

Statistical Parameters of the Geostrophic Ocean Flow Field, Estimated from the Jason-1 - TOPEX/Poseidon Tandem Mission

TOPEX/POSEIDON

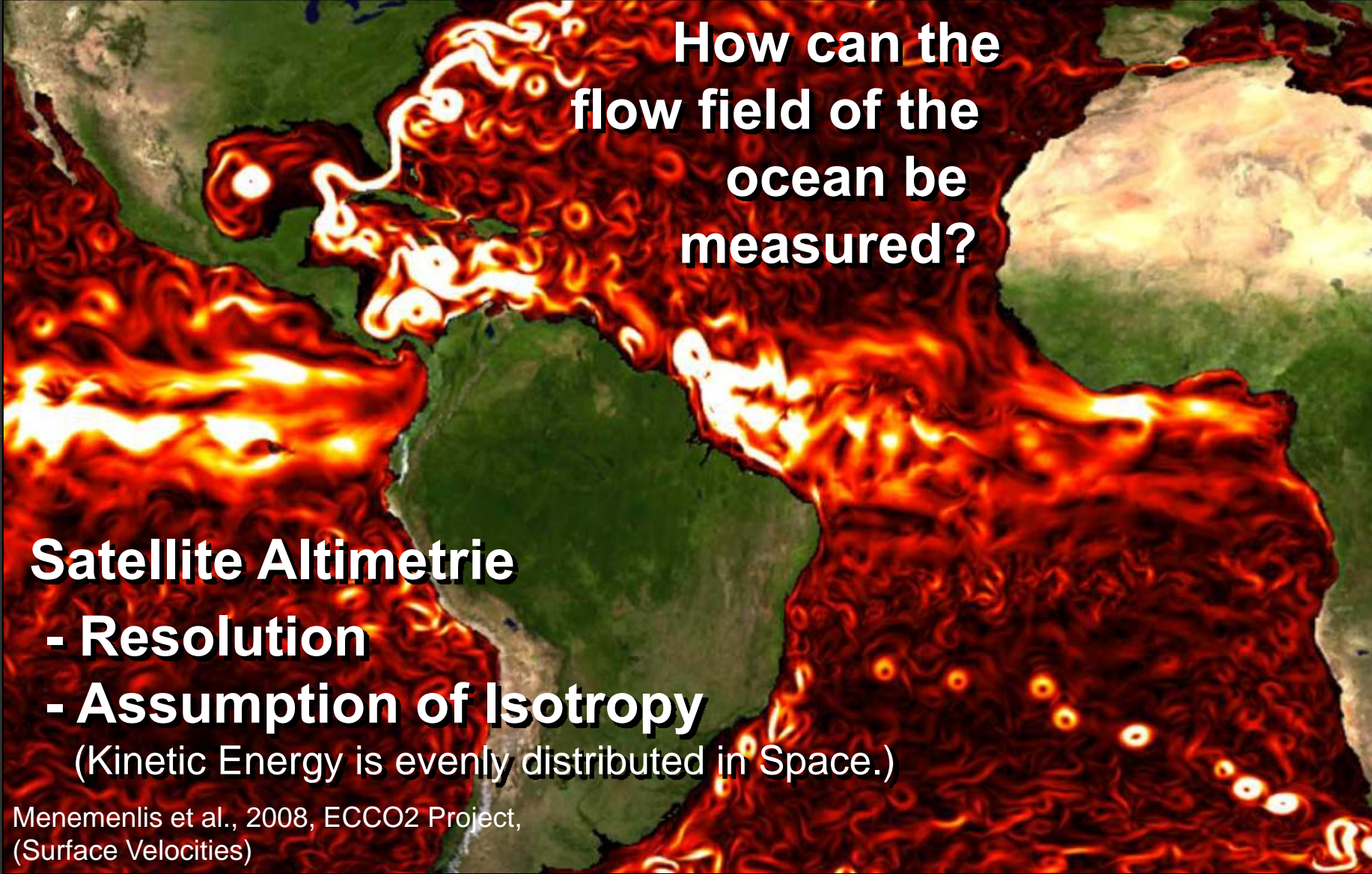
JASON-1

day 1
arc 1



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**How can the
flow field of the
ocean be
measured?**

Satellite Altimetrie

- Resolution**

- Assumption of Isotropy**

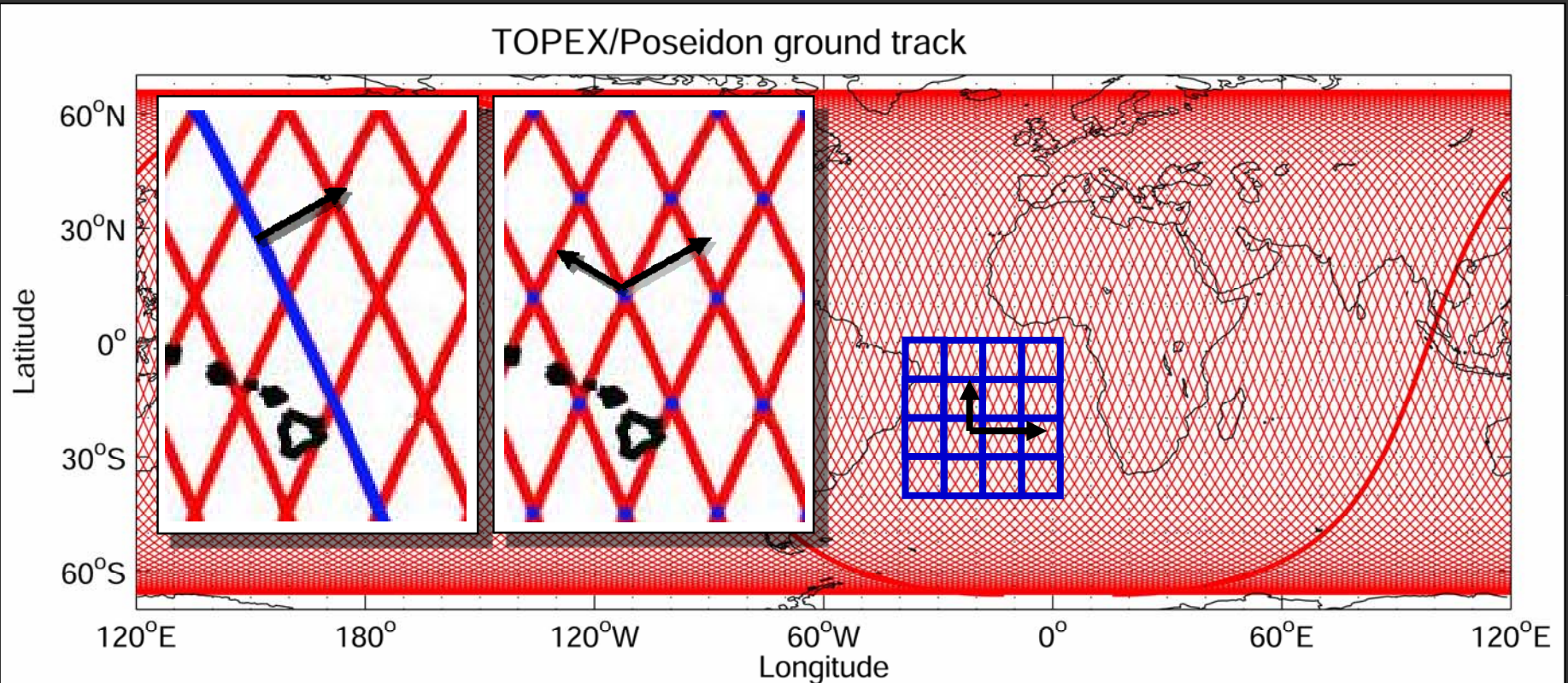
(Kinetic Energy is evenly distributed in Space.)

Menemenlis et al., 2008, ECCO2 Project,
(Surface Velocities)

Calculation of geostrophic velocities using SSH – Anomalies

so far:

JTP-Tandem:



Cross track

Cross over points

Gridded
SSH-values

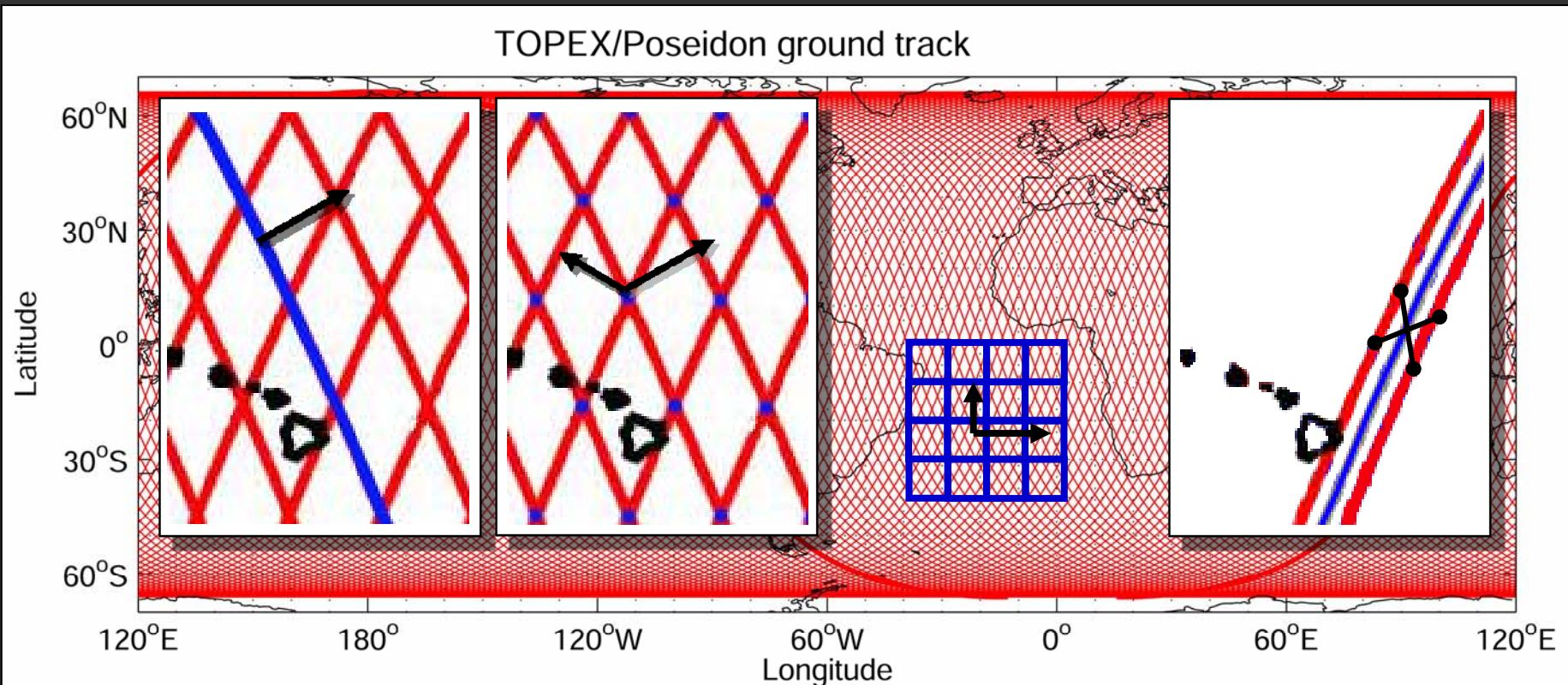
Parallel-Track

Stammer and Dieterich (1999)

