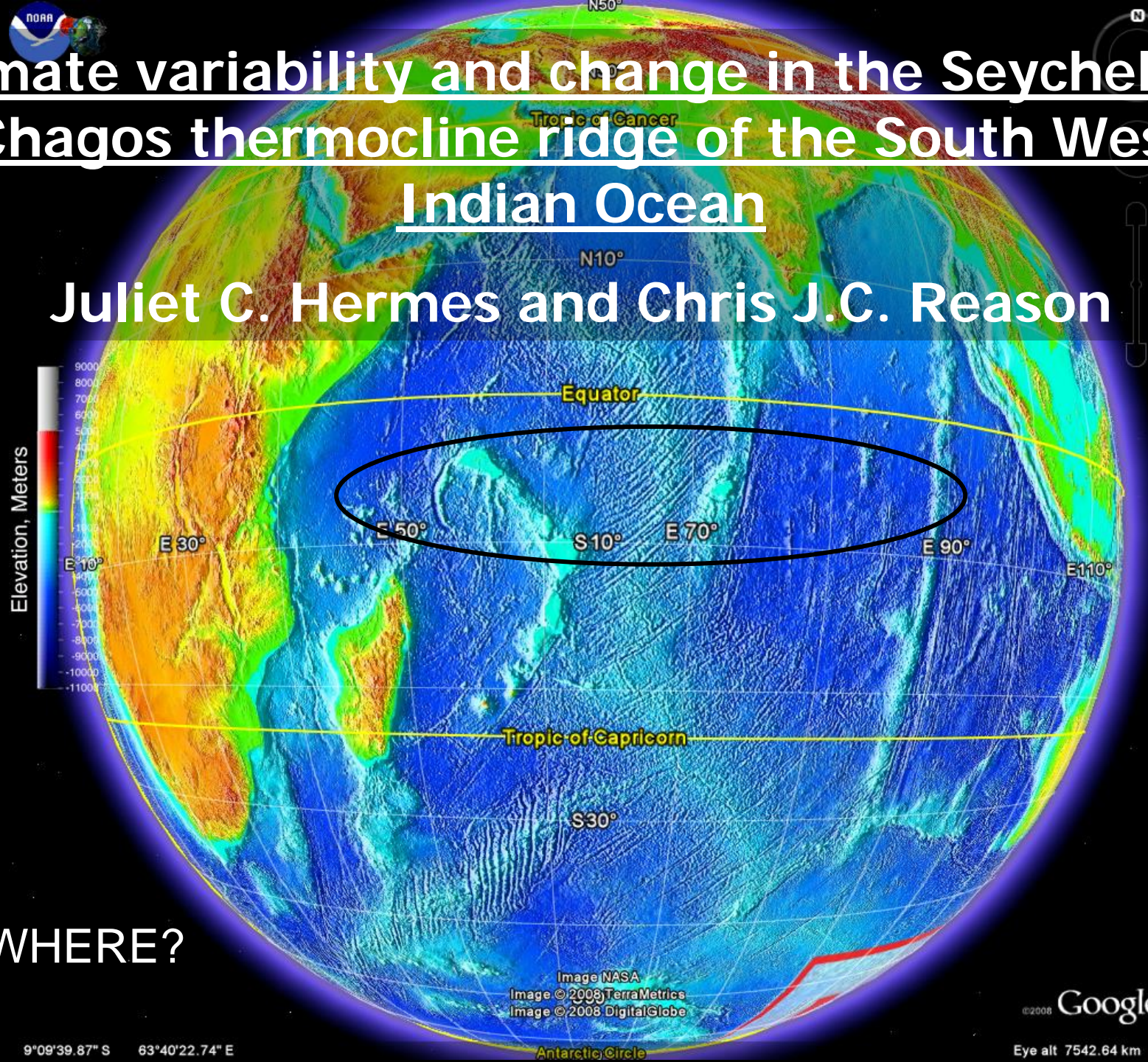




Climate variability and change in the Seychelles-Chagos thermocline ridge of the South West Indian Ocean

Juliet C. Hermes and Chris J.C. Reason



WHERE?

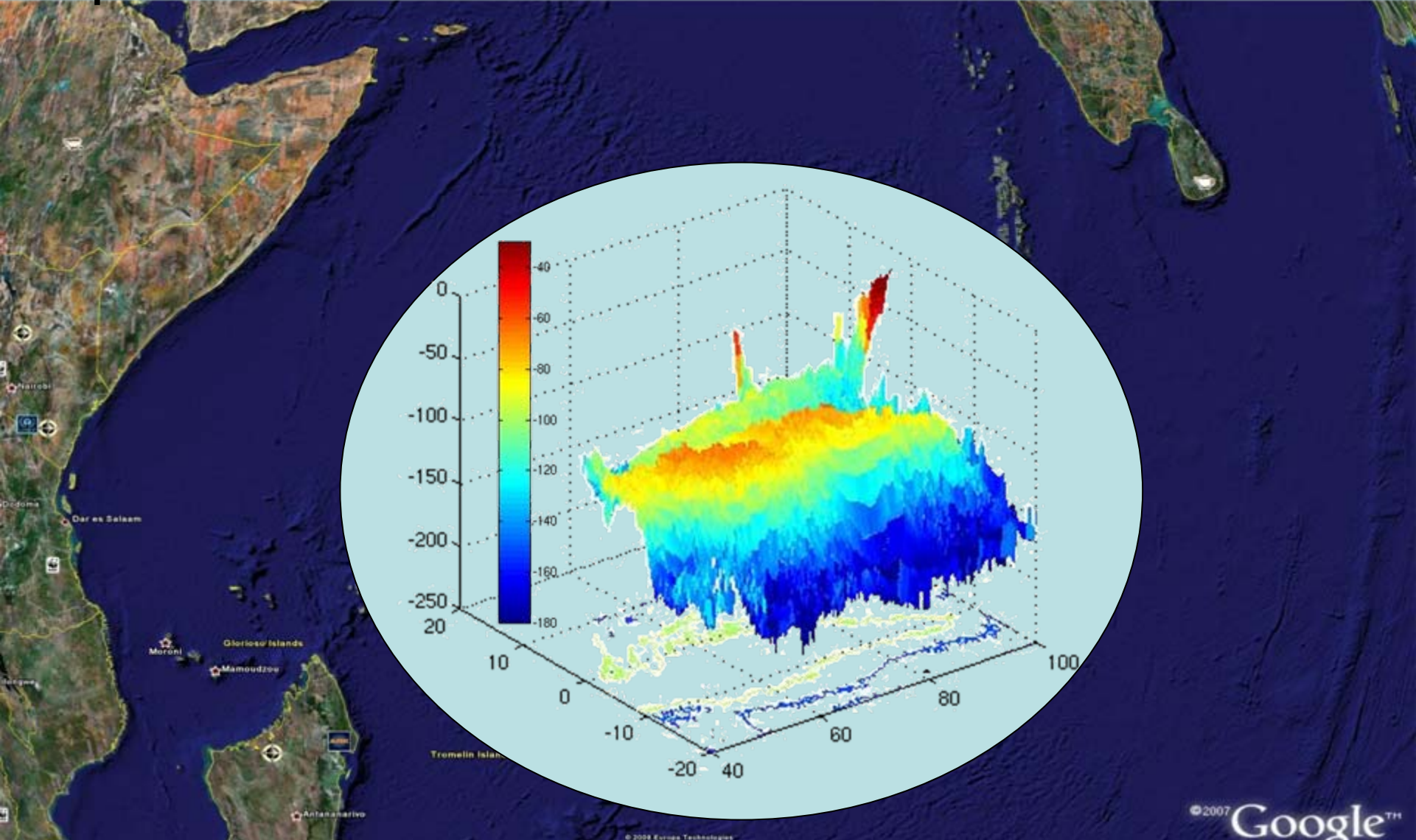
Image NASA
Image © 2008 TerraMetrics
Image © 2008 DigitalGlobe

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9°09'39.87" S 63°40'22.74" E

