Investigating the triggers of the 2023 Wrangell, Alaska landslides

Community Presentation
January 18, 2025

Introductions

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NSF RAPID award to collect field data that rapidly disappears after an event

We acknowledge that this is a heavy topic to discuss

U.S. National Science Foundation

Award Abstract # 2421234

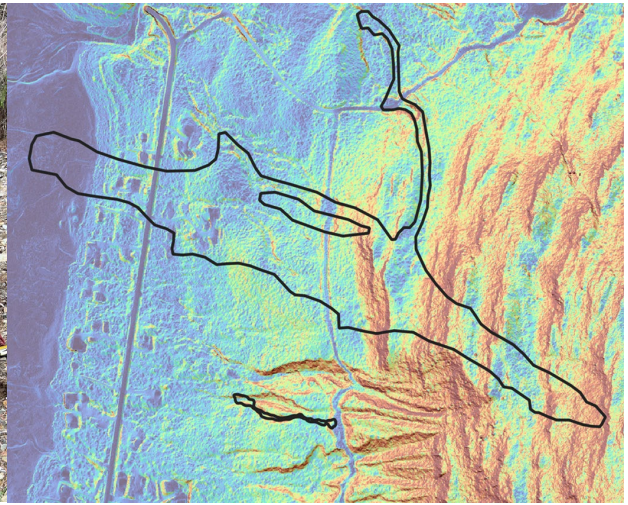
RAPID: Investigating the Triggers of the 2023 Wrangell, Alaska Landslides

August’s presentation recap:

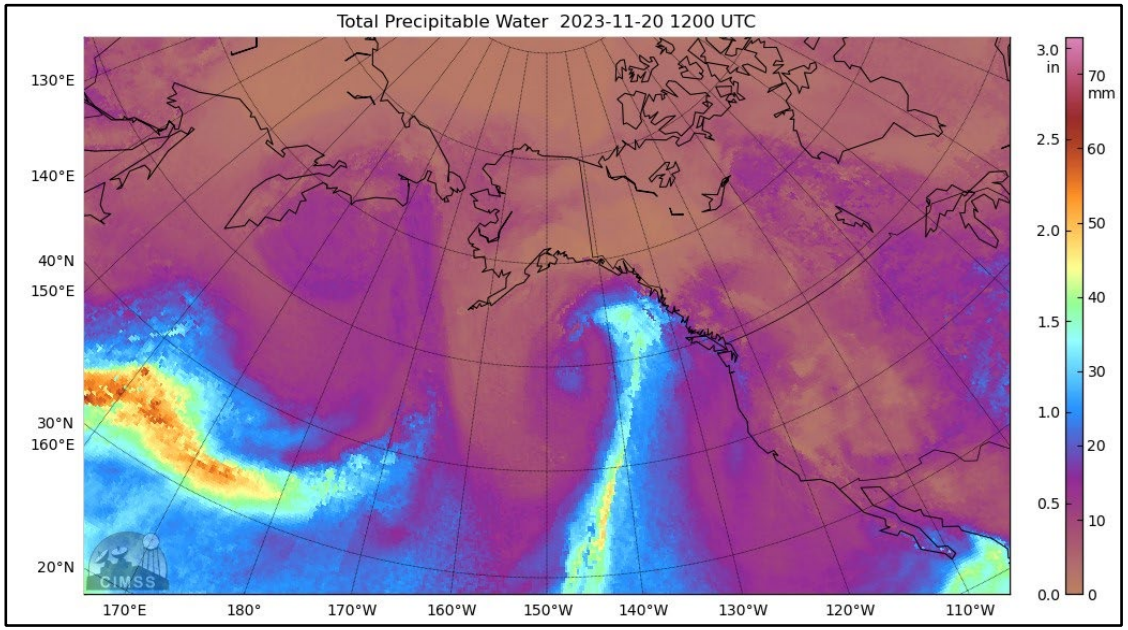
- Overview of the project
- Overview of storm event - surprisingly moderate storm
- Presented preliminary field observations

Today’s ongoing research update

- Why was this landslide so large?
- Why did it happen that day?
- What we don’t know



What we know so far: the storm



Airport: 1.13” was reported in 6 hrs from 3pm to 9pm

Large storm, but not extreme (1-yr storm)

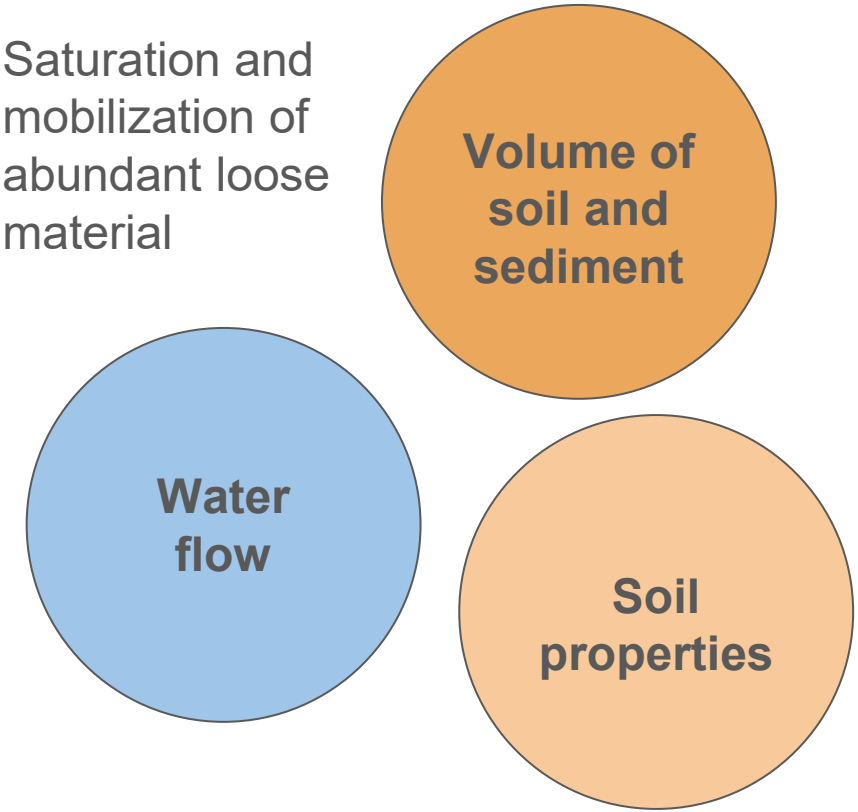
Update: Modeling indicates rainfall at the triggering site was similar to the airport with more results to come

Strong Atmospheric River transporting sub-tropical moisture from the central Pacific into Southeast Alaska November 20th 2023.

