Autonomous observations in the context of ocean time--series:

Some recent science showcases

Arne Körtzinger

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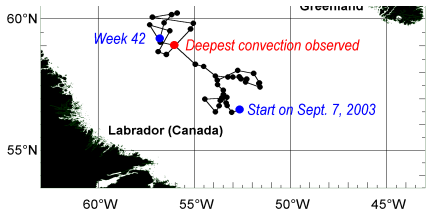
The Ocean Takes a Deep Breath

Science, 2004

Arne Körtzinger,* Jens Schimanski, Uwe Send, Douglas Wallace



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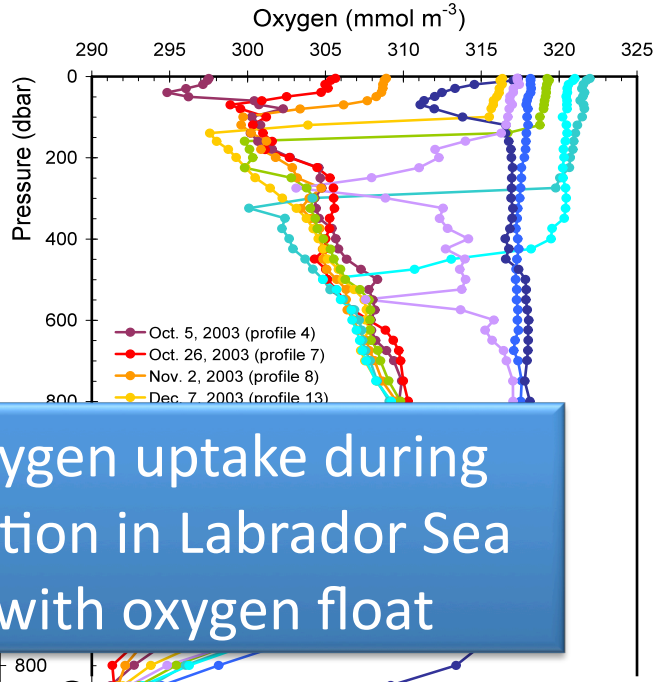

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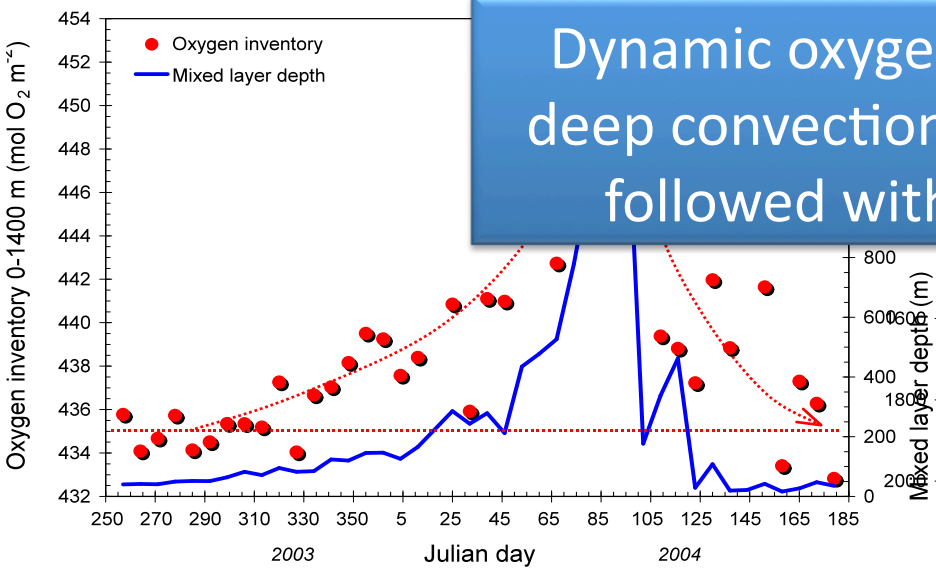


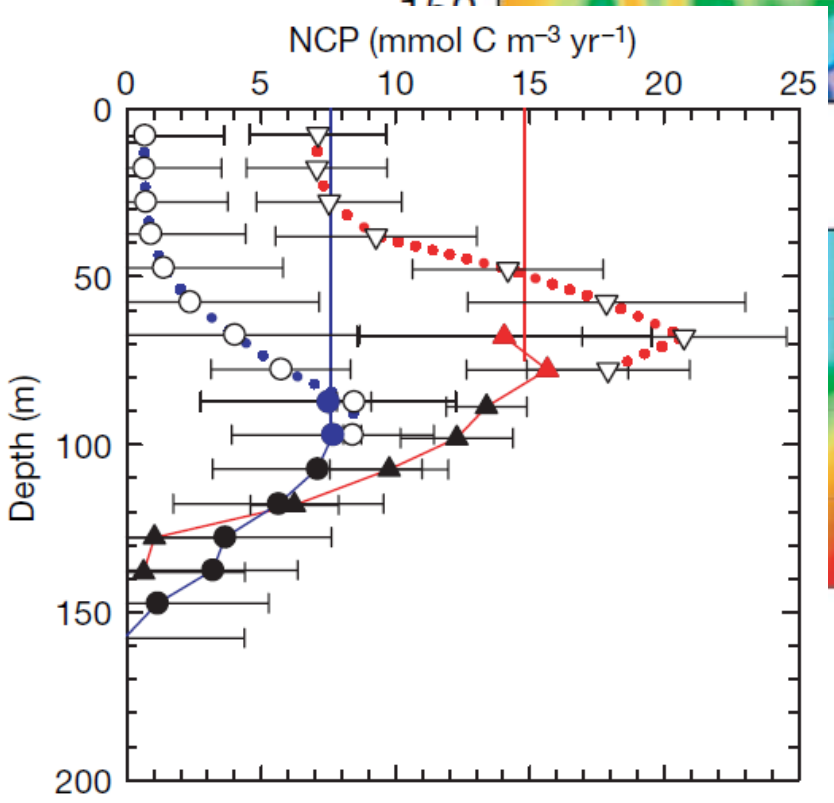
Dynamic oxygen uptake during deep convection in Labrador Sea followed with oxygen float

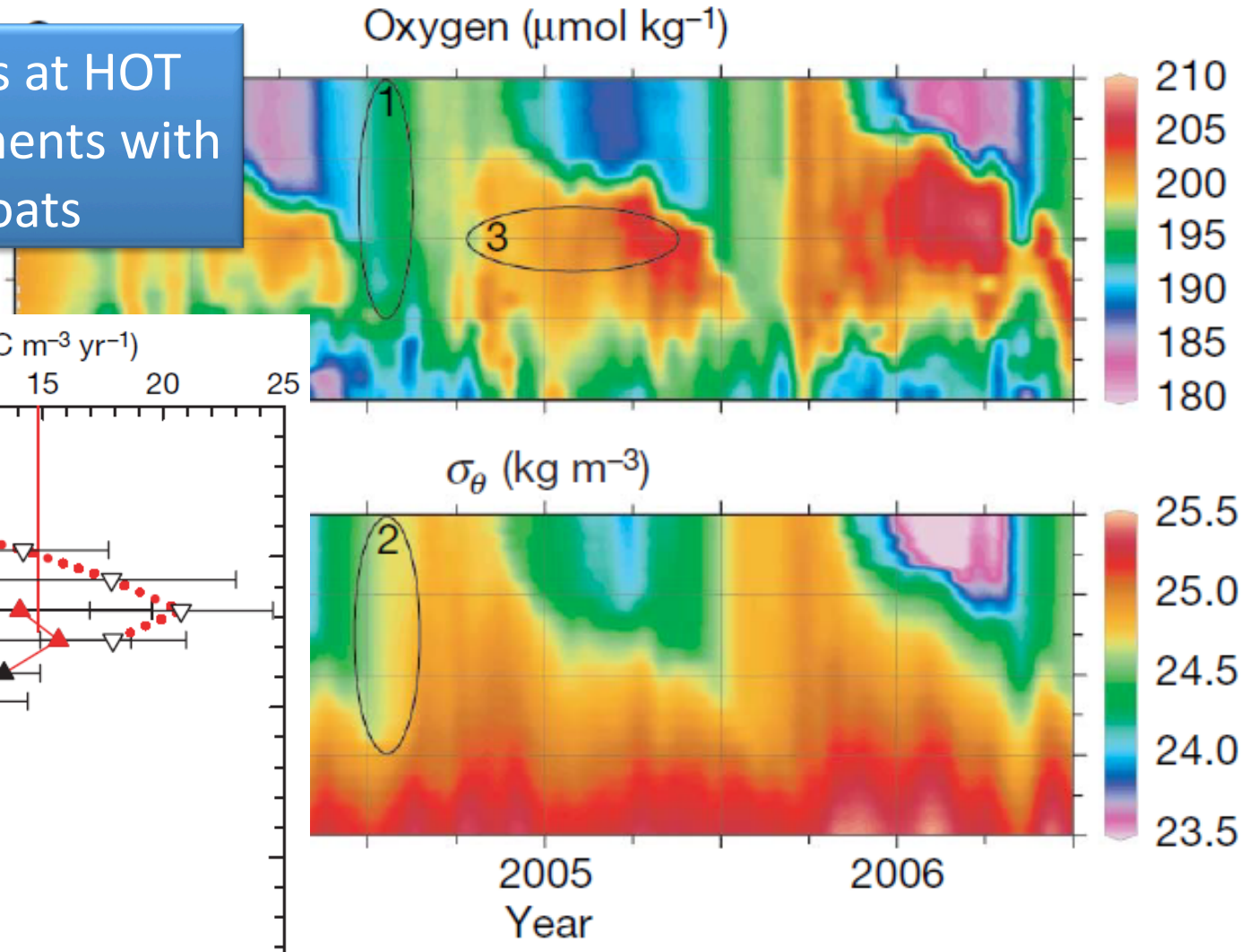
Net production of oxygen in the subtropical ocean

Nature, 2008

Stephen C. Riser[1] & Kenneth S. Johnson[2]

