

HYCOM on the Agulhas Shelf

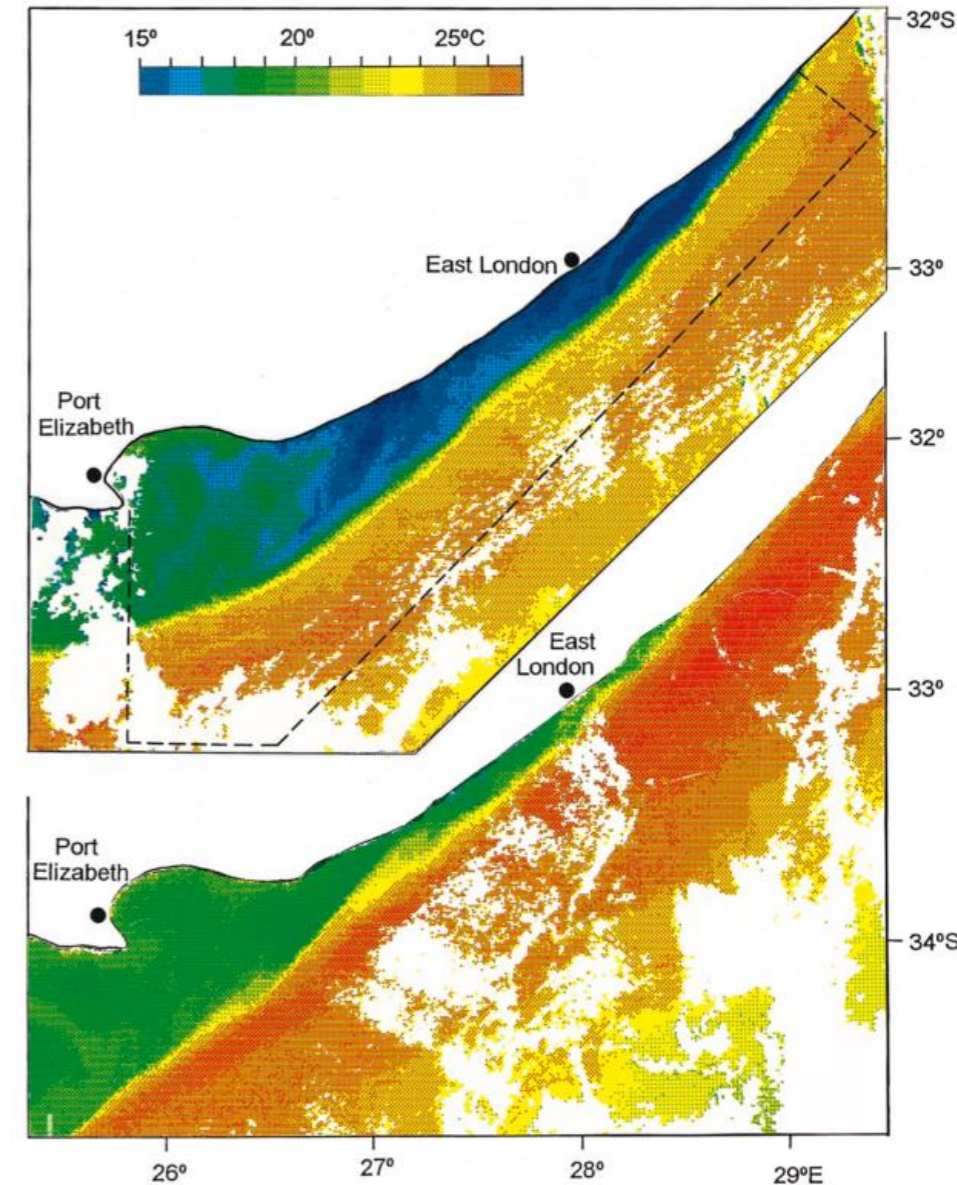
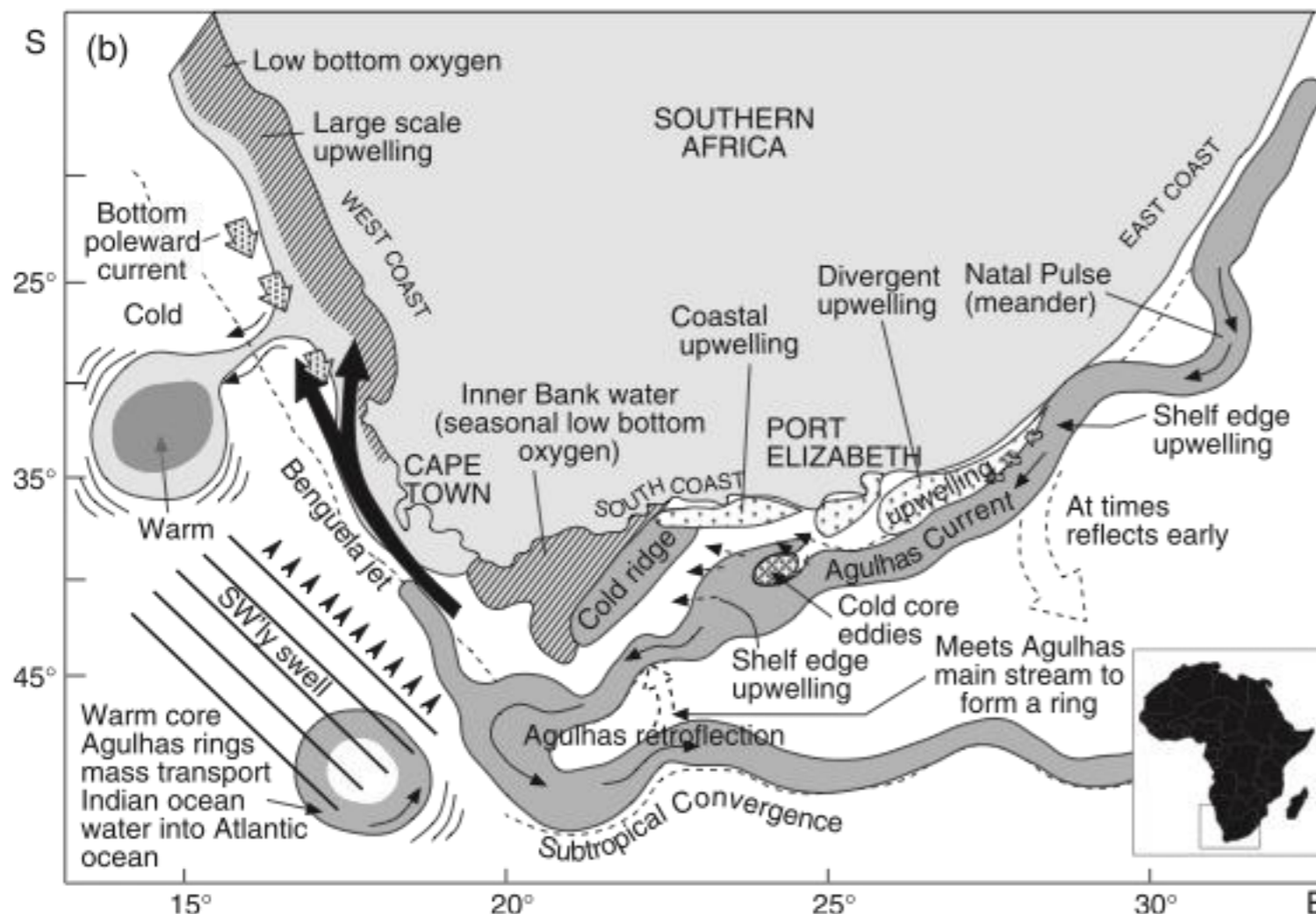
Neil Malan

SAEON Egagasini Marine Offshore Systems and Dept. Oceanography, University of Cape Town

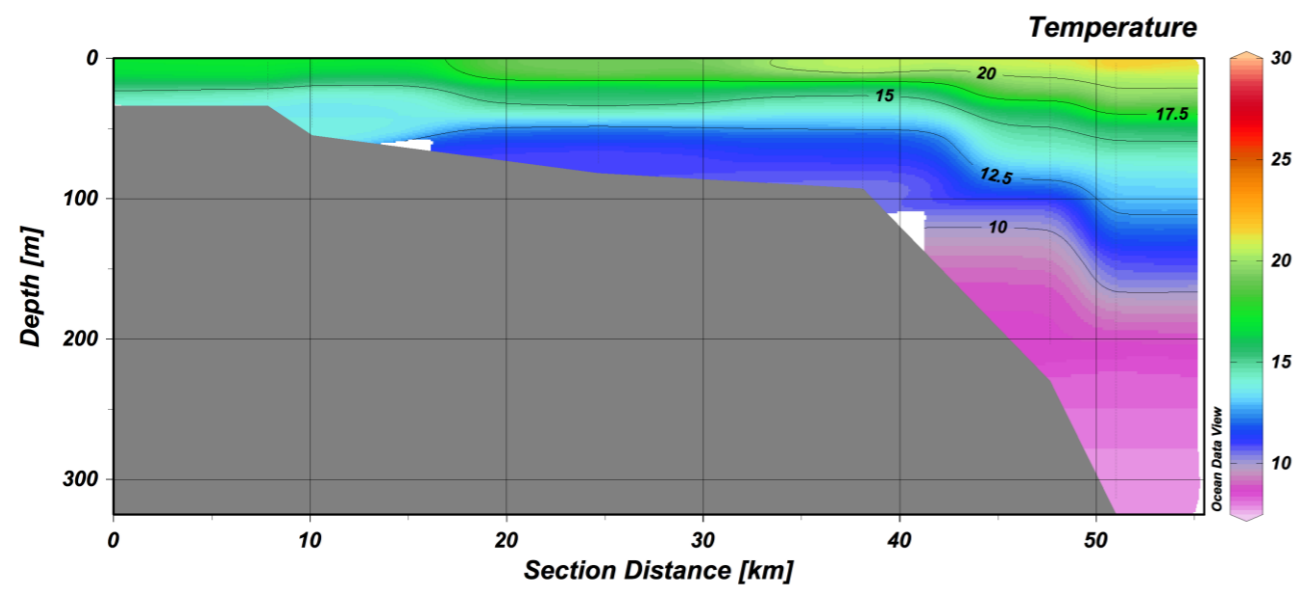
Bjorn Backeberg, Annette Samuelsen

Upwelling inshore of western boundary currents

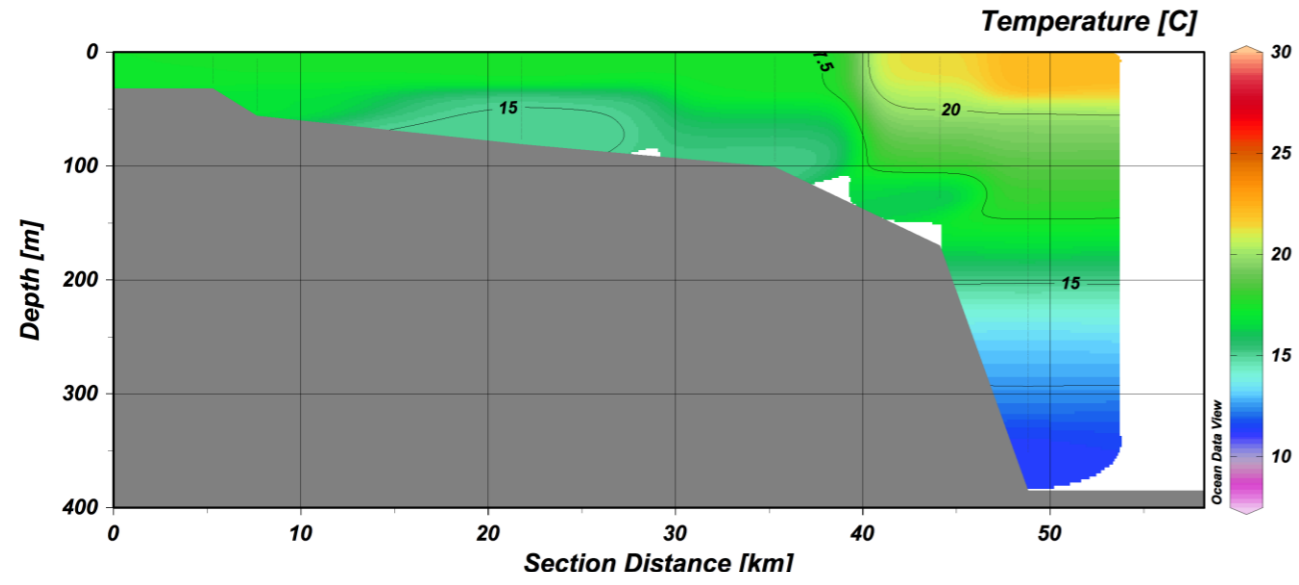
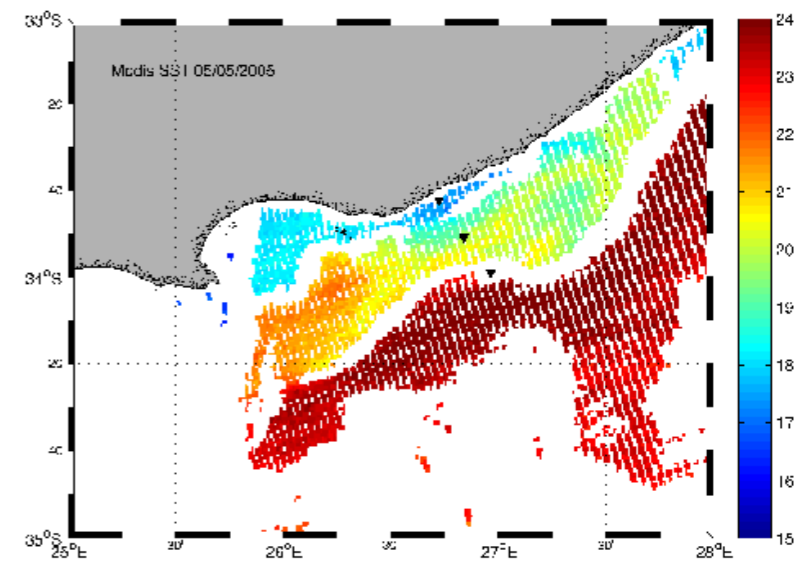
- In the Agulhas -Port Alfred upwelling cell, bringing South Indian Central Water onto the shelf.
- Hypothesised to feed Agulhas Bank thermocline
- Environmental shifts a strong driver of biological processes on Agulhas Bank



