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Establishment of CEOP Tsukuba Reference Site

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Abstract

Data archive project for Tsukuba Science City was initiated under the Coordinated Energy and water cycle Observations Project for four years (2007-2010). Five institutes and one university contribute to archive the hydro-meteorological data in the uniformed format. At present, http://www.geoenv.tsukuba.ac.jp/~ceoptsukuba/ is the main source for detailed information regarding the project and access to the data.

Key words: CEOP, data archive, Tsukuba Science City.

1. Introduction

In the 1970s, Tsukuba Science City (http://www.info-tsukuba.org/) was established approximately 60 km northeast of Tokyo as a center for advanced research and higher education to promote science and technology. Several national institutes and university observe hydro-meteorological parameters in the city for their own research purposes, and some of their data are open to the public. Because archiving these data would be quite beneficial in order to examine the variability of the mesoscale parameters in relation to land-surface heterogeneity in the city, the data archive project for Tsukuba Science City was initiated under the Coordinated Energy and water cycle Observations Project (CEOP) in 2007. The project was supported by a Grant-in-Aid for Scientific Research from Japan Society for the Promotion of Sciences. CEOP entered the second phase (CEOP2) in 2007, updating the reference sites (RSs), the data archiving structure, and the science panels.

CEOP is an international project under under the World Climate Research Project (WCRP) Global Energy and Water-cycle Experiment (GEWEX) (http://www.ceop.net/). The first phase of CEOP (CEOP1) was to construct an observation and data archival system which could contribute to the Global Earth Observation System of Systems (GEOSS) to enhance the understanding and prediction of continental- to local-scale hydroclimtates for hydrologic applications (Koike, 2004). More than 30 of the RSs were categorized as ground-based in-situ observatories (http://monsoon.t.u-tokyo.ac.jp/ceop2/data/refsites.html) where multiple satellite data from new-generation satellites such as TERRA, AQUA, ENVISAT and ADEOS2, as well as model output data from numerical weather prediction centers (MOLTS) have been intensively archived. Plans are underway to archive satellite data and MOLTS data from 10 centers.

The process of resistrating Tsukuba City as a CEOP-RS began in 2006, in synchrony with the start of CEOP2. The process was called the CEOP Tsukuba Reference Site Project (CTRSP). In September 2007, at the first CEOP International Planning Meeting at Bali, Indonesia, the Tsukuba City sites was officially approved as the first RS in Japan. The main objective of the CTRSP is to archive meteorological data from multiple national institutes and a university located in and around Tsukuba City and to handle these data at the CEOP data center by unifying formats with site descriptions. In accordance with CEOP policy, the data are opened to the public via a newly established home page. The CTRSP is to continue for four years (2007-2010).

2. Framework of the CEOP Tsukuba project

As of August 2008, the following institutes were members of the CTRSP; the Meteorological Research Institute (MRI), the Terrestrial Environment Research Center (TERC) and Mt. Tsukuba Station (MtTSUKUBA) of the University of Tsukuba (UT), the National Research Institute for Earth Science and Disaster Prevention (NIED), the National Institute for Agro-Environmental Sciences (NIAES), the National Institute for Environmental Studies (NIES), and the Japan Meteorological Agency/ Aerological Observatory (JMA/AO). Seven observation stations are registered at the site (Table 1). Each organization has a station manager who is responsible for original data quality checks.

Under CEOP1, four types of RS data sets are defined; surface meteorological and radiation (sfc), flux (flx), soil temperature and soil moisture (stm), and meteorological

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Table 1 List of stations and data sets

Station name	Latitude	Longitude	Elevation	Data set
TERC	36° 06' 35" N	140° 06' 00" E	27 m	SFC, FLX, TWR
MRI	36° 03' 09" N	140° 07' 24" E	25.2 m	SFC, FLX, STM
AO/JMA	36° 03' 09" N	140° 08' 24" E	25.2 m	SFC, Sonde
NIES	36° 03' 04" N	140° 07' 13" E	29 m	Lidar
NIED	36° 07' 33" N	140° 05' 24" E	24 m	SFC, STM
NIAES-Mase	36° 03' 14.3" N	140° 01' 36.9" E	11 m	SFC, STM
MtTSUKUBA	36° 33' 7.2" N	140° 05' 52.8" E	868 m	SFC

