-TAIPEI-

The City of Taipei

From the beginning of the 18th century large numbers of immigrants flooded into Taiwan from the Chinese mainland, the population concentrated in the Taipei area which had well-developed marine transport and the city was formed. In 1885 it became the capital of Taiwan Province, and it has continued its development as a modern city. From 1895 to 1945 during the period of colonial administration by Japan a large amount of infrastructure was developed through city planning. The population continued to increase after independence from Japan, expanding from 300,000 people in 1900 to 2,610,000 people currently (2005), and a large metropolitan area centered on Taipei City has also formed.

Urban heat islands and urban climate change in Taipei

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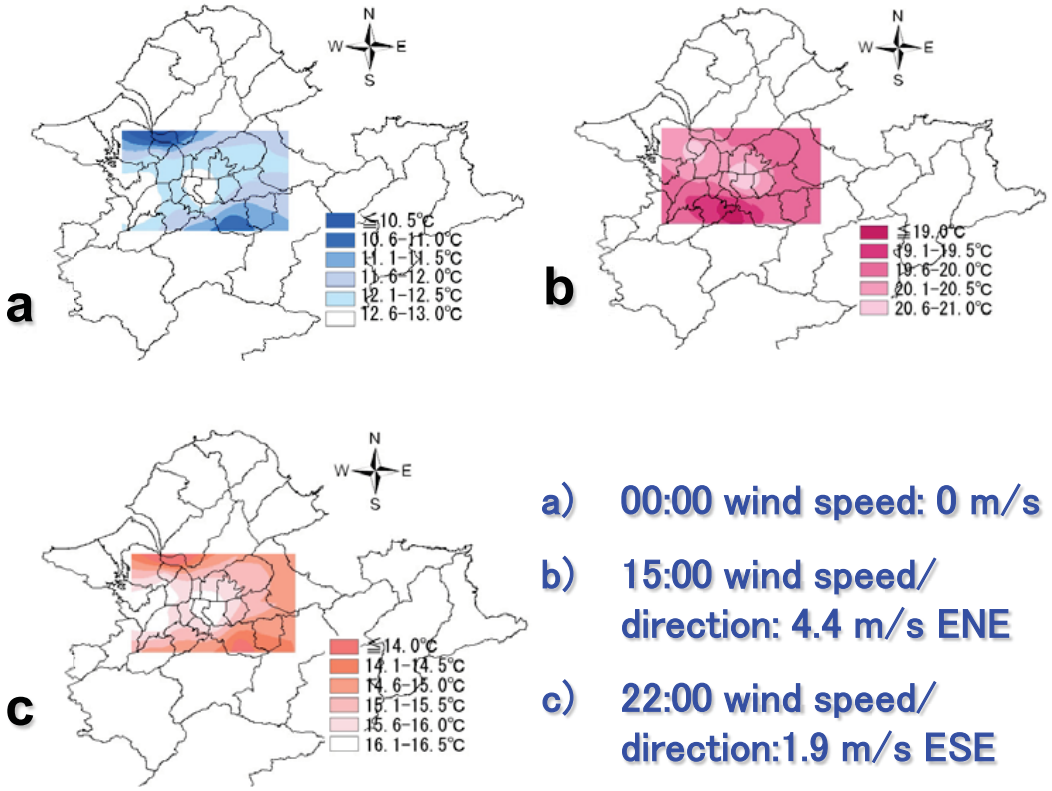
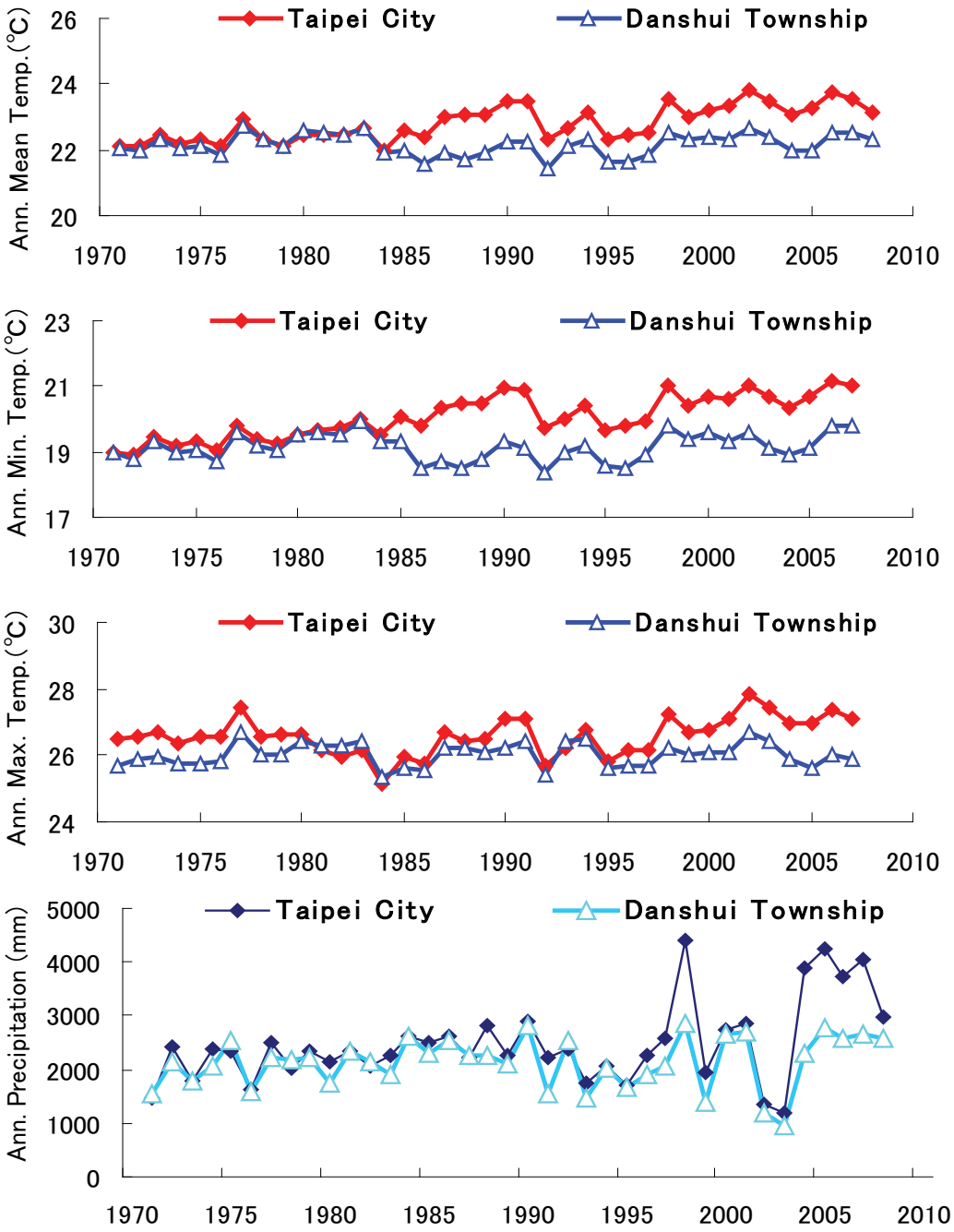


