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ESA Sea Level CCI

Validation Report: WP2700 Coastal areas

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| Applicable documents |

AD Sea level CCI project Management Plan  
CLS-DOS-NT-10-013

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| Reference documents |

RD 1 Manuel du processus Documentation  
CLS-DOC

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# Introduction

The main objective of this document is to provide the analysis of the RRDP reports dedicated to the coastal correction of the sea level (WP2700) in order to estimate the best corrections to improve the sea-level computation for climate applications.

This document discuss the impact of all new algorithms separating the different climate applications defined in the sea level CCI URD (User Requirement Document) and separating the several temporal scales related with climate applications. A clearly and easily understandable impact indicator has been defined and is described in annex of this document (see Appendix B -).

## Radiometer wet troposphere correction

The major aim of WP2710 is to provide a wet tropospheric correction for coastal zones, applicable to all missions, fully compatible with respect to the microwave radiometer based correction that shall be adopted in the open ocean, and ensuring its continuity and consistency in the open ocean/coastal transition zone.

The following RRDP have been performed for Envisat mission:

* Comparison of GPD wet tropospheric correction with the composite correction: RRDP\_WP2700\_Coast\_GPD\_vs\_Composite\_11\_08\_30.pdf
* Comparison of GPD wet tropospheric correction with the radiometric correction: RRDP\_WP2700\_Coast\_GPD\_vs\_Radiometer\_11\_08\_30.pdf

The reference composite wet tropospheric correction used as in sea level AVISO products is computed as follows: for Envisat the radiometric wet tropospheric correction from GDR products is used offshore 50 km while ECMWF operational model is used inshore. Values from the model inshore 50km are adjusted on the radiometric wet tropospheric correction to provide continuity of the correction.

The studied wet tropospheric correction has been computed using the GNSS-derived Path Delay (GPD) algorithm, developed at the University of Porto, Faculty of science (J. Fernandes) in the scope of the ESA project COASTALT (Development of radar altimetry data processing in the oceanic coastal zone) for the generation of Envisat Coastal Geophysical Data Records (CGDR).

The GPD algorithm is based on the combination of zenith wet delays (ZWD) from three data types:

* Tropospheric delays derived at a network of coastal GNSS (Global Navigation Satellite System) stations
* ZWD from valid microwave radiometer (MWR) measurements at the nearby points
* ZWD from the European Centre for Medium-range Weather Forecasts (ECMWF) Deterministic Atmospheric Model

At each altimeter point with an invalid MWR value, the wet tropospheric correction is estimated, along with the associated mapping error, using a linear space-time objective analysis technique that takes into account the spatial and temporal variability of the ZWD field and the accuracy of each data set used. For more information, the following technical report is available: GPD algorithm: [WP2710\_Techical\_Note\_V1.docx](ftp://slcci_team:%2fextcci2011-@ftp.esa-sealevel-cci.org/Data/TechnicalRef/WP2710_Techical_Note_V1.docx).

The method was first applied in the SW European region for the whole Envisat data series (Fernandes et al., 2010) and was later extended to global altimeter data sets.

These RRDP have been performed on points where the studied correction is a valid estimate (GPD flag=1) and on non corrupted ocean points where it equals the radiometric correction (GPD flag=0).Note that on cycles 46 onwards, the extracted points also include lakes and enclosed seas.

## Coastal Proximity parameter

A new coastal parameter has been developed in the frame of the Sea-Level CCI project in order to better capture differences in coastal morphology. This parameter (P), is expected to improve screening: impact on the regional variability in coastal regions.

This parameter is available on a 2D-grid (0.02 deg) which is constant on time. This new algorithm is not a correction of the SSH calculation as all the other algorithms developed within the project. It can be used as an auxiliary data to improve some algorithms as for instance the editing procedure to remove spurious measurements in coastal areas. Therefore, the diagnoses of validation defined in the PVP document are not applicable for this algorithm and the coastal proximity parameter has not been evaluated.

The following technical document explains in more details the technical content of the coastal proximity parameter:

* [Day2\_15\_SLCCI\_AR1\_WP2700\_CoastalProximity\_NOC.pptx](ftp://slcci_team:%2fextcci2011-@ftp.esa-sealevel-cci.org/Documents/Meeting/20110919_AR1/Day2_15_SLCCI_AR1_WP2700_CoastalProximity_NOC.pptx)

# Global Mean Sea Level

## Long-term evolution

### Validation diagnoses used

The validation diagnosis of the long-term sea-level evolution (A201-a) allows us to evaluate the impact on the global MSL trend using successively the different corrections. Their impact is also analyzed separating descending and ascending passes (A201-b): the reduction of the MSL trend differences is a good quality criterion to determine which correction is the best. Cross-comparison of MSL trends between altimetric missions collocated on the same period (B001) and the comparison with in-situ measurements (tide gauge C001) also give a relevant indication to know whether the potential drift of altimeter MSL is reduced or not with new correction.

### Composite, radiometric and GPD wet tropospheric corrections

For Envisat, no impact is detected for the global MSL trend (Δ=-0.03 mm/yr) when comparing the GPD correction with the composite reference one used in the sea-level AVISO products. The use of the radiometric correction instead of the reference has a low impact on the Envisat global MSL trend. At last, the use of the GPD correction instead of the radiometric correction has a significant impact (-0.16mm/yr). The following table shows the global MSL trends obtained with the different wet tropospheric corrections:

|  |  |  |  |
| --- | --- | --- | --- |
| Altimetric missions | Composite correction (Reference) | Radiometric correction | GPD correction |
| Envisat | 0.45 mm/yr | 0.58 mm/yr  (+0.13 / Composite) | 0.42 mm/yr  (-0.03 /Composite) |

Table : [Diagnosis A201-a] Impact of the wet tropospheric corrections on global MSL trends for Envisat

Concerning the consistency of the global MSL trend as seen by ascending or descending tracks (A201), we don’t expect to detect any impact of the wet tropospheric correction on this diagnosis. This is shown in the following table where the global MSL trend difference between ascending and descending tracks is the same for all studied corrections (0.80 mm/yr). Therefore, in this case, this diagnosis is not relevant to determine the best correction for the long-term evolution of the global MSL.

|  |  |  |  |
| --- | --- | --- | --- |
| Altimetric missions | Composite correction (Reference) | Radiometric correction | GPD correction |
| Envisat | = 0.82 mm/yr | = 0.79 mm/yr | = 0.80 mm/yr |

Table : [Diagnosis A201-b] Global MSL trend differences between ascending and descending passes for Envisat

Tide gauges are used as an external independent reference (C001) to assess the drift of the global MSL. The following table indicates the MSL drift difference between Envisat data and in-situ data with various wet tropospheric corrections. The accuracy of the method of comparison with tide gauges on Envisat time series is close to 0.5 mm/yr. And yet the three observed values (see the following table) are too close to each other (differences much below this error value). Thus, it is impossible to determine with this method which correction is the best concerning the long-term evolution of the global MSL.

|  |  |  |  |
| --- | --- | --- | --- |
| Altimetry missions | Composite correction (Reference) | Radiometric correction | GPD correction |
| Envisat | =-0.87 mm/yr | =-0.79 mm/yr | =-0.93 mm/yr |

Table : [Diagnosis C301] Impact of the wet tropospheric corrections on global MSL trends detected with tide gauges for Envisat

Therefore, no diagnosis enable us to determine which wet tropospheric correction is the best concerning the long-term evolution of the global MSL. However, as discussed further (§ 3.3), the GPD correction could be the one providing the best MSL trend estimation (particularly in coastal areas).

