Comparing in situ current data with current anomalies derived from the PISTACH products

The Agulhas Current

M. Cancet & E. Jeansou
NOVELTIS

S. Labroue & C. Dufau
CLS

F. Birol & R. Morrow
CTOH/LEGOS

L. Beal
RSMAS

A. Guillot & N. Picot
CNES

- Context:
  - Using geostrophic current anomalies derived from the altimeter data to observe the coastal currents or meso-scale structures is very challenging.
  - PISTACH project:
    - Funded by the CNES
    - New processing methods and corrections dedicated to coastal applications, for the Jason-2 mission products.
    - Up to now: Jason-2 IGDR products + about 80 extra fields
    - PISTACH level-3 products: high frequency SLA on reference ground-tracks *(presentation by C. Dufau)*
  - "Test zones" chosen after consulting the coastal altimetry community:
    - The Florida Strait *(last year)*
    - The Agulhas Current

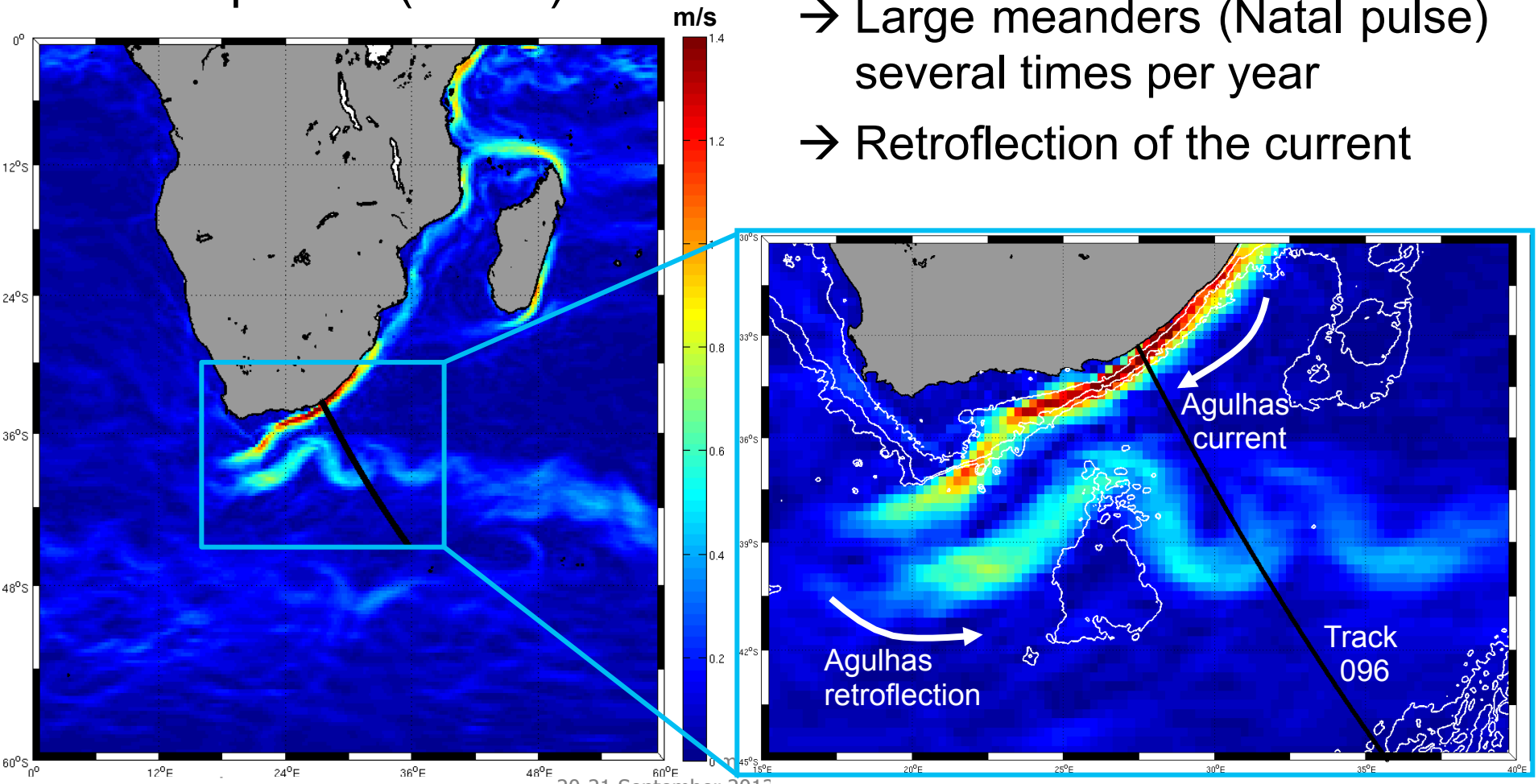
- Objectives:
  - **Validate** the L3 PISTACH demonstration products with independent data
  - **Estimate the added value** of these products in coastal zones, compared to classical SLA products.
  - **Establish the best "recipe"** for the combination of parameters and corrections to be used to monitor coastal currents

    ➔ In this study, only the retrackings were evaluated.

- Description of the study area: the Agulhas Current region
- Altimetry data post-processing
- Comparison of the current observations
- Conclusions and perspectives

Study area

Mean geostrophic current amplitude (Rio09)

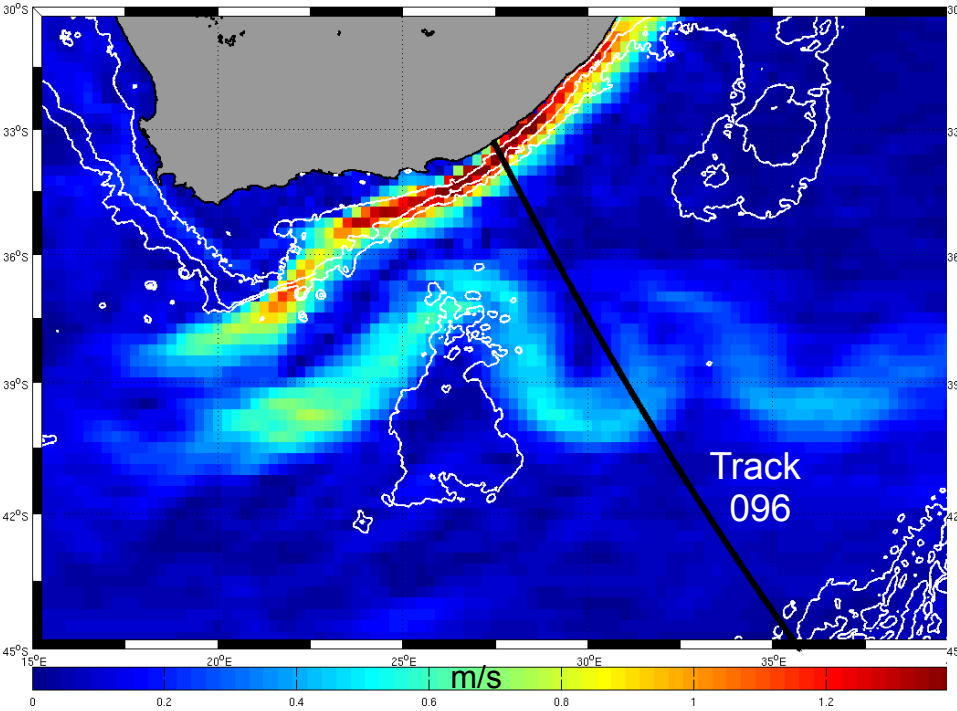


- → Coastal and narrow current
- → Large meanders (Natal pulse) several times per year
- → Retroflection of the current

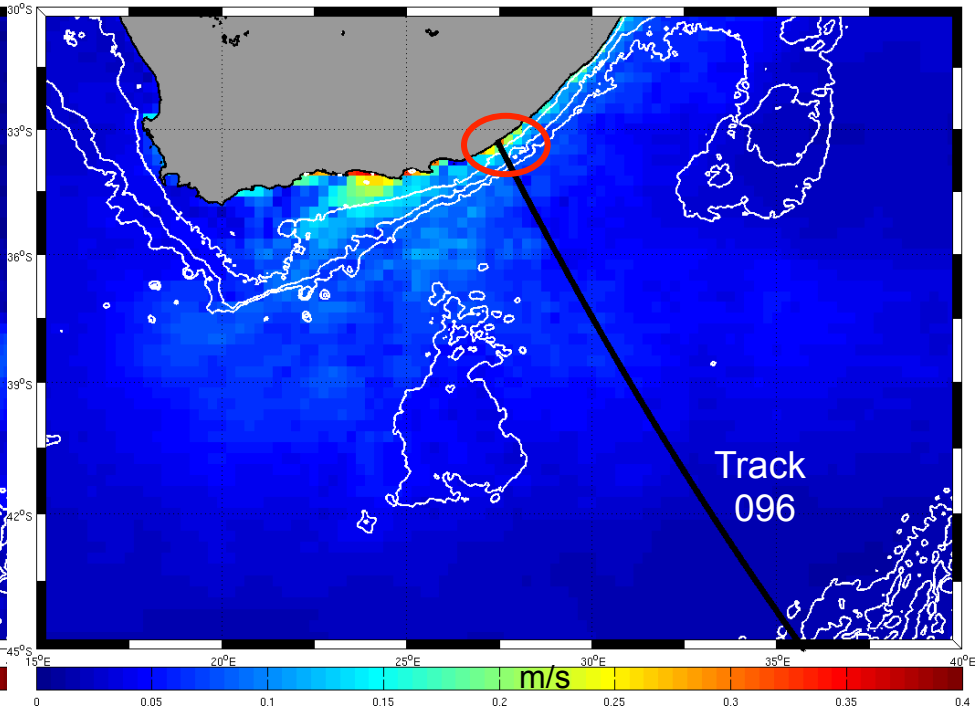
White contours: isobaths 200m, 2000m and 3000m

Study area

Mean geostrophic current amplitude (Rio09)



Errors on the mean geostrophic current amplitude (Rio09)



White contours: isobaths 200m, 2000m and 3000m

→ Degradation of the mean current estimates near the coasts
→ Need for better coastal altimetry data
→ High spatial frequency altimetry data

+ Track 096 almost perpendicular to the coast: across-track velocities close to the Agulhas Current direction

- Altimetry SLA datasets & post-processing

  - PISTACH data:

    - 5Hz products (1.4km), 7km low-pass filtered
    - 3 retrackings: MLE4, RED3, OCE3
    - SLA / Jason-2 mean profiles (2 years)

