National Oceanography Centre

TAO data support the existence of large amplitude wind-driven high frequency variations in the cross-equatorial overturning circulation

Adam Blaker[1], Lois Baker[2],

Mike Bell[3], Joel Hirschi[1]

[1] National Oceanography Centre, UK

[2] Imperial College, London, UK [3] Met Office, Exeter, UK

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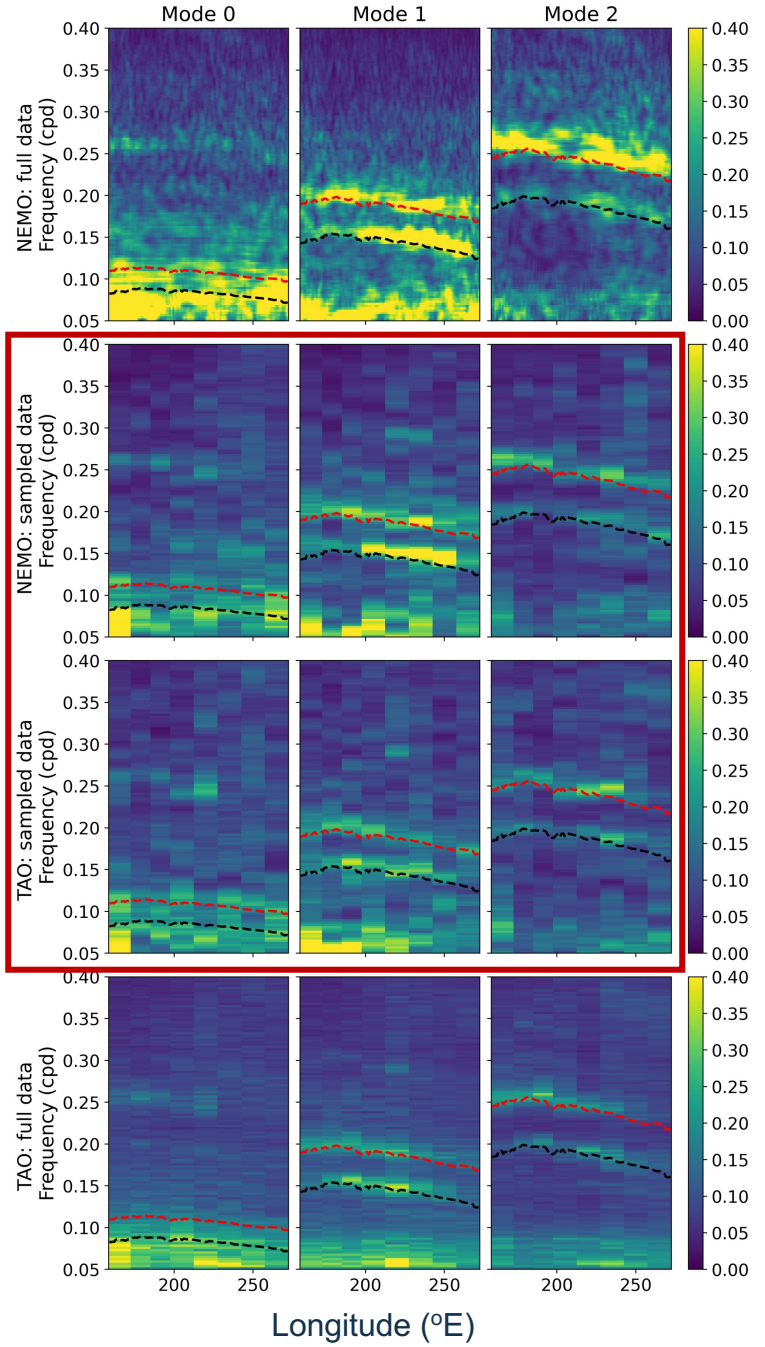
Met Office