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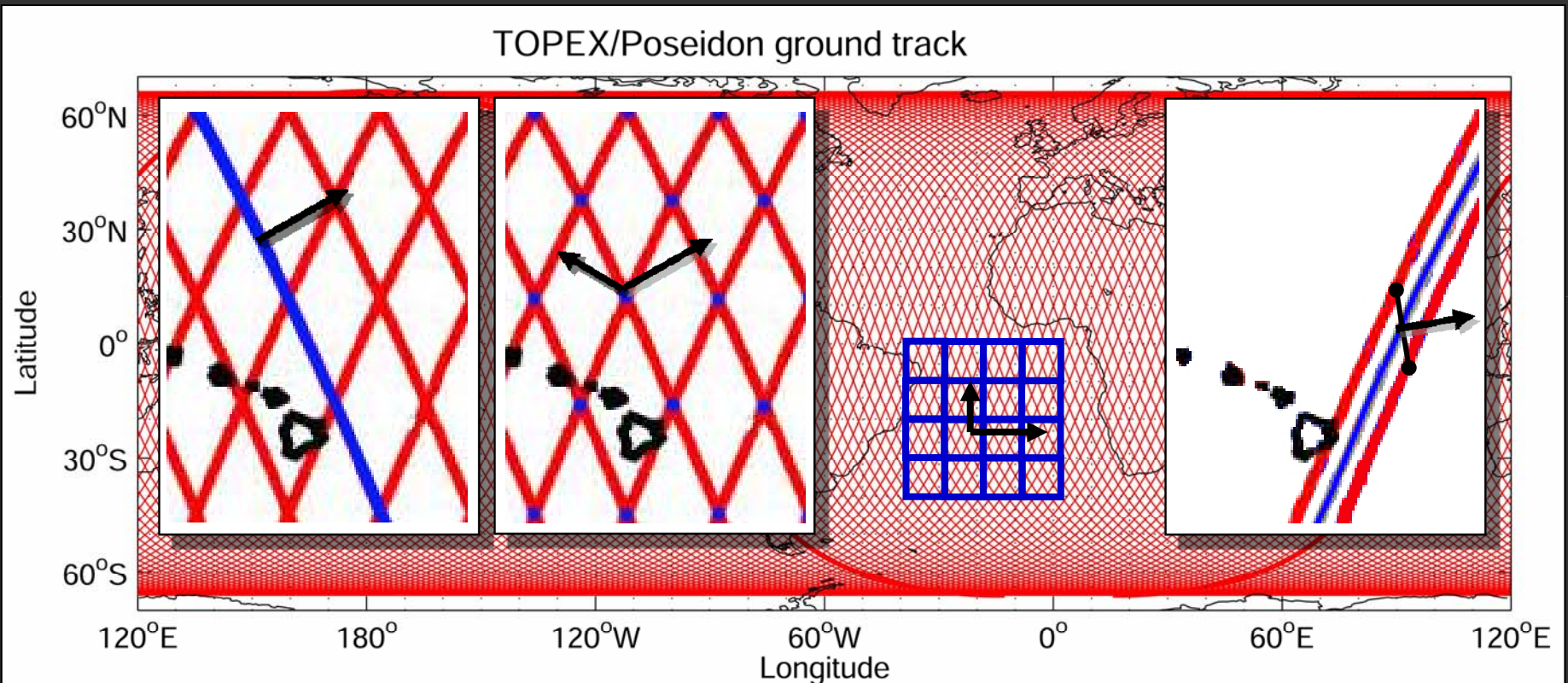
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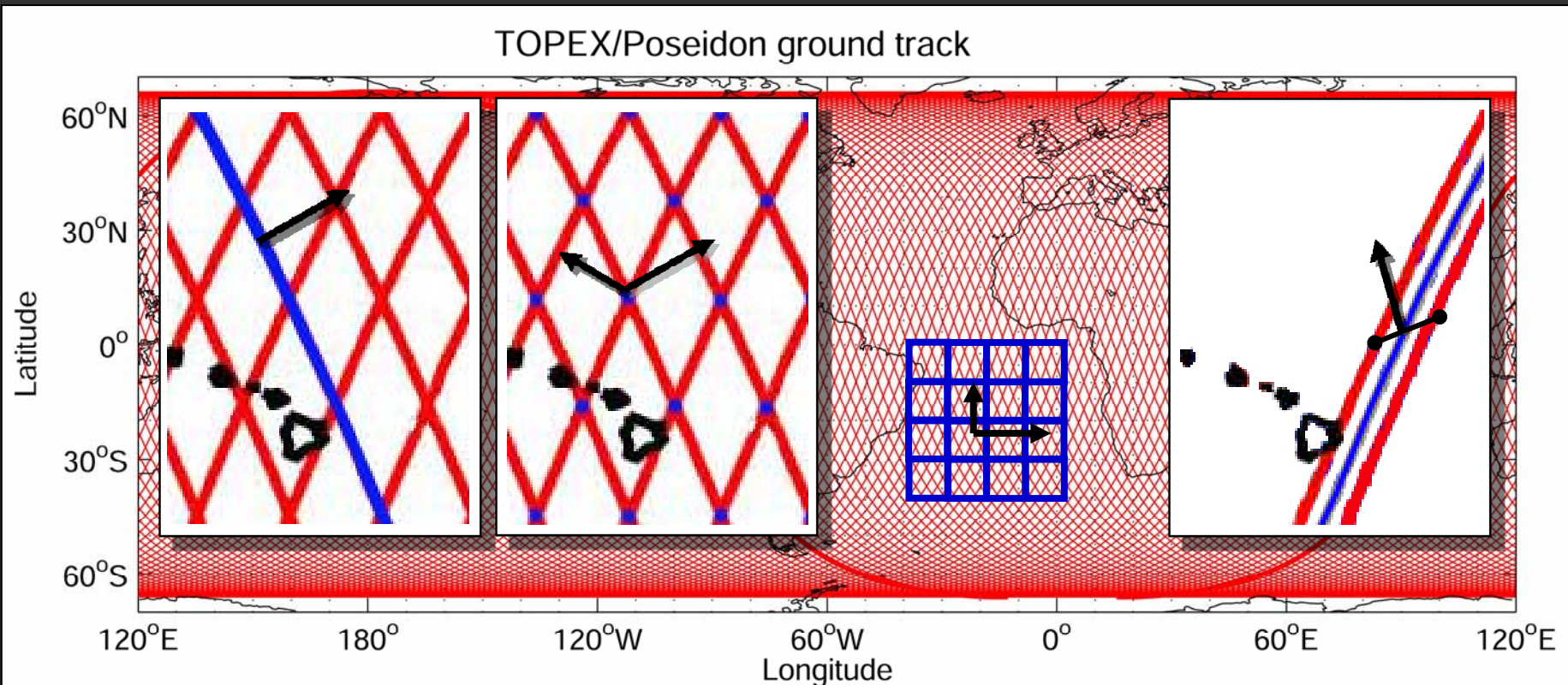
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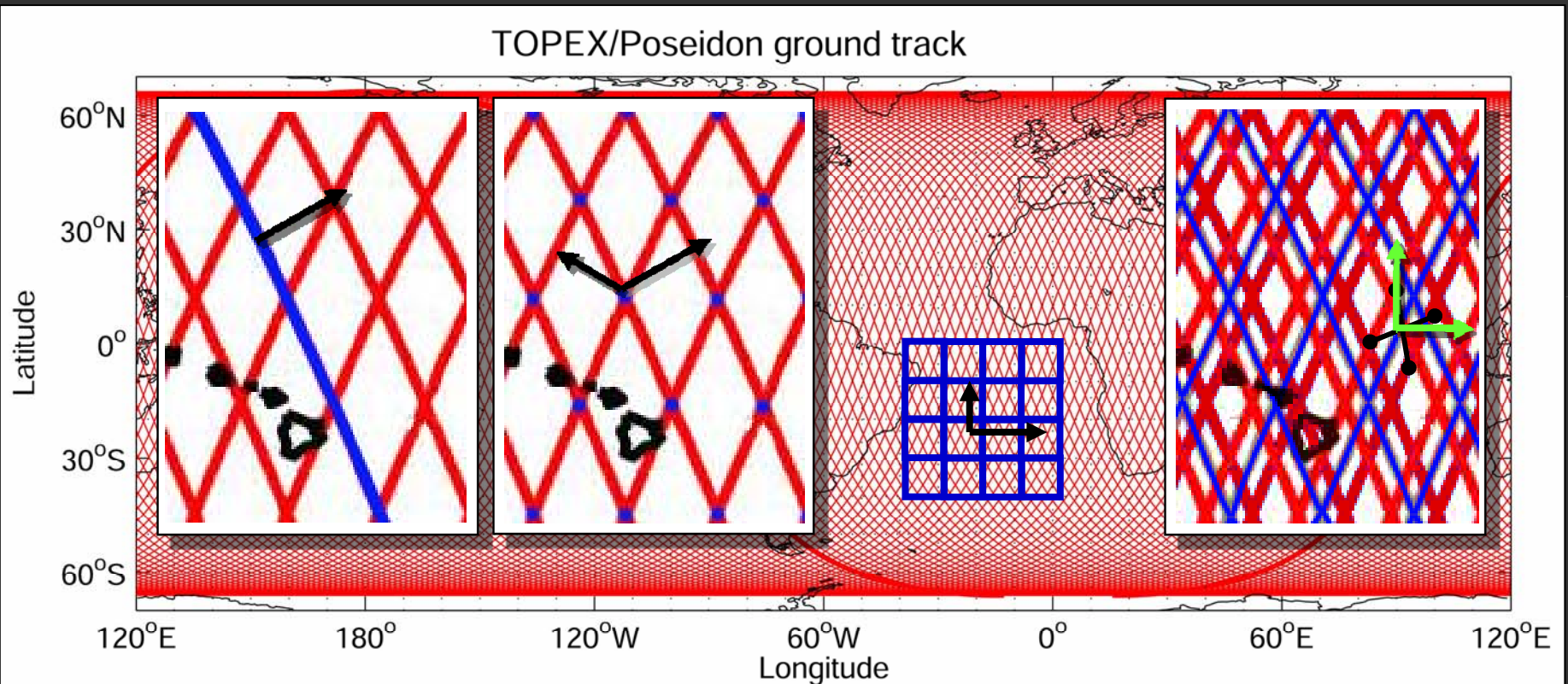
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Stammer and Dieterich (1999)

- **How important is the anisotropic consideration of the Ocean Circulation?**
- **Can the findings be seen in the now for both velocity components available Frequency Spectra?**
- **What information can be gained from the Velocity Wavenumber Spectra sampled on a Satellite Track?
Or: How to interpret Velocity Wavenumber Spectra along a Satellite Track.**

- **How important is the anisotropic consideration of the Ocean Circulation?**

$$ISO = \frac{\langle v'^2 \rangle - \langle u'^2 \rangle}{\langle v'^2 \rangle + \langle u'^2 \rangle}$$

