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Numerical and experimental investigation of crack propagation regimes in large-scale snow fracture experiments

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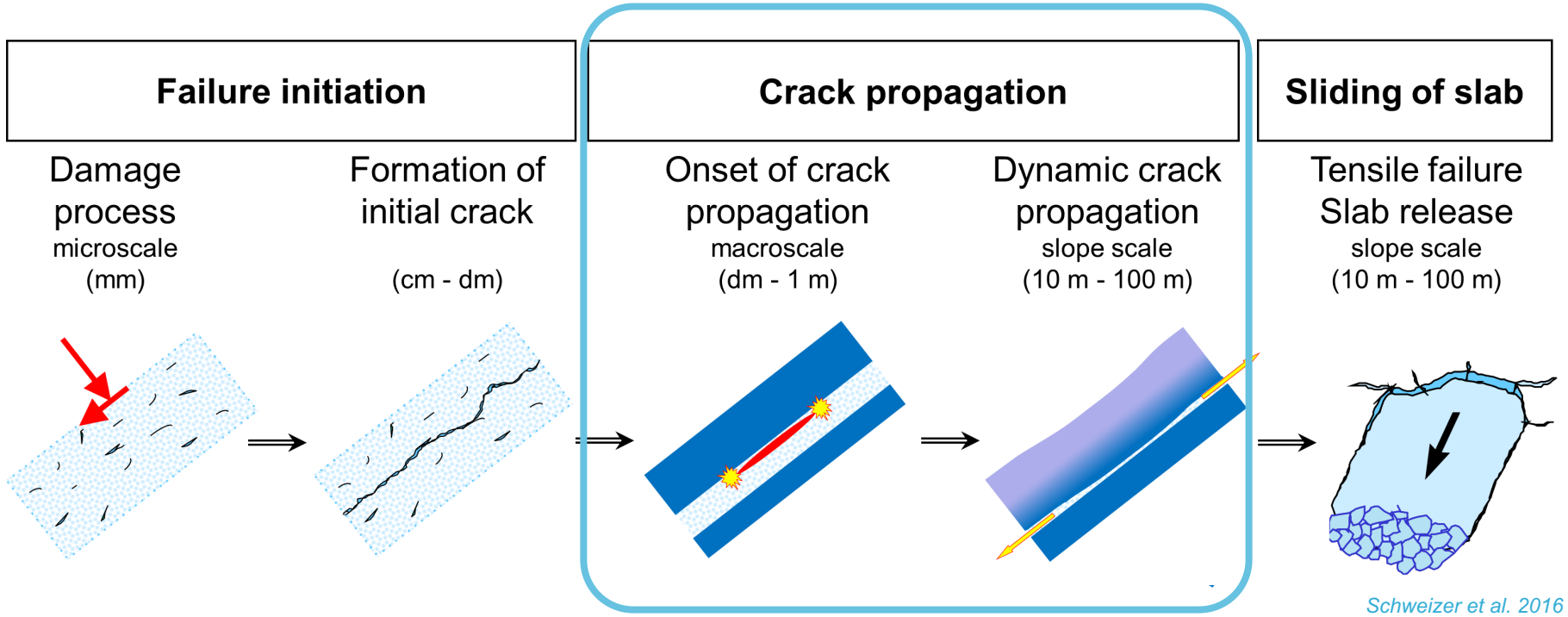
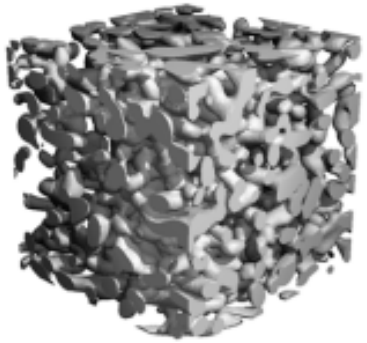
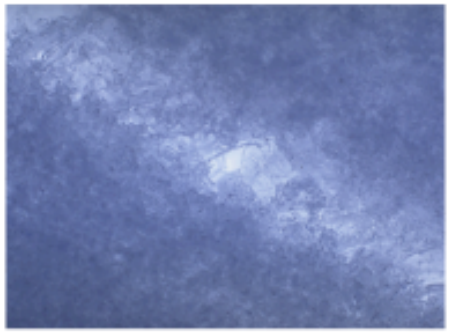
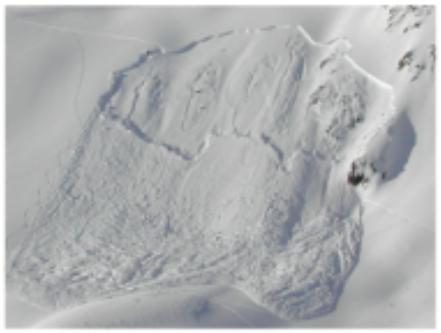
Dry-snow slab avalanche process