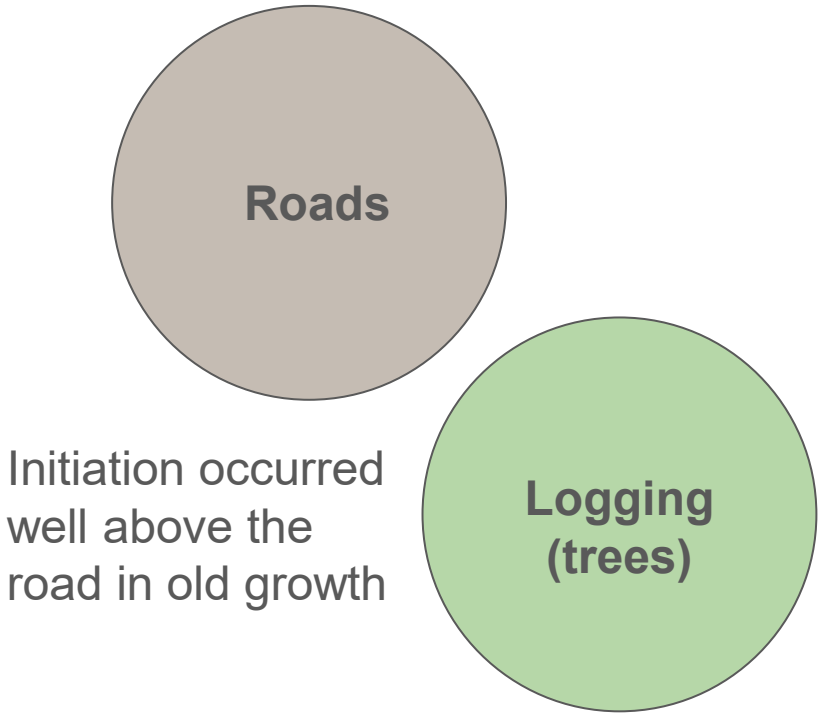
- Pineapple Express=A flavor of an Atmospheric River

