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Recent meteorological extremes as triggers of hydrological extremes

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Simulations of environmental change impacts on hydrological processes such as water cycle often suffer from incomplete or scarce model parameterization and input data. Consequently, comprehensive sensitivity analyses, as well as accuracy and error propagation assessments are important tools to evaluate the influence of deviations and inherent errors on the model results. In this study we investigate the spatial and temporal pattern of daily minimum and maximum air temperatures as well as daily precipitation over the complex terrain in Switzerland using the DAYMET model. We test the degree of accuracy of the model for simulating continuous daily surfaces of temperature, precipitation, and vapor pressure between 1961 and 2006 across Switzerland. The test is based on a cross validation analysis, comparing predicted and observed daily, monthly, and seasonal predictions. Predictions of minimum and maximum temperatures received very high correlations with observed values, with a smaller bias for maximum temperature. In order to draw general conclusions of the model performance, we summarize this uncertainty analysis (using MAE and bias) in an environmental space along both temperature and vapor pressure gradients. Based on a regionalization of precipitation by means of a combined principal component and cluster analysis explore to what degree the model uncertainty is affected by precipitation characteristics. To validate this proposal, we simulate recent meteorological extremes (with respect to the 1961-1990 mean) as triggers of three hydrological extremes: 1) the avalanche winter 1999, 2) the record-breaking summer-heat 2003, and 3) the flood in August 2005. Interpolated DAYMET data provide high resolution representative information on meteorological extremes and provide a detailed data basis that can be applied for the estimation and understanding of trends in hydrological extremes.