# Surface ocean variability in the northern North Atlantic: Insights from the new SWOT mission

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**What insights could SWOT's new 2D SSH measurements provide about the variability of surface geostrophic velocities and its link to bathymetry in the northern North Atlantic?**

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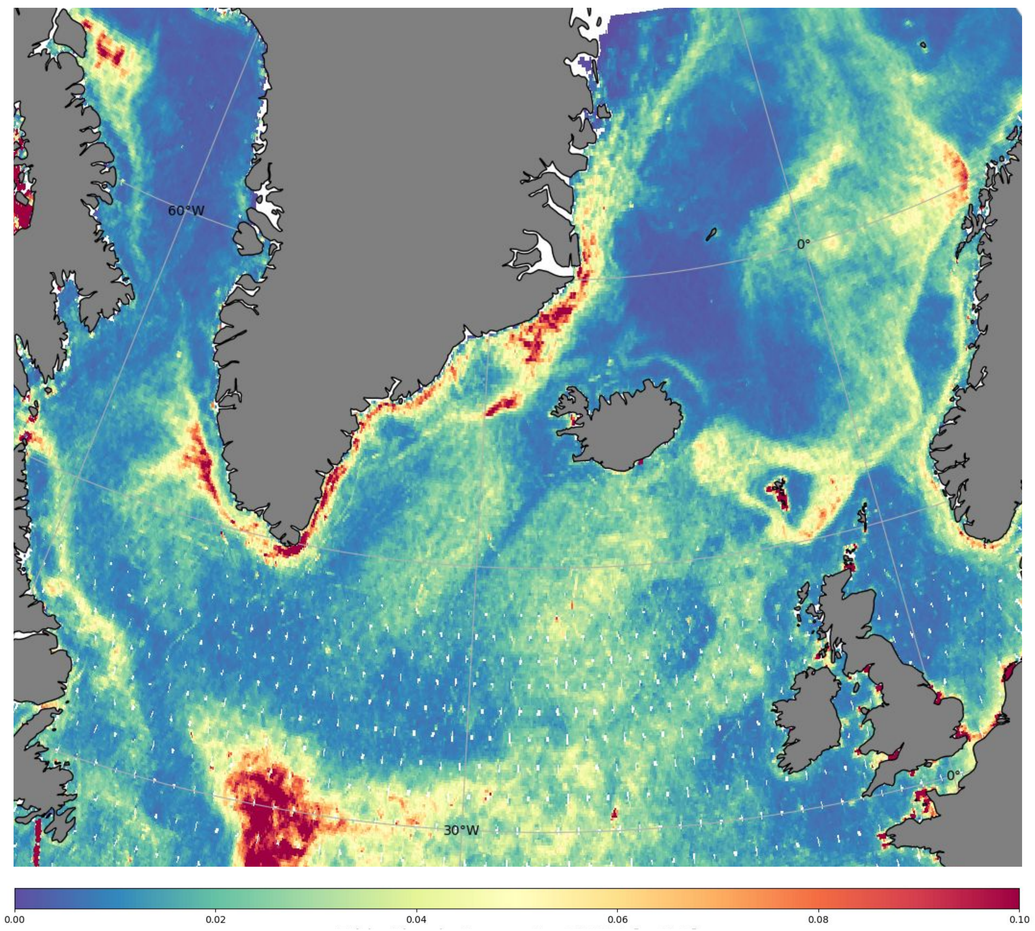



***Figure 1****: Eddy kinetic energy [$m^2/s^2$] calculated from the Level 2 SSHA field, with additional smoothing, interpolated to a 0.1 degree resolution.*

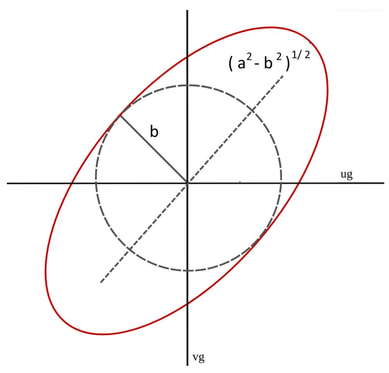
## Data & Methods

**DATA:**

- Low rate measurements form the Ka-band Radar Interferometer (KaRIn)
- Level 2, Version C, karin_2: with all corrections applied, 21-day repeat orbit, with approximately 1.5 years of data
- Geostrophic velocities from the SSHA-field were calculated (additional smoothing by a 9-point filter twice)

**VARIANCE ELLIPSES:**

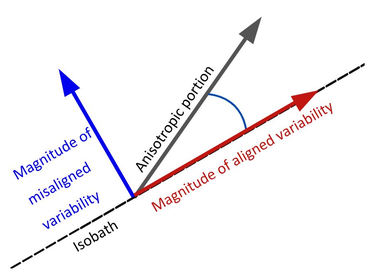
- Reynolds decomposition to create the velocity covariance matrix
- The trace of the matrix displays 2***EKE**
- Eigenvalue decomposition gives the principal components a and b
- The variance ellipse can be interpreted as the sum of a totally isotropic portion with magnitude **b** and totally anisotropic portion with magnitude $(a^2-b^2)^{1/2}$
- The angle of the variance ellipse tells the preferred direction of the variability in the geostrophic velocity




Projected magnitude: $\frac{\mathbf{a} \cdot \mathbf{b}}{\|\mathbf{b}\|}$

**TOPOGRAPHIC ALIGNMENT:**

- The magnitude of variability is projected onto the direction of the (smoothed) isobaths
- The difference between these projections indicates whether the variability is more aligned or misaligned with the isobaths




