Downscaled Climate Models
Caspar Ammann, Jonathan Vigh
and NCPP Core / Tech Teams

NCPP-QED2013 Workshop, August 12-16 2013
National Center for Atmospheric Research
Connecting Science and Management
Integration of data and knowledge across scales.
Global - to - Local

e.g.: Utility Planning
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Integration of data and knowledge across scales.
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Are the current evaluations useful?

What other analyses are necessary?

How to connect to known, yet different uncertainties?
NCPP-Evaluation “Conveyor”
Available:

- BCCA (12 km) : 9 + 1 models
- ARRM (12 km) : 16 models
- NARCCAP (12, 50 km) : 7, 5 models
- GFDL PerfectModel (25 km) : 1 ARRM

Ready to add:

- Full NARCCAP suite
- MACA-Univ. of Idaho (12 km) : 12 models
- BCSD (monthly, 12 km) :
- PRISM-Observations (monthly, 12 km)
- U-Delaware-Observations (monthly, 12 km)
- BerkeleyEarth (monthly, 12 km)
Please! Build and “App for That”! Please!
Need to explore all possible options

What is Likely?

What is Possible?

NEVER TELL ME THE ODDS
You never know, I might roll a 20.
ALL GFDL

tas, mean, DJF

Seasonal Average of Daily Mean Temperature [DJF]
Period: 1971-2000

BCCA GFDM21 - Maurer02v2

Seasonal Average of Daily Mean Temperature [DJF]
Period: 1971-2000

ARRM GFDM2.1 - Maurer02v2

Seasonal Average of Daily Mean Temperature [DJF]
Period: 1971-2000

ECP2 GFDM2.1 - Maurer02v2

Seasonal Average of Daily Mean Temperature [DJF]
Period: 1971-2000

RCM3 GFDM2.1 - Maurer02v2

Seasonal Average of Daily Mean Temperature [DJF]
Period: 1971-2000

HRM3 GFDM2.1 - Maurer02v2
ALL GFDL
pr, mean, annual

BCCA

Annual Average of Total Precipitation
Period: 1971-2000
BCCA GFDLCM21 - Maurer02v2

ARRM

Annual Average of Total Precipitation
Period: 1971-2000
ARRM GFDL2.1 - Maurer02v2

ECP2

Annual Average of Total Precipitation
Period: 1971-2000
ECP2 GFDL - Maurer02v2

RCM3

Annual Average of Total Precipitation
Period: 1971-2000
RCM3 GFDL - Maurer02v2

HRM3

Annual Average of Total Precipitation
Period: 1971-2000
HRM3 GFDL - Maurer02v2
To: BCCA CMIP3/5 Archive Users

It has come to our attention that the BCCA precipitation has a dry bias over much of the contiguous U.S., and more especially over the central and eastern U.S. Using mean-annual precipitation as an indicator, BCCA results during the late 20th century are as much as 20 percent drier than observed climatology over the central and eastern U.S. regions (see e.g., Illustrations at http://mesoscale.agron.iastate.edu/downscale/, courtesy of Prof. Raymond Arritt, Iowa State University).

**Background:** As background, recall that BCCA involves three steps each producing a data product: (1) **REGRID** data produced when biased global climate projection outputs are regressed to a 2-degree grid over the U.S., (2) **BC** data produced when 2-degree **REGRID** data are adjusted using a quantile-mapping bias-correction technique to statistically match observed climatology from Maurer et al. (2002), and (3) **BCCA** data produced when **BC** data are spatially downscaled from 2 degree to 0.125 degree using the constructed analog technique. Method details are described in Appendix A at: http://gdo-dcp.ucar.edu/downscaled_cmip_projections/techmemo/downscaled_climate.pdf.

Evaluating the three data products for a given projection, one example (http://mesoscale.agron.iastate.edu/downscale/) shows that biases are generally eliminated in **BC**, but then present again in **BCCA**, suggesting that the problem likely lies with the implementation of the constructed analogs. This bias exists in both the **BCCA** CMIP3 and CMIP5 results. Precise causes for the error are still being evaluated by the Archive Team. Preliminary thinking is that it stems from several factors.

