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The merits of using Primary Peak Retrackers for determination of Sea Surface Heights/Gravity Fields in the Arctic using Cryosat-2 SAR Altimetry

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Precise sea surface height estimation and gravity field estimation is done using Cryosat-2 SAR (Synthetic Aperture Radar) data. First, using Cryosat-2 altimetric data, precise sea surface heights are computed. Gravity field is next determined based on the along track variation of the sea surface height anomaly. Thus precise sea surface height determination using Cryosat-2 SAR data is critical for reliable gravity field determination.

This work involves improvement and customization of classical empirical retrackers for sea surface height determination. Classical retrackers work well in open ocean, but in cryospheric areas, like in the Arctic which have a significant presence of sea ice, the classical retrackers either fail or provide unreliable sea surface heights. The Arctic has this typical problem where the SAR echo waveforms are contaminated because of superposition of echoes from sea ice and water and hence a need of customization/improvement in classical empirical retrackers is desired.

In order to make this improvement, the primary peak of the SAR waveform is extracted and isolated from the rest of the waveform. Next, the classical OCOG (Offset Centre of Gravity) and Threshold retrackers are applied on this extracted primary peak rather than the complete waveform. The extraction of the primary peak is helpful as this is the part of the reflected waveform where interaction between the altimetric pulses and the sea surface occurs. The extraction of the primary peak is based on start/stop thresholds based on the standard deviation of power difference in consecutive/alternate bins of the complete reflected waveform.

After processing is done based on the Primary Peak retrackers, the sea surface heights are computed and gravity fields are determined from the same. There are two methods of evaluating the performance of the retrackers.

In the first method, the sea surface heights are corrected, the mean sea surface is removed and various geophysical corrections are applied, and the residual is the sea surface height anomaly. A lower value of the standard deviation in the sea surface height anomaly indicates a more precise retracker.

Secondly, the variation of the sea surface height anomaly along the track is used to compute the gravity field and the difference of the retracked gravity field and marine gravity field is obtained. A lower value of the standard deviation of this difference in gravity fields indicates a more precise retracker.

The above two retracker performance evaluation techniques were employed for the traditional OCOG and Threshold retrackers, the Primary Peak retrackers and the ESA retracker (Cryosat2 Level 2 heights). The results in both the performance evaluations concluded that the Primary Peak retrackers performed better than the classical/ESA retrackers. Hence a conclusion is reached that focusing on just the primary peak rather than the complete waveform yields better sea surface height/gravity field in the cryospheric Arctic.