Current and Oxygen Variability in the Tropical North East Atlantic

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SFB 754

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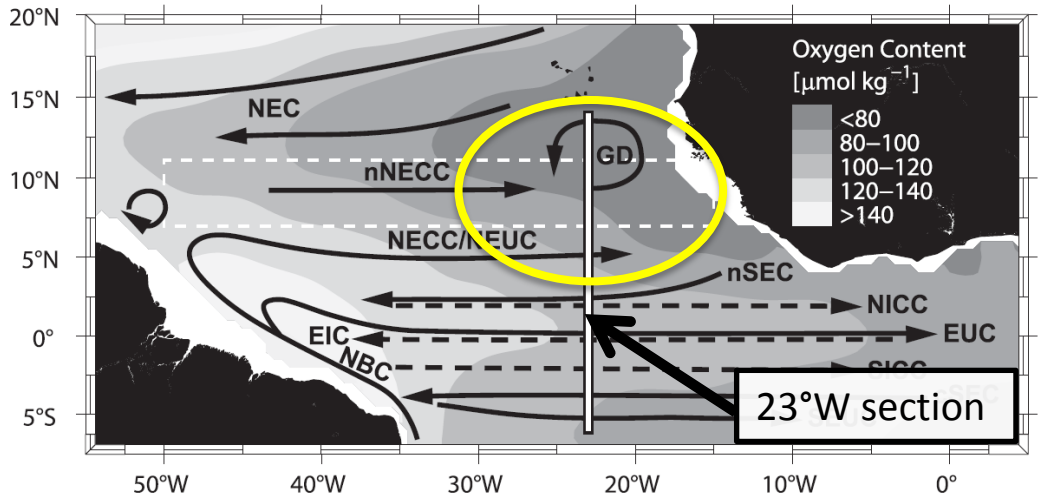
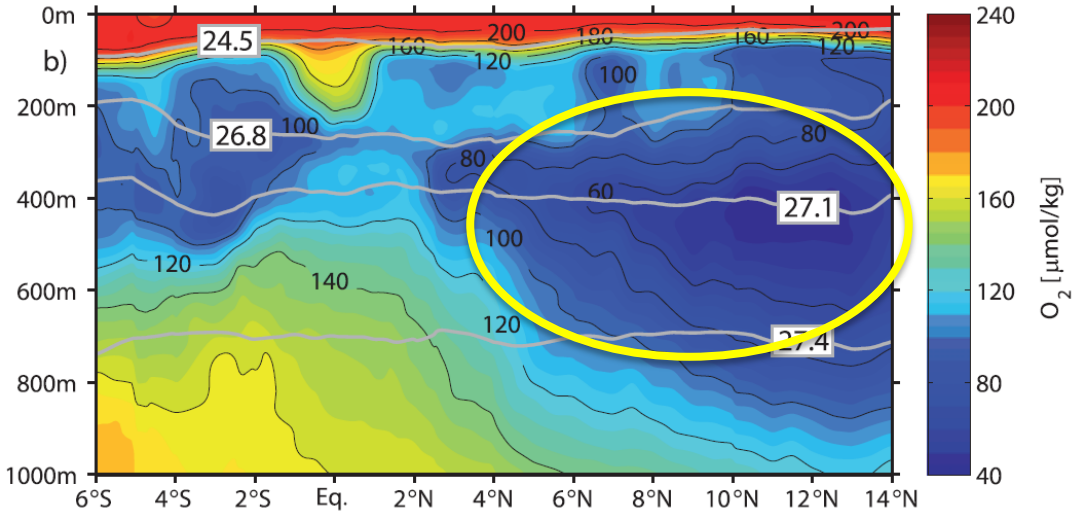
Helmholtz Centre for Ocean Research Kiel

Oxygen Distribution in the Tropical Atlantic



Brandt et al. (2010)

O_2 distribution, top view (depth 300m - 500m)

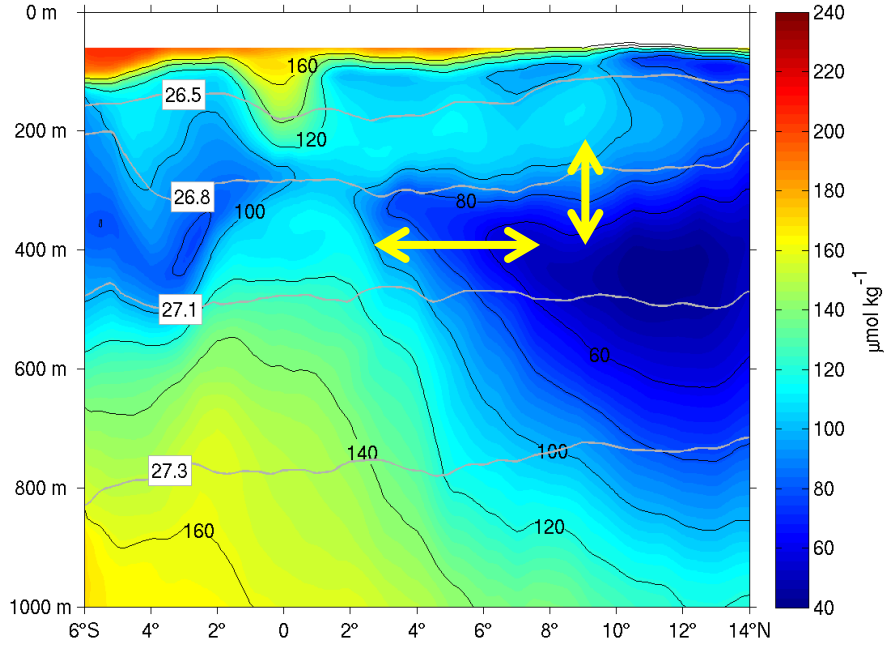


Brandt et al. (2010)

O_2 cross section

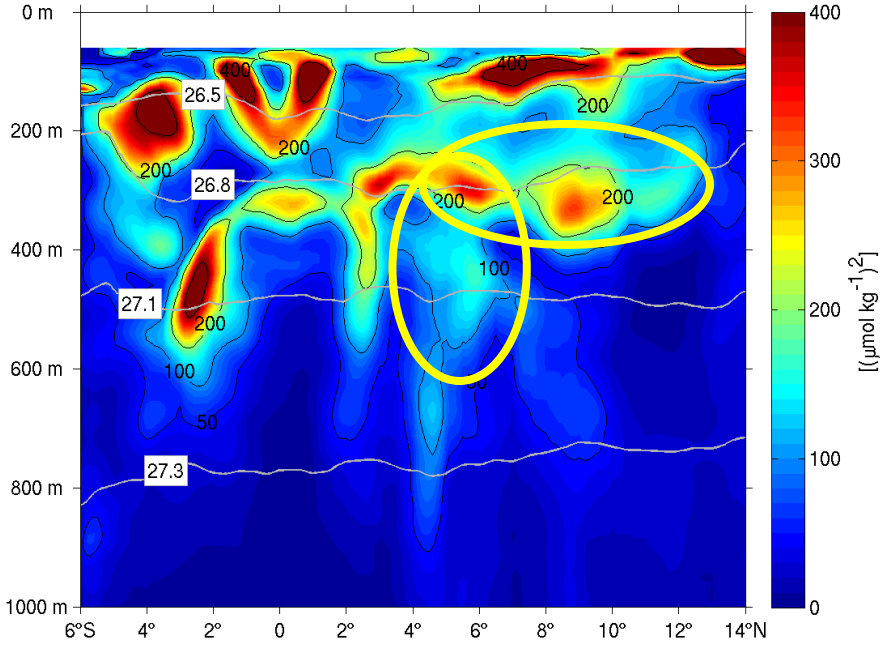
Analysis of repeated ship sections

Mean O_2



Hahn et al. (subm.)

O_2 variance

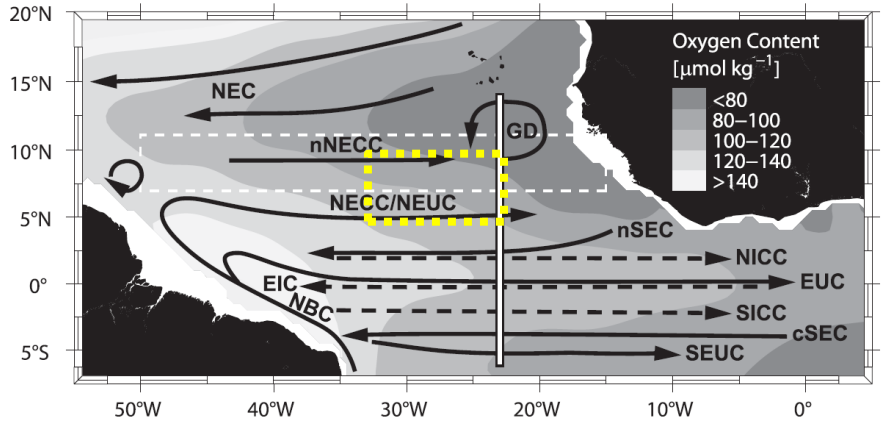


Hahn et al. (subm.)

sources for O_2 variance?

