High frequency variability

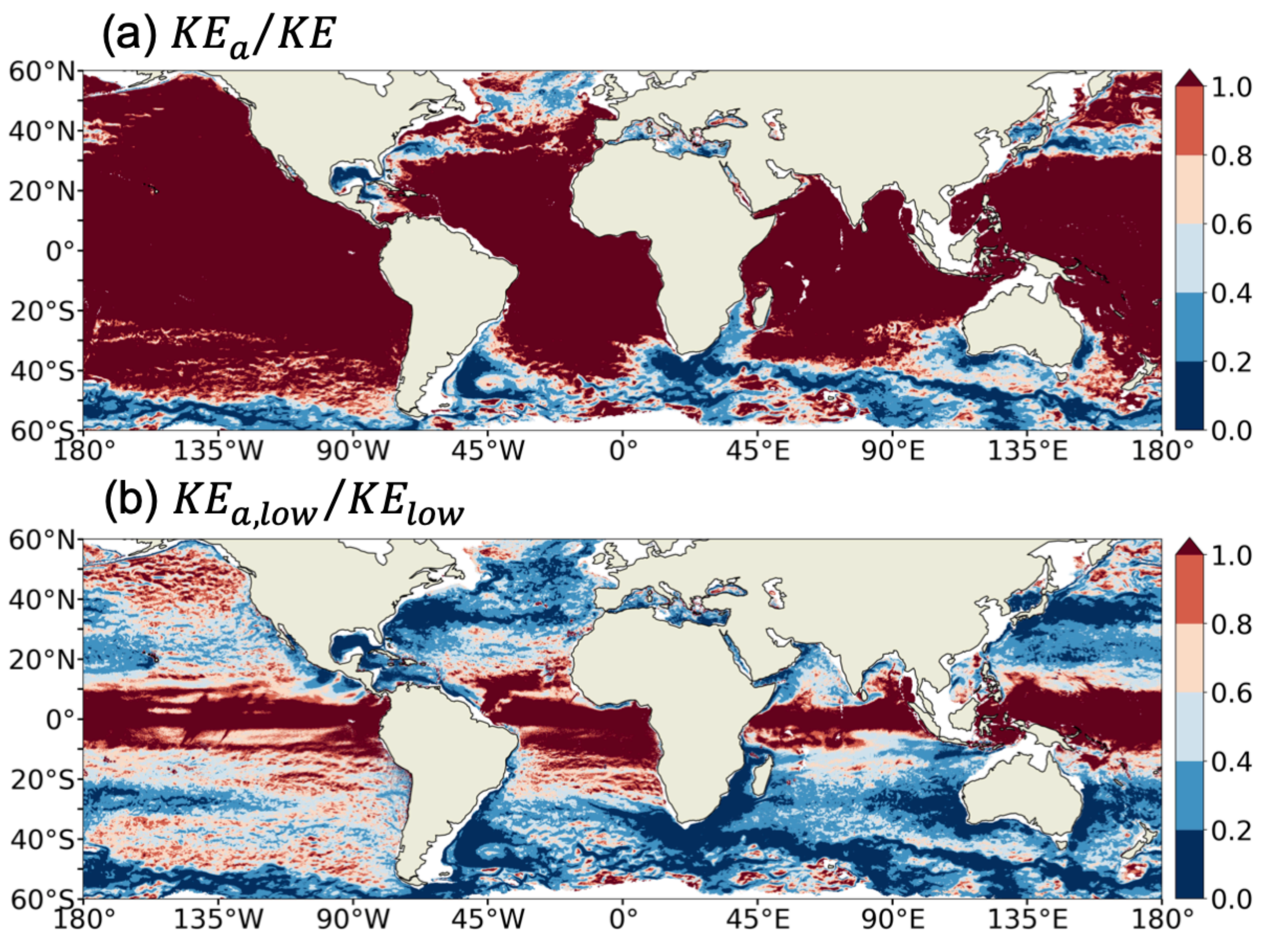
with a focus on internal tides

- Zoé Caspar-Cohen (SIO, San Diego)
- **Noé Lahaye** (Inria, Rennes)
- Aurélien Ponte (LOPS-Ifremer, Brest)
- Xiaolong Yu (SYSU, Zhuhai)

1. Constraining high-frequency variability for SWOT with surface drifter data
2. Internal tide surface signature and incoherence in the North Atlantic

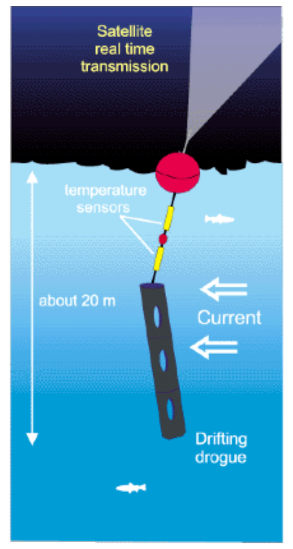
constraining high frequency variability for swot with surface drifter data

