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Non-tidal loading by the Baltic Sea: comparison of modelled deformation with GNSS time series

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The Baltic Sea is a well-monitored semi-enclosed sea in northern Europe. The mass variations of the Baltic Sea are mostly due to atmospheric pressure changes and wind, which redistribute the water within the basin and also govern the so-called fill level, the amount of water exchange with the North Sea. The variations in the sea level can be abrupt and and large, for example during storms. The variable load may cause significant effects in geodetic measurements, especially near the coastline.

We have computed the time series of non-tidal loading due to Baltic Sea for 193 stations in northern Europe. These stations are used for GNSS, absolute and relative gravity measurements and other geodetic observations.. We have used hourly observations of the sea level at the tide gauges of the Baltic Operational Oceanographic Service (BOOS, http://boos.org) to estimate the momentary sea level over the whole basin of the Baltic Sea. These sea level models are then convolved with Green's functions for the Gutenberg-Bullen Earth model using program SPOTL (Agnew, 2012, http://escholarship.org/uc/item/954322pg) to obtain gravity change, deformation in three dimensions and change in tilt and strain. The time period is four years, February 2008 to February 2012. The time series could be used for several purposes, e.g. for the studies of other error sources, to create stable time series and also to correct campaign measurements, which take place in varying conditions.

In this study we have compared the computed deformation to coordinate changes measured by GNSS at selected stations around the Baltic Sea. We use two different daily time series of GNSS positions: the PPP (Precise Point Positioning) time series provided by Jet Propulsion Laboratory (JPL, http://sideshow.jpl.nasa.gov/post/series.html) and a double difference solution computed at our institute.