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METEOROLOGICAL OBSERVATIONS AT TOKYO METROPOLITAN UNIVERSITY IN 2002 AND 2003

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Abstract An observational tower with 15 m high standing on Tokyo Metropolitan University has been providing basic meteorological data since March 1997. Data of air temperature, relative humidity, wind speed and direction, and solar radiation from January 2002 to December 2003 are reported in this paper.

Key words: meteorological data, observational tower, climatic characteristics

1. Introduction

An observational tower (15 m high) stands in the east part of Tokyo Metropolitan University (TMU) campus (35°37'N, 139°23'E, and 130 m asl). Meteorological parameters have been measured on this tower and recorded at intervals of 1-hour since March 1997. In this paper, we report the meteorological data in 2002 and 2003, and describe climatic characteristics in TMU in these years.

2. Data

On the observational tower, the following items have been measured: air temperature (height: 1.5 m and 9.5 m above the ground surface), relative humidity (1.5 m and 9.5 m), wind speed and direction (14.5 m), and global solar radiation (14.0 m). Some soil properties (temperature, heat flux, and water content) have also been measured at a depth of 30 cm below the ground surface beside the tower. Details on the instruments were described in Suzuki *et al.* (1999). We report the monthly and daily statistics of air temperature, relative humidity, wind speed and direction, and solar radiation from January 2002 to December 2003 in this paper. The data were missed on the following days due to troubles of power supply: from January 19 to February 5, from February 17 to March 8, March 17 and 18, from April 13 to May 6, from July 20 to August 1 in 2002, and from February 1 to 4, March 16 and 17, from August 7 to 27, December 9 to 31 in 2003. In addition, the data of wind speed and direction were missed from September 19 to October 27 in 2003 due to a trouble of the equipment. The monthly statistics were calculated for the month, which the data were obtained for more than 80% days of a month.

Meteorological observation at Otemachi in central Tokyo (35°41'N, 139°46'E and 5.3 m asl) is made by JMA. We also used the JMA data in 2002 and 2003 to investigate the differences of meteorological factors between the central Tokyo and the suburbs (TMU). The data were published as the monthly reports of 2002 and 2003 (JMA 2002, 2003).

Table 1 Monthly values of meteorological data at TMU in 2002 and 2003

	Air temperature (°C)						Relative Humidity (%)		Wind Speed (m/s)	
	Monthly Mean	Mean Daily Max.	Mean Daily Min.	Mean Daily Range	Extremes Highest	Extremes Lowest	Monthly Mean	Extremes Lowest	Monthly Mean	Monthly Max.
2002 Jan*	–	–	–	–	–	–	–	–	–	–
Feb*	–	–	–	–	–	–	–	–	–	–
Mar*	–	–	–	–	–	–	–	–	–	–
Apr*	–	–	–	–	–	–	–	–	–	–
May**	16.9	21.5	13.3	8.2	25.8	11.2	88.2	37.4	1.8	8.2
Jun	20.1	24.2	16.7	7.4	30.9	12.8	89.3	26.7	1.9	9.6
Jul*	–	–	–	–	–	–	–	–	–	–
Aug	26.4	30.7	23.1	7.6	35.6	17.6	86.1	42.4	2.0	10.4
Sep	21.4	24.9	18.4	6.5	32.6	13.0	89.9	42.6	1.8	8.7
Oct	16.8	20.9	13.0	7.9	27.3	4.8	86.1	36.7	1.9	15.0
Nov	9.2	14.0	4.9	9.1	19.6	0.6	76.4	21.6	1.9	8.7
Dec	5.4	9.8	1.7	8.1	17.9	-2.8	79.8	30.3	1.9	13.6
2003 Jan	3.5	8.9	-1.0	9.9	15.1	-5.4	67.2	18.5	2.1	12.9
Feb**	5.5	10.5	1.3	9.1	16.3	-3.8	73.6	21.0	2.3	9.6
Mar**	7.5	13.2	2.5	10.7	22.9	-3.0	65.9	20.1	2.7	14.1
Apr	14.2	19.5	9.7	9.8	28.3	2.9	78.3	27.6	2.6	15.2
May	17.7	22.3	13.9	8.4	26.9	7.9	85.4	23.3	1.9	7.9
Jun	21.9	25.7	18.7	6.9	31.6	12.9	90.4	51.2	1.6	12.0
Jul	22.1	25.4	19.5	5.8	33.4	17.4	94.8	61.8	1.6	5.9
Aug*	–	–	–	–	–	–	–	–	–	–
Sep	22.9	26.8	19.5	7.3	33.4	12.3	87.1	38.2	–	–
Oct	15.9	19.9	12.2	7.7	26.7	7.1	85.3	50.1	–	–
Nov	12.9	16.0	9.9	6.1	22.4	3.0	89.6	33.5	1.8	7.4
Dec*	–	–	–	–	–	–	–	–	–	–

