

Collaboration between France and South Africa in observing the Southern Ocean

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Ansorge (UCT)

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M. Roberts (DEA)

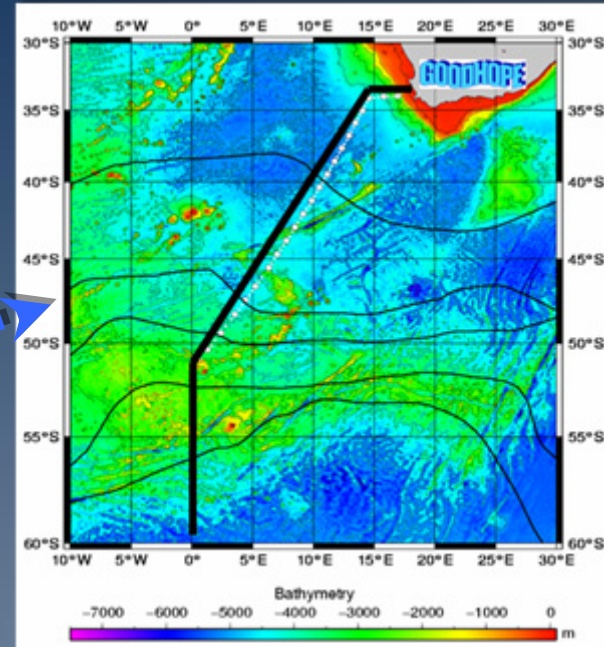
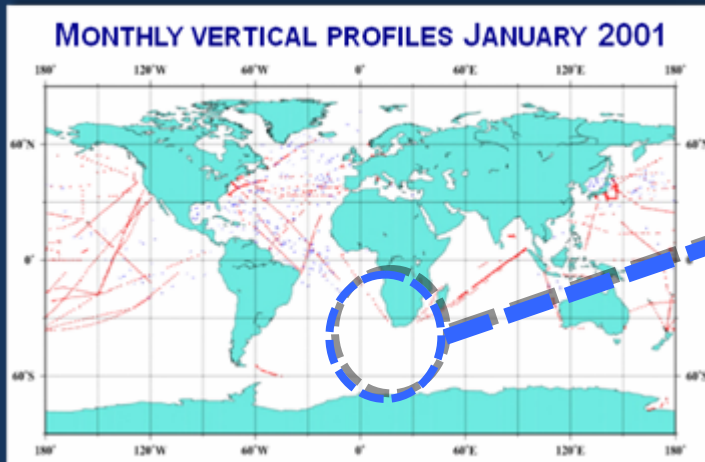


SOUTHERN OCEAN AND CLIMATE
FIELD STUDIES WITH INNOVATIVE TOOLS



The Southern Ocean even in the early 2000 : A desert in observations

CLIVAR GoodHopeSince 2004



Focus on interbasin exchanges :

To understand the processes and to monitor the variability

- To implement a network of different but complementary observations
- To accompany the observing system with global, regional and process modeling and adapted diagnostics

An international cooperation: 15 institutions, 8 countries

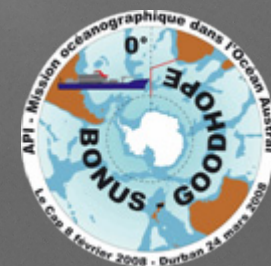


Clivar GoodHope

- 23 high resolution XBT transects (2/yr)
- 6 Full-depth hydrological transects (5 Russian, 1 French– IPY BONUS-GoodHope)
- 2 transects including CFCs and anthropogenic Carbon estimates
- More than 100 Argo profiling floats deployed

IPY BONUS-GoodHope

- 1 transect including full geochemistry, biogeochemistry and atmosphere obs
- 2 long term bottom mooring (C-PIES)



10 year of GoodHope !

References:

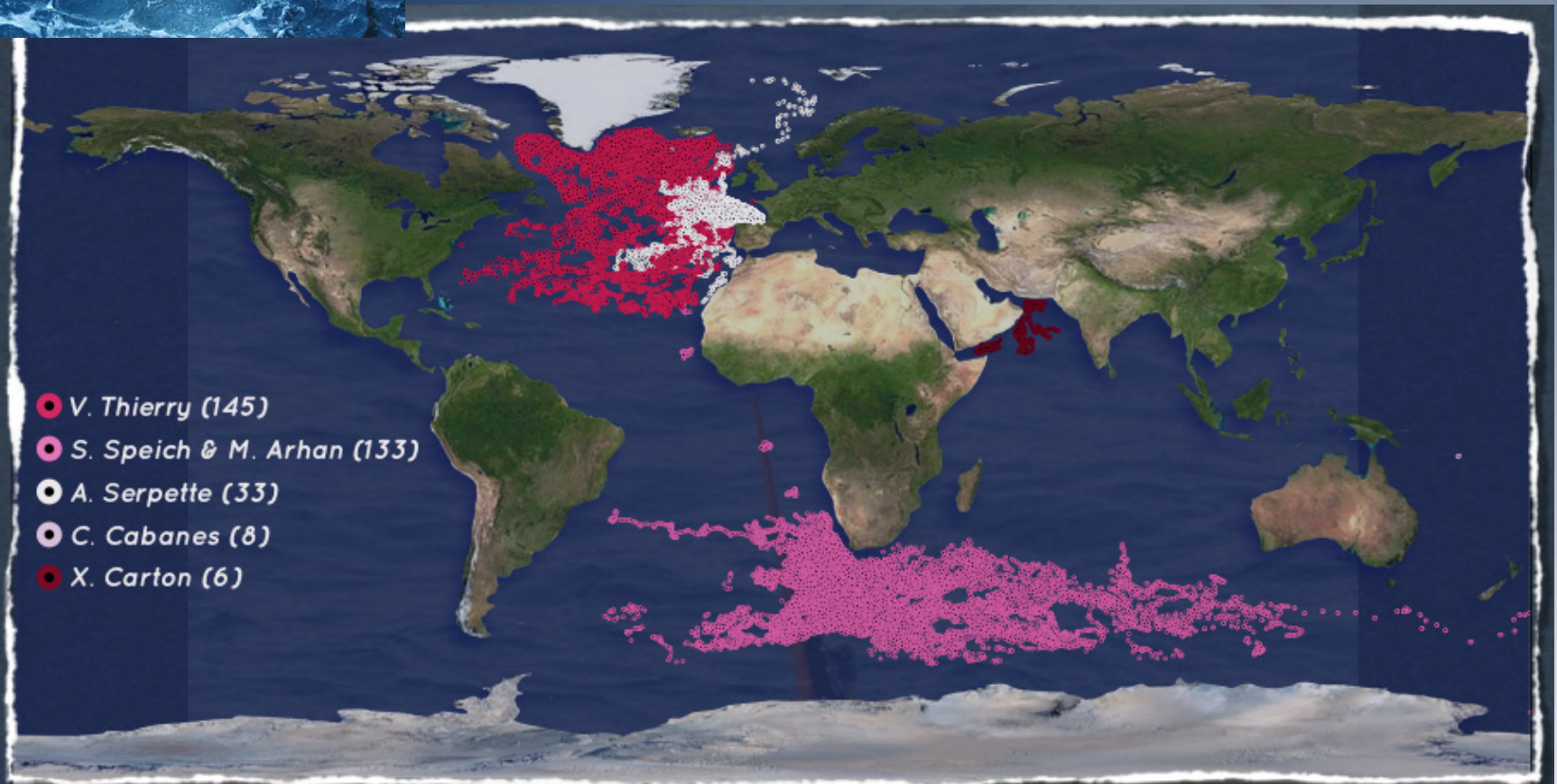
Ansorge et al. 2004; Legeais et al. 2006; Speich et al. 2008; Swart et al. 2008; Gladyshev et al. 2008; Rouault et al. 2009; Swart et al. 2010; Swart & Speich 2010; Dencausse et al. 2010a, 2010b, 2010c.

References:

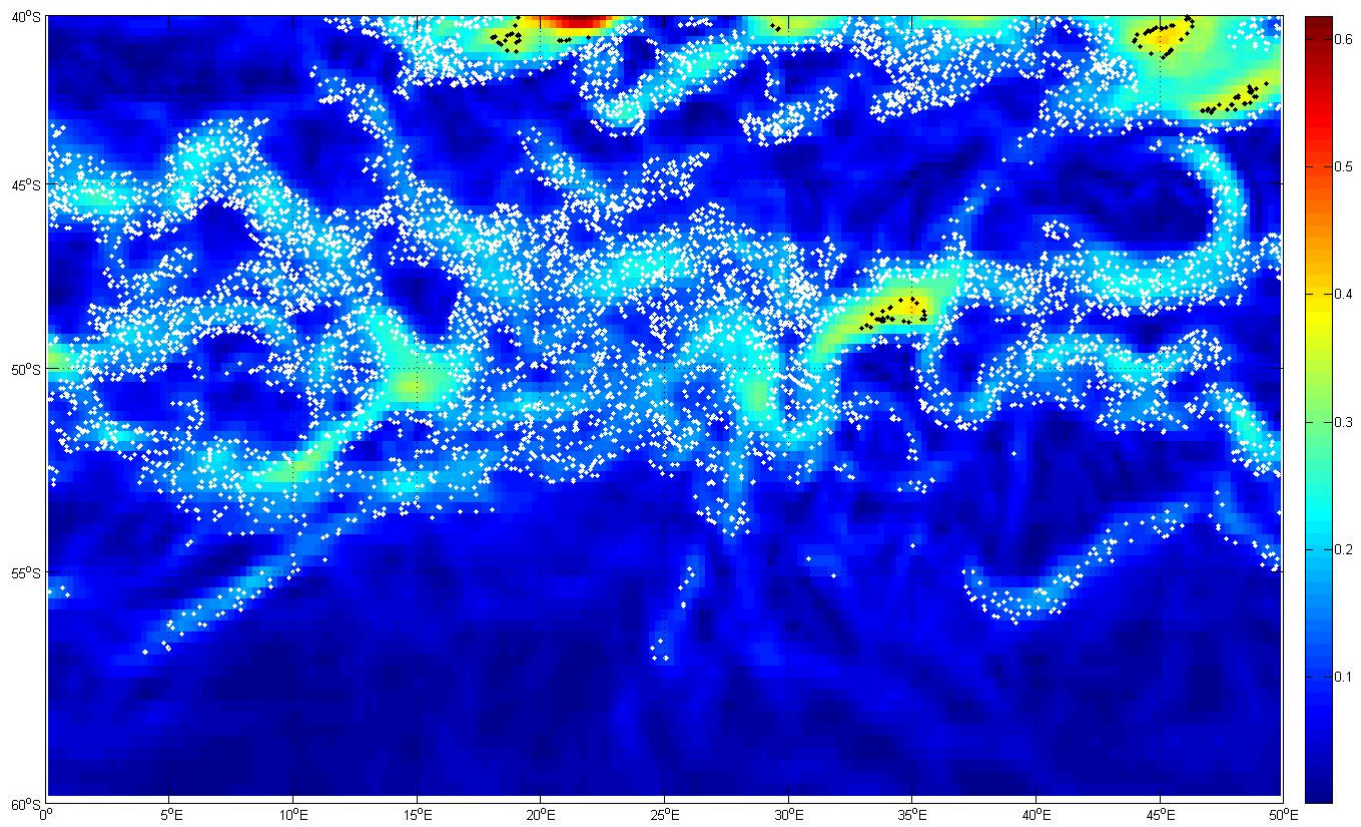
- More than 25 published articles;
- A Special issue *in Ocean Science and Biogeosciences*.
- 8 PhD, 15 Masters, 5 Post-Docs



GoodHope & Argo floats



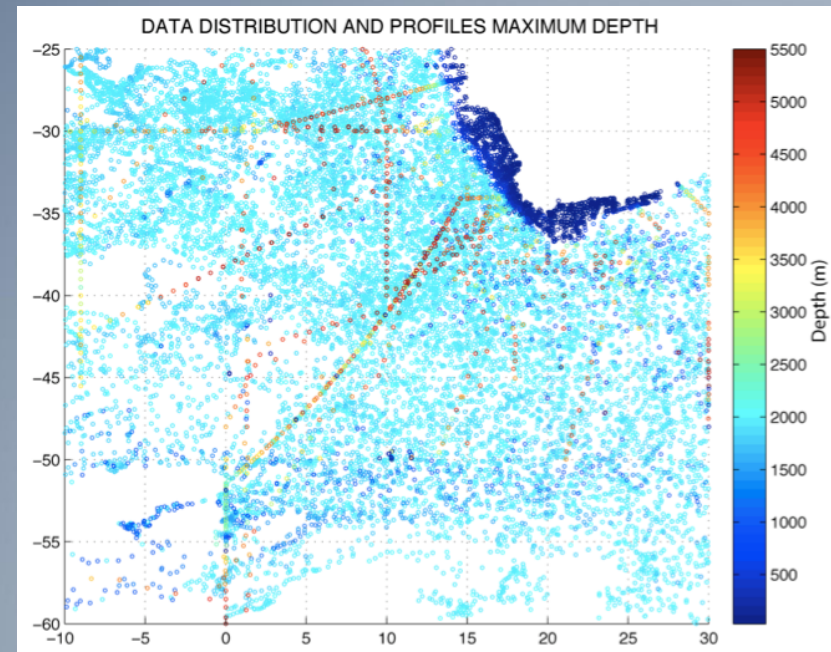
Sources: FTP Coriolis le 11/12/12. Statistiques basées sur le nom des PIs des flotteurs.



GoodHope & Argo floats

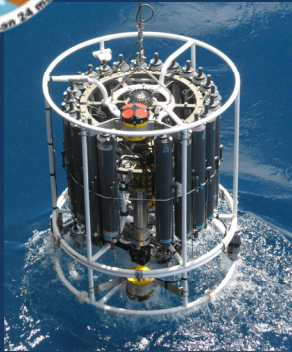
All vertical profiles (up to mid-2011)

- **Deployed since early 2004**
- **More than 30 000 profiles in the GoodHope region**

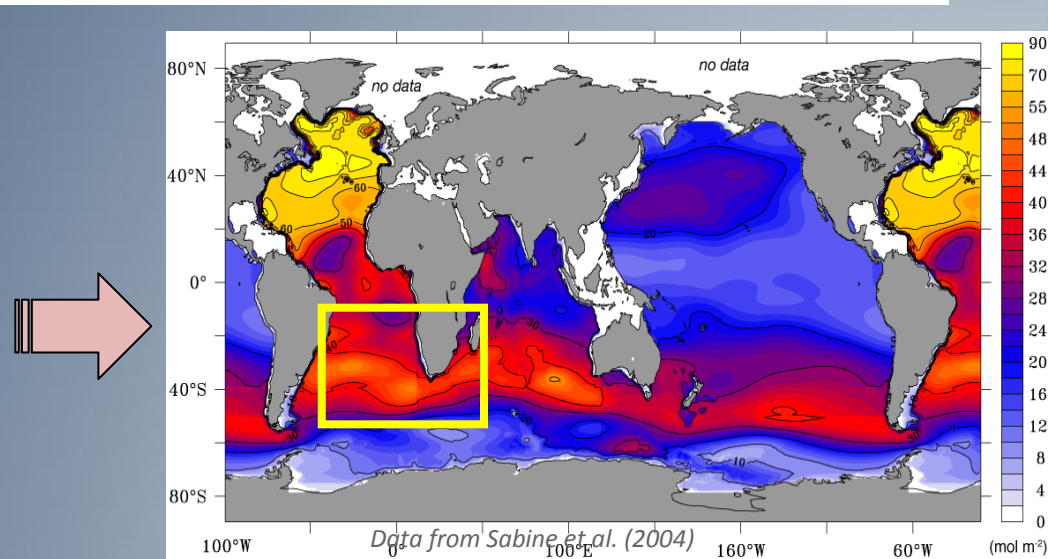
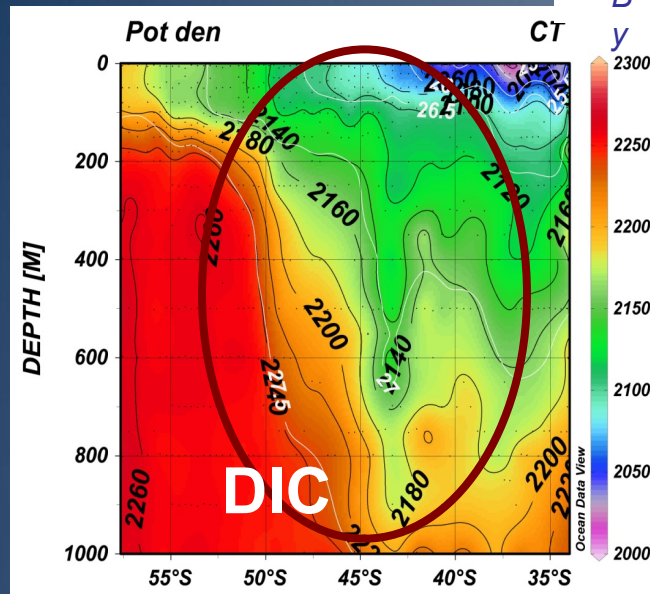
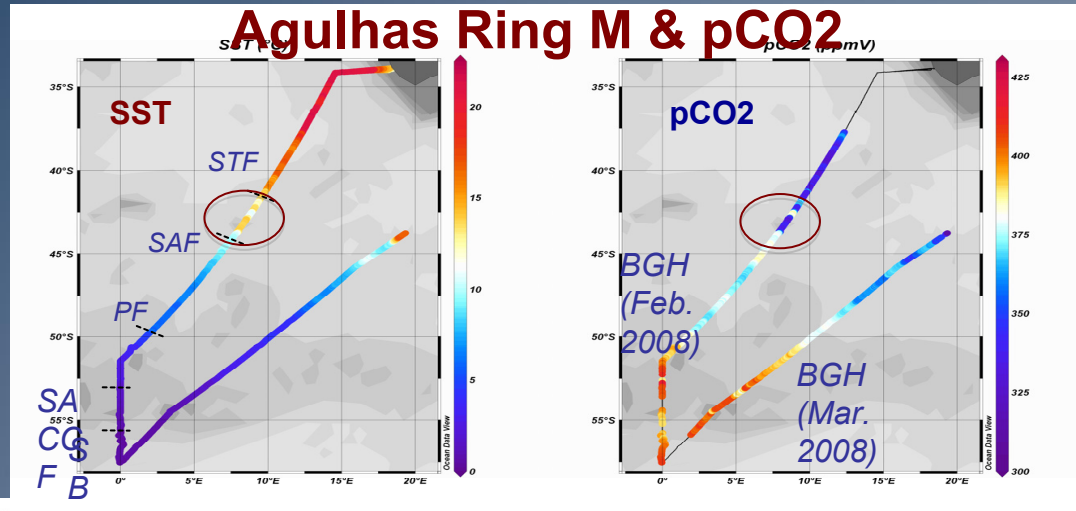