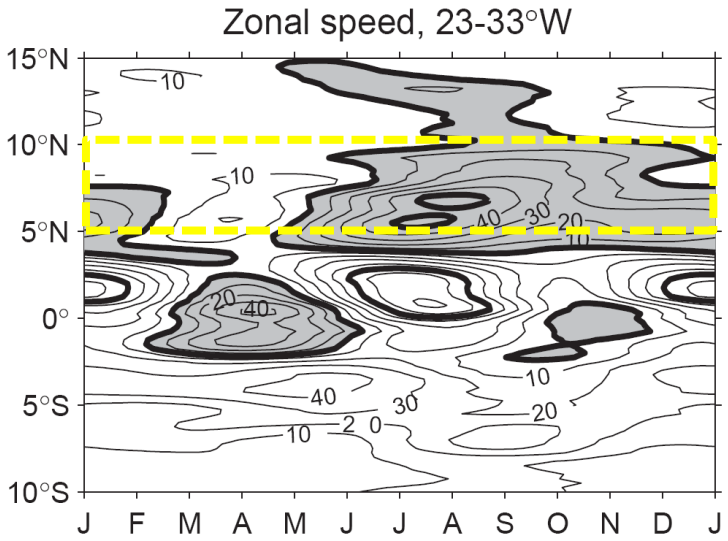
- stirring by mesoscale eddies / diapycnal mixing
- (zonal) current variability

Zonal currents



Brandt et al. (2010)

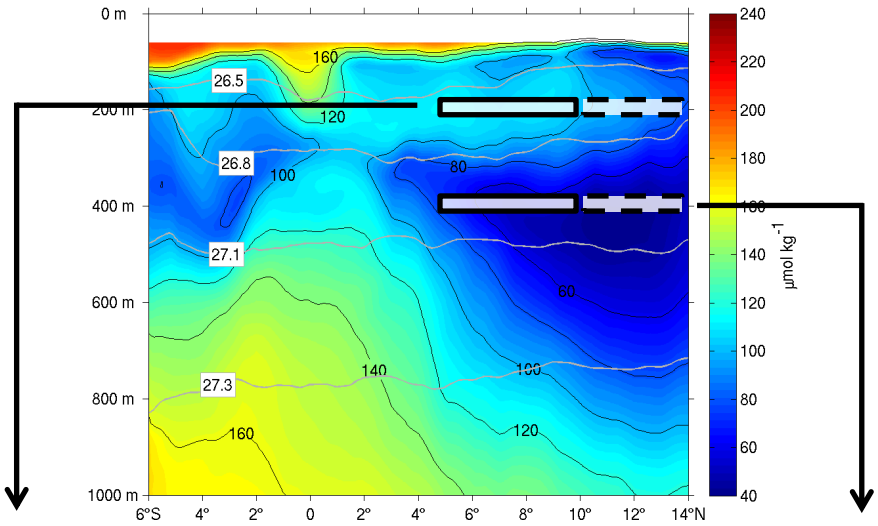
characteristic mean field
(surface and near surface currents)

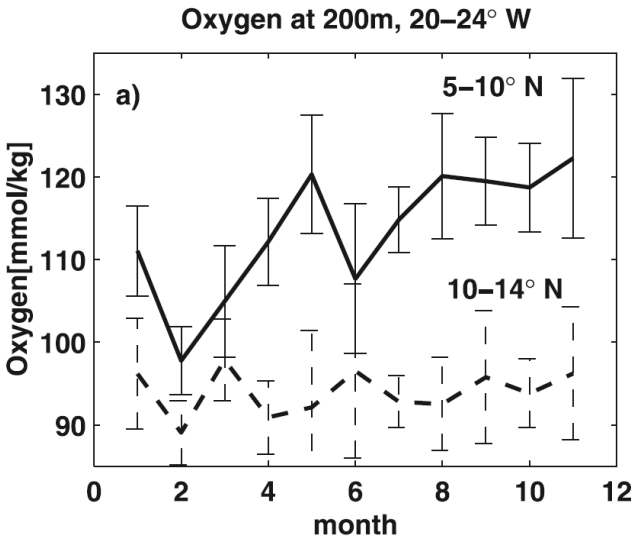


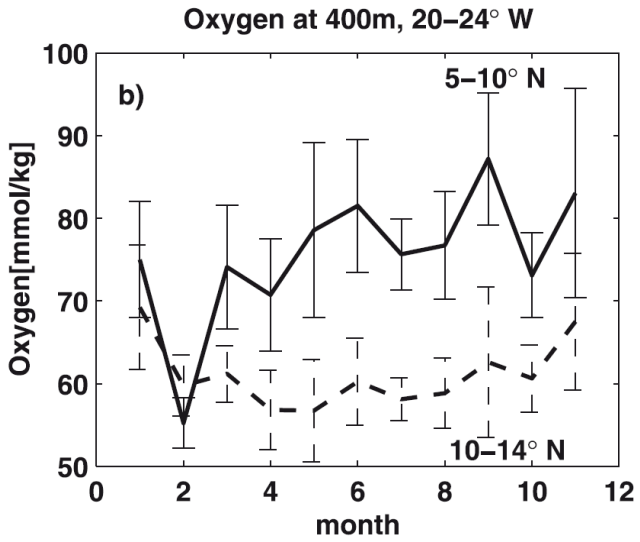
Lumpkin and Garzoli (2005)

seasonal cycle of surface currents
(shaded regimes: eastward velocity)

Seasonal cycle of oxygen from CTD/O_2 data







Stramma et al. (2008)

Goals

Goal I: Identify characteristic time scales of oxygen variability.

⇨ Is there pronounced variability at defined time scales, e.g. seasonal or intraseasonal variability?

Goal II: Identify the physical processes that are responsible for the ventilation of the Tropical North East Atlantic.

⇨ Does a seasonal cycle in zonal velocity contribute to the O_2 flux / O_2 supply?

1. Motivation

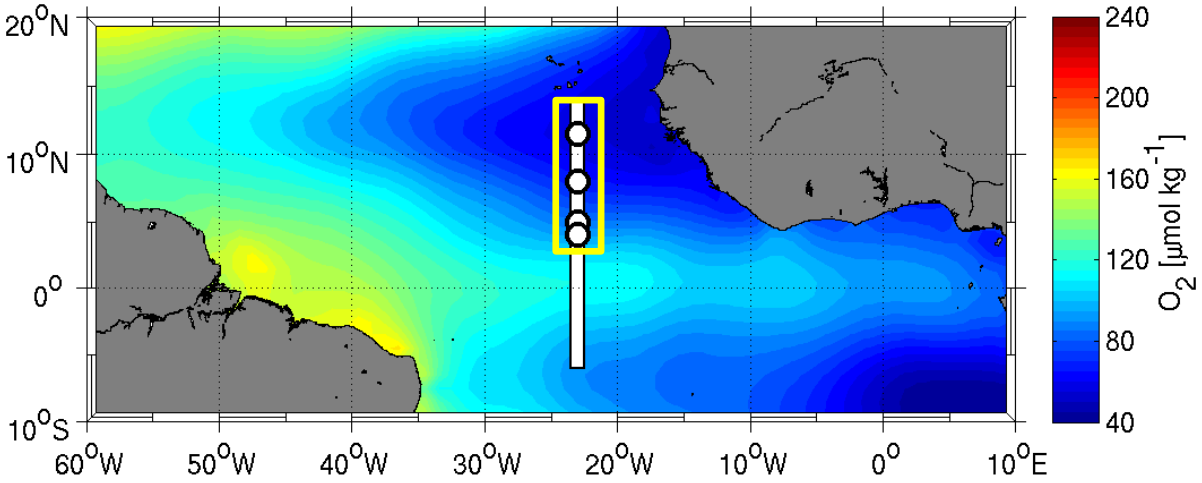
2. Data

3. Results

- 3.1 O_2 mooring time series / dominant time scales of O_2 fluctuations
- 3.2 Seasonal cycle
- 3.3 Velocity and O_2 fluctuations / O_2 flux

