

# The 2010 Chile Tsunami Observed from Altimeters



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## Abstract:

Several satellite altimeter tracks, Jason-1 and 2, had observed the 2010 Chile tsunami, generated by the M8.8 earthquake of Feb. 27, 2010. Their observing time is between 3 and 8 hours after the initial earthquake (Fig. 1). Unlike the 2004 Indian Ocean tsunami, the tsunami generated by the Chile M8.8 earthquake is almost comparable with other ocean dynamic signals during the observing period, and therefore difficult to be isolated from. By synchronizing all the satellite tracks into a three-dimensional tsunami model, we are able to identify some of the leading tsunami waves and their propagation patterns. These identified waves are confirmed independently by nearby tidal observations. Based on the observations and a recently-developed tsunami theory, we are able to explain why the Chile M8.8 earthquake, the fifth largest ever recorded by instruments, failed to generate an expected strong tsunami.

## Tsunami Model:

The tsunami model, based on a global ocean circulation model, has coupled to the earthquake force through bottom pressure, as described by Song et al. [2008].

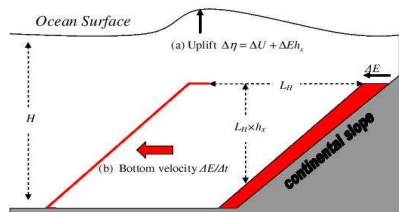


Fig. 3 Coupled Earthquake-Ocean Model—tsunami is mainly forced by the horizontal slip of continental slope, not the vertical uplift as previously thought.

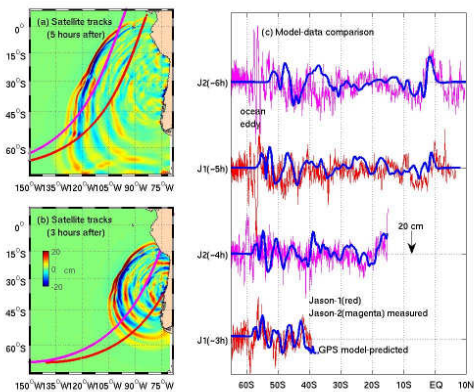


Fig. 1 Satellite altimeter tracks synchronized into a tsunami model.

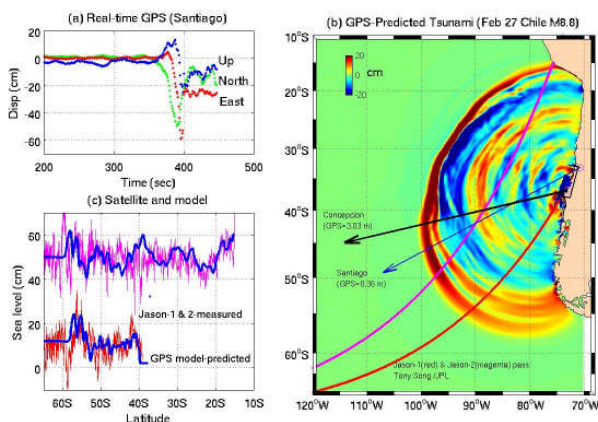
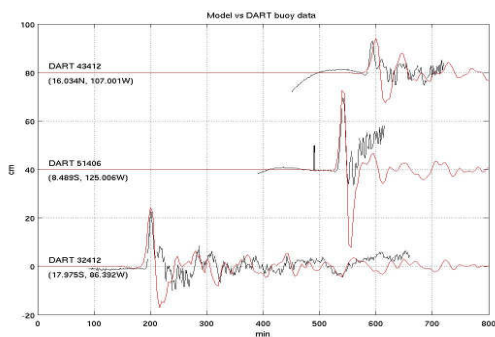


Fig. 4 This study demonstrated that GPS data were used successfully in estimating the size of the Chile tsunami and altimetry data were used to confirm the estimation after the event: (a) GPS-forced Real-time GPS displacement data obtained from NASA/JPL global differential GPS system on the day of 27 February 2010. (b) The GPS data were used in the earthquake source model and forced an ocean model for simulation of the Chile tsunami. (c) The model tsunami is compared with altimeter Jason-1 and Jason-2 data, which confirmed the tsunami size.



Bottom Pressure Data & Verification: Fig. 2 verifies the model by the DART buoy data.

## Related Publications & NASA Press Releases:

Song, Y. T. and S.C. Han, 2010: Satellite observations defying the long-held tsunami genesis theory. *Remote sensing of global ocean changes*, Springer, (in press).

Song, Y. T., L.-L. Fu, V. Zlotnicki, C. Ji, V. Hjorleifsdottir, C.K. Shum, and Y. Yi, 2008: The role of horizontal impulses of the faulting continental slope in generating the 26 December 2004 Tsunami. *Ocean Modelling*, doi:10.1016/j.ocemod.2007.10.007.

Song, Y. T., 2007: Detecting tsunami genesis and scales directly from coastal GPS stations. *Geophys. Res. Lett.*, **34**, L19602, doi:10.1029/2007GL031681.

Song Y. T., C. Ji, L.-L. Fu, V. Zlotnicki, C. K. Shum, Y. Yi, V. Hjorleifsdottir, The 26 December 2004 Tsunami Source Estimated from Satellite Radar Altimetry and Seismic Waves. *Geophys. Res. Lett.* Vol. **32**, L20601, doi:10.1029/2005GL023683, 2005. Related Links:

NASA Tests GPS Tsunami Prediction System:

[http://www.jpl.nasa.gov/news/news.cfm?release=2010-198&cid=release\\_2010-198](http://www.jpl.nasa.gov/news/news.cfm?release=2010-198&cid=release_2010-198)

Related Links: NASA Tsunami Research Makes Waves in Science Community:  
<http://www.sciencedaily.com/releases/2008/01/080123182522.htm>

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