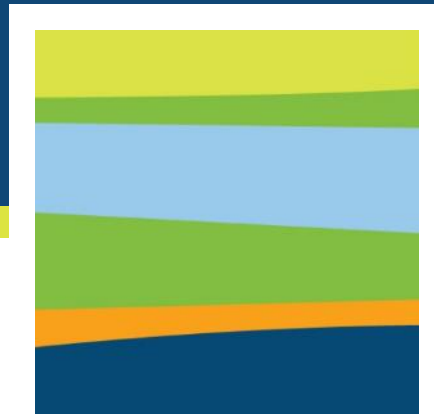


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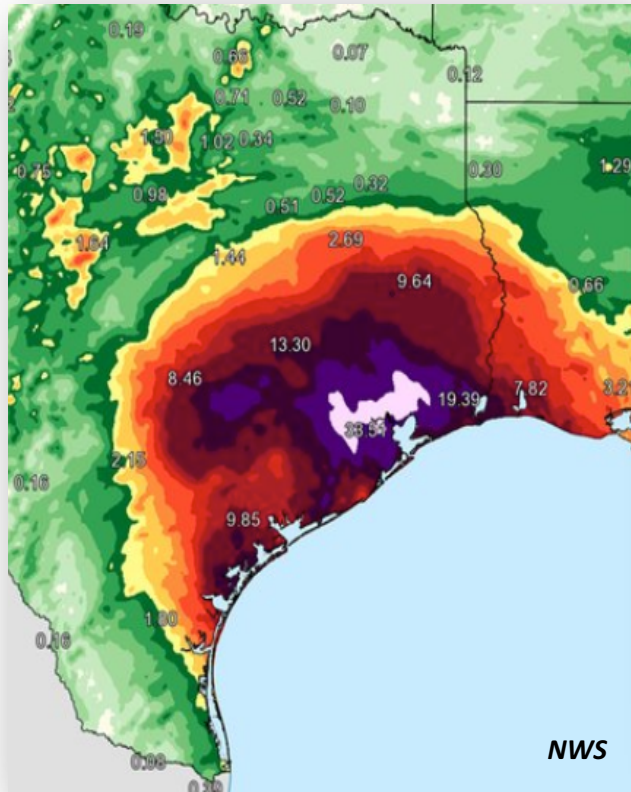