Fig. 1 Air temperature distribution for downtown Taipei and surrounding areas (29 Nov. 2008)

Field observation results 2008–2009 indicated the following: (1) during the rainy season, the nocturnal UHI phenomenon is predominant—with a higher daytime UHI intensity than at night; (2) the nocturnal occurrence of UHIs reached its highest intensity on cloudless nights before sunrise, and during the dry season the highest UHI intensity was approximately 2 ° C; and (3) diurnal UHI reached its highest intensity around 12:00 and 15:00, with the highest UHI intensity of 4–5 ° C, occurring under a clear day-sky and calm wind conditions (generally during a wet winter). Fig. 1 is a sample distribution of air temperature during a clear day-sky in November 2008.



Taipei has experienced rapid urbanization since 1967, with urban warming occurring since 1985. The effects of urbanization on local weather and climate change have resulted in a remarkable increase in mean and minimum temperatures. There has been a significant increase in the minimum summer temperatures in Taipei. However, urbanization has resulted in little change to Taipei's maximum temperatures. In addition, the increase in precipitation last spring and fall can be attributed to an increase in annual precipitation levels. There is a significant correlation between annual precipitation levels and precipitation levels from last spring and fall. Heavy precipitation has been occurring with greater frequency in Taipei since 1998.

Yingjiu BAI, Juang JY. and Kondoh A.(2010): Urban Heat islands and Urban Warming in Taipei, 『Groundwater and Subsurface Environment』(Ed. Taniguchi M.), Springer.

Yingjiu BAI, Juang J.-Y. and Kondoh A. (2009) : Analysis on the Relationship Between the change of Urban Climate and Urban Development in TAIPEI, *The 7th International Conference on Urban Climate (Yokohama, Japan)*, CD-ROM.

Groundwater in Taipei

In the Taipei region excessive pumping of groundwater due to industrialization led to a huge draw down of the groundwater level and resulted land subsidence in 1970's. To conpensate this situation groundwater regulation laws were prepared and the alternative surface water supply system were developed, and the land subsidence problem has been solved follwing to the recovery of the groundwater level. While in the Tainan region the land subsidence problem has become more serious during recent 10 years, including the groundwater salinisation problem in which sea water emerges into the groundwater aquifer and damage the groundwater quality.

Subsurface Thermal Environment in Taipei

In Taipei City and its surrounding suburbs the rise in the ground surface temperature caused by human activities is having an impact on the subsurface, and the underground temperature reversal phenomenon similar to those in Tokyo and Osaka can be observed here too. The formation of a subsurface heat island has been in progress, and the temperature a few dozen meters underground has been gradually rising.

Temperature increase in the subsurface of the Taipei area:

Measurement of borehole temperature profiles and long-term temperature monitoring

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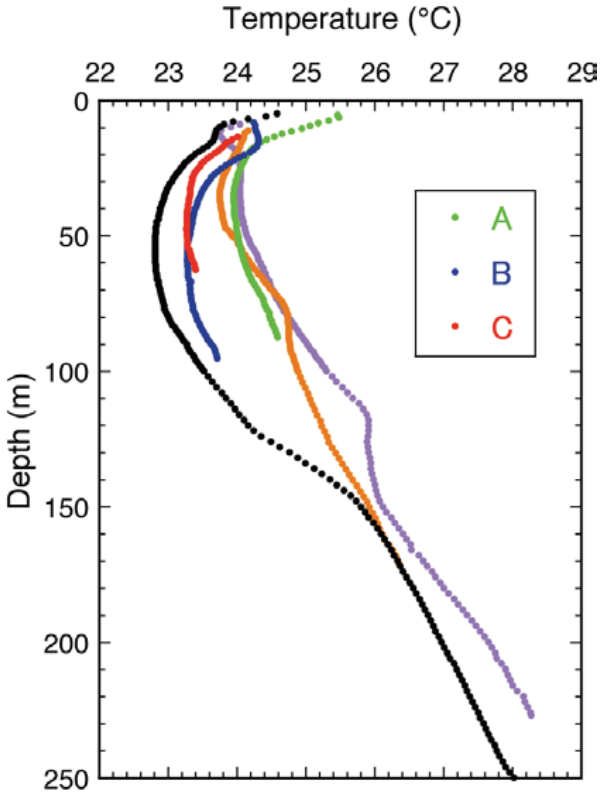

Fig. 1. Examples of subsurface temperature profiles in the Taipei area (measured in 2009)

Temperature profile measurement in an urban area (A in Fig. 1)

Influence of temperature increase at the ground surface due to urbanization propagates downward, resulting in warming in the subsurface. For investigation of this subsurface heat island effect, we conducted measurements of temperature profiles in observation wells at eleven sites in the Taipei area. Most of the temperature profiles are curved and have negative temperature gradients in the upper several ten meters (Fig. 1), which reflects recent increase in the ground surface temperature (GST).