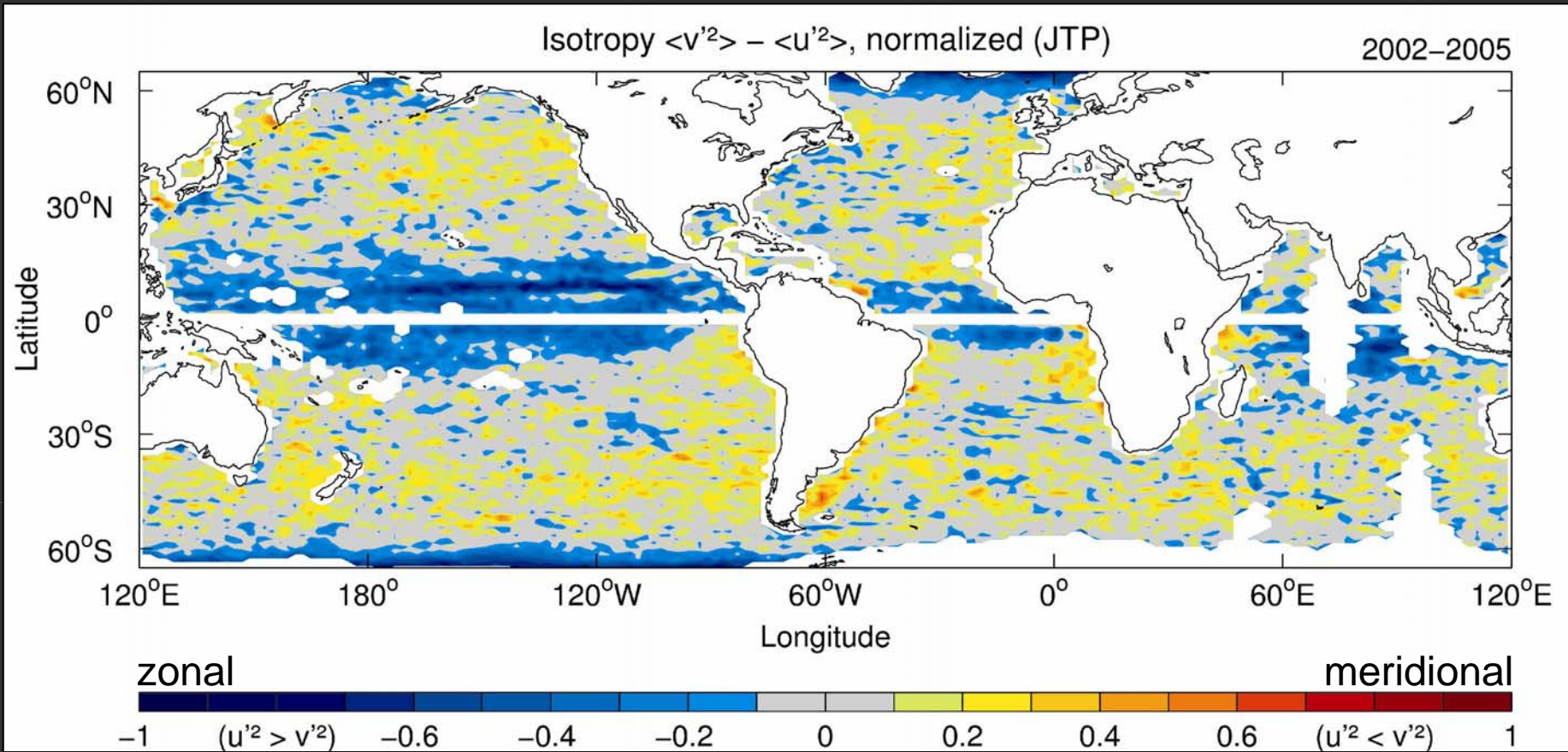
Wunsch, 1997

Using global Ocean-Mooring-Datasets

Outside the boundary current regions the mesoscale eddy-field is isotropic.

Huang et al., 2007

Temporally not averaged velocity-fields (AVISO / Model) are isotropic.
Temporally averaging – (zonal) anisotropy.



(Scharffenberg and Stammer, 2010)

- Tropical ocean zonal current-field
- Mid latitudes slightly higher meridional variability

Slight preference of meridional above zonal velocity variability. (Scott et al., 2008)

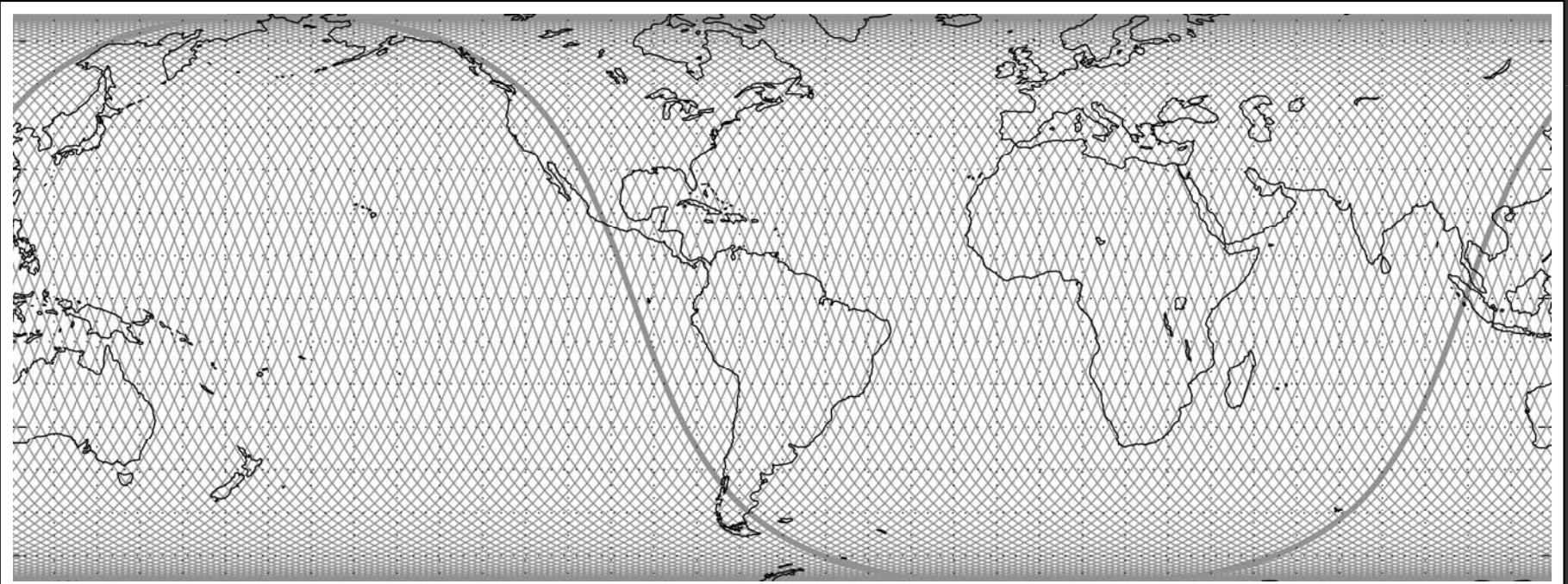
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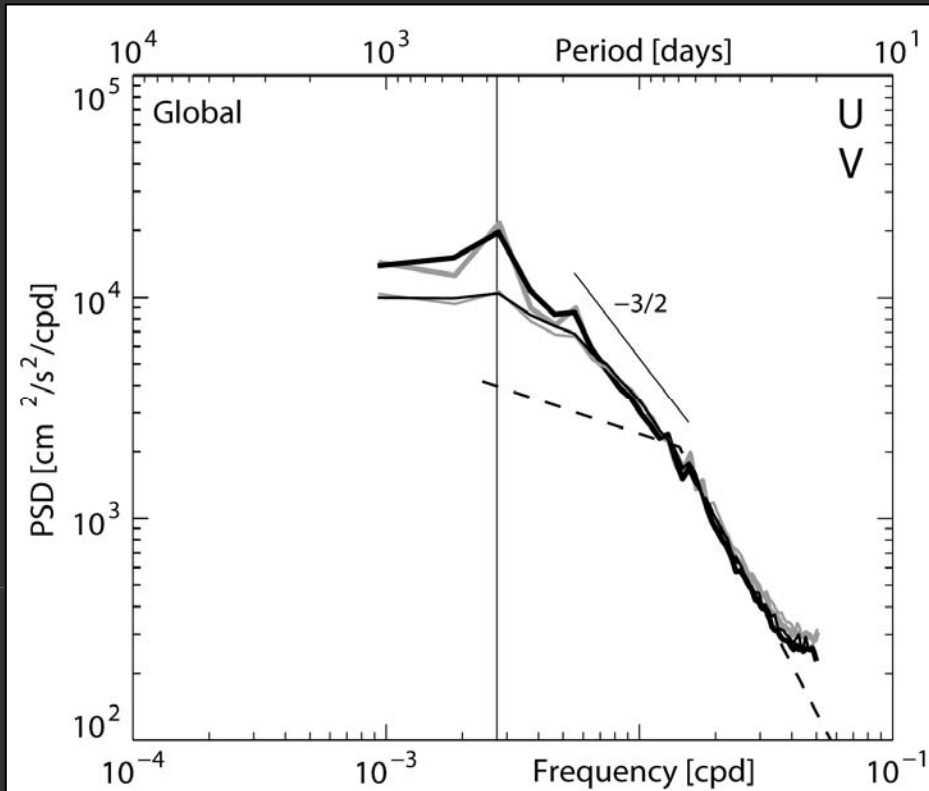
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Calculation (linear) data-interpolation, no extrapolation (zero)

Frequency-spektra (u, v)

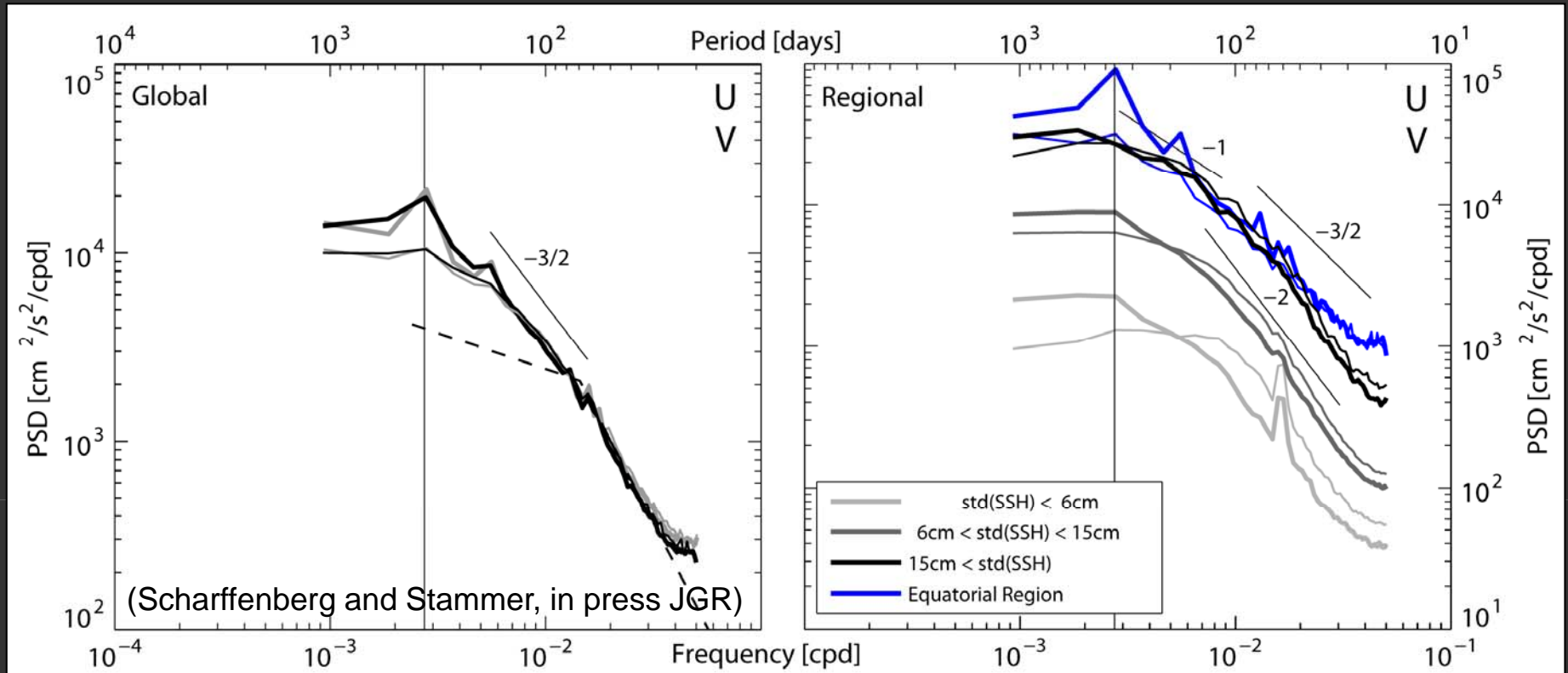
- One FFT-Spektrum for each JTP-track point
- Averaging of Spektra
e.G. on $2^\circ \times 1^\circ$ grid / globally





