Seasonal variability of the Mauritania Current

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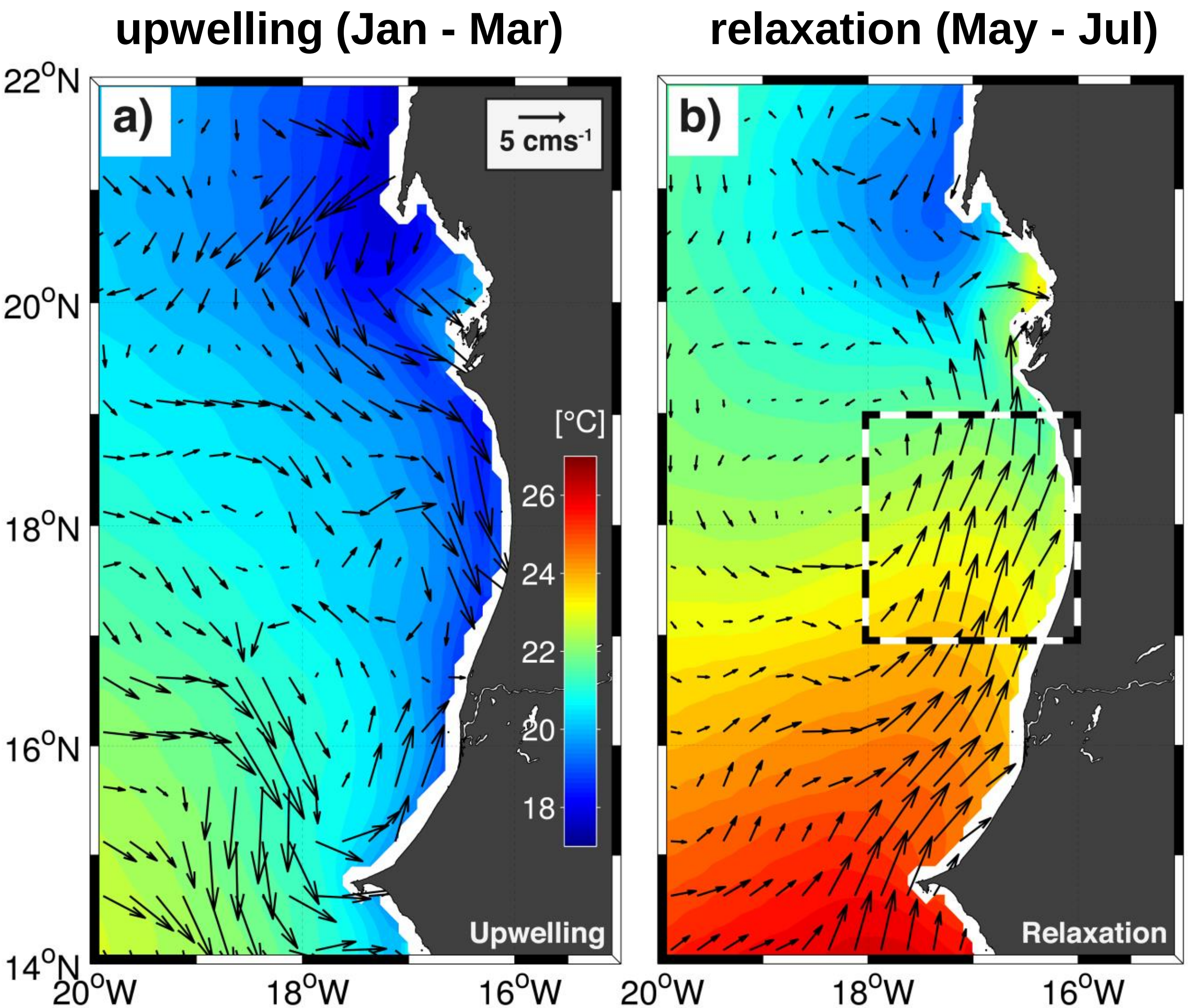
PREFACE

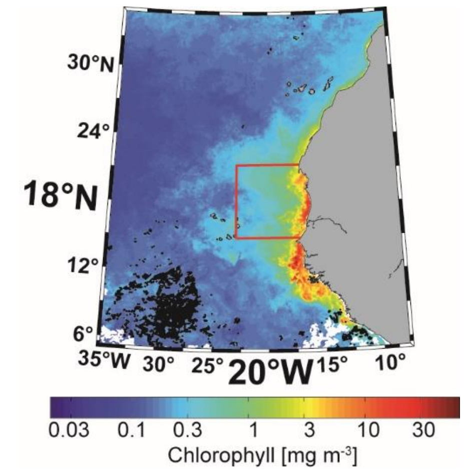
GEOMAR

OCEANS
FROM THE DEEP SEA
TO THE ATMOSPHERE

Pirata23 meeting | 22-23 Oct. 2018

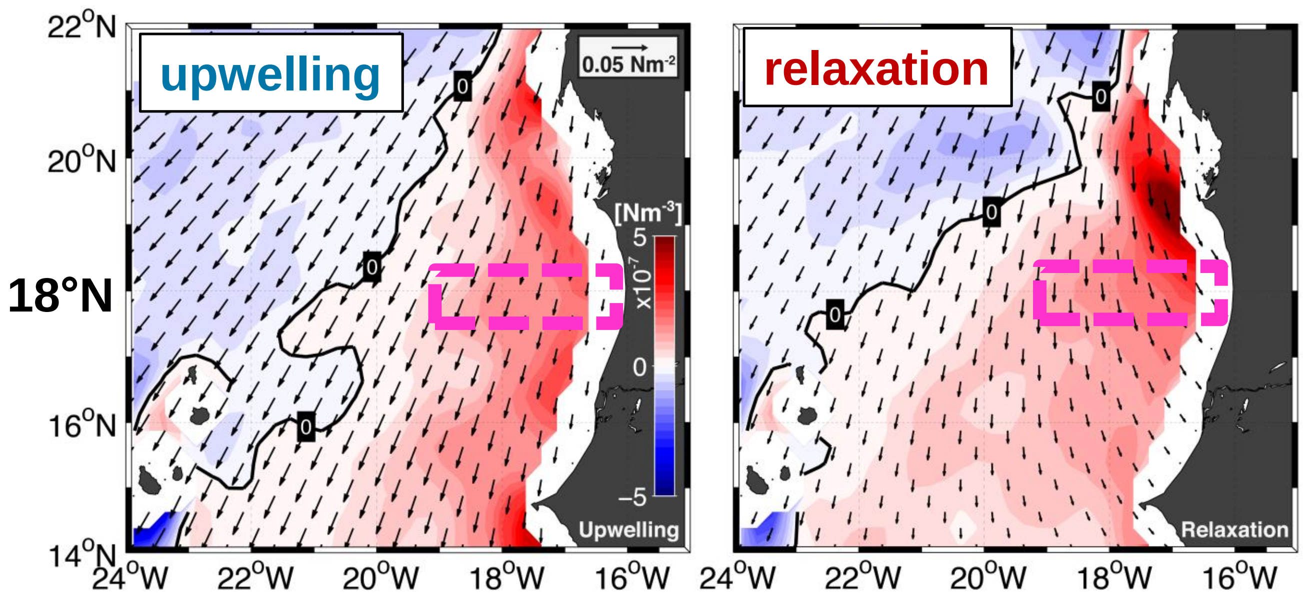
Geostrophic surface velocities (**AVISO**) and sea surface temperature (**OISST**)





