Tracer variability and stirring the Antarctic Circumpolar Current

High resolution observations from gliders and Argo float

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Questions

- Across ACC and surface to interior transport in the Southern Ocean is largely a result of eddy stirring.

$$\frac{\partial}{\partial t}(hC) + \nabla_b(h\mathbf{u}C) = 0$$

$$\frac{\overline{vhC}}{\overline{h}} = \overline{v'h'}\frac{\overline{C}}{\overline{h}} + \overline{v'C'} + \frac{\overline{v'h'C'}}{\overline{h}},$$

Residual circulation/ Thickness Stirring

Tracer Stirring

Likely small

- Looking at details of c' (the filaments) can help.

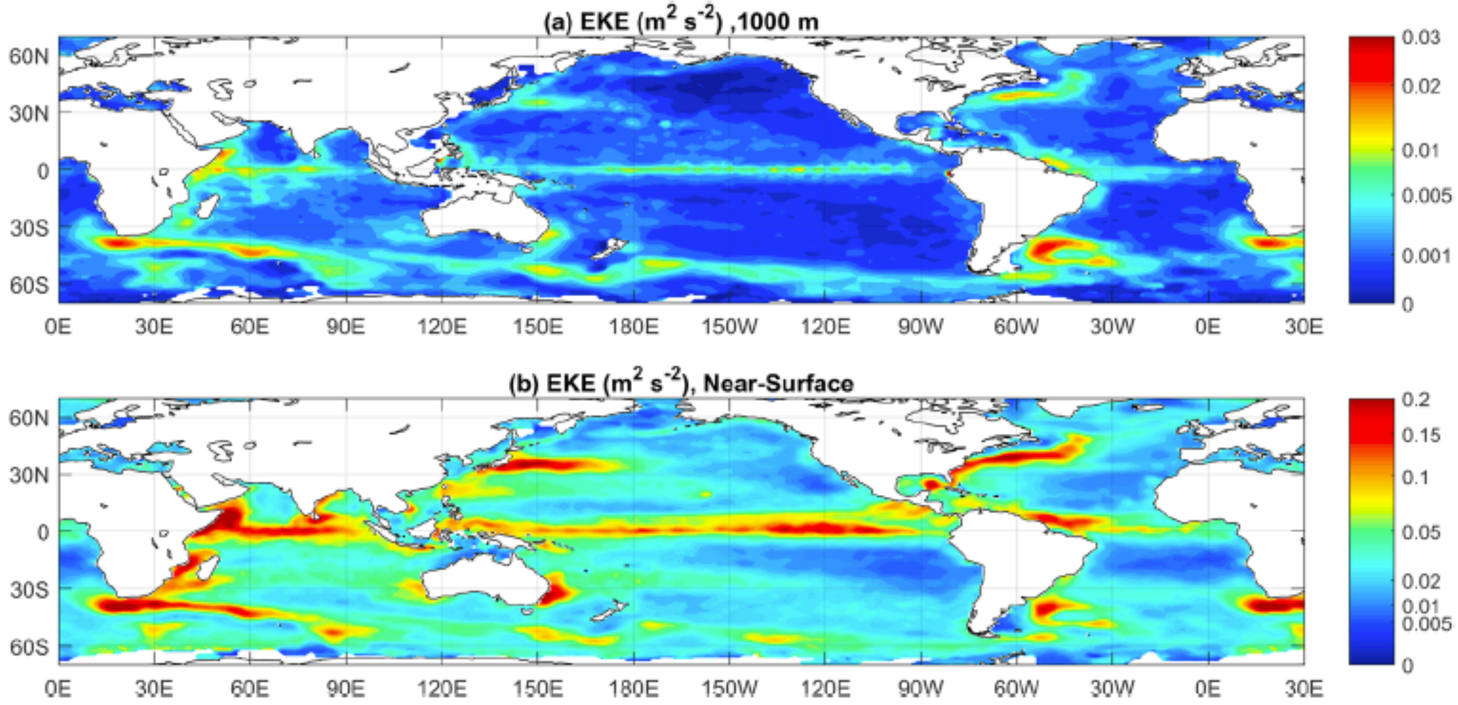
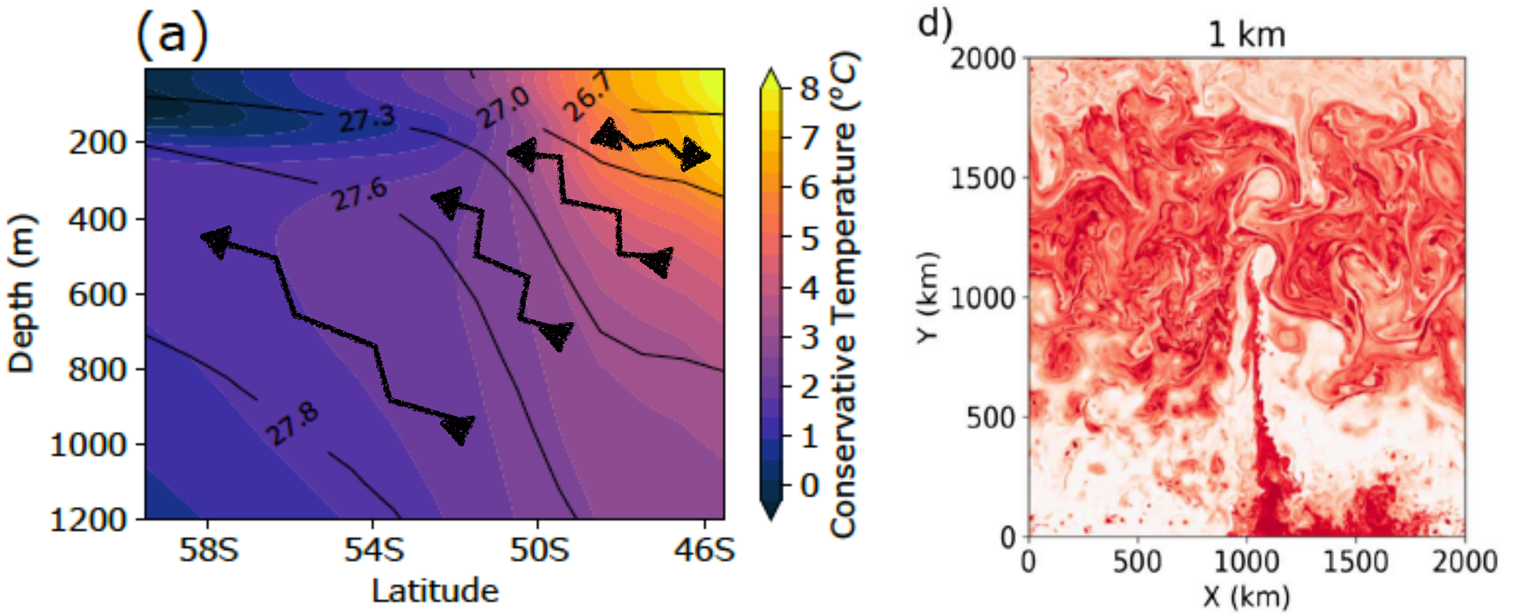
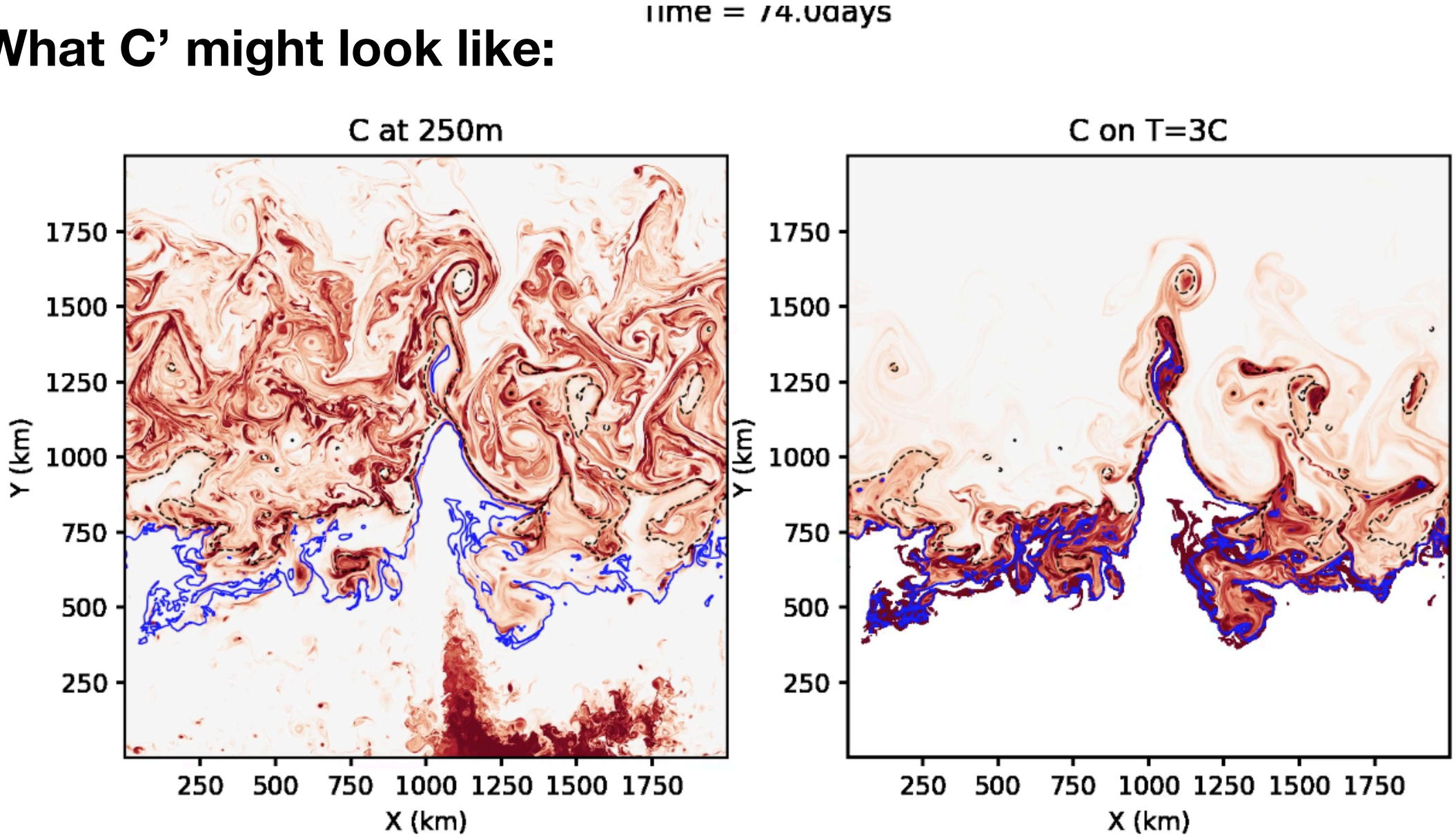


