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Water-Age Accounting, Fully Distributed Watershed Modeling for Flood Forecasting

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Water-age accounting, and its stable isotopic signature due to fractionation, is becoming a powerful tool in gaining further insights in several science questions related to watershed hydrologic response in extreme weather events and its sensitivity to land and climate changes. Experience is quite limited on fully distributed watershed models capable of explicitly tracking water age and stable isotopes variations along the modelled fluxes. Most of these models rely on a full-mixing simplifying hypothesis inside each model conceptual reservoir, e.g. a soil layer in a computational pixel or a river reach. This hypothesis is known to seriously affect the capability of matching model results with isotope data, especially at time scales much shorter than the seasonal one, hence preventing efficient data assimilation to improve model calibration ad state estimation. We propose here a water age-and-isotope tracking version of the fully distributed watershed model MOBIDIC, which in its standard operational version includes surface energy-mass balance, snowpack dynamics, hydraulic river and reservoir routing, surface-groundwater interactions. An augmented EnKF isotope and river discharge data assimilation framework is also presented based on such a model, aimed at both estimating key model parameters and improving the estimation of river water partitioning among different sources during floods. While input hydrometeorological data used in the experiments refer to real high-flow events on a mid-size mountain basin, synthetic data are generated (with an ideally 'unknown' set of model parameters) for river flows and isotopes in a first assimilation efficiency assessment presented here.