A numerical investigation of the Southern Gyre using ROMS

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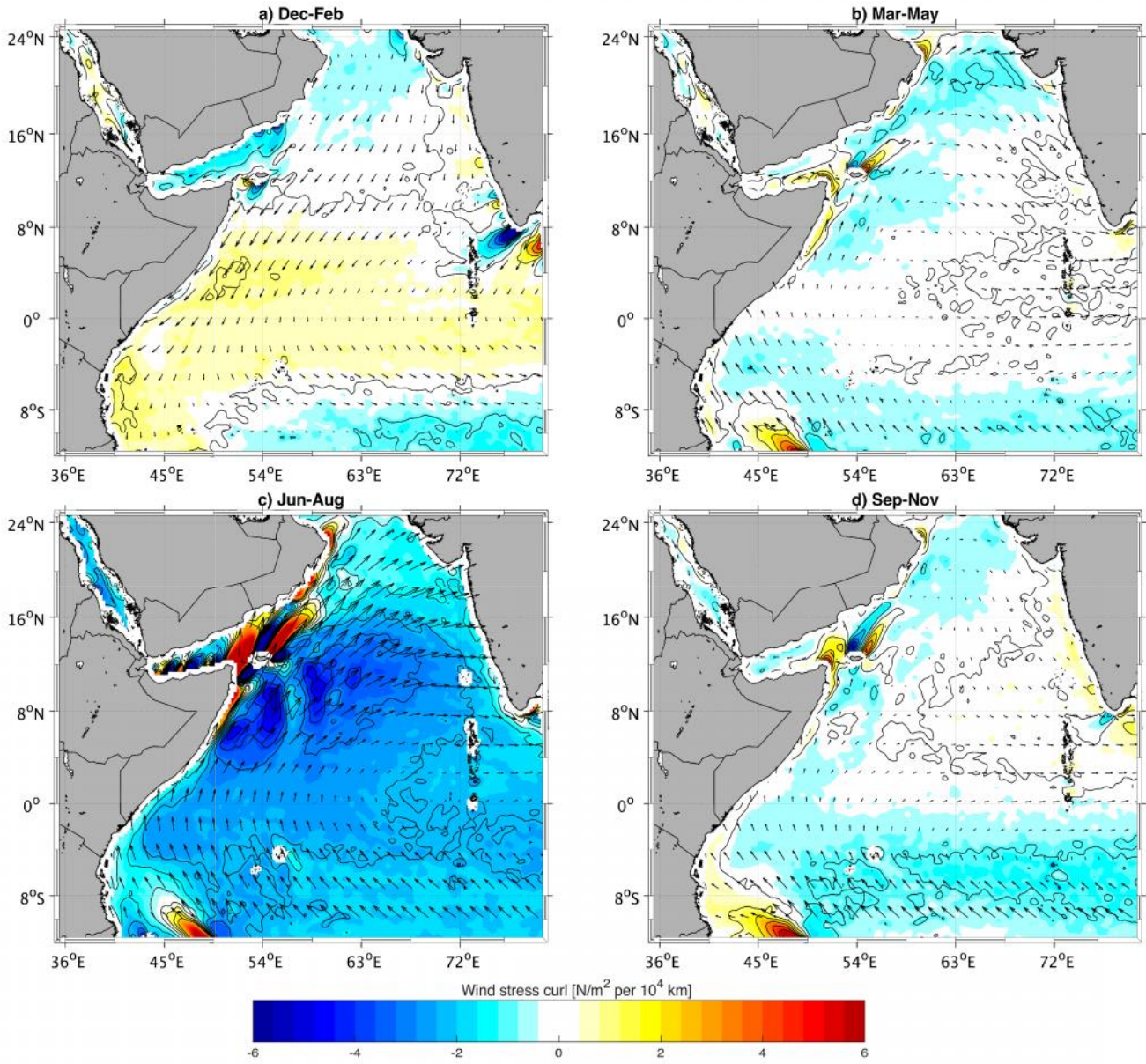
Context

circulation of the western Indian Ocean
O) is influenced by the seasonally
rsing monsoon winds.

WIO basin circulation mainly follows the
e-scale wind stress patterns with a
sonally reversing current known as
nali Current (SC).

is associated with two quasi-
ionary eddies namely; the **Southern**
e and Great Whirl.



