The use of coastal altimetry to explore the continental shelf dynamics

Joint study with ASPEX and MOUTON/PROTEVS measurements in 2009-2011

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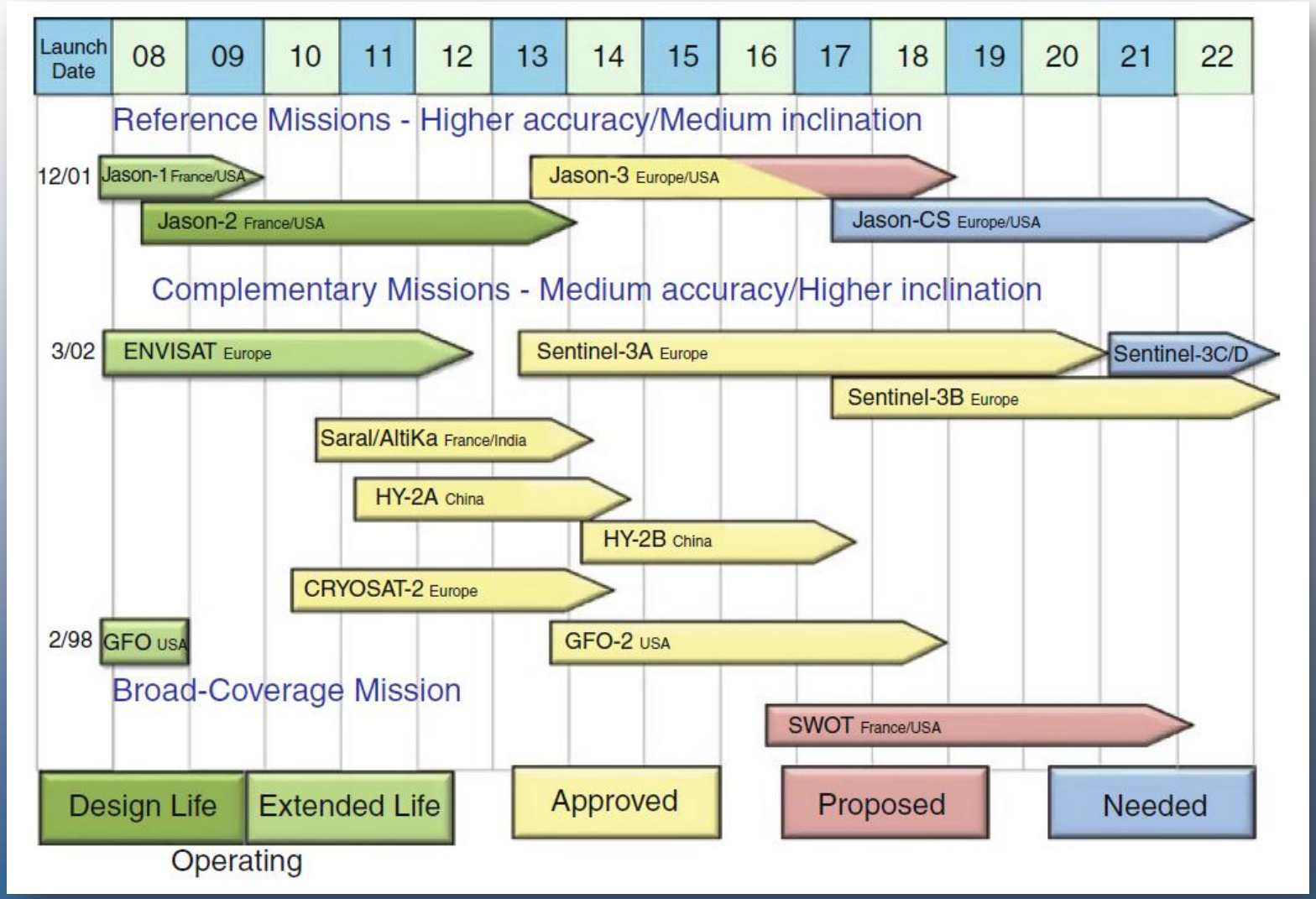
Thanks to Claire Dufau (CLS) and Jérôme Bouffard (MIO) for fruitful discussions

First exploration …
Open discussion …

In space today and tomorrow ...



Vignudelli et al., Coastal Altimetry, 2011

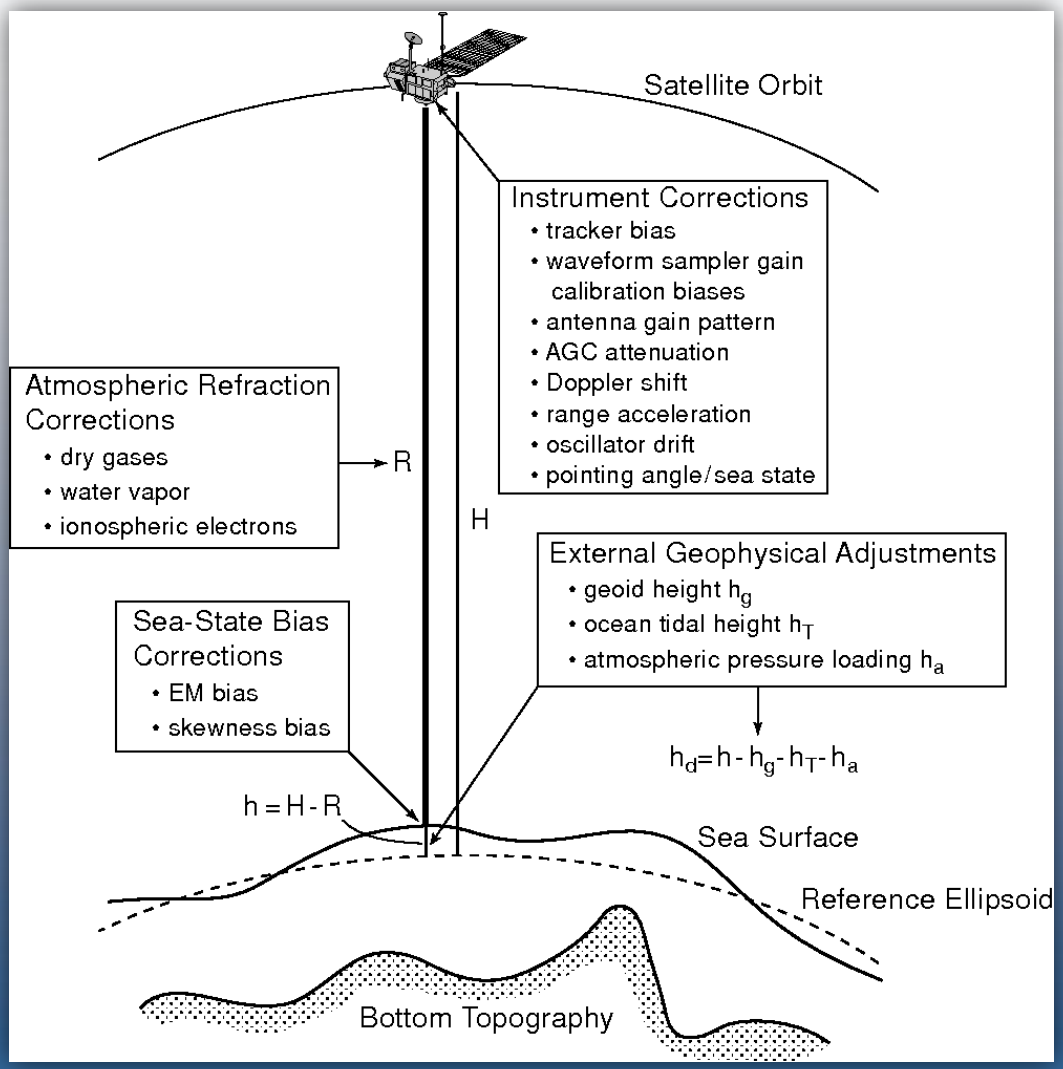
Coastal altimetry vs. “classical” altimetry

« Classical » Altimetry

Loss of signal ~50Km off the coast + geophysical corrections from open ocean

Coastal Altimétry

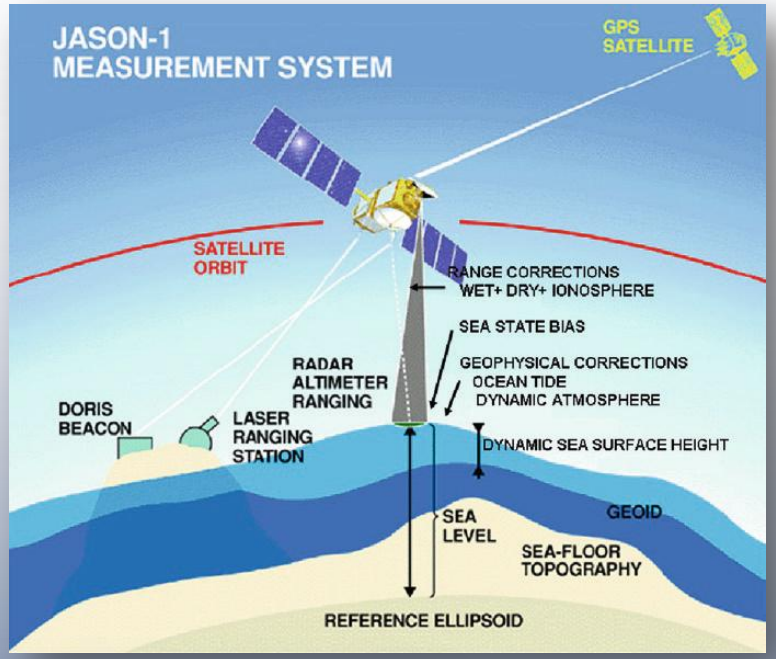
- « Retracking »
  Close to the coast … modification of the radar echo (sea/land) => specific treatement in coastal environment
- Specific wet tropospheric correction in coastal zone linked to the water vapor content



« Retracking » = « Waveform analysis »

Coastal altimetry vs. “classical” altimetry

Vignudelli et al., Coastal Altimetry, 2011



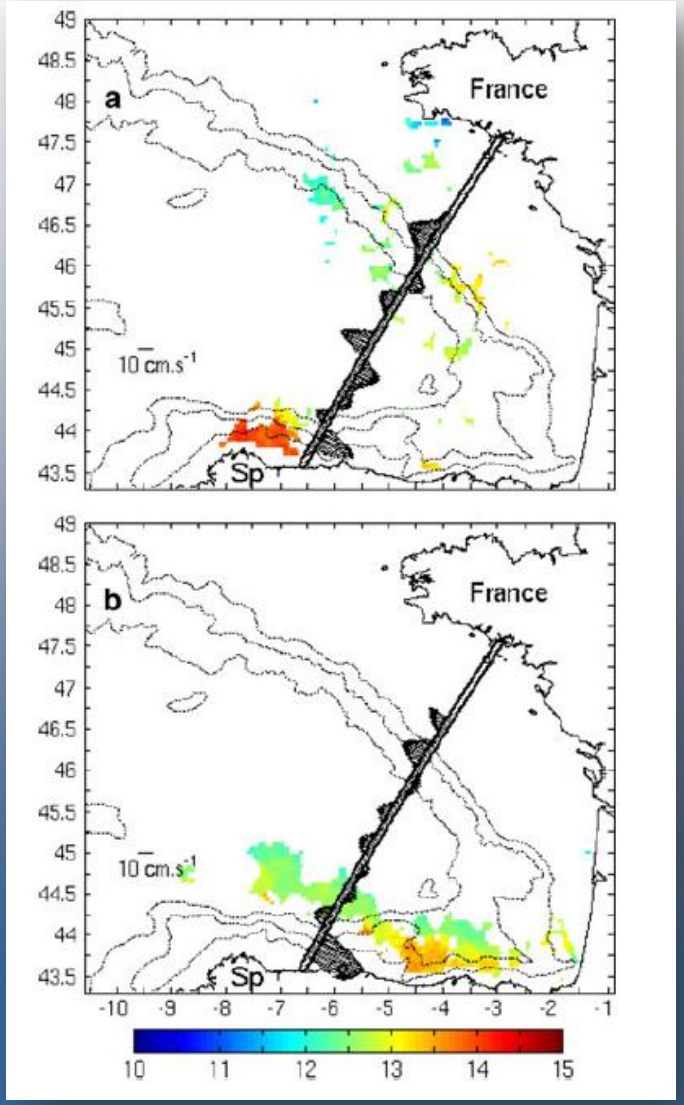
6 years of Jason-1 altimeter data
Coastal regions limited by the 500m depth contour

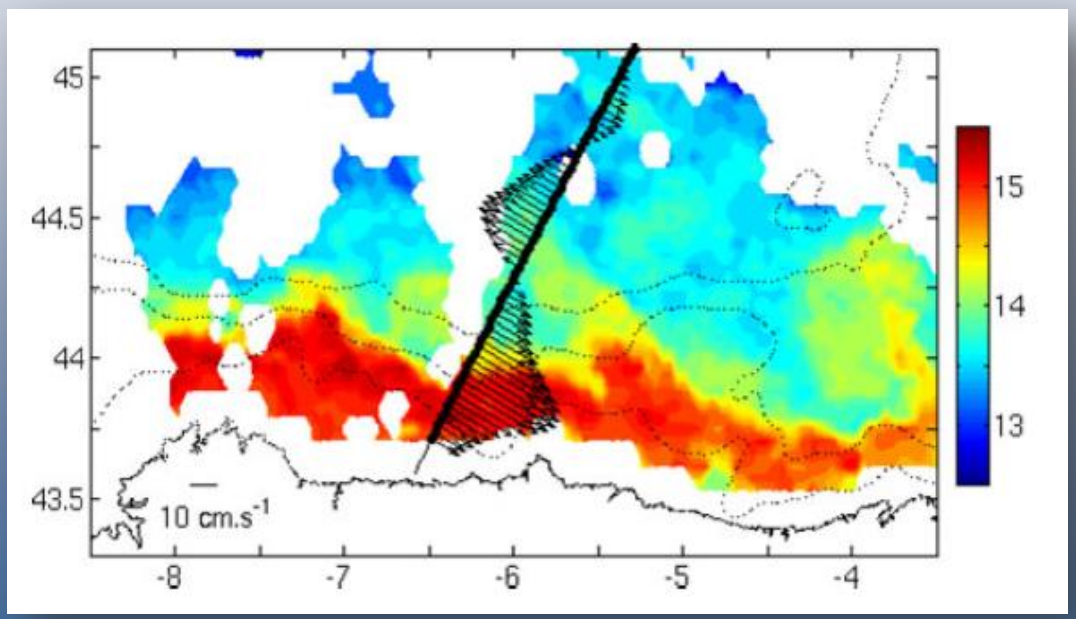
	Mean[a] (cm)	Time-variable deep ocean (std dev) (cm)	Time variable coastal (std dev) (cm)
Dry troposphere	−231	0–2	0–2
Wet troposphere	−16	5–6	5–8
Ionosphere	−8	2–5	2–5
Sea-state bias	−5	1–4	2–5
Tides	~ 0–2	0–80	0–500
Dynamic atmosphere	~ 0–2	5–15	5–15

