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Time Asymmetry and Stochastic Modelling of Streamflow

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Time asymmetry, i.e., temporal irreversibility, has a very important role in many scientific fields and has been studied thoroughly. Its detection in time series indicates the need to preserve it in stochastic simulations. This also seems to be the case for the streamflow process in hydrological simulation. Relevant large-scale studies have shown that time asymmetry of the streamflow is absolutely evident at small scales (hours) and vanishes only at larger scales (several days). The latter highlights the need to reproduce it in flood simulations of fine-scale resolution. To this aim, an enhancement of a recently proposed simulation algorithm for irreversible processes was developed, based on an asymmetric moving average (AMA) scheme that allows for the explicit preservation of time asymmetry at two or more timescales simultaneously. The method is tested through some case studies from around the world to further explore the method's strengths and limitations and to examine the stochastic characteristics of the simulated results.