Exploiting ocean altimeter data in the Gulf of Maine and Middle Atlantic Bight region: assessments

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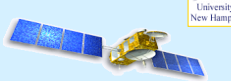


Introduction

Operational processing of altimeter sea surface height (SSH) data over the open oceans is now in a mature stage, and their value for capturing SSH signatures and their gradients in basin and meso-scale studies are widely recognized. Once an altimeter approaches the coastline, however, the quality of SSH measurements becomes questionable due to numerous causes including 1) corrupted radiometer and altimeter measurements due to land contamination within their antenna footprints, 2) inaccurate geophysical corrections, and 3) improper sampling schemes. In recent years significant progress has been reported in some coastal settings, such as the North-Black seas (Madsen et al., 2007), the northwest European shelf (Volkov et al., 2007), the northeast Mediterranean Sea (Bouffard et al., 2008), and the US west coast (Saraceno et al., 2008). Various processing approaches have been proposed to improve the data quality in coastal regions

This poster presents the progress made under a NASA-OSTST funded project with the focus on the altimeter data assessment in the Gulf of Maine and Mid-Atlantic Bight (GoM-MAB) region.

Objectives

One goal of this project is to develop altimeter data processing approaches dedicated to the US northeast coastal zone and shelf region in the (GoM-MAB) regions.

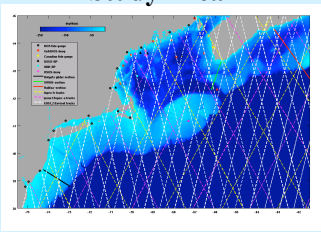
As a first step, the quality of the altimeter SSHA is examined by

Assessment 1: the performance of various de-aliasing geophysical corrections including

- Regional tide model (WebTide) vs. global tidal models (FES2004, GOT00.2, and GOT4.7)
- MOG2D-G model-based IB vs. simple IB,
- ECMWF model-based vs. radiometer-based (e.g. TMR, JMR, AMR) wet-tropospheric delay corrections

Assessment 2: Comparing altimeter SSHA records with coastal tide gauge measurements.

Study Area



Gulf of Maine and Middle Atlantic Bight map with various observational sites: Shown are NOS coastal tide gauges, NDBC, and GoMOOS buoy sites as well as nominal ground tracks of the TOPEX, Jason and Envisat altimeter missions.

Assessment 1: Approach of performance evaluation

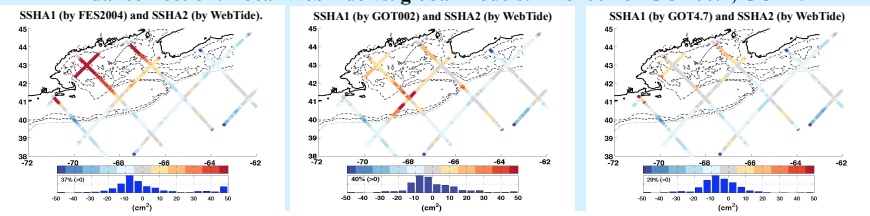
- the variance gain (VG12) is defined as the difference between the variance of SSHA1(r,t) obtained with correction 1 and the variance of SSHA2 obtained with correction 2 at an along-track measurement point r over the multi-year time t series data span:

$$VG12(r) = var[SSHA1(r,t))] - var[SSHA2(r,t))]$$

Note that a positive value of VG12 indicates that correction 2 explains more variance than correction 1 and thus improves SSHA data quality.

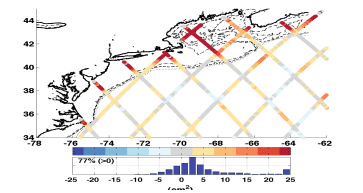
- Altimeter data is TOPEX from Sept.1992 to Aug. 2002 (Cycles 001-364)

Tidal correction: Local WebTide vs. global models: FES2004 or GOT00.2, GOT4.7



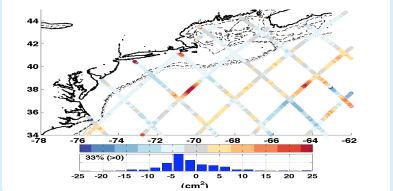
The along-track variance gain (cm²) of TOPEX/a from Sept. 1992 to Aug. 2002 (Cycles 001-364) between the variances of SSHA1 and SSHA2. Bathymetry is contoured at 0, 100, 200, and 1000m. The frequency distribution of the VG is plotted in the lower inset with the percent of positive VG also indicated.

