Determination of Geoid Undulations around the Ulleung Basin from Dense Altimeter data

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INTRODUCTION

In this study, geoid undulations were derived around the Ulleung Basin from GEOSAT GM(Geodetic Mission) altimeter data sets. Using global models and mathematical approaches, we removed uncorrelated and non-geologic components from observed sea surface height. In particular, wavenumber correlation analysis and spectral quadrant reconstruction methods in frequency domain were found to be very effective for the determination of geoid undulations of the study area. The measured Mean sea surface height(MSSH) is itself an important geophysical information, and can also be used in geology, oceanography, meteorology, and other areas of earth science.

DATA-PROCESSING

Firstly, we calculated 1-seceond average value of the study area(129°-134°E, 34°-39°N) by straight line fit based on Tau-test with 95% confidence level using 0.1-second Sea Surface Height(SSHs)[Cheney et al., 1987]. After making average 1-second values, we assigned unique revolution ID to each ascending and descending track in the time order. To extract highly-correlated features between adjacent tracks, wavenumber correlation analysis(WCA) was applied in the frequency domain. In the case of Geosat GM data, which have high density observation points, we can assume that the two most geographically-closely adjacent tracks contain common signal of highly-correlated features. From this, we can resolve static and highly-correlated components by pruning out lowly-correlated components from adjacent two tracks. To determine minimum cut-off CC, we analyzed power variation with increasing minimum cut-off CC in each

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track and cut-off CC of 0.75 was selected for the ascending and descending data sets. Also, we performed a least-square orbit adjustment at cross-over points to remove the most longest wavelength orbit error using Knudsen [1987]' algorithm. But, above-mentioned data processings were applied only to pairs of co-linear tracks within ascending and descending tracks separately, and simple arithmetic mean of ascending and descending data is not enough for removing track-line noise effectively. So, to obtain combined GU map free from track-line noise, we used spectral quadrant swapping method by Kim et al.(1998). The resultant GU map do not appear to show any lineation and other high frequency effects related to the orbit tracks.

RESULTS AND DISCUSSIONS

To assess the results of this study, we calculated GUs of the study area from two different models, OSU91A[Rapp et al., 1991] and EGM96 geopotential models. In Fig. 1, four GUs maps of the study area are presented. Table 1 shows CC values among the data sets. As in Table 1, the results of this study show high-CC values(CC>0.97) with other data sets. Fig. 2 compare the results of this study with Sandwell's and two other data set along 4 profiles. Similarly, each data shows high CC values. The results obtained in this study demonstrated that described data processing are effective for the recovery of GUs. Considering these results are derived from only one satellite mission data, it is thought to be that most of uncorrelated and time-dependent (non-geologic) components from measured SSHs were removed effectively.

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Table 1. Statistical Comparison of geoid undulations.

	This Study	Sandwell	OSU91A	EGM96
This Study	1.0	0.961	0.974	0.970
Sandwell	0.961	1.0	0.987	0.986
OSU91A	0.974	0.987	1.0	0.993
EGM96	0.970	0.986	0.993	1.0

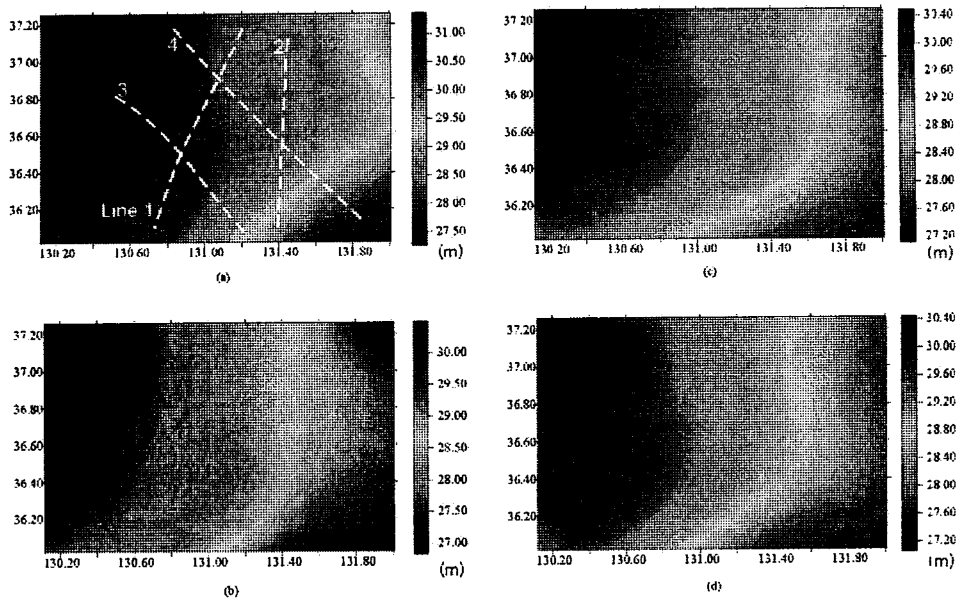

Fig. 1. Comparisons of geoid undulations of (a) this study, (b) Sandwell's, (c) OSU91A model, and (d) EGM96 model.

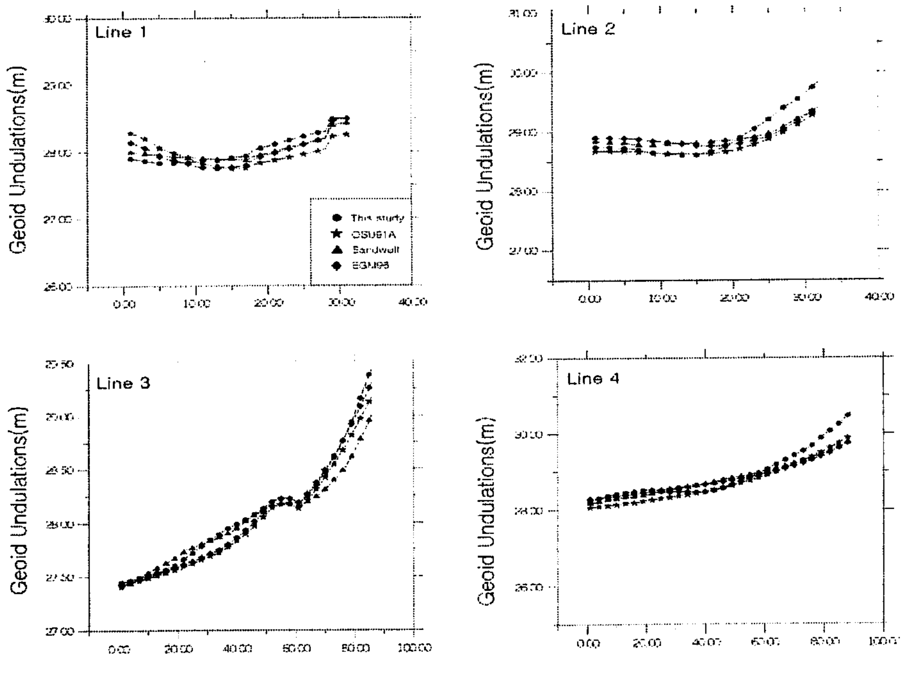

Fig. 2. Profiles of geoid undulations along lines #1,#2,#3, and #4.