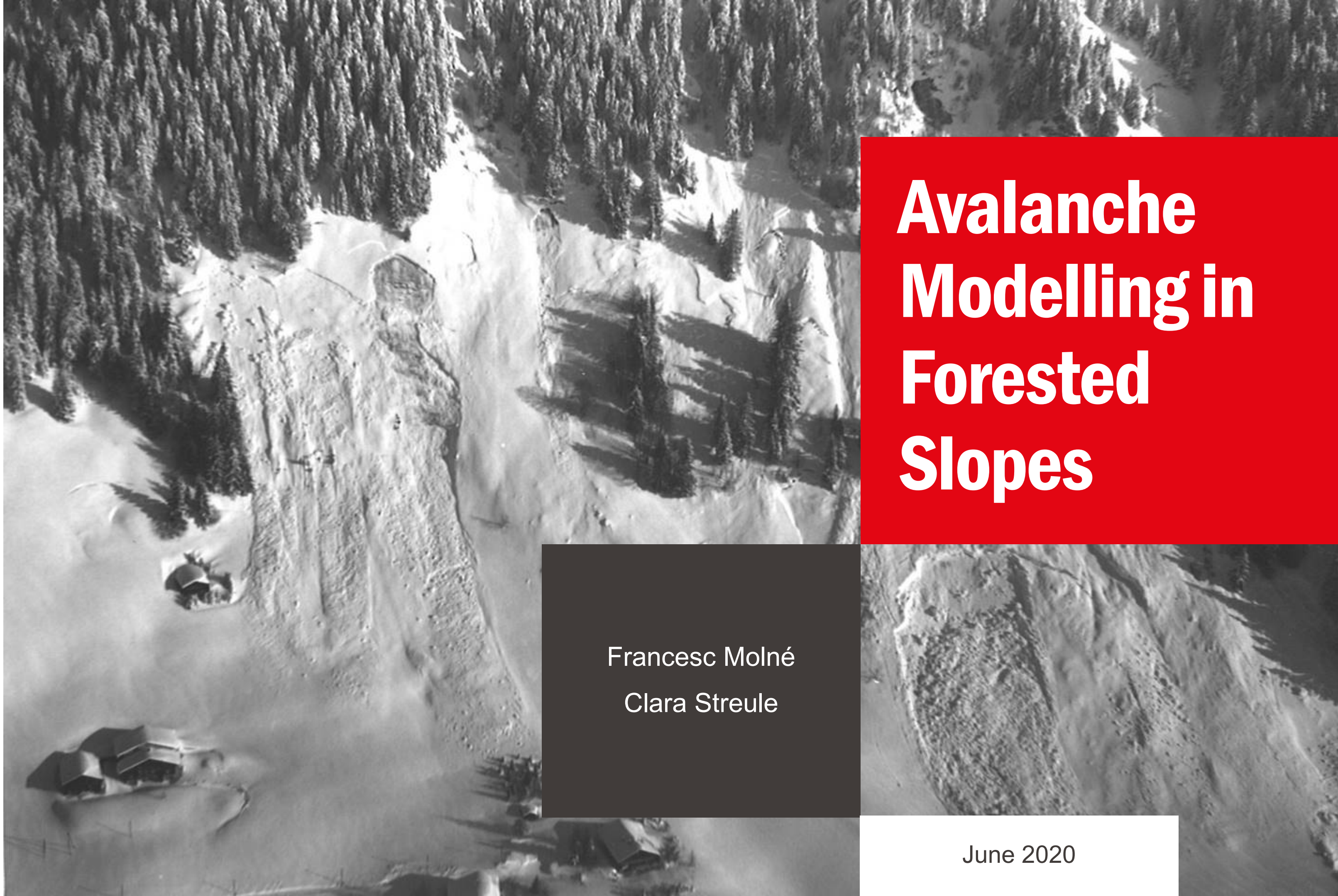
EPFL



Avalanche Modelling in Forested Slopes

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Introduction

Introduction

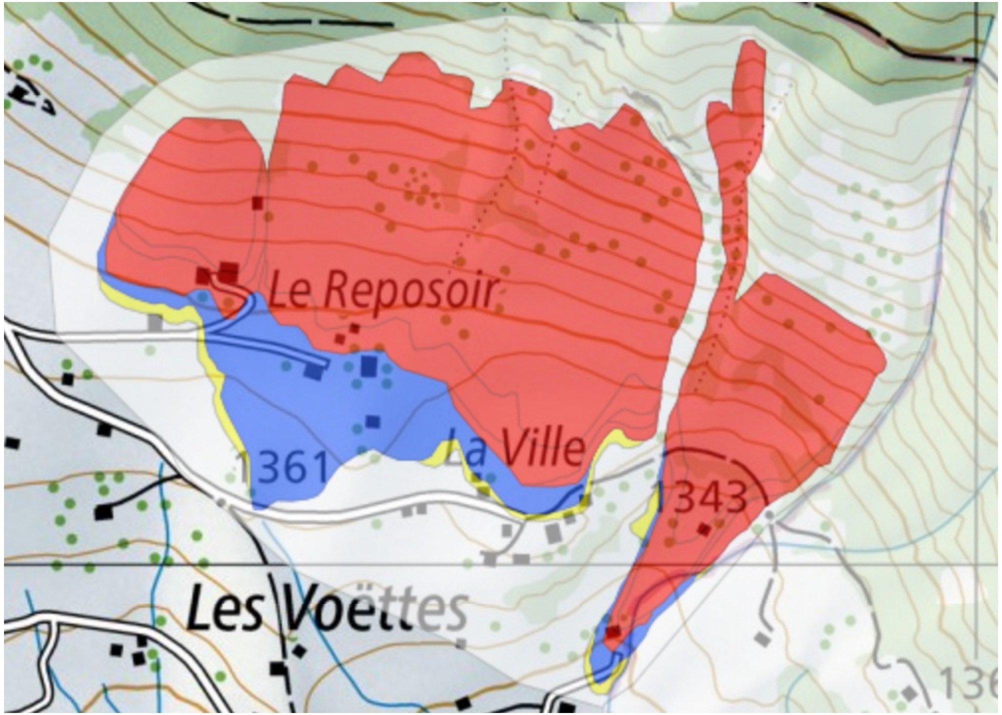
Assess the protection quality of forests in avalanche slopes

- Identify critical parameters: Experimental simulations
- Apply findings: Case Study

