

Intrusion of warm tropical water in the Benguela upwelling system

Mathieu Rouault. Department of Oceanography, University of Cape Town,
South Africa

Thanks Anne Marie Treguier for ORCA model output

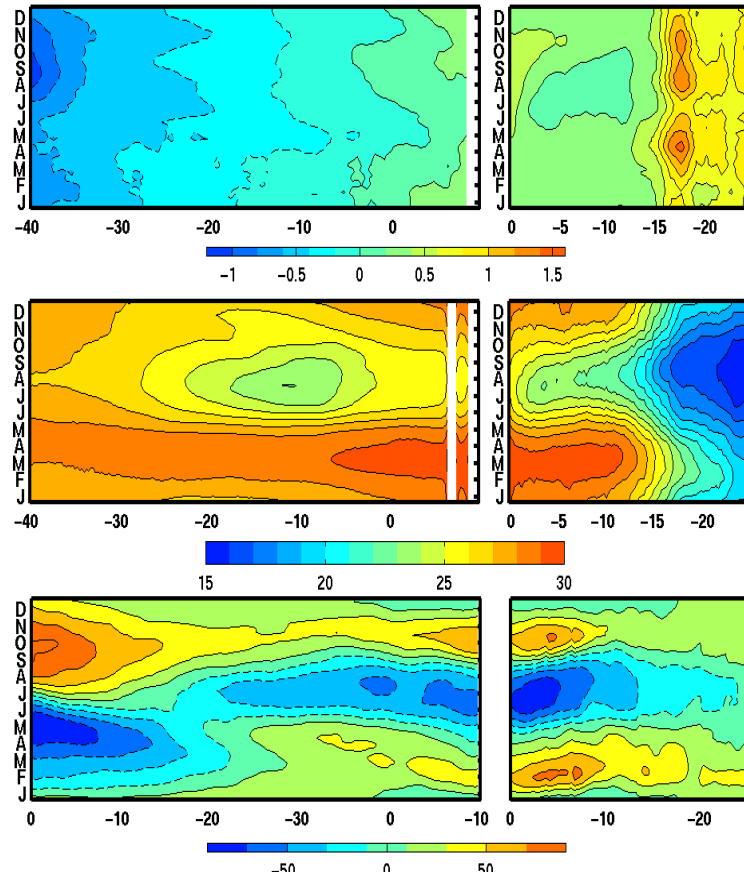
Mathieu Golhen for initial analyses of the model.

Africa Centre for Climate and Earth Systems Science and
Water research commission for funding

Climatology of various parameters estimated with satellite remote sensing in the Atlantic along the Equator (left) and then polewards (right) along the African coast from 0 to 25 S.

Seasonal cycle dominates interannual variability unlike Pacific Ocean.

Other differences from Pacific are the existence of a steep ocean front at 17 S, the Angola Benguela front and land masses to the North (West Africa

