A fleet of miniature, neutrally buoyant, floats

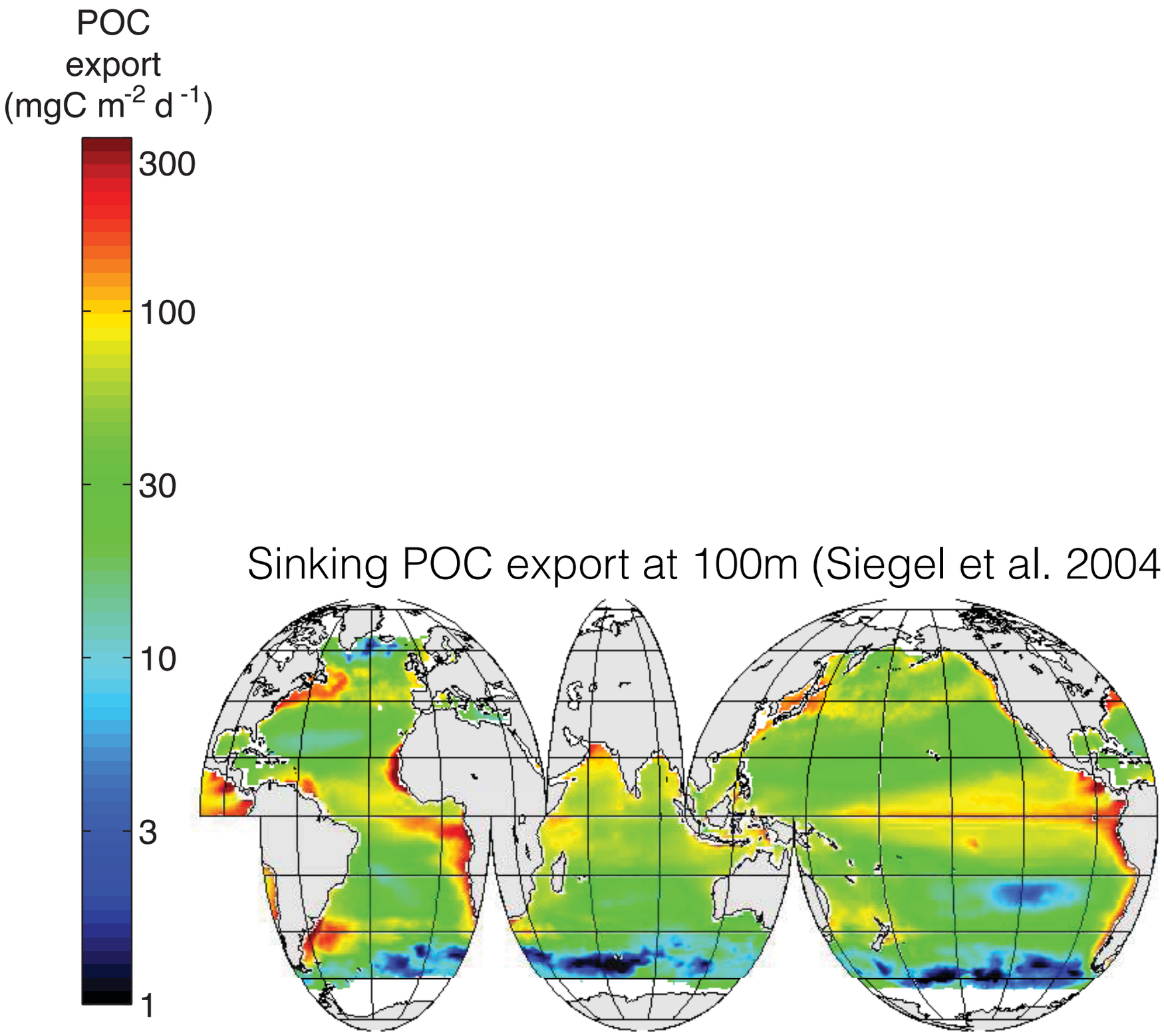
alternate title:

Eddy-driven subduction and sinking of POC….
…and a proposal on how to observe this.

Melissa Omand, URI
Collaborators: Tom Rossby (URI), Ken Buesseler (WHOI)

thank you to MBARI for float data and hosting!

WBCs are biological pump hot-spots..



Sinking POC export at 100m (Siegel et al. 2004)

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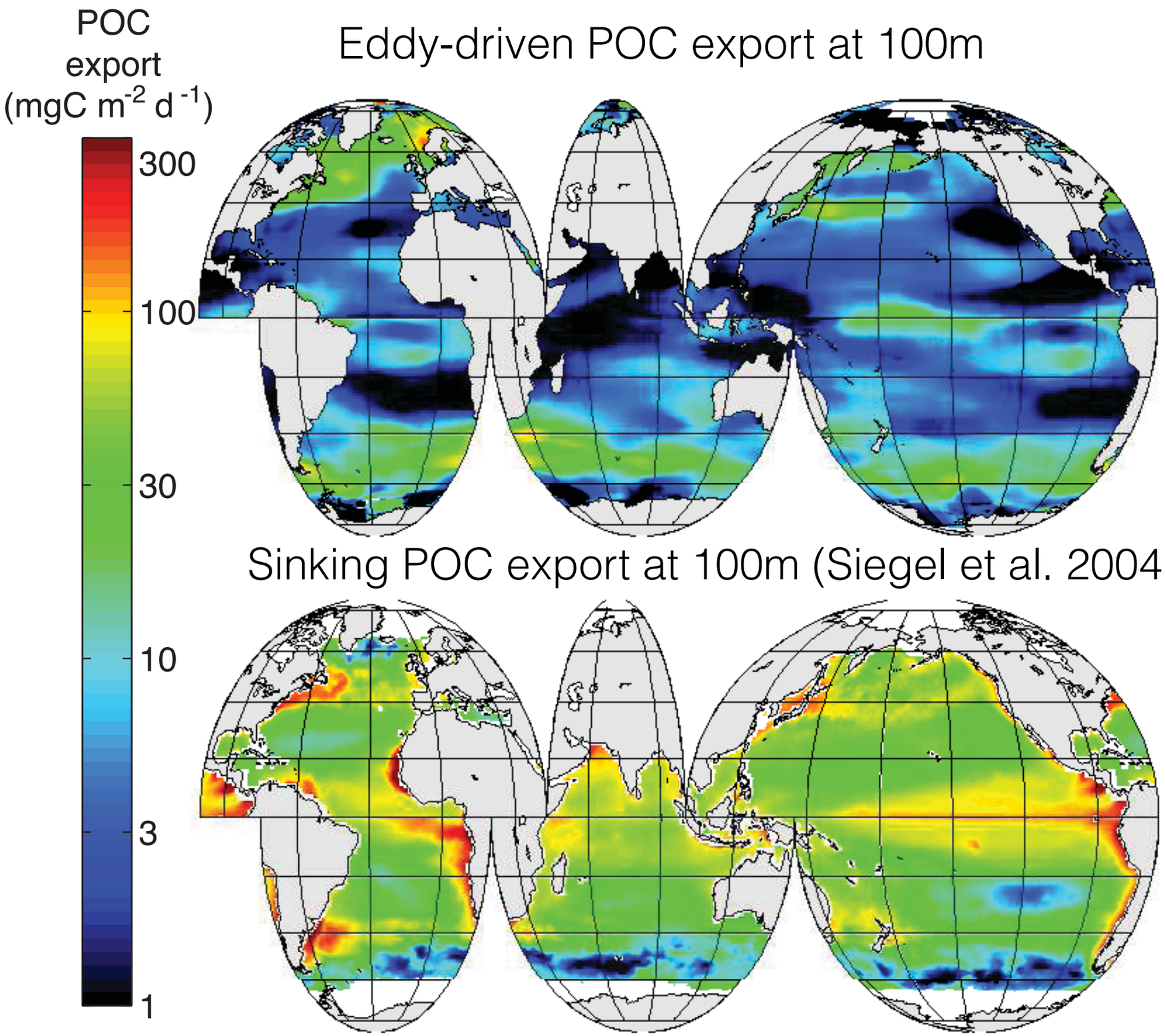


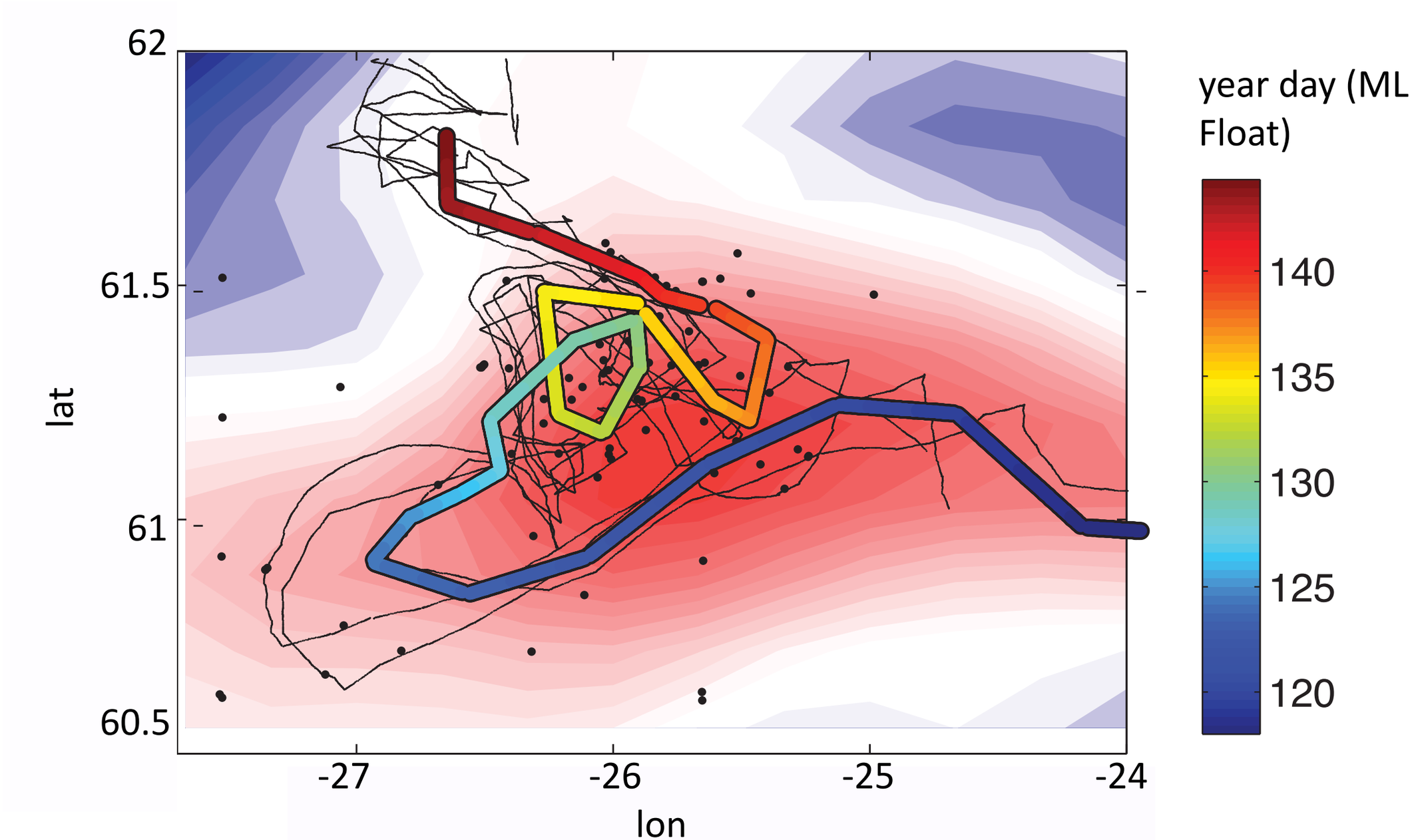
(Omand et al. 2015)

..and regions of enhanced "Eddy-driven Subduction"