- Geostrophic surface velocities show equatorward near-shore flow during **upwelling season**
- Low reversal and rapid surface warming up to 20°N observed during **relaxation season**

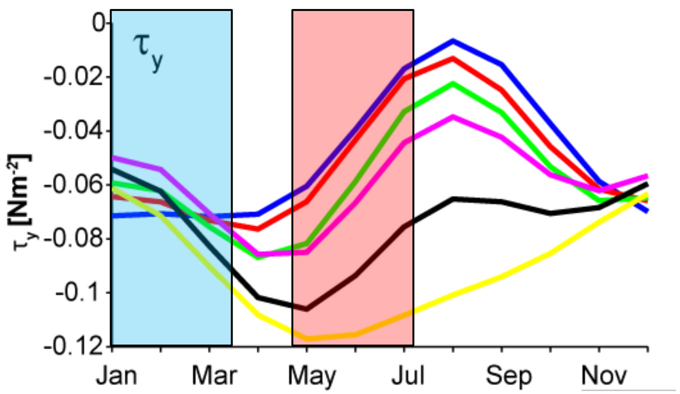
Seasonal variability of wind stress and wind stress curl



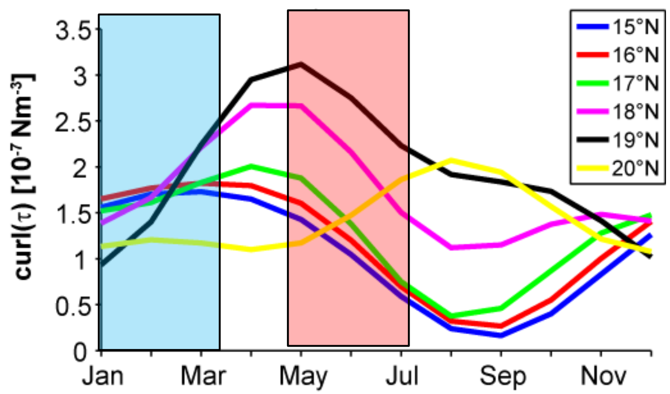
Winds equatorward during both seasons:

- Upwelling season shows reduced wind stress curl;
- wind stress curl is enhanced during relaxation season.

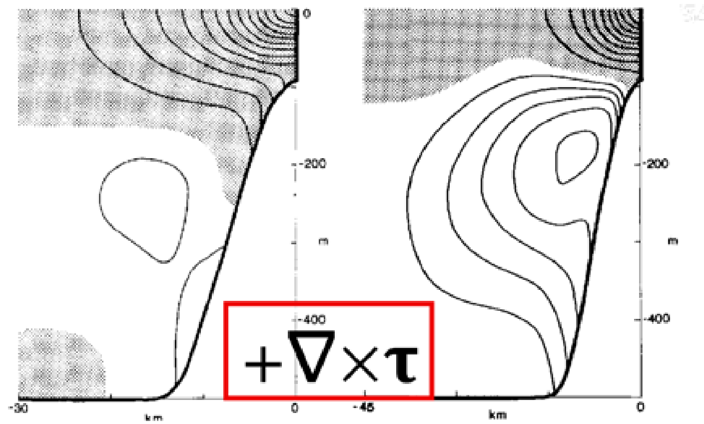
wind stress



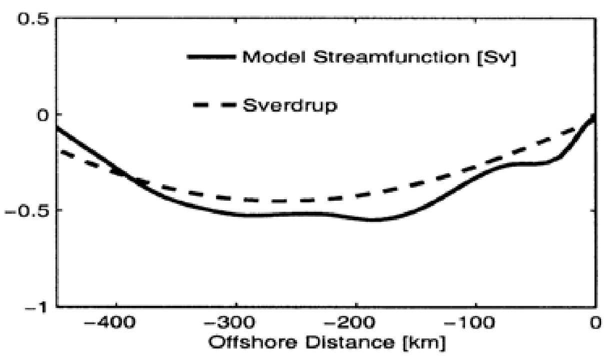
wind stress curl



Dynamics of eastern boundary currents

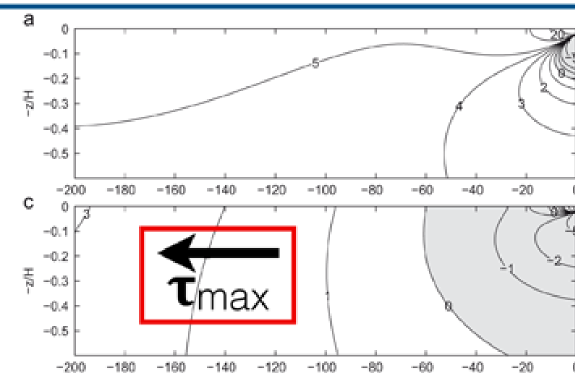


- ***Philander & Yoon* [1982]**: Poleward undercurrent (PUC) beneath downwind, equatorward jet
- **McCreary & Chao [1985]**: Observed strength of PUC only matched when wind stress curl is introduced



- ***McCreary et al.* [1987]**: PUC largely driven by curl; equatorward surface flow can exceed PUC
- ***Marchesiello et al.* [2003]**: Good quantitative agreement between ROMS transport and Sverdrup from local wind stress curl

- ***Fennel et al.* [2012]**: Zonal structure of wind stress curl sets the structure of the surface flow
- ***Junker et al.* [2015]**: Flow variability directly corresponds to seasonal variability of wind stress curl



Geostrophic surface velocities (AVISO) and sea surface temperature (OISST)