tower (twr). These types are divided into two categories; standard data and enhanced or experimental data (see details in http://www.eol.ucar.edu/projects/ceop/dm/documents/refdata_report/). The required parameters are defined with a format and error flag. The station manager determine which parameters to open to the public on a non-profit basis. Ancillary data sets, such as sonde or lidar data, can be archived with their own format. CEOP requests that standard data (Category 1) be freely open to the science community after a basic turn-around period of six months. The turn-around period is 15 months for enhanced or experimental data (Category 2), such as flux data or special data obtained through intensive observations in remote areas. The CTRSP collects the data twice a year, in August and February. The data from each station are first send to the UT after the manager conducts a data quality check by adding the error flags. Metadata which explain the observation conditions and data quality are also archived. The UT acts as a data center in the CTRSP, reformatting the data into the CEOP format and putting them on the home page. CEOP recommends 30-minuete standard data intervals. The CTRSP data center also re-samples the data if the archived data interval is less than 30 minuets. Re-sampling methods are explained in the metadata. At present, http://www.geoenv.tsukuba.ac.jp/~ceoptsukuba/ is the main source for detailed information regarding the project and access to the data. The home page is supported in English and Japanese.

3. Observation stations

The Tsukuba RS is situated on the Joso Plateau (20-30 m a.s.l.) and consists of the northeastern Kanto plain (Fig. 1). The site covers two main zones. The urbanized zone stretches north to south and includes public facilities, residential areas, and commercial and business areas (Tsukuba Science city). The rural area is used for paddy fields, dry fields and orchards. Most of the paddy field are utilized for rice cultivation, and the dry fields are for turf or vegetables. Most of the stations are located in Tsukuba Science city, but meteorological measurements may reflect the effects of mixtures of surface components surrounding the station. CEOP2 project plans to archive satellite data in the domain of a 2.5 by 2.5 degree grid with a center at 36°06′ 35" N, 140°06′ 00" E , corresponding to the location of the TERC.

Since the Tsukuba Express Railway, which connects Tokyo and Tsukuba Science City, started opening in August 2005, the urbanized area has expanding. The Sakura-gawa and Kokai-gawa riveres run northeast and southwest of the site, and the paddy fields are distributed mainly along these rivers. Mt. Tsukuba (876 m a.s.l.) located about 7 km north of the city center is forested primary with beech, tall evergreen oak, and Japanese red pine. On calm winter days, the development of a nighttime inversion layer over the Kanto Plain causes thermal belts along the mountain slopes, which is utilized for habitats and fruit plantations. Therefore, the CEOP-Tsukuba reference site covers various land use areas and a rapidly growing city representing land cover conditions in the Kanto Plain of central Japan.

Each station has its own characteristics. MRI and the neighboring JMA/AO are key aerological and meteorological observatories which together are referred to as the Tateno station. Under the WCRP, the station is categorized as a Baseline Surface Radiation Network (BSRN) project where sonde and radiation data are downloaded from BSRN home page (http://www.bsrn.awi.de/), and reformatted. Since the late 1970s, the TERC which has a 30 m tower has measured the surface flux and hydrometeorological parameters in its circular grassland field. This facility has been used as a core station in a large-scale field campaign (Sugita *et al*., 1993), and used in a study of large-scale surface flux (Hiyama *et al*., 1995). In the mid-1990s, measurements of the surface flux of carbon dioxide began at this station (Saigusa *et al*., 1996). NIAES-Mase is another flux-measuring point representing paddy fields about 7 km west of the city center (http://ecomdb.niaes.affrc.go.jp/). At the NIAES-Mase site, long-term greenhouse gas exchange between paddy fields and the atmosphere is monitored. The data from the NIAES-Mase site are also utilized for process studies of gas exchange (Han *et al*., 2007) and gas flux measurement technique (Saito *et al*., 2007; Ono *et al*., 2008) as well as

