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Insights from a LiDAR-based manual inventory of the recent earthquake-induced landslides case in Japan

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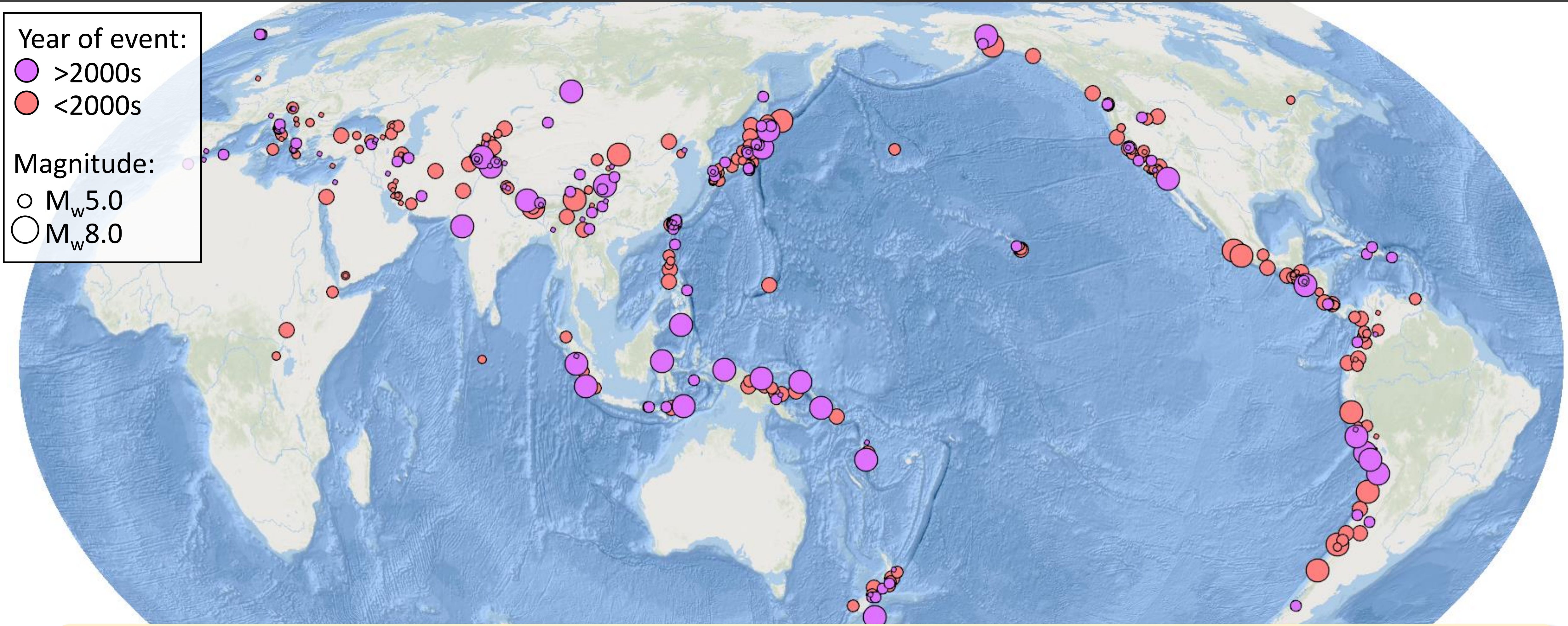
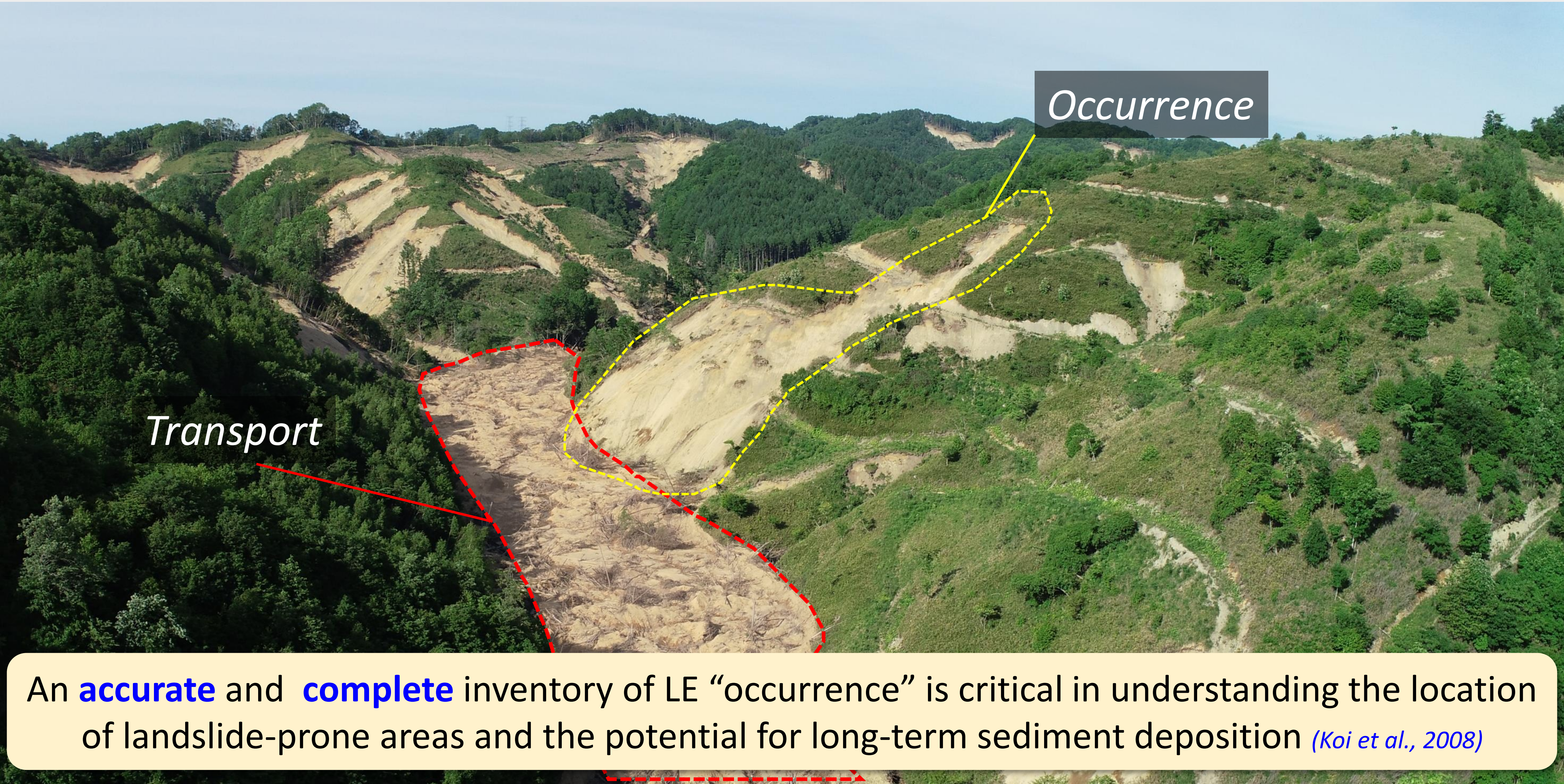
Global Earthquake-Induced Landslides (LE)

