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# Why does inverse modeling of drainage inventories work?

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We describe and apply a linear inverse model which calculates spatial and temporal patterns of uplift rate by minimizing the misfit between inventories of observed and predicted longitudinal river profiles. This approach builds upon a more general, non-linear, optimization model, which suggests that shapes of river profiles are dominantly controlled by upstream advection of kinematic waves of incision produced by spatial and temporal changes in regional uplift rate. We have tested both algorithms by inverting thousands of river profiles from Africa, Eurasia, the Americas, and Australia. For each continent, the drainage network was constructed from a digital elevation model and the fidelity of river profiles extracted from this network was carefully checked using satellite imagery. Spatial and temporal patterns of both uplift rate and cumulative uplift were calibrated using independent geologic and geophysical observations. Inverse modeling of these substantial inventories of river profiles suggests that drainage networks contain coherent signals that record the regional growth of elevation. In the second part of this presentation, we use spectral analysis of river profiles to suggest why drainage networks behave in a coherent, albeit non-linear, fashion. Our analysis implies that large-scale topographic signals injected into landscapes generate spectral slopes that are usually red (i.e. Brownian). At wavelengths shorter than tens of km, spectral slopes whiten which suggests that coherent topographic signals cease to exist at these shorter length scales. Our results suggest that inverse modeling of drainage networks can reveal useful information about landscape growth through space and time.