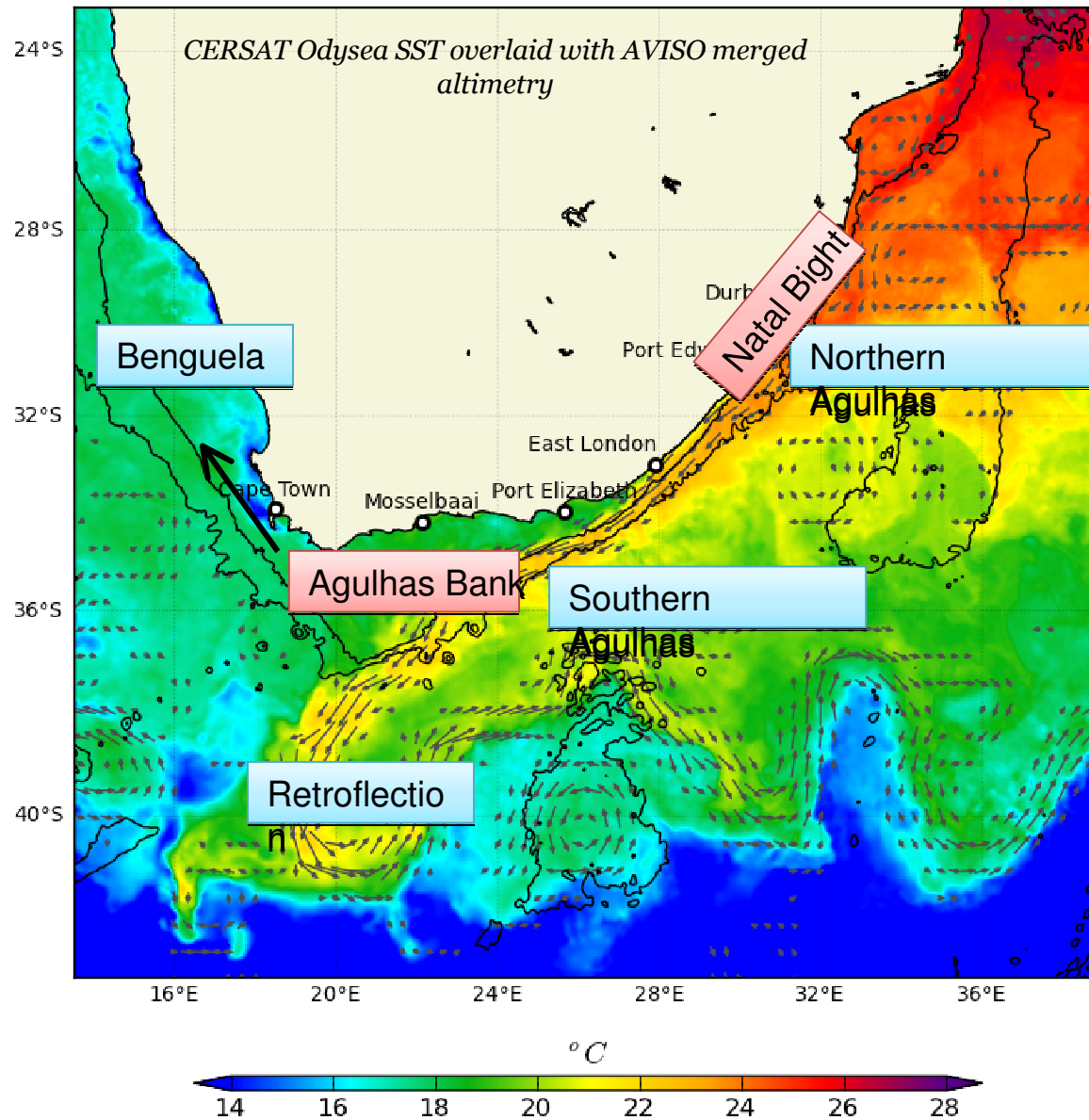


Some Challenges of SST and altimetry observations in the Agulhas Current region

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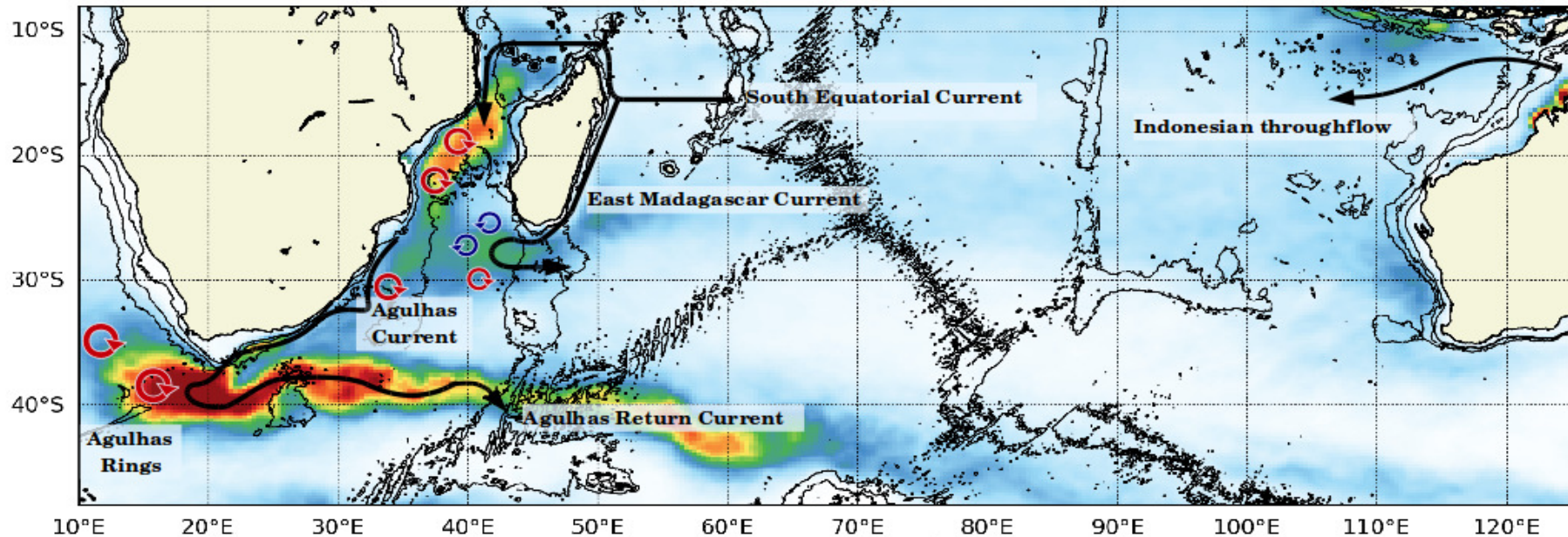
THE AGULHAS CURRENT REGION



- Strongest western boundary current of Southern Hemisphere with a mean transport = 70SV (at 32S) and maximum speeds > 2m/s
- Key component of global climate
- Region of intense ocean / atmosphere flux
- Influences coastal regions through dynamical upwelling, mixing, transport of larvae to the Benguela
- Region of intense Wave / Current interaction
- Lies on major shipping route for oil tankers

THE AGULHAS CURRENT REGION

Schematics of the greater Agulhas Current system. Colour contours show EKE derived from AVISO merged altimetry