    + Along-track 30-point (=42km) low-pass filter

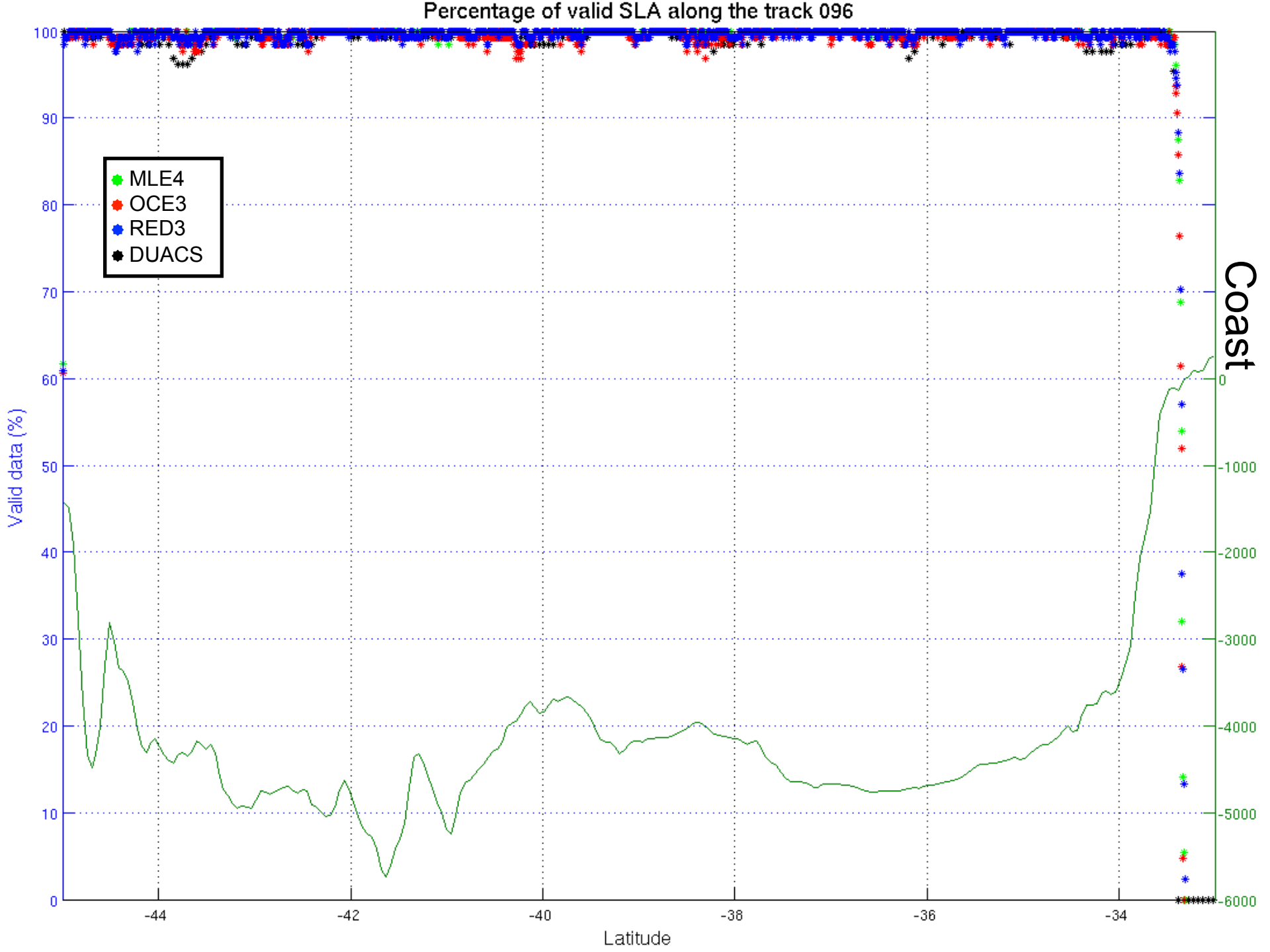
  - Jason-2 DUACS SLA:

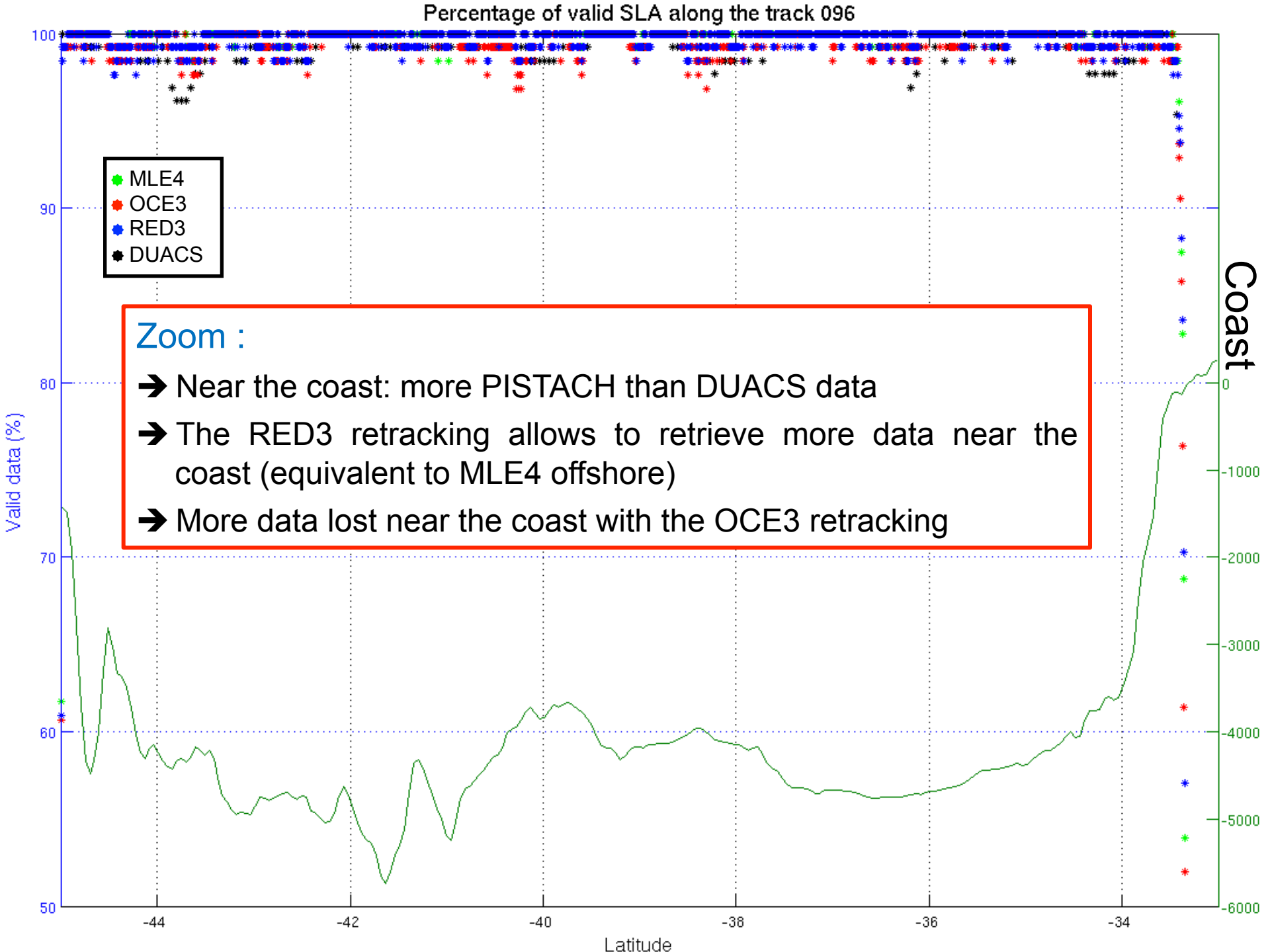
    - Monomission 1Hz along-track product

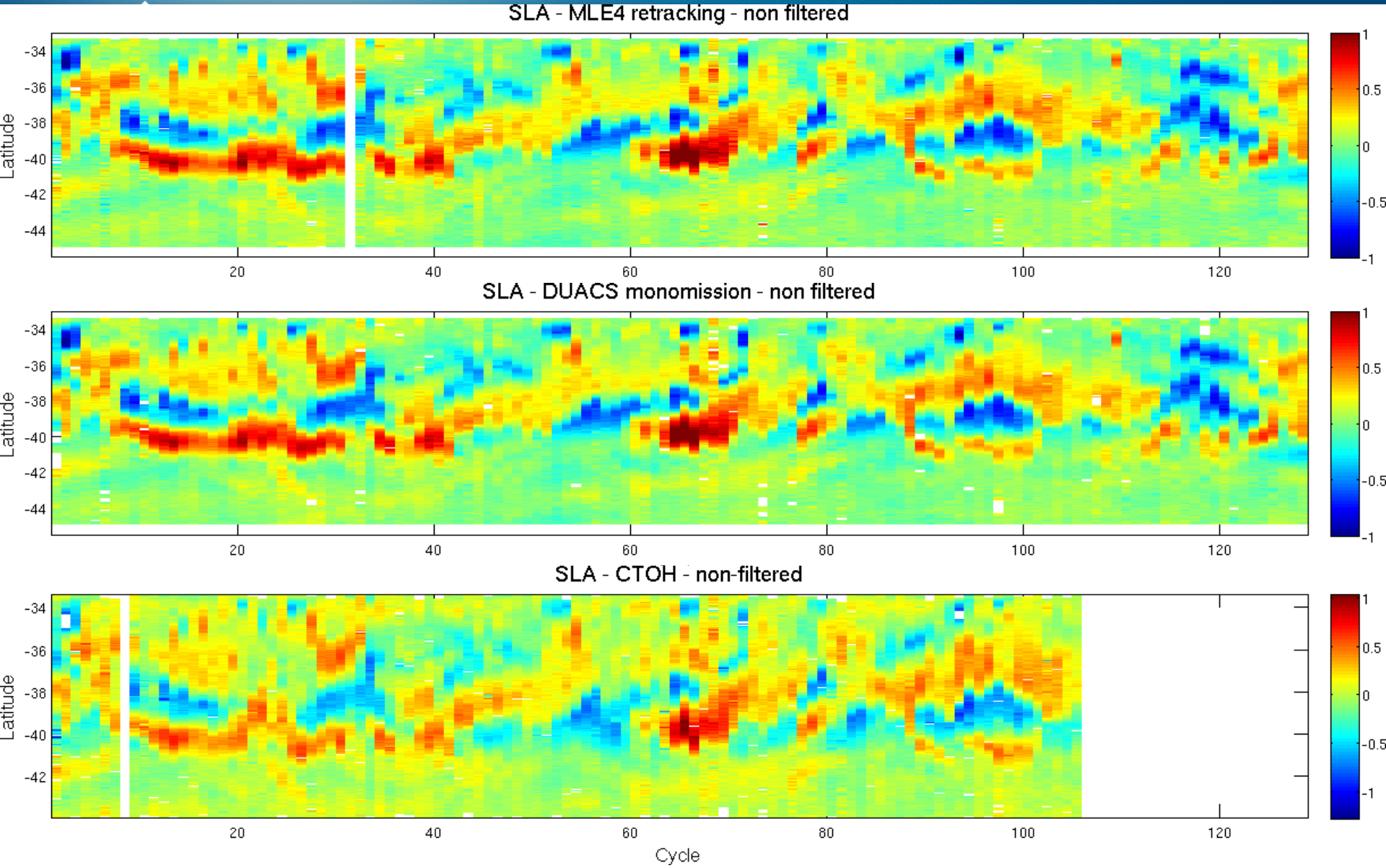
    + Along-track 6-point (=42km) low-pass filter