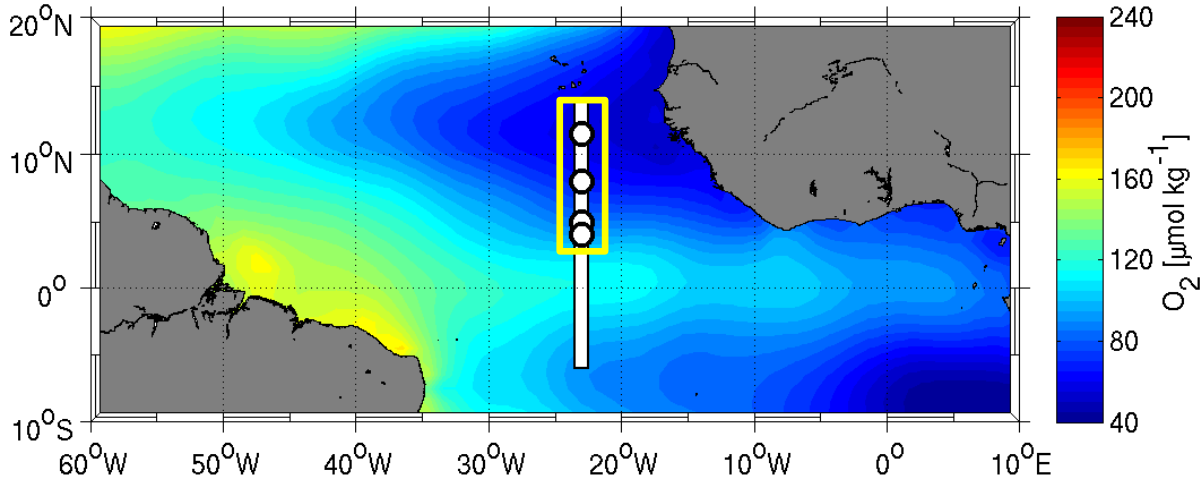
4. Summary

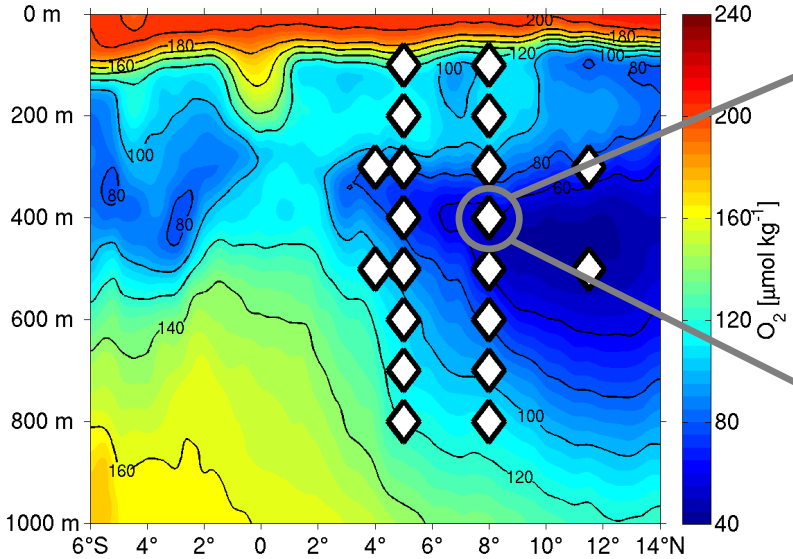
Moored observations along 23°W



background: O_2 distribution at 400m depth from *World Ocean Atlas 2009*

Moored observations along 23°W



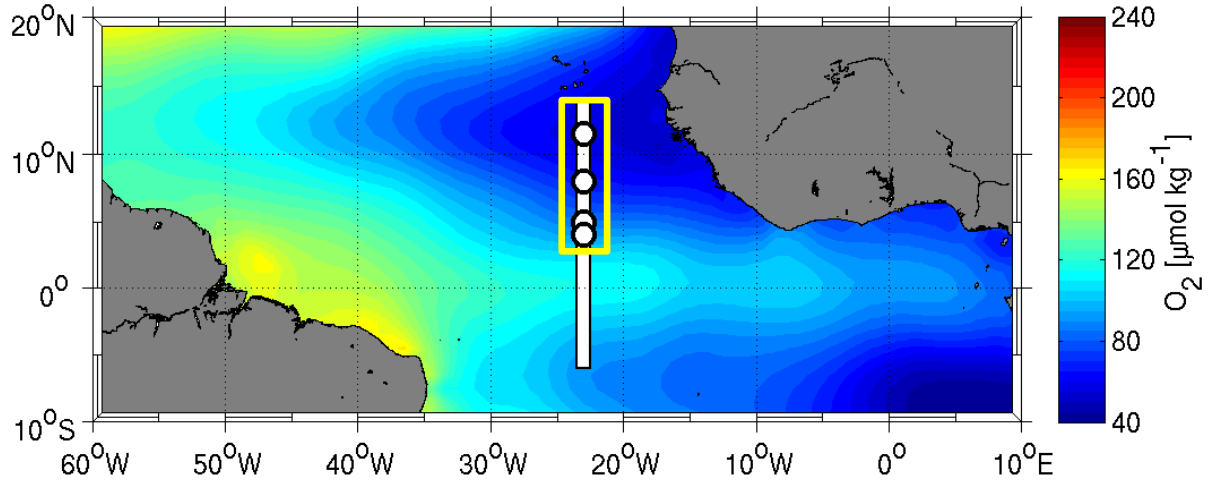


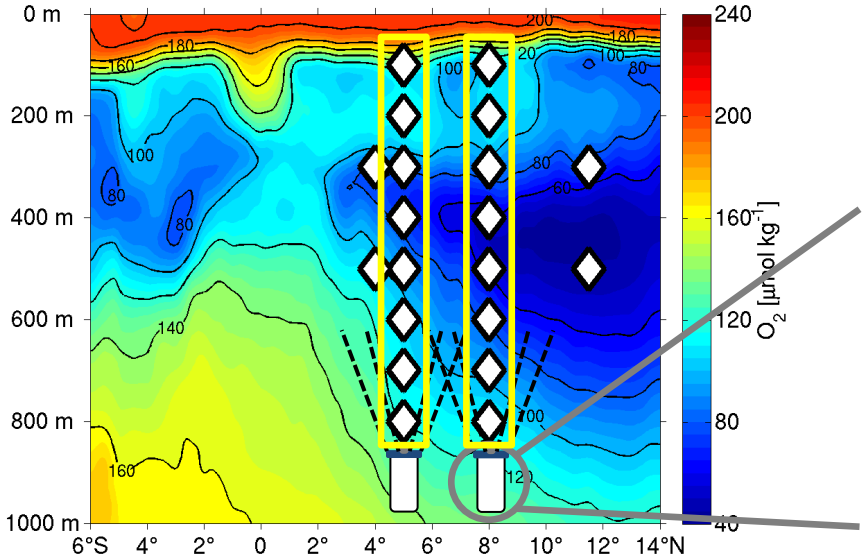
O_2 time series (optodes)

photo: B. Vogel

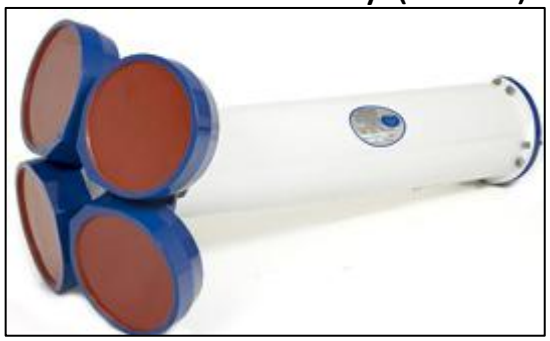
Moored observations along 23°W
(O_2 distribution: update from *Brandt et al. (2010)*)

Moored observations along 23°W





horizontal velocity (ADCP)



Moored observations along 23°W
(O_2 distribution: update from *Brandt et al. (2010)*)

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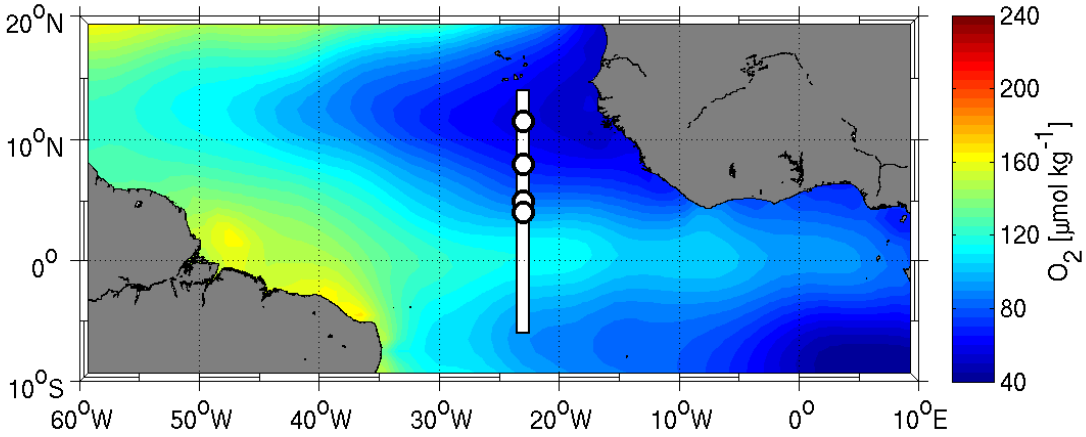
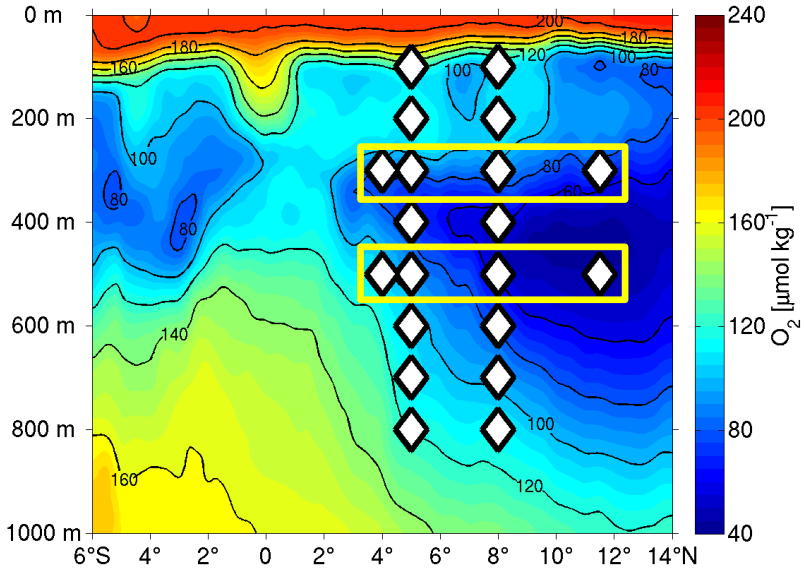
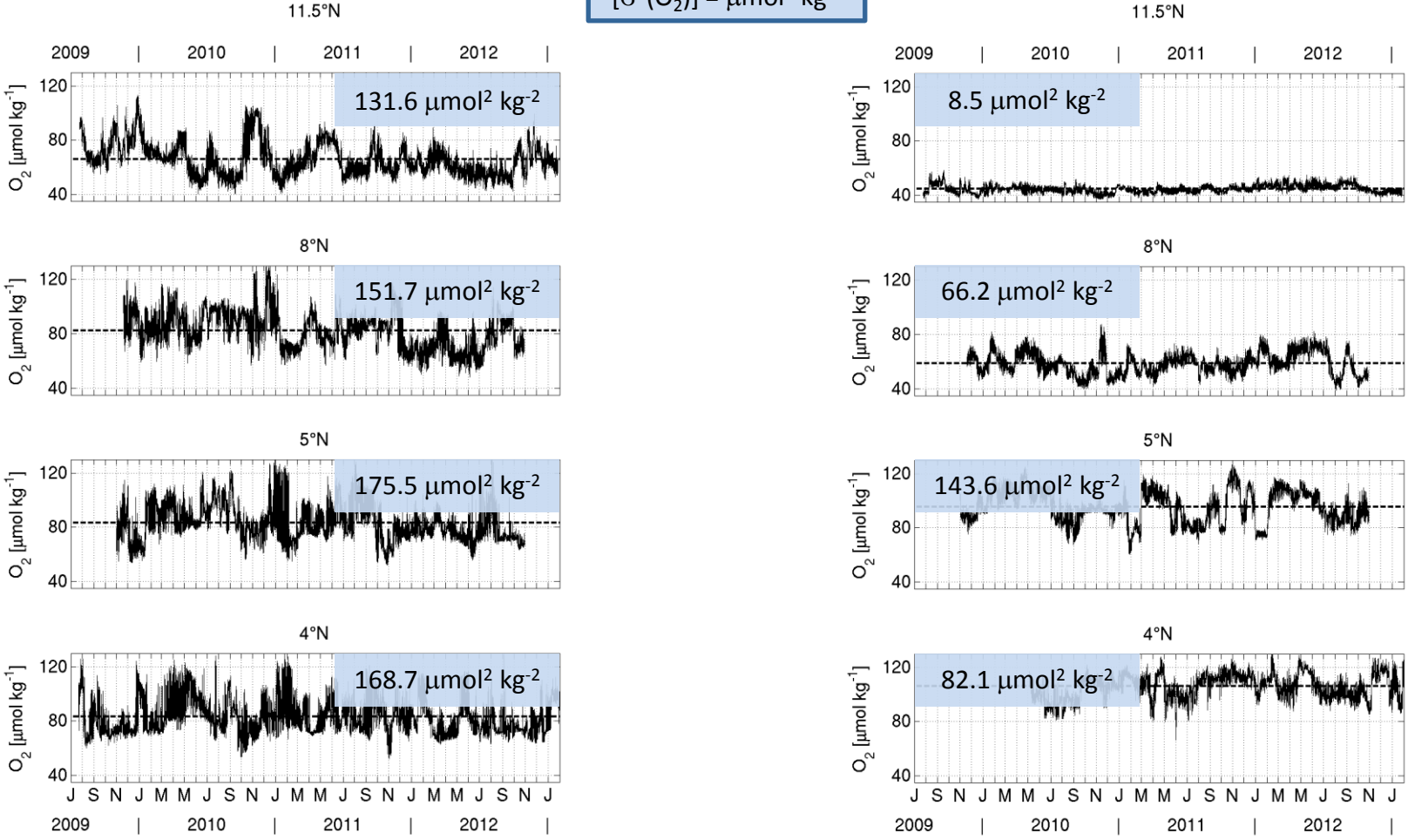




