Seasonal Variability of the Somali current in the North Indian Ocean Sector Using Regional Ocean Modeling System (ROMS)

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UNDER THE SUPERVISION OF

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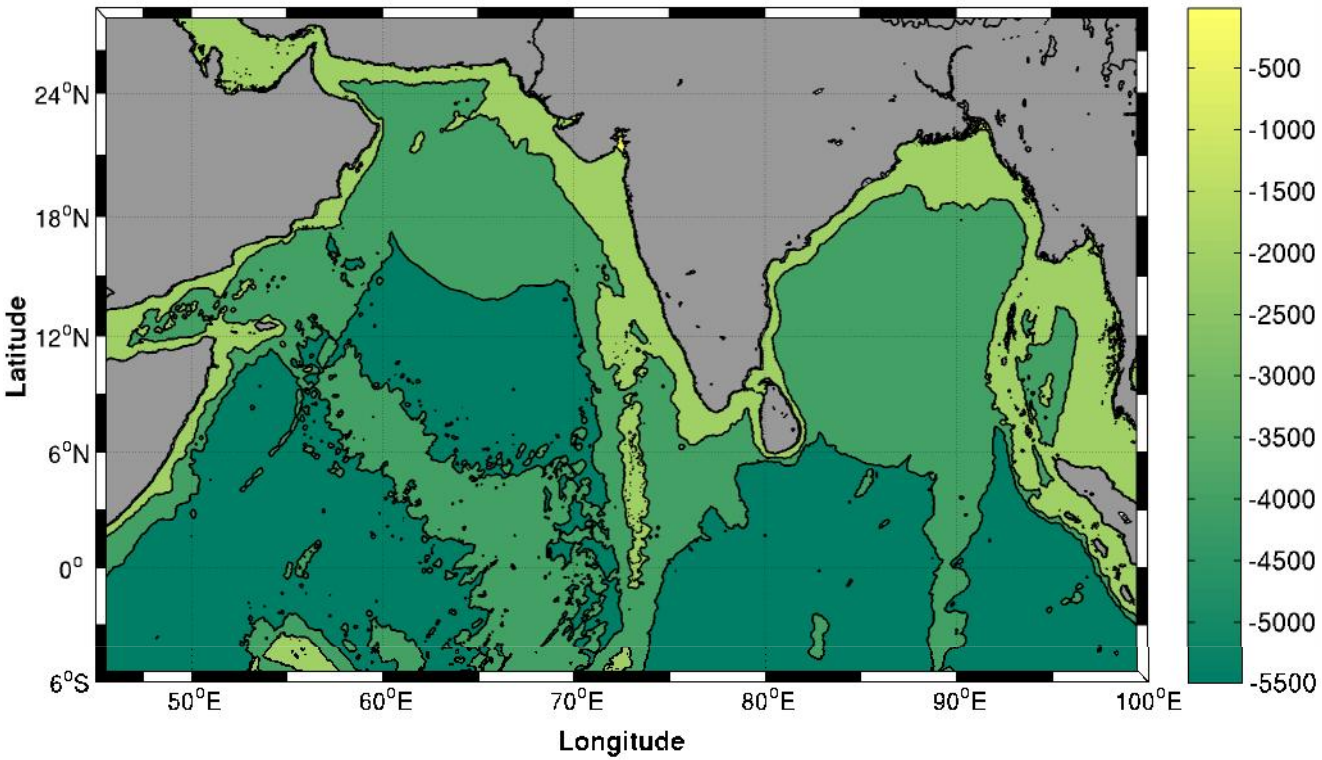


Figure 1: Domain of Study (North Indian Ocean) showing bathymetry in meter.

The north Indian Ocean mainly consists of the Bay of Bengal and the Arabian Sea which are distinguished by the presence of semiannually reversing monsoon wind.

Bay of Bengal (BOB):

- Excess precipitation over evaporation (Prasad et al., 1997).
- Freshwater influx from major rivers (Subramanian et al., 1993).

- Influenced by remote effects (Vinayachandran et al. 1996).

Arabian Sea (AS):

- Excess evaporation exceeds the precipitation (Vinayachandran and Kurian, 2008).
- AS salinity is more (Vinayachandran and Kurian, 2008).

