Sea Surface cooling mechanism during ocean SACZ episodes at Southwestern Atlantic

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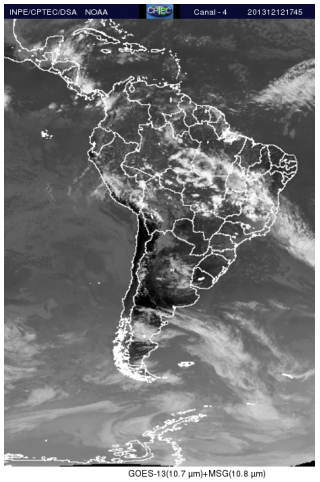
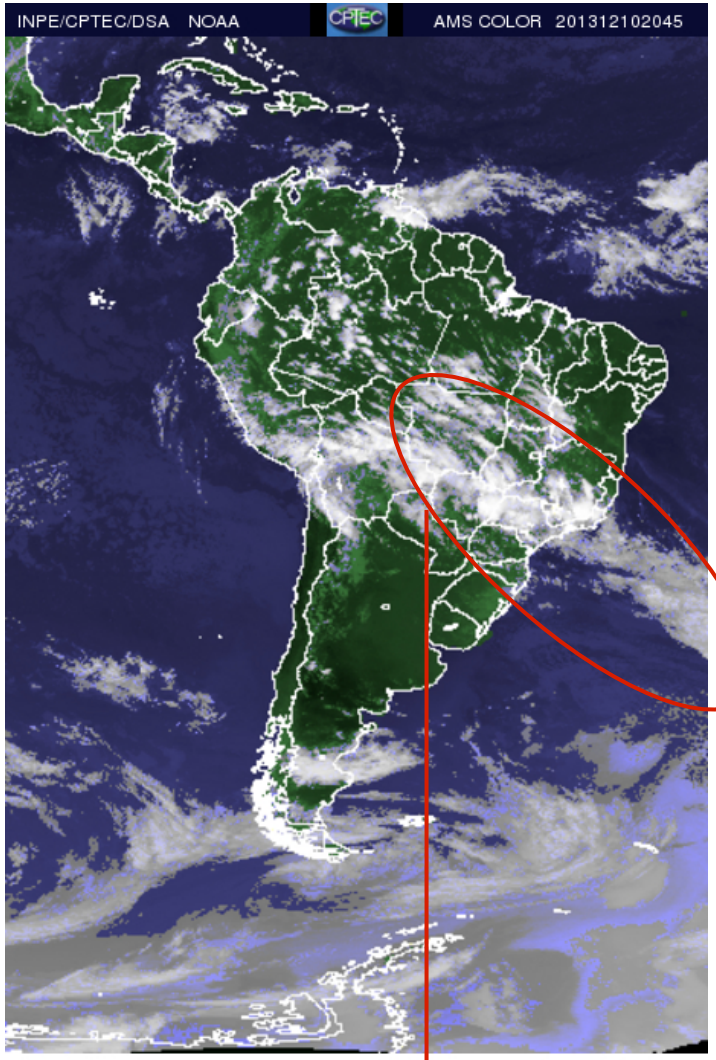
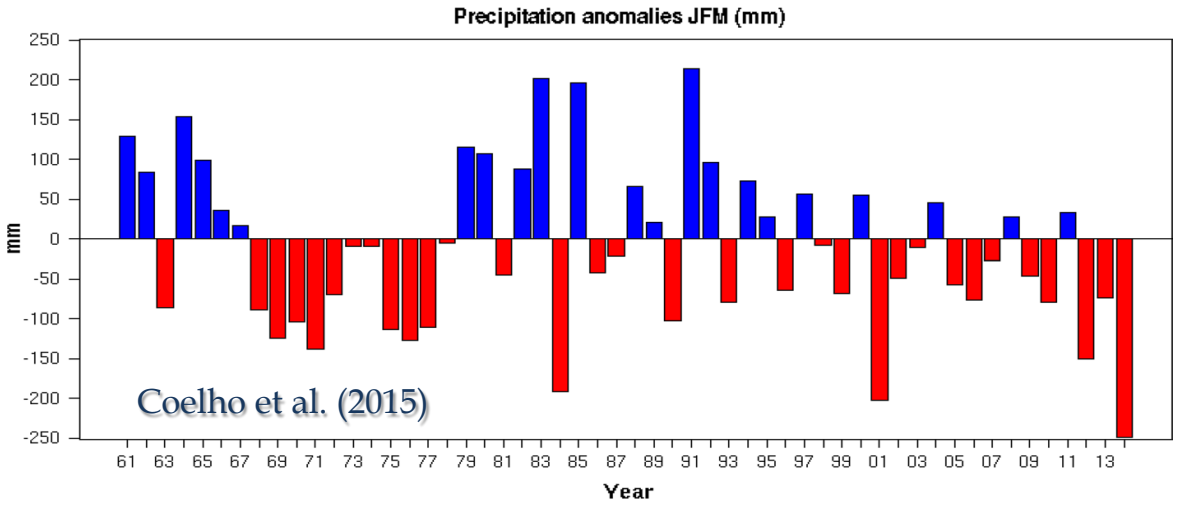


... and some other colleagues from science academic community



Introduction

- SACZ is an atmospheric convective system that forms during the South America summer.
- It is characterized by a marked convergence region at low levels and by the persistence of a northwest-southeast-oriented cloud band (NW-SE).
- South American Monsoon System contributes to SACZ.
- SACZ occurrence is associated to the positive/ negative precipitation anomalies over Brazil CW & SE.



Introduction

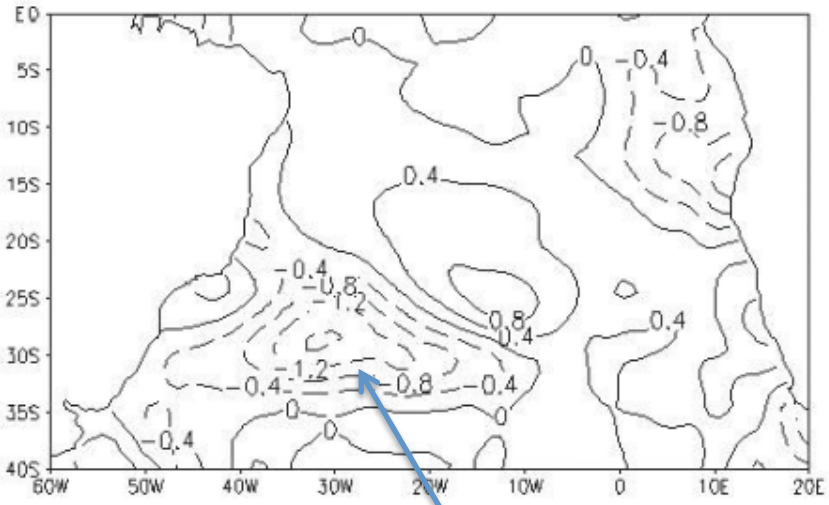


Figura 4 – Diferença entre a média das anomalias de TSM (°C) do período de 16 a 30/01/2003 e 01 a 15/02/2003. (Fonte: NCEP)