- USGS—LE Open Repository → **371 recorded LE events** (1906-2020)



LEs are present on all continents and poses a serious hazard to communities and river ecosystems.
LE Inventory is important to investigate the distribution and location of landslides

Accurate and complete inventory of landslide “occurrence”



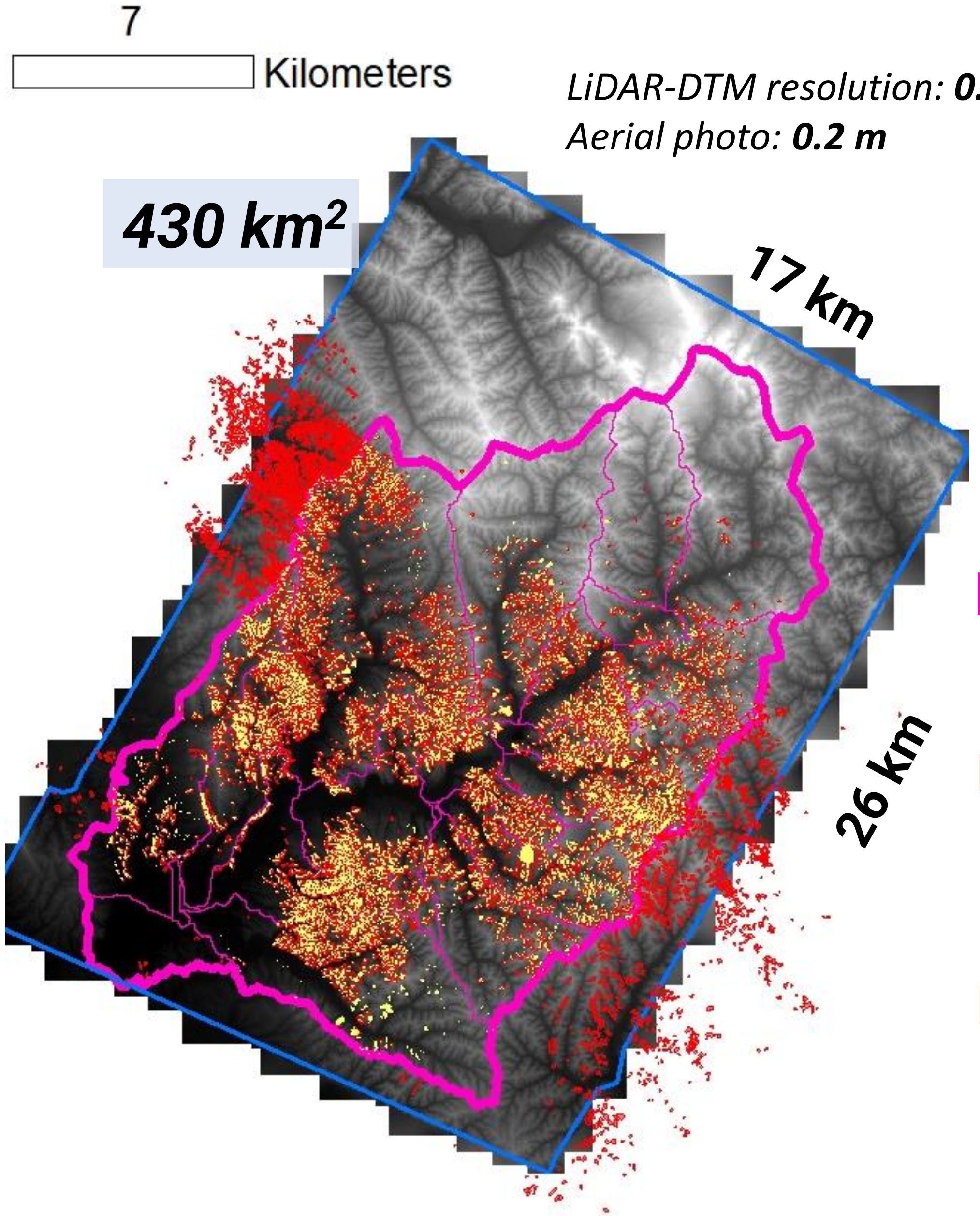
An **accurate** and **complete** inventory of LE “occurrence” is critical in understanding the location of landslide-prone areas and the potential for long-term sediment deposition *(Koi et al., 2008)*

The dilemma of landslide amalgamation

Few studies focused on separating individual LE from amalgamations for the sake of a complete and accurate inventory → Using LiDAR-DTM to separate amalgamated landslides

The 2018 Hokkaido Eastern Iburi Earthquake

LiDAR-DTM resolution: ***0.5 m***
Aerial photo: ***0.2 m***

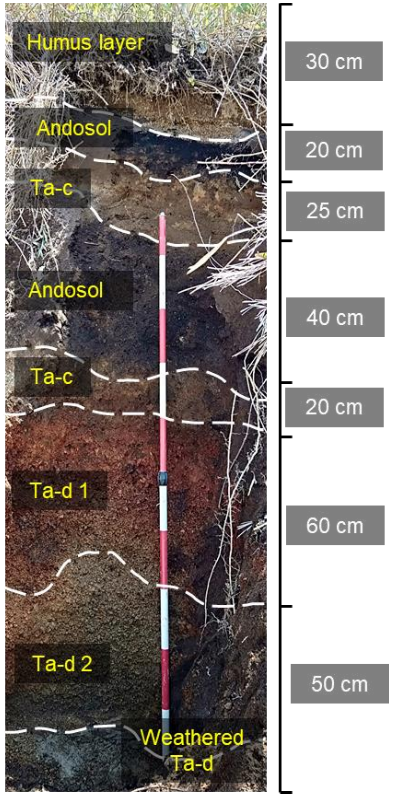


Atsuma watershed (80% of total areas affected by landslides)