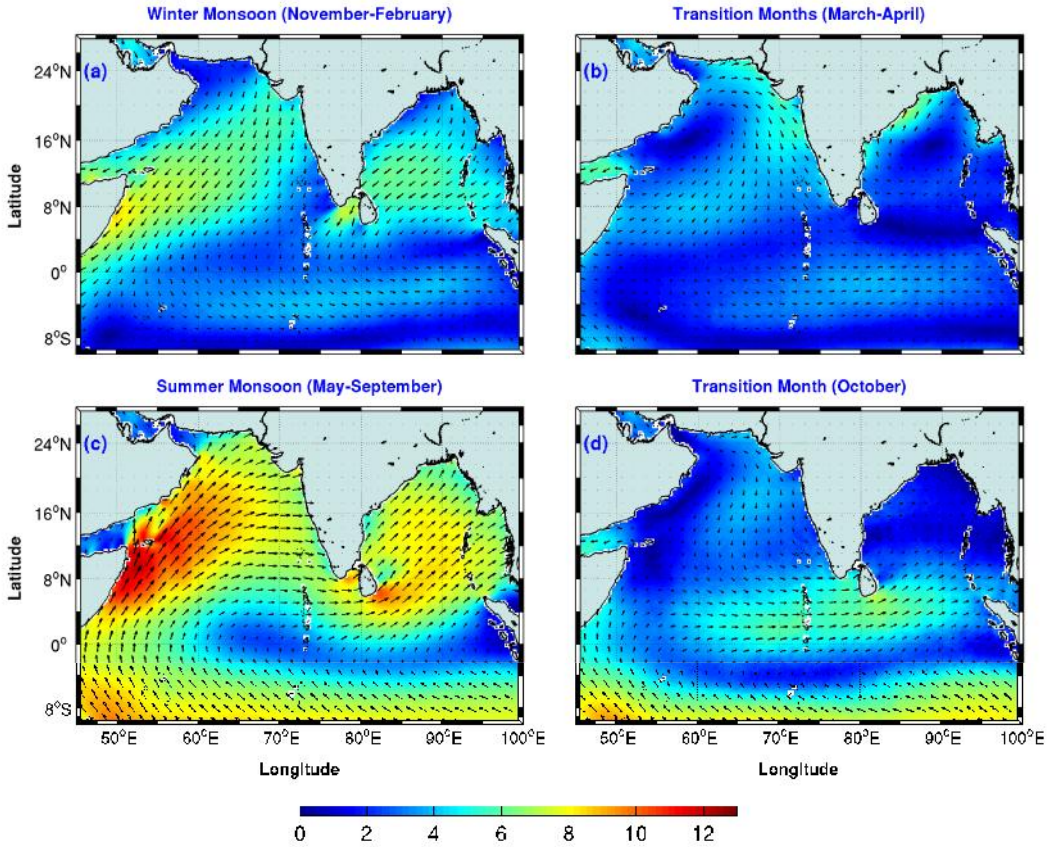


Figure 2: Seasonal variations of QuikSCAT wind (ms^{-1}) with magnitude (shaded) and the direction of the wind (vector) for (a) Winter Monsoon (b) Transition months (March-April) (c) Summer Monsoon (d) Transition Month (October).

Climate is controlled by:

- Northeast Monsoon (during winter season -November to February).
- Southwest Monsoon (during summer season -May to September).
- Over the north Indian Ocean wind generally blow from the southwest direction during May-September and from the northeast direction during November-February.

Shankar et al.(2002)

- The winds during the summer monsoon are much stronger than during the winter monsoon. Winds during the transition months (March-April and October) are weak.

Shankar et al.(2002)

Data

Regional Ocean Modeling System (ROMS):

- 439 and 281 grid points in zonal and meridional directions respectively.
- Model is constructed with 32 vertical levels corresponding to 13 km resolution.
- The eastern, western, northern and southern boundary of the domain are open.