Coastal altimetry in the Bay of Biscay:
Iberian Poleward Current

Le Hénaff et al., 2010

TOPEX/Poseidon track 137 – 3rd January 2001

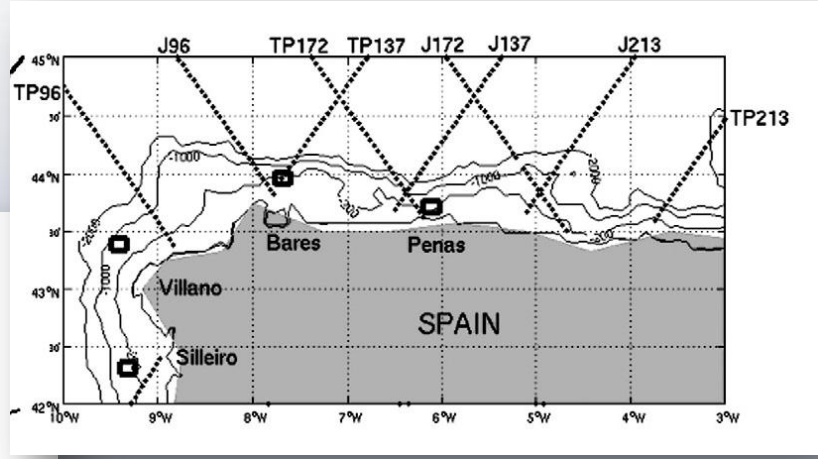




TOPEX/Poseidon track 137 – 6th January 1996

Coastal altimetry in the Bay of Biscay:
Iberian Poleward Current

Herbert et al., 2011



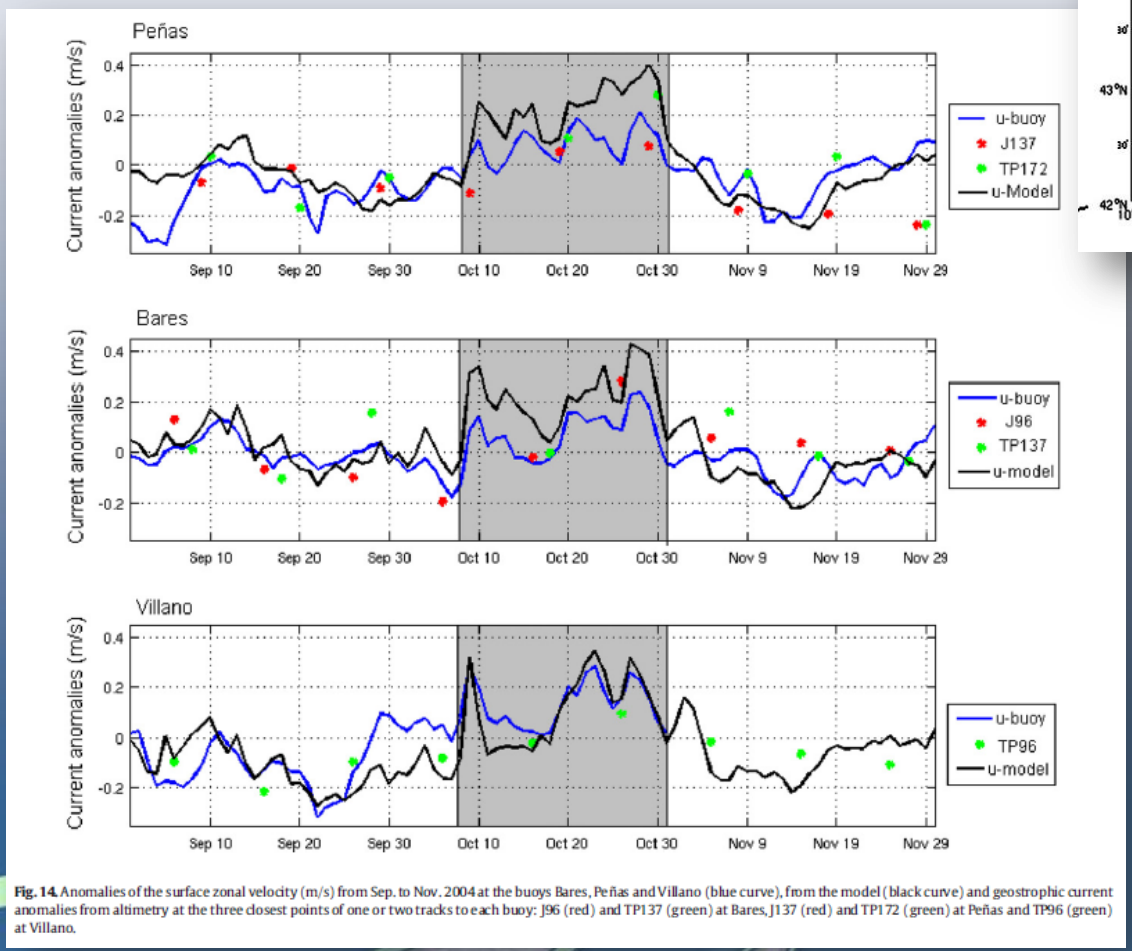
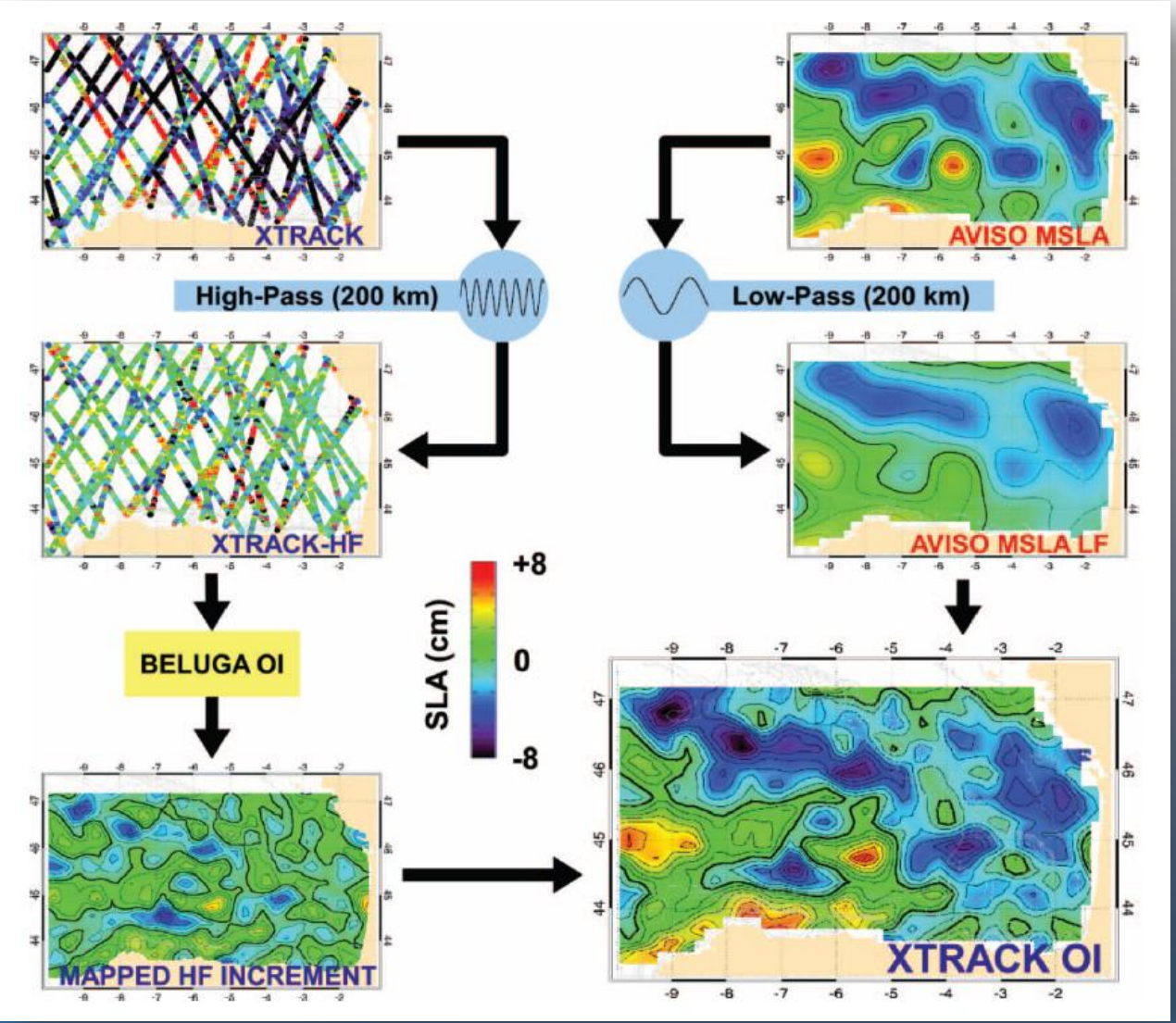


Fig. 14. Anomalies of the surface zonal velocity (m/s) from Sep. to Nov. 2004 at the buoys Bares, Peñas and Villano (blue curve), from the model (black curve) and geostrophic current anomalies from altimetry at the three closest points of one or two tracks to each buoy: J96 (red) and TP137 (green) at Bares, J137 (red) and TP172 (green) at Peñas and TP96 (green) at Villano.

Coastal altimetry in the Bay of Biscay:
The improvements from coastal altimetry for gridded products



Dussurget et al., 2011

Coastal altimetry in the Bay of Biscay:
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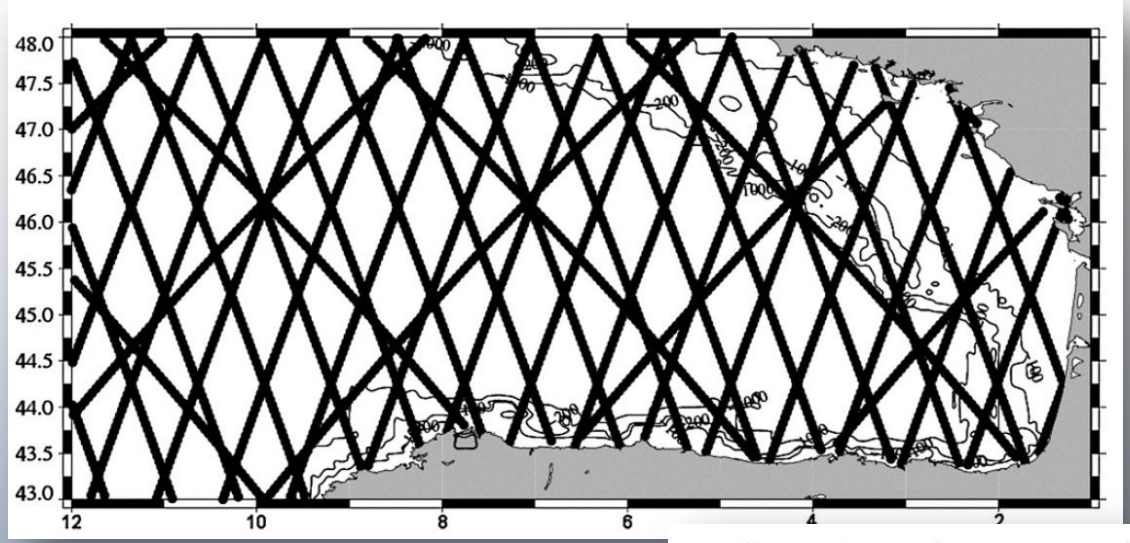
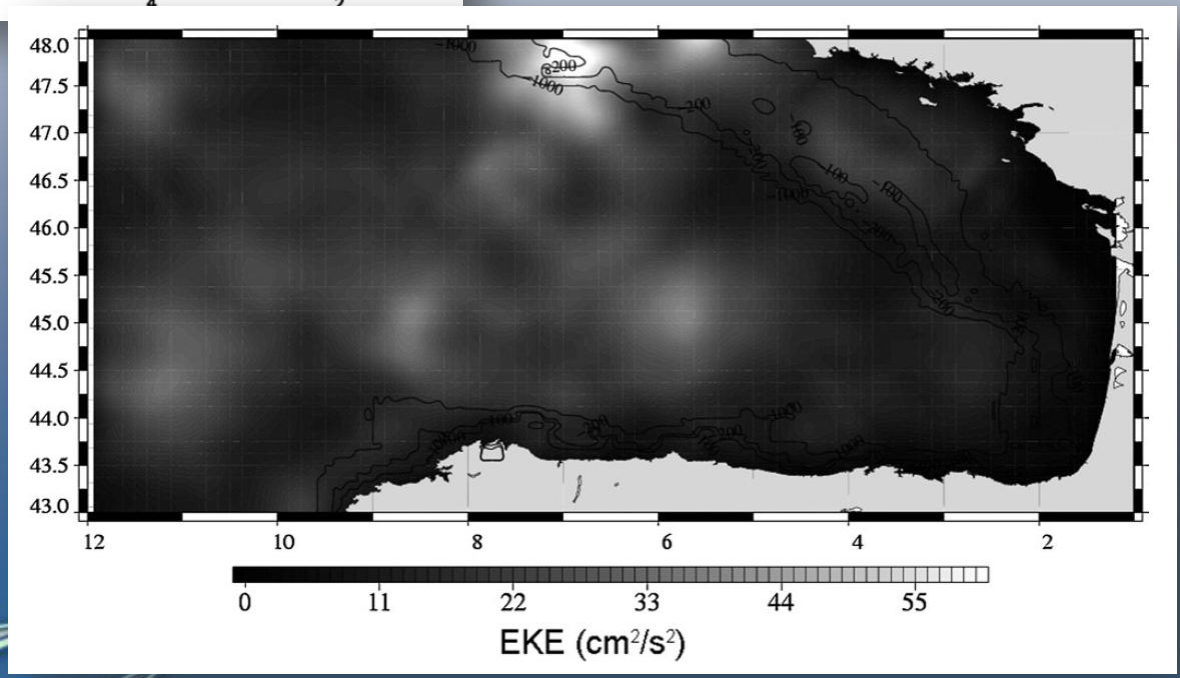


Caballero et al., 2008

Satellites:

- ERS-1/2,
- TOPEX/Poseidon,
- Envisat,
- Jason-1

From January 1993
to May 2005



Overview

Where, when, and which data ?

Validation using Tide Gauges and ADCP

Altimetry in the Bay of Biscay … an overview

Near the Loire river plume: altimetry, MOUTON and ASPEX cruises

Conclusions & Perspectives

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The satellite, where and when ?

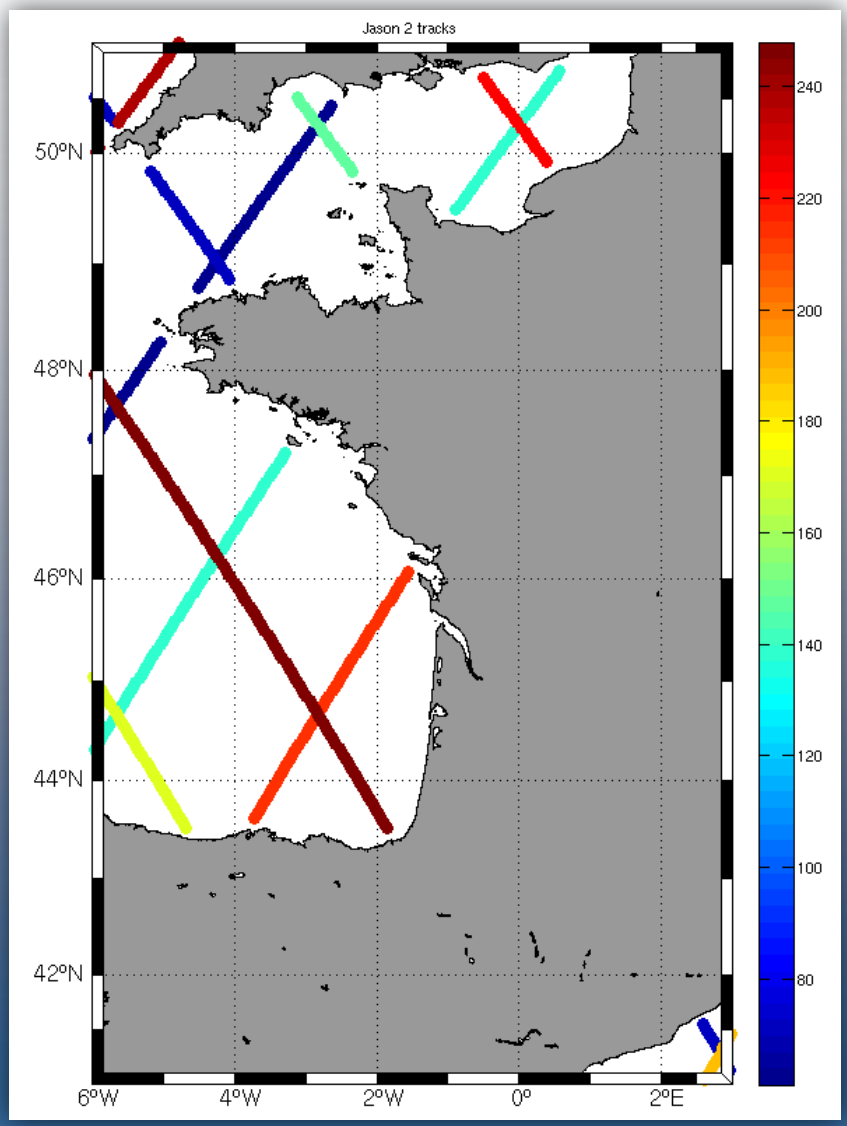
Satellites: JASON 1 / 2
⇒ Analysed data: JASON 2

Products: Sla Extended & Pistach

Frequency: 1 track every 10 days

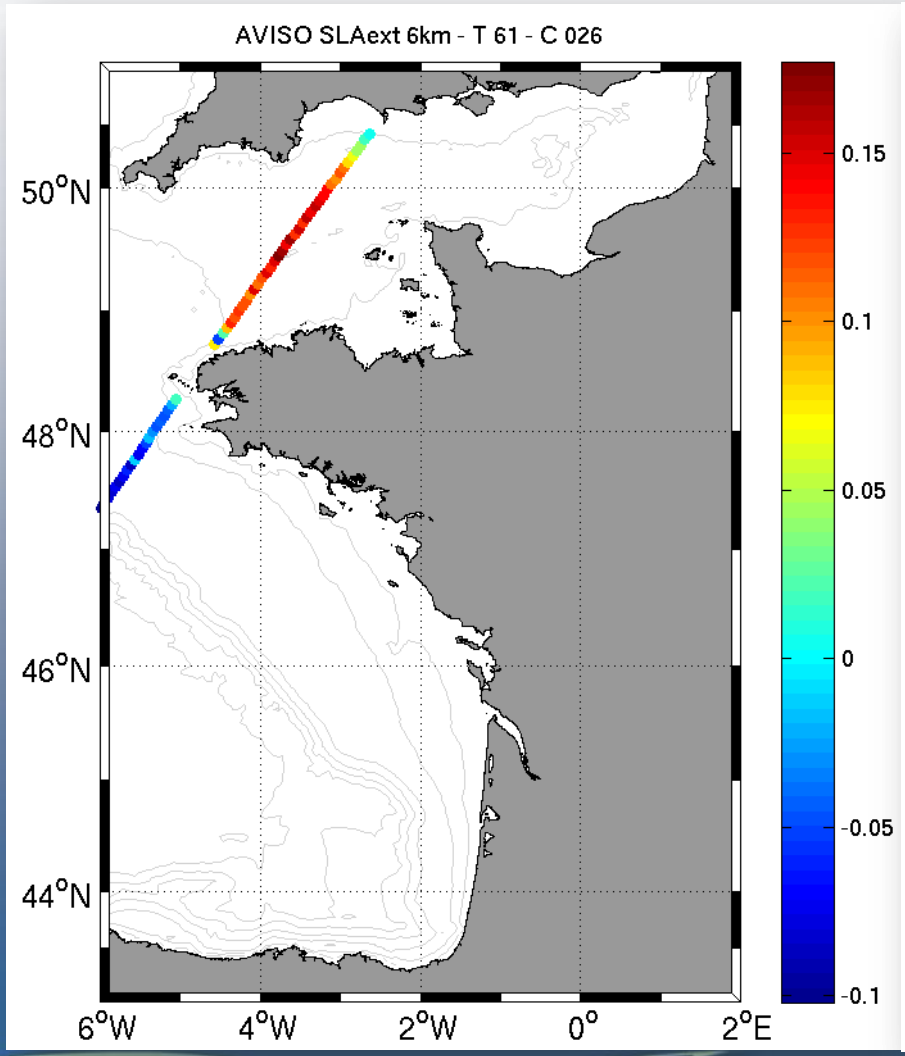
Period:
⇒ 08/01/2009 – 28/02/2011 (Sla Extended)
⇒ 29/12/2008 – 26/11/2011 (Pistach)

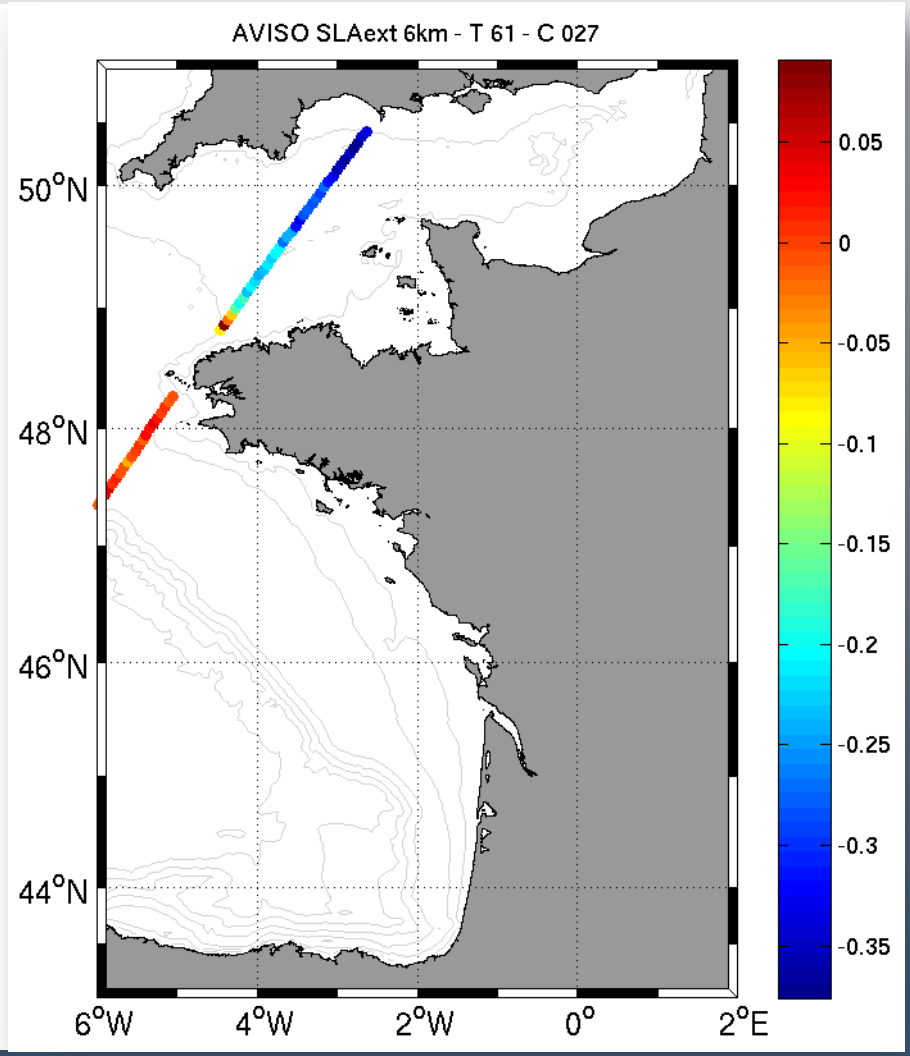
Tracks n°: 61, 137, 213, 248, 70, 146, 222

