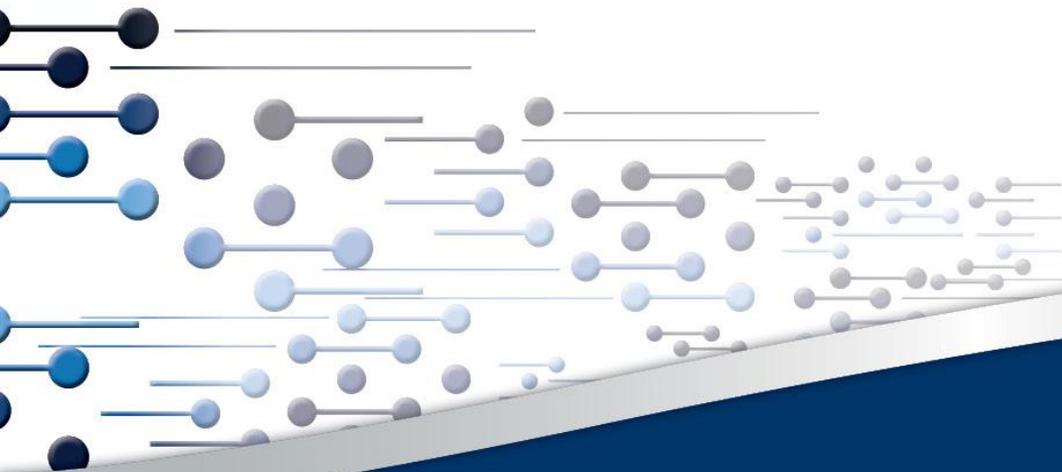


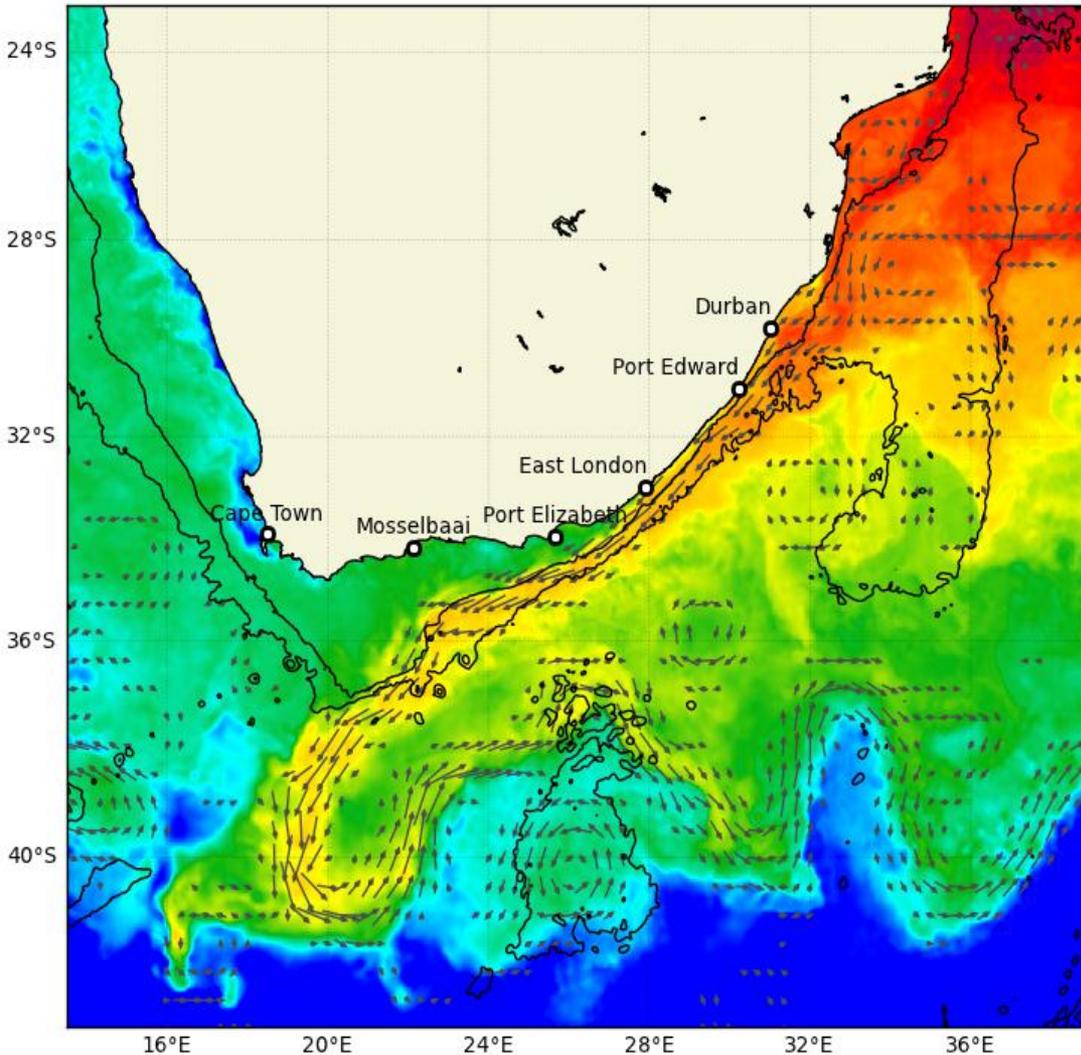
Observation challenges in the Agulhas Current coastal and shelf regions

Marjolaine Krug^{1,2}, Seb Swart⁴, Bjorn Backeberg^{2,3}

1. CSIR-NRE, Ecosystem Earth Observations, Cape Town, South Africa
2. Nansen-Tutu Center for Marine Environmental Research, Department of Oceanography, University of Cape Town, South Africa
3. CSIR-NRE, Coastal Systems, Stellenbosch, South Africa
4. University of Gothenburg, Sweden



The Agulhas Current region

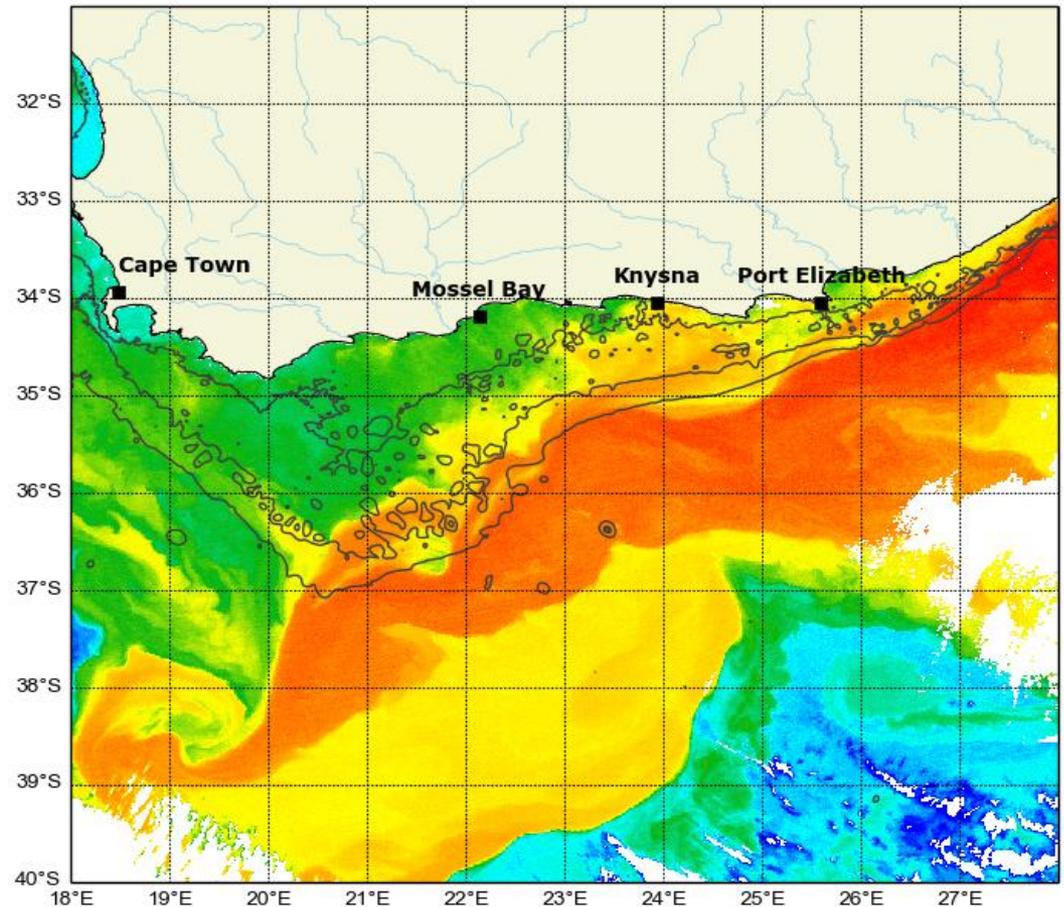


- Strongest western boundary current of Southern Hemisphere
- Large density and velocity gradients
- Flows in close proximity to the shore
- Influences coastal regions through intrusions, meanders, dynamical upwelling, mixing, transport of larvae to the Benguela
- Region of intense Wave / Current interaction
- Lies on major shipping route for oil tankers

Challenges for observations

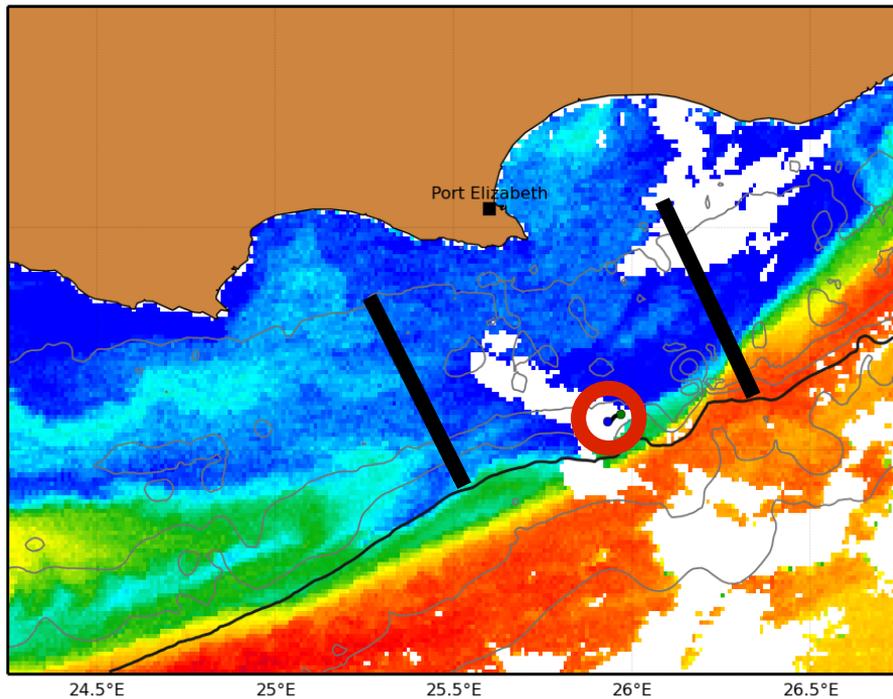


The Shelf Agulhas Glider Experiment (SAGE)
1st experience with ocean gliders illustrates some observational challenges.