Eye alt 7542.64 km

Depth of the thermocline – red is shallower



©2007 Google™

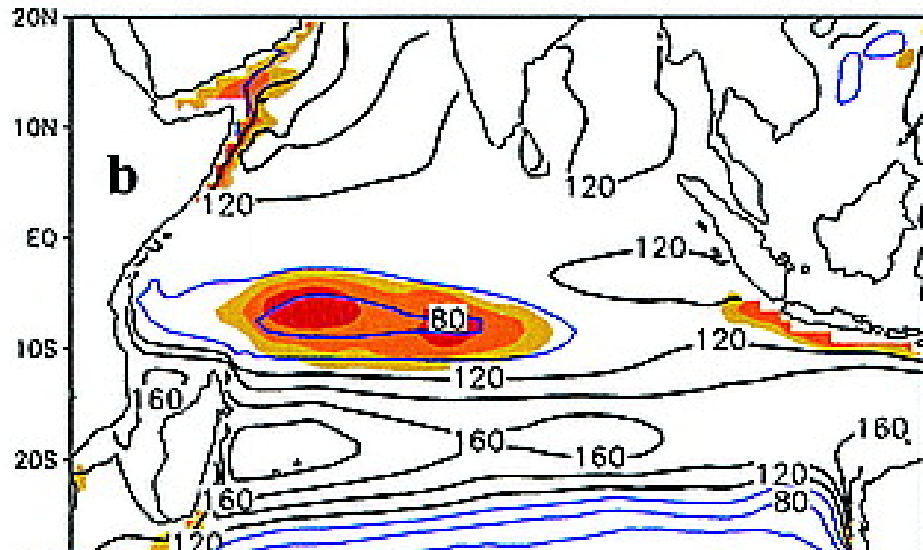
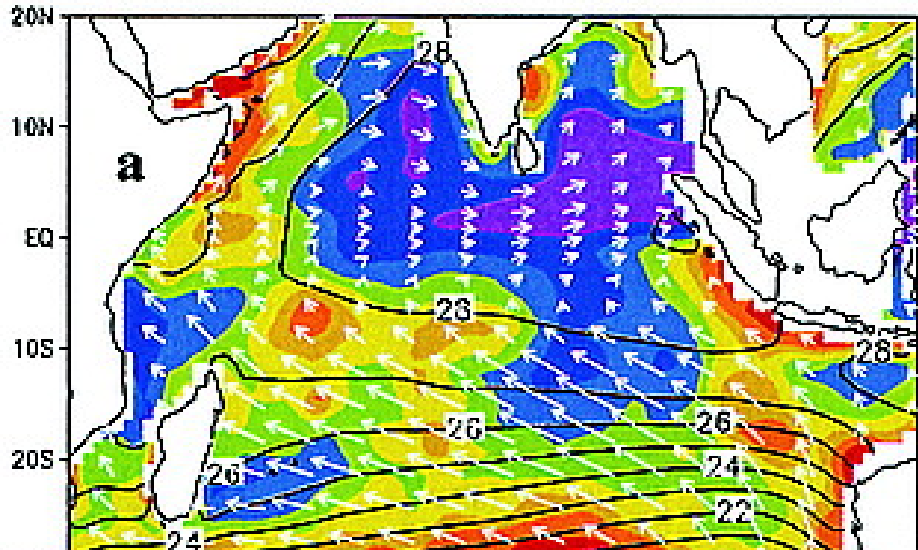


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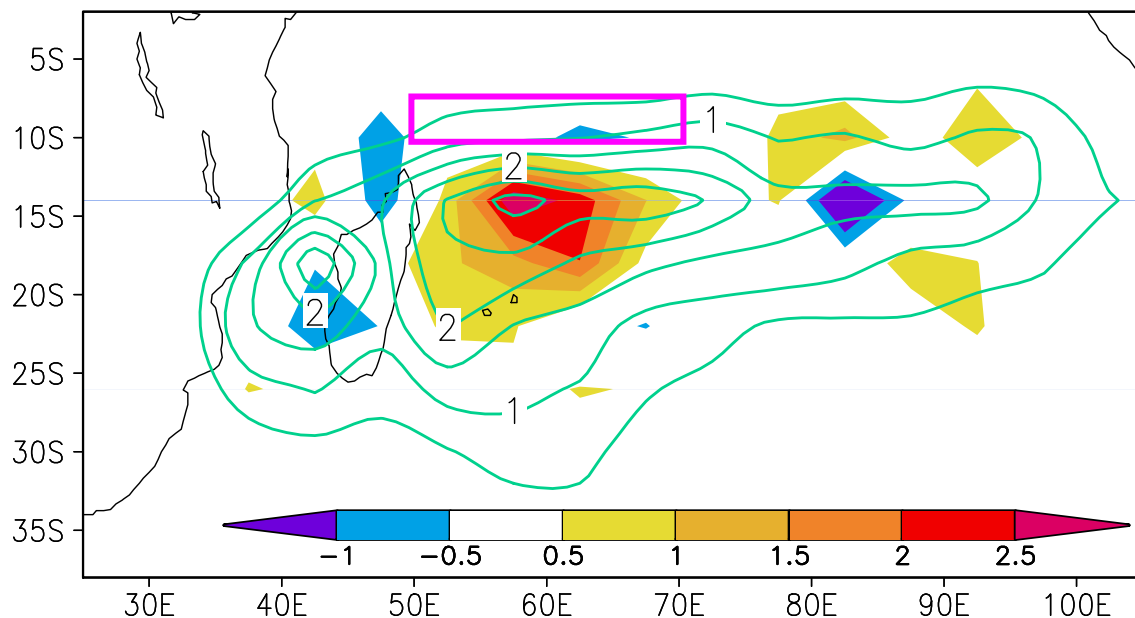


WHAT?



