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

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Sea level rise and its acceleration is a major global challenge of the 21st century. Besides the uniform increase, the rise of sea level exhibits considerable regional variations. Consequently, coastal vulnerability is becoming an increasingly important issue for many countries all over the world.

In Bangladesh, large areas of the country lie just above the sea level. Here, sea level rise in combination with land subsidence resulting from groundwater pumping, sediment load or tectonic motion, poses a major threat to the coastal regions, which are the home of about 30 million inhabitants. Monitoring of sea level and comprehensive knowledge of all recurrent effects in this region is crucial for future investments in coastal protection. As part of the Belmont-project “Bangladesh Delta: Assessment of the Causes of Sea-level Rise Hazards and Integrated Development of Predictive Modeling Towards Mitigation and Adaptation” (BanD-AID) a joint inversion method is employed to estimate the different contributors, such as melting of mountain glaciers/ice caps and Greenland and Antarctica ice-sheets, hydrology, glacial isostatic adjustment, and steric sea level changes.

In the joint inversion method, spatial patterns (fingerprints) are forward computed for each of the contributors, utilizing the sea level equation for mass fingerprints, e.g. individual ice-sheets and glaciers and a Principal Component Analysis for steric fingerprints derived from ARGO float data. Temporal GRACE gravity data and along-track Jason-1 and -2 altimetry data is combined to estimate the time variable amplitudes of these individual fingerprints, which allow the computation of sea level trends linked to each of the considered contributors.

In this work we provide preliminary results for the Bangladesh region as performed withing the framework of the BanD-AID project. Results from a global solution of the inversion are compared to local measurements for offshore Bangladesh. Estimated sea level trends are compared to trends derived from tide gauge data and their differences are interpreted in terms of unmodeled regional effects, such as land subsidence. The initial results give an indication on the magnitude of the contributions from the different sources at the coast of Bangladesh; e.g. the contribution from the Greenland ice-sheets between 2003 and 2011 (0.69 mm/yr) is significantly larger compared to that of the ice-sheets in Antarctica (0.15 mm/yr), but the biggest effect results from steric sea level changes (-1.5 to 6 mm/yr).