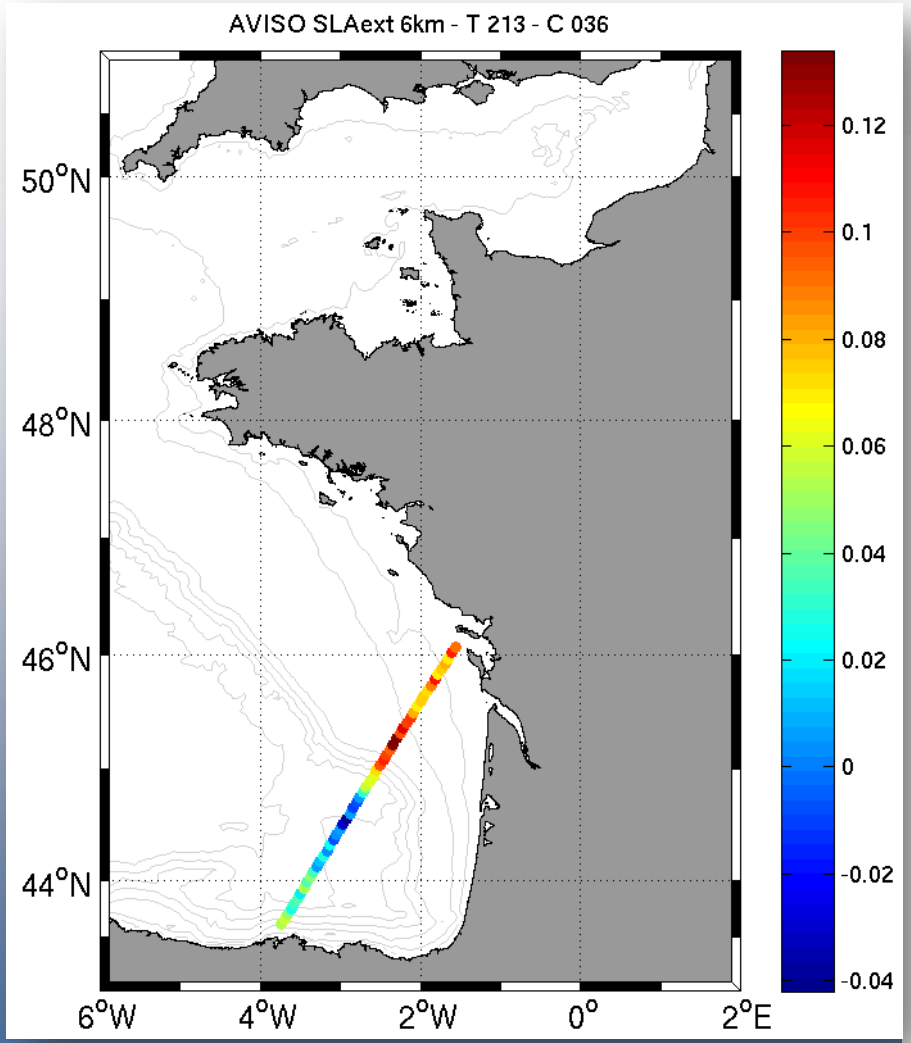


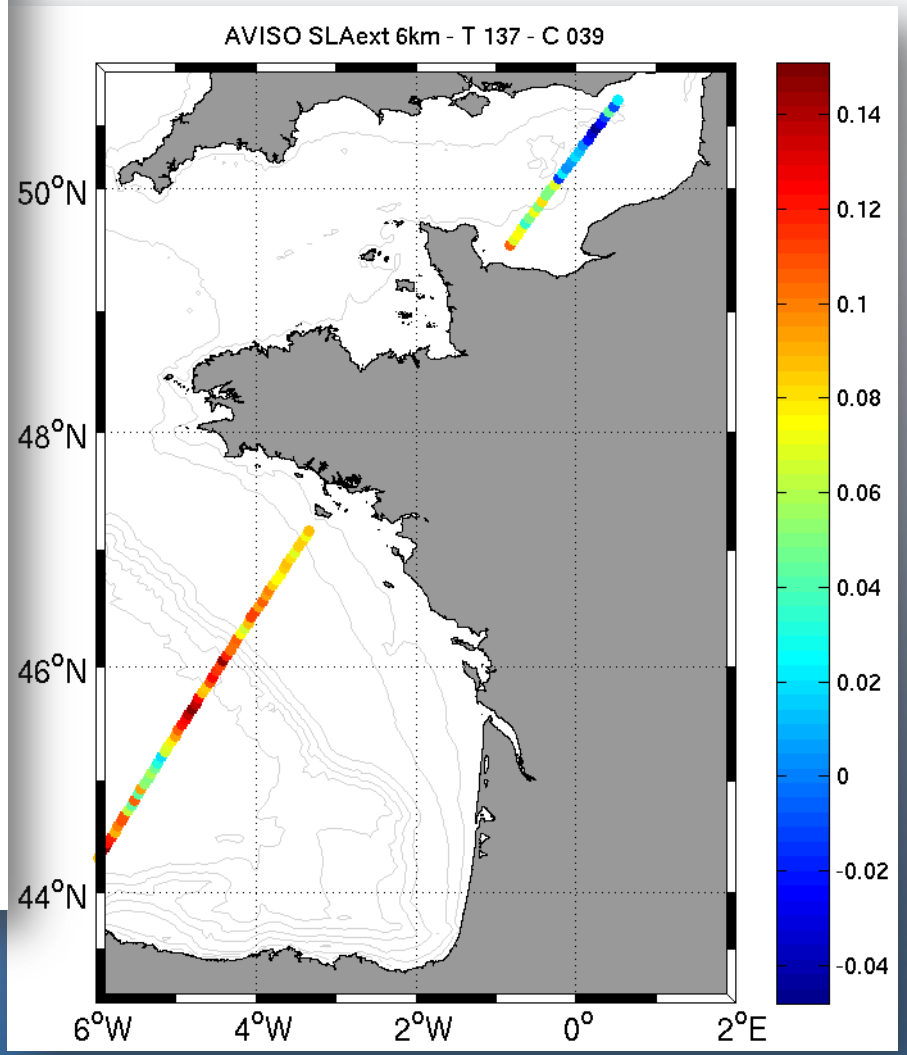
Along track Sea Level Anomalies ...

Sea Level Anomalies (m) along the track 61 - 2 serial tracks (10 days interval)





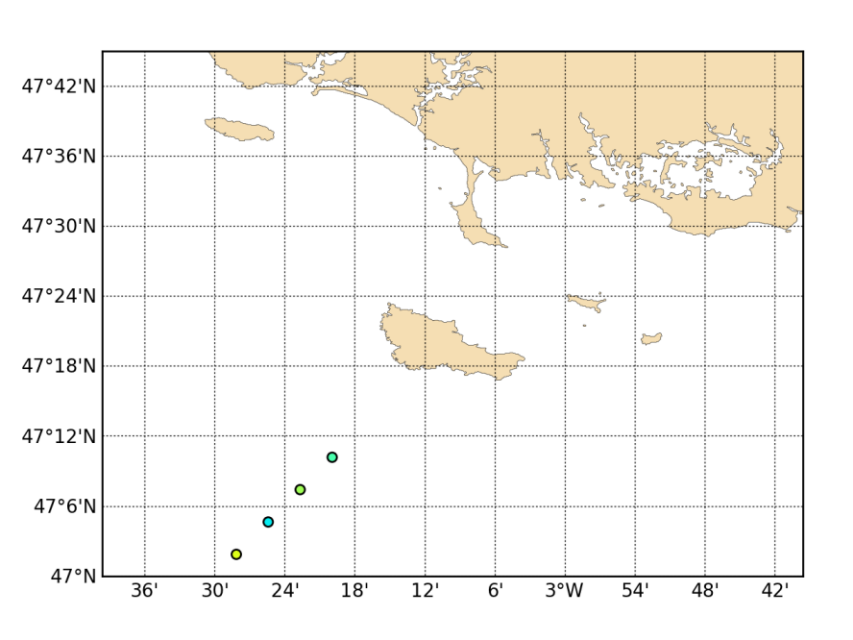




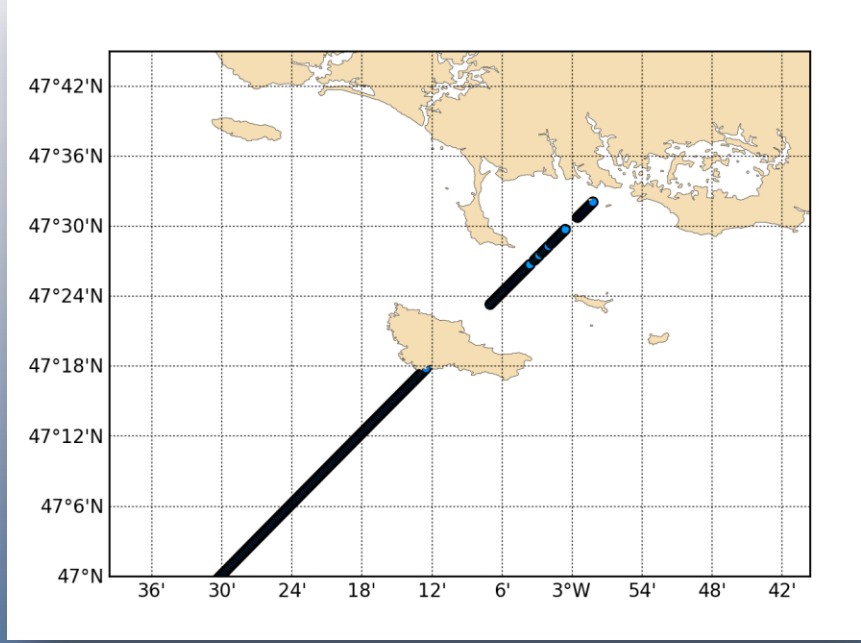
Localized structures.
Gradient between shelf and open ocean.

Tow products: Sla Extended / Pistach

*Jason-2 track 137 – **Sla Extended***



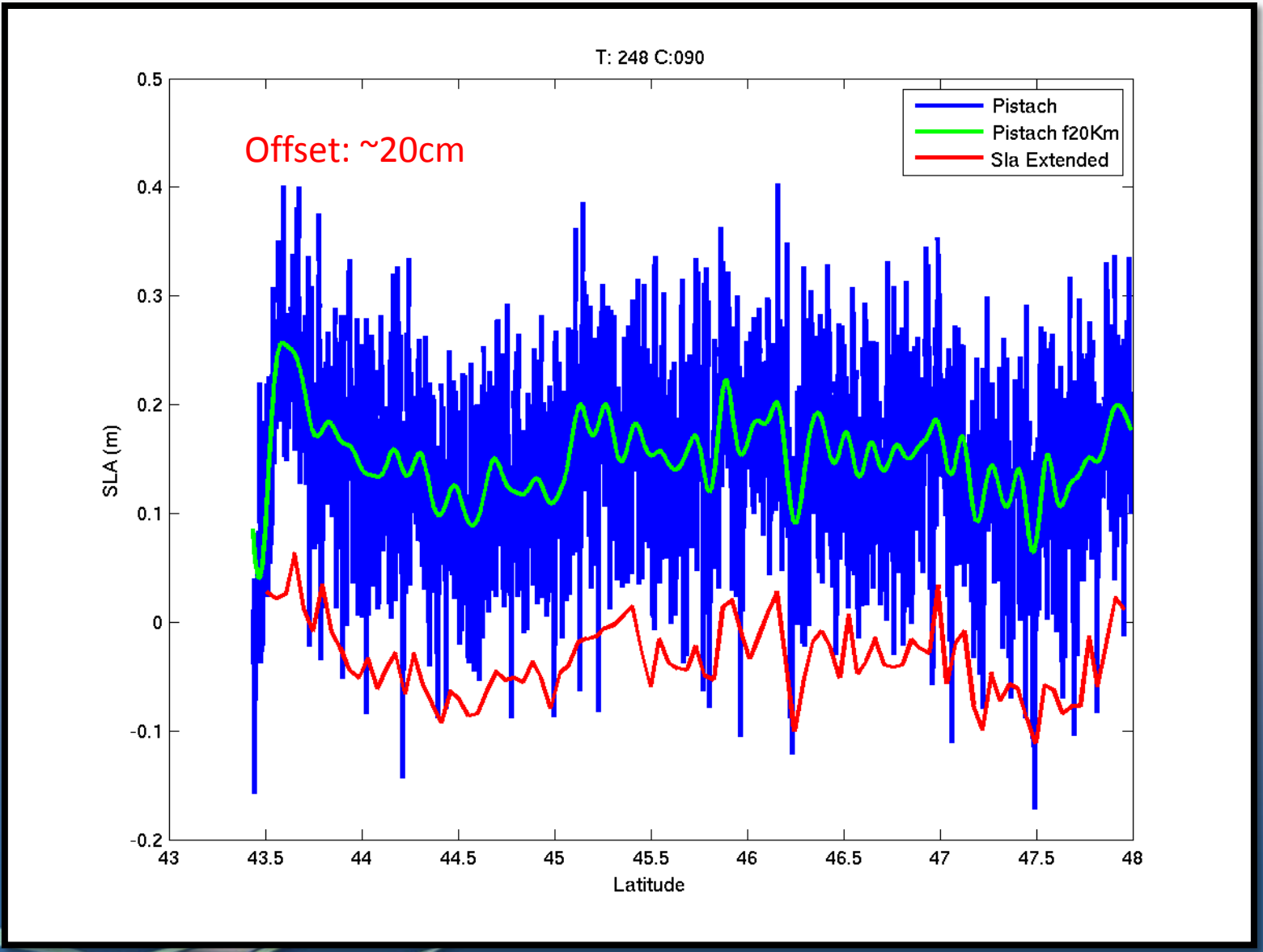
*Jason-2 track 137 – **Pistach***



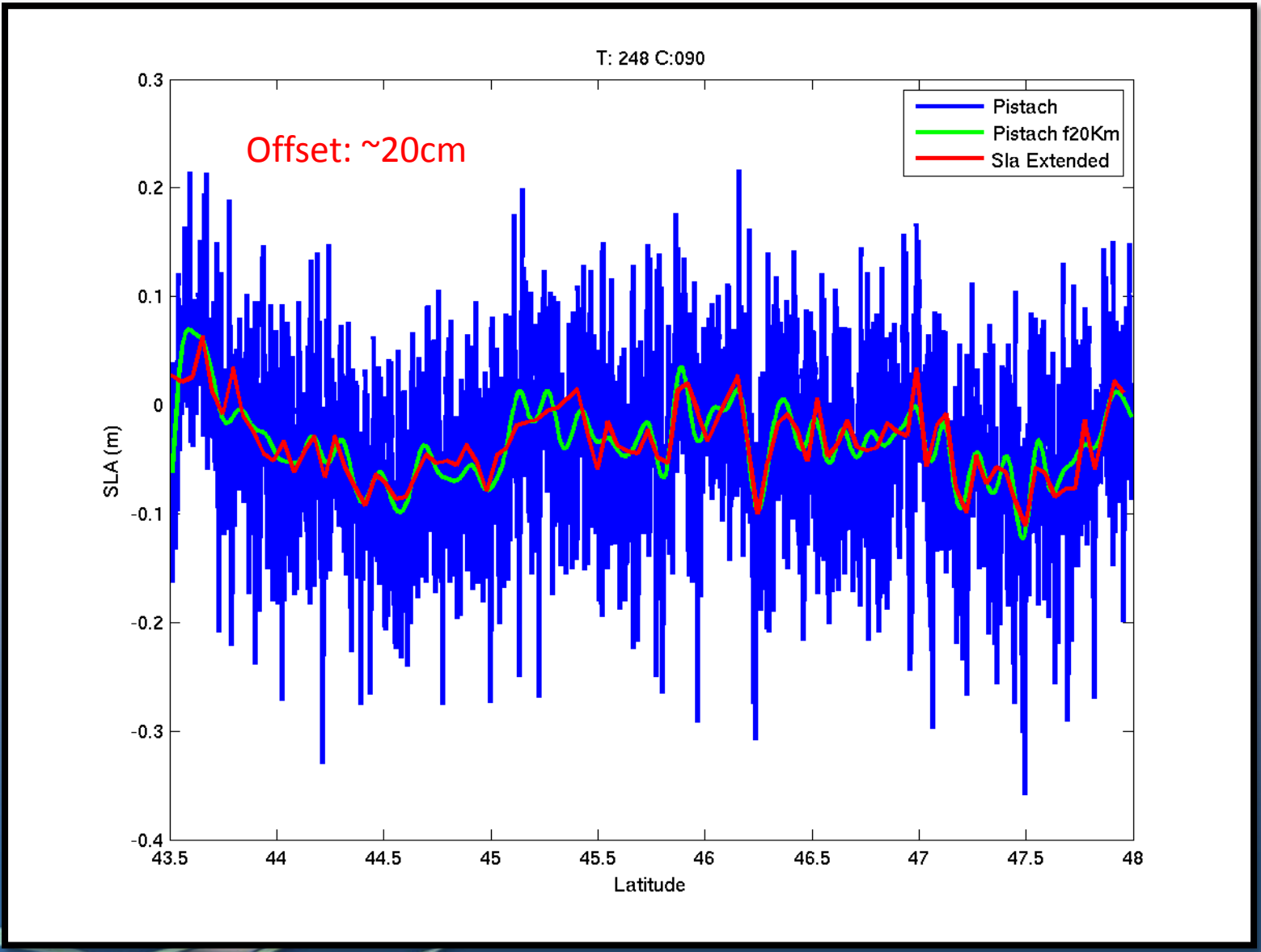
Tow products: Sla Extended / Pistach

	Sla Extended	Pistach
Spatial resolution 1 point every …	… **7 Km**	… **350m (20Hz)**
Tide correction	GOT4v7	GOT4v7, FES04
Large wavelength bias correction	No	Yes
Complementary specific processings	Mersea Regional products (tides, inverse barometer, HF)	Same as Sla Extended + new estimations of the altimeter-ocean distance, new estimations of the wet tropospheric correction