Xie et al. (JC2002) - courtesy Fritz Schott

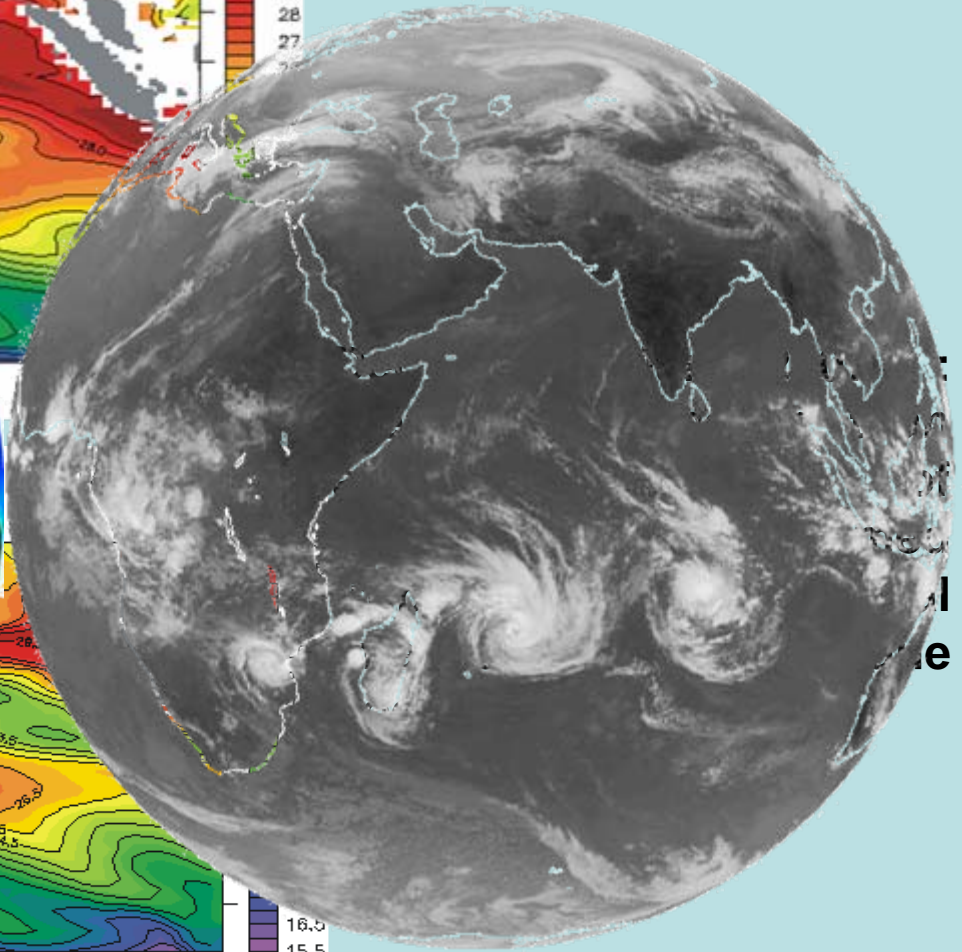
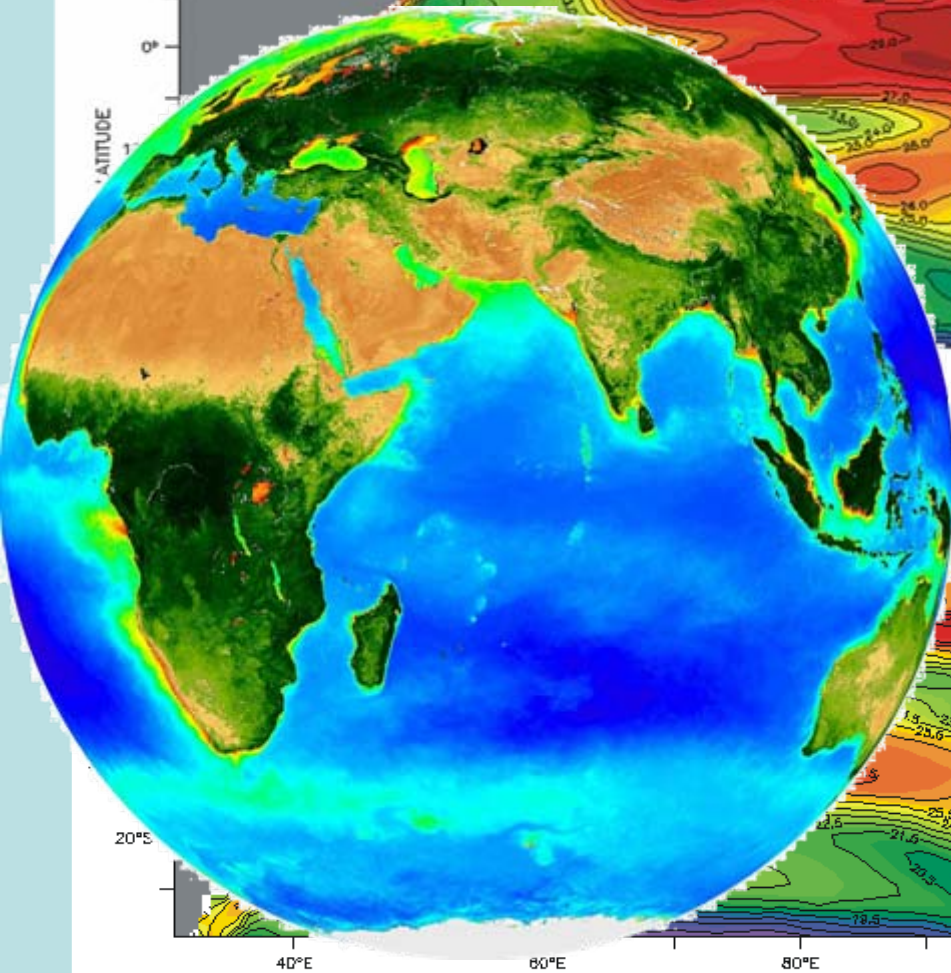
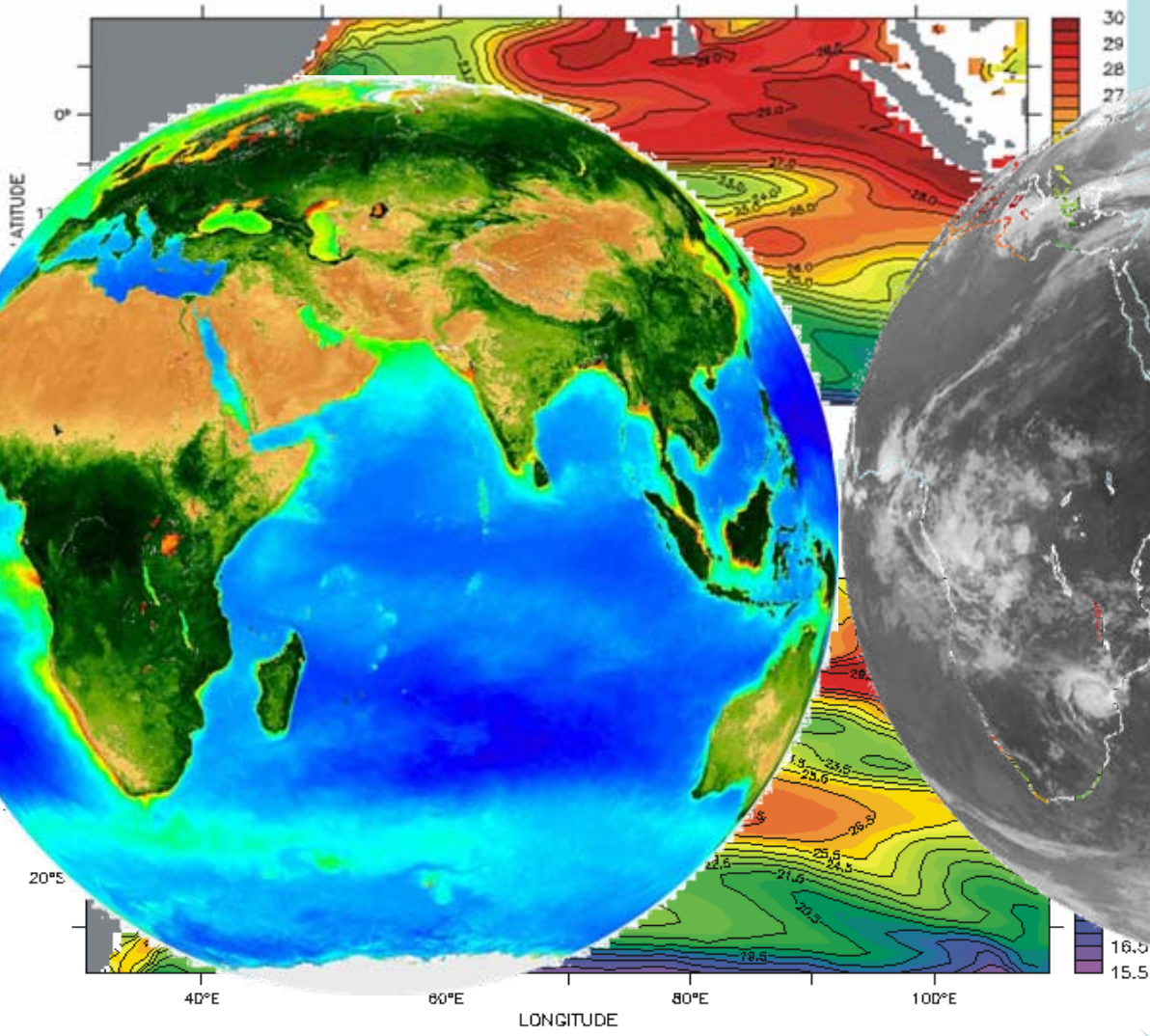
Tropical cyclone days for Dec-Apr when mixed-layer particularly deep (=high SST) NE of Madagascar (8-12S, 50-70E): More cyclone generation and anomalous rainfall



Climatological mean of number of cyclone days (contours) difference between deep and shallow mixed layer (shading)

January climatological temperature at 65m

Simulation (c20010701 and k066a2)



METEDSAT IR 2 23 2007 0630Z



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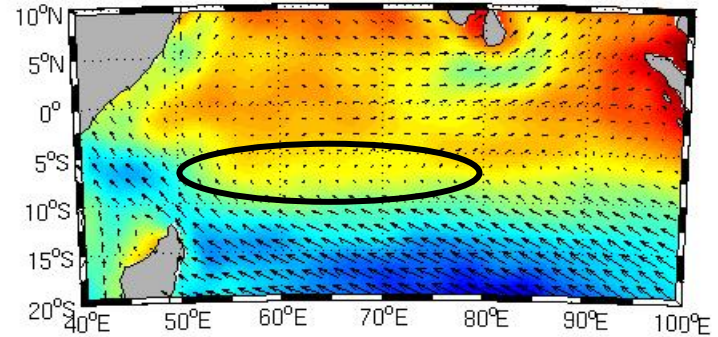
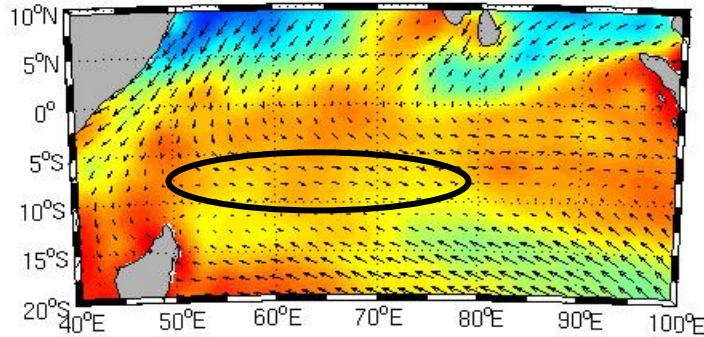


WHY?

