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# Use of an ensemble approach to evaluate the importance of initial conditions and atmospheric forcing on hydrological prediction uncertainty in the Amazon River basin

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Recent extreme events in the Amazon River basin, such as the 2009 flood and the 2005 drought, and the extreme dependence of local population to water resources for obtaining food and transport motivate the development of hydrological forecast systems (HFS) in that region. HFS are often based on hydrological models and its prediction errors arise from uncertainty on (i) model structure and parameters, (ii) atmospheric forcing such as precipitation and (iii) initial states (e.g. preceding soil moisture and volume of water stored in rivers and floodplains). Knowledge of the relative importance of these terms plays an important role on the hydrological predictability but also on the improvement of model structure, choice of model forcing and development of data assimilation systems. We evaluate the importance of the initial conditions and atmospheric forcing (i.e. precipitation) for the hydrological predictability in the Amazon River basin. We use a hindcast approach developed by Wood and Lettenmaier (2008) that contrasts Ensemble Streamflow Predicton (ESP) and a reverse Ensemble Streamflow Prediction (reverse-ESP). In ESP, the model uses perfect initial conditions and runs forced by an ensemble of observed meteorological data from past years, while in reverse-ESP the model runs from an ensemble of simulated initial conditions from past years forced by a perfect forecast. The comparison of the spread of both set of ensembles allows evaluation of the relative importance of the initial conditions and meteorological forecasts on model predictability as functions of lead time. Moreover, an estimate of the river basin memory can be assessed by verifying in which lead time the spread of ESP ensemble becomes larger than the reverse-ESP. Simulations are performed using the MGB-IPH model, a large-scale, distributed and process based hydrological model using a catchment-based discretization and the Hydrological Response Units (HRU) approach. Physical and conceptual based models are used to simulate the hydrological processes, such as the Penman Monteith for evapotranspiration and the Moore and Clarke infiltration model. Streamflow routing is performed using either the Muskingum Cunge approach or a full 1D hydrodynamic model with a simple floodplain storage model. The model is forced using TRMM-derived precipitation (i.e. 3B42 algorithm), with spatial resolution of 0.25o $\times$ 0.25o and daily time step for a period spanning 13 years (1998 - 2010). We discuss features such as the hydrological memory in different parts of the Amazon River basin, the relative weight of each kind of state variable and how it relates to the characteristics of different regions of the Amazon.