

## **Goals and objectives of the MDS-lidar project: Scientific application**

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In this report, I tried to describe what we were aiming at in the MDS-lidar project from the view points of scientific application. As the MDS-2 satellite which will carry the ELISE is a single-mission satellite, what we are getting from its observations will be only lidar backscattering signals. Information reduction from lidar signals is a matter of future studies, but basically what we can expect is attenuation-corrected backscattering (or extinction) coefficient profiles of cloud and aerosols if we could apply an appropriate lidar equation solution like the Klett's equation.

It would be most fundamental to get climatological information on cirrus distributions, multiple layer cloud structures, and aerosol distributions. Optical thickness will be derived for some limited cases for moderate or thin clouds. Improving climate models would be very interesting application of this experiments. Sensitivity tests of climate models have shown that the difference in cloud treatments causes uncertainties of long-term predictions of surface temperature and humidity changes. Information on cloud climatology, especially for cirrus clouds which has been difficult to detect, could improve the GCM and climate model performances.

To get data from ELISE measurements which can be used for maximizing scientific achievements, it is very important to have a strategic observation plan.

**Recognizing that the MDS-lidar is the first step toward a full scale "Lidar on an Earth Observing Satellite", which should be materialized in the future,**

**Basic concepts for the Proposal of MDS-lidar from the scientific application's viewpoints are:**

- (1) In addition to technological verification, the MDS lidar must produce the maximum scientific results despite its restrictions.**
- (2) The data acquired shall be used as a reference for developing the future satellite-borne lidar system, as well as for scientific research on global warming.**
- (3) To achieve these, the vertical distribution of clouds and aerosol distribution should be measured quantitatively and globally using the MDS lidar.**

### ***Scientific Objectives of MDS lidar measurements***

**High altitude thin clouds (cirrus)**

**Multiply-layered clouds detection**

**Aerosols in the troposphere and the stratosphere**

***Research fields***

- Climatological (statistical) analysis of upper clouds and cirrus clouds
- Identification and climatological (statistical) analysis of the vertical distribution and multi-layer structure of clouds
- Identification of clouds and the radiation balance by conducting simultaneous ground-based observations
- Research on the formation process of cirrus clouds, such as validation of a formation process model, by understanding the structure of cirrus clouds
- Wide-area three-dimensional distribution of tropospheric aerosols
- Wide-area distribution of stratospheric aerosols and the atmospheric circulation

***Researches to be conducted for MDS lidar experiments***

- Algorithms for data processing to derive quantitative information from the measurement data
- Strategy for effective data acquisition under various limitations of satellite operation
- Climate modeling with use of cloud/aerosol information