Inundation maps on the Pacific coast of eastern Hokkaido from an unusual tsunami in the 17th century

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Tsunami deposit surveys along the Pacific coast of eastern Hokkaido have shown that unusual Holocene tsunami deposits can be traced 1-4 km from the coast, much further inland than the inundation limits of 19-20th century tsunamis (Nanayama et al., 2000; Hirakawa et al., 2000). Geologic evidence indicates that such unusual tsunamis have recurred 5-6 times in the last 2.5 ka, with an average interval of ca 500 years.

We have previously carried out tsunami numerical simulation (Satake et al., 2002). Comparisons of the tsunami heights along the Hokkaido and Sanriku coasts, as well as inundation modeling for Kiritappu marsh indicate that an interplate earthquake from multi-segments (300 km-long fault) can explain the various observations.

Here, we show tsunami inundation maps computed at four other marshes (Nambu-numa in Nemuro, Tokotan-numa in Akkeshi, Pashukuru-numa in Onbetsu and Oikamanai-numa in Taiki) and compare the results with the distribution of tsunami deposits.

We made numerical modeling of tsunamis by using finite-difference computations of the non-linear long-wave equation. For the inundation, moving boundary condition with the minimum grid interval of 25 m was adopted.

We modeled various fault parameters. The fault widths are 50 km (tsunami earthquake), 100 and 150 km (typical interplate events), 200 and 250 km (wide faults that would uplift the coast). We also varied fault length along the trench axis as 200 km (single segment) and 300 km (multi-segment).

Only the multi-segment fault can explain the tsunami deposits at all the five marshes. The largest tsunami heights are computed from multi-segment fault or tsunami earthquake. The wide faults produce smaller heights, because the coast is also uplifted. The computed heights from tsunami earthquake locally vary because of the shorter wavelength. The tsunami inundation is largest from the multi-segment fault, reproducing the extent of tsunami deposits. The wide faults produce less inundation, whereas the single-segment fault or tsunami earthquake does very little inundation.