Geophysical Research Abstracts
Vol. 13, EGU2011-4805-2, 2011
EGU General Assembly 2011

Relationships between extreme daily precipitation intensity and temperature over the world based on in-situ observation data

Nobuyuki Utsumi (1), Taikan Oki (1), Shinta Seto (1), Shinjiro Kanae (2), and Eduardo Eiji Maeda (3)

(1) Institute of Industrial Science, University of Tokyo, 153-8505, Tokyo, Japan (utsumi@rainbow.iis.u-tokyo.ac.jp), (2) Tokyo Institute of Technology, Tokyo, Japan, (3) Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland

In this study, the relationships between extreme daily precipitation intensity and daily temperature were investigated over broad range of the world based on in-situ observation data. The results showed that regions with Clausius-Clapeyron like relationships between extreme daily precipitation intensity and temperature were limited.
Recently, it has been discussed whether extreme precipitation intensity scales with the atmospheric water vapor content which is expected to increase with rising temperature at a rate of approximately 7%/oC from Clausius-Clapeyron (C-C) relationship, if the constant relative humidity can be assumed.
Although there were precedential studies which investigate the relationships between extreme precipitation intensity and daily mean temperature (e.g., Lenderink and van Meijgaard [2008], Berg et al.[2009], Jones et al., [2010]), studies were limited only in Europe and Australia. This study aims to clarify how the relationships between extreme precipitation intensity and daily mean temperature is universal on the globe.
The methodology of Lenderink and van Meijgaard [2008] was followed in this study using in-situ data for daily precipitation and temperature obtained from Global Historical Climatology Network - Daily (GHCN-daily).Daily precipitation data for each station were grouped based on daily "average" temperature bin, which were calculated by averaging daily minimum and daily maximum temperature, and 99th percentile of daily precipitation intensity for each temperature bin were estimated.
At most part of the world except for very low and very high latitude regions, the relationships between precipitation intensity and temperature at a station can be separated to two phases: (1) the precipitation intensity increases exponentially with rising temperature in the lower to middle temperature range, (2) the precipitation intensity decreases and the slope of precipitation intensity and temperature relationship become negative at higher temperatures. At the very high latitude regions, the stations with only phase 1 were dominant. On the other hand, stations with only phase 2 were dominant at the equatorial regions.
Regions where the C-C like relationship of precipitation intensity and temperature can be found at phase 1 were limited. The C-C like relation were dominant in eastern Asia at middle latitudes, eastern Australia at middle latitude, coastal regions around the Gulf of Mexico, pacific coastal regions of North America, and a part of the eastern Europe around Ukraine and Romania.

References

Lenderink, G. & Van Meijgaard, E. Increase in hourly precipitation extremes beyond expectations from temperature changes. Nature Geoscience 1, 511–514 (2008).
Berg, P. et al. Seasonal characteristics of the relationship between daily precipitation intensity and surface temperature. Journal of Geophysical Research 114, D18102 (2009).
Jones, R.H., Westra, S. & Sharma, A. Observed relationships between extreme sub-daily precipitation, surface temperature, and relative humidity. Geophys. Res. Lett. 37, 5 PP. (2010).