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Editorial

LIDAR Monitoring of the Atmosphere – Recent Developments

The need for better knowledge of physico-chemical processes in the atmosphere became obvious to the scientific community when the ozone hole over Antarctica was discovered in 1985 and when the crucial role of CFCs in its creation was confirmed at the end of 1987. Stratospheric ozone is an effective shield against solar UV radiation of wavelengths below 300 nm and a further decrease in ozone concentration will certainly endanger all forms of life.

Due to the high altitude of the stratosphere, aircraft- and balloon-borne probes cannot easily be employed. Therefore, remote sensing techniques are best suited for the investigation of the upper atmosphere. Ground-based LIDAR (light detection and ranging) stations have now achieved a high level of sophistication concerning stability of optical setups, power and tunability of lasers, and advanced yet fast algorithms running on workstations. The advantages of such LIDAR stations are evident: On the one hand, conventional instruments cannot compete with LIDAR's vertical range, and on the other hand, satellite remote sensing still needs further development and is very expensive.

This feature issue of Applied Physics B presents contributions concerned with recent developments of LIDAR techniques as applied in ground-based stations monitoring physical and chemical characteristics of both the troposphere and the stratosphere.

The first two contributions are concerned with the monitoring of ozone together with polar stratospheric clouds which might be of importance in the ozone depletion process. A new LIDAR system is presented that covers measurements of ozone within the troposphere and the stratosphere. Polar stratospheric clouds and stratospheric aerosols are detected by means of a four-wavelength depolarization backscattering LIDAR using wavelengths in the ultraviolet, visible and infrared. The importance of new developments in laser technology fostering progress in LIDAR techniques is also emphasized.

The three consecutive articles deal above all with meteorological parameters: moisture, aerosols, temperature, and wind fields. The first contribution treats a combined Raman elastic-backscatter LIDAR for vertical profiling of moisture, aerosols, and ice-clouds; test measurements of carbon dioxide are also described using the Raman LIDAR technique. The second contribution presents two methods for temperature monitoring: The Rayleigh LIDAR which is used for measurements up to 100 km, and the use of rotational Raman lines of oxygen and nitrogen which completes the Rayleigh LIDAR toward lower altitudes. The third contribution describes the monitoring of wind fields by a Doppler Rayleigh LIDAR covering altitudes from 25 to 60 km, where radar measurements cannot provide reliable results.

The last and only contribution in this field presents measurements of air pollutants with the differential-absorption LIDAR technique. For the first time, this technique is applied to the monitoring of toluene and other aromatic hydrocarbons by using wavelengths in the near ultraviolet. Interferences due to other pollutants are discussed.

In summary, this feature issue presents contributions on the ozone depletion processes bringing along the necessity to monitor meteorological parameters both in the stratosphere and the troposphere in order to obtain a better understanding of the physico-chemical behavior of the atmosphere. It is also recalled that the survey of air pollutants in cities and at industrial sites needs effective long range methods and that LIDAR may become a standard technique competing with hitherto introduced conventional monitoring methods.

Finally, I want to emphasize that there are other contributions that could not be included in this special issue. These will be published in one of the forthcoming issues of Applied Physics B. Further, new contributions on LIDAR are welcome and should be submitted to the editor of Applied Physics B.

I would like to thank all colleagues who contributed to this special issue and the referees from Europe and overseas for their critical reviews and encouragement. Special thanks are due to Dr. H. K. V. Lotsch enviting me as a guest editor of this feature issue on LIDAR.

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