Contributions of Foehn winds and Urban Heat Island to the nocturnal Extreme High-Temperature Event in Niigata City, Japan.

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We quantitatively examined the contributions of foehn winds and urban heat island (UHI) effect on the extreme high-temperature (EHT) event at Niigata, Japan during the night of 23 August and early morning of 24 August 2018.

On 23 August 2018, tropical cyclone was approaching the Japanese islands. From both observation data and numerical simulation, nocturnal temperatures remained above 30.0 ℃ until 0400 local standard time (LST, UTC+9) on 24 August. During this nocturnal EHT event, southeasterly winds blew continuously.

Observation data showed that nocturnal temperatures were higher on the Niigata Plain than on the windward side of the mountain range. Backward-trajectory analysis showed the southeasterly winds came from the upwind region of the mountain range. While the southeasterly winds blew, there was rain on the windward side of the mountain range. These results suggest that the foehn wind with latent heating and precipitation blew on the day of the nocturnal EHT event. Both of the numerical simulations with and without topography showed the contribution of the foehn winds to the EHT in Niigata city was about 2.8 ℃ at 2100 LST.

Observation data indicated that a UHI effect occurred in Niigata city at 2100 LST. Both numerical simulations with and without urban area around Niigata city showed that the UHI increased surface temperatures in Niigata city by about 1.9 ℃ at 2100 LST.

The contribution of the foehn winds was greater around midnight, whereas the contribution of the UHI was greater early in the night. This result suggested that both effects changed with time.