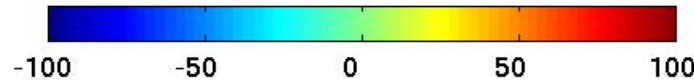
NCEP surface net heat fluxes $W\ m^2$ (positive is heat gain by the ocean), with QuikSCAT wind stress vectors ($N\ m^2$) overlaid

DJF

MAM



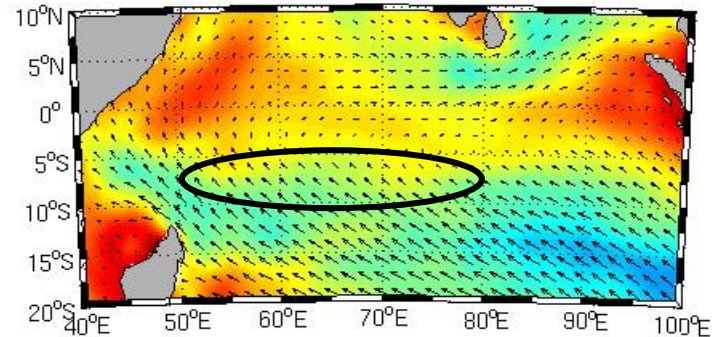
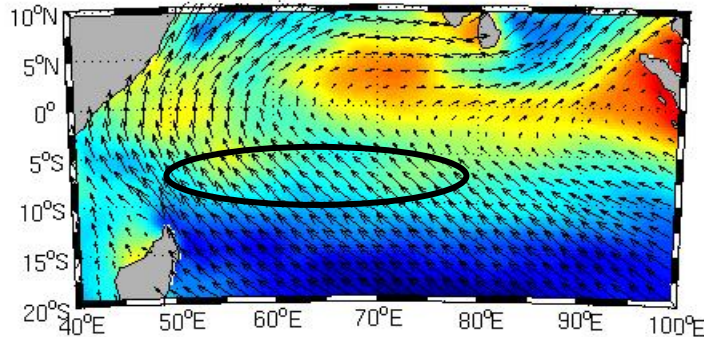
NH winter NE monsoon



NH summer SW monsoon

JJA

SON

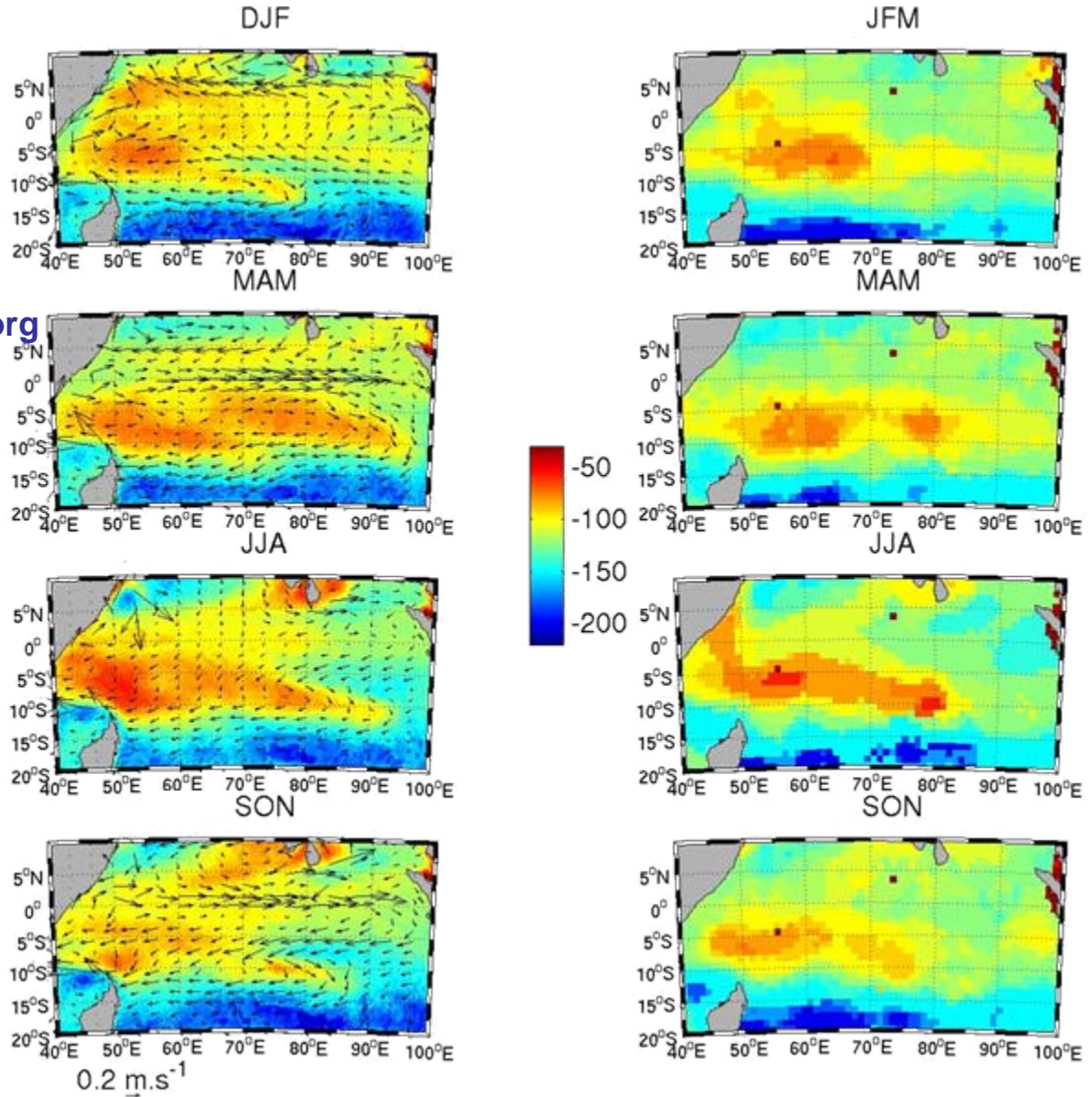


$0.2\ N\ m^{-2}$

ROMS

<http://www.myroms.org>

OBSERVATIONS



Upwelling present throughout the year, more defined in MAM, JJA

WHEN?



