Subject: Errata for "Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections: Release of Downscaled CMIP5 Climate Projections, Comparison with preceding Information, and Summary of User Needs", May 2013, available at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/techmemo/downscaled_climate.pdf

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This document lists corrections to data and method development descriptions in the subject Report. For each correction topic, the affected sections of the technical report are identified, the issue is explained, documentation corrections are offered, and (if necessary) data application guidance is suggested. This document will be updated as new corrections are identified and implemented.

1. Daily BCCA precipitation results have a dry bias (17 July 2013)

Affected Sections

(Executive Summary, page x, second paragraph, last sentence) "*The comparison focuses on monthly BCSD results because: (1) most website data requests involve this resource, and (2) prior studies have shown that at monthly to coarser time resolution, downscaling results have been similar, whether they were derived using monthly BCSD or daily BCCA."*

(Section 3, page 14, second paragraph, third sentence) "*Second, Maurer et al. (2010) showed that at the monthly level, BCSD and BCCA (aggregated from daily to monthly) show roughly similar results. Therefore, BCCA CMIP5 (BCCA5) versus BCCA CMIP3 (BCCA3) comparisons should be roughly similar to that of BCSD CMIP5 (BCSD5) and BCSD CMIP3 (BCSD3) at the monthly level.* "

(Appendix A, page A-12, third bullet) "*Whether to construct analogs of magnitude or anomaly patterns; and, if the latter, anomalies relative to what pattern "datum." (For the BCCA CMIP3 application, analogs are constructed relative to 1961-1999 means within the geographic domain of downscaling [i.e., contiguous U.S.], computed separately for each day of year; for BCCA CMIP, the approach is the same, except the historical period is 1950-1999.)*"

Issue

In June 2013, several archive users discovered that daily 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. For example, see illustrations at http://mesoscale.agron.iastate.edu/downscale/, courtesy of Prof. Raymond Arritt, Iowa State University.

As background, recall that BCCA involves three steps each producing a data product: (1) REGRID data produced when biased global climate projection outputs are regridded 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.ucllnl.org/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. As of July 17, 2013, 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 larger 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.

Corrected Documentation

(Executive Summary, page x, second paragraph, last sentence) "*The comparison focuses on monthly BCSD results because: (1) most website data requests involve this resource, and (2) prior studies have shown that at monthly to coarser time resolution, downscaling results have been similar, whether they were derived using monthly BCSD or daily BCCA. However, BCCA may be applied in various forms, and a choice to apply it to construct "precipitation anomaly" analogs rather than "total precipitation" analogs (as chosen for prior studies) does result in the BCCA data having a dry climatological bias relative to BCSD data over much of the contiguous U.S."*

(Section 3, page 14, second paragraph, third sentence) "*Second, Maurer et al. (2010) showed that at the monthly level, BCSD and BCCA (aggregated from daily to monthly) show roughly*

similar results. Therefore, BCCA CMIP5 (BCCA5) versus BCCA CMIP3 (BCCA3) comparisons should be roughly similar to that of BCSD CMIP5 (BCSD5) and BCSD CMIP3 (BCSD3) at the monthly level. However, note that these CMIP5 to CMIP3 comparisons may be affected by how BCCA application for this archive differed from that of Maurer et al. (2010), involving the use of "total precipitation" analogs rather than "precipitation anomaly" analogs, which seems to have contributed to the dry climatological bias found in the BCCA results compared to their BCSD counterparts."

(Appendix A, page A-12, third bullet) "*Whether to construct analogs of magnitude or anomaly patterns; and, if the latter, anomalies relative to what pattern "datum." (For the BCCA CMIP3 application, analogs are constructed relative to 1961-1999 means within the geographic domain of downscaling [i.e., contiguous U.S.], computed separately for each day of year; for BCCA CMIP5, the approach is the same, except the historical period is 1950-1999) Please note that the BCCA CMIP3 and CMIP5 precipitation products are based on constructed analogs of total precipitation magnitude, rather than anomalies. The BCCA CMIP3 and CMIP5 temperature products are based on anomalies.*

Data Application Guidance

Short-Term: Accounting for BCCA bias in Current Applications

Before applying BCCA CMIP3 or CMIP5 outputs, users should account for the historical bias described above. One simple way to do this is using a ratio scaling factor uniformly applied to a given projection's data over a given 0.125 grid-cell location. This approach can be thought of as bias-correction in the mean and involves two steps. First, compute the historical bias as a period-ratio; so, e.g., for BCCA CMIP3 data, the ratio equals the 1961-2000 mean observed precipitation (Maurer et al. 2002) divided 1961-2000 mean BCCA precipitation; for BCCA CMIP5, use the 1950-1999 period. In the second step, multiply all time-series values in the BCCA projection's historical and future periods by this ratio to produce a result showing no bias in historical mean-annual precipitation and somewhat mitigated biases in quantile-specific values. Other bias-correction approaches may also be applied. Some of those could involve applying the technique described above on a quantile-specific basis in order to bias-correct the distribution.

Long-Term: Redevelopment or Adjustment of BCCA data

Archive collaborators are continuing to assess the issue to diagnose why their constructed analogs application leads to this dry bias. Once this evaluation is complete, a decision will be taken either to (1) develop and implement a corrected constructed analogs algorithm, or (2) mitigate the problem by applying a post-downscaling bias-correction to archive data.

We hope this notification provides adequate explanation of the issue, and we regret any inconvenience that this issue may have caused. We will keep archive users apprised of the long-term efforts to remedy the matter. If you have any comments or questions, please let us know by submitting a comment to the archive Feedback page (http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html#Feedback).