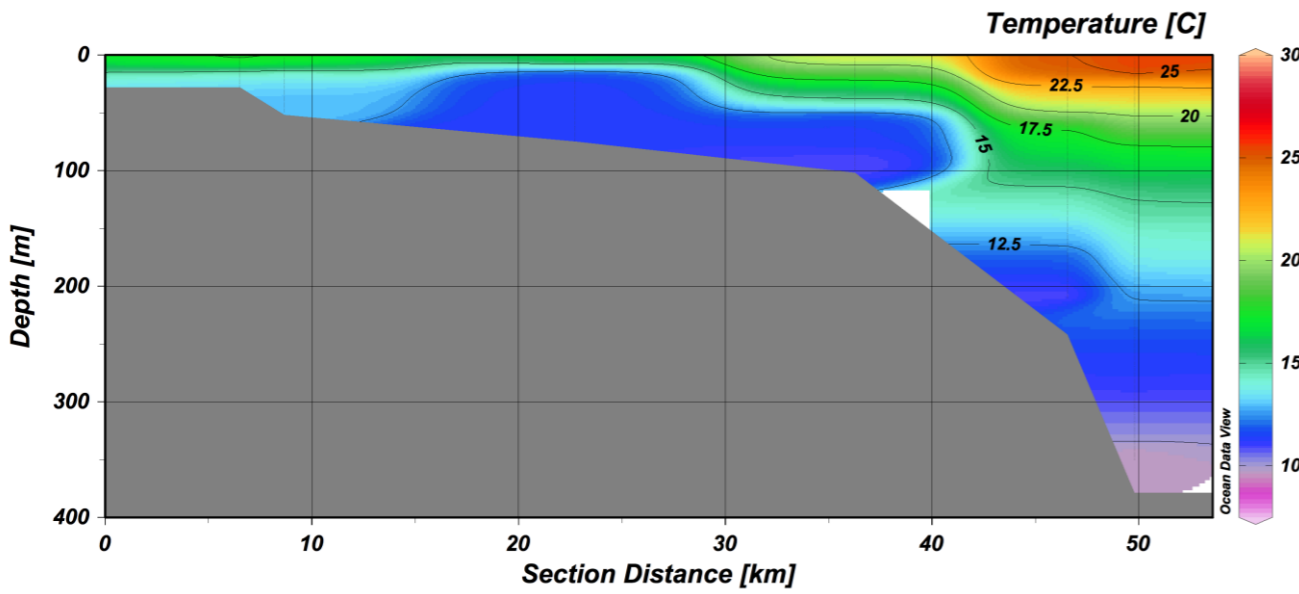
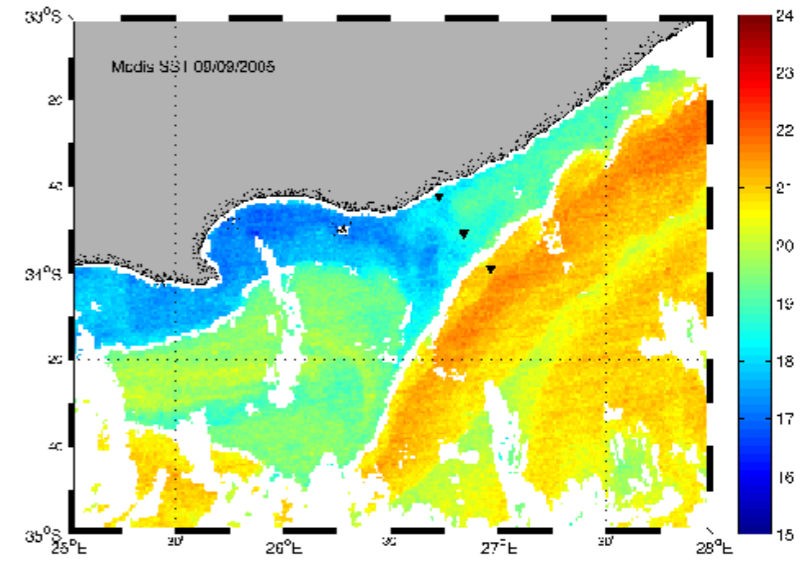
Port Alfred Observational Programme