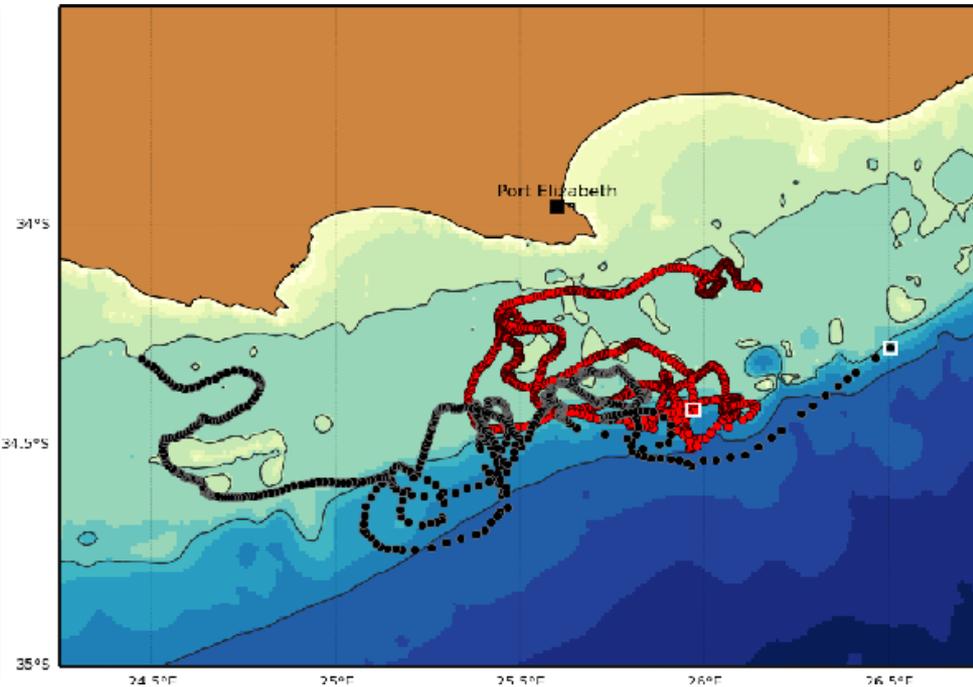


Challenges for observations

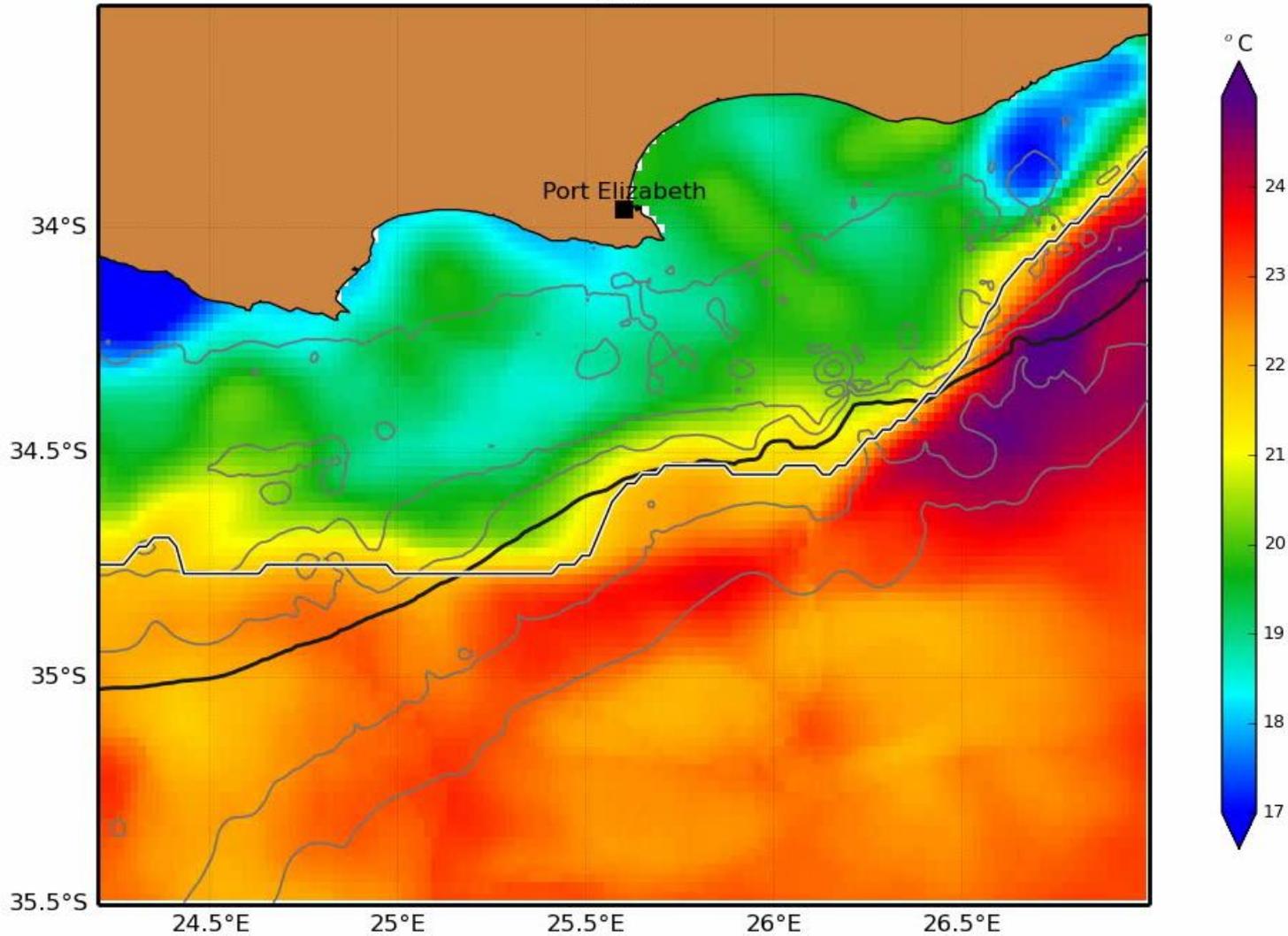
Planned sampling strategy



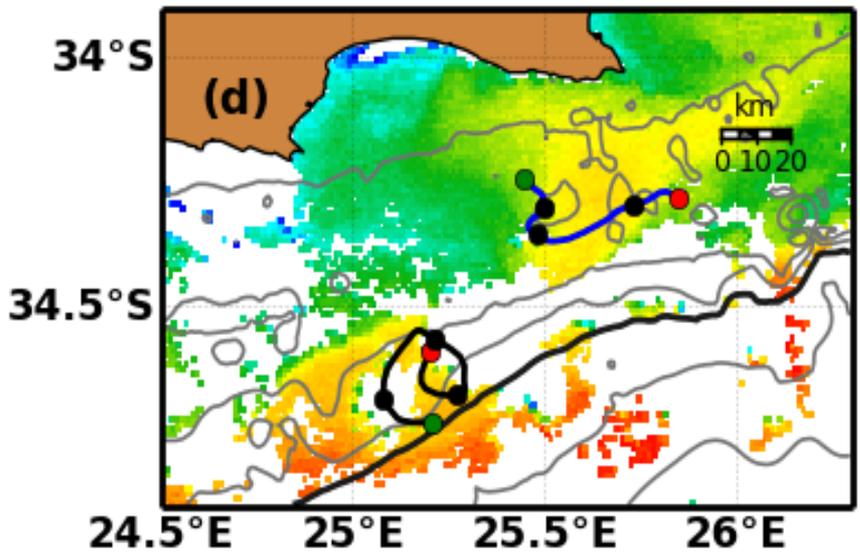
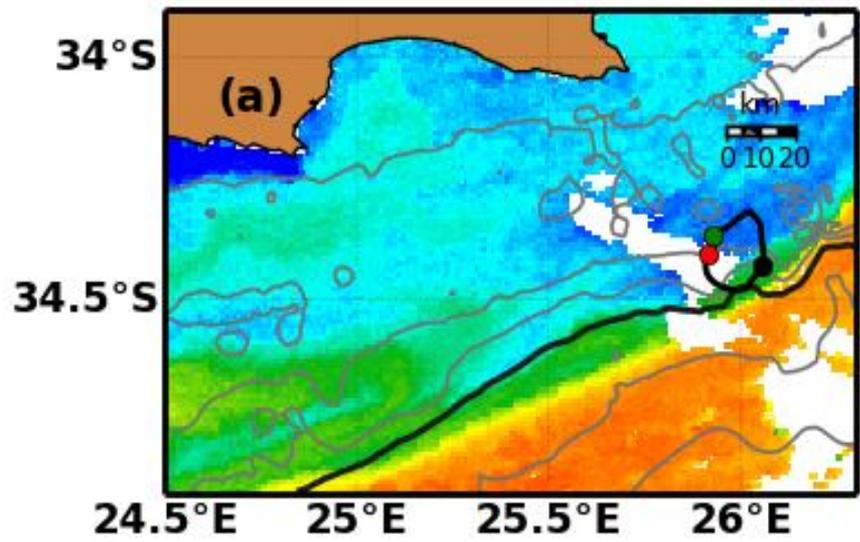
Sampled region



