



NARCCAP



NARCCAP Third Users' Meeting

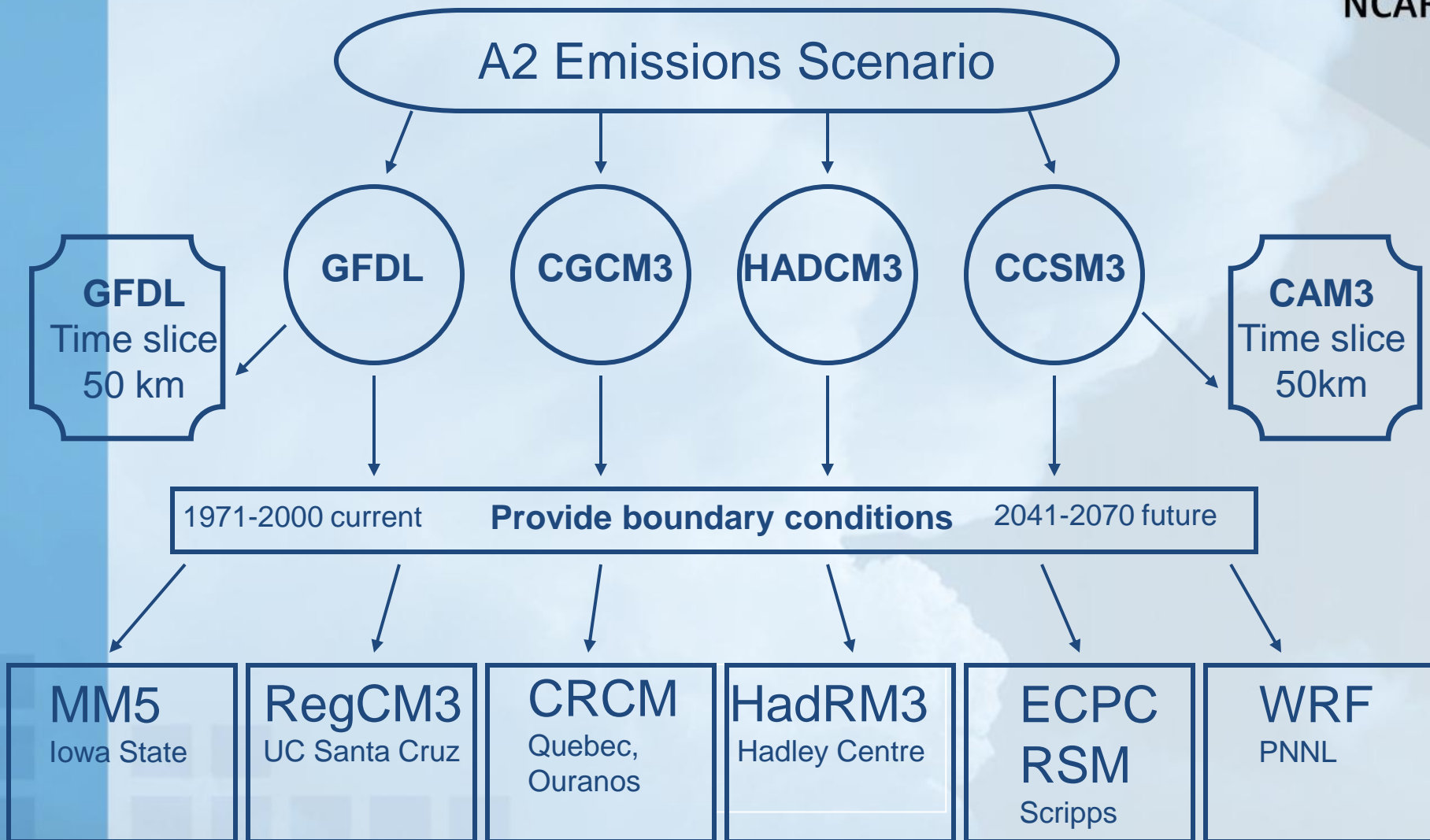
Overview of Climate Change Results

**Linda O. Mearns
National Center for Atmospheric Research**

**Boulder, CO
April 7-8, 2011**

National Center for Atmospheric Research

NARCCAP PLAN – Phase II

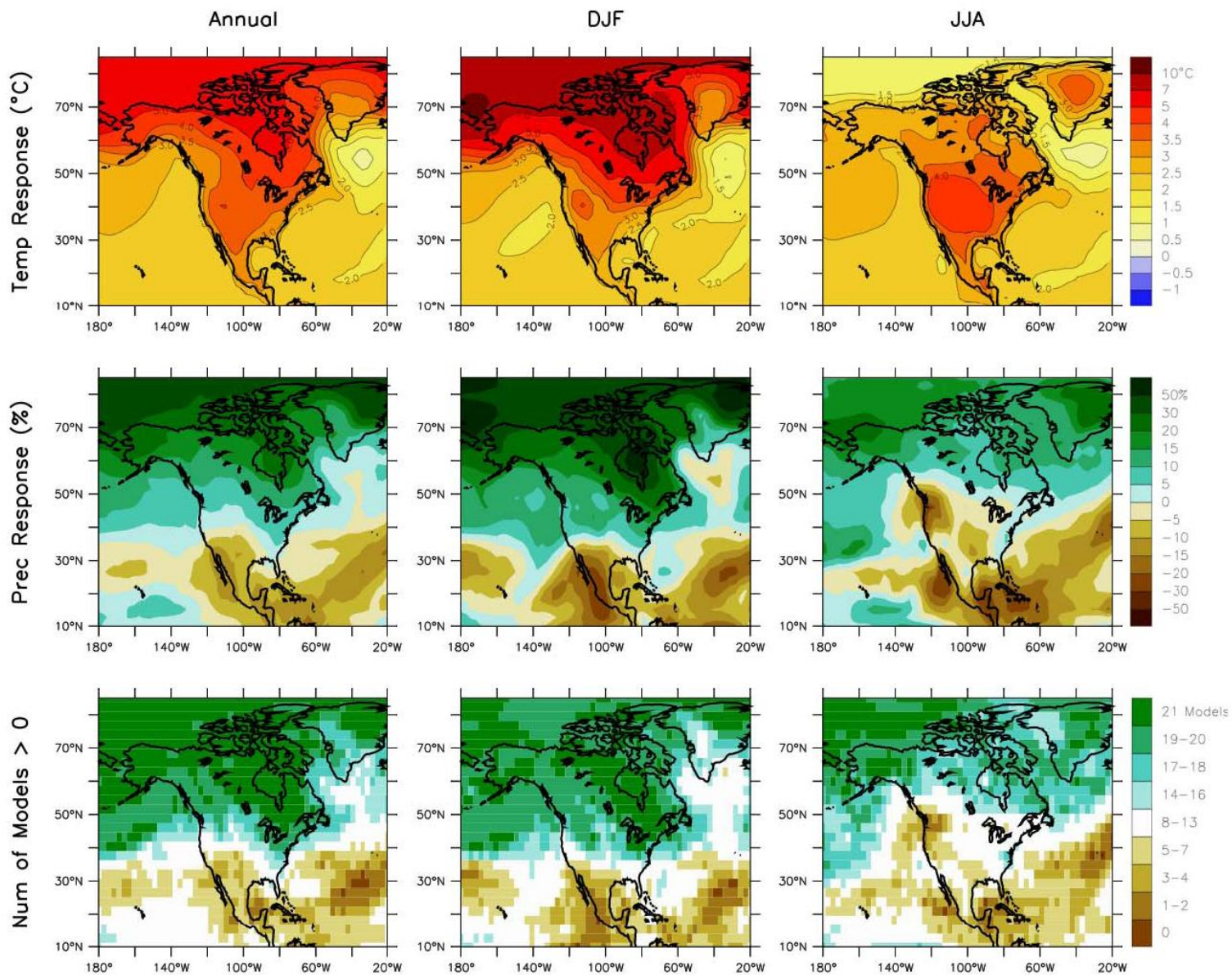


Temperature and precipitation changes with model agreement

(2080-2099 minus 1980-1999) A1B Scenario



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AOGCM-RCM Matrix

AOGCMS

| | | GFDL | CGCM3 | HADCM3 | CCSM3 |
|-------|-------|------|-------|--------|-------|
| RCMs | MM5 | | | X | X1** |
| | RegCM | X1** | X** | | |
| | CRCM | | X1** | | X** |
| | HadRM | X | | X1** | |
| | RSM | X1 | | X | |
| | WRF | | X** | | X1** |
| | *CAM3 | | | | X |
| *GFDL | X** | | | | |

1 = chosen first GCM

* = time slice experiments

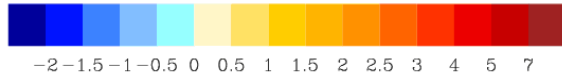
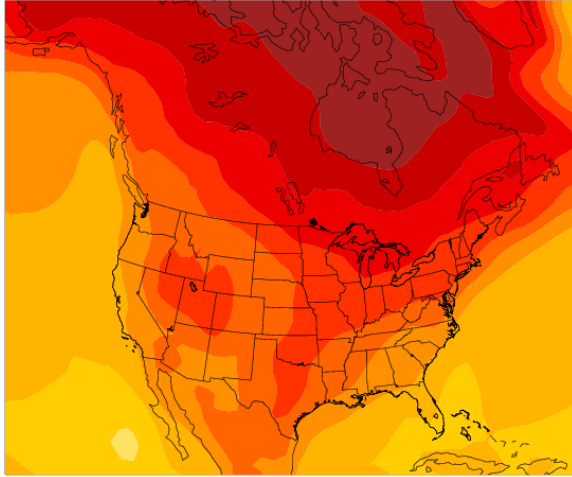
Red = run completed