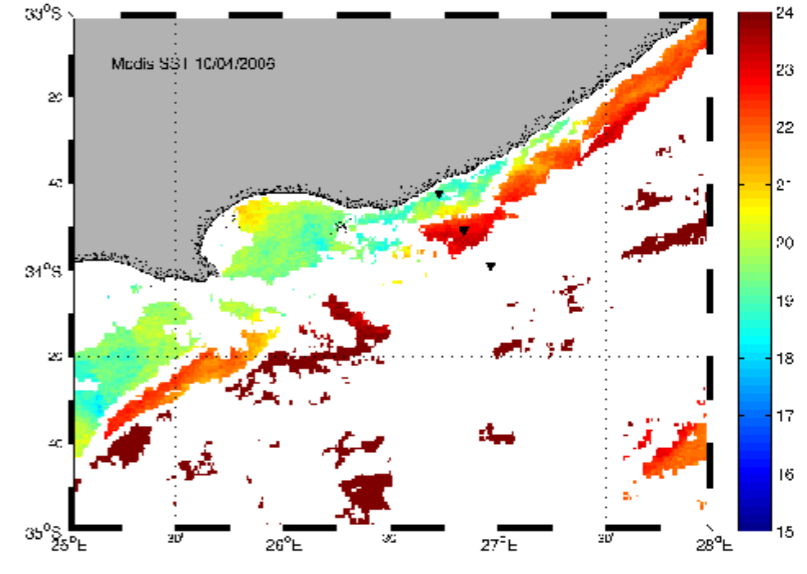
May '05



Sept '05

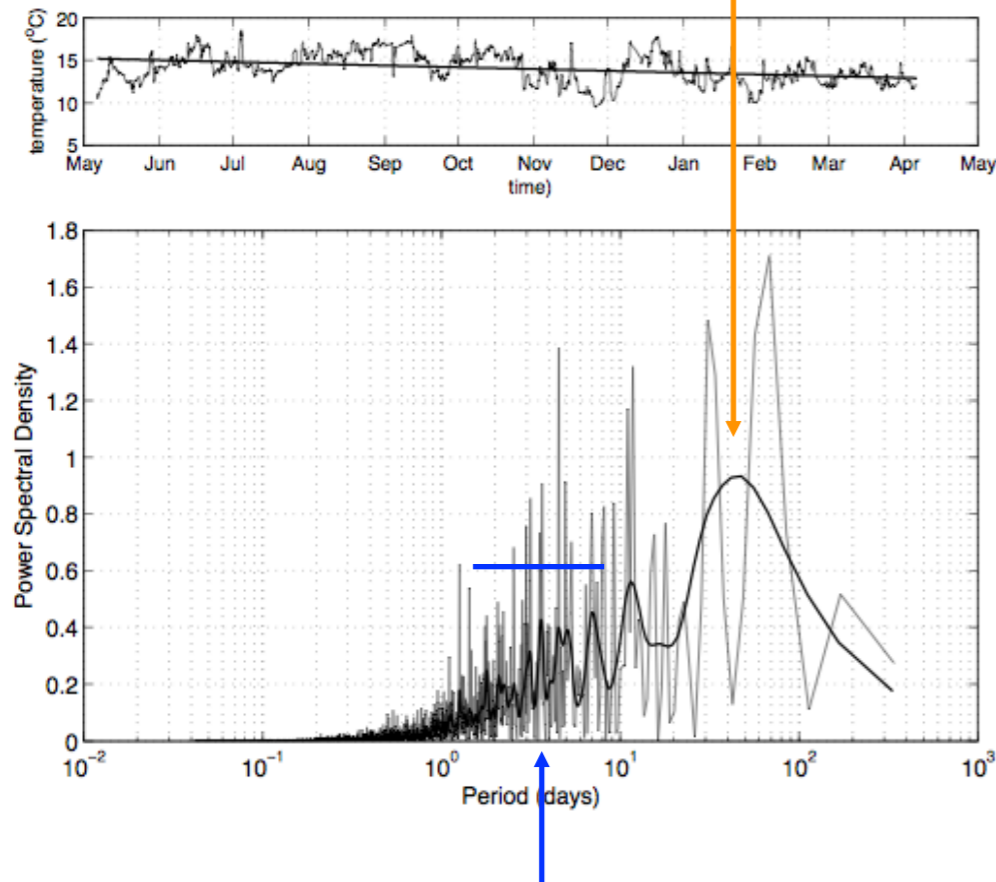


Apr '06



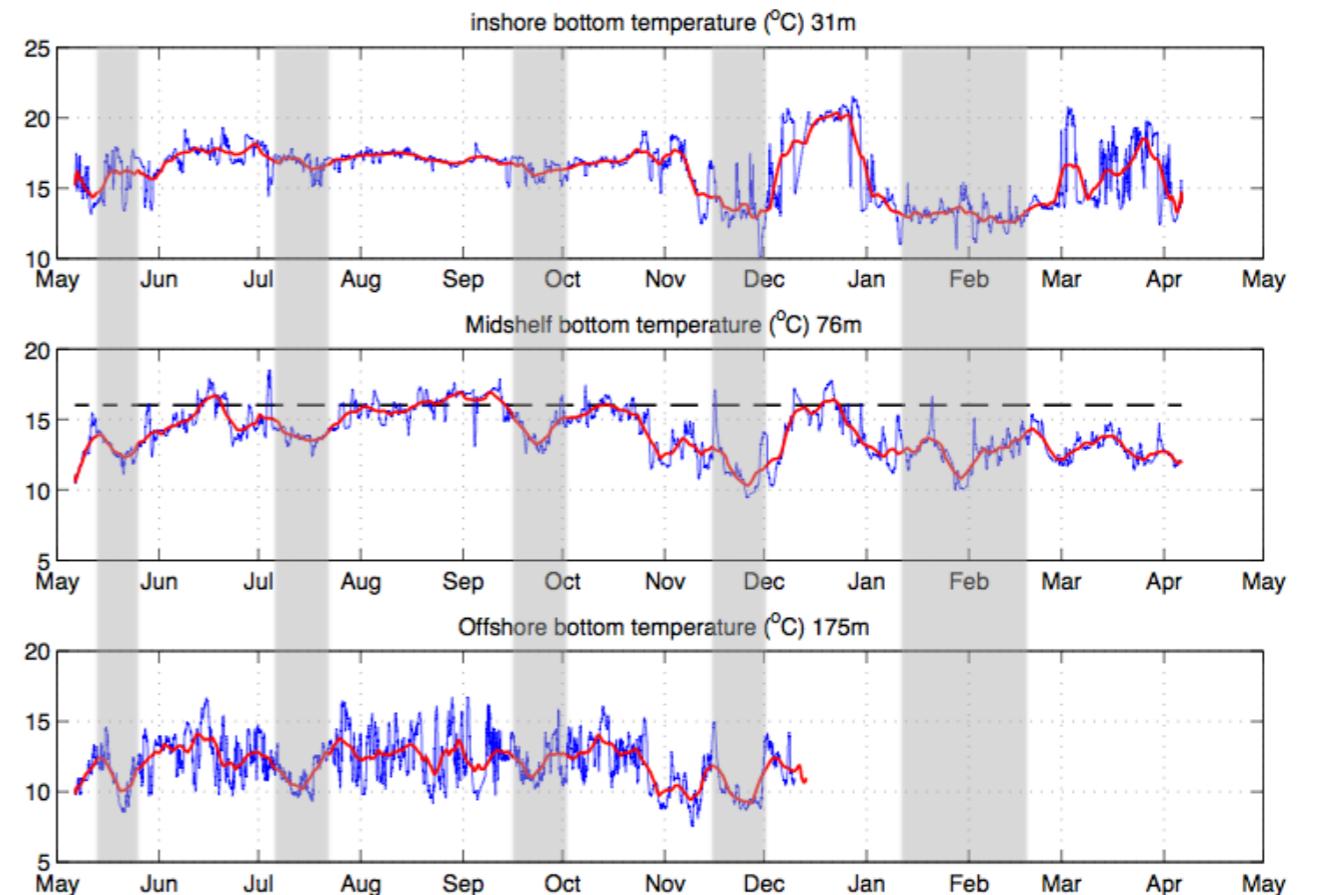
Bottom Temperature at 80m 2005-2006

50 day peak



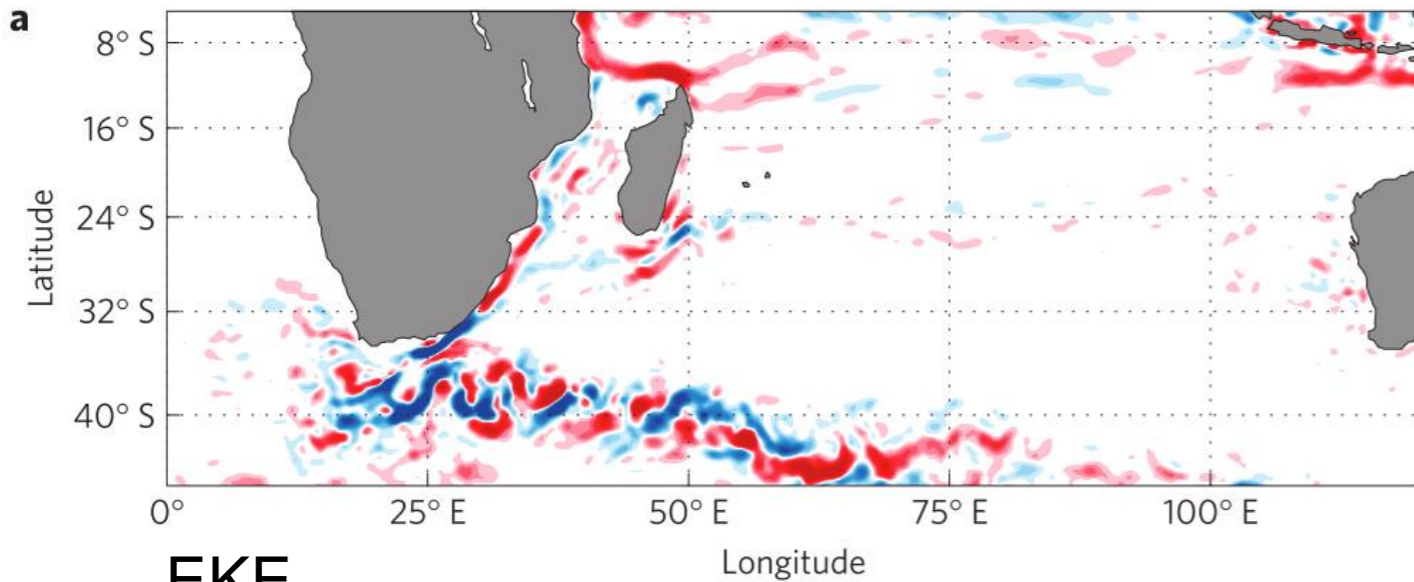
upwelling wind variability: 2-7 days

- A significant proportion of upwelling events are current rather than wind-driven
- These events appear to be related to large solitary meander events (usually Natal Pulses)

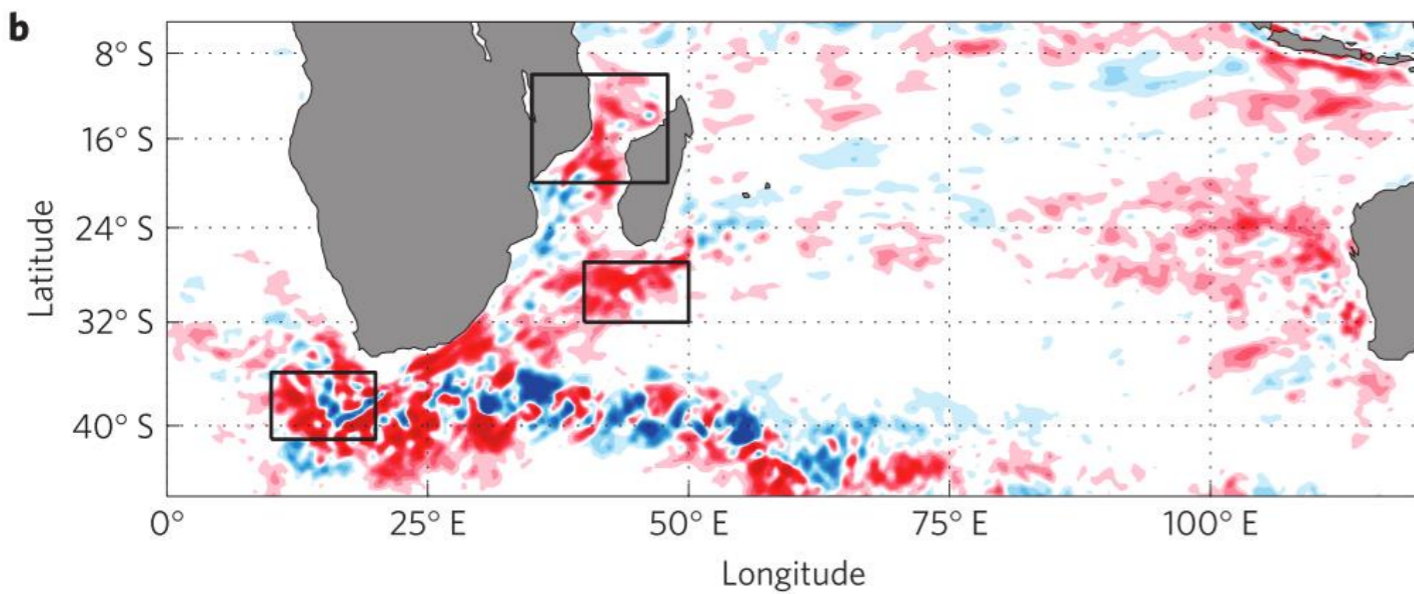


Recent Changes in the Agulhas System

MKE



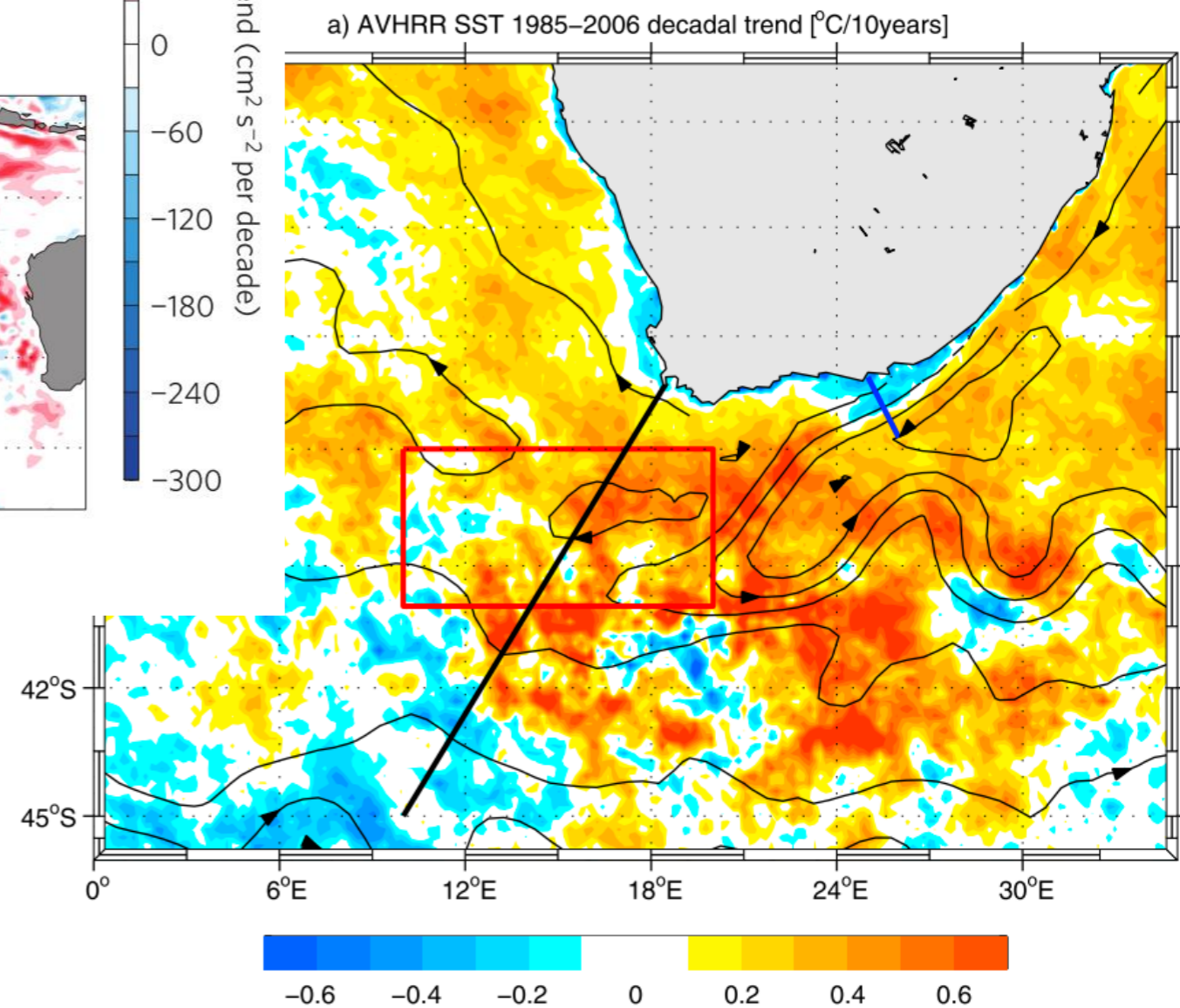
EKE



(From Backeberg et. al. 2012, *Nature Climate Change*)