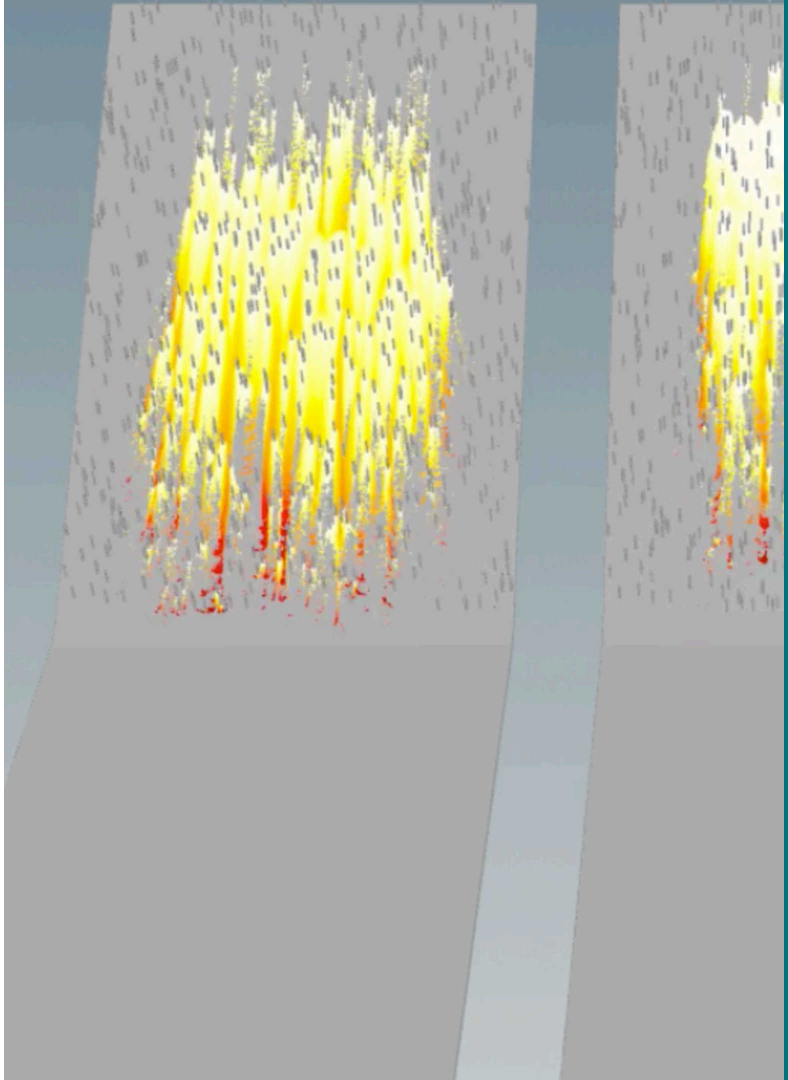
Introduction

Site location

Introduction



Avalanche hazard map



Introduction

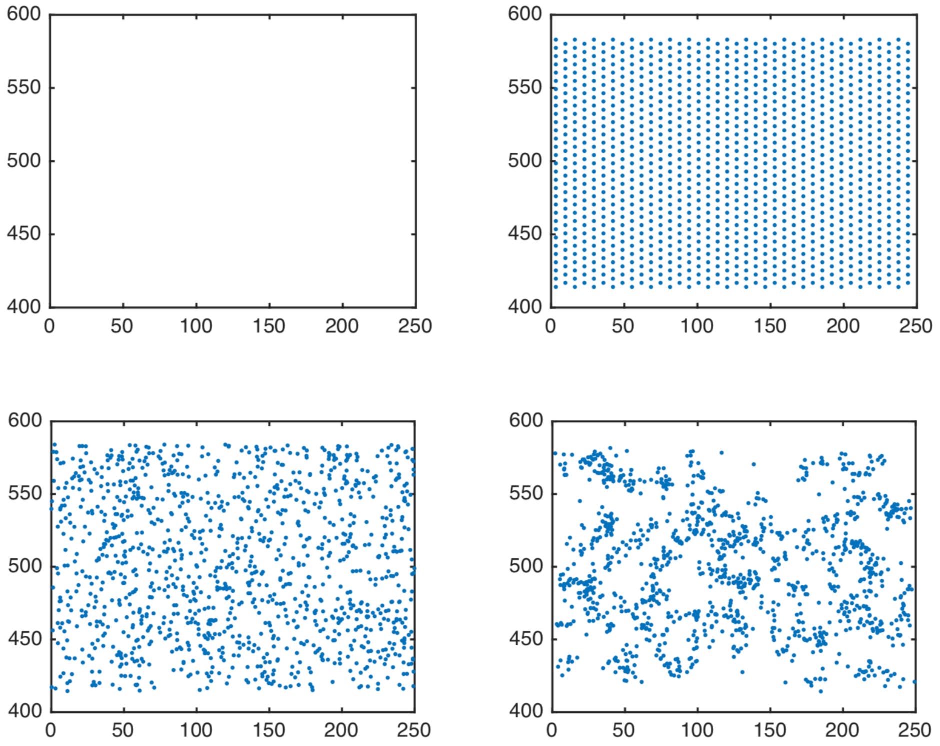
A: Experimental Simulations

B: Case Study

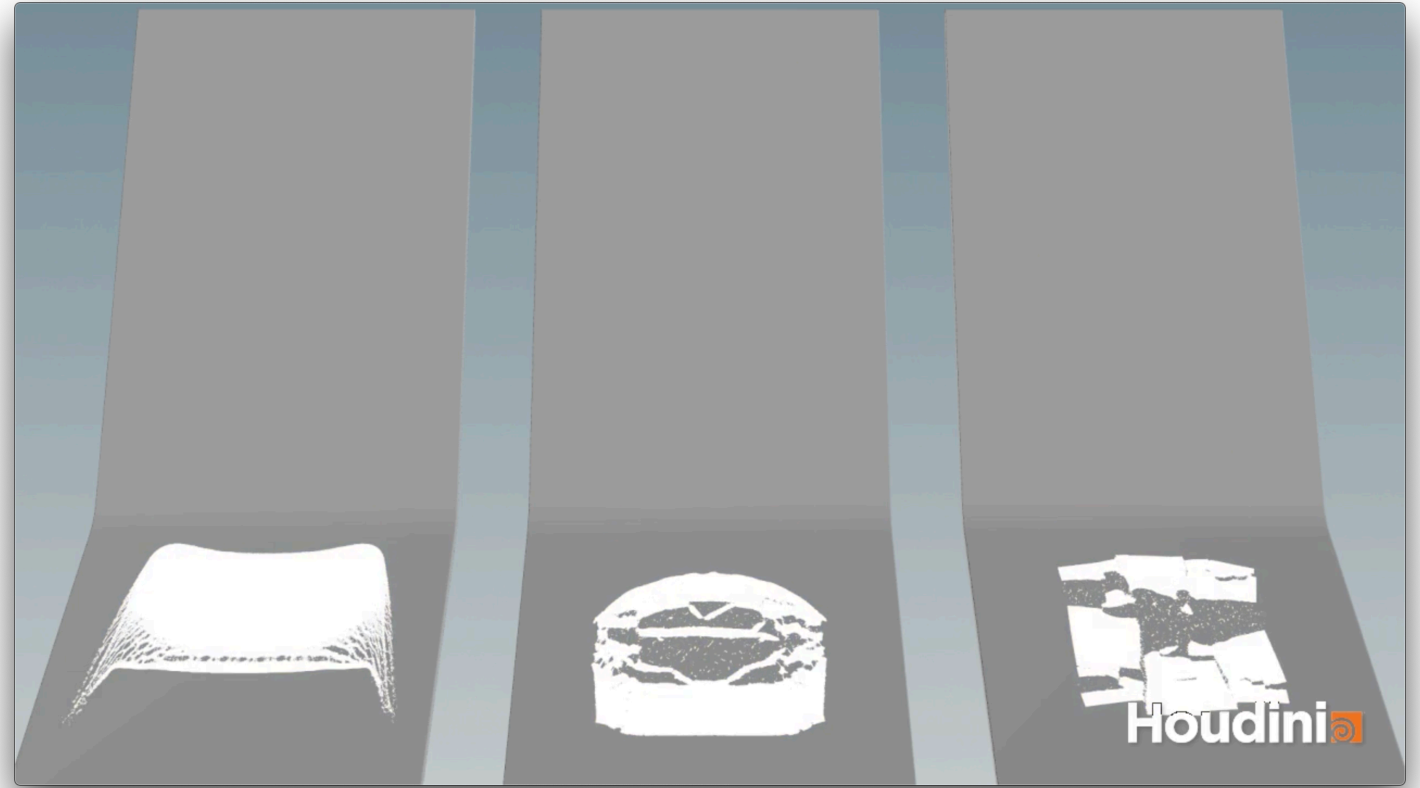
Conclusions and Outlook

A: Methods

- Material Point Method MPM
- Input Variables