SLA Extended vs. PISTACH: an example



SLA Extended vs. PISTACH: an example



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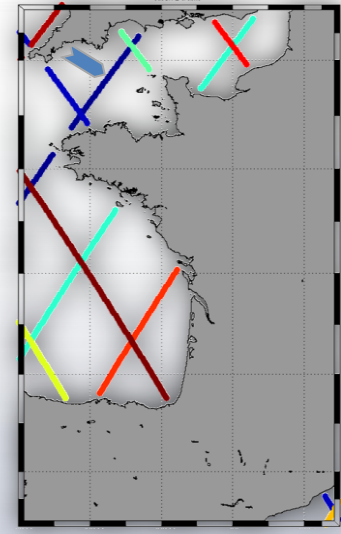
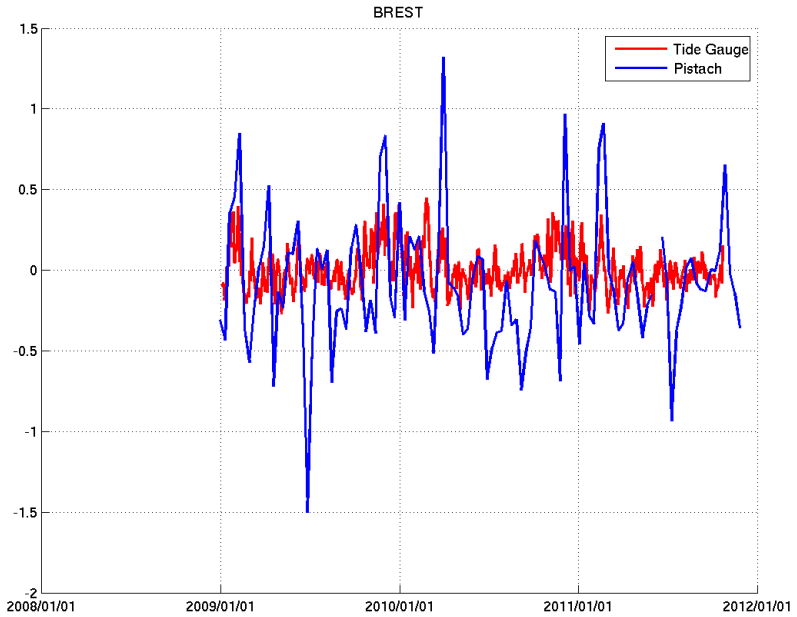
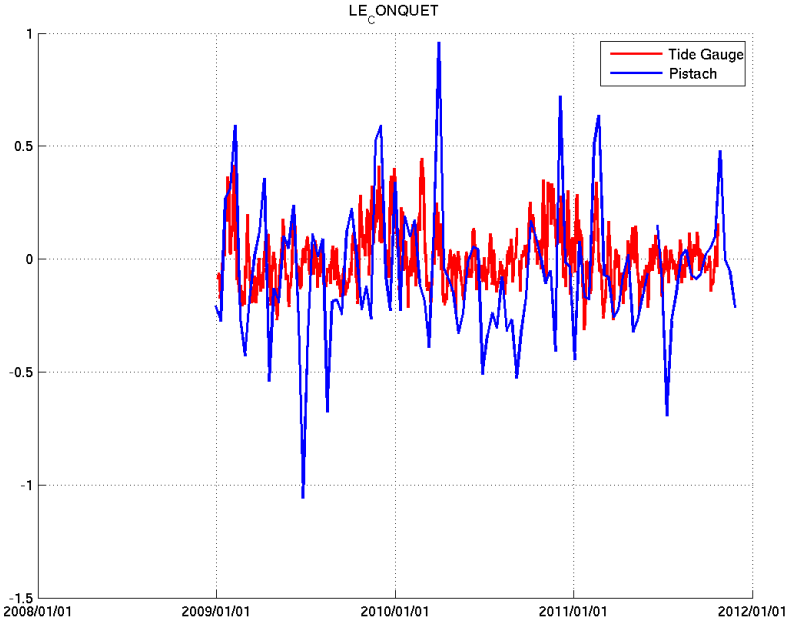
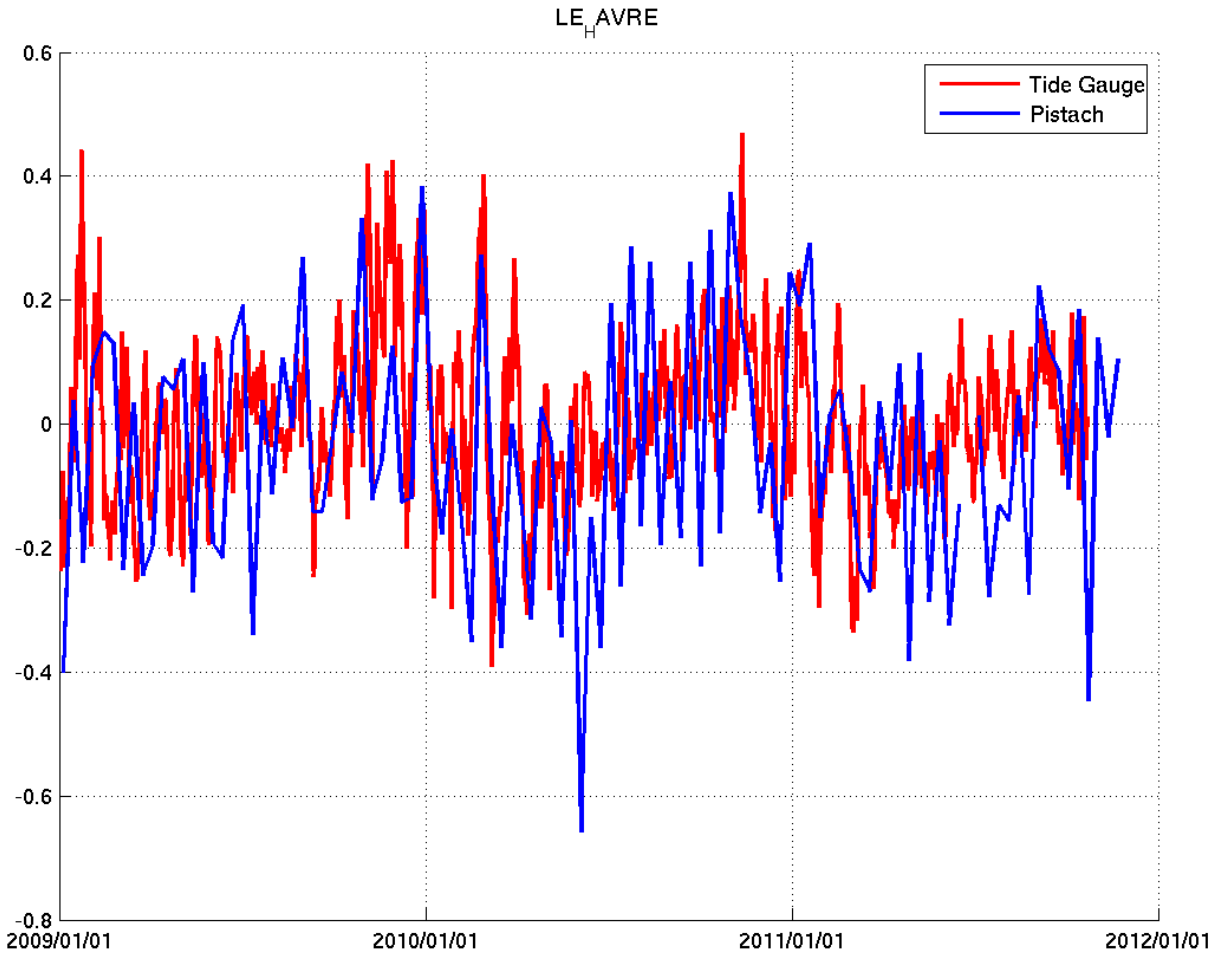
Validation: Tide Gauges – Brest/Le Conquet

