Installation of ABL observation system on the "Changwu Agro-Ecological Experimental Station"

Tetsuya HIYAMA[1)], Atsushi HIGUCHI[1)], Atsuhiro TAKAHASHI[2)], Masanori NISHIKAWA[1)], Wei LI[1)], Wenzhao LIU[3)] and Yoshihiro FUKUSHIMA[2)]

1) *Hydrospheric Atmospheric Research Center (HyARC), Nagoya University, Japan*
2) *Research Institute for Humanity and Nature, Japan*
3) *Institute of Soil and Water Conservation, China*

1. Introduction

The purposes of the observation for atmospheric boundary layer (ABL) over the Loess Plateau are to detect exchange processes in momentum, heat, water, and CO_2 among land - vegetation - atmosphere system, and to re-evaluate water cycle system over Loess Plateau.

We will analyze atmospheric turbulence in the ABL and get seasonal variations in surface fluxes of momentum, heat, water, and CO_2 on the Plateau. We will also use satellite remote sensing data also to diagnose the land surface conditions around the target region. Analyzing processes in development of convective boundary layer (CBL) and generation of cumulus clouds using a "cloud resolving model" on the basis of the ABL observation data is our final target, too. Namely, the improvements of parameterizations schemes in the processes of ABL, cloud physics, and precipitation systems over a dry and high altitude region will be our final goals.

In order to achieve the purposes, we established ABL observation system at the "Changwu Agro-Ecological Experimental Station, Chinese Academy of Science (CAS)" located at southern part of Loess Plateau, in the middle of May 2004.

2. Installed Devises

The ABL observation system consists of;

1) Wind Profiler Radar (WPR)
2) Flux and Radiation Observation System (FROS).

Next Japanese fiscal year (after April 2005), we will install;

3) Microwave Radiometer (MR).

Fig. 1 The 30-m high tower established on the field of "Changwu Agro-Ecological Experimental Station".

Fig. 2 A set of ultra-sonic anemometer-thermometer and infrared H_2O/CO_2 gas analyzer installed on the tower.

The ABL measurement system was (and will be) established at the meteorological field of the "Changwu Agro-Ecological Experimental Station" on Loess Plateau located at N35 ° 12 ′ , E107 ° 40 ′ . The FROS measurements include the surface flux observations of momentum, sensible heat, latent heat (water vapor), and CO_2. For FROS operation, we have established a 30-m high flux tower on the center of the research field (Fig.1), on which three sets of ultra-sonic anemometer-thermometers and infrared H_2O/CO_2 gas analyzers were installed (Fig.2). Especially, fine resolution (both in time and in spectral) radiation measurement system was included as a part of FROS (Fig.3). Those installation height/depth are shown in Table 1. The data obtained from this radiation system will be used for the improvement of local surface characteristics of optical satellite measurements.

Fig. 3 The radiation measurement system installed on the ground surface. A set of ultra-sonic anemometer-thermometer and infrared H_2O/CO_2 gas analyzer are also shown.

Also included in the ABL observations are the profile measurements of three-dimensional wind speed components (using WPR; Fig.4), air temperature, and absolute humidity (using MR) in and around 10 minutes interval. The WPR data were partly obtained after the establishment (Fig.5).

Fig. 4 Wind profiler radar (WPR) and its observation shelter.