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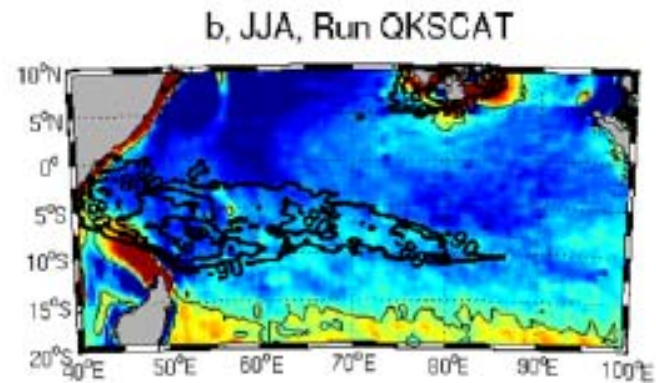
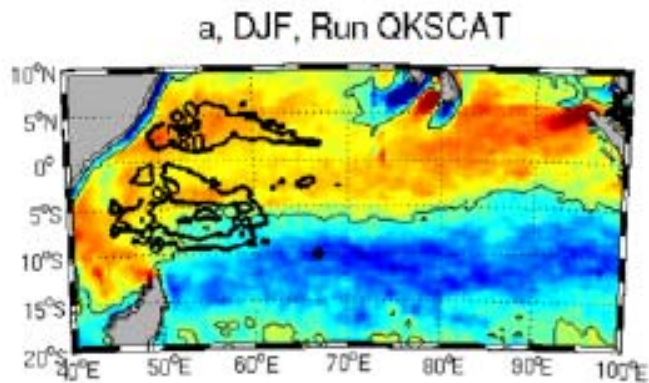


and by

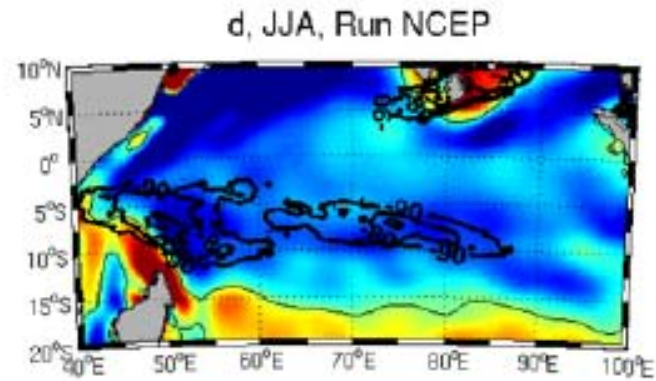
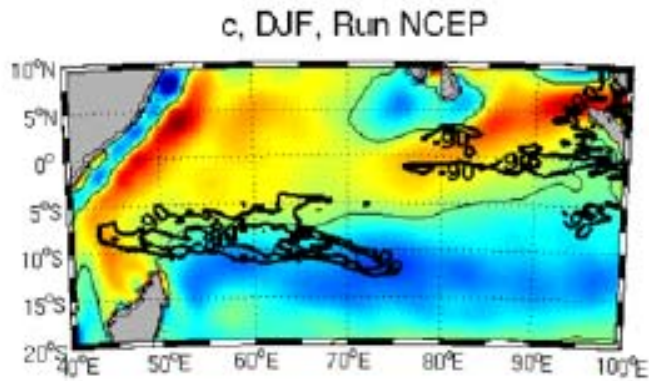


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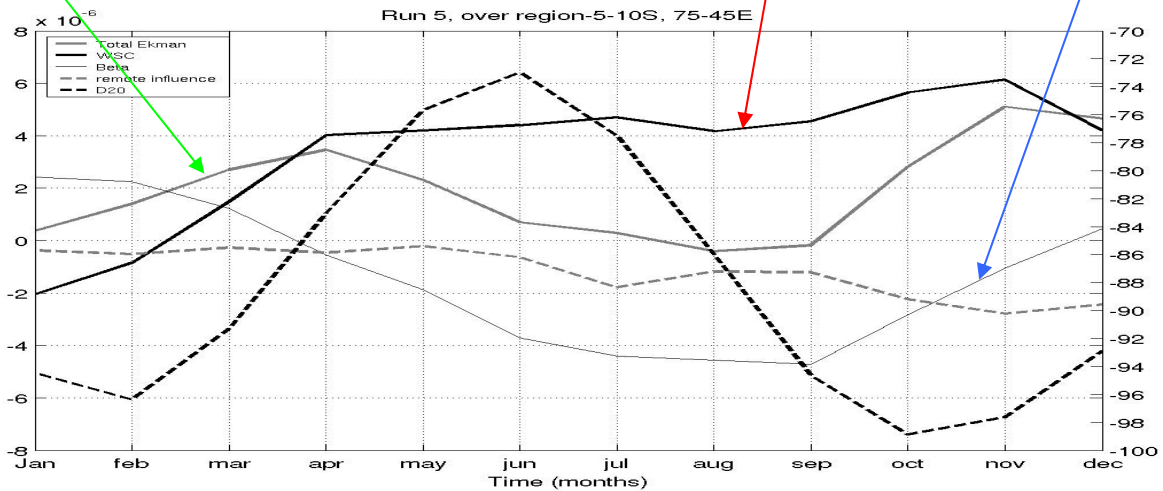
QuikSCAT wind stress curl ($N\ m^3$) with the minimum thermocline depth contours (70, 80, 90 m)



NCEP wind stress curl ($N\ m^3$) with the minimum thermocline depth contours (70, 80, 90 m)

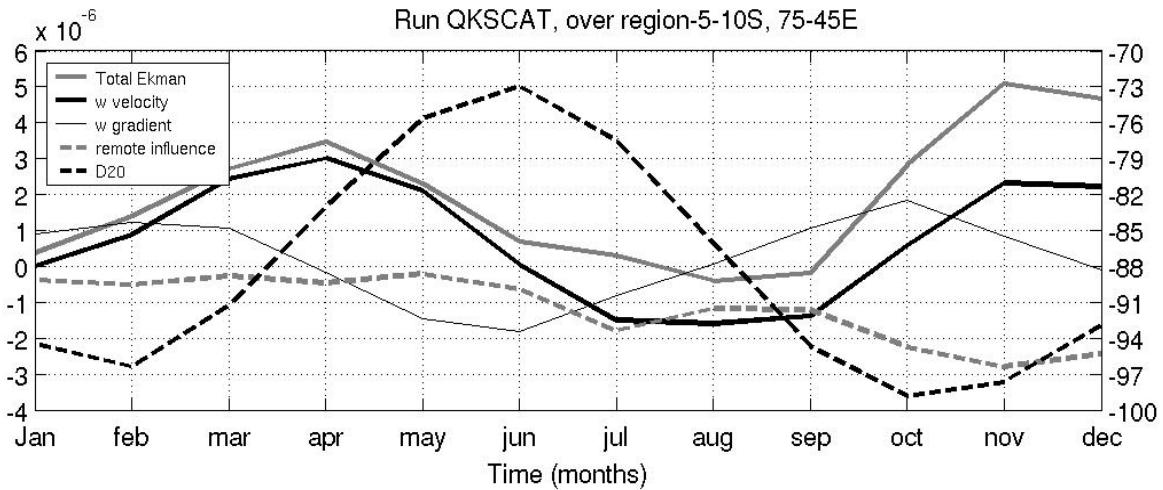
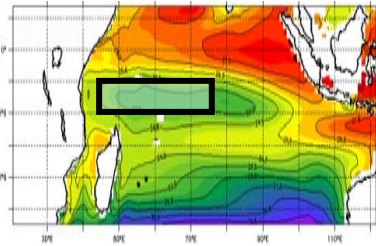
Upwelling equation:

$$\frac{1}{\rho_0 f} \text{curl} \vec{\tau} + \frac{\beta \tau^x}{\rho_0 f^2}$$



Shallow

Deep



HOW?



