Landslide Hazard Susceptibility Mapping Haines, Alaska

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For More Information:
Report of Investigation 2024-8
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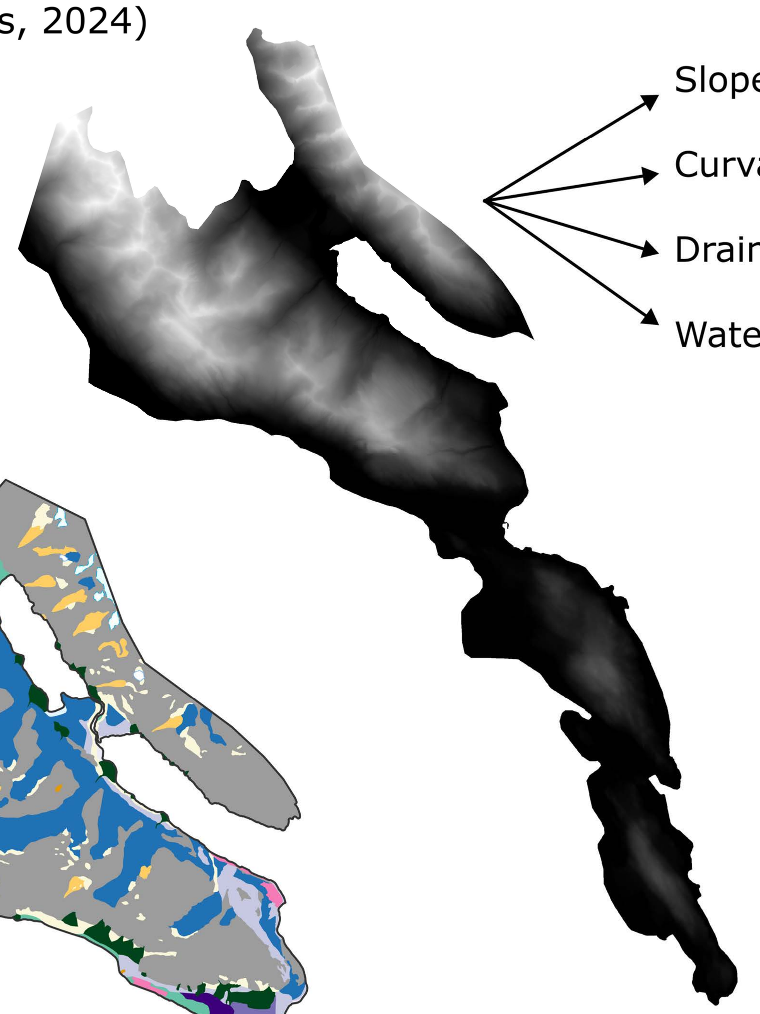
Introduction

