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Studying Subantarctic Mode Water in the South Atlantic Ocean using HYCOM.

Gisle Nondal (gislen@nersc.no)

Clarion Hotel Admiral, 21.08.07

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Outline.

- Subantarctic Mode Water (SAMW)
- South Atlantic Ocean circulation
- SAMW as observed from profiling floats
  - HYCOM output compared to float data
- Synthetic floats in HYCOM
  - Optimizing float deployment using HYCOM
- HYCOM setup for the South Atlantic Ocean and Antarctica
  - Nested system for the western Atlantic

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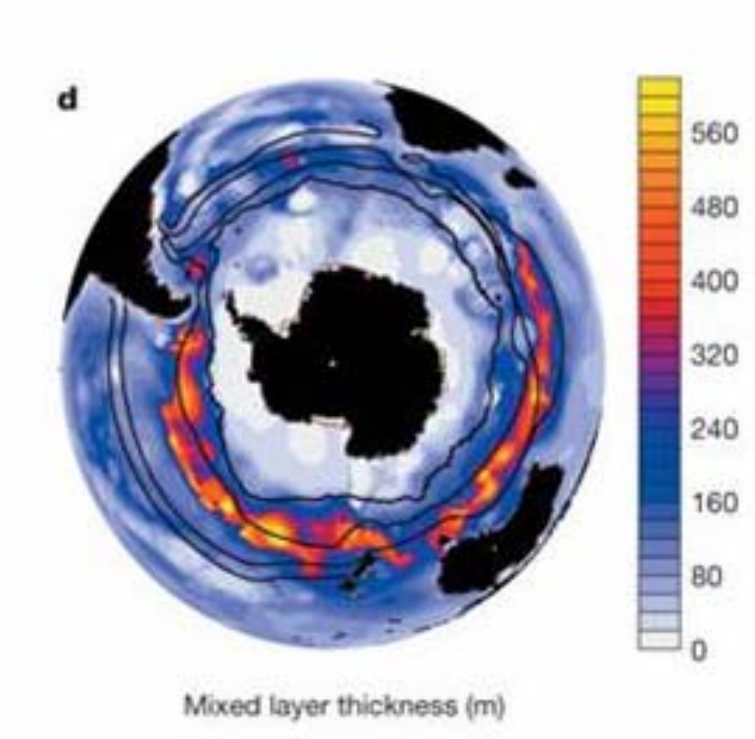
Subantarctic Mode Water (SAMW).

- "Mode water is the name given to a layer of nearly vertically homogenous water found over a relatively large geographical area" (Hanawa and Talley, 2001)
- One of the most abundant water masses in the world oceans
- Strong pycnostad
- Vertical maximum of oxygen → convective origin
- Low potential vorticity, PV= $\frac{f}{\rho_0}\frac{\partial \rho}{\partial z}$ (Talley 1996, McCarthy and Talley 1999)) and Brunt-Vaisala frequency
- Supplies large amount of nutrients to the Southern Hemisphere as well as the North Atlantic Ocean (Sarmiento et al. 2004)



(Sarmiento et al. 2004, *Nature*)

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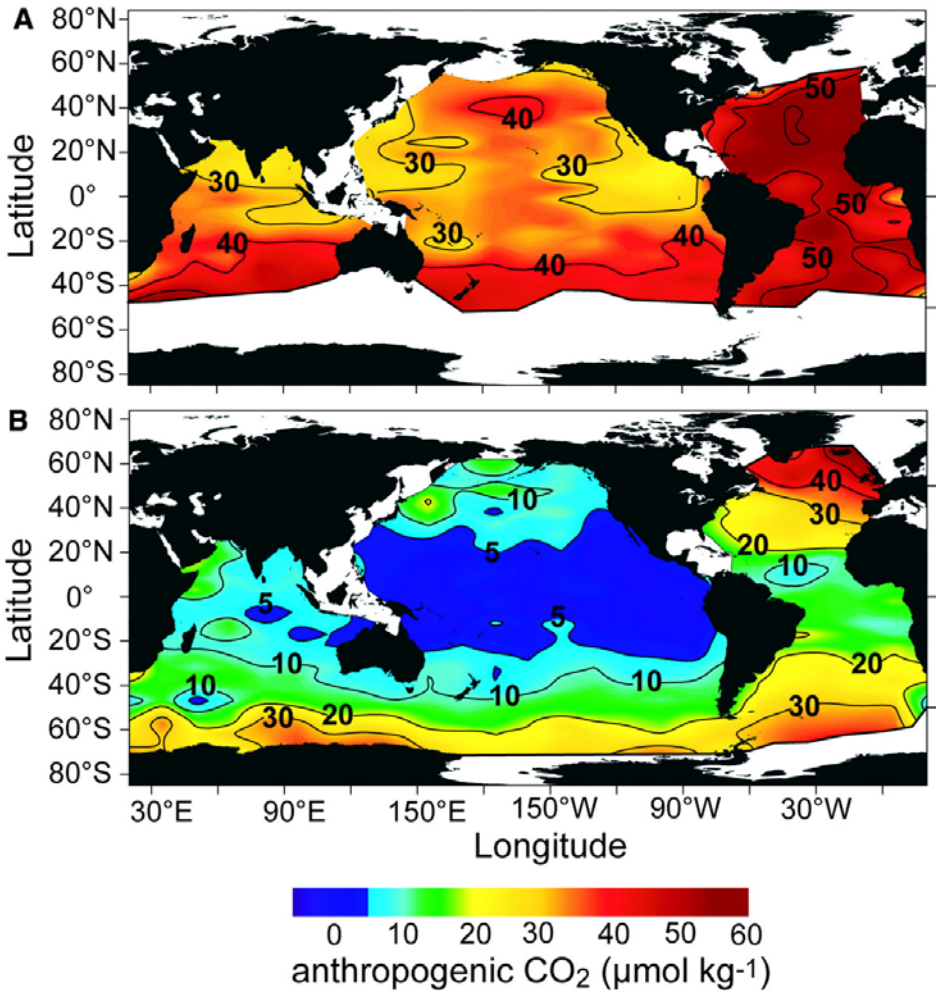
SAMW and Anthropogenic CO_2



$\sigma_0 = 26.0$

$\sigma_0 = 27.3$ (~900m)

- Sabine et al. (2004)

