

## **Meteorological Causes of Observed Extreme Precipitation Trends in the U.S.**

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### **Abstract**

This study investigated whether there have been secular changes in the frequency, intensity, and other characteristics of the meteorological phenomena producing heavy precipitation. A set of 930 long-term stations, distributed throughout the U.S., was used to identify extreme daily heavy precipitation events over the period of 1908-2009. Extreme events were defined as daily precipitation totals exceeding the threshold for a 1 in 5 year recurrence. A total of 20,242 events were examined. The meteorological cause of each event was identified as one of the following: extratropical cyclone near a front (ETC-FRT), extratropical cyclone not near a front (ETC-NFRT), tropical cyclone (TC), mesoscale convective system (MCS), air mass convection (AMC), North American Monsoon (NAM), and upslope flow (USF).

Analysis of this new set of data reveals the following key points:

- The percentage of events ascribed to each cause were 54% for ETC-FRT, 24% for ETC-NFRT, 13% for TC, 5% for MCS, 3% for NAM, 1% for AMC, and 0.1% for USF
- The overall upward trend in the frequency of heavy events is primarily a warm season phenomena, and concentrated in the late summer/early fall
- The upward trends appear to be largely driven by increases in events associated with fronts (ETC-FRT) and tropical cyclones
- The recent (last 25 years) elevated level of frequency of occurrence is accompanied by increases in the precipitable water associated with events in the warm season. This is suggestive that increases in water vapor may be a primary cause.