Baltic SEAL: new insights into the mean and variability of the sea level in the Satellite Altimetry era

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> For sea level studies, coastal adaptation, and planning for future sea level scenarios, regional responses require regionally-tailored sea level information including sea level budgets.

- > The Baltic Sea region features a well developed and regarded tide gauge network, is a semi-enclosed sea basin, and now features an improved estimate of mean sea surface and regionalised sea level trends (from the Baltic SEAL project).
- > Opportunity to investigate trends and sea level variability at different spatial scales, using the dataset suite.





Sea level trends (A) and corresponding uncertainties (B) estimated by altimetry (shading) and tide gauges (circles) from May 1995 to May 2019. Tide gauge data are corrected using the NKG2016 vertical land motion model. Uncertainties are reported as 95% confidence interval.



The Baltic SEAL Project

Used the Baltic Sea (with low tide signal) as a testbed to:

>Exploit high-frequency multi-mission altimetry observations (LRM & SAR) to obtain sea-level measurements;

>Advance data retrieval very close to coasts (~ 3km);



- >Improve and update our understanding of mean sea level in the entire Baltic Sea, including in the vicinity of jagged coastlines and sea-ice;
- >Provide various timeframe datasets, extending as far as 25 years, with monthly triangulated meshes and high-temporal resolution grids, validated with tide gauge data.



coastal altimetry to

develop a new and

improved Baltic

sea level product

> Potential for synergy with other projects in the ESA Regional **Initiative Baltic+ programme** (e.g. Baltic+ Salinity), and **multi-source** in-situ data.

> Data to exploit could include: data from Argo floats and cruise measurements, Sea Surface Salinity data, and Sea Surface **Temperature** data (for the steric component), and **mass data from** the GRACE and GRACE-FO missions.

gauge sea level and the altimetry-derived nearest sea-level grid value in the Baltic SEAL gridded product classified as good data.

differences in trends: A portion of the sea level trend gradient can directly linked to enhanced be southerly wind forcing and associated towards the Ekman transport Bothnian Bay, such as in this example from winter 2014.

Passaro M, Müller FL, Oelsmann J, Rautiainen L, Dettmering D, Hart-Davis MG, Abulaitijiang A, Andersen OB, Høyer JL, Madsen KS, Ringgaard IM, Särkkä J, Scarrott R, Schwatke C, Seitz F, Tuomi L, Restano M and Benveniste J (2021) Absolute Baltic Sea Level Trends in the Satellite Altimetry Era: A Revisit. Front. Mar. Sci. 8:647607. doi: 10.3389/fmars.2021.647607

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> Potential to develop sea level budget approaches for **non-tide**gauged regions, using the Baltic Sea's extensive network to refine and explore methodologies

User manual & Python code for novices and educators

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