Coastal Climate Change and variability around Southern Africa

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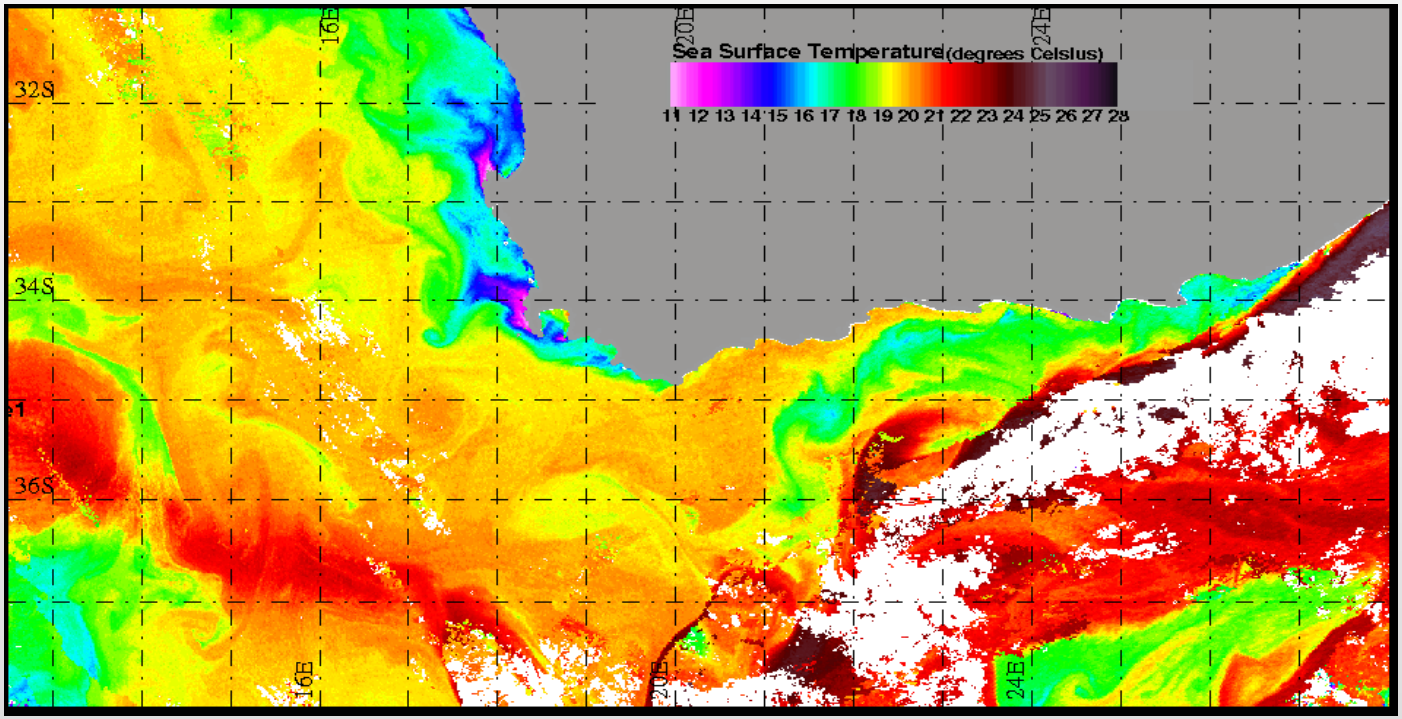
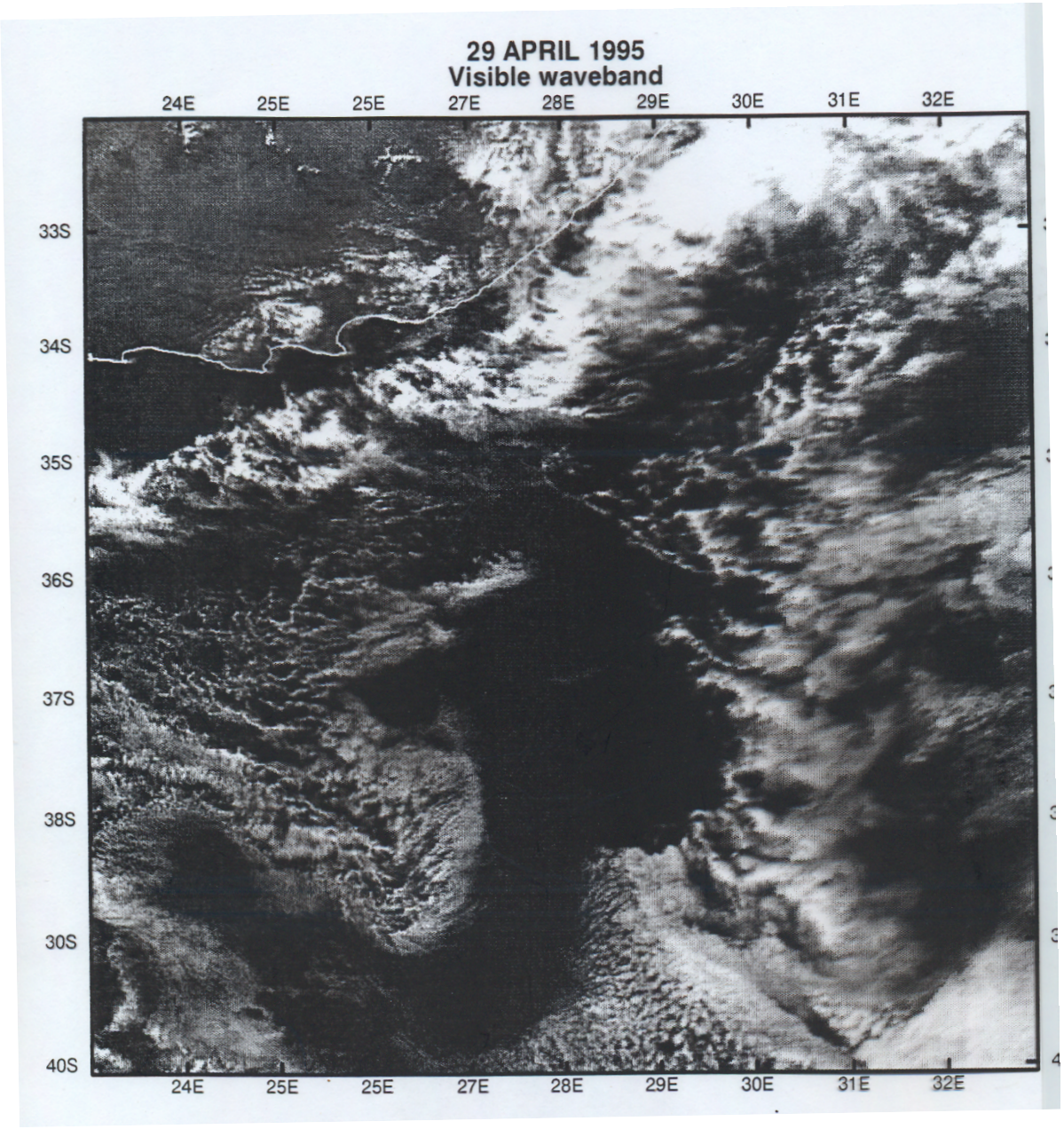
Nansen-Tutu Center for Marine Environment,, University of Cape Town