Chaves e Satyamurty (2006)

Cooling of Ocean Surface (<< TSM) during SACZ episodes.
(variability on Southwest Atlantic ocean)

Observational and coupled modeling studies shown negative SST anomalies

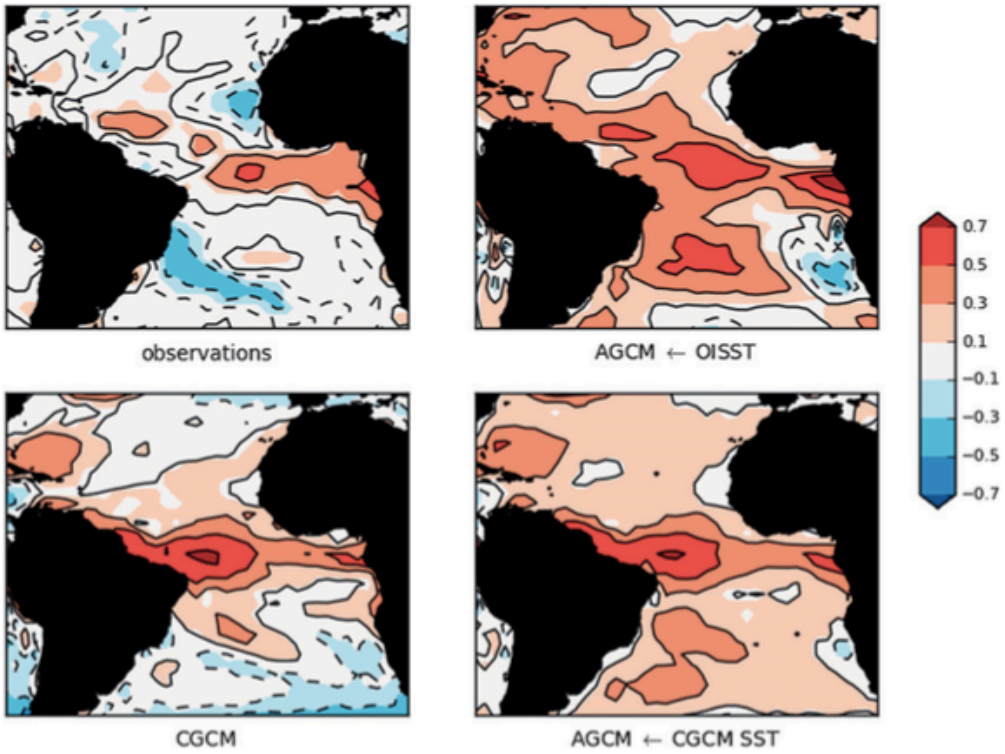


FIG. 1. DJF SST and rainfall ACC maps for (top left) observations, and 10-member ensemble means for (top right) rainfall hindcast from CPTEC AGCM forced with OISST, (bottom left) CPTEC CGCM rainfall forecast, and (bottom right) rainfall forecast from CPTEC AGCM forced with CMSST forecast, with the respective SST fields used to force the AGCM or product of the CGCM itself. Shaded areas depict values statistically significant at the 95% level.

Nobre et al. (2012)

Introduction

Two feedback mechanisms have been discussed between ....

SST & SACZ

1. Thermodynamic

2. Dynamic

(Nobre et al., 2012; Almeida 2007; Nobre et al., 2004; Kalnay, 1986; Chaves and Satyamurty, 2006; ... and few others)

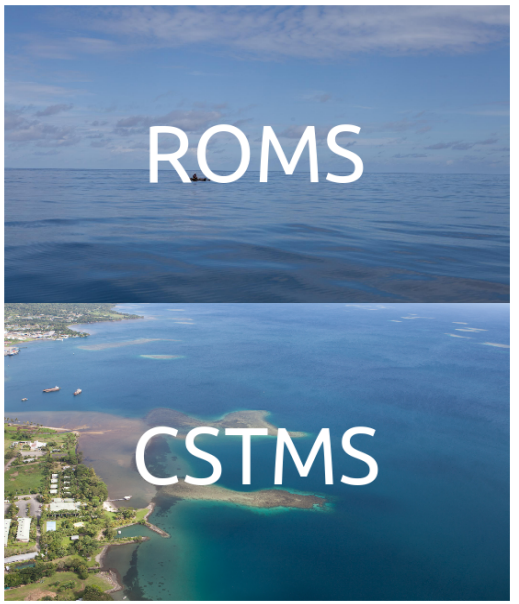
COAWST components

Atmosphere: **WRF (NCAR)**
Ocean: **ROMS (U. Rutgers)**
Waves: **SWAN (Delft U. Technology)**
Sediment Transport: **CSTM (USGS)**

Coupler: **MCT (Argonne Nat. Lab.)**
Regriding: **SCRIP (Los Alamos)**

WRF + ROMS + SWAN

COAWST
USGS
Many thanks to
John Warner



Uvento Vvento Patm UR
Tar nuvem prec
ROC ROL

TSM

Uvento
Vvento

Honda
Londa

us vs η bat

Honda Londa Donda
Tsup Tfundo Qb
Wdissp Uf

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Experiments:

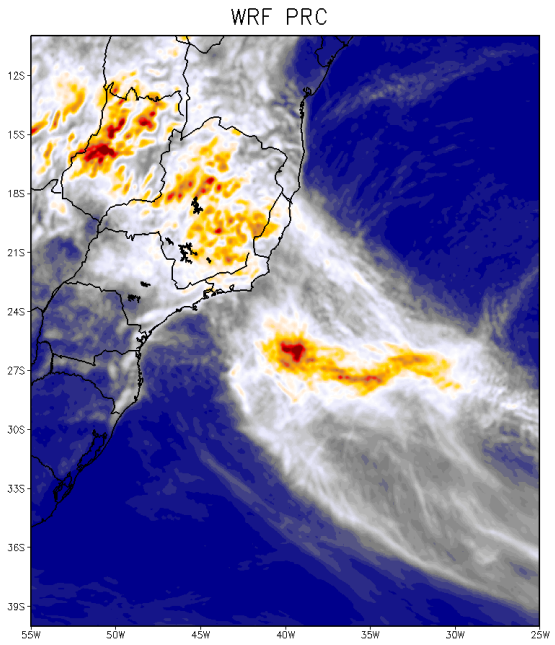
- **WRF** - WRF solo
- **COA** - WRF + ROMS
- **COA2** - WRF + ROMS + SWAN

