

Modelling the Arabian Sea with a $1/2^\circ$ -resolution ROMS model

– May 13, 2019 –

Carolynne Chercham

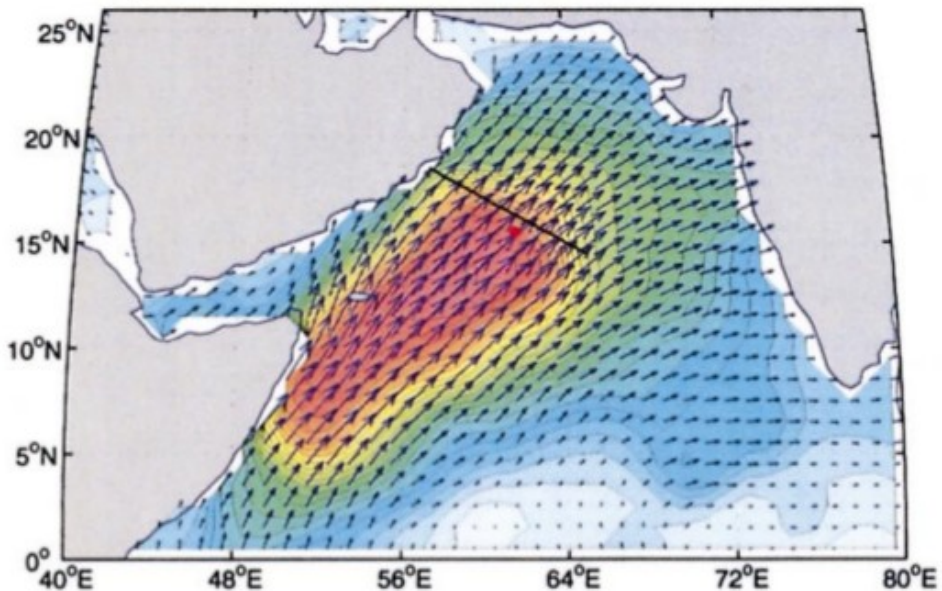
Realised as part of the course UE OPB205
(Modélisation 3D)

Summer semester 2019

The Arabian Sea

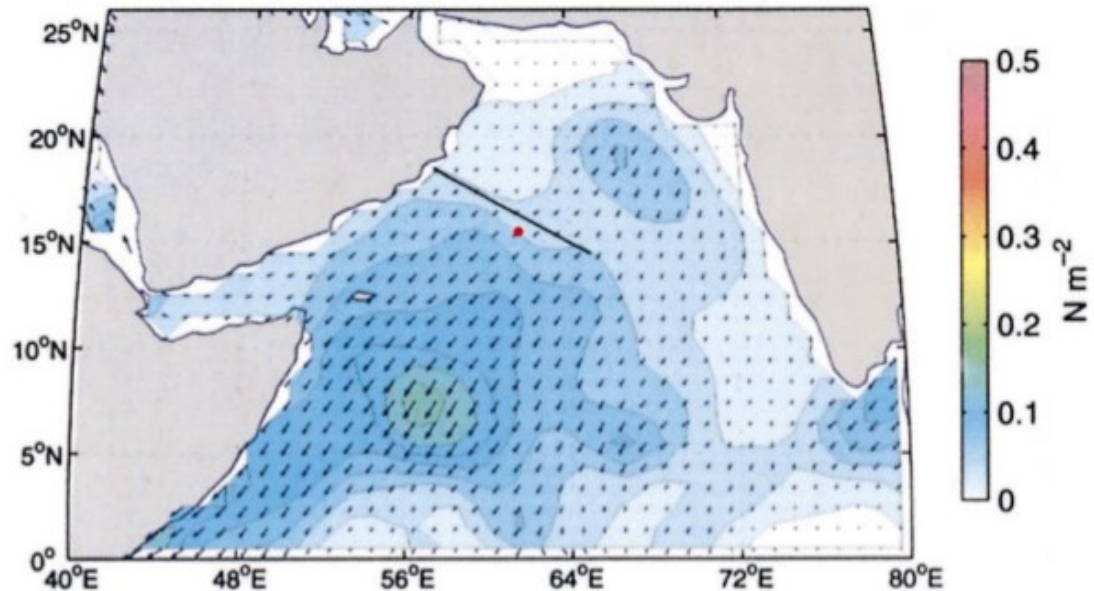
SW Monsoon **SWM**

July 1995 τ wind stress direction and magnitude



NE Monsoon **NEM**

January 1995 τ wind stress direction and magnitude



- Monsoon winds
- seasonality of circulation
 - upwelling (& downwelling)
 - eddies
 - ...

ROMS



myroms.org

- Primitive Equations:

- Boussinesq approximation

- hydrostatic approximation

- Reynolds averaging

{3D}

- + volume conservation (continuity)

- + freshwater and heat conservation

- + equation of state (TEOS-10)

