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# ELITE-94

## *The European 'LITE' Correlative Measurement Campaign*

### Final Results
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# ESA-LITE
# COMPARING UNIVERSITY OF L'AQUILA AEROSOL LIDAR MEASUREMENTS WITH LITE DATA.

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**Introduction**
During the NASA Lidar In-Space Technology Experiment (LITE) on the Space Shuttle in September 1994, the lidar Station of University of L'Aquila (SLAQ) was able to collect data in connection with two overpasses of LITE on September 11, 1994. We present these results within the stratospheric sounding activities of the SLAQ lidar systems.

**SLAQ lidar systems.**
The SLAQ (42.35N, 13.33E and 700 m asl) includes two lidar systems (an aerosol lidar and an ozone DIAL, DIfferential Absorption Lidar) and balloon sounding facilities for the *in situ* measurement of pressure, temperature, umidity and ozone density profiles.
The aerosol lidar uses a Nd-YAG laser from Continum (NY 80) which emits laser pulses at 532nm with energy ≅ 400 mJ and width ≅ 10 nsec (before March 1993 the emitter was a Dye colorant laser emitting 589 nm laser pulses). The laser beam is expanded by a factor of 3 before being transmitted into the stratosphere, then the divergence is reduced to about 0.2 mrad. A 0.5 m diameter Cassegrain telescope with a focal ratio of f/5 is used as receiver; a field stop followed by a mechanical chopper and a field lens provide the needed shape of the optical beam for the photomultiplier (Thorn EMI 9858A) and the following *counting mode* electronic chain. The altitude resolution is about 0.3 km, and the overall accurancy for the measurement of the aerosol backscattering ratio profile ranges between 5 % and 10 %, in the altitude region between 10 km and 40 km (D'Altorio et al, 1993a).
A pulsed excimer laser from Lambda Physik (EMG 150 MCS) working in *two-color* mode constitutes the emitting part of the ozone DIAL system. The two cavities of the laser are filled up with two gas mixtures, i.e., XeF and XeCl, originating simultaneous laser pulses at 351 nm and 308 nm respectively, with energy ≅ 70-80 mJ and width ≅ 10 nsec. The detection chain is constituted by 1 m diameter Cassegrain telescope, a mechanical chopper, a field lens coupled to a series of long-wavelength-pass beam splitters and interference filters which separate the component wavelengths simultaneously received. The separated signals are recovered by two photomultipliers (Thorn EMI 9804QB) used in *counting-mode.* The ozone density profile can be measured with an accuracy between 10 % and 30 %, over the altitude region from 15 km to 45 km with 0.3 km resolution (D'Altorio et al., 1993b).

**SLAQ performance evaluations.**
To evaluate the quality of SLAQ lidar data it has participated in a number of intercomparisons and calibration campaign.

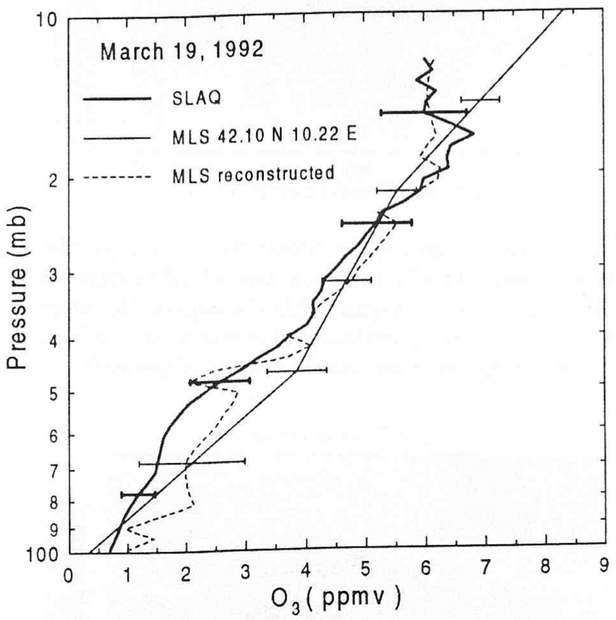


**Figure 1.** *An example of the comparison and calibration between the SLAQ and UARS-MLS ozone profiles during March 19, 1992 overpass event. The latitude and longitude of the MLS sounding is indicated in the figure.*

An example of the SLAQ ozone DIAL performances during the UARS (Upper Atmosphere Research Satellite) intercomparison and calibration campaign is shown in Figure 1. This figure compares the SLAQ ozone density profile with the MLS (Mircrowave Limb Sounder) measurements, and shows a reasonable agreement which becomes better after having reconstructed the MLS data over the SLAQ site through the conservative properties of certain meteorological fields (Redaelli et al., 1994).