## Inter-Annual signals

### Validation diagnoses used

The monitoring of the differences between both corrections (A001) but also of the SLA variance differences (A202) may provide information concerning the impact of the studied correction on the global MSL at inter-annual time scales.

### Composite, radiometric and GPD wet tropospheric corrections

The monitoring of the wet tropospheric corrections differences (Figure 1, A001) reveals an almost significant jump (0.4 mm) at Envisat cycle 86 (January 2010) both for GPD versus composite corrections and GPD versus radiometric corrections. It can not be considered as an inter-annual evolution of the wet tropospheric correction but it is likely associated with data processing. This evolution should be explained. This jump has an impact on the monitoring of the SLA variance differences (A202) where an increased variance gain is observed following cycle 86.

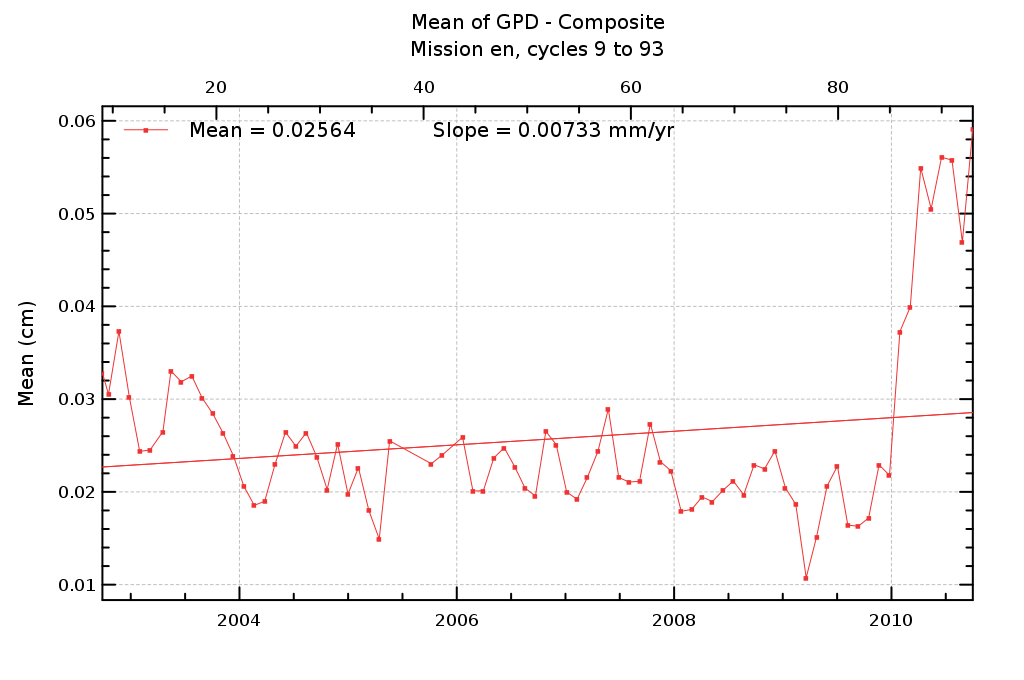


Figure [Diagnosis A001]: Mean difference between the GPD and the reference composite correction over Envisat period

Except this particular evolution, no variation at temporal scales higher than 1 year is clearly observed for Envisat mission. In particular, the well-known impact of the 2008 La Nina event on the atmospheric water vapor content is not detected.

## Annual and semi-annuals signals

### Validation diagnoses used

The periodograms of differences between the corrections allow us to determine the impact of the studied correction at annual and semi-annual scales (A003). Analyzing the difference of sea-level periodograms (A206), we can describe which correction allows us to reduce the periodic signals. The comparison with in-situ measurements (tide gauge) (C003) also gives a relevant indication of whether the periodic signals are reduced or not with the new correction.

### Composite, radiometric and GPD wet tropospheric corrections

For Envisat mission, the use of the GPD wet tropospheric correction has no impact on the annual signal amplitude of the global MSL (A206), whatever the reference used (radiometric or composite correction). The same conclusion is obtained concerning semi-annual signals. An explanation could be that these periodic signals are mainly observed in the open ocean and differences between these corrections mainly concern coastal areas.

The comparison of altimetry with tide gauges may provide an external information in order to know if the GPD wet tropospheric correction has an impact on the annual signal amplitude (C003). It indicates that the annual signal amplitude is weakly increased (0.2 mm) with the GPD correction compared with the radiometric correction. No difference is detected when comparing with the composite reference correction.

# Regional Mean Sea Level

## Long-term evolution

### Validation diagnoses used

The validation diagnosis of the regional trend of sea-level differences using successively two different corrections (A204a) allows us to evaluate the impact of these corrections on the local MSL trends. Their impact may also be analyzed separating descending and ascending passes (A204b) but this diagnosis is not the most relevant concerning the wet tropospheric correction. Cross-comparison of MSL trends evolution between altimetry missions collocated on the same period (B202) may also give a relevant indication of whether the potential MSL drift is reduced or not with the studied correction. But this diagnosis is not available since only Envisat data are used.

