duration events and these are not well represented by NARCCAP RCMs (Mishra et al., 2012).

Extreme Events and Climate-Change Models

Event Duration and Temporal Resolution

NARCCAP models have an output resolution of 3 hours. Mishra et al. (2012) performed a study on the reliability of RCMs to reproduce seasonal precipitation maxima at 100 locations throughout the United States. The main findings suggested that RCMs are deficient in their capability to reproduce maxima for 3-hour events, which tend to be underestimated by the ensembles. The authors suggested this deficiency was due to physical mechanics, which are not well represented by the ensembles, and the model lacks definition for an appropriate reproduction of short-duration convective events. Thus, their article described a lack of agreement and underestimation of the 3-hour events. As result, the 3-hour events were not included in this study; 3-hour events are important because they are the monsoon-characteristic events that typically result in high-intensity precipitations for a short duration.

Mishra et al. (2012) suggested that 24-hour maxima tended to be able to reproduce the observed 24-hour events. For all comparisons made in the study, 25% of 24-hour maxima fell within 10% of the observed maxima. Mishra et al. suggested that values in this range are acceptable for stormwater design. The researchers also performed a frequency analysis and a precipitation estimate for the 24-hour 100-year return period for both ensemble and observed series, and a comparison analysis was made for all 100 sites. The authors suggested that ensemble 24-hour, 100-year-return-period precipitation was not significantly different from the observed base estimate. However, the ensemble mean 24-hour 100-year return period was statistically different at the 5% level from the derived estimates.

The Mishra et al. (2012) study also reflected on the seasonality of precipitation extremes and determined that the 24-hour simulated season maxima was emulated at most locations including the western United States, coastal stations, and the southeast. The 24-hour events are of importance in the Phoenix metropolitan region because they characterize typical winter storms. Mishra et al. analyzed the performance of the ensemble's ability to represent the 100-year return-period estimate. However, they did not reflect the most frequent events like the 2-year, 10-year and 50-year data, which are often in greatest use for stormwater-infrastructure design.

Probability Distribution Function of Regional Climate Model Extreme Precipitation

Hosking et al. (1985) defined the GEV distribution function as follows:

$$F(x) = exp\left\{-\left(1-\kappa\left(\frac{x-\mu}{\sigma}\right)\right)^{\frac{1}{\kappa}}\right\}, \kappa \neq 0 \quad (1)$$

$$F(x) = exp\left\{-exp\left(\left(\frac{x-\mu}{\sigma}\right)\right)\right\}, \kappa = 0. \quad (2)$$

Hanel, Buishand, and Ferro (2009) described the parameters of the distribution as μ for the location, σ for scale and κ for the shape parameters. Chow et al. (1988) defined μ as the mode of the distribution, and σ as a linear relationship with the standard deviation. Other authors such as Rao and Hamed (2000) pointed out that the value of κ is directly related to the skewness coefficient *Cs*, and defined the characteristic of the distribution in three special cases: Extreme Value Type I for κ = 0, Extreme Value Type II for κ < 0 and *Cs* > 1.1396, and Extreme Value Type III for k > 0 and *Cs* > 1.1396. Hosking, Wallis, and Wood (1985) suggested that the practical range of the shape parameter (κ) values be bounded by -0.5 < κ < 0.5.

Chow et al. (1988) and Von Storch and Zwiers (1999) related the quantile precipitation to the return period for an Extreme Value Type I distribution by using the following relationship:

$$y(T) = \varepsilon - \alpha\left\{-ln\left[ln\left(\frac{T}{T-1}\right)\right]\right\}, \quad (3)$$

where $y(T)$ is the precipitation exceedance value associated with the return period T, μ is the mode of the distribution, and σ is linearly related to the *s* standard deviation ($\sigma = \frac{\sqrt{6}}{\pi}s$). Chow et al. suggested that rainfall is more commonly fitted using the Extreme Value Type I distribution.

Hanel et al. (2009) performed tests on the use of the GEV distribution for extreme precipitation using a case study in the Rhine basin of Western Europe. The parameter ε was dissociated with the mode definition and assigned a definition of an “index flood” parameter. The α parameter was defined as a product of the location parameter ε and the coefficient of dispersion, and all of them are a function of time *t*. Relating this statistical measurement to a temporal variable provided the authors a recursive method to consider the influences of climate change in temporal trends. This approach allowed the authors to develop a better understanding of the differences in regional GEV distribution due to climate change, and reduce standard errors rather than analyzing the differences using a single quantile independently. The GEV distribution has often been found to describe well the extreme precipitation maxima for observed and simulated records. The use of the regional concept allowed Hanel et al. to assume single-distribution values for the distribution across a region. The results showed that the more frequent return periods for the 1-day summer event, such as that in the 2nd year, had estimated precipitation changes with no statistical significance from the mean, in contrast to less frequent events such as the 50-year in which these estimated precipitation differences became statistically significant. Schliep, Cooley, Sain, and Hoeting (2009) and Mishra et al. (2012) also performed analysis of extreme precipitation using the assumption of the GEV distribution.

Plotting Positions of a Sample of Observations

Gringorten (1963) proposed a general plotting-position formula:

$$P(X \geq x_m) = \frac{m-a}{n+1-2a}, \tag{4}$$

where $P(X \geq x_m)$ represents the probability that a sample observation (X_m) of rank *m* will be equated or exceeded. The parameter *m* represents the rank, *n* the sample size, and *b* the parameter that can be adjusted to best fit probability distributions. Gringorten

(1963) proposed that the optimal value for the *b* parameter was 0.44 and worked best for an Extreme Value Type I distribution. Guo (1990) evaluated other plotting-position alternatives and found that Gringorten's method provided the least biased plotting positions to fit the GEV distribution.

One shortcoming of the function by Gringorten (1963) is that the probability calculated using the *m, n* and *a* factors can result in probabilities that sometimes are associated with real numbers. However, the values of the return period *T* are integers, as they represent a population of an entire period (i.e., a year) The nature of the inverse proportional relationship among the probability and the return period can lead to return periods that are not integers. For this reason, when relating probabilities with a return period, such return periods should be rounded up to the next integer. For example, for a probability of 0.0197 there is an equivalent return period of 50.76 years; it should be rounded to 51 years. It is difficult to conceptualize a return period that has a value of 50.76 years because the parent population is bounded by an integer set of years and assessing the fractional 0.76 year does not belong to the return-period domain. In this thesis, rounding up to the next integer return period is considered to remediate this shortcoming.

Regional Climate-Model Realization and Observed-Data Comparison and Evaluation

An approach to better understand the changes in climate involves validating RCM present-day climate and comparing present-day and future-day climates. Consequently, the value of the observed dataset serves to qualify the efficacy of the RCM in replicating present-day climate. As an alternative to statistical procedures that can be used to compare observed and RCM data, I used a procedure developed by Giorgi and Mearns (2002) to identify the model that best reproduces the present climate.

Reliability Ensemble Average (REA) Approach

Giorgi and Mearns (2002) proposed a simplified procedure to determine the REA by performing simple statistical comparisons. Moise and Hudson (2008) defined reliability as the model's ability to reproduce present-day climate conditions. This method has also been used by Dominguez et al. (2010), Moise and Hudson, and Rodriguez-Iturbe and Valdes (2011), who proposed it as an appropriate procedure for climate ensembles in the Hydrology Expert Facility Technical Report 2 for the World Bank.

Georgi and Mearns (2002) initially proposed the REA as a method to evaluate simulated climate changes on the continental scale from ensembles of AOGCM. They used the method to calculate the average, the uncertainty range, and a measure of reliability. The reliability concept used in this research is defined as a measurement result of evaluating model convergence and emulating present-day climate. The evaluation of model performance is completed by first comparing its results with the average of all ensembles and, secondly, using observed data to evaluate the reproduction of present-day climate. Dominguez et al. (2010) also employed the method to perform a model evaluation of RCMs. The main differences between the two sets of researchers were that Dominguez et al. implemented Giorgi's and Mearns methodology using a two-variable analysis—temperature and precipitation—to estimate the REA and Dominguez et al. used a different equation to calculate the reliability factor associated with present-day climate.

Results Analysis Using the Reliability Ensemble Average

Giorgi and Mearns (2002) used the REA method to analyze AOGCM performance among different regions on the globe. They found it difficult to determine an AOGCM model that fulfills the reliability qualifications for all regions. They highlighted that some models performed better in some regions than others. They used the reliability criterion to evaluate temperature and precipitation, even though in conclusion the bias from present-day climate was generally high. The authors recommended the use of this methodology to study climate performance in regions and the use of climatic variables in addition to climate statistics, which can potentially be applicable to regional climatic simulations.

Dominguez et al. (2010) applied the REA methodology to assess the RCM capacity to replicate and reproduce El Niño/La Niña southern oscillation events. These authors mainly focused on the southwestern United States and evaluated mean temperature and precipitation climatic changes. Their study suggested that the models reproduced temperature reasonably well, but precipitation tended to run high in the RCMs. The study used two sets of historical grids of precipitation data, one from New, Hulme, and Jones (2000) and another from the precipitation-elevation regressions on independent slopes model developed by Daly, Neilson, and Phillips (1994).

Conclusion

Climatology scientists have developed deterministic models and statistical tools to best describe the climate state, including atmospheric-circulation models. These models have been used as prediction tools for the study of climate change. In particular, the IPCC SRES AR4 has relied on these models and a set of plausible scenarios described in the

SRES report to make assessments of future climate on the globe. As it relates to water resources, the SRES AR4 projected that climate change will exacerbate current stresses in water resources due to population growth, economics, and urbanization. Despite the great scientific effort that amassed this analysis, the report left a great deal of uncertainty about regional and local assessments of the repercussions of climate change. Consequently, NARCCAP has paired RCMs with the AOGCMs to best represent the effects of climate change at the regional level in the North American region. NARCCAP is an eminent source of the data that are currently being studied by different scientists from various fields with interest in climate change.

The thesis that seasonal analysis of extremes is more appropriate was tested based on this literature research. I tested the assumptions of the two canons of homogeneity and stationarity. First, to test the homogeneity assumption, I developed two sets of series: the annual-maximum series and the seasonal annual-maximum series. The assumption here was that the seasonal annual-maximum series is more accurate than the annual-maximum series, as the seasonal maximum series would capture precipitation events of the winter season. Using the REA methodology, I compared the series between present-day and future-day climate. This comparison helped me identify which models provide a more effective characterization of the 24-hour event, thereby illustrating which approach is more appropriate for precipitation estimates.

In the second part of the thesis, I tested the stationarity assumption by generating precipitation estimates using the GEV function. In this part, I determined the change in the parameters of the GEV to suggest whether the stationarity assumption is valid. Additionally, I compared the precipitation estimates for the 2-year, 10-year, 25-year, 50-

year, and 100-year return periods to illustrate the implications for change in GEV-function parameters.

CHAPTER 2

RAINFALL OBSERVATIONS AND RCM REALIZATIONS

Introduction

To perform seasonal and annual analysis on present-day climate and future-day climate, two sets of data were attained: (a) the NARCCAP dataset RCM pairings that emulate present- and future-day rainfall and (b) the Flood Control District of Maricopa County (FCDMC) dataset that records observed rainfall. In Chapter 2, I discuss the different RCM pairings with AOGCM, to provide a background of the RCM pairing realizations and the interpretation of its resulting rainfall data. For the observed dataset, I discuss the way the FCDMC collects the precipitation data and how it was provided. In the last section in the chapter, I discuss the considerations and treatments of the data to account for space and time.

North America Regional Climate Change Assessment Program (NARCCAP)

NARCCAP is the program that serves the high-resolution climate scenario needs of the United States, Canada, and Northern Mexico, using RCMs coupled with AOGCMs. The following subsections provide a brief overview for each of the AOGCMs and RCMs models used by NARCCAP.

Atmospheric-Ocean General Circulation Models:

There are four driver models coupled with the RCMs. The following chapters provide a brief description about their basic spatial and temporal resolutions:

1. The CCSM3 is a coupled model for simulating past, present, and future climates. The model consists of four components for the atmosphere, ocean, sea ice, and land surface. These four components are linked through a coupler

that manages the exchange of data. The most recent version of this CCSM3 was released in June 2004. The model has a nominal equatorial resolution of 1^o and a temporal resolution of 1 hour. The calendar year for this model has 365 days with no leap year. For more information about this model, refer to Collins (2006).

2. The Hadley Centre Coupled model (HadCM3) is a model that couples the atmosphere and ocean components. In the atmosphere component the model has 19 vertical layers and 2.75^o X 3.75^o horizontal layers with a temporal resolution of 30 minutes. The ocean component has a resolution of 1.25^o X 1.25^o latitude–longitude grids and 20 vertical levels. The model calendar year is 360 days, with 12 months of 30 days each. For more information about this model, refer to Gordon et al. (2000) and Pope, Gallani, Rowntree, and Stratton (2000).
3. The GFDL developed an atmospheric-land model. The earth-system model developed by the GFDL couples the atmospheric and land components. The atmospheric model is a finite-difference dynamical model that uses a spatial resolution of 2^o latitude X 2.5^o longitude. The model has 24 vertical layers using hybrid coordinate systems. The model uses time steps up to 30 minutes. The land model consists of 18 vertical layers. The model calendar year has 365 days with no leap year. For more information about this model, please refer to Anderson et al. (2004).
4. The third version of CGCM is the Canadian Centre for Climate Modeling and Analysis. The model couples an atmosphere and ocean component. The

atmospheric component has a spatial resolution of 3.75° X 3.75° latitude–longitude and 31 levels in the vertical. The ocean component has a spatial resolution of 1.85° degrees with 29 vertical levels. The calendar year is 365 days with no leap year. For more information refer to Scinocca, McFarlane, Lazare, and Plummer (2008) and Environment Canada (2010).

Regional Climate Models (RCMs)

The RCMs used by NARCCAP have a spatial resolution of 31 miles (50km) on average and a temporal resolution for the rainfall realizations of 3-hour intervals. The present-day climate simulations cover a range of 33 years from 1968 through 2000, including the initial spin-off years. The future-day climate scenario covers a range of 33 years from 2038 through 2070, also including the initial spin-off years. Because there is a period of spin off, the actual period to be used is defined by the water years 1971 through 2000 for the present-day climate and the period of 2041 through 2070 as the future-day climate.

Precipitation is presented in the units of kg m^{-2} s^{-1} for all RCM models. The constant for transforming the rainfall rate to a volume in inches for 3-hour durations is the following:

$$\frac{1\ kg}{m^2 * s} * \frac{1\ mm\ of\ rainfall}{1\ kg/_{m^2}} * \frac{3600s/_{hr} * 3\ hour\ duration}{\frac{25.4mm}{inch}} = 425.2\ \frac{inch * m^2 * s}{kg}$$

This 3-hour volume is calculated for each realization and would be concatenated in 24-hour intervals for the development of the AMS for each grid point.

The NARCCAP has used a set of six RCMs: (a) The Canadian regional climate models (CRCM), the Hadley Centre's Hadley Regional Model 3 (HRM3), (b) the NCAR, and Pennsylvania State University Mesoscale Model 5 (MM5I), (c) the NCAR Weather Research and Forecasting model, (d) the Abdus Salam International Center for Theoretical Physics' RCM3, (e) the Weather Research and Forecasting with the Grell scheme model (WRFG) developed by the Pacific Northwest National Lab, and (f) the Regional Spectral Model by the Experimental Climate Prediction Center (ECP2) at Scripps Institute of Oceanography (Mearns et al. 2007).

Table 1 shows the available RCM-AOGCM paired models and their downloaded date. Although all grids have different coordinate systems, for the purposes of this study the coordinate projection of the World Geodetic System (WGS 84) was used to plot all the RCMs and the FCDMC data. The calendar type refers to the number of days that were used for each simulation year. Shaded blocks were intentionally colored to indicate nonmodel availability or not applicable.

Event Observations: Flood Control District of Maricopa County Data

The FCDMC in Arizona maintains and operates a robust rainfall sensor network providing "real-time" information to the county and many other related agencies. This network operates in the National Weather Service Automated Local Evaluation in Real Time (ALERT) format and is commonly referred as an ALERT system. The network was first developed as a result of major flooding during the late 1970s, to monitor major rivers and critical flood-control structures. The network also serves to provide stored hydrologic data that helps in the reconstruction of storm events and related flooding. This ALERT system is comprised of more than 300 weather sensors that feed the FCDMC with field collected data, where the District stores and qualifies the data (FCDMC, 2012).

Table 1

General Information About the North American Regional Climate Change Assessment Program Regional Climate Models and the Atmosphere-Ocean General Circulation Model Pairings

RCM Spatial Resolution (50km)	Grid Horizontal Coordinate System	AOGCM driving model Present day climate 1971–2000; future day climate 2041–2070			
		CCSM	CGCM3	GFDL	HadCM3
CRCM	Polar Stereographic	Download Date Present Day 1/23/13 Future Day 1/23/13	Download Date Present Day 1/23/13 Future Day 1/23/13		
ECP2	Polar Stereographic			Download Date Present Day 1/22/13 Future Day 1/24/13	
HRM3	Rotated latitude longitude			Download Date Present Day 10/11/12 Future Day 10/11/12	Download Date Present Day 1/24/13 Future Day 10/11/12
MM5I	Lambert Conformal Conic	Download Date Present Day 1/26/13 Future Day 2/11/13			
RCM3	Transverse Mercator		Download Date Present Day 1/26/13 Future Day 2/11/13	Download Date Present Day 1/26/13 Future Day 1/26/13	
WRFG	Lambert Conformal Conic	Download Date Present Day 1/26/13 Future Day 2/10/13	Download Date Present Day 1/24/2013 Future Day 2/10/13		
Type		365 day no leap year	365 day no leap year	365 day no leap Year	360 day year, 12 months of 30 days each.

Note. AOGCM = atmosphere-ocean general circulation model; RCM = regional climate models; CCSM = community climate system model; CGCM3 = Canadian Coupled Global Climate Model 3; GFDL = Geophysical Fluid Dynamics Laboratory model; HadCM3 = HadCM3 Hadley Centre coupled model; CRCM = Canadian regional climate model; ECP2 = Experimental Climate Prediction Center model 2; HRM3 = Hadley regional model 3; MM5I = Mesoscale Model 5; RCM3 = regional climate model version 3; WRFG = Weather research and forecasting with the Grell model.

The entire FCDMC rainfall sensor network uses a Tipping Bucket Rainfall Sensor type and measures rainfall rates with a volumetric resolution of 1mm (0.04 in) per tip. The device accuracy is tabulated in Table 2 (HydroLynx Systems, 2008, p. 5).

Table 2

Tipping Bucket Rainfall Sensor Accuracy and Precipitation Rates as Indicated in the User's Manual.

Accuracy	Precipitation rate in mm/hr (in/hr)
+/-3%	0 to 50 (0 to 2)
+/-2%	50 to 150 (2 to 6)
+/-5%	150 to 300(6 to 12)

Note. Source: HydroLynx Systems, 2008 with permission.

The FCDMC performs data quality control on a regular basis and stores data records up to a time resolution of 5 minutes for all gages. The rainfall data is accessible through the district's website, as well as a sensor report. The time resolution is adequate to characterize the representative 24-hour storms and to account for the volume of the extreme events.

Selection of Rainfall Sensors

For the purpose of this thesis, a selected set of sensors were retrieved from the District ALERT system. The set of sensors selected met the following criteria:

1. The period of record was older than Water Year 1984. The water year is defined by the USGS (2013).
2. The sensor had less than 10% of data missing from the period of record, a procedure similar to that presented by Mishra et al. (2012). The District reviews the data at each gage, and places annual reports describing the months

and partial months that the record at the sensor is missing for its entire historical record. The percent of data missing was calculated by using the following formula:

$$\%\ Data\ Missing = \frac{(\sum Missing\ Months + 0.5 \sum Partial\ Missing\ Months\ )}{\sum Period\ of\ Record\ Months}$$

Table 3 shows information about the gage such as installation date, elevation in feet, and position in latitude and longitude. Table 3 also shows the number of months that data were partially missing and completely missing. The period of record in months was calculated using October 1999 as the reference.

Management of Data

The spatial nature of the location of the different NARCCAP RCM grid centroids and the FCDMC gage location made it quite challenging to make a one-to-one comparison when evaluating extreme time series. Tables indicating the spatial relation among the NARCCAP RCMs and FDCMC gage locations can be found in Appendix B. Consequently, a manually drawn grid was developed to best fit all the NARCCAP centroids. Figure 3 shows the location of the grid and the surrounding areas. The figure also shows the location of the FCDMC rainfall gages. Each of the grids in the mesh has been assigned an identifier index to relate both the FCDMC gages and each of the RCMs. This special index number was used to develop one representative AMS from the NARCCAP model results and from the FCDMC rainfall gages. The development of the AMS is discussed Chapter 3.

Table 3

Informational Table for Selected Flood Control District Rainfall Gages

	Installed date	Elevation NAVD 29 (ft)	Latitude decimal degree	Longitude decimal degree	Partial months	Missing months	Period of record in months	Percent missing record
4620	09/28/83	1,280	33.53316667	-111.8978889	2	1	180	1
4630	01/01/82	1,430	33.61055556	-111.9224444	1	1	200	1
4700	06/23/80	1,050	33.42663889	-112.1186111	0	0	219	0
4940	07/14/81	5,205	33.98075000	-111.7979444	3	2	206	2
4950	11/12/81	4,615	34.05227778	-111.8593611	5	5	202	4
5000	04/01/81	1,740	33.05125000	-113.1367222	2	25	209	12
5130	11/01/81	2,175	33.81030556	-113.1751667	5	4	202	3
5070	08/27/82	2,200	33.90283333	-113.2981667	0	1	193	1
5180	11/19/81	2,420	33.94325000	-113.0005278	1	2	202	1
5190	05/01/80	5,120	34.06780556	-113.3500556	2	4	220	2
5200	07/26/83	1,090	33.45775000	-112.7499722	2	2	182	2
5215	09/14/82	1,725	33.71544444	-112.8817778	1	1	192	1
5260	10/14/81	2,380	33.95236111	-112.7717500	1	2	203	1
5275	09/24/81	2,740	34.11852778	-112.9625833	1	2	204	1
5290	07/13/81	5,120	34.20594444	-112.7490000	2	2	206	1
5320	09/01/81	2,960	34.10330556	-112.4054167	1	9	207	5
5335	06/16/81	5,610	34.16591667	-112.4054167	1	9	207	5
5580	08/01/81	2,170	33.90097222	-112.0549722	1	4	205	2
5625	06/10/81	1,940	33.89594444	-112.1495833	2	2	207	1

	Installed date	Elevation NAVD 29 (ft)	Latitude decimal degree	Longitude decimal degree	Partial months	Missing months	Period of record in months	Percent missing record
5670	04/14/81	2,635	33.98308333	-112.4121944	9	11	209	7
5685	07/27/81	2,370	34.01800000	-112.3553889	2	15	206	8
5715	10/18/82	6,750	34.21427778	-112.3538333	1	4	191	2
5730	07/11/81	3,395	34.18697222	-112.1346111	1	2	206	1
5745	05/01/81	3,805	34.23055556	-112.0002778	2	3	208	2
5760	04/01/81	4,490	34.36727778	-111.9636750	1	2	209	1
5775	04/04/81	3,805	34.39080556	-112.1321667	1	10	209	5
5805	11/01/81	4,740	34.52475000	-112.1467500	3	12	202	7
5820	12/07/82	5,230	34.67863889	-112.2551944	1	2	189	1
5960	10/28/82	7,140	33.90491667	-111.4090833	8	11	191	8
6510	09/28/82	2,255	33.34438889	-112.0330833	0	3	192	2
6610	05/01/82	1,410	33.26147222	-111.6288611	1	1	196	1
6655	04.01/82	2,550	33.49480556	-111.6410833	0	3	197	2
6670	12/16/81	1,810	33.44141667	-111.5517778	3	3	201	2

Note. NAVD = North American Vertical Datum

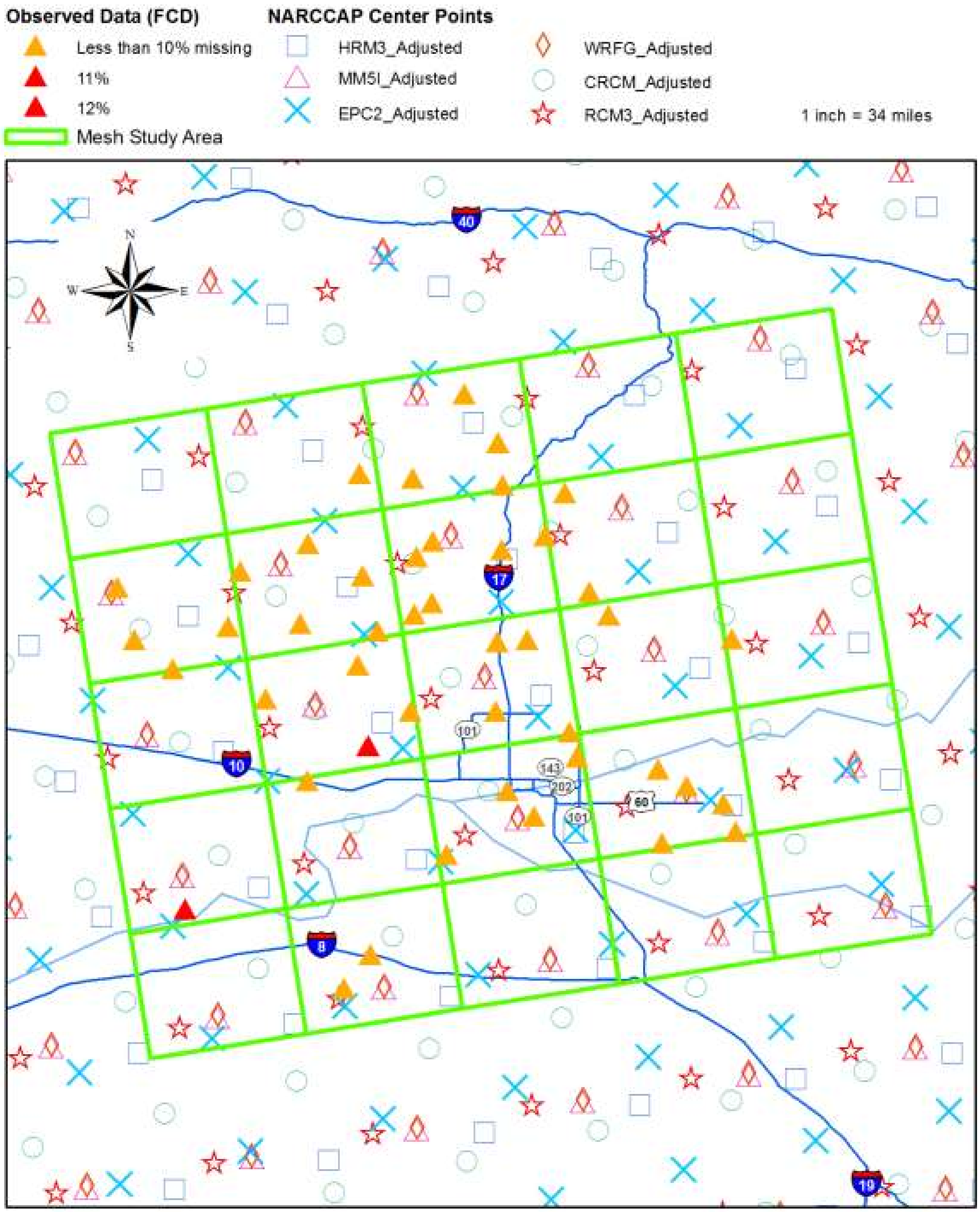

Figure 3. The location of the North American Regional Climate Change Assessment Program Centroids, the flood control district location, and the Study Area Mesh.
Note. Each grid in the mesh is a 27.5 miles by 28.8 miles wide, and the entire mesh is 137 miles in height and 146 miles in width. Source: *ESRI® ArcMAP™ Version. 10.1*

Build(3035), by Environmental Systems Research Institute, 2012, retrieved from http://www.esri.com/software/arcgis under Educational Use License.

During spatial mapping of the centroids of the NARCCAP models, it was difficult to plot all the models in one projection, due to source-projection conflicts. NARCCAP published its website maps for all the RCM models with their plotted grid points. These maps were used in the verification and adjustment of the local centroids from the RCM models. The data fit well in the vicinity of the study area, but is inadequate for use outside the study area. The fit was done using the Georeferencing Toolbar in ArcMAP version 10.1. The fit is adequate for the analysis as the size and overlay of the RCM grid results has coarse resolutions, allowing for small differences in centroid location.

Conclusion

In summary, the NARCCAP dataset provides a robust construct of the climatic variables, in particular the rainfall rates, in the vicinity of the Metropolitan Phoenix Area. Although, there were some manual adjustments made to fit this data to match its spatial location, the adjustments were adequate for the purposes of this study. The horizontal coordinate system used for this analysis is the WGS 84, that was applied to all layers. The output rainfall rate from the RCM models was transformed into a 3-hour volume by using the constant $425.2\ \frac{inch*m^2*s}{kg}$. The accuracy of the rainfall volume is limited by that of the observed dataset, which is one decimal place. The observed rainfall volume resolution is 0.04 inches (1 mm). In addition, the calendar years are governed by the AOGCM models, presented in Table 1. This basic information lays the foundation for the development of the rainfall AMS, the rainfall-frequency analysis, and validation of the RCM models.

CHAPTER 3

METHODOLOGY

Introduction

Determining whether the seasonal analysis of data is the appropriate method to understand the effects of climate change in extreme precipitation requires the application of some methodologies. The first part of Chapter 3 covers the development of the lumped maximum series for both the seasonal and annual populations. Here, definitions of time boundaries are presented as well as the detail of spatial treatments for both observed rainfall and modeled rainfall datasets. The GEV function parameters require the manipulation of data, qualification of the RCM pairings, and analysis of the frequency of maximum precipitation. In this chapter, the methodology for deriving the representative maximum precipitation series is shown, including an example. One of the main methodologies considered in this study was the REA. In the chapter, I illustrate the way the methodology was applied to analyze the different lumped series. Last, I present a brief discussion on the GEV distribution and its associated parameters. The discussion includes the methodology used to fit the GEV distribution to the lumped series.

Lumped Maximum Precipitation Series

The purpose of lumping precipitation maxima for a given indexed grid is to provide a series that represents such a grid. Because there is variation in the location of the rainfall sensors and the centroids of the RCM grids, indexed grids allow for the spatial normalization of data. By generating lumped maximum precipitation series, the comparisons among present-day climate and future-day climate can be performed one-to-one for observed and each different RCM model. In general, the lumping procedure is performed by selecting the highest precipitation maxima for each year from grid-coincident maximum series. The precipitation series is representative of the water year, defined in Chapter 2. to develop these sets of lumped maximum series, the NARCCAP data and the FCDMC are reviewed. These series can be found in Appendix C

Flood Control District of Maricopa County Annual Maximum Precipitation Series

The FCDMC provided two data sets of annual maximum precipitation series for each rainfall sensor selected, as indicated in Chapter 2. The two series consist of the AMS for the water year and the Seasonal AMS for the "winter" season. The winter season is defined as the period of a water year bounded by the months of November and March.

NARCCAP Annual Maximum Precipitation Series

The NARCCAP data set for each different RCM-AOGCM pairing comes in seven different files with a format of Network Common Data Form for each scenario of present-day and future-day climates. These files contain varied information about the model including spatial location of nodes, time steps indexing, point indexes, and precipitation values. The point indexes are referenced as the xc and yc variables and they are unique to each RCM grid. The extent of all RCM meshes cover the entire North American continent; refer to Chapter 2 for more information about the RCMs. ArcMap 10.1 was used to identify the xc and yc points for each of the RCMs to extract the precipitation information. Next, a set of scripts were written in Matlab R2011b to extract the rainfall values from the NARCCAP files and placed into a set of standard ASCII tables for review. These sets of tables consist of present-day and future-day precipitation values that are enclosed by the study area. Each table contains the information about the date, time, day number, and precipitation columns for each xc and yc point in the given RCM-AOGCM pairing model.

The NARCCAP dataset contains missing values that are replaced by large values. For the purpose of this study, these values, reported by NARCCAP, were assumed to be zero. Assuming zero values would not affect the maximum series because the data are not averaged, but just sampled.

Next, the developed tables with the NARCCAP extracted precipitation were used to develop the maximum precipitation series for each of the xc and yc points. A further step was taken to aggregate the AMS for each of the grids in the mesh. The procedure used to lump the series consisted of selecting the maximum-precipitation volume for a given year among the two or more AMS contained in a grid. The resulting series would be representative of the extreme event observed in a grid. This is the series used for estimating the change in climate, and performing the REA analysis and the frequency analysis.

Example 1: Develop a Lumped AMS for a grid.

Problem: Develop the Lumped AMS (LAMS) for grid C2. Assume that the following AMS fall spatially in grid C2 as illustrated in Figure 4.

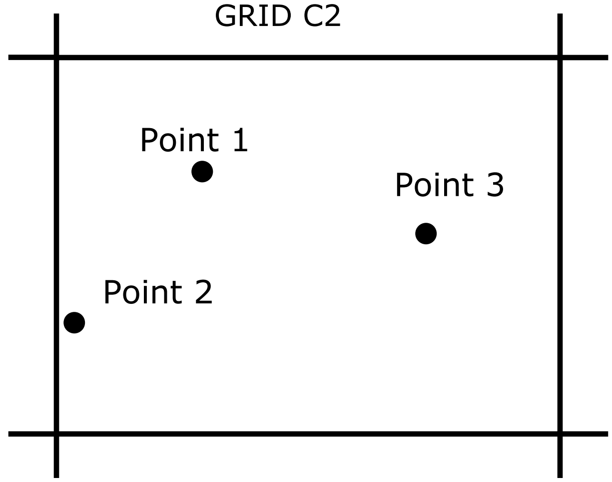

Figure 4. Location of Grid B3 and the points contained within, denoted as Points 1, 2, and 3.
Note. Each of the points represents a "rainfall sensor" and its associated annual maximum series.

The lumped series for grid C2 is shown in Table 4. The lumped series was developed using the highest numbers among the three different series, when data were available. For unavailable data, the series also picks the highest among the two series and, if all data were not available, then the series would be set to no data.

Table 4

Example of How Three Series are Used to Generate the Lumped Series for the Grid Containing the Sensors

Year	Point 1	Point 2	Point 3	Lumped series for Grid C2
1980	N/A	N/A	N/A	N/A
1981	N/A	0.47	0.94	0.94
1982	N/A	1.53	1.61	1.61
1983	2.05	1.57	2.95	2.95
1984	1.30	1.54	1.26	1.54
1985	1.30	1.58	1.38	1.58
1986	1.22	1.69	1.61	1.69
1987	1.50	1.50	1.46	1.50
1988	1.78	1.45	1.49	1.78
1989	0.86	1.30	1.34	1.34
1990	3.54	3.27	1.46	3.54
1991	1.06	1.81	1.53	1.53
1992	1.81	3.23	1.69	3.23
1993	1.50	2.60	2.71	2.71
1994	1.81	1.26	1.97	1.97
1995	1.18	1.97	1.93	1.97
1996	1.54	0.86	0.82	1.54
1997	1.30	1.89	1.26	1.30
1998	2.13	1.53	1.30	2.13
1999	0.91	1.69	1.65	1.69
2000	1.26	1.77	1.74	1.77
2001	0.91	2.67	2.32	2.67
2002	1.10	1.38	1.14	1.38

Note. The first column shows the year in which data were available, the second to fourth columns show the series associated with each point, and the last column shows lumped series.

Assumption About Spatial Location

The development of the LAMS introduces a spatial and temporal bias when performing analyses with the methodology used in this thesis. The spatial bias is associated with the rainfall spatial distribution in the grid and the way it is measured for each different event. The temporal distribution and day of the year would also contribute to increasing the bias of the precipitation event represented in the grid. Consequently, it is assumed that the LAMS from the representative grid of the study-area mesh represent the performance of the RCM-AOGCM pairings and the observed period of record. However, this is not the only source of bias. The NARCCAP models have already introduced bias in modeling the atmospheric, hydrologic, and topographic elements of the RCMs, in addition to assumptions made on the AOGCM along the same lines. Having in mind the context of this level of analysis, this LAMS methodology was deliberately developed to better interpret the precipitation behavior in the study area.

Regional Climate Model Selection Process: Reliability Ensemble Average Method

Purpose of Applying REA to Aggregated AMS

The purpose of performing the REA method on the aggregated AMS is to determine the level at which the regional climate and atmosphere ocean global climate model pairings emulate present-day climate and the quality at which the model realizations compare with the average future-day climate realizations from all models. The resulting REA calculations and reference equations can be found in Appendix D.

Calculation of REA using AMS

For each model i, determine the reliability factor for the model bias, $R_{B,i}$.

$$R_{B,i} = \frac{1}{S}\sum_{j=1}^{S}\left(P_{o,j} - P_{i,j}\right)^2 \tag{5}$$

where *S* is the number of years in the series, $P_{o,j}$ represents the observed precipitation maxima for the jth year, $P_{i,j}$ represents the historical precipitation maxima output for each for the jth year and the ith model.

For each model i, determine the reliability factor for model convergence, $R_{D,i}$.

$$R_{D,i} = \frac{1}{S}\sum_{j=1}^{S}\left(g_{i,j} - x_j\right)^2 \tag{6}$$

where *S* represents the number of years in the series, $g_{i,j}$ represents precipitation projection for the j^{th} year for ith model, and $x_j(R_i, g_{i,j})$ represents the REA-weighted average projection of all models for each year j^{th}. $x_j(R_i, g_{i,j})$ is defined as:

$$x_j = \frac{\sum_{i=1}^{N}(R_i \, g_{i,j})}{\sum_{i=1}^{N} R_i} \tag{7}$$

where N represents the number of models, and Ri represents the REA for ith model, and $g_{i,j}$ represents the projection for the jth year for each ith model.

Determine the reliability ensemble average factor.

$$R_i = R_{D,i} R_{B,i} \tag{8}$$

where Ri is the REA for each ith model, Rdi is the convergence reliability factor for each ith model and Rbi is the bias reliability factor for each ith model.

Since the convergence reliability factor ($R_{D,i}$) is a function of the REA (R_i), the calculations of $R_{D,i}$ require iterative calculations until convergence is achieved. During the convergence iterative loop, the convergence criterion was set to 0.001, when subtracting, comparing the iteration calculated set of R_i.

Example 2: Estimate Reliability Ensemble Average

Problem: Estimate the REA for the winter season of the climate model pairing of CRCM with the CCSM3 from NARCCAP. Use the HRM3 and its associated pairings with the GFDL and the HadCM3 for the future-day climate. For the present-day climate use the FCDMC observed. The reliability factor bias ($R_{B,i}$) for the two models were given as 1.752 and 1.48 respectively (see Table 5 and Table 6).

Table 5

Seasonal Annual Maximum Series for the Observed Period 1983–1999.

Year	CCSM crcm	FCDMC
1983	1.09	1.65
1984	1.11	0.79
1985	0.54	0.71
1986	1.7	1.38
1987	0.37	0.87
1988	0.67	1.42
1989	0.5	1.61
1990	0.59	1.61
1991	0.98	1.65
1992	1.43	2.36
1993	0.57	2.72
1994	0.86	0.75
1995	0.27	1.65
1996	0.48	1.1
1997	0.62	0.98
1998	0.76	1.26
1999	0.44	0.63

Note. The observed data set includes data from the Flood Control District of Maricopa County. The modeled dataset was obtained from the community climate system model, the Canadian regional climate model, and the North American Regional Climate Change Assessment Program model. CCSM = community climate system model; crcm = Canadian regional climate model; FCDMC = flood control district of Maricopa County.

Table 6

Future-Day Climate Seasonal Annual Maximum Series for the Simulated Winter Periods of Years 2038–2070.

Year	CCSM crcm	HRM3 hadcm3	HRM3 GFDL
2039	0.26	0.87	1.13
2040	0.36	2.82	1.31
2041	1.38	2.02	1.52
2042	0.78	1.82	1.03
2043	0.4	0.96	1.74
2044	0.45	1.79	1.31
2045	0.48	1.32	1.08
2046	0.76	1.39	1.16
2047	1.93	1.78	1.47
2048	0.54	0.87	0.85
2049	0.67	1.16	2
2050	0.59	1.81	1.45
2051	0.92	1.87	1.36
2052	0.66	1.73	1.43
2053	1.08	2.16	1.9
2054	0.38	1.22	1.62
2055	0.3	3.58	1.09
2056	0.43	0.91	1.69
2057	0.54	0.81	1.21
2058	0.77	1.02	0.85
2059	0.42	1.66	1.27
2060	0.64	2.77	0.95
2061	0.5	1.17	1.31
2062	0.8	2.09	1.24
2063	0.65	1.16	1.03
2064	0.52	2.01	1.58
2065	0.4	2.27	0.8
2066	0.36	2.55	2.14
2067	0.4	2.3	1.41
2068	1.46	1.06	1.31
2069	0.55	1.41	1.54
2070	1.68	1.22	1.4

Note. CCSM = community climate system model; crcm = Canadian regional climate model; HadCM3 Hadley Centre coupled model; HRM3 = Hadley regional model 3; HadCM3 Hadley Centre coupled model; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model.

Procedure

Using the given information estimate $R_{B,i}$, shown in table 7, and the first iteration of $R_{B,i}$, shown in table 8. Using these values estimate an initial value for R_i, iterate until $R_{B,i}$ and R_i converge.

Estimate $R_{B,i}$.

Table 7

Example of Estimation of the Reliability Bias factor, $R_{B,i}$

Year j	CCSM crcm $P_{1,j}$	FCDMC $P_{o,j}$	Square error $(P_{o,j} - P_{i,j})^2$
1983	1.09	1.65	0.313
1984	1.11	0.79	0.102
1985	0.54	0.71	0.028
1986	1.7	1.38	0.102
1987	0.37	0.87	0.250
1988	0.67	1.42	0.562
1989	0.5	1.61	1.232
1990	0.59	1.61	1.040
1991	0.98	1.65	0.449
1992	1.43	2.36	0.865
1993	0.57	2.72	4.622
1994	0.86	0.75	0.012
1995	0.27	1.65	1.904
1996	0.48	1.1	0.620
1997	0.62	0.98	0.130
1998	0.76	1.26	0.250
1999	0.44	0.63	0.036

Note. Based on squared error calculated in column 4, the mean square error is 0.736. The value of the present day climate model bias is $R_{B,i}$=0.736; CCSM = community climate system model; crcm = Canadian regional climate model; FCDMC = flood control district of Maricopa County.

Determine initial Reliability factor for model convergence, $R_{D,1}$. Assume R_1=2.

Table 8

Example of the calculation to the Reliability factor for model convergence, $R_{D,1}$

Year j	CCSM crcm $g_{1,j}$ R_1=2	HRM3 hadcm3 $g_{2,j}$ R_2=1.752	HRM3 gfdl $g_{3,j}$ R_3=1.48	Xj $\frac{\sum_{i=1}^{N}(R_i\, g_{i,j})}{\sum_{i}^{N} R_i}$	Square error $(g_{i,j} - x_j)^2$
2039	0.26	0.87	1.13	0.710	0.203
2040	0.36	2.82	1.31	1.452	1.194
2041	1.38	2.02	1.52	1.634	0.064
2042	0.78	1.82	1.03	1.199	0.176
2043	0.4	0.96	1.74	0.967	0.321
2044	0.45	1.79	1.31	1.142	0.479
2045	0.48	1.32	1.08	0.931	0.203
2046	0.76	1.39	1.16	1.084	0.105
2047	1.93	1.78	1.47	1.750	0.033
2048	0.54	0.87	0.85	0.738	0.039
2049	0.67	1.16	2	1.210	0.292
2050	0.59	1.81	1.45	1.242	0.425
2051	0.92	1.87	1.36	1.363	0.196
2052	0.66	1.73	1.43	1.236	0.332
2053	1.08	2.16	1.9	1.674	0.352
2054	0.38	1.22	1.62	1.012	0.399
2055	0.3	3.58	1.09	1.622	1.747
2056	0.43	0.91	1.69	0.947	0.267
2057	0.54	0.81	1.21	0.820	0.078
2058	0.77	1.02	0.85	0.876	0.011
2059	0.42	1.66	1.27	1.076	0.430
2060	0.64	2.77	0.95	1.441	0.642
2061	0.5	1.17	1.31	0.953	0.206
2062	0.8	2.09	1.24	1.356	0.310
2063	0.65	1.16	1.03	0.928	0.077
2064	0.52	2.01	1.58	1.319	0.638
2065	0.4	2.27	0.8	1.139	0.547
2066	0.36	2.55	2.14	1.597	1.530
2067	0.4	2.3	1.41	1.322	0.850
2068	1.46	1.06	1.31	1.284	0.031
2069	0.55	1.41	1.54	1.118	0.323
2070	1.68	1.22	1.4	1.447	0.054

Note. CCSM = community climate system model; crcm = Canadian regional climate model; HadCM3 Hadley Centre coupled model; HRM3 = Hadley regional model 3; HadCM3 Hadley Centre coupled model; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model.

The first iteration of the reliability convergence factor yields an MSE of 0.392.

Calculate the reliability ensemble average.

$$R_i = R_{D,i} R_{B,i} = 0.392*0.735=0.289$$

Iterate calculations of $\mathbf{R_1}$ and $\mathbf{R_{D,1}}$ until their values converge. For this case R_1 converges at 0.552 and $R_{D,1}$ at 0.750.

Frequency Analysis Using the Generalized Extreme Value Distribution

The purpose of performing the frequency analysis on the RCM is to determine the change in GEV distribution parameters. This change in GEV parameters can help in understanding the effects of climate change on extreme climate events. Various authors, including Chow et. al. (1988), Hanel et.al.(2009), and Von Storch and Swiers (1999) coincide in that the probability-distribution function that best fits the extreme rainfall precipitation is the GEV. The inverse-GEV function can be used to determine precipitation estimates based on a given set of precipitation series. These results in a frequency analysis and its precipitation estimates are then compared using design events between present- and future-day climate. The typical design events are the 2-year, 10-year, 25-year, 50-year, and 100-year return periods, and these are used in a comparison exercise. The GEV fitted parameters for each grid can be found in Appendix E.

Generalized Extreme Value Probability Function

The GEV distribution function for a given random variable x is defined as

$$F(x) = exp\left\{-\left(1-\kappa\left(\frac{x-\mu}{\sigma}\right)\right)^{\frac{1}{\kappa}}\right\}, \kappa \neq 0 \quad (9)$$

$$F(x) = exp\left\{-exp\left(\left(-\frac{x-\mu}{\sigma}\right)\right)\right\}, \kappa = 0 \quad (10)$$

where x is bounded by by $\mu + {}^{\sigma}/_{\kappa}$ for κ > 0 and from below for κ < 0. Here μ represents the location parameter; σ is a scale parameter, and κ represents the shape parameter. Hosking (1985) suggested that the practical range in which the shape parameter κ usually lies is between $-{}^{1}/_{2} < \kappa < {}^{1}/_{2}$. The value of the shape parameter κ determines which extreme value distribution is represented: Type I (Gumbel) for κ = 0, Type II (Frechet) for κ < 0, and Type III (Weibull) for κ > 0. The inverse distribution function is:

$$x(F) = \mu + \frac{\sigma\{1-(-lnF)^{\kappa}\}}{\kappa}, \kappa \neq 0 \quad (11)$$

$$= \mu - \sigma\, ln(-\, ln\, F), \kappa = 0 \quad (12)$$

The maximum-likelihood method is used to estimate the parameters for each GEV distribution for a given set of values. Prescott and Walden (1980) derived the explicit expression of the information matrix of the three-parameter generalized extreme-value distribution. Later, Hosking (1985) presented an algorithm to solve for the maximum-likelihood estimates for the location parameter μ, scale parameter σ, and shape parameter κ. Currently, Matlab R2011b, has the maximum-likelihood algorithm that allows it to fit various distributions to a set of given data. In this case, the Maximum Likehood is used to determine the fit of the GEV curve to the AMS.

One of the objectives in this thesis was to determine the shift of these location (μ), scale (σ), and shape (κ) parameters, if any. Comparisons were made between the future and present curves. The following shows the computations:

$$\Delta\kappa = \kappa_{f,i} \text{-} \kappa_{p,I} \quad (13)$$

$$\Delta\sigma = \sigma_{f,I} \text{-} \sigma_{p,i} \quad (14)$$

$$\Delta\mu = \mu_{f,i} \text{-} \mu_{p,I} \quad (15)$$

where $\Delta\kappa$,$\Delta\sigma$, and $\Delta\mu$ represent the shifts of the GEV parameters and the subscripts p, f and i represent present, future, and RCM pairings, respectively.

Conclusion

The thesis objective was to compare the AMS with winter maximum series for the 24-hour event, and determine the shifts of their frequency of occurrence. These required the development of lumped maximum series that allows one-to-one comparison. In this chapter, the procedures for addressing the spatial variation of the sensors and the nodes for each of RCM pairings were presented. These procedures led to the development of the Lumped Maximum Series. Next, the REA is a methodology that helps qualify the given variety of RCM pairings by NARCCAP. This REA methodology was adapted to evaluate the lumped series, and its procedures were presented here. Last, the chapter concluded by presenting the reader with a brief overview of the estimation of the GEV parameters and its associated precipitation estimates.

CHAPTER 4

RESULTS AND ANALYSIS

Introduction

In this chapter various methodologies are presented to illustrate that seasonal analysis of extremes as the most appropriate approach when studying the effects of climate change in extreme precipitation. This study was focused on the 24-hour duration event. The location of the study area is presented in Figure 5. The first section shows the results of the comparison of the annual and winter series. It starts by presenting the results of the comparison of present-day climate and observed data; then I discuss another comparison of the shifts of the series over time. Next, REA values are presented and compared. In the following section, the GEV function is used to estimate the statistical changes as a result of the modeled climate change. The GEV distribution is used as the statistical function to determine the precipitation estimates for different return periods. The section also presents the shifts of the GEV parameters over a lapse of 70 years. The chapter concludes with a sensitivity analysis including a comparison of the NARCCAP precipitation estimates with NOAA Atlas 14 parameters. In addition, I consider the variation of the GEV parameters 100-year return periods to understand how the shifts due to the modeled climate change affect the calculation of the precipitation estimates.

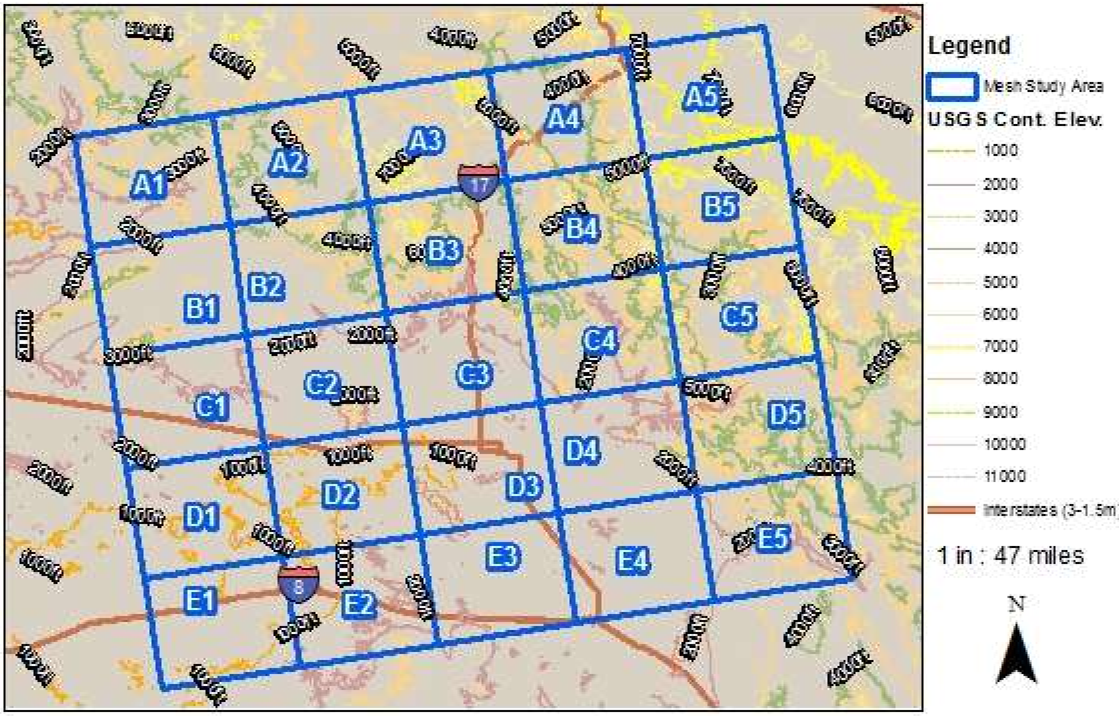

Figure 5. General study area of the mesh used for the study and the U.S. Geological Survey topographic elevation contours of surroundings.

Annual and Winter Seasonal Series

Annual- and seasonal-precipitation maxima series were developed for each of the RCMs, except for the model pairings for RCM3 gfdl and RCM3 cgcm3, where no points laid inside the grids A3 and B2. Subsequent calculations were performed with these missing values in mind. The figures below describe the variation and changes in the precipitation-maxima series during a period 70 years in the future.

Annual Series Comparison: Present-Day RCM Versus Observed

One factor used to calculate REA is the reliability bias (Rb). This factor evaluates the emulation of concurrent present-day precipitation maxima by calculating the mean square error (MSE) between each model realization and the observed dataset. The factor was calculated individually for each gird and the average for each RCM pairing is presented in Figures 6 and 7. Figure 6 and Figure 7 plot the Rb with respect to the grids to illustrate the range of values for all RCM pairings for each location. A couple of patterns can be observed in the figures. The first pattern that can be seen is that for cells A3, B2, B3, and C5, the bias for the models is generally higher for both the annual and winter series. This pattern is suspected to be generated by the differences in the model terrain and in the actual terrain in the area; consequently it will be referred to as a topographical bias.

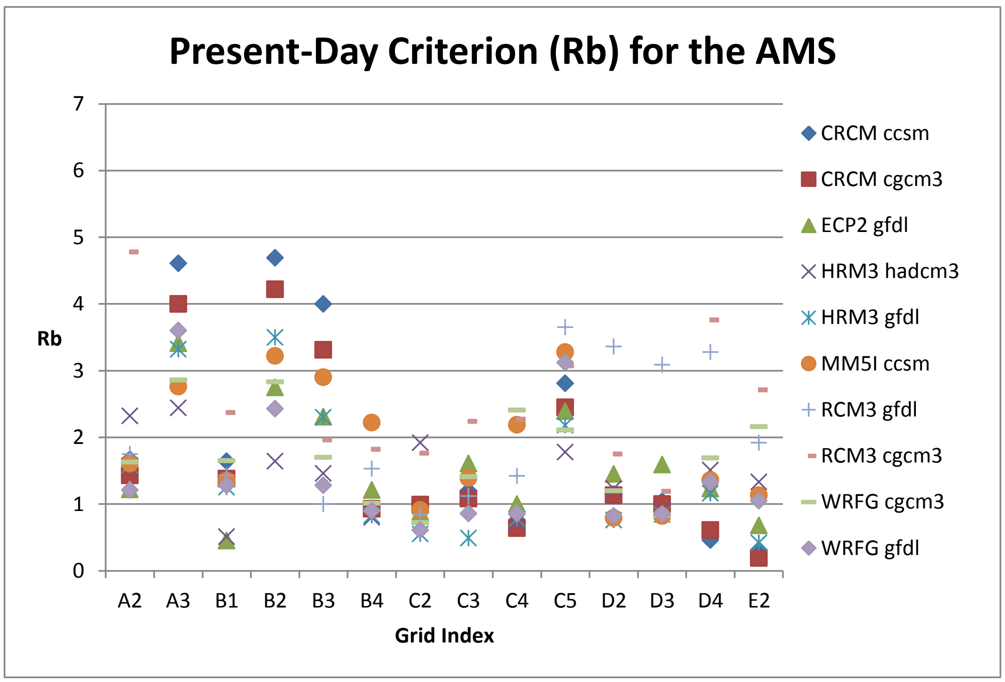

Figure 6. Annual reliability bias for all grids in the study area used for comparison purposes.
Note. The annual reliability bias values range from 0.19 through 4.78.

The next pattern that can be observed from looking at Figures 6 and 7 is that the winter seems to be more precisely predicted by all models, generating a smaller range of bias when compared with the annual bias. In addition, the accuracy of the models is better depicted by the winter, because the generality of the grids have biases that are, on average, smaller than the bias for the annual series. In summary, these two figures show that the present-day criterion Rb rates the winter series better than it does the annual series.

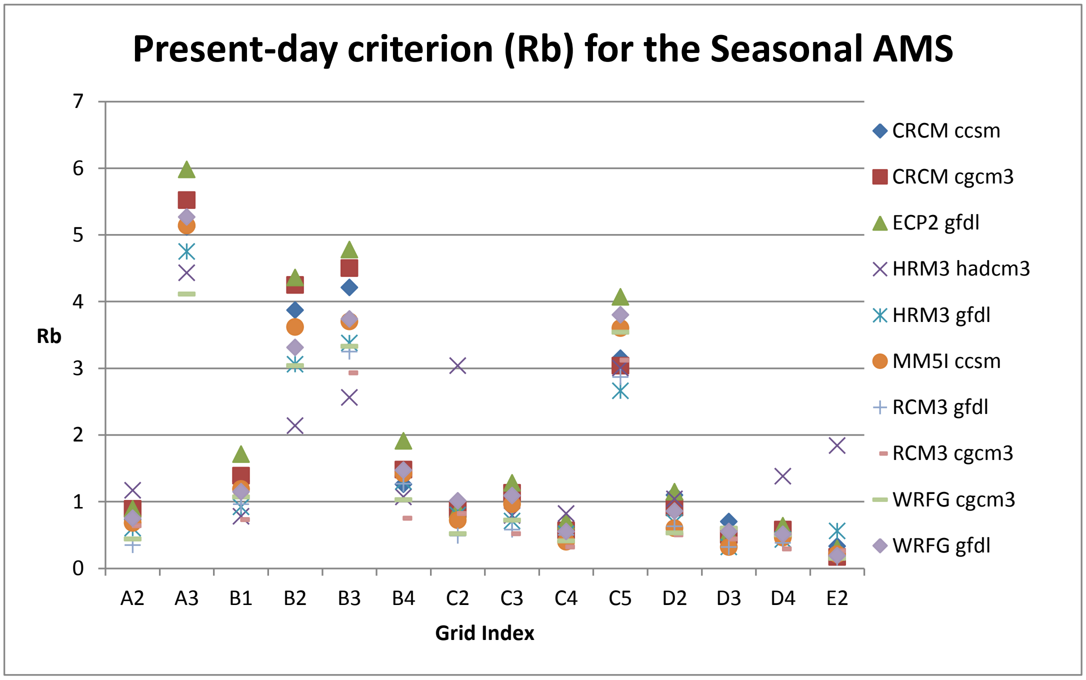

Figure 7. Spatial distribution of the seasonal reliability bias for each grid in the study area.
Note. The seasonal reliability bias ranges from 0.16 through 5.98 for the winter-season series.

Figures 8 and 9 show the plot of the Rb criterion and the RCM pairing models. Each data point in these figures represents each different grid shown in the legend. This is another way to look at the data. Despite the fact that the winter series shows higher Rb values, those higher values are related to the grids that have a topographic bias. Those topographic biases are not as high for the annual series; however, one can clearly see those grids in Figure 9, whereas in Figure 8 these are not easily discernible. These figures also allow for the inspection of the skill of each individual model. For example RCM3 cgcm3 shows a range of values from 1 to 5 for the annual series and a range of values below 1 to 3 for the winter series. This shift in the ranges from the annual to the seasonal shows that the models have better skill in reproducing winter than they do the rest of the year.

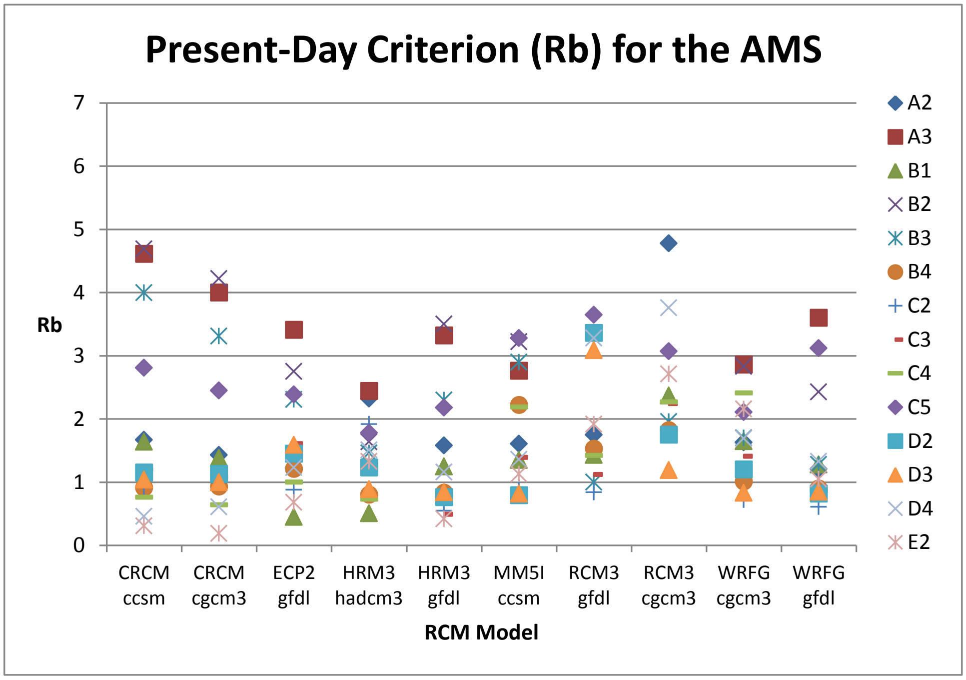

Figure 8. Reliability bias per regional climate models.
Note. The figure shows how each of the regional climate model performs with respect of the entire study area.

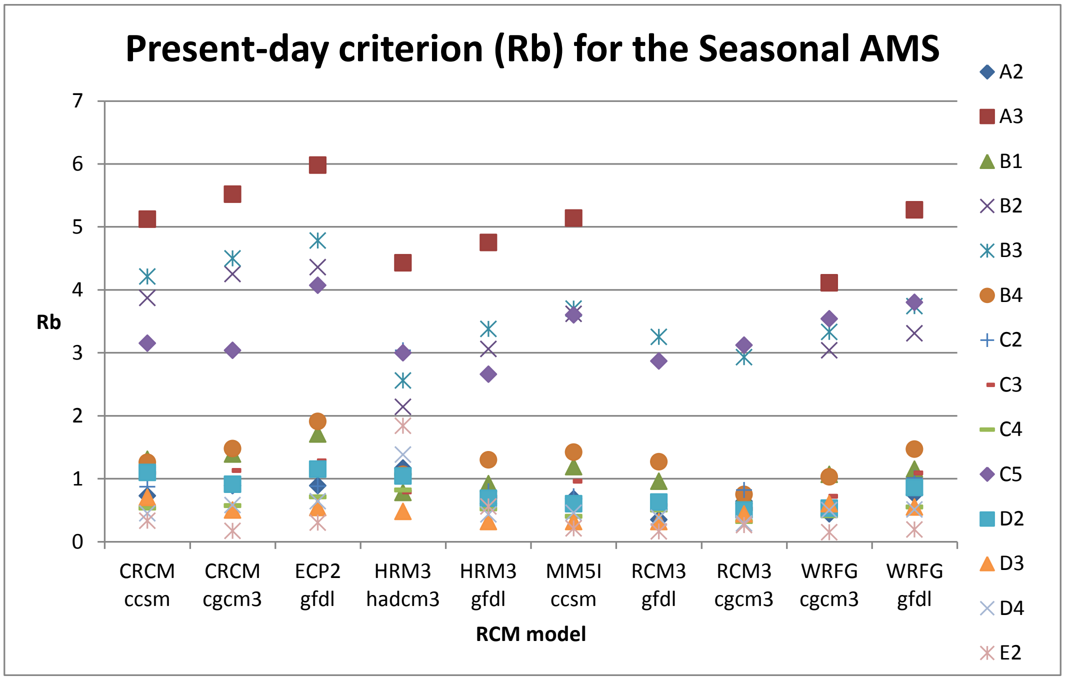

Figure 9. Seasonal reliability bias per regional climate model.
Note. On the y axis the calculated reliability bias as calculated per the reliability-ensemble average procedure.

Average Maxima Variation Among Regional Climate Models

A comparison was made by subtracting the present-day climate from the future-day climate to estimate the shifts simulated by the RCMs. A general trend line was developed to estimate the average shift for the precipitation maxima for all models. Figures 10 and 11 show the plot of change of precipitation maxima with respect to rank. Here Rank 1 is associated with the most frequent events and increases in the rank are associated with decreases of frequency for the span of the series. The change in precipitation maxima is calculated by the subtraction of the precipitation volumes between future-day and present-day climates. A trend line was developed by estimating an average shift of the precipitation difference for each rank position, then plotting the line and points in the chart.

