File Revision Date:
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Data Set Description:

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Instrument:	Lidar
Site(s):	Mauna Loa Observatory
Measurement Quantities:	Aerosol Backscatter (532 nm, 1064 nm), water vapor and Temperature

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Reference Articles:

Determination of Aerosol Height Distributions by Lidar, F.G. Fernald, B.M. Herman, and J.A. Reagan, Journal of Applied Meteorology, Vol. 11, April, 1972.

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Correction for nonlinear photon-counting effects in lidar systems, D.P. Donovan, J.A. Whiteway, and A.I. Carswell, Applies Optics, Vol. 32, No. 33, November, 1993.

Barnes, J. E., and D. J. Hofmann, Lidar measurements of stratospheric aerosol over Mauna Loa Observatory, Geophys. Res. Lett., 24, 1923-1926, 1997.

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David Hofmann, John Barnes, Michael O'Neill, Michael Trudeau, and Ryan Neely, Increase in background stratospheric aerosol observed with lidar at Mauna Loa Observatory and Boulder, Colorado, Geophys. Res. Lett., 36, doi:10.1029/2009GL039008, 2009.

Stefanie Kremser, et. al, Stratospheric aerosol-observations processes, and impact on climate (2016), Rev. Geophysics, 54,10.1002/2015RG000511.

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Instrument Description:

The lidar is based on a Spectra Physics GCR-6 Nd:YAG laser (30 Hz, 40 Watt)with frequency doubling and tripling (1064, 532, 355 nm) although the 355 nm has not been used routinely. One 61 cm telescope is dedicated to 532 nm measurements, one 61 cm to the 1064 nm and a 74 cm to Raman nitrogen (607 nm) and water vapor (660 nm). Photomultiplier tubes are used in the photon counting mode for all channels. The system uses a PC 80486 and the data acquisition electronics are MSC II boards made by Tennelec. Measurements are made during the night, usually once a week.

Algorithm Description:

The calculation is a single pass calculation (Fernald et al, 1972) which uses a reference altitude range (no aerosol) between 38 and 40 km. This entire range is forced to an average aerosol backscatter of zero, with the altitude bins weighted by signal error. The atmospheric density comes from the Hilo, Hawaii National Weather Service radiosondes and the MAP 85 model interpolated in time from monthly averages above the radiosonde.

In 2012 the analysis was modified include a better interpolation of atmospheric density between the radiosonde and the MAP85 model. The change was slight but effected the very low aerosol loading during background conditions, especially in the winter. The decrease of winter values reduced the annual cycle published in Barnes and Hofmann, 2001. The database has been reanalyzed with the new interpolation method.

Expected Precision/Accuracy of Instrument:

The error in the backscatter ratio is contained in the data file at eachaltitude. THe typical error is about 5% for the integrated aerosol stratospheric backscatter. This error (Russell et al, 1979) accounts for the signal error both at the altitude being calculated and the reference altitude, and the error resulting from the transmission calculation. The aerosol measurement has been intercompared with the Ruby lidar, also operated by NOAA/Mauna Loa Observatory, and with the NASA/LITE instrument. The temperature measurement has been intercompared with three other lidars during the MLO3 campaign in August, 1995. Further aerosol and water vapor comparisons have been made with the NASA/Goddard mobile NDACC lidar.

Instrument History:

Aerosol backscatter was first measured in April, 1994 and has continued tothe present. Temperature measurements started in June, 1994. Routine water vapor measurements started in October, 2005. Measurements are usually made weekly, more often during intensive campaigns.