O_2 time series

300m | *500m*

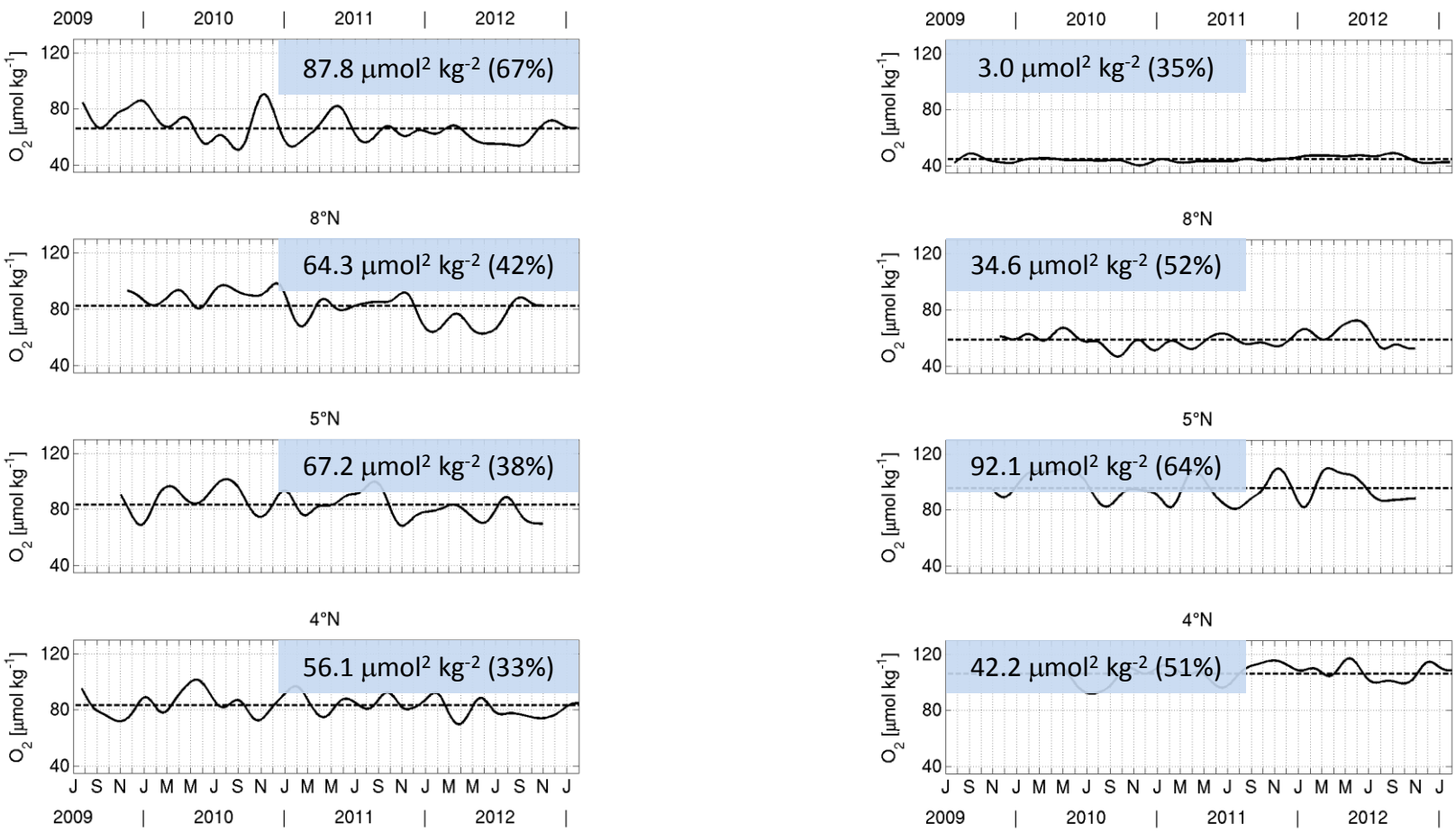
$[\sigma^2(O_2)] = \mu mol^2\ kg^{-2}$



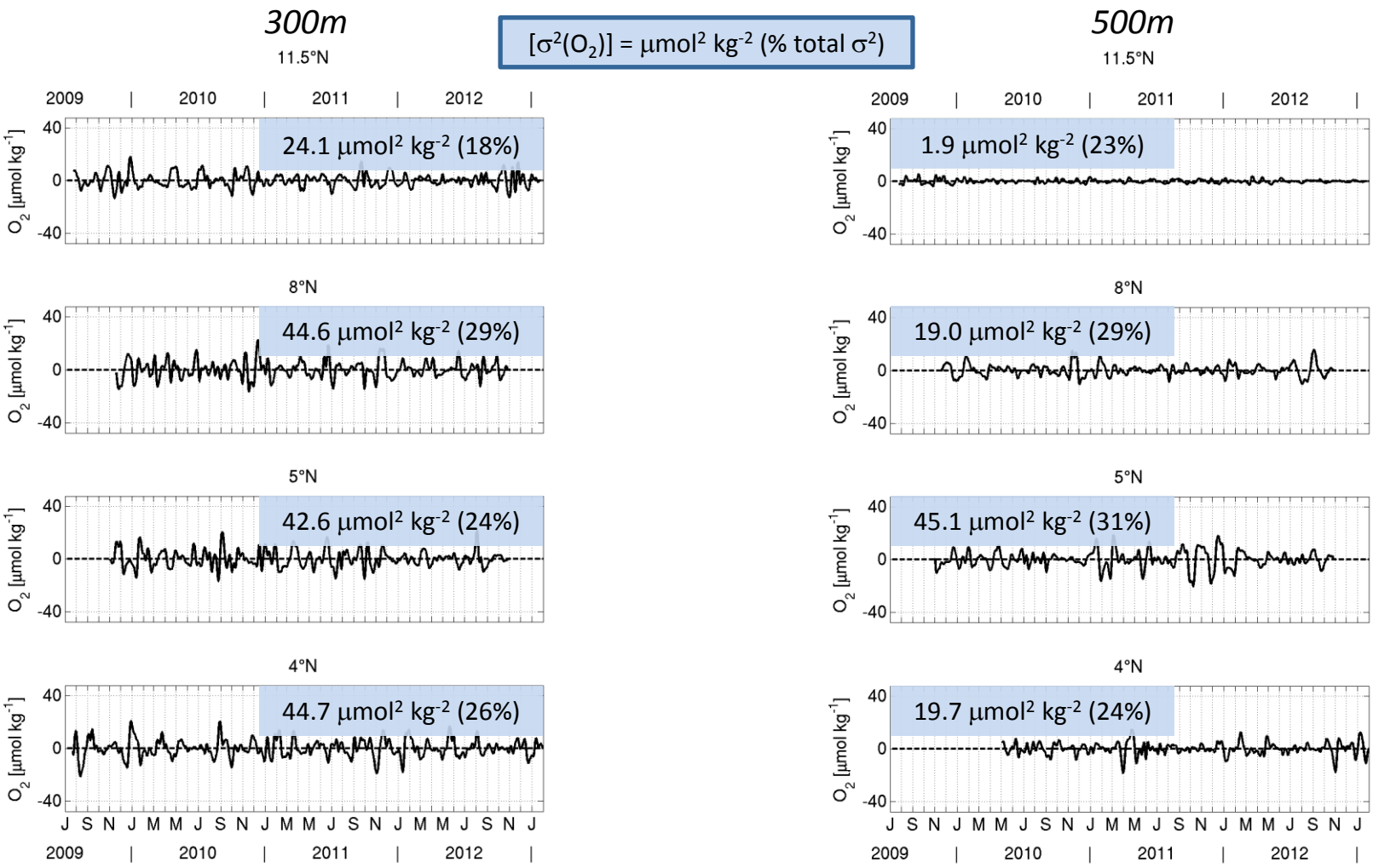
O_2 time series, lowpass >90d

300m | *500m*

$[\sigma^2(O_2)]$ = µmol² kg⁻² (% total σ^2)



O_2 time series, bandpass (10d – 90d)



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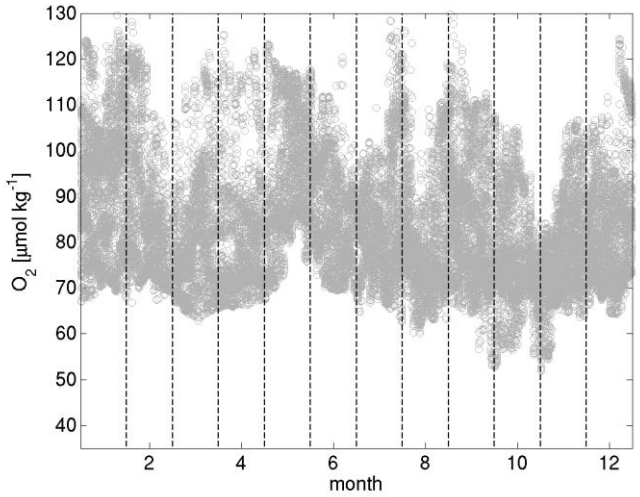
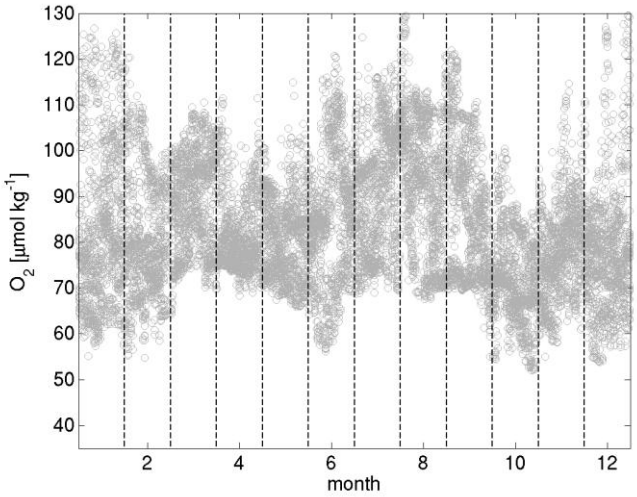
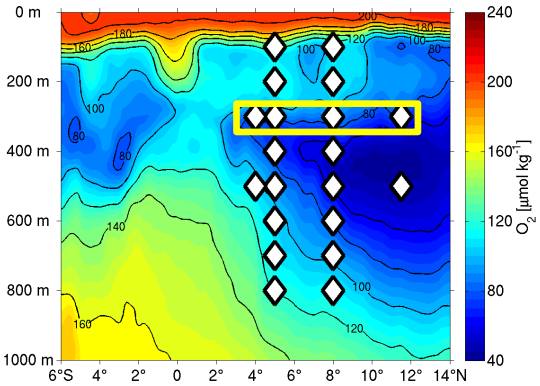
O_2 seasonal cycle at 300m along 23°W

