

Geotechnical Damage caused by M7.5 Noto Peninsula Earthquake of January 1, 2024

(Updated version from EERI QQB presentation on Feb. 23, 2024)

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Port Facility (Crustal Deformation)



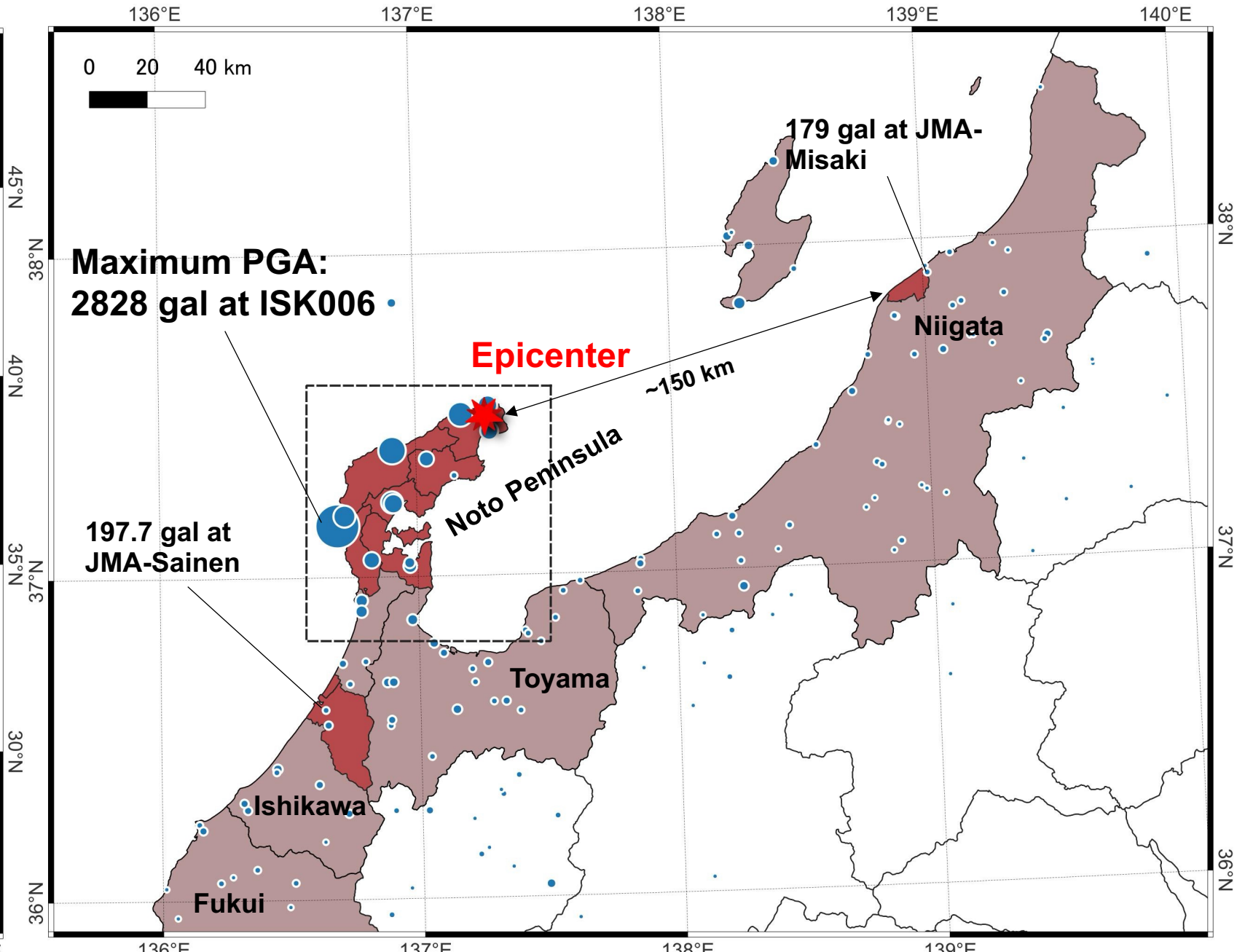
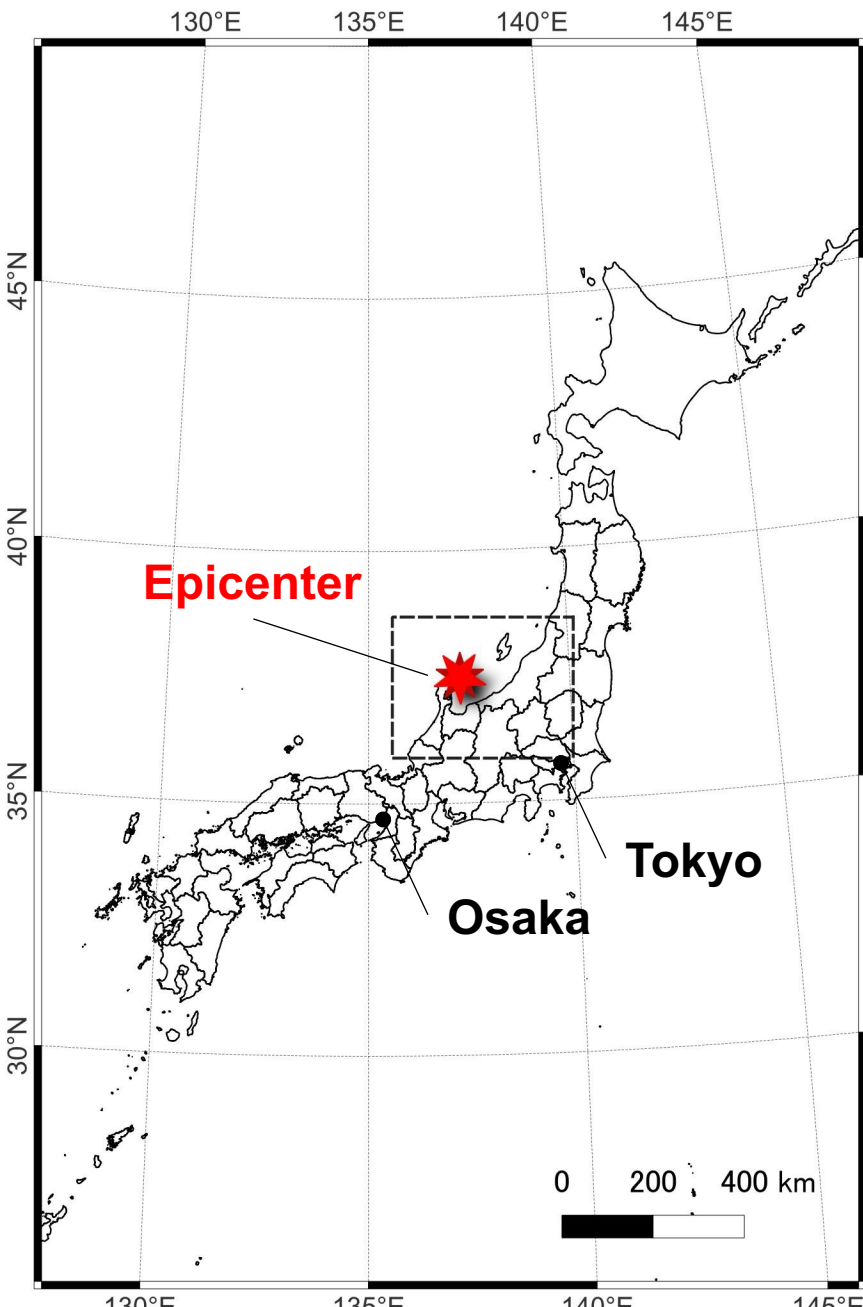
Liquefaction-induced Slope Failure