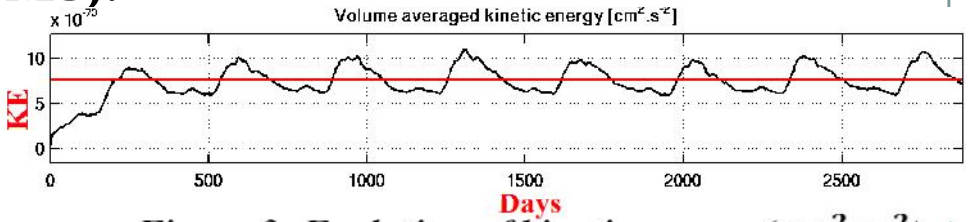


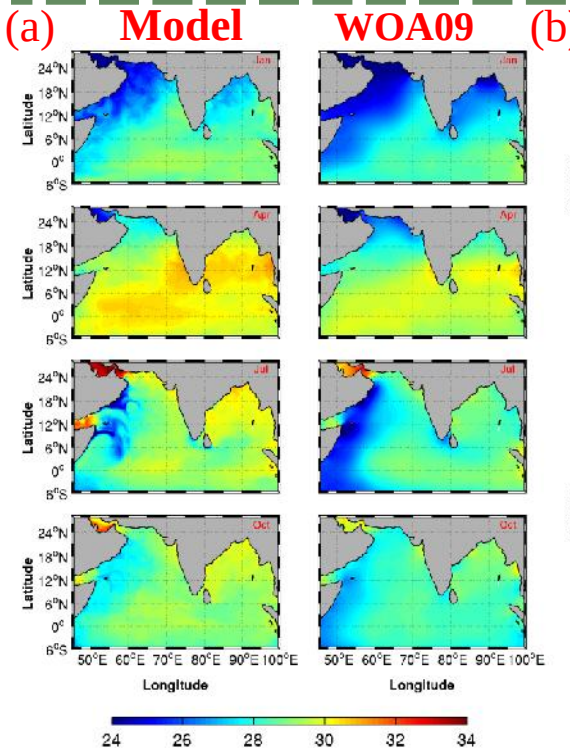
Figure 3: Evolution of kinetic energy ($cm^2 s^{-2}$) with time (days).

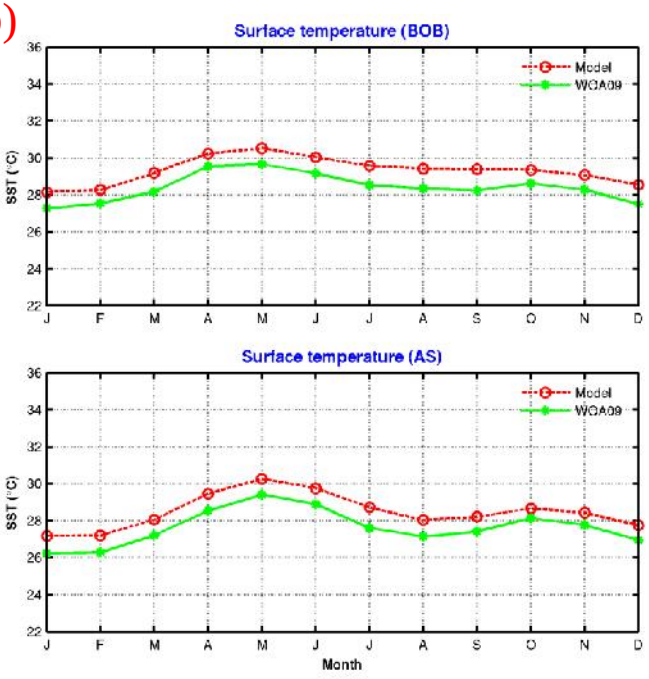
The model parameters are chosen As :

Model parameter	Value
Depth	0-5500 m
s-coordinate surface control parameter (theta_s)	7.0
s-coordinate bottom control parameter (theta_b)	0.1
Thermocline depth (Tcline)	10 m
Mean density	1025 kgm-3

- OSCAR data used in the present study span the period from January 2003 to December 2015. The data are available at 5-day intervals and at $^1/_3{}^\circ \times {}^1/_3{}^\circ$ spatial resolution for the NIO and are obtained from the NOAA.
- Monthly mean of WOA09 with $1^\circ \times 1^\circ$ resolution data are taken in this work.
- The wind stress product is calculated from the QUIKSCAT wind data (January 2000 to December 2008). The data are remapped to $^1/_4{}^\circ \times {}^1/_4{}^\circ$ latitude/longitude map.
- ETOPO5 datasets used here is a gridded elevation (land) and bathymetry (sea floor) data set for the entire Earth at a grid spacing of 5 minutes (1/12 of a degree or 300 arc seconds).