** = data loaded

Global - CCSM3

CCSM Change In Seasonal Avg Temp

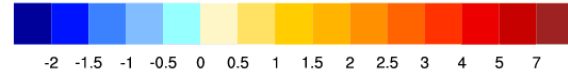
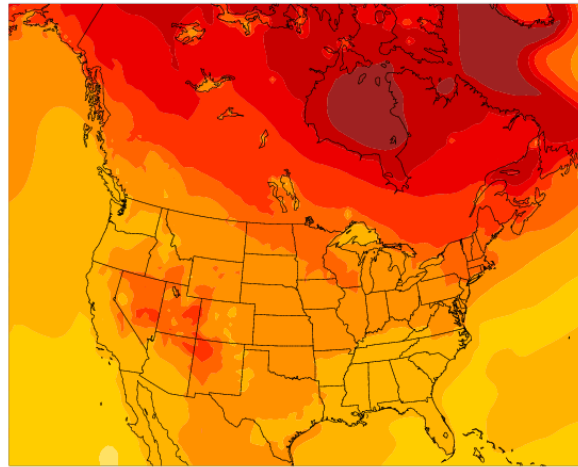
DJF 2041-2070 minus 1971-2000 Deg C



MM5 RCM

MM5+CCSM Change in DJF Avg Temp

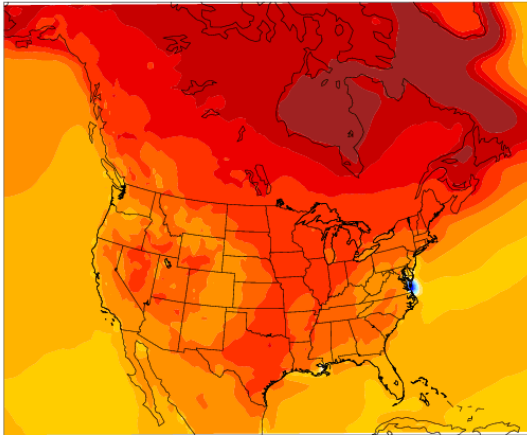
Surface Air Temperature C



WRF RCM

WRF+ccsm Change In Seasonal Avg Temp

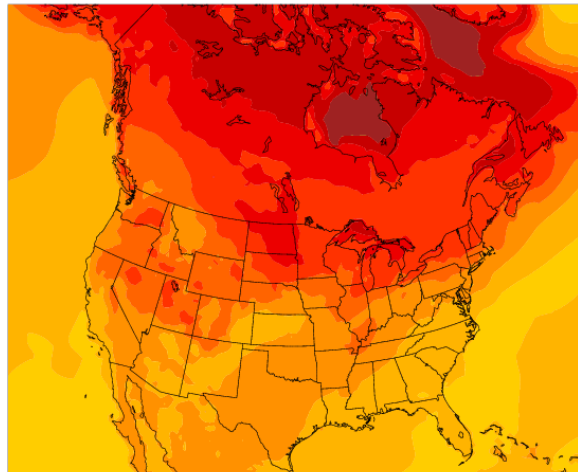
DJF 2041-2070 minus 1971-2000 Deg C



CRCM

CRCM+CCSM Change in DJF Avg Temp

Surface Air Temperature C



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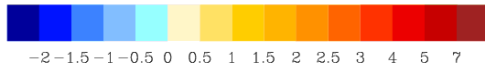
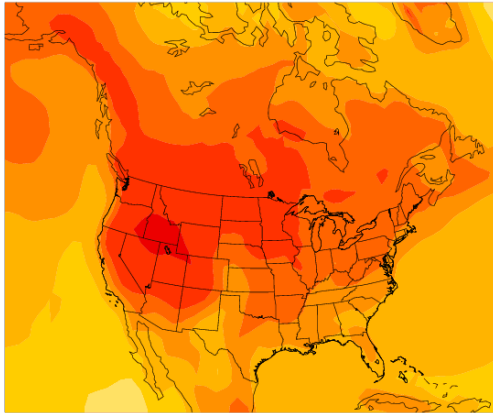
Change in Winter Temperature
CCSM3,
3 RCMs



NCAR

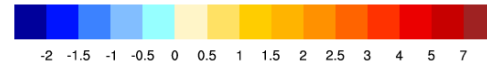
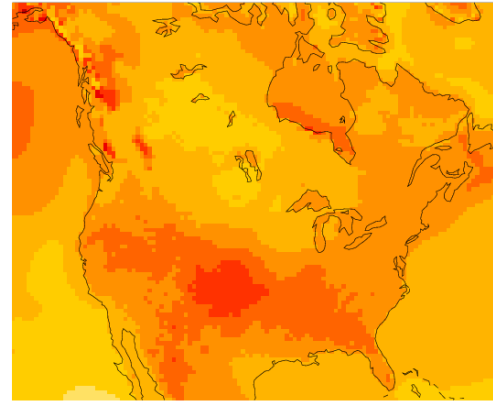
CCSM Change In Seasonal Avg Temp

JJA 2041-2070 minus 1971-2000 Deg C



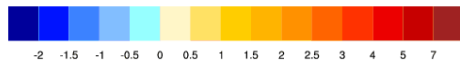
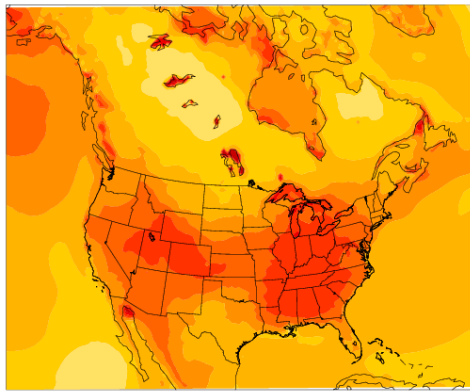
MM5+CCSM Change in JJA Avg Temp

Surface Air Temperature C



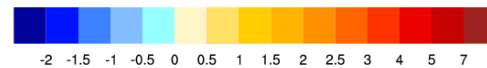
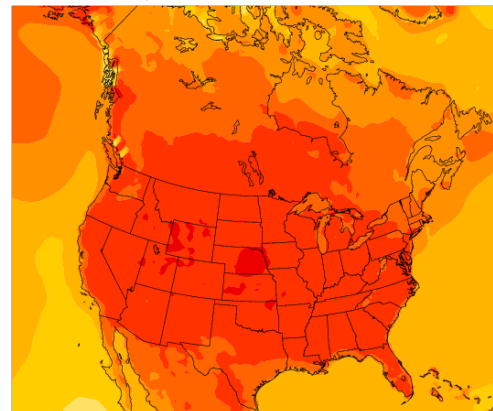
WRFG+ccsm Change In Seasonal Avg Temp

JJA 2041-2070 minus 1971-2000 Deg C



CRCM+CCSM Change in JJA Avg Temp

Surface Air Temperature C



CCSM-driven
change in
summer
temperature



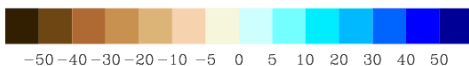
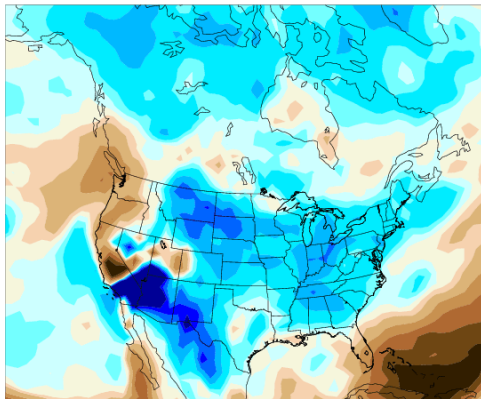
NCAR

CCSM-driven
change in
summer
precipitation

CCSM

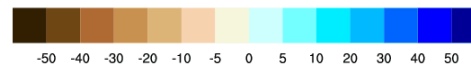
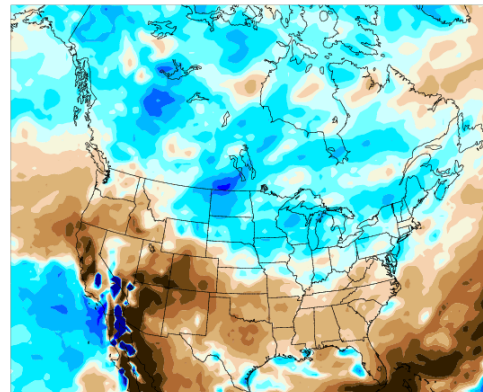
CCSM Change In Seasonal Avg Precip

JJA 2041-2070 minus 1971-2000 %



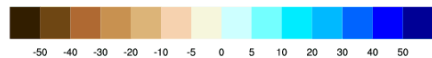
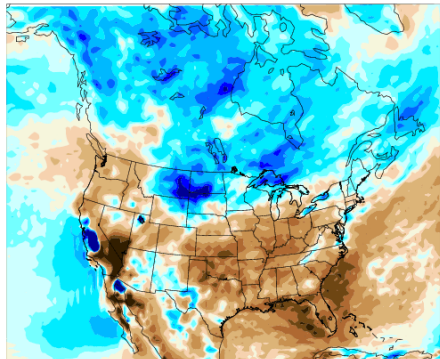
MM5I+Percent-Change in JJA Avg Precip

