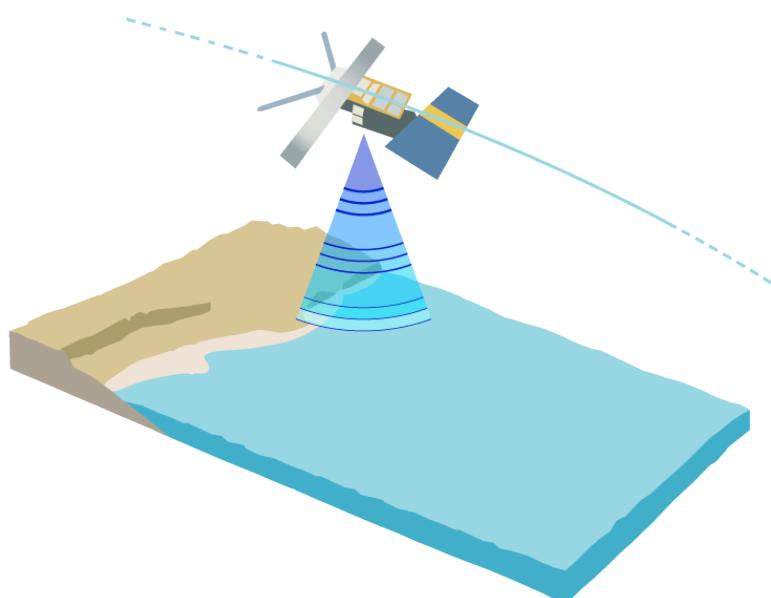
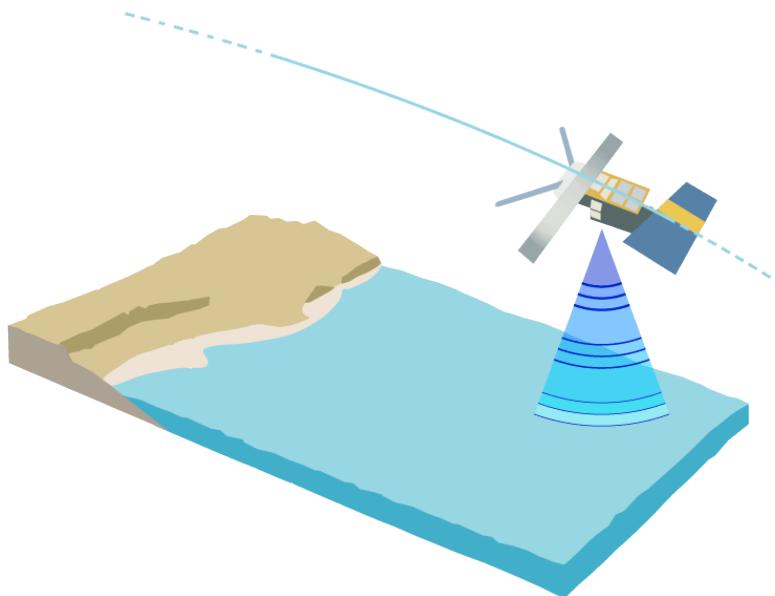




