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Linking Hydrology and Biogeochemistry at multiple spatial and temporal Scales

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Until recently, it has been challenging to couple hydrologic and biogeochemical processes at the watershed scale. We have coupled two well-known models, TOPMODEL and MEL, to simulate lateral water and nutrient fluxes and their influence on ecosystem functioning, applicable to multiple spatial and temporal scales. TOPMODEL is a conceptual rainfall-runoff modeling framework at the catchment-scale. It represents lateral subsurface water redistribution, and is based on hydrological similarity of points in a catchment (i.e. topographic index, dependent on contributing area and the local slope). Points within a catchment with the same topographic index are assumed to respond identically to atmospheric forcing. Our hydrologic model is based on the TOPMODEL concepts, but includes a layered soil water scheme. The Multiple Element Limitation (MEL) model is an ecosystem model, developed to examine limitation in vegetation acclimating to changes in the availability of two resources (carbon and nitrogen). MEL also incorporates the recycling of resources through the soil.

In our preliminary coupled model, the bulk statistical average TOPMODEL fluxes (baseflow) are separated into fluxes within the catchment. Nutrients are treated as inert solutes and are transported using a mixing model. Nutrients moving down the slope could repeatedly be taken up, cycled through vegetation and soils, and released back into the soil solution. We tested the preliminary coupled model, using data from the H.J. Andrews LTER in the western Oregon Cascades as well as the Hubbard Brook LTER in northern New Hampshire.