Natural Hazards Resiliency: An Insurers Perspective

Brion Callori

Who is FM Global®

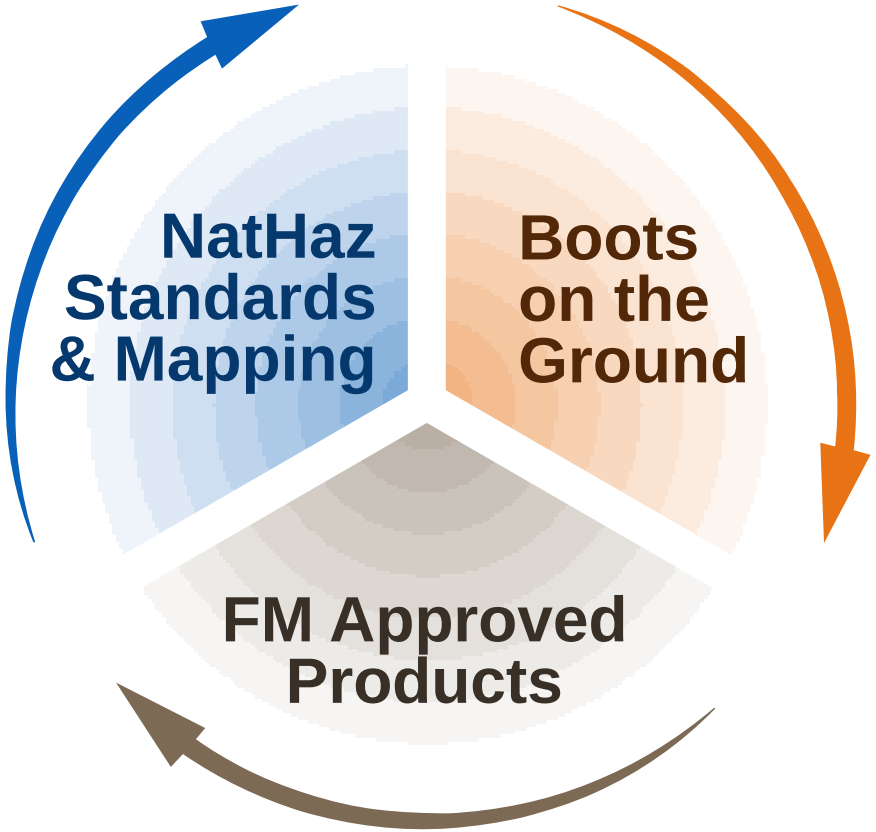
FM Global

Research-Based Engineering

FM Global®

The majority of natural hazard loss is preventable

Science



Engineering

Mitigation Solutions

FM Global
Hudson River
East River

FM Global
Flood

FM Global®
The Flood Challenge

Global Flood Mapping

100-year Map

FLOOD

Table of Contents

Page

1.0 SCOPE 3
1.1 Hazards 3
1.2 Changes 3
2.0 LOSS PREVENTION RECOMMENDATIONS 4
2.1 Introduction 4
2.2 Construction and Location 4
2.2.1 Site Selection for New Construction 4
2.2.2 Storm Water Runoff and Terrain Management 5
2.2.3 Elevating the Entire Site 6
2.2.4 Elevating Individual Buildings and Key Equipment 6
2.2.5 Lessening Damage for New Buildings Not Built Above Flood Levels 7
2.2.6 Lessening Damage for Existing Buildings and Equipment 7
2.2.6.1 Permanent Site Flood Protection Systems 8
2.2.6.2 Complete And Partial Building Protection 10
2.2.6.3 Protection or Relocation of Equipment, Production Lines, and/or Storage 11
2.2.6.4 Temporary Perimeter Flood Protection Systems 11
2.2.6.5 Hybrid Solutions 12
2.3 Occupancy 12
2.4 Protection 13
2.5 Equipment and Processes 13
2.6 Utilities 13
2.7 Electrical 14
3.0 SUPPORT FOR RECOMMENDATIONS 14
3.1 Avoid the Zone 14
3.2 Flood Maps and Data 14
3.2.1 Levees Don't Eliminate the Threat 15
3.2.2 Site-Specific Flood Studies 16
3.2.3 Flood Protection Breach Studies 16
3.3 Strategy to Understanding the Flood Potential 16
3.4 Understanding Flood Sources and Their Characteristics 16
3.4.1 Flood Sources 17
3.4.2 Flood Characteristics 18
3.5 Understanding the Flood Impact 19
3.6 Understanding All Possible Solutions; Building or Retrofitting in a Flood Prone Area: A Strategy is Needed 20
3.6.1 Freeboard is a Key Design Consideration 21
3.7 Selecting Barriers to Protect Building Openings 21
3.7.1 Permanently Mounted Flood Gates 22
3.7.2 Flood Gates That Require Assembly 26
3.8 Temporary Perimeter Barriers Remote from Buildings 30
3.8.1 Bladders Filled with Water 30
3.8.2 Rigid/Shaped Containers Filled with Water or Sand 30
3.8.3 Flexible Containers Filled with Gravel or Sand 32
3.8.4 Deployable Flood Walls Without Foundations 32
3.8.5 Waterproof Fabric Cofferdams 33
3.9 Designed, Semi-Permanent Deployable Flood Walls 34
4.0 REFERENCES 35