NCP estimates at HOT from measurements with oxygen floats





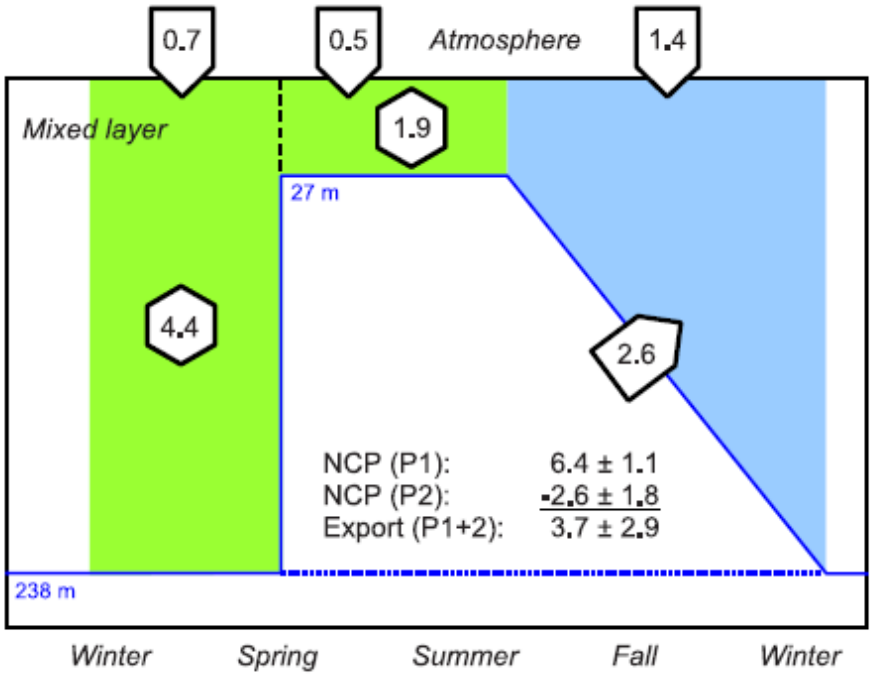
Vol 451|17 January 2008|doi:10.1038/nature06441

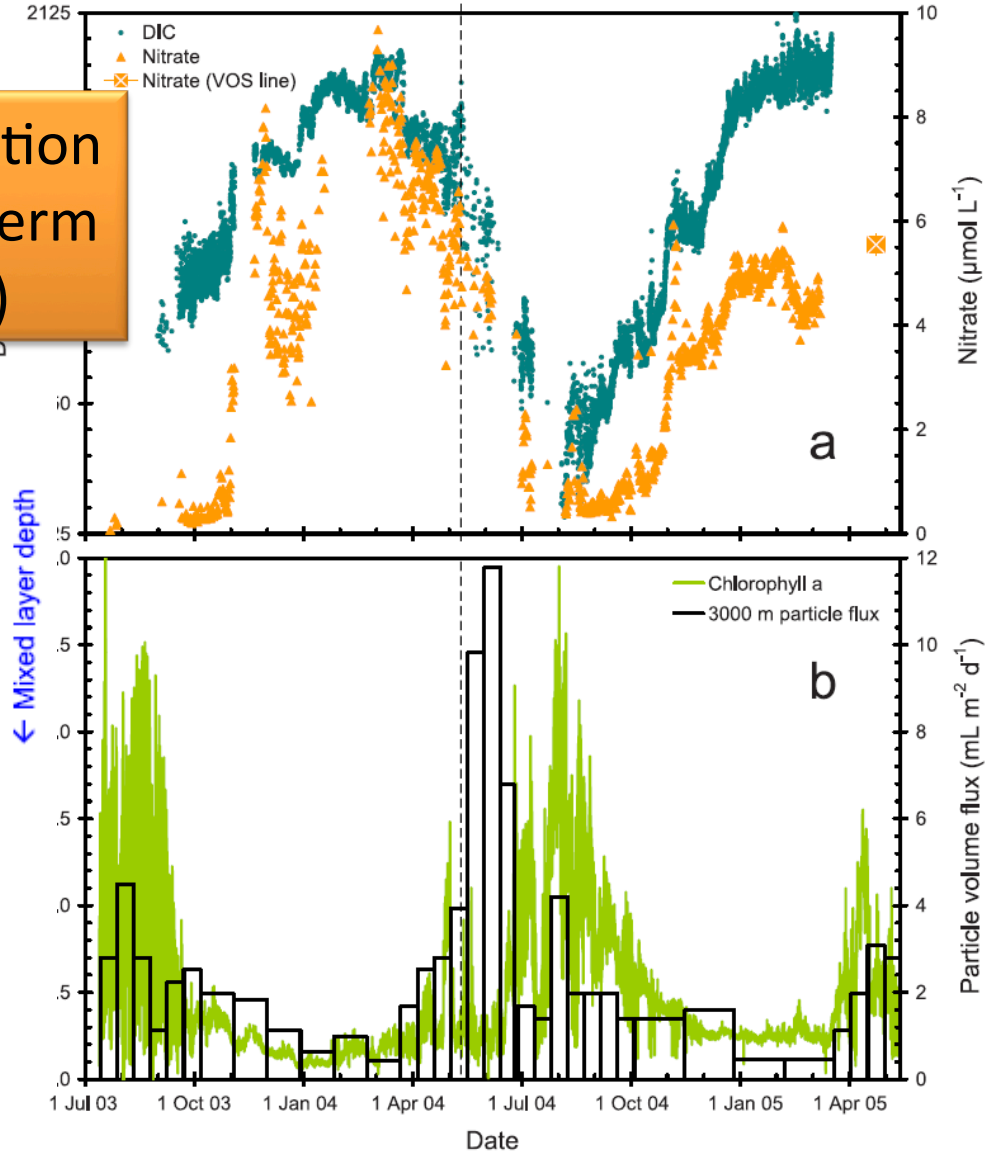
The seasonal pCO_2 cycle at 49°N/16.5°W in the northeastern Atlantic Ocean and what it tells us about biological productivity

JGR, 2008

A. Körtzinger,[1] U. Send,[2] R. S. Lampitt,[3] S. Hartman,[3] D. W. R. Wallace,[1] J. Karstensen,[1] M. G. Villagarcia,[4] O. Llinás,[4] and M. D. DeGrandpre[5]

CO_2 sink and pre-/post-stratification NCP observed at PAPA by long-term mooring (pCO_2, nitrate, trap)



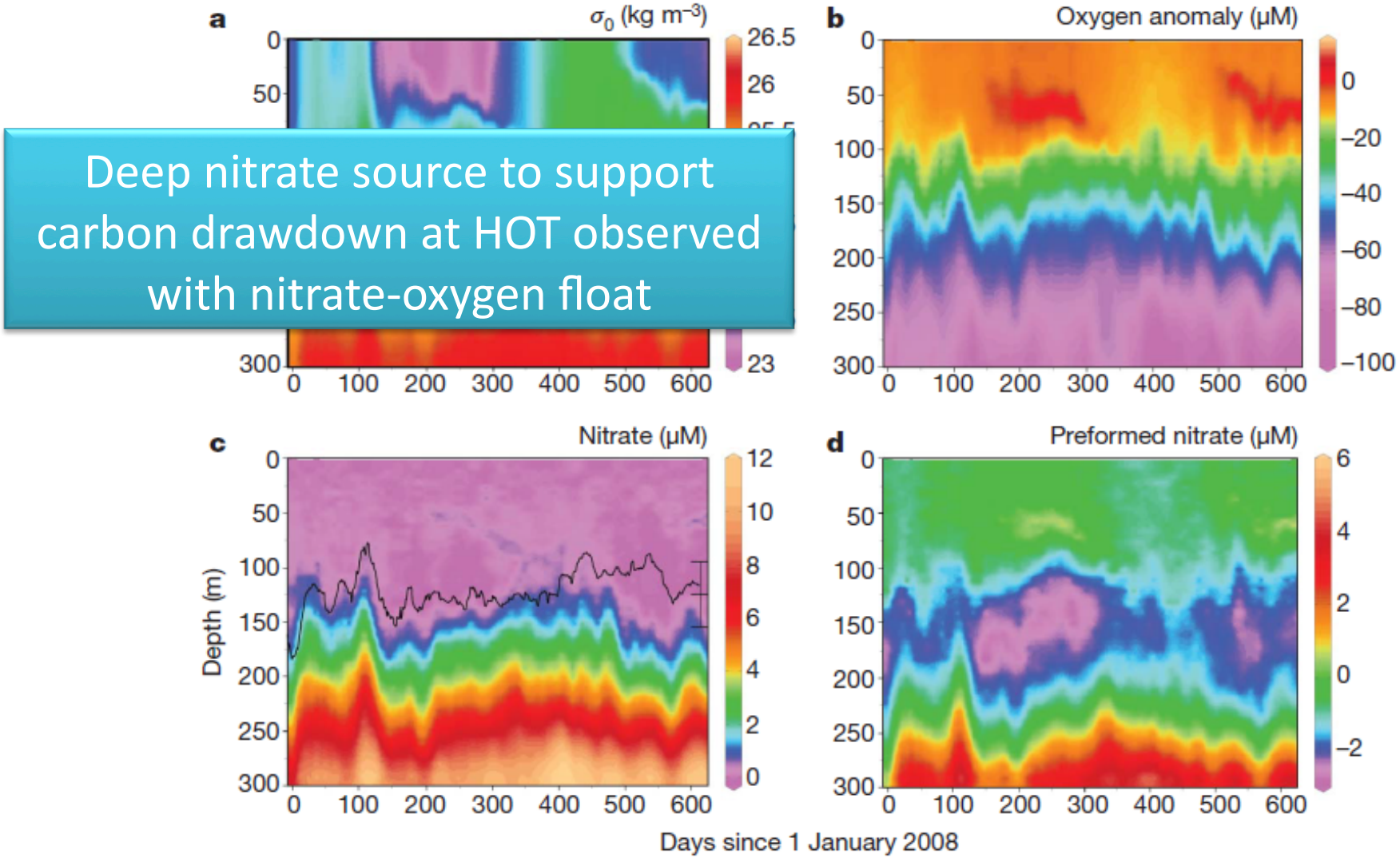


JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 113, C04020, doi:10.1029/2007JC004347, 2008