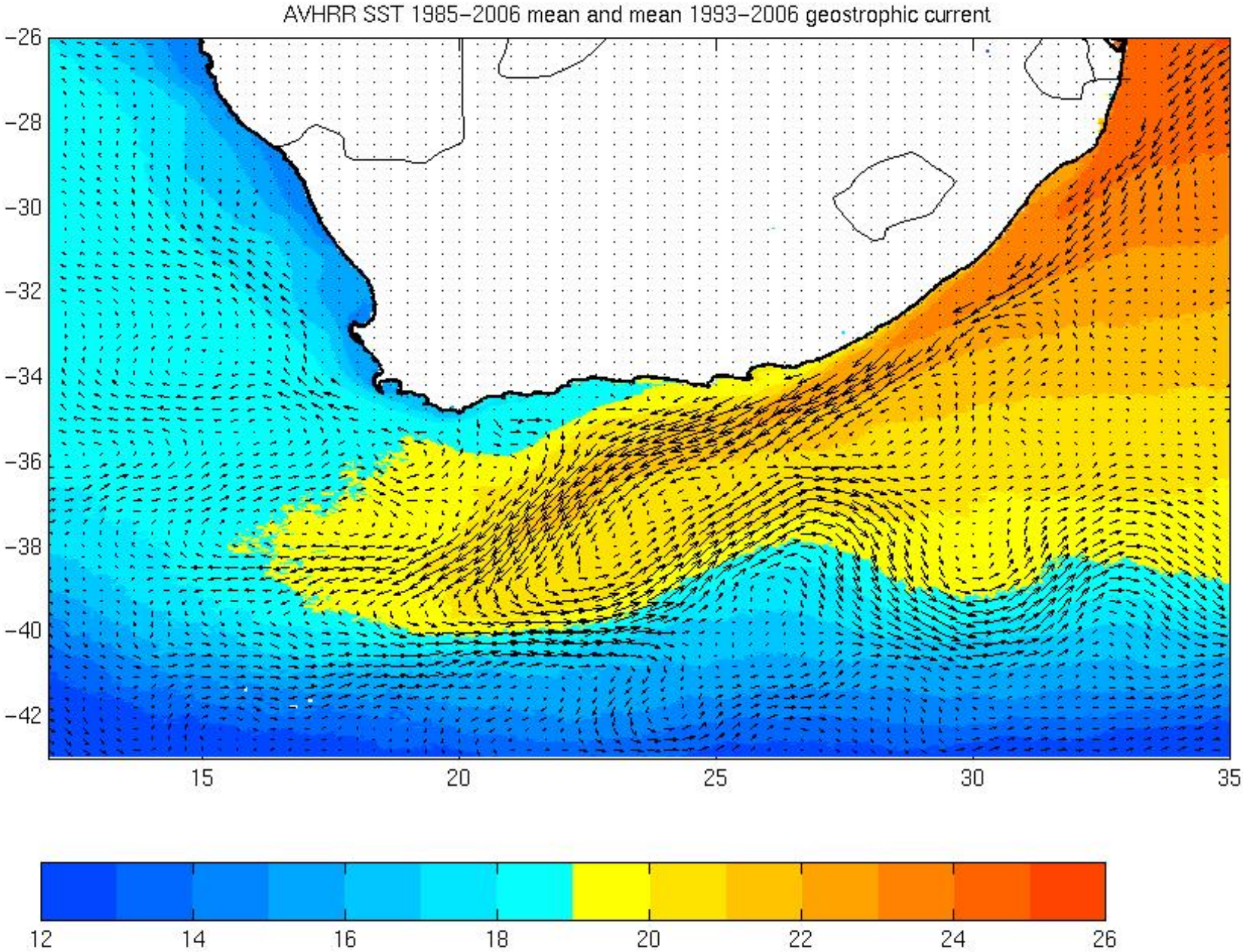


sea surface temperature estimated by AVHRR aboard NOAA at 1x1 km resolution

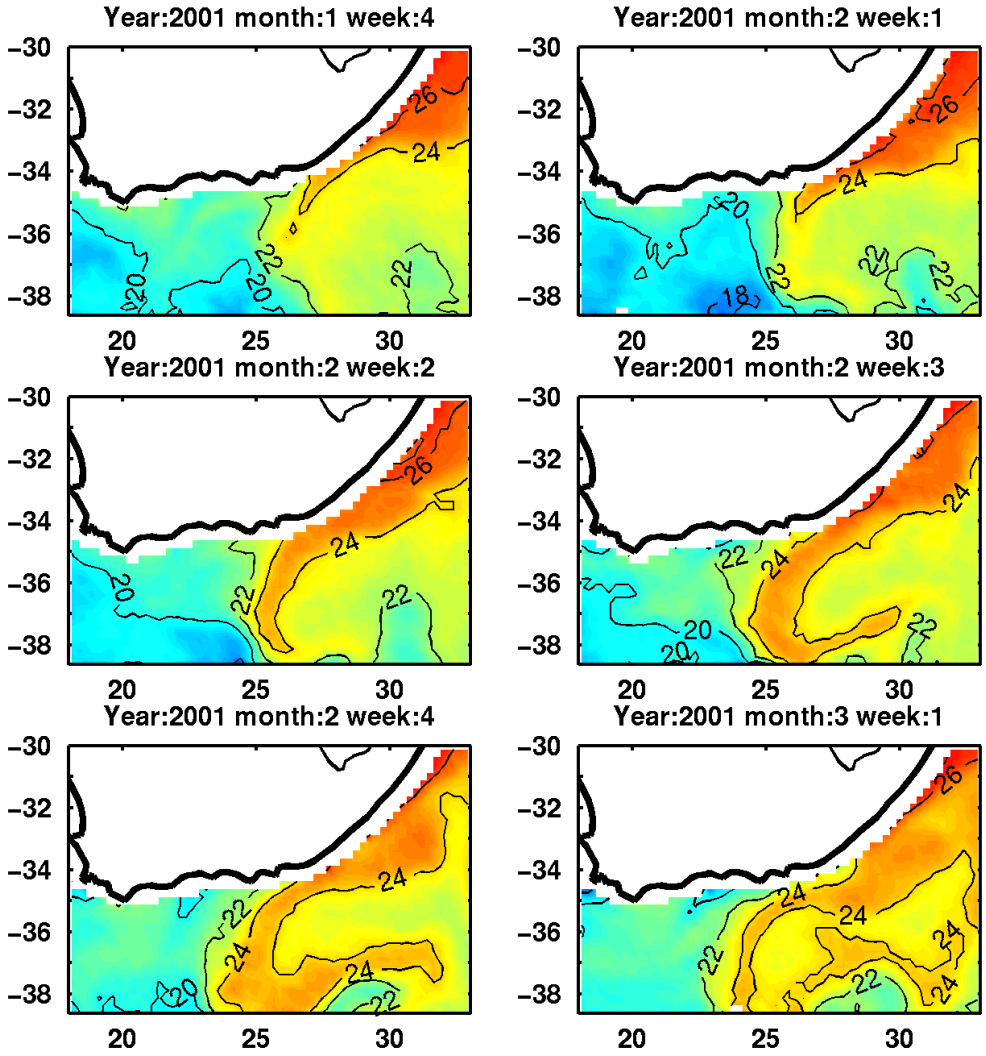
Funding from WRC, NRF, ACCESS, Nansen Tutu Center

Meteosat visible Image on the 29 April 1995

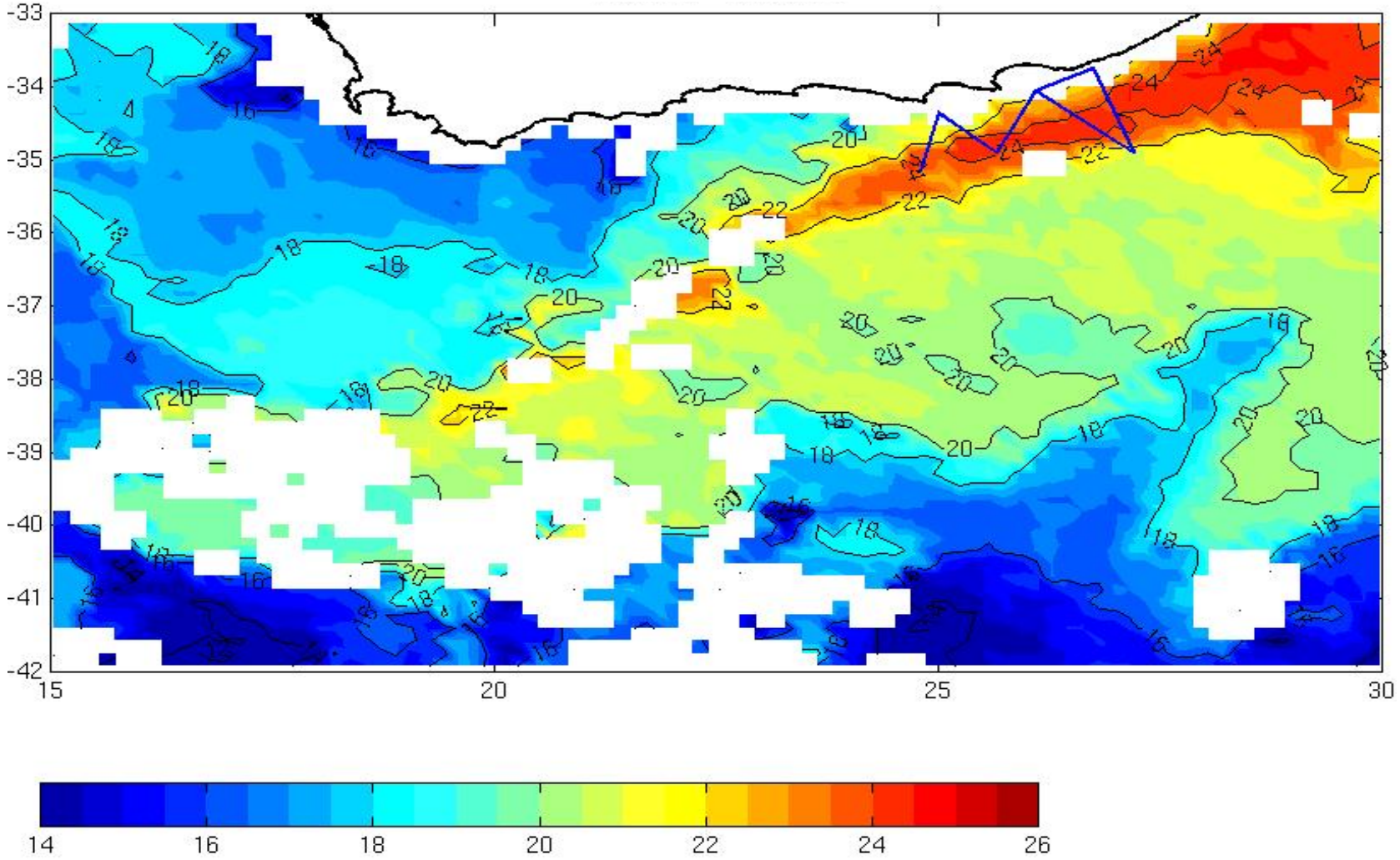




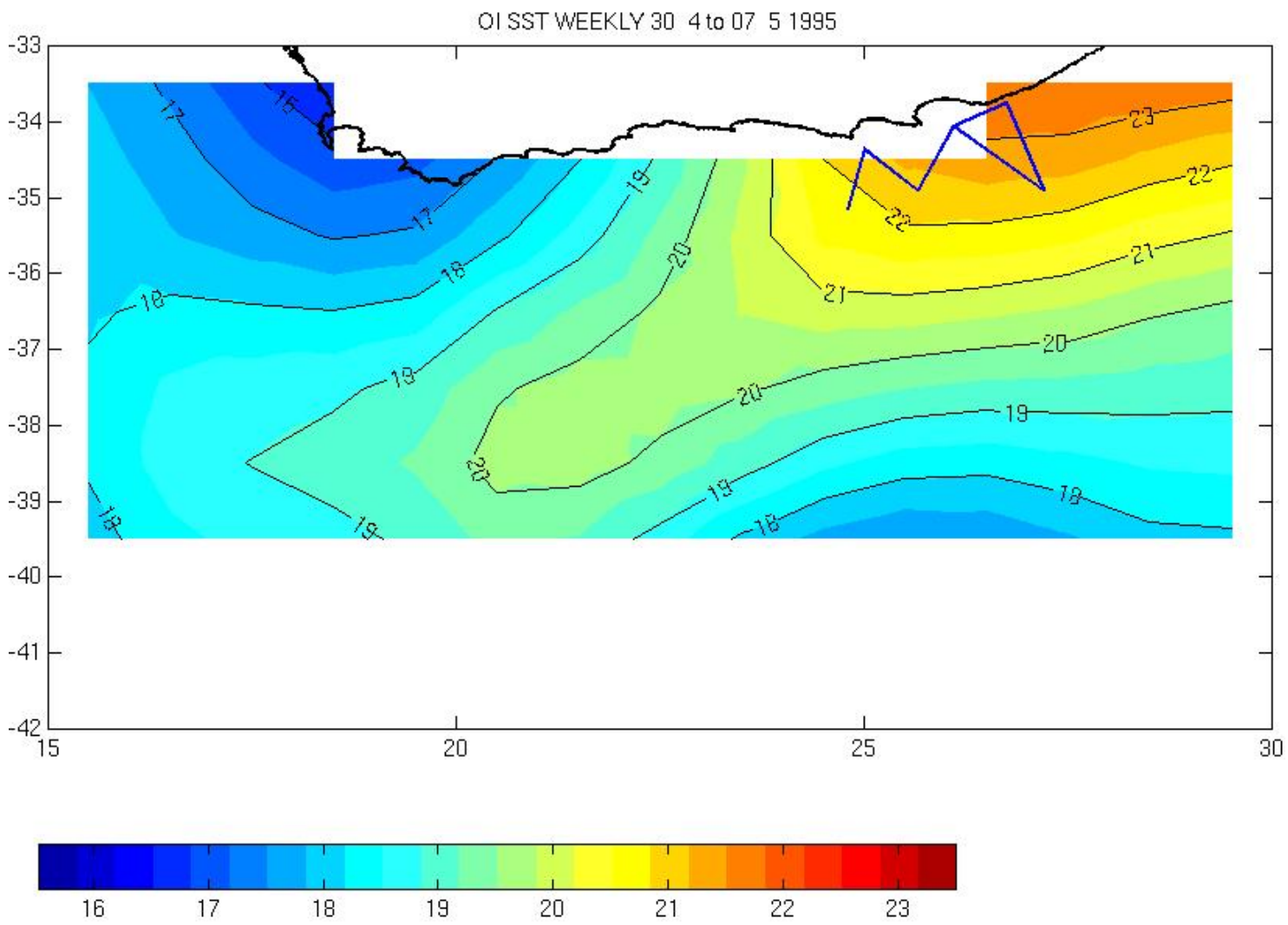
Mean AVHRR Pathfinder V4 sea surface temperature and altimetry derived ocean currents



