**Data Quality Assessment of in situ and altimeter observations through two-way intercomparison methods**

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**Context & Objectives**

Intercomparison methods also called multi-observations CalVal (Calibration/Validation) methods are widely used between in situ and satellite data to assess the quality of the latest. The stability of the different altimeter missions is, for example, commonly assessed by comparing altimeter sea surface height measurements with those from arrays of independent tide gauges [Mitchum, 2000; Valladeau et al., 2012]. Other examples include the validation of altimeter velocity products with drifting buoys observations provided by the Global Drifter Program (GDP) [Bonejano and Lagardère, 2002; Pascual et al., 2009] that are also used for the systematic validation of satellite SST thanks to their in situ surface temperature measurements. In turn, comparison of in situ and altimeter data can also provide an indication of the quality of the in situ measurements [Guinehut et al., 2009; Rio et al., 2012].

We present here the two-way intercomparison activities performed at CLS for both space and in situ observation agencies, and why these activities are required steps to obtain accurate and homogeneous datasets.

1. Assessment of the stability of altimeter missions through SSH comparisons with tide gauges (SALP program)
2. Detection of drifts or jumps in altimeter missions through SSH comparisons with the Argo array (SALP program)
3. Detection of drifts or jumps in Argo floats time series through SSH comparisons with altimeter observations (Iremmer/Coriolis center)
4. Detection of drop loss of surface drifting buoys and computation of a correction tool for wind slippage through combine use of altimeter and wind observations

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**Stability of altimeter missions through comparison with tide gauges**

- **Data & Method** (Valladeau et al., 2012a,b)
  - Tide gauge measurements from the GLCSS/CLIVAR “fast” sea level data network (http://ilikai.soest.hawaii.edu/uhslc)
  - Along-track (level 2) SLA from satellite altimeters with updated compared to the official GDR altimeter products

- **Collocation Method**
  - Collocated altimeter along track products within a 100 km distance circle

- **Assessment of TOPEX/Poseidon, Jason-1, Jason-2 and Envisat MSL drifts**
  - Detection of potential drifts or jumps in altimeter time series: by analyzing the collocated altimeter and tide gauge SLA differences
  - Impact of new altimeter standards (orbit solution, geophysical or instrumental correction, retracking algorithm): by comparison of collocated altimeter/tide gauge SLA
  - Quality assessment of in situ tide gauge time series
  - Since spurious drifts or jumps can remain in tide gauge time series, a quality control is performed to select relevant in situ measurements for the altimeter/tide gauge differences

- **The tide gauge quality control is performed:**
  - by comparing altimeter/tide gauge SLA differences using the four main missions
  - by correlating altimeter and in situ SSH time series

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**Drifts or jumps in altimeter missions through comparison with Argo floats**

- **Data & Method** (Valladeau et al., 2012a)
  - Collocated DHA + Grace - SLA
  - SLA maps derived from 10-day box-averaged along-track data
  - Argo Coriolis-GDAC data base, DH-900 dbar – synth. clim.

  - **Regional MSL trend differences between Jason-1 and Envisat**
    - Strong trend difference on Envisat and Argo + Grace data
    - The anomaly is mainly observed on Envisat
    - Test of the impact of new preliminary CNES GDR orbit solutions (where long-term evolution of gravity field has been improved)

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**Validation of Argo floats through comparison with altimeter observations**

- **Data & Method** (Guinehut et al., 2009)
  - For each Argo float time series: DH = DHA - Mean-DH - SLA
  - DH : Argo Coriolis-GDAC data base
  - DH calculated from T/S profile using a reference level at 200/400/900/1200/1900 dbar
  - Mean-DH : Argo synthetic climatology
  - SLA : AVISO combined maps – co-located in time and space to the Argo measurements

  - Mean differences (cm)
  - Problems in DH
  - Problems in SLA
  - Differences between DHA and SLA arise from:
    - Differences in the physical content of the two data sets
    - Use of mean statistics
    - Problems in SLA
    - Problems in the Mean-DH - Inconsistencies between Mean-DH and DH
  - Problems in DH (i.e. the Argo data set)

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**Drogue loss of surface drifting buoys through combine use of altimeter and wind observations**

- **Context:** Spurious trend in global surface drifter currents (SD-DAC) dataset due to anomalous drogue loss detection recently identified (Grodsky et al., 2011, Rio et al. 2011)
  - **ALL**
    - First three months of each trajectory only (Grodsky et al., 2011)
    - Only drifters identified as drogued by our method ($\alpha_{best}$=0.3%)

  - Development of a method to detect the drogue loss (Rio, 2012)
    - Computation of a new Ekman model from the first three months of the AOML drifter trajectories (by latitudinal band and by month - spatial and seasonal change in stratification)
    - Computation along the drifter trajectories (only trajectories longer than 200 days are considered) vectorial correlation between the wind:
      1. $\text{Vb} - \text{Vd}$
      2. $\text{Vb} - \text{Vekman}$
    - Computation of a new $\text{Vekman}$ wind from SD-DAC are used to fit a 2 parameter (f/θ) Ekman model

  - On the basis of the total drogue loss on SD-DAC dataset with important spatial variability

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**Summary & Future work**

- **Efficient methods:** efficiency & limitations now well known
- **General consistency check:** of the whole Argo data set & the whole surface drifting buoys data set & the whole tide gauge data set & of the different altimeter missions consistent datasets to be used together for climate studies or in assimilation/validation tools
- **Continuous improvement of the methods**
- **Results to be updated on a regular basis**