BUBBLE: Backscatter Lidar for Planetary Boundary Layer studies

The objectives of the lidar measurements in BUBBLE is the detection of the relative variation of the atmospheric aerosol vertical profile in the Planetary Boundary Layer and the troposphere. From the lidar signal we may asses the Aerosol Mixed Layer height (AML height) in the PBL, the aerosol layers and clouds in the lower troposphere.

The lidar is realised in Observatory f Neuchâtel. It is single-wavelength backscatter-depolarisation. The operational wavelength is 532nm (2^{nd} harmonic of the Nd:YAG laser). The backscatter signal is measured separately in two polarisations, where one is parallel to the polarisation of the transmitted laser beam (referred as 'p' polarisation) and the other is perpendicular to it (referred as 's' polarisation). This makes it possible to identify ice-particles in optically thin clouds, as example, cirrus. The full overlap starts at about 180m. The lidar is automatic with a possibility for a remote control and the data down-loading via Internet.
The performances of the lidar subsystems are given in Table 1.

Table 1. Performances of the lidar subsystems

Laser	Wavelength	532 nm
	Average Output power	18-20 mW
	Polarisation	Linear
	Beam divergence	0.25 mrad full angle
	Pulse duration	<1 ns
	Pulse repetition rate (prr)	5-6 kHz
Receiver	Telescope type	Newtonian
	Effective aperture	100 mm ∅
	Field of view	0.5 mrad full angle
	Range of full overlap	180m
Detection and data acquisition	Detection type	Photon counting, two independent channels ('p' and 's' polarisations)
	Detectors	PMT
	Range resolution	10 m
	Technical Detection range	till approx 19km
	Number of laser pulses for a single measurement	Adjustable, 100-2'000'000 pulses
	Interface to the PC for operational control	Serial RS232

The lidar is automatic, i.e., the operation starts after switching-on. The operation control and the data down-loading is remotely controlled via Internet connection of the PC controlling the operation. In the frame of BUBBLE the lidar operated in Basel

For its operation in Basel the lidar was installed on the balcony in the 5^{th} floor of the Institute of Meteorology, Climatology and Remote Sensing of the University of Basel. A view of the instrument configuration during BUBBLE is shown in Fig. 1. The lidar was transported from ON and operated in a mechanical protection box (the green box in front of the white cabinet). The white cabinet is the environmental protection housing. The cabinet has an window on its tilted

roof, protected by the rectangular baffle. In the cabinet there are also temperature control, air-conditioning and (optional) a place for the PC necessary to control the lidar operational. During BUBBLE, this PC was not in the cabinet but in one of the offices of the Institute.

Figures 2 and 3 present examples of measurements for the periods as follows: 13h–24h UTC on 26 June 2002 in Fig. 2 and 00h-24h UTC on 27 June 2002 in Fig. 3. This presentation is a 'time-height cross-section', where the horizontal axis shows the time of measurements and the vertical axis show the altitude. The range, background and laser power corrected lidar signal with 'p' - polarisation is presented by colour areas in relative units. The time resolution is 6min and the altitude resolution is 40m. The time-height cross section for these days shows a lidar signal variation which may be clearly associated to the successive stages of PBL diurnal cycle development. The black areas in Fig. 3, respective for very high signal, indicate clouds (starting approximately from 12h) and rain (around 16h-19h), what is confirmed also by surface observations. The marks 'x' indicate the altitude of the AML top determined from the log-derivative of the lidar signal.

Fig. 1. View of the lidar on the 5th floor balcony of the Institute of Meteorology, Climatology and Remote Sensing in Basel. The lidar itself is in the green box (protection and transportation). For long-term operation the lidar was installed in the white cabinet.