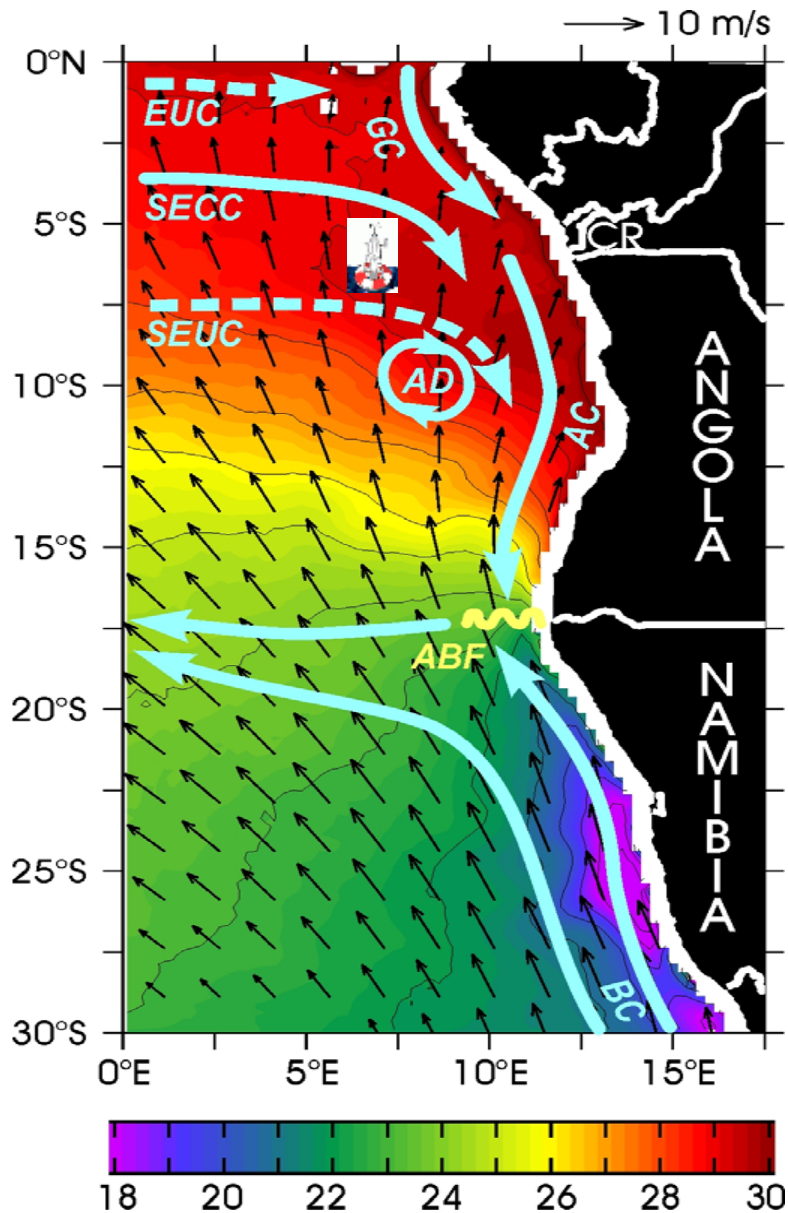


Quickscat wind stress (zonal right panel, meridional left panel) 1999-2006

TMI TRMM SST (1998-2006)

Sea level anomaly, merged altimetry (1993-2006)

From top to bottom: a) 1999-2006 Quickscat wind stress (u component along the Equator and v component along the coast). b) 1998-2006 TMI sea surface temperature c) 1993-2006 TOPEX/ERS/JASON merged sea level anomaly d) 1984-2004 OA latent heat fluxes e) 1984-2004 OA net heat budget (latent+sensible + shortwave+infrared fluxes). N.B usually there is no valid data from the coast to about 50 km offshore. Coastal data in left panel is the averaged from the coast to 2 degree offshore following the coast.



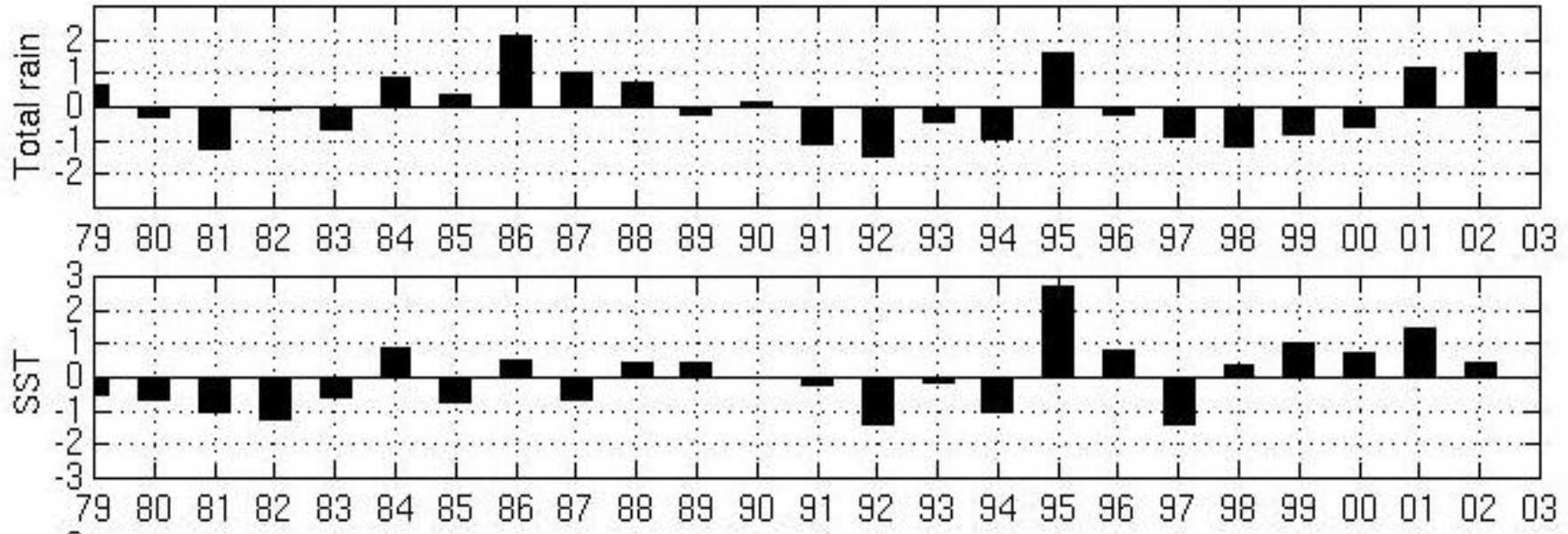
- Equatorial undercurrent
- South Equatorial countercurrent
- Guinee Current
- Congo river
- South equatorial undercurrent
- Angola dome
- Angola gyre
- Angola Current
- Angola Benguela front
- Coastal upwelling
- Benguela Current

From Rouault et al (2007)

Figure made by Serena Illig

Schematic of the major oceanographic features in the South East Tropical Atlantic in late austral summer with mean March TRMM TMI SST and QuikScat wind speed and direction. SST is plotted every degree from 17 to 30 C. Maximum wind speed is 8 m/s in the south and minimum wind speed is 3 m/s north of the ABF.

