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We have conducted a study assessing the impact of three months of Spire and COSMIC-2 observations in the ECMWF and Met Office systems. Spire provides about 6,000 occultations globally per day, and hence, assimilating this data would approximately double the number of GNSS-RO observations used at the Met Office. We have run various Observing System experiments (OSEs) adding and excluding bending angles from Spire, COSMIC-2 and other GNSS-RO data. With this set of experiments, we have assessed forecast impacts and fits to other independent observations. Adding Spire and COSMIC-2 data to the 4D-Var system clearly improves forecast scores at ECMWF and Met Office. At ECMWF, tropical forecast scores in humidity are very much improved by about 1.3% at 500hPa for COSMIC-2 compared to 0.5% for Spire at day 2. In general, adding Spire data has a bigger impact on forecast scores in the southern hemisphere, whereas adding COSMIC-2 data has a bigger impact in the tropics, especially for temperature and humidity. Fits to independent observations sensitive to temperature, wind and humidity improve largely when adding Spire both at ECMWF and Met Office. For example, fits to radiosonde temperature observations at 150hPa improve by 1.2% and 4%, to microwave imager observations sensitive to total water vapour by 0.5% and 0.5%, and to wind observations at 850hPa from atmospheric motion vectors by 0.3% and 0.1% for ECMWF and Met Office, respectively.

Additionally, at ECMWF we have performed ensemble data assimilation experiments (EDAs) using the same set of GNSS-RO observations as in the OSEs. This is done to study the spread-skill relationship and compare to previously performed theoretical studies. First results show that adding Spire or COSMIC-2 reduces the spread for temperature by about 7% at 30hPa in the southern hemisphere, whereas adding Spire and COSMIC-2 reduces the spread by 12%. In the tropics the addition of COSMIC-2 has the largest effect on reducing the spread by about 15% at 30hPa, whereas Spire reduces the spread by 6%. In summary, both Spire and COSMIC-2 data provide valuable information in improving the forecast scores and fits to observations sensitive to humidity, wind and temperature.

Presentation file

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