

Giant Volcano Flank Motion Imaged by Historical Air Photos Correlation during the M7.7 Kalapana Earthquake (1975), Big Island, Hawaii

Stefano Mannini, Joël Ruch, James Hollingsworth,
Don A. Swanson, Ingrid Johanson

¹ Department of Earth Sciences, University of Geneva, Switzerland

² ISTERre Université Grenoble Alpes, France

³ U.S. Geological Survey - Hawaiian Volcano Observatory, United States of America



**UNIVERSITÉ
DE GENÈVE**

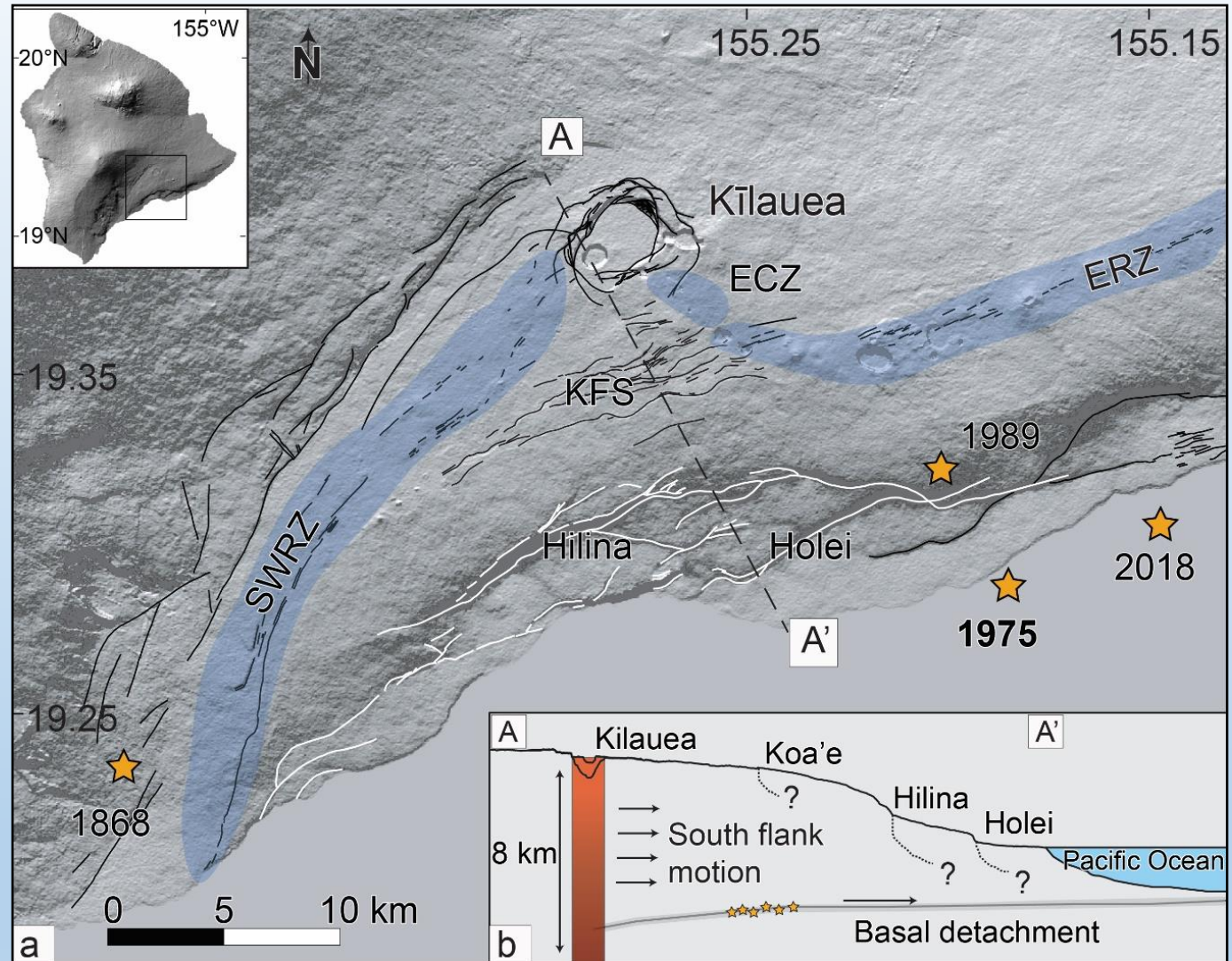


FONDS NATIONAL SUISSE
DE LA RECHERCHE SCIENTIFIQUE



Kīlauea volcano

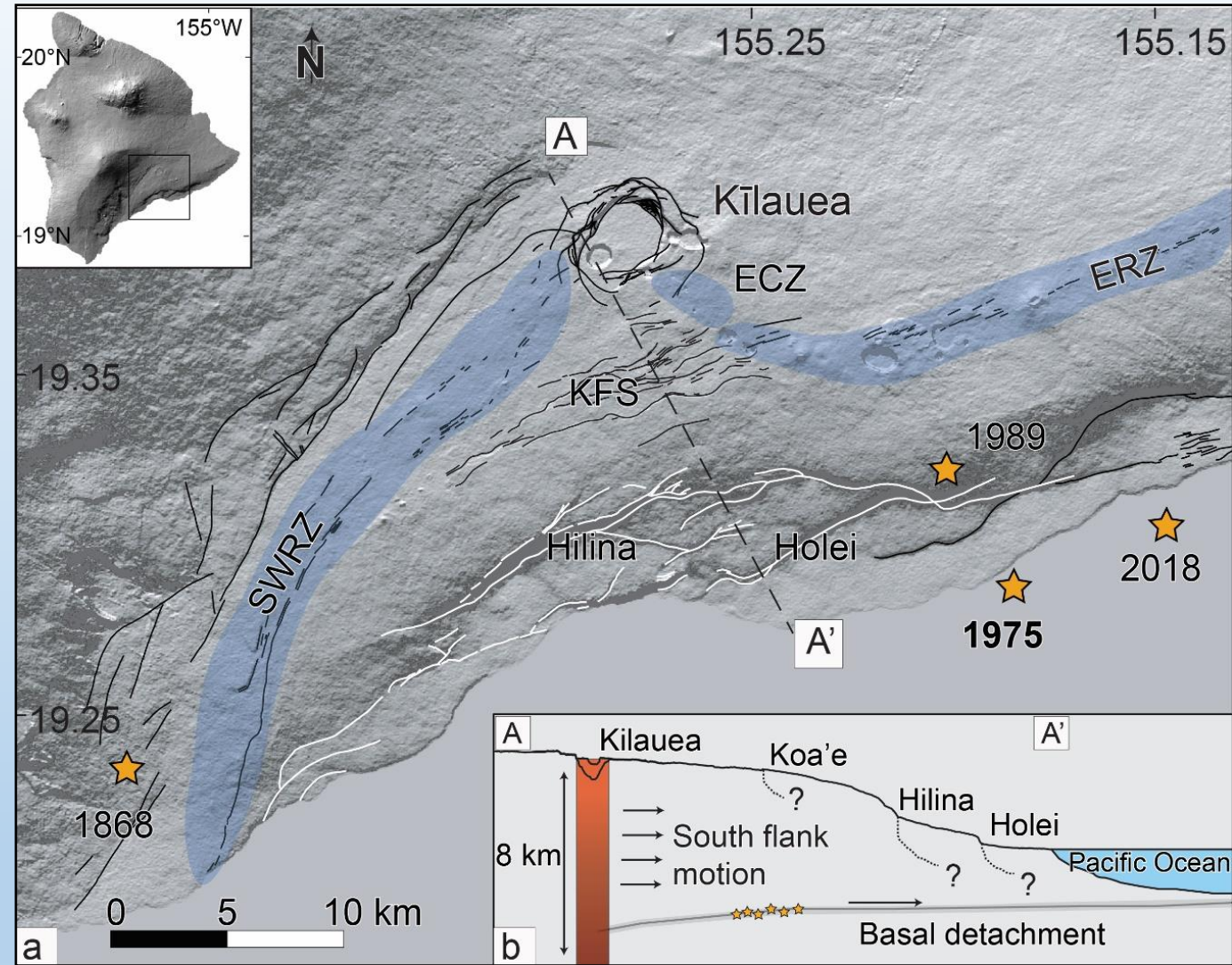
- **Recurrent volcano-tectonic events** (1868, 1969, 1974, **1975**, 1989, 2018)