10°S-20°S / 8°E-14°E



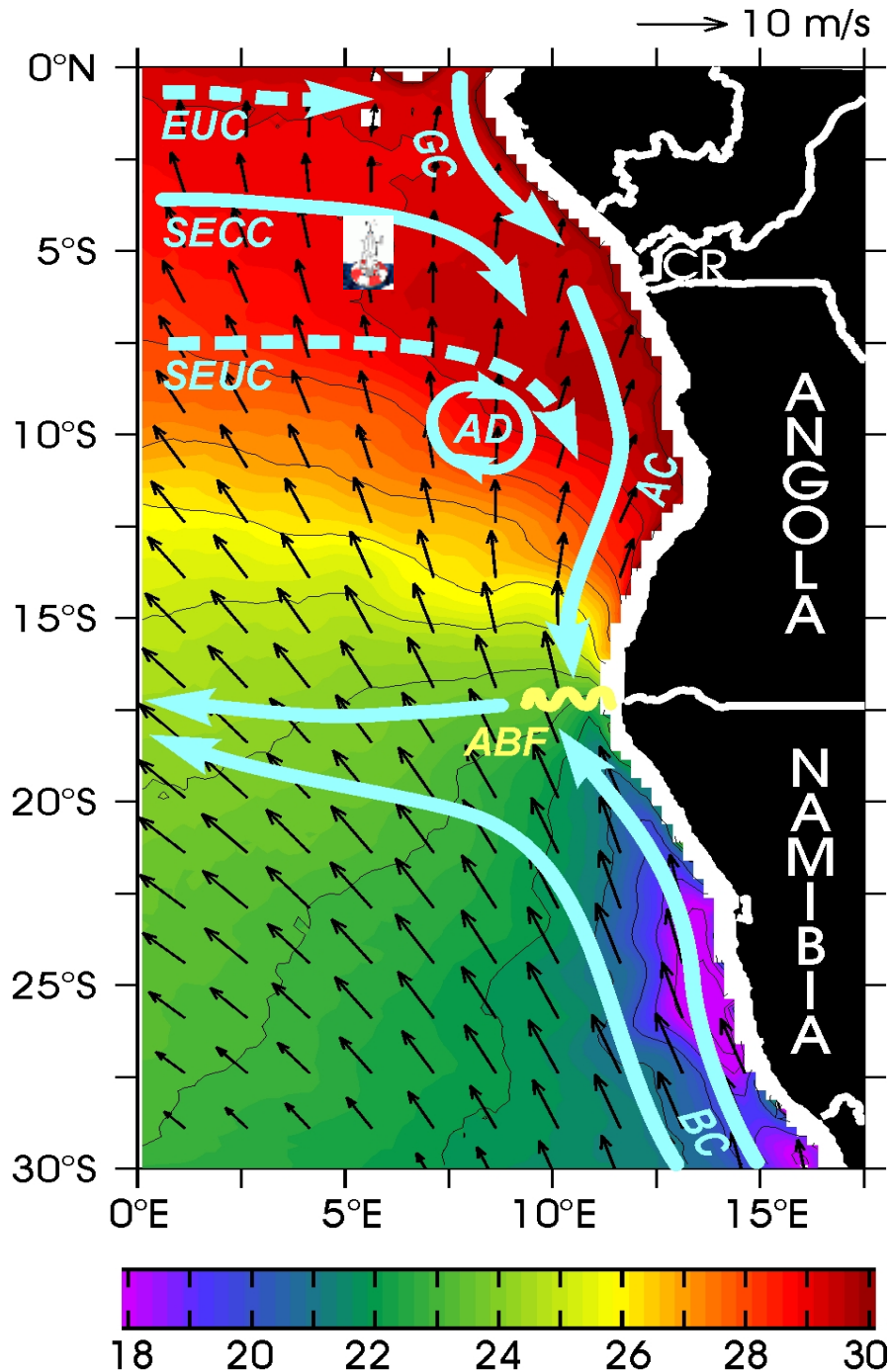
Top: GPCP Rainfall Bottom: Hadley SST

Late austral summer normalized anomaly (anomaly of the mean of February March and April of each year relative to the 1979–2003 mean of FMA divided by the standard deviation of FMA) from 1979 to 2003 in domain 10S to 20S and 8 E to the coast).