Intensification of eddy kinetic energy 1993-2009

Rouault et. al 2009, *GRL*

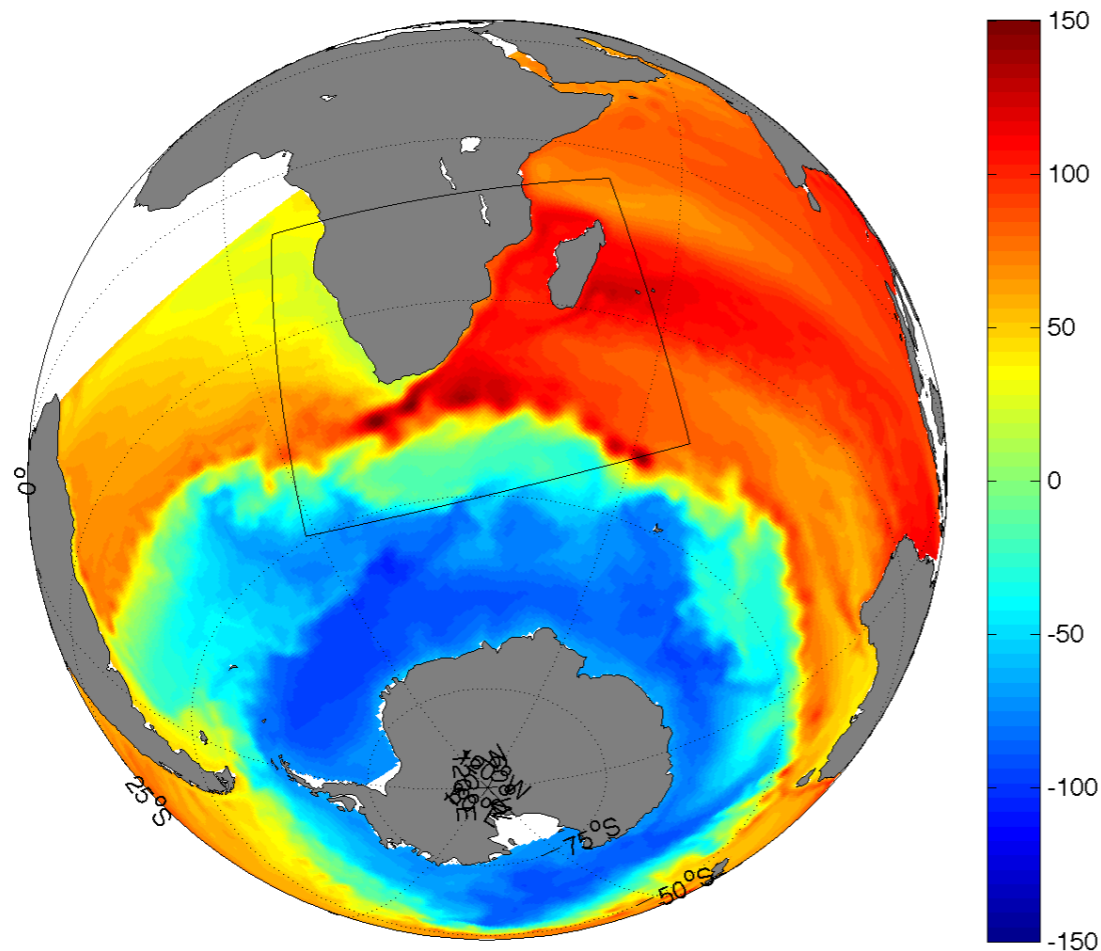


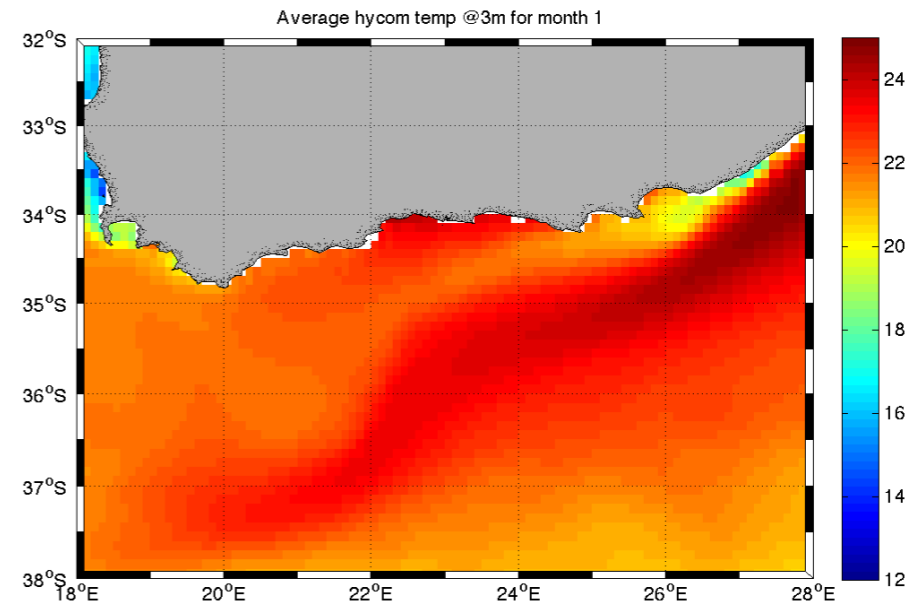
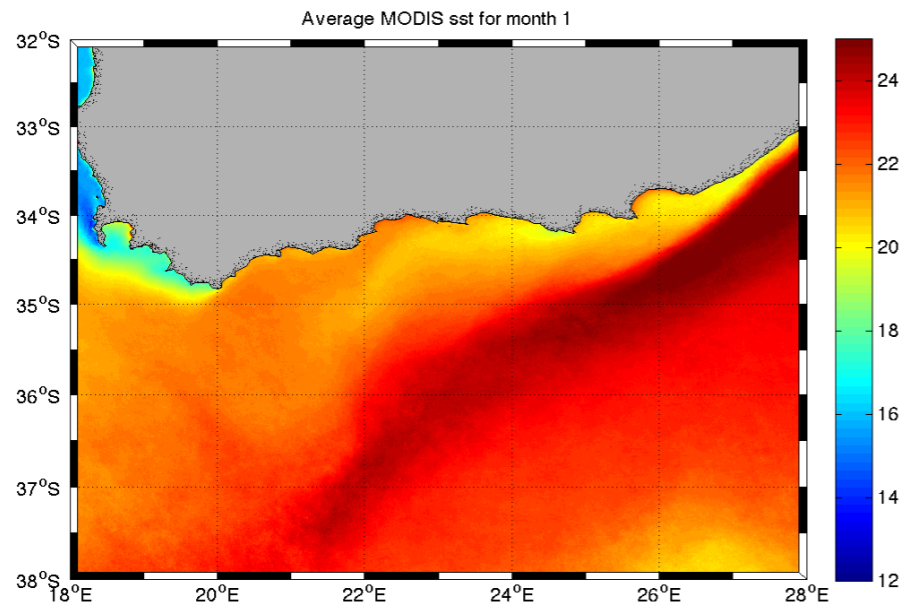
To further understanding of the system

- Large influence of Agulhas current invasions and mesoscale features on upwelling cells and shelf circulation.
- Supply of nutrients for coastal upwelling most likely to be forced by the Current itself.
- How do we separate the mechanisms?
- How does inter-annual variability affect the system.
- How will the intensification of the Greater Agulhas System influence the shelf water?
- What are the important features and how well do models represent them?

Agulhas HYCOM

- Parent model: INDIA
- 1 way nested
- 1/10 deg resolution (child nest)
- 30 hybrid layers (isopycnic and Z levels)
- Code: HYCOM 2.2
- Forcing: ERA40 and ECMWF
- Bathymetry: GEBCO (1 min)
- Backeberg et. al. *Ocean Dynamics*, 2014



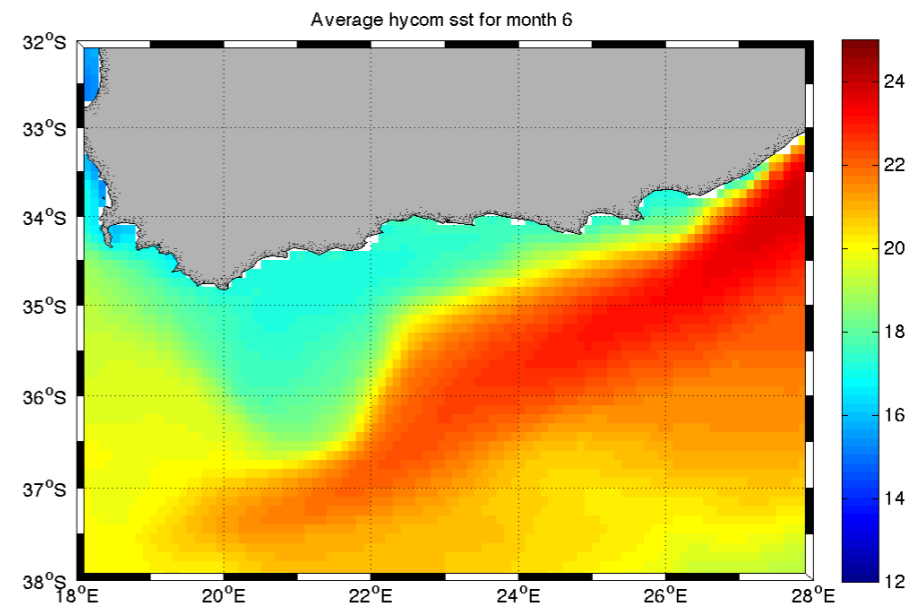
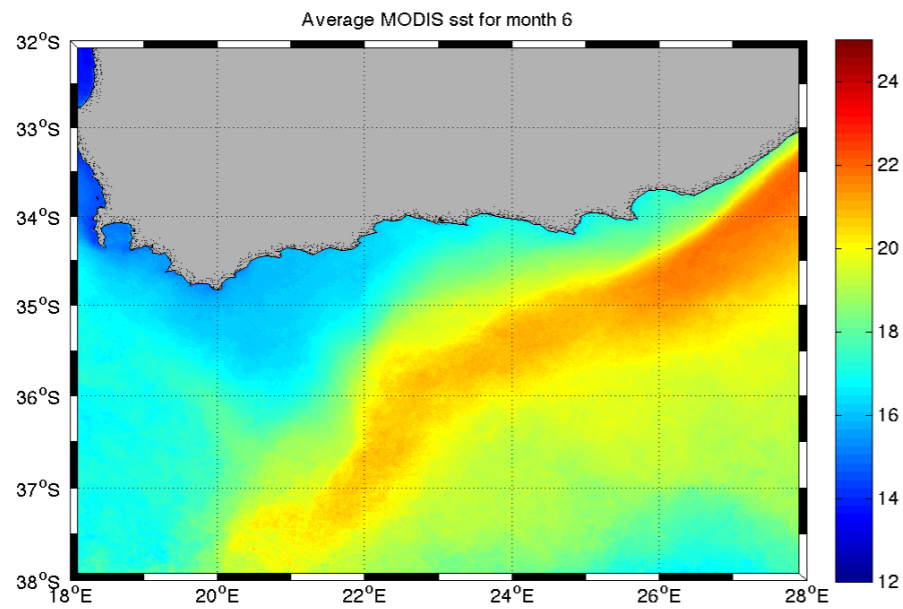


January Climatology (2002-2007)

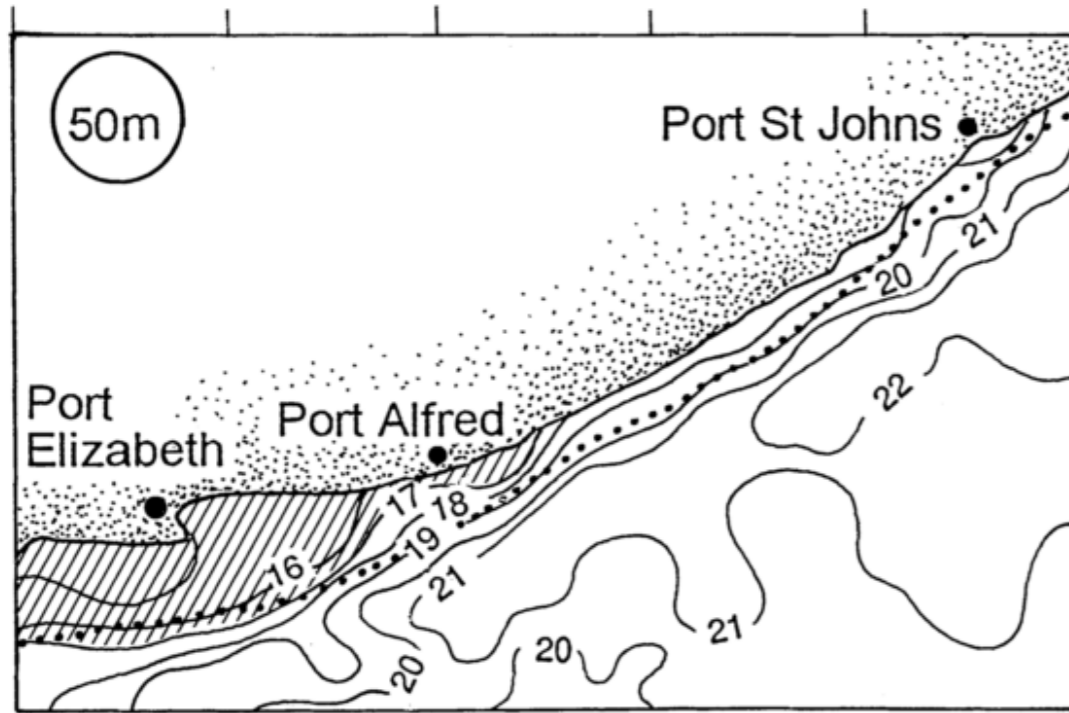
MODIS

HYCOM

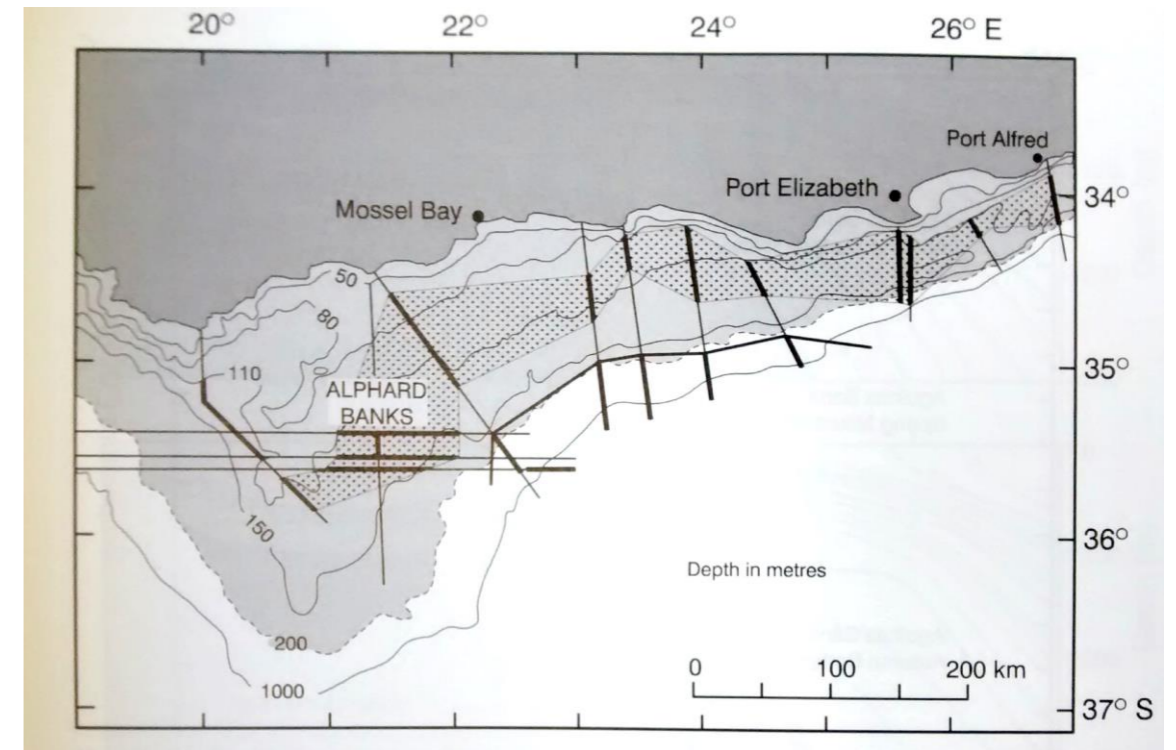
June Climatology (2002-2007)