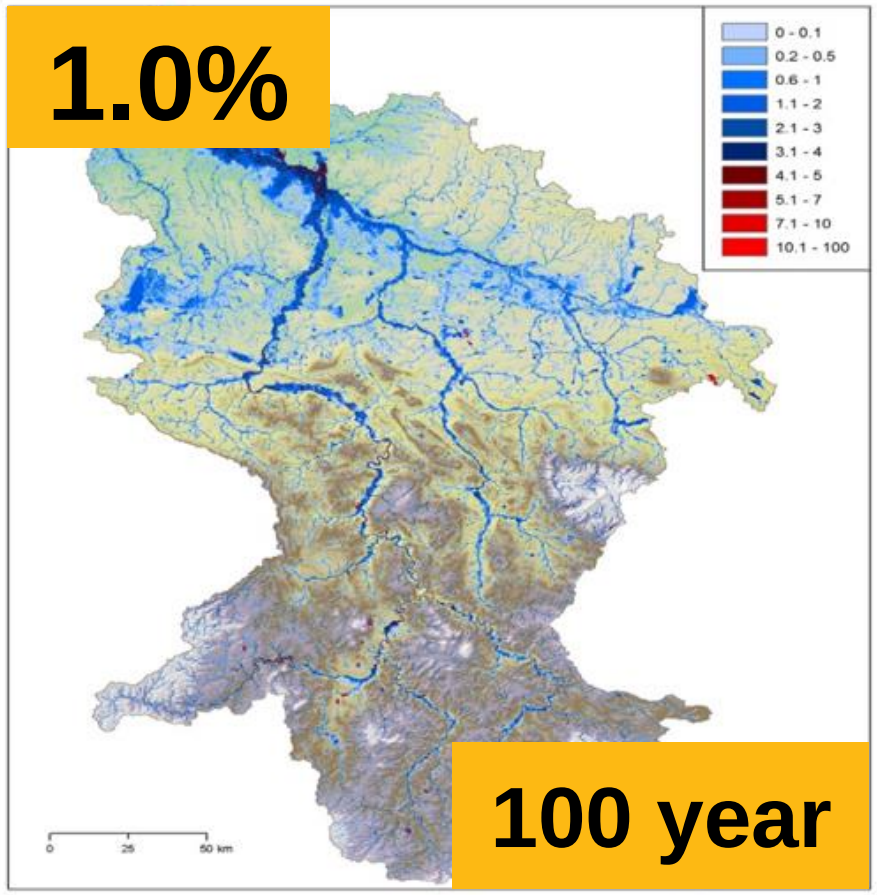
©2010-2016 Factory Mutual Insurance Company. All rights reserved. No part of this document may be reproduced, stored in a retrieval system, or transmitted, in whole or in part, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission of Factory Mutual Insurance Company.

