

Influence of urban heat excess on heavy rain environment

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There are several observed fact that cities give influence on the precipitation, or cumulus generation. However the mechanism of urban influence on precipitation is not clarified. There would be three physical processes. Buildings could form updraft through a roughness effect. Much heat excess from cars, air conditioners and asphalt roads could also form updraft. Urban aerosol can be a condensation nuclei and gives chance to form cloud, however too much nuclei should suppress cloud droplets growing.

This study focuses on the heat effect. We measured surface sensible heat flux in urban, suburban and rural areas, and evaluated the urban heat excess quantitatively. The resulted heat excess amount was used to in calculation of atmospheric stability index.

In the heat flux measurement, the eddy correlation method which should be the most reliable way of heat flux measurement was used at the rural and suburban site. At urban site, we used the scintillation method which has a advantage of larger scale of measurement (km scale) than that of the eddy correlation method (100 m scale). The reason for taking scintillation method at urban site is severe heterogeneity in urban area. Urban area is mosaic of buildings, roads, parks, bare soil on the school ground field, and sometimes rivers or channels. Scintillation method enable us to measure the area-averaged heat flux in the urban heterogeneity. We used a modified scintillation method which takes into account of surface unevenness by the buildings. We operated measurement site for three years and analyzed a hourly composite of 50 fine days in July. As a result, urban heat flux is largest followed by suburban and rural. The difference between urban and rural was 140 Wm⁻² at noon time.

We evaluated CAPE index for each site. We used simple 1D model to calculate the change of temperature profile by the surface flux. The morning initial condition to calculate daytime growing of mixed layer was acquired from the sonde observation. We adopted same initial profile for urban, suburban and rural, and give observed surface heat flux for each. This way of analysis evaluates thermal influence of land-use on CAPE index. The CAPE at 1500 LST is largest in cities and the difference between rural and city is 15%.

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