28PF1

STRATOSPHERIC TEMPERATURE MEASUREMENTS INTERCOMPARISON USING LIDARS AND UARS INSTRUMENTS AT TABLE MOUNTAIN NDSC STATION

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As a part of the international Network for the Detection of Stratospheric Change (NDSC), which is made up of state-of-the-art ground based research instruments with capability to detect chemical and physical changes in the stratosphere, the mobile NASA/GSFC Stratospheric Ozone and Temperature lidar was deployed from February 15 to March 20, 1992 at JPL's Table Mountain Facility (TMF) (34.4°N, 117.7°W) in the San Gabriel Mountains, northeast of Los Angeles, California, during a UARS/NDSC Correlative Measurement and Validation Campaign. The objective of this deployment was to carry out middle atmospheric measurement of ozone, temperature, and aerosols, and to intercompare the results with the UARS borne instruments and JPL's stratospheric lidar stationed at TMF. The subject of this article is to present the results of the temperature intercomparison between the lidars and the UARS instruments. For the period starting February 19 to March 19, 1992, a total of nineteen and sixteen temperature profiles were retrieved from data acquired by the GSFC and JPL lidars, respectively. Measurements were also taken by UARS instrument: Microwave Limb Sounder (MLS), Halogen Occultation Experiment (HALOE) , Cryogenic Limb Array Etalon Spectrometer (CLAES); and by local NMC radiosondes. Temperature intercomparisons between the lidars and different UARS sensors are reported for the first time. Also, this is for the first time that two near-coincident ground-based lidars, of similar kind and ability, were deployed for temperature intercomparison and validation of the UARS borne satellite instruments under the UARS Correlative Measurement Program.

Atmospheric density and temperature measurements in the upper stratosphere and lower mesosphere (30 to 70 km), in recent years, have been primarily accomplished by using a single wavelength Rayleigh backscatter lidar. This lidar utilizes the Rayleigh scattering by atmospheric gases to precisely record the changes in the vertical density of the atmosphere, from which one can determine the pressure and temperature of the atmosphere as a function of altitude. Rayleigh lidar systems that measure temperature and density are used extensively as a part of the NDSC (Network for the Detection of Stratospheric Change) and also as a ground-truth and validation instrument for various UARS (Upper Atmosphere Research Satellite) Correlative Measurement Campaigns. Rayleigh backscatter return of laser light at 351 and 353 nm by air molecules was used by the GSFC and JPL lidars, respectively, to measure the density and then the temperature of the middle atmosphere. For lidar measurements, monochromatic laser pulses are sent vertically into the atmosphere and backscattered signals as a function of altitude are collected by the telescope. A temporal analysis of the backscattered signal provides information about the structure and composition of the atmosphere as a function of altitude. The two elastic scattering mechanisms contributing to the laser backscattering are Rayleigh and Mie scattering. Rayleigh scattering is due to particles in the atmosphere, such as molecules or fine dust, that are much smaller than the laser wavelength. Mie scattering is associated with larger particles such as aerosols whose size is of the order of the laser wavelength. For an altitude above 30-35 km , where amounts of aerosols are negligible, scattering can be considered purely Rayleigh, and then the backscattering signal becomes directly proportional to the atmospheric density. Under this condition and assuming that the atmosphere is in hydrostatic equilibrium , density measurement can be used for absolute temperature determination.

The daily average temperature profile obtained by the two near-coincident lidar will be presented and will be intercompared with the profiles obtained by different UARS instruments, such as MLS, HALOE, and CLAES. The general trend of agreement/disagreements will be discussed.