

## Scenario reconstructions of the 1920 and 0403 Hualien tsunami events and tsunami hazard assessment of Hualien area

On 3 April 2024, a moment magnitude ( $M_w$ ) 7.2 earthquake struck Hualien, Taiwan, with a focal depth of 22.5 km. The event generated a tsunami that reached 89 cm at the Wushi tide gauge and produced a run-up height of approximately 2.5 m along the coastal area of Yanchao Village in Shoufeng Township. Fortunately, the tsunami occurred during low tide, resulting in no casualties. Nevertheless, this event demonstrated that the coastal geomorphology from Hualien to Yilan is conducive to tsunami amplitude amplification. Therefore, a larger tsunami source could pose significant hazards to this region. The earthquake occurred near the boundary between the Philippine Sea Plate and the Eurasian Plate, where the fault and trench systems are complex. Although the mechanism of this event remains under discussion, it is widely believed to be associated with rupture along the Coastal Range or Central Range fault systems. Due to its proximity to the Ryukyu Trench, the  $M_w$  8 earthquake in the Ryukyu subduction zone in 1920 has also drawn renewed attention.

This study uses the 3 April 2024 Hualien earthquake tsunami as a starting point. By integrating extensive coastal tide gauge observations and, for the first time, seafloor cable seismic data from the earthquake's vicinity, tsunami simulations and analyses are conducted using the COMCOT model to infer the tsunami source of the 0403 Hualien event. Furthermore, the 1920 Ryukyu subduction zone earthquake tsunami is reconstructed and analyzed. Given that subduction-zone earthquakes have a higher likelihood of reaching magnitudes of  $M_w$  8 or greater, additional scenario analyses are performed to assess the potential impacts of large-scale subduction-type tsunamis on the Hualien–Yilan region and the entirety of Taiwan.

A notable feature of the 0403 Hualien earthquake is that, despite its epicenter being located on land, it still generated a tsunami along the eastern coast—an uncommon characteristic among tsunami events. To investigate this type of nearshore tsunami, this study conducts a qualitative analysis of the relationship between epicentral distance and coastline proximity. Threshold criteria for issuing tsunami alerts for such nearshore earthquakes are further identified, along with evaluations of the resulting tsunami amplitudes and their potential impacts.

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**Track Classification:** Track 3: Earth & Environmental Sciences & Biodiversity Applications