Schweizer et al. 2016

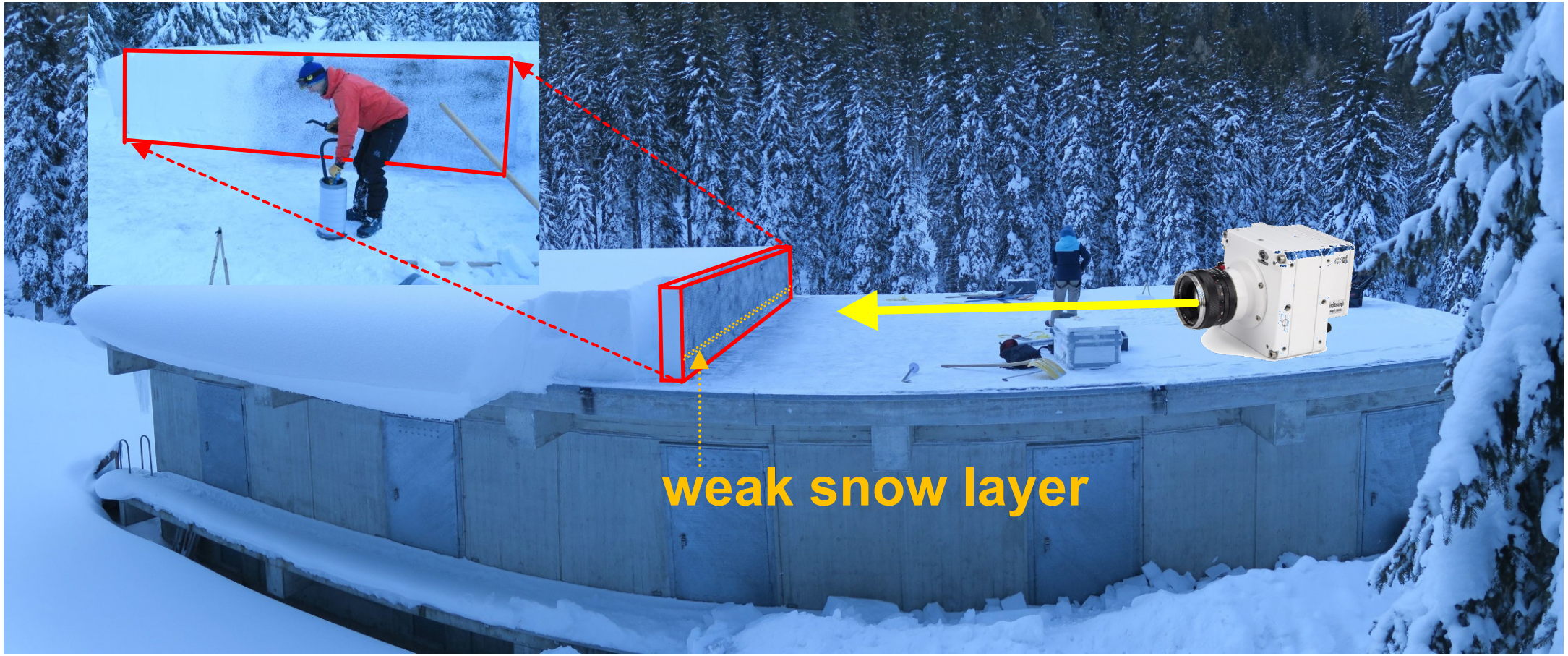




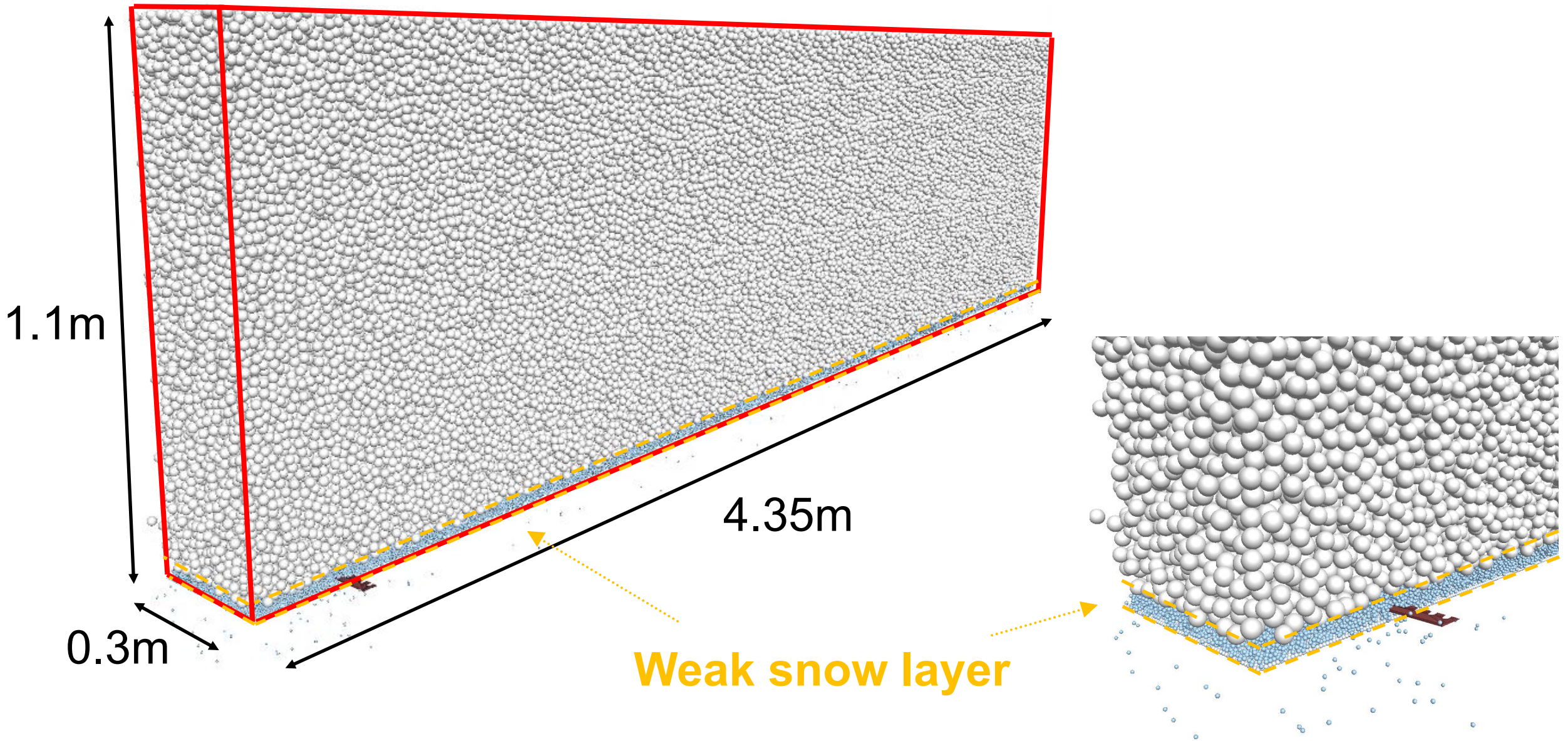


Field experiments

Propagation Saw Test (**PST**)

