Bias-adjusted CRCM-CGCM3 simulation and its application in the SWAT modeling of lower Missouri River Basin

Lei Qiao, Zaitao Pan and Robert Herrmann
Department of Earth and Atmospheric Sciences
Saint Louis University
Outline

- Overview of climate modes used by NARCCAP
- Biases and bias corrections to the CRCM-CGCM3 simulations
- SWAT modeling of lower Missouri River basin with CRCM-CGCM3 data
Atmosphere-Ocean General Circulation Models (AOGCMs)

- the Canadian Global Climate Model version 3 (CGCM3, T47 spatial resolution, [Flato 2005]);
- the NCAR Community Climate Model version 3 (CCSM3, [Collins 2006]);
- the Geophysical Fluid Dynamics Laboratory (GFDL) Climate Model version 2.1 (CM2.1, [GFDL 2004]);
- the United Kingdom (UK) Hadley Centre Climate Model version 3 (HadCM3, [Gordon 2000], [Pope 2000]).
Regional Climate Models (RCMs)

- European PRUDENCE program (HadRM3 and RegCM)
- Canadian Regional Climate Model (CRCM)
- NCEP regional spectral model (RSM)
- PSU/NCAR mesoscale model (MM5)
- Weather Research and Forecasting model (WRF)
Objective

- Examine and correct the biases between observations and the NARCCAP data;
- Reduce the uncertainty in the climate change impacts on the hydrology processes of the lower Missouri River basin.

- Mainly working for the CRCM-CGCM3 data
Lower MoRB

Upper MoRB

CRCM-CGCM3

HRM3-HADCM3
1.2 Bias in maximum temperature

Better agreement spatially and temporally for temperature than for precipitation.
2. Bias correction

The distribution mapping approach (Wood et al., 2002 and 2004; Ines and Hansen, 2006; Christensen and Lettenmaier, 2007; Sharma et al., 2007)
Precipitation: after correction

Left: UW data

Right: bias-corrected crcm-cgcm3
Temperature: after correction

**top:** UW data  
**bottom:** bias-corrected crcm-cgcm3
3. SWAT modeling of lower MoRB

(Soil and Water Assessment Tool)
4. Streamflow output with NARCCAP inputs

- Missouri River at Boonville
- Missouri River at Herrmann
- Osage River at St. Thomas

Graphs showing flow data with different inputs:
- OBS
- With corrected crcm-cgcms
- With original crcm-cgcms3
Means and standard deviations at Herrmann discharge

- OBS
- with corrected crcm-cgcm3
- with original crcm-cgcms3
- With UW data
5. Preliminary conclusion

- The bias–corrected CRCM-CGCM3 can be used to improve the watershed hydrology simulations.
- However, it still tends to under-estimate the streamflow, especially for the peak flows.
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- CPC US Unified Precipitation data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site at http://www.esrl.noaa.gov/psd/ in any documents or publications using these data.
- Daily gridded meteorological data obtained from the Surface Water Modeling group at the University of Washington from their web site at http://www.hydro.washington.edu/Lettenmaier/Data/gridded/, the development of which is described by Maurer et al. (2002):