Nitrate supply from deep to near-surface waters of the North Pacific subtropical gyre

Nature, 2010

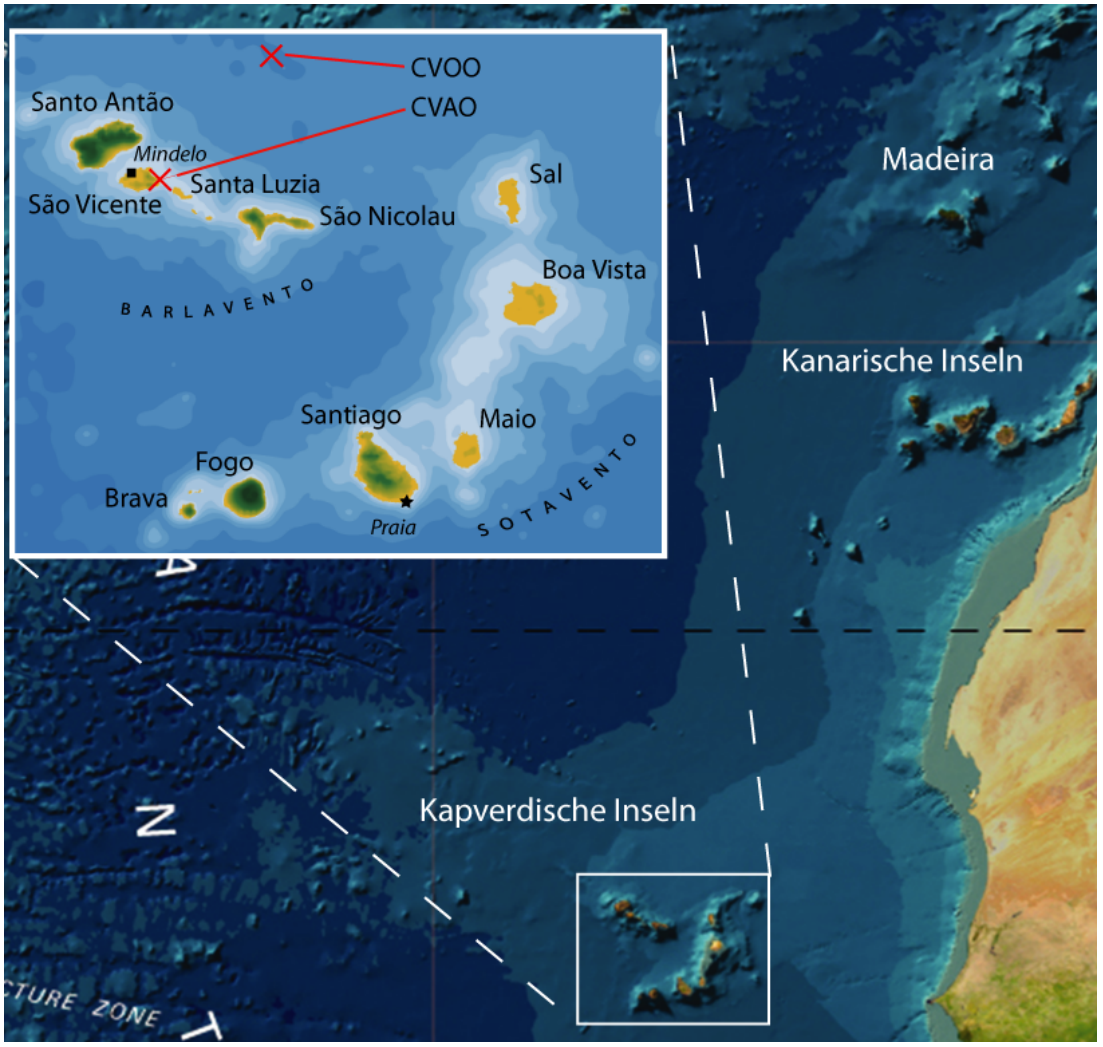
Kenneth S. Johnson[1], Stephen C. Riser[2] & David M. Karl[3]



Deep nitrate source to support carbon drawdown at HOT observed with nitrate-oxygen float

Cape Verde Observatories

- Eastern tropical North Atlantic (ETNA)
- 350 nm off West Africa (Mauritania & Senegal)
- Open ocean enviroment (60 nm NE off Cape Verde)
- 3600 m water depth
- NE trade wind region
- Generally oligotrophic
- Combined ocean (CVOO) and atmosphere (CVAO) observatories



CVOO Components

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Long-term multidisciplinary mooring

- CTD
- Currents
- O_2
- pCO_2
- Particle flux

Ship-based sampling

- CTD
- Fluorescence/Turbidity
- PAR
- O_2
- DIC & TA
- Nutrients
- Chlorophyll
- POC/PON & TOC/TON

Shore-based laboratory

Time series sampling

Field experiments

In situ CO_2 and O_2 Measurements on a Profiling Float

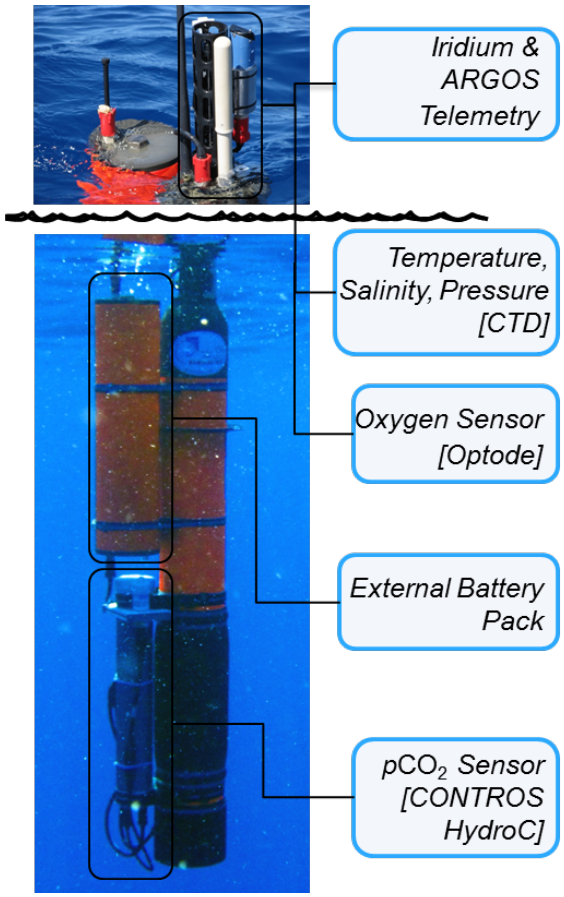
B. Fiedler, P. Fietzek, N. Vieira, P. Silva, H. C. Bittig, T. Steinhoff, A. Körtzinger (2012). *Journal of Atmospheric and Oceanic Technology*, 30, 112-126, DOI: 10.1175/JTECH-D-12-00043...

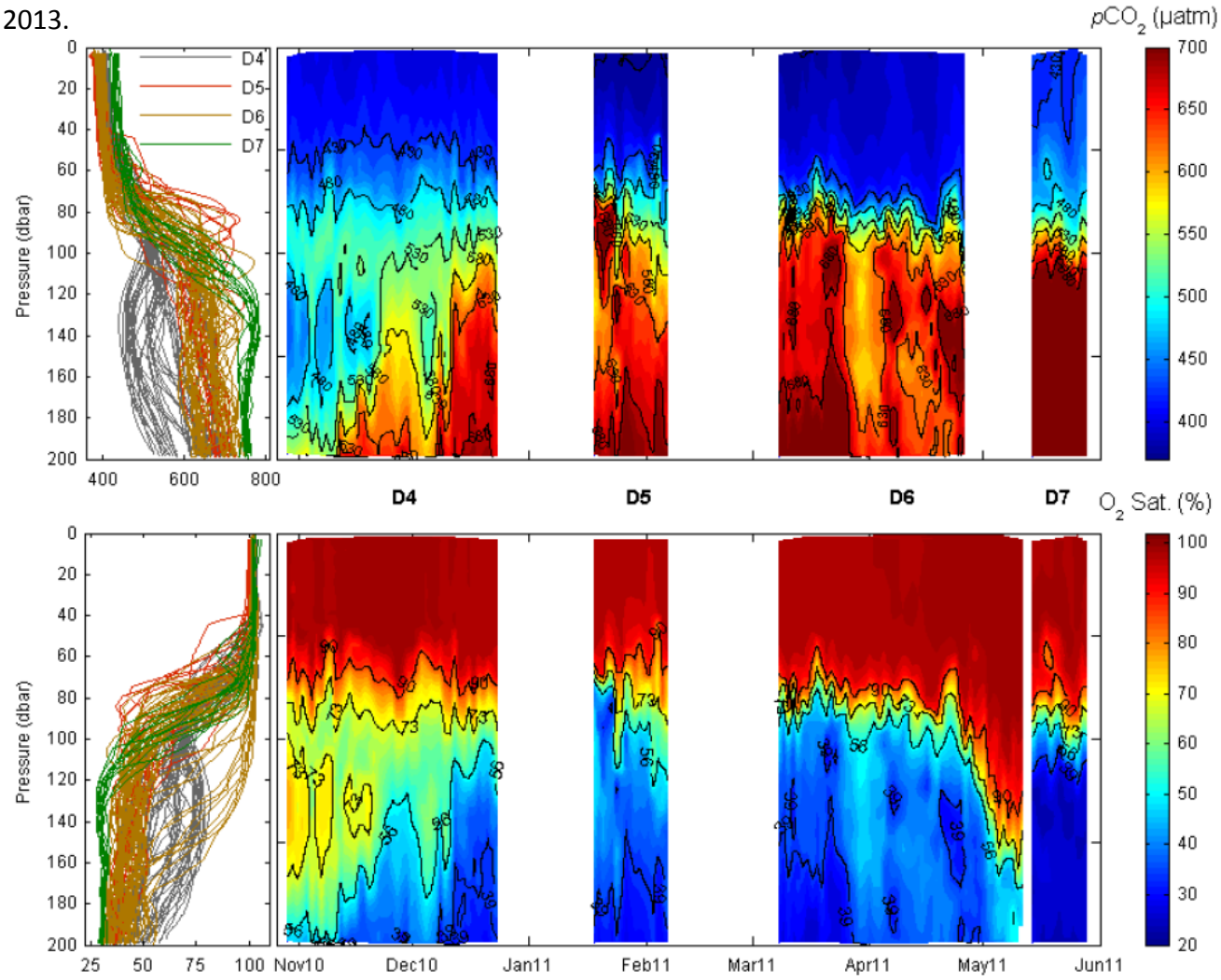
B. Fiedler, Ph.D. thesis, Kiel University, December 2012

Float-based measurements of CO_2 and O_2

GEOMAR

Fiedler *et al.*, J. Atmos. Oceanic Technol., 2013.

