

The importance of compound events in water-related impact assessments (Wahl et al., in prep)

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# HURRICANE HARVEY

## SATELLITE AND RADAR



**HURRICANE HARVEY**  
Category: 4  
Wind: 130 mph  
Movement: NW at 8 mph

Houston

Victoria

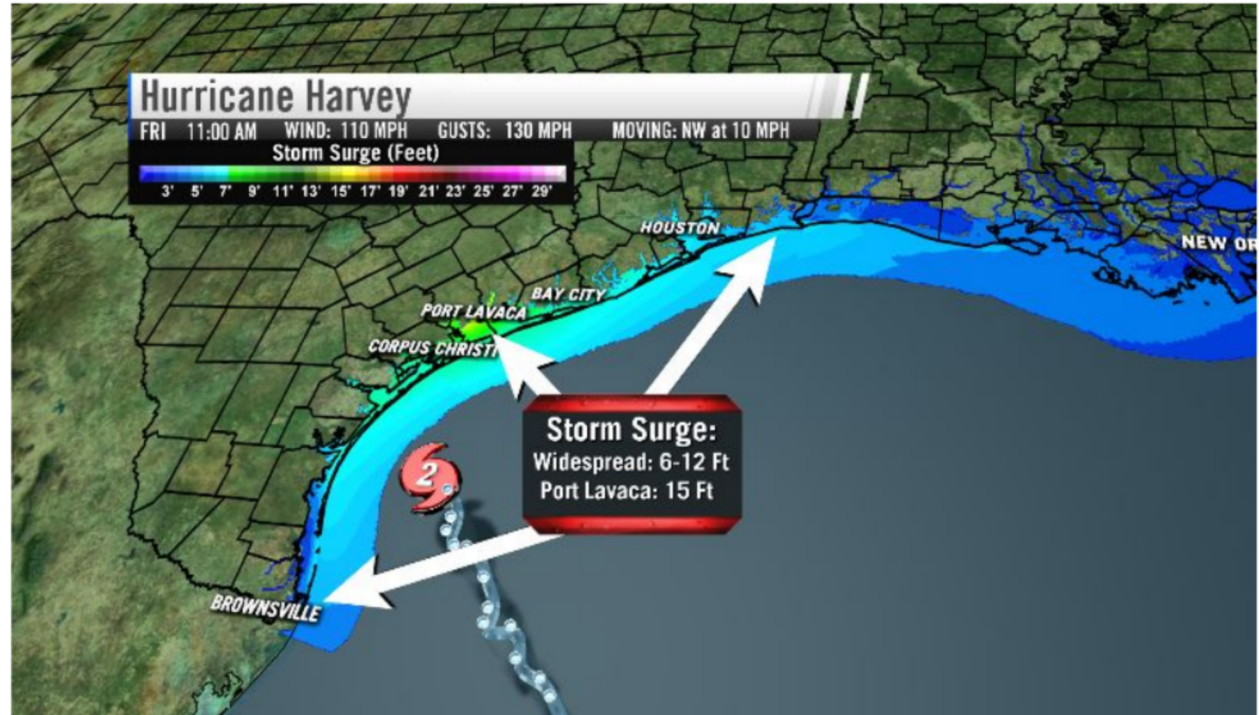
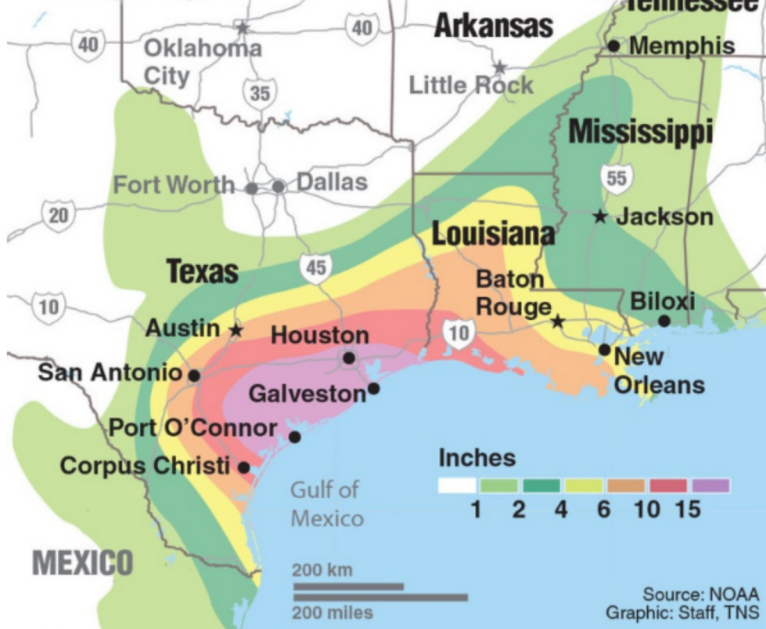
Corpus Christi