Benguela Niños happened in 1984 and 1995, smaller events in 1986 and 2001.

Angola Benguela Front is at 17.5

Warm events can reach to 25 S



Methods

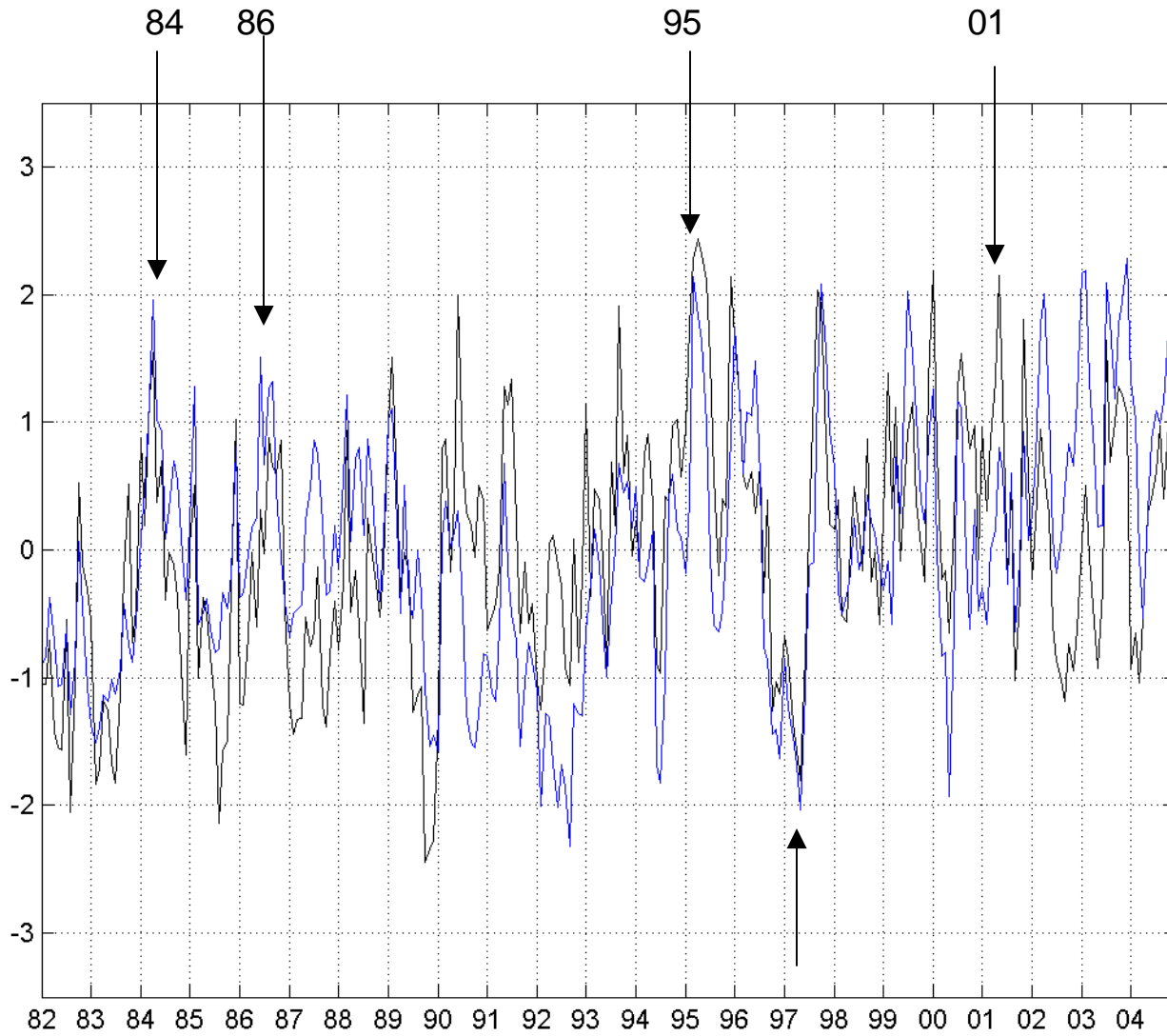
Reynolds SST versus ORCA SST.

Monthly mean and normalized anomaly from monthly clim from 1982 to 2004.