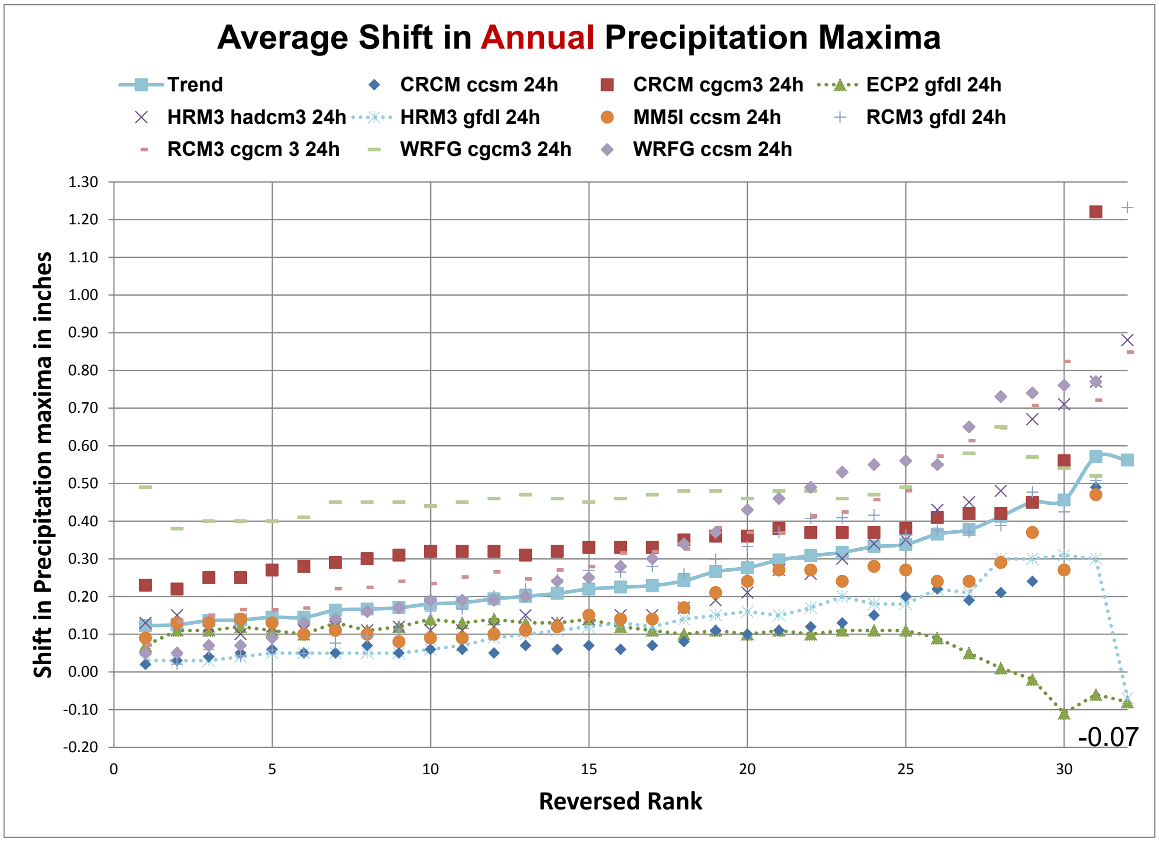

Figure 10. The Annual Maximum Series for the precipitation volume for each regional climate model and its ranking with respect of magnitude.
Note. The ranking is performed by sorting the volumes from low to high. The length of the rank corresponds to the number of years in the series. Some series have 32 years others have 31. A trend was calculated by plotting the mean variation for each ranking position.

Figure 10 shows the plot of the change in precipitation calculated for the annual series. The trend line shows that there is a positive shift on all the series, averaging from just over 0.1 inch on the most frequent events to 0.56 inch for the less frequent events. The figure also shows larger precipitation differences toward the less frequent (higher ranking) events, suggesting a large range of uncertainty on the changes in precipitation.

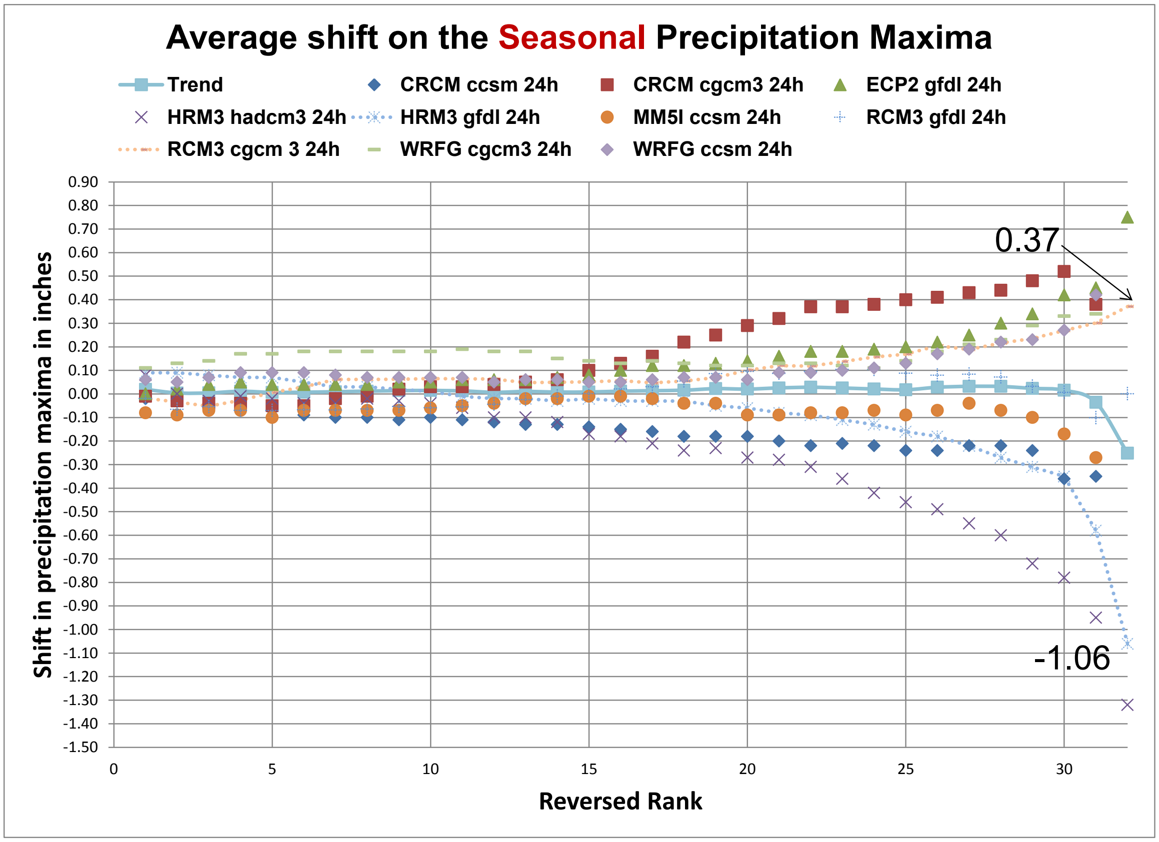

Figure 11. Variation in Seasonal Annual Maximum Series.
Note. As in Figure 10, the ranking is assigned from the smallest precipitation volume to the largest. The variation is calculated by subtracting the present-day climate series from the future day climate series.

The better-skilled models, according to the REA analysis, are the ECP2 gfdl and the HRM2 gfdl. The REA analysis results are presented in the subsequent section. These models were selected because they rank lowest in the REA analysis for the annual series. The ECP2 gfdl had the lowest Ri values, suggesting it is the most appropriate model for this study area. If the ECP2 gfdl scenario was chosen, it would indicate that the least frequent events in the future would result in lower precipitation, as the series drops to a 0.10 of an inch range as the series is sampled in the future. The HRM2 gfdl was also chosen because the model showed better skill than the ECP2 gfdl in reproducing present-day climate and it ranked second with the lowest Ri values. If the results from this model were chosen, the scenario indicates an increase in of 0.3 inch precipitation for less frequent events. These two model results infer that the change in the greatest ranked event, the least frequent in the series, would shift in a range of -0.1 inch to 0.3 inch. Despite the skill of the models, both models predict a shift in precipitation that is below the trend of the average of all the models. This demonstrates that the models do not accurately reproduce precipitation shifts at the same level as the others do collectively, if one assumes that the accuracy of the models approximates the trend.

Figure 11 shows the change in precipitation per rank for the seasonal series, a similar plot to Figure 10. In this case, the trend line indicates that the winter season precipitation maxima do not change in the future, despite the changes in climatic variables. I chose three models based on their scoring on the REA analysis, the HRM3 gfdl, RCM3 cgcm3, and RCM3 gfdl. These models can be identified with the dotted lines. The best rated REA model, the HRM3 gfdl, shows that there is a decreasing change in the precipitation volume up to 1.0 inch. The other two RCMs were chosen because they had better skill than the present-day climate in reproducing than the HMR3 gfdl. RCM3 gfdl shows no change in precipitation climate and RCM3 cgcm3 shows an increase of up to 0.3 inches for the future-day climate. Unlike the annual series, the selected models vary over and under the trend. The trend suggests that there will be drier winters in the future-day climate.

One major difference that can be observed between Figures 10 and 11 is that from Rank 1 through 10, the winter shows a constant range, about 0.25 inch in width of variability among the series, when predicting the future climate. The annual series shows a variability range of 0.35 inches in how the models predict the change in precipitation. It is interesting to see that there are drops in the changes for future precipitation maxima, but the data have been sorted and the analysis done on time-independent variables. This analysis, unlike the REA analysis, does not qualify a model's ability to replicate the average future-day climate concurrently with each model. This is an independent analysis that looks at the maximum precipitation changes in a span of time, regardless of their time of occurrence.

Reliability Ensemble Average Methodology

The REA is a methodology used to qualify the ability of a model to reproduce the present-day climate and its consistency with other models in the simulation of future-day climate events. The REA has been applied as a method to analyze the trends of the average climate realization from the RCMs. *Realization* describes the resulting climate variables after an RCM simulation is completed. The REA methodology was applied to compare precipitation maximum series with concurrent realizations of observed records and future-day climate. Figures 12, 13, and 14 show the three different reliability factors calculated. The Rb is the factor that compares the present-day climate RCM model and the observed record, by calculating the MSE. The reliability distance bias (Rd) is the other factor that compares each RCM and its ability to replicate the future-day climate when compared with all the model results, and is calculated in fashion similar to the Rb: it calculates the MSE.. The REA is the calculation made between the Rb and Rd, as shown in Equation 16. The exponents are assumed to be n = m = 1. A more detailed discussion of this methodology can be found in Chapter 3.

$$R_i = R_{d,i}^{n} R_{b,i}^{m} \tag{16}$$

The following sections show a dissected analysis of the REA application to the annual and seasonal series. The NARCCAP models were used to develop maximum series that were identified in the modeling period. This is important to mention because the REA methodology uses temporal relationships to calculate different factors. The findings of this analysis are presented in short separate sections.

Annual Maximum Series

Figure 12 presents a bar plot of the values of the factors Rb and Rd, and the Ri index and their relationship to each respective model. For example, for the NARCCAP model CRCM ccsm, the chart displays three bars. The bar to the left represents the Rb, the center bar represents the Rd, and the bar to the right represents the Ri index. The ranges of the calculations for all the RCM Ri factors, Rb, and Rd range from 1.4 to 2.5 and 0.5 to 1.5, respectively. The range for Ri for all models is 0.9 through 3.75. Because the Ri is based on error calculations; the models that have the lowest Ri, therefore, have the least cumulative error. Consequently, these values can be interpreted to be better at replicating present-day climate and modeling future-day climate.

In specific, the ECP2 gfdl model is shown in Figure 12 to have the lowest Ri value and therefore is the better model to predict the AMS, considering the time concurrence. The Rd are smaller than the Rb, leading to the inference that the models are better skilled in agreeing on future climate than they are in emulating present-day climate.

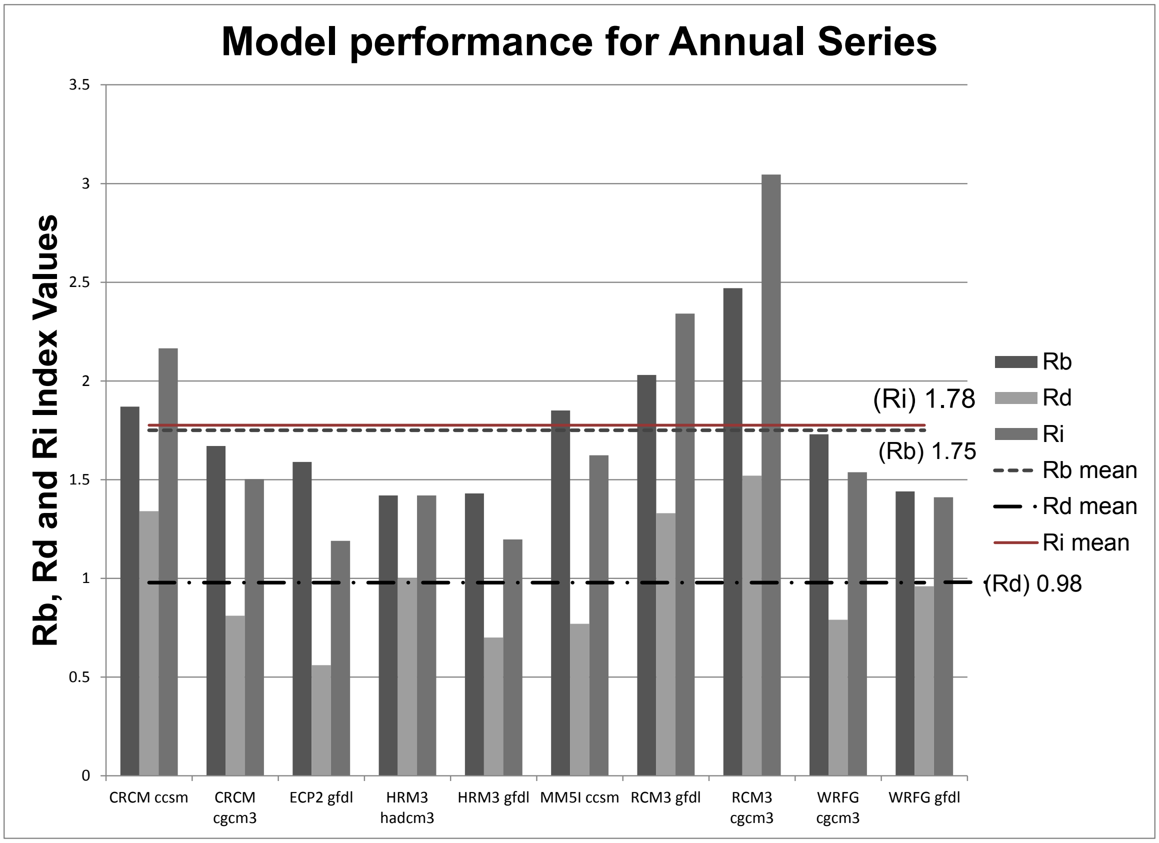

Figure 12. Annual index values for all the reliability bias, reliability distance bias, and reliability ensemble average for all the regional climate models.

Seasonal Maximum Series

The same REA procedure was applied to the winter seasonal series. Figure 13 is an emulation of Figure 12, except it plots the Rb, Rd and Ri for the winter seasonal series. Rb, the present-day climate bias factor, ranged from 0.94 to 2.09. Rd, the future-day climate related factor, ranged from 0.11 to 0.3. The Ri index values ranged from 0.16 to 0.52. Similar to the annual series, the Rd are smaller than the Rb. However, because of the range of the values of the Rd, the Ri calculations were significantly smaller than the annual series REA analysis. Similar to the annual series, based on the values of the Rd, one can infer that all the models agree more closely when simulating the future maxima than they are at replicating the present-day climate.

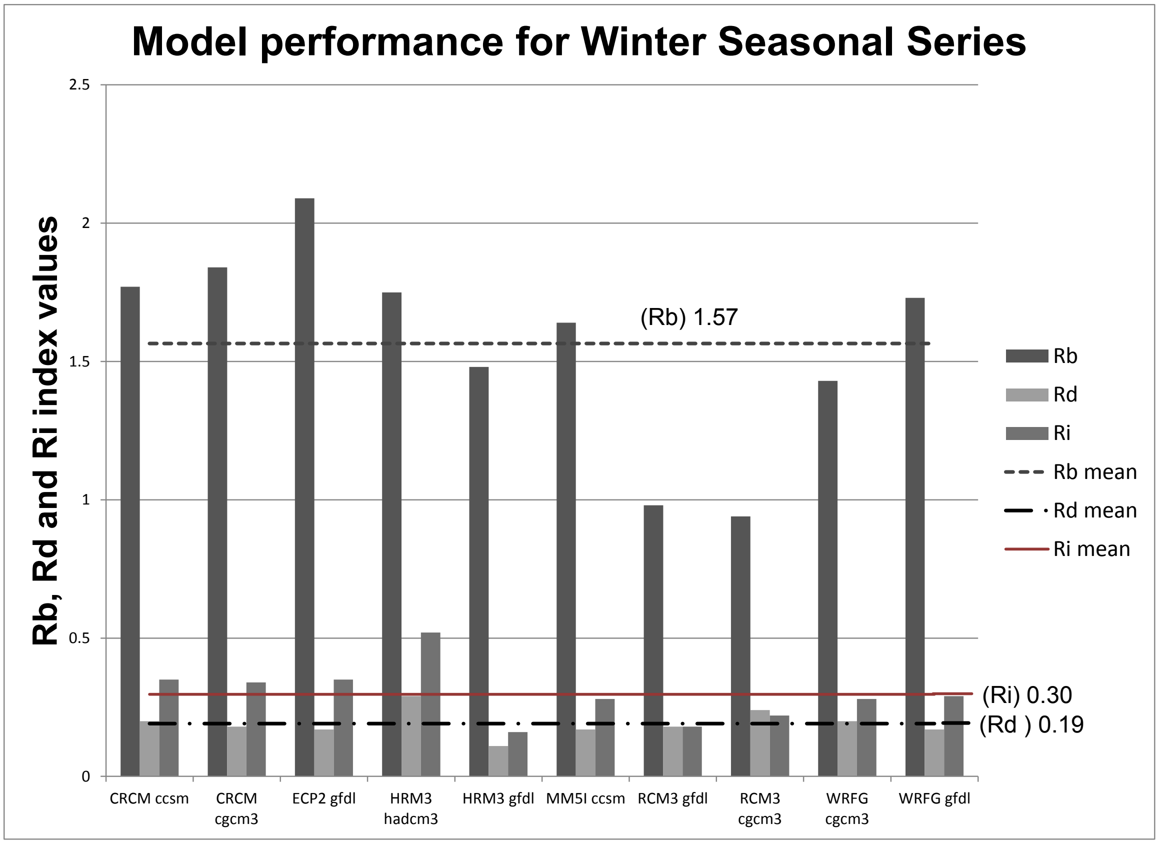

Figure 13. Seasonal index values for all the relability bias, reliability distance bias, and reliability ensemble average for all regional climate models.

Seasonal Versus Annual REA

In the previous sections, the evaluation of the skills of the models through the REA analysis were presented. The models are better at predicting future climate than they are at replicating present-day climate for both analyses of annual and seasonal Ri values. In the case of the winter seasonal Ri calculation, the Rd is so small that the entire Ri is biased by these values. In the calculation of Ri values, each factor was assumed to have an exponent of 1. However, changes to the value of these two exponents can be used to provide more weight to the Rb, because it relates the models to the present-day climate; this relationship could help in discerning between models that have very close scores and in emphasizing the skill of emulation of present-day climate.

In comparing the Rb, Rd, and Ri index values among the annual and seasonal series, one has to consider that the Ri is greatly bias by the small Rd calculations. Consequently, one would need to compare the two factors to better differentiate between the seasonal vs. annual series. The Rd values in the two models are so largely different that one can conclude that the winter seasonal series is much better in producing consistent future precipitation maxima. The REA analysis shows smaller reliability values for the seasonal series. This suggests that the models in general do a better job of replicating the present-day climate and are more consistent in the simulation of the future-day climate in the seasonal series than the AMS. Moreover, the Ri values are significantly different for each series because the Rd is significantly smaller for the seasonal series, indicating a better convergence of the overall models.

Change in the GEV parameters due to Climate Change

Frequency analysis is a method in hydrology that hydrologists use to relate the magnitude of extreme hydrologic events with their frequency through the use of probability frequency distributions. In this case, the GEV distribution was selected to relate the series of maximum precipitation to their annual frequency. These series were developed for each of the grids in the study area with the objective of determining their frequency. To fit the GEV, the maximum-likelihood method was used to determine the GEV parameters that better fit each of the series. The GEV consists of a distribution that uses three parameters: (a) the shape parameter (κ), (b) the scale parameter (σ), and (c) the location parameter (μ) (refer to Equations 17 and 18). This section focuses largely on the average of the fitted curves of each grid, resulting on an average set of GEV parameters.

$$F(x) = exp\left\{-\left(1-\kappa\left(\frac{x-\mu}{\sigma}\right)\right)^{\frac{1}{\kappa}}\right\}, \kappa \neq 0 \quad (17)$$

$$F(x) = exp\left\{-exp\left(\left(-\frac{x-\mu}{\sigma}\right)\right)\right\}, \kappa = 0 \quad (18)$$

The analysis was performed at a grid level, but for the purposes of analysis, results were averaged throughout the study area. For example, each grid has a corresponding κi, σi, μi; but for the study area an average κ, σ, μ for the purposes of simplifying the comparison and results. Similarly the computation of the differences among the future and present parameters were performed at a grid level, but presented as an average for the study area. In the following section I discuss the resulting parameters and the predicted variation among them.

Figures 14, 15, and 16 show the variation of the different GEV distribution parameters for each different RCM pairing scenario, as well as illustrating shifts resulting from climatic changes. Tables 9, 10, and 11 present a summary of the average parameters that were computed from the analysis performed on the annual and seasonal series.

To better understand the results, the following section presents a summary of the findings by looking at the trends for both AMS and Seasonal Annual Maximum Series (SAMS). Figure 14, 15, and 16 plot the shifts between present-day and future-day climate for AMS and SAMS of the fitted GEV parameters of location (μ), scale (σ), and shape (κ), respectively. Each plot also provides a trend that is related to each parameter as indicated. In Figures 14 and 15 it can be observed that there is a positive shift for the AMS of about 0.206 units for location parameter and 0.076 units for shape parameters on average. Figure 16 also shows a positive shift in average for all models of 0.028 units in the shape parameter; however, some models indicate a negative shift and others a significant increase up to 0.2 units.

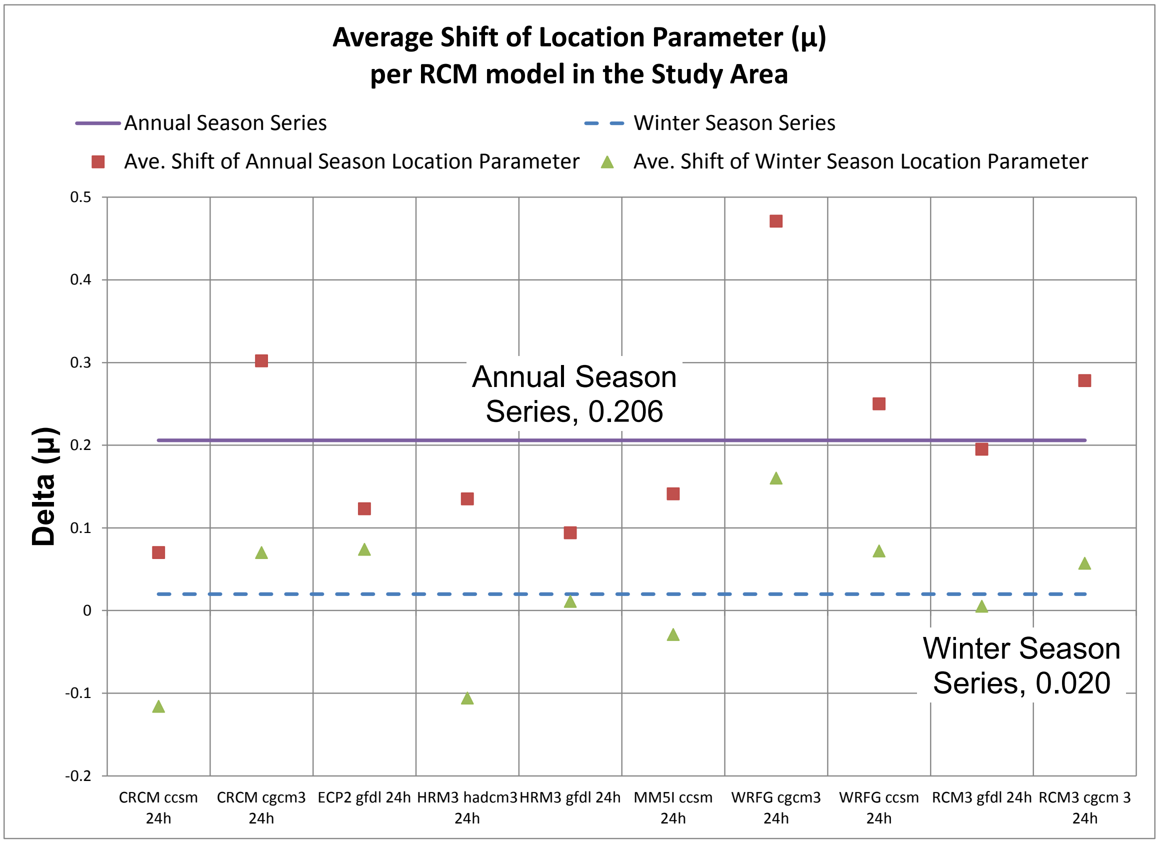

Figure 14. Average shift of location parameter (μ) for each of the regional climate models and both the seasonal (squares) and annual (triangles) series.

For the case of the seasonal series, the average shift for all the models are very close to zero. Figure 14 illustrates that the average shift for all the models oscillates around zero with an average of 0.020, without great variability for the location parameter. Figures 15 and 16 illustrate that the average shift is almost negligible, as the number is very close to zero. However, the average trend does not serve as an indicator of the behavior of the shifts of the shape parameter, as they have a significant variability, ranging from -0.211 to 0.167. As a result of the magnitude in the shifts of the shape parameter, significant changes are observed in the precipitation estimates for less frequent return periods.

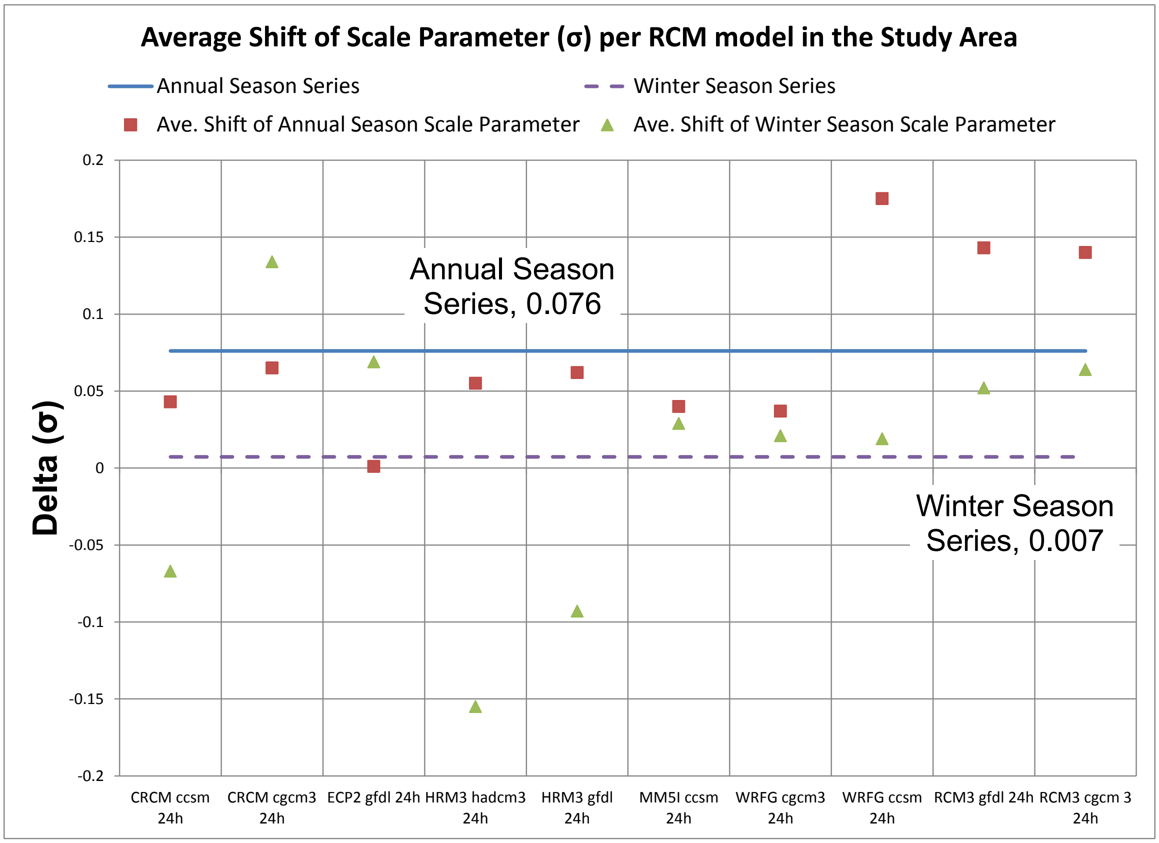

Figure 15. Average shift of scale parameter (σ) for each of the regional climate models and both Seasonal (red squares) and Annual (green triangles) series.

Table 9 shows the average shift of the GEV parameters for each RCM pairing. Tables 10 and 11 shows the average GEV parameters for each RCM pairing. Hosking et. al. (1985) suggested that a reasonable range for the shape parameters of the GEV used in frequency analysis lay in the range of -0.5 through 0.5. As can be observed on both tables, the shape parameter (κ) ranges between -0.2 and 0.2.

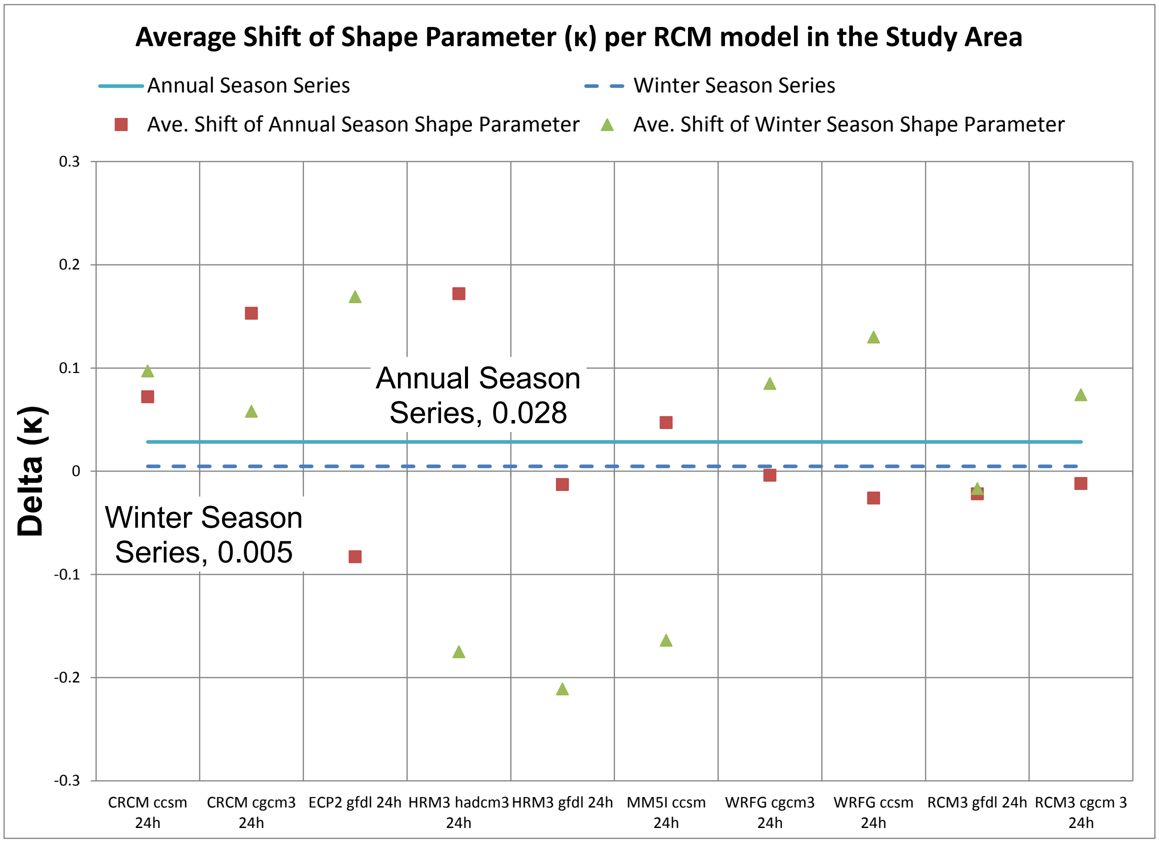

Figure 16. Average shift of shape parameter (κ) for each of the regional climate models and both present (red squares) and future (green triangles) day climate.

The analysis of the annual and seasonal series suggest different outcomes. In the case of the annual series, the resulting shift of the GEV curve parameters is positive. This then would suggest that the precipitation estimates for a given return period would be expected to increase. In the case of the winter seasonal series, despite the fact that average shift of the GEV parameters is negligible, the results vary based on the RCM pairing predictions. In the latter case, the qualification of the skill of each model is critical to weight the results. This GEV analysis allows for the measurement of the magnitude of the modeled climate shifts presented by the models.

Table 9

The Predicted Change in Generalized Extreme Value Parameters for Each of the Regional Climate Model Pairings When the Future-Day Generalized Extreme Value Parameters are Substracted From the Present Day Generalized Extreme Value Parameters

RCM model pairing	Predicted change in winter GEV parameters			Predicted change in annual GEV parameters		
	Δκ	Δσ	Δμ	Δκ	Δσ	Δμ
CRCM ccsm 24h	0.097	-0.067	-0.116	0.072	0.043	0.07
CRCM cgcm3 24h	0.058	0.134	0.07	0.153	0.065	0.302
ECP2 gfdl 24h	0.169	0.069	0.074	-0.083	0.001	0.123
HRM3 hadcm3 24h	-0.175	-0.155	-0.106	0.172	0.055	0.135
HRM3 gfdl 24h	-0.211	-0.093	0.011	-0.013	0.062	0.094
MM5I ccsm 24h	-0.164	0.029	-0.029	0.047	0.04	0.141
WRFG cgcm3 24h	0.085	0.021	0.16	-0.004	0.037	0.471
WRFG ccsm 24h	0.13	0.019	0.072	-0.026	0.175	0.25
RCM3 gfdl 24h	-0.017	0.052	0.005	-0.022	0.143	0.195
RCM3 cgcm 3 24h	0.074	0.064	0.057	-0.012	0.14	0.278

Note. GEV = Generalized Extreme Value; CRCM = Canadian Coupled Global Climate model; ccsm = community climate system model; cgcm3 = Canadian Coupled Global Climate Model 3; ECP2 = Experimental Climate Prediction Center model2; HRM3 = Hadley regional model 3; hadcm = Hadley Centre coupled model3; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model; MM5I = Mesoscale Model 5; WRFG = weather research and forecasting with the Grell model; RCM = regional climate models.

Table 10

Average Generalized Extreme Value Parameters for all the Different Regional Climate Models Based on Annual Maximum Series

RCM model pairing	Present-day climate GEV parameters κ_p	σ_p	μ_p	Future-day climate GEV parameters κ_f	σ_f	μ_f
CRCM ccsm 24h	-0.062	0.301	1.051	0.01	0.344	1.121
CRCM cgcm3 24h	-0.143	0.284	1.145	0.011	0.349	1.446
ECP2 gfdl 24h	0.035	0.452	1.699	-0.048	0.453	1.822
HRM3 hadcm3 24h	0.021	0.484	1.81	0.193	0.539	1.945
HRM3 gfdl 24h	0.107	0.419	1.642	0.095	0.48	1.737
MM5I ccsm 24h	0.063	0.533	1.719	0.11	0.573	1.86
WRFG cgcm3 24h	-0.036	0.596	1.714	-0.04	0.633	2.185
WRFG ccsm 24h	0.086	0.503	1.71	0.06	0.678	1.96
RCM3 gfdl 24h	0.133	0.569	2.182	0.112	0.712	2.377
RCM3 cgcm 3 24h	0.084	0.653	2.324	0.072	0.793	2.602

Note. RCM = regional climate models; GEV = Generalized Extreme Value; CRCM = Canadian Coupled Global Climate model; ccsm = community climate system model; cgcm3 = Canadian Coupled Global Climate Model 3; ECP2 = Experimental Climate Prediction Center model2; HRM3 = Hadley regional model 3; hadcm = Hadley Centre coupled model3; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model; MM5I = Mesoscale Model 5; WRFG = weather research and forecasting with the Grell model.

Table 11

Average Generalized Extreme Value Parameters for all the Different Regional Climate Models Models Based on Seasonal Annual Maximum Series

RCM model pairing	Present day climate GEV parameters			future day climate GEV parameters		
	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
CRCM ccsm	0.109	0.273	0.669	0.206	0.206	0.553
CRCM cgcm3	-0.014	0.236	0.691	0.044	0.37	0.761
ECP2 gfdl	0	0.147	0.536	0.169	0.216	0.61
HRM3 hadcm3	0.139	0.53	1.19	-0.036	0.374	1.084
HRM3 gfdl	0.064	0.36	0.955	-0.148	0.266	0.966
MM5I ccsm	0.079	0.296	0.804	-0.085	0.324	0.775
WRFG cgcm3	-0.04	0.3	0.784	0.046	0.32	0.944
WRFG ccsm	-0.145	0.287	0.742	-0.015	0.307	0.815
RCM3 gfdl	0.096	0.266	0.914	0.059	0.318	0.915
RCM3 cgcm 3	-0.051	0.297	0.949	0.012	0.367	1

Note. RCM = regional climate models; GEV = Generalized Extreme Value; CRCM = Canadian Coupled Global Climate model; ccsm = community climate system model; cgcm3 = Canadian Coupled Global Climate Model 3; ECP2 = Experimental Climate Prediction Center model2; HRM3 = Hadley regional model 3; hadcm = Hadley Centre coupled model3; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model; MM5I = Mesoscale Model 5; WRFG = weather research and forecasting with the Grell model.

Sensitivity Analysis on the Results

In the previous section the changes of GEV parameters were presented, but it is also important to explain the meaning of the findings. First, present-day climate was compared with the NOAA Atlas 14 precipitation quantiles on the return periods of 2, 5, 10, 25, 50, and 100 for the 24-hour event. Next, sensitivity was analyzed on the effects of the GEV curve to changes in the parameters and how they relate to the projection of quantiles.

The NOAA Atlas 14 is a very detailed and elaborate study of the frequency and duration of extreme events, using two sets of data: an AMS and a partial-duration series. For this case, the AMS frequency estimates were retrieved from the NOAA server and filtered through the mesh of the study area, to capture the precipitation values for each of the return periods, following a similar procedure performed to determine the development of the maximum series. These frequency estimates per grid can be found in Appendix F Next, the resulting matrix of values was compared to precipitation estimates from the GEV inverse function corresponding to each return period and to each RCM pairing. The differences for each grid can be found in Appendix G. Then, the NOAA Atlas 14 precipitation estimates were subtracted from the AMS derived from the RCM pairings and the average difference was plotted in Figure 17. The resulting estimates suggest that most models underestimate precipitation estimates, assuming that NOAA Atlas 14 precipitation estimates are the standard. Only two models seemed to overpredict the precipitation estimates: the RCM3 gfdl and RCM3 cgcm. These overestimating models have been qualified by the Ri with the highest values, suggesting higher bias than the other sets of models in the analysis of annual maxima. The Ri estimates with the lowest values show that the models that best predicted the present-day climate were ECP2 gfdl and HRM3 gfdl, which shows that models tend to underestimate the NOAA Atlas 14 precipitation estimates. This is expected, as the models lack the resolution to appropriately capture some local climate characteristics.

The difference between the precipitation estimates of NOAA Atlas 14 and the precipitation estimates developed in this study are the length of the period of record, the number of rainfall sensors, and the integration of regional statistical parameters that govern regional climate. In a sense, the frequency analyses have different sizes in the populations and hence very different precipitation-estimate outcomes.

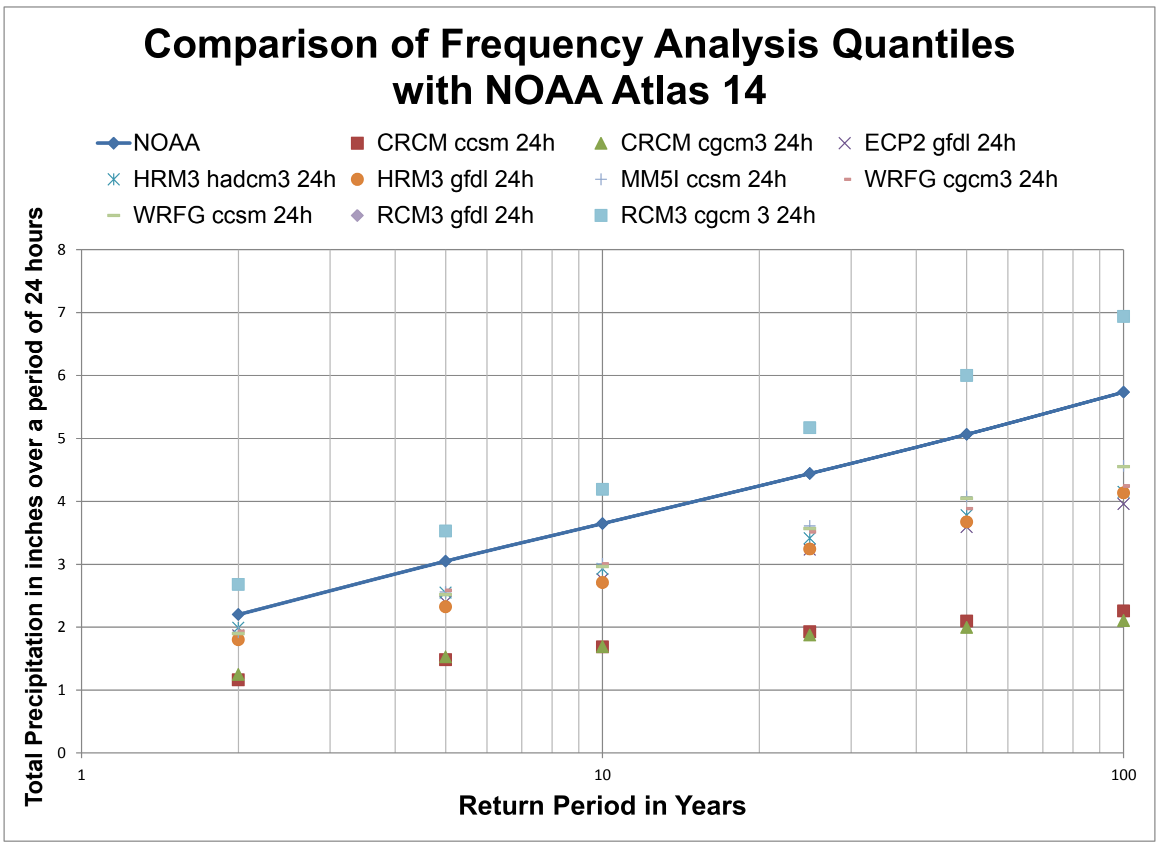

Figure 17. Comparison of precipitation estimates for present-day climate frequency analysis on the Annual Maximum Series with the National Oceanic and Atmospheric Administration Atlas 14 precipitation estimates.

Next, another sensitivity analysis addressed the magnitude of the precipitation estimates in relation to the changes of the GEV parameters. In Figure 14, a summary of the shifts for AMS and SAMS were presented. Also, in Tables 10 and 11 the values for the GEV were tabulated for the AMS and SAMS. Based on those values, a range of precipitation estimates were tabulated in Tables 12, 13, and 14. The objective is to determine the magnitude corresponding to the shift due to climate change. For example, HRM3 hadcm3 predicts a shift for the AMS of $\Delta\kappa = 0.172$, $\Delta\sigma = 0.05$ and $\Delta\mu = 0.135$. The present-day climate initial values are $\kappa = 0.021$, $\sigma = 0.484$ and $\mu = 1.81$. The values of this model are close to those tabulated in the tables. By looking at Table 12, it could be said that the change in shape parameter alone will cause a shift of a precipitation estimate of approximately 1.0 inches, the change associated with the scale parameter would be 0.2 inches, and the change associated with the location parameter would result on 0.4 inches. As a result, a cumulative increment of the precipitation estimates results from the changes of all three parameters, which roughly amounts to 1.6 inches of more precipitation for the 100-year return period for this example. The actual estimate of the increment is 1.75 inches, using the GEV parameters mentioned above.

Table 12

Matrix of Precipitation Estimates in Inches Using Shape (κ) Versus Scale Parameter (σ) Assuming Location Parameter (μ) = 1.5 for a 100-Year Return Period

	Shape parameter k								
Scale parameter σ	-0.2	-0.15	-0.1	-0.05	0	0.05	0.1	0.15	0.2
0.1	1.80	1.83	1.87	1.91	1.96	2.02	2.08	2.16	2.26
0.15	1.95	2.00	2.05	2.12	2.19	2.28	2.38	2.49	2.63
0.2	2.10	2.17	2.24	2.32	2.42	2.53	2.67	2.83	3.01
0.25	2.25	2.33	2.42	2.53	2.65	2.79	2.96	3.16	3.39
0.3	2.40	2.50	2.61	2.73	2.88	3.05	3.25	3.49	3.76
0.35	2.55	2.66	2.79	2.94	3.11	3.31	3.54	3.82	4.14
0.4	2.70	2.83	2.98	3.14	3.34	3.57	3.84	4.15	4.52
0.45	2.85	3.00	3.16	3.35	3.57	3.83	4.13	4.48	4.90
0.5	3.00	3.16	3.34	3.56	3.80	4.09	4.42	4.81	5.27
0.55	3.15	3.33	3.53	3.76	4.03	4.35	4.71	5.14	5.65
0.6	3.30	3.49	3.71	3.97	4.26	4.60	5.01	5.48	6.03

Table 13

Matrix of Precipitation Estimates in Inches Using Shape (κ) Versus Location (μ) Assuming Scale Parameter (σ) = 0.4 for a 100-Year Return Period

Location parameter μ	Shape parameter k								
	-0.2	-0.15	-0.1	-0.05	0	0.05	0.1	0.15	0.2
0.5	1.70	1.83	1.98	2.14	2.34	2.57	2.84	3.15	3.52
0.7	1.90	2.03	2.18	2.34	2.54	2.77	3.04	3.35	3.72
0.9	2.10	2.23	2.38	2.54	2.74	2.97	3.24	3.55	3.92
1.1	2.30	2.43	2.58	2.74	2.94	3.17	3.44	3.75	4.12
1.3	2.50	2.63	2.78	2.94	3.14	3.37	3.64	3.95	4.32
1.5	2.70	2.83	2.98	3.14	3.34	3.57	3.84	4.15	4.52
1.7	2.90	3.03	3.18	3.34	3.54	3.77	4.04	4.35	4.72
1.9	3.10	3.23	3.38	3.54	3.74	3.97	4.24	4.55	4.92
2.1	3.30	3.43	3.58	3.74	3.94	4.17	4.44	4.75	5.12
2.3	3.50	3.63	3.78	3.94	4.14	4.37	4.64	4.95	5.32
2.5	3.70	3.83	3.98	4.14	4.34	4.57	4.84	5.15	5.52

For a constant Δκ, the rate of change of the precipitation estimate increases as κ gets larger. The steeper increases in precipitation estimates occurs when the shape parameter indicates a Weibull distribution (κ>0). The average shape parameter for all models for present-day climate is κ = 0.029 for the AMS and κ = 0.024 for the SAMS. The average shift of shape parameter for all models is Δκ = 0.005 for the AMS and Δκ = 0.028 for the SAMS. These small changes suggest a small increase in precipitation estimates due to the shape parameter for both annual and seasonal events.

Table 14

Matrix of Precipitations Estimates Using Location (μ) Versus Scale (σ) Assuming Shape Paramter (κ) = 0.10 for a 100-Year Return Period

Scale parameter σ	Location parameter μ										
	0.5	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5
0.1	1.08	1.28	1.48	1.68	1.88	2.08	2.28	2.48	2.68	2.88	3.08
0.15	1.38	1.58	1.78	1.98	2.18	2.38	2.58	2.78	2.98	3.18	3.38
0.2	1.67	1.87	2.07	2.27	2.47	2.67	2.87	3.07	3.27	3.47	3.67
0.25	1.96	2.16	2.36	2.56	2.76	2.96	3.16	3.36	3.56	3.76	3.96
0.3	2.25	2.45	2.65	2.85	3.05	3.25	3.45	3.65	3.85	4.05	4.25
0.35	2.54	2.74	2.94	3.14	3.34	3.54	3.74	3.94	4.14	4.34	4.54
0.4	2.84	3.04	3.24	3.44	3.64	3.84	4.04	4.24	4.44	4.64	4.84
0.45	3.13	3.33	3.53	3.73	3.93	4.13	4.33	4.53	4.73	4.93	5.13
0.5	3.42	3.62	3.82	4.02	4.22	4.42	4.62	4.82	5.02	5.22	5.42
0.55	3.71	3.91	4.11	4.31	4.51	4.71	4.91	5.11	5.31	5.51	5.71
0.6	4.01	4.21	4.41	4.61	4.81	5.01	5.21	5.41	5.61	5.81	6.01

The location and scale parameters are linearly related to the precipitation estimates, so changes in x(f) are directly proportional to Δμ and Δσ. The average scale and location parameters are σ =0.479 and μ = 1.7 for the AMS and σ =0.299 and μ = 0.823 for the SAMS. The average predicted change is Δσ =0.076 and Δμ = 0.206 for the AMS and Δσ =0.007 and Δμ = 0.020 for the SAMS. The resulting changes associated with the precipitation estimates including all the parameters would suggest an estimated increment of 0.61 inches for the 100-year 24-hour annual event and an increment of 0.15 for the seasonal 100-year 24-hour annual event.

Conclusion

In this chapter I describe a parallel analysis of various aspects of climate change and how they affected precipitation estimates and the GEV distribution function for a single duration event of 24 hours. The parallel analysis looked at annual maxima and seasonal annual maxima. This chapter began, as I looked at the shifts on the maximum series, then it evaluated the REA methodology; I also looked at the frequency analysis of the maximum series and determined the change in the parameters of the GEV as a result of climate change over 70 years.

The shift in the maximum series showed how precipitation varied with respect to ranking. It was illustrated that the AMS and seasonal maximum series had different outcomes in how changes were expected to occur. The AMS shifts were suggested to increase precipitation in the future, whereas in the winter seasonal variations there was no significant change. When comparing the better-skilled models with the general trend of all the models, the winter seasonal series showed better performance than the annual series, as the model series mostly followed the trend.

A methodology to qualify RCM pairings, the REA method consists of calculating a representative value that consists of two factors: (a) the calculation of the Rb, and (b) the calculation of the Rd. Most important is the Rb because it compares the ability of a model to replicate present-day climate. In general, the models were better at replicating the seasonal winter-event durations than they were at replicating the annual-event durations. For the Rd, the models had better convergence when simulating future climate in the winter season than they did for the annual climate. For both cases, the Rb was greater than the Rd. As a result, the Ri calculations were smaller in the winter season overall than in annual events, demonstrating that the winter season is better modeled by the RCM pairings. This outcome would suggest that models were better at replicating the winter season overall.

The last part of the chapter evaluated the behavior of GEV parameters and their shift due to climate change. The series used the maximum-likelihood method to fit GEV curves to each different discrete series for all scenarios. As a result each different series associated with each of the study-area grids had associated shape, scale, and location parameters for all conditions: present day, future day, annual, and seasonal. The analysis consisted of determining the change based on the estimation of the parameters. Precipitation estimates were calculated for the present-day climate based on the AMS and then compared directly with NOAA Atlas 14 data. The comparison showed that the RCM-pairings-derived series underestimated precipitation estimates when compared with NOAA Atlas 14, as was expected.

Last, a sensitivity analysis was performed to better understand the magnitude of the variation in GEV parameters; the change was cumulative to the variation of the three GEV parameters. The shape parameter dominated the change when it was greater than zero, due to its exponential relationship to precipitation estimates. The other two parameters had a linear relationship with the precipitation estimates and the change was constant. As a result, the average predicted change was for the shape parameter $\Delta\kappa = 0.005$, $\Delta\sigma = 0.076$ and $\Delta\mu = 0.206$ for the AMS, and $\Delta\kappa = 0.028$, $\Delta\sigma = 0.007$ and $\Delta\mu = 0.020$ for the SAMS. The shifts in winter-season GEV parameters are very specific to each model, which overall happen to average close to zero.

CHAPTER 5

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

Introduction

Seasonal analysis of extremes has been demonstrated to be a more appropriate approach to the alternative annual analysis when exploring the effects of climate change in extreme precipitation. To better understand it, I applied frequency analysis. In the frequency analysis of the extreme precipitation, the canons of stationarity and homogeneity assumptions are essential. This chapter presents an interpretation and limitations of the results and analyses on the shift of precipitation maxima as a result of climate change. I also discuss future research that would complement this study.

Qualifying Models Using the Reliability Ensemble Average Method

The application of the REA methodology to the AMS is based on the model's ability to replicate present-day climate and the average prediction of the AMS. The following are the conclusions of the analysis:

- For the annual and the winter season, the REA method showed that all RCM models are better at agreeing with the average future predictions than they are at replicating present-day climate.
- The method also showed that winter is better reproduced by both criteria, resulting in significantly lower REA values. The significant difference in the Rd factor for each season was particularly low for the winter season, resulting on low REA values. The ability to replicate present-day climate was better represented by the winter season with an average Rb = 1.59, when compared with the annual season average Rb = 1.75, a small difference.

- The model that ranked best in the REA index among all models in the winter season was the HadCM3, paired with the gfdl athmospheric land generalized model. However, there was a model that scored better in the replication of present-day climate: the Abdus Salam International Center for Theoretical Physics' RCM3 paired with the gfdl.

What is the Shift of Extreme Precipitation on the 24-Hour Duration Event in the Region?

Estimating the shift in 24-hour-duration events required the development of the AMS for each RCM, climate scenario, and both annual and winter seasons. Two analyses were performed: (a) estimation of the difference of the precipitation maxima using the AMS, and (b) estimation of the difference between the GEV function parameters.

Shifts on the Precipitation Maxima Using the Annual Maximum Series

The AMS were developed for all models—the present-day climate and future-day climates—and both annual and winter seasons. The following are the main findings:

- The shift in precipitation maxima trend for all RCMs suggests an increase in the precipitation volume for the annual season, but shows no significant change for the winter season.
- There were two models selected by using (a) a lower REA index, and (b) a lower Rb factor. In the case of the annual season, these indexes suggest that the shift in precipitation is below the trend for all RCMs for the annual season. A similar analysis was performed for the winter season and the model with the lower REA index suggested a significant decrease in precipitation volumes for

the least frequent events, whereas the model with the lowest Rb factor showed an increase in precipitation volumes for the less frequent events.

Shifts in the Generalized Extreme Value Parameters

The GEV function consists of three parameters: shape (κ), the scale (σ), and the location (μ). Through the use of the maximum-likelihood methodology, a fitted GEV curve was attained for each individual series. The GEV parameter difference was calculated by subtracting the present-day GEV parameters from the future-day parameters, resulting in representation of the shift of the GEV curve between modeling periods. The following are the findings:

- The overall average predicted change is for the shape parameter $\Delta\kappa = 0.005$, $\Delta\sigma = 0.076$, and $\Delta\mu = 0.206$ for the annual season and $\Delta\kappa = 0.028$, $\Delta\sigma = 0.007$, and $\Delta\mu = 0.020$ for the winter season. The overall average shift of the GEV parameters in the annual season suggests an increase in precipitation of about 0.8 inches for the 100-year return period. In the case of the winter season, the shift is an increase close to about 0.1 inch for the 100-year return period.
- The annual season's chosen model HRM3 gfdl had a shift of $\Delta\kappa = 0.172$, $\Delta\sigma = 0.055$, and $\Delta\mu = 0.1375$, resulting on an estimated shift of 0.37 inch for the 100-year return period. In the case of the winter season, the chosen RCM3 cgcm3 suggests a shift of $\Delta\kappa = 0.074$, $\Delta\sigma = 0.064$, and $\Delta\mu = 0.057$, resulting an increase in the 100-year precipitation estimate by approximately 0.57 inch.
- Another effort was made to quantify the magnitude of the shift of the GEV parameters. During this analysis, the precipitation estimates varied depending

on the change of all three parameters. The positive shifts on the shape parameter have the greatest influence in the precipitation estimate when it approaches $\kappa = 0.5$. Both scale and location parameters affect precipitation estimates linearly. The shift in precipitation is a consequence of the cumulative shift of all three parameters in the GEV distribution.

Limitations

Finding a methodology to understand the shift in precipitation maxima is a first step in understanding the implications of climate change in water resources. The applications of the methodologies presented in this document have limitations that are associated with the nature of the analysis, the source of the data and the data availability.

Data Limitations

The two sources of data used were the NARCCAP and the FCD sets. The limitations of the NARCCAP dataset includes: spatial resolution and projection, temporal resolution and climate scenario temporal boundaries. Similarly, the FCD data set has limitations on its spatial coverage and observed dataset temporal boundaries.

The spatial resolution and projection for NARCCAP and spatial coverage of FCD were addressed by developing a common grid system for the analysis, which has a similar spatial resolution as the RCMs. It was assumed that RCMs nodes and FCD gages were co-located inside each grid, for the purposes of the analysis. One shortcoming of the development of the grid area is that it covered a large extent, in the vicinity of 20 thousand square miles, and the topography of the terrain varies from about 1000 ft to about 7000 ft in elevation. There are distinct climate differences in the lower 1000 ft areas and the mountainous higher elevations, which were not taken in consideration during the presented analyses.

In the case of the temporal boundaries there are two limitations. The first limitation is associated with 20 years of overlap between the present day climate scenario and the observed dataset. This is primarily important when developing the Rb factor because it does not account for the first 10 years of the present day climate scenario. The second limitation is associated with the length of the precipitation maximum series, in where it assumed the length of the modeled years for each climate scenario. In the estimation of the GEV parameters using the maximum likelihood method, the size of the sample is important. Ailliot et.al.(2011) compared various methods for estimating the GEV parameters and found that for small sample sizes of n= 30 the maximum likelihood method generally performed well. For this reason, it was assumed that the sample size in the NARCCAP 30 year scenarios would be sufficient to complete this analysis. It is also important to remark that large sample sizes n=100, will capture the statistical properties of precipitation maxima for the last 100 years but not necessarily those of future climate.

There are also inherent limitations to at which the NARCCAP datasets can emulate climate at the sub regional scale that are not only exclusively subject to the model accuracy, but the assumptions about future climate variable states. There is a wide range of literature, particularly from the IPCC that addresses these uncertainties.

Limitations on Analysis

The following subsections discuss the limitations associated with the analyses presented in this document. The discussion includes the limitations on averaging and trends, REA methodology, homogeneity and stationarity assumptions

Averaging and trends: The trends presented in the results contain model bias because these trends represent the overall shift in precipitation for all models. In order to account for the bias present in each individual model, the incorporation of the REA using an inverse weighted average is recommended for future calculations. Also the trends represent the entire heterogeneous climate sub-region and do not necessarily reflect the performance of the models on homogeneous climate sub-regions.

REA Methodology: The methodology implemented in this document presents a shortcoming on accounting correctly for the factors, resulting similar qualifications for different models. This methodology is flexible and can be further expanded upon.

Sensitivity Analysis: The precipitation estimates for the annual analysis were performed and compared with the NOAA Atlas 14 precipitation estimates. On average, most models under predicted precipitation estimates for the different return periods. This under prediction comes as a result of various differences in the source of the data, the assumptions, and the type of analysis performed. In the case of the NOAA Atlas 14 data, the observed period of record included rainfall records dating from the early 1900s. In addition, the precipitation estimates are a result of a regional frequency analysis that integrated regional statistical patterns and integrated qualifying gages. As a result, the analysis of the AMS of the NOAA data set yielded more conservative precipitation estimates. In contrast, the present-day climate modeled by the RCM pairings did not represent annual events well, as they lack the spatial and temporal resolution to reproduce local convective-type events, which are better represented using higher resolution models.. Consequently, the RCM pairings precipitation extreme estimates underestimate the NOAA Atlas 14.

Homogeneity Assumption Discussion

The U.S. Army Corps of Engineers (Beard & Fredrich, 1975) suggested that a population of hydrologic datasets used for a frequency analysis must be ideally homogeneous with respect to a specific property. To enhance the homogeneity of the annual and the winter seasons, the USGS definition of the water year was used, along with the FCDMC's definition of the winter season. The water year is defined as the period bounded between the dates of October 1st and September 30th of any given year. In a similar fashion, the winter season is bounded by November 1 through March 31 of any given year. These definitions were fundamental in developing the annual maximum precipitation series for each season.

I used the REA method as the instrument evaluating the homogeneity assumption. The findings suggested that analysis of the winter season is a better approach to represent precipitation maxima. First, the Rb for the winter season was less variable when plotted spatially, compared with the annual season. Second, the convergence of future-day predictions with the winter season was much more consistent than the annual season when performing the REA analysis, resulting in a significant difference when compared with the annual season. This was particularly expected because the winter season better captures the uniformity of climate variables particular to that season, where the annual season captures a combination of all the events over the year. This is important, as the models do not have the skill to reproduce all seasons well, but serve to qualify those seasons that are represented satisfactorily.

There is a significant difference between the shift of the annual precipitation maxima and the seasonal winter precipitation maxima. Perhaps there are events that are occurring during the other seasons of the year, that are reflected in the annual but not occurring in the winter. This represents a limitation of the of the seasonality analysis included in this document.

Additionally, the homogeneity of sub-regional climates within the mesh was not analyzed individually. There is a range in elevations in which climate behave differently since it covers arid valleys and mountains ranges. This preliminary analysis only accounts for the general behavior of the models over a sub-regional area but does not address the questions related with the orographic climate homogeneity.

Stationarity Assumption Discussion

The U.S. Army Corps of Engineers (Beard & Fredrich, 1975) suggested that a population in a hydrologic dataset used for frequency analysis must ideally have its statistical properties time-invariant or stationary, in addition to having a homogeneous population. Much science has gone into simulating the changes in climate variables and the reproduction of plausible climate-change scenarios. NARCCAP (Mearns et al. 2009) developed a set of RCM pairings that reproduce present-day climate and future-day climate. The statement that climate is changing suggests that there are time-variant statistical properties in the way extreme events occur.

There is a trade off in the size of the precipitation maxima sample and the stationarity assumption. The larger the sample sizes are, the more historical precipitation data is included. Given the impact of the anthropogenic effects on the global climate systems and its associated climate change, does not necessarily imply that the historical data would be replicated in the future. This change in climate would have an expected effect on the climatic variables and consequently being non-stationary. If the use of shorter periods of time this assumption could be more plausible than using it over longer periods of time. One issue that is not investigated in this document is how long a period in which is climate can be considered stationary and whether that period is dynamically changing over time.

I analyzed how the series are shifting over a period of 70 years and how the GEV parameters vary from one scenario to another to evaluate the stationary assumption, assuming that in each climate scenario the climate was stationary. If the statistical properties of climate are not changing significantly or remaining stationary, it would be expected to have small shifts in the GEV parameters. The GEV analysis showed that the annual precipitation series had an overall average shift in the GEV parameters over the 70 year period, where the winter showed that this overall average was not the case. However, the individual model GEV parameters still vary on their shift in the GEV parameters in average per model and per individual grids. In fact this is one of the most critical limitations in this analysis.

Recommendations and Future Research

There are many and further analysis to address the assumptions of homogeneity, stationarity, and that allows characterizing climate change and estimating the shift in precipitation maxima.

More homogeneity

Improve the assumptions about the spatial distribution by dividing the mesh into two sub-regions and better capture the orographic homogeneity. A similar analysis and trending can be implemented to better characterize the specific shifts in precipitation maxima at this sub-regional levels.

Develop precipitation maxima series that cover other annual seasons so that the shift in precipitation observed during the annual season can be better understood. Since the winter season did not display a shift in precipitation similar to the one presented in the annual maximum series, then there must be another season in where the shift is greater. This was not investigated in this study.

Stationarity of the System

The assumption that during the time lapse of 30 years the climate is stationary was not evaluated in detail during this study. Further investigation can be completed to better understand the changes in the statistical properties of a maximum series, by determining a feasible sample size that provides enough information about the system and yet representing a stationary system. This can be addressed by using the alternative partial duration maximum series.

Improve REA methodology

The REA methodology used in this study was only one case in where the exponents were assumed to be 1 for the bias and convergence factors. One can use these exponents to provide more clarity on which model performs better. In the case of this study it was assumed that REA evaluated the models equally by bias an conveyance. Perhaps, more emphasis should be given to the models that have better reliability bias scores, since they are emulating better the sub-regional level climate. This resulting REA then should be used when developing trend analysis and comparing results among models.

Other event durations

Additional studies about other types of duration events such as the 3 hour, 6 hour 12 hour, 48 hour, and higher should be considered, to further evaluate the findings of this thesis. The North American continent covers a large area, and generalized studies can only reveal so much about one location. However, the more of these studies, the better the understanding of the consequences of climate change and its effects on extreme events such as extreme precipitation.

Higher Resolution Models

With the advent of higher resolution sub-regional models, this methodology can be applied to better understand the implications of the shift of the precipitation maxima. Upon improvement of the analyses aforementioned, this methodology can be used to compare these sub-regional better resolution models with both observed and regional climate models. It can also be used to determine a more “reliable” model to for a better characterization of the local climate.

Summary

Estimating the shift of the precipitation maxima required the understanding of the modeling of regional climate models, the availability of rainfall sensor datasets and a three step analysis that characterize the shift in terms on magnitude, reliability and probability. The comparison among the precipitation maxima series indicated that the trend for the annual maximum series indicates a shift, while for the winter there is no shift. REA methodology suggested that the winter seasonal analysis yielded the smallest bias and the models in general had better skill in reproducing when compared with annual maximum series. In addition, I tested the capability of the models to reproduce present-day climate using the REA methodology. I determined that both annual and winter maximum series performed similarly. I also determined that in both cases the future day climate scenario was converging for both scenarios. Using the GEV parameters, I intended to determine the statistical shift of the series over the 70 year period. It was found that the annual series had some shift in the GEV parameters, while the winter did not demonstrated a significant shift when looking at the overall trend. There are many limitations with the proposed approach, but there are also many variables and uncertainties associated with the current methodologies dealing with extreme precipitation.