# Hurricane Harvey (Houston) - 2017

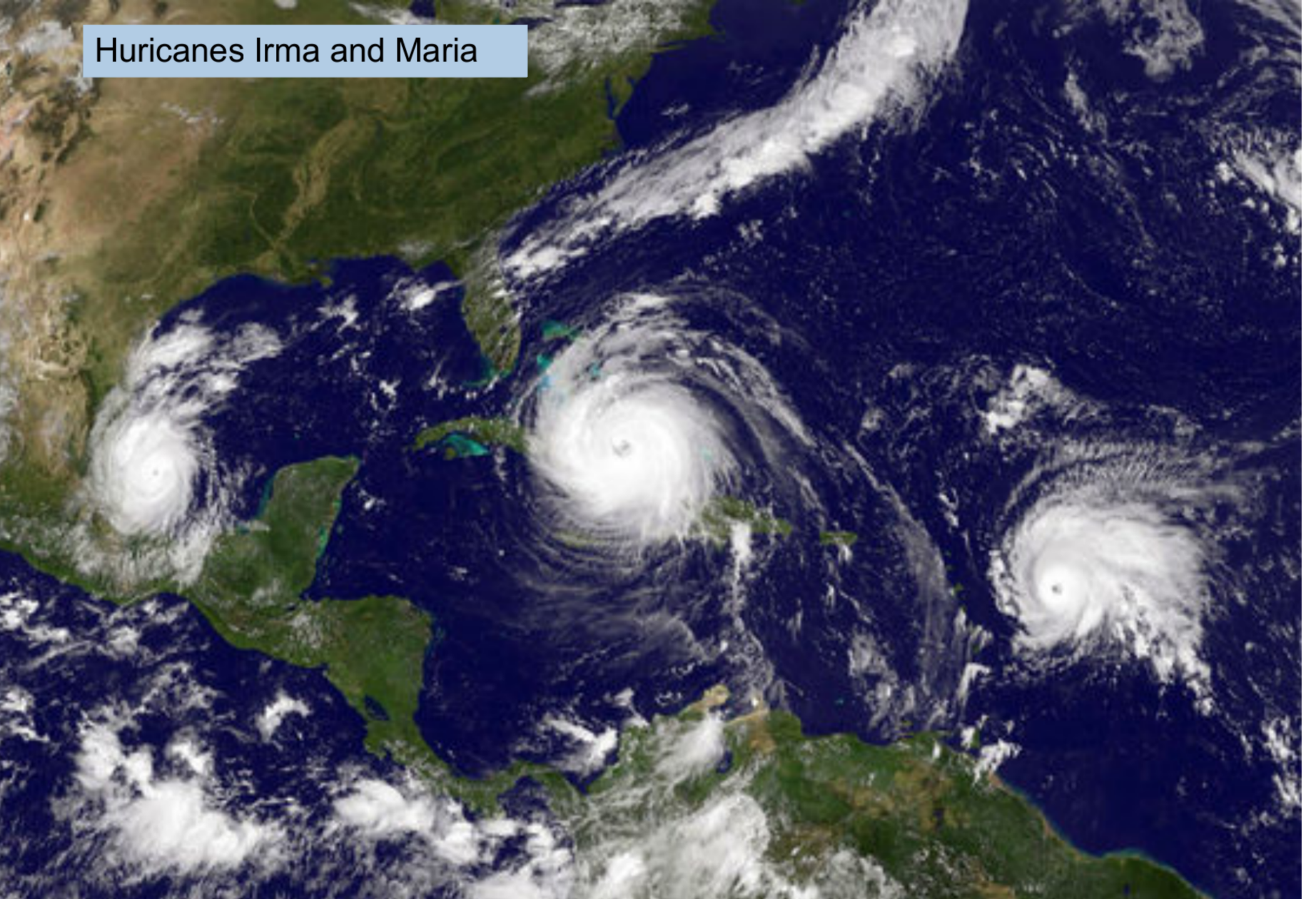
## Potential Harvey rainfall

Through Aug. 31