{2D}

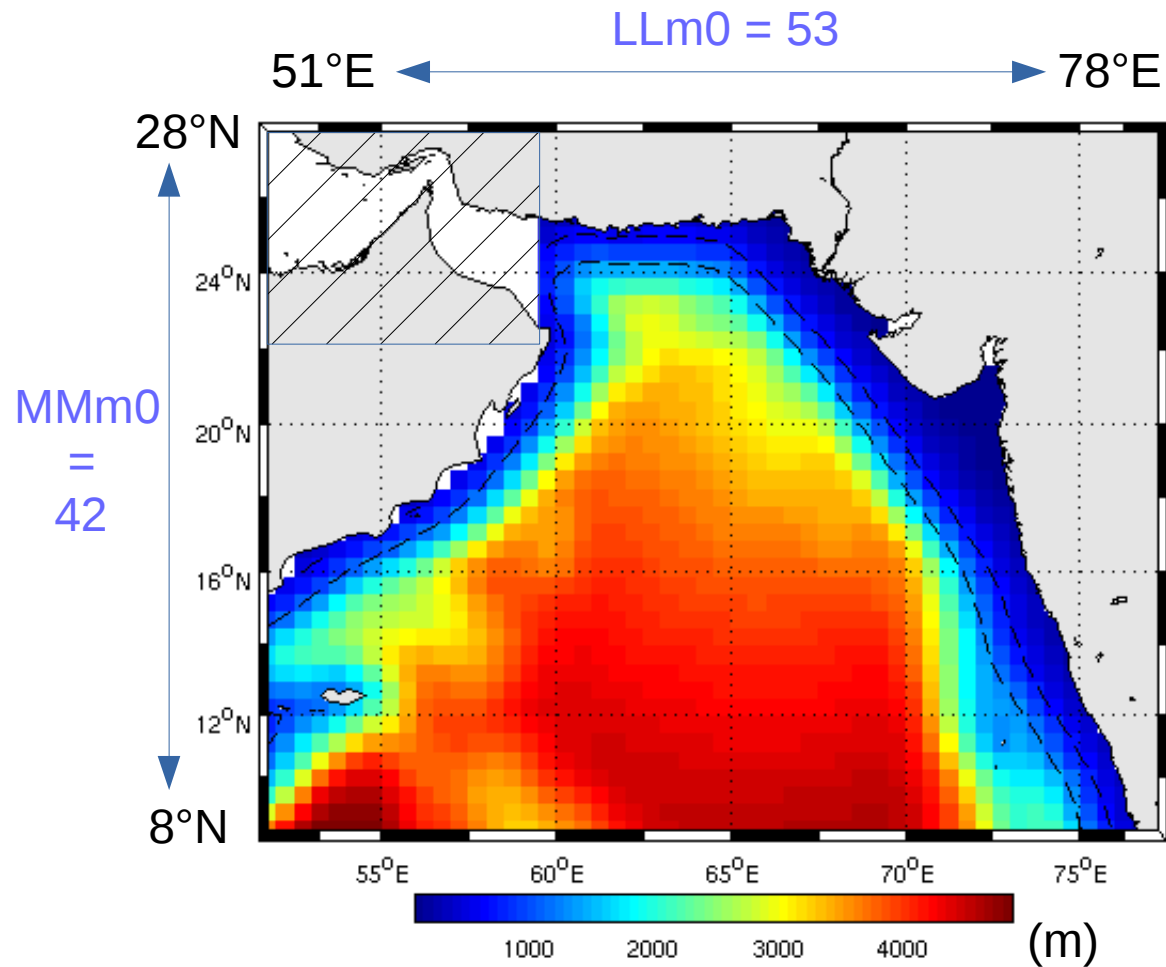
- + Shallow water equations



www.croco-ocean.org

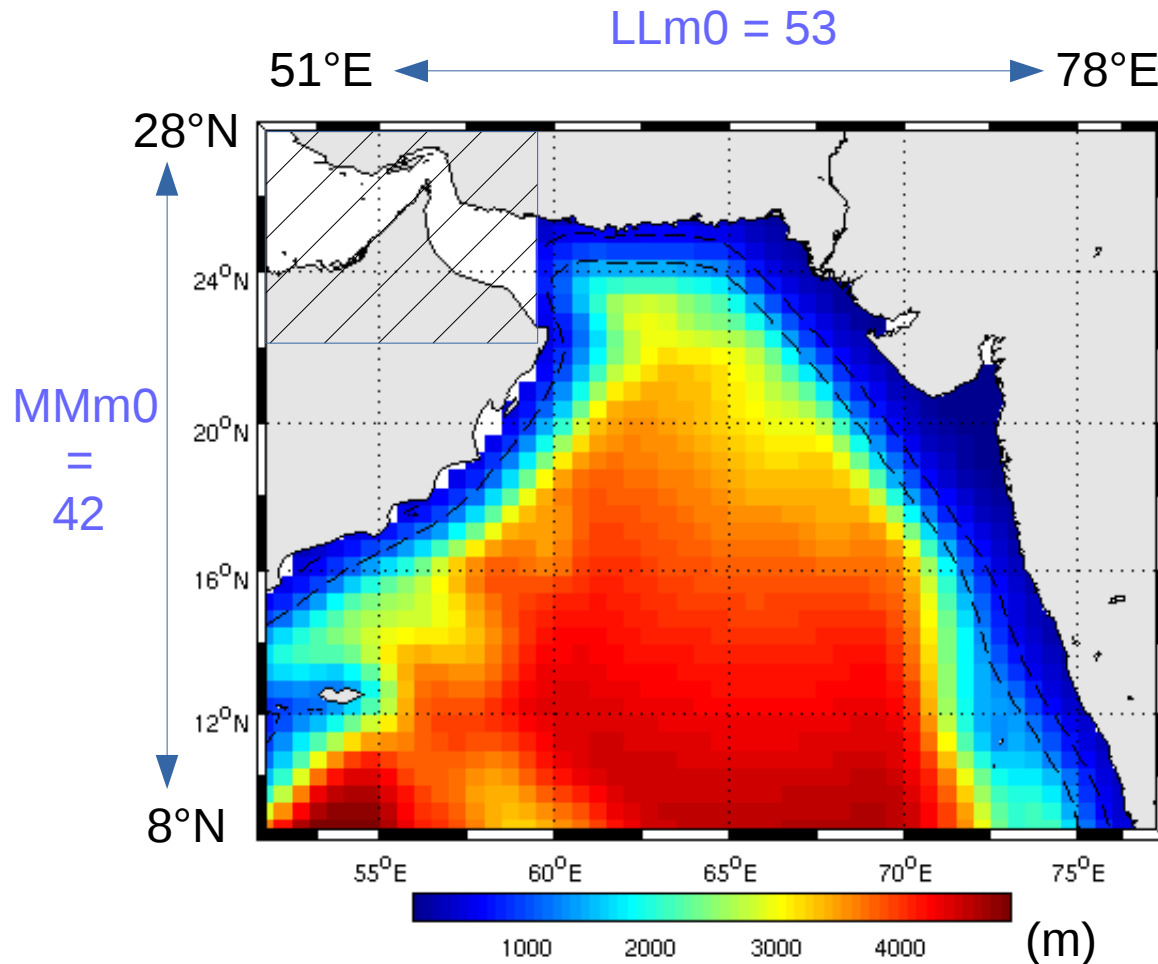
► ROMS_AGRIF

Model setup: $1/2^\circ$ -resolution



- 2 open boundaries (W, S)
- Arakawa C grid

Model setup: 1/2°-resolution



- 2 open boundaries (W, S)
- Arakawa C grid

Vertical levels: N = 32
(terrain-following)

