Session: C8 Poster: M68A

Changes in intense precipitation over the conterminous U.S.: Observational evidence and possible causes

Pavel Groisman[†]; Richard Knight; Thomas Karl
[†] UCAR at NOAA National Climatic Data Center, USA
Leading author: pasha.groisman@noaa.gov

In the United States during the past 62 years (1948-2009), the climatology of intense precipitation events, their regional distribution, internal structure (mean and peak hourly intensity and duration) and changes can be analyzed using the long-term time series of dense networks of daily and hourly precipitation gauges. After a major data rescue effort in 2000, daily precipitation data set can be analyzed on a century time scale. Hourly precipitation measurements, HPD (while being conducted for more than 100 years at a dense network of U.S. stations) are in digital form only since 1948. When the data rescue efforts of the HPD network will be completed for the pre-1948 period, analyses of the hourly data can also be expanded to the century time span. On average over the conterminous United States (CONUS), two thirds of annual precipitation falls during approximately 20% of rain days with totals above 12.7 mm (or 0.5 inch; intense precipitation). We focus only on these precipitation days and multi-day events constructed from consecutive intense precipitation days. We also define extreme daily and multi-day rain events that may be loosely attributed to floods, property damage, or loss of life and in the following discussion are associated with rare events that are above 155 mm (6 inches). We found that over time in each large region of CONUS, the internal precipitation structure (e.g., mean duration and mean and maximum hourly precipitation rates within each preselected range of daily or multi-day event totals) did not noticeably change. Furthermore, our analyses show that over the eastern two-thirds of CONUS, a redistribution in the frequency distribution of intense precipitation days/events during the past decades has occurred. Moderately heavy events (those with daily totals between 12.7 mm and 25.4 mm) became less frequent compared to days and events with precipitation totals above 25.4 mm. During the past 3 decades (compared to the previous 3 decades), significant increases occurred in the frequency of "very heavy" (above 76.2 mm) and extreme precipitation events in the central region of the CONUS (which is about 35% of CONUS spreading from the Great Lakes and Midwest to the Gulf Coast), with up to 40% increases in the frequency of days and multi-day rain events with precipitation totals above 155 mm. Several possible causes of observed changes in intense precipitation are discussed and/or tested. Tropical cyclones do not significantly contribute to the changes that we found for the Central U.S. The observed changes coincided with (a) global warming and (b) a significant (two-or threefold) increase in the total yield of agriculture production in the Central U.S. (soybeans and corn yield). Keeping in mind that evapotranspiration from the agriculture fields is linearly proportional to their yield, we speculate that the observed dramatic changes in extreme precipitation in the Central U.S. (at least partially) can be a result of the local anthropogenic factor, the change in land use that intensified recycling of local precipitation during the warm season. Over the next several decades, society cannot realistically impact the "global climate" component of Earth System changes. However, the impact of regional land use changes (after it is understood and quantified) arguably can be projected and even reversed if its negative impact is proven and outweighs its benefits. A combination of global and regional climate and hydrological modeling driven by well documented external anthropogenic forcing (that includes in addition to global factors, regional land use and water management changes) can be a way to perform this attribution study. Only thereafter, can the acquired knowledge be used for realistic regional projections of intense precipitation including extreme rainfall.