Figure 3. Maps of eddy kinetic energy (m^2/s^2) (a) at 1,000 m and (b) in the near-surface layer.

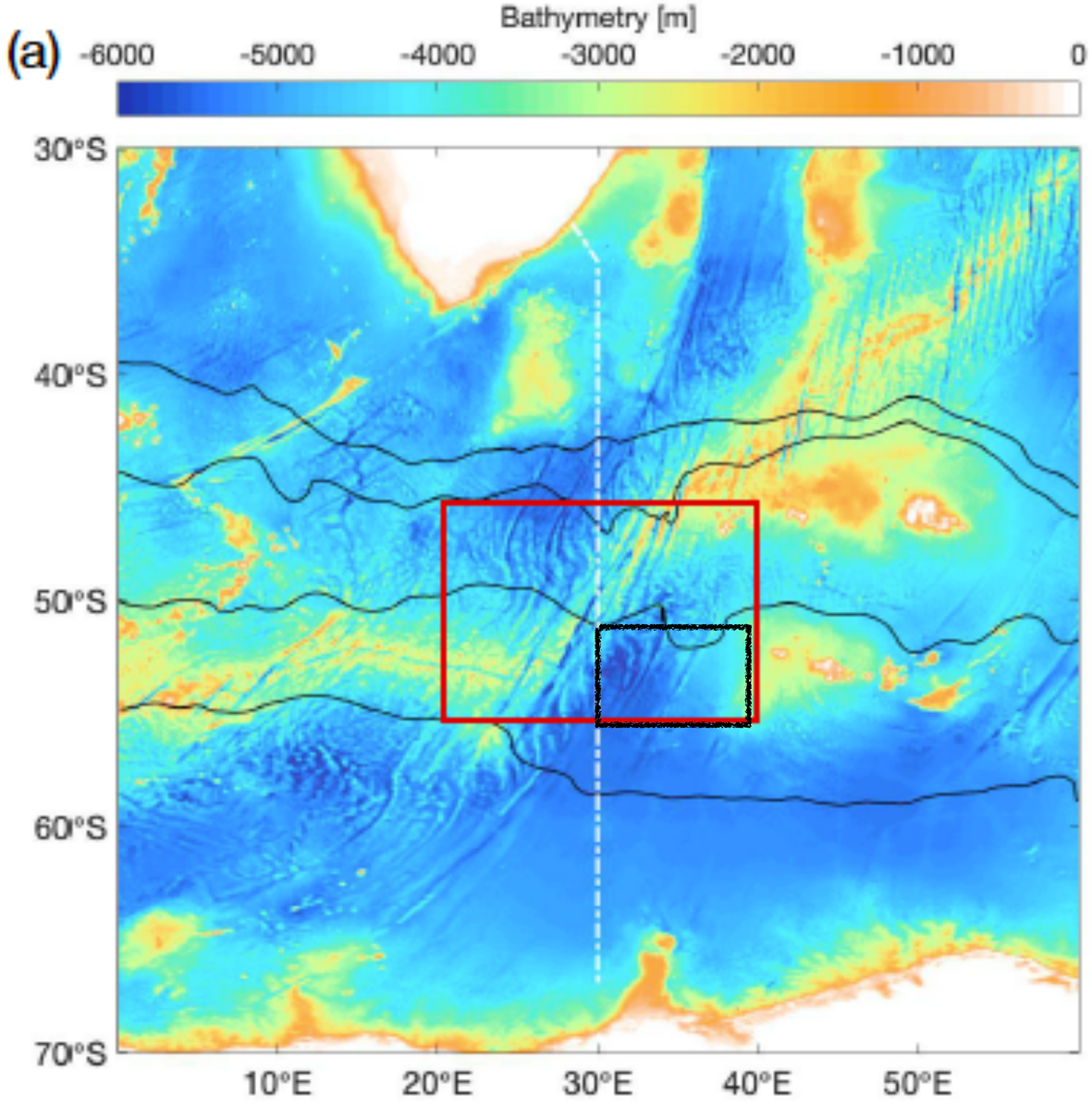


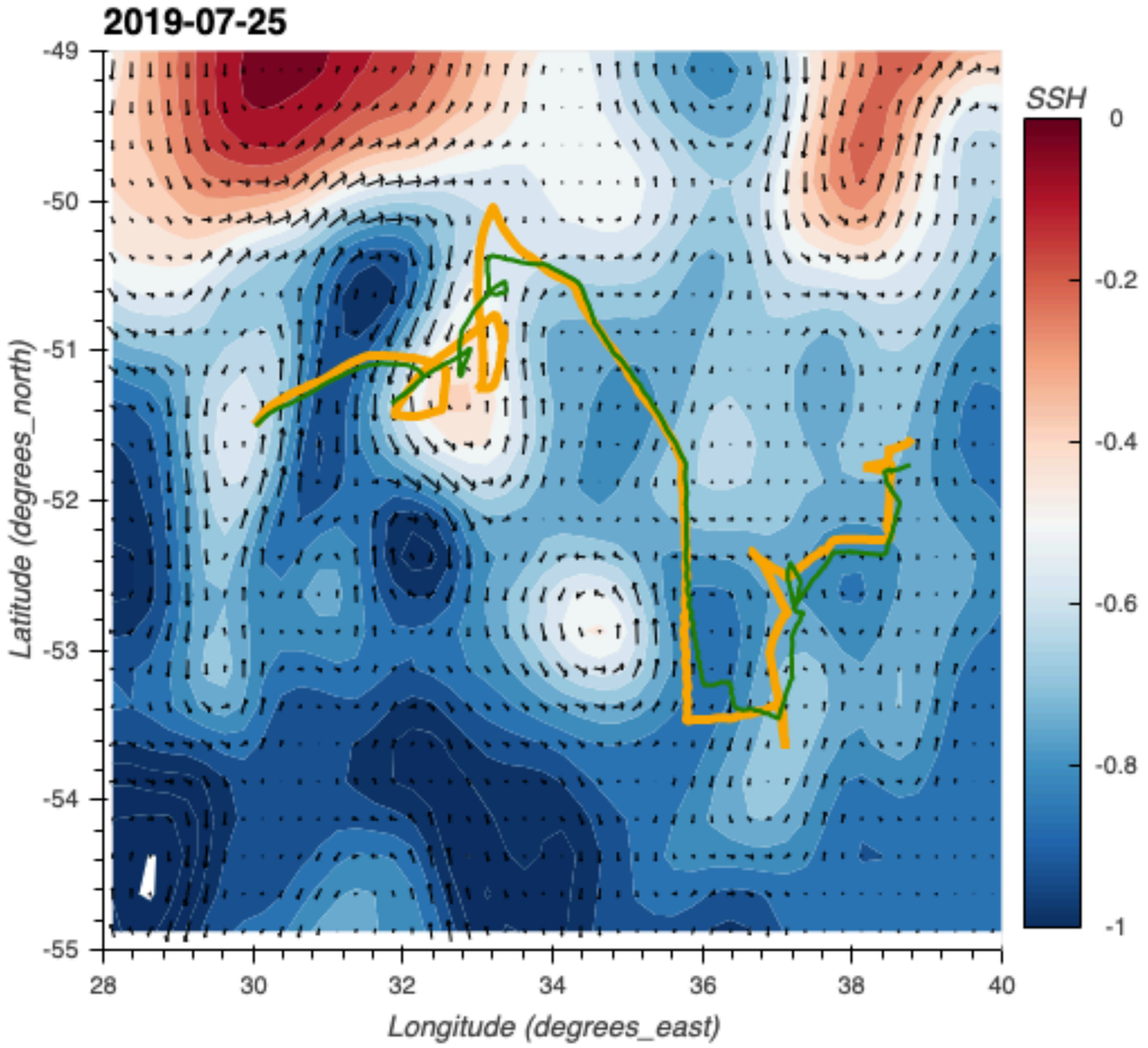
What C’ might look like:



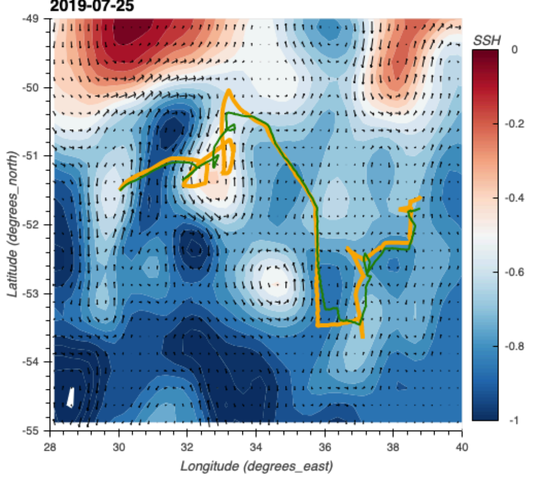
Movie at: https://www.youtube.com/watch?v=ry3ldVfcp70

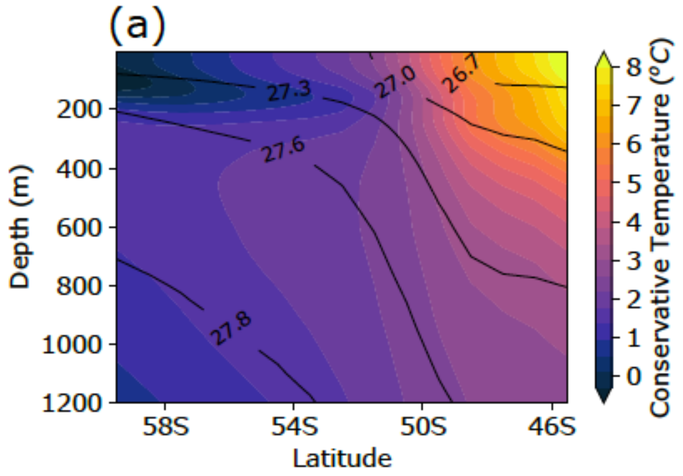
Observations

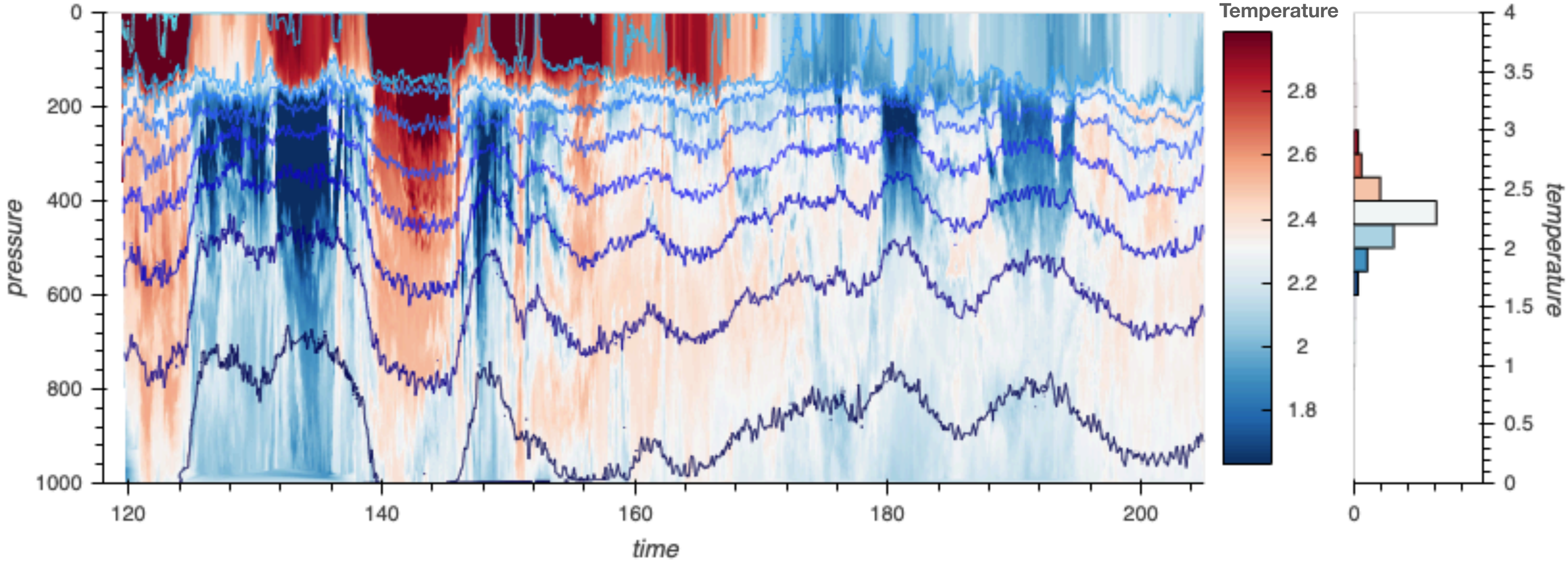




Observations



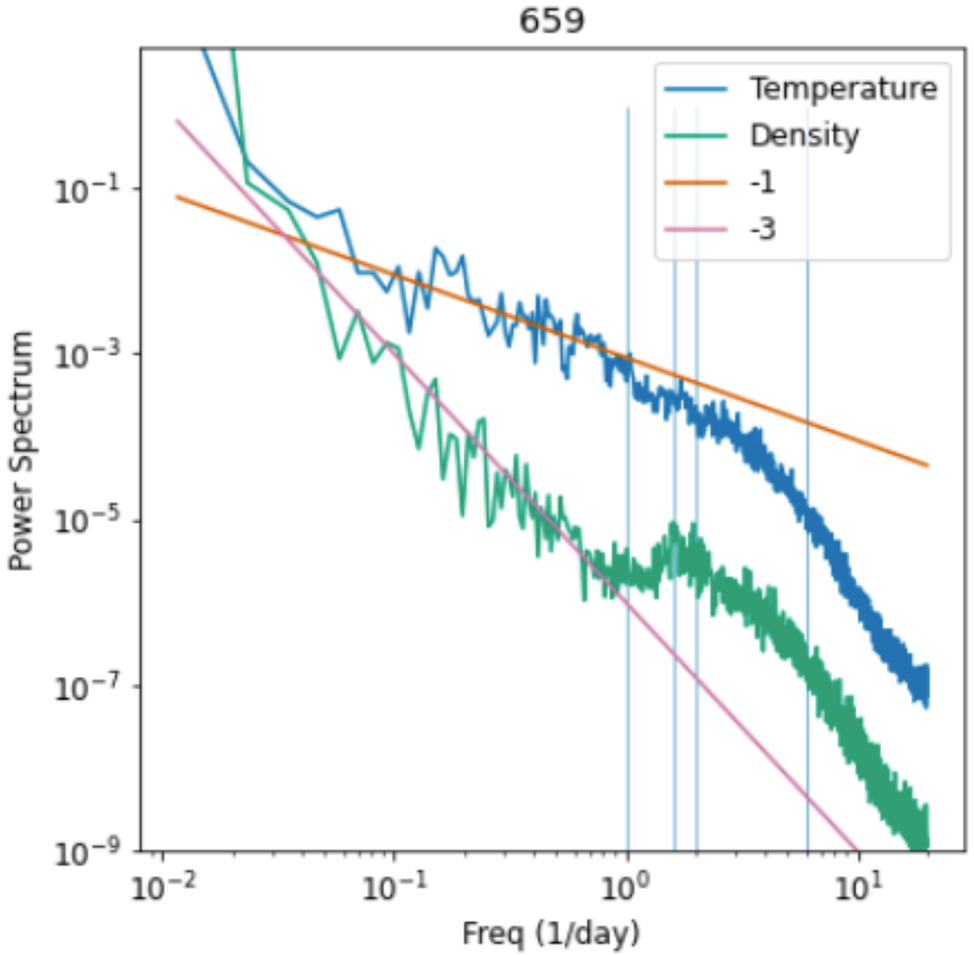