### Composite, radiometric and GPD wet tropospheric corrections

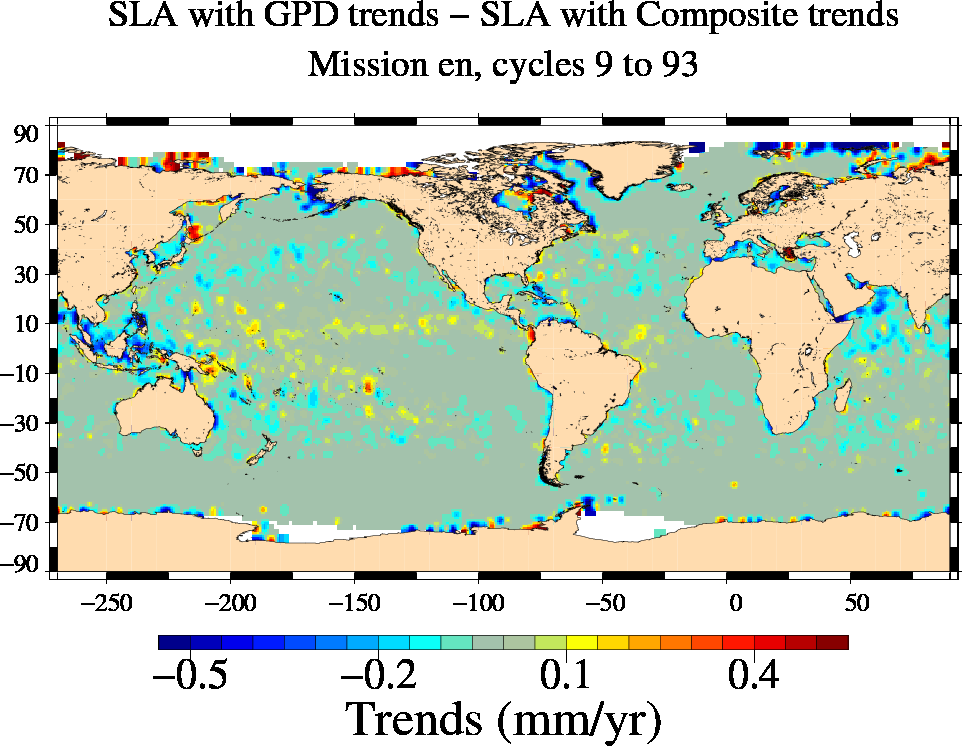
Maps of regional MSL trend differences using successively the different wet tropospheric corrections (A204) are shown on Figure 2.

The comparison between GPD and the composite reference corrections (top map) shows significant impact (>0.5mm/yr) on the long-term evolution of the regional MSL localized in some coastal areas: Indonesia, Bering Strait, Labrador Sea and coastal areas of Spitsberg and of islands north of the Siberia coast). In these regions MSL trend is lower with the GPD correction. No significant impact is detected elsewhere.

Note that in coastal regions where GNSS data are not available, as we approach land, the GPD estimate will be less influenced by the valid nearby radiometer measurements and will be dominated by the ECMWF model. In these regions, as the track approaches land, the GPD correction shall get closer to the composite correction, apart from a possible bias, and will depart from the radiometric correction. The GPD and composite corrections are expected to be quite different in the presence of GNSS data. In addition, the two corrections shall generally be different in the region from ~20 to 50 km from the coast (as further shown in section 3.3). This is due to the fact that the composite correction uses the distance from the coast to define where the ECMWF shall replace the radiometer correction while GPD uses flag information to define which points shall keep the radiometric or shall be replaced by the GPD estimate.

Comparing GPD correction with the radiometric correction (bottom map), a strong impact (>0.5mm/yr) on the long-term evolution of the regional MSL is detected in all coastal regions. The MSL trend is systematically lower with the GPD correction than with the radiometer. No impact is detected in the open ocean.

As it will be discussed further, diagnosis A207 suggests that the GPD correction provides a better estimation of the MSL trend in coastal areas.



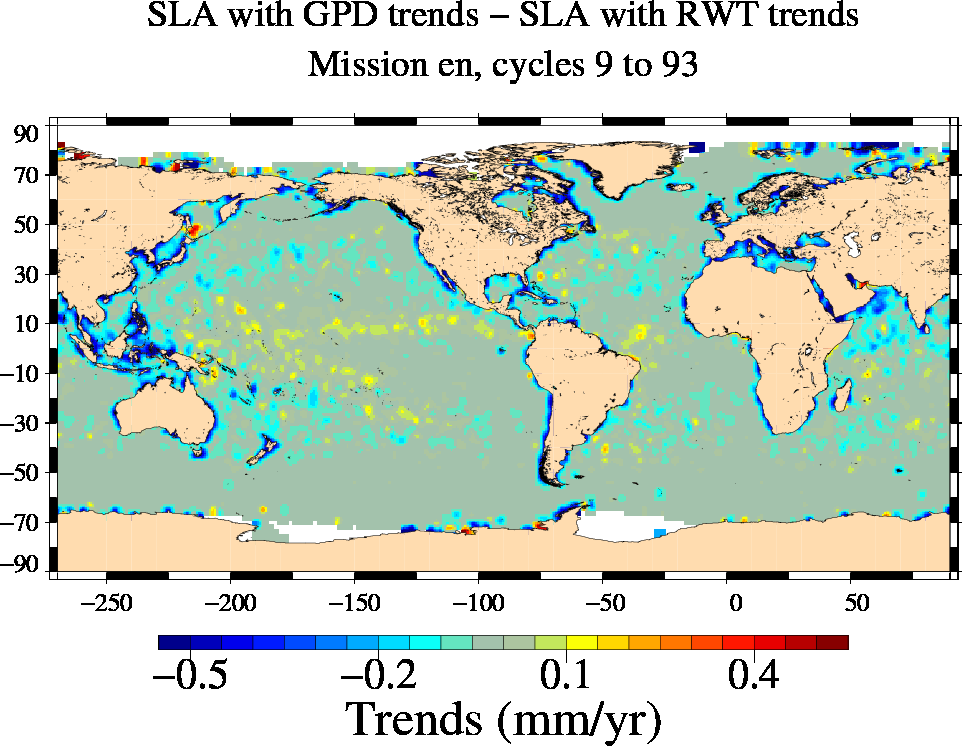


Figure : [Diagnosis A204-a] Maps of MSL trend differences using GPD wet tropospheric correction compared with the composite reference (top) and the radiometric correction (bottom).

## Annual and semi-annuals signals

### Validation diagnoses used

The analyses of periodic signals of regional mean sea level are performed thanks to diagnosis A205 where the difference of amplitudes and phases between SLA using successively 2 wet tropospheric corrections are mapped for annual and semi-annual signals. These diagnoses allow us to characterize the local or regional impact of new corrections.

The comparison with in-situ measurements (temperature and salinity profiles for instance) also give a relevant indication of whether the periodic signals are better estimated or not with the studied correction. Nevertheless, this diagnosis has not been yet processed.

### Composite, radiometric and GPD wet tropospheric corrections

The amplitude differences of annual (Figure 3) and semi-annual (Figure 4) signals have been mapped using the GPD versus the composite wet tropospheric corrections (left part of figures) and the GPD versus the radiometric corrections (right part of figures) in Envisat MSL computation. For annual signals (Figure 3), only very weak impact (0.5mm) is detected at equatorial latitudes mainly in the Atlantic Ocean and in the Indonesian through flow (better detected while comparing GPD with the radiometer). This is likely associated with rain falls areas which are not taken into account the same way with the GPD and the radiometer. No impact is detected elsewhere and in particular coastal areas are not affected. Nevertheless, a medium impact (more than 1mm) is observed in the Arctic Ocean around Spitsberg and around islands north of Siberia.

Figure 4 indicates that the amplitude of the semi-annual signal is not modified (<0.5mm) with the GPD wet tropospheric correction.

