ESA Baltic+ SEAL: Using the Baltic Sea as a test-bed for developing advanced, regionalised sea-level products

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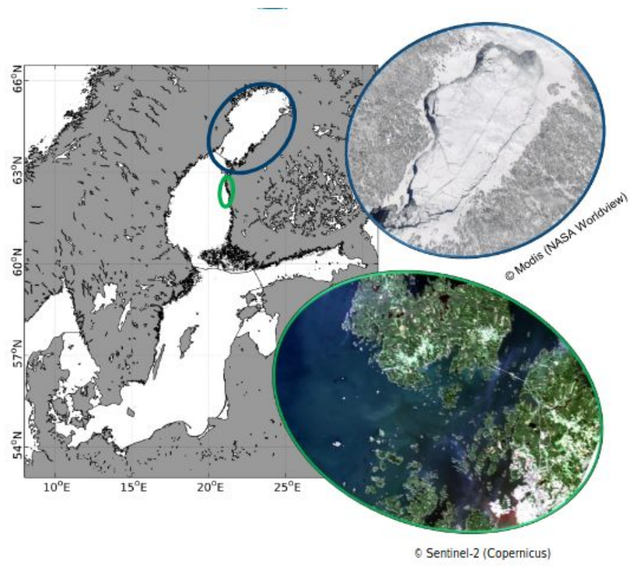
Baltic SEAL Project

The project aims to develop novel, multi-mission along-track and gridded sea level products using state-of-the-art methods. This allows for:

- ➢ enhanced performance in areas with sea-ice, such as in the northern Baltic Sea
- ➢ increased accuracy in the proximity of the coast ~ 3 km

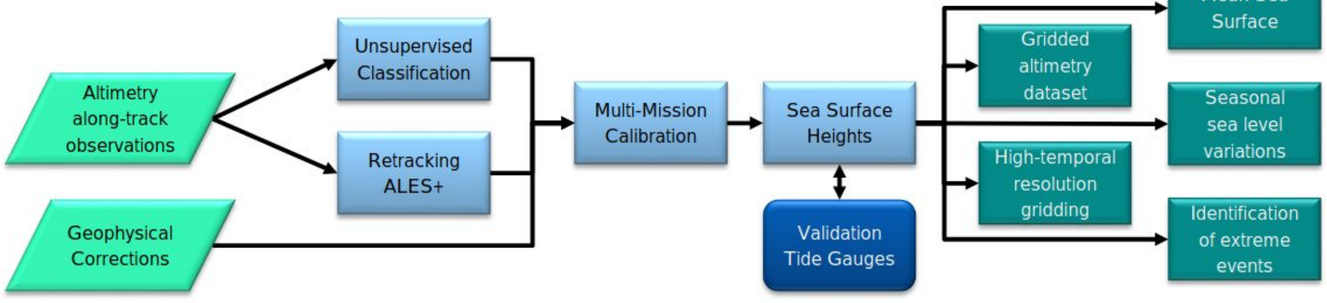


New technological improvements enable advanced solutions:

- The homogenous retracking strategy applied for open-ocean, coastal and sea-ice conditions (ALES+)
- The unsupervised classification method based on artificial intelligence developed to detect radar echoes reflected by open-water gaps within the sea-ice layer
- The multi-mission cross-calibration, which allows the user to exploit along-track data from the full constellation of altimetry missions in combination
- The development of the gridded product based on a triangulated surface mesh, characterised by a spatial resolution higher than 0.25º degree and enhanced utility for coastal areas

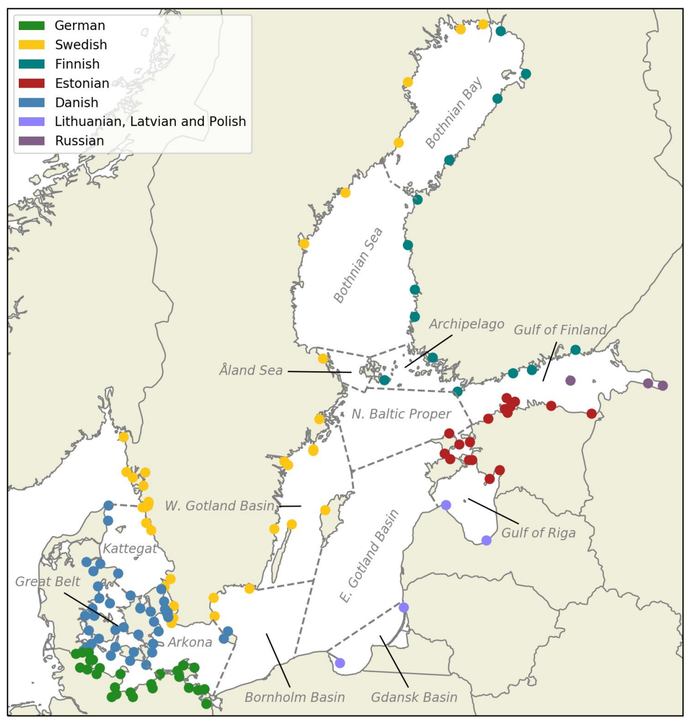
For more information on ALES+ and coastal altimetry approach see Passaro et al. 2018.