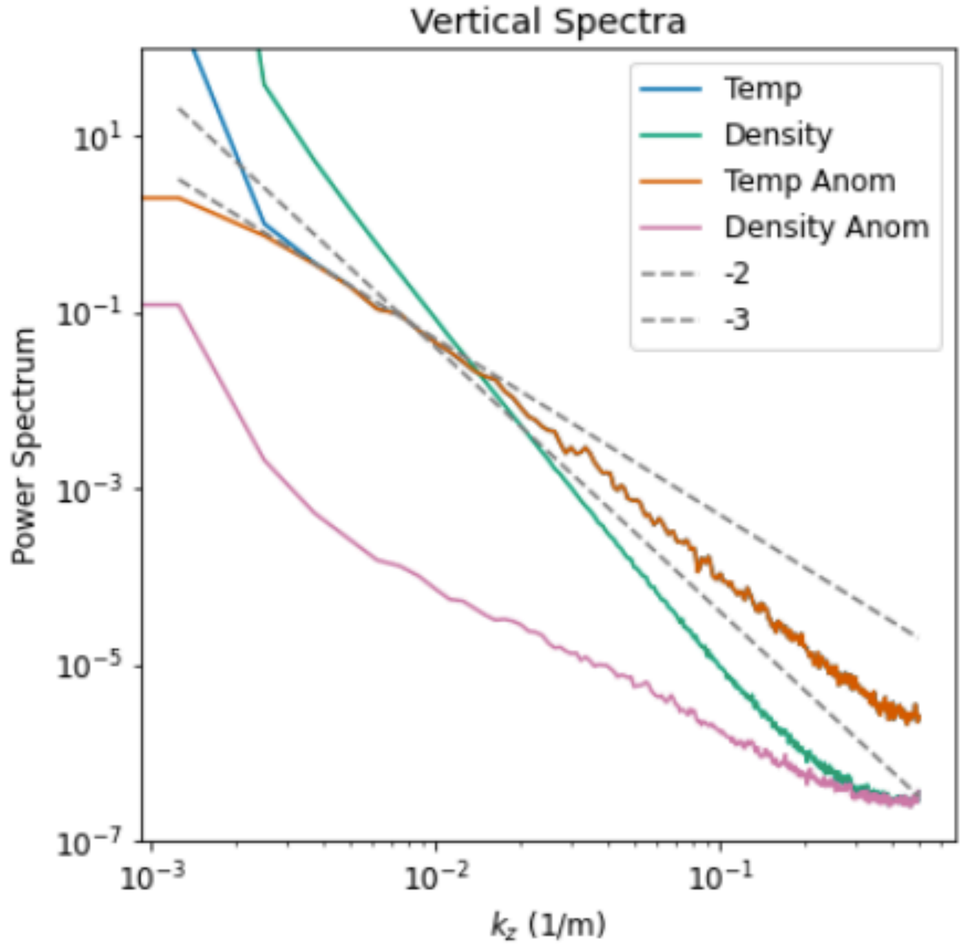


Metrics

- Displacements relative to the mean (mixing length scales)
- Correlation length/time scales (2nd order structure functions)
- Spectra horizontal, vertical, time, etc.
- Filament shapes/ slopes
- PDFs of gradients