Moreover the phase of the annual and semi-annual signals (diagnosis A205) is not modified with the GPD correction.

The lack of impact on annual and semi-annual signals in coastal areas could be associated with the fact that these periodic signals are mainly observed in the open ocean and differences between the studied corrections mainly concern coastal areas.

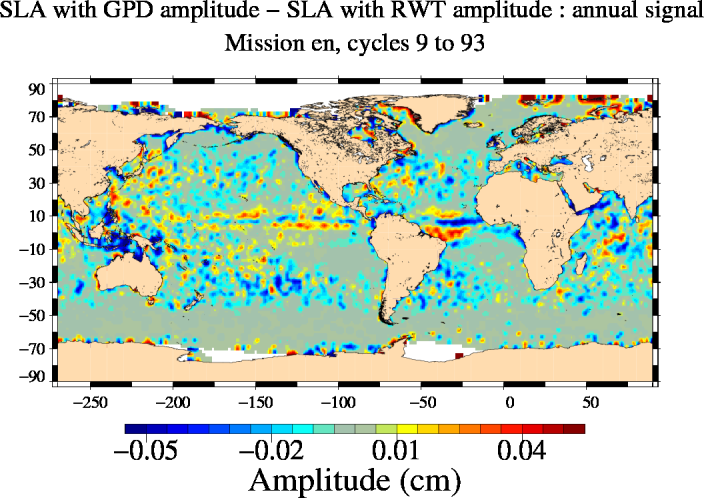
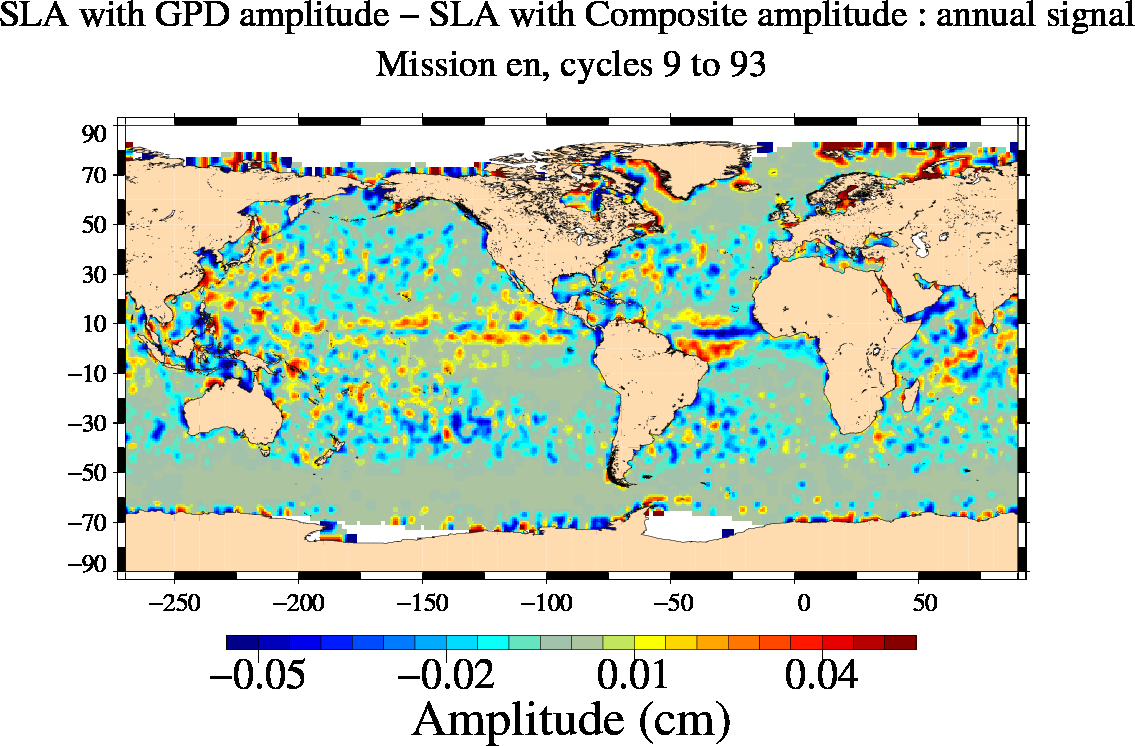


Figure : [Diagnosis A205] : Amplitude differences of regional MSL annual signals using GPD correction versus the composite reference (left) and GPD correction versus the radiometric correction (right) for Envisat mission.

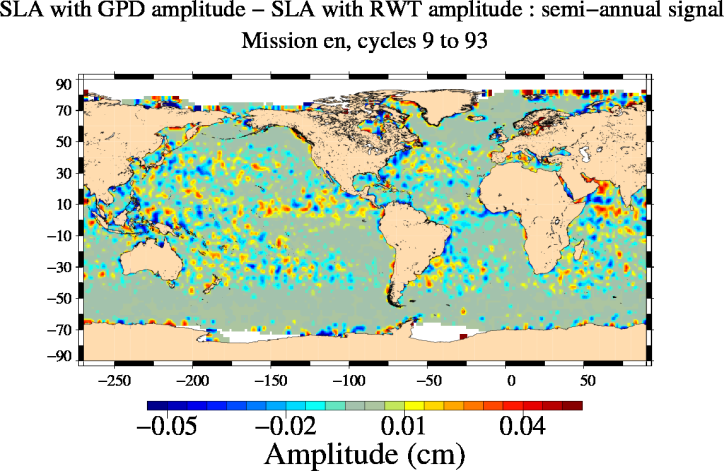
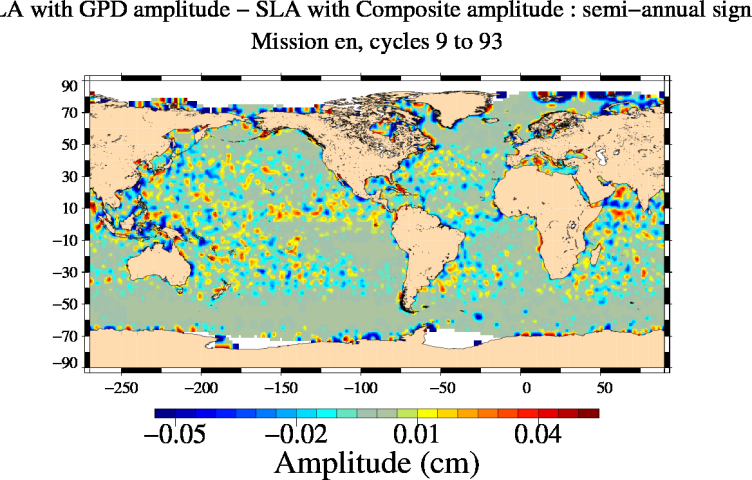
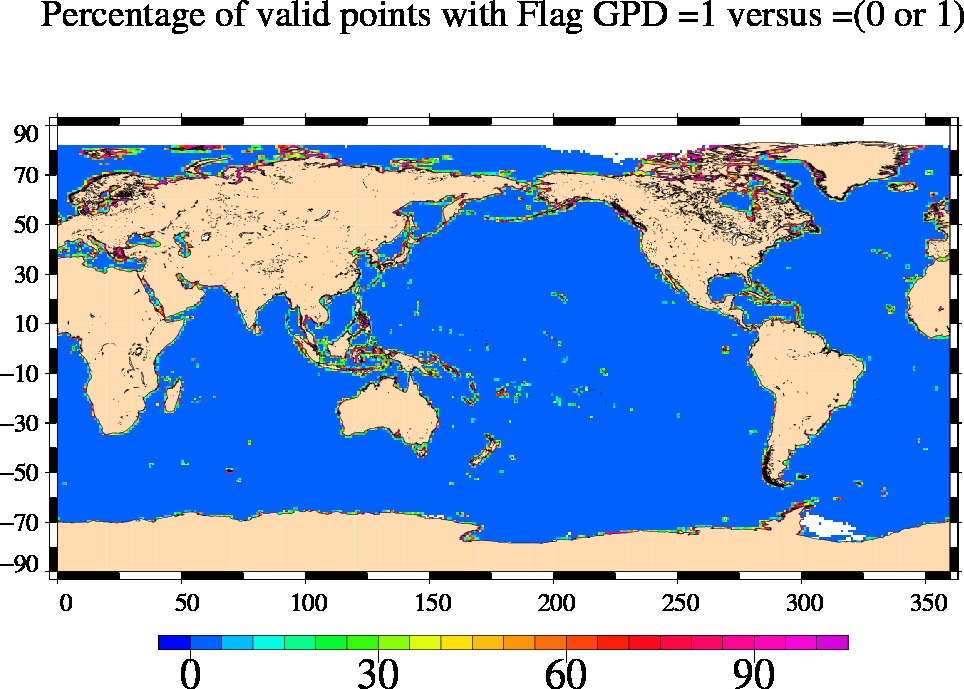