Cases:
10/12/2002 a 16/12/2002
13/01/2003 a 19/01/2003
25/01/2003 a 31/01/2003
10/12/2013 a 25/12/2013

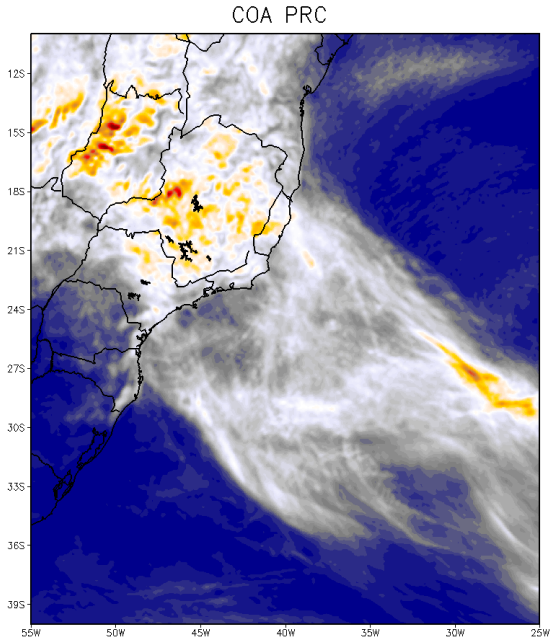
Model's resolution:
WRF: 6 km
ROMS: 9 km
SWAN: 9 km

Experiment	Period	Model	SACZ
1_WRF	10/12/2002 to 16/12/2002	WRF	yes
1_COA	10/12/2002 to 16/12/2002	WRF ROMS	yes
1_COA2	10/12/2002 to 16/12/2002	WRF ROMS SWAN	yes
2_WRF	13/01/2003 to 19/01/2003	WRF	yes
2_COA	13/01/2003 to 19/01/2003	WRF ROMS	yes
2_COA2	13/01/2003 to 19/01/2003	WRF ROMS SWAN	yes
3_WRF	25/01/2003 to 31/01/2003	WRF	yes
3_COA	25/01/2003 a 31/01/2003	WRF ROMS	yes
3_COA2	25/01/2003 to 31/01/2003	WRF ROMS SWAN	yes
4_WRF	10/12/2013 to 24/12/2013	WRF	yes
4_COA	10/12/2013 to 24/12/2013	WRF ROMS	yes
4_COA2	10/12/2013 to 24/12/2013	WRF ROMS SWAN	yes
5_WRF	27/12/2002	WRF	no

WRF

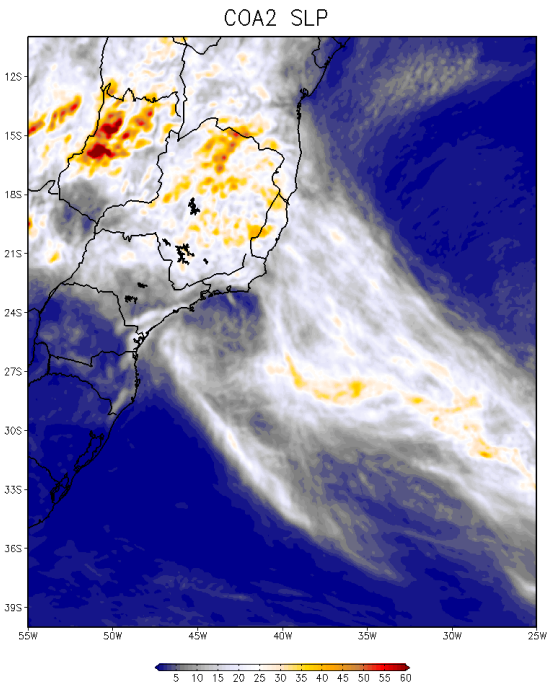


COA

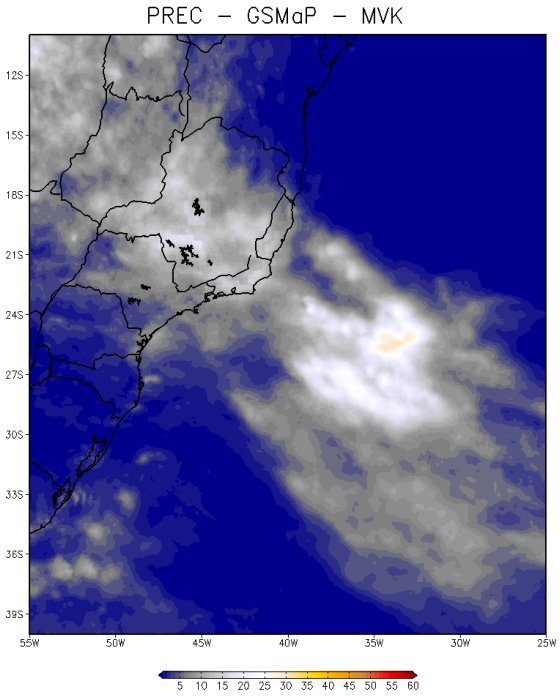


PRC
mm.day^{-1}

COA2



OBS



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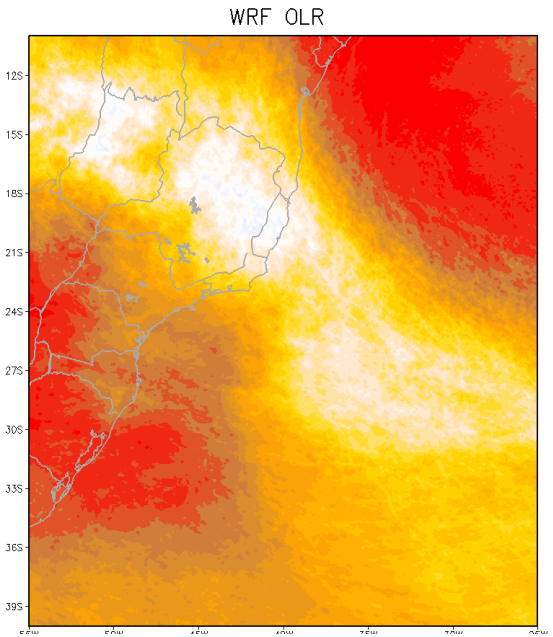
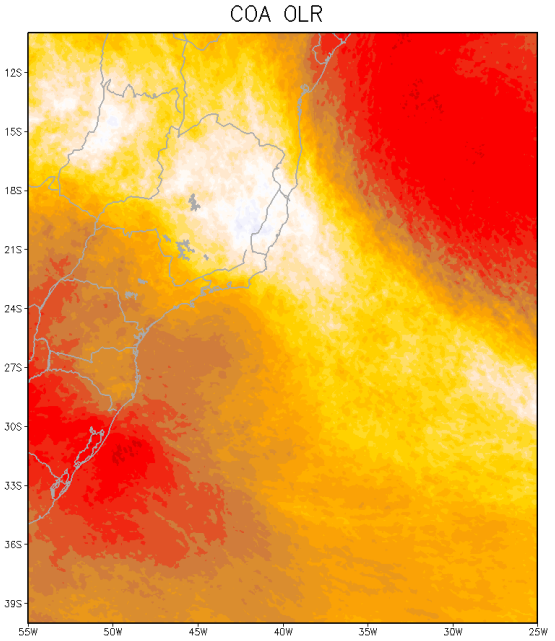
IWMO 2018
THE 10TH INTERNATIONAL WORKSHOP ON MODELING THE OCEAN