HARC

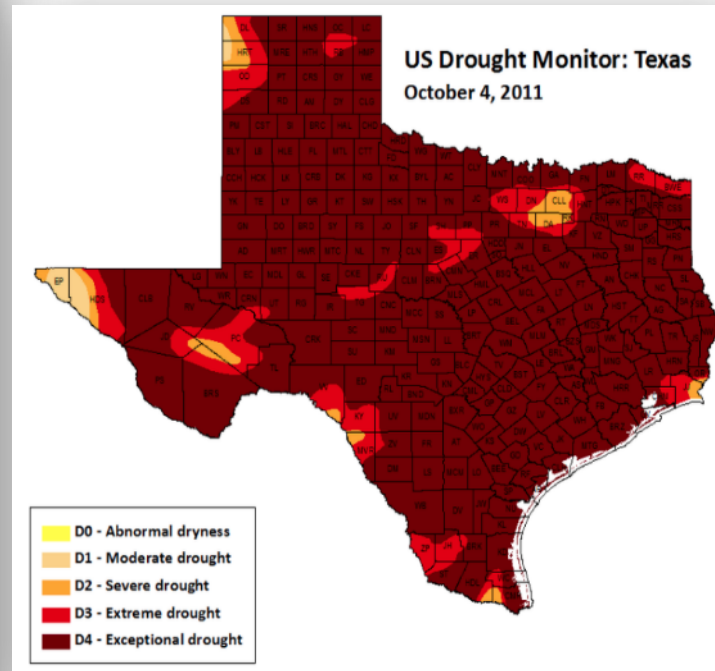
Resilience: Going Beyond Recovery



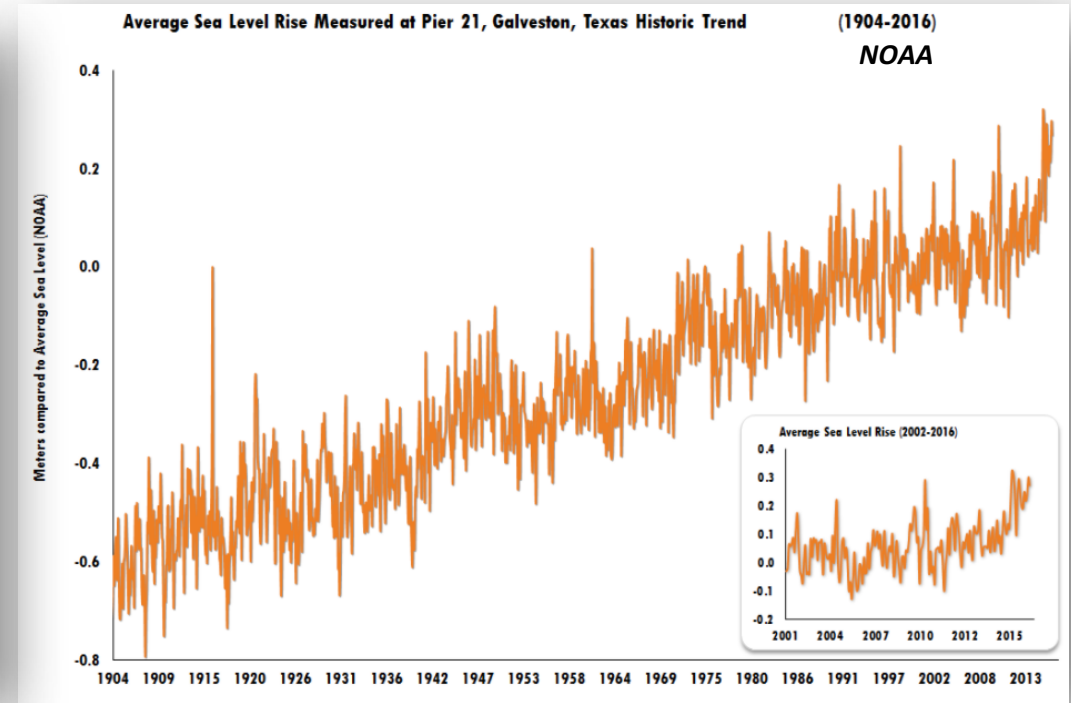
Managing to Extremes in Texas



Flood



Drought



Relative Sea Level Rise

Is the Past a Good Guide for the Future?