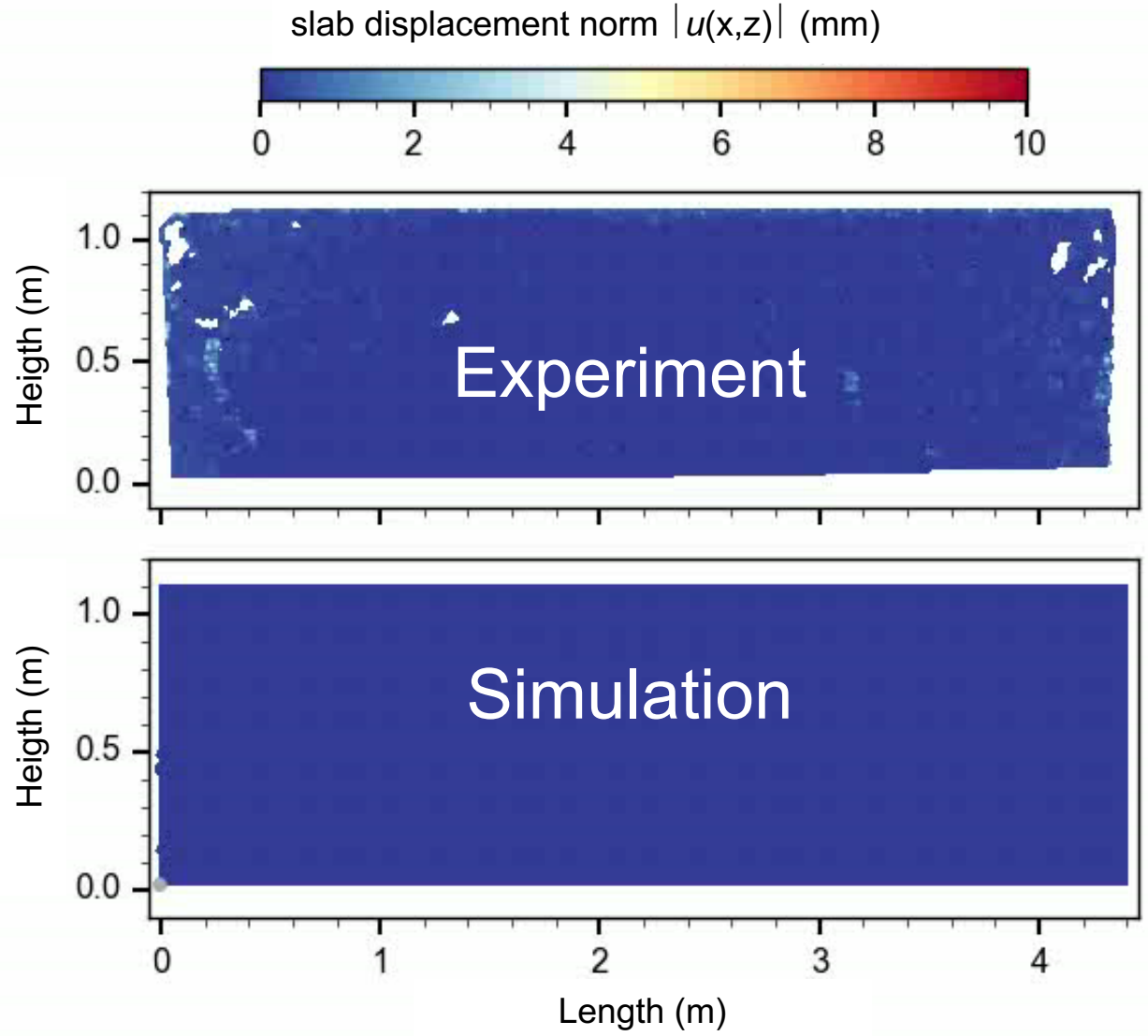


Modeled DEM PST



Modeling realistic crack propagation behavior

Evolution of slab displacement $|u(x,z)|$ along the beam