Sequence of weekly mean TMI TRMM sea surface temperature showing an unusual early retroflection of the Agulhas Current at a position more eastward and northwards than normal. Warm Agulhas water eventually re-enter the current. Data is shown each week from the last week of January 2001 to the first week of March 2001



18 km resolution AVHRR Pathfinder SST (Reynolds and Smith, 1994) averaged over the period 23-30 April 1995 during which the ACASEX field expedition took place. The ACASEX cruise track is shown in blue. The core of the Agulhas Current has SST > 22 C. White areas over the ocean correspond to those for which there was persistent cloud cover during the cruise



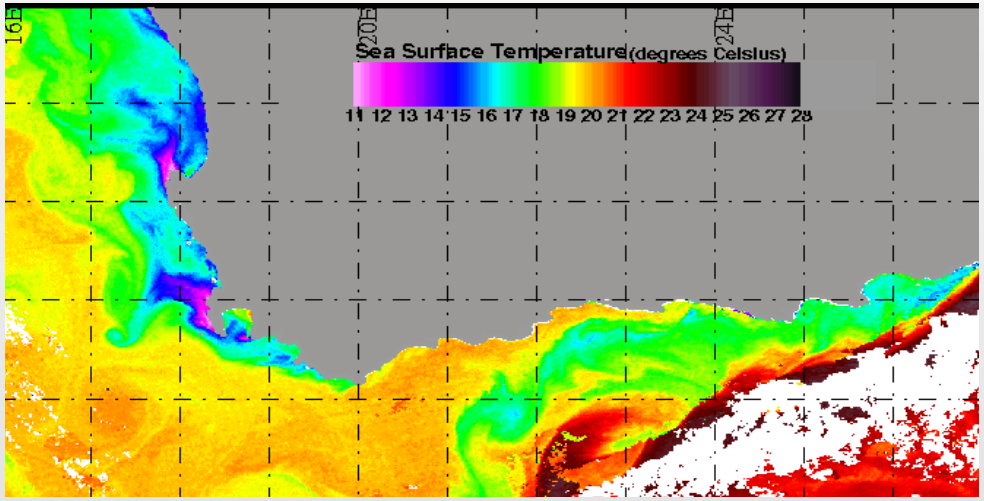
1 Degree resolution Optimal Interpolation weekly mean SST used by NCEP and ship track during the cruise.

Using 1 degree resolution dataset for atmosphere or climate modelling or for analysis, one misses the core of the Agulhas Current.

THE ACASEX crew

Carlton Phyllis, Mark Majodina, Ashley Johnson ,Mathieu Rouault, Isabelle Ansorge, Andrew Lee-thorp, Patrick Fowley.

Sardine, anchovy, west coast rock lobster and horse mackerel have shifted their distributions southwards and eastwards (van der Lingen *et al.* 2006; Cockcroft *et al.* 2008).

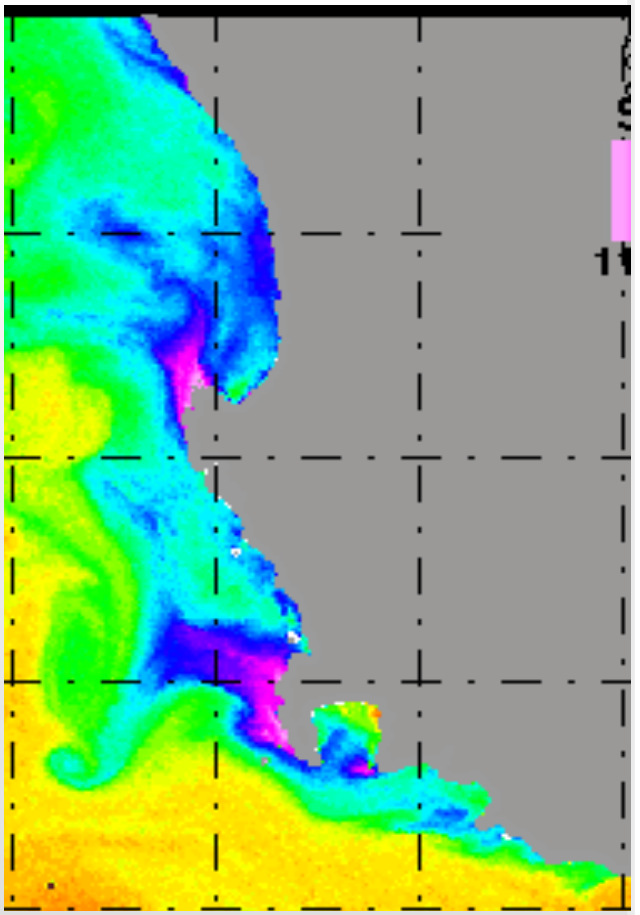


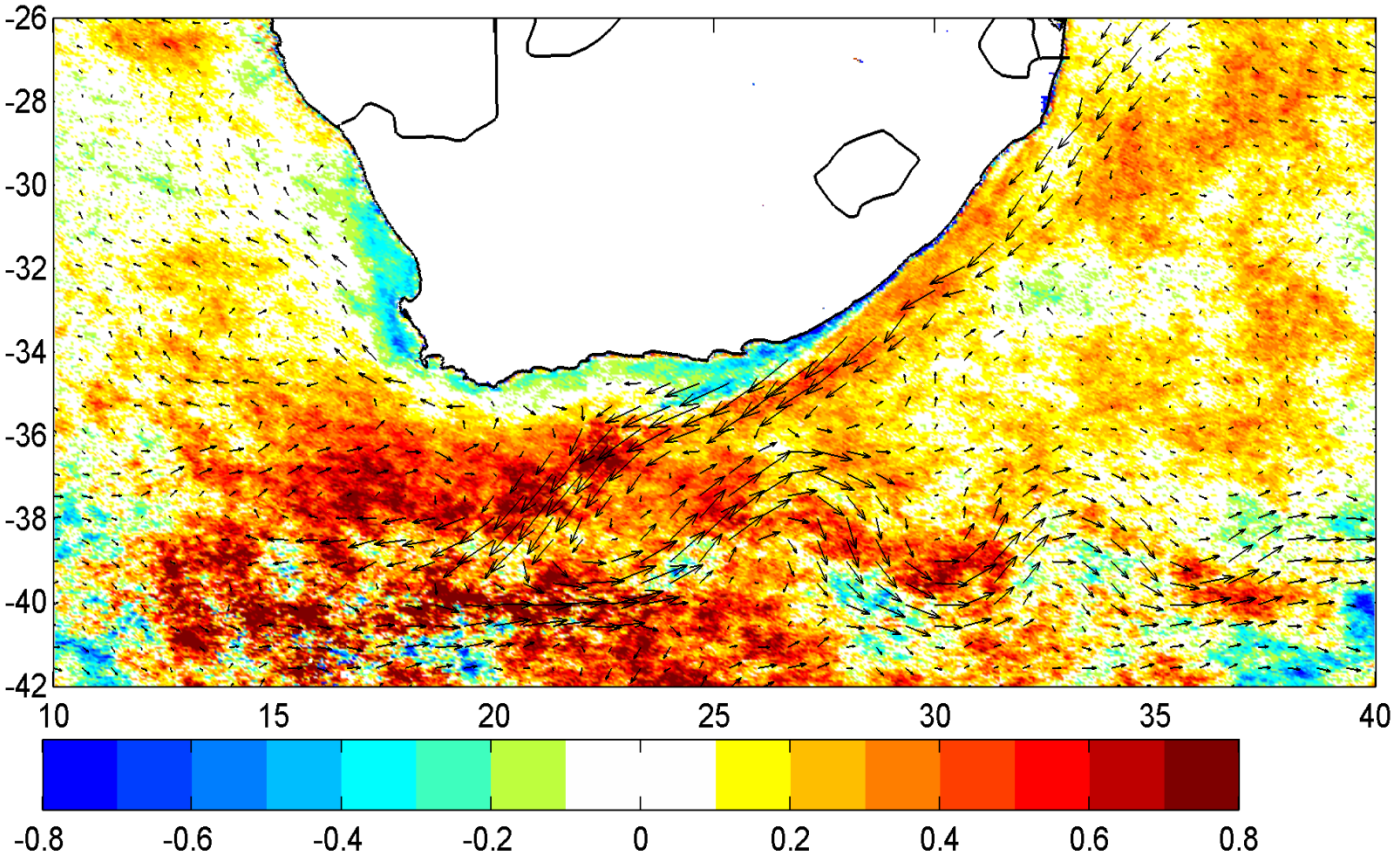
Since the late 1980s, west coast rock lobster have moved southwards into the kelp forests between Cape Hangklip and Danger Point (Tarr *et al.* 1996).

Cold water mussel species and kelp have invaded False Bay (Mead et al, 2010)

Since rock lobsters prey on sea urchins, the sea urchin population in these invaded areas collapsed. Sea urchins provide shelter for recruiting juvenile abalone and reduce predation on juvenile abalone by rock lobsters. Thus, an area that was previously an important abalone fishing ground has undergone a dramatic shift in community structure.

