論文の内容の要旨

Tsunami Source Estimation from Transoceanic Waveforms

（　遠地波形による津波波源の推定　）

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In the present dissertation, we demonstrate the process of applying transoceanic tsunami waveforms in source inversion. First, we improve the existing phase correction method by incorporating the effects of ocean density stratification, the actual tsunami ray path, and the actual bathymetry. Second, we validate the improved method and the application of far-field tsunami data by the 2011 Tohoku earthquake tsunami. Third, we recover the source of the 1960 Chile earthquake by jointly inverting the near-field geodetic and tsunami data, and the newly available far-field tsunami data.

In Chapter 1, we review the tsunami inversion method and the previous method for phase correction. Due to the arrival time and waveform differences between observations and long-wave simulations after long distance traveling, the far-field data could not be used until the problems were solved by the phase correction method.

In Chapter 2, we further improve the accuracy of the existing phase correction method by adding the effects of ocean density stratification, actual ray path, and actual water depth. In our analysis, the existing method amounts to about 73% correction in our improved method. The new considered effects of ocean density stratification, actual ray path, and actual bathymetry, contribute to about 13%, 4.5%, and 9.5%, respectively.

Chapter 3 demonstrates that the improved method provides a more accurate estimate for the waveform inversion and forward prediction of far-field data. We also clarify the advantage and limit of far-field data. We perform single and multiple time window inversions for the 2011 Tohoku tsunami using far-field data corrected by different methods to investigate the initial sea surface displacement. The inversion results show that Green’s functions corrected by improved method better fit observed waveforms. We also apply the

improved method to forward simulation. Our results show good agreements between the observed and computed waveforms at both near-field and far-field tsunami gauges, as well as satellite altimeter data.

In Chapter 4, we recover the source feature of the 1960 Chile earthquake. With the improved phase correction method in Chapter 2 and Chapter 3, we solve the systematic arrival time problem. In addition, we apply the nonlinear inversion NOMAD (Nonlinear Optimization by Mesh Adaptive Direct Search) with the OTA (Optimal Time Alignment) method to correct the random arrival time difference problems caused by the instrumental problem, local effect, or other unknown response. Our results show that a rupture extended about 800 km with a width of about 150 km at the shallow region. Three asperities with slips of 33 m, 29 m, and 33 m appear at north, central, and south area, respectively. The estimated magnitude is about Mw 9.4. Our results also indicate that the south peak contributes to the large uplift of south coasts, e.g. Guamblin Island, and the later high amplitude tsunami wave phase at Honolulu.

Chapter 5 is the summary of this dissertation. Our study may provide a reference for using far-field tsunami data. We hope that the tsunami source research and forecast for transoceanic tsunami may be developed from our study.