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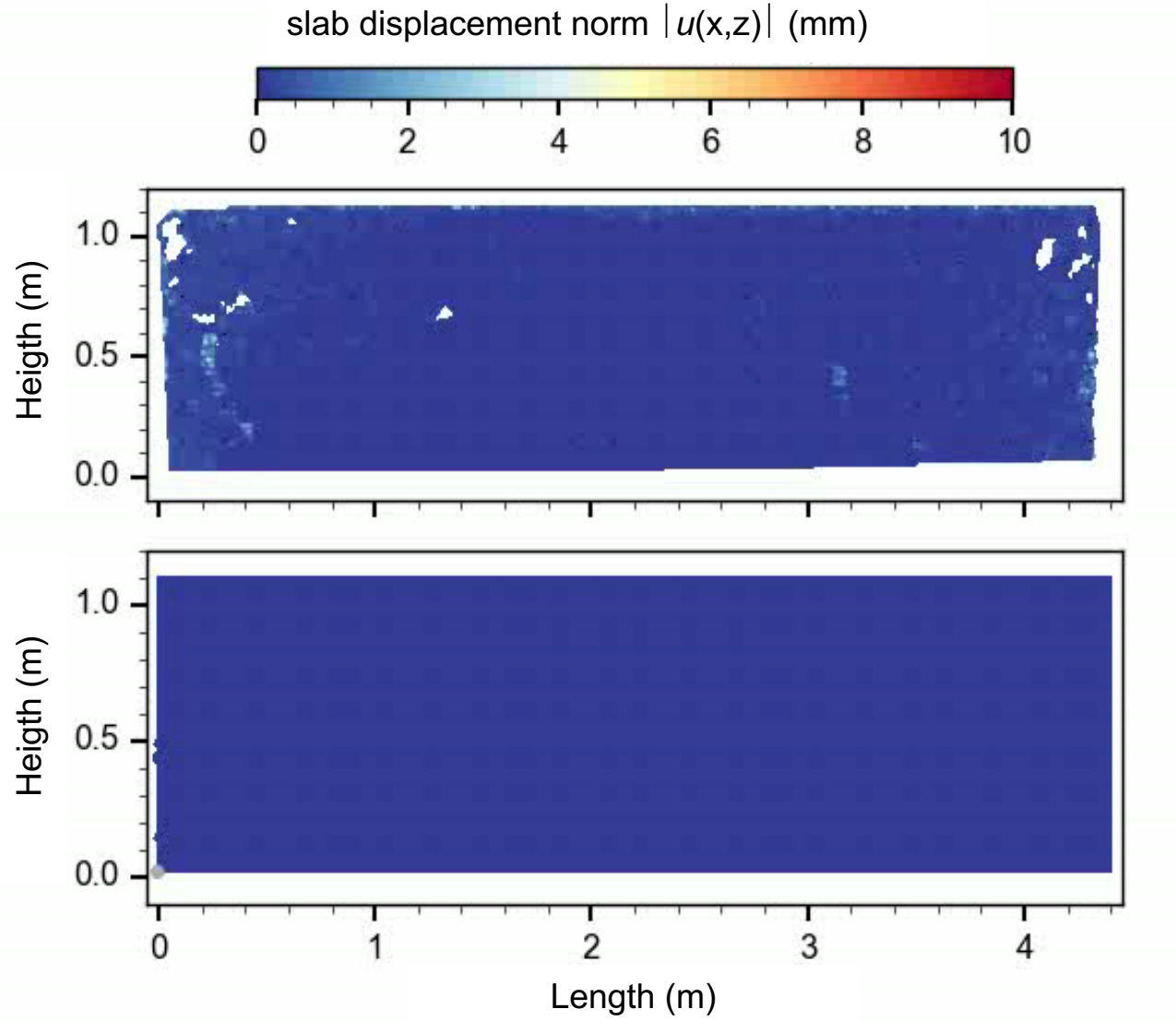
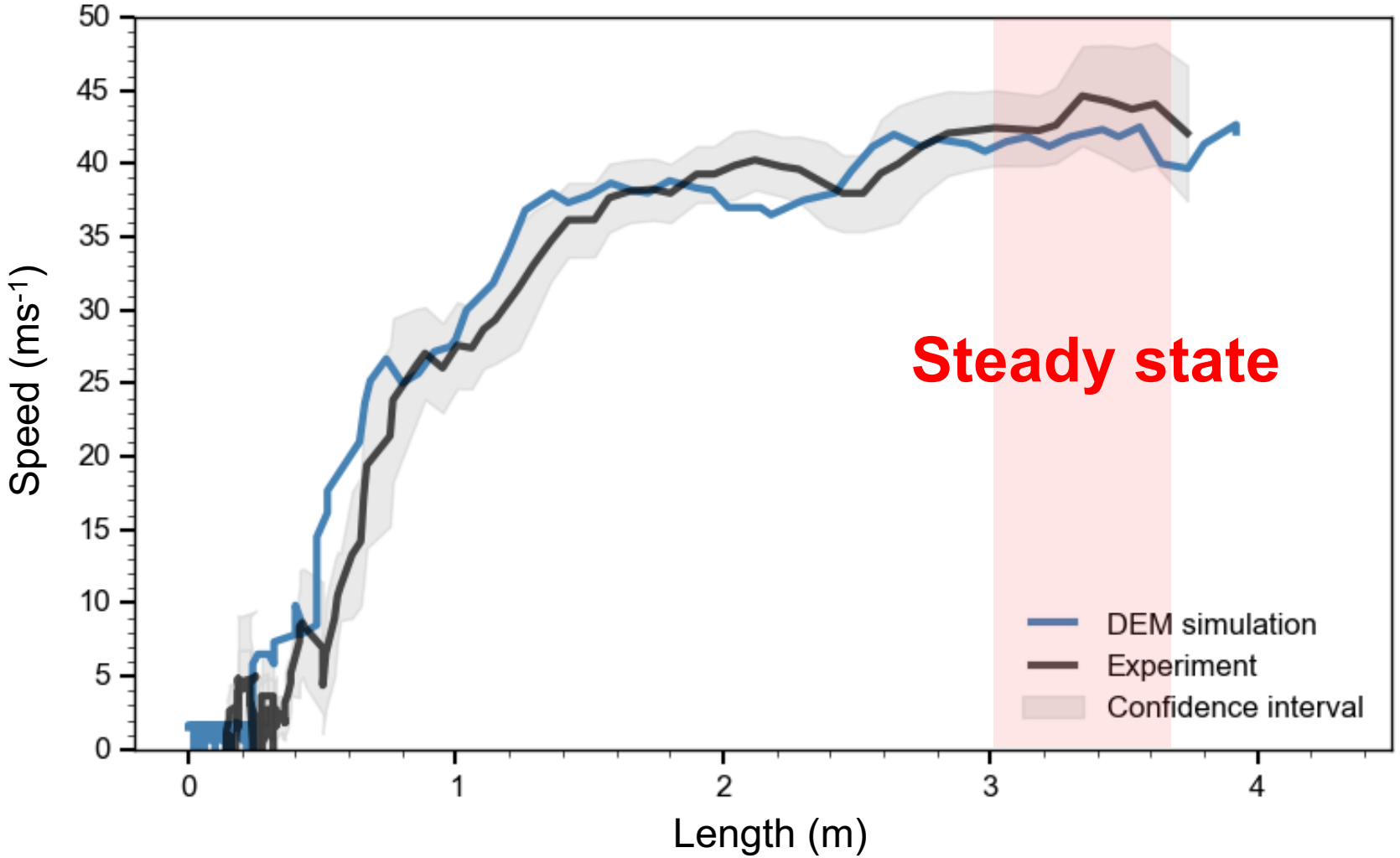
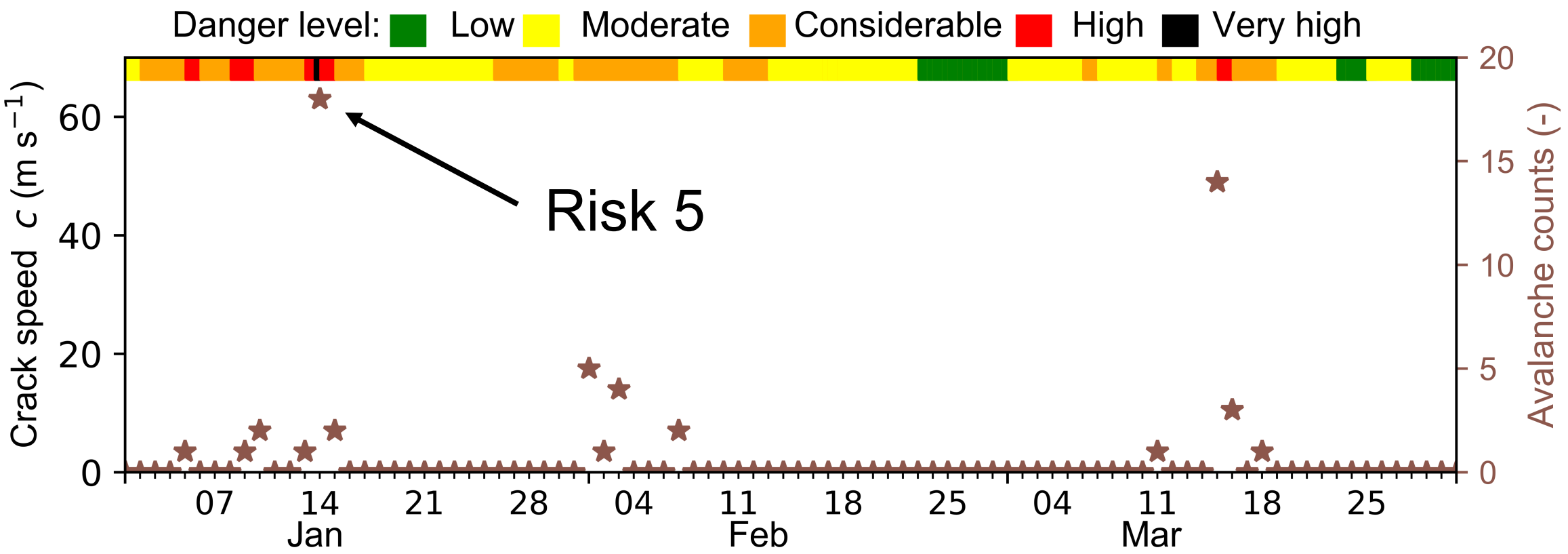


