Comparing in situ current data with current anomalies derived from the PISTACH products: the Florida Current case


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Context of the study

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 and poster by S. Labroue)

- “Test zones” chosen after consulting the coastal altimetry community:
  - The Florida Strait
  - The Alguilhas Current (next year)
Objectives of the study

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 Florida Strait

Altimetry data post-processing

In situ data post-processing

Comparison of the current anomalies

Conclusions and perspectives
Study area: the Florida Strait
Study area: the Florida Strait

Bathymetry

- Florida Current
- Wind-driven counter-current
- Looe Key ADCP mooring (23m depth)
- Track 102

~30 km
4 altimetry SLA datasets

- **PISTACH retrackings**: 5Hz products (1.4km), 7km low-pass filtered
  - MLE4
  - RED3 = MLE3 applied on a reduced number of gates
  - OCE3 = MLE4 applied to filtered waveforms

- **Jason-2 DUACS SLA**: monomission 1Hz product

Post-processing:

- Along-track 30-point (=42km) low-pass filter
- 20-point (=28km) filter to compute the geostrophic anomalies
  \((Powell & Leben, 2003)\)

- First Rossby radius of deformation: about 30km in the area
Altimetry data post-processing

- MLE4
- OCE3
- RED3
- DUACS

Cuba Florida Keys Florida
Geostrophic current anomalies – track 102

DUACS

OCE3

RED3

26° N
23° N

m/s

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Geostrophic current anomalies – track 102

MLE4

OCE3

RED3

Latitude

26° N

23° N

m/s

10
RMS of SLA along the track 102

Non-filtered SLA at 24.40°N - track 102
Non-filtered SLA along the track 102 - cycle 58

Filtered SLA along the track 102 - cycle 58

- **MLE4**: Intensification of the current anomalies
- **OCE3**: Different structures
MLE4: Shift of the structures in the current anomalies

Current anomalies along the track 102 - cycle 73
Lower variability of OCE3 due to decrease in data availability
18/10/2011

Different behaviour of MLE4: Sigma bloom? Rain cells?

Non-filtered SLA along the track 102 - cycle 76

Filtered SLA along the track 102 - cycle 76
Altimetry data post-processing

- Large gain of data for the PISTACH products, compared to DUACS
  - Especially in the 24.5°N-25°N area, near the Keys

- Coherent signals near the Keys
  - Variations visible on several consecutive cycles
  - Consistent with the DUACS data

- RED3 retracking:
  - Allows to retrieve more data near the coasts
  - Generally close to MLE4, but less noisy

- MLE4 retracking:
  - Sometimes more noisy than the others, with large SLA variations along the track

- OCE3 retracking:
  - Largest decrease in the data availability near the coasts
  - May see different structures
Large gain of data for the PISTACH products, compared to DUACS
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RED3 retracking:
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- Largest decrease in the data availability near the coasts
- May see different structures

Which one is the most realistic?

Comparison to independent in situ data
In situ data post-processing

- **Looe Key ADCP mooring** (81.40°W - 24.54°N)

- Dataset divided into two periods
  - January 2008 – February 2009
  - May 2009 – February 2010
  - 14 months in common with Jason-2 (44 cycles)

- Depth: 23m depth (shallow waters)
In situ data post-processing

- 60h low-pass filter
  (Inertial period in the area = 29h)
- Interpolation of the in situ data at the altimeter measurement dates
- Projection in the cross-track direction

In situ currents’ main direction close to the altimetry cross-track direction

⇒ Should be a good configuration for comparisons
Comparison of the current anomalies

In situ data: 10-day filtered

Correlation between altimetry and in situ currents

Looe Key ADCP mooring

Key West tide gauge

DUACS 0.3Hz

MLE4

OCE3

RED3

DUACS

GDR 1Hz

PISTACH MLE4 5Hz

Correlation coefficient

Labroue et al
Comparison of the current anomalies

Correlation between altimetry and in situ currents

In situ data: 10-day filtered

Slight increase of the correlations without this period (from 0.6 to 0.65)

Looe Key ADCP mooring
Comparison of the current anomalies structure visible in all the datasets, over several consecutive cycles.
Comparison of the current anomalies

Limits of the comparison:
- Position of the ADCP mooring (bathymetry bend)
- Distance between the altimeter track and the mooring (30 km)
- Length of the time series (14 months - 44 cycles)

Perspectives:
- Use well-known structures to validate the altimetry data retrieved thanks to the PISTACH processing
- Comparison to other types of data
  - Model simulations
  - Ocean colour
  - SST, SSS
Comparison of the current anomalies

PISTACH RED3

DUACS

Mean geostrophic current – HYCOM model – 30/08/2009

Provided by M. Le Hénaff, RSMAS
Conclusions

- Large gain in the data coverage in the Keys area with the L3 PISTACH products, compared to DUACS products
- Coherent signals, including with the *in situ* tide gauge and ADCP data
- Differences between the 3 retrackings appear (data coverage, noise, different behaviours...)
  - Need of more investigation to determine which “PISTACH recipe” is the most adapted (other regions with different ocean dynamics)
Perspectives

- Quantify the differences and realism of the various retrackings, focusing on particular events
  - SST, SSS and ocean colour data
  - Model simulations
- Assess the influence of other parameters, such as ocean tide corrections, wet tropo, DAC...
- Very encouraging results
  - Use the coastal altimetry products for scientific studies!
- Same kind of work to be done over the Algalhas Current (2012)

On-going work...
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Photo by Ron Wiecki on Flickr