  - Point to point computation of the geostrophic anomalies *(Powell & Leben, 2003)*

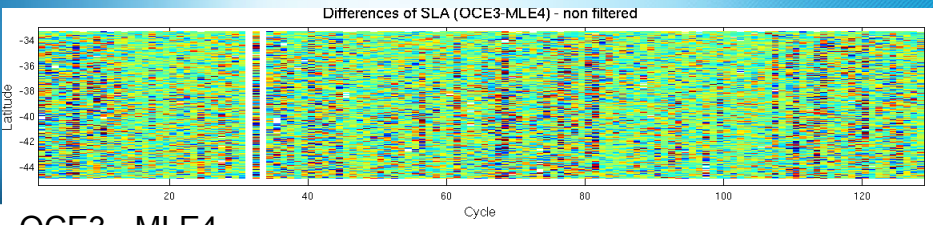
    ✓ First Rossby radius of deformation: about 40km in the area

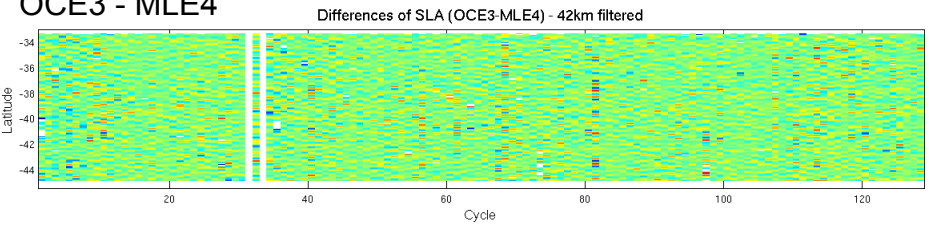

Percentage of valid SLA along the track 096
MLE4
OCE3
RED3
DUACS
Valid data (%)
Coast
Latitude
100
90
80
70
60
50
40
30
20
10
0
0
-1000
-2000
-3000
-4000
-5000
-6000
-44
-42
-40
-38
-36
-34

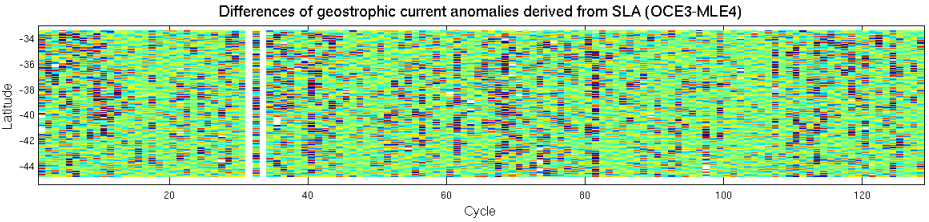

Percentage of valid SLA along the track 096
MLE4
OCE3
RED3
DUACS
Zoom :
➔ Near the coast: more PISTACH than DUACS data
➔ The RED3 retracking allows to retrieve more data near the coast (equivalent to MLE4 offshore)
➔ More data lost near the coast with the OCE3 retracking
Valid data (%)
Coast
Latitude
100
90
80
70
60
50
0
-1000
-2000
-3000
-4000
-5000
-6000
-44
-42
-40
-38
-36
-34


SLA - MLE4 retracking - non filtered
SLA - DUACS monomission - non filtered
SLA - CTOH - non-filtered
Latitude
-34
-36
-38
-40
-42
-44
20
40
60
80
100
120
Cycle
1
0.5
0
-0.5
-1

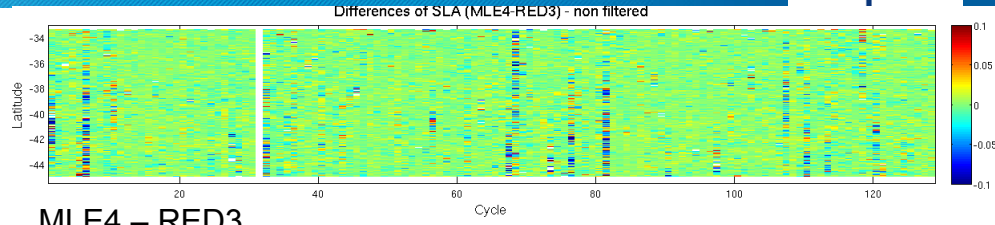
OCE3 - MLE4

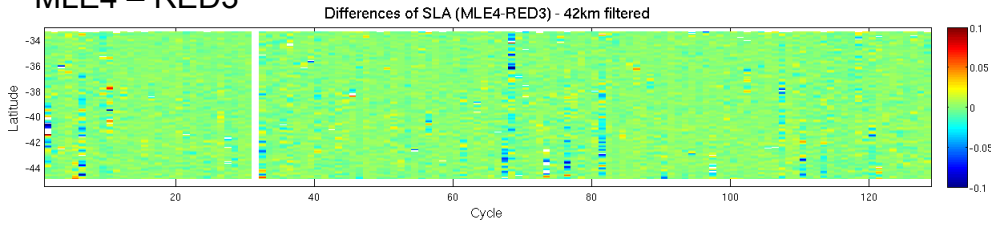


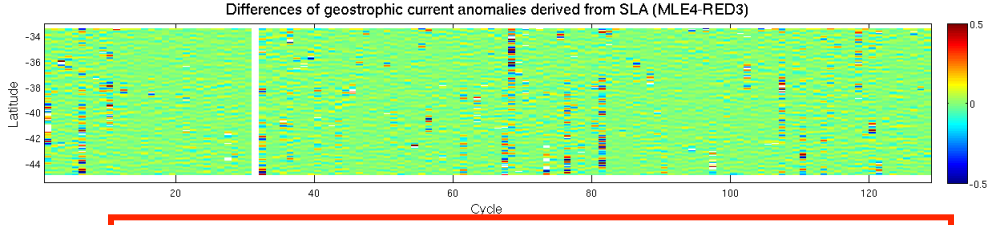




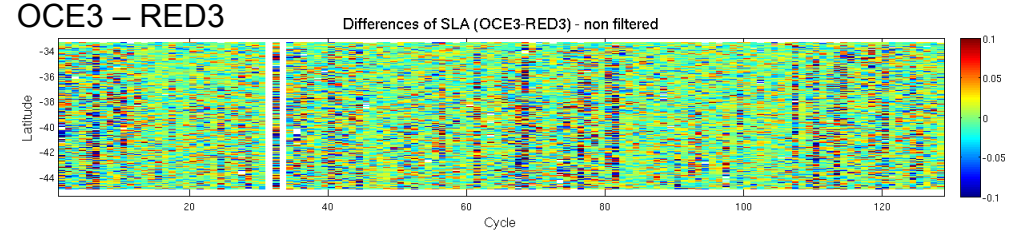
MLE4 – RED3

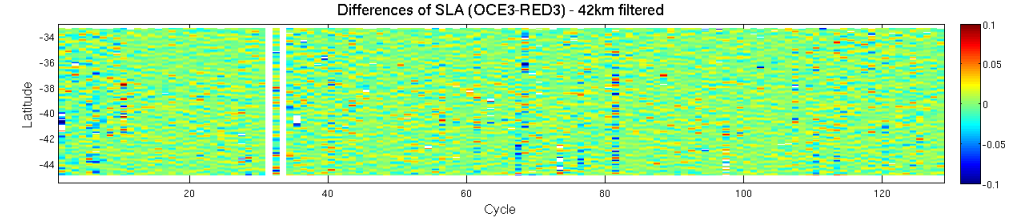


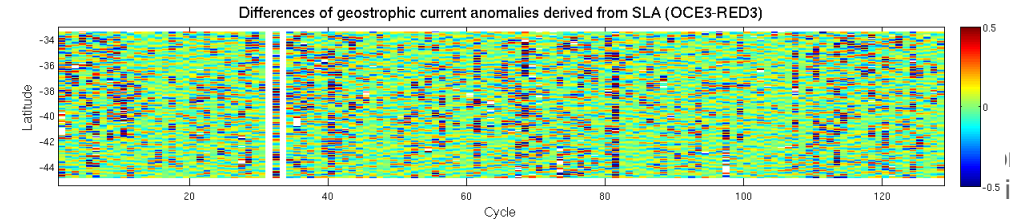




OCE3 – RED3







A few discrepancies between MLE4 and RED3 (as already observed in the Florida Strait).

