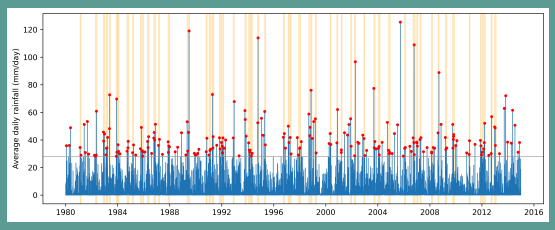
CLUSTERING OF EXTREME RAINFALL IN SOUTHEAST TEXAS

SOUTHEAST TEXAS
URBAN INTEGRATED FIELD LAB

How back-to-back heavy rainfall events increase flood risk

WHY NOW?

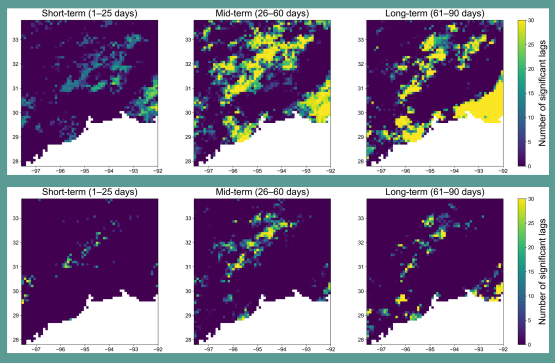
Flooding in Southeast Texas is often driven by heavy rainfall, but flood risk depends on more than how much rain falls in a single storm. When heavy rainfall events occur close together in time, rivers and soils may not fully recover between events. This clustering of rainfall can increase flood risk, strain infrastructure, and worsen impacts on communities, especially in a rapidly urbanizing, coastal region like Southeast Texas. These concerns motivate a closer look at rainfall timing effects, which are rarely examined directly in flood assessments.



Average daily rainfall (blue) highlighting independent extreme storms (red) and clustered rainfall periods (orange).

WHAT WE DID

The SETx-UIFL analyzed more than five decades of daily rainfall and river discharge data across Southeast Texas to examine whether extreme rainfall events occur randomly or tend to cluster over time. The research team identified extreme rainfall days using location-specific thresholds derived from gridded precipitation data. The researchers then evaluated the timing of these events by comparing observed rainfall patterns to both random and seasonal expectations. Finally, researchers assessed whether clustered rainfall episodes were followed by higher river flows across major river basins. To better understand these relationships, the SETx-UIFL also evaluated how the rainfall–discharge response varied under different rainfall accumulation conditions, helping confirm that the clustering signal was consistent.



Spatial patterns of clustered rainfall across Southeast Texas (A) Clustering compared to a random rainfall pattern. (B) Clustering after accounting for seasonal rainfall. Brighter areas show locations where storms occur close together in time.

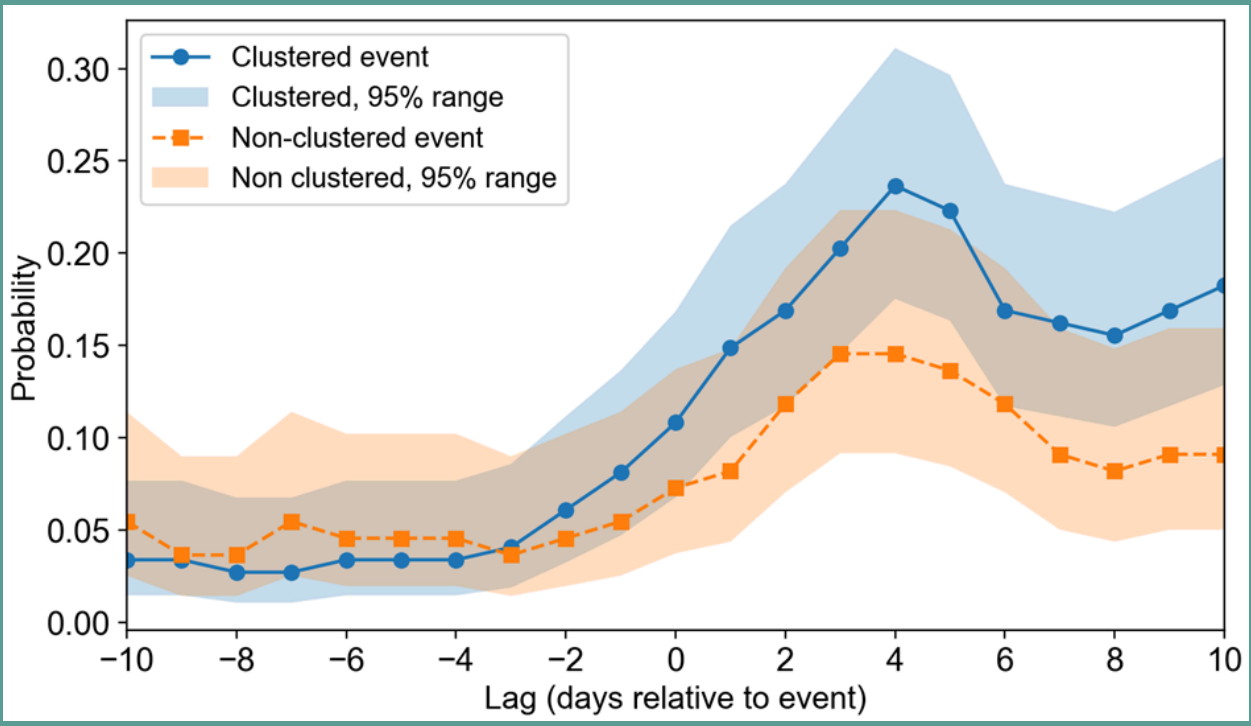
FINDINGS

• Extreme rainfall often occurs in clusters. In Southeast Texas, heavy rainfall events frequently occur close together in time rather than as isolated storms, with clustered periods lasting several weeks.

• Clustering varies across the region. Some areas show stronger clustering than others. Apparent coastal clustering weakens when seasonal rainfall patterns are considered, highlighting the role of organized storm systems such as tropical cyclones, or hurricanes.

• Clustered rainfall increases the likelihood of high river discharge. Periods with clustered rainfall are associated with a higher likelihood of extreme river discharge, especially within a few days after a clustered episode ends.

• Rainfall timing matters for flood risk. Flood risk is influenced not only by how much rain falls, but also by how closely heavy rainfall events occur in time. Including rainfall timing in flood assessments can help better anticipate periods of elevated flood risk.



Probability curves show a higher likelihood of extreme river flow after clustered rainfall compared to isolated storms.

MORE ABOUT SETX-UIFL

The Southeast Texas Urban Integrated Field Lab (SETx-UIFL) is one of four projects funded in 2022 by the U.S. Department of Energy to study how climate, environment, and urban changes affect cities. A team of over 80 researchers from UT, Lamar University, Texas A&M, Prairie View A&M, Oak Ridge National Lab, and Los Alamos National Lab has collected data and conducted modeling across hazards including flooding, hurricanes, heat stress, and air quality. Our Why: Southeast Texas faces numerous hazards, yet smaller communities like this one have often felt forgotten compared to larger cities. The SETx-UIFL was designed to explore the complex dynamics of disaster vulnerability for this economically and culturally vibrant region. We believe Southeast Texas is a bellwether for the entire Gulf Coast, and an exemplar for strategies that protect people and places. We hope this effort supports your path toward lasting resilience.

PAOLA PASSALACQUA
University of Texas at Austin & ETH Zurich
ppassalacqua@ethz.ch

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