

Aerosol Lidar Validation Experiment

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General Description:

We will perform the simultaneous validation of aerosol extinction profiles obtained from a Raman and a Micro Pulse Lidar using the NASA Ames Airborne Tracking 14-channel Sun photometer (AATS-14). The extinction profiles obtained from AATS-14 flown aboard a profiling aircraft are increasingly viewed as a standard to which other methods are compared.

The two lidars are part of the DOE Southern Great Plains (SGP) ARM Climate Research Facility (ACRF) in Oklahoma. An initial validation of both lidars with AATS-14 has been performed during the recent ARM Aerosol Intensive Operations Period (AIOP, May 2003).

The ACRF Raman Lidar started to operate at the SGP site in April 1997 as a turnkey, automated system for unattended, around-the-clock profiling of water vapor and aerosols with the goal of producing a 10-year climate data record. The AIOP validation results revealed that an unnoticed loss of sensitivity of the Raman lidar had occurred leading up to AIOP resulting in a significant high bias in derived aerosol extinction (54% with respect to AATS-14).

However, major modifications made to the Raman lidar in 2004 (after AIOP) have dramatically improved the system's sensitivity. Further validation of ACRF Raman Lidar is therefore crucial to test the integrity of the entire Raman lidar aerosol extinction record. The hypothesis to be tested is that for the periods not affected by lower sensitivity the ACRF Raman Lidar can measure aerosol extinction profiles at 355 nm with systematic uncertainties not exceeding the range of 15-20%, or 0.025 km⁻¹, whichever is larger. In addition to the Raman Lidar at SGP, ARM uses Micro-Pulse Lidars (MPL) at all of its ACRFs including the ARM Mobile Facility. ARM has only very recently developed algorithms to retrieve aerosol extinction from its MPLs. The B-version of the retrieval has been validated using data from AIOP. The ARM SGP MPL was found to have a high bias of 24% (with respect to AATS-14). Further validation with a larger data set is highly desirable.

During the Lidar Validation IOP, AATS-14 will obtain extinction vertical profiles aboard the Sky Research Jetstream 31 aircraft during spiral ascents and descents over the SGP ACRF (~20 flight hours, profiles 300 - 23'000 ft altitude).

The NASA Research Scanning Polarimeter (RSP) will be operated as a piggy-back instrument aboard the Jetstream. The RSP will provide multi-spectral measurements of the upwelling polarization and radiance.

Added benefit can be obtained by coordinating the proposed validation flights with the ARM In-situ Aerosol Profile (IAP) aircraft (as done in the 2003 Aerosol IOP). These measurements would help evaluate the IAP measurements after the IAP instruments are moved to a new aircraft.

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