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Hydrology and Earth System Sciences Discussions

Interactive comment on "Utility of daily vs. monthly large-scale climate data: an intercomparison of two statistical downscaling methods" *by* E. P. Maurer and H. G. Hidalgo

Anonymous Referee #2

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Maurer and Hidalgo Utility of daily vs. monthly large-scale climate data: an intercomparison of two statistical downscaling methods

This paper tackles an important issue in statistical downscaling, namely whether such methods can provide skill at the daily time scale. Two methods are compared that treat daily variability quite differently and yet obtain similar skill at the monthly scale. The results are very instructive to the statistical downscaling community in how to apply such methods where daily skill is important. I recommend it be published after minor revisions taking into account review comments.

1) The basic premise of the paper is to evaluate the skill of statistical downscaling at the daily time scale. You use two methods, one applied directly to daily large-scale data and one applied to monthly large-scale data with essentiallt random temporal disaggregation. The two downscaling methods are quite different in other ways, and I think you minimize this too much. The differences between the methods does not weaken the overall approach, so I would prefer to see a more open discussion of these differences.

In fact, neither of these methods depends, in terms of the basic algorithm, on the time step between samples. BCSD could be applied to daily GCM sequences. You could either do this by directly downscaling the daily fields. Or, you could d.s. monthlies and then scale the GCM daily sequence to the monthly mean. Likewise, you could construct a CA based on monthly mean sequences. So, in theory, we could have four experiments: 1) CA monthly 2) CA daily 3) BCSD monthly 4) BCSD daily.

Given the strong correspondence at monthly scales, however, I think it is definitely fair to use the two experiments presented in the paper (i.e. 2 and 3) to explore the differences in skill at the daily time step. This is more a comment on presentation than on methodology. In fact, I think a good argument could be made that CA is well-suited to daily time steps and BCSD to monthly, if the bias correction is more sensitive to errors in the simulated daily variance. If you could provide some discussion of why each method is more appropriate to daily or monthly samples, that would strengthen the case for using these two methods.

2) You state "the two methods will be expected to distinguish themselves only inasmuch as the large-scale climate exhibits skill at the daily time scale." However, their monthly scale performance differs somewhat. These differences are minor, but they appear to relate to the ability to capture orographic effects, which could be quite important in some contexts.

3) p3417 – aren't temperatures likewise adjusted for terrain?

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4) p 3422 (fig 4) You discuss problems with simulating precipitation over complex terrain, and this appears to be reflected later in skill at daily scale. Some studies have looked at the importance of large-scale circulation patterns in determining the precipitation variability over the western US (e.g. Leung et al 2003: Hydroclimate of the Western United States Based on Observations and Regional Climate Simulation of 1981–2000. Part II: Mesoscale ENSO Anomalies 2003 J Climate and Widmann et al 2002: J Climate). The CA may indirectly be a little better at capturing such effects to the extent that they are even weakly reflected in the reanalysis.

5) Conclusion: Widmann and Bretherton (2000) conclude that the reanalysis can provide useful information about daily precipitation anomalies in the Pacific Northwest, but this skill may be absent for other regions. However, this paper shows that, in a practical sense, this skill is not realized in downscaled data. While there is some skill in the PNW, BCSD does almost as well as CA, implying that the skill really derives from the monthly scale (i.e. random daily sequences about the monthly-mean do about as well as the simulated daily sequence). I think you could state more strongly that there may be no useful skill in large-scale precipitation simulations. For temperature, there is some skill in the reanalysis, but not substantial. For a free-running GCM, one would expect daily skill to be even less reliable.

7) final sentence: Also consider that although circulation is well represented, you would expect changes in precipitation under climate change even as circulation was more or less the same. Thus, while circulation may be a good predictor for seasonal-scale precipitation variability, it is not suitable by itself for climate change. This is another reason why precipitation is preferred as a predictor: even if it is poorly represented, it likely best captures the climate change forcings.

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