Characterisation of numerical weather prediction model biases using GRUAN reference radiosondes.

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The characterisation of uncertainties in Numerical Weather Prediction (NWP) models is a major challenge that is addressed as part of the Horizon 2020 GAIA-CLIM project. In that regard, observations from the radiosonde GCOS reference upper-air network (GRUAN) are being used at the Met Office and ECMWF to assess uncertainties associated with model data.

A stand-alone module, decoupled from the NWP systems at the Met Office and ECMWF, is being developed based on a core radiative transfer modelling capability built around two existing open-source software packages (EUMETSAT's NWP SAF RTTOV fast radiative transfer model, and the NWP SAF Radiance Simulator). This software, referred to as the GRUAN Processor, enables the comparison of collocated geophysical fields and simulated brightness temperature between radiosonde and model fields.

A preliminary study has been conducted with all available GRUAN profiles in 2013. This includes 11 sites located in the Northern hemisphere, 3 in the tropics, and 1 in the Southern hemisphere. Brightness temperatures have been simulated for 4 microwave satellite instruments (AMSU-A, AMSU-B, ATMS, and MHS) and 3 infra-red instruments (CrIS, HIRS, and IASI).

On average, the free tropospheric specific humidity in both centres is consistent with GRUAN observation and within GRUAN uncertainty. However, a distinctive wet model bias of ~30% is observed in the upper-troposphere both at the Met Office and ECMWF. The Met Office model temperature field is mostly consistent with GRUAN observations and within GRUAN uncertainty. A cold model bias, up to 0.6K in the stratosphere, mostly outside of GRUAN uncertainty, is observed at ECMWF. The best estimations of simulated brightness temperatures suggest differences model-sonde better than ±0.6K for humidity sensitive channels, ±0.2K for temperature sensitive channels, and ±0.3K for surface sensitive channels.