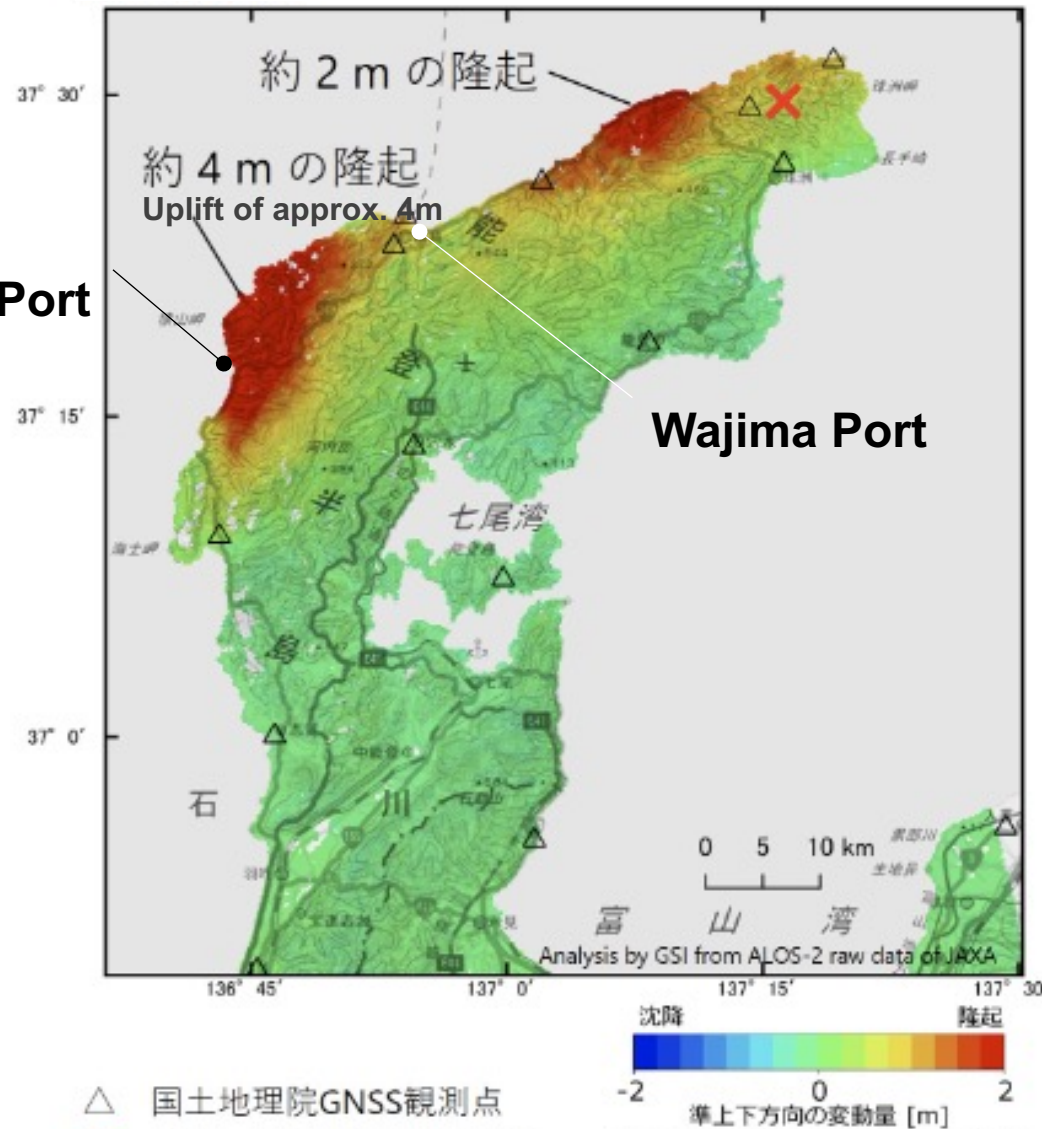
Landslide



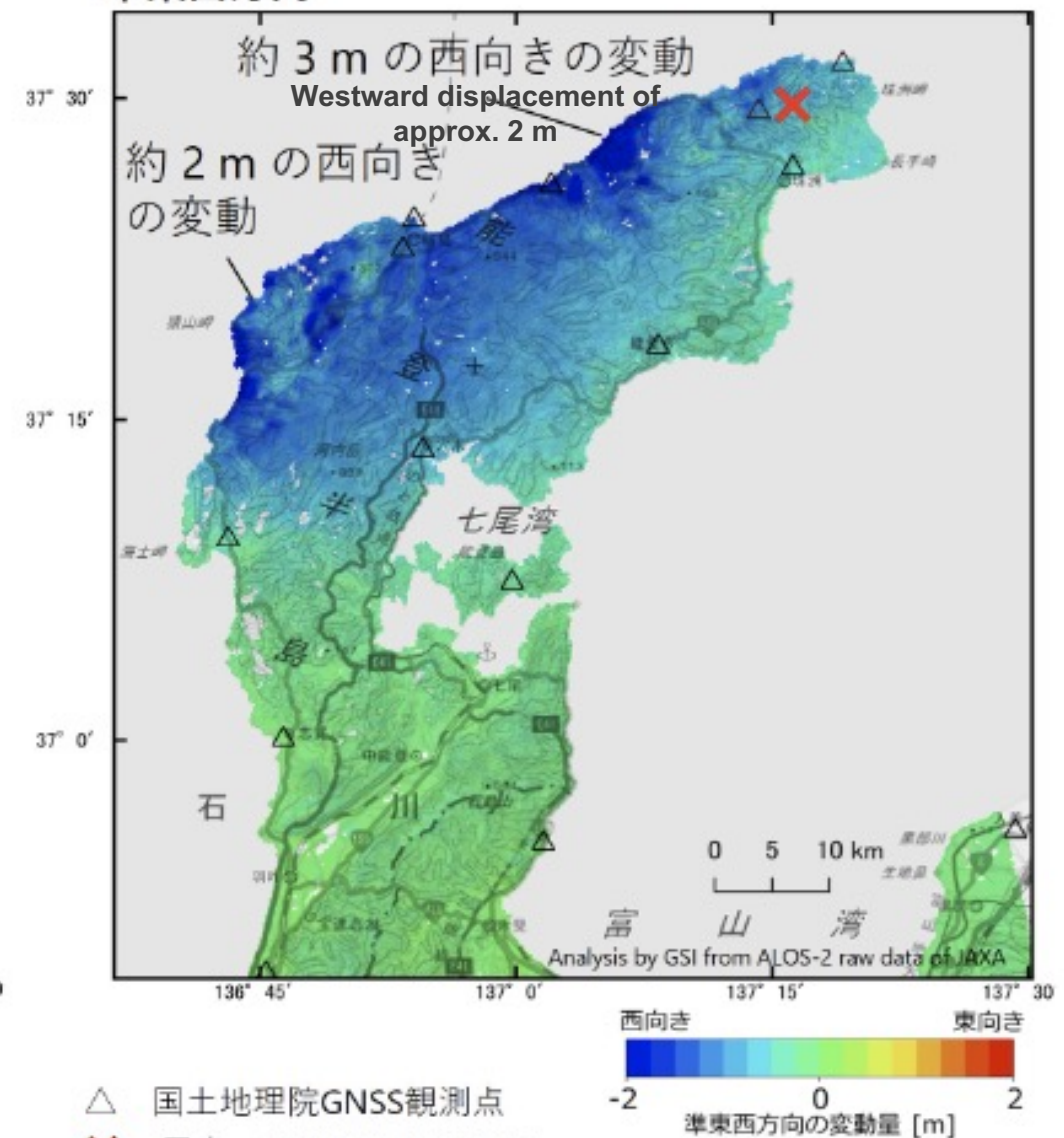
Sand Ejection



U-D Direction



E-W Direction



InSAR analysis has detected ~4m vertical and ~3m horizontal displacements in the north-west of the peninsula