What mattered…

Saturation and mobilization of abundant loose material

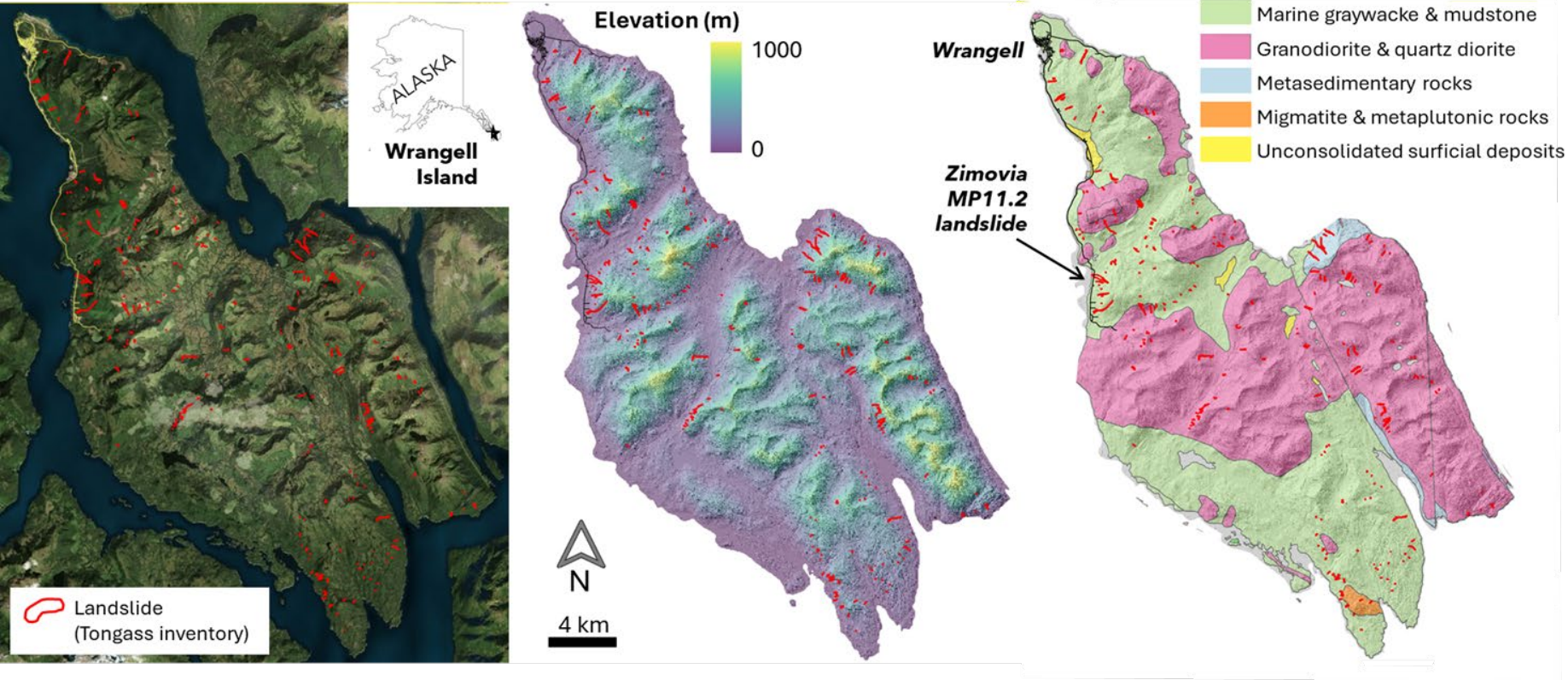


…and what didn't

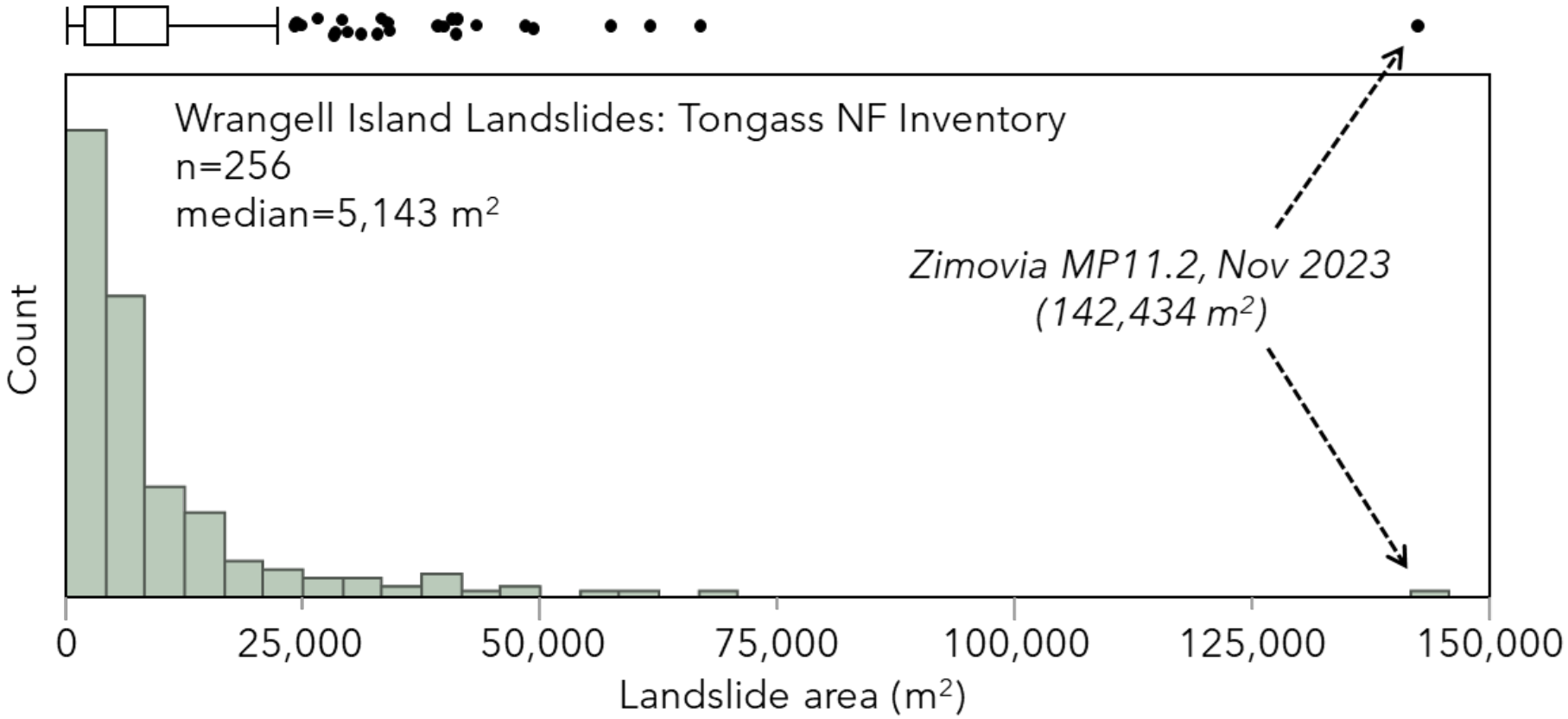


Initiation occurred well above the road in old growth

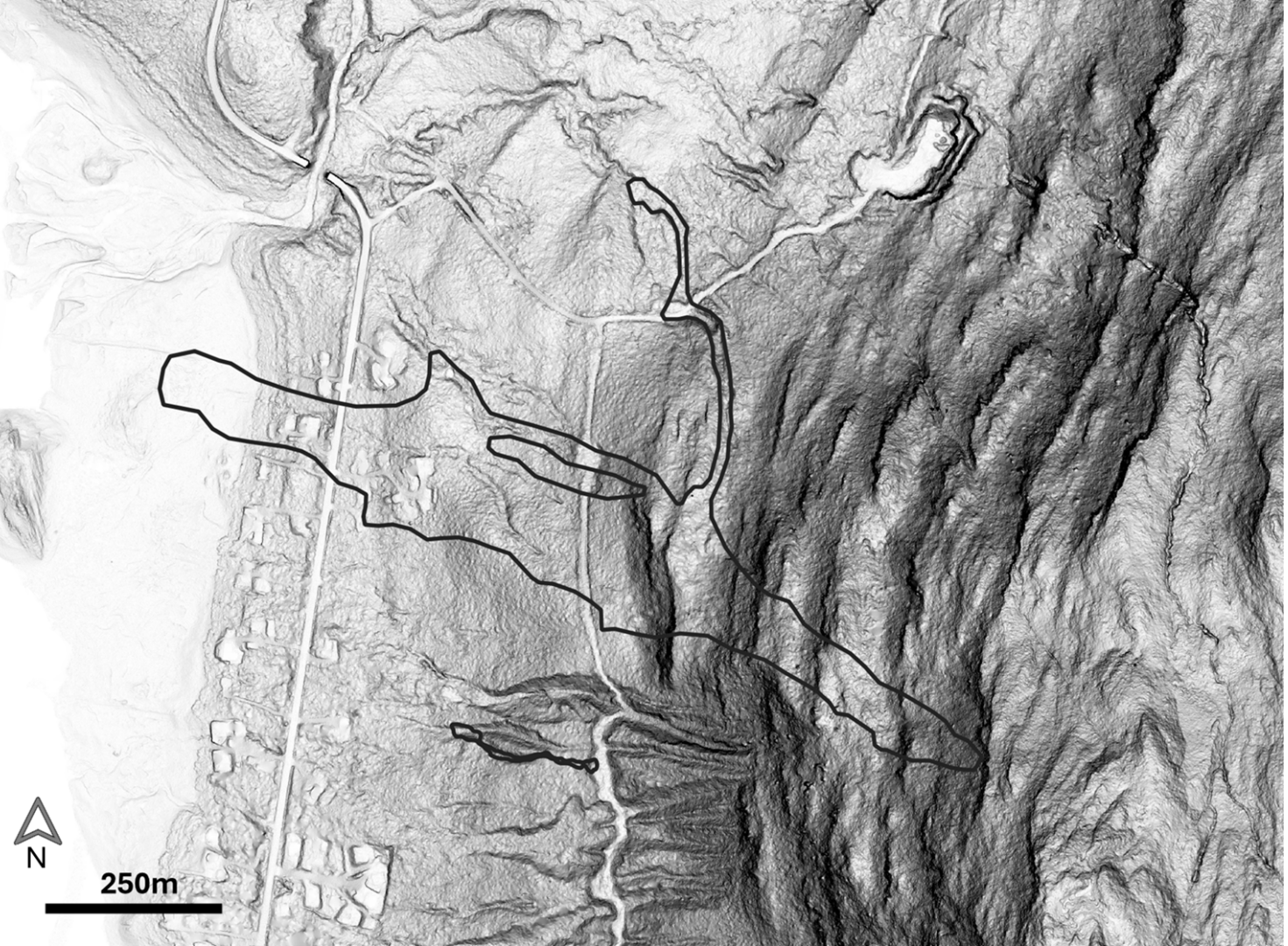
The Tongass National Forest Landslide Inventory has documented 256 landslide events on Wrangell Island since the 1940s



The Zimovia MP11.2 landslide in November 2023 was more than twice as big as the next largest landslide mapped on Wrangell