LOPS-IFREMER: Aurélien Ponte, SIO: Zoé Caspar-Cohen,
INRIA: Noé Lahaye; SYSU: Xiaolong Yu



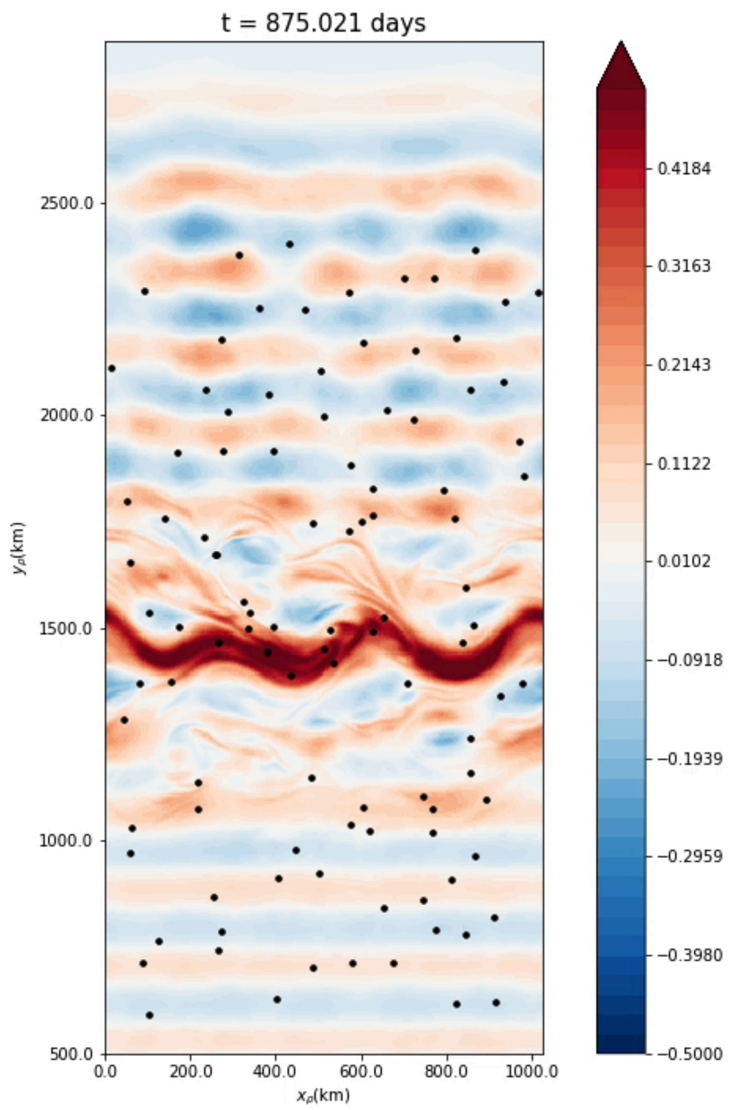
Yu et al. 2021

Motivation: high frequency variability complicates the estimation of ocean surface current from sea level
Yet our knowledge of high frequency motions is limited



Surface drifters are the only global high frequency observations that can help us fill this gap

