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In-channel landslide deposits and future debris flows

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Research background

Landslide material deposited within debris flow channels can be easily entrained by future events increasing their magnitude (Iverson et al., 1997)

Source: Hölbling, Daniel, Barbara Friedl, and Clemens Eisank. "An object-based approach for semi-automated landslide change detection and attribution of changes to landslide classes in northern Taiwan." Earth Science Informatics 8.2 (2015): 327-335.

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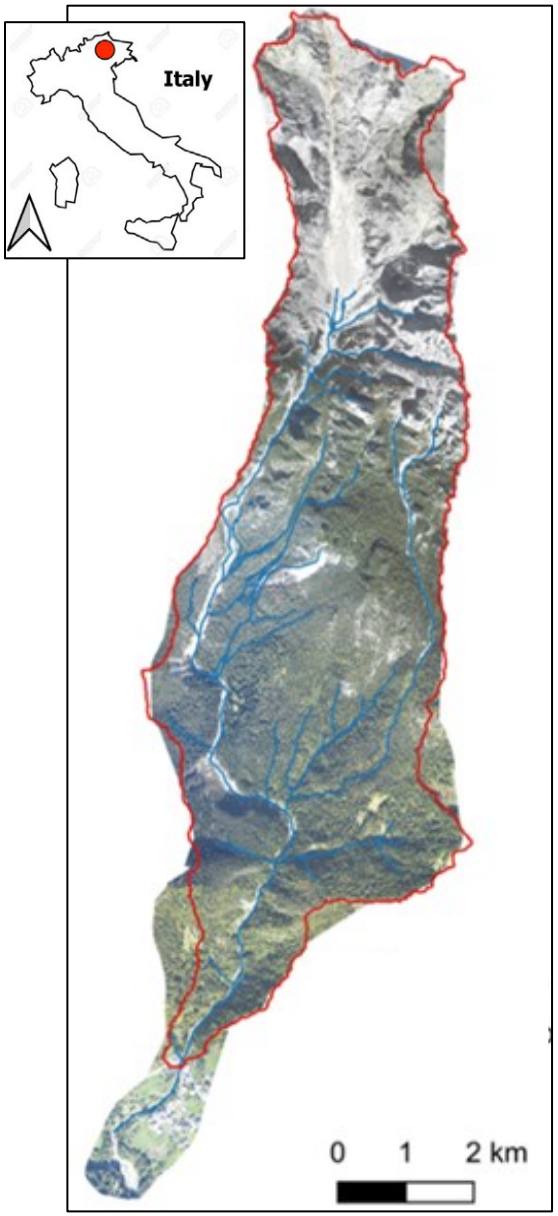
Research objective

Predict the potential impact of future debris flows in a mountain channel blocked by the deposit of a landslide.

Rio Rudan (province of Belluno)

