Dynamic, Tsunami-Induced Nearshore Currents

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Abstract:

In this talk, the well-established approaches of coupling tsunami generation to seismic seafloor motion and the following trans-oceanic wave propagation will be briefly introduced. The focus of the presentation will be on the complex transformation of the tsunami as it approaches very shallow waters, as well as how these possibly large and fast-moving water waves interact with coastal infrastructure. Examples of coastal impact will be discussed and used to frame the theoretical efforts. The majority of the discussion will focus on tsunami-induced currents in ports and harbors. Tsunamis, or "harbor waves" in Japanese, are so-named due to the common observation of enhanced damage in harbors and ports. However, the dynamic currents induced by these waves, while regularly observed and known to cause significant damage, are poorly understood. We will show that the strongest currents in a port are governed by horizontally sheared and rotational shallow flow with imbedded turbulent coherent structures. Without proper representation of the physics associated with these phenomena, predictive models may provide drag force estimates that are an order of magnitude or more in error (Lynett et al., 2012). Such an error can mean the difference between an unaffected port and one in which vessels 300 meters in length drift and spin chaotically through billions of dollars of infrastructure (e.g. Okal et al., 2006).

References:

1. P. Lynett et al., Earth and Planetary Science Letters, 327/328, 68-74 (2012).
2. E. Okal et al., Earthquake Spectra, 22, S203-S218 (2006).