

Interdecadal Variability of Tropical Instability Waves: Shifts, Characteristics and Energetics

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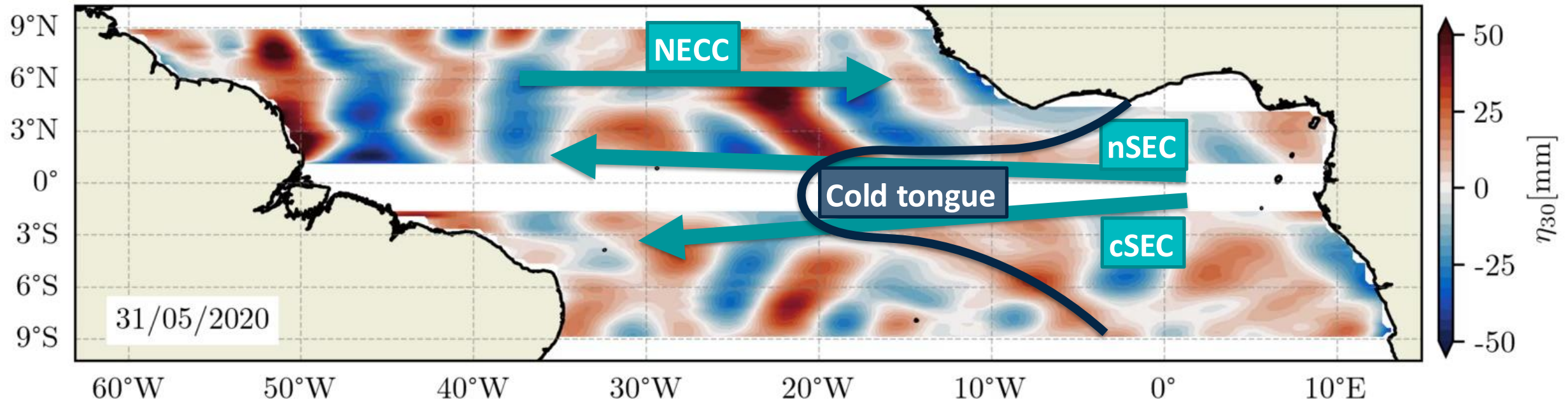
Co-authors: Luciano Pezzi

Tiago Bilo

Paulo Polito

What is a Tropical Instability Wave?

Perturbations in the velocity field that propagate as short unstable Rossby Waves and Yanai Waves.



What do we know?

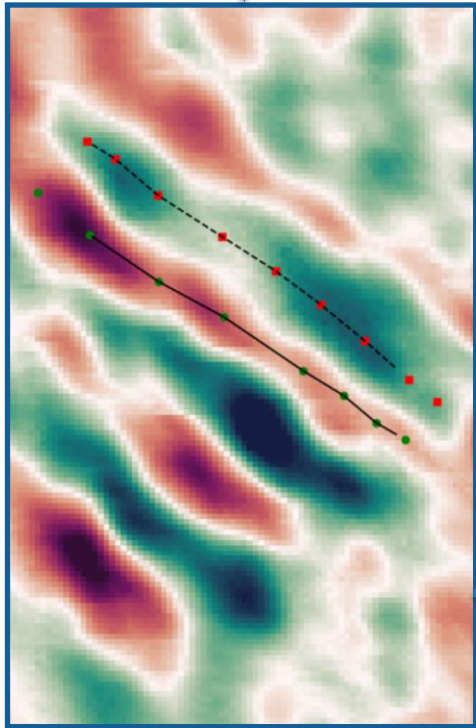
- **Importance:** Atmospheric coupling, turbulent heat advection and mixing, influence in biologic productivity and energy transfer.
- **Interannual and Seasonal Variability** (Arthie & Marin, 2008; Perez et al., 2012)
- **Multidecadal variability** (Tuchen et. al., 2022):
 - **Wave Activity (amplitude) intensifying in the North Hemisphere** (between 0 and 6°N), 1993 -2021.
 - Reason: increase in **Barotropic Energy Conversion**

Open Questions

- Tuchen et al. (2022) small $\uparrow$ trends in TIWs' amplitude **in the Southern Hemisphere** $\rightarrow$ investigate possible changes
- Peng et al. (2022) & Tuchen et al. (2024): **SST $\uparrow$** and **$u, v \uparrow$**
 - **Is the Baroclinic Energy conversion increasing?**
 - **Is the wave C_p , P or λ changing?**