# **Coastal Altimetry: recent developments and proposed use in the Agulhas region**

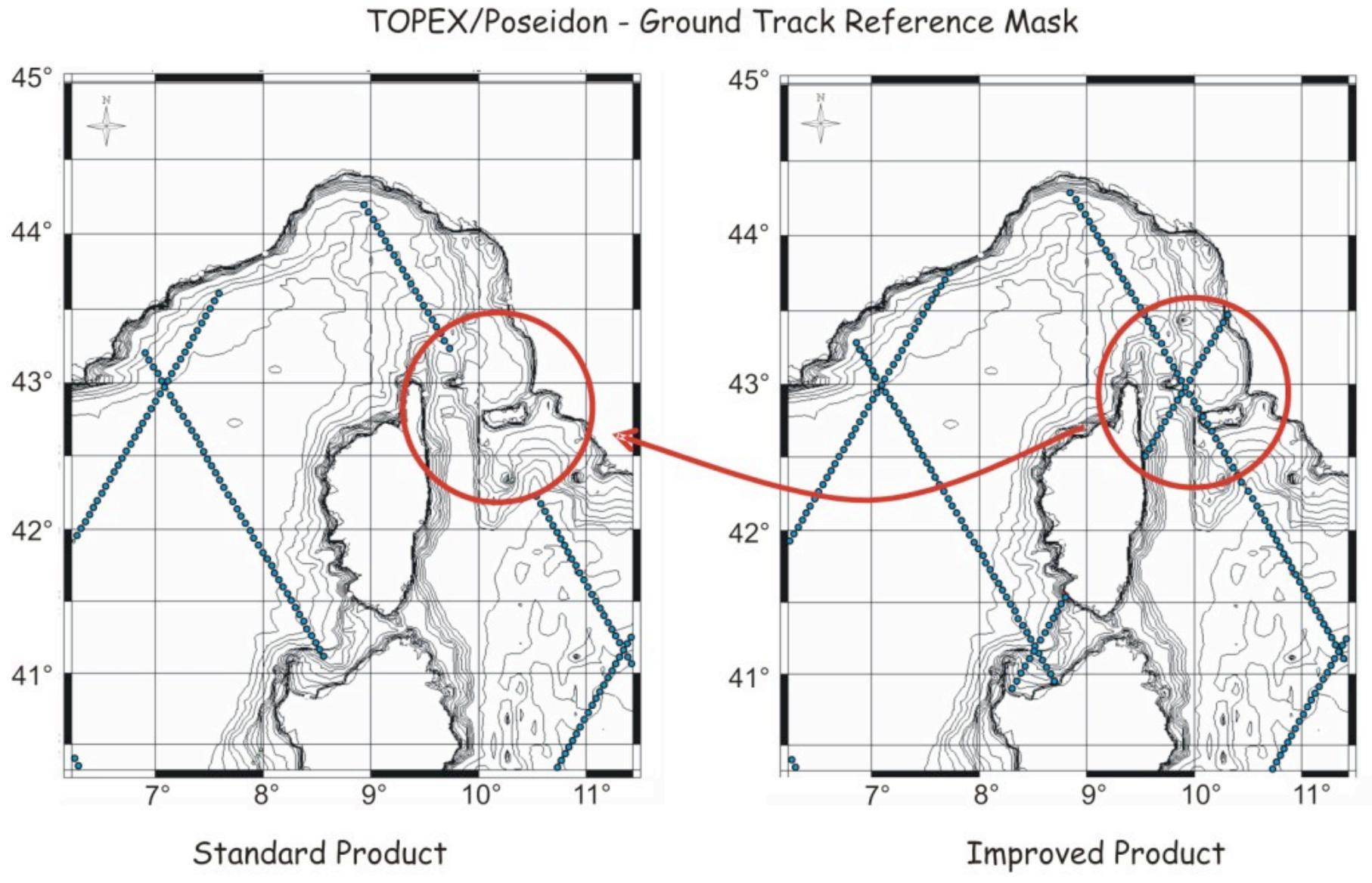
**Paolo Cipollini (NOCS, UK)**

# Coastal altimetry - the concept



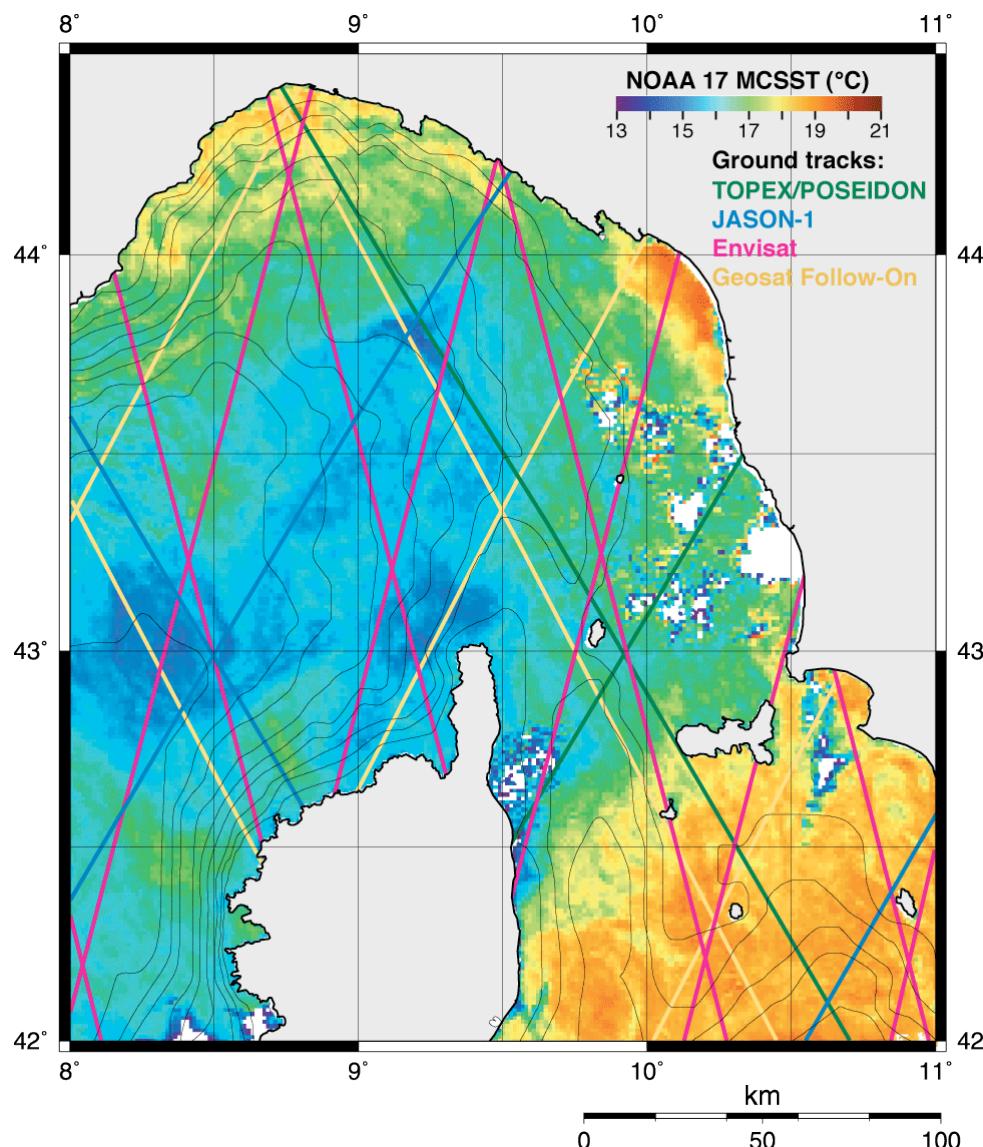
- Satellite altimetry has been designed for the open ocean
- 15 years of data over the coastal ocean are still **unexploited** and could improve our knowledge of coastal processes dramatically
  - These data are normally flagged as ‘bad’ in the official Geophysical Data Records (GDRs) for a number of reasons - non-standard waveforms, inaccurate corrections, etc.
- As *coastal altimetry* we define **altimetry over that ocean domain close to land where standard processing is problematic** (information is somehow hidden)
- We want to recover that information!

For instance - can we recover these?



**Standard editing strategy is too much conservative !**

# Coastal altimetry - potential uses



- The coastal region has **enormous socio-economic-strategic importance**
- Long term monitoring (sea level, currents, wave, wind) and climatologies - 15 years of data!
  - Integrates in situ observations (TG, currentmeters, wave meters)
  - Can provide observations where no instruments are available
- Assimilation into coastal models
  - Sediment transport and resuspension, contaminant dispersion modelling
  - Some schemes exist already: SOFA and SEQUOIA schemes
  - Might well be used in near-real-time Environmental Assessment
- In short: **a legitimate component of a coastal ocean observing system!**

# What the users want (survey by the COASTALT and PISTACH Projects)

**Modelling community** is an important user community

**Wind and Waves** matter to a good share of the users

Some scope for **near-real-time** or even **real-time** delivery of coastal altimetry

- **Provide not only SSH, but also waves and wind**
- **Get as close to the coast as possible**, and provide quality flags
- **develop delayed products first**, but compatible with the delivery of near-real-time and real-time data, as some users are interested in those too!