## Results: Eddy kinetic energy and Topographic alignment

**ROOT MEAN SQUARE SSH:**

- Higher along the coasts, and generally low over flat regions such as basin interiors and continental shelves
- A local maximum in the middle of the Lofoten Basin (Lofoten Vortex)

**EDDY KINETIC ENERGY:**

- Higher along steep slopes, in regions of unstable boundary currents
- High in regions of eddy growth and shedding

**TOPOGRAPHIC INFLUENCE:**

- Variability is more anisotropic along steep slopes (not shown), aligning with isobaths (topographic PV gradient)
- Less topographic influence in the basins

**EDDY SHEDDING AREAS:**

- A signal of misaligned variability at high eddy kinetic energy areas, where the isobaths diverge, areas known for eddy shedding and eddy generation

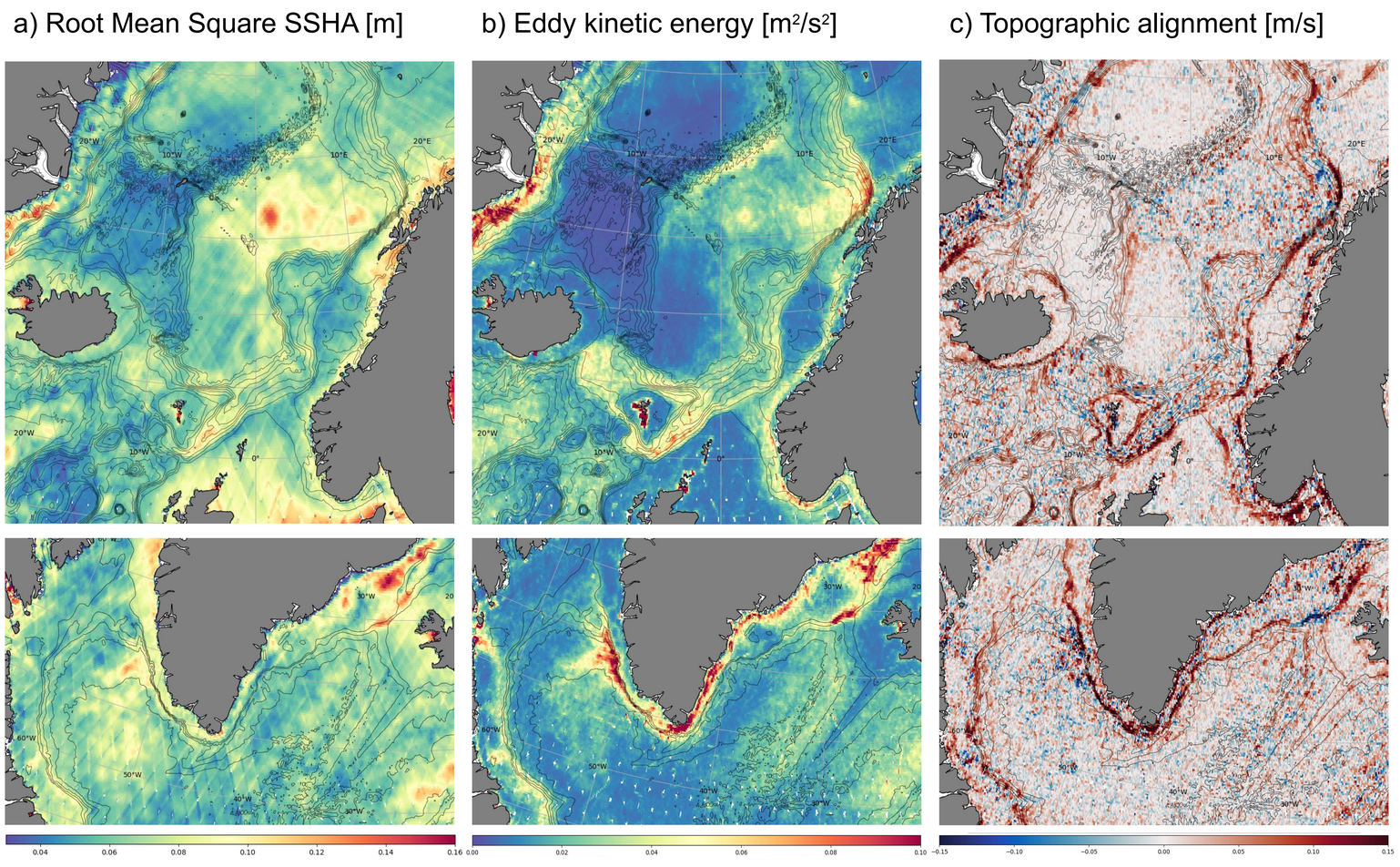



***Figure 2****: Zoom in on the Nordic Seas and the Labrador Sea. Bathymetric contours every 250 m are shown with the black lines.*

**Steep bathymetric slopes influence the direction of anisotropic variability, while regions of eddy generation and shedding display misaligned signals.**

## Future work

- The version C dataset is outdated, and the results should be improved with the newest version of SWOT data. This results are based on the Level 2 datasets, revisiting the results using Level 3 data could highlight the results with less noise.
- The calculations are based on the assumption that the motions are geostrophically balanced, and that the Rossby numbers are small, this might not hold true.
- A longer period of observation could confirm result significance and seasonal trends.
- An intercomparison with the Barents-2.5km EPS model is planned. This intercomparison study will aim to evaluate the model's bias relative to SWOT high-resolution observations, as a preparatory step toward its future assimilation into the operational forecasting system.

Barents-2.5km EPS