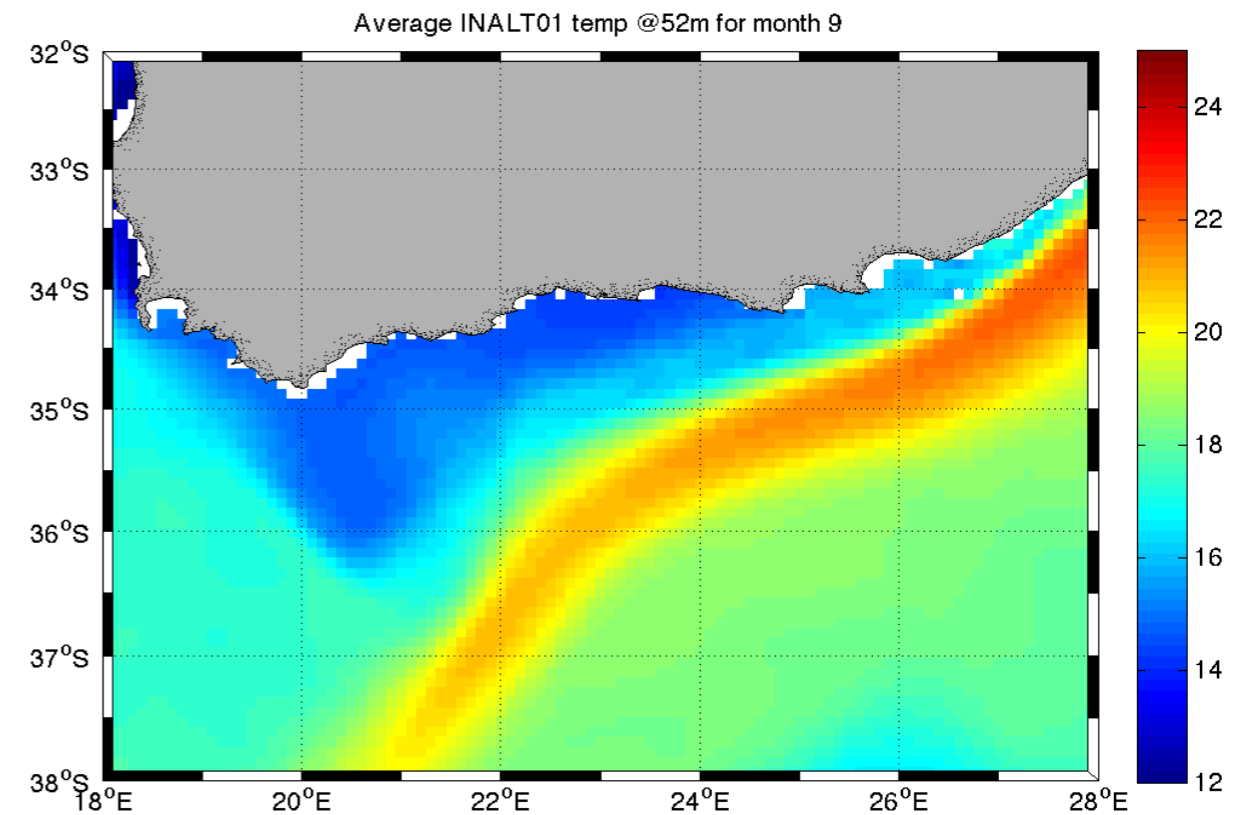
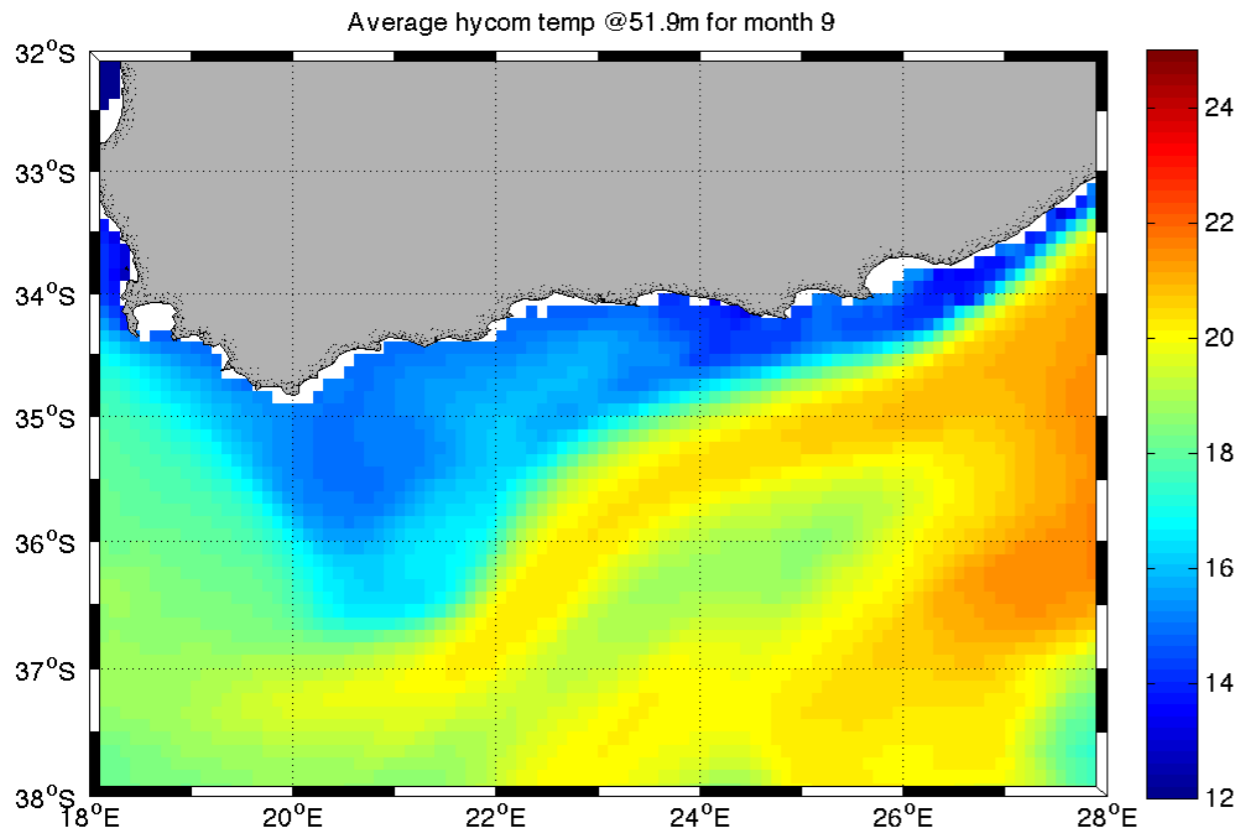
Model Evaluation...



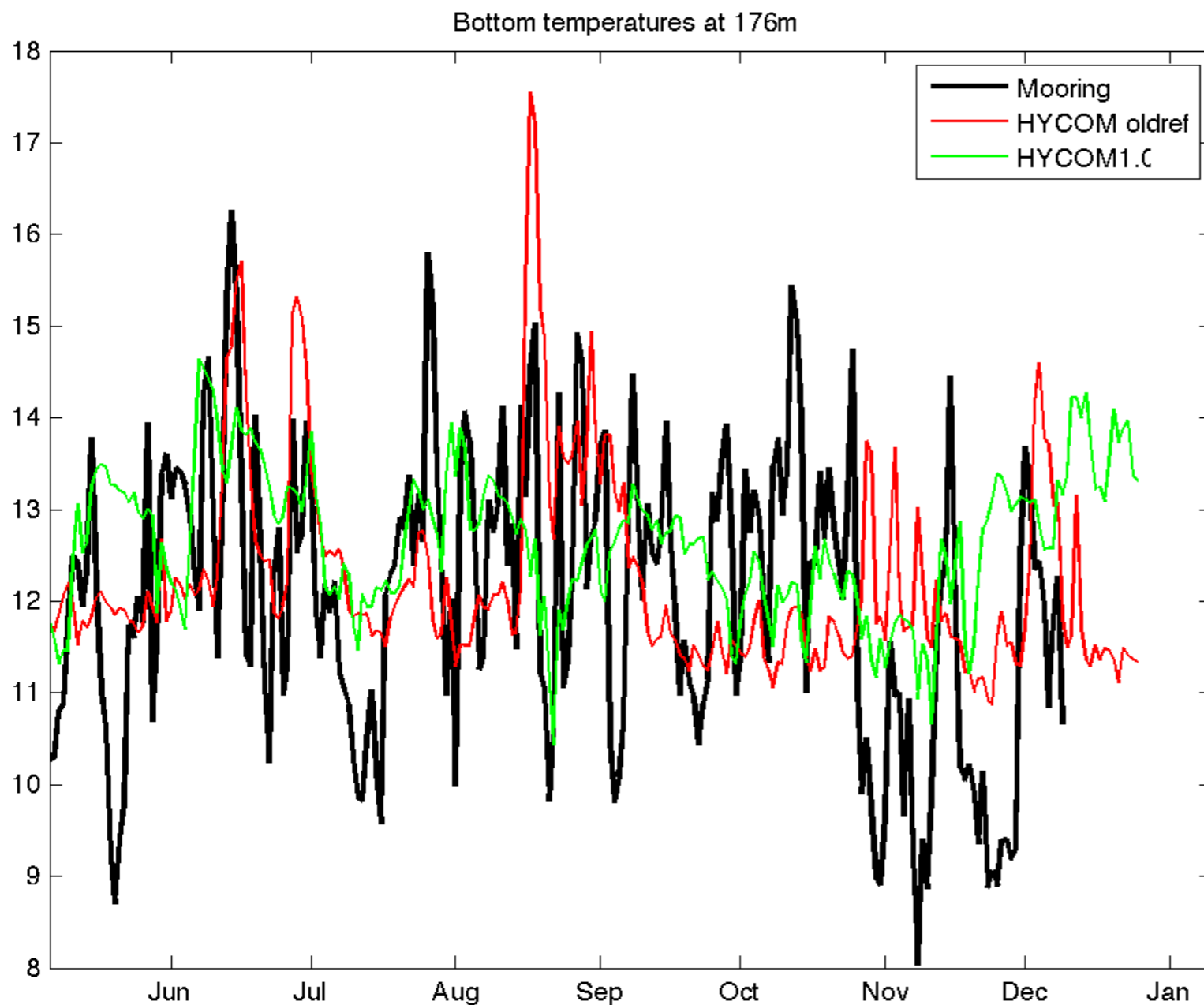
(From Lutjeharms et. al. 2000)



(From Lutjeharms 2006)