# Hurricanes Irma and Maria





# Hurricane Irma & Maria (Caribbean) - 2017

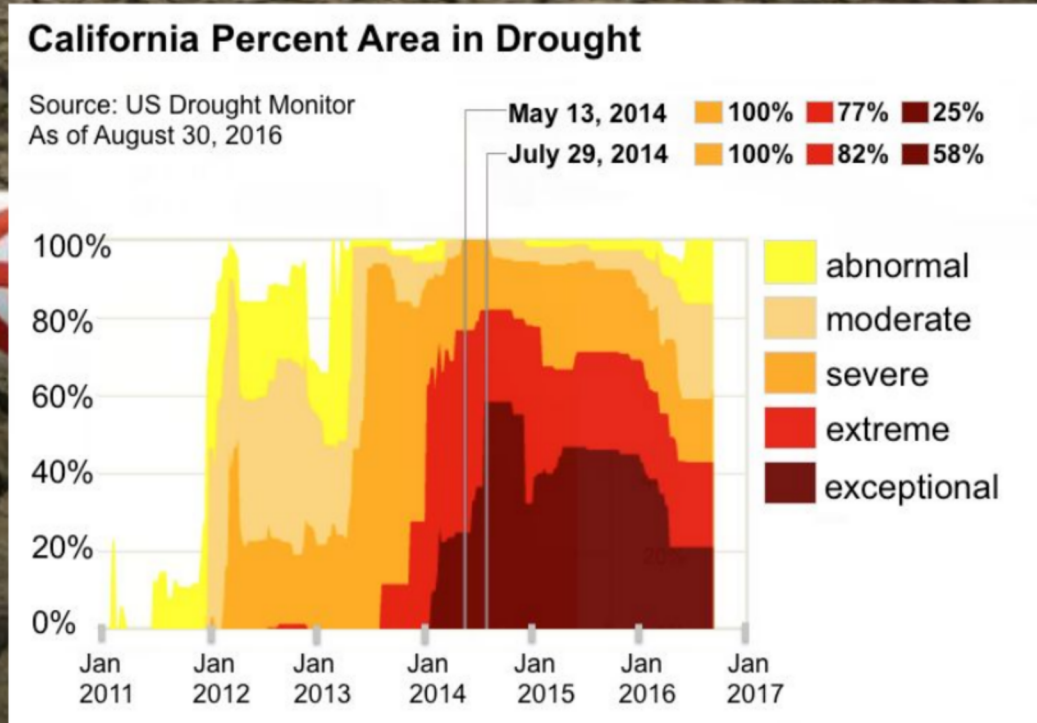
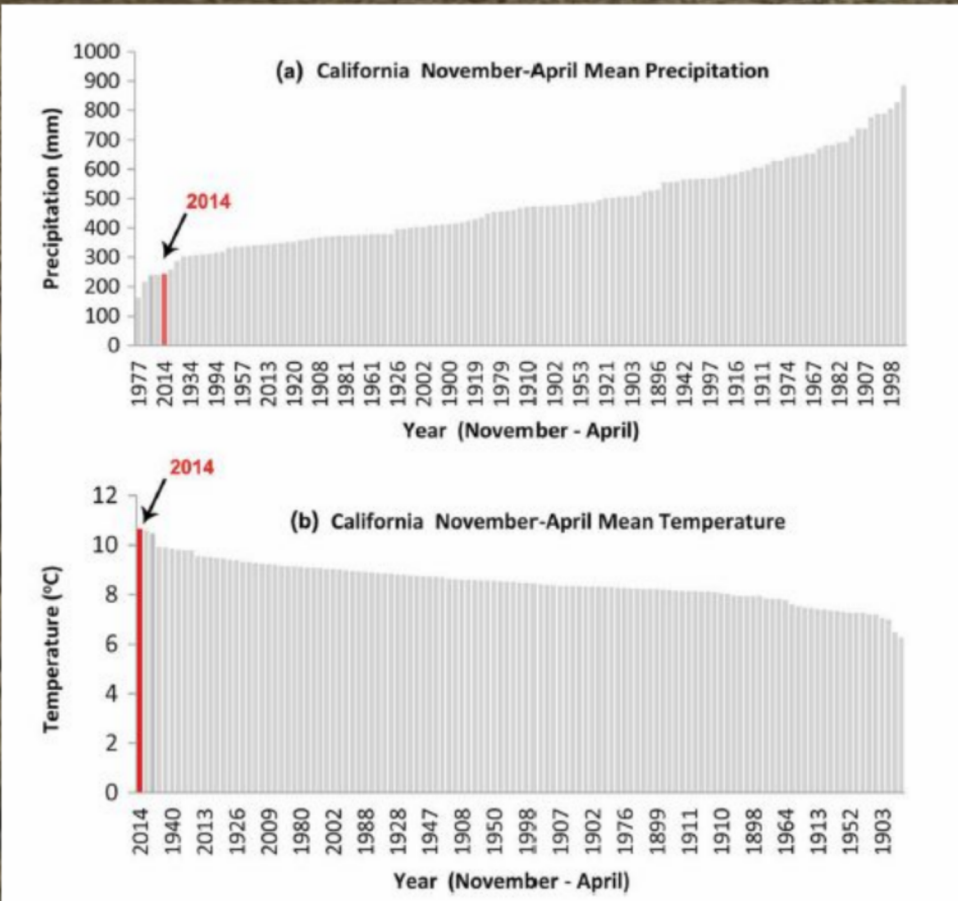