Crack propagation speed



P.S.T crack speed evolution during winter



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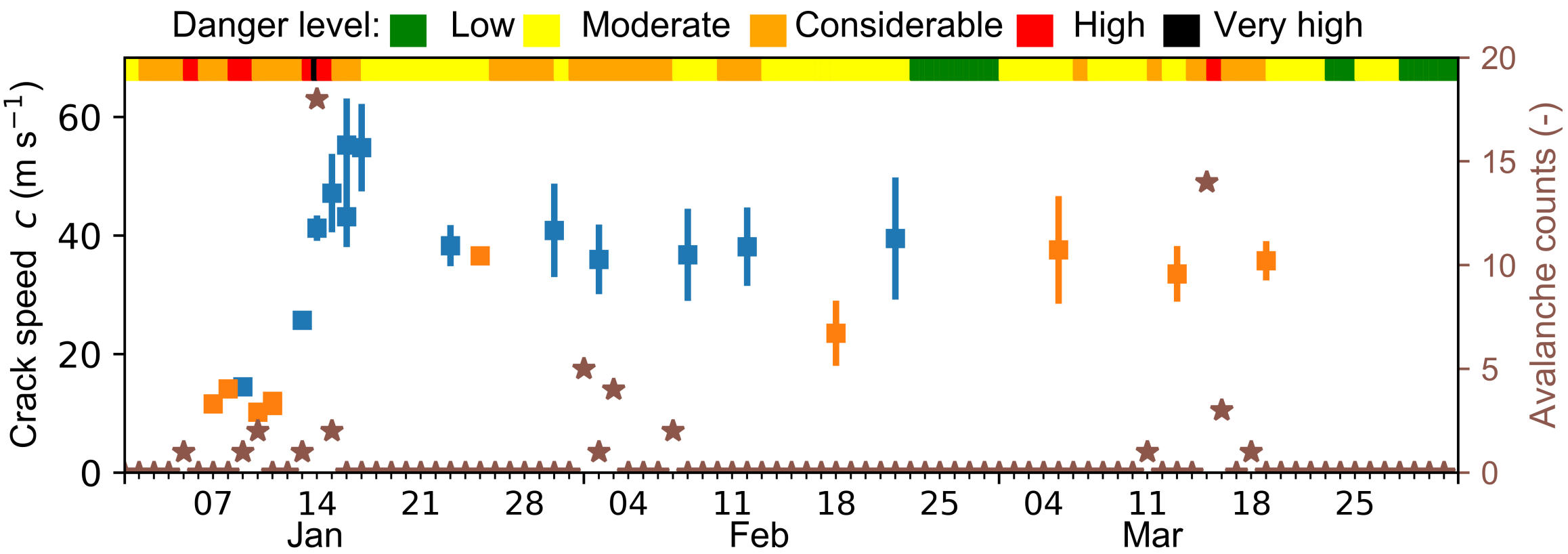

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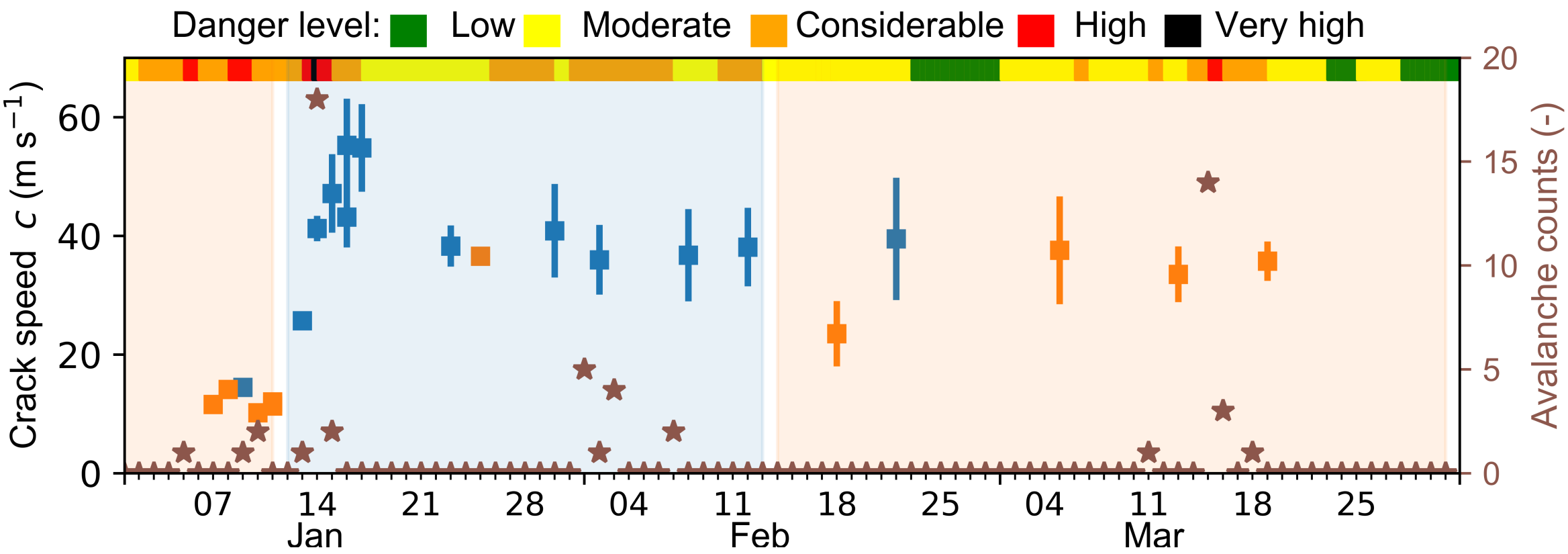
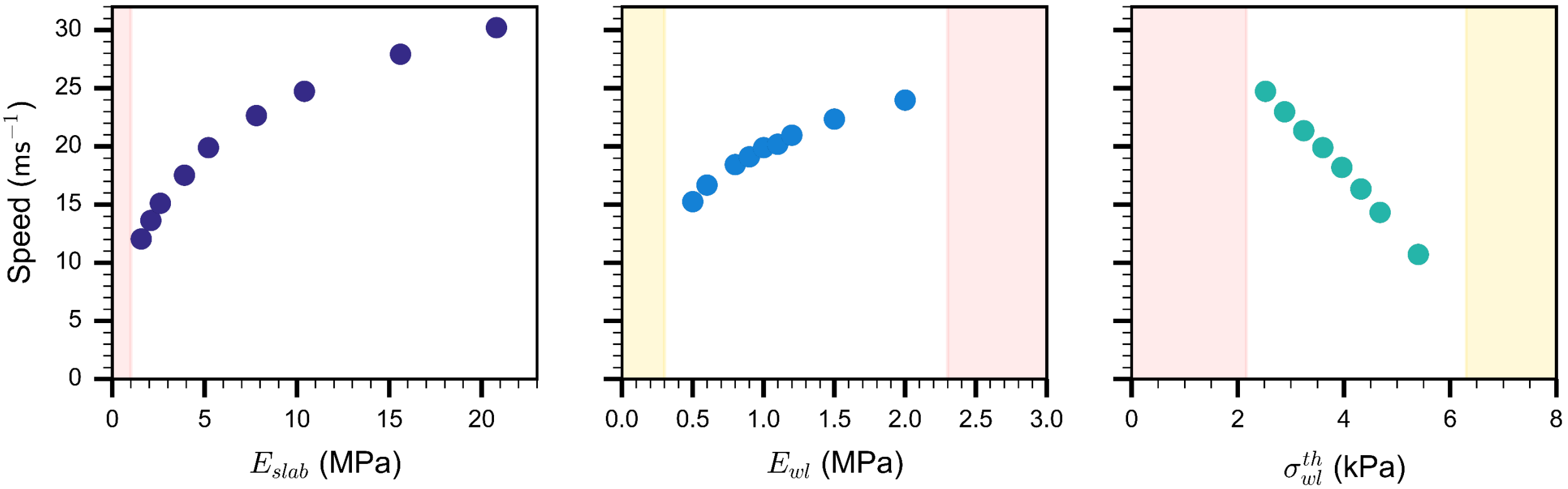