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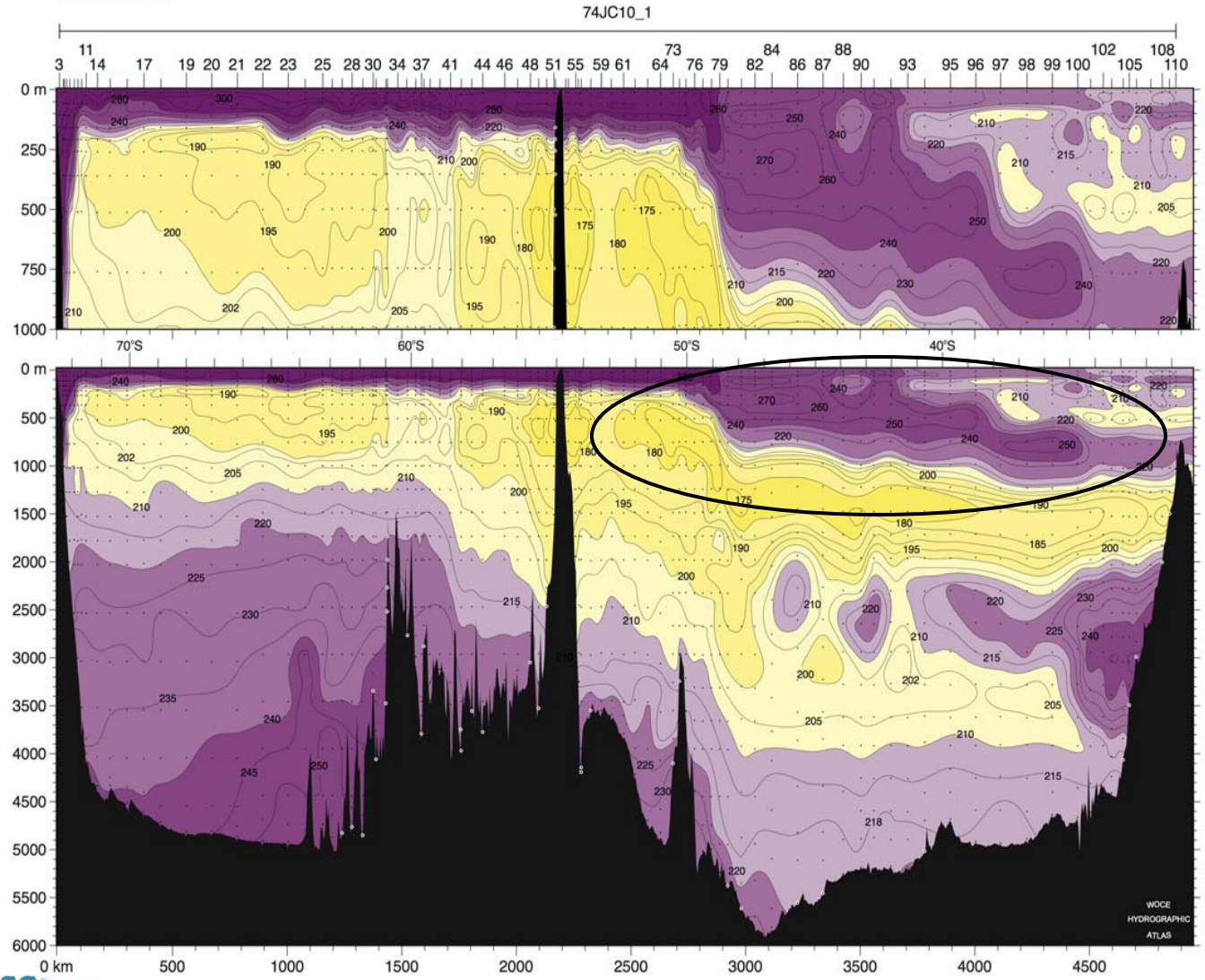

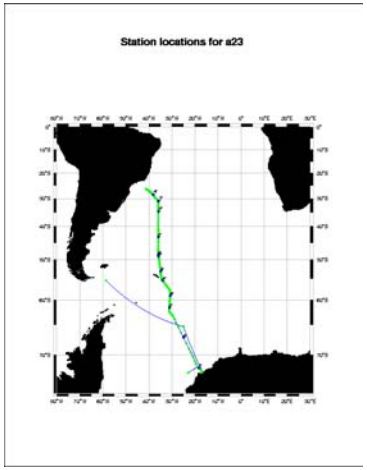

(WOCE section A23, O_2)

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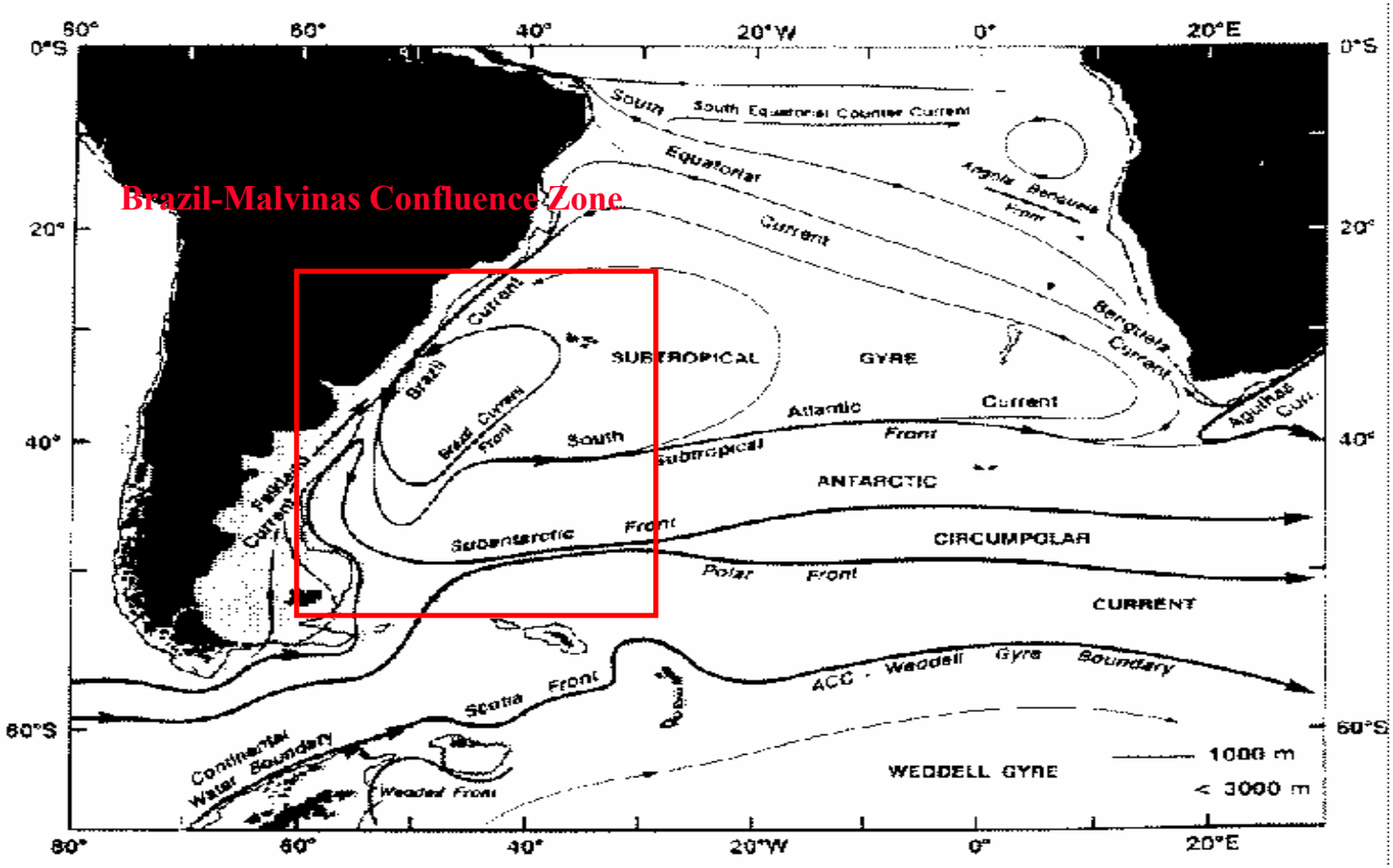
South Atlantic Ocean.