Precipitation %



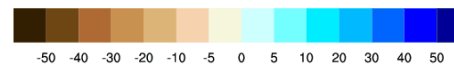
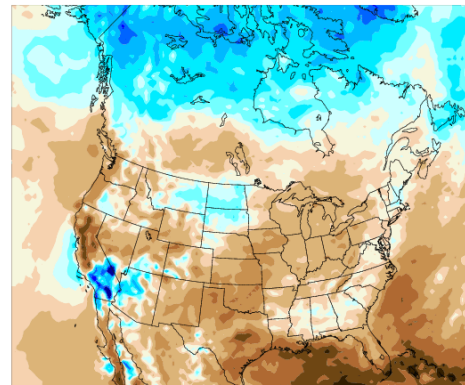
WRFG+ccsm Change In Seasonal Avg Precip

JJA 2041-2070 minus 1971-2000 %



CRCM

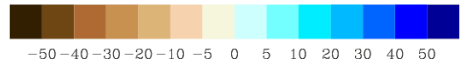
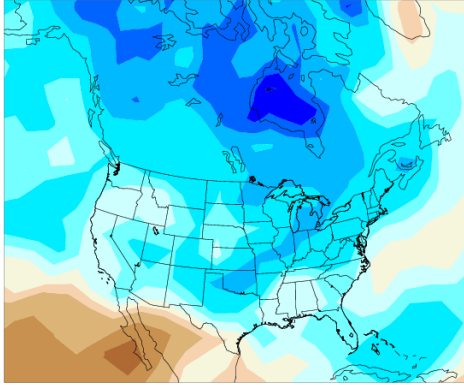
Precipitation %



CGCM3 – Global

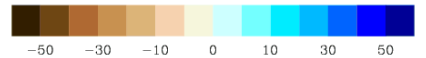
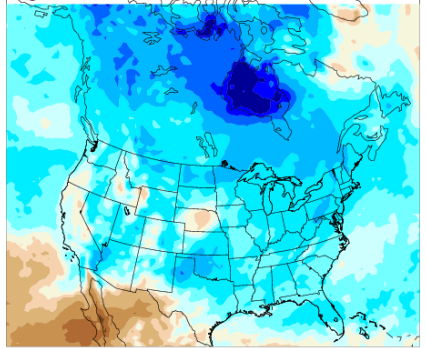
CGCM3 Change In Seasonal Avg Precip

DJF 2041-2070 minus 1971-2000 %



CRCM+CGCM3 Change In Seasonal Avg Precip

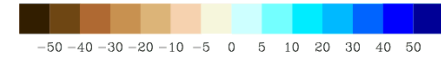
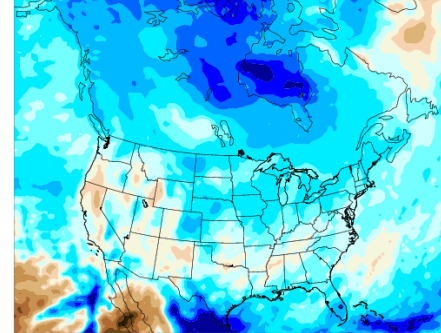
DJF 2041-2070 minus 1971-2000 %



RegCM3

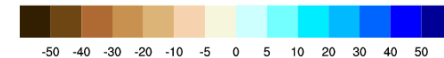
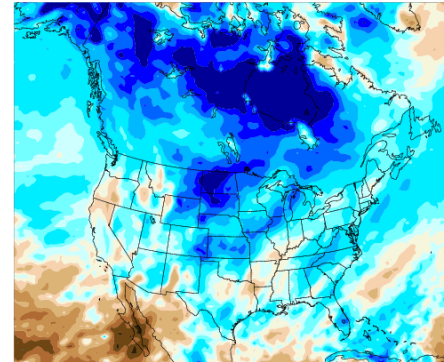
RCM3+CGCM3 Change In Seasonal Avg Precip

DJF 2041-2070 minus 1971-2000 %



WRF+CGCM3 %-Change in DJF Avg Precip

Precipitation mm/day



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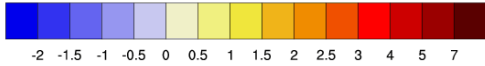
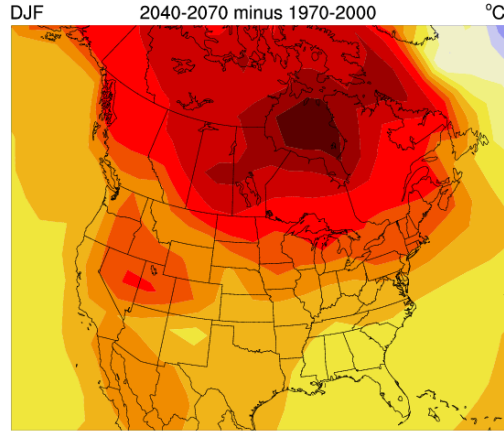
CGCM-driven
% Change in
Winter
Precipitation

CRCM

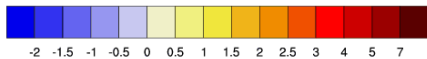
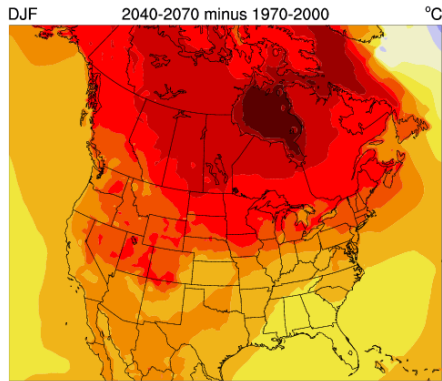
WRF+CGCM3

CGCM3 Global Model

CGCM3 Change in Seasonal Avg Temp

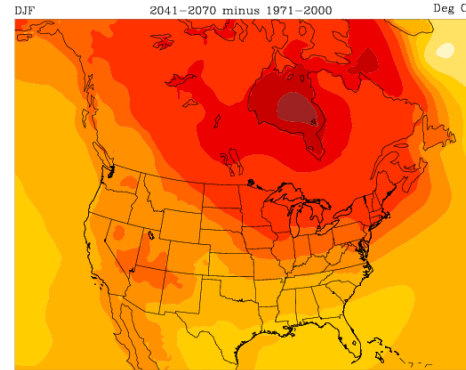


CRCM+CGCM3 Change in Seasonal Avg Temp

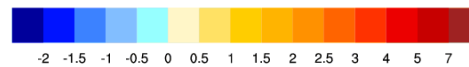
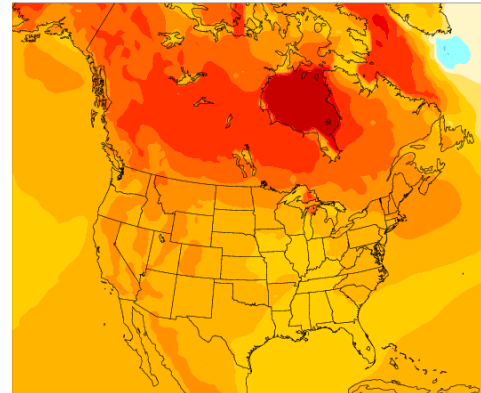