  - Forest configuration:
    no forest, ordered, random, clustered.
  - Snow types:
    low density, granular, cohesive
- Response Variables
  - Runout distance
  - Front velocity
  - Percentage of non-released particles

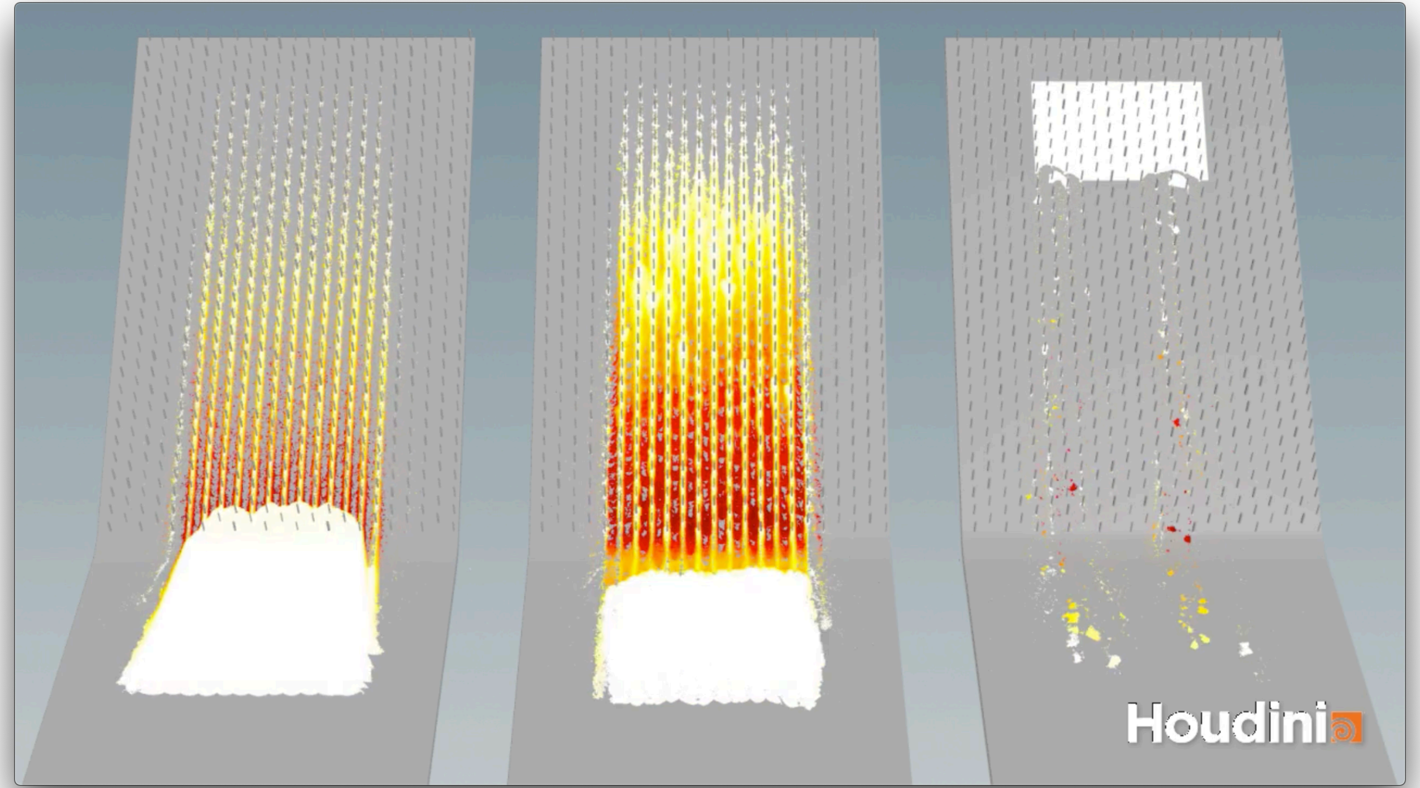


A: Results



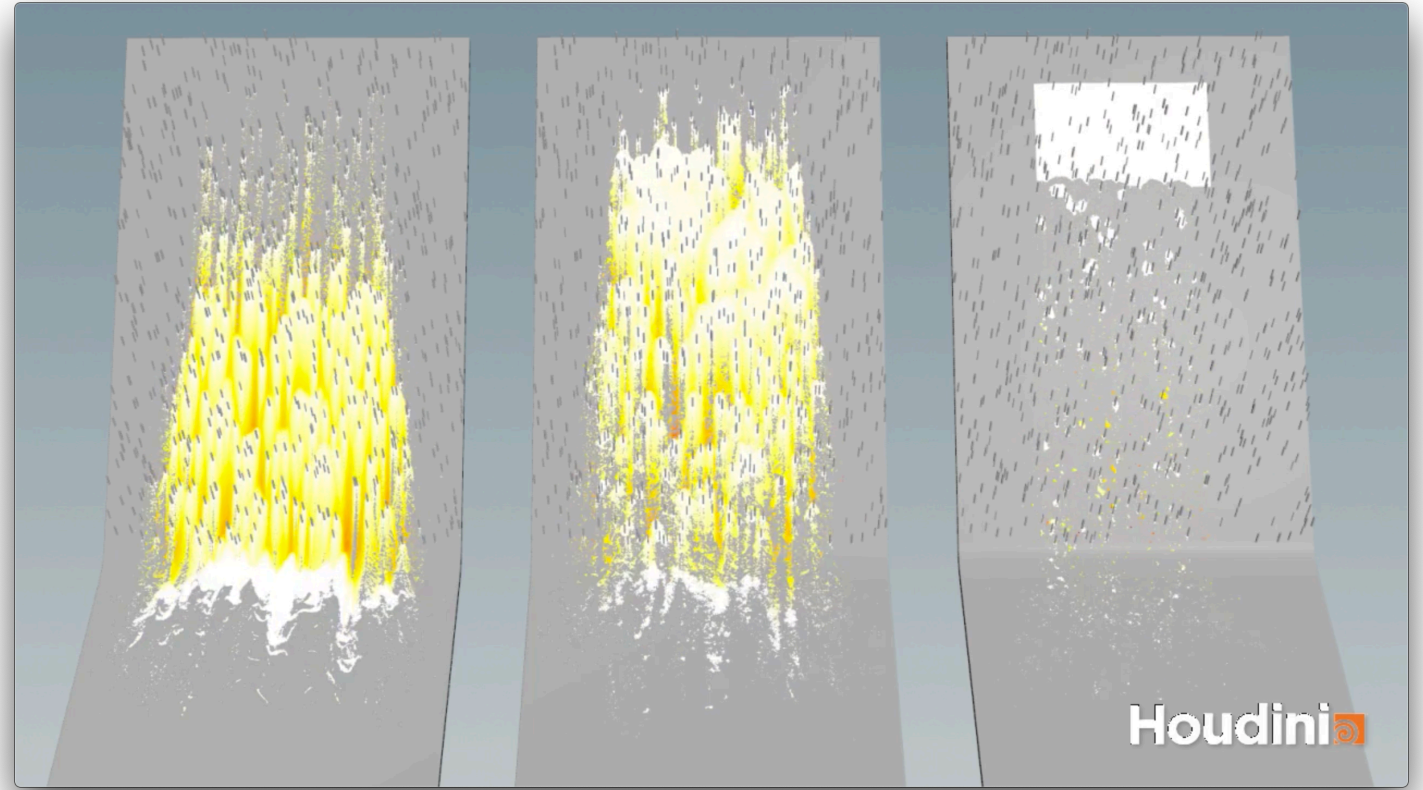
No forest (time frame 130)