(http://earth.esa.int/workshops/ers97/papers/romaneesse/mean_circulation.gif)

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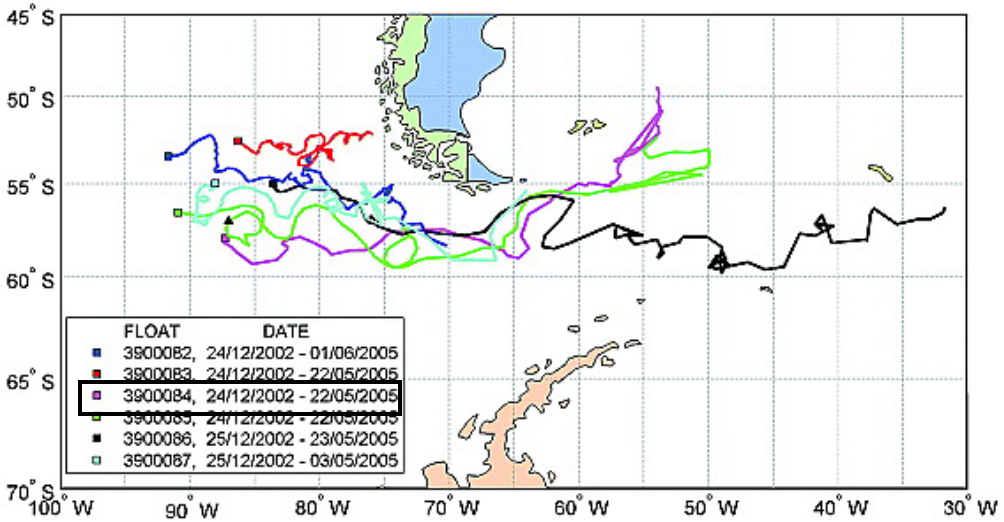
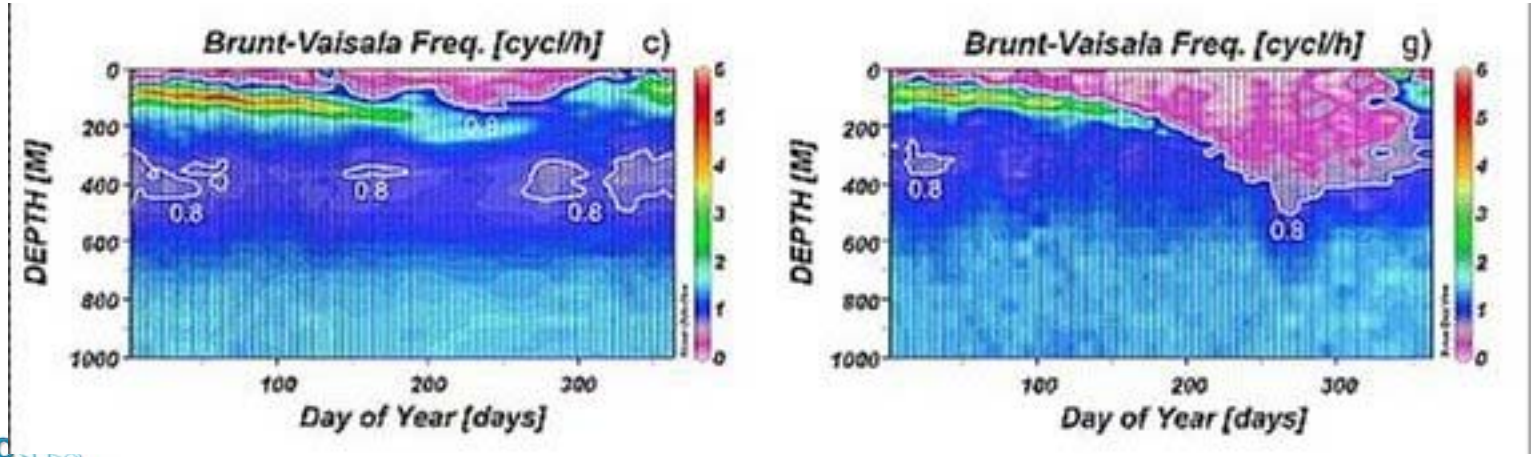
SAMW formation observed by profiling floats.





•W. Scneider and L. Bravo, 2006 (GRL, 33).

