### Adjusted GIM ionospheric correction on Jason-1

<table>
<thead>
<tr>
<th>Study variable</th>
<th>Adjusted GIM ionospheric correction on Jason-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference variable</td>
<td>CNES/AVISO GIM ionospheric correction</td>
</tr>
<tr>
<td>Missions</td>
<td>Envisat (en)</td>
</tr>
<tr>
<td>Period</td>
<td>[19259, 22090]</td>
</tr>
</tbody>
</table>

Creation date: 2011/09/06

**Contents**

A001  3
A002  4
A003  5
A201  7
A202  12
A203  14
A204  17
A205  19
A206  21
A209  24
Study overview

In this study, a new GIM correction based on Jason-1 has been compared to the ionospheric correction used in CNES/AVISO (GIM GDR product Level 2) product to calculate the Envisat sea-level height (SSH).

The impact of using these both ionospheric correction on the SSH calculation has been analyzed for Envisat mission from September 2002 (cycle 9) to June 2010 (cycle 90).

The Jason-1 based GIM correction has been developed in a previous study (cf Report CLS-DOS-NT-20-241 SALP-NT-P-EA-21877-CLS). Long-term stability of GIM ionospheric correction does not seem to be insured, notably for high solar activities periods. Considering that the bifrequency correction (notably Jason-1's) is more reliable for long-term purposes, a correction based on cross-calibration method with Jason-1 has been proposed. The low frequency component of the Jason-1 dual frequency correction selected at particular time is estimated and injected in the GIM Envisat correction.

The reference ionospheric correction is the GIM model for comparison between correction. As done in CNES/AVISO products, for SSH or SLA (Sea Level Anomaly), an hybrid correction is used, combining the Bi-frequency ionospheric correction (until cycle 65) and the GIM model correction (after cycle 65).

All the validation diagnostics displayed in this report have been performed in agreement with the Sea-Level CCI Product Validation Plan (PVP).
Diagnostic A001 (mission en)

Name: Temporal evolution of differences between both altimetric components

Input data: Along-track altimetric components

Description: The temporal evolution of global statistics (mean, variance, slope) of differences between 2 different standards of a same altimetric component (sea surface height correction, altimeter parameter, orbit) are calculated from a cyclic way (altimeter repetivity, daily, weekly, monthly). These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements.
**Diagnostic A002 (mission en)**

**Name:** Map of differences between both altimetric components over all the period

**Input data:** Along-track altimetric components

**Description:** The map of global statistics (mean, standard deviation) of differences between 2 different standards of a same altimetric component (sea surface height correction, altimeter parameter, orbit) are calculated over a given period which is the longer as possible to have obtain reliable statically results. These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements.

![Map of differences between both altimetric components over all the period](image)
Name: Periodogram derived from temporal evolution of altimetric component differences

Input data: Along-track altimetric components

Description: The periodogram derived from temporal and global altimetric component differences is calculated from cycle by cycle monitoring of altimetric component differences (derived from diagnostic A001). It is calculated from the mean or the variance differences. The Periodogram can be calculated for all the periods, but it can be focused on a dedicated period.
Diagnostic A003_b (mission en)

Name: Periodogram derived from temporal evolution of altimetric component differences

Input data: Along-track altimetric components

Description: The periodogram derived from temporal and global altimetric component differences is calculated from cycle by cycle monitoring of altimetric component differences (derived from diagnostic A001). It is calculated from the mean or the variance differences. The Periodogram can be calculated for all the periods, but it can be focused on a dedicated period.

![Periodogram of the mean of GIM_11ADJ - GIM (period = [0, 1 year])](image1)

![Periodogram of the standard deviation of GIM_11ADJ - GIM (period = [0, 1 year])](image2)
Diagnostic A201.a (mission en)

**Name**: Temporal evolution of Sea Level Anomaly (SLA)

**Input data**: Along track SLA

**Description**: The temporal evolution of SLA statistics (mean, standard deviation) are calculated from a cyclic way (altimeter repetivity, daily, weekly, monthly) using successively both altimetric components in the SLA calculation. These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements. They are calculated globally, but also separating ascending and descending passes (except for SLA Grids), or separating North and South hemispheres.

![Graph of Global MSL](image)

**Global MSL**

**Mission en, cycles 9 to 89**

- **SLA with GIM [1AD]**
  - Slope = 0.68 mm/yr [L.S.R. = 0.121]

- **SLA with GIM**
  - Slope = 0.692 mm/yr [L.S.R. = 0.121]
**Name**: Temporal evolution of Sea Level Anomaly (SLA)

**Input data**: Along track SLA

**Description**: The temporal evolution of SLA statistics (mean, standard deviation) are calculated from a cyclic way (altimeter repetitivity, daily, weekly, monthly) using successively both altimetric components in the SLA calculation. These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements. They are calculated globally, but also separating ascending and descending passes (except for SLA Grids), or separating North and South hemispheres.
Name: Temporal evolution of Sea Level Anomaly (SLA)

Input data: Along track SLA

Description: The temporal evolution of SLA statistics (mean, standard deviation) are calculated from a cyclic way (altimeter repetitivity, daily, weekly, monthly) using successively both altimetric components in the SLA calculation. These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements. They are calculated globally, but also separating ascending and descending passes (except for SLA Grids), or separating North and South hemispheres.
**Name**: Temporal evolution of Sea Level Anomaly (SLA)

**Input data**: Along track SLA

**Description**: The temporal evolution of SLA statistics (mean, standard deviation) are calculated from a cyclic way (altimeter repetivity, daily, weekly, monthly) using successively both altimetric components in the SLA calculation. These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements. They are calculated globally, but also separating ascending and descending passes (except for SLA Grids), or separating North and South hemispheres.