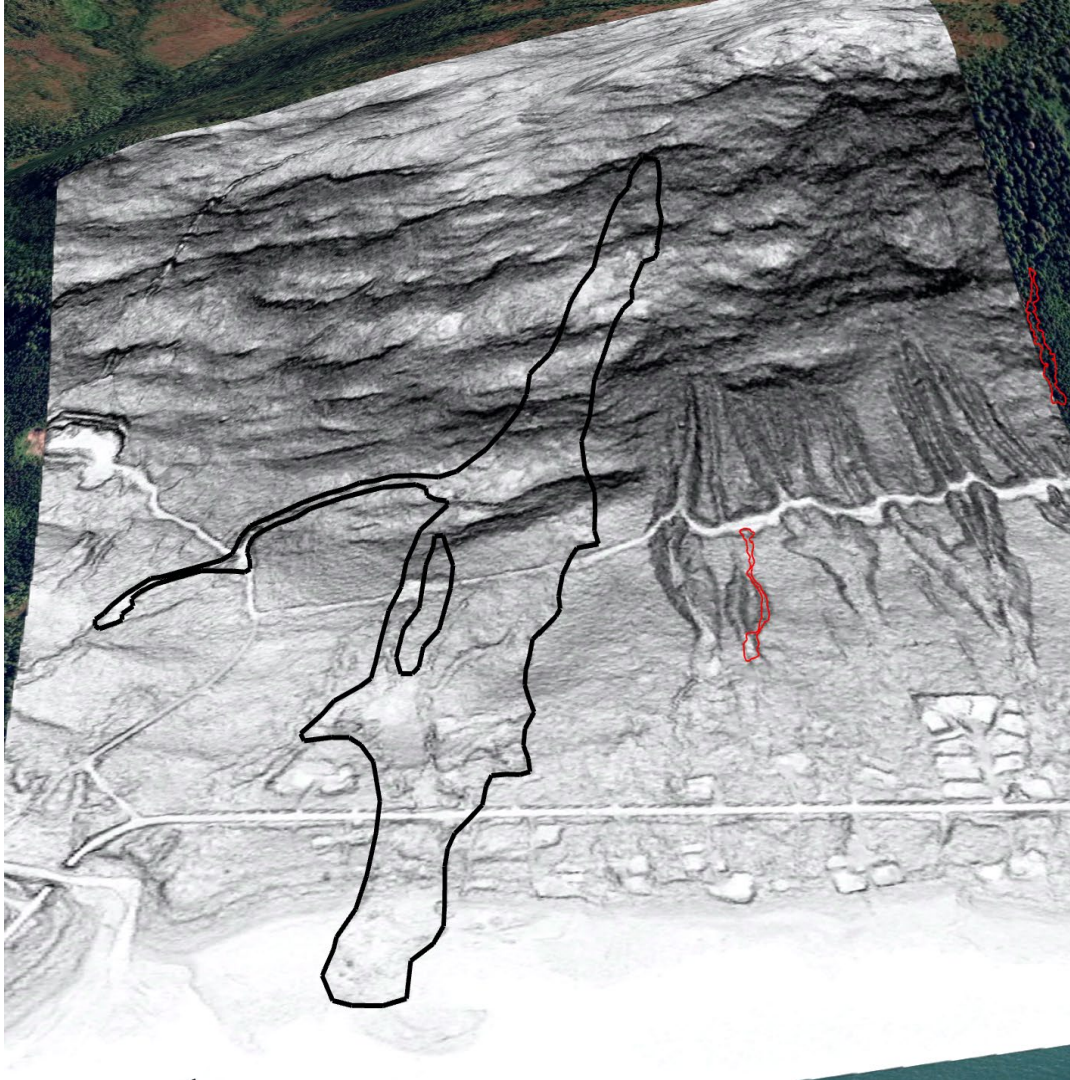
Why was this landslide so large?

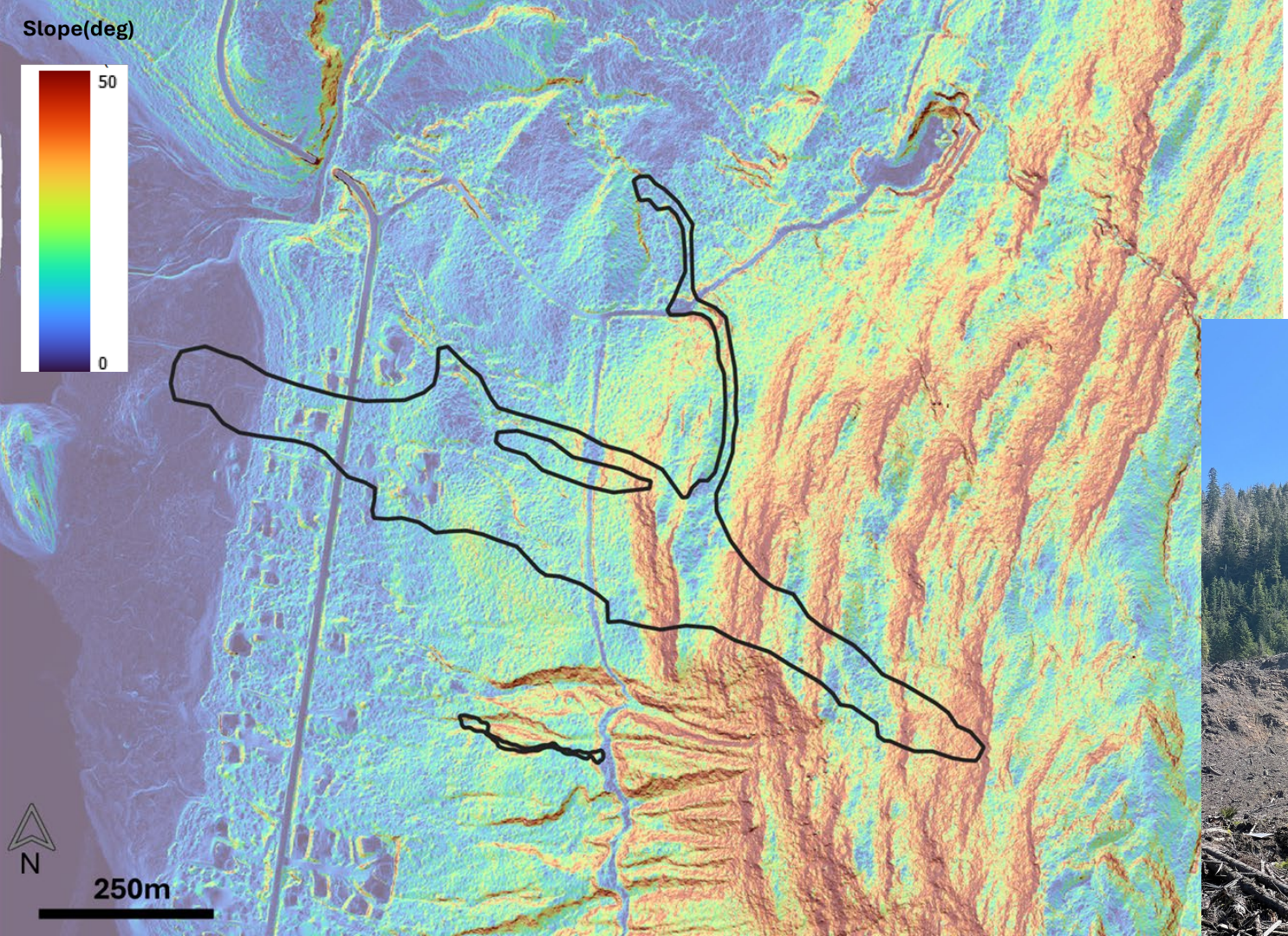


Airborne lidar data reveals extensive bedrock ledges across the ridgeline

***Lidar acquired before and after the 2023 event by**: Alaska Div of Geological & Geophysical Surveys (DGGS)*

Another view of the slope looking head on…





Bedrock ledges are steep and tend to generate rockfall deposits just downslope

Change in land surface (m)