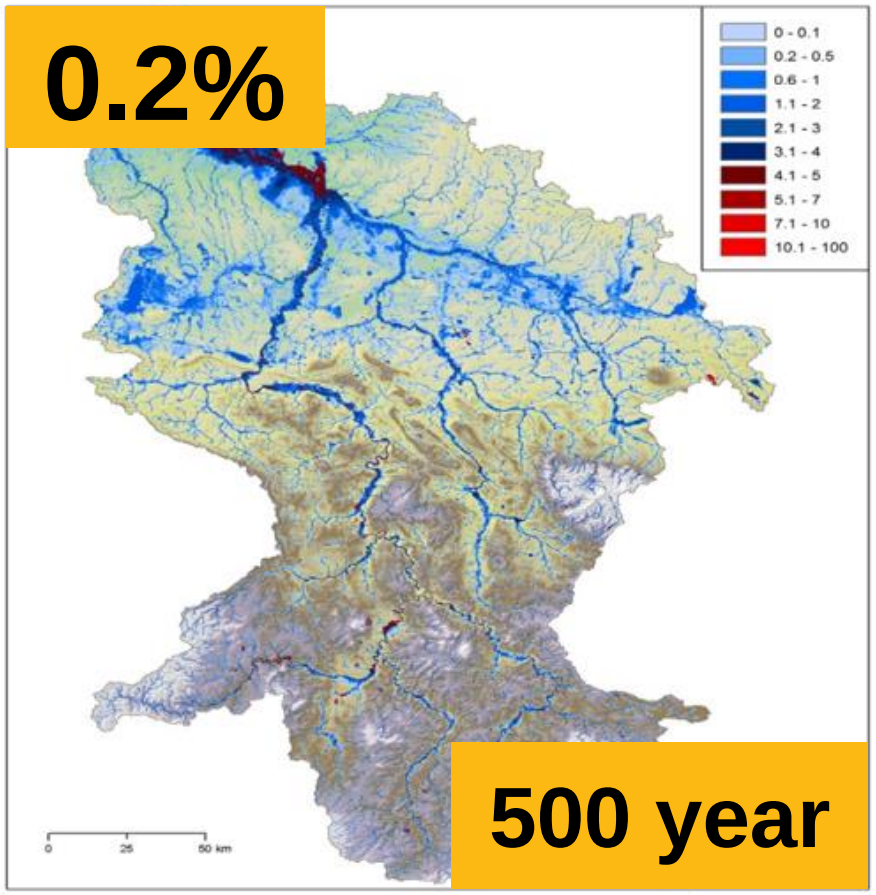
obal Flood Map Zones

Hazard

Moderate Hazard

Regional Flood Mapping: Weser River Basin

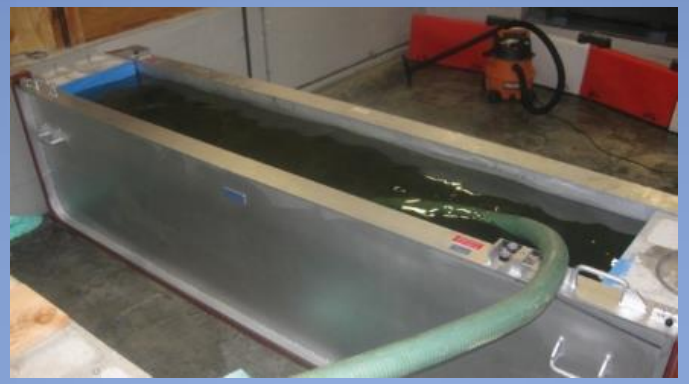




5,000 rivers, 20,000 km in length 25 meter Digital Terrain Model (DTM), >100 gauging stations with observations

