Title – Recent developments in the GNSS-derived Path Delay (GPD) targeting at better wet tropospheric corrections for open-ocean and coastal studies

Authors:

Clara Lázaro[1,2], M. Joana Fernandes[1,2]

[1] Faculdade de Ciências, Universidade do Porto, Porto, Portugal, mjfernan@fc.up.pt, clazaro@fc.up.pt
[2] Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR/CIMAR), Universidade do Porto, Porto, Portugal

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Abstract:

In the scope of the ESA Climate Change Initiative Sea Level (SL-cci) project, which aims at generating a long term stable sea level dataset accurate to 0.3 mm/yr, new and inter-calibrated sets of wet path tropospheric correction (WTC) were generated at University of Porto U.Porto), using the GNSS-derived Path Delay Plus (GPD+) algorithm evolved from GPD. The new algorithm was applied to eight altimetry missions: TOPEX/Poseidon (TP), Jason-1 (J1), Jason-2 (J2), ERS-1 (E1), ERS-2 (E2), Envisat (EN), CryoSat-2 (C2) and SARAL/AltiKa (SA).

For each mission, the GPD methodology combines, through objective analysis, valid wet tropospheric path delays (WPD) observations i) from the microwave radiometer (MWR) on board that mission, whenever they exist and ii) derived from Global Navigation Satellite Systems (GNSS) data acquired at coastal and island stations to estimate a new WTC for all invalid MWR measurements. The GPD+ has the advantage of combining also WPD observations from scanning imaging radiometers (SI-MWR) on board various remote sensing satellites, this way increasing data availability.

In the estimation process, the WPD derived from an atmospheric model, such as the European Centre for Medium-range Weather Forecasts (ECMWF) ReAnalysis (ERA) Interim or the ECMWF operational, are used as first guess and also as the GPD+ estimated WTC in the absence of WPD observations.

To achieve the requisite long term stability of the WTC datasets, the radiometers used in the GPD+ estimations require proper inter-calibration. For this purpose, all radiometers have been inter-calibrated, using the set of Special Sensor Microwave Imager (SSM/I) and Special Sensor Microwave Imager/Sounder (SSM/IS) on-board the Defense Meteorological Satellite Program (DMSP) satellite series (F10, F11, F13,F14, F16 and F17) as reference, since their stability and independent calibration are well documented. Due to the different orbits and sampling of the various satellites, the inter-calibration was performed differently for the i) NASA/CNES, ii) ESA and CNES/ISRO altimetry missions and iii) for the SI-MWR radiometers. For each radiometer, a set of three parameters (offset, scale factor and linear trend) were calculated and applied to the original WPD dataset.

These recent developments in the GPD algorithm, targeting at better wet tropospheric corrections are discussed in detail. They are shown to have contributed to the generation of new WTC products that reduce sea level anomaly variance with respect to previous non-calibrated versions (e.g., calculated using GPD) and are expected to be an added-value both for open-ocean and coastal studies.