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Invited Talk
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Since the pioneering Global Navigation Satellite System (GNSS) radio occultation (RO) mission GPS/Met in the mid-1990s, and in particular since the start of the CHAMP multi-year dataflow by 2001, an RO data record of more than fifteen years has been accrued. Formosat-3/COSMIC and GRAS on MetOp have significantly enlarged the dataset as of 2006 and also other missions such as GRACE and FengYun-3/GNOS have made or are starting to make valuable contributions and several new RO constellations are in the pipeline. Now in 2017 is therefore a good time to take stock of where we stand in realizing the ambitious claim coined many years ago by one of our RO community pioneers, Rick Anthes from UCAR Boulder, “GNSS RO is the most accurate, precise, and stable thermometer from space.”

This claim neatly encapsulates RO’s core promise of exceptional climate monitoring utility due to a unique combination of high accuracy, high vertical resolution, long-term stability, and nearly all-weather global coverage. So, given all the great work so far on this elegant space-borne refractometric technique—that so solidly is empowered by satellite geodesy to act as an SI-traceable thermometer in principle—how do we currently live up to Rick’s claim and what’s next?

In this talk I will first recall the characteristics of RO along these lines, in the context of related upper air observing methods and of needs of the Global Climate Observing System, and then focus on where we stand, about twenty years after GPS/Met, in preparing and using RO as a dataset aiming to lead in accuracy, precision, and long-term stability, in particular for climate studies that fit best for illustrating the case. I will summarize our status towards providing benchmark quality climate data from RO and in using the data for studying climate variability and change in the troposphere and stratosphere, as a reference for model evaluation and other observing systems, and in helping detect (anthropogenic) climate trends.

In this way we will see substantial successes towards meeting the claim but also get clear clues where and how we still fall short and so where to go next. The key next step that I see at the processing side is to indeed realize the promise of a rigorous SI-trace, from fundamental time-based tracking data to retrieved climate variables such as temperature and humidity. Pioneering such a traceable processing, in form of the reference occultation processing system rOPS with integrated uncertainty propagation, is a current core project at WEGC from which I will report on status and results. There are also key next steps to expand RO use in climate science, to better underpin the claim and duly merit its broad acceptance, in particular a better integration with the climate modeling and analysis communities, far beyond the more narrow RO and Earth observation communities being in camp now. I will address RO collaborations and emerging partnerships in WMO, WCRP, and other initiatives in this respect.

The overarching prospect and, I suggest, goal of our next improvement steps both in processing and data use is to see Rick’s claim in future realized not only “half way” but rather by a genuine community-wide recognition of RO as a fundamental reference standard for the thermodynamic state and evolution of the global atmosphere, for the benefit of atmospheric and climate science and applications.
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