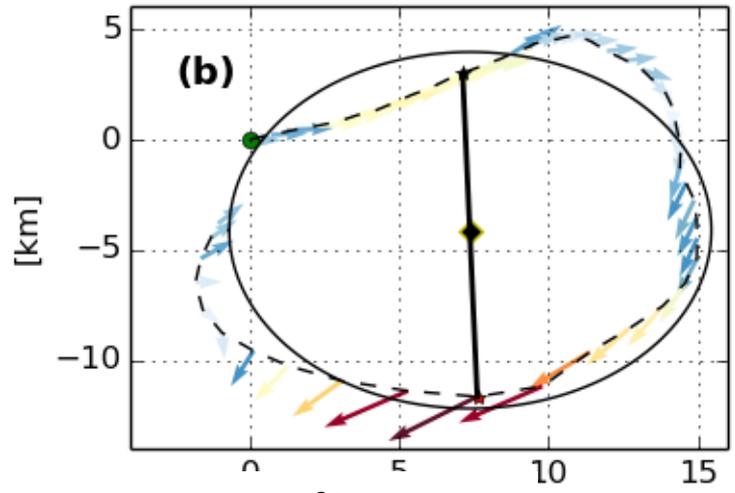
Challenges for observations



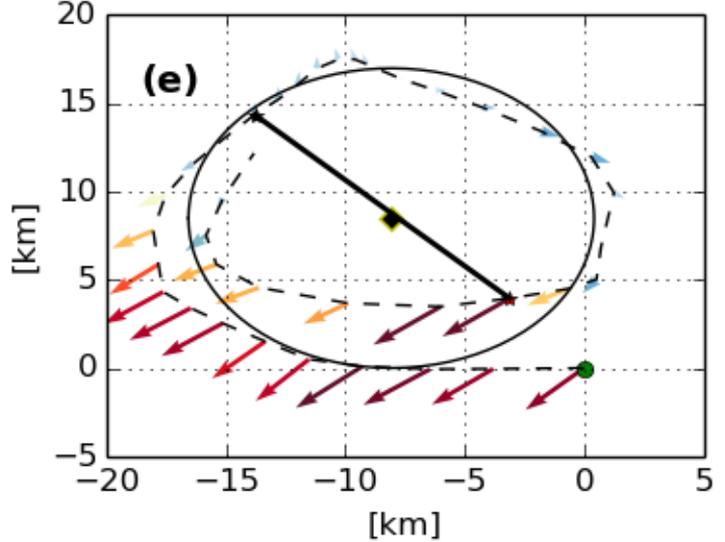
Challenges for observations



Max $\zeta/f = 1.02$

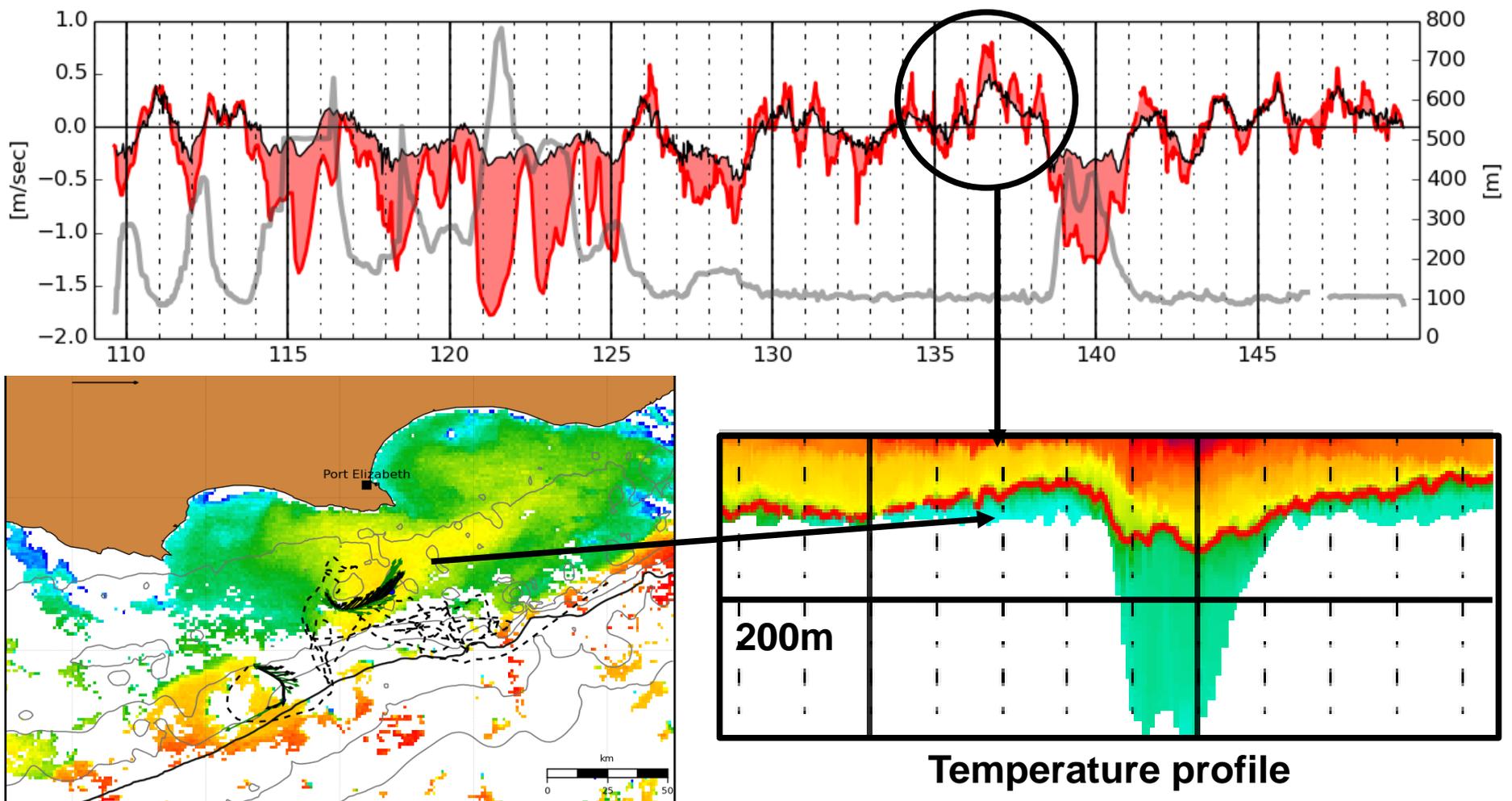


Max $\zeta/f = 1.15$



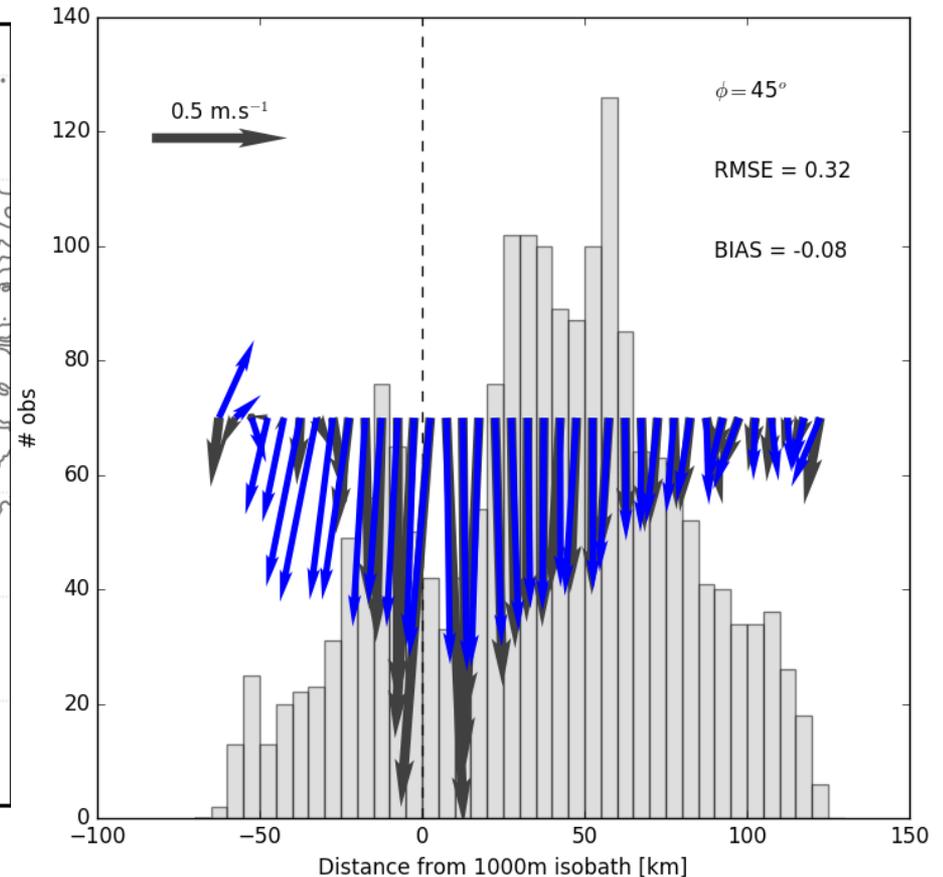
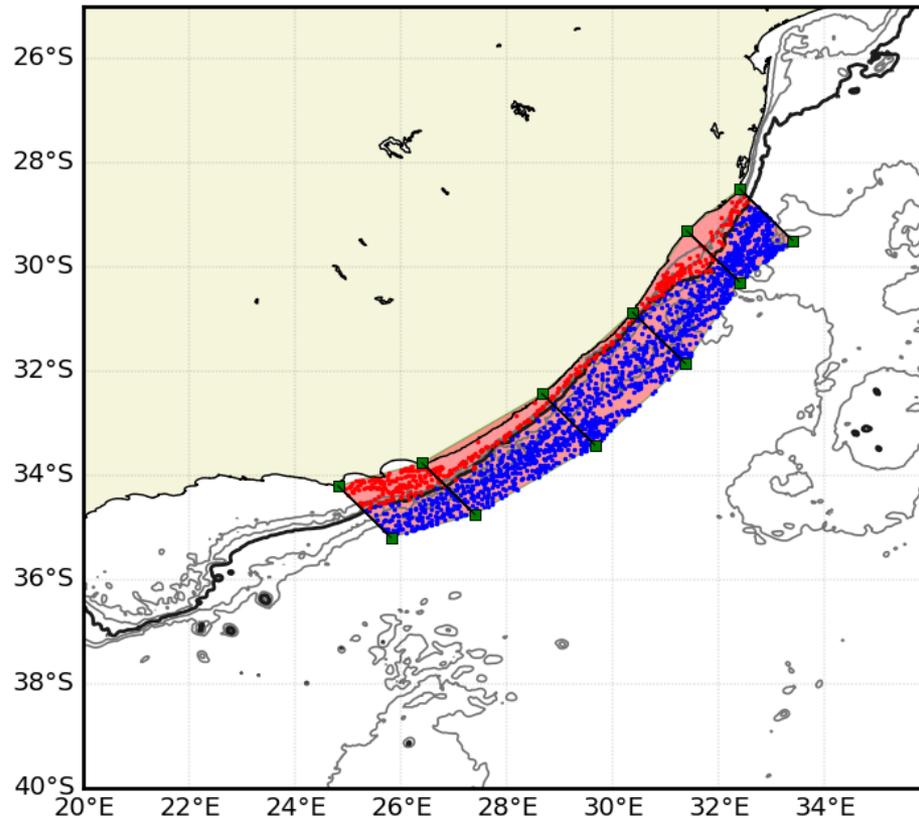
Challenges for observations