Agulhas Ring & CO₂-Carbon ocean pumping



Agulhas Ring M
325 ktons of C





Nonlinear ocean dynamics and interocean transfers

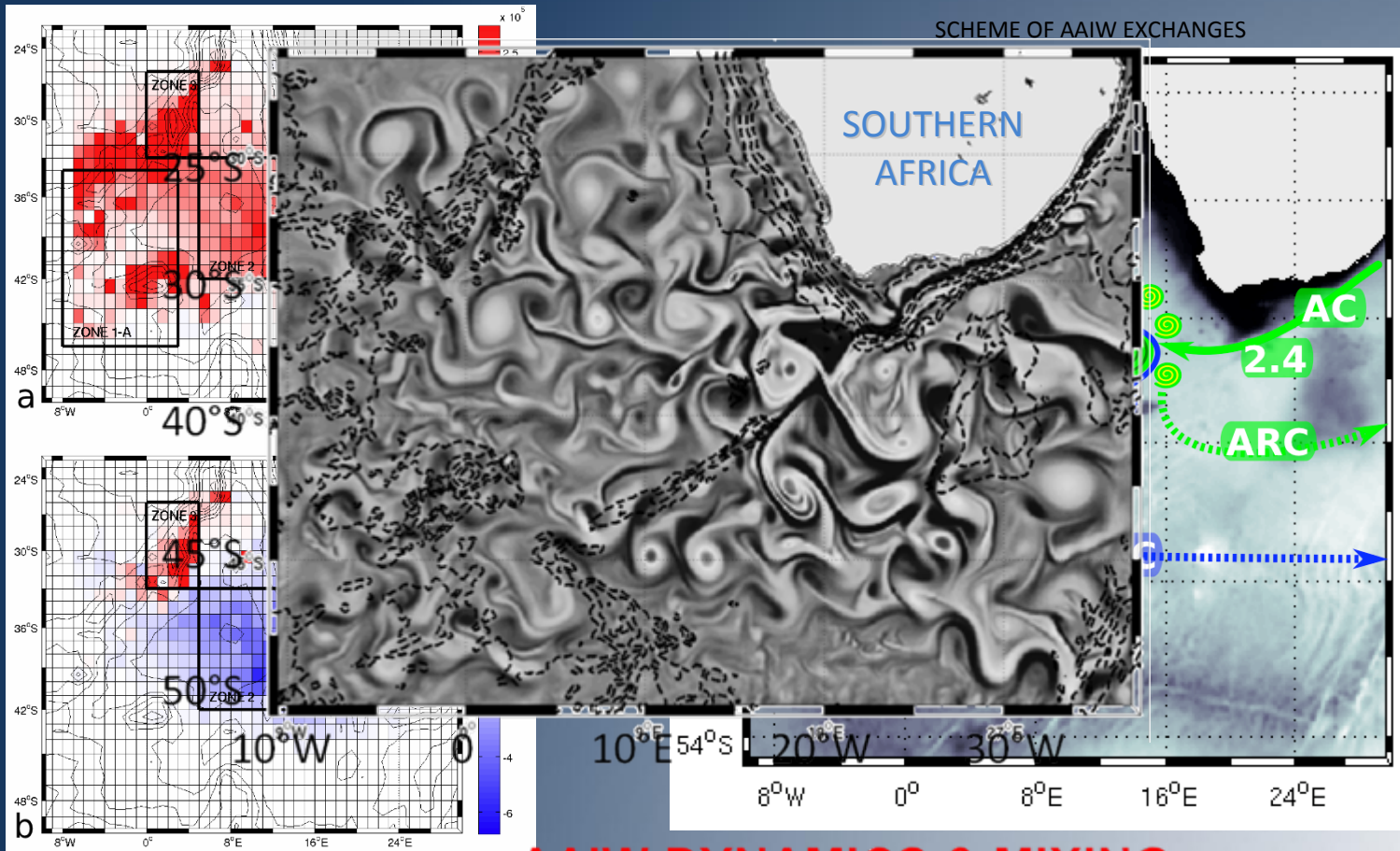
Ventilation of the Southern Hemisphere thermocline

Regions of Salinity Changes $1/12^\circ$ ROMS regional simulation

Relative vorticity

Atlantic AAIW

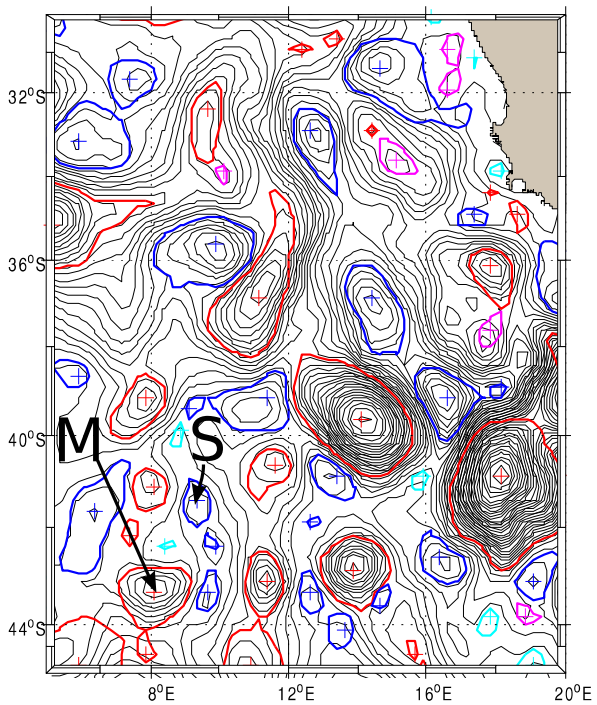
Indian AAIW



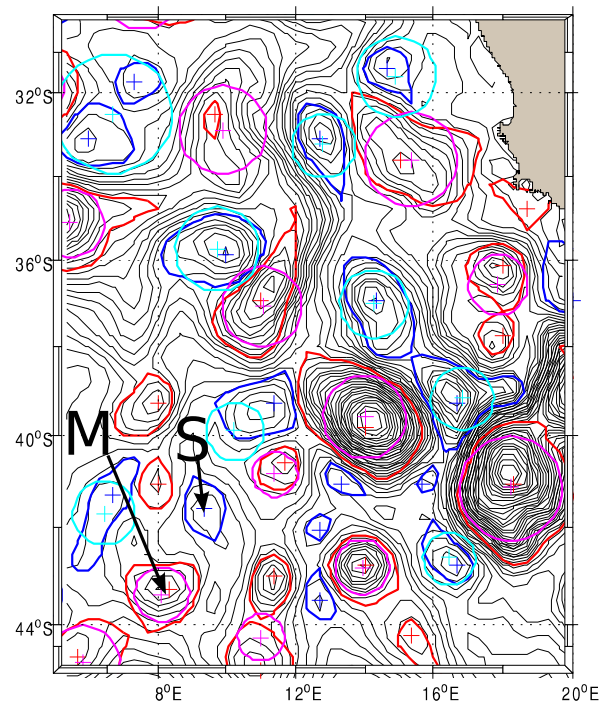
SCHEME OF AAIW EXCHANGES

AAIW DYNAMICS & MIXING

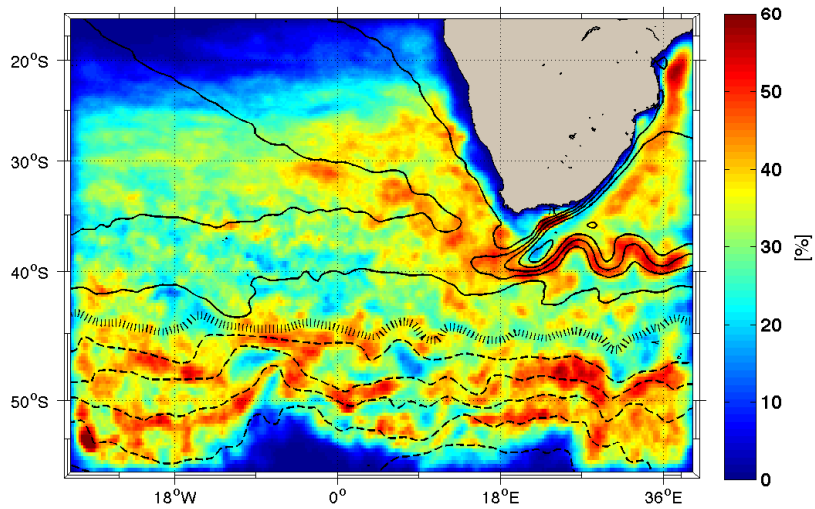
MESOSCALE & SUBMESOSCALE AT PLAY



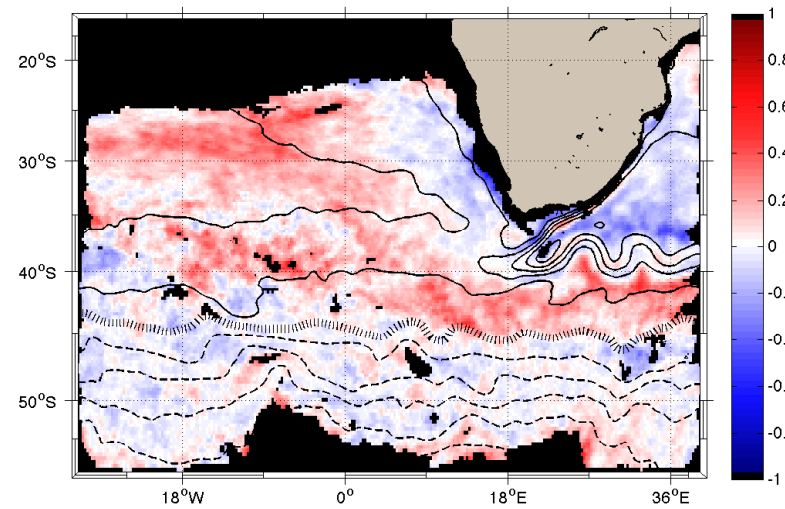
(a) Algorithm of this study



(b) Comparison with Algorithm developed by Chelton et al. (2011)