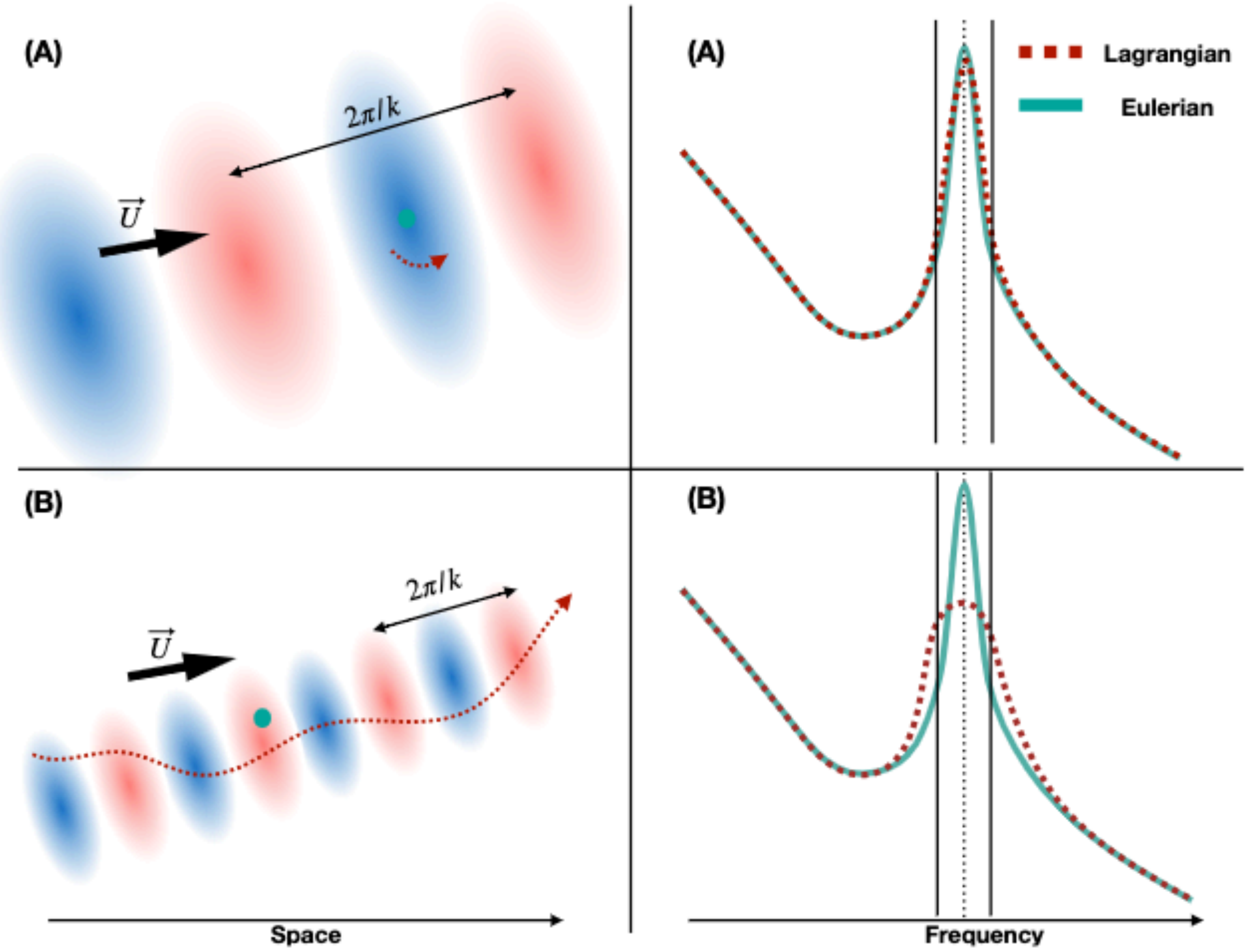
- Focus so far on mapping statistically averaged kinetic energy
- One potential difficulty: Lagrangian biases
- Past efforts: quantifying such biases



Internal tides: care must be taken relative to « apparent incoherence »

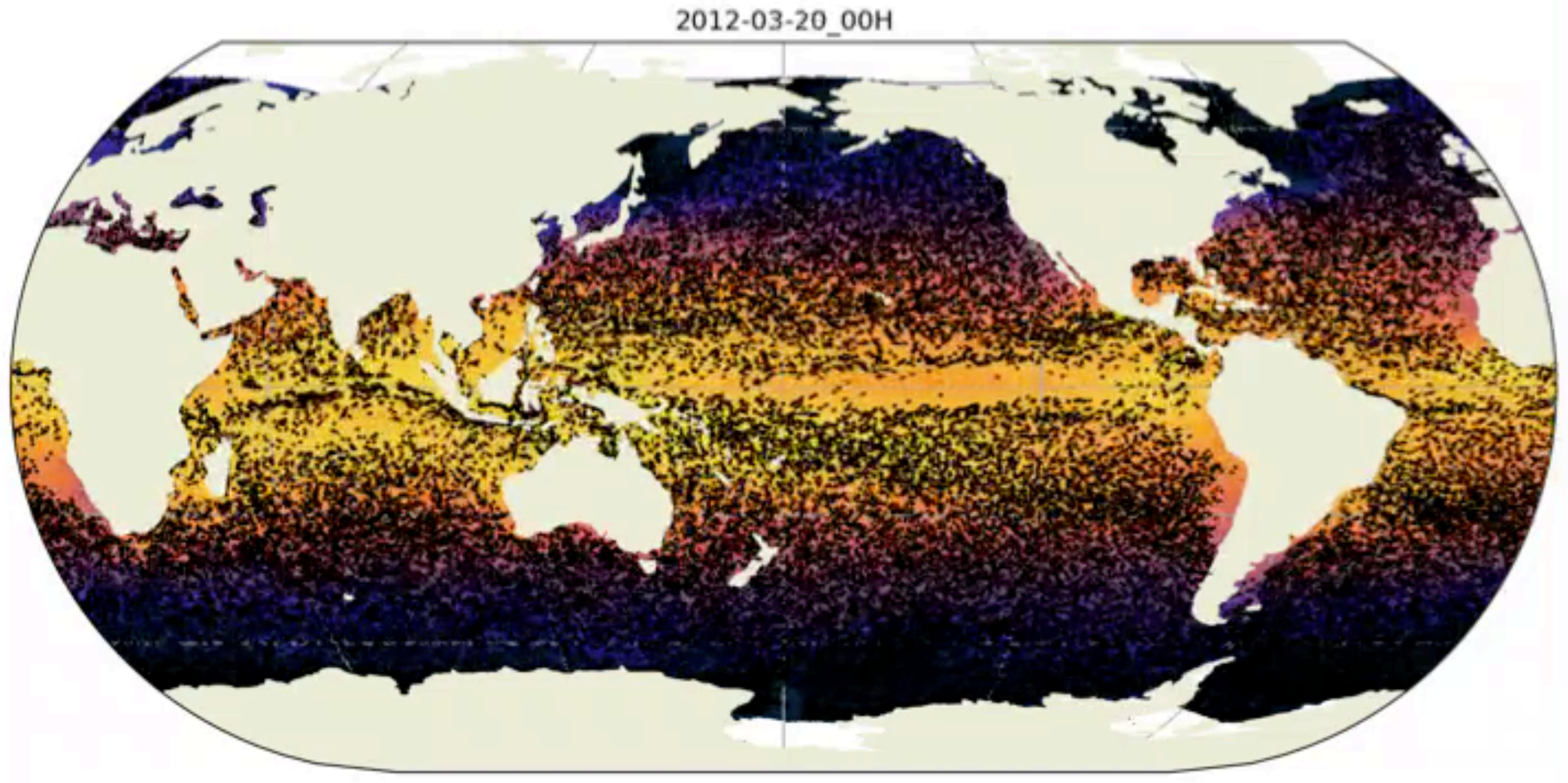
Distortion of the internal tide signal in the drifter frame of reference
-> spectral broadening

