

Tsunami simulation for the 1707 Hōei earthquake: a revised source model and tsunami inundation to onshore lakes

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Based on recent findings of geodetic and geological investigations, we present a revised source-rupture model for the great 1707 Hōei earthquake that occurred in the Nankai Trough off southwestern Japan. Of the series Nankai Trough M8 earthquakes that recur approximately every 100 to 150 years, the Hōei earthquake is considered to be the largest shock. Its fault rupture extended from Suruga Bay to the westernmost end of Shikoku, more than 700 km. However, many recent findings, such as those based on geodetic data from Japan's GEONET nationwide GPS network and geological investigations of a tsunami-inundated lake in Kyushu have claimed that the source rupture area of the Hōei earthquake should extend further, to the Hyuga-nada, more than 70 km beyond the currently accepted location. Numerical simulation of the tsunami using a new source-rupture model for the Hōei earthquake explains the distribution of the very high tsunami observed along the Pacific coast from western Shikoku to the Hyuga-nada more consistently than though those derived from former source models. A simulation of the tsunami run-up into Ryujin Lake using the onshore tsunami estimated by the new model demonstrates a tsunami inundation process in which a larger tsunami with large amount of water flux transporting sea sand to the lake through a narrow channel connecting the sea and the lake could leave water and sand behind when the tsunami retreated back to the sea. The results of tsunami inundation simulation confirmed that Ryujin Lake could not be inundated by a tsunami Nankai Trough fault rupture unless the earthquake extended beyond the westernmost end of Shikoku. This was the case during the 1854 Ansei Nankai and 1946 Showa Nankai earthquakes because their tsunamis were shorter and the ground surface did not subside. The irregular sedimentation properties of tsunami-induced deposits in Ryujin Lake from the 684 Tenmu and 1361 Shōkei earthquakes warn that the history of Nankai Trough earthquake occurrences is not so simple. There may be a hyper-earthquake cycle of approximately 300 to 500 years that causes larger tsunamis along the Pacific coast from western Shikoku to Kyushu.