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APPENDIX A

GLOSSARY OF TERMS

ALERT Automated Local Evaluation in Real Time

AMS Annual Maximum Series

AOGCM atmosphere-ocean general circulation model

AR4 Intergovernmental Panel on Climate Change Fourth-Assessment Report

CCSM Community Climate System Model

CGCM3 Canadian Coupled Global Climate Model 3

CRCM Canadian regional climate models

ECP Experimental Climate Prediction Center

FCDMC Flood Control District of Maricopa County

GCM general circulation model

GEV Generalized Extreme Value

gfdl Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model

GFDL Geophysical Fluid Dynamics Laboratory model

HadCM3 Hadley Centre coupled model

HRM3 Hadley Centre Regional Model 3

IPCC Intergovernmental Panel on Climate Change

LAMS Lumped Annual Maximum Series

MM5I Mesoscale Model 5 by Iowa State University

MSE mean square error

NARCCAP North American Regional Climate Change Assessment Program

NAVD North American Vertical Datum

NCAR National Center for Atmospheric Research

NOAA National Oceanic and Atmospheric Administration

RCM3 Regional Climate Model version 3 by University of California.

RCM regional climate models

Rb Reliability bias

Rd Reliability distance bias

Ri reliability ensemble average for the ith model

REA reliability ensemble average

SAMS Seasonal Annual Maximum Series

SRES Special Report on Emission Scenarios

USGS U.S. Geological Survey

WGS World Geodetic System

WRFG Weather Research and Forecasting by Pacific Northwest National Lab

APPENDIX B

SPATIAL LOCATION AND XC AND YC POINTS

Table B1

Study Area Grid Centroids in Latitude and Longitude, WGS72

Column	Row	Latitude	Longitude
A	1	34.39555944	-113.2856018
A	2	34.47455469	-112.7918815
A	3	34.55354994	-112.2981612
A	4	34.63254519	-111.8044409
A	5	34.71154044	-111.3107205
B	1	34.00058319	-113.2224056
B	2	34.07957844	-112.7286853
B	3	34.15857369	-112.234965
B	4	34.23756894	-111.7412447
B	5	34.31656419	-111.2475243
C	1	33.60560694	-113.1592094
C	2	33.68460219	-112.6654891
C	3	33.76359744	-112.1717688
C	4	33.84259269	-111.6780485
C	5	33.92158794	-111.1843281
D	1	33.21063068	-113.0960132
D	2	33.28962593	-112.6022929
D	3	33.36862118	-112.1085726
D	4	33.44761643	-111.6148523
D	5	33.52661169	-111.1211319
E	1	32.81565443	-113.032817
E	2	32.89464968	-112.5390967
E	3	32.97364493	-112.0453764
E	4	33.05264018	-111.5516561
E	5	33.13163543	-111.0579357

Table B2

Regional Climate Nodes and Spatial Relation with Study Area Grid

HRM3			CRCM			ECP2			WRFG			MM5I			RCM3		
XC	YC	Grid Ref	XC	YC	Grid Ref	XC	YC	Grid Ref	XC	YC	Grid Ref	XC	YC	Grid Ref	XC	YC	Grid Ref
46	38	A1	34	29	A1	35	32	A1	31	23	A1	36	25	A1	37	29	A1
47	38	A2	35	29	A2	36	32	A2	32	23	A2	37	25	A2	38	29	A2
48	38	A3	36	29	A3	37	31	A3	33	23	A3	38	25	A4	39	29	A3
49	38	A4	37	29	A3	38	31	A4	34	23	A4	39	25	A5	40	29	A4
50	38	A5	38	29	A4	39	31	A5	35	23	A5	36	24	B1	41	29	A5
46	37	B1	39	29	A5	35	31	B1	31	22	B1	37	24	B3	37	28	B1
47	37	B2	34	28	B1	36	30	B2	32	22	B2	38	24	B4	38	28	B2
48	37	B3	35	28	B2	36	31	B2	33	22	B3	39	24	B5	39	28	B3
49	37	B4	36	28	B3	37	30	B3	34	22	B4	35	23	C1	40	28	B4
50	37	B5	37	28	B4	38	30	B4	35	22	B5	36	23	C2	41	28	B5
46	36	C1	38	28	B4	39	30	B5	31	21	C1	37	23	C3	37	27	C1
47	36	C2	39	28	B5	34	30	C1	32	21	C2	38	23	C4	38	27	C2
48	36	C3	34	27	C1	35	30	C1	33	21	C3	39	23	C5	39	27	C3
49	36	C4	35	27	C2	35	29	C2	34	21	C4	35	22	D1	40	27	C4
50	36	C5	36	27	C3	36	29	C2	35	21	C5	36	22	D2	41	27	C5
46	35	D1	37	27	C4	37	29	C3	31	20	D1	37	22	D3	37	26	D1
47	35	D2	38	27	C5	38	29	C4	32	20	D2	38	22	D4	38	26	D2
48	35	D3	39	27	C5	39	29	C5	33	20	D3	39	22	D5	39	26	D3
49	35	D4	34	26	D1	34	28	D1	34	20	D4	35	21	E1	40	26	D4
50	35	D5	35	26	D2	34	29	D1	35	20	D5	36	21	E2	41	26	D5
46	34	E1	36	26	D3	35	28	D2	31	19	E1	37	21	E3	37	25	E1
47	34	E2	37	26	D4	36	28	D3	32	19	E2	38	21	E4	38	25	E2
48	34	E3	38	26	D5	37	28	D3	33	19	E3	39	21	E5	39	25	E3
49	34	E4	34	25	E1	38	28	D4	34	19	E4				40	25	E4
50	34	E5	35	25	E2	39	28	D5	35	19	E5				41	25	E5
			36	25	E3	34	27	E1									
			37	25	E4	35	27	E2									
			38	25	E5	36	27	E3									
						37	27	E3									
						38	27	E4									
						39	27	E5									

Table B3

Flood Control District of Maricopa County Data and Spatial Relation to the Study Area Grid

Gage ID	Grid ID	Gage ID	Grid ID
5365	A2	5430	C2
5775	A3	5215	C2
5805	A3	5475	C2
5380	A3	5445	C2
5820	A3	5625	C3
5190	B1	5580	C3
5130	B1	4630	C3
5180	B1	5535	C3
5170	B1	4940	C4
5290	B2	5960	C5
5320	B2	5000	D1
5275	B2	5200	D2
5260	B2	4700	D3
5490	B2	6510	D3
5670	B3	6880	D3
5745	B3	4620	D3
5335	B3	6745	D4
5730	B3	6670	D4
5685	B3	6655	D4
5715	B3	6610	D4
5760	B4	6730	D4
4950	B4	6960	E2
		6940	E2

APPENDIX C

ANNUAL PRECIPITATION MAXIMUM SERIES AND SEASONAL (WINTER) PRECIPITATION MAXIMUM SERIES

Table C1

Canadian Regional Climate Model; Community Climate System Model Series

Table C1.A: Annual Maximum Series: Present Day Climate																									
Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	1.59	1.69	1.89	1.88	1.70	1.64	1.81	1.85	1.93	1.51	2.28	2.55	2.55	2.09	1.92	1.25	1.37	1.48	1.13	0.96	1.41	1.20	1.49	1.19	1.03
1970	0.99	1.31	1.38	0.91	1.04	1.03	0.95	0.99	1.11	1.12	0.93	0.96	1.06	0.94	1.00	0.97	1.09	1.07	0.96	0.94	1.03	1.36	1.18	1.22	1.15
1971	1.11	0.83	1.25	1.00	1.00	0.80	0.55	0.62	0.99	0.92	0.61	0.65	0.70	0.55	1.09	0.57	0.57	0.48	0.55	0.52	0.76	0.70	0.67	0.89	0.95
1972	1.61	1.81	1.73	2.26	1.92	2.06	2.21	1.62	2.45	1.82	2.20	2.10	1.49	2.25	2.31	2.03	1.68	1.85	2.09	2.10	1.71	1.47	1.92	1.85	1.83
1973	1.21	1.43	2.07	1.29	1.66	1.65	2.21	1.83	1.54	1.88	1.98	2.38	1.36	1.78	1.54	2.30	1.33	1.58	1.32	1.17	1.09	1.46	1.27	1.13	1.35
1974	0.98	1.50	1.69	1.36	1.09	1.13	1.49	1.61	1.57	1.12	1.23	1.51	1.64	1.59	1.32	1.35	1.66	1.70	1.50	1.25	1.47	1.85	1.74	1.48	1.14
1975	0.82	0.91	1.34	0.91	0.90	0.66	0.94	1.42	1.11	1.14	0.61	0.95	1.43	1.20	1.13	0.56	0.88	1.34	1.27	1.12	0.51	0.66	1.14	1.23	1.28
1976	0.89	1.14	1.29	1.19	1.28	1.34	1.47	1.30	1.88	1.55	1.41	1.27	1.16	1.02	1.17	1.20	1.17	1.25	1.17	0.81	1.20	1.47	1.23	0.81	0.81
1977	1.53	1.35	1.38	1.25	0.94	1.27	1.22	1.23	1.40	1.09	1.31	1.24	1.20	1.00	1.49	1.44	1.38	1.23	1.26	1.38	1.33	1.33	1.10	0.89	0.82
1978	1.08	1.00	1.24	1.72	1.50	0.93	0.97	0.91	1.05	1.19	0.92	1.18	1.02	1.22	1.32	1.10	1.04	0.89	1.15	1.38	1.00	1.28	1.02	1.43	1.47
1979	1.08	1.20	1.20	1.32	1.29	0.84	1.06	1.27	1.11	1.48	0.86	0.94	1.01	1.05	1.49	0.85	0.87	0.95	1.09	1.69	0.91	0.93	1.02	1.22	1.66
1980	1.60	2.18	2.16	1.24	0.82	1.06	1.08	0.99	1.23	0.79	1.06	0.81	0.84	1.30	1.13	0.78	0.64	0.62	0.91	1.35	0.59	0.58	0.60	0.77	0.94
1981	1.22	1.15	1.14	1.27	1.28	1.19	1.06	1.16	1.08	1.16	1.11	0.98	0.77	0.73	0.84	1.08	1.01	0.73	0.80	0.81	1.09	1.08	0.91	0.93	0.88
1982	0.59	0.65	0.98	0.86	1.01	0.58	0.61	0.72	1.04	1.32	0.58	0.63	0.99	1.13	1.67	0.65	0.91	1.04	1.24	1.21	0.94	1.06	1.20	1.23	1.22
1983	0.87	1.04	1.34	1.15	1.53	0.94	1.03	1.14	1.68	1.91	1.09	1.09	1.16	1.58	2.01	1.19	1.18	1.22	1.70	1.90	1.23	1.26	1.24	1.53	1.45
1984	1.31	1.29	1.78	1.42	1.45	1.33	1.28	1.17	1.63	1.27	1.14	1.12	1.04	1.01	1.15	1.31	1.07	1.01	1.09	1.10	1.30	1.19	0.93	1.04	1.04
1985	1.06	1.32	1.39	0.83	1.07	1.04	1.06	1.03	1.15	0.99	0.67	0.86	1.13	1.20	1.58	0.59	0.78	1.09	1.20	1.64	0.72	0.76	0.97	1.56	1.73
1986	1.71	1.81	1.84	1.70	1.67	1.62	1.69	1.80	1.89	1.82	1.70	1.70	1.83	1.98	2.00	1.81	1.82	1.89	2.06	2.08	1.91	2.02	2.05	2.12	2.07
1987	0.77	0.77	0.93	1.17	1.37	0.82	0.80	0.90	0.95	1.29	0.83	0.85	0.88	0.92	1.52	0.75	0.75	1.05	1.28	1.74	0.66	0.86	0.89	1.30	1.36
1988	0.70	0.91	1.17	1.47	1.72	0.90	1.26	1.59	2.18	2.18	1.52	1.79	2.01	2.11	2.01	1.63	1.64	1.63	1.56	1.36	1.06	1.41	1.50	1.36	1.41

Table C1.A: Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	0.84	0.81	1.01	0.87	0.94	0.89	0.83	0.83	1.31	1.27	0.86	0.81	0.96	1.09	1.66	0.86	0.97	1.09	1.16	1.46	1.02	1.13	1.19	1.18	1.21
1990	1.38	1.27	1.41	1.68	1.11	1.20	1.19	1.23	1.57	1.28	1.11	1.10	0.97	1.26	1.56	1.16	1.07	1.06	1.34	1.54	1.34	1.44	1.22	1.32	1.47
1991	0.99	1.01	1.23	0.93	1.19	1.01	1.27	1.17	1.13	1.18	1.02	1.22	1.19	1.05	1.28	1.10	0.85	1.09	1.31	1.16	0.82	0.71	0.68	1.01	1.31
1992	1.91	1.71	1.58	1.14	1.40	1.67	1.62	1.47	1.34	1.43	1.48	1.43	1.47	1.47	1.60	1.19	1.21	1.35	1.43	1.40	1.17	0.98	1.08	1.28	1.38
1993	0.70	0.69	1.17	1.18	1.17	0.79	0.83	0.80	1.13	1.35	0.96	0.94	0.86	0.91	1.06	0.96	0.99	0.99	1.08	0.87	0.92	1.16	1.10	1.17	1.04
1994	1.38	1.40	1.23	1.25	1.44	1.37	1.40	1.38	1.42	1.53	1.36	1.40	1.44	1.39	1.39	1.29	1.34	1.30	1.29	1.28	1.21	1.14	1.06	1.26	1.34
1995	0.80	0.74	0.78	1.00	1.39	0.73	0.73	0.73	1.08	1.39	0.74	0.69	0.84	0.87	1.37	0.73	0.80	0.80	0.88	1.20	0.87	0.86	0.98	0.94	1.19
1996	0.84	0.79	1.05	1.04	0.87	0.72	0.64	0.73	1.08	0.89	0.61	0.72	0.81	0.86	0.87	0.83	0.66	0.83	0.84	0.77	1.01	0.63	0.66	0.72	0.68
1997	1.37	1.24	1.43	1.34	1.52	1.38	1.28	1.45	1.60	1.72	1.26	1.40	1.40	1.33	1.49	1.74	1.37	1.03	1.03	1.27	1.44	1.40	1.49	1.56	1.51
1998	1.27	0.89	0.73	0.68	0.76	0.91	0.73	0.71	0.78	0.75	0.76	0.76	0.65	0.69	0.96	0.68	0.66	0.52	0.79	0.69	0.66	0.46	0.72	0.65	0.70
1999	1.46	1.08	1.10	1.25	1.05	1.25	1.01	0.95	1.41	1.12	1.10	1.05	1.26	1.23	1.51	1.00	1.05	1.07	1.16	1.42	0.95	0.94	1.11	1.24	1.79

Table C1.B: Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.00	1.22	1.30	1.35	1.27	0.98	1.19	1.32	1.23	1.15	0.90	0.85	1.07	1.41	1.30	0.94	1.27	1.49	0.98	0.80	1.60	1.22	0.68	0.91	0.92
2040	1.29	1.15	0.89	1.20	1.39	0.88	1.07	1.27	1.42	1.51	0.95	0.86	1.26	1.53	1.53	0.75	0.89	1.32	1.25	1.18	1.08	0.91	1.03	0.96	1.25
2041	1.66	1.78	1.62	1.85	1.84	1.47	1.44	1.27	1.30	1.45	1.64	2.14	2.77	1.26	1.60	2.25	2.32	2.12	1.91	1.53	1.88	2.00	1.52	2.00	1.91
2042	1.21	0.94	1.26	1.12	0.98	1.19	0.97	0.86	1.67	1.29	1.16	0.78	0.76	0.96	1.57	0.80	0.72	0.87	0.80	0.79	0.61	1.00	0.71	0.92	0.79
2043	1.07	1.03	1.46	1.01	1.12	1.07	1.27	1.20	1.08	1.15	1.13	1.20	0.99	1.03	1.23	1.21	1.07	1.11	1.17	1.34	1.16	1.40	1.43	1.46	1.50
2044	1.34	1.17	1.46	1.54	1.44	1.32	1.36	1.18	1.39	1.59	1.41	1.09	1.03	1.16	1.56	1.17	0.93	0.99	1.10	1.47	1.04	1.04	1.05	1.25	1.64
2045	1.22	1.27	1.63	1.08	1.06	0.87	1.32	1.45	1.72	1.29	1.09	1.38	1.89	1.33	1.41	1.27	0.92	1.17	1.36	1.78	1.39	1.71	1.02	1.31	1.43
2046	0.91	0.93	0.99	0.84	0.97	0.72	0.84	1.00	1.07	1.03	0.61	0.89	1.11	0.96	1.24	0.91	0.99	0.88	1.13	1.35	0.67	0.70	0.97	1.26	1.47
2047	1.43	1.43	1.54	1.42	1.46	1.71	1.74	1.84	1.70	1.48	1.76	1.93	2.00	1.79	1.78	1.73	1.81	1.76	1.53	1.47	1.52	1.46	1.40	1.41	1.35
2048	1.42	1.61	1.84	1.39	1.19	1.69	1.86	1.93	1.81	1.34	1.95	1.97	1.93	1.72	1.47	2.10	2.00	1.88	1.59	1.30	2.10	2.09	1.75	1.45	1.19
2049	0.90	1.07	0.76	1.06	0.80	0.89	0.81	0.83	0.96	0.91	1.18	0.75	0.89	0.95	0.98	0.87	0.70	0.71	0.79	0.90	0.78	0.85	0.99	0.92	0.78
2050	0.69	0.49	0.67	0.55	0.98	0.48	0.47	0.61	0.89	1.07	0.59	0.59	0.83	0.76	1.27	0.74	0.63	0.64	0.65	0.88	0.60	0.56	0.73	0.89	1.20
2051	1.27	1.38	2.38	2.22	2.00	1.06	1.47	2.18	2.57	2.01	1.31	1.62	2.30	2.60	2.48	1.50	1.81	2.28	2.50	2.38	1.78	1.97	2.19	2.28	2.13
2052	1.06	1.04	0.94	1.61	1.25	1.07	1.12	1.00	2.51	2.24	1.36	1.06	1.19	1.48	3.10	0.98	1.06	1.31	1.38	1.46	1.17	1.17	1.39	1.20	1.16
2053	1.14	0.93	1.16	1.38	1.45	0.90	0.98	1.08	1.42	1.72	1.09	1.08	1.19	1.55	1.78	1.14	1.06	1.58	1.51	1.16	1.01	1.00	1.67	0.87	1.01
2054	0.74	1.32	2.18	2.10	1.71	1.03	1.61	1.89	1.93	1.19	1.19	1.45	1.45	1.26	1.20	1.13	1.14	1.10	1.08	1.07	1.10	0.95	1.09	1.03	1.28
2055	1.00	1.11	1.57	1.17	1.25	0.91	1.15	1.25	1.26	1.62	1.00	0.91	0.97	0.98	1.73	1.07	1.00	0.99	1.02	1.58	0.98	1.23	1.08	1.49	1.84
2056	1.87	1.70	1.67	1.51	1.45	1.52	1.74	1.93	1.94	1.60	1.55	1.43	1.41	1.65	1.84	1.53	1.54	1.74	1.67	1.85	1.60	2.05	2.33	2.29	2.44
2057	0.68	0.79	0.95	0.89	1.54	0.90	0.87	0.81	1.26	1.48	0.77	0.78	1.07	1.33	1.38	0.67	0.69	0.76	0.84	0.92	0.81	0.85	0.92	1.11	0.70
2058	0.57	0.83	1.53	1.13	1.44	0.69	0.83	1.13	1.54	2.01	0.76	0.77	0.93	1.25	2.26	0.81	0.93	1.53	1.59	1.93	0.77	1.06	1.40	2.18	2.15
2059	1.53	1.27	1.91	1.33	1.02	0.63	1.26	1.89	1.37	0.91	0.82	1.51	1.64	1.41	1.35	0.98	1.22	1.14	1.04	1.00	1.28	1.33	1.21	1.16	0.95
2060	1.07	0.97	1.11	1.37	1.19	0.92	0.72	0.77	1.24	1.50	0.91	0.87	0.82	0.81	1.29	1.11	0.91	0.89	1.04	1.18	1.31	1.28	1.21	1.29	1.29

Table C1.B: Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.23	0.59	0.81	1.04	0.76	1.03	0.54	0.70	0.80	0.90	0.78	0.53	0.70	0.78	0.84	0.71	0.52	0.73	0.79	0.75	0.73	0.92	0.79	0.72	0.58
2062	1.63	0.99	1.82	2.53	2.93	1.68	1.04	1.33	2.81	3.25	1.68	1.09	1.40	2.07	3.54	1.53	1.20	1.54	2.30	3.39	1.59	1.32	1.72	2.57	3.39
2063	2.59	2.56	1.38	1.52	1.24	2.03	2.36	1.16	1.64	1.01	1.82	1.34	1.37	1.01	1.01	1.36	1.18	1.21	1.01	1.07	0.99	1.08	1.04	1.03	1.03
2064	0.94	0.99	1.33	1.62	1.72	0.64	0.66	0.82	1.75	1.28	0.59	0.94	0.84	1.07	1.42	0.63	0.90	1.16	1.03	0.95	1.02	0.91	1.07	1.10	1.10
2065	1.36	1.86	1.91	1.01	0.92	1.51	1.55	1.15	1.09	0.83	1.87	1.60	1.13	1.18	1.16	2.85	1.65	1.18	1.16	1.26	3.08	2.03	1.43	1.55	1.09
2066	1.20	1.41	1.26	1.48	1.27	1.07	1.33	1.46	1.69	1.24	1.01	1.09	1.75	2.06	1.95	1.19	0.86	0.98	1.14	1.86	1.49	1.07	1.12	1.22	1.56
2067	1.32	1.32	1.86	1.57	1.61	1.15	2.02	2.05	1.78	1.47	1.81	2.31	1.95	1.77	2.11	2.36	2.25	1.79	1.77	1.51	2.64	2.01	1.63	1.61	1.25
2068	1.62	1.69	1.54	1.11	1.24	1.47	1.57	1.55	1.54	1.26	1.37	1.46	1.42	1.45	1.35	1.32	1.29	1.23	1.29	1.27	1.35	1.20	1.23	1.38	1.34
2069	1.13	1.56	1.53	1.11	1.09	1.32	1.16	1.25	1.27	1.14	1.28	1.88	1.64	1.28	1.43	1.91	2.40	1.70	1.33	1.44	2.15	2.05	2.14	2.11	2.01
2070	1.55	1.52	1.23	1.25	1.21	1.59	1.69	1.45	1.20	1.21	1.47	1.68	1.52	1.33	1.23	1.34	1.47	1.42	1.30	1.19	1.66	1.42	1.25	1.16	1.21

Table C1.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	1.59	1.69	1.15	0.75	0.76	1.36	1.56	1.18	0.83	0.79	1.10	1.51	1.36	0.97	0.83	0.88	1.37	1.48	1.13	0.83	0.74	1.20	1.49	1.19	0.84
1970	0.91	0.91	1.13	0.85	0.75	0.91	0.90	0.99	0.89	0.86	0.89	0.83	0.82	0.94	1.00	0.78	0.80	0.74	0.88	0.94	0.74	0.70	0.66	0.80	0.87
1971	0.41	0.43	0.49	0.46	0.48	0.41	0.43	0.45	0.47	0.43	0.43	0.43	0.45	0.44	0.53	0.42	0.43	0.43	0.49	0.51	0.46	0.50	0.46	0.47	0.48
1972	0.74	0.77	1.73	2.26	1.92	0.79	0.78	1.21	2.45	1.82	0.83	0.79	1.49	2.25	2.31	0.85	0.89	1.85	2.09	2.10	0.82	1.18	1.92	1.85	1.83
1973	0.89	0.82	0.75	0.59	0.61	0.89	0.85	0.81	0.73	0.63	0.95	0.86	0.82	0.77	0.74	1.00	0.91	0.87	0.83	0.74	1.00	0.93	0.82	0.77	0.87
1974	0.98	1.50	1.69	1.36	1.09	1.13	1.49	1.61	1.57	1.03	1.23	1.51	1.64	1.59	1.24	1.35	1.66	1.70	1.50	1.19	1.47	1.85	1.74	1.48	1.14
1975	0.50	0.85	1.34	0.91	0.80	0.56	0.94	1.42	1.11	0.75	0.58	0.95	1.43	1.20	0.97	0.56	0.88	1.34	1.27	1.12	0.51	0.66	1.14	1.23	1.28
1976	0.89	1.14	1.29	1.18	1.01	1.34	1.47	1.30	1.06	0.95	1.41	1.27	0.95	0.82	0.95	1.09	0.93	0.73	0.76	0.81	0.90	0.95	0.74	0.75	0.81
1977	1.26	1.27	1.25	0.85	0.94	1.27	1.22	1.23	1.05	1.09	1.31	1.24	1.20	0.97	0.99	1.44	1.38	1.23	0.91	0.70	1.33	1.33	1.10	0.83	0.76
1978	0.97	0.95	0.99	0.84	0.77	0.86	0.84	0.83	0.85	0.71	0.78	0.71	0.69	0.70	0.68	0.65	0.60	0.55	0.65	0.62	0.70	0.64	0.61	0.57	0.51
1979	0.63	0.74	0.64	0.48	0.52	0.65	0.78	0.68	0.57	0.56	0.73	0.76	0.74	0.66	0.69	0.85	0.77	0.76	0.74	0.76	0.91	0.93	0.82	0.83	0.85
1980	0.67	0.61	0.71	0.55	0.54	0.55	0.46	0.56	0.58	0.50	0.47	0.41	0.44	0.39	0.44	0.43	0.48	0.39	0.39	0.46	0.33	0.35	0.34	0.46	0.51
1981	1.22	1.15	0.89	0.83	0.79	1.19	1.06	0.80	0.88	0.89	1.11	0.98	0.73	0.71	0.84	1.08	1.01	0.72	0.71	0.69	1.09	1.08	0.70	0.75	0.69
1982	0.59	0.65	0.70	0.79	0.97	0.58	0.60	0.58	0.98	1.08	0.58	0.62	0.66	0.91	1.18	0.65	0.71	0.76	1.03	1.21	0.75	0.83	0.85	1.14	1.22
1983	0.79	0.92	1.18	1.10	0.99	0.94	1.03	1.14	1.24	1.09	1.09	1.09	1.16	1.29	1.25	1.19	1.18	1.22	1.29	1.26	1.23	1.26	1.24	1.23	1.20
1984	1.21	1.19	1.27	1.07	0.99	1.19	1.20	1.17	1.06	1.00	1.14	1.11	1.00	1.01	1.12	1.10	1.07	1.01	0.93	1.10	1.12	0.95	0.93	1.04	0.93
1985	0.60	0.62	0.65	0.52	0.52	0.60	0.59	0.56	0.56	0.61	0.57	0.54	0.55	0.59	0.66	0.51	0.52	0.55	0.64	0.66	0.49	0.53	0.61	0.68	0.65
1986	1.71	1.81	1.84	1.70	1.67	1.62	1.69	1.80	1.89	1.82	1.70	1.70	1.83	1.98	2.00	1.81	1.82	1.89	2.06	2.08	1.91	2.02	2.05	2.12	2.07
1987	0.27	0.35	0.36	0.35	0.39	0.33	0.37	0.35	0.38	0.37	0.41	0.37	0.40	0.40	0.42	0.55	0.49	0.49	0.50	0.49	0.56	0.52	0.53	0.53	0.51
1988	0.70	0.68	0.61	0.67	0.69	0.58	0.61	0.63	0.73	0.73	0.61	0.67	0.69	0.73	0.79	0.64	0.69	0.71	0.74	0.80	0.67	0.71	0.73	0.74	0.78
1989	0.69	0.56	0.57	0.60	0.63	0.80	0.72	0.57	0.83	0.61	0.61	0.50	0.60	0.75	0.63	0.63	0.43	0.48	0.53	0.56	0.71	0.51	0.47	0.55	0.59
1990	0.50	0.67	0.71	0.73	0.68	0.55	0.66	0.70	0.64	0.66	0.53	0.59	0.66	0.59	0.64	0.52	0.52	0.62	0.58	0.59	0.49	0.49	0.63	0.58	0.50

Table C1.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1991	0.98	1.01	1.00	0.93	0.96	1.01	0.92	0.87	1.01	0.92	1.02	0.98	0.80	0.90	1.06	1.10	0.85	0.58	0.97	1.11	0.76	0.56	0.63	1.01	1.15
1992	1.47	1.55	1.39	1.05	1.00	1.67	1.62	1.47	1.34	1.06	1.48	1.43	1.47	1.47	1.34	1.15	1.21	1.35	1.43	1.40	0.84	0.95	1.08	1.28	1.36
1993	0.34	0.37	0.54	0.70	0.83	0.48	0.50	0.56	0.75	0.75	0.54	0.57	0.61	0.65	0.65	0.55	0.51	0.54	0.59	0.51	0.45	0.44	0.45	0.52	0.50
1994	0.55	0.56	0.69	0.74	0.74	0.70	0.70	0.70	0.90	0.90	0.86	0.86	0.85	0.93	1.07	1.01	1.02	0.95	1.00	1.11	1.06	1.02	0.98	1.06	1.19
1995	0.40	0.34	0.63	1.00	1.39	0.32	0.27	0.39	1.08	1.39	0.29	0.27	0.45	0.77	1.37	0.28	0.30	0.52	0.88	1.20	0.24	0.40	0.62	0.94	1.19
1996	0.84	0.79	1.05	1.04	0.84	0.72	0.64	0.73	1.08	0.89	0.61	0.48	0.50	0.81	0.87	0.54	0.51	0.52	0.62	0.77	0.56	0.52	0.54	0.57	0.57
1997	0.54	0.56	0.61	0.58	0.61	0.59	0.59	0.63	0.66	0.63	0.60	0.62	0.66	0.67	0.67	0.64	0.60	0.63	0.66	0.68	0.61	0.60	0.61	0.66	0.68
1998	1.27	0.62	0.62	0.58	0.65	0.82	0.73	0.71	0.67	0.54	0.76	0.76	0.65	0.62	0.56	0.68	0.32	0.45	0.31	0.27	0.37	0.30	0.29	0.35	0.36
1999	0.31	0.25	0.31	0.32	0.34	0.33	0.34	0.34	0.42	0.42	0.44	0.44	0.37	0.38	0.43	0.45	0.39	0.32	0.38	0.45	0.35	0.34	0.42	0.51	0.59

Table C1. D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	0.31	0.37	0.44	0.40	0.43	0.42	0.34	0.45	0.45	0.46	0.22	0.26	0.39	0.47	0.53	0.24	0.22	0.25	0.36	0.42	0.22	0.18	0.26	0.32	0.54
2040	0.38	0.32	0.38	0.36	0.41	0.49	0.31	0.34	0.40	0.41	0.51	0.36	0.40	0.41	0.47	0.46	0.45	0.44	0.47	0.45	0.50	0.51	0.48	0.52	0.51
2041	1.05	1.08	1.23	1.25	1.21	1.30	1.28	1.16	1.19	1.16	1.59	1.38	1.15	1.09	1.09	1.53	1.23	0.99	0.94	0.92	1.12	0.94	0.80	0.77	0.71
2042	0.56	0.51	0.48	0.40	0.41	0.73	0.66	0.64	0.58	0.49	0.88	0.78	0.73	0.65	0.60	0.80	0.70	0.62	0.58	0.53	0.61	0.51	0.42	0.39	0.37
2043	0.41	0.39	0.72	1.01	1.12	0.37	0.37	0.53	1.08	1.15	0.39	0.40	0.66	0.96	1.23	0.37	0.42	0.77	1.07	1.34	0.34	0.58	0.88	1.19	1.40
2044	0.61	0.56	0.63	0.69	0.71	0.53	0.44	0.52	0.62	0.75	0.42	0.45	0.53	0.51	1.01	0.48	0.44	0.48	0.86	1.04	0.48	0.53	0.86	1.15	0.87
2045	0.39	0.42	0.55	0.65	0.72	0.44	0.42	0.47	0.74	0.69	0.49	0.48	0.66	0.76	0.70	0.46	0.70	0.82	0.70	0.57	0.63	0.83	0.82	0.60	0.54
2046	0.60	0.93	0.76	0.84	0.97	0.57	0.84	1.00	1.07	1.03	0.61	0.76	0.99	0.95	1.24	0.62	0.66	0.88	1.10	1.35	0.67	0.70	0.97	1.26	1.47
2047	1.22	1.43	1.54	1.42	1.23	1.55	1.74	1.84	1.70	1.26	1.76	1.93	2.00	1.67	1.44	1.73	1.81	1.76	1.53	1.43	1.52	1.46	1.40	1.41	1.35
2048	0.43	0.41	0.42	0.45	0.49	0.41	0.40	0.43	0.52	0.43	0.53	0.54	0.50	0.49	0.55	0.67	0.68	0.65	0.64	0.67	0.56	0.62	0.61	0.64	0.64
2049	0.40	0.50	0.68	0.59	0.58	0.49	0.61	0.65	0.67	0.62	0.56	0.67	0.72	0.71	0.67	0.63	0.69	0.71	0.71	0.69	0.65	0.69	0.74	0.78	0.75
2050	0.48	0.46	0.67	0.54	0.59	0.47	0.38	0.61	0.55	0.64	0.46	0.59	0.58	0.49	0.74	0.53	0.50	0.39	0.61	0.72	0.60	0.39	0.47	0.72	0.83
2051	1.27	1.11	1.05	0.71	0.66	0.93	1.03	0.99	0.98	0.55	0.93	0.92	0.80	0.59	0.74	0.76	0.63	0.51	0.61	0.55	0.32	0.42	0.48	0.48	0.48
2052	0.64	0.59	0.94	0.98	1.00	0.70	0.62	0.58	0.71	0.75	0.69	0.66	0.56	0.58	0.69	0.67	0.62	0.58	0.66	0.68	0.64	0.56	0.64	0.76	0.56
2053	0.63	0.71	0.88	0.94	0.97	0.90	0.98	1.05	1.09	0.81	1.09	1.08	1.09	1.03	0.80	1.14	1.06	1.01	0.86	0.71	1.01	0.95	0.87	0.76	0.77
2054	0.33	0.37	0.58	0.51	0.56	0.31	0.52	0.45	0.53	0.65	0.38	0.38	0.41	0.57	0.98	0.44	0.44	0.54	0.78	1.07	0.53	0.54	0.69	1.00	1.28
2055	0.31	0.29	0.28	0.30	0.35	0.32	0.31	0.35	0.35	0.40	0.29	0.30	0.40	0.42	0.39	0.30	0.32	0.38	0.44	0.42	0.29	0.32	0.38	0.37	0.36
2056	0.40	0.43	0.45	0.48	0.62	0.37	0.34	0.42	0.51	0.65	0.41	0.43	0.44	0.47	0.63	0.55	0.55	0.56	0.58	0.60	0.55	0.55	0.56	0.57	0.57
2057	0.50	0.43	0.44	0.39	0.42	0.53	0.49	0.46	0.41	0.38	0.52	0.54	0.47	0.46	0.48	0.46	0.51	0.58	0.53	0.51	0.36	0.45	0.56	0.67	0.70
2058	0.57	0.70	0.80	0.78	0.87	0.61	0.70	0.84	0.86	1.00	0.76	0.77	0.85	0.92	1.10	0.81	0.76	0.87	0.96	1.12	0.77	0.77	0.89	0.97	1.08
2059	0.41	0.46	0.87	0.66	0.42	0.39	0.39	0.48	0.60	0.64	0.53	0.42	0.45	0.48	0.66	0.68	0.50	0.48	0.56	0.83	0.74	0.69	0.64	0.70	0.95
2060	0.48	0.50	0.68	0.84	1.01	0.54	0.52	0.59	0.93	1.08	0.52	0.64	0.82	0.81	1.15	0.72	0.91	0.89	1.04	1.18	1.31	1.28	1.21	1.29	1.29

Table C1. D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.23	0.59	0.81	0.80	0.71	1.03	0.54	0.70	0.80	0.59	0.78	0.50	0.70	0.78	0.65	0.53	0.52	0.70	0.68	0.60	0.45	0.53	0.59	0.58	0.58
2062	0.88	0.75	0.76	0.82	0.78	0.72	0.70	0.77	0.82	0.82	0.69	0.80	0.88	0.84	0.83	0.74	0.90	0.93	0.84	0.82	0.80	0.94	0.99	0.90	0.85
2063	0.51	0.59	1.38	1.12	0.91	0.50	0.58	1.16	1.20	0.66	0.56	0.65	0.85	0.88	0.65	0.57	0.61	0.68	0.67	0.67	0.59	0.57	0.62	0.58	0.58
2064	0.39	0.41	0.92	1.20	1.30	0.40	0.41	0.48	1.18	1.28	0.38	0.52	0.58	0.93	1.42	0.46	0.60	0.90	0.98	0.95	0.72	0.91	1.07	0.85	0.72
2065	0.49	0.54	0.65	0.61	0.58	0.47	0.43	0.48	0.52	0.49	0.40	0.40	0.35	0.39	0.56	0.33	0.42	0.44	0.43	0.46	0.33	0.46	0.59	0.55	0.49
2066	0.39	0.39	0.44	0.42	0.48	0.29	0.35	0.42	0.45	0.49	0.29	0.36	0.40	0.37	0.44	0.38	0.37	0.39	0.41	0.44	0.47	0.46	0.48	0.51	0.53
2067	0.35	0.33	0.32	0.29	0.41	0.36	0.35	0.30	0.30	0.48	0.46	0.40	0.36	0.31	0.51	0.59	0.55	0.52	0.49	0.45	0.60	0.58	0.57	0.57	0.54
2068	1.62	1.69	1.54	1.11	0.89	1.47	1.57	1.55	1.54	1.05	1.37	1.46	1.42	1.45	1.35	1.32	1.29	1.23	1.23	1.17	1.34	1.20	1.10	1.14	1.01
2069	0.26	0.28	0.55	0.52	0.57	0.38	0.36	0.54	0.62	0.71	0.54	0.55	0.66	0.66	0.89	0.68	0.67	0.66	0.89	1.05	0.65	0.67	0.73	1.06	1.12
2070	1.55	1.52	1.23	1.25	1.11	1.59	1.69	1.45	1.20	0.89	1.47	1.68	1.52	1.33	1.09	1.34	1.47	1.42	1.30	1.19	1.24	1.27	1.25	1.16	1.21

Table C2

Canadian Regional Climate Model; Canadian Coupled Global Climate Model 3

Table C2.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	1.02	0.99	1.27	1.02	1.31	1.06	1.23	1.29	1.34	1.22	1.12	1.32	1.36	1.34	1.63	1.28	1.36	1.31	1.25	1.28	1.38	1.29	1.19	1.27	1.33
1970	1.00	1.13	1.16	1.48	1.97	1.01	1.07	1.13	1.49	2.02	1.18	1.23	1.31	1.12	1.41	1.50	1.59	1.46	1.18	1.07	1.54	1.50	1.09	1.27	0.92
1971	0.55	0.66	0.66	0.96	0.70	0.94	0.60	0.76	0.77	0.94	0.79	0.69	0.52	0.64	0.81	0.65	0.54	0.68	0.83	0.86	0.49	0.55	0.66	0.80	0.87
1972	1.03	1.00	1.06	0.94	0.90	0.82	1.27	0.97	1.24	1.46	0.98	0.99	1.23	1.22	1.49	1.36	1.70	1.35	1.30	1.62	2.14	1.79	1.25	1.39	1.84
1973	1.84	1.07	1.46	1.17	1.01	1.45	1.25	1.65	1.34	1.17	1.41	1.39	1.74	1.87	2.11	1.24	1.59	1.66	1.16	1.56	1.14	1.59	1.29	0.99	1.24
1974	1.07	1.14	1.13	1.14	1.13	1.27	1.26	1.11	1.17	1.18	1.28	1.16	1.06	1.10	1.07	1.46	1.19	1.19	1.09	1.06	1.59	1.32	1.20	1.16	1.13
1975	1.01	1.29	1.47	1.56	1.78	1.08	1.37	1.55	1.53	2.20	1.20	1.15	1.36	1.40	1.45	1.28	1.19	1.17	1.14	1.33	1.39	1.27	1.17	1.17	1.28
1976	1.23	0.82	1.12	0.77	0.74	0.66	0.87	0.67	0.99	0.71	0.89	0.88	1.02	0.80	0.74	1.28	1.31	0.94	0.96	0.87	1.47	1.22	1.31	1.18	1.11
1977	0.89	0.95	1.01	1.21	1.86	1.03	1.09	1.18	1.32	1.44	1.28	1.22	1.45	1.55	1.59	1.19	1.37	1.25	1.17	1.21	1.29	1.39	1.25	1.31	1.34
1978	1.20	0.89	0.99	0.90	1.15	0.95	0.97	0.83	0.85	1.61	0.78	0.80	0.82	0.94	0.91	0.88	0.89	0.89	0.86	1.34	0.91	0.90	1.50	1.30	1.23
1979	1.07	1.15	1.13	1.20	1.38	0.86	1.02	0.91	1.44	1.12	0.84	0.82	0.98	1.31	1.45	0.67	0.85	1.28	1.63	1.57	0.76	1.02	1.72	2.30	2.13
1980	1.46	1.47	1.75	1.58	1.79	1.59	1.28	1.29	1.52	1.72	1.61	1.34	1.43	1.57	1.45	1.47	1.49	1.54	1.42	1.34	1.52	1.61	1.48	1.36	1.40
1981	1.20	1.36	1.34	1.31	1.22	1.36	1.44	1.34	1.25	1.16	1.68	1.42	1.22	1.21	1.75	0.99	1.17	1.34	1.68	1.82	1.63	1.21	1.14	1.58	1.77
1982	1.03	0.92	1.17	0.98	0.87	1.05	1.01	0.92	0.85	0.78	1.12	0.75	0.79	0.89	0.95	0.90	0.95	1.09	1.07	1.22	1.29	1.37	1.46	1.64	1.72
1983	1.93	1.92	1.93	1.33	1.11	1.95	1.81	1.52	1.42	1.55	1.71	1.52	1.28	1.53	1.67	1.81	1.22	1.55	1.81	1.85	1.83	1.46	1.75	2.17	2.41
1984	0.83	1.00	1.50	1.88	1.98	0.93	1.03	1.45	1.91	1.34	0.97	1.38	1.71	1.67	2.36	1.28	1.53	1.45	1.30	1.88	1.37	1.24	1.35	1.45	1.82
1985	0.89	1.14	1.41	1.21	1.29	1.28	1.14	1.33	1.34	1.93	1.38	1.26	1.05	1.13	1.70	1.46	1.31	1.40	1.47	1.50	1.22	1.14	1.52	1.74	1.48
1986	1.00	0.85	1.14	1.30	1.22	1.11	0.91	0.97	0.97	1.12	1.10	0.80	0.92	1.26	1.05	0.92	0.97	0.90	0.87	1.12	0.81	1.01	0.90	1.00	0.97
1987	2.06	1.75	1.29	1.33	1.52	1.56	1.41	1.19	1.46	1.70	1.54	1.32	1.38	1.49	1.91	1.38	1.50	1.65	1.53	1.73	1.07	1.13	1.15	1.31	1.76
1988	1.36	1.42	1.41	1.11	1.40	1.55	1.42	1.28	1.27	1.09	1.44	1.19	1.16	1.05	1.46	1.45	1.21	1.16	1.19	1.19	1.69	1.45	1.35	1.25	1.07

Table C2.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	0.79	0.92	2.14	1.76	1.80	0.91	1.17	0.96	1.61	1.18	0.71	0.90	1.12	1.80	1.40	0.79	0.85	2.42	1.86	1.08	1.10	1.25	2.48	1.45	1.18
1990	1.03	1.10	1.40	1.54	1.40	1.44	1.18	1.26	1.44	1.19	1.21	1.26	1.23	1.17	1.09	1.16	0.97	0.87	0.96	1.08	1.21	1.27	1.07	1.09	1.22
1991	1.46	1.08	1.17	1.34	1.58	1.64	1.78	1.25	1.20	1.07	0.80	0.80	0.90	0.98	0.93	0.87	0.95	0.97	1.04	0.84	0.89	0.92	0.96	0.99	0.99
1992	1.03	1.19	1.25	1.07	1.06	1.03	1.12	1.14	1.11	1.15	1.09	1.06	1.00	0.99	1.16	1.12	0.99	0.89	0.83	1.07	1.08	1.06	0.83	0.87	1.11
1993	0.90	1.04	1.69	1.89	1.51	1.00	1.10	1.46	1.73	1.27	0.92	1.16	1.32	1.54	1.57	0.90	1.04	1.24	1.26	1.25	1.03	1.11	1.24	1.22	1.18
1994	1.32	0.94	1.09	1.03	1.31	1.19	1.11	1.26	1.25	1.51	1.09	1.20	1.63	1.38	1.32	1.08	1.44	1.28	1.63	1.59	1.27	1.56	1.59	1.29	1.17
1995	1.19	1.42	1.70	1.45	1.41	1.05	1.40	1.43	1.00	1.01	1.20	1.11	0.79	1.07	1.24	1.06	0.85	1.01	1.12	1.10	0.92	1.03	1.13	1.17	1.54
1996	1.19	1.26	1.04	1.68	1.48	1.11	1.03	0.96	0.89	1.30	0.82	0.92	0.81	1.12	1.02	0.91	0.95	1.05	1.04	1.40	1.07	1.05	1.14	1.19	1.18
1997	0.93	1.17	1.12	1.35	1.67	1.15	1.11	1.08	1.45	2.01	1.41	1.15	1.35	1.57	2.39	1.52	1.73	1.97	2.23	2.26	1.80	2.47	2.61	2.40	1.56
1998	1.67	1.62	1.65	1.69	1.60	1.19	1.41	1.64	1.90	1.82	1.02	1.31	1.69	2.01	2.11	1.36	1.16	1.62	2.06	2.21	1.44	1.18	1.44	2.02	2.26
1999	1.11	1.70	1.94	1.09	1.00	1.01	1.68	1.72	1.19	1.25	1.02	1.58	1.43	1.29	1.99	1.24	1.46	1.22	1.55	2.08	1.26	1.32	1.50	2.21	1.74

Table C2.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	2.13	1.72	2.31	1.21	1.77	1.98	1.73	2.43	2.08	2.38	1.87	1.61	2.37	2.41	2.70	1.87	1.28	2.36	2.78	2.27	1.69	1.49	2.05	2.84	2.18
2040	1.54	1.47	2.18	1.91	1.75	1.19	1.24	1.89	1.69	1.46	1.14	1.49	1.62	1.48	1.28	1.41	1.64	1.70	1.58	1.36	2.06	2.02	1.89	1.91	1.97
2041	1.47	1.43	1.36	1.16	1.06	1.32	1.30	1.21	1.28	1.20	1.11	1.08	1.11	1.16	1.26	1.57	0.99	1.02	1.07	1.05	1.51	1.26	1.01	1.04	1.03
2042	0.94	0.94	0.96	0.84	2.13	1.29	1.21	1.25	1.22	1.37	1.67	1.67	1.55	1.25	1.42	1.40	1.44	1.18	1.40	1.55	1.26	1.30	1.49	2.00	2.03
2043	0.84	0.73	0.71	0.78	0.87	0.82	0.89	0.77	0.94	1.11	0.84	0.85	0.81	0.99	1.25	1.43	1.24	1.03	1.01	1.36	1.88	1.55	1.29	1.27	1.43
2044	1.83	1.53	1.19	1.15	1.66	1.68	1.66	1.50	1.82	1.17	1.39	1.38	1.58	1.56	1.66	1.13	1.21	1.33	1.54	1.70	1.34	1.31	1.31	1.49	1.66
2045	1.56	2.35	2.22	1.28	1.20	1.68	2.17	2.39	1.65	1.15	1.41	1.56	1.34	1.51	1.66	1.33	1.47	1.38	1.15	1.10	1.12	1.22	0.95	1.06	1.28
2046	1.88	1.92	1.70	1.38	1.36	2.03	2.16	2.12	1.82	1.43	2.08	2.03	1.66	1.51	1.44	1.73	1.76	1.39	1.40	1.74	1.58	1.89	1.74	1.86	1.89
2047	1.26	1.51	1.69	1.62	1.59	1.46	1.66	1.70	1.55	1.24	1.64	1.82	1.74	1.76	1.37	1.78	1.85	1.64	1.66	1.55	1.78	1.66	1.66	1.67	1.56
2048	1.13	3.33	4.12	3.52	2.75	1.35	3.11	4.20	4.00	2.99	1.43	2.88	3.78	3.47	3.45	1.51	1.92	2.69	2.73	3.29	1.06	1.81	2.05	2.17	2.78
2049	1.78	1.38	1.43	1.51	1.65	1.36	1.71	2.22	1.98	1.71	2.15	2.21	1.55	1.27	0.90	1.86	1.62	1.35	1.20	1.23	2.19	1.78	1.52	1.26	1.26
2050	1.19	1.42	1.69	1.83	1.53	1.40	1.67	2.07	1.88	1.60	1.49	1.88	2.42	2.20	2.21	1.38	1.51	2.01	1.92	1.91	1.46	1.43	1.47	2.01	1.80
2051	1.38	0.97	1.28	1.21	1.84	1.48	1.16	1.18	1.30	1.88	1.52	1.22	1.30	1.45	1.83	1.46	1.46	1.60	1.30	1.16	1.82	1.31	1.10	1.07	1.23
2052	1.65	1.61	1.73	1.70	1.41	1.78	1.68	1.59	1.64	1.35	1.82	1.54	1.44	1.94	1.48	1.67	1.40	1.37	1.71	1.24	1.54	1.39	1.29	1.83	1.15
2053	2.42	1.73	1.73	1.41	1.47	2.66	2.05	1.93	1.79	1.60	2.96	2.40	2.34	1.83	1.66	3.22	3.72	2.92	2.40	1.74	2.49	3.87	3.59	3.10	1.94
2054	1.63	1.52	1.59	2.56	3.10	1.75	1.67	1.53	1.91	2.70	1.87	1.77	1.53	1.35	2.06	2.05	1.83	1.35	1.55	1.78	2.06	1.75	2.11	2.10	2.18
2055	1.85	2.08	1.96	1.44	1.40	1.94	2.72	1.91	1.79	1.47	1.93	2.34	2.62	2.35	1.92	1.73	1.78	1.74	1.71	1.55	1.73	1.83	1.76	1.97	1.81
2056	0.66	0.66	1.40	1.52	1.87	0.95	1.56	2.16	2.50	2.27	1.55	2.04	2.51	2.83	2.70	1.41	1.70	2.01	2.18	1.97	1.16	1.34	1.56	1.53	1.34
2057	1.12	1.04	1.38	1.50	1.28	1.18	1.22	1.44	1.65	1.53	1.37	1.31	1.44	1.57	1.59	1.45	1.47	1.27	1.42	1.49	1.38	1.50	1.24	1.36	1.26
2058	1.68	1.76	1.70	1.81	1.82	1.85	1.65	1.42	2.17	2.60	1.64	1.30	1.52	1.65	2.21	1.28	1.14	1.51	1.78	1.70	1.08	1.11	1.46	1.49	1.44
2059	2.06	1.83	1.50	1.24	1.41	2.12	1.77	1.64	1.35	1.45	2.27	1.87	1.65	1.44	1.68	2.22	1.77	1.45	1.46	1.77	1.87	1.46	1.42	1.63	1.76
2060	1.43	1.38	1.71	1.78	1.51	1.06	1.26	1.26	1.72	1.59	1.15	1.15	1.52	1.57	1.72	1.32	1.26	1.63	1.64	1.37	1.51	1.92	1.99	1.59	1.55

Table C2.B Annual Maximum Series: Future Day Climate																									
Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.39	1.91	1.92	1.33	1.54	1.49	1.80	1.61	1.48	1.26	1.77	1.62	1.41	1.27	1.37	1.45	1.47	1.31	1.30	1.34	1.25	1.05	1.17	1.27	1.29
2062	1.56	1.17	1.82	1.55	1.29	1.76	1.44	1.48	1.58	1.07	1.65	1.19	1.46	1.02	1.27	1.73	1.24	1.08	1.10	1.15	1.71	1.14	1.03	0.99	1.30
2063	1.79	1.58	1.54	1.52	1.23	1.48	1.46	1.08	1.35	1.13	1.83	2.03	0.95	1.10	1.17	1.31	1.16	1.40	1.20	1.23	1.05	0.99	0.90	0.99	1.13
2064	2.31	1.76	1.57	1.45	1.89	1.56	1.42	1.55	1.66	2.11	1.68	1.44	1.97	1.75	2.36	1.60	1.49	1.55	1.79	1.97	2.05	1.74	1.52	1.81	1.99
2065	1.04	1.42	1.99	2.11	1.50	1.24	1.44	1.92	2.13	1.36	1.45	1.62	2.10	2.11	1.63	1.85	1.65	2.04	2.01	1.42	1.23	1.53	2.39	1.88	1.71
2066	1.69	1.91	1.83	1.70	2.11	1.75	1.79	1.88	1.61	2.11	1.67	1.41	1.61	1.91	1.44	2.15	1.61	1.65	1.85	1.65	2.62	1.77	1.81	1.63	1.16
2067	1.61	1.53	1.42	1.60	1.46	1.68	1.51	1.30	1.72	1.95	2.30	1.43	1.78	2.27	1.51	1.89	2.19	1.69	1.58	1.50	2.11	1.64	1.88	1.80	1.54
2068	1.08	1.37	1.78	1.93	2.26	1.20	1.60	1.58	2.07	1.79	1.33	1.63	1.80	1.84	1.71	1.47	1.72	1.75	2.05	1.97	1.90	1.72	1.63	2.07	1.38
2069	1.40	1.43	1.38	1.80	1.61	1.44	1.43	1.40	1.65	1.90	1.48	1.44	1.41	1.38	2.01	1.55	1.48	1.42	1.36	1.22	1.49	1.46	1.36	1.29	1.19
2070	1.86	1.39	1.88	2.23	1.84	1.60	1.86	1.69	2.10	1.61	2.06	1.76	1.65	2.13	1.82	1.84	1.58	2.00	2.23	1.47	1.69	1.37	2.16	1.90	1.72

Table C2.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	0.79	0.96	1.08	1.02	0.92	0.98	1.17	1.27	1.25	1.09	1.12	1.32	1.36	1.34	1.30	1.28	1.36	1.31	1.25	1.28	1.38	1.29	1.19	1.17	1.17
1970	0.46	0.77	1.11	1.12	0.94	0.82	0.98	1.13	1.23	0.85	1.18	1.23	1.31	1.12	0.97	1.50	1.59	1.46	1.06	0.80	1.54	1.50	1.09	0.68	0.53
1971	0.28	0.31	0.41	0.47	0.60	0.25	0.27	0.36	0.55	0.65	0.24	0.29	0.37	0.51	0.72	0.29	0.32	0.40	0.57	0.70	0.39	0.55	0.66	0.74	0.87
1972	0.31	0.29	0.33	0.36	0.45	0.24	0.25	0.32	0.36	0.50	0.36	0.35	0.36	0.47	0.54	0.57	0.51	0.49	0.58	0.70	0.72	0.62	0.60	0.72	0.82
1973	0.84	0.85	0.77	0.85	0.95	0.80	0.77	0.69	0.97	1.17	0.78	0.64	0.73	0.89	1.34	0.73	0.65	0.75	0.94	1.24	0.81	0.70	0.84	0.98	1.24
1974	0.25	0.24	0.30	0.32	0.37	0.27	0.26	0.34	0.45	0.56	0.40	0.43	0.49	0.54	0.70	0.59	0.63	0.61	0.61	0.70	0.66	0.68	0.61	0.64	0.73
1975	0.95	1.08	1.11	0.85	0.76	1.08	1.11	1.13	1.10	0.81	1.20	1.15	1.16	1.17	1.01	1.28	1.19	1.17	1.13	1.03	1.32	1.27	1.17	1.17	1.08
1976	0.59	0.52	0.47	0.48	0.59	0.66	0.56	0.54	0.65	0.62	0.70	0.62	0.60	0.51	0.63	0.75	0.74	0.60	0.57	0.63	0.82	0.79	0.63	0.63	0.65
1977	0.88	0.89	0.87	0.76	0.69	0.94	0.90	0.83	0.80	0.68	0.96	0.87	0.75	0.71	0.79	0.94	0.82	0.71	0.73	0.73	0.91	0.88	0.78	0.76	0.78
1978	0.76	0.84	0.78	0.73	0.79	0.78	0.97	0.82	0.80	0.83	0.73	0.80	0.82	0.85	0.90	0.88	0.89	0.89	0.86	0.92	0.91	0.90	0.87	0.91	0.87
1979	0.80	0.63	0.59	0.72	0.88	0.69	0.56	0.53	0.78	0.95	0.61	0.51	0.52	0.65	1.05	0.60	0.48	0.51	0.68	0.97	0.66	0.51	0.53	0.76	1.06
1980	0.80	0.92	1.19	1.17	1.16	0.92	1.15	1.29	1.32	1.25	1.14	1.32	1.43	1.43	1.36	1.36	1.49	1.54	1.42	1.34	1.52	1.61	1.48	1.36	1.23
1981	1.02	0.91	0.80	0.70	0.71	0.98	0.87	0.72	0.67	0.69	0.94	0.77	0.67	0.69	0.71	0.83	0.75	0.72	0.69	0.71	0.75	0.83	0.74	0.73	0.75
1982	0.50	0.50	0.65	0.67	0.70	0.49	0.47	0.52	0.60	0.62	0.51	0.50	0.54	0.58	0.62	0.53	0.55	0.59	0.61	0.66	0.56	0.60	0.62	0.65	0.65
1983	0.35	0.41	0.60	0.71	0.79	0.36	0.36	0.59	0.77	0.88	0.35	0.43	0.54	0.63	0.95	0.36	0.44	0.49	0.64	1.09	0.35	0.45	0.56	0.74	1.06
1984	0.83	1.00	1.13	1.16	1.30	0.93	1.03	1.13	1.27	1.30	0.97	1.02	1.17	1.28	1.33	1.07	1.18	1.21	1.29	1.16	1.15	1.20	1.35	1.08	1.30
1985	0.89	0.82	0.68	0.63	0.97	1.28	1.14	0.87	0.76	0.86	1.38	1.26	1.02	0.91	0.83	1.29	1.17	1.12	1.00	0.91	1.22	1.14	1.06	1.02	0.90
1986	0.87	0.80	0.75	0.70	0.76	0.82	0.69	0.62	0.68	0.75	0.83	0.65	0.54	0.62	0.68	0.85	0.64	0.62	0.64	0.71	0.81	0.62	0.57	0.64	0.67
1987	0.18	0.21	0.33	0.44	0.52	0.21	0.22	0.31	0.53	0.48	0.26	0.34	0.51	0.58	0.48	0.38	0.59	0.64	0.48	0.47	0.59	0.68	0.55	0.47	0.52
1988	1.00	1.00	0.74	0.88	1.18	0.90	1.10	0.96	0.86	1.09	0.83	1.07	1.16	0.93	1.01	0.83	1.08	1.16	0.95	1.05	0.86	0.83	1.07	1.06	1.00
1989	0.70	0.74	0.82	0.66	0.59	0.70	0.74	0.85	0.92	0.80	0.71	0.77	0.88	0.96	0.99	0.79	0.85	0.90	0.93	0.97	0.94	0.99	0.96	0.91	0.88
1990	1.03	1.10	1.11	1.00	1.01	1.15	1.05	1.00	0.98	0.97	1.20	0.98	0.89	0.89	0.86	1.06	0.84	0.77	0.96	0.96	0.97	0.77	0.82	1.09	1.04

1991	0.67	0.79	0.81	0.76	0.69	0.71	0.76	0.85	0.85	0.71	0.80	0.80	0.78	0.82	0.73	0.87	0.79	0.76	0.73	0.74	0.82	0.79	0.69	0.67	0.66
1992	0.66	0.65	0.80	1.02	1.06	0.70	0.66	0.60	1.03	1.15	0.70	0.63	0.62	0.79	1.16	0.77	0.70	0.63	0.83	1.07	0.91	0.85	0.77	0.87	1.11
1993	0.90	0.81	0.70	0.73	0.84	0.89	0.72	0.64	0.83	0.92	0.90	0.67	0.67	0.72	1.04	0.89	0.65	0.55	0.63	0.82	0.87	0.65	0.47	0.62	0.84
1994	0.46	0.46	0.58	0.54	0.56	0.41	0.39	0.52	0.56	0.56	0.53	0.46	0.48	0.52	0.62	0.64	0.67	0.67	0.62	0.60	0.67	0.84	0.82	0.70	0.64
1995	0.35	0.41	0.58	0.65	0.77	0.46	0.55	0.60	0.84	0.98	0.58	0.70	0.79	0.92	1.08	0.67	0.85	1.01	1.06	1.08	0.81	1.03	1.13	1.10	1.02
1996	0.57	0.57	1.03	1.68	1.48	0.58	0.55	0.54	0.89	1.30	0.57	0.54	0.55	0.84	0.96	0.66	0.54	0.55	0.88	1.12	0.58	0.71	0.67	0.62	0.58
1997	0.93	0.76	0.79	0.81	0.80	0.96	0.74	0.61	0.77	0.81	0.99	0.75	0.61	0.63	0.77	1.01	0.75	0.57	0.53	0.60	1.05	0.73	0.54	0.48	0.51
1998	1.22	1.40	1.65	1.69	1.60	1.11	1.41	1.64	1.90	1.82	0.93	1.31	1.69	2.01	2.11	0.78	1.14	1.62	2.06	2.21	0.81	0.96	1.44	2.02	2.26
1999	0.54	0.54	0.65	0.84	0.80	0.60	0.60	0.67	0.83	0.84	0.66	0.61	0.68	0.75	0.96	0.69	0.63	0.67	0.89	1.08	0.69	0.64	0.77	1.08	1.24

Table C2.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.67	1.43	1.06	0.75	0.72	1.64	1.24	1.00	0.86	0.61	1.57	1.12	0.94	0.84	0.71	1.48	1.09	0.80	0.75	0.65	1.37	1.02	0.78	0.79	0.81
2040	0.38	0.49	0.61	0.56	0.50	0.62	0.64	0.65	0.68	0.67	0.91	0.84	0.78	0.75	0.86	1.18	1.01	0.87	0.85	0.84	1.32	1.17	1.04	1.01	0.88
2041	1.47	1.43	1.36	1.13	1.06	1.32	1.21	1.21	1.21	0.99	1.11	1.08	1.11	1.16	1.10	1.06	0.99	1.02	1.07	1.05	0.96	0.97	0.99	0.99	0.93
2042	0.90	0.86	0.70	0.74	1.36	0.89	0.81	0.72	1.22	1.05	0.95	1.00	1.08	1.02	1.00	1.40	1.44	1.16	1.18	1.03	1.26	1.30	1.32	1.22	1.07
2043	0.55	0.56	0.59	0.75	0.76	0.64	0.65	0.61	0.67	0.69	0.67	0.68	0.66	0.67	0.60	0.60	0.66	0.66	0.72	0.71	0.51	0.59	0.60	0.68	0.74
2044	0.63	0.71	0.86	1.05	1.17	0.62	0.64	0.61	1.08	1.17	0.67	0.70	0.67	0.71	1.14	0.71	0.83	0.78	0.69	0.92	0.86	0.94	0.86	0.78	1.04
2045	0.55	0.53	0.46	0.42	0.43	0.62	0.58	0.52	0.48	0.39	0.68	0.67	0.61	0.60	0.53	0.73	0.72	0.71	0.75	0.73	0.79	0.77	0.82	0.85	0.88
2046	0.40	0.56	0.60	0.45	0.45	0.42	0.44	0.47	0.50	0.53	0.42	0.42	0.47	0.54	0.58	0.38	0.42	0.51	0.58	0.60	0.36	0.39	0.49	0.68	0.54
2047	0.42	0.37	0.36	0.37	0.45	0.48	0.29	0.29	0.46	0.55	0.31	0.31	0.36	0.43	0.66	0.35	0.38	0.41	0.48	0.56	0.40	0.47	0.49	0.53	0.64
2048	0.54	0.64	0.98	1.11	1.21	0.46	0.54	0.75	1.13	1.19	0.43	0.51	0.66	0.90	1.22	0.45	0.51	0.69	0.85	1.09	0.51	0.52	0.59	0.85	1.05
2049	0.49	0.44	0.57	0.57	0.63	0.48	0.49	0.57	0.64	0.69	0.52	0.56	0.65	0.71	0.75	0.51	0.65	0.73	0.75	0.77	0.60	0.73	0.77	0.79	0.81
2050	0.70	0.69	1.21	1.42	1.46	0.67	0.84	1.05	1.55	1.60	0.85	1.05	1.20	1.43	1.73	0.99	1.17	1.26	1.43	1.68	1.08	1.22	1.27	1.44	1.80
2051	0.49	0.45	0.37	0.43	0.46	0.47	0.45	0.43	0.43	0.51	0.43	0.44	0.46	0.51	0.53	0.44	0.42	0.46	0.54	0.56	0.60	0.52	0.47	0.51	0.55
2052	1.65	1.61	1.73	1.70	1.41	1.78	1.68	1.59	1.64	1.35	1.82	1.54	1.44	1.48	1.48	1.67	1.40	1.37	1.36	1.24	1.54	1.39	1.29	1.29	1.15
2053	1.22	1.53	1.73	1.41	1.24	1.62	1.87	1.93	1.79	1.32	1.99	2.03	1.97	1.83	1.66	2.21	2.06	1.96	1.95	1.74	2.28	2.16	1.94	2.14	1.94
2054	0.95	1.18	1.25	1.11	0.94	1.26	1.30	1.33	1.33	0.79	1.43	1.33	1.53	1.35	1.05	1.56	1.41	1.19	0.98	0.92	1.50	1.28	0.94	0.92	0.95
2055	1.72	1.15	1.11	1.04	0.86	1.66	1.20	1.23	1.11	0.89	1.65	1.41	1.15	0.90	0.88	1.71	1.44	1.00	0.92	0.98	1.73	1.32	1.00	0.91	0.96
2056	0.47	0.45	0.57	0.77	0.99	0.61	0.62	0.65	0.77	0.85	0.77	0.80	0.83	0.86	0.86	0.63	0.69	0.78	0.82	0.87	0.68	0.79	0.83	0.87	0.88
2057	0.42	0.39	0.41	0.35	0.36	0.38	0.35	0.38	0.43	0.44	0.38	0.33	0.34	0.39	0.47	0.34	0.32	0.33	0.37	0.41	0.36	0.36	0.37	0.44	0.49
2058	1.68	1.76	1.70	1.81	1.82	1.85	1.65	1.42	1.64	1.65	1.64	1.30	1.52	1.65	1.68	1.28	1.14	1.51	1.78	1.70	1.08	1.09	1.46	1.49	1.44
2059	2.06	1.83	1.50	0.93	1.01	2.12	1.77	1.64	1.29	1.00	2.27	1.87	1.65	1.44	1.32	2.22	1.77	1.45	1.46	1.30	1.87	1.36	1.06	1.10	1.04
2060	0.56	0.69	0.86	1.13	1.34	0.55	0.69	0.81	1.11	1.30	0.53	0.69	0.81	1.06	1.26	0.49	0.66	0.79	1.13	1.30	0.46	0.59	0.76	1.15	1.39