Kaiso Fishing Port, Shika, Ishikawa

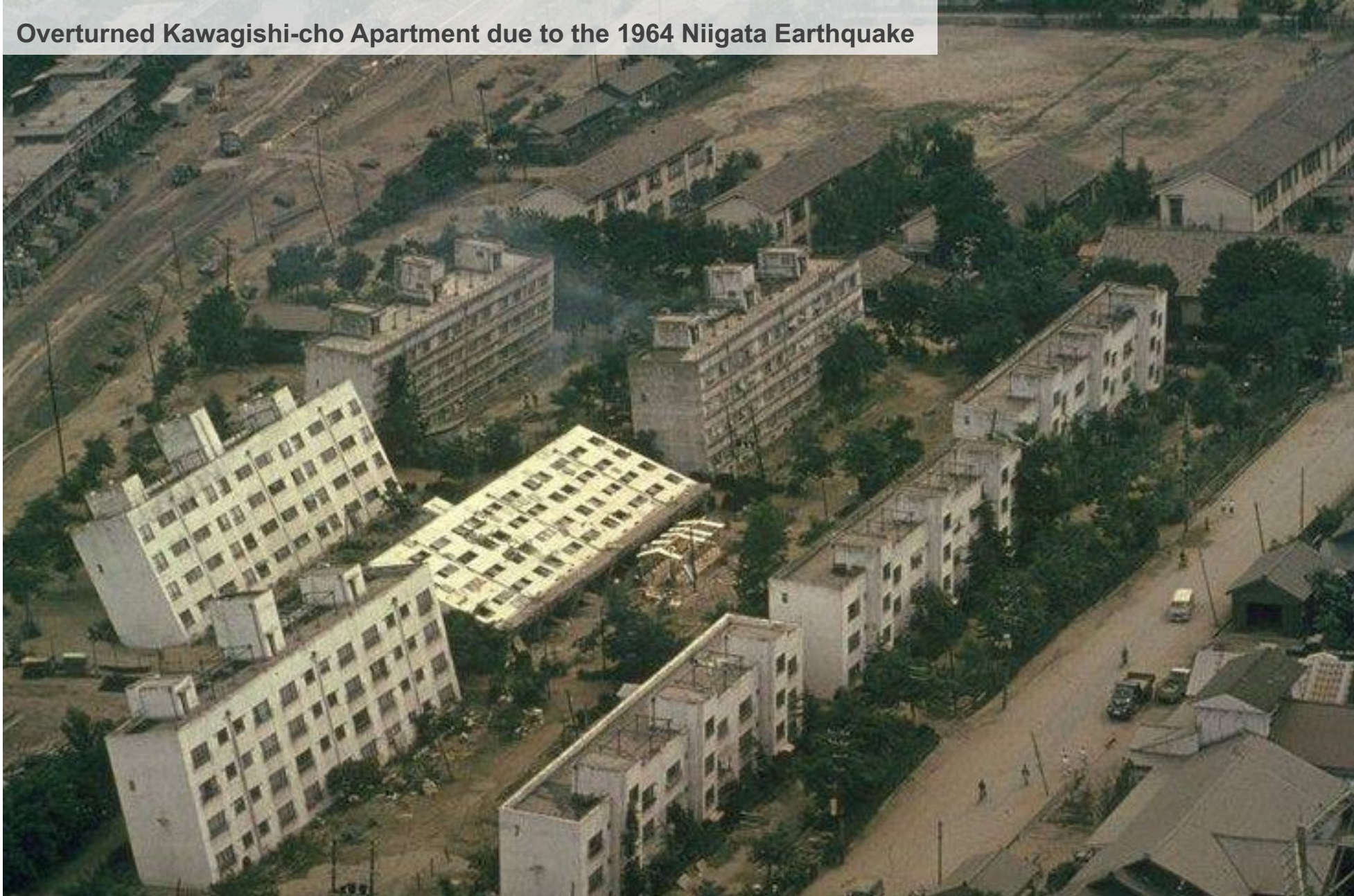


