EGU2020-11411, updated on 29 Nov 2020
https://doi.org/10.5194/egusphere-egu2020-11411
EGU General Assembly 2020

Improving tsunami forecast with data assimilation on dense pressure gauge arrays: the 2009 Dusky Sound, New Zealand, tsunami

Aditya Gusman[1], Anne Sheehan[2], and Kenji Satake[3]
[1]GNS Science, Earth Structure and Processes, New Zealand (a.gusman@gns.cri.nz)
[2]Department of Geological Sciences, University of Colorado Boulder, Boulder, United States (anne.sheehan@colorado.edu)
[3]Earthquake Research Institute, The University of Tokyo, Tokyo, Japan (satake@eri.u-tokyo.ac.jp)

Tsunami warnings in New Zealand rely on first locating and determining size of a large earthquake and then using precomputed simulation results to forecast the threat level and timing of the resulting tsunami. The number of offshore pressure gauges for tsunami monitoring around the world is increasing and it provides the opportunity to develope new methods to forecast tsunamis. In cases where a dense array of offshore pressure gauges is available, a data assimilation method can be applied to estimate the tsunami using the observations of pressure changes. Here we apply the data assimilation method to the tsunami generated from the 2009 Dusky Sound, New Zealand, magnitude 7.8 earthquake and determine a rapid and accurate estimate of the tsunami wave arrival time and size along the west coast of New Zealand. The tsunami was recorded by the Marine Observations of Anisotropy near Aotearoa (MOANA) OBS network which consists of a total of 30 differential pressure gauges.

We use tsunami waveform inversion applied to Deep□ocean Assessment and Reporting of Tsunamis (DART) offshore pressure gauge and coastal tide gauge data to estimate the fault slip distribution of the Dusky Sound earthquake. The tsunami from this fault slip estimate is then used as a reference to measure the forecast accuracy from different methods to forecast the tsunami threat in New Zealand's tsunami warning zones. Methods that are evaluated here include the currently operational tsunami warning procedure in New Zealand, tsunami data assimilation that relies only on the dense pressure gauge array data, and tsunami data assimilation with an initial condition model from W-Phase inversion result.

A good match was found between the forecast from the data assimilation method and observed tsunami waveforms at the Charleston tide gauge station on the west coast of New Zealand's South Island. However, this method gives an accurate forecast only along the west coast of New Zealand because the offshore pressure gauge network is located off the west coast of the South Island. While an advantage of the data assimilation is that no initial condition is needed, we find that our forecast is improved especially along the south and east coasts of the South Island by merging tsunami forward modelling from a rapid W□phase earthquake source solution with the data assimilation method.