Tsunami Runup onto a Complex Three-dimensional Beach; Monai Valley

The Hokkaido-Nansei-Oki tsunami of 1993 that struck Okushiri Island, Japan, with extreme runup height of 30 m and currents of the order of 10-18 m/sec was a disaster, but provided fortuitous high-quality data. The extreme tsunami runup mark was discovered at the tip of a very narrow gulley within a small cove at Monai. High resolution seafloor bathymetry existed before the event and when coupled with bathymetric surveys following the event allowed meaningful identification of the seafloor deformation.

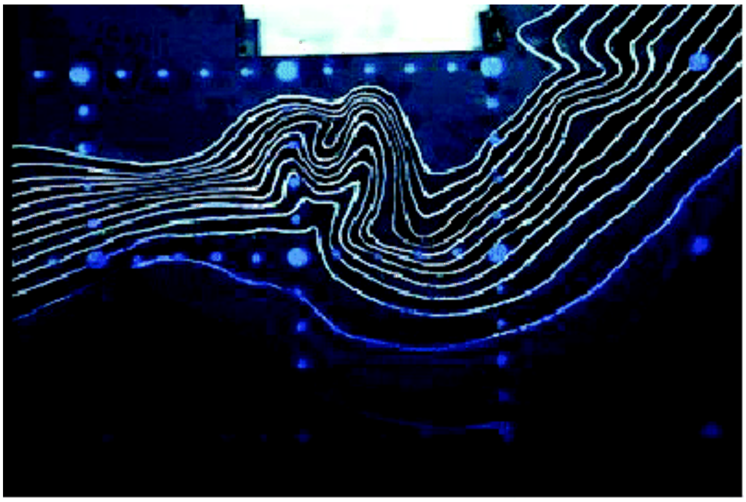

Figure 1: Bathymetric profile for experimental setup for Monai Valley experiment. Link to the movie of the experiment.

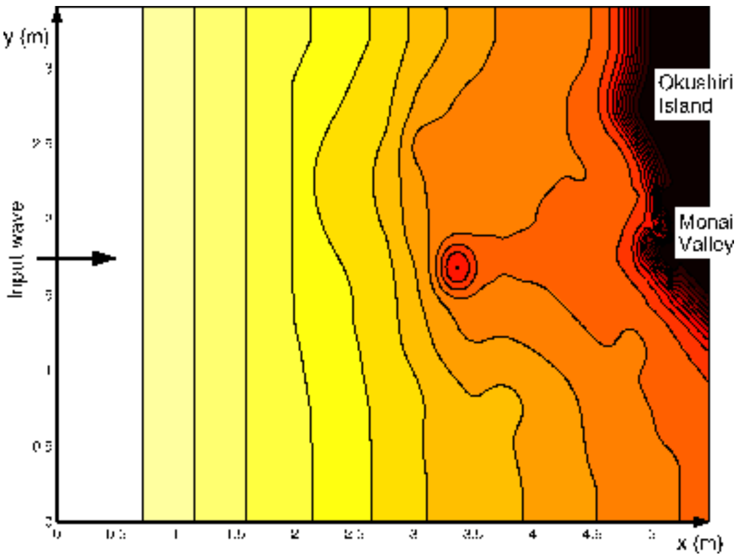

Figure 2: Computational area for Monai Valley experiment.

A 1/400 laboratory model of Monai was constructed in a 205 m-long, 6 m-deep, and 3.5 m-wide tank at Central Research Institute for Electric Power Industry (CRIEPI) in Abiko, Japan and partly shown in Fig. 1. The laboratory setup closely resembles the actual bathymetry. The incident wave from offshore, at the water depth $\tilde{d}$ = 13.5 cm is known. There are reflective vertical sidewalls at $\tilde{y} = 0$ and 3.5 m (Fig. 2). The entire computational area is 5.448 m $\times$ 3.402 m, and the recommended time step and grid sizes for numerical simulations are $\widetilde{\Delta x} = \widetilde{\Delta y}$ = 1.4 cm and $\widetilde{\Delta t}$ = 0.05 sec.

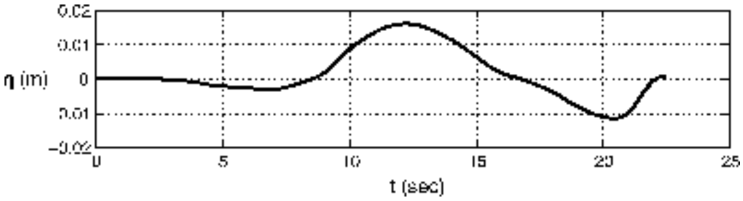

Figure 3: Initial wave profile for Monai Valley experiment.

The input wave is a LDN with a leading-depression height of —2.5 mm with a crest of 1.6 cm behind it (Fig. 3). Waves were measured at thirteen locations and complete time histories are given at three locations, i.e., $(\widetilde{x}, \widetilde{y})$ = (4.521, 1.196), (4.521, 1.696), and (4.521, 2.196) in meters (Fig. 4). These experiments were used in the 2004 Catalina Island, Los Angeles, California NSF Long-Wave Runup Models Workshop (Liu *et al.*, 2008).

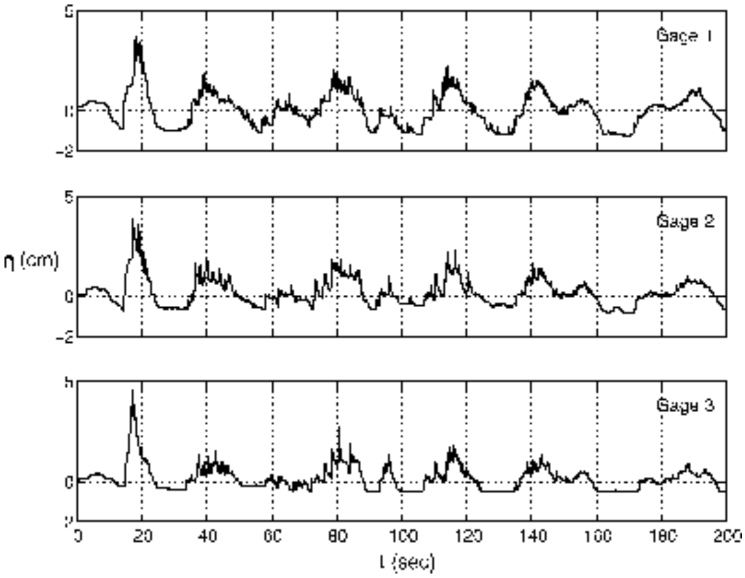

Figure 4: Time series of surface elevation at three different gages. Gages 1, 2, and 3 are located at (4.521, 1.196), (4.521, 1.696), and (4.521, 2.196) meters, respectively.

References:

Liu, P.L.-F., H. Yeh, and C. Synolakis (2008): Advanced Numerical Models for Simulating Tsunami Waves and Runup. *Advances in Coastal and Ocean Engineering, 10*, 250 pp.