*: Month which the data were missed for more than 20% days of a month.
**: Month which the data were missed for less than 20% days of a month.
***: "All" means the day that obtained 24 hourly data in a day.

3. Climate of Tokyo Metropolitan University in 2002 and 2003

Monthly statistics of the meteorological data were summarized in Table 1 and temporal variations in daily values were plotted in Figs. 1 and 2.

Climate of these two years at TMU was characterized by low temperature in July of 2003. This extremely low temperature was caused by the stronger Okhotsk anticyclone than normal, and was observed in the entire Japan area, especially in northeastern Japan. Monthly mean air temperature (MMAT) at Otemachi (central Tokyo) in July of 2003 was 2.6°C lower than normal (JMA 2003). MMAT at TMU in July was 3.8°C lower than that averaged through the previous 6 years (1997 to 2002), and the number of day that the daily maximum air temperature was higher than 30°C was only 2 days. The solar radiation in July 2003 (11.0 MJ/m^2/d) was considerably low and ratio of solar radiation at the ground level to that at the top of the atmosphere was only 0.27; this value was lower than that in Bai-u season (0.31 in June 2002 and 0.33 in June 2003). This extreme low solar radiation would pertain to the low temperature.

Monthly mean relative humidity was higher than 80% from May 2002 to October 2002 and from May 2003 to November 2003. Relative humidity sometimes reached 100% at night or on rainy days in every season. Daily minimum one became less than 20% in January 2003.

Monthly mean wind speed was approximately 2 m/s throughout the years, while the value in spring was relatively high (2.7 m/s in March 2003 and 2.6 m/s in April 2003). A considerable high value of daily mean wind speed (7.9 m/s) was recorded on April 4, 2002 (Fig. 1c). This strong

Table 1 (continued)

	Most Prevailing Wind Direction	Freq. (%)	Daily Total Solar Radiation ($MJ/m^2/d$) Monthly Mean	Monthly Max.	Number of Day (Days) Daily Min. Air Temp. < 0 ℃	Daily Min. Air Temp. >= 25℃	Daily Max. Air Temp. >= 30℃	All***
2002 Jan*	-	-	-	-	9	0	0	18
Feb*	-	-	-	-	8	0	0	11
Mar*	-	-	-	-	1	0	0	21
Apr*	-	-	-	-	0	0	0	12
May**	N	13.3	14.4	26.3	0	0	0	25
Jun	N	12.1	13.1	28.3	0	0	2	30
Jul*	-	-	-	-	0	0	9	19
Aug	S	12.4	17.0	25.7	0	6	18	31
Sep	NNW	16.9	10.7	23.7	0	0	5	30
Oct	NNW	14.8	11.6	19.0	0	0	0	31
Nov	NNW	14.9	9.2	16.6	0	0	0	30
Dec	NNW	17.3	7.4	12.7	10	0	0	31
2003 Jan	NNW	13.8	10.5	14.6	20	0	0	31
Feb**	N	19.2	11.3	19.3	8	0	0	23
Mar**	N	18.9	15.0	22.5	5	0	0	29
Apr	N	12.8	14.7	26.6	0	0	0	30
May	NNW	10.3	15.3	27.0	0	0	0	31
Jun	S	11.9	13.8	27.2	0	0	3	30
Jul	N	13.3	11.0	25.3	0	0	2	31
Aug*	-	-	-	-	0	0	5	10
Sep	-	-	13.5	21.4	0	1	11	30
Oct	-	-	10.7	17.5	0	0	0	31
Nov	NNW	21.9	6.5	13.6	0	0	0	30
Dec	-	-	-	-	0	0	0	8

wind was brought about by a passing of cyclone low. Normally the most frequent wind direction was northerly in winter and southerly in summer, reflecting the monsoon. However, north wind prevailed in July 2003.