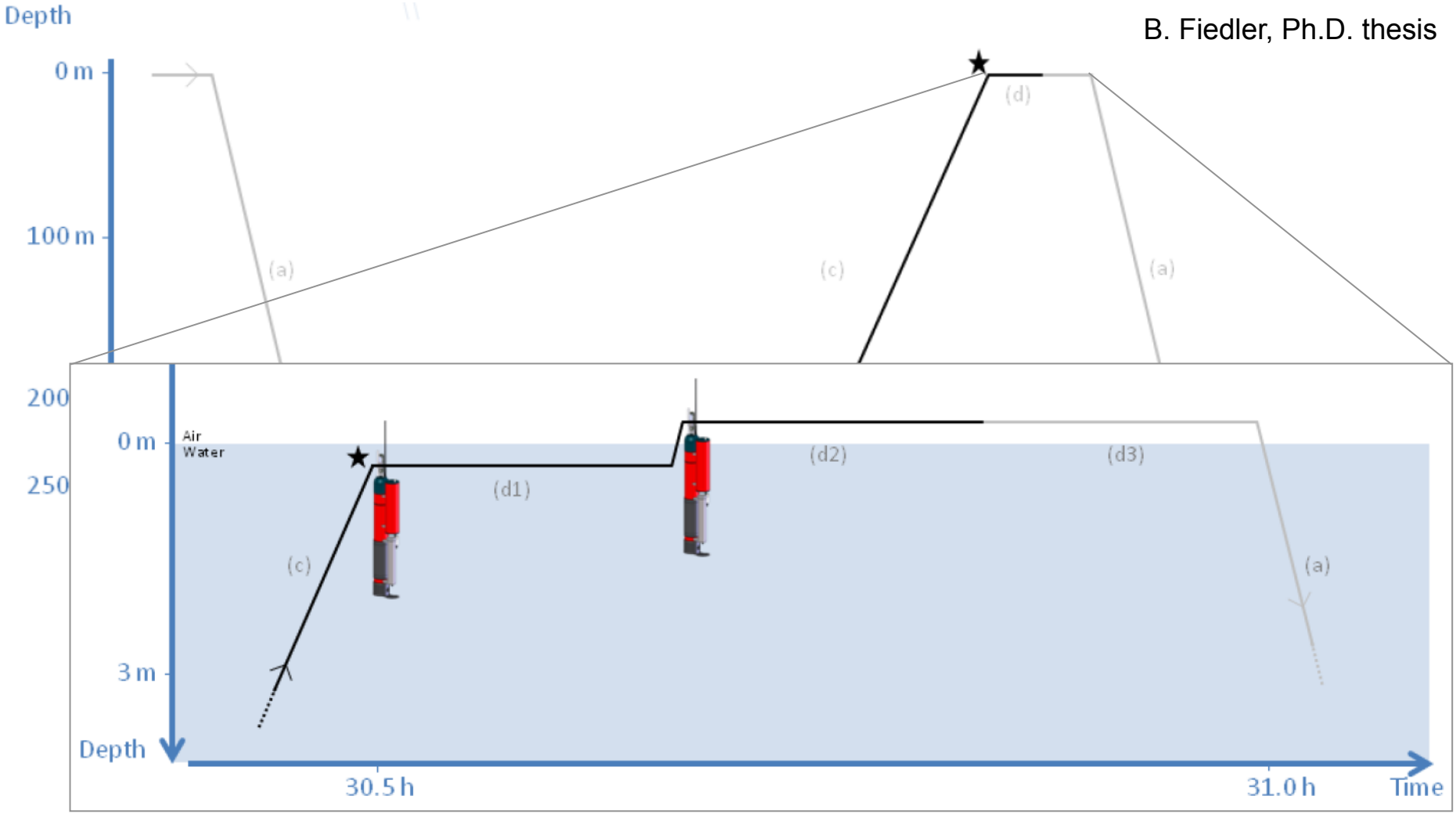




HELMHOLTZ ASSOCIATION

Float-based measurements of CO_2 and O_2

B. Fiedler, Ph.D. thesis



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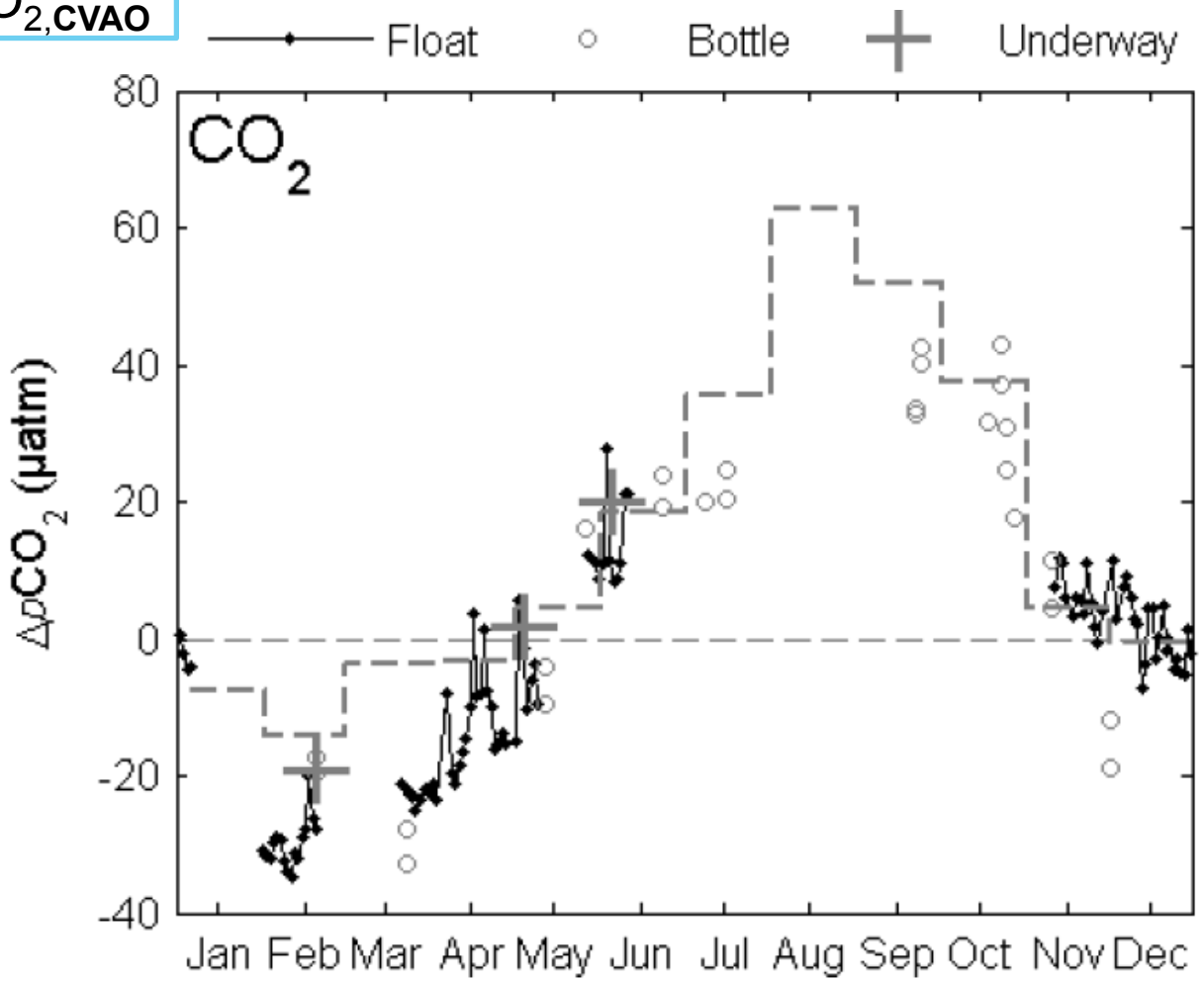
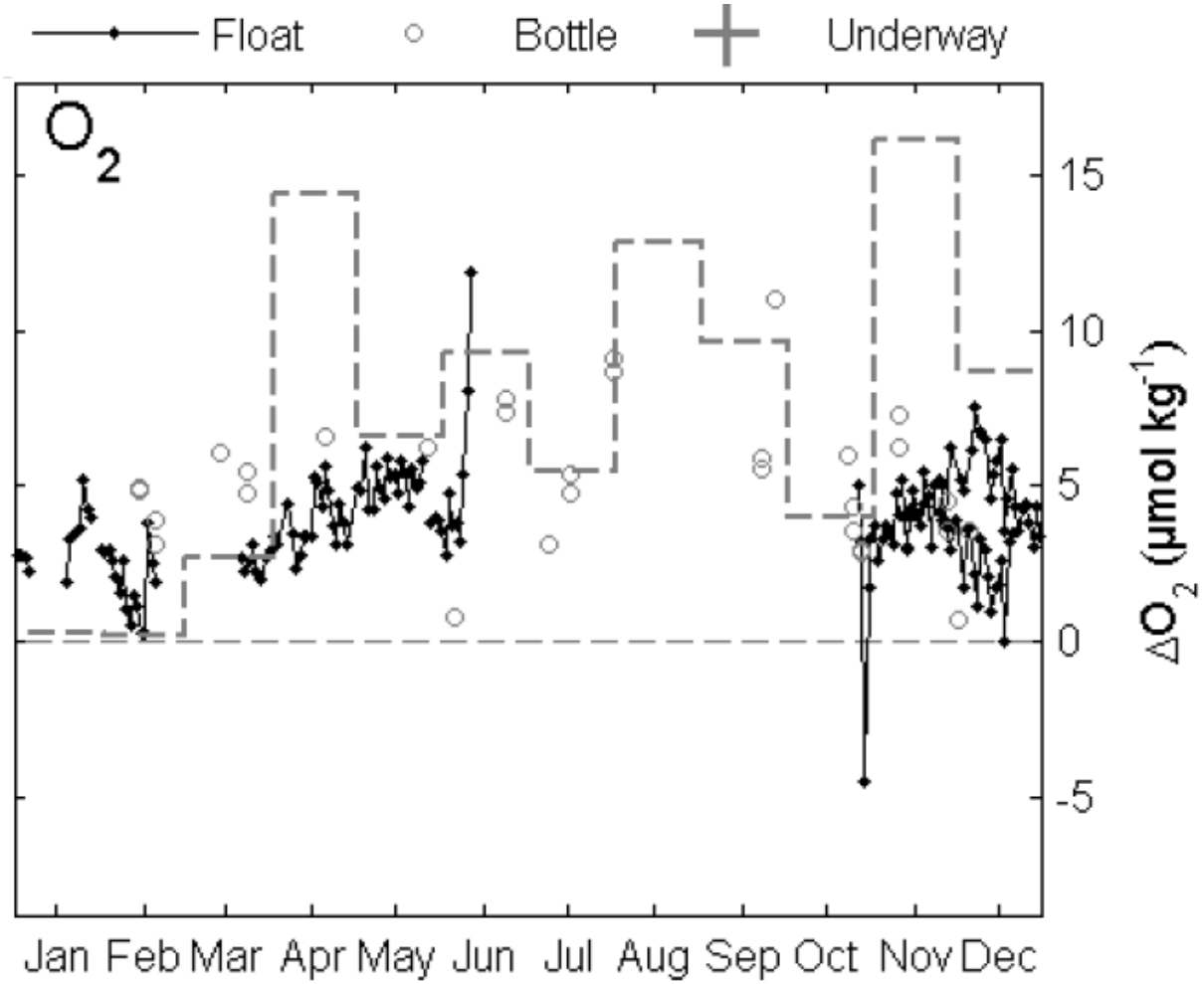
Surface ocean pCO_2 dynamics

