TIDE-TSUNAMI INTERACTIONS

Zygmunt Kowalik and Tatiana Proshutinsky
Institute of Marine Science, University of Alaska, Fairbanks, Alaska
Andrey Proshutinsky
Woods Hole Oceanographic Institution, Woods Hole, Massachusetts

ABSTRACT

Observations and computations of the Indian Ocean Tsunami have shown significant amplifications of tsunami magnitudes in the near-shore regions due to water shoaling. Also, numerous observations have depicted a quite long ringing of tsunami oscillations in the coastal areas, suggesting either local resonances or local trapping of tsunami energy. In reality, the short-period tsunami wave rides on the longer-period tide and tsunami-tide interaction in these regions contaminates observational data. This effect has not been accurately taken into account in the previous studies. The question is whether these two waves can be superposed linearly for the purpose of determining the resulting sea surface height (SSH) or rather in the shallow water they interact nonlinearly, enhancing the total SSH and currents. Since the near–shore bathymetry is important for the run-up computation, the previous tsunami investigations demonstrated that the change of depth caused by tide should not be neglected in tsunami run-up considerations. On the other hand, we hypothesize that much more significant effect of the tsunami-tide interaction should be observed in the interactions of currents generated by tides and tsunami. This is important especially for simulations of and assessing the coastal erosion associated with tsunami events. In order to test this hypothesis, we apply a simple set of 1-D equations of motion and continuity to investigate dynamics of tsunami and tide interaction in the vicinity of an idealized shelf breaks. Afterwards, to elucidate the role of bathymetry in the tide-tsunami interactions in real conditions we apply 2-D models for two coastal domains located in the Gulf of Alaska and investigate this phenomenon in the shallow waters of Cook Inlet and deep waters of Prince William Sound.