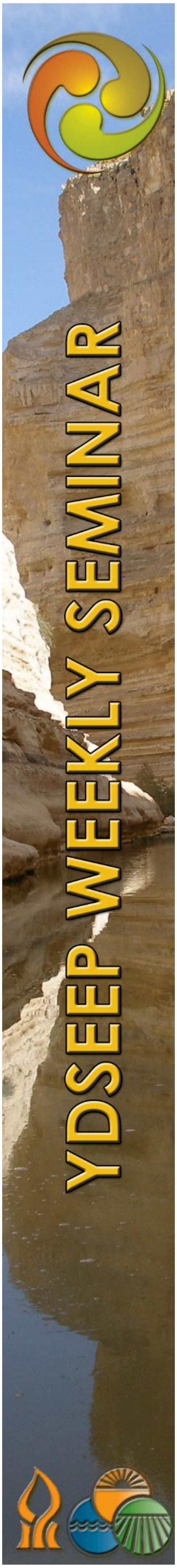

Ben-Gurion University of the Negev
Blaustein Institutes for Desert Research
The Swiss Institute for Dryland Environmental and Energy Research
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Title:

Tectonics, climate and fluvial relief: forward and inverse problems and solutions

Speaker:

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Abstract:

Fluvial channels respond to changing tectonic and climatic conditions by adjusting their erosional and relief patterns. It is therefore expected that by examining these patterns, we should be able to infer the tectonic and climatic conditions that shaped the channels. However, to do so, we need to develop deep understanding of the ways in which changes in environmental conditions manifest in the fluvial relief, and the ways in which this manifestation evolves through space and time.

Within the framework of the stream power model that describes incision rate of mountainous bedrock rivers, variability in tectonic conditions leads to slope breaks that propagate upstream along the channel. The present-day location of these slope breaks corresponds to the timing of the tectonic change that induced them and to the fluvial response time. Climatic variability has a dual effect: it influences the erosive power of the river, potentially causing local slope change, and it changes the fluvial response time that controls the rate at which tectonically and climatically induced slope breaks are communicated upstream. Because of this dual role, the fluvial response time during continuous climate change has so far been elusive, which hinders our understanding of environmental signal propagation and preservation in the fluvial topography.

To address this issue, I present an analytical solution of the stream power model that is valid for general tectonic and climatic histories. The solution gives rise to a new, general definition of the fluvial response time that applies also for temporal variations in climatic conditions. The analytic solution offers accurate predictions for fluvial landscape evolution that are hard to achieve with classical numerical schemes and thus can be used to validate and evaluate the accuracy of numerical landscape evolution models. The analytic solution together with the new definition of the fluvial response time further forms the building blocks of a linear inverse model that allows us to formally invert fluvial topography to infer the history of the tectonic or climatic conditions that shaped it.

An analytic study of landscape evolution during periodic climate change reveals that high frequency (10-100 Kyr) climatic oscillations with respect to the response time, such as Milankovitch cycles, are not expected to leave significant fingerprints in the long profile of upstream reaches of fluvial channels.

To demonstrate the linear inversion scheme and the implications of the insensitivity of fluvial topography to high frequency climatic oscillations, I use several field examples. These include inference of the history of slip rate along a normal fault that bounds the Inyo Mountains range in California, and a detailed study of the effect of late Quaternary climatic oscillations on the incision rate history of the Tinee river in the French Alps.

Date & Location:

Tuesday, December 5, 2017, 11:00
Lecture room, Physics Building (ground floor)