Inverse Barometer correction comparison for Jason-2 mission between
Corrections based on JRA-55 and ERA-Interim atmospheric reanalyses

The JRA-55 correction is referred to as JRA55 in the following study
The ERA-Interim correction is referred to as ERA

Lionel Zawadzki, Michael Ablain (CLS)
Introduction:

• We will observe and analyse the impact of the Inverse Barometer correction computed from the JRA-55 atmospheric reanalysis for climate applications on the Jason-2 period

• We will compare this correction with the Inverse Barometer correction computed from the ERA-Interim atmospheric reanalysis. It will be referred to as “ERA”.

• In order to determine the impact of this alternative Inverse Barometer correction in terms of climate applications and temporal scales, we will try in this study to indicate for each impact detected if it’s a positive (+) or a negative (-) impact:

  - Low impact
  - Significant impact
  - No impact detected
## Global Mean Sea Level

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### Global Mean Sea Level

- **Long-term evolution (trend)**
  - Interannual 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

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**Low impact detected on Global Mean Sea Level trend**

$0.09 \text{ mm/yr}$ on the Global MSL is low.

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Temporal evolution of SLA mean calculated **globally**.
Global Mean Sea Level

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**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

Low impact detected on Inter annual Signals

⇒ The figure below shows the mean difference between the two corrections calculated globally by cycle.
### Global Mean Sea Level

#### Climate Applications

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#### Global Mean Sea Level

- **Long-term evolution (trend)**
- **Interannual 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**

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**Low impact detected on Annual and Semi-annual Signals**

![Periodogram of SLA (reference period = 1 year)](chart1)

![Periodogram of SLA (period = [0, 1 year])](chart2)
## Mesoscale

### Significant impact detected on a short temporal scale (signals < 2 months):

- Crossovers Variance Differences are generally positive (see figures on next slide) between 0 and +0.3 cm$^2$ : this means that the JRA-55 IB correction shows degradation by comparison to the ERA-Interim correction.

- The map of SSH crossovers Variance Differences shows that these degradations are mainly below -40° latitudes.

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Mesoscale

Map of Variance differences of Sea Surface Height at crossovers between the JRA-55 and ERA corrections (over all the period):
- Low degradation at high negative latitudes

Temporal evolution of Variance differences of Sea Surface Height at crossovers between two IB corrections:
- Low degradation (around 0.15cm²) over all the period
## Significant impact detected on Regional Mean Sea Level

⇒ We observe a significant impact (around +1 mm/yr) at high latitudes
Regional Mean Sea Level

⇒ Map of Sea Level Anomaly differences between two JRA-55 corrections (over all the period)
# Regional Mean Sea Level

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### Significant impact detected on Annual and Semi-Annual Signals

⇒ Over 10° latitudes, amplitude differences of annual signal are positive around reach 1mm and negative around -1mm below.

⇒ At high latitudes, the corresponding phase shift reaches 10° (~about 10 days=1cycle)
Regional Mean Sea Level

⇒ Map of Sea Level Anomaly differences **amplitude** for **annual signal**

⇒ Map of Sea Level Anomaly differences **amplitude** for **semi-annual signal**

SLA with JRA-55 amplitude – SLA with ERA amplitude : annual signal

[Image of map showing SLA with JRA-55 amplitude - SLA with ERA amplitude: annual signal]

SLA with JRA-55 amplitude – SLA with ERA amplitude : semi-annual signal

[Image of map showing SLA with JRA-55 amplitude - SLA with ERA amplitude: semi-annual signal]
Regional Mean Sea Level

⇒ Map of Sea Level Anomaly differences phase for annual signal.

⇒ Map of Sea Level Anomaly differences phase for semi-annual signal.

To be noted a phase value equal to 30° corresponds to a period of one month

SLA with JRA-55 phase – SLA with ERA phase: annual signal

SLA with JRA-55 phase – SLA with ERA phase: semi-annual signal
Regional statistics between corrections

Map of Mean differences between JRA-55 and ERA (extension period)
On this map we observe clearly differences near coast reaching 4cm.

Map of Standard deviation differences between JRA-55 and ERA (extension period)
On this map we observe differences mainly near coasts reaching 3cm
To conclude:

- JRA-55 correction extension shows performances degraded by comparison to ERA-Interim.
- Main impact is on the long term evolution at regional scale and near coasts.

⇒ Performances at crossovers are close, however the analysis of MSL shows a low degradation over this period.