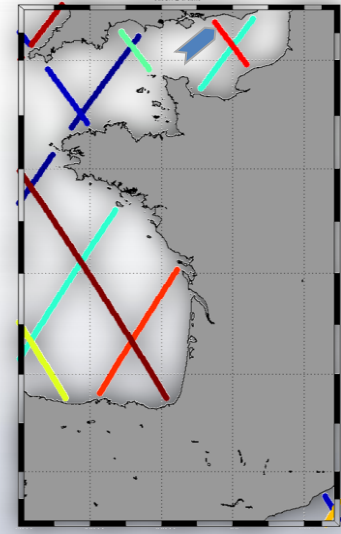




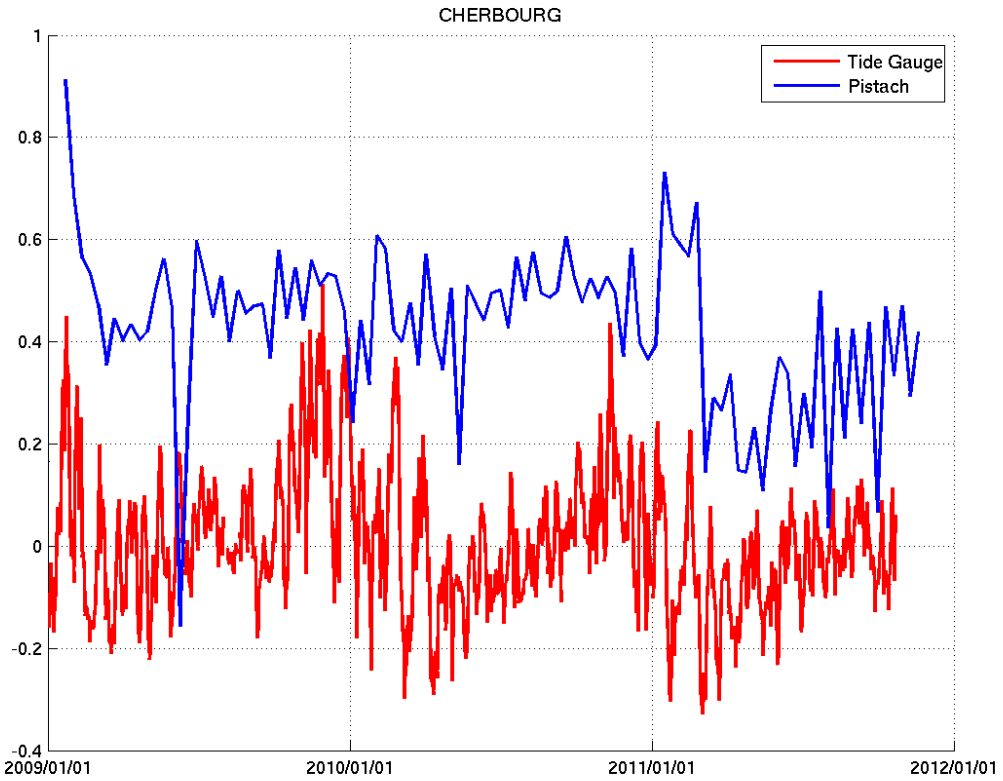


Validation: Tide Gauge – Le Havre

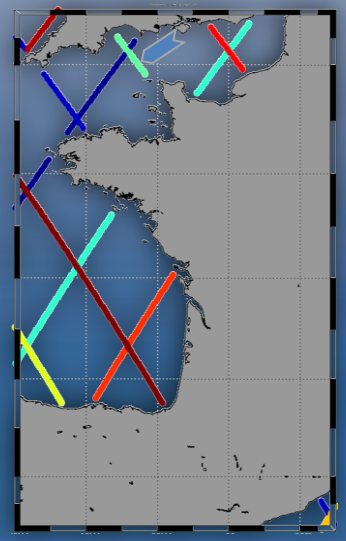




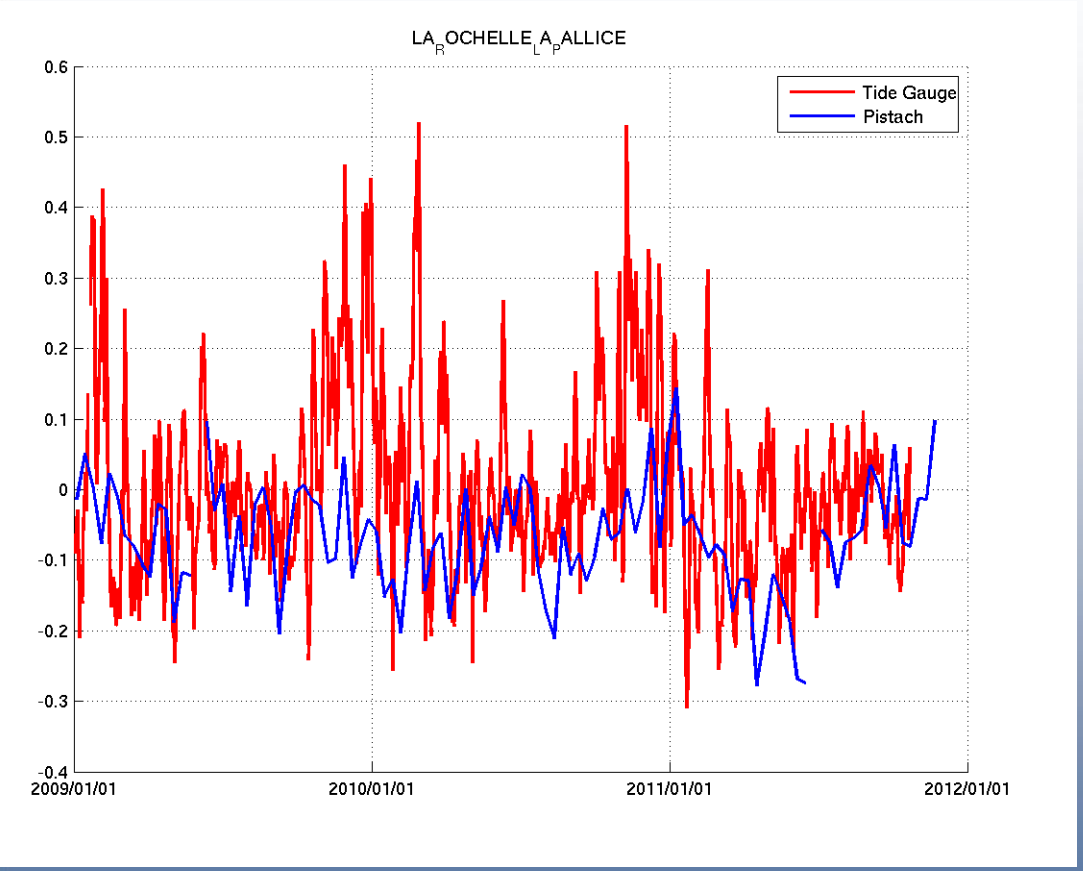
Validation: Tide Gauge – Cherbourg

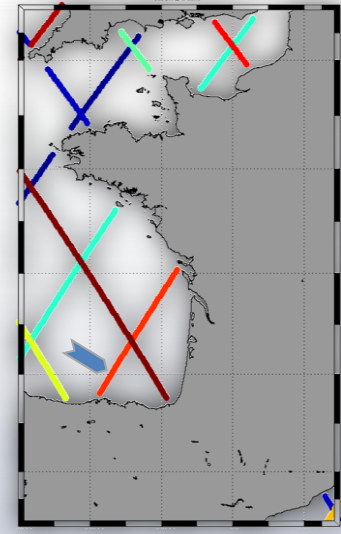


Same variability but mean bias …

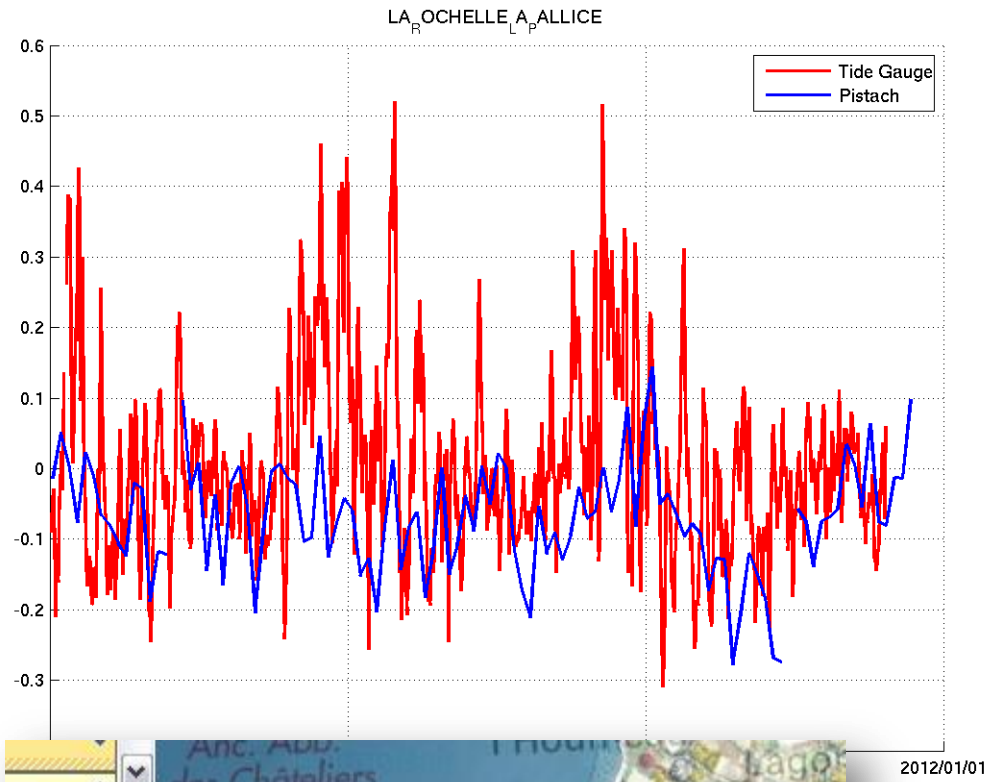


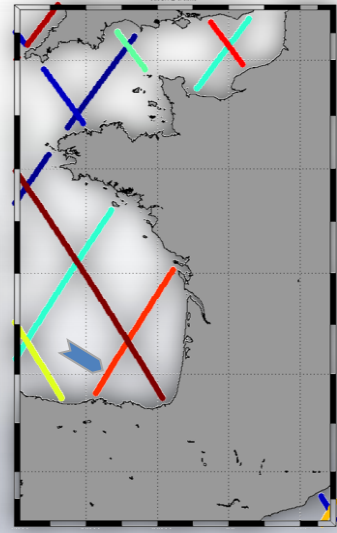
Validation: Tide Gauge – La Rochelle

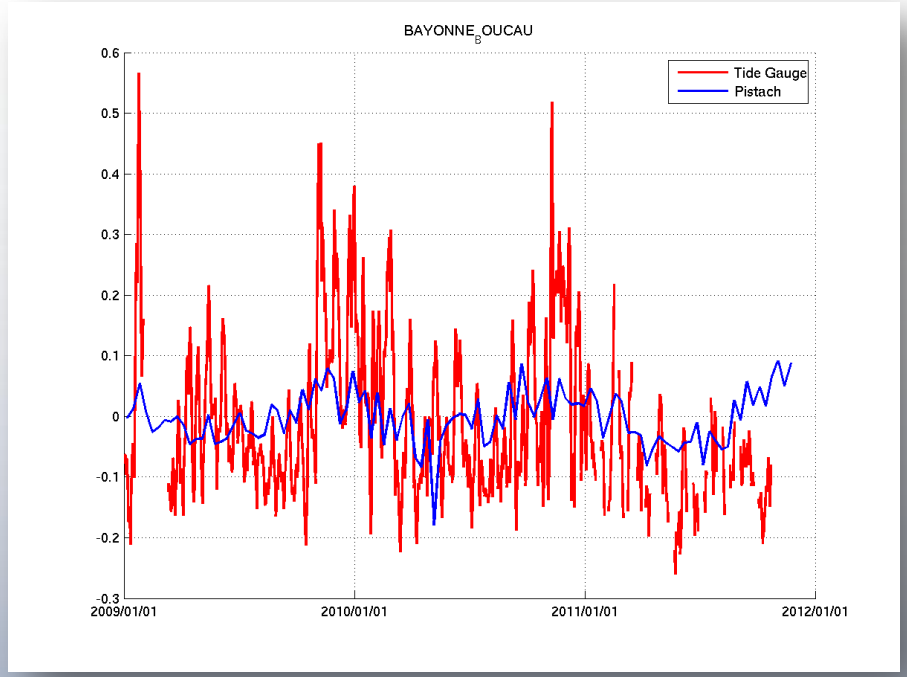


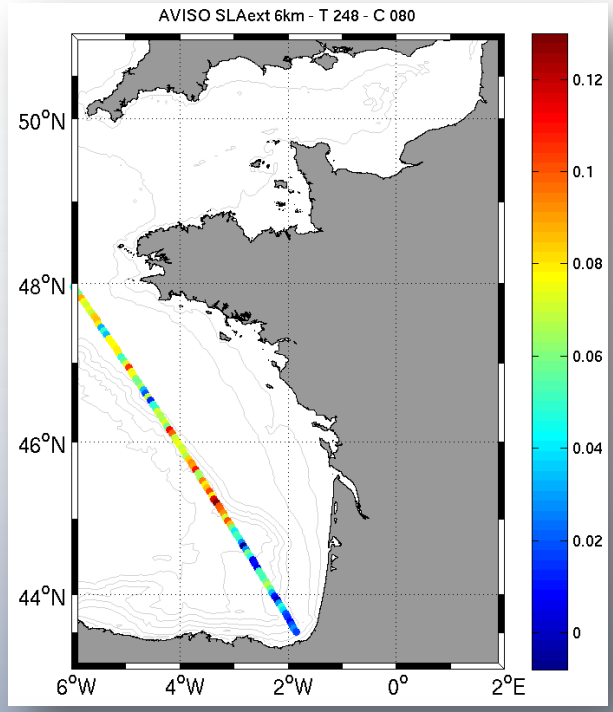


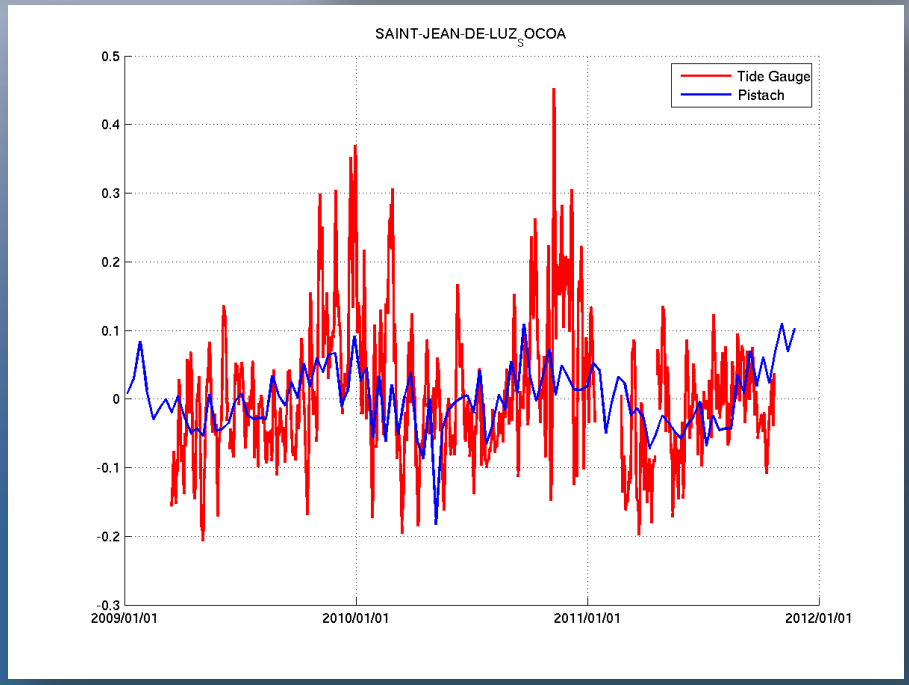
Validation: Tide Gauge – La Rochelle



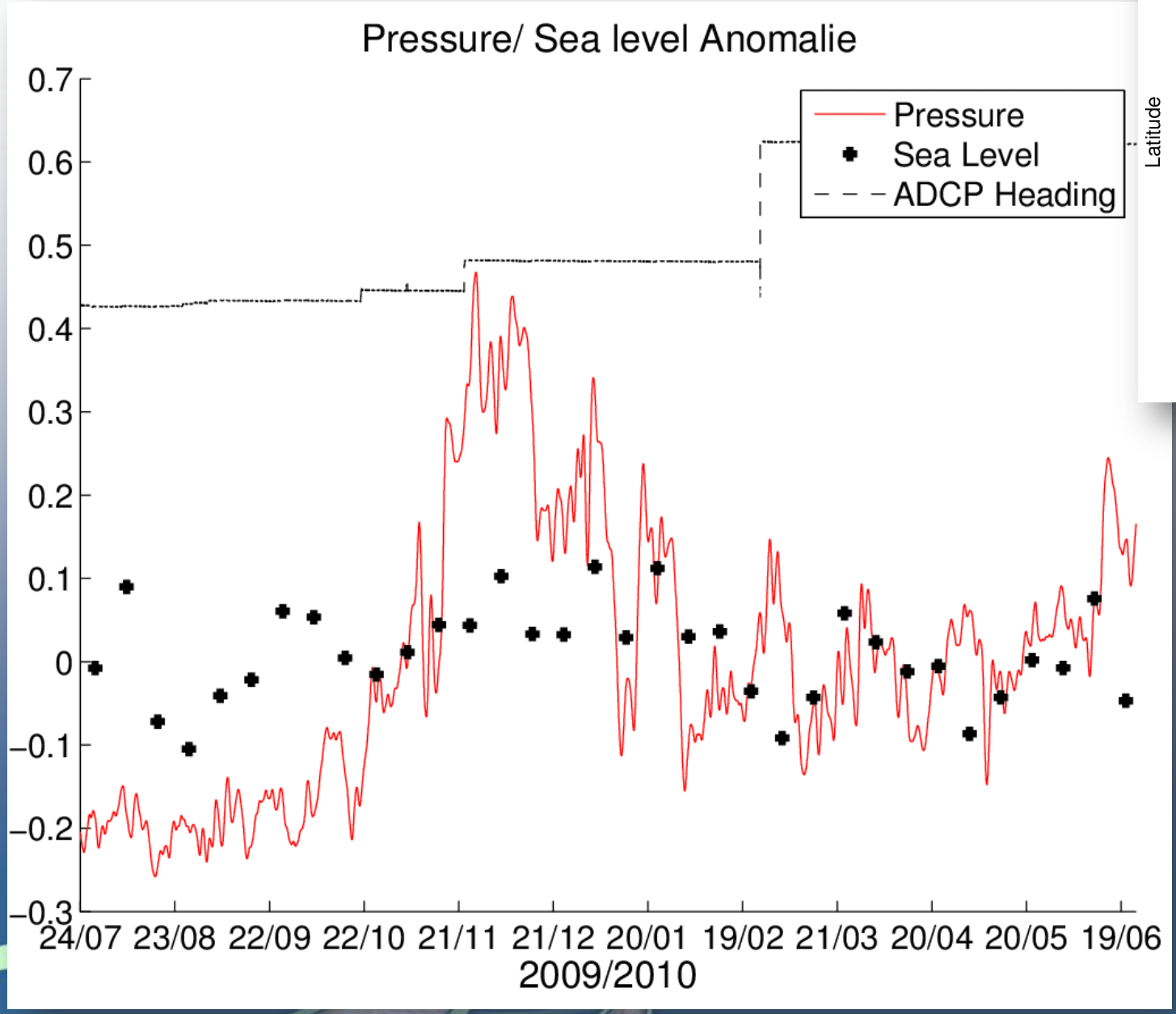


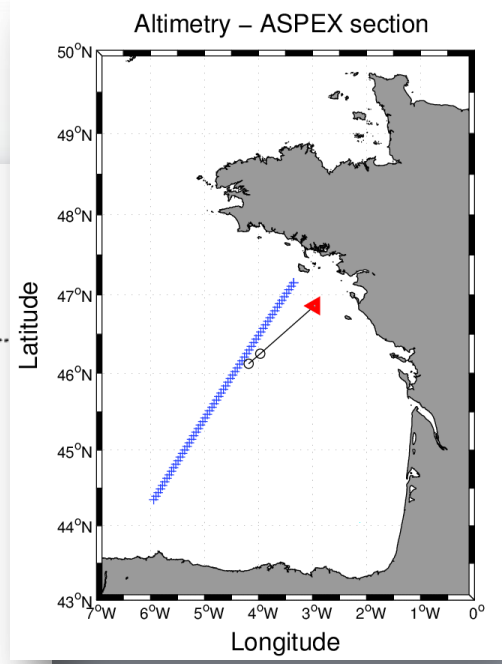

BAYONNE_BOUCAU
Tide Gauge
Pistach
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
2009/01/01
2010/01/01
2011/01/01
2012/01/01


AVISO SLAext 6km - T 248 - C 080
50°N
48°N
46°N
44°N
6°W
4°W
2°W
0°
2°E
0.12
0.1
0.08
0.06
0.04
0.02
0


SAINT-JEAN-DE-LUZ_OCOA
Tide Gauge
Pistach
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
2009/01/01
2010/01/01
2011/01/01
2012/01/01

Validation: ASPEX ADCP - bottom pressure





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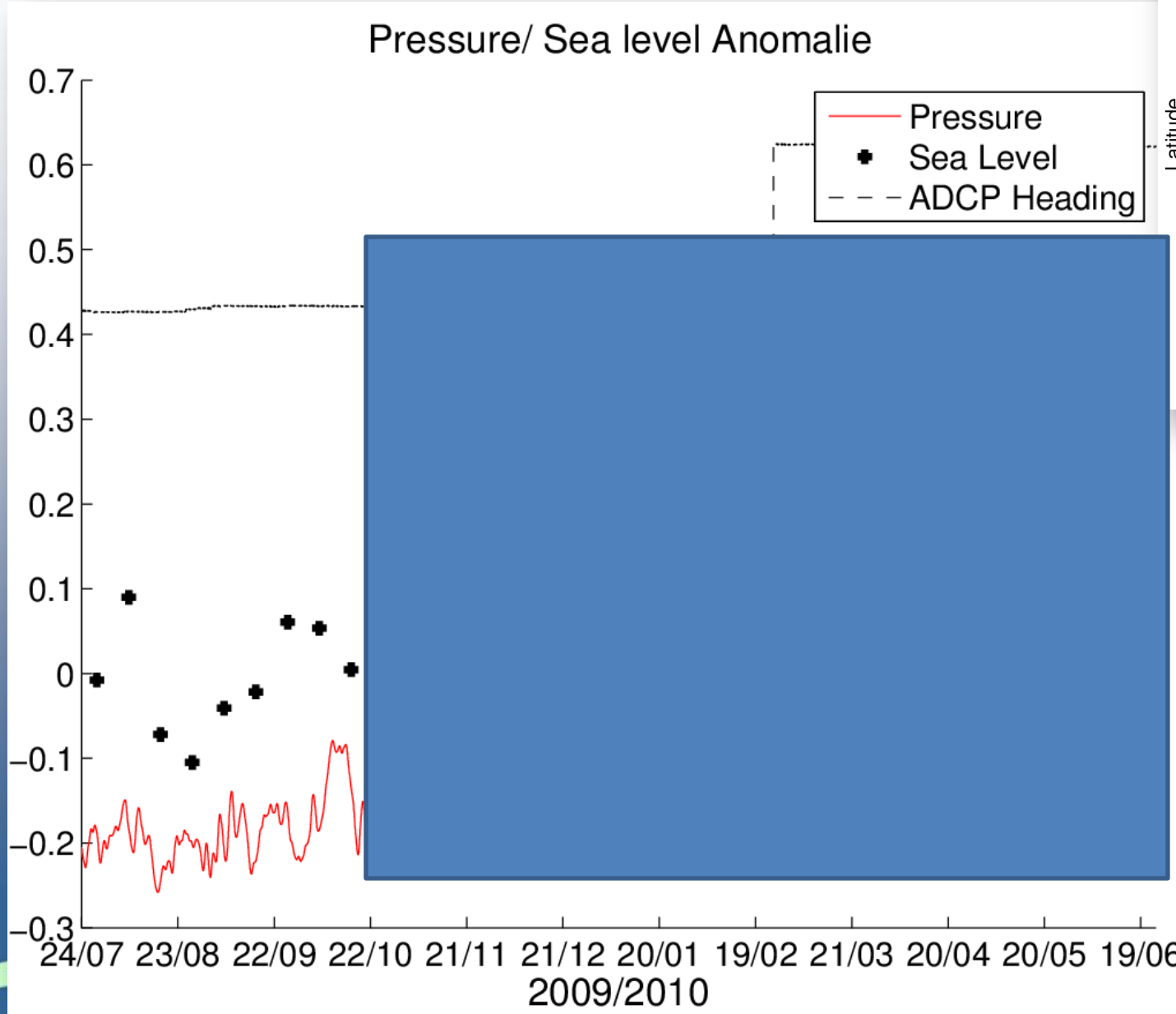
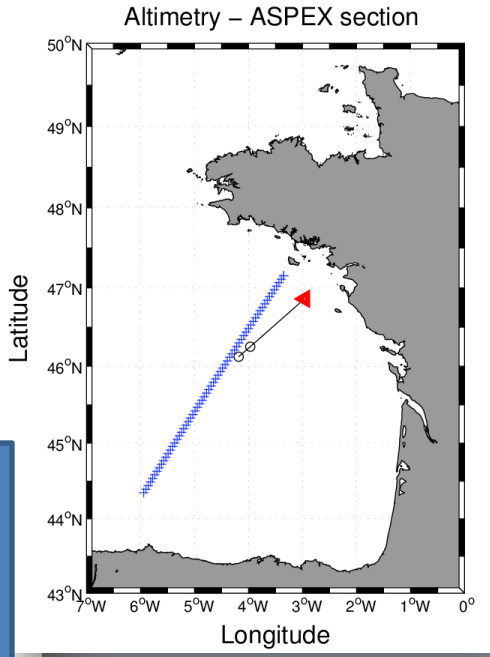
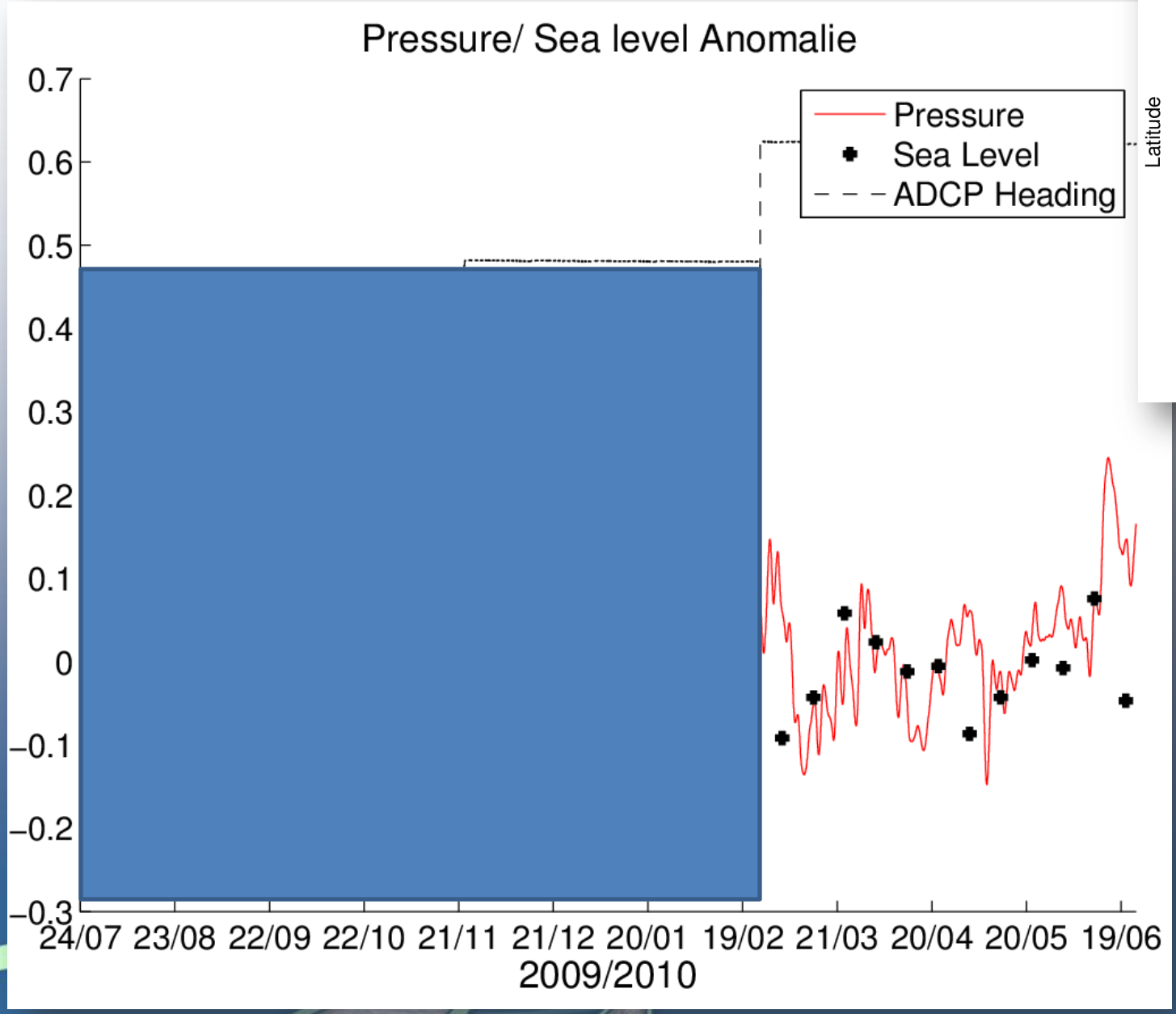
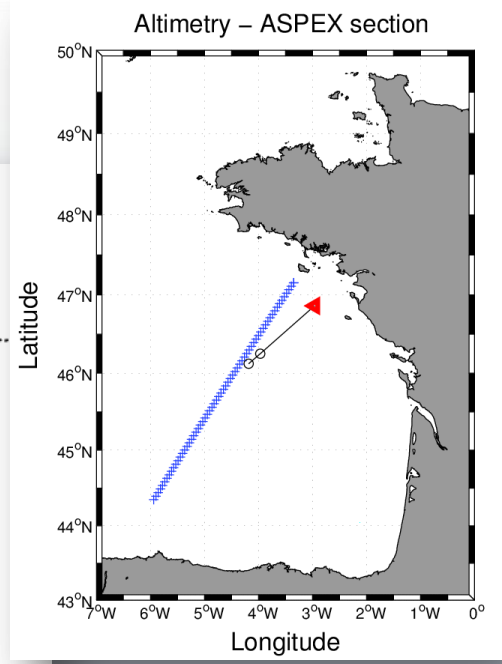