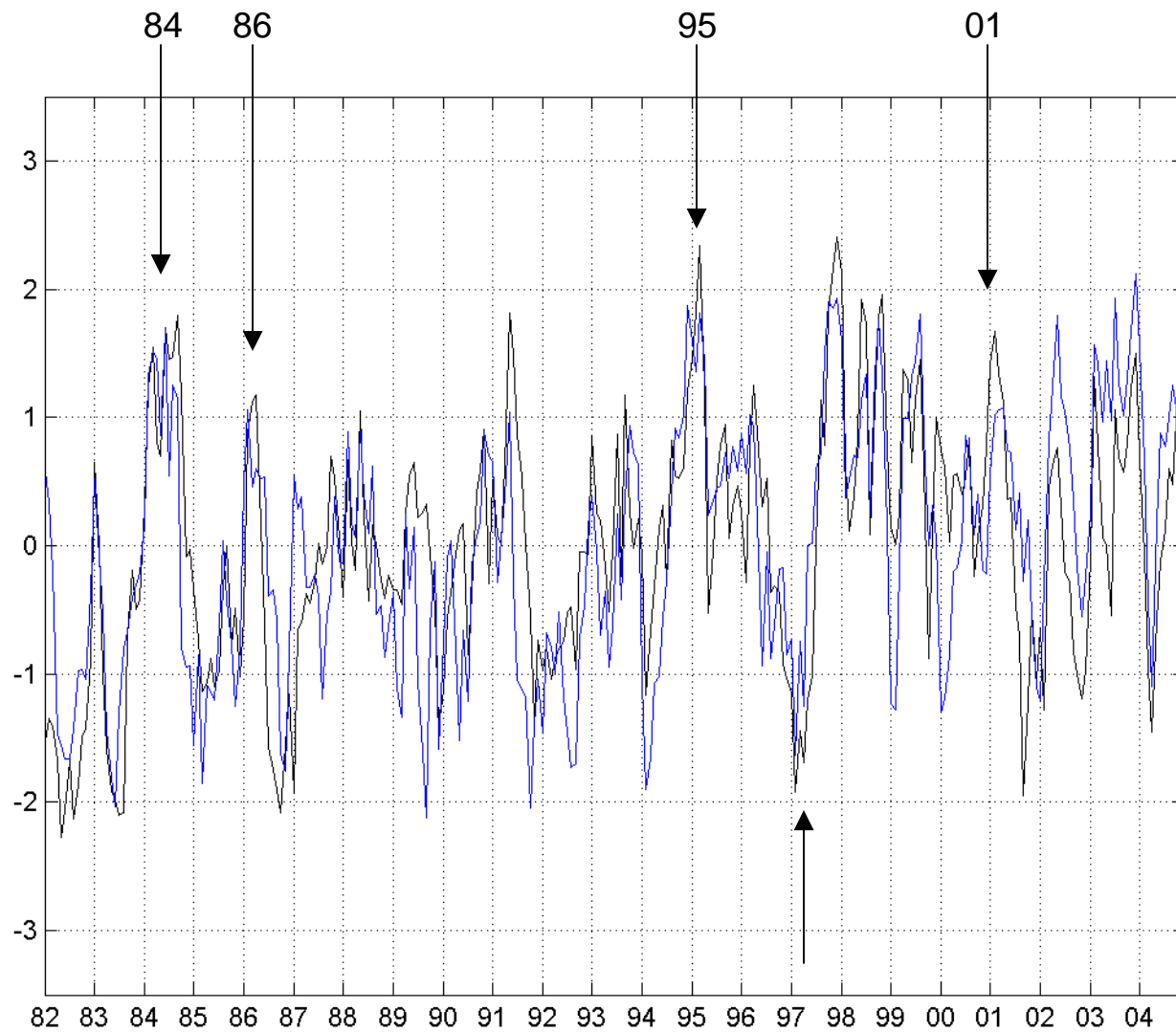
SST in domain South Angola (11 S to 16 S and Northern Namibia (19 S to 24 S)extending 1 degree offshore

V velocity component versus depth at 17.5 S at the Angola Benguela Front from the coast to about 250 km offshore.