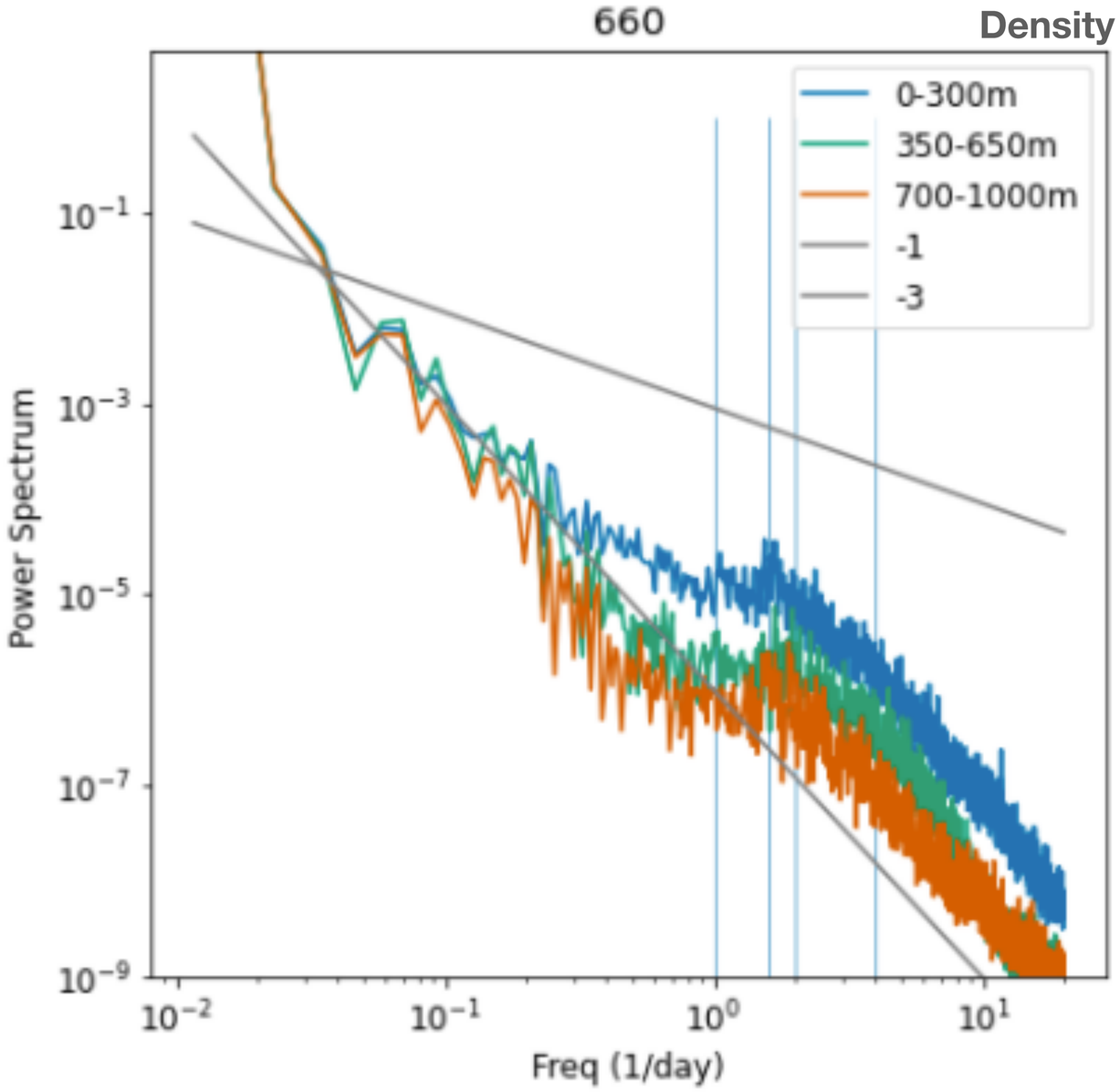
Spectra





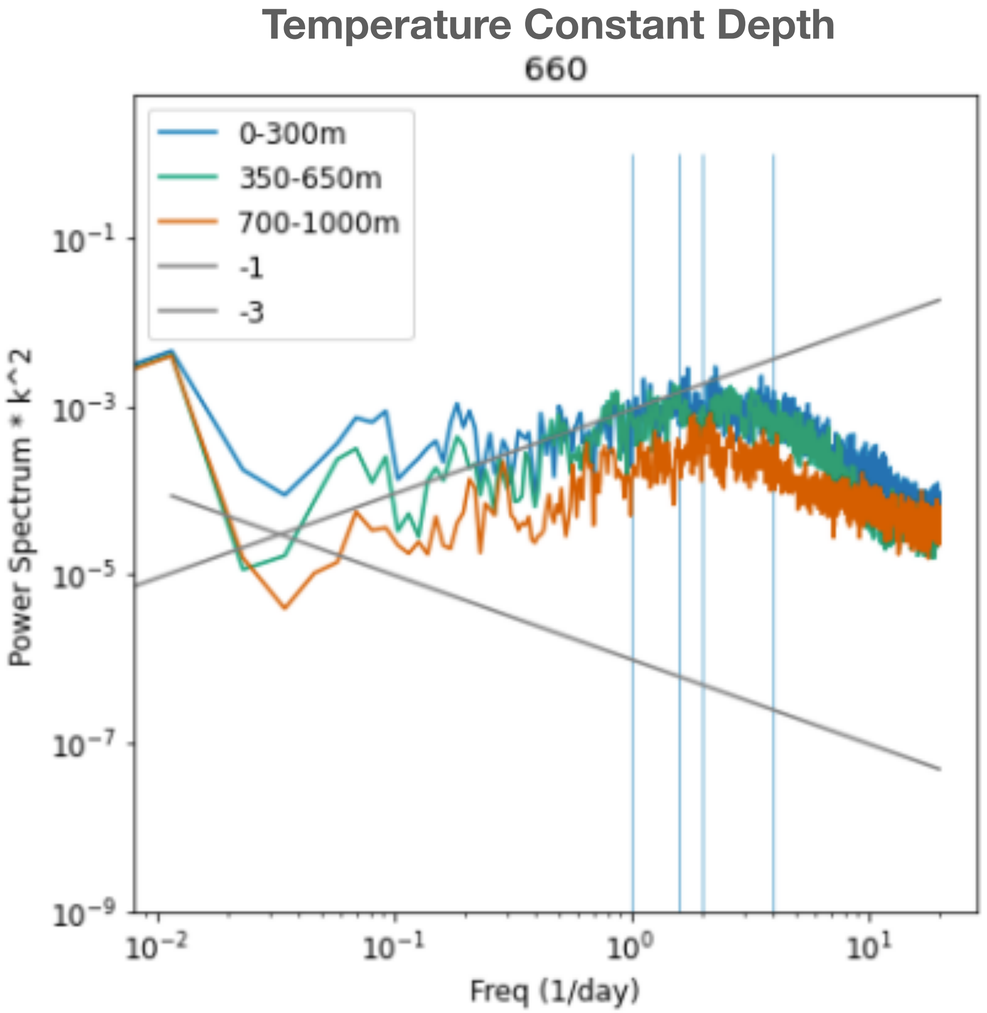
- Flatter temperature spectra, like passive tracers.
- Wave/tide peak in density
- Interesting break in slope at 50-100m in the vertical

