Regional sea level trends in the Bay of Bengal: preliminary results from a GRACE and Jason-1/-2 joint inversion

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Abstract

Sea level rise is not uniform, but it exhibits considerable regional variations. In Bangladesh, sea level rise in combination with land subsidence resulting from groundwater pumping, sediment load and/or tectonic motion, poses a major threat to the coastal regions. As part of the Belmont-project “BanD-AID”, a joint inversion method is employed to estimate the different contributors to the total sea level rise, such as melting of mountain glaciers/ice caps and Greenland and Antarctica ice-sheets, hydrology, glacial isostatic adjustment, and steric sea level changes. Spatial patterns (fingerprints) are forward computed for each of the contributors. Temporal GRACE gravity data and along-track Jason-1 and -2 sea level anomaly data is combined to estimate the time variable amplitudes of these individual fingerprints, which allow the computation of individual sea level trends. In this work, we provide preliminary results from a global solution of the inversion which are compared to local measurements for offshore Bangladesh.

Joint Inversion

Usual approach: GRACE minus altimetry
Problems arise from:
- Corrections
- Filtering of GRACE data
- Reference system
- Separation of the different contributions (mass, steric) to the total sea level

The joint inversion combines GRACE and altimetry data in a (constrained) Least Squares solution.

It is based on an 1D elastic response Earth model and includes a consistent reference frame treatment (incl. degree 1 coefficients)

Global Results

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Inversion</th>
<th>IPCC AR5</th>
<th>Church, 2011</th>
<th>Jacob, 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antarctica</td>
<td>0.40 ± 0.03</td>
<td>0.27 ± 0.11</td>
<td>0.45 ± 0.20</td>
<td>0.45 ± 0.19</td>
</tr>
<tr>
<td>Greenland</td>
<td>0.66 ± 0.01</td>
<td>0.43 ± 0.08</td>
<td>0.31 ± 0.17</td>
<td>0.60 ± 0.02</td>
</tr>
<tr>
<td>Glaciers</td>
<td>0.43 ± 0.02</td>
<td>0.76 ± 0.37</td>
<td>0.59 ± 0.04</td>
<td>0.41 ± 0.08</td>
</tr>
<tr>
<td>Hydrology</td>
<td>-0.20 ± 0.09</td>
<td>0.38 ± 0.11</td>
<td>-0.08 ± 0.19</td>
<td></td>
</tr>
<tr>
<td>Steric</td>
<td>1.20 ± 0.14</td>
<td>1.10 ± 0.30</td>
<td>0.88 ± 0.33</td>
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<tr>
<td>Total</td>
<td>2.50 ± 0.11</td>
<td>2.80 ± 0.50</td>
<td>2.54 ± 0.46</td>
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</tr>
</tbody>
</table>

References