+ Some very different cycles

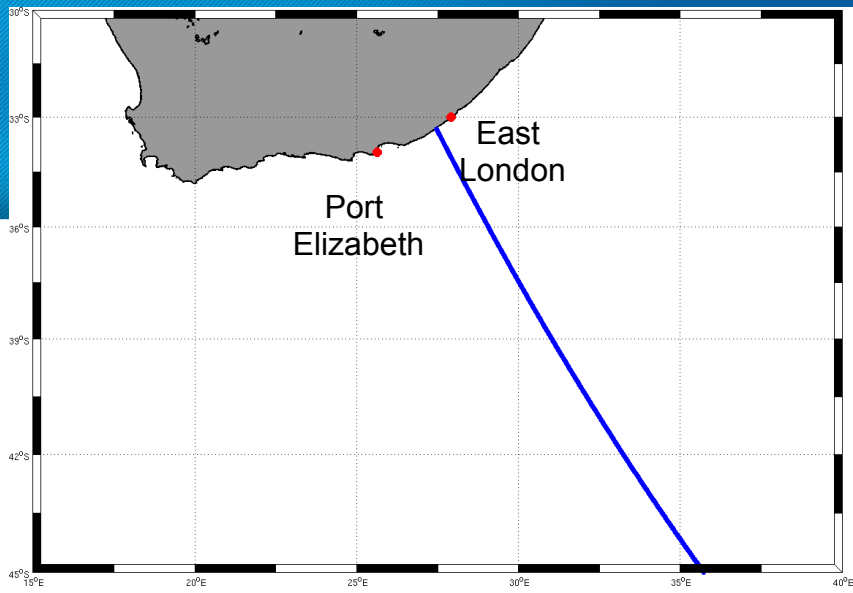
➔ Should be further investigated

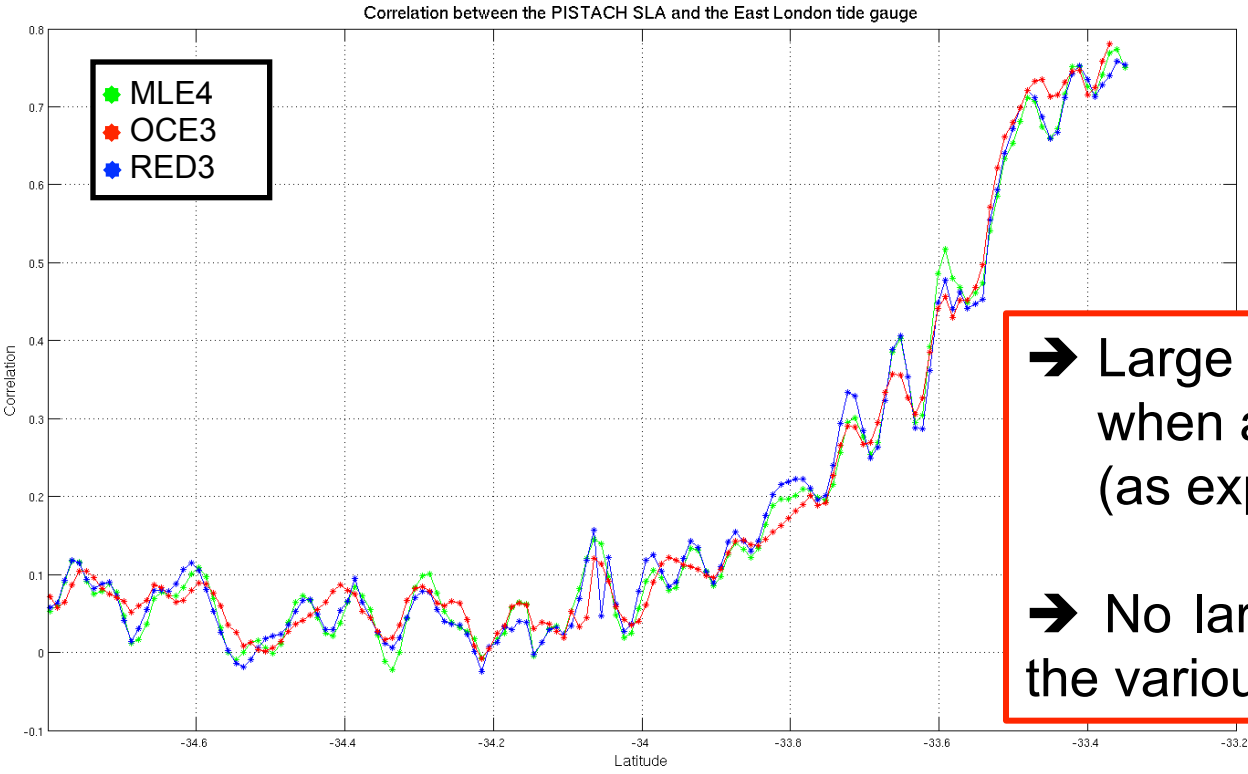
Many differences for OCE3

➔ Necessity to compare to independent data

NOVELTIS

- Comparison to tide gauge data
  - East London tide gauge without the tide
  - PISTACH SLA (>70% valid cycles) + DAC
  - SLA computed over the same period





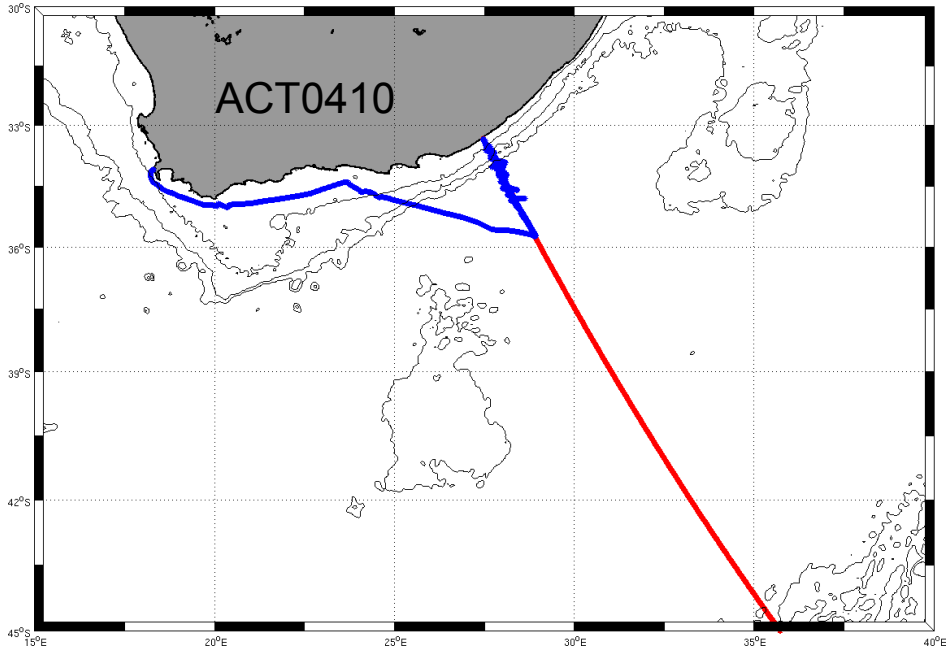
➔ Large increase in the correlation when approching the coast (as expected)

➔ No large discrepancies between the various retrackings

- Agulhas Current Timeseries (ACT) experiment: 2 campaigns at sea
  - April 2010 (ACT0410)
    - ADCP and CTD measurements

    → ADCP data available along the track 096 (1 transect)

    - Deployment of the currentmeter line on the track 096

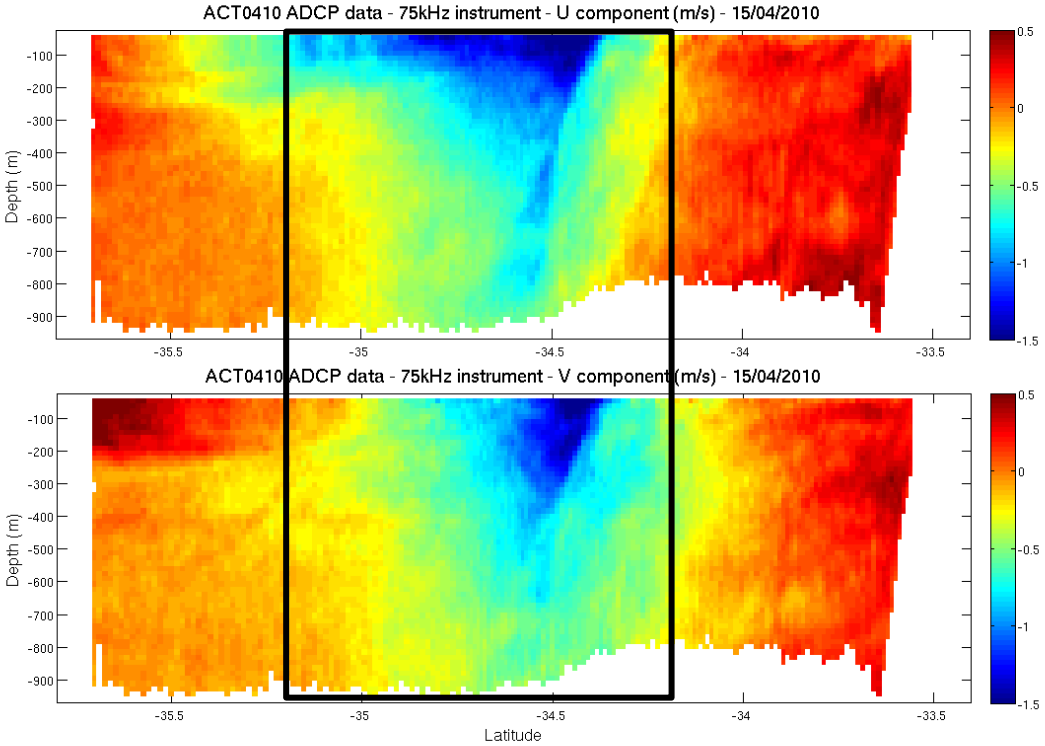


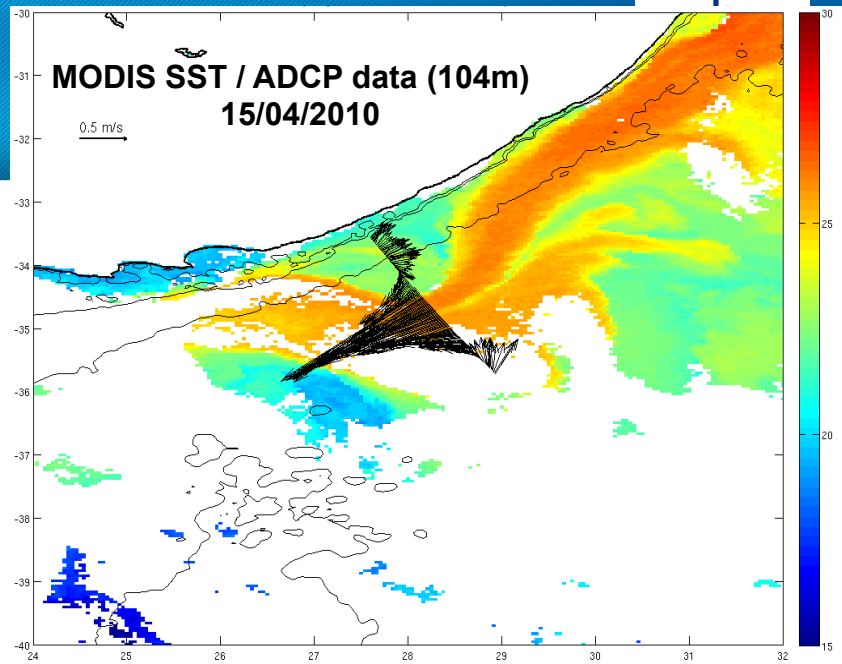
ADCP measurements along the track 096: 15/04/2010

