

Effects of valley topography on run-up of the 2011 Tohoku tsunami on the Sanriku coast, northeastern Japan

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The 2011 Tohoku earthquake and tsunami caused heavy damage in low-lying valleys of the Sanriku coast, northeastern Japan. The landward extent of inundation by the tsunami varied considerably among the river valleys, indicating that tsunami run-ups were strongly affected by the subaerial fluvial morphology of the valleys. We used detailed tsunami inundation maps to investigate tsunami run-ups along river valleys along the Sanriku coast, considering both the protected areas landward of coastal seawalls and levees (protected zone), and areas riverside of levees (channel zone). We compiled detailed longitudinal river profiles and used them in conjunction with published tsunami inundation maps to determine the distances and heights of tsunami run-ups in 68 valleys along the Sanriku coast. Run-up heights tended to be higher and run-up distances longer in the channel zone than in the protected zone. Comparison among valleys of run-ups with longitudinal valley slopes showed that run-up distances decreased with increasing valley slopes, and that run-up heights increased with increasing slopes. Further studies of the effects of subaerial fluvial morphology and friction on tsunami run-ups, and the influence of tsunami wave height, are needed to improve our interpretation of paleo-tsunami deposits in Quaternary sediments and improve future tsunami-disaster prevention programs.

Keywords: 2011 Tohoku earthquake, Sanriku coast, Tsunami run-up, Narrow valley floor, Longitudinal valley profile, Tsunami inundation map