LSD Topo Tools
Open source geomorphology

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LSDTopoTools is an **open source** package which facilitates **reproducible topographic analysis**
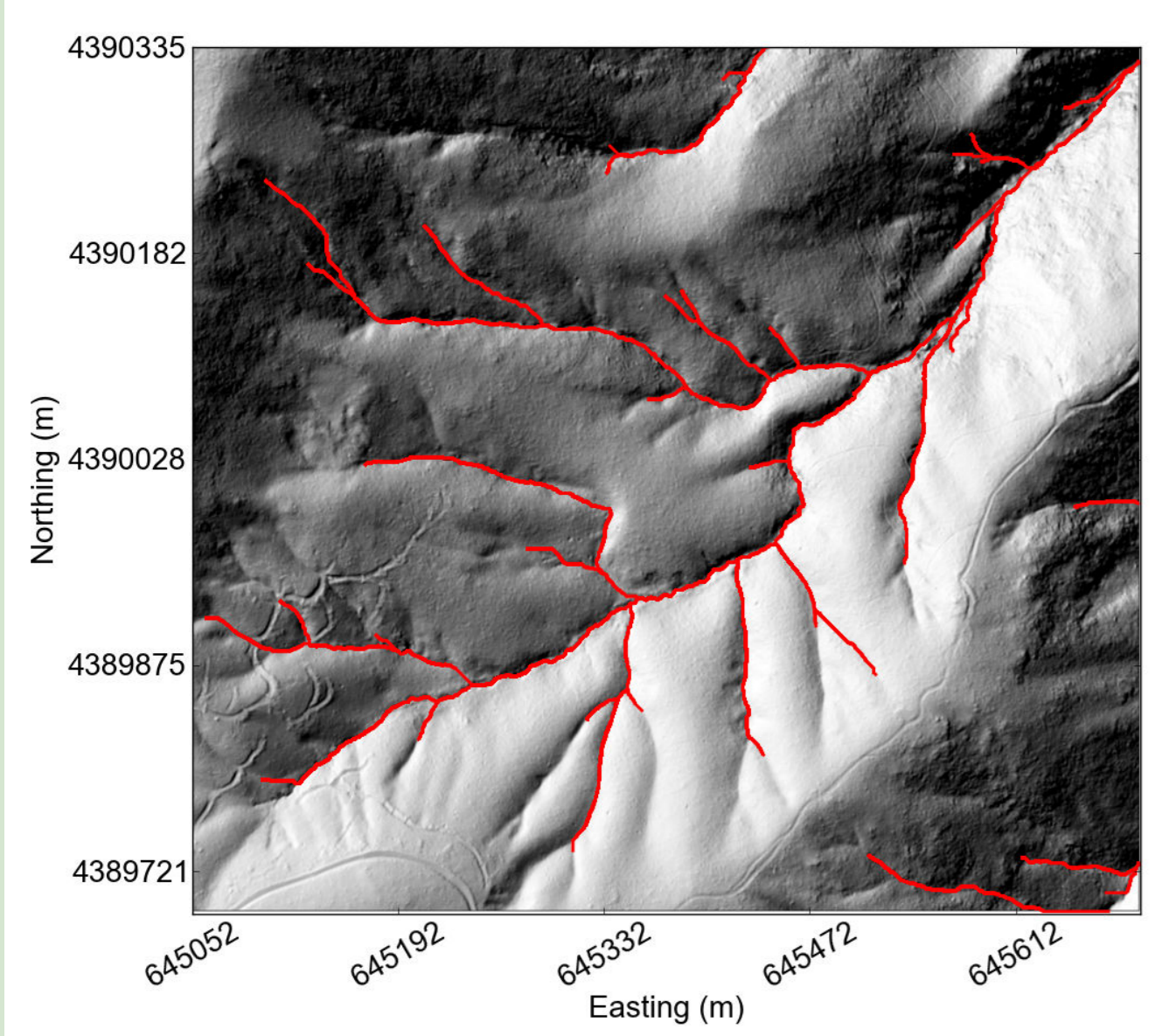
Channel extraction

Figure 1: Example channel network extracted by the DrEICH algorithm from the Feather River, CA.

LSDTopoTools can extract accurate channel networks from lidar data using the DrEICH algorithm (Clubb et al., 2014). This method identifies channel heads using transformed river long profiles (Mudd et al., 2014), marking the upstream extent of the topographic signature of fluvial incision.

Clubb FJ, Mudd SM, Milodowski DT, Hurst MD, Slater LJ. 2014. Objective extraction of channel heads from high-resolution topographic data. Water Resources Research **50** : 4283–4304.

