Disaster and Failure Studies Program

Sept. 28, , 2017
NCST Advisory
Committee Meeting

Judy Mitrani-Reiser	*Director, DFS Program*
Jason Averill	*Chief, MSS Division*
John van de Lindt	*co-Director, CoE*
Walt Peacock	*Leader, CoE Social Science Team*

NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

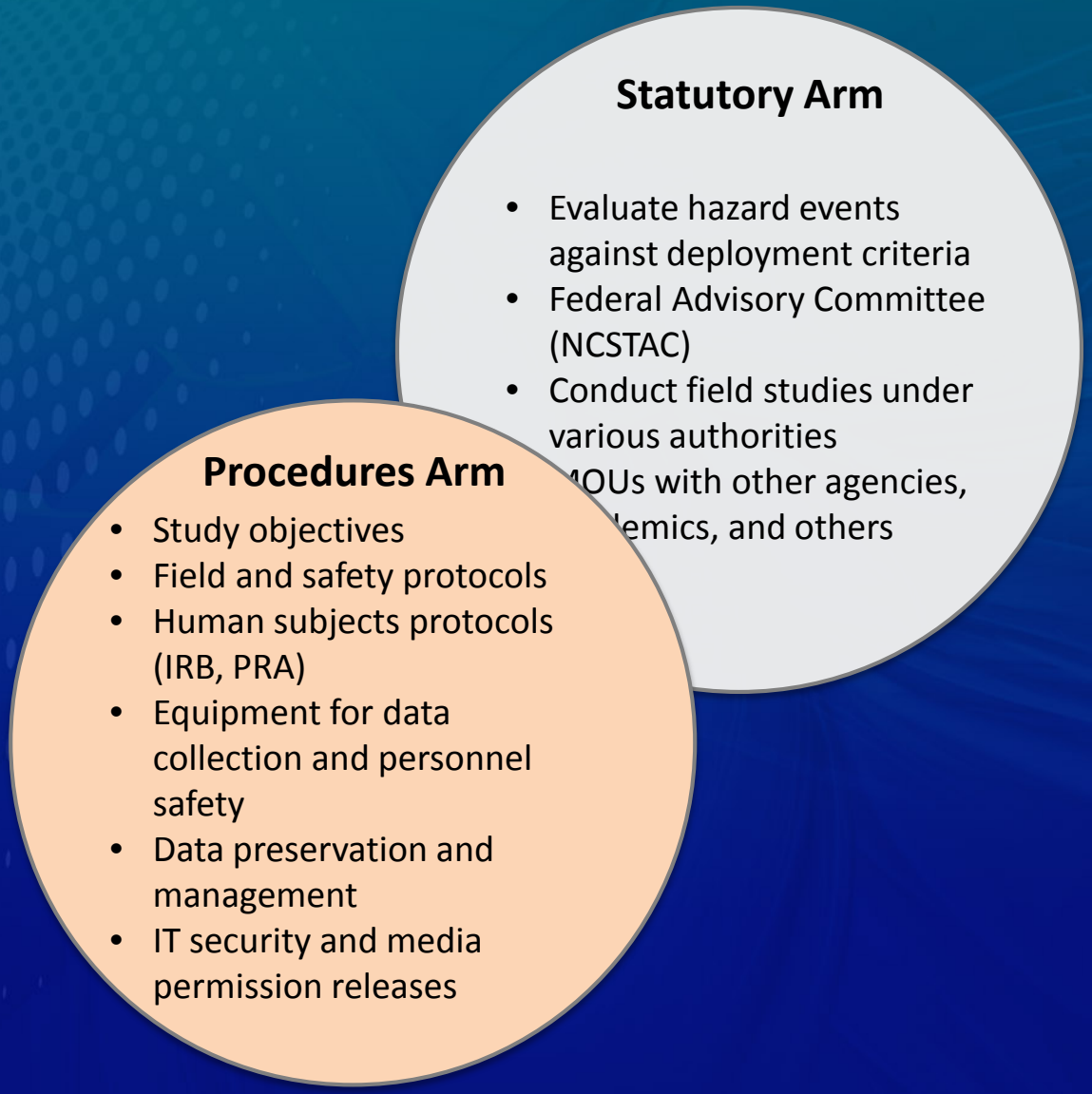
Disaster and Failure Studies Program Updates