Very active channel in terms of debris flow events

Landslide occurred on the 15th December 2020



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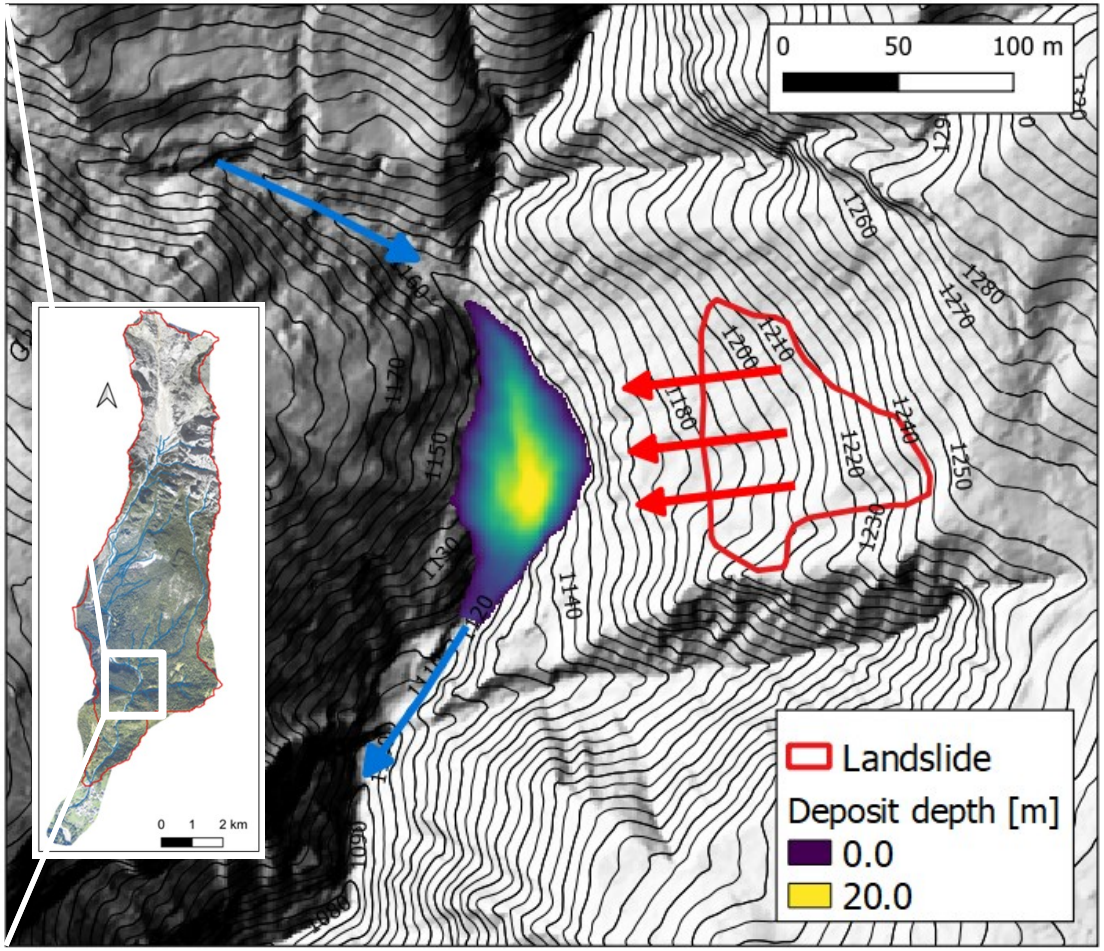
Case study



Deposited landslide material within the channel: 40 000 m^3

(Estimated through GPS measurements)

DTM updated with the deposit depths for routing simulations

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Methods

r.avaflow (version 2.4):

- **two-phase mass routing model** (Pudasaini and Mergili, 2019)
- **two-phase empirical erosion model** (Mergili et al., 2017)

$$D_{E,s} = C_E M_s + M_f \alpha_{s,Emax} \Delta t$$

$$D_{E,f} = C_E M_s + M_f (1 - \alpha_{s,Emax}) \Delta t$$

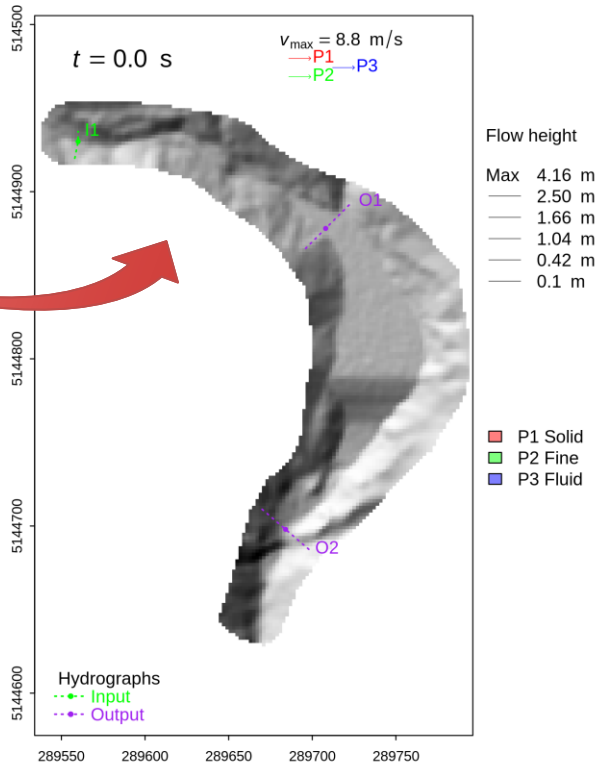
Landslide deposit erodible

Coefficient of erosion equal to 10^{-6} kg^{-1} (high value compared to Baggio et al.(2021)

Release of triangular shape hydrographs located 100 m upward the deposit:

1- debris flow hydrographs with peak discharges of: 20, 40, 60, 80 and 100 m^3 s^{-1}