COASTALT is funded by ESA,  
focuses on ERS/Envisat altimeters



PISTACH is funded by CNES,  
focuses on Jason altimeters

# The collaborative framework

- ‘Pioneer’ projects were ALBICOCCA (France/Italy/UK) and **ALTICORE** (EU INTAS)
- ALTICORE also triggered:
  - ALTICORE-India
    - NIO Goa, INCOIS Hyderabad
  - **ALTICORE-Africa** (Cape Town Workshop ’08)
    - Many studies/initiatives/PhDs proposed – seeking funding now
- At end of 2007 ESA and CNES launched ITTs to support research and development in Coastal Altimetry
- **COASTALT** (ESA funded study) – led by NOCS
  - Envisat reprocessing on a number of pilot regions, processor available in late spring ’09, then hopefully extended to other regions and ERS satellites
- **PISTACH** (CNES funded study) – led by CLS
  - Jason-1 and -2, first data available on CLS FTP server



# Two main problems (and, hopefully, their solutions!)

- Land and/or specular targets (flat water patches) enter the altimeter footprint => non-standard altimetric waveforms

**Solution: RETRACKING**



~1 km  
From coast

- Some corrections to be applied to the raw altimetric measurement are inadequate (example: tides) or contaminated by vicinity of land (example: wet tropospheric correction)

**Solution: IMPROVED CORRECTIONS**



~10km  
From coast

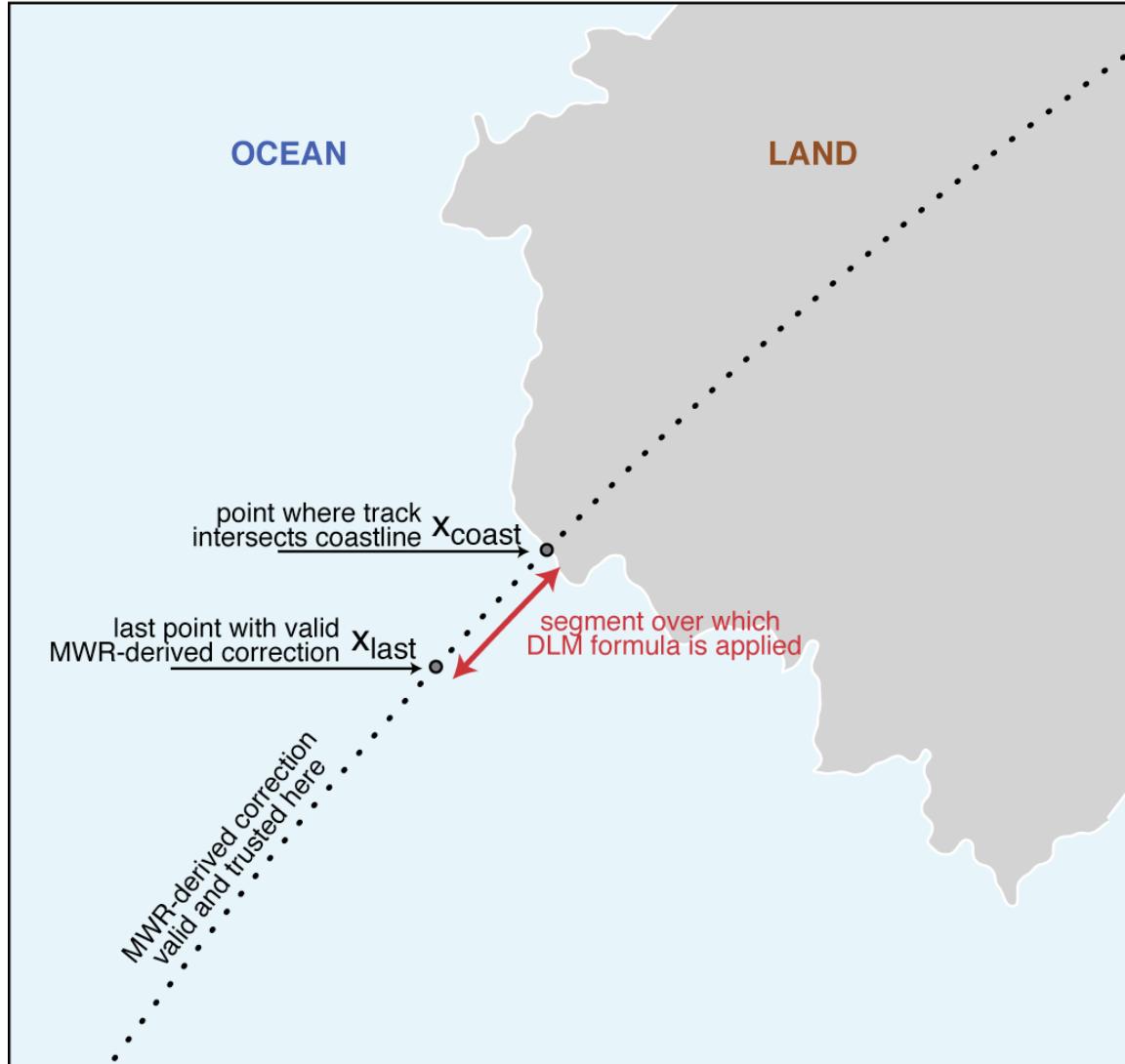
# Example: Wet Tropospheric Correction

- One of the two largest sources of errors in coastal areas (the other is tides)
- Corrects for water vapour. Over open ocean it is estimated with on-board microwave radiometer, but this has large footprint (~50Km) so is contaminated by land when close to the coast
- Three approaches to improve this correction
  - model the correction from some atmospheric model (such as ECMWF), adjusting the correction values so that there is continuity with the open-ocean radiometer-derived correction (this is the so-called **Dynamically Linked Model** approach)
  - model, and hence **remove the influence of land** for specific coastal areas in the radiometer readings such as the methods described by Desportes *et al* (2007).
  - use maps of path delay derived from **GNSS/GPS observations**