A: Results



Ordered forest (time frame 130)

A: Results



Random forest (time frame 130)

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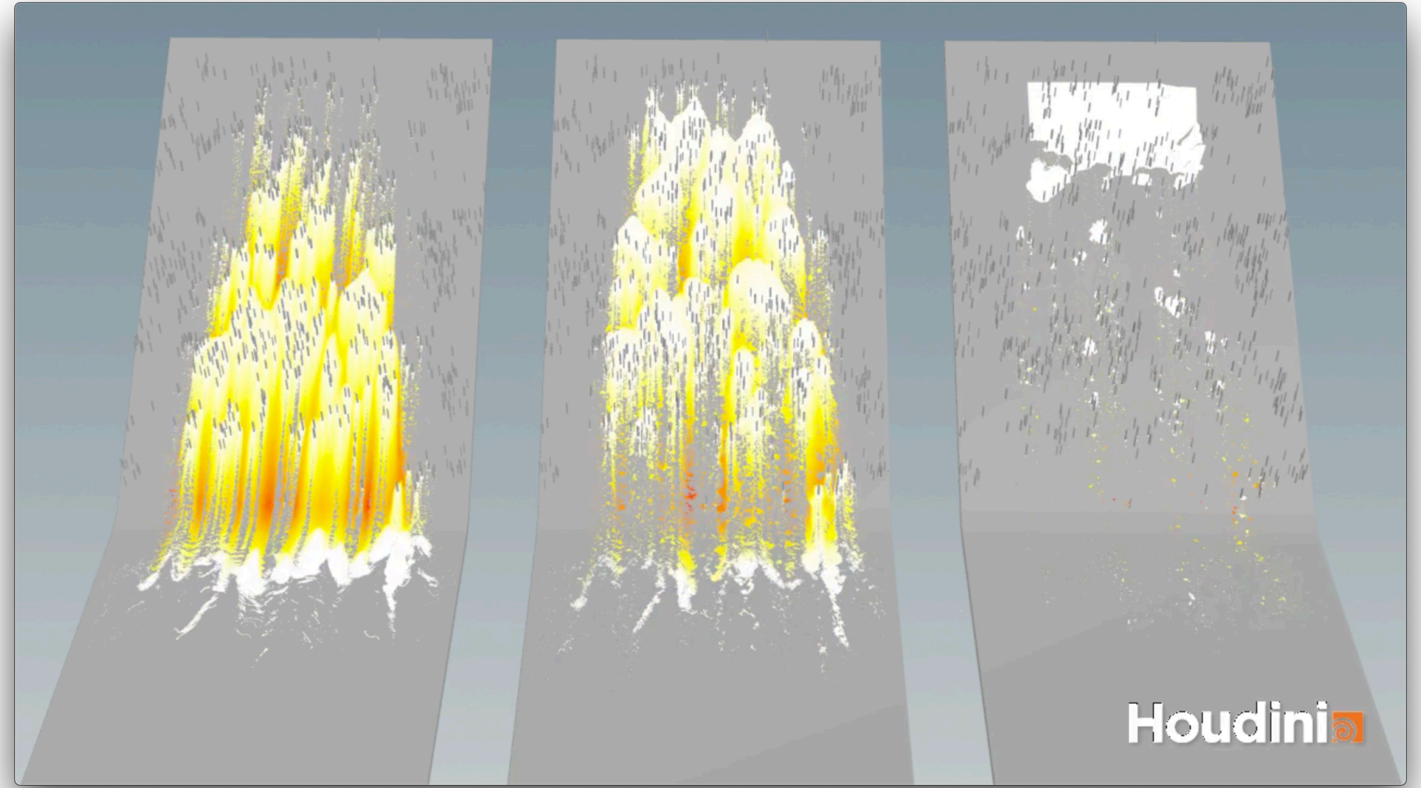
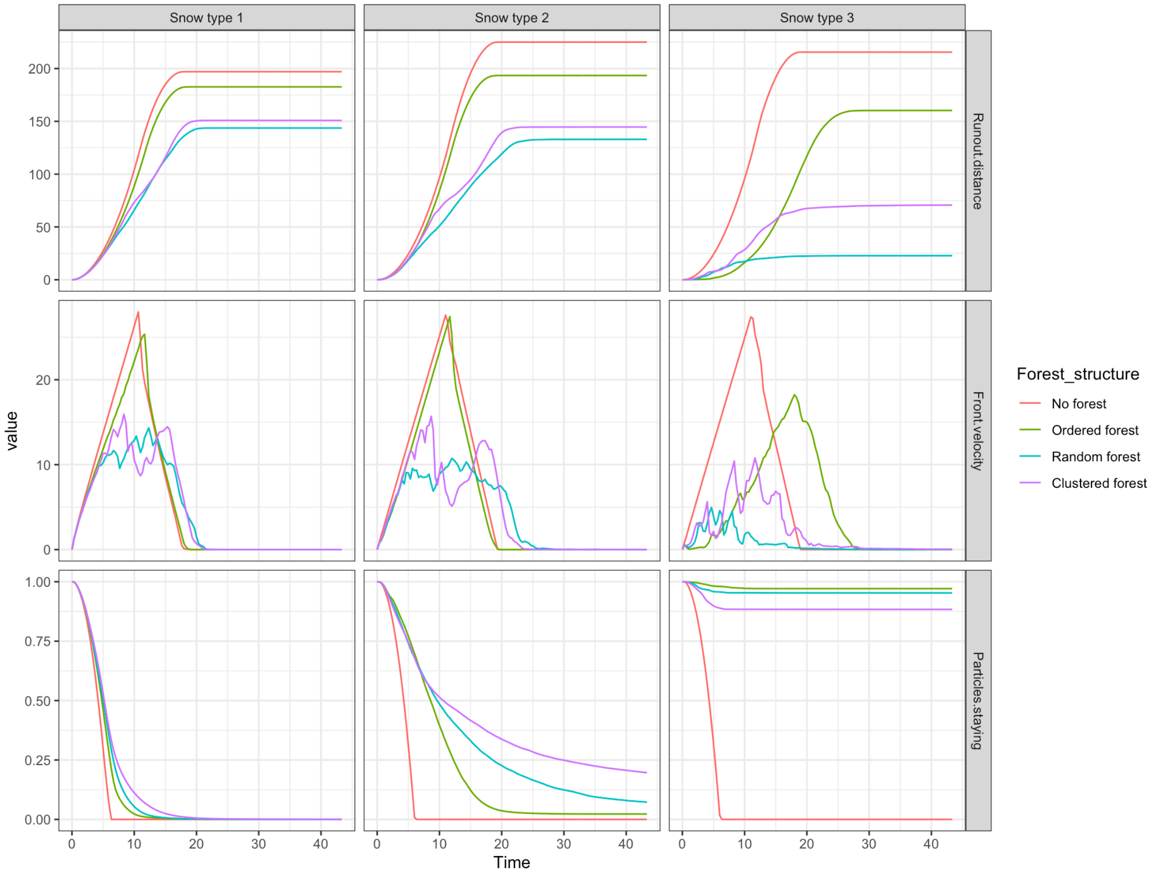
A: Results