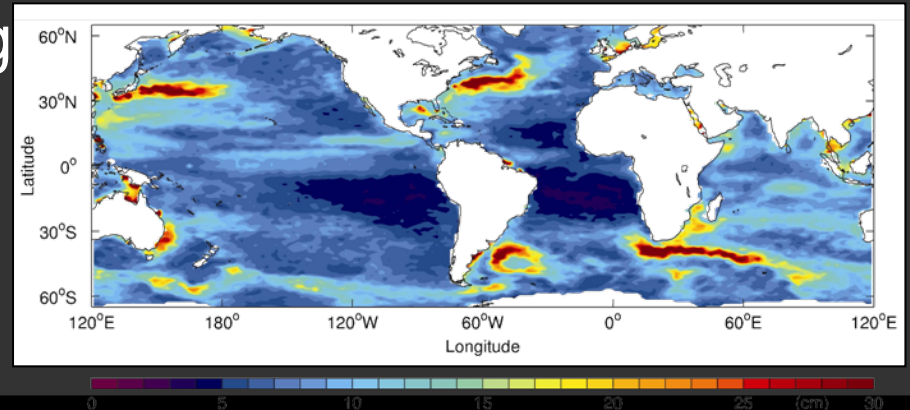
(Scharffenberg and Stammer, in press JGR)

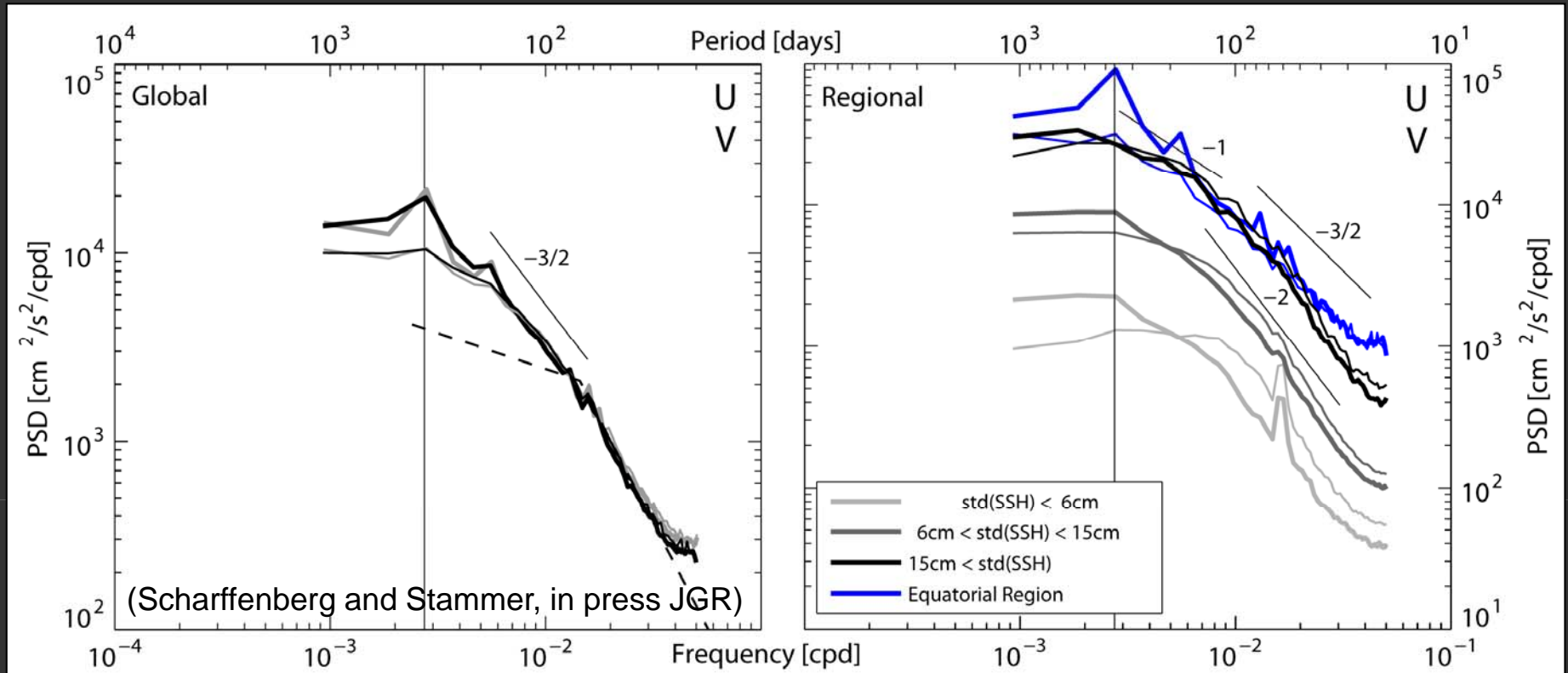
- Peaks at (semi-) annual period
- **U** and **V** differ clearly from each other for periods > 180 Tage
- Periods > 365 days: white spectrum (**U**, **V**)



Average over regions containing certain amounts of energy

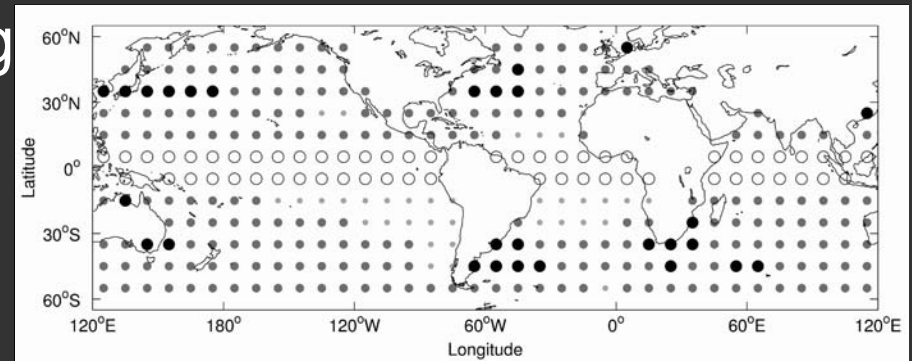
- U and V spectra differ in their shape
- Extra-tropical, behavior very similar
- Anisotropy in mid latitudes



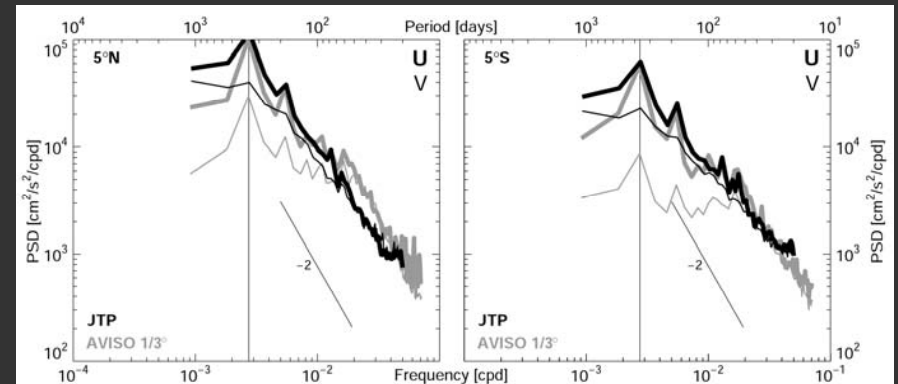
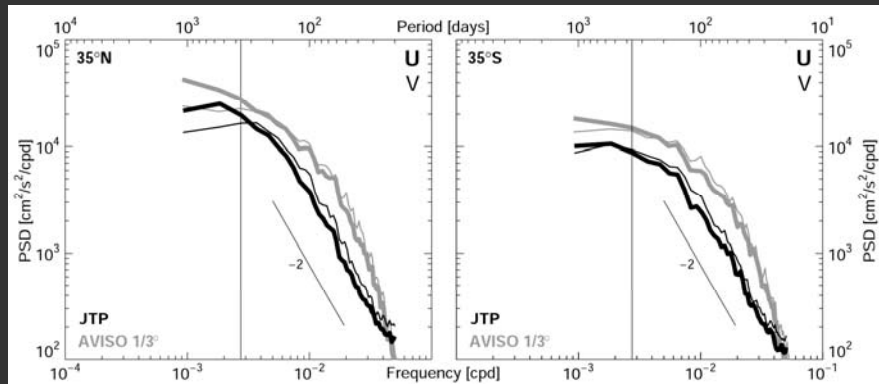
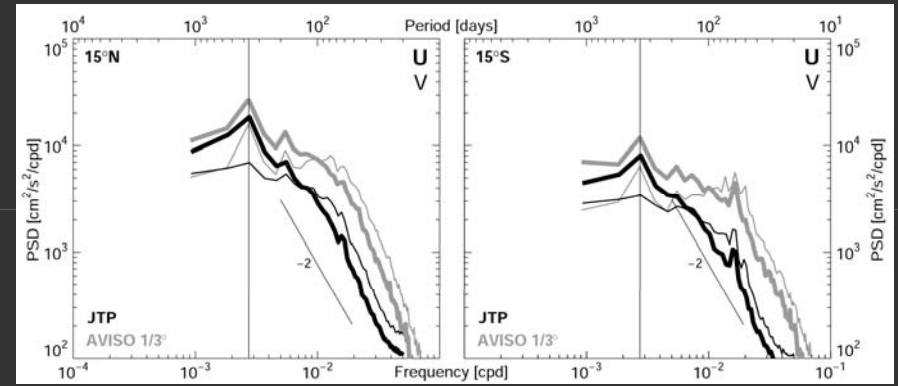
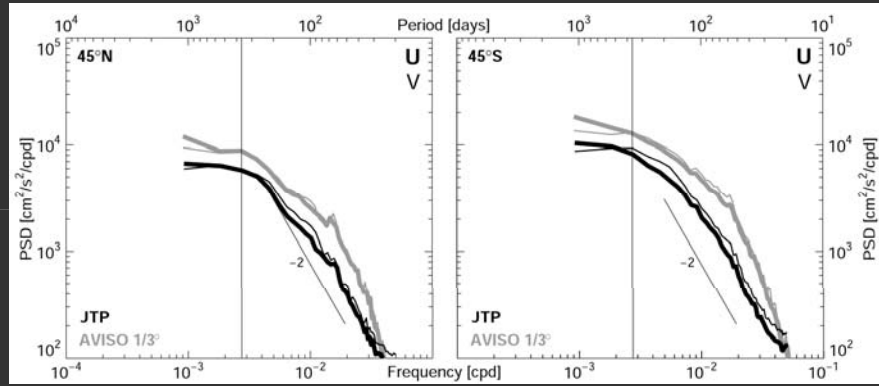
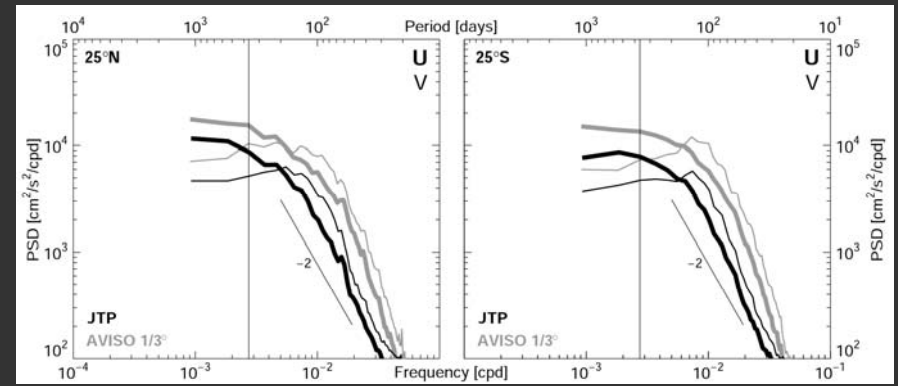
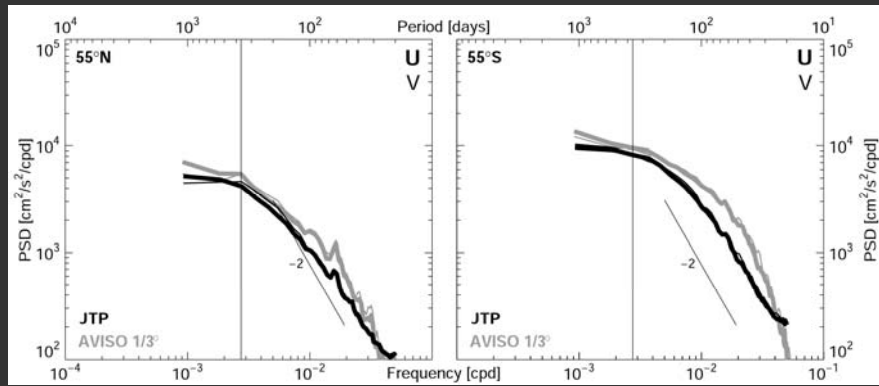