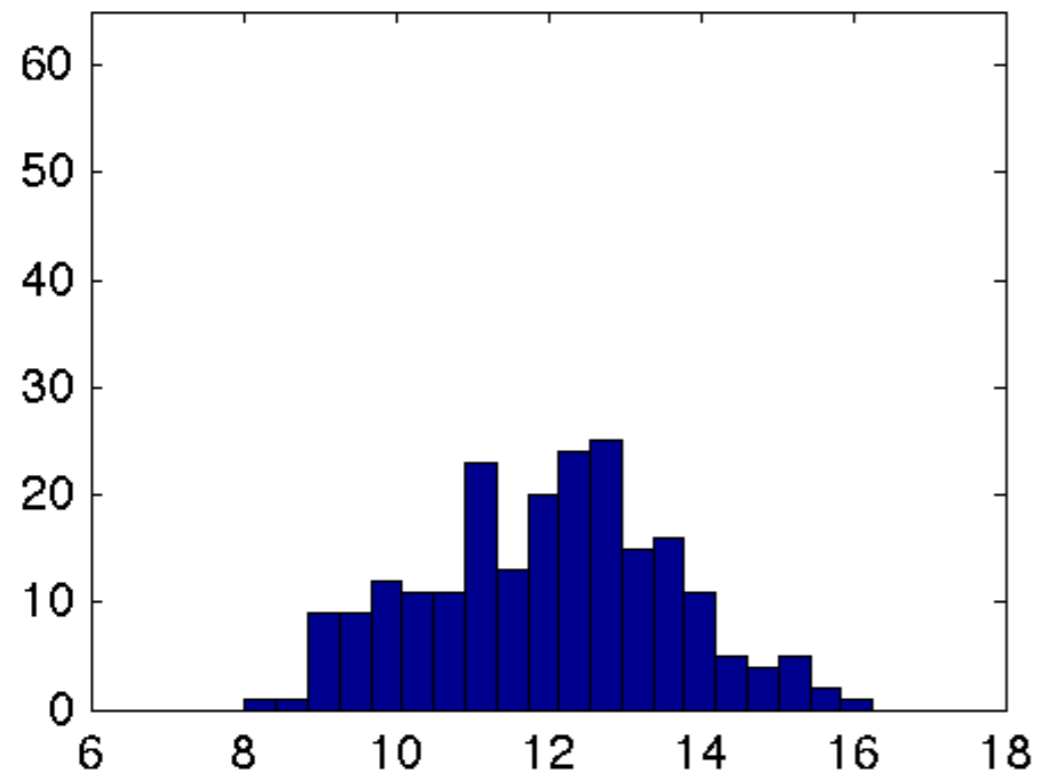


PA offshore mooring site comparison

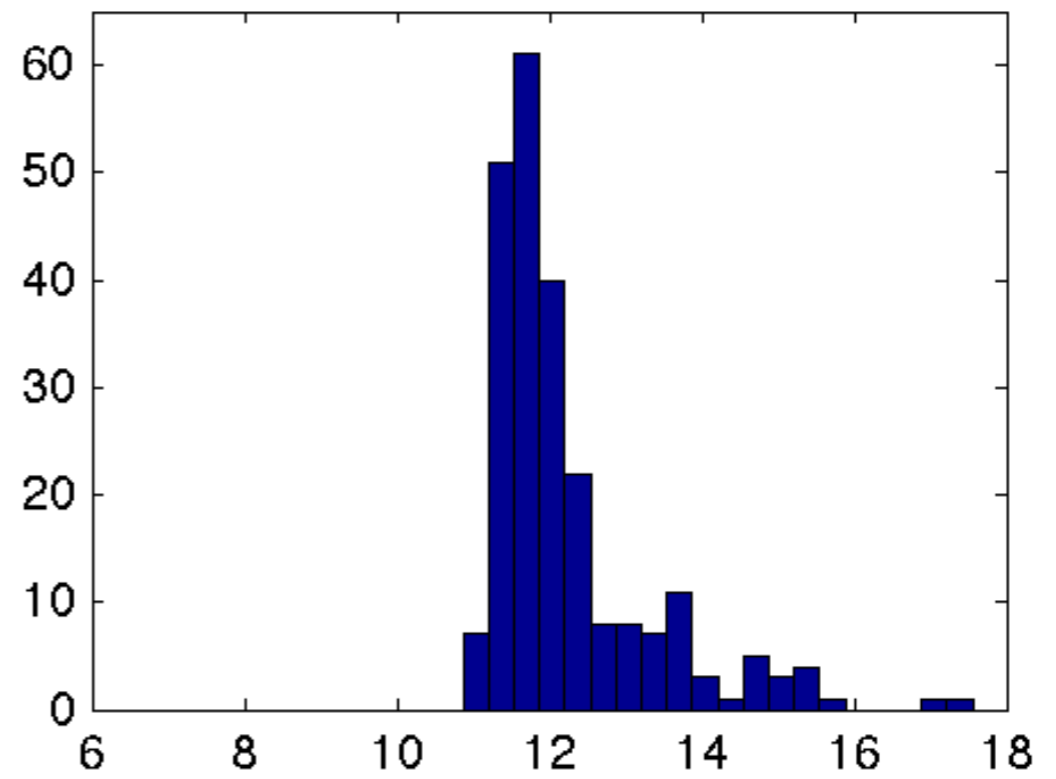


Mean Temperature
Obs: 12
HYCOM_oldref: 12.64
HYCOM_newref: 12.23

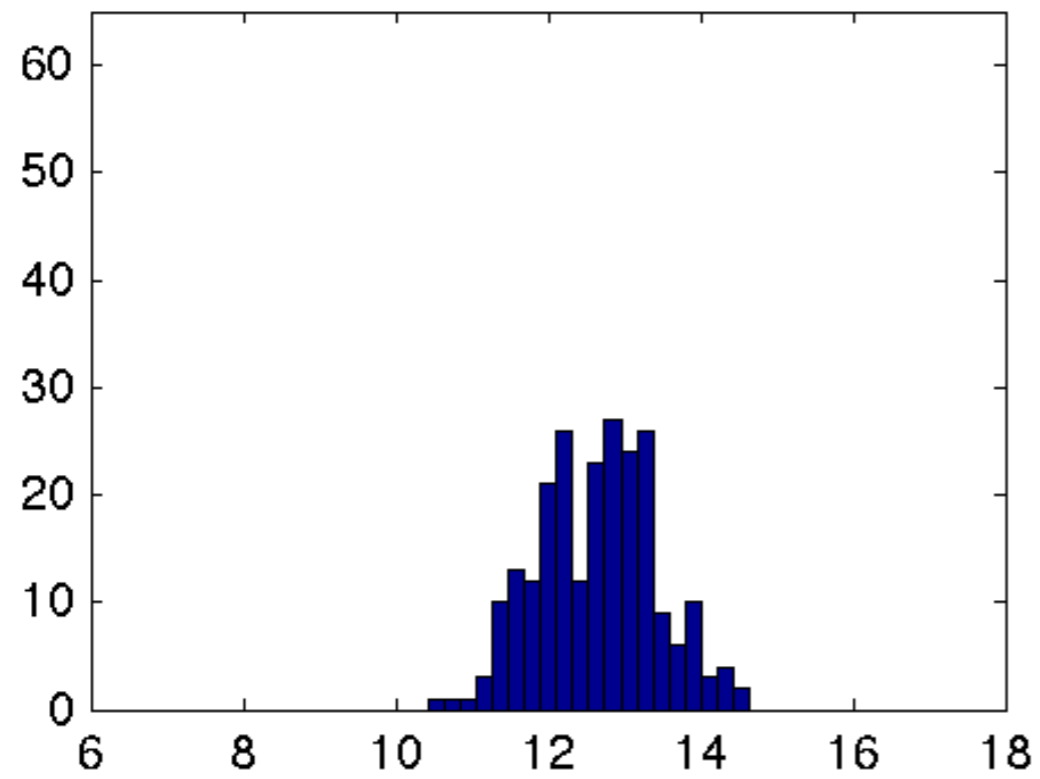
Observed



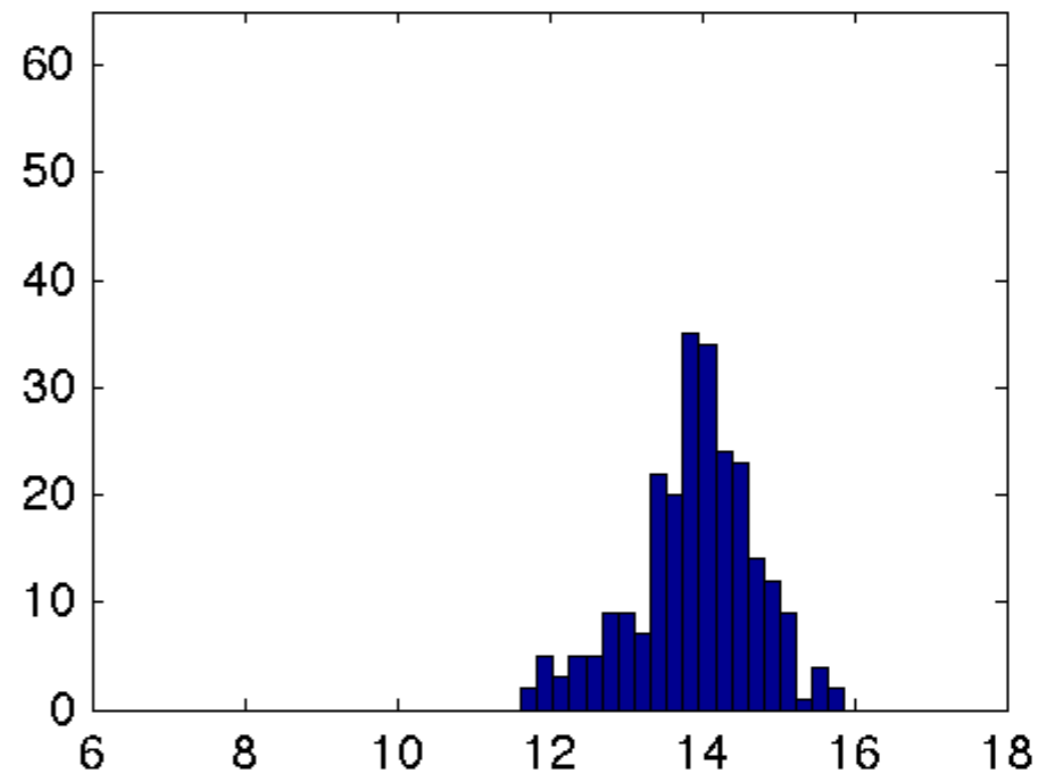
HYCOM expt1.C

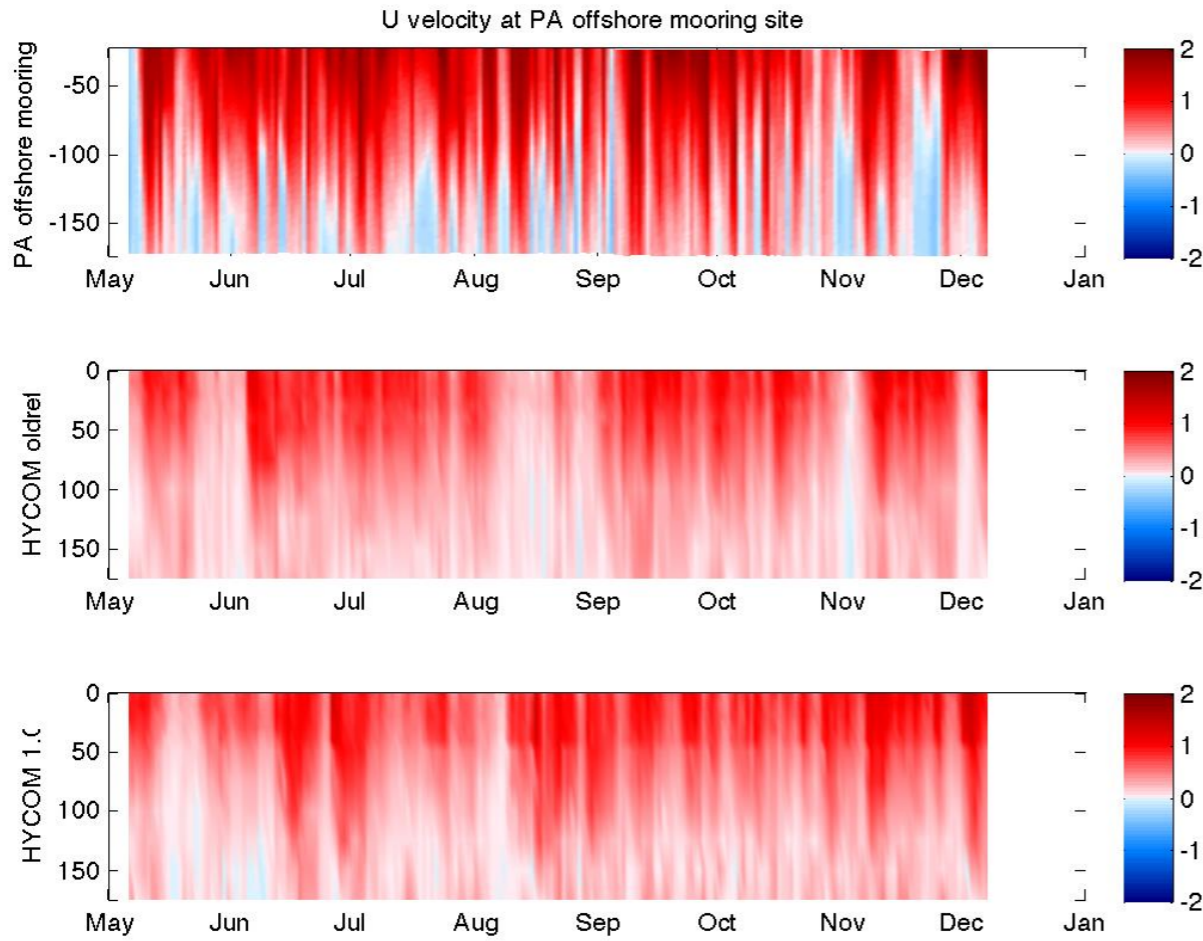


HYCOM old ref