Caspar-Cohen et al. 2022

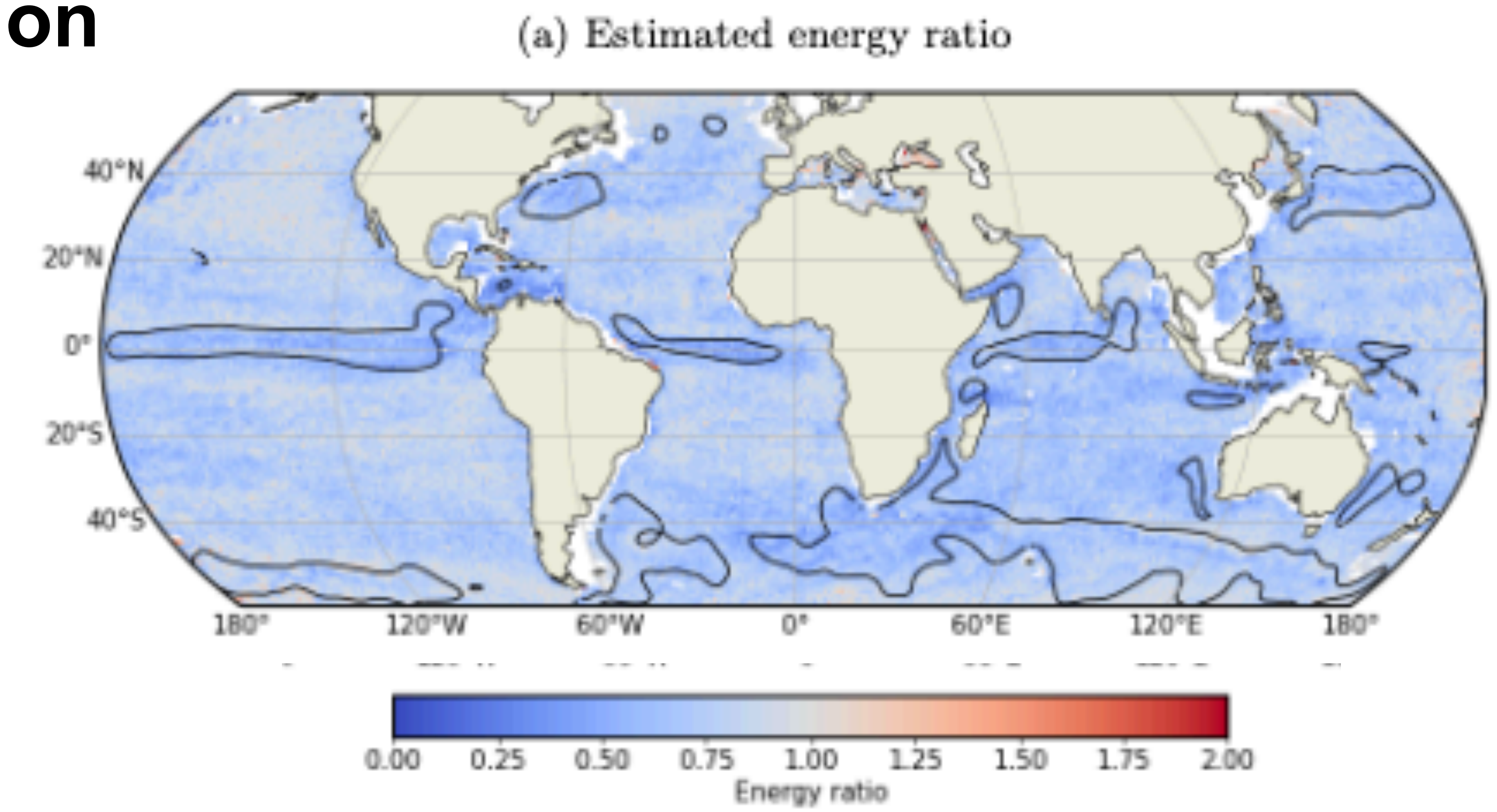


constraining high frequency variability for swot with surface drifter data

Realistic context (LLC4320)