RegCM3

RCM3+CGCM3 Change In Seasonal Avg Temp



WRF+CGCM3 Change in DJF Avg Temp 2 m Air Temperature



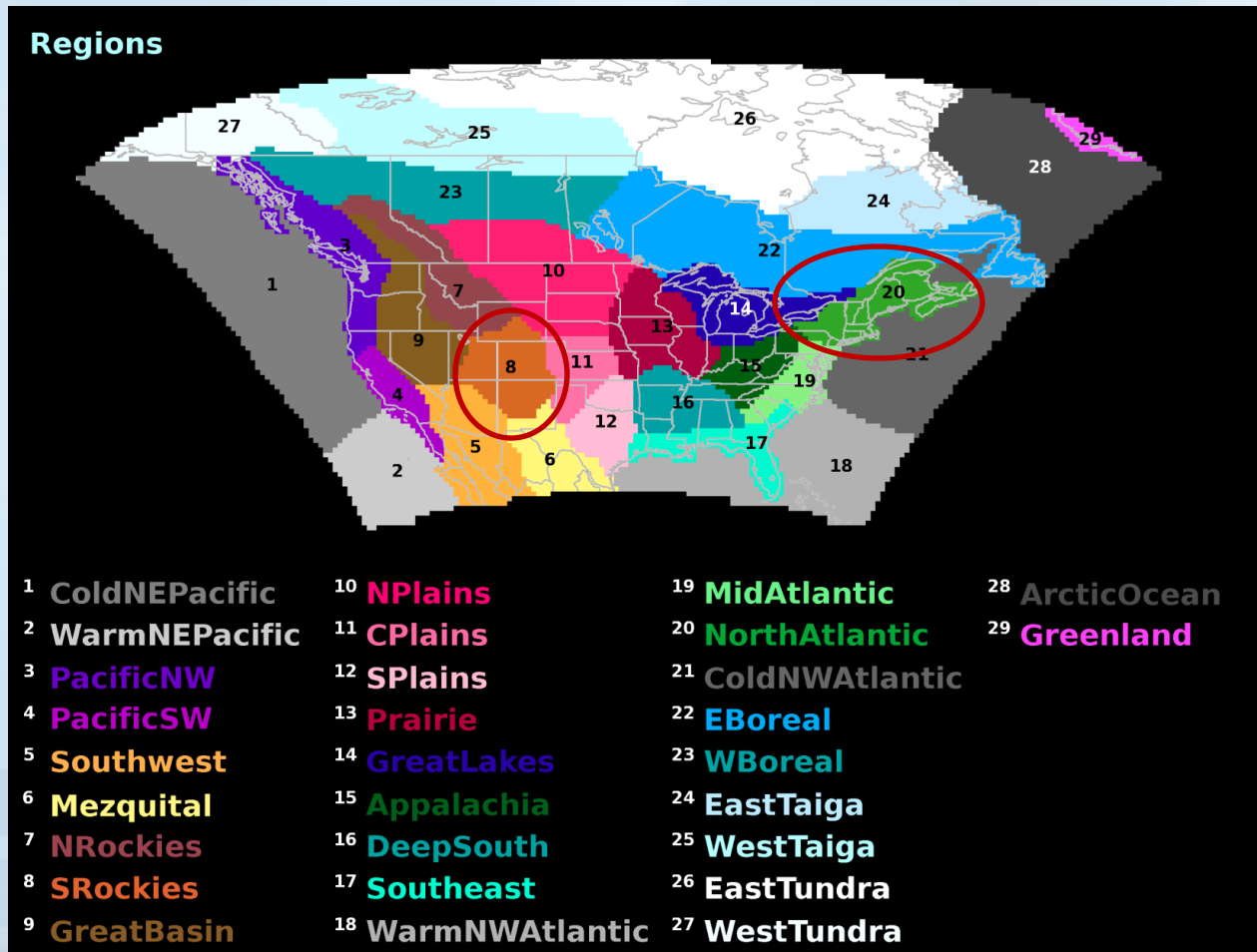
NCAR

CGCM - driven
Change in Winter
Temperature

WRF

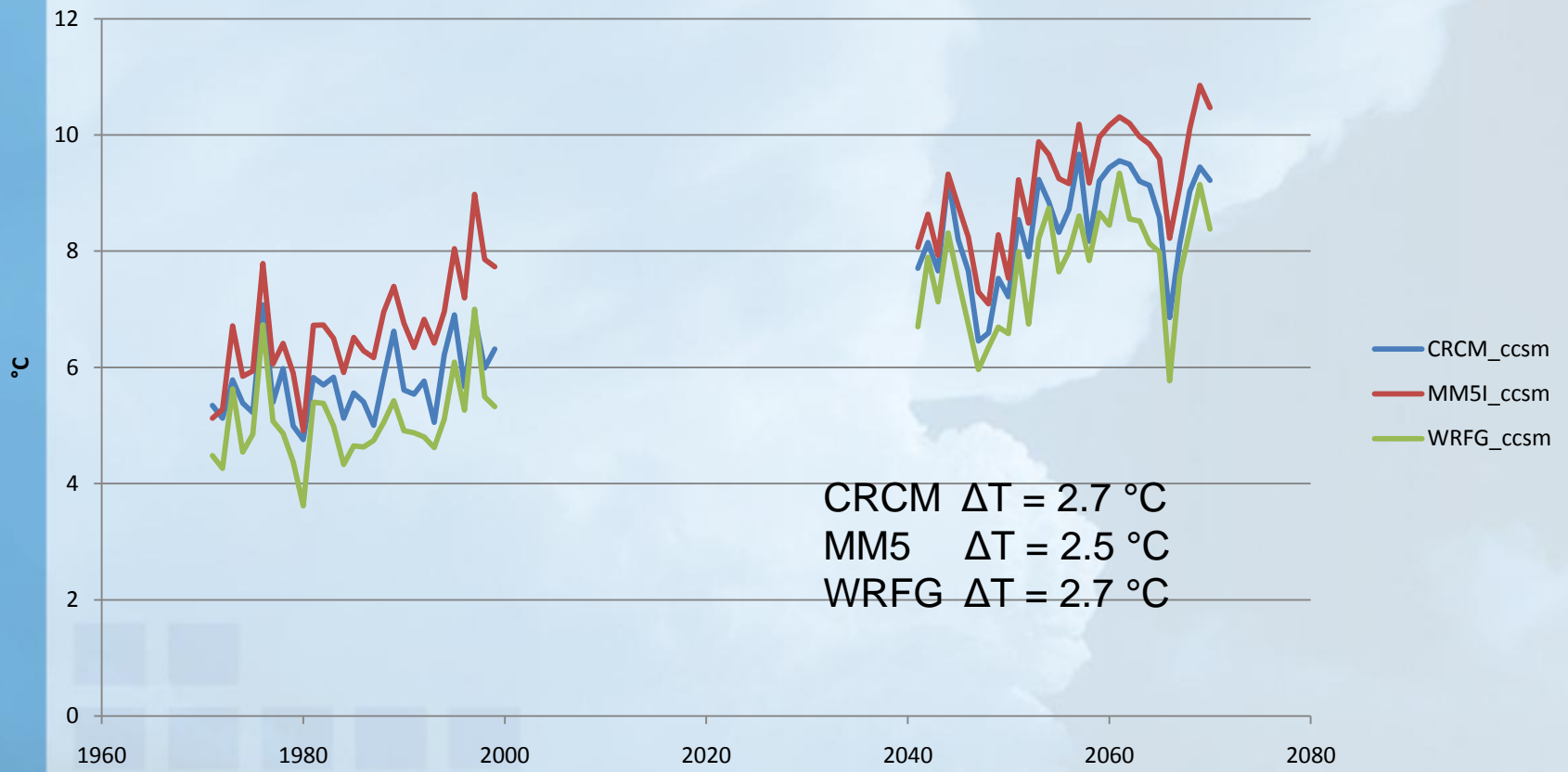
CRCM

Bukovsky Regions



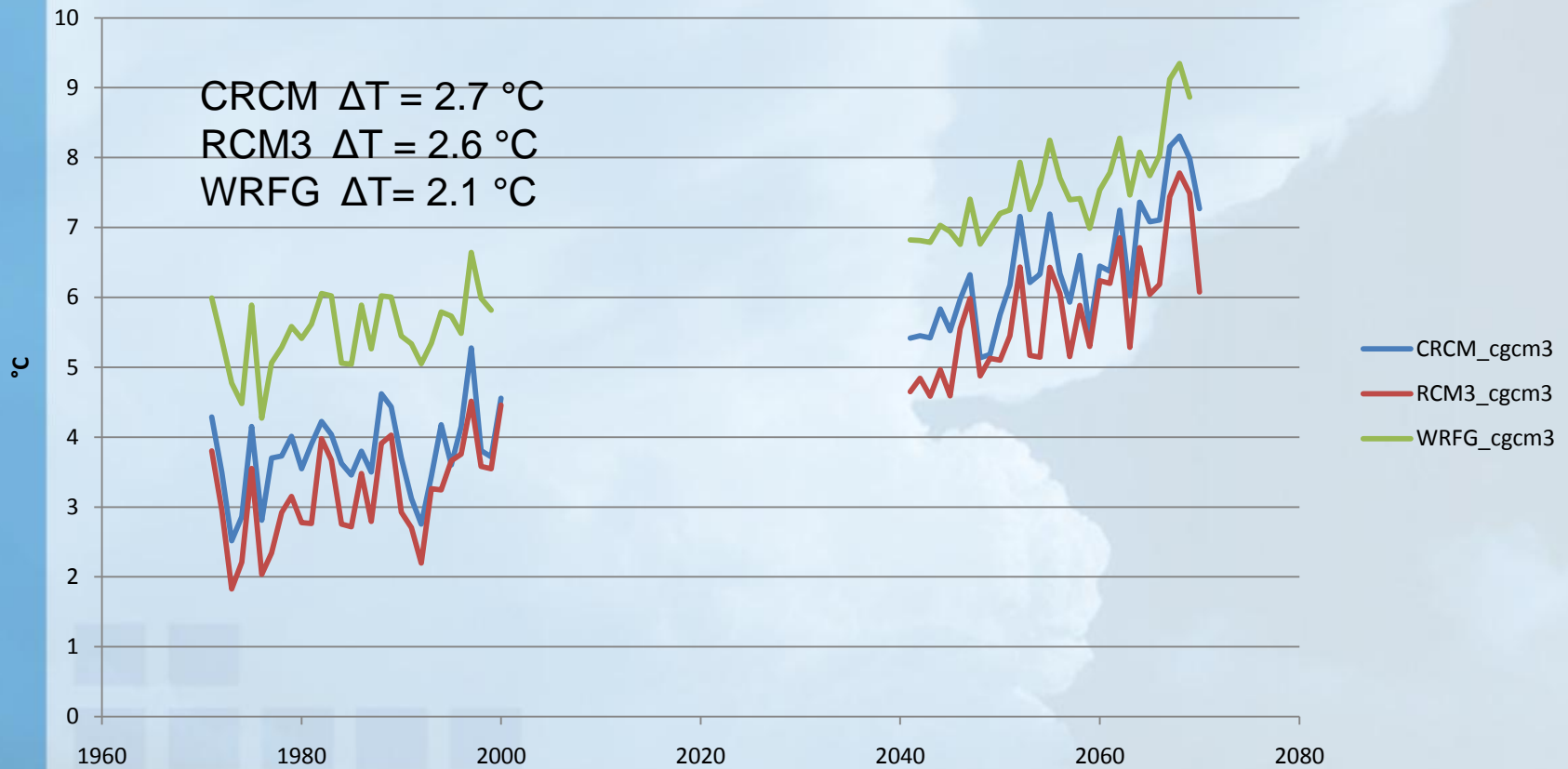
North Atlantic Region

Annual Avg Temp - CCSM, NAtlantic



North Atlantic Region

Annual Avg Temp - CGCM3, NAtlantic

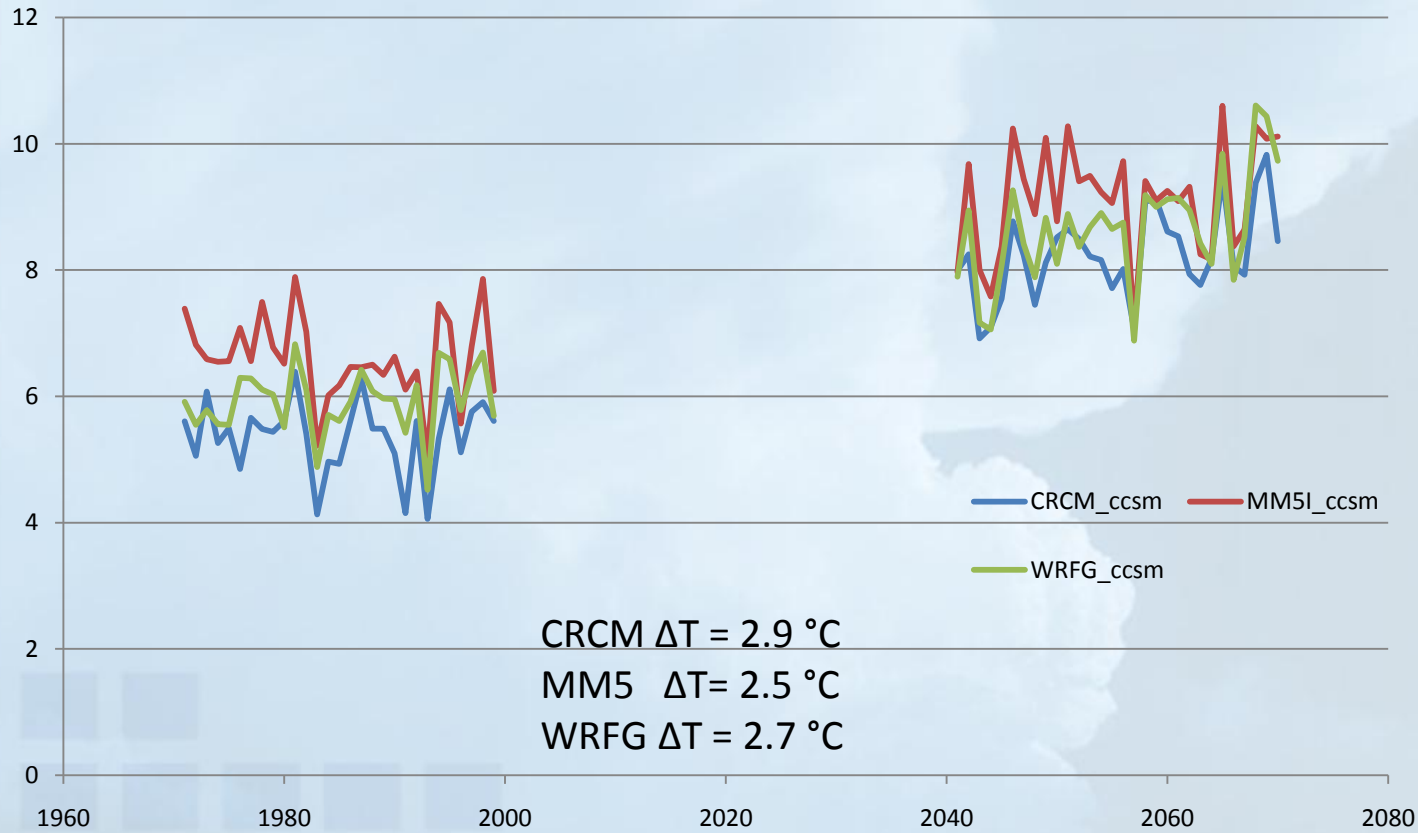


South Rocky Mountain Region