Sub-mesoscale frontal instabilities directly impact coastal regions

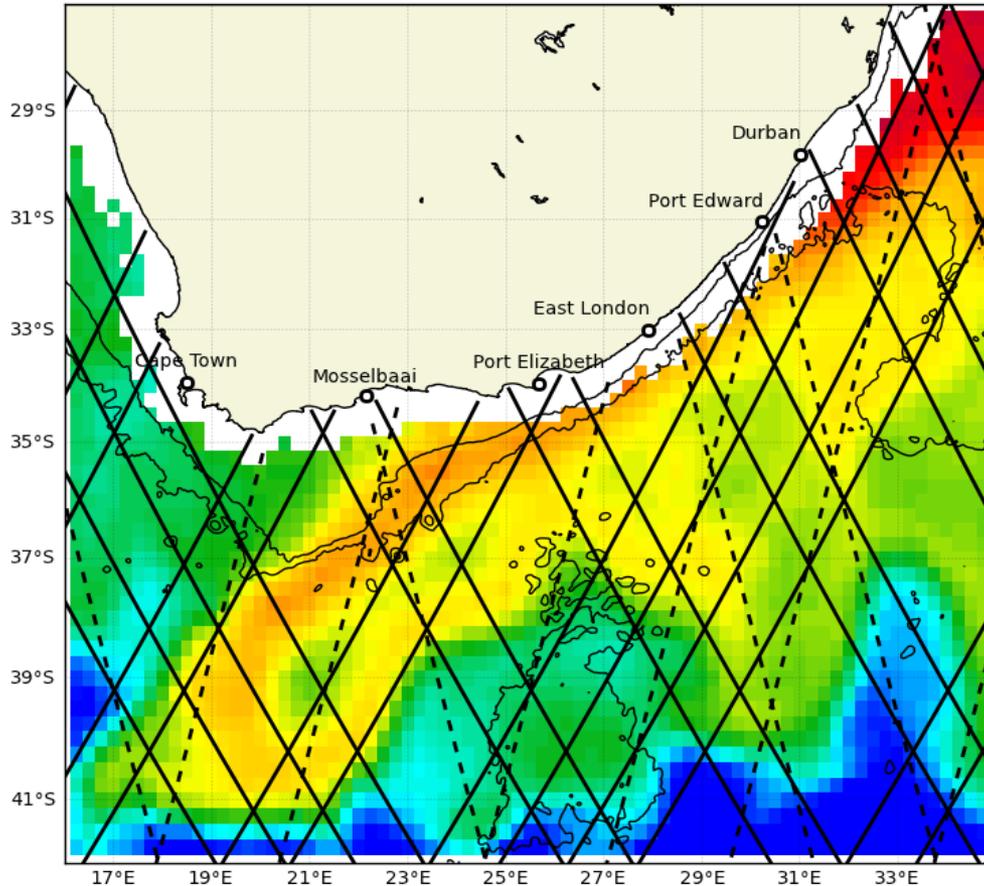


Current observations

Comparisons between surface drifters and GlobCurrent product show large biases in Agulhas Current core and near shelf and coast regions



Current observations



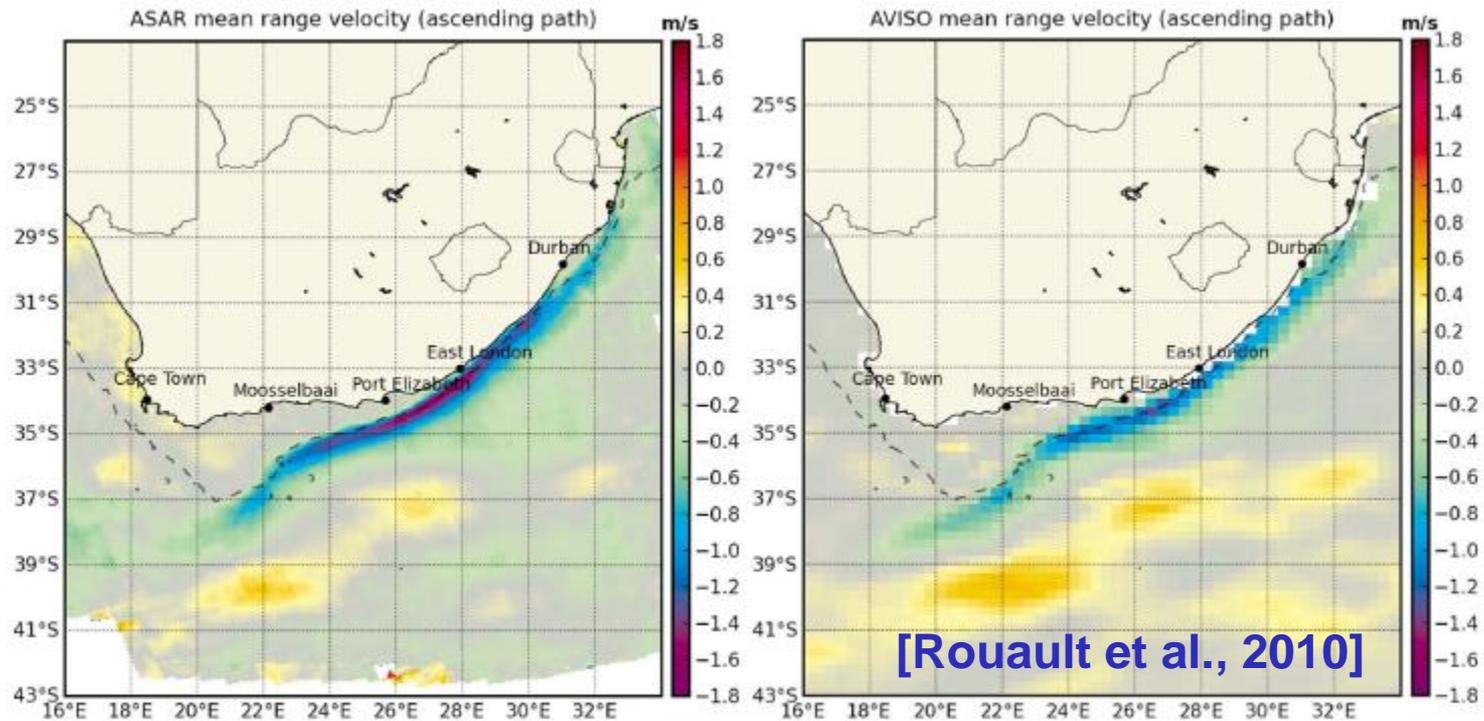
7-day coverage from a 3-altimeter configuration

GlobCurrent product is largely based on merged altimetry product.

Spatial and temporal averaging of in merged altimetry products result significant biases in current speed estimates in the Agulhas Current.