Table C2.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	0.37	0.40	0.34	0.30	0.35	0.33	0.36	0.31	0.35	0.42	0.31	0.34	0.38	0.38	0.51	0.29	0.39	0.41	0.29	0.34	0.41	0.43	0.36	0.36	0.63
2062	0.70	0.68	0.68	0.69	0.70	0.72	0.77	0.71	0.74	0.75	0.73	0.75	0.77	0.78	0.82	0.71	0.82	0.79	0.80	0.83	0.81	0.86	0.77	0.72	0.73
2063	0.55	0.57	0.68	0.70	0.68	0.46	0.47	0.54	0.65	0.65	0.34	0.38	0.44	0.49	0.71	0.32	0.33	0.36	0.50	0.64	0.45	0.39	0.38	0.54	0.64
2064	1.30	1.46	1.57	1.45	1.40	1.27	1.42	1.55	1.66	1.54	1.26	1.35	1.53	1.75	1.86	1.29	1.36	1.52	1.79	1.97	1.28	1.35	1.52	1.81	1.99
2065	0.72	1.12	1.99	2.11	1.50	0.84	1.23	1.65	2.13	1.36	0.95	1.34	1.95	2.11	1.63	1.05	1.44	2.04	2.01	1.42	1.14	1.53	2.39	1.88	1.32
2066	0.87	0.91	0.97	0.86	0.76	1.04	1.19	0.98	0.83	0.70	1.54	1.41	0.90	0.83	0.63	2.15	1.61	0.91	0.69	0.54	2.62	1.54	0.83	0.59	0.58
2067	1.61	1.53	1.41	1.17	1.06	1.68	1.51	1.30	1.35	1.15	1.69	1.43	1.39	1.35	1.37	1.60	1.62	1.69	1.58	1.50	1.43	1.64	1.88	1.80	1.54
2068	0.96	1.37	1.78	1.93	1.52	1.20	1.60	1.58	2.07	1.48	1.33	1.63	1.58	1.84	1.71	1.47	1.63	1.55	2.05	1.97	1.31	1.38	1.63	2.07	1.38
2069	1.40	1.43	1.38	0.98	0.85	1.44	1.43	1.40	1.30	0.94	1.48	1.44	1.41	1.38	1.20	1.55	1.48	1.42	1.36	1.22	1.49	1.46	1.36	1.26	1.13
2070	0.24	0.26	0.54	0.59	0.58	0.33	0.46	0.66	0.75	0.56	0.56	0.72	0.81	0.69	0.56	0.71	0.76	0.70	0.57	0.44	0.68	0.63	0.59	0.50	0.45

Table C3

Experimental Climate Prediction Center; Geophysical Fluid-Dynamics Laboratory Atmospheric-Land Generalized Model

Table C3.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	2.29	2.51	2.18	2.28	2.05	1.88	2.20	2.15	2.13	2.25	2.01	2.32	2.23	1.74	2.08	2.09	2.08	1.99	1.86	1.69	2.16	2.16	2.26	1.53	1.50
1970	1.89	1.66	1.61	1.73	1.84	1.83	2.08	1.92	1.86	2.05	2.24	1.77	1.54	1.26	2.13	1.56	1.63	1.84	1.41	2.03	1.57	1.28	1.68	2.00	2.52
1971	1.30	1.28	1.13	1.13	1.41	1.35	1.61	1.36	1.54	1.74	1.69	2.16	1.75	1.86	1.92	2.67	2.28	1.93	1.94	2.03	2.77	2.08	2.58	2.90	3.00
1972	1.89	1.93	1.68	1.73	1.59	1.84	1.73	1.59	1.54	1.63	1.85	1.96	1.40	1.49	1.68	1.89	1.35	2.10	2.34	2.34	1.61	1.96	2.79	2.60	2.21
1973	1.36	1.45	1.40	1.44	1.72	1.53	2.15	2.01	1.83	2.05	2.26	2.20	2.37	2.26	2.06	1.97	1.66	2.42	2.24	2.18	1.81	2.08	2.41	2.24	2.11
1974	3.40	3.12	2.77	2.81	2.66	3.69	3.37	1.41	1.81	1.48	1.65	1.59	1.34	1.84	1.24	1.81	1.45	1.40	1.38	1.67	2.04	1.44	1.97	1.76	1.60
1975	1.82	1.52	1.33	1.02	1.19	1.50	1.69	0.95	0.93	1.34	1.08	1.02	0.93	0.93	1.01	1.21	1.12	1.23	1.33	1.46	1.41	1.57	1.66	1.56	1.16
1976	3.22	3.02	2.36	2.48	2.11	2.17	2.35	1.43	1.89	2.24	1.52	1.98	2.00	1.82	2.07	2.55	2.15	2.29	1.85	2.10	4.01	2.88	2.44	1.87	2.00
1977	1.17	1.38	1.45	2.74	2.38	2.20	1.82	1.89	2.46	2.55	2.15	1.87	2.68	1.56	1.94	2.06	1.96	2.92	1.79	2.03	1.69	1.81	2.36	2.18	1.66
1978	2.94	2.17	1.73	1.28	1.77	2.56	1.61	1.30	1.11	1.49	3.29	1.53	1.52	1.80	1.78	2.33	2.03	2.13	1.72	1.32	1.13	1.38	1.35	1.41	1.47
1979	2.16	2.08	1.76	2.16	2.15	1.67	1.55	1.98	2.31	1.99	1.80	1.65	2.11	2.14	1.57	1.51	1.54	2.27	1.65	1.27	1.77	1.87	2.01	1.23	1.12
1980	2.09	2.02	1.79	1.81	1.92	1.91	2.01	1.97	1.97	1.71	2.07	1.78	1.56	1.96	1.90	2.01	1.74	2.02	1.50	1.37	1.40	1.40	2.40	2.14	1.89
1981	2.15	1.62	1.72	1.41	2.06	1.90	2.10	2.03	2.41	3.26	2.52	3.91	3.50	2.86	2.36	3.33	2.20	3.06	3.13	3.22	3.26	3.15	3.18	2.23	2.48
1982	1.80	1.72	2.55	2.68	2.16	1.29	1.85	2.22	3.08	3.64	1.99	2.60	2.85	2.95	3.05	3.98	4.14	4.19	3.46	2.75	3.82	3.34	3.10	3.28	3.23
1983	2.32	2.13	1.72	1.85	2.50	1.72	2.03	2.11	1.83	1.79	1.89	1.82	1.42	1.44	1.33	2.17	1.84	2.26	1.53	1.74	2.28	1.51	2.02	1.83	2.00
1984	1.24	1.39	1.41	1.46	1.57	1.37	2.04	1.44	1.60	1.88	2.08	2.45	2.31	1.83	2.19	1.18	1.10	1.86	1.90	1.74	1.33	1.53	1.76	1.63	1.66
1985	2.14	2.32	3.09	2.42	2.02	2.06	2.14	1.17	1.82	1.37	2.21	1.58	1.72	2.11	1.82	1.77	1.19	2.02	1.53	1.72	1.20	1.56	2.35	2.52	2.42
1986	1.50	1.32	1.28	1.72	1.87	2.22	1.33	1.18	1.11	1.51	2.61	1.61	1.35	1.29	1.30	1.89	1.59	2.05	1.35	1.19	1.30	1.50	1.74	1.72	1.56
1987	1.56	1.65	2.14	2.34	3.25	2.09	2.29	2.57	2.42	2.49	2.25	2.98	2.98	2.60	2.94	2.71	2.53	2.75	2.17	2.81	1.92	2.31	2.39	2.20	2.20
1988	1.93	2.59	4.18	4.27	3.78	2.07	3.51	4.18	3.87	2.90	2.00	3.69	3.94	2.88	1.45	2.22	1.97	2.78	2.09	1.26	1.53	1.66	2.10	1.26	1.38

Table C3.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	1.87	2.37	2.21	2.35	2.39	1.68	2.07	2.13	1.84	1.98	1.85	1.80	1.64	1.56	2.14	1.72	2.38	2.81	1.72	1.58	2.04	2.26	2.51	1.38	1.51
1990	2.29	3.02	1.72	1.27	1.49	1.68	1.30	1.52	1.64	1.63	2.01	2.03	1.46	1.36	1.64	2.08	1.71	2.08	2.21	2.00	2.25	1.67	2.26	2.57	2.74
1991	1.87	1.27	1.33	1.53	1.49	1.60	1.66	1.96	1.97	2.32	1.40	1.66	1.93	1.90	1.99	1.06	1.30	2.11	1.73	1.49	1.47	1.36	2.24	1.77	1.63
1992	1.50	1.23	1.37	2.08	3.45	1.33	1.36	1.32	2.16	2.83	1.49	1.61	1.64	1.76	2.51	1.26	1.44	1.61	1.54	1.68	1.11	1.67	1.60	1.55	1.46
1993	1.56	1.27	1.12	0.91	1.15	1.94	1.69	1.13	1.18	1.08	1.91	1.70	1.27	0.85	1.02	1.79	1.63	1.59	1.35	1.58	1.24	1.17	1.97	1.91	1.78
1994	1.46	1.04	1.10	1.02	1.47	1.14	1.18	1.03	1.56	1.33	1.34	1.09	1.12	1.57	2.17	1.13	1.21	1.23	1.26	1.30	0.99	1.15	1.37	1.31	1.21
1995	2.31	2.25	2.97	2.52	3.22	3.32	3.25	2.76	1.75	2.38	3.30	2.73	1.63	1.80	1.56	2.78	1.76	1.77	1.58	2.08	1.70	1.55	2.38	2.11	2.24
1996	2.03	1.23	1.42	2.21	1.86	1.44	1.95	1.87	2.84	3.62	1.96	3.28	3.59	3.13	2.67	2.20	2.67	2.64	2.41	1.99	2.21	2.44	2.97	2.23	1.72
1997	2.94	2.33	2.49	2.00	1.81	3.06	2.72	1.93	1.96	1.65	2.19	1.95	1.82	1.80	1.84	2.98	2.99	3.15	2.17	1.90	2.60	2.30	3.08	2.65	2.67
1998	2.08	2.26	1.32	1.47	1.61	1.98	1.90	1.83	1.39	1.44	1.56	1.40	2.36	2.83	1.44	1.48	1.18	1.75	2.81	1.96	1.21	1.89	2.40	2.39	2.29
1999	1.30	1.17	1.43	1.37	1.73	1.28	1.30	1.37	1.51	2.26	1.27	1.37	1.76	2.09	2.27	2.93	2.45	2.89	2.36	2.19	2.56	2.72	3.50	2.16	1.86
2000	3.15	3.04	1.37	1.28	3.48	2.20	1.97	1.57	2.07	3.08	1.81	2.60	2.10	2.91	3.05	1.51	1.88	2.38	3.13	2.79	1.44	2.56	1.88	1.94	2.01

Table C3.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.70	2.18	1.71	1.77	2.24	1.60	1.80	1.38	2.36	1.61	1.59	2.08	2.05	1.89	2.56	1.93	1.82	1.76	2.03	2.12	1.24	1.31	2.40	2.21	2.30
2040	2.26	2.07	3.53	2.48	2.28	1.90	3.68	2.11	2.14	1.24	2.64	3.75	2.83	2.09	2.27	3.03	2.84	2.98	2.77	3.35	3.85	2.43	2.07	2.84	1.99
2041	1.16	1.05	1.20	1.72	1.97	1.68	1.99	1.85	1.99	1.86	2.30	2.36	2.17	2.12	2.02	1.48	2.05	2.76	2.51	2.79	1.71	2.59	2.91	3.01	2.41
2042	1.76	1.97	1.37	1.51	2.06	1.73	1.59	1.55	1.66	1.44	1.62	1.69	2.15	2.36	2.55	1.68	1.75	2.15	2.24	2.02	2.29	1.60	2.02	2.11	2.55
2043	1.33	1.52	1.61	1.51	1.61	1.51	1.72	1.84	2.00	2.42	2.03	2.05	1.91	1.85	2.12	2.11	1.80	1.74	2.05	2.20	1.28	1.40	2.36	1.71	2.22
2044	2.19	2.01	2.41	2.62	2.57	1.66	2.99	2.69	2.22	1.91	2.40	2.65	1.93	1.86	1.44	2.19	1.21	1.89	1.32	1.31	1.05	0.93	1.89	1.57	1.88
2045	2.11	2.24	1.96	2.83	2.82	1.55	2.28	2.31	2.45	2.42	2.01	2.25	2.01	2.22	2.27	2.39	1.45	1.99	1.92	2.17	1.86	1.72	1.90	1.95	1.95
2046	2.28	1.80	2.25	2.97	2.33	2.26	2.55	1.98	2.09	2.98	1.70	2.12	1.86	1.65	1.81	1.60	2.35	2.36	2.31	2.09	1.36	2.97	2.72	1.88	1.41
2047	2.37	2.27	1.26	1.65	2.03	2.64	3.18	2.73	2.76	2.68	3.44	1.89	2.33	2.50	2.51	2.37	1.39	2.27	2.42	1.70	1.69	1.57	2.04	2.11	2.02
2048	2.26	1.61	1.62	1.75	1.91	1.73	1.86	1.43	1.65	2.12	1.52	1.70	2.02	1.95	2.47	1.99	2.21	2.08	2.73	2.19	2.22	1.52	2.75	2.68	1.93
2049	1.93	1.71	1.38	1.94	2.80	1.53	1.44	1.85	2.27	3.27	1.50	1.82	2.26	2.90	3.37	2.08	1.84	3.58	3.93	3.28	2.54	2.67	4.17	3.53	2.33
2050	1.77	1.92	2.79	2.67	2.79	2.96	3.32	2.30	2.35	2.98	2.33	2.69	2.43	3.66	4.23	2.51	2.97	2.51	2.72	3.12	2.85	2.53	3.20	2.32	2.83
2051	2.15	2.05	2.17	3.48	3.40	1.30	2.32	3.08	3.37	3.23	1.56	2.80	2.55	2.01	1.53	2.13	1.95	2.32	1.89	2.08	1.89	1.96	2.87	2.94	2.90
2052	3.09	3.28	1.78	1.78	1.76	3.47	2.27	2.18	2.12	2.23	2.41	2.14	2.35	2.31	2.06	2.07	1.44	1.78	2.30	2.47	1.35	1.66	2.27	2.65	2.04
2053	3.12	2.92	2.57	2.31	2.41	2.43	2.54	2.37	2.50	2.06	3.03	2.79	1.74	2.10	2.29	1.75	2.15	2.58	2.00	1.60	1.58	2.05	2.53	1.70	1.71
2054	0.94	1.19	1.74	1.91	1.67	1.54	1.71	1.69	1.95	2.13	2.22	3.06	3.30	2.87	2.15	1.55	2.17	4.04	3.09	2.70	1.88	2.02	2.56	2.60	2.39
2055	2.20	1.89	1.57	1.61	2.19	2.28	1.84	1.36	2.00	2.25	1.48	1.58	1.24	1.02	1.13	1.70	1.57	2.21	2.44	2.27	1.12	1.85	2.26	2.26	2.40
2056	2.13	1.68	1.52	1.78	1.40	2.35	1.47	1.29	1.74	2.04	2.19	2.15	1.87	1.51	1.43	2.08	1.27	2.11	2.23	2.11	2.77	2.59	2.85	1.65	2.13
2057	3.19	1.28	1.02	0.95	1.15	2.43	1.97	1.81	1.47	2.03	2.01	1.60	1.54	1.67	1.84	2.74	1.75	2.88	3.03	2.33	1.79	1.73	2.67	3.00	2.32
2058	1.82	1.30	2.02	1.99	2.11	1.73	2.25	2.28	2.32	2.42	1.95	2.99	2.80	2.84	2.75	1.73	1.45	2.48	2.81	2.66	1.46	1.45	1.68	1.76	2.28
2059	1.77	1.73	1.70	2.09	2.67	1.52	1.73	1.85	2.39	2.78	1.73	2.53	2.52	2.60	2.67	2.24	2.26	2.14	2.33	2.30	2.39	2.23	2.05	2.19	2.36
2060	1.37	1.34	1.52	1.05	1.27	1.72	1.92	1.47	1.39	1.43	1.54	1.59	1.83	1.45	1.62	1.54	1.52	1.74	1.46	1.71	1.72	1.83	1.98	2.28	2.50

Table C3.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.95	2.28	1.72	1.47	1.44	1.56	1.20	1.25	1.02	1.51	1.98	1.20	1.16	1.20	1.87	1.06	1.49	1.34	1.45	1.43	1.15	1.24	1.50	1.36	1.85
2062	1.70	1.73	2.89	2.69	1.72	2.35	2.69	2.38	1.59	1.61	2.77	2.11	2.11	1.86	1.41	1.84	1.34	1.49	1.18	1.47	1.24	1.24	2.65	2.60	1.59
2063	0.98	1.12	2.07	2.95	1.92	2.05	3.59	3.23	2.10	2.53	3.49	4.01	2.86	1.83	2.43	3.44	2.20	2.24	2.32	1.95	3.16	2.10	2.74	2.72	2.37
2064	1.84	2.08	1.77	1.62	1.55	2.05	2.00	1.92	1.59	1.26	1.96	1.90	1.39	1.63	1.39	1.81	1.39	1.52	1.92	2.20	1.34	1.24	1.56	1.90	2.06
2065	2.59	2.56	1.05	1.61	1.47	1.96	1.71	2.13	1.31	1.17	1.90	1.88	1.60	1.12	1.26	2.01	1.99	1.66	1.47	1.28	1.41	1.44	1.61	1.37	1.34
2066	1.30	1.70	2.34	2.66	2.44	1.70	2.89	2.55	2.07	2.33	2.75	2.38	2.22	2.12	1.96	2.21	1.70	1.95	1.69	2.05	2.07	2.39	3.24	3.67	4.34
2067	3.09	3.28	2.43	1.73	1.66	2.66	2.32	1.84	1.50	1.53	2.08	1.78	1.64	1.67	1.77	1.56	1.49	1.69	1.67	1.74	1.58	1.53	1.68	1.44	1.66
2068	1.98	1.45	1.67	1.82	1.89	1.43	1.85	1.99	1.95	1.94	1.55	2.50	2.11	2.09	2.18	1.98	2.50	2.65	2.36	2.30	2.36	2.31	2.56	2.42	2.33
2069	1.70	1.72	1.52	1.47	1.81	1.88	1.57	1.49	1.57	1.88	1.40	1.46	1.77	1.90	2.08	1.43	1.56	2.31	2.46	2.57	1.98	2.04	2.69	2.57	2.41
2070	1.98	2.06	1.53	1.59	1.89	1.66	1.98	1.79	2.50	2.65	2.15	1.54	1.79	2.53	1.86	1.29	1.13	1.84	1.71	1.35	1.58	1.40	1.84	1.51	1.24

Table C3.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	0.91	0.93	0.63	0.56	0.53	0.84	0.81	0.60	0.52	0.55	0.81	0.71	0.64	0.52	0.53	0.74	0.78	0.83	0.62	0.52	0.75	0.81	0.97	0.79	0.64
1970	0.51	0.43	0.42	0.43	0.44	0.47	0.43	0.44	0.46	0.46	0.44	0.43	0.47	0.51	0.56	0.47	0.46	0.63	0.65	0.62	0.51	0.49	0.64	0.66	0.68
1971	0.61	0.60	0.51	0.50	0.54	0.52	0.60	0.55	0.52	0.48	0.63	0.68	0.64	0.57	0.53	0.74	0.66	0.75	0.67	0.59	0.85	0.76	0.93	0.88	0.79
1972	0.53	0.42	0.42	0.43	0.64	0.47	0.62	0.63	0.64	0.64	0.68	0.94	0.76	0.67	0.61	0.71	0.96	1.39	0.94	0.74	0.44	0.46	0.93	0.77	0.68
1973	0.70	0.65	0.62	0.60	0.59	0.70	0.68	0.62	0.57	0.54	0.72	0.69	0.65	0.54	0.53	0.70	0.69	0.71	0.53	0.55	0.67	0.60	0.63	0.62	0.61
1974	0.87	0.85	0.58	0.52	0.49	0.95	0.82	0.52	0.46	0.53	1.05	0.83	0.51	0.45	0.55	0.99	0.73	0.58	0.55	0.56	0.86	0.61	0.63	0.64	0.60
1975	0.43	0.44	0.52	0.54	0.65	0.52	0.51	0.52	0.54	0.74	0.64	0.63	0.59	0.65	0.85	0.61	0.59	0.72	0.69	0.88	0.81	0.70	0.77	0.75	0.95
1976	0.48	0.44	0.38	0.34	0.34	0.42	0.47	0.42	0.34	0.35	0.43	0.56	0.48	0.36	0.34	0.51	0.50	0.50	0.37	0.39	0.45	0.41	0.45	0.45	0.43
1977	0.91	0.82	0.48	0.48	0.55	0.82	0.72	0.50	0.51	0.55	0.76	0.62	0.56	0.50	0.55	0.66	0.42	0.53	0.47	0.54	0.43	0.35	0.48	0.53	0.57
1978	0.57	0.65	0.80	0.81	0.96	0.64	0.74	0.83	0.90	0.98	0.66	0.80	0.86	0.90	0.87	0.74	0.80	0.89	0.83	0.73	0.80	0.83	0.88	0.77	0.69
1979	0.41	0.47	0.60	0.99	0.92	0.43	0.56	0.68	0.77	0.84	0.51	0.91	0.89	0.85	0.83	0.85	0.64	0.92	0.72	0.74	0.41	0.58	0.95	0.71	0.81
1980	0.79	0.71	0.66	0.60	0.62	0.88	0.95	0.86	0.79	0.79	1.12	1.01	1.00	0.89	0.83	0.92	0.54	0.88	0.82	0.76	0.71	0.62	0.90	0.87	0.88
1981	1.00	0.84	0.70	0.71	0.70	0.99	0.73	0.66	0.69	0.63	1.09	0.70	0.54	0.57	0.50	0.81	0.45	0.51	0.44	0.41	0.42	0.47	0.67	0.60	0.63
1982	0.30	0.39	0.41	0.39	0.45	0.36	0.48	0.44	0.43	0.49	0.38	0.57	0.51	0.43	0.47	0.49	0.53	0.64	0.45	0.45	0.50	0.54	0.62	0.51	0.45
1983	0.73	0.69	0.72	0.70	0.71	0.78	0.77	0.67	0.72	0.71	0.80	0.70	0.64	0.74	0.69	0.80	0.60	0.68	0.69	0.66	0.50	0.48	0.67	0.68	0.67
1984	0.44	0.41	0.32	0.33	0.44	0.39	0.35	0.33	0.34	0.37	0.37	0.40	0.39	0.35	0.34	0.37	0.36	0.42	0.32	0.32	0.37	0.35	0.37	0.34	0.32
1985	0.78	0.71	0.70	0.63	0.55	0.71	0.69	0.68	0.62	0.52	0.74	0.70	0.69	0.61	0.58	0.76	0.54	0.71	0.67	0.61	0.51	0.52	0.68	0.70	0.69
1986	0.31	0.26	0.34	0.39	0.43	0.28	0.34	0.35	0.43	0.46	0.31	0.43	0.45	0.47	0.49	0.46	0.48	0.59	0.56	0.54	0.53	0.51	0.63	0.59	0.57
1987	0.55	0.49	0.43	0.46	0.60	0.57	0.50	0.43	0.48	0.54	0.58	0.52	0.55	0.40	0.42	0.57	0.46	0.61	0.51	0.57	0.45	0.45	0.55	0.63	0.63
1988	0.33	0.26	0.28	0.33	0.40	0.39	0.33	0.33	0.34	0.49	0.33	0.41	0.40	0.45	0.59	0.35	0.37	0.58	0.64	0.80	0.37	0.39	0.75	0.85	0.94
1989	0.54	0.39	0.50	0.51	0.46	0.49	0.46	0.45	0.49	0.54	0.47	0.48	0.46	0.52	0.56	0.44	0.51	0.55	0.59	0.62	0.42	0.45	0.56	0.57	0.59
1990	0.82	0.45	0.60	0.71	0.76	0.49	0.58	0.69	0.81	0.86	0.62	0.67	0.77	0.83	0.85	0.63	0.69	0.86	0.88	0.81	0.65	0.72	0.88	0.78	0.76

Table C3.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1991	0.43	0.38	0.42	0.57	0.88	0.49	0.49	0.48	0.66	0.88	0.52	0.48	0.57	0.76	0.89	0.48	0.37	0.69	0.80	0.80	0.34	0.30	0.81	0.85	0.81
1992	0.57	0.54	0.67	0.71	0.76	0.68	0.82	0.82	0.76	0.62	0.75	1.00	0.95	0.69	0.54	0.82	0.88	1.06	0.64	0.56	0.91	0.86	0.98	0.62	0.60
1993	0.40	0.36	0.36	0.35	0.35	0.45	0.51	0.45	0.41	0.43	0.48	0.55	0.53	0.50	0.51	0.49	0.46	0.66	0.63	0.59	0.54	0.57	0.66	0.68	0.66
1994	0.75	0.76	0.55	0.41	0.44	0.81	0.74	0.47	0.42	0.43	0.79	0.59	0.45	0.44	0.47	0.73	0.42	0.48	0.49	0.49	0.40	0.41	0.47	0.56	0.58
1995	0.62	0.68	0.57	0.50	0.66	0.59	0.70	0.65	0.53	0.66	0.58	0.88	0.67	0.58	0.71	0.72	0.92	1.00	0.66	0.76	0.81	0.97	0.89	0.77	0.83
1996	1.25	1.23	1.18	1.08	0.97	1.24	1.32	1.28	1.06	1.01	1.21	1.35	1.40	1.12	1.05	1.01	0.96	1.43	1.22	1.07	0.81	0.82	1.28	1.25	1.07
1997	0.52	0.50	0.54	0.66	0.74	0.53	0.70	0.66	0.70	0.71	0.60	0.84	0.76	0.66	0.57	0.60	0.72	0.94	0.60	0.54	0.64	0.72	0.90	0.60	0.49
1998	0.60	0.63	0.49	0.52	0.54	0.47	0.48	0.51	0.52	0.55	0.44	0.44	0.51	0.52	0.55	0.40	0.42	0.53	0.44	0.48	0.44	0.42	0.46	0.46	0.53
1999	0.38	0.34	0.31	0.33	0.41	0.35	0.38	0.36	0.34	0.37	0.37	0.48	0.46	0.44	0.41	0.55	0.57	0.61	0.57	0.53	0.59	0.58	0.66	0.70	0.68
2000	0.94	0.76	0.58	0.65	0.74	0.67	0.71	0.68	0.71	0.73	0.63	0.73	0.75	0.76	0.72	0.64	0.64	0.76	0.76	0.66	0.70	0.61	0.70	0.71	0.66

Table C3.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	0.56	0.50	0.49	0.59	0.68	0.39	0.47	0.59	0.63	0.76	0.33	0.62	0.69	0.73	0.85	0.33	0.58	0.83	0.87	0.84	0.48	0.70	0.92	0.87	0.61
2040	0.37	0.36	0.41	0.43	0.49	0.43	0.45	0.45	0.47	0.49	0.53	0.48	0.50	0.50	0.50	0.44	0.46	0.57	0.53	0.51	0.47	0.48	0.58	0.55	0.51
2041	1.09	1.05	1.20	1.28	1.30	1.18	1.24	1.30	1.29	1.28	1.18	1.15	1.20	1.19	1.11	1.07	0.98	1.07	1.05	0.99	0.94	0.87	0.96	1.00	0.98
2042	0.92	0.86	0.80	0.79	0.74	0.85	0.81	0.79	0.75	0.71	0.83	0.84	0.89	0.85	0.80	0.83	0.77	0.96	0.95	0.86	0.84	0.84	1.03	1.04	1.00
2043	0.52	0.53	0.43	0.45	0.50	0.43	0.54	0.57	0.57	0.57	0.51	0.61	0.65	0.61	0.59	0.62	0.57	0.69	0.63	0.58	0.65	0.59	0.67	0.57	0.56
2044	0.68	0.53	0.64	0.91	0.98	0.56	0.61	0.62	0.77	0.70	0.51	0.58	0.63	0.59	0.49	0.55	0.42	0.64	0.52	0.46	0.77	0.78	0.79	0.65	0.45
2045	0.58	0.44	0.46	0.51	0.58	0.56	0.51	0.50	0.53	0.56	0.74	0.76	0.61	0.55	0.55	0.70	0.76	0.81	0.63	0.55	0.62	0.71	0.90	0.75	0.65
2046	1.38	1.35	1.11	0.85	0.68	1.43	1.27	1.16	0.70	0.56	1.44	1.18	0.96	0.62	0.51	1.34	0.90	0.90	0.60	0.46	0.90	0.78	0.71	0.48	0.49
2047	0.79	0.72	0.76	0.89	1.08	0.88	0.85	0.89	1.02	1.19	0.94	0.97	1.05	1.08	1.24	0.97	0.89	1.00	1.15	1.18	0.87	0.87	0.99	1.18	1.15
2048	0.68	0.68	0.60	0.60	0.63	0.62	0.63	0.49	0.52	0.56	0.55	0.49	0.43	0.46	0.50	0.48	0.50	0.60	0.43	0.43	0.52	0.53	0.69	0.47	0.46
2049	0.78	0.81	1.10	1.42	1.69	0.97	1.20	1.27	1.46	1.64	1.25	1.58	1.48	1.46	1.51	1.30	1.47	1.58	1.35	1.38	1.16	1.31	1.43	1.39	1.45
2050	0.57	0.60	0.54	0.57	1.11	0.67	0.62	0.63	0.58	1.36	0.67	0.71	0.72	0.70	1.48	0.69	0.57	0.63	0.78	1.47	0.57	0.55	0.69	0.77	1.37
2051	0.47	0.48	0.49	0.45	0.45	0.55	0.58	0.53	0.50	0.48	0.59	0.55	0.53	0.52	0.48	0.55	0.45	0.61	0.53	0.40	0.47	0.43	0.59	0.49	0.43
2052	1.19	1.05	1.05	0.76	0.76	1.05	1.02	0.81	0.85	1.03	0.92	0.68	0.96	1.11	1.31	0.62	0.71	1.28	1.41	1.52	0.70	0.99	1.51	1.61	1.46
2053	1.00	0.90	0.81	0.77	0.67	0.99	0.90	0.66	0.61	0.54	0.91	0.75	0.65	0.56	0.50	0.79	0.64	0.61	0.55	0.49	0.74	0.59	0.63	0.59	0.49
2054	0.41	0.29	0.34	0.38	0.47	0.36	0.32	0.35	0.38	0.41	0.53	0.38	0.39	0.39	0.44	0.40	0.51	0.57	0.51	0.53	0.43	0.52	0.64	0.60	0.58
2055	0.59	0.47	0.39	0.33	0.38	0.58	0.44	0.38	0.42	0.49	0.43	0.55	0.57	0.52	0.44	0.68	0.71	0.85	0.74	0.60	0.80	0.87	1.06	0.93	0.78
2056	0.66	0.63	0.71	0.73	0.80	0.63	0.82	0.88	0.83	0.82	0.73	0.99	1.00	0.88	0.69	0.90	0.96	1.02	0.72	0.57	0.98	0.90	0.83	0.62	0.55
2057	1.01	0.94	0.74	0.84	1.00	0.95	0.84	0.76	0.84	0.99	0.86	0.85	0.84	0.96	0.91	0.80	0.66	0.87	0.88	0.79	0.62	0.56	0.72	0.78	0.87
2058	0.67	0.60	0.71	0.88	1.00	0.68	0.80	0.91	0.99	1.01	0.77	0.90	0.99	0.99	0.93	0.88	0.91	1.15	1.04	0.92	0.90	1.05	1.25	1.10	0.99
2059	0.59	0.69	1.70	1.91	1.75	0.60	1.73	1.85	1.84	1.63	1.25	2.07	2.00	1.85	1.80	2.24	2.26	2.14	2.00	2.12	2.39	2.23	2.05	2.05	2.36
2060	0.70	0.38	0.28	0.29	0.32	0.40	0.30	0.31	0.30	0.32	0.48	0.30	0.31	0.32	0.33	0.30	0.31	0.34	0.32	0.33	0.38	0.36	0.39	0.44	0.51

Table C3.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	0.64	0.54	0.43	0.61	0.82	0.59	0.52	0.73	0.97	1.06	0.53	0.90	1.16	1.18	1.06	0.66	1.01	1.34	1.11	0.90	1.15	1.24	1.28	0.96	0.83
2062	0.66	0.63	0.54	0.56	0.62	0.54	0.56	0.55	0.57	0.59	0.50	0.53	0.55	0.59	0.60	0.56	0.55	0.66	0.66	0.69	0.65	0.66	0.75	0.73	0.73
2063	0.54	0.50	0.42	0.41	0.43	0.46	0.46	0.43	0.40	0.43	0.44	0.43	0.46	0.45	0.45	0.42	0.37	0.45	0.45	0.46	0.36	0.35	0.41	0.43	0.44
2064	0.58	0.58	0.71	0.82	0.82	0.67	0.84	0.89	0.80	0.64	0.73	0.99	0.85	0.63	0.69	0.98	0.94	0.79	0.76	0.75	0.97	0.70	0.84	0.87	0.82
2065	0.82	0.82	0.50	0.44	0.50	0.77	0.65	0.48	0.46	0.47	0.73	0.54	0.54	0.46	0.58	0.61	0.49	0.54	0.52	0.67	0.52	0.49	0.58	0.66	0.71
2066	1.00	1.01	1.05	1.08	1.22	1.04	1.21	1.20	1.22	1.31	1.11	1.46	1.44	1.39	1.20	1.11	1.34	1.54	1.16	1.13	1.18	1.39	1.43	1.03	0.96
2067	0.62	0.63	0.57	0.58	0.57	0.55	0.56	0.46	0.47	0.49	0.47	0.48	0.48	0.51	0.55	0.46	0.50	0.55	0.55	0.57	0.57	0.57	0.63	0.68	0.66
2068	0.69	0.71	0.75	0.75	0.78	0.67	0.70	0.75	0.76	0.77	0.70	0.74	0.77	0.75	0.81	0.62	0.62	0.72	0.77	0.84	0.60	0.59	0.83	0.87	0.87
2069	0.97	0.99	0.89	0.81	0.96	1.01	1.00	0.86	1.01	1.03	1.02	0.92	0.95	0.88	0.81	1.16	0.94	0.86	0.87	0.86	1.08	0.87	0.96	1.00	0.96
2070	1.98	2.06	1.53	1.59	1.89	1.66	1.98	1.79	2.50	2.65	2.15	1.54	1.79	2.53	1.86	1.29	1.13	1.84	1.71	1.35	1.58	1.40	1.84	1.51	1.24

Table C4

Hadley Centre Regional Model 3; Hadley Centre Coupled Model 3

Table C4.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	1.96	1.66	1.41	1.43	1.35	1.86	1.70	1.28	1.35	1.78	2.46	2.35	1.76	1.73	2.10	1.80	1.49	1.21	2.25	2.19	1.39	1.26	1.14	2.51	2.03
1970	1.49	1.25	1.05	0.93	1.03	1.40	1.16	0.92	1.17	1.15	1.66	1.69	1.54	1.14	1.32	1.39	1.28	1.15	1.98	1.55	1.28	1.29	1.02	1.90	2.14
1971	0.95	1.13	1.29	1.51	1.93	1.15	1.36	2.23	3.12	3.53	2.23	3.39	4.08	3.51	3.33	2.51	2.76	2.05	3.32	2.09	2.57	2.28	2.04	2.86	3.31
1972	1.84	1.59	1.50	1.46	1.75	1.68	1.66	1.92	2.14	2.10	1.78	2.06	2.08	1.68	1.92	1.55	1.41	0.93	1.86	2.11	1.56	1.45	1.40	2.08	2.22
1973	1.66	1.47	1.29	1.76	1.96	1.26	1.56	1.63	1.90	1.98	2.40	2.71	2.88	2.53	2.74	2.36	2.38	1.96	3.20	2.67	2.68	2.30	2.47	3.52	3.65
1974	2.86	2.57	2.00	1.61	1.60	2.89	2.07	1.25	1.15	1.10	2.29	2.00	1.62	1.02	1.26	1.92	1.76	1.12	1.67	1.86	2.45	2.49	1.70	2.76	2.37
1975	1.49	1.38	1.80	2.10	1.94	1.33	1.74	1.92	2.06	2.12	1.76	2.28	2.14	1.67	1.66	1.65	1.87	1.47	2.20	1.61	2.56	2.79	1.61	1.79	1.60
1976	1.25	1.14	0.96	1.09	1.49	0.99	1.10	1.41	1.74	1.91	2.25	2.58	2.57	2.28	2.14	2.66	2.67	2.34	2.79	2.26	2.25	2.11	1.86	2.35	2.08
1977	1.73	1.68	1.58	1.65	1.49	1.77	1.49	1.61	1.39	1.35	1.73	1.85	1.86	1.13	1.28	1.60	1.66	1.41	1.65	1.40	2.32	2.08	1.42	1.72	1.89
1978	2.05	1.90	1.87	2.06	2.48	1.93	1.79	1.93	2.43	2.60	2.15	2.59	3.35	3.40	3.67	2.08	2.29	2.26	3.70	3.27	2.38	2.05	1.70	3.86	3.15
1979	1.81	2.42	2.85	2.66	1.85	1.95	1.88	1.95	1.82	1.68	1.92	2.40	2.66	2.14	1.78	2.60	2.83	2.26	2.50	2.14	2.76	2.10	1.73	2.50	2.79
1980	1.37	1.29	1.20	1.33	1.36	1.24	1.24	1.22	1.23	1.39	1.89	1.67	1.38	1.15	1.50	1.57	1.50	1.10	1.85	1.87	2.25	2.16	1.53	2.06	2.14
1981	1.89	1.79	1.73	1.79	1.87	1.52	1.66	1.76	2.02	2.22	1.94	2.19	2.26	2.04	2.47	2.43	2.33	1.65	2.47	2.72	3.58	3.91	2.66	3.53	2.88
1982	0.96	1.26	1.56	1.73	1.63	1.41	1.92	2.15	2.05	1.67	2.23	2.76	2.51	1.49	1.33	1.84	1.90	1.13	1.99	2.01	1.92	1.79	1.26	3.08	2.27
1983	2.26	2.47	2.49	2.34	1.96	1.50	1.82	2.03	2.15	1.81	1.86	2.04	2.30	2.02	2.11	1.53	1.74	1.13	2.20	2.55	1.78	1.34	1.12	2.39	2.79
1984	1.81	1.70	1.65	1.77	1.97	2.02	2.10	2.12	2.17	2.17	1.93	2.34	2.58	2.12	2.12	2.43	2.67	2.05	3.06	2.22	2.60	2.64	2.21	3.28	2.15
1985	1.88	1.69	1.33	1.18	1.06	1.34	1.23	1.13	1.04	0.89	2.27	2.29	1.63	1.01	0.94	1.60	1.46	1.02	1.68	1.90	1.72	1.47	1.19	2.09	2.58
1986	2.35	2.94	2.75	2.80	2.88	2.49	2.62	2.51	2.75	2.37	3.34	3.43	3.55	2.91	2.91	4.73	3.68	1.90	2.67	2.27	6.09	3.92	2.02	2.63	2.91
1987	1.89	1.64	1.75	1.91	1.62	1.49	1.69	1.87	1.44	1.02	2.11	2.43	2.23	1.24	1.41	1.84	1.91	1.49	2.59	2.37	1.74	1.72	1.52	3.08	3.20
1988	5.70	6.06	4.78	2.33	1.33	2.73	2.22	1.72	1.73	1.92	2.31	2.16	1.96	2.03	2.39	1.48	1.27	1.08	2.27	2.53	1.50	1.30	1.11	1.99	2.00

Table C4.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	1.60	1.64	1.74	1.45	1.71	2.01	1.88	1.94	1.44	1.83	2.57	2.67	2.61	2.10	2.03	2.03	2.00	1.86	2.74	2.69	2.14	2.00	1.66	2.20	2.91
1990	1.74	2.31	2.47	1.99	1.64	1.82	2.16	2.08	1.52	1.40	2.20	2.43	2.20	1.50	1.99	1.36	1.50	1.18	2.05	1.89	1.47	1.35	1.12	2.18	2.09
1991	1.71	2.12	2.41	2.61	2.44	1.91	2.28	2.54	2.73	2.53	2.02	2.44	2.54	1.99	2.04	1.36	1.59	1.27	2.50	2.70	1.82	1.71	1.47	2.77	2.78
1992	2.10	2.32	2.31	2.18	1.96	2.09	2.24	1.85	1.45	1.97	3.40	3.79	3.02	1.28	1.44	2.21	2.25	1.42	2.64	2.07	1.48	1.55	1.46	3.28	2.67
1993	2.01	1.79	2.08	2.18	2.04	1.56	1.87	2.23	2.73	2.73	1.91	1.95	2.02	1.74	2.14	2.20	2.16	1.78	3.14	2.78	2.50	2.38	2.00	3.14	2.91
1994	2.41	2.40	2.36	2.31	2.14	1.10	0.95	1.47	1.68	1.49	1.32	1.47	1.31	1.15	1.50	1.02	1.12	0.93	2.02	1.78	1.43	1.63	1.36	2.35	1.97
1995	1.85	1.87	1.99	1.90	2.35	1.92	2.21	2.16	1.67	1.70	3.08	3.41	2.82	1.20	1.12	3.65	3.53	2.54	2.23	2.14	3.41	4.05	3.85	3.92	3.54
1996	1.51	1.74	1.92	2.06	2.16	2.02	1.54	1.52	1.35	1.16	1.69	2.18	1.80	1.63	1.93	2.19	2.40	2.10	2.57	2.61	2.85	3.03	2.57	3.48	3.43
1997	1.64	2.04	2.72	3.55	3.87	2.55	3.58	4.16	3.76	3.14	4.15	4.14	3.42	2.52	2.28	2.88	2.36	1.86	2.74	2.82	2.14	2.24	1.85	2.81	2.44
1998	3.08	3.06	2.65	2.35	2.08	2.52	2.28	1.75	1.95	2.43	2.48	2.09	2.51	2.53	2.76	3.48	2.63	2.44	3.16	2.52	3.44	2.59	2.00	2.19	1.36
1999	2.30	1.85	1.85	1.92	2.22	1.54	1.65	1.65	1.85	1.65	1.72	1.89	2.12	1.65	1.43	1.68	1.69	1.42	2.28	1.86	1.59	1.55	1.49	2.52	2.27
2000	1.82	2.62	3.90	3.97	3.59	2.39	3.80	4.53	3.90	2.55	3.87	5.27	4.77	2.65	2.16	3.33	3.37	2.37	2.83	3.16	2.48	2.42	2.10	3.33	3.02

Table C4.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.63	1.62	1.62	1.92	2.49	1.60	1.60	1.59	1.55	1.42	2.03	2.11	1.99	1.47	1.42	1.43	1.28	0.93	2.08	1.54	1.35	1.17	1.14	1.95	1.89
2040	1.68	1.70	1.66	2.09	2.06	1.83	2.04	2.45	3.01	2.47	2.33	2.82	3.41	2.40	2.12	1.86	2.06	1.78	3.15	2.50	2.17	2.24	1.52	2.83	3.31
2041	2.30	2.27	2.12	2.34	2.29	1.81	1.91	2.08	2.01	1.87	2.86	3.45	3.52	2.37	2.19	3.96	4.21	3.67	4.96	3.47	3.63	3.17	2.66	4.12	2.77
2042	1.73	2.10	1.96	1.99	1.93	2.02	2.07	1.58	1.62	1.53	2.26	1.91	1.86	1.55	1.44	1.62	1.14	0.97	1.58	1.49	1.66	1.43	1.11	1.62	1.80
2043	1.56	1.46	1.58	1.74	1.68	0.98	1.35	1.45	1.52	1.49	1.36	1.93	1.89	1.28	1.50	1.22	1.41	0.99	2.49	2.52	2.35	2.62	2.24	3.10	2.79
2044	2.07	1.62	1.76	1.69	1.27	2.38	2.48	1.88	1.49	1.36	2.07	3.50	3.04	1.07	1.32	1.95	2.64	2.52	2.38	1.31	2.27	2.09	1.76	2.35	1.50
2045	1.97	2.07	1.95	1.80	1.83	1.95	2.01	1.96	1.83	1.81	1.86	2.26	2.00	1.45	1.47	1.67	1.75	1.62	2.36	1.93	1.91	1.73	1.64	2.45	1.97
2046	3.84	3.31	2.79	2.19	2.12	3.55	2.75	2.08	2.23	2.17	1.66	2.30	3.05	2.36	2.50	1.48	1.50	1.31	3.08	3.62	1.66	1.32	1.31	3.22	3.59
2047	1.49	1.43	1.72	1.85	1.77	1.34	1.47	1.53	1.38	1.30	2.36	2.12	2.23	1.78	1.95	2.76	3.10	2.52	3.40	3.45	4.35	4.39	3.62	3.91	3.40
2048	1.47	1.45	1.45	1.74	1.73	1.28	1.47	1.10	1.21	1.40	1.84	1.76	1.45	1.18	1.83	1.75	1.39	0.92	2.34	2.14	1.46	1.48	1.25	2.39	1.98
2049	1.90	2.42	2.84	2.71	2.20	2.34	2.78	2.61	2.32	1.93	2.91	3.26	2.60	1.55	1.71	2.80	2.44	1.78	2.09	2.28	2.91	2.45	1.45	2.07	2.10
2050	2.67	2.49	2.63	2.44	2.23	2.14	2.90	3.13	2.50	1.52	3.26	4.67	4.38	2.15	1.37	3.08	3.33	2.33	3.52	2.18	2.85	2.50	2.70	3.69	2.64
2051	1.96	1.86	1.64	1.59	1.50	2.27	2.26	1.80	1.86	1.74	3.27	3.38	2.78	2.16	2.34	2.71	2.66	2.09	3.50	3.69	2.55	3.12	3.69	4.62	3.80
2052	4.37	4.82	4.79	3.87	2.76	5.18	5.61	4.65	2.91	1.61	5.15	3.64	2.91	1.35	1.43	2.20	1.63	1.10	2.65	1.66	1.79	1.44	1.09	3.01	2.55
2053	2.85	2.87	2.83	2.91	2.59	3.11	3.01	2.62	2.89	2.96	3.54	3.34	3.53	2.53	2.72	2.58	2.37	1.56	2.24	2.04	2.41	2.22	1.77	2.79	2.84
2054	1.32	1.31	1.21	1.90	1.86	1.41	1.44	1.79	2.44	1.85	2.08	2.55	2.27	2.54	1.89	2.05	2.80	2.08	3.50	2.77	1.90	2.27	1.87	3.56	3.00
2055	2.24	3.01	3.21	3.50	2.80	2.57	3.33	3.02	2.60	2.83	2.97	3.61	3.57	3.10	4.78	2.92	2.89	3.10	5.17	5.36	4.46	4.43	4.87	5.19	3.16
2056	1.79	1.61	1.77	2.00	2.05	1.52	2.04	2.49	2.71	2.42	2.41	2.79	3.02	2.72	2.13	1.30	1.42	1.36	2.70	2.33	1.97	2.21	2.03	2.42	2.64
2057	2.66	2.42	2.22	2.36	2.43	2.43	2.50	2.51	2.50	2.94	2.49	2.70	3.12	2.83	3.11	2.70	3.12	2.89	3.82	3.14	4.05	3.85	3.15	4.26	4.45
2058	1.37	1.46	1.38	1.33	1.12	1.30	1.48	1.48	1.53	1.37	1.85	2.16	2.65	2.54	2.37	2.94	3.85	4.02	5.16	4.34	2.85	3.68	4.14	5.45	4.84
2059	4.81	5.45	4.93	3.32	2.31	4.61	3.07	2.18	1.83	2.09	7.62	5.39	2.34	2.36	2.65	7.39	4.05	1.71	3.13	3.03	5.79	2.92	1.79	3.06	2.98
2060	3.39	3.82	3.26	2.40	2.39	3.30	3.51	2.60	2.34	2.08	4.28	3.64	2.44	2.24	2.22	2.62	2.41	1.82	3.01	2.65	2.53	2.48	2.06	2.85	3.29

Table C4.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	2.19	2.33	2.41	2.56	2.51	3.99	4.15	4.11	4.11	3.94	5.35	5.77	5.61	4.61	4.64	4.13	4.11	3.60	4.64	4.10	1.88	1.72	1.64	3.29	3.23
2062	1.48	1.69	1.76	1.92	1.88	1.61	1.82	1.88	1.92	1.73	1.72	2.43	2.26	2.00	2.19	1.92	1.76	1.34	1.91	1.58	1.89	1.58	1.32	2.35	1.87
2063	3.32	4.04	3.37	2.32	2.00	3.40	2.60	1.73	1.98	2.03	2.15	1.86	2.09	1.85	2.22	1.28	1.27	1.14	2.60	3.07	1.38	1.64	1.37	2.46	3.30
2064	2.30	1.77	1.57	1.61	1.56	1.54	1.66	1.56	1.55	1.55	1.73	2.01	2.02	1.59	1.55	1.98	2.08	1.43	2.10	2.22	2.29	2.20	1.57	2.36	2.62
2065	2.54	2.12	1.79	1.90	2.31	2.37	2.32	1.78	2.27	1.95	3.25	3.21	2.22	1.83	2.06	2.75	2.45	1.49	3.27	1.87	2.24	1.95	1.57	2.26	1.86
2066	1.98	2.08	1.72	2.15	2.65	2.10	2.04	2.00	2.24	2.18	3.41	2.83	2.05	1.55	1.33	4.00	2.72	1.22	1.91	1.61	4.25	2.33	1.15	2.06	2.16
2067	3.93	3.52	3.28	3.66	3.40	2.33	2.29	2.02	1.82	1.53	2.40	2.30	1.72	1.17	1.21	1.92	1.44	1.51	2.40	1.99	1.49	1.52	1.59	2.52	2.12
2068	3.20	2.85	2.39	2.16	2.32	1.57	1.85	2.49	2.26	1.68	1.94	2.61	3.24	2.06	1.58	1.95	2.29	1.57	2.83	1.81	1.97	2.18	1.56	2.56	2.12
2069	2.04	2.34	2.21	2.15	1.99	1.67	1.93	1.87	1.80	1.79	1.75	2.02	2.41	1.84	2.01	1.55	1.48	1.48	2.72	2.28	1.74	1.67	1.38	2.71	2.24
2070	1.68	1.54	1.33	1.44	1.28	1.31	1.28	1.20	1.13	1.31	1.97	1.84	1.74	1.35	1.71	2.08	2.01	1.58	2.45	2.22	2.64	2.36	1.76	2.58	2.52

Table C4.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	0.89	0.86	0.85	0.87	0.79	0.82	0.85	0.84	0.85	0.76	0.89	0.99	0.92	0.58	0.80	0.61	0.61	0.50	0.92	1.22	1.39	1.26	0.80	1.32	1.37
1970	0.44	0.48	0.54	0.70	0.79	0.44	0.51	0.62	0.73	0.75	0.57	0.78	0.88	0.69	0.75	0.62	0.68	0.52	1.25	1.16	0.88	0.96	0.89	1.52	1.60
1971	0.95	1.08	1.12	1.07	0.86	1.15	1.32	1.16	0.94	0.73	1.89	1.91	1.26	0.52	0.68	1.97	1.61	0.65	0.89	1.14	2.12	1.54	0.82	1.16	1.13
1972	0.82	0.87	0.87	0.94	0.84	0.85	0.91	0.68	0.72	0.62	1.27	1.41	0.99	0.46	0.45	1.12	1.06	0.61	1.18	0.78	1.45	1.31	0.96	1.53	0.89
1973	0.89	0.78	0.59	0.41	0.31	0.86	0.78	0.57	0.37	0.26	1.20	1.32	0.64	0.27	0.21	1.01	0.77	0.39	0.59	0.56	1.04	0.83	0.37	0.93	0.84
1974	1.60	1.37	1.24	1.18	1.00	1.00	0.86	0.72	0.63	0.61	0.95	1.13	0.93	0.41	0.57	1.13	1.10	0.73	0.99	0.89	1.34	1.30	0.94	1.39	1.23
1975	0.75	0.63	0.56	0.65	0.62	0.91	0.70	0.75	0.79	0.73	1.42	1.21	0.94	0.61	0.68	0.95	0.76	0.47	1.41	1.18	1.03	1.06	0.62	1.76	1.55
1976	0.75	0.82	0.83	0.98	0.95	0.87	0.74	0.85	0.82	0.96	1.17	1.27	1.15	0.72	1.04	0.89	0.88	0.58	1.12	1.24	1.36	1.15	0.72	1.16	1.31
1977	1.13	1.28	1.39	1.55	1.49	0.79	1.00	1.16	1.37	1.35	0.83	1.13	1.31	0.99	1.04	0.63	0.56	0.45	1.10	0.90	0.73	0.61	0.55	1.29	1.28
1978	1.48	1.61	1.77	1.83	1.70	1.19	1.66	1.89	2.21	2.43	1.86	2.59	3.35	3.40	3.67	2.08	2.29	2.20	3.70	3.07	1.87	1.95	1.70	2.29	2.12
1979	1.65	1.92	1.99	2.02	1.85	1.54	1.88	1.95	1.82	1.68	1.79	1.68	1.58	1.06	1.17	1.13	1.00	0.80	1.29	1.16	1.14	0.93	0.76	1.46	1.41
1980	1.37	1.29	1.20	1.33	1.36	1.24	1.24	1.22	1.23	1.39	1.89	1.61	1.38	1.15	1.50	1.57	1.50	1.10	1.62	1.87	2.25	2.16	1.53	2.06	2.14
1981	0.87	0.68	0.65	0.64	0.74	0.61	0.63	0.57	0.57	0.72	0.73	0.82	0.84	0.46	0.65	0.64	0.71	0.78	1.16	0.82	0.86	0.84	0.72	1.29	1.26
1982	0.89	1.08	1.24	1.46	1.52	1.01	1.11	1.09	1.21	1.27	0.99	1.02	0.96	0.64	1.09	0.98	0.84	0.64	1.16	1.31	1.49	1.33	0.88	1.46	1.51
1983	0.69	0.78	1.16	1.45	1.53	0.77	0.73	0.80	1.45	1.43	1.35	1.40	1.25	1.24	1.40	1.05	0.87	0.71	2.03	2.04	0.72	0.85	0.81	1.83	1.96
1984	1.74	1.70	1.65	1.61	1.45	2.02	2.10	2.12	2.12	2.01	1.76	2.15	2.27	1.94	2.12	1.06	1.17	1.01	2.15	2.09	1.19	1.10	0.94	1.68	1.78
1985	1.22	1.01	0.91	0.99	0.90	1.34	1.20	0.97	0.95	0.87	2.27	2.29	1.63	0.88	0.71	1.51	1.29	0.66	1.62	1.10	1.48	1.10	0.78	1.78	1.39
1986	2.19	2.42	2.54	2.80	2.88	2.37	2.46	2.51	2.75	2.37	3.34	3.30	2.86	1.99	1.80	4.73	3.68	1.90	2.13	2.15	6.09	3.92	1.85	2.63	2.91
1987	1.89	1.64	1.75	1.91	1.62	1.42	1.69	1.87	1.44	0.98	1.82	2.34	2.16	1.22	0.73	1.28	1.59	1.29	1.75	2.18	1.54	1.19	0.98	2.31	2.09
1988	1.44	1.54	1.68	1.56	1.26	1.57	1.62	1.52	1.73	1.92	1.64	1.76	1.96	2.03	2.39	1.21	1.17	1.08	2.27	2.53	1.43	1.30	1.11	1.54	1.93
1989	1.60	1.64	1.74	1.45	1.71	2.01	1.88	1.94	1.44	1.83	2.57	2.67	2.61	2.10	2.03	2.03	2.00	1.86	2.74	2.69	1.42	1.31	1.31	2.09	2.91
1990	1.74	2.31	2.47	1.99	1.64	1.82	2.16	2.08	1.52	1.40	2.20	2.43	2.20	1.50	1.48	1.36	1.50	1.18	2.05	1.66	1.47	1.35	1.12	2.18	2.09

Table C4.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1991	1.71	2.12	2.41	2.61	2.44	1.91	2.28	2.54	2.73	2.53	2.02	2.44	2.54	1.99	2.04	1.10	1.28	1.24	2.50	2.70	1.20	0.98	0.77	1.33	1.75
1992	0.60	0.59	0.56	0.57	0.78	0.67	0.78	0.73	1.45	1.97	1.23	1.75	2.03	1.28	0.95	0.75	0.70	0.64	1.23	1.09	0.79	0.75	0.58	1.24	1.21
1993	2.01	1.61	1.76	1.44	1.24	0.97	0.92	1.07	1.22	1.11	1.91	1.95	1.70	1.19	1.16	2.20	2.16	1.78	3.14	2.78	2.50	2.38	2.00	3.14	2.91
1994	1.09	1.03	1.14	1.19	1.17	1.10	0.92	1.05	1.11	1.03	1.32	1.47	1.31	1.03	1.13	1.02	1.12	0.93	2.02	1.52	1.12	1.17	1.00	2.35	1.91
1995	1.85	1.79	1.80	1.83	2.35	1.64	1.83	1.89	1.65	1.70	3.08	2.60	2.28	1.12	1.04	3.65	3.53	2.54	2.23	1.57	3.41	4.05	3.85	3.92	3.54
1996	1.51	1.74	1.92	2.06	2.16	2.02	1.54	1.52	1.35	1.16	1.69	2.18	1.80	1.63	1.93	2.19	2.40	2.10	2.57	2.61	2.85	3.03	2.57	3.48	3.43
1997	1.64	2.04	2.72	3.55	3.87	2.55	3.58	4.16	3.76	3.14	4.15	4.14	3.42	2.52	2.28	2.88	2.36	1.86	2.74	2.82	2.14	2.24	1.85	2.81	2.44
1998	3.08	3.06	2.65	2.35	2.08	2.52	2.28	1.75	1.95	2.43	2.48	2.09	2.51	2.53	2.76	3.48	2.63	2.44	3.16	2.52	3.44	2.59	2.00	2.19	1.36
1999	2.30	1.85	1.85	1.92	2.22	1.54	1.65	1.65	1.85	1.65	1.45	1.89	2.12	1.65	1.32	1.63	1.69	1.42	2.23	1.86	1.57	1.55	1.49	2.52	2.27
2000	1.37	2.62	3.90	3.97	3.59	2.39	3.80	4.53	3.90	2.55	3.87	5.27	4.77	2.65	1.65	3.33	3.37	2.37	2.22	2.00	2.48	2.42	1.97	2.55	2.33

Table C4. D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	0.37	0.37	0.36	0.50	0.56	0.36	0.42	0.55	0.78	0.90	0.74	0.87	1.09	0.77	0.87	0.86	0.77	0.62	1.43	1.22	1.35	1.17	0.74	1.48	1.36
2040	1.11	1.24	1.66	2.09	2.06	1.27	1.67	2.45	3.01	2.16	2.03	2.82	3.41	2.40	1.82	1.86	2.06	1.78	3.15	2.21	2.13	1.55	1.35	2.64	3.31
2041	1.54	1.63	1.52	1.31	0.94	1.53	1.70	1.51	1.23	0.90	1.85	2.02	1.59	1.04	0.98	1.71	1.49	0.83	2.12	1.65	1.66	1.37	0.87	2.12	1.75
2042	1.46	1.61	1.58	1.49	1.29	1.32	1.33	1.44	1.61	1.53	1.41	1.82	1.86	1.55	1.44	1.15	1.14	0.97	1.58	1.49	1.66	1.43	1.11	1.61	1.38
2043	0.78	0.81	0.69	0.63	0.59	0.75	0.74	0.63	0.58	0.64	0.85	0.96	0.72	0.43	0.62	0.67	0.54	0.37	1.01	1.02	1.11	0.99	0.58	1.19	1.19
2044	1.22	1.42	1.33	1.10	1.00	1.22	1.25	1.16	1.05	1.01	1.70	1.79	1.18	0.70	1.00	1.47	1.34	0.75	1.15	1.25	1.39	1.34	0.71	1.25	1.35
2045	0.64	0.84	1.09	1.58	1.83	0.71	0.92	1.12	1.37	1.81	1.13	1.32	1.26	0.97	1.47	1.16	1.18	0.91	1.67	1.71	1.54	1.44	1.09	1.79	1.97
2046	1.03	0.90	0.85	0.77	0.66	0.62	0.73	0.72	0.90	0.86	1.30	1.39	1.16	1.22	1.24	1.48	1.05	1.27	2.08	1.74	1.66	1.06	1.31	1.66	1.51
2047	1.02	0.80	0.78	0.93	0.98	1.32	0.96	0.87	0.97	1.04	2.36	1.78	1.13	0.92	1.06	1.78	1.12	0.63	1.33	1.26	1.36	1.13	0.91	1.28	1.21
2048	0.82	0.86	0.90	1.01	1.05	0.80	0.81	0.78	0.86	1.01	0.72	0.87	0.69	0.69	1.18	0.66	0.61	0.42	1.08	1.65	1.46	1.48	1.08	1.47	1.62
2049	0.75	0.82	0.85	0.85	0.75	0.83	0.88	0.91	0.88	0.65	0.85	1.16	1.36	0.85	0.64	0.93	0.86	0.84	1.52	1.10	1.39	1.17	0.70	1.38	1.31
2050	0.97	1.01	0.88	0.68	0.51	0.93	1.08	1.05	0.77	0.45	1.32	1.81	1.88	0.96	0.68	1.14	1.44	1.31	2.33	1.66	1.13	1.27	1.34	2.52	2.34
2051	1.69	1.74	1.44	1.16	1.12	1.58	1.65	1.31	1.05	1.09	1.72	1.87	1.44	0.87	0.95	1.77	1.59	0.87	1.44	1.20	2.03	1.59	1.01	1.48	1.40
2052	1.62	1.53	1.71	1.70	1.61	1.46	1.44	1.36	1.43	1.15	1.52	1.73	1.51	1.01	1.16	1.67	1.55	0.84	1.47	1.48	1.79	1.44	1.00	1.48	1.48
2053	1.63	1.71	1.67	1.33	1.04	1.55	1.66	1.35	0.98	1.15	1.98	2.16	1.73	1.02	1.32	1.72	1.79	1.23	1.78	1.74	1.93	1.95	1.71	2.79	2.54
2054	0.73	0.89	1.17	1.42	1.38	0.71	0.98	1.19	1.33	1.23	1.11	1.22	1.24	1.02	1.07	1.01	1.06	0.89	1.42	1.43	1.44	1.23	1.05	1.60	1.60
2055	1.62	1.90	1.90	2.30	2.03	1.94	2.33	2.83	2.60	2.00	2.43	3.58	3.57	2.33	2.05	2.48	2.83	2.27	2.96	2.61	2.38	2.38	2.00	3.30	3.06
2056	0.94	0.96	0.86	0.82	0.66	0.88	0.86	0.80	0.74	0.64	0.86	0.91	0.92	0.95	1.20	0.62	0.78	0.79	1.40	1.27	0.88	0.92	0.85	1.22	1.14
2057	0.54	0.60	0.58	1.08	1.36	0.51	0.51	0.63	1.19	1.33	0.67	0.81	1.04	1.10	1.20	0.66	0.68	0.95	1.62	1.32	0.76	1.12	1.25	1.75	1.13
2058	0.87	0.83	0.94	1.12	1.08	0.71	0.75	0.79	0.72	0.76	0.96	1.02	0.72	0.57	0.71	1.05	0.86	0.43	0.88	1.04	1.00	0.98	0.54	1.02	1.40
2059	0.61	0.66	0.76	0.90	0.89	0.88	0.96	1.02	1.08	0.93	1.59	1.66	1.61	1.02	1.03	0.94	1.03	0.79	1.33	1.58	1.33	1.55	1.27	1.73	1.84
2060	1.77	2.08	2.10	1.98	1.66	1.74	2.01	2.60	2.31	1.66	2.12	2.77	2.44	1.49	1.68	1.26	1.36	1.22	2.12	1.92	1.70	1.85	2.00	2.31	1.90

Table C4. D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.50	1.41	0.94	0.52	0.50	1.26	1.21	0.82	0.53	0.48	1.20	1.17	0.94	0.55	0.63	0.71	0.68	0.56	1.02	1.02	0.73	0.77	0.68	1.62	1.72
2062	1.36	1.21	1.34	1.26	1.13	1.15	1.43	1.49	1.35	1.15	1.72	2.09	1.73	1.00	1.18	1.92	1.69	0.81	1.47	1.58	1.89	1.57	0.99	1.79	1.84
2063	0.65	0.64	0.70	0.75	0.75	0.61	0.68	0.72	0.75	0.79	1.02	1.16	0.91	0.61	0.76	0.65	0.74	0.58	1.62	1.70	0.62	0.66	0.62	1.96	2.38
2064	1.38	1.51	1.57	1.61	1.56	1.54	1.66	1.56	1.55	1.42	1.73	2.01	2.02	1.34	1.48	1.98	2.08	1.43	1.91	1.99	2.29	2.20	1.57	2.08	2.18
2065	1.45	1.50	1.34	1.24	1.06	1.41	1.39	1.26	1.01	0.88	2.10	2.27	1.93	0.82	0.88	2.22	2.12	1.39	1.74	1.25	2.24	1.95	1.50	2.26	1.86
2066	1.25	1.40	1.49	1.57	1.44	1.56	1.82	1.70	1.47	1.35	2.17	2.55	2.05	1.06	1.05	1.86	1.76	1.01	1.44	1.38	1.42	1.39	1.15	1.89	1.80
2067	1.11	1.33	1.36	1.38	1.24	1.75	1.88	1.69	1.47	1.24	2.40	2.30	1.65	0.94	1.05	1.92	1.43	0.62	1.10	1.27	1.49	1.16	0.80	1.42	1.43
2068	0.45	0.49	0.45	0.46	0.54	0.51	0.58	0.51	0.50	0.49	0.92	1.06	0.94	0.61	0.57	0.66	0.70	0.56	1.42	1.33	0.79	0.73	0.62	1.83	2.11
2069	1.33	1.20	1.04	1.09	1.26	1.02	0.98	1.00	1.20	1.37	1.09	1.41	1.42	1.19	1.52	1.22	1.14	0.93	1.77	1.90	1.35	1.51	1.37	2.03	1.81
2070	0.64	0.75	0.71	0.83	0.81	0.64	0.82	0.78	0.84	0.84	1.09	1.22	1.06	0.70	1.00	1.01	1.01	0.73	1.16	1.43	1.39	1.40	1.06	1.42	1.59

