MUSICAL
Multi-Sensors Information: ocean Color and ALtimetry

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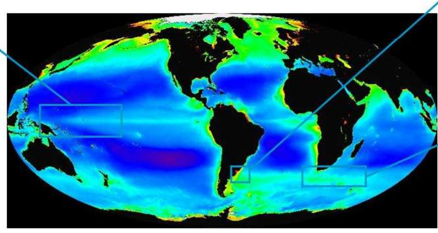
Our **MUSICAL** (MUlti-Sensors Information: ocean Color and ALtimetry) proposal intends to combine eclectic satellite and *in situ* data to provide a comprehensive three-dimensional picture of the highly climate sensitive regions we study.
We use the combined altimetry T/P-JASON data in conjunction with other remotely sensed data (ocean colour, sea surface temperature, surface winds), with *in situ* data (TAO/TRITON mooring array, ARGO floats), and with model outputs over a wide range of temporal scales.

3. at the intra-seasonal to interannual range, we study the impact of westerly wind bursts (WWB) on biology in the western tropical Pacific and its potential modulation during El Niño and non-El Niño years



1. with high frequency data, we observe mesoscale and sub-mesoscale structures and their interactions with biology in the Brazil-Malvinas Confluence zone

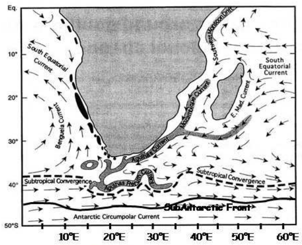
2. at the seasonal to interannual range, we investigate the possibility of detecting planetary wavelike features all along the South Atlantic Subtropical Convergence zone

This year, we focus on the South Atlantic Subtropical Convergence zone and the western tropical Pacific.

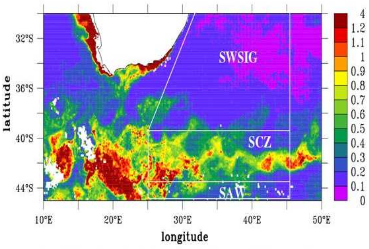
The South Atlantic Subtropical Convergence zone

South of Africa, using simultaneously T/P-ERS-2, AVHRR and SeaWiFS data, we have deduced, with wavelets transforms, the dominant wavelengths associated to the Rossby wave of the Agulhas Return Current (Llido, 2004; Llido et al., 2004).

Rossby waves signature could be easily detected, along the Subtropical Convergence, in altimetric sea level, SST and ocean color anomalies as well as in outputs of dynamical heights, SST and chlorophyll anomalies from a three dimensional coupled physical-biological model of the Agulhas Current System (Llido, 2004).

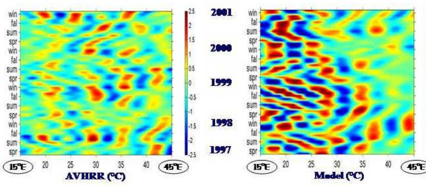


The Agulhas Current system
(Lutjeharms et al., 2001)

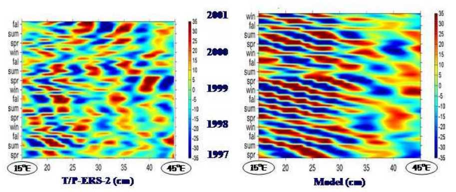


SWSIG : South Western Indian Subtropical Gyre
SCZ : Subtropical Convergence Zone
SAW: Subantarctic Waters

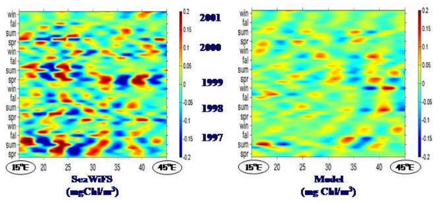
Thermal signature of the Rossby wave (along 40°S) :



Dynamic signature of the Rossby wave (along 40°S):



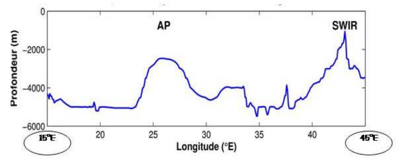
Ocean color signature of the Rossby wave (along 40°S):



The Agulhas Plateau (AP) delimits the region in two zones :

west of AP: westward propagation of anomalies with characteristic speeds between 3.6-5.4 cm s-1, 4.5-7.6 cm s-1, 2.3-3.6 cm s-1 for SST, SLA and Chl*a*, respectively.

east of AP: either stationary features (mostly for Chl*a*) or slower eastward propagation with typical speeds between 1.1-4.4 cm s-1, 1-3.4 cm s-1 for SST and SLA, respectively.