Channel profile analysis

LSDTopoTools can extract channel steepness, normalised for drainage area, using a coordinate transformation wherein drainage area is integrated along channel distance. In some cases the steepness of the channel can be used as a proxy for erosion rate. LSDTopoTools includes statistical analyses and visualisation scripts for such analysis (e.g., Mudd et al., 2014).
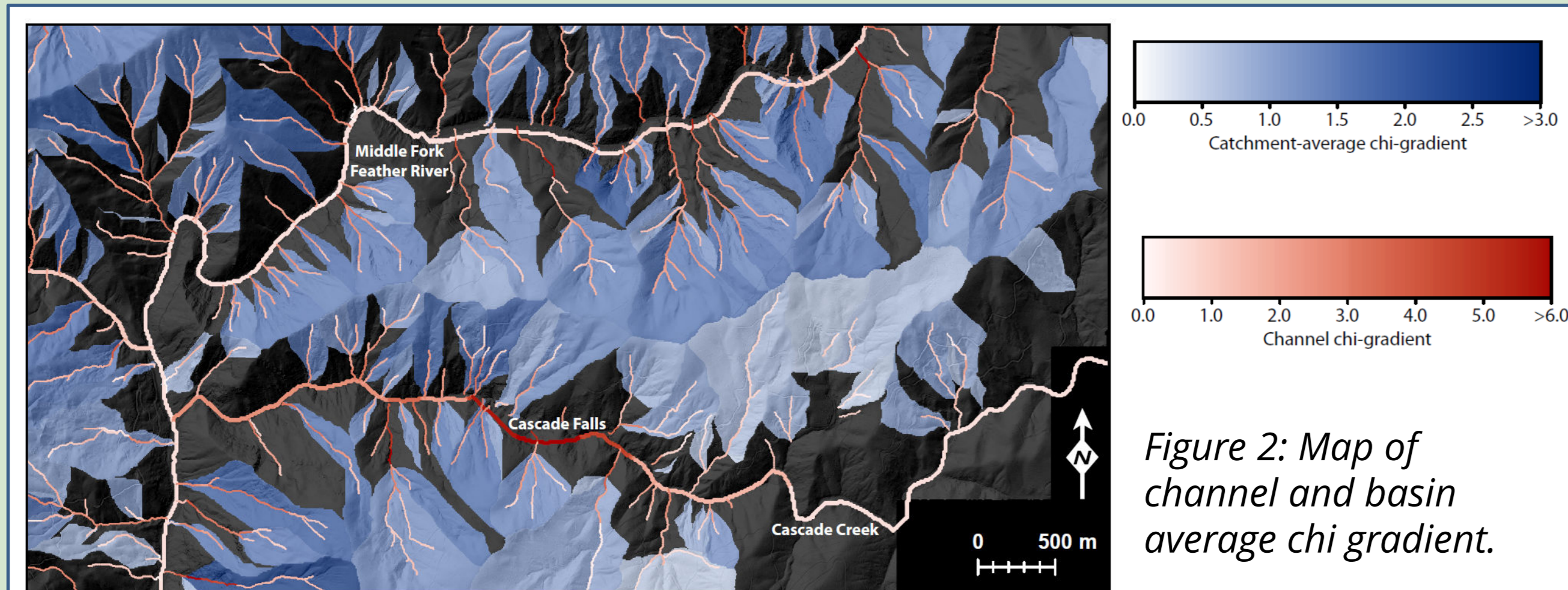

Catchment-average chi-gradient
0.0 0.5 1.0 1.5 2.0 2.5 >3.0

Channel chi-gradient
0.0 1.0 2.0 3.0 4.0 5.0 >6.0

Middle Fork Feather River

Cascade Falls

Cascade Creek

Figure 2: Map of channel and basin average chi gradient.