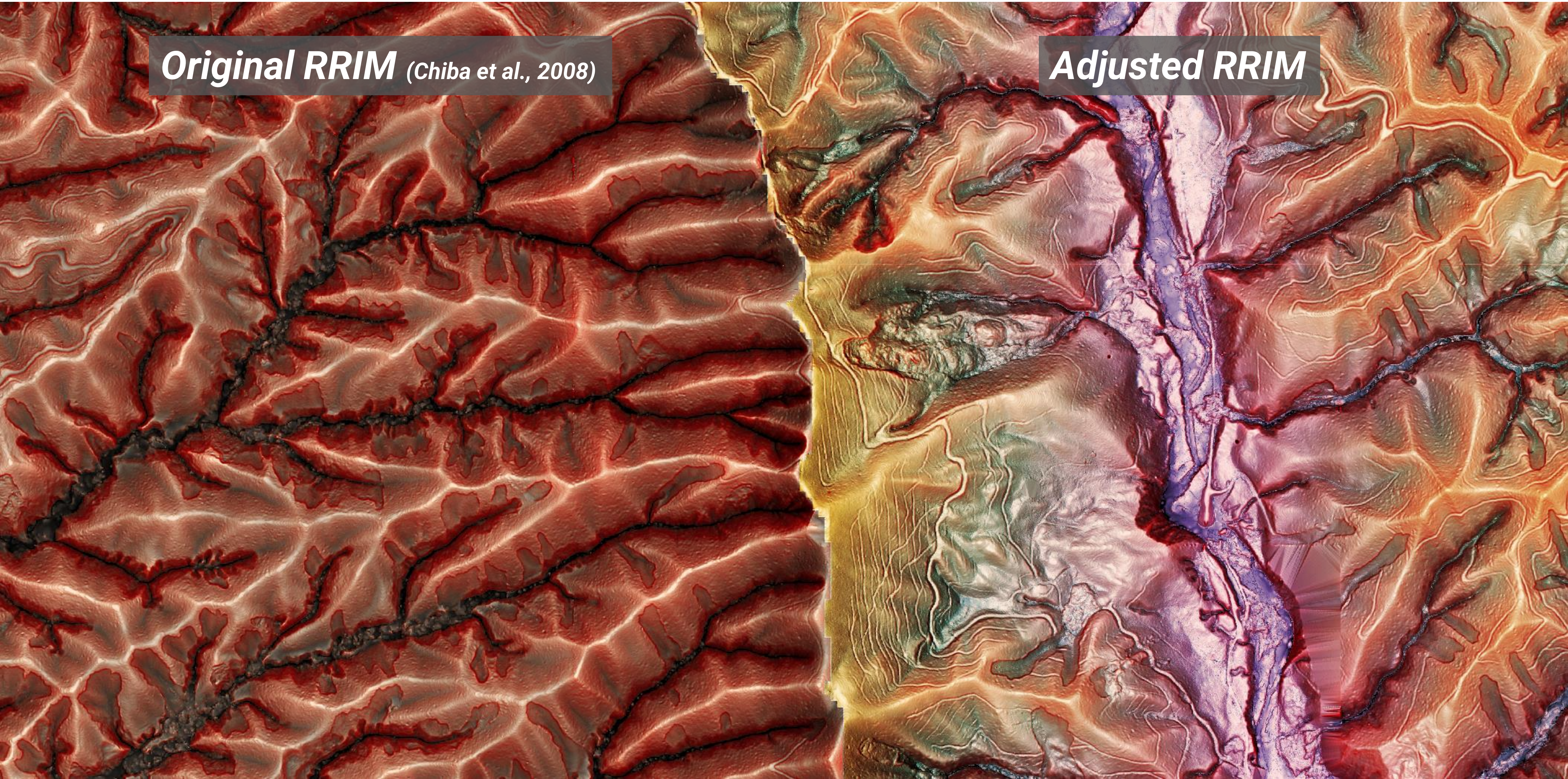
Delineated landslides by a semi (automated) inventory or **SA** *(Kita, 2018)*

Delineated landslides by manual LiDAR-DTM or **ML**

- Landslide slip surface → volcanic deposits of Ta-d layer (depth: 1.4m)
- Elevation of **36-400 m asl**
- The mean annual precipitation and air temperature are **997 mm and 6.7°C.**



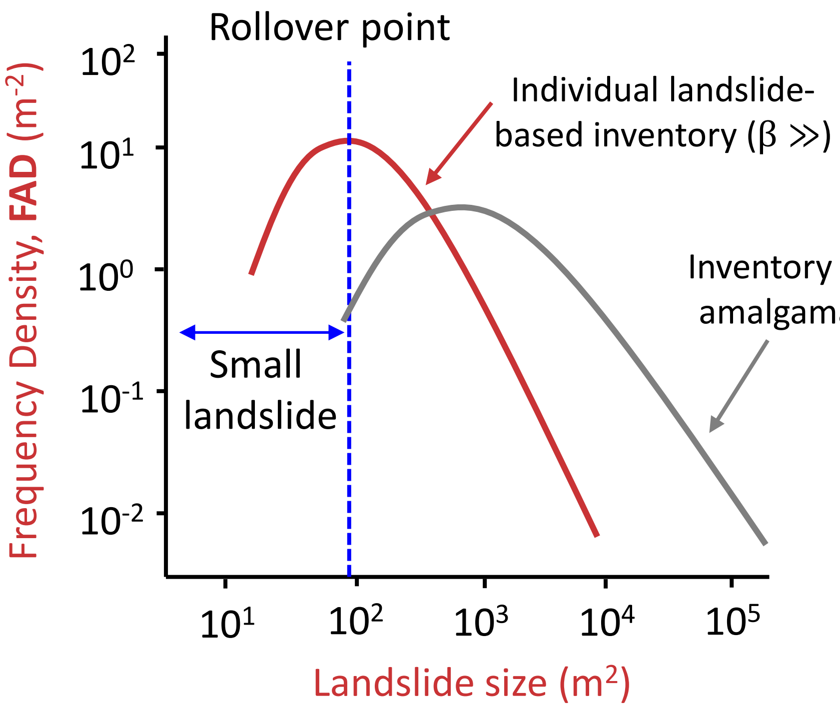
LiDAR-DTM visualization used for manual inventory



The reliability of landslides occurrence inventory

Mapping accuracy

- Map each landslide feature separately (landslide scar, deposition), including in the amalgamated form *(Fan et al., 2019)*.