At equal bandwidth, **apparent incoherence** leads to an **underestimation** of semidiurnal energy
-> build a **correction**

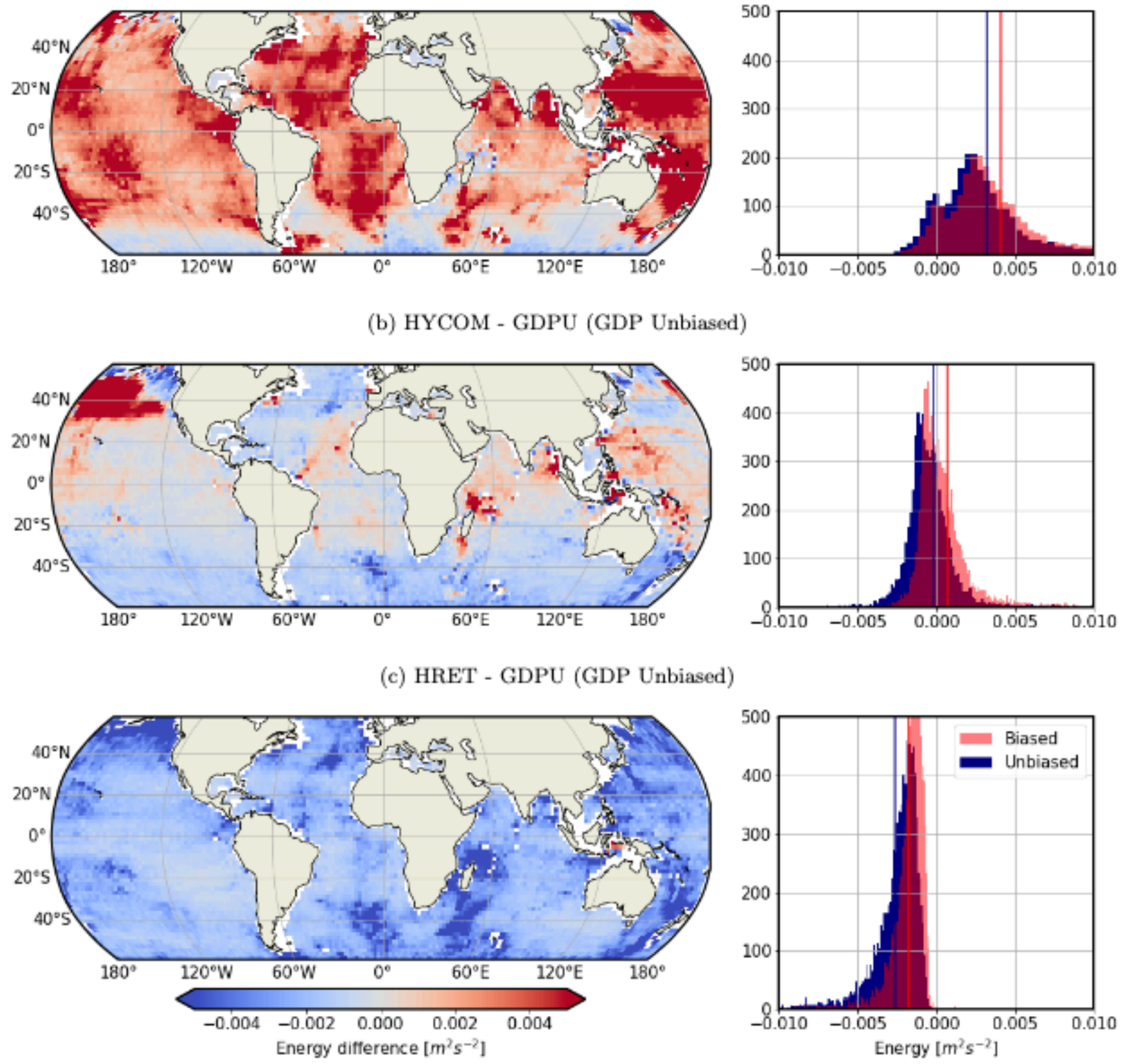


Updated estimated energy from **GDP** dataset

LLC4320

HYCOM

HRET



How can such information about high frequency motion can be leveraged for SWOT?
IT mapping: provides an estimate of the **total** IT kinetic energy

Leads for future research:
- seasonally modulated maps of kinetic energy
- kinetic energy / sea level variance conversion
- towards instantaneous mapping of IT variability - leveraging drifter information