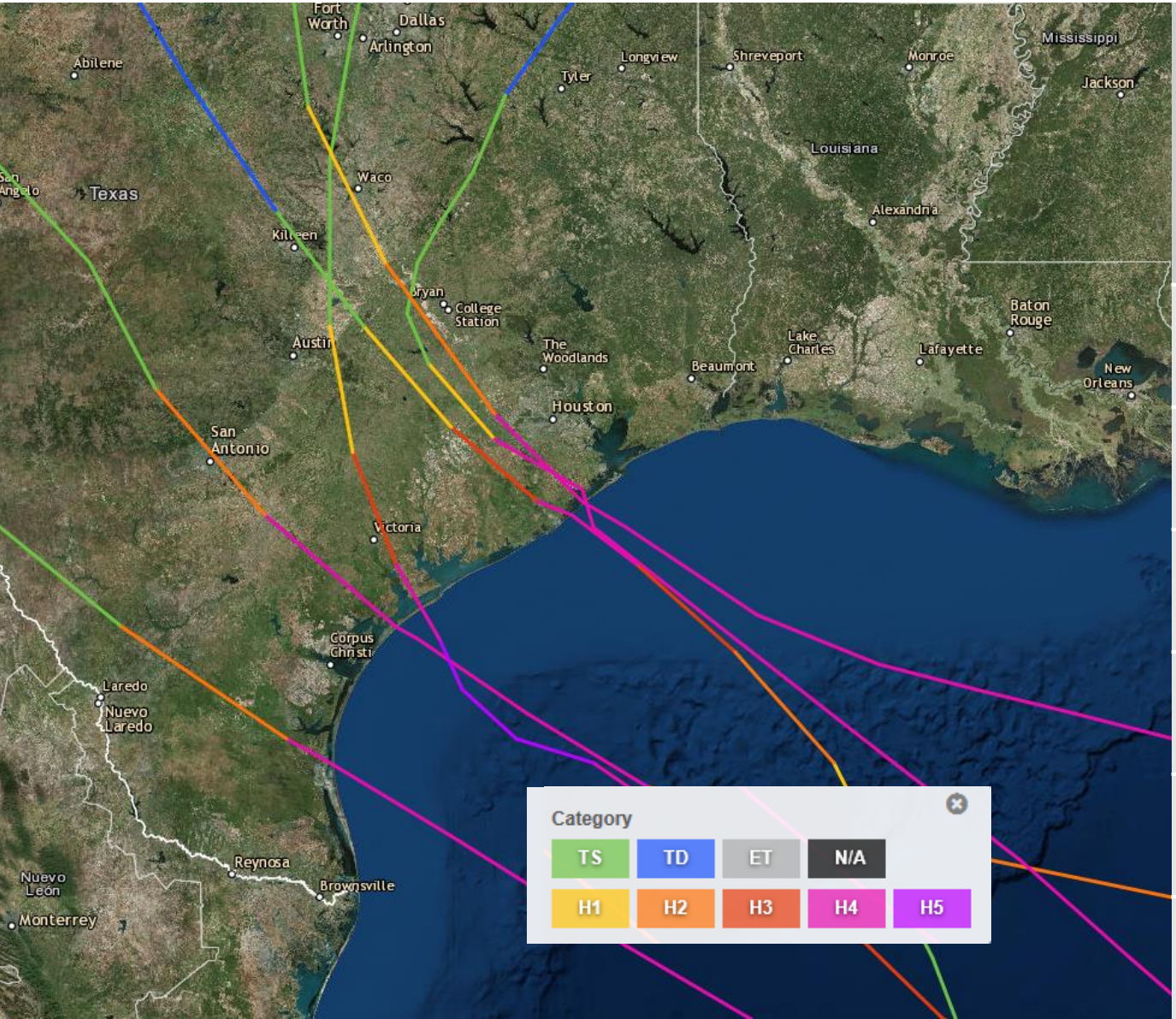
Flood imminent? You have options

Flood imminent? You have options

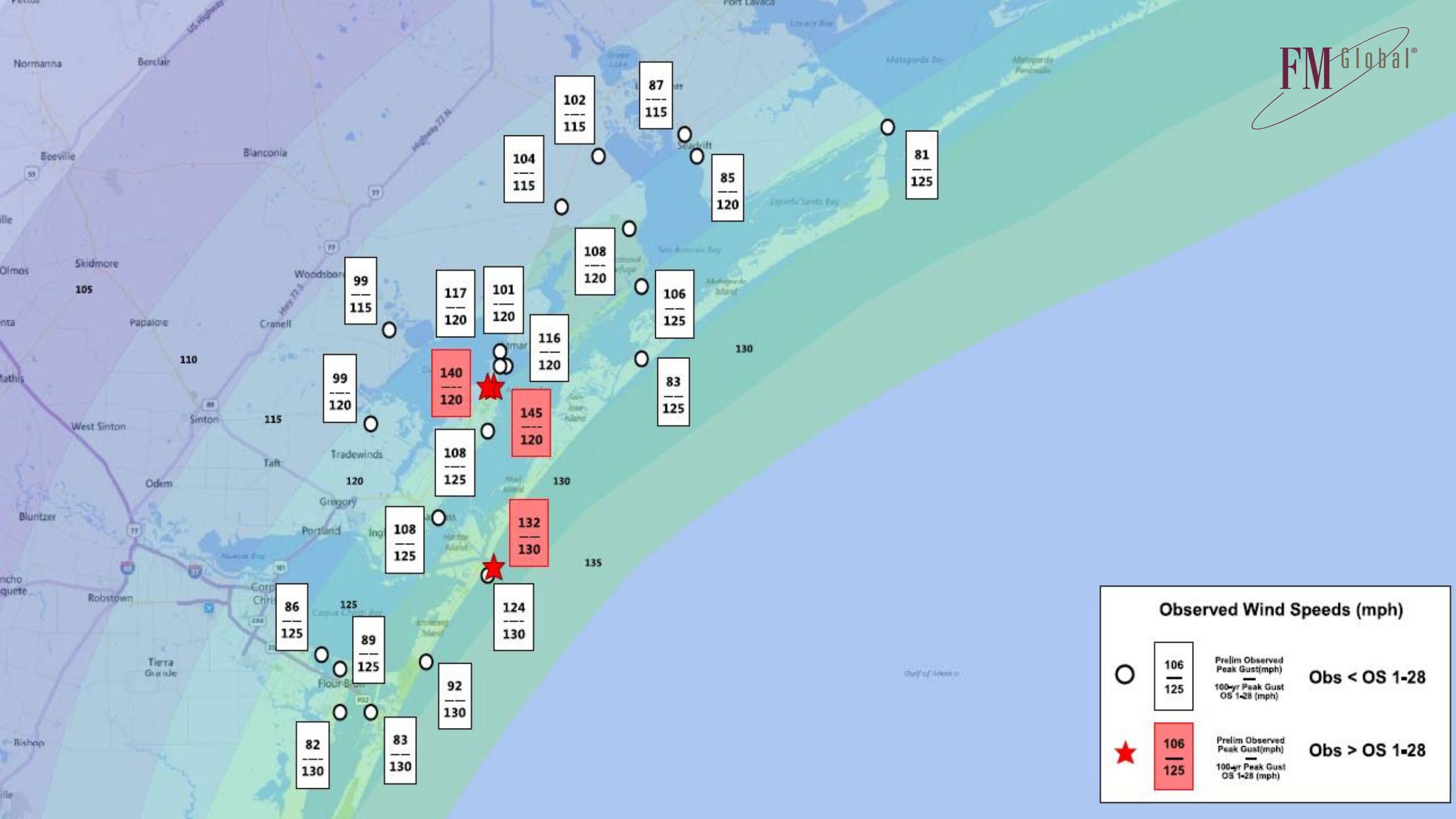


4
Harvey
August 2017

Past CAT 4 Hurricanes Hitting Texas

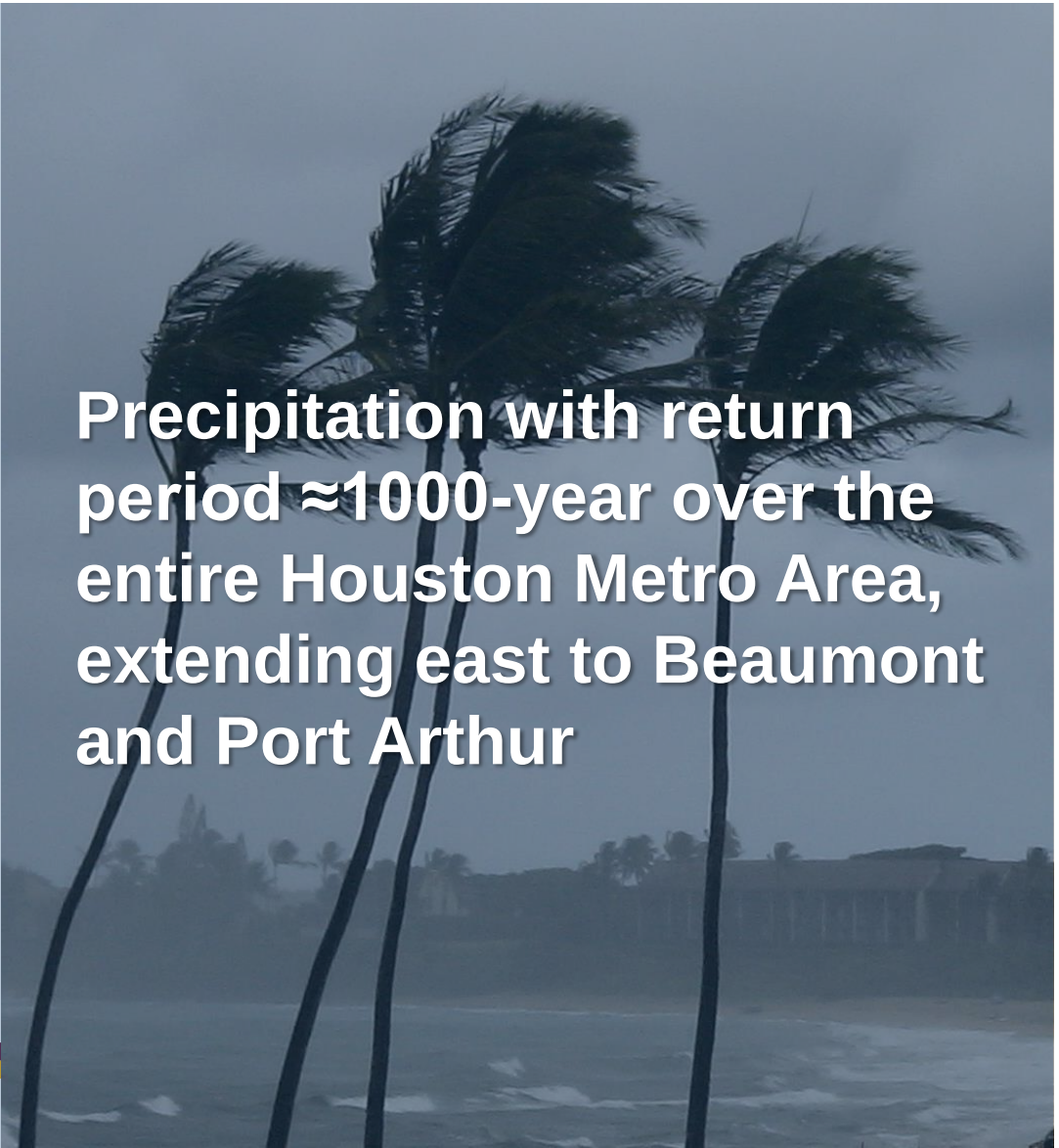


Year	Name	1-min Max Sustained Wind @ Landfall (kt)	Central Pressure @ Landfall (mb)
1886	Indianola	130	925
1900	Galveston	120	936
1915	Galveston	115	940
1916	No Name	115	932
1932	Freeport	130	935
1961	Carla	125	931



