

CM AND MM WAVELENGTH LEO-LEO OCCULTATIONS FOR CLIMATE - THE ATOMMS PROJECT

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To address fundamental climate monitoring and process study needs, we have been developing a cm and mm wavelength satellite-to-satellite occultation instrument called the Active Temperature, Ozone and Moisture Microwave Spectrometer (ATOMMS) that will provide an unprecedented, long-term determination of the state of Earth's troposphere and middle atmosphere. This new class of active, orbiting, limb-viewing spectrometer measurement is a cross between GPS occultations and the microwave limb sounder (MLS). The ATOMMS observations will yield a quantum step in performance relative to passive observations in terms of vertical resolution, precision and accuracy of moisture, ozone, temperature and pressure measurements in both clear and cloudy conditions. Typical precisions of the ~ 200 m vertical resolution temperature, geopotential height and moisture profiles will be ~ 0.4 K, 10 m and 1-3% respectively extending from near the surface to the mesopause (ionosphere effects at mm-wavelengths are negligible). 1-3% precision ozone profiles will extend from the upper troposphere into the mesosphere. With additional signal frequencies, other trace constituents such as water isotopes, can be measured in the upper troposphere and above with similar performance. The system also measures cloud liquid water and ice content. Our analysis indicates performance in cloudy conditions will be no more than a factor of two worse than clear sky performance. With averaging, the accuracy of the temperature and pressure profiles will be one to two orders of magnitude beyond the precision of the individual profiles. The accuracy of the moisture and ozone profiles will be at least as good as the individual profile precision and may be significantly better depending on our spectroscopic knowledge. The system is self-calibrating and experiences no drift because the signal source is viewed either immediately before or after each occultation.

We envision a mission consisting of approximately two groups of six satellites in approximately counter rotating low Earth orbits, a number sufficient to provide full sampling of the diurnal cycle each orbit like COSMIC. The unique coverage and performance of this system would fill many of the critical needs defined for a global climate observing system.

We will also describe our recently funded, 3 year effort to develop a prototype ATOMMS instrument and demonstrate the first set of ATOMMS occultation measurements and retrievals using 2 high altitude aircraft.