Caspar-Cohen, to be submitted; in collab. with B. Arbic, E. Zaron

Internal tide surface signature & incoherence in the North Atlantic

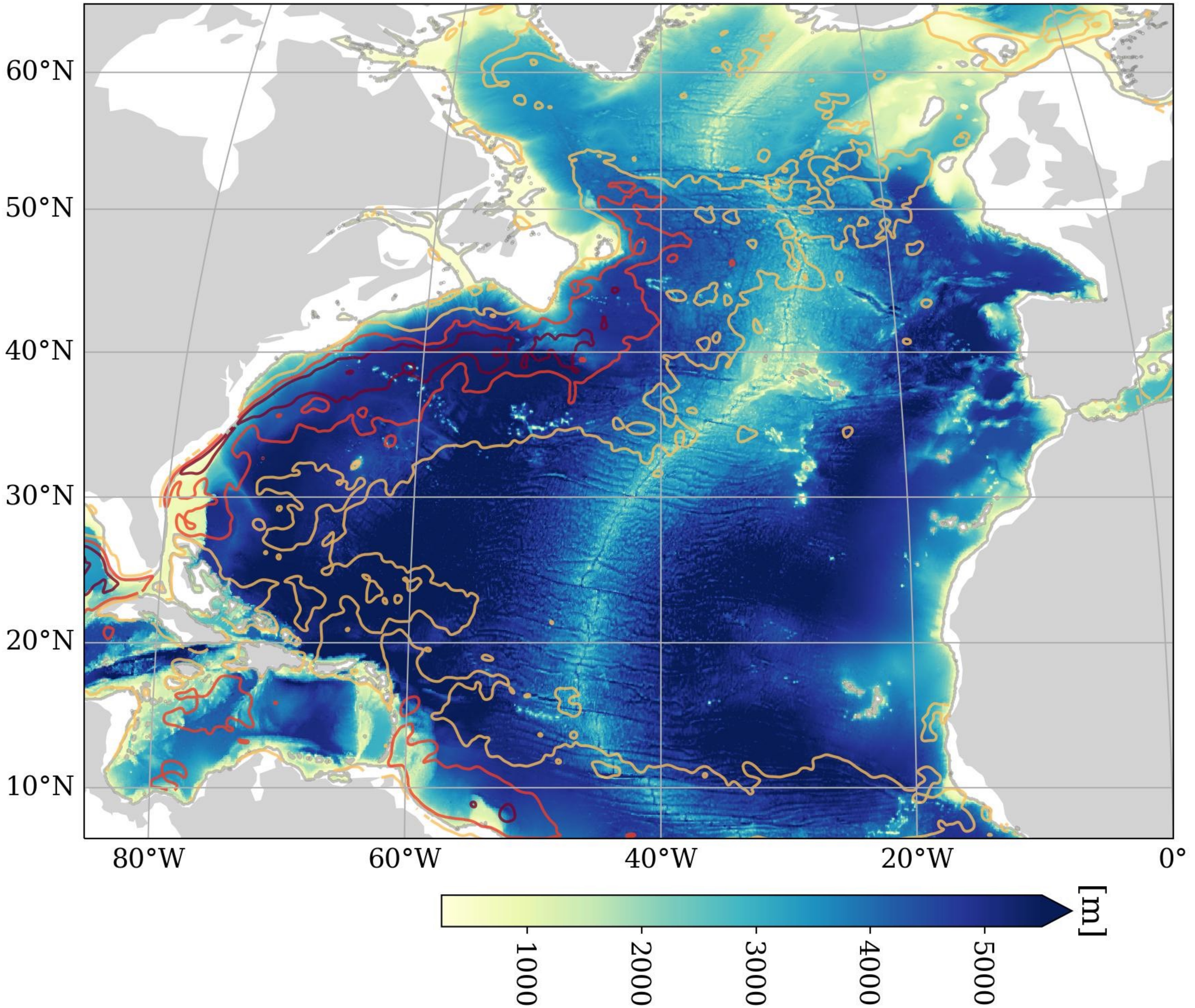
Noé Lahaye (Inria), Aurélien Ponte (LOPS-Ifremer), Julien Le Sommer & Aurélie Albert (IGE-CNRS)

Motivations

- Quantify surface signature of IT: amplitude & scales
- Characterize (in)coherence properties

Data & methods

- Realistic high-res simulation eNATL60
- vertical mode decomposition (8 months)
- complex demodulation, etc.
- N.B.: semidiurnal band as a whole