Imperial College London



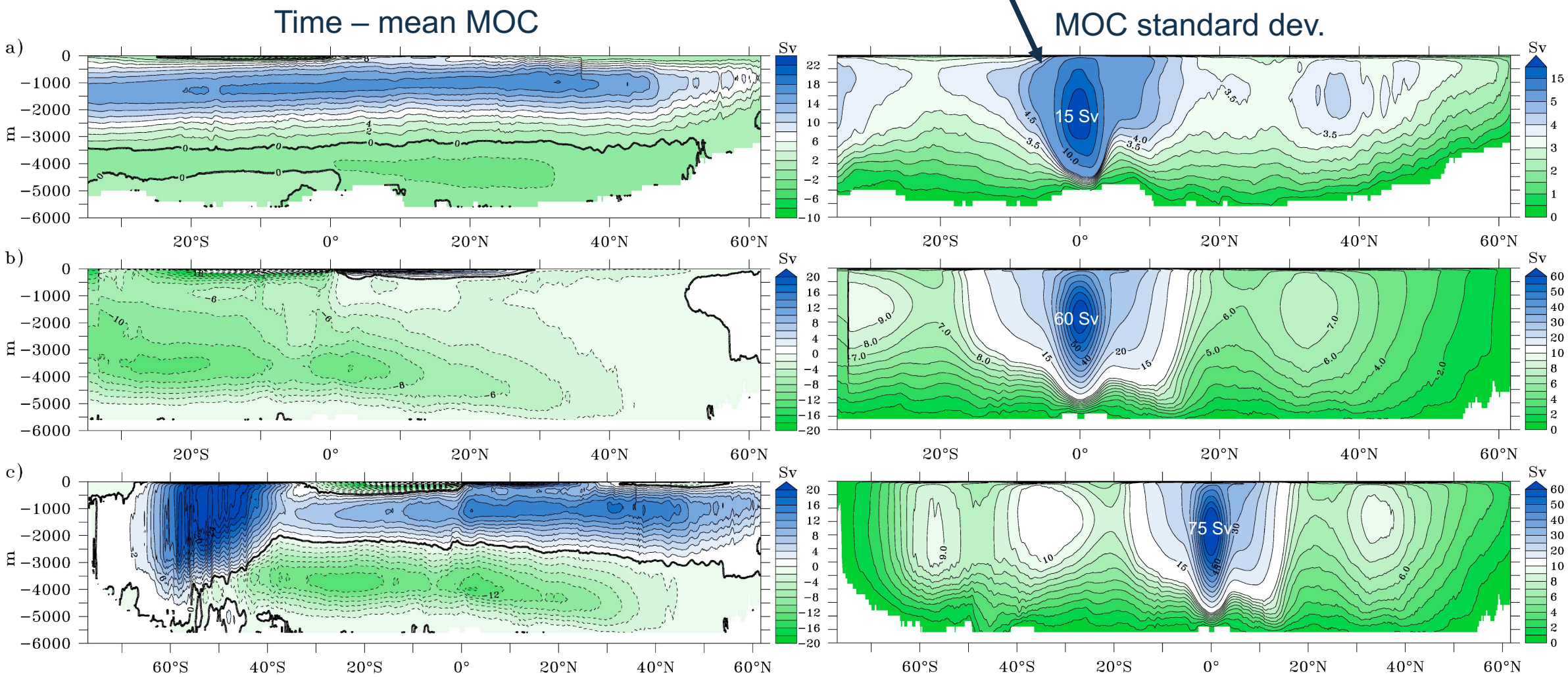
Baker, Bell, Blaker (2022) GRL

Large equatorial MOC variability

Atlantic

Indo-Pacific

Global

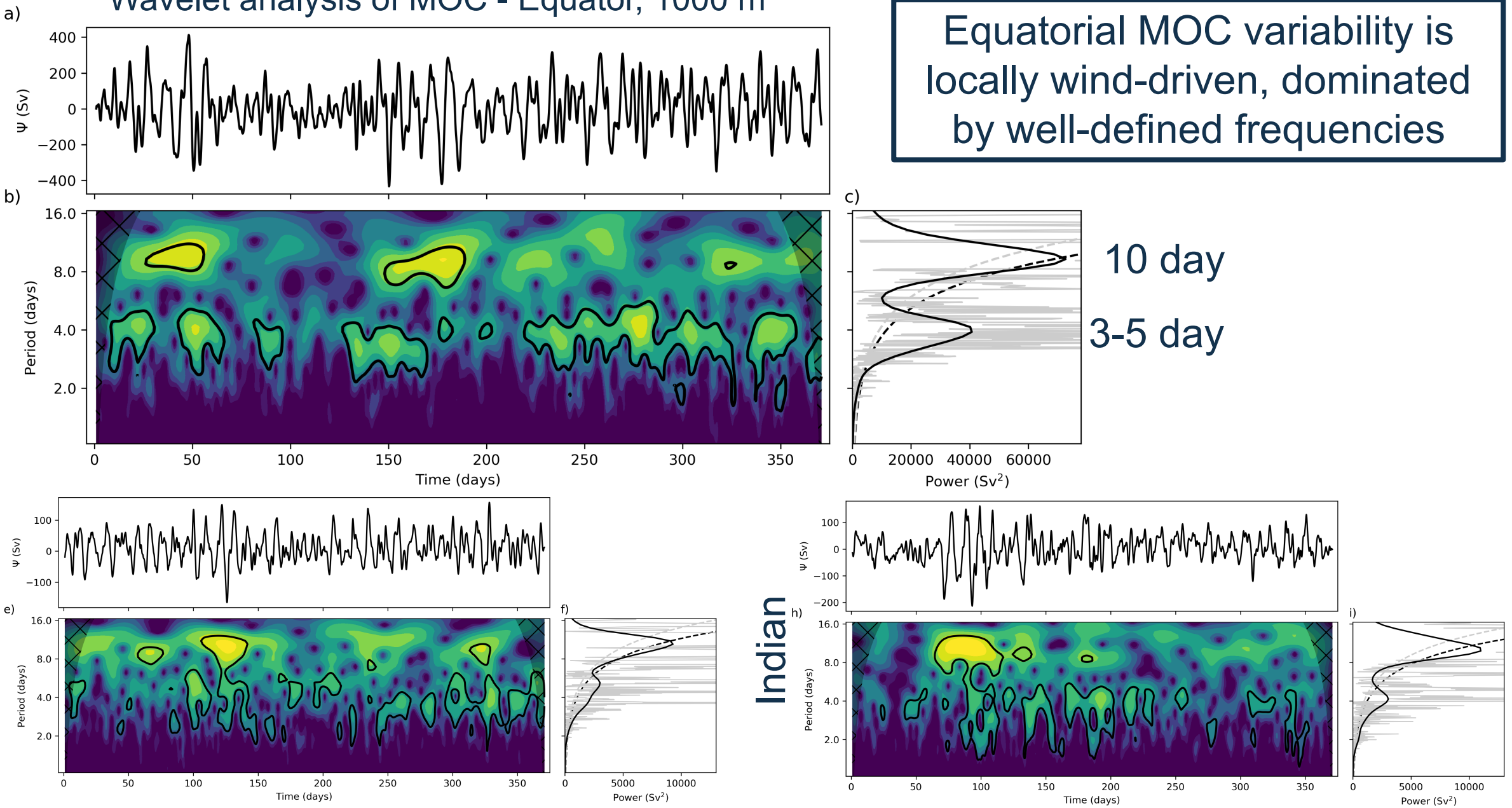