# DLM approach

- Take correction from model, ‘linked’ to last available value
- question is then on which particular strategy to adopt to ensure the continuity in the transition region
- U Porto to study this in details
- Here we suggest straightforward approach for immediate implementation in the processor
- Two cases:
  - “Long” (>60km) wet tropo gap
  - “Short” (<60km) or “ocean-only” wet tropo gap

# DLM approach example – "Single-ended" wet tropo gap

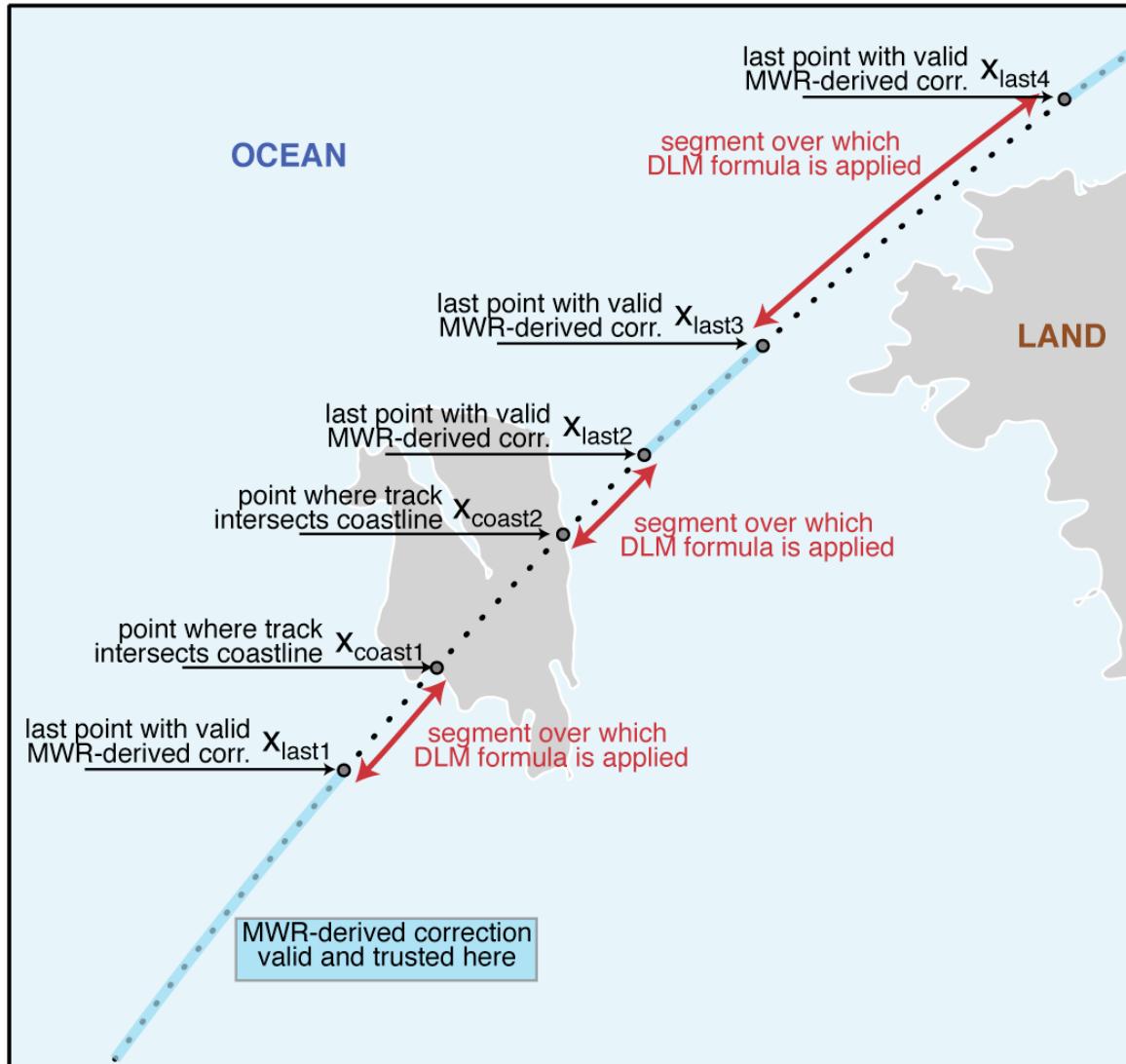