Table C5

Hadley Regional Model 3; Geophysical Fluid-Dynamics Laboratory Atmospheric-Land Generalized Model

Table C5.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	2.20	2.36	2.59	2.73	2.46	1.99	2.15	2.25	1.90	1.61	1.94	2.15	2.04	1.52	1.52	1.75	1.90	1.53	1.93	1.84	1.78	1.80	1.57	2.41	2.33
1970	1.74	1.86	2.01	1.91	1.62	1.42	1.45	1.43	1.35	1.12	1.24	1.61	1.51	0.92	1.05	1.22	1.23	0.87	1.39	1.29	1.44	1.40	1.18	1.69	1.75
1971	1.70	1.79	1.55	1.57	1.77	1.75	1.71	1.47	1.68	1.81	1.73	1.65	1.77	1.62	1.70	1.26	1.42	1.26	1.77	1.61	1.52	1.45	1.31	1.95	1.74
1972	2.46	2.07	2.19	2.22	2.27	2.19	1.88	1.77	1.49	1.86	2.30	2.47	2.10	1.49	1.70	1.94	2.09	1.22	1.80	1.66	2.00	2.13	1.49	2.03	1.84
1973	1.97	2.10	2.22	2.36	2.20	1.95	2.32	2.58	2.54	2.47	2.67	3.92	4.54	2.85	2.32	2.64	3.20	3.50	5.14	3.55	2.64	2.81	2.83	4.83	4.01
1974	1.23	1.31	1.43	1.43	1.61	1.36	1.39	1.49	1.36	1.28	1.61	1.55	1.54	1.11	1.17	1.50	1.17	1.03	2.03	1.51	1.73	1.23	1.06	2.34	2.09
1975	2.32	2.33	2.27	2.98	3.16	2.43	2.19	2.04	2.56	2.59	1.56	1.50	1.71	1.92	2.41	1.32	1.35	0.98	2.63	2.79	2.07	2.20	1.66	2.58	2.56
1976	1.84	1.61	1.87	1.95	1.88	1.50	2.24	1.98	2.08	2.61	2.20	2.58	2.38	2.04	2.91	1.63	1.63	1.54	2.46	2.48	1.85	1.62	1.56	2.45	1.97
1977	2.52	2.69	4.10	4.79	3.91	2.09	4.06	5.00	4.64	3.04	2.97	5.16	5.26	3.01	2.76	2.83	3.52	2.75	3.16	2.24	2.54	2.81	2.00	2.31	2.59
1978	4.99	6.09	4.77	2.30	1.55	5.81	4.94	2.34	1.69	1.69	4.56	2.44	2.02	1.59	1.66	2.44	2.31	1.66	2.72	2.55	2.34	2.37	1.75	2.66	2.96
1979	1.53	1.69	1.87	1.99	1.84	1.73	1.88	1.93	2.06	2.03	2.21	2.38	2.09	1.41	1.61	2.33	2.02	1.15	1.59	1.73	2.31	1.97	1.28	1.46	1.49
1980	0.99	1.09	1.38	1.79	1.89	1.05	1.54	1.93	2.14	1.93	1.84	2.35	2.57	1.83	1.75	1.62	1.94	1.70	2.22	1.92	1.64	1.66	1.33	1.82	1.87
1981	1.64	1.59	1.60	1.57	1.41	1.48	1.42	1.38	1.36	1.29	1.42	1.63	1.61	1.21	1.40	1.31	1.28	1.13	1.71	1.80	1.70	1.76	1.49	1.87	1.80
1982	1.83	1.72	1.49	1.30	1.14	1.49	1.29	1.06	1.00	1.02	1.61	1.49	1.46	1.14	1.12	1.45	1.24	0.88	1.66	1.24	1.53	1.18	0.88	1.85	1.61
1983	1.02	1.39	1.36	1.72	1.72	0.83	0.95	1.03	1.21	1.40	1.13	1.56	1.58	0.99	1.36	0.77	1.06	0.92	1.99	1.75	1.14	1.24	1.13	1.97	1.75
1984	1.35	1.69	1.78	2.01	2.26	1.43	1.77	1.69	1.84	1.94	1.67	1.99	1.85	1.44	1.84	2.03	1.94	1.66	3.00	2.77	2.53	2.28	1.87	3.35	3.21
1985	1.51	1.61	2.15	2.34	2.60	2.00	2.31	2.44	2.38	2.16	2.39	2.70	2.29	1.22	1.10	1.24	1.29	0.98	1.60	1.38	1.06	1.07	1.07	1.57	1.51
1986	1.49	1.53	1.75	2.04	2.12	1.63	1.55	1.45	1.62	1.78	2.35	2.45	2.29	1.83	2.09	2.87	2.89	2.30	2.92	2.75	2.31	2.18	1.81	2.28	2.29
1987	2.87	3.13	3.20	2.94	2.13	2.50	2.86	2.93	2.96	2.57	2.36	2.63	2.72	2.25	2.52	1.85	1.75	1.39	2.50	2.40	2.57	2.47	1.75	2.91	3.32
1988	1.51	1.80	1.79	1.67	1.49	1.49	1.70	1.57	1.19	1.24	1.77	1.94	1.47	1.39	1.41	2.02	2.03	1.75	2.36	1.88	1.60	1.51	0.77	1.45	1.09

Table C5.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	1.46	1.35	1.95	2.01	1.58	1.36	1.39	1.58	1.56	1.74	2.05	1.97	1.74	1.82	2.16	1.80	1.37	1.53	2.47	2.04	1.58	1.38	1.45	2.03	1.97
1990	1.34	1.57	1.74	1.93	1.95	1.25	1.58	1.79	1.87	2.24	1.43	1.78	2.02	1.72	2.31	1.45	1.62	1.44	2.41	2.85	1.63	1.49	1.70	2.82	3.21
1991	2.43	2.46	1.82	2.03	2.03	2.45	2.31	1.62	1.67	1.44	2.61	1.90	1.75	1.36	1.53	1.62	1.23	1.02	2.24	2.01	1.20	1.08	1.00	1.46	1.57
1992	1.23	1.42	1.86	2.17	2.09	1.25	2.07	2.34	2.22	1.96	1.84	2.37	2.63	1.89	1.89	1.35	1.65	1.67	2.74	2.39	1.55	1.64	1.66	2.84	2.69
1993	0.93	1.00	1.11	1.99	2.31	1.02	1.22	1.50	1.81	1.93	1.57	1.96	2.15	1.95	2.19	1.88	2.13	1.93	2.34	2.43	2.11	2.00	1.60	1.69	1.53
1994	1.79	1.87	1.87	1.91	1.99	1.82	2.02	2.10	2.20	2.27	1.47	1.82	1.92	1.69	2.05	1.14	1.23	1.04	1.99	1.81	1.32	1.30	1.36	2.15	1.96
1995	2.42	2.93	3.12	2.84	2.32	3.12	3.60	2.86	2.64	3.03	2.27	2.90	3.13	2.78	3.08	2.23	2.86	2.24	3.28	3.16	3.02	3.05	2.32	2.56	2.43
1996	1.20	1.19	2.03	2.43	2.33	1.14	1.48	1.98	2.05	1.98	1.61	2.06	1.91	1.73	1.77	1.46	1.50	1.52	2.38	1.89	1.58	1.95	1.89	2.36	1.70
1997	1.70	1.31	1.16	1.49	1.58	1.25	1.20	1.23	1.71	1.43	1.28	1.40	1.70	1.68	1.42	1.09	1.29	1.29	2.68	2.04	1.40	1.61	1.49	2.51	2.05
1998	1.73	2.17	1.92	1.82	1.44	2.01	1.99	1.84	1.64	1.36	2.00	2.21	2.14	1.43	1.45	1.33	1.34	1.23	1.98	1.43	1.62	1.43	0.94	1.54	1.49
1999	1.32	1.51	1.60	1.48	1.30	1.37	1.67	1.77	1.51	1.05	1.81	2.13	2.09	1.29	0.98	1.47	1.49	1.23	1.87	1.55	2.09	1.97	1.59	2.91	2.40
2000	3.66	3.05	2.49	2.27	2.04	3.04	2.27	1.79	1.89	1.75	1.86	1.79	1.70	1.36	1.46	1.36	1.27	1.25	2.23	1.75	2.27	2.15	1.73	2.28	2.02

Table C5.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.67	2.31	3.36	4.77	4.68	1.88	3.13	4.45	4.41	3.67	2.26	3.67	3.96	2.79	2.25	1.62	2.22	1.82	2.31	1.74	1.72	1.98	1.58	2.01	1.92
2040	1.77	1.62	1.95	2.24	2.32	1.71	1.93	2.59	3.33	3.45	2.16	3.08	3.76	3.65	3.89	2.64	2.66	2.82	5.11	4.26	2.83	2.54	2.52	4.48	4.40
2041	1.08	1.18	1.34	1.75	1.91	1.39	1.79	2.02	2.01	1.59	2.39	2.79	2.54	1.27	1.20	2.29	2.03	1.64	2.72	2.30	2.83	2.33	1.61	1.95	1.66
2042	2.50	2.44	2.61	2.38	1.54	2.81	2.75	2.11	1.37	1.33	3.37	2.75	2.13	1.67	1.70	2.44	2.26	1.79	2.13	1.75	2.86	2.05	1.99	3.31	2.09
2043	1.59	1.70	1.67	1.68	1.51	1.55	1.50	1.38	1.31	1.50	2.13	2.13	1.73	1.09	1.11	2.06	1.87	1.23	1.61	1.88	2.55	2.96	2.87	3.54	3.36
2044	1.52	1.32	1.40	1.56	1.57	1.44	1.26	1.16	1.19	1.23	1.89	1.65	1.54	1.02	1.33	1.92	1.63	1.14	1.71	1.79	1.94	1.46	1.11	2.09	1.65
2045	2.40	2.64	2.57	2.55	2.16	2.10	2.30	2.27	2.29	2.14	2.12	2.36	1.88	1.99	2.73	1.81	1.75	1.56	2.06	2.36	1.41	1.43	1.13	1.84	1.89
2046	2.64	1.91	1.26	1.33	1.40	2.06	1.67	1.57	1.42	1.53	1.09	1.67	1.79	1.53	1.85	1.36	1.46	1.30	1.86	1.99	1.87	1.85	1.58	2.39	2.02
2047	1.89	1.45	0.82	0.83	0.86	2.11	2.00	1.69	1.39	1.05	1.56	1.74	1.85	1.58	1.72	1.55	1.37	0.92	1.44	1.55	1.31	1.12	0.93	1.68	1.61
2048	1.97	2.30	2.43	2.61	3.38	1.69	1.75	2.46	3.00	3.77	1.73	2.53	3.13	2.77	3.63	2.11	2.76	1.88	3.55	4.09	3.12	2.28	1.98	3.22	3.60
2049	1.74	1.91	2.05	2.47	2.47	1.69	2.10	2.07	1.79	1.85	2.39	2.66	2.34	1.99	2.47	2.31	2.18	2.18	4.83	5.73	3.12	3.51	3.18	5.82	6.29
2050	1.86	2.10	2.13	2.18	2.02	1.75	1.94	2.21	2.34	2.07	1.89	1.96	2.64	2.03	1.92	1.60	1.49	1.50	2.56	2.06	1.95	2.00	1.77	2.50	2.35
2051	2.16	2.04	1.78	1.70	1.52	2.10	2.13	2.10	1.88	1.73	2.32	2.54	2.42	1.84	1.92	2.19	2.01	1.41	1.91	1.86	1.83	1.47	1.24	1.73	1.87
2052	1.68	1.58	1.43	1.43	1.31	1.48	1.43	1.27	1.27	1.20	1.31	1.43	1.47	1.34	1.21	1.09	1.24	1.07	1.77	1.14	1.28	1.31	1.00	1.44	1.42
2053	1.17	1.20	1.30	1.37	1.50	1.17	1.42	1.41	1.64	1.61	1.68	1.90	1.98	1.53	1.54	1.81	1.76	1.21	2.83	2.31	2.08	1.86	1.33	2.61	2.86
2054	1.85	1.63	1.33	1.94	1.89	1.33	1.17	1.39	1.90	1.44	1.51	1.62	1.65	1.32	1.06	1.36	1.23	0.91	1.71	1.24	2.15	2.13	1.26	1.83	2.01
2055	1.70	1.73	1.73	1.72	1.67	1.29	1.82	2.11	2.29	1.63	1.84	2.29	2.63	2.14	1.61	1.33	1.51	1.59	2.89	1.74	1.45	1.52	1.76	2.70	1.91
2056	2.49	3.13	3.49	3.55	3.12	2.74	2.59	2.19	2.09	2.65	2.12	2.20	1.76	1.09	1.90	1.43	1.44	0.99	1.81	1.95	1.59	1.61	1.15	1.60	1.80
2057	1.40	1.94	2.53	2.38	1.91	1.36	1.47	1.99	2.03	1.86	1.42	1.35	1.50	1.62	1.99	1.10	1.21	1.13	2.10	2.28	1.01	1.21	1.49	1.93	1.41
2058	2.29	2.30	2.26	2.31	1.97	2.25	2.20	2.12	2.02	1.48	2.74	2.96	2.85	2.09	1.99	2.83	2.99	2.58	3.62	3.09	2.18	2.41	2.27	3.27	2.95
2059	2.26	1.98	1.95	2.11	2.09	1.32	1.31	1.34	1.54	1.69	1.31	1.32	1.60	1.68	2.28	1.36	1.43	1.62	2.52	3.00	1.99	2.32	2.60	3.26	3.46
2060	0.91	0.95	1.37	1.65	1.69	1.34	1.45	1.68	1.86	2.06	1.53	1.94	2.34	1.98	2.40	2.20	2.65	2.42	2.93	3.08	3.33	3.75	3.27	3.85	4.06

Table C5.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	2.09	2.09	2.05	2.12	2.17	2.01	2.30	2.50	2.60	2.65	2.65	3.13	3.31	2.53	2.74	2.96	3.21	2.80	3.49	3.35	3.20	2.99	2.72	3.75	3.41
2062	1.56	1.80	1.63	1.29	1.16	1.40	1.58	1.55	1.58	1.45	1.41	1.84	2.05	1.83	2.04	1.38	1.55	1.23	1.66	1.58	1.54	1.52	1.24	1.60	1.37
2063	2.21	2.29	2.37	2.30	2.12	2.27	2.37	2.39	2.30	2.02	2.28	2.48	2.61	1.93	1.95	2.46	2.47	2.11	2.52	2.12	2.60	2.24	1.67	1.85	1.66
2064	3.24	3.59	3.89	3.01	1.91	3.37	3.53	2.27	2.08	1.63	3.45	2.65	2.40	1.42	1.82	2.11	2.12	1.75	2.61	2.50	2.19	2.12	2.10	3.14	2.62
2065	3.98	4.49	4.27	3.75	3.20	4.27	3.43	2.75	2.70	2.09	2.47	2.28	3.05	2.23	1.87	1.07	1.34	1.57	3.16	2.21	1.29	1.37	1.14	1.88	1.77
2066	1.66	1.79	1.95	2.10	1.97	1.47	1.82	2.25	2.45	2.21	1.72	2.14	2.72	2.09	2.34	2.12	2.01	2.00	2.92	2.76	2.54	2.28	1.84	1.98	1.91
2067	1.36	1.61	1.75	1.90	1.90	1.49	1.59	1.66	1.64	1.50	1.67	1.97	1.87	1.35	1.48	1.68	1.73	1.33	1.72	1.58	1.72	1.77	1.71	2.18	2.58
2068	3.15	3.19	3.21	3.27	3.21	2.40	2.12	2.02	1.81	1.36	1.94	1.90	1.82	1.11	1.18	1.83	1.64	1.07	1.44	1.14	1.31	1.35	0.93	1.41	1.40
2069	1.51	1.69	1.80	2.02	1.87	1.56	1.57	1.57	1.51	1.56	1.54	1.54	1.46	1.29	1.69	1.97	1.81	1.34	2.13	2.21	1.82	1.67	1.53	2.17	2.46
2070	1.32	1.51	1.89	2.38	2.15	1.37	1.84	2.17	1.96	1.58	2.19	2.30	2.01	1.76	2.76	1.75	1.55	1.78	2.91	3.40	2.10	2.65	2.60	3.08	2.44

Table C5.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	0.94	0.99	1.14	1.16	1.03	1.03	1.38	1.48	1.28	1.06	1.67	2.15	2.04	1.26	1.13	1.75	1.90	1.53	1.93	1.84	1.78	1.80	1.57	2.41	2.33
1970	0.86	0.87	0.90	0.98	0.97	0.84	0.95	0.95	0.92	0.96	1.16	1.22	1.16	0.79	0.95	1.14	1.14	0.87	1.23	1.29	1.31	1.25	1.09	1.69	1.75
1971	0.70	0.80	0.85	0.93	1.00	0.75	0.95	0.88	0.84	0.87	1.10	1.30	1.00	0.69	0.86	1.16	1.15	0.55	0.96	1.05	1.39	1.26	0.77	1.19	1.28
1972	1.57	1.85	1.81	1.51	1.06	1.57	1.88	1.77	1.26	0.89	2.01	2.47	1.93	0.97	0.85	1.94	2.09	1.22	1.55	1.43	2.00	2.13	1.49	2.03	1.81
1973	1.75	2.10	2.22	2.36	2.20	1.95	2.32	2.58	2.54	2.47	2.67	3.92	4.54	2.85	2.32	2.64	3.20	3.50	5.14	3.55	2.64	2.81	2.83	4.83	4.01
1974	0.96	1.12	1.23	1.28	1.18	1.23	1.39	1.37	1.23	1.04	1.61	1.39	1.33	0.78	0.92	1.50	1.08	1.03	2.03	1.46	1.73	1.09	1.06	2.34	2.09
1975	1.09	1.16	1.07	1.10	1.28	1.01	1.07	0.94	1.09	1.20	1.24	1.43	1.13	0.89	1.16	1.32	1.29	0.74	1.30	1.67	1.42	1.32	1.11	1.62	1.82
1976	0.51	0.55	0.63	0.76	0.95	0.59	0.73	0.79	0.79	1.13	0.87	1.05	0.95	0.66	1.27	0.60	0.66	0.43	1.03	1.26	0.71	0.73	0.59	0.98	1.43
1977	0.51	0.48	0.47	0.43	0.40	0.47	0.53	0.49	0.36	0.35	0.73	0.91	0.72	0.38	0.33	0.74	0.82	0.60	0.93	0.76	0.95	1.00	0.69	1.18	1.15
1978	0.93	1.04	1.04	0.82	0.66	1.11	1.29	1.08	0.63	0.63	1.68	1.84	1.22	0.57	0.69	1.49	1.22	0.43	0.95	1.03	1.41	0.93	0.61	1.05	1.14
1979	0.70	0.84	0.91	1.12	1.15	0.93	1.08	0.97	1.05	1.02	1.41	1.55	1.23	0.80	0.80	1.45	1.32	0.70	1.16	1.07	1.48	1.25	0.70	1.14	1.13
1980	0.80	0.88	0.95	1.05	0.91	0.85	0.90	0.88	0.76	0.67	0.83	0.83	0.67	0.45	0.51	0.69	0.63	0.38	0.56	0.60	0.70	0.54	0.34	0.69	0.72
1981	0.95	1.28	1.37	1.42	1.28	1.10	1.32	1.32	1.36	1.29	1.14	1.40	1.38	1.21	1.40	1.17	1.28	1.13	1.71	1.80	1.70	1.76	1.49	1.87	1.80
1982	0.40	0.40	0.50	0.66	0.76	0.39	0.45	0.49	0.61	0.69	0.51	0.66	0.62	0.46	0.78	0.43	0.50	0.48	0.82	1.16	0.72	0.70	0.45	1.00	1.16
1983	1.02	0.96	0.91	0.88	0.84	0.72	0.74	0.74	0.79	0.90	0.68	0.83	0.84	0.66	0.92	0.57	0.59	0.37	1.08	1.21	0.90	0.87	0.63	1.02	1.09
1984	1.08	1.21	1.06	1.13	1.02	1.27	1.39	1.12	1.11	1.18	1.67	1.99	1.59	1.24	1.31	2.03	1.94	1.10	1.76	1.66	2.53	2.28	1.50	2.14	1.78
1985	0.49	0.47	0.45	0.40	0.36	0.39	0.41	0.41	0.43	0.37	0.71	0.79	0.70	0.42	0.42	0.65	0.67	0.50	0.68	0.83	0.92	0.74	0.51	0.95	1.51
1986	1.22	1.41	1.42	1.28	1.10	1.35	1.54	1.45	1.18	0.87	1.76	1.87	1.61	0.75	0.69	1.91	1.56	0.90	1.41	1.01	1.84	1.49	0.96	1.41	1.33
1987	0.83	1.09	1.38	1.67	1.61	1.13	1.51	1.68	1.59	1.32	1.57	1.85	1.66	1.17	1.37	1.85	1.75	1.29	1.91	1.69	2.57	2.47	1.75	2.11	2.14
1988	0.75	0.88	1.02	1.23	1.25	0.79	0.95	1.07	1.12	1.04	0.92	1.16	1.26	0.74	0.82	0.65	0.70	0.57	0.86	1.13	0.71	0.64	0.52	0.78	1.06
1989	1.04	0.92	0.80	0.74	0.60	1.36	1.31	1.01	0.64	0.70	2.05	1.97	1.31	0.94	1.11	1.80	1.37	1.01	1.53	1.74	1.58	1.37	1.27	1.91	1.97
1990	0.70	0.82	0.91	1.05	1.01	0.84	1.00	1.05	1.10	1.07	1.43	1.25	1.33	0.98	1.26	1.12	1.07	0.73	1.32	1.73	1.48	1.49	0.83	1.23	1.57

Table C5.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1991	0.66	0.74	0.96	1.20	1.31	1.04	1.15	1.26	1.26	1.09	1.59	1.80	1.75	0.95	0.68	1.20	1.16	0.89	1.42	0.79	1.02	0.84	0.67	1.10	0.91
1992	0.56	0.64	0.74	0.87	0.89	0.55	0.72	0.81	0.84	0.83	0.64	0.85	0.88	0.61	0.83	0.99	1.06	0.58	0.84	1.26	1.39	1.64	0.80	1.15	1.44
1993	0.56	0.58	0.59	0.62	0.56	0.56	0.63	0.58	0.46	0.40	0.95	1.07	0.88	0.42	0.36	0.77	0.80	0.54	0.92	0.67	0.66	0.69	0.59	1.20	1.11
1994	0.72	0.84	0.89	0.88	1.11	0.78	0.84	0.87	1.03	1.14	0.93	1.12	1.11	1.03	1.29	0.81	1.03	0.88	1.69	1.70	1.32	1.30	1.36	2.15	1.96
1995	1.70	1.91	1.82	1.58	1.34	2.09	2.45	2.30	1.57	1.72	2.27	2.90	3.13	1.48	2.16	2.23	2.86	1.92	2.76	2.73	2.36	2.40	1.70	2.23	2.00
1996	0.75	0.89	1.00	1.10	1.05	0.94	1.08	1.05	1.03	0.97	0.95	1.05	1.14	0.88	0.93	0.83	0.82	0.70	1.39	1.21	0.93	0.81	0.66	1.24	1.18
1997	1.70	1.31	1.16	1.29	1.23	1.25	1.20	1.11	1.24	1.34	1.14	1.36	1.19	0.96	1.29	1.09	1.29	0.67	1.27	1.40	1.36	1.54	1.05	1.27	1.99
1998	0.79	0.65	0.64	0.97	1.21	0.83	0.78	0.87	1.11	1.22	1.28	1.39	1.12	0.97	1.09	1.07	1.01	0.79	1.18	1.08	1.36	1.43	0.94	1.38	1.35
1999	1.32	1.51	1.60	1.48	1.30	1.37	1.67	1.77	1.51	1.01	1.81	2.13	2.09	1.29	0.98	1.47	1.49	1.23	1.87	1.55	1.19	1.32	1.15	1.81	1.80
2000	1.64	1.38	1.20	1.08	0.90	1.05	0.98	0.83	0.64	0.54	1.24	1.35	1.04	0.44	0.53	1.19	1.09	0.73	1.03	0.79	1.40	1.13	0.66	1.04	1.08

Table C5.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	0.91	0.98	1.05	1.18	1.14	0.93	1.04	1.02	1.09	1.13	0.96	1.13	1.09	0.87	1.10	0.99	0.97	0.73	1.20	1.24	1.06	0.96	0.77	1.15	1.11
2040	0.95	1.14	1.47	1.84	1.74	0.94	1.14	1.41	1.72	1.62	0.99	1.31	1.38	1.34	1.48	0.83	1.04	0.88	1.79	1.74	1.11	1.23	1.34	1.62	1.76
2041	1.08	1.18	1.24	1.33	1.27	1.11	1.28	1.31	1.33	1.25	1.24	1.52	1.50	1.03	1.20	1.34	1.41	1.03	1.36	1.61	1.70	1.63	1.23	1.56	1.66
2042	0.32	0.45	0.61	0.86	1.05	0.36	0.52	0.62	0.88	1.08	0.95	1.03	0.74	0.71	1.20	0.80	0.73	0.47	1.04	1.52	0.93	1.14	0.88	1.33	1.54
2043	0.91	0.96	0.93	0.81	0.82	0.87	1.08	1.07	0.83	0.76	1.35	1.74	1.73	0.82	0.76	1.14	1.40	1.09	1.51	1.11	1.02	1.01	0.82	1.52	1.43
2044	1.11	1.26	1.13	1.21	1.09	1.06	1.18	1.00	1.04	1.17	1.37	1.31	0.87	0.75	1.33	1.00	0.87	0.98	1.33	1.79	0.84	0.83	1.11	1.65	1.64
2045	0.70	0.64	0.85	0.97	0.99	0.87	0.88	1.02	1.18	0.99	0.82	1.08	1.21	1.06	1.15	0.99	1.02	0.82	1.43	1.43	1.41	1.43	1.13	1.33	1.44
2046	0.59	0.65	0.65	0.71	0.71	0.68	0.81	0.71	0.67	0.59	1.08	1.16	0.85	0.50	0.67	0.95	0.84	0.60	1.01	1.11	1.20	1.04	0.61	1.05	1.20
2047	0.66	0.60	0.65	0.75	0.75	0.55	0.61	0.56	0.56	0.49	1.30	1.47	1.23	0.57	0.48	1.35	1.32	0.92	1.44	1.05	1.04	1.04	0.93	1.68	1.45
2048	0.49	0.53	0.54	0.70	0.80	0.49	0.57	0.58	0.62	0.72	0.70	0.85	0.84	0.56	0.69	0.59	0.66	0.51	1.23	0.83	0.60	0.58	0.58	1.16	0.97
2049	0.75	0.77	0.97	1.04	0.97	1.03	1.13	1.18	1.03	0.70	1.67	2.00	1.70	0.77	0.65	1.43	1.43	0.97	1.25	0.83	1.33	0.97	0.89	1.26	1.03
2050	0.98	1.01	1.05	1.11	1.31	1.10	1.17	1.15	1.18	1.28	1.37	1.45	1.23	0.92	1.20	1.60	1.41	0.87	1.49	1.75	1.83	1.54	1.31	2.09	2.35
2051	0.95	1.06	1.15	1.24	1.12	1.06	1.21	1.24	1.20	1.07	1.13	1.36	1.29	0.87	1.02	1.28	1.17	0.77	1.11	1.27	1.34	1.28	0.91	1.59	1.60
2052	1.68	1.58	1.43	1.43	1.31	1.48	1.43	1.27	1.27	0.96	1.31	1.43	1.37	0.97	0.78	1.09	1.13	0.90	1.40	1.14	1.28	1.31	1.00	1.17	1.42
2053	1.17	1.20	1.30	1.37	1.20	1.17	1.42	1.41	1.32	1.17	1.68	1.90	1.67	1.02	1.06	1.81	1.76	1.07	1.22	1.28	2.08	1.86	1.20	1.41	1.30
2054	0.60	0.62	0.55	0.51	0.49	0.86	0.93	0.76	0.53	0.50	1.51	1.62	1.22	0.48	0.52	1.36	1.23	0.72	1.18	1.00	0.94	0.87	0.65	1.40	1.34
2055	0.51	0.66	0.80	0.95	0.91	0.58	0.81	0.87	0.97	0.90	0.86	1.09	1.09	0.72	0.77	0.74	0.91	0.68	1.19	1.00	1.01	1.07	0.91	1.23	1.18
2056	1.06	1.04	1.20	1.41	1.38	1.06	1.28	1.28	1.29	1.32	1.46	1.69	1.46	1.00	1.18	1.43	1.44	0.83	1.18	1.44	1.59	1.55	1.08	1.34	1.46
2057	0.89	0.72	0.77	0.73	0.85	0.80	0.82	0.87	0.70	0.83	1.06	1.21	1.13	0.59	0.84	1.05	1.21	1.01	1.34	1.04	1.01	1.07	1.11	1.62	1.41
2058	0.46	0.53	0.56	0.64	0.72	0.56	0.64	0.62	0.74	0.89	0.76	0.85	0.79	0.78	1.09	1.21	1.08	0.78	1.26	1.38	1.71	1.45	1.11	1.53	1.43
2059	0.93	0.90	0.79	0.93	0.98	0.99	0.85	0.82	0.71	0.62	1.25	1.27	1.11	0.50	0.43	1.14	1.08	0.83	0.96	0.71	0.94	0.77	0.67	1.02	0.77
2060	0.53	0.53	0.58	0.76	0.81	0.55	0.69	0.79	0.93	0.89	0.76	0.95	1.15	0.91	0.94	0.90	0.86	0.71	1.11	1.02	1.25	1.19	0.83	1.16	1.21

Table C5.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.04	0.86	0.75	0.74	0.74	0.82	0.81	0.76	0.60	0.59	1.15	1.31	1.18	0.63	0.58	1.16	1.19	0.96	1.37	0.98	1.35	1.28	1.05	1.64	1.24
2062	0.96	0.90	0.85	1.04	1.08	0.89	0.92	0.97	1.12	1.00	0.95	1.24	1.32	0.86	0.93	1.10	1.16	0.95	1.31	1.06	1.51	1.52	1.12	1.25	1.01
2063	0.63	0.77	0.91	1.13	1.18	0.72	0.95	1.14	1.26	1.19	0.80	1.03	1.15	0.97	1.06	0.80	0.70	0.64	1.24	1.32	0.95	0.78	0.67	1.36	1.30
2064	1.13	1.03	0.92	0.88	0.85	0.97	0.89	0.80	0.89	0.88	1.55	1.58	1.38	0.80	0.90	1.62	1.54	1.06	1.45	1.21	1.68	1.47	1.24	2.18	1.92
2065	0.77	0.94	1.09	1.31	1.37	0.47	0.63	0.72	0.80	0.77	0.66	0.80	0.69	0.33	0.36	0.62	0.68	0.53	0.86	0.78	0.53	0.52	0.52	0.88	0.94
2066	1.14	1.12	1.26	1.38	1.75	1.11	1.82	2.25	2.45	2.21	1.70	2.14	2.72	2.09	1.83	1.36	1.41	1.23	2.27	1.77	1.08	0.93	0.87	1.36	1.40
2067	1.08	1.23	1.33	1.45	1.38	1.11	1.22	1.20	1.26	1.26	1.23	1.41	1.38	0.87	1.03	1.43	1.23	0.93	1.58	1.26	1.66	1.76	1.14	1.85	1.60
2068	0.60	0.60	0.60	0.67	0.60	0.56	0.75	0.76	0.71	0.67	1.07	1.31	1.08	0.62	0.79	1.07	1.11	0.59	1.03	1.14	1.31	1.35	0.93	1.21	1.12
2069	1.00	1.22	1.39	1.58	1.56	1.08	1.24	1.36	1.51	1.50	1.28	1.54	1.46	1.00	1.31	1.37	1.38	0.96	1.65	1.78	1.69	1.49	1.07	2.09	2.30
2070	0.74	0.75	0.79	0.80	0.71	0.83	0.96	0.95	0.86	0.75	1.76	1.40	1.11	0.83	0.98	1.75	1.24	0.85	1.38	1.15	1.46	1.27	1.24	1.33	1.29

Table C6

Mesoscale Model 5; Community Climate System Model

Table C6.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	1.66	4.27	3.61	2.25	1.35	2.09	1.50	1.69	1.64	2.21	1.54	1.39	2.08	2.61	2.37	2.39	2.70	1.72	2.87	4.02	3.79	4.23	4.27	4.69	3.75
1970	2.09	2.07	2.61	2.71	1.03	3.77	3.71	4.15	3.29	2.52	1.92	2.03	3.39	2.86	2.18	1.48	1.96	2.70	2.75	2.07	1.45	1.89	2.70	2.34	2.49
1971	2.41	1.99	2.20	2.20	1.93	1.43	1.16	1.37	1.32	1.28	1.67	1.47	1.30	1.38	1.40	1.44	1.47	1.38	1.49	1.67	1.70	1.78	1.65	1.88	2.45
1972	2.24	1.59	1.44	1.72	1.75	2.44	2.74	3.57	4.33	3.90	2.42	2.80	3.52	3.41	2.27	2.51	2.69	3.42	2.44	1.68	2.11	1.81	2.22	1.72	1.58
1973	1.94	1.84	3.06	3.45	1.96	1.70	1.64	2.19	1.54	1.41	1.73	1.36	1.81	1.70	2.13	2.47	2.24	1.34	2.17	3.55	1.52	1.51	1.95	2.86	3.78
1974	1.90	1.19	1.25	1.16	1.60	1.74	1.61	1.55	1.23	1.30	0.83	1.05	1.44	1.50	1.99	0.80	0.92	1.32	1.80	3.03	0.98	0.97	1.12	1.88	1.81
1975	3.14	2.65	2.20	2.50	1.94	1.48	2.90	3.78	3.80	3.78	2.41	3.26	2.90	2.49	2.71	2.45	2.30	2.26	2.09	1.72	3.47	2.93	2.27	1.97	2.19
1976	2.77	1.91	2.09	2.37	1.49	1.98	2.23	1.77	2.43	2.68	1.86	1.83	2.52	2.72	2.23	1.45	1.27	1.62	1.48	1.50	1.34	1.32	1.30	1.45	1.59
1977	1.56	4.24	3.83	3.15	1.49	1.18	1.34	1.35	1.63	2.16	1.11	1.11	1.97	2.08	2.86	1.42	2.28	1.30	1.46	2.01	4.04	4.35	2.65	3.26	3.59
1978	1.28	1.86	1.92	1.73	2.48	1.56	1.67	1.87	1.21	1.63	1.63	1.88	1.71	2.11	1.98	1.85	1.84	2.28	1.97	2.36	2.01	1.86	1.75	2.05	2.15
1979	1.29	1.75	2.72	1.93	1.85	1.29	1.35	1.14	1.60	1.83	1.45	1.43	1.41	1.45	1.79	1.65	1.53	1.51	1.72	2.15	1.99	1.66	1.60	1.82	2.63
1980	1.33	1.45	1.37	1.41	1.36	1.56	1.75	1.73	1.81	1.94	1.36	1.39	1.94	2.03	1.92	1.51	1.24	1.26	1.39	1.19	1.75	1.47	1.29	1.41	1.44
1981	1.47	1.45	1.57	1.40	1.87	1.70	1.90	2.37	3.82	2.64	1.74	2.02	3.76	3.36	1.76	1.81	2.24	2.43	2.02	2.06	1.78	1.64	2.37	2.04	1.89
1982	1.37	1.99	2.13	2.30	1.83	1.19	1.64	1.24	1.38	1.45	1.71	2.12	1.79	1.66	1.63	2.53	1.93	1.84	1.87	1.83	2.10	1.94	1.90	1.78	1.72
1983	1.48	1.65	2.04	2.20	1.97	1.66	1.88	1.69	1.85	1.99	2.09	2.16	2.14	2.29	2.39	2.40	2.22	2.29	2.41	2.29	2.22	1.78	2.14	1.96	1.96
1984	2.02	2.43	2.25	1.87	1.45	2.24	2.41	1.84	2.03	2.33	2.23	2.72	2.29	2.51	1.94	2.63	3.50	3.08	2.39	1.43	3.44	2.73	2.71	1.88	1.88
1985	1.26	3.09	2.13	2.58	1.05	1.21	2.29	4.31	3.72	2.18	1.40	2.27	3.52	3.04	1.99	1.79	2.26	2.84	2.36	1.97	2.46	3.38	2.91	2.72	1.94
1986	1.81	2.34	2.23	1.97	2.88	1.18	1.41	4.34	4.49	3.71	1.06	0.98	2.04	3.54	4.92	1.92	1.60	1.24	1.79	2.92	2.34	2.35	1.44	1.77	1.82
1987	2.49	2.67	2.23	1.57	1.62	2.30	2.31	3.42	2.56	1.23	1.61	1.60	1.83	1.26	1.34	1.35	1.55	1.39	1.41	1.42	2.75	2.87	2.02	2.25	2.11
1988	2.55	1.96	2.49	1.82	1.33	1.36	1.70	3.31	3.90	3.62	1.52	2.86	2.63	3.85	4.41	2.37	2.52	2.94	2.73	2.52	2.10	1.73	3.38	3.51	3.23

Table C6.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	3.42	1.54	1.52	1.86	1.71	1.67	1.95	2.74	2.47	3.02	1.73	2.23	2.50	3.10	3.16	1.91	2.12	2.54	2.27	1.40	1.59	1.54	2.12	1.64	1.17
1990	1.83	1.66	2.07	2.04	1.64	1.90	1.94	1.40	1.36	2.00	1.12	1.42	1.99	1.95	2.13	1.28	1.63	1.75	1.91	1.79	1.61	1.60	1.74	1.42	1.52
1991	1.27	1.90	2.13	2.58	2.44	0.77	0.85	0.78	0.73	0.85	1.33	1.46	1.38	1.52	1.51	1.21	1.04	1.44	1.48	2.23	3.43	2.49	1.11	1.69	2.42
1992	1.19	1.42	1.68	2.20	2.02	1.58	3.55	1.81	2.30	2.76	3.14	3.90	5.28	5.82	5.82	2.83	2.51	4.25	4.19	3.68	1.69	1.32	2.26	2.00	2.34
1993	1.52	2.49	2.13	2.22	2.04	1.42	1.67	2.85	2.31	1.60	1.58	1.26	1.53	1.38	1.69	1.53	2.40	1.40	2.09	2.62	3.03	2.90	2.82	2.70	2.80
1994	2.44	1.49	1.80	1.83	2.14	1.94	1.97	1.56	1.51	1.39	1.53	1.58	1.85	1.31	1.49	1.50	1.46	1.61	1.42	1.65	1.47	1.43	1.40	1.41	1.61
1995	1.83	2.28	2.26	1.96	2.35	1.29	1.63	1.90	2.01	2.09	1.32	1.66	1.96	2.01	1.84	1.47	1.73	1.94	2.11	2.03	1.64	2.17	2.08	2.30	2.23
1996	1.53	0.77	1.16	1.36	2.16	1.63	1.82	1.99	3.00	3.48	1.58	1.42	2.36	2.08	2.02	1.21	0.94	1.55	1.75	1.23	0.83	0.75	1.21	1.04	1.05
1997	1.59	1.09	1.15	1.85	3.87	1.38	1.87	1.24	1.21	1.29	1.24	1.25	2.27	1.25	1.21	1.19	1.06	1.05	1.41	1.35	0.94	1.05	1.11	1.30	2.11
1998	1.04	1.67	2.01	2.43	2.08	2.41	1.60	1.25	1.66	2.02	2.82	2.84	1.96	2.18	1.94	2.18	3.20	1.32	1.08	1.15	1.65	2.08	2.38	1.38	1.80
1999	4.29	2.17	1.87	2.06	2.28	3.00	2.22	2.22	3.20	4.24	1.65	1.85	3.16	4.40	4.48	2.38	2.78	2.99	3.66	2.69	3.44	2.46	2.38	2.56	2.28

Table C6.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	2.06	3.27	3.89	3.78	3.90	2.25	2.49	1.94	2.26	3.04	1.60	1.36	1.84	1.96	2.56	1.27	1.40	2.17	2.18	2.06	1.24	1.75	2.29	2.11	1.95
2040	1.97	3.13	3.34	2.11	1.44	2.28	2.07	2.15	1.58	1.84	1.52	1.35	1.51	2.44	2.54	2.93	1.86	1.81	1.86	2.48	3.17	1.97	1.83	1.89	1.71
2041	2.74	3.09	3.33	3.84	4.00	1.95	1.75	1.65	2.23	2.35	1.52	1.49	1.70	1.83	1.63	1.38	1.76	1.84	1.50	1.67	1.45	1.54	1.55	1.62	1.61
2042	1.65	1.97	2.29	3.20	4.05	1.76	1.68	1.71	1.91	1.83	2.04	2.13	2.32	2.43	2.44	4.40	4.65	4.65	4.26	3.89	2.96	3.23	3.25	2.88	2.51
2043	2.16	2.03	1.97	1.84	2.03	1.52	1.37	1.80	2.33	2.39	1.24	1.66	2.02	2.33	2.27	1.54	1.81	1.83	1.74	2.14	1.69	1.80	2.15	1.85	2.01
2044	5.66	5.15	3.35	1.61	1.75	2.25	2.30	2.19	2.92	3.08	1.67	1.63	1.80	1.86	1.98	1.47	1.48	1.45	1.68	2.42	1.67	1.53	1.44	2.13	3.95
2045	2.30	2.71	2.29	1.82	2.45	1.79	2.04	2.30	1.97	1.79	2.44	2.18	1.77	2.21	1.81	2.51	1.76	1.94	2.54	2.79	4.03	3.57	1.81	1.97	2.19
2046	2.36	2.40	2.23	2.02	1.85	1.94	2.30	2.29	2.02	1.83	1.87	1.89	1.82	1.92	1.93	1.90	1.65	1.41	1.27	1.45	1.83	1.47	1.39	1.70	1.67
2047	3.32	2.96	1.78	1.47	3.37	2.13	1.96	2.18	4.92	5.63	1.62	3.33	5.98	5.76	3.11	3.04	4.18	3.28	2.02	1.66	2.26	1.82	1.95	1.59	1.54
2048	1.89	1.80	2.57	3.18	2.63	1.40	1.82	2.33	2.27	2.25	1.92	2.69	3.38	3.17	2.33	2.49	1.79	2.12	2.06	1.84	3.56	2.52	1.52	1.22	1.27
2049	1.81	1.63	1.99	1.97	1.68	1.85	2.19	3.05	2.60	2.00	3.64	2.83	2.24	3.21	3.51	4.32	4.03	3.15	2.46	2.40	1.79	2.33	2.10	2.22	2.05
2050	2.04	1.43	1.39	1.33	1.49	1.79	1.48	1.64	1.88	2.09	1.41	1.35	1.56	1.79	1.85	1.54	1.52	1.88	2.32	2.71	2.45	1.42	1.43	2.31	3.02
2051	4.36	5.64	5.51	4.56	4.12	4.05	5.00	4.74	3.58	2.73	2.81	2.55	2.59	2.52	1.78	3.48	2.71	2.12	2.37	2.96	2.46	3.19	4.04	4.03	3.28
2052	1.16	1.07	1.12	1.60	1.75	1.15	1.23	2.11	2.23	1.53	1.46	2.29	2.41	1.69	1.59	2.51	2.32	1.52	1.28	1.56	2.45	1.68	1.47	1.39	1.85
2053	1.57	1.28	1.24	1.28	2.28	1.84	1.86	1.17	1.22	1.35	3.01	3.07	2.16	1.50	1.41	1.73	3.54	4.31	3.66	2.52	2.73	3.19	3.00	3.65	4.01
2054	1.40	1.37	1.27	1.08	1.13	1.56	1.55	1.84	2.49	2.55	1.64	1.81	1.91	2.10	2.04	1.66	1.73	1.77	1.83	1.67	3.94	3.47	3.11	3.52	3.67
2055	1.66	1.51	2.01	2.15	2.43	1.69	1.90	1.97	2.20	3.21	2.68	2.87	3.39	4.42	5.12	2.71	3.08	3.12	3.28	3.09	2.35	2.08	2.36	2.66	2.60
2056	1.68	1.56	1.41	1.41	1.49	2.07	1.87	2.33	2.69	3.04	3.67	3.10	2.96	3.16	3.15	3.86	3.38	3.08	2.94	2.82	1.49	1.64	2.30	2.75	2.17
2057	2.39	2.31	2.35	2.34	2.31	2.36	2.27	2.08	1.94	1.75	1.57	1.37	1.36	1.62	1.74	2.44	1.62	1.70	1.97	2.01	2.83	2.68	2.12	1.51	1.78
2058	1.42	1.70	1.45	1.43	1.30	1.65	1.59	1.77	1.80	1.81	1.66	1.79	1.86	1.83	1.68	1.54	1.41	1.50	1.46	2.65	1.25	1.20	1.54	2.61	3.97
2059	0.94	0.97	1.27	1.46	1.72	0.76	1.03	1.29	1.26	1.67	1.06	1.26	1.05	0.75	0.80	1.18	1.02	0.89	0.85	0.93	1.24	1.47	1.47	1.87	2.21
2060	2.64	3.43	3.45	2.85	2.18	1.70	2.36	3.46	3.93	3.56	3.20	3.10	2.85	2.69	2.36	2.74	2.29	2.32	2.60	3.45	1.59	1.68	1.86	2.27	2.69

Table C6.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.27	1.26	1.46	1.85	2.00	1.07	1.33	1.56	2.10	2.82	0.95	1.48	1.84	2.46	2.62	1.14	1.21	1.84	2.49	2.40	2.49	1.84	1.92	2.46	2.70
2062	2.37	2.09	2.01	1.96	1.47	2.17	2.11	1.99	1.69	1.65	2.00	2.01	1.69	1.67	1.41	1.87	1.65	1.56	1.50	1.95	1.73	1.62	1.64	1.88	2.20
2063	4.80	4.16	2.73	2.64	3.09	3.10	2.52	2.83	3.12	2.93	2.70	2.92	3.11	2.82	2.65	3.18	3.36	2.66	2.79	2.47	3.28	2.71	3.11	2.55	1.76
2064	3.06	2.89	3.38	2.03	2.94	2.42	2.67	3.06	3.44	3.96	2.29	2.72	3.10	4.29	5.38	2.13	2.68	3.32	3.09	3.35	2.00	3.29	3.50	2.05	1.64
2065	3.28	2.66	2.93	2.93	2.43	3.06	2.27	1.78	1.86	2.62	2.62	2.04	1.70	2.65	3.80	2.12	1.72	2.57	2.54	2.34	1.92	2.51	2.65	2.45	2.18
2066	1.49	1.67	2.09	2.66	2.64	1.51	1.42	1.43	1.89	2.24	1.39	1.44	1.52	1.84	2.06	1.45	1.18	1.64	1.69	1.83	1.49	1.45	1.71	1.78	1.52
2067	3.74	4.22	4.03	3.96	4.43	2.18	2.46	2.69	2.75	2.37	2.42	2.77	1.91	1.74	3.02	2.10	2.83	2.30	1.75	2.67	1.46	2.52	2.43	1.63	2.54
2068	1.58	1.55	1.68	2.04	2.50	1.67	1.38	1.67	1.68	1.95	1.50	1.43	1.44	1.67	2.18	1.19	1.47	1.60	1.47	1.62	1.40	1.52	1.45	1.87	2.35
2069	1.17	1.34	1.13	1.43	1.99	1.19	1.66	2.35	2.83	3.18	1.81	3.22	3.59	3.49	3.08	2.14	2.51	2.59	2.45	2.40	1.61	1.39	1.58	2.67	3.27
2070	1.83	1.98	1.96	1.76	1.92	1.90	1.89	1.80	2.02	1.91	3.19	2.78	2.28	3.30	3.85	1.87	1.68	2.44	3.31	3.52	1.74	1.51	1.93	2.57	3.40

Table C6.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	0.73	0.70	0.59	0.42	0.79	0.80	1.07	1.14	1.23	0.91	0.72	0.85	1.40	1.50	1.07	0.74	0.70	1.05	1.22	0.84	0.89	0.85	0.86	0.81	0.58
1970	1.26	0.83	0.89	0.85	0.79	1.19	1.23	1.31	0.99	0.61	1.20	1.08	1.17	0.87	0.50	1.10	0.93	1.01	0.84	0.55	0.93	0.73	0.95	0.88	0.67
1971	0.87	1.99	2.20	2.11	0.86	0.98	1.13	1.32	1.32	1.20	1.13	1.25	1.30	1.38	1.40	1.44	1.47	1.38	1.49	1.67	1.70	1.78	1.65	1.88	2.18
1972	2.09	1.16	1.17	1.14	0.84	2.24	1.80	1.13	0.80	0.83	2.09	1.62	0.91	0.91	0.92	1.87	1.40	1.04	1.07	1.10	1.68	1.24	1.20	1.21	1.25
1973	1.11	1.31	1.25	1.20	0.31	1.14	1.42	1.66	1.53	1.41	1.26	1.27	1.48	1.53	1.46	1.45	1.36	1.34	1.40	1.35	1.52	1.51	1.31	1.24	1.21
1974	0.92	0.74	0.79	0.86	1.00	0.89	0.75	0.73	0.79	0.99	0.78	0.72	0.75	0.95	1.03	0.80	0.92	0.86	0.89	0.83	0.98	0.93	0.87	0.73	0.71
1975	0.69	0.71	0.59	0.58	0.62	0.73	0.64	0.75	0.69	0.72	0.86	0.78	0.65	0.61	0.58	0.90	0.89	0.71	0.62	0.60	0.71	0.73	0.80	0.67	0.54
1976	0.91	1.32	1.46	1.57	0.95	0.99	0.99	0.83	1.36	1.50	1.09	1.02	1.01	1.42	1.45	1.19	1.09	1.12	1.42	1.50	1.34	1.28	1.30	1.42	1.59
1977	0.94	1.30	1.34	1.27	1.49	0.77	0.80	0.87	0.96	0.98	0.80	0.89	0.98	1.06	1.02	0.84	0.95	1.04	1.17	1.14	0.79	1.07	1.19	1.32	1.24
1978	1.28	0.58	0.73	1.13	1.70	1.56	1.67	1.87	1.12	0.53	1.63	1.39	1.24	0.54	0.56	1.68	1.18	0.77	0.57	0.57	1.70	0.92	0.58	0.57	0.80
1979	0.69	1.20	0.94	0.89	1.85	0.73	0.84	0.87	0.83	0.84	0.81	0.86	0.95	0.96	1.03	0.98	1.20	1.01	1.24	1.33	1.25	1.29	1.33	1.33	1.18
1980	0.38	0.77	0.83	0.93	1.36	0.37	0.42	0.46	0.41	0.43	0.35	0.45	0.48	0.48	0.50	0.52	0.60	0.51	0.60	0.65	0.64	0.70	0.67	0.72	0.77
1981	0.67	0.61	0.85	0.92	0.74	0.74	0.72	0.86	0.76	0.72	0.77	0.71	0.81	0.74	0.75	0.78	0.68	0.77	0.70	0.81	0.71	0.57	0.68	0.72	0.88
1982	1.37	0.64	1.02	1.43	1.52	1.17	1.00	1.09	0.93	0.82	0.90	0.77	0.87	0.72	0.98	0.70	0.55	0.64	0.83	0.93	0.55	0.58	0.61	0.76	1.05
1983	0.71	0.90	1.32	1.84	1.53	1.24	1.18	1.06	1.04	0.95	1.58	1.17	1.08	1.00	0.87	1.60	1.11	1.02	0.86	0.96	1.15	1.01	0.93	0.98	1.48
1984	1.05	1.33	1.33	1.87	1.45	1.20	1.29	1.38	1.21	1.08	1.33	1.25	1.29	1.11	1.04	1.51	1.19	1.10	1.16	1.16	1.60	1.27	1.25	1.30	1.49
1985	0.98	0.69	0.79	0.89	1.05	0.82	0.91	0.76	0.82	0.83	0.88	0.89	0.97	0.98	0.98	0.82	0.79	0.94	1.00	1.01	0.68	0.65	0.81	0.86	0.91
1986	0.78	1.10	1.35	1.28	2.88	0.75	0.68	0.72	0.68	0.94	0.87	0.80	0.65	0.86	1.10	1.08	0.96	0.76	1.07	1.27	1.23	1.10	0.94	1.25	1.33
1987	0.40	0.78	0.71	0.63	1.62	0.24	0.37	0.32	0.44	0.61	0.39	0.62	0.58	0.77	0.91	0.60	0.66	0.73	0.74	0.74	0.51	0.64	0.76	0.80	0.70
1988	0.61	1.67	2.40	1.79	1.26	0.56	0.64	0.64	0.84	1.37	0.65	0.69	0.74	1.15	1.85	0.78	0.79	0.92	1.63	2.32	0.94	0.99	1.28	2.11	2.25
1989	1.67	1.20	0.98	1.06	1.71	1.48	1.64	1.91	1.79	1.60	1.30	1.54	1.74	1.62	1.44	1.16	1.35	1.58	1.46	1.12	1.00	1.27	1.39	1.19	0.95
1990	0.57	1.07	0.99	0.98	1.64	0.70	0.76	1.01	1.07	0.94	0.91	1.17	0.95	0.85	0.78	1.20	1.43	1.10	0.84	0.74	1.55	1.26	1.21	0.90	0.93

Table C6.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1991	0.56	0.59	0.67	0.73	2.44	0.59	0.70	0.72	0.73	0.69	0.72	0.75	0.74	0.75	0.75	0.85	0.74	0.70	0.74	0.74	0.82	0.66	0.65	0.65	0.74
1992	1.12	0.60	0.62	0.61	0.78	1.07	0.90	0.66	0.45	0.36	1.07	0.83	0.68	0.49	0.46	1.10	0.78	0.62	0.51	0.51	1.23	0.75	0.59	0.56	0.58
1993	0.50	0.60	0.67	0.82	1.24	0.43	0.46	0.59	0.62	0.56	0.43	0.45	0.56	0.66	0.66	0.53	0.54	0.51	0.62	0.71	0.51	0.57	0.54	0.62	0.76
1994	0.78	1.30	1.23	1.10	1.17	0.91	0.93	0.74	0.68	0.62	1.04	1.03	0.94	0.85	0.72	1.18	1.07	0.98	0.85	0.73	1.44	1.39	0.96	0.81	0.68
1995	1.31	2.18	2.26	1.96	2.35	1.29	1.63	1.90	2.01	1.76	1.32	1.66	1.93	2.01	1.84	1.47	1.73	1.94	2.11	2.03	1.64	1.90	2.08	2.30	2.23
1996	0.88	0.68	0.65	0.94	2.16	0.85	0.83	0.76	0.71	0.64	0.83	0.83	0.82	0.79	0.72	0.85	0.82	0.83	0.81	0.79	0.83	0.75	0.79	0.76	0.75
1997	0.65	0.49	0.60	0.66	3.87	0.68	0.47	0.51	0.67	0.79	0.68	0.56	0.48	0.59	0.57	0.78	0.65	0.37	0.35	0.43	0.92	0.76	0.43	0.44	0.55
1998	0.86	1.58	2.01	2.43	2.08	0.70	0.56	0.57	0.62	0.66	0.64	0.63	0.58	0.69	0.81	0.79	0.89	0.72	0.93	1.15	1.11	1.33	1.12	1.38	1.80
1999	0.45	0.79	0.79	0.65	2.22	0.43	0.38	0.46	0.45	0.48	0.38	0.39	0.39	0.42	0.44	0.41	0.48	0.44	0.52	0.60	0.50	0.67	0.62	0.74	0.78

Table C6. D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.84	1.91	1.47	1.41	1.35	1.67	1.71	1.33	1.16	1.11	1.43	1.36	1.31	1.41	1.45	1.27	1.40	1.77	1.83	1.78	1.24	1.71	2.11	2.11	1.95
2040	0.61	0.54	0.69	0.72	0.61	0.96	0.75	0.77	0.71	0.61	0.93	0.96	0.78	0.72	0.66	0.70	0.79	0.83	0.71	0.56	0.86	0.91	0.78	0.64	0.61
2041	1.25	0.95	0.99	0.92	1.08	1.40	1.26	1.10	1.02	1.13	1.52	1.48	1.31	1.25	1.38	1.37	1.39	1.40	1.50	1.67	1.27	1.41	1.55	1.62	1.61
2042	0.53	0.51	0.70	0.92	0.92	0.43	0.57	0.72	0.77	0.59	0.49	0.51	0.57	0.53	0.36	0.44	0.39	0.44	0.31	0.32	0.30	0.37	0.32	0.29	0.36
2043	1.07	1.41	1.79	1.84	1.89	0.98	1.37	1.80	1.88	1.61	1.24	1.66	1.88	1.74	1.37	1.54	1.81	1.83	1.55	1.09	1.69	1.80	1.74	1.31	0.75
2044	0.87	1.16	1.26	1.21	1.09	1.10	1.28	1.36	1.27	1.11	1.25	1.36	1.44	1.33	1.14	1.47	1.48	1.45	1.28	1.11	1.67	1.53	1.36	1.18	1.05
2045	1.50	1.40	1.28	1.01	0.87	1.40	1.25	1.07	0.83	0.89	1.33	1.15	0.93	0.79	0.80	1.26	1.09	0.89	0.79	0.82	1.15	1.05	0.95	0.82	0.95
2046	0.84	0.96	1.07	1.20	1.29	0.81	1.01	1.18	1.14	1.09	0.85	1.10	1.17	1.09	0.95	0.90	1.09	1.12	0.94	0.80	0.91	0.98	0.91	0.90	0.64
2047	0.90	0.89	0.92	0.96	0.94	0.96	0.93	0.96	1.01	1.03	0.89	0.88	0.94	1.05	1.06	0.71	0.72	0.84	0.90	0.92	0.58	0.58	0.66	0.67	0.64
2048	0.93	1.29	1.48	1.52	1.53	0.84	1.16	1.40	1.54	1.55	0.85	1.07	1.29	1.49	1.50	0.87	1.06	1.23	1.37	1.43	0.75	1.03	1.19	1.22	1.16
2049	0.67	0.99	0.87	0.76	0.56	0.64	0.97	0.90	0.75	0.74	0.63	0.98	0.83	0.94	1.06	0.89	0.96	1.01	1.15	1.27	1.09	1.10	1.18	1.29	1.34
2050	0.50	0.47	0.41	0.77	1.17	0.43	0.45	0.46	0.87	1.14	0.58	0.48	0.57	0.90	1.12	0.99	0.96	1.09	1.37	1.68	1.53	1.35	1.43	1.76	2.12
2051	0.38	0.73	0.72	0.40	0.37	0.30	0.55	0.48	0.40	0.38	0.22	0.26	0.37	0.41	0.46	0.25	0.38	0.80	1.24	1.61	0.63	1.12	1.49	1.81	1.91
2052	0.98	0.97	0.91	0.87	0.82	1.00	0.97	0.94	0.85	0.80	1.01	1.00	0.99	0.90	0.79	0.99	1.01	1.04	0.97	0.96	0.94	0.95	1.02	1.13	1.06
2053	0.93	1.11	1.20	1.10	0.93	0.87	0.97	0.85	0.63	0.89	0.76	0.74	0.62	0.92	1.21	0.64	0.57	0.75	0.96	0.79	0.62	0.62	0.64	0.73	0.70
2054	0.70	0.79	0.86	0.90	0.86	0.74	0.85	0.89	0.81	0.65	0.61	0.81	0.78	0.61	0.74	0.46	0.46	0.62	0.70	1.13	0.30	0.36	0.66	0.97	1.26
2055	0.44	0.42	0.40	0.35	0.37	0.45	0.41	0.44	0.43	0.40	0.39	0.44	0.45	0.45	0.37	0.41	0.43	0.44	0.49	0.53	0.42	0.46	0.49	0.52	0.83
2056	0.61	0.57	0.55	0.66	0.61	0.66	0.63	0.75	0.67	0.61	0.75	0.71	0.69	0.68	0.67	0.88	0.86	0.83	0.80	0.80	1.02	1.00	0.95	0.87	1.04
2057	0.65	0.65	0.69	0.70	0.70	0.56	0.57	0.57	0.58	0.68	0.52	0.53	0.53	0.52	0.76	0.46	0.49	0.52	0.54	0.92	0.41	0.42	0.48	0.57	1.00
2058	1.42	1.70	1.45	0.78	0.82	1.65	1.59	1.11	0.80	0.85	1.66	1.32	0.84	0.92	0.94	1.54	0.96	0.93	0.94	0.96	1.25	1.06	0.97	0.94	0.97
2059	0.42	0.45	0.47	0.49	0.80	0.41	0.50	0.59	0.64	0.88	0.42	0.44	0.43	0.61	0.76	0.37	0.35	0.41	0.61	0.71	0.30	0.31	0.49	0.78	0.68
2060	0.94	0.81	0.83	0.85	1.37	0.91	0.99	1.02	0.98	1.71	0.97	1.01	0.98	1.51	1.44	0.94	0.94	1.33	1.97	1.23	1.24	1.11	1.71	1.73	0.81

Table C6. D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	0.65	0.50	0.44	0.62	0.95	0.57	0.47	0.45	0.79	0.87	0.44	0.52	0.63	0.71	0.72	0.47	0.57	0.76	0.78	0.95	0.70	0.66	0.72	0.97	1.10
2062	0.65	0.77	0.81	0.74	0.64	0.46	0.60	0.74	0.76	0.73	0.43	0.39	0.40	0.43	0.48	0.53	0.45	0.50	0.50	0.55	0.69	0.71	0.71	0.74	0.71
2063	1.35	1.76	1.92	1.77	1.66	1.40	1.56	1.70	1.67	1.56	1.64	1.45	1.37	1.32	1.44	1.82	1.52	1.34	1.12	1.64	1.76	1.64	1.33	1.36	1.74
2064	0.81	0.95	1.06	1.07	1.12	0.66	0.84	0.87	0.80	1.36	0.56	0.63	0.60	0.97	1.39	0.53	0.47	0.67	1.21	1.31	0.50	0.54	1.05	1.53	1.10
2065	0.48	0.44	0.38	0.45	0.55	0.35	0.32	0.35	0.45	0.64	0.33	0.28	0.31	0.62	0.76	0.27	0.34	0.56	0.87	0.92	0.30	0.48	0.96	1.16	1.03
2066	1.49	1.31	1.00	0.70	0.76	1.51	1.25	0.97	0.85	0.93	1.39	1.15	0.86	0.86	0.95	1.40	1.02	0.83	0.71	0.79	1.32	0.96	0.81	0.74	0.69
2067	0.78	0.75	0.84	0.72	0.70	0.67	0.80	0.90	0.69	0.85	0.66	0.94	0.99	0.74	1.03	0.66	0.96	1.08	0.86	1.23	0.67	0.97	1.04	1.16	1.43
2068	1.05	1.13	0.89	0.64	0.62	1.01	0.94	0.82	0.51	0.45	0.95	0.90	0.80	0.53	0.46	1.06	0.99	0.84	0.62	0.57	1.15	1.02	1.01	0.84	0.63
2069	0.67	0.68	0.74	0.92	1.00	0.75	0.95	1.08	1.10	1.03	1.00	0.99	0.99	0.94	0.85	0.79	0.71	0.78	0.74	0.87	0.63	0.67	0.76	1.04	1.32
2070	0.64	0.82	1.14	1.46	1.50	0.94	0.97	1.08	1.15	1.20	1.10	1.13	1.26	1.40	1.45	1.29	1.26	1.41	1.58	1.70	1.43	1.51	1.66	1.85	1.91

Table C7

Regional Climate Model 3; Geophysical Fluid-Dynamics Laboratory Atmospheric-Land Generalized Model