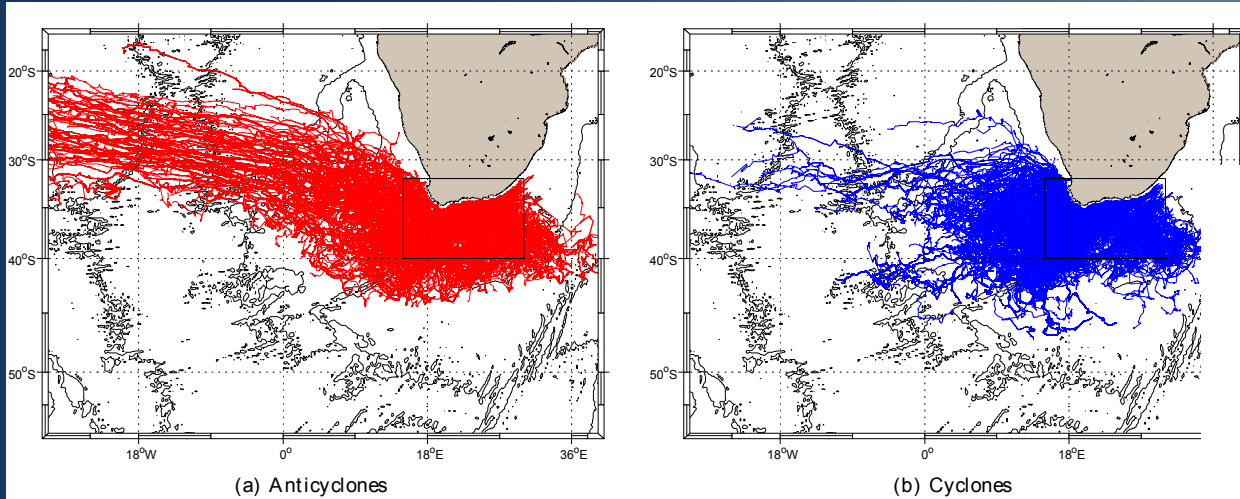
(a) Frequency of eddy presence



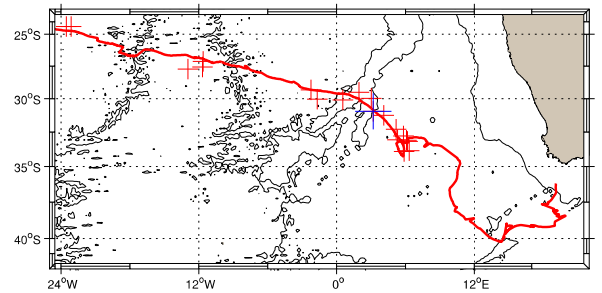
(b) Polarity

Circulation océanique globale et Interactions d'échelles

Détection des tourbillons à partir de l'altimétrie

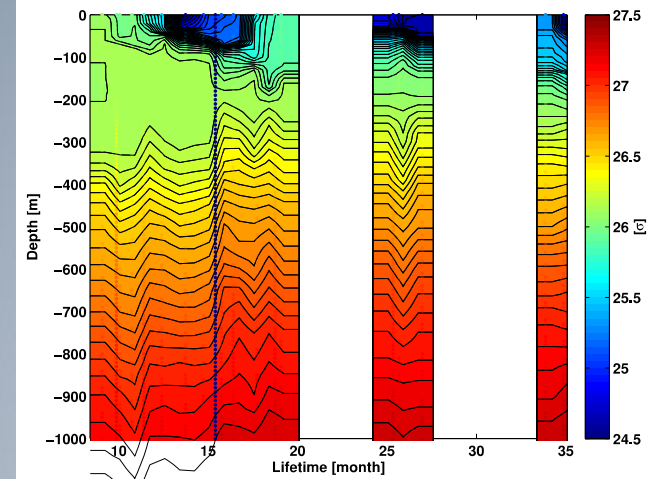


Suivi des propriétés des anneaux des Aiguilles co-localisé Argo-altimétrie



(a) Trajectory path from the observations

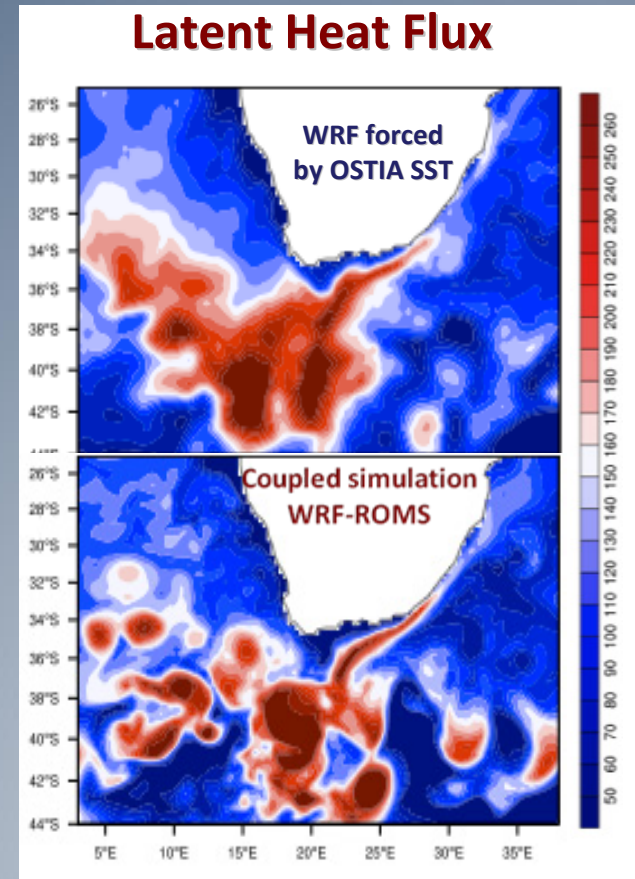
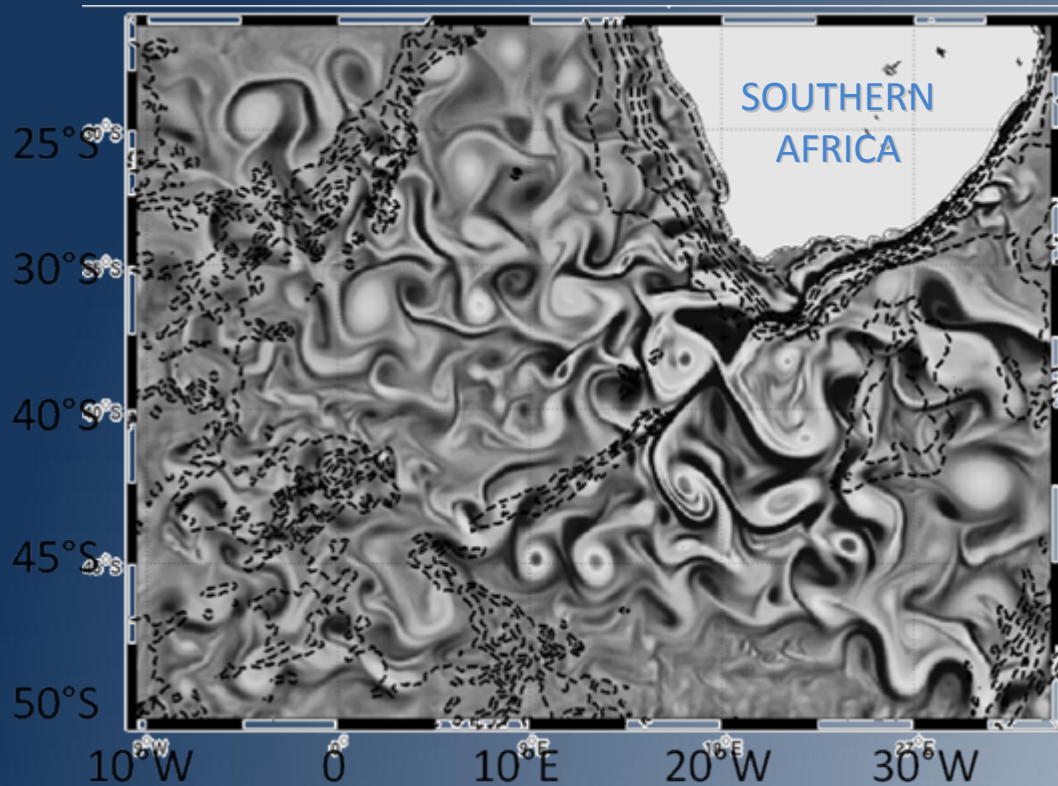
Ventilation des eaux de la thermocline par interaction air-mer au niveau des anneaux des Aiguilles. dans les



