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Potential Systematic Errors in Radio Occultation Climatologies due to Irregular Distributions of Apparent Outliers in the Retrieval Process

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Monitoring global climate change requires measuring atmospheric parameters with sufficient coverage on the surface, but also in the free atmosphere. GPS Radio Occultation (RO) provides accurate and precise measurements in the Upper Troposphere–Lower Stratosphere region with global coverage and long-term stability thanks to a calibration inherent to the technique. These properties allow for the calculation of climatological variables of high quality to track small changes of these variables.
High accuracy requires keeping systematic errors low. The purpose of this study is to examine the impact of the Quality Control (QC) mechanism applied in the retrieval system of the Wegener Center for Climate and Global Change, Karl-Franzens-University Graz (WEGC), on systematic errors of climatologies calculated from RO data.
The current RO retrieval OPSv5.4 at the WEGC uses phase delay profiles and precise orbit information provided by other data centers, mostly by UCAR/CDAAC, Boulder, CO, USA for various receiver satellites. The satellites analyzed in this study are CHAMP, GRACE-A and FORMOSAT-3/COSMIC. Profiles of bending angles, refractivity and atmospheric parameters are retrieved and these are used to calculate climatologies.
The OPSv5.4 QC rejects measurements if they do not fulfill certain quality criteria. If these criteria cause a biased rejection with regard to the spatial or temporal distribution of measurements it can increase the systematic component of the so-called Sampling Error (SE) in climatologies. The SE is a consequence of the discrete and finite number of RO measurements that do not completely resemble the total variability of atmospheric parameters.
The results of the calculations conducted show that the QC of the retrieval system indeed has a strong influence on geographical sampling patterns, causing a large number of rejections at high latitudes in the respective winter hemisphere. During winter, a monthly average of up to 60 % of all measurements are discarded at high latitudes. The QC also influences temporal sampling patterns systematically, more measurements are rejected during nighttime. The systematic rejections by the QC also have a strong effect on the SE, causing it to increase fourfold in some cases and regions. Measurements of cold temperatures are particularly affected, in these cases derived climatologies are biased towards higher temperatures.
The results and new insight gained are used to improve the QC of following processing system versions.