Figure : [Diagnosis A205] : Amplitude differences of regional MSL semi-annual signals using GPD correction versus the composite reference (left) and GPD correction versus the radiometric correction (right) for Envisat mission.

## Coastal areas

The GPD wet tropospheric correction is dedicated to the improvement of the wet tropospheric correction in coastal areas.

Figure 5 indicate that the GPD algorithm provides valid corrections in coastal areas. An average of 30% of valid estimation is available in these regions but the percentage reaches 100% in some coastal regions. Note that up to 1 % of the data in some regions of the open ocean comes from the GPD algorithm (Figure 5, bottom). As shown above, these data directly impact the MSL trend and the annual signals in the open ocean.



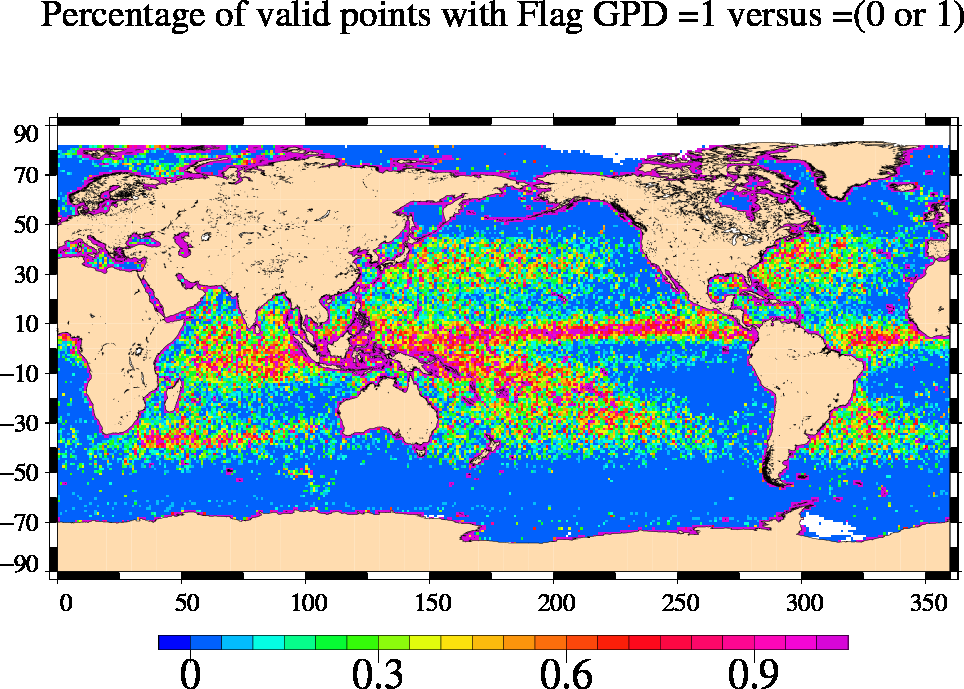


Figure : [No RRDP diagnosis] Map of the percentage of valid points where the GPD algorithm provides a new estimation with two different ranges: 0/100% (top) and 0/1% (bottom).

Figure 6 shows the difference between two radiometric corrections versus the coastal distance. It indicates that the difference between the GPD and composite correction (left) increases from 0.5mm to 4mm from 50km offshore to the coast and is less than 0.5 mm offshore 50km from the coast. The difference between GPD and the radiometric corrections (right) decreases from 3.5 cm at the coast to 2 mm 20km offshore and no difference is observed offshore.

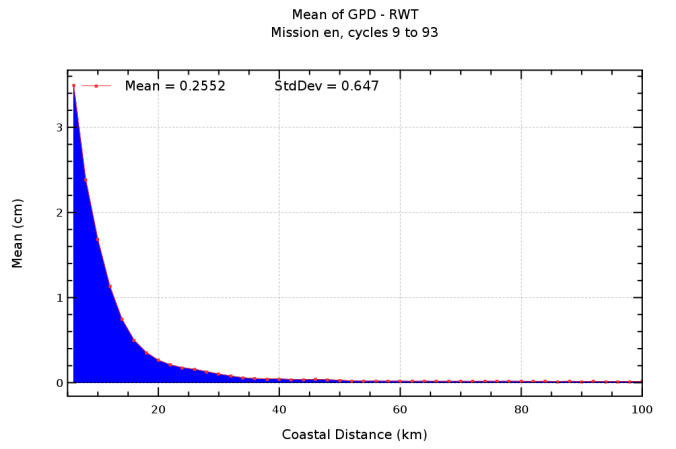
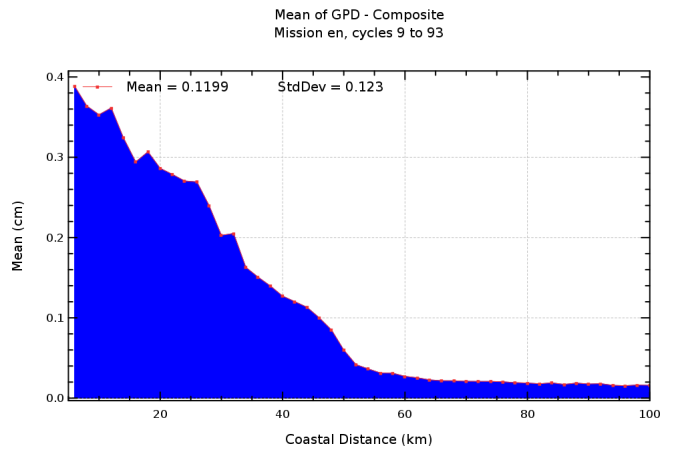


Figure : [Diagnosis A004] Mean difference versus coastal distance of the GPD versus composite corrections difference (left) and the GPD versus radiometric corrections difference (right).

