Impacts of future land cover and climate changes on landslide susceptibility. Results obtained from regional-scale modelling in the Pyrenees.

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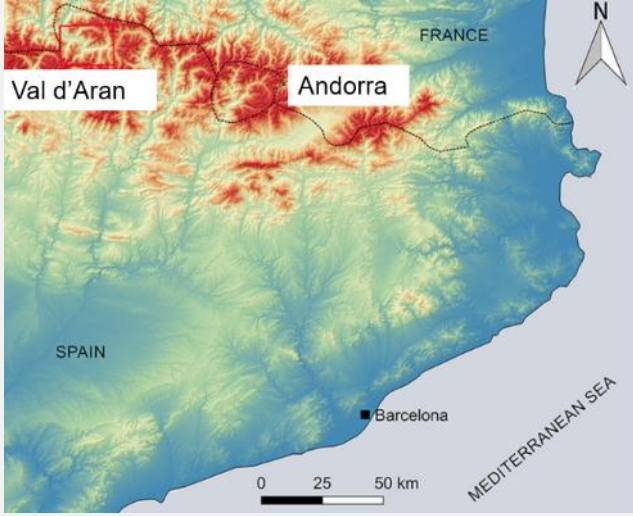
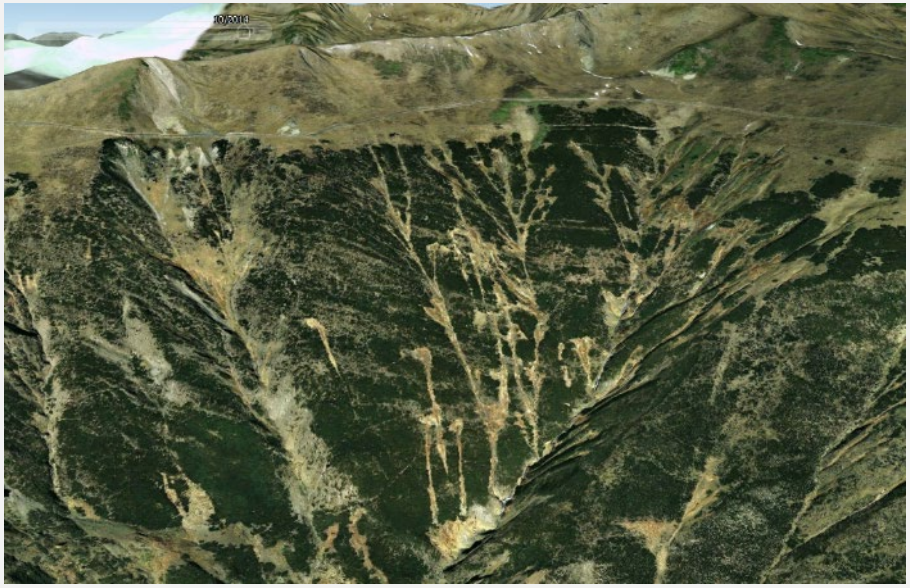
ICGC 2013