Clustered forest (time frame 130)

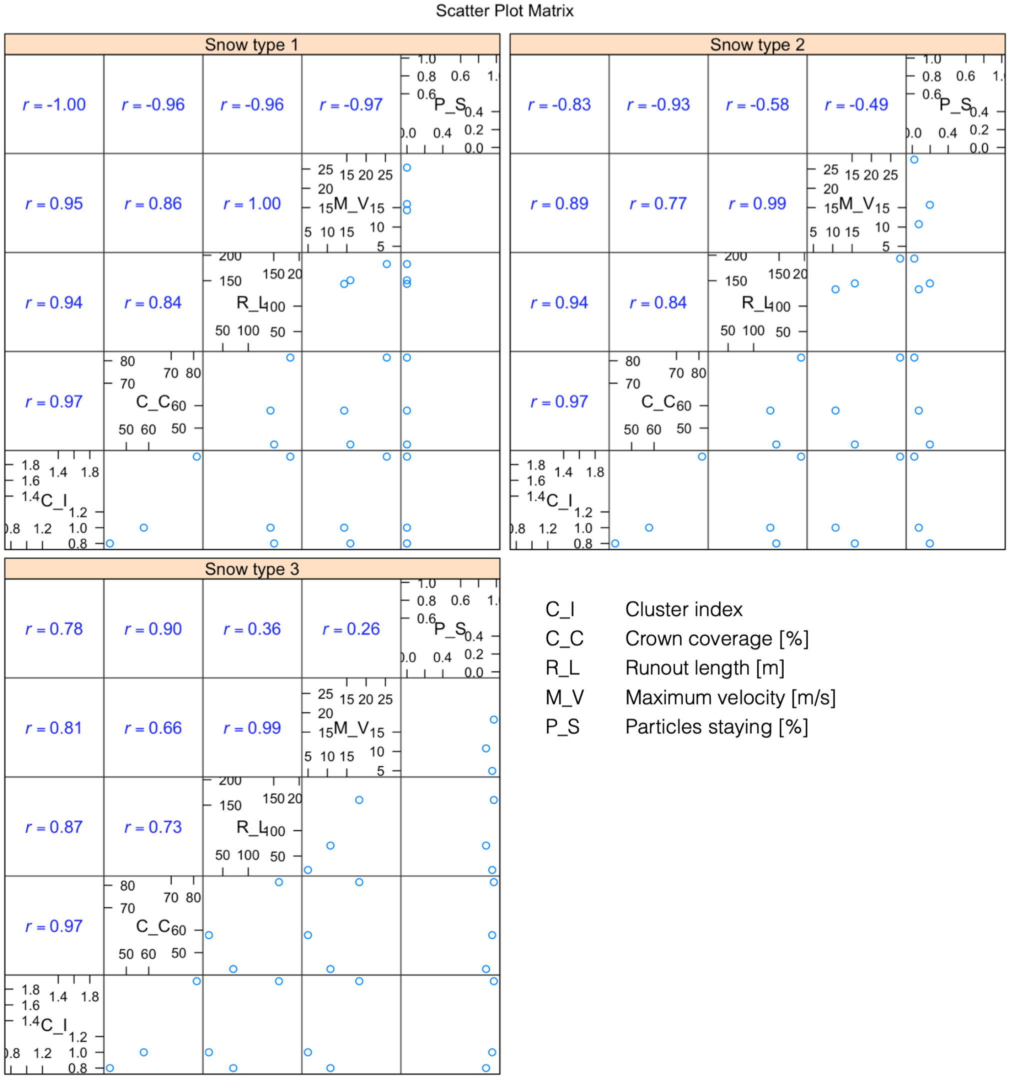
A: Results

Avalanche response variables as a function of time [s] and snow type for eachtested forest structure.