Normanna
Berclair
Beeville
Blanconia
Skidmore
Olmos
Woodsboro
Papalote
Cranell
Sinton
West Sinton
Tradewinds
Taft
Odem
Gregory
Portland
Bluntzer
Robstown
Tierra Grande
Flour Bluff
Bishop
Seadrift
Port Lavaca
Matagorda Bay
Matagorda Peninsula
Espiritu Santo Bay
San Antonio Bay
Matagorda Island
San Jose Island
Mud Island
Harbor Island
Corpus Christi Bay
Nueces Bay
Gulf of Mexico
105
110
115
120
125
130
135
87 / 115
102 / 115
104 / 115
85 / 120
81 / 125
108 / 120
106 / 125
99 / 115
117 / 120
101 / 120
116 / 120
140 / 120
83 / 125
99 / 120
145 / 120
108 / 125
132 / 130
108 / 125
124 / 130
86 / 125
89 / 125
92 / 130
82 / 130
83 / 130
Observed Wind Speeds (mph)
106 / 125
Prelim Observed Peak Gust(mph) / 100-yr Peak Gust OS 1-28 (mph)
Obs < OS 1-28
106 / 125
Prelim Observed Peak Gust(mph) / 100-yr Peak Gust OS 1-28 (mph)
Obs > OS 1-28

Not Unprecedented In Texas!



2017 Hurricane Harvey

≈24" in 1-day, 43.88" total at NWS Houston office,
≈52" in 7-day period

2001 Tropical Storm Allison

≈29" in 12 hour period (Harris County),
≈41" in 5-day period (Moore Road Detention Pond, TX),
≈37" total at Port of Houston