- Wind driven variability in the south Indian ocean radiated as Rossby waves along the 12S and 25S zonal bands (de Ruijter et al. [2005]).
- Large anti-cyclonic eddies from Mozambique channel and Madagascar trigger formation of Natal Pulses (large cyclonic meander at landward edge of the current).
- Natal Pulses are thought to play an important part in the downstream variability of the Agulhas Current and the subsequent leakage of warm and salty Agulhas Current water into the Atlantic ocean.

SST IR OBSERVATIONS

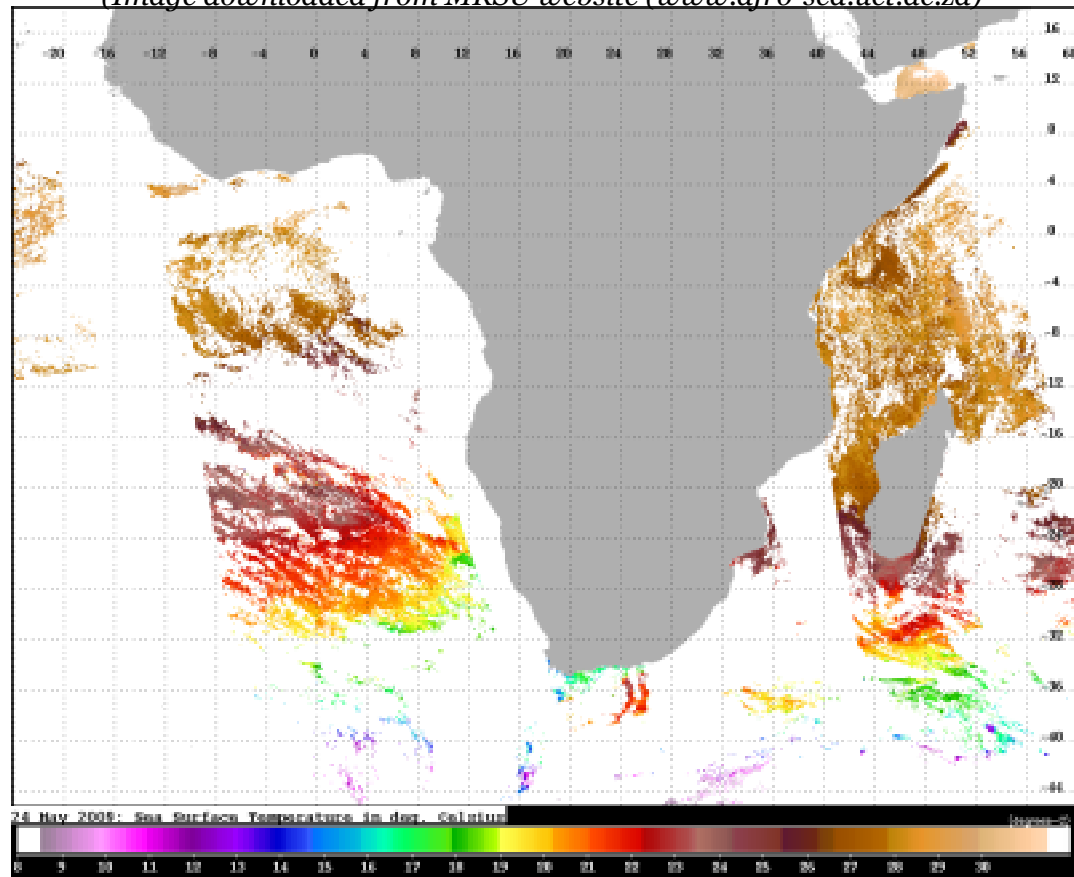
- Observations of SST from space have been available for close to 30 years, making SST one of the preferred remote sensing variable to study climate change
- The Agulhas Current is a warm and narrow flow associated with a distinct thermal signature and SST should provide a powerful tool for monitoring the current's variability.