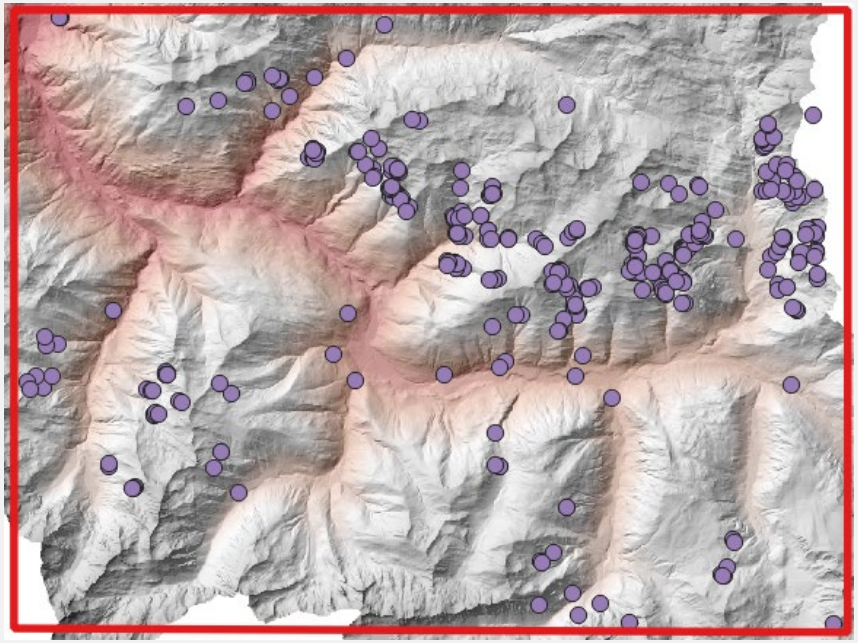
Study areas and landslide inventories



Val d'Aran:

Val d'Aran: ~340 km2
Related to the 2013 rainstorm (+ important snowmelt)
The inventory includes 393 landslides.
Most common types: small shallow slides, large slope failures and hill-slope debris flows

