Lucy
Halperin
Massachusetts Institute of Technology
Stephen Leroy, Atmospheric and Environmental Research (AER)
Kerri Cahoy, Massachusetts Institute of Technology
Amelia Gagnon, Massachusetts Institute of Technology
Oral
GNSS radio occultation (RO) provides extremely high vertical resolution retrievals in the marine boundary layer (MBL) but is unable by itself to distinguish between the contributions of water vapor and the “dry” atmosphere to refractivity. Interesting MBL structure generally incurs super-refraction in RO, which greatly biases retrievals of refractivity in the MBL. Retrieval techniques that combine auxiliary information with RO can constrain the retrieval of refractivity and other quantities in the MBL, especially those that use passive microwave (MW) nadir sounders. Such retrievals require colocated RO and MW soundings. In this work, we consider current RO and MW sounders such as the COSMIC-2/FORMOSAT-7 RO constellation and the Advanced Technology Microwave Sounder (ATMS) on JPSS-1/NOAA-20. Our goal is to design a satellite constellation that maximizes RO-MW colocations within the subtropics, where the marine stratocumulus to trade cumulus transition occurs, which is strongly related to cloud radiative feedbacks and equilibrium climate sensitivity.

We present an analysis of colocation spatial and temporal properties for representative radio occultation and MW atmospheric sounding satellites. We evaluate three configurations: (1) COSMIC-2 RO soundings with NOAA-20 ATMS soundings, (2) COSMIC-2 RO soundings with TROPICS MW soundings, and (3) GRAS RO soundings with AMSU-A MW soundings by Metop-C. A rotational transformation can be applied to the microwave sounding patterns to greatly reduce the computational expense of finding RO-MW colocations.

Our initial results show that only ~8% of COSMIC-2 RO soundings are colocated with NOAA-20 ATMS soundings, but all colocations are in the tropics. We anticipate better performance for COSMIC-2 RO soundings and TROPICS MW soundings, and we anticipate the best performance for the co-hosted GRAS RO soundings and AMSU-A MW soundings on Metop-C. The colocations from GRAS RO and AMSU-A MW are global in coverage. We expect that the optimal colocation sampling patterns would be obtained for co-hosted RO and MW instruments on a satellite in a low inclination orbit.
Presentation file
halperin-presentation.pdf
Download to PDF