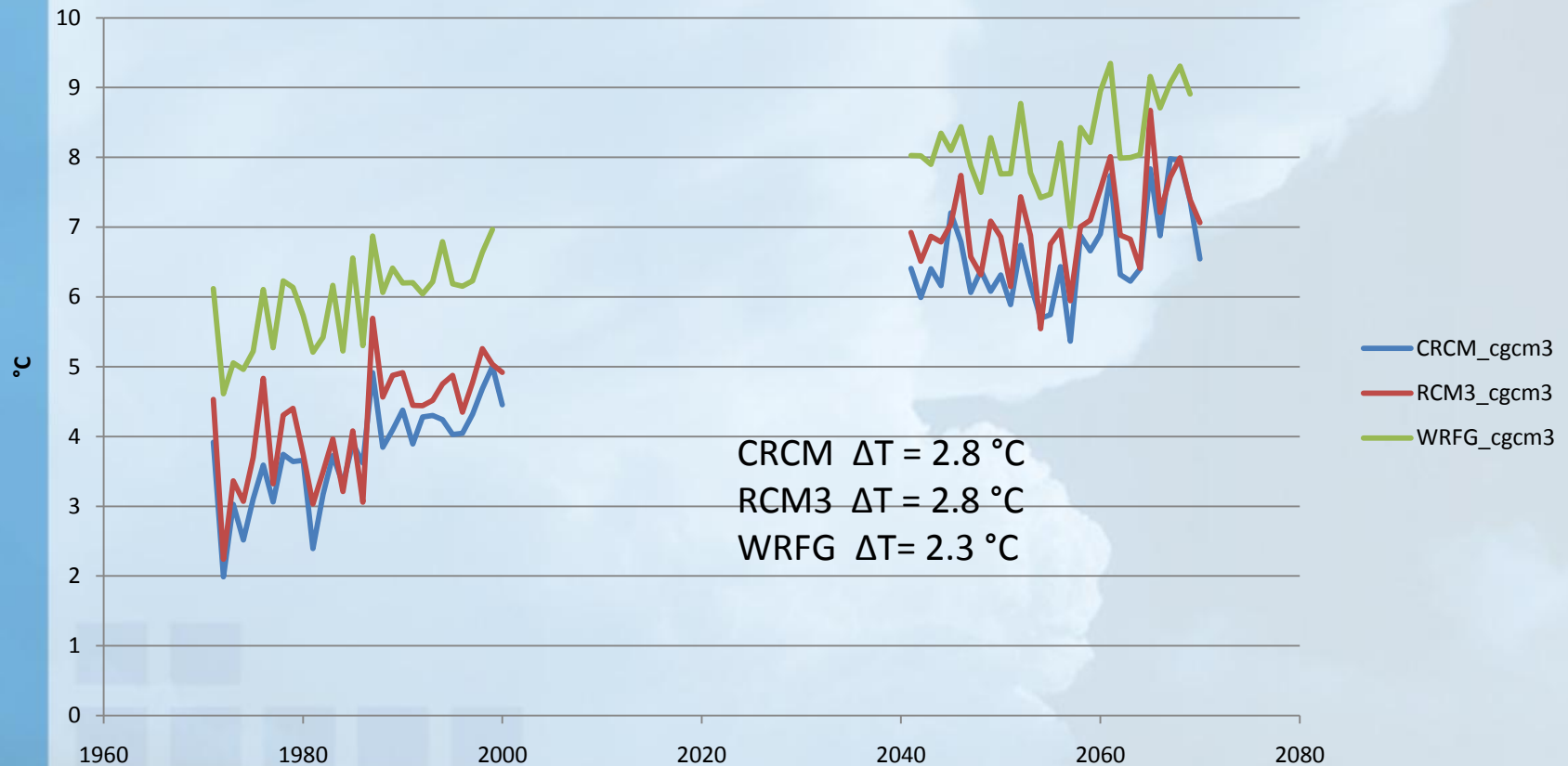
NCAR

CCSM temperature



South Rocky Mountain Region

Annual Avg Temp - CGCM3, SRockies



Change in Temperature °C



North Atlantic

CCSM3

CGCM3

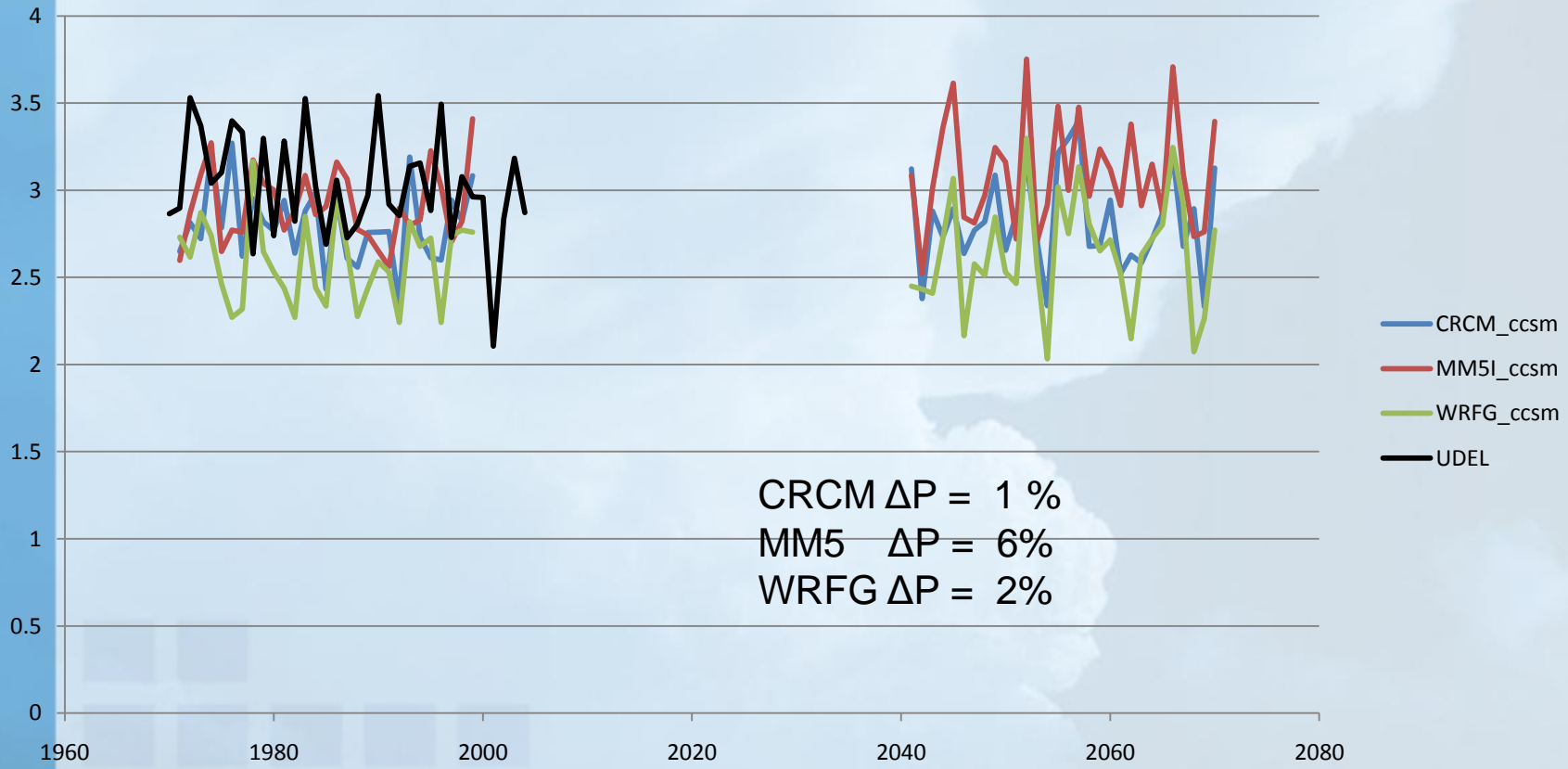
| | Winter | Summer | Annual | Winter | Summer | Annual |
|------|--------|--------|--------|--------|--------|--------|
| CRCM | 3.3 | 2.6 | 2.7 | 2.8 | 2.9 | 2.7 |
| WRFG | 3.4 | 2.2 | 2.7 | 2.1 | 2.2 | 2.1 |
| RCM3 | | | | 3.2 | 2.6 | 2.6 |
| MM5I | 3.0 | 2.2 | 2.5 | | | |