Time splitting: NDTFAST = 60s
dt = 3600s
(!! CFL-criterion)

Initial & lateral boundary conditions:
WOA data

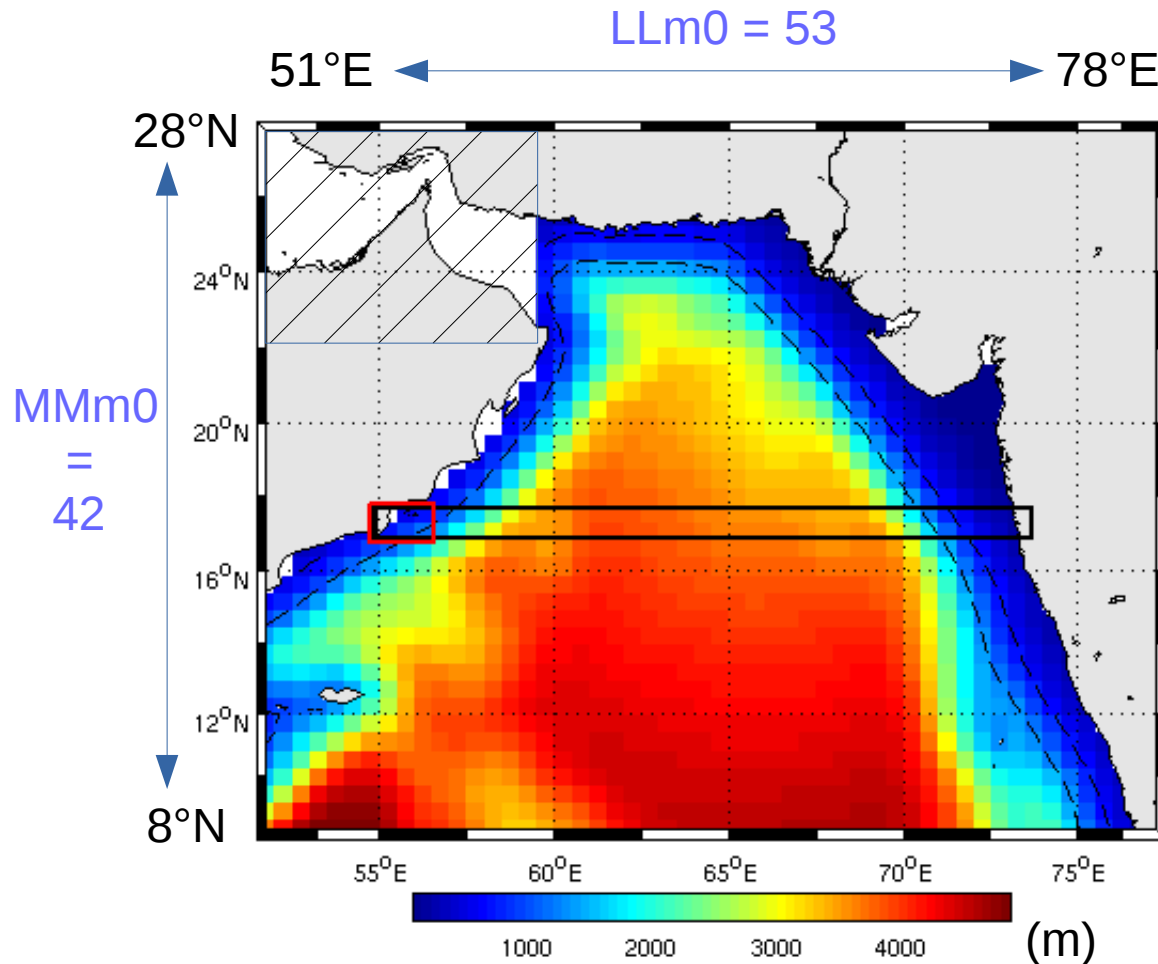
Climatological forcing:
COADS data

Vertical diffusivity:
KPP

Integration period:
10 years
(climatological)

