Remote sensing of “atmospheric boundaries” with GNSS radio occultation

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In this talk, I will describe two applications of GNSS RO that highlights the unique contribution of these measurements. The first is on the latitudinal structure of the tropopause (TP) and its trend. The second is on the climatology and variability of the planetary boundary layer (PBL) height. Both the TP and PBL heights are difficult to obtain reliably from other passive remote sensing techniques due to their limited vertical resolution.

The application of RO in TP has long been recognized, and there have now been many published studies on this subject. Here, I report on a recent study where the monthly-averaged latitudinal structure of the TP from CHAMP and COSMIC data is used to infer the variability and trends in the width of the tropical belt. Our result shows interesting differences between the North and South Hemispheres.

The use of RO in estimating PBL height is an active area of research. Various algorithms have been proposed, and they all rely on a large vertical change of the retrieval variables from bending angles to refractivity to water vapor. While algorithm refinement and validation need to continue, the key challenge concerns the quality of the data affecting the lowest ~ 2 km of the retrieved profiles. Currently, a significant fraction of the COSMIC profiles in the tropics do not reach the lowest 500 m from the surface. Not only does this markedly reduce the number of useful measurements, it could also lead to a sampling bias in the mean PBL heights. We examine here the cause of the profile truncation and evaluate its impact on PBL height determination.