2

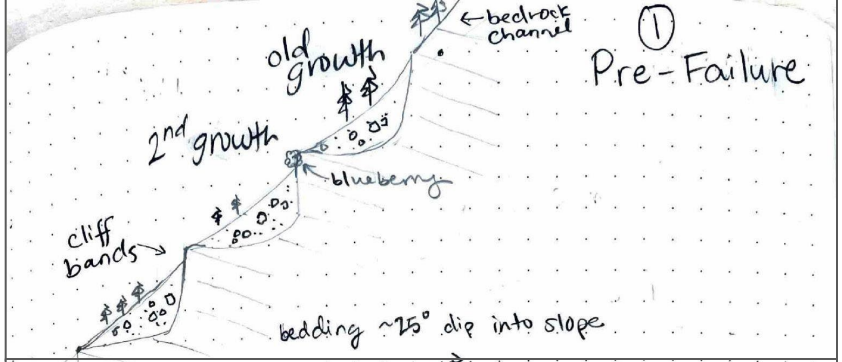
-2

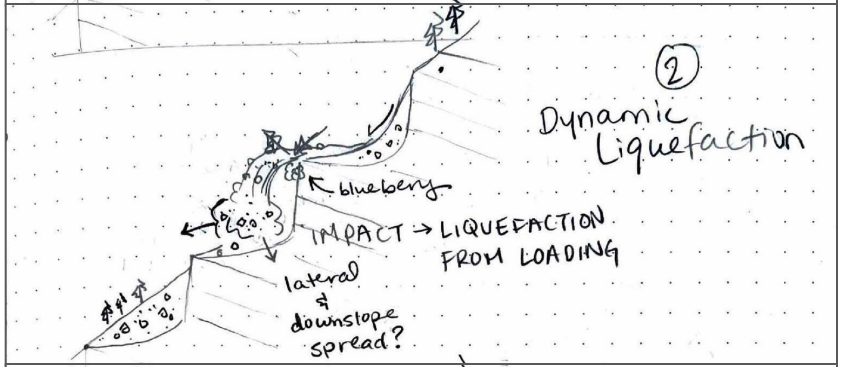
N

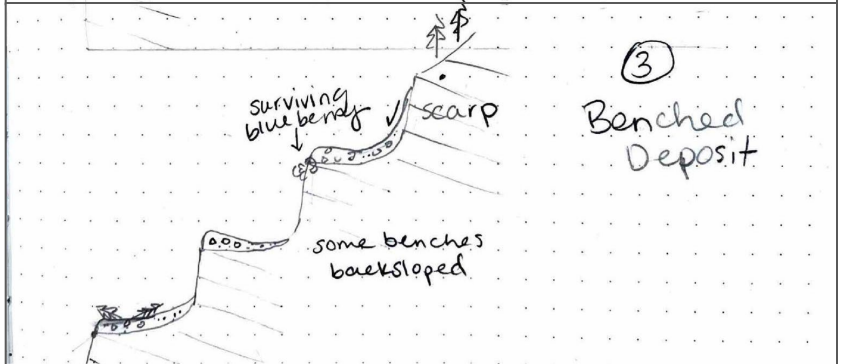
250m

The 2023 landslide initiated below a ledge and gained material before depositing on the lower slope

Ledges and Wedges







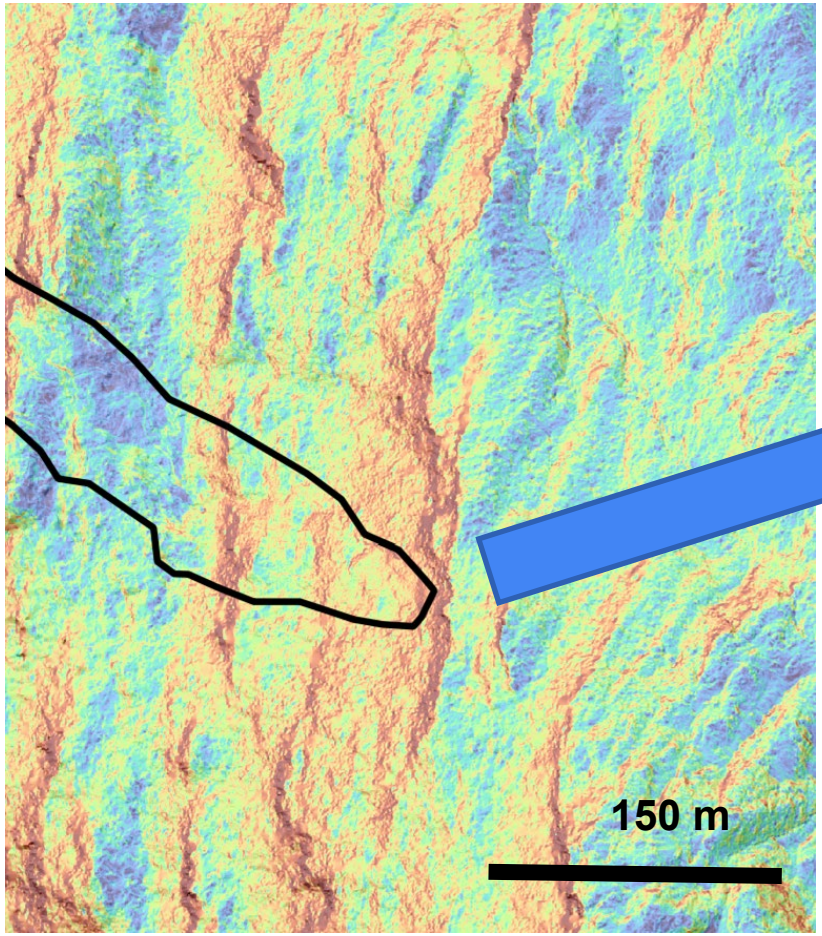
Runout behavior: blueberry tree observation

