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Hydrology and Earth System Sciences Discussions

Interactive comment on "Future humidity trends over the western United States in the CMIP5 global climate models and variable infiltration capacity hydrological modeling system" *by* D. W. Pierce et al.

Anonymous Referee #2

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The authors present a thorough and well-written article that explores fairly deeply a model phenomenon that could have significant implications. As is pointed out, the VIC model has been used in many studies of historical hydrology and future projections around the world. As a well established and widely used model, this identification of a shortcoming in some settings will help the model developers improve VIC (or the VIC/VMS implementation) for future applications. I have only a few relatively minor comments on the manuscript, which are outlined below.

1) p. 13654, line 15, the text correctly states that VIC, when used for future projections, is typically run using daily P, Tmax, Tmin. However, in most applications it has not been driven by downscaled daily GCM output, but monthly GCM output, with a resampling procedure to generate daily data for input to VIC. This is not a detail that would affect the results of this study, but the implication in the text is that daily GCM output is used, and that has been rare.

2) p. 13654, line 17, it might be worth mentioning that a motivating reason for using the MT-CLIM algorithms to estimate variables besides P, Tmax and Tmin is that the remaining variables are relatively sparsely observed.

3) It is a good distinction that the VIC land surface model, while usually used with the full VMS algorithms, is actually distinct as a land surface-atmosphere interaction scheme. There are a couple of places where the notation uses VIC where VMS may be more correct: Figure 3 legend, Fig 8 caption.

4) p. 13658, line 13, I found one detail a little confusing. The calculation of average P in VMS is summarized as a 90-day moving accumulation, with a lower limit of 8cm. However, the VIC documentation (http://www.hydro.washington.edu/Lettenmaier/Models/VIC/Documentation/Info/annual_prec.shtml) allows annual average P as an input variable for each grid cell. As I understand it (and I may be wrong here), if it is supplied as an input, that overrides the internal calculation using the 90-day technique. If this is the case, then what would be the effect of supplying the average annual precipitation to VMS up front? At least some of the results would seem to be affected by this.

5) p.13659, line 28, it is not clear how a UTC-based day would affect results. Could a short example be supplied? For instance, if a typical case has Tmax recorded at 2pm local time and Tmin at 6am the following day (both being reported as corresponding to, say 7am the second day, along with accumulated P for 7am-7am), what would the UTC-transformed data look like?

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6) p.13661, the paragraph on bispectral analysis is too abstract without a figure to accompany it. the take-away message from this paragraph is also not clear. Either that portion should be lengthened to show what it adds to the discussion more clearly, or maybe it could be removed.

7) p.13661, line 29, the text states "many locations ... have mean biases < -10C". The color bar (Fig 4) is truncated at -10C, so this is not evident.

8) p. 13662, line 22, add to the text a reminder of what the "original algorithm" is. Is that using the actual long-term avg P rather than the 90-day window?

9) I found the switch from %/century (p. 13664, line 20) to %/decade (p.13666, line 4 and elsewhere) confusing. The latter seems to be more consistently used in the paper, so I would prefer to see just that one.

10) In section 4 and the conclusions it is shown that the RH bias may result in an underprediction of runoff at Lees Ferry of 4%. The result from a recent study is shown as projecting a decline of 7.6%by end of 21st century, the conclusion being that this shows the importance of this RH bias. This is a somewhat unfair comparison. Showing that RH bias can result in an underestimate of runoff does not imply that the runoff sensitivity is also decreased. In fact, a table compiled in an article on which the first author was also an author (Barnett & Pierce, PNAS, 2009) showed the runoff declines for the Colorado basin simulated by the studies that used VIC as being mid-range or less negative than other models. I'd be wary, based on what is in the paper at present, of implying that VIC underestimates projected future changes in streamflow as a result of the RH issues.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 13651, 2012.