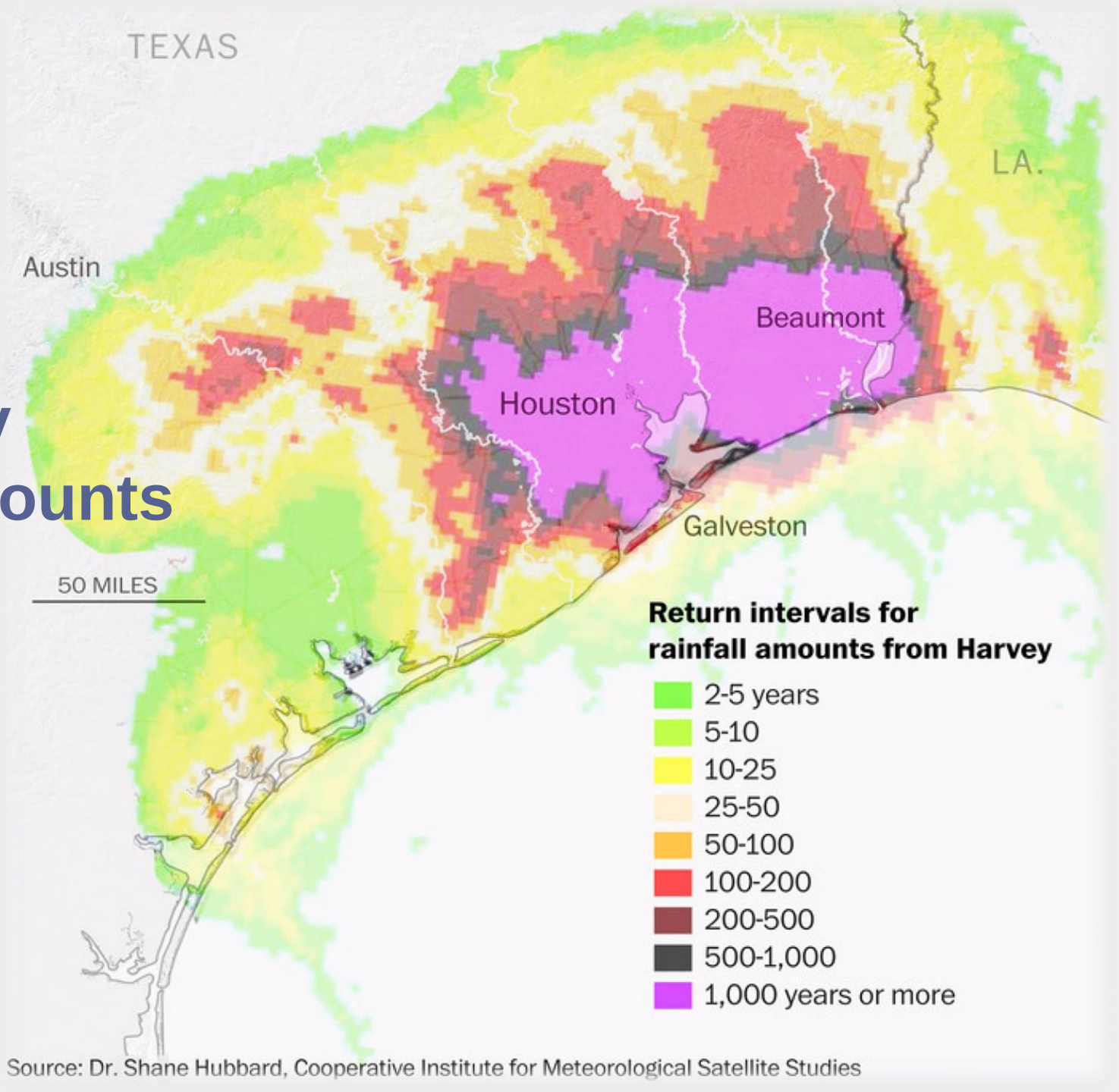
1979 Tropical Storm Claudette

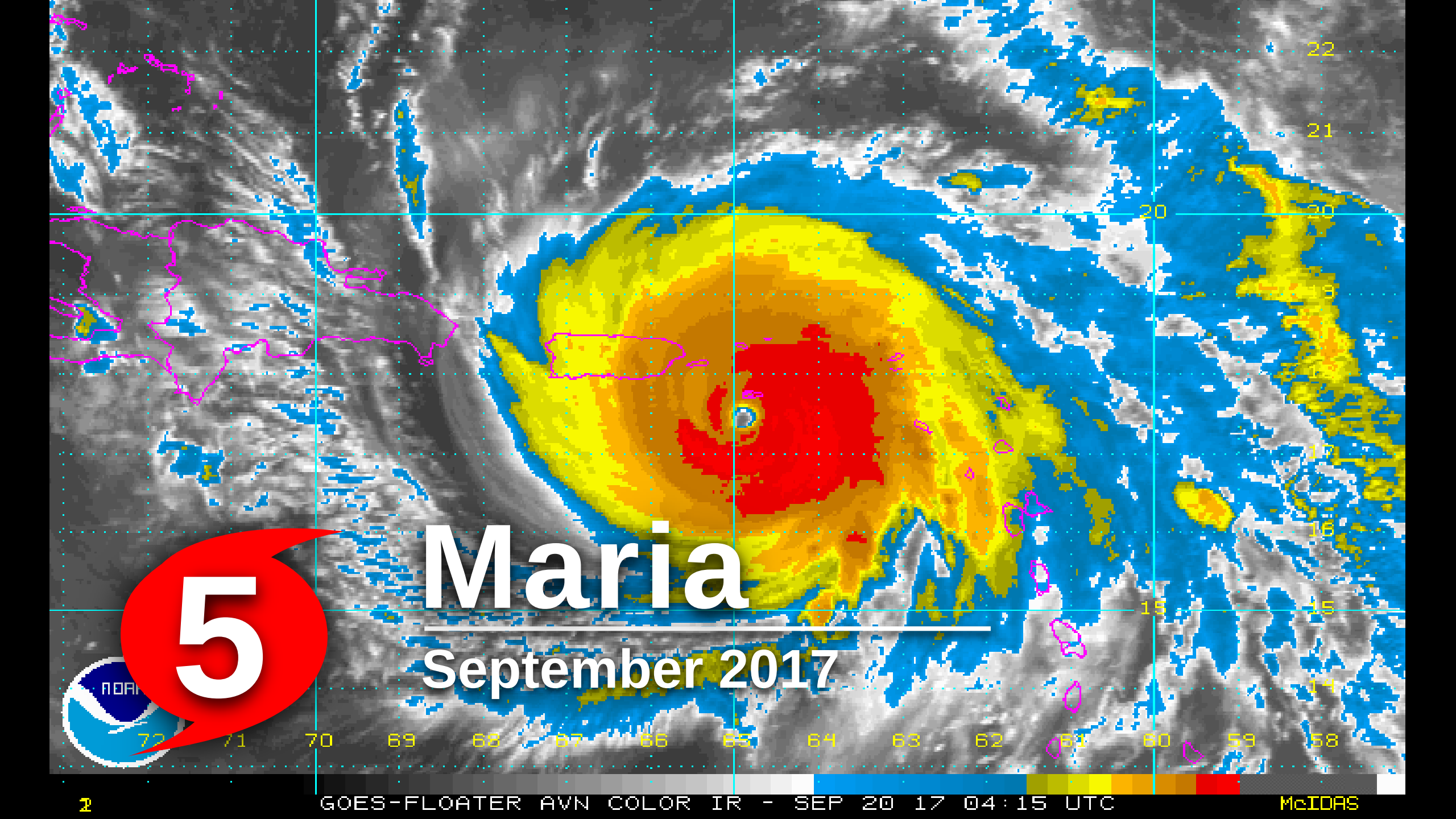
≈42" in 24 hour period at Alvin Cooperative Site, TX