NAVG = 72 ; NRST = 720

Model setup: 1/2°-resolution



- 2 open boundaries (W, S)
- Arakawa C grid

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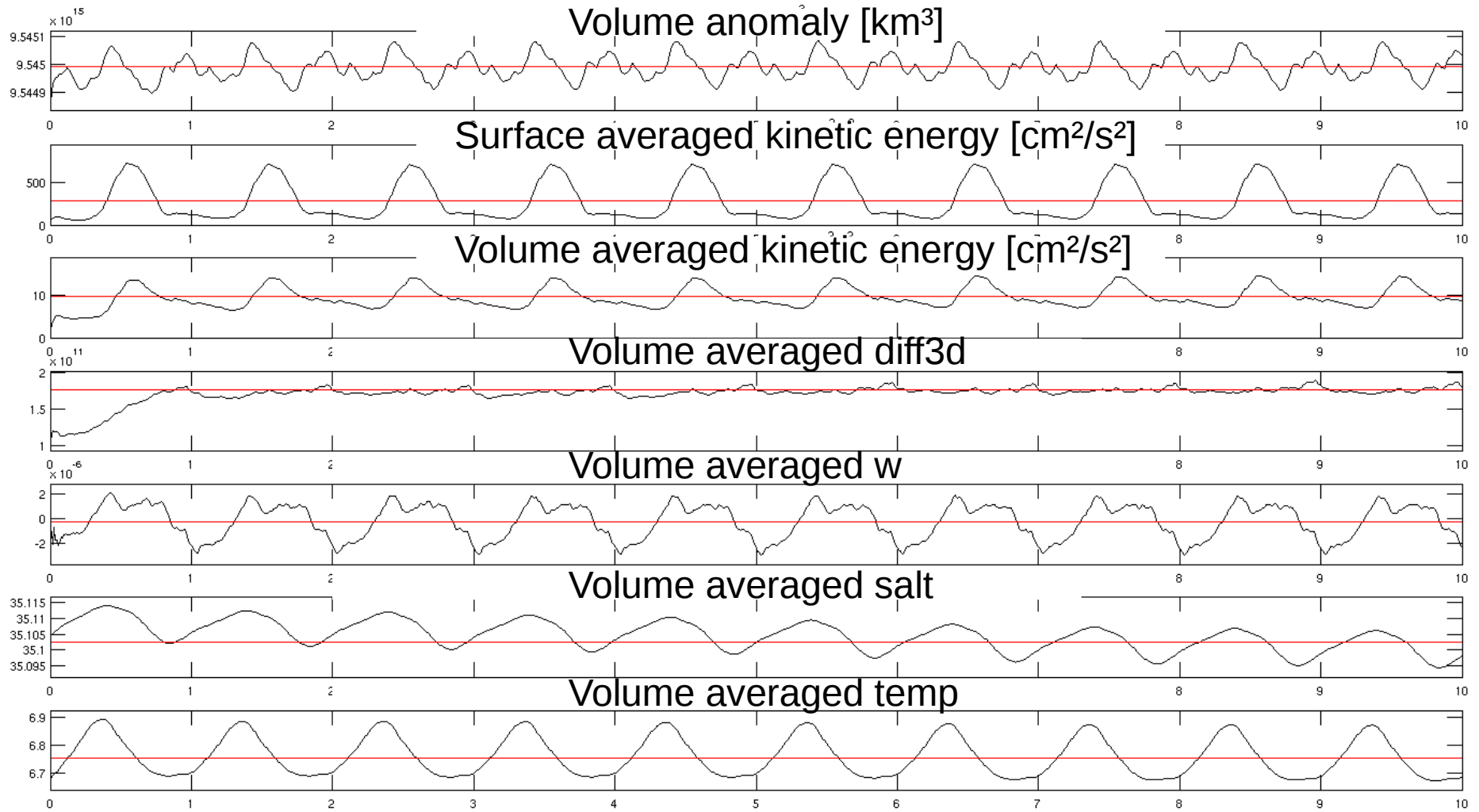
Climatological forcing:
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Vertical diffusivity:
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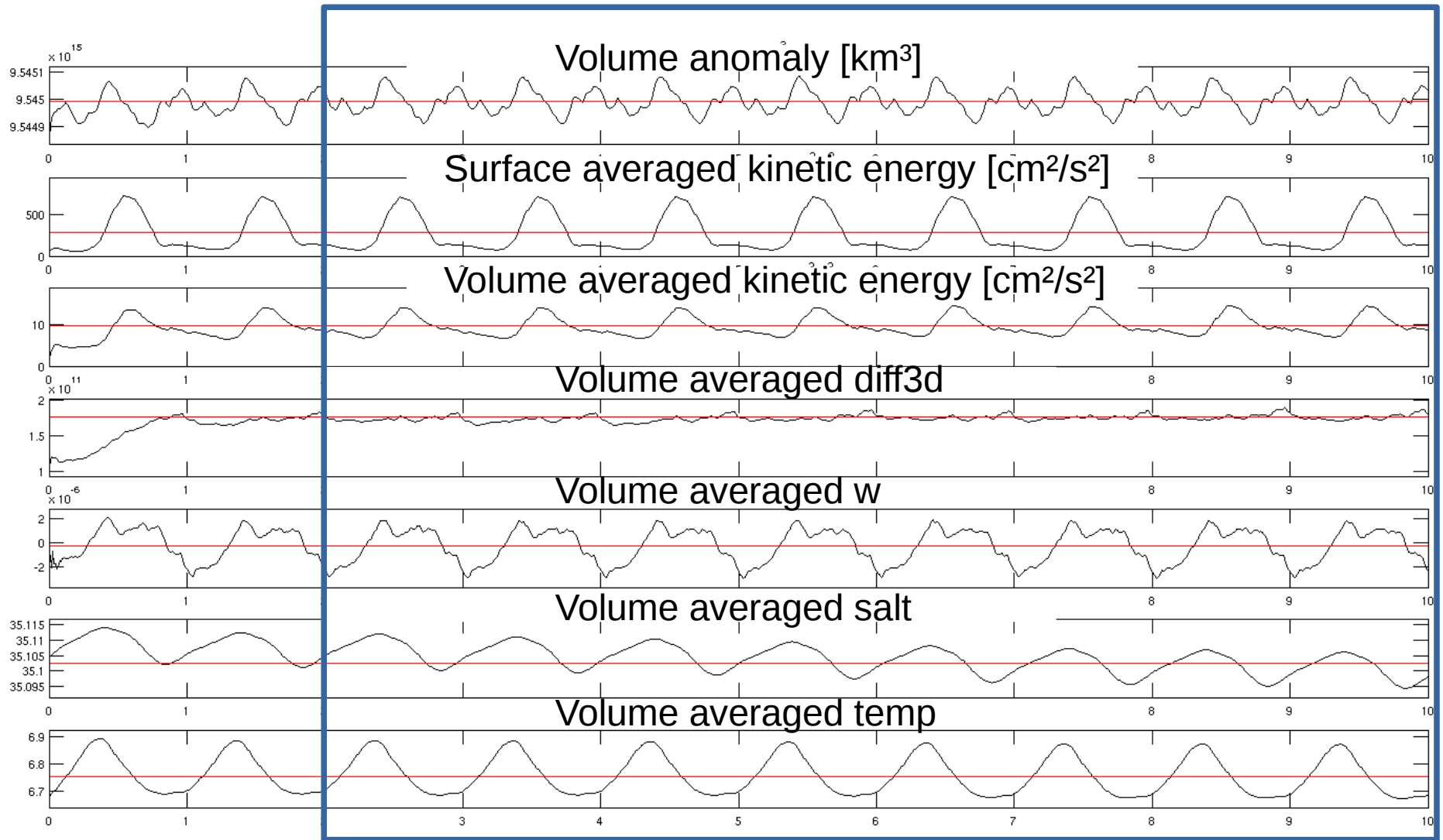
Integration period:
10 years
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Diagnostics