Or maybe not ...

Over the Agulhas Current core, about 5 times as much water vapor is transferred to the atmosphere in comparisons to neighboring waters (Rouault et al. 2000).

The Agulhas Retroflection also constitutes one of the most significant region of heat flux loss globally (Lutjeharms, 2006).

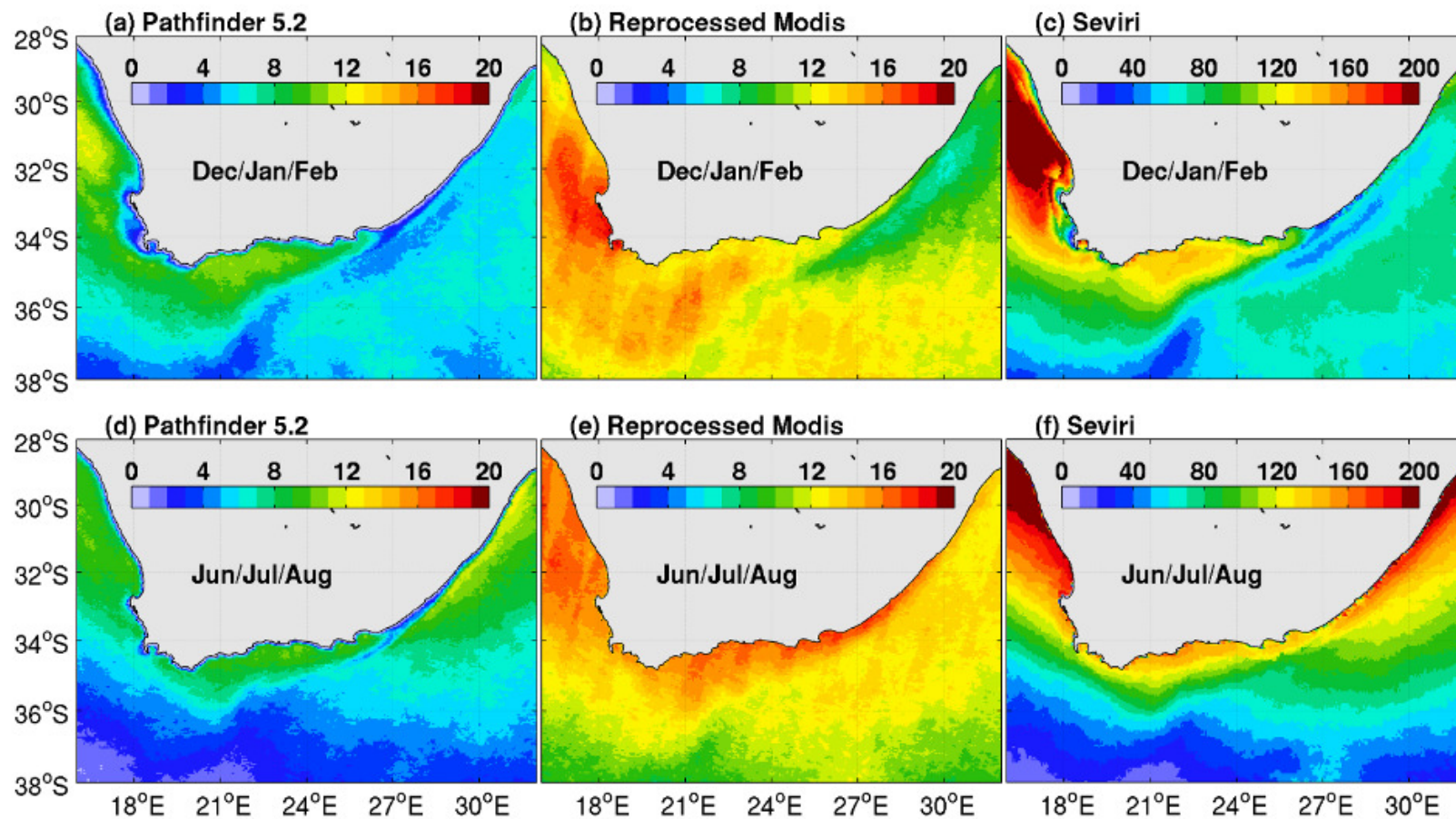
MODIS SST, 24 May 2009
(Image downloaded from MRSU website (www.afro-sea.uct.ac.za))



