Baltic+ Salinity

Exploring synergies between remote sensing products developed under the framework of ESA Baltic+ initiative: Sea Surface Salinity and Sea Surface Height

C. González-Haro[1], M. Passaro[2], F.L. Müller[2], V. González-Gambau[1], E. Olmedo[1], A. Turiel[1]

- **Baltic + Salinity and SEAL** projects have developed dedicated products of sea surface salinity (**SSS**) and sea surface height (**SSH**), respectively.

- We explore the potential synergy between both products, with twofold purpose:

  – Intercomparison of both products

  – To address some of the scientific challenges identified by ESA and Baltic Earth community (circulation patterns, inflow and outflow dynamics,...).

ITT Baltic+ Salinity/SEAL Synergies

- SSS and SSH are dynamically interrelated. Both variables can be used to retrieve the stream function of the flow.

- For geostrophic balance conditions, SSH provides a direct estimation of the stream function.

$$\psi(\vec{x}) = \frac{g}{f_0}\eta(\vec{x})$$

g: gravity constant

f0: coriolis frequency

- Other dynamic models, such as the Surface Quasi Geostrophy (SQG) theory (Held 1995), describe surface intensified flows due to buoyancy. In this case, the stream function can be theoretically derived from surface buoyancy (bs).

$$\hat{\psi}(\vec{k}) \sim k^{-1}\hat{b}_s(\vec{k})$$

$$b(\vec{x}) = -g\rho_0^{-1}\left[\alpha(T(\vec{x}) - T_0) + \beta(S(\vec{x}) - S_0)\right]$$

- Transfer function relating both variables.

Baltic+ SEAL Product

- The product developed under Baltic SEAL will be further presented later:

10:50	Baltic+ SEAL	Marcello Passaro Technical University Munich, Germany	**Baltic SEAL: new insights into the mean and variability of the sea level in the Satellite Altimetry era**
11:10	Baltic+ SEAL	Denise Dettmering Technical University Munich, Germany	**Baltic SEAL: Exploiting regional opportunities and a natural laboratory to advance processing algorithms for altimetry-derived Sea Surface Height estimation**

- We usually refer as SSH to the actual "absolute dynamic topography" (ADT), the portion of sea level representing the motion.

- There is not a dedicated product for ADT in the Baltic region.

- TUM has provided gridded ADT retrieved from Baltic+ SEAL SSH at:

  - 0.25 deg spatial resolution (same as SSS)
  - Monthly temporal resolution (SSH)