Diagnostics

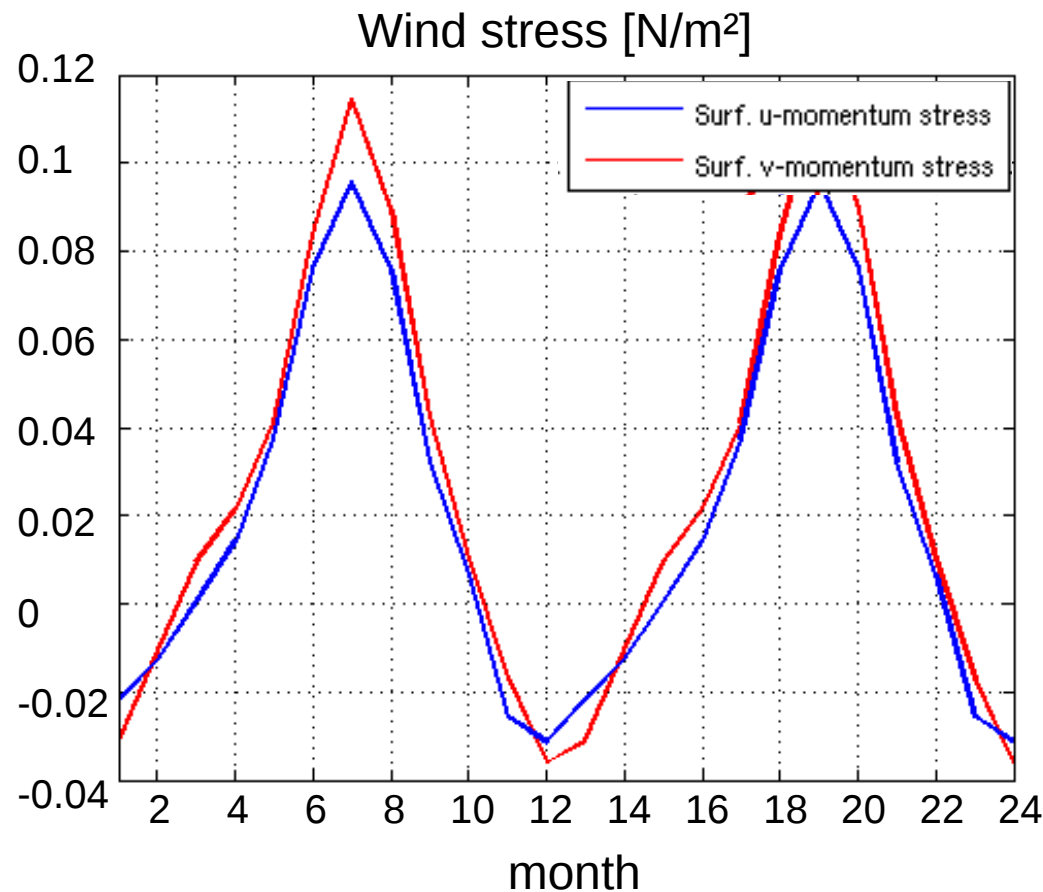


„spin-up“

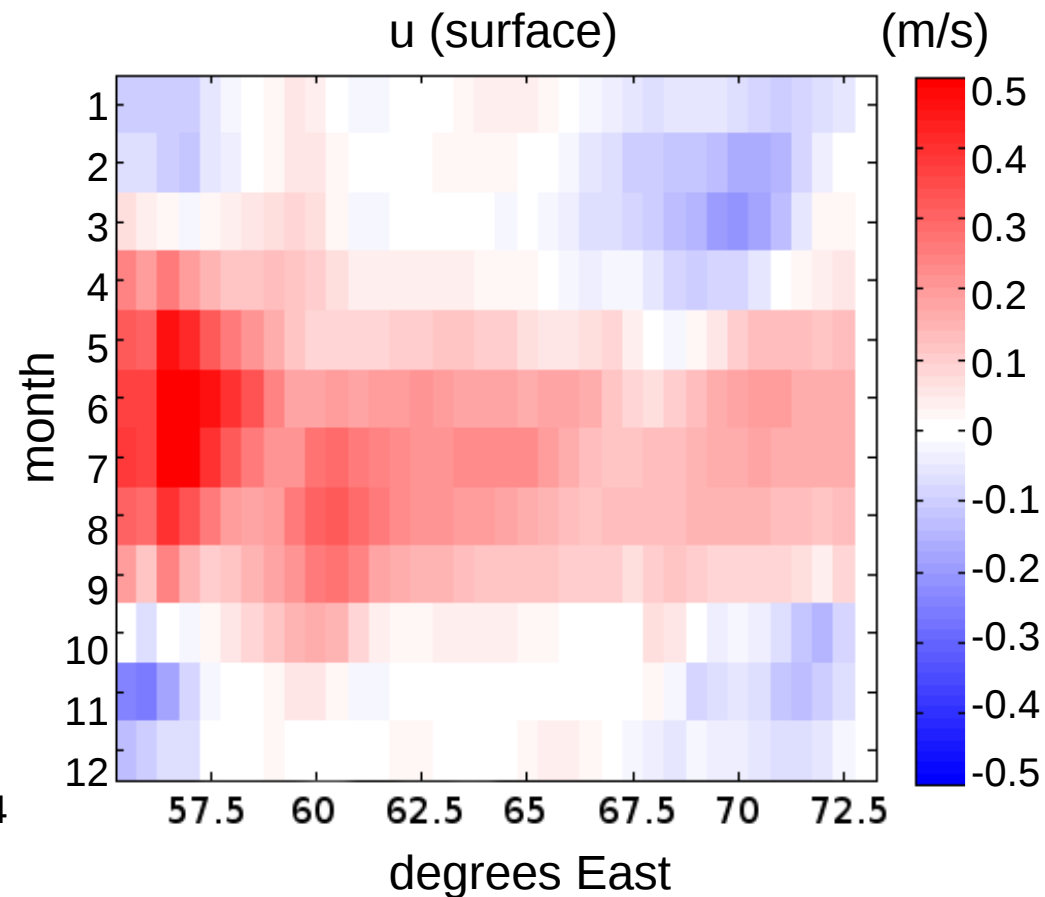
Period used for calculation of climatological means

