

An essential feature of the 1906 Colombia-Ecuador earthquake clarified by observed tsunami waveforms

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The earthquake that occurred in Colombia-Ecuador subduction zone in 1906 has been the most significant earthquake in this area. The ruptured area is widely known to have covered the large area in the subduction zone along the Nazca plate as shown by Kelleher (1972) and Kanamori and McNarry (1982), while the detailed source process of this earthquake is unclear because of the lack of quantitative observation data. On the other hand, the 1906 earthquake generated a large tsunami propagating across the Pacific Ocean, and it was observed at tide gauge stations in some countries. Yoshimoto et al. (2017) attempted to estimate the slip distribution of the earthquake based on an inverse analysis using the observed tsunami waveforms, but their estimated source model insufficiently reproduces an observed tsunami waveform that the tsunami height was the largest of them. Thus, this study carefully investigates the observed tsunami waveforms with the findings from previous studies for the 1906 earthquake and aims to clarify the detailed source process of the earthquake.

The tide gauge records with the tsunami remain at several stations: Naos in Panama, San Francisco, and Honolulu in the United States, Hakodate, Ayukawa, Kushimoto, Hososhima, and Fukahori in Japan. However, their tsunami heights were very small at most of the stations in addition to a large noise comparable to the heights. Thus, we decided to use only two capable waveforms as target waveforms in slip inverse analysis of the earthquake, observed at Naos, where the observed tsunami height in the waveforms was the largest, and Honolulu. Next, some Green's functions including proper dispersion effects for the tsunami waveforms were computed assuming source areas in the subduction zone as suggested by Kelleher (1972). A comparison of the arrival times between the Green's functions and observed tsunami waveforms indicated that the source area should cover a longer area that extends from southwest to northeast than Kelleher (1972) suggested in order to reproduce both observed waveforms. Finally, a slip inverse analysis based on the Green's functions and observed waveforms was conducted and indicated that a large local slip with 6 m occurred at a northern part of the assumed source area. This developed source model producing well tsunami waveforms at Naos and Honolulu was consistent with the results of previous studies to the earthquake and historical/recent seismicity around the subduction zone.

Keywords: 1906 Colombia-Ecuador earthquake, slip distribution, observed tsunami waveforms