Mudd SM, Attal M, Milodowski DT, Grieve SWD, Valters DA. 2014. A statistical framework to quantify spatial variation in channel gradients using the integral method of channel profile analysis. Journal of Geophysical Research: Earth Surface **119** : 2013JF002981.
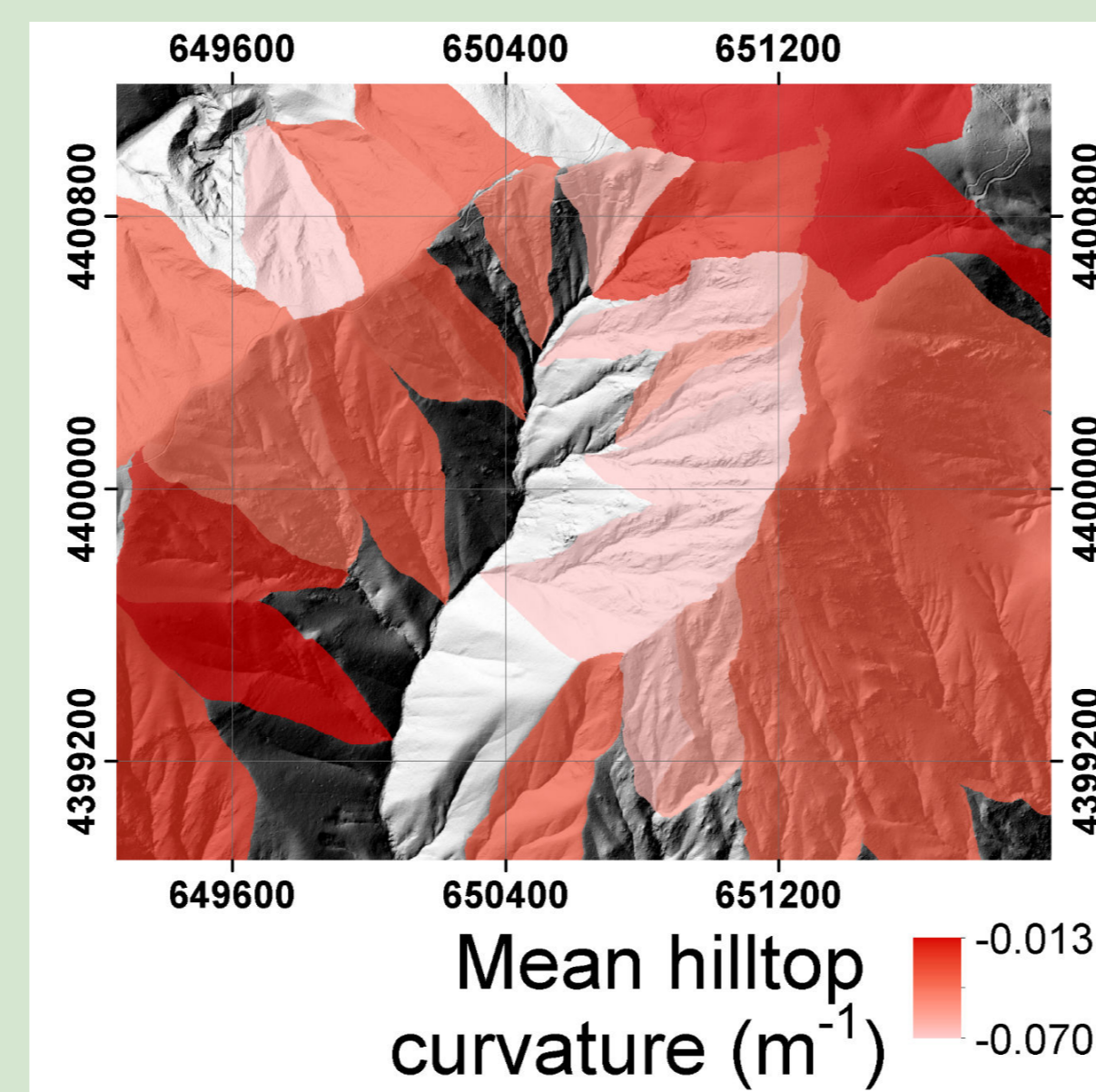
Basin analysis

