The DTU18 MSS Mean Sea Surface improvement from SAR altimetry

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Altimetric Mean sea surface.

Reference for deriving sea level anomalies (SLA).

DTU MSS are purely altimetric (no remove/restore vrt geoid (like CLS))

20 years mean profile of TOPEX/J1/J2 is fundament.

20 years mean profiles of E1/E2/N1/SA is fitted on this (remove d/o 10 diff)

Short frequencies from geodetic mission altimetry C2+J1+SA.

Baseline for MDT (ocean current) estimation

\[ \text{MDT} = \text{MSS} - \text{Geoid} \]
DTU Space National Space Institute

CLS 15 vs DTU15 at different wavelengths

Short wavelengths $\lambda < 150$ km

Long wavelengths $\lambda > 150$ km

Average difference is less than 2 cm

- No significant difference at short wavelengths
- Some differences seen at wavelength $> 150$ km.

Zoom on the Hawaiian-Emperor seamount chain

Courtesy of Shaeffer et al., 2017
DTU15MSS-UCL13MSS (Regional)

- Confirms that DTU15 is
- Potential too high by
- 10 cm in the Arctic
- (ice covered regions
- So also around
- Antarctica....
Problem:

- Cryosat 8 year Mean
- Relative to DTU15MSS.
- INDICATE THAT MSS
- SHOULD BE HIGHER
- What's wrong?
RADS prefers “ocean like” waveforms in the Arctic this is sea-ice height.
Four steps to update DTU15MSS to DTU18MSS.

- New Arctic and Antarctic dataset -> Reprocessing/retracking of Cryosat-2 within leads
- Long wavelength Correction TP/J1/J2 mean profiles
- Coastal zone update using S3A and TP/J1/J2 + TDM profiles
- Removing Geodetic Mission ocean variability in interpolation.
C2 Lead (SAR+SARin) data

- 8 year mean estimated from > 4 million 20 Hz observations
- Retracker bias for Gauss Threshold retracker found and corrected.
Long wavelength

- An-isotropic Gauss Markov covariance function
- Correlation length: 50 km NS & 150 km East west
- Stronger fit to mean tracks.
Coastal Zone (TP+TDM+ 2 years of S-3A)

- Within 70 km of coast (zeroed elsewhere).
- Long wavelength removed.
Dynamic Sea level Variability

Interannual & seasonal oceanic variability corrected using 3D Optimal interpolation

From Daily AVISO SLA maps (Le Traon et al, 1998) >>>

$$\text{SSH}_{\text{cor}}(t,\lambda,\phi) = \text{SSH}(t,\lambda,\phi) - [\text{SLA}^i(t,\lambda,\phi)]$$

AVISO Daily SLA grids estimated from All Altimeter missions

Variance of Cryosat-2 SLA before and after dynamical SLA variability

Before SLA variability correction

After SLA variability correction

• Correction performed for Cryosat-2 (7y); SARAL GM (1y), Jason-1 GM (1y)
DTU18-DTU15

- Within +/- 66 bounds corrections up to 8 cm (std < 2 cm)
- Outside 66 bounds lowering with an average of 12-13 cm from C2 lead.
<table>
<thead>
<tr>
<th></th>
<th>DTU15</th>
<th>DTU18</th>
<th>CLS15</th>
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</thead>
<tbody>
<tr>
<td>TP/J1/J2 mean</td>
<td>1.3 cm</td>
<td>0.8 cm</td>
<td>0.8 cm</td>
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<tr>
<td>TDM</td>
<td>2.81 cm</td>
<td>2.1 cm</td>
<td>2.2 cm</td>
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<tr>
<td>S3</td>
<td>4.1 cm</td>
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Summary.

- DTU18MSS is ready to be released.

- Several smaller issues with DTU15MSS has been corrected.

- DTU15/18 are still only true global MSS available.

- 220 km Cross Pole-hole extrapolation performed wrt geoid

- Final Testing around Arctic and Antarctic coasts are ongoing.

- Testing if appropriate to “Direct Sea-ice Freeboard estimation”