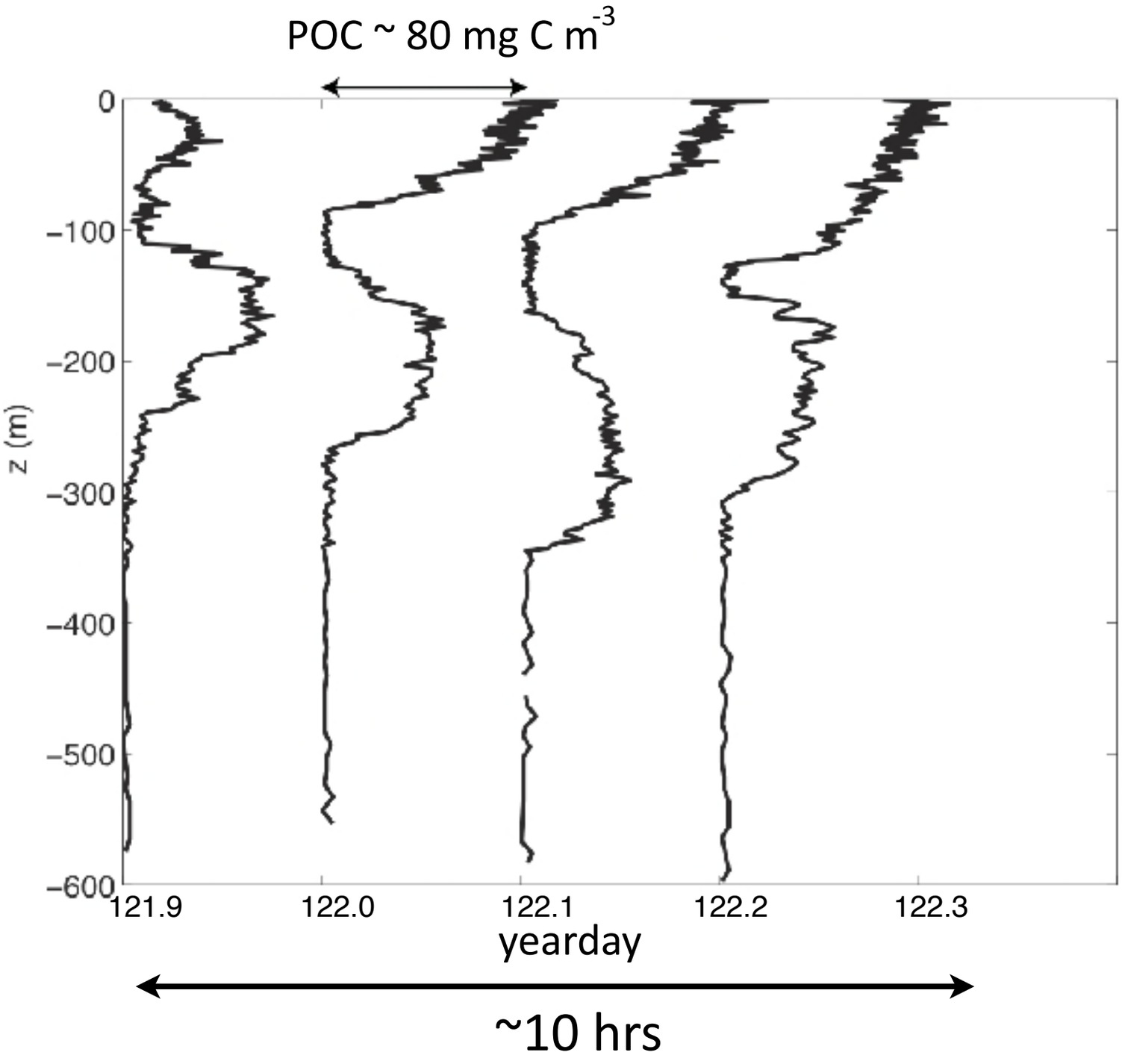
= meso- and submesoscale processes that mix POC along tilted isopycnals

The North Atlantic Bloom experiment motivated this parameterization

A Lagrangian ML float (colored track) and 4 float-following Seagliders (black lines) were entrained in an anticyclone. Black dots are ship-based CTD profiles.



Many Seaglider profiles and CTD casts had subsurface features in optical/BGC properties. ~800 were individually examined for evidence of local, lateral subduction.



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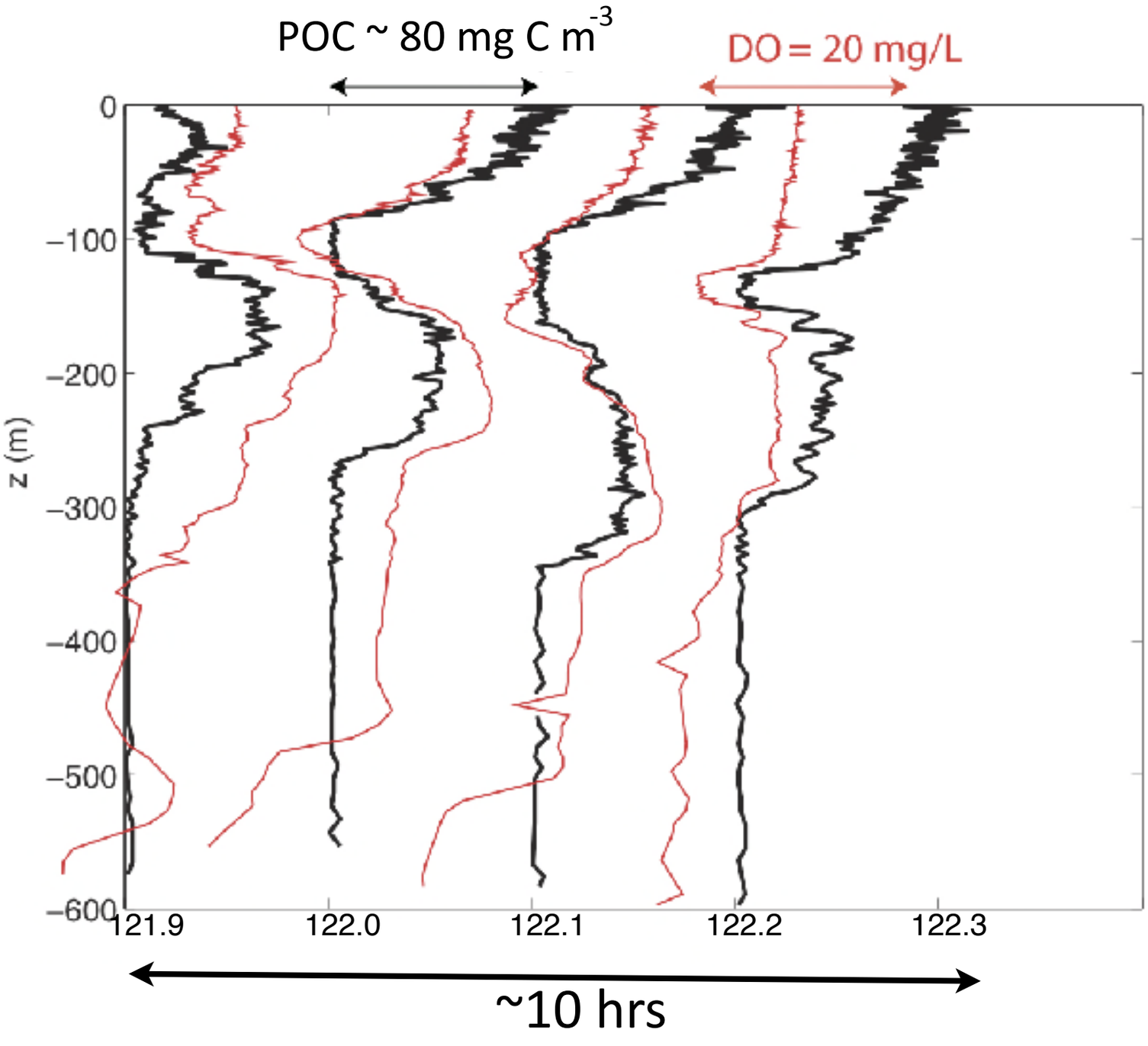

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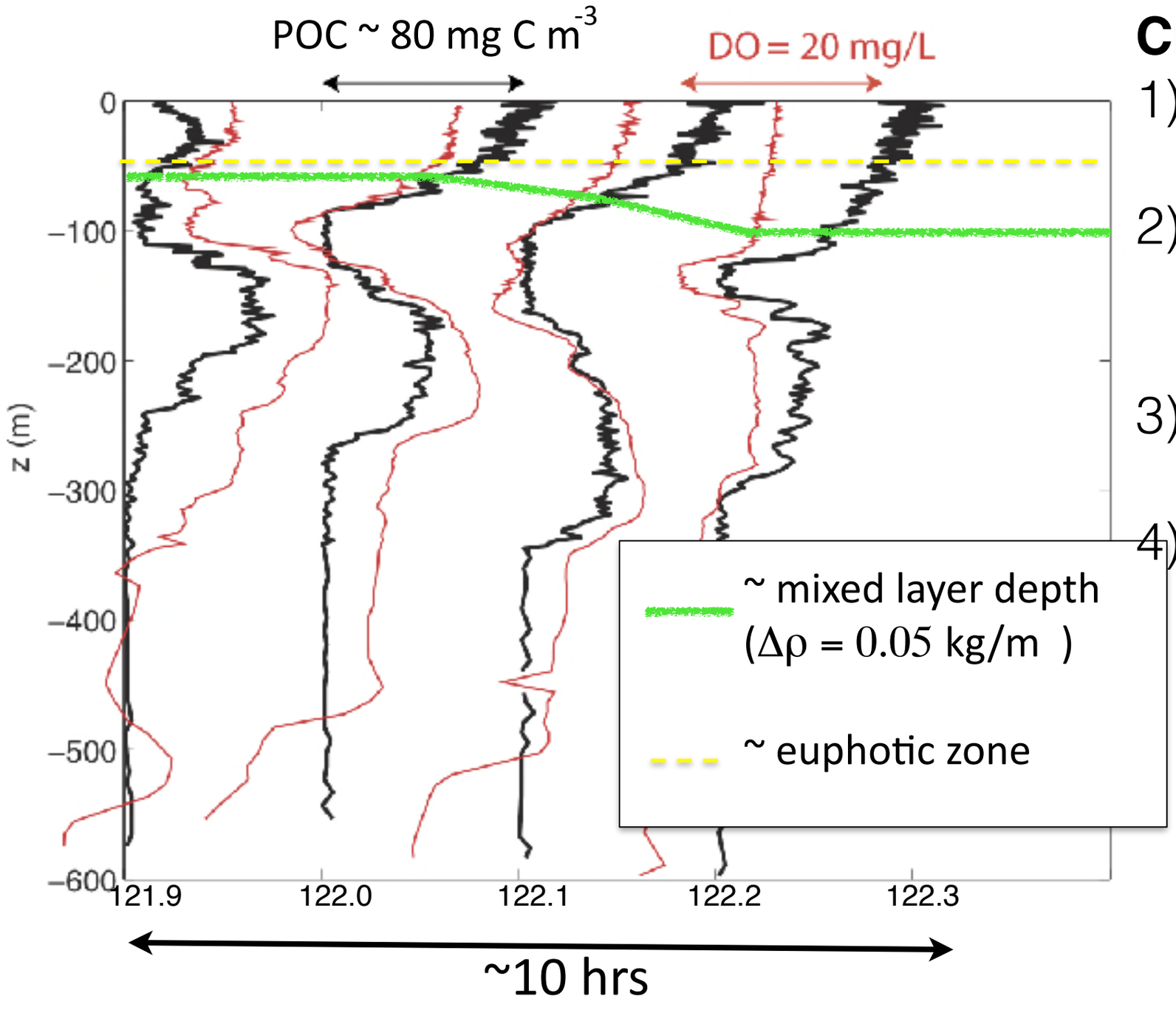

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3) Occurring below the MLD and euphotic zone
4) Unique T-S characteristics from the water above and below

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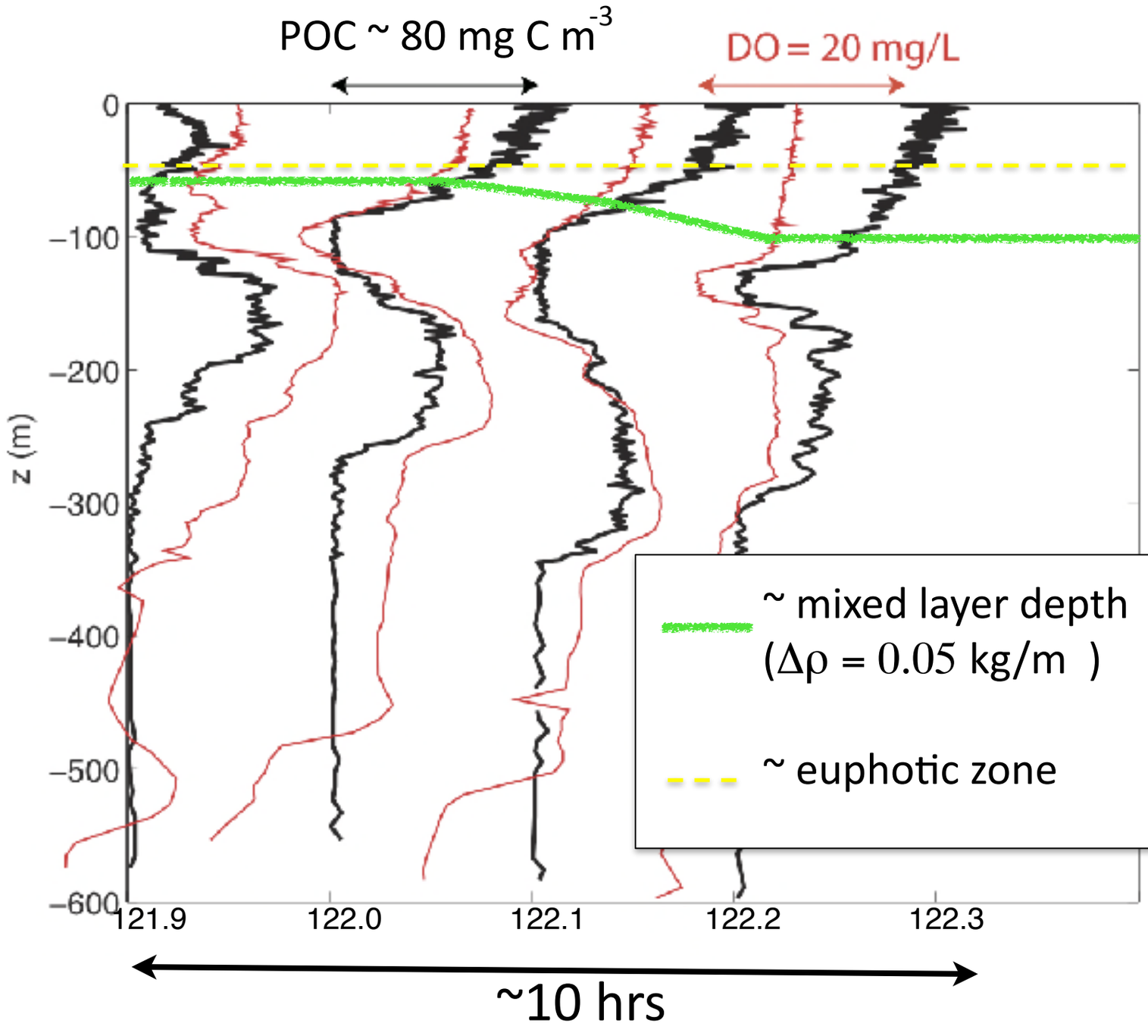