Based on 5 day mean output

Hirschi et al. (2013)

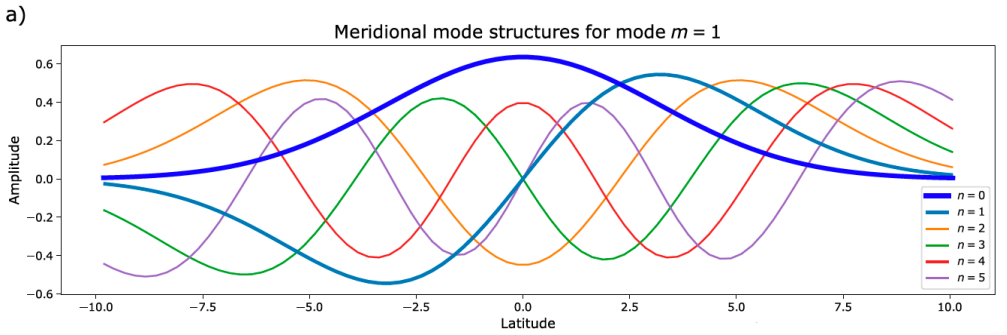
Wavelet analysis of MOC - Equator, 1000 m

Equatorial MOC variability is locally wind-driven, dominated by well-defined frequencies