On the west coast of South Africa, African penguins have halved in numbers between 2007 and 2009, and overall, the South African population of penguins has been reduced to just 37% its level in 2001 (Crawford 2009).





Linear trend SST pathfinder V4.2 1985 2007 +mean altimetry

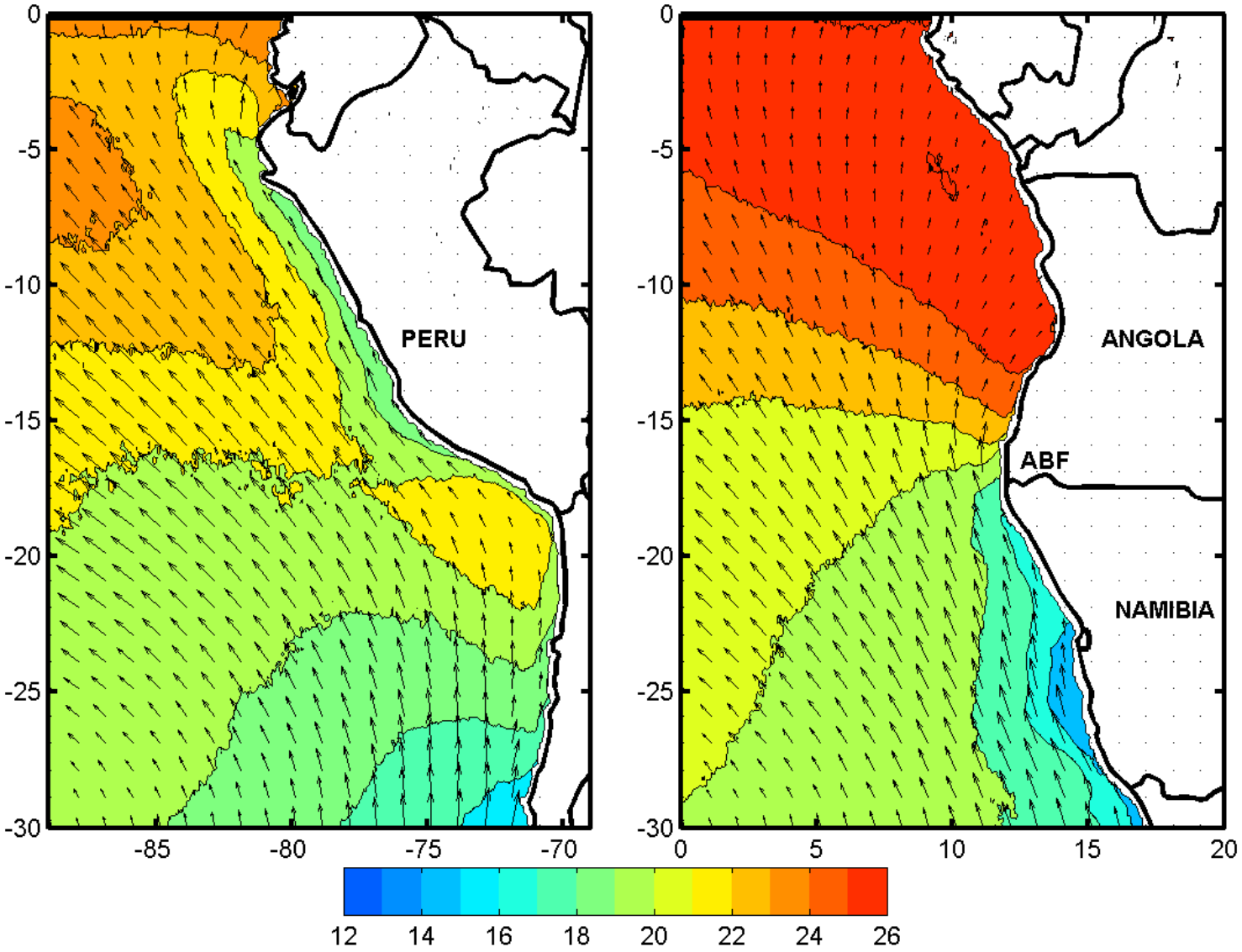
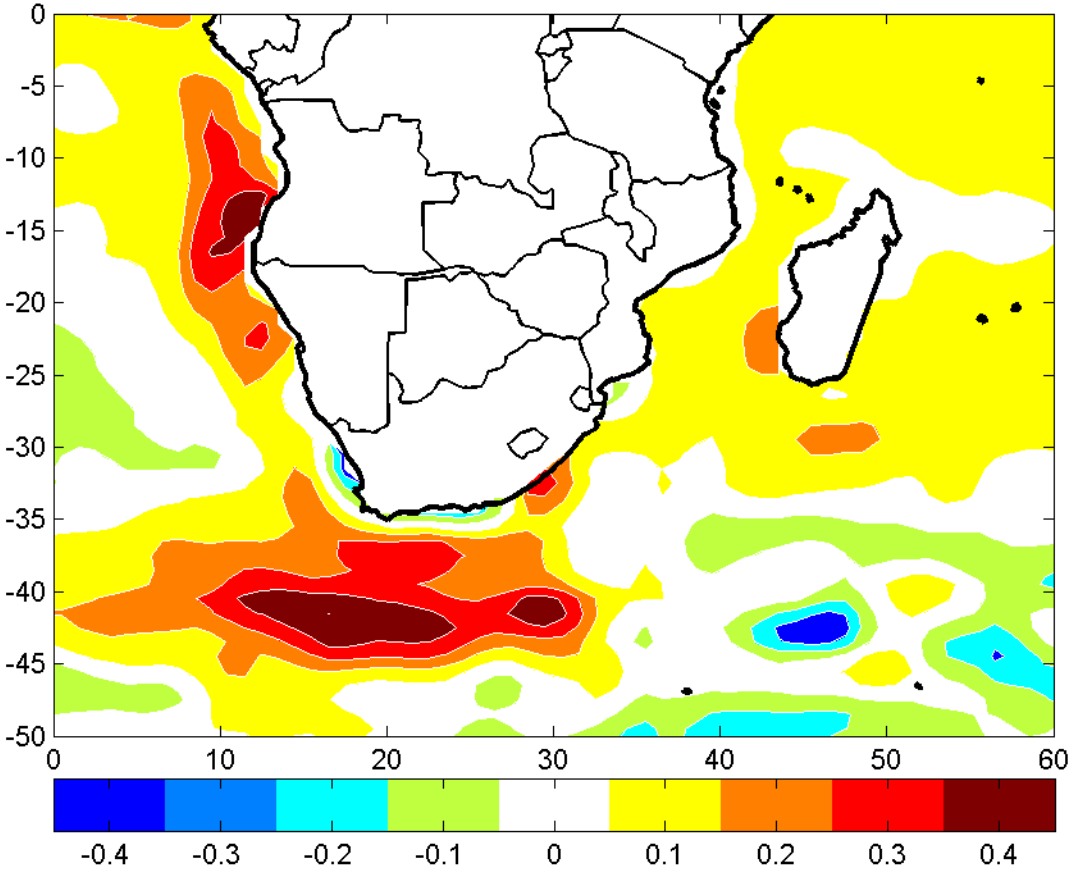


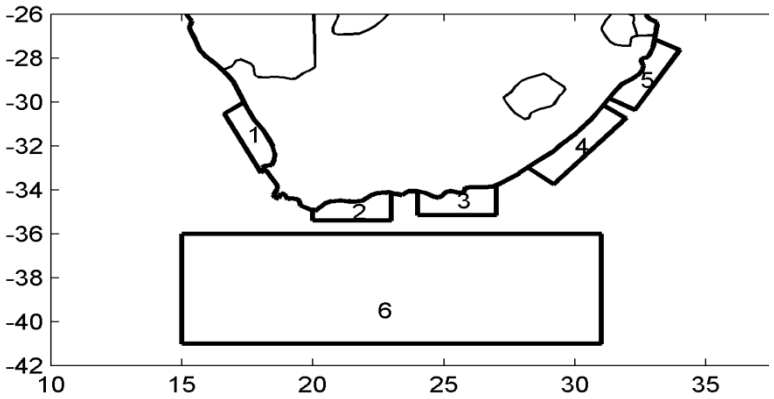
Figure 1: Mean (October to Mars) austral summer pathfinder SST (C) V5.2 and QuickScat wind stress (N/m2) off South America (left) and Southern Africa (right) with position of the Angola Benguela Front (ABF).

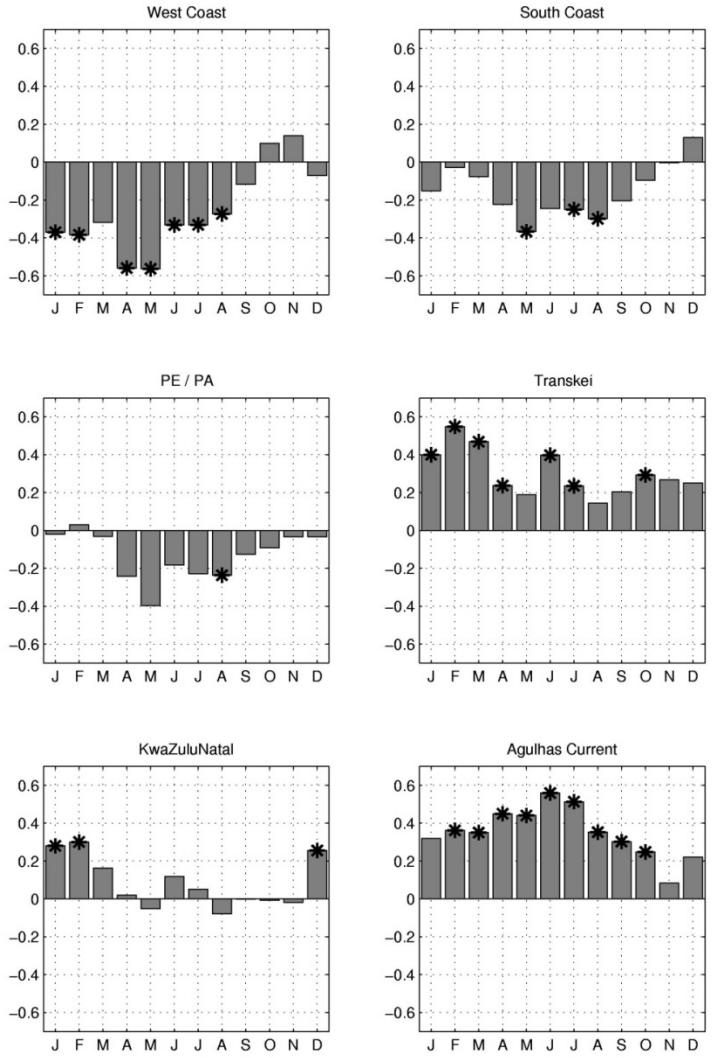


Linear trend Reynolds OI SST 1982-2012 in C per decade

Coastal climate change

Linear trend in °C per decade for each month of the year from 1982 to 2009.