Mean hilltop curvature (m^{-1})
-0.013
-0.070

Figure 3a: Basin average hilltop curvature.
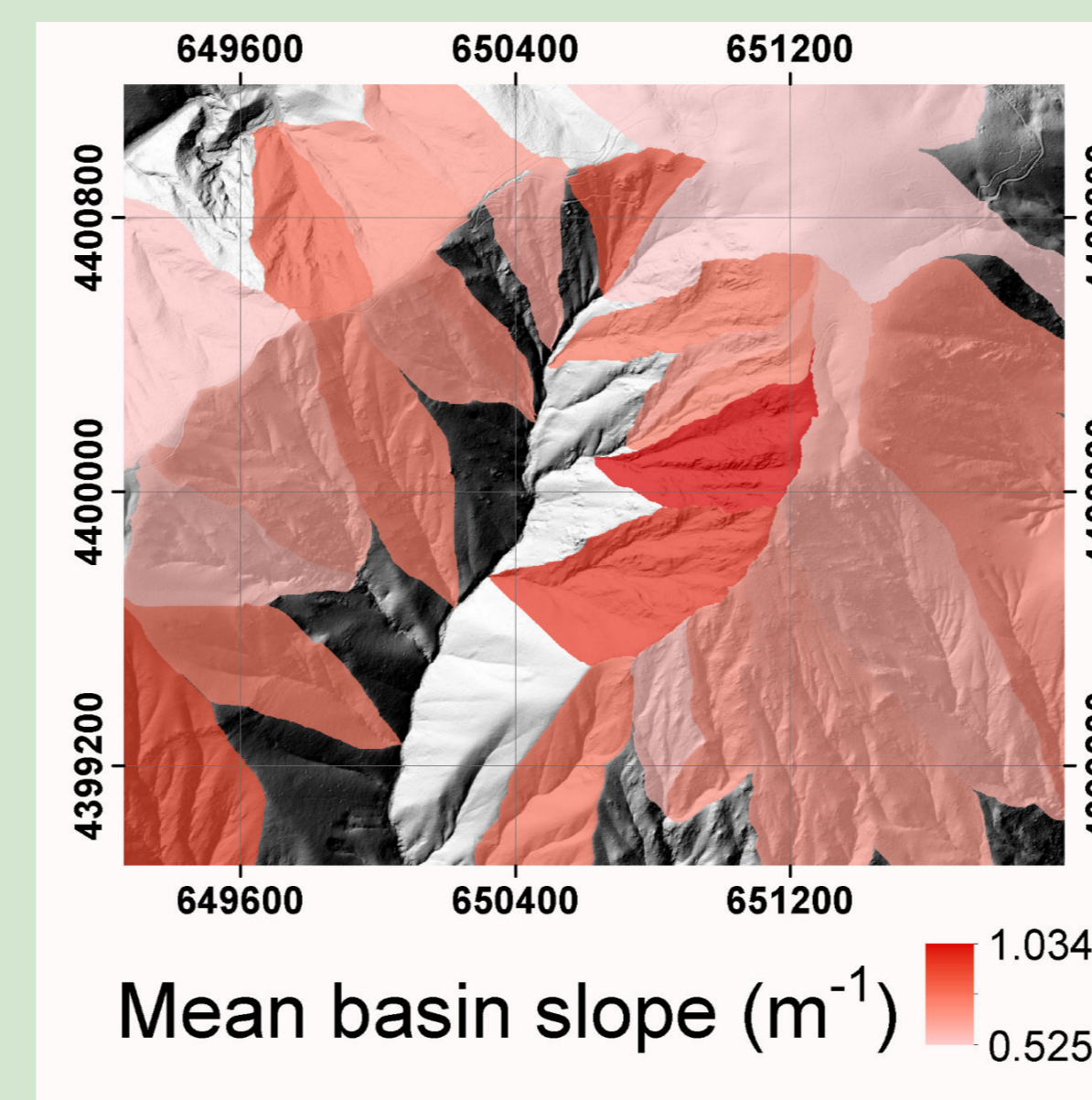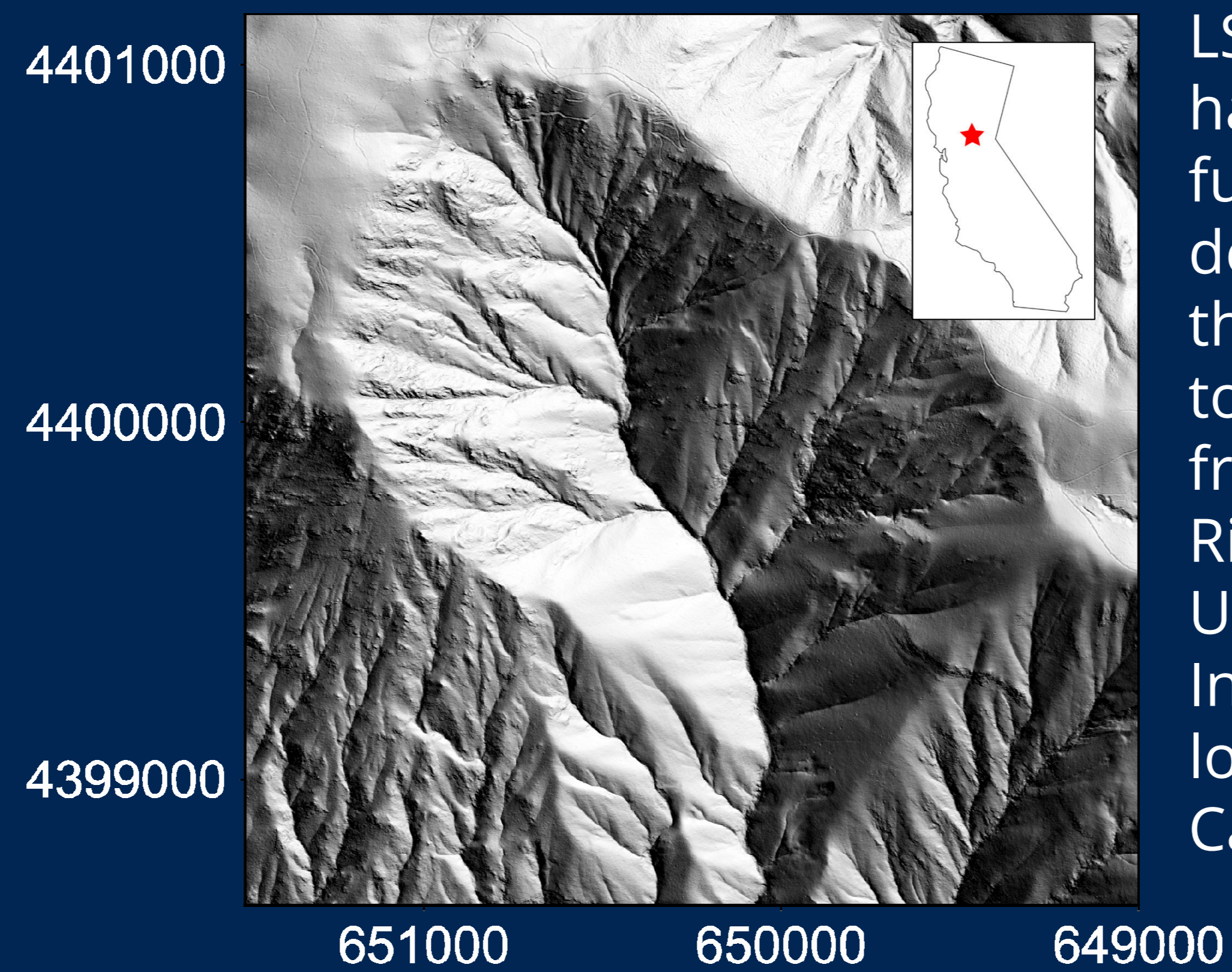
Mean basin slope (m^{-1})
1.034
0.525

