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The radiosonde data product provided by the GCOS (Global Climate Observing System) Reference Upper-
Air Network (GRUAN) as well as radio occultation (RO) measurements are commonly used as reference
data sets. Here the COSMIC RO and GRUAN Vaisala RS92 data are compared on a station-by-station basis
using a double differencing technique, i.e. the mean RO and mean GRUAN Vaisala RS92 departures
(observation minus background, O-B) from co-located profiles extracted from the Met Office global
numerical weather prediction (NWP) system, are compared. The NWP model is used as a transfer medium to
minimize to minimize (i) the effect of spatial temporal co-location errors between the radiosonde and RO
observation, and (ii) the statistical noise.
The comparison of RO and GRUAN Vaisala RS92 departures is presented for five GRUAN sites based on
the availability of GRUAN RS92 data, i.e. data from Sodankylä, Nye Ålesund, Lindenberg, Cabauw, Barrow,
and Southern Great Plains are analysed.
At many levels agreement or consistency between RO and GRUAN data is found in the stratosphere, which
is analysed here. At most GRUAN stations the negative difference in the RO departures and GRUAN
departures indicates a warm bias in the GRUAN data at the highest analysed pressure level of 10hPa for
daytime launches. At Sodankylä and Nye Ålesund a negative difference between the RO O-B and the
GRUAN O-B is found at all solar elevation angle ranges, which might be caused by

radiosonde sampling
biases as the GRUAN sample size decreases at the highest levels.
For a quantitative comparison of the RO and GRUAN departures, an estimate of the uncertainty is required.
The GRUAN Vaisala RS92 data product includes a traceable estimate of the uncertainty on every value
which is propagated into the uncertainty on the mean GRUAN departure profile for a given upper-air site.
The RO technique relies on measuring the time delay of a radio signal transmitted by Global Navigation
Satellite System when traversing the atmosphere. Due to the high accuracy of time measurements, highly
accurate profiles of bending angles are retrieved from the RO raw measurements. Bending angle O-Bs are
used to calculate dry temperature O-Bs, using a tangent linear retrieval. An estimation of the uncertainty in
the dry temperature O-Bs is calculated including the structural uncertainty originating from the tangent linear
retrieval as well as the sampling uncertainty.
The method applied here to compare GRUAN and RO profiles was originally developed by the authors to
correct radiosonde temperature biases in the operational radiosonde network prior to the assimilation into the
UK Met Office NWP model .
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