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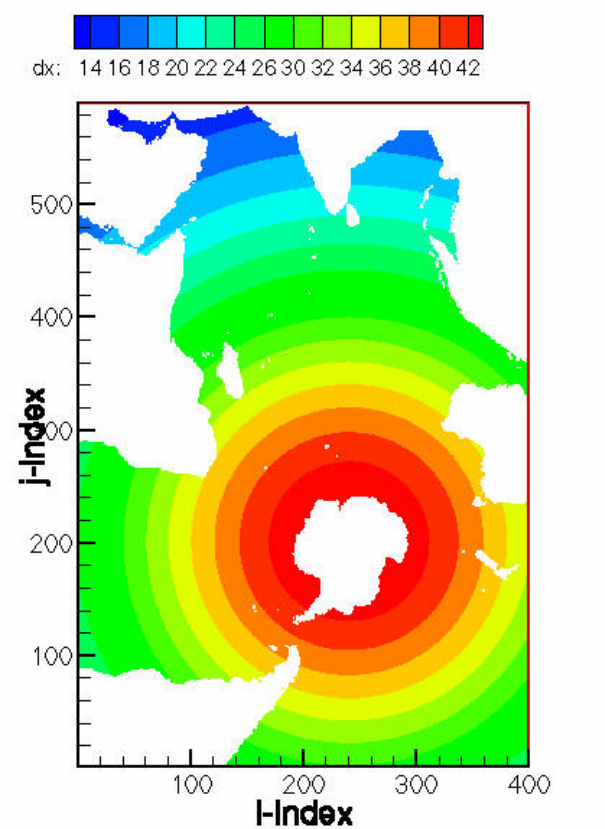
SAMW in HYCOM.

NERSC INDIA model:

- Set up for the Indian Ocean including Antarctica
- 30 hybrid layers
- Ice model
- Spun up for 8 years



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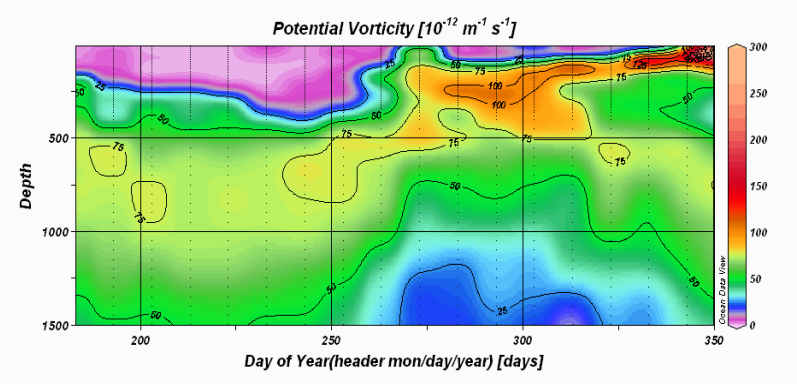
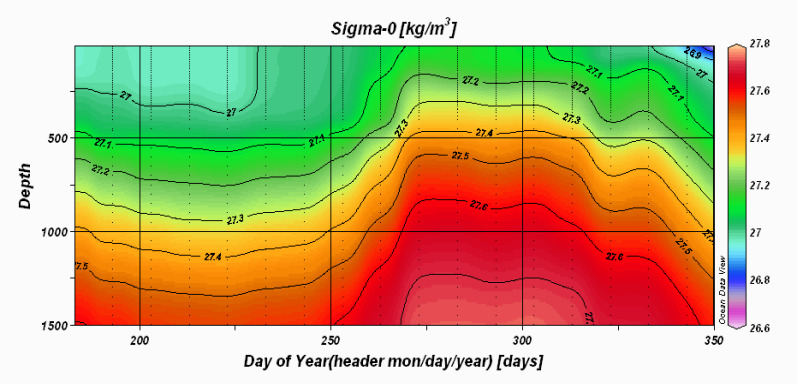
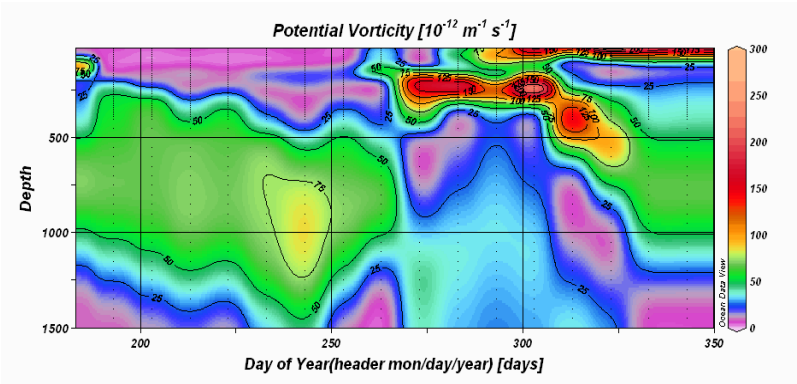
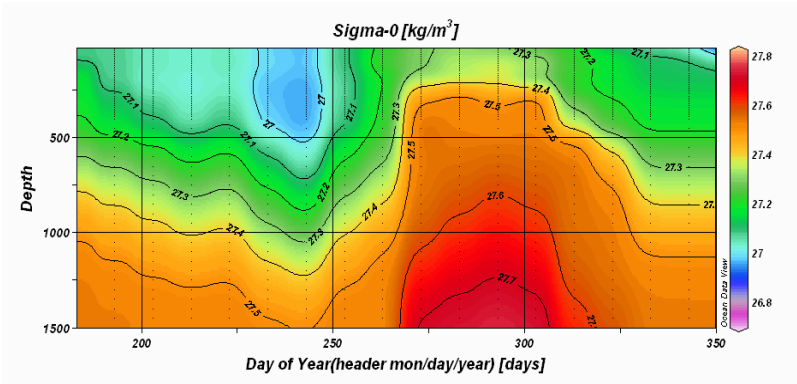
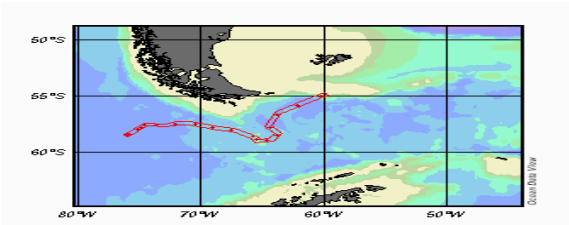
Float 3900084 data compared to HYCOM output.











