

Preface

The First MDS-lidar Workshop was held at Kagetsuen Hotel, Hakone, Japan, in March 11, 1998. The MDS-lidar is one of the experimental projects which NASDA is going to conduct using an Mission Demonstration Satellite(MDS), and a space-borne lidar for measuring clouds and aerosols is planned to launch on board the MDS-2 satellite in early 2000's. The purposes of the MDS-lidar project is mainly to show the technical feasibility of key components used for a space-borne lidar and also that of a space-borne lidar itself as a system for space use.

Scientists in the Japanese lidar community have long been involved in studies on space-borne lidars and supported the NASDA's activities related to them from various points of view. Since the MDS-lidar Team was established under the Committee for Earth Observation Systems of ESTO/Forum in FY1995, the Team members have been actively involved in the studies for defining mission objectives from a scientist's side. The Team members also have recognized that the MDS-lidar project will greatly contribute to the researches related to the climate changes due to global warming through observations of global clouds and aerosols distributions. To derive the maximum benefits from the experiments, the scientists gathering in the MDS-lidar Team proposed to hold a international workshop to get scientists in the world know more about this project and make them more involved in it. The Hakone Workshop was thus convened and organized as the First MDS-lidar Workshop.

The purposes of the workshop were to get the newest information available to the scientists in the world who are interested in the MDS-lidar Project, and to discuss future scientific issues related to it to get the maximum scientific achievements from the MDS-lidar experiments even though its primary objectives is the technical demonstration. The past achievements and lessons relevant to the MDS-lidar project were also reported to get better understanding on the issues and problems we might be facing in the course of our project. Discussion on future collaboration between Japanese and foreign scientists was also intended in the workshop.

The total number of participants to the workshop was 45 including 12 from overseas. The number of participants from overseas really indicated their big interests in the MDS-lidar Project.

In the workshop, one of the main purposes was to get across the newest information on the MDS-lidar project. Therefore, more than a half of the day were spent to report the present status of the project, including the project organization, system design and specifications, data reduction algorithms studies, products definition, and validation plan. These were presented mainly by Noritaka Tanioka and other project members of NASDA/R&D Division, and Nobuo Sugimoto and Yasuhiro Sasano from NIES as the members of the MDS-lidar Team.

Some reports were made by the participants regarding data reduction algorithms, especially with consideration of multiple scattering, and regarding future possibilities of validation experiments for the MDS-lidar. A future plan of establishing a Science Team was also mentioned by Yasuhiro Sasano, which was concluded to be an issue that would need further discussion.

From the discussion we had, I believe that many of the participants showed big interests in the MDS-lidar project and indicated their hopes to be involved in this project in some way, like as a Science Team member. Therefore I feel it is very important to keep their interests and invite them to the project in an appropriate way, for example, by organizing a Science team on a firm basis and defining its activities clearly.

Following the MDS-lidar Workshop, another two-day workshop on Clouds, aerosols and radiation budget measurements and their sciences was held at the same place, to which almost all the participants to the MDS-lidar Workshop remained to join. As is reported separately, this two-day workshop was also a very active and fruitful one. So the idea of having two workshops consecutively for three days in a row was a big success.

Finally, on behalf of the MDS-lidar Team, I would like to express our sincere thanks to NASDA and ESTO/Forum that made this workshop realized. Natsuhiko Motomura, Yasuyuki Itoh, Yoshiyuki Otake, Takako Kikuchi and Ryoichi Nishiyachi, the workshop secretariats from ESTO/Forum, are greatly appreciated for their excellent work. I also thank all the participants to the workshop for their informative presentations and fruitful discussion.

Yasuhiro Sasano
Chair, MDS-lidar Team
Co-chair, Joint Program Committee

Statement by the Joint Program Committee

The representation of clouds and aerosols is one of the major sources of uncertainty in numerical models used for weather forecasting and for climate studies which aim to predict the response of the atmosphere to increased concentrations of greenhouse gases. There is an urgent need for a global data set of the vertical structure of clouds and aerosols to improve our understanding of the earth radiation budget and validate the representation of radiation in such models. Recent technological advances mean that it is now feasible, for the first time, to place active instruments such as lidar and radar in space which can provide global data on these vertical profiles. This contrasts with previous instruments which can provide only the properties of cloud top or a single path integrated parameter to represent the vertical structure. This workshop reviews the present status of such instruments, the synergy between them and the requirements and specifications for such instruments in future space missions.

Results of the first lidar to be flown in space during the LITE experiment aboard the NASA space shuttle in September 1994 are presented showing, for example, the vertical structure of the aerosol from biomass burning. The detailed specification of the NASDA future mission demonstration satellite(MDS) lidar due for launch in 2001 and the accompanying planned validation experiments are also described. Plans for an MDS cloud profiling radar to be flown by NASDA are also outlined together with plans for space-borne cloud radars and lidars by NASA and ESA together with the various ground-based radar studies of clouds presently being carried out in different parts of the world.

It became evident during the workshop that there would be enormous benefit in a future space mission which contained both a nadir pointing lidar and radar; the simultaneous data from both instruments leading to a more detailed retrieval of the vertical profile of cloud particle characteristics such as size and concentration and aerosol properties than can be achieved by each instrument separately. These observations using active sensors in addition to the previous ones involving visible, infrared and microwave sensors give many kinds of aspect of characteristics of aerosols and clouds. Measurements of these parameters on a global scale would transform our understanding of the earth radiation budget and provide data for model validation.