- **Large flank instability** (~ 10 cm/yr) interrupted by metrical displacement (5 m) triggered by **magmatic intrusion** and **flank instability acceleration**
- Unique area to study the evolution of fracture zone affected by **magmatic intrusion** and **gravitational spreading**



(Mannini et al., in prep)

Aim of this study

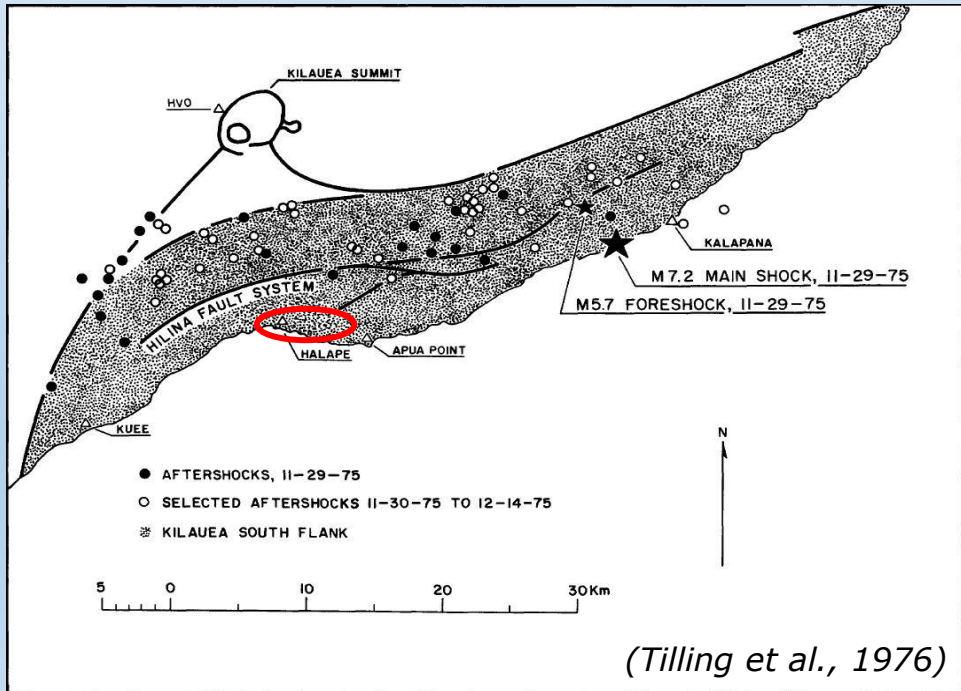
- Quantifying the **ground displacement** that occurred during the M 7.7 Kalapana earthquake (1975) along **the entire south flank** of Kilauea volcano
- Identify **which** fault was **re-activated** during the event
- How the faults are connected with basal detachment ?