4 + analysis

Windinduced up- & downwelling: 17°N

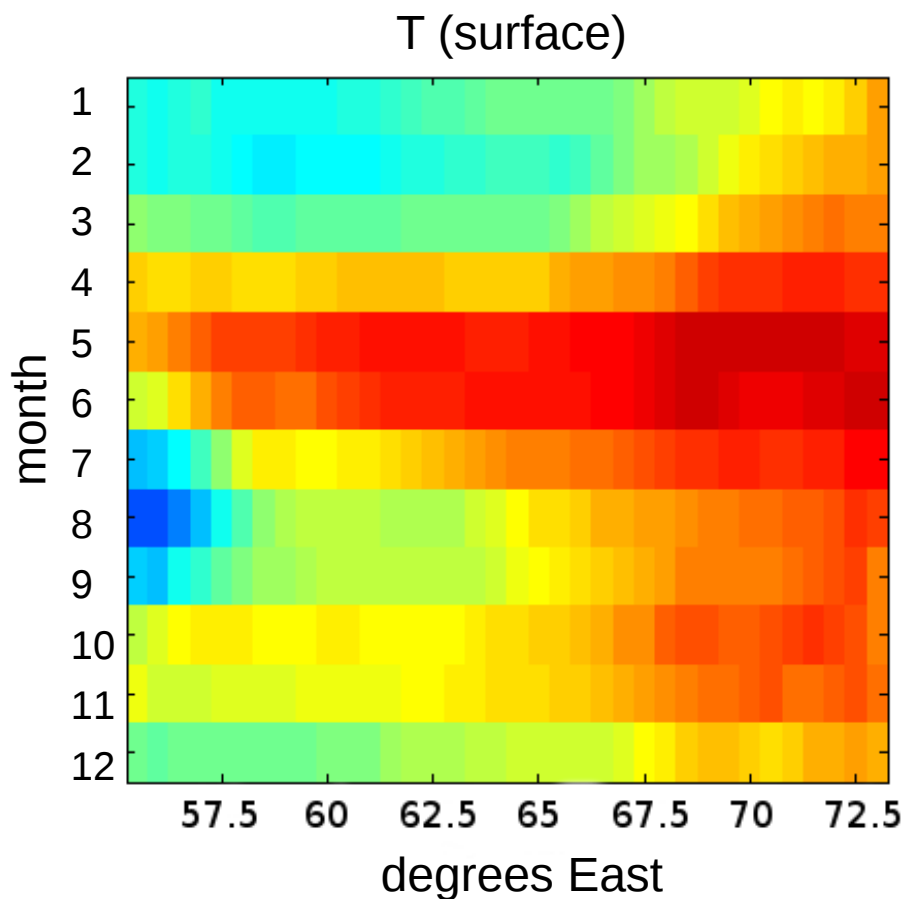


(17°N, 56°E)