- One factor is that analog construction for a noisy spatial field (e.g., a contiguous U.S. day-specific precipitation condition showing organized weather systems in the West and convective events in the Midwest and East) may result in analogs more strongly influenced by the large organized systems at the expense of locally important events which may be averaged out. For regions where convective, local events significantly contribute to annual total precipitation, this could lead to a negative bias in mean-annual precipitation.
- Two other factors relate to how the constructed analogs technique was applied for this archive: (1) using large-domain analogs, and (2) developing total precipitation rather than precipitation anomaly analogs. On the first, the application involved daily construction of “contiguous U.S.” analogs rather than a set of region-specific analogs over the U.S. domain; this may have exacerbated the factor one issue described just above. On the second, the application involved daily construction of “total precipitation” analogs rather than “precipitation anomaly” analogs, where the latter are anomalies relative to that day’s climatology. If precipitation anomaly analogs had been constructed, greater consistency with mean-annual precipitation would have been a likely outcome, although minor biases may have remained due to the unavoidable spatial error of analog construction.

**Implications:**

- The **BCCA** results should be interpreted with caution. The implications of the dry bias over the central and eastern U.S. are significant for understanding regional precipitation patterns.
- Further investigation is needed to pinpoint the causes of the bias and to refine the analog construction methods.

**Actions:**

- Review the data products to identify the extent of the dry bias.
- Collaborate with the Archive Team to evaluate and address the issues.
- Consider using region-specific analogs for more localized results.
- Implement precipitation anomaly analogs to better capture local variations.

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**Importance of “registration / sign-up” for updates!**

- Ensure you are subscribed to receive updates on relevant research and developments.
- Regularly check for the latest papers and datasets.
- Stay informed about the latest climate models and projections.

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Bias-Correction in BCCA

Original BCCA

Corrected BCCA
#Tropical Nights (August)

**ARRM**

**BCCA**

**Median Number of Tropical Nights (TR) [Aug]**

- Period: 1971-2000
- ARR M ECHAM5 - Maurer02v2

**Median Number of Tropical Nights (TR) [Aug]**

- Period: 1971-2000
- BCCA MPIECHAM5 - Maurer02v2

The images show two maps comparing the median number of tropical nights across different regions in the United States, one for ARR M ECHAM5 and another for BCCA MPIECHAM5, both over the period from 1971 to 2000.
#Tropical Nights (August)

ARRM

BCCA

Median Number of Tropical Nights (TR) [Aug]

Period: 1971-2000

ARRM ECHAM5 - Maurer02v2

days

Median Number of Tropical Nights (TR) [Aug]

Period: 1971-2000

BCCA MPIECHAM5 - Maurer02v2

days

Median Number of Tropical Nights (TR) [Aug]

Period: 1971-2000

BCCAP REGRID 12KM WRFG.CGCM3 - Maurer02v2

days

WRF-G
# Days of >=10mm (August)

NARCCAP - Maurer02

All NARCCAP Models driven by CGCM
Different Audiences for NCPP Evaluation Output

**enable better focused science, applications and education**

- **for science:**
  expand time for doing science by reducing data handling

- **for applications:**
  explore different scenarios, using process knowledge

- **for education:**
  use modules to connect audience to concepts, stimulate curiosity
Connection to familiar “weather forecast” terms?

What other Indices / What other Metrics
What Visualizations?
Superposing Station Data?

1 Nov. 2007-1 May 2008

SNOTEL Obs.

36 km    6 km    2 km

WRF - Roy Rasmussen (NCAR-RAL)
Superposing Station Data?

1 Nov. 2007-1 May 2008

SNOTEL Obs.  36 km  6 km  2 km

WRF - Roy Rasmussen (NCAR-RAL)
OpenClimate GIS: NCPP Capabilities towards local and regional scales

Ben Koziol: Presentation Wednesday
“Climatic” Rifting
“Climatic” Rifting
An early warning?
An early warning?
Daily Temperature Range

Minimum Diurnal Temperature Range (DTR) [Jan]

Period: 1971-2000
ARRM CCSM

degC

degC

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45

NCPP

30N

40N

50N

120W

100W

80W
THE END