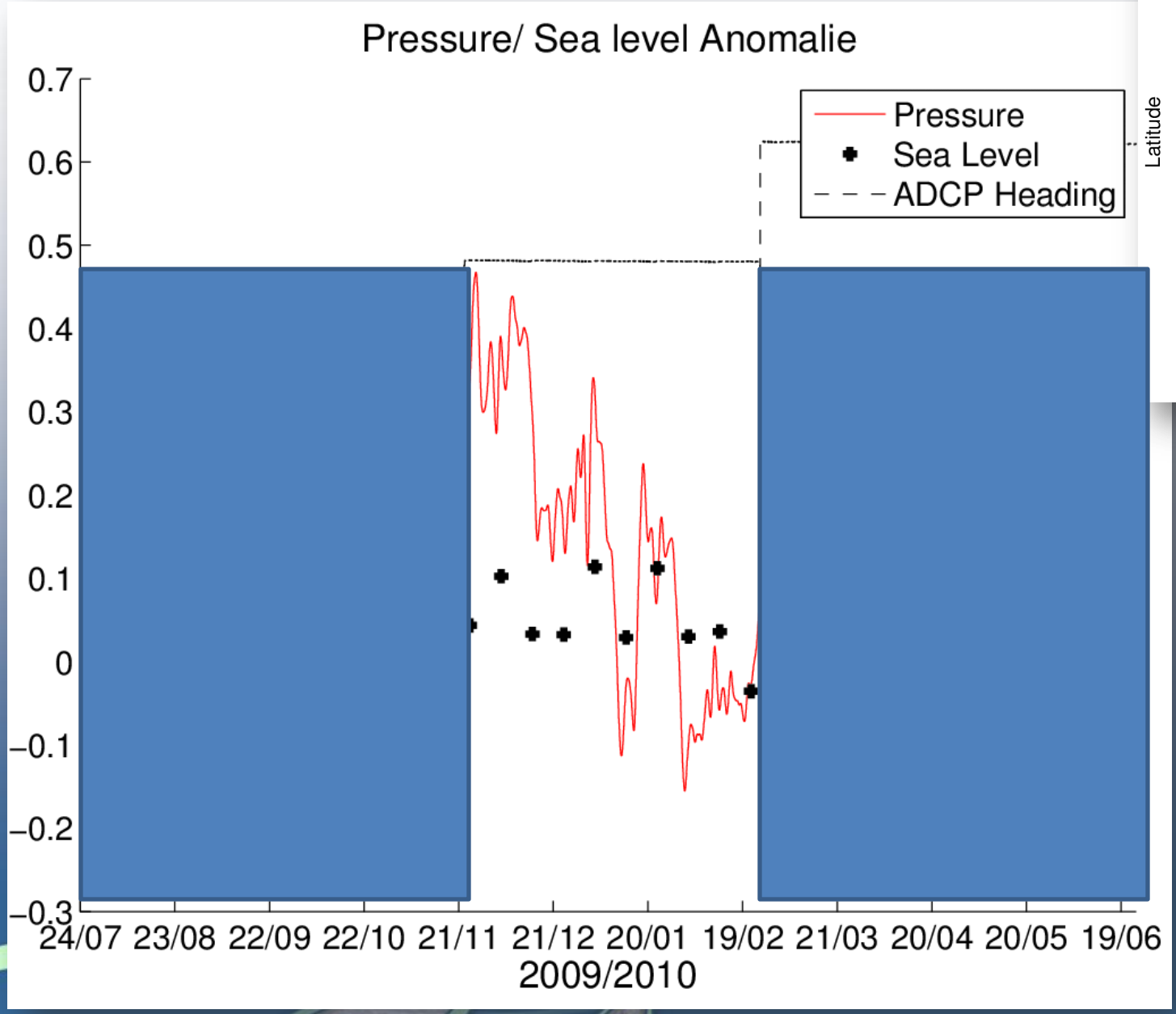


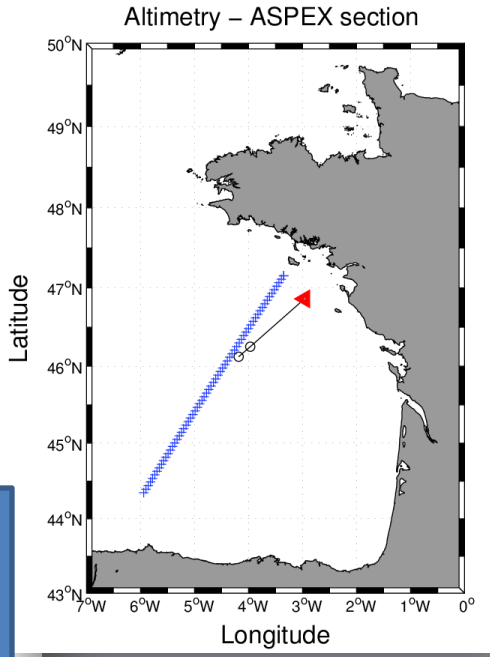
Validation: ASPEX ADCP - bottom pressure





Validation: ASPEX ADCP - bottom pressure





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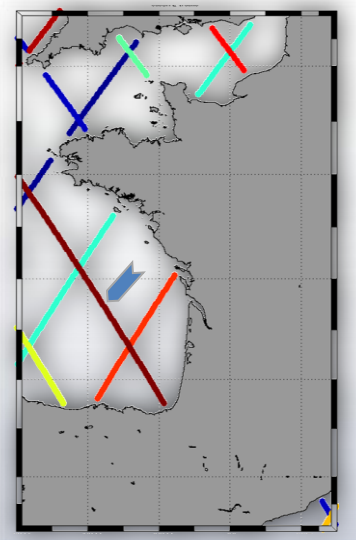
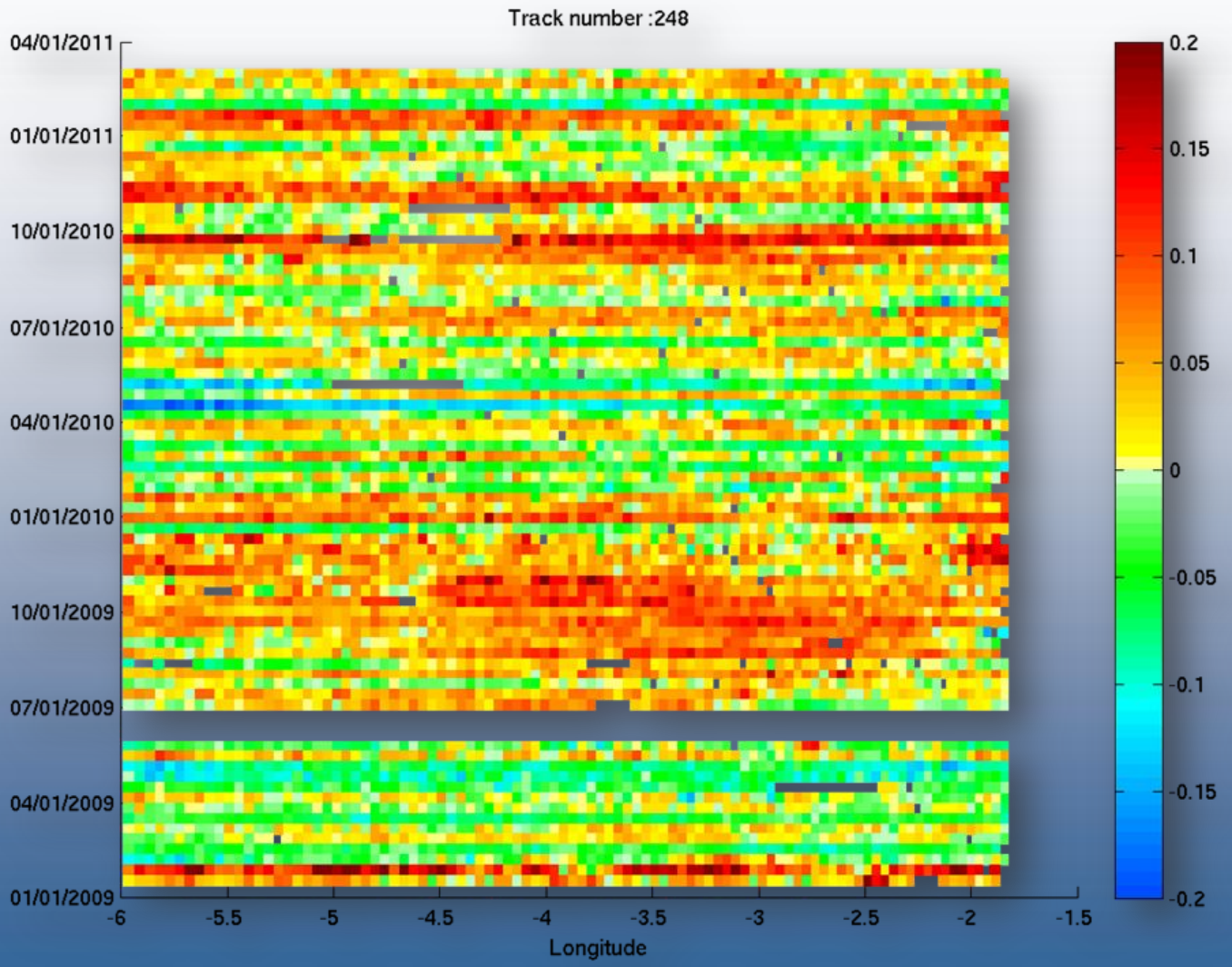
Finally ... What can we see ?

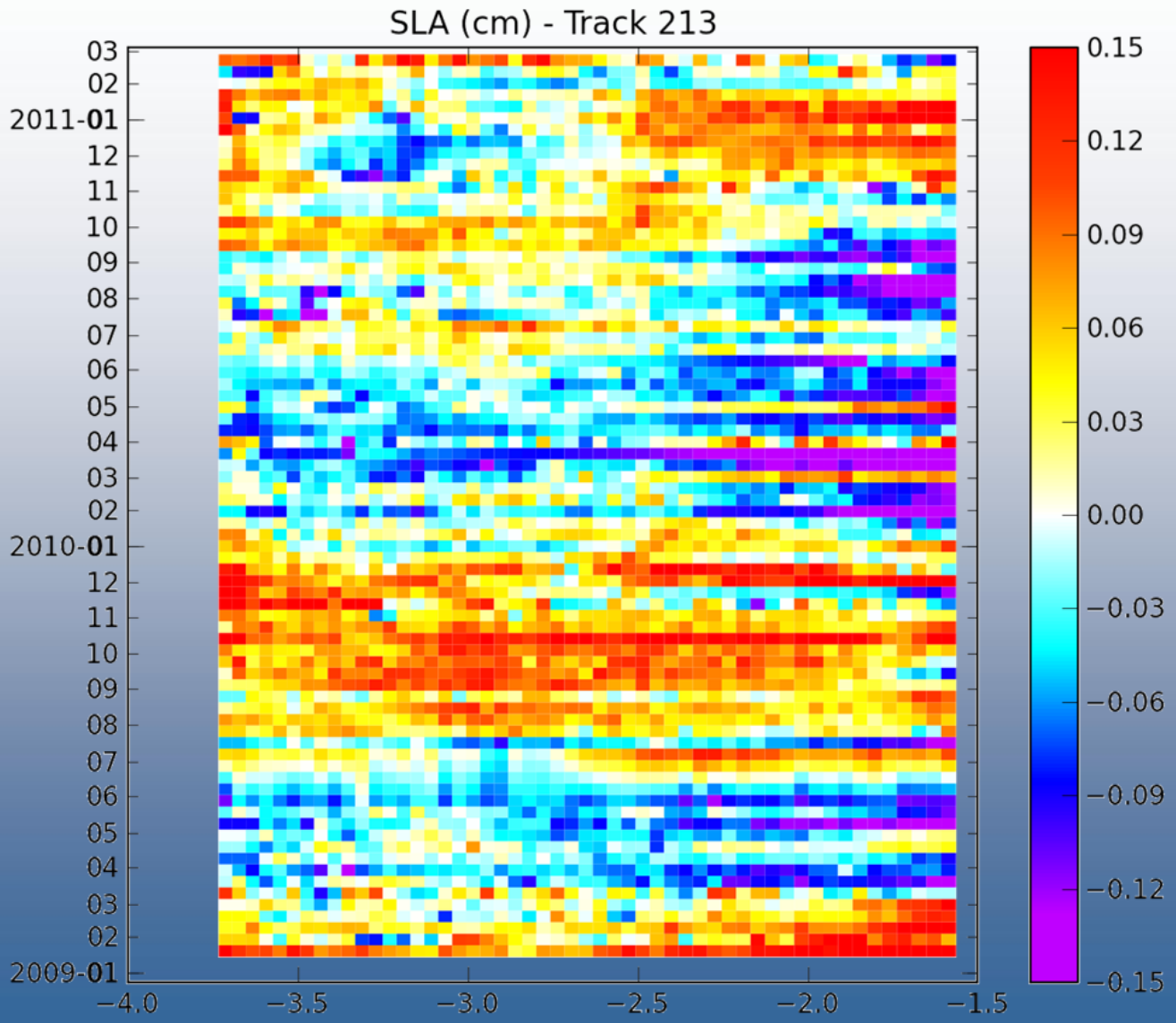


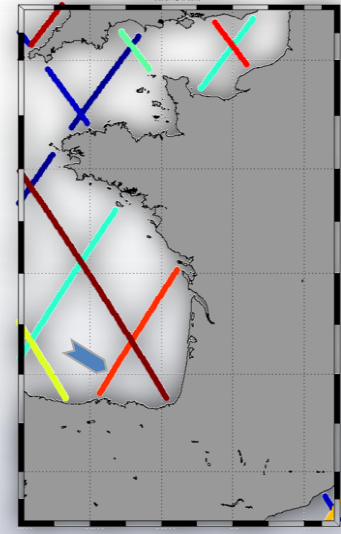
Seasonal cycle
⇒steric effect

Short increase during 1-2 cycles
⇒ offset ?
⇒ structure



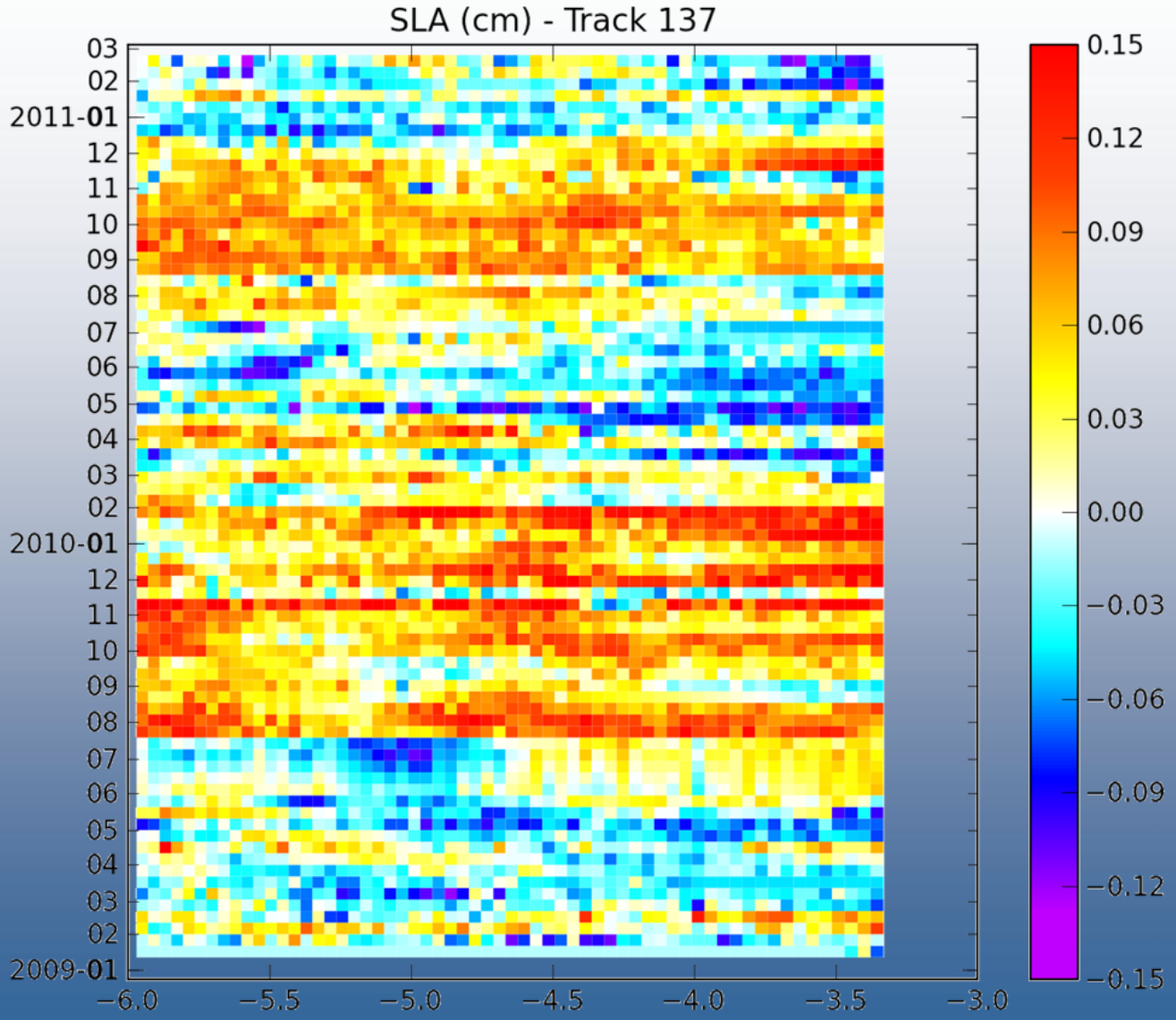
South

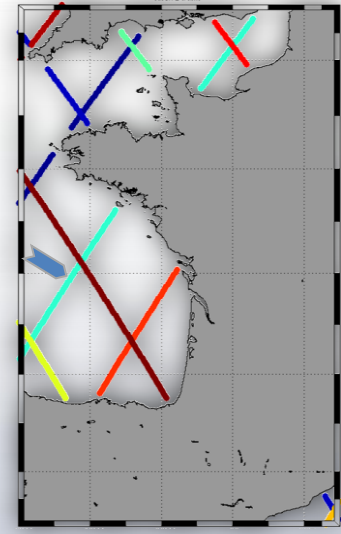

SLA (cm) - Track 213
03
02
2011-01
12
11
10
09
08
07
06
05
04
03
02
2010-01
12
11
10
09
08
07
06
05
04
03
02
2009-01
−4.0
−3.5
−3.0
−2.5
−2.0
−1.5
0.15
0.12
0.09
0.06
0.03
0.00
−0.03
−0.06
−0.09
−0.12
−0.15