Southern Rockies

| | Winter | Summer | Annual | Winter | Summer | Annual |
|------|--------|--------|--------|--------|--------|--------|
| CRCM | 2.4 | 3.7 | 2.6 | 2.6 | 3.4 | 2.8 |
| WRFG | 2.6 | 3.0 | 2.7 | 1.9 | 2.6 | 2.8 |
| RCM3 | | | | 2.4 | 3.4 | 2.3 |
| MM5I | 2.6 | 2.7 | 2.5 | | | |

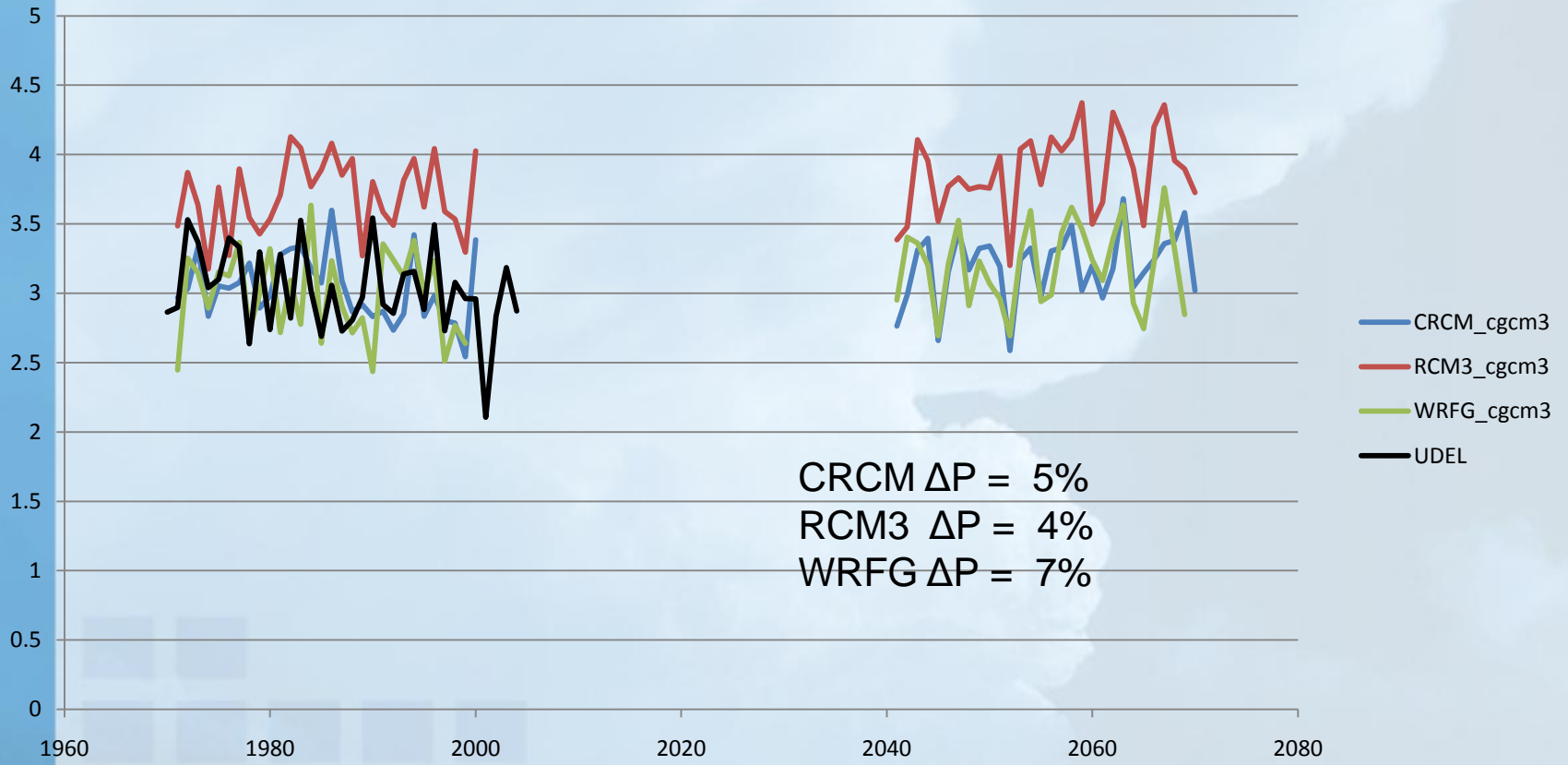
North Atlantic Precipitation

Avg Annual Precip, NAtlantic



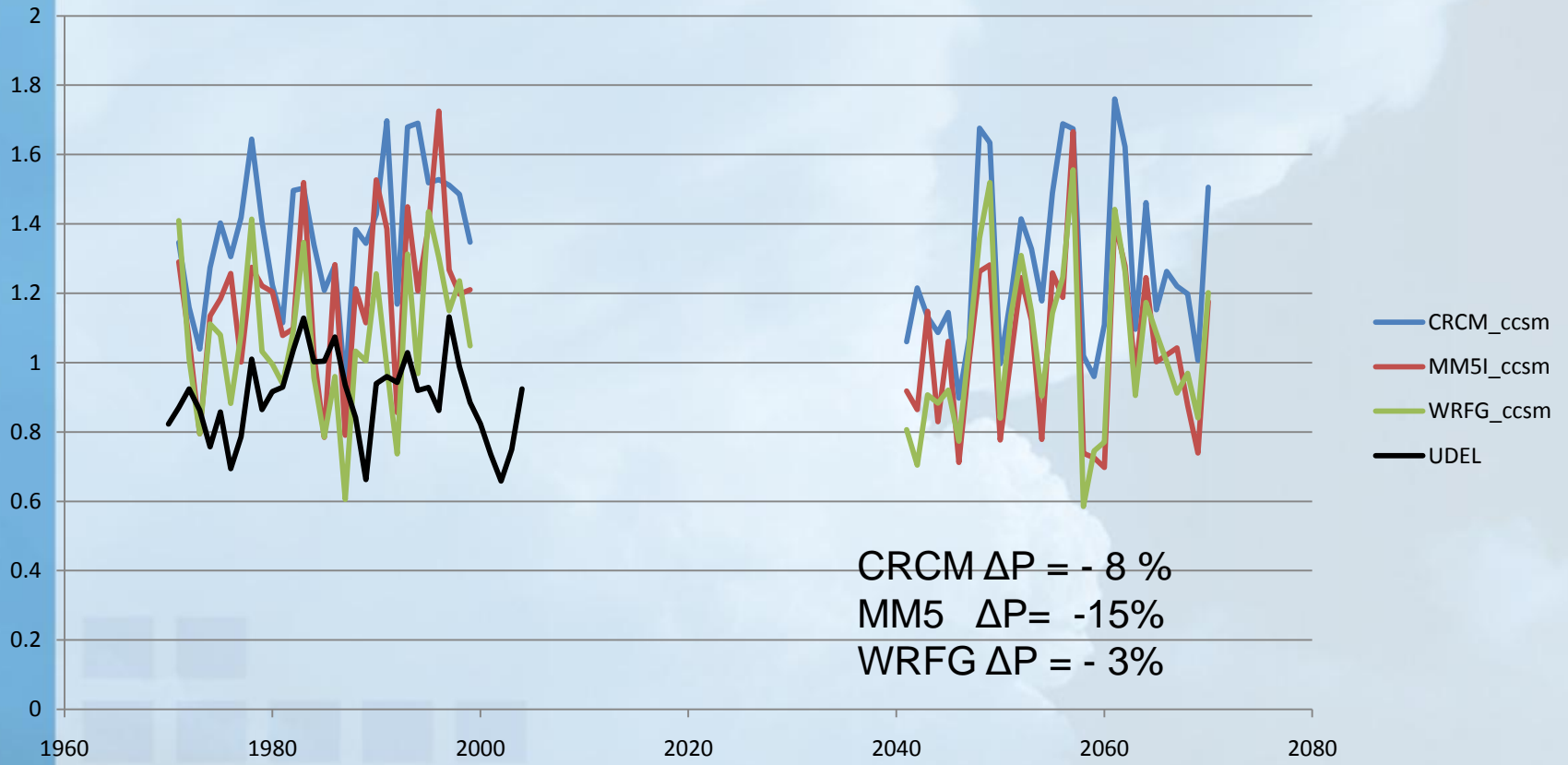
North Atlantic Precipitation

Avg Annual Precip, NAtlantic



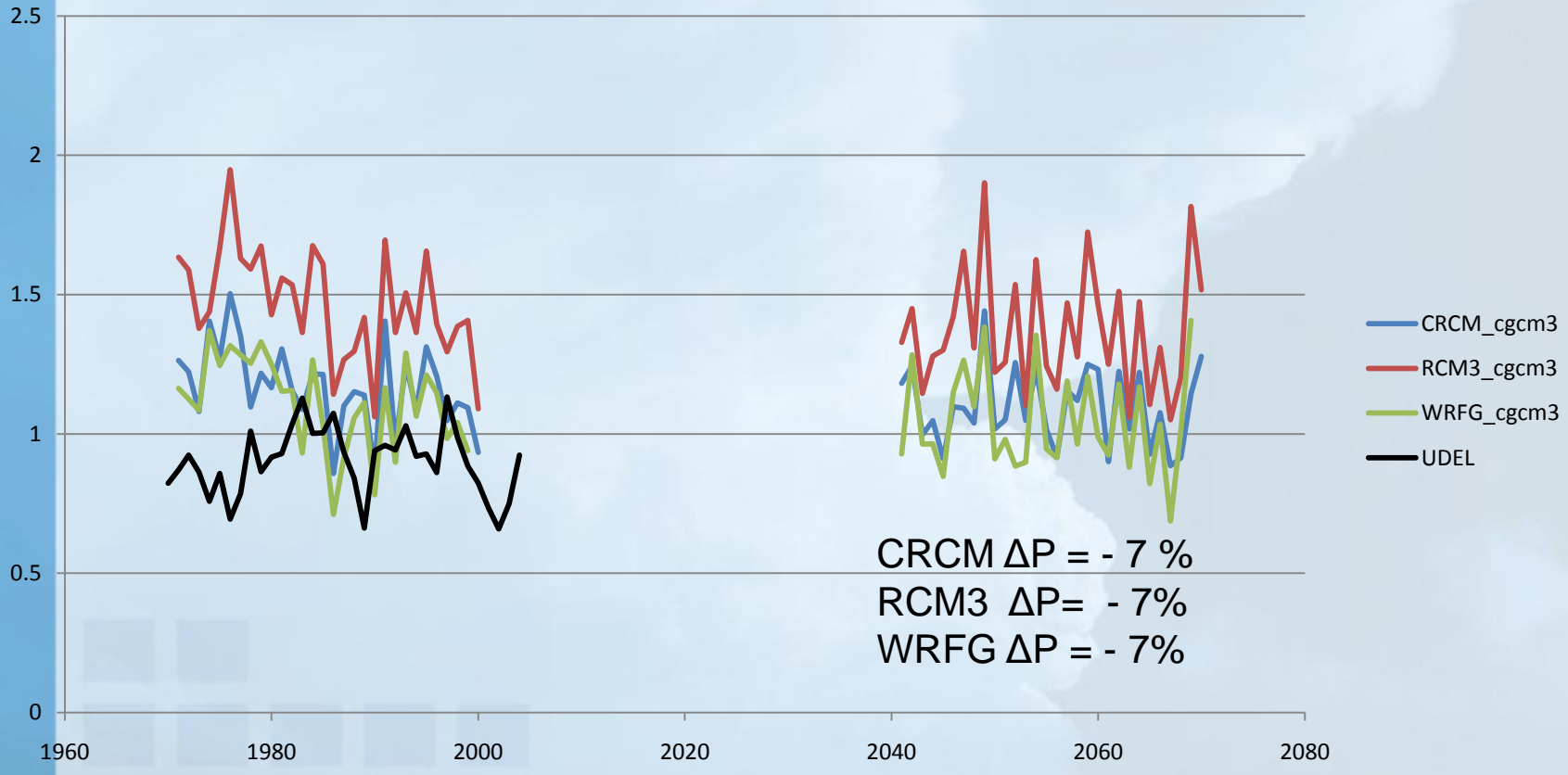
Southern Rockies

Annual Avg Precip, SRockies



Southern Rockies

Annual Avg Precip, SRockies



Change in Precipitation (%)

North Atlantic