Disaster and Failure Studies (DFS) Program Overview

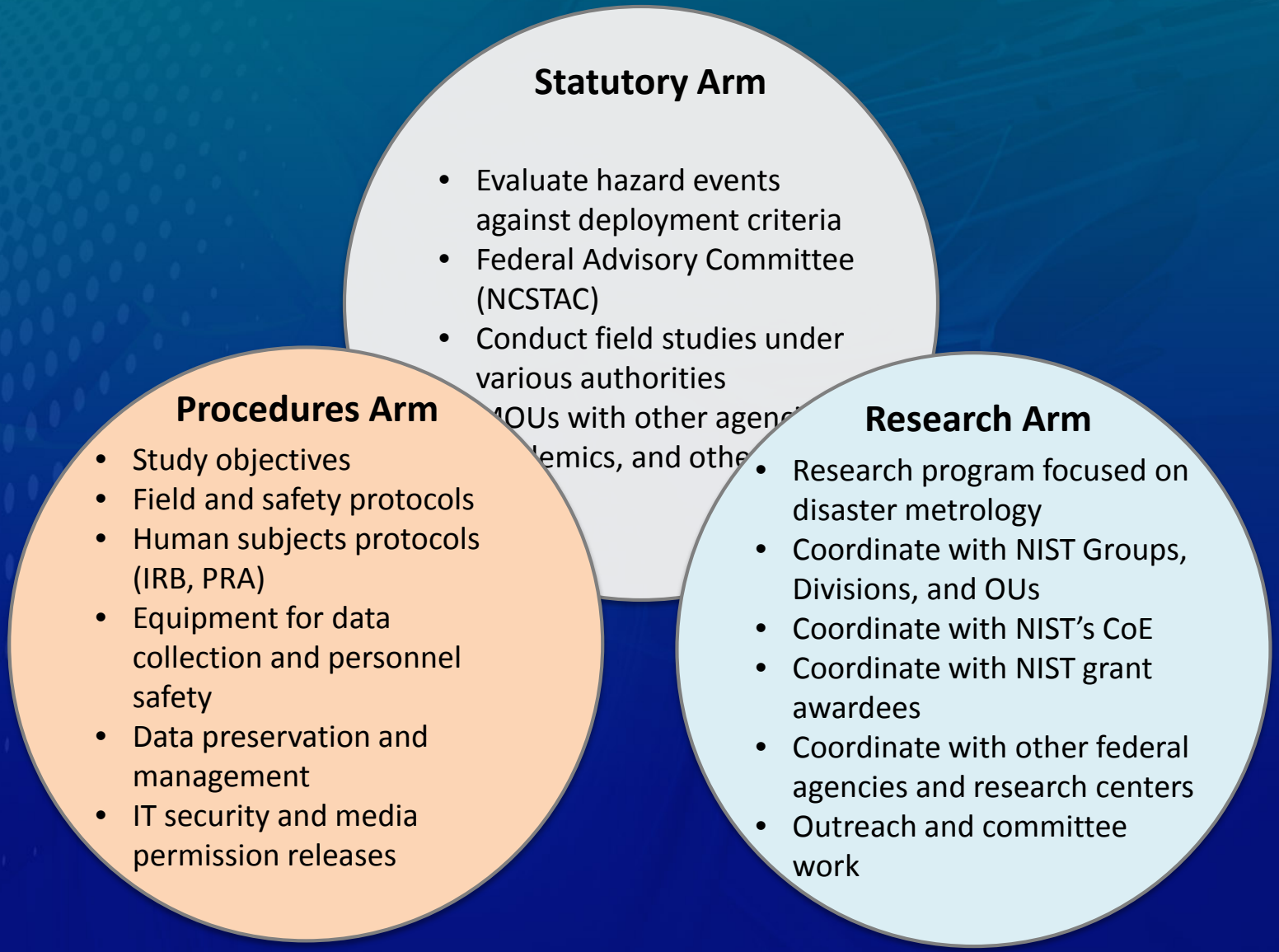
Statutory Arm

- Evaluate hazard events against deployment criteria
- Federal Advisory Committee (NCSTAC)
- Conduct field studies under various authorities
- MOUs with other agencies, academics, and others

Disaster and Failure Studies (DFS) Program Overview



Disaster and Failure Studies (DFS) Program Overview



Disaster and Failure Studies (DFS) Program Overview: Statutory Arm

- The National Construction Safety Team (NCST) Act authorizes the Director of NIST to establish Teams for deployment after events causing the *failure of a building or buildings that has resulted in substantial loss of life or that posed significant potential for substantial loss of life* (15 U.S.C. 7301(a)).

- The Teams shall: (a) establish the likely technical cause or causes of the building failure; (b) evaluate the technical aspects of evacuation and emergency response procedures; (c) recommend, as necessary, specific improvements to building standards, codes, and practices based on the findings; and (d) recommend any research and other appropriate actions needed to improve the structural safety of buildings, and improve evacuation and emergency response procedures, based on the findings of the investigation (15 U.S.C. 7301(b)(2)).