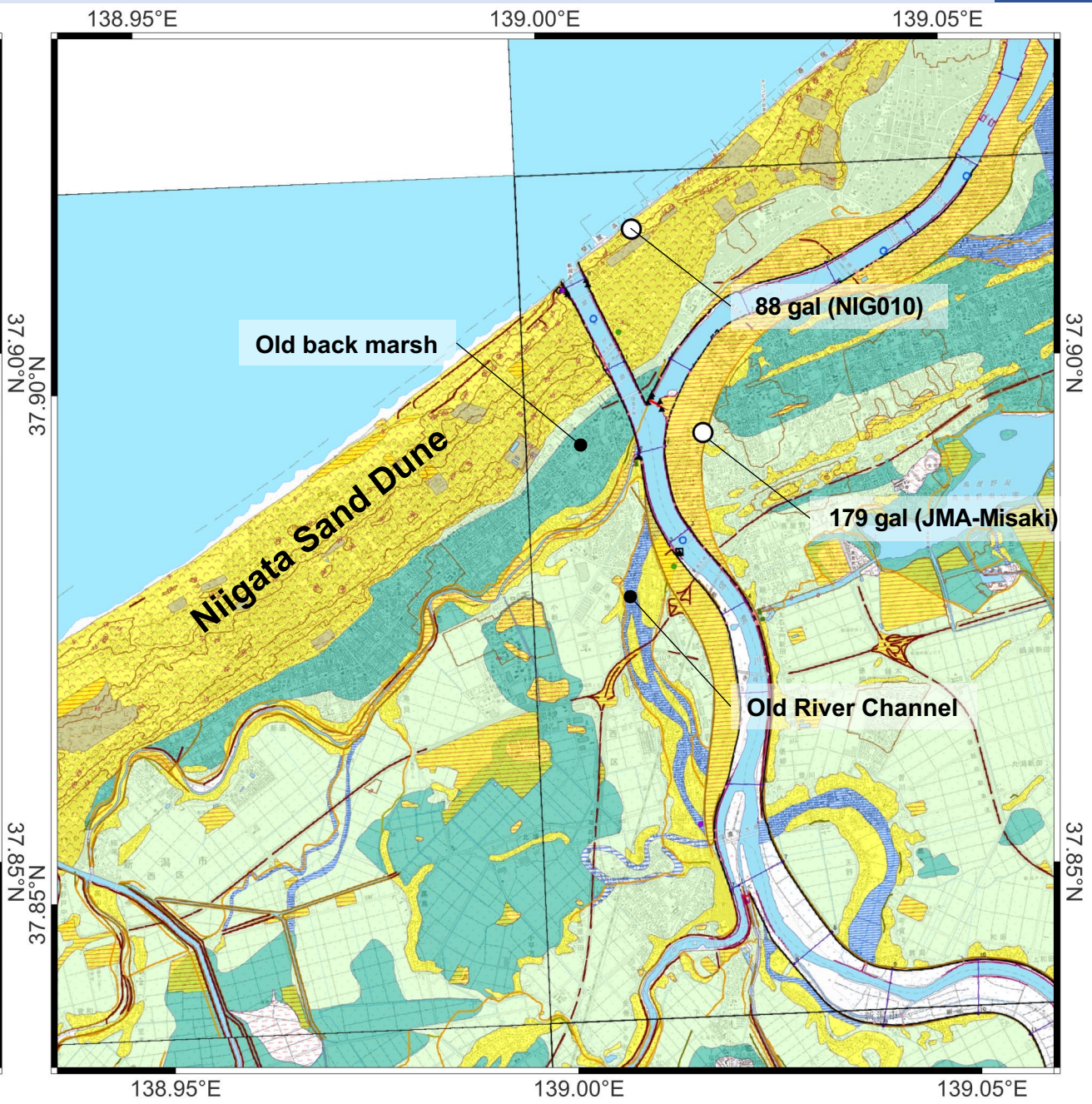
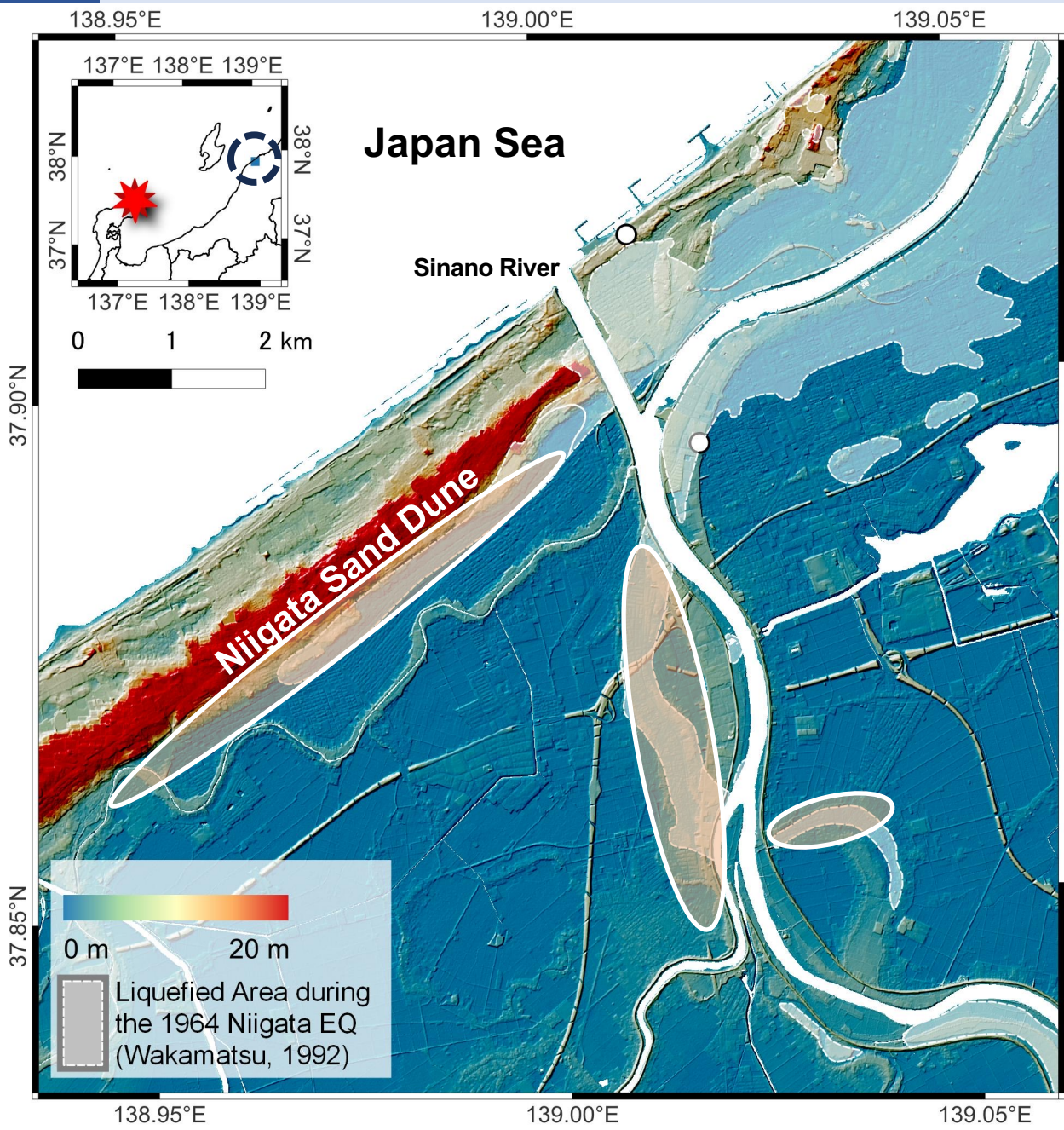
Wajima Port, Ishikawa