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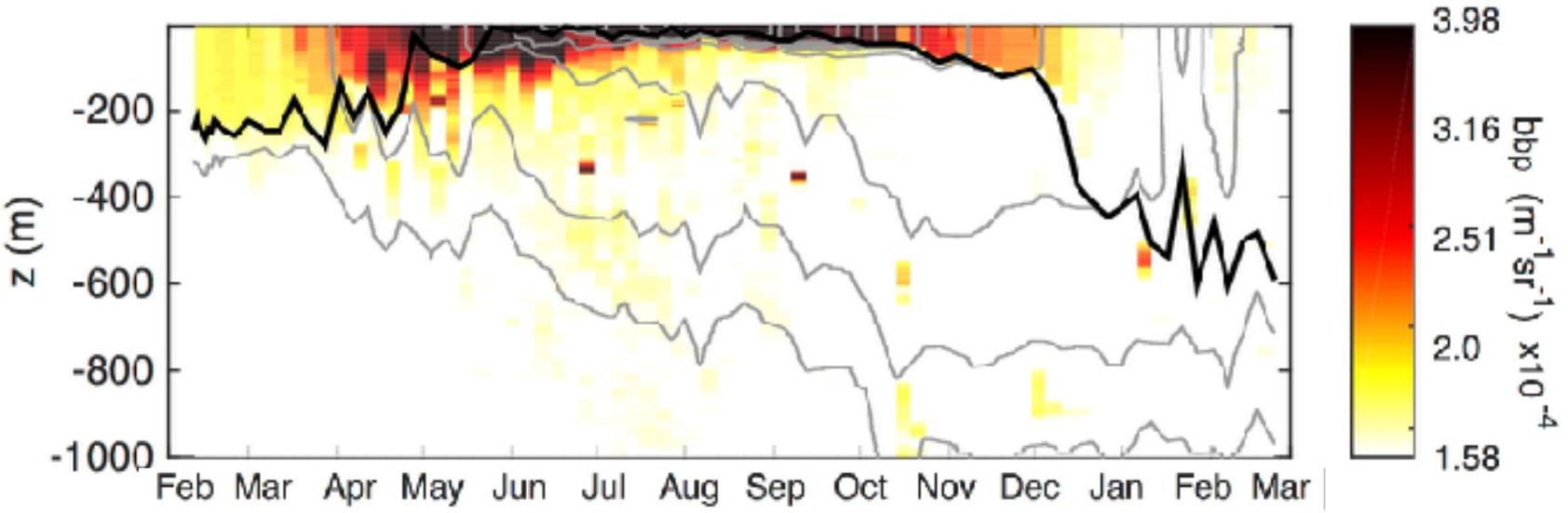
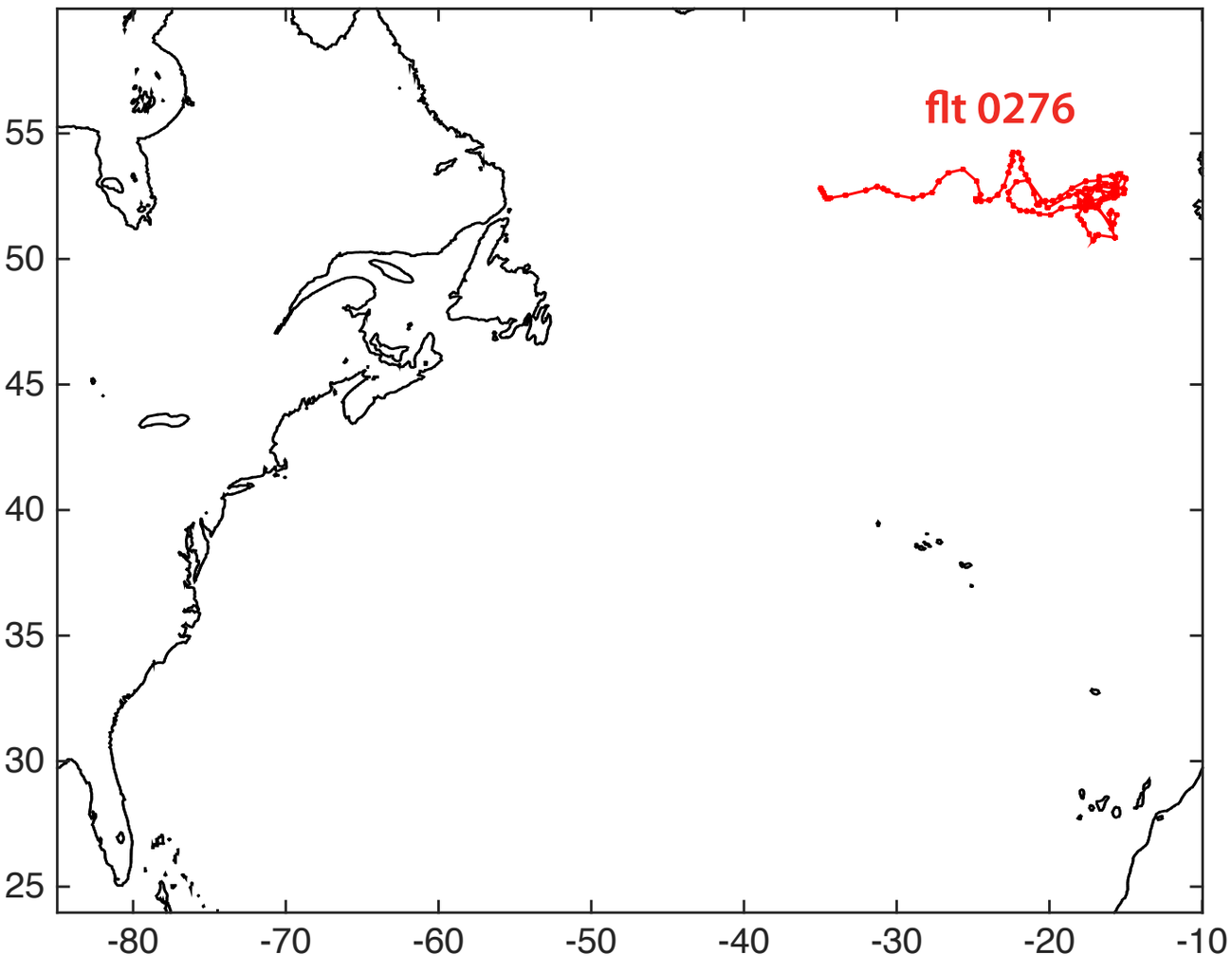
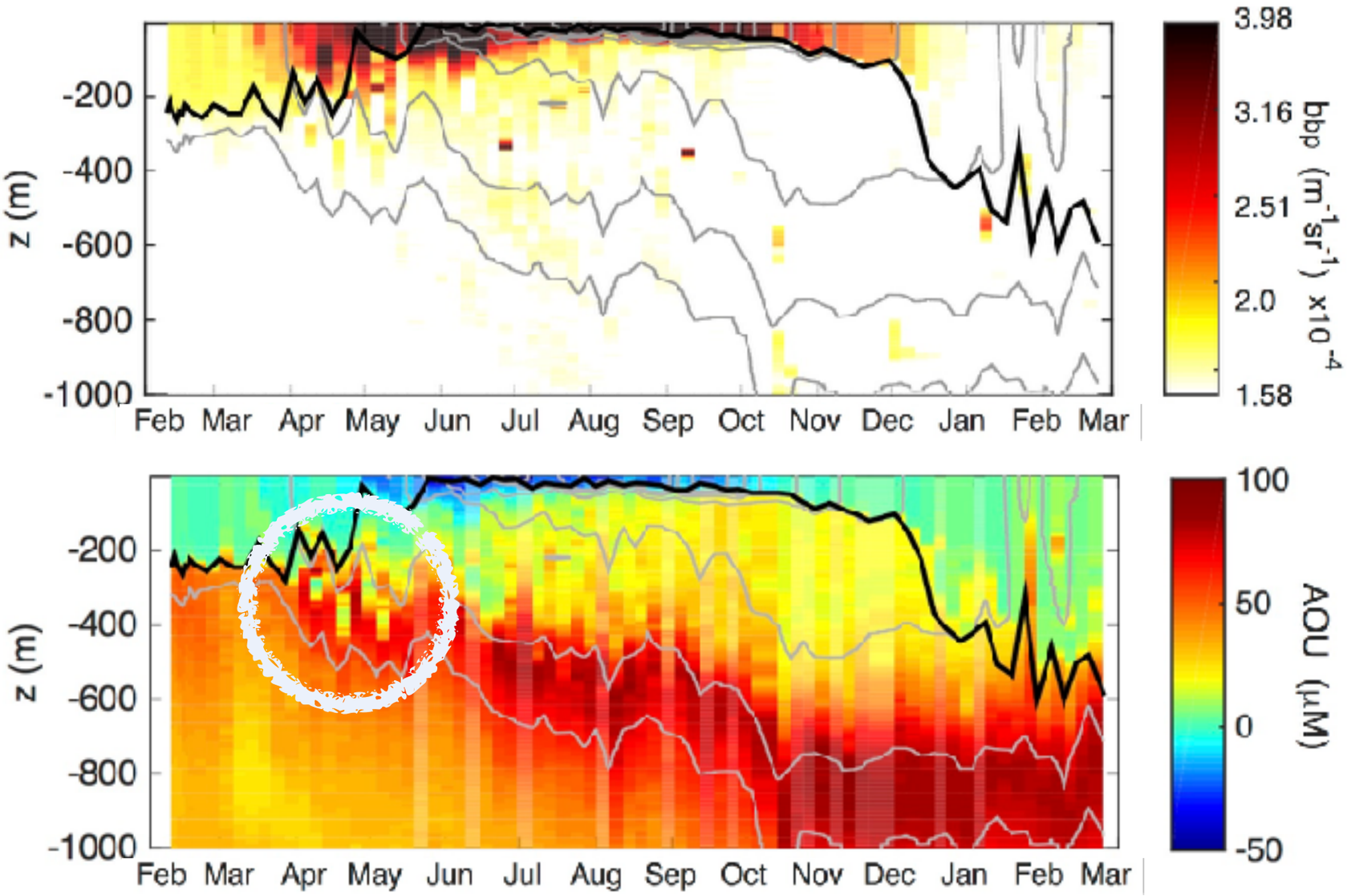
10% of profiles had evidence of local subduction.





Flt 0276:
Lots of subsurface features in bbp (a POC proxy) during and after the spring bloom…. following isopycnals.



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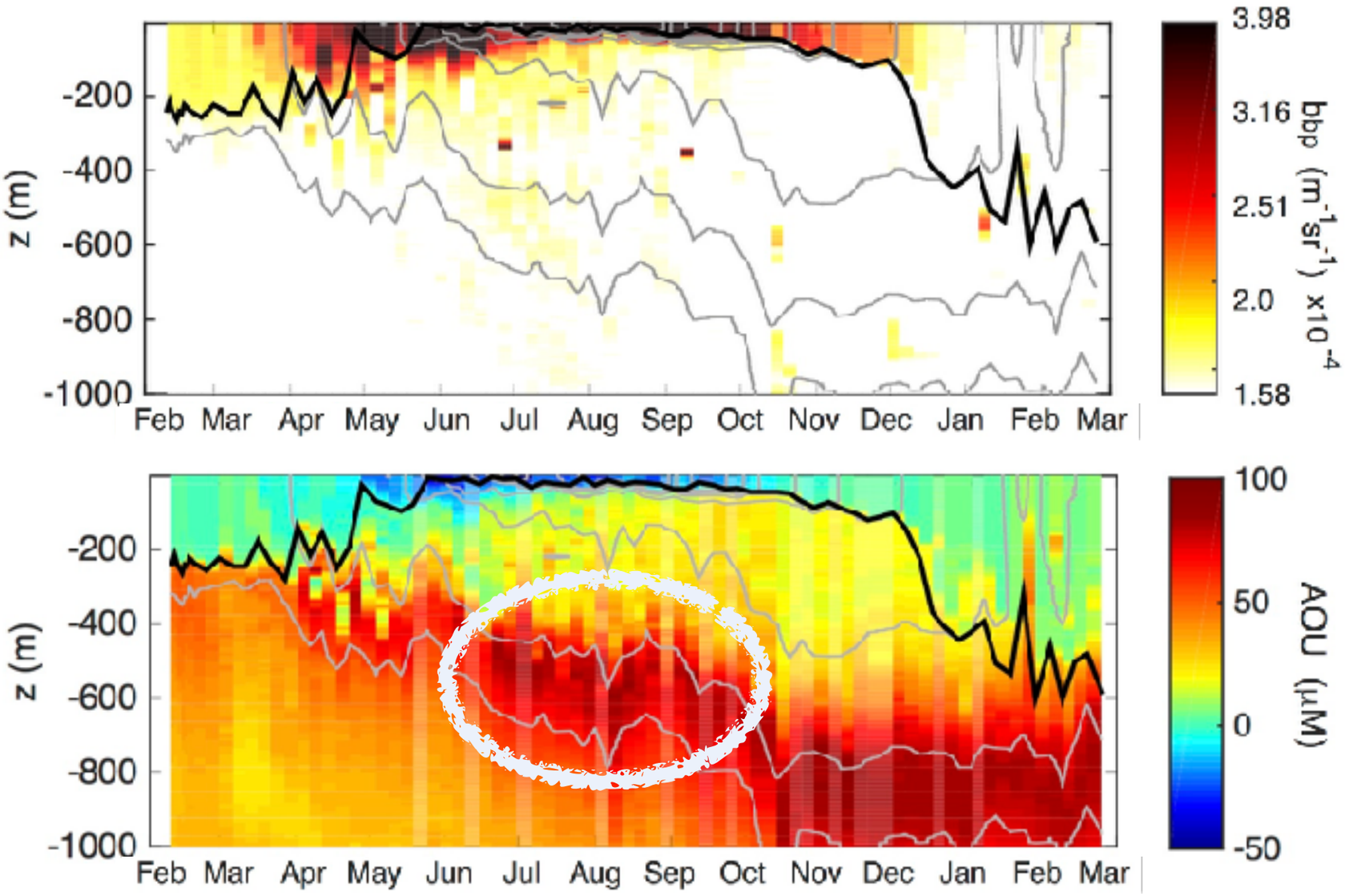

