Poster #160

Scale-Adaptive Watershed Simulation of Watershed Function

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The Watershed Reactor Component of the Watershed Function SFA is pursuing a set of modeling activities to quantify key controls on watershed system behavior driven by coupled hydrologic, vegetation and biogeochemical parameters. The modeling tasks are motivated by the need to quantify water and nutrient fluxes into, cycling within, and export from interconnected hydrologic units without undue sacrifice of resolution and process fidelity.

A key task within this component focuses on bringing vegetation models into hydrological codes (ATS, ParFlow) to account for water, carbon, nitrogen cycling by means of a generic interface. Other modeling activities focus on floodplain meanders near the East River Pump House, where data indicate nitrification and Fe(III) reduction to Fe(II) across <1m spatial scales. Bedform data show complete oxygen consumption over a 10cm vertical scale in the riverbed. Models developed with these data are currently being tested to assess how early snowmelt conditions will influence key redox controls on carbon and nutrient budgets. A two-dimensional transect is used to demonstrate how hyporheic flow paths within an intra-meander region impact carbon and nitrogen export into the stream system. Efforts are also underway to upscale the local carbon cycling displayed with individual stream meanders to the larger East River system, in part by making use of the high performance computing platform provided by PFLOTRAN and ATS.

Another activity in collaboration with the Hydrology Component of the Watershed Function SFA involves high resolution hill slope modeling of an instrumented transect. The hill slope modeling, which will eventually consider the chemical weathering of the shale over geologic time, will be paired with the floodplain modeling to develop mesoscale models for water and nutrients. Comparisons of fluid residences times of two mesoscale models, a high-elevation upper montane and a low-elevation floodplain site, will be used to explain differences in carbon exports measured in the field. This mesoscale modeling effort will serve as the basis for a more comprehensive scale-adaptive approach that will consider parallel-in-time fine and coarse scale watershed simulations.

A 10m resolution integrated hydrologic model of the East River has been developed to test hypotheses and guide observations. Watershed scale model resolution is varied over 2 orders of magnitude across all 255km^2, from a near-observational scale (10m) to a regional modeling scale (1km), providing an opportunity to bracket uncertainty in projected environmental changes and to determine the scale at which functional hydrologic relationships break down.