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LIDAR Measurements during the ACE-Asia 2001 IOP at Gosan, Jeju Island, Korea

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ABSTRACT : In order to investigate the characteristic of optical properties of Asian dust particles, atmospheric aerosol vertical profile was measured with the multi-wavelength LIDAR system at the Gosan super site (33°17′N, 126°10′E) in Jeju Island of Korea during the ACE-Asia intensive observation period, 11 March ~ 4 May 2001. Air mass backward trajectory analysis by using Hysplit-4 was carried out to track the aerosol plume with high mass loading from Chinese desert regions during the period of the Asian dust storm events periods. Vertical profiles of atmospheric aerosol have been analyzed, three major Asian dust storm event days, 22 March, 13 April, and 26 April 2001 have been analyzed. LIDAR-derived aerosol optical depth values were compared with those measured by a collocated sunphotometer.

KEYWORDS : atmospheric aerosol, multi-wavelength LIDAR, Asian Dust storm, aerosol optical depth, ACE-Asia, vertical profile

1. INTRODUCTION

In general Asian dust storms occurring during the spring season in northeast Asia area play an important part in radiative forcing and regional climate change. Asian dust aerosols have been monitored in the past decades at many places using ground-based instruments such as LIDAR, sunphotometer, skyradiometer, and optical particle counter (OPC) as well as satellites. Most of LIDAR sites in the Northeast Asia in China and Japan. Due to its central location between the Asian continent and the Pacific Ocean, Gosan station in Jeju Island, Korea was designated as the super ground site for the ACE-Asia intensive field study. In order to monitor atmospheric aerosol characteristics in the Northeast Asia region effectively, Advanced Environmental Monitoring Research Center (ADEMRC), K-JIST in cooperation with Nagoya University had set up a multi-wavelength LIDAR System at Gosan Super Site, Jeju Island, Korea. The LIDAR system was used to monitor the vertical profile of atmospheric aerosols including Asian dust plume during the ACE-Asia intensive observation period (IOP), 22 March ~ 4 May 2001. During the period, a number of Asian dust storms occurred significantly increased the atmospheric aerosol mass loading. The K-JIST LIDAR at Gosan is a member of a large Asian-Dust Network (AD-Net) which is composed with a number of LIDAR sites in Japan, China, and Korea. Aerosol optical depth (AOD) and backward trajectory analyses were used to identify the different origin of different air mass by combining with the LIDAR data.

2. MEASUREMENT

The Gosan super site(33°17′N, 126°10′E, 50m above sea level) is located 45 km southeast from the Jeju city on the western tip of Jeju Island, Korea. A number of domestic and foreign research teams had participated in the surface aerosol measurements at Gosan during ACE-Asia IOP. The

K-JIST LIDAR system transmits Nd:YAG laser as pluses consisting of three wavelengths, 355 nm, 532 nm, and 1064 nm vertically into the atmosphere and collects the backscattered light from atmospheric aerosol particles with three telescopes.

3. RESULTS

During the ACE-Asia IOP multiple Asian dust events were reported at Gosan for the time period March 20th(0245) thru March 22nd(1215), March 23rd (0218) thru March 24th (0420), April 10th (0406) thru April 12th (0900), April 13th (0012) thru April 14th (0150), April 25th (0216) thru April 25th (1725). In order to investigate the characteristics of aerosol vertical profile structure, three major dust storms observed at Gosan on 22 March, 13 April, and 26 April plus a clean day of 9 April and a hazy day of 15 April have been analyzed and displayed in Figure 1. On March 22 there was a thick aerosol layer in the lower troposphere and a cloud layer above. LIDAR observed weak aerosol signal at high altitudes on April 9, which was a very clean day. On April 13, multiple aerosol layers were observed at 1 km, 4 km, and 7 km altitudes in the middle of a very strong Asian dust storm event. On April 15 high concentration aerosol layer was observed under 2 km altitude in the marine boundary layer. Finally, weak aerosol signal was measured in the lower troposphere on April 26 in the end of a major Asian dust storm passed over Gosan 23~26 April. The LIDAR derived column aerosol optical depth (AOD) was calculated by integrating aerosol extinction profile measured by the LIDAR from surface up to the top of the atmosphere. Atmospheric aerosol optical depth was also determined from a collocated sunphotometer at Gosan, which was part of AERONET network. Figure 2 shows the LIDAR derived AOD measured during nighttime along with the AERONET sunphotometer AOD measured during daytime. The LIDAR measurements of AOD show large variability of atmospheric aerosol loading during the ACE-Asia IOP with peak values observed on April 13. The LIDAR derived AOD was compared favorably with those measured by a collocated AERONET sunphotometer.

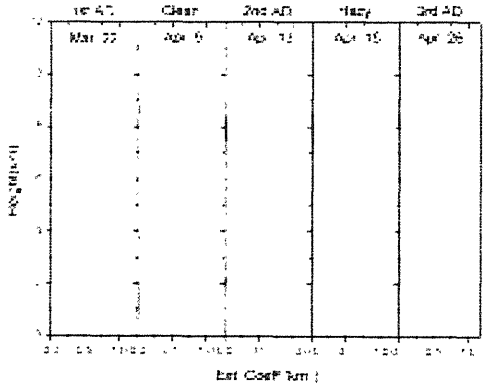

Figure 1. Average profile of atmospheric aerosol Extinction coefficient measured by The K-JIST LIDAR

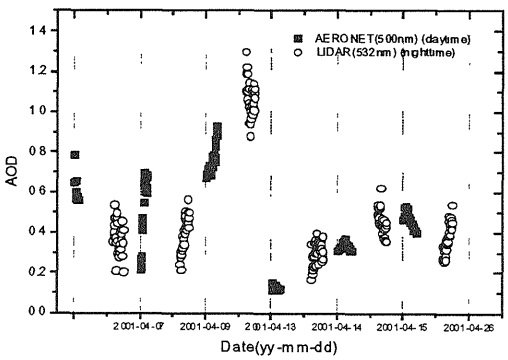

Figure 2. Comparison between LIDAR derived AOD and AERONET sunphotometer AOD

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