WRF

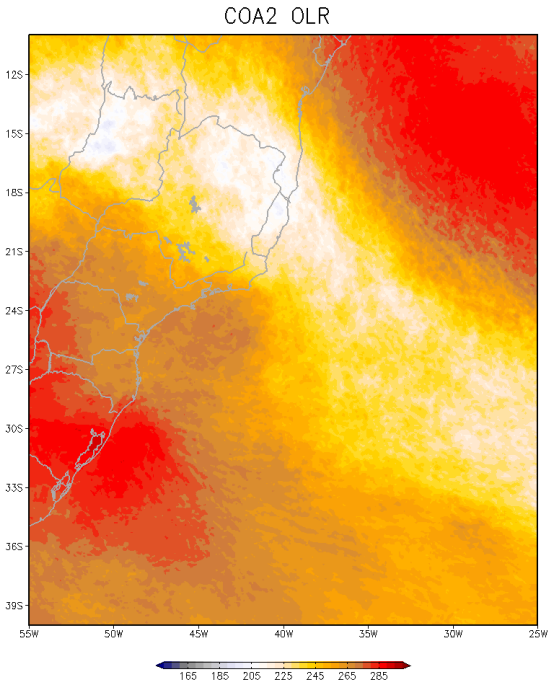


COA

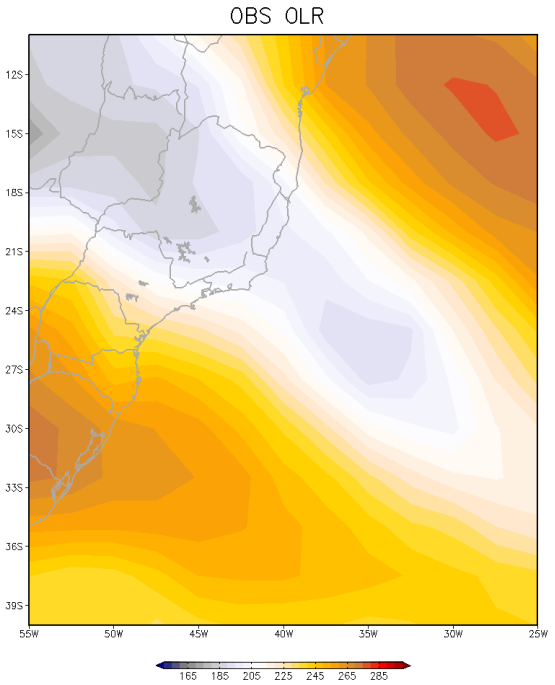


OLR
W.m^2

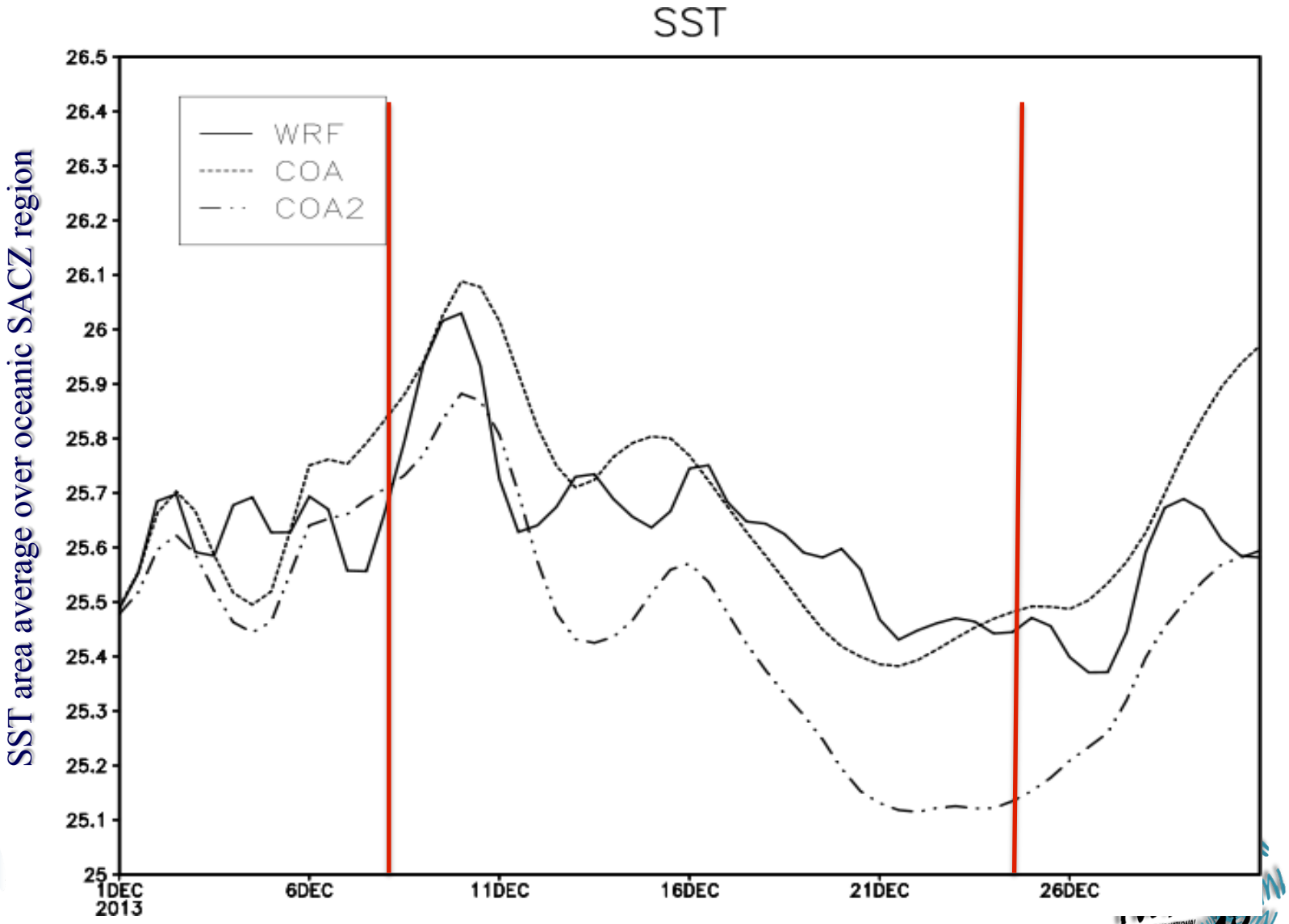
