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Hydrol. Earth Syst. Sci., 13, 715-733, 2009
www.hydrol-earth-syst-sci.net/13/715/2009/

Semiarid watershed response in central New Mexico and its sensitivity to climate variability and change

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Abstract. Hydrologic processes in the semiarid regions of the Southwest United States are considered to be highly susceptible to variations in temperature and precipitation characteristics due to the effects of climate change. Relatively little is known about the potential impacts of climate change on the basin hydrologic response, namely streamflow, evapotranspiration and recharge, in the region. In this study, we present the development and application of a continuous, semi-distributed watershed model for climate change studies in semiarid basins of the Southwest US. Our objective is to capture hydrologic processes in large watersheds, while accounting for the spatial and temporal variations of climate forcing and basin properties in a simple fashion. We apply the model to the Río Salado basin in central New Mexico since it exhibits both a winter and summer precipitation regime and has a historical streamflow record for model testing purposes. Subsequently, we use a sequence of climate change scenarios that capture observed trends for winter and summer precipitation, as well as their interaction with higher temperatures, to perform long-term ensemble simulations of the basin response. Results of the modeling exercise indicate that precipitation uncertainty is amplified in the hydrologic response, in particular for processes that depend on a soil saturation threshold. We obtained substantially different hydrologic sensitivities for winter and summer precipitation ensembles, indicating a greater sensitivity to more intense summer storms as compared to more frequent winter events. In addition, the impact of changes in precipitation characteristics overwhelmed the effects of increased temperature in the study basin. Nevertheless, combined trends in precipitation and temperature yield a more sensitive hydrologic response throughout the year.

Final Revised Paper (PDF, 1664 KB) | Discussion Paper (HESSD)

Citation: Vivoni, E. R., Aragón, C. A., Malczynski, L., and Tidwell, V. C.: Semiarid watershed response in central New Mexico and its sensitivity to climate variability and change, Hydrol. Earth Syst. Sci., 13, 715-733, 2009. Bibtex | EndNote | Reference Manager

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