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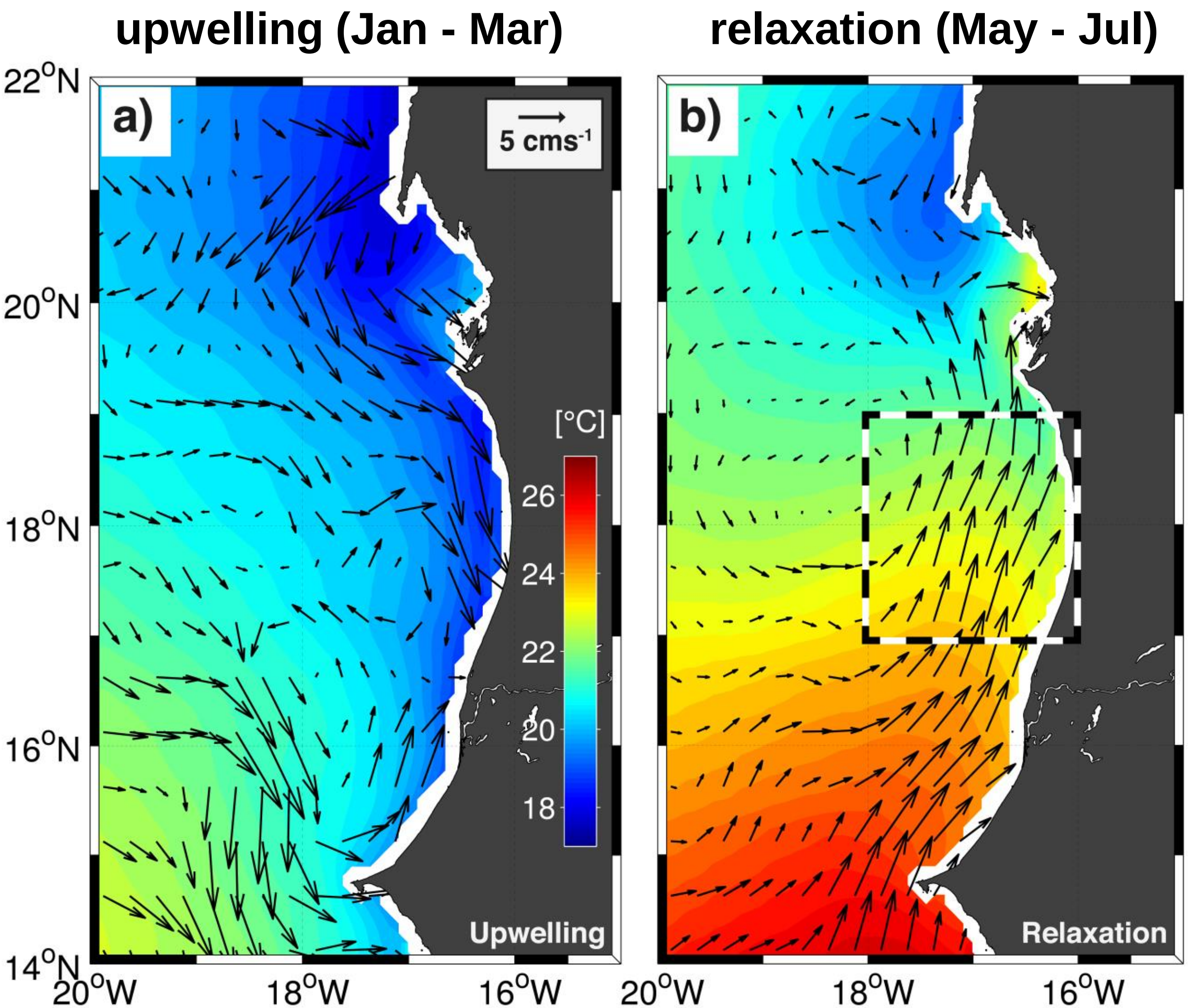

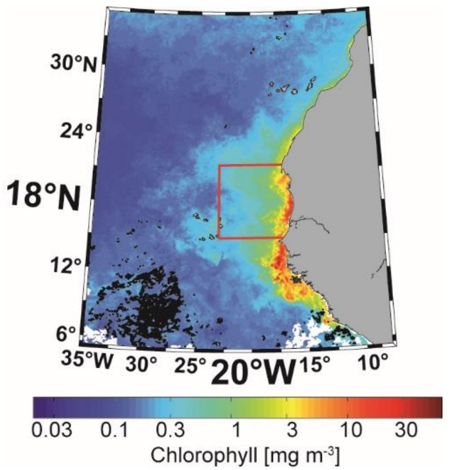

- Geostrophic surface velocities show equatorward near-shore flow during **upwelling season**
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Previous observations of the Mauritanian eastern boundary circulation

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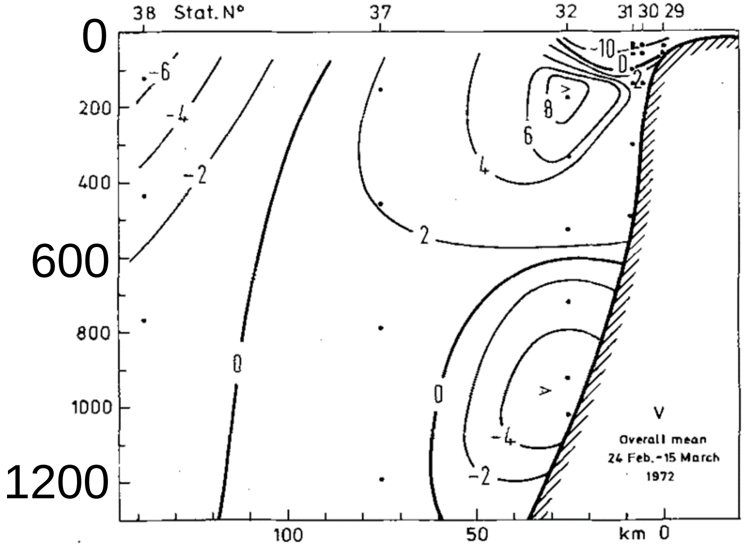
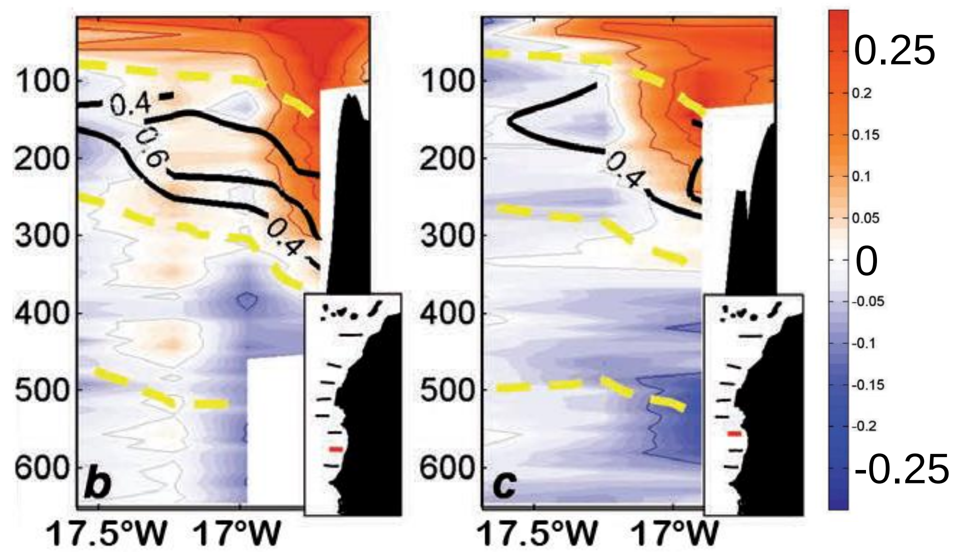
March 1972