4°N

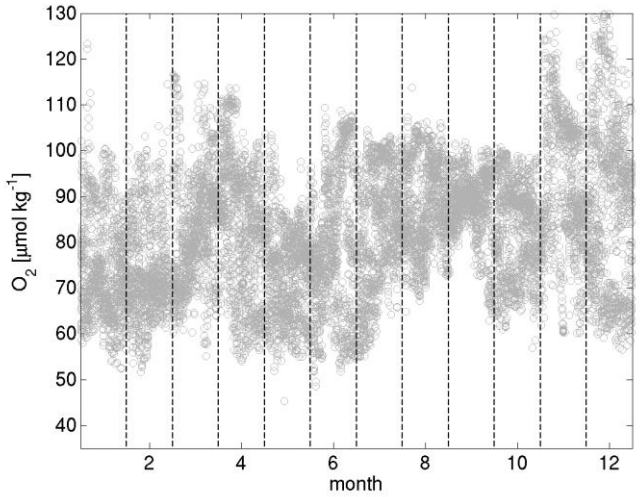


5°N

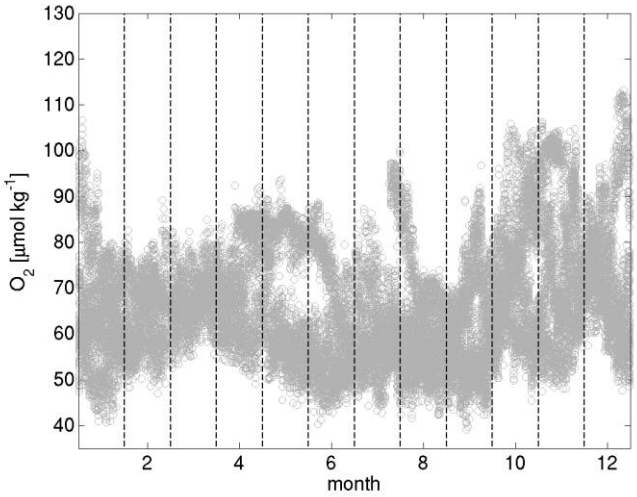




8°N

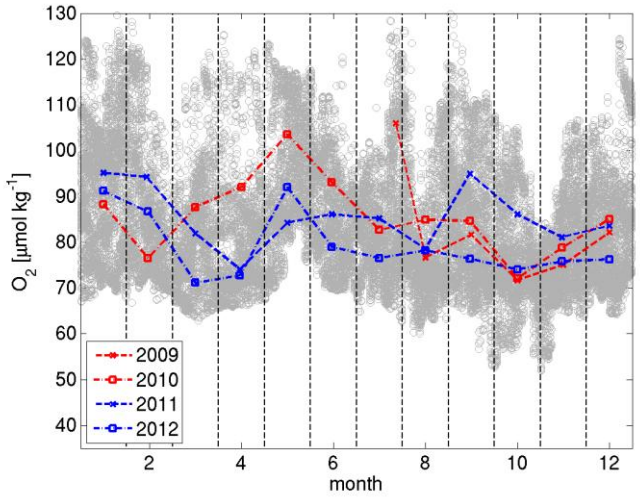


11.5°N

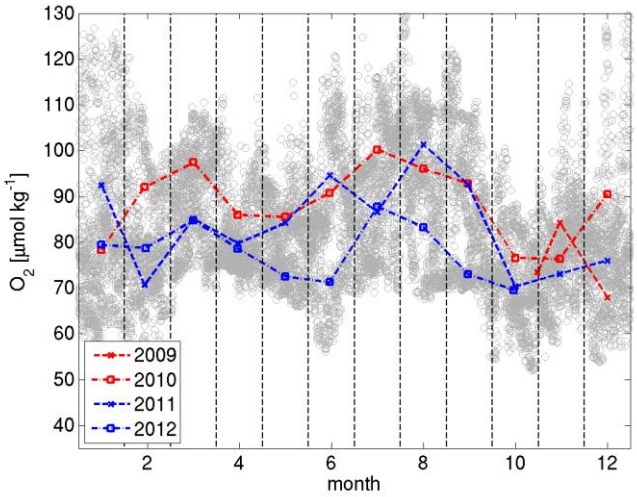


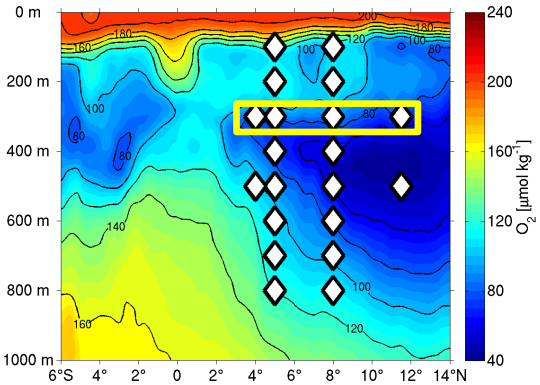
O_2 seasonal cycle at 300m along 23°W

4°N

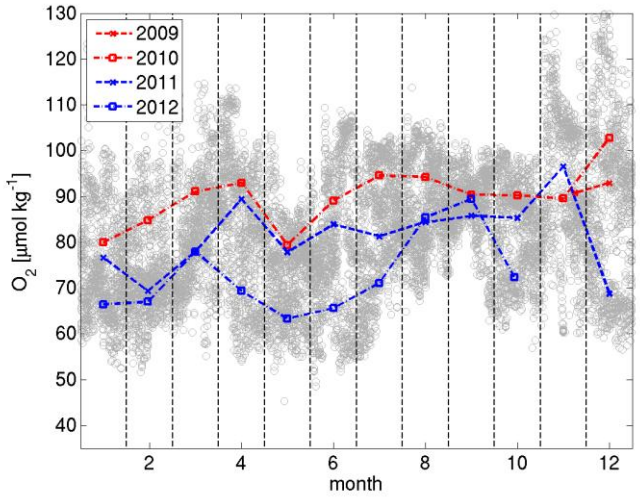


5°N

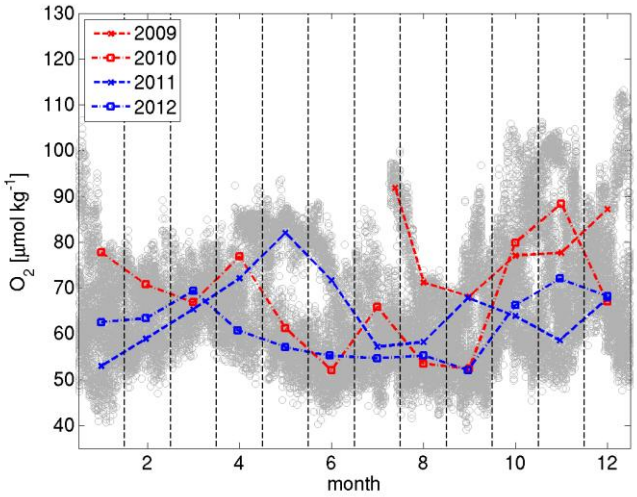




8°N



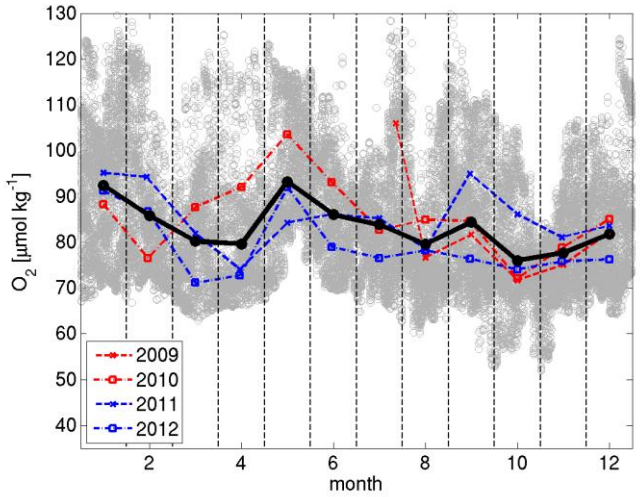
11.5°N



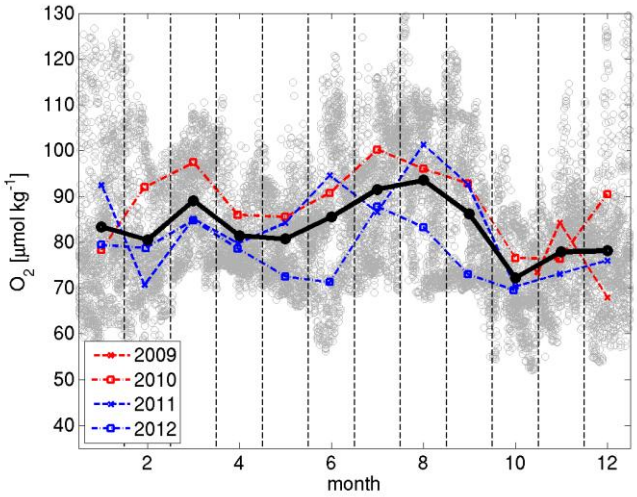
blue/red:
monthly means of individual years