Llido, Machu, Sudre, Dadou and Garçon, 2004, J. Mar. Res., 62, 595-609.
Lutjeharms, Monteiro, Tyson, and Obura, 2001, S. Afr. J. Sci., 97, 119-130.
Llido J., 2004, Variabilité spatiale et temporelle du système biologique dans la Convergence Subtropicale au sud de l'Afrique. PhD University Paul Sabatier, Toulouse, France, 303 pp.

The western tropical Pacific: WWE during the 2002 EL Niño

- WWE (Harrison and Vecchi, 1997) episodically replace climatologically low winds over the warm pool (T>29°C & oligotrophic waters; fig. 1).
- Generation of intense eastward equatorial surface currents, SST decrease, deepening of the isothermal layer (Cravatte, 2003).
- Occurr between November and April.
- Strong interannual variability
  - strong and frequent WWE during El Niño
  - almost vanish during La Niña
- Associated with the Madden-Julian Oscillation, cyclones, cold surges.

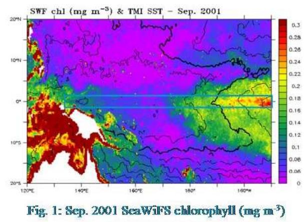


Fig. 1: Sep. 2001 SeaWiFS chlorophyll (mg m^{-3})

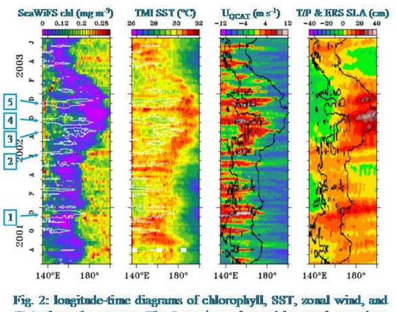


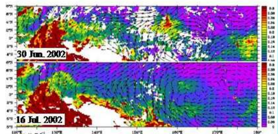
Fig. 2: longitude-time diagrams of chlorophyll, SST, zonal wind, and SLA along the equator. The 5 m s^{-1} zonal speed is superimposed on chl and SST diagrams. The 0.1 mg m^{-3} chl isoline is superimposed on U_{QCAT} and SLA.

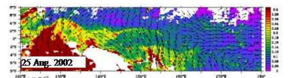
- The SeaWiFS archive gives the opportunity to study their impact on the surface chlorophyll.
- The intraseasonal activity was low in 1998-2001 and intensified during the 2002 El Niño.
- Along the equator during the mild 2002 El Niño event (fig. 2):
  - eastward migration of the warm pool
  - SLA decrease in the west
  - SST decrease in the west
  - Chl increase in the west
  - WWE move toward the central basin

- Five major WWE in 2002 and their impact on surface chlorophyll are illustrated with sequences of wind vectors superimposed on chlorophyll maps.

1.December 2001
- evolution similar to 5 except for the cold tongue that reaches 170°E in December 2001
- beginning of the chl increase associated with El Niño in the western equatorial basin
- short-lived impact on chl east of 150°E

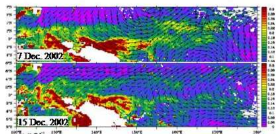
2.June 2002
- SE monsoon, cyclone centered at 163°E, 3°S
- chl increase develops in the cyclone region
- local transient impact between 150°E and 160°E

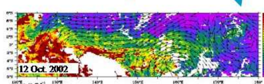




3.August 2002
- WWE east of 155°E
- no strong local impact on chl

4.October 2002
- NW monsoon & pair of cyclones (160°E,7°S & 175°E,2°N)
- chl enrichment north of Papua New Guinea (PNG; Kozai et al., 2004)
- strong equatorial chl enrichment from north PNG to 170°E





5.December 2002
- NW monsoon & pair of cyclones (167°E,8°S & 152°E,8°N)
  - chl enrichment north of PNG
  - chl enrichment in 0°S-2°S from north PNG to 170°E

➢**WWE contribute to the chlorophyll increase observed in the western Pacific warm pool during with El Niño events.**

➢**The relative contribution of local processes and advection of chlorophyll-rich waters from the west seems to differ from on WWE to the other.**

Cravatte S. (2003) El Niño et les ondes intrasaisonnières dans l'océan Pacifique équatorial générées par les vents dans l'ouest du bassin.Doctorat de l'Université Toulouse III, 193 p.

Harrison D.E. and G.A. Vecchi (1997) Westerly wind events in the tropical Pacific, 1986-95. *J. Clim.*, 10, 3131-3156.
Kozai et al. (2004) Wind-induced upwelling in the western equatorial Pacific Ocean observed by multi-satellite sensors. *Adv. Space Res.*, 33, 1189-1194.