$\Delta pCO_2 = pCO_{2,\mathbf{CVOO}} - pCO_{2,\mathbf{CVAO}}$



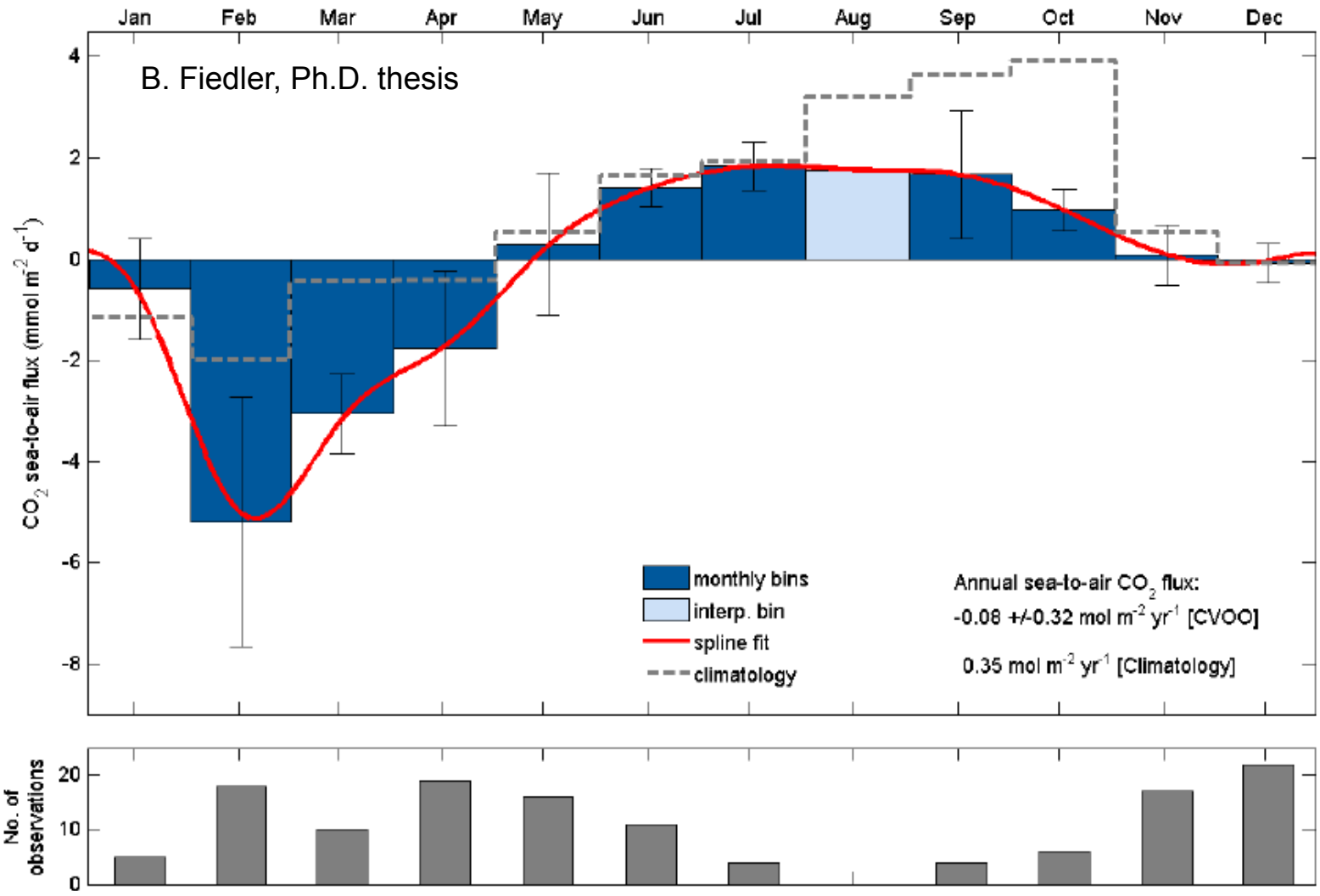
B. Fiedler, Ph.D. thesis

Surface ocean O_2 dynamics

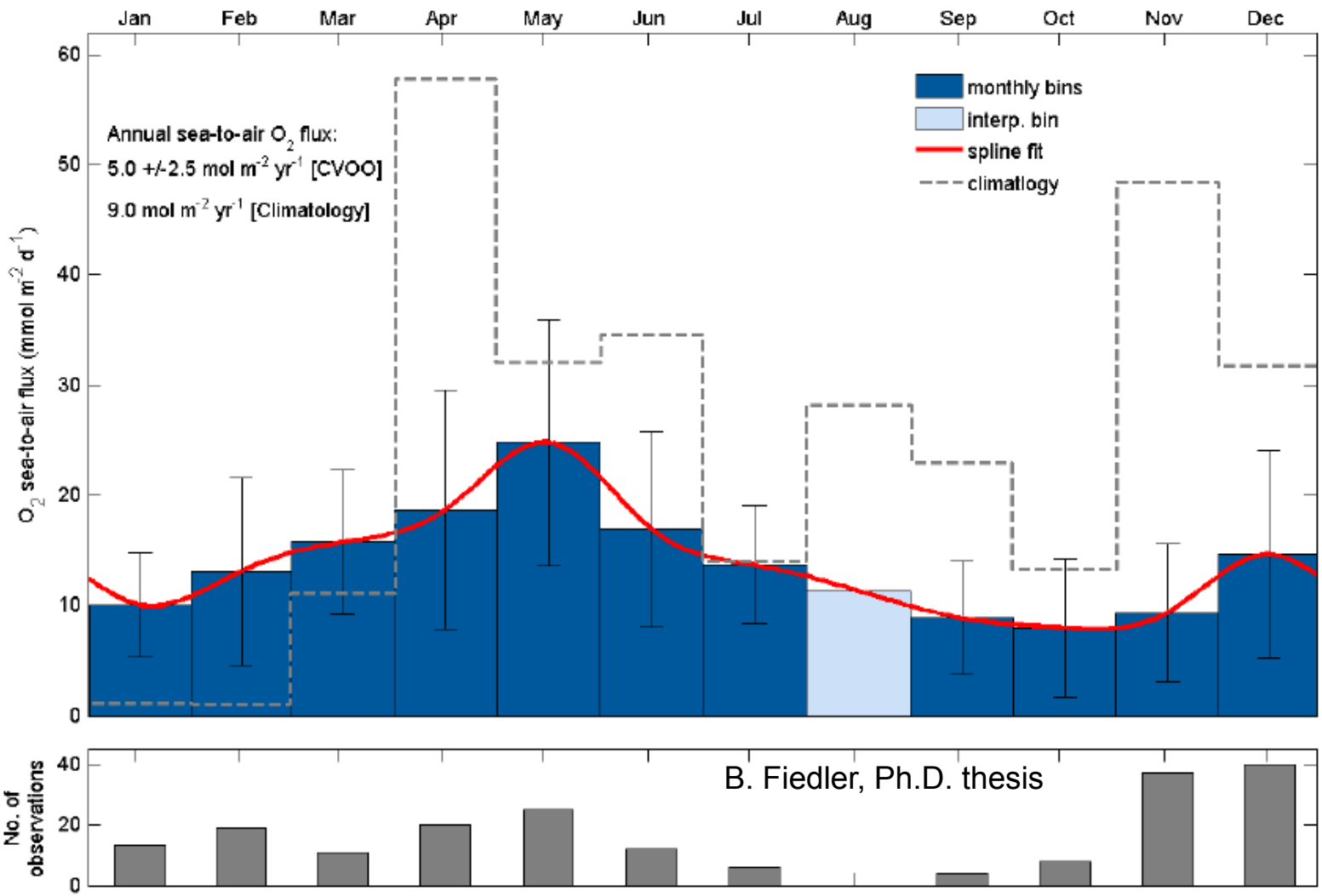


B. Fiedler, Ph.D. thesis

Seasonal cycle of CO_2 air-sea flux



Seasonal cycle of O_2 air-sea flux



Seasonal cycle of APO air-sea flux