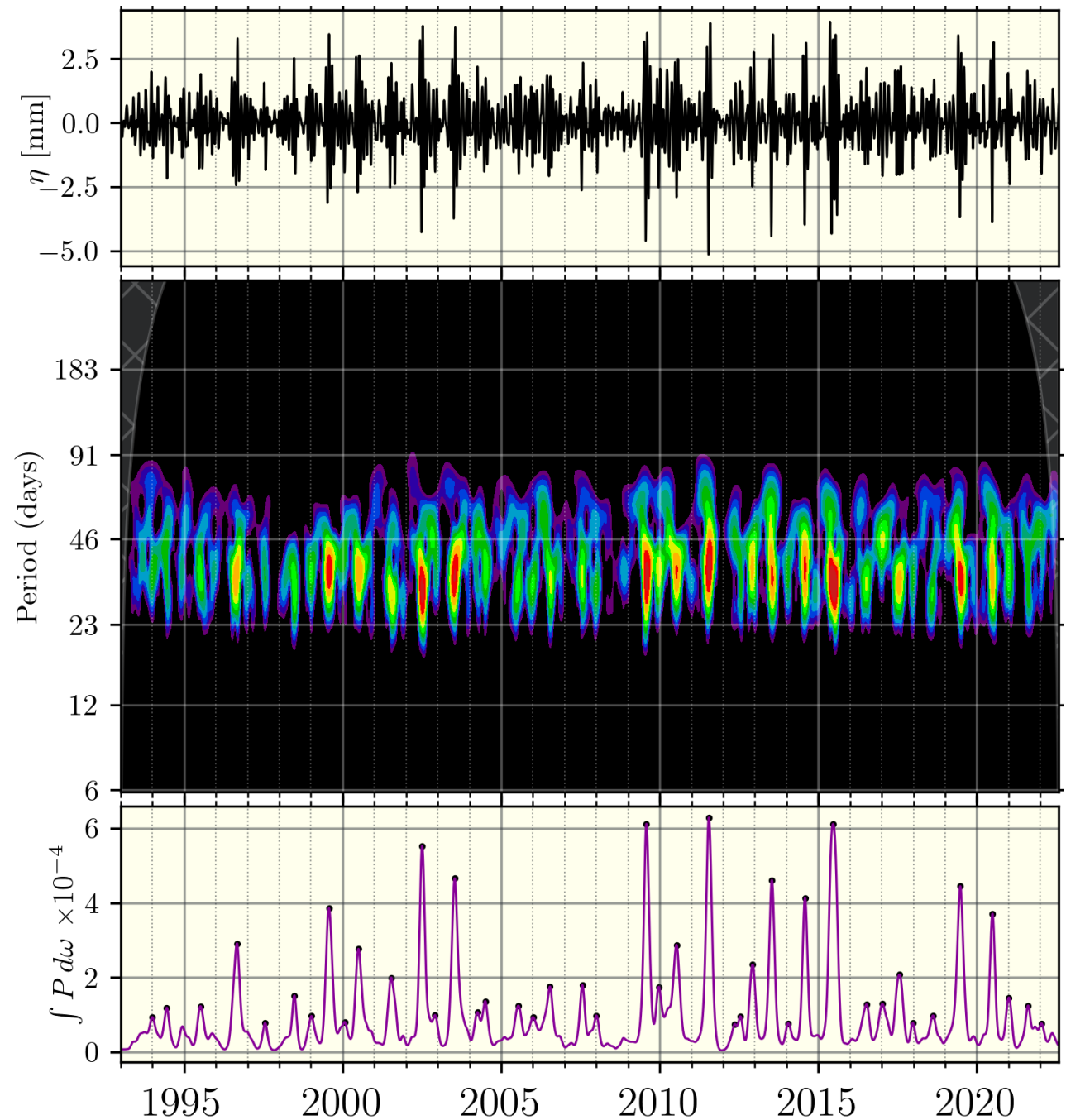
Isolating Tropical Instability Waves

Sea Surface Height Anomaly (η) from 1993 to 2022
(Altimeter L4 - CMEMS)



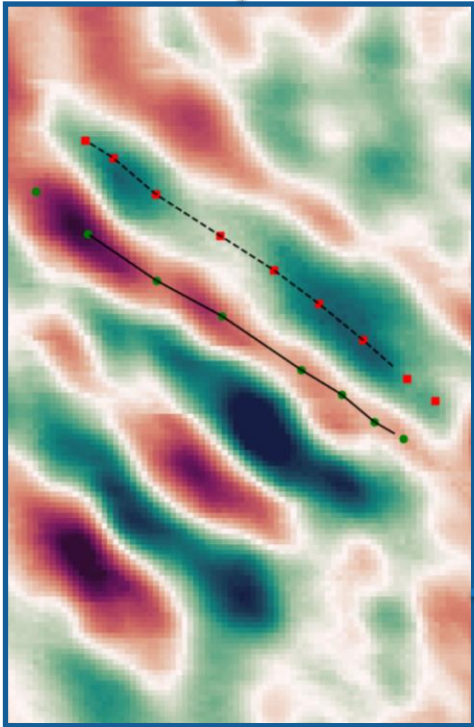
Apply Wavelet Transform to the filtered data