1978 Tropical Storm Amelia

≈48" in 48 hours in West Central TX (Medina),
≈26" in 12 hour period

Return Intervals for 7-Day Accumulated Rainfall Amounts

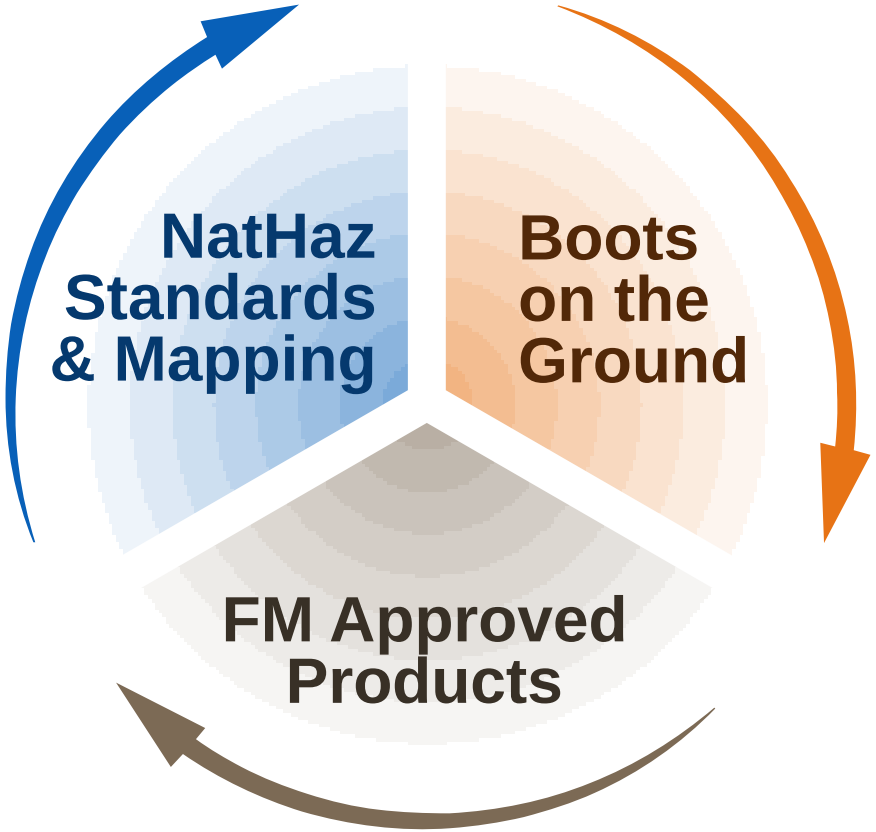



5
Maria
September 2017
GOES-FLOATER AVN COLOR IR - SEP 20 17 04:15 UTC
McIDAS

PUERTO RICO
(U.S.)
Isabela
Cacao
Arecibo
Aguadilla
San Antonio
Manati
Vega Baja
Toa Baja
Vega Alta
Esperanza
EST de
Sabana
Barahona
Rio Grande
San Sebastian
Fajardo
El Yunque
El Yunque
National
Forest
Espino
Utuado
Pozas
Palomas
Juncos
Guayacan
Mayaguez
Maricao
Afuera
Bartolo
Jauca
Punta Peak
1338 m (4390 ft)
Ala de la
Piedra
Hayales
Cidra
Cordillera Central
Hormigueros
Humacao
Candelero
Arriba
Cayey
Cabo Rojo
San German
Sabana
Grande
Coamo
Juana Diaz
Yauco
Guaya
Ponce
Palmas
Yaurel
Palo Seco
Costa
Ensenada
Playa
Unidad San
Martin
Culebra Town
Vieques
Vieques
National
Wildlife
Refuge
Esperanza
St Thomas
St John
Virgin
Islands
N.P.
Crown Mountain
474 m (1555 ft)
La Vallee
Frederiksted
St Croix
81
145
109
145
119
145
118
145
113
145
120
145
91
145
113
145
137
145
137
145
136
145
175
145

The majority of natural hazard loss is preventable

Science



Engineering

Mitigation Solutions