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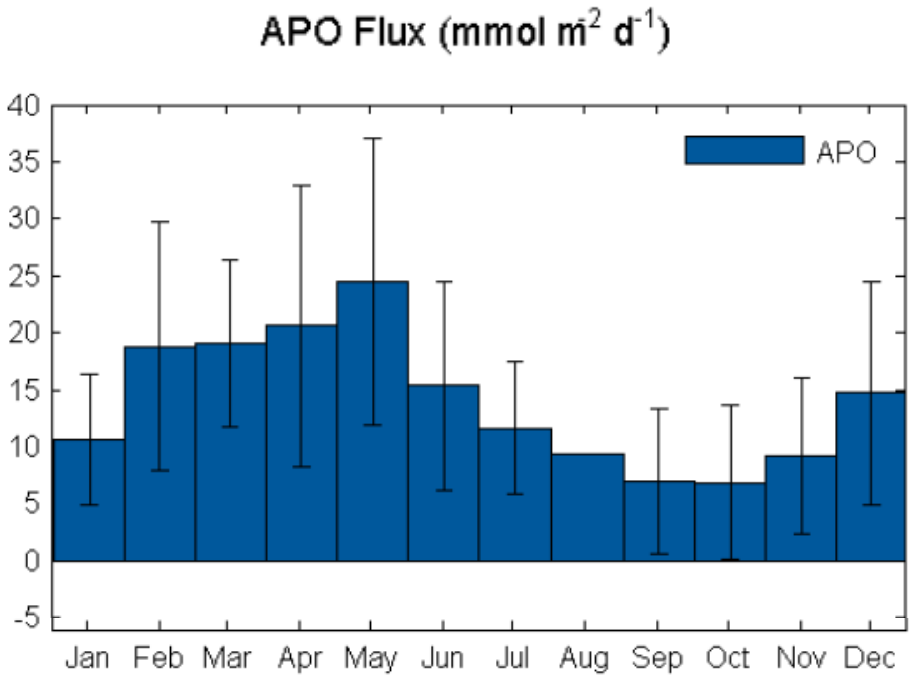
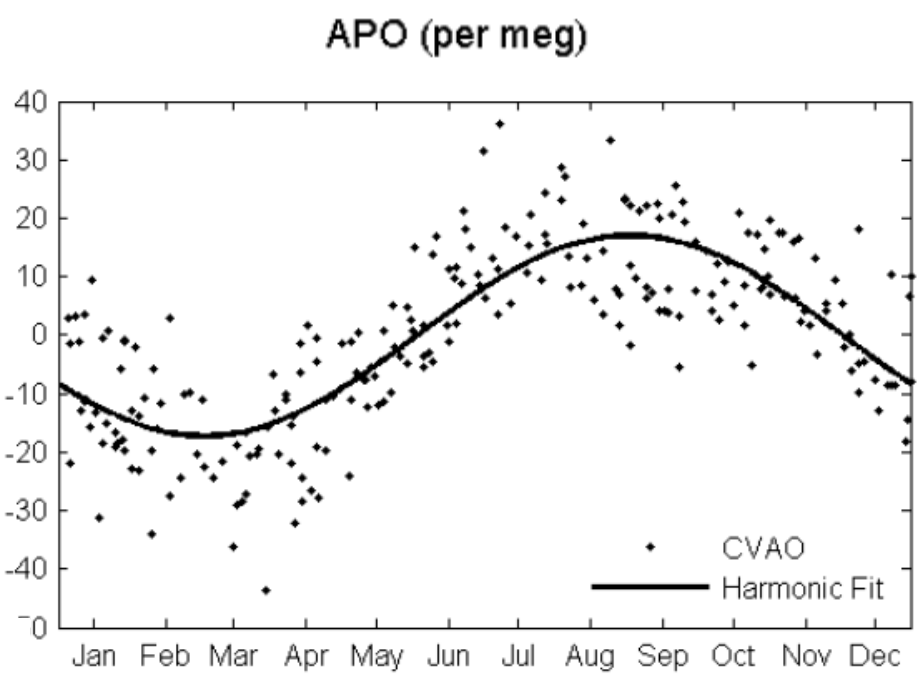
Cape Verde Ocean Observatory

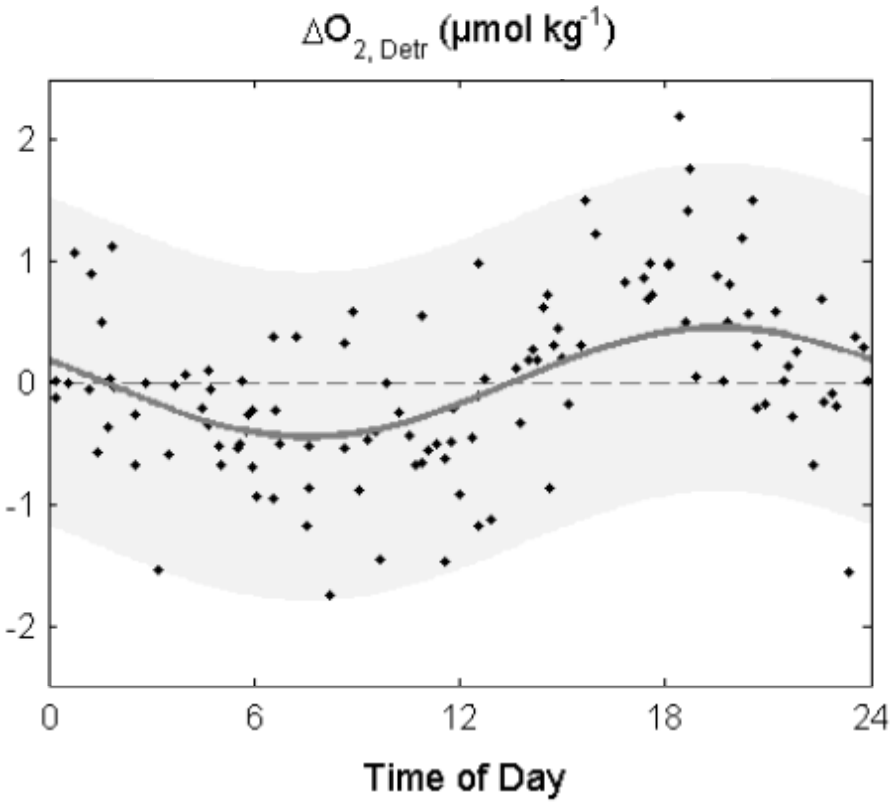
Cape Verde Atmosphere Observatory

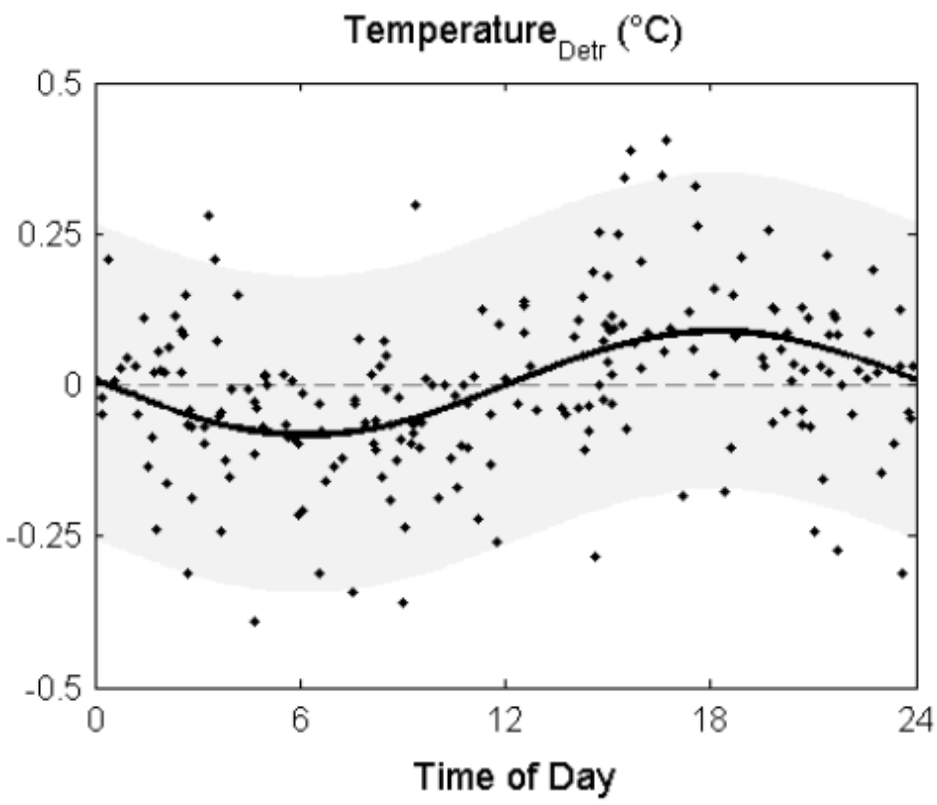




B. Fiedler, Ph.D. thesis

Diel oxygen cycle (@ 30 cm depth)