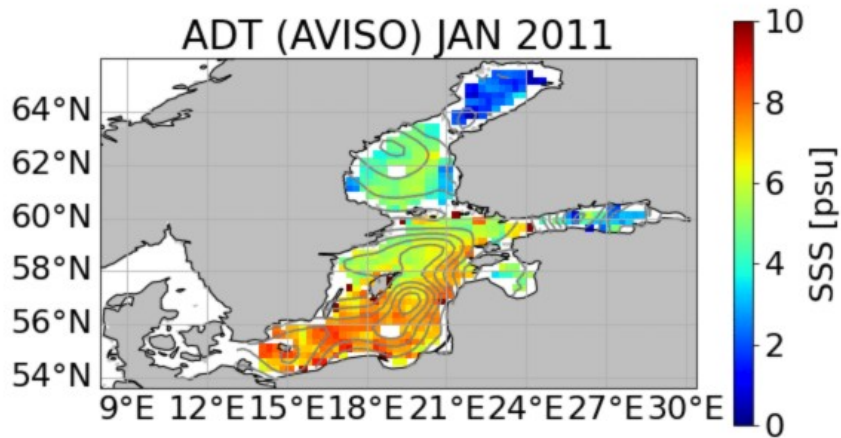SSH – GEOID = **ADT**

Reference ellipsoid
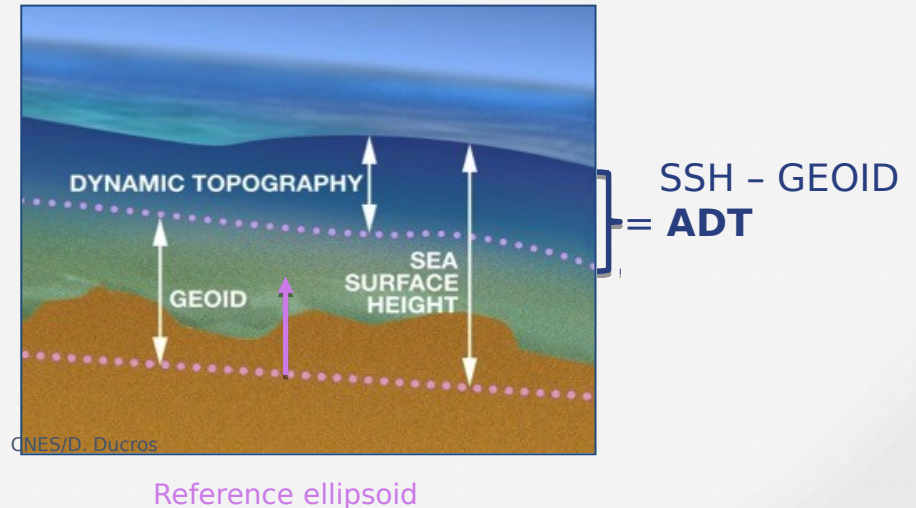
Baltic+ Salinity Product

- Baltic + SSS v1
  - Monthly averaged
  - 25 km spatial resolution

- Temporal range: (2011-2013)

- First **qualitative assessment**
  - SSS monthly fields
  - ADT isolines (15 levels [0,0.8m]).

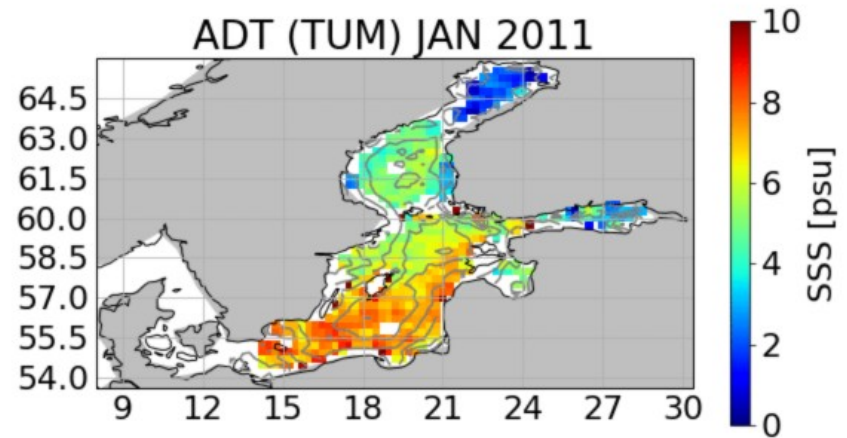- ADT bandpass filtered [350-25] km (Lanczos filter)
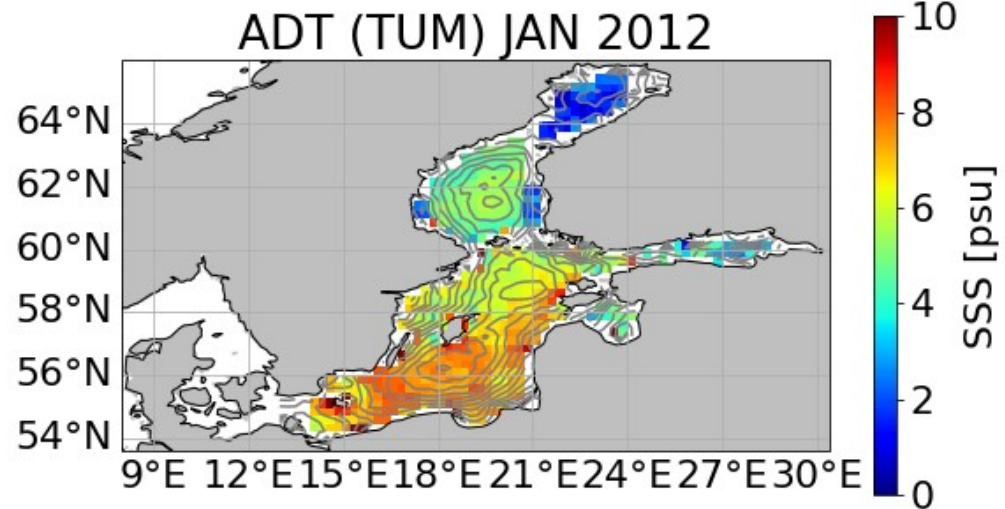
ITT Baltic+ Salinity/SEAL Synergies

Field: Baltic + SSS v1
Contour: ADT (AVISO) (monthly averaged)
CMEMS ID: SEALEVEL_GLO_PHY_L4_REP_OBSERVATIONS_008_047

Field: Baltic + SSS v1
Contour: Baltic SEAL ADT
                    (bandpass filtered)

- The comparison between the first version of Baltic regional SSS and ADT products gives encouraging results. (Independent validation)

- TUM ADT product presents more oceanic structures compared to available altimetric products.