Table C7.A Annual Maximum Series: Present Day Climate																									
Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	2.36	2.06	-99	2.27	2.58	2.43	-99	2.65	2.07	1.81	3.45	3.25	2.25	1.77	1.91	2.54	2.43	2.28	2.52	3.67	1.77	2.57	3.56	2.90	2.27
1970	3.01	3.24	-99	3.51	1.94	2.14	-99	2.74	2.31	2.12	2.85	2.73	1.82	2.14	2.70	7.29	1.61	2.00	2.53	3.20	6.19	3.00	2.90	4.23	3.69
1971	2.03	1.54	-99	1.84	2.86	2.65	-99	2.57	3.34	3.20	2.28	2.61	2.78	2.54	2.16	3.43	2.61	2.18	2.11	2.13	3.21	4.18	4.02	4.39	4.54
1972	1.86	1.74	-99	1.79	2.01	2.54	-99	1.71	2.14	2.77	3.46	2.96	3.48	2.00	4.38	3.35	5.04	5.81	6.00	5.50	2.30	1.88	1.32	1.48	1.79
1973	2.17	2.41	-99	2.47	2.44	2.75	-99	2.69	2.47	2.40	2.24	1.95	1.82	1.48	1.81	2.84	3.45	2.98	1.79	2.57	3.34	1.74	2.25	1.67	1.70
1974	1.89	1.50	-99	2.05	2.44	1.80	-99	1.93	1.74	2.09	1.78	2.00	1.64	1.71	3.57	1.88	1.68	2.09	2.06	2.23	2.33	2.70	2.74	2.48	2.03
1975	1.44	1.38	-99	1.56	1.69	1.74	-99	1.73	1.76	1.82	2.47	2.18	2.08	2.11	2.92	1.83	2.18	2.30	2.25	2.02	2.03	2.26	2.20	1.89	2.06
1976	2.42	2.52	-99	2.11	1.38	2.20	-99	2.18	1.69	2.23	2.10	2.61	2.36	2.71	2.31	2.70	3.42	3.59	3.29	4.42	2.38	2.21	2.85	2.79	3.52
1977	1.26	2.96	-99	3.94	4.33	1.24	-99	2.56	3.75	2.94	1.39	1.73	2.13	1.47	1.97	2.28	2.29	2.15	2.02	3.05	2.20	2.26	3.22	3.28	3.37
1978	3.50	2.75	-99	3.39	4.95	2.38	-99	3.14	4.66	4.05	1.43	2.67	4.66	3.22	3.95	2.78	3.54	2.73	3.13	3.15	3.55	4.73	6.34	4.96	3.68
1979	2.97	4.60	-99	5.09	4.65	2.27	-99	2.21	2.30	2.64	1.75	2.18	1.61	2.31	2.21	2.56	2.56	2.50	2.09	1.95	2.46	2.24	1.98	2.20	1.82
1980	2.37	2.62	-99	2.74	2.23	2.65	-99	2.43	2.27	2.41	1.89	1.94	1.93	2.04	1.81	1.78	2.23	4.15	5.97	5.81	2.19	3.27	3.69	4.14	4.67
1981	1.77	1.91	-99	2.07	1.76	1.96	-99	2.81	2.00	2.83	5.25	3.08	2.13	3.33	3.30	2.12	1.71	2.53	2.14	3.12	2.16	1.79	4.62	2.52	2.46
1982	2.27	2.22	-99	2.61	2.13	3.16	-99	2.24	2.27	2.23	2.71	2.91	2.38	2.99	3.08	2.81	3.33	2.97	2.89	2.86	1.99	1.94	2.03	1.96	2.77
1983	1.96	1.71	-99	2.37	3.14	2.38	-99	1.99	2.29	3.41	4.48	3.91	3.51	3.42	2.79	2.21	1.99	2.23	2.16	2.04	2.56	1.91	1.68	2.29	2.48
1984	2.46	1.50	-99	1.47	1.84	3.01	-99	2.57	1.97	1.96	2.48	2.45	2.83	2.40	2.87	2.38	2.05	2.70	2.06	2.07	2.15	2.32	2.32	2.70	2.49
1985	2.30	1.94	-99	1.53	1.88	3.01	-99	2.55	2.52	2.33	3.89	3.20	3.45	2.05	2.37	3.06	4.01	3.76	3.07	2.82	2.40	2.99	4.88	3.64	2.97
1986	2.00	2.41	-99	2.73	2.62	2.53	-99	2.57	2.88	2.61	3.05	2.90	2.92	3.50	4.57	6.40	6.78	6.94	7.46	7.67	2.88	2.44	2.12	4.19	2.86
1987	4.65	3.69	-99	2.86	1.98	4.12	-99	3.12	3.87	2.20	2.16	2.13	3.32	1.79	1.92	2.07	1.91	2.34	1.60	2.18	1.66	1.36	1.52	1.86	2.41
1988	2.01	3.15	-99	3.95	6.08	2.92	-99	2.05	2.38	2.47	2.17	1.58	2.14	2.38	2.81	1.95	2.05	2.21	2.51	2.49	2.20	2.00	2.20	2.30	2.11

Table C7.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	2.22	2.14	-99	3.19	2.95	3.15	-99	1.81	2.38	2.49	1.48	1.28	1.69	3.16	5.03	1.16	1.40	2.05	2.96	3.97	2.76	3.08	2.91	1.88	2.52
1990	3.74	2.81	-99	2.10	2.24	2.35	-99	2.00	2.07	2.53	2.26	1.87	2.07	1.77	2.28	2.68	2.69	1.95	1.74	2.35	1.92	2.29	2.32	2.30	2.96
1991	2.11	3.01	-99	1.99	2.25	2.41	-99	3.18	2.08	2.53	2.19	2.43	3.27	2.52	2.66	4.71	4.41	3.97	2.98	2.85	2.49	3.25	3.03	5.56	4.64
1992	2.36	2.17	-99	2.33	2.46	2.05	-99	2.32	2.45	1.67	2.56	1.94	2.02	2.44	1.51	2.07	2.35	1.38	2.59	2.38	1.57	2.01	1.39	1.94	1.31
1993	4.14	4.28	-99	2.80	2.29	3.37	-99	2.79	1.49	1.69	1.91	1.85	2.87	2.03	1.88	3.25	3.59	2.59	2.67	2.20	2.73	4.12	4.04	2.58	3.08
1994	3.06	3.14	-99	2.86	1.78	1.90	-99	1.94	4.03	5.45	1.68	1.93	2.07	1.91	1.94	2.28	2.29	2.14	2.33	1.87	2.41	2.17	2.73	1.70	2.44
1995	2.30	2.65	-99	2.80	1.70	2.62	-99	3.42	2.69	2.85	1.76	2.00	3.42	2.94	4.38	2.01	1.94	1.56	1.76	2.57	2.37	1.76	1.44	2.06	2.47
1996	1.83	2.19	-99	3.09	3.19	2.97	-99	2.82	3.44	3.51	2.49	3.08	2.73	3.72	2.47	3.21	2.57	2.02	2.56	2.62	3.46	2.43	2.54	2.01	2.37
1997	1.59	2.86	-99	4.42	5.80	2.33	-99	1.77	1.88	2.11	1.74	2.04	2.10	2.28	3.20	2.44	3.59	1.69	2.19	2.57	4.24	1.95	2.51	1.89	2.18
1998	2.90	2.33	-99	2.84	3.12	2.54	-99	1.88	1.91	2.62	3.11	1.82	2.42	2.55	1.75	2.15	1.60	2.00	1.92	2.11	1.76	3.30	2.16	1.86	4.09
1999	2.40	2.66	-99	5.39	3.22	2.11	-99	4.37	2.72	2.71	2.68	2.71	2.13	2.48	2.58	2.99	2.40	2.76	3.09	2.88	3.85	2.75	2.49	3.90	2.87
2000	2.03	1.96	-99	2.09	2.00	2.10	-99	1.85	1.88	1.80	2.15	2.45	2.20	2.16	1.73	3.34	2.77	2.77	2.94	2.35	2.90	3.43	3.29	2.35	3.19

Table C7.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	2.16	4.14	-99	3.58	2.74	2.53	-99	1.94	3.02	2.50	2.60	2.51	3.21	3.41	3.67	2.37	4.51	2.94	2.10	3.08	4.88	3.03	2.52	2.86	3.15
2040	3.07	2.94	-99	3.40	4.52	2.25	-99	1.55	1.33	2.02	1.99	2.13	3.12	2.74	3.18	2.64	3.16	4.64	4.70	4.38	2.62	2.54	3.02	2.40	2.82
2041	1.29	1.42	-99	1.28	1.21	2.94	-99	1.98	2.09	2.14	4.04	2.87	2.39	2.91	2.28	2.66	2.06	2.44	2.38	4.49	2.35	2.37	2.89	2.62	2.57
2042	1.97	1.85	-99	1.76	1.85	3.33	-99	3.42	2.01	1.92	2.02	2.11	2.21	1.60	2.53	1.87	2.41	3.15	3.37	2.95	2.70	3.98	2.33	2.36	2.25
2043	3.20	3.73	-99	2.50	3.17	2.58	-99	2.02	1.63	1.55	5.46	8.62	2.51	1.53	1.85	2.22	6.59	8.56	2.71	2.56	2.43	1.76	7.11	9.95	3.52
2044	2.31	1.78	-99	1.64	2.12	1.75	-99	1.62	2.44	2.21	2.45	2.62	2.78	1.97	2.40	2.99	2.69	1.80	1.87	3.15	1.97	1.94	2.54	4.21	4.81
2045	3.51	2.58	-99	2.49	2.80	3.95	-99	3.93	3.97	4.92	3.49	5.40	5.75	5.35	5.98	3.20	3.13	4.09	4.78	5.54	1.90	1.77	1.60	1.67	2.38
2046	1.63	2.11	-99	3.54	4.05	3.10	-99	4.62	4.40	3.16	4.47	4.62	2.78	2.79	3.60	3.79	3.98	2.23	2.89	3.04	3.14	2.90	2.26	2.67	1.93
2047	5.00	1.60	-99	1.58	1.62	3.67	-99	3.39	3.11	2.44	2.74	2.32	1.81	2.30	2.53	2.39	2.59	2.33	3.02	3.77	2.17	2.70	3.33	4.21	4.62
2048	5.55	4.87	-99	5.84	5.15	2.48	-99	4.59	4.30	4.10	3.02	3.56	5.94	4.33	3.66	2.11	2.64	2.34	2.78	4.04	3.00	3.09	2.53	2.28	3.28
2049	2.60	3.29	-99	2.39	2.41	2.43	-99	2.73	2.53	2.36	6.45	4.18	2.78	3.26	2.33	4.17	4.23	3.10	3.33	2.39	2.55	2.38	2.58	2.79	2.40
2050	2.44	2.62	-99	2.40	2.05	3.23	-99	2.69	2.17	2.24	2.43	2.09	2.88	3.67	3.51	3.65	3.37	4.54	3.56	2.32	4.79	3.87	3.40	3.11	2.04
2051	2.61	2.99	-99	2.62	2.52	2.95	-99	2.32	3.80	3.08	3.06	2.68	3.65	3.25	1.94	2.90	2.80	1.82	2.83	2.33	4.37	1.94	2.02	2.15	1.88
2052	1.78	2.07	-99	1.63	1.92	1.88	-99	1.97	2.00	2.51	1.59	3.21	1.78	1.96	1.91	1.92	1.84	1.74	2.51	1.92	2.67	2.74	2.75	2.64	2.83
2053	2.68	2.34	-99	1.91	2.40	2.07	-99	2.61	3.15	3.18	2.52	3.62	2.34	2.40	3.91	1.59	2.90	2.16	2.59	3.39	2.32	2.74	3.16	3.47	3.37
2054	1.81	2.11	-99	3.03	5.93	1.76	-99	1.88	1.90	2.56	3.45	3.32	2.14	2.77	3.73	2.91	2.99	2.24	1.97	7.43	2.78	1.73	3.12	1.91	5.54
2055	3.49	2.83	-99	3.39	3.77	3.91	-99	3.54	4.12	6.01	1.74	1.95	3.36	4.27	2.61	3.21	3.49	2.29	2.52	3.74	3.06	2.69	2.45	4.30	2.55
2056	1.93	3.29	-99	3.01	3.69	3.56	-99	2.75	2.11	2.85	3.22	2.65	3.80	2.13	1.67	2.87	2.91	2.68	2.40	3.76	2.45	2.26	2.28	2.48	5.10
2057	2.01	2.28	-99	2.67	2.85	3.71	-99	3.34	2.60	2.42	2.71	1.78	2.20	2.78	1.98	2.47	3.00	3.05	2.13	2.40	3.28	2.33	3.78	3.32	3.47
2058	2.79	1.80	-99	1.70	1.73	1.58	-99	1.30	1.52	2.27	1.56	1.60	1.88	1.80	4.24	2.04	1.89	2.97	2.17	2.10	1.97	1.56	2.19	2.34	1.96
2059	2.27	2.28	-99	1.80	3.31	1.83	-99	1.82	2.74	3.54	1.99	1.80	2.26	3.31	3.23	1.92	2.39	3.42	3.80	2.15	2.03	3.06	2.64	2.19	2.09
2060	2.68	3.27	-99	3.03	2.49	2.60	-99	3.34	2.33	2.46	2.81	2.52	2.72	3.01	2.87	2.46	2.91	3.39	3.39	3.09	2.97	3.38	3.45	2.95	2.01

Table C7.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	2.85	3.92	-99	6.52	5.50	4.75	-99	5.32	2.71	3.29	2.12	2.20	3.20	4.01	4.40	2.99	4.81	5.39	6.51	4.18	4.95	6.28	5.27	3.91	2.60
2062	3.39	2.68	-99	2.76	5.37	2.39	-99	3.10	3.00	3.33	3.89	4.46	4.26	3.54	3.05	4.54	4.24	3.28	2.46	1.89	3.59	2.62	2.29	1.74	1.76
2063	2.88	2.80	-99	2.97	2.63	4.22	-99	3.91	3.02	3.30	2.57	2.92	3.61	2.83	2.81	2.85	2.70	3.48	3.18	2.83	3.33	2.44	2.55	2.16	1.82
2064	5.66	5.52	-99	4.11	2.37	5.12	-99	3.00	3.84	2.31	3.52	3.37	3.44	3.61	3.81	3.58	4.30	2.60	3.17	3.20	3.16	3.09	2.56	3.53	3.15
2065	2.56	3.07	-99	2.61	2.88	1.66	-99	2.38	2.24	3.62	1.54	2.57	2.31	2.37	3.12	1.53	2.18	2.53	3.03	3.09	2.45	2.67	4.17	3.64	2.97
2066	2.93	2.46	-99	2.72	2.53	2.52	-99	1.90	2.69	4.21	1.71	5.39	8.72	9.70	8.43	1.88	4.38	5.73	4.88	3.53	2.19	2.73	3.37	3.80	2.69
2067	2.29	2.05	-99	1.91	1.96	1.79	-99	2.03	2.33	2.67	2.16	2.05	2.10	2.37	1.80	2.13	1.86	1.91	1.94	1.84	1.82	1.75	1.59	1.54	1.36
2068	1.92	1.79	-99	2.50	3.83	1.79	-99	1.68	2.43	2.93	2.07	2.15	2.08	1.90	2.22	2.04	1.99	1.93	2.23	2.03	2.39	1.84	1.91	1.73	1.65
2069	2.73	2.45	-99	1.98	2.82	3.57	-99	2.84	3.71	2.38	4.31	3.56	3.24	4.22	2.38	3.39	3.77	4.09	3.62	3.77	4.00	3.38	3.56	2.37	2.50
2070	1.75	1.93	-99	1.50	1.57	1.48	-99	1.46	2.46	1.33	1.61	1.47	1.58	1.47	3.28	2.29	1.77	1.79	1.26	3.78	1.82	1.79	2.64	2.82	2.95

Table C7.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	0.70	0.72	-99	0.79	0.80	0.80	-99	0.87	0.90	0.92	0.86	0.89	0.93	0.97	0.94	0.89	0.95	0.85	0.81	0.85	1.04	0.98	0.84	0.73	0.68
1970	2.19	2.34	-99	2.29	1.94	2.02	-99	2.16	2.05	1.79	1.46	1.51	1.66	1.79	2.21	1.40	1.24	1.26	1.72	2.28	1.47	1.36	1.59	2.10	2.21
1971	0.89	0.93	-99	1.00	0.97	1.14	-99	1.22	1.25	1.20	1.16	1.32	1.48	1.50	1.44	1.15	1.34	1.48	1.56	1.45	0.97	1.18	1.26	1.44	1.41
1972	0.40	0.52	-99	0.57	0.59	0.45	-99	0.53	0.52	0.55	0.44	0.46	0.52	0.59	0.67	0.50	0.61	0.72	0.76	0.79	0.75	0.82	0.90	0.92	0.91
1973	1.06	1.05	-99	0.75	0.76	1.09	-99	0.97	0.68	0.67	0.93	1.02	0.87	0.63	0.60	0.93	0.98	0.82	0.62	0.59	0.85	0.90	0.84	0.67	0.62
1974	1.09	1.05	-99	1.00	0.96	1.16	-99	1.07	1.02	1.09	1.05	0.96	0.87	0.87	1.04	0.81	0.70	0.62	0.72	0.94	0.89	0.78	0.71	0.85	1.06
1975	1.30	1.38	-99	1.56	1.69	1.58	-99	1.68	1.76	1.82	1.64	1.86	2.08	2.11	2.04	1.83	2.18	2.30	2.25	2.02	2.03	2.26	2.20	1.88	1.57
1976	0.54	0.56	-99	0.56	0.52	0.61	-99	0.62	0.63	0.62	0.73	0.75	0.73	0.70	0.71	0.62	0.65	0.70	0.76	0.81	0.60	0.62	0.63	0.70	0.81
1977	0.41	0.56	-99	0.70	0.62	0.58	-99	0.72	0.70	0.68	0.63	0.71	0.69	0.73	0.85	0.72	0.72	0.68	0.75	0.68	0.75	0.71	0.71	0.62	0.67
1978	0.72	0.76	-99	0.83	0.88	0.71	-99	0.84	0.83	0.86	0.91	0.74	0.84	0.86	0.91	0.89	0.75	0.86	0.93	0.94	0.70	0.77	0.86	0.89	0.88
1979	1.04	1.09	-99	1.19	1.49	1.32	-99	1.26	1.39	1.61	1.34	1.42	1.43	1.50	1.45	1.33	1.48	1.58	1.47	1.21	1.41	1.61	1.56	1.29	1.19
1980	2.37	2.62	-99	2.74	2.01	1.53	-99	1.57	1.48	1.17	1.16	1.13	1.19	1.35	1.23	0.99	1.12	1.06	1.06	0.94	1.00	1.02	1.03	0.94	0.90
1981	1.15	1.27	-99	1.09	1.09	1.12	-99	1.18	1.11	1.03	0.97	1.06	0.92	1.04	1.06	1.02	1.07	0.94	0.95	1.22	1.04	1.17	1.04	1.24	1.54
1982	0.78	0.96	-99	0.94	0.99	0.81	-99	0.91	0.79	0.72	0.75	0.88	0.90	0.74	0.63	0.83	0.93	0.92	0.78	0.70	0.92	0.98	0.94	0.88	0.77
1983	1.04	1.00	-99	1.04	1.05	1.10	-99	1.06	1.30	1.23	1.23	1.31	1.45	1.66	1.41	1.30	1.55	1.78	1.69	1.31	1.39	1.63	1.68	1.43	1.24
1984	1.09	0.99	-99	0.98	0.97	1.19	-99	1.22	1.04	0.97	0.89	1.33	1.42	1.19	1.06	0.89	1.30	1.41	1.34	1.23	1.05	1.19	1.24	1.28	1.14
1985	0.77	0.85	-99	0.74	0.69	0.76	-99	0.80	0.87	0.89	0.98	0.89	0.91	0.92	0.90	0.92	0.94	0.90	0.84	0.77	0.87	0.90	0.85	0.84	0.84
1986	1.13	1.20	-99	1.24	1.23	1.22	-99	1.33	1.33	1.32	1.36	1.43	1.41	1.43	1.40	1.50	1.53	1.49	1.48	1.50	1.43	1.43	1.48	1.58	1.63
1987	1.03	1.10	-99	1.34	1.47	0.95	-99	1.13	1.24	1.32	0.63	0.84	0.92	0.92	0.97	0.70	0.74	0.76	0.79	0.83	1.03	0.93	0.90	0.84	0.81
1988	0.76	0.99	-99	0.97	0.86	0.91	-99	1.07	0.99	0.98	0.85	1.04	1.04	1.24	1.21	0.96	1.04	1.22	1.30	1.18	0.99	1.15	1.39	1.40	1.14
1989	1.17	1.09	-99	0.89	0.86	1.00	-99	0.95	0.85	0.83	0.76	0.87	0.86	0.88	0.88	0.60	0.79	0.91	0.88	0.96	0.77	0.86	0.83	0.89	0.97
1990	1.20	1.59	-99	1.67	1.19	1.08	-99	1.39	1.47	1.18	0.93	0.92	1.15	1.19	1.06	0.96	0.92	1.07	1.05	0.95	0.86	0.82	1.02	1.06	1.04

Table C7.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1991	0.76	0.72	-99	0.70	0.86	0.73	-99	0.64	0.68	0.82	0.72	0.67	0.70	0.76	0.92	0.69	0.73	0.74	0.81	0.88	0.72	0.83	0.95	0.99	1.40
1992	1.11	1.12	-99	1.07	1.04	1.05	-99	1.10	1.14	1.06	0.79	0.79	0.87	0.90	0.86	0.73	0.82	0.79	0.71	0.77	0.82	0.82	0.75	0.82	0.93
1993	1.00	1.09	-99	1.20	1.48	0.80	-99	0.77	0.77	1.10	1.03	0.90	0.76	0.77	0.92	0.87	0.94	0.91	0.85	0.97	0.80	0.90	0.92	1.01	1.26
1994	1.02	1.09	-99	1.13	1.17	1.30	-99	1.29	1.27	1.29	1.31	1.34	1.23	1.15	1.31	1.19	1.11	1.09	1.15	1.28	1.16	1.06	1.05	1.02	1.03
1995	0.90	0.94	-99	1.00	1.18	0.96	-99	0.93	1.05	1.15	1.05	0.99	0.96	1.02	1.09	0.93	0.92	0.94	0.92	1.02	0.98	0.96	0.90	0.93	1.05
1996	1.83	1.76	-99	1.84	1.89	1.94	-99	1.77	1.83	1.87	2.21	2.05	1.72	1.65	1.75	2.41	2.39	2.02	1.87	2.05	2.28	2.43	2.12	2.01	2.37
1997	1.24	1.20	-99	1.28	1.64	1.60	-99	1.77	1.86	2.05	1.50	1.74	1.63	1.51	1.75	1.20	1.32	1.30	1.19	1.27	1.00	1.19	1.28	1.24	1.19
1998	1.12	1.06	-99	1.13	1.23	1.08	-99	1.02	1.05	1.22	1.16	1.34	1.36	1.18	1.27	1.38	1.54	1.40	1.13	1.11	1.43	1.55	1.48	1.14	0.84
1999	0.79	0.79	-99	0.78	0.74	1.06	-99	1.09	1.00	0.89	1.23	1.25	1.22	1.08	0.90	1.36	1.37	1.29	1.10	0.92	1.20	1.29	1.25	1.09	0.94
2000	0.85	0.94	-99	1.02	0.73	1.00	-99	1.08	1.02	0.73	0.85	1.07	1.14	0.91	0.85	0.89	1.07	1.07	0.84	0.96	0.91	1.07	0.90	1.05	1.03

Table C7.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.25	1.58	-99	1.35	1.20	1.45	-99	2.23	2.08	1.22	1.37	1.56	1.98	1.69	1.35	1.37	1.35	1.30	1.41	1.18	1.55	1.21	1.53	1.27	1.24
2040	1.03	0.62	-99	0.67	0.87	0.91	-99	0.70	0.97	1.10	1.11	0.91	0.91	1.05	1.19	1.21	1.01	0.90	1.00	1.10	1.29	1.13	0.78	0.95	1.11
2041	0.93	0.84	-99	1.24	1.77	1.00	-99	0.97	1.32	2.00	0.71	1.02	1.12	1.50	2.21	0.83	0.91	1.27	1.78	2.34	0.86	1.20	1.49	1.95	2.27
2042	0.66	0.81	-99	0.99	0.83	0.69	-99	0.79	0.81	0.99	0.76	0.79	0.86	1.06	1.24	1.15	0.92	0.94	1.18	1.34	0.93	0.92	1.03	1.29	1.43
2043	2.01	2.02	-99	1.34	0.92	2.00	-99	1.04	0.70	0.74	1.92	0.76	0.53	0.75	0.69	0.59	0.41	0.62	0.69	0.56	0.50	0.58	0.58	0.52	0.61
2044	0.72	0.60	-99	0.73	0.84	0.70	-99	0.67	0.99	1.28	0.79	0.87	1.19	1.35	1.17	1.05	1.43	1.40	1.02	0.72	1.77	1.57	1.01	0.94	0.62
2045	0.50	0.53	-99	0.90	1.08	0.61	-99	0.60	1.08	1.22	0.61	0.61	0.77	1.17	1.20	0.44	0.46	0.94	1.14	1.23	0.45	0.69	1.02	1.29	1.46
2046	0.84	0.94	-99	1.07	1.16	0.97	-99	0.95	1.07	1.15	0.93	0.91	1.11	1.05	1.01	0.75	1.21	1.17	0.91	0.94	1.01	0.92	0.96	0.87	0.98
2047	1.80	1.65	-99	1.70	1.49	1.48	-99	1.18	1.23	1.29	1.61	1.34	1.19	1.18	1.19	1.34	1.39	1.37	1.15	1.11	1.29	1.44	1.28	1.12	1.39
2048	1.33	1.35	-99	1.43	1.67	1.62	-99	1.62	1.67	1.72	1.81	1.79	1.73	1.47	1.76	1.60	1.56	1.26	1.57	1.73	1.37	1.15	1.34	1.62	1.65
2049	0.92	0.87	-99	0.86	0.68	0.75	-99	0.65	0.69	0.64	0.91	0.62	0.55	0.56	0.56	0.92	0.74	0.63	0.89	0.61	0.91	1.02	0.64	0.69	0.76
2050	0.89	0.88	-99	0.68	1.10	0.85	-99	0.72	0.84	1.31	0.73	0.77	0.89	0.99	1.09	1.00	0.93	1.03	1.25	1.80	0.97	1.20	1.43	1.83	1.30
2051	1.29	1.47	-99	1.23	1.13	1.37	-99	1.17	1.03	1.08	1.66	1.64	0.95	1.09	1.30	1.88	1.41	1.00	1.15	1.53	1.57	1.00	1.01	1.41	1.52
2052	1.76	1.65	-99	1.91	1.43	1.77	-99	1.74	1.89	1.40	1.73	1.71	1.80	1.87	1.36	1.56	1.59	1.92	1.73	1.56	1.52	1.54	2.15	1.67	1.90
2053	0.68	0.74	-99	0.80	0.87	0.75	-99	0.70	0.75	0.94	1.02	0.78	0.91	1.02	0.97	1.16	0.94	0.96	0.89	1.13	1.19	1.07	1.04	1.13	1.27
2054	0.83	0.95	-99	1.16	1.00	0.80	-99	1.02	1.25	1.12	0.93	0.93	1.09	1.23	1.10	0.88	1.00	1.09	1.06	1.27	0.92	1.00	1.14	1.29	1.23
2055	1.74	1.63	-99	1.78	2.02	1.59	-99	1.41	1.67	2.15	1.44	1.19	1.08	1.78	2.92	0.88	1.06	1.14	1.84	3.25	0.69	0.88	1.13	1.77	2.94
2056	0.91	1.13	-99	1.47	1.33	1.46	-99	1.32	1.63	1.48	1.87	1.93	1.83	1.70	1.50	1.01	1.26	1.39	1.62	1.78	1.10	1.05	1.31	1.53	1.67
2057	1.35	1.26	-99	1.42	1.26	1.32	-99	1.41	1.44	1.37	1.54	1.45	1.46	1.45	1.45	1.97	1.73	1.26	1.45	1.46	2.03	1.51	1.14	1.27	1.70
2058	1.33	1.64	-99	1.98	2.05	1.44	-99	1.64	1.95	2.27	1.45	1.75	2.08	2.45	3.01	1.42	1.97	2.53	2.74	2.84	1.82	2.44	2.49	2.09	1.71
2059	1.05	1.21	-99	1.29	1.53	1.08	-99	1.29	1.42	1.61	0.82	1.07	1.29	1.48	1.63	0.70	1.00	1.16	1.28	1.64	0.70	0.91	0.92	1.15	1.50
2060	0.87	1.09	-99	1.38	1.51	0.83	-99	1.11	1.33	1.46	0.87	0.80	1.06	1.21	1.29	0.84	0.87	0.99	1.01	1.13	0.82	0.94	1.02	0.92	1.06

Table C7.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	0.91	1.06	-99	0.70	0.68	1.16	-99	0.75	0.91	0.76	1.17	0.84	0.54	0.62	0.67	0.91	0.50	0.48	0.57	0.62	0.84	0.66	0.64	0.67	0.58
2062	0.76	0.57	-99	0.69	0.86	0.54	-99	0.73	0.87	1.11	0.57	0.75	1.01	1.19	1.43	0.72	0.94	1.23	1.35	1.50	1.00	1.16	1.32	1.44	1.58
2063	0.82	0.88	-99	1.01	1.26	0.96	-99	0.95	1.21	1.17	1.08	1.08	1.11	1.01	1.12	1.20	0.97	0.87	1.01	1.11	0.93	0.81	0.87	0.99	1.08
2064	0.65	0.80	-99	1.38	1.29	0.90	-99	1.06	1.18	0.99	0.78	0.65	0.69	0.58	1.24	0.42	0.38	0.44	0.85	1.13	0.41	0.40	0.43	0.60	0.70
2065	0.51	0.78	-99	0.91	1.54	0.57	-99	0.83	0.99	1.71	0.63	0.70	0.87	1.07	2.03	0.67	0.95	1.05	1.36	2.64	0.97	1.09	1.20	1.55	3.16
2066	2.59	2.27	-99	1.69	1.30	2.40	-99	2.06	1.99	1.40	2.06	2.09	1.81	1.84	1.30	2.08	1.96	1.50	1.56	1.10	2.26	1.92	1.28	1.29	1.07
2067	1.37	1.24	-99	1.25	0.87	1.69	-99	1.36	1.05	0.84	1.91	1.75	1.41	1.08	1.11	1.78	1.58	1.40	1.05	0.79	1.66	1.47	1.45	1.32	1.00
2068	1.46	1.28	-99	1.28	1.20	1.06	-99	1.57	1.19	1.15	1.28	1.43	1.42	0.99	1.24	1.15	1.51	1.43	1.33	1.83	1.51	1.86	1.74	1.91	2.04
2069	1.41	1.82	-99	2.81	1.68	2.45	-99	2.18	2.39	1.95	2.13	2.21	2.21	2.40	2.02	2.02	1.89	1.80	1.65	1.40	1.90	1.95	1.63	1.42	1.17
2070	0.50	0.49	-99	0.70	0.68	0.62	-99	0.62	0.88	0.65	0.79	0.70	0.79	0.95	0.52	0.57	0.66	0.77	0.76	0.42	0.58	0.64	0.56	0.58	0.40

Table C8

Regional Climate Model 3; Canadian Coupled Global Climate Model 3

Table C8.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	1.79	1.97	-99	1.62	1.52	1.38	-99	1.36	1.49	1.88	3.48	2.06	1.88	2.44	2.33	2.88	2.57	2.85	2.69	2.37	2.20	2.89	3.06	2.27	2.26
1970	2.04	1.87	-99	1.76	2.25	2.72	-99	2.68	2.21	3.01	2.23	1.91	2.32	2.14	2.90	1.98	1.88	2.61	2.84	2.26	1.85	2.09	2.89	2.68	2.19
1971	2.80	2.32	-99	1.95	2.66	4.37	-99	1.97	2.09	1.81	2.70	2.87	3.31	2.41	2.22	1.87	2.92	2.49	2.49	2.74	3.32	2.98	3.58	6.05	3.21
1972	3.00	3.07	-99	3.16	3.87	2.28	-99	2.79	3.36	4.55	3.23	2.58	1.94	1.83	2.48	3.35	4.87	4.65	3.19	2.58	1.70	1.72	2.80	4.09	4.41
1973	1.91	2.21	-99	2.10	4.00	2.86	-99	2.03	1.61	1.56	2.62	1.90	1.69	1.86	2.18	1.57	1.82	1.81	1.92	2.03	1.93	1.79	1.90	1.91	1.85
1974	1.37	1.09	-99	1.21	1.51	1.78	-99	1.29	1.58	1.91	2.21	2.45	2.63	2.42	1.82	1.87	2.21	2.66	2.63	3.00	3.02	2.92	3.05	2.91	2.24
1975	1.66	2.11	-99	3.68	6.88	2.72	-99	3.13	4.96	5.22	2.75	1.98	1.63	1.51	1.57	2.70	2.91	1.88	1.67	2.19	2.95	2.85	2.22	2.54	1.82
1976	2.07	2.33	-99	4.24	3.67	1.56	-99	3.47	2.83	2.23	1.64	1.77	3.07	3.40	2.17	2.47	2.54	1.60	1.58	1.72	3.91	1.88	1.84	1.85	2.47
1977	4.64	3.65	-99	2.67	1.96	3.47	-99	3.66	3.98	4.18	2.01	2.35	2.30	2.60	2.85	2.30	2.03	2.05	3.08	2.77	2.25	2.51	2.98	3.06	3.07
1978	3.14	2.58	-99	2.42	3.40	3.85	-99	2.96	3.76	3.80	3.04	2.27	3.14	3.30	2.97	4.89	2.55	2.09	2.88	3.06	1.73	2.21	3.13	3.92	3.21
1979	1.82	2.02	-99	2.06	2.62	3.09	-99	3.54	2.66	2.46	2.11	2.11	2.08	2.47	2.65	1.94	2.26	2.66	2.43	2.49	1.97	1.62	3.19	1.60	1.90
1980	1.59	1.86	-99	2.24	2.36	3.13	-99	3.77	5.36	4.81	3.20	4.38	3.14	4.07	5.12	2.41	3.47	3.20	4.33	3.29	2.32	3.31	3.03	4.70	5.43
1981	4.95	5.33	-99	3.14	2.14	5.42	-99	5.49	2.48	3.02	2.13	2.79	5.81	3.19	3.61	2.14	2.67	6.94	3.29	2.66	4.38	5.96	8.54	5.51	4.48
1982	3.34	2.94	-99	3.34	3.82	3.20	-99	3.56	3.55	3.20	3.52	3.41	2.91	2.74	3.65	2.49	2.75	3.41	4.25	3.97	2.87	2.85	2.46	3.01	3.79
1983	2.38	1.70	-99	2.26	1.76	2.60	-99	1.97	1.74	3.33	2.21	3.38	2.33	2.69	3.68	2.03	1.97	2.67	4.30	2.76	2.23	2.11	4.19	2.59	3.05
1984	2.40	2.74	-99	3.27	3.31	3.26	-99	3.30	3.79	4.08	3.17	2.89	3.36	3.53	3.76	3.83	3.03	2.71	3.66	3.16	3.12	4.94	4.00	3.67	3.66
1985	2.67	2.72	-99	2.34	2.32	2.95	-99	2.64	2.52	2.04	3.86	2.85	2.87	2.58	2.21	4.69	3.12	4.03	3.56	3.34	4.03	3.51	3.59	4.37	3.40
1986	3.17	2.48	-99	2.04	2.13	3.03	-99	3.05	3.17	2.58	2.79	1.87	2.18	2.71	3.83	2.25	3.80	2.05	2.31	1.50	1.85	2.23	2.34	2.77	3.63
1987	5.78	7.39	-99	3.40	3.19	2.15	-99	2.69	3.90	4.80	4.88	3.26	3.70	2.98	3.66	2.50	1.67	2.27	3.54	4.01	2.44	2.83	2.81	2.12	2.54
1988	1.68	2.08	-99	2.22	2.98	1.98	-99	2.32	1.41	1.71	1.64	2.05	2.27	2.67	2.73	1.44	1.59	2.25	2.99	2.66	2.34	1.85	2.00	2.31	3.30

Table C8.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	2.06	2.12	-99	2.33	2.23	2.33	-99	2.39	3.75	3.86	1.97	3.20	3.04	3.33	2.71	1.74	2.44	2.75	2.71	2.42	2.51	3.56	3.79	4.35	4.51
1990	2.86	2.42	-99	3.28	3.65	2.60	-99	5.50	4.56	4.86	2.55	4.74	3.49	5.12	5.87	3.83	4.34	2.69	3.71	2.66	3.31	1.58	1.72	2.01	2.46
1991	3.65	4.80	-99	5.70	5.97	3.01	-99	2.65	2.72	2.49	2.50	1.77	1.82	2.29	2.25	2.12	2.51	2.84	1.98	2.87	1.90	3.07	1.90	2.13	3.04
1992	1.57	1.40	-99	3.02	3.08	1.98	-99	2.41	2.21	3.08	1.65	2.43	3.16	4.56	4.87	2.74	2.72	3.57	5.70	4.19	2.29	2.68	2.69	4.55	5.03
1993	4.19	2.52	-99	1.86	1.71	2.45	-99	1.95	2.03	2.10	1.85	2.68	2.31	1.49	2.61	3.07	2.63	2.21	2.54	3.02	2.64	2.76	2.67	3.06	3.06
1994	2.43	2.54	-99	2.74	2.98	3.00	-99	2.27	2.41	2.99	2.50	2.21	2.11	2.52	2.42	1.92	1.95	1.97	1.65	2.23	2.45	2.66	3.08	2.29	2.73
1995	2.32	1.74	-99	2.19	2.53	3.05	-99	2.99	3.19	3.29	2.55	2.10	2.09	2.82	2.57	2.66	1.73	2.43	2.20	2.22	1.55	2.27	2.33	3.88	3.94
1996	2.27	2.20	-99	2.17	2.66	3.33	-99	2.85	2.24	2.87	3.35	3.21	3.06	3.54	3.56	2.66	2.15	3.11	3.43	3.96	2.55	2.34	2.88	2.26	2.94
1997	1.90	2.24	-99	2.00	2.05	2.35	-99	2.40	1.69	2.10	2.50	2.06	1.81	1.76	1.66	3.17	2.39	2.17	2.27	2.77	3.69	3.27	2.38	2.54	3.36
1998	2.22	2.10	-99	5.13	5.38	1.98	-99	2.57	2.50	2.77	2.58	2.94	3.30	2.98	2.83	3.02	3.35	3.21	2.61	1.99	3.10	3.13	2.15	3.53	3.53
1999	1.53	1.75	-99	2.03	1.67	1.75	-99	1.62	1.84	2.20	1.83	2.00	1.97	2.30	2.53	1.58	1.74	1.85	2.18	1.93	2.06	1.58	1.70	2.24	1.79
2000	5.96	5.96	-99	3.55	3.43	3.98	-99	3.27	2.34	2.59	2.61	3.30	3.16	2.65	2.90	1.83	2.40	2.19	2.50	3.50	3.40	3.37	3.28	5.07	4.34

Table C8.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	2.10	2.88	-99	3.03	3.24	2.76	-99	2.23	2.08	3.28	1.98	2.48	2.28	3.26	3.36	3.04	4.76	4.96	3.09	2.96	4.33	3.82	2.59	2.86	3.61
2040	2.36	2.28	-99	1.69	2.28	2.91	-99	2.87	2.26	1.89	5.76	3.95	4.01	2.96	2.25	4.14	3.11	3.27	3.80	3.86	3.26	3.42	2.65	1.57	1.78
2041	2.12	1.59	-99	2.01	2.36	3.75	-99	2.56	2.24	2.00	3.10	3.12	3.03	2.83	2.56	2.46	2.45	2.25	2.42	2.34	3.05	3.95	4.94	4.77	4.21
2042	3.33	3.49	-99	4.34	3.89	5.42	-99	4.10	3.28	3.41	2.72	3.58	3.84	3.95	3.69	3.95	4.08	2.62	2.76	3.30	4.05	3.42	2.85	3.37	3.71
2043	2.01	2.02	-99	1.87	1.64	2.00	-99	1.58	2.18	2.49	1.92	1.27	1.35	1.68	2.41	2.69	1.63	2.25	2.48	2.64	3.42	2.84	3.11	2.74	2.93
2044	1.94	1.85	-99	2.21	2.21	1.90	-99	1.99	1.90	2.03	2.36	2.50	2.51	2.50	2.54	2.16	2.19	2.04	2.00	2.29	2.44	2.16	2.07	2.55	3.03
2045	3.19	2.50	-99	1.74	2.80	4.37	-99	1.73	2.37	2.84	3.33	2.96	2.03	2.66	3.48	3.31	2.16	3.90	3.93	3.96	2.29	3.48	4.26	5.48	3.86
2046	3.24	3.03	-99	2.69	2.33	4.69	-99	4.68	2.26	2.92	4.67	5.21	3.64	3.38	3.32	2.46	3.26	3.00	3.25	3.20	3.08	2.53	2.00	4.44	7.68
2047	3.25	1.70	-99	2.52	3.00	6.48	-99	6.75	5.20	3.61	3.24	3.28	2.38	1.56	2.09	3.36	1.74	1.42	1.76	1.86	1.67	2.26	1.71	2.22	2.87
2048	3.41	3.36	-99	2.62	2.83	3.49	-99	3.86	4.62	2.64	2.17	3.07	3.95	4.36	4.73	4.56	5.19	5.75	6.72	8.09	3.78	5.16	5.21	4.48	2.76
2049	2.23	2.41	-99	2.99	2.64	4.65	-99	4.04	4.48	3.99	4.48	4.41	3.45	2.88	3.03	3.21	1.86	1.54	1.70	2.83	3.32	2.12	1.90	2.66	3.01
2050	2.67	3.11	-99	3.36	1.91	3.48	-99	2.89	3.09	2.55	3.18	2.37	2.57	1.96	1.51	2.39	3.66	2.83	2.11	2.69	2.11	1.92	1.87	1.91	2.51
2051	3.43	2.55	-99	2.51	2.48	4.91	-99	2.78	2.46	2.31	2.09	3.02	3.29	1.87	3.32	2.47	1.94	1.72	3.08	4.31	1.75	1.64	2.19	2.74	2.31
2052	2.01	2.01	-99	2.23	3.43	2.02	-99	2.64	2.55	2.35	2.79	2.48	1.84	3.03	3.95	2.46	2.65	3.42	4.61	4.81	2.36	3.18	2.59	2.59	2.28
2053	2.52	2.37	-99	1.42	1.32	2.90	-99	3.12	2.71	2.67	1.74	3.96	3.57	4.00	5.41	2.11	2.02	3.16	2.85	3.77	2.21	2.56	4.27	4.28	2.69
2054	6.09	4.35	-99	5.36	3.78	4.72	-99	4.00	2.86	4.35	3.44	3.95	3.10	3.87	3.21	3.16	3.42	3.85	3.85	2.56	4.23	3.20	3.42	4.13	3.71
2055	2.17	1.63	-99	3.08	4.88	2.60	-99	2.59	2.18	2.33	3.66	3.17	3.12	3.05	3.43	2.93	2.99	2.49	3.02	3.25	2.70	2.91	2.89	3.57	3.39
2056	2.23	1.64	-99	2.20	1.79	2.86	-99	2.52	2.31	1.87	2.46	2.17	2.63	3.02	2.67	1.93	2.68	2.68	2.37	2.89	3.21	4.64	3.35	2.54	1.98
2057	2.41	2.70	-99	2.40	2.77	1.85	-99	1.56	1.83	2.28	4.57	3.75	3.94	3.44	3.12	6.21	3.70	5.73	6.64	3.88	3.16	5.88	4.63	6.88	3.89
2058	5.31	2.65	-99	2.80	3.39	2.52	-99	3.86	4.51	4.83	3.41	3.07	3.12	3.16	3.13	3.84	3.34	4.07	3.55	4.04	3.24	2.82	2.73	4.10	3.44
2059	4.18	3.18	-99	3.28	3.08	3.75	-99	2.12	1.89	1.83	2.01	2.54	1.58	1.66	2.14	2.69	2.28	1.75	1.46	2.18	2.79	2.58	4.00	3.87	2.41
2060	3.42	3.72	-99	4.69	5.30	5.71	-99	5.97	6.15	4.87	5.96	5.49	5.40	4.50	4.13	2.99	2.67	4.19	4.77	4.57	3.08	2.97	3.27	4.58	5.00

Table C8.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	2.37	1.45	-99	2.34	3.01	1.76	-99	2.46	2.35	1.83	1.67	1.60	2.56	2.27	2.82	2.44	1.95	3.78	3.06	2.77	2.34	2.65	2.41	2.27	3.25
2062	2.84	2.20	-99	2.02	3.40	2.90	-99	3.06	2.57	2.22	3.22	1.99	2.08	2.83	3.62	2.36	2.77	6.42	5.66	4.18	4.29	6.45	4.41	3.53	4.34
2063	2.91	2.73	-99	2.53	2.58	2.74	-99	2.95	3.75	3.76	3.77	3.93	4.24	4.10	4.47	3.85	4.05	3.53	3.44	4.82	2.80	2.89	4.01	5.01	5.17
2064	2.05	2.83	-99	3.13	3.60	2.33	-99	2.19	5.01	4.61	2.08	2.52	3.22	3.71	3.50	2.63	2.50	2.10	2.61	2.02	4.65	4.42	2.25	2.43	2.94
2065	1.83	2.30	-99	5.44	4.72	4.05	-99	3.02	2.80	2.87	2.80	3.72	2.95	2.80	2.22	3.11	2.50	1.87	2.08	2.66	1.85	1.74	1.96	3.62	3.16
2066	2.59	3.89	-99	2.82	4.52	3.26	-99	3.34	4.44	5.25	2.30	2.62	2.68	5.58	5.34	3.75	3.72	3.24	5.47	5.21	3.06	2.86	3.60	5.49	4.04
2067	6.71	7.59	-99	3.98	2.94	4.55	-99	5.80	3.06	3.60	2.87	3.27	4.38	2.54	2.05	2.32	3.09	4.44	2.46	2.57	2.91	2.17	3.24	2.43	2.73
2068	2.83	2.54	-99	2.36	2.67	2.21	-99	3.46	3.27	2.98	5.14	4.04	3.26	2.80	2.72	4.95	4.26	3.44	3.26	3.95	4.83	9.55	7.00	4.73	4.51
2069	1.75	1.82	-99	2.81	1.82	2.98	-99	2.18	2.39	2.36	2.72	2.21	2.21	3.81	2.02	2.02	2.39	2.68	3.58	1.50	2.08	2.74	2.40	2.38	2.68
2070	2.33	2.08	-99	2.25	1.75	3.02	-99	3.18	2.42	1.72	5.67	3.68	5.04	5.23	4.51	6.39	7.67	7.40	7.30	5.91	3.77	3.02	3.07	2.23	2.43

Table C8.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	1.48	1.23	-99	1.32	1.52	1.38	-99	1.36	1.22	1.19	1.26	1.50	1.38	1.30	1.20	1.29	1.50	1.39	1.29	1.06	1.32	1.36	1.40	1.24	0.90
1970	1.28	0.9	-99	0.72	0.69	0.89	-99	0.82	0.74	0.81	0.93	0.85	0.80	0.74	0.76	0.99	0.97	0.84	0.73	0.81	0.98	0.91	0.82	0.67	0.77
1971	0.87	0.8	-99	0.72	0.65	0.84	-99	0.79	0.61	0.72	1.00	0.90	0.77	0.63	0.91	0.95	0.84	0.77	0.82	0.79	0.87	0.77	0.79	0.65	0.84
1972	0.63	0.63	-99	0.78	0.82	0.54	-99	0.61	0.84	0.80	0.46	0.54	0.74	0.86	0.84	0.62	0.79	0.95	1.22	1.32	0.94	1.28	1.57	1.70	1.63
1973	0.81	0.79	-99	0.98	1.01	0.98	-99	0.89	1.03	1.02	1.14	1.13	1.15	0.94	1.14	1.19	1.21	1.20	0.95	1.11	1.11	1.21	1.11	0.97	1.06
1974	0.55	0.67	-99	0.93	1.01	0.58	-99	0.84	0.91	1.00	0.66	0.72	0.88	0.83	0.92	0.84	0.82	0.82	0.90	1.01	0.90	0.86	0.79	1.04	1.06
1975	0.87	0.82	-99	0.77	0.73	1.07	-99	1.01	0.93	0.85	0.82	0.93	1.03	1.03	0.99	0.69	0.57	0.73	0.86	0.95	0.64	0.69	0.78	0.77	0.91
1976	0.77	0.69	-99	0.65	0.7	0.78	-99	0.80	0.86	0.75	0.73	0.82	0.88	0.82	0.81	0.71	0.74	0.77	0.79	0.77	0.63	0.67	0.76	0.96	1.07
1977	0.64	0.64	-99	0.77	0.81	0.69	-99	0.70	0.89	0.97	0.76	0.75	0.88	0.99	1.07	0.86	1.01	1.10	1.20	1.32	0.98	1.09	1.09	1.13	1.29
1978	1.29	1.3	-99	1.3	1.07	1.22	-99	1.16	1.08	0.87	1.21	1.05	0.90	0.83	0.77	0.97	0.89	0.71	0.68	0.61	0.64	0.56	0.63	0.70	0.72
1979	0.7	0.94	-99	1.1	0.91	1.12	-99	1.24	1.11	1.13	0.95	1.04	1.15	1.17	1.23	0.96	1.27	1.20	1.33	1.24	0.99	1.11	1.23	1.38	1.39
1980	1.18	1.13	-99	1.03	1.18	1.15	-99	1.00	1.24	1.62	1.21	1.10	1.30	1.64	1.94	1.07	1.20	1.68	1.92	2.31	1.18	1.72	1.80	2.18	2.57
1981	1.21	1.6	-99	1.67	1.34	1.55	-99	1.99	1.71	1.34	1.31	1.81	1.86	1.45	1.60	1.34	1.54	1.30	1.48	1.47	1.16	1.08	1.18	1.37	1.36
1982	0.47	0.41	-99	0.48	0.54	0.52	-99	0.54	0.62	0.69	0.70	0.72	0.77	0.84	1.19	0.85	0.96	0.98	1.31	1.55	0.85	1.08	1.27	1.50	1.60
1983	1.11	1.12	-99	1.02	0.91	1.26	-99	1.17	1.00	1.15	1.39	1.34	1.04	0.89	1.21	1.53	1.40	1.04	0.81	1.24	1.60	1.16	0.79	0.84	1.26
1984	0.97	0.98	-99	0.92	0.82	0.92	-99	0.84	0.79	0.96	0.95	0.87	0.85	0.96	1.15	1.20	1.16	1.05	1.21	1.37	1.40	1.24	1.26	1.47	1.55
1985	1.49	1.28	-99	1.18	1.07	2.35	-99	2.09	1.88	1.51	2.50	2.54	2.43	2.20	1.79	2.16	2.12	1.89	1.79	1.67	1.54	1.33	1.25	1.22	1.26
1986	1.06	0.97	-99	0.93	0.91	1.05	-99	0.97	0.92	0.92	1.15	1.09	1.03	0.97	0.91	1.42	1.33	1.20	1.12	1.04	1.58	1.55	1.49	1.47	1.38
1987	1.12	1.16	-99	1.28	1.44	1.13	-99	1.20	1.31	1.44	1.05	1.20	1.27	1.30	1.37	1.15	1.28	1.31	1.28	1.16	1.23	1.40	1.36	1.24	1.25
1988	1.29	1.33	-99	1.28	1.24	1.39	-99	1.22	1.24	1.28	1.40	1.30	1.23	1.41	1.28	1.31	1.32	1.54	1.55	1.15	1.23	1.60	1.84	1.46	1.03
1989	1.04	0.97	-99	1.14	1.01	0.95	-99	1.10	1.22	1.11	0.75	1.04	1.19	1.35	1.24	0.67	0.99	1.20	1.43	1.22	0.77	0.94	1.22	1.36	1.13
1990	0.68	0.85	-99	0.95	1.03	0.73	-99	0.90	1.00	1.13	0.77	0.90	0.91	0.81	0.72	0.89	0.89	0.72	0.66	0.88	0.83	0.72	0.71	0.66	0.98

Table C8.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1991	1.16	1.27	-99	1.63	1.79	1.43	-99	1.81	2.06	1.27	1.29	1.53	1.67	1.17	0.96	1.36	1.24	0.90	0.91	1.00	0.97	0.70	0.87	1.00	1.03
1992	0.8	0.92	-99	1.05	0.82	1.00	-99	0.82	1.00	0.71	1.02	0.96	0.63	0.85	1.16	0.99	0.69	0.53	0.69	0.65	0.86	0.72	0.60	0.53	0.75
1993	1.39	1.28	-99	1.26	1.29	1.68	-99	1.30	1.34	1.20	1.85	1.84	1.38	1.30	1.02	1.77	1.94	1.57	1.17	1.07	1.62	1.81	1.52	1.14	1.05
1994	0.47	0.52	-99	0.83	1.15	0.45	-99	0.46	0.73	0.99	0.41	0.41	0.49	0.67	0.93	0.50	0.48	0.52	0.85	1.10	0.52	0.50	0.66	1.19	1.37
1995	1.15	1.41	-99	1.61	1.49	1.52	-99	1.69	1.52	1.39	1.52	1.73	1.54	1.35	1.45	1.55	1.69	1.51	1.66	1.81	1.55	1.64	1.62	1.76	1.67
1996	0.88	0.99	-99	0.89	0.89	0.86	-99	0.99	1.03	0.94	1.13	1.07	1.16	1.13	0.99	1.12	1.16	1.23	1.10	0.95	1.14	1.27	1.21	1.04	1.08
1997	1.79	1.61	-99	1.22	0.77	1.97	-99	1.44	1.18	0.83	2.12	1.78	1.33	1.12	0.83	2.13	1.42	1.29	1.27	0.92	1.93	1.03	1.12	1.03	1.06
1998	1.2	1.39	-99	1.65	1.63	1.07	-99	1.46	1.48	1.14	0.84	1.17	1.35	1.30	1.08	1.09	1.14	1.37	1.37	1.21	1.15	1.43	1.68	1.51	1.37
1999	0.48	0.55	-99	0.87	0.86	0.61	-99	0.73	0.81	0.70	0.77	0.77	0.74	0.74	0.71	0.84	0.77	0.73	0.73	0.68	0.81	0.75	0.65	0.67	1.12
2000	0.99	1.42	-99	1.56	1.61	1.47	-99	1.44	1.58	1.63	1.36	1.69	1.65	1.72	1.77	1.68	1.60	1.88	1.89	2.10	1.61	1.77	1.96	2.27	2.55

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.25	1.58	-99	1.35	1.20	1.45	-99	2.23	2.08	1.22	1.37	1.56	1.98	1.69	1.35	1.37	1.35	1.30	1.41	1.18	1.55	1.21	1.53	1.27	1.24
2040	1.03	0.62	-99	0.67	0.87	0.91	-99	0.70	0.97	1.10	1.11	0.91	0.91	1.05	1.19	1.21	1.01	0.90	1.00	1.10	1.29	1.13	0.78	0.95	1.11
2041	0.93	0.84	-99	1.24	1.77	1.00	-99	0.97	1.32	2.00	0.71	1.02	1.12	1.50	2.21	0.83	0.91	1.27	1.78	2.34	0.86	1.20	1.49	1.95	2.27
2042	0.66	0.81	-99	0.99	0.83	0.69	-99	0.79	0.81	0.99	0.76	0.79	0.86	1.06	1.24	1.15	0.92	0.94	1.18	1.34	0.93	0.92	1.03	1.29	1.43
2043	2.01	2.02	-99	1.34	0.92	2.00	-99	1.04	0.70	0.74	1.92	0.76	0.53	0.75	0.69	0.59	0.41	0.62	0.69	0.56	0.50	0.58	0.58	0.52	0.61
2044	0.72	0.60	-99	0.73	0.84	0.70	-99	0.67	0.99	1.28	0.79	0.87	1.19	1.35	1.17	1.05	1.43	1.40	1.02	0.72	1.77	1.57	1.01	0.94	0.62
2045	0.50	0.53	-99	0.90	1.08	0.61	-99	0.60	1.08	1.22	0.61	0.61	0.77	1.17	1.20	0.44	0.46	0.94	1.14	1.23	0.45	0.69	1.02	1.29	1.46
2046	0.84	0.94	-99	1.07	1.16	0.97	-99	0.95	1.07	1.15	0.93	0.91	1.11	1.05	1.01	0.75	1.21	1.17	0.91	0.94	1.01	0.92	0.96	0.87	0.98
2047	1.80	1.65	-99	1.70	1.49	1.48	-99	1.18	1.23	1.29	1.61	1.34	1.19	1.18	1.19	1.34	1.39	1.37	1.15	1.11	1.29	1.44	1.28	1.12	1.39
2048	1.33	1.35	-99	1.43	1.67	1.62	-99	1.62	1.67	1.72	1.81	1.79	1.73	1.47	1.76	1.60	1.56	1.26	1.57	1.73	1.37	1.15	1.34	1.62	1.65
2049	0.92	0.87	-99	0.86	0.68	0.75	-99	0.65	0.69	0.64	0.91	0.62	0.55	0.56	0.56	0.92	0.74	0.63	0.89	0.61	0.91	1.02	0.64	0.69	0.76
2050	0.89	0.88	-99	0.68	1.10	0.85	-99	0.72	0.84	1.31	0.73	0.77	0.89	0.99	1.09	1.00	0.93	1.03	1.25	1.80	0.97	1.20	1.43	1.83	1.30
2051	1.29	1.47	-99	1.23	1.13	1.37	-99	1.17	1.03	1.08	1.66	1.64	0.95	1.09	1.30	1.88	1.41	1.00	1.15	1.53	1.57	1.00	1.01	1.41	1.52
2052	1.76	1.65	-99	1.91	1.43	1.77	-99	1.74	1.89	1.40	1.73	1.71	1.80	1.87	1.36	1.56	1.59	1.92	1.73	1.56	1.52	1.54	2.15	1.67	1.90
2053	0.68	0.74	-99	0.80	0.87	0.75	-99	0.70	0.75	0.94	1.02	0.78	0.91	1.02	0.97	1.16	0.94	0.96	0.89	1.13	1.19	1.07	1.04	1.13	1.27
2054	0.83	0.95	-99	1.16	1.00	0.80	-99	1.02	1.25	1.12	0.93	0.93	1.09	1.23	1.10	0.88	1.00	1.09	1.06	1.27	0.92	1.00	1.14	1.29	1.23
2055	1.74	1.63	-99	1.78	2.02	1.59	-99	1.41	1.67	2.15	1.44	1.19	1.08	1.78	2.92	0.88	1.06	1.14	1.84	3.25	0.69	0.88	1.13	1.77	2.94
2056	0.91	1.13	-99	1.47	1.33	1.46	-99	1.32	1.63	1.48	1.87	1.93	1.83	1.70	1.50	1.01	1.26	1.39	1.62	1.78	1.10	1.05	1.31	1.53	1.67
2057	1.35	1.26	-99	1.42	1.26	1.32	-99	1.41	1.44	1.37	1.54	1.45	1.46	1.45	1.45	1.97	1.73	1.26	1.45	1.46	2.03	1.51	1.14	1.27	1.70
2058	1.33	1.64	-99	1.98	2.05	1.44	-99	1.64	1.95	2.27	1.45	1.75	2.08	2.45	3.01	1.42	1.97	2.53	2.74	2.84	1.82	2.44	2.49	2.09	1.71
2059	1.05	1.21	-99	1.29	1.53	1.08	-99	1.29	1.42	1.61	0.82	1.07	1.29	1.48	1.63	0.70	1.00	1.16	1.28	1.64	0.70	0.91	0.92	1.15	1.50
2060	0.87	1.09	-99	1.38	1.51	0.83	-99	1.11	1.33	1.46	0.87	0.80	1.06	1.21	1.29	0.84	0.87	0.99	1.01	1.13	0.82	0.94	1.02	0.92	1.06

Table C8.D Seasonal Maximum Series: Future Day Climate

Table C8.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	0.91	1.06	-99	0.70	0.68	1.16	-99	0.75	0.91	0.76	1.17	0.84	0.54	0.62	0.67	0.91	0.50	0.48	0.57	0.62	0.84	0.66	0.64	0.67	0.58
2062	0.76	0.57	-99	0.69	0.86	0.54	-99	0.73	0.87	1.11	0.57	0.75	1.01	1.19	1.43	0.72	0.94	1.23	1.35	1.50	1.00	1.16	1.32	1.44	1.58
2063	0.82	0.88	-99	1.01	1.26	0.96	-99	0.95	1.21	1.17	1.08	1.08	1.11	1.01	1.12	1.20	0.97	0.87	1.01	1.11	0.93	0.81	0.87	0.99	1.08
2064	0.65	0.80	-99	1.38	1.29	0.90	-99	1.06	1.18	0.99	0.78	0.65	0.69	0.58	1.24	0.42	0.38	0.44	0.85	1.13	0.41	0.40	0.43	0.60	0.70
2065	0.51	0.78	-99	0.91	1.54	0.57	-99	0.83	0.99	1.71	0.63	0.70	0.87	1.07	2.03	0.67	0.95	1.05	1.36	2.64	0.97	1.09	1.20	1.55	3.16
2066	2.59	2.27	-99	1.69	1.30	2.40	-99	2.06	1.99	1.40	2.06	2.09	1.81	1.84	1.30	2.08	1.96	1.50	1.56	1.10	2.26	1.92	1.28	1.29	1.07
2067	1.37	1.24	-99	1.25	0.87	1.69	-99	1.36	1.05	0.84	1.91	1.75	1.41	1.08	1.11	1.78	1.58	1.40	1.05	0.79	1.66	1.47	1.45	1.32	1.00
2068	1.46	1.28	-99	1.28	1.20	1.06	-99	1.57	1.19	1.15	1.28	1.43	1.42	0.99	1.24	1.15	1.51	1.43	1.33	1.83	1.51	1.86	1.74	1.91	2.04
2069	1.41	1.82	-99	2.81	1.68	2.45	-99	2.18	2.39	1.95	2.13	2.21	2.21	2.40	2.02	2.02	1.89	1.80	1.65	1.40	1.90	1.95	1.63	1.42	1.17
2070	0.50	0.49	-99	0.70	0.68	0.62	-99	0.62	0.88	0.65	0.79	0.70	0.79	0.95	0.52	0.57	0.66	0.77	0.76	0.42	0.58	0.64	0.56	0.58	0.40

Table C9

Weather Research and Forecasting with the Grell Model; Canadian Coupled Global Climate Model 3

Table C9.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	1.67	1.84	1.46	1.54	1.19	2.23	2.50	2.41	1.52	1.76	2.20	2.16	2.21	1.84	2.97	1.79	1.58	2.14	2.55	3.23	1.31	1.35	1.28	1.84	1.51
1970	1.31	1.44	1.58	1.36	2.06	1.08	1.18	1.13	2.20	1.97	0.93	0.84	1.75	1.43	1.99	1.31	1.03	1.06	0.95	1.15	1.47	1.43	1.57	1.89	2.06
1971	1.21	1.26	1.59	1.69	1.26	1.52	1.55	1.64	1.51	1.35	2.37	1.31	1.62	1.44	1.06	2.95	2.39	1.54	1.46	1.91	2.68	2.01	1.53	2.25	3.32
1972	1.42	1.17	1.49	1.50	1.49	0.98	1.31	1.13	0.99	1.31	0.90	0.73	0.72	1.42	1.29	1.05	1.13	2.44	3.44	2.44	1.49	2.72	2.20	1.79	1.57
1973	1.47	1.72	1.47	1.60	2.08	1.48	1.22	1.17	1.56	2.61	1.65	1.73	1.54	3.35	3.21	1.55	1.87	1.96	1.70	1.53	1.78	1.71	2.03	3.56	1.58
1974	1.87	1.72	1.40	1.41	1.04	1.37	1.93	1.29	1.29	1.68	1.28	1.25	1.48	1.14	1.71	1.13	1.55	1.77	1.88	1.76	1.14	1.59	2.45	2.15	1.90
1975	2.61	4.53	2.69	1.96	1.03	2.61	2.84	2.26	1.01	1.15	2.20	1.94	1.33	2.51	2.57	1.76	2.45	2.01	2.00	1.86	1.66	1.94	1.52	2.73	1.46
1976	0.61	0.84	0.80	0.90	1.10	0.92	1.16	1.01	1.46	1.22	0.80	0.59	0.78	1.27	1.17	0.57	0.67	0.92	1.31	1.25	0.59	0.65	1.24	0.94	1.19
1977	1.31	1.86	2.04	1.93	2.10	2.40	2.18	1.70	1.78	2.22	1.80	1.09	1.72	2.05	1.65	1.03	1.09	1.39	1.45	2.21	0.94	1.18	1.31	2.47	2.34
1978	2.66	1.38	1.29	2.25	2.53	1.89	1.85	1.83	1.62	1.61	2.17	2.06	1.56	1.82	1.47	2.36	2.29	2.01	1.90	2.39	1.54	1.90	2.56	2.11	2.16
1979	1.30	0.87	0.62	0.49	0.56	1.30	0.79	0.59	0.56	0.63	1.35	1.05	0.75	0.84	1.55	1.06	1.04	1.34	1.49	2.34	1.79	1.96	2.02	2.00	2.03
1980	2.56	3.83	5.29	5.56	3.02	3.53	4.77	3.73	2.76	1.93	5.42	3.14	2.51	2.08	1.97	4.15	1.77	3.36	2.45	2.79	2.33	2.49	2.70	3.14	3.41
1981	2.13	1.93	2.36	1.45	1.15	1.76	1.43	2.63	1.39	2.60	1.35	1.86	2.50	3.35	3.05	2.02	2.54	3.70	2.56	2.90	2.59	3.05	3.14	3.21	2.83
1982	1.63	1.50	1.39	1.10	1.65	1.64	1.34	1.71	1.62	1.83	2.21	1.31	1.55	1.69	1.55	1.87	2.42	2.51	2.46	2.71	3.22	2.62	3.61	3.86	3.34
1983	2.61	1.83	2.81	2.90	1.90	1.70	2.11	2.64	2.16	2.25	1.59	2.12	2.03	1.92	2.02	2.32	2.78	2.64	2.68	4.25	1.87	2.75	2.81	2.89	3.53
1984	2.16	1.86	1.25	1.65	2.40	1.82	1.32	2.04	2.58	2.10	1.38	2.07	2.71	2.36	1.91	1.48	1.89	3.11	2.53	1.62	1.36	3.04	3.94	1.49	3.43
1985	1.79	2.41	2.49	2.47	2.51	2.80	3.48	3.12	1.61	1.87	2.30	2.28	2.44	2.89	2.09	1.74	2.69	2.04	2.35	1.90	2.10	2.94	1.49	1.88	1.76
1986	2.05	2.26	2.62	2.77	2.18	2.16	2.19	2.10	1.94	1.80	1.87	2.13	4.58	4.69	3.53	2.35	3.68	2.93	3.44	3.61	1.96	4.80	3.19	2.88	3.48
1987	1.45	1.62	1.31	2.20	3.14	1.64	2.06	3.08	2.64	2.71	1.67	2.49	3.04	1.98	2.12	1.58	2.09	1.52	1.97	2.65	1.48	1.31	1.52	2.25	2.60
1988	1.50	1.78	1.45	1.28	1.52	1.66	1.51	1.28	1.45	1.70	1.80	1.26	1.85	1.83	1.84	2.01	2.12	2.38	1.81	2.08	1.37	1.82	2.00	2.43	2.49