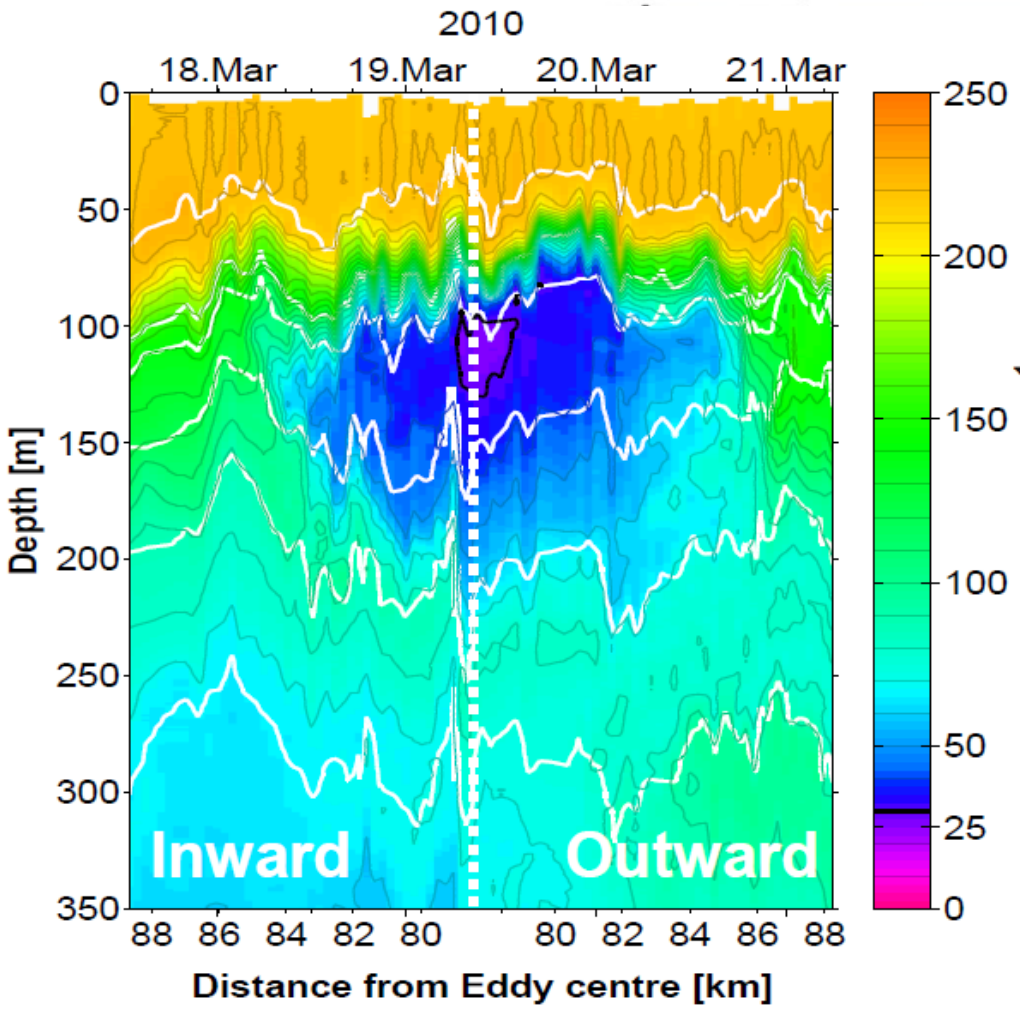


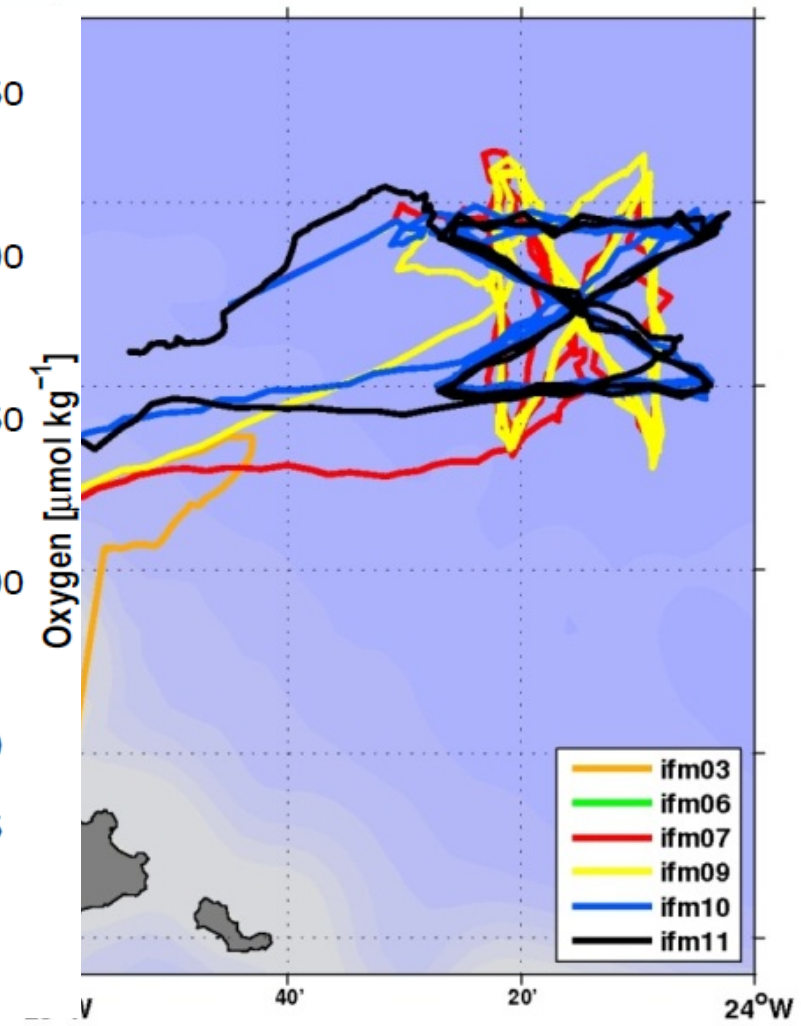
B. Fiedler, Ph.D. thesis

Anoxic and Hypoxic Eddies in the Open North Atlantic

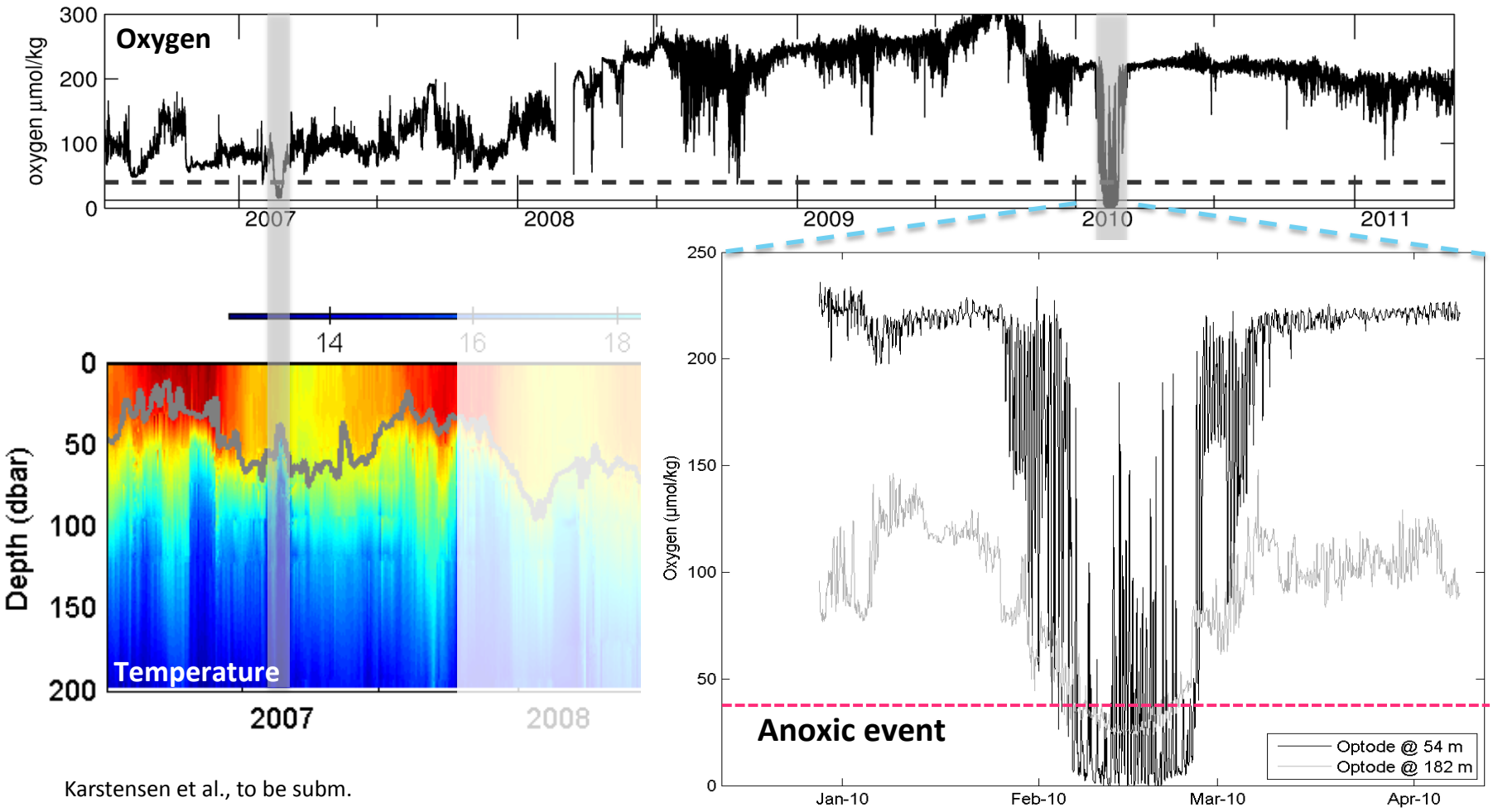
J. Karstensen, B. Fiedler, P. Brandt J. Hahn, T. Kanzow, A. Körtzinger, G. Krahmann, O. Melicio, M. Visbeck, D. R. Wallace, R. Zantopp (2013).
Manuscript to be submitted.