(Mannini et al., in prep)

1975 Kalapana earthquake

- Magnitude **7.7** largest earthquake since 1868
- Small eruption inside the caldera
- Tsunami wave **12m**
- Maximum **horizontal** displacement **8m** and **vertical** displacement **4m** (*Lipman et al, 1985*)

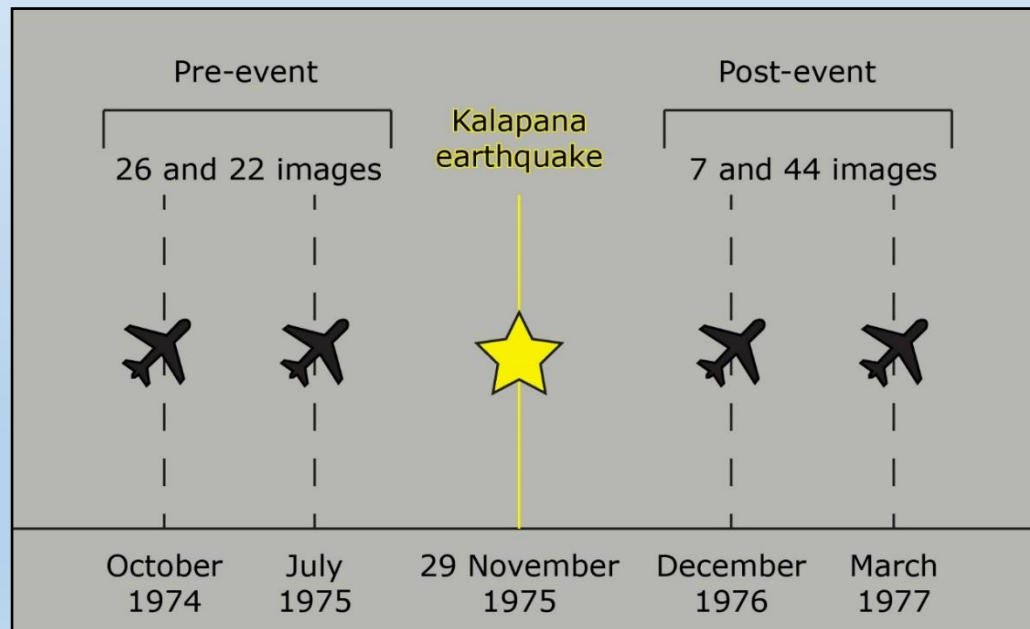


(USGS 1975)