SST IR OBSERVATIONS

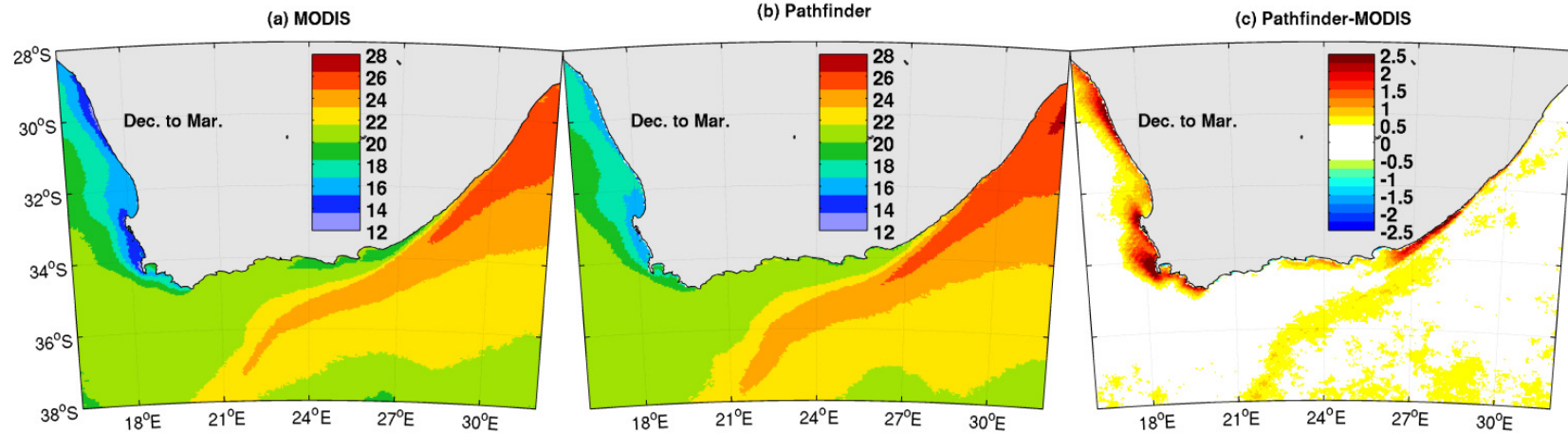
Monthly climatologies of the number of unclouded SST observations in the Agulhas Current region were derived from the Pathfinder v5.2, Reprocessed MODIS and OSI-SAF SST dataset to illustrate the importance of cloud contamination in the Agulhas Current region.

Average number of valid SST observations for the summer and winter seasons and for all 3 daytime IR

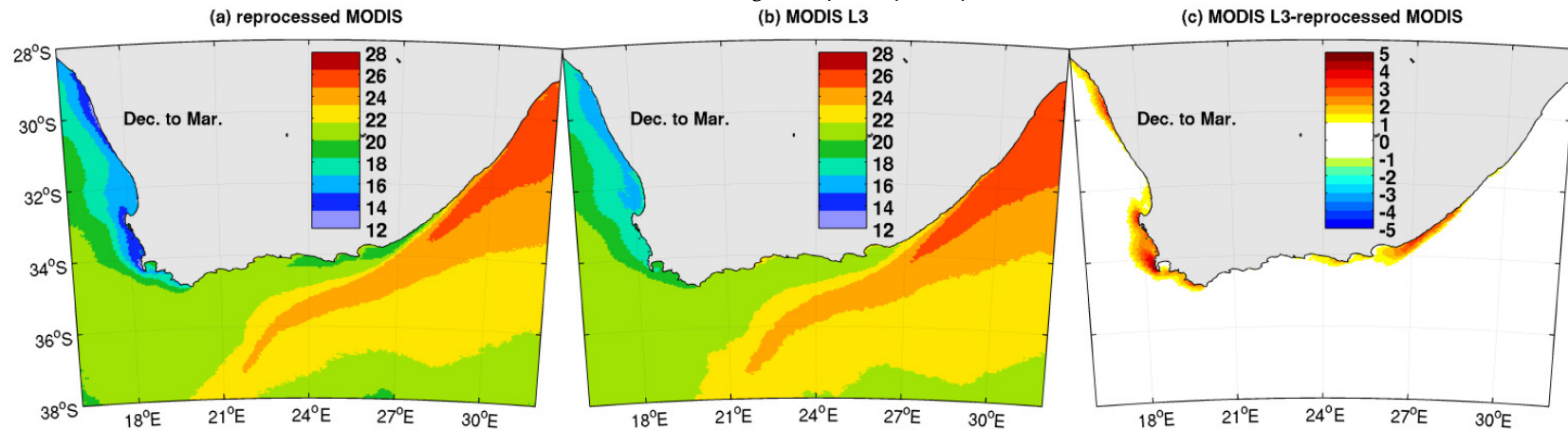


SST IR OBSERVATIONS

Seasonal summer climatologies of SST derived from the Reprocessed MODIS (a) and Pathfinder v5.2 (b) dataset. (c) shows SST difference ($^{\circ}\text{C}$) between Pathfinder v5.2 daytime and the reprocessed MODIS from 2000 to 2010 during Dec./Jan./Feb./Mar.