Liam Reading, University of Maine

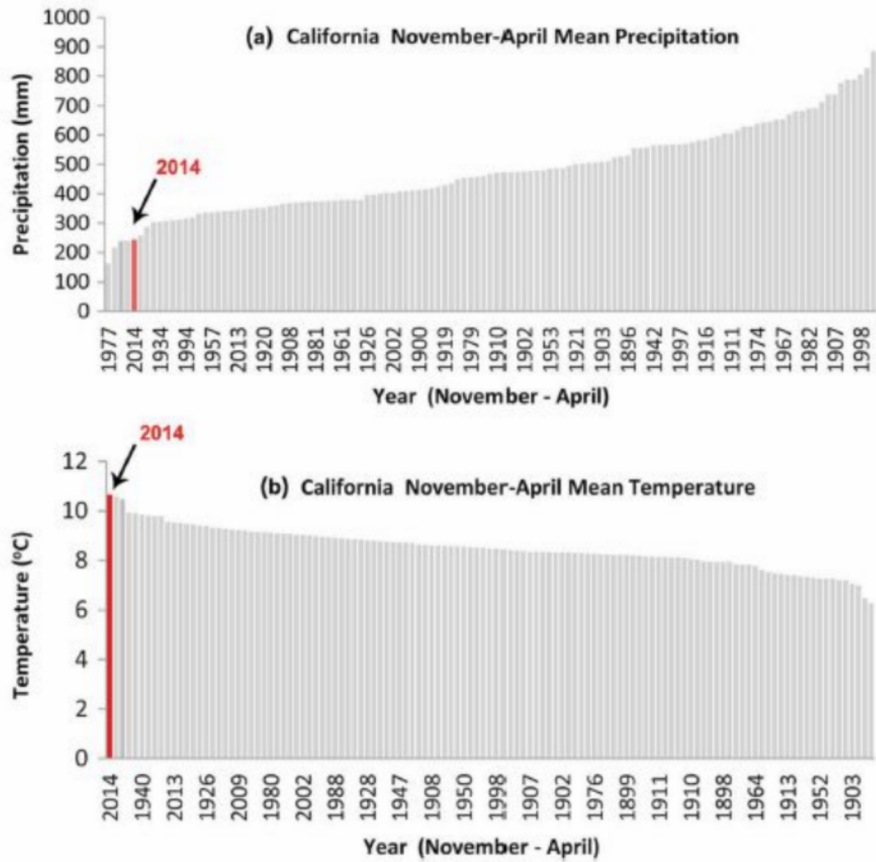




(AghaKouchak et al., 2014)