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Bottom topography

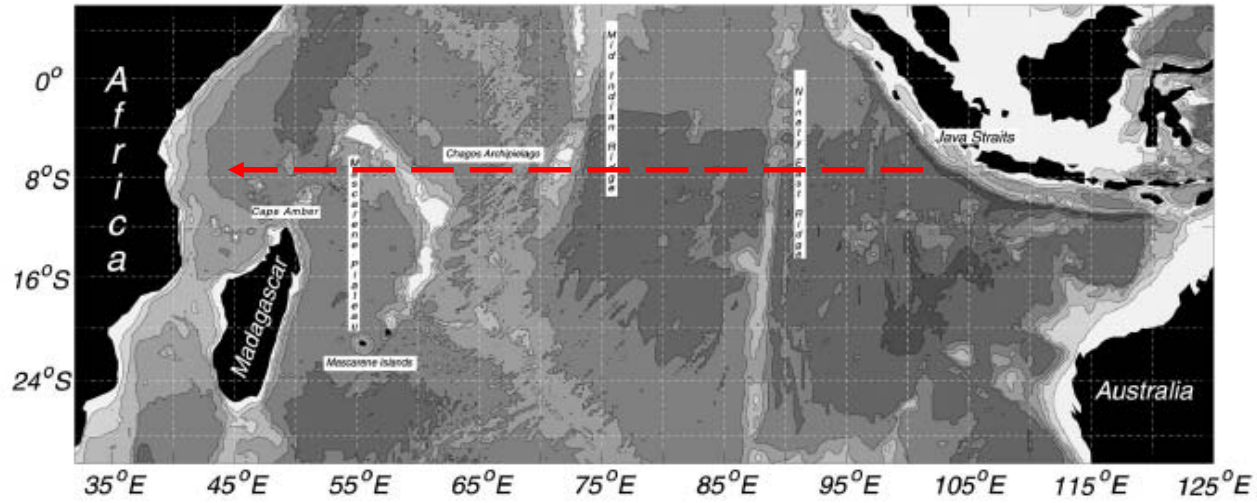
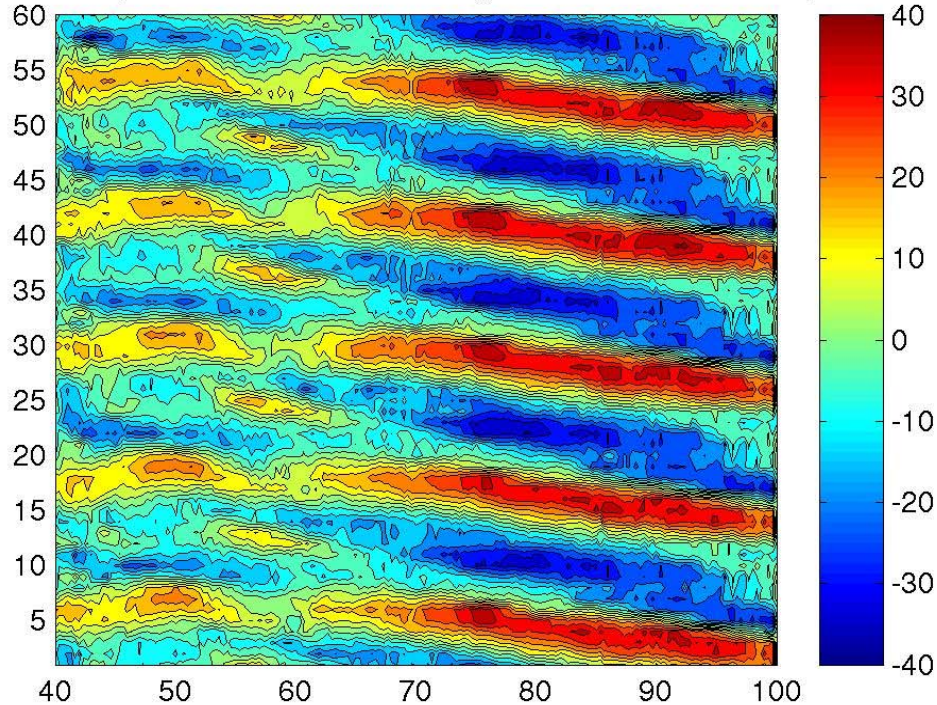


FIG. 9. Bottom topography of the south Indian Ocean.