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Frequency Spectra



(Scharffenberg and Stammer, in press JGR)

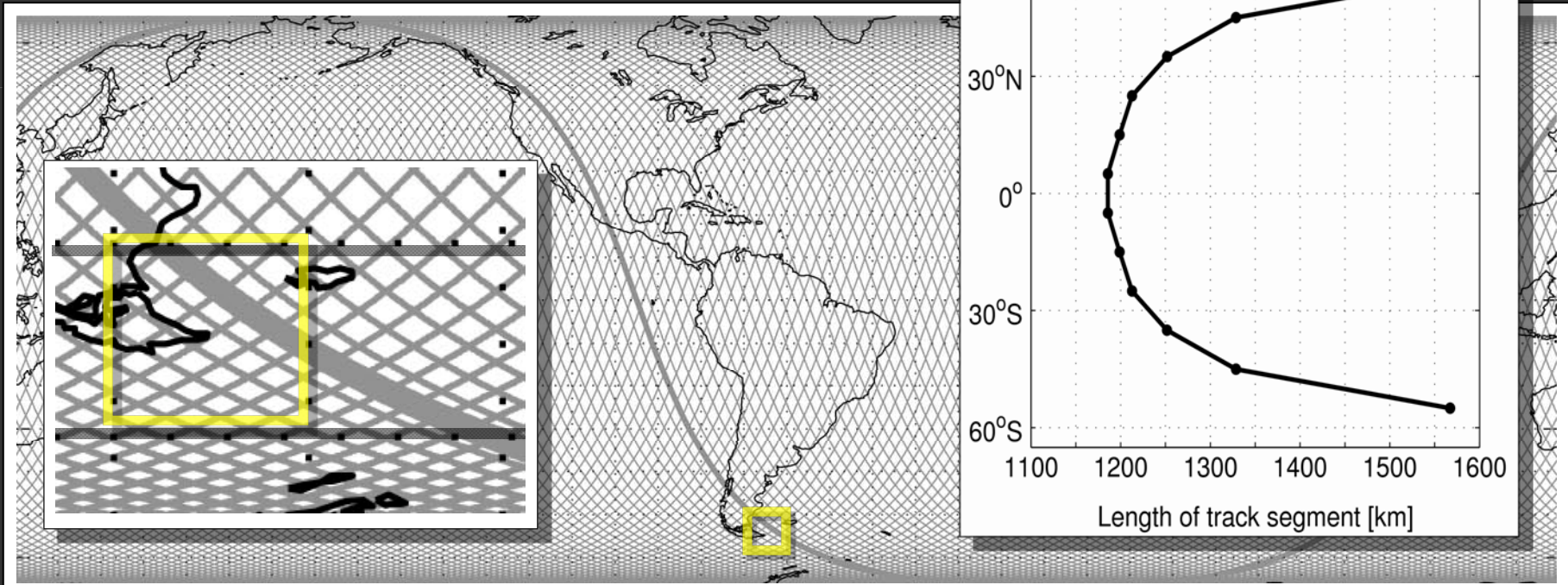
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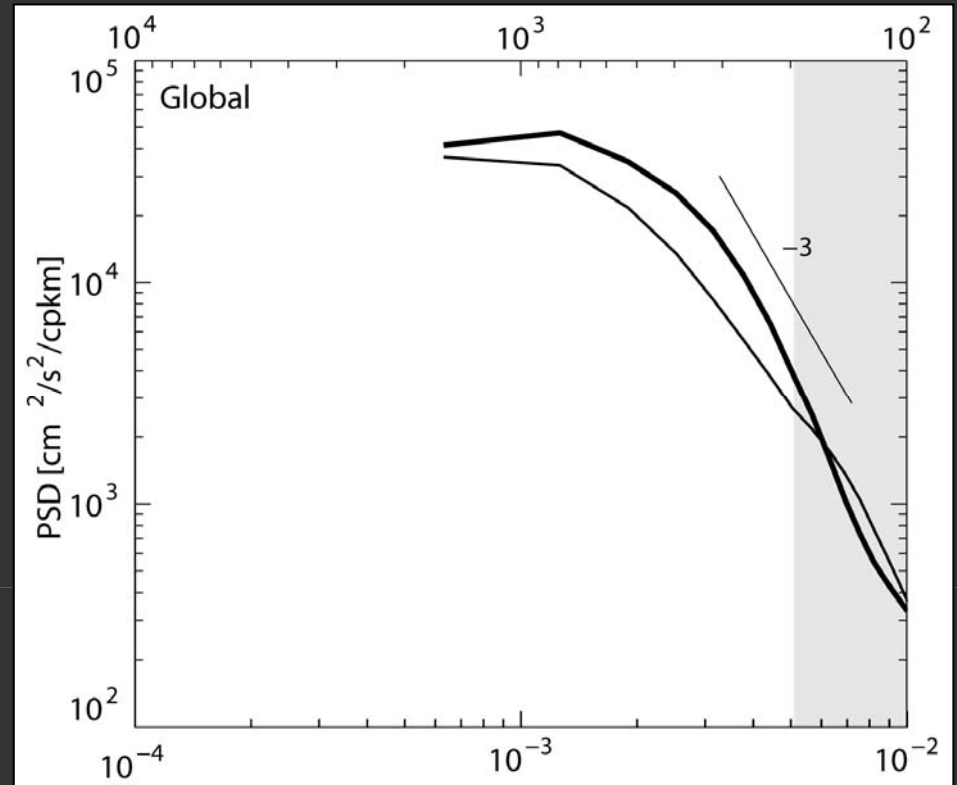
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Calculation (linear) data-interpolation, no extrapolation (zero)

Wavenumber-spektra

- FFT along Satellite tracks
- Along 10° latitude ranging ARC Segments ($10^\circ \times 10^\circ$ Boxes)



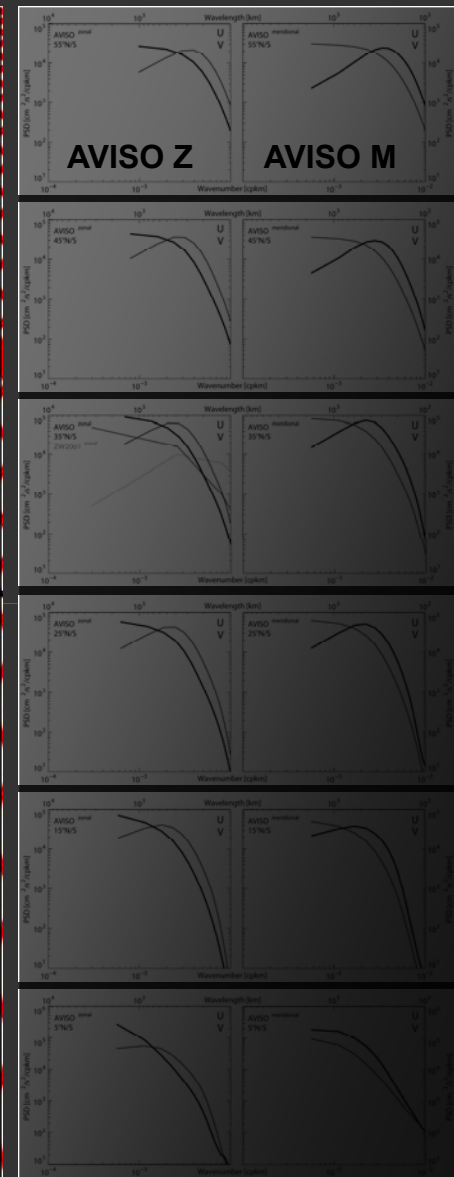
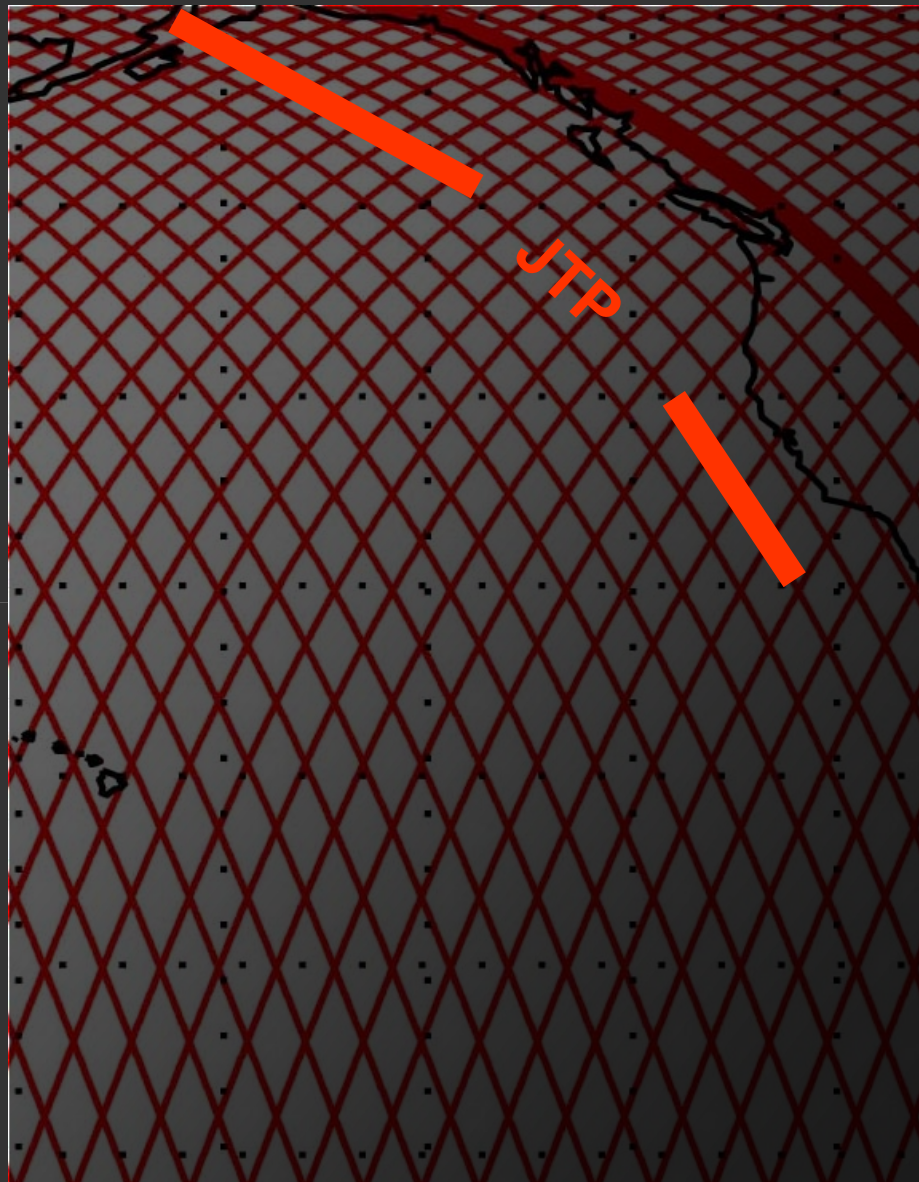
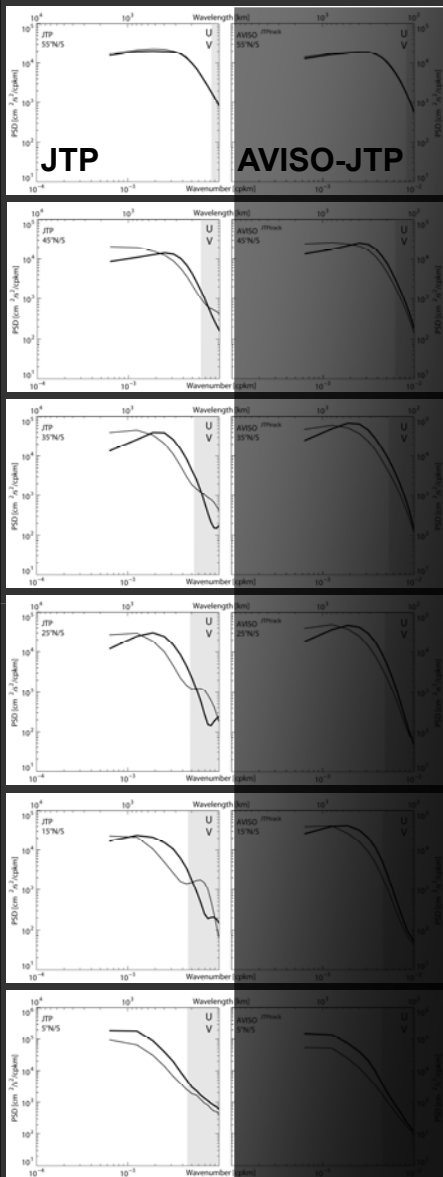