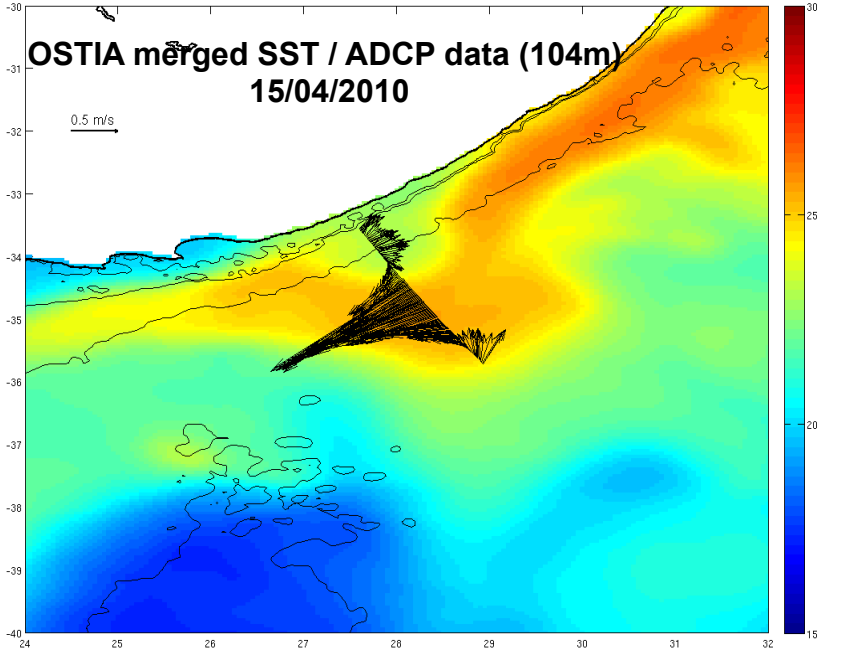
→ Cycle 65 (11/04/2010)

→ Cycle 66 (21/04/2010)

ACT0410 75kHz ADCP data / SST



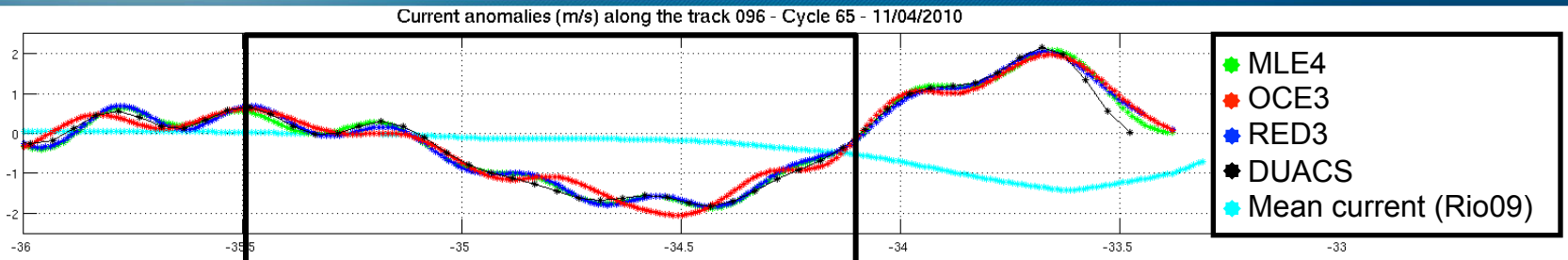




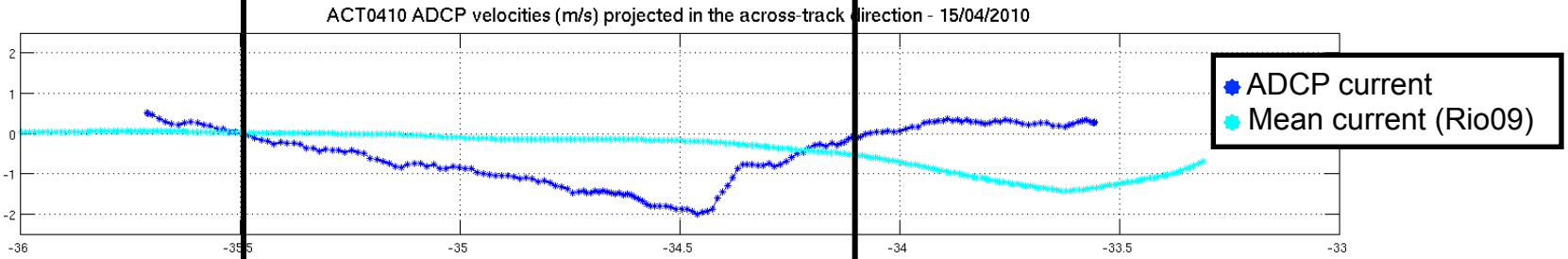
Large meander of the current, visible in the ADCP and SST data ➔ Natal pulse

ACT0410

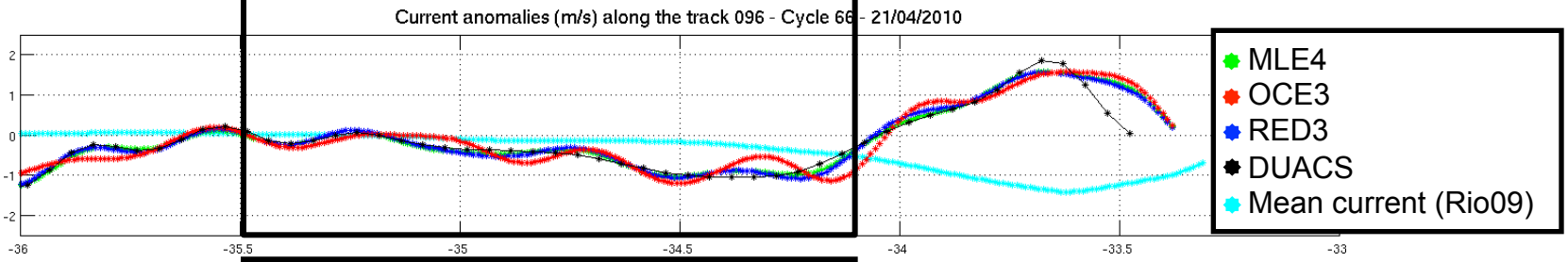
Anomalies



Absolute current



Anomalies



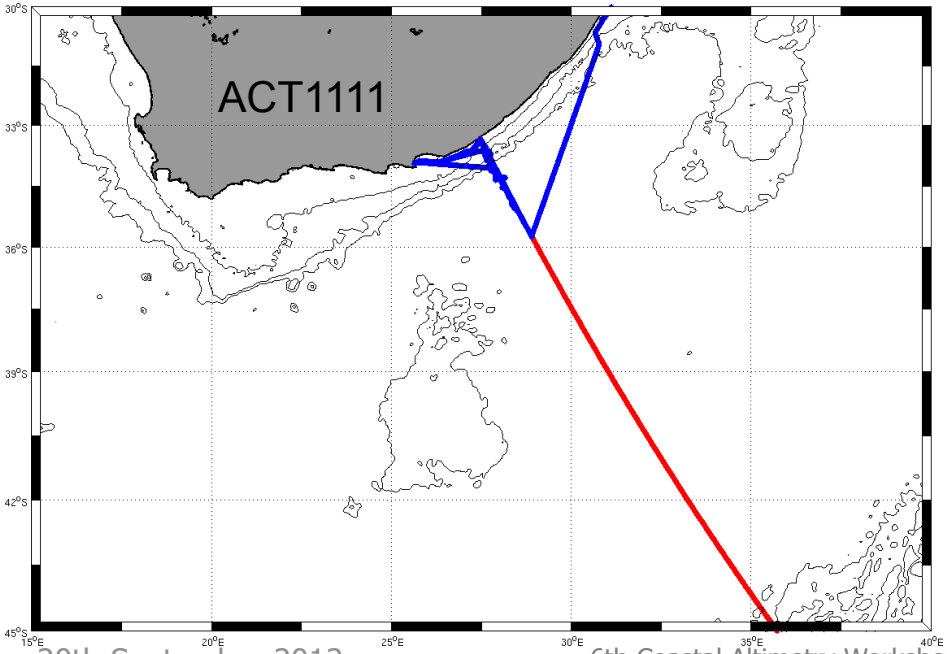
Current vein during the Natal pulse (ADCP)

Coherency of the main structure in position and amplitude
Smaller-scale variations in the anomalies, especially OCE3

- Agulhas Current Timeseries (ACT) experiment: 2 campaigns at sea
  - November 2011 (ACT1111)
    - ADCP and CTD measurements

    → ADCP data available along the track 096 (1 transect)

    - Collection of the currentmeter data (18 months)



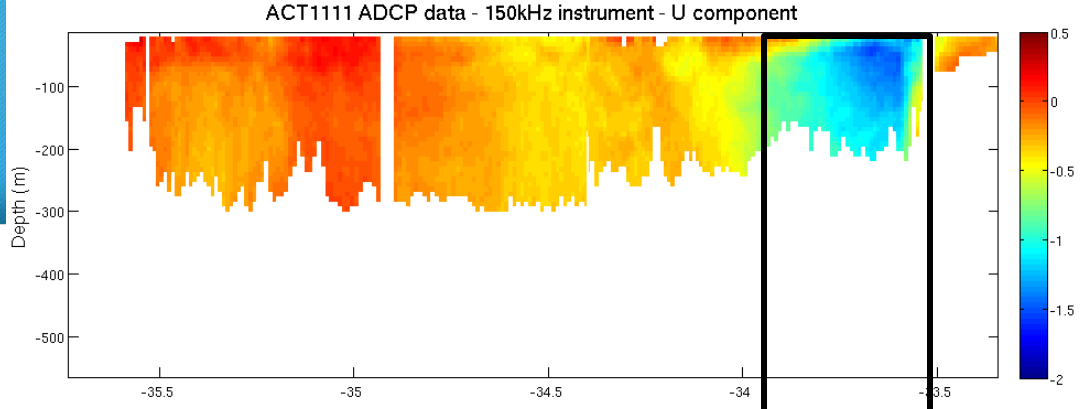
ADCP measurements along the track 096: 22-23/11/2011