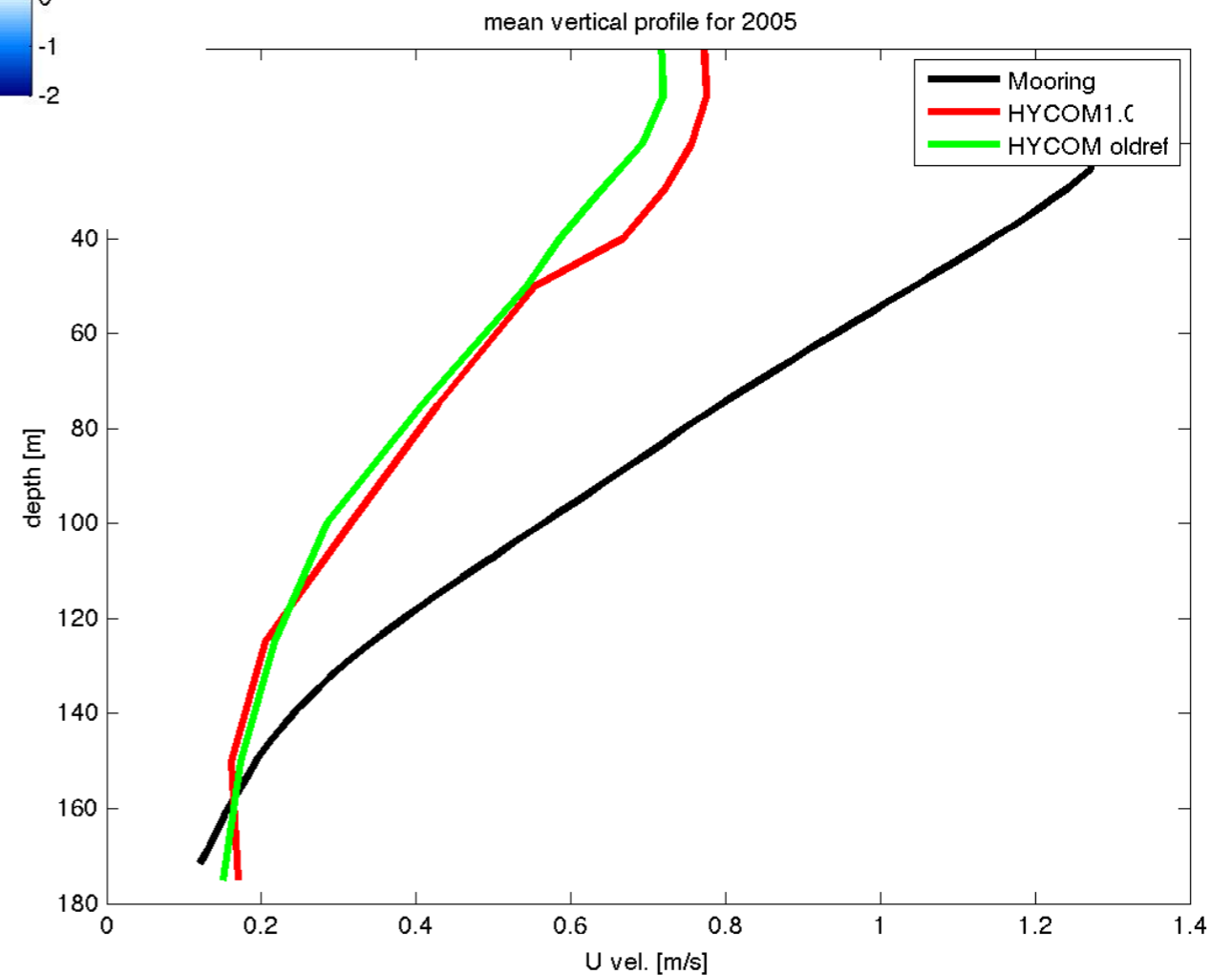


INALT01



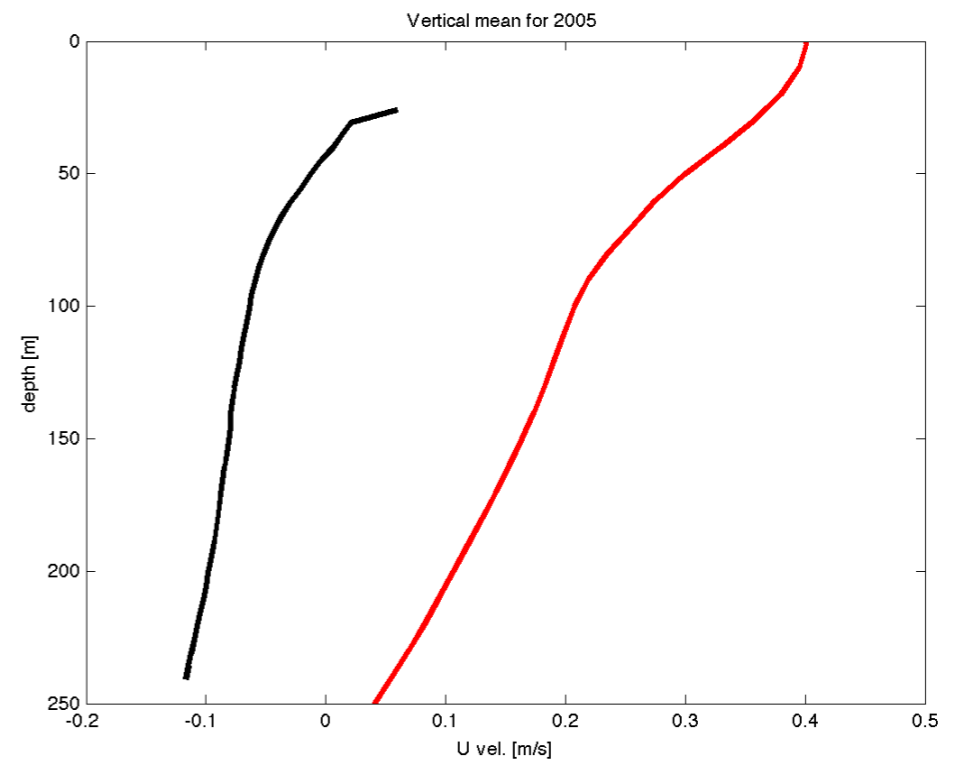
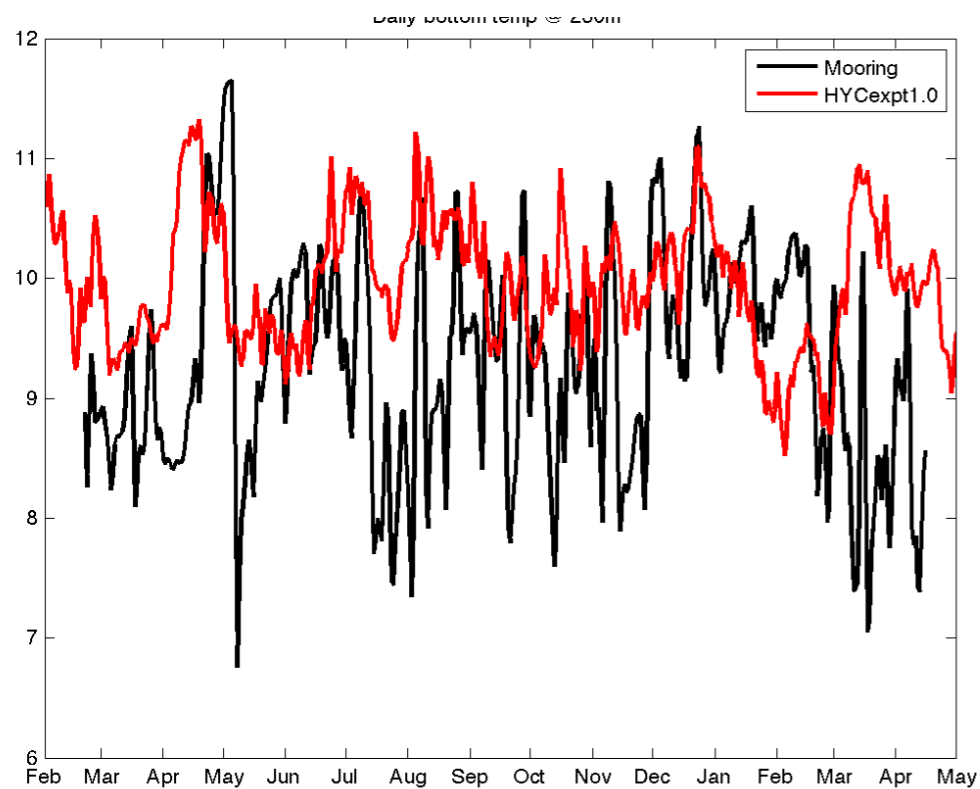
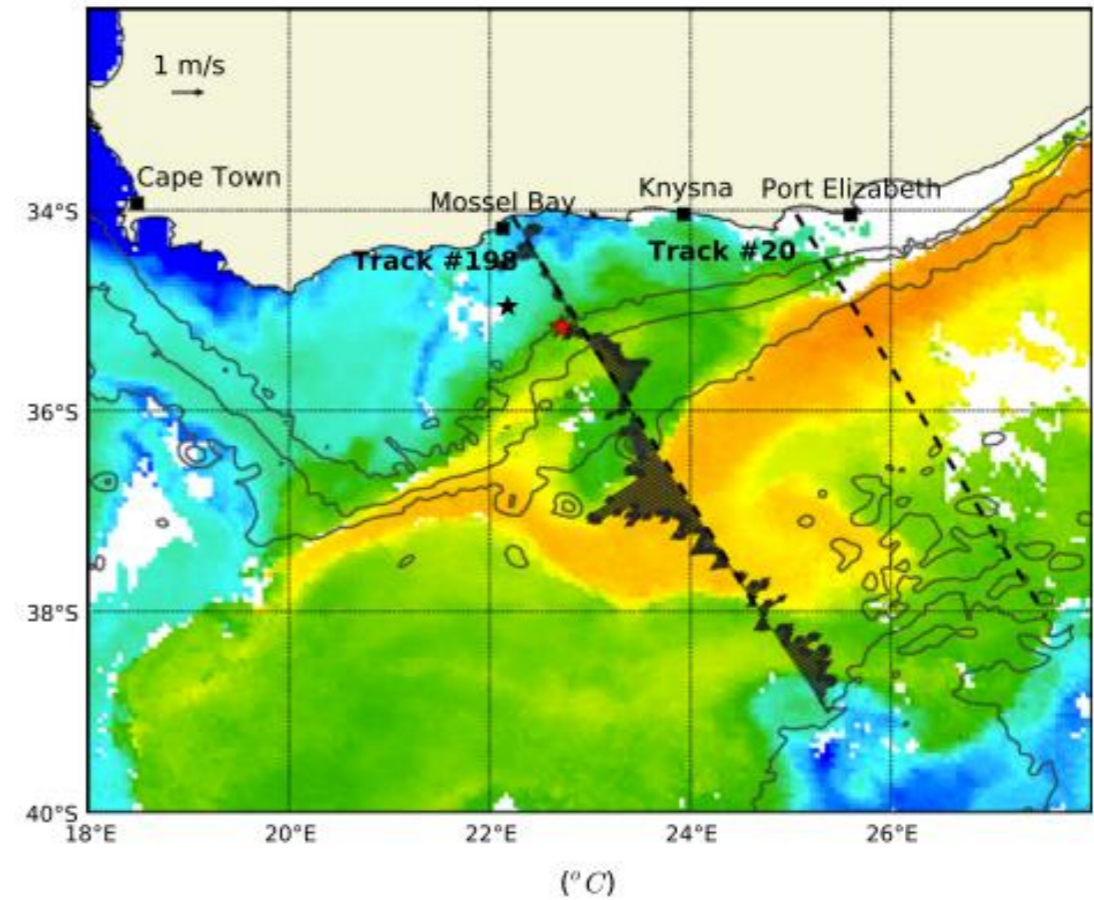
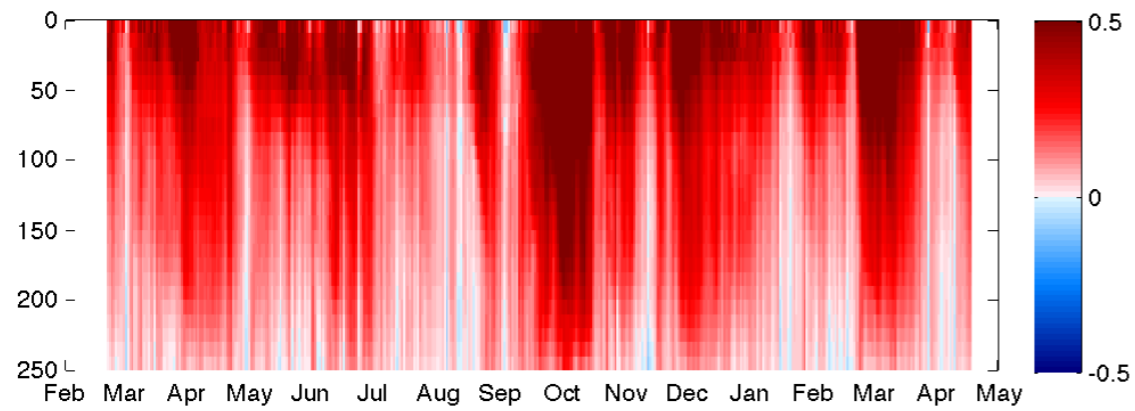
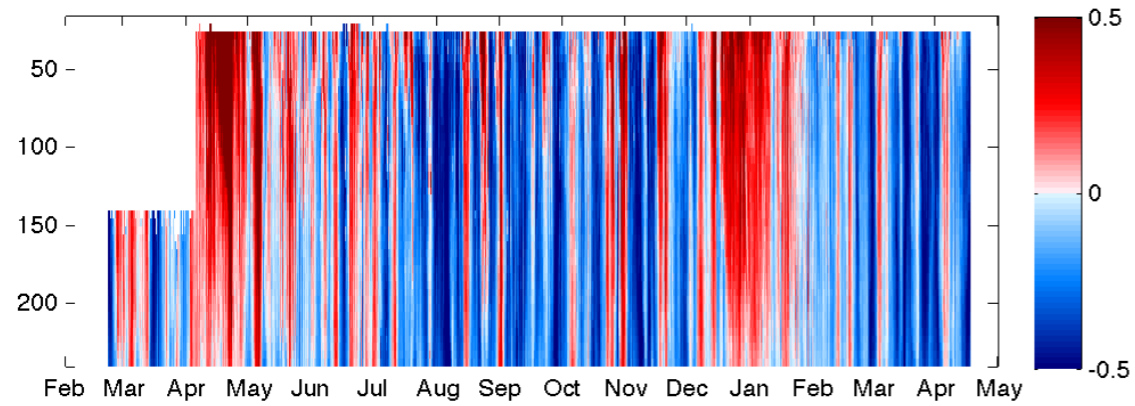


- Shear and current reversals underestimated.
- Small improvement with new vertical stratification.