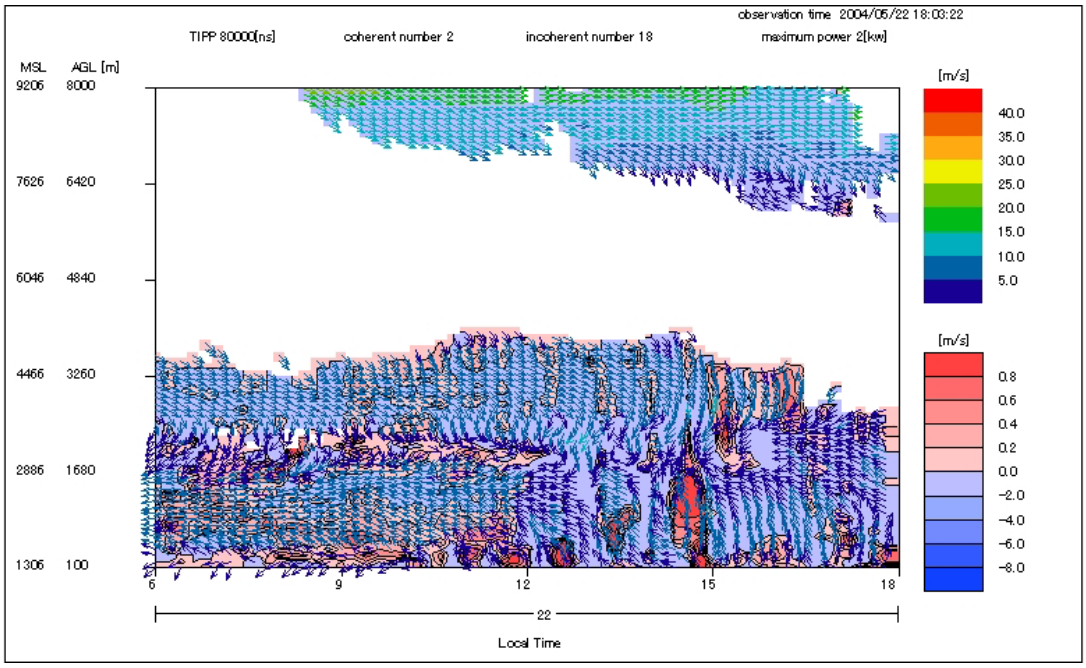

Fig. 5 An example of diurnal variation in profiles of three-dimensional wind speed obtained from the WPR.

3. Schedule

The observations will be carried out continuously from 2004 to 2007 (more than three years). Descriptions described below are the finished and planned schedules for the establishment of the ABL observation system.

1) Construction of basement (finished)
   November, 2003 ～ March, 2004
2) Transportation of WPR and FROS from Japan to China (finished)
   February ～ April, 2004
3) Establishment of WPR and FROS (finished)
   May, 2004
4) Observation
   May, 2004 ～ August, 2007
5) Transportation of MR (planned)
   April, 2005
6) Establishment of MR (planned)
   May, 2005
7) Withdrawal of all devises (planned)
   August, 2007
8) Transportations of WPR, FROS and MR from China to Japan (planned)
   August ～ October 2007

4. Expected Results

As one of the product, we can obtain plenty of data sets from the ABL observation system. Flux data set will be opened for the FluxNet community in worldwide. These obtained data sets can be used for the re-evaluation of parameters on ABL turbulence, entrainment process, and cloud physics in cloud-layers, using a cloud resolving model (CRM). Improved parameterization schemes can be added to some regional climate models (RCMs) and re-evaluation of water cycle system in the Yellow River Basin can be achieved. These new parameterizations are possible to apply hopefully for the re-evaluation of water cycle system in the Yellow River Basin.

Table 1 Installation height/depth of FROS.

Stage	Equipment	Height / Depth
30-m	Ultrasonic Anemo.-Thermometer	31.75 m
	Infrared CO_2/H_2O Gas Analyzer	31.75 m
	3-Cup Anemometer	31.45 m
	Wind Direction Sensor	31.57 m
	HUMICAP (Vaisala)	30.97 m
	Infrared Thermometer	31.23 m
10-m	Ultrasonic Anemo.-Thermometer	12.17 m
	Infrared CO_2/H_2O Gas Analyzer	12.17 m
	3-Cup Anemometer	11.92 m
	HUMICAP (Vaisala)	10.52 m
2-m	Ultrasonic Anemo.-Thermometer	1.86 m
	Infrared CO_2/H_2O Gas Analyzer	1.86 m
	3-Cup Anemometer	1.65 m
	HUMICAP (Vaisala)	1.90 m
	Infrared Thermometer	2.35 m
	Barometer (Air Pressure Sensor)	2.00 m
Underground	Soil Heat Flux Plate (x 2)	5, 5 cm
	Soil Temperature (x 5)	2, 10, 20, 40, 80 cm
	Soil Moisture Sensor (TDR) (x 6)	2, 2, 10, 20, 40, 80 cm
Radiation	S↓, S↑, L↓, L↑, PAR↓, PAR↑	2.50 m
	SpectroRadiometer	2.50 m
	Direct Solar Radiation	0.5 m
Precipitation	Tipping Bucket Rain Gauge	0.4 m