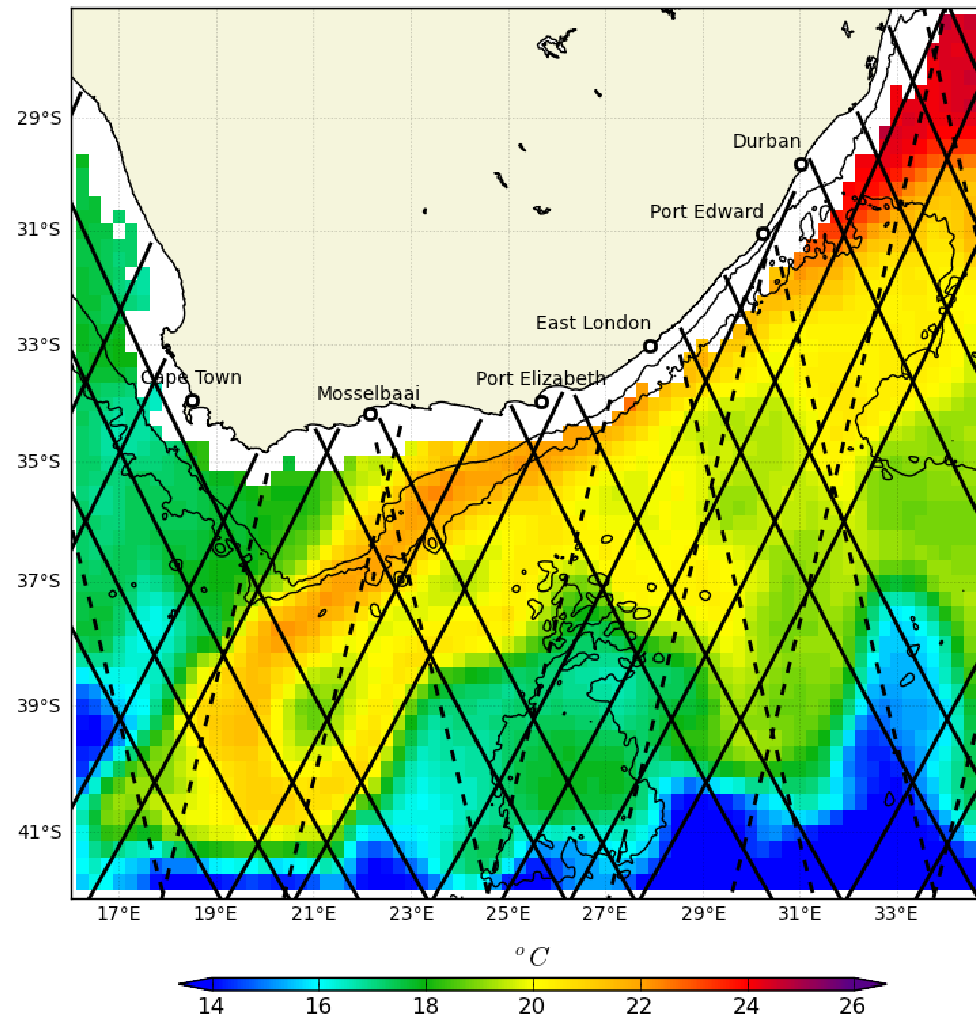
SST difference ($^{\circ}\text{C}$) between MODIS L3 downloaded from the oceancolor website and the reprocessed MODIS from 2000 to 2010 during Dec./Jan./Feb./Mar



SST MICROWAVE OBSERVATIONS

Weekly composite of AMSRE-E microwave SST over Agulhas Current region over the period 2010-11-18 to 2010-11-24. The black lines overlaid show altimetry tracks from all available altimeters (Jason-1, Jason-2 and Envisat) during the same week. The tracks of the Jason-1 and Jason-2 altimeters are shown as solid black lines. The stippled black line shows the track of the Envisat altimeter.

The same regions that are really challenged in IR SST observations are not sampled by microwave SST sensors

