Kuo-Nung
Wang
Jet Propulsion Laboratory
Chi Ao, Jet Propulsion Laboratory
Manuel de la Torre Juarez, Jet Propulsion Laboratory
Feiqin Xie, Texas A&M University - Corpus Christi
Oral
Global Positioning System (GPS) radio occultation (RO) is an effective technique in the lower atmosphere remote sensing because of its high vertical resolution and cloud-penetrating capability. However, extreme refractivity gradients near the top of planetary boundary layer (PBL) can cause ducting, which leads to a negative bias in RO retrieved refractivity below. In this research, we incorporate optimization framework into low altitude RO retrievals based on the assumption of linear structure inside the ducting layer to remove the bias. The near-coincident precipitable water (PW) retrievals, which are widely available from passive microwave radiometers such as AMSR-E and SSM/I over oceans and ground GPS network over land, are used as external observation constraints. Our results suggest that this new approach can drastically reduce the negative bias in reconstructed refractivity profiles, and capture the sharp gradient and height of the transition layer between the free troposphere and the boundary layer. Additional constraints are also being examined to further improve the accuracy and robustness of the reconstruction method.
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