2- Debris flood hydrograph 20 m^3 s^{-1}



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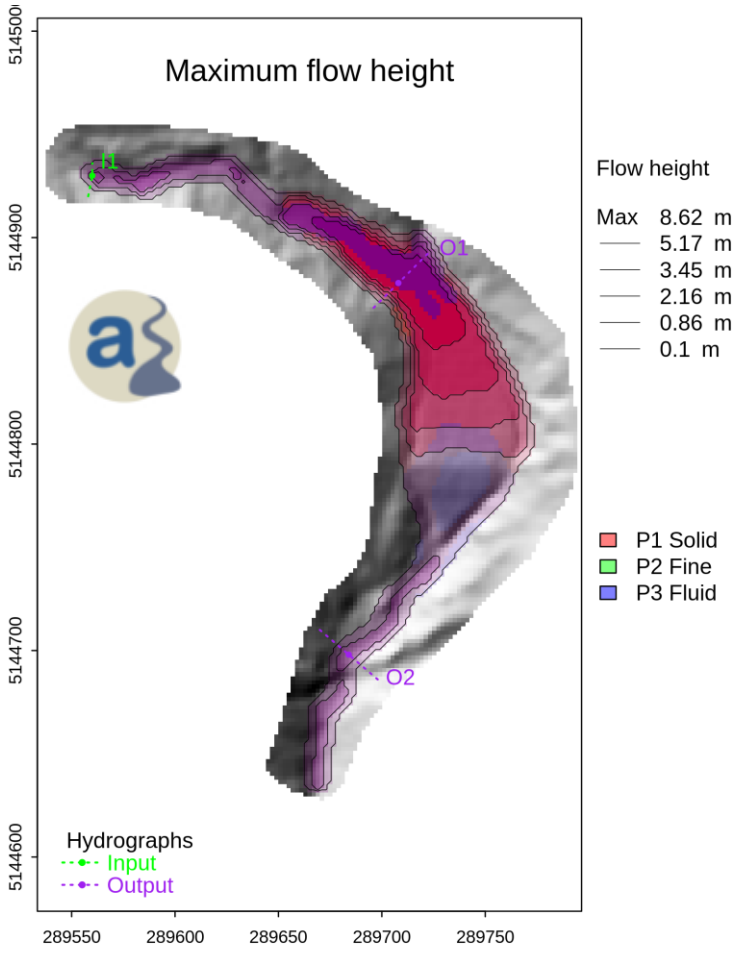
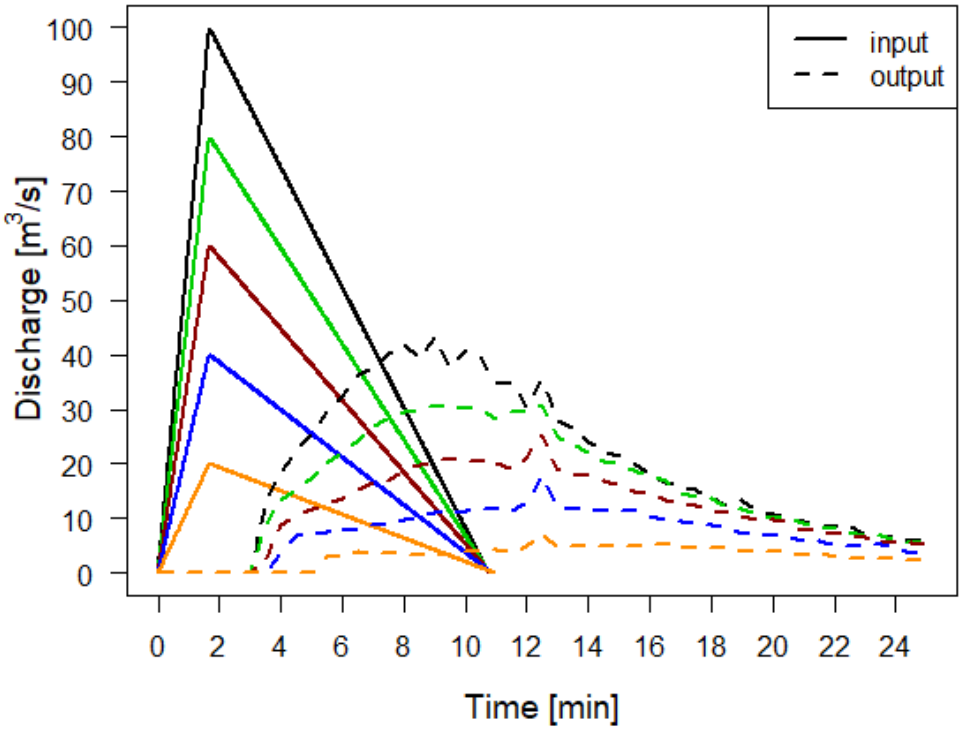
Results: debris flow hydrographs