hovmoller plot of 20 iso anom averaged between 5 to 9 S exp 5

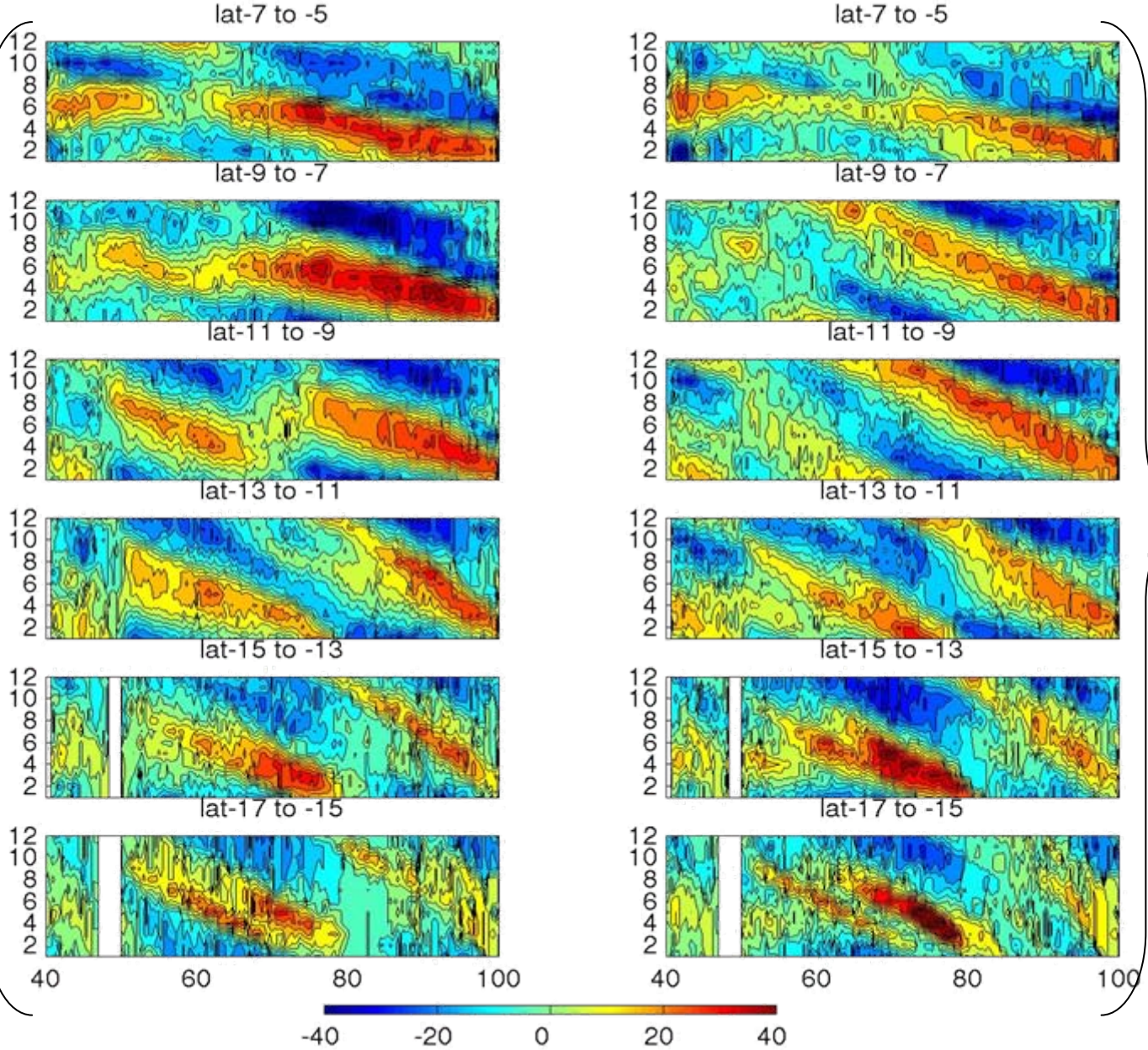


Rossby waves

Anomalies in z20 depth for run with

Quikscat wind forcing

NCEP
wind
forcing



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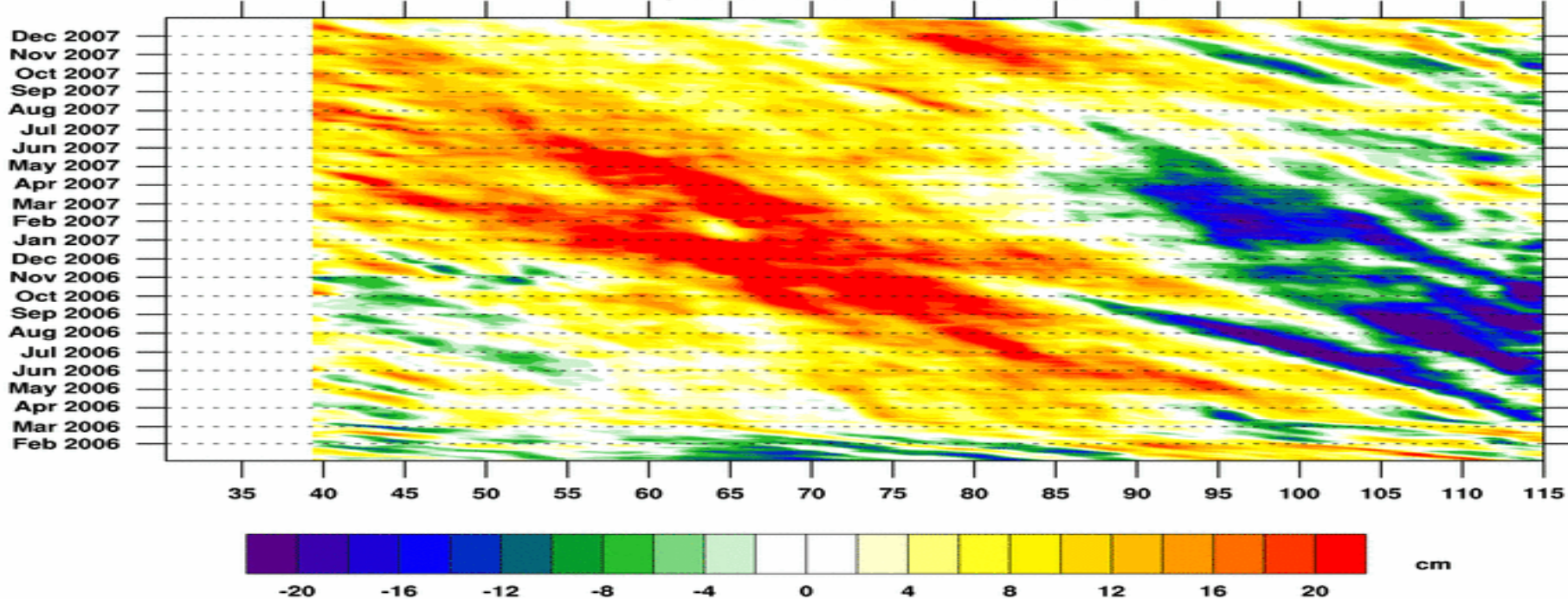
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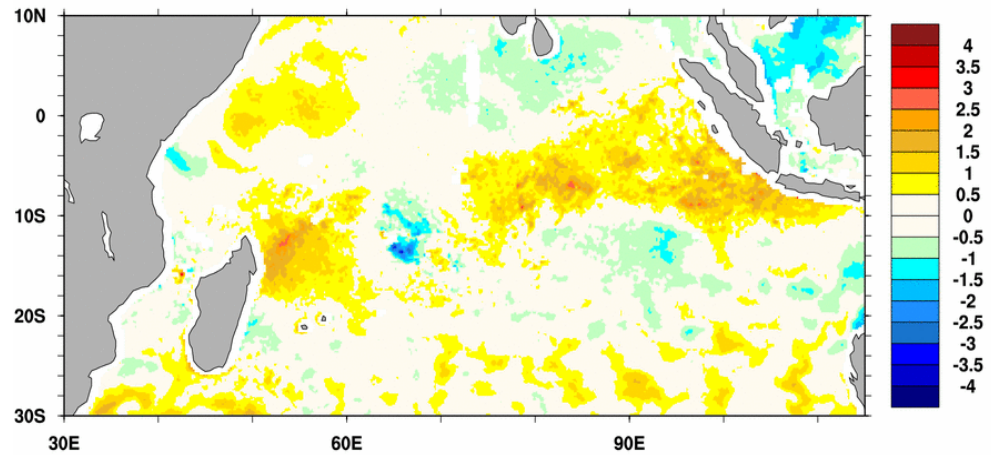
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SSH anomaly from a monthly mean - Year 2006 to 2007
Hovmuller plot between 30E and 120E at latitude 10 S



Weekly SST anomaly from a monthly mean centered on the week below
28 1 2007-3 2 2007
Deg.C



Near real-time monitoring of SSH,
SST, winds, rain

<http://realtime.sea.uct.ac.za/realtime/indian>

Marjolaine Rouault



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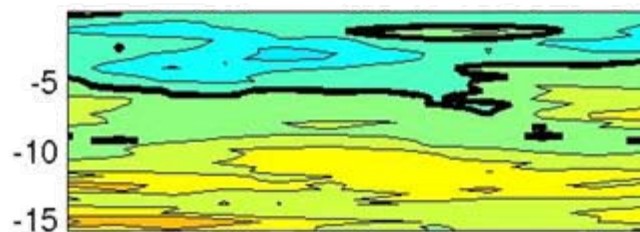
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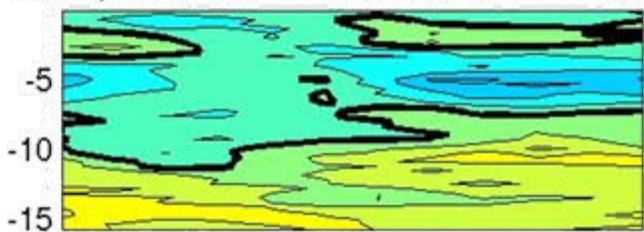
run5, control



run6, winds shifted north over ridge



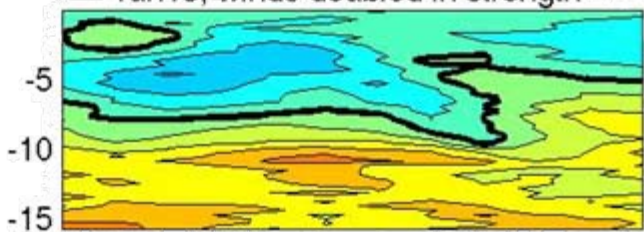
run11, winds shifted south over whole domain



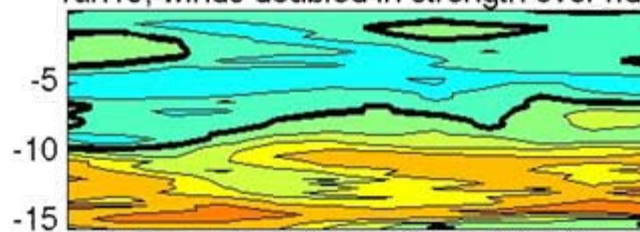
run12, winds shifted north over whole domain



