S2-2 Continuous Observation of Asian Aerosol and Cloud Features by Automated Lidar

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1. Introduction

Continuous monitoring of aerosols, especially in Asian area, is important for the prediction of global warming point of view, as well as of air pollution. The aerosol emission in the global scale is decreasing or not increasing in the 21st century except Asia, where the development of the economy is affecting the serious effect in air quality in Asia and Western Pacific. The aerosol is generated from many kinds of sources; natural and anthropogenic. Asian dust, biomass burning and urban plume are major sources of pollutant. Also the cloud behavior is very important for global budget of radiative forcing. Long term observation using lidar enables us to illustrate how aerosol and cloud varies with days, months and season. There are important in the study of aerosol transport. The conventional lidar systems can not be operated continuously because of their complicated configuration, not eye-safe and without enough robust. It is necessary to design a compact system to provide long term, unattended observation of all significant atmospheric aerosol and cloud structure with eye safety. LD pumped solid state laser was a well candidate laser source for this kind of lidar system [1]. The micro-pulse lidar (MPL) which was developed at NASA is the first lidar system with above feature [2]. MPL has been applied in some research projects such as ARM and GEAM. A MPL system was deployed at Sukhothai, Thailand since 1997. A similar and more robust system called PAL (portable automated lidar) [3] is to be developed at Chiba University and to be operated in Chiba for long term mixing layer monitoring.

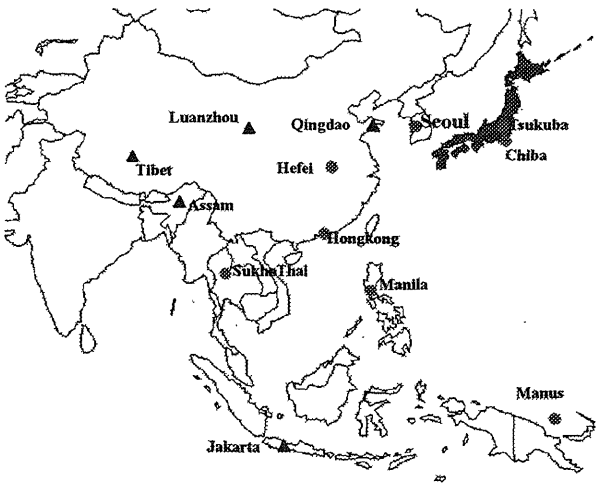

Fig.1 The sites map of lidar network for aerosol monitoring (● present, ▲ to be setup)

In this paper, we proposed to setup an Asian lidar network, mainly using automated lidar systems such as MPL and PAL, which are used to measure the aerosol and cloud features. The aerosol sampling will be also conducted at sites of network. The map of sites in shown in the Fig.1. This network will also provide the necessary aerosol and

cloud data for the project of ACE-Asia which will be started from end of this year. Some sample result of aerosol and cloud in Sukhothai will be presented in section 2. And the development of PAL will be described in section 3.

2. MPL Observations in Sukhothai

A MPL system was deployed at Sukhothai since July, 1997. This is one part of GAME-T project. This lidar system is used to monitoring the cloud feature in Sukhothai. One month data of MPL is shown in the Fig. 2. The cloud events occurred frequently in July, and slowly in December. But aerosol layer is deeper in December than in July. Cloud Base Height was also retrieved from MPL data. The statistic results in July and December are shown in Fig. 3. Most cloud was concentrated below 5 km in July. And the cloud in high altitude between 10 and 15 km in July is almost same that in December.