- The NCST Advisory Committee shall advise the NIST Director on: (1) carrying out the NCST Act; (2) a review of the procedures for the establishment and deployment of Teams; and (3) the reports issued as a result of an NCST investigation (2016 NCST Advisory Committee Charter).

- On January 1 of each year, the NCST Advisory Committee shall transmit a report to congress that includes: (1) an evaluation of Team activities, along with recommendations to improve the operation and effectiveness of teams; and (2) an assessment of the implementation of the recommendations of Teams and of the advisory committee (2016 NCST Advisory Committee Charter).

Disaster and Failure Studies (DFS) Program Overview: Procedures Arm

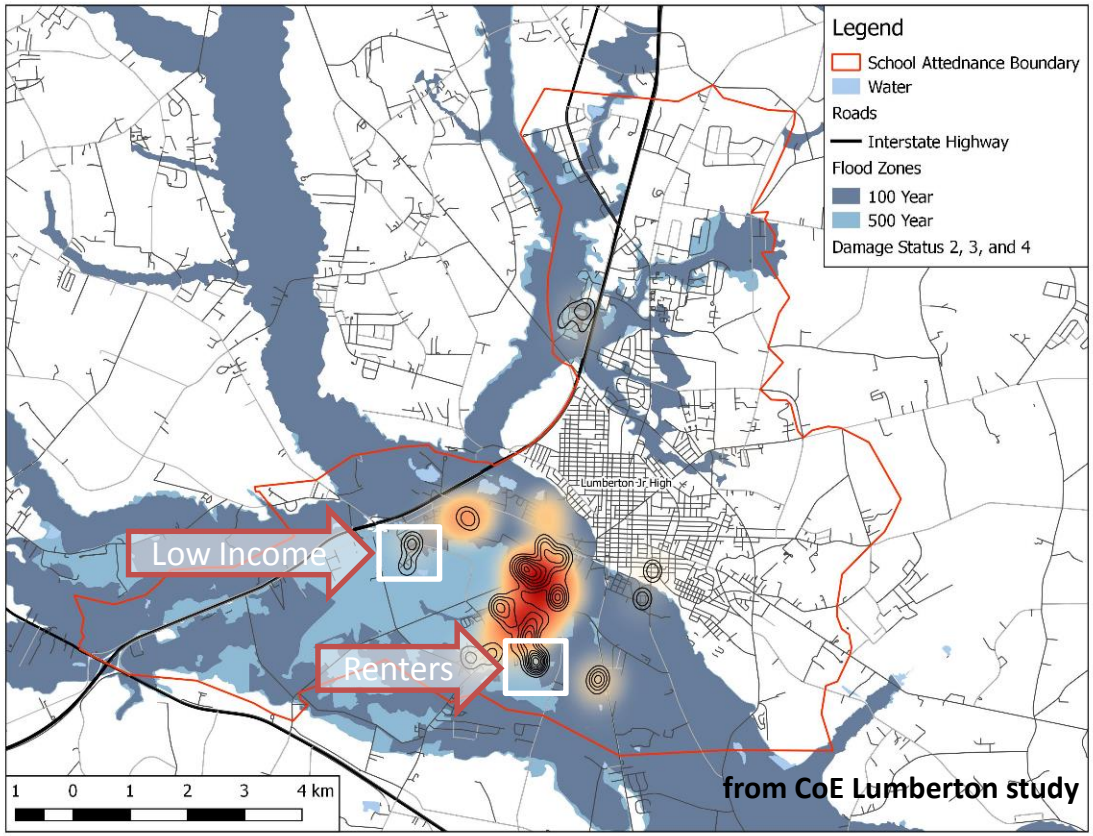
Preliminary Reconnaissance Screening Criteria