$$bias = R_{MOD}(x_{last}) - R_{MWR}(x_{last})$$

$$R_{wettropo}(x) = R_{MOD}(x) - bias$$

for  $x = x_{last}$  to  $x_{coast}$

# "Double-ended" wet tropo gap



$$bias_1 = R_{MOD}(x_{last1}) - R_{MWR}(x_{last1})$$

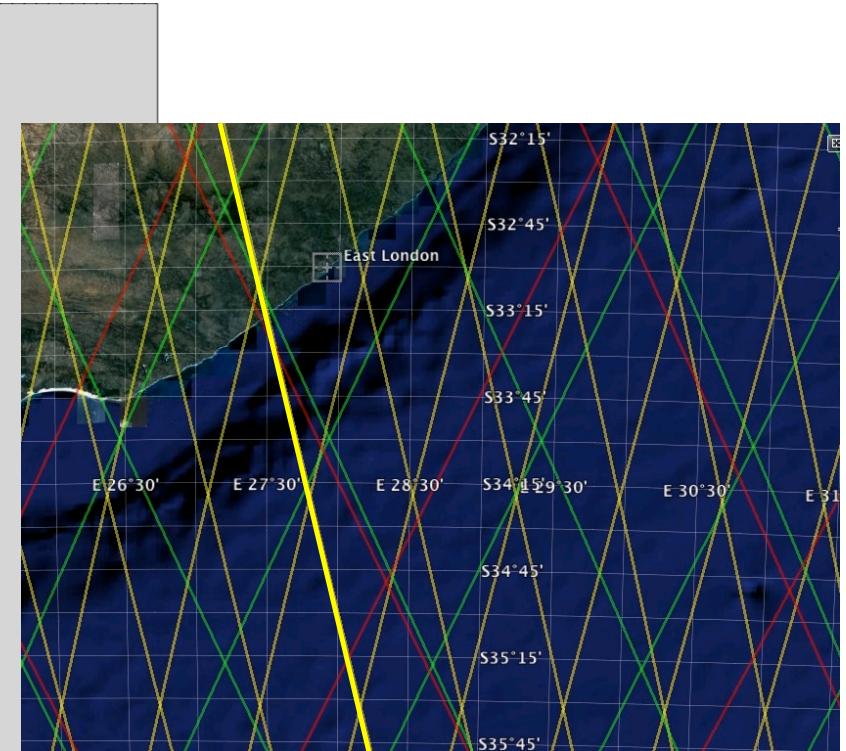
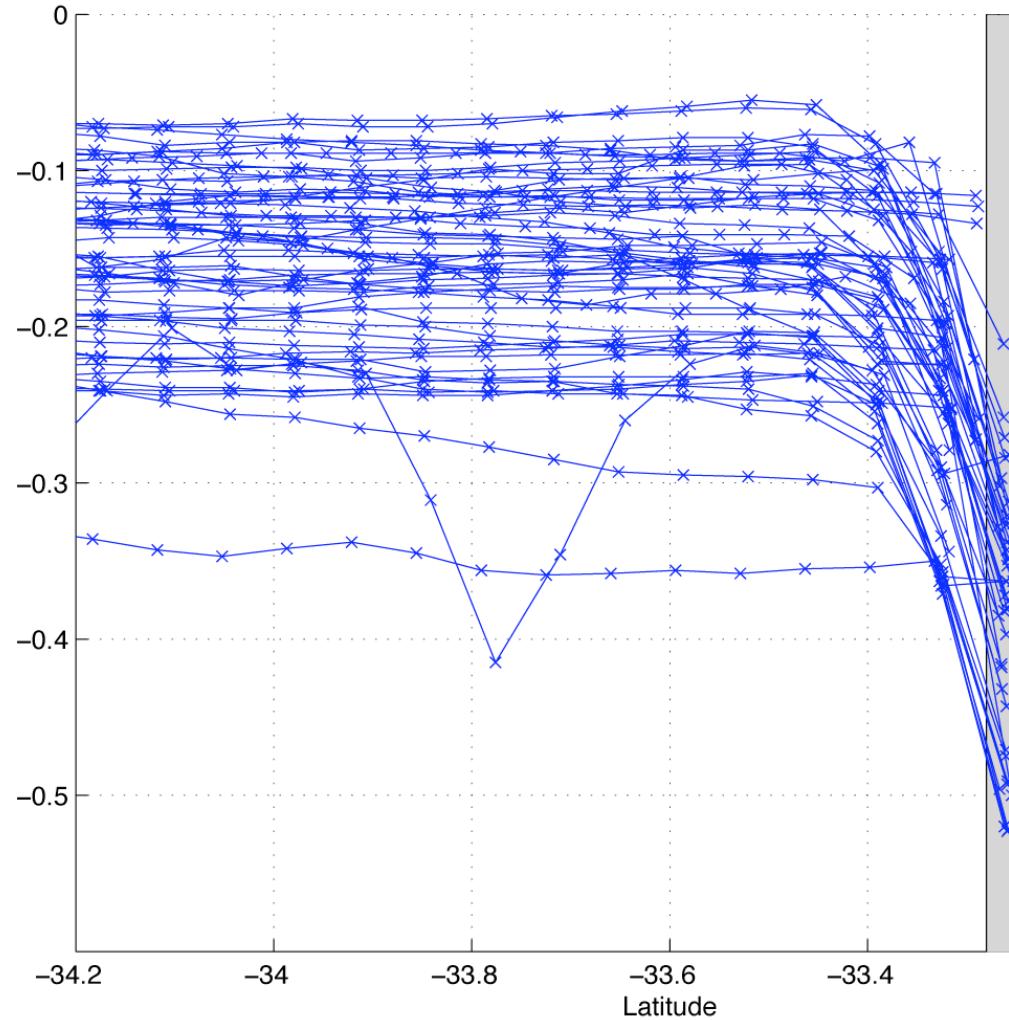
$$bias_2 = R_{MOD}(x_{last2}) - R_{MWR}(x_{last2})$$

$$\begin{aligned} R_{wettropo}(x) = \\ R_{MOD}(x) - [ (1-\alpha) \cdot bias_1 + \\ \alpha \cdot bias_2 ] \end{aligned}$$