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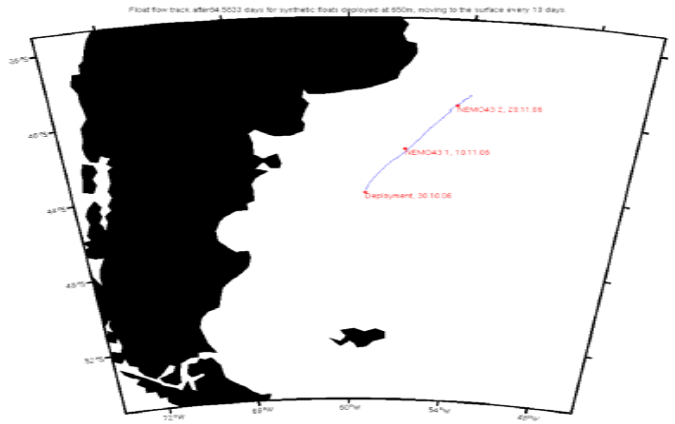
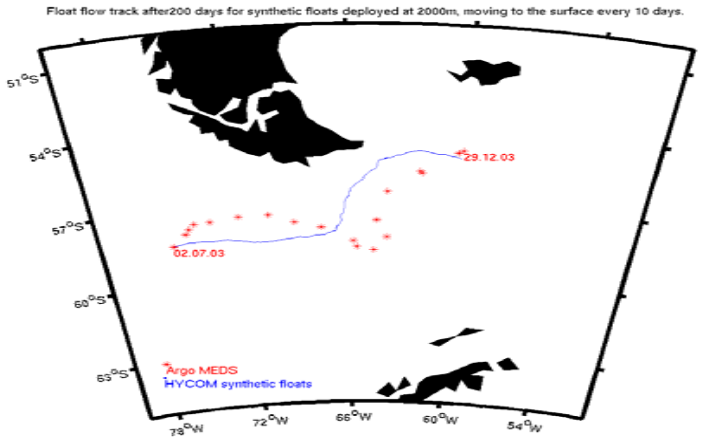
Synthetic floats in HYCOM.

- Model equipped with code for simulating three types of floats:
  - 1) 3-d lagrangian
  - 2) isopycnic
  - 3) isobaric
  - 4) stationary (mooring)
- Code has been modified in order for the floats to mimic the Argo “pop-up” floats





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Optimal deployment locations for NEMO floats for studying SAMW in the South Atlantic.

Navigating European Marine Observer (NEMO)

- Autonomous operation
- Max. depth 1000m
- Ice detection algorithm
- Data transfer via satelitte (Iridium,Argo)
- Aanderaa Instruments Oxygen Optode
- www.optimare.de
- Life time of about three years

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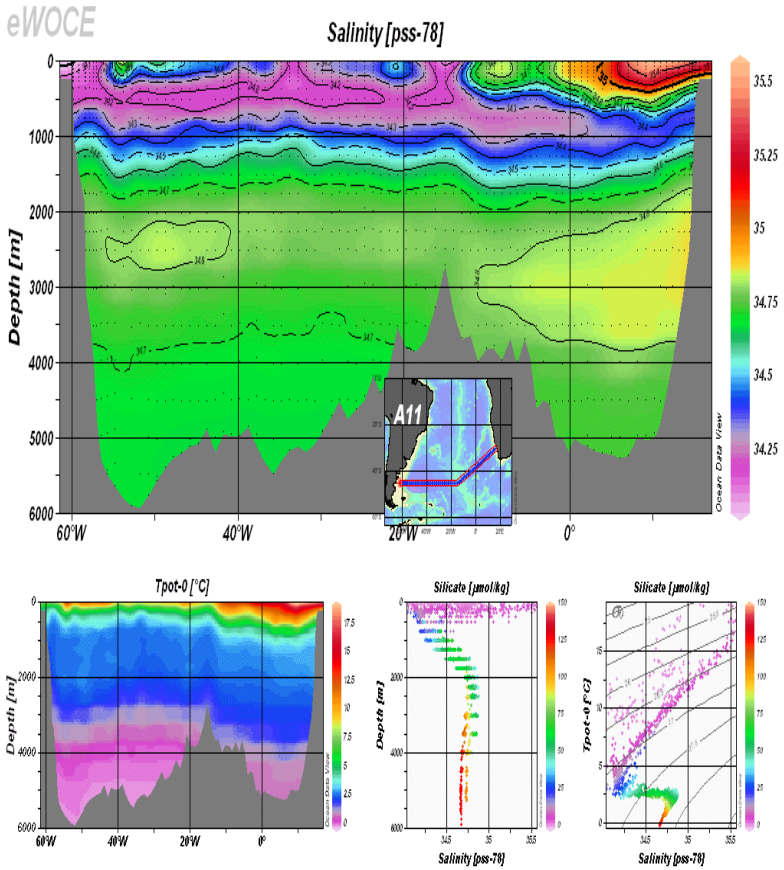
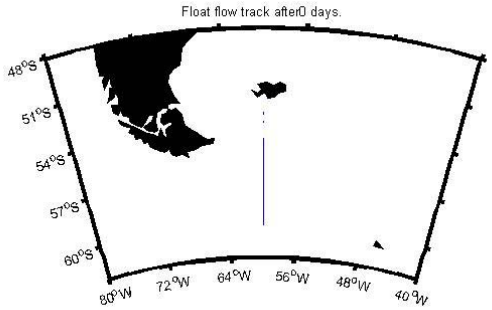
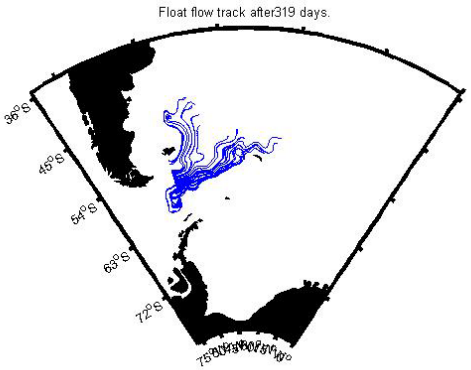
In situ measurements combined with HYCOM output.