ROMS validation





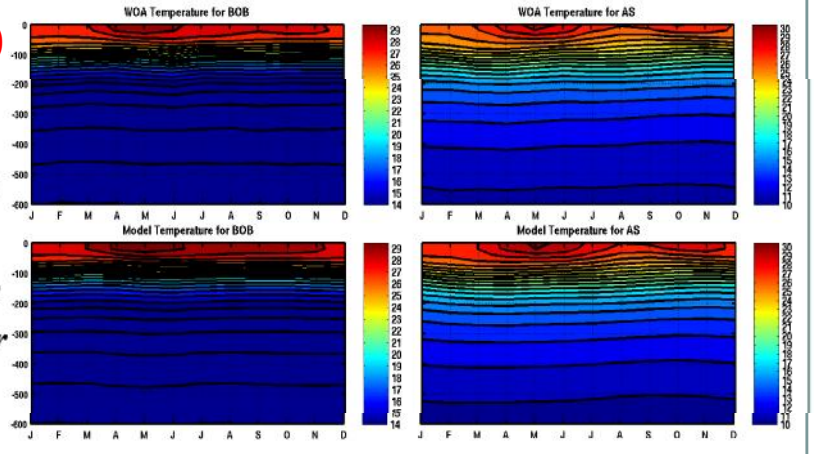


Figure 4: (a) Comparison between ROMS-derived and WOA09-derived surface SST for January, April, July and October, (b) Comparison between ROMS-derived and WOA09 -derived surface SST in time series for AS and BOB Sector and (c) Comparison between simulated and WOA temperature (℃) variations for the upper 600 m from January to December for the BOB and AS.

Results

(a)

