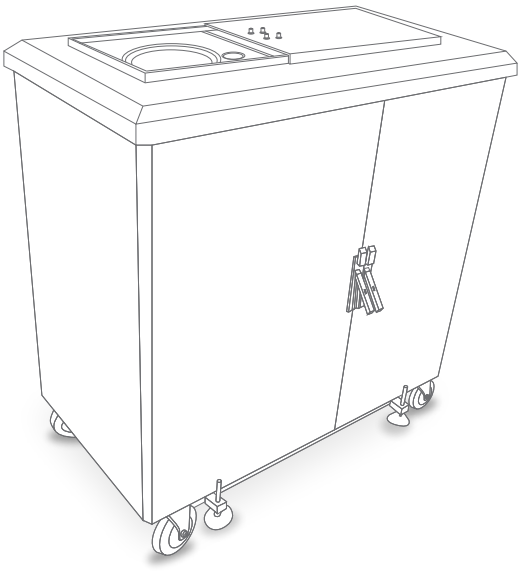
raymetrics
lidar systems

Aerosol LIDAR

Meteorology | Aviation

LR111-D300



LR111-D300

Raman Depolarization LIDAR

Introduction

The LR111-D300 model LIDAR is an active laser remote sensing instrument designed to provide a wealth of information about the atmosphere, including aerosol loading, PBL mixing height, definitive identification of volcanic ash and ash layer heights. The system can also be upgraded to detect water vapour, allowing for remote humidity profiling (night only). Designed for meteorological and aviation applications, the specifications have been determined according to Met Office (UK) and EARLINET (European LIDAR Network) requirements, making the LR111-D300 probably the most powerful eye-safe Aerosol LIDAR available commercially.

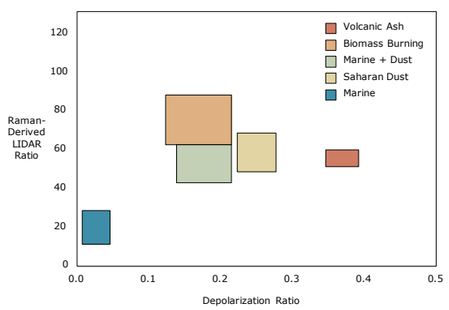
Applications

- *PBL structure/mixing height*
- *Weather model forecast validation*
- *Air quality/pollution model remote data*
- *Volcanic ash/smoke/dust identification*
- *Volcanic ash layer altitudes*
- *Humidity profiling (upgrade - night only)*
- *Cloud/precipitation measurement*
- *Aerosol loading/layering*
- *Optical depth (vertical visibility)*

How do LIDARs Work?

The LIDAR emits an eye-safe laser beam into the atmosphere. The light is scattered by particles and some is "backscattered" to a telescope. From the time the light takes to return, the distance to aerosol layers can be determined.

Particle distinction can be achieved by plotting the depolarization ratio against the Raman-derived LIDAR ratio (see graph below).



Left: Adapted from Groß et al, 2012

Key Features

- Laser emitting ~50 mJ per pulse at 355 nm (high energy)
- Large 300 mm telescope designed specifically for LIDARs
- Range at 355 nm > 14 km at night, > 12 km during day*
- Range at 355 nm cross-polar > 12 km at night, > 11 km during day*
- Range at 387 nm (Raman) > 12 km at night, > 3 km during day*
- Remotely controllable - up to 3 - 4 months unattended
- Robust, weatherproof, double-walled enclosure with climate control
- Rain sensor with automatically closing hatch to protect windows
- UPS with safe shutdown and automatic restart after power outage
- Blowers for windows, temp. and humidity sensors, external camera
- Complete software suite including real-time display
- Compliant with all EARLINET (European LIDAR Network) requirements
- Eye-safe according to EU standard on laser safety 60825-1: 2007

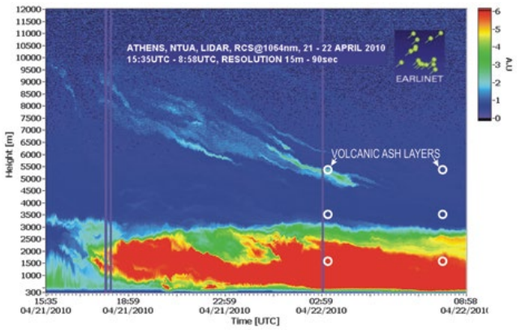
** with excellent Signal to Noise Ratio (SNR) >10*

Why a LIDAR?

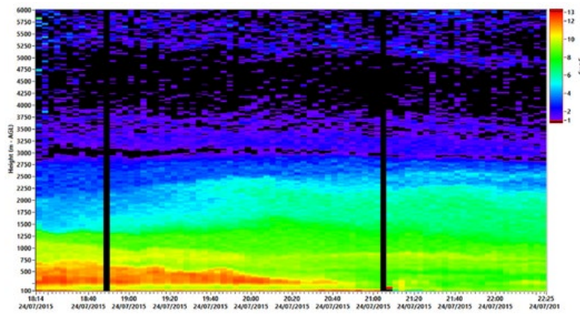
The Planetary Boundary Layer (PBL) is important for everything from climate to air quality studies. LIDARs with high spatial and temporal resolution can monitor the PBL using aerosols as tracers. The distribution of aerosols inside the PBL plays a crucial role in accurate modeling of air quality and estimation of the Air Quality Index. LIDARs may also improve forecasting of the PBL mixing height and air pollutant dispersion.