4. Comparison with the JMA data in Central Tokyo

Differences of temperature statistics between TMU and Otemachi are presented in Fig. 3. A positive value of the difference represents that the temperature at Otemachi is higher than that at TMU. The differences of MMAT and monthly mean of daily minimum temperature were consistently positive, indicating that these temperatures at Otemachi were higher than those at TMU throughout the years. Both differences were largest (2.4°C for MMAT and 3.3°C for minimum temperature) in November 2002 and smallest (0.7°C for MMAT and 0.6°C for min. temp.) in July 2003. On the contrary, the differences of monthly mean values of daily maximum temperature between TMU and Otemachi were largest in summer and smallest in winter. The differences of monthly mean of diurnal temperature range were always negative except for July 2003, and its absolute value was larger in winter than in summer. All of the differences were remarkably small in July 2003, probably relating to the extremely low temperature and low solar radiation mentioned above.

The number of 'winter days' (the daily minimum air temperature is below 0°C) at TMU was much larger than that at Otemachi. On the other hand, the numbers of 'tropical night days' (the daily minimum air temperature is 25°C or above) and 'mid-summer day' (the daily maximum air

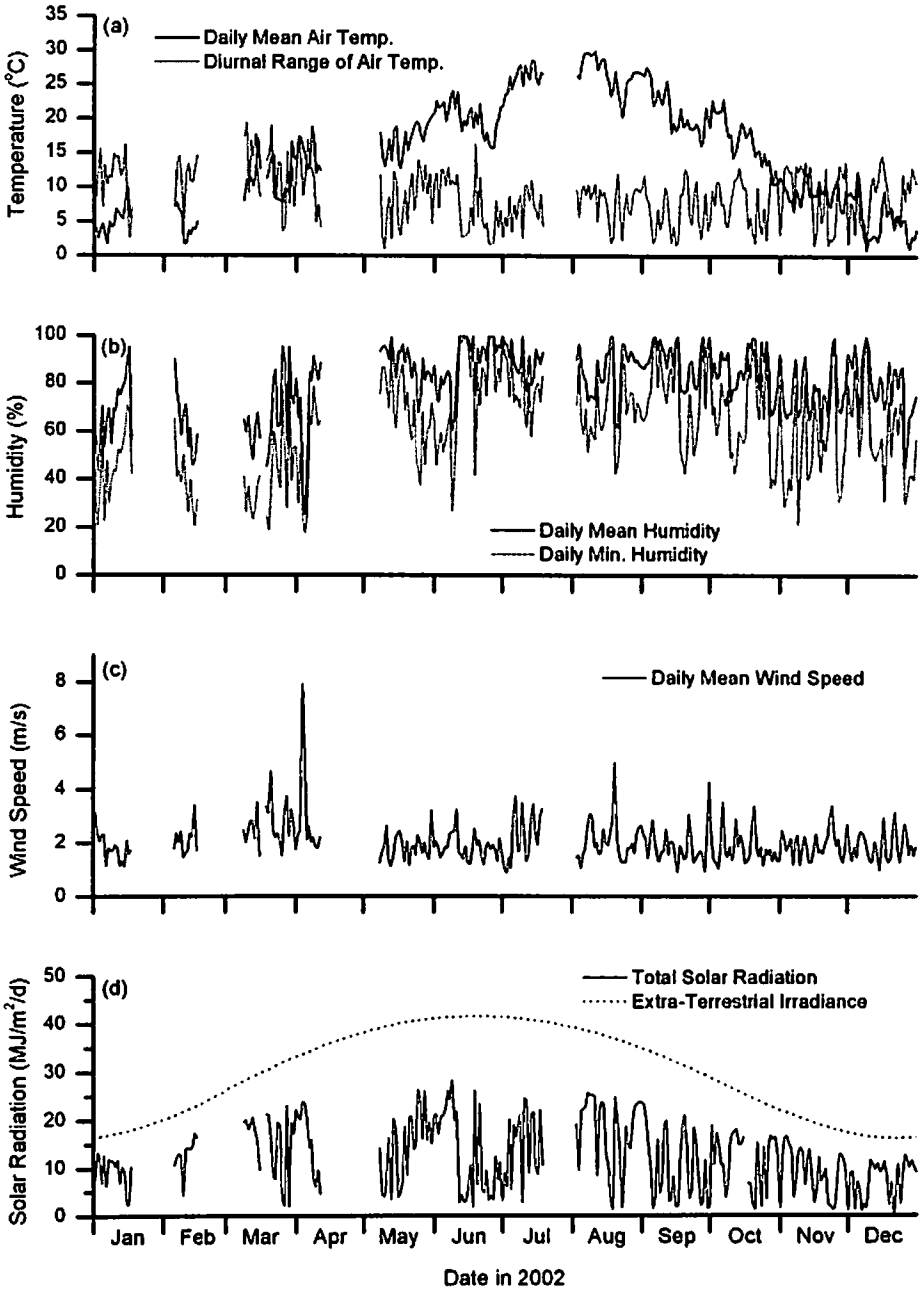

Fig. 1 Daily values of meteorological data at TMU in 2002. (a) Temperatures, (b) relative humidity, (c) wind speed, and (d) solar radiation.