HF atmospheric correction: Global MOG2D-G model IB vs. a simple inverse barometer model



The along-track variance gain (cm²) of TOPEX from Sept. 1992 to Aug. 2002 between the variance of SSHA1 (corrected by inverse barometer) and SSHA2 (corrected by global MOG2D-G IB).

Wet-range delay tropospheric correction: ECMWF model vs.TOPEX-radiometer (TMR)

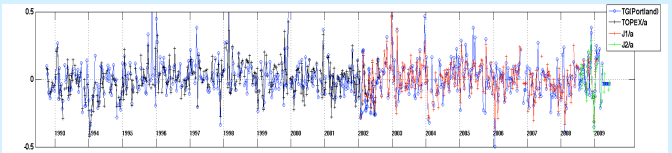


The along-track variance gain (cm²) of TOPEX from Sept. 1992 to Aug. 2002 between the variance of SSHA1 (by ECMWF -wet tropospheric model correction) and SSHA2 (by TMR -correction).

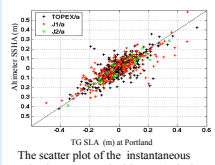
Assessment 2: Comparison to Tide Gauge Sea level Anomaly

Data processing

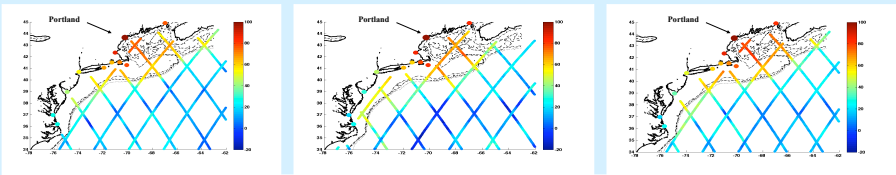
- Tide Gauge (TG) SLA is de-tided
- Altimeter SSHA is obtained by the RADS default processing settings
- No IB correction is applied for both SLA and SSHA



The time series of the Portland, ME, tide gauge sea level anomaly (SLA) and altimeter (TOPEX/a: cycles001-364, Jason1/a:cycles 001-260 and Jason2/a: cycles001-034) measured sea surface height anomaly (SSHA) : the instantaneous TG SLA and the altimetric SSHA values at the maximum-correlation positions



The scatter plot of the instantaneous Portland TG SLA and altimeter (Black: TOPEX/a: Red: J1/a:; Green: J2/a) measured SSHA at the maximum-correlation positions



Mapped correlation (in %) between the tide gauge sea level at Portland and altimeter TOPEX/a (1992 to Aug. 2002 (Cycles 001-364) , and TOPEX /b(cycle 369-481) and Jason1/a (cycles 1-260) SSHA measurements. The Portland TG SLA correlations with other coastal TG stations are shown as well.

Conclusions

- **Assessment 1**
  - A local model (e.g. WebTide) shows an improvement of altimeter SSHA estimates over the global FES2000 and GOT00.2 , and equivalent performance with GOT4.7 over most of the region, slightly better in the inner GOM near the Bay of Fundy.
  - The simple IB correction does not work well within the 1000-m coastal/shelf zone over the GOM-MAB region. The HF-aliasing corrections in the MOG2D-G IB solution are able to reduce variance at the 10-25cm² level.
  - The TMR wet-tropospheric correction is superior in comparison with ECMWF, but the latter will have the advantage of increasing the data return rate near the coast. Some questions remain near the Gulf Stream region.
- **Assessment 2**
  - The altimeter measured SSHA is highly correlated with tidal gauge SLA
  - The TG SLA and altimeter SSHA correlation map reveals a relatively large- scale coherence region of sea level variability over the shelf of the GoM-MAB system.

Acknowledgments
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