RETRACKING STRATEGY BASED ON WAVEFORM CLASSIFICATION AND SUB-WAVEFORM EXTRACTION FOR COASTAL ALTIMETRY ALONG CHINA COASTAL SEAS

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Abstract

Radar altimeters can measure the instantaneous sea surface height to a precision of approximately 4 cm in the open ocean [1], which are widely used to study mean sea level, ocean gravitational field, tidal system, etc. by oceanography community [2, 3]. However, coastal altimetry data are flagged as unusable due to land contamination of the altimeter return waveforms and inappropriate geophysical corrections. Demands of using accurate coastal altimetry data motivated researches and projects [4, 5] to re-analyze and improve the valuable coastal altimetry measurements. The problem of waveform contamination near the coastal area is the primary one of coastal altimetry, as a significant number of ocean return waveforms do not conform to the Brown model [6] near coasts. In order to make improved use of the altimetry waveform data near the coastal area, we compare five existing retracking algorithms: Ocean[7, 8], Ice-2[9], Offset Centre of Gravity (OCOG)[10], Threshold[11], and Beta5[12] retracking algorithms, using one year (March, 2006 to February, 2007; cycle 155 to cycle 188) of Jason1 waveform off the China and adjacent coastal seas (14-45°N, 105-130°E). The retracked Sea Level Anomaly (SLA) differences of Jason1 ascending and descending passes at crossovers, as well as the Sea Surface Height (SSH) variation between five retrackers and ground tide gauge station measurements are calculated. As comparisons demonstrated, the Ocean algorithm is most accurate when the distance of the altimeter nadir measured point is more than 50 km from the nearest land. But the accuracy and the valid-result percentage of the Ocean algorithm decrease rapidly and

the Ocean algorithm cannot provide valid-result when the altimeter ground track gets close to the land, especially when the distance is less than 10 km. Among the other four retracking algorithms, we find that the OCOG algorithm provides more accurate results than others in coastal seas. The Ice-2 retracking algorithm performs least well because its retracking results depend on empirical knowledge of the return waveform. The Beta5 retracker is based on a parametric waveform model, which is not appropriate to the complex coastal waveforms. Both Threshold and OCOG retracker are easy to implement, but the OCOG is better than Threshold retracker.

Given the conclusion of existing retracking algorithms comparison, a Retracking strategy based on Waveform Classification and sub-waveform Extraction (ReWCE), which combined the advantages of OCOG retracker and Ocean retracker, for coastal altimetry along China coastal seas is developed. The coastal altimetry waveforms are categorized into three classes (Class I: ocean-like waveform, Class II: coastal waveform can be retracked, Class III: coastal waveform can not be retracked) according to three kinds of criteria: the first criteria is the derivative of the waveform, which gives the number of leading edges; the second kind of criteria is the Height, Width and Centre of Gravity Position parameters of the waveform produced by OCOG retracker, which are sensitive to the shape of waveform; the third one is peak power of the waveform. The classified thresholds are determined for each of the criteria based on numerous waveforms analysis around China coastal zone. After the waveform classification, different retracking processes are employed for the three classes of waveforms. Waveforms belonged to Class I are retracked using the Ocean retracker. For waveforms belonged to Class II, the sub-waveforms which contained the leading edge and corresponded to the ocean surface are extracted, and then the Ocean retracker is applied to the extracted sub-waveforms. Waveforms belonged to Class III are discared. The ReWCE retracking algorithm is further validated using tide gauge station SSH measurements and buoy Significant Wave Height (SWH) measurements. Comparisons show that the standard deviation of ReWCE retracking algorithm with the in-situ SSH measurements is less than that of OCOG algorithm around coastal tide gauge stations, and the standard deviation of ReWCE with buoy

SWH measurements is the lowest among retrackers.

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