Table C9.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	2.91	2.95	2.62	2.49	1.75	3.73	3.53	2.68	1.94	2.19	1.63	2.29	2.31	2.11	1.98	1.63	1.56	1.58	1.98	1.89	1.60	1.61	1.93	2.30	2.50
1990	2.46	2.69	1.92	1.87	1.68	2.39	2.39	2.69	2.42	3.77	1.90	2.32	2.80	3.80	2.47	1.81	2.53	2.78	2.54	2.13	2.53	3.76	2.36	1.58	1.32
1991	3.74	2.73	1.89	1.72	1.72	2.31	2.39	2.58	2.91	2.79	3.12	2.41	1.98	1.94	2.08	1.80	2.75	2.38	2.34	2.24	2.09	1.74	1.74	1.89	3.40
1992	1.45	1.78	1.79	2.04	1.47	2.40	1.45	1.51	1.16	2.19	3.03	2.28	2.22	1.89	2.55	1.81	1.74	2.35	2.54	3.01	0.90	0.83	1.36	1.68	1.35
1993	1.56	2.14	2.10	2.31	1.60	1.51	2.74	1.91	1.58	1.87	2.52	1.76	1.76	1.41	1.74	1.54	1.75	1.70	1.35	1.92	1.66	1.28	1.40	1.40	1.60
1994	2.40	2.17	1.62	1.73	1.77	1.80	1.69	1.93	2.84	4.16	2.26	2.27	3.93	4.81	2.48	2.37	2.43	1.65	1.54	3.62	0.99	1.47	1.38	2.25	3.52
1995	2.57	3.94	1.71	1.44	1.33	2.69	2.13	2.11	1.94	1.69	2.32	2.08	1.83	1.71	1.63	3.03	2.29	1.69	1.29	1.49	1.32	1.85	1.39	1.25	1.63
1996	1.75	2.13	1.65	1.44	1.08	2.00	1.99	1.85	3.52	4.63	1.68	2.20	3.13	3.17	2.27	1.99	1.75	1.59	1.52	3.95	1.93	1.49	1.31	1.57	2.26
1997	1.89	1.69	1.63	2.03	1.48	1.43	1.52	1.81	1.72	1.54	1.48	1.43	1.98	2.48	2.69	2.10	2.20	2.02	3.08	3.07	2.59	2.47	2.38	2.36	1.55
1998	2.18	1.27	1.25	1.79	1.71	2.28	2.30	3.22	2.61	2.45	1.83	2.88	2.97	2.20	1.90	1.60	2.23	1.83	1.85	2.11	1.56	3.22	1.62	1.67	1.78
1999	2.40	2.66	2.35	1.85	1.42	2.72	2.63	2.27	1.85	1.76	2.78	2.28	2.13	2.49	2.94	1.95	1.84	2.42	3.94	4.22	1.47	3.46	5.23	4.20	3.38

Table C9.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	2.63	2.90	2.87	2.67	2.30	2.43	2.70	2.73	2.61	2.11	2.63	2.58	2.91	2.35	2.12	2.31	2.92	2.89	2.55	2.82	2.55	3.11	2.48	1.96	2.03
2040	1.55	3.17	1.95	2.18	2.43	1.74	2.21	2.50	2.77	2.32	1.81	2.60	2.28	3.21	2.07	2.71	3.04	2.90	2.66	3.11	2.58	3.03	2.46	2.80	3.40
2041	2.17	1.75	1.99	1.91	1.60	1.61	1.86	1.93	2.09	2.00	2.24	1.87	1.77	2.48	2.08	2.27	1.97	2.12	2.32	2.60	2.08	1.76	2.27	2.90	3.27
2042	1.31	1.37	1.24	1.33	1.90	3.70	1.74	1.57	1.39	2.10	2.09	2.53	3.72	3.93	4.60	0.90	0.95	1.20	2.05	1.79	1.32	1.25	1.54	1.27	1.31
2043	2.44	1.93	1.78	1.95	1.98	2.44	2.64	2.54	3.03	3.29	2.58	2.08	1.82	1.80	2.51	2.22	2.32	1.86	2.93	1.75	1.39	1.68	2.12	1.88	2.05
2044	1.47	1.62	2.13	3.44	2.54	2.58	2.59	2.99	2.83	1.77	1.87	1.87	1.75	1.79	1.44	1.28	1.57	2.69	3.35	3.87	3.96	4.29	3.45	2.76	2.41
2045	2.89	2.49	2.03	1.95	2.37	2.26	2.53	1.42	1.71	2.15	2.41	1.31	1.13	1.73	2.41	1.72	1.13	1.10	1.51	2.01	1.50	1.53	2.92	1.69	1.91
2046	2.22	2.18	1.47	1.63	2.00	2.36	1.93	1.72	1.96	1.90	2.08	2.27	2.60	2.34	1.73	2.31	3.56	2.98	2.22	1.72	2.45	2.32	1.23	2.02	1.80
2047	1.78	2.16	2.07	2.13	2.32	1.72	1.64	2.23	2.78	2.90	2.08	2.28	3.48	3.28	3.95	2.27	3.27	4.43	3.70	4.58	2.48	4.76	4.58	3.44	2.69
2048	1.78	1.84	1.52	1.55	2.17	1.75	1.57	2.42	2.50	1.56	2.02	2.14	1.84	2.55	2.08	1.78	1.80	2.45	2.26	2.27	1.58	2.53	2.69	2.06	2.08
2049	2.93	3.03	1.29	3.24	3.52	1.99	1.22	1.26	1.69	1.87	0.95	1.45	1.65	2.92	3.25	1.87	1.74	3.25	4.05	3.17	1.86	1.76	1.25	1.30	1.54
2050	2.80	3.40	2.79	2.11	2.80	2.61	2.79	2.82	2.18	2.85	1.71	1.73	2.59	2.15	2.70	1.59	1.95	2.17	2.85	2.70	2.07	2.21	2.70	2.30	2.42
2051	3.18	4.00	3.32	1.89	2.61	3.67	2.62	2.49	2.40	2.14	4.13	2.49	2.57	2.24	2.00	3.49	2.86	2.90	2.82	2.28	2.73	2.42	1.97	2.23	2.66
2052	2.07	1.70	3.33	2.50	3.04	1.51	2.54	3.34	5.39	7.38	1.92	2.74	3.62	3.56	2.75	1.99	2.37	1.69	3.98	2.16	2.15	2.29	2.30	3.31	2.01
2053	2.64	2.26	3.09	2.94	3.02	2.04	2.72	2.47	2.56	2.73	1.85	1.70	2.31	4.28	3.65	1.91	3.76	5.37	3.05	2.44	5.28	4.31	2.11	2.02	2.28
2054	4.40	2.93	1.97	2.30	2.02	2.70	2.34	2.77	1.92	2.28	2.74	2.33	2.01	1.67	1.97	2.62	2.10	2.31	3.51	3.59	3.79	2.95	4.13	2.32	2.93
2055	1.89	2.11	3.63	2.33	2.32	1.79	2.91	3.36	2.21	2.06	2.23	2.14	2.50	4.03	6.74	2.58	2.81	2.13	1.91	4.40	2.45	2.41	2.44	2.50	2.19
2056	2.38	3.38	1.86	1.32	1.31	3.26	1.97	1.59	2.05	2.98	2.51	1.89	3.04	2.76	2.40	2.72	3.56	2.87	2.08	1.79	2.72	3.63	3.11	1.78	1.91
2057	1.72	1.58	2.68	2.09	1.47	1.59	2.62	2.58	1.57	1.85	2.57	2.30	1.29	1.67	1.71	1.44	1.10	1.43	1.71	1.65	1.04	1.27	1.54	1.88	5.26
2058	2.43	2.84	3.45	2.71	2.43	1.97	3.51	3.64	2.80	2.46	1.61	3.37	3.43	2.86	2.76	3.68	3.02	3.63	3.05	2.49	3.37	2.57	2.33	2.74	3.58
2059	1.42	2.05	1.75	1.61	1.38	1.13	2.20	2.00	2.13	2.26	1.40	2.34	1.91	2.50	2.57	2.33	2.25	2.51	2.99	3.39	3.37	3.12	2.37	2.72	3.83
2060	3.19	2.27	2.29	3.03	2.17	2.66	2.14	2.62	3.09	3.55	2.16	2.44	2.05	3.20	3.33	3.26	2.44	3.56	2.74	4.03	3.01	2.93	3.78	3.98	4.17

Table C9.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.32	1.85	1.68	2.06	1.73	1.72	2.06	2.06	1.65	1.66	2.46	2.73	2.58	2.23	2.71	2.72	1.90	2.02	3.41	2.75	2.26	2.35	3.77	3.96	2.83
2062	1.83	1.85	1.86	2.27	2.38	1.76	1.55	1.99	2.08	3.23	2.14	2.25	2.14	2.73	2.81	2.91	2.26	2.46	2.67	2.86	2.53	2.19	1.94	1.69	2.06
2063	2.60	2.65	2.74	3.31	3.05	2.76	3.80	4.01	2.92	2.87	4.30	3.66	2.31	2.27	2.19	2.37	2.14	2.26	2.34	1.51	2.34	2.19	2.59	1.56	2.21
2064	2.82	2.96	3.45	3.36	2.93	4.04	4.38	4.35	3.74	2.55	4.66	4.74	3.09	2.52	2.23	2.48	2.28	2.94	2.12	2.29	2.11	3.56	3.37	2.55	2.89
2065	1.49	1.92	2.07	2.09	1.63	1.62	2.31	2.95	2.15	2.96	2.36	3.55	2.88	3.53	3.43	3.37	3.51	3.30	2.31	2.18	3.19	2.31	2.50	3.04	5.46
2066	3.26	2.94	3.45	3.61	3.12	3.45	2.86	2.66	2.26	3.39	2.15	3.60	3.39	3.77	2.94	3.57	3.14	2.48	4.39	4.42	2.46	3.21	5.62	4.25	2.30
2067	2.79	2.25	2.54	1.79	2.25	2.97	3.94	3.62	2.92	3.04	4.26	3.56	4.14	3.73	3.71	4.08	4.82	3.49	2.69	2.62	4.12	2.34	2.80	2.99	2.14
2068	1.98	2.34	3.00	3.43	3.24	1.61	2.98	1.93	1.91	2.15	2.16	1.81	1.91	1.93	3.11	2.69	2.03	2.96	2.92	1.52	2.27	2.58	2.72	2.17	1.72
2069	3.55	2.62	1.79	2.09	1.68	1.84	2.16	1.71	1.89	1.73	1.70	1.61	1.90	2.89	3.17	1.96	2.51	2.94	2.37	2.24	1.86	2.64	1.40	2.01	1.65
2070	2.39	3.04	1.78	2.80	2.54	2.82	3.23	2.51	2.38	3.13	2.74	2.63	2.26	4.37	3.68	2.44	2.04	4.56	3.16	3.91	2.14	3.63	3.22	4.84	4.77

Table C9.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	0.50	0.52	0.74	0.83	0.76	0.83	0.59	0.75	0.79	0.73	0.85	0.55	0.65	0.63	0.63	0.57	0.64	0.68	0.67	0.69	0.65	0.80	0.81	0.81	0.88
1970	0.68	0.57	0.58	1.04	1.26	0.85	0.53	0.89	1.02	1.03	0.73	0.67	0.65	0.63	0.56	0.70	0.65	0.64	0.62	0.50	0.82	0.67	0.48	0.46	0.53
1971	0.66	0.72	0.67	0.66	0.74	0.58	0.50	0.51	0.52	0.54	0.48	0.42	0.33	0.45	0.51	0.51	0.39	0.59	0.55	0.53	0.48	0.59	0.70	0.50	0.44
1972	0.57	0.53	0.53	0.53	0.78	0.58	0.60	0.66	0.67	0.71	0.62	0.56	0.53	0.51	0.60	0.50	0.53	0.62	0.65	0.73	0.91	1.07	1.00	0.85	0.91
1973	0.68	0.64	0.43	0.48	0.64	0.66	0.45	0.54	0.77	0.90	0.72	0.55	0.79	1.00	1.01	0.66	0.89	1.10	1.12	0.94	1.03	1.28	1.24	0.97	0.99
1974	0.44	0.47	0.71	1.01	1.00	0.47	0.59	0.90	0.96	0.73	0.60	0.66	0.89	0.85	0.64	0.60	0.70	0.99	0.88	0.76	0.75	0.84	0.94	0.99	0.97
1975	0.99	0.89	0.84	0.93	0.67	0.90	0.87	0.95	0.92	0.48	0.84	0.90	1.09	0.69	0.43	0.89	1.07	0.98	0.62	0.51	0.99	1.15	0.84	0.58	0.63
1976	0.54	0.58	0.58	0.82	1.10	0.53	0.52	0.75	1.04	1.22	0.56	0.59	0.78	0.76	0.75	0.57	0.67	0.64	0.69	0.53	0.59	0.65	0.49	0.55	0.53
1977	0.83	0.94	1.00	1.10	1.11	0.83	1.01	1.11	1.05	1.18	1.04	1.01	1.04	0.88	0.90	1.03	1.02	1.07	0.96	0.85	0.94	1.10	1.11	0.94	0.87
1978	0.48	0.59	0.73	0.90	0.98	0.56	0.72	0.96	1.09	1.11	0.65	0.73	0.85	0.90	0.84	0.76	0.75	0.81	0.74	0.94	0.77	0.74	0.80	0.67	1.17
1979	0.75	0.87	0.62	0.44	0.51	0.73	0.49	0.50	0.50	0.54	0.63	0.54	0.53	0.56	0.61	0.66	0.53	0.54	0.65	0.86	0.71	0.52	0.59	0.87	0.98
1980	1.06	1.20	1.06	0.84	0.73	1.01	0.83	0.62	0.62	0.97	0.65	0.44	0.33	0.68	1.06	0.53	0.41	0.46	0.84	1.08	0.56	0.51	0.61	0.91	1.06
1981	1.37	1.57	1.66	1.45	1.01	1.40	1.43	1.13	0.87	0.73	1.26	1.00	0.63	0.49	0.45	1.00	0.80	0.75	0.69	0.61	0.90	0.93	1.04	1.01	0.90
1982	1.63	1.50	1.39	1.07	1.03	1.27	0.97	0.98	0.82	0.96	0.97	0.80	0.72	0.74	0.77	0.87	0.73	0.63	0.71	0.82	0.72	0.61	0.76	0.79	0.94
1983	0.99	1.19	1.24	1.22	1.09	1.00	1.23	1.49	1.45	1.29	1.06	1.11	1.21	1.21	1.11	1.23	1.40	1.31	1.25	1.19	1.65	1.71	1.64	1.46	1.29
1984	0.54	0.61	0.62	0.62	0.73	0.54	0.59	0.75	0.83	0.89	0.73	0.80	0.80	0.81	0.90	0.91	0.92	0.88	1.01	1.00	1.16	1.25	1.21	1.10	1.06
1985	0.82	0.93	1.05	1.03	1.12	0.86	0.85	1.19	1.37	1.45	0.88	0.88	1.10	1.20	1.40	1.12	1.11	1.17	1.27	1.51	1.27	1.30	1.19	1.34	1.66
1986	1.24	1.75	2.00	2.01	1.68	1.63	2.13	2.10	1.57	1.21	1.53	1.42	1.25	1.03	0.91	1.22	1.02	1.03	0.97	1.10	1.10	1.20	1.22	1.26	1.29
1987	0.97	1.22	1.31	1.30	1.04	1.10	1.27	1.43	1.39	1.17	1.14	1.10	1.26	1.28	1.29	1.22	1.04	1.23	1.45	1.33	1.38	1.12	1.32	1.41	1.57
1988	1.50	1.78	1.45	1.10	0.63	1.34	0.97	0.83	0.70	0.76	1.22	0.84	0.91	1.00	0.82	1.32	1.04	1.29	1.41	1.19	1.37	1.23	1.53	1.55	1.24
1989	1.17	1.24	1.15	1.30	1.32	1.31	1.48	1.79	1.77	1.57	1.57	1.58	1.55	1.57	1.46	1.63	1.56	1.58	1.54	1.85	1.60	1.61	1.93	2.30	2.50
1990	1.40	1.67	1.75	1.87	1.68	1.65	1.83	1.88	1.69	1.46	1.83	1.67	1.38	1.18	1.02	1.56	1.26	1.19	1.09	0.89	1.35	1.24	1.15	1.06	0.96

Table C9.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1991	0.71	1.12	1.07	1.29	1.37	0.98	1.20	1.23	1.38	1.12	1.26	1.16	1.21	1.00	0.92	1.28	1.22	1.07	0.90	0.99	1.41	1.23	0.87	0.99	1.08
1992	1.31	1.78	1.79	1.51	1.23	0.60	0.68	0.91	0.77	0.67	0.64	0.57	0.50	0.61	0.68	0.57	0.47	0.75	1.00	0.99	0.54	0.60	1.07	1.16	1.10
1993	1.05	1.12	1.13	1.26	1.29	0.99	1.30	1.59	1.58	1.49	1.33	1.76	1.76	1.41	1.10	1.54	1.61	1.44	1.35	1.21	1.23	1.28	1.40	1.40	1.08
1994	0.52	1.01	1.07	0.62	0.54	0.69	0.93	0.80	1.06	1.18	0.59	0.58	0.70	0.92	0.98	0.62	0.57	0.51	0.49	0.50	0.76	0.74	0.62	0.43	0.32
1995	0.51	0.58	0.50	0.48	0.47	0.47	0.43	0.43	0.40	0.46	0.42	0.36	0.36	0.42	0.44	0.46	0.35	0.37	0.36	0.45	0.50	0.50	0.50	0.53	0.54
1996	1.47	1.52	1.57	1.44	0.95	1.60	1.50	1.76	1.70	1.07	1.68	1.60	1.38	1.37	0.91	1.92	1.57	1.18	1.21	1.00	1.93	1.24	1.06	1.09	1.12
1997	0.59	0.45	0.51	0.38	0.35	0.51	0.46	0.40	0.27	0.30	0.57	0.44	0.37	0.36	0.24	0.67	0.62	0.57	0.54	0.48	0.93	0.89	0.84	0.75	0.69
1998	0.69	0.81	1.03	1.00	0.90	0.75	0.89	1.05	0.97	0.64	0.72	0.94	1.06	0.68	0.53	0.85	0.99	1.07	0.62	0.61	0.85	1.10	0.99	0.69	0.76
1999	1.19	1.40	1.52	1.54	1.15	1.37	1.08	1.41	1.28	0.95	1.09	1.06	1.21	1.13	0.85	1.00	1.01	1.11	1.05	0.82	0.83	0.89	0.97	0.94	0.81

Table C9.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.09	0.98	0.95	1.02	1.03	0.77	0.94	0.98	1.08	0.94	0.89	0.92	0.86	0.78	0.65	0.79	0.89	0.89	0.76	0.83	0.83	0.99	0.97	0.88	1.04
2040	1.05	1.03	1.18	1.05	0.90	1.24	0.90	0.65	0.88	1.18	1.07	0.58	0.73	1.08	1.22	0.95	0.61	0.72	0.91	1.08	0.63	0.61	0.72	0.89	1.12
2041	0.76	0.73	1.15	1.69	1.60	0.56	0.72	1.60	2.09	1.99	0.45	0.76	1.55	1.92	1.87	0.59	0.88	1.29	1.63	1.83	0.68	0.91	1.05	1.23	1.81
2042	1.10	1.14	1.24	1.01	0.58	0.97	1.08	1.23	0.77	0.95	0.86	0.81	0.89	0.82	0.84	0.90	0.94	1.03	0.87	0.94	1.04	0.98	0.91	0.95	0.98
2043	0.88	1.11	1.33	1.37	1.28	0.80	0.95	1.11	1.36	1.26	0.64	0.59	0.90	1.01	0.80	0.61	0.75	0.97	0.90	1.05	0.75	0.85	1.20	1.05	1.18
2044	0.44	0.72	0.84	1.21	0.86	0.40	0.73	0.85	1.13	0.93	0.41	0.61	0.84	0.76	1.44	0.42	0.43	0.83	1.03	1.30	0.76	0.70	0.86	1.49	1.32
2045	0.69	0.52	0.49	0.71	0.84	0.53	0.46	0.69	1.06	1.23	0.50	0.58	0.80	0.76	0.64	0.48	0.63	0.66	0.56	0.50	0.45	0.55	0.59	0.54	0.43
2046	0.67	0.79	0.75	0.75	0.88	0.79	0.81	0.87	0.82	0.75	0.86	0.81	0.77	0.69	0.66	0.85	0.72	0.68	1.00	0.93	0.63	0.56	1.21	1.17	0.66
2047	1.11	1.12	1.07	1.07	0.97	1.09	1.15	1.14	1.00	1.09	1.02	1.10	1.25	1.28	1.13	1.43	1.46	1.28	1.10	1.10	1.41	1.08	1.30	1.45	1.39
2048	1.12	1.43	1.52	1.55	1.48	1.28	1.50	1.66	1.33	1.22	1.52	1.42	1.29	1.10	1.01	1.51	1.29	1.35	1.30	1.12	1.44	1.61	1.70	1.59	1.27
2049	0.74	0.94	0.91	0.83	0.90	0.83	0.93	0.99	1.05	1.07	0.82	0.81	0.88	0.97	0.86	0.96	1.09	1.27	1.30	1.15	0.90	1.13	1.25	1.26	1.31
2050	1.48	1.83	2.03	2.11	1.72	1.49	1.77	2.07	2.18	1.83	1.71	1.56	1.57	2.14	2.38	1.59	1.95	2.17	2.85	2.70	1.76	2.04	2.22	2.28	2.42
2051	1.21	1.31	1.20	1.13	0.96	1.12	1.03	1.23	0.97	0.62	0.88	1.02	0.96	0.81	0.96	1.00	1.04	1.00	1.36	1.66	1.14	0.98	1.33	1.67	1.67
2052	1.03	1.27	0.94	1.29	1.30	0.88	0.80	1.13	1.38	1.41	0.79	0.82	1.06	1.37	1.31	0.89	0.89	1.32	1.23	1.27	0.95	1.02	1.68	1.15	1.11
2053	0.47	0.44	0.47	0.58	0.79	0.53	0.42	0.54	0.74	0.60	0.82	0.46	0.67	0.66	0.67	1.02	0.65	0.68	0.87	0.93	0.70	0.75	0.86	1.01	1.06
2054	0.47	0.77	1.03	0.90	0.95	0.47	0.77	0.88	1.06	1.02	0.57	0.78	1.07	1.08	0.74	0.65	0.77	1.12	0.83	0.55	0.71	0.96	0.99	0.76	0.93
2055	1.12	1.49	1.54	1.86	1.71	1.28	1.76	1.88	1.85	1.76	1.51	2.14	2.06	1.70	1.71	1.71	2.34	2.13	1.87	1.93	1.68	2.41	2.44	2.50	2.19
2056	0.88	1.34	1.06	1.16	1.31	1.02	0.88	1.03	1.36	1.38	0.62	0.76	0.98	1.16	1.22	0.70	0.87	1.16	1.25	1.22	0.78	0.96	1.34	1.46	1.72
2057	1.29	1.25	0.76	1.16	1.47	1.06	0.83	1.16	1.57	1.85	0.82	0.96	1.29	1.67	1.71	1.11	1.10	1.39	1.71	1.65	1.04	1.27	1.54	1.88	1.57
2058	0.94	0.97	0.86	1.06	1.28	0.94	0.77	1.09	1.36	1.53	0.79	0.90	1.09	1.26	1.18	0.92	0.93	0.89	0.92	0.92	0.74	0.71	0.78	1.07	1.16
2059	0.62	0.62	0.57	0.92	1.06	0.64	0.76	1.05	1.21	1.07	1.09	1.15	0.93	0.80	0.73	1.32	1.31	1.10	0.84	0.73	1.79	1.70	1.45	1.66	1.35
2060	1.35	1.87	1.14	1.68	1.11	1.61	1.58	1.14	1.71	1.36	1.50	1.24	0.85	1.48	1.18	1.41	1.21	0.98	1.09	1.23	1.15	1.08	1.13	0.90	1.13

Table C9.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.07	1.28	1.44	1.61	1.14	1.01	1.14	1.58	1.50	1.11	1.04	1.03	1.63	1.61	1.18	0.98	0.95	1.67	1.73	1.38	0.90	0.87	1.59	1.95	1.71
2062	1.01	1.17	1.25	1.25	1.13	1.10	1.14	1.20	1.11	1.16	1.07	0.78	0.87	0.95	1.18	0.96	0.76	0.79	0.84	1.39	0.87	0.86	0.79	0.87	1.47
2063	0.87	0.95	0.70	0.56	0.81	0.69	0.52	0.58	0.56	0.92	0.56	0.47	0.54	0.61	1.05	0.61	0.61	0.64	0.90	1.29	0.64	0.69	0.69	1.15	1.33
2064	0.49	0.55	0.35	0.69	0.69	0.44	0.39	0.53	0.74	0.72	0.55	0.49	0.74	0.80	0.60	0.70	0.75	0.74	0.64	0.66	0.74	0.81	0.74	0.77	0.87
2065	1.38	0.93	0.94	2.09	1.37	1.11	0.98	1.47	2.15	1.49	0.90	1.08	2.13	2.24	1.56	0.84	1.06	2.02	2.31	1.56	0.96	1.37	2.07	2.26	1.33
2066	0.63	0.72	0.82	1.01	1.08	0.69	0.74	0.81	0.84	0.96	0.76	0.76	0.71	0.80	1.30	0.81	0.76	0.85	1.64	2.11	0.83	1.60	2.65	2.84	2.28
2067	0.77	0.93	1.00	1.15	1.52	0.92	0.99	1.23	1.49	1.39	1.02	0.99	1.07	1.32	1.07	1.15	1.11	1.13	1.22	1.13	1.33	1.34	1.56	1.42	1.28
2068	1.23	1.68	1.56	1.46	1.88	1.61	1.82	1.93	1.82	2.15	1.79	1.81	1.91	1.55	1.67	1.94	1.74	1.54	1.22	1.52	1.97	1.62	1.63	1.75	1.72
2069	0.59	0.78	0.87	1.08	1.09	0.83	0.96	1.11	1.28	1.19	1.04	1.08	1.16	1.15	1.10	1.15	1.14	1.08	1.19	1.36	1.12	1.21	1.13	1.36	1.49
2070	2.39	3.04	1.30	1.70	1.77	2.82	3.23	1.53	1.80	1.77	2.74	2.63	1.53	1.62	1.52	2.44	2.04	1.52	1.59	1.18	2.14	1.67	1.54	1.34	1.34

Table C10

Weather Research and Forecasting with the Grell Model; Community Climate System Model

Table C10.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	1.51	1.89	2.45	2.27	1.53	2.91	2.69	2.25	1.90	2.25	2.65	1.68	1.82	2.54	2.46	2.02	2.70	2.48	1.89	1.70	1.84	1.93	2.12	2.45	3.15
1970	1.65	3.34	2.59	2.72	2.22	3.39	3.21	2.97	2.55	3.27	3.13	2.36	2.01	2.12	2.57	1.90	1.99	1.93	2.52	2.13	1.88	1.34	2.30	2.23	3.93
1971	1.37	1.19	1.86	1.46	1.09	1.70	1.58	1.46	1.25	1.31	1.31	1.82	2.05	1.21	1.59	1.57	1.37	1.14	1.20	2.09	1.02	1.18	1.15	1.49	2.19
1972	1.94	2.61	2.03	2.14	1.84	2.20	2.14	2.18	2.30	1.96	2.13	2.60	2.72	2.92	2.49	1.92	3.01	3.83	3.71	2.87	1.41	1.74	1.72	2.28	2.60
1973	1.14	1.39	1.42	1.82	1.99	1.33	1.44	1.82	2.06	2.00	1.24	1.60	1.87	1.65	1.54	1.42	1.50	1.50	1.42	1.89	1.20	1.61	1.62	3.73	4.17
1974	2.86	1.79	1.21	1.14	1.15	1.90	1.37	1.94	2.14	2.23	2.13	2.22	2.10	2.16	1.96	2.09	1.81	1.57	1.49	2.05	1.45	1.11	1.90	2.44	2.27
1975	3.73	4.24	2.47	2.96	1.94	4.42	3.01	2.55	2.65	2.99	2.41	1.94	2.01	3.20	2.88	2.33	1.87	2.12	3.13	2.71	2.10	2.43	1.56	1.98	1.93
1976	1.69	1.63	1.36	1.60	1.48	2.16	1.21	1.55	2.03	1.89	1.17	1.23	1.45	1.63	2.91	1.85	1.39	2.78	3.75	3.55	2.12	3.36	3.05	1.91	1.31
1977	2.64	2.92	1.52	1.44	1.81	2.44	1.92	2.79	3.15	2.71	2.50	1.67	2.05	1.56	1.40	2.40	1.96	1.70	1.41	1.86	2.14	1.72	1.60	1.63	1.56
1978	2.62	2.66	2.29	1.98	1.37	1.99	2.01	2.20	1.87	1.34	2.27	2.55	2.15	1.83	1.80	2.85	2.45	1.75	1.71	2.04	3.14	1.81	2.16	2.58	2.64
1979	1.24	2.11	1.69	1.63	1.23	2.46	1.78	1.93	1.18	1.20	1.56	1.31	1.22	1.41	1.42	1.33	1.50	1.84	1.68	1.58	1.81	1.69	1.47	1.66	1.45
1980	1.61	2.08	4.41	4.48	4.24	2.46	5.95	5.84	4.48	4.95	3.27	5.15	4.22	2.67	4.93	5.83	2.32	1.70	3.01	3.21	4.95	1.84	1.83	2.16	1.87
1981	2.20	2.42	2.21	2.47	1.65	2.33	1.59	1.64	2.89	1.85	1.98	1.83	3.10	2.77	3.01	1.39	1.93	2.72	2.38	1.45	2.96	4.05	3.96	1.26	1.41
1982	3.61	4.11	3.62	3.41	2.06	2.17	3.15	3.50	1.47	2.35	1.42	2.39	1.69	2.58	1.94	1.19	1.50	2.73	2.72	1.69	1.81	2.34	2.96	1.68	1.20
1983	2.32	2.67	2.74	2.87	2.56	2.43	3.02	2.96	2.58	1.76	2.23	1.76	1.19	1.08	1.42	2.41	2.37	2.27	2.22	2.30	4.50	4.00	3.55	3.17	2.86
1984	1.19	1.63	1.50	1.66	1.79	1.68	1.74	1.22	1.81	1.68	1.93	0.73	1.66	2.36	2.10	1.37	0.92	1.73	2.26	1.35	1.50	1.30	2.18	1.75	1.26
1985	0.93	1.28	1.75	1.84	1.42	0.82	1.46	1.82	1.62	1.67	1.02	1.31	1.57	1.61	2.36	1.94	1.68	1.66	1.69	2.02	1.77	1.81	1.55	1.63	1.74
1986	1.74	1.32	2.30	2.66	1.97	1.77	2.36	2.60	2.47	2.65	2.43	2.44	1.48	2.80	3.70	2.24	1.93	1.86	3.38	4.47	1.36	1.19	2.29	3.85	4.72
1987	2.59	2.69	1.92	2.33	2.36	1.43	1.51	2.02	2.32	2.25	1.81	1.91	2.17	2.28	2.46	1.90	1.97	2.35	2.40	2.93	1.72	2.06	2.61	2.36	2.54
1988	1.78	1.98	1.76	1.39	1.30	1.22	1.23	1.77	1.64	1.53	1.39	1.50	1.22	1.52	1.55	1.69	1.47	2.09	1.82	2.04	1.43	2.07	2.22	2.54	2.26

Table C10.A Annual Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1989	3.23	2.91	2.53	1.49	1.52	3.12	2.42	1.47	1.49	2.15	3.50	3.11	2.02	2.26	1.93	2.34	2.50	2.47	1.96	1.94	1.83	2.53	2.01	2.17	2.40
1990	1.85	2.56	2.36	1.11	1.41	2.09	2.60	1.64	1.55	1.71	2.51	2.16	1.77	1.68	2.01	2.37	1.85	1.66	2.19	2.63	1.63	1.90	2.13	2.85	2.34
1991	1.78	1.89	1.63	1.39	1.02	1.62	1.47	1.54	1.47	1.11	1.88	1.50	1.56	1.23	1.16	1.13	1.15	1.47	1.48	1.25	1.10	1.04	1.57	1.35	2.08
1992	1.89	2.71	2.77	1.46	1.79	3.16	2.75	1.52	2.20	1.91	2.01	1.42	2.06	2.23	1.24	1.85	1.63	2.12	1.40	1.67	1.90	1.61	1.35	1.40	1.81
1993	1.15	1.43	1.21	1.29	1.28	1.07	3.78	3.64	1.88	2.65	2.29	1.32	1.68	2.69	2.24	1.79	2.28	2.36	2.40	1.46	1.33	1.73	1.70	1.27	1.34
1994	1.47	1.01	1.32	0.98	1.47	0.96	0.92	1.80	1.25	2.02	1.34	2.28	1.25	2.27	2.94	1.87	1.09	1.43	3.13	3.31	1.32	2.18	3.09	3.28	2.43
1995	1.32	1.70	1.34	1.21	1.25	1.28	1.54	1.70	1.61	1.94	1.39	1.36	1.46	1.79	1.52	1.28	1.37	2.10	2.18	1.58	1.63	2.17	2.33	1.96	2.11
1996	0.91	1.89	1.26	1.72	2.09	1.47	1.04	1.61	2.28	2.34	1.20	1.30	1.89	2.27	1.88	1.51	1.37	1.93	1.98	1.38	1.22	1.60	1.94	1.25	0.93
1997	2.05	2.27	1.83	1.65	1.38	2.10	1.76	1.91	1.77	1.93	1.63	1.69	2.07	2.16	2.04	1.93	2.21	2.71	2.60	3.11	2.58	2.92	3.17	2.45	2.54
1998	1.60	1.45	1.71	1.72	1.38	2.46	2.11	2.02	1.70	1.42	1.90	1.27	1.30	1.92	0.91	1.07	1.07	1.04	1.68	1.40	1.01	1.01	1.39	1.65	3.28
1999	1.74	1.92	1.37	1.37	1.28	2.03	1.83	1.81	1.77	2.67	2.43	1.90	1.95	1.99	1.50	2.19	2.07	2.13	3.13	4.09	2.48	1.85	2.72	4.11	3.40

Table C10.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.80	2.63	2.72	2.05	2.43	2.18	2.93	2.24	3.72	3.89	2.61	2.77	2.61	3.49	2.79	2.74	3.20	4.27	2.92	1.92	3.38	4.46	3.44	2.11	1.63
2040	1.77	1.78	1.87	1.59	1.78	1.43	1.77	2.18	1.68	1.97	1.79	1.48	2.04	1.80	2.18	1.77	1.93	1.77	2.51	1.80	2.08	1.76	1.73	3.14	2.34
2041	1.37	2.07	2.32	2.88	2.23	1.76	2.66	2.35	1.42	1.60	1.96	2.40	1.12	1.12	1.49	2.61	1.46	1.35	1.74	1.56	2.38	1.84	1.41	1.50	1.60
2042	0.89	0.99	1.16	1.05	0.87	1.14	1.29	1.21	0.85	1.27	1.27	1.05	1.22	1.49	1.88	1.28	1.28	2.13	3.07	3.60	1.26	1.72	2.36	2.87	2.74
2043	1.27	1.38	1.26	2.62	2.89	1.42	1.45	1.88	3.01	2.22	1.57	1.77	2.90	2.82	1.61	2.00	2.24	3.48	2.11	1.76	1.97	2.20	2.13	1.78	2.23
2044	1.63	2.70	2.97	3.13	2.58	3.06	2.41	2.98	2.32	1.97	2.69	3.22	3.81	1.39	2.17	3.29	3.92	3.31	1.68	2.22	3.22	2.76	3.13	3.06	2.41
2045	1.04	1.71	2.87	2.36	1.94	0.83	0.85	1.25	1.87	1.93	2.57	2.51	2.31	1.84	2.45	2.50	3.02	2.75	2.71	2.95	1.40	1.73	1.43	1.55	2.52
2046	2.12	2.12	1.79	1.99	1.73	2.21	2.15	2.00	1.78	1.78	1.53	1.23	1.18	0.99	1.52	2.16	1.27	1.26	2.00	2.16	2.87	2.21	2.46	2.68	2.38
2047	1.19	1.40	1.66	2.36	2.63	1.30	1.46	1.81	2.36	2.35	1.34	1.36	1.63	1.80	1.68	1.37	1.48	1.71	1.75	1.74	1.76	1.69	1.70	1.16	1.80
2048	3.54	2.44	2.22	1.34	1.45	2.94	2.27	1.24	1.32	4.27	2.10	1.41	1.46	1.68	1.52	1.64	1.69	1.85	2.00	1.77	1.78	3.98	4.54	4.35	4.04
2049	2.62	3.00	2.42	2.70	2.58	4.33	4.52	3.90	3.16	2.69	2.11	1.79	1.62	2.01	1.69	2.20	2.06	1.84	1.83	1.60	2.60	1.56	1.76	1.53	1.59
2050	1.37	1.08	1.18	1.65	2.58	1.86	2.05	2.59	2.22	2.09	1.62	1.76	2.15	2.03	1.79	1.72	1.85	1.66	1.67	2.17	1.56	1.88	2.09	2.37	2.11
2051	2.82	2.30	2.75	2.17	1.59	2.32	2.46	3.09	4.47	4.31	4.01	3.88	8.31	5.46	2.86	2.98	6.66	6.33	2.72	2.19	2.77	3.12	1.93	2.35	2.41
2052	2.35	3.51	2.52	2.31	1.24	1.62	1.39	1.24	1.19	1.26	2.81	1.53	1.56	2.02	1.66	2.07	2.27	1.66	1.46	1.68	1.73	1.29	1.04	1.83	1.25
2053	3.82	2.79	1.69	1.11	1.29	3.12	1.96	1.79	3.52	2.51	4.34	2.00	1.38	1.49	2.50	2.24	1.46	1.55	2.35	1.66	1.35	1.88	2.18	3.15	3.63
2054	1.88	2.97	2.11	1.93	3.69	1.94	2.51	2.61	4.64	3.09	2.36	1.75	4.23	2.78	2.33	1.74	4.16	2.20	2.85	4.38	2.27	1.43	3.94	4.37	1.83
2055	2.28	2.43	3.14	3.74	2.85	3.24	3.86	3.18	4.40	5.04	3.10	2.38	2.93	5.88	3.59	3.86	3.79	3.70	3.22	2.83	2.97	3.24	3.16	4.06	3.43
2056	2.26	2.43	2.14	2.69	1.81	1.31	1.91	1.44	1.80	2.17	1.58	1.61	2.20	1.88	1.93	2.01	1.87	1.91	2.39	2.65	2.15	2.58	2.76	3.36	3.40
2057	1.48	1.85	1.85	2.70	1.83	1.67	1.55	1.73	2.52	3.01	1.44	2.74	3.15	3.38	3.04	2.71	2.98	2.03	3.13	3.04	3.47	10.40	4.71	4.25	2.45
2058	2.92	3.90	2.96	3.90	3.41	3.52	2.78	3.60	4.48	2.63	2.26	2.98	5.63	3.74	2.71	2.33	5.42	4.88	2.87	3.24	4.37	5.34	3.32	3.51	2.32
2059	1.38	1.09	1.06	1.49	1.56	0.81	1.17	1.13	1.20	1.60	0.96	1.18	1.28	1.49	1.68	1.34	1.43	1.28	1.60	1.61	1.76	1.33	1.43	1.47	1.38
2060	2.95	4.24	3.25	2.10	1.22	3.37	2.43	1.52	1.36	2.27	1.38	1.25	1.45	1.86	1.98	1.32	1.39	1.44	1.79	4.62	1.13	1.11	1.28	1.40	2.00

Table C10.B Annual Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	3.64	1.58	1.70	1.87	2.42	1.67	2.02	1.94	2.38	3.08	1.98	1.65	2.59	3.01	2.41	1.90	3.31	2.26	2.85	1.74	4.07	1.91	2.85	1.92	1.82
2062	6.73	5.89	4.34	3.67	3.42	4.38	3.00	3.62	3.22	2.33	1.91	1.58	1.99	1.89	2.47	1.98	1.56	2.14	2.43	2.88	2.39	1.90	2.32	3.24	3.61
2063	3.09	4.07	2.89	4.55	3.07	3.90	2.99	5.13	3.51	3.23	3.58	4.19	4.08	3.03	5.06	3.79	3.65	2.99	2.59	2.76	3.42	3.58	2.44	2.84	2.92
2064	1.70	1.95	2.11	2.57	3.18	1.85	2.60	2.41	1.90	2.45	2.95	3.29	2.98	2.24	2.25	3.51	3.46	2.22	2.28	1.49	3.96	2.31	2.48	1.79	1.09
2065	2.07	2.34	1.79	2.30	1.74	1.81	2.72	1.62	2.47	1.95	2.07	1.93	2.03	1.91	2.55	2.56	2.72	3.42	3.51	3.46	3.37	3.58	3.01	3.35	3.20
2066	3.82	2.15	2.29	2.41	2.27	1.56	2.19	2.47	2.04	1.81	3.04	2.67	2.75	2.66	2.79	2.06	2.61	2.84	2.62	2.63	2.53	2.74	3.04	3.20	3.15
2067	2.80	4.15	1.88	2.15	2.95	4.47	2.88	3.89	2.76	3.50	2.67	3.07	2.56	2.61	1.91	1.70	2.62	2.72	2.15	3.48	2.16	4.17	2.92	2.34	2.34
2068	2.03	1.31	1.42	2.86	2.51	1.43	1.66	1.77	3.51	1.90	1.71	1.57	3.65	2.77	1.56	1.73	2.09	3.34	2.34	1.54	2.00	2.69	3.46	1.76	2.08
2069	0.83	0.97	1.14	2.37	2.14	1.55	1.48	3.14	1.56	1.35	1.51	2.50	1.10	1.39	1.33	2.07	1.19	1.89	1.98	2.57	1.28	2.29	2.34	2.78	2.55
2070	2.32	2.09	2.76	2.53	3.75	2.40	3.17	3.11	2.69	2.14	3.09	3.05	1.96	1.99	2.51	2.99	3.67	2.64	2.70	4.59	2.23	2.30	2.69	3.81	2.86

Table C10.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1969	0.84	1.08	1.29	1.22	0.99	0.97	1.19	1.32	1.18	1.25	1.11	1.22	1.21	1.22	1.24	1.19	1.11	1.01	0.83	0.82	1.11	0.97	0.92	0.85	0.81
1970	1.28	1.47	1.34	0.83	0.74	1.52	1.50	0.96	0.81	1.11	1.50	1.27	0.80	1.11	1.12	1.34	1.19	1.09	1.45	1.07	1.12	1.11	1.47	1.30	0.82
1971	0.72	0.83	0.89	1.12	0.93	0.70	0.85	0.86	0.87	0.73	0.68	0.77	0.88	0.84	0.72	0.70	0.72	0.94	0.96	0.82	0.71	0.73	0.85	0.92	0.95
1972	1.93	1.27	1.10	1.12	0.80	2.10	0.82	1.08	0.83	0.87	2.04	0.83	1.08	0.84	0.89	1.50	1.05	1.10	1.00	1.00	1.07	1.03	1.06	1.08	1.09
1973	1.14	0.89	0.72	0.64	0.65	0.75	0.61	0.51	0.51	0.63	0.85	0.72	0.52	0.43	0.59	0.69	0.76	0.58	0.54	0.70	0.51	0.67	0.60	0.80	1.11
1974	1.01	1.18	1.21	0.72	0.66	1.14	1.10	0.73	0.76	0.81	1.21	0.95	0.66	0.66	0.73	1.30	0.97	0.73	0.76	0.75	1.31	1.03	0.88	0.85	0.74
1975	0.42	0.50	0.51	0.51	0.51	0.46	0.52	0.53	0.51	0.58	0.50	0.56	0.60	0.62	0.61	0.47	0.52	0.54	0.57	0.60	0.52	0.46	0.51	0.73	0.59
1976	1.23	1.14	1.23	1.36	1.34	1.18	1.02	1.11	1.25	1.24	1.11	0.90	0.93	0.86	0.86	1.36	1.04	0.81	0.75	1.13	1.43	1.07	0.77	1.09	1.24
1977	0.98	0.92	0.98	0.94	0.93	0.94	1.00	1.02	0.93	0.82	1.05	0.95	0.98	0.92	0.85	2.37	1.96	1.70	1.41	1.05	2.14	1.72	1.60	1.28	1.35
1978	1.23	1.01	0.88	0.79	0.63	1.05	1.06	0.94	0.54	0.63	0.91	0.96	0.54	0.59	0.67	0.86	0.59	0.62	0.73	0.72	0.62	0.69	0.68	0.70	0.74
1979	0.61	0.69	0.77	1.02	1.18	0.59	0.68	0.79	0.86	0.83	0.70	0.70	0.87	0.94	0.85	0.91	0.86	1.13	1.21	1.09	1.10	1.02	1.29	1.25	0.95
1980	0.93	0.92	0.91	1.01	0.66	1.12	1.00	1.07	0.82	0.41	1.31	1.28	1.19	1.12	1.02	1.47	1.61	1.66	1.61	1.51	1.22	1.46	1.60	1.66	1.58
1981	0.81	0.58	0.34	0.36	0.39	0.71	0.41	0.40	0.45	0.55	0.49	0.44	0.46	0.55	0.57	0.42	0.43	0.49	0.52	0.59	0.39	0.47	0.50	0.56	0.67
1982	0.96	0.99	1.04	0.97	0.76	0.96	1.07	1.05	0.82	0.70	0.96	0.93	0.85	0.76	0.78	0.70	0.81	0.84	0.92	0.94	0.91	0.95	1.01	1.04	0.99
1983	0.52	0.78	0.90	1.09	1.13	0.75	0.97	1.15	1.15	1.01	1.08	1.19	1.19	1.08	0.89	1.27	1.27	1.19	1.13	1.25	1.27	1.46	1.57	1.67	1.71
1984	0.94	0.98	1.13	0.98	1.04	0.99	1.16	1.00	0.88	1.09	0.91	0.73	0.69	0.87	0.99	0.90	0.88	0.94	1.07	0.95	0.83	0.85	1.05	1.18	1.00
1985	0.78	0.70	0.77	0.82	0.63	0.67	0.75	0.81	0.64	0.45	0.65	0.73	0.62	0.45	0.42	0.64	0.66	0.56	0.55	0.54	0.64	0.64	0.66	0.64	0.62
1986	0.98	1.32	1.47	1.46	1.36	1.48	1.80	1.85	1.57	1.58	1.60	1.60	1.30	1.31	1.26	1.24	1.15	1.21	1.29	1.29	1.11	1.19	1.25	1.36	1.39
1987	0.50	0.45	0.44	0.63	0.75	0.40	0.49	0.70	0.90	1.03	0.51	0.66	0.84	0.96	1.00	0.67	0.85	0.92	0.95	0.83	0.90	1.04	0.93	0.92	0.83
1988	0.72	0.87	0.90	0.82	0.74	0.75	1.08	1.08	0.85	0.87	0.65	0.78	0.85	0.80	0.82	0.57	0.64	0.87	1.05	0.81	0.70	0.81	1.09	1.02	0.82
1989	0.91	1.01	0.93	0.98	0.98	1.16	1.13	1.13	1.02	1.00	1.30	1.22	1.06	0.92	0.79	1.19	1.05	0.90	0.75	0.81	0.96	0.84	0.69	0.85	0.78
1990	0.89	1.24	1.05	0.88	0.64	0.92	0.95	0.70	0.58	0.53	0.89	0.77	0.70	0.81	0.69	0.89	0.87	0.92	0.84	0.76	0.82	0.88	0.77	0.65	0.80

Table C10.C Seasonal Maximum Series: Present Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
1991	1.10	1.40	1.63	1.39	0.72	1.00	1.28	1.41	0.97	0.62	1.13	1.17	1.16	0.90	0.83	1.13	0.98	1.04	1.00	1.17	1.10	0.86	0.95	1.09	1.45
1992	0.72	0.83	0.79	0.56	0.41	0.79	0.62	0.46	0.49	0.86	0.73	0.46	0.44	0.69	0.81	0.66	0.47	0.55	0.66	0.68	0.61	0.51	0.57	0.60	0.76
1993	0.42	0.49	0.50	0.62	0.60	0.29	0.57	0.61	0.58	0.48	0.35	0.48	0.57	0.51	0.59	0.38	0.50	0.51	0.63	0.70	0.42	0.49	0.58	0.85	0.97
1994	0.48	0.45	0.39	0.56	0.59	0.49	0.36	0.27	0.36	0.42	0.40	0.26	0.25	0.26	0.33	0.27	0.19	0.18	0.31	0.75	0.18	0.19	0.26	0.44	1.01
1995	1.22	1.38	1.34	1.18	1.08	1.20	1.05	1.16	1.05	0.69	1.21	1.09	1.06	0.77	0.63	1.28	1.22	0.94	0.77	0.84	1.41	1.08	0.69	0.82	1.03
1996	0.79	1.20	1.26	1.04	1.02	0.81	1.04	1.20	1.32	1.01	0.86	0.97	1.06	1.34	0.79	0.95	1.03	1.27	1.25	0.65	1.07	1.13	1.35	1.14	0.64
1997	0.29	0.22	0.20	0.39	0.52	0.32	0.33	0.35	0.35	0.52	0.35	0.35	0.32	0.39	0.45	0.43	0.43	0.40	0.43	0.49	0.48	0.48	0.45	0.49	0.54
1998	0.84	0.88	0.88	0.91	0.95	0.93	0.87	0.79	0.70	0.69	0.64	0.53	0.53	0.76	0.91	0.62	0.52	0.74	1.22	1.40	0.60	0.61	0.93	1.55	1.73
1999	0.58	0.45	0.39	0.39	0.48	0.46	0.44	0.38	0.38	0.46	0.50	0.43	0.43	0.45	0.44	0.54	0.55	0.63	0.66	0.69	0.65	0.74	0.83	0.79	0.75

Table C10.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	0.91	1.17	1.40	1.50	1.60	0.85	1.11	1.34	1.44	1.63	1.03	1.23	1.43	1.55	1.51	1.15	1.37	1.50	1.39	0.91	1.38	1.46	1.50	0.83	0.66
2040	0.64	0.59	0.53	0.58	0.61	0.61	0.51	0.56	0.56	0.53	0.58	0.58	0.71	0.88	0.76	0.65	1.10	1.40	1.22	0.86	0.57	1.10	1.28	1.12	0.62
2041	1.37	1.71	1.60	1.42	1.24	1.36	1.44	1.29	0.98	0.99	1.29	1.22	1.10	1.12	1.11	1.28	1.18	1.35	1.51	1.56	1.27	1.27	1.41	1.50	1.60
2042	0.45	0.50	0.65	0.52	0.87	0.38	0.57	0.60	0.51	0.89	0.33	0.66	0.48	0.46	0.64	0.39	0.70	0.50	0.51	0.55	0.48	0.67	0.60	0.62	0.73
2043	1.23	1.38	1.26	1.26	1.01	1.42	1.45	1.36	1.14	0.84	1.57	1.44	1.24	0.93	0.95	1.61	1.43	1.11	1.11	1.76	1.65	1.32	0.99	1.43	1.93
2044	0.75	0.81	0.85	1.29	1.24	0.90	0.82	0.98	1.14	0.87	0.89	0.80	0.89	0.88	0.71	0.88	0.75	0.93	0.90	1.26	0.86	0.83	0.97	1.13	1.94
2045	0.76	0.83	0.81	0.79	0.81	0.83	0.85	0.89	0.87	0.94	0.88	0.89	0.87	0.93	0.97	0.98	1.06	0.99	1.04	1.21	1.10	1.25	1.43	1.54	1.59
2046	0.89	0.86	0.90	1.11	1.06	0.73	0.85	1.12	1.07	1.11	1.07	1.23	1.18	0.99	1.52	1.37	1.27	1.26	2.00	2.16	1.25	1.68	2.46	2.68	2.18
2047	0.56	0.70	0.75	0.98	1.06	0.48	0.76	1.11	1.11	0.81	0.76	1.12	1.07	0.59	0.75	1.09	1.07	0.43	0.79	1.16	0.89	0.40	0.86	1.16	0.81
2048	0.60	0.62	0.63	0.65	0.67	0.78	0.81	0.81	0.81	0.88	0.96	0.97	1.00	1.06	1.11	1.00	1.04	1.11	1.22	1.29	0.78	0.89	1.28	1.18	1.20
2049	0.57	0.75	0.88	1.01	1.19	0.85	0.94	1.06	1.09	1.22	0.59	0.64	0.71	0.92	1.08	0.58	0.66	0.87	1.11	1.17	0.73	0.97	1.38	1.53	1.59
2050	0.96	0.75	0.55	0.72	1.05	0.92	0.78	0.54	1.20	1.38	0.95	0.70	1.10	1.28	1.19	1.01	0.68	1.29	1.10	0.48	0.93	0.97	1.31	0.60	0.57
2051	0.42	0.44	0.47	0.44	0.36	0.36	0.36	0.34	0.35	0.45	0.27	0.27	0.34	0.41	0.42	0.30	0.33	0.38	0.33	0.55	0.34	0.35	0.34	0.40	0.74
2052	0.70	1.00	1.18	1.07	0.88	0.85	1.09	1.16	1.00	1.06	1.06	1.22	0.93	0.78	0.96	0.98	0.87	0.68	0.77	0.95	0.68	0.67	0.65	0.79	1.00
2053	1.18	1.12	1.00	1.11	1.18	0.82	0.84	1.10	1.21	0.80	0.63	0.90	1.14	0.78	0.60	0.58	0.81	0.89	0.68	0.54	0.66	0.83	0.82	0.56	0.48
2054	0.48	0.50	0.52	0.71	1.10	0.54	0.53	0.76	1.16	1.04	0.47	0.78	0.81	0.73	0.78	0.70	0.84	0.73	0.95	1.37	0.65	0.70	0.72	1.31	1.64
2055	0.69	0.74	0.77	0.72	0.57	0.76	0.83	0.78	0.60	0.59	0.80	0.77	0.61	0.61	0.65	0.65	0.57	0.78	1.05	1.41	0.41	0.75	0.94	1.37	2.10
2056	1.03	1.42	1.37	0.84	0.76	1.24	1.61	1.13	0.72	0.68	1.30	1.32	0.81	0.67	0.67	0.95	1.01	0.99	0.74	0.82	0.73	0.99	1.09	0.76	0.87
2057	0.58	0.79	0.98	1.22	1.20	0.59	0.81	1.04	1.02	0.94	0.71	0.88	0.99	0.92	0.77	0.77	0.84	0.78	0.87	1.59	0.79	0.79	0.76	1.66	2.45
2058	0.55	0.64	0.77	1.36	1.59	0.75	0.90	1.31	1.78	1.06	0.88	1.15	1.77	1.53	0.67	0.78	1.40	1.43	0.85	0.75	0.94	1.03	1.02	0.92	0.79
2059	0.69	0.66	0.81	0.89	0.76	0.72	0.82	0.90	0.75	0.62	0.93	0.86	0.83	0.80	0.79	0.83	0.87	0.95	1.06	1.14	0.86	0.95	1.13	1.19	1.15
2060	0.52	0.37	0.37	0.39	0.51	0.38	0.42	0.48	0.55	0.72	0.52	0.63	0.91	1.07	1.19	0.66	1.09	1.14	1.36	1.48	0.87	1.11	1.28	1.40	1.70

Table C10.D Seasonal Maximum Series: Future Day Climate

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2061	1.45	1.58	1.70	1.74	2.08	1.67	1.82	1.94	2.28	3.08	1.73	1.65	1.82	3.01	2.41	1.35	1.20	2.26	2.85	1.74	1.08	1.55	2.85	1.92	1.82
2062	0.63	0.94	1.28	1.13	0.84	0.67	0.76	0.86	0.86	0.81	0.78	0.85	0.86	0.81	0.79	0.83	0.91	0.87	0.92	0.96	0.88	0.89	1.01	1.10	1.23
2063	1.21	1.39	1.65	1.54	1.77	1.20	1.43	1.52	1.58	1.76	1.18	1.31	1.23	1.39	1.32	1.24	1.27	1.23	1.29	1.19	1.91	1.73	1.23	1.24	1.22
2064	1.70	1.68	1.07	1.63	1.76	1.38	1.62	1.38	1.84	1.74	0.98	1.32	1.27	1.46	1.18	0.79	0.99	1.23	1.21	0.90	0.82	0.82	1.14	0.92	0.72
2065	0.64	0.73	0.69	0.57	0.51	0.47	0.47	0.55	0.58	0.52	0.41	0.60	0.77	0.62	0.43	0.79	0.83	0.76	0.57	1.02	0.84	0.72	0.94	1.04	1.27
2066	0.45	0.61	0.79	0.85	0.75	0.78	0.97	1.25	1.32	1.13	1.00	1.40	1.78	1.70	1.09	1.39	1.87	2.04	1.60	0.85	1.49	1.62	1.58	1.30	1.24
2067	0.61	0.70	0.66	0.77	0.78	0.71	0.65	0.69	0.81	0.83	0.58	0.60	0.70	0.73	0.68	0.73	0.79	0.77	0.70	0.63	0.87	0.86	0.80	0.72	0.68
2068	0.58	0.82	0.72	0.77	0.66	0.68	0.74	0.69	0.78	0.77	0.83	0.98	1.09	1.00	0.72	1.22	1.39	1.38	0.97	0.61	1.30	1.39	1.19	0.72	0.68
2069	0.83	0.58	0.57	0.48	0.41	0.65	0.51	0.51	0.45	0.39	0.64	0.54	0.42	0.47	0.53	0.60	0.56	0.64	0.67	0.69	0.72	0.73	0.69	0.62	0.53
2070	0.86	1.03	1.11	1.08	1.39	0.72	0.81	1.11	1.40	1.59	0.71	0.79	1.17	1.52	1.36	1.05	1.31	1.56	1.44	1.02	1.55	1.77	1.71	1.27	0.87

Table C11

Flood Control District of Maricopa County: Observed Precipitation Maximum Series

Table C11.A Annual Maximum Series: Present Day Climate

YEAR	A2	A3	B1	B2	B3	B4	C2	C3	C4	C5	D2	D3	D4	E2
1980	-99	-99	1	-99	-99	-99	-99	-99	-99	-99	0.45	-99	-99	-99
1981	-99	1.38	1.26	1.88	2.21	0.67	-99	0.94	1.26	-99	0.92	-99	0.12	-99
1982	2.44	1.26	2.01	4.68	4.84	1.93	-99	1.61	1.97	-99	0.49	1.26	1.42	1.26
1983	2.52	4.41	2.56	2.73	3.23	2.36	2.76	2.95	2.99	2.84	2.36	2.56	1.46	1.1
1984	1.10	2.95	1.42	2.01	2.40	2.52	0.79	1.54	1.69	2.48	2.68	1.26	0.79	1.89
1985	1.30	2.13	1.25	2.44	2.01	1.58	1.69	1.58	1.10	1.14	1.26	2.24	1.46	0.87
1986	1.85	2.99	3.11	4.72	2.56	2.20	2.99	1.69	1.06	0.98	1.46	1.26	1.38	1.06
1987	1.10	1.49	1.61	1.45	1.85	0.99	1.54	1.50	1.15	0.98	1.81	1.38	1.18	1.38
1988	1.14	2.79	3.03	2.13	1.81	2.13	2.79	1.78	1.26	1.69	2.52	1.22	1.14	1.54
1989	1.45	2.05	1.69	1.93	2.32	1.81	1.61	1.34	1.45	1.34	2.64	1.3	0.91	1.06
1990	1.38	2.36	1.65	1.73	2.48	2.04	1.61	3.54	1.41	2.24	3.27	2.64	2.52	1.5
1991	1.93	5.90	1.50	3.51	3.38	3.19	1.65	1.81	2.24	4.21	1.02	1.26	1.65	0.94
1992	2.09	3.11	1.46	2.01	2.95	2.52	2.36	3.23	3.27	3.97	3.03	3.54	2.01	1.1
1993	2.05	5.00	2.99	3.38	3.81	3.62	2.83	2.71	2.09	3.78	2.24	1.74	1.97	1.22
1994	1.30	2.32	1.10	2.13	3.19	1.89	1.50	1.97	1.85	2.88	2.28	2.91	2.01	1.89
1995	1.89	4.84	2.56	3.46	3.74	2.24	1.65	1.97	1.85	2.13	1.96	1.69	2.01	1.26
1996	1.10	1.58	1.26	1.81	2.21	0.87	1.73	1.54	1.65	1.18	1.57	1.77	1.3	1.77
1997	5.39	4.57	4.52	6.65	3.90	1.89	1.73	1.89	1.18	1.18	1.69	1.38	1.02	1.14
1998	2.05	1.61	1.81	2.09	2.01	1.58	1.73	2.13	1.85	5.12	1.3	2.07	2.44	1.54
1999	2.16	2.64	1.77	2.72	3.67	1.73	1.42	1.69	1.54	2.64	1.65	1.46	1.34	1.65
2000	1.38	1.97	2.64	4.60	2.40	1.42	1.38	1.77	3.54	1.22	1.73	1.81	1.58	1.53
2001	2.40	2.21	3.27	3.23	2.36	3.42	1.26	2.67	2.28	1.58	1.22	1.81	1.53	1.34

Table C11.B Seasonal (Winter) Maximum Series: Present Day Climate

YEAR	A2	A3	B1	B2	B3	B4	C2	C3	C4	C5	D2	D3	D4	E2
1981	-99	-99	0.55	-99	-99	-99	-99	-99	-99	-99	0.83	-99	-99	-99
1982	2.44	1.22	1.93	4.68	4.84	1.93	-99	1.61	1.97	-99	0.49	0.91	1.42	1.26
1983	1.97	4.41	2.04	2.73	3.23	1.89	1.65	1.89	1.42	2.84	2.36	1.54	1.46	0.94
1984	0.71	2.95	0.75	1.08	1.22	0.55	0.79	1.26	0.94	0.08	1.26	0.91	0.79	0.98
1985	1.30	2.13	1.25	2.44	2.01	1.58	0.71	1.58	1.10	1.06	1.26	1.38	1.30	0.87
1986	1.85	2.99	3.11	4.17	2.56	2.20	1.38	1.69	1.06	0.98	1.06	1.02	1.38	1.06
1987	0.67	1.02	1.61	1.45	1.26	0.99	0.87	1.50	1.15	0.98	1.81	1.38	1.18	1.38
1988	0.83	1.46	1.14	1.30	1.81	1.18	1.42	1.78	1.02	-99	1.38	1.02	0.83	1.02
1989	1.45	2.05	1.69	1.93	2.32	1.81	1.61	1.34	1.45	1.18	2.64	1.30	0.91	0.71
1990	0.51	2.13	0.63	1.10	1.14	0.94	1.61	1.46	0.94	0.55	1.06	0.67	0.67	0.55
1991	1.93	5.90	1.50	3.51	3.38	3.19	1.65	1.81	2.24	4.21	0.91	1.14	1.65	0.94
1992	1.06	2.01	1.30	2.01	2.60	1.18	2.36	1.69	1.06	1.02	0.91	1.06	1.42	1.10
1993	2.05	5.00	2.99	3.38	3.81	3.62	2.72	2.71	2.09	3.78	2.24	1.74	1.97	1.22
1994	0.79	2.32	0.71	2.13	3.19	1.89	0.75	1.97	0.91	2.88	2.28	2.91	2.01	0.87
1995	1.89	4.84	2.56	3.46	3.74	2.16	1.65	1.97	1.85	2.13	1.96	1.69	2.01	1.26
1996	0.55	0.71	0.67	1.26	0.79	0.47	1.10	1.54	0.55	1.18	1.57	1.06	1.30	0.71
1997	1.38	1.65	1.93	2.52	2.72	1.46	0.98	1.89	0.87	1.18	1.14	1.38	1.02	0.94
1998	1.34	1.50	1.81	2.09	1.69	1.58	1.26	1.53	0.94	5.12	1.30	1.10	1.18	1.54
1999	1.02	1.06	1.30	0.91	1.02	0.75	0.63	0.47	0.47	1.18	0.31	0.59	0.35	0.71
2000	1.06	1.97	1.22	2.24	2.40	1.42	1.38	1.77	2.01	1.22	1.73	1.81	1.58	1.53
2001	1.06	0.87	1.57	1.97	1.22	0.98	1.26	1.14	0.91	0.71	0.95	1.02	0.98	0.63

APPENDIX D

RELIABILITY ENSEMBLE AVERAGE REFERENCE EQUATIONS AND RESULTS

Table D1

Annual Maximum Series Model Reliability Bias Factor (Rb), Model Reliability Convergence Factor (Rd), and Model Reliability Ensemble Average (Ri)

	CRCM ccsm	CRCM cgcm3	ECP2 gfdl	HRM3 hadcm3	HRM3 gfdl	MM5I ccsm	RCM3 gfdl	RCM3 cgcm3	WRFG cgcm3	WRFG gfdl
Rb	1.87	1.67	1.59	1.42	1.43	1.85	2.03	2.47	1.73	1.44
Rd	1.34	0.81	0.56	1.00	0.70	0.77	1.33	1.52	0.79	0.96
Ri	2.50	1.34	0.89	1.42	1.00	1.42	2.70	3.75	1.36	1.38

Note. RCM = regional climate models; GEV = Generalized Extreme Value; CRCM = Canadian Coupled Global Climate model; ccsm = community climate system model; cgcm3 = Canadian Coupled Global Climate Model 3; ECP2 = Experimental Climate Prediction Center model2; HRM3 = Hadley regional model 3; hadcm = Hadley Centre coupled model3; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model; MM5I = Mesoscale Model 5; WRFG = weather research and forecasting with the Grell model.

Table D2

Seasonal (winter) Maximum Series Model Reliability Bias Factor (Rb), Reliability Model Convergence Factor (Rd), and Reliability Ensemble Average (Ri)

	CRCM ccsm	CRCM cgcm3	ECP2 gfdl	HRM3 hadcm3	HRM3 gfdl	MM5I ccsm	RCM3 gfdl	RCM3 cgcm3	WRFG cgcm3	WRFG gfdl
Rb	1.77	1.84	2.09	1.75	1.48	1.64	0.98	0.94	1.43	1.73
Rd	0.20	0.18	0.17	0.29	0.11	0.17	0.18	0.24	0.20	0.17
Ri	0.35	0.34	0.35	0.52	0.16	0.28	0.18	0.22	0.28	0.29

Note. RCM = regional climate models; GEV = Generalized Extreme Value; CRCM = Canadian Coupled Global Climate model; ccsm = community climate system model; cgcm3 = Canadian Coupled Global Climate Model 3; ECP2 = Experimental Climate Prediction Center model2; HRM3 = Hadley regional model 3; hadcm = Hadley Centre coupled model3; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model; MM5I = Mesoscale Model 5; WRFG = weather research and forecasting with the Grell model.

