Ocean 2D eddy energy fluxes from small mesoscale processes with SWOT

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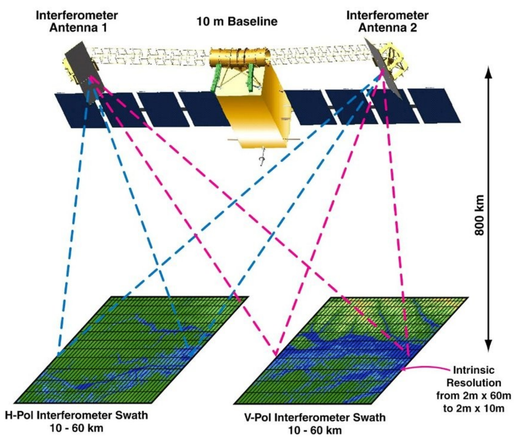
1 - RESEARCH QUESTION AND OBJECTIVES

- **Observability with SWOT**, after processing and reduction of instrumental and geophysical noise
  - ► Diagnostic of small scal variability, not possible with conventional altimetry
- Understand if small scale processes (15 to 150 km wavelength) increase or compensate the **mesoscale eddy fluxes** observable nowadays (>150 km) with nadir altimetry



- First study in the **Agulhas** current, then the **full southern ocean**
  - ►SWOT **simulator** & MITgcm **model** (forced)
  - ►model accounting for **air-sea interaction** (L. Renault)
  - ►SWOT **real data** and DUACS data

2 – OBSERVABLE FREQUENCIES

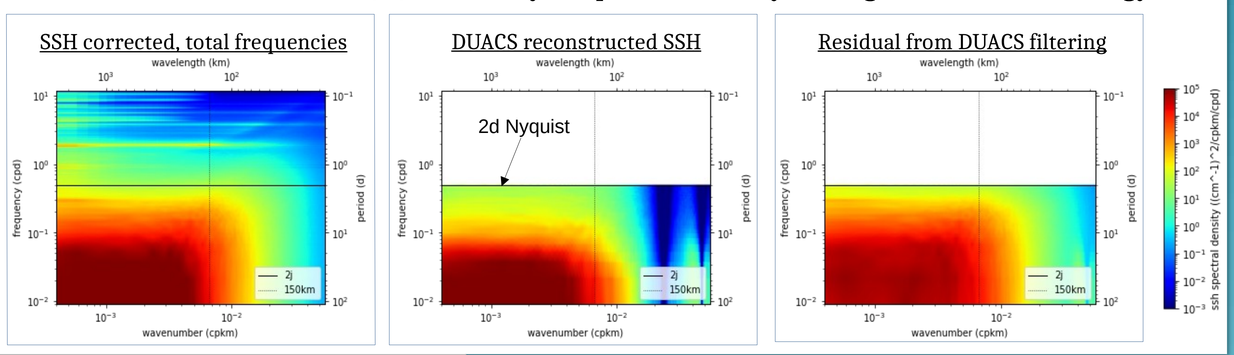
Current altimetry

DUACS reconstructed maps: MITgcm along track sampling + OI, data corrected for barotropic tide and DAC, periods > **10-20d**, wavelength > **150-200 km** (daily sampling)

What is new with SWOT

New scales observed defined as the **residual** of the total ssh (corrected for tide and DAC) **minus the DUACS products**

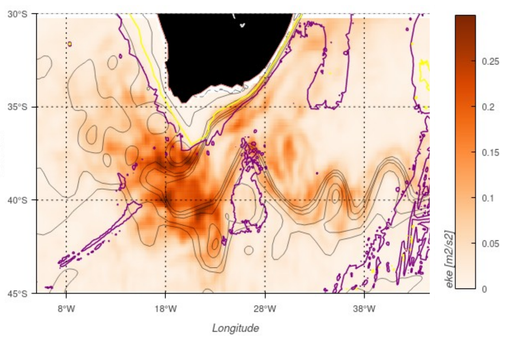
2D spectra of frequency and wavelength show the different **distribution of energy** for the filtered and unfiltered cases [1] Note daily snapshots or daily average have similar energy