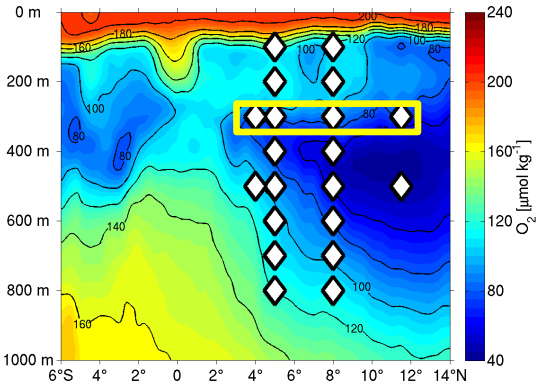
O_2 seasonal cycle at 300m along 23°W

4°N

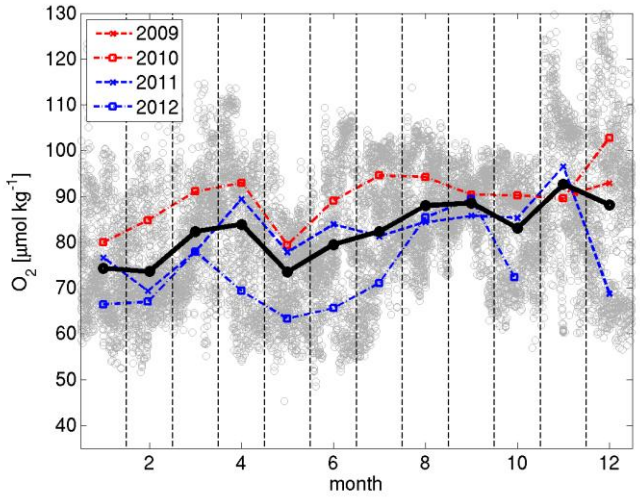


5°N

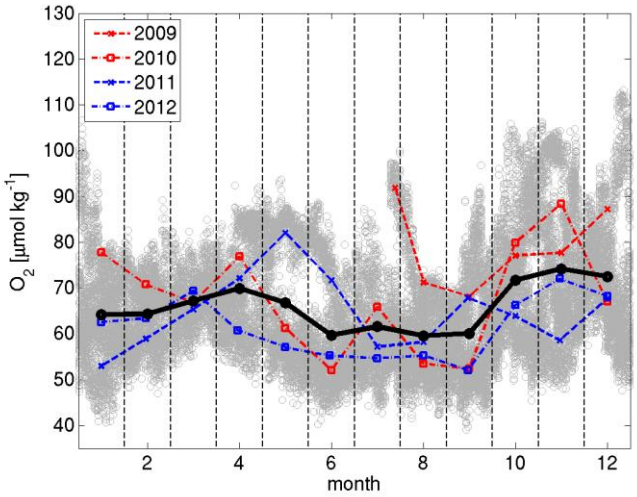




8°N



11.5°N

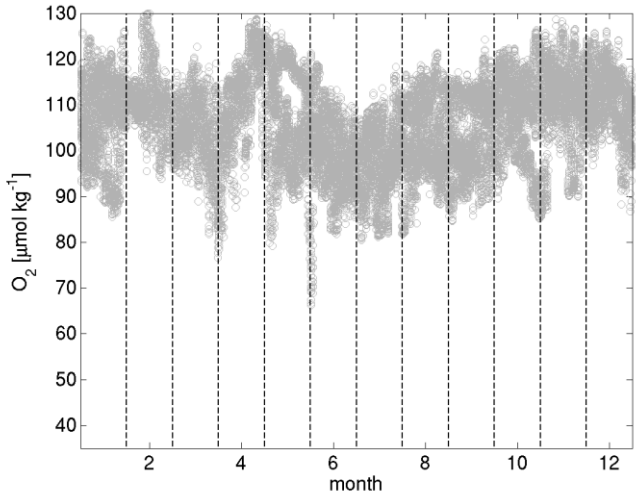


blue/red:
monthly means of individual years

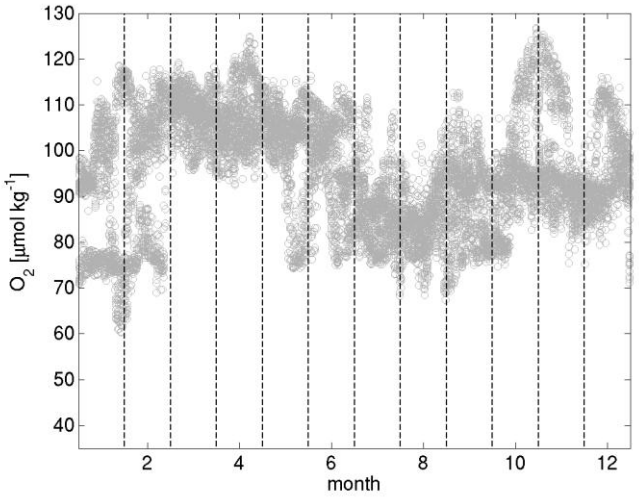
black:
monthly means of all years

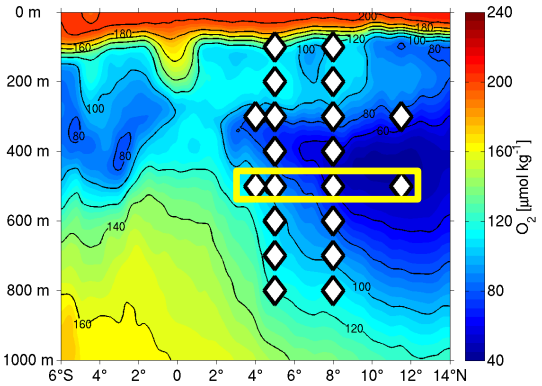
O_2 seasonal cycle at 500m along 23°W

4°N

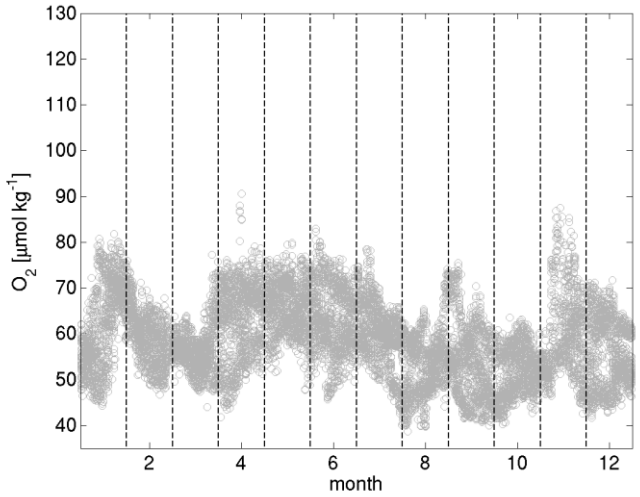


5°N

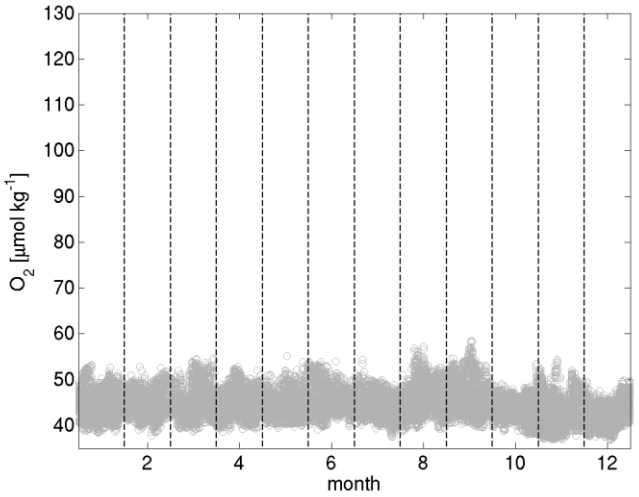




8°N



11.5°N



blue/red:
monthly means of individual years

O_2 seasonal cycle at 500m along 23°W

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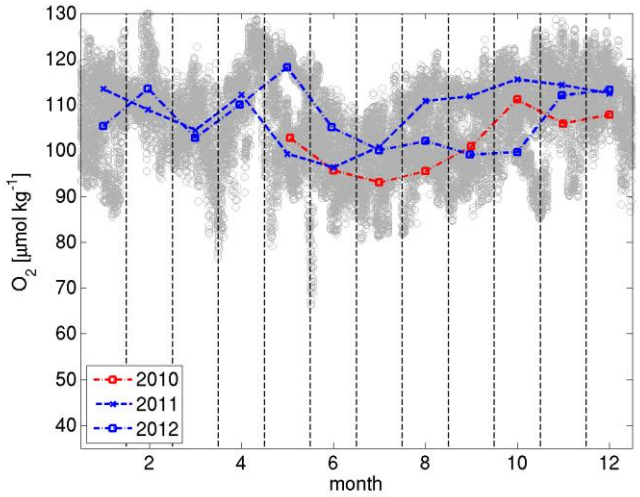
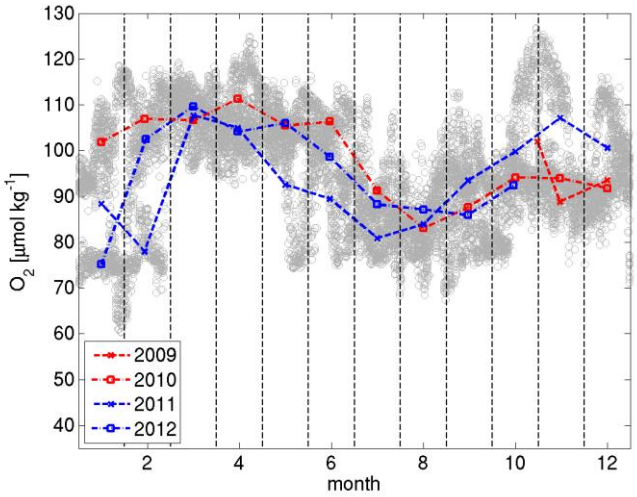
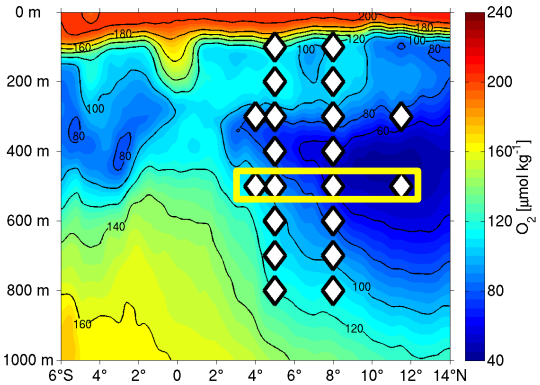
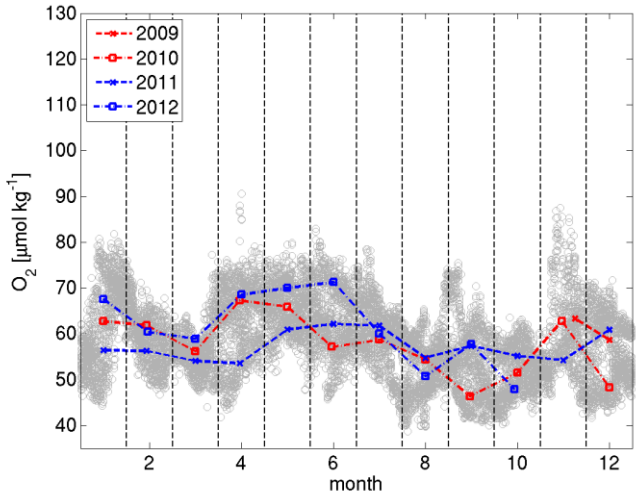


