SOUNDING THE ATMOSPHERE BY LEO-LEO OCCULTATION: A SIMULATION-RETRIEVAL SYSTEM AND PERFORMANCE ANALYSIS RESULTS

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We will discuss a complete and thorough sensitivity study of LEO-LEO intersatellite links in profiling tropospheric and stratospheric water vapor and stratospheric ozone. It is intended to form the major background for the intersatellite links technology demonstration of the ACE+ mission. In this system, the forward model is based on a distribution of crosslinks occultations like that to be obtained in the ACE+ mission. The 6-hourly analyses of the U.S. NOAA's NCEP weather forecasting "FNL" model are used to represent a "truth" atmosphere. The Microwave Propagation Model of Liebe and the Jet Propulsion Laboratory's microwave catalog are used to simulate complex refractivity in the atmosphere. The "truth" observations are then computed using the inverse of Gorbunov's (2001) canonical transform methodology, which is ideally suited to not only estimating bending (phase) but also attenuation (amplitude). At this point we superimpose systematic and random noise to simulate stability error and thermal noise (SNR) error. The inversions are done using the canonical transform of the complex scalar field to bending and attenuation, Abelian transforms to retrieve complex refractivity profiles, and a physically constrained geophysical variable retrieval scheme. The last stage of the retrieval scheme is of great interest because it utilizes the null-space method of solving the constrained least-chi-squared problem.

We will discuss what frequencies must be used to successfully eliminate clouds when profiling water vapor in the low to mid-troposphere using the 22-GHz water vapor absorption line. Clouds provide a significant challenge because the frequencies chosen for crosslinks sounding are typically done so as to maximize coverage of sensitivity to water vapor throughout the troposphere, but clouds can complicate such coverage. In addition, we will demonstrate that the diffraction effects seen in GPS occultation should play no role in the retrieval of water vapor by crosslinks because of the nature of the backpropagation/canonical transform "physical" optics schemes. Finally, we will discuss the advantages to using a physically constrained level 2 retrieval scheme—namely, that it provides a solid error analysis while preventing physically unrealistic results like convective instability, negative water vapor concentrations, etc., without the consideration of outside information/data sets.