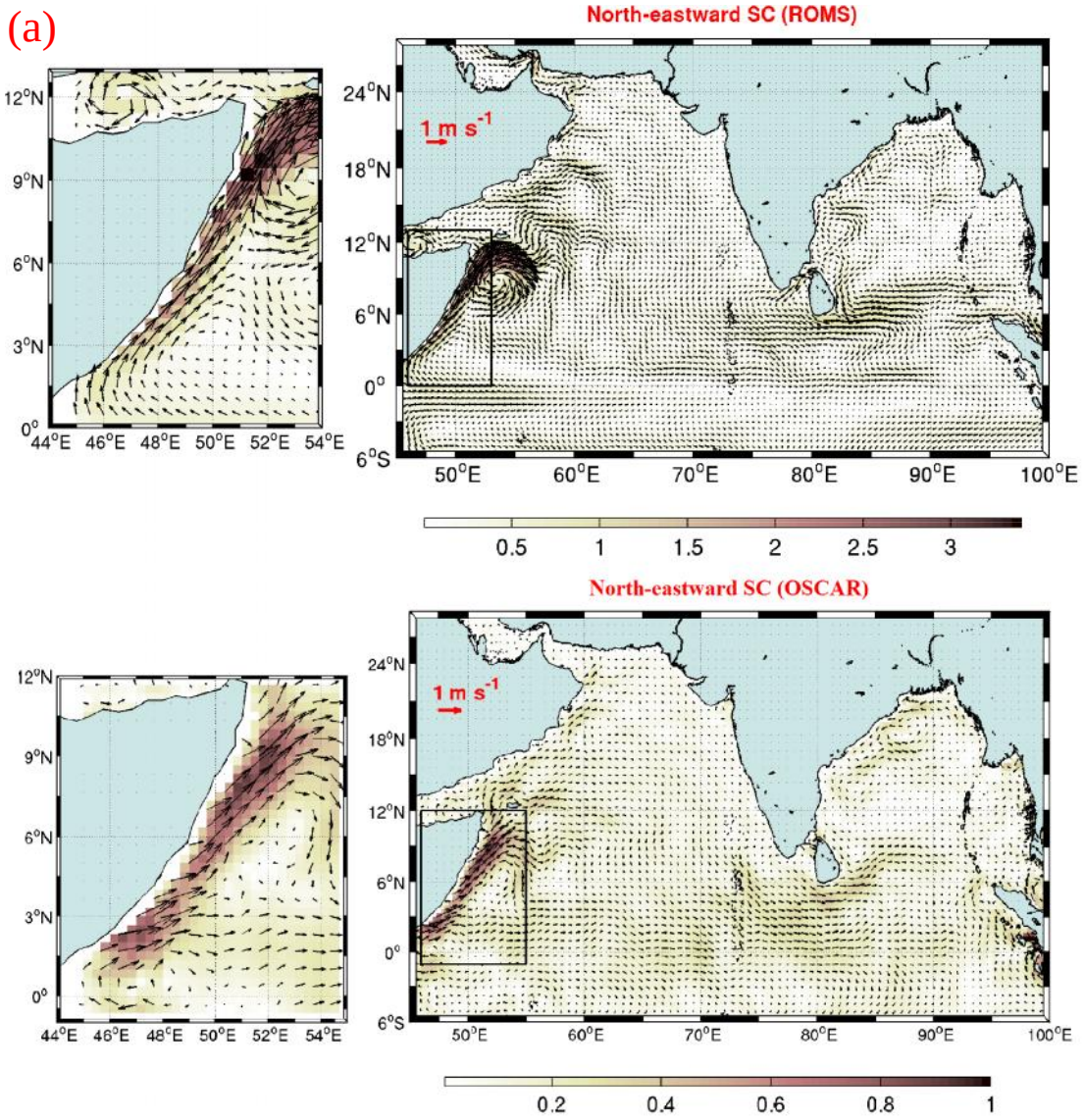


Figure 5: Comparison between monthly means of ROMS and OSCAR surface currents (ms^{-1}) for (a) North-eastward SC (Colour shading shows the magnitud--es while the arrows show the directions.

(b)

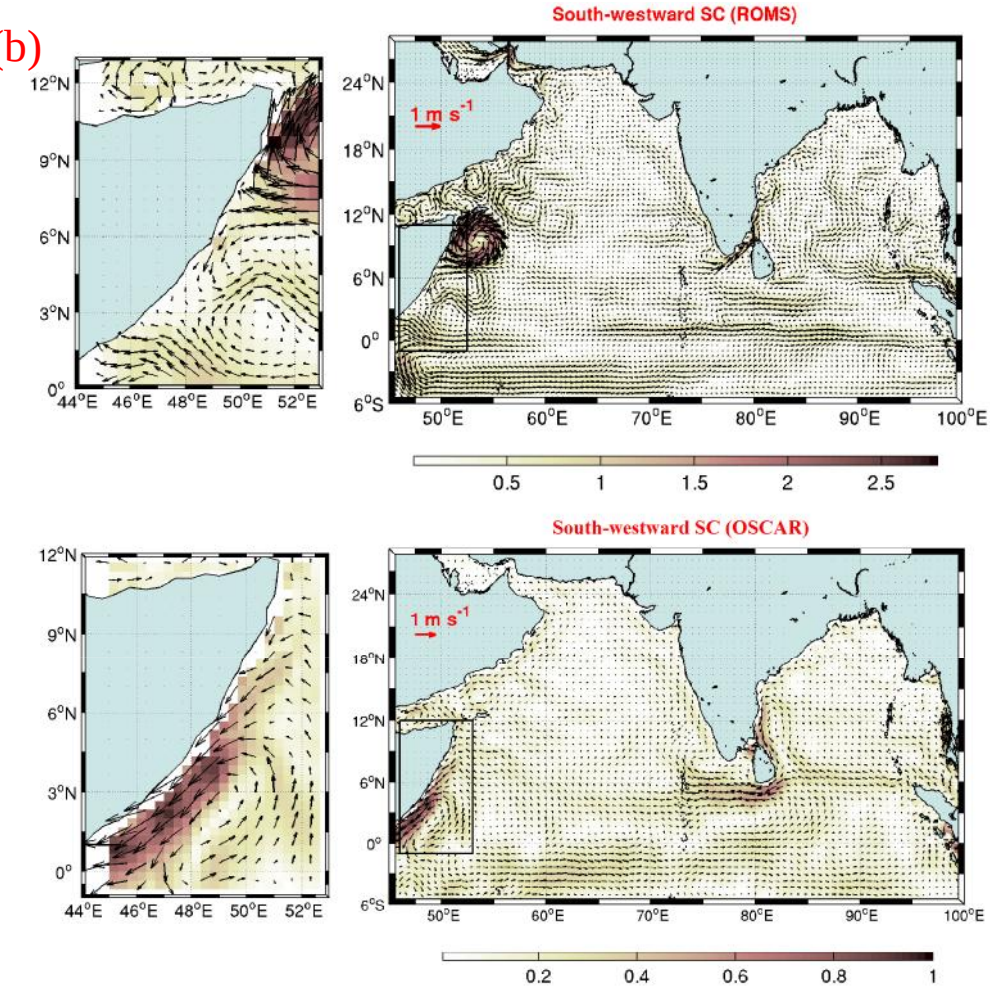


Figure 5 (cont.): Comparison between Monthly means of ROMS and OSCAR surface currents (ms^{-1}) for (b) South-westward SC (Colour shading shows the magnitudes while the arrows show the directions.

