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Water age and stream solute dynamics at the Hubbard Brook Experimental Forest (US)

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The contribution discusses experimental and modeling results from a headwater catchment at the Hubbard Brook Experimental Forest (New Hampshire, USA) to explore the link between stream solute dynamics and water age. A theoretical framework based on water age dynamics, which represents a general basis for characterizing solute transport at the catchment scale, is used to model both conservative and weathering-derived solutes. Based on the available information about the hydrology of the site, an integrated transport model was developed and used to estimate the relevant hydrochemical fluxes. The model was designed to reproduce the deuterium content of streamflow and allowed for the estimate of catchment water storage and dynamic travel time distributions (TTDs). Within this framework, dissolved silicon and sodium concentration in streamflow were simulated by implementing first-order chemical kinetics based explicitly on dynamic TTD, thus upscaling local geochemical processes to catchment scale. Our results highlight the key role of water stored within the subsoil glacial material in both the short-term and long-term solute circulation at Hubbard Brook. The analysis of the results provided by the calibrated model allowed a robust estimate of the emerging concentration-discharge relationship, streamflow age distributions (including the fraction of event water) and storage size, and their evolution in time due to hydrologic variability.