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Scaling of GNSS radio occultation impact with observation number using an ensemble of data assimilations

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Global Navigation Satellite System Radio Occultation (GNSS-RO) measurements are an important component of the current Global Observing System (GOS) used for Numerical Weather Prediction (NWP). Currently, about 2,000 bending angle profiles per day are assimilated, and these account for around 2–3 % of the total number of observations assimilated at ECMWF. The GNSS-RO measurements have a statistically significant positive impact on the analysis and forecast accuracy, particularly in areas with significant model biases. There is no indication of saturation of forecast impact with the current GNSS-RO observation numbers, but there is very little guidance on where this effect might occur.

This presentation will discuss results of a study which aims to estimate the optimal number of GNSS-RO measurements required for NWP. The impact as a function of observation number is analysed using simulated GNSS-RO observations. The study is based on Ensemble of Data Assimilations (EDA) approach using ten ensemble members. The EDA system provides a statistical estimate of the analysis and short-range forecast uncertainty of the NWP system, based on the spread of the ensemble members. A set of EDA experiments is performed with different numbers of simulated GNSS-RO profiles, ranging from 2000 to 128000 profiles per day, in addition to the real conventional and satellite observations assimilated operationally. The use of the EDA approach for estimating observation impact will be discussed. It is shown that the impact of 16000 GNSS-RO profiles per day in the upper tropospheric and lower stratospheric temperatures is clearly not saturated, based on the behaviour of the ensemble spread as a function of observation number.