$$\alpha = (x - x_{last1}) / (x_{last2} - x_{last1})$$

# Land Decontamination

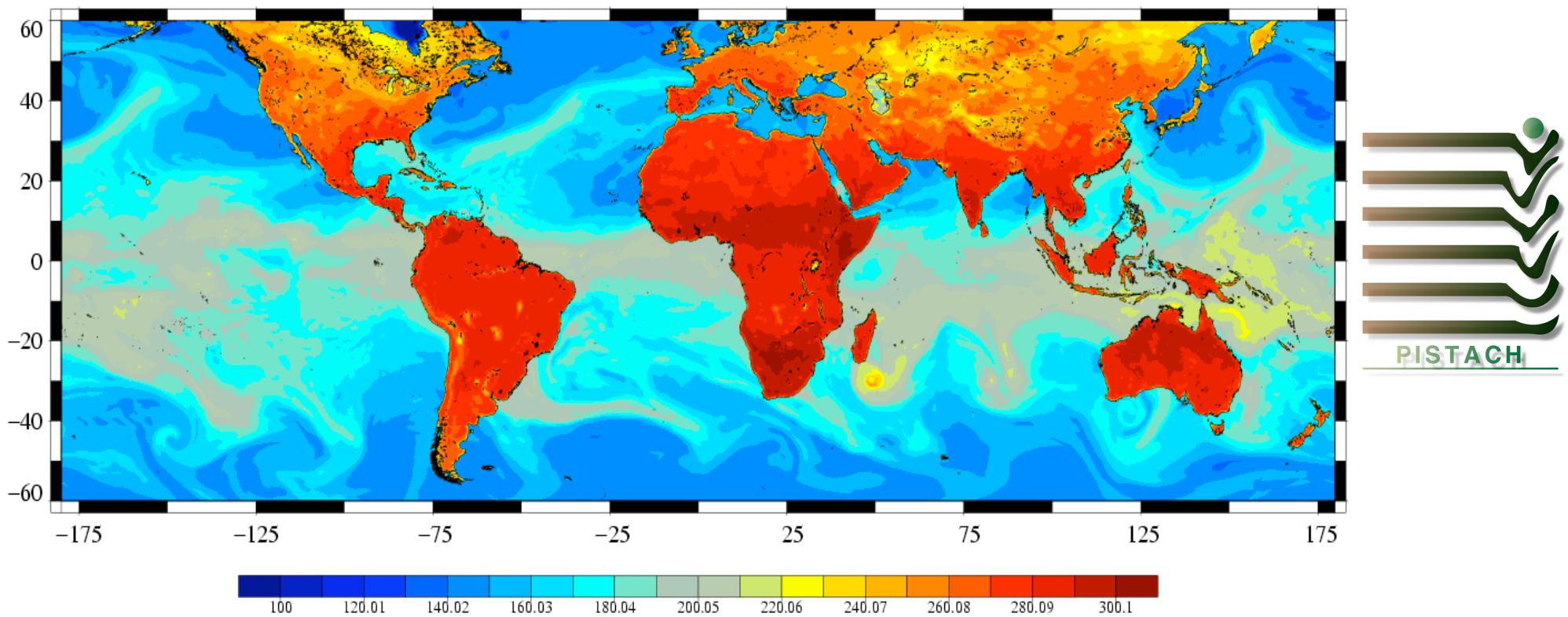
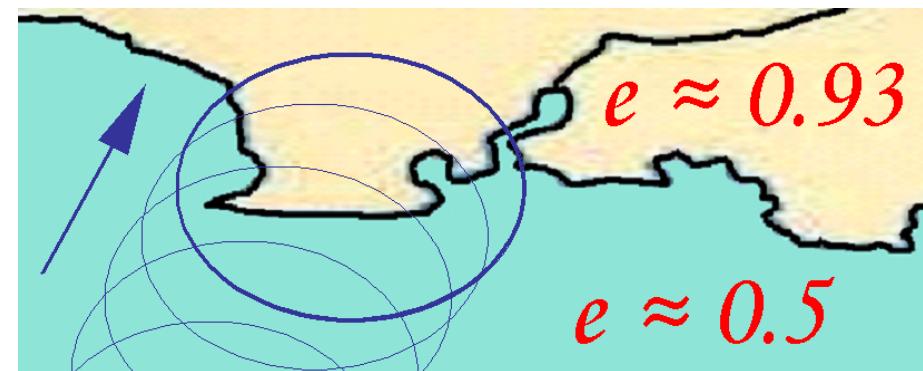
Radiometer Wet tropo correction along Envisat track 343



Plot by Joseph M. Mbui for  
ALTICORE -Africa

# Land decontamination - PISTACH

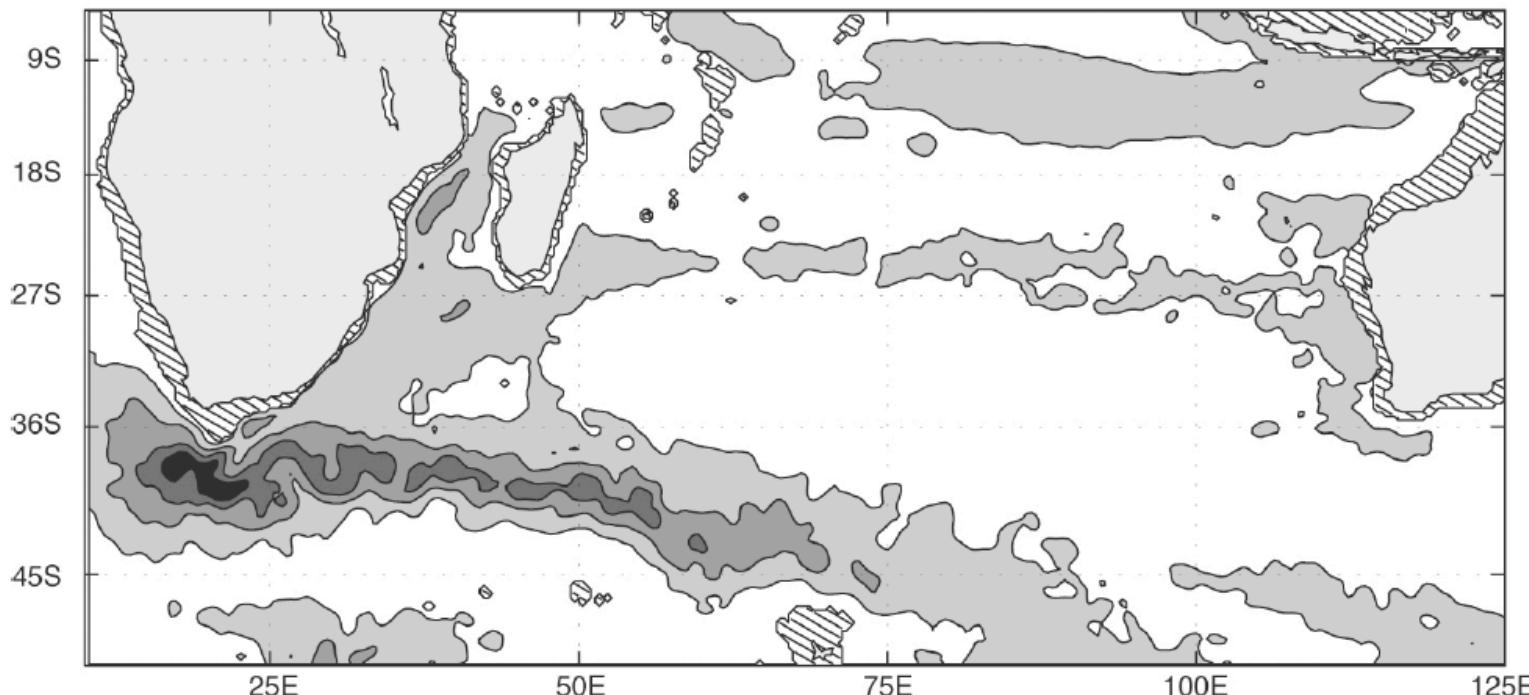
Model land contribution based on  $T_B$  climatology, remove from observed  $T_B$