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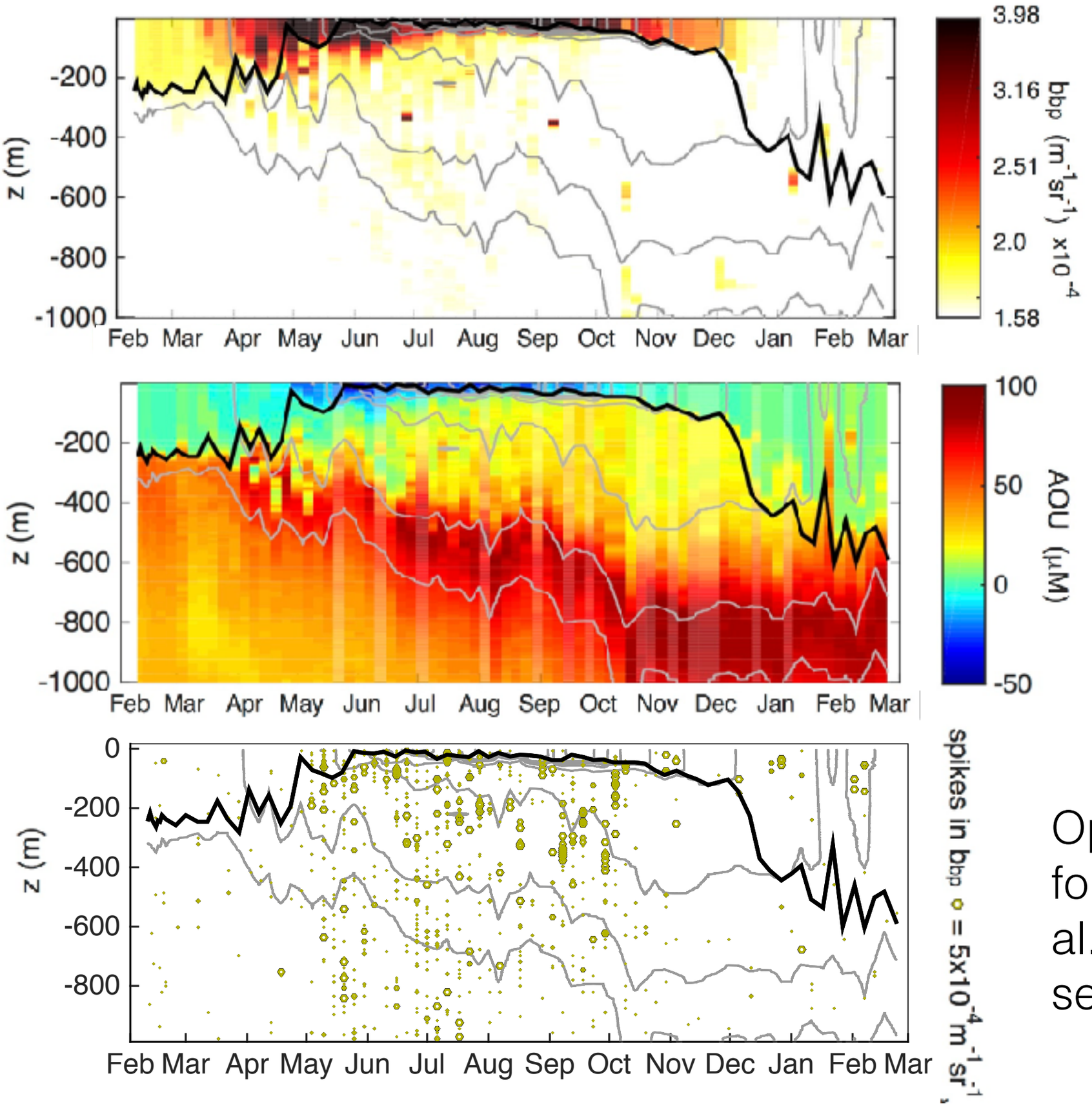

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Optical spikes (a proxy for aggregates, Briggs et al. 2011) also shows a seasonality.

Summary

1) **Evidence of eddy-driven subduction was apparent in the 10% of the data (and model) during NA spring**

2) Consistent features were also seen in the NA STMW formation region (but we need floats with bio-optical sensors there!)

3) Eddy-driven subduction is inherently along-isopycnal. Other processes, slow sinking or lateral transport are required for longer sequestration

4) Fleets of inexpensive Lagrangian floats could be useful for understanding the statistics and fate of subducted water and sinking particle characteristics

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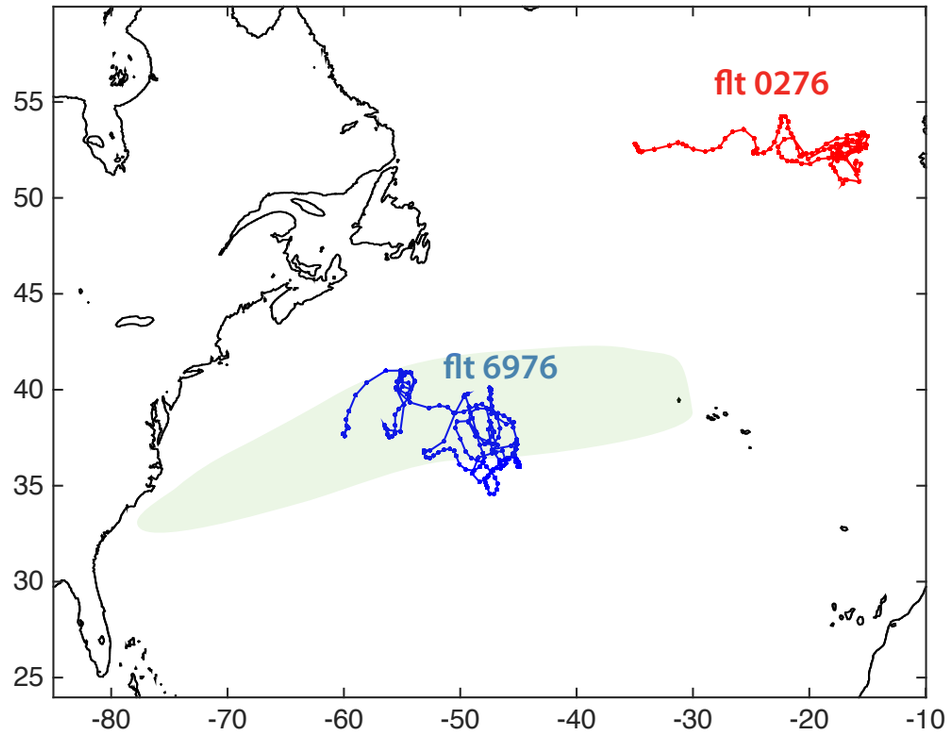
As does a float from the NA STMW formation region.



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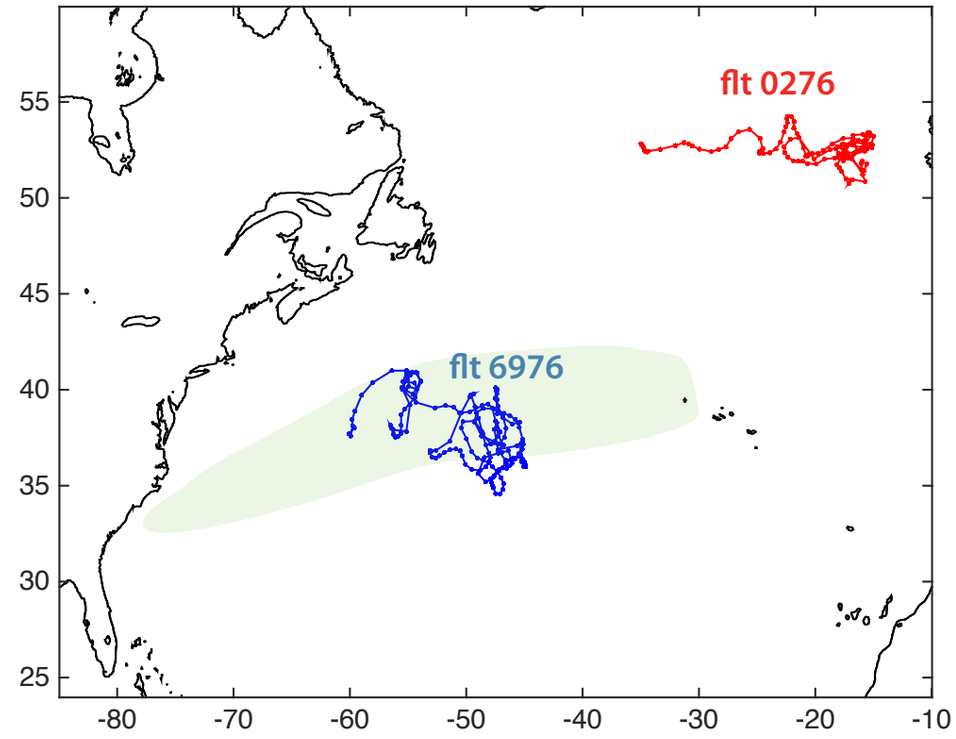

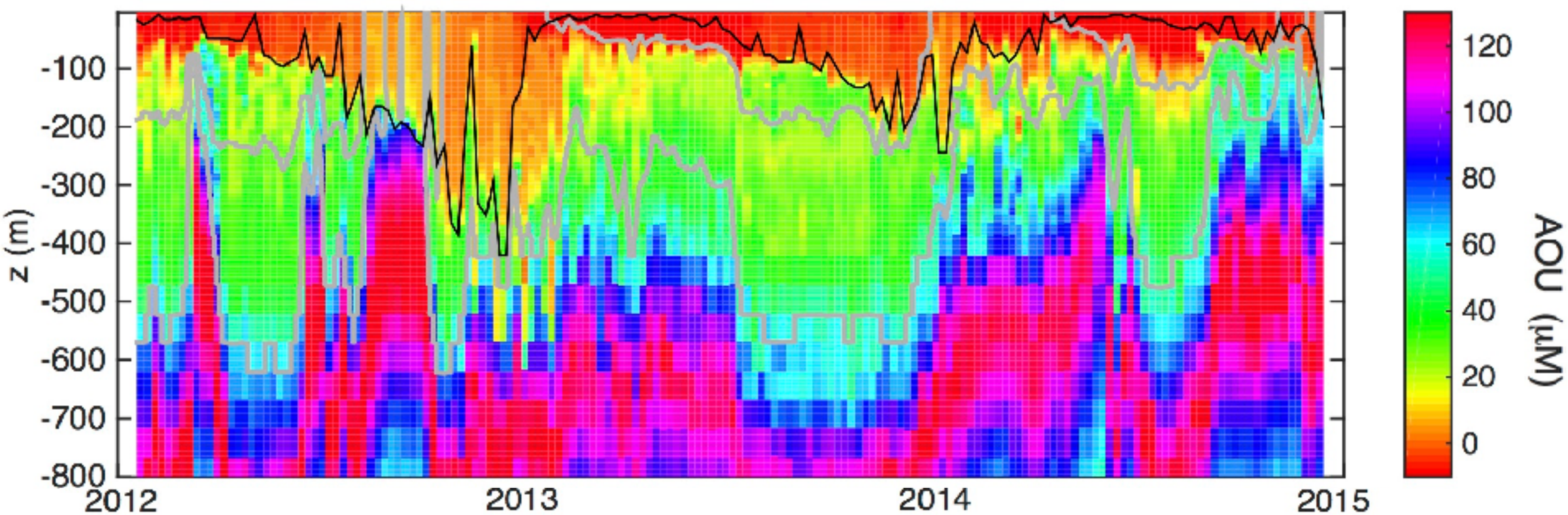

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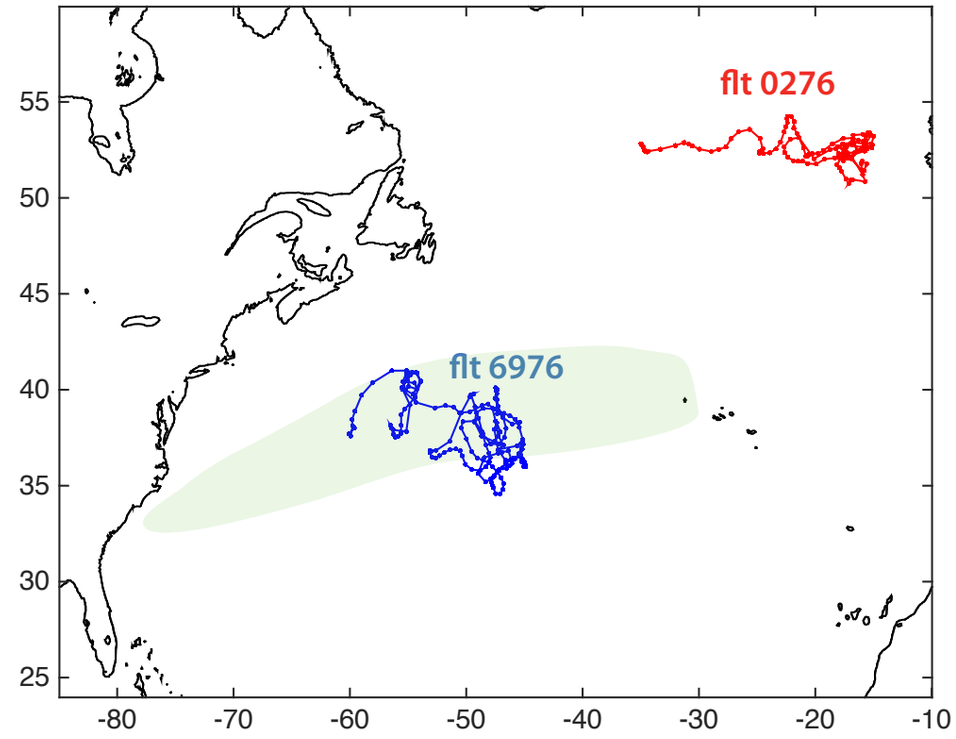