Table D3

Annual Maximum Series Model Reliability Bias Factor per Grid

	A2	A3	B1	B2	B3	B4	C2	C3	C4	C5	D2	D3	D4	E2
CRCM ccsm	1.67	4.61	1.64	4.69	4.00	0.91	0.91	1.2	0.76	2.81	1.15	1.04	0.46	0.31
CRCM cgcm3	1.43	4.00	1.38	4.22	3.31	0.93	0.99	1.08	0.64	2.45	1.13	1.00	0.61	0.19
ECP2 gfdl	1.22	3.41	0.45	2.75	2.31	1.21	0.88	1.61	1.00	2.39	1.45	1.59	1.23	0.68
HRM3 hadcm3	2.32	2.44	0.51	1.64	1.46	0.80	1.92	1.27	0.73	1.78	1.23	0.89	1.51	1.33
HRM3 gfdl	1.58	3.32	1.25	3.50	2.30	0.83	0.55	0.49	0.78	2.18	0.76	0.84	1.16	0.42
MM5I ccsm	1.61	2.76	1.35	3.22	2.90	2.22	0.91	1.39	2.19	3.28	0.79	0.82	1.36	1.13
RCM3 gfdl	1.75	—	1.43	—	1.00	1.53	0.84	1.12	1.42	3.65	3.36	3.09	3.28	1.92
RCM3 cgcm3	4.78	—	2.37	—	1.96	1.82	1.76	2.24	2.27	3.07	1.75	1.19	3.76	2.71
WRFG cgcm3	1.63	2.86	1.65	2.83	1.70	1.01	0.72	1.41	2.41	2.11	1.20	0.83	1.69	2.16
WRFG gfdl	1.21	3.60	1.28	2.43	1.28	0.90	0.61	0.86	0.86	3.12	0.82	0.85	1.33	1.05

Note. RCM = regional climate models; GEV = Generalized Extreme Value; CRCM = Canadian Coupled Global Climate model; ccsm = community climate system model; cgcm3 = Canadian Coupled Global Climate Model 3; ECP2 = Experimental Climate Prediction Center model2; HRM3 = Hadley regional model 3; hadcm = Hadley Centre coupled model3; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model; MM5I = Mesoscale Model 5; WRFG = weather research and forecasting with the Grell model.

Table D4

Annual Maximum Series Model Reliability Bias Factor per Grid

	A2	A3	B1	B2	B3	B4	C2	C3	C4	C5	D2	D3	D4	E2
CRCM ccsm	0.73	5.12	1.31	3.87	4.21	1.26	0.87	1.09	0.53	3.15	1.10	0.70	0.45	0.33
CRCM cgcm3	0.89	5.52	1.39	4.25	4.50	1.48	0.88	1.13	0.57	3.04	0.91	0.50	0.58	0.17
ECP2 gfdl	0.89	5.98	1.71	4.36	4.78	1.91	0.88	1.28	0.71	4.07	1.15	0.54	0.64	0.30
HRM3 hadcm3	1.17	4.43	0.78	2.14	2.56	1.07	3.04	0.79	0.82	3.00	1.04	0.48	1.38	1.84
HRM3 gfdl	0.60	4.75	0.92	3.06	3.38	1.30	0.80	0.71	0.52	2.66	0.69	0.32	0.43	0.56
MM5I ccsm	0.68	5.14	1.19	3.62	3.70	1.42	0.72	0.96	0.40	3.6	0.6	0.32	0.46	0.21
RCM3 gfdl	0.35	—	0.96	—	3.25	1.27	0.49	0.58	0.50	2.87	0.63	0.32	0.38	0.16
RCM3 cgcm3	0.64	—	0.73	—	2.93	0.75	0.82	0.52	0.32	3.12	0.5	0.44	0.29	0.26
WRFG cgcm3	0.44	4.11	1.07	3.04	3.33	1.03	0.52	0.72	0.41	3.54	0.53	0.60	0.50	0.15
WRFG gfdl	0.75	5.27	1.15	3.31	3.74	1.47	1.01	1.09	0.55	3.8	0.86	0.55	0.51	0.19

Note. RCM = regional climate models; GEV = Generalized Extreme Value; CRCM = Canadian Coupled Global Climate model; ccsm = community climate system model; cgcm3 = Canadian Coupled Global Climate Model 3; ECP2 = Experimental Climate Prediction Center model2; HRM3 = Hadley regional model 3; hadcm = Hadley Centre coupled model3; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model; MM5I = Mesoscale Model 5; WRFG = weather research and forecasting with the Grell model.

Table D5

Annual Maximum Series $x_j(R_i, g_{i,j})$ All Models per Year j^{th}

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	1.89	2.60	1.51	2.64	2.67	2.10	1.33	2.12	2.39	2.52	1.98	2.15	2.36	2.56	2.61	2.07	2.87	2.87	2.31	2.23	2.83	2.55	2.12	2.24	2.35
2040	2.02	2.16	1.27	2.06	2.35	1.93	1.17	2.14	2.01	1.96	2.58	2.40	2.70	2.45	2.30	2.52	2.37	2.66	3.04	2.93	2.53	2.36	2.14	2.21	2.32
2041	1.78	1.75	1.24	2.02	2.03	2.27	1.14	1.95	1.89	1.84	2.51	2.48	2.37	2.09	1.96	2.37	2.19	2.16	2.33	2.47	2.37	2.49	2.63	2.82	2.56
2042	1.91	1.96	0.99	2.21	2.28	2.83	1.00	2.27	1.94	1.97	2.04	2.15	2.31	2.25	2.52	2.21	2.29	2.16	2.41	2.42	2.29	2.36	2.03	2.32	2.29
2043	1.86	1.90	0.95	1.79	1.89	1.69	0.95	1.64	1.88	1.95	2.21	2.62	1.74	1.61	1.84	1.95	2.39	2.80	2.10	2.10	2.19	2.07	2.99	3.36	2.49
2044	2.14	1.99	1.30	2.01	1.97	1.95	1.31	1.93	2.03	1.89	2.05	2.21	2.22	1.74	1.94	2.01	2.00	1.88	1.85	2.23	2.09	1.96	1.99	2.47	2.72
2045	2.38	2.24	1.36	1.90	2.19	2.50	1.18	2.14	2.30	2.46	2.44	2.65	2.44	2.47	2.87	2.35	1.95	2.48	2.76	3.01	1.92	2.18	2.13	2.48	2.35
2046	2.30	2.22	1.11	2.17	2.15	2.74	1.22	2.81	2.25	2.19	2.61	2.88	2.35	2.15	2.33	2.13	2.39	1.94	2.28	2.38	2.20	2.04	1.76	2.65	3.19
2047	2.58	1.74	1.02	1.84	2.15	3.04	1.16	3.17	3.04	2.59	2.31	2.36	2.46	2.27	2.24	2.40	2.25	2.13	2.23	2.36	2.04	2.35	2.27	2.43	2.55
2048	2.75	2.73	1.40	2.75	2.67	2.21	1.25	2.87	3.01	2.66	2.09	2.54	3.21	3.01	2.96	2.51	2.71	2.82	3.29	3.72	2.58	3.02	2.91	2.76	2.49
2049	2.05	2.25	1.07	2.33	2.22	2.57	1.28	2.61	2.60	2.39	3.22	2.82	2.28	2.35	2.31	2.69	2.28	2.09	2.35	2.41	2.39	2.03	1.95	2.28	2.25
2050	2.01	2.10	1.11	2.14	1.93	2.30	1.19	2.30	2.19	2.09	2.09	2.04	2.39	2.18	2.12	2.11	2.40	2.37	2.32	2.23	2.32	2.05	2.09	2.25	2.22
2051	2.60	2.56	1.68	2.41	2.36	2.89	1.50	2.56	2.80	2.50	2.53	2.61	3.21	2.54	2.37	2.51	2.58	2.33	2.63	2.77	2.44	2.13	2.29	2.60	2.37
2052	2.00	2.13	1.36	2.05	2.15	2.00	1.33	2.19	2.41	2.39	2.25	2.27	1.96	2.16	2.42	1.93	1.91	1.89	2.62	2.35	1.96	2.04	1.89	2.22	1.95
2053	2.36	2.05	1.19	1.73	1.88	2.24	1.25	2.18	2.40	2.35	2.38	2.76	2.39	2.52	3.12	1.95	2.38	2.64	2.54	2.50	2.27	2.51	2.80	2.93	2.62
2054	2.64	2.36	1.10	2.85	3.04	2.29	1.12	2.38	2.41	2.63	2.45	2.58	2.37	2.45	2.38	2.21	2.50	2.32	2.55	3.13	2.77	2.22	2.73	2.78	3.10
2055	2.11	1.99	1.49	2.54	2.90	2.33	1.50	2.50	2.52	2.98	2.36	2.35	2.69	3.15	3.24	2.49	2.59	2.29	2.65	3.04	2.40	2.47	2.49	3.17	2.62
2056	1.96	2.10	1.18	2.12	2.05	2.34	1.20	2.19	2.20	2.31	2.37	2.19	2.60	2.37	2.21	2.13	2.30	2.25	2.27	2.56	2.24	2.72	2.51	2.33	2.64
2057	1.88	1.92	1.15	2.08	2.13	2.00	1.10	1.96	1.94	2.13	2.40	2.14	2.29	2.38	2.23	2.82	2.30	2.72	3.06	2.44	2.43	3.41	2.90	3.41	2.83
2058	2.61	2.05	1.29	2.11	2.18	1.88	1.21	2.33	2.62	2.69	2.02	2.22	2.55	2.36	2.79	2.40	2.52	3.01	2.77	2.88	2.29	2.28	2.32	3.04	2.87

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2059	2.49	2.29	1.29	2.09	2.20	2.05	1.06	1.80	1.82	1.99	2.05	2.17	1.77	1.94	2.13	2.32	2.03	1.86	2.07	2.05	2.41	2.24	2.33	2.45	2.22
2060	2.46	2.73	1.40	2.74	2.56	2.84	1.20	2.94	2.97	2.82	2.93	2.76	2.70	2.61	2.61	2.24	2.13	2.59	2.83	3.12	2.32	2.41	2.52	2.87	2.97
2061	2.09	1.91	1.03	2.58	2.57	2.21	1.16	2.51	2.14	2.24	2.01	2.02	2.47	2.47	2.71	2.18	2.41	2.81	3.17	2.55	2.52	2.57	2.53	2.46	2.38
2062	2.61	2.19	1.41	2.30	2.91	2.32	1.15	2.37	2.38	2.37	2.46	2.20	2.25	2.35	2.70	2.38	2.21	2.88	2.79	2.62	2.62	2.75	2.37	2.38	2.68
2063	2.81	2.84	1.47	2.60	2.31	2.88	1.69	2.83	2.72	2.63	2.88	2.94	2.91	2.50	2.78	2.68	2.59	2.49	2.51	2.68	2.44	2.23	2.43	2.59	2.61
2064	2.65	2.77	1.44	2.62	2.52	2.54	1.38	2.26	3.04	2.64	2.38	2.53	2.55	2.61	2.77	2.31	2.43	2.07	2.31	2.18	2.76	2.73	2.18	2.30	2.30
2065	2.14	2.41	1.39	2.86	2.57	2.45	1.36	2.20	2.15	2.30	2.24	2.59	2.24	2.24	2.33	2.44	2.20	2.11	2.38	2.28	2.27	2.14	2.34	2.72	2.56
2066	2.27	2.42	1.29	2.45	2.75	2.20	1.24	2.27	2.61	3.08	2.03	2.70	3.28	4.08	3.73	2.51	2.65	2.67	3.27	3.10	2.48	2.31	2.73	3.21	2.61
2067	3.35	3.58	1.52	2.58	2.47	2.67	1.51	3.06	2.35	2.50	2.48	2.55	2.65	2.20	2.06	2.23	2.50	2.55	2.07	2.17	2.32	2.13	2.24	2.05	2.02
2068	2.17	2.03	1.28	2.28	2.60	1.74	1.17	2.15	2.37	2.16	2.45	2.32	2.35	2.05	2.07	2.44	2.35	2.26	2.31	2.16	2.51	3.49	2.96	2.47	2.34
2069	1.81	1.84	0.99	2.00	1.90	2.14	1.01	2.05	2.17	1.98	2.21	2.28	2.18	2.65	2.09	2.12	2.31	2.42	2.59	2.18	2.17	2.31	2.20	2.31	2.34
2070	1.93	1.92	1.11	1.93	1.88	2.03	1.33	2.11	2.09	1.74	2.90	2.38	2.49	2.76	2.93	2.92	3.09	3.25	3.24	3.47	2.32	2.20	2.38	2.53	2.52

Table D6

Seasonal (Winter) Maximum Series and $x_j(R_i, g_{i,j})$ All Models per Year j^{th}

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2039	0.91	0.94	0.72	0.87	0.89	0.86	0.72	0.94	0.97	0.92	0.88	0.93	1.02	0.94	0.95	0.89	0.90	0.90	1.07	0.98	1.02	1.00	0.99	1.06	1.03
2040	0.70	0.70	0.76	0.92	0.91	0.82	0.72	0.94	1.11	0.99	0.99	1.06	1.18	1.06	0.99	0.95	0.99	0.97	1.25	1.06	1.03	0.97	0.93	1.16	1.25
2041	1.19	1.20	1.13	1.25	1.20	1.20	1.13	1.25	1.25	1.22	1.24	1.30	1.26	1.21	1.26	1.20	1.14	1.08	1.43	1.43	1.14	1.12	1.07	1.38	1.39
2042	0.89	0.92	0.78	0.92	0.94	0.85	0.74	0.92	0.96	0.97	0.94	1.02	1.00	0.92	0.92	0.96	0.93	0.84	0.95	0.94	1.01	0.97	0.88	0.99	0.96
2043	0.87	0.95	0.79	1.01	0.98	0.86	0.73	0.91	0.96	0.93	0.92	0.91	0.93	0.85	0.84	0.81	0.82	0.85	0.99	1.01	0.89	0.91	0.87	1.03	1.08
2044	0.81	0.90	0.82	1.07	1.03	0.82	0.75	0.90	1.02	1.00	0.92	1.00	0.93	0.82	1.02	0.94	0.93	0.88	0.98	1.09	1.08	1.03	0.94	1.13	1.12
2045	0.68	0.68	0.65	0.87	0.96	0.72	0.63	0.76	0.91	1.03	0.84	0.87	0.86	0.85	0.94	0.86	0.89	0.86	1.01	1.02	0.98	1.02	0.99	1.11	1.16
2046	0.86	0.89	0.73	0.84	0.84	0.81	0.72	0.90	0.87	0.85	1.04	1.06	0.98	0.87	0.95	1.07	0.96	0.99	1.19	1.15	1.05	0.95	1.11	1.23	1.10
2047	0.95	0.91	0.74	1.00	1.01	1.03	0.81	1.00	1.03	1.01	1.33	1.26	1.14	1.00	1.05	1.25	1.12	0.94	1.11	1.12	1.08	0.95	0.98	1.16	1.13
2048	0.80	0.94	0.76	1.04	1.04	0.88	0.69	1.02	1.00	1.00	0.92	1.02	0.97	0.91	1.04	0.90	0.94	0.88	1.05	1.15	0.98	1.05	1.03	1.13	1.12
2049	0.71	0.79	0.73	0.90	0.96	0.80	0.75	0.93	0.98	0.98	0.86	1.01	1.05	0.97	0.96	0.92	0.97	1.02	1.20	1.09	1.01	1.08	1.04	1.23	1.21
2050	0.81	0.83	0.78	0.94	1.03	0.85	0.75	0.92	1.03	1.13	0.96	1.06	1.12	1.05	1.22	1.02	1.04	1.09	1.45	1.48	1.06	1.09	1.21	1.52	1.65
2051	0.98	1.02	0.76	0.79	0.73	0.93	0.78	0.90	0.79	0.71	0.92	0.97	0.83	0.70	0.77	0.94	0.85	0.73	0.92	0.99	0.98	0.89	0.85	1.04	1.08
2052	1.24	1.22	1.10	1.28	1.16	1.20	0.99	1.14	1.19	1.09	1.20	1.17	1.14	1.08	1.10	1.14	1.07	1.05	1.20	1.21	1.13	1.08	1.17	1.24	1.24
2053	1.06	1.14	1.01	1.09	1.02	1.09	1.01	1.12	1.04	0.95	1.25	1.26	1.20	1.01	1.02	1.24	1.18	1.05	1.14	1.09	1.26	1.23	1.13	1.35	1.27
2054	0.64	0.73	0.71	0.89	0.92	0.68	0.67	0.87	0.96	0.86	0.83	0.90	0.94	0.86	0.86	0.82	0.85	0.84	0.95	1.04	0.87	0.85	0.85	1.09	1.19
2055	0.99	0.99	0.84	1.09	1.03	1.05	0.96	1.20	1.17	1.08	1.14	1.38	1.34	1.10	1.12	1.15	1.25	1.13	1.33	1.40	1.11	1.20	1.17	1.48	1.59
2056	0.75	0.84	0.70	0.85	0.87	0.84	0.73	0.86	0.88	0.87	0.90	0.98	0.94	0.90	0.94	0.80	0.88	0.91	1.01	1.01	0.87	0.92	0.95	1.01	1.06
2057	0.75	0.75	0.56	0.86	0.96	0.71	0.54	0.76	0.90	0.97	0.76	0.80	0.86	0.89	0.94	0.80	0.78	0.84	1.02	1.05	0.79	0.83	0.88	1.16	1.18
2058	0.99	1.06	0.86	1.16	1.24	1.04	0.84	1.07	1.15	1.17	1.10	1.11	1.13	1.13	1.16	1.09	1.06	1.08	1.16	1.20	1.07	1.10	1.08	1.18	1.21

Year	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2059	0.80	0.81	0.83	0.99	0.99	0.86	0.86	1.07	1.05	0.98	1.16	1.22	1.17	1.02	1.03	1.17	1.14	1.03	1.17	1.23	1.27	1.23	1.10	1.29	1.34
2060	0.91	0.99	0.83	1.09	1.11	0.89	0.85	1.08	1.20	1.19	0.97	1.10	1.11	1.11	1.19	0.83	0.92	0.95	1.29	1.26	1.03	1.09	1.21	1.34	1.29
2061	1.03	0.94	0.73	0.81	0.85	0.94	0.75	0.87	0.93	0.95	0.90	0.89	0.97	1.02	0.93	0.73	0.76	0.99	1.13	0.96	0.81	0.89	1.06	1.19	1.18
2062	0.89	0.87	0.83	0.91	0.86	0.79	0.77	0.92	0.92	0.90	0.88	0.97	0.96	0.82	0.91	0.95	0.94	0.81	0.95	1.03	1.03	1.01	0.91	1.07	1.14
2063	0.76	0.84	0.87	0.93	0.97	0.73	0.68	0.90	0.95	0.94	0.82	0.85	0.84	0.81	0.89	0.78	0.75	0.72	0.97	1.09	0.83	0.79	0.72	1.06	1.20
2064	1.01	1.08	0.93	1.26	1.25	0.99	0.92	1.09	1.23	1.22	0.99	1.12	1.14	1.07	1.24	1.05	1.09	1.02	1.23	1.27	1.15	1.12	1.11	1.30	1.28
2065	0.85	0.90	0.85	1.06	0.96	0.79	0.71	0.89	1.00	0.90	0.93	0.99	1.12	0.96	0.96	0.96	1.01	1.06	1.19	1.14	1.00	1.06	1.23	1.39	1.31
2066	1.04	1.09	0.86	1.13	1.09	1.13	1.02	1.23	1.22	1.11	1.35	1.49	1.36	1.14	1.04	1.41	1.37	1.15	1.23	1.12	1.44	1.35	1.26	1.33	1.23
2067	0.95	1.00	0.81	1.00	0.98	1.11	0.90	1.07	1.05	1.00	1.28	1.24	1.11	0.93	0.98	1.20	1.13	0.98	1.03	1.01	1.12	1.11	1.08	1.19	1.13
2068	0.99	1.11	0.89	1.03	0.98	1.01	0.92	1.13	1.12	1.00	1.13	1.25	1.21	1.05	1.01	1.12	1.17	1.06	1.19	1.20	1.18	1.16	1.14	1.38	1.31
2069	0.96	0.99	0.79	1.07	1.03	1.04	0.79	1.08	1.17	1.12	1.12	1.17	1.18	1.11	1.15	1.18	1.11	1.04	1.23	1.27	1.18	1.19	1.12	1.33	1.30
2070	0.95	1.06	0.79	1.05	1.08	1.03	1.01	0.99	1.04	0.99	1.19	1.21	1.11	1.05	1.02	1.16	1.12	1.04	1.13	1.05	1.20	1.18	1.12	1.13	1.13

Table D7

Reliability Ensemble Average Equations Presented by Giorgio and Mearns (2002)

Equation description	Equation	Variable description
Equation 1 Ensemble Average Change in Precipitation, $\overline{\Delta P}$	$\overline{\Delta P} = \frac{1}{N}\sum_{i=1,N} \Delta P_i$	N is the number of Ensemble models Δ depicts the model-simulated change ΔP_i represents the mean change in precipitation per ensemble.
Equation 2 Root Mean Square Difference from the ensemble average change, used for uncertainty range determination $\pm\delta_{\Delta P}$ assuming a Normal PDF.	$\delta_{\Delta P} = \left[\frac{1}{N}\sum_{i=1,N} (\Delta P_i - \overline{\Delta P})^2\right]^{1/2}$	
Equation 3. Reliability Ensemble Weighted Average, $\widetilde{\Delta P}$	$\widetilde{\Delta P} = \tilde{A}(\Delta P) = \frac{\sum_i R_i \Delta P_i}{\sum_i R_i}$	$\tilde{A}$ denotes the REA averaging R_i is defined as the model reliability factor
Equation 4 and 5 Model Reliability Factor R_i	$R_i = \left[(R_{B,i})^m (R_{D,i})^n\right]^{\frac{1}{mn}}$ $R_i = \left\{\left[\frac{\epsilon_P}{abs(B_{P,i})}\right]^m \left[\frac{\epsilon_P}{abs(D_{P,i})}\right]^n\right\}^{\frac{1}{mn}}$	m and n are weight factors $R_{B,i}$ is denoted as the reliability as a function of the model bias in simulating present-day precipitation $R_{D,i}$ is denoted as the reliability as a function of the model bias in simulating present-day precipitation ϵ_P is denoted as the natural variability calculated from the observed record $B_{P,i}$ Model Bias in simulating present day climate, simulated minus observed. $(\overline{P_i} - \overline{P_{obs}})_{present-day}$ $D_{P,i}$ is defined as the model distance, where the model deviates from the ensemble average change $(\Delta P_i - \widetilde{\Delta P})$, this variable is calculated iterative until it converges, because the term $\widetilde{\Delta P}$ needs to be recalculated.

Equation description	Equation	Variable description
Equation 6 Root Mean Square Difference from the reliability ensemble weighted average change, similar to equation 2.	$\tilde{\delta}_{\Delta P} = \left[\frac{\sum_i R_i \left(\Delta P_i - \widetilde{\Delta P} \right)^2}{\sum_i R_i} \right]^{1/2}$	ΔP_{ul} is defined as the upper limit uncertainty limits ΔP_{ll} is defined as the lower limit uncertainty limits
Equation 7 and 8 Upper and Lower Limit uncertainty boundaries estimation of the reliability ensemble weighted average.	$\Delta P_{ul} = \widetilde{\Delta P} + \tilde{\delta}_{\Delta P}$ $\Delta P_{ll} = \widetilde{\Delta P} - \tilde{\delta}_{\Delta P}$	ΔP_{ul} is defined as the upper limit uncertainty limits ΔP_{ll} is defined as the lower limit uncertainty limits
Equation 9 Measure of the collective reliability, $\tilde{\rho}$	$\tilde{\rho} = \tilde{A}(R_i) = \frac{\sum_i {R_i}^2}{\sum_i R_i}$	
Equation 10 and 11 Collective measurement of reliability with respect of model bias ($\overline{R_B}$) and model convergence ($\overline{R_D}$).	$\overline{R_B} = \frac{1}{N} \sum_{i=1,N} R_{B,i}$ $\overline{R_D} = \frac{1}{N} \sum_{i=1,N} R_{D,i}$	

Table D8

Reliability Ensemble Average by Dominguez, Cañon, and Valdes (2010)

Equation Description	Equation	Variable Description
Equation 4 and 5. Alternatives REA estimate, including two climatic variables (i.e. Temperature and Precipitation)	$R_i = R_{P,i}R_{T,i}$ $R_{P,i} = R_{P,B,i}R_{P,D,i}$ $R_{T,i} = R_{T,B,i}R_{T,D,i}$	The variables are an example for the application of the pair of variables evaluated by Dominguez.
Equation 4 and 5. Alternatives Reliability factor calculation for model Bias, $R_{B,i}$	$R_{B,i} = MSE(f,x) \therefore$ $= \frac{1}{S}\sum_{j}^{S}\left(f_{j,i} - x_i\right)^2$	For a given climatic variable, S represents a time frame, (i.e. total months in a year) j represents a partial time frame (i.e. months) $f_{j,i}$ represents the historical output of a model i for month j x_i represents the observation for each month j
Equation 4. Alternatives Reliability factor calculation for model convergence, $R_{D,i}$	$R_{D,i} = MSE(g,y) \therefore$ $= \frac{1}{S}\sum_{j}^{S}\left(g_{j,i} - y_i\right)^2$ $y_i = \frac{\sum_i^N (R_i\, g_{j,i})}{\sum_i^N R_i}$	For a given climatic variable, S represents a time frame, (i.e. total months in a year) j represents a partial time frame (i.e. months) i represents the individual set of models tested $g_{j,i}$ represents the model i projection for each month j y_i represents the REA-weighted average for each month j Note: Similar to the method proposed by Giorgio, the y_i is a function of R_i
Equation 12 Normalized reliability index. Dominguez refers to it as $R_{B,i}$ or $R_{D,i}$.	$\eta_{B,i} = \frac{R_{Bmax} - R_{B,i}}{R_{Bmax}}$ $\eta_{D,i} = \frac{R_{Dmax} - R_{D,i}}{R_{Dmax}}$	R_{Bmax} is the maximum reliability calculated bias from all models. R_{Bmax} is the maximum reliability calculated for conveyance among all models This index is used for comparison purposes, and compares the models against the highest reliability values. High reliability values suggest that the model departs from the historical observation or the convergence of the other models.

APPENDIX E

GENERALIZED EXTREME VALUE DISTRIBUTION FIT

Table E1

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Canadian Regional Climate Model; Community Climate System Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	-0.136	0.298	1.010	-0.054	0.324	1.071
A2	-0.003	0.296	1.019	-0.081	0.347	1.076
A3	-0.118	0.303	1.207	-0.231	0.392	1.268
A4	-0.020	0.267	1.094	-0.078	0.340	1.185
A5	-0.187	0.274	1.143	0.068	0.279	1.156
B1	0.004	0.274	0.960	-0.118	0.322	0.983
B2	0.015	0.321	0.979	-0.163	0.397	1.075
B3	-0.178	0.320	1.041	-0.109	0.364	1.122
B4	0.072	0.280	1.198	0.014	0.355	1.316
B5	-0.118	0.298	1.195	0.146	0.288	1.196
C1	0.113	0.310	0.923	-0.240	0.373	1.066
C2	0.247	0.287	0.950	-0.008	0.371	1.030
C3	0.125	0.272	1.004	0.128	0.338	1.110
C4	0.001	0.332	1.058	0.012	0.315	1.163
C5	-0.133	0.318	1.285	0.151	0.348	1.343
D1	0.063	0.317	0.923	0.222	0.331	1.005
D2	-0.091	0.279	0.950	0.128	0.343	0.983
D3	-0.198	0.325	1.002	-0.077	0.350	1.107
D4	-0.104	0.286	1.078	0.050	0.306	1.090
D5	-0.211	0.361	1.131	0.154	0.322	1.134
E1	-0.132	0.283	0.944	0.106	0.401	1.065
E2	-0.185	0.337	0.980	-0.015	0.357	1.103
E3	-0.058	0.284	0.992	0.014	0.321	1.096
E4	-0.116	0.281	1.078	0.164	0.313	1.141
E5	-0.193	0.314	1.134	0.075	0.394	1.146

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E2

Seasonal (Winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Canadian Regional Climate Model; Community Climate System Model.

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.004	0.296	0.646	0.483	0.154	0.431
A2	0.025	0.306	0.663	0.471	0.152	0.438
A3	0.015	0.314	0.740	0.097	0.241	0.589
A4	0.097	0.261	0.673	-0.004	0.248	0.584
A5	0.063	0.238	0.681	0.041	0.217	0.598
B1	0.011	0.286	0.660	0.526	0.152	0.444
B2	0.024	0.300	0.674	0.770	0.129	0.418
B3	0.072	0.285	0.684	0.401	0.184	0.509
B4	0.110	0.280	0.748	0.117	0.249	0.612
B5	0.073	0.246	0.693	0.101	0.195	0.600
C1	0.048	0.267	0.659	0.287	0.204	0.479
C2	0.031	0.286	0.658	0.370	0.192	0.485
C3	0.230	0.250	0.653	0.448	0.182	0.525
C4	0.159	0.269	0.695	0.214	0.209	0.564
C5	0.152	0.269	0.732	0.095	0.225	0.669
D1	0.048	0.260	0.655	0.203	0.209	0.516
D2	0.122	0.272	0.622	0.150	0.213	0.534
D3	0.332	0.247	0.612	0.093	0.218	0.572
D4	0.140	0.284	0.679	0.040	0.212	0.634
D5	0.101	0.290	0.695	0.151	0.222	0.638
E1	0.053	0.269	0.609	0.105	0.223	0.521
E2	0.209	0.263	0.603	0.008	0.225	0.556
E3	0.222	0.265	0.624	-0.068	0.225	0.621
E4	0.193	0.258	0.683	-0.073	0.246	0.659
E5	0.192	0.257	0.685	0.135	0.227	0.638

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E3

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Canadian Regional Climate Model; Canadian Coupled Global Climate Model 3.

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	-0.024	0.263	1.025	-0.287	0.407	1.394
A2	-0.026	0.232	1.044	-0.076	0.416	1.353
A3	-0.128	0.284	1.209	-0.014	0.413	1.488
A4	-0.155	0.261	1.181	-0.004	0.382	1.397
A5	-0.353	0.349	1.250	-0.014	0.347	1.467
B1	-0.038	0.226	1.046	-0.129	0.332	1.396
B2	-0.196	0.242	1.113	-0.007	0.332	1.469
B3	-0.336	0.268	1.123	0.032	0.411	1.482
B4	-0.241	0.276	1.193	0.020	0.358	1.576
B5	-0.095	0.312	1.207	0.234	0.314	1.412
C1	-0.134	0.241	1.035	-0.109	0.361	1.503
C2	-0.402	0.247	1.062	-0.088	0.361	1.477
C3	-0.359	0.304	1.102	0.014	0.413	1.493
C4	-0.213	0.298	1.171	0.081	0.381	1.476
C5	-0.135	0.387	1.277	0.045	0.373	1.509
D1	-0.285	0.274	1.079	0.129	0.238	1.486
D2	-0.380	0.298	1.116	0.100	0.272	1.408
D3	-0.029	0.282	1.130	0.079	0.306	1.417
D4	0.070	0.266	1.133	0.036	0.341	1.448
D5	0.001	0.302	1.222	0.135	0.270	1.391
E1	-0.231	0.337	1.148	-0.112	0.354	1.474
E2	-0.093	0.287	1.147	0.119	0.280	1.381
E3	-0.001	0.300	1.176	0.055	0.370	1.385
E4	0.099	0.288	1.207	-0.046	0.399	1.470
E5	0.118	0.278	1.223	0.076	0.289	1.402

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E4

Seasonal (Winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Canadian Regional Climate Model; Canadian Coupled Global Climate Model 3.

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	-0.380	0.274	0.609	0.329	0.307	0.606
A2	-0.246	0.273	0.613	0.191	0.339	0.660
A3	-0.101	0.254	0.658	0.013	0.391	0.763
A4	0.005	0.241	0.670	0.036	0.365	0.736
A5	-0.037	0.225	0.724	-0.178	0.363	0.779
B1	-0.403	0.297	0.648	0.434	0.310	0.628
B2	-0.289	0.309	0.632	0.113	0.364	0.698
B3	0.008	0.244	0.614	-0.009	0.375	0.737
B4	-0.011	0.235	0.732	-0.050	0.408	0.837
B5	0.038	0.213	0.755	-0.066	0.313	0.765
C1	-0.314	0.293	0.677	0.139	0.405	0.715
C2	-0.065	0.259	0.630	-0.138	0.420	0.786
C3	0.185	0.218	0.626	-0.052	0.391	0.790
C4	0.261	0.189	0.681	0.060	0.363	0.793
C5	0.062	0.226	0.797	0.079	0.327	0.818
D1	-0.163	0.266	0.713	0.048	0.458	0.759
D2	0.029	0.235	0.678	-0.220	0.452	0.835
D3	0.273	0.200	0.651	-0.018	0.373	0.782
D4	0.267	0.185	0.701	0.064	0.375	0.790
D5	0.080	0.219	0.792	0.010	0.358	0.803
E1	-0.098	0.248	0.751	0.126	0.408	0.767
E2	0.096	0.197	0.725	-0.142	0.401	0.820
E3	0.218	0.185	0.691	0.105	0.352	0.753
E4	0.127	0.198	0.731	0.135	0.340	0.785
E5	0.110	0.223	0.769	0.081	0.299	0.814

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E5

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Experimental Climate Prediction Center; Geophysical Fluid-Dynamics Laboratory Atmospheric-Land Generalized Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.016	0.458	1.743	-0.192	0.538	1.776
A2	0.033	0.483	1.619	-0.035	0.442	1.665
A3	0.345	0.364	1.487	0.016	0.427	1.611
A4	0.039	0.519	1.578	-0.071	0.493	1.744
A5	0.117	0.468	1.768	-0.104	0.444	1.822
B1	0.119	0.385	1.649	0.212	0.310	1.711
B2	0.047	0.412	1.736	0.056	0.468	1.895
B3	0.079	0.421	1.513	-0.062	0.416	1.780
B4	-0.033	0.473	1.663	-0.171	0.442	1.825
B5	0.070	0.495	1.770	-0.227	0.540	1.908
C1	-0.081	0.414	1.771	0.160	0.375	1.822
C2	0.053	0.493	1.740	0.026	0.481	1.929
C3	0.117	0.497	1.644	-0.173	0.440	1.885
C4	-0.159	0.530	1.706	-0.125	0.494	1.815
C5	-0.182	0.487	1.734	-0.005	0.485	1.827
D1	-0.029	0.542	1.757	-0.077	0.413	1.778
D2	0.115	0.423	1.583	0.037	0.349	1.597
D3	-0.062	0.514	1.970	0.045	0.427	1.954
D4	0.233	0.355	1.657	-0.124	0.519	1.970
D5	0.018	0.381	1.661	-0.169	0.489	1.940
E1	0.262	0.442	1.514	0.191	0.418	1.540
E2	0.132	0.396	1.629	-0.163	0.454	1.657
E3	-0.179	0.479	2.067	-0.061	0.483	2.130
E4	-0.123	0.433	1.797	-0.127	0.529	2.015
E5	-0.072	0.443	1.716	-0.046	0.451	1.957

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E6

Seasonal (Winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Experimental Climate Prediction Center; Geophysical Fluid-Dynamics Laboratory Atmospheric-Land Generalized Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.009	0.177	0.519	0.013	0.177	0.632
A2	0.013	0.167	0.478	-0.050	0.195	0.585
A3	0.011	0.133	0.463	0.135	0.202	0.549
A4	0.078	0.131	0.468	0.112	0.224	0.580
A5	-0.033	0.142	0.523	0.095	0.245	0.640
B1	0.080	0.157	0.502	0.074	0.188	0.590
B2	-0.011	0.160	0.534	0.071	0.228	0.606
B3	0.071	0.135	0.492	0.172	0.211	0.575
B4	-0.007	0.140	0.497	0.189	0.215	0.580
B5	0.006	0.137	0.527	0.256	0.224	0.603
C1	0.025	0.178	0.533	0.065	0.206	0.616
C2	0.064	0.157	0.578	0.158	0.235	0.622
C3	0.225	0.124	0.537	0.142	0.239	0.631
C4	0.086	0.129	0.515	0.248	0.212	0.592
C5	-0.021	0.136	0.532	0.327	0.210	0.588
D1	-0.234	0.165	0.584	0.151	0.233	0.599
D2	0.062	0.132	0.513	0.240	0.208	0.575
D3	0.160	0.151	0.625	0.151	0.243	0.682
D4	-0.063	0.149	0.562	0.165	0.223	0.627
D5	-0.118	0.137	0.557	0.294	0.216	0.594
E1	0.104	0.129	0.493	0.228	0.204	0.600
E2	-0.062	0.140	0.500	0.212	0.211	0.599
E3	-0.140	0.178	0.649	0.106	0.242	0.716
E4	-0.107	0.145	0.617	0.236	0.210	0.657
E5	-0.195	0.148	0.611	0.427	0.192	0.612

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E7

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit:

Hadley Centre Regional Model 3; Hadley Centre Coupled Model 3

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.089	0.473	1.648	0.341	0.515	1.869
A2	0.220	0.444	1.643	0.437	0.511	1.839
A3	0.105	0.532	1.671	0.302	0.508	1.812
A4	-0.023	0.509	1.716	0.100	0.432	1.939
A5	0.020	0.454	1.691	-0.215	0.471	1.918
B1	-0.094	0.419	1.583	0.220	0.609	1.772
B2	0.021	0.451	1.621	0.205	0.545	1.904
B3	0.085	0.469	1.637	0.102	0.504	1.815
B4	0.155	0.465	1.619	-0.021	0.491	1.831
B5	-0.112	0.532	1.661	0.317	0.320	1.629
C1	0.109	0.421	1.983	0.340	0.611	2.124
C2	0.145	0.488	2.166	0.336	0.563	2.343
C3	0.030	0.577	2.088	0.108	0.579	2.267
C4	0.043	0.505	1.565	0.079	0.501	1.696
C5	-0.044	0.518	1.695	0.315	0.422	1.686
D1	0.125	0.522	1.781	0.268	0.612	1.899
D2	0.020	0.513	1.799	0.067	0.675	1.908
D3	-0.085	0.424	1.402	0.273	0.484	1.427
D4	-0.155	0.464	2.253	0.096	0.660	2.524
D5	-0.218	0.423	2.099	0.148	0.633	2.103
E1	0.215	0.526	1.883	0.313	0.576	1.972
E2	0.180	0.496	1.773	0.129	0.581	1.908
E3	0.150	0.372	1.463	0.469	0.414	1.493
E4	-0.148	0.542	2.442	0.104	0.634	2.563
E5	-0.302	0.558	2.355	-0.009	0.614	2.377

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E8

Seasonal (Winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Hadley Centre Regional Model 3; Hadley Centre Coupled Model 3

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	-0.064	0.480	1.129	-0.457	0.425	0.982
A2	-0.063	0.535	1.163	-0.207	0.404	0.978
A3	0.031	0.592	1.184	-0.207	0.405	0.975
A4	0.048	0.602	1.212	-0.081	0.388	0.973
A5	0.078	0.586	1.166	-0.058	0.358	0.913
B1	0.011	0.471	1.091	-0.281	0.412	0.946
B2	0.283	0.480	1.061	-0.072	0.403	0.980
B3	0.404	0.476	1.022	0.222	0.349	0.918
B4	0.128	0.555	1.122	0.177	0.342	0.923
B5	-0.060	0.587	1.135	-0.048	0.346	0.905
C1	0.083	0.610	1.394	-0.147	0.477	1.236
C2	0.142	0.609	1.522	0.090	0.486	1.348
C3	0.172	0.605	1.370	0.169	0.424	1.182
C4	0.102	0.558	0.945	0.113	0.277	0.827
C5	0.072	0.542	0.996	-0.071	0.299	0.954
D1	0.420	0.490	1.077	-0.123	0.459	1.097
D2	0.408	0.468	1.037	0.084	0.387	1.008
D3	0.444	0.374	0.769	0.085	0.279	0.739
D4	-0.084	0.646	1.519	0.083	0.355	1.373
D5	-0.186	0.646	1.444	0.023	0.271	1.349
E1	0.336	0.493	1.241	-0.295	0.452	1.320
E2	0.340	0.435	1.139	-0.132	0.352	1.205
E3	0.260	0.384	0.881	-0.004	0.303	0.913
E4	0.135	0.494	1.587	0.060	0.370	1.556
E5	0.042	0.525	1.543	0.178	0.334	1.508

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E9

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Hadley Regional Model 3; Geophysical Fluid-Dynamics Laboratory Atmospheric-Land Generalized Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.209	0.460	1.491	0.012	0.496	1.664
A2	0.243	0.449	1.573	0.069	0.506	1.715
A3	0.173	0.451	1.709	0.047	0.587	1.743
A4	0.127	0.394	1.840	-0.009	0.611	1.862
A5	0.019	0.405	1.760	0.043	0.532	1.737
B1	0.214	0.460	1.457	0.414	0.316	1.531
B2	0.187	0.480	1.627	0.131	0.402	1.688
B3	0.115	0.439	1.632	0.035	0.438	1.756
B4	0.090	0.433	1.640	0.138	0.429	1.719
B5	-0.118	0.469	1.637	0.223	0.382	1.568
C1	0.113	0.408	1.692	-0.030	0.444	1.757
C2	0.252	0.391	1.855	-0.113	0.490	1.975
C3	0.394	0.333	1.800	0.162	0.451	1.938
C4	0.039	0.369	1.443	0.056	0.417	1.533
C5	-0.033	0.443	1.557	0.020	0.499	1.688
D1	-0.032	0.411	1.467	-0.187	0.458	1.671
D2	0.415	0.314	1.417	0.152	0.369	1.621
D3	0.276	0.313	1.205	0.078	0.383	1.362
D4	0.089	0.460	2.041	0.209	0.566	2.063
D5	0.006	0.442	1.817	0.140	0.630	1.914
E1	-0.102	0.416	1.658	-0.127	0.559	1.817
E2	-0.016	0.417	1.581	0.060	0.478	1.727
E3	-0.099	0.367	1.339	0.127	0.471	1.450
E4	0.081	0.464	1.972	0.308	0.573	2.035
E5	0.041	0.478	1.852	0.408	0.521	1.881

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E10

Seasonal (Winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Hadley Regional Model 3; Geophysical Fluid-Dynamics Laboratory Atmospheric-Land Generalized Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.101	0.272	0.757	-0.147	0.253	0.741
A2	0.015	0.318	0.828	-0.143	0.242	0.777
A3	-0.015	0.319	0.871	-0.199	0.259	0.833
A4	-0.094	0.332	0.935	-0.088	0.273	0.907
A5	-0.136	0.321	0.907	-0.115	0.274	0.919
B1	-0.057	0.329	0.831	-0.269	0.251	0.774
B2	-0.013	0.374	0.932	-0.089	0.248	0.866
B3	0.044	0.354	0.903	0.064	0.243	0.859
B4	-0.042	0.343	0.861	0.092	0.269	0.858
B5	-0.051	0.330	0.830	0.041	0.266	0.828
C1	-0.056	0.424	1.093	-0.274	0.299	1.069
C2	0.167	0.428	1.200	-0.142	0.289	1.218
C3	0.258	0.369	1.053	0.005	0.281	1.093
C4	0.141	0.274	0.695	0.011	0.227	0.705
C5	-0.016	0.343	0.809	-0.168	0.296	0.820
D1	-0.028	0.438	1.013	-0.260	0.298	1.055
D2	0.163	0.383	0.976	-0.287	0.268	1.050
D3	0.342	0.255	0.641	-0.345	0.188	0.781
D4	0.209	0.400	1.103	-0.024	0.209	1.204
D5	0.097	0.389	1.115	-0.151	0.272	1.118
E1	-0.023	0.445	1.171	-0.252	0.347	1.133
E2	0.078	0.425	1.064	-0.328	0.329	1.086
E3	0.186	0.321	0.759	-0.502	0.239	0.912
E4	0.239	0.406	1.213	-0.067	0.257	1.305
E5	0.081	0.402	1.324	-0.061	0.287	1.253

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E11

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Mesoscale Model 5; Community Climate System Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.259	0.426	1.564	0.230	0.646	1.760
A2	0.027	0.557	1.693	0.280	0.689	1.768
A3	-0.055	0.507	1.836	0.194	0.668	1.817
A4	-0.123	0.441	1.881	0.224	0.556	1.779
A5	-0.016	0.430	1.664	0.129	0.632	1.948
B1	0.038	0.423	1.483	-0.058	0.518	1.673
B2	-0.008	0.474	1.674	0.071	0.445	1.706
B3	0.177	0.665	1.694	0.086	0.463	1.850
B4	0.106	0.750	1.784	0.059	0.552	2.009
B5	0.014	0.708	1.851	0.175	0.534	2.055
C1	-0.015	0.390	1.469	0.049	0.554	1.716
C2	0.177	0.456	1.539	-0.356	0.670	1.972
C3	0.206	0.518	1.909	0.171	0.545	1.844
C4	0.251	0.632	1.876	0.022	0.732	2.034
C5	0.314	0.523	1.847	0.027	0.743	2.040
D1	-0.288	0.510	1.652	0.176	0.600	1.787
D2	-0.195	0.605	1.718	0.270	0.571	1.723
D3	0.356	0.442	1.567	0.048	0.607	1.879
D4	0.088	0.464	1.752	-0.082	0.641	1.901
D5	0.131	0.509	1.739	-0.227	0.635	2.117
E1	0.007	0.674	1.752	0.277	0.495	1.741
E2	0.046	0.623	1.674	0.340	0.423	1.707
E3	-0.016	0.570	1.751	0.536	0.348	1.705
E4	0.118	0.483	1.744	0.019	0.492	1.945
E5	-0.013	0.535	1.868	0.100	0.565	2.029

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E12

Seasonal (Winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Mesoscale Model 5; Community Climate System Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.072	0.268	0.721	0.121	0.249	0.686
A2	0.348	0.251	0.772	0.089	0.291	0.736
A3	0.516	0.244	0.804	-0.054	0.320	0.774
A4	0.112	0.351	0.901	-0.001	0.285	0.755
A5	0.029	0.557	1.154	-0.048	0.301	0.789
B1	-0.027	0.316	0.738	-0.004	0.303	0.683
B2	-0.005	0.314	0.747	-0.159	0.324	0.775
B3	0.096	0.304	0.748	-0.117	0.303	0.783
B4	0.084	0.272	0.740	0.043	0.251	0.734
B5	0.049	0.258	0.720	-0.095	0.296	0.792
C1	-0.055	0.320	0.781	-0.100	0.342	0.698
C2	-0.079	0.283	0.788	-0.294	0.364	0.767
C3	0.027	0.278	0.770	-0.055	0.302	0.712
C4	0.080	0.267	0.767	-0.017	0.286	0.752
C5	0.071	0.276	0.761	-0.473	0.369	0.865
D1	-0.076	0.307	0.864	-0.089	0.357	0.698
D2	-0.056	0.260	0.825	-0.093	0.332	0.704
D3	-0.046	0.270	0.776	-0.038	0.302	0.783
D4	-0.003	0.301	0.802	-0.051	0.329	0.821
D5	0.186	0.276	0.780	-0.181	0.354	0.897
E1	-0.215	0.359	0.918	-0.185	0.398	0.744
E2	0.201	0.244	0.814	-0.172	0.374	0.785
E3	0.036	0.276	0.809	-0.072	0.356	0.851
E4	0.213	0.276	0.803	-0.109	0.378	0.917
E5	0.414	0.265	0.801	0.027	0.346	0.886

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E13

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Regional Climate Model 3; Geophysical Fluid-Dynamics Laboratory Atmospheric-Land Generalized Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.055	0.533	2.079	0.119	0.667	2.268
A2	-0.009	0.600	2.159	0.125	0.633	2.263
A4	0.104	0.672	2.295	0.173	0.704	2.168
A5	0.314	0.609	2.153	0.103	0.858	2.402
B1	-0.160	0.510	2.275	0.045	0.742	2.328
B3	0.079	0.422	2.177	0.083	0.743	2.224
B4	0.188	0.464	2.123	-0.105	0.702	2.395
B5	0.134	0.470	2.236	0.023	0.702	2.449
C1	0.164	0.556	2.055	0.236	0.712	2.258
C2	-0.128	0.510	2.147	0.279	0.756	2.376
C3	0.169	0.464	2.155	0.295	0.692	2.421
C4	-0.078	0.504	2.156	0.183	0.830	2.449
C5	0.223	0.591	2.230	0.222	0.746	2.528
D1	0.135	0.707	2.302	-0.031	0.599	2.342
D2	0.233	0.657	2.208	0.090	0.761	2.629
D3	0.221	0.601	2.207	0.384	0.695	2.415
D4	0.373	0.519	2.204	0.032	0.768	2.534
D5	0.515	0.474	2.358	0.121	0.776	2.707
E1	0.194	0.513	2.222	0.219	0.562	2.419
E2	0.075	0.559	2.205	0.130	0.574	2.254
E3	0.080	0.774	2.278	0.120	0.648	2.469
E4	0.361	0.582	2.162	0.230	0.698	2.387
E5	-0.047	0.697	2.431	0.116	0.692	2.326

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function. Function. Grids A3 and B2 do not have a series assigned to them.

Table E14

Seasonal (Winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Regional Climate Model 3; Geophysical Fluid-Dynamics Laboratory Atmospheric-Land Generalized Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.013	0.312	0.863	-0.148	0.345	0.919
A2	0.097	0.288	0.907	0.093	0.328	0.869
A4	0.173	0.277	0.909	0.036	0.345	0.902
A5	0.051	0.301	0.921	0.013	0.327	0.922
B1	-0.066	0.298	0.929	-0.009	0.359	0.928
B3	-0.035	0.292	0.966	0.148	0.319	0.848
B4	-0.010	0.300	0.949	0.193	0.278	0.877
B5	0.028	0.287	0.938	0.200	0.240	0.929
C1	-0.018	0.273	0.895	0.018	0.377	0.941
C2	-0.052	0.293	0.953	0.152	0.350	0.895
C3	-0.019	0.286	0.959	0.143	0.285	0.873
C4	0.068	0.274	0.939	0.277	0.219	0.868
C5	0.099	0.271	0.949	0.255	0.189	0.924
D1	0.102	0.257	0.867	-0.107	0.405	0.943
D2	0.200	0.256	0.913	0.090	0.357	0.882
D3	0.234	0.248	0.914	0.105	0.283	0.870
D4	0.337	0.219	0.883	0.303	0.227	0.865
D5	0.189	0.240	0.915	0.088	0.248	0.928
E1	0.199	0.213	0.892	-0.158	0.422	0.953
E2	0.220	0.233	0.934	-0.069	0.383	0.960
E3	0.229	0.237	0.930	-0.079	0.310	0.941
E4	0.149	0.246	0.936	-0.037	0.290	0.966
E5	0.166	0.248	0.937	-0.171	0.311	1.022

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function. Grids A3 and B2 do not have a series assigned to them.

Table E15

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Regional Climate Model 3; Canadian Coupled Global Climate Model 3

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.368	0.635	2.076	0.407	0.534	2.336
A2	0.213	0.688	2.098	0.204	0.618	2.193
A4	0.083	0.680	2.268	0.105	0.663	2.375
A5	0.193	0.776	2.376	-0.070	0.809	2.529
B1	-0.064	0.704	2.437	0.046	0.928	2.840
B3	-0.035	0.756	2.422	0.113	0.841	2.602
B4	0.072	0.770	2.307	0.418	0.567	2.426
B5	0.042	0.798	2.543	0.242	0.646	2.416
C1	0.009	0.549	2.298	0.175	0.818	2.605
C2	0.274	0.444	2.230	-0.178	0.872	2.797
C3	0.121	0.556	2.292	-0.164	0.859	2.725
C4	-0.051	0.657	2.431	-0.139	0.866	2.768
C5	0.073	0.691	2.521	-0.092	0.822	2.799
D1	0.144	0.561	2.150	0.297	0.611	2.632
D2	0.095	0.530	2.234	0.203	0.728	2.496
D3	0.222	0.526	2.294	0.098	1.029	2.668
D4	-0.001	0.704	2.503	0.149	0.996	2.736
D5	-0.155	0.601	2.491	0.060	0.954	2.885
E1	0.045	0.558	2.271	-0.181	0.770	2.733
E2	0.089	0.640	2.300	0.246	0.817	2.645
E3	0.176	0.635	2.438	0.160	0.788	2.625
E4	0.182	0.783	2.581	0.012	0.979	2.931
E5	-0.130	0.832	2.816	0.091	0.762	2.870

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function. Grids A3 and B2 do not have a series assigned to them.

Table E16

Seasonal (Winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Regional Climate Model 3; Canadian Coupled Global Climate Model 3

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	-0.209	0.308	0.869	0.121	0.333	0.880
A2	-0.332	0.317	0.914	-0.006	0.363	0.935
A4	-0.157	0.279	0.952	0.062	0.342	1.024
A5	0.000	0.250	0.907	-0.098	0.318	1.063
B1	-0.025	0.342	0.908	0.184	0.342	0.918
B3	-0.019	0.318	0.926	0.235	0.303	0.909
B4	0.033	0.264	0.959	0.134	0.305	1.045
B5	-0.060	0.223	0.945	-0.078	0.346	1.113
C1	0.013	0.335	0.909	0.092	0.361	0.975
C2	0.000	0.347	0.958	0.423	0.277	0.881
C3	0.013	0.302	0.958	-0.011	0.363	0.986
C4	0.107	0.240	0.938	-0.043	0.369	1.077
C5	0.105	0.222	0.970	0.017	0.419	1.123
D1	-0.003	0.315	0.964	-0.036	0.376	0.919
D2	-0.120	0.331	0.997	-0.258	0.421	0.982
D3	-0.167	0.328	0.977	-0.078	0.352	0.990
D4	-0.057	0.299	0.995	-0.001	0.324	1.072
D5	0.040	0.287	0.995	0.023	0.489	1.105
E1	-0.122	0.304	0.965	-0.104	0.411	0.963
E2	-0.258	0.352	0.990	-0.038	0.356	0.973
E3	-0.158	0.348	0.999	-0.065	0.365	0.986
E4	-0.067	0.352	1.008	-0.311	0.412	1.121
E5	0.134	0.266	1.058	-0.013	0.483	1.106

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E17

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Weather Research and Forecasting with the Grell Model; Canadian Coupled Global Climate Model 3

Grid	Present-day climate GEV parameters			Future-day climate GEV parameters		
	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	-0.146	0.574	1.699	-0.070	0.607	2.039
A2	0.064	0.603	1.669	-0.095	0.538	2.149
A3	0.052	0.556	1.521	-0.072	0.594	2.027
A4	0.020	0.588	1.553	-0.120	0.563	2.091
A5	-0.107	0.506	1.463	-0.271	0.552	2.118
B1	-0.059	0.555	1.700	0.033	0.559	1.971
B2	0.063	0.591	1.667	-0.091	0.610	2.206
B3	-0.211	0.683	1.757	-0.116	0.650	2.213
B4	-0.148	0.585	1.612	0.094	0.490	2.091
B5	-0.000	0.634	1.744	0.252	0.493	2.155
C1	0.050	0.586	1.628	0.022	0.609	2.027
C2	-0.363	0.640	1.664	0.032	0.558	2.115
C3	-0.087	0.720	1.764	-0.141	0.648	2.165
C4	0.088	0.657	1.813	-0.100	0.676	2.452
C5	-0.122	0.531	1.859	0.108	0.660	2.378
D1	-0.063	0.562	1.578	-0.225	0.685	2.164
D2	-0.228	0.618	1.768	-0.138	0.755	2.129
D3	-0.119	0.565	1.821	-0.108	0.807	2.361
D4	-0.054	0.580	1.831	-0.143	0.606	2.494
D5	-0.024	0.670	2.082	0.059	0.675	2.283
E1	-0.133	0.519	1.480	-0.031	0.710	2.143
E2	-0.011	0.723	1.730	-0.102	0.731	2.303
E3	0.672	0.388	1.581	-0.026	0.768	2.254
E4	-0.037	0.610	1.922	0.041	0.645	2.127
E5	0.010	0.645	1.946	0.212	0.634	2.159

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E18

Seasonal (Winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Weather Research and Forecasting with the Grell Model; Canadian Coupled Global Climate Model 3

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.174	0.252	0.709	0.020	0.290	0.795
A2	-0.030	0.352	0.827	0.097	0.331	0.890
A3	-0.019	0.353	0.841	-0.164	0.329	0.897
A4	-0.153	0.367	0.869	-0.089	0.344	1.036
A5	-0.201	0.306	0.837	-0.110	0.289	1.029
B1	0.163	0.256	0.732	0.104	0.301	0.777
B2	0.270	0.272	0.699	0.140	0.320	0.808
B3	0.017	0.350	0.832	-0.114	0.343	0.989
B4	-0.252	0.380	0.881	-0.088	0.366	1.103
B5	-0.338	0.330	0.845	-0.111	0.339	1.083
C1	0.190	0.252	0.735	0.172	0.287	0.766
C2	0.163	0.269	0.679	0.218	0.272	0.769
C3	-0.178	0.341	0.749	0.165	0.265	0.910
C4	-0.140	0.278	0.740	0.171	0.302	0.958
C5	-0.203	0.270	0.706	0.013	0.322	0.969
D1	0.272	0.247	0.722	0.091	0.306	0.837
D2	-0.093	0.300	0.737	0.138	0.284	0.844
D3	-0.246	0.297	0.797	0.147	0.283	0.946
D4	-0.117	0.270	0.769	0.131	0.320	1.002
D5	0.011	0.254	0.735	-0.047	0.373	1.059
E1	0.029	0.281	0.818	0.191	0.271	0.830
E2	-0.216	0.303	0.864	0.133	0.300	0.906
E3	-0.088	0.293	0.851	0.072	0.376	1.064
E4	0.016	0.297	0.804	0.033	0.406	1.143
E5	-0.017	0.319	0.820	-0.167	0.394	1.195

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E19

Annual Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Weather Research and Forecasting with the Grell Model; Community Climate System Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	0.086	0.521	1.566	0.130	0.756	1.762
A2	0.033	0.596	1.818	0.083	0.796	1.886
A3	0.268	0.429	1.640	-0.096	0.640	1.879
A4	0.235	0.450	1.542	-0.108	0.681	2.085
A5	0.225	0.325	1.428	-0.276	0.732	2.034
B1	-0.059	0.641	1.748	0.122	0.739	1.740
B2	0.194	0.590	1.675	-0.099	0.682	1.934
B3	0.293	0.420	1.773	0.093	0.701	1.904
B4	0.112	0.439	1.736	-0.060	0.884	2.070
B5	0.069	0.502	1.794	0.100	0.643	2.049
C1	-0.091	0.539	1.731	0.021	0.628	1.868
C2	0.070	0.508	1.582	0.130	0.586	1.756
C3	0.123	0.379	1.625	0.364	0.729	1.812
C4	-0.298	0.531	1.892	0.193	0.652	1.848
C5	0.070	0.576	1.749	0.189	0.453	1.890
D1	0.159	0.442	1.625	0.019	0.534	1.934
D2	-0.179	0.462	1.614	0.354	0.728	1.912
D3	-0.072	0.473	1.798	0.283	0.640	1.947
D4	-0.006	0.564	1.928	-0.256	0.510	2.176
D5	0.294	0.500	1.799	0.525	0.491	1.940
E1	0.300	0.450	1.507	-0.049	0.719	2.037
E2	0.119	0.506	1.614	0.349	0.717	1.952
E3	0.069	0.502	1.841	-0.110	0.775	2.171
E4	0.134	0.540	1.823	-0.212	0.870	2.292
E5	0.006	0.701	1.902	-0.188	0.674	2.123

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

Table E20

Seasonal (winter) Precipitation Maximum Series Generalized Extreme Value Distribution Fit: Weather Research and Forecasting with the Grell Model; Community Climate System Model

	Present-day climate GEV parameters			Future-day climate GEV parameters		
Grid	κ_p	σ_p	μ_p	κ_f	σ_f	μ_f
A1	-0.079	0.279	0.725	0.297	0.185	0.627
A2	-0.440	0.337	0.819	0.126	0.250	0.709
A3	-0.346	0.359	0.796	0.042	0.268	0.748
A4	-0.316	0.292	0.783	-0.156	0.324	0.826
A5	-0.090	0.218	0.690	-0.023	0.338	0.819
B1	-0.054	0.313	0.726	0.026	0.239	0.669
B2	-0.173	0.313	0.760	0.052	0.273	0.729
B3	-0.171	0.325	0.745	-0.152	0.322	0.830
B4	-0.117	0.260	0.680	-0.020	0.345	0.836
B5	0.037	0.215	0.656	0.160	0.303	0.789
C1	-0.025	0.316	0.733	-0.113	0.288	0.716
C2	-0.198	0.295	0.713	-0.243	0.304	0.830
C3	-0.416	0.296	0.713	-0.130	0.316	0.855
C4	-0.277	0.263	0.703	0.149	0.300	0.794
C5	-0.249	0.217	0.697	0.107	0.263	0.765
D1	0.022	0.338	0.730	-0.217	0.287	0.797
D2	-0.078	0.311	0.711	-0.173	0.293	0.877
D3	-0.156	0.306	0.736	-0.057	0.346	0.888
D4	-0.175	0.288	0.772	0.025	0.340	0.883
D5	0.018	0.197	0.766	-0.058	0.338	0.901
E1	-0.078	0.334	0.732	-0.033	0.292	0.786
E2	-0.178	0.305	0.748	-0.144	0.329	0.882
E3	-0.127	0.309	0.769	0.019	0.363	0.953
E4	-0.102	0.277	0.837	-0.028	0.366	0.941
E5	0.137	0.222	0.822	0.165	0.392	0.914

Note. κ is the shape parameter; σ is the scale parameter and μ is the location parameter in the GEV Distribution Function.

APPENDIX F

NOAA ATLAS 14 PRECIPITATION ESTIMATES FOR THE 24 HOUR EVENT IN THE STUDY AREA

Table F1

NOAA ATLAS 14 Precipitation Volume Estimates in Inches for the 24-Hour Duration Event

	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	D1	D2	D3	D4	D5	E1	E2	E3	E4	E5
2-year 24 hour	2.14	2.33	2.51	2.35	2.75	1.89	2.45	3.04	2.48	3.12	1.80	1.92	2.11	2.56	3.19	1.39	1.48	1.42	2.31	2.72	1.40	1.57	1.82	1.61	2.64
5-year 24 hour	2.93	3.20	3.42	3.18	3.71	2.76	3.37	4.14	3.45	4.20	2.65	2.65	2.94	3.58	4.33	2.08	2.09	1.99	3.21	3.77	1.99	2.22	2.57	2.22	3.58
10-year 24 hour	3.47	3.80	4.04	3.75	4.38	3.38	4.01	4.90	4.16	4.96	3.24	3.16	3.53	4.33	5.13	2.57	2.51	2.38	3.85	4.52	2.41	2.67	3.10	2.64	4.24
25-year 24 hour	4.17	4.60	4.86	4.50	5.25	4.22	4.86	5.88	5.12	5.95	4.05	3.83	4.32	5.36	6.20	3.24	3.07	2.91	4.73	5.53	2.98	3.28	3.82	3.20	5.11
50-year 24 hour	4.70	5.21	5.49	5.08	5.93	4.89	5.52	6.66	5.89	6.72	4.68	4.35	4.95	6.20	7.03	3.77	3.51	3.32	5.42	6.34	3.41	3.75	4.37	3.64	5.80
100-year 24 hour	5.27	5.86	6.17	5.69	6.65	5.60	6.22	7.47	6.73	7.54	5.36	4.94	5.62	7.13	7.92	4.34	3.98	3.76	6.18	7.20	3.88	4.26	4.97	4.10	6.52

APPENDIX G

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION COMPARISON

Table G1

Difference in Frequency Quantiles in Relation to NOAA Atlas 14 Quantiles (RCM-NOAA)

	Return period					
	2 year 24 hour	5 year 24 hour	10 year 24 hour	25 year 24 hour	50 year 24 hour	100 year 24 hour
CRCM ccsm	-1.04	-1.57	-1.96	-2.50	-2.94	-3.43
CRCM cgcm3	-0.95	-1.52	-1.95	-2.55	-3.03	-3.57
ECP2 gfdl	-0.33	-0.65	-0.88	-1.19	-1.42	-1.68
HRM3 hadcm3	-0.21	-0.50	-0.71	-0.99	-1.20	-1.45
HRM3 gfdl	-0.40	-0.72	-0.93	-1.16	-1.31	-1.44
MM5I ccsm	-0.28	-0.48	-0.61	-0.76	-0.85	-0.94
RCM3 gfdl	0.26	0.15	0.13	0.19	0.33	0.55
RCM3 cgcm3	0.43	0.40	0.39	0.42	0.47	0.54
WRFG cgcm3	-0.27	-0.46	-0.62	-0.85	-1.00	-1.15
WRFG gfdl	-0.30	-0.53	-0.68	-0.84	-0.94	-1.03

Note. RCM = regional climate models; GEV = Generalized Extreme Value; CRCM = Canadian Coupled Global Climate model; ccsm = community climate system model; cgcm3 = Canadian Coupled Global Climate Model 3; ECP2 = Experimental Climate Prediction Center model2; HRM3 = Hadley regional model 3; hadcm = Hadley Centre coupled model3; gfdl = Geophysical Fluid-Dynamics Laboratory atmospheric-land generalized model; MM5I = Mesoscale Model 5; WRFG = weather research and forecasting with the Grell model.

APPENDIX H

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To: Alejandro Riano <ariano@asu.edu>

Tue, Oct 22, 2013 at 10:56 AM

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