MONDAY, MAY 29TH

PLENARY

TIME: 0800 TO 0845 ROOM: ESB 1013

The geomorphologic perils of neglecting history: why preexisting conditions matter

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A wide range of processes from the long-term evolution of mountain ranges, to the complex interactions of vegetation, flow and sediment involve the use of geomorphologic models. In such models, the histories (e.g. sequences of flows) of a channel, hillslope or even an individual particle are often neglected either for the sake of simplicity or because little is known about preexisting conditions. Here, we use a combination of field measurements, laboratory experiments and numerical modeling to demonstrate the importance of geomorphic history at a range of temporal (minutes to decades) and spatial scales. We specifically focus on three key assumptions made about bedload transport in rivers, predictions of which can be inaccurate by many orders of magnitude.

First, the sediment supply to mountain rivers can often temporally vary depending on episodic hillslope erosion events such as landslides or debris flows. Sediment supply is often neglected in calculations of bedload transport or channel morphology because it is difficult to measure. We demonstrate, using field measurements, that the histories of sediment supply and extreme flood events are essential to understand current river conditions, and that a simply proxy for sediment supply can be used to accurately predict bedload fluxes. Second, bedload transport hysteresis (different sediment fluxes on rising and falling limbs of hydrographs) is often observed in rivers but few observations of streambed properties during hydrographs exist to explain this temporal variation. We use laboratory flume experiments to show that hysteresis is caused by changes in bed structure, which in turn depend on the history of flow discharges in a channel. Third, the critical Shields stress (stress needed for the onset of sediment motion) is often expected to be temporally constant although empirical values of this parameter can vary by almost an order of magnitude. We use Discrete Element Method (DEM) modeling of individual grains to show that the critical Shields stress is unlikely to be constant, but instead will depend on grain-scale processes such as the concurrent sequence (history) of turbulence fluctuations and local bed structure changes. These three examples imply that the history of flow, sediment supply and channel conditions are integral to both understanding and predicting geomorphic change.

Bio: Dr. Elowyn Yager is an Associate Professor in the Department of Civil Engineering and the Center for Ecohydraulics Research at the University of Idaho. Elowyn obtained her B.S. and Ph.D. in Geology at SUNY Buffalo and the University of California at Berkeley, respectively. She has received a number of awards for her research and teaching including an NSF Career Award and a Fulbright Fellowship. Elowyn's research is focused on understanding the mechanics of geomorphic processes from the grain to the landscape scale. She is also particularly interested in the interactions between physical and ecological processes.

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