Improved Global Marine Gravity by Re-tracking Altimeter Waveforms

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Abstract: We present a new global marine gravity anomaly model with errors nearly a factor of two lower than our previous global models. This improvement is achieved by re-tracking the raw echoes of the ERS-1 radar altimeter. Ocean surface waves are a fundamental limitation to the recovery of gravity anomalies from satellite altimeter profiles. For example, to recover the gravity field at an accuracy of 1 mGal at 20-km full wavelength requires measuring the ocean surface height change over a 10-km horizontal distance to a precision of 1 cm. Standard processing of altimeter data provides a height precision of only about 5 cm at this length scale. These standard products are optimized for recovery of ocean surface height, significant wave height and wind speed and are based on tracking algorithms having at least three unknown parameters. The most precise retracking algorithms are heavily weighted to match the onset time of the leading edge but we show this onset time is nearly perfectly correlated with the wave height parameter. If one assumes the wave height changes only slowly with distance, re-tracking can be performed with a more precise, two-parameter model. Repeat cycles across the South Pacific (area of high sea state) show improvement in along-track slope error from 6.39 microradian to 3.34 microradian and there is a corresponding improvement in resolution from 40 km to 31 km. In addition there are improvements in ocean coverage, especially near coastlines and on the shallow continental margins. The quality of the retracked ERS-1 data are superior to non-retracked Geosat geodetic mission data suggesting the Geosat data can be improved as well.

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