![Graph](image-url)
**Name**: Temporal evolution of Sea Level Anomaly (SLA)

**Input data**: Along track SLA

**Description**: The temporal evolution of SLA statistics (mean, standard deviation) are calculated from a cyclic way (altimeter repetivity, daily, weekly, monthly) using successively both altimetric components in the SLA calculation. These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements. They are calculated globally, but also separating ascending and descending passes (except for SLA Grids), or separating North and South hemispheres.
**Diagnostic A202_a (mission en)**

**Name**: Differences between temporal evolution of Sea Level Anomaly (SLA)

**Input data**: Along track SLA

**Description**: The differences between temporal evolution of SLA are calculated from statistics derived from diagnostic A201 (mean, variance) using 2 different components in the SLA calculation. They are calculated globally, but also separating ascending and descending passes (except for SLA Grids) or separating North and South hemispheres.

![Graph showing differences in SLA variances](image-url)
**Name**: Differences between temporal evolution of Sea Level Anomaly (SLA)

**Input data**: Along track SLA

**Description**: The differences between temporal evolution of SLA are calculated from statistics derived from diagnostic A201 (mean, variance) using 2 different components in the SLA calculation. They are calculated globally, but also separating ascending and descending passes (except for SLA Grids) or separating North and South hemispheres.
Diagnostic A203_a (mission en)

**Name**: Map of Sea Level Anomaly (SLA) over all the period

**Input data**: Along track SLA

**Description**: The map of global statistics (mean, standard deviation) of SLA are calculated using successively both altimetric components in the SLA calculation over a large period. These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements.

---

**SLA with GIM_J1ADJ trends**

Mission en, cycles 9 to 89

**Trends (mm/yr)**

SLA with GIM trends

Mission en, cycles 9 to 89

**Trends (mm/yr)**
Diagnostic A203.b (mission en)

Name: Map of Sea Level Anomaly (SLA) over all the period

Input data: Along track SLA

Description: The map of global statistics (mean, standard deviation) of SLA are calculated using successively both altimetric components in the SLA calculation over a large period. These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements.
Diagnostic A203_c (mission en)

**Name**: Map of Sea Level Anomaly (SLA) over all the period

**Input data**: Along track SLA

**Description**: The map of global statistics (mean, standard deviation) of SLA are calculated using successively both altimetric components in the SLA calculation over a large period. These statistics are calculated from 1 Hz altimetric measurements after removing spurious sea level measurements.
Diagnostic A204_a (mission en)

**Name**: Differences between maps of SLA

**Input data**: Along track SLA

**Description**: The difference of SLA maps (mean, standard deviation, slope) is calculated from maps derived from diagnostic A203 using successively both altimetric components in the SLA calculation over a given period. This can be done globally, or separating in ascending and descending passes (except for SLA Grids).

---

**SLA with GIM_J1ADJ trends – SLA with GIM trends**

**Mission en, cycles 9 to 89**

![SLA with GIM_J1ADJ trends – SLA with GIM trends](image)
**Diagnostic A204.b (mission en)**

**Name**: Differences between maps of SLA

**Input data**: Along track SLA

**Description**: The difference of SLA maps (mean, standard deviation, slope) is calculated from maps derived from diagnostic A203 using successively both altimetric components in the SLA calculation over a given period. This can be done globally, or separating in ascending and descending passes (except for SLA Grids).
Name: Differences between maps of SLA (2)

Input data: Along track SLA

Description: The difference of SLA maps (mean, standard deviation, slope) is calculated from maps derived from diagnostic A203 using successively both altimetric components in the SLA calculation over a given period. This can be done globally, or separating in ascending and descending passes (except for SLA Grids).
Name: Differences between maps of SLA (2)

Input data: Along track SLA

Description: The difference of SLA maps (mean, standard deviation, slope) is calculated from maps derived from diagnostic A203 using successively both altimetric components in the SLA calculation over a given period. This can be done globally, or separating in ascending and descending passes (except for SLA Grids).
**Name**: Periodogram derived from temporal evolution of Sea Level Anomaly (SLA)

**Input data**: Along track SLA

**Description**: The periodogram derived from temporal evolution of SLA (global, northern or southern hemisphere) can be done over all periods or focusing on particular periods, such as annual, semi annual or 60 day signal. Therefore mean of SLA differences are computed (every day or cycle), and time data series are plotted as a periodogram.
Diagnostic A206_b (mission en)

Name: Periodogram derived from temporal evolution of Sea Level Anomaly (SLA)

Input data: Along track SLA

Description: The periodogram derived from temporal evolution of SLA (global, northern or southern hemisphere) can be done over all periods or focusing on particular periods, such as annual, semi annual or 60 day signal. Therefore mean of SLA differences are computed (every day or cycle), and time data series are plotted as a periodogram.
Name: Periodogram derived from temporal evolution of Sea Level Anomaly (SLA)

Input data: Along track SLA

Description: The periodogram derived from temporal evolution of SLA (global, northern or southern hemisphere) can be done over all periods or focusing on particular periods, such as annual, semi-annual or 60 day signal. Therefore mean of SLA differences are computed (every day or cycle), and time data series are plotted as a periodogram.
**Diagnostic A209 (mission en)**

**Name**: Differences between maps of SLA (3)

**Input data**: Along track SLA

**Description**: The differences between maps of SLA are calculated from the SLA differences (mean, standard deviation) using successively both altimetric components in the SLA calculation.

**VAR(SLA with GIM_J1ADJ) − VAR(SLA with GIM)**

Mission en, cycles 9 to 89

Difference of variances (cm^2)