Figure 7 displays the evolution versus coastal distance of the mean sea level anomalies (referenced to a MSS) computed with the reference, the radiometric and the GPD corrections. A difference of behaviour is only observed inshore 50km. All MSL increase close to the coast compared with the offsho+re estimation. The smallest increase is obtained with the GPD correction while the highest is obtained with the composite reference correction. No physical reason is expected to explain the observed increase in this very short range of coastal distances and it may be associated with instrumental effects. As the distribution of water masses is expected to be homogeneous over a few tens of kms, we could say that the GPD correction is the best in coastal areas.

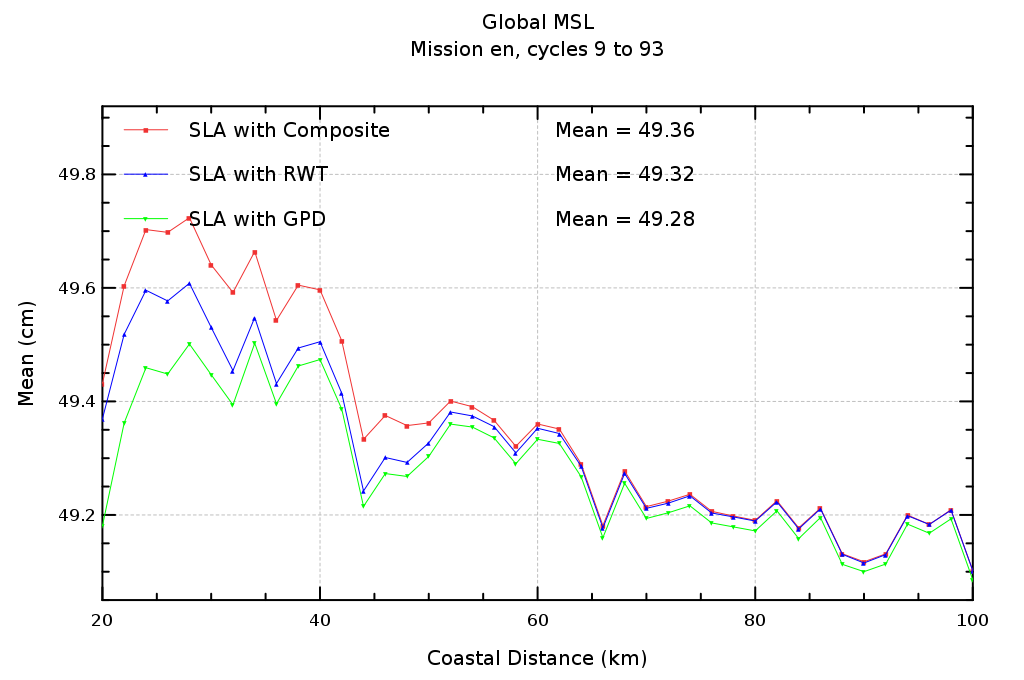


Figure : [Diagnosis A207] Mean of the sea level anomalies versus coastal distance computed with different wet tropospheric corrections

## High latitudes

No particular impact of the GPD algorithm is detected at high latitudes compared with lower bands of latitudes. Nevertheless, coastal areas at high latitudes are impacted by the algorithm and in particular, Figure 2 [A204] shows that the long term evolution of the MSL is significantly affected in the coastal areas of Spitsberg and of islands north of the Siberia coast. As discussed above, Figure 7 [A207] suggests that it is associated with an improvement of the MSL trend estimation in these particular regions. Nevertheless, a lot of data are missing in these regions because of the ice coverage and the MSL trend estimation at high latitudes is thus affected by a strong formal error.

# Mesoscale

## Validation diagnoses used

Along-track sea-level analyses and differences at crossover points allow us to detect improvements at short temporal scales (< 2months) for mesoscale applications. The most relevant diagnoses performed in RRDP are the monitoring and the map of the variance SSH differences using successively 2 different wet tropospheric corrections.

Diagnoses A102 and A104 display the monitoring and the map of SSH variance differences at crossover points: the reduction of variance indicates a better homogeneity of the sea-level between ascending and descending tracks within a 10-day window.

Diagnoses A203 and A209 display the monitoring and the map of SSH variance differences relative to a mean sea surface (MSS): the reduction of variance indicates a better homogeneity with the MSS. Most of the time, it indicates an improvement of the sea-level computation. But note that in few cases, the variance increase can also indicate a systematic error in the MSS due to geographical bias for instance.

## Composite, radiometric and GPD wet tropospheric corrections

### Global analyses

The monitoring of the SSH variance differences at crossover points (Figure 8, A102) show that the GPD correction has a low impact on the SSH coherence between ascending and descending passes, improving the altimetric sea level estimation at short time scales (0.5 cm2 when comparing with the reference). In particular, an enhanced improvement is detected after Envisat cycle 86. This is associated with the observed bias (0.4 mm) between the GPD correction and the others after this cycle (cf diagnosis A001), which generates a 0.4 cm2 improvement. Similar results are obtained when comparing with the radiometer.

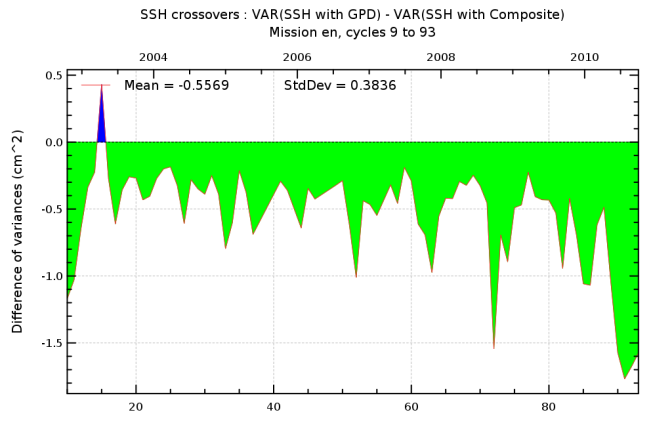


Figure : [Diagnosis A102] Monitoring of the SSH variance differences at crossover points comparing the GPD versus composite corrections.