- Uplift of approx. 4m resulted in the formation of a new marine terrace ([AIST](#) or [Shishikura et al., 2020](#))
- Some port facilities were rendered unusable by the uplift
 - Typical open cracks and uneven settlement were observed

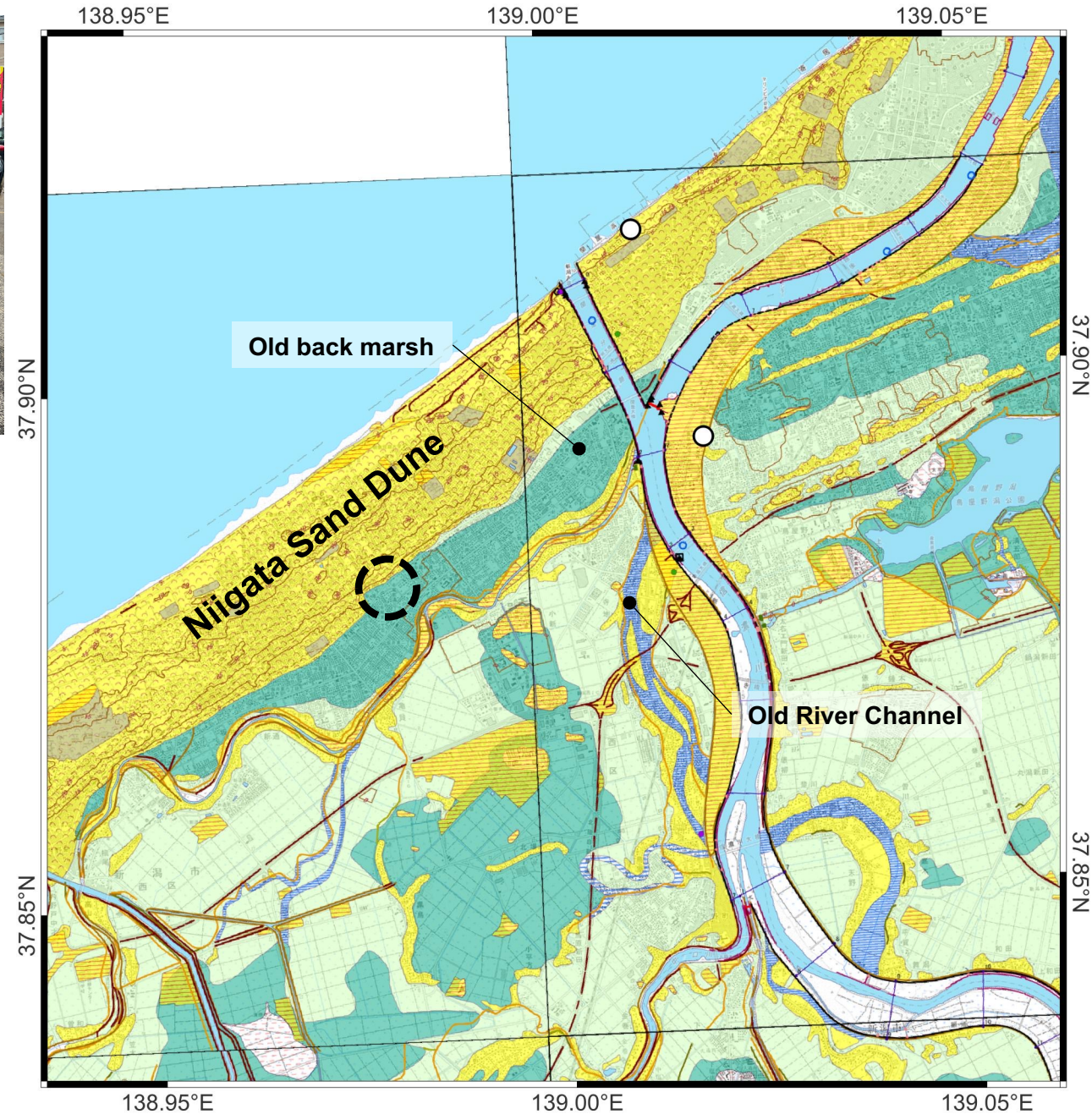
Overtaken Kawagishi-cho Apartment due to the 1964 Niigata Earthquake