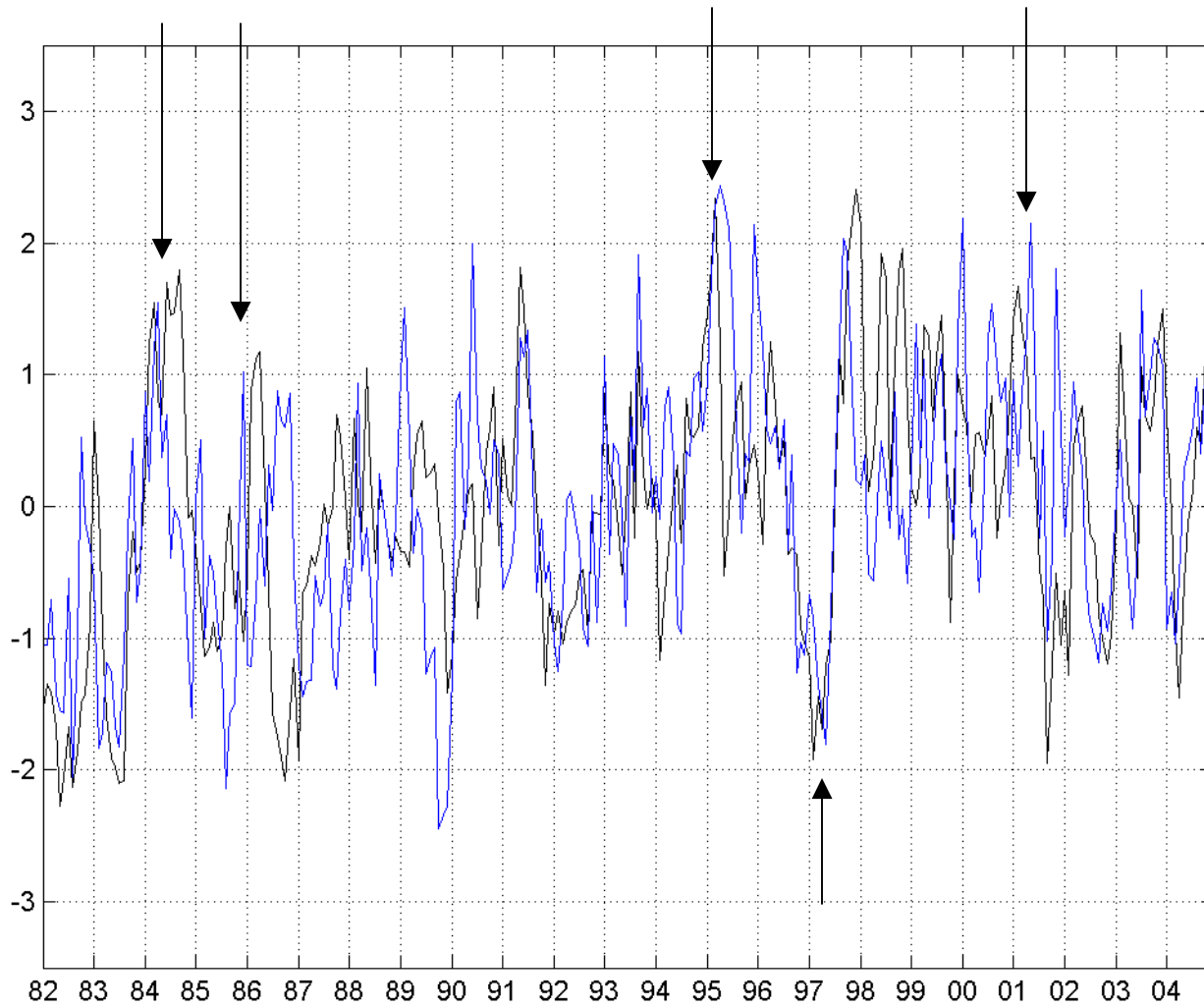
Inferred transport from surface to 250 m



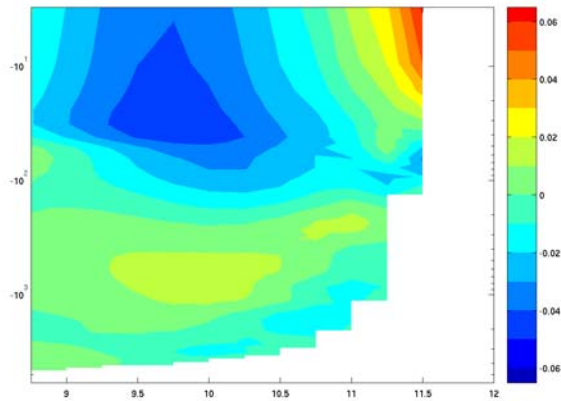
Blue model Black obs. Normalized monthly anomaly in domain Northern Namibia. Correl=0.48.



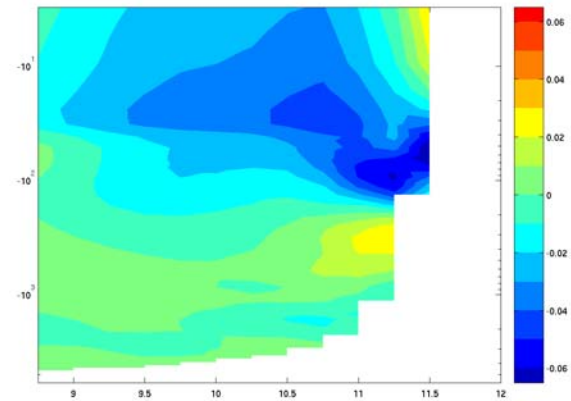
Blue model Black obs. Normalized monthly anomaly in domain Southern Angola. Correl=0.58.