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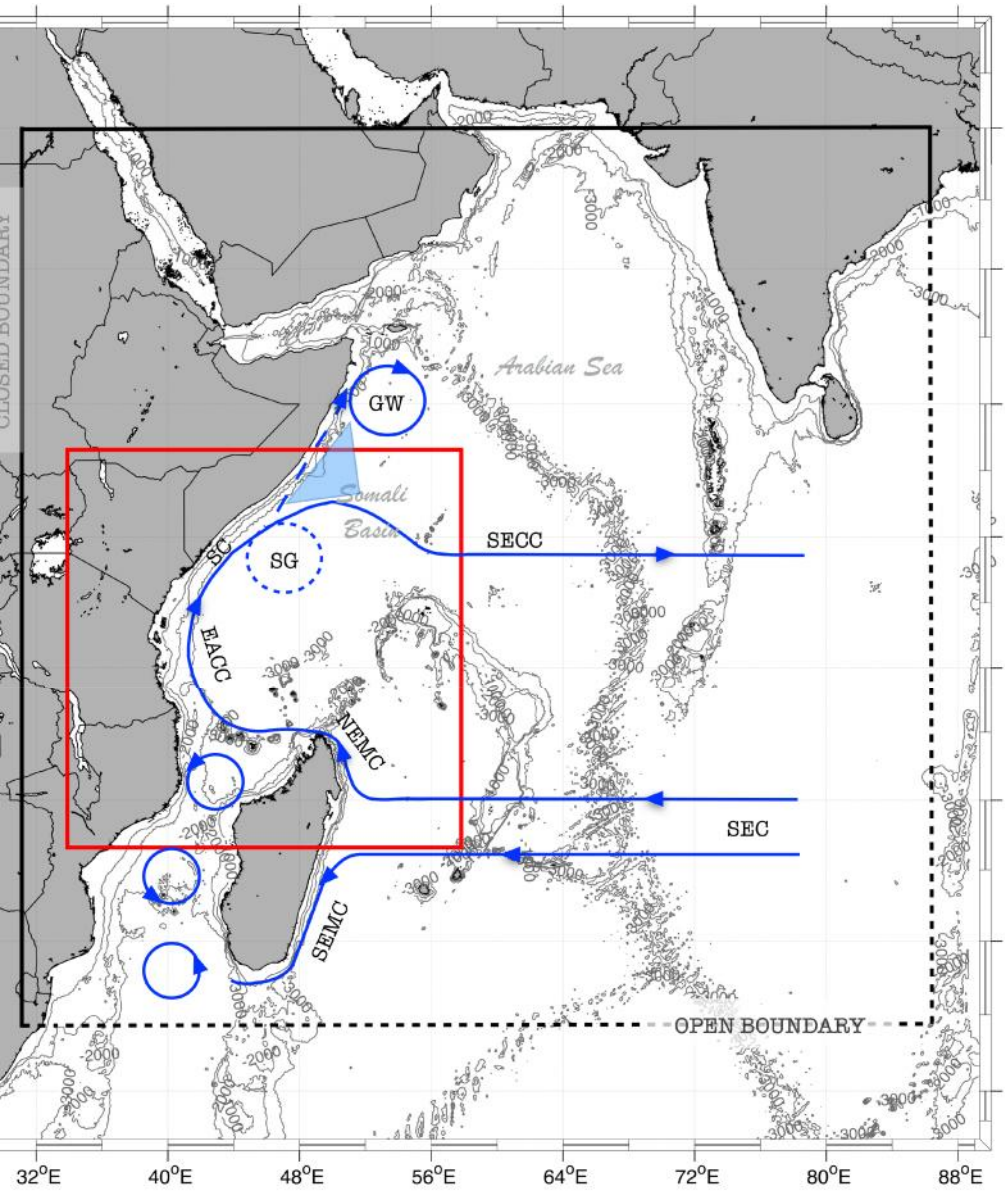


Hydrodynamic model

- Two-way nesting approach is applied as it allows for the coarse resolution outer domain to provide boundary conditions for the higher resolution embedded inner domain (child) and additionally allows the inner domain to feed back into the outer domain (parent).

