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Topside TEC and Radio Occultation ionospheric products from EUMETSAT satellites

R. Notarpietro*, S. Paolella, A. Nardo, Y. Andres, L. Butenko, F. M. Alemany, A. Von Engeln, and C. Marquardt
EUMETSAT, Darmstadt, Germany; e-mail: Riccardo.Notarpietro@eumetsat.int

EUMETSAT, the European operational satellite agency for monitoring weather and climate, operates a system of meteorological satellites that observes the atmosphere and ocean and land surfaces 24 hours a day, 365 days a year. Even if the main observing target of the organization is the neutral atmosphere, in the last few years there has been an increased interest in EUMETSAT's user community for space weather. This has driven the exploitation of data, which are already available for other purposes, also for the ionosphere monitoring.

All the EUMETSAT Low Earth's Orbiting (LEO) satellites carry on board a GNSS receiver for Precise Orbit Determination (POD) purposes. We have used data collected by such receivers to generate and monitor the overall electron content characterizing the topside region above the LEO satellites (the topside Total Electron Content - tTEC). We have done it considering observations from the three EUMETSAT Polar System Metop (A, B and C) satellites and the two Sentinels 3 (A and B) satellites. We performed the analysis considering data taken during 2019 and the overall agreement between tTEC is good. With this contribution we also want to present the product we would like to routinely offer to the user community, which contains daily tTECs as well as the Differential Code Biases estimated for the GNSS-POD receivers used in the framework of the EUMETSAT missions.

Moreover, one of the payload available in all the three Metop satellites is a GNSS Radio Occultation receiver (the GRAS receiver). In the framework of the EPS Metop-A End-of-Life testing campaign which was done in 2020, we will have the opportunity to test an updated configuration of the instrument, extending its vertical measurement range into the lower and mid ionosphere. Thank to this we will collect Radio Occultation ionospheric data at a relatively high sampling rate (50 Hz) for producing vertical profiles of amplitude and phase scintillation indices. Moreover, this extension will give us the possibility to verify the feasibility of the implementation of a new approach for implementing ionospheric corrections for the retrieval of bending angles in neutral atmosphere (this is the main Radio Occultation product delivered by EUMESTAT). The current data processing is based on simplified models of electron density in the ionosphere, in particular below the F-layer. Large parts of this altitude range will be covered by the extended GRAS Radio Occultation soundings, making it possible to validate results and verify the theoretical basis of the new correction algorithms. Finally, such data will be processed to derive vertical profiles of electron density.

In case the extension of the vertical measurement range of GRAS on board Metop-A will not interfere with the operational processing of neutral atmospheric data, this capability could also be provided by the other GRAS receivers on board the Metop-B and -C satellites (to be confirmed, at the time of writing this abstract). They will be operative for the next 5/7 years until the future EUMETSAT EPS-Second Generation constellation will be operative. The six satellites of this future constellation are all equipped with GNSS receivers for POD purposes and with modernized Radio Occultation receivers. These will routinely provide Radio Occultation data at 200/250 Hz up to 500 km height also for ionospheric monitoring.

This contribution presents all such outlined activities carried out at EUMESTAT in exploiting data from its own satellites for space weather and ionosphere monitoring purposes.