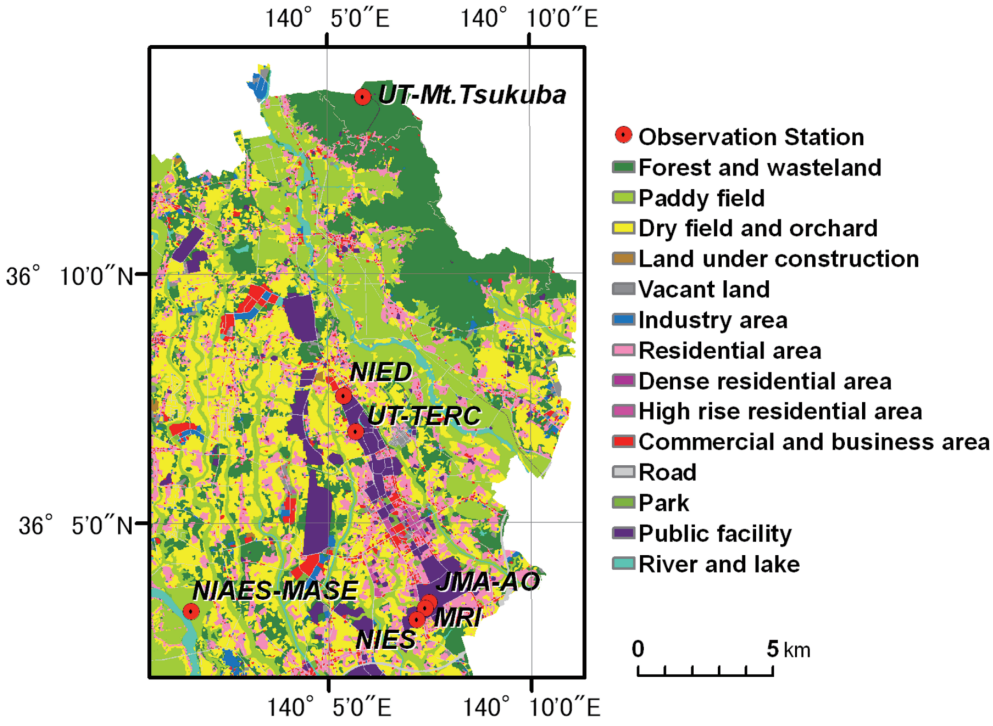

Fig. 1 Locations of observation stations and land use in the Tsukuba RS
The land use is based on the Detailed Digital Information (10 m Grid Land Use) of the Tokyo Metropolitan Area in 1994, Geographical Survey Institute of Japan.

for collaboration with modelers and remote sensor users (Inoue *et al.*, 2008). At the NIED site, which is adjacent to a red pine forest, rain and soil moisture are measured in order to validate radar observation. Meteorological data are collected at the MtTSUKUBA site on Mt. Tsukuba located 17 km north from the city center at an altitude of 868 m (Hayashi and Research Group for Intramural Project(S), 2006). The NIES provides compact Mie Lidar data through an automated-dual-wavelength-polarization lidar network in the East Asian region. Details of the observation are given on the home page.

4. Future perspectives

Focus of this project is to construct a database of mesoscale observations by different national institutes funded by their own agencies. Such cross-cutting way through different organization is quite unique and challengeable. We expect that the data will be utilized for hydrometeorological research including the verification of satellite estimates and numerical predictions, process studies of land-atmospheric interactions, evaluation of urbanization, and education and policy-making in the local community.

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References

Koike, T., 2004: The Coordinated Enhanced Observing Period – An initial step for integrated global water cycle observations. *WMO Bull.*, **53**, 115-121.

Han, G.H., H. Yoshikoshi, H. Nagai, T. Yamada, K. Ono, M. Mano, and A. Miyata, 2007: Isotopic disequilibrium between carbon assimilated and respired in a rice paddy as influenced by methanogenesis from CO_2. *Journal of Geophysical Research*, **112**, G02016, doi:10.1029/2006JG000219.

Hayashi and Research Group for Intramural Project(S), 2007: Meteorological observation station at the summit of Mt. Tsukuba. *Tsukuba Geoenvironmental Sciences*, **2**, 19-23.

Hiyama,T., M. Sugita, and I. Kayane,1995: Variability of surface fluxes within a complex area observed during TABLE 92. *Agricultural and Forest Meteorology*, **73**, 189-207.

Inoue, Y., J. Peñuelas, A. Miyata, and M. Mano, 2008: Normalized difference spectral indices for estimating photosynthetic efficiency and capacity at a canopy scale derived from hyperspectral and

CO_2 flux measurements in rice. *Remote Sensing of Environment*, **112**, 156-172.

Ono, K., A. Miyata, and T. Yamada, 2008: Apparent downward CO_2 flux observed with open-path eddy covariance over a non-vegetated surface, *Theoretical and Applied Climatology*, DOI 10.1007/s00704-007-0323-3.

Saigusa, N. S. Liu, T. Oikawa and T. Watanabe, 1996: Seasonal change in CO_2 and H_2O exchange between grassland and atmosphere, *Ann. Geophysicae*, **14**, 3, 342-350.

Saito, M., J. Asanuma, and A. Miyata, 2007: Dual-scale transport of sensible heat and water vapor over a short canopy under unstable conditions. *Water Resources Research*, **43**, W05413, doi:10.1029/2006WR005136.

Sugita,M., I. Kayane, and T. Hiyama, 1993: IGBP/BAHC field experiment to address scale problems in land-surface parameterization. *IAHS Publications*, No.212, 389-396.

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