Spatio-temporal convolution filter
(Polito & Sato, 2003)



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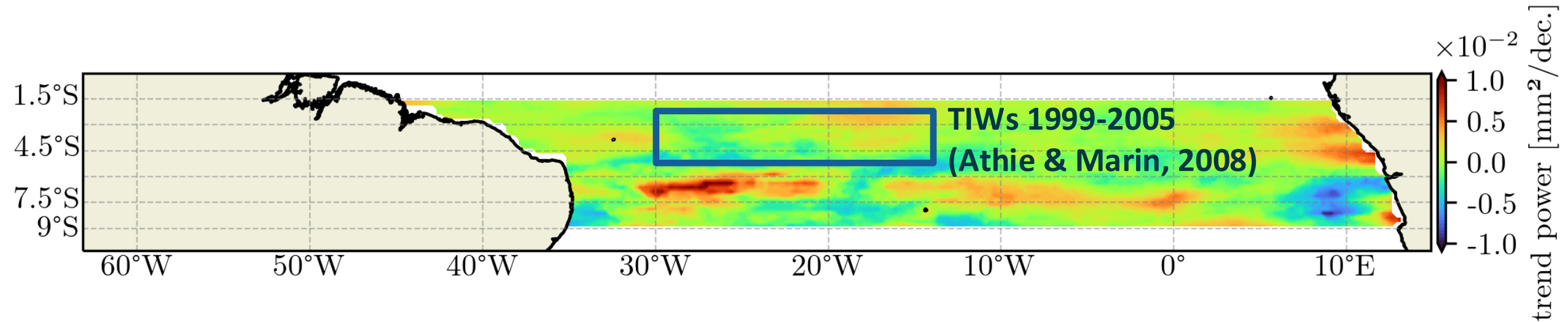
Calculating Baroclinic energy conversion

GLORYS dataset:
 u, v and ρ

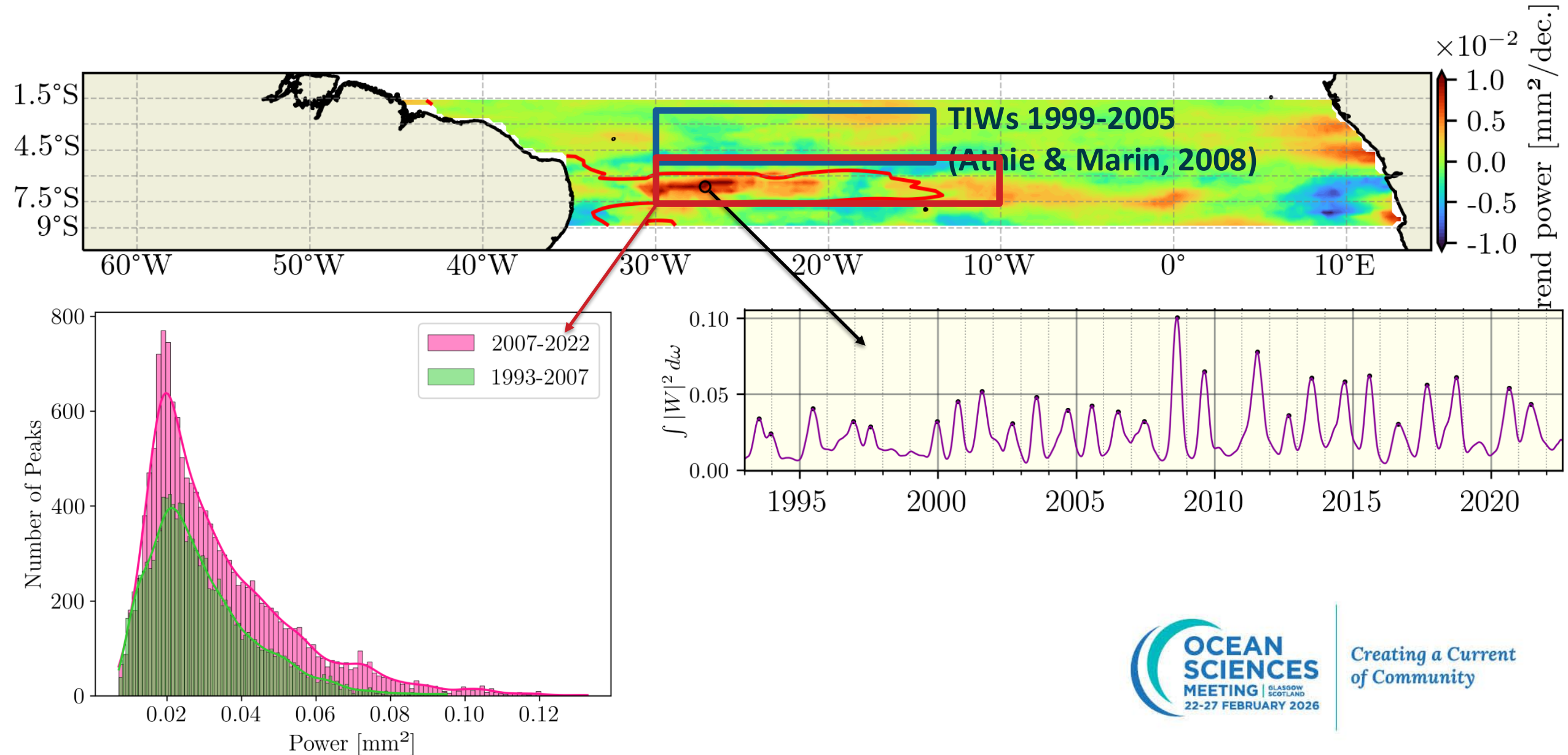
$$= \int_z^0 \frac{\partial u'}{\partial x} + \frac{\partial v'}{\partial y} dz$$