Mittelstaedt (1976)

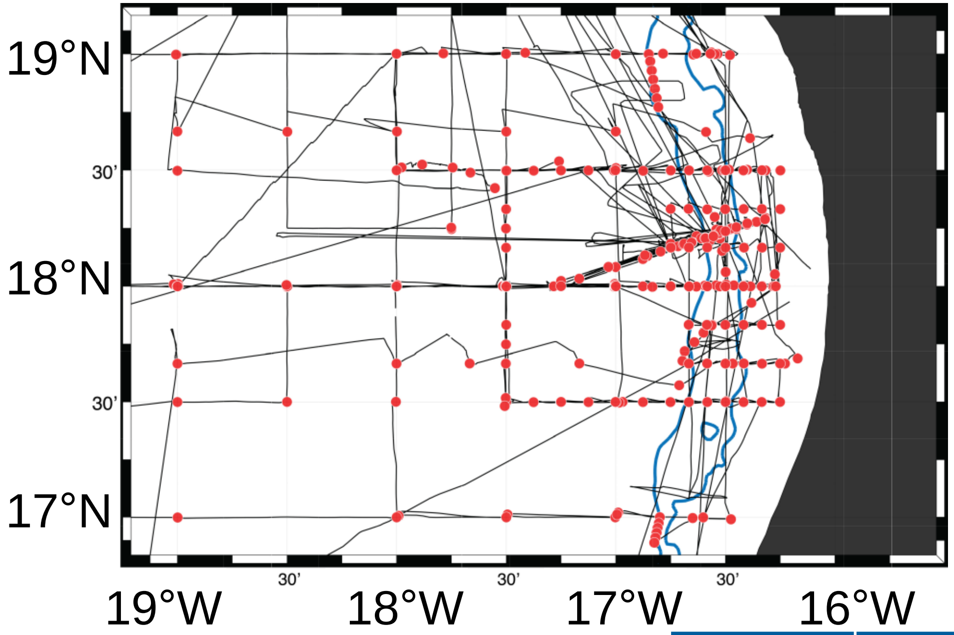
November 2008



Peña-Izquierdo et al. (2012)

- Pervious studies have been limited to single-cruise data or short-term moored observations that did not resolve seasonal variability

Observations

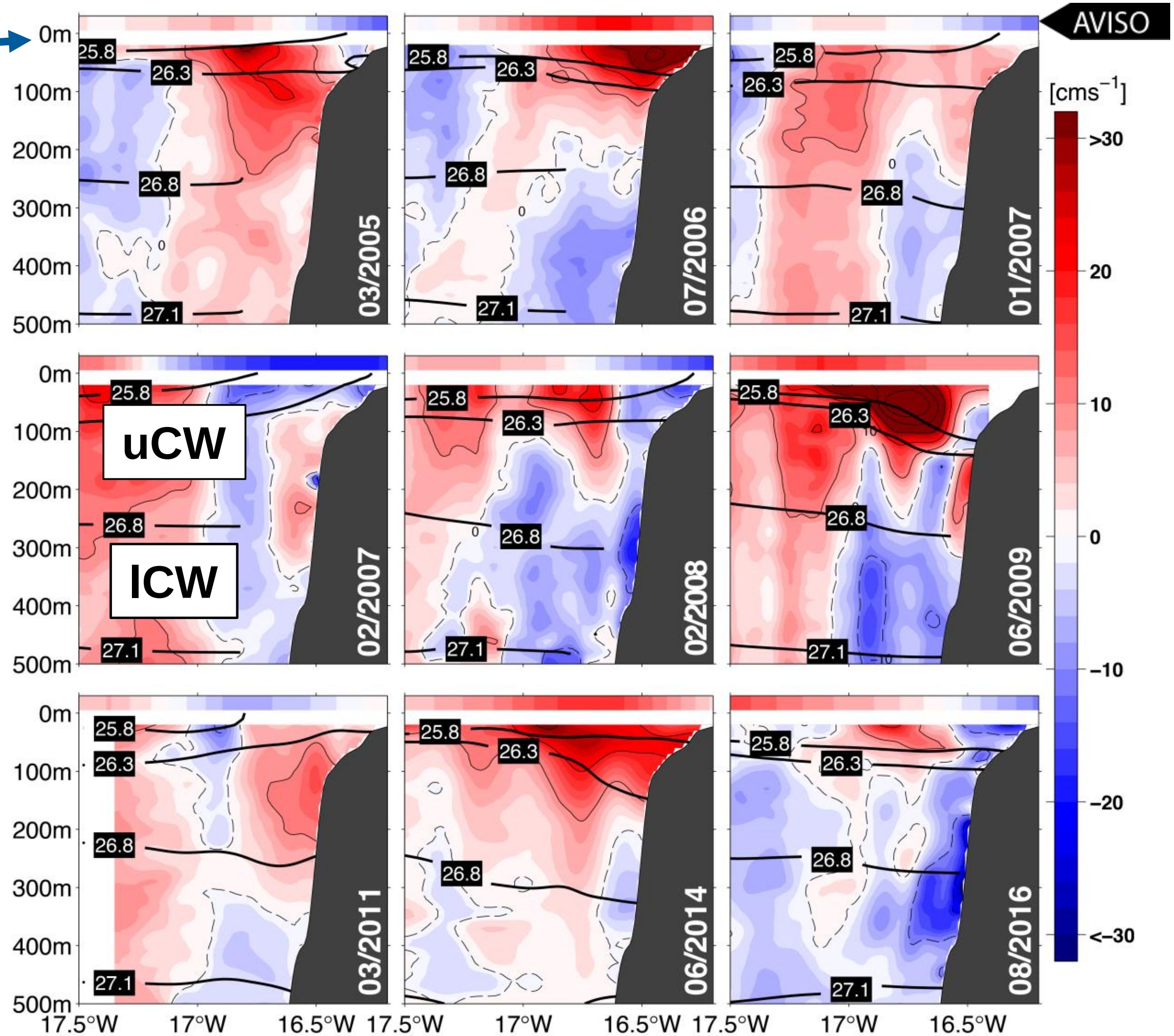


Shipboard velocity and hydrography observations from 9 research cruises to the Mauritanian Upwelling region between 2005 -2016 are used covering the upwelling (Jan-March) and relaxation (May-July) seasons