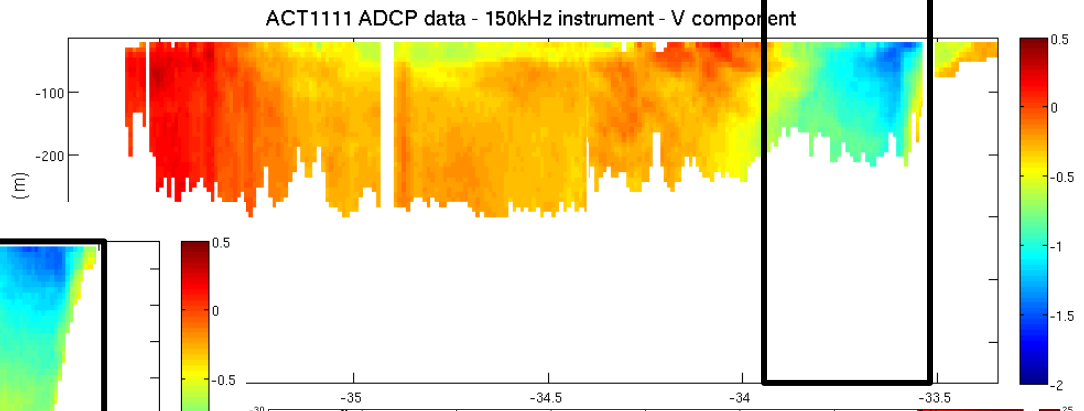
→ Cycle 124 (18/11/2011)

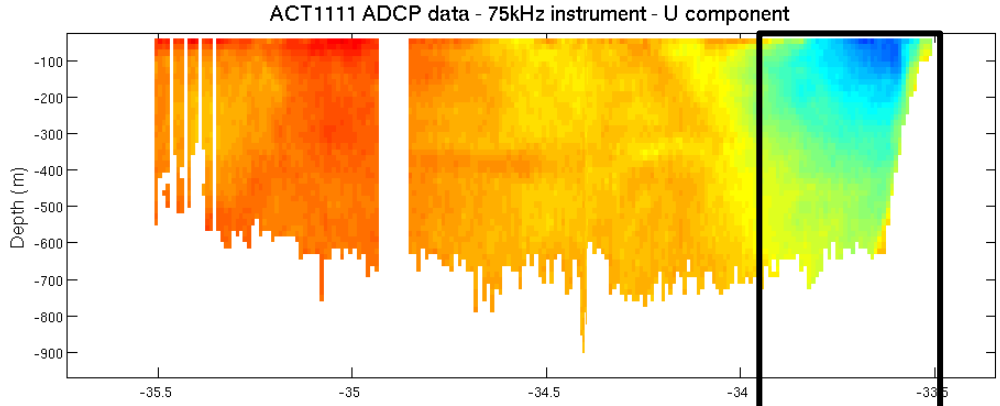
→ Cycle 125 (28/11/2011)

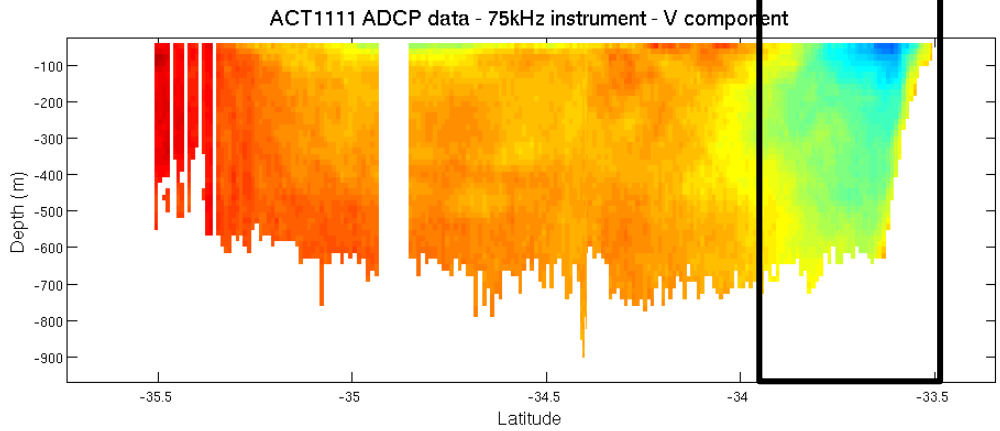
ACT1111 ADCP data / SST

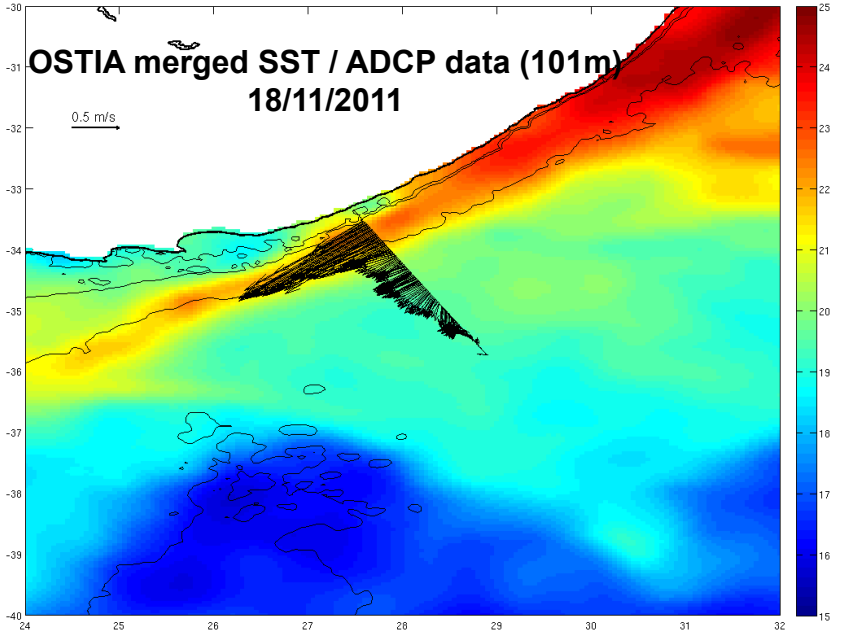
Narrow coastal current
➔ Usual configuration





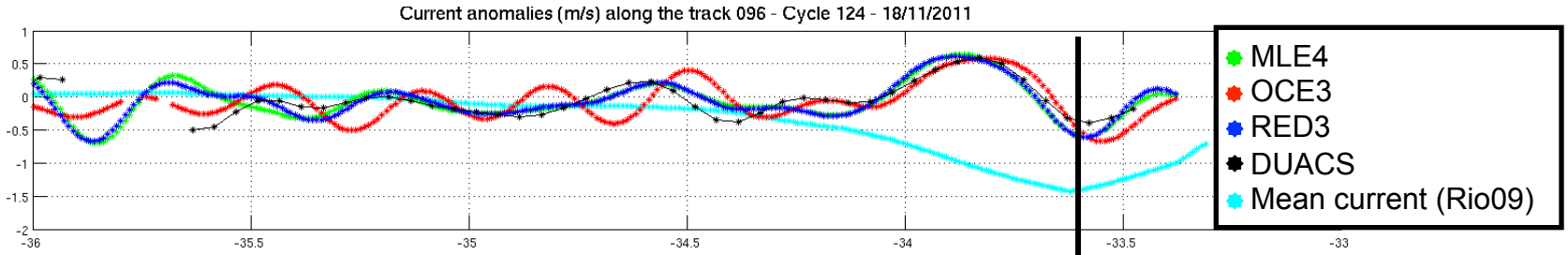




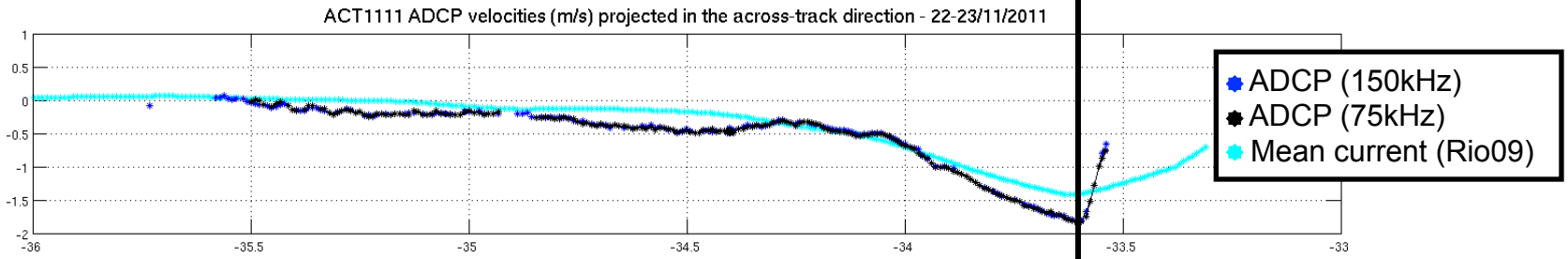


ACT1111

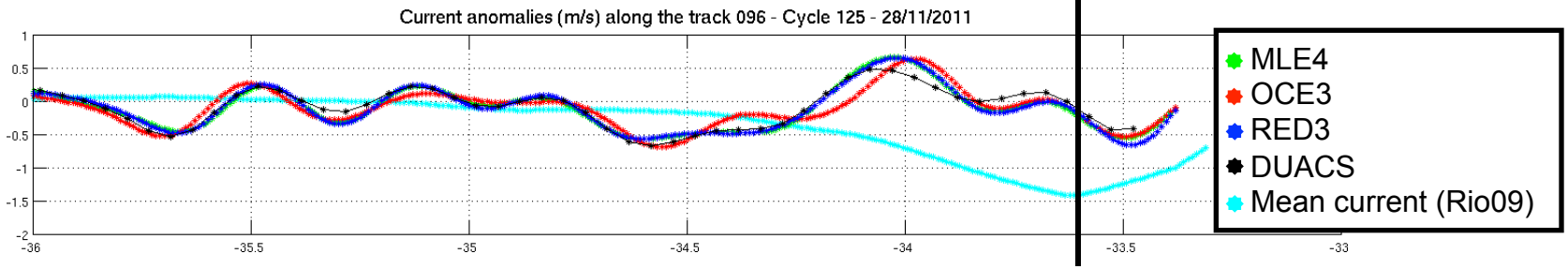
Anomalies



Absolute current



Anomalies



Max ADCP current

➔ Position of the maximum of ADCP current coherent with the MLE4 and RED3 retrackings (cycle 124)