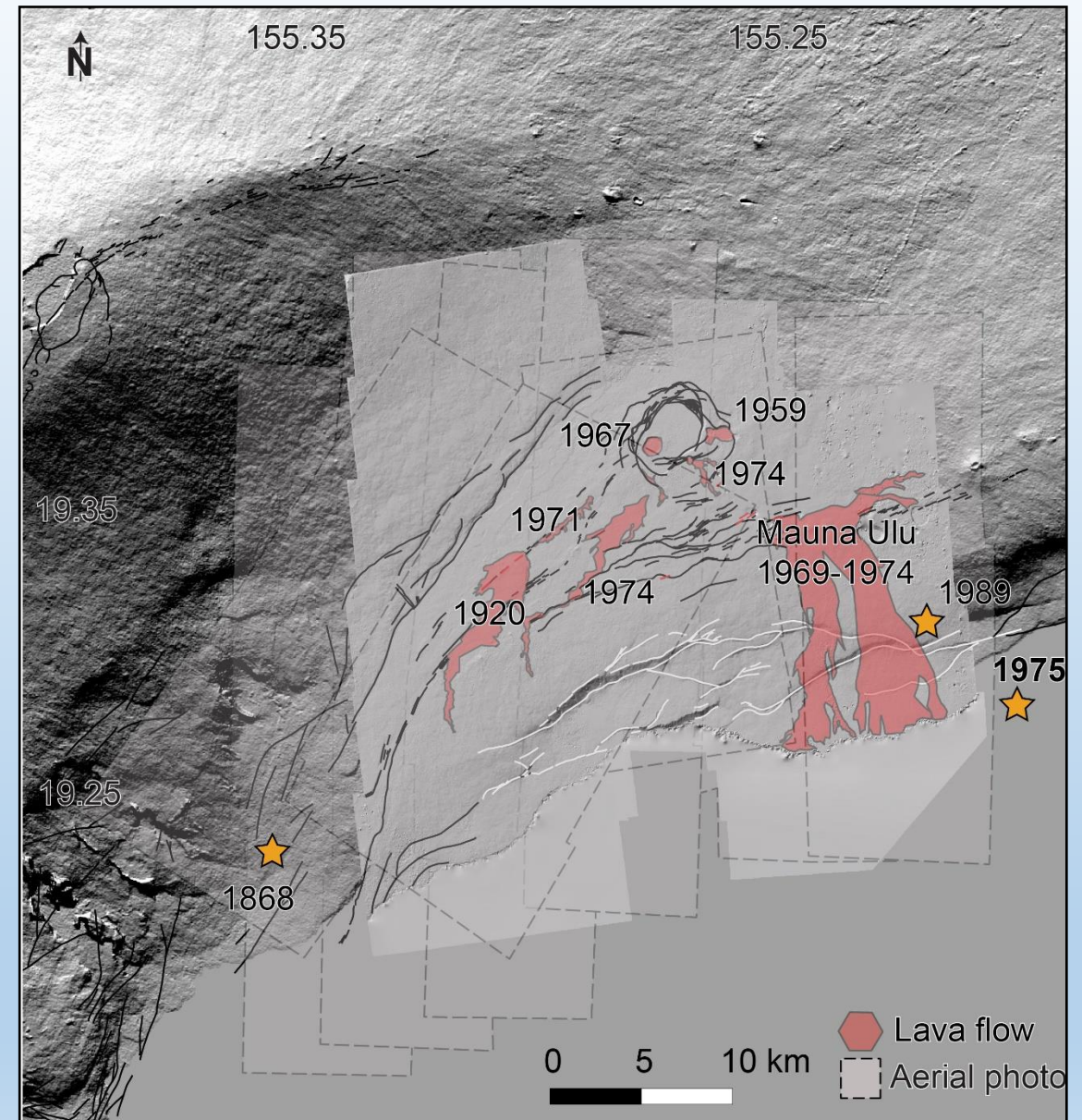


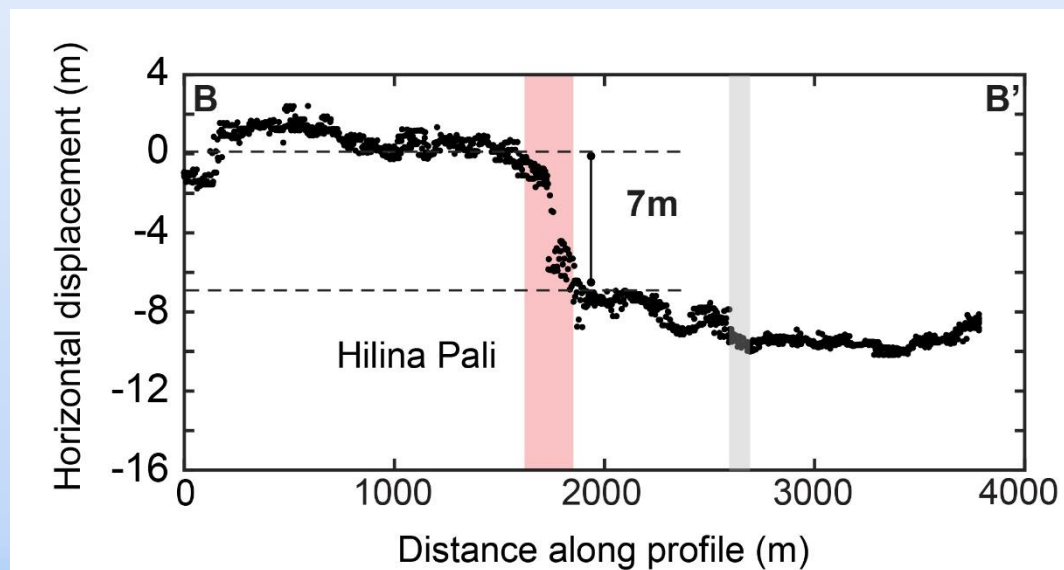
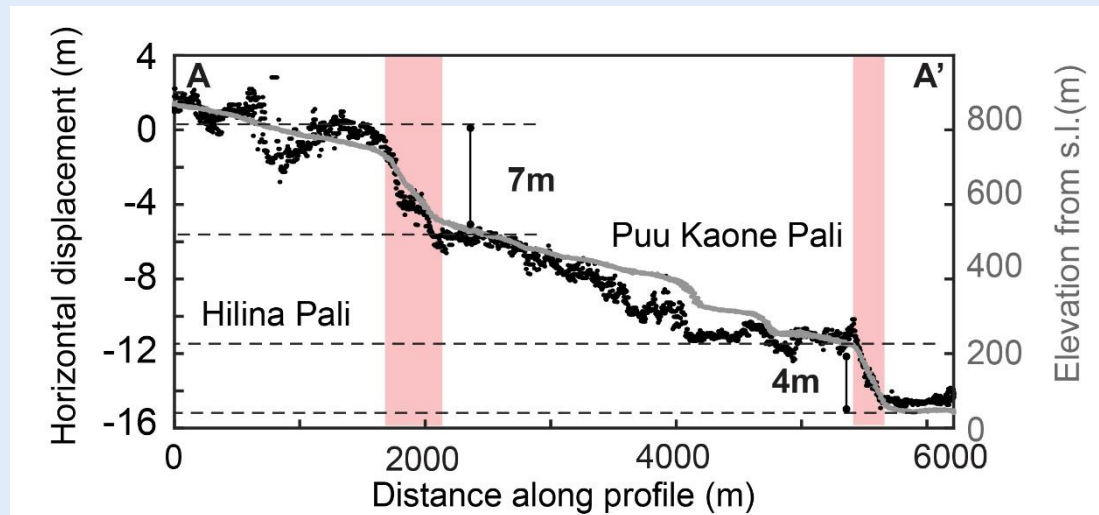
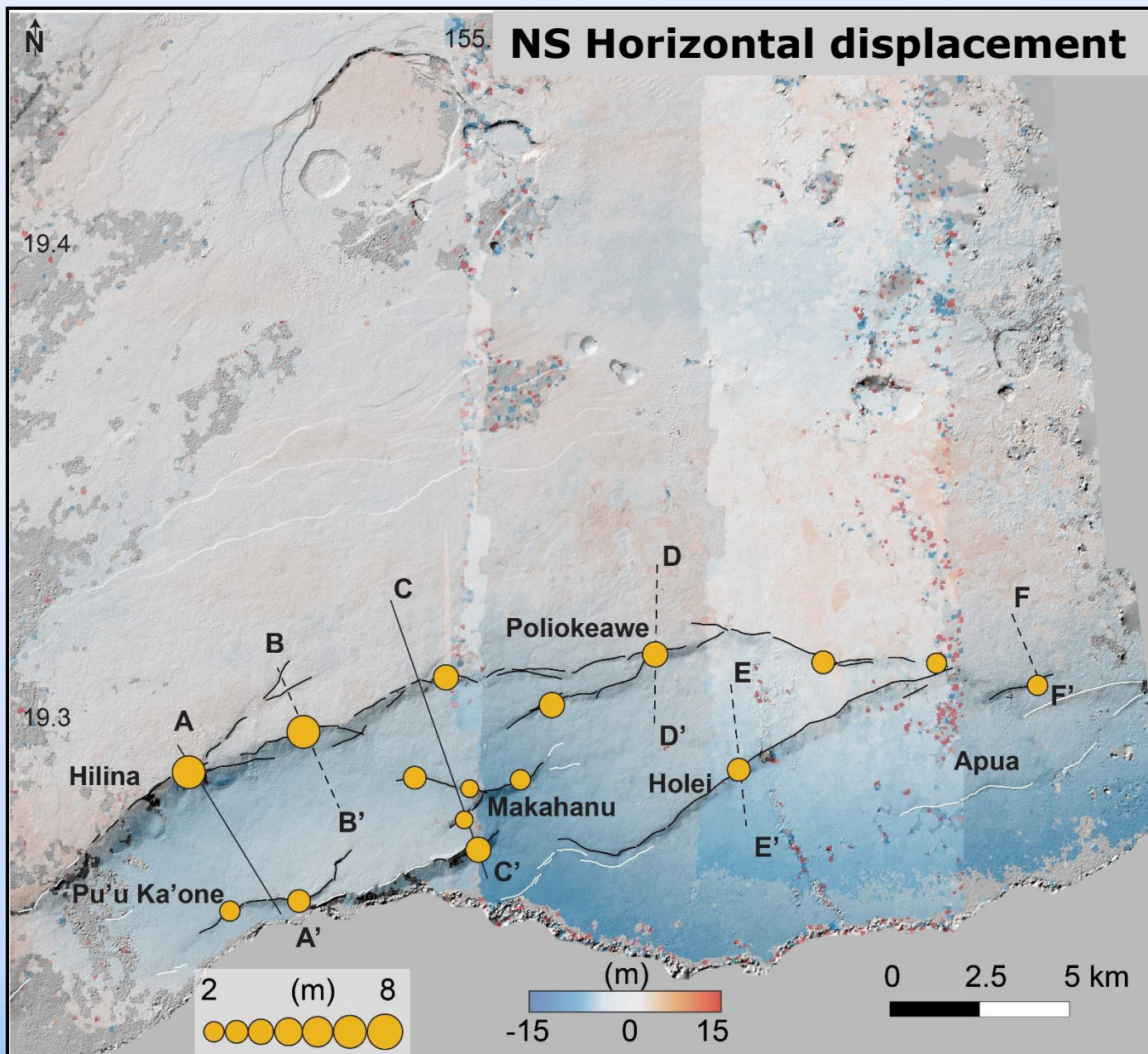
Air photo correlation

- The flight surveys covered **the entire south flank rupture**.
- Combining **optical images** collected before and after the earthquake, we evaluate the **ground displacement** during the event.