Cruise	Vessel	Date
P320	RV Poseidon	Mar - Apr 2005
M68/3	RV Meteor	Jul – Aug 2006
P347	RV Poseidon	Jan – Feb 2007
P348	RV Poseidon	Feb 2007
ATA3	RV L'Atalante	Feb 2008
P399	RV Poseidon	Jun 2009
MSM17/4	RV M.S. Merian	Mar - Apr 2011
M107	RV Meteor	Jun 2014
M129	RV Meteor	Aug 2016

Velocity sections at 18°N

Geostropic velocities from satellite altimetry (AVISO)



Watermasses:

upper Central Water (uCW) $25.8<\sigma_\theta<26.8$

lower Central Water (lCW) $26.8<\sigma_\theta<27.1$

Velocity sections at 18°N

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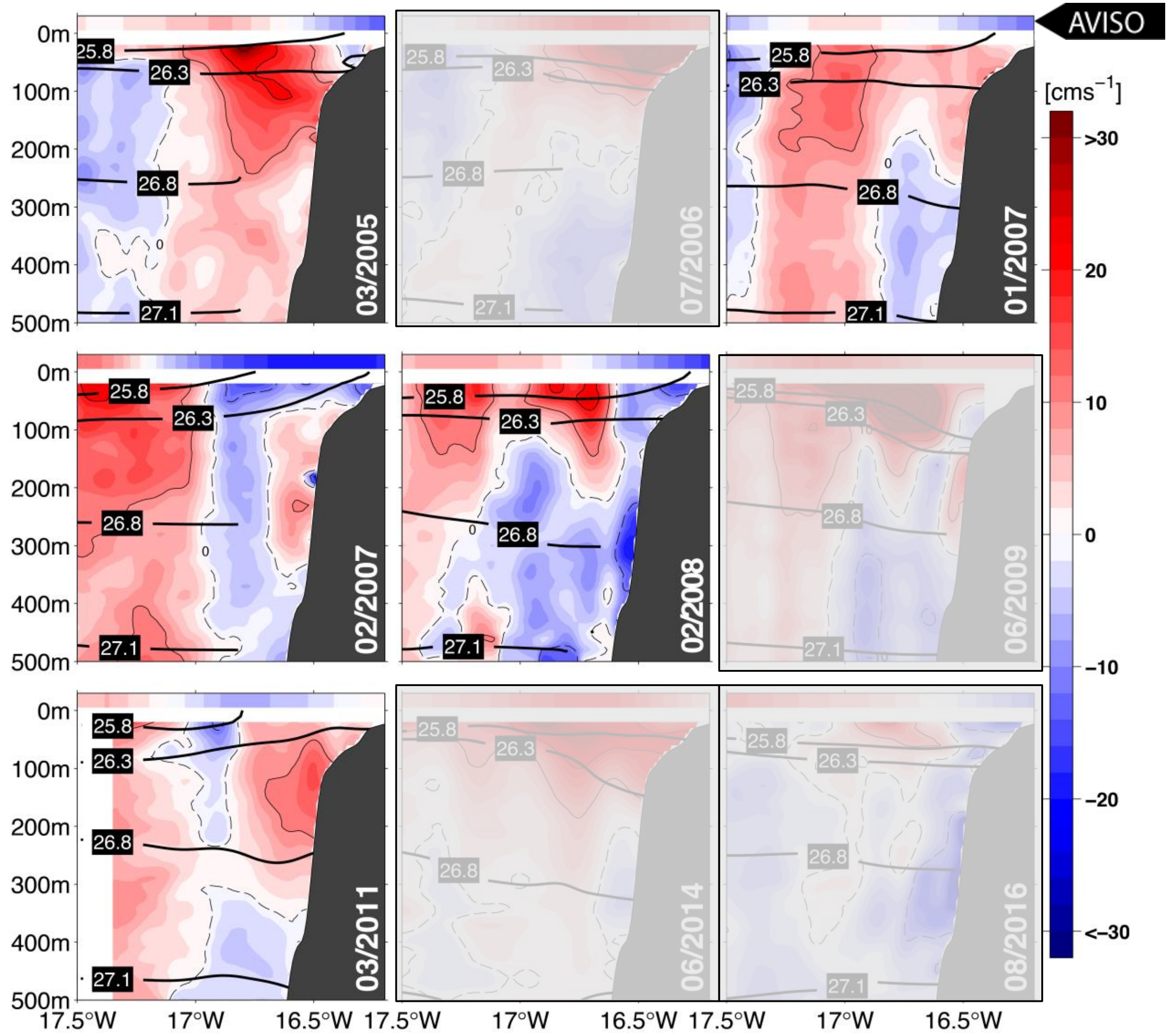
<u>Upwelling season:</u>

- ➢ equatorward flow above the shelf
- ➢ weak poleward subsurface flow;
- ➢ weak equatorward flow in ICW layer (300-500m)

<u>Relaxation season:</u>

- ➢ elevated poleward flow from the surface to 300m depth.
- ➢ weak equatorward flow in ICW layer (300-500m)