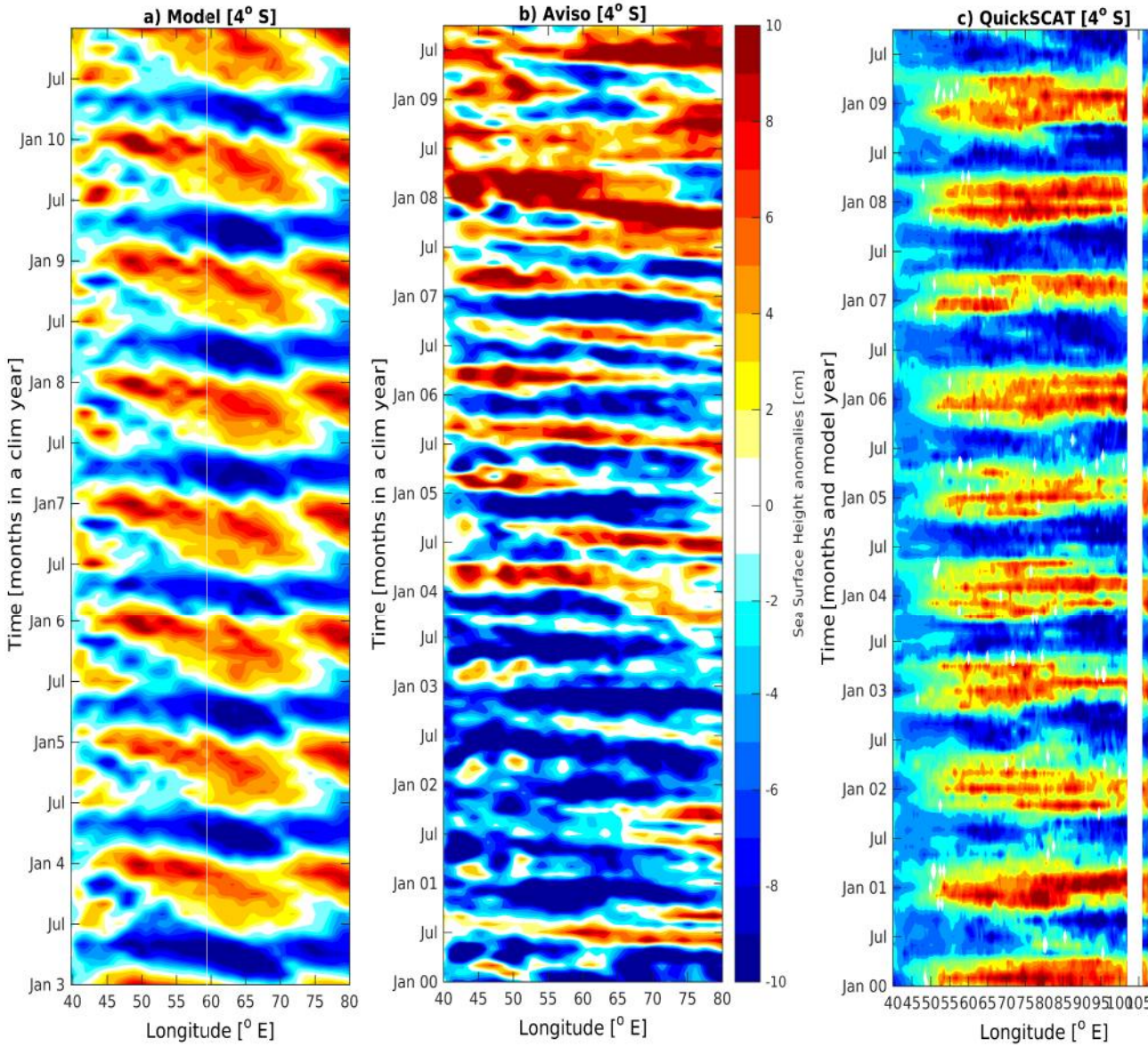
Remote Forcing

he model shows a strong annual cycle in SH that is essentially driven by the easonally reversing winds over the opical Indian Ocean.

esterly winds in the eastern equatorial dian Ocean during the autumn and nter drive downwelling Rossby waves at propagate westwards towards East rica.

takes 4-6 months for the Rossby waves reach the East African coast from 80°E hile, in the model (Figure 5a), the opagating signal appears slower.

he phase speed associated with the odel and Aviso are are 0.18 $m.s^{-1}$ and 15 $m.s^{-1}$.



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Characteristics

	Aviso	Model
Life span (days)	70	98
Eddy scale	358	400
Rotational speed	0.55	0.72
Eddy amplitude	0.51	0.80
Total integrated energy ($m^4.s^2$)	$9.33*10^{11}$	$11.15*10^{11}$

- The tracked Southern Gyre has a mean lifespan of about 70 days from Aviso and 98 days from the model with the eddy radius being similar in the observed data and model.
- The rotational speed is a measure of the eddy currents that characterizes the strength of the eddy with faster (slower) rotational speeds implying stronger (weaker) eddies.

