

[http://www.eohandbook.com/eohb2012/sat\\_earth\\_obs\\_lidars.html](http://www.eohandbook.com/eohb2012/sat_earth_obs_lidars.html)

## Lidars

### Description

Lidars (Light Detection And Ranging instruments) measure the radiation that is returned either from molecules and particles in the atmosphere or from the Earth's surface when illuminated by a laser source. Compared with radar, the shorter wavelengths used in a lidar allow greater detail to be observed. On the other hand, the light cannot penetrate optically thick layers such as clouds.

There are different types of lidar instrument:

- the backscatter lidar, in which the laser beam is backscattered, reflected or re-radiated by the target, gives information on the scattering and extinction coefficients of the various atmospheric layers being probed;
- the differential absorption lidar analyses the returns from a tuneable laser at different wavelengths to determine densities of specific atmospheric constituents, as well as water vapour and temperature profiles;
- Doppler lidar measures the Doppler shift of the light backscattered from particles or molecules moving with the wind, thereby allowing the determination of wind velocity;
- the ranging and altimeter lidar provides accurate measurements of the distance from a reference height to precise locations on the Earth's surface.

The first satellite-borne ranging and altimeter lidar, ALISSA, was flown on the manned MIR station in 1996 and provided valuable information for more than a year on cloud top heights and multi-layer cloud structure. Later, the GLAS ranging and altimeter lidar was flown on the NASA ICESat mission (launched in January 2003 and completed September 2010) to study variations of ice topography, as well as cloud and atmospheric properties. Launched in April 2006, the CALIOP backscatter lidar, flying on the NASA-CNES CALIPSO platform, has completed six years of successful operations and continues measurements of cloud and aerosol properties. ESA is currently implementing two laser missions, ADM-Aeolus and EarthCARE. The ALADIN high spectral resolution Doppler wind lidar on board ADM-Aeolus will measure profiles of line-of-sight winds globally. The ATLID high spectral resolution lidar on board EarthCARE will measure cloud and aerosol optical properties.

### Current & planned instruments

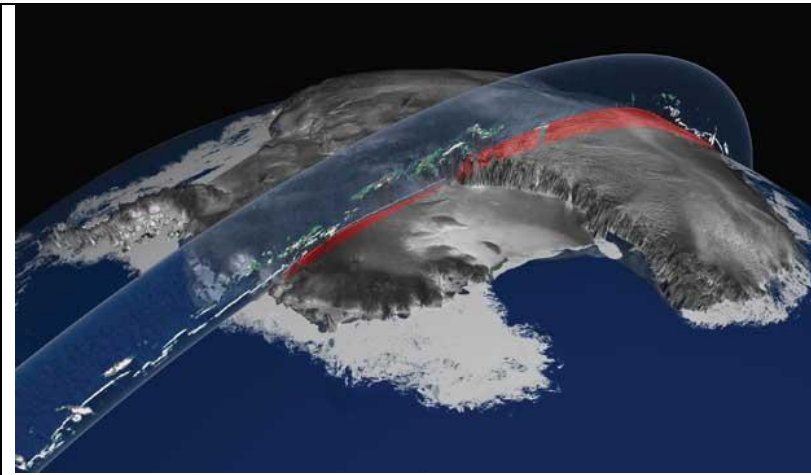
ALADIN	CO <sub>2</sub> LIDAR (ASCENDS)
ATLAS	HDWL (3D Winds)
ATLID	HSRL (ACE)
CALIOP	Laser altimeter (LIST)

### Applications

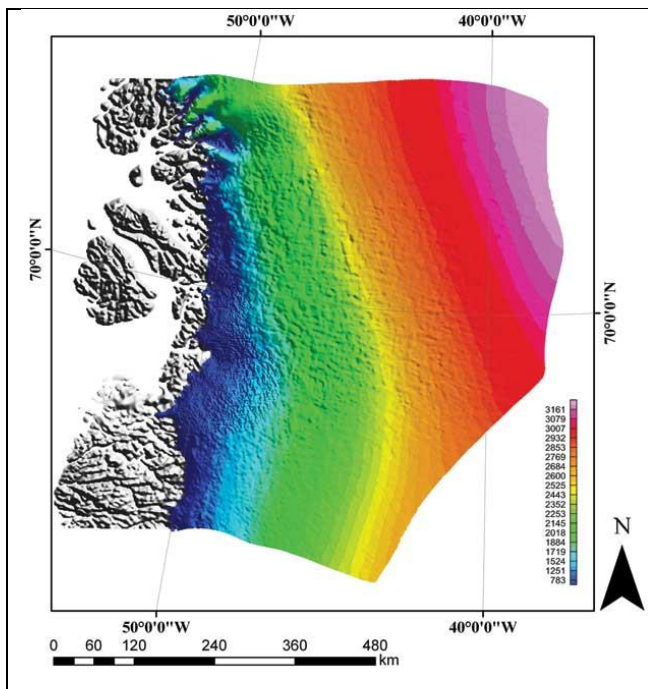
The different types of lidars may be used to measure a diverse range of parameters. Ranging and altimeter lidars may be used to provide surface topography information, for example on ice sheet height and land altitude. Missions planned within the next few years will undertake to determine the mass balance of the polar ice sheets and their contributions to global sea level change; others will focus on study of the vegetation canopy structure and provide unique data sets, including estimations of global biomass and

carbon stocks, and fractional forest cover.

Multifrequency and high spectral resolution ranging lidars with probe wavelengths in the UV, visible and near IR will be used to measure aerosol height distributions, heights of clouds and their vertical profiles. Differential absorption and backscatter lidar may be used to measure aerosol and cloud properties as well as atmospheric composition. Doppler lidars may be used to measure wind profiles in clear air (i.e. in the absence of clouds or winds above clouds) and within optically thin layers. The capability of measuring clear air winds is of particular importance since it will correct a major deficiency in wind-profiling of the current global meteorological observing systems. Instruments such as ESA's ALADIN on ADM-Aeolus will provide wind profile measurements to establish significant advances in atmospheric prediction and analysis.



ICESat swath over Antarctica.



DEM of Jakobshavn drainage basin created by fusing SPIRIT SPOT and ICESat/photoclinometry DEMs.

## Further Information

ALADIN: [www.esa.int/esaLP/LPadmaeolus.html](http://www.esa.int/esaLP/LPadmaeolus.html)

ATLID: [www.esa.int/esaLP/LPearthcare.html](http://www.esa.int/esaLP/LPearthcare.html)

GLAS: [icesat.gsfc.nasa.gov](http://icesat.gsfc.nasa.gov)

CALIPSO: [www.nasa.gov/mission\\_pages/calipso/main/](http://www.nasa.gov/mission_pages/calipso/main/)