The workflow of the project:

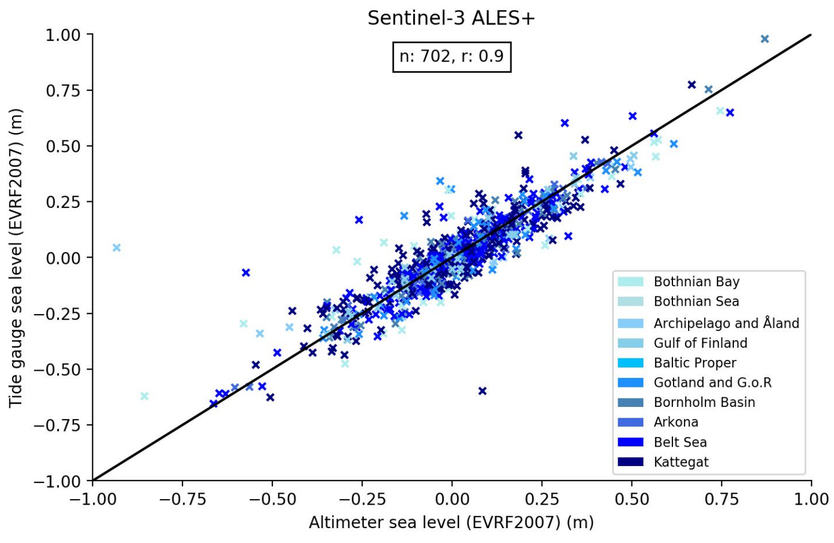


The Baltic Sea of Opportunity

- The Baltic Sea has a low tidal signal, complex coastlines, thousands of small islands in the coastal archipelagos, and seasonal ice cover.
- Hence, a near-perfect testbed to explore the coastline and sea-ice issues for altimeter data processing.
- Regional investment has ensured the availability of high quality, long-term tide gauge (TG) data to support validating any new sea-level products.



TGs located near the altimeter track points or grids were used, data were detrended to remove the effects of vertical land motion, national height coordinates were unified to EVRF2007 and the measurements were interpolated to the time of the satellite over-flight, or monthly averaged. In areas such as the eastern coast of the Baltic Proper, the sparsity of TGs is limiting the validation.

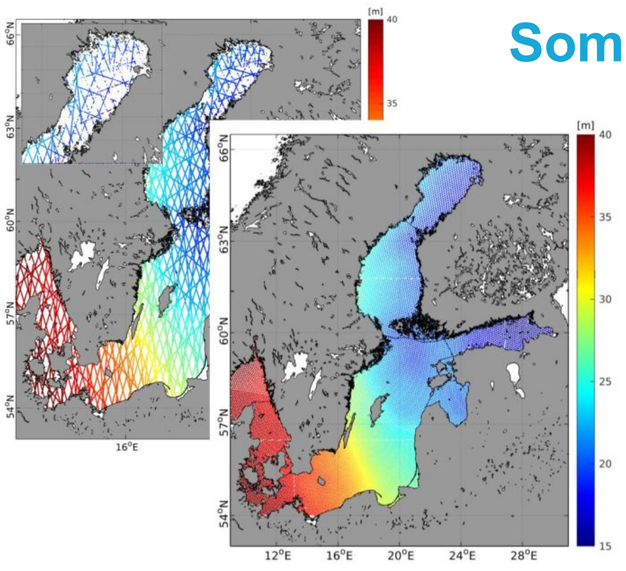


Validation results are promising

Along-track products perform well 3 to 10 km away from the coast:

- ➢ Out of 248 TG-product pairs, **RMSE is <20 cm** for 214 pairs and **r>0.8** for 297 pairs and **r>0.9** for 103 pairs
- ➢ Median PCHC ~ 100 % for most along-track products 3 kilometers away from the coast
- ➢ Sentinel-3A product performs best out of the altimeter products (r=**0.9**) and ALES+ retracker out-performs SAMOSA2 retracker

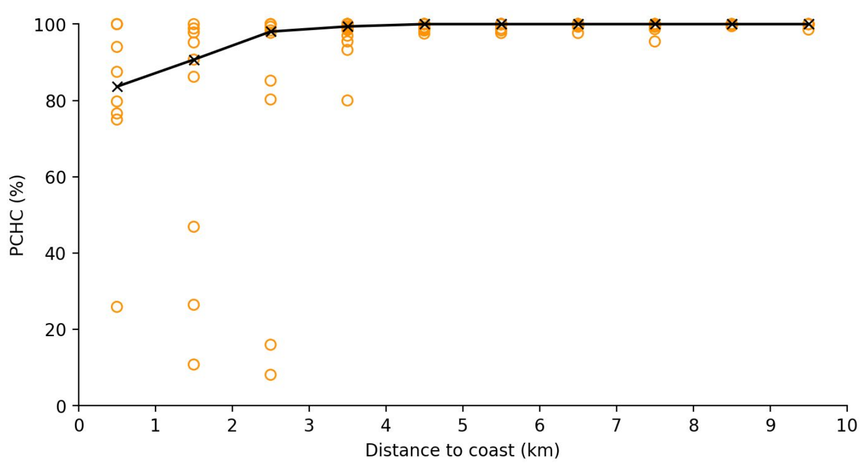
Something to look forward to:



A multi-mission cross-calibrated along-track product, monthly grids and a new mean sea surface will be freely available by the end of the year 2020

Although developed for the Baltic Sea, these products can be easily adapted to other regions as well

Median PCHC for Jason-1



PCHC = Percentage of Cycles for High Correlation (r>0.8)

Calculated through rounds of eliminations.

See Passaro et al. 2015

References:
Passaro M., Rose S.K., Andersen O.B.,Boergens E., Calafat F.M., Dettmering D., Benveniste J.: ALES+: Adapting a homogenous ocean retracker for satellite altimetry to sea ice leads, coastal and inland waters. Remote Sensing of Environment, 211 (2018), pp. 456-471.

Passaro M., Fenoglio-Marc L., Cipollini P.: Validation of significant wave height from improved satellite altimetry in the German Bight IEEE Trans. Geosci. Remote Sens., 53 (2015), pp. 2146-2156.

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