Sea level change from satellite altimetry and tide gauges in the Baltic Sea

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RADS data availability on May 11, 2008
http://rads.tudelft.nl/rads/status.shtml
(using IOS mirror site)
Data coverage (%)

Topex-B
Jason-1
ERS-2
Envisat-1
RADS data are not collocated

example of a Jason-1 crossover
east of Gotland Island

only values < 10 cm are shown
An ad-hoc “1-sec collocation” scheme
near Jason-1 track crossover east of Gotland Island
Collocated tracks and Russian tide gauge stations in Kaliningrad area
Collocated tracks and Russian tide gauge stations in eastern Gulf of Finland and near Gulf of Neva
What about storm surges?

6 years of Jason-1 anomalies along tracks 111 and 187 (next slide)
6-year time series at Jason-1 locations near 2 EGF coastal stations (next 2 slides)
Jason-1 track 168 at 59.929N, 28.800E (27.0 km from station 86056)

Trend = 3.20 cm y\(^{-1}\) (± 2.00 at 95% conf.)

Sea Level Anomaly (cm)

Time (months from 2002)
Jason-1 track 187 at 60.180N, 28.551E (60.4 km from station 86035)

Trend = 3.33 cm y$^{-1}$ (± 2.21 at 95% conf.)
6-year time series at a Jason-1 location near a coastal station in Kaliningrad region (next slide)
Jason-1 track 144 at 54.605N, 19.622E (18.5 km from station 86181)

Trend = 2.07 cm y\(^{-1}\) (± 1.07 at 95% conf.)
Scenarios from a coupled model (RCAO) simulated 100-year changes in maximum sea levels.

Upper-left: present climate.
Upper-right: “low-case” scenario of global mean SL rise of 9 cm.
Lower-left: “ensemble average” scenario of mean SL rise of 48 cm.
Lower-right: “high case” scenario of mean SL rise of 88 cm.

(from H.E. Markus Meier, New Scenario Simulations for the Baltic Sea. BALTEX Newsletter, Dec. 2005, pp 5-7.)
The “high case” scenario:

Global mean SL rise of 88 cm over 100 years

Gdansk: 2.3 cm yr\(^{-1}\)
Parmu: 3.3 cm yr\(^{-1}\)
Hamina: 2.9 cm yr\(^{-1}\)
St. Petersburg: 3.6 cm yr\(^{-1}\)

How tall are the gates in the SPB flood protection barrier?
Conclusions:

- Four satellite altimeters (Jason-1, Envisat, ERS-2 and Topex-B) provide a relatively dense observation network of up-to-date sea level in Baltic Sea.
- An ad-hoc “1-sec collocation” scheme was used to tie each alongtrack altimeter position to same location at each cycle for time series and statistics.
- Time-distance plots of alongtrack Jason-1 sea levels (2002-2008) exhibit large scale signatures of past storm surges, though due to the 10-day repeat cycle, these plots are not likely to capture peak amplitudes of flooding events.
- Plots of coastal station and nearby Jason altimeter sea level timeseries show a good agreement between the two very different observing systems.
- The 6-year long (2002-2008) Jason-1 data show a surprisingly large sea level rise of about 3.2 cm/year in Eastern Gulf of Finland, and about 2.1 cm/year in southeastern Baltic Sea (Kaliningrad region).
- Work is in progress to ascertain that altimeter-derived rates are consistent with those from coastal stations and to compute sea level statistics in Baltic Sea.