Velocity sections at 18°N

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- weak poleward subsurface flow;
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- elevated poleward flow from the surface to 300m depth.
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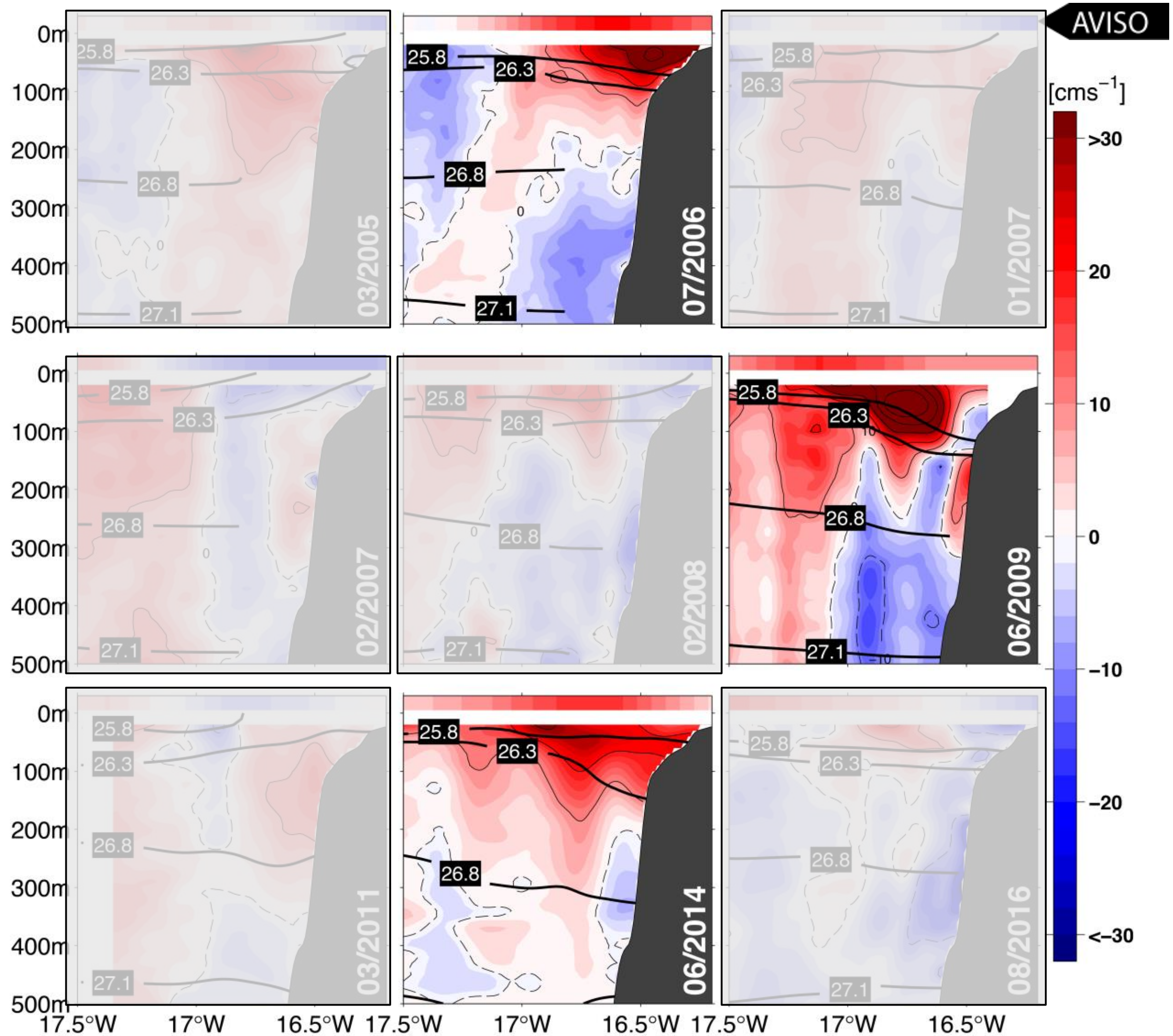
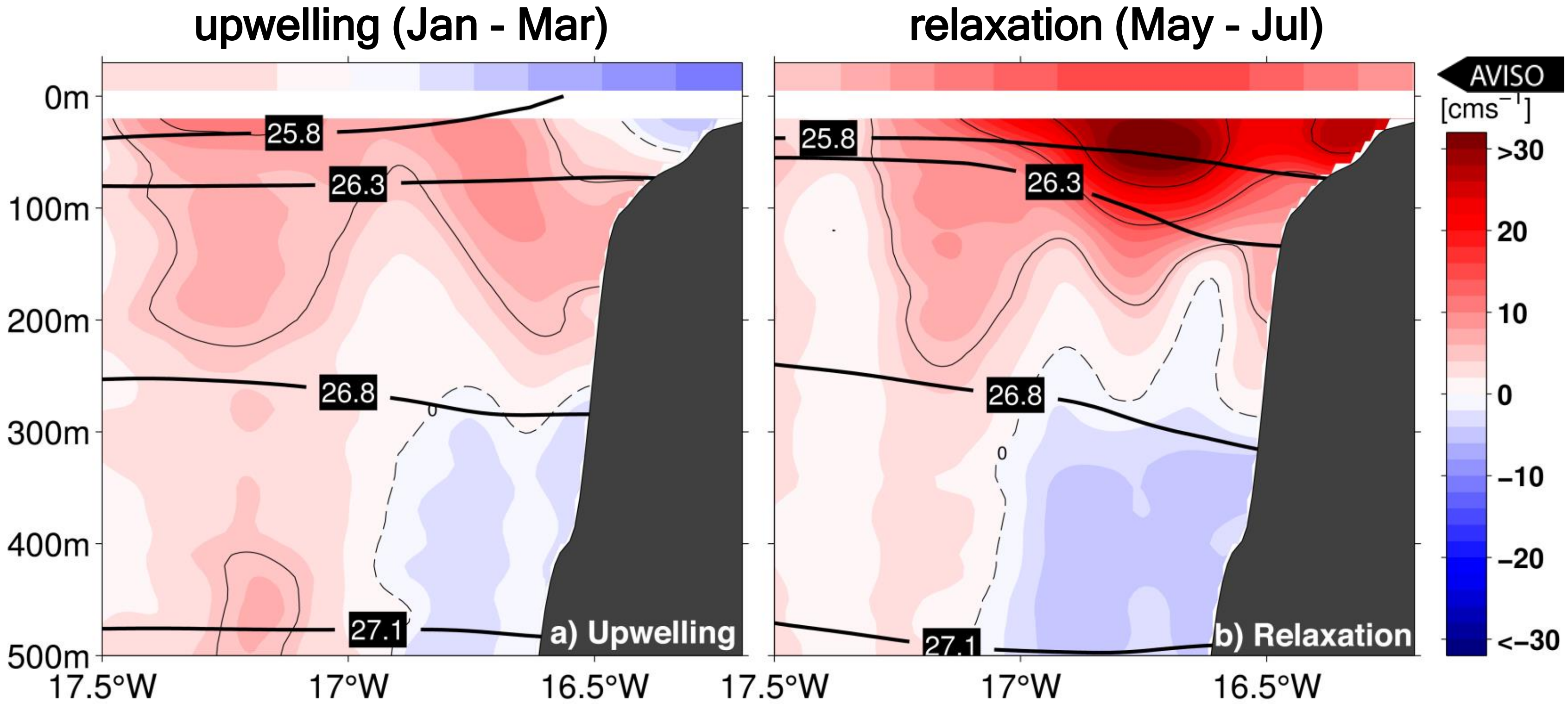