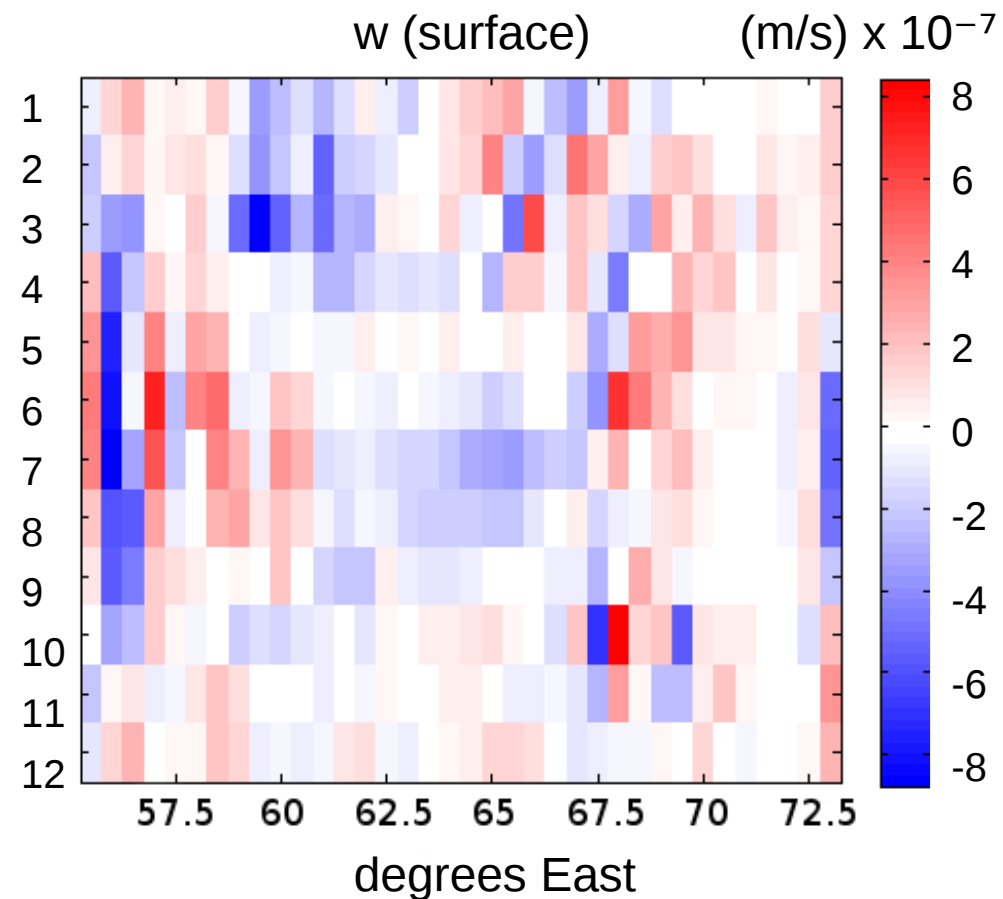


CLIMATOLOGICAL MEAN

Windinduced up- & downwelling: 17°N



CLIMATOLOGICAL MEAN



CLIMATOLOGICAL MEAN

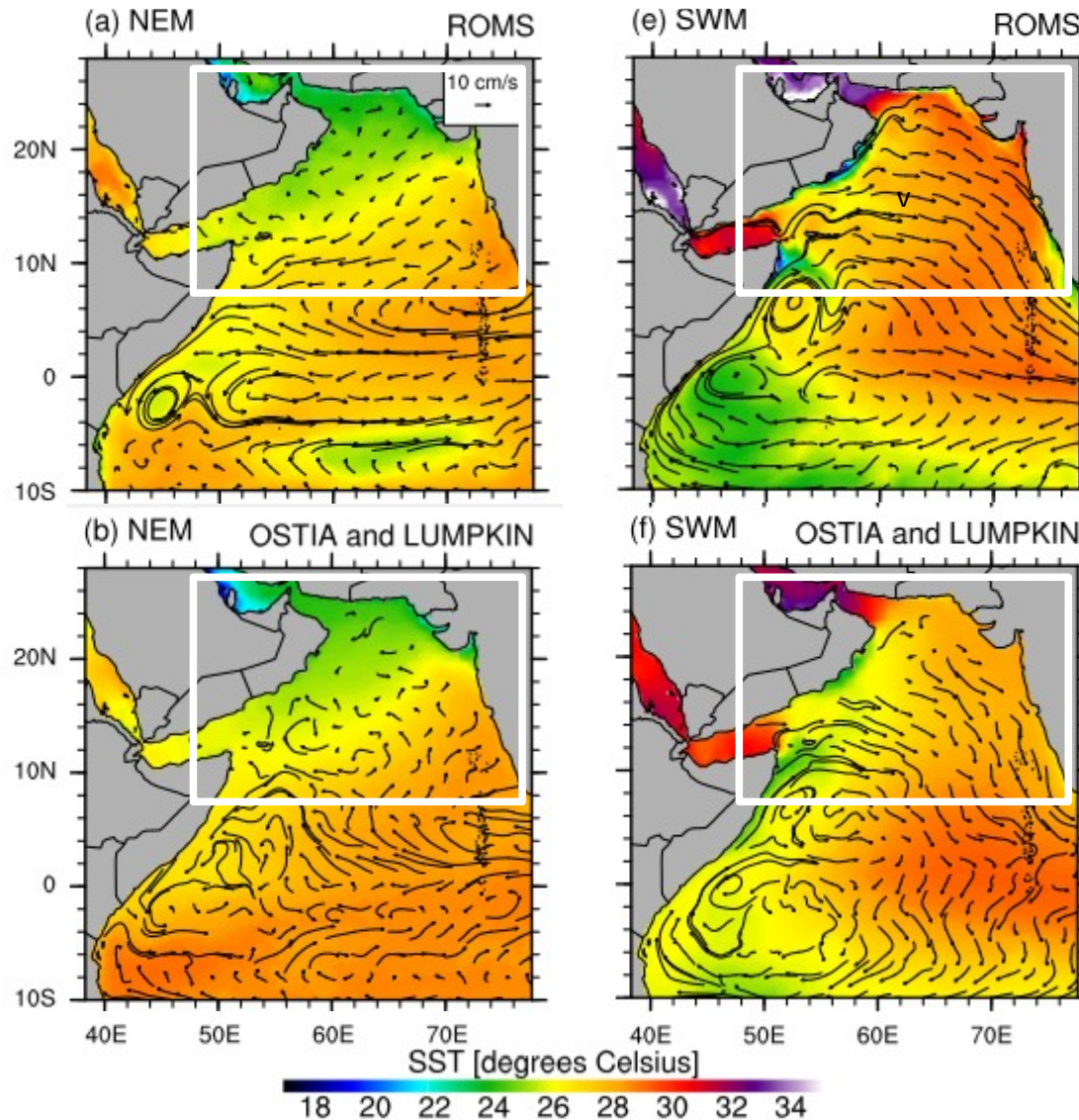
Surface circulation + SST

NEM

SWM

ROMS
(1/16°)