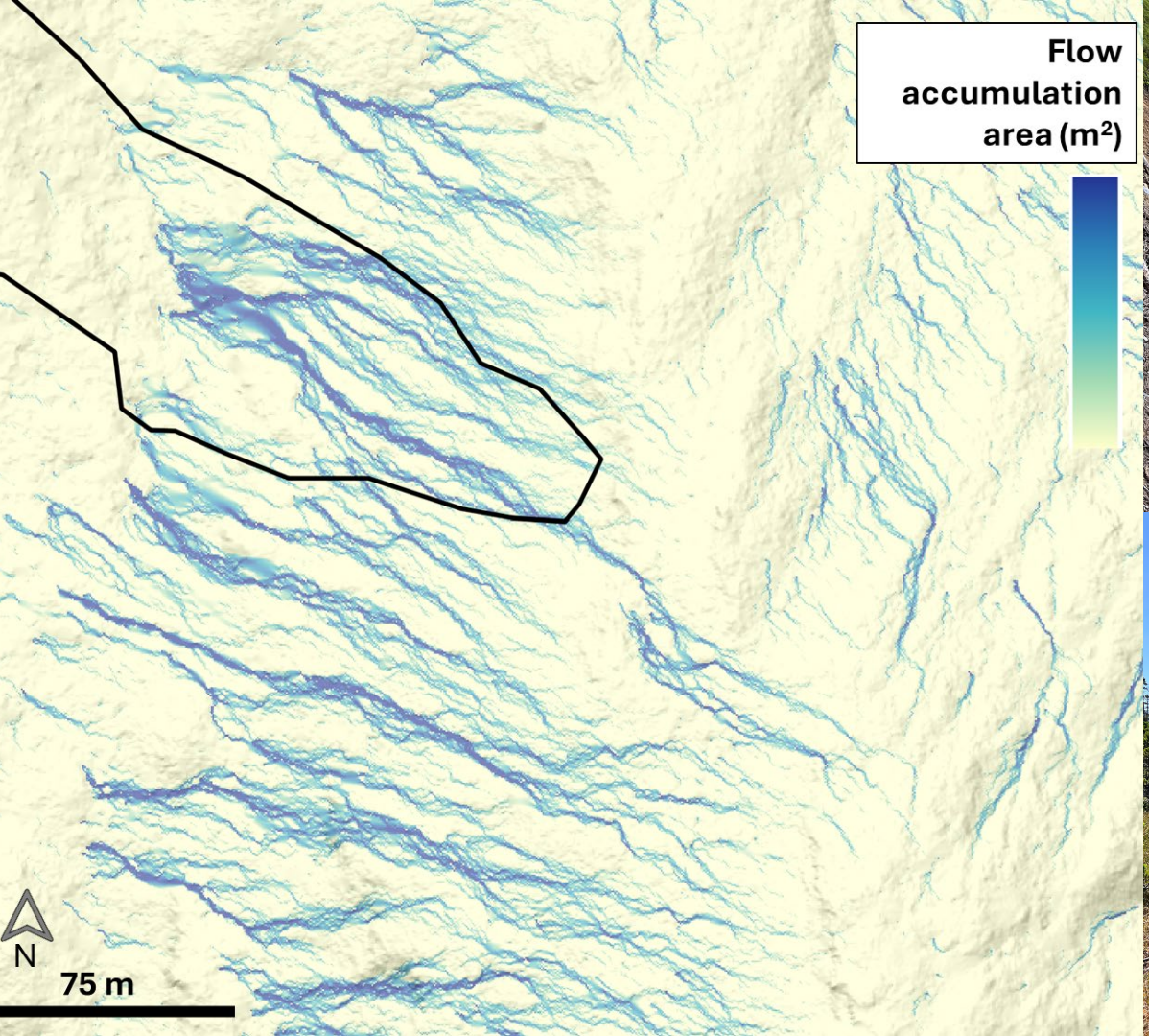
The landslide initiated on a steep hillslope with thick soil with indications of high saturation from upslope seepage

Looking north

Looking south

Hydrology of the initiation zone




Flow accumulation area (m²)
N
75 m


Seepage


Ridgetop muskeg water source

Why did it happen that day?

Images generated by Chat GPT

Pre-slide
tree canopy

Canopy
height (m)

45

0

N

250m

No substantial area of blowdown outside of the slide

Post-slide tree canopy

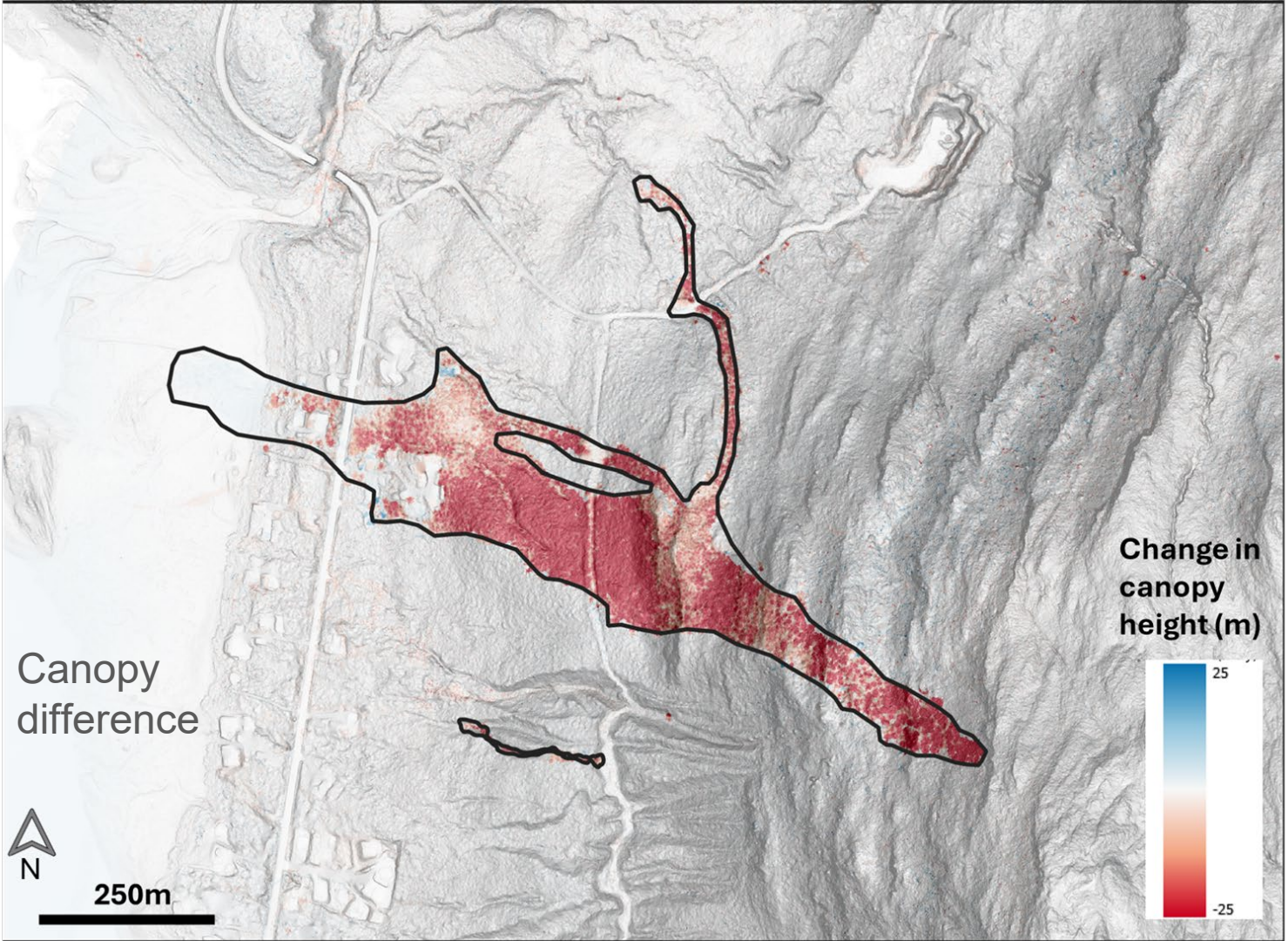
Canopy height (m)