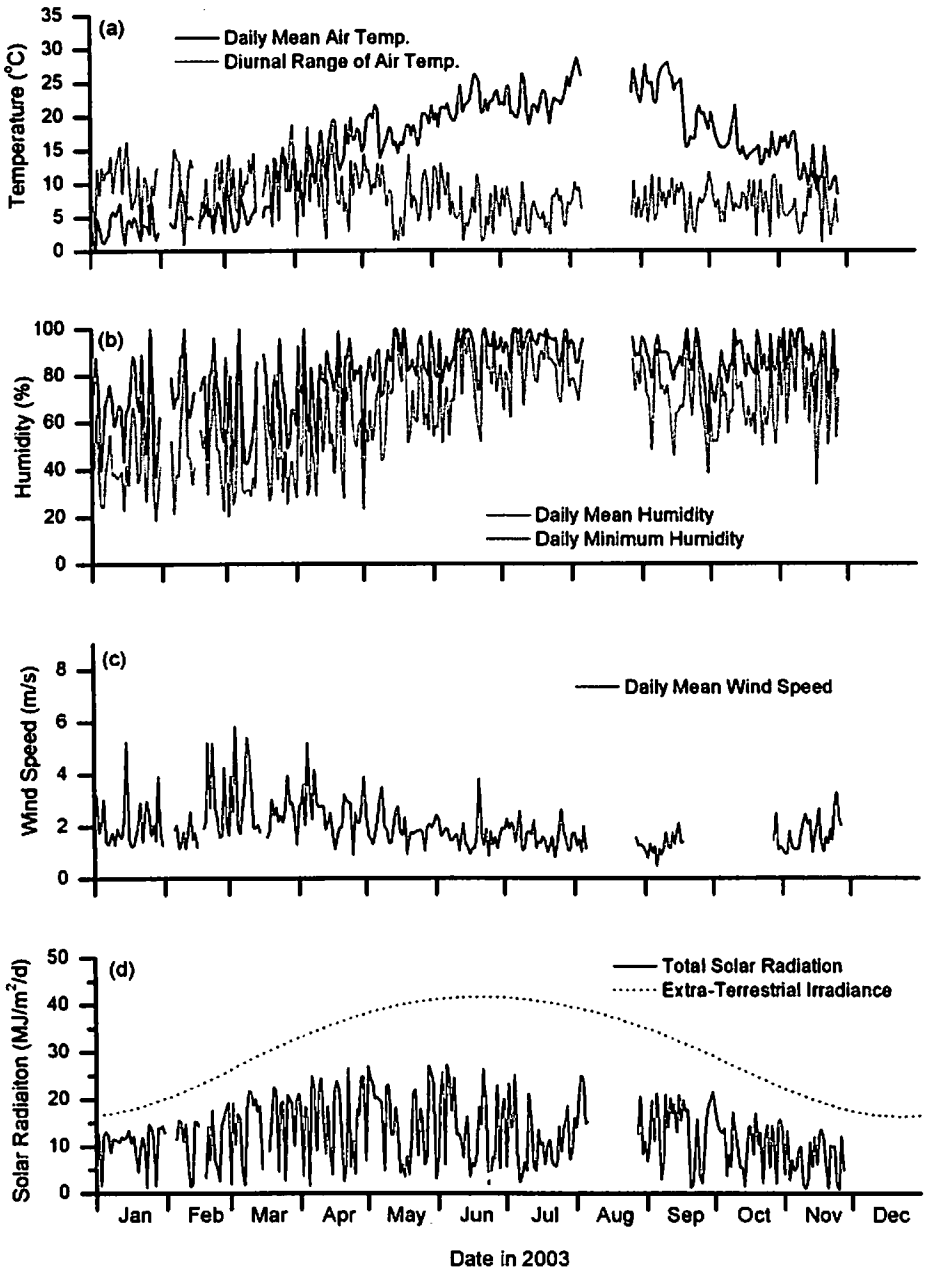

Fig. 2 Daily values of meteorological data at TMU in 2003. (a) Temperatures, (b) relative humidity, (c) wind speed, and (d) solar radiation.

Table 2 Monthly values of meteorological data at Otemachi in central Tokyo in 2002 and 2003

	Air temperature (℃)						Relative Humidity (%)		Wind Speed (m/s)	
	Monthly Mean	Mean Daily Max.	Mean Daily Min.	Mean Daily Range	Extremes Highest	Extremes Lowest	Monthly Mean	Extremes Lowest	Monthly Mean	Monthly Max.
2002 Jan	7.4	11.5	3.4	8.1	18.1	-0.3	46	14	3.2	10.6
Feb	7.9	11.9	4.4	7.5	17.7	0.3	48	15	3.1	10.3
Mar	12.2	16.5	8.1	8.4	23.9	3.9	49	9	3.5	11.7
Apr	16.1	20.3	12.4	7.9	28.0	9.1	57	13	3.7	11.1
May	18.4	22.3	15.3	7.0	27.5	12.4	64	17	3.1	7.8
Jun	21.6	25.3	18.6	6.8	31.1	15.6	69	13	3.0	10.5
