

# METEOROLOGICAL OBSERVATIONS AT TOKYO METROPOLITAN UNIVERSITY IN 2000

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*Abstract* Meteorological observations have been carried out at the 15 m observational tower in Tokyo Metropolitan University since March 1997. Data of air temperature, relative humidity, wind speed and direction, and solar radiation from January to December 2000 are reported in this paper.

**Key words:** meteorological data, observational tower, climatic characteristics

## 1. Introduction

An observational tower (15 m high) stands on the east part of Tokyo Metropolitan University (TMU) campus (35°37'N, 129°23'E, and 130 m ASL). Meteorological parameters have been measured on this tower and recorded at intervals of 1-hour since March 1997. Data from April 1997 to March 1999 was reported in Suzuki *et al.* (1999). In this paper, we report the meteorological data in 2000 and describe climatic characteristics at TMU in the year.

## 2. Data

On the observational tower, the following items are 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) are also 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 monthly and daily statistics of air temperature, relative humidity, wind speed and direction, and solar radiation from January to December 2000 in this paper. The data are missing from January 1 to 14, from February 6 to March 21, and from September 16 to 27 in 2000 due to the network trouble.

We also use the weather station data collected by Japan Meteorological Agency (JMA) to compare with the TMU data. The weather station, Otemachi, is located at 35°41'N, 139°46'E and 5.3 m ASL. The data was published as the monthly reports of 2000 (JMA 2000).

### 3. Climate of Tokyo Metropolitan University in 2000

Monthly statistics of the meteorological data were summarized in Table 1 and seasonal variation was plotted in Fig. 1.

Monthly mean air temperature varied between 4.7 °C in January and 26.6 °C in August. The temperature in summertime (July, August, and September) was higher than the values in the previous years (Suzuki *et al.* 1999), while the temperature in wintertime was similar, exclusive of January. Assuming that the temperature in January was the lowest in the year as well as in 1997 due to some missings, annual range of air temperature was 21.9 °C. The diurnal range of air temperature was large in winter and spring, and relatively small in summer and autumn.

Table 1 Monthly values of meteorological data at TMU in 2000

	Air temperature (°C)						Relative Humidity (%)		Wind Speed (m/s)	
	Monthly Mean	Mean Daily	Mean Daily	Mean Daily	Extremes		Monthly Mean	Extremes Lowest	Monthly Mean	Monthly Max.
		Max.	Min.	Range	Highest	Lowest				
Jan*	4.7	9.9	0.2	9.7	15.7	-4.1	64.7	19.6	2.0	7.3
Feb*	-	-	-	-	-	-	-	-	-	-
Mar*	-	-	-	-	-	-	-	-	-	-
Apr	13.4	19.2	8.4	10.8	25.8	3.5	69.3	16.5	2.7	11.2
May	18.9	24.1	15.0	9.2	29.2	9.2	82.0	28.4	2.3	8.9
Jun	21.2	25.3	17.8	7.4	30.2	14.8	89.4	29.8	2.1	12.0
Jul	26.2	31.0	22.7	8.3	35.9	18.4	85.3	46.0	2.3	12.9
Aug	26.6	31.4	23.4	8.0	33.9	21.5	87.6	56.4	1.8	8.0
Sep*	24.0	27.9	20.9	7.0	37.3	13.5	87.3	26.6	2.1	8.7
Oct	16.9	20.4	13.8	6.6	27.4	8.1	87.0	41.9	1.7	7.8
Nov	11.5	15.2	8.2	7.0	21.8	-0.1	81.2	35.2	2.0	9.2
Dec	6.4	11.8	1.6	10.2	18.7	-3.0	67.9	23.5	1.9	9.9

\*: The data are missing from Jan. 1 to 14, from Feb. 6 to Mar. 21, and from Sep. 16 to 27.

