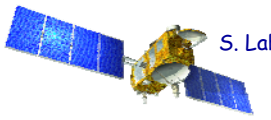
# Level 3 PISTACH Products for Coastal Studies



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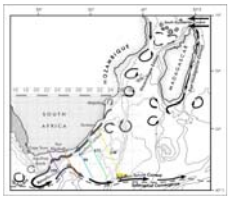
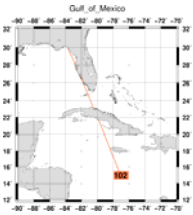
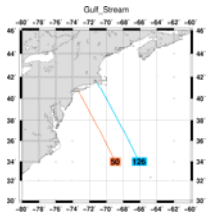
## Context

Level 2 PISTACH products are delivered since November 2008 for Jason-2 mission. The aim of this project is twofold

1. Provide level3 products on dedicated regions (Agulhas current, Florida Strait and East US coast)
2. Demonstrate the improvement gained from the high resolution PISTACH data sets





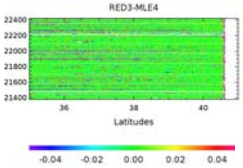




## Level 3 approach

The following corrections have been chosen for the SSH
- GOT4.8 ocean tide model
- Composite wet troposheric model
- PISTACH L2 corrections for DAC, solid earth tide and polar tide
- PISTACH dual frequency ionospheric correction
- MSS DTU 2010
- 3 retrackings are provided:
  - standard MLE4
  - OCE3 which is a MLE4 applied to filtered waveforms
  - RED3 which is a MLE3 applied on a reduced number of gates

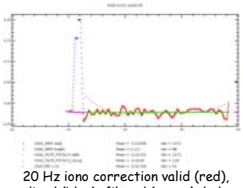
### Retracking calibration

The RED3 retracking shows a residual signal correlated with sea state when compared to MLE4 retracking. This residual bias is estimated as a function of SWH RED3 and the correction is applied to L3 PISTACH products.




Difference between 20 Hz MLE4 range and RED3 range after calibration for track 50

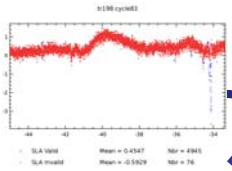
### Ionospheric correction filtering



20 Hz iono correction valid (red), edited (blue), filtred (green), holes filled (pink), 1 Hz filtred (brown)

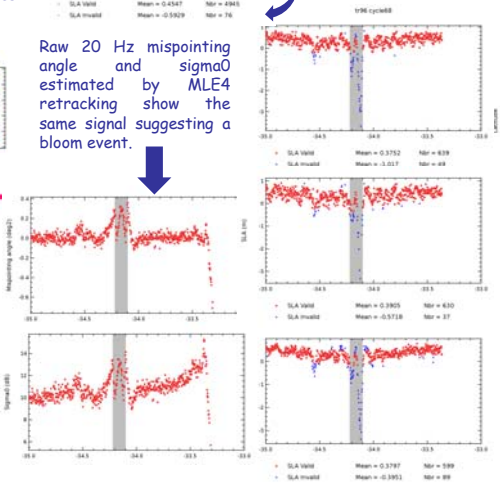
Specific editing and low pass filtering has been performed at 20 Hz to filter the dual frequency ionospheric correction. Thanks to this processing all the valid 20 Hz data are kept and data gaps are filled by interpolation.

### 20 Hz editing



Specific editing is performed at 20 Hz using the raw 20 Hz SLA. It helps removing events impacting the SLA over scales as small as 20 km .

Raw 20 Hz mispointing angle and sigma0 estimated by MLE4 retracking show the same signal suggesting a bloom event.



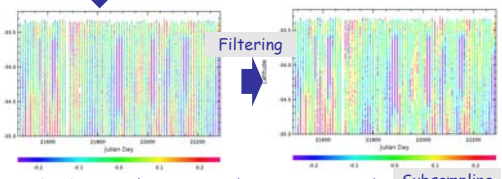
20 Hz SLA MLE4 (upper right), RED3 (middle right ), OCE3 (bottom right) with valid (red) and edited points (blue) for track 96, cycle 68.

### Low pass filtering

Once data are edited, 20 Hz SLA are filtered with a low pass filter :
- 3.5 km filtering to provide a high resolution date set
- 7 km filtering for comparison with the 1 Hz data

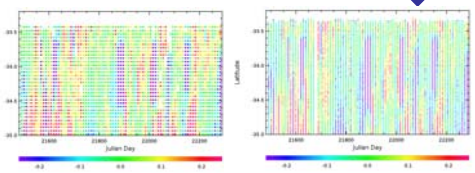
Editing

Filtering



PISTACH products provide an improved coverage both in coastal zone and open ocean.