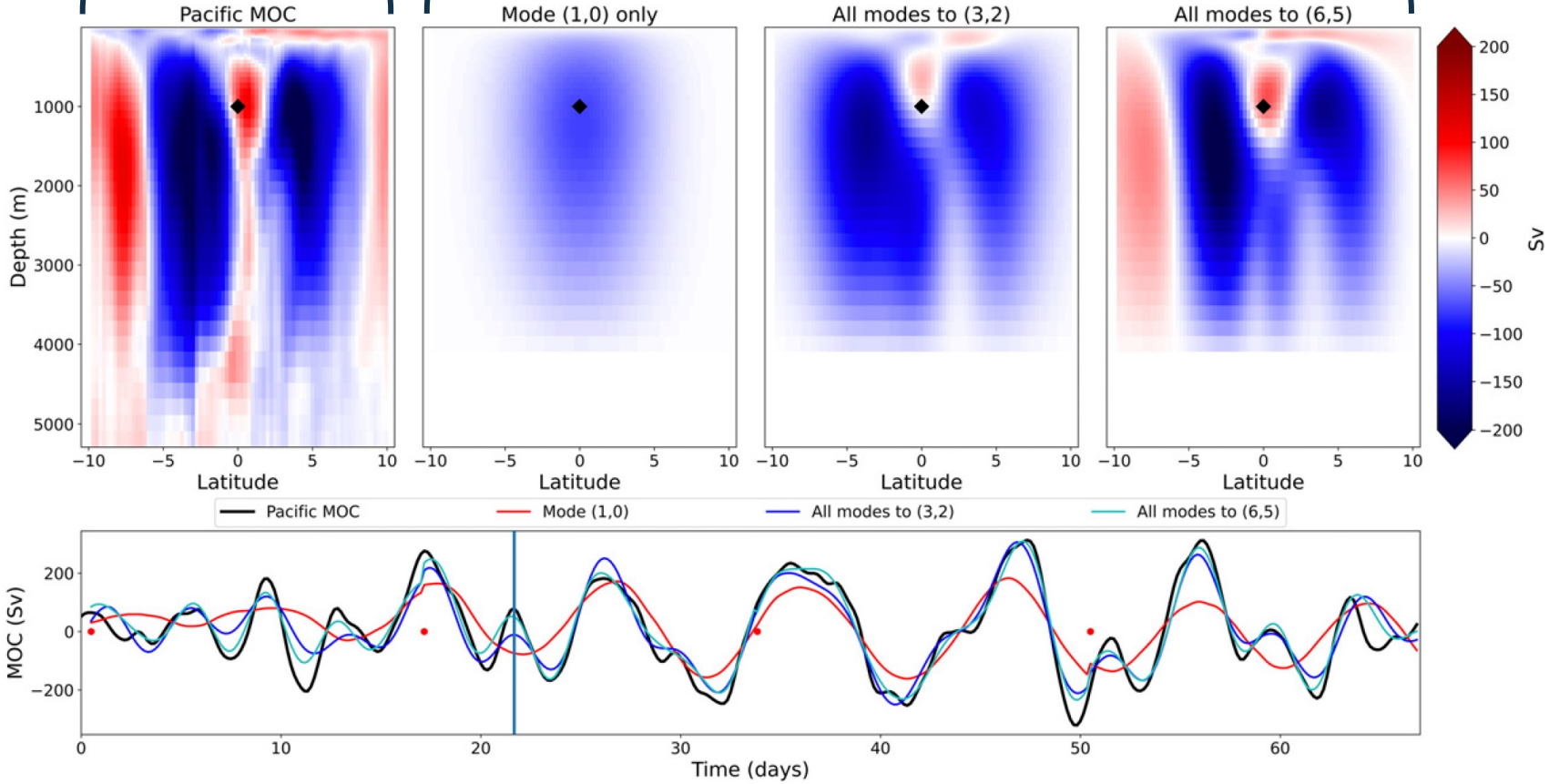
Blaker et al (2021) JPO

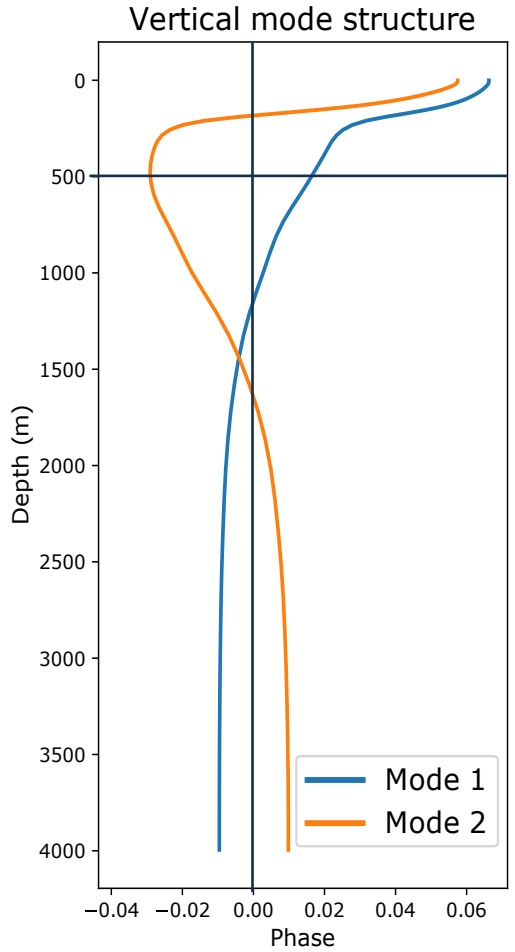
Equatorial MOC variability can be reproduced by a linear sum of a small number of wind-driven wave modes