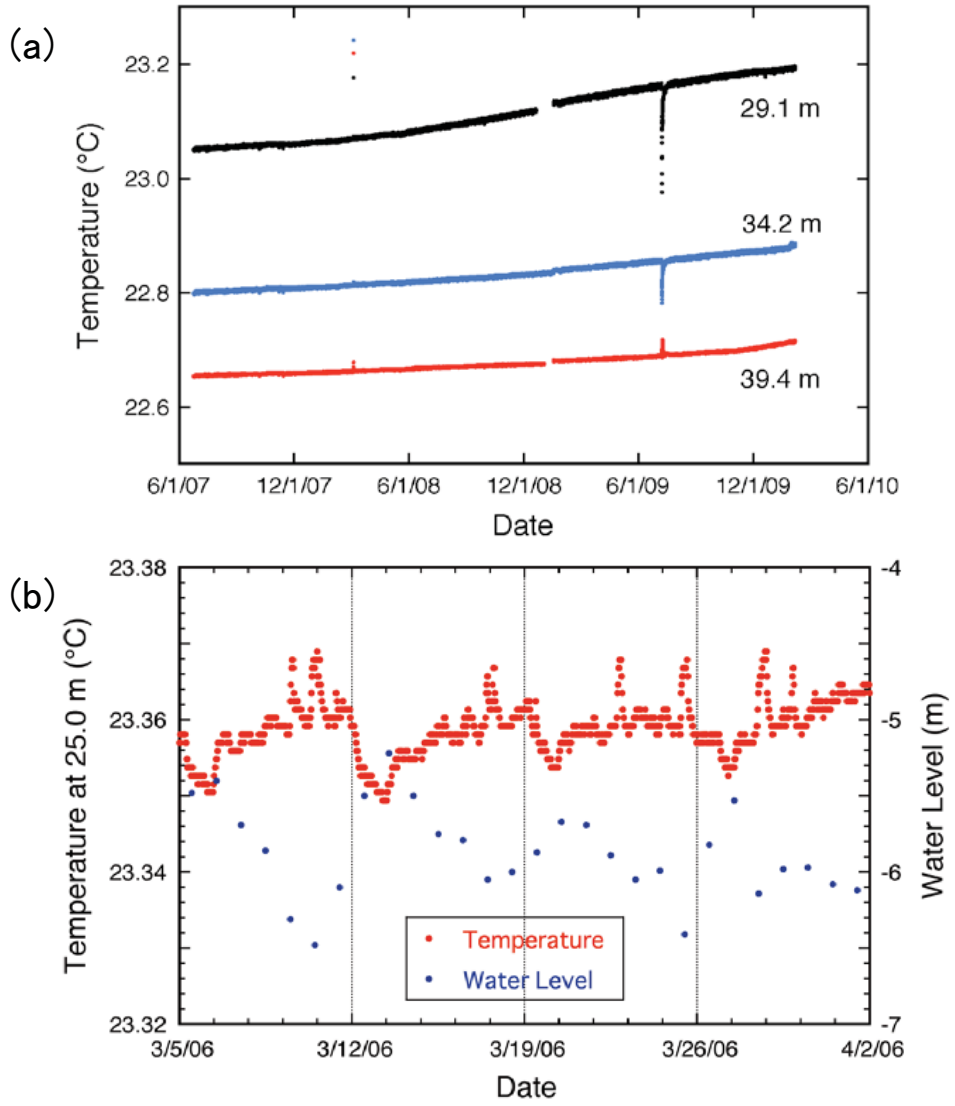

Fig. 2. (a) Temperature records for about 2.5 years in a well where the profile B in Fig. 1 was obtained. (b) Temperature and water level records in a well where the profile C was obtained.

Long-term monitoring of borehole water temperature should provide information on the process of subsurface warming due to urbanization. Long-term data obtained with water temperature recorders installed in a well in the Taipei area show monotonous increase at three depths, 30 to 40 m below the surface (Fig. 2(a)). It may represent downward propagation process of influence of GST increase.

We also observed oscillations of temperature and water level with a strong 1-week component in another well (Fig. 2(b)). This short-period variation most probably results from vertical movement of borehole water due to human activity around the site.

Yamano, M. et al. (2009) Reconstruction of the thermal environment evolution in urban areas from underground temperature distribution, Sci. Total Environ., 407, 3120-3128.

Yamano, M. et al. (2009) Long-term temperature monitoring in boreholes for studies of the ground surface thermal environment and groundwater flow, in "From Headwaters to the Ocean", M. Taniguchi et al. (eds.), 523-527, Taylor & Francis Group, London.

Groundwater Pollution in Taipei

Regarding Taipei City, the groundwater quality is monitored by the government of Taipei and the city has one of the best management systems in Asia. On the other hand, development is lagging in regions outside Taipei City and measures for Taiwan overall are considered to be necessary.