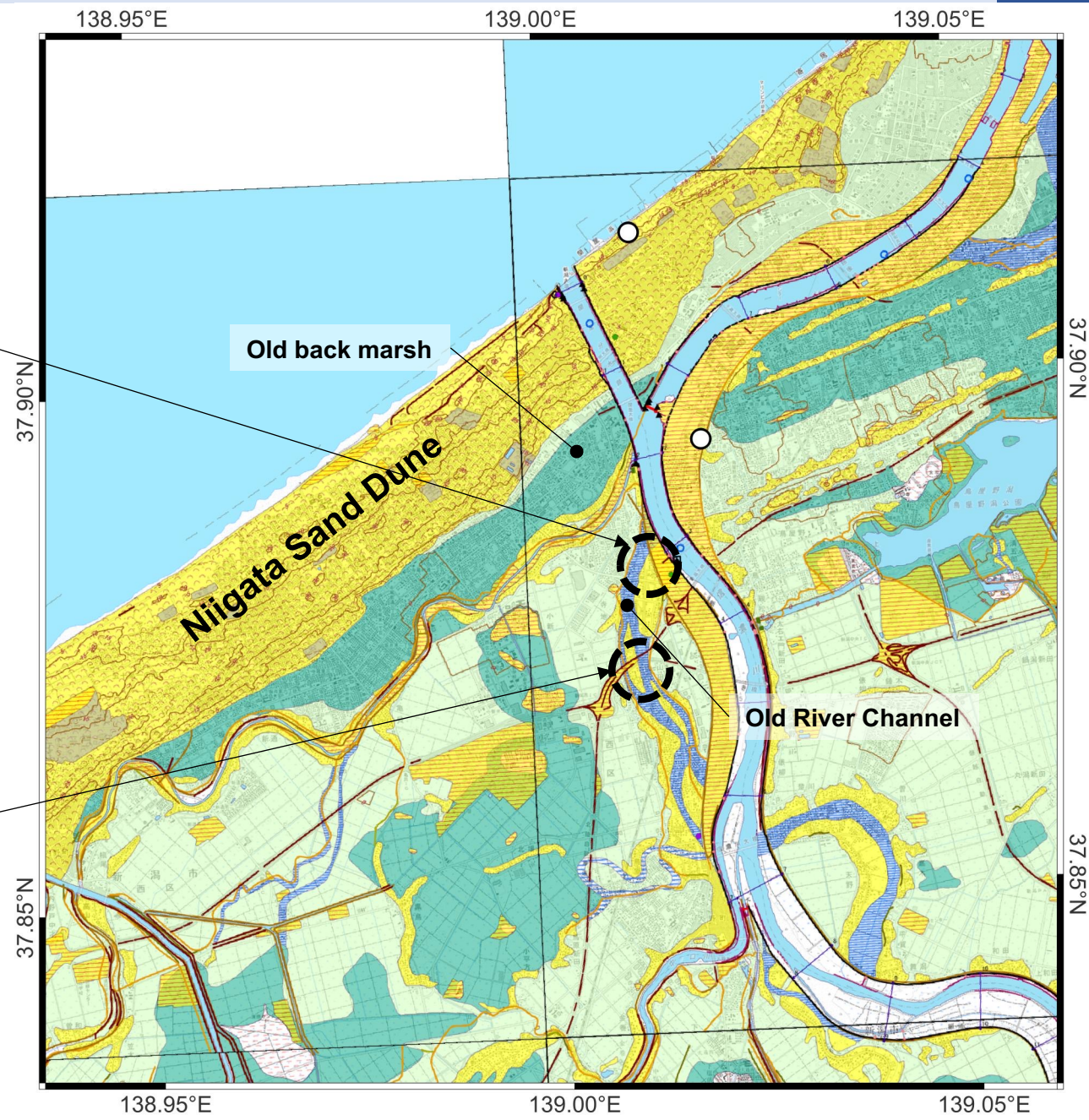


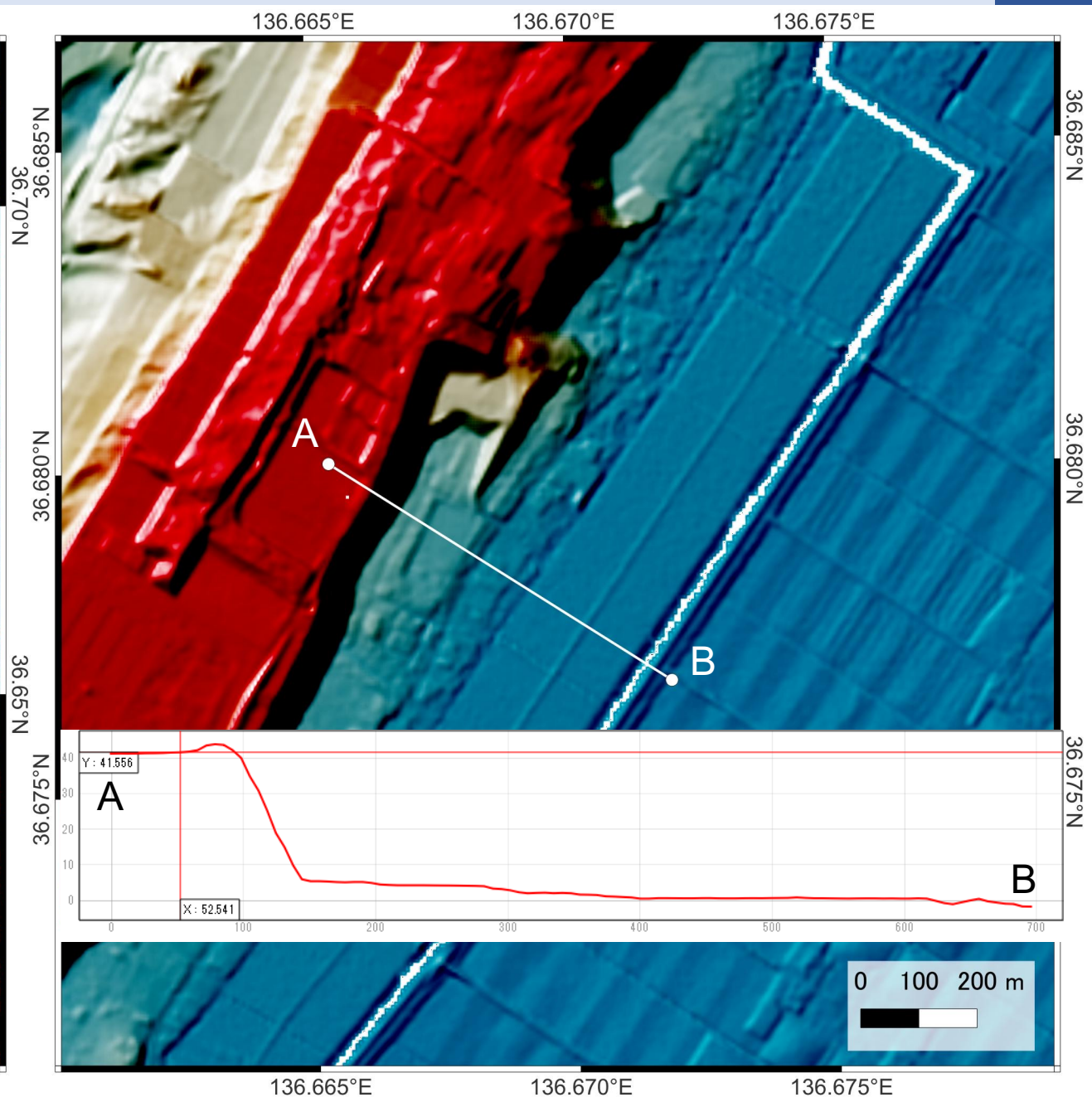