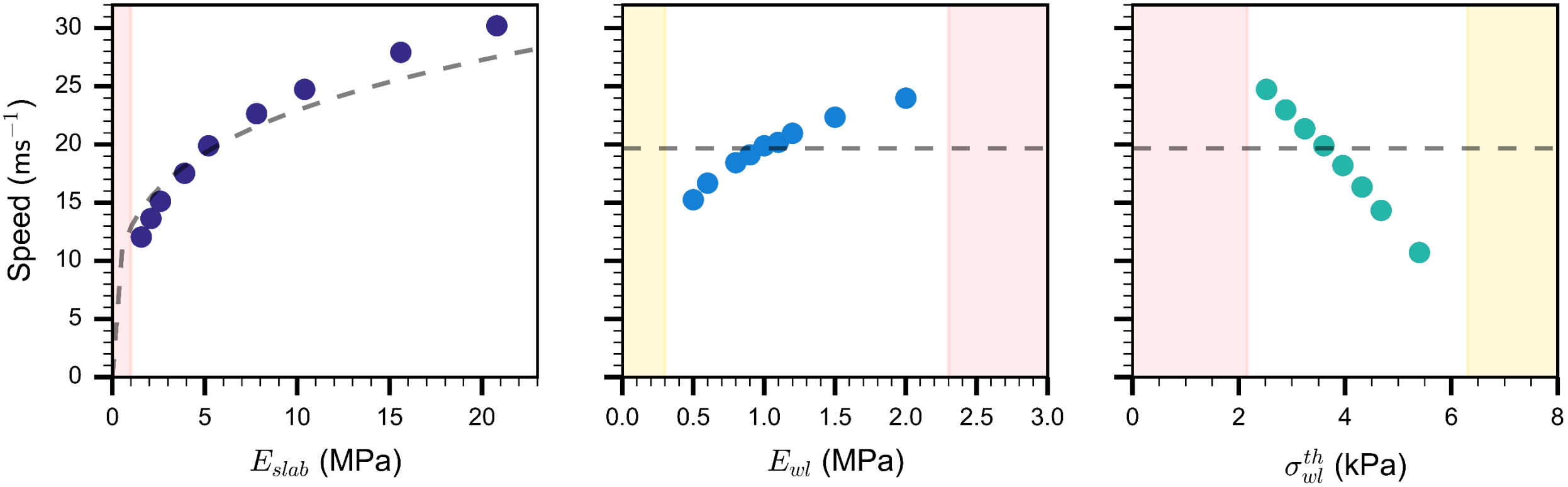
Influence of snow cover properties (flat terrain)