Figure 3b: Basin average slope.

Example landscape: Feather River

LSDTopoTools has hundreds of functions. We demonstrate these using topographic data from the Feather River, California, UTM Zone 10N. Inset map shows location of site in California.

Get the software

LSDTopoTools is under continuous development. For tutorials, documentation and to get the latest versions, visit:

lsdtopotools.github.io
github.com/LSDtopotools
csdms.colorado.edu

Get in touch with us:
🐦 LSDTopoToolBox
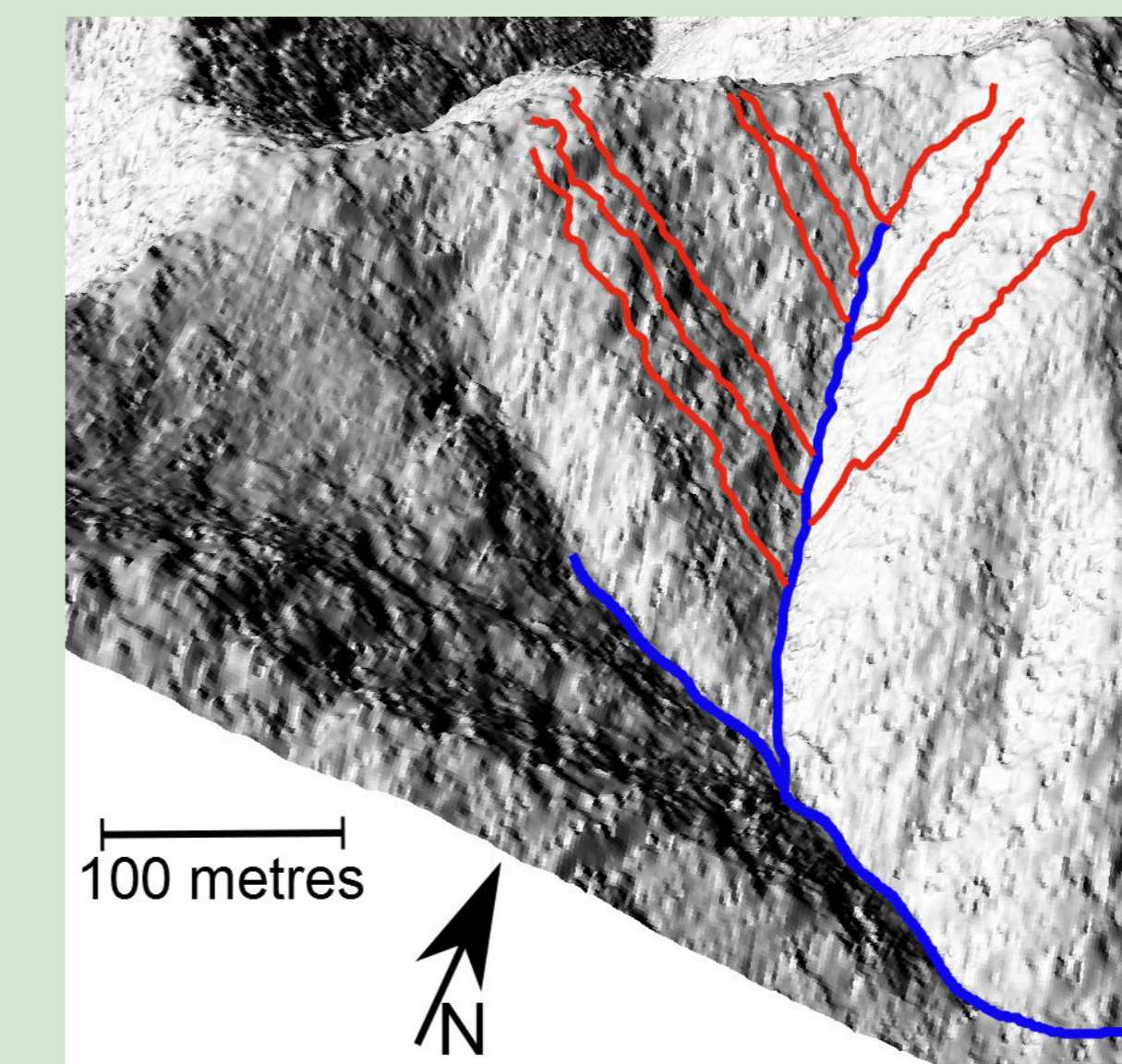✉ simon.m.mudd@ed.ac.uk

