Climate Change Adaptation to Disasters in Urban Environments

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[Abstract]

Key Words: Climate change, weather disasters, urban environments, typhoons, heat stress, extreme precipitation, regional municipalities, adaptation.

This project investigated the impacts of climate change on extreme heat, winds, snow, and rain events in the urban environments of Sapporo, Kumagaya, Niigata, Kyoto, and Osaka. First, it was found that urban heat stress is projected to worsen future climates, and in the case of Sapporo city, the number of heat-related illnesses was projected to increase significantly. While much attention has been given to urban heat island effects in major metropolitan environments, cities such as Niigata that border the Sea of Japan was also shown to experience extremely high temperatures due to the Foehn effect, often without the presence of precipitation. Next, high wind events in urban environments were examined in Kyoto and Osaka. For strong winds associated with approaching typhoons, subtle shifts in the storm track were shown to affect the distribution of the wind field. In addition, areas with low building density and varying heights were clearly shown as areas prone to strong wind gusts. Therefore, it was revealed that strong winds in urban environments are dictated by several factors, such as storm tracks, intensity, and urban layout. Lastly, weather risks associated with extreme rain and snow events were investigated. As a case study, the impacts of an extreme rain event associated with “senjo-kousuitai” on the Motsukisamu river in Sapporo were analyzed for the potential risk of flooding in the present and future climates. For extreme snow events, future projections showed that while the overall risk of record snow events will decrease throughout much of Japan, in areas such as the Sea of Japan side in Hokkaido, a potential increase was seen even toward the end of the 21st century.

Consistent dialogue with local municipalities on adaptation strategies was conducted throughout the project. For example, urban model simulations were performed to convey the benefits of large, shading structures or more densely planted trees in cities such as Kumagaya and Niigata, where such measures are already being considered to reduce heat stress in urban environments. In Sapporo, the effectiveness of a drainage tunnel in smaller river basins to reduce flooding disasters was validated for present and future extreme rain events. These studies provided supporting evidence on the effectiveness of improved building codes and disaster prevention measures planned in urban environments. For regions where further improvements can be suggested, this project’s accomplishments can provide pertinent information for adaptation and mitigation measures in response to climate change.

[References]

1) Asano, Y., Y. Nakamura, A. Suzuki-Parker, S. Aiba, and H. Kusaka: Building and Environment, 213 (2022). Effect of walking in heat-stressful outdoor environments in an urban setting on cognitive performance indoors.
2) Takemi, T., T. Yoshida, M. Horiguchi, and W. Vandebauwhede: Urban Climate, 32, 100625 (2020). Large-eddy-simulation analysis of airflows and strong wind hazards in urban areas.
3) Takabatake, D., and M. Inatsu: Climate Dynamics (2021). Summertime precipitation in Hokkaido

and Kyushu, Japan in response to global warming.