| | CCSM3 | | | CGCM3 | | |
|------|--------|--------|--------|--------|--------|--------|
| | Winter | Summer | Annual | Winter | Summer | Annual |
| CRCM | 12 | -5 | 1 | 14 | -7 | 5 |
| WRFG | 7 | 7 | 2 | 8 | -6 | 7 |
| RCM3 | | | | 10 | -2 | 4 |
| MM5I | 7 | 4 | 6 | | | |

Southern Rockies

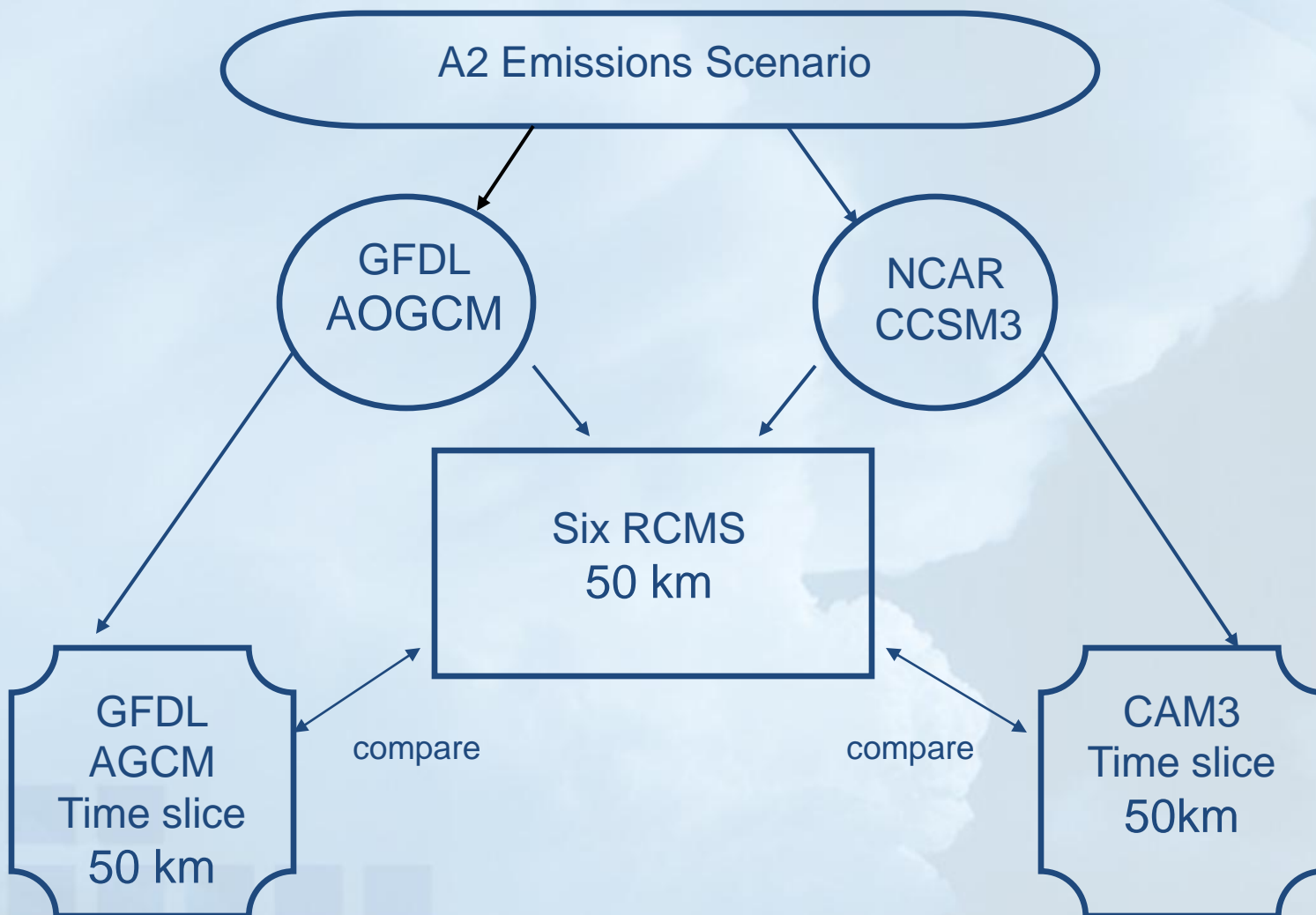
| | CCSM3 | | | CGCM3 | | |
|------|--------|--------|--------|--------|--------|--------|
| | Winter | Summer | Annual | Winter | Summer | Annual |
| CRCM | 1 | -15 | -8 | 6 | -22 | -7 |
| WRFG | 8 | -9 | -3 | 7 | -17 | -7 |
| RCM3 | | | | 1 | -23 | -7 |
| MM5I | 1 | -50 | -15 | | | |

Global Time Slice / RCM Comparison

at same resolution (50km)



