Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-101-RC1, 2016

Hydrology and Earth System Sciences Discussions
Open Access

Interactive comment on "An experimental seasonal hydrological forecasting system over the Yellow River basin – Part I: Understanding the role of initial hydrological conditions" *by* Xing Yuan et al.

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Received and published: 2 April 2016

A set of two papers by Xing Yuan is presented for the review. The first one is devoted to the investigation of the role of initial watershed conditions for streamflow forecasting in the Yellow River basin, China. The second paper deals with seasonal ensemble forecasting of the human-induced streamflow by the means of North American Multimodel Ensemble (NMME) and forecast post-processing procedure. Given a vast material and several main issues under consideration within a single modeling framework, splitting up the papers is a good decision. This comment addresses the first paper of the two.

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Discussion paper

The paper investigates the predictability of streamflow and soil moisture on a seasonal extent (up to 6 months ahead) within a large river basin, characterized with different streamflow formation patterns. Seasonal streamflow predictability studies are considered to be one of the major directions for the hydrological scientific community (Blöschl, 2006), and the presented paper is aimed to outline the regional patterns of predictability, thus fully corresponding with the international hydrological agenda. The authors assess contributions of initial watershed conditions and meteorological forcings within the forecast window to seasonal predictability of the streamflow along the main course of the Yellow River. To fulfill the task, an experiment is designed based on the Reverse-Ensemble streamflow prediction method (rev-ESP, Wood and Lettenmaier, 2008). The Variable infiltration capacity (VIC) hydrological model (Liang et al., 1996) with global routing model by Yang et al. (2015) is used to describe the initial conditions and simulate the streamflow for the test period of 1982 – 2010. Meteorological forcings are set on a grid-base with 0.25 degree resolution holding the interpolated data from 324 meteorological stations within the basin. The hydrological model is calibrated against naturalized streamflow (reconstructed for the whole basin with the rainfall data using rainfall-runoff ratio at 12 main river gauges) and shows overall good performance with NSE values of 0.78 – 0.91. One of the issues the reviewer would like to address concerning the experiment is that the naturalized streamflow may contain errors concerning the precipitation and streamflow measurements. Reaching up to 10% of the measured value, the errors, when combined, might introduce uncertainties in the naturalized streamflow time-series. The uncertainties may be transferred forward to the hydrological model by calibrating it against these time-series which may result in unrealistic parameters. It should be noted that the authors use naturalized streamflow in order to assess natural and unperturbed hydrological predictability apart of the human induced water subtractions. The observed streamflow is used in the second paper to condition the hydrological forecasts. The overall design of the experiment complies with the ESP/revESP framework. For the ESP experiments the model is first run from 1951 to 2010 to simulate the natural initial conditions of the basin, then for the ESP experiment the simulation is initialized at the beginning of each calendar month within the period 1982 – 2010 with 28 6-month-long realizations of meteorological forcing. For the revESP experiment the model is run again for 6 months starting each month within the test period with single actual meteorological forcing, but the initial conditions are taken from the ensemble of 28 members excluding the year under consideration. The memory of the hydrological system is demonstrated by calculating the ratio of the RMSE from ESP and revESP experiments, respectively. The ratio values less than 1 show initial conditions prevailing over meteorological forcing in streamflow predictability over the forecast period and the memory of the hydrological system is controlling the streamflow conditions. The ratio greater than 1 shows that the predictability depends on climatic system and the memory of the hydrological system has no control over the streamflow. Results obtained for 12 gauges along the river course show that the initial conditions control the system in Autumn and Winter, while meteorological conditions tend to influence the system in the Spring and Summer rainy season. The authors outline that it has been discovered that the hydrological system memory drops to the lowest level at the end of the dry season. Further investigation of the initial surface water conditions is also carried out, concluding that the system memory of the surface water state lasts for less than a month in general and has no influence on the long lead-time, yet for the short leads it is crucial. Next, the initial conditions are selected to attribute for a wet and dry state of the basin, thus tending the model to reproduce extremes. This part concludes that the wet state of the basin is generally more influenced by the initial conditions, while the drier case is less stable. To assess the predictability of the soil moisture the same ESP/revESP technique is applied, showing that again the best forecast performance for such a slow process as soil moisture transport is obtained for the dry winter season and a significant lead-time up to 2 – 3 months can be still obtained for summer months. The overall characteristic of the paper is very good, it is a major contribution to global investigations of the limits of hydrological predictability. The paper can be published without any revisions.

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