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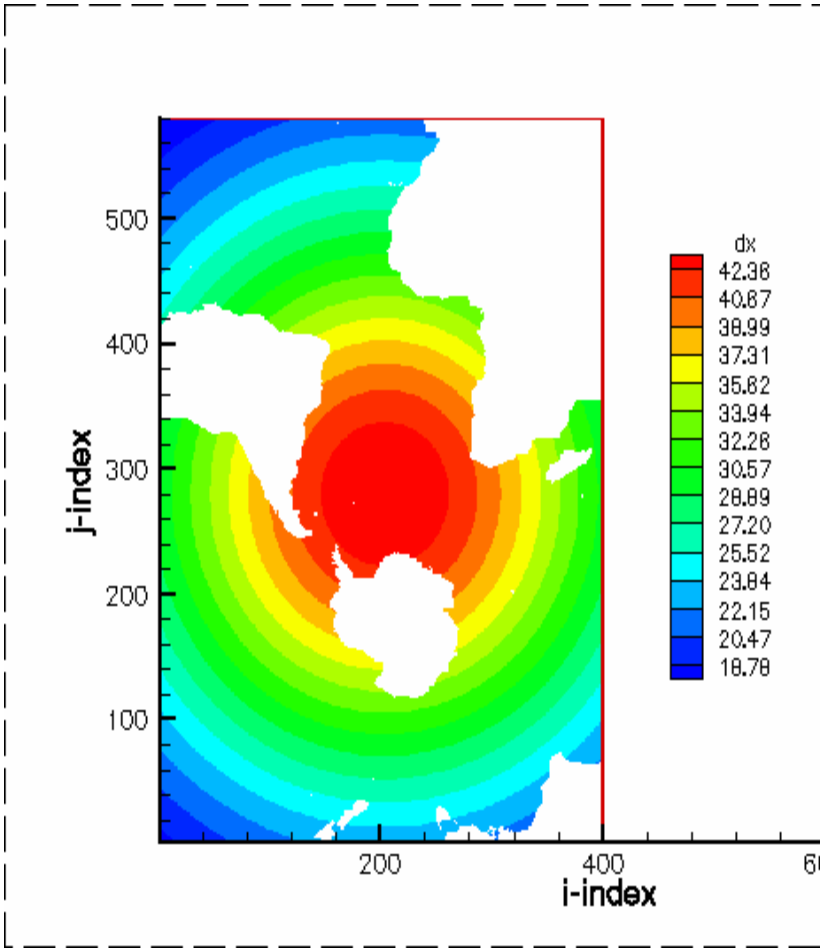
South Atlantic HYCOM.

- Grid set up using mapping tool of Bentsen *et al.* 1999
- Horizontal resolution of 18-42 km
- 35 hybrid layers
- One version using σ_0 and one version using σ_2
- Closed Mediterranean
- No tides included
- 100 days relaxation time for temperature and salinity
- 11 years spin-up completed for σ_0
- Hindcast from 1987-2007 currently running



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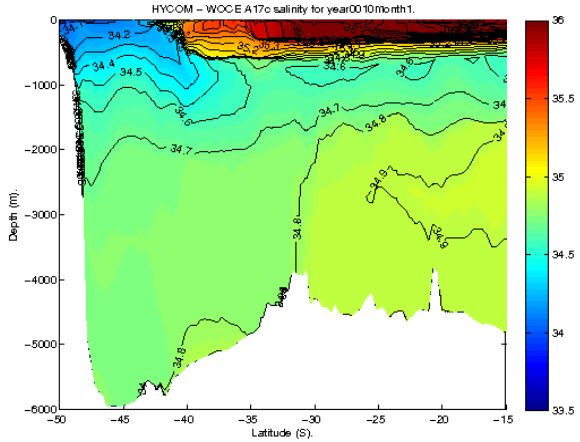
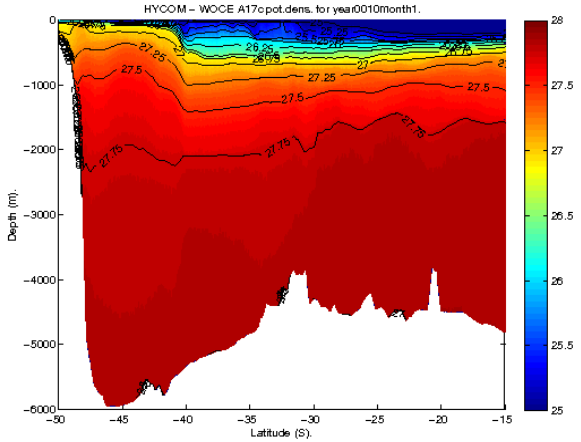
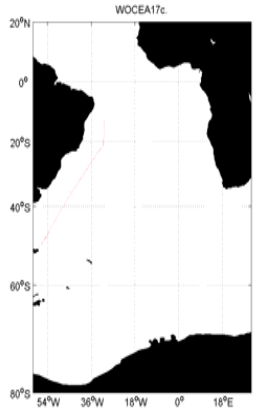
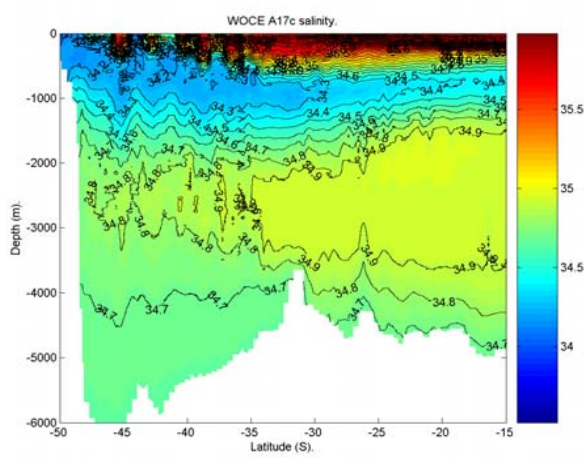
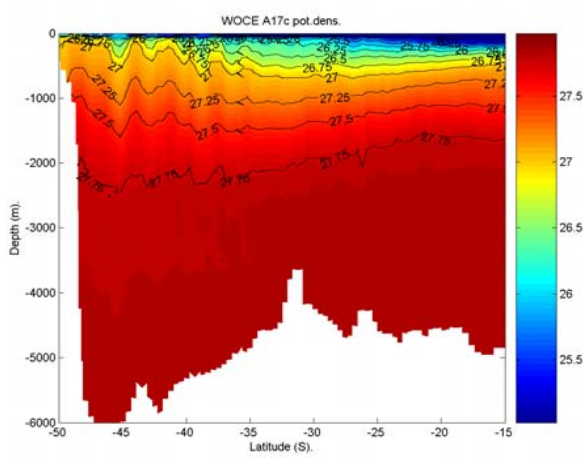
Final year of spin-up.











