Title – Inter-calibrated wet path delays for eight altimetric missions – impacts on coastal sea level

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Abstract:

Coastal sea level variation is of most interest due to its socio-economic impacts. Recent developments in satellite altimetry, particularly on wave retracking and on the improvement of range and geophysical corrections, such as those due to ocean tides and to the atmosphere, have allowed the inspection of the coastal ocean up to a few km from the coast.

One of the major sources of uncertainty on satellite altimetry measurements in the coastal regions is the delay induced by the water vapour content of the atmosphere in the altimeter signal or wet tropospheric correction (WTC). When using standard altimeter products at distances less than 20-40 km from the coast, depending on the mission, the user is faced with the decision whether to adopt a WTC from an atmospheric model or from the on-board microwave radiometer (MWR), contaminated by land effects.

In phase 2 of the ESA Climate Change Initiative Sea Level (SL-cci) project, wet path delays (PD) for all missions used to generate the SL essential climate variable (ECV) were derived at the University of Porto using the GNSS-derived Path Delay Plus (GPD+) methodology. A new and inter-calibrated set of WTC was generated for eight altimetric 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).

This paper demonstrates how this new data set improves the retrieval of the coastal sea level and illustrates the major impacts in regional coastal sea level variation.

Compared to previous GPD products, the main differences are: 1) the series is extended to 8 altimetry missions, including C2 and SA, thus allowing to fill the Envisat gap and extend the higher spatial resolution ESA satellite series until present; 2) additional data from scanning imaging radiometers on-board various remote sensing satellites have been used, improving the WTC retrieval, particularly for the most recent missions such as C2 and SA; 3) all radiometer data sets 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 as reference, thus ensuring the long term stability of the corrections and reducing the uncertainty in the long term sea level variation.

For most missions, the new products are shown to reduce coastal sea level anomaly variance with respect to previous non-calibrated versions and to other WTC data sets such as the AVISO Composite WTC or the ERA Interim model. Coastal improvements are also illustrated through the reduction of the RMS differences between GNSS-derived wet path delays at coastal stations and the WTC at the nearby altimeter points, function of the distance from

coast. Finally, the impacts on regional sea level variation is illustrated for various regions with different WTC variability and sea level conditions, such as Indonesia and the German Bight.