Hilltop flow routing

100 metres
N

Figure 4a: Schematic example of hilltops coupled to channels.

Individual hillslope traces
Count
60000
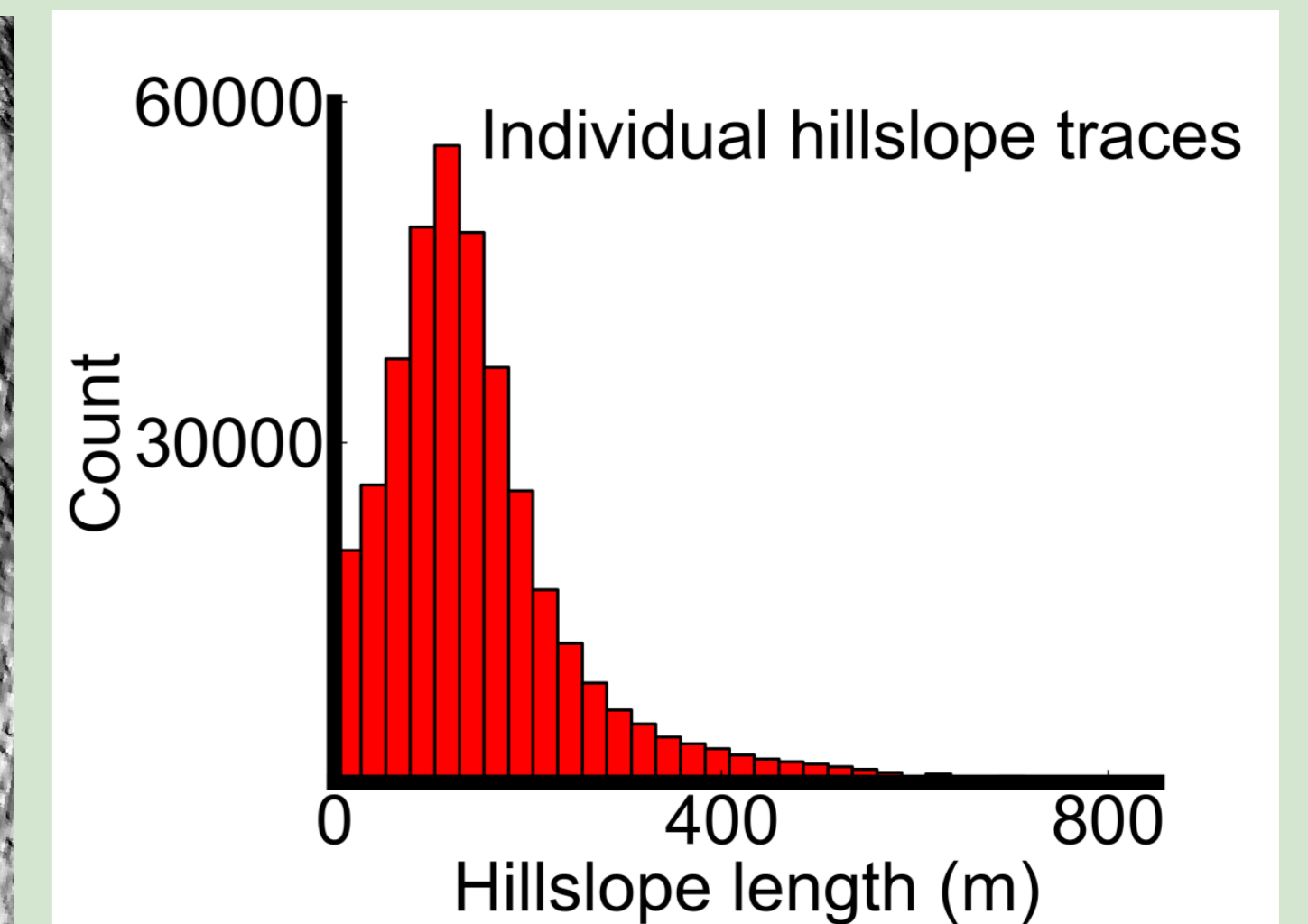30000
0   400   800
Hillslope length (m)

Figure 4b: Histogram of hillslope length measurements.