(c) Potential Density from the observations

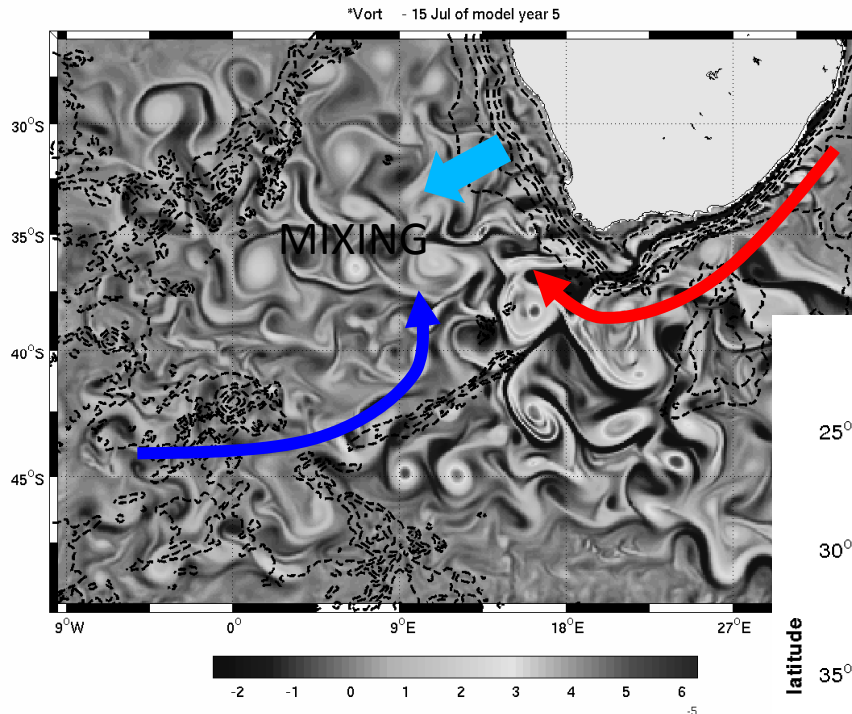
Modélisation régionale couplée océan-atmosphère

Relative vorticity
1/12° ROMS regional simulation



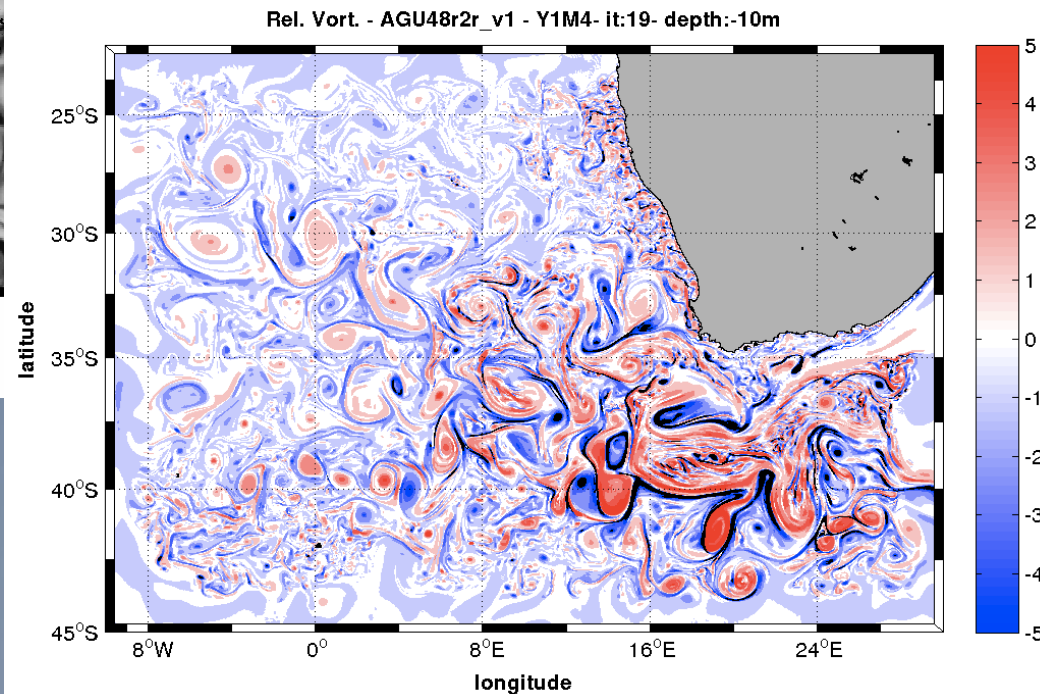
Circulation océanique globale et Interactions d'échelles

Roms simulation 1/12°



Simulations numériques et observations

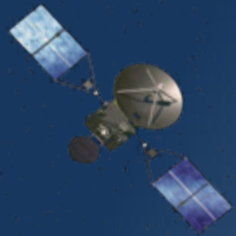
Roms simulation 1/48°



- PhD Tonia Capuano
- Postdoctorat E. Rusciano
- Stage de M2 Rémi Laxenaire

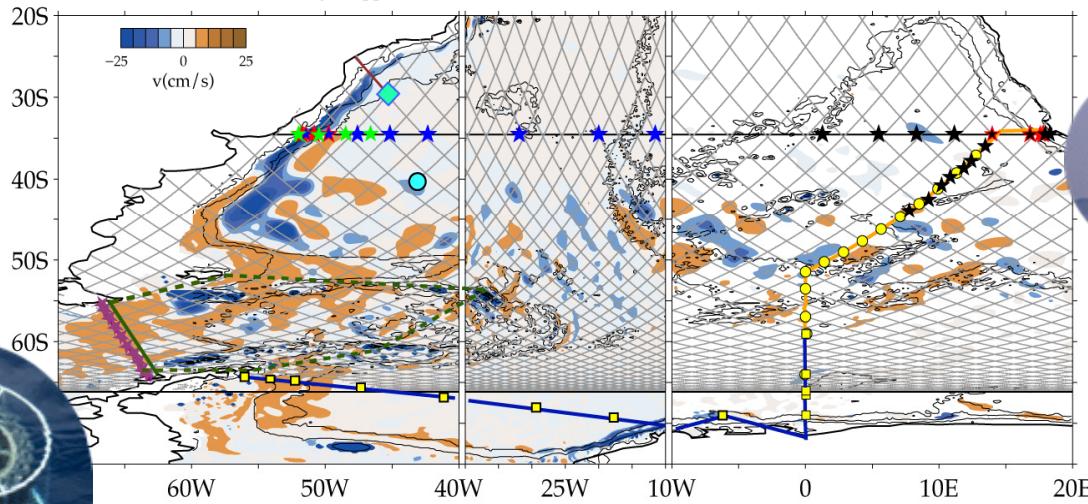
Nonlinear ocean dynamics and interocean transfers

Towards a Southern Ocean – South Atlantic observing system: The SAMOC array



Funded in France (ANR, LEFE & Ifremer), Brésil, South Africa, USA (NOAA), Germany, Russia, ...

- ★ Moorings ZA?, France ? ● CPIES/PIES Germany — CTD line Brazil? Argentina? South Africa? ◆ Atlas-B buoy INCT-MC Brazil
- ★ Moorings Brazil ■ Tall moorings Germany — CTD line Russia — CTD line INCT-MC Brazil
- ★ Moorings NOAA USA ★ CPIES CDrake NSF USA — CTD line Russia-South Africa — CTD Germany
- ★ Moorings NSF USA ? ● OOI mooring Scripps USA — CTD line CDrake NSF USA - - - SBE21 & VMADCP Russia



Argentina Brazil
France Germany
USA
Russia South
Africa

Observing new time and space scales: Overview of the Southern Ocean Seasonal Cycle Experiments (SOSCEX)

Many many contributors...
Sebastiaan Swart
Pedro Monteiro
Sandy Thomalla





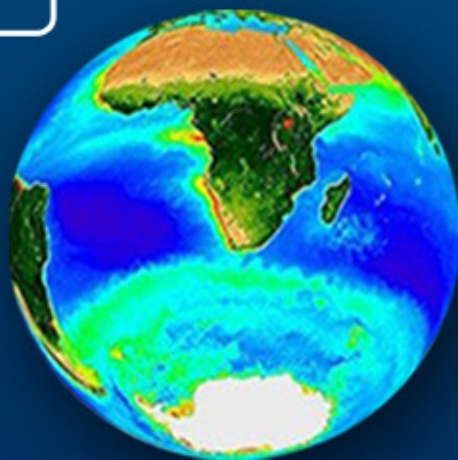
CHPC

Center for High Performance Computing

- Global and regional high resolution modelling (CSIR)



Integrated earth systems
scale climate research in the
Southern Hemisphere



OCEAN ROBOTICS

Interdisciplinary observational facilities

- Physics, carbon, bio-optics (CSIR)
- Engineering R&D (STS)



SATELLITES

Sustained long term observations and interdisciplinary process studies

- In situ algorithm validation and development
- Asses ecosystem variability at required spatial and temporal scales



