Title of the project:
Development of an Enhanced WPD for SWOT for coastal and inland regions (DEW)

List of investigators involved:
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General objectives and approach:

The path delay of the radar pulse due to the presence of water vapor in the atmosphere is considered in the altimeter range measurements through the application of the wet tropospheric correction (WTC). Due to its large space-time variability, the best way to retrieve the WTC is via space-time collocated measurements of microwave radiometers (MWR) on board the altimetric missions. However, the WTC retrieval algorithms are usually tuned for open-ocean conditions and do not work properly over surfaces such as coastal regions, ice surfaces and land, where the collected WTC retrievals become invalid. Figure 1 shows, as an example, the along-track points for Sentinel-3A cycle 35 for which MWR measurements have been flagged as invalid.

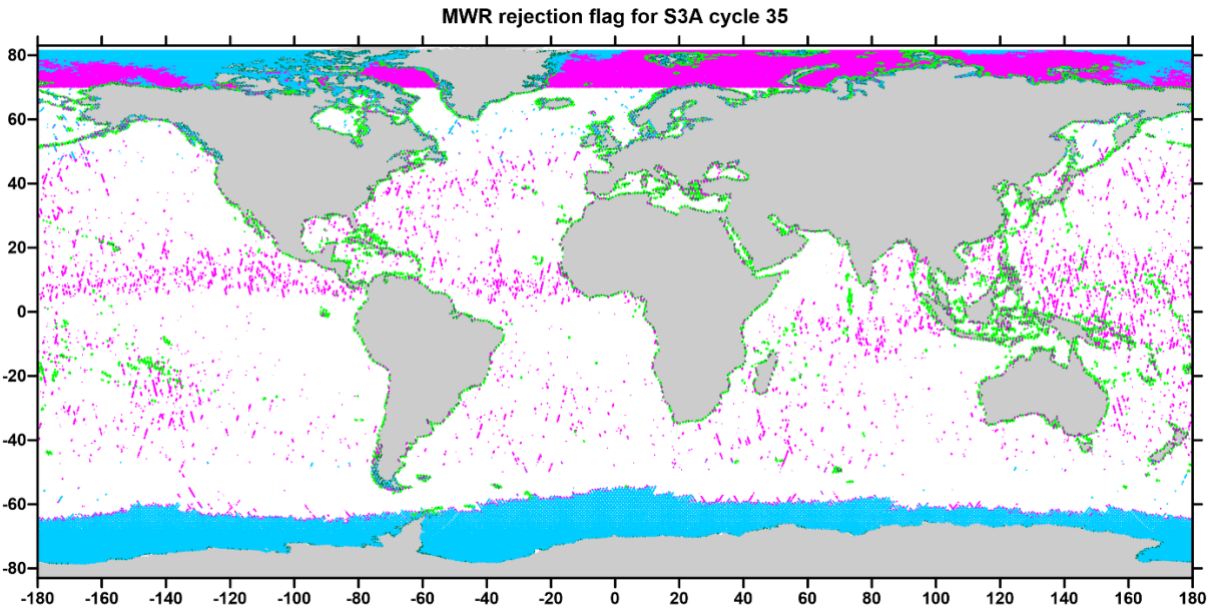

Figure 1 – Along-track points for Sentinel-3A cycle 35 with invalid MWR observations. Green points show land contamination, blue points show ice contamination and points in pink represent heavy rain or outliers.

The main aim of this study is the computation of an enhanced WTC for the SWOT mission for all surfaces of interest, both along the nadiral direction and for all the points in the cross-track direction. The GNSS-derived Path Delay Plus (GPD+) methodology, developed by the University of Porto (UPorto) will be used. Two GPD+ WTC will be computed and inter-compared, one using measurements from the SWOT MWR suite and another computed using only third-party WPD data, the so-called the 'à la CryoSat' GPD+ WTC. Due to the MWR characteristics, the former GPD+ WTC is expected to be a significant improvement when compared to the baseline correction, while the latter is expected to be a valuable source for the validation of the baseline MWR-derived WTC. Regarding the example given in Figure 1 for Sentinel-3A, the GPD+ output is a valid WTC for all points with an invalid baseline MWR-derived WTC, which in this case are nearly 28% of all points. Along-track points with all corrections necessary for the computation of the sea level anomaly (SLA) but the WTC, reach a percentage of 10.2%. Therefore, the GPD+ algorithm, by providing a valid WTC for these points, enhances the final along-track products and extend the SLA computation to high latitudes and coastal regions.

It is also aimed to exploit the use of the SWOT baseline WTC as an input source for the generation of improved GPD+ WTC for the remaining past and operational altimetric missions. Combined all together, these GPD+ WTCs are expected to constitute a unique set of consistent and inter-calibrated WTC, with global coverage, including open-ocean, coastal regions, and high latitudes.

The baseline MWR-derived WTC for SWOT will be analysed seeking the tuning of the GPD+ methodology to this mission. Adjusting and improving the existing criteria as well as establishing new ones for detecting invalid MWR measurements, is a fundamental step in this study. These criteria aim at identifying invalid MWR measurements, allowing their correction and replacement by the GPD+ estimates. Valid MWR-derived measurements are always maintained in the output of GPD+ methodology, therefore guaranteeing their availability to end users. The GPD+ methodology and the GPD+ datasets generated for other altimetry missions are fully described in Fernandes et al. (2015), Fernandes and Lázaro (2016, 2018) and Lázaro et al. (2019).

Expected results and milestones of the project:

This proposal has been organized in three main tasks, with a total duration of 48 months:

Task 1 – GPD+ WTC for the SWOT mission (42 months): this task encompasses the analysis and compilation of the various WPD that will be used as input in the

GPD+ estimations, the tuning of the GPD+ algorithm for the SWOT mission and the computation/validation of the GPD+ WTC for the SWOT mission;
Task 2 – Contribution of the SWOT-derived WTC for improving the GPD+ WTC for the remaining altimetric missions (6 months): it is intended in this task to exploit the added value of this dataset as an additional input data set for the computation of the GPD+ WTC for the remaining altimeter missions;
Task 3 – Contribution of the SWOT-derived WTC for the space-time description of the WTC field and its response to climate phenomena (6 months): it is intended to assess the space-time variability of the WPD and its response to climate phenomena using a global, consistent and inter-calibrated set of wet tropospheric corrections computed for all altimeter missions from 1992 onwards.

The outcome of this study will be a global and consistent set of WTC for the SWOT mission, inter-calibrated with respect to the SSMI/SSMI(S) missions, and provided along the nadiral direction and for all the points in the cross-track direction that constitute the mission's swaths. This WTC dataset will be available for both oceanic and hydrological studies, allowing the measurement of the water storage globally. Therefore, it is expected to be an added benefit also for hydrological sciences.
SWOT GPD+ WTC generated in the scope of this proposal will also significantly contribute to the knowledge of the WPD space-time variability and will lead to a better understanding of the WPD response to climate phenomena.