45

0

N

250m


Canopy difference
N
250m
Change in canopy height (m)
25
-25

Results of tree slab analysis

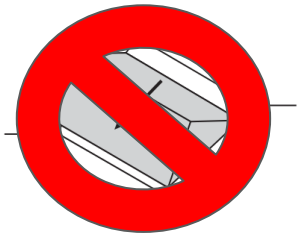
Photograph courtesy of J. Fields

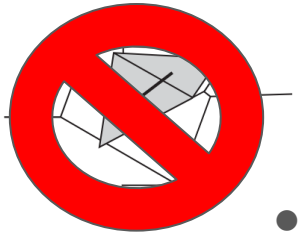
Results of tree slab analysis

- Sampled trees were ~300 years old
- Reaction wood present in all four tree slabs
- ~2,000 trees were removed by the landslide

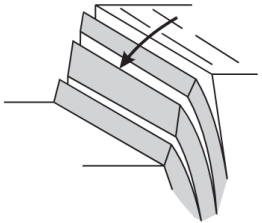
Materials: soil and bedrock, composition and structure

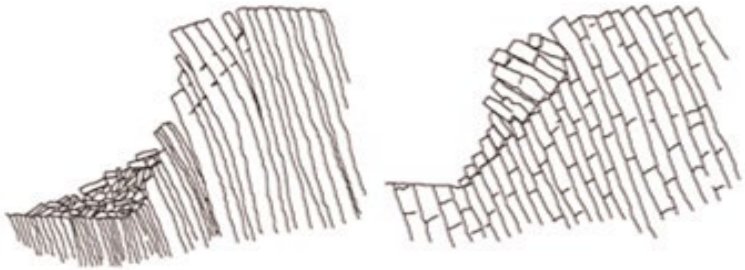
- SOILS: testing is ongoing; preliminary results - silty sand with gravel for slide material





- BEDROCK: In-the-field structural measurements of rock discontinuities (Schmidt Hammer)





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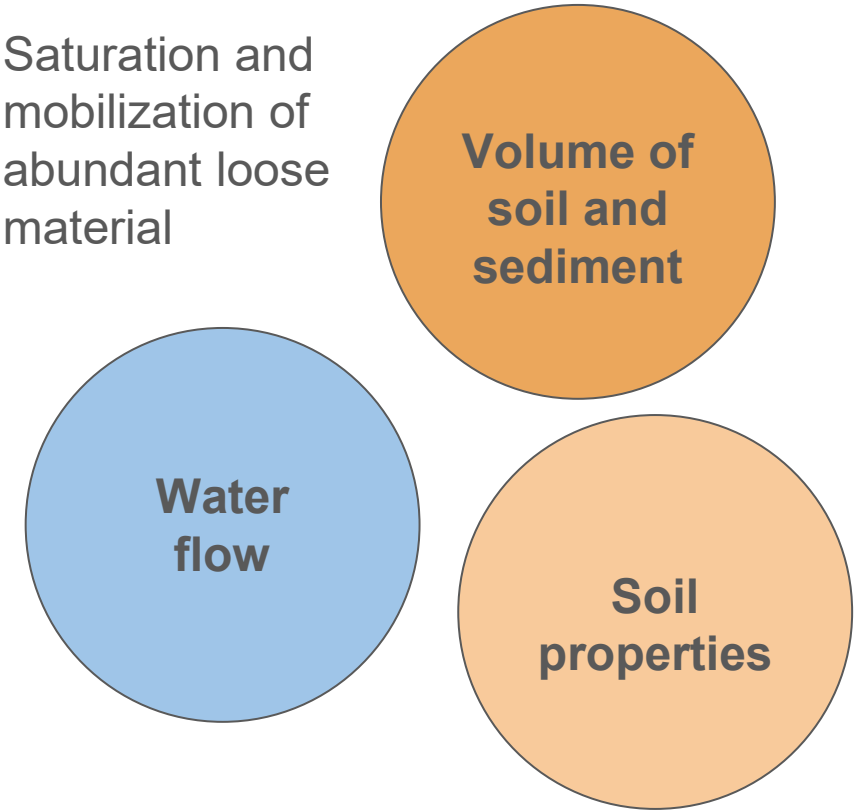
Saturation and mobilization of abundant loose material



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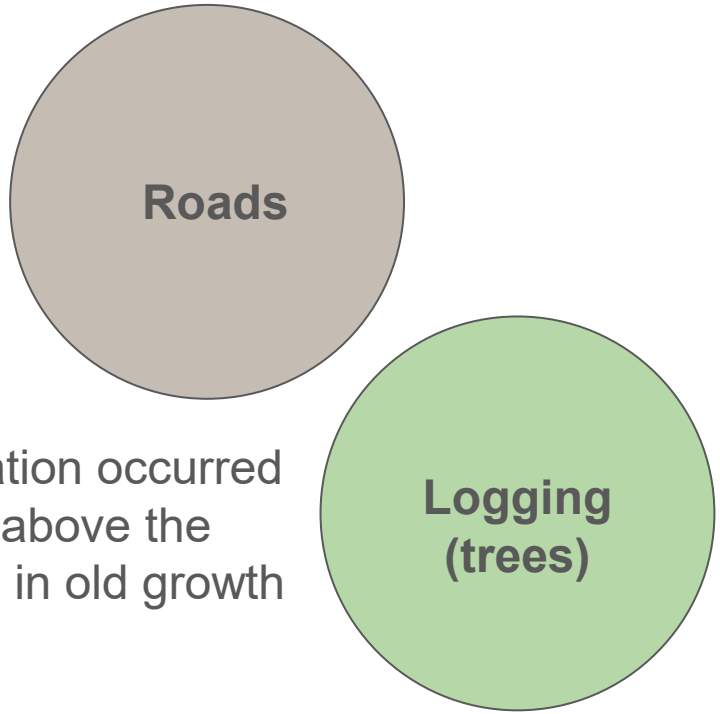