Altimetry is challenged closer to the coast (regions in white in the Microwave SST map)

Current observations



ASAR

Port Elizabeth: 1.5 m/s

AVISO (MDT 2009)

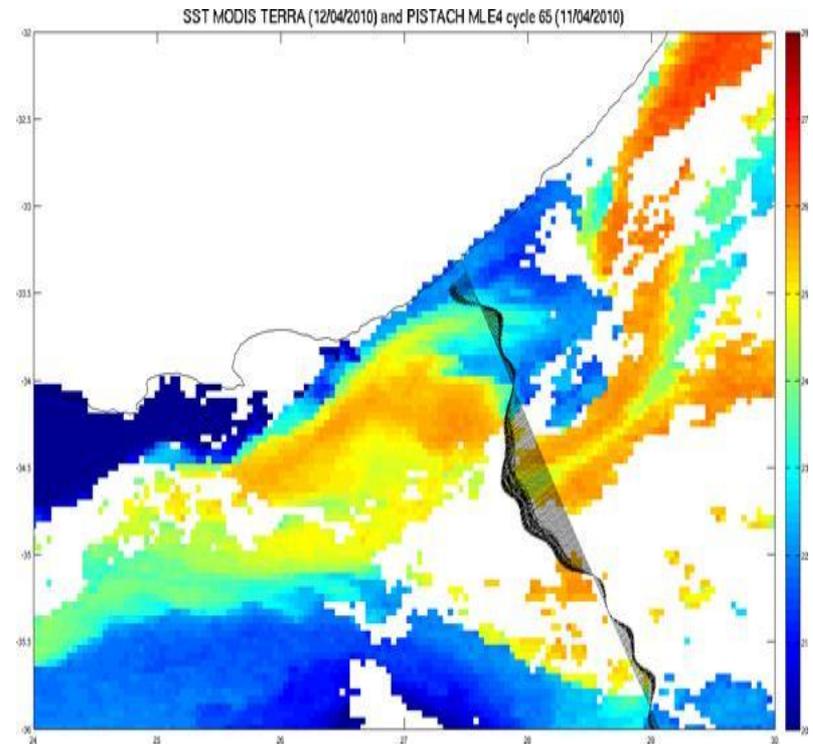
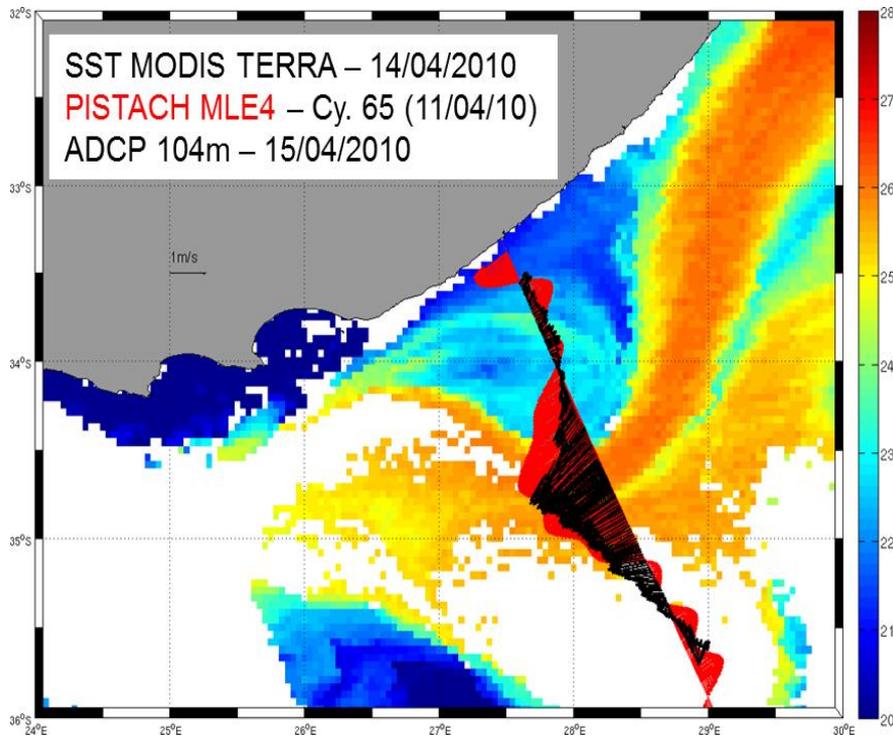
Port Elizabeth: 1.1 m/s

ACT (3 -years)
East London: 1.8 m/s

A new MDT has been derived from the ASAR observations. It could be used to improve current velocities in the Agulhas Current core.

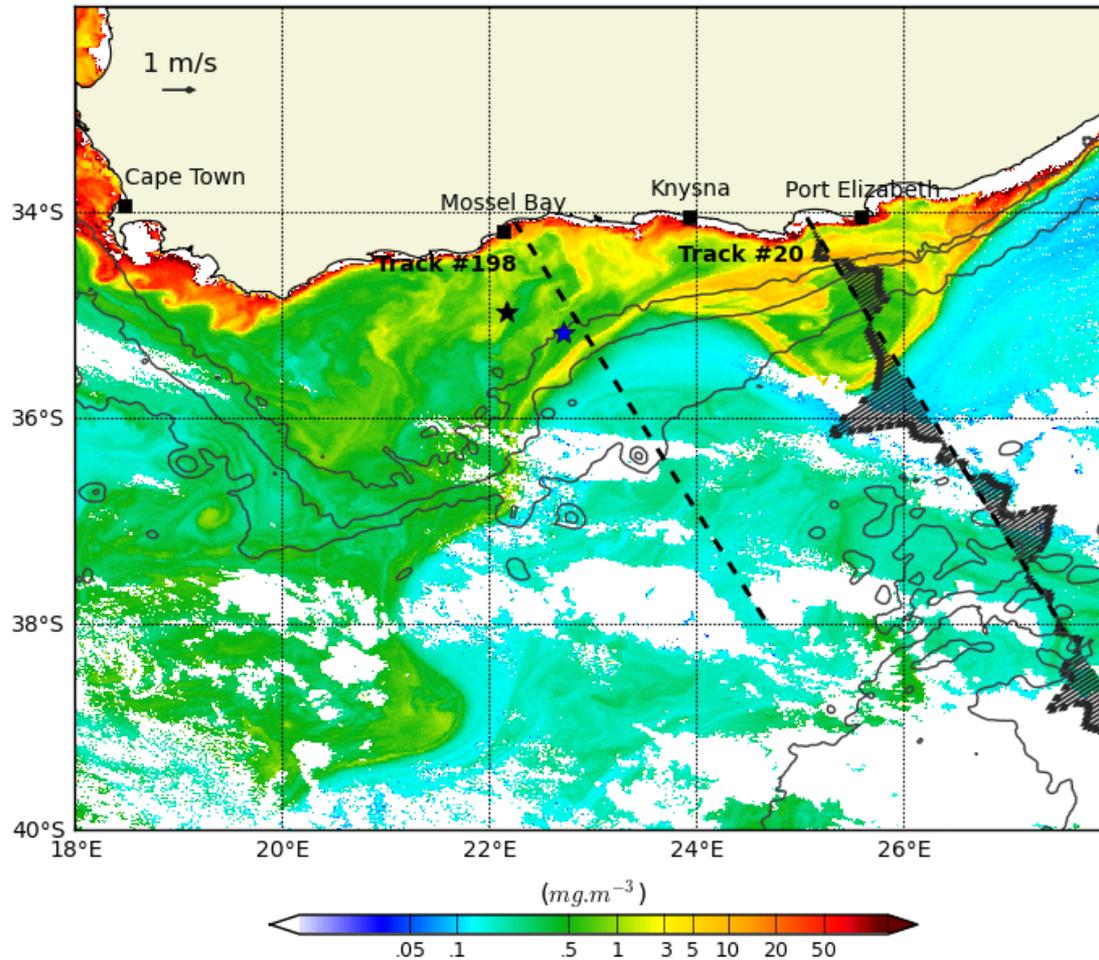
Current observations

New coastal altimetry products are improving our observations near the coast and shelf (images courtesy of Mathilde Cancet).



Evaluation of the PISTACH altimetry products in the Agulhas Current
(M. Cancet, S. Labroue, C. Dufau, L. Beal, F. Birol, A. Guillot & N. Picot)

Current observations



Comparisons between:

Absolute geostrophic current velocities from 20Hz Along-track altimetry filtered at 2.8km resolution for Track #020)

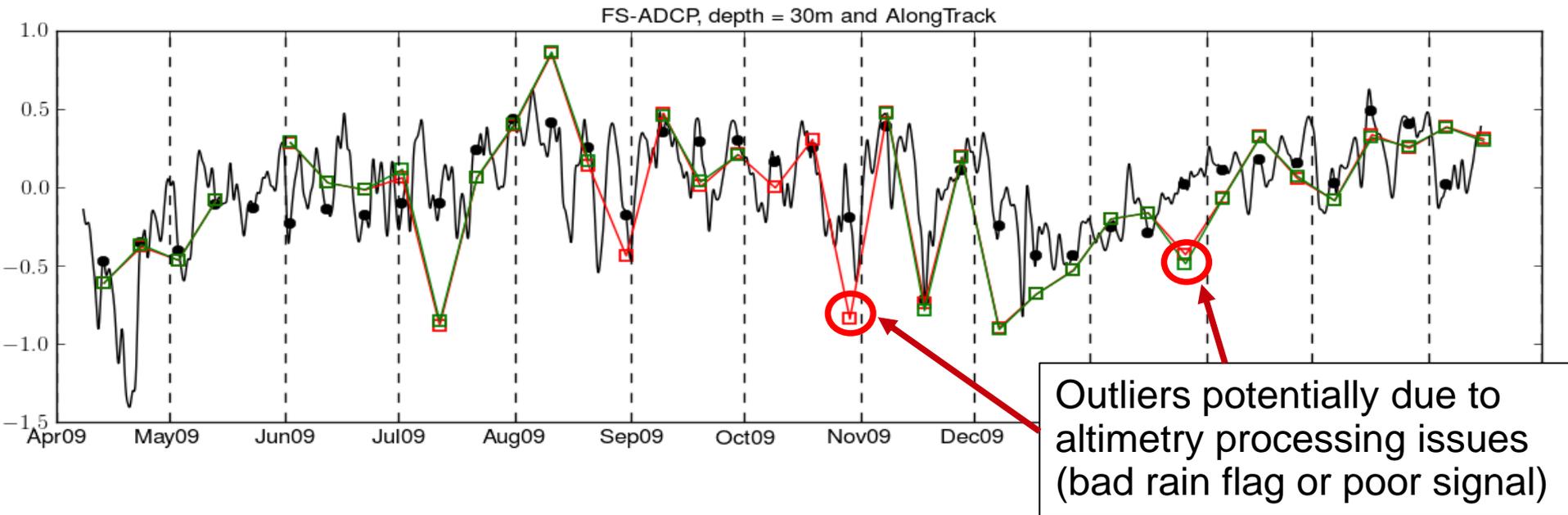
And

In-situ ADCP observations (blue arrow) moored in 250m waterdepth

In-situ data low-passed filtered with 36H cut-off to remove tide and inertial forcing variability