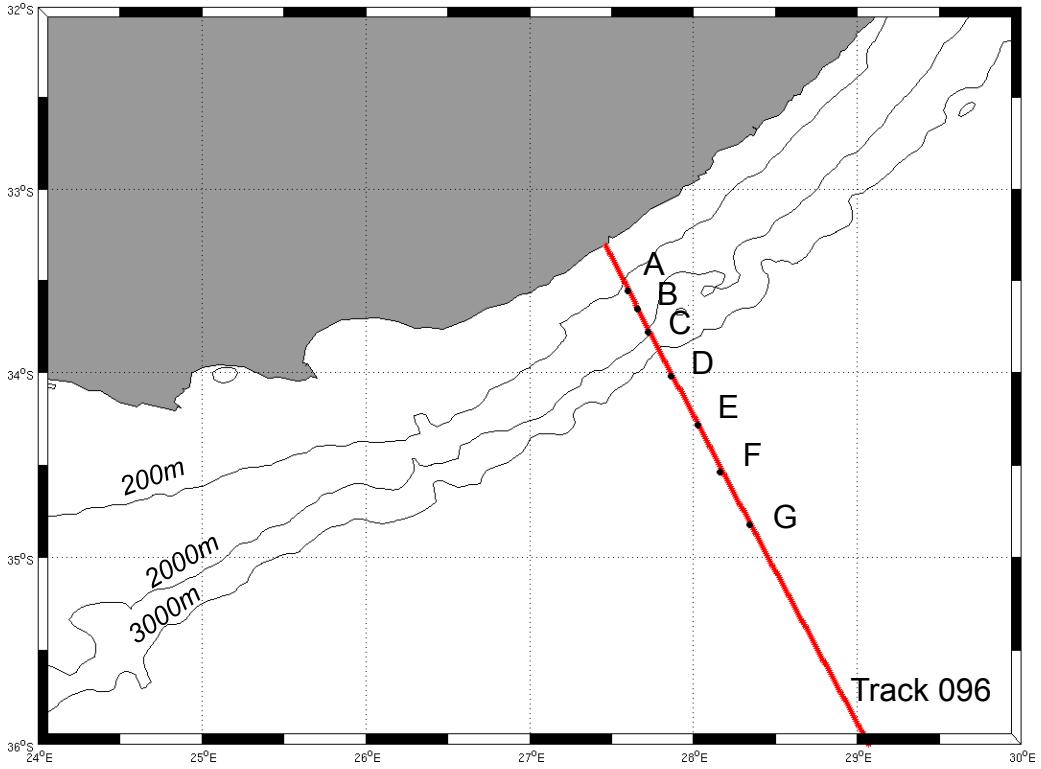
➔ OCE3 appears to be shifted all along the cycle

Currentmeter line:

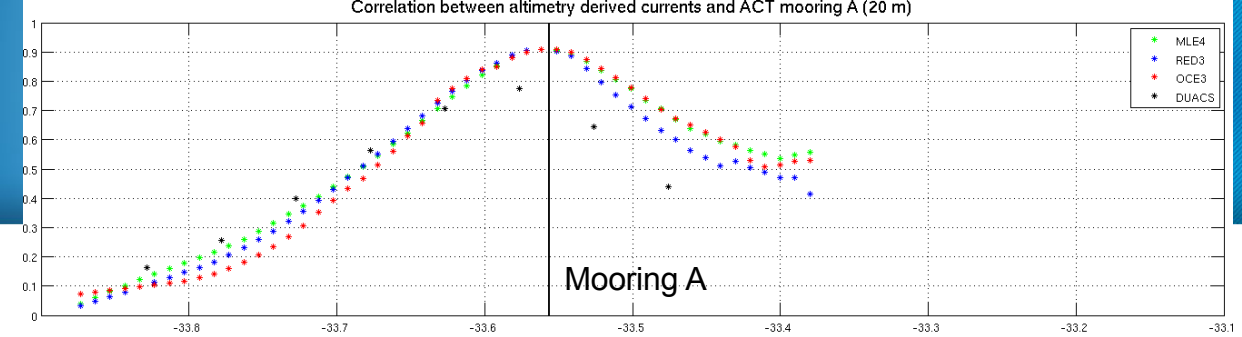
→ 7 moorings installed along the track 096

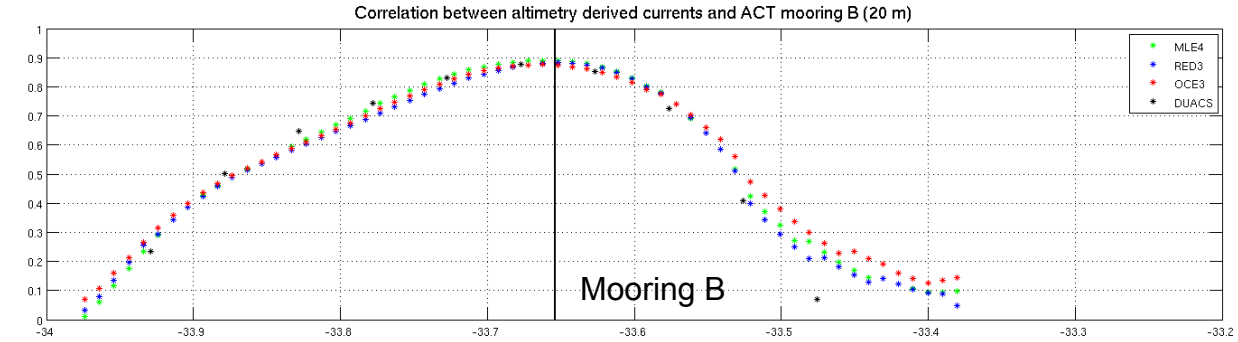
→ 18 months of data: 15/04/2010 – 04/11/2011

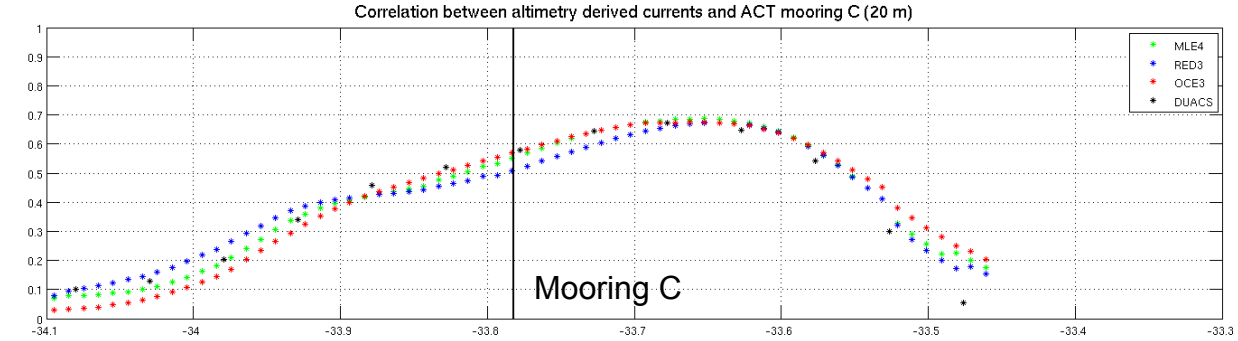
Preliminary results !