COA2

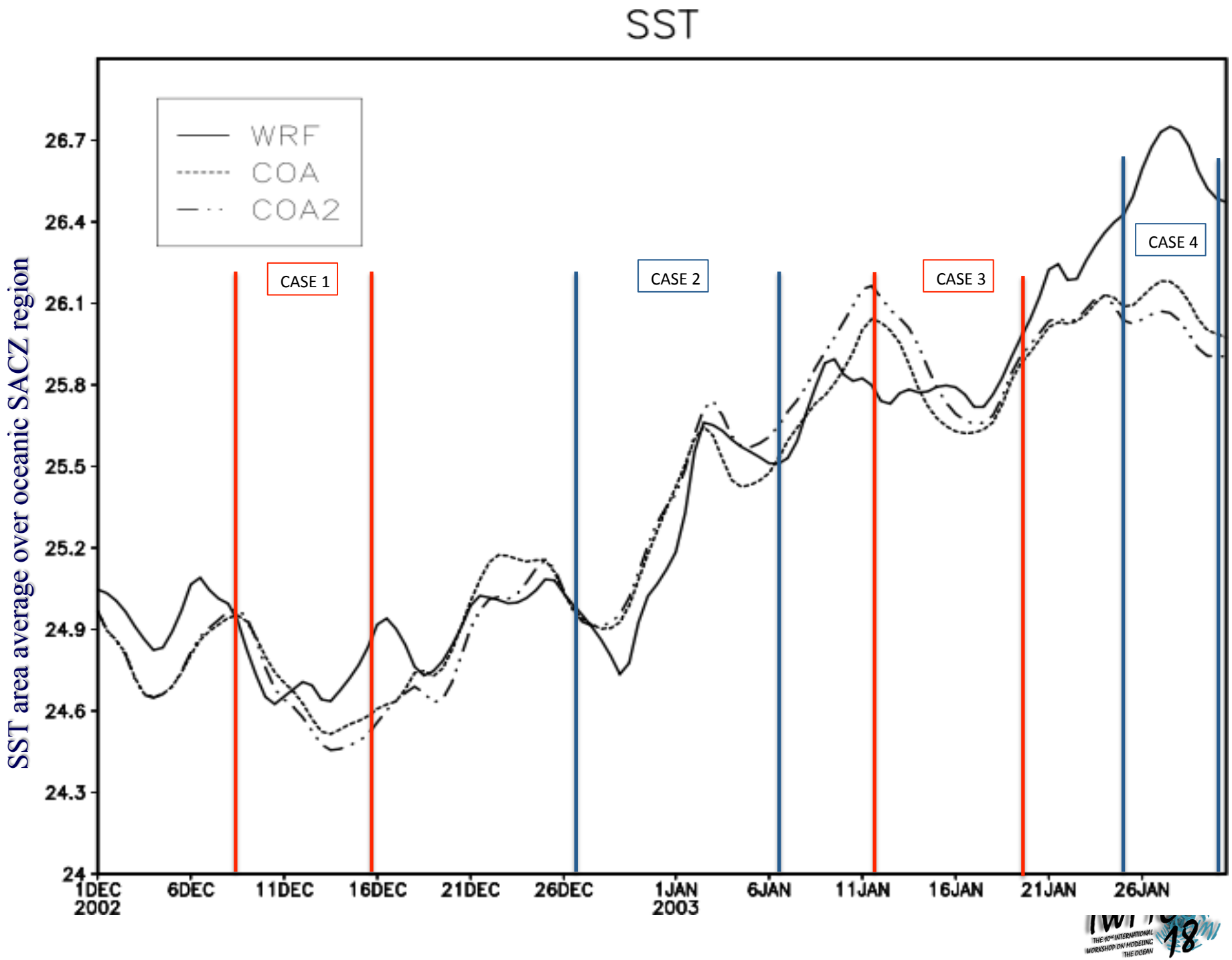


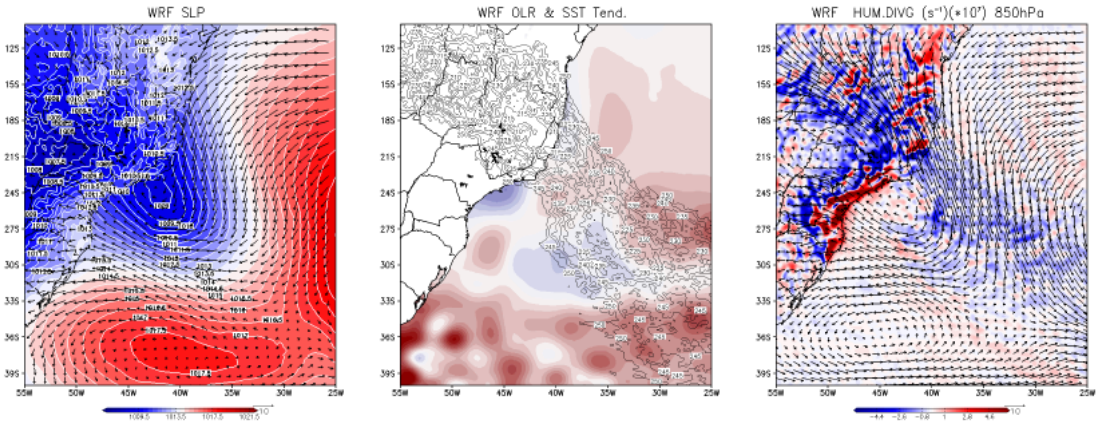
OBS

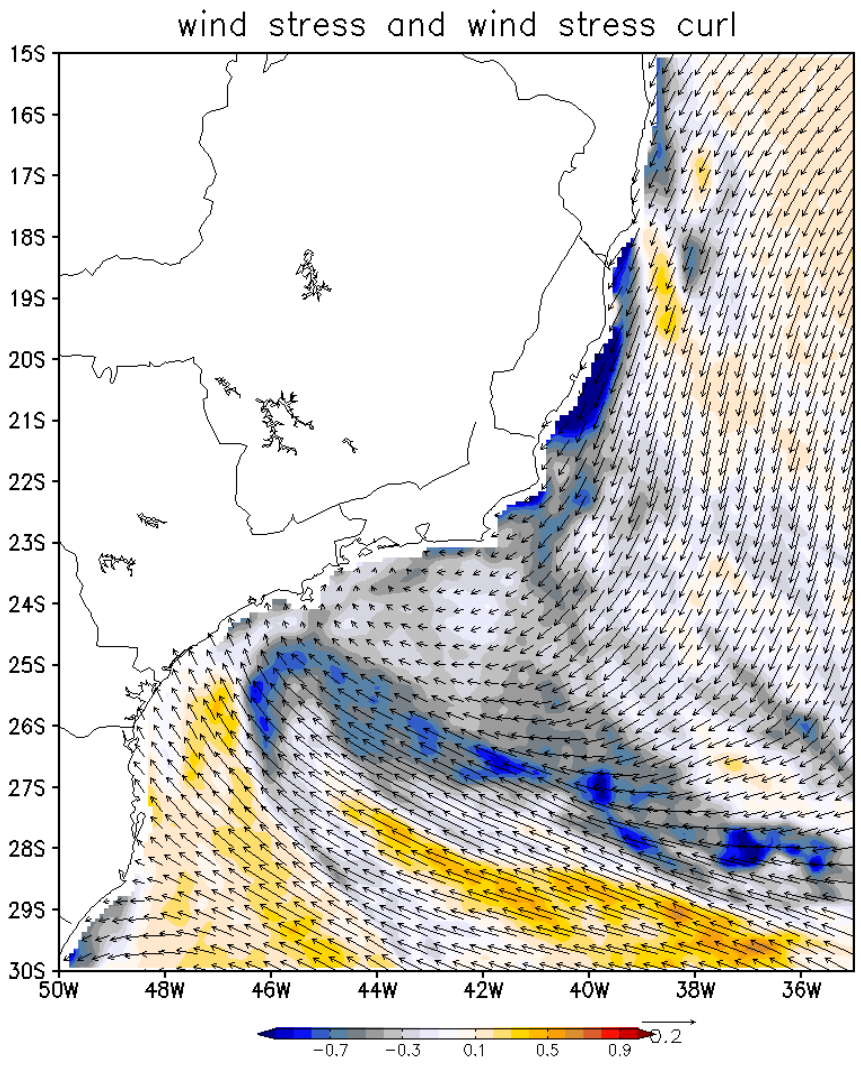