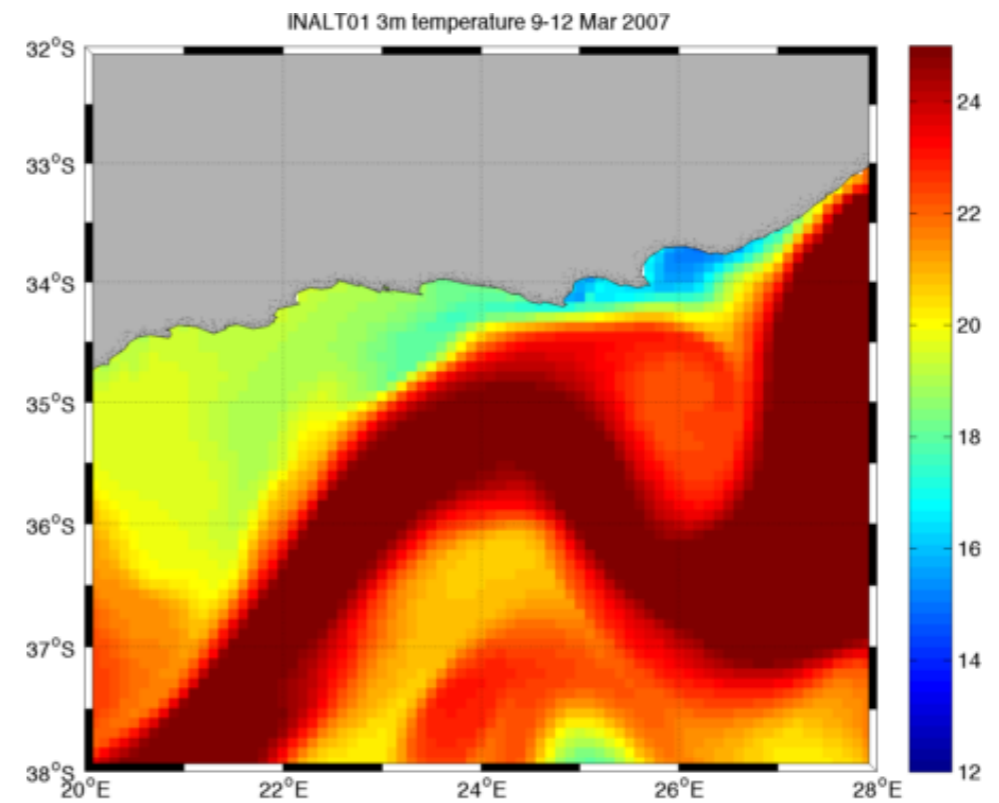
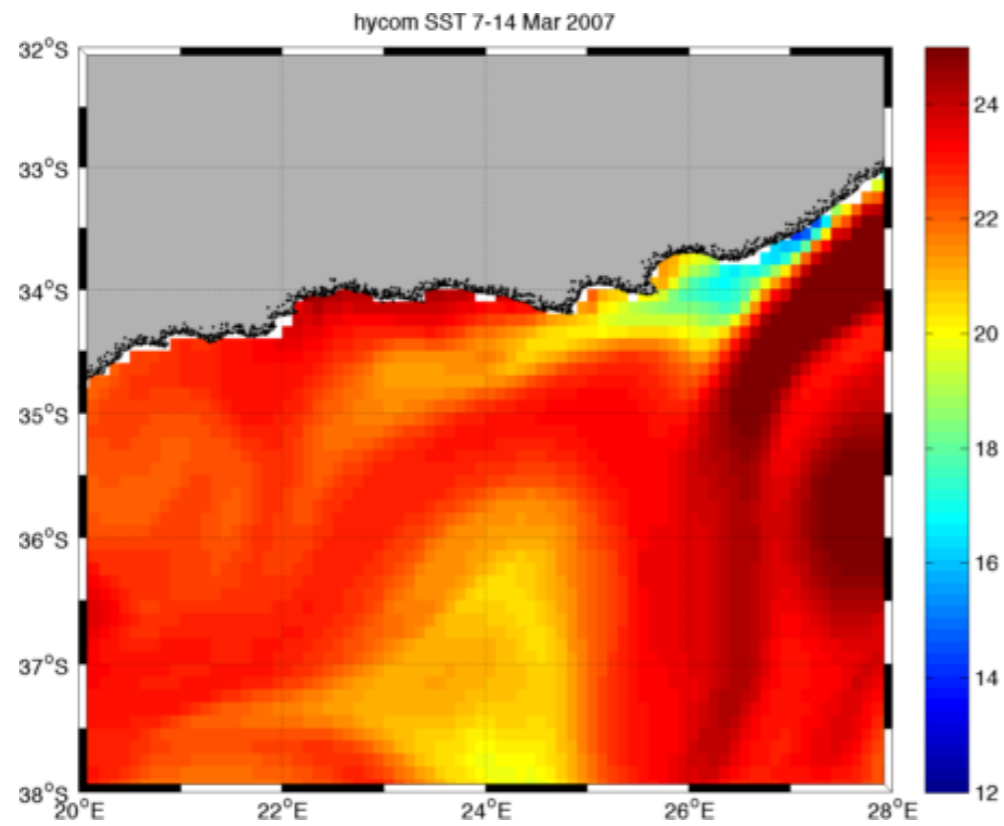
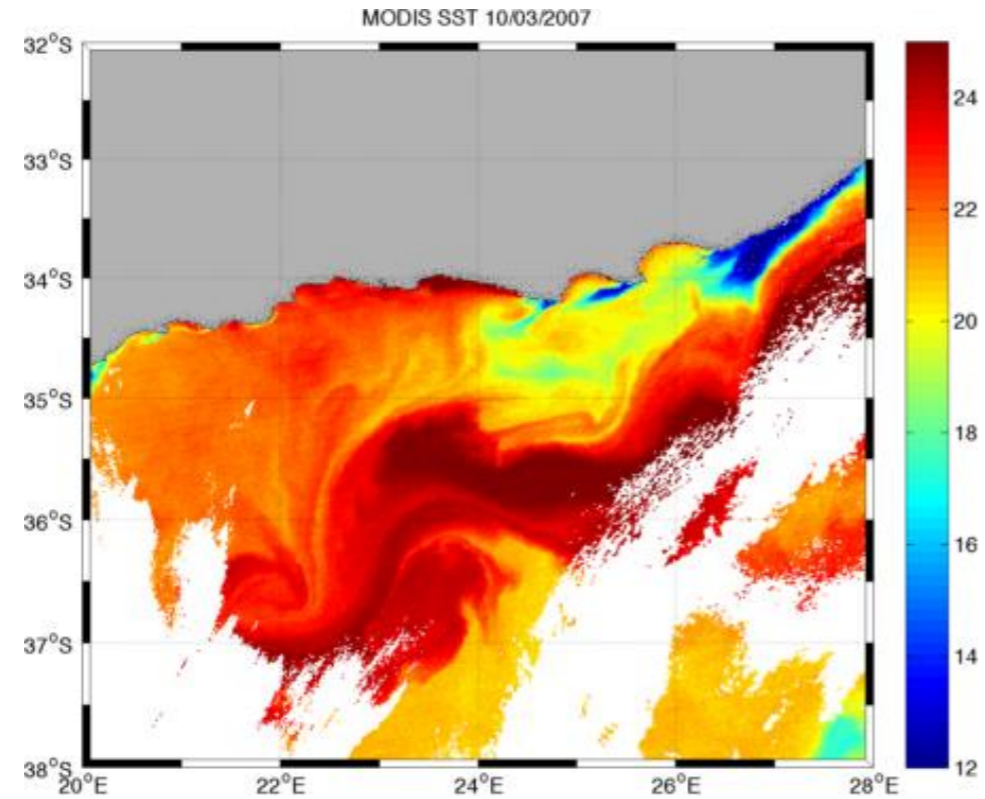
The Southern Agulhas Current

Krug et. al. 2014

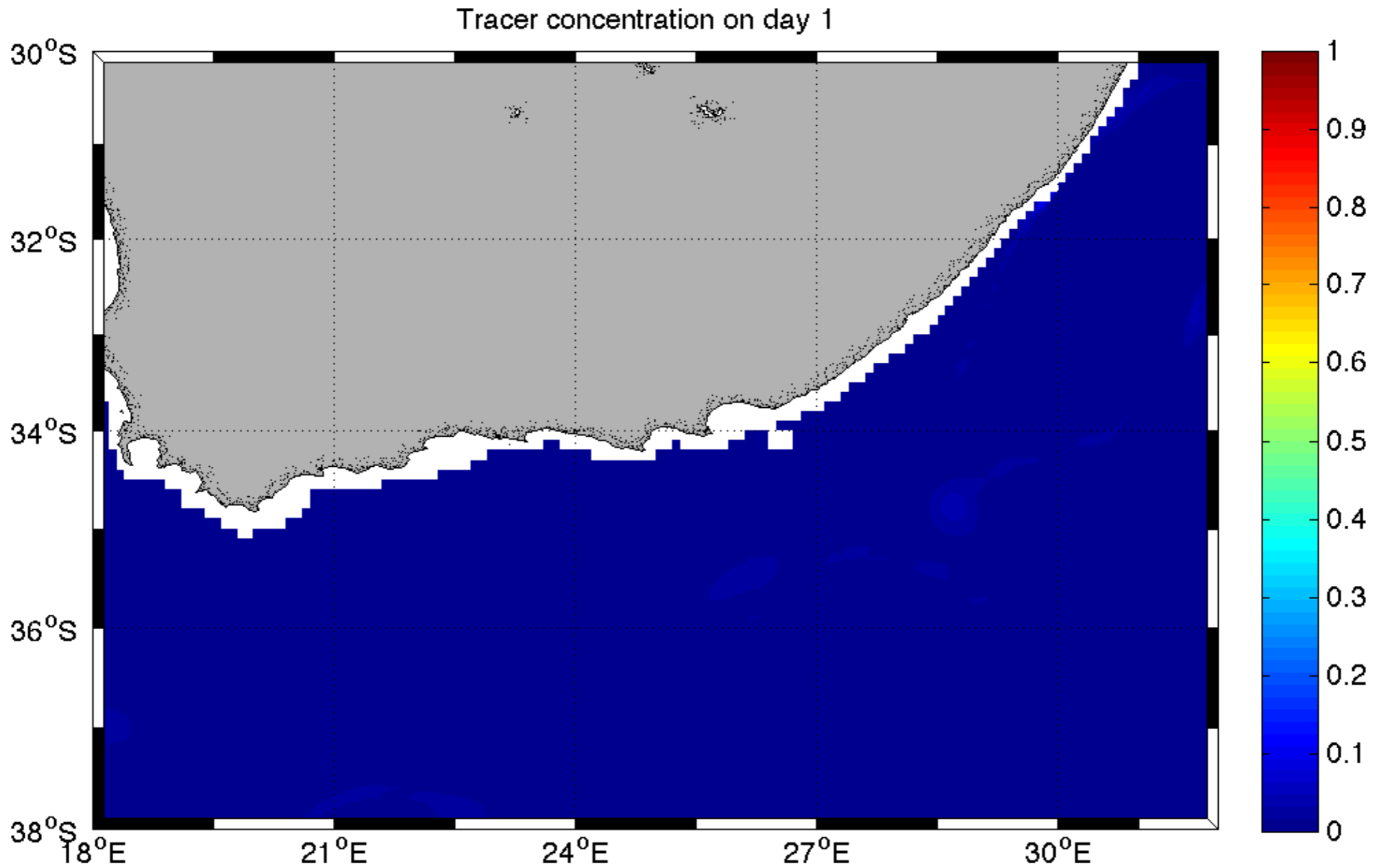


Large meander effects

- Case study March 2007



Tracer evolution during a large meander event



Where to from here?

- Improve vertical resolution over the shelf - sigma layers?
- Increase horizontal resolution.
- How to actually define upwelling in a Western boundary system?

Thanks

- Dr. Jonathan Durgadoo (GEOMAR) for INALT01 data.
- Francois Counillion
- Dr. Mike Roberts, Marcel van den Berg, all involved in Port Alfred mooring cruises.
- Nansen-Tutu Centre, NRF SAEON, ONR for funding.