Jul	28.0	31.7	25.1	6.6	34.8	21.1	70	38	3.2	11.5
Aug	28.0	32.1	24.8	7.3	35.8	20.7	66	23	3.4	11.0
Sep	23.1	26.2	20.4	5.9	33.9	15.4	69	25	2.9	7.6
Oct	19.0	22.6	15.5	7.1	29.4	9.1	62	23	3.1	13.9
Nov	11.6	15.2	8.2	7.0	20.4	4.8	50	19	3.1	9.4
Dec	7.2	10.4	4.1	6.4	18.7	0.0	57	15	3.0	8.9
2003 Jan	5.5	9.3	2.0	7.4	13.8	-0.8	46	10	3.2	9.6
Feb	6.4	9.9	3.2	6.7	14.5	0.9	52	6	3.3	9.6
Mar	8.7	12.7	5.1	7.5	20.4	1.1	49	14	3.5	10.5
Apr	15.1	19.2	11.5	7.7	27.9	5.6	61	9	3.6	11.4
May	18.8	22.4	15.5	6.9	26.9	10.5	65	13	2.9	9.9
Jun	23.2	26.6	20.2	6.4	33.3	16.4	69	28	2.8	9.4
Jul	22.8	26.0	20.1	6.0	31.9	17.7	75	39	2.8	7.6
Aug	26.0	29.5	23.1	6.3	34.3	18.4	73	44	2.9	10.1
Sep	24.2	28.1	21.0	7.1	34.3	13.9	65	23	3.3	10.8
Oct	17.8	21.4	14.6	6.8	28.7	12.1	59	25	3.1	10.4
Nov	14.4	17.4	11.5	5.9	24.8	7.3	37	20	3.0	8.1
Dec										