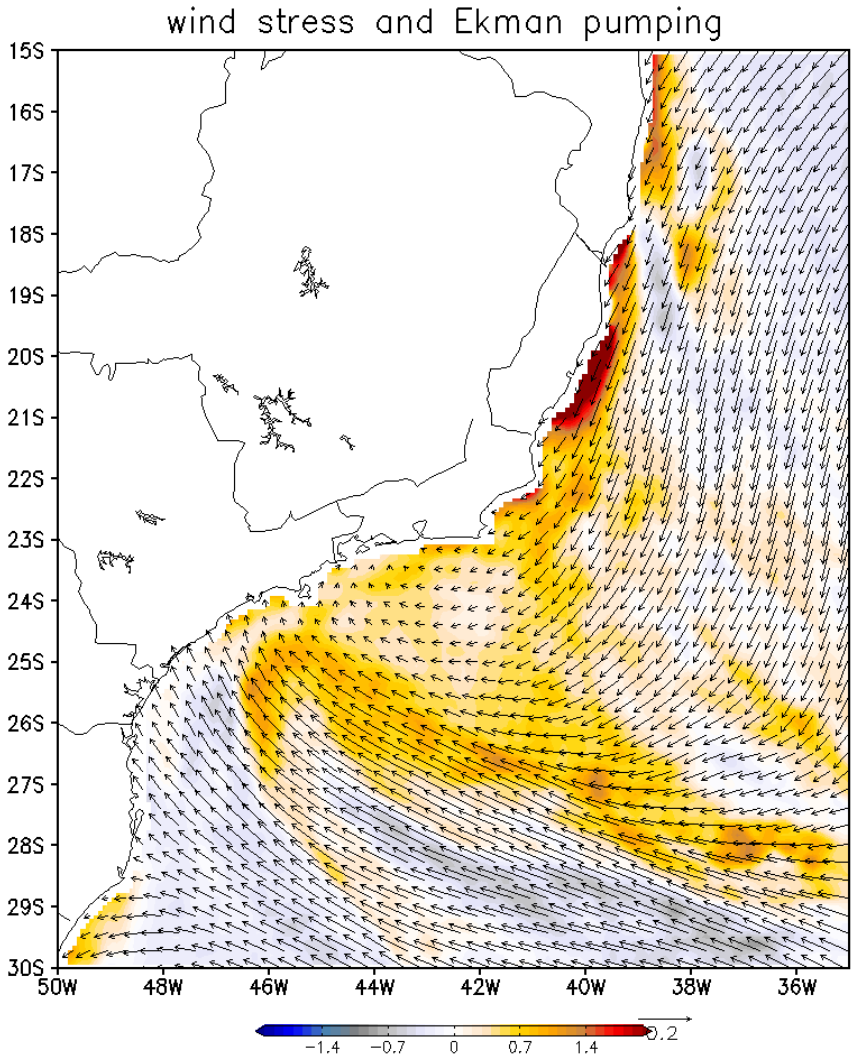
SST decreases during Oceanic SACZ episodes… (long case with 17 days)

