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A general framework to study multi-process connectivity: Multilayer Networks

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In recent years, connectivity in geomorphic systems has been the subject of intense research [*e.g.*, *Heckmann et al.*, 2015, *Wohl et al.*, 2018], and graph theory has emerged as a suitable mathematical framework to characterize and quantify connectivity [*e.g.*, *Tejedor et al.*, 2016]. In general, system connectivity is not associated with a single process, but rather it emerges from the interaction of diverse (in nature and temporal scales) processes; for instance, transport of water, nutrients, or energy fluxes occurs along different pathways (*i.e.*, channelized, overland and subsurface flow) having a wide range of transport timescales and might exchange fluxes with each other dynamically. Here, we present a general framework based on graph theory for transport on multiscale coupled connectivity systems, via multilayer networks, that allows to quantify the connectivity properties emerging from the simultaneous action of different processes, enabling us to assess the overall system properties and dynamics [*Tejedor et al.*, 2018]. Within this framework, the system is conceptualized as a set of interacting networks, each arranged in a separate layer, and with interactions across layers acknowledged by interlayer links. We illustrate this framework by examining transport in river deltas as a dynamic interaction of flow within river channels and overland flow on the islands, when controlled by the flooding level. We show the potential of the framework to answer quantitative questions related to the characteristic timescale of response in the system.

References:

Heckmann T, Schwanghart W, Phillips JD (2015), Graph theory—recent developments of its application in geomorphology. *Geomorphology* 243: 130–146.

Tejedor, A., A. Longjas, R. Caldwell, D. A. Edmonds, I. Zaliapin, and E. Foufoula-Georgiou (2016), Quantifying the signature of sediment composition on the topologic and dynamic complexity of river delta channel networks and inferences toward delta classification, *Geophys. Res. Lett.*, 43, 3280–3287.

Tejedor, A., Longjas, A., Passalacqua, P., Moreno, Y., Foufoula-Georgiou, E. (2018). Multiplex networks: A framework for studying multiprocess multiscale connectivity via coupled-network theory with an application to river deltas. *Geophys. Res. Lett.*, 45, 9681–9689.

Wohl, E., et al. (2018), Connectivity as an emergent property of geomorphic systems. *Earth Surf. Process. Landforms*, . https://doi.org/10.1002/esp.4434.