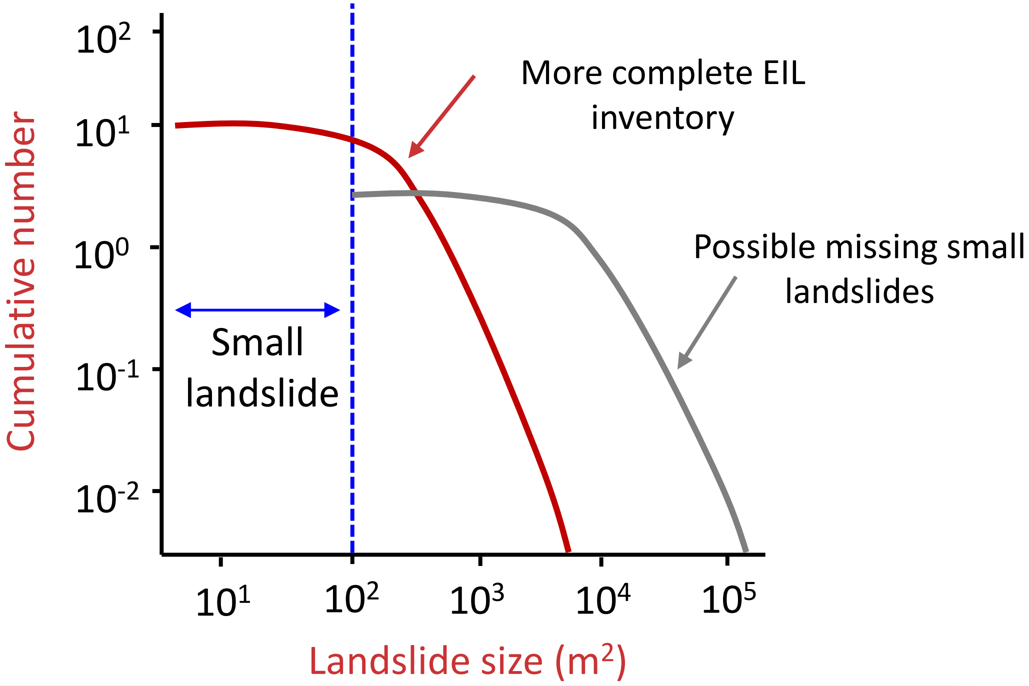


Non-cumulative size distribution

Cumulative size distribution

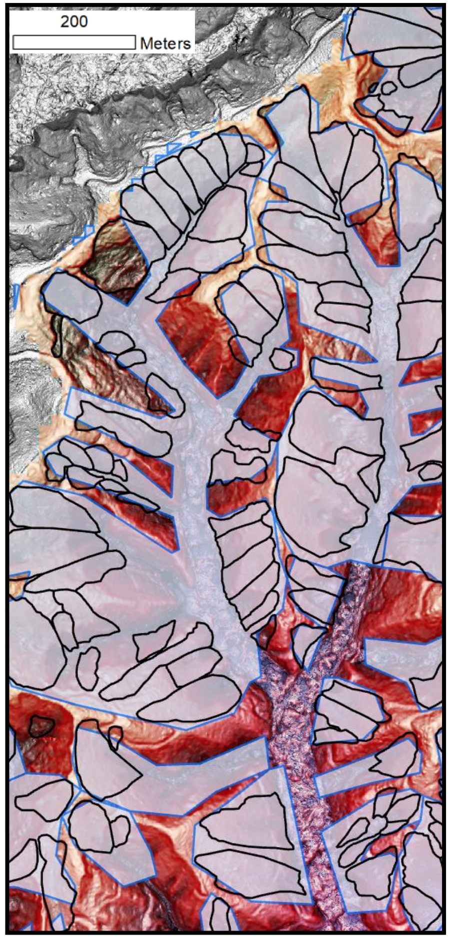
Completeness of landslide inventory

- Includes all co-seismic under dense forest cover (including a substantial fraction of the smallest landslides) *(Guzzetti et al., 2012)*.