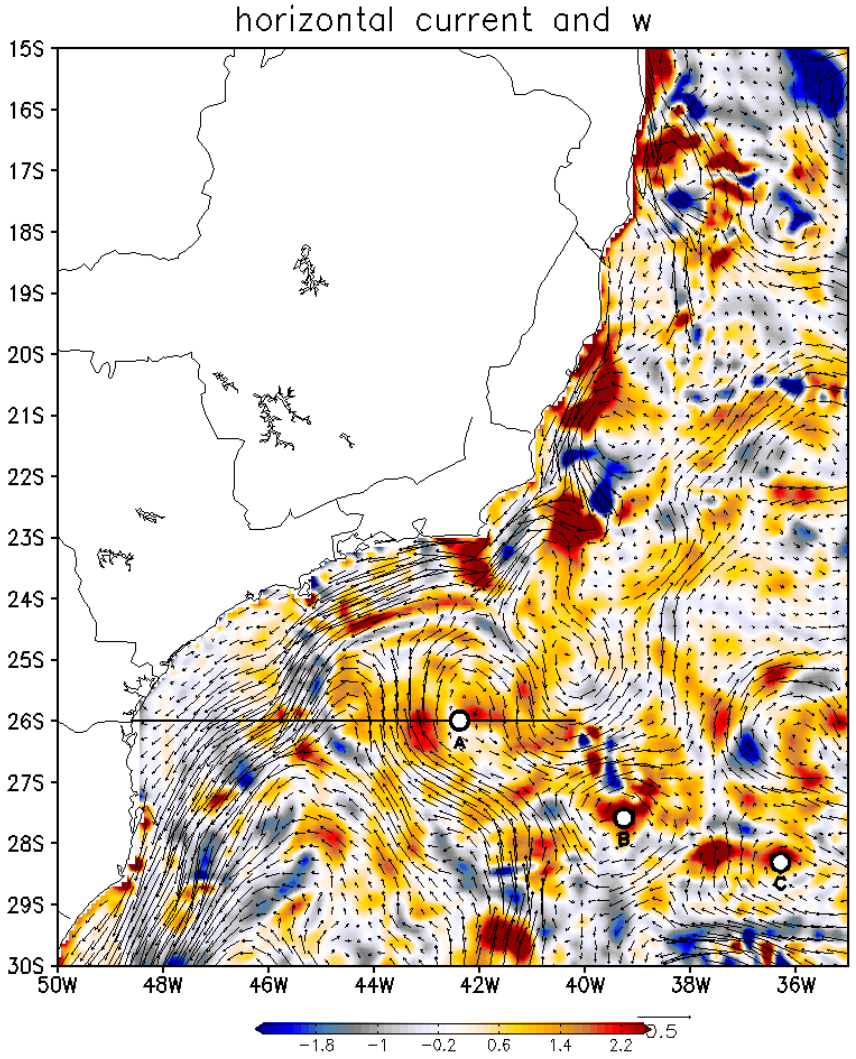


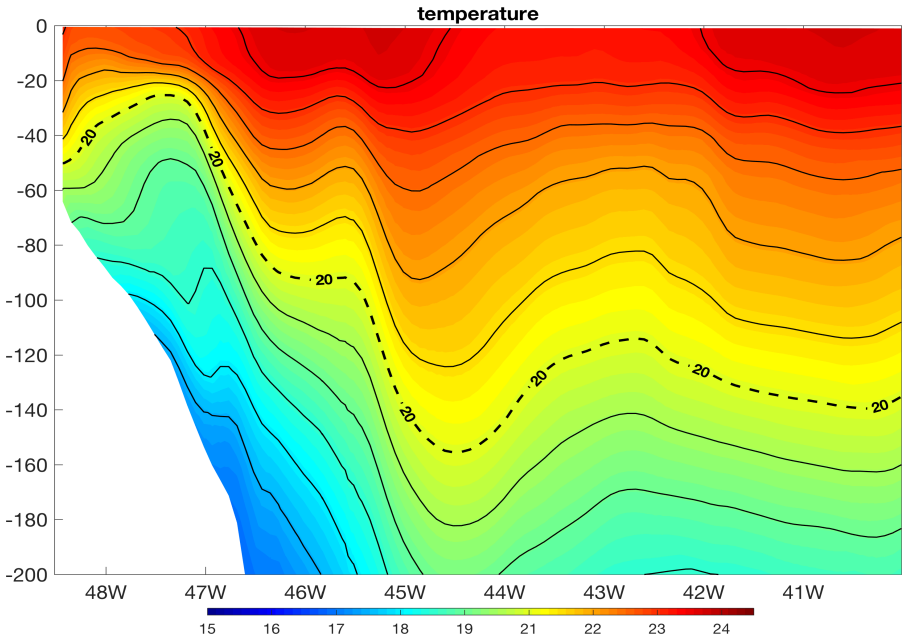

SST
WRF
COA
COA2
CASE 1
CASE 2
CASE 3
CASE 4
SST area average over oceanic SACZ region
26.7
26.4
26.1
25.8
25.5
25.2
24.9
24.6
24.3
24
1DEC 2002
6DEC
11DEC
16DEC
21DEC
26DEC
1JAN 2003
6JAN
11JAN
16JAN
21JAN
26JAN


WRF SLP
WRF OLR & SST Tend.
WRF HUM.DIVG (s⁻¹)(*10⁷) 850hPa
a)
b)
c)
COA SLP
COA OLR & SST Tend.
COA HUM.DIVG (s⁻¹)(*10⁷) 850hPa
d)
e)
f)
COA2 SLP
COA2 OLR & SST Tend.
COA2 HUM.DIVG (s⁻¹)(*10⁷) 850hPa
g)
h)
i)


wind stress and wind stress curl
15S
16S
17S
18S
19S
20S
21S
22S
23S
24S
25S
26S
27S
28S
29S
30S
50W
48W
46W
44W
42W
40W
38W
36W
−0.7
−0.3
0.1
0.5
0.9
0.2


wind stress and Ekman pumping
15S
16S
17S
18S
19S
20S
21S
22S
23S
24S
25S
26S
27S
28S
29S
30S
50W
48W
46W
44W
42W
40W
38W
36W
−1.4
−0.7
0
0.7
1.4
0.2