Seasonal mean velocity sections at 18°N

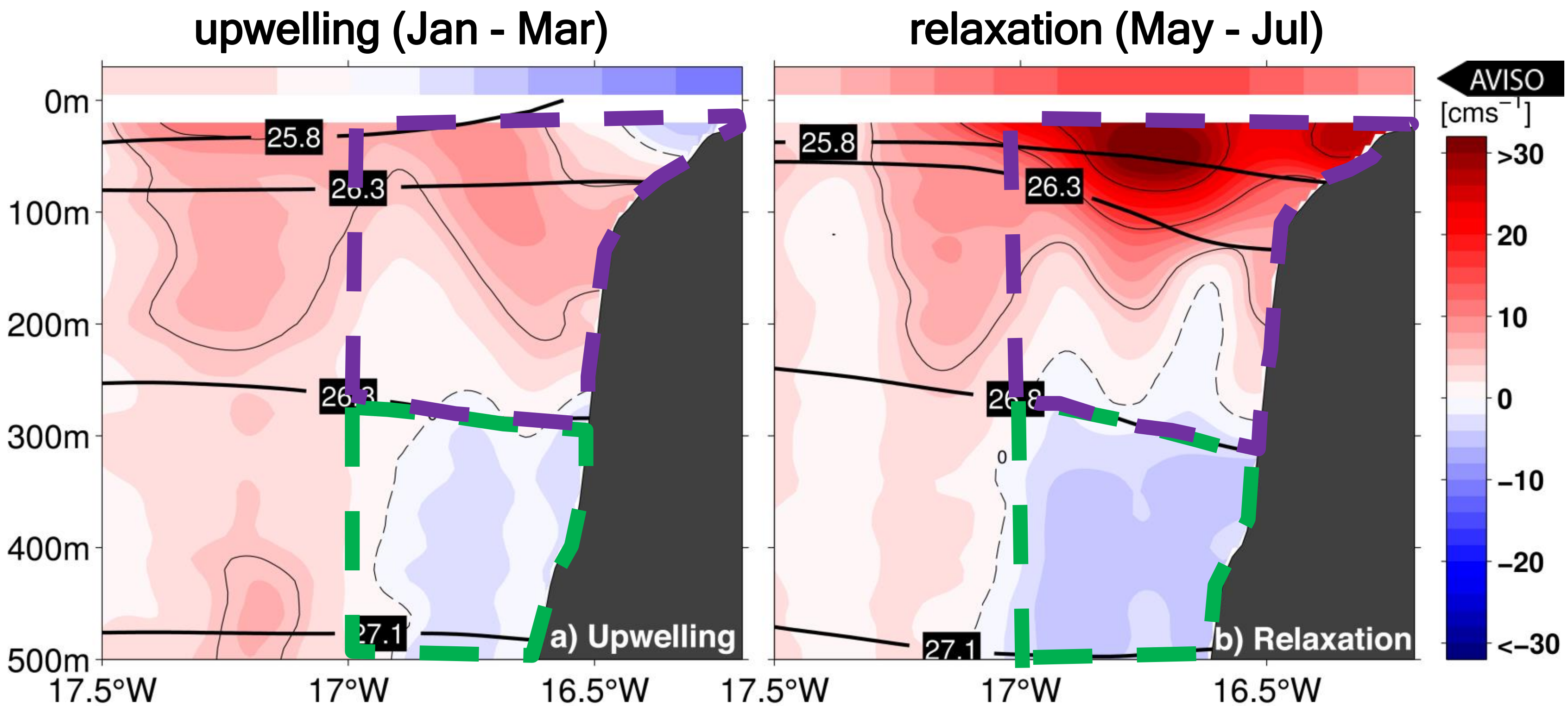


Upwelling season: Classical eastern boundary circulation exhibiting an equatorial jet and poleward flow in the uCW layer below;

Relaxation season: Poleward flow thoughout the upper water column surface + uCW layer;

ICW layer: Equatorward flow at the boundary, elevated during relaxation.

Seasonal mean velocity sections at 18°N



<u>EBC transports:</u>
Elevated polward transport in uCW layer (x 2.5) during relaxation season.

Season	surface+uCW	lCW
relaxation	1.75±0.13	-0.60±0.27
upwelling	0.68±0.35	-0.04±0.18

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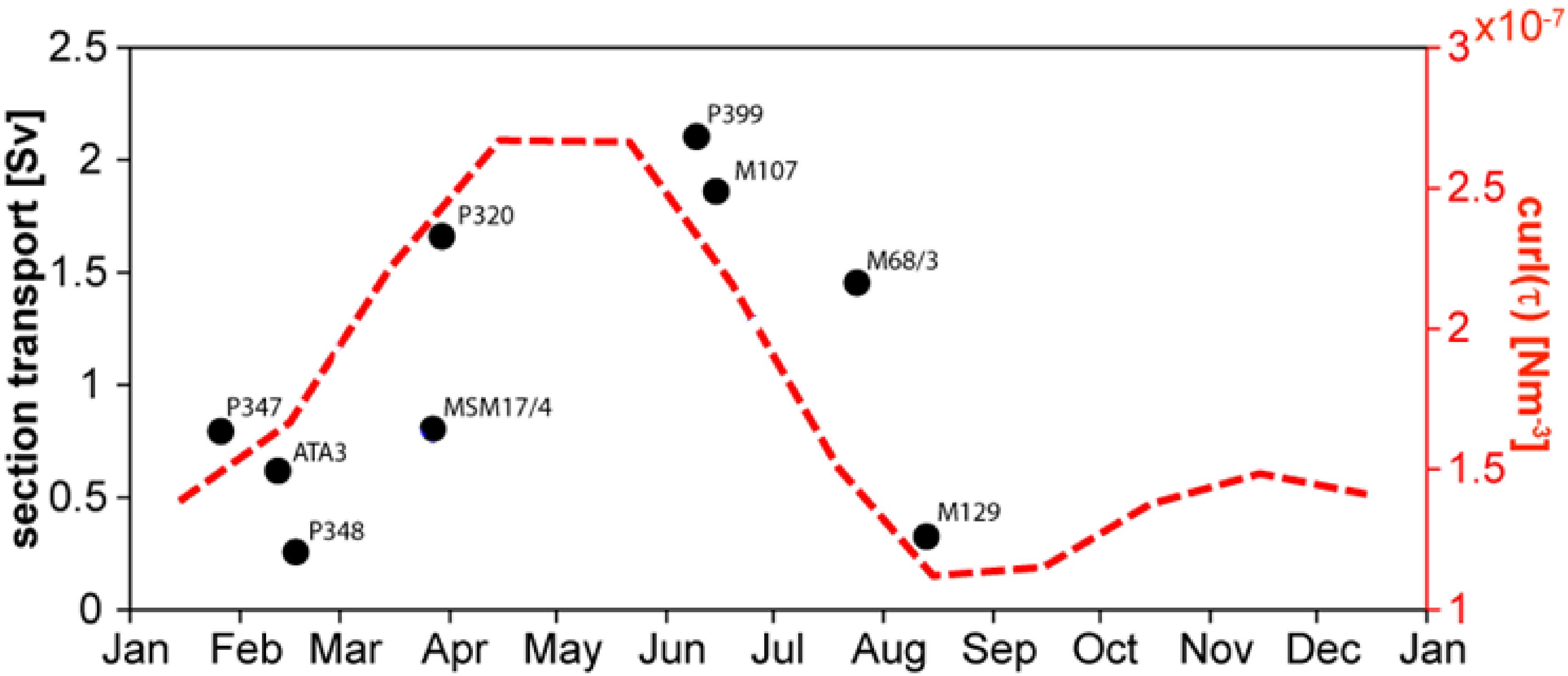
Average seasonal wind stress curl variability and individual section transports (0-500m)