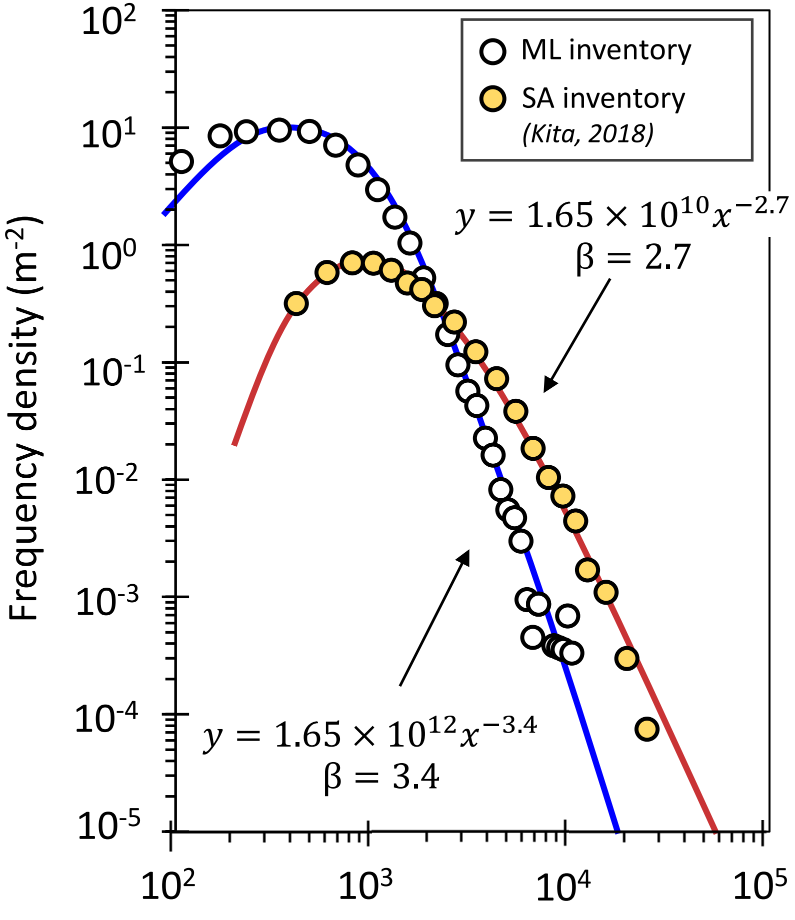


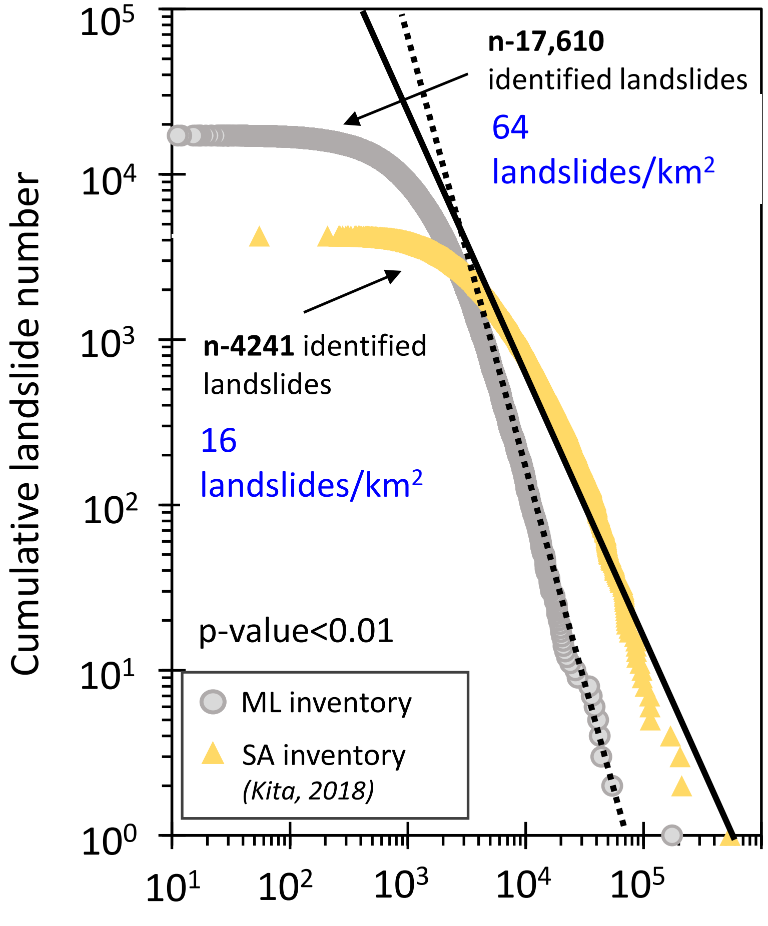
Comparing two inventories by using non-cumulative and cumulative distribution would give clear images to detect the effect of landslide amalgamations