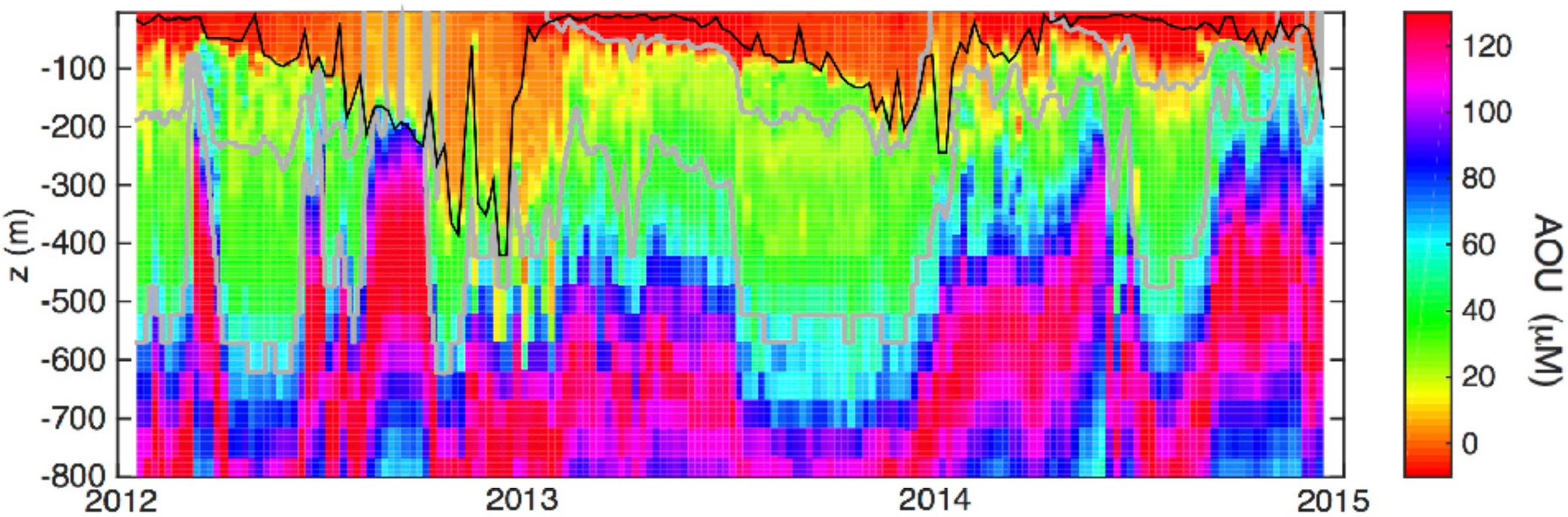

Eddy-driven subduction is likely pervasive, but its effect on a net annual export remains poorly understood.

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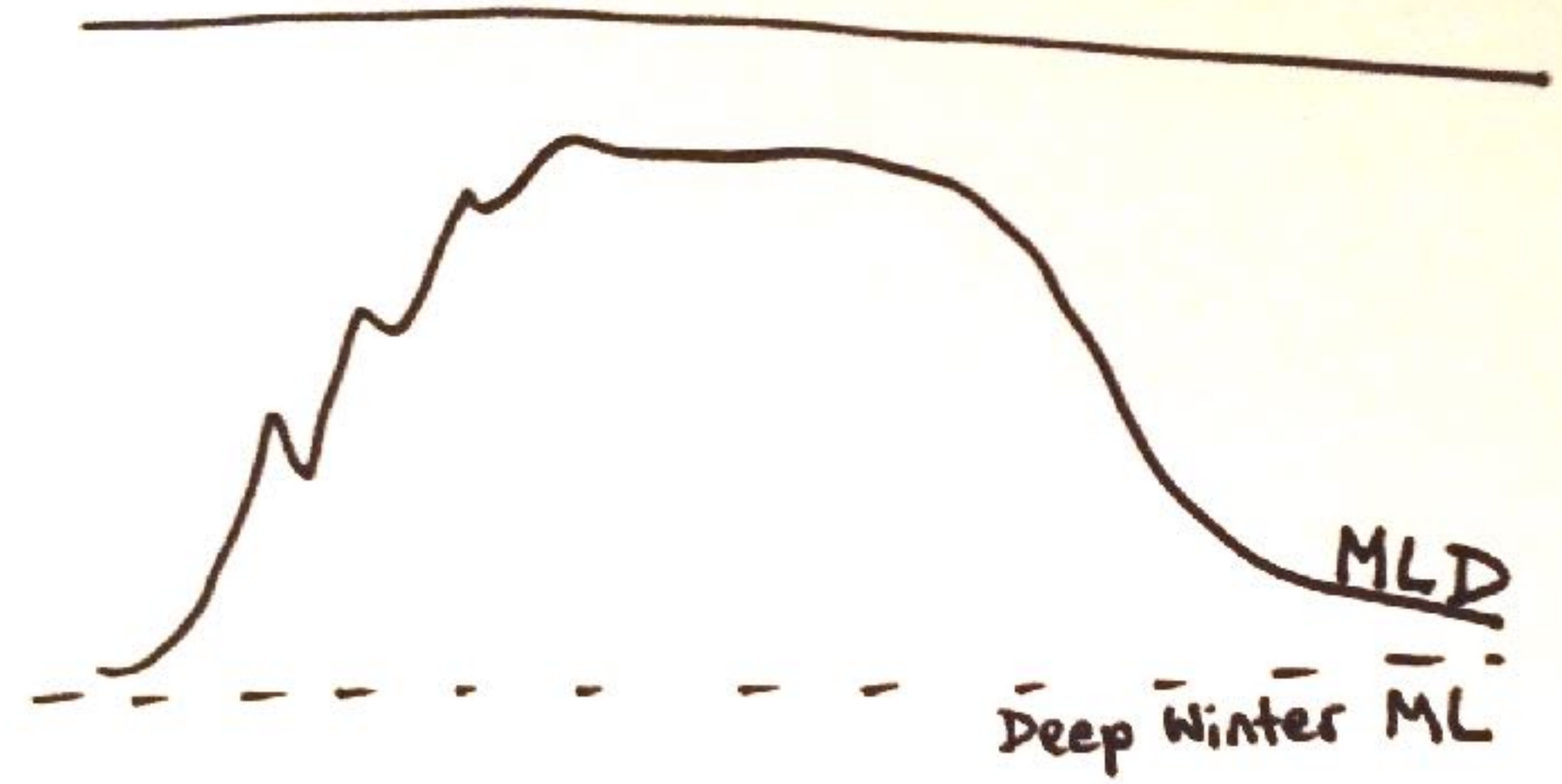
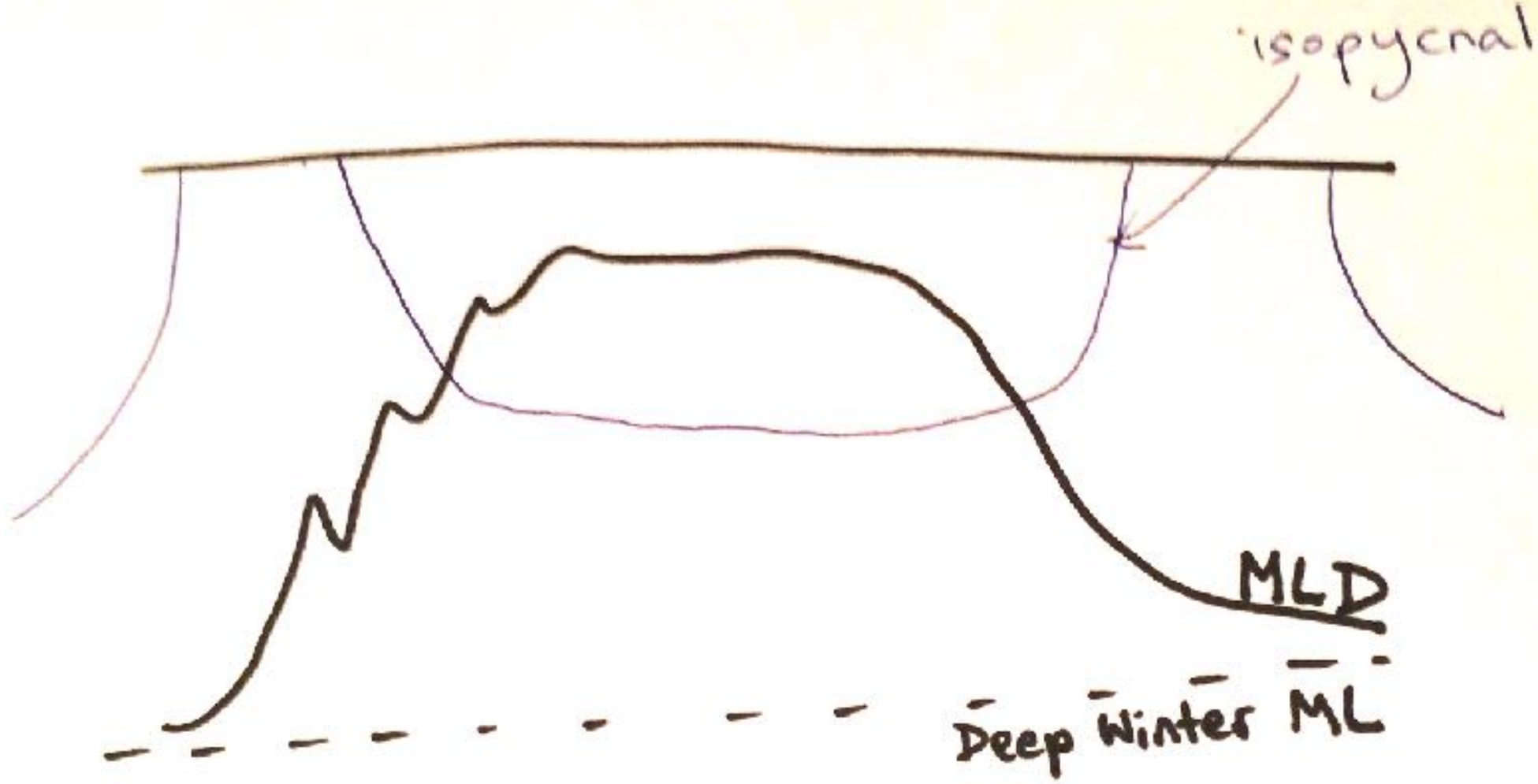


