# Retrieval of coastal sea surface height from along-track continuous AltiKa data


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## 1. Introduction

**Waveforms are contaminated near lands**

- Bright reflection from calm water in semi-closed bays or flat areas on land (Wang and Ichikawa, 2014)
- Darker reflection from lands (Gómez-Enri *et al.*, 2010)

**Coastal Retracker**

- Algorithms for individual waveform for universal use and/or on-board processing
- Limit use of waveform near the leading edge; *e.g.* ALES (Passaro *et al.*, 2014)
- However, identification of a leading edge among many sharp bright contaminations is not easy

**In this study,**

- Along-track sequential waveform data are used at once, instead of independent use of individual waveforms
  - -Bright reflection at a point is *geometrically related* to ones at the next point
  - -Most of the coastal oceanographic applications requires post-processed data only
- SSHAs estimated by different methods will be compared with tide gauge data.

## 2. Data and Method

### Data

**AltiKa 40Hz Sensor-GDR** (from AVISO; Bronner and Picot, 2013)
Pass 305 near Tsushima Island between Japan and Korea (Fig.1)
Cycle 1-17 (2013/3-2014/11)

**hourly tide gauge record** (from JODC)
Izuhara (34 12'N, 129 18'E)

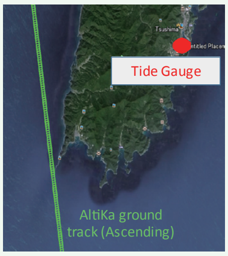



Fig.1) Location of pass 305 and Izuhara tide gauge station

### Method

**1)Mask bright contaminations from point targets**

- Find **parabolic shapes** with larger echo intensity in Latitude-Gate echogram (Fig.2)
- Mask values 50% brighter than the reference waveform away from land (at 34.05N)
- Fit Brown model curve (Fig.3)

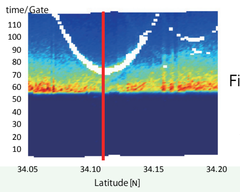



Fig.2) Example of Latitude-Gate echogram at cycle 6
White parabolic curves are masked as bright reflections from calm water in small bays

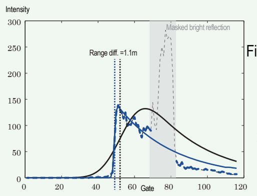



Fig.3) Waveform at 34.11N
Observed waveform (black broken line) at the red line in Fig.2 is modified (blue).
Brown model curves fitted for each broken lines produce 1.1m range difference.

**2) Compensate land area within footprint**

- To compensate loss of reflection from land, the echo intensity at each gate is enlarged by the proportion of the land area within the footprint concentric circle (Fig.4)
  GSHHS product (http://www.ngdc.noaa.gov) is used to calculate land area
- Refit Brown model curve (Fig.5)

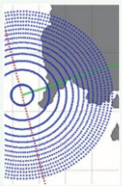


Fig.4) AltiKa footprint circles
The green line at 34.11N normal to the pass shows the location of the bright target (calm water in a small bay)

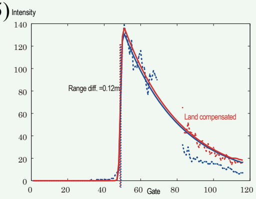



Fig.5) Land-compensated waveform at 34.11N
Echo intensity is enlarged in the trailing edge (red broken line).
Fitted Brown model curves produce 0.12m range difference.

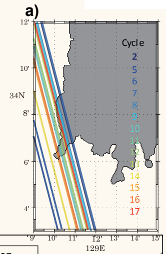
## 3. Results

### 3.1 Along-track de-tided SSHA

**SSHA derived from ocean and ALES retrackers and this study (Fig.6)**
Bias and trend are removed as for ocean tides

**Better estimates in this study**
Especially good in the coastal area south of the land

**Estimates around 34.15N (north of the land) are bad in all products**
Especially, for cycles whose subsatellite track shifts toward the land (Fig.6a)



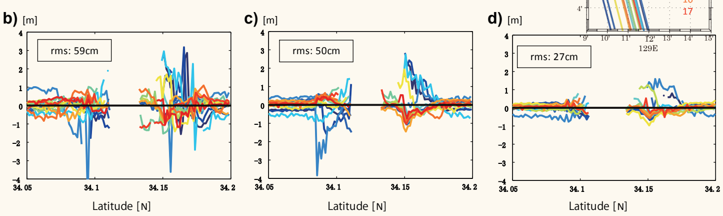
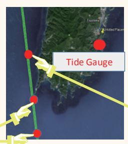
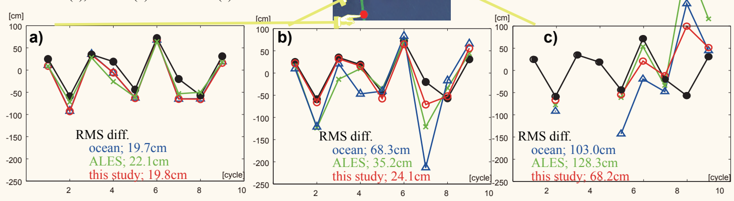




Fig.6) Location of points in each cycle (a) and along-track de-tided SSHA by ocean retracker (b), ALES retracker (c) and this study (d).
Colors indicate the cycles as shown in the panel a.

### 3.2 Comparison with tide gauge time series

Fig.7) Time series of SSHA
SSHA (including tides) by ocean retracker (blue), ALES retracker (green) and this study (red) compared with tide gauge data (black) at 34.05N (a), 34.10N (b) and 34.15N (c).




**SSHA (mostly tides) are compared with tide gauge data**

- **At 34.05N,** away from the land
  All estimates are similarly good (about 20cm RMS diff.)
- **At 34.10N,** south of the land
  RMS diff. of this study remains similar (24.1cm) to one at 34.05N
- **At 34.15N,** north of the land
  Although this study is the best estimates, RMS diiff is too large.

## 4. Summary

Waveform contaminations near lands are removed from along-track AltiKa data, accounting their geometric relation

- Better results than ALES retracker applied for *individual* waveforms
- Estimates in some coastal area (just exiting from a land) are still bad by unknown reasons to be determined in future

**Reference**


Bronner and Picot, SALP-MU-M-OP-15984-CN, 2013.
Gómez-Enri *et al.*, *IEEE Geosci. Rem. Sen. Lett.*, **7**(3), 2010.
Passaro *et al.*, *Rem. Sens. Env.*, **145**, 173-189, 2014.
Wang and Ichikawa, SAR Altimetry Workshop, 2014.