(Scharffenberg and Stammer, in press JGR)

For the first time it has been possible to calculate wavenumber spectra for both velocity components separately and without assuming isotropy!

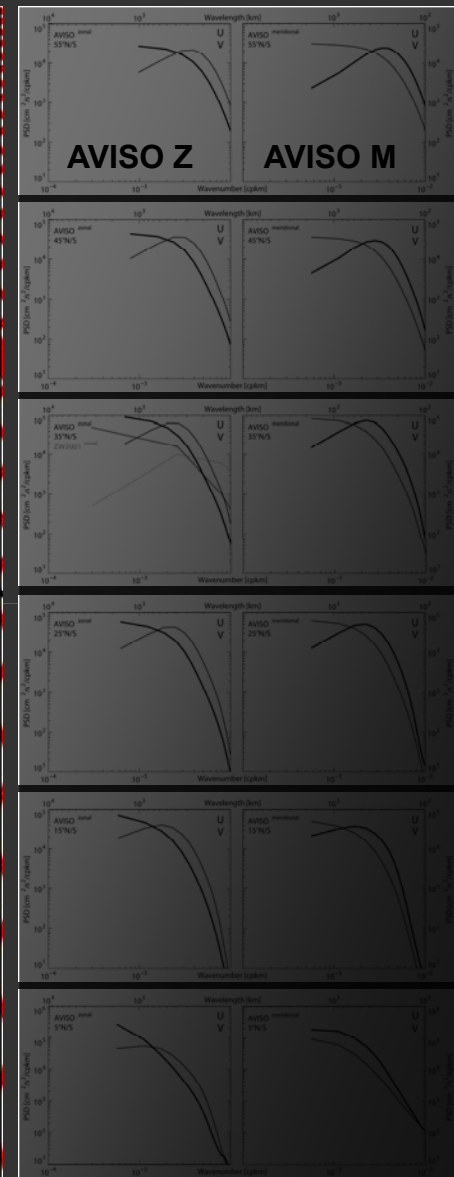
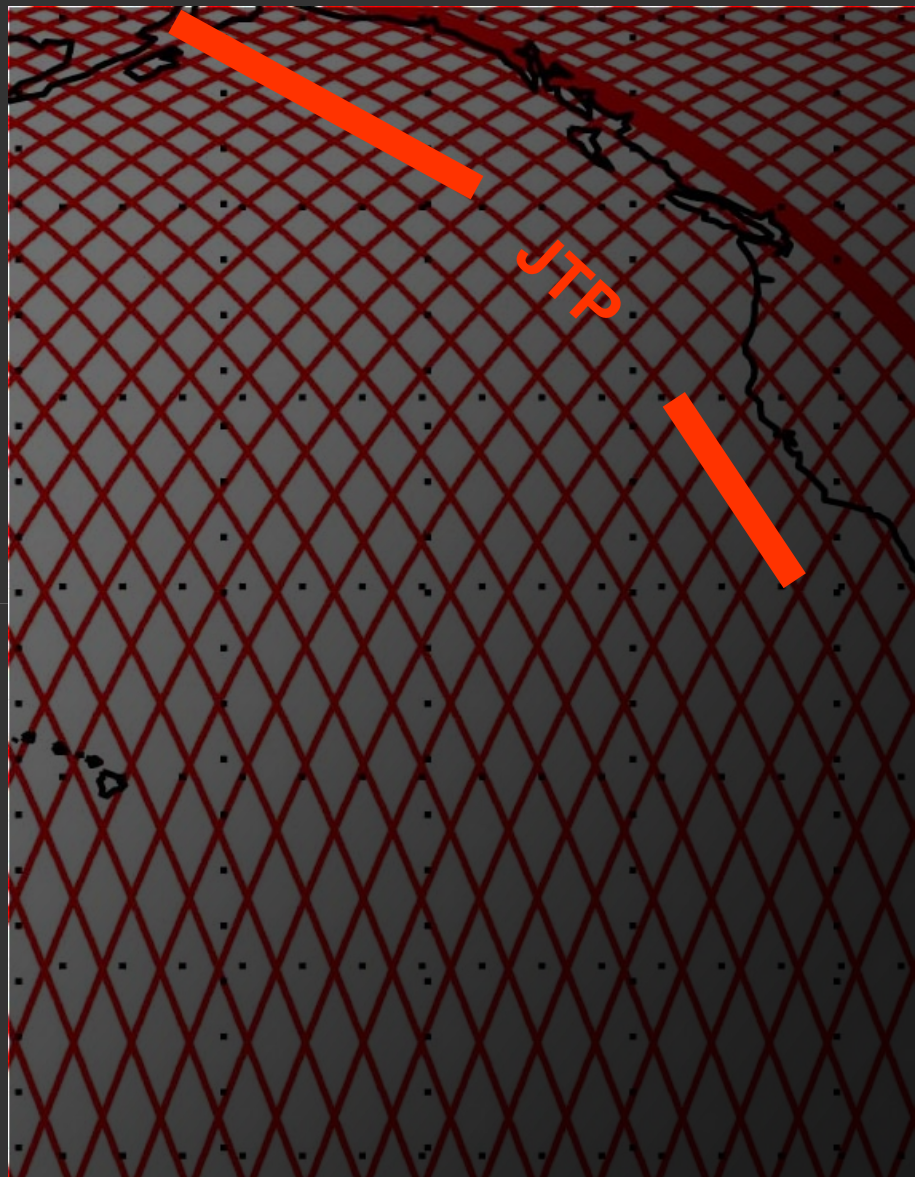
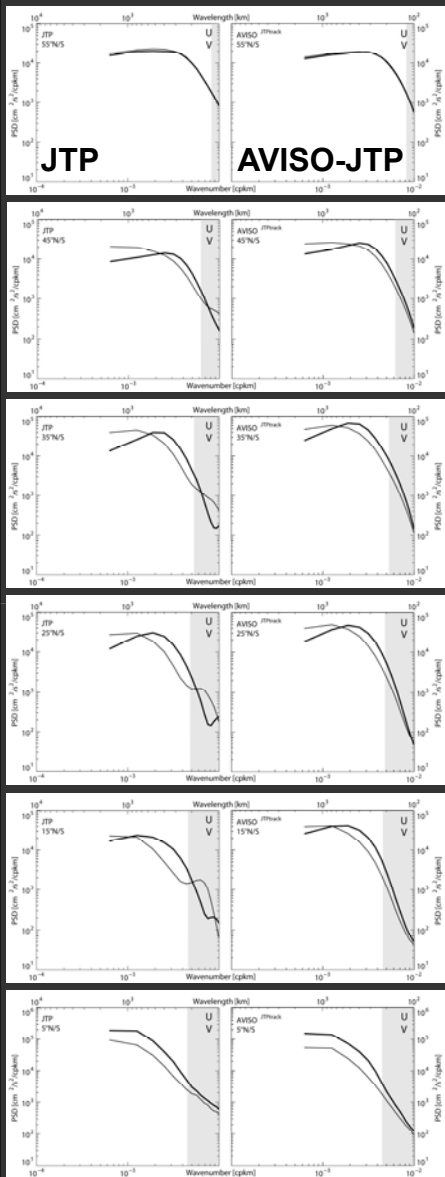
- **U** and **V** differ for wavelength > 200 km
- **U** steeper slope than **V**