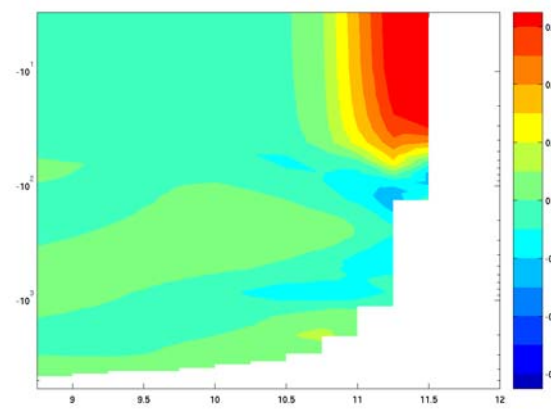
Black Southern Angola Blue Northern Namibia Reynolds SST. Normalized monthly anomaly in domain Southern Angola.



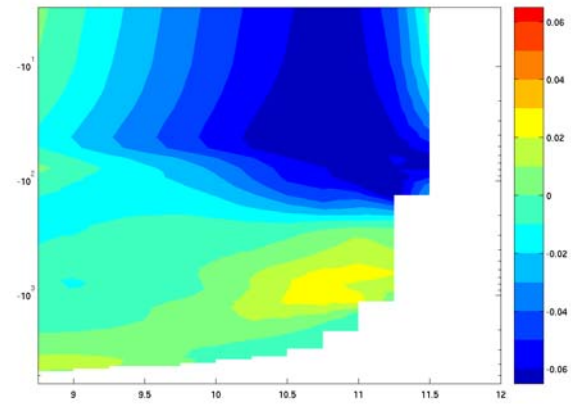
December



February

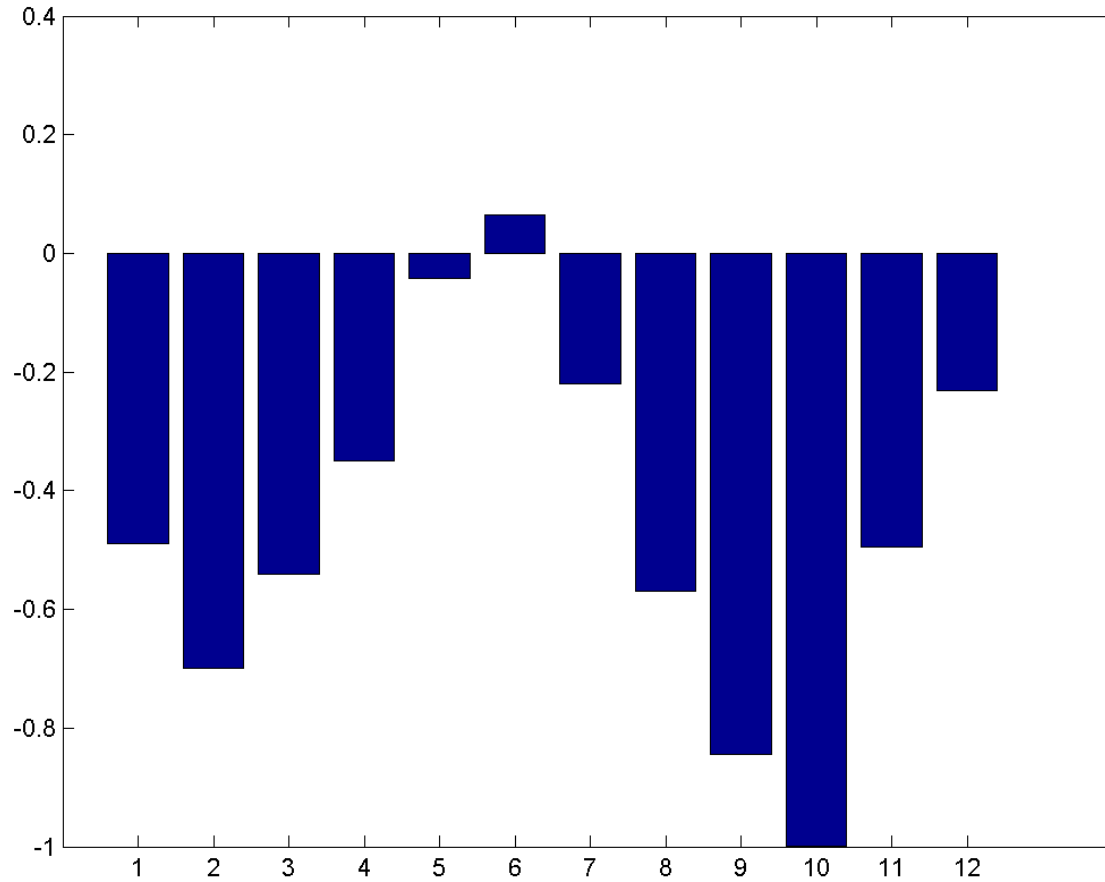


June

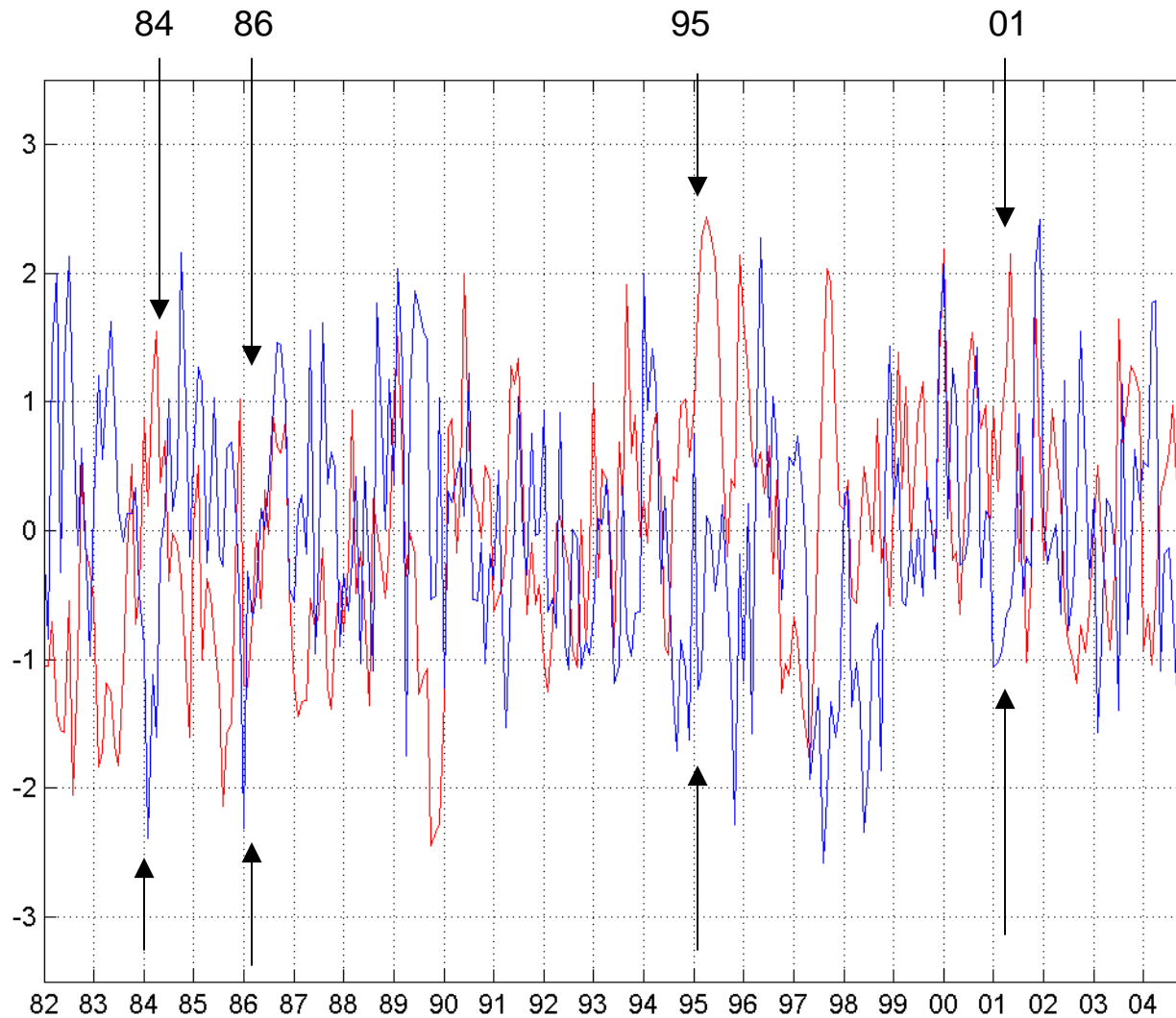


October

Annual cycle of V component of ORCA model longitude/log(depth) along 17.5 S at the Angola Benguela Front (8.75 E to 11.5 E)



Annual cycle of surface(0-250 m) transport (V component) from ORCA model at the Angola Benguela Front (8.75 E to 11.5 E 0 to 250 m)



Red: Reynolds SST in domain Southern Angola

Blue: model surface transport.

Normalized monthly anomaly. Correl=0.1 at zero lag but -0.35 2 month lag

Ongoing work

Origin of the Southward flow

Connection with wind stress curl in the Tropical Southeast Atlantic

Joint analyses of TRMM SST, merged altimetry and quickscat wind speed