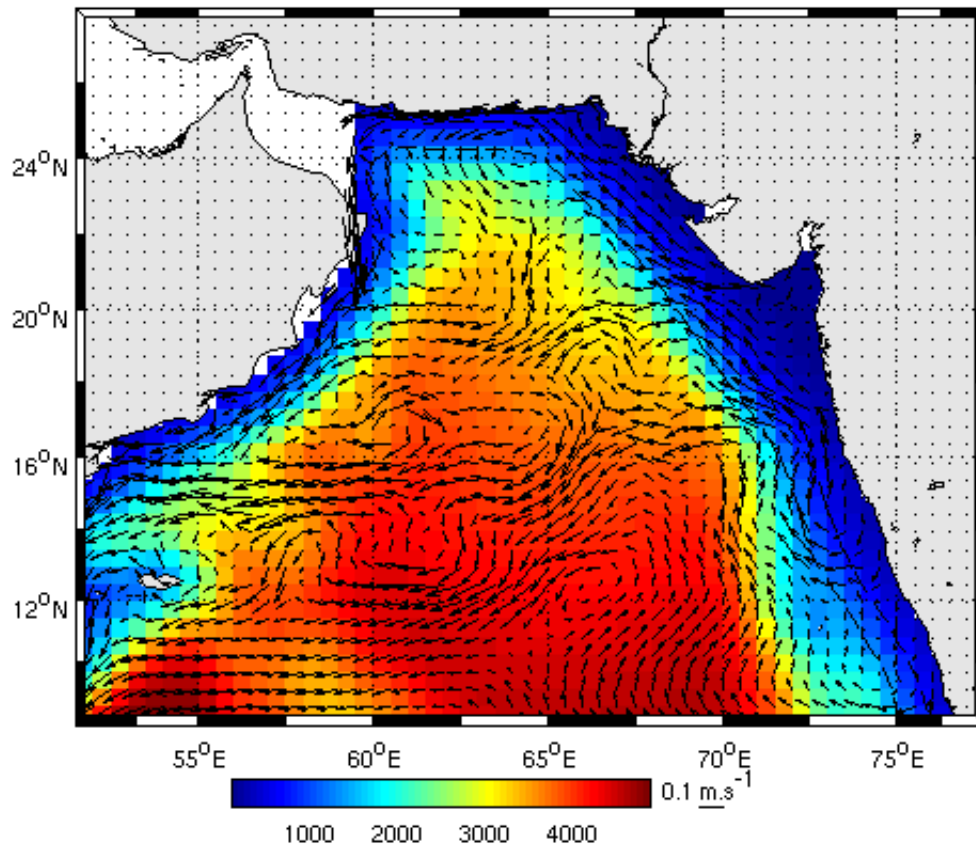
Satellite
+ floats



adapted from Vic et al., 2014

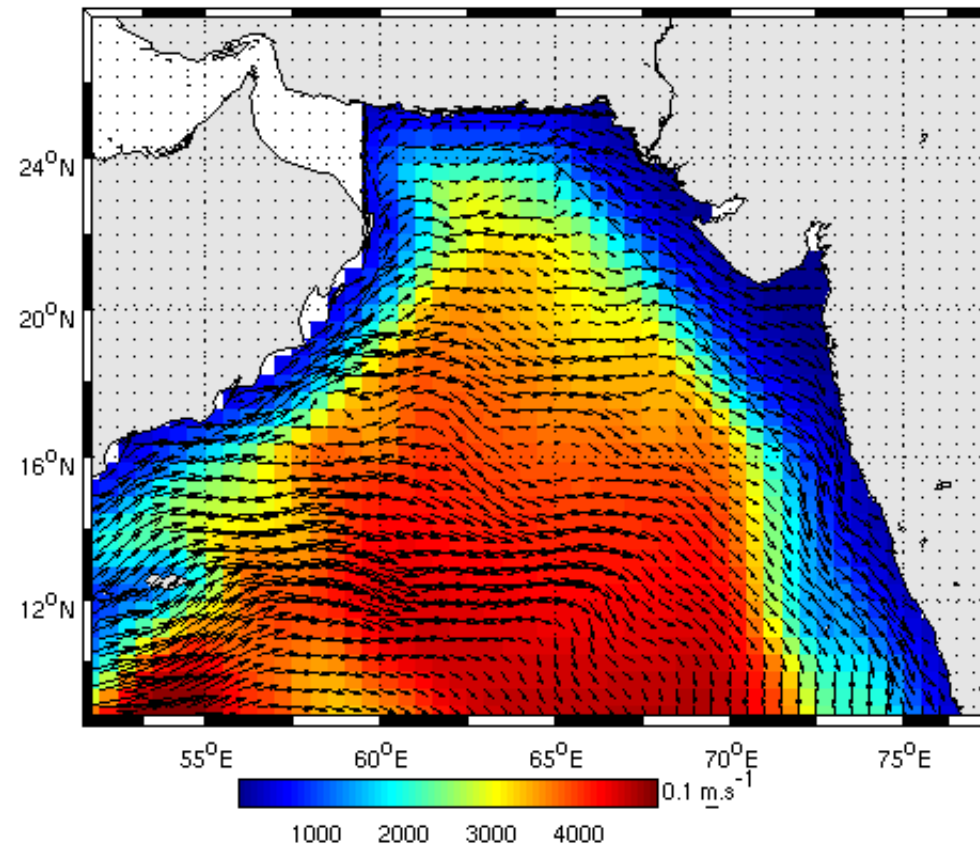
Surface circulation: ROMS (1/2°)

h - 2 Feb 10



NEM
cyclonic

h - 2 Jul 10



SWM
anticyclonic

Conclusion

- Results comparable (and similar) to:
 - observations (Lee et al., 2000, Vic et al., 2014)
 - model data (Vic et al., 2014)
- But:
 - tracer conservation (diagnostics)
 - changed coastlines (Gulf of Oman)
 - low resolution ($1/2^\circ$)
 - extends only to 8°N

References

- Lee, C. M., Jones, B. H., Brink, K. H., & Fischer, A. S. (2000). The upper-ocean response to monsoonal forcing in the Arabian Sea: seasonal and spatial variability. *Deep Sea Research Part II: Topical Studies in Oceanography*, 47(7-8), 1177-1226.
- Vic, C., Roullet, G., Carton, X., & Capet, X. (2014). Mesoscale dynamics in the Arabian Sea and a focus on the Great Whirl life cycle: A numerical investigation using ROMS. *Journal of Geophysical Research: Oceans*, 119(9), 6422-6443.

Windinduced up- & downwelling: 17°N, 56°E