NCAR



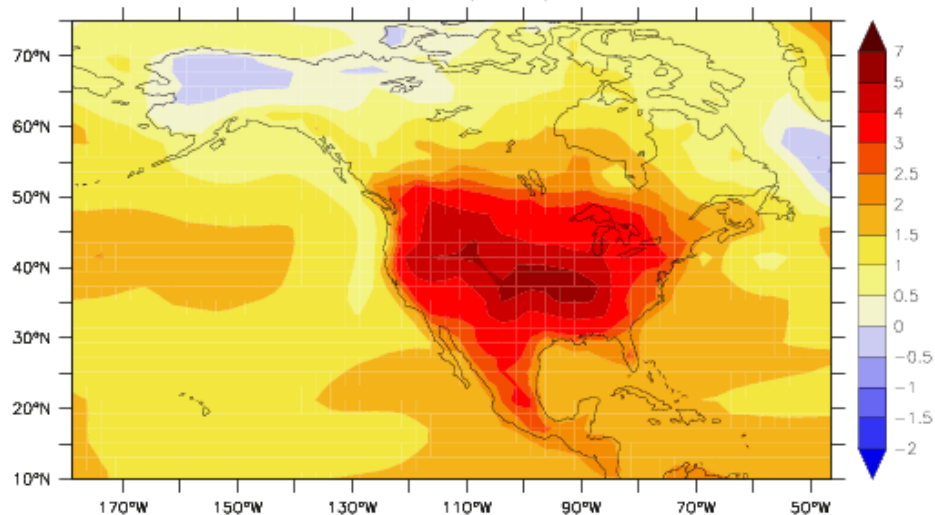


NCAR

Future-current Summer Temperatures

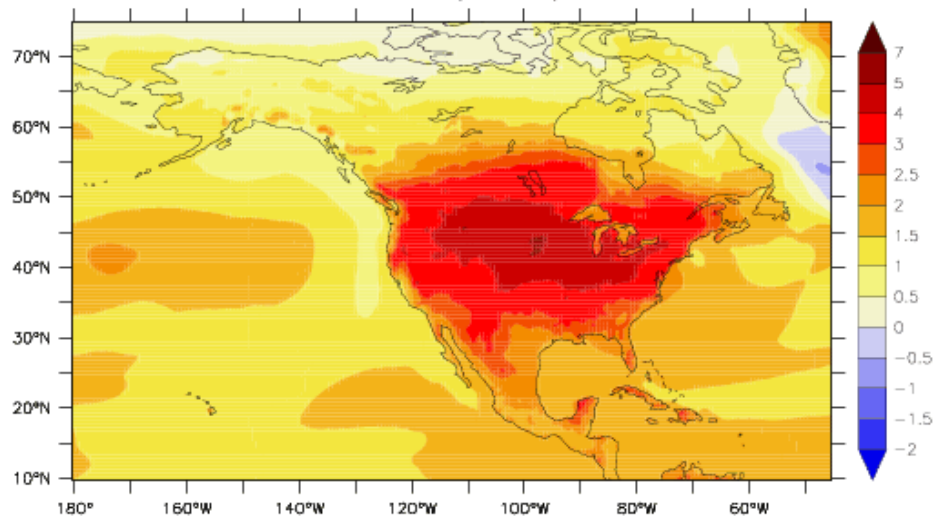
Near Surface Air Temperature, deg C, JJA

CM2.1 (M45)



GFDL
CM2.1

AM2.1 (M180)



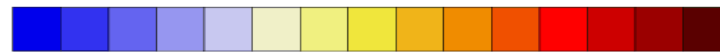
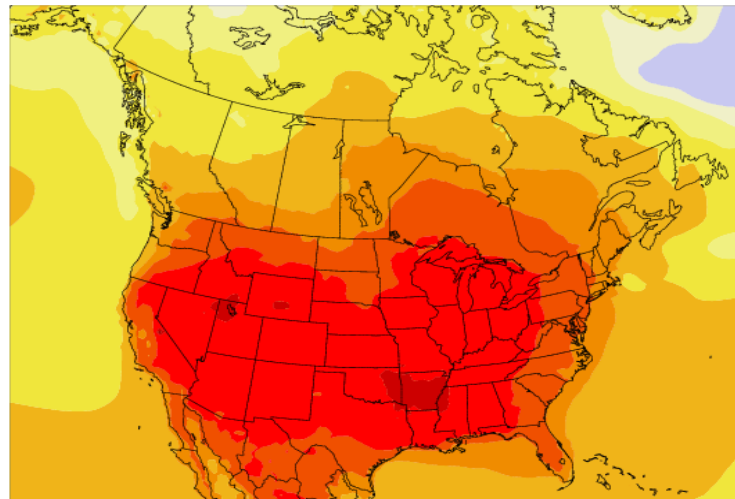
GFDL
AM2.1

RegCM3 in GFDL

Change in Summer Temperature

RCM3+GFDL Change in Seasonal Avg Temp

JJA 2041-2070 minus 1971-2000 deg C



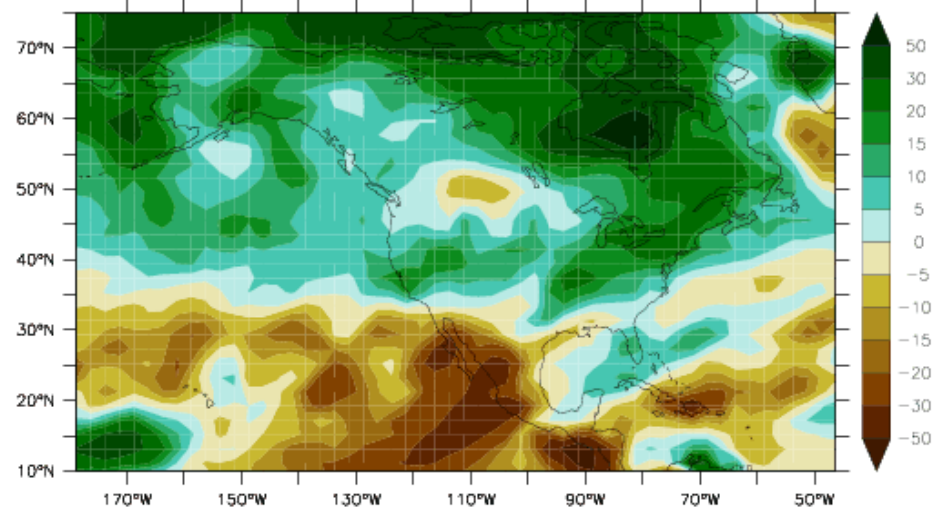
-2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5 3 4 5 7



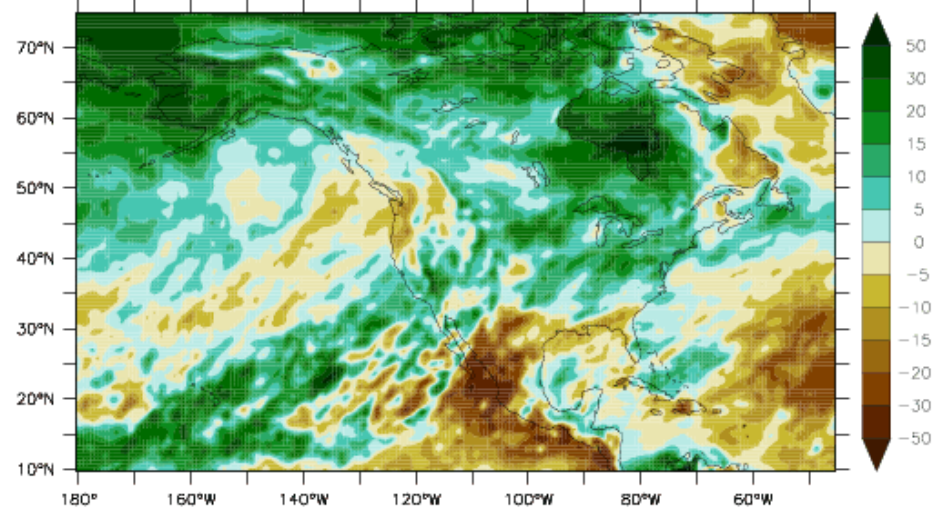
NCAR

Precipitation Response, percent, DJF

CM2.1 (M45)



AM2.1 (M180)





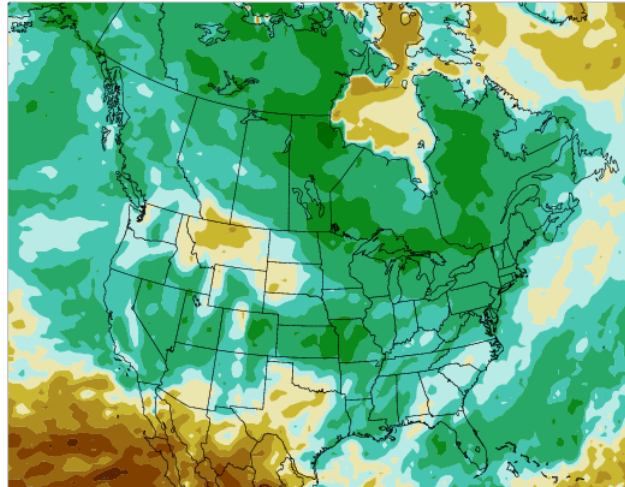
NCAR

RegCM3 in GFDL

% Change Precip - Winter

RCM3+GFDL Change in Seasonal Avg Precip

DJF 2041-2070 minus 1971-2000 %



-50 -40 -30 -20 -10 -5 0 5 10 20 30 40 50



NCAR

End

South Rocky Mountain Region



NCAR

CCSM temperature