North

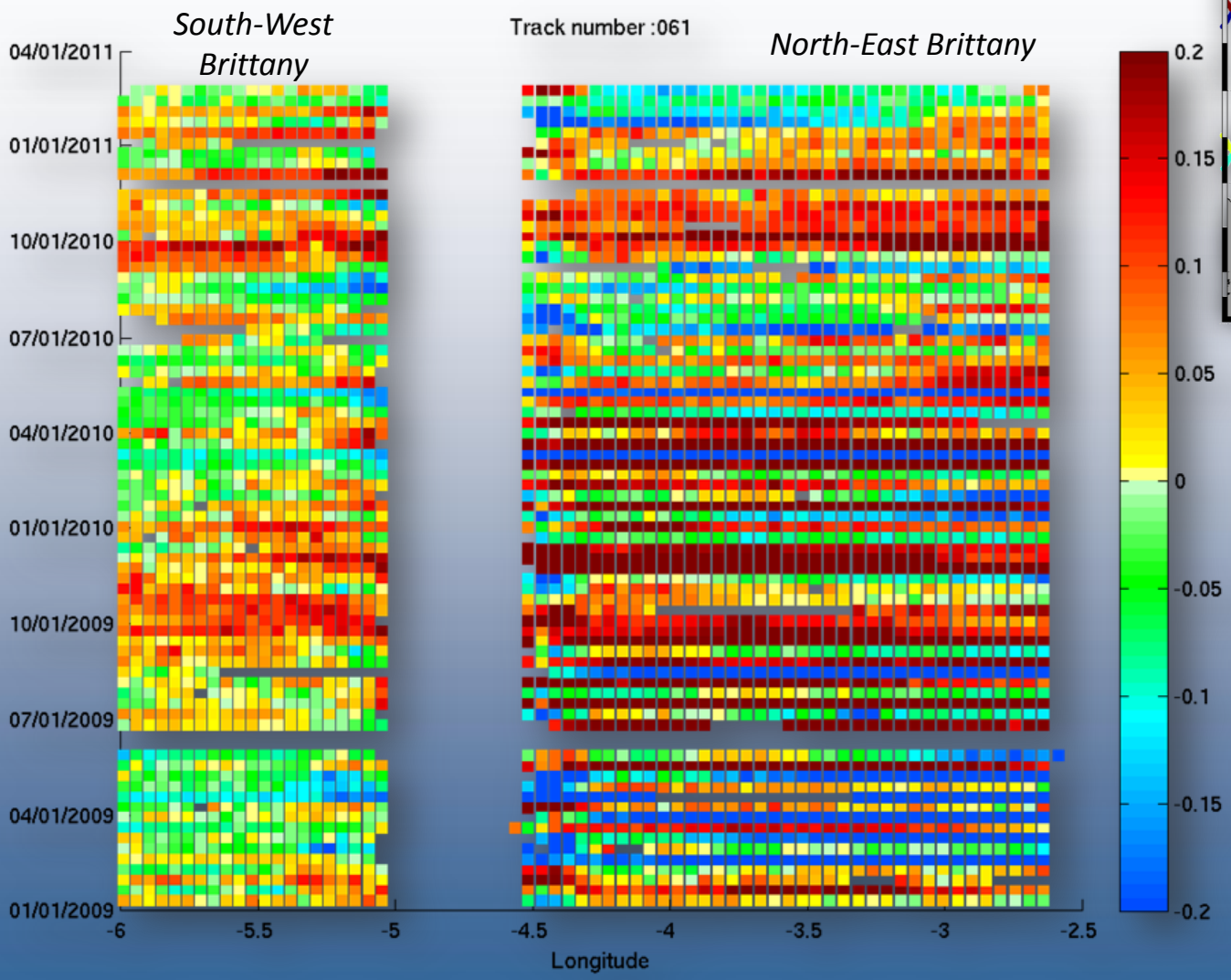
South


SLA (cm) - Track 137
03
02
2011-01
12
11
10
09
08
07
06
05
04
03
02
2010-01
12
11
10
09
08
07
06
05
04
03
02
2009-01
−6.0
−5.5
−5.0
−4.5
−4.0
−3.5
−3.0
0.15
0.12
0.09
0.06
0.03
0.00
−0.03
−0.06
−0.09
−0.12
−0.15



North

South


South-West Brittany
Track number :061
North-East Brittany
04/01/2011
01/01/2011
10/01/2010
07/01/2010
04/01/2010
01/01/2010
10/01/2009
07/01/2009
04/01/2009
01/01/2009
-6
-5.5
-5
-4.5
-4
-3.5
-3
-2.5
Longitude
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0.15
0.1
0.05
0
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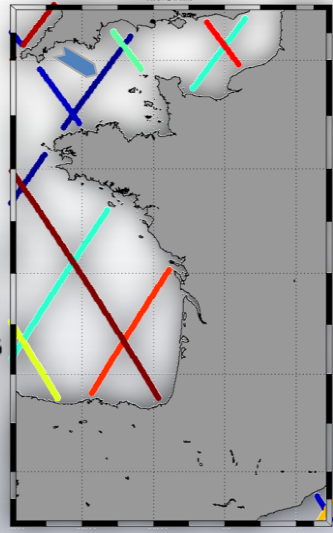
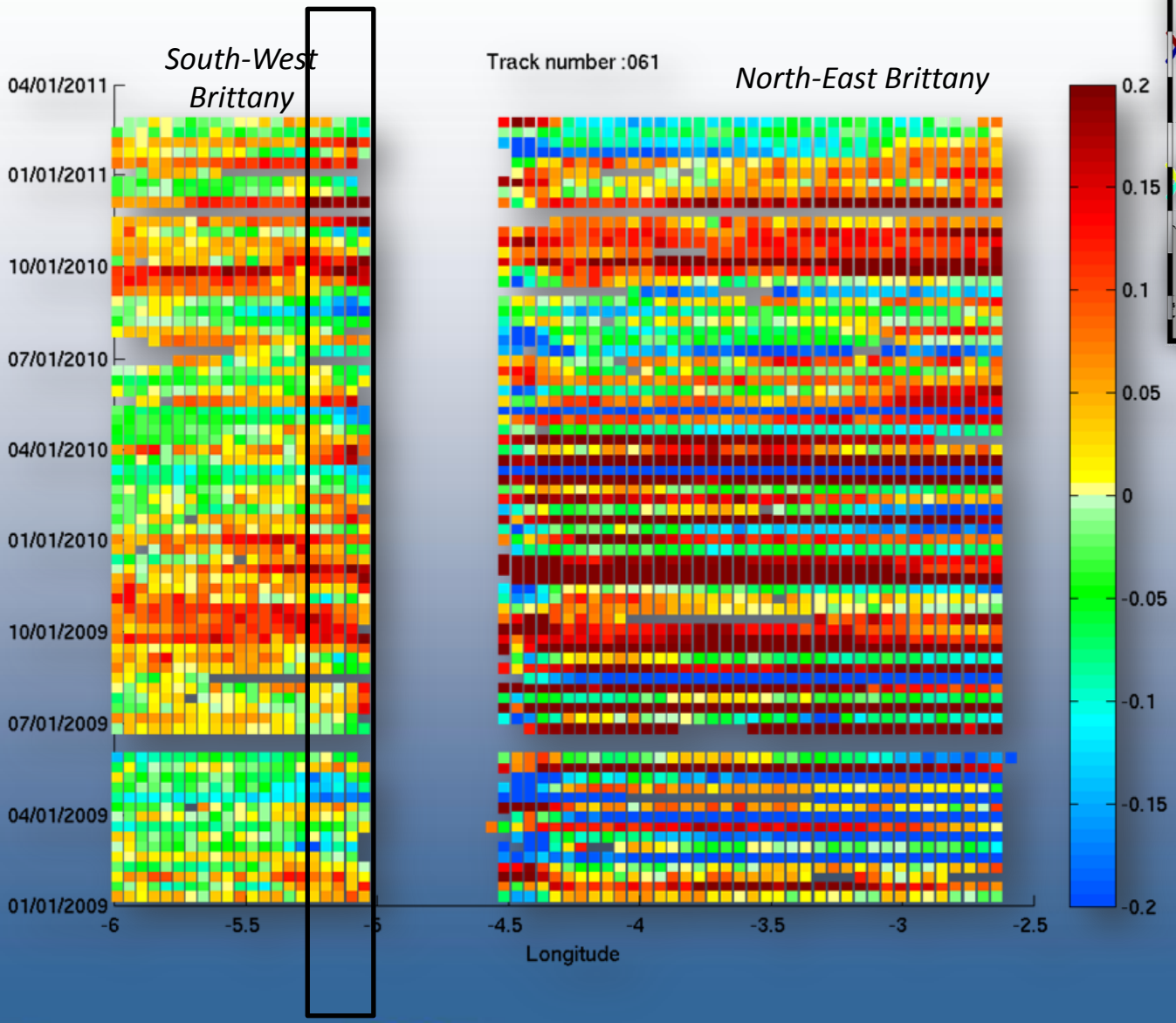
-0.1
-0.15
-0.2



North

South


South-West Brittany
Track number :061
North-East Brittany
04/01/2011
01/01/2011
10/01/2010
07/01/2010
04/01/2010
01/01/2010
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07/01/2009
04/01/2009
01/01/2009
-6
-5.5
-4.5
-4
-3.5
-3
-2.5
Longitude
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2

North

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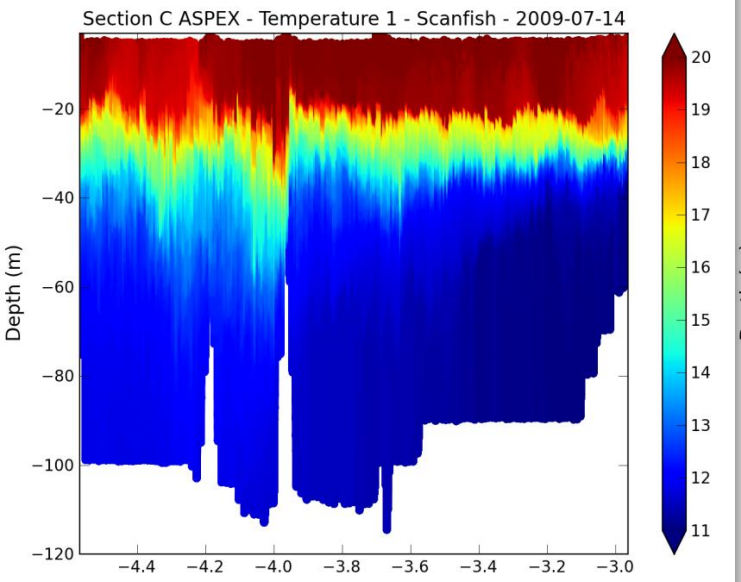
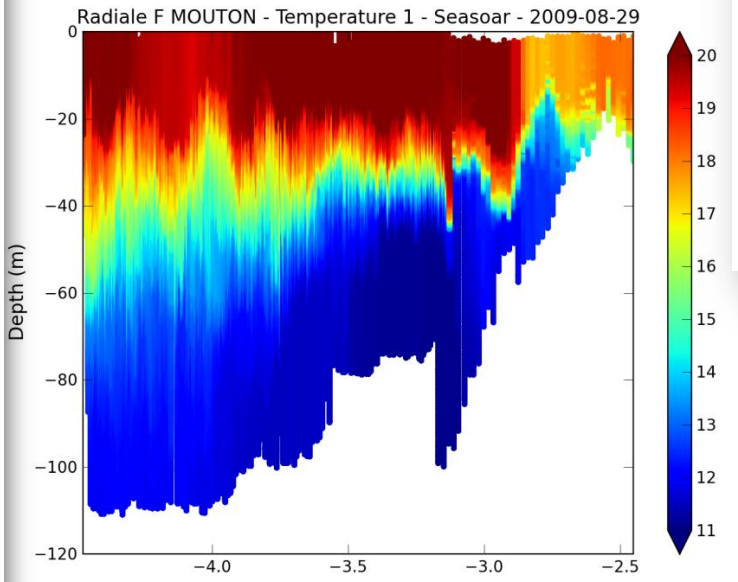
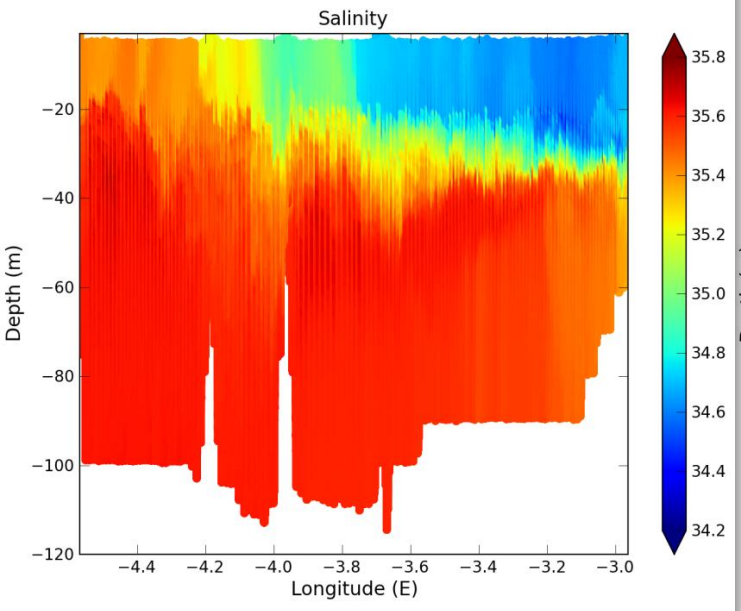
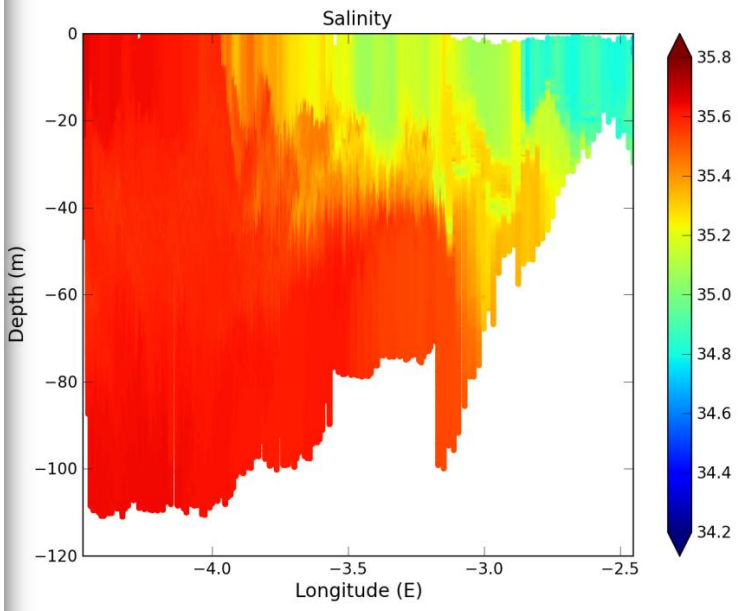
Conclusions & Perspectives

