Millimeter-Wave Ozone Measurements for the Network for the Detection of Stratospheric Change

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Research Objective

The primary research objective is to initiate long-term monitoring of stratospheric ozone with a ground-based millimeter-wave spectrometer, the first of several such instruments projected to be part of the Network for the Detection of Stratospheric Change. The ultimate goal of this monitoring is twofold. First, to detect any secular trend in stratospheric ozone abundance, whether of natural or anthropogenic origin and, second, to provide "ground- truth" validation for existing and future satellite measurements of ozone. With this goal in mind, a more immediate objective is to validate the millimeter-wave measurements by tests of the instrument, internal consistency tests on the data, and most importantiy, by intercomparison with all other available ozone measurements. The validation process is expected to lead to refinements in the instrument and its operating procedures and in the data analysis. The final objective is to perform short-term scientific studies with the data, including studies of the ozone diurnal and seasonal variations, and comparison of ozone variations with changes in other geophysical parameters, notably temperature and water vapor.

Progress to Date

The instrument was permanently installed at Table Mountain Observatory in California, in June 1989. We participated there in the Stratospheric Ozone Intercomparison (STOIC) in July 1989. Our results are shown in the figure. Other elements of STOIC were two ground-based lidar instruments, three groups launching ECC balloon sondes, a series of rocketsonde launches, overpasses by the SAGE II satellite, Umkehr observations by both Dobson and Brewer spectrometers, and ground-based observations by the ATMOS instrument. Comparisons between the millimeter-wave, lidars, and two of the ECC series were performed on site by an independent coordinator and were "blind" to the experimenters. The data were released to all the experimenters at the end of the period. These preliminary results show excellent agreement among the five measurements, all of them typically falling within a total range of less than 10 percent between 20 and 40 km. Intercomparison with the rest of the STOIC data set is pending. The millimeter measurements extend up to 64 km; the only other measurements above 50 km are SAGE and the rocketsondes. Thus, comparison of these with the millimeter-wave measurements will be particularly important.

Routine observations are now ongoing; these will allow continuing intercomparisons with SAGE II and one of the lidars, which is permanently on site. The experience gained during STOIC caused us to refine our calibration procedures and identify the need for internal shielding of the millimeter receiver from radio frequency interference. Installation of this shielding is planned for the near future and should allow improvements in the instrument calibration and a higher signal-to-noise ratio, both of which will result in improved measurement precision.

Publications

None

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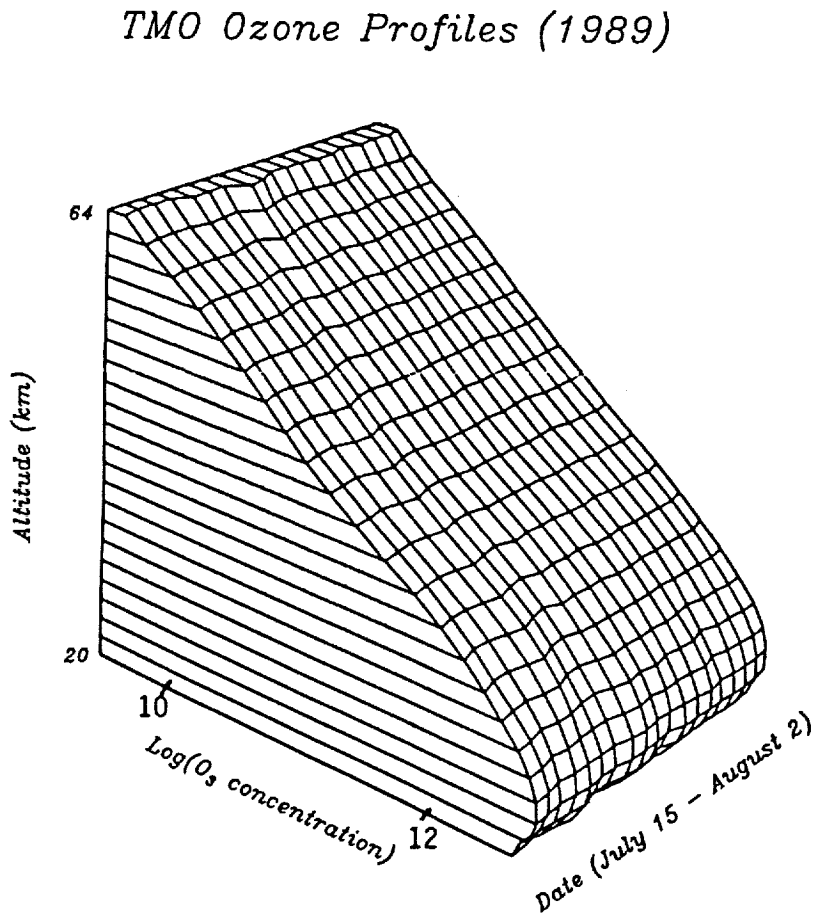

Nighttime ozone measurements during STOIC with the millimeter-wave spectrometer. Units of concentration are cm^{-3}.