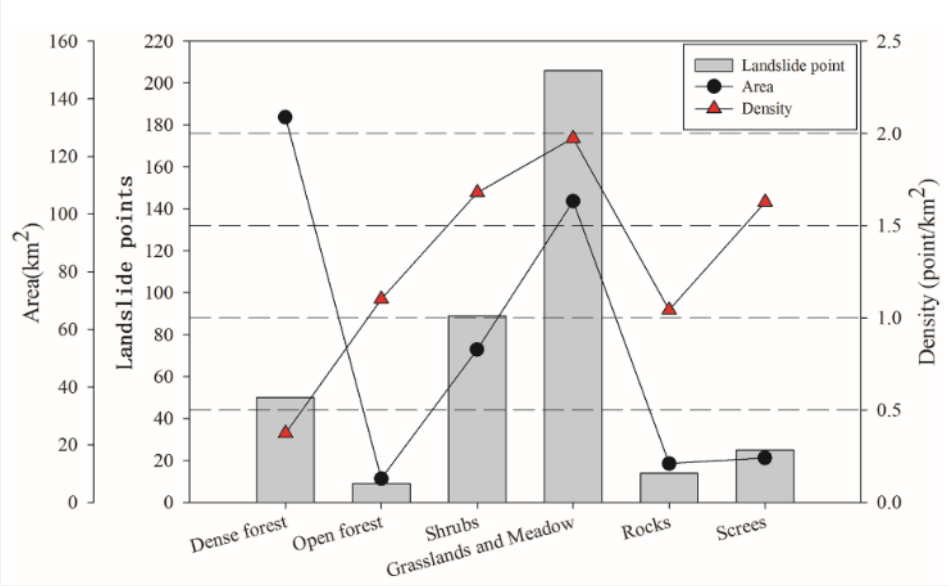


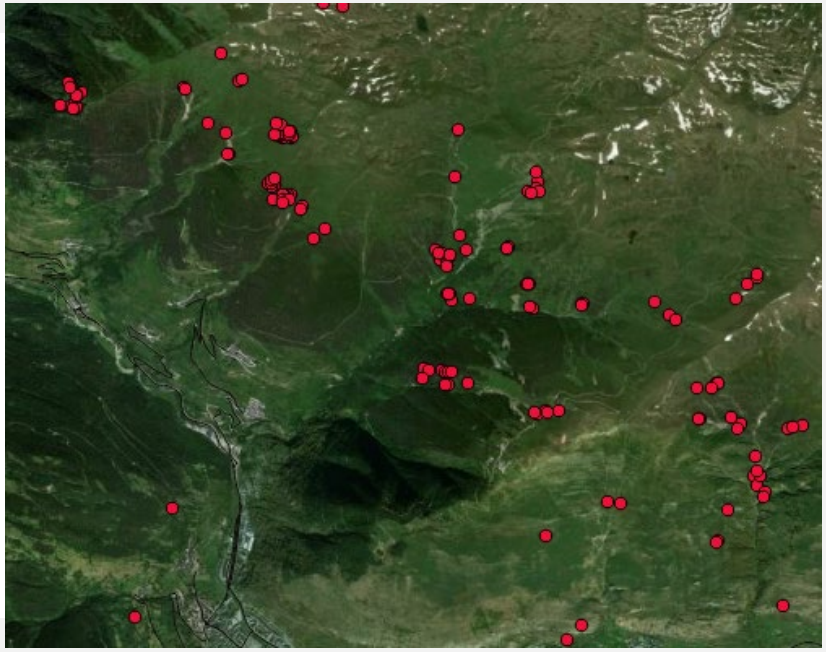


Study areas and landslide inventories

Val d'Aran:

Important effect of Land Use and Land Cover (LULC) on landslide density





Left figure adapted from: *Shu et al. (2019) - doi.org/10.1016/j.scitotenv.2019.07.363*

Study areas and landslide inventories

Andorra:

Andorra: ~470 km2
Inventory of 164 historic and recent shallow slides and debris flows

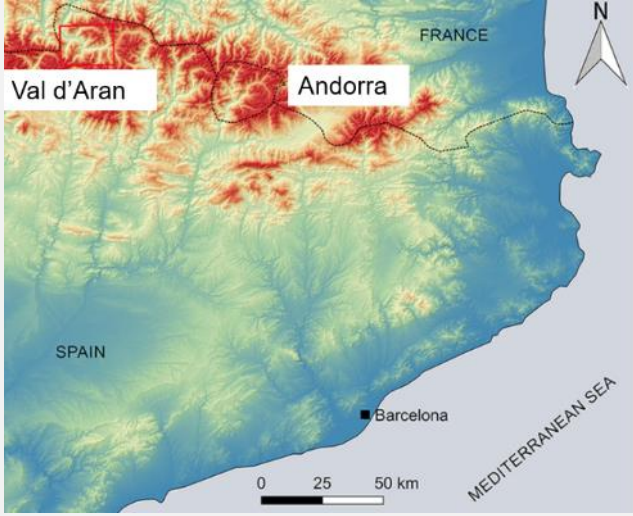
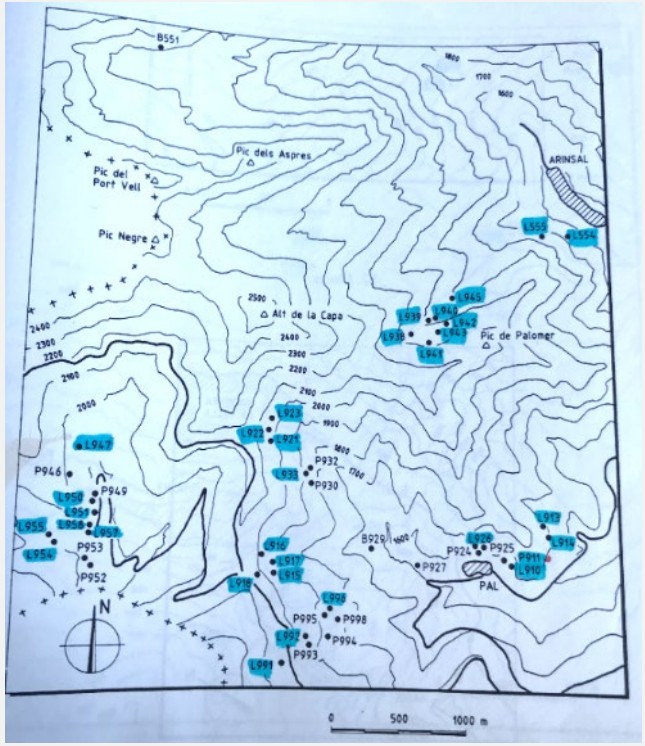


Photo: Jordi Corominas



Baeza (1994) PhD

Physically-based landslide susceptibility model

Newly developed model:

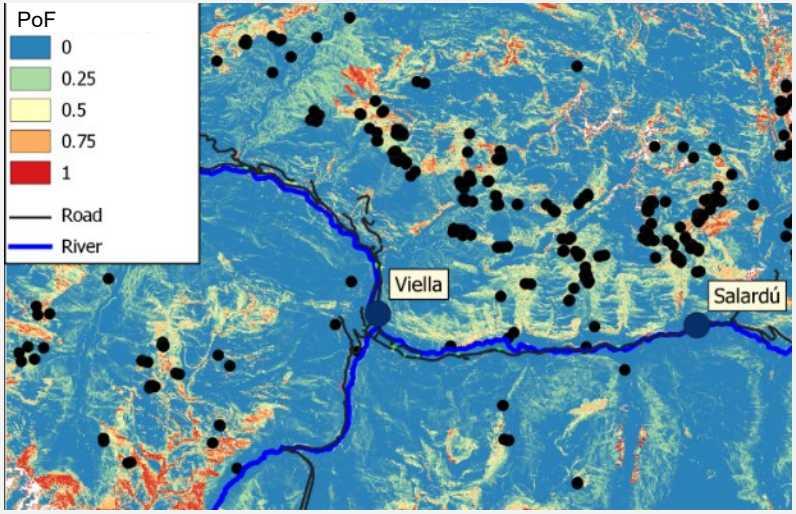
"Fast shallow landslide assessment model" (FSLAM)

Based on infinite slope theory, two hydrologic approaches and stochastic input of cohesion and friction angle:

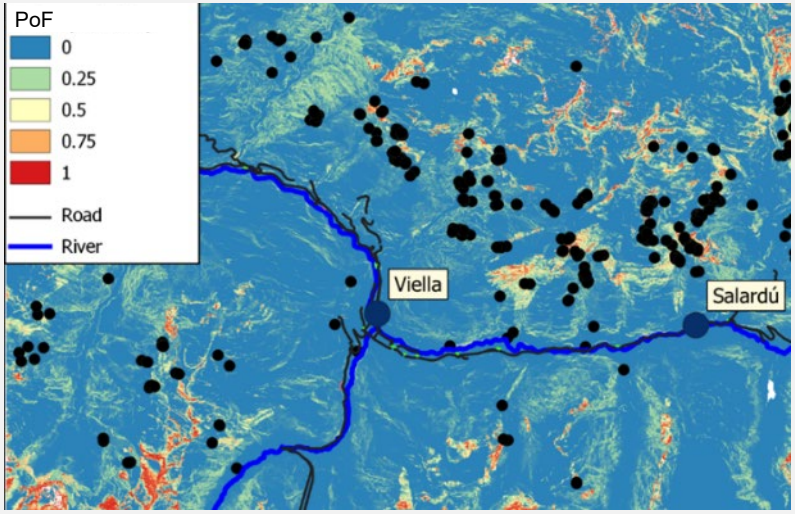
$$FS = \frac{C}{g\rho_s z \cos\theta \sin\theta} + \left(1 - \left(\left(\frac{a}{b}\right)\frac{q_a}{K_h z \sin\theta \cos\theta} + \frac{q_e}{n \cdot z}\right)\left(\frac{\rho_w}{\rho_s}\right)\right)\left(\frac{\tan\varphi}{\tan\theta}\right)$$

Preliminary results

Computed landslide susceptibility of the Val d'Aran study area for present (left) and future (right) conditions.



Probability of failure (PoF) in each cell for the 2013 landslide episode.



Prediction of future probability of failure (PoF) for including LULC and climate changes

→ Increase of global stability conditions in the study area due to a larger area of forest (shrubs) and the consequent higher cohesion due to augmented root strength.

→ These preliminary results must be confirmed and the uncertainty in values of root strength must be evaluated – future analyses and simulations are necessary!!

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SmuCPhy

Slope mass-wasting under climate change