Comparison of ADT observations

Normalized 2D Histogram

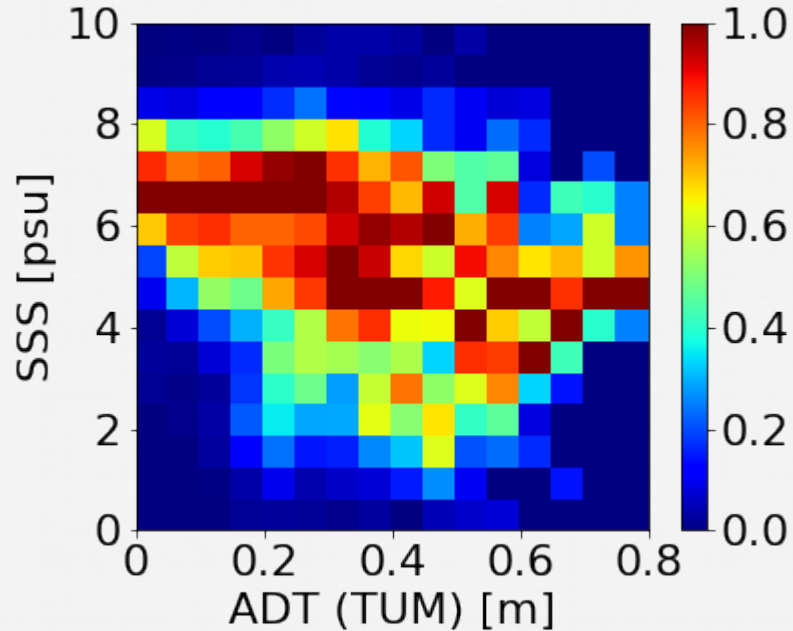Conditioned mean and std
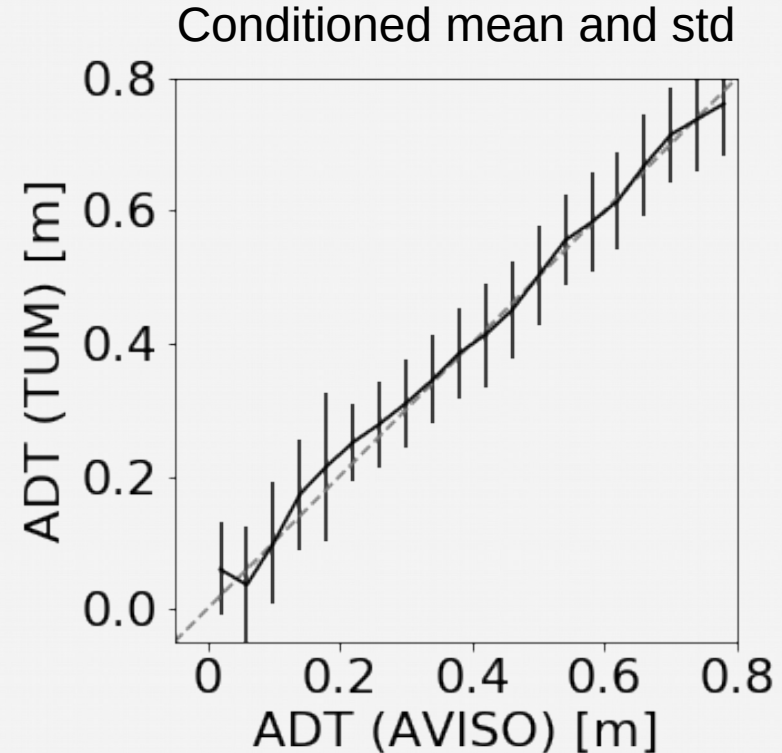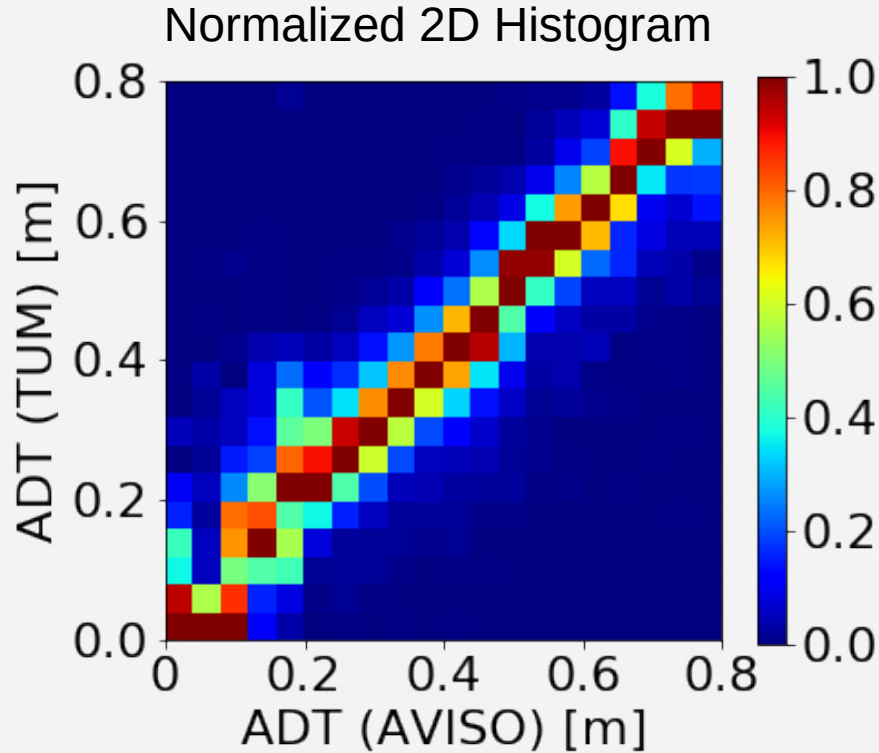
- Good correspondence between the values of both ADT datasets. However ADT TUM resolves more oceanic structures (AVISO has smoother gradients)
- Depending on the application, a simple match up of dataset may lead to uncomplete conclusions on the quality of dataset.

