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Sea level variations in the coastal region from altimetry – Using optimal interpolation in the Baltic Sea for 3-day mean sea level from altimetry, tide gauge and model data

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The rise and fall of the sea surface in the coastal region is observed closely by two different sources: tide gauges measure the relative sea level anomaly at the coast at high temporal resolution (minutes or hours) and satellite altimeters measure the absolute sea surface height of the open ocean along tracks multiple times a day. However, these daily tracks are scattered across the Baltic Sea with each track being repeated at a lower temporal resolution (days). Due to the inverse relationship between spatial and temporal coverage of the satellite altimetry data, gridded satellite altimetry products often prioritize spatial coverage over temporal resolution, thus filtering out the high sea level variability. In other words, the satellite data, and especially averaged products, often miss the daily sea level variability, such as storm surges, which is most important for all societies in the coastal region. To compensate for the sparse spatial coverage from satellite altimetry, we here present an experimental product developed as part of the ESA project Baltic+SEAL: on a 3-day scale, the DMI Optimal Interpolation (DMI-OI) method is combined with error statistics from a storm surge model as well as 3-day averages from both tide gauge observations and satellite altimetry tracks to generate a gridded sea level anomaly product for the Baltic Sea for year 2017. The product captures the overall temporal evolution of the sea level changes well for most areas with an average RMSE wrt. tide gauge observations of 17.2 cm and a maximum of 34.2 cm. Thus, the 3-day mean gridded product shows potential as an alternative to monthly altimetry products, although further work is needed.