Preliminary Reconnaissance Criteria	Low (1)	Med (3)	High (5)
Date and Event Description			
1. Substantial Loss of Life or Disabling Injury			
A. Facility context	0	1 to 2	>2
B. Community context	0 to 3	4 to 9	>10
C. Regional context	0 to 5	6 to 19	>20
2. Significant Potential for Substantial Loss of Life: Exposed Population			
A. Facility context	<100	100 to 499	≥500
B. Community context	<1 000	1 000 to 9 999	≥10 000
C. Regional context	<100 000	100 000 to 999 999	≥1 000 000
3. Hazard and/or Failure Event(s)			
A. Earthquake	≤ MMI IV	MMI V to VII	≥MMI VIII
B. Hurricane at Landfall	≤Cat 3	Cat 4	Cat 5
C. Tornado	≤EF3	EF4	EF5
D. Coastal Inundation	< 3 ft	3 to 9 ft	≥ 10 ft
E. Fire Spread in Structures	Fire spread not beyond area of origin	Fire spread throughout a structure	Fire spread beyond structure of origin
F. Wildland Urban Interface Fire (WUI)	High Forest Service Fire Danger Rating	Very High Forest Service Fire Danger Rating	Extreme Forest Service Fire Danger Rating
G. Blast	< 99 lbs. TNT-equivalent	100 - 999 lbs. TNT-equivalent	> 1000 lbs. TNT-equivalent
H. Impact	< 1 x 10^6 ft lb/sec	1 x 10^6 to 1 x 10^7 ft lb/sec	> 1 x 10^7 ft lb/sec
4. Consequences to Resilience			
A. Failure during Construction or in Service	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
B. Engineered Building Systems	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
C. Transportation & Utility Systems	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
D. Non-Engineered Building Systems	Minimal physical damage and/or loss of function	Moderate physical damage and/or loss of function	Severe physical damage and/or loss of function
Score: __/__ = __ Sum	__ x 1	__ x 3	__ x 5
5. Evacuation and Emergency Response			
A. Evacuation	Normal evacuation	Moderate evacuation challenges	Severe evacuation challenges
B. Emergency Response	Normal operations	Moderate operational challenges	Severe operational challenges

- Provide a rational basis for evaluating the need for an NCST investigation and considers many factors, including:
  - substantial loss of life or disabling injury;
  - significant potential for loss of life (exposed population);
  - level of hazard;
  - consequences to resilience;
  - evacuation/emergency response challenges;
  - applicability of international events (code enforcement; similarity of practices);
  - unique new knowledge that may potentially be gained;
  - potential impact on standards, codes, and practices;
  - safety of field personnel

Disaster and Failure Studies (DFS) Program Overview: Research Arm

Heat maps indicating damage
and
contours indicating dislocation

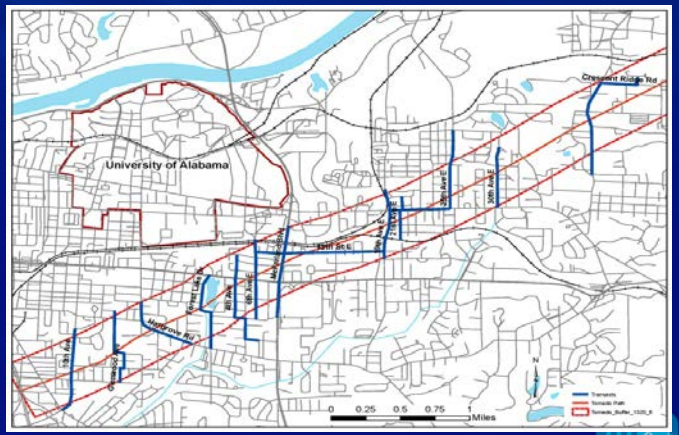


from CoE Lumberton study

NIST funds UC San Diego on use of UAV Swarms for Post-Event Damage Data Collection

Photos by Erik Jepsen/UC San Diego Aug 3, 2017

Summer students explore best practices in sampling protocols (figure by Prevatt et al., 2012).



Recent Disasters		
Date	Event	Event Consequence Score Evacuation & Response Score
09/19/17	Puebla Earthquake (Mexico)	**3.9/5.0** **3.6/5.0**
09/10/17	Hurricane Irma (Florida)	**3.7/5.0** **4.0/5.0**
09/06/17	Hurricane Irma (USVI)	**4.7/5.0** **5.0/5.0**
09/06/17	Hurricane Irma (Puerto Rico)	**2.3/5.0** **4.0/5.0**
08/25/17	Hurricane Harvey (Texas)	**4.7/5.0** **5.0/5.0**
08/02/17	Central Oklahoma Earthquake	**2.5/5.0** **1.0/5.0**
06/14/17	Grenfell Tower (London, UK)	**4.0/5.0** **3.6/5.0**
04/24/17	Fuse-47 Apt. Fire (College Park, MD)	**2.5/5.0** **2.0/5.0**
03/19/17	Sunshine Fire	**2.0/5.0** **1.0/5.0**
03/16/17	Raleigh Apartment Fire	**3.0/5.0** **1.0/5.0**
12/02/17	Ghost Ship Fire (Oakland, CA)	**3.5/5.0** **3.0/5.0**
11/30/16	Gatlinburg WUI Fire (Tennessee)	**2.5/5.0** **3.0/5.0**

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(1) What is the unique new knowledge that would be potentially gained from this study?

(2) What is the anticipated potential impact on standards, codes and practices?

(3) Do we have sufficient resources (people and funding) to support a study? If there is an existing study in the same hazard area, what is the impact on the current study?

(4) What is a current assessment of how site conditions would affect safety for a field deployment? Would current site conditions affect the timing of the field deployment?

