Effects of Mountain Winds on Air Temperature in an Urban Area during Summer Nights

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Effects of Mountain Winds on Air Temperature in an Urban Area during Summer Nights

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Abstract

To clarify the effects of mountain winds on urban temperatures, meteorological observations were conducted in the summers of 2008 and 2009 in Nagano City, central Japan. Hamada *et al.* (2006) showed that mountain winds blew along the Susobana River, extending into the center of Nagano City. This study selected Nagano Prefectural Office (NPO), which is near the center of Nagano City as a site to observe mountain winds blowing into the city, while Nagano Local Meteorological Observatory (NLMO) at the periphery of the city was selected as an observation site not to mountain winds. Wind conditions at NPO and NLMO were classified as days with (15 cases) and without (37 cases) mountain winds, respectively. Average air temperature, wind direction and speed, and relative humidity at the two points were compared for each case. As a result, at NPO, average wind speed was about 5 m/s, air temperature dropped, and relative humidity increased on days with mountain winds. On these days, air temperature was reduced by up to 2℃, with an average drop of 0.5℃. The drop in temperature with the mountain winds was negatively correlated ($r = -0.46, p < 0.001$) with wind speed, and the relationship depended on the strength of radiative cooling.

Key words : mountain wind, temperature depression, urban area, heat island, summer

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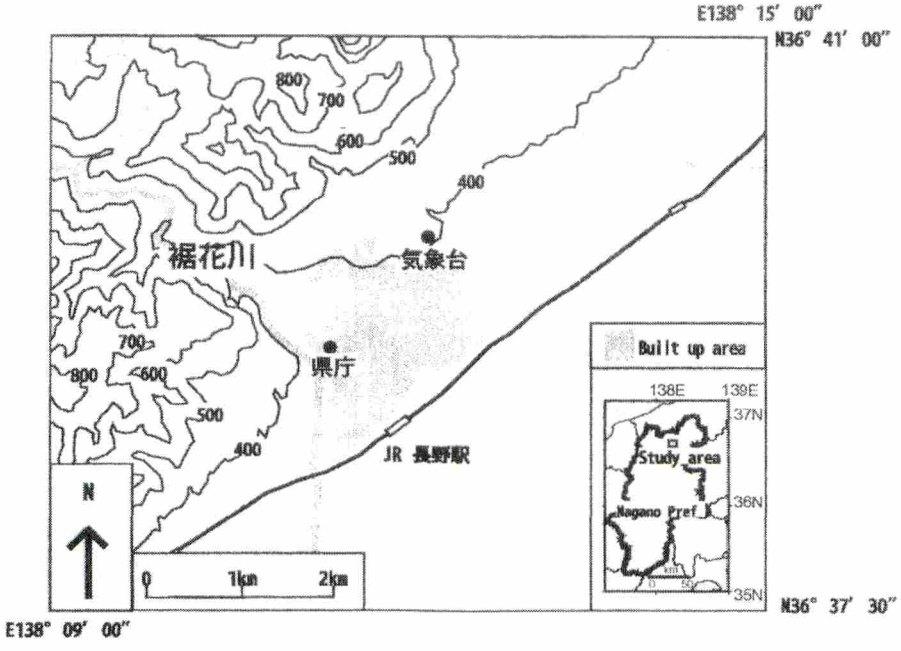

Fig. 1 Map of study area. The shaded area indicates a highly built-up area. Solid circles show meteorological measurement points.