[Krug et al., 2014]

Observing currents



ADCP = black line and round black dots

Altimetry = squares. Red = geostrophic. Green squares = geostrophic+ ekman

Altimetry: mean bias: -0.06m/sec and rmse: 0.27m/sec

Altimetry+ekman: mean bias: -0.04 m/sec and rmse: 0.27 m/sec

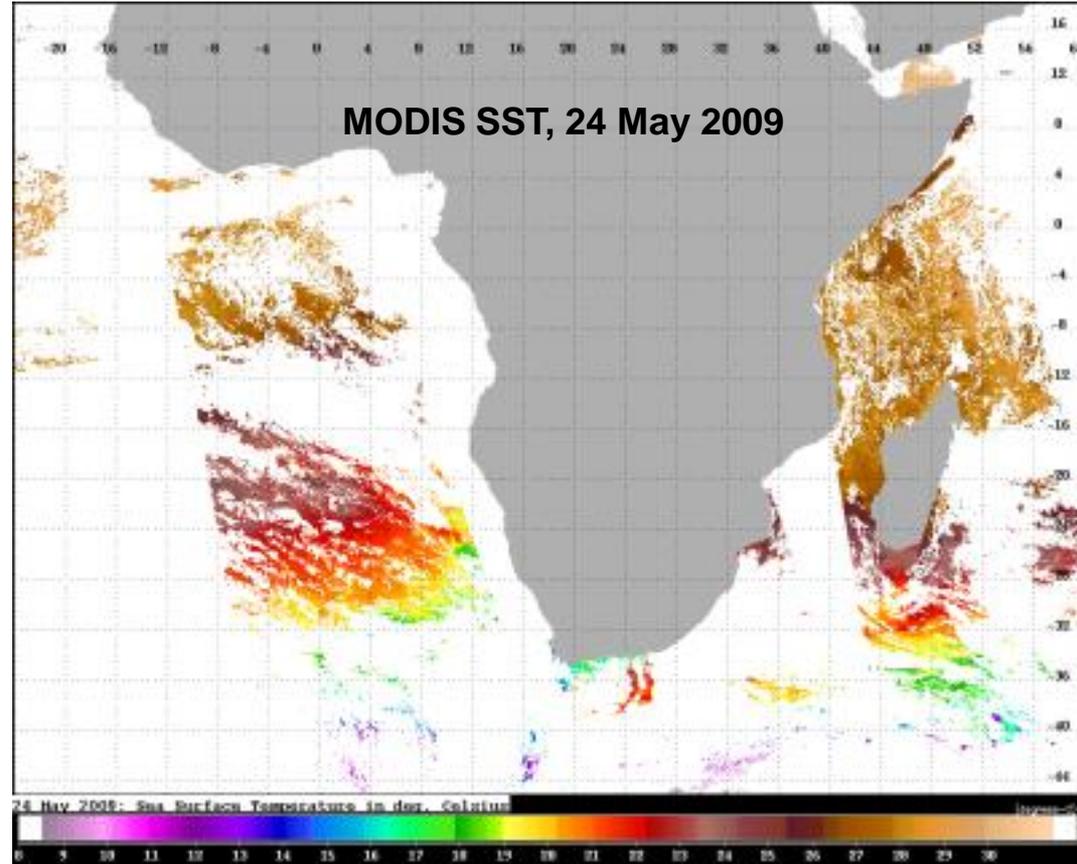
Altimetry absolute geostrophic current is fairly good agreement with ADCP measured current in the upper layer (30m) but a lot of the variability is missed.

SST 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.

But...

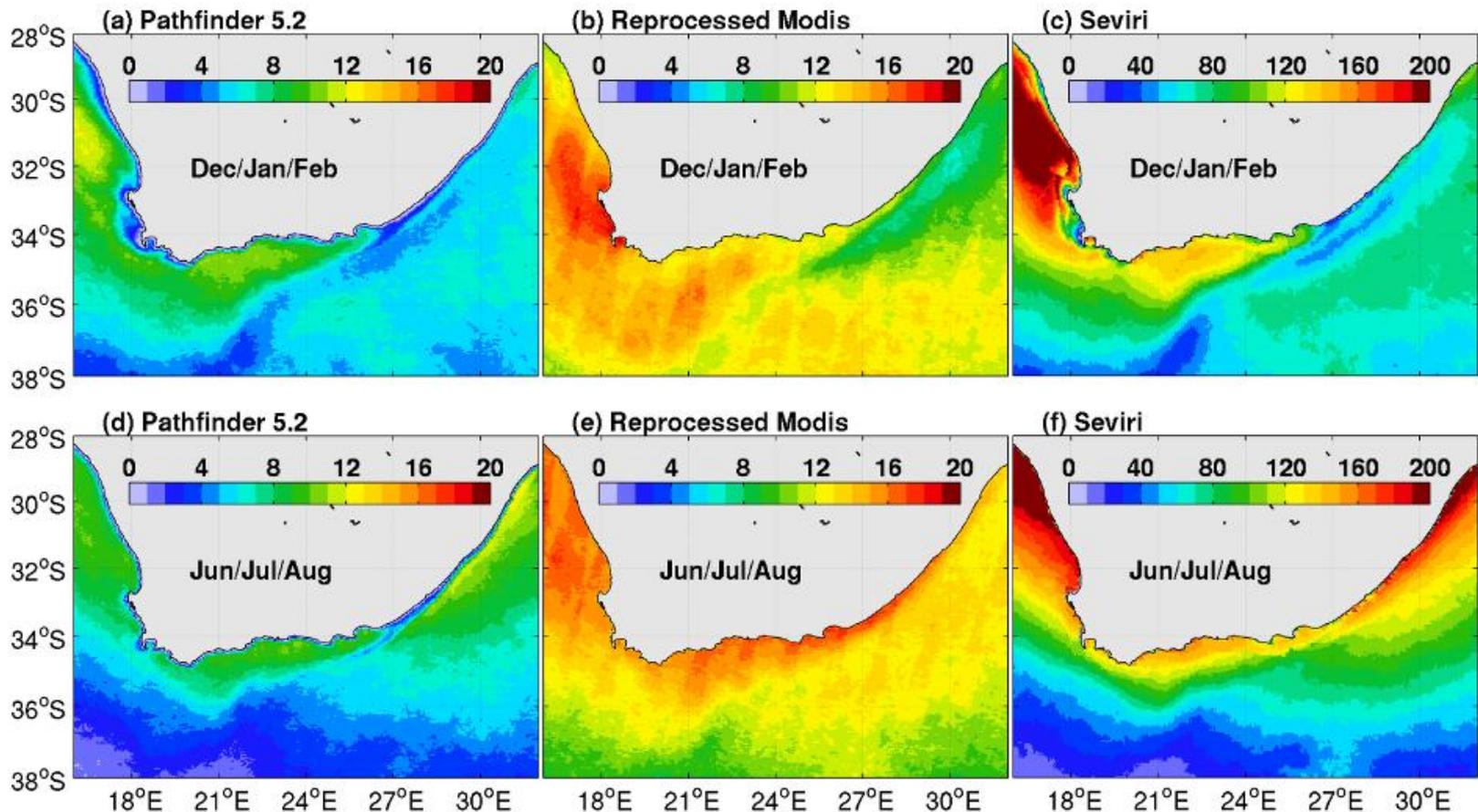
Over the Agulhas Current core, about 5 times as much water vapor is transferred to the atmosphere in comparisons to neighboring waters (Rouault et al. 2000).