POLAR RESEARCH VESSEL

Sustained long term observations and interdisciplinary process studies

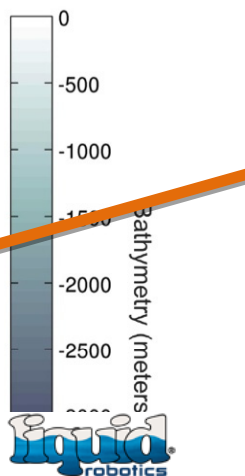
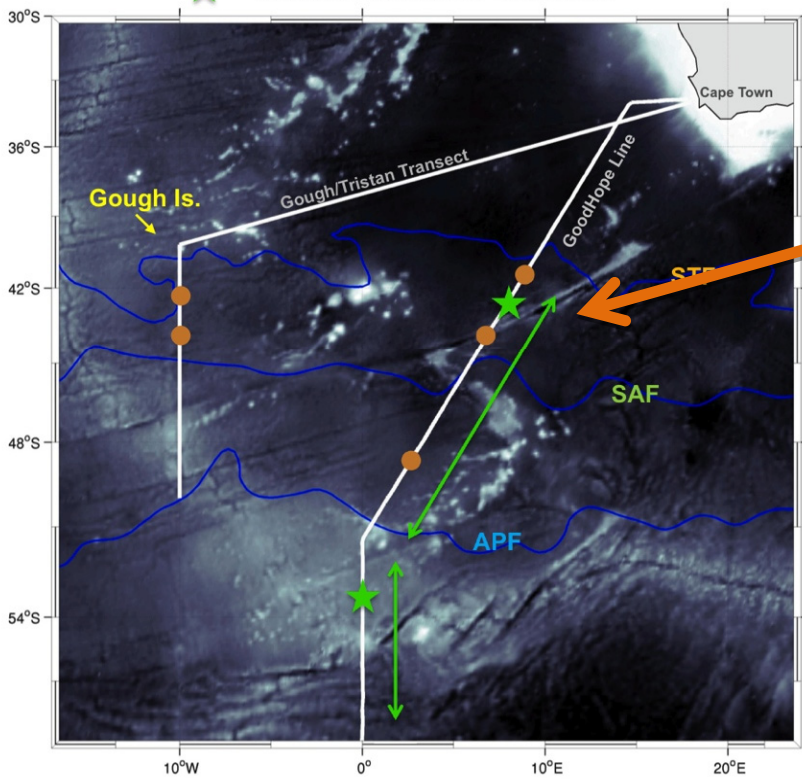
- Iron (Fe) clean analytical chemistry
- High precision CO₂ and pCO₂ (CSIR)
- High precision Bio-optics (CSIR)
- Nutrient & Oxygen biogeochemistry (UCT)
- Ocean productivity (UCT)





SOSCEx II: October 2013 – 9 February 2014

- = Seaglider deployment & ship CTD station
- = ship based underway measurements
- ★ = Seaglider & wave glider deployment



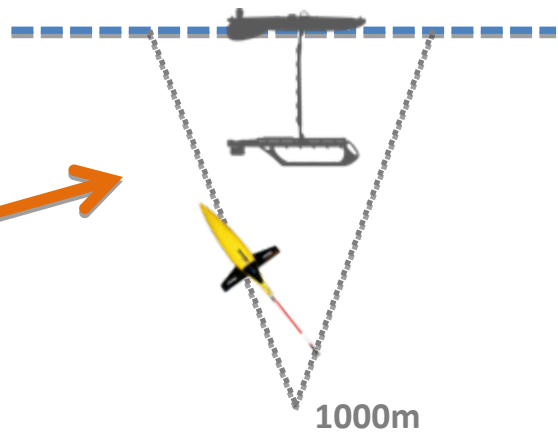
CSIR #2

Auto Evasion

Mode: Follow Custom Course
 Ave Speed(kts): 0.89
 Last Speed(kts): 0.48
 Target Waypoint: 220
 Meters to Target: 1522.4
 Ave Water Speed(kts): 1.19181

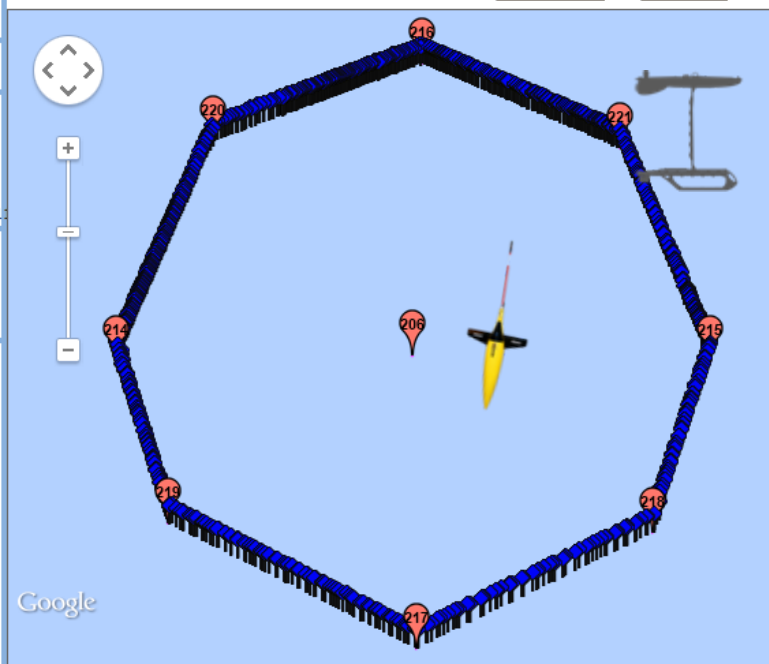
Light: IR: XBee:
 P/L1: P/L2: Sub:
 P/L3: PEP:

Follow Sequential Course
 Hold Station At Waypoint
 Follow Custom Course
 Hold Current Position
 Follow Fixed Heading
 Set Parameter
 Comment
 More Commands ...

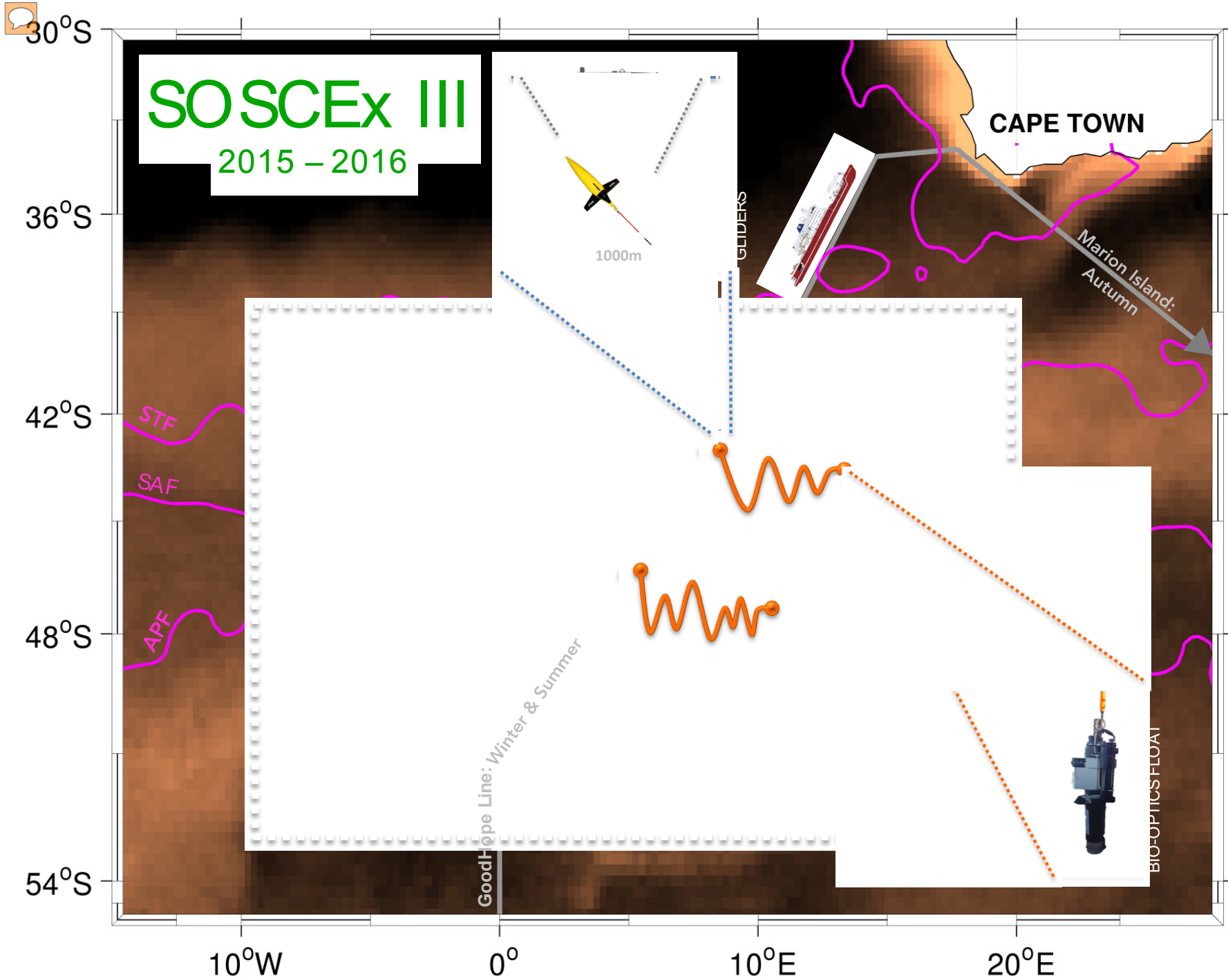


Alarms: Last refresh: Fri-Nov-22-2013 6:23:29 (Pacific Standard Time) Autorefresh