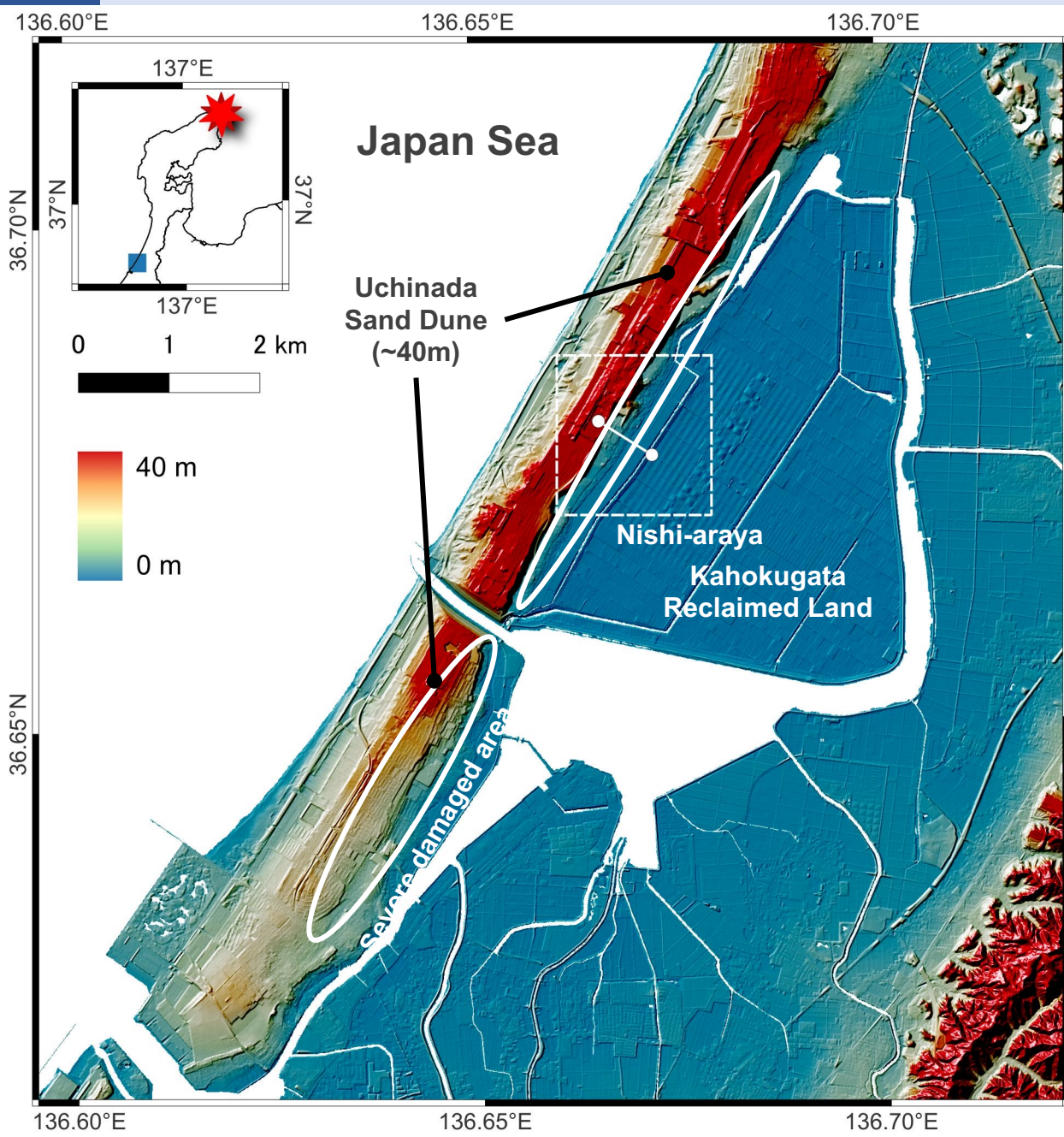