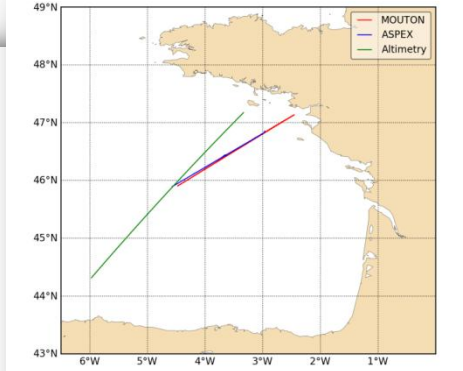
ASPEX 2009 - MOUTON 2009



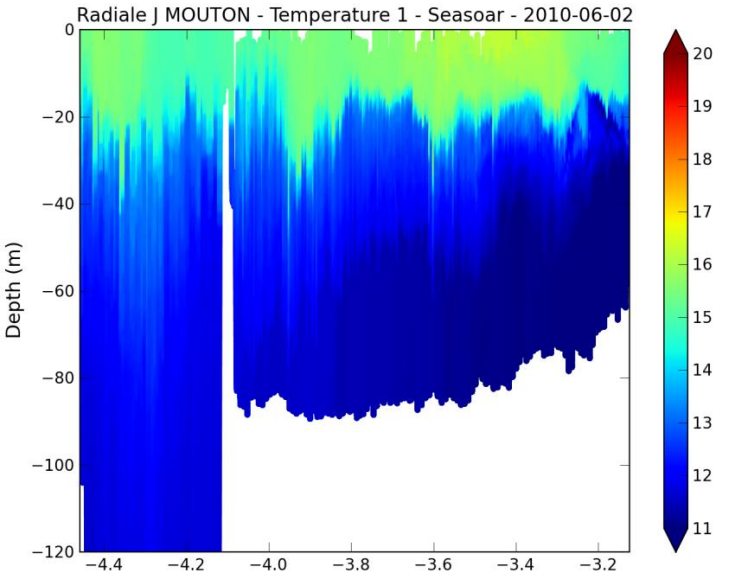


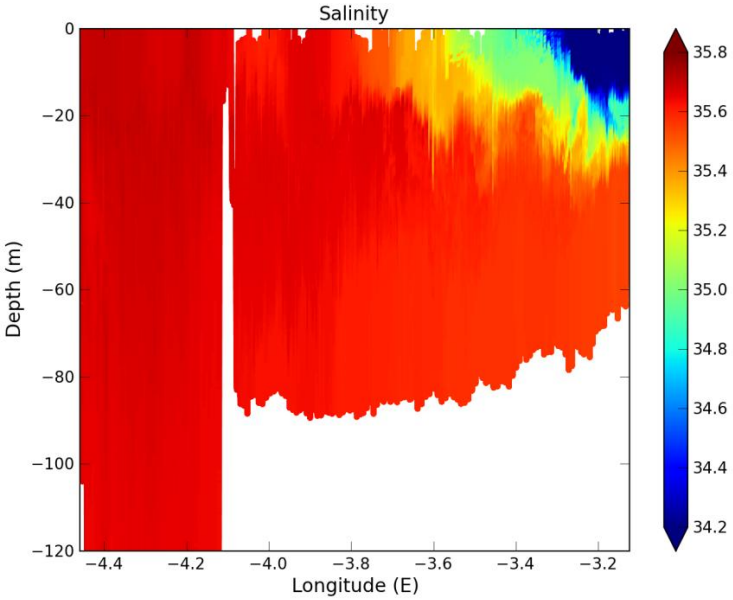


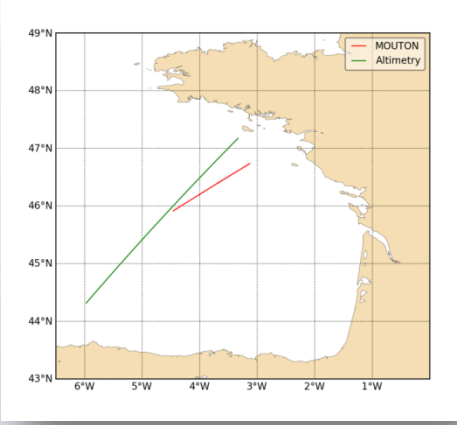




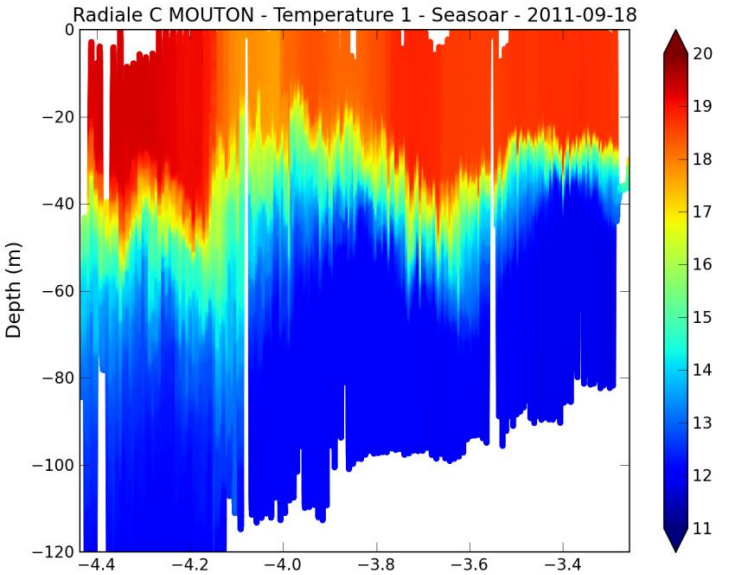
PROTEVS 2010

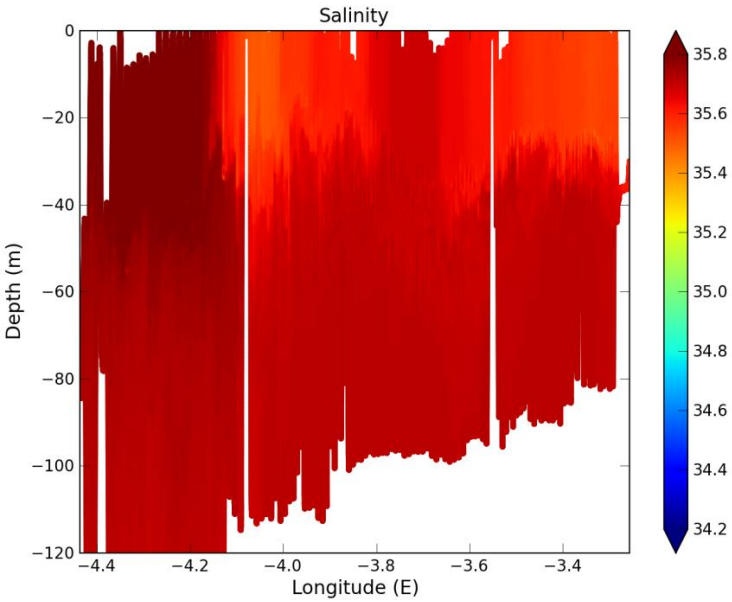


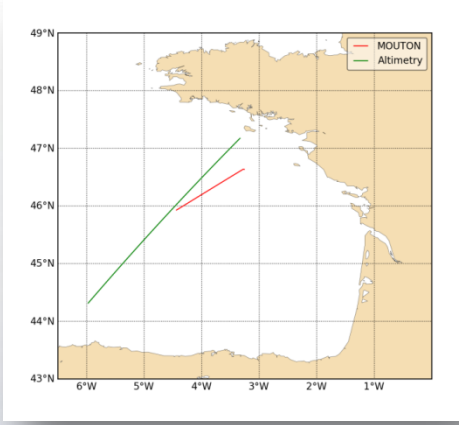




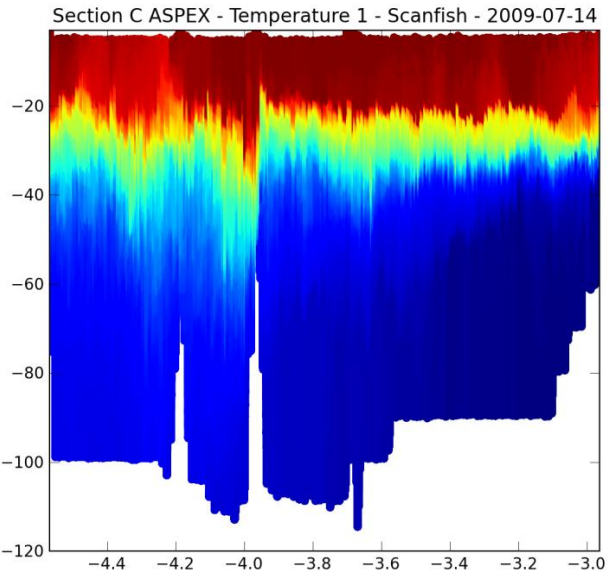
PROTEVS 2011

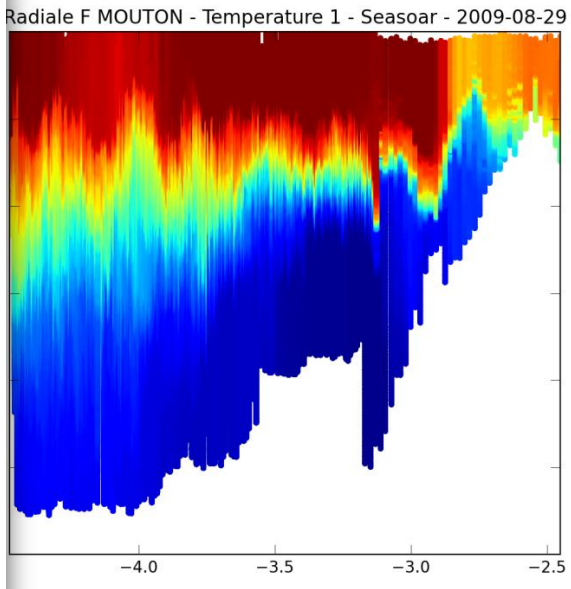


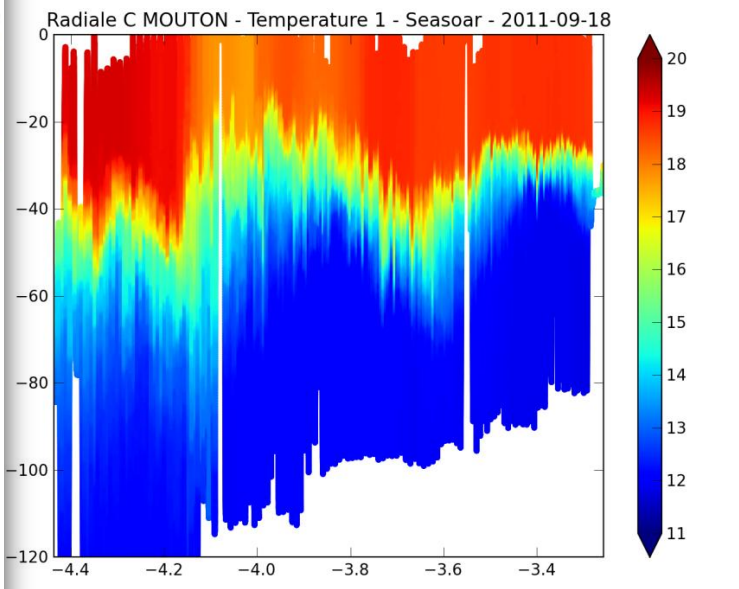


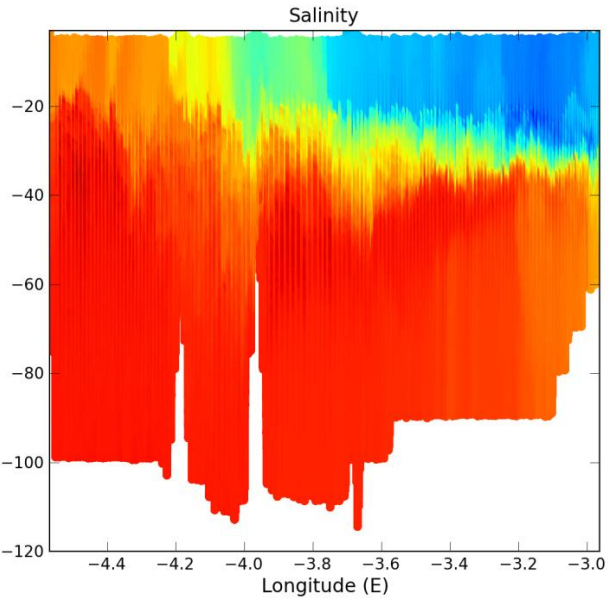


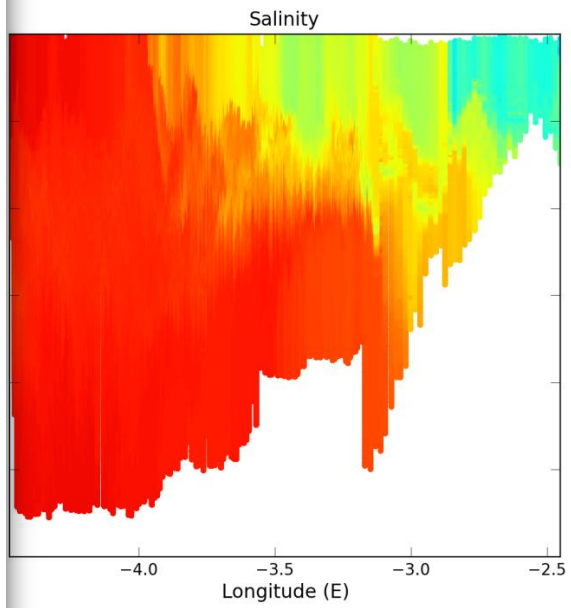
2009 vs 2011

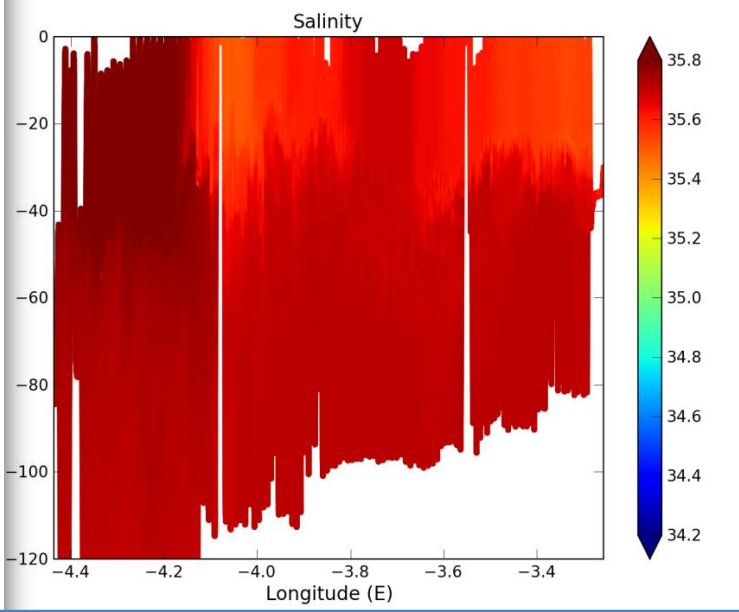








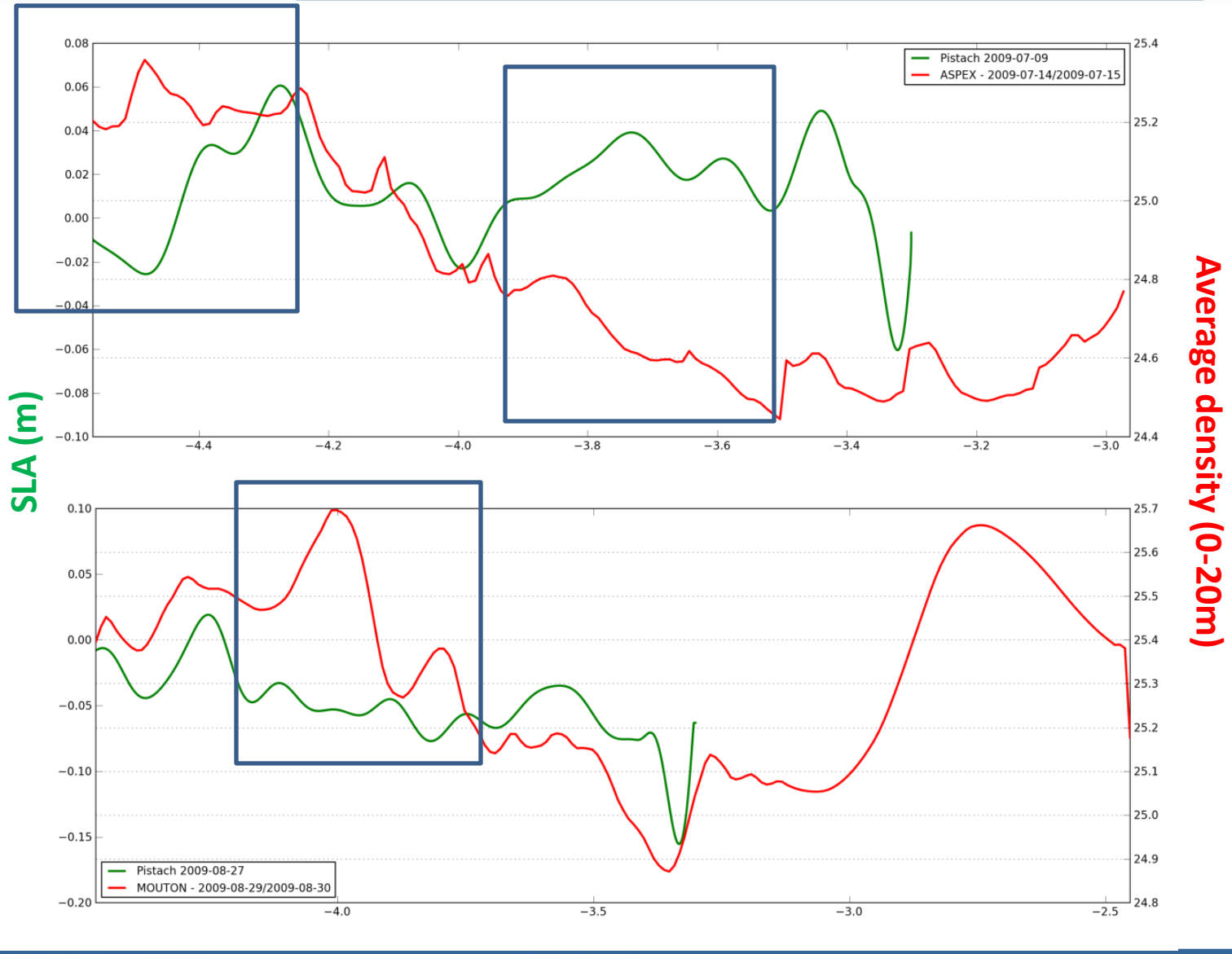




2011: saltier and colder surface waters

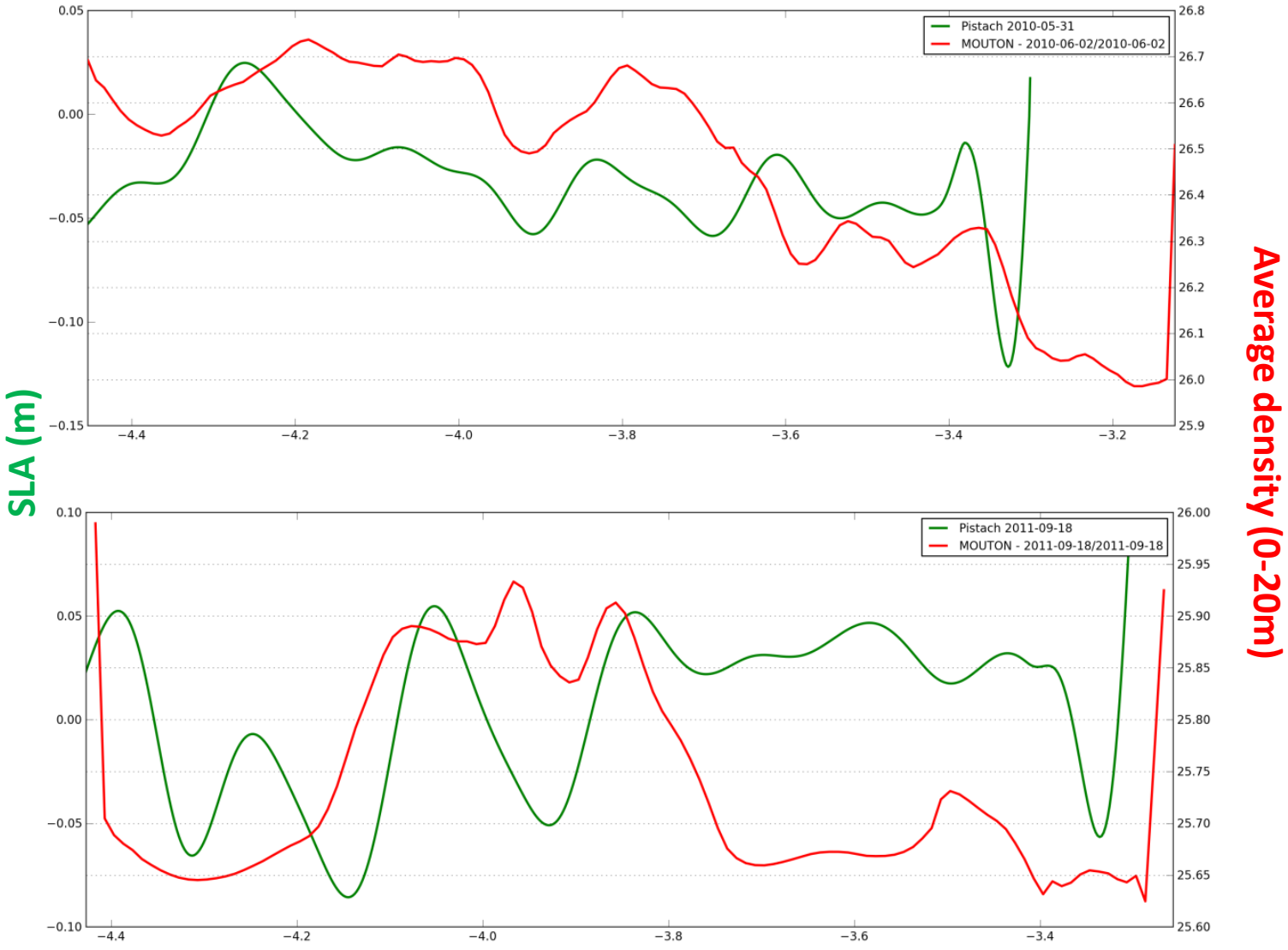
First comparisons with altimetry

First comparisons with altimetry



Only Part of the tracks are coherent with a geostrophic dynamics

First comparisons with altimetry



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Coastal altimetry …

1) improves the **accuracy** of Sea Level Anomalies in **coastal regions**,

2) allows investigating the signal **closer to the coast**,

3) allows a **long time (seasonal to interannual) tracking** of part of the shelf dynamics.

However …

1) products remain noisy, alongtrack and **only every 10 days**, which is undersampled for shelf dynamics,

2) short spatial scales remain tricky to identify and to explain.

The use of in situ data collected during recent cruises (MOUTON/PROTEVS, ASPEX) is a key point in the exploration of coastal altimetry products.

Thank you for your attention …