A seasonal cycle with a deep winter mixed layer



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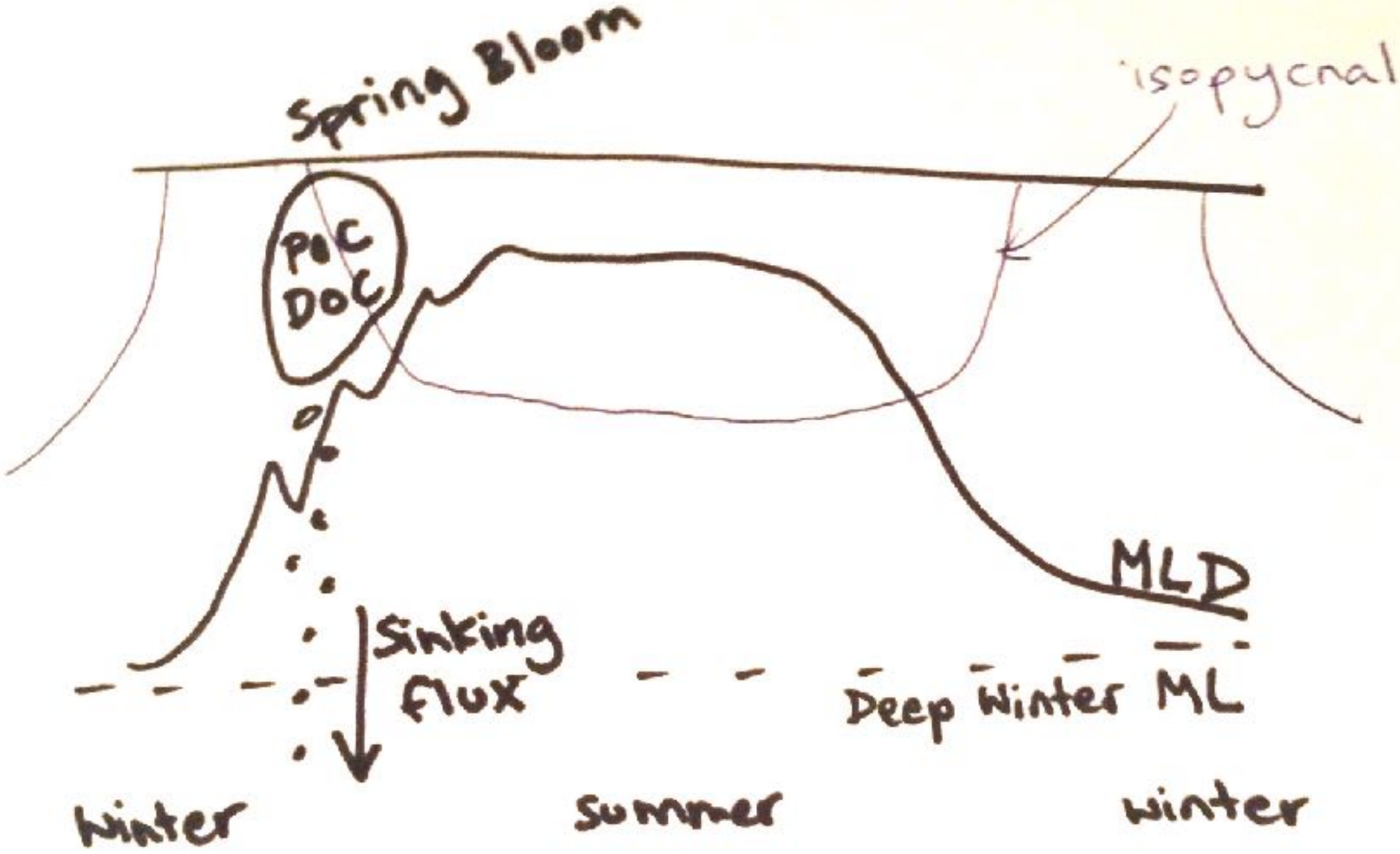
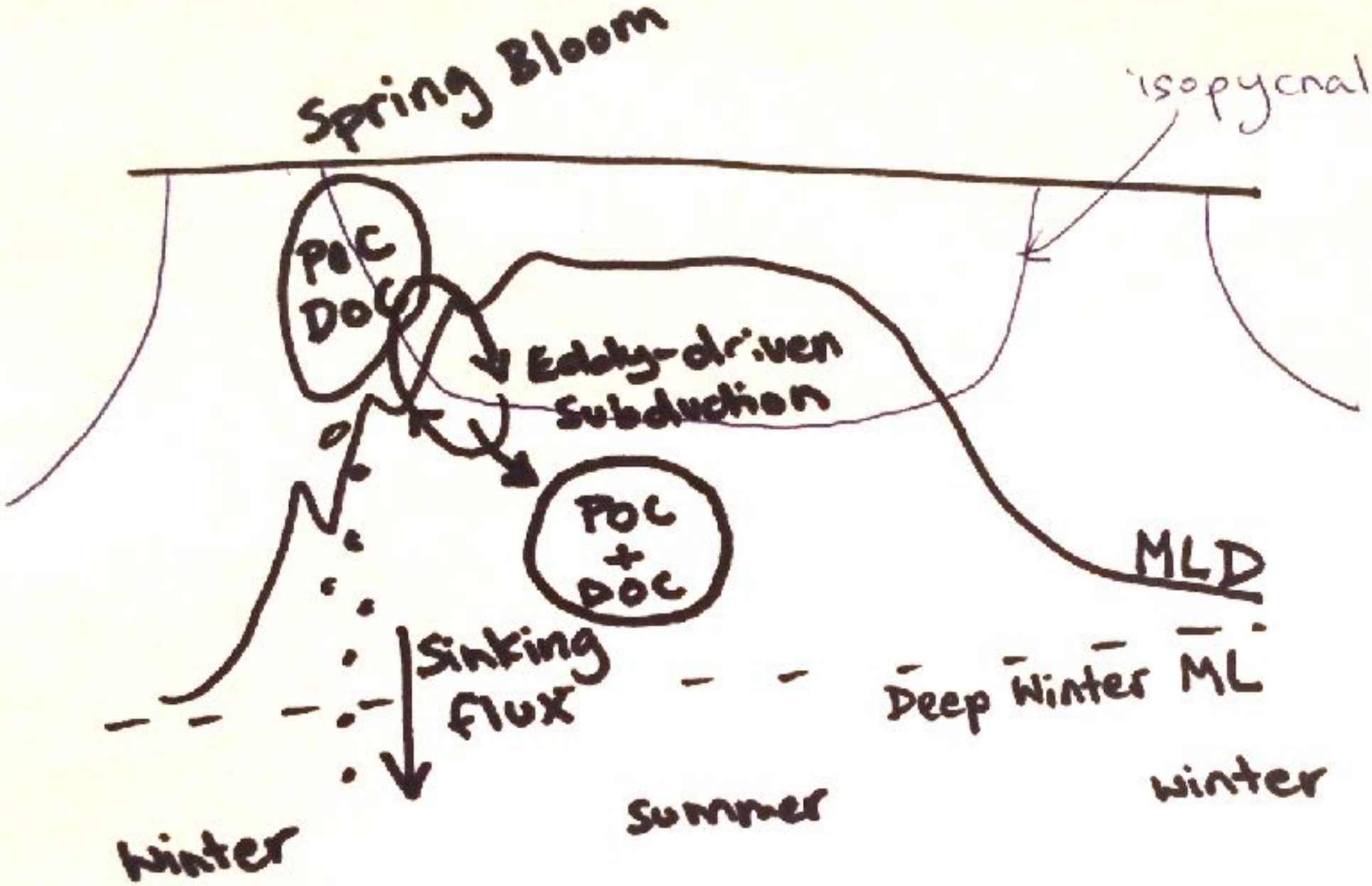
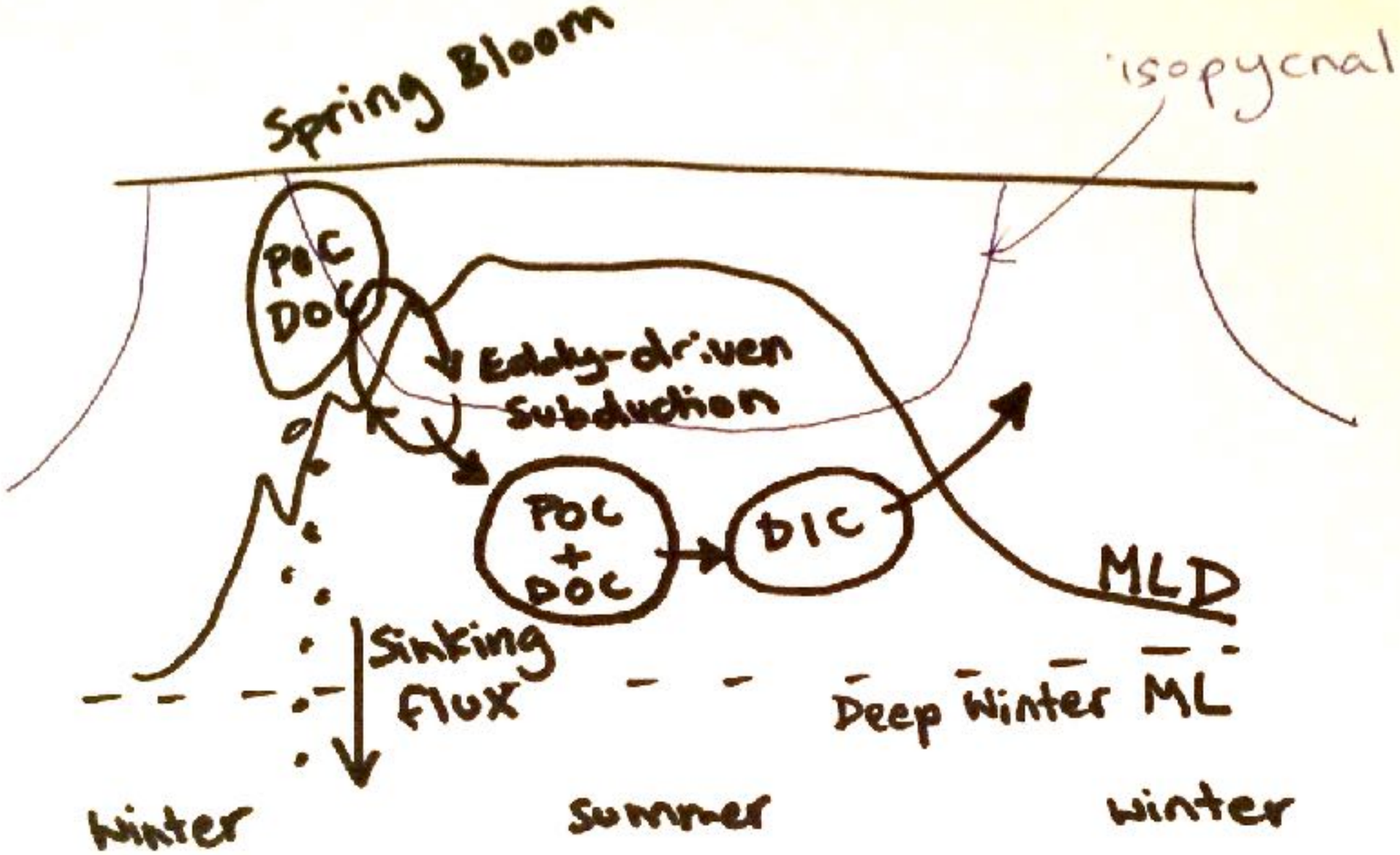


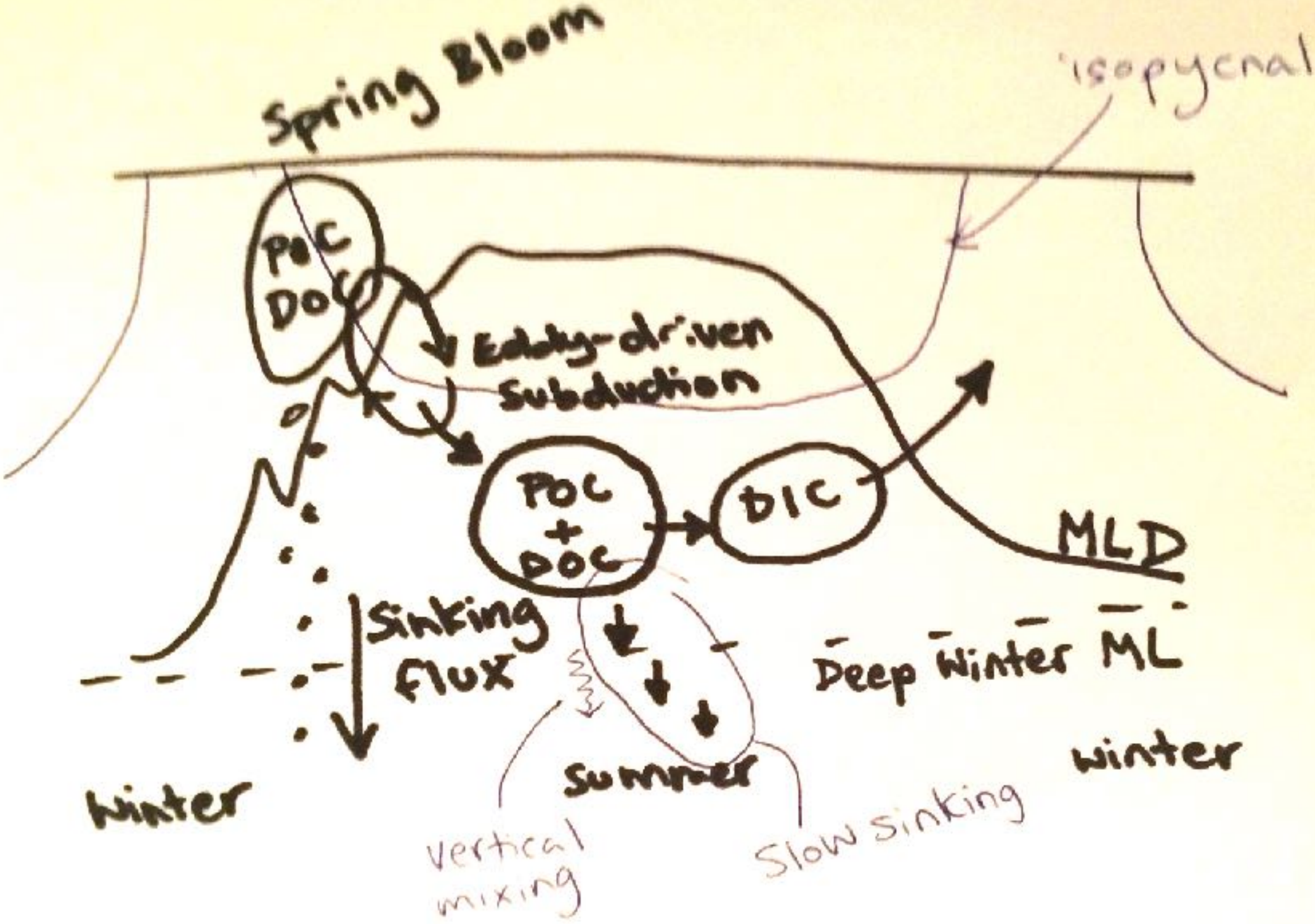
We get a spring bloom and some of the POC sinks