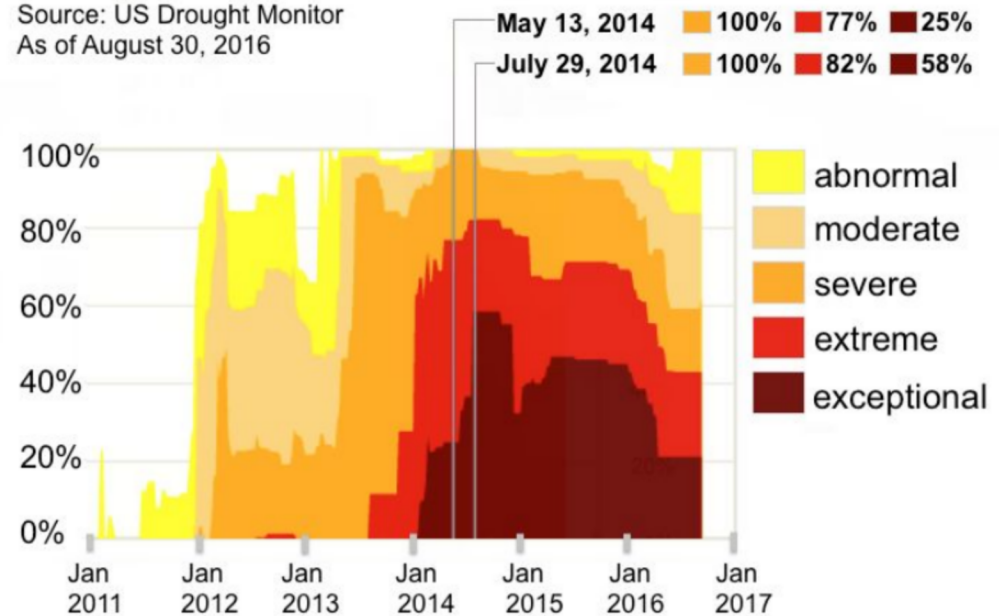


# California drought – 2012-2016



## California Percent Area in Drought

Source: US Drought Monitor  
As of August 30, 2016



(AghaKouchak et al., 2014)



# Compound events (Seneviratne et al., 2012):

- (1) two or more extreme events occurring simultaneously or successively;
- (2) combinations of extreme events with underlying conditions that amplify the impact of the events;
- (3) combinations of events that are not themselves extremes but lead to an extreme event or impact when combined. The contributing events can be of similar (clustered multiple events) or different type(s)

Not align with traditional extreme-categories or methodologies to assess risk

Compound events often overlooked in global policy making



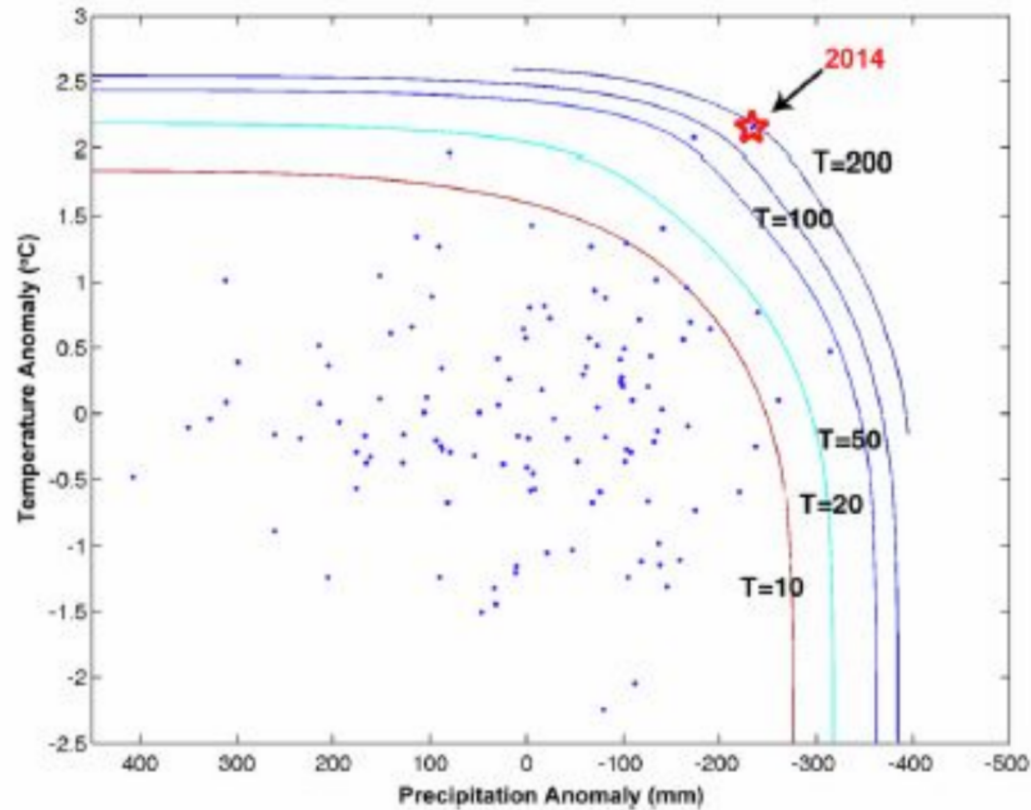


**Preparedness to compound events is critical and has been identified as an important challenge (WCPD and Challenge on Extremes)**