Wavenumber Spectra



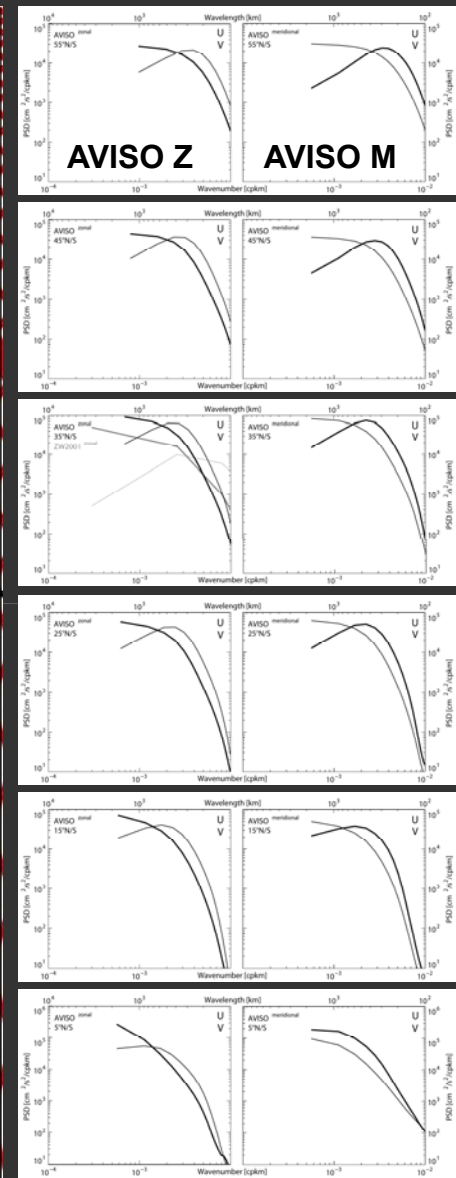
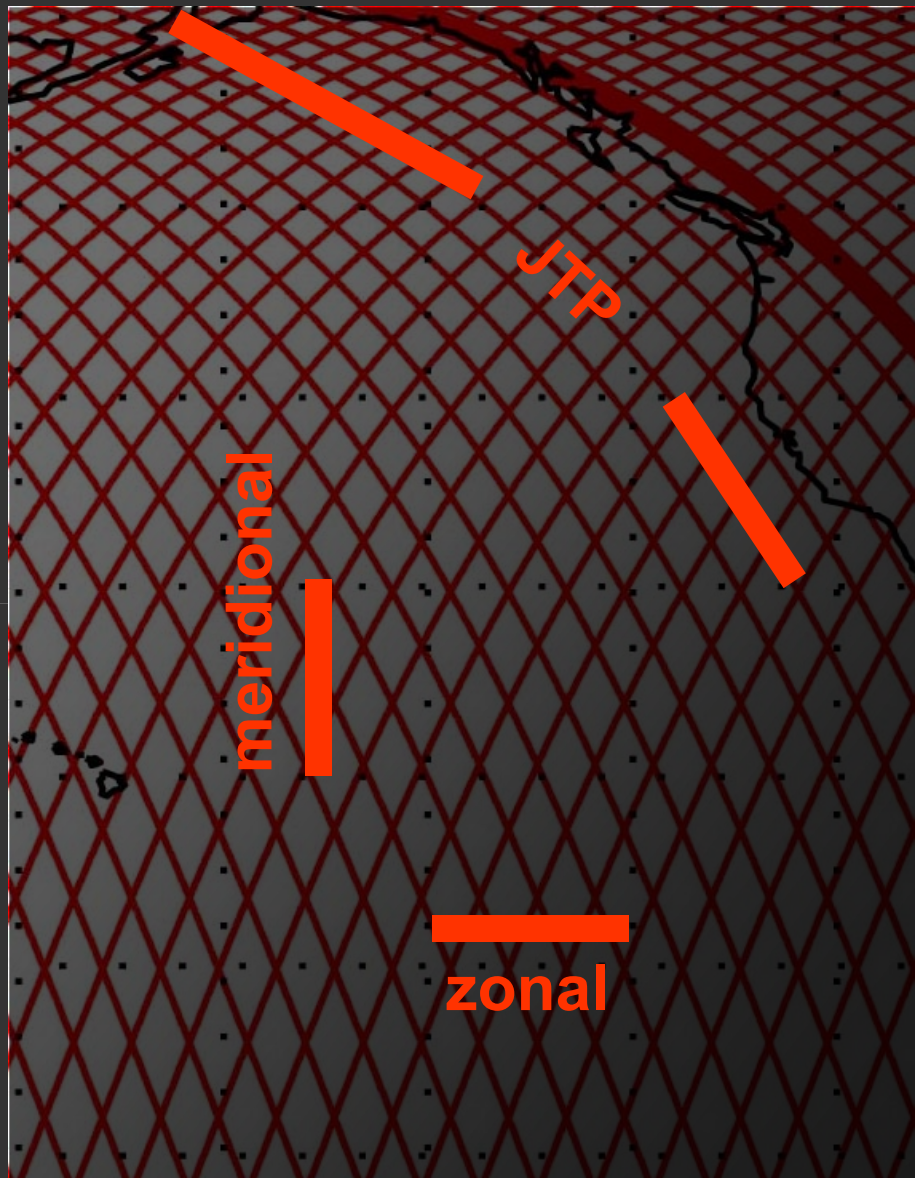
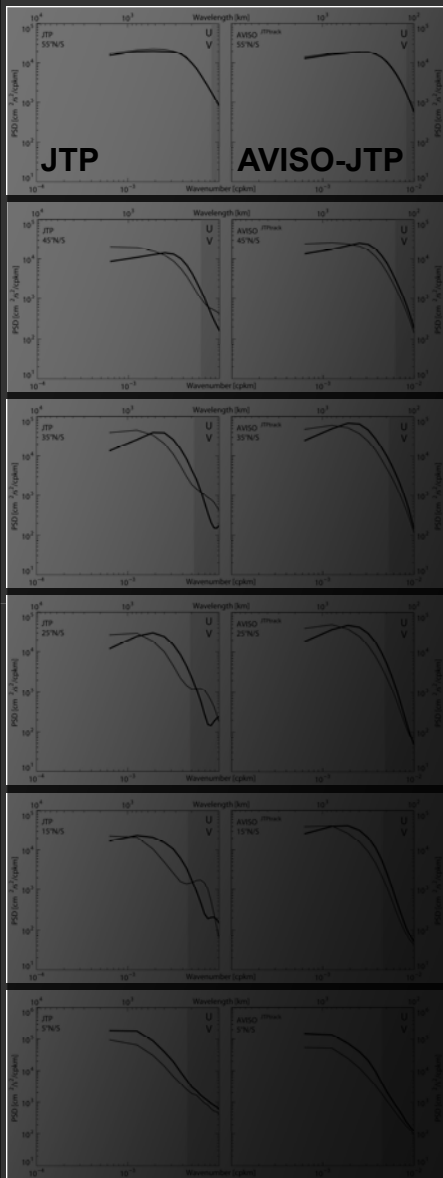
(Scharffenberg and Stammer, in press JGR)