Duration: 3 days Prior To: Now Switch To: Date Range Submit

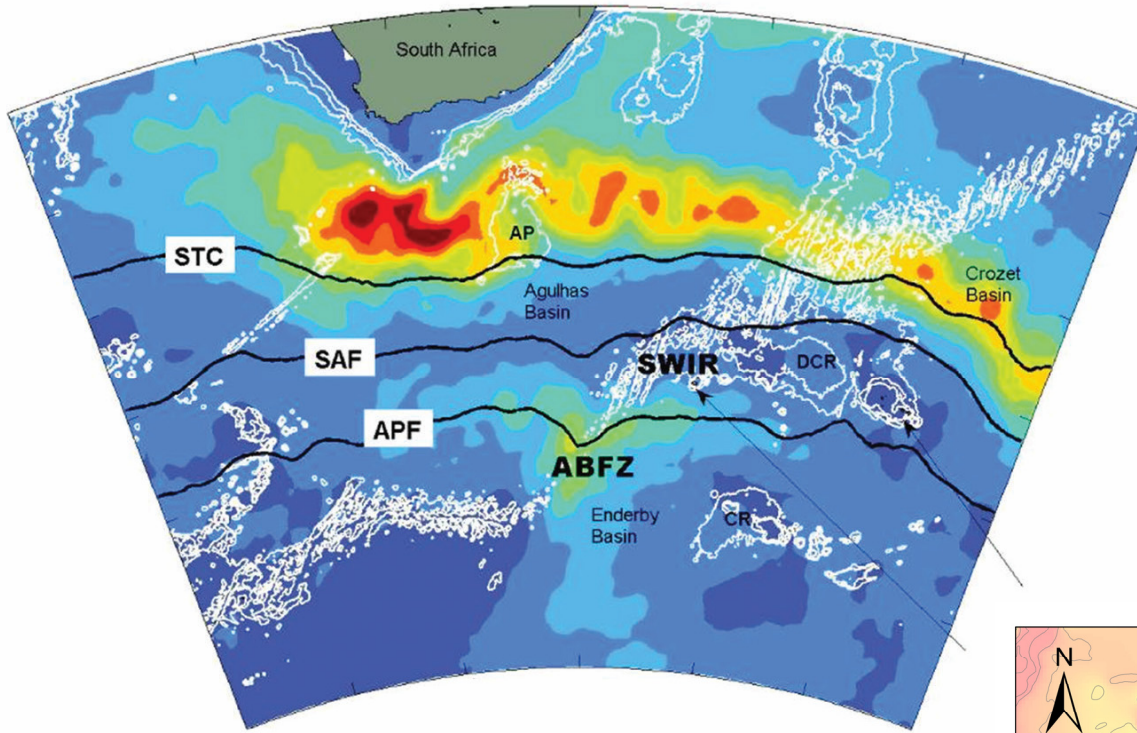


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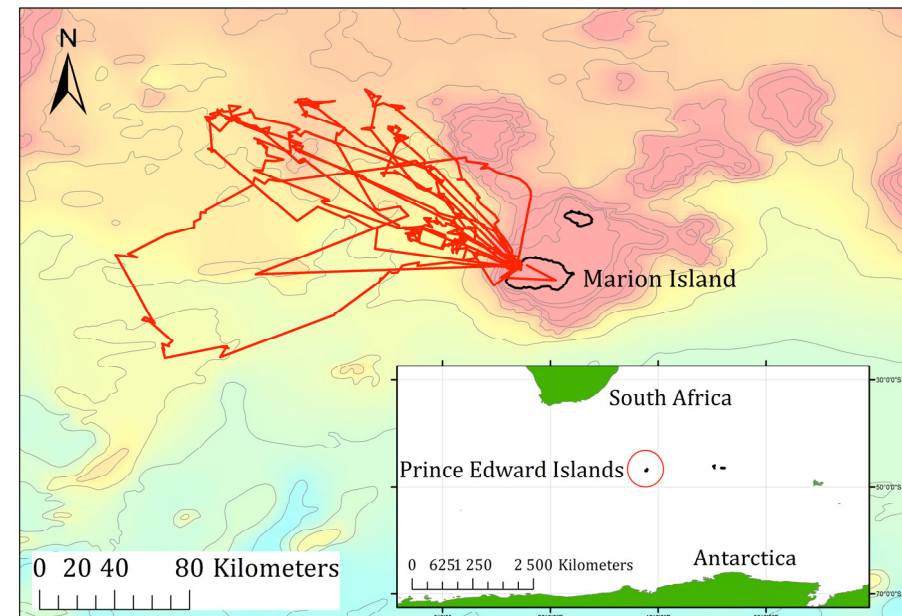


Isabelle J. Ansorge, UCT, Cape Town

Sentinels to
climate change.
The need for
monitoring at
South Africa's
Subantarctic
laboratory



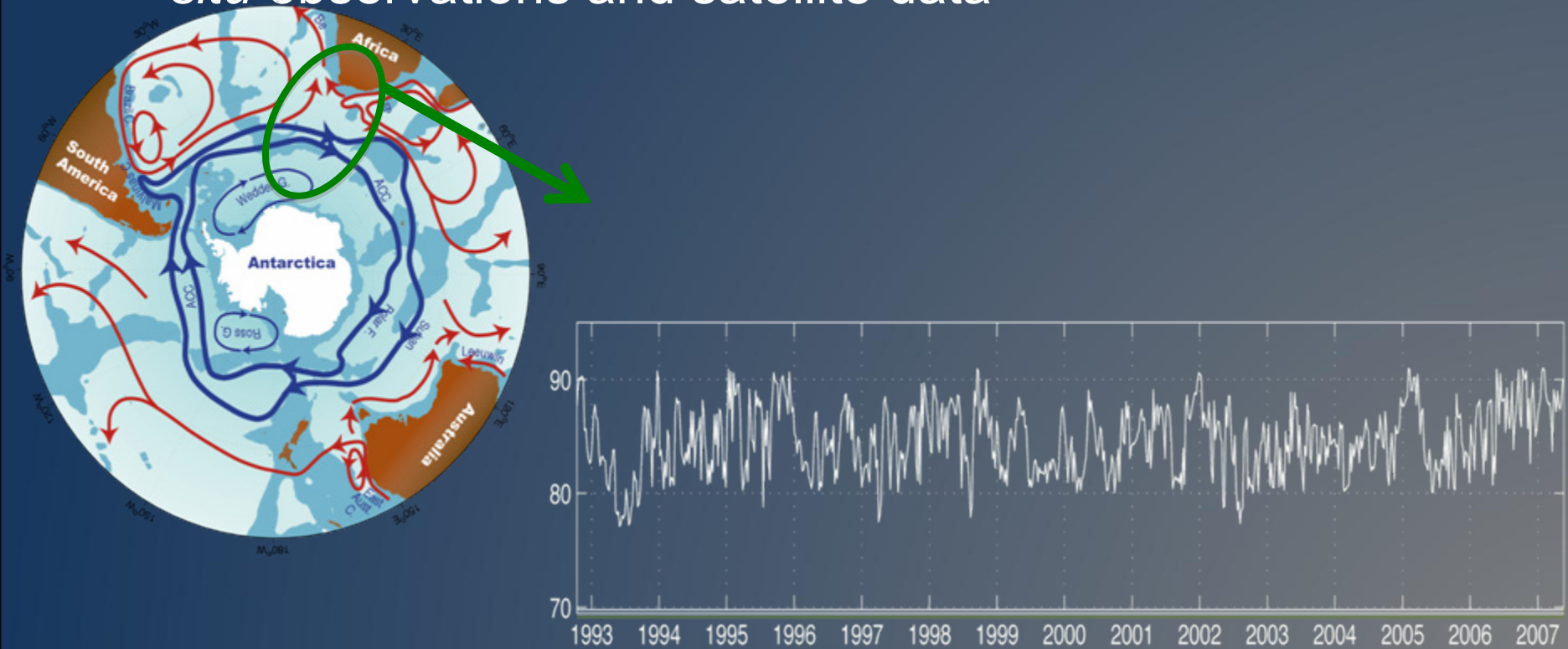
SA Agulhas II, a brand new ship



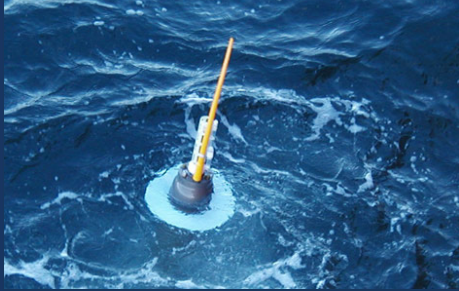


GoodHope: DEVELOPMENT OF OCEAN STATE INDICATORS

Ex.: ACC transport monitoring by a proxy method build upon *in situ* observations and satellite data



