Reducing oceanographycal backgrounds in sea surface height data on 2004 Indian Ocean Tsunami from satellite altimetry

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1. Introduction

Jason-1 and TOPEX/Poseidon (T/P) have flown across the Gulf of Bengal about 2 hours after the occurrence of the Sumatra-Andaman earthquake of 26 December, 2004. These satellites captured the Indian Ocean Tsunami in propagating as changes of sea surface heights from their altimetry on board (Gower, 2005). Clear profiles of tsunami height in the ocean have been observed for the first time.

The difference between observed sea surface height at the tsunami and that of the last cycle before the earthquake has been defined and utilized as the analyzed tsunami height by Song et al.(2005), Hirata et al.(2006), Fujii and Satake(2006) and so on. However, such tsunami heights involve not only errors from observation and data processing, but also effects from various oceanographical phenomena during one cycle of a satellite.

This research aimed at improving the quality of sea surface height data in terms of tsunami observation from satellite altimetry by removing the effects resulting from oceanographical phenomena other than tsunami.

2. Data and Technique

(1) Data

On the day of the Sumatra-Andaman earthquake, 32 totalled tracks from 4 satellites equipped altimetry (Jason-1, T/P, ENVISAT, GFO) passed through the Indian Ocean after the occurrence of the earthquake. I focused these tracks. Sea surface height data analyzed near real time along tracks (NRT-AT-SLA) distributed by AVISO are used.

To examine the background originated from oceanographical phenomena other than tsunami, mean sea level anomaly (DT-MSLA and NRT-MSLA) producted by AVISO are also refferred. These are grid point values whose grid intervals are about 1/3 degrees in latitude and longitude and 7 or 3.5 days in the time scale.

(2) Method

Reference values for each sampling points are processed from grid point values of mean sea level anomaly by trilinear interpolation (longitude, latitude and observation time).

Background levels at each sampling points are statistically estimated from data on sea surface heights (NRT-AT-SLA) and mean sea level anomaly (NRT-MSLA).

(3) Result

The RMS noise levels measured in the section which includes tsunami signal are reduced from 5-10cm by conventional method to 2-3cm, by applying the method of this research. S/N ratios have also improved about 3 times. This method enables to determin the precise locations of the tsunami front in 3 tracks: Jason-1 cycle109 track129, T/P cycle452 track129 and ENVISAT cycle033 track352.

3. Discussion and Conclusion

As the result of applying the above mentioned method to the 2004 Sumatra-Andaman earthquake, effects to sea surface heights from oceanographical phenomenon whose spacial or time scales are larger than the grid sizes or the intervals of MSLA analysis can considerably be removed.

On the other hand, we have to pay attention to that some of MSLA products are partly be affected by disturbed sea surface height data from satellite altimetry by the tsunami.

In the near future, I would like to apply this noise reduction method to fixed data being provided soon, in order to process sea surface height data from satellite altimetry for tsunami profiles with reduced noise levels.

References

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