$$\overline{BC} = g \overline{\rho' w'}$$

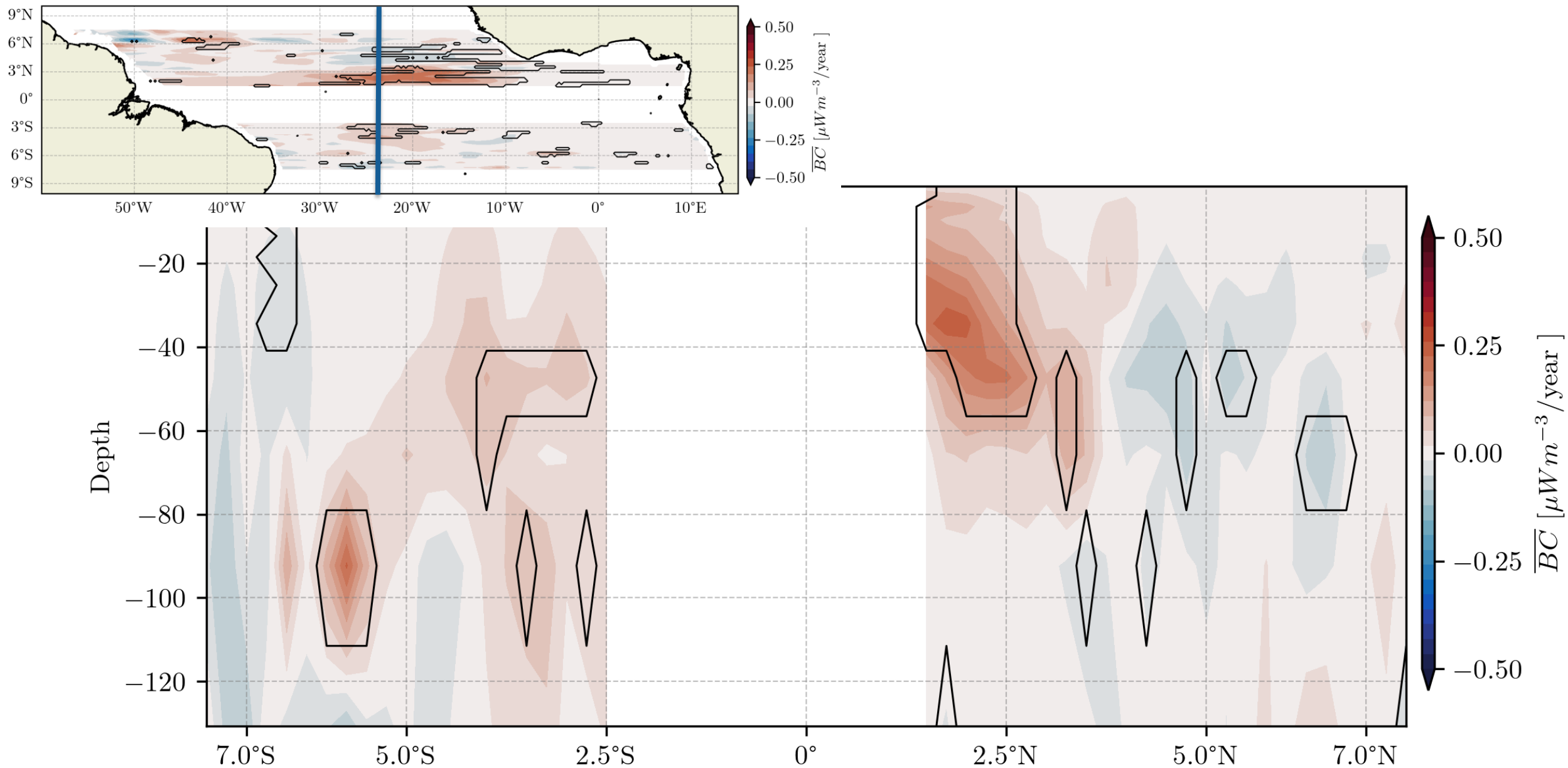
Shifts in the TIWs in the Southern Hemisphere