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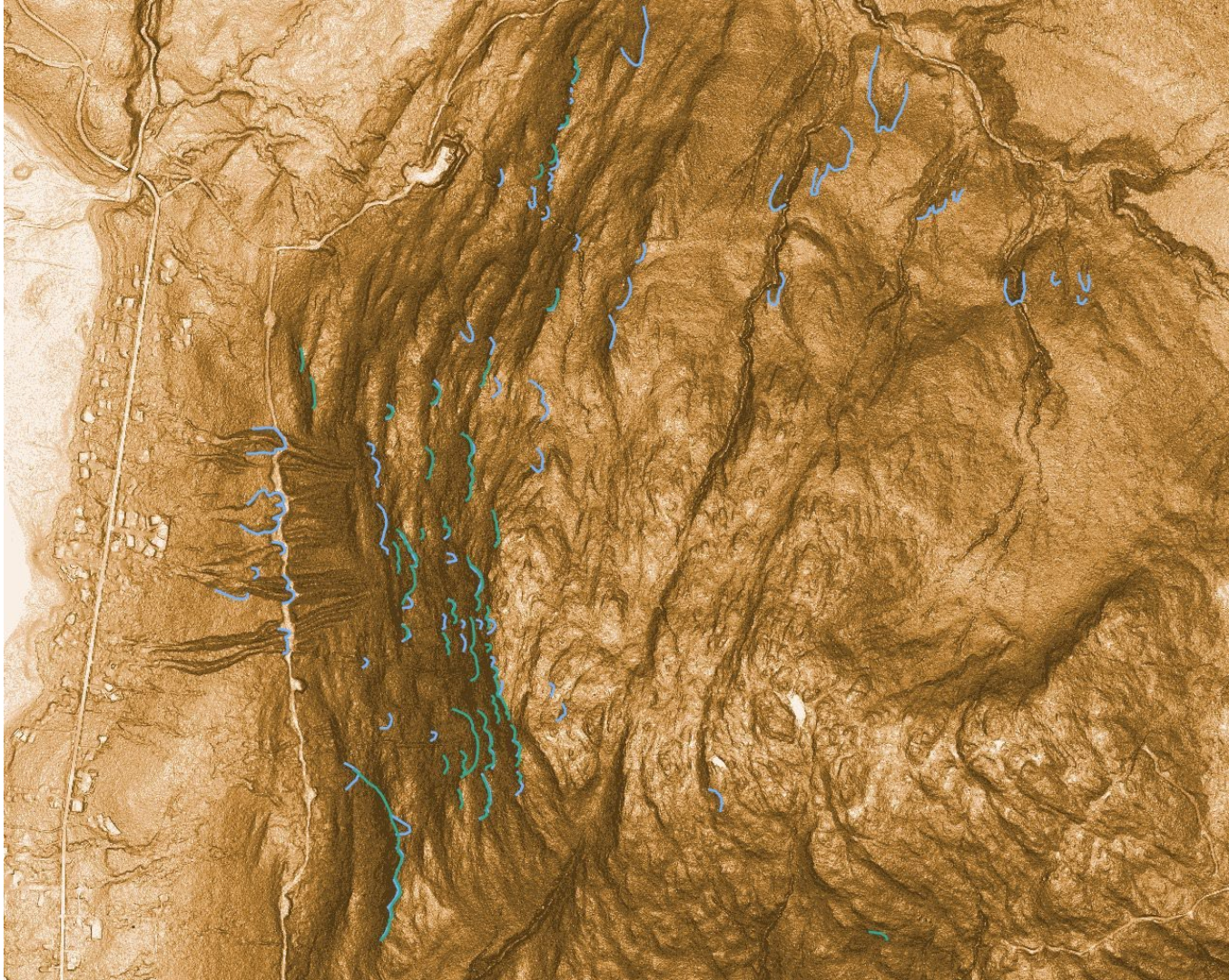
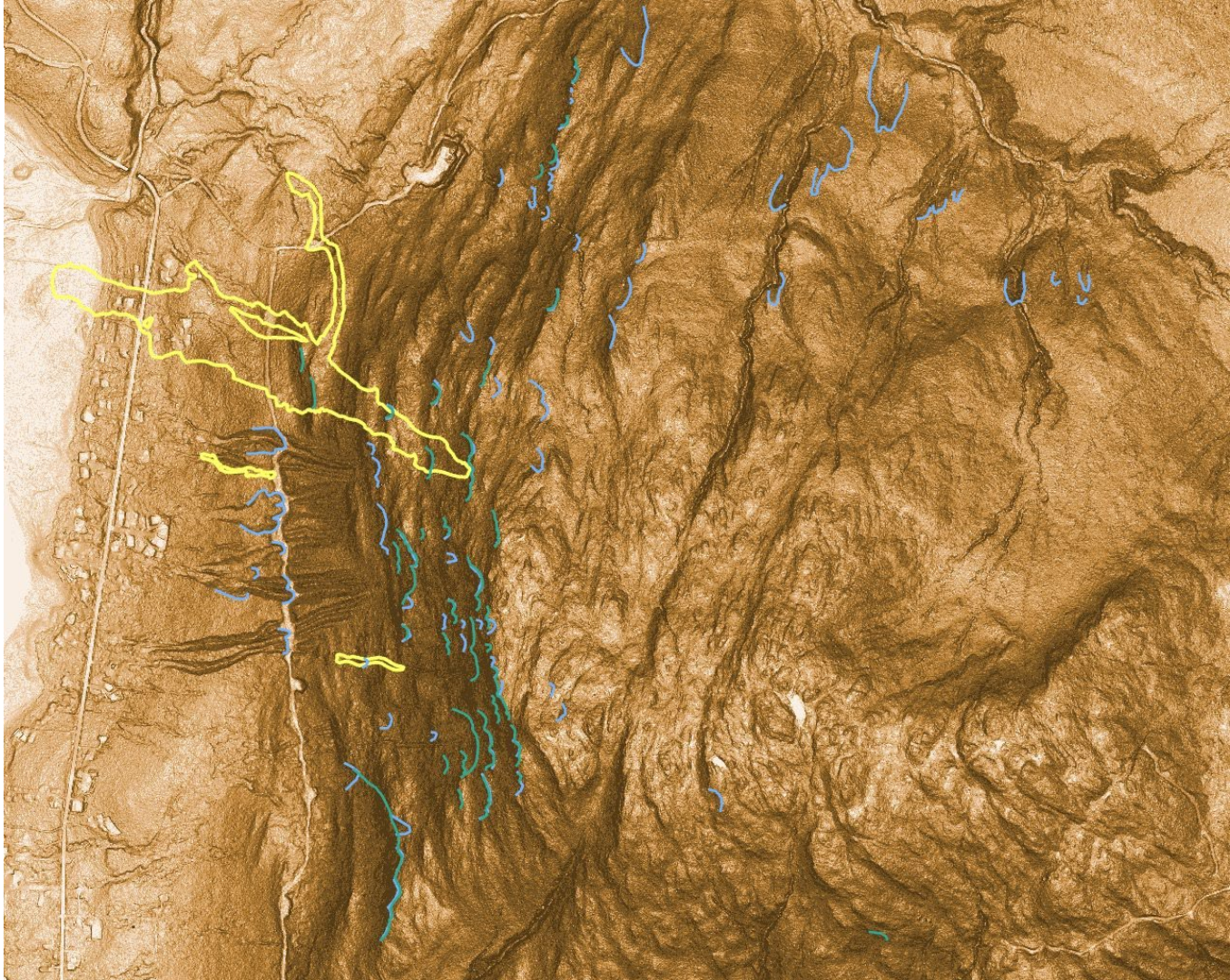
Mapping head scarps



Mapping head scarps, with the 2023 landslides

This map does not estimate runout (where do landslides go?)

Alaska state survey received further funding for mapping and modeling



What we don’t know

What about that storm triggered the landslide?

- Moderate rainfall
- No evidence for widespread blowdown
- **RECOMMENDATION**: hydrologic analysis of the ridgeline

Is a landslide this large possible anywhere else?

- **RECOMMENDATION**: how thick are soil accumulations on other hillslopes?

Middle Ridge Landslide was different…

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Please feel free to contact any of us!

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