Manual LiDAR (ML) vs Semi-Automated (SA)

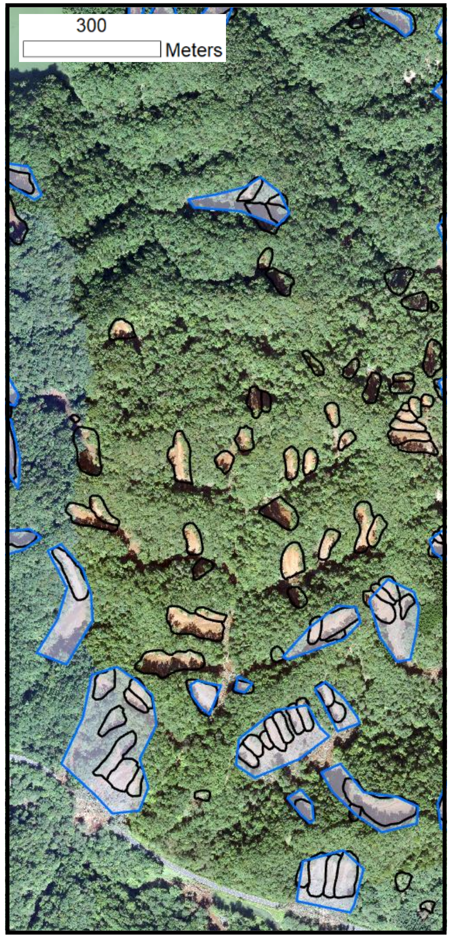


LiDAR inventory
Aerial inventory *(Kita, 2018)*





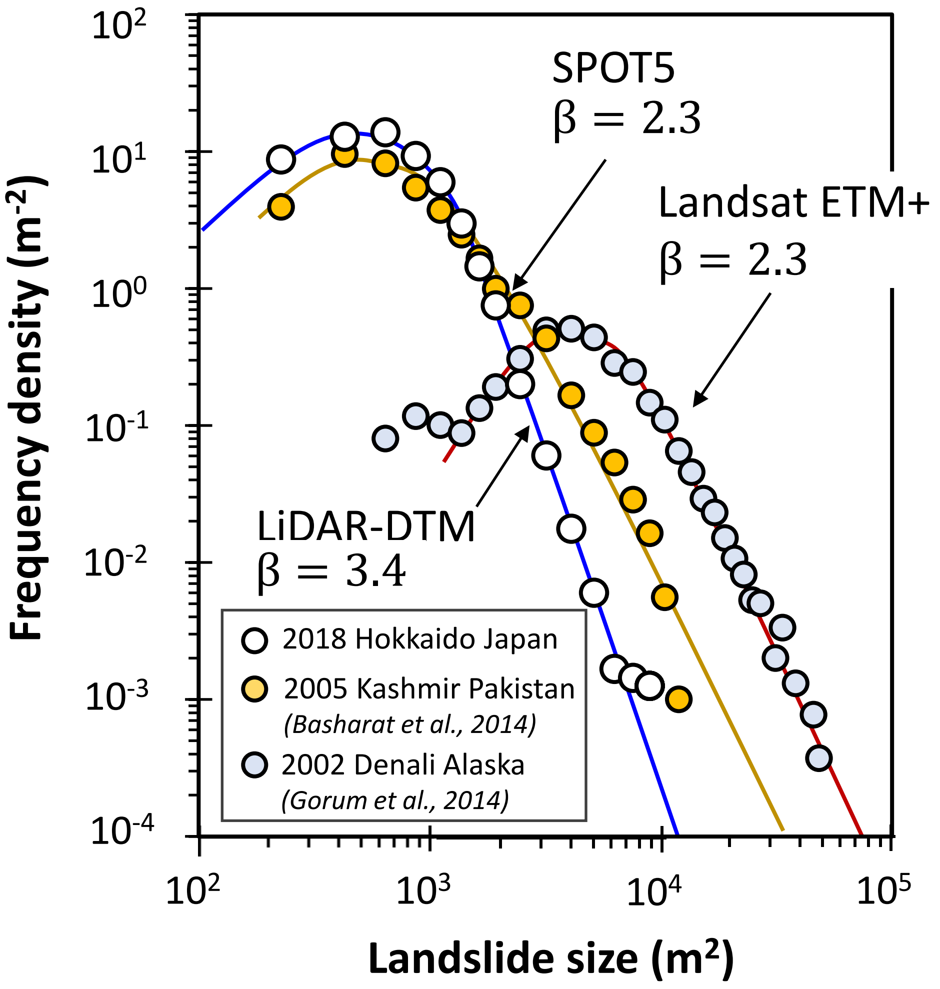
Landslide size (m^2)