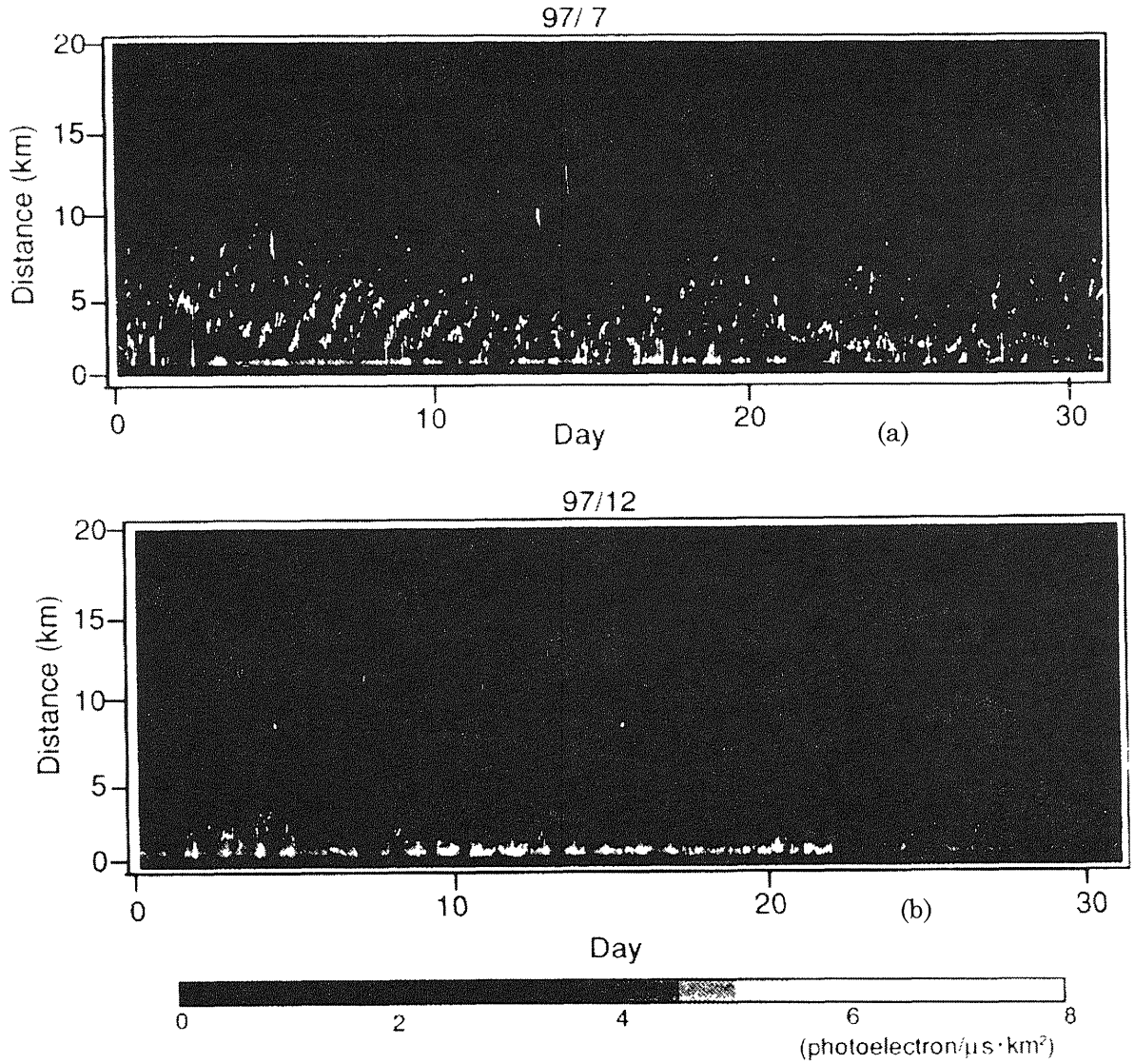

Fig. 2 (a) One month continuous observation in Sukhothai , July 1997. (b) the same as a) except December , 1997.