The geographical distribution of the SSH variance differences at crossover points (Figure 9, A104) reveals an almost significant (1 cm2) improvement of the sea level variations at short temporal scales localized in the subtropical gyres and at equatorial latitudes associated with areas of highest variability of the water vapor content.

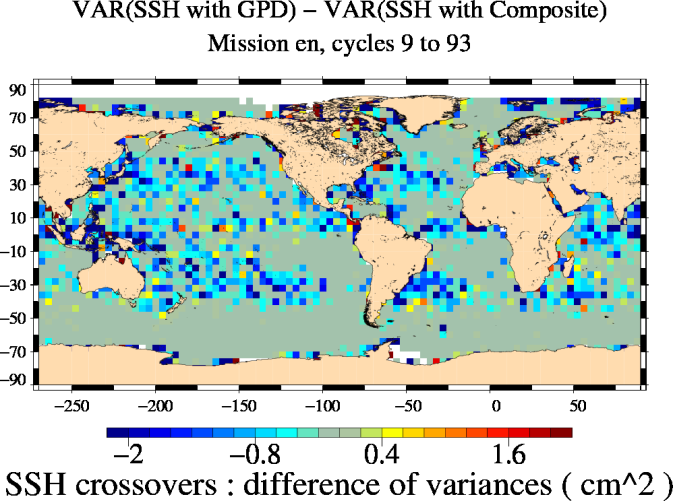


Figure : [Diagnosis A104] Maps of the SSH variance differences at crossover points comparing the GPD versus composite corrections.

The use of the GPD correction compared with the reference (Figure 10, A203) generates a low (0.3 cm2) but homogeneous improvement of the Sea Level Anomalies over the Envisat mission life time (reduction of the SLA variance referenced with the MSS). Note that as with the analysis at crossover points, an enhanced improvement is observed after Envisat cycle 86. Similar results are obtained when comparing with the radiometer.

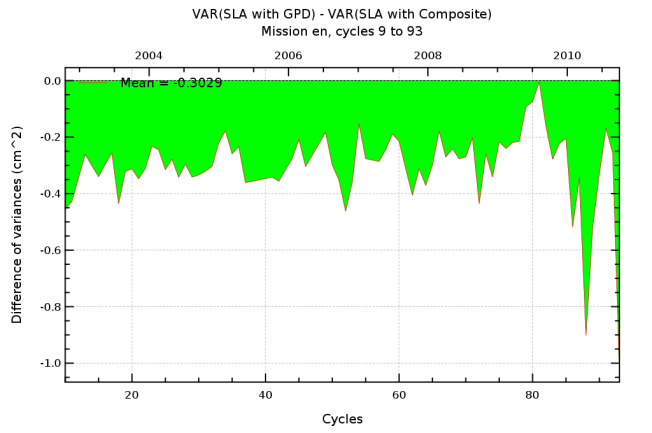


Figure : [Diagnosis A203] Monitoring of the SLA variance differences comparing the GPD versus composite corrections.

Similarly with the analysis at crossover points, the geographical distribution of the SLA variance differences (Figure 11, A209) reveals an almost significant (>1 cm2) improvement of the Sea Level Anomalies (reduction of the SLA variance referenced with the MSS) localized in the subtropical gyres and at equatorial latitudes associated with areas of highest variability of the water vapor content. The improvement is particularly high in the Indonesian region. Two regions of strong improvement (>2cm2) are also detected in coastal areas of Spitsberg and islands north of Siberia.

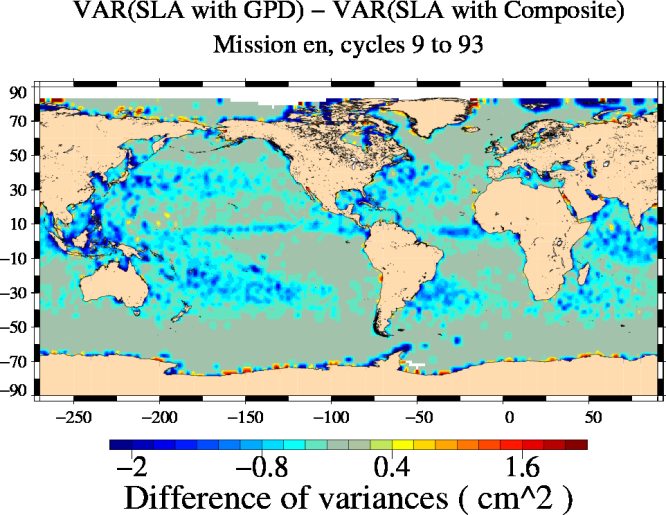


Figure : [Diagnosis A209] Maps of the SLA variance differences comparing the GPD versus composite corrections.

### Coastal areas

Focusing on the impact of the GPD correction on the mesoscale activity in coastal regions, global maps of SSH variance differences at crossover points (Figure 9, A104) indicate whether the GPD correction improve the SSH coherence between ascending and descending passes. Compared with both the reference and the radiometric corrections, the GPD correction has an almost significant positive impact (1 cm2) in some coastal areas at low and mean latitudes in the subtropical gyres, improving the altimetric sea level estimation at short time scales. Similar results are observed on SLA performances (Figure 11, A209: map of SLA variance difference). The Indonesian region is particularly impacted. This evolution is likely associated with the global distribution of the water vapor content rather than with an impact of the GPD algorithm.

Two regions of strong improvement (>2cm2) are also detected in coastal areas of Spitsberg and islands north of Siberia, likely associated with the GPD algorithm.

Figure 12 (A208) indicates that the GPD wet tropospheric correction provides a strong improvement (2 cm2) of the Sea Level Anomalies (referenced to a MSS) in coastal regions inshore 50 km (reduction of the SLA variance) for Envisat mission compared with the reference. The improvement is reduced to 0.3 cm2 between 50km and 100km from the coast.

Figure 12 (right) indicates that except at very short distances to the coast (<15 km), the GPD correction has a similar impact as the radiometric correction on the SLA performances with a weak improvement (0.3 cm2) obtained with the GPD correction.

Thus for mesoscale applications in coastal areas, the GPD correction is better than the reference currently used in the AVISO products and than the radiometric correction.