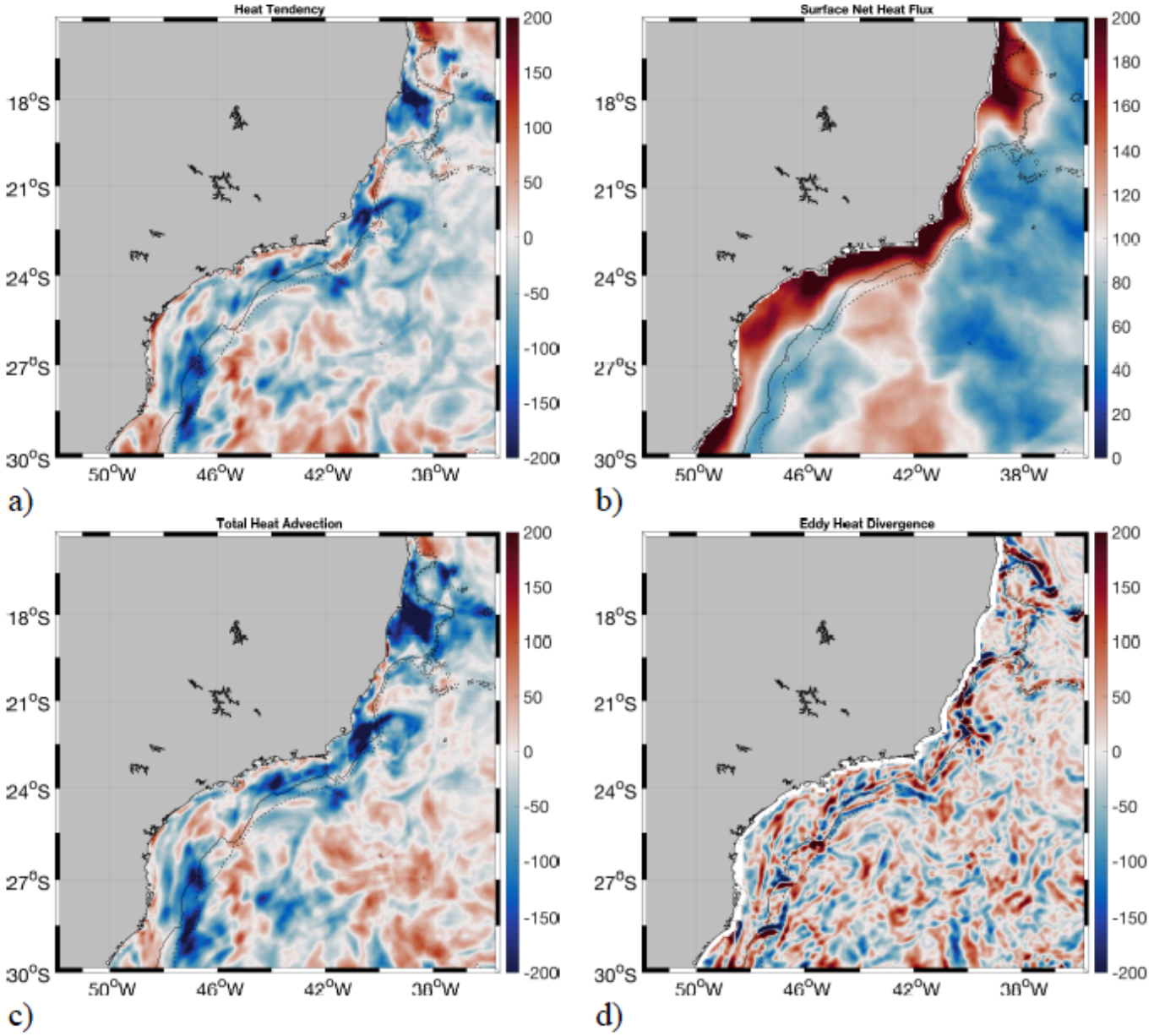

horizontal current and w
15S
16S
17S
18S
19S
20S
21S
22S
23S
24S
25S
26S
27S
28S
29S
30S
50W
48W
46W
44W
42W
40W
38W
36W
A
B
C
−1.8
−1
−0.2
0.6
1.4
2.2
0.5


temperature
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
48W
47W
46W
45W
44W
43W
42W
41W
20
15
16
17
18
19
21
22
23
24

$$\int_{d1}^{dn}\int_{-h}^{0}\frac{\partial T}{\partial t}\,dzdt$$

Mixed Layer Depth (h) Heat budget analysis

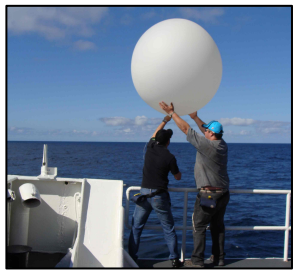
$$=\left\{\int_{d1}^{dn}\frac{Q_{net}}{C_p\,\rho}-\int_{-h}^{0}\left[U.\nabla_h T+w\,\frac{dT}{dz}+\nabla.(\overline{U'T'})+k_h\nabla^2 T\right]dz-\int_{-h}^{0}k_v\,\frac{dT}{dz}\right\}dt$$

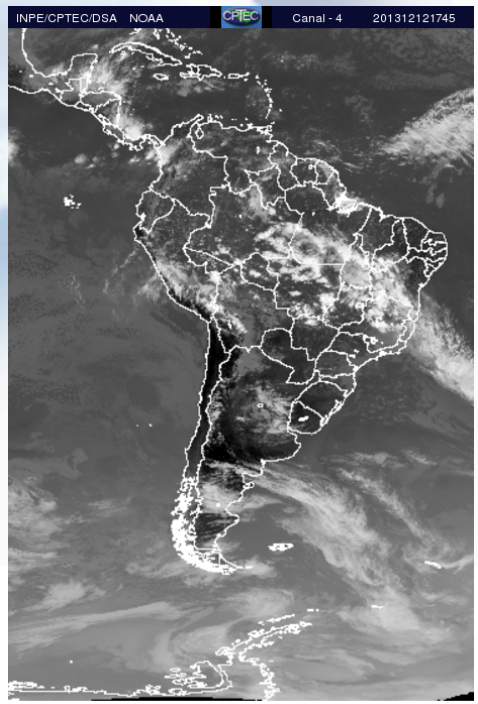


Final remarks and conclusions… (few of them)

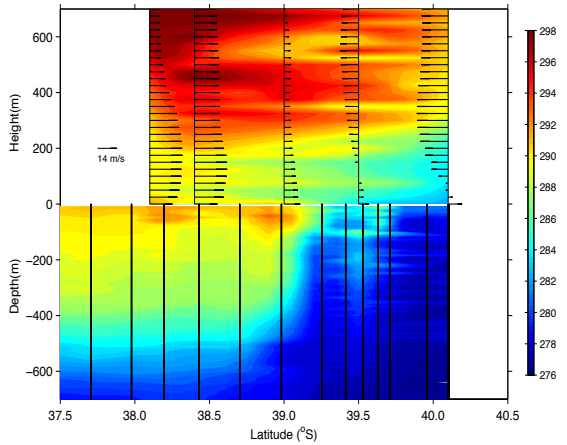
- SACZ does modify sea surface cooling, it down (through dynamics and thermodynamics mechanisms),
- Ocean dynamics contributes to the surface cooling (Ekman pumping, Ekman transport…., Total upwelling...) at same order than thermodynamics!!!!
- Our composites revealed an atmospheric cyclonic vortex (striking characteristic of SACZ oceanic) that acts at sea surface, but more at southward of SACZ's position,
- Investigate (considering more cases) and check this battle between "Ocean Dynamics x Radioactive Fluxes" and the atmospheric dynamical configuration of oceanic SACZ
- There are room for *in situ* measurements (dream… SACZ's cruise) and integrated studies using models + *in situ* + satelite data

- Pezzi et. al. (2018). Do oceanic SACZ episodes modulate SST via upper-ocean dynamics and thermodynamics? Journal of Climate (under review)

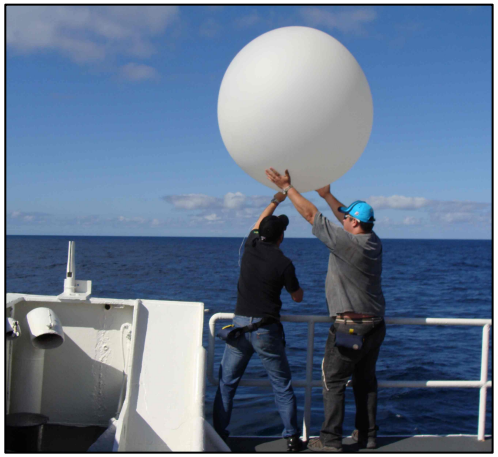




GOES-13(10.7 μm)+MSG(10.8 μm)



Thank you for your attention!!!



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