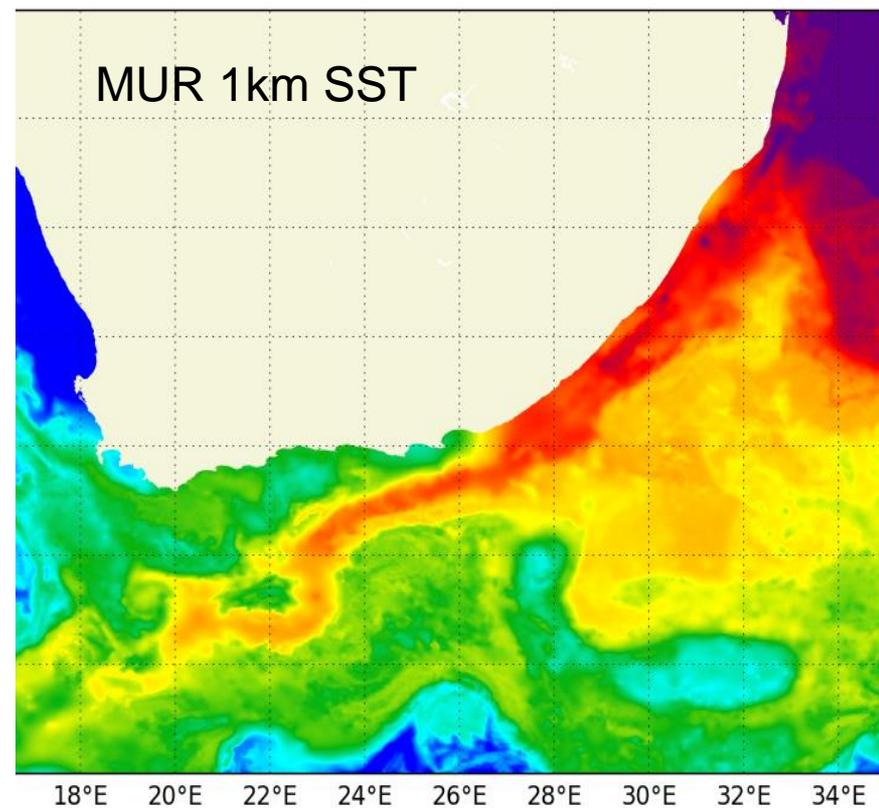
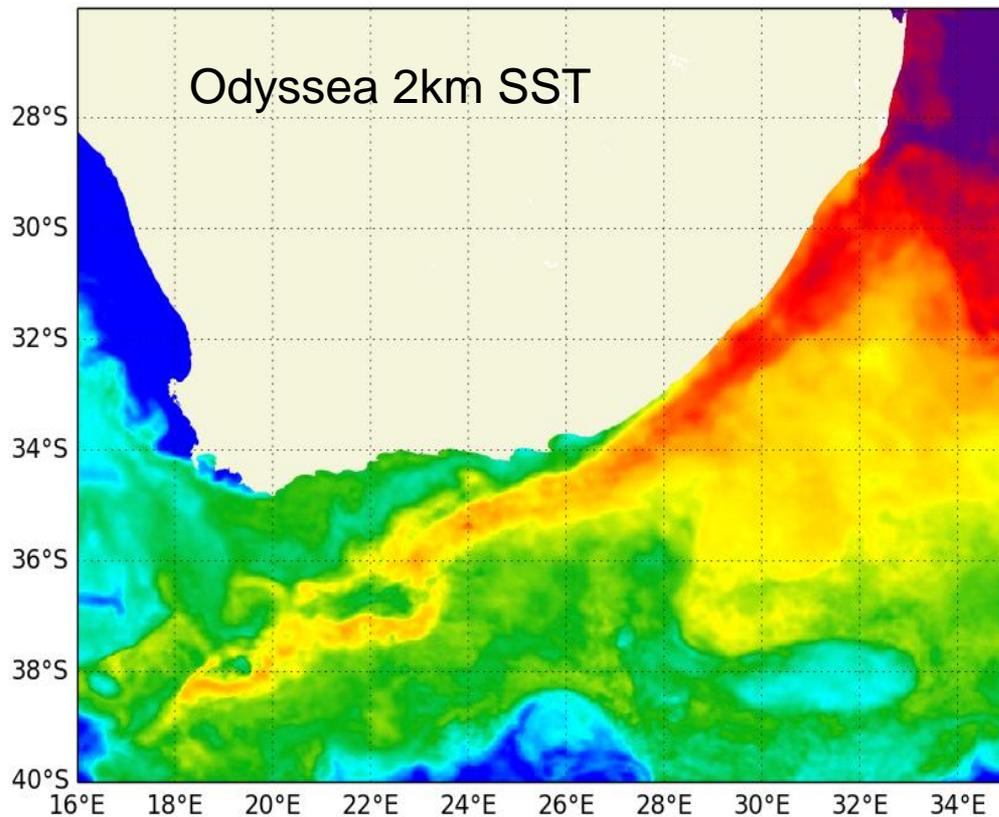
SST observations

Averaged number of unclouded SST in summer and winter illustrate the importance of cloud contamination in the Agulhas Current region.

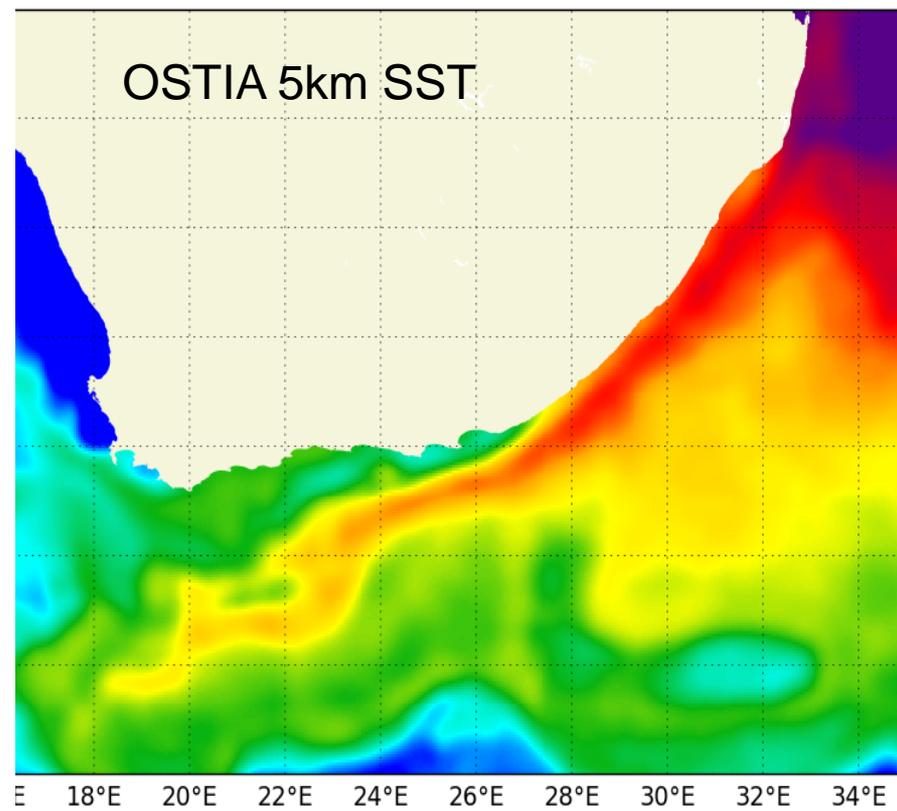
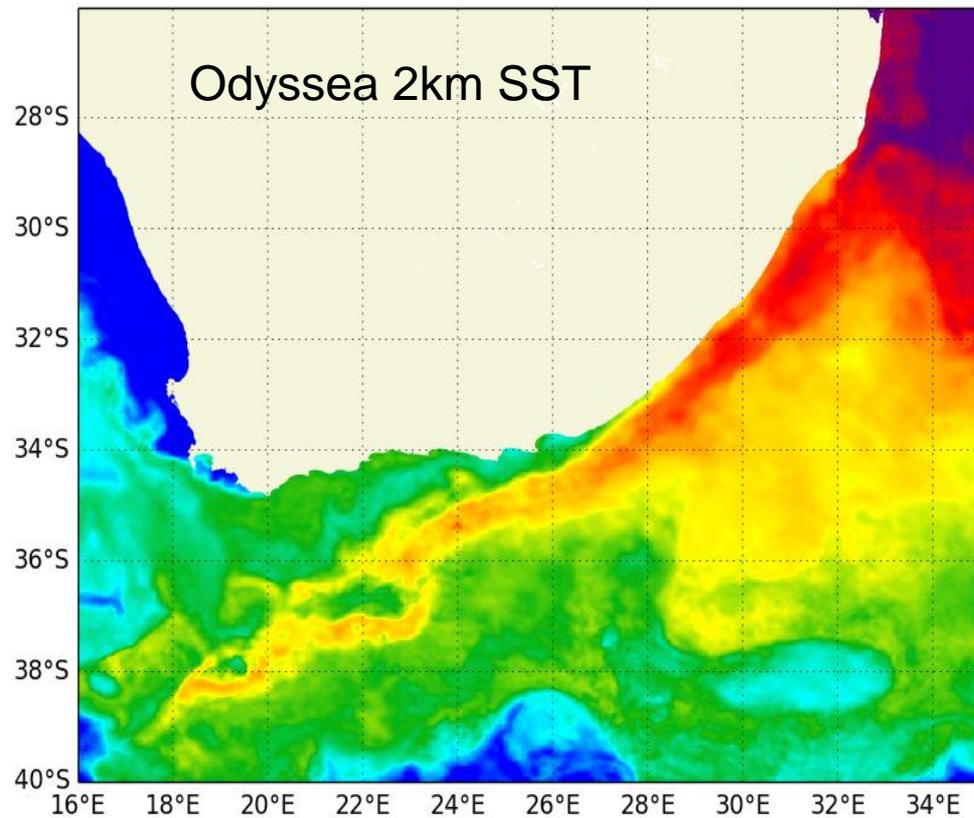
-> Cloud contamination makes use of Merged SST products attractive.