- Boundary current transport is increased when wind stress curl is increased

Wind stress curl variability and individual section transports

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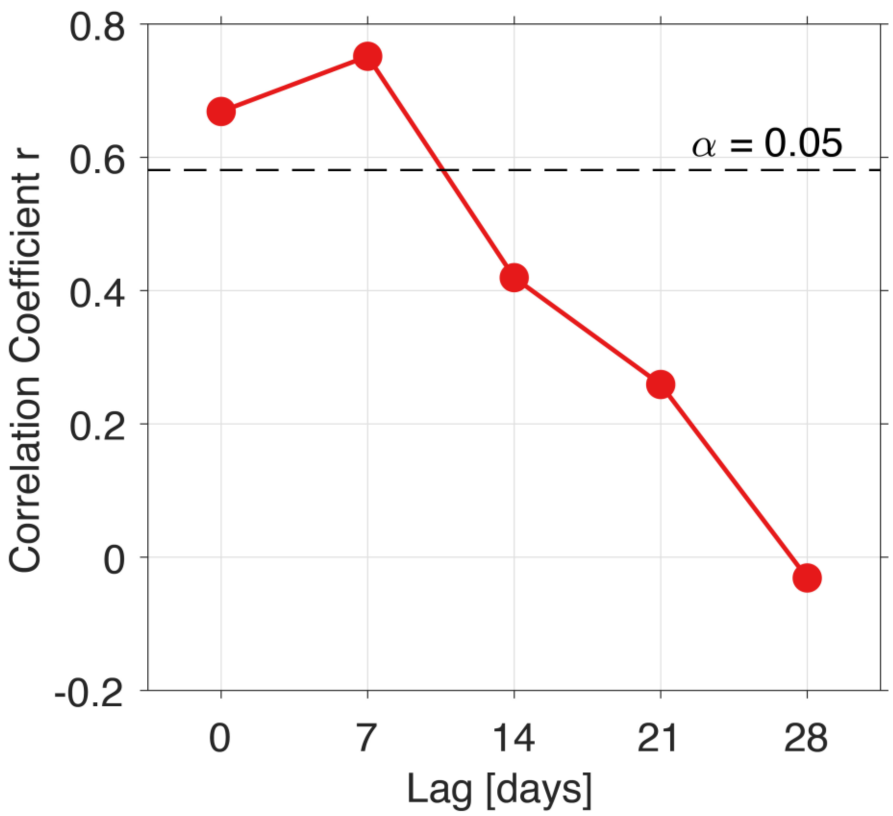
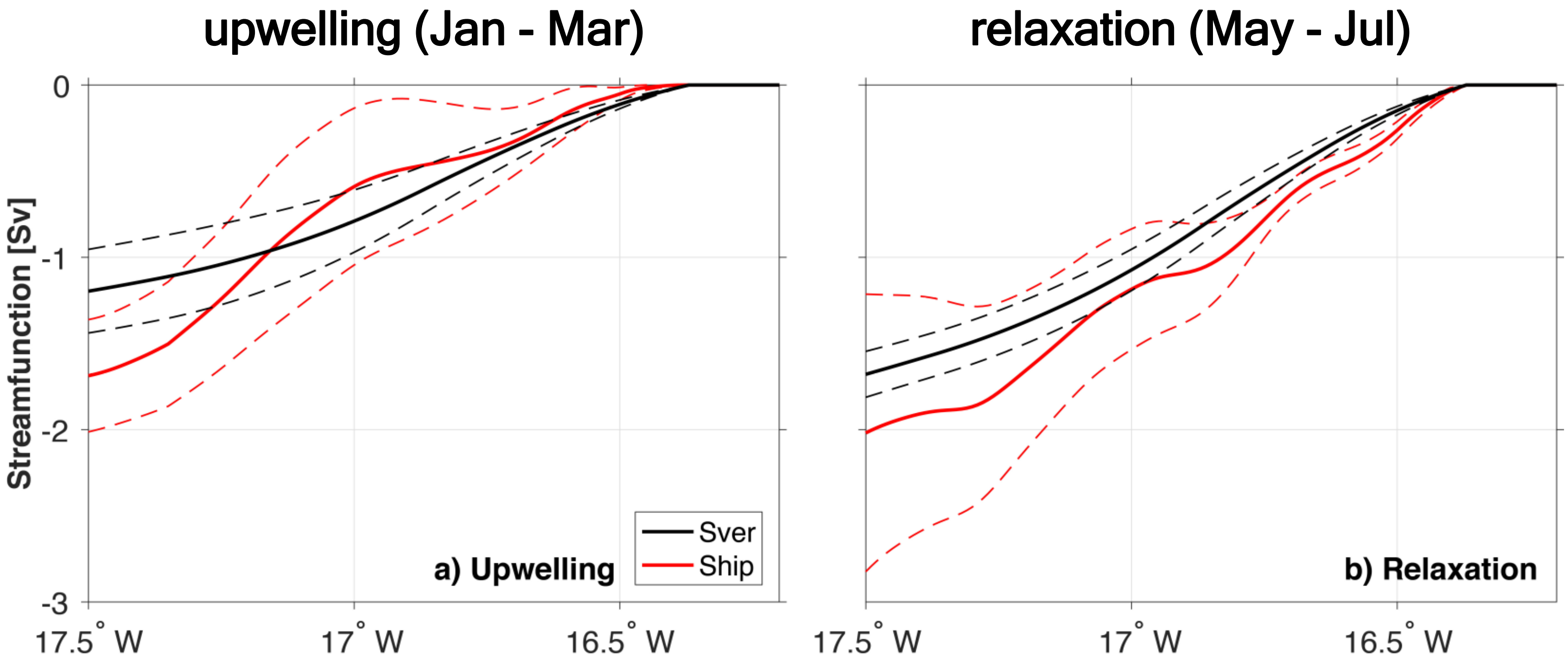
Linear correlation of alongshore individual ship section transport and Sverdrup transport calculated from weekly-averages of the scatterometer winds

- ➢ Elevated correlation at a lag of **7 days** (99% confidence)!

- ❖ Rapid ocean adjustment to wind stress curl variability must be accomplished by coastally trapped waves.



Observed transport vs. Sverdrup transport



Streamfunctions ([Sv]) of Sverdrup transport 7-days prior to observations and ship-based transports between 20-500 m water depth integrated westwards from the first available satellite grid point.

- Sverdrup transport and observed transports agree very well, particularly close to the eastern boundary.

Summary

- First multi-year, multi-cruise description of the seasonal eastern boundary circulation of Mauritania;

- Variability of the boundary current structure, direction and its transport is predominately related to variability in the wind stress curl;

- Ocean adjustment to wind stress curl variability occurs at short temporal scales (within 7 days), and thus must be accomplished by coastally trapped waves;

- The boundary current transport is in close agreement to Sverdrup transport.