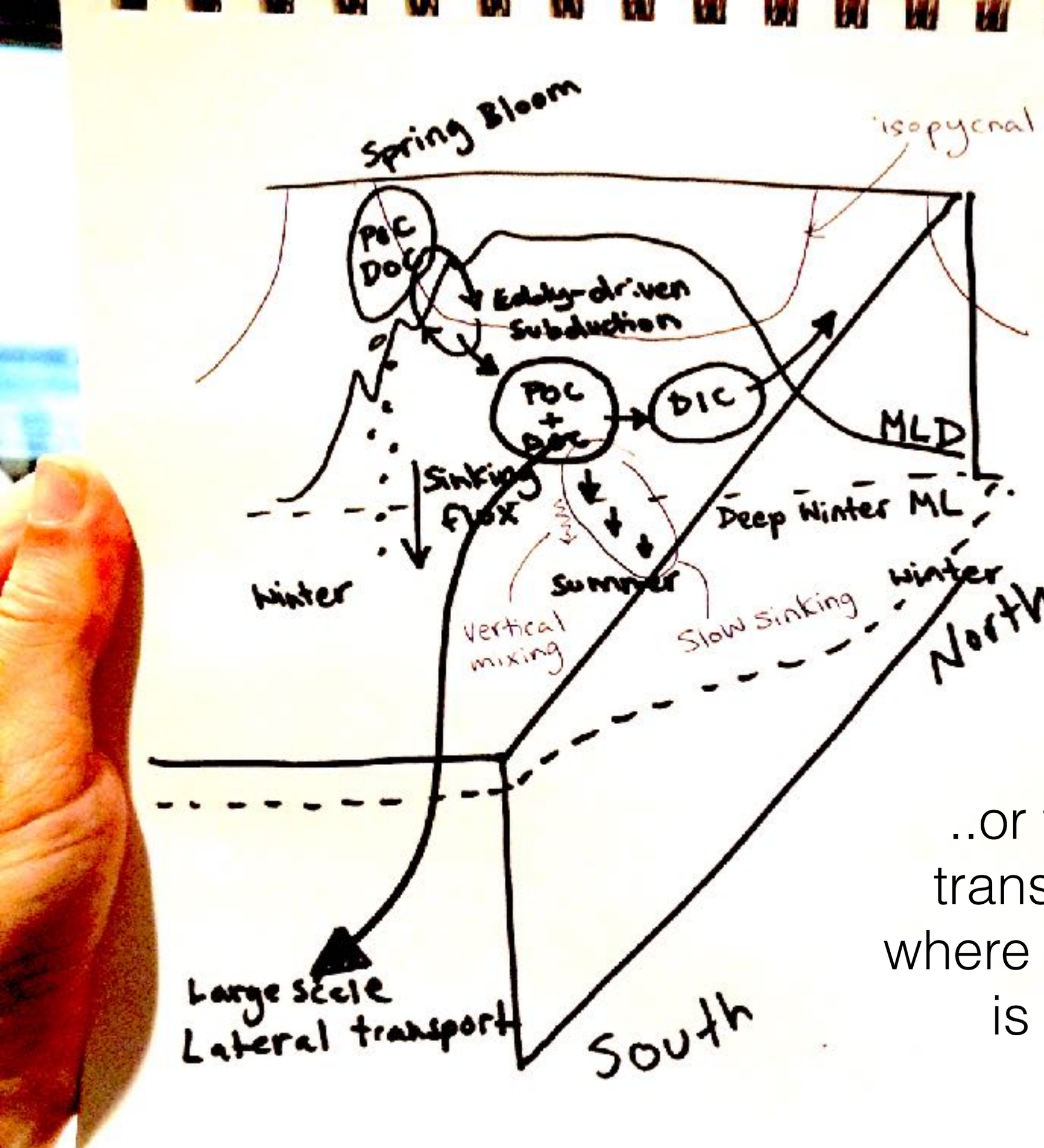
Eddy-driven processes also transfer POC & DOC along isopycnals where they are trapped below the restratifying ML.



The POC is remineralized back to DIC.
Much is re-entrained into the ML the following winter.

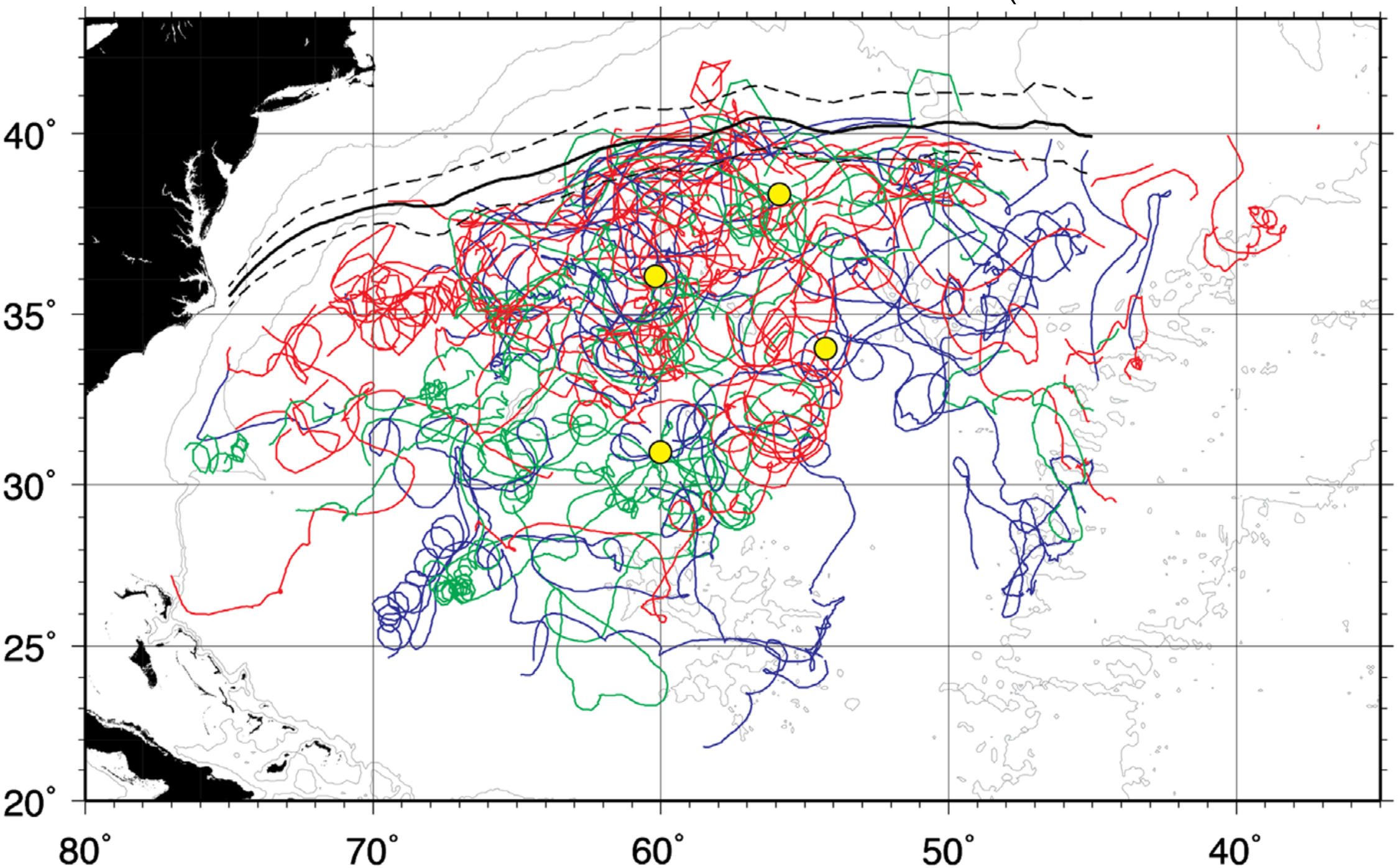


Longer-term sequestration could happen through diapycnal mixing, slow sinking, particle transformations..



..or through lateral transport to regions where the winter mixing is not so deep.

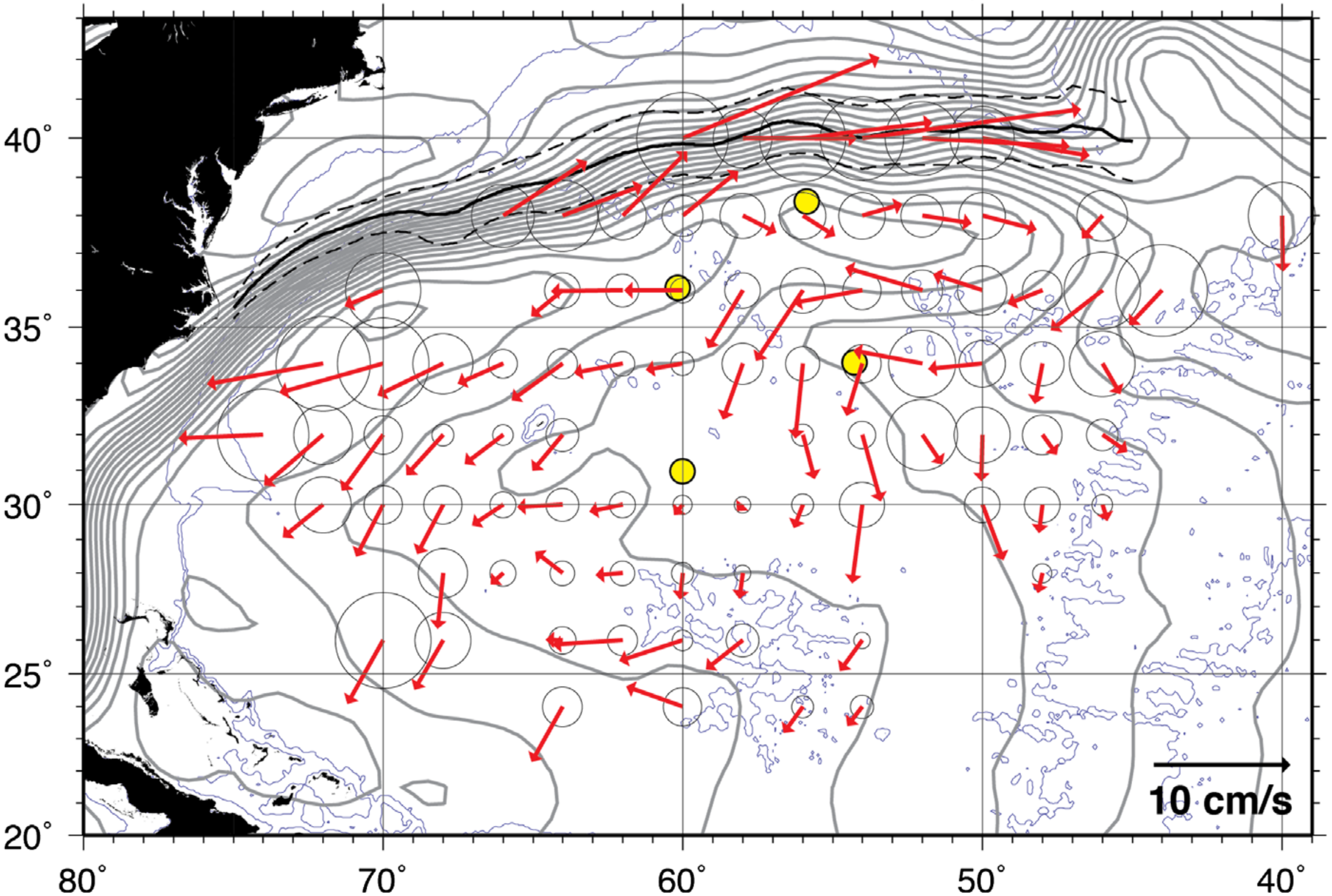
(Fratentoni et al. 2013)



- 40 “bobbers” released during CLIMODE

- acoustically tracked with RAFOS sound sources

(Fratentoni et al. 2013)



- Net southward transport with mean velocities of ~5 cm/s

We want Lagrangian obs of subducted BCG properties.
STMW formation would be a great place for a field campaign.