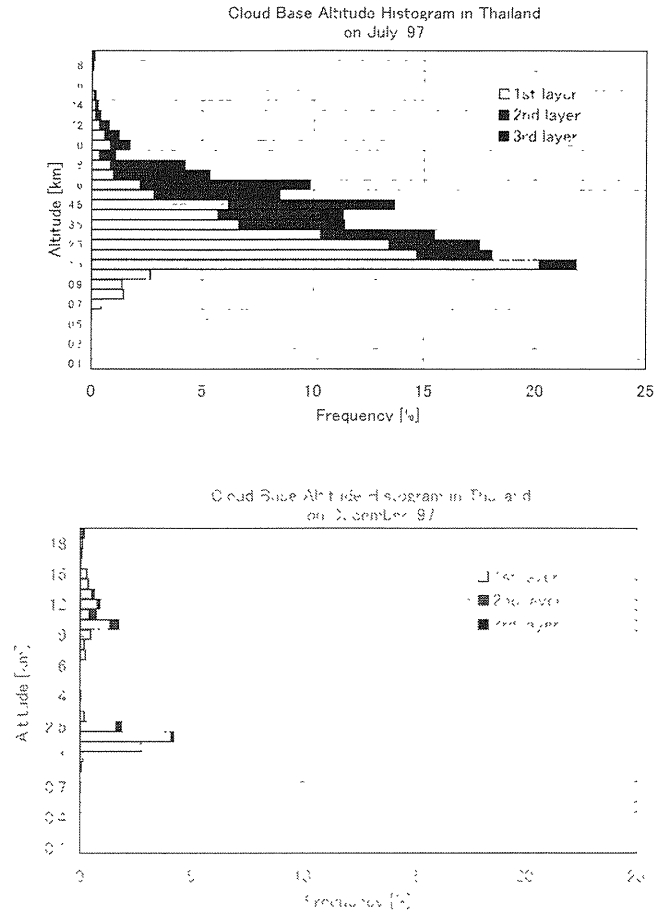

Fig. 3 a) Statistics of cloud base height measured by MPL in Sukhothai, July 1997. In a case of multi-layer cloud structure, each cloud base height is counted as the second, and as third. b) the same as a) except in December, 1997.

3. Development of PAL

In order to setup Asian lidar network, we need develop more robust, cheap price, automated and easy operating lidar system to satisfy the long term stable observation.

PAL system will consist of diode laser pumped, frequency doubled Nd:YAG laser, a Schmidt-Cassegrain telescope and signal detection and automatic executable program units. The laser will output more than 10μJ/pulse at 2500 Hz . The beam size will be expanded to 20 cm for eye safety, which is the same as the telescope diameter.

At present, we are developing a test model PAL system. In the test model, the laser will be installed above the telescope. An interference filter with bandwidth of 0.3nm will be used in the PAL system. PMT output signal will be recorded by a multi-channel scaler (SR430), In the future commercial product, we will use a multi-channel scaler PC card to replace the SR430. When lidar is working in tropical zone, the temperature protection becomes necessary. We will install the temperature sensor on laser crystal, detector and lidar box. If the temperature is too high, PAL system will be shut off automatically. A program will control the PAL system and take data automatically whenever power is available. Figure 4 is the block diagram of the test model system.

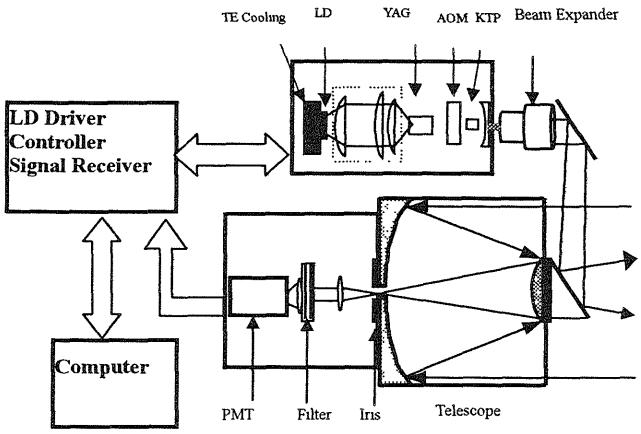

Fig.4 The block diagram of PAL test model system

4. PAL Future Plan

In order to test and gather long-term data, we plan to use the test version system at a municipal research institute in Chiba Prefecture. This area is neighboring to the industrial area consisting of one part of Metropolitan Tokyo Area. There are many chemical plants and oil refineries. This area faces to Tokyo Bay and the sea and land breath will be expected. As the meteorological condition is complicated, the monitoring of boundary layer height and aerosol conditions are desired to be monitored. This place is also one of the monitoring station for local government air pollution. Aerosol sampling and analysis have been done for more than ten years.

The aerosol monitoring at some locations in Asia is tried in July, 1999. The sampled aerosols are collected to Chiba and chemically analyzed for the estimation of optical properties. This type of monitoring will support the analysis of the air pollution from the satellite data. The lidar network monitoring will become effective when it is done with the combination of aerosol sampling and other monitoring.

PAL will be a friendly candidate for monitoring of air pollution.

References

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3. N. Takeuchi, W. Chen, H.Kuze, T. Imatsu, A. Sone and H. Kan, "Design of a Portable Automated Lidar for Aerosol and Cloud Sensing", CLEO/Pacific Rim'99, Seoul,1999.