run13, winds doubled in strength



run15, winds doubled in strength over ridge

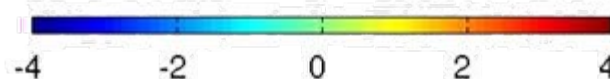


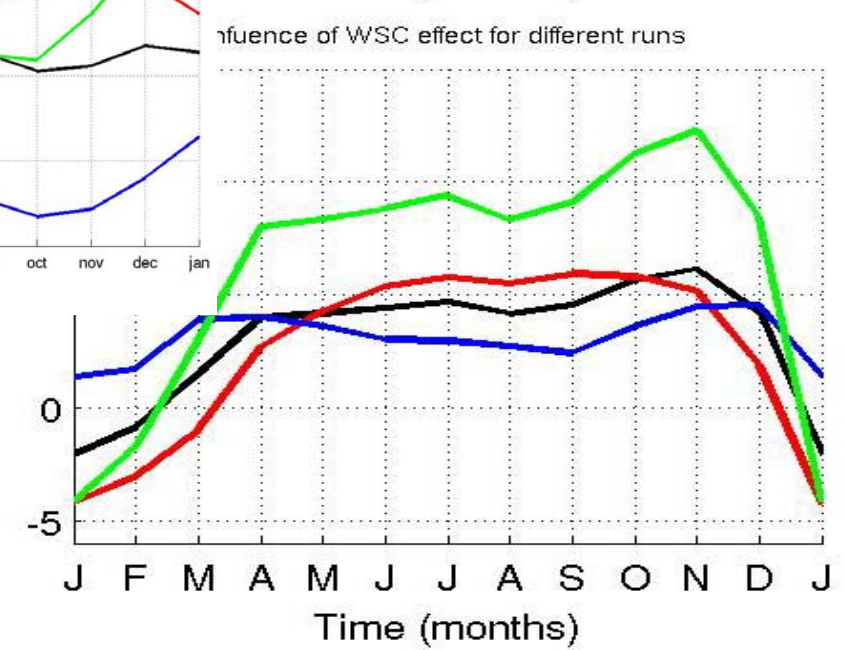
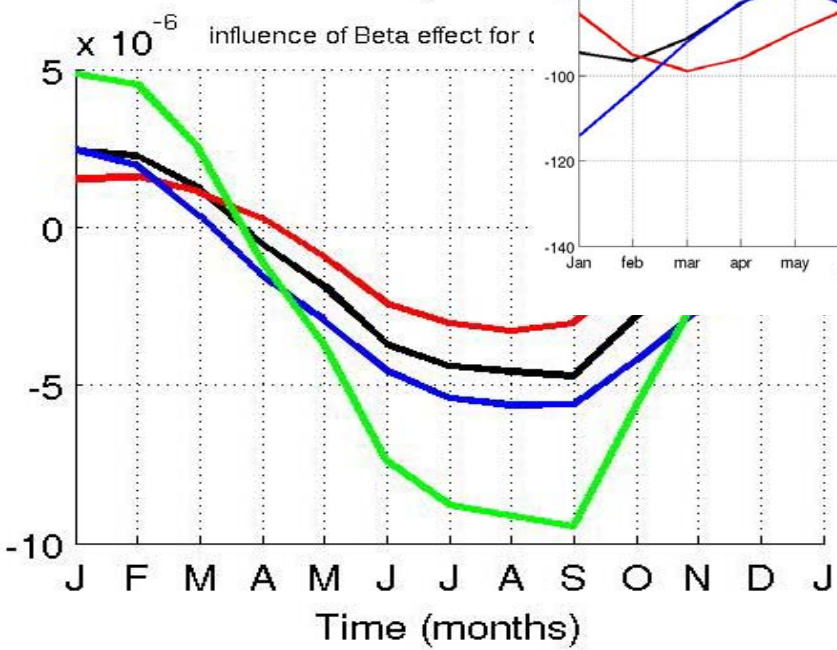
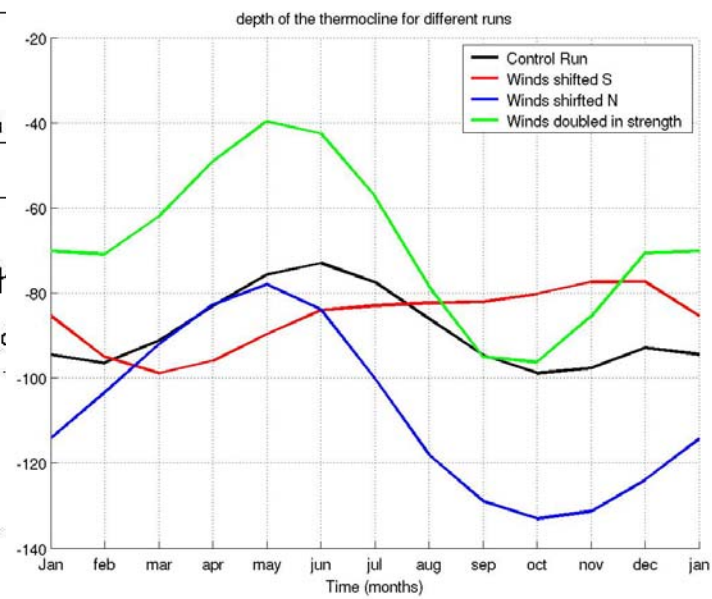
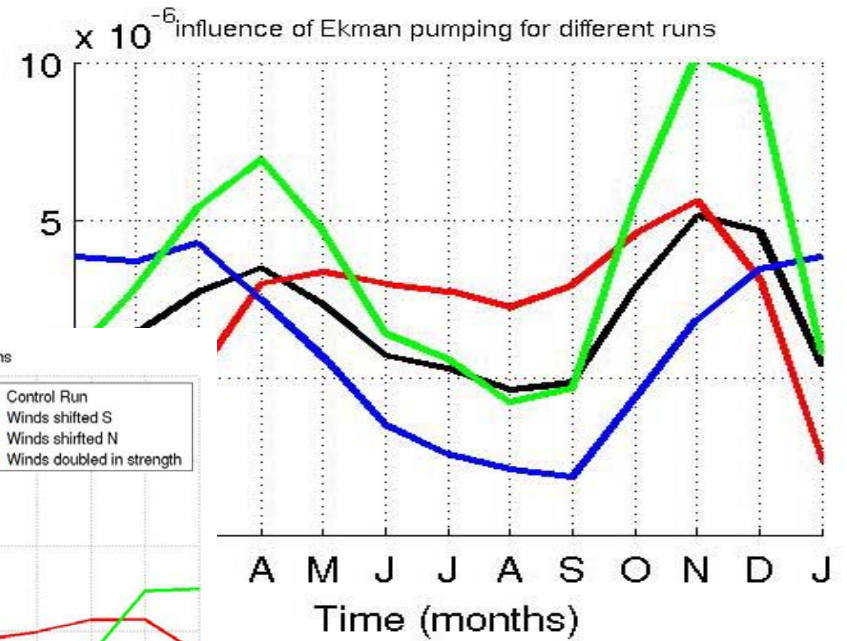
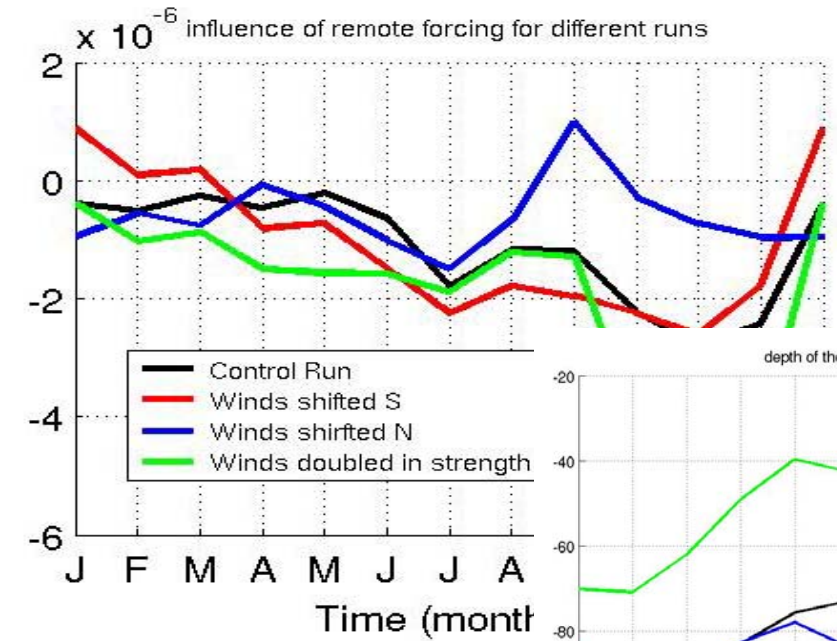
run16, winds doubled in strength east of ridge



2 4 6 8 10 12

meridional temperature gradient between 45-75 east





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Summary

- Region of open ocean upwelling in the tropical South Indian Ocean, showed that the term ridge (**Seychelles-Chagos ridge**) was more appropriate than dome. Boundaries approx 5-12S, 50-70E, varies throughout the year
- Ridge straddles a complex region of forcing
- Semi-annual signal in upwelling
- Not simply forced by wind stress curl, combination of WSC and Beta effect (meridional gradient of the Coriolis parameter)
- Impact of remotely forced Rossby waves, modified by local wind, both annually and inter-annually. More complex due to change in speed of Rossby wave with latitude
- Shift in South Indian Ocean high will affect the depth of the thermocline either directly or through impact of remote forcing. This is likely to impact on weather and biology.

Further information:

Hermes J. C. and C. J. C. Reason, **2008**: Annual cycle of the Tropical Indian Ocean (Seychelles-Chagos) thermocline ridge in a regional ocean model. *J. Geophys. Res.*, doi: 10.1029/2007JC004363.

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