SIMULATING THE INFLUENCE OF HORIZONTAL GRADIENTS ON RETRIEVED PROFILES FROM ATOMS OCCULTATION MEASUREMENTS — A PROMISING APPROACH FOR DATA ASSIMILATION

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The ATOMS (Active Tropospheric Ozone and Moisture Sounder) will provide information about the vertical distribution of atmospheric refractivity, volume absorption coefficients, temperature, pressure, water vapor pressure, clouds, and ozone via observations of the phase and amplitudes of LEO-LEO occultation signals at certain frequencies.

The retrieval of these products assumes that the atmosphere in the vicinity of the ray path tangent points are spherically symmetric. Since the tropospheric horizontal distribution of especially water vapor can be quite variable over relatively short distances, this assumption is far from perfect and may result in very large errors in the retrieved profiles of volume absorption coefficients and water vapor pressure. We have assessed close to worst-case errors by simulating the occultation measurements in cases where the signals propagate through a model of a weather front, including moisture.

If the retrieved profiles are compared to the corresponding model profiles following the locus of the ray tangent points, errors in volume absorption coefficients and water vapor pressure can exceed 60%. An alternative comparison involves a simple linear mapping of the two-dimensional structure in the occultation plane into a one-dimensional profile, mimicking the occultation geometry, as well as the subsequent data inversion process. The maximum difference between the retrieved profiles and such mapped profiles is about 15%. The maximum differences found in refractivity profiles are about 8% and 2%, respectively, for the two comparison approaches.

The linear mapping approach is simple and fast, and seems to be a good candidate as a forward model for future data assimilation of occultation measurements of various kinds. A simulation study assessing the statistical errors in refractivity profiles from GPS occultations, using the mapping approach and a global weather model, is currently in progress.