1, West Coast

2, South Coast

3, Port Elizabeth/Port Alfred

4, Transkei

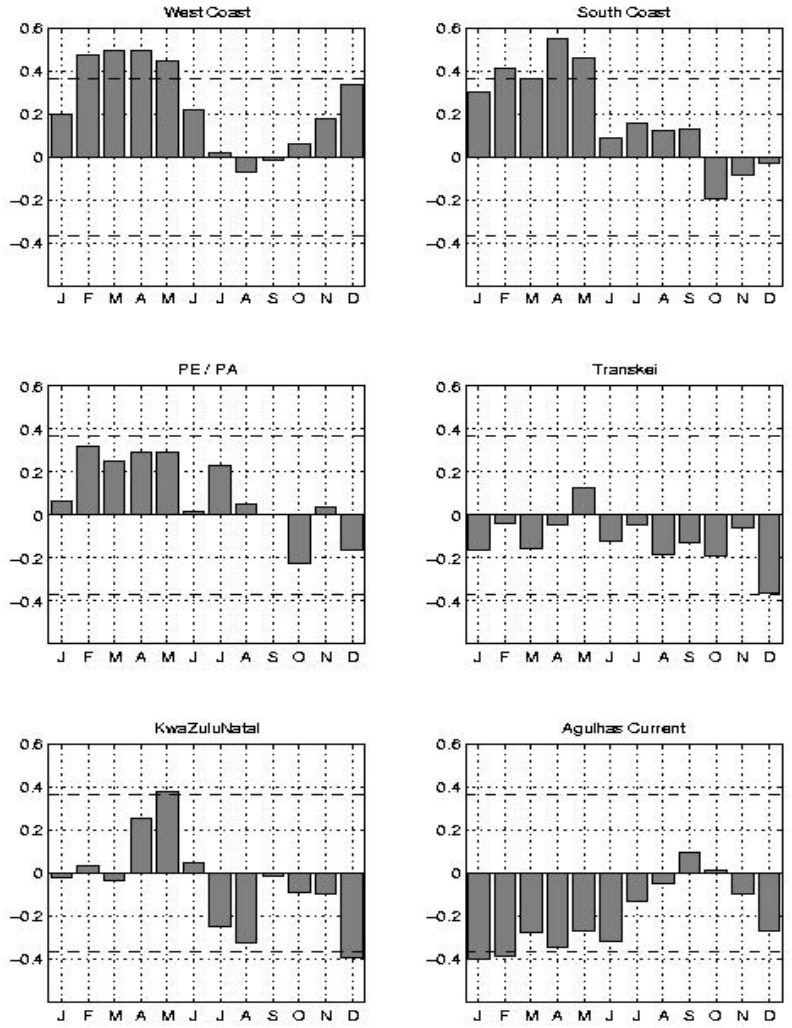
5, KwaZulu–Natal

6, Agulhas Current system

Statistically significant trends are marked with a star

Coastal variability

Correlation between ENSO (MEI index) and the Reynolds SST normalized anomalies from 1982 to 2009



1, West Coast

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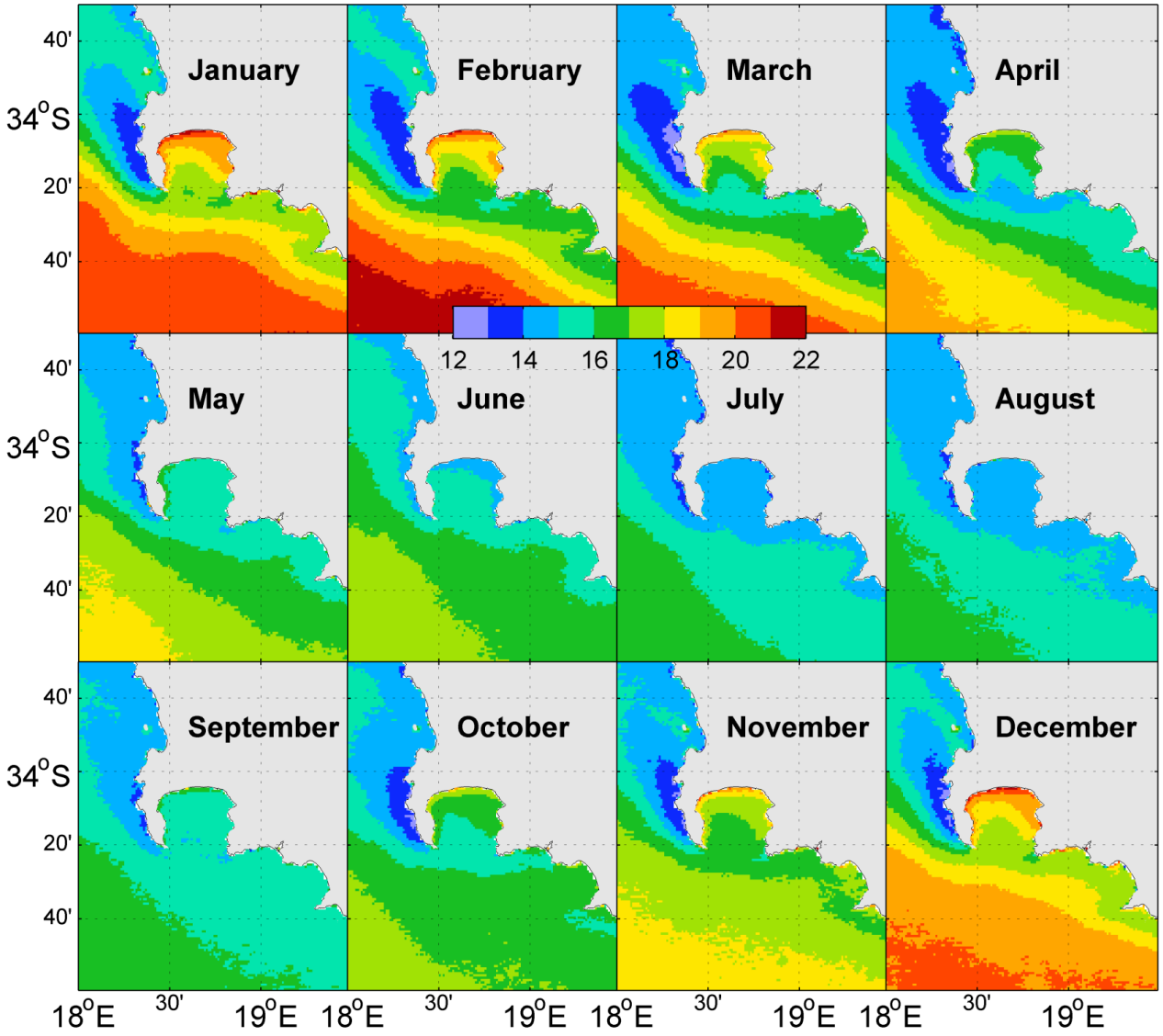
Seasonal cycle - Climatology

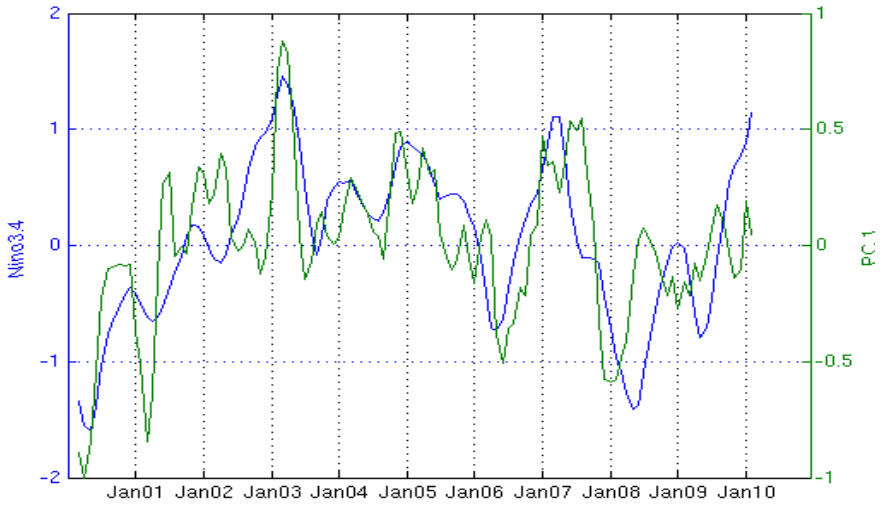
from 10 years of MODIS/TERRA data

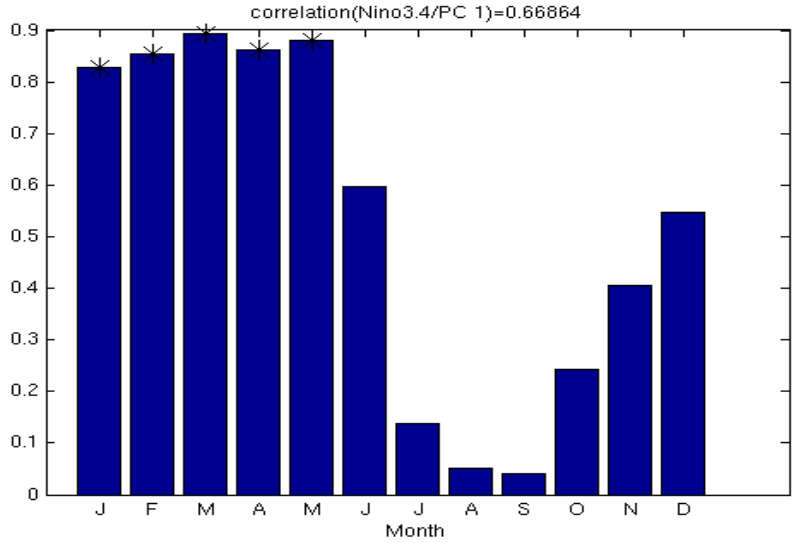


Dufois and Rouault 2012

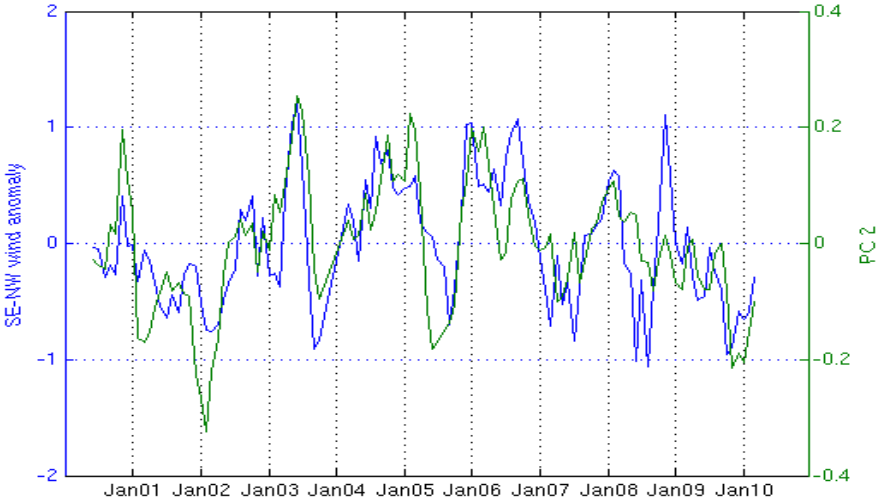
Principal components & correlations...