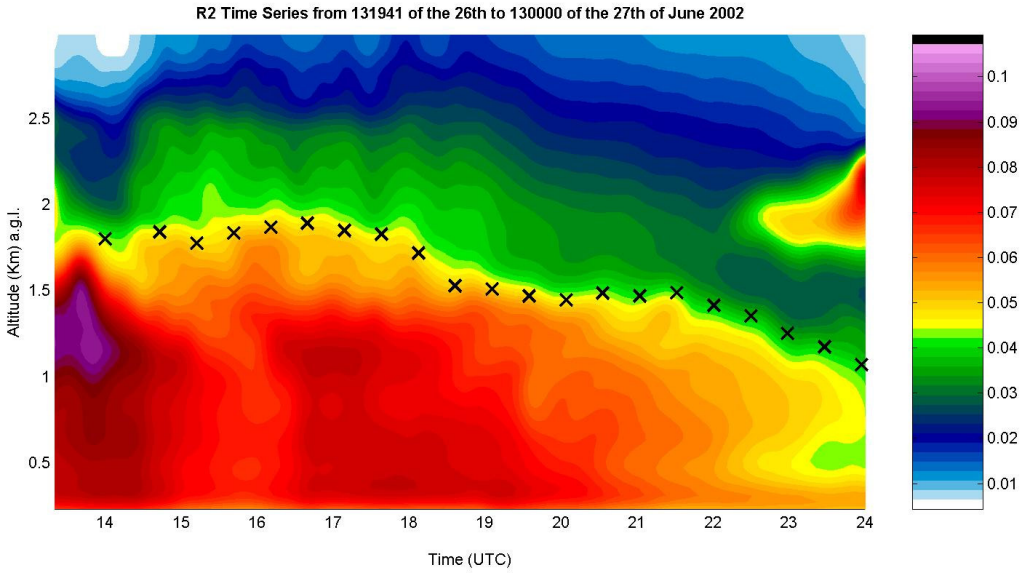

Fig. 2. Time-height cross-section of the range-corrected lidar signal during 26 June 2002 (project BUBBLE, measurements in Basel-city center); the superimposed marks 'x' show the height of Aerosol Mixed Layer (AML) determined from the gradient (log-derivative) of the lidar signal.

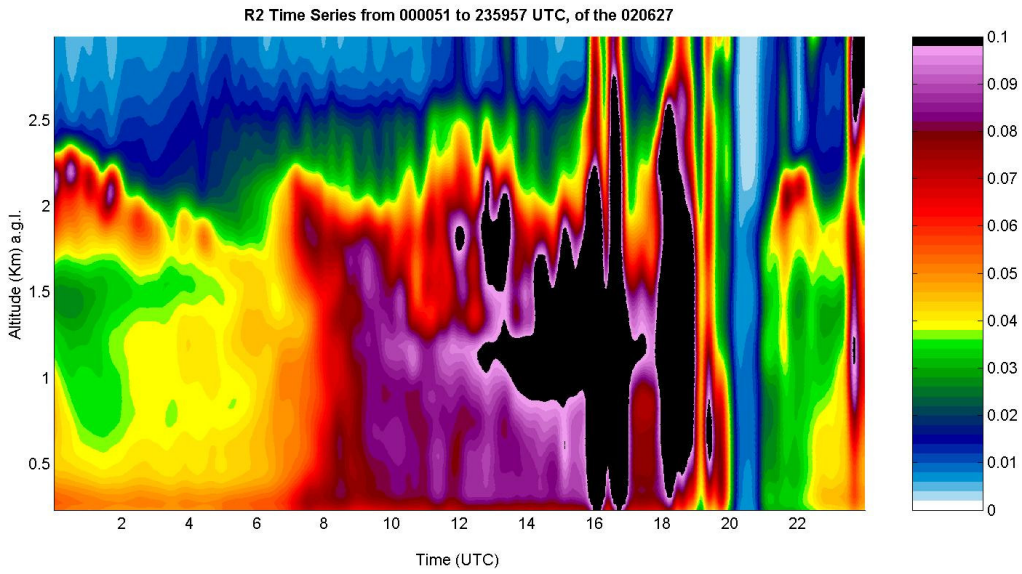

Fig. 3. Time-height cross-section of the range-corrected lidar signal during 27 June 2002 (project BUBBLE, measurements in Basel-city center).