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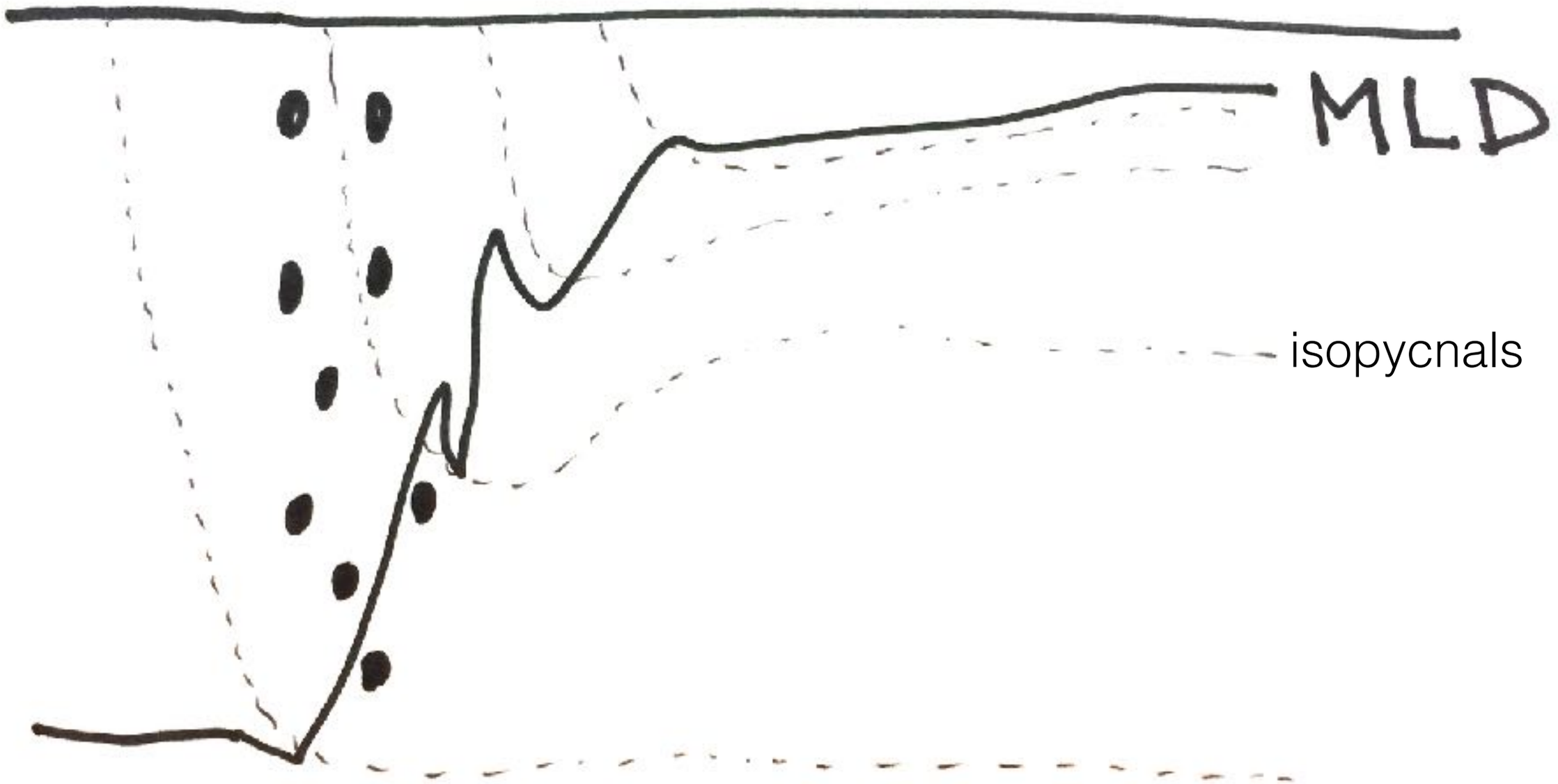
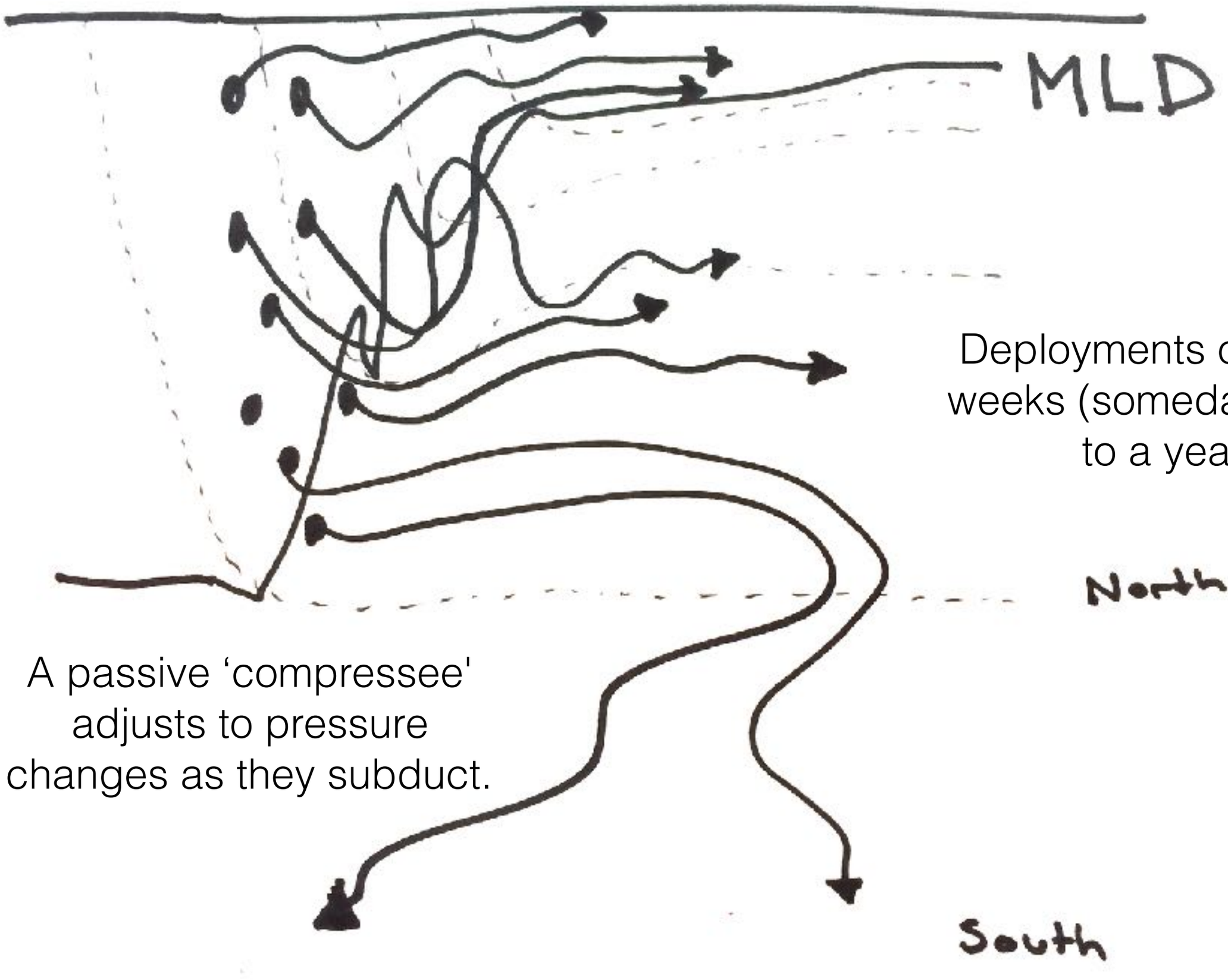
My Ocean Obs ’19 pitch..



A fleets of low-cost, acoustically tracked Lagrangian floats pre-ballasted to go to a prescribed isopycnal



Deployments of days to weeks (someday months to a year?)

A passive ‘compressee' adjusts to pressure changes as they subduct.

MINION 2.0

Burn wire

Retrieval LED

Passive Satellite
GPS Unit

"Fish Tag" acoustic tracking

Payload:

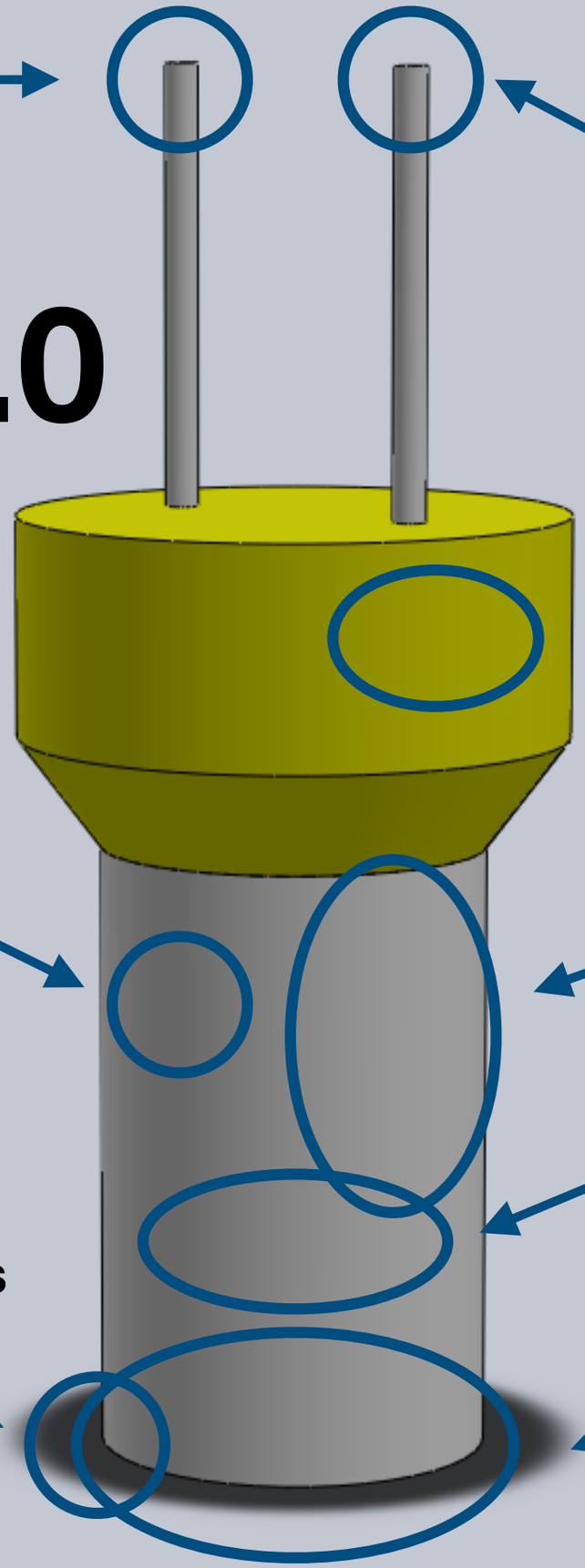
- 3 Axis Accelerometer
- Temperature
- Pressure
- Real Time Clock

24 Volt Battery Stack
For 5 Day Deployments

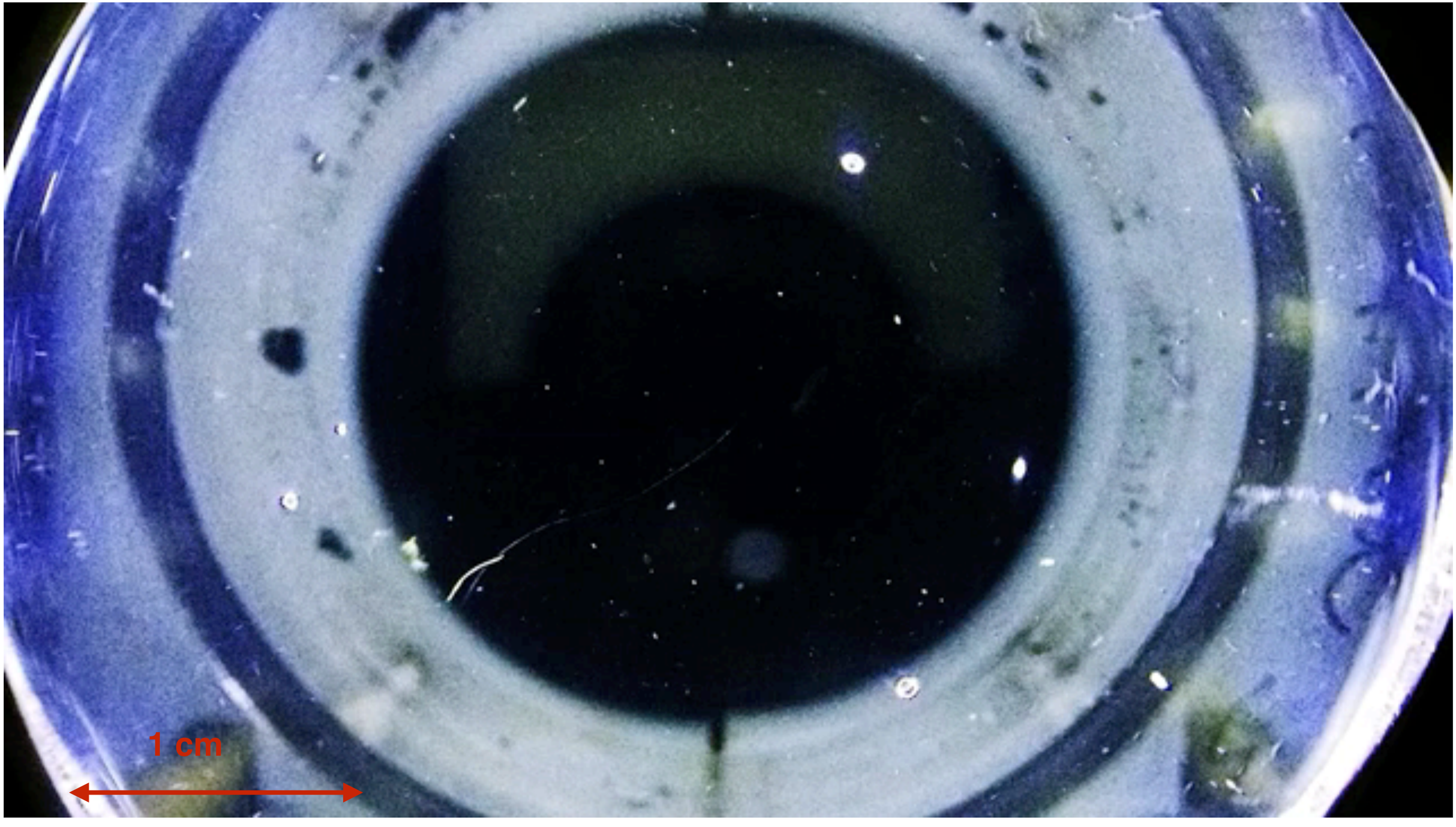
Raspberry Pi Computer

Reed Switch:
System Power + Wi-Fi Access

High Resolution Camera
(2592 x 1944)



COST: ~$250



upward looking timelapse (every 20 minutes)

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