3 - EDDY DIAGNOSTICS

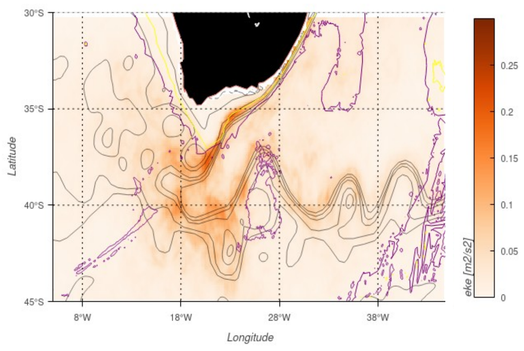
- Eddy Kinetic Energy (EKE) [2]
  - ► Identify high variability zones

$$EKE = \frac{1}{2}\left(u'^2 + v'^2\right)$$



Top: scales **>150 km** observable today

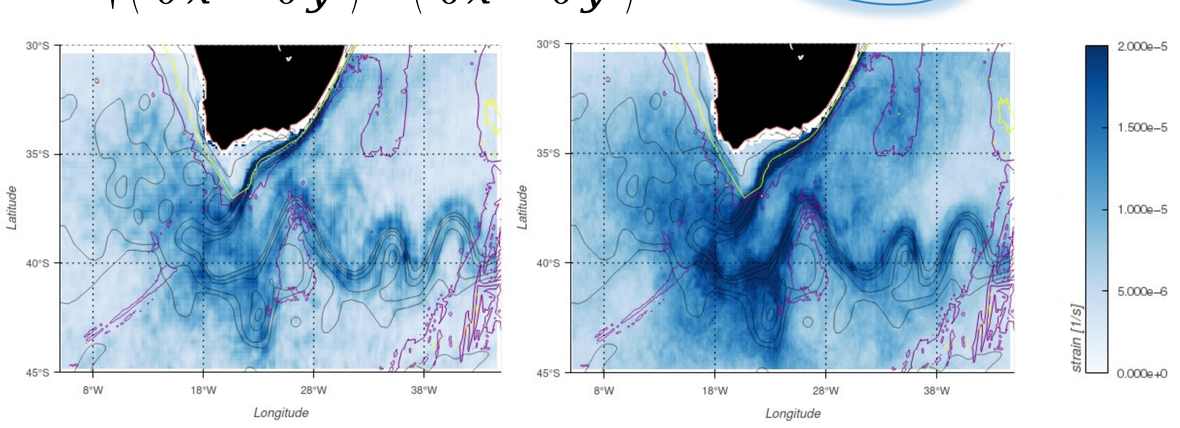
Bottom: scales **<150 km** observable with SWOT



- Eddy energy transfer and cascades [4]
  - ► Interaction with mean current
- Anisotropy of eddy variability [5]
- Strain rate [3]
  - ► Proxy for vertical velocity

$$S_g = \sqrt{\left(\frac{\partial u_g}{\partial x} - \frac{\partial v_g}{\partial y}\right)^2 + \left(\frac{\partial v_g}{\partial x} + \frac{\partial u_g}{\partial y}\right)^2}$$

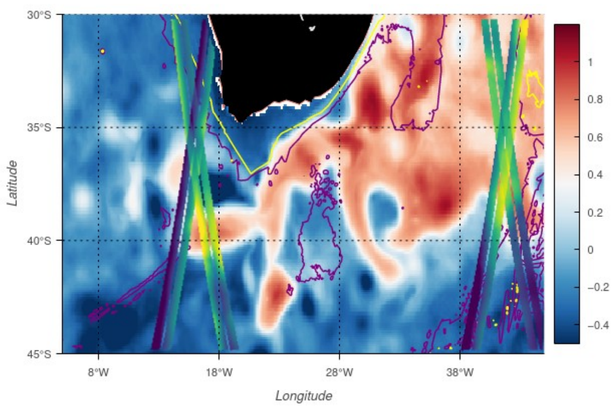
3 times more energy in the small scales!