LSDTopoTools can connect hilltops to the channel network using the hilltop flow routing algorithm (Grieve et al., in review). It operates by modelling the flow of material across the surface of hillslopes. This allows the spatial variation in hillslope length and relief to be mapped.

Grieve SWD, Mudd SM, Hurst MD. In review. How long is a hillslope? Earth Surface Processes and Landforms
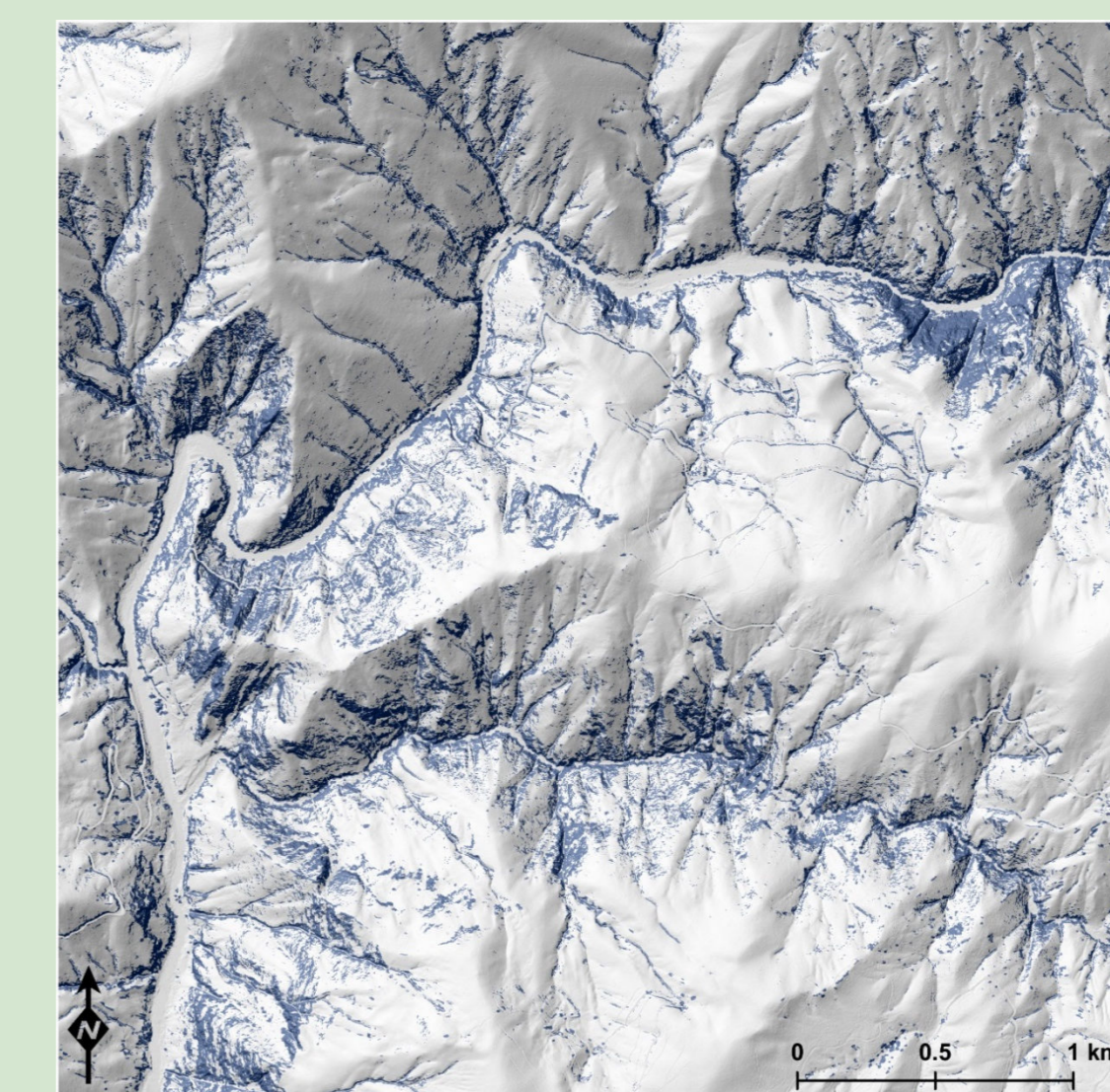
Mapping Rock Exposure

