Baltic SEAL: Exploiting regional opportunities and a natural laboratory to advance processing algorithms for altimetry-derived Sea Surface Height estimation.

Felix L. Müller[1], Marcello Passaro[1], Adili Abulaitijiang[2], Ole B. Andersen[2], Emma Chalençon[5], Denise Dettmering[1], Jacob L. Høyer[3], Milla Johansson[4], Julius Oelsmann[1], Laura Rautiainen[4], Ida M. Ringgaard[3], Eero Rinne[4], Jani Särkkä[4], Rory Scarrott[5], Christian Schwatke[1], Florian Seitz[1], Kristine Skovgaard Madsen[3], Laura Tuomi[4], Americo Ambrozio[6*], Marco Restano[6**], Jérôme Benveniste[6]

1 Deutsches Geodätisches Forschungsinstitut, Technische Universität München (DGFI-TUM), Germany
2 SPACE National Space Institute, Technical University of Denmark, (DTU), Denmark
3 Danish Meteorological Institute (DMI), Denmark
4 Finnish Meteorological Institute (FMI), Finland
5 MaREI Centre, Department of Geography, Environmental Research Institute, University College Cork (UCC), Ireland
6* DEIMOS, c/o ESA-ESRIN, Italy 6** SERCO, c/o ESA-ESRIN, Italy 6 ESA-ESRIN, Italy

Globally focused datasets are often not entirely appropriate for supporting regional actions. Global sea-level products produced under the European Space Agency's (ESA) Climate Change Initiative have regional limitations, highlighting the need to compliment global products with regionalised datasets. The ESA project Baltic SEAL is an example of one such regionalisation effort. It demonstrates the technical advances needed to realise regional capitalisation of the global satellite altimetry resource.

The Baltic Sea presents a range of opportunities to advance regional altimetry exploitation. Its complex coastlines, with thousands of small islands in the coastal archipelagos, coupled with seasonal sea-ice prevents the direct use of altimetry-derived sea level observations, without the application of dedicated processing steps to address this limitation. Moreover, the Baltic Sea is the perfect playground to test and validate coastal and open ocean dedicated algorithms in the vicinity of a complex topography and an extensive network of tide gauge stations. Meanwhile its low tidal signal allows these factors to be studied more exclusively in comparison to regions with a more influential tidal signal.

The main focus is the development and application of a retracking algorithm, fitting altimetry radar echoes (i.e. waveform) independent of the surface characteristics (e.g. coastal or sea ice conditions) and a waveform classification based on artificial intelligence strategies in order to detect radar echoes reflected by open water areas within the sea ice cover (i.e. leads, polynyas). The retracking algorithm (known as ALES+) enables the homogenous determination of sea surface heights of typical ocean waveforms, but also of complex coastal and very peaky lead reflections. The algorithm is applied to all types of altimetry waveforms, including those acquired using a Delay-Doppler instrument. The unsupervised waveform classification ingests data from all current and past satellite altimetry missions, identifying waveforms returned from narrow cracks within the sea ice domain. Moreover, a relative cross-calibration (i.e. MMXO), referring to the TOPEX/Poseidon mission, was performed to account for radial orbit differences of 13 included altimetry missions, enabling the generation of a regionally-tailored, multi-mission range of along-track datasets. For the first time, the project enables the joint exploitation of a wide cross-calibrated along-track altimetry dataset, a processing step that is usually only performed to generate interpolated grids.

The profiled datasets are used to generate a novel Baltic Sea dedicated mean sea surface. The improved altimetry-derived sea surface heights form the basis of a gridding procedure onto a triangulated surface mesh, featuring a spatial resolution of 7-8 km, to obtain monthly sea level snapshots. The gridding is based on a least-squares approach, fitting an inclined plane to the mesh nodes.

This presentation overviews the current stage of the methodical background of the Baltic SEAL project, providing a deeper insight into the individual processing and data exploitation steps. In doing so, it highlights the technical advances made in regionalizing datasets acquired with a global perspective, and opportunities for knowledge transfer beyond the Baltic Sea to other regions.