Unstable

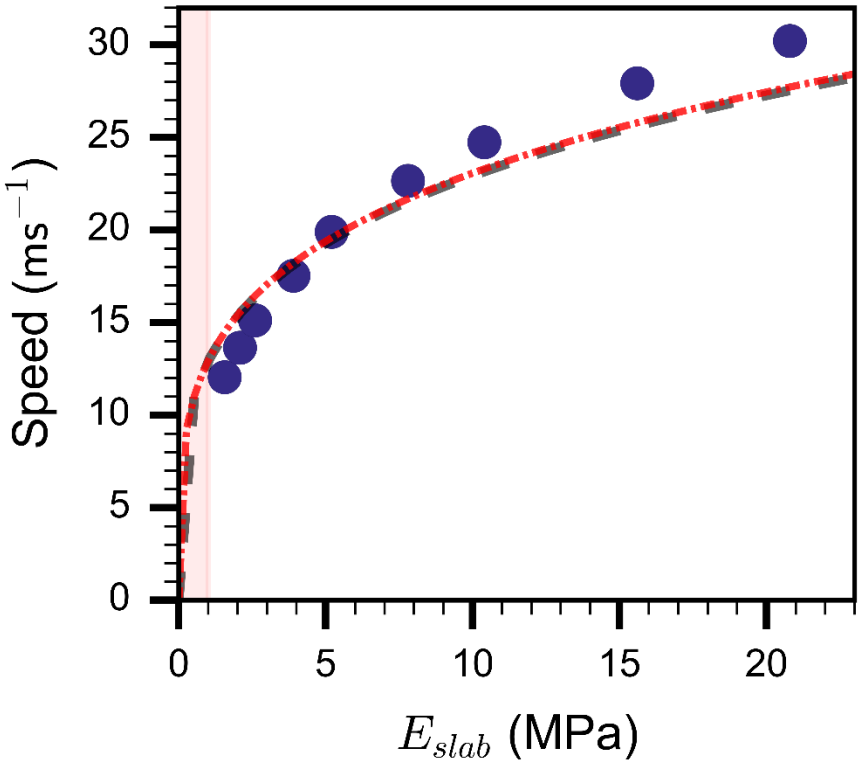
No propagation

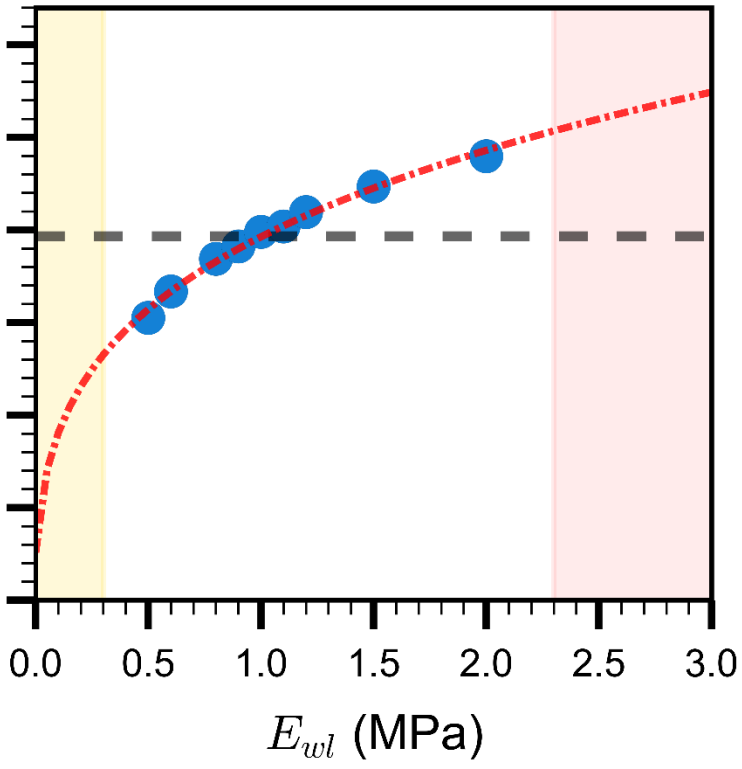
Influence of snow cover properties (flat terrain)

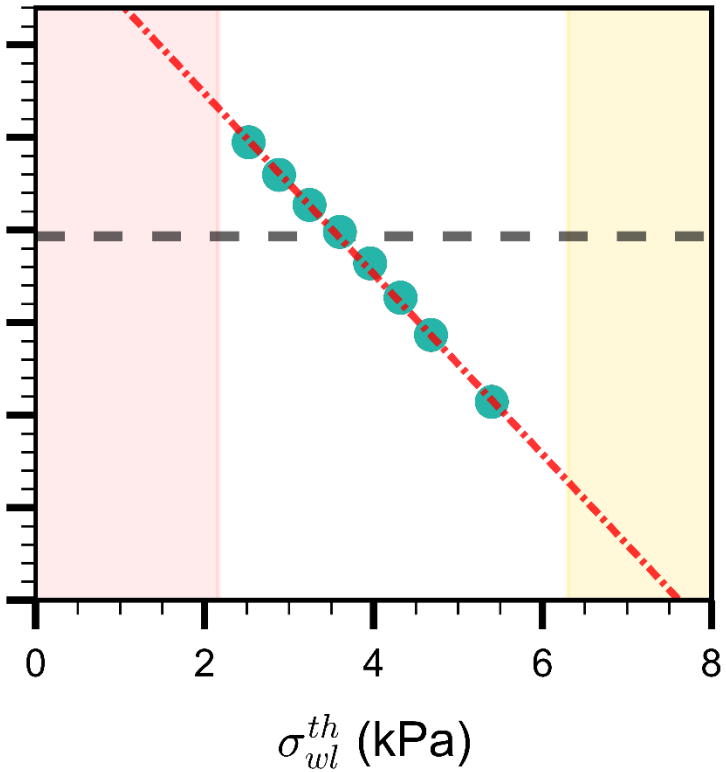


Solitary wave model, Heierli (2005): $c = \sqrt[4]{-\frac{g}{2h}\frac{\frac{E_{slab}\,H_{slab}^{\,3}}{12(1-\upsilon^2)}}{\rho\,H_{slab}}}$

Influence of snow cover properties (flat terrain)





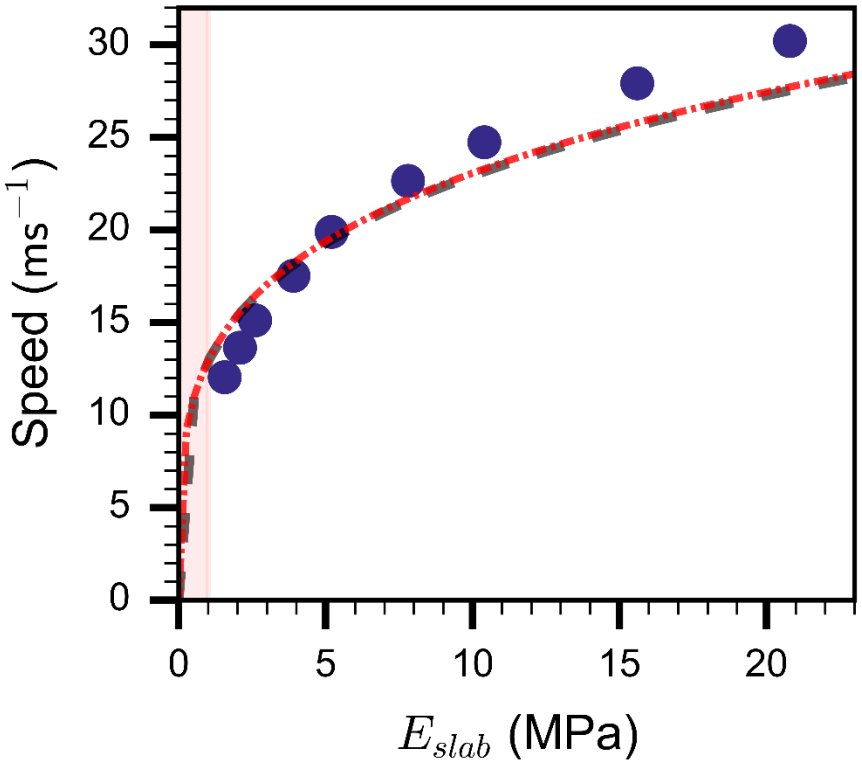


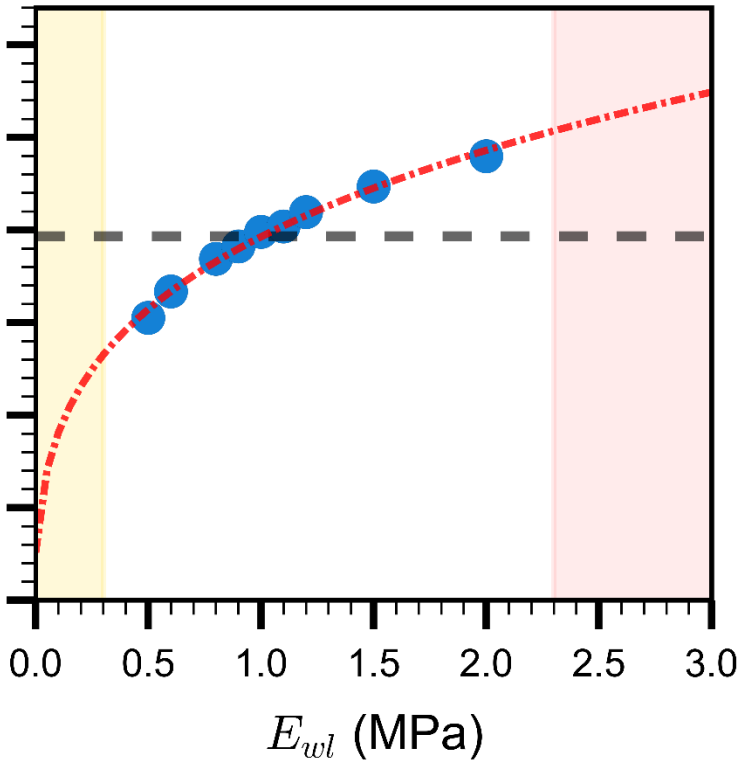
$$c = \sqrt[4]{-\frac{g}{2h}\frac{\frac{E_{slab}\,{H_{slab}}^3}{12(1-\upsilon^2)}}{\rho\, H_{slab}}}$$