*Compound events often overlooked in global policy making*



# What makes compound events challenging?



(AghaKouchak et al., 2014)

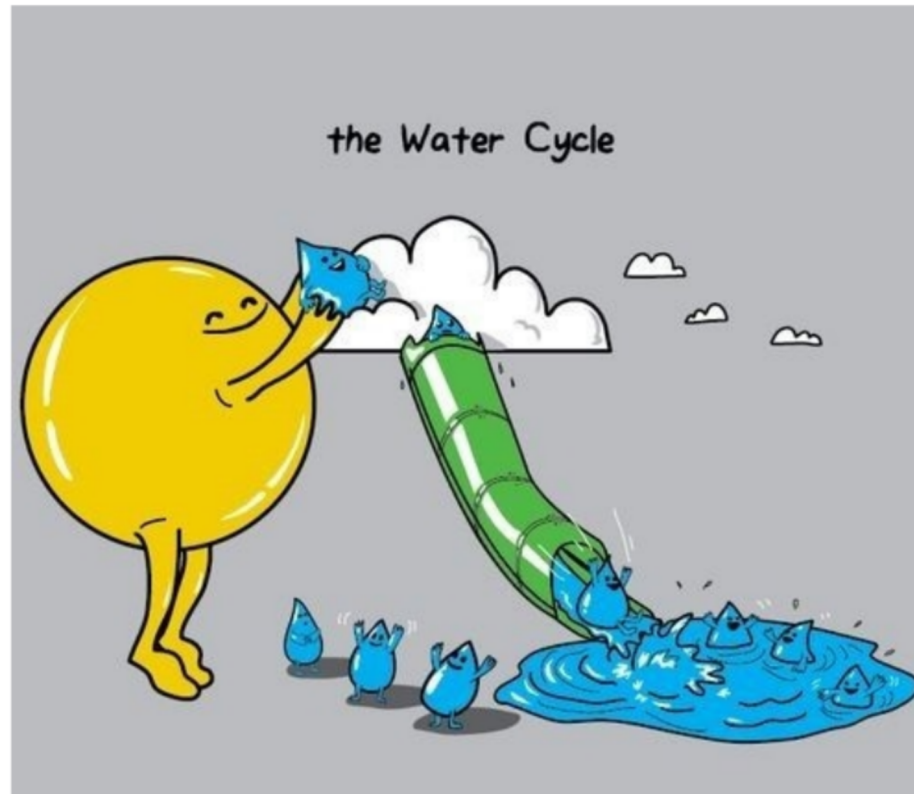
**Not align with traditional extreme-categories or methodologies to assess risk**