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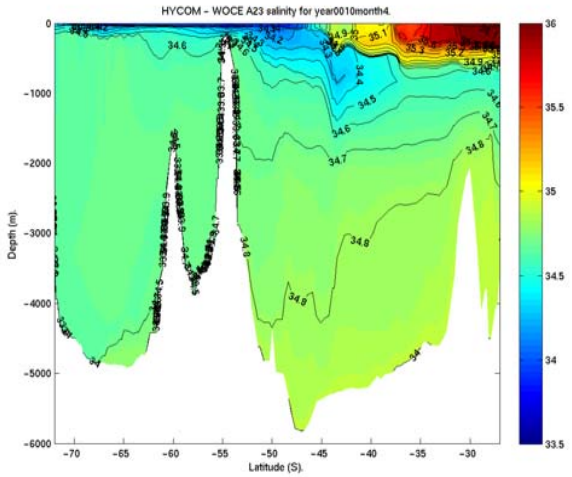

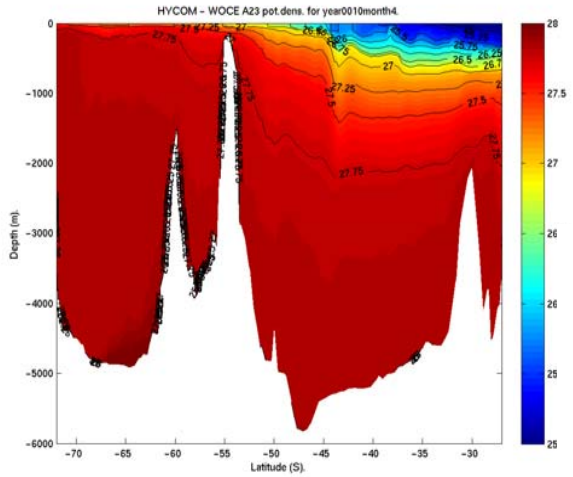

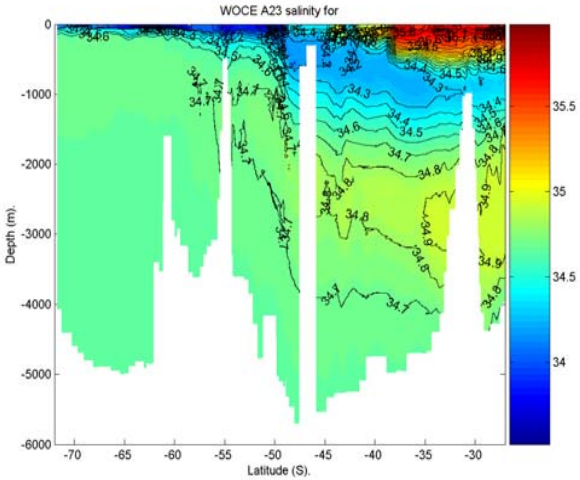

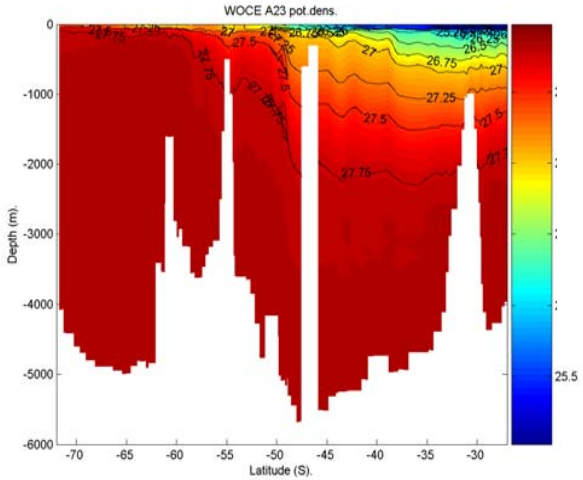

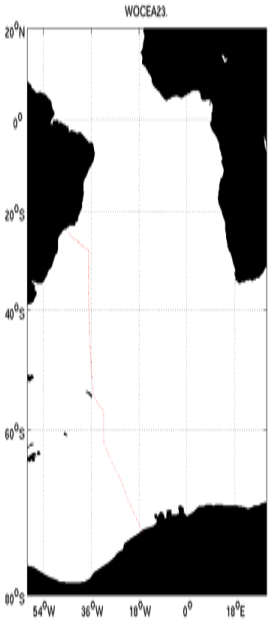

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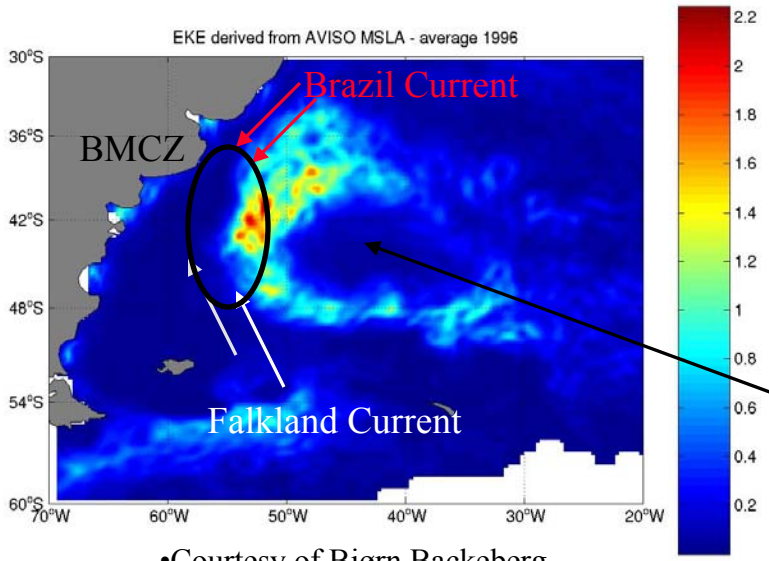
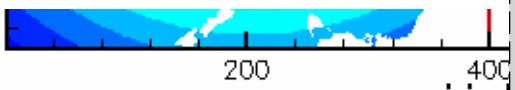
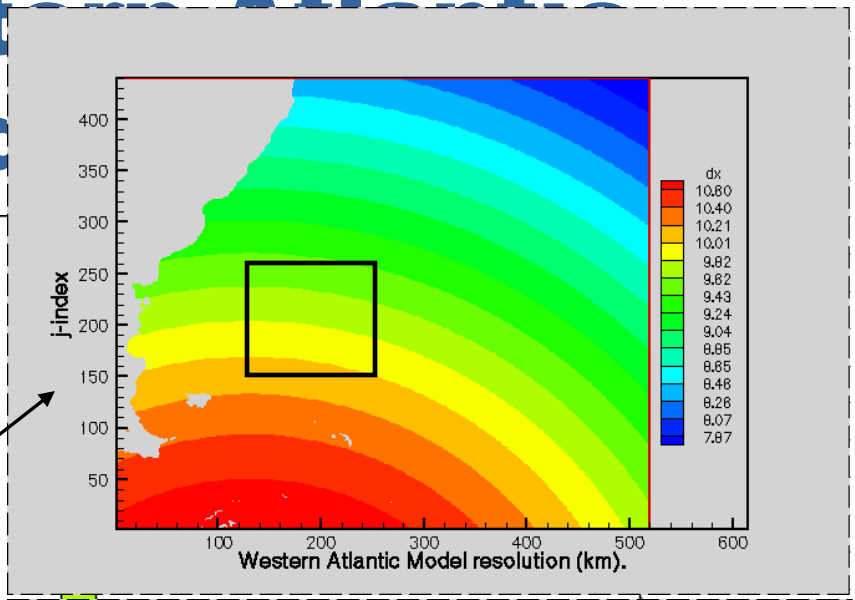