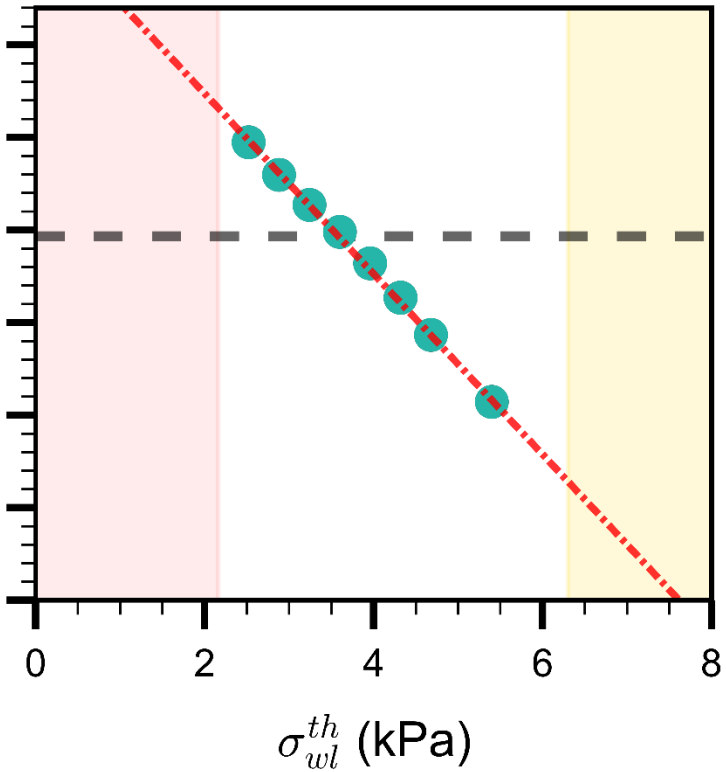
$$c = \sqrt[4]{\beta_1 E_{wl}}$$

$$c = \beta_2\left(\sigma_{wl}^{th} - \rho g H_{slab}\right)$$

Influence of snow cover properties (flat terrain)



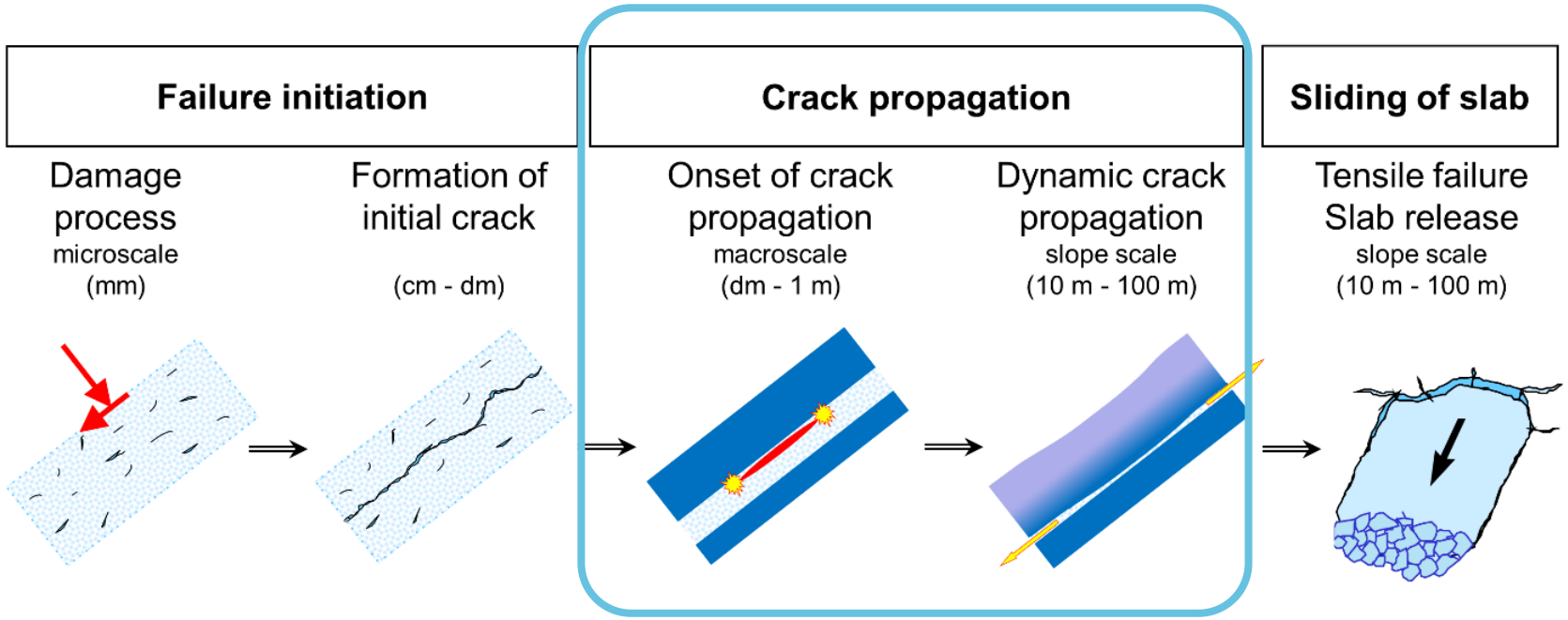




$$c = \sqrt[4]{-\frac{g}{2h}\frac{\frac{E_{slab}\,{H_{slab}}^3}{12(1-\upsilon^2)}}{\rho\, H_{slab}}} + \sqrt[4]{\beta_1 E_{wl}} + \beta_2\left(\sigma_{wl}^{th} - \rho g H_{slab}\right) + \varepsilon \qquad R^2 = 0.93$$

Conclusions

- Investigation of weak layer life cycle over a winter.
- 3D DEM modeling of realistic crack propagation behaviour during PST.
- Investigation of snow cover properties on crack propagation speed.



Outlook

- Investigate larger scale snow fracture experiments.
- Investigate slope angle influence on crack propagation speed.