# What makes compound events challenging?

Different mechanisms may impact driving variables

Changing dependency structures may alleviate/worsen impacts



**Unraveling the potential influence of climate change and natural variability**



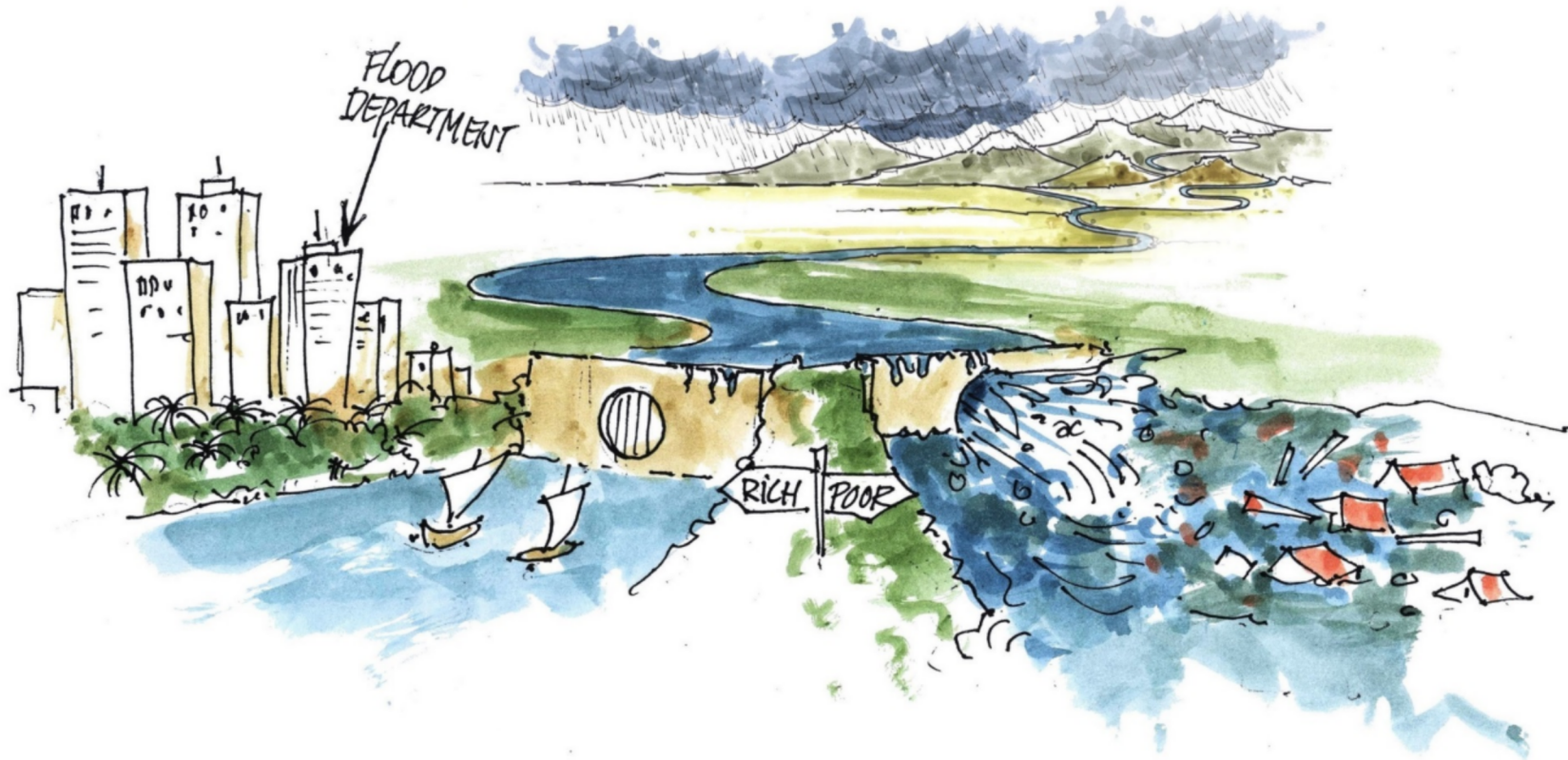
# What makes compound events challenging?

- Different mechanisms may impact driving variables
- Changing dependency structures may alleviate/worsen impacts





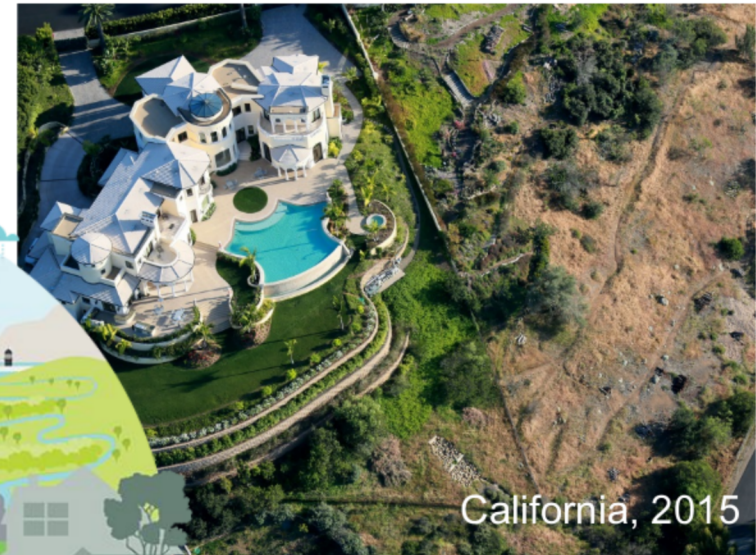
# What makes compound events challenging?