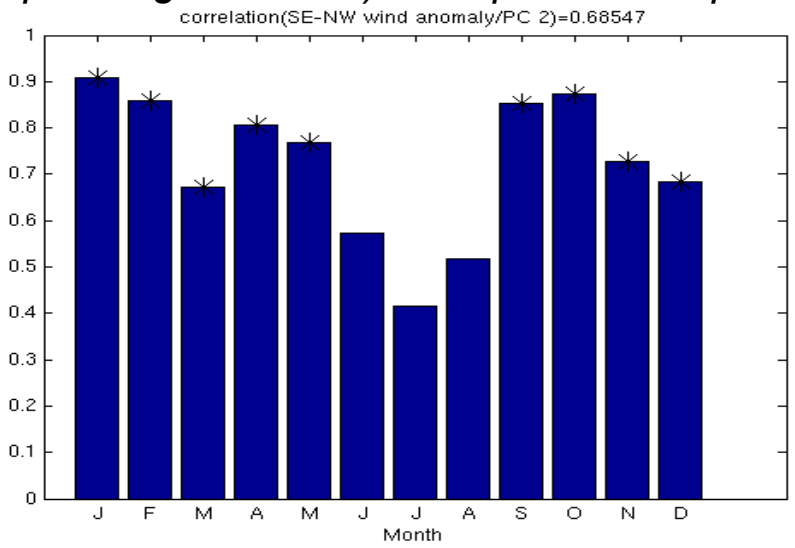
PC1 is correlated with Niño 3.4 (with a 4 month lag)...





PC2 is correlated with SE monthly wind anomaly (upwelling favorable) at Cape Town airport...

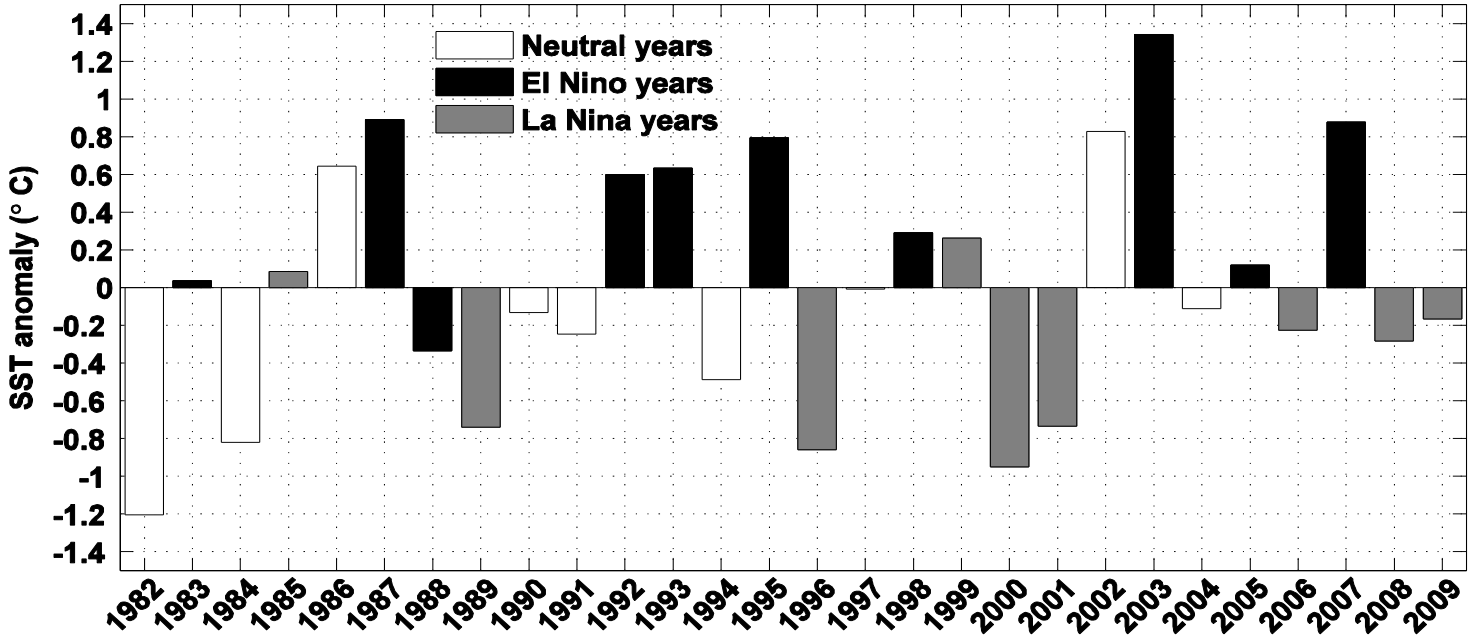




Dufois and Rouault 2012

Inter-annual variability in False Bay

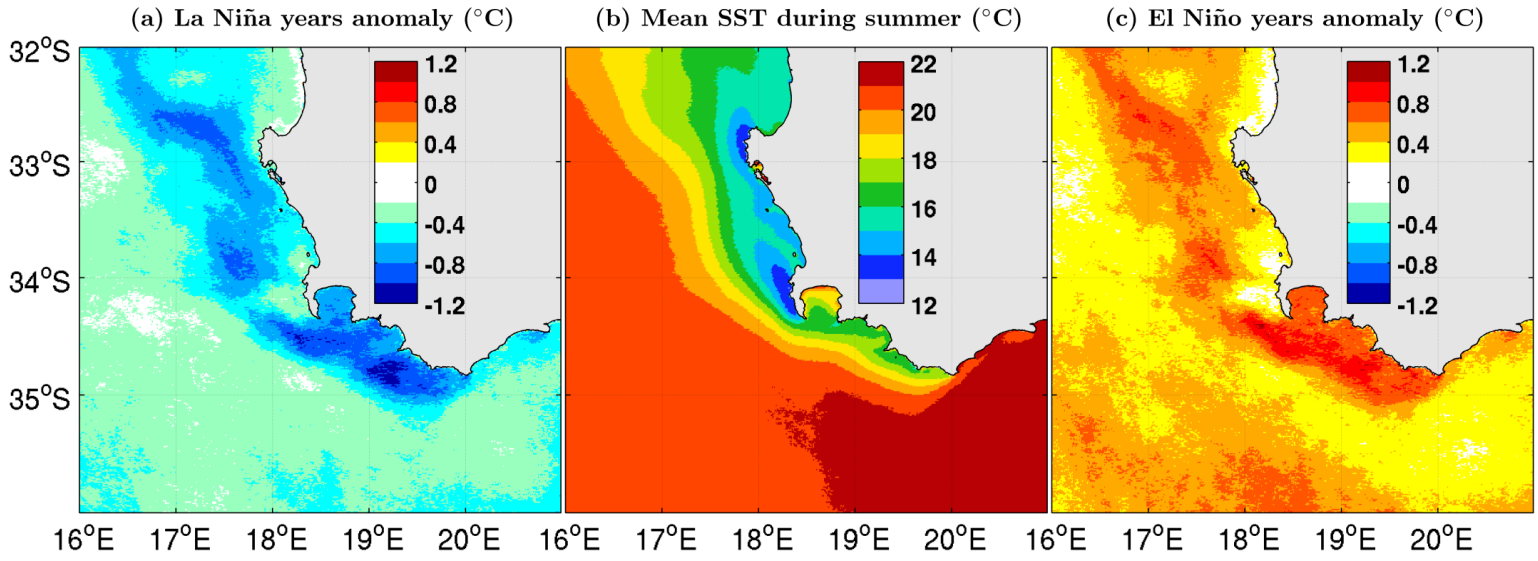
With 30 years of Pathfinder data averaged over False Bay from January to May