LIDARs can be used to validate numerical weather forecast models - a new field in LIDAR - such as COSMO (COnsortium for Small-scale MOdelling) or the Weather Research Forecasting model (WRF). LIDARs are also able to discriminate particle types including volcanic ash, dust, anthropogenic pollution, fire smoke and marine particles, as well as providing altitudes of the layers.

Through the use of ceilometers, the LIDAR technique has become a standard throughout the meteorology and aviation sectors. Now however there is a need for higher quality data, increased capabilities and greater range, which only LIDARs can provide.



Volcanic ash detected from the 2010 Eyjafjallajökull eruption using a Raymetrics LIDAR in EARLINET (data courtesy of NTUA)



Remote humidity profiling using an upgraded Raymetrics LR111-D300 LIDAR (Note: Humidity measurement from sunset-sunrise only due to sunlight masking signal)

Effective Range

IMPORTANT: Values are with Signal to Noise Ratio (SNR) > 10

355nm Co-Polar		355nm Cross-Polar		387nm Nitrogen Raman	
• Night:	> 14 km	• Night:	> 12 km	• Night:	> 12 km
• Day:	> 12 km	• Day:	> 11 km	• Day:	> 3 km

Why Raymetrics?

- EXPERIENCE: Raymetrics is probably the most experienced atmospheric LIDAR company in the world, with Raman Depolarization LIDARs on sale since 2004 and backscatter LIDARs since 2002.
- GLOBAL BRAND: We have sold instruments all over the world, including in Europe, North America, China, India, Africa, South East Asia, and South America.
- REASSURANCE: Our client list includes such prestigious organizations as the German Weather Service (DWD), European Space Agency, National Environment Agency (Singapore), German Aerospace Centre (DLR), Dirección Meteorológica de Chile and many more including networks of LIDARs in Italy (ISAC), South Korea (CATER - KMA) and the United Kingdom (Met Office).
- COMPLETE SOLUTION: All required hardware and software is provided to run the LIDAR, including the capability to network systems for remote operation and automated measuring.
- POWER: Raymetrics uses lasers with higher energies per pulse than most other manufacturers.
  Note: LIDARs work by plotting every individual pulse - meaning energy per pulse is of the highest importance. Data quality can be improved by stacking multiple profiles together, but this does not greatly improve range. Raymetrics offers some of the highest energy-per-pulse eye-safe lasers on the market.
- SIZE: Raymetrics also uses telescopes which are larger than most other manufacturers' in order to capture more signal.
  Note: Raymetrics telescopes are custom-designed with the focal point inside the telescope, allowing obscuration from the secondary mirror to be greatly reduced, resulting in up to 40% more signal compared with off-the-shelf telescopes.
- STANDARDS: Raymetrics LIDARs comply with EARLINET requirements - international authority on LIDAR.

Specifications

EMITTER	
Laser energy	50mJ per pulse at 355 nm
Repetition rate	20 Hz
Beam Expansion	X5
Eye-safe	YES (EU standard on laser safety EN 60825-1: 2007)
Laser Class	IV
RECEIVER	
Size (primary mirror)	300 mm
Field of view (FOV)	0.25 - 3 mrad (user adjustable)
Overlap	< 250 m (with factory set FOV)
DETECTION UNIT	
Wavelengths detected	355 nm co-polar 355 nm cross-polar 387 nm nitrogen Raman 408 nm water vapour Raman (upgrade - night only)
Spatial resolution	7.5 m
Temporal resolution	1 sec single shot 10 secs multiple acquisition mode (user selectable upwards)
FWHM bandwidth	Approx. 0.5 nm per wavelength
Detection modes	Analogue and photon counting for near and far field measurement
GENERAL	
Internal PC	Industrial grade PC running Windows
Software	Full suite of software supplied
Automation	Remotely operable with measurement scheduling for automation
Enclosure	Double-walled aluminium alloy for better heat regulation and for weatherproofing
Warranty	1 year as standard
Training	3 day installation and training course on-site as standard
Extras	Rain sensor + automatically closing hatch UPS + automatic re-start after power loss
Upgrades	200 mm or 400 mm telescope options 30 mJ or 90 mJ laser energy options (90 not eye-safe) Options for additional wavelengths including water vapour
ADDITIONAL	
Effective Range	> 14 km (night), > 12 km (day) at 355 nm co-polar > 12 km (night), > 11 km (day) at 355 nm cross-polar > 12 km (night), > 3 km (day) at 387 nm nitrogen Raman Values measured with Signal to Noise Ratio (SNR) > 10*
Environmental tolerance	-20 to +45 °C
Dimensions	1.6 m x 1.2 m x 0.8 m (HxWxD)
Weight	Approx. 250 kg
Power	110 - 240 V, 50 - 60 Hz (standard domestic power supply). Consumption 0.2 / 0.8 / 2.5 kW (idle / measuring / measuring + climate control). Peak current 25 Amps.

**Effective ranges depend on atmospheric conditions and integration times. Values provided were observed in factory in general conditions with Signal to Noise Ratio (SNR) >10.*

References:
Groß S., Freudenthaler V., Wiegner M., Gasteiger J., Geiß A., Schnell F., Dual-wavelength linear depolarization ratio of volcanic aerosols: LIDAR measurements of the Eyjafjallajökull plume over Maisach, Germany. Atmospheric Environment 48 (2012) 85e96.

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