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Effect of temperature on post-earthquake landsliding near the epicentre of the 2008 Wenchuan earthquake

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Geostatistical models of landslide susceptibility do not usually account for thermal data, although these data are widely available, and experiments demonstrate that temperature does influence the mechanical and hydraulic behaviours of soils and rocks via a variety of thermo-hydro-mechanically coupled processes.

We took the epicentral region of the 2008 Wenchuan earthquake in China as our study area, for which a rich multi-temporal inventory of landslides is available. We built a landslide susceptibility model using a generalised additive model with a slope-unit partitioning of the area (~500 km^2, comprising 42 sub-catchments), and a minimal set of covariates, including the map of peak ground acceleration of the mainshock and Landsat 7 land surface temperature (LST) data retrieved from Google Earth Engine.

We demonstrated that the LST relates to the decay of post-earthquake landslide activity, and in particular that warmer slopes seems to be comparatively more affected by prolonged landsliding. We also verified that LST data provided different insight from that offered by the normalised difference vegetation index (NDVI), by running our model with NDVI maps instead of LST maps. The two input maps showed little collinearity, and the variable effects of the NDVI in the model output showed less complexity compared to those of the LST. This hints at the presence of thermo-mechanical effects in slopes in addition to the known hydrological effects, the latter being associated with changes in evapotranspiration and thus in principle capturable by the NDVI.

Even though studies in other regions, seismic and non-seismic, are necessary, we suggest that thermal data should be used in landslide susceptibility modelling more systematically because they could potentially improve the model results and suggest physically-based relationships influencing slope stability.