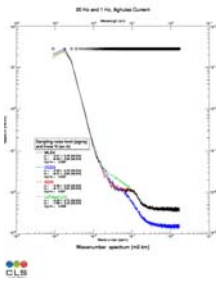
Subsampling



20 Hz SLA (upper left), 20 Hz SLA with 7 km filtering (upper right), 5 Hz SLA obtained from 7 km filtering (bottom right), Aviso SLA (bottom left), track 96 over the Agulhas current

## Analysis of coastal altimetry data sets

### Which spatial scales are modified with PISTACH products?



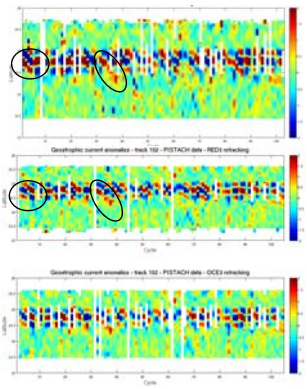
The spectral analysis of the 20 Hz SLA shows:

- The scales greater than 100 km are similar to what observed by Xu and Fu (2011) and LeTraon et al. (2008), with a spectrum slope of -3.6.
- The OCE3 retracking reduces instrumental noise by 30% (20 Hz noise drops to 5.2 cm) and it decreases the energy bump for scales smaller than 14 km.

SLA spectrum of 20 Hz MLE4, 20 Hz OCE3, 1 Hz GDR and LeTraon 2008

### Comparison with other high resolution data set: Xtrack products

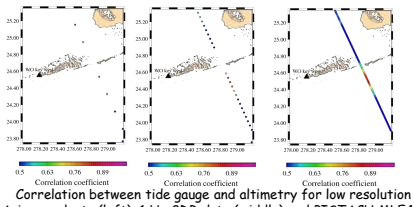
The comparison with CTOH products is performed on cross track velocities
- The PISTACH products allow retrieving coherent structures in the velocities, both in time and space.
- The RED3 retracking provides the best coverage over the Florida Keys.



Across track velocities derived form altimetry over the Florida Keys for CTOH product (upper),PISTACH RED3 (middle) and PISTACH OCE3 (bottom)

## Comparison of L3 PISTACH products with external data

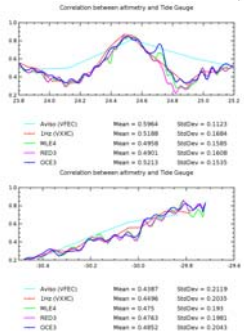
### Tide gauges



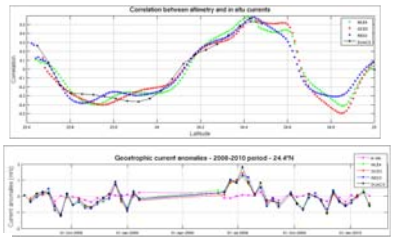
Correlation between tide gauge and altimetry for low resolution Aviso products (left), 1 Hz GDR data (middle) and PISTACH MLE4 (right).

The 7 km L3 PISTACH products are compared to tide gauge time series in the Florida strait. The 5 Hz data sets show that more data are recovered in the area of the Keys compared to classical 1 Hz data and even more compared to the Aviso products.

The L3 PISTACH helps to better discriminate the location of the maximum of correlation between altimetry and tide gauge.



### Current meter in the Florida Strait



Correlation between current meter and altimetry (upper) and current anomalies time series (bottom) for 1 Hz GDR data and PISTACH retrackings

The L3 PISTACH products are compared to current meter time series in the Florida strait. The 3 retrackings exhibit similar correlation with the in situ data. The geostrophic velocities are compared at the location of the maximum of correlation. Altimetry shows large temporal variations which are also seen on the current meter but with lower magnitude, except for a marked event in July 2009.

Correlation between tide gauge and altimetry for Aviso products, 1 Hz GDR data and all PISTACH retrackings for Florida (up) and Durban (bottom).

## Conclusion

1. Level 3 PISTACH products are now available over 3 regions. A standard 7 km content and a high resolution content (3.5 km) are available both at 5Hz sampling.
2. The analysis of these products shows that the coverage is improved in the coastal case and even in the open ocean conditions thanks to refined 20 Hz L3 processing.

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OSTST and Coastalt meetings
San Diego, October 2011