NEMO

Wind-driven wave modes

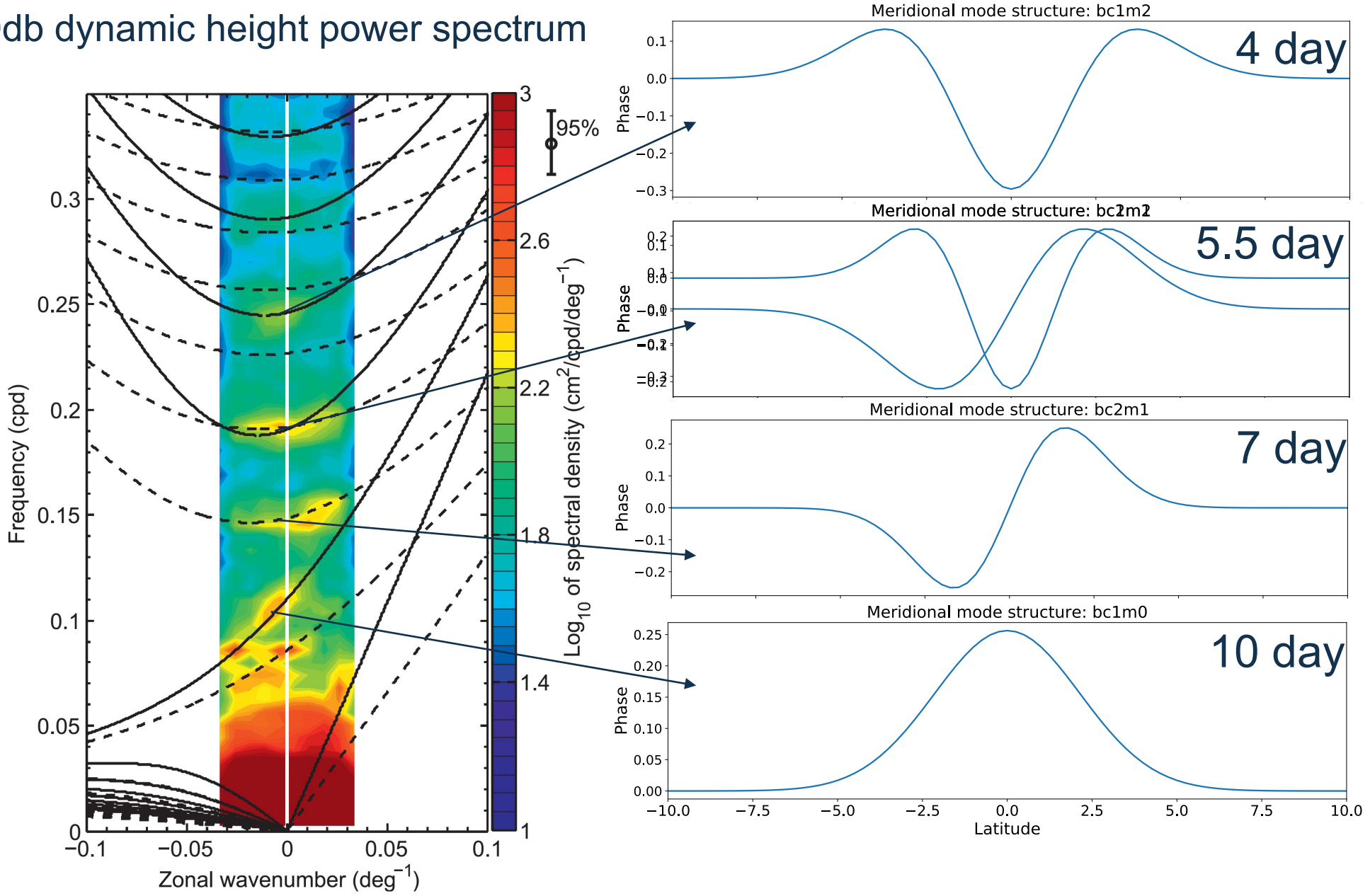




Bell, Blaker, Hirschi (2021), JPO