Dufois and Rouault 2012

Inter-annual variability

SST anomalies during El Nino/La Nina years in January/February/March



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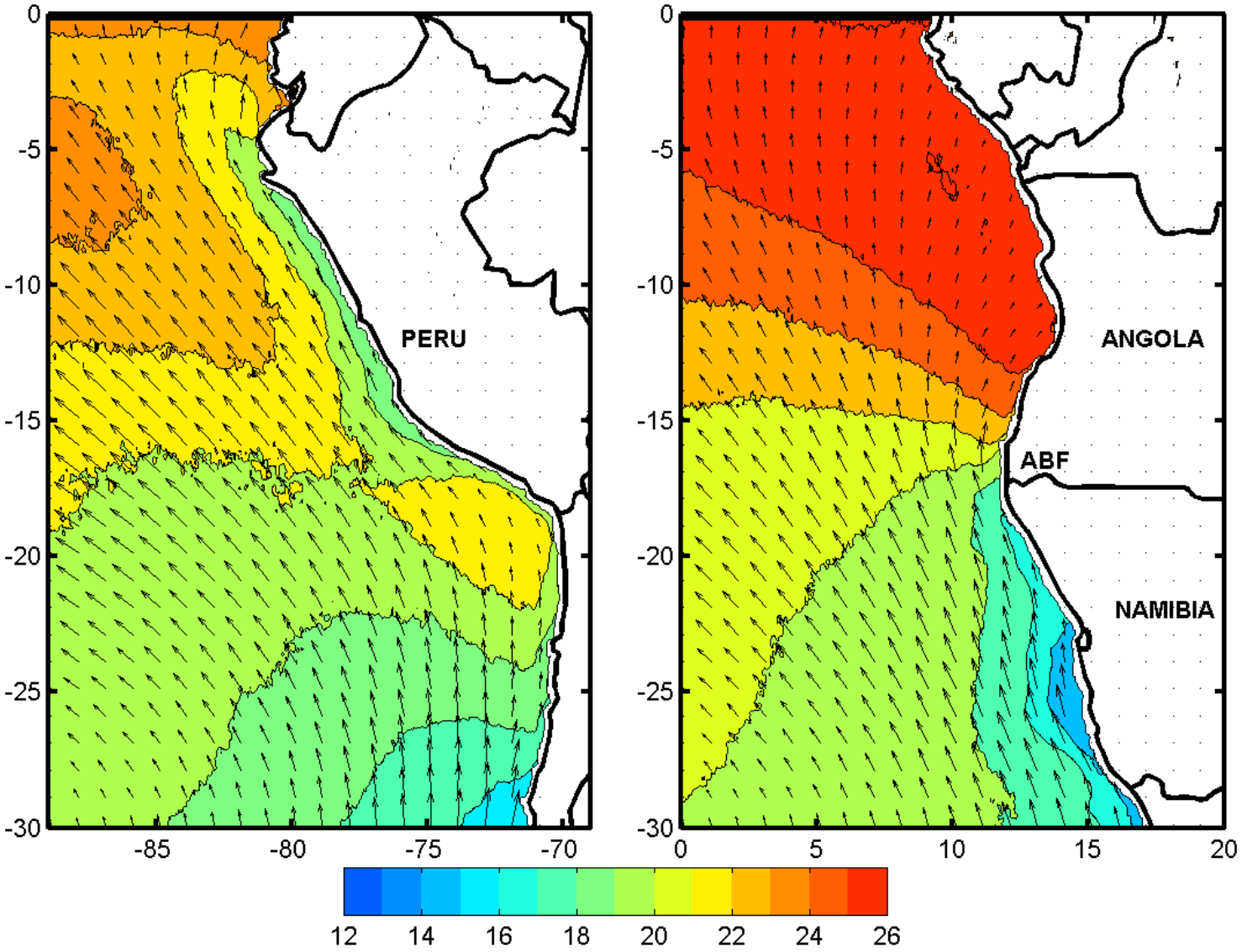

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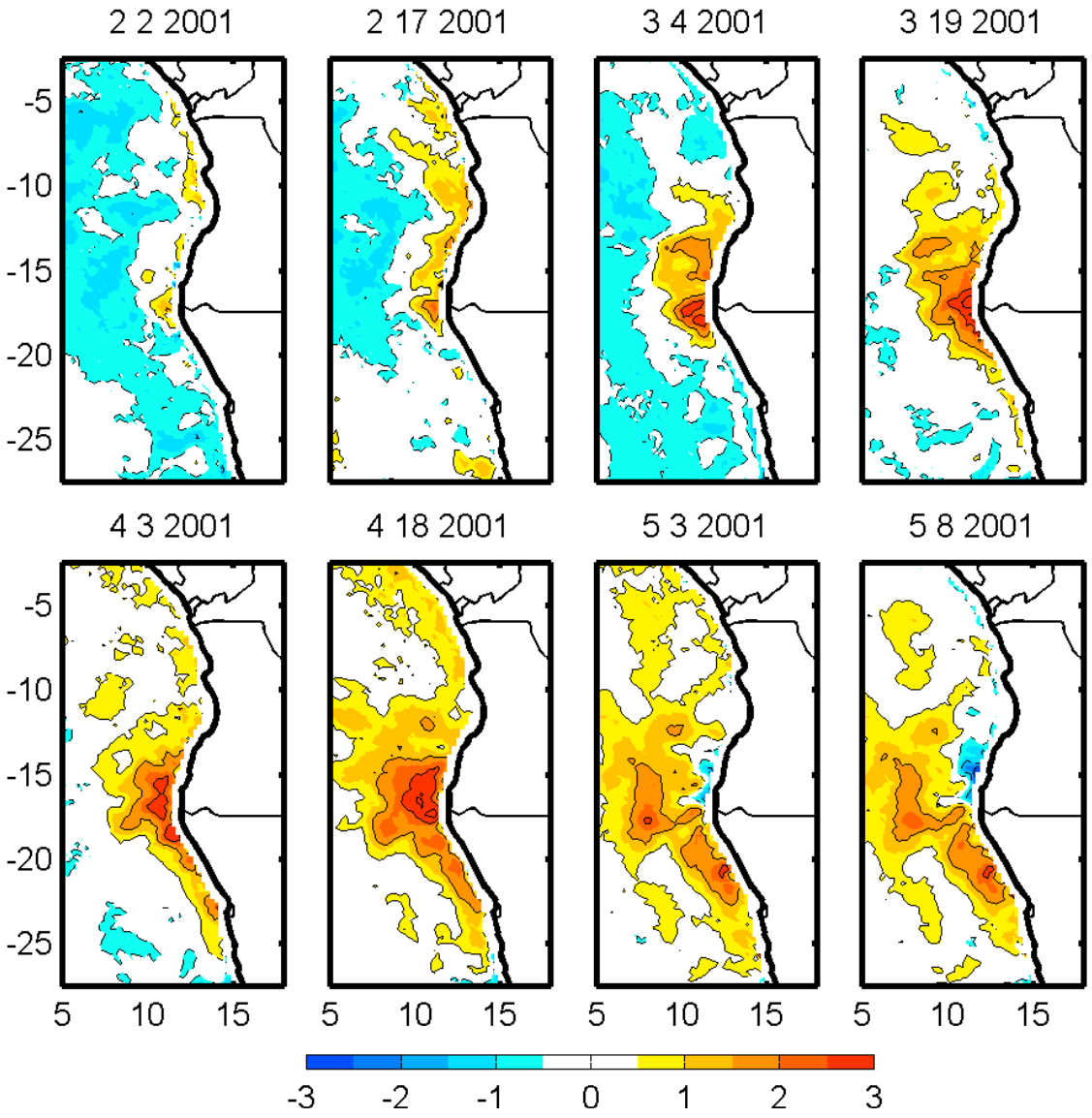
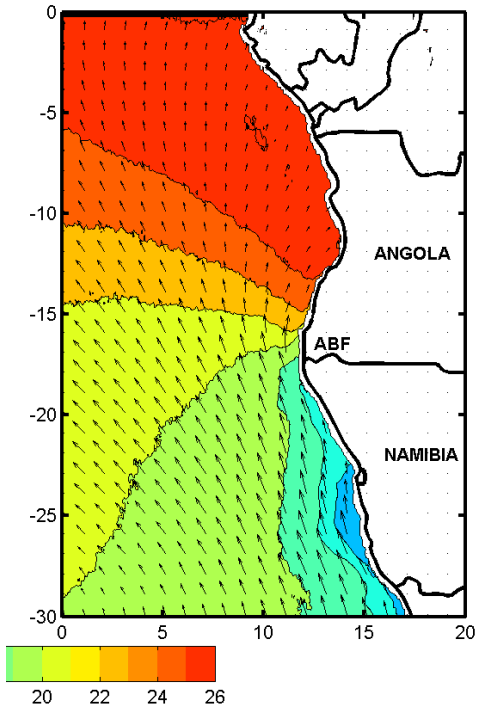
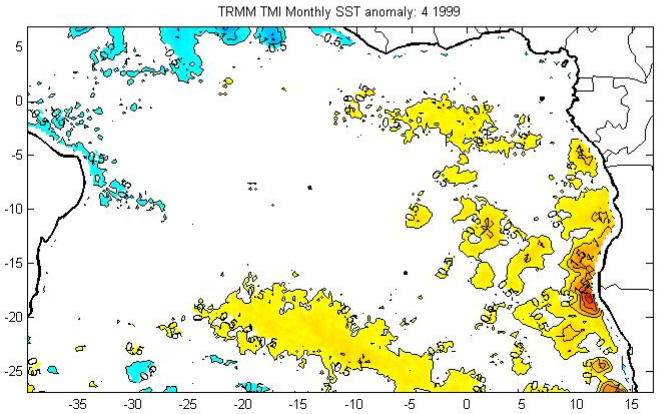




TRMM SST Monthly anomaly centered on the date of interrest from February 2001 to May 2001



