RESULTS OF A LONGER TERM NDACC MEASUREMENTS COMPARISON CAMPAIGN AT MAUNA LOA OBSERVATORY

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ABSTRACT

Between November, 2012 and January, 2015, the Goddard Space Flight Center operated a pair of lidar instruments at the NOAA facility at Mauna Loa on the Big Island of Hawaii (Lat. 19.5N, Lon. 155.5 W, Altitude 3.397 km). Measurements were made during six different four week periods during this time period by both the NASA GSFC Stratospheric Ozone Lidar (STROZ) and the Aerosol and Temperature (ATL) lidar. Also making measurements were the JPL Stratospheric Ozone Lidar and the NOAA Aerosol and Water Vapor Lidar. All instruments participate and archive data with the Network for the Detection of Atmospheric Composition Change. Measurement comparisons were made among various instruments in accordance with the standard intercomparison protocols of the NDACC.

1. INTRODUCTION

In August of 2012, the GSFC Stratospheric Ozone Lidar (STROZ) was shipped to Mauna Loa Observatory from a previous campaign at Lauder, New Zealand, for the purpose of an NDACC Measurement Validation Campaign. The STROZ Lidar makes measurements of the vertical profiles of temperature, aerosols and ozone in the stratosphere. The instrument has also been modified to make measurements of water vapor, from near the ground to the upper troposphere. This instrument was designed and built for the purpose of making such periodic comparisons of instruments making similar vertical profile measurements as part of the NDACC Validation Protocols which were established at the very beginning of the Network. These types of campaigns are extremely important to the credibility of measurements which are used for the purpose of determining the existence and the magnitude of observed or suspected trends. Goddard Space Flight Center has provided these services within NDACC since immediately prior to the official founding of NDACC (then NDSC) in 1991. Shortly after the STROZ lidar arrived and was set up at the observatory, the Aerosol and Temperature Lidar (ATL) arrived at the site from its' home base at the Goddard Space Flight Center. The AT Lidar is capable of making vertical measurements of numerous aerosol properties, including aerosol backscatter at three wavelengths (1064, 532 and 355 nm) , as well as extinction at two wavelengths (532 and 355 nm). Aerosol depolarization is recorded at 532 nm at the same time. The instrument make two separate temperature measurements, one a rotational Raman retrieval at 532 nm which measures the temperature vertical profile between .5 km above the instrument to about 22 km, and the second measurement is a Rayleigh/Vibrational Raman measurement between about 12 and 80 km above sea level. The instrument also uses the UV Raman technique to retrieve a water vapor profile from approximately 0.2 km above the site to about 22 km above sea level. The JPL Stratospheric Ozone Lidar has very similar ozone and stratospheric temperature capabilities to the GSFC STROZ lidar, and has been operated at MLO since 1992. This instrument also retrieves an aerosol backscatter profile, but does not retrieve water vapor. The NOAA Aerosol Lidar has been operating at MLO since the early 1970's, with Temperature and Water Vapor lidar measurements added subsequently. The original NOAA lidar utilized a Ruby laser (694 nm) but this was later converted to a Nd-YAG laser transmitting at 532 and 1064 nm. The NOAA

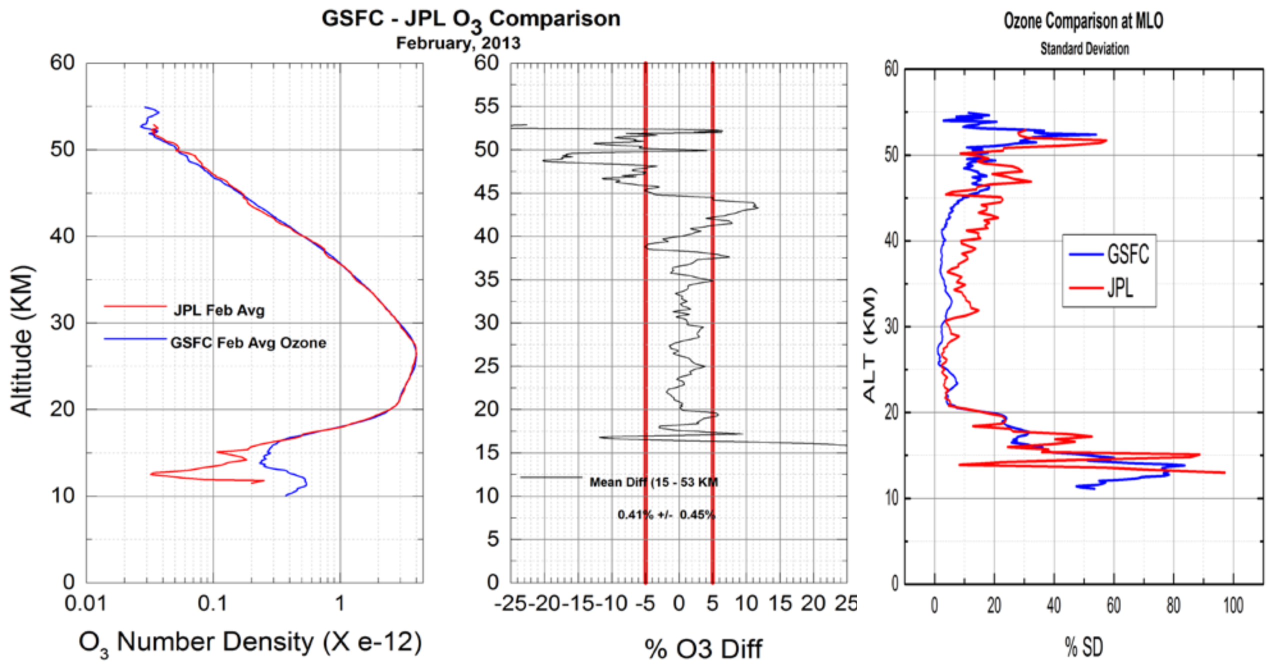

Figure 1. Results of comparisons between the GSFC and the JPL ozone measurements during February, 2013. There were a total of six coincident measurements during that period, largely because of weather.

MLO aerosol data record is one of the longest records in the world. The primary purpose for the Goddard AT lidar being at MLO for this extended period was to determine the added benefits that the AT lidar measurements could provide to the lengthy aerosol data record at MLO.

3. RESULTS

Measurements by the GSFC lidar instruments began in November of 2012. Early in this campaign the YAG laser within the STROZ instrument failed and parts from the AT Lidar YAG laser were shifted to the STROZ YAG laser so that an ozone intercomparison could begin. The AT YAG was repaired after the November measurement period. The poster being described will largely present data from the Ozone comparisons between the JPL Ozone lidar and the STROZ, although temperature and water vapor results will also be presented. In all there were approximately 45 coincident ozone profile measurements made by the two lidar systems. Figure 1. Below shows the results of one such period, February, 2013.

There were six coincident measurements between the JPL and GSFC instruments and the overall results are presented in the figure. Between about 16 km (where the tropopause is located) and 45 km (where signal to noise ratio is getting small) the agreement is shown to be within +/- 5%, generally considered very good. Below the tropopause, the ozone concentration is small and absorption at the wavelengths used (308, 355 nm) is insufficient for an accurate measurement.

The poster will present data from all of the periods measurements were made, and will also include comparisons between the NOAA water vapor and the GSFC water vapor from both the STROZ and AT lidars, as well as temperature measurements from the JPL and GSFC lidars.