Assessment of Land Cover Map as a Proxy for Soil Type in Large-Area Rockfall Simulations

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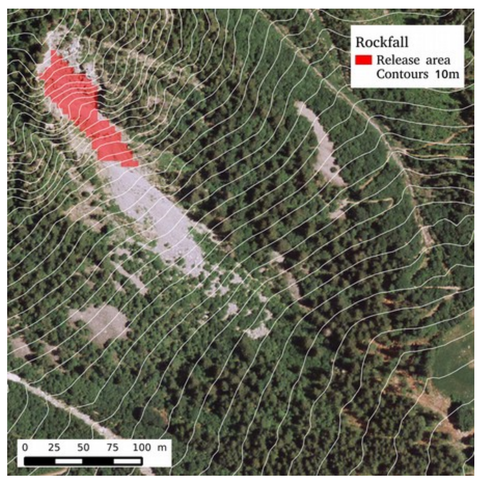
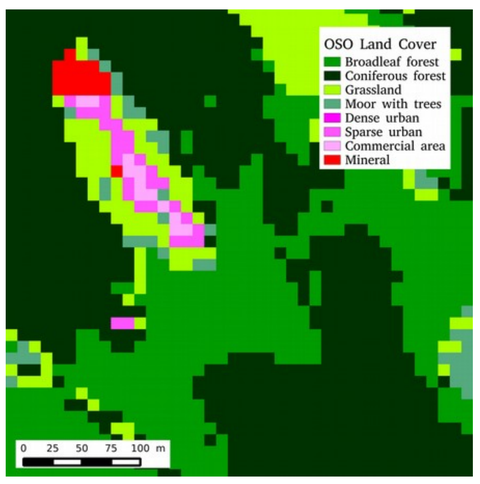
Numerical simulations and real-size experiments have supported the development of rockfall models. Remote sensing data now make it possible to implement them at operational scale. However, soil elasticity is a key parameter which remains difficult to map in large areas. This study evaluates the use of land cover map OSO as a proxy for soil type.

Study area

- 20 ha forested hillside in Chamonix Valley, France
  - Mainly spruce-dominated stands, a few broadleaf areas
  - Rockfall activity under small cliff



Orthophoto and rockfall start area



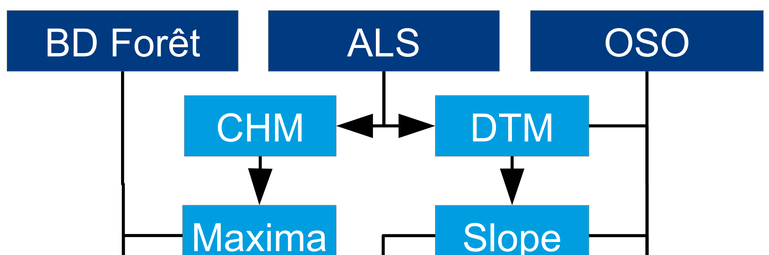
OSO Land Cover map

Material

- Field inventory (2017)
  - Soiltype and roughness: RockyFor3D[1] input parameters
- Land cover maps
  - OSO 2016 (Cesbio)[2,3]
  - BD Forêt® 2014 (IGN)
- Airborne laser scanning (ALS): 2008, 9 points/m²)

Methods

- RockyFor3D rockfall simulations on study area:
  - Cubic blocks, 0.125 m³, 2.7 t/m³
  - Soil type input
    - from field inventory
    - from OSO cover map
  - Tree positions extracted from ALS canopy height model (CHM)
  - Release areas mapped based on slope criterion



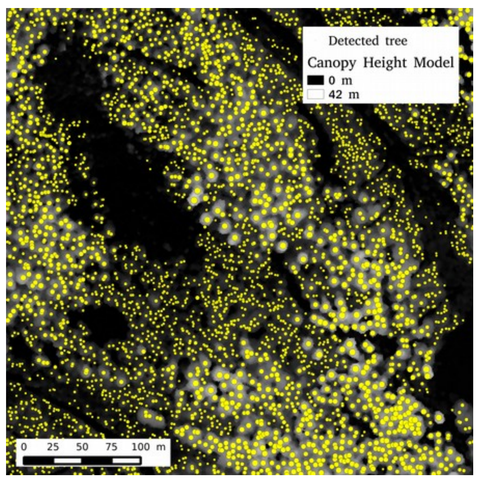
Workflow for the creation of simulation input data

OSO cover types and corresponding soil parameters

OSO type	Additional criteria	Soil category - parameters*
Water	-	Water - 0
Dense urban	-	Man-made - 0
Sparse urban / Indus. & com areas	Slope<25	
Sparse urban / Indus. & com areas	Slope>25	Mineral 6, (0.1, 0.1, 0.1)
Mineral	-	
Moor with trees	Alt>2000	
Grassland	Alt>2000 OR Slope>25	
Grassland	Alt<2000 & Slope<25	Deep soil 2, (0.05, 0.05, 0.05)
Crops / Pastures / Orchards / Vine	-	
Moor with trees	Alt<2000	
Broaadleaf / coniferous forest	-	Forest soil 4, (0.1, 0.15, 0.2)
Road	-	Road - 7

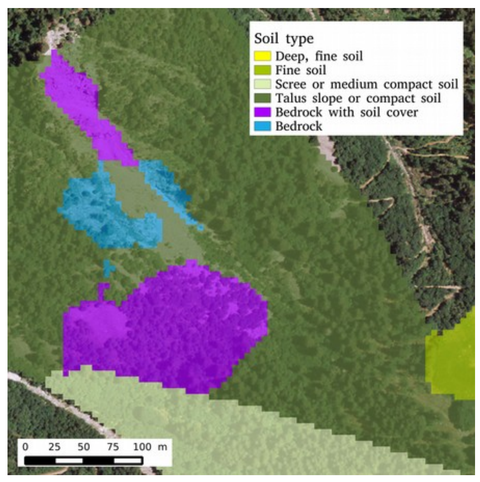
* Soil type, (Rg10, Rg20, Rg70)

