

Reproducibility of an extremely high-temperature event in d4PDF regional climate model experiment

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In this study, we confirm whether extremely high-temperature events in the future can be expressed in regional climate model experiment of the database for Policy Decision making for Future climate change (d4PDF-RCM). Multiple dynamical downscaling (DDS) experiments from d4PDF-RCM with Weather Research and Forecasting model (WRF) were conducted and the downscaled temperature and wind fields around Niigata city on EHT event were compared with the d4PDF-RCM. In a DDS experiment with a horizontal resolution of 3 km (WRF3), the daily maximum temperature is about 3 °C higher than the d4PDF-RCM. In a DDS experiment with the topography of the d4PDF-RCM and a horizontal resolution of 20 km (WRF20d), the daily maximum temperature is about 2 °C higher than that of the d4PDF-RCM. The reason for these differences in daily maximum temperatures is that the horizontal resolution of the d4PDF-RCM and its topography was too coarse to express small-scale phenomena such as the foehn winds. The spatio-temporal structure of foehn winds is clearly expressed in WRF3. On the other hand, in the d4PDF-RCM, the structure cannot be expressed at all. Therefore, it can be not enough to directly analyze d4PDF-RCM to discuss the regional EHT events in the future climate. In addition, the spatio-temporal structure of foehn winds in WRF20d is not clearer than that of WRF3. From these results, we concluded that the DDS experiment with appropriate horizontal-resolution and topography needs to be performed to discuss regional EHT events in the future climate.

The results of the WRF3 and a DDS experiment without topography shows that foehn winds have a contribution of about 2.0 °C on this EHT event. This result suggests that more than half of the difference between the maximum temperature of the WRF3 and d4PDF-RCM was brought by the topography effect. This contribution of foehn winds is almost the same as that in the current EHT event, shown in the previous study.

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