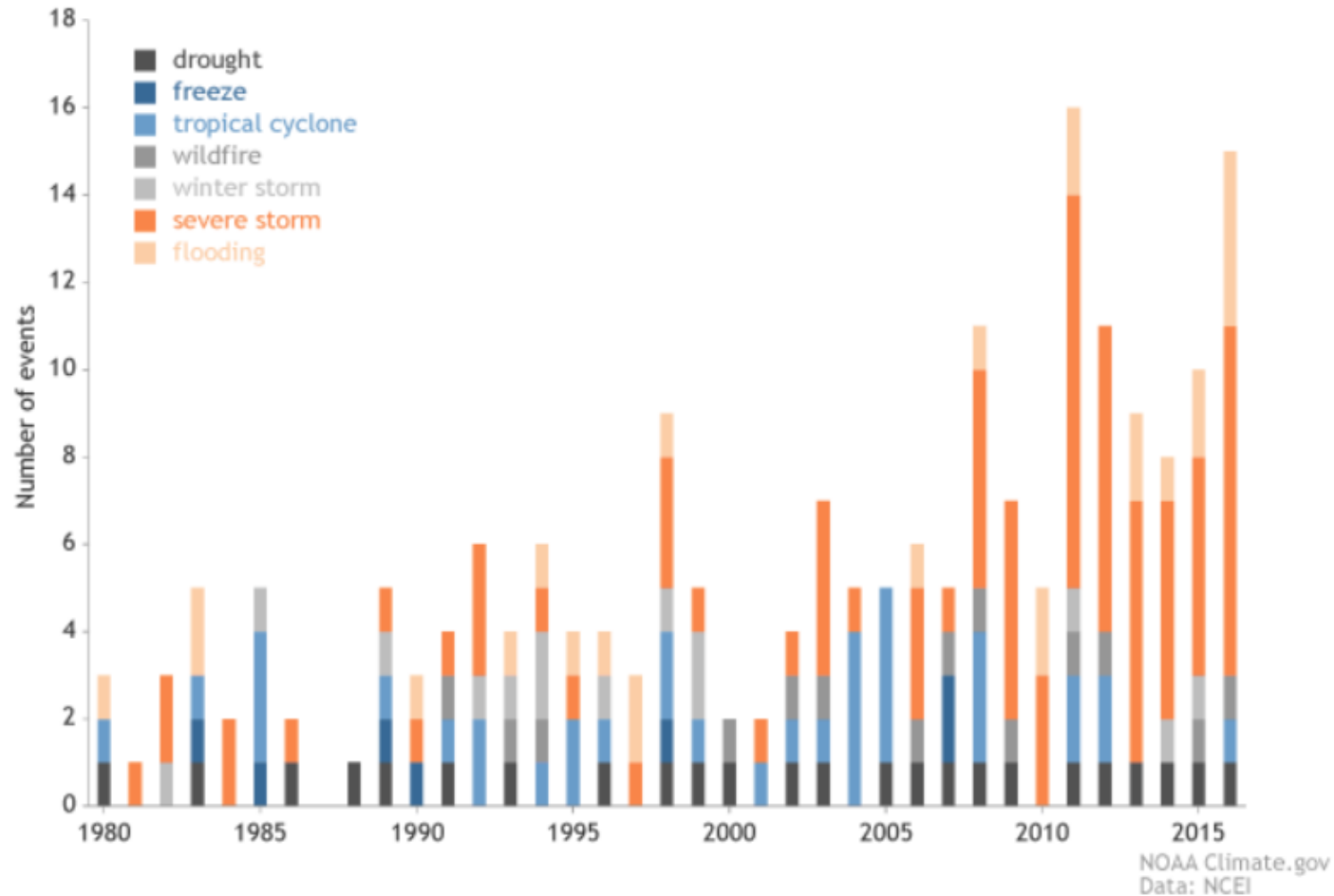


- New sources of information & analyses
- Plan for possible future scenarios
- New strategies & solutions



Future Likelihood of Extreme Events

Billion-dollar disasters by type, from 1980-2016



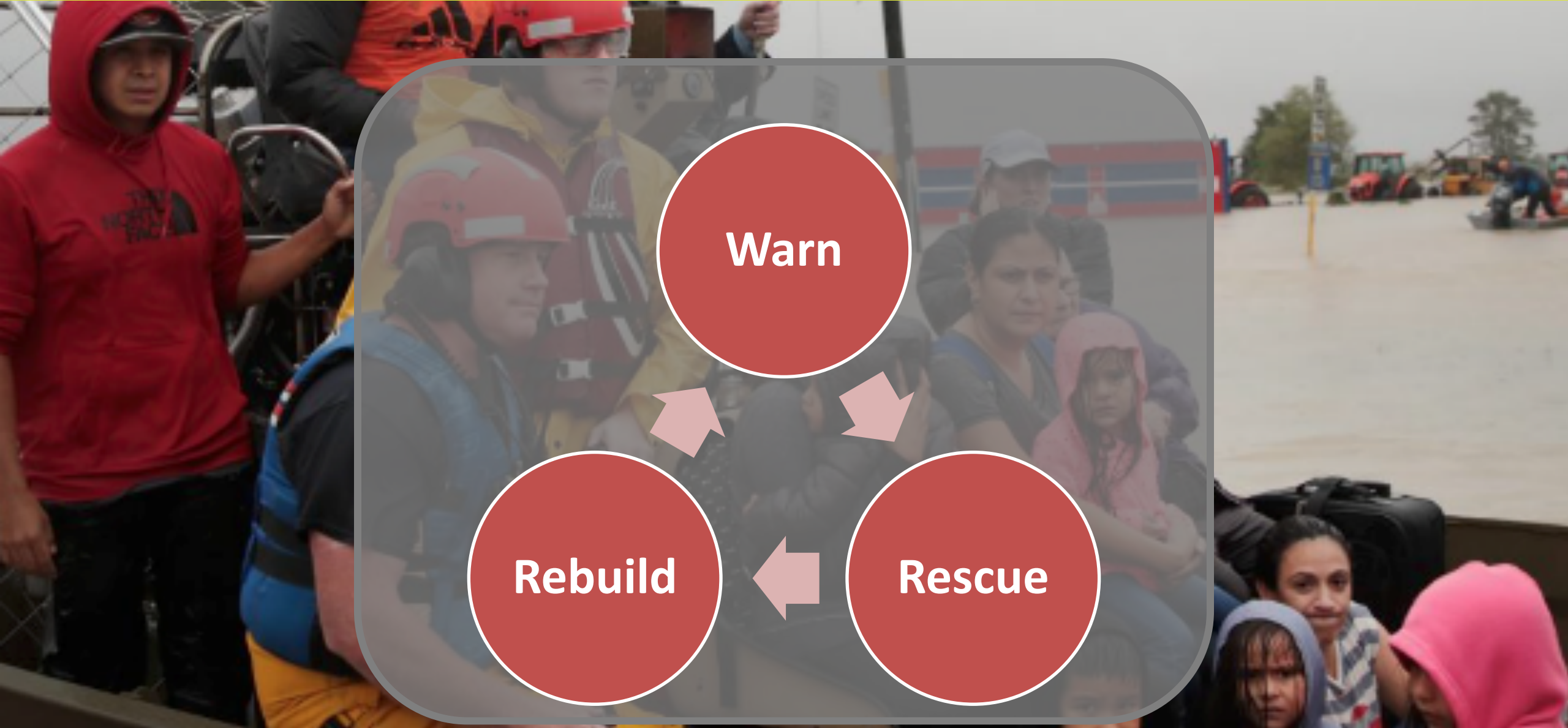
Increasing annual likelihood of Texas rainfall events > 20 inches:

- Yr 2000 ~ every 100 years
- Yr 2017 ~ every 16 years
- Yr 2100 ~ every 5.5 years

K. Emanuel. 2017. Assessing the present and future probability of Hurricane Harvey's rainfall. Proc Nat. Acad. Sci.

Are we ready???

Traditional Response & Recovery

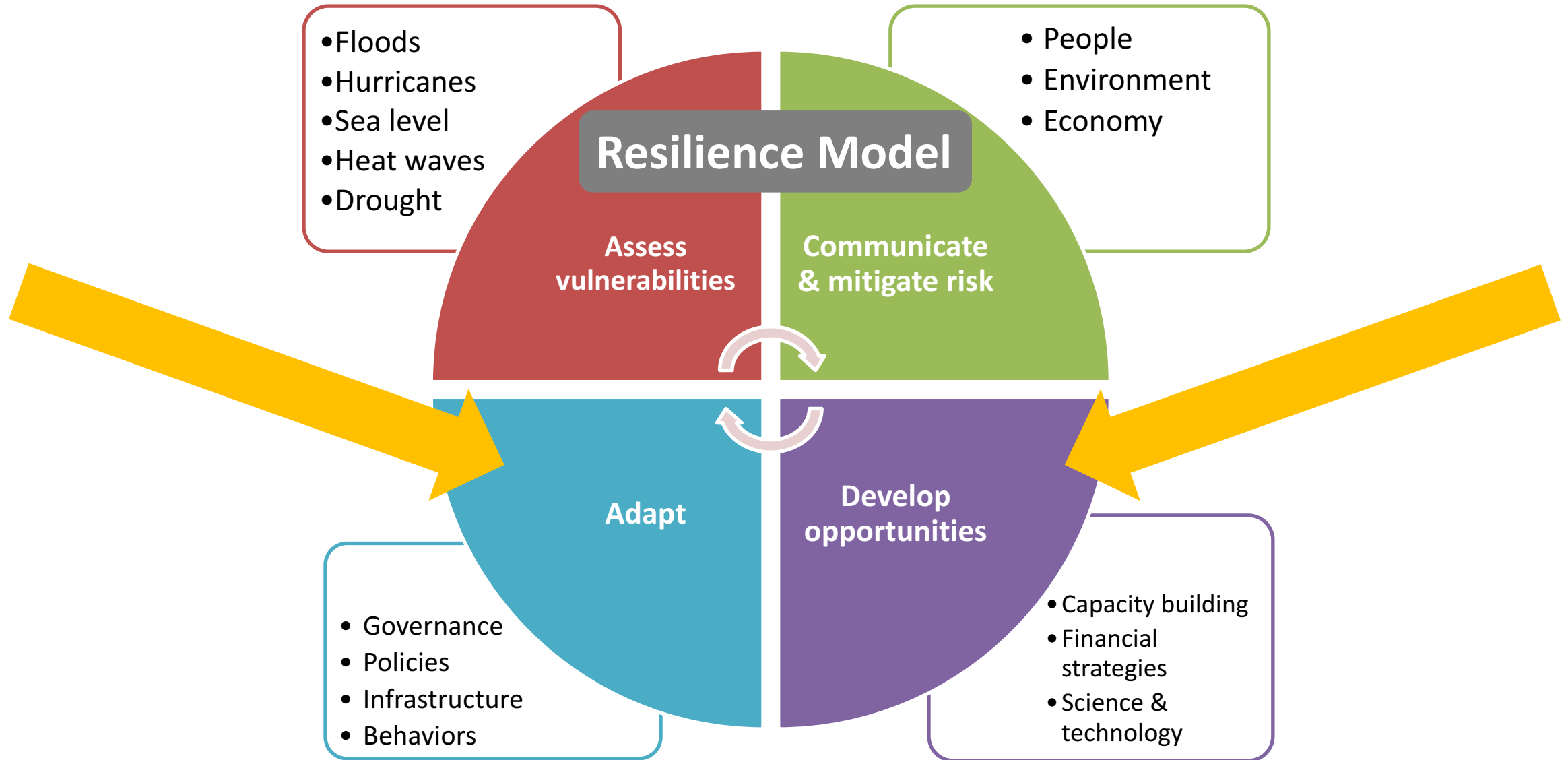


Warn

Rebuild

Rescue

Resilience: Going Beyond Recovery

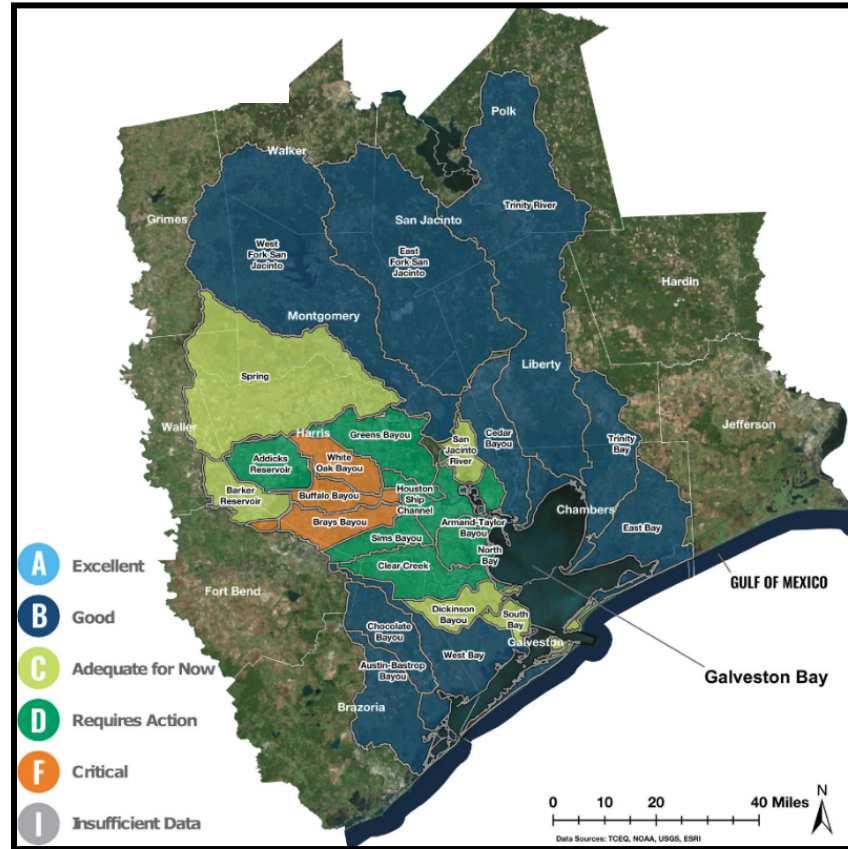


Gray + Green Infrastructure: A Watershed Approach

Houston-Galveston Watershed	HARC Wetland & Development Index
Brays Bayou	73%
White Oak Bayou	67%
Buffalo Bayou	56%
Sims Bayou	50%
Houston Ship Channel	41%
Greens Bayou	44%
Armand-Taylor Bayou	38%
Clear Creek	42%
North Bay	30%
Addicks Reservoir	26%
Dickinson Bayou	23%
Barker Reservoir	22%
South Bay	20%
Spring Creek	18%
San Jacinto River	15%
West Bay	9%
Cedar Bayou	8%
West Fork San Jacinto	9%
Chocolate Bayou	7%
Trinity Bay	3%
East Fork San Jacinto	3%
Austin-Bastrop Bayou	3%
East Bay	2%
Trinity River	2%

Flooding & Water Quality Issues

Wetlands & Development



2017 Galveston Bay Report Card

Rethink development design practices, ordinances & building codes

Low Impact Development (LID)

Retrofit existing homes

Bayou greenways & buffers

Stormwater detention with created wetlands

Rain cisterns, gardens, barrels

Wetland protection & conservation easements

EMPLOY A WATERSHED APPROACH THAT ACCOUNTS FOR CONNECTIVITY & CUMULATIVE IMPACTS

Based on NOAA C-CAP 2010

Is Designing with Nature Possible in Houston?