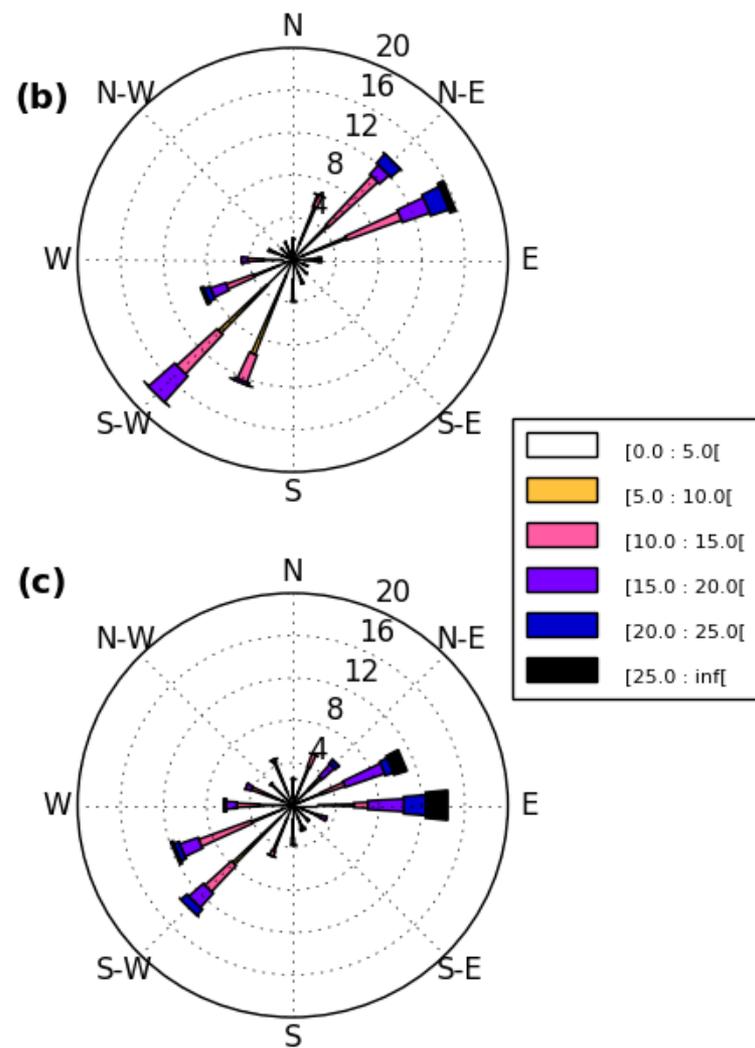
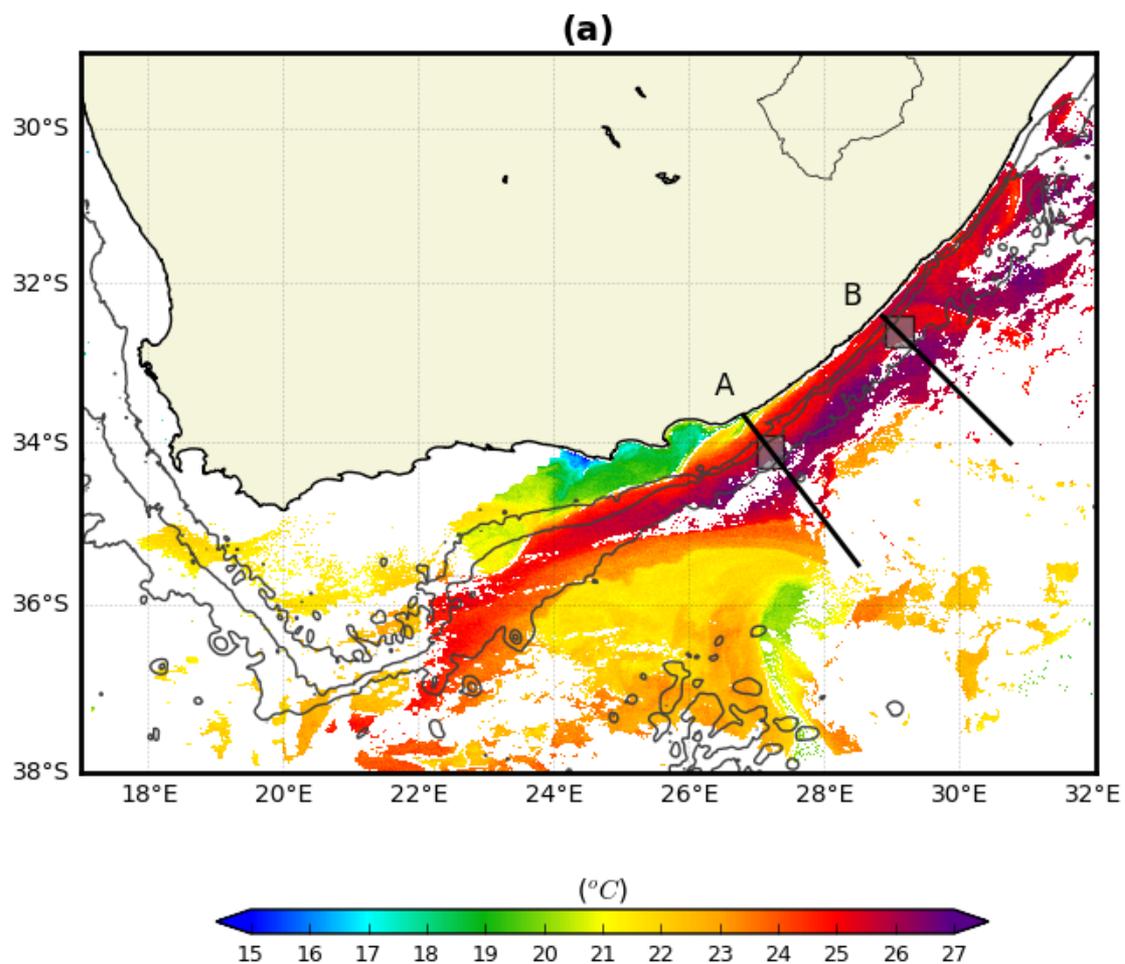
SST observations



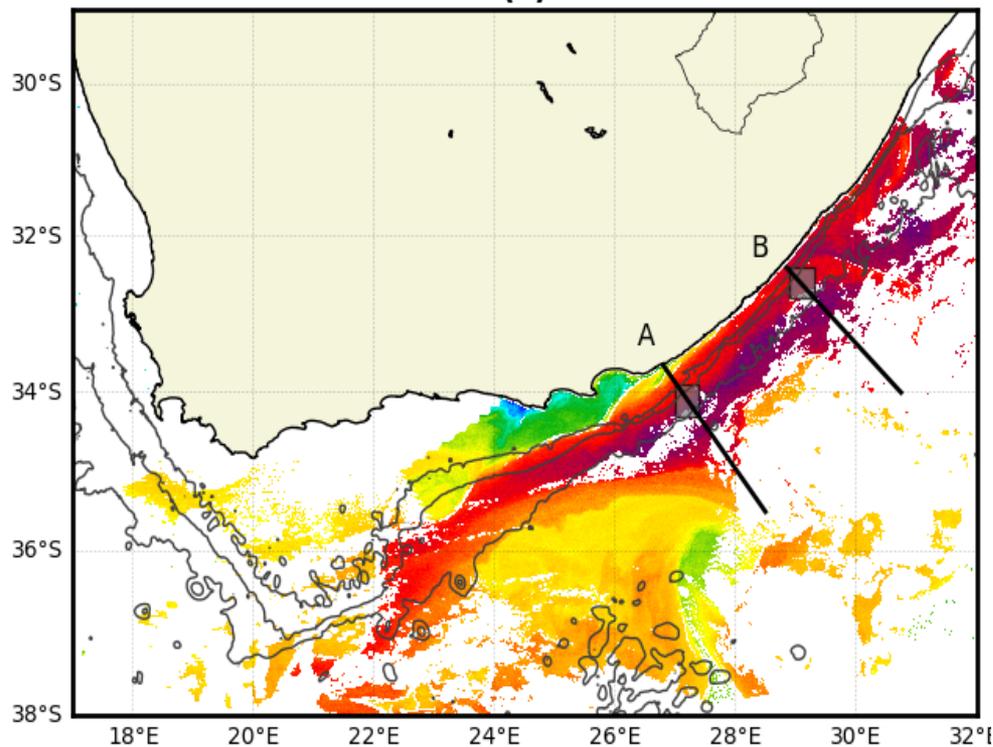
SST observations



Wind observations

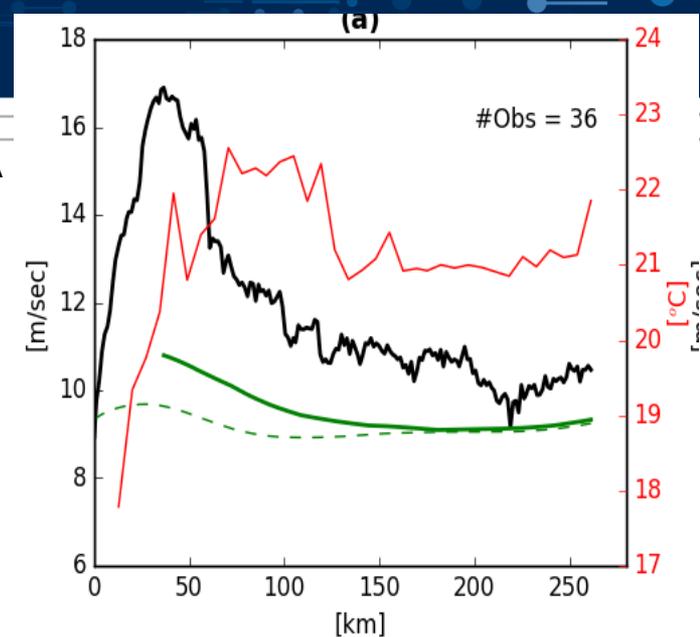


Wind observations

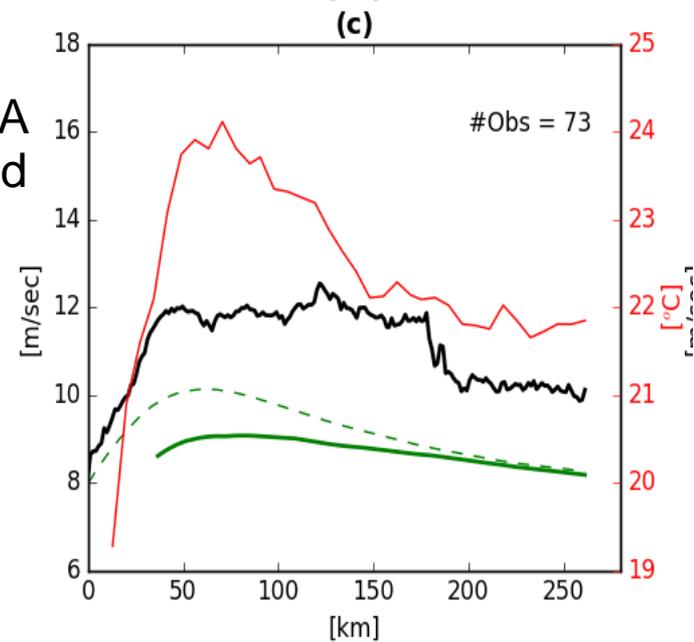


- ASAR winds
- SST
- CFS winds
- CFS winds + current effect

Transect A
Upwind



Transect A
Downwind



Future perspectives

- **Synergetic use of altimetry and SST will lead to better altimetry, effectively same effect as increasing the number of altimeters in space.**
- **SAR sensors will give in future synoptic ocean current imaging capabilities.**
- **Could be some time before we have good wind observations in regions of strong current from satellite.**
- **Ocean gliders and autonomous platforms seem well suited for these regions and their use is growing.**

Thank you



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