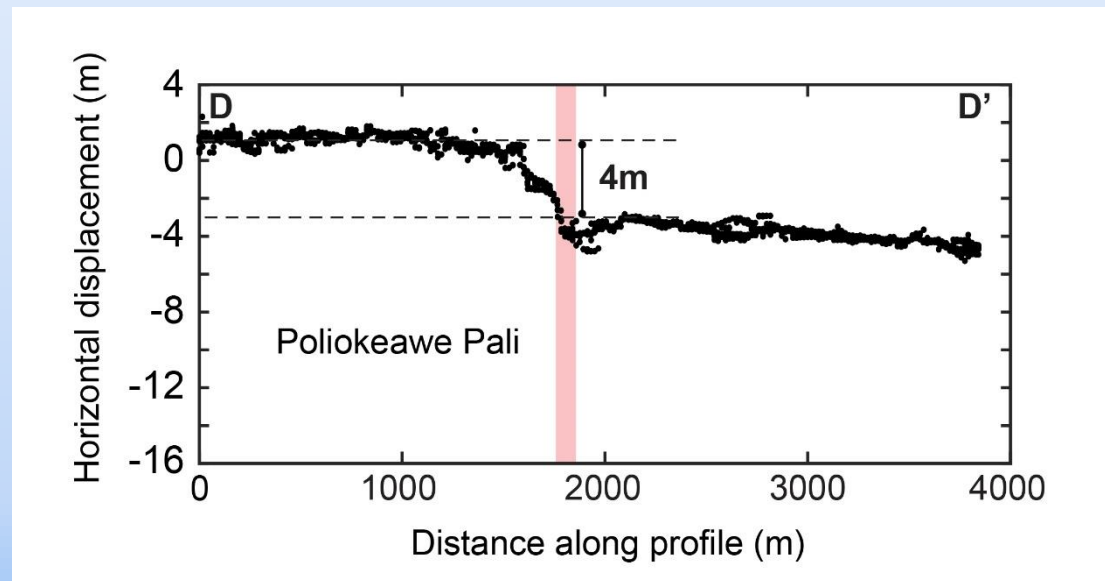
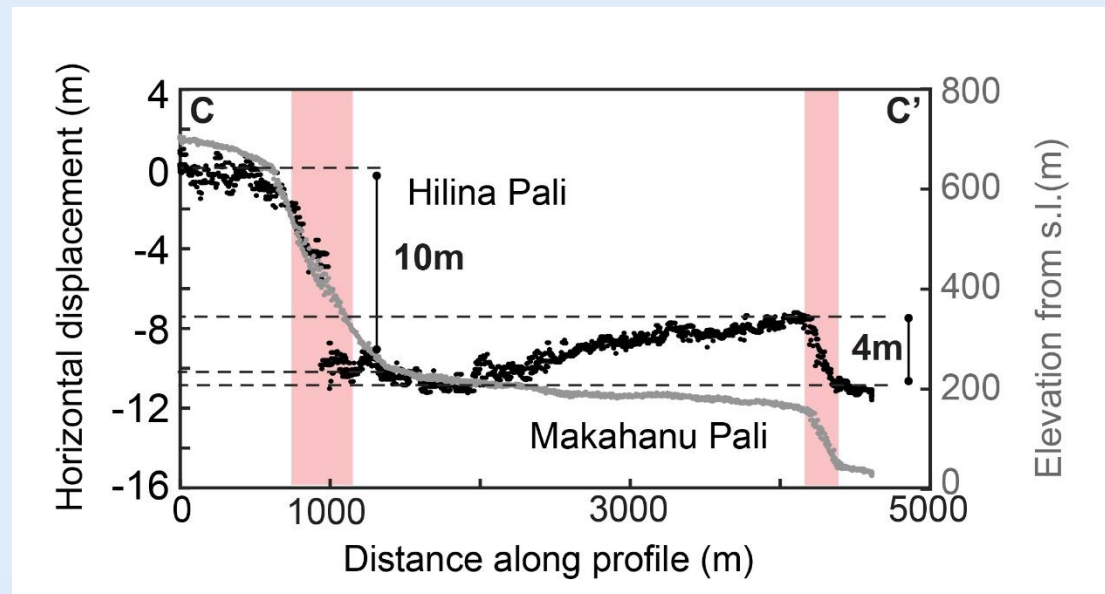
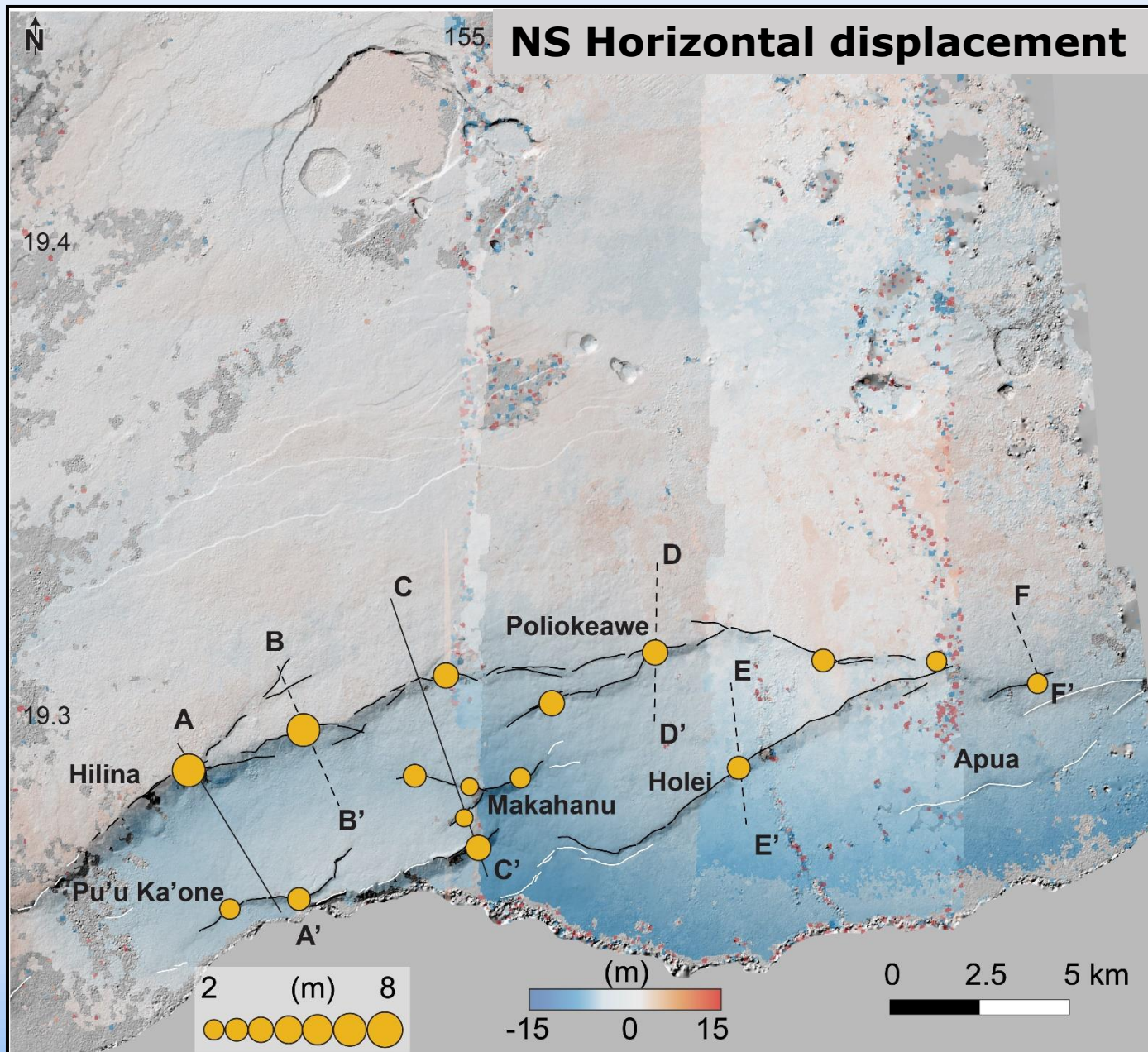