Name of current	Location	Direction of flow	Time of flow	
			ROMS	OSCAR
SC	Along the coast of Somalia	North-eastward	May-October	May-October
		South-westward	November-February	November-February

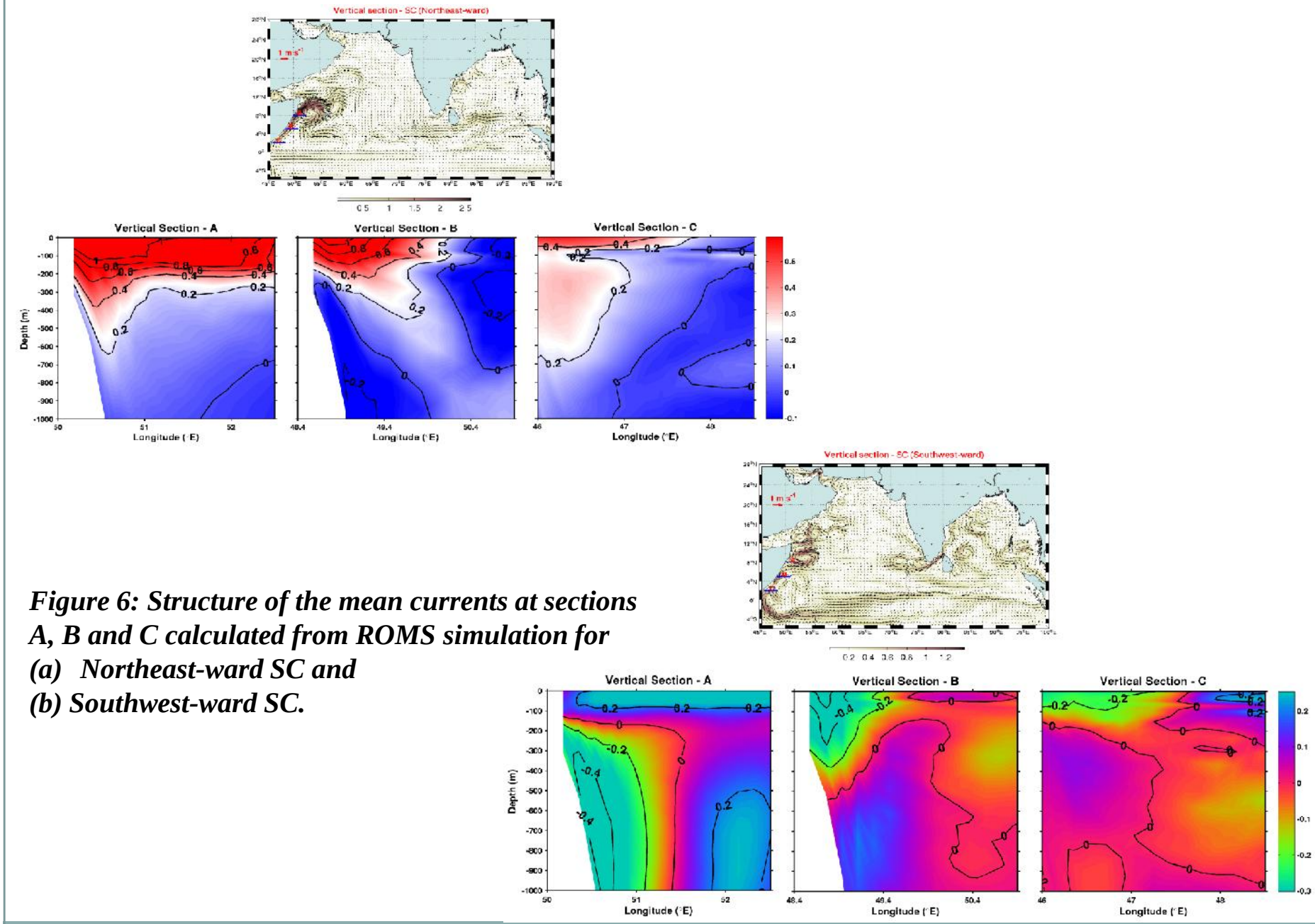


Figure 6: Structure of the mean currents at sections A, B and C calculated from ROMS simulation for
(a) Northeast-ward SC and
(b) Southwest-ward SC.

Summary

- ***ROMS climatology depicts northeast-ward SC (May-October) and southwest-ward SC (November-February). It is well matched with OSCAR climatology.***
- ***Maximum surface current velocities of OSCAR climatology are much lower than ROMS***
- ***climatology.***
- ***ROMS results reveal that the maximum surface velocity of northeast-ward SC is approximately*** $3ms^{-2}$.
- ***From the section plot it is noticed that the vertical extent of northeast-ward SC is almost 600 m and it very strong current.***

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THANK YOU