100 m^3 s^{-1} peak discharge



Mitigation effect of the landslide deposit



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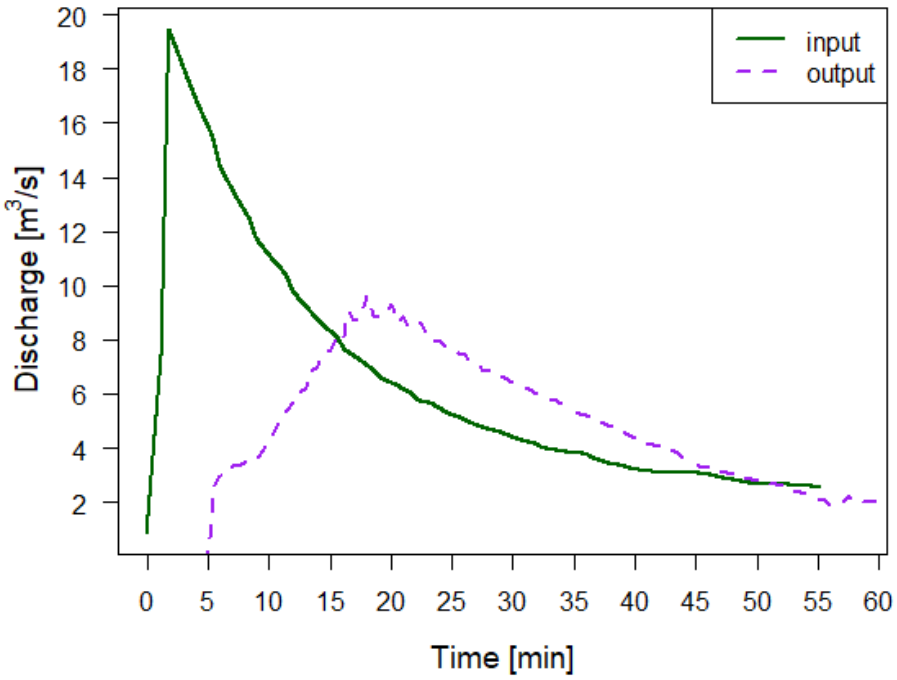
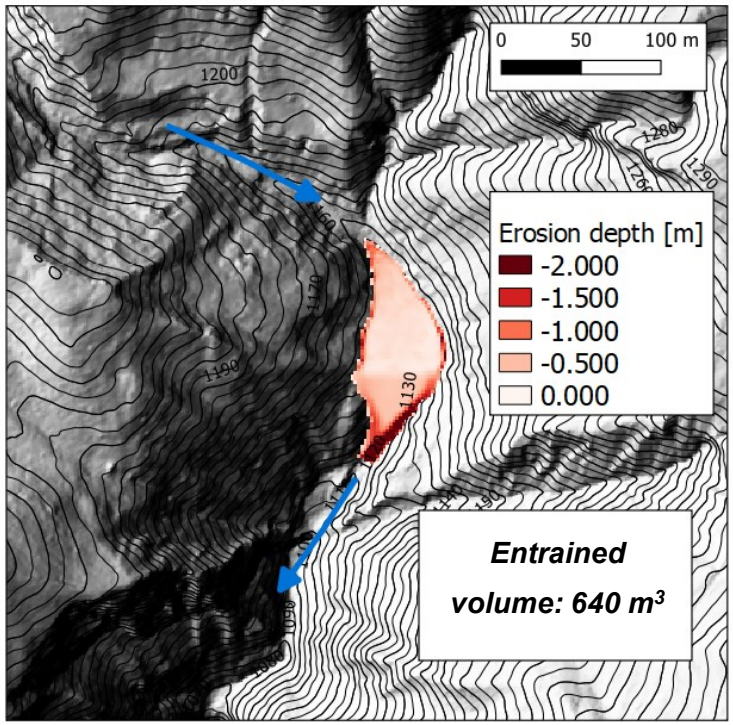
Results: debris flood hydrograph

Mitigation effect of the landslide deposit regarding the peak discharge



Increase of the total volume due to progressive erosion of the landslide deposit



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Conclusions

- ***The landslide deposit can mitigate debris flow events of important magnitude (RT 20 – 30 years).***
- ***In case of debris floods (prolonged events) probable enlargement of the solid volume.***

Accurate use of models to avoid excessive intervention costs and evaluate the residual hazard for no intervention.

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Thanks for your attention!

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