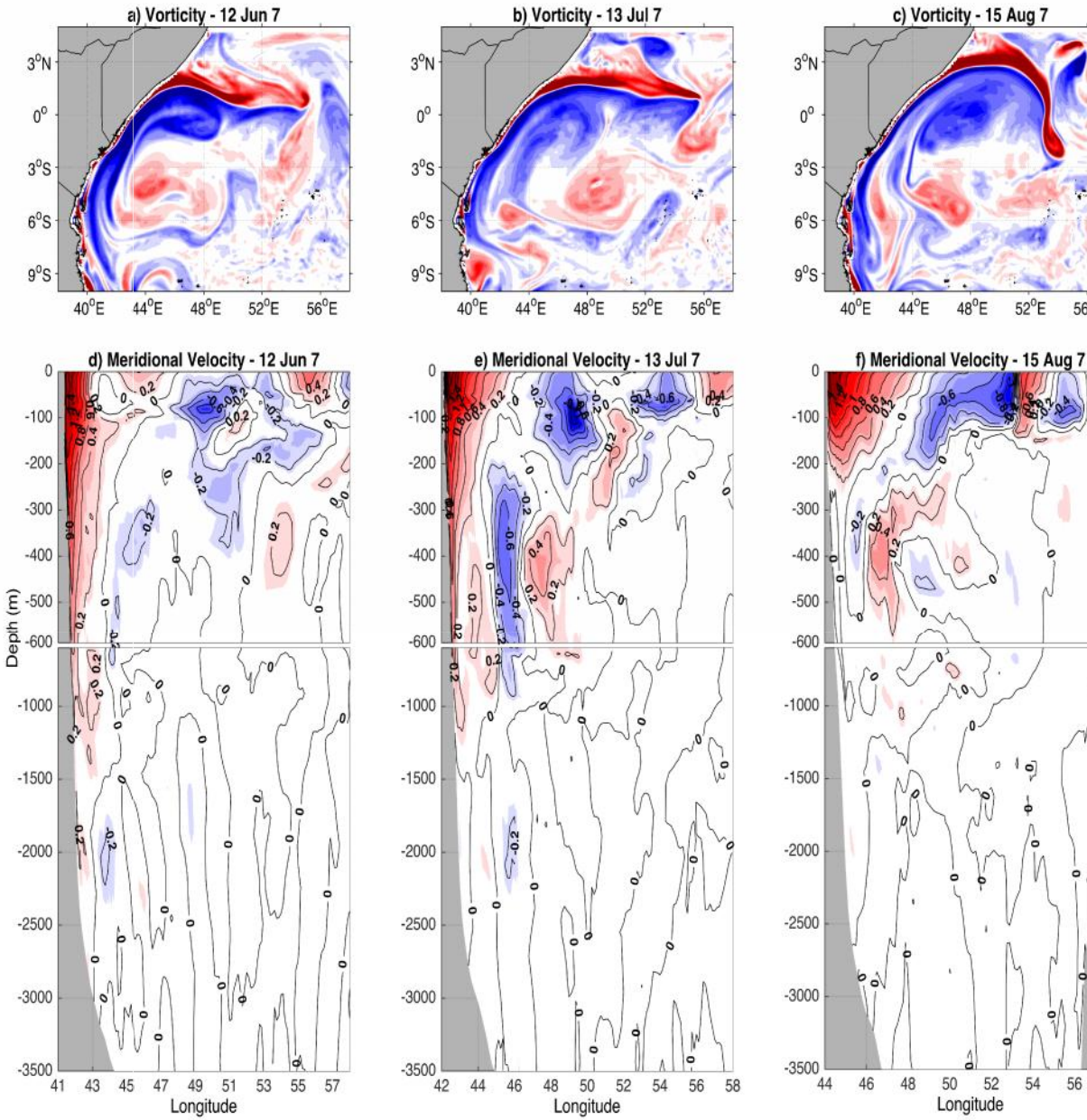
Characteristics

June, the Southern Gyre is positioned near e equator with maximum surface velocities of 2 m. s^{-1} and penetrates to about 100 m epth.

multaneously, the northward flowing ongshore SC which is part of the gyre rengthens with a maximum velocity of 1.4 m. $^{-1}$ and deepens to over 1000 m resulting in a shaped structure between the East African helf and 43°E similar to other western oundary currents.

tensification of the SWM amplifies the tensity of the Southern Gyre which has a pical flow speed of ∼0.6 m.s^{-1} which then dens and deepens to about 200 m.

he evolution of the Southern Gyre is ominated by chaotic detachments of positive rticity which might contribute to its decay.