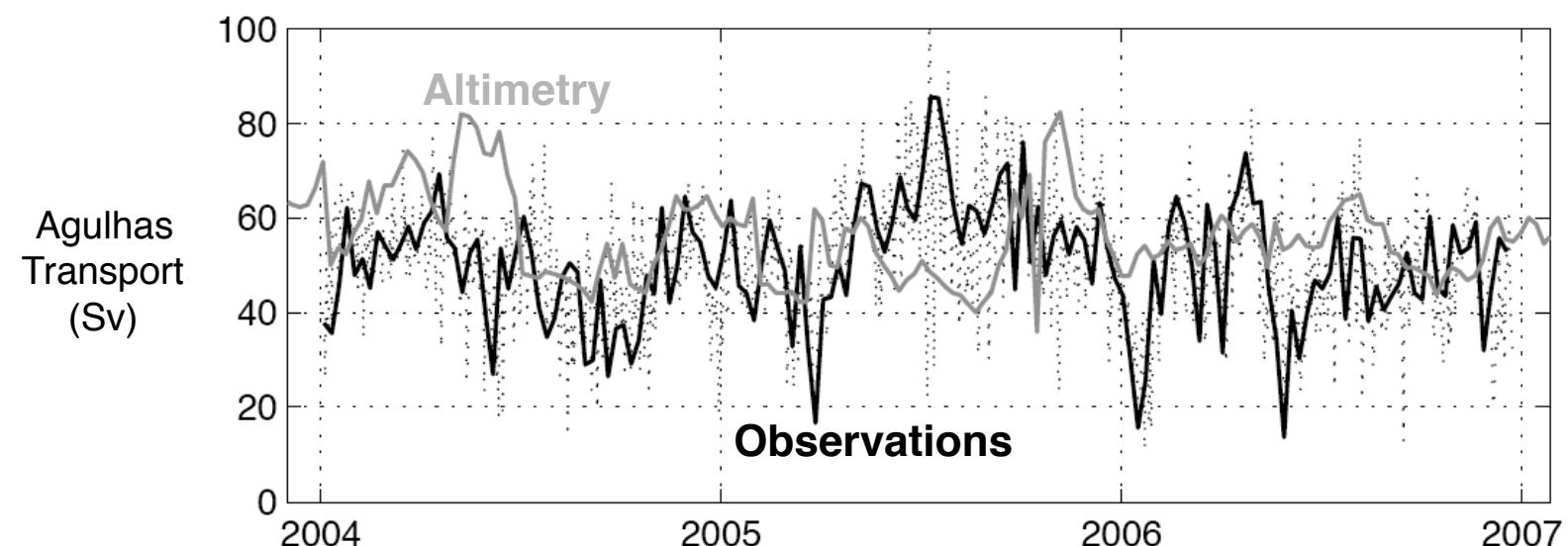
# Why use Coastal Altimetry in the Agulhas region?

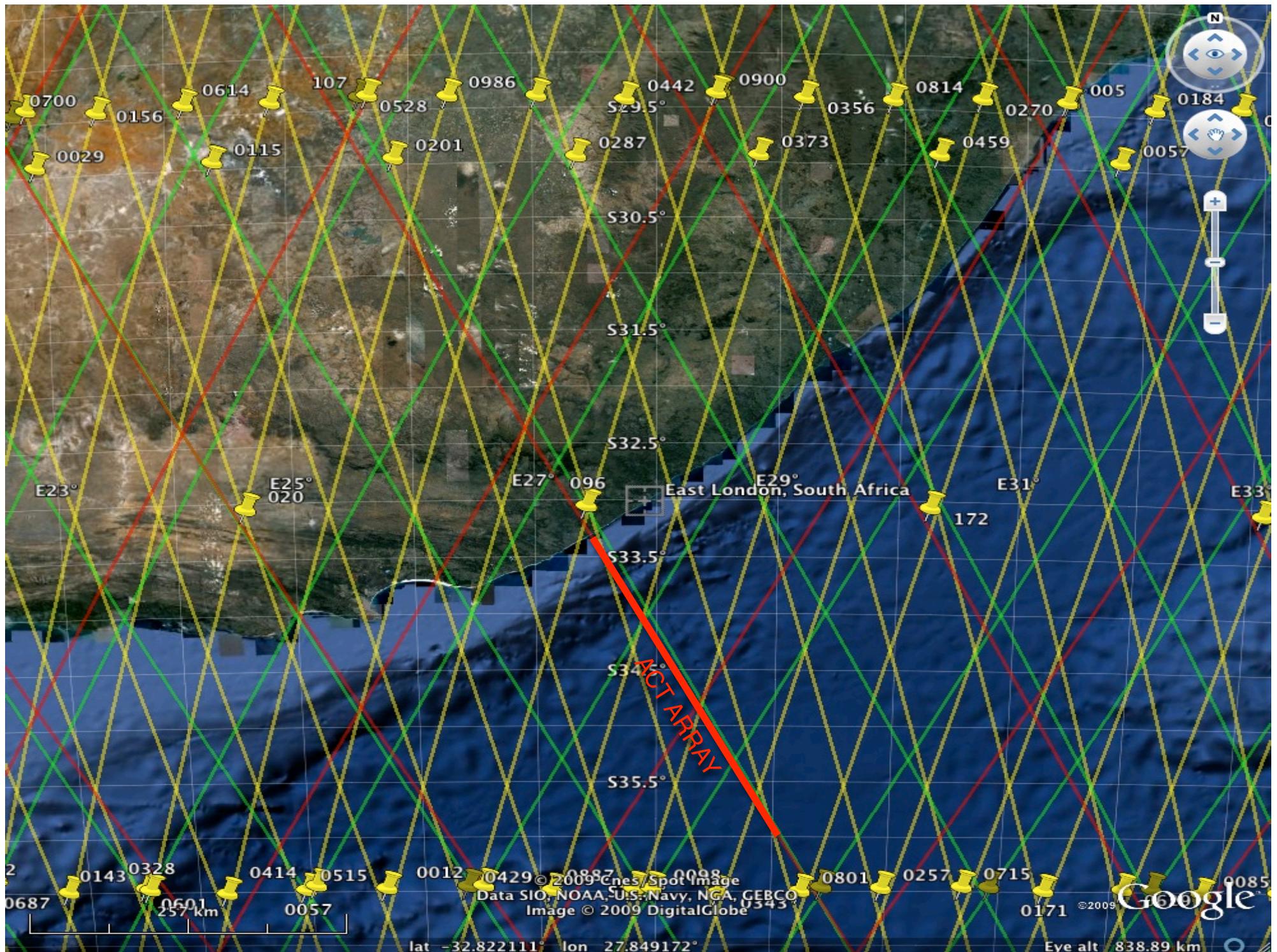
- It will **complement the existing and future observations** (including those from ACT array)
- It will extend the observations back in time (end of 1992)
- Also, the observational system makes the Agulhas region a **perfect validation case** for the new Coastal Altimetry products (and one of exceptional relevance for understanding global ocean dynamics)