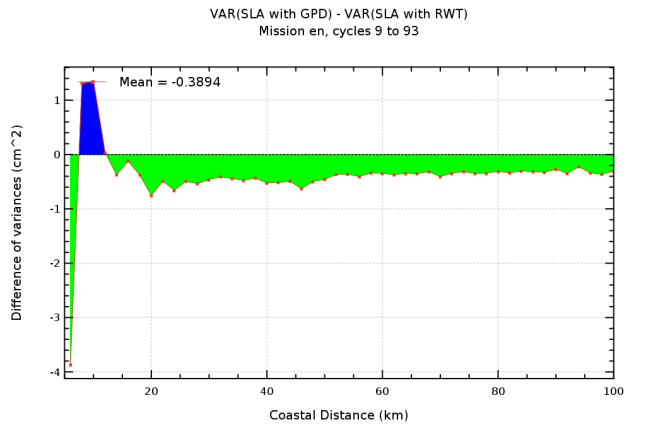
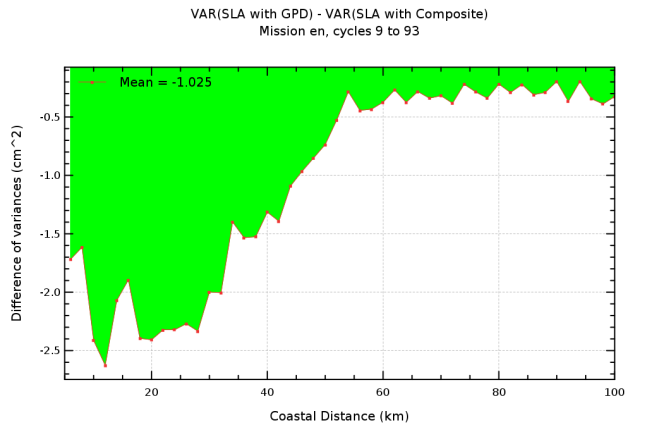


Figure : [Diagnosis A208] SLA variance difference versus coastal distance comparing the GPD versus composite correction (left) and the GPD versus radiometric correction (right).

### High latitudes

Figure 9 (A104) and Figure 11 (A209) show the maps of the SSH variance differences at crossover points and of the SLA variance difference respectively. At high latitudes, they both indicate a significant improvement (2cm2) of the estimation of mesoscale signals with the GPD correction only localized in the coastal areas of Spitsberg and of islands north of the Siberia coast. But as mentioned above, less data are available in these regions because of the ice coverage. Except these particular coastal regions, no impact is detected at high latitudes with the GPD algorithm on mesoscale applications.

# Conclusions and recommendations

The GPD algorithm provides new estimations of the wet tropospheric correction in coastal areas. It has no impact on the global MSL trend estimation compared with the reference composite correction currently used in AVISO products. The MSL trend estimation is significantly modified in coastal areas with the GPD correction and it also improve the estimation of the sea level for mesoscale applications compared with the reference.

The diagnosis performed in the Round Robin Data Package have also shown that in coastal areas, the composite wet tropospheric correction currently used in AVISO products provides a deteriorated estimation of the sea level in terms of MSL trend estimation and of variance of the signal.

* Therefore we recommend to use the GPD algorithm for the estimation of the wet tropospheric correction for climate applications.

1. Synthesis

This section synthesizes the impact of the new algorithm dedicated to the wet tropospheric correction for coastal regions for the Envisat altimetric mission and separating the different climate applications defined in the sea level CCI URD (User Requirement Document). The impact is also estimated for several temporal scales impacting climate studies for each application.

In order to have a clear view of these potential impacts, the information is summarized in a single table for the studied altimetric mission. An impact indicator clearly and easily comprehensible has been defined with 3 levels: significant impact, low impact, no impact detected. Each level is represented by a different color box.

The choice of a value indicator (significant, low or null) is quite subjective. As it depends on the application (Global MSL, regional MSL, mesoscale…), the rule to classify this impact has been defined in annex of this document (see Appendix B -).

## Envisat

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Envisat [October 2002- November 2010] | | | | | |
| Climate  Applications | Temporal Scales | Round Robin Data Package (RRDP) | | | |
| GPD vs composite | | GPD vs radiometer | |
| Global Mean Sea Level | Long-term evolution (trend) |  | |  | |
| Inter annual signals (> 1 year) |  | |  | |
| Annual and semi-annual Signals |  | |  | |
| Regional Mean Sea Level | Long-term evolution (trend) |  | |  | |
| Annual and semi-annual Signals |  | |  | |
| Mesoscale | Signals < 2 months | + | | + | |
| Specific regional areas of main interest for climate studies: | | | | | |
| Coastal areas | Long-term evolution (trend) | + | | + | |
| Signals < 2 months | + | | + | |
| High latitudes | Long-term evolution (trend) |  | |  | |
| Signals < 2 months |  | |  | |
|  | | | | | |
|  | Significant impact | Low impact | No impact detected | | Not yet evaluated |
|  | + | Positive impact (low) | | | |
|  | - | Negative impact (significant) | | | |

1. Definition of the indicator value

In this table, the choice of the indicator value is defined for each climate applications and temporal scales. The thresholds defined here are valid for time series long enough (> 7 years). If time series is too short, the thresholds have to be majored.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Climate  Applications | Temporal Scales | Definition of the indicator value | | |
| Significant impact | Low impact | No impact detected |
| Global Mean Sea Level | Long-term evolution (trend) | Trend >0.15 mm/yr | Trend> 0.05 mm/yr | Trend< 0.05 mm/yr |
| Inter annual signals (> 1 year) | Amplitude> 0.5 mm | Amplitude> 0.2 mm | Amplitude< 0.2 mm |
| Annual and semi-annual Signals | Amplitude> 1 mm | Amplitude> 0.2 mm | Amplitude< 0.2 mm |
| Regional Mean Sea Level | Long-term evolution (trend) | Trend > 0.5 mm/yr | Trend> 0.1 mm/yr | Trend< 0.1 mm/yr |
| Annual and semi-annual Signals | Amplitude> 5 mm | Amplitude> 0.5 mm | Amplitude< 0.5 mm |
| Mesoscale | Signals < 2 months | Crossovers Variance differences > 1 cm² | Crossovers Variance differences > 0.2 cm² | Crossovers Variance differences < 0.2 cm² |
| Specific regional areas of main interest for climate studies: | | | | |
| Coastal areas | Long-term evolution (trend) | Trend > 0.5 mm/yr | Trend> 0.1 mm/yr | Trend< 0.1 mm/yr |
| Signals < 2 months | Crossovers Variance differences > 1 cm² | Crossovers Variance differences > 0.2 cm² | Crossovers Variance differences < 0.2 cm² |
| High latitudes | Long-term evolution (trend) | Trend > 0.5 mm/yr | Trend> 0.1 mm/yr | Trend< 0.1 mm/yr |
| Signals < 2 months | Crossovers Variance differences > 1 cm² | Crossovers Variance differences > 0.2 cm² | Crossovers Variance differences < 0.2 cm² |

1. List of acronyms

|  |  |
| --- | --- |
| TBC | To be confirmed |
| TBD | To be defined |
| AD | Applicable Document |
| RD | Reference Document |