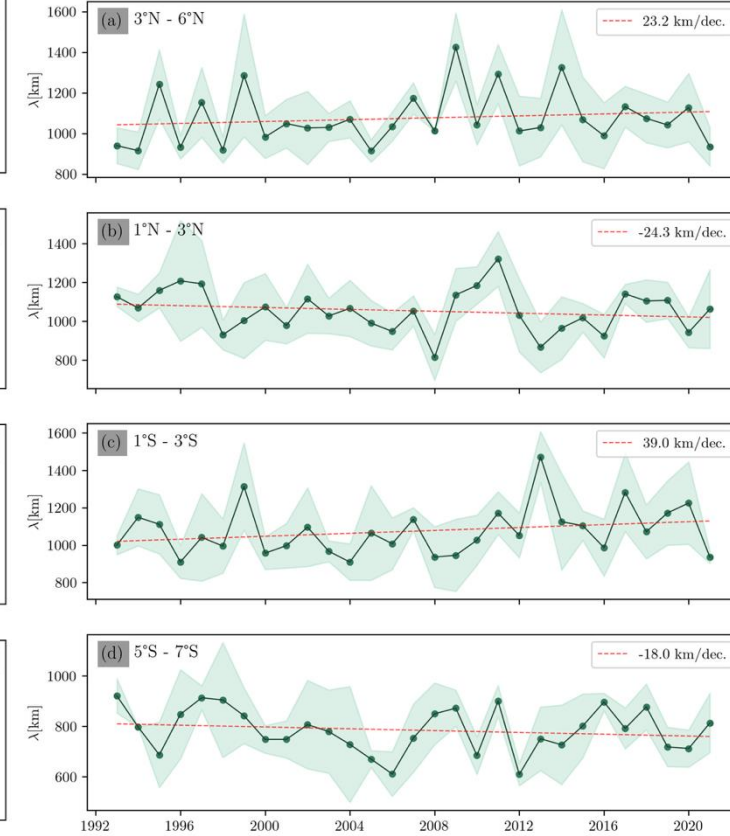
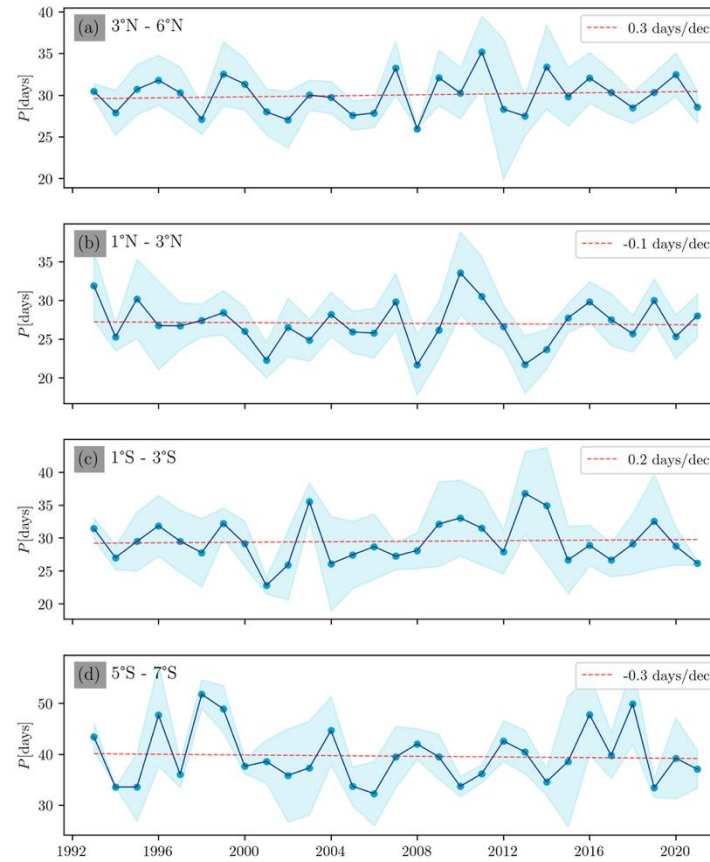