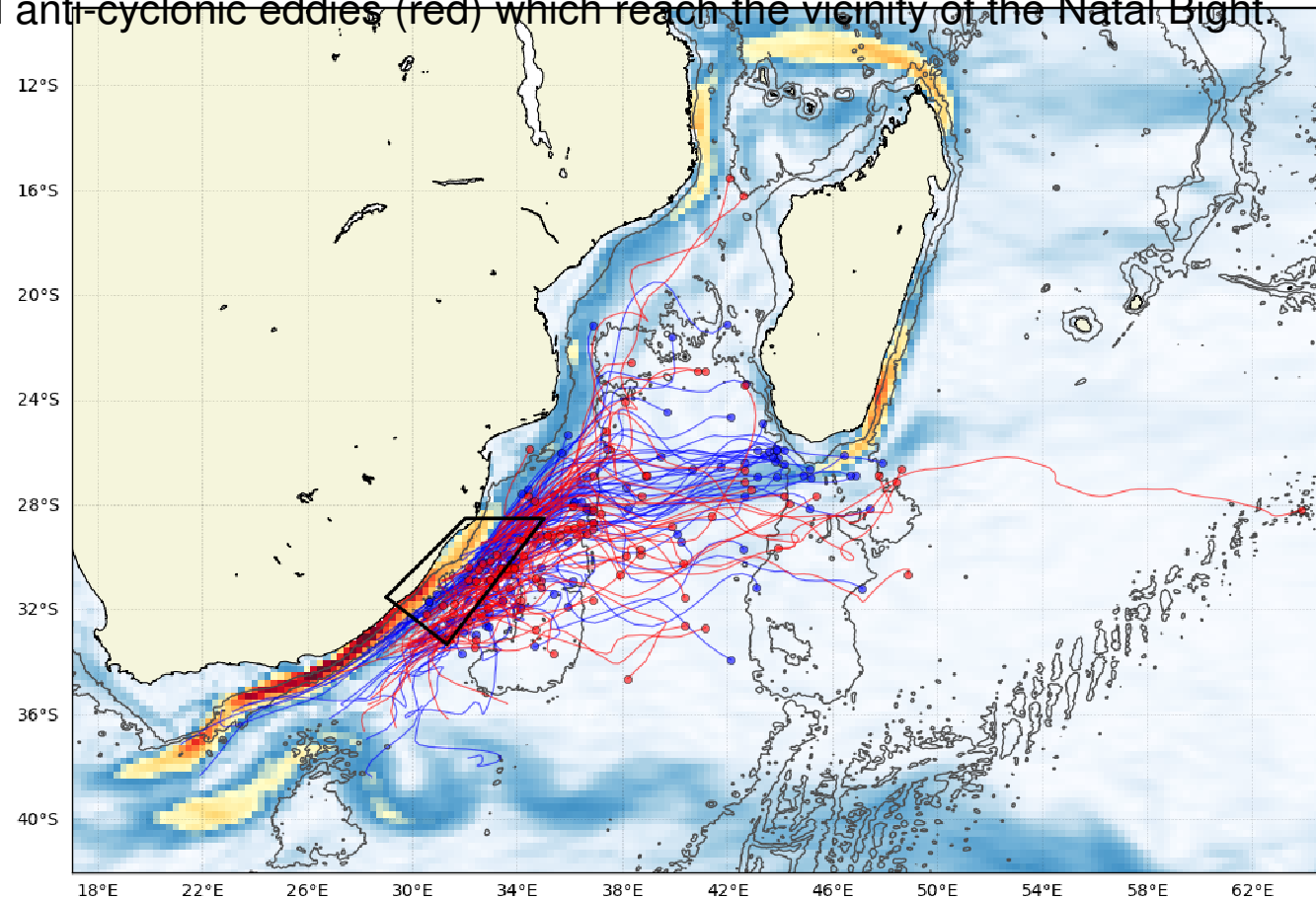


ALTIMETRY

- Altimetry can help us connect the variability in the Agulhas Current from forcing in the subtropical regions.

Here using the eddy database derived by Chelton et al. (2011) from SSH observations, we can trace the path of cyclonic (blue) and anti-cyclonic eddies (red) which reach the vicinity of the Natal Bight.

A lot of the eddies identified originate near the current. Is that a fact or is it a limitation of the eddy detection method / observations ?

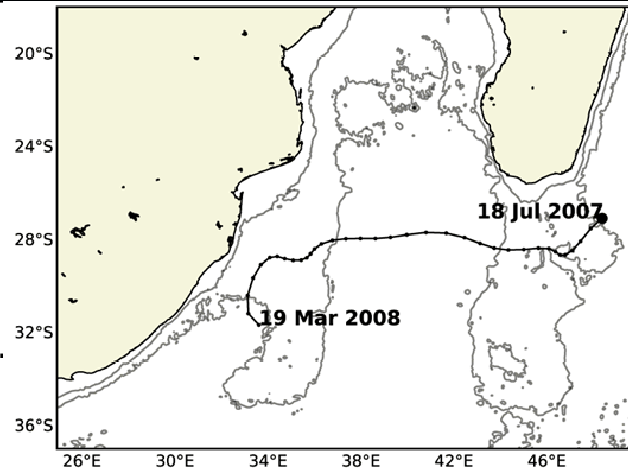


ALTIMETRY + SST

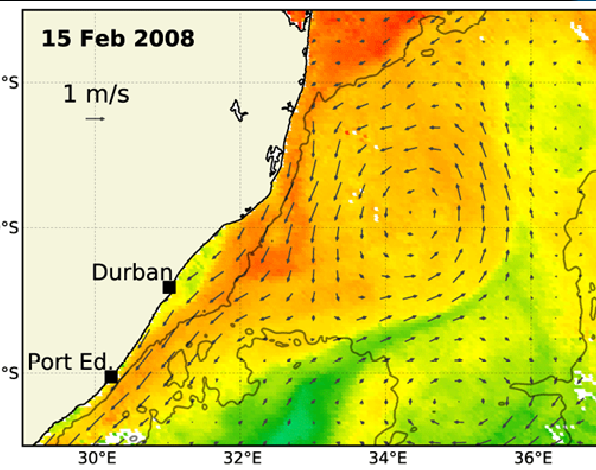
Inception of a Natal Pulse from an anti-cyclonic eddy. Path of the anti-cyclonic eddy extracted from the global eddy database of Chelton et al. (2011)

The high frequency capability of the SEVIRI sensor allows us to image fluctuations in the Agulhas Current on the 15th of Feb 2008 and 4th of April 2008 which the merged altimetry can not resolve.

