Hydrol. Earth Syst. Sci. Discuss., 6, S199–S202, 2009
www.hydrol-earth-syst-sci-discuss.net/6/S199/2009/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Numerical simulations of the impact of climate variability and change on semiarid watershed response in central New Mexico" *by* E. R. Vivoni et al.

Anonymous Referee #1

Received and published: 2 March 2009

This paper is relevant to HESS and could make a useful contribution towards understanding the possible implications of changes to precipitation and/or temperature patterns for regional/basin scale hydrology. The method presented for quantifying the potential impacts of climate change is innovative and simple (and therefore useful in practice). Overall, the structure and readability of the paper is reasonable and the objectives, methods and conclusions are clear, as are the descriptions of the limitations of the study. However, the following comments should be addressed before acceptance for publication in HESS:

1)The title does not accurately convey what the paper is about. Numerical simulations

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of the impact of climate variability and change implies that you will be getting some climate change/variability impact scenarios, determining the resulting impact on hydrological drivers (e.g. temp, precip) and subsequently the hydrological response to the altered climate regimes. What has actually been done is the development of a hydrological model, comparison of streamflow produced by this model with historical observations and then the use of this model to test how sensitive the hydrological response is to variations in precipitation intensity, duration and frequency (as well as temp seasonality). Therefore, the thrust of this paper is about modelling hydrological processes, and resulting watershed response in Central New Mexico and then testing how sensitive these processes and hydrological responses are to climate variations/change. As such I suggest the revised title "Semiarid watershed response in central New Mexico and its sensitivity to climate change"..

2)Section 3.1 Comparison with historical streamflows. There are some serious problems here and a much more significant demonstration of the adequacy of the hydrological model needs to be presented before this paper can be accepted (as all the results and conclusions of the paper hinge on this). Specific problems include:

a.Excluding extreme event years just because they are not captured by your stochastic model is not acceptable. Extremes (be they droughts or floods) are what cause all the problems and therefore what we (researchers, water resource practitioners, policy makers etc) are interested in. If your stochastic model does not adequately capture extreme events then you need to use a better stochastic model.

b.Figure 5 i do not understand. Why are you comparing observations at one point with simulations at 3 points? And then in the text of Sect. 3.1 you refer to an average of 2.22km3. How is this average calculated? And why do you compare an average with the point observation of 9.89km3??

c.The model validation is not very good.Ignoring the problems listed above in (a) and (b) the obs column in Fig 5 does not come close to any of the modelled values (whether

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it is based on obs precip or stochastically generated precip). Further, what about presenting some hydrographs and some validation stats (e.g. Nash-Sutcliffe)? Simulation of total streamflow over a 30 year period (which Fig 5 indicates is not done very well anyway) is not a very rigorous test of hydrological model performance.

3)Section 3.2: Analysis of long-term simulations. It needs to be further explained how the long-term simulations were generated and how they differed from each other. What does varying the random number generator seeds actually mean?

4)Section 3.3: Analysis of precip and temp change scenarios. You state you applied % changes to winter inter-storm duration and summer storm intensity "within reasonable ranges". What do you mean by reasonable ranges? How did you decide what is reasonable and what is not, especially given observed records are only about 50 years at most? Did you account for naturally occurring multidecadal variability and if so, how? Even if you can justify your classification of reasonable, how do you know what you consider to be unreasonable now will not be reasonable in the future? Since this is a sensitivity analysis why exclude anything as unreasonable???

5)JAS to represent summer? why not JJA (i.e. the standard summer season, similar to DJF is standard for winter)?

6)The combination of scenarios..ideally it would be good to see a worst case scenario (i.e. a scenario when all precipitation changes are in the same direction). This is alluded to in the last paragraph before the conclusions. The scenario presented was a decrease in winter storm duration (which would make things drier) and an increase in summer storm intensity (which would make things wetter), possibly cancelling each other out to some degree when considered in the annual context. An analysis of decreased winter storm duration + decreased summer storm intensity would give an indication of the DRY worst case. Similarly, an increased winter storm duration + increased summer storm intensity would give an indication of the WET worst.

Technical corrections

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Fairly trivial but there are several typos and grammatical errors that should be corrected. For example:

"El Niño/Southern Oscillation (ENSO)" is the standard terminology not "El-Nino-Southern Oscillation"

"little is known on" should be "little is known about"

"Sect. 3" etc should be fully spelled out as "Section 3"

"winter season","summer season"..the inclusion of season is redundant

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 319, 2009.