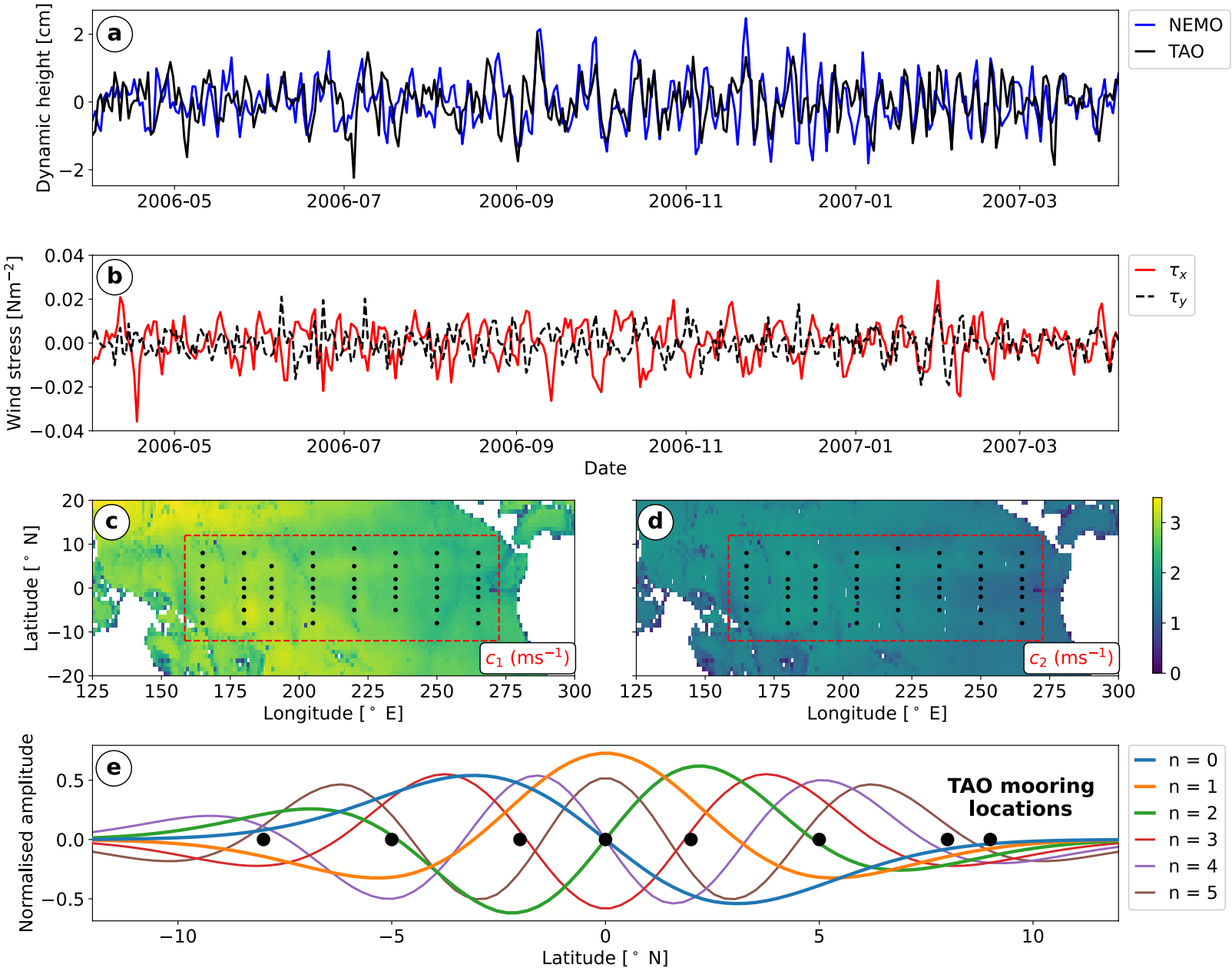
TAO/TRITON 500db dynamic height power spectrum