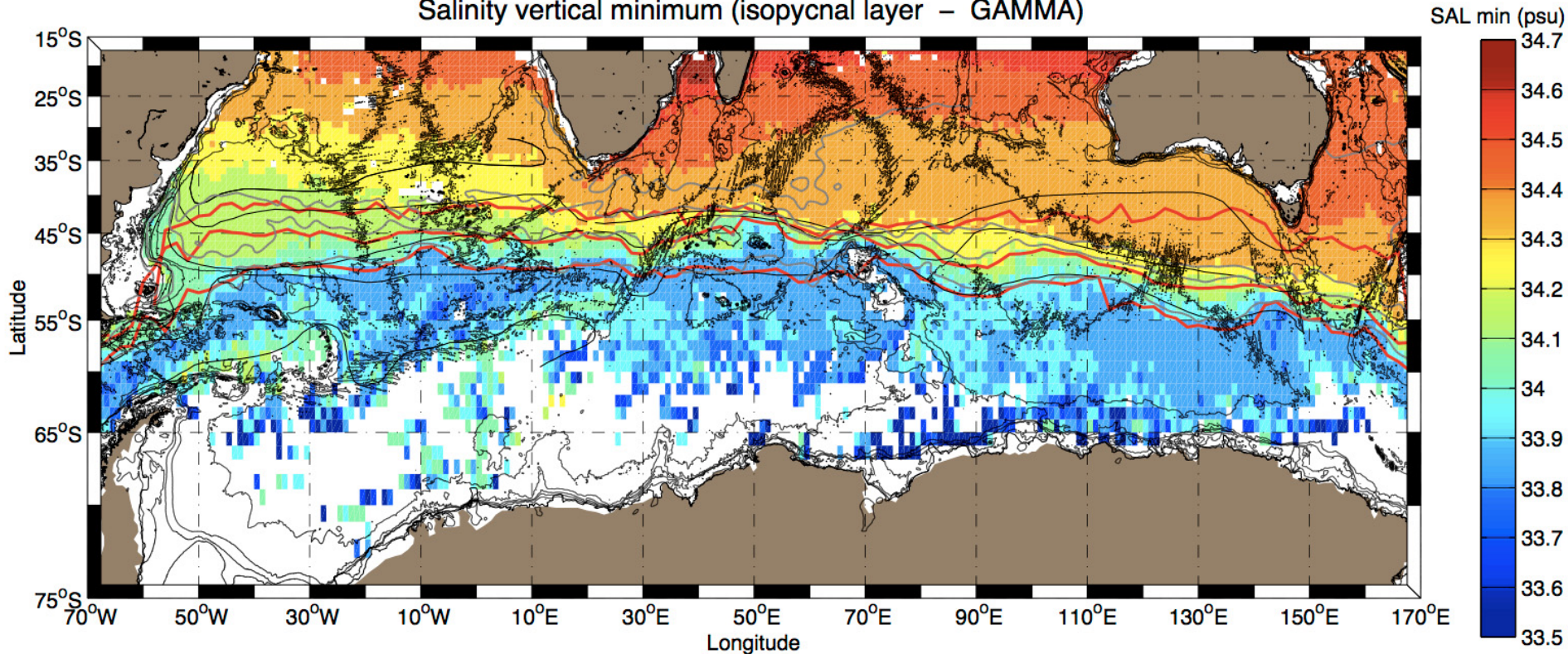
Legouis et al. 2006; Swart et al. 2008



Nonlinear ocean dynamics and interocean transfers

Ventilation of the Southern Hemisphere thermocline

Salinity vertical minimum (isopycnal layer – GAMMA)

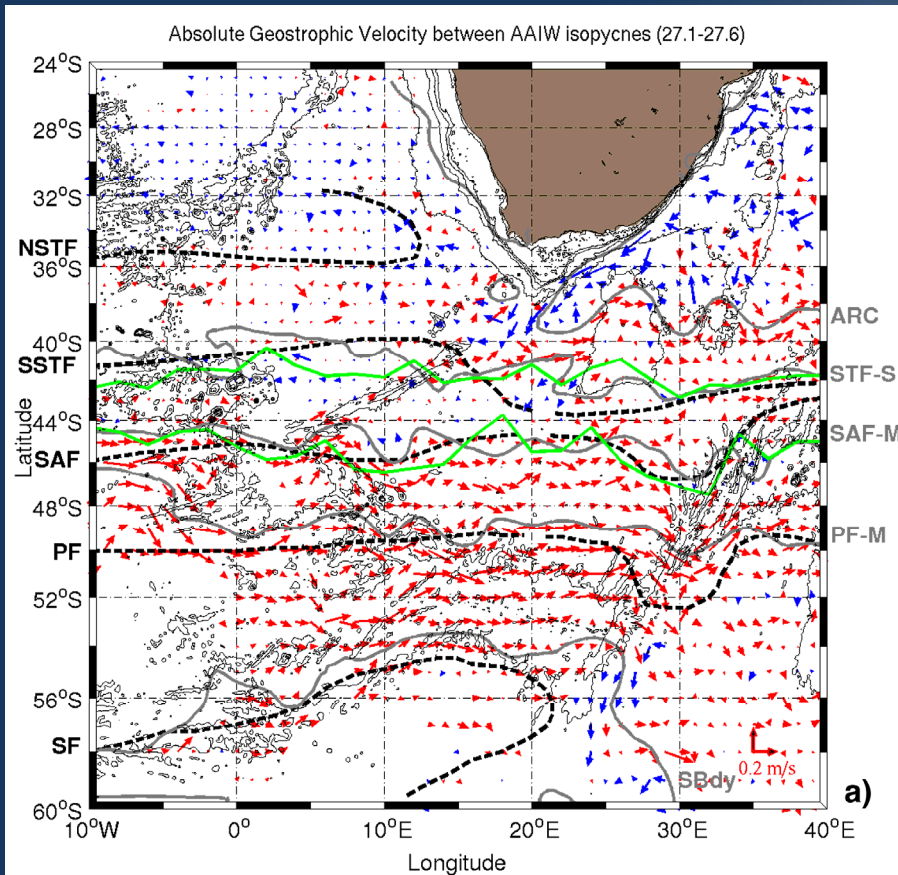


Eastern Boundary small scale mixing

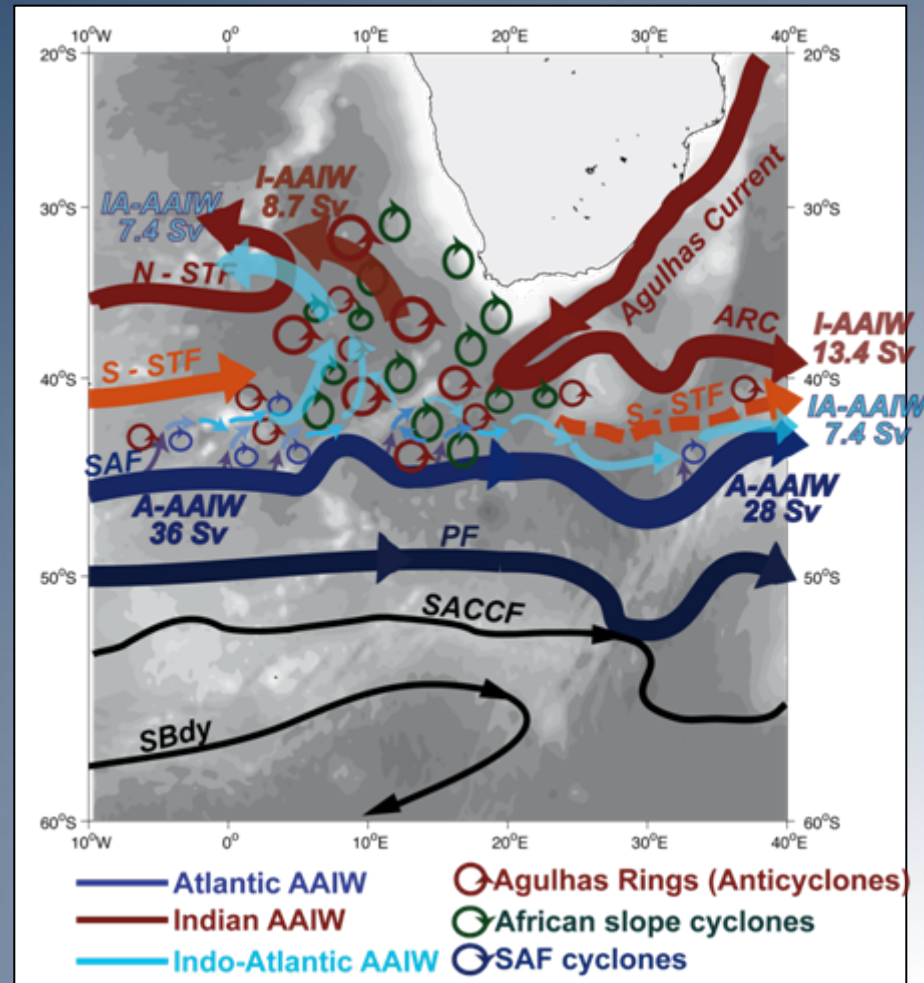
Nonlinear ocean dynamics and interocean transfers

Ventilation of the Southern Hemisphere thermocline

ARGO ABSOLUTE GEOSTROPHIC VELOCITY



SCHEME OF AAIW EXCHANGES





Ocean Profiling
(Ship-based)
CSIR - SANAP

CSIR Robotics and Sensor
Engineering R&D (spin-off)



Ocean Robotics
CSIR - SANAP

Ocean Iron and
Trace Metal
Chemistry
SUN - CSIR



Specialized
Container labs
(ship-based)



New Interdisciplinary
Research Facilities in support
of SANAP and GCGC science

Ocean CO2
Chemistry and
gas fluxes
CSIR



Ocean Bio-
optics
UWC?



Ocean
Productivity
UCT