Table 1 (continued)

	Most Prevailing Wind Direction		Freq. (%)	Daily Total Insolation (MJ/m <sup>2</sup> /day)		Number of day (days)			
				Monthly Mean	Monthly Max.	Daily Min. Air Temp. < 0 °C	Daily Min. Air Temp. >= 25 °C	Daily Max. Air Temp. >= 30 °C	All**
	Jan	NNE	15.2	9.8	14.4	8	0	0	17
Feb	-	-	-	-	3	0	0	5	
Mar	-	-	-	-	1	0	0	10	
Apr	N	12.5	15.9	24.7	0	0	0	30	
May	S	12.2	17.4	27.6	0	0	0	31	
Jun	S	12.2	14.0	25.9	0	0	4	30	
Jul	S	18.5	18.2	26.7	0	2	24	31	
Aug	S	13.0	17.3	25.6	0	4	25	31	
Sep	NNE	12.0	12.2	22.7	0	0	5	18	
Oct	NNE	17.5	8.5	17.8	0	0	0	31	
Nov	N	18.2	7.5	14.6	1	0	0	30	
Dec	N	12.4	8.8	11.8	8	0	0	31	

\*\*:"All" means the day that obtained 24-hours data.

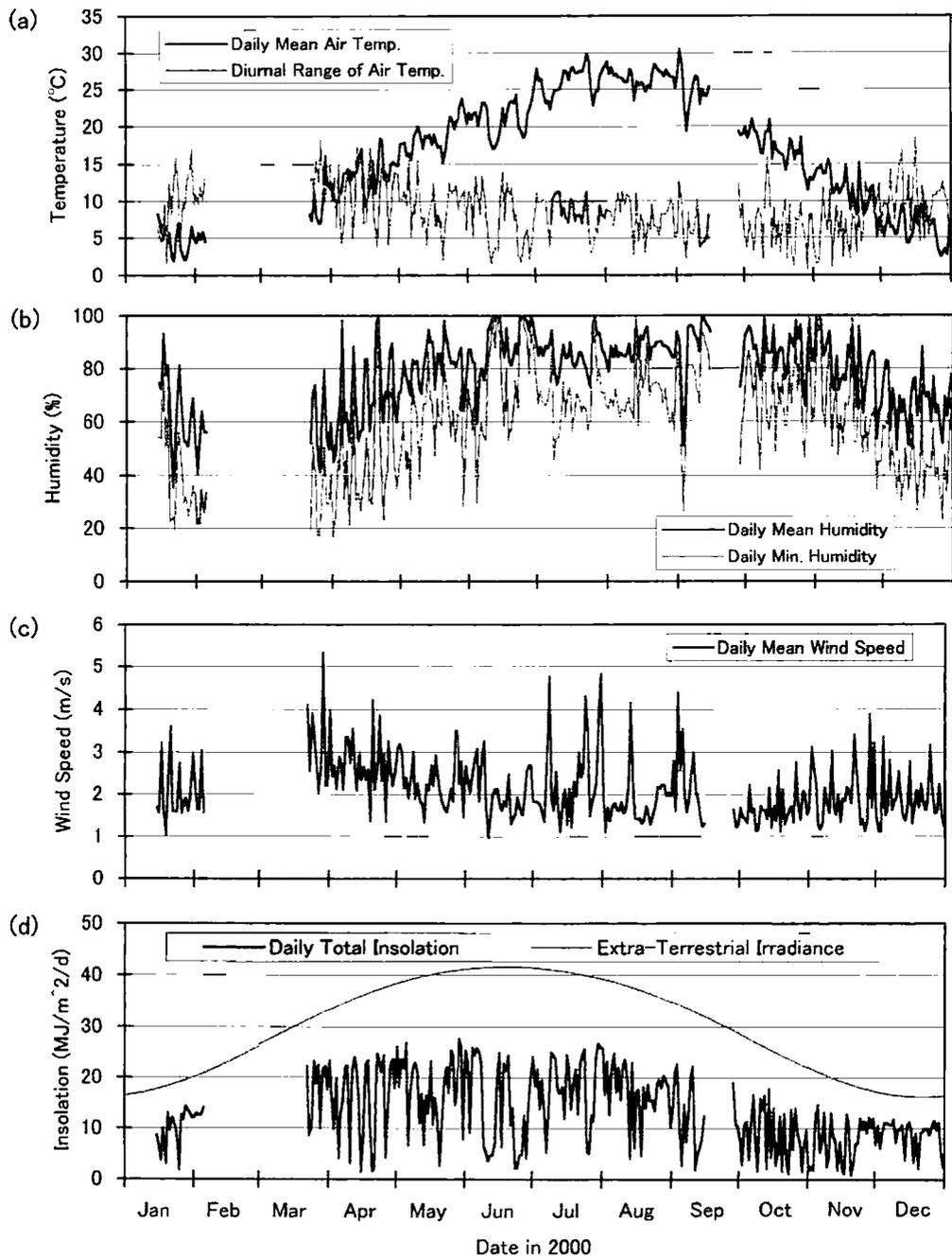


Fig. 1 Daily values of meteorological data at TMU in 2000. (a) Temperatures, (b) relative humidity, (c) wind speed, and (d) insolation.

Monthly mean relative humidity was higher than 80% from May to November and less than 70% in January, April, and December. Relative humidity sometimes reached 100% at night or on rainy days in every season. Daily minimum humidity was less than 20% in January and April.

Monthly mean wind speed was approximately 2 m/s throughout the year, although the value in April was relatively high (2.7 m/s). The most frequent wind direction was the south from May to August, and the north or NNE in the other months. This seasonal change is considered to reflect the monsoon. Spikes in daily mean wind speed were observed in July and August (Fig. 1c). Some of these strong winds were brought about by the passing of typhoon, and were accompanied by a drop in air temperature. In June and July, some events occurred when the southerly winds blew into a Baiu front on the Japan Sea, which caused a high temperature.

