Kipp & Zonen - Distributor of LIDAR Systems

LIDAR - Light Detection And Ranging, the optical equivalent of RADAR

Figure 1. LB-Series backscatter LIDAR

LIDAR is the acronym for Light Detection And Ranging and is the optical equivalent of RADAR. It is an active remote sensing technique for monitoring atmospheric processes and properties. Laser pulses are transmitted into the atmosphere and a proportion of the energy is reflected and scattered back by molecules and aerosols in the atmosphere to the receiving telescope, which collects the radiation and focuses it onto a sensitive detector. The time delay between the transmitted pulse and any part of the return signal is equivalent to the range.

Kipp & Zonen is the exclusive world-wide distributor of LIDAR systems designed and manufactured by Raymetrics SA of Athens, Greece. Years of research and co-operation within international campaigns has resulted in the design of compact, portable, turn-key and cost-effective systems designed for continuous outdoor operation. Thanks to the innovative modular construction and specially developed software; LIDAR technology is now available to everyone.

A key advantage of the technique is the ability to provide ranging (distance) information and to derive profiles. Typical applications include the study of atmospheric dynamics, aerosols, pollution development, cloud base, cloud properties, ozone and water vapour profiles. Raymetrics offers a complete range of LIDAR systems to suit different measurement applications.

Cloud monitoring

Since the 1970s clouds have been the subject of intense investigation by ground-based and airborne imagers, humidity sounders, radars, radiometers, ceilometers and LIDAR systems. Clouds absorb and scatter the incoming solar radiation and emit thermal radiation according to their temperature. They determine to a large extent the variability of the radiative regime of Earth's climatic system.

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The radiation balance depends, in particular, on the cloud fraction, the shape of the clouds, their height and the morphology of the cloud boundaries. Therefore, the spatial distribution of clouds and the diurnal variation of their properties are important parameters that need to be investigated. LIDAR is an efficient tool for the continuous monitoring of clouds and aerosols in conjunction with local, regional and global climate studies. LIDARs provide long-term accurate data on cloud height, optical depth and spatial distribution and can be configured to detect microphysical properties of the cloud such as the presence of water droplets or ice crystals.

Aerosol profiling

Tropospheric aerosols arise from natural sources, such as wind-borne dust, sea spray, volcanoes, forest fires, and anthropogenic sources,

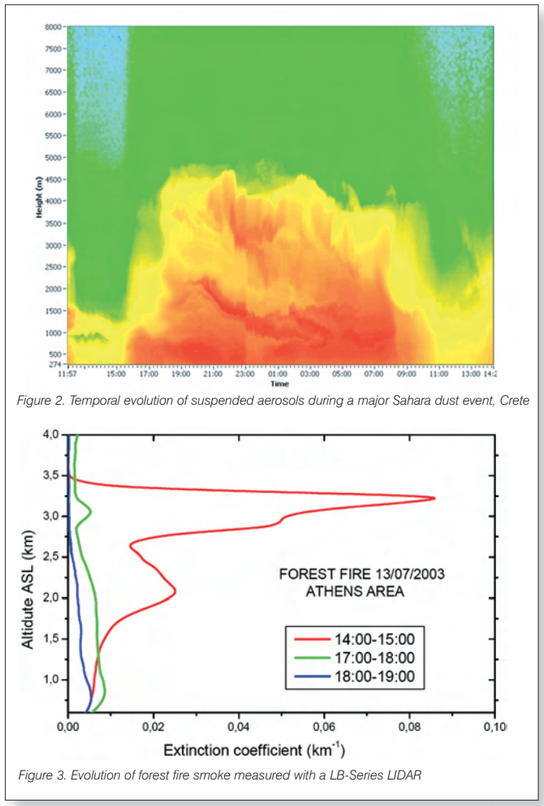

Figure 2. Temporal evolution of suspended aerosols during a major Sahara dust event, Crete

Figure 3. Evolution of forest fire smoke measured with a LB-Series LIDAR

such as the combustion of fossil fuels and biomass burning activities. Every year large quantities of dust particles are emitted into the atmosphere in desert regions of high convective activity. A large fraction of the smaller particles can be transported over very large distances (thousands of km). With spreading urbanisation and industrialisation the content of aerosols, particularly in the lower troposphere, increases continuously.

Atmospheric particles, mainly the mineral dust, influence the earth's radiation balance and climate in two ways; by scattering and absorbing both incoming and outgoing radiation, and by acting as cloud condensation nuclei (CCN). CCN determine the concentration of the initial cloud droplets, albedo, precipitation formation and life-time of warm clouds. Due to the high spatial and temporal resolution, the LIDAR technique is a powerful tool for monitoring the evolution of basic meteorological and atmospheric parameters.

Water vapour profiling

Water vapour plays a very important role in the earth's radiation budget by the absorption and emission of long-wave infrared radiation and it indirectly has an effect on the formation and development of clouds.

Traditionally, water vapour profiles are obtained by means of balloon sounding (radiosondes). LIDAR measurements can provide systematic observations with high temporal and spatial resolution, with the added advantage that the measurements are not influenced by wind.

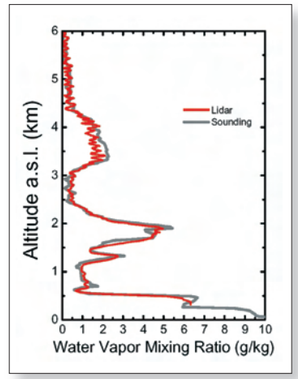

Figure 4. Water vapour mixing ration measured with a LR-Series Raman LIDAR and balloon sounding

For this application a Raman LIDAR is configured to detect the optical return signals from specific atmospheric constituents, Nitrogen and water vapour. The ratio of these signals is a measure of the 'water vapour mixing ratio' expressed in g/kg. Figure 4 shows water vapour mixing ratio measurements taken with a LR-Series Raman LIDAR at the same time as a balloon sounding.

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Scanning LIDAR system

The latest development at Raymetrics is a compact fully automated eye-safe scanning LIDAR system capable of retrieving 2D aerosol profiles of the atmosphere. The system is based on the reliable turn-key technology which Raymetrics offers for all their systems combined with tracking and positioning technology from Kipp & Zonen.
In November of this year a demonstration of the scanning LIDAR system and other remote sensing instruments from Kipp & Zonen will be organised in the centre of London. ■

More information on LIDAR systems and the forthcoming demonstration is available from Martin Veenstra. (martin.veenstra@kippzonen.com) or at www.kippzonen.com/LIDAR and www.raymetrics.gr

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