As for the past activities to accomplish the attractive satellite plans, there has been several meetings/workshops;

- (1) ISY(International Space Year) Workshop for TRMM follow-on mission on Nov. 1992 in Tokyo, Japan. Recommendation for space-borne CPR has been issued from GEWEX community in this Workshop.
- (2) GEWEX Workshop on the utility and feasibility of a cloud profiling radar on June, 1993 in Pasadena, USA.
- (3) GEWEX CPRT ad hoc science panel meeting on June, 1994 in Luneburg, Germany.
- (4) International Workshop on Space-borne Lidar 1995, on Oct. 1995 in Nara, Japan.
- (5) International Workshop on Space-borne Lidar 1996, Dec. 1996 in Hakone, Japan.

At those meetings, innovative and wider views of future space-borne lidars/CPRs were discussed including the MDS-lidar plan. The Hakone workshop in February this year was more focused on the MDS lidar project, which a lot of efforts had been made to realize based on the discussion in the previous workshops.

It became clear that the accomplishment of the satellite observations with combined sensors would be a key to understand the global climate change and global warming. This task of deploying a radar and lidar together in space will not be easy and it is important that the independent efforts by each space agency are undertaken with a framework of international cooperation.

Joint Program Committee for
The First Workshop on Mission Demonstration Satellite Lidar
and
Workshop on Cloud, Aerosol, and Radiation Budget Measurements
from Space and Their Sciences

Joint Program Committee

Asai, Kazuhiro	(Tohoku Institute of Technology)
Hayasaka, Tadahiro	(Tohoku University)
Illingworth, Anthony J.	(University of Reading)
Ingmann, Paul	(ESA/European Space Research and Technology Centre)
Kumagai, Hiroshi	(Communications Research Laboratory)
Nakajima, Teruyuki	(University of Tokyo)
Sasano, Yasuhiro	(National Institute for Environmental Studies)
Spinhirne, Jim	(NASA/Goddard Space Flight Center)
Takamura, Tamio	(Chiba University)
Winker, David M.	(NASA/Langley Research Center)

The First Workshop on Mission Demonstration Satellite Lidar

Agenda

11 March (Wed.), 1998

- 9:00 - 9:05 Welcome [J. Ohtao]
- 9:05 - 9:10 Introductory remarks [Y. Sasano]
- 9:10 - 9:30 Goals and objectives of the MDS-lidar project
 - "Overview of MDS-2 Project" [N. Tanioka]
 - "Scientific application" [Y. Sasano]
- 9:30 - 9:50 Project organization, status and plan
 - "Overall project organization and status" [Y. Kawamura]
 - "Establishing researchers groups and a science team" [Y. Sasano]
- 9:50 - 10:30 Hardware design and hardware development plan
 - "Hardware design and development plan of Experimental Lidar In Space Equipment (ELISE)" [K. Tatsumi, T. Imai, Y. Kawamura, N. Tanioka, T. Aoyagi and T. Takada]
- 10:30 - 10:50 Coffee break
- 10:50 - 11:10 Eye safety consideration
 - "Ocular hazard probability of MDS-LIDAR" [H. Koshiishi]
- 11:10 - 11:40 Data acquisition requirement and operation plan (strategy)
 - "Data acquisition requirement from application" [Y. Sasano]
 - "Data acquisition and operation plan" [T. Imai]
- 11:40 - 13:00 Lunch
- 13:00 - 13:40 Lessons learnt from the past experiments/projects
 - "Design and Performance of LITE" [D. Winker]
 - "Simulation of the MDS lidar from ER-2 CLS data" [J. Spinhrne]
 - "LITE Correlative Measurements and Multiple Scattering Estimates Using Airborne Lidar Systems" [E.V.Browell]

- 13:40 - 15:00 **Algorithm study and development plan**
 "Algorithm studies needed and development plan" [N. Sugimoto]
 "An Iterative Algorithm Using Near-End Boundary for Stable Lidar Inversion" [Z. Liu, N. Sugimoto, T. Kobayashi, I. Matusi, and Y. Sasano]
 "Retrieval of optical and microphysical properties of clouds from space-based lidar data [C. M. R. Platt, D. Winker, M. Vaughan and W. Hunt]
- 15:00 - 15:20 **Coffee break**
- 15:20 - 15:40 **Data processing requirement**
 "Product definition and data processing requirements" [N. Sugimoto]
- 15:40 - 16:10 **Validation requirement and plan**
 "Validation requirement and plan" [Y. Sasano]
 "Plan for lidar network observation of SPM in East Asia and validation of MDS lidar data"
 [N. Takeuchi, H. Kuze, S-C. Yoon, and H. Hu]
 "Plan of MDS lidar validation" [O. Uchino]
 "Lidar observation of aerosols and clouds in Jakarta, Indonesia"
 [N. Sugimoto]
 "CRL lidar sites for MDS lidar validation" [T. Itabe]
- 16:00 - 17:00 **Individual research reports and plans**
 "Multiple Scattering Effects on detecting multi-layered clouds with space-borne Lidar" [T. Kobayashi]
 "Trivariate Mixed Lognormal Distribution: A Statistical Model for Analyzing Cloud Data" [K. Shimizu, T. Hayasaka, N. Sugimoto, and I. Matsui]
 "Studies on Ground-Base Experiments for Verifications of a Spaceborne Lidar" [M. Abo and C. Nagasawa]
 "Research topics proposed" [Y. Sasano]
- Comments, suggestions and discussion [all the participants]**
- 17:00 - 17:30 **General discussion [Y. Sasano]**
- 17:30 - **Closing**

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