Preliminary results of ABL observations in LAPS project in Huaihe river basin

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Abstract

In order to clarify the relationships between the terrestrial surface and the atmospheric boundary layer (ABL), a continuous observation system for the surface and the ABL meteorology was installed on August 2003, in the mid-latitude flat regions in Huaihe river basin. A 30-meter tower was installed to obtain the hydro-meteorological parameters within the surface sub-layer, on the surface, and under the ground. Mixed layer meteorology was observed by a wind profiler radar (WPR), Doppler sodars, and a micro-wave water vapor profiler. Intensive observation was carried out including the research of the surrounding vegetation during before and after Meiyu season 2004. The surrounding surface condition clearly reflected on the ABL meteorology through the surface heat fluxes. The WPR echo intensity within the ABL showed periodical peaks during daytime of clear days, implying the plume-like turbulences.

Keyword: atmospheric boundary layer, surface heat flux, wind profiler radar, observation

1. Introduction

LAPS, the Lower Atmosphere and Precipitation Study, one of the projects of the Core Research for Evolutional Science and Technology (CREST) of the Japan Science and Technology Agency (JST), aims to clarify the processes and mechanisms of precipitation onset, the Surface-ABL-Cloud-Precipitation relationship. The main target of the observation in this study was the Surface-ABL relationship before and after the *Meiyu*, the rainy season in China. The intensive observation including vegetation researches for surroundings was carried out from 24th May through 16th July in 2004. This paper introduces the LAPS observation in China, and reports the preliminary results of the surface-ABL observations including the tower observation, the wind profiler radar (WPR) observation, and the manual observations during the intensive observation period.

2. Site and Materials

2.1. Study site

The study site was set at the mid-latitude flat surface regions in China. The main site is located at Shouxian, 116.78E and 32.55N, 22.7m A.S.L., the middle reaches of Huaihe river, Anhui province of China (*cf.* Fig.1). The other sites were set at Xiaoxian and Feixi for the Doppler sodar observations.

2.2. Continuous observations

The observation started in summer 2003 at Shouxian, Xiaoxian, and Feixi with a 30-meter tower (*cf.*, Fig. 2), a WPR (L-28, Sumitomo Electric Industries, LTD., Japan), three Doppler sodars (XFAS, Scintec, AG., Germany), and a micro-wave water vapor profiler (TP/WVP-3000, Radiometrics, Co., USA.)

The tower, the flux and meteorological observation system was installed to obtain the hydro-meteorological parameters such as the turbulent fluxes, the radiation fluxes, the wind velocity, the temperature, the humidity, and so on. The positions of the installed devices on the tower were shown in Fig. 2. The static parameters excepting the turbulent variables were stored every 5 minutes. The turbulent fluxes were computed every 30 minutes using the turbulent variables collected by 10Hz.

The 3-D wind vector profiles within the ABL were obtained by the WPR observation every minute. The WPR observation also provided the echo intensity from the atmosphere, which indicates the turbulent intensity at each altitude.

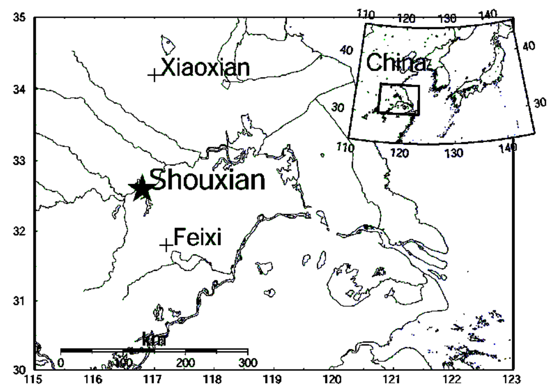

Fig. 1: Location of the observation site.

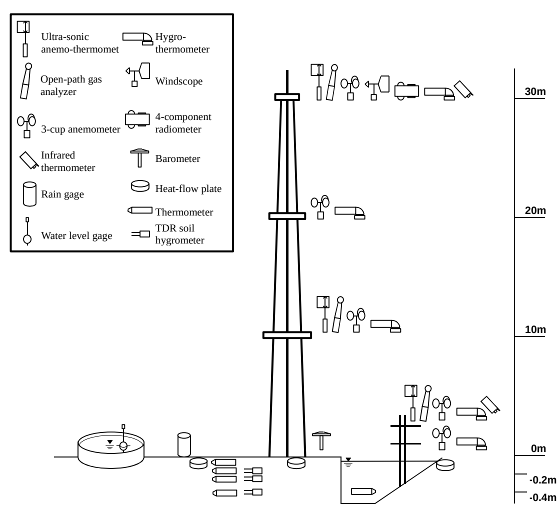

Fig. 2: Illustration for the tower observation.

2.3. Manual observations

The manual observations were carried out at 6 points around the Shouxian site. The temperatures of the paddy water, the soil, and the surface were observed everyday with approximately 1 hour intervals during daytime. The canopy height, the water depth, and the SPAD values reflecting the chlorophyll concentration were taken once a day. The leaf area indexes (LAI) for unit area was observed once a week.

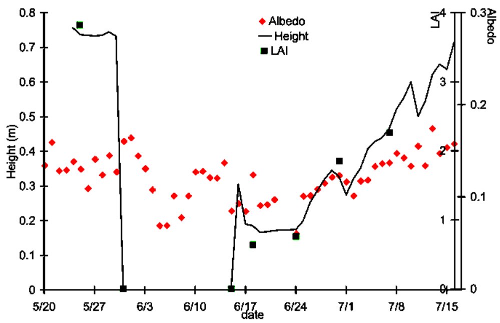

Fig. 3: The change in the canopy height, the leaf area index (LAI), and the albedo during the intensive observation period in 2004.