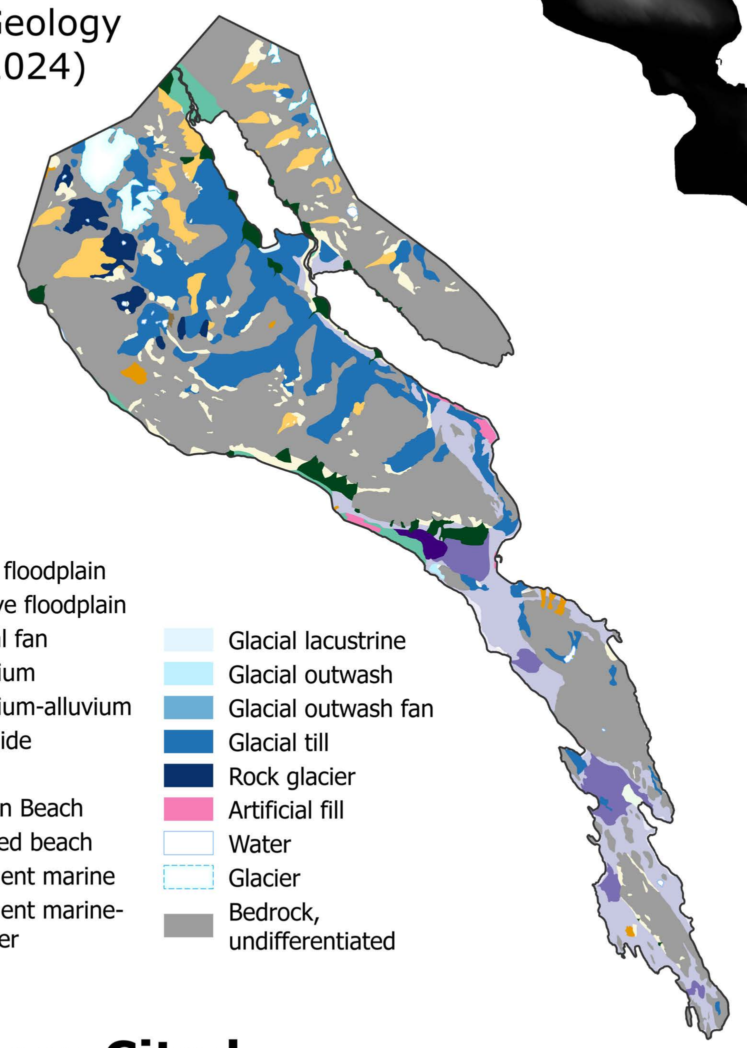
A record-breaking storm hit Southeast Alaska the first week of December 2020. This **atmospheric river** produced heavy rain in the Haines area. The rain mixed with snow on already frozen ground and caused flooding, road washouts, and numerous landslides. The landslide on Beach Road was widely publicized because it caused **two fatalities**. Landslides and debris flows in other areas of town also closed roads, impacted homes, and led to emergency evacuations. In total, **eight homes were destroyed** and at least 21 were temporarily inaccessible. There was widespread and long-lasting disruption of daily life.

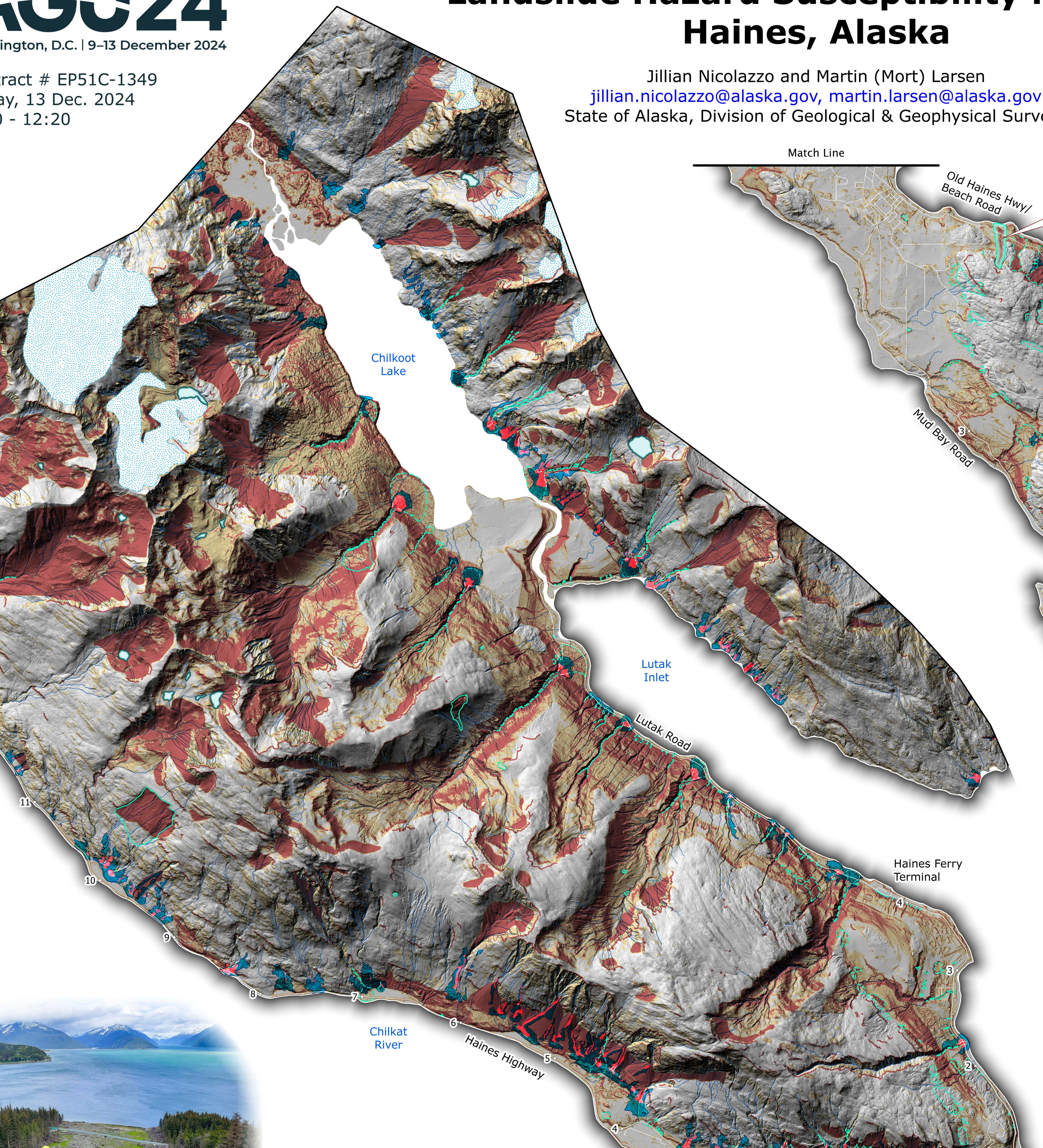
Inputs:

50-cm DTM
(Zechmann and others, 2024)



Surficial Geology
(Larsen, 2024)





Map Explanation

- Road milepost
- Road centerline
- DTM-derived drainage (Zechmann and others, 2024)
- Glacier (Larsen, 2024)
- Pond (Larsen, 2024)

Landslide Inventory

- Undifferentiated, high confidence
- Undifferentiated, approximate

Shallow Landslide Susceptibility

- Moderate: FOS 1.25 - 1.50
- High: FOS less than 1.25

Channelized Debris Flow Inundation

- Typical event: low volume, high frequency
- Extreme event: high volume, low frequency

Beach Road landslide, photo from May 2023

Methods

This poster is a simplified compilation of three map sheets generated for the *Landslide Hazard Susceptibility Mapping in Haines, Alaska* project.

The **landslide inventory** map integrates previously mapped landslides with newly mapped slope failures that were identified using high-resolution light ranging and detection (lidar) datasets, and available aerial imagery (landslides, debris flows, and rockfalls, are shown here undifferentiated). This inventory was prepared using protocols similar to that of Burns and Madin (2009) and was used as an input layer in both shallow landslide susceptibility and debris flow susceptibility.

Shallow landslide susceptibility combines the landslide inventory and surficial deposits (Larsen, 2024) with calculated factors of safety (FOS) following the protocols of Burns and others (2012). FOS is the relationship between forces acting to move material downslope and forces resisting that movement.

$$FOS = \frac{\text{Resisting Forces}}{\text{Driving Forces}}$$

A slope is theoretically stable where the resisting forces are greater than the driving forces, and is theoretically unstable where the driving forces are greater than the resisting forces. Due to variability and uncertainties across a slope or soil unit, and to be conservative, for this project, an FOS less than 1.25 is considered highly unstable, and an FOS between 1.25 and 1.50 is moderately unstable.

The **channelized debris flow deposition** areas shown here were modeled using the protocol developed by Burns and others (2022) and are based on physical characteristics of the ground surface (i.e. slope and curvature) that were derived from a 50-centimeter digital terrain model (DTM; Zechmann and others, 2024). Several iterations were performed to find the input parameters that best matched debris flow deposition after the December 2020 storms.

Deposition occurs where the slope flattens, stream flow slows, and sediment settles out of the water. The "typical" event shown here has a relatively low-impact and might occur every few years or decades. Once these parameters were selected, they were scaled-up to model the "extreme" event, which is a high-impact event that might occur once per millennia or less frequently.

References Cited

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