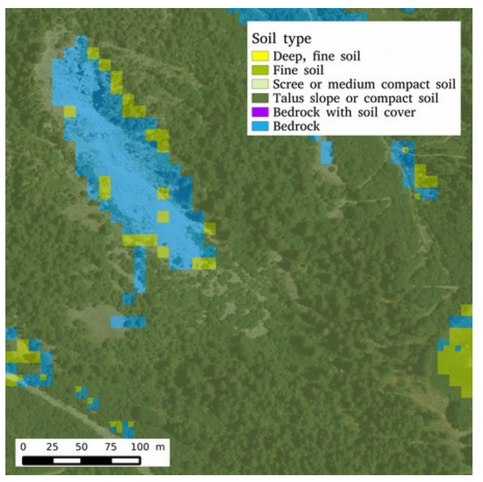
Results



Trees detected on CHM

- Runout area is globally similar but slight differences in roughness may change results locally
- Topographic criteria improve soil cover information in slope areas
- Workflow is applicable for the whole valley (~ 100 km²)

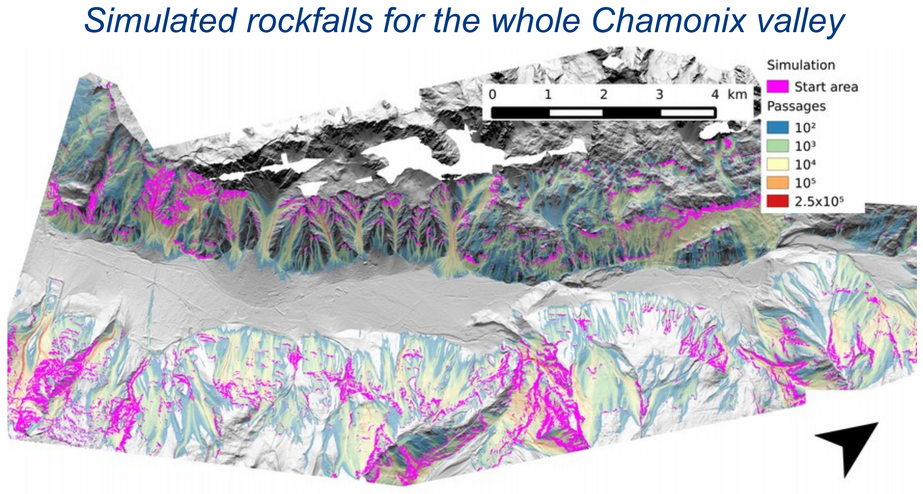




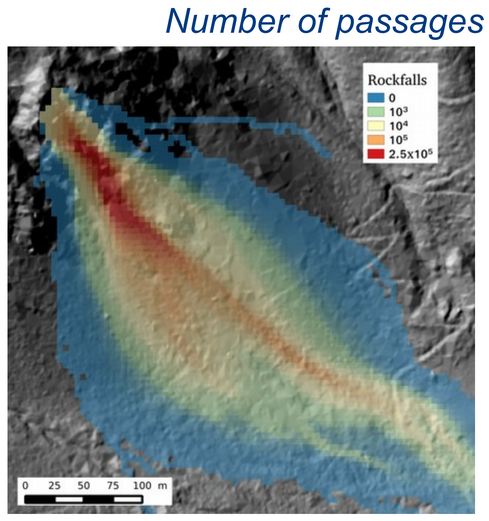
Soil type from field inventory (left) or OSO (right)

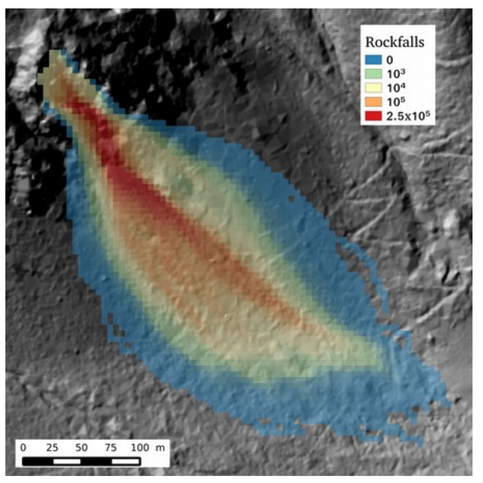
- Simulated rockfall tend to propagate along streams: soil parameters have to be modified with additional GIS information
- Valley-level information is valuable despite local approximations

Simulated rockfalls for the whole Chamonix valley



Number of passages of simulated rockfalls





Guidelines drawn from the results are expected to help experts figure out when remote sensing products can be safely used for cost-efficient estimation of input data in rockfall simulations.

Links4Soils EUROPEAN REGIONAL DEVELOPMENT FUND
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1 Dorren. 2015. Rockyfor3D (v5.2) revealed - Transparent description of the complete 3D rockfall model. ecorisQ paper (www.ecorisq.org): 32 p.
2 Inglada et al. 2017. Theia OSO Land Cover Map 2106 [Data set]. http://doi.org/10.5281/zenodo.1048161
3 Inglada et al. 2017. Operational High Resolution Land Cover Map Production at the Country Scale Using Satellite Image Time Series. Remote Sens., 9, 95. http://doi.org/10.3390/rs9010095