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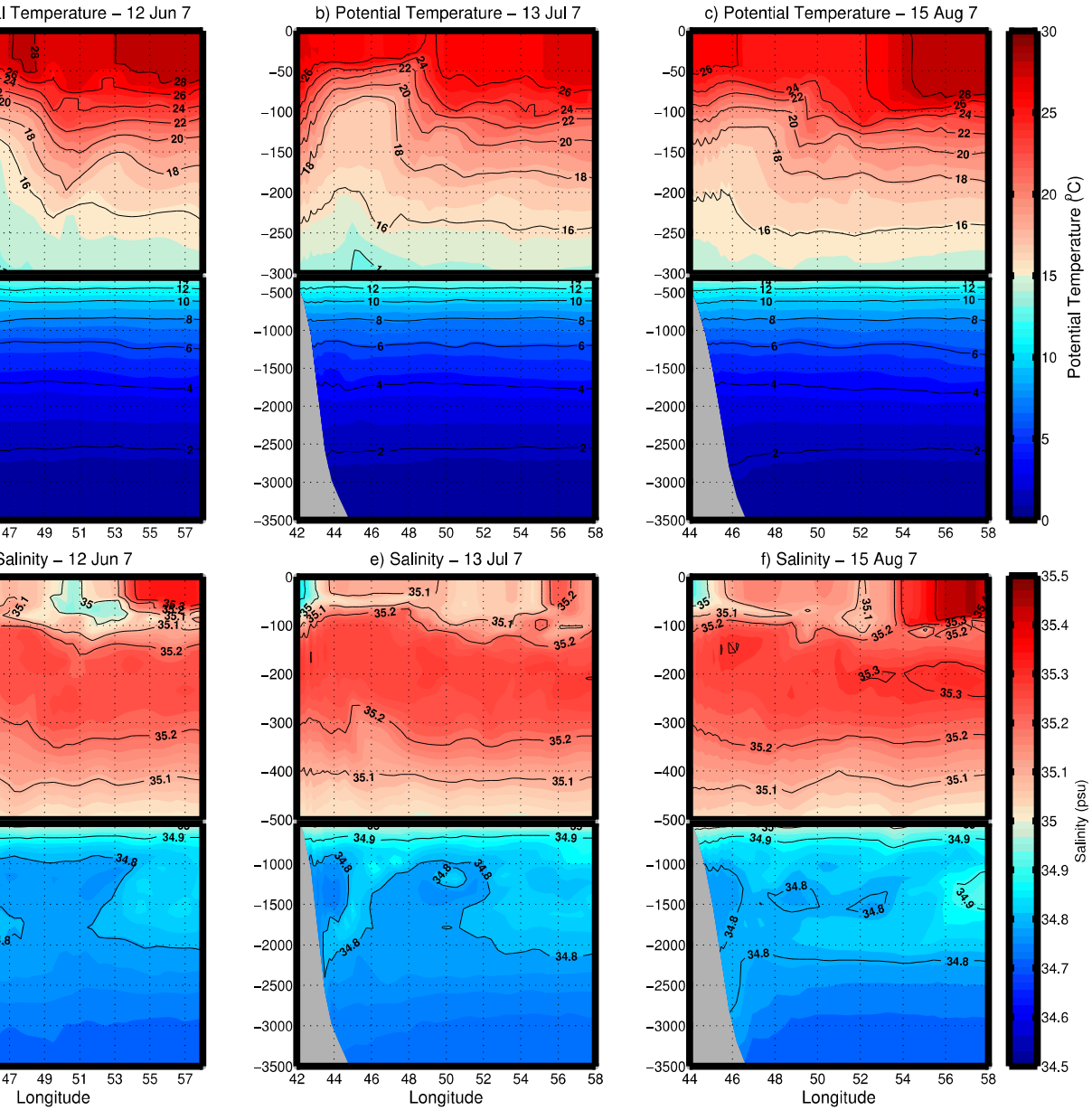

Vertical sections

- The water mass signature of the Southern Gyre is of interest in terms of influence fro the Indonesia Through Flow.
- Above the thermocline (∼200 m), a layer high potential temperature and low salinity surface water is observed intensification.
- These temperature and salinity characteris are due to seasonal heating and advection low salinity waters from the east.

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Conclusion

Crucial role of the strong negative wind stress curl in the SG dynamics.

Importance of a downwelling Rossby wave signal in the onset o the SG → location and timing.

Role of positive vorticity bursts which are absorbed into the gyre prompting in it's collapse.

Much cooler and fresher water properties of the gyre suggest the water is advected from a source located to the east through the Indonesian Through Flow and south Equatorial Current