5°N

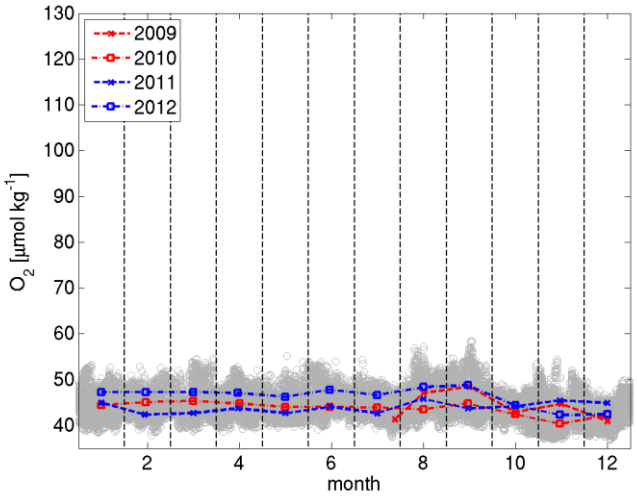




8°N



11.5°N



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O_2 seasonal cycle at 500m along 23°W

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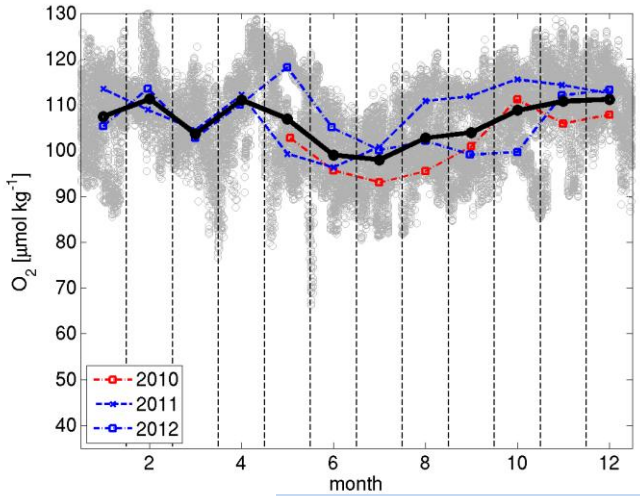

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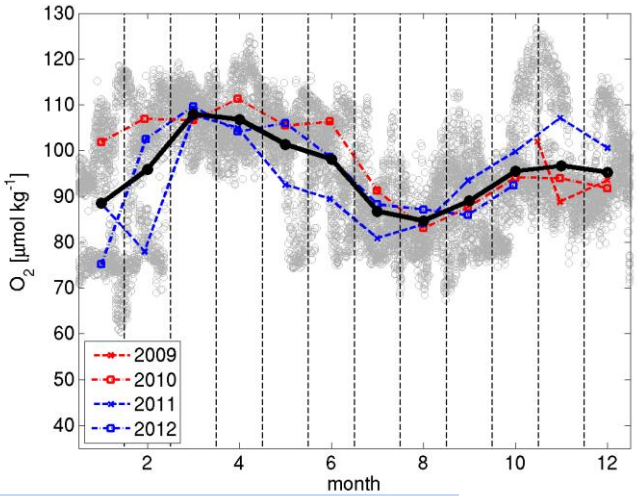
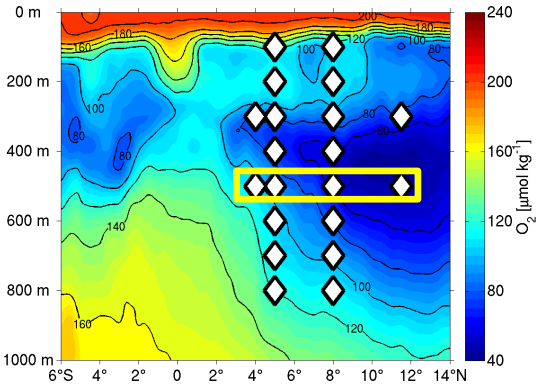
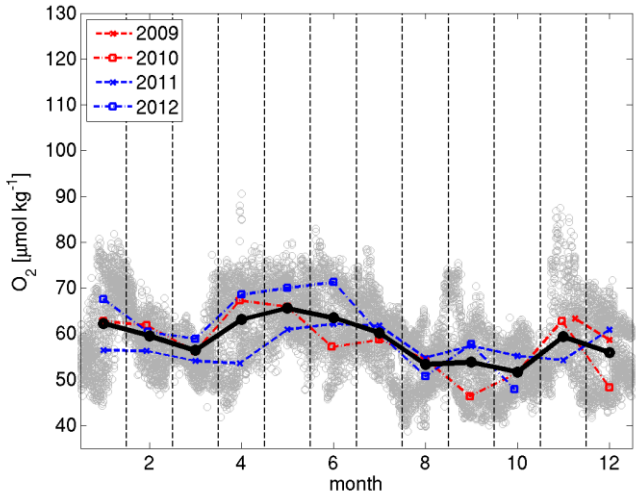


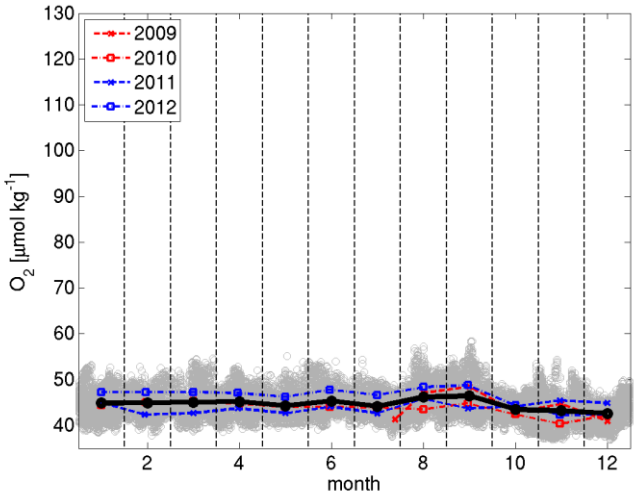


indication for persistent seasonal variability

8°N



11.5°N



blue/red:
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black:
monthly means of all years

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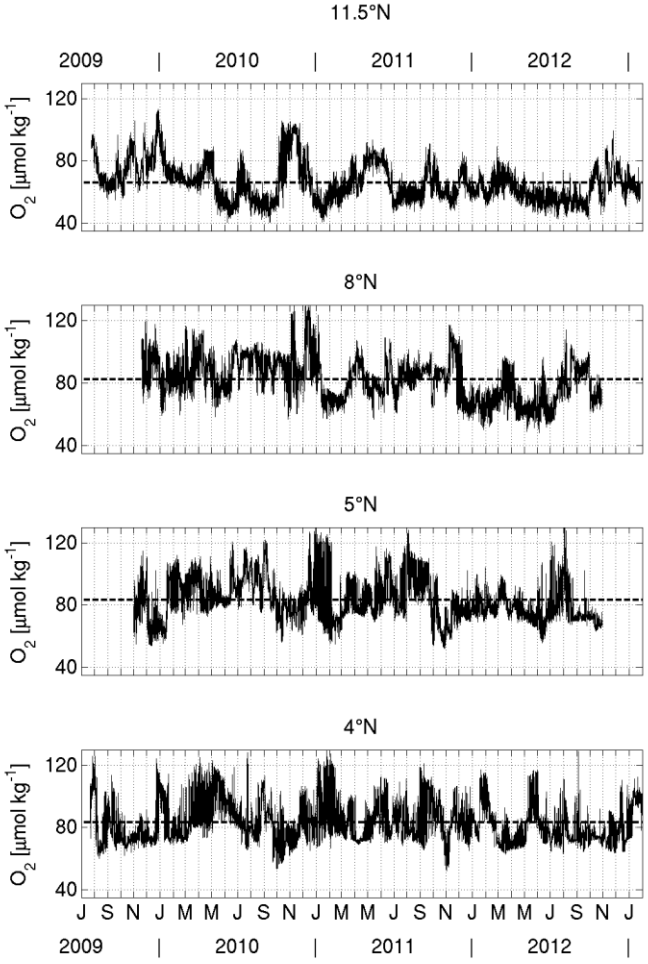
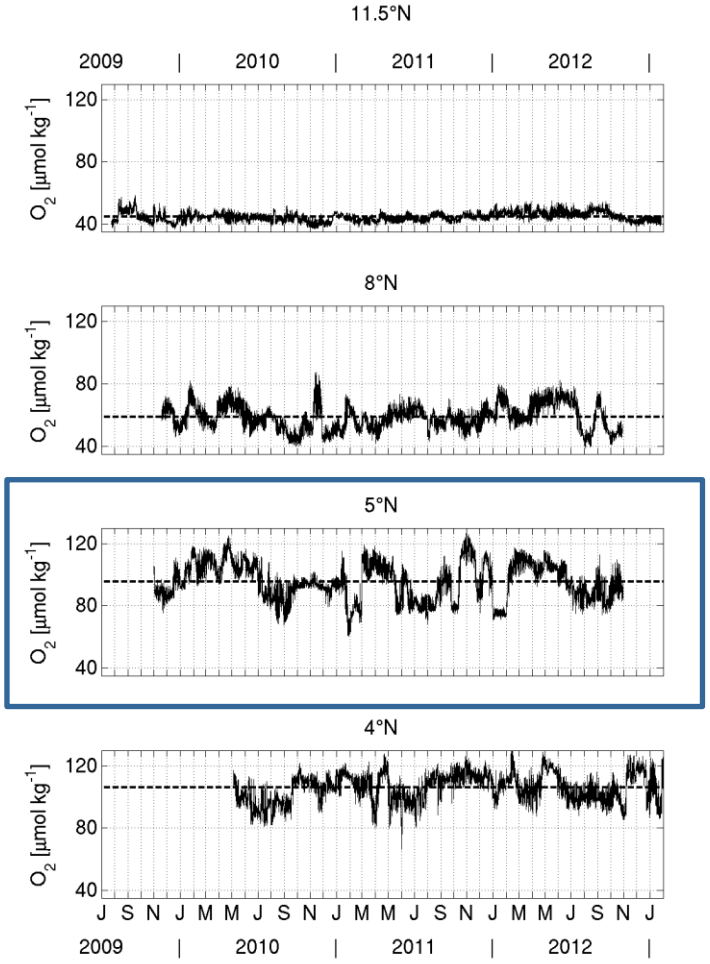
O_2 time series