Drainage swales surrounded by preserved habitat



Natural bank ponds

Collector streets, check dams, water impoundment on soils with good infiltration capacity

- Less stormwater runoff during 100-year storms
- Lower nutrient loadings
- Lower levels of forest fragmentation
- Average of 2°C lower land surface temperature
- Higher walkability and pedestrian access to open space

B. Yang & S. Li. 2015. Design with Nature: Ian McHarg's ecological wisdom as actionable and practical knowledge. Landscape & Urban Planning.

Financing Resilience

- Total Harvey costs ~ \$180B
- Harvey, Irma & Maria exceed federal recovery capacity
- Harvey recovery funds → traditional infrastructure & buyout projects

What about everything else?

- Innovative financing needed for future resilience projects
 - Property Assessed Clean Energy (PACE Financing)
 - Green Bonds (standard bonds)
 - Resilience Bonds (bond premium rebates)
 - Environmental Impact Bonds (with private sector investment)



Community Adaptation & Resilience Alliance (CARA)

- National trend in resilience collaboratives
- **Goal:** Build long-term capacity
- Approach: multi-institutional & regional
 1. ***Assess progress and barriers*** to community resilience along the Texas Gulf Coast
 2. Create a ***science information network***
 3. Develop a regional ***framework of resilience and adaptation strategies*** with broad input
 4. Build a ***community of practice*** to share technical expertise, leverage resources, and advance comprehensive and coordinated strategies



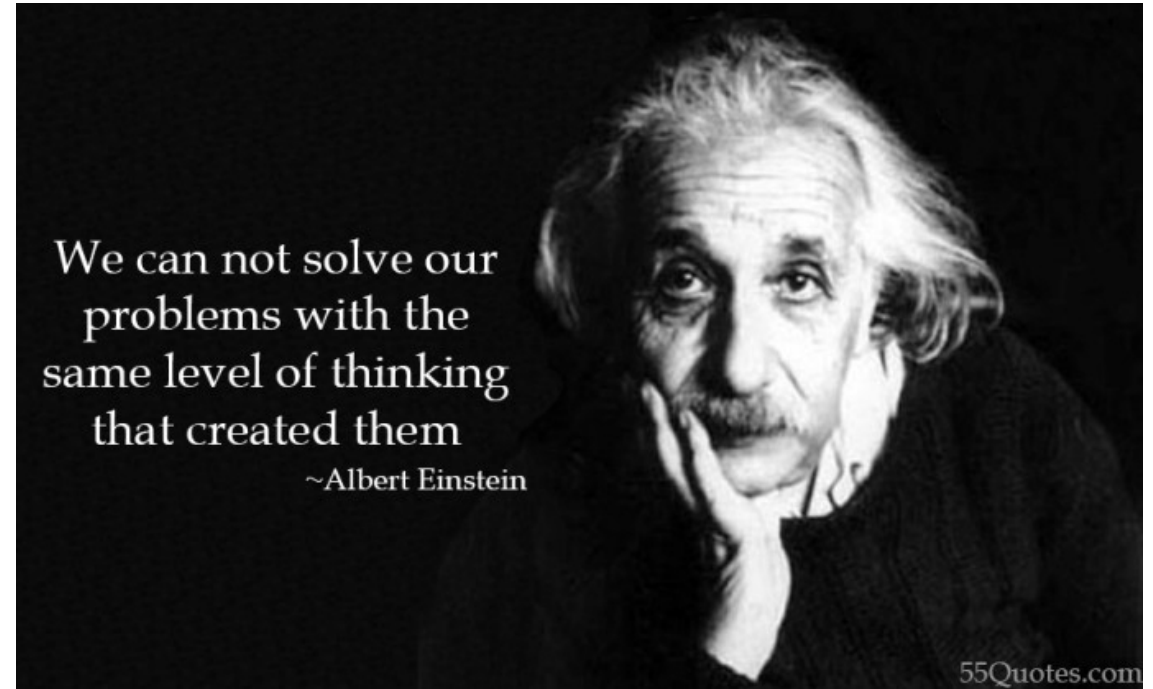
Thank You



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HARCresearch.org



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an independent research
hub helping people thrive
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