**The (changing) nature of human activities**



# What makes compound events challenging?

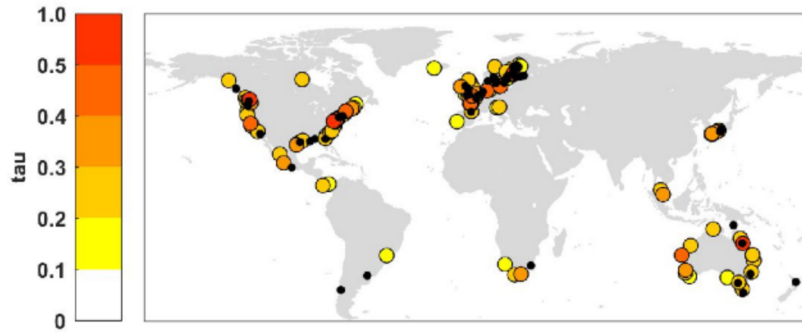




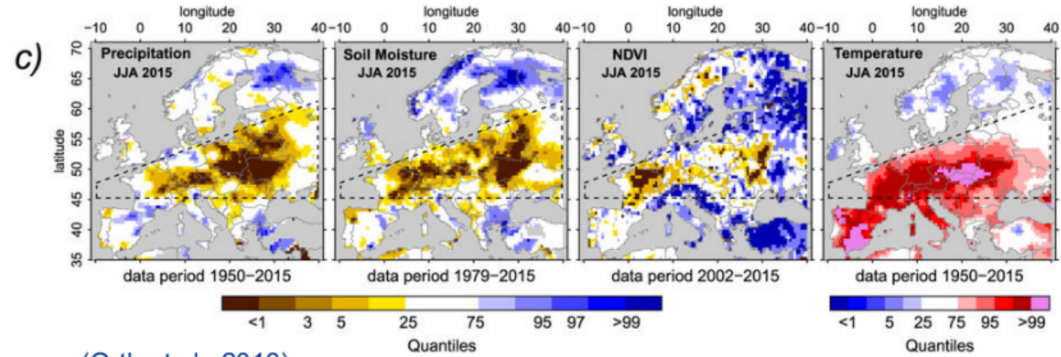


**Compound events provide an important interdisciplinary lens to identify knowledge gaps in disaster risk management and infrastructure design.**

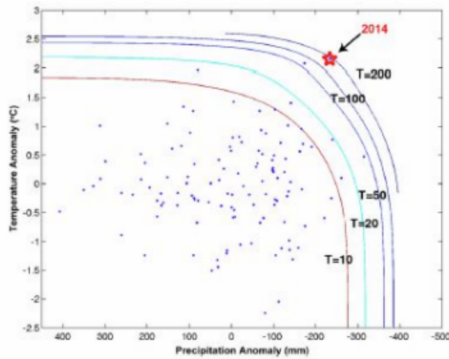
# Growing scientific community



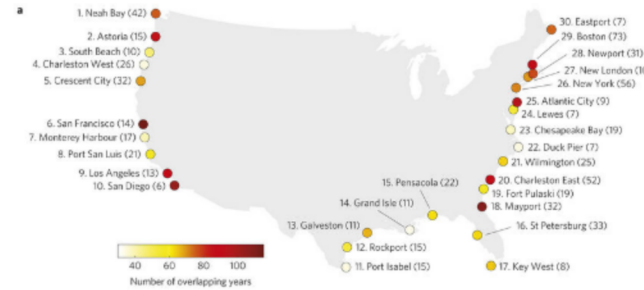
(Ward et al., in prep)



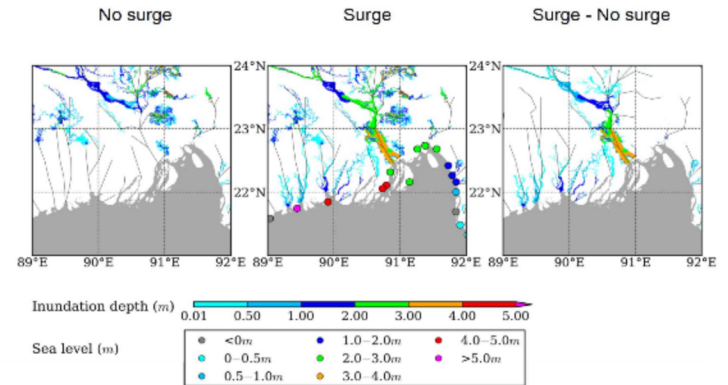
(Orth et al., 2016)



(AghaKouchak et al., 2014)



(Wahl et al., 2015)



(Ikeuchi et al., 2017)



# The way forward

- Exploit bottom-up approaches to articulate the relevant attributes of the impact system;
- Include understanding of how (bounded) human rational behavior may potentially trigger, create, or alleviate the occurrence/impact of compound events;
- Identify additional key variable and event combinations needing scrutiny;
- Use appropriate statistical methods to simulate dependence in time, space, and across variables;
- Identify data and model requirements for documenting, understanding, simulating and attributing compound events;
- Incorporate compound events into impact assessments and disaster risk mitigation efforts.