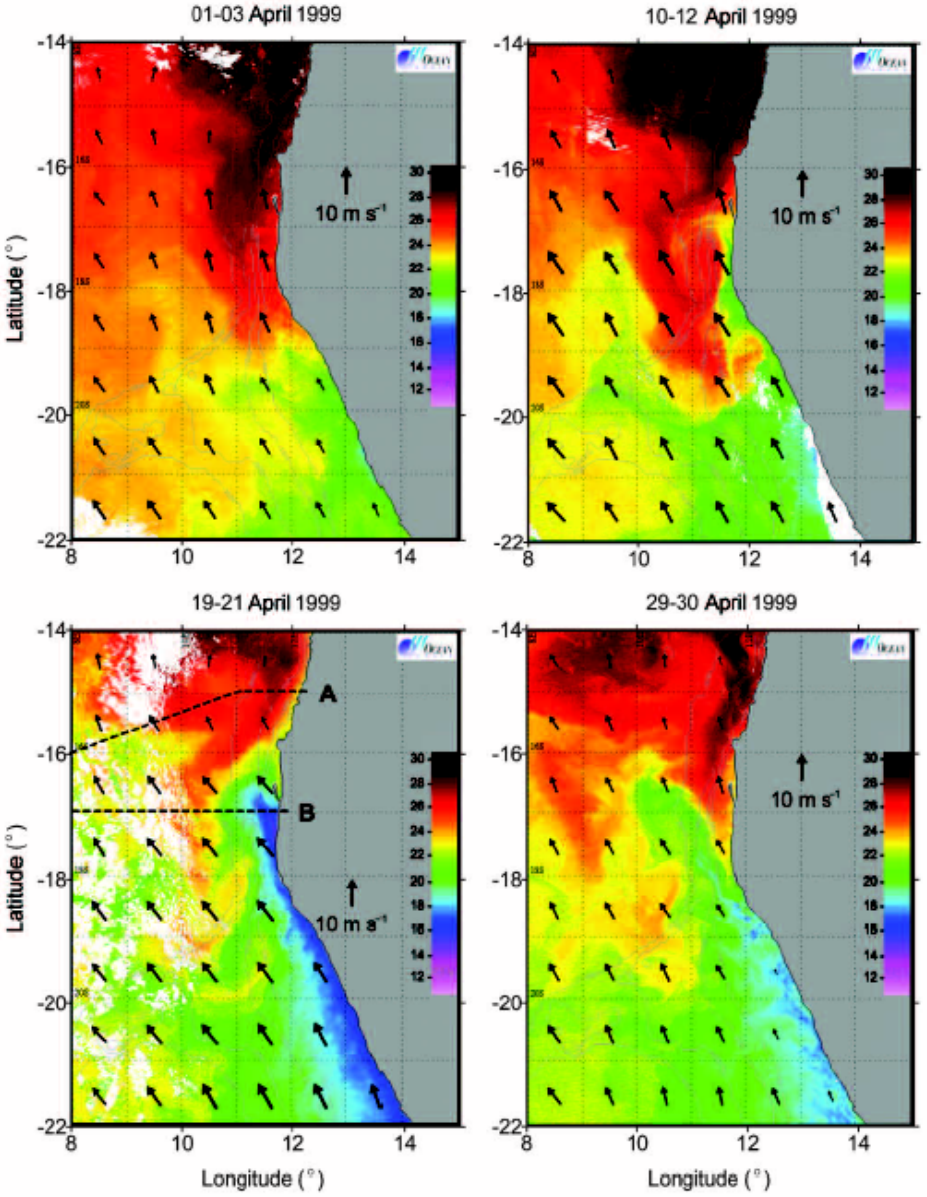
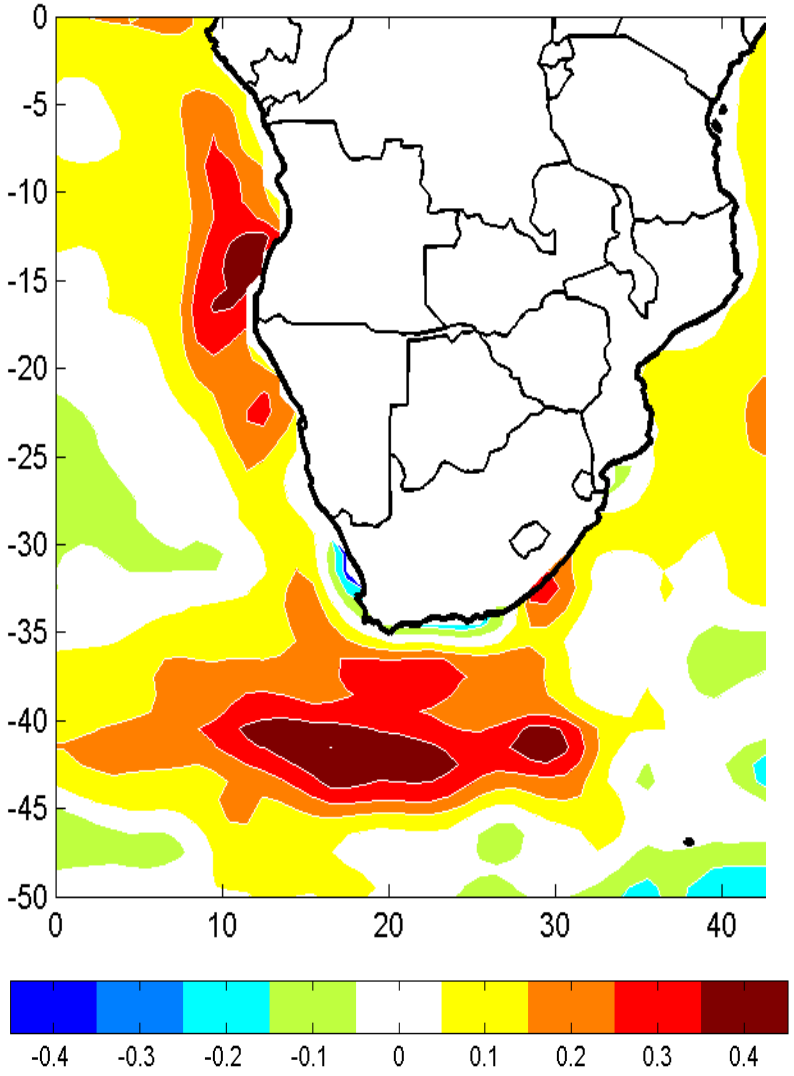
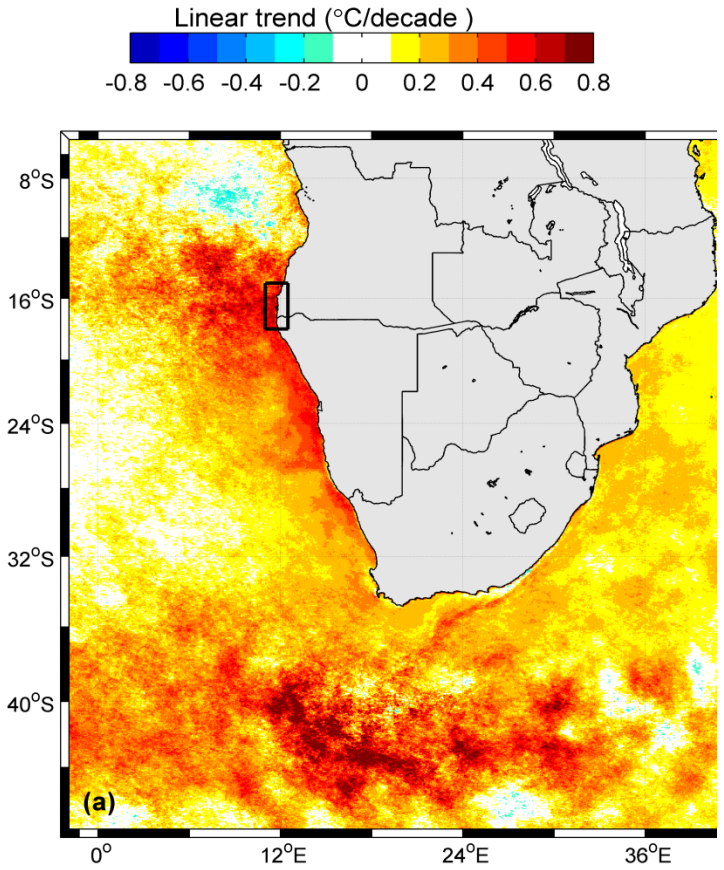


Figure 2. Sea surface temperature overlain with ERS2 derived wind vector off the Angolan and Namibian coast in April 1999.

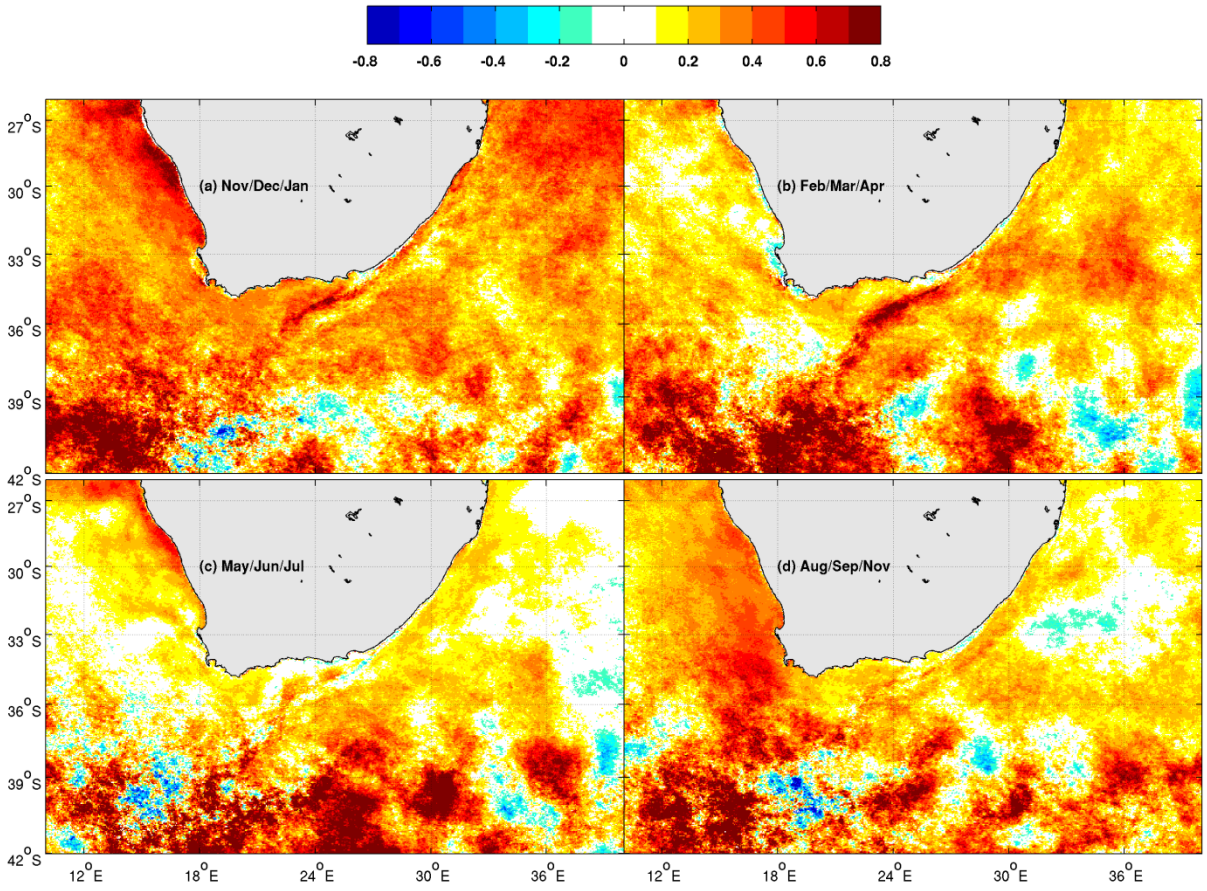
Mohrholtz et al, 2001, 2004, John et al, 2001



Linear trend Reynolds OI SST 1982-2012 in degree per 10 year



Linear trend Pathfinder SST 1980-2011 night in degree per 10 year



Seasonal trend pathfinder SST V5.2 Blamey et al in preparation