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The looming chasm in spaceborne limb sounding observations of atmospheric composition, and some possibilities for filling it.

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Understanding and tracking of key processes affecting atmospheric ozone, and hence climate and human/ecosystem health, demand continued vertically resolved observations of atmospheric composition. Spaceborne limb sounding instruments measuring thermal emission or solar backscatter are the only means to obtain such measurements with the needed vertical resolution on a daily near-global basis. Solar (and lunar/stellar) occultation sounders making much sparser observations, though typically with better precision/resolution, provide complementary information. The past decade has arguably witnessed a "golden age" for limb and occultation observations, with, at peak, twelve instruments operating on eight different satellites. In stark contrast, only one limb sounder (measuring only ozone and aerosol) and one solar occultation sounder are currently planned for the coming decade. This bleak picture is also a notable contrast with that for nadir sounders, for which a wealth of current and planned sensors exist (including instruments in both low-Earth and geostationary orbits). The looming gap in limb observations of key species has been highlighted in multiple community reports over the years. Key science questions requiring a continued and augmented record of limb observations are articulated.

Observations from the Microwave Limb Sounder (MLS) instrument on NASA's Aura satellite have been central to many studies of the upper troposphere and lower stratosphere (UTLS), including polar ozone loss and associated phenomena, processes affecting the budgets of UTLS water vapor, the impact of pollution on clouds, and long range transport of pollution. We review potential future instruments utilizing the MLS technique. Specifically, we describe work underway to develop a simplified "continuity" instrument to extend the MLS record (and add further species), as well as a more ambitious "Scanning Microwave Limb Sounder" (SMLS) that makes measurements with 50x50 km horizontal sampling. Depending on the choice of orbit, SMLS could make multiple (as many as eight) measurements per day over selected regions. The SMLS temporal and spatial resolution would enable valuable new insights into the impact of fast processes, such as deep convection, on UTLS composition. We also introduce the "Airborne Scanning Microwave Limb Sounder" (A-SMLS) that, using SMLS technology, makes the same observations as Aura MLS over a $\sim$300 km-wide swath in the upper troposphere when flown on a high-altitude aircraft such as the NASA ER-2, WB-57 or Global Hawk. The potential utility of A-SMLS measurements to future airborne campaigns is described.