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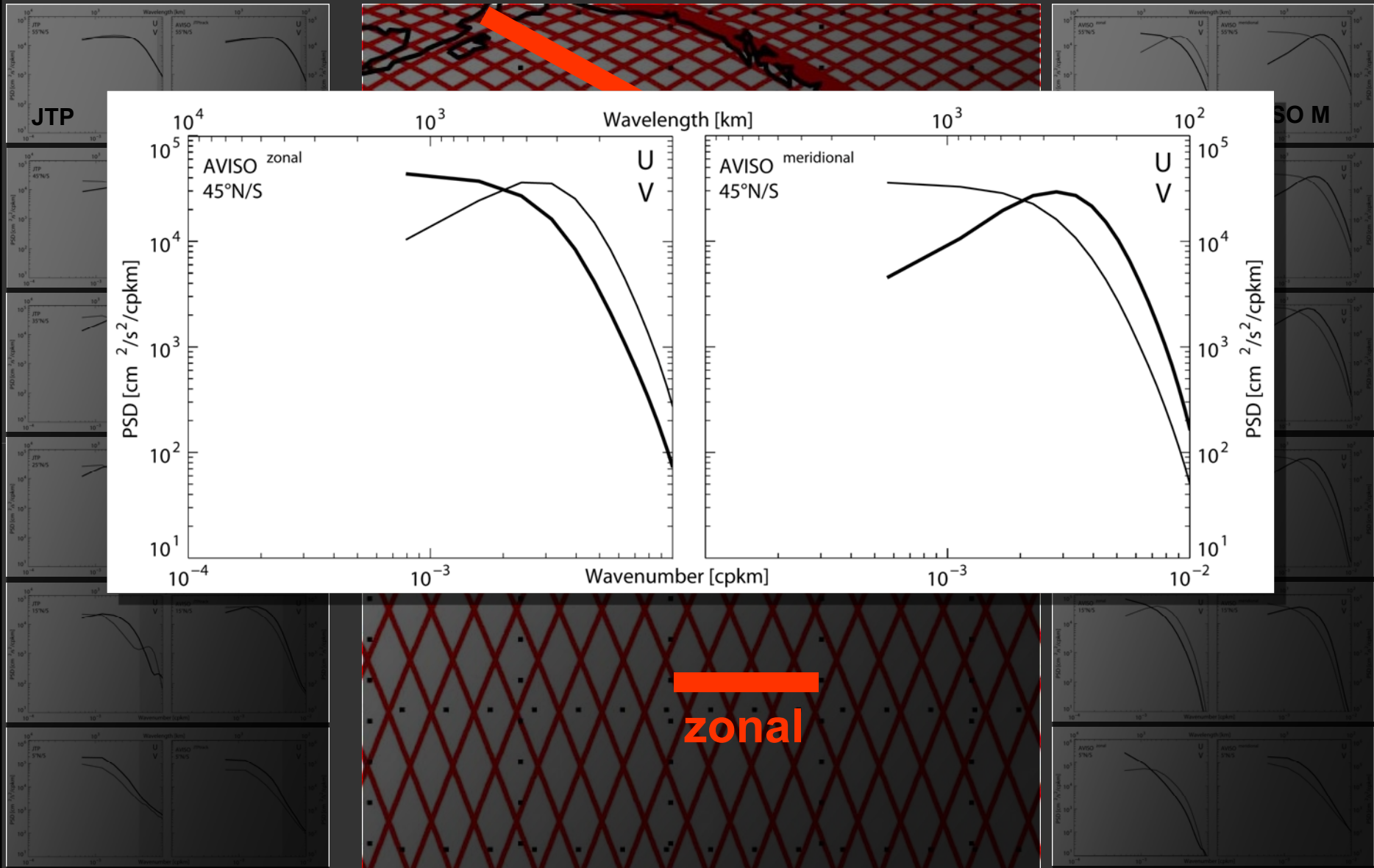
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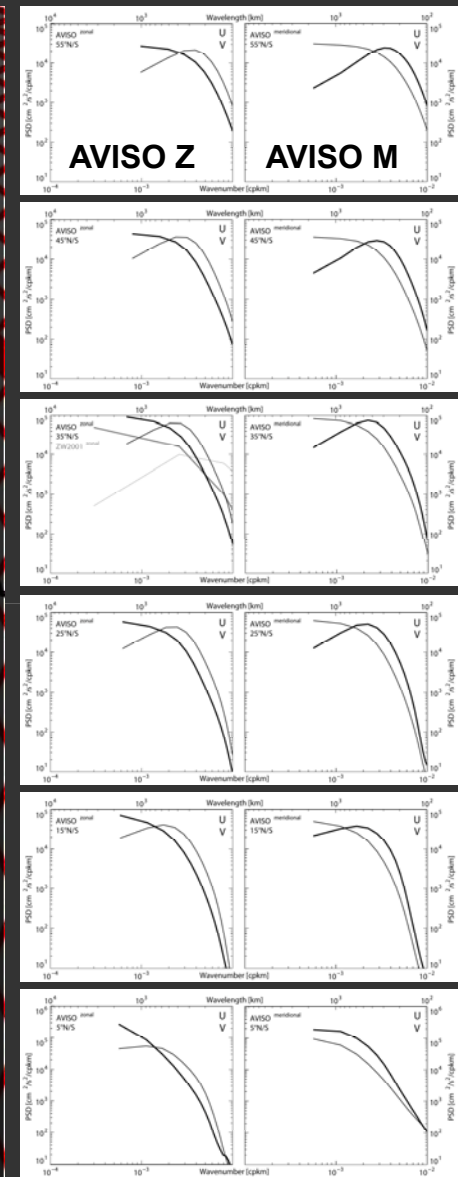
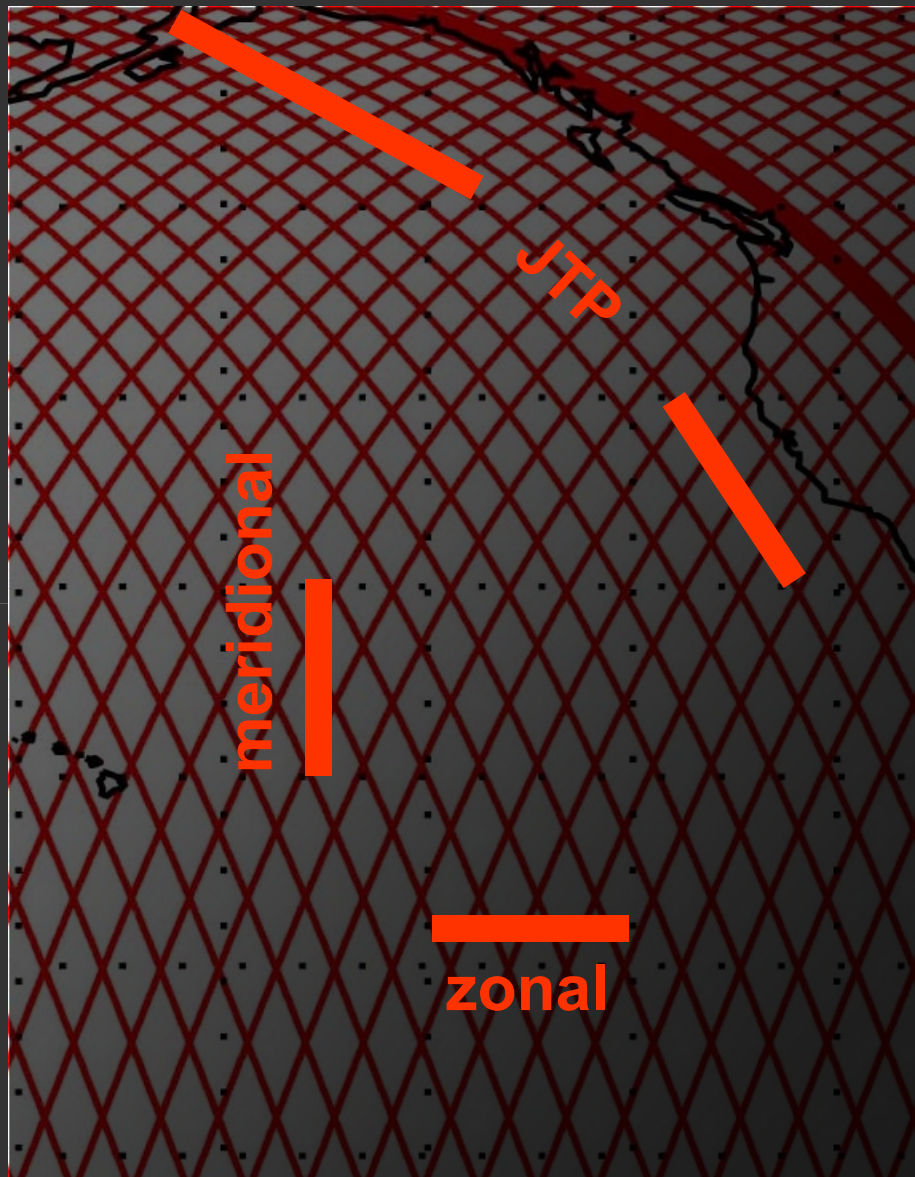
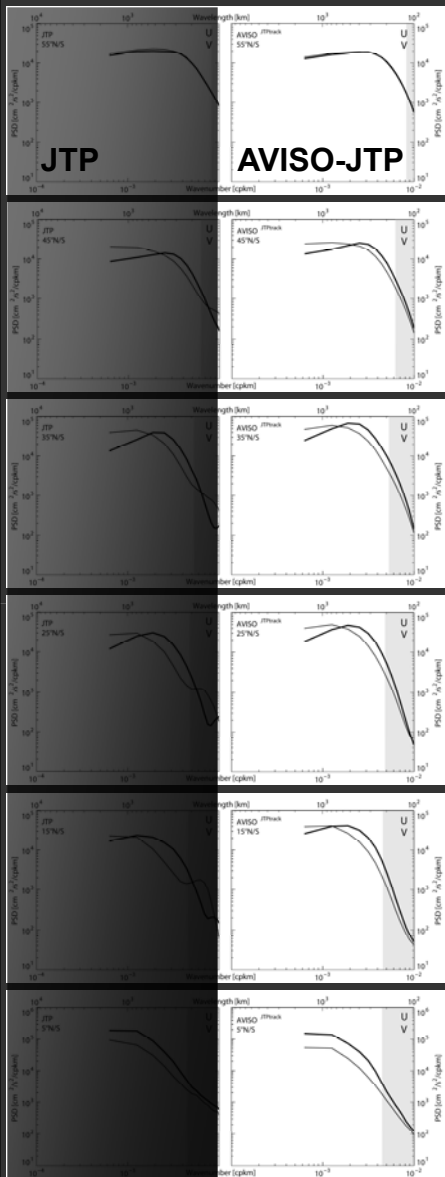
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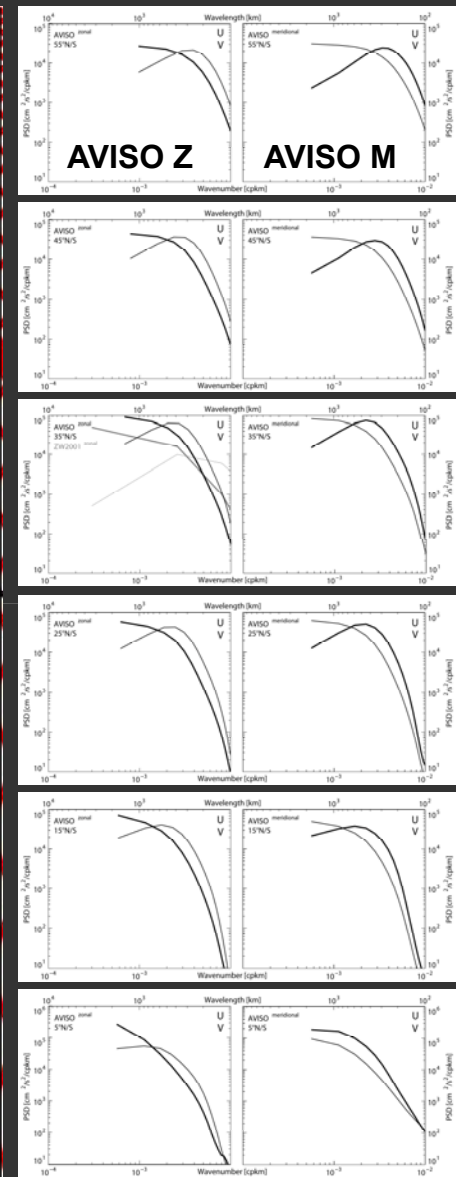
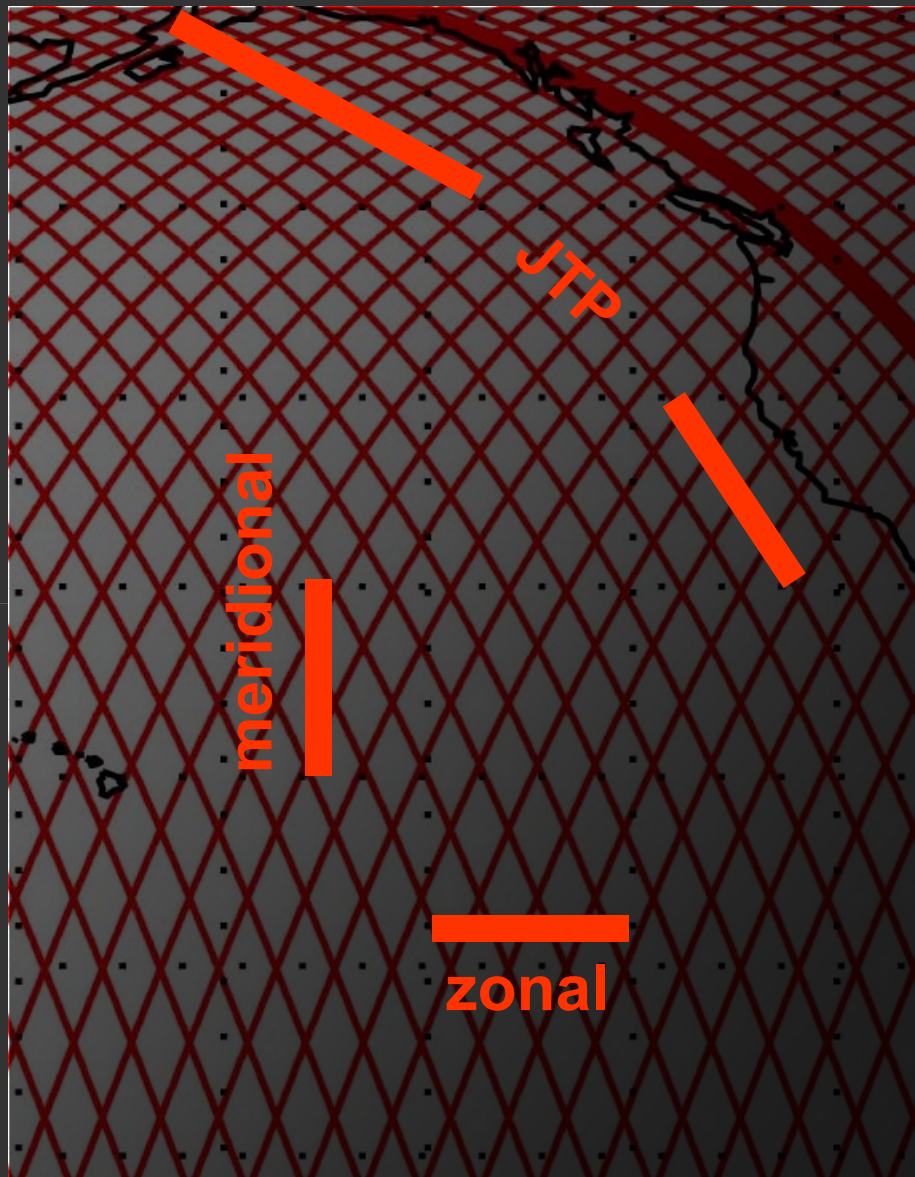
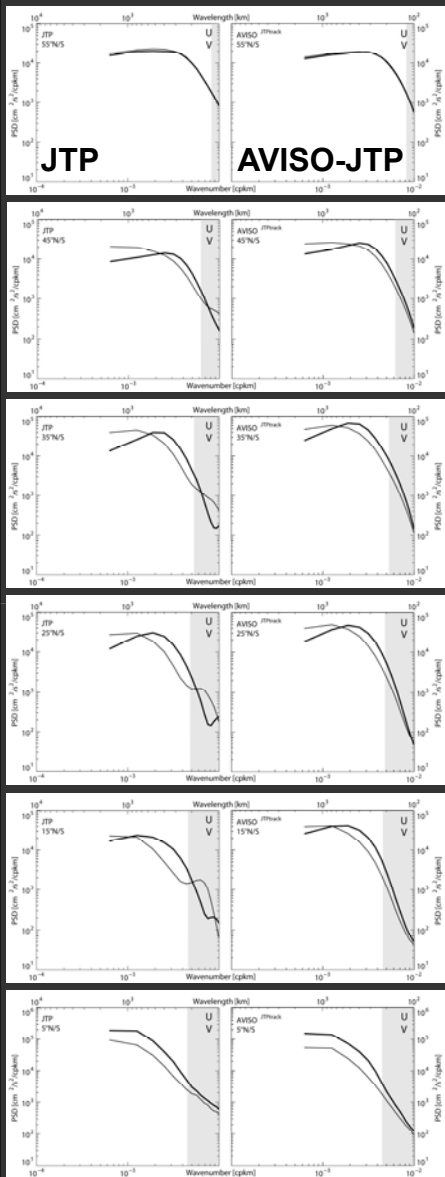
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Wavenumber Spectra



(Scharffenberg and Stammer, in press JGR)

Wavenumber Spectra



(Scharffenberg and Stammer, in press JGR)

- **In many regions the ocean-circulation is anisotropic.**
- **Due to the separate treatment of both velocity components, the anisotropy can now be seen in the velocity frequency spectra.**
- **Velocity (-vector) wavenumber spectra calculated on a satellite track are a mixture of purely zonal and purely meridional wavenumber spectra.**

The possibility to achieve both velocity components for the first time, together and instantaneously, yields a gain of knowledge for the description of the ocean circulation. Looking forward to SWOT mission.