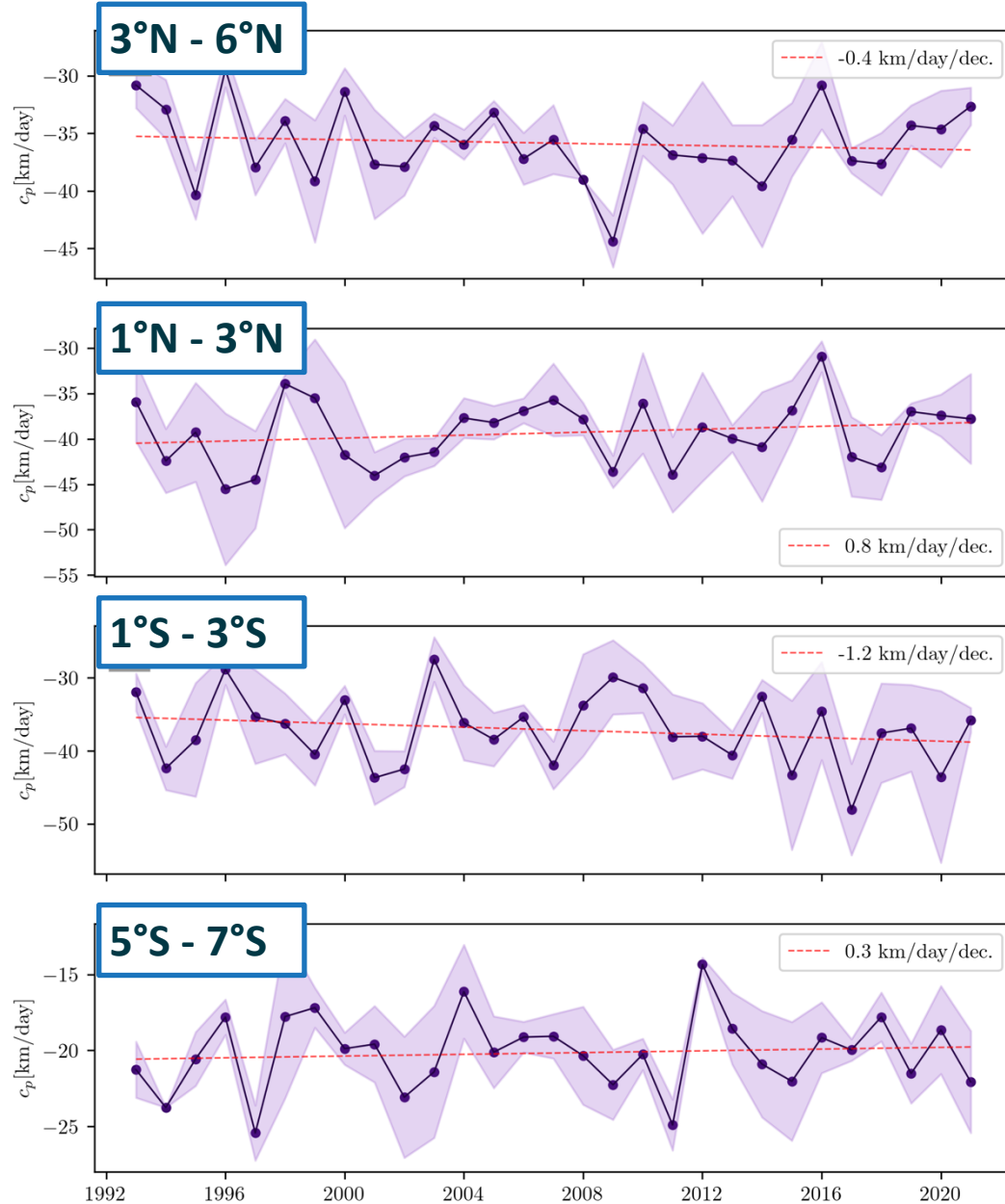
Shifts in the TIWs in the Southern Hemisphere