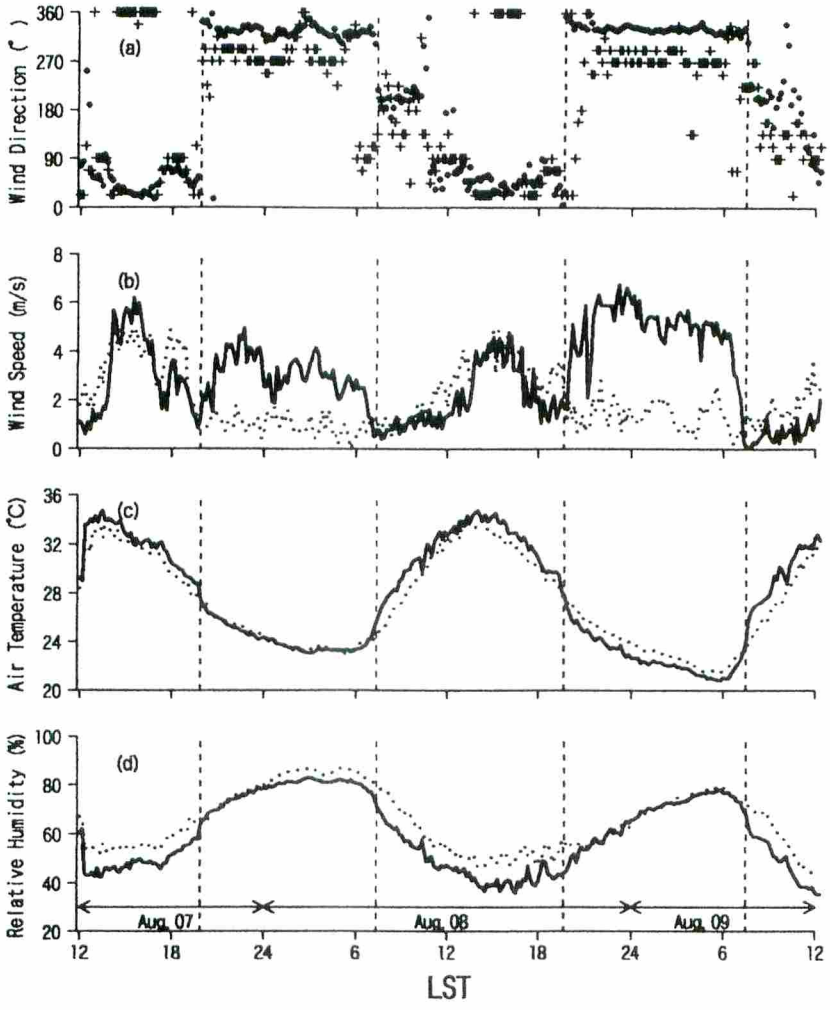

Fig. 2 Cases of typical durnal variations of mountain winds (during Aug., 7th to 9th, in 2008). (a) Wind direction, (b) Wind speed, (c) Air temperature and (d) Relative humidity. Thick lines and solid circles show observation data at NPO, and dotted lines and plus signs show meteorological data at NLMO.