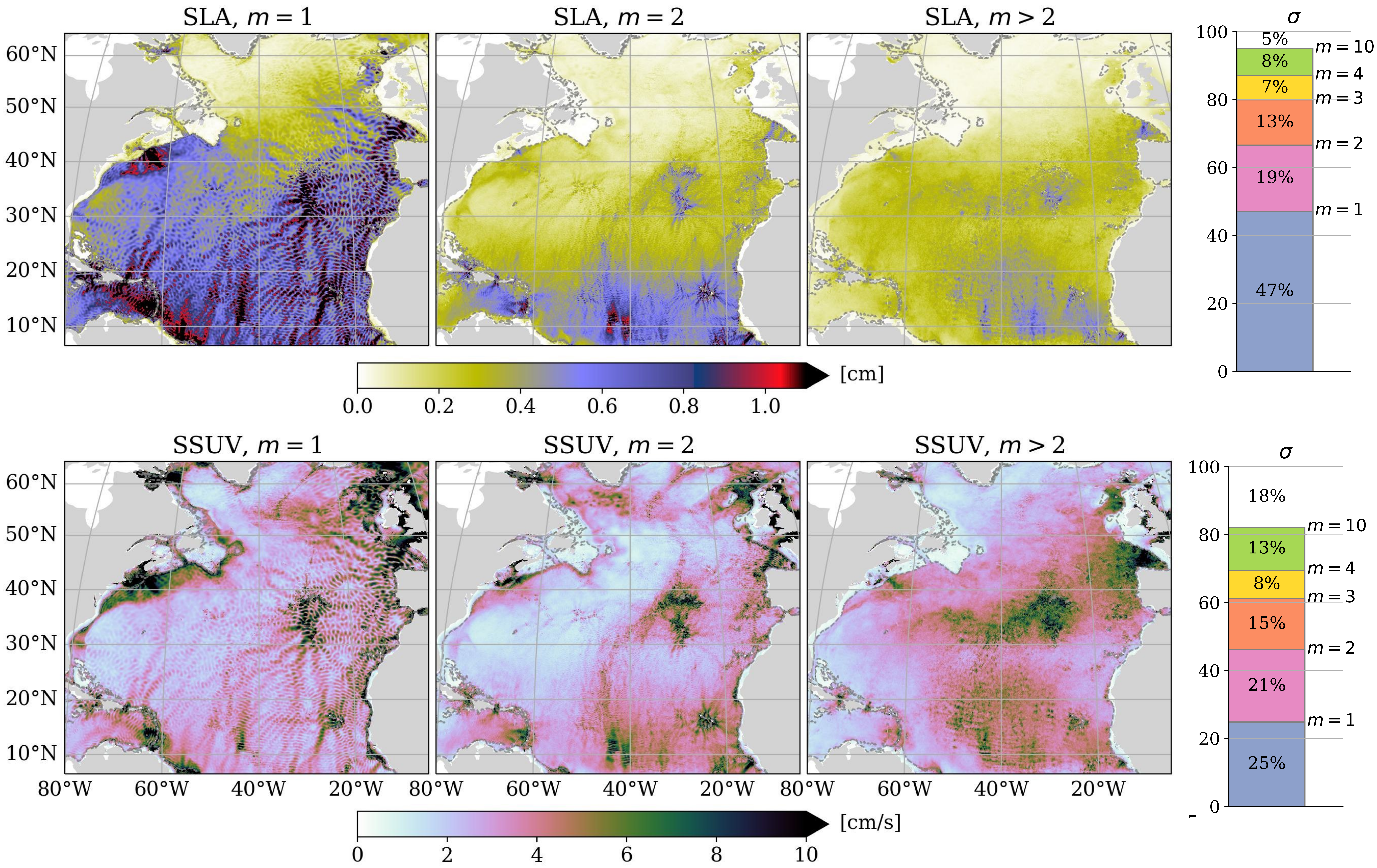


Internal tide surface signature & incoherence in the North Atlantic

Surface RMS amplitude

per vertical mode

Sea Level Anomaly (SLA) and Sea-Surface horizontal currents

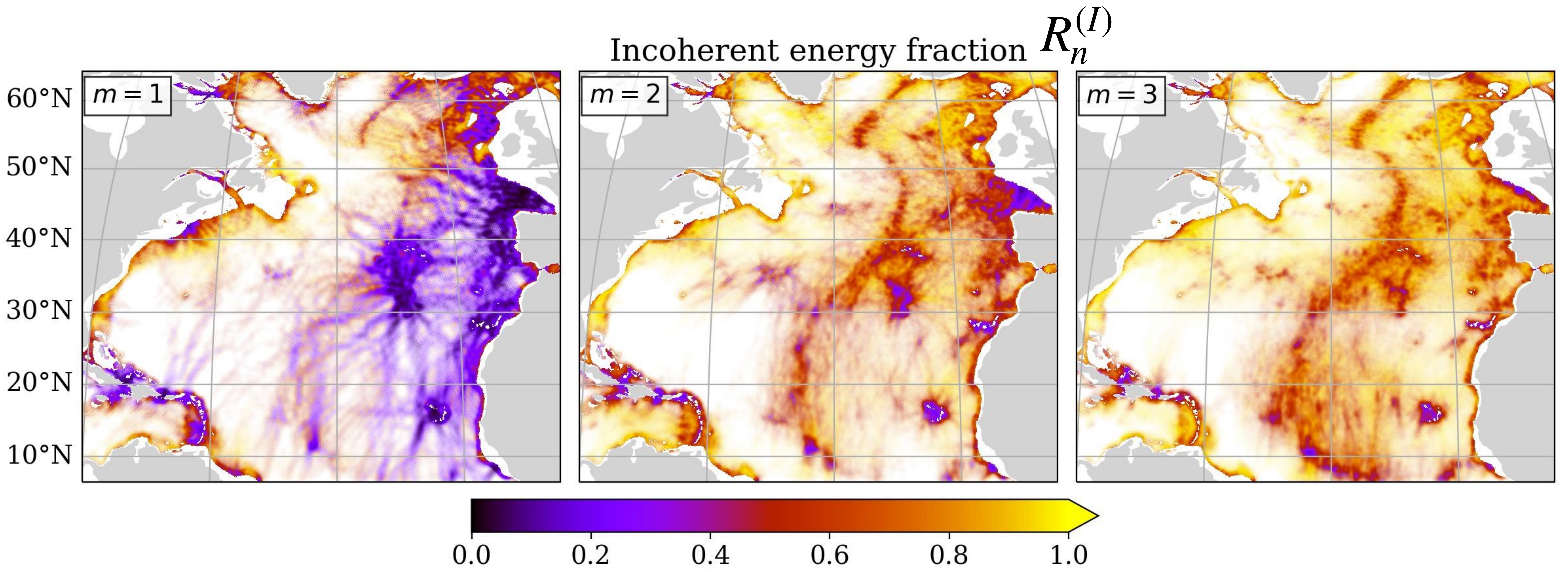


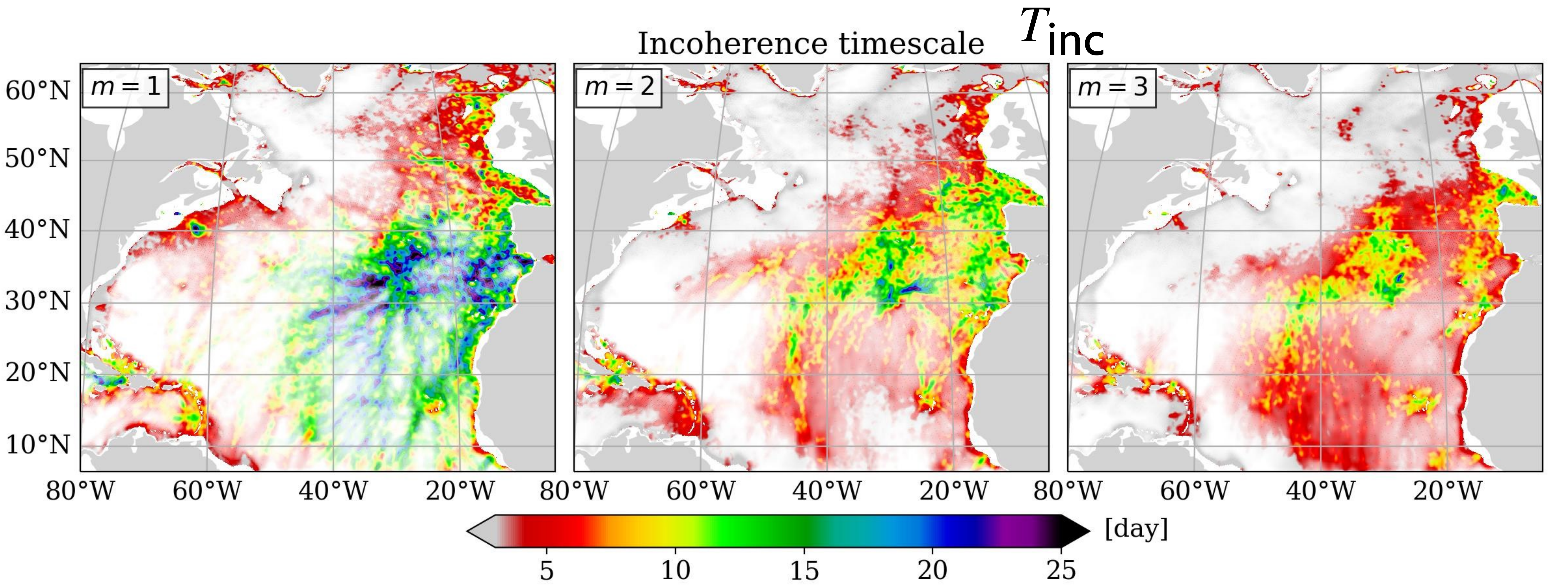
Internal tide surface signature & incoherence in the North Atlantic

Relative incoherent energy fraction & incoherent timescale

Methods:

- harmonic analysis
  ⇒ coherent IT (8 months)
- Residual = incoherent IT
  ⇒ $R_n^{(I)}$
- Correlation function on residual (incoherent IT)
- Exponential fit $\propto e^{-t/T_{\text{inc}}}$
  ⇒ T_{inc}





Internal tide surface signature & incoherence in the North Atlantic

A few numbers…

- to be compared with SWOT typical sampling (20 days, 150 km)
- Need a model that captures IT/mesoscale interactions
  - -> Egbert & Erofeeva 2021 (EOFs)
  - -> Le Guillou et al 2021 (RSW+QG)
  - -> **open postdoc position!**

	$m = 1$	$m > 2$
SLA amplitude	0.5 cm	0.25 cm
SSUV amplitude	3 cm/s	3 cm/s
incoherent fraction	0.1 - 0.6	0.4 - 0.9
decorrelation timescale	5 - 20+ day	5 - 15 day

To be submitted to GRL

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