Inverse Barometer correction comparison for TOPEX/Poseidon 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

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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 TOPEX/Poseidon 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)
  - 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 Global Mean Sea Level trend**

⇒ 0.05 mm/yr on the Global MSL is significant.

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

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#### Global Mean Sea Level

- Long-term evolution (trend)
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#### Regional Mean Sea Level

- Long-term evolution (trend)
- Annual and semi-annual Signals

#### Mesoscale

- Signals < 2 months

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No impact detected on Inter annual Signals

⇒ The figure below shows the mean difference between the two corrections calculated globally by cycle.

![Mean of JRA55 - ERA](Mean_of_JRA55ERA.png)

Mission tp, cycles 2 to 480

- Mean: -0.5269
- Slope: 0.0032 m/yr

[Graph showing mean difference between JRA55 and ERA corrections over time.]
Global Mean Sea Level

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Global Mean Sea Level

- Long-term evolution (trend)
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Regional Mean Sea Level

- Long-term evolution (trend)
- Annual and semi-annual Signals

Mesoscale

- Signals < 2 months

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

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**Global Mean Sea Level**
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**Regional Mean Sea Level**
- Long-term evolution (trend)
- Annual and semi-annual Signals

**Mesoscale**
- Signals < 2 months

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 -1 cm²: this means that the Inverse Barometer correction based on JRA55 shows degradations by comparison to the ERA-Interim correction.

⇒ The map of SSH crossovers Variance Differences shows that these degradations are mainly below -50° latitude.
⇒ Map of Variance differences of Sea Surface Height at crossovers between the Inverse Barometer based on JRA55 and ERA-Interim (over all the period):
- significant degradation at high latitudes, below -50°

⇒ Temporal evolution of Variance differences of Sea Surface Height at crossovers between two Inverse barometer corrections:
- Significant degradation (~0.5cm²)
## Regional Mean Sea Level

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Significant impact detected on Regional Mean Sea Level

⇒ We observe a significant impact (1 mm/yr) on the regional trends near coasts and ~0.5mm/yr in the open ocean, mainly in the Pacific.
Regional Mean Sea Level

⇒ Map of Sea Level Anomaly differences between two JRA55 corrections (over all the period)
## Regional Mean Sea Level

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

- Amplitude differences reach 2mm or – 2mm for annual and semi-annual signal (see figures on next slide). A North/South hemispheres difference is visible.
- The corresponding phase shifts are low (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 JRA55 amplitude – SLA with ERA amplitude : annual signal

SLA with JRA55 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 JRA55 phase – SLA with ERA phase: annual signal

SLA with JRA55 phase – SLA with ERA phase: semi-annual signal
Regional statistics between corrections

Map of Mean differences between JRA55 and ERA (extension period)
On this map we observe clearly differences near coast, up to +4mm.

Map of Standard deviation differences between JRA55 and ERA (extension period)
On this map we observe differences mainly near coasts
**To conclude:**

- The Inverted Barometer (IB) correction based on the JRA55 atmospheric reanalysis shows degraded performances by comparison to the IB based on ERA-Interim
  ⇒ The degradations are mainly at crossovers
  ⇒ Main impact is on the long-term evolutions at regional scale
  ⇒ Significant differences near coasts