CVOO glider swarm experiment





CVOO mooring

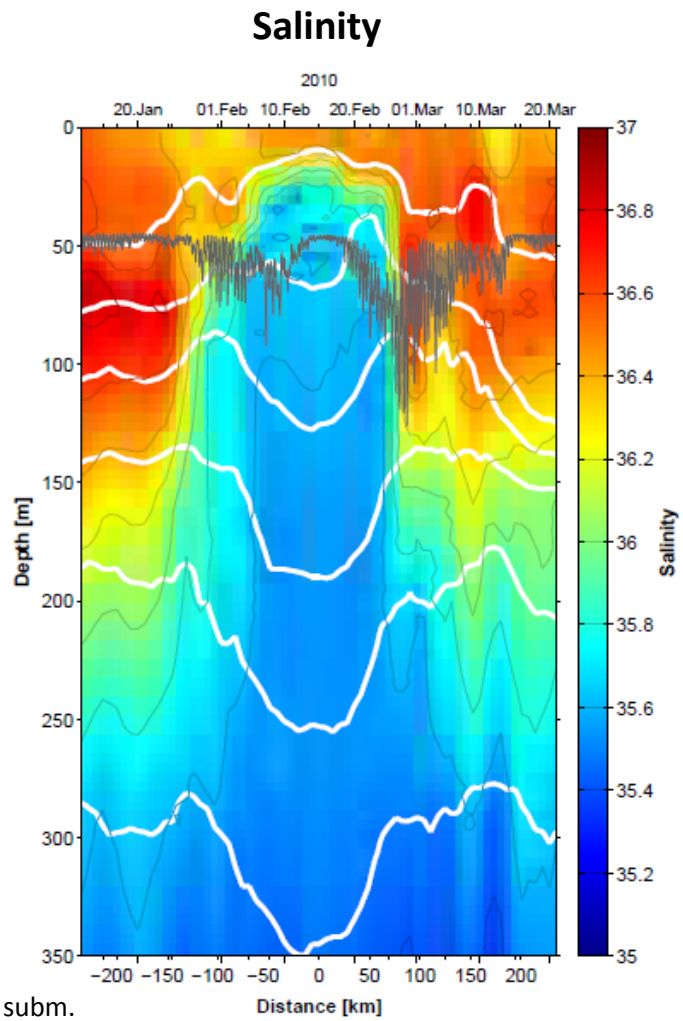


Karstensen et al., to be subm.

Anoxic eddy (ACME) at CVOO mooring

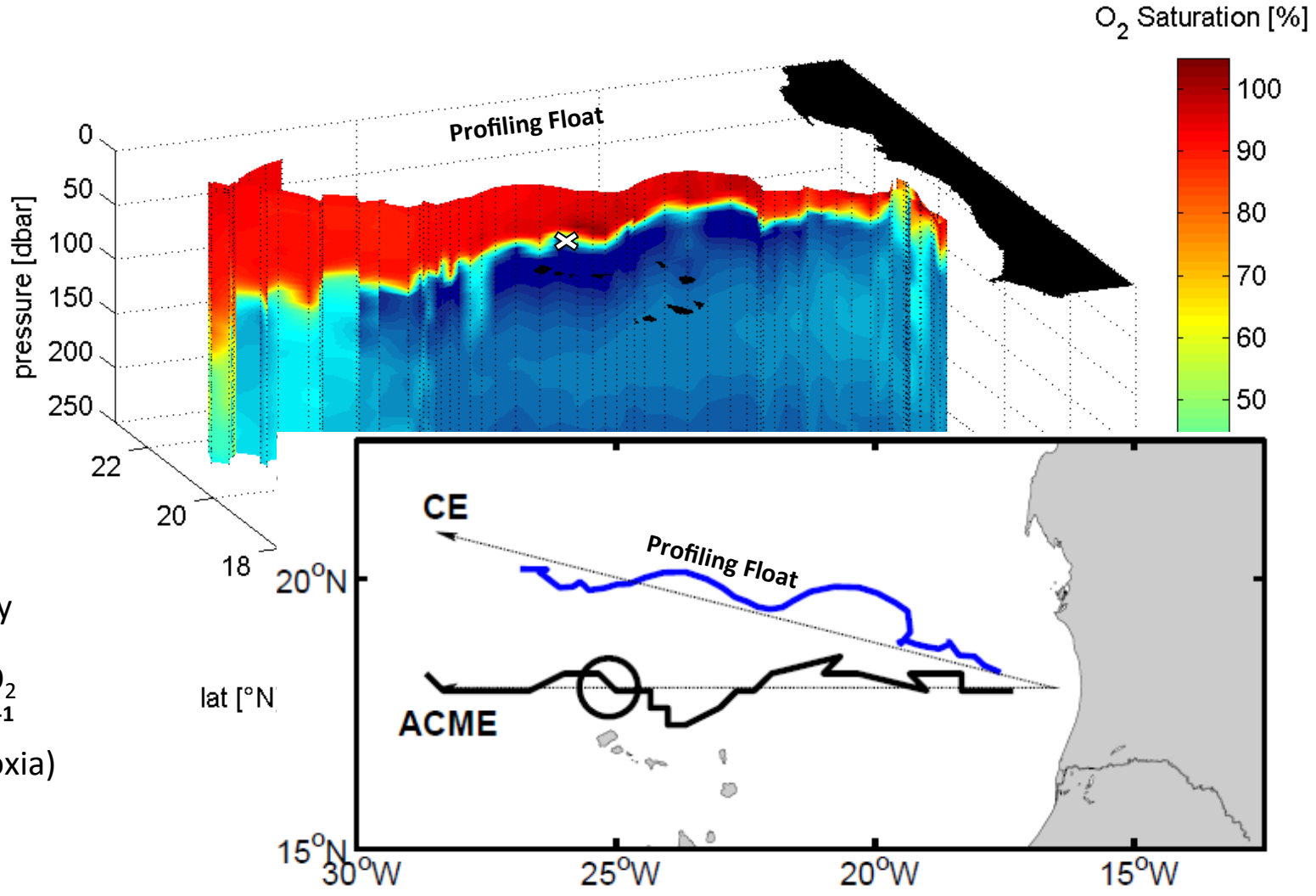
Mooring (2010):

- Anticyclonic mode-water type **Eddy**
- Radius: ~70 km
- **Subsurface O_2 <1 µmol kg^{-1} (Anoxic)**
- Max. Rotational velocity: ~0.7ms^{-1}
- Background flow < 0.1 m s^{-1}



Karstensen et al., to be subm.

Oxygen float



Float (2008):

- Trapped in a Cyclonic Eddy
- Subsurface O_2 **<20 µmol kg^{-1}** (severe Hypoxia)

Oxygen float caught in eddy (CE)

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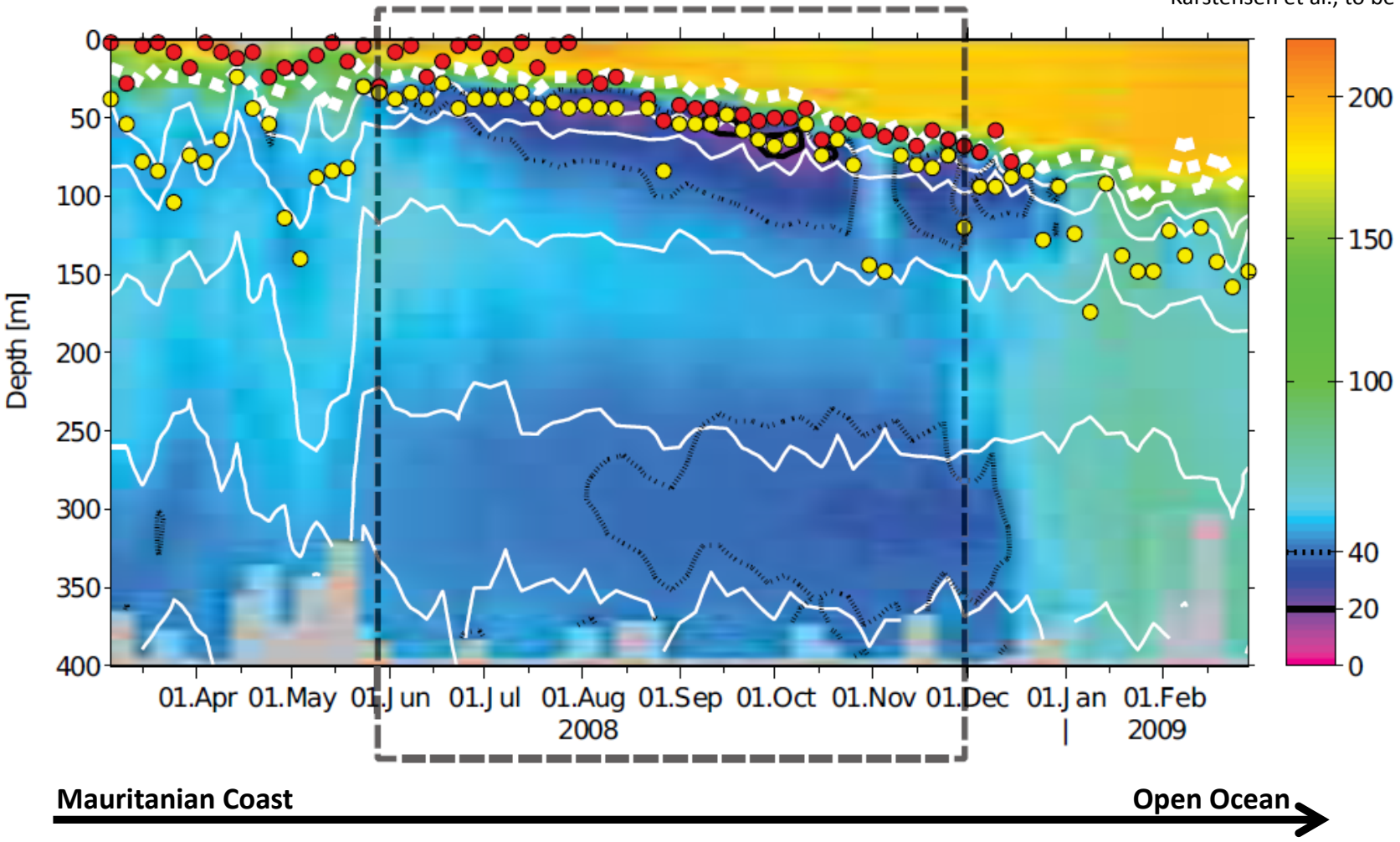
Karstensen et al., to be subm.



Eddy dynamics (ACME vs. CE)

Karstensen et al., to be subm.