3. Results and Discussions

3.1. Surface conditions

The dominant vegetation was wheat until 30th May when it was harvested. The wheat litter was burned artificially on the ground from 1st through 4th June. Rice seedlings were planted with filling water on 14th June, after the ash of the wheat litter was plowed under the ground. Then the rice seedlings grew up during the later half of the observation period. The change in the canopy height and the LAI were shown in Fig. 3 with the observed albedo. The change of the albedo was well corresponding to the surface events mentioned above. The canopy height was good indicator of LAI in this season.

3.2. Surface fluxes and ABL structures

The diurnal changes of the energy fluxes over the surface on 5 clear days were shown in Fig. 4. Both of the sensible H and latent flux λE were changed similarly, corresponding to the change in the solar radiation on 22nd May, before the wheat was cut off. The λE was decreased between the cutting and water filling, 31st May and 3rd June. After filling water and planting rice seedlings, 22nd June and 3rd July, the H dropped and the λE increased.

Figure 5 shows the echo intensity obtained by the WPR observation on the same days as Fig. 4, implying the turbulent intensity. The periodical peaks were detected when H was not small, at the daytime of 22nd, 31st May and 3rd June. These peaks might indicate the plume-like turbulences due to the large surface heating indicated by the H. The relatively large echo during the daytime on 22nd June might reflect the high humidity due to the large λE. The ABL depth was developed until 1.5-2.0 km, even when the H was not significant on the humid days, 22nd June and 3rd July.

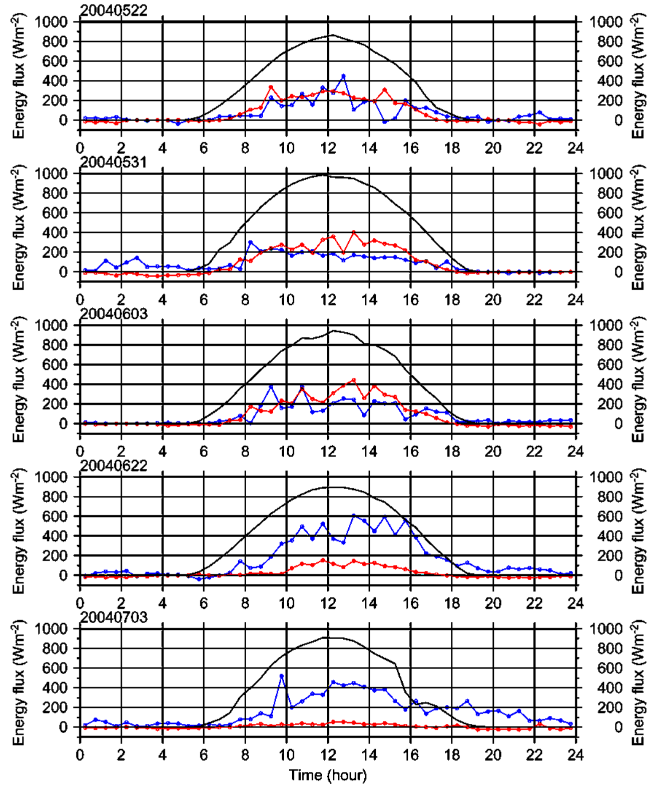

Fig. 4: Diurnal changes of the solar radiation (black line), the sensible heat flux (red marked lines), and the latent heat flux (blue marked lines) on clear days in 2004.

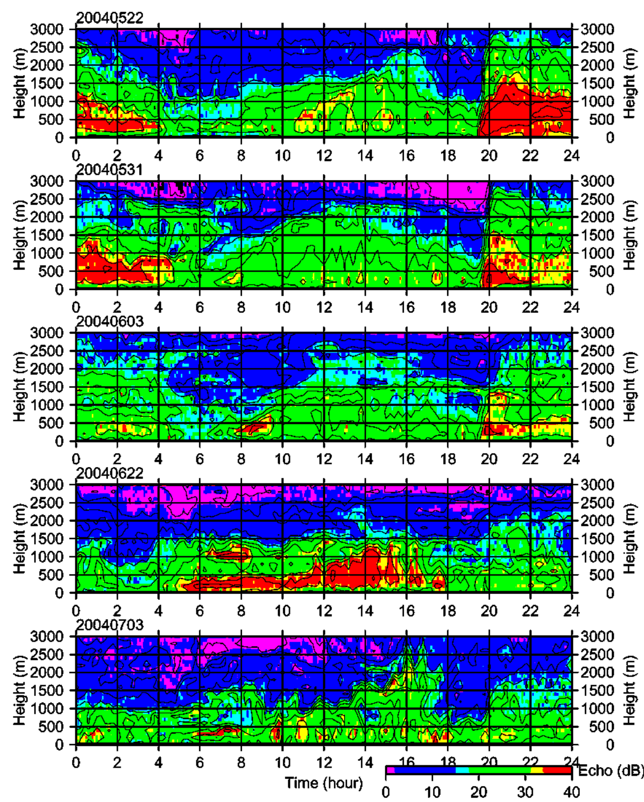

Fig. 5: Diurnal time-height sections of the echo intensity received by the Windprofiler on the same days as Fig. 4.