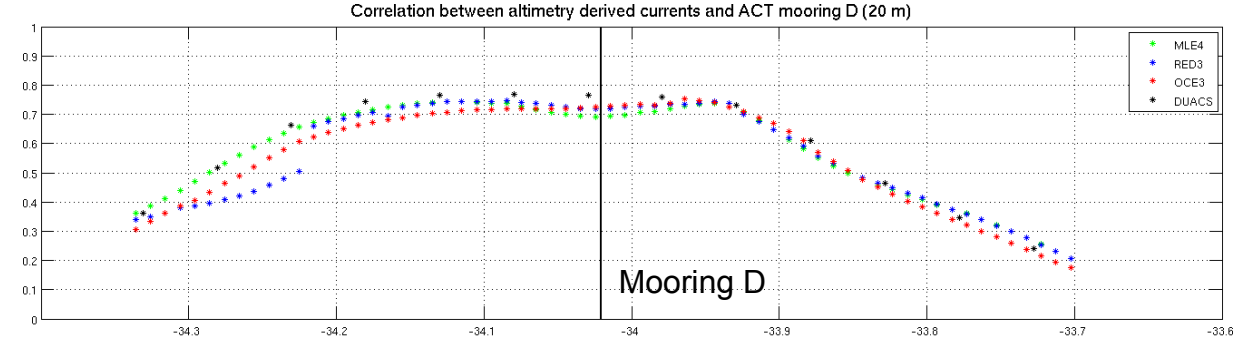


@Dallas Murphy
ACT0410 campaign *http://act.rsmas.miami.edu*



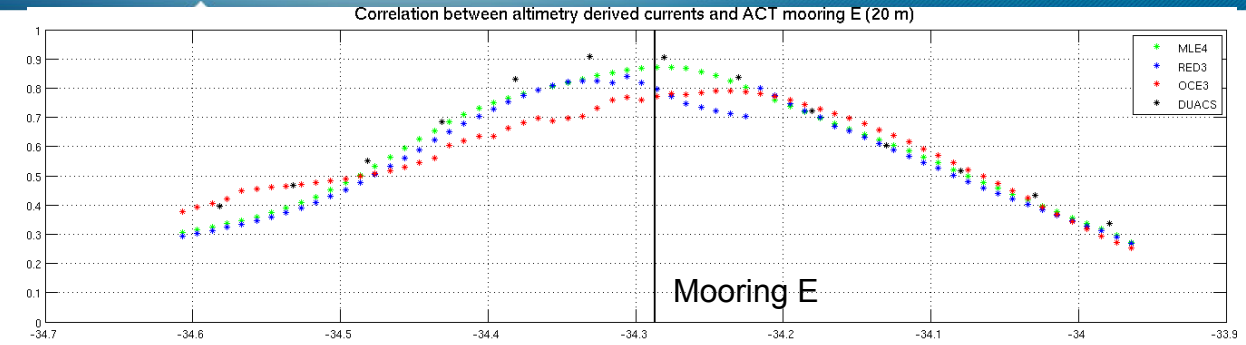


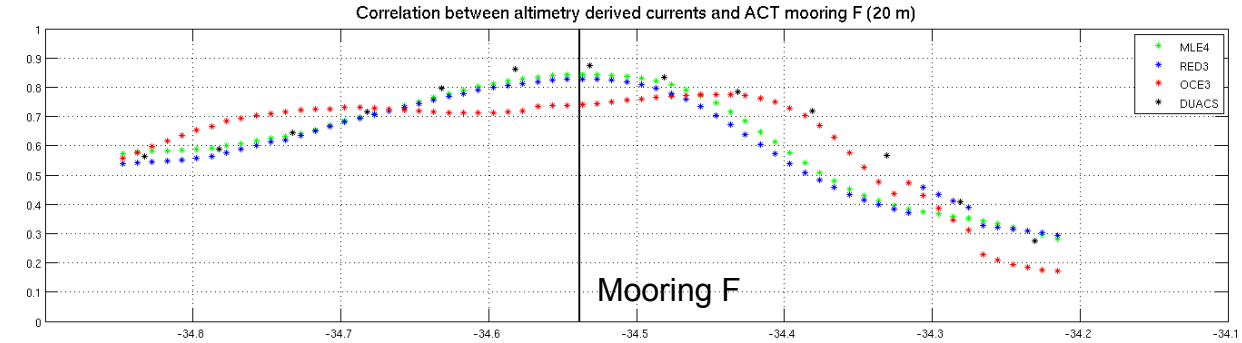


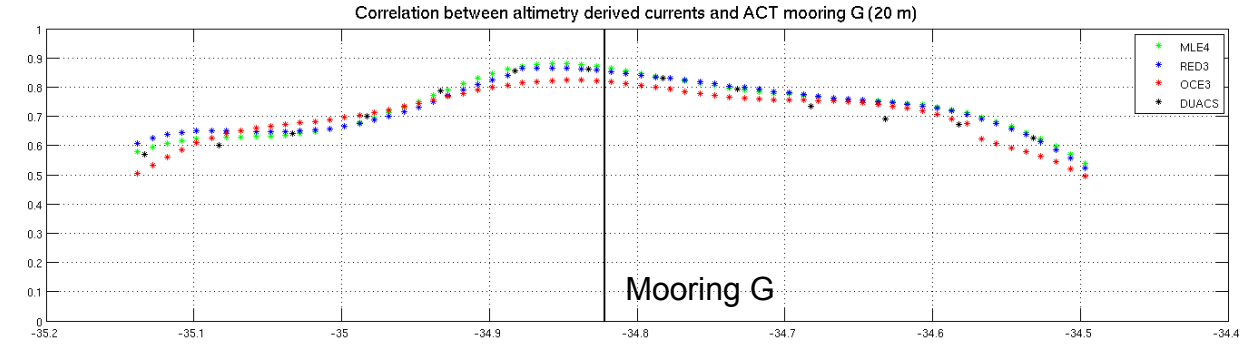


Correlations between each mooring and the altimeter data along the track 096

(altimeter points situated up to 40km around each mooring only)



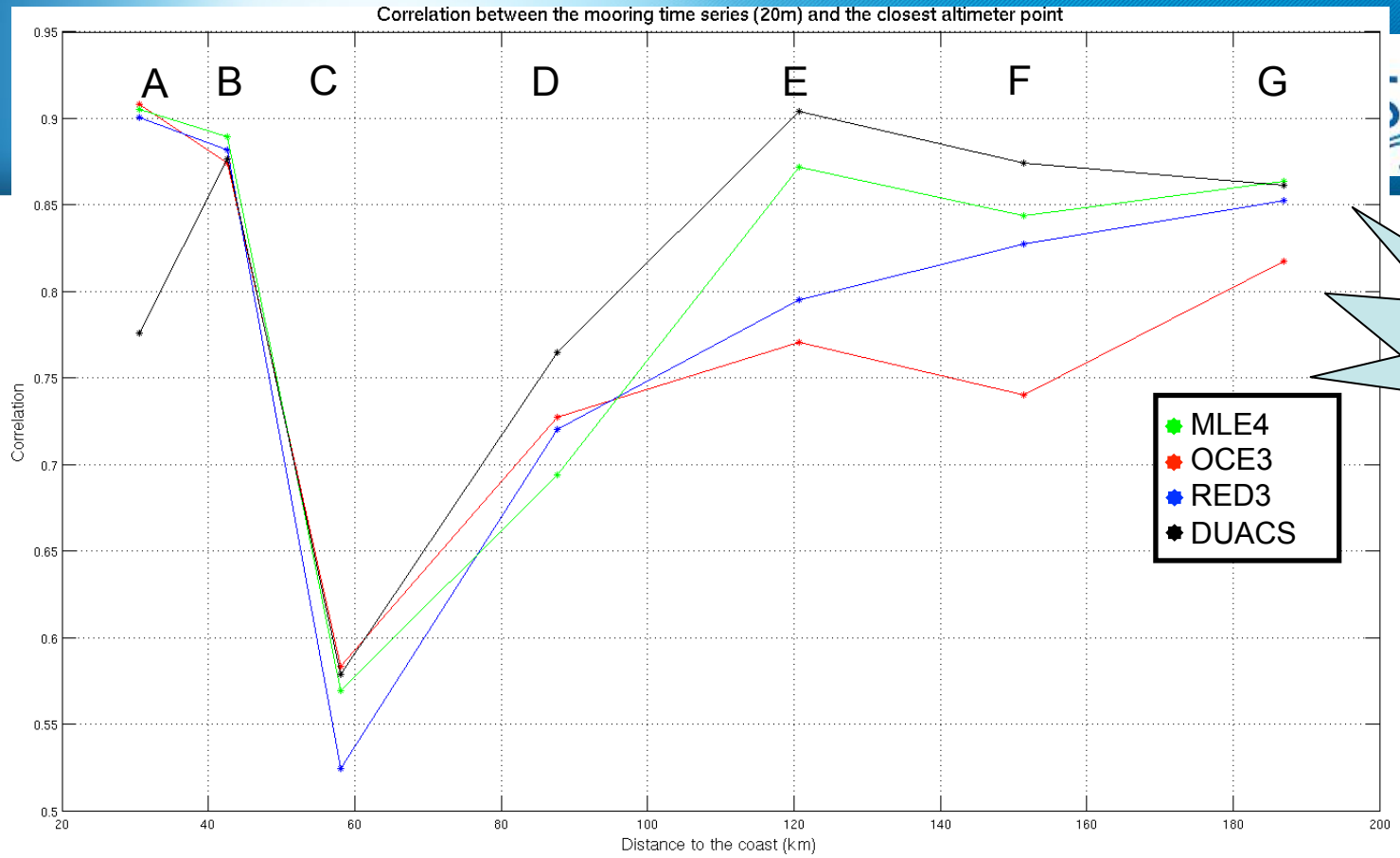




Preliminary results !

Correlations between each mooring and the altimeter data along the track 096

(altimeter points situated up to 40km around each mooring only)



Preliminary results !

➔In the first 40km from the coast, the PISTACH data are more correlated with the moorings than the DUACS data.

➔The correlation large decrease at mooring C should be investigated

➔Offshore, the DUACS data are more coherent with the in situ data (smoother)

➔Offshore, the OCE3 retracking seems to be less coherent with the moorings than the other altimetry datasets (more small structures)

Conclusions

- Gain in the data coverage very close to the coast with the L3 PISTACH products, compared to the DUACS products
- Altimetry large-scale signals coherent with the in situ tide gauge and ADCP data
- More small-scale structures in the PISTACH data (due to the higher spatial frequency) than in the 1Hz DUACS data, but difficult to interpret

Conclusions

- Limitations of the comparison with the ADCP transects:

➔ ADCP absolute and total currents / altimetry geostrophic current anomalies

➔ Only 2 ADCP transects available, corresponding to ~ 4 cycles

- Difficult to evaluate the various retracking strategies in the area (OCE3 showing a different behavior most of the time)

- The comparison with the moorings brings more information:

➔ PISTACH is closer to the in situ data than DUACS in the first 40km from the coast

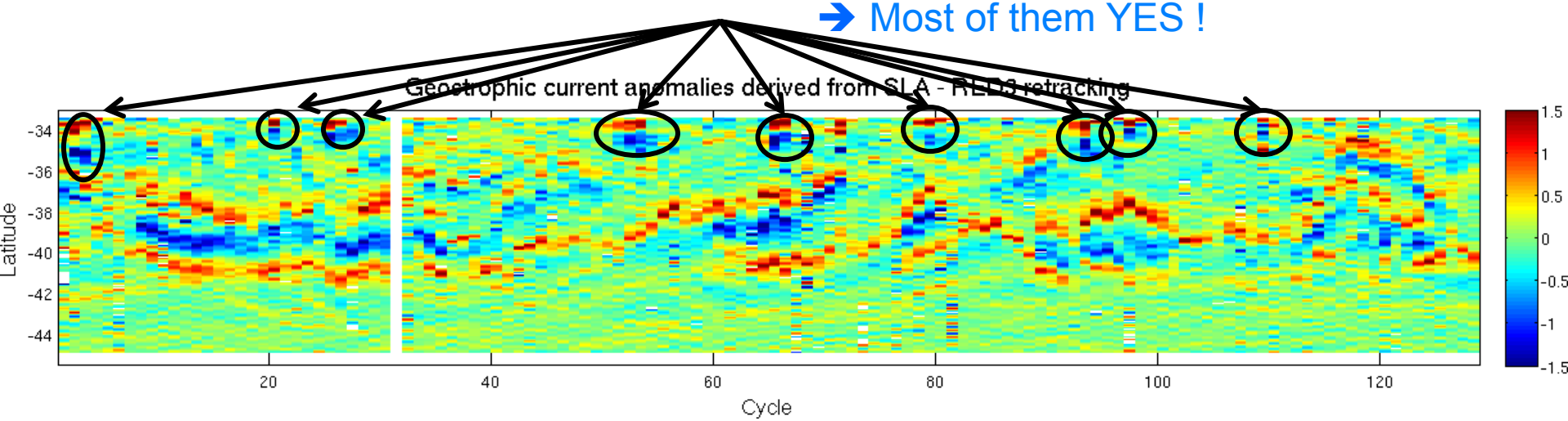
➔ DUACS is smoother offshore, and closer to the moorings

➔ OCE3 is less coherent with the moorings than the other retrackings offshore

Perspectives

- Further investigate the comparison with the moorings data
- Try to understand the small-scale structures in the altimetry
- Quantify the differences between the various retrackings, focusing on particular events
  - SST, SSS and ocean colour data
  - Model simulations

Natal pulses ?
➔ Most of them YES !



- Assess the influence of other parameters: ocean tide, DAC, wet troposphere,…