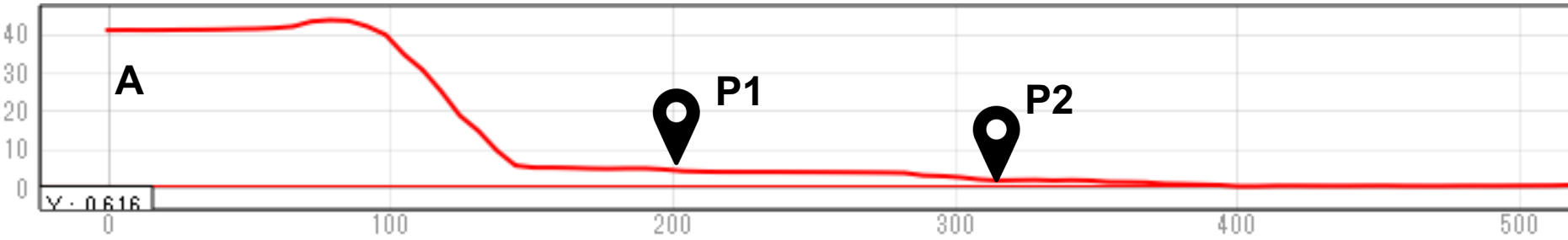


- The middle to tail end of Niigata dune slopes showed many open cracks or sand ejecta
- Thick pavement or small channels may block larger sliding









- Tension cracks and vertical offset parallel to the dune axis in the closer area
- Road pavement was buckled or lifted up along Pref. Road No.8



P1

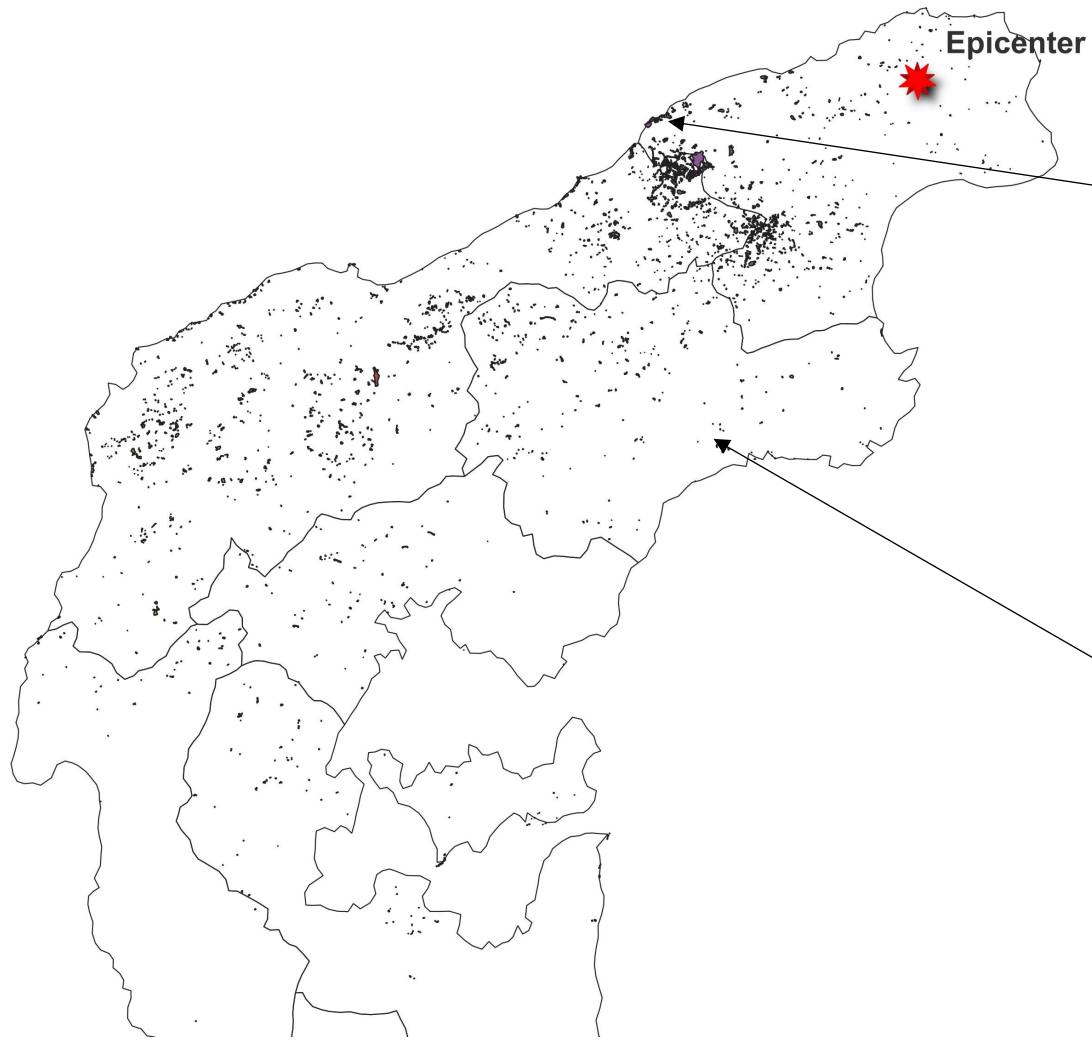


P2


[Link to 3D model](#)



A two-stories house with cement mixing improvement has stood without apparent tilting while other houses inclined several degrees and had serious damage to the base ground



More than 2,000 landslides, which are mainly composed of pyroclastic ([Abe et al., 2024](#)), made access to remote areas difficult



Link to 3D model



© Google Street View

East Exit of Ushitsu No.3 Tunnel



Steep slopes of weathered rock collapsed even with shotcrete

Saida Bridge, Konan, Ishikawa



Torikawa Bridge, Suzu, Ishikawa



[Copied from the report of Prof. Takahashi in Kyoto Univ.](#)

- **Bridge approaches with embankments offset vertically over tens of centimeters**
 - Partially because of small bridges do not have approach slab
 - Another reason to make access to remote areas difficult in the early restoration stage



- Small filled had slid or settled towards the valley side



[Copied from the report of Prof. Ishikawa in Tokyo Denki Univ.](#)

- **Filled valleys opened for school or residential houses slid downward**
 - Weathered filled material or poor compaction may cause these failure
 - Another reason for these slidings could be ~ 40 mm/day precipitation the day before the EQ occurred

- **Damage to port facilities** caused by tectonic uplift and strong seismic motion
- **Liquefaction-induced ground failure** even up to 150km far away from the epicenter
 - **Niigata:** Tail end of sand dune and old river channel
 - Compared to the 1964 Niigata Earthquake, the liquefied area is minor.
 - **Uchinada:** Tail end of a sand dune or filled slope
- **Landslide or filled valley failure** blocking access to remote areas of the northern part of the peninsula
- **Subsidence or cracks at the embankment of bridge approaches**