Figure 5a: Bedrock exposure

Rock Exposure (%)
100
80
60
40
20
0
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18
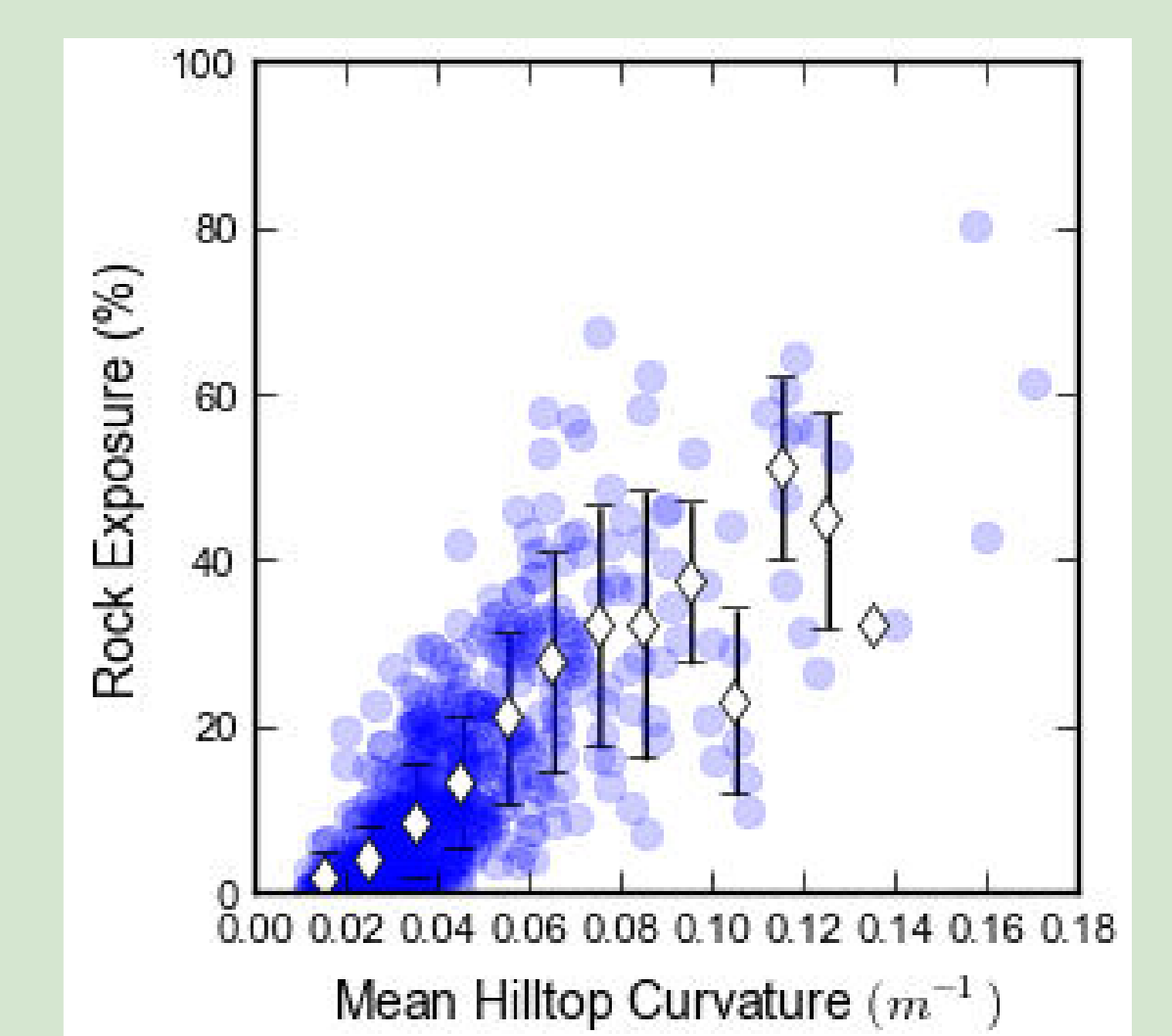Mean Hilltop Curvature (m^{-1})

Figure 5b: Relationship between hilltop curvature and rock exposure

Rock exposure can be distinguished from soil mantled hillslopes due to the small wavelength roughness of the topographic surface. This can be incorporated with other functions in LSDTopoTools to explore how hillslope bedrock exposure varies with other geomorphic characteristics, such as erosion rate.

Milodowski, DT, Mudd SM, Mitchard ETA, 2015, Topographic roughness as a signature of the emergence of bedrock in eroding landscapes, Earth Surface Dynamics Discussions, *3*(2), 371–416.