300m



500m



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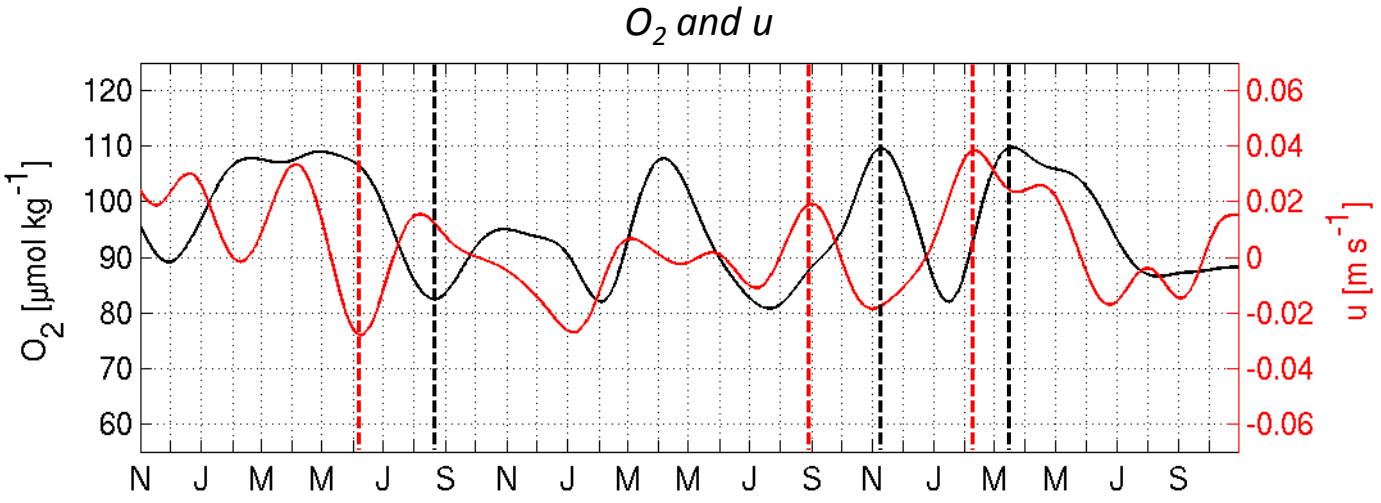
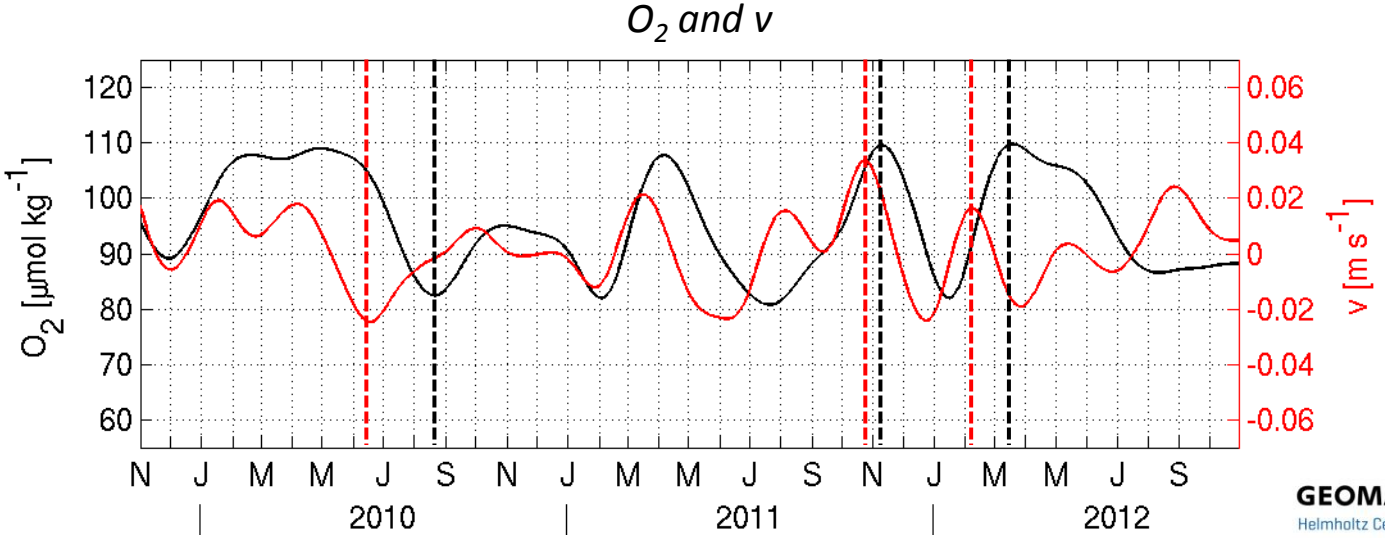
O_2 and velocity time series at 5°N, 500m, lowpass >90 days

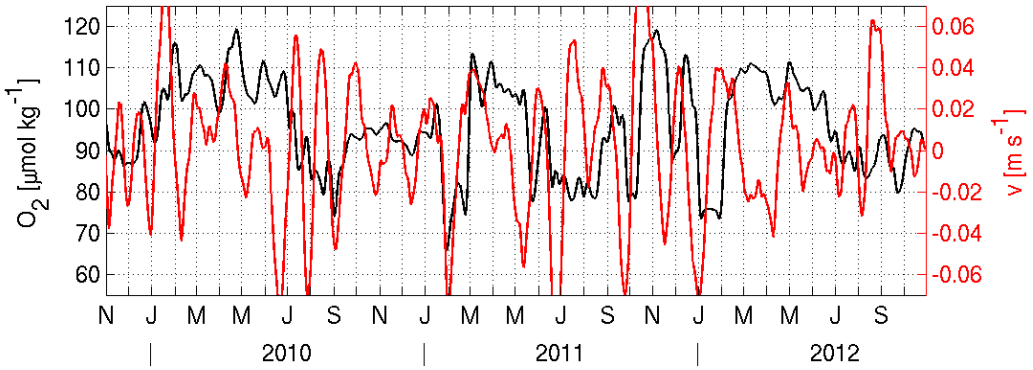


u, v leading **O_2**



O_2 flux at 5°N

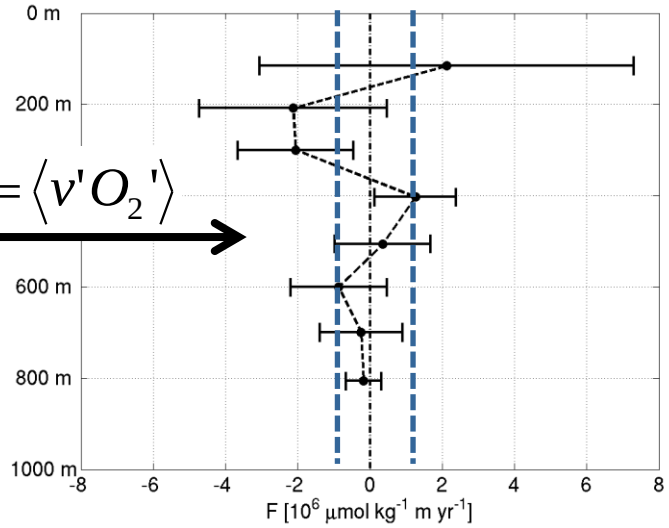
O_2 and v, lowpass > 10d (500m)



Analysis from Hahn et al. (subm.)

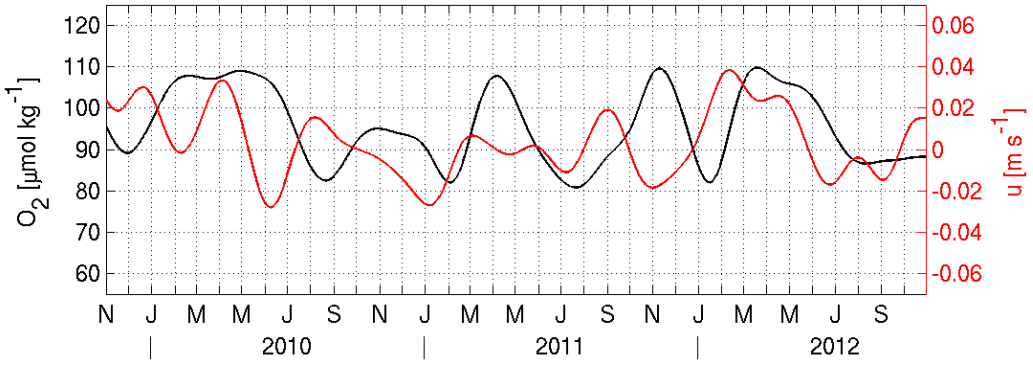
$$F = \langle v' O_2' \rangle$$

Meridional O_2 flux based on time series anomalies



Hahn et al. (subm.)

O_2 and u, lowpass > 90d (500m)

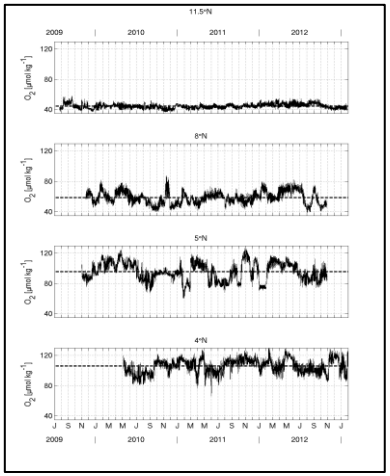


Zonal O_2 flux based on annual harmonic: of order O(F) = $1 \cdot 10^6$ µmol kg^{-1} m yr^{-1}

1. Motivation
2. Data
3. Results
   - 3.1 O_2 mooring time series / dominant time scales of O_2 fluctuations
   - 3.2 Seasonal cycle
   - 3.3 Velocity and O_2 fluctuations / O_2 flux

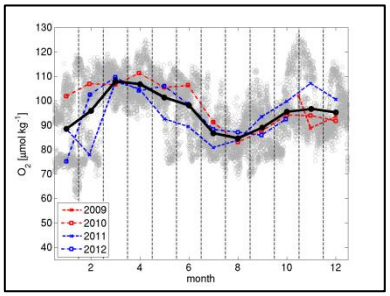
4. Summary

Summary

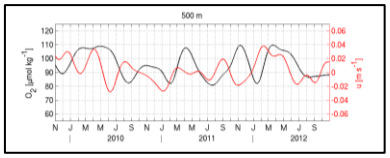


⇨ **O_2 mooring time series provide a reliable data set to manifest the complexity of O_2 fluctuations.**

⇨ **The Tropical Atlantic is rich of O_2 variability on seasonal (30% - 60%) and intraseasonal (up to 30% of total O_2 variance) time scales.**



⇨ **No well-defined seasonal cycle at 300m / some indication for a seasonal cycle at 500m.**



⇨ **Seasonal variability of zonal currents might contribute to O_2 supply of the southern OMZ boundary.**

Acknowledgements

This study was founded by the Sonderforschungsbereich SFB754 ‘Climate-Biogeochemistry Interactions in the Tropical Ocean’.

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Thank you for your attention!