Monthly mean of daily total insolation ranged from 7.5 MJ m<sup>-2</sup> d<sup>-1</sup> in November to 18.2 MJ m<sup>-2</sup> d<sup>-1</sup> in July. Ratio of solar radiation at the ground level to the top of the atmosphere was larger than 0.5 in January and December, while it was small (less than 0.35) in June and October.

#### 4. Comparison with Central Tokyo

Meteorological observation at Otemachi in central Tokyo is made by JMA. We used the JMA data in 2000 (Table 2) to clarify differences between the central Tokyo and the suburbs (TMU).

Monthly mean air temperature was lower at TMU than that at Otemachi throughout the year. The difference was large (about 2 °C) in winter and small (about 1 °C) in spring. Figure 2 shows the differences of daily maximum and minimum air temperatures between TMU and Otemachi. Positive value in Fig. 2 represents that TMU is warmer than Otemachi. This figure indicates that there were seasonal variations in both daily maximum and minimum temperature differences, and their seasonal patterns were different from each other. The

Table 2 Monthly values of meteorological data at Otemachi in central Tokyo in 2000

	Air temperature (°C)							Relative Humidity (%)		Wind Speed (m/s)	
	Monthly Mean	Mean Daily	Mean Daily	Mean Daily	Extremes		Monthly Mean	Extremes Lowest	Monthly Mean	Monthly Max.	
		Max.	Min.	Range	Highest	Lowest					
Jan	7.6	11.2	4.2	7.0	16.9	-0.7	51	10	3.2	11.3	
Feb	6.0	9.9	2.4	7.5	14.5	0.0	38	12	3.7	11.7	
Mar	9.4	13.5	5.2	8.3	19.9	1.5	44	14	3.7	13.8	
Apr	14.5	18.7	10.7	8.0	24.1	6.4	55	11	3.6	11.1	
May	19.8	24.0	16.5	7.5	30.0	12.9	68	23	3.1	9.2	
Jun	22.5	26.1	19.5	6.6	30.5	16.4	74	19	3.1	10.9	
Jul	27.7	31.6	24.5	7.1	34.9	19.9	70	33	3.3	12.6	
Aug	28.3	32.4	25.4	7.0	34.5	22.2	69	38	2.7	9.9	
Sep	25.6	28.9	22.7	6.2	37.8	17.8	69	20	3.0	10.4	
Oct	18.8	21.9	16.2	5.7	28.1	11.1	67	27	2.9	9.4	
Nov	13.3	16.7	10.5	6.2	23.1	5.3	63	21	3.3	9.0	
Dec	8.8	12.6	5.2	7.4	20.2	1.7	46	16	3.1	10.2	