Both stratospheric aerosol and ozone profiles obtained simultaneously at SLAQ during the first 6 months after the Pinatubo eruption have been compared with the corresponding nearby Stratospheric Aerosol and Gas Experiment (SAGE) II profiles; the agreement between the two data sets have been found to be reasonably good (Yue et al., 1995).
From July 1991 and September 1994 the ozone DIAL system has been routinely operated, on the other hand the aerosol profile data set stopped in March 1993 due to an irreversible failure of the laser, and the old Dye colorant laser (589 nm) was replaced with a new Nd-YAG laser. As examples of the long-term measurements provided by the SLAQ systems, Figure 2 and Figure 3 show the time evolution of the aerosol backscattering ratio and ozone density profiles along a period which also covers the fate of the stratospheric aerosol loading induced by the Pinatubo eruption (June 1991).

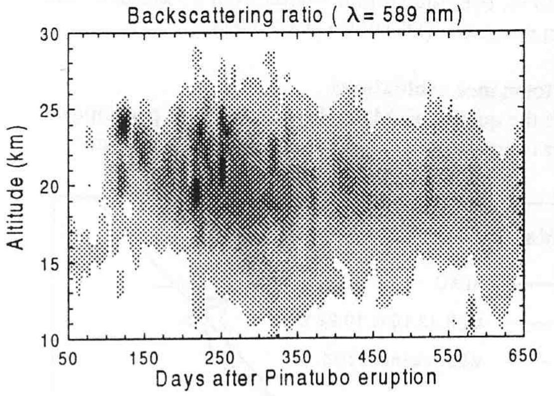


**Figure 2.** *Time evolution of the backscattering ratio profiles at 589nm wavelength. The time scale starts 50 days after the Pinatubo eruption (early August 1991) and stops on December 1992; the grid has been obtained with a resolution of 5 days and 0.5 km for the time scale and the altitudes respectively.*

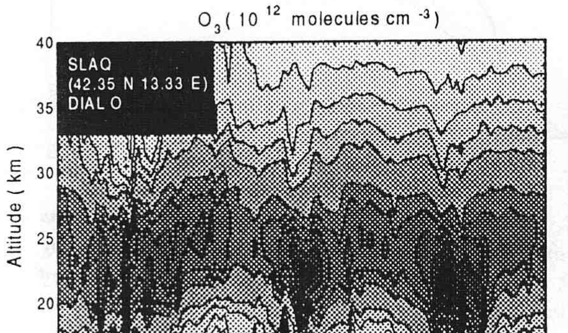


**Figure 3.** *Time evolution of the SLAQ ozone number density profiles between 15 km and 40 km from August 1991 and September 1994. The grid has the same resolution of Figure 2.*

The SLAQ multi-wavelngth lidar observations provide some additional information about the Pinatubo aerosol properties and allow to retrieve the ozone density profiles after having estimated the aerosol optical interference in the DIAL technique (D'Altorio et al., 1993a,b).

**SLAQ measurements during LITE.**

SLAQ systems were able to collect data on September 11, 1994 from 19:00 GMT to 24:00 GMT, then there was a full overlap with the orbit 33 and 34 of LITE.
The lidar data have been averaged over the whole period, and they are compared with LITE data of the two coinciding orbits in Figure 4.

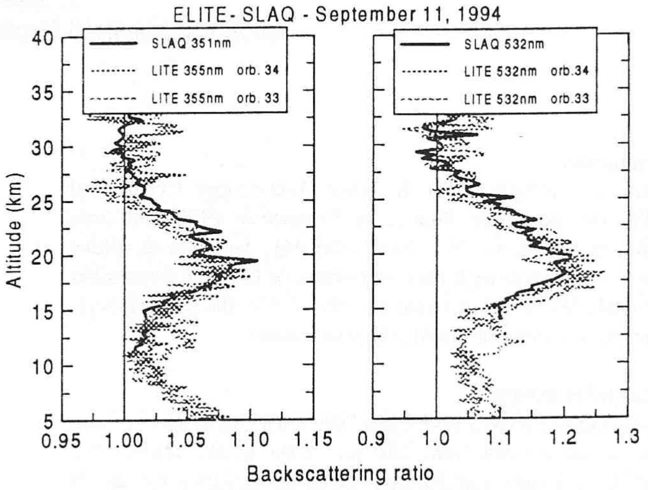


**Figure 4.** *The comparison between the SLAQ averaged (from 19:00 GMT to 24:00 GMT) backscattering ratio (351 nm and 532nm) with those observed by LITE (355 nm and 532 nm) during the orbit 33 and orbit 34: the Space Shuttle groundtracks pass within 1000 km of SLAQ site.*

The agreement between the profiles is encouraging both in UV and visible range, although the UV wavelength available at SLAQ (351 nm) is slightly different from the LITE one (355 nm), and SLAQ 532 nm profile was obtained only above 15 km. The LITE groundtracks of the orbit 33 and orbit 34 are quite apart from SLAQ site (anyway within 1000 km), then some discrepancies between local and LITE observations could survive in the lower part of the stratosphere (between 10 km and 14 km), where the regimes of the dynamics should be more variable.

**Acknowledgments.**

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