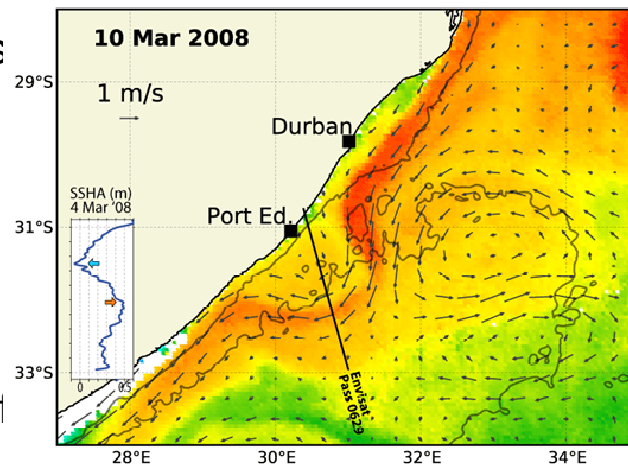
Instability in the current evolve quickly and most of the time, no along-track altimetry data is available.



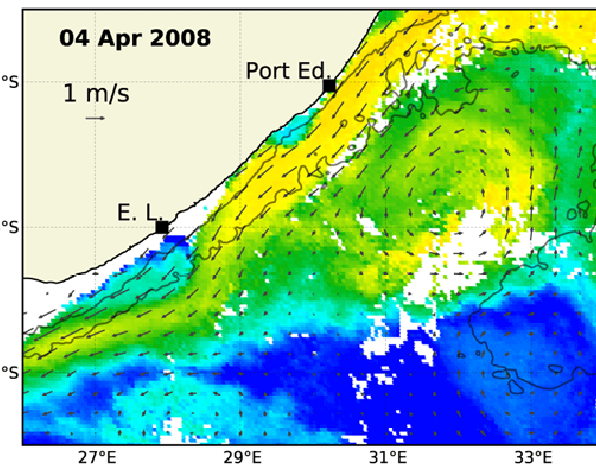
(a)



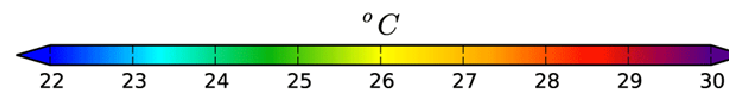
(b)



(c)



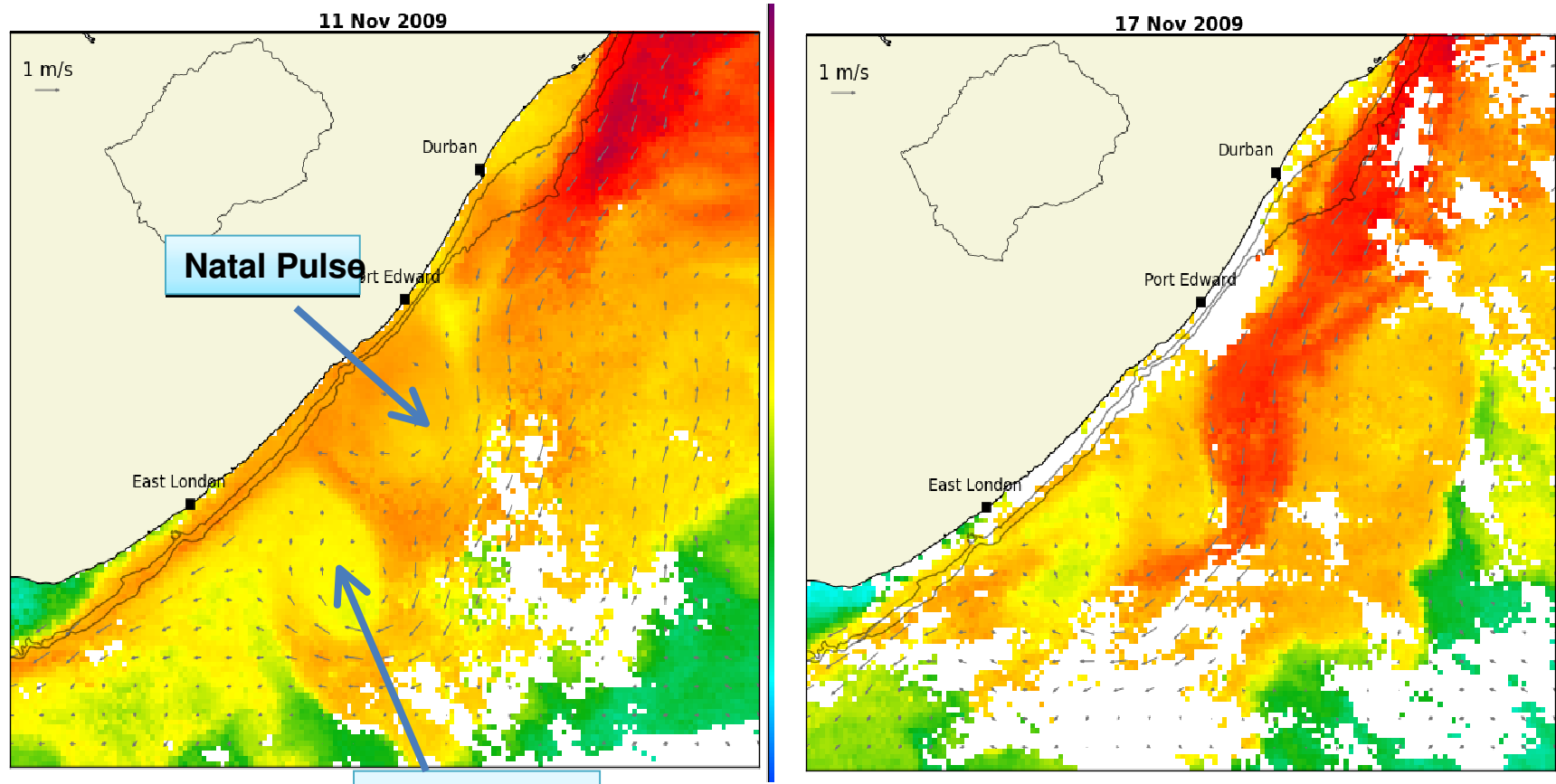
(d)