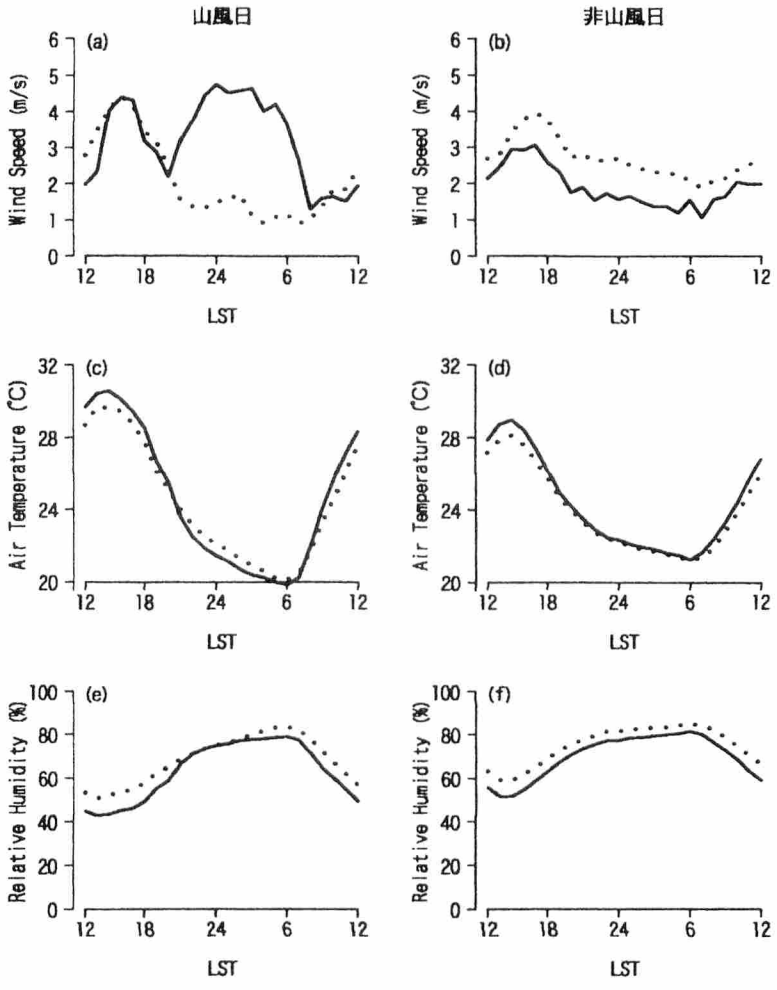

Fig. 3 Durnal variations of hourly averaged wind speeds (a, b), air temperatures (c, d) and relative humidities (e, f) both on days when mountain winds blew and did not blow. Thick lines show observation data at NPO, and dotted lines show meteorological data at NLMO.

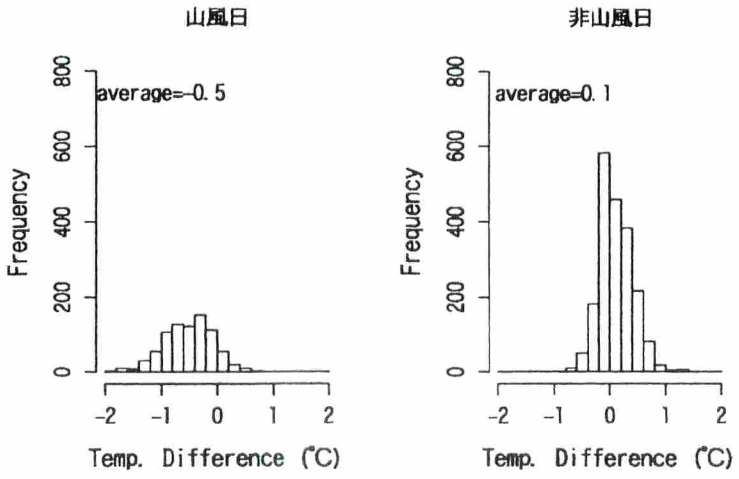

Fig. 4 Histograms of air temperature differences at NPO and NLMO both on days when mountain winds blew and did not blow.

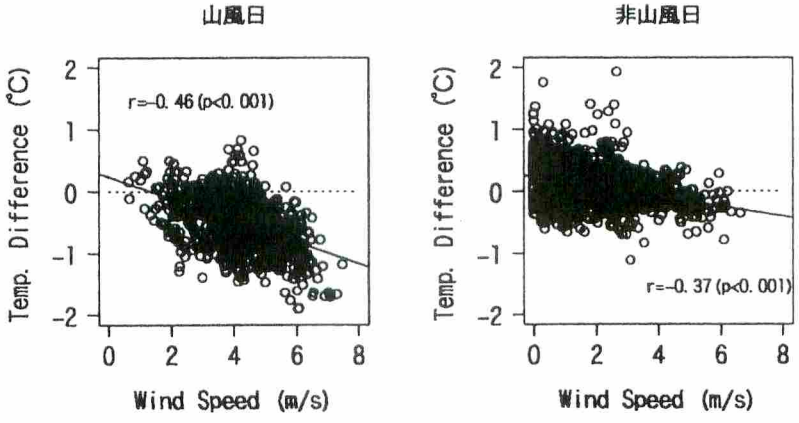

Fig. 5 Relationships between of wind speed at NPO and air temperature differences between at NPO and NLMO both on days when mountain winds blew and did not blow.

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