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Channel head representation using point-cloud elevation data

Aljoscha Rheinwalt (1), Bedartha Goswami (2), Fiona Clubb (1), and Bodo Bookhagen (1)

(1) Institute of Geosciences, University of Potsdam, Potsdam, Germany (aljoscha.rheinwalt@uni-potsdam.de), (2) Potsdam Institute for Climate Impact Research, Potsdam, Germany

Channel heads are the upstream tips of the river network and represent the points of channel initiation. They constitute an important geomorphologic boundary between fluvial processes in convergent and hillslope processes in divergent topography. Previous research often used a catchment area versus channel slope framework to identify breaks in the scaling relation between convergent and divergent topography and referred to this as the characteristic hillslope length. Many methods have been proposed for predicting channel head locations using high-resolution digital elevation models (DEMs), yet they all suffer from artifacts created by the transformation of the original point-cloud into gridded data. Here, we propose a channel head estimation approach for point-cloud data that circumvents gridding point clouds into the commonly used DEMs. Rather than using flow accumulation on DEMs, we put forward the idea to compute it in terms of specific catchment areas (SCAs) on the triangulated irregular network (TIN) of the point cloud itself. The resulting river networks incorporate more subtle features important for channel head detection. We evaluate our method both on synthetic data as well as on high-resolution lidar data from the Channel Islands in California.