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On the predictability of hydrological droughts with a conceptual model

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Since the extreme summer of 2003 the importance of early drought warning is increasingly recognized also in apparently water-rich countries like Switzerland. The year 2011 provided additional examples of drought conditions in Switzerland, which are expected to become more frequent in the future. So far, little has been done regarding drought forecasting in Europe. A fundamental question related to drought forecasting is: How long before a hydrological drought actually occurs, can it be predicted? To address this question, we assessed the relative importance of current hydrological state and weather during the prediction period.
A conceptual catchment model, the HBV model, was calibrated to 21 Swiss catchments and for each of them two modeling experiments were performed: 1) Streamflow was simulated starting with the same initial hydrological state but with different observed series (i.e. from different years) of precipitation and temperature to derive 'predictions'. 2) Streamflow was simulated using various initial hydrological states, but the same longterm means of precipitation and temperature as forcing. Both experiments were repeated four times, shifting the start of the simulations to different seasons. The relative importance of initial hydrological state and weather during the prediction period was evaluated by estimating the persistence of the initial hydrological states in the prediction for both experiments. To further distinguish between effects of weather and catchment properties, the resulting persistences were tested on their sensitivity to changes in total precipitation amounts and air temperature.
For the investigated catchments the persistence in streamflow appeared to be more depending on catchment characteristics and less on the start of the prediction period. Drier initial conditions of soil moisture and deeper groundwater storage resulted for most catchments in longer persistence estimates, while the initial conditions of snow and upper groundwater storage showed no clear effect on the persistence. From the preliminary results of the sensitivity analysis, the persistence estimates seem not sensitive to changes in precipitation.