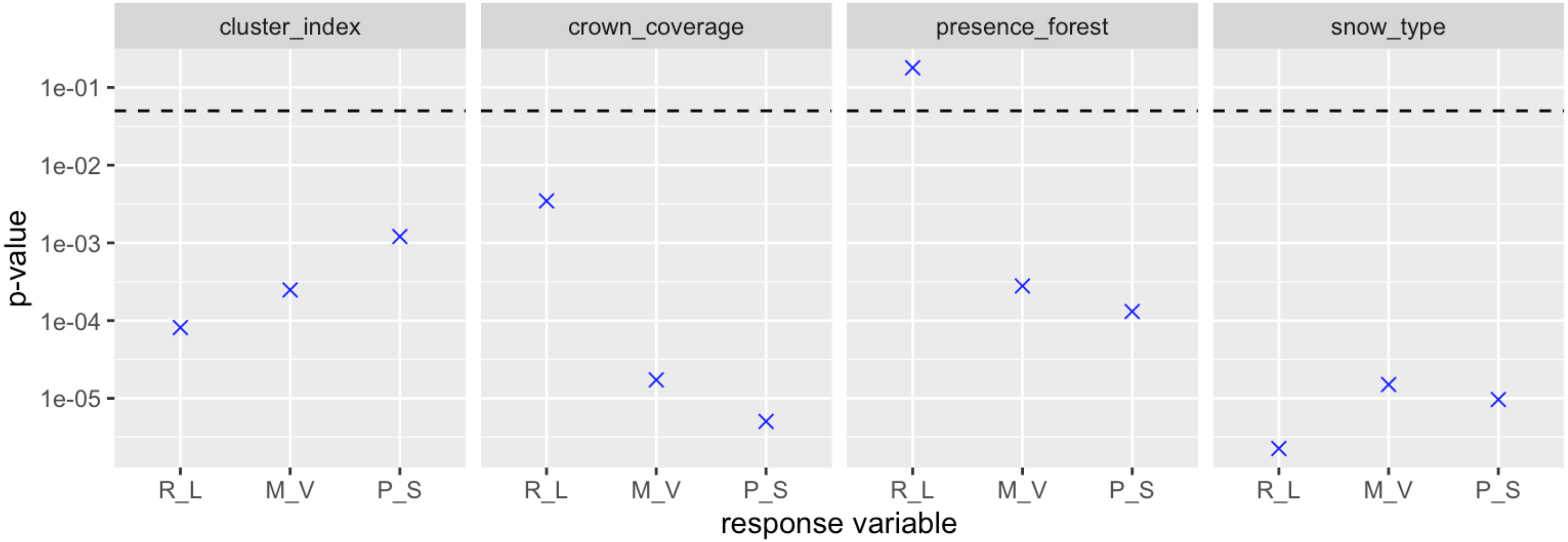
A: Results

Cross-correlations of the forest parameters and the avalanche release and flow.



C_I	Cluster index
C_C	Crown coverage [%]
R_L	Runout length [m]
M_V	Maximum velocity [m/s]
P_S	Particles staying [%]

A: Results



Effect of the forest and snow parameters on the runout length (RL), maximum velocity (MV) and percentage of non-released particles (PS). The dashed line represents the significance level of 0.05.

Introduction

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EPFL

B: Methods

Orthophoto and Digital Surface Model

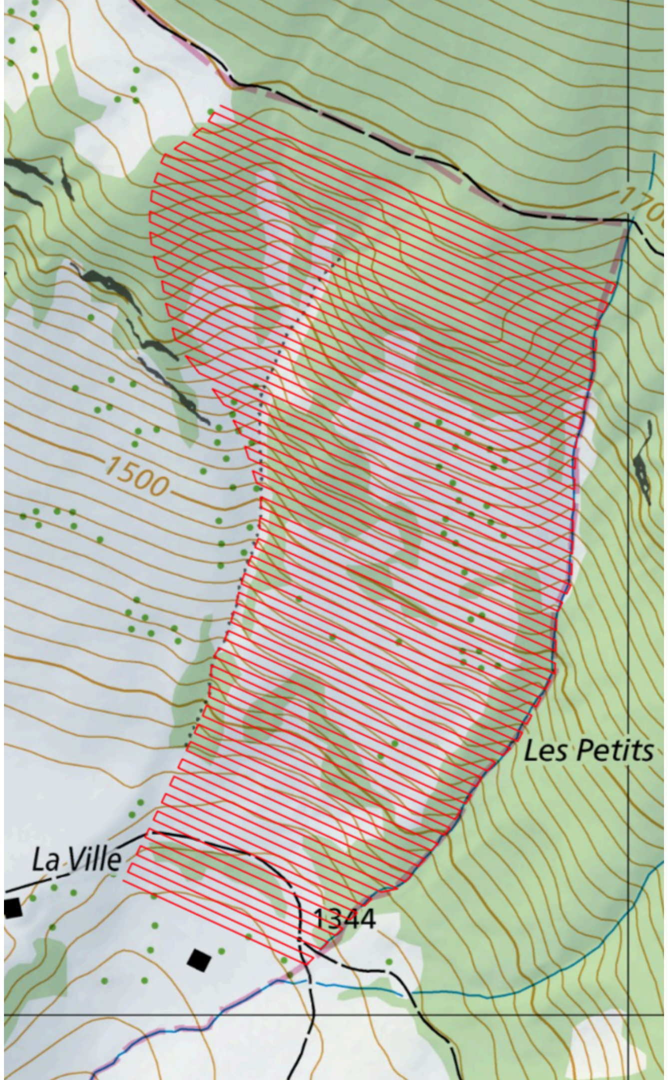
- Data collection: drone mission
- Pix4D: Bundle adjustment

Tree identification

- Position: Variable window filter on CHM
- Crown segmentation: Watershed algorithm

Release area defintion

- Sliding window, coverage ratio <50%



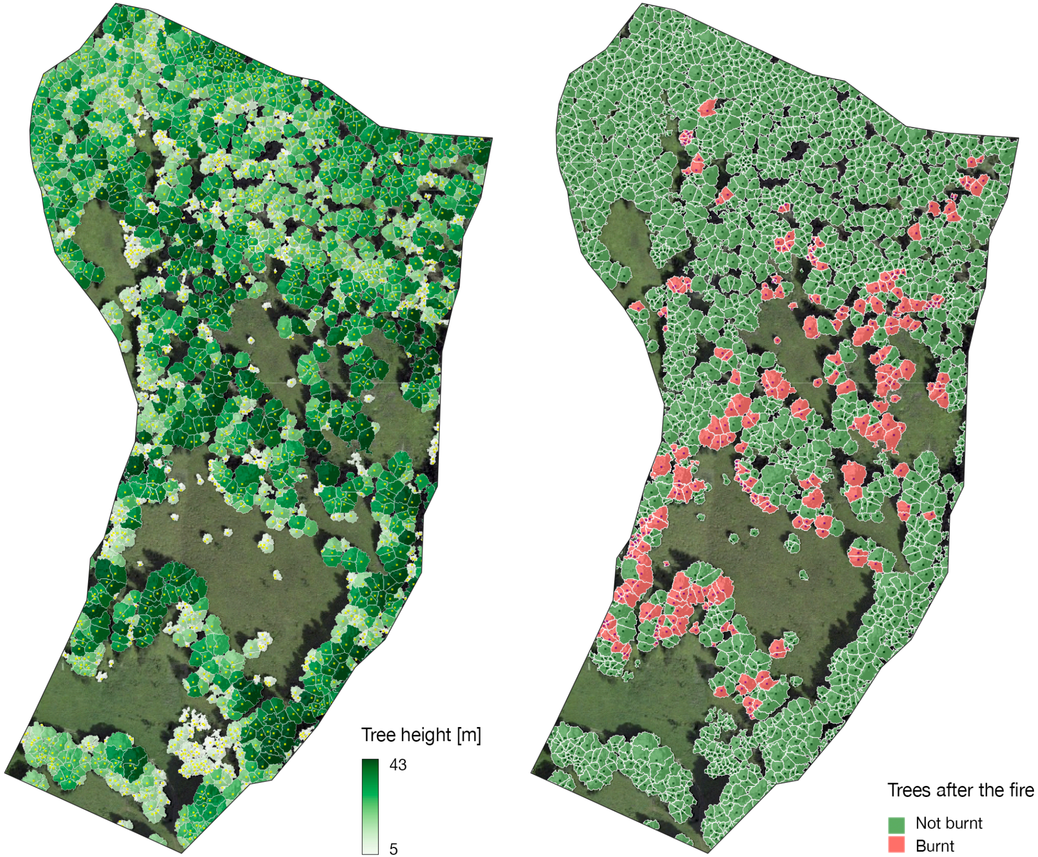
B: Results

Orthophoto of Les Voëttes:

Left: 2015 before fire

Right: 2020 after fire

B: Results



Forest canopy at Les Voëttes:

Left: Tree heights and postions (2015)

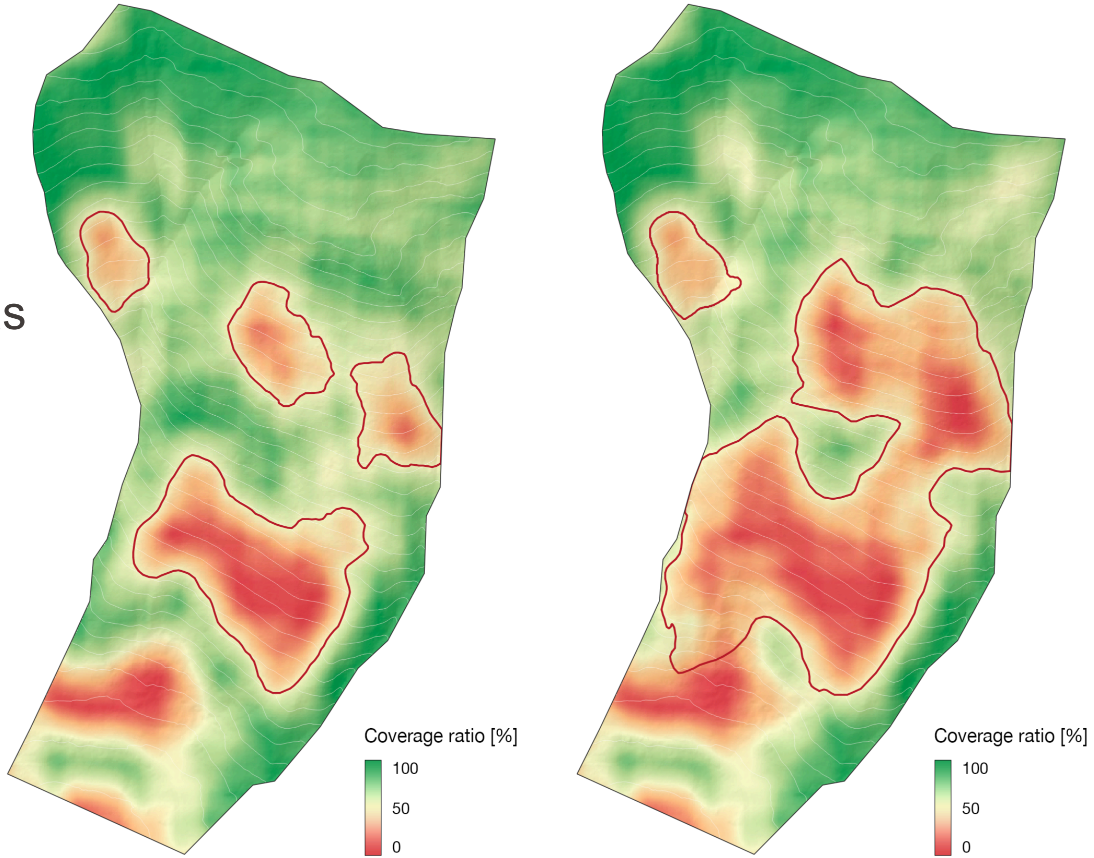
Right: Identification of burnt trees (2020)

B: Results

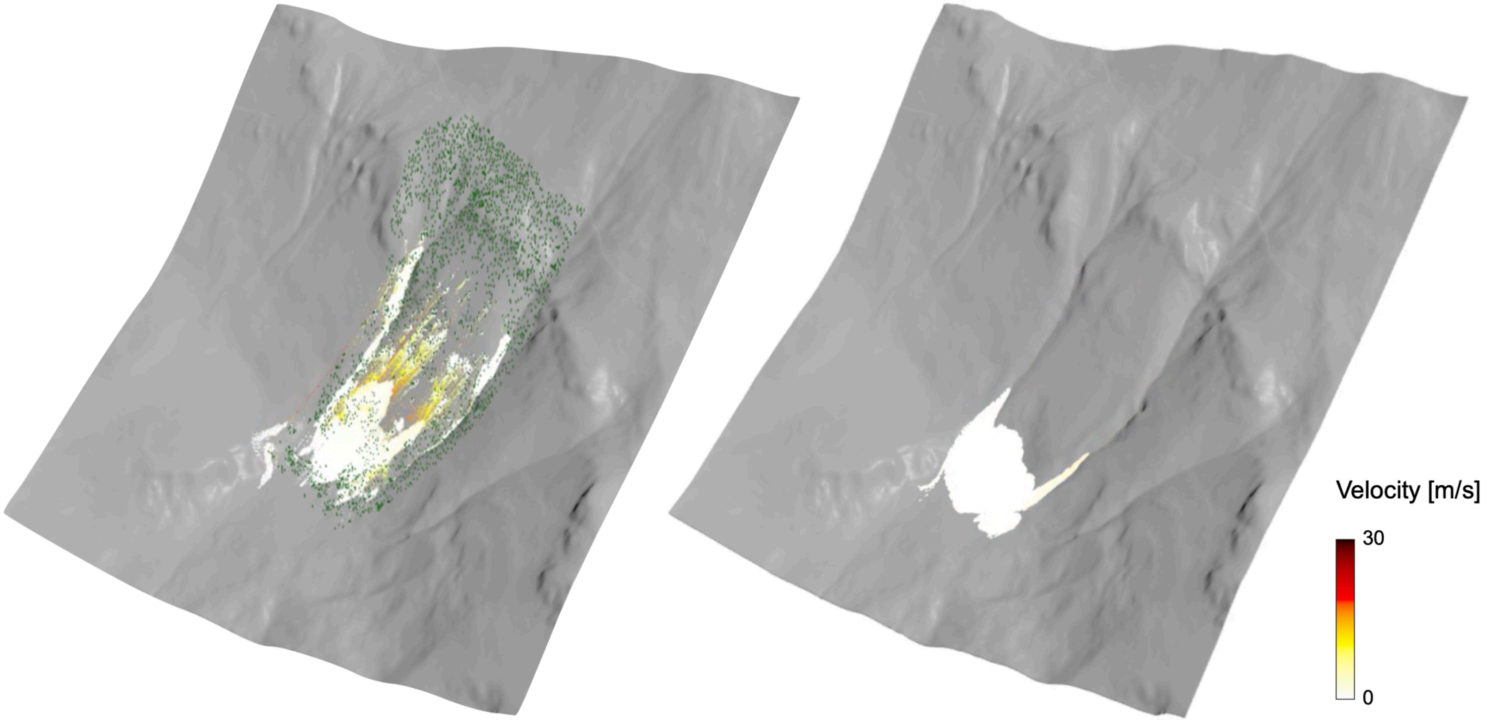
Avalanche release areas in Les Voëttes:

Left: 2015 before fire

Right: 2020 after fire

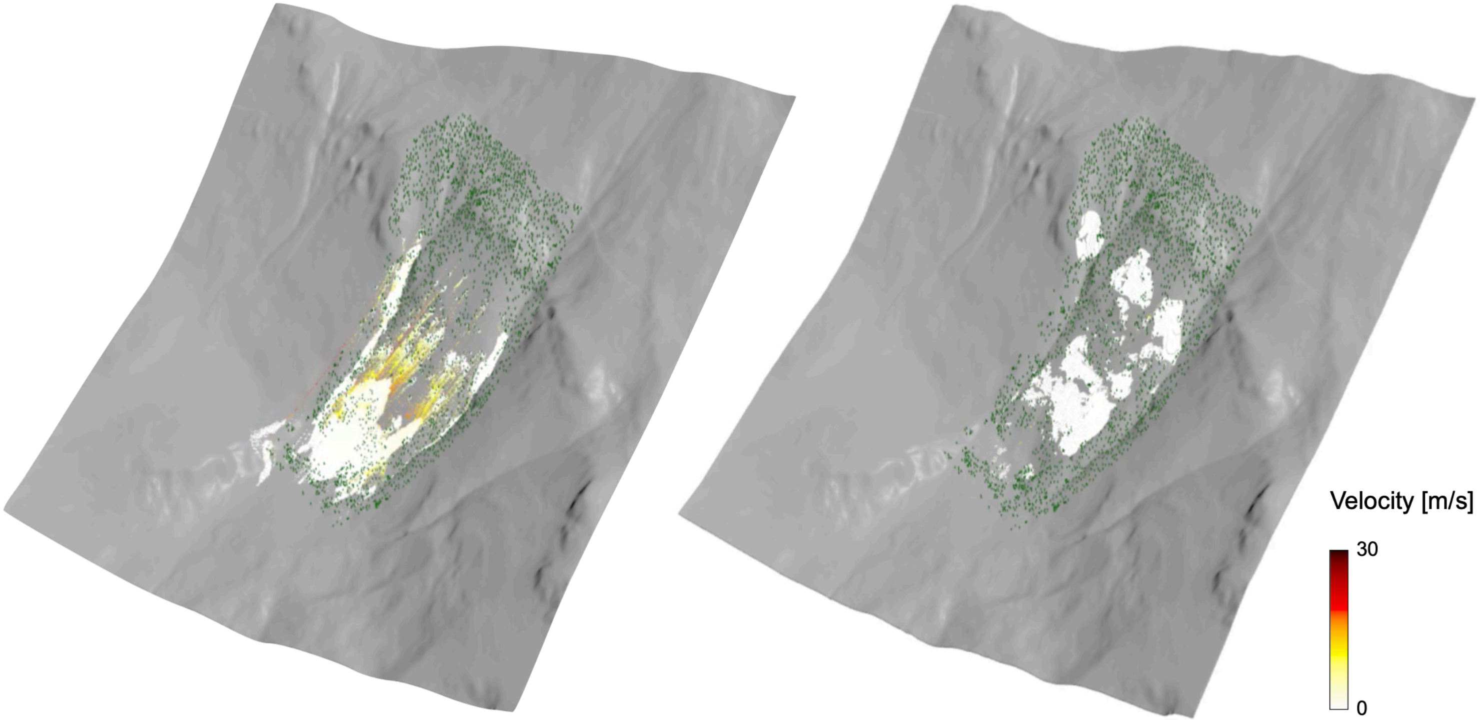


B: Results



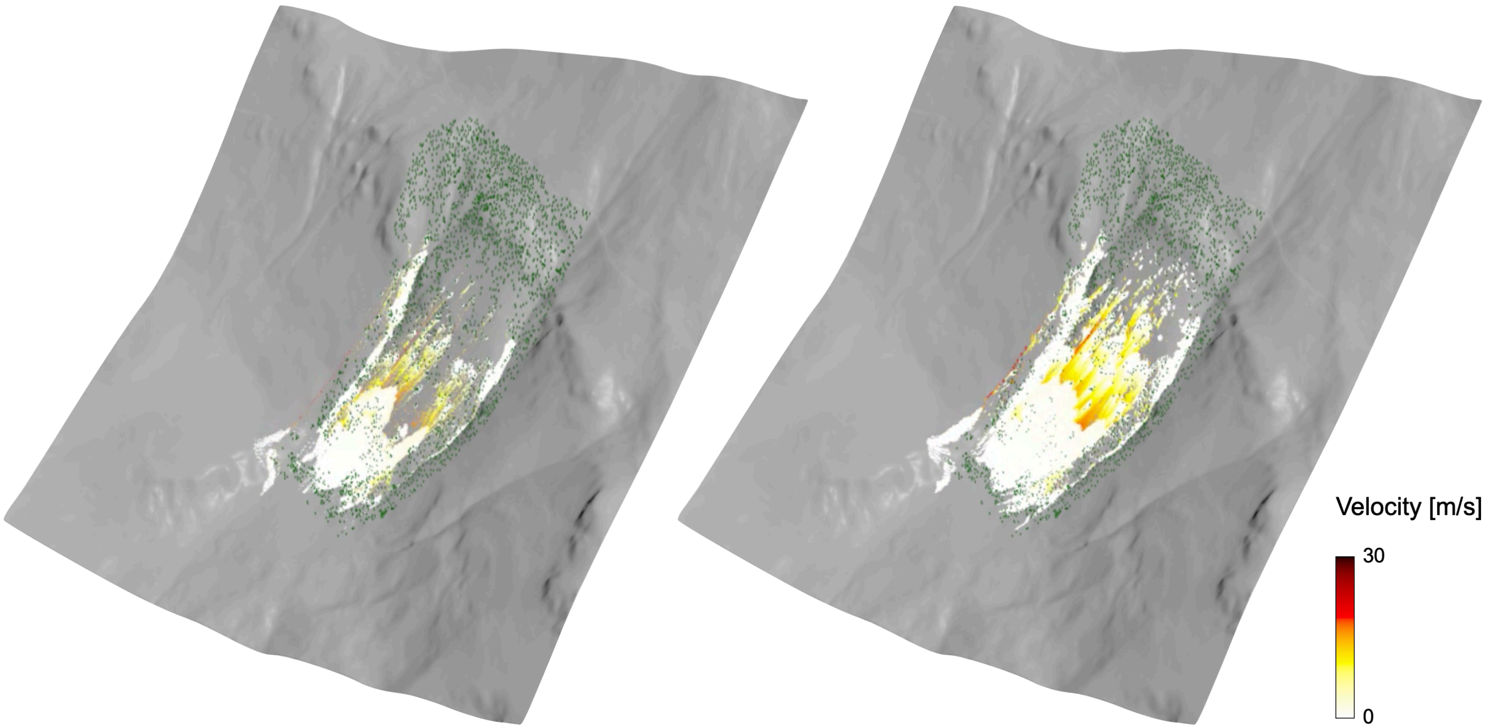
Effect of the forest. Left: forested slope, right: non forested slope.

B: Results



Effect of the snow type in the forested terrain. Left: granular, right: cohesive.

B: Results



Avalanche simulation before the fire (left) and after the fire (right).

Introduction

A: Experimental Simulations

B: Case Study

Conclusions and Outlook

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Questions

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