Trend in Baroclinic Energy Conversion



Change in the Phase Velocity, P or λ of TIWs?



Not statistically significant

Take home messages

- TIWs activity/amplitude increased from 2007-2022 compared to 1993-2007 along 5°S to 7°S
- Increase in the baroclinic energy conversion:
 - 1°N to 3°N
 - 5°S to 7°S
 - 2.5°S to 4°S (less intense)
- Despite changes in velocity and stratification in recent years, no change in the propagation speed or wave dynamics

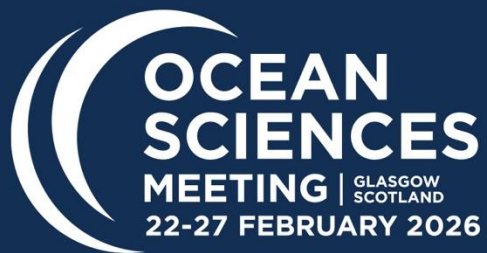


Article from MSc.
Thesis submitted
to Deep Sea
Research (Under
Review)

Backup Slides



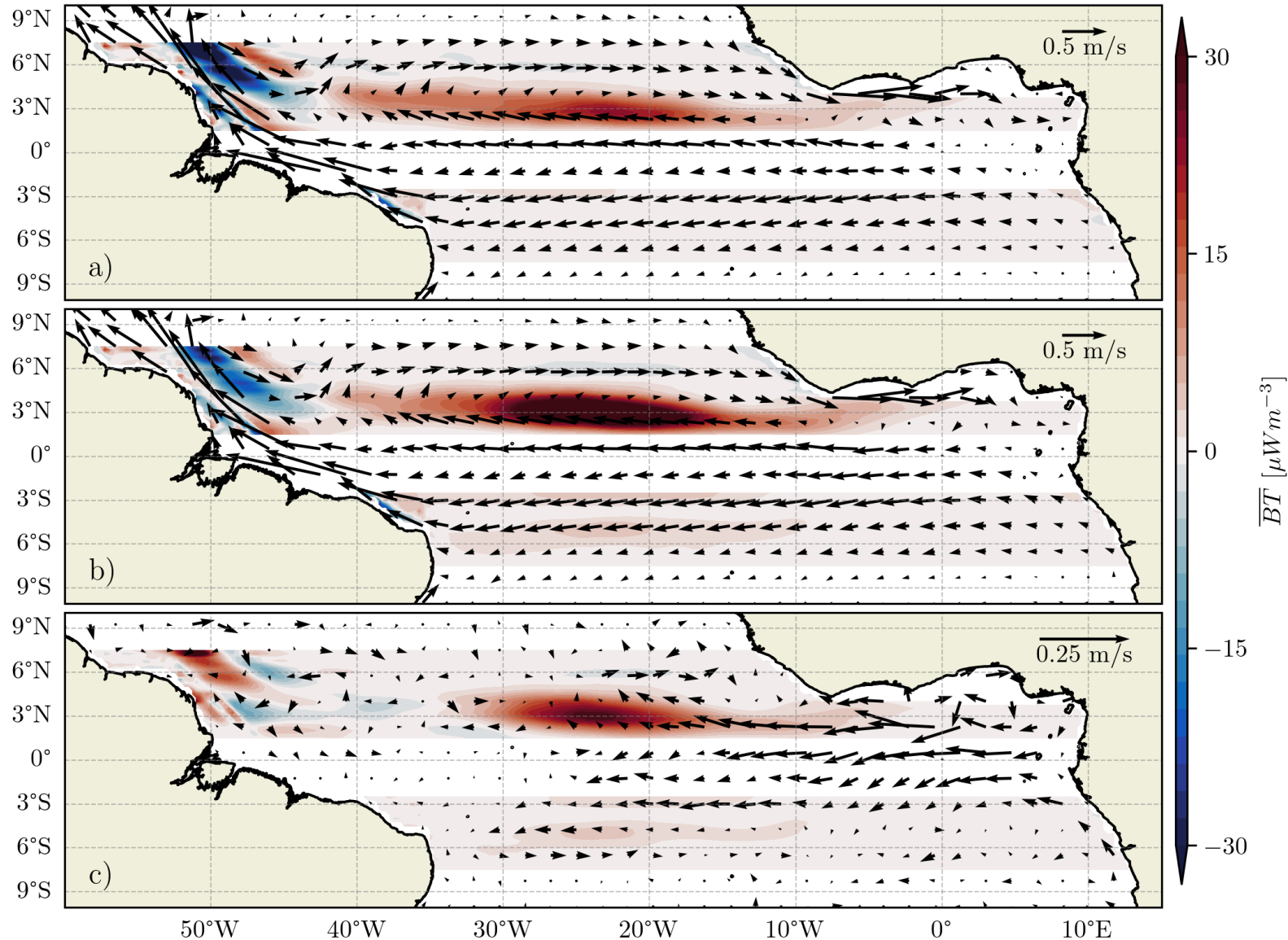
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*Creating a Current
of Community*

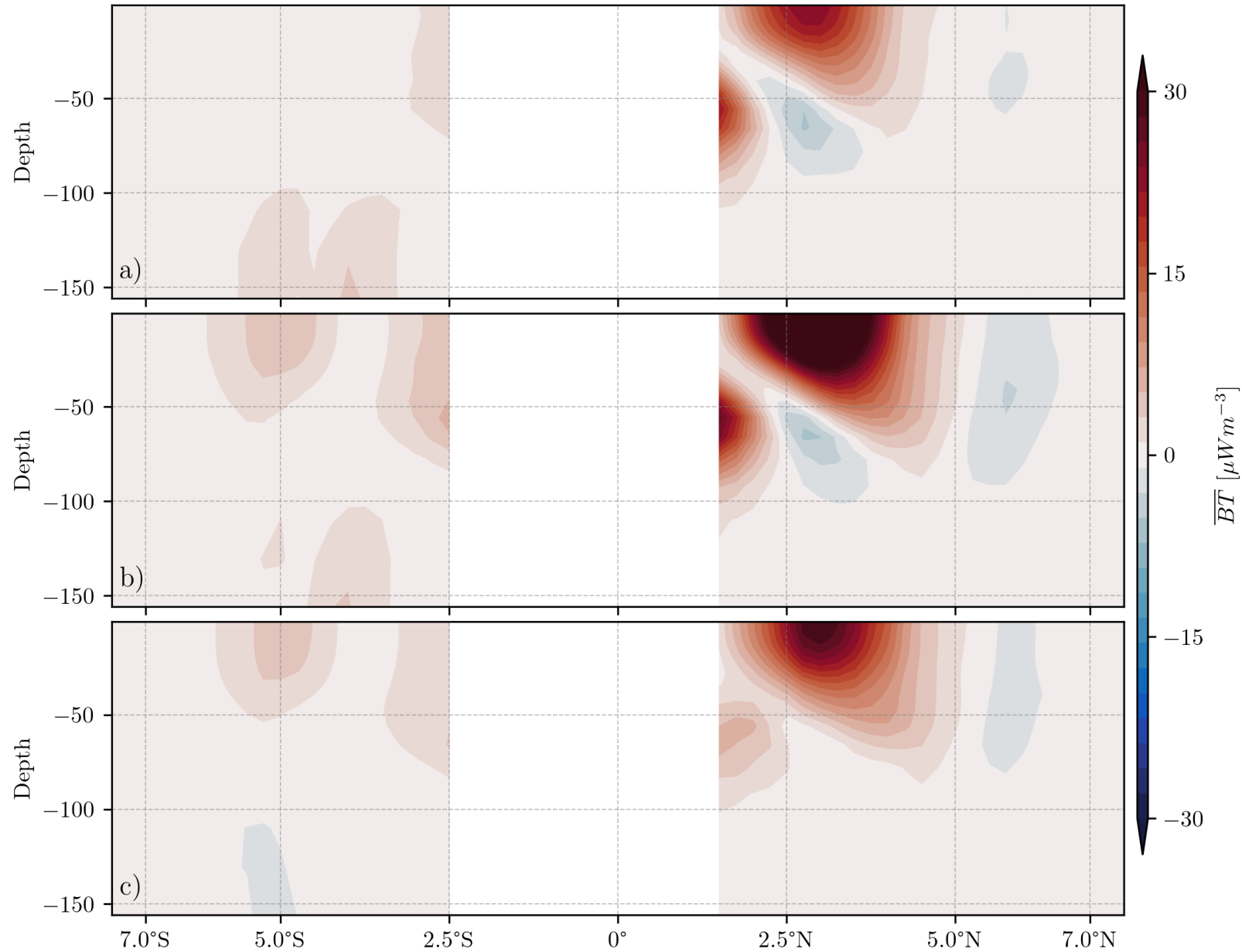


Barotropic Energy Composite - Surface



#OSM26

Barotropic Energy Composite – 23°W



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