Table 2 (continued)

	Most Prevailing Wind Direction	Daily Total Insolation (MJ/m <sup>2</sup> /day) Monthly Mean	Number of day (days)			
			Daily Min. Air Temp. < 0 °C	Daily Min. Air Temp. >= 25 °C	Daily Max. Air Temp. >= 30 °C	All*
Jan	NNW	8.3	1	0	0	31
Feb	NNW	12.6	0	0	0	29
Mar	NNW	14.7	0	0	0	31
Apr	NNW	15.6	0	0	0	30
May	S	17.7	0	0	1	31
Jun	SW	14.2	0	0	3	30
Jul	SW	18.1	0	15	24	31
Aug	SW	16.1	0	20	29	31
Sep	NNW	11.5	0	6	10	30
Oct	NNW	8.3	0	0	0	31
Nov	NNW	6.8	0	0	0	30
Dec	NNW	8.0	0	0	0	31

\*. "All" means the day that obtained 24-hours data.

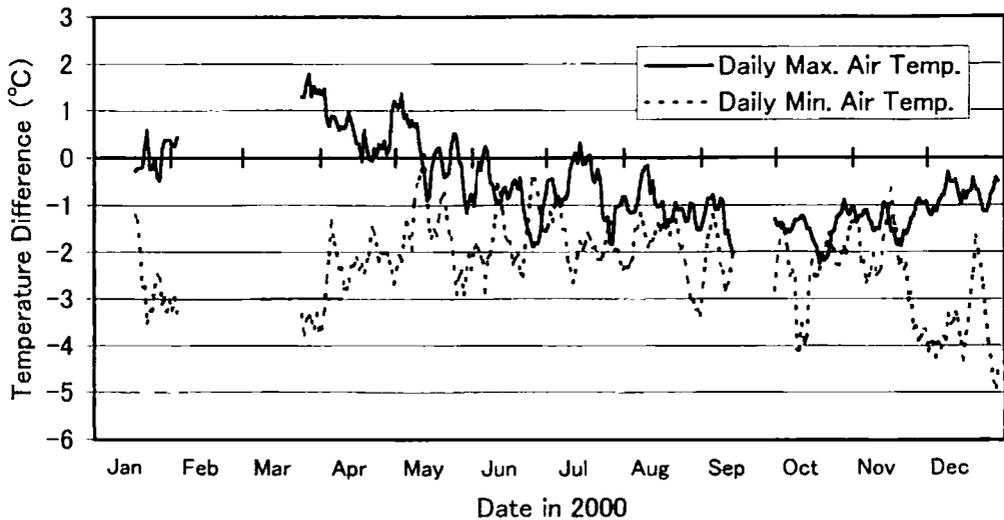


Fig. 2 Differences of daily maximum and minimum air temperatures between TMU and Otemachi. Positive value represents that TMU is warmer than Otemachi.

value of daily maximum temperature difference was large and positive in spring, and small and negative in autumn, suggesting that the daily maximum temperature in spring was higher in the suburb (TMU) than in the central Tokyo (Otemachi). The daily minimum temperature difference was negative throughout the year. Absolute value of the difference was large (3 to 4 °C) in winter and small (about 1 °C) in summer.

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

day' (the daily maximum air temperature is 30 °C or above) at TMU were quite less than those at Otemachi.

The value of monthly mean relative humidity at TMU was 14 to 22% higher than that at Otemachi. Wind speed was approximately 1 m/s lower at TMU than that at Otemachi. Daily total solar radiation at both sites showed similar values throughout the year.

Phenomena such as rise of daily minimum air temperature, especially in winter, and fall of relative humidity are regarded as climatic changes with urbanization. Our data revealed the urbanization in central Tokyo by the comparison between the suburbs (TMU) and the central Tokyo (Otemachi).

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).

### References

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