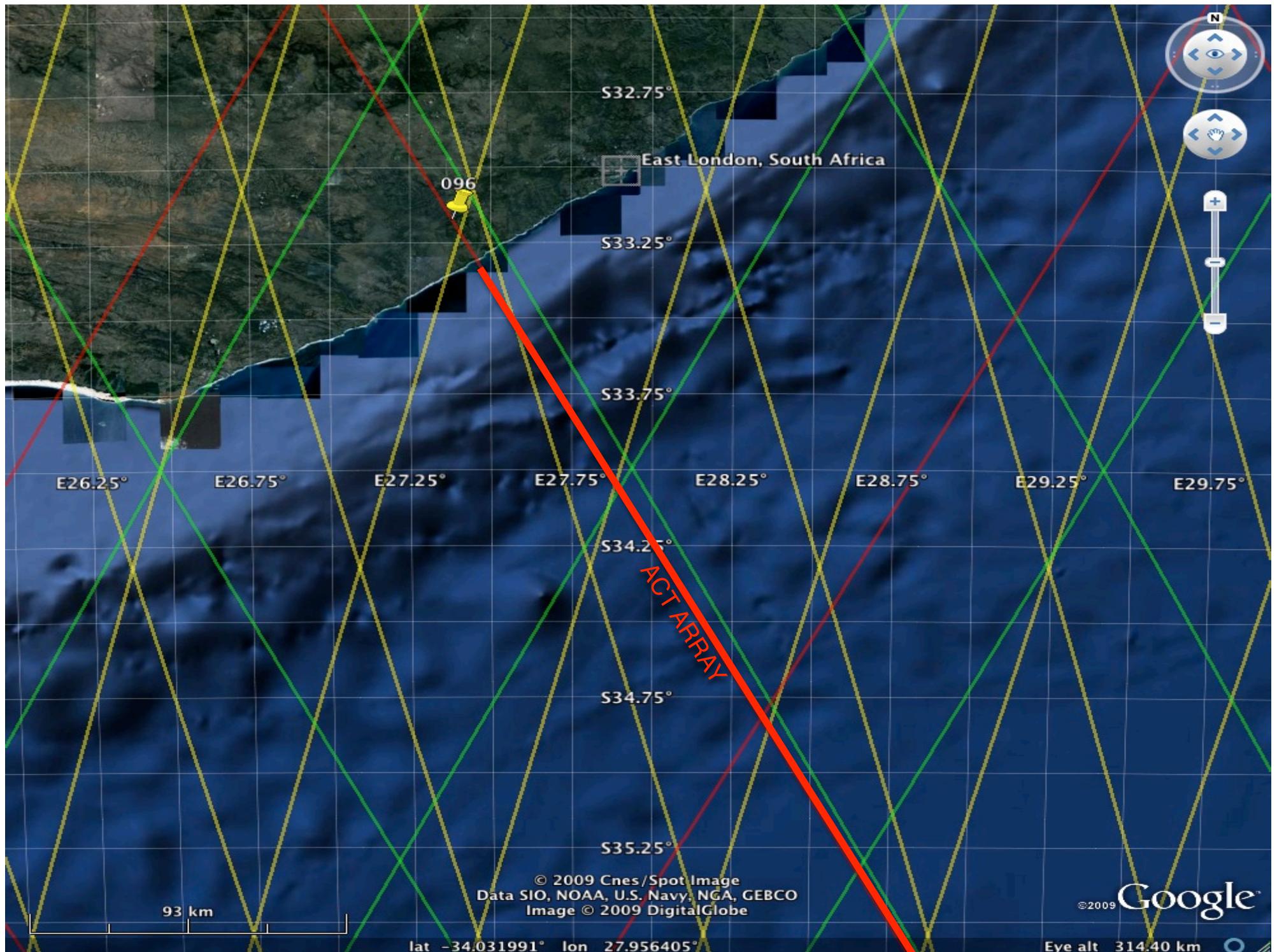
# Need to improve on this



Figures from  
Lisa Beal's  
ACT proposal







# In summary, we can ....

- Take all reprocessed Coastal Altimetry along-track data from different missions
  - training in coastal altimetry at NOCS can be offered in order to produce the best possible altimeter data set along the various ground tracks in the area.
- Do a direct comparison with ACT array...
- ..then use altimetry to extend transport estimated back to 1992
  - therefore building a multi-decadal Agulhas transport time series
- Use observations to develop regional tidal model
  - Subject of a proposed NOCS PhD within the ALTICORE-Africa framework