ALTIMETRY + SST

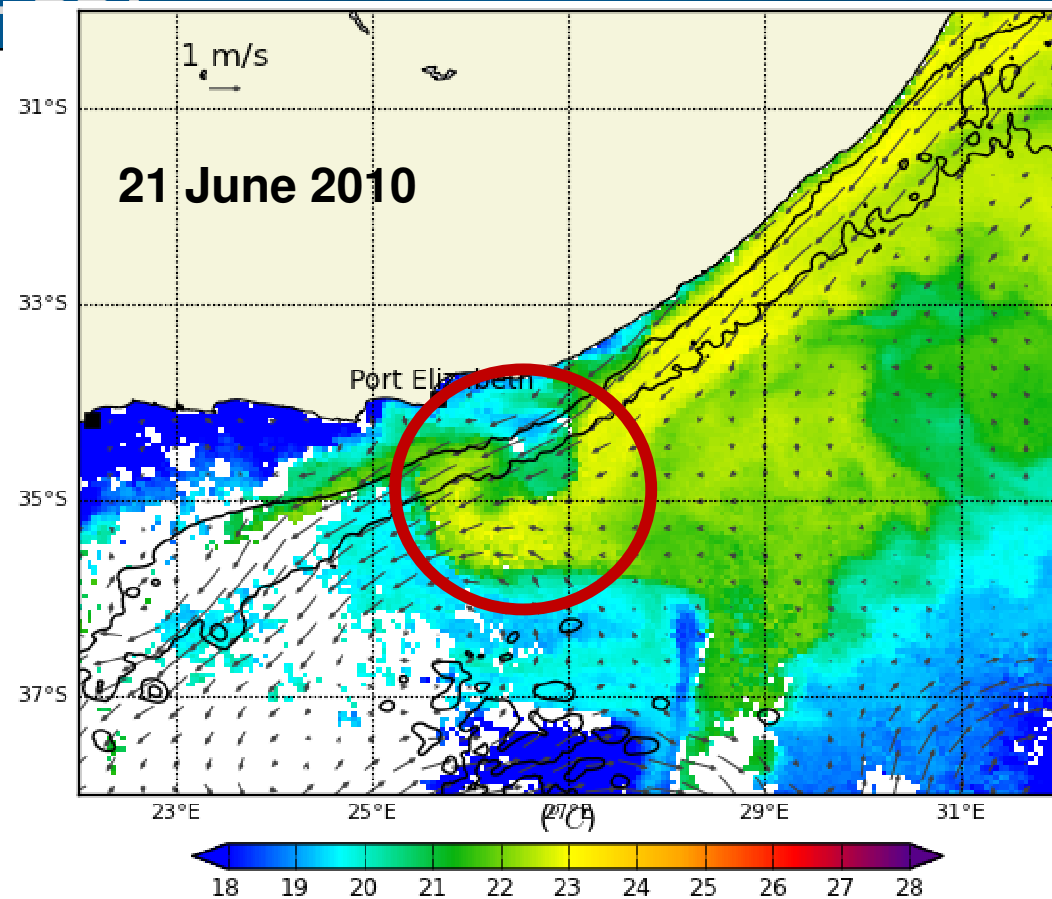
Complex interactions between the Agulhas Current, the topography and the offshore eddy field can occur. These behaviors are not reproduced in oceanic numerical models.

Here a Natal Pulse merges with a cyclonic eddy located downstream



Cyclonic eddy downstream and offshore

ALTIMETRY + SST



The rapid evolution of meso-scale features in the Agulhas Current region presents a challenge for observations.

By the time large meanders reach the southern Agulhas they are well established and can be imaged successfully using merged-altimetry. In the northern Agulhas Current however, perturbations in the Agulhas Current evolve rapidly and altimetry is not always able to resolve them.

REQUIREMENTS ?

- High frequency acquisitions.

SEVIRI SST significantly improve our imaging capacity in the Agulhas Current .

- Regional-focused cloud masking algorithm for IR SST observations:

For the coastal regions of the Benguela and the Agulhas Current, the use of reference SST in the cloud-masking algorithm was detrimental.

- Observations closer to the coast

Hopeful that coastal altimetry and SAR observations will improve our understanding of the Agulhas Current system

- More validation data (in-situ measurements)

Data from ACT (Agulhas Current Timeseries) moorings should be very beneficial and help us improve our remote sensing products