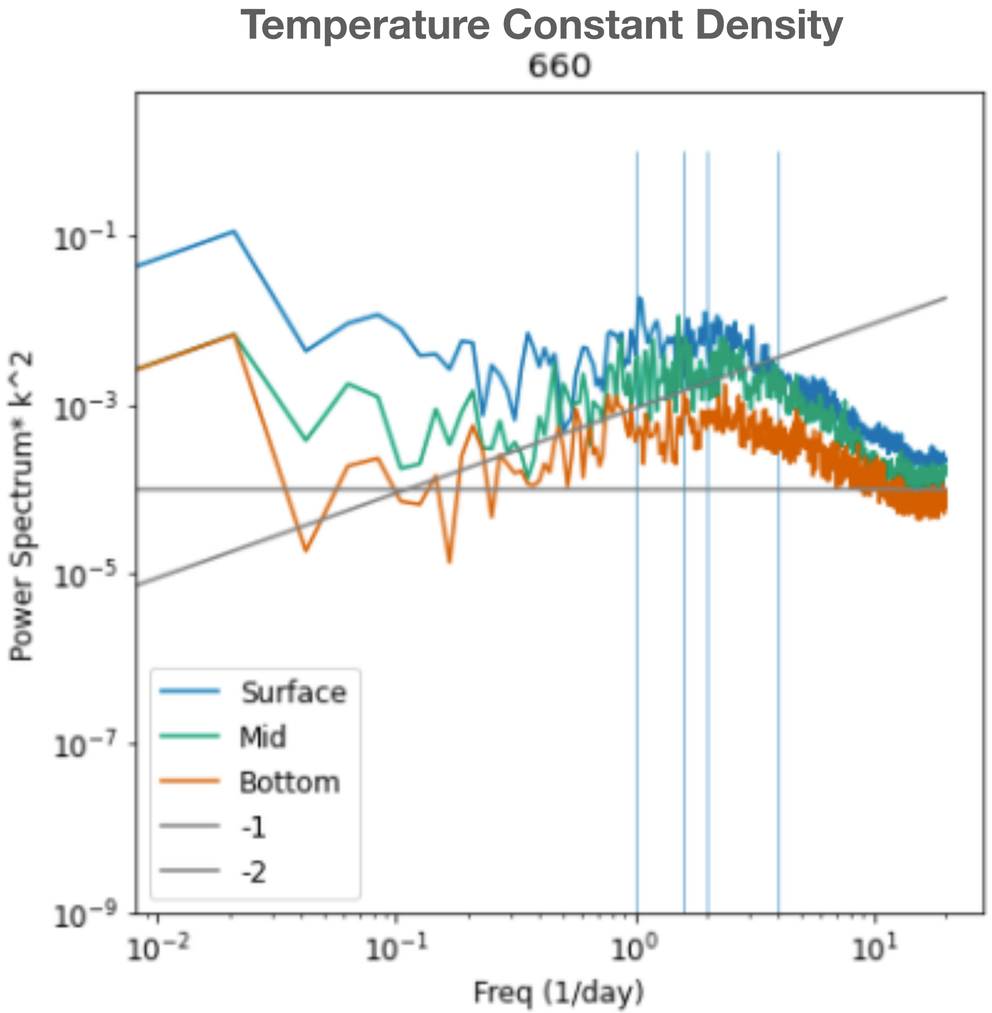
Spectra



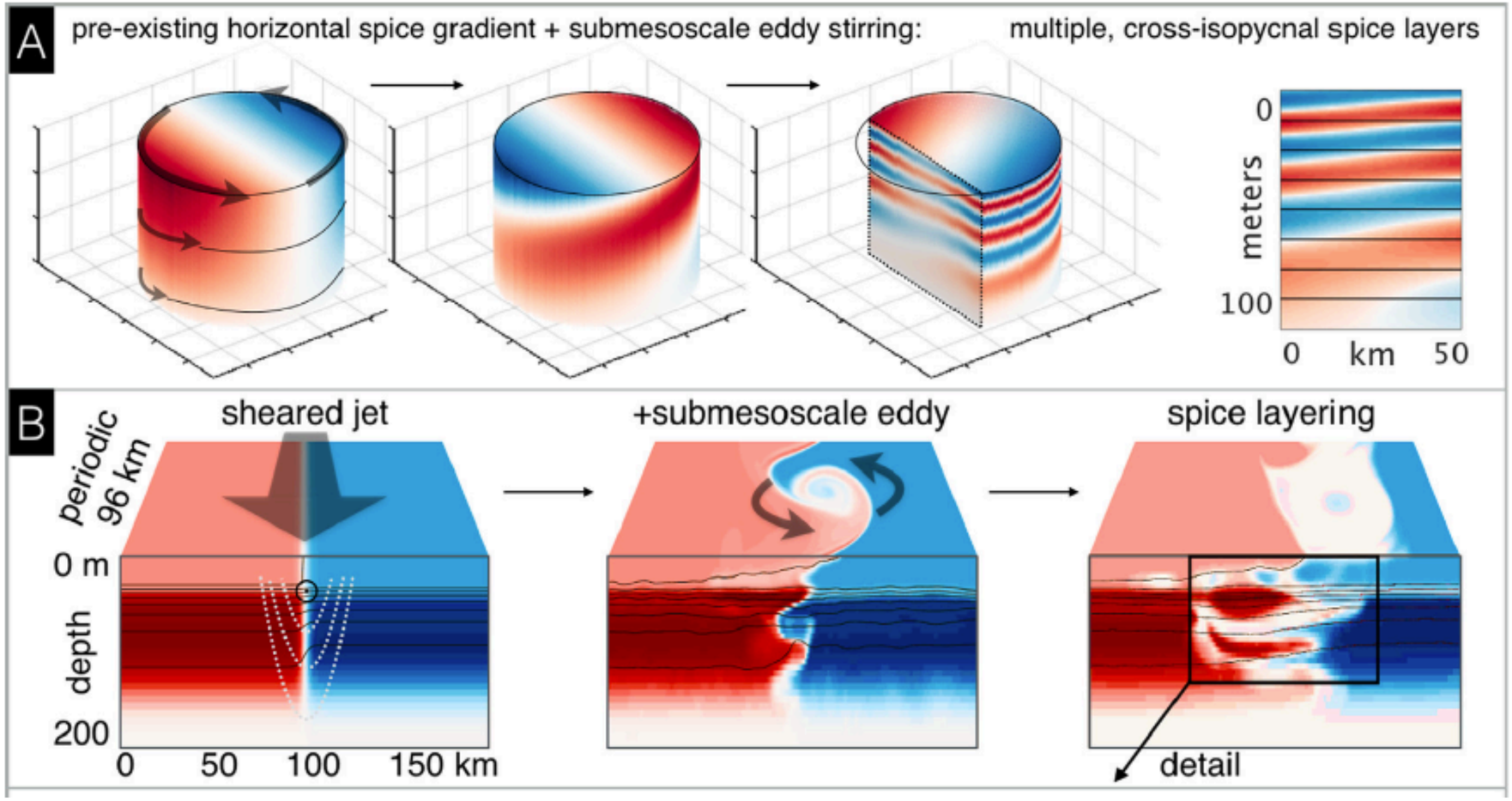
- Wave/tide peak in density at all depths.
- 1-5 day band has more variance near the mixed layer (submesoscales?)

Spectra

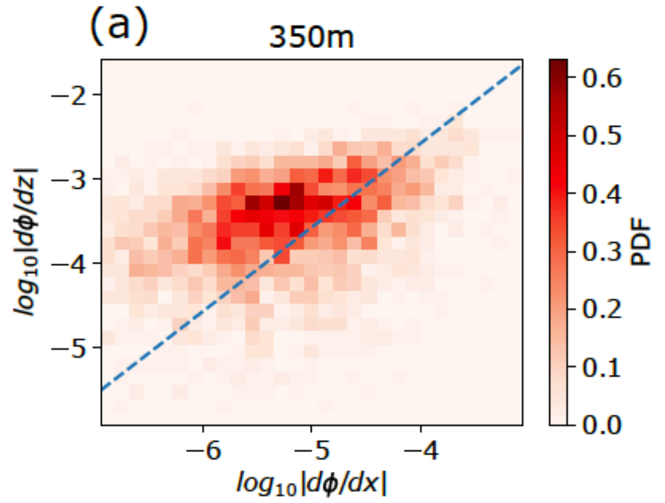

Temperature Constant Depth
660
0-300m
350-650m
700-1000m
-1
-3
Power Spectrum * k^2
Freq (1/day)

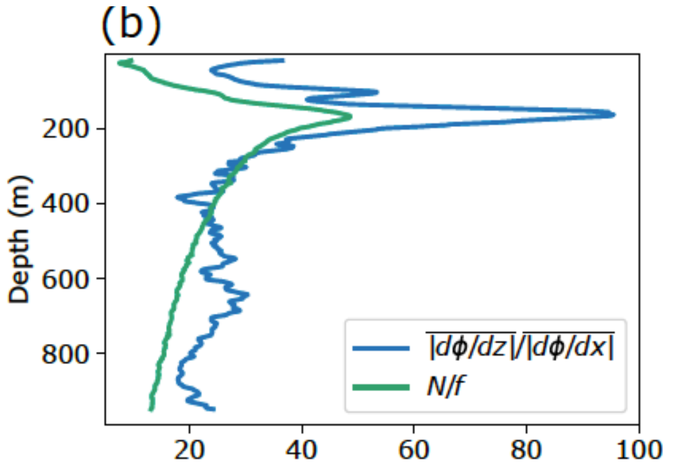

Temperature Constant Density
660
Surface
Mid
Bottom
-1
-2
Power Spectrum* k^2
Freq (1/day)

Filament Shapes/Slopes



Smith and Ferrari 2009, Jaeger et al 2020





Summary

- **Questions -> Observations ->** *Metrics* **->** Answers/stories
- Have some visualization software working to explore details
- Identified metrics
- Some interesting results in spectra
- Working on calculating other metrics and interpretation.