Table 2 (continued)

	Most Prevailing Wind Direction	Daily Total Solar Rad. (MJ/m²/d) Monthly Mean	Number of Day (Days) Daily Min. Air Temp. < 0 ℃	Daily Min. Air Temp. >= 25℃	Daily Max. Air Temp. >= 30℃
2002 Jan	NNW	9.2	1	0	0
Feb	NNW	11.3	0	0	0
Mar	NNW	14.3	0	0	0
Apr	ENE	15.5	0	0	0
May	SW	16.0	0	0	0
Jun	SW	13.8	0	0	4
Jul	SW	17.6	0	15	24
Aug	SW	18.1	0	13	25
Sep	N	10.7	0	4	6
Oct	NNW	11.3	0	0	0
Nov	NNW	8.3	0	0	0
Dec	NNW	6.6	0	0	0
2003 Jan	NNW	9.6	4	0	0
Feb	NNW	10.6	0	0	0
Mar	N	14.8	0	0	0
Apr	SW	14.6	0	0	0
May	S	15.4	0	0	0
Jun	SW	14.1	0	1	4
Jul	ENE	10.2	0	0	3
Aug	SW	13.4	0	11	17
Sep	ENE	13.6	0	5	13
Oct	NNW	10.9	0	0	0
Nov	N	6.3	0	0	0
Dec					

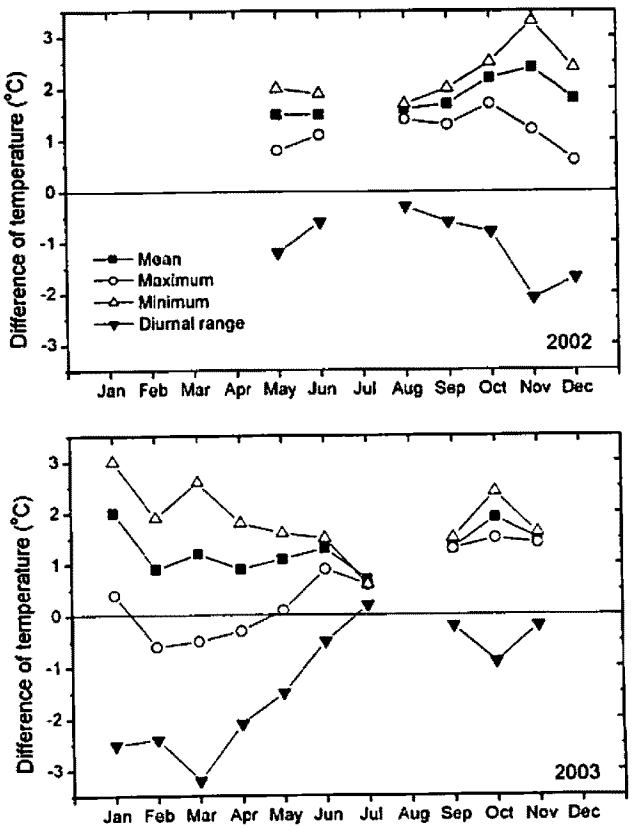

Fig. 3 Differences between TMU and Otemachi (Otemachi minus TMU) of monthly mean values of daily mean, maximum, minimum, and diurnal range of air temperature.

temperature is 30°C or above) at TMU were quite less than those at Otemachi.

The values of monthly mean relative humidity at TMU were 17% (March 2003) to 26% (November 2002) higher than those at Otemachi. Wind speed was approximately 1 m/s lower at TMU than that at Otemachi. Daily total solar radiation was approximately 1 MJ/m^2/d larger at TMU than that at Otemachi in winter (November 2002 to February 2003), and was approximately 1 MJ/m^2/d smaller than that at Otemachi in summer (May, June and August) of 2002.

The original data (hourly values), daily mean and monthly mean values were all stored as digital information. To get and use these data, please contact the corresponding author by e-mail (nakanot@comp.metro-u.ac.jp).

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