Geophysical Research Abstracts
Vol. 16, EGU2014-3585, 2014
EGU General Assembly 2014

Estimating sediment-fill thickness in intermontane valleys using artificial neural networks

Juergen Mey (1), Dirk Scherler (2), Manfred R. Strecker (1), and Gerold Zeilinger (1)

(1) Institute of Earth and Environmental Science, University of Potsdam, Potsdam, Germany (mey@geo.uni-potsdam.de), (2) Geological and Planetary Sciences, California Institute of Technology, Pasadena, USA

Knowledge about the thickness and spatial distribution of sedimentary fills in intermontane valleys and internally drained orogenic plateau settings is important for many applications in the fields of hydrology, geology, geohazards, economic resources, and geomorphology. However, direct measurements of sediment thickness are time consuming and require sophisticated geophysical tools, infrastructure and logistics that are often not available. This has resulted in a general scarcity of such data, often incomplete and fraught with error, especially in remote areas. Here, we present a new approach to estimate valley fill thickness based on the geometric properties of a landscape using artificial neural networks. We test the potential of this approach by employing a 3-stage procedure. First, we run tests with three synthetic datasets representing valleys involving different complexities to explore our model's sensitivity to network architecture and training data. Second, we apply the method to a glacierized setting in the European Alps in the region of the Unteraar Glacier and the Rhone Glacier where ground-penetrating radar measurements of ice thickness allow for an analysis of the prediction performance in active subglacial terrain. In the third step, we estimate the sediment-fill thickness of the Rhone Valley, one of the largest intermontane basins in the Western Alps, where seismic reflection data are used as a benchmark for an assessment of the method's performance on a large spatial scale of a formerly glaciated landscape. Our results to date show that a successful application strongly depends on the network architecture and the choice of the training region. For the currently ice-covered catchments our prediction of the ice thickness is in good agreement with the geophysical control data, but below that of methods, which are based on ice-mechanical principles. However, in case of the sedimentary fill of the Rhone Valley where no corresponding physically-based approach exists, the new method yields results, which are consistent with the ground measurements. The minimal input to our model is a digital elevation model combined with a mask of the valley fill. This requirement makes the method easily applicable and a useful contribution for quantifying sediment storage on the scale of catchments to entire mountain belts.