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UNIFIED MODELING OF THE RELEASE AND FLOW OF SNOW AVALANCHES USING MPM

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Snow slab avalanches start with the failure of a weak snow layer buried below a cohesive snow slab. After failure, the very porous character of the weak layer leads to its volumetric collapse and thus closing of crack faces due to the weight of the overlaying slab. This complex process, generally referred to as anticrack, explains why avalanches can be remotely triggered from flat terrain. On the basis of a new elastoplasticity model for porous cohesive materials and the Material Point Method, we accurately reproduce the onset and propagation dynamics of anticracks observed in snow fracture experiments. The key ingredient consists of a modified strain-softening plastic flow rule which captures the complexity of porous materials under mixed-mode loading accounting for the interplay between volumetric collapse and cohesion loss. Finally, we simulated the release and flow of slab avalanches at the slope scale triggered either artificially (bombing) or accidentally (remote triggering). Our unified model represents a significant step forward as it allows simulating solid-fluid phase transitions in geomaterials which is of paramount importance to mitigate and forecast gravitational hazards.

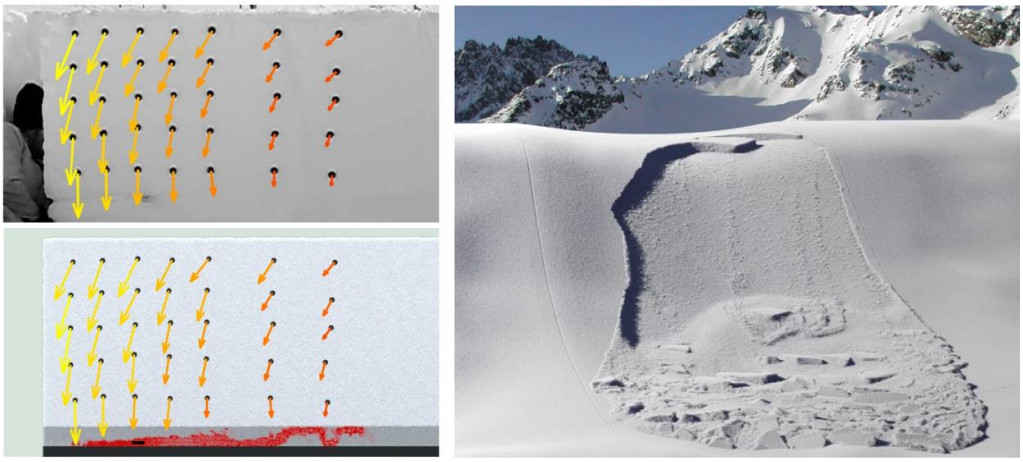

Figure: Left: Propagation Saw Test experiment (top) reproduced using our model (bottom). Right: Simulation of a snow slab avalanche using MPM.

REFERENCES

[1] Gaume J, Gast T, Teran J, van Herwijnen A, Jiang C, 2018. Dynamic anticrack propagation in snow. Under review.