(Mannini et al., in prep)

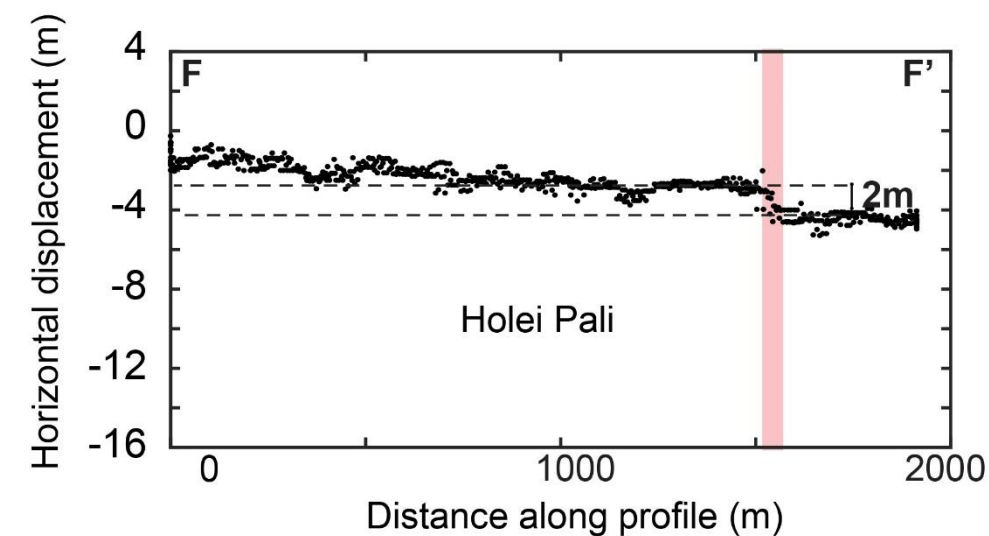
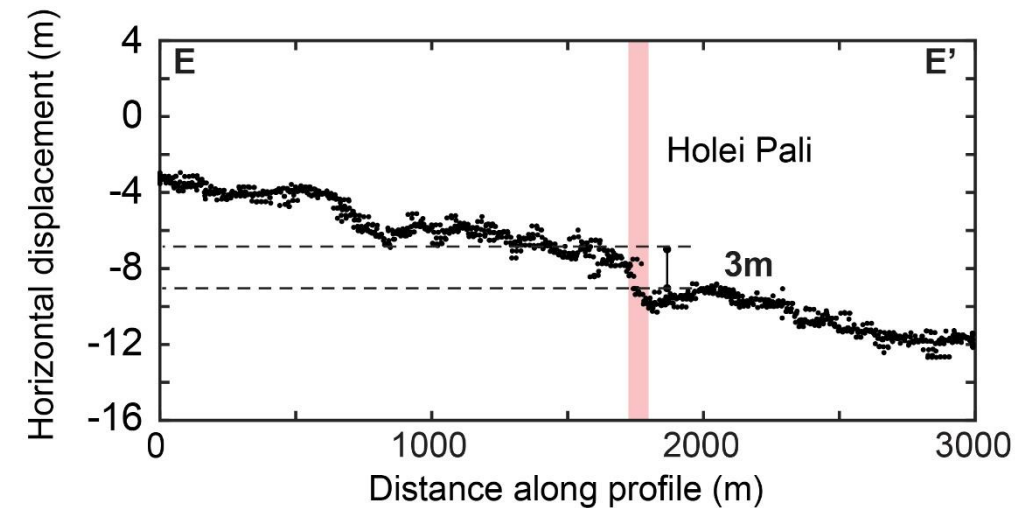
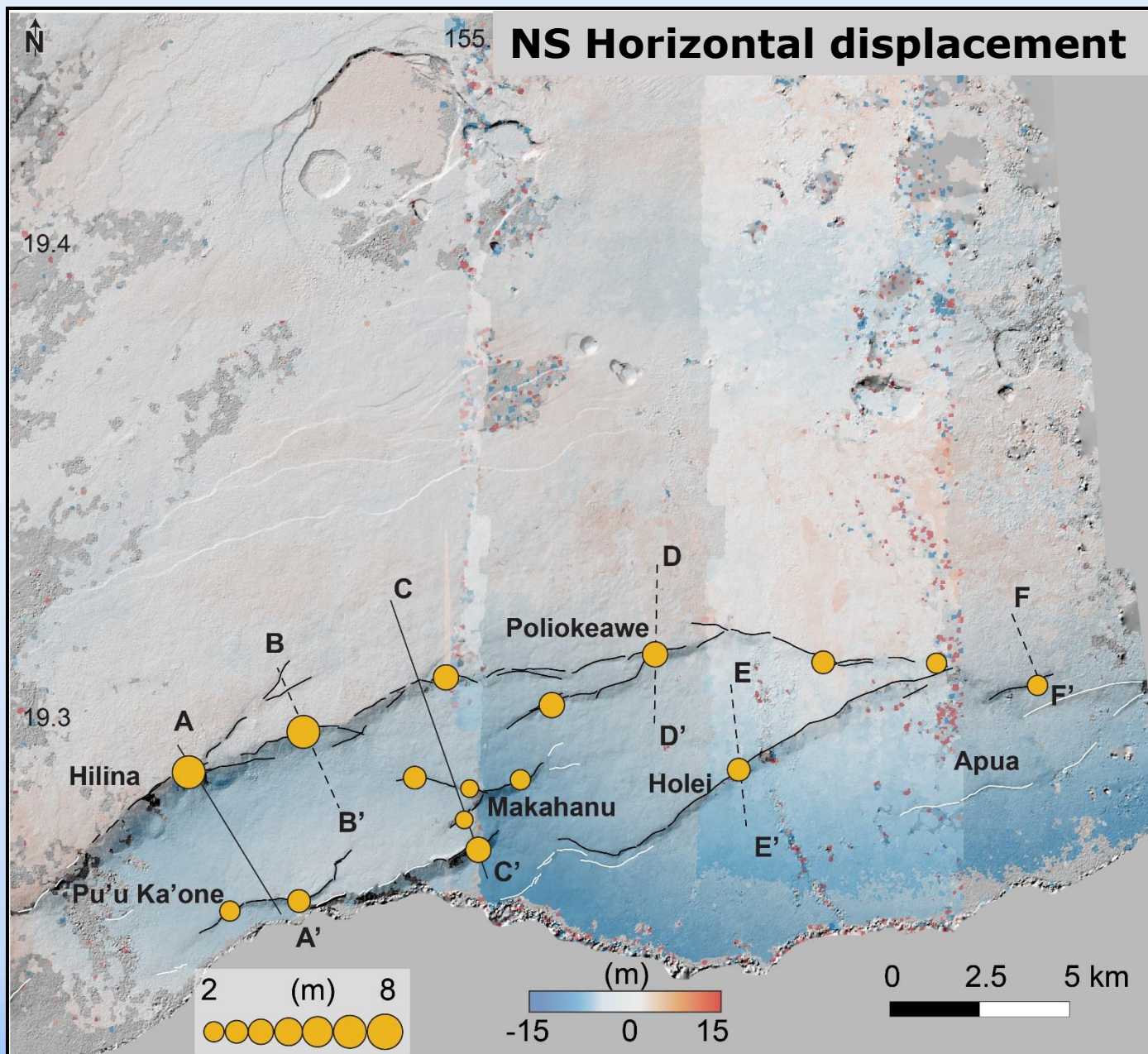




(Mannini et al., in prep)



(Mannini et al., in prep)



(Mannini et al., in prep)

Conclusions

- Show for the first time a **displacement map** covering the entire 1975 earthquake **fault rupture** over 25 km long area
- Measure **horizontal displacement** up to **10 m** (NS direction)
- Highlight the **reactivation of fault** segments during the event
- **Good agreement** with geodetic data (Lipman, 1985; Cannon et al., 2001)

Perspective

- Compare the results of the air photo correlation with **structural ground observations** (April 2022)
- Propose a **kinematic model** explaining the link between **shallow normal fault** (Hilina Pali system), rift zones and **deep basal detachment**



**UNIVERSITÉ
DE GENÈVE**



Thank for your attention!!



FONDS NATIONAL SUISSE
DE LA RECHERCHE SCIENTIFIQUE

