Lower troposphere sounding with GPS occultation: challenges and progress

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Analysis of atmospheric occultation data from the GPS/MET experiment revealed that the refractivity profiles retrieved in the lower troposphere were systematically smaller than those obtained with global weather analyses. We show here that a similar bias exists in the CHAMP and SAC-C data and describe its characteristics. It has been suggested in the past that this so-called *negative N-bias* was due to a combination of atmospheric multipath, critical refraction, and receiver tracking errors. To better understand and delineate the underlying causes, we perform end-to-end simulations that incorporate full-wave signal propagation and realistic receiver tracking effects. We find that atmospheric ducting often associated with the top of the planetary boundary layer (PBL) at 1–2 km altitude can cause retrieval errors at and below the PBL even in the absence of receiver errors. Furthermore, receiver tracking based on phase-locked loop algorithms could introduce substantial errors under the low signal-to-noise ratio (SNR) conditions often encountered in the lower troposphere. The latter problem has prompted the implementation of open-loop tracking where an *a priori* atmospheric Doppler model is used to track the GPS signal. The effectiveness of open-loop tracking is evaluated based on simulations and recent open-loop occultation data from SAC-C.

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