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# River network bio-geochemical transport: a new conceptual framework that accounts for landscape connectivity and spatially explicit dynamics

Stefano Zanardo (1), Ilya Zaliapin (2), Efi Foufoula Georgiou (3), Mary Power (4), Bill Dietrich (5), and Michael Ghil (6)

(1) National Center for Earth-surface Dynamics, University of Minnesota, Minneapolis, USA (stefano.zanardo@unipd.it), (2) Department of Mathematics and Statistics, University of Nevada, Reno, USA (zal@unr.edu), (3) National Center for Earth-surface Dynamics, University of Minnesota, Minneapolis, USA (efi@umn.edu), (4) Department of Integrative Biology, University of California, Berkley, USA (mepower@berkeley.edu), (5) Earth and Planetary Science Department, University of California, Berkley, USA (bill@eps.berkeley.edu), (6) Department of atmospheric and oceanic sciences, University of California, Los Angeles (ghil@atmos.ucla.edu)

Most river network models are limited in their ability to accurately predict the transport and processing of fluxes (water, sediment, nutrients, contaminants) in a landscape. The main limitations are: (1) difficulty to incorporate off-channel processes (floodplains, riparian corridors, hyporheic zones) in a robust, network-based framework; and (2) difficulty to adequately incorporate transient hydrologic conditions and spatially explicit temporal dynamics that often drive most bio-geochemical processing and transport. Yet, such models are needed for accurately estimating the response of catchments to human actions and climate-related perturbations at three temporal scales: event, seasonal, and decadal; and at spatial scales ranging from a small stream reach to large watersheds. Recently, the concept of dynamic river networks (DRNs) was proposed as a conceptual framework of attaching more than a topological (order) and geometrical (length scale) attribute to any stream in a river network [Zaliapin et al, JGR-ES, 2010]. In this work, we extend this framework to incorporate spatially and temporally variable hydro-geomorphology and in-stream nitrogen dynamics towards the purpose of building a simple model for nitrogen cycling. We consider this model as a "toy model" for understanding biogeochemical transport in fluvial landscapes with various degrees of hydrologic connectivity and residence time distributions, yielding for the same static river network (SRN) different DRNs depending on the specific different spatio-temporal dynamics and thus allowing hypothesis testing, scaling analysis and probabilistic prediction over a range of scales.