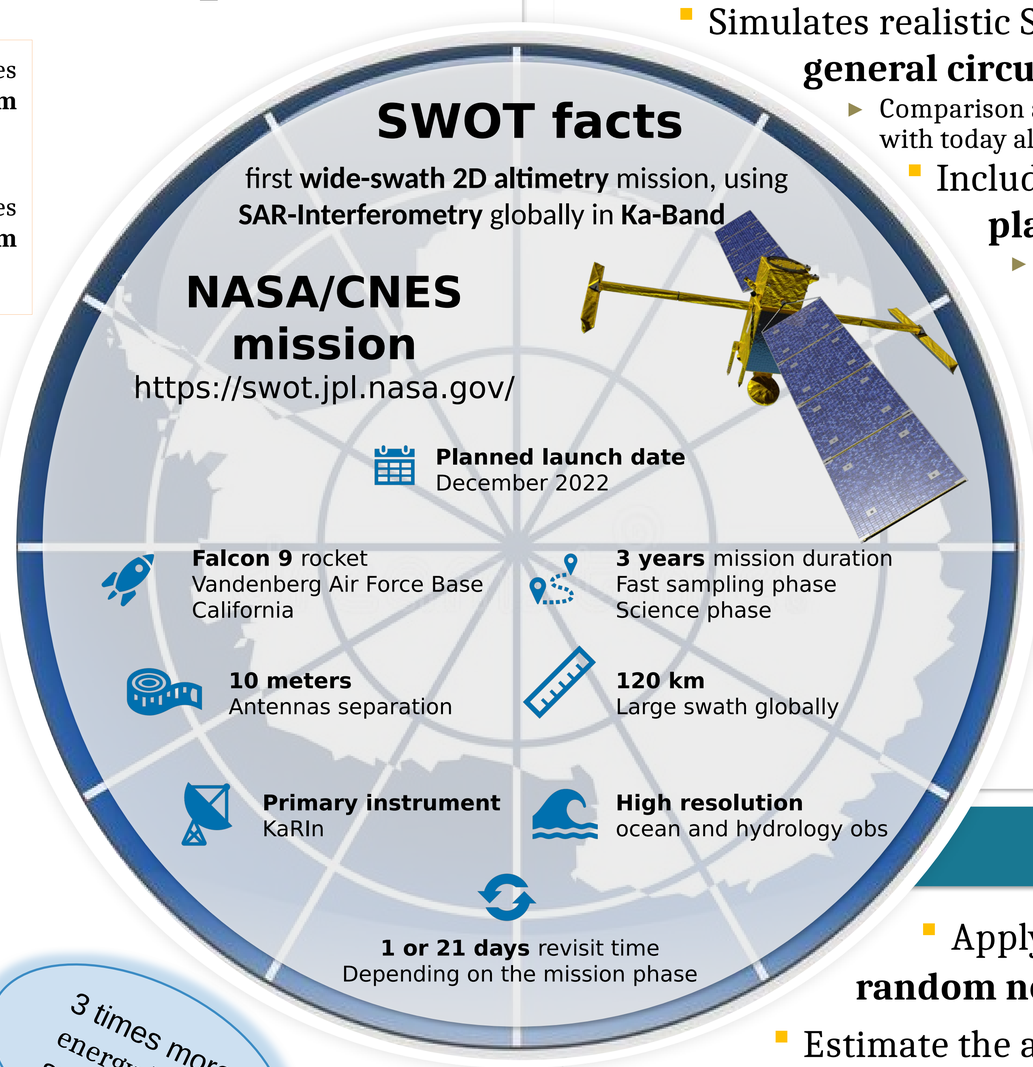
Strain for DUACS reconstructed maps, **large scales** > 150 km (left), **and small scales** < 150 km observable with SWOT (rigth)

4 – SWOT SIMULATOR

- Predicts **SWOT track position** (fast sampling and science phases) [6]
  - ► 4 tracks in the Agulhas current zone during the fast sampling phase
    - Simulates realistic SSH time/space coverage from **ocean general circulation models**
      - ► Comparison against a full 2D field allows to diagnose what is not observed with today altimetry
    - Includes random **KarIn noise** and the **systematic platform errors** [7]
      - ► How will the errors impact our 2D diagnostics?



MITgcm 01/01/2012 snapshot **SSH:** background **2D map** and simulated **SWOT swaths** including full errors



5 - FUTURE WORK

- Applying **machine learning** techniques for **random noise** & **cross-calibration corrections**
- Estimate the actual **SWOT observability** after denoising
- Calculate **eddy diagnostics** on denoised 1-day swaths
  - ► On all scales
  - ► On SWOT observable scales
- Start using **coupled ocean-atmosphere** models
- Use real **SWOT data**

ACKNOWLEDGMENTS

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