ITT Baltic+ Salinity/SEAL Synergies

Normalized 2D Histogram

Conditioned mean and std
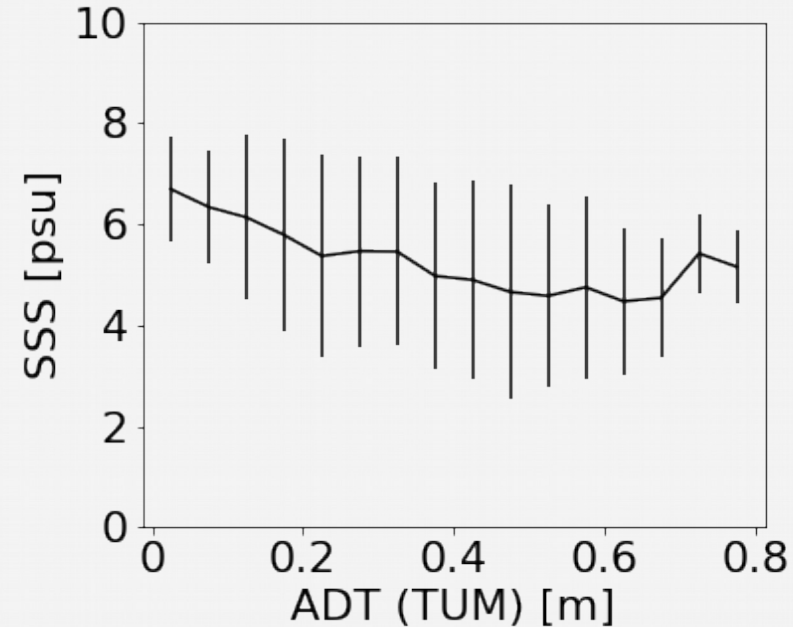
- For monthly and sub-basin scales, there is a negative lineal relationship between both variables.
- Baltic+ SSS v1 may be used to infer circulation in the basin and to study other dynamic processes.

Summary and further work

- The preliminary intercomparison between the first version of Baltic regional SSS and the ADT products gives encouraging results.

- The derived ADT from the Baltic SEAL shows a better performance for reconstructing the dynamics than the actual satellite based product available.

- The existing relationship between SSS and ADT shows the potential of the Baltic + SSS v1 product to infer circulation in the basin or study other dynamic processes.

Further work

- Once v2 of Baltic+ SSS product is available (2011-2019), we will further explore the synergy between both products to characterise the gradient in sea level trend observed in the last decades between S-W and N-E sub-basins. It is likely to be caused by interannual anomalies in the winter westerlies wind forcing, which trap water masses in the N-E [Gräwe et al. 2019].

Baltic+ Salinity

BALTIC SEAL

Baltic+ Salinity Dynamics

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