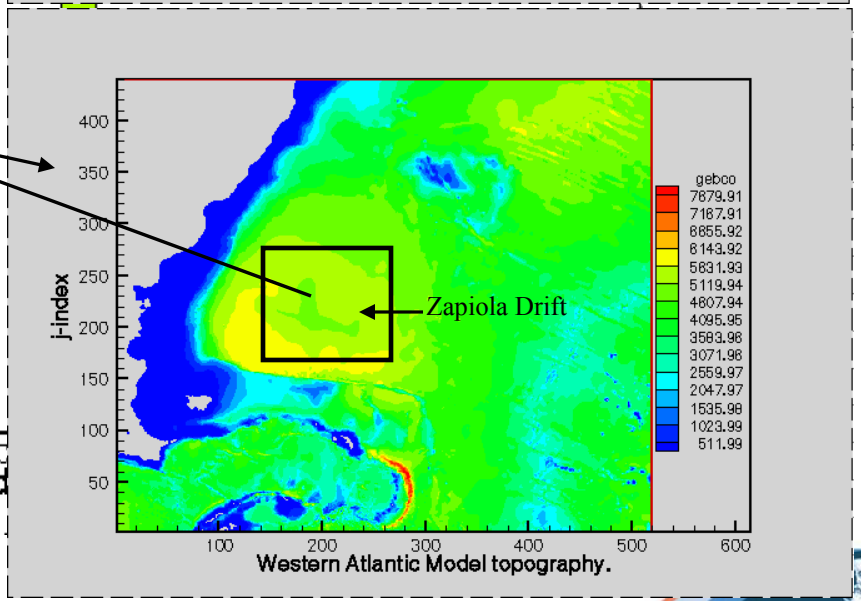
Nested West Atlantic Mod



•Courtesy of Bjørn Backeberg







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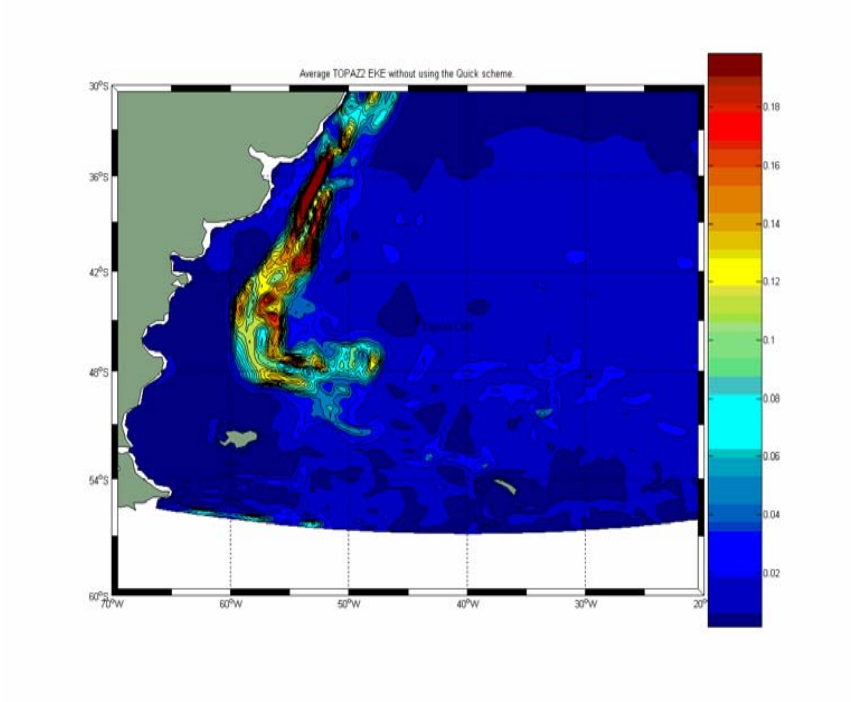
Eddy kinetic energy.



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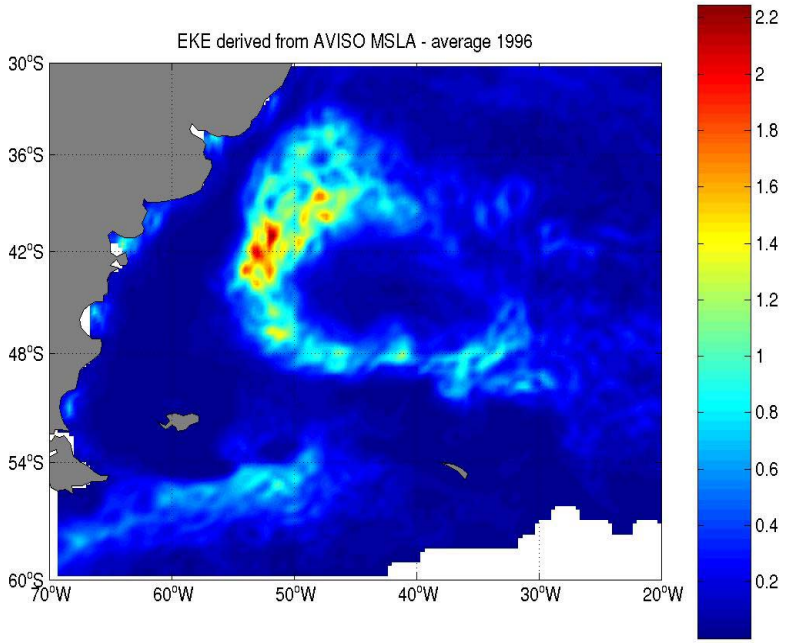

Satellite altimetry

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Thank you!! ☺

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