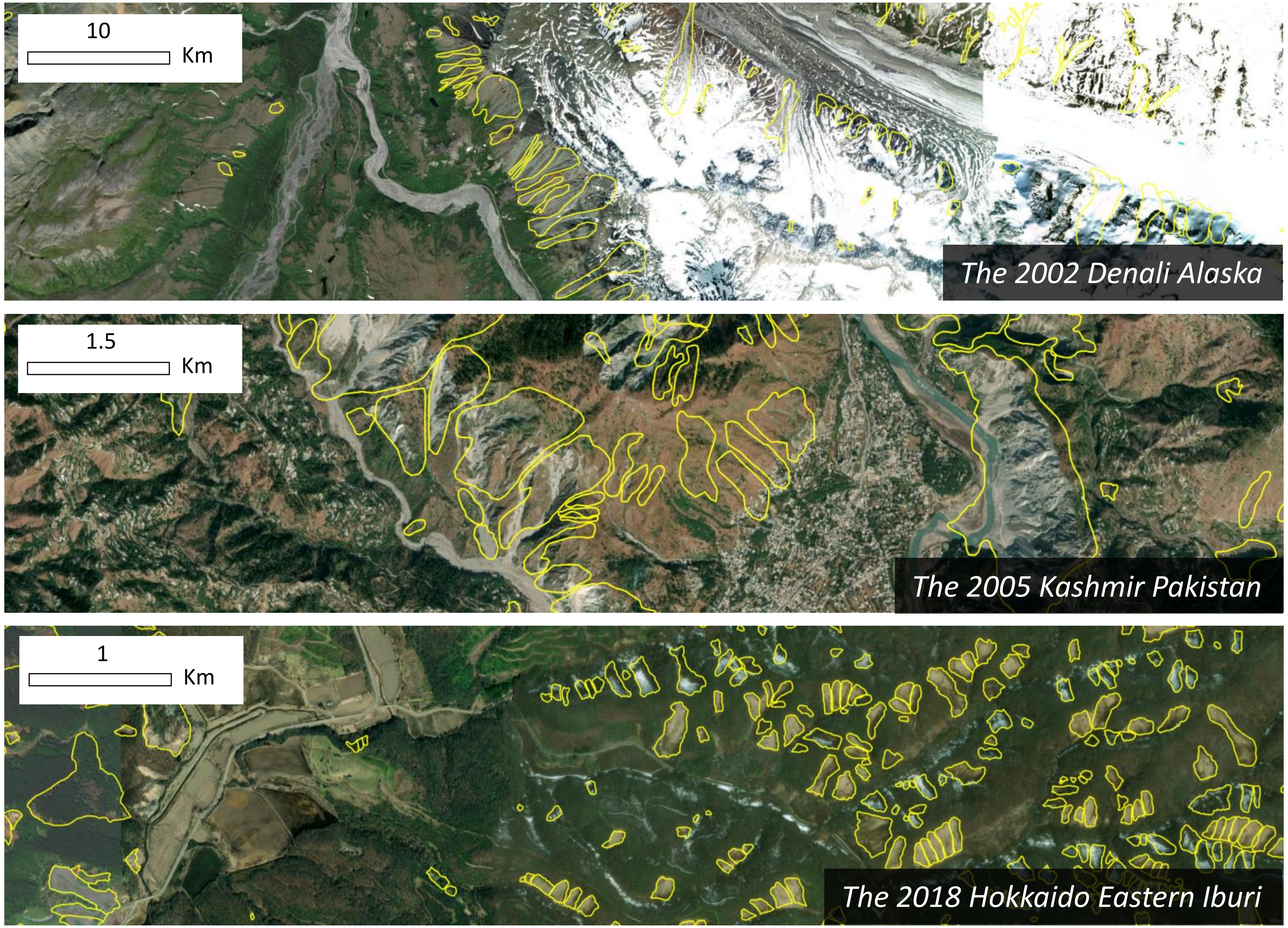


LiDAR inventory
Aerial inventory *(Kita, 2018)*

The ML inventory makes it possible to detect more individual landslides even though they were amalgamated, especially for smaller landslide sizes.

Why so small compared to the other LE?





Topography might be one of the reasons for small sizes landslides in 2018 Hokkaido LE → limiting the boundaries of sliding material (despite the reliability of ML inventory)

Summary

1. We found amalgamation landslides produced by SA tended to include the channels in the delineation → sediment transport results would be problematic in sediment disaster recovery and disaster control structure.

2. Manual LiDAR-DTM inventory could visualize individual landslide occurrence clearly, with four times more individual landslides compared to Semi-Automated inventory

The ML inventory might contribute to the USGS Open Repository of Earthquake-induced landslides

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