Peaks in TAO dynamic height power spectra similar to the MOC analysis



Farrar & Durland (2012)

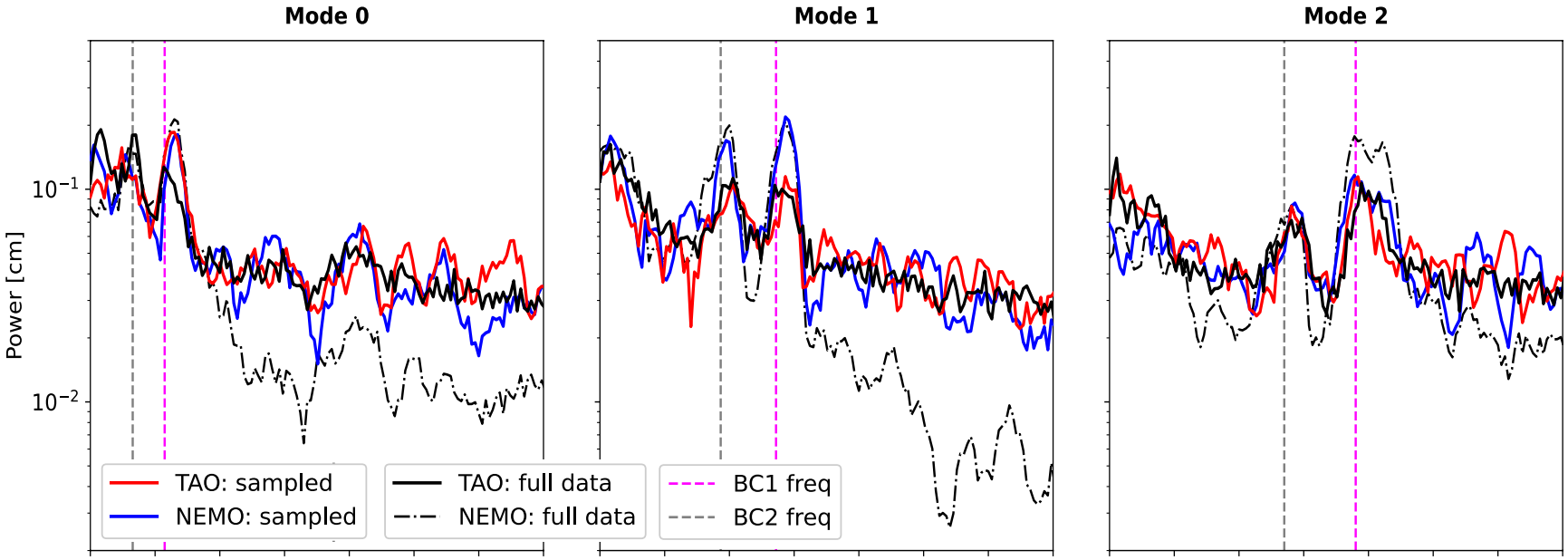
TAO/TRITON 500db dynamic height

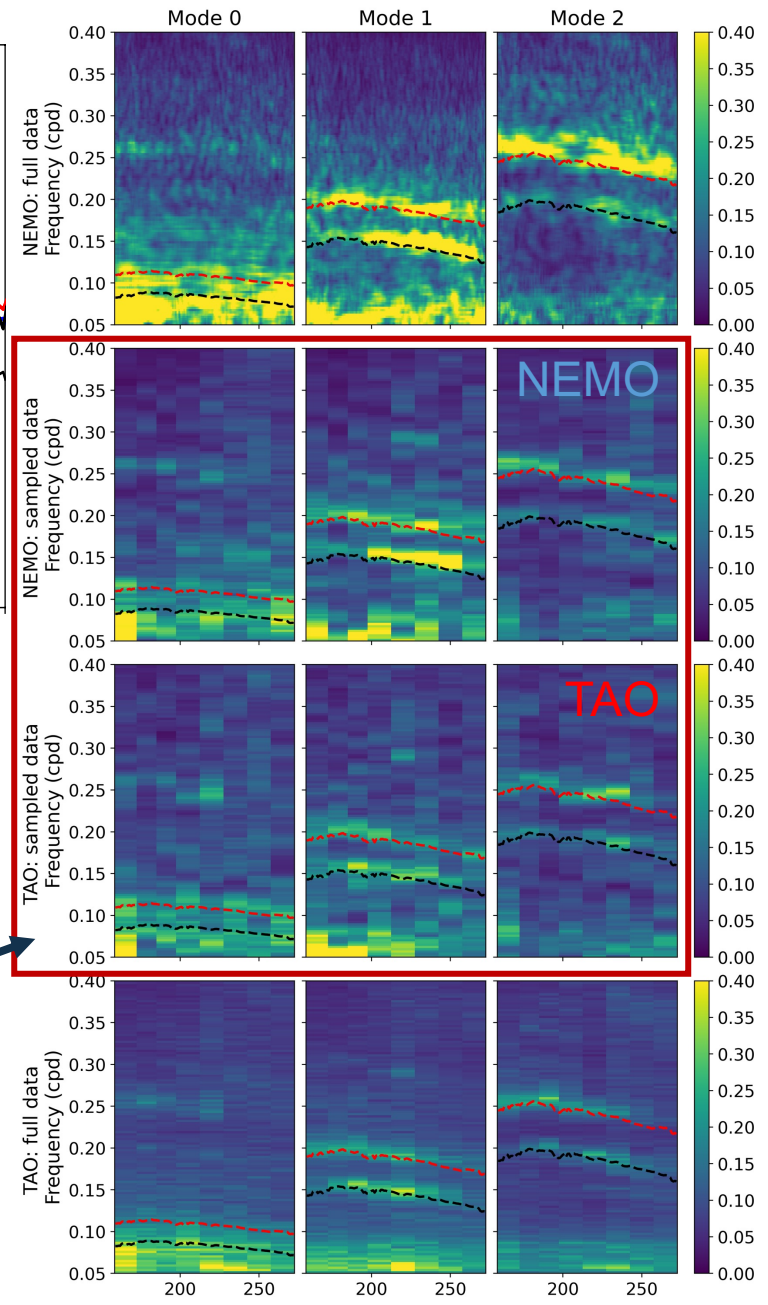


Significant correlation (~0.4) between TAO and NEMO dynamic height time series

Although wind-driven, essentially zero correlation between the wind stresses and the dynamic height variability (or the MOC)

Baker, Bell, Blaker (2022) GRL





Excellent agreement between power spectra of TAO dynamic height data and NEMO model

Like-for-like comparison of TAO dynamic height data and NEMO model

Baker, Bell, Blaker (2022) GRL

Summary

- **Large, locally wind-forced MOC variability present in all basins**
  - Amplitude scales linearly with basin width
  - Equatorial planetary waves with 10 and 3-5 day period dominate the variability

- **MOC variability shown to be superposition of wind-driven normal modes (equatorial Poincare waves)**
- **Can explain ~90% MOC variance with a small number of modes**
- **Excellent agreement between TAO mooring dynamic height and model solution**

Further questions:

- **What structures/patterns in the wind field excite resonances in these modes?**
- **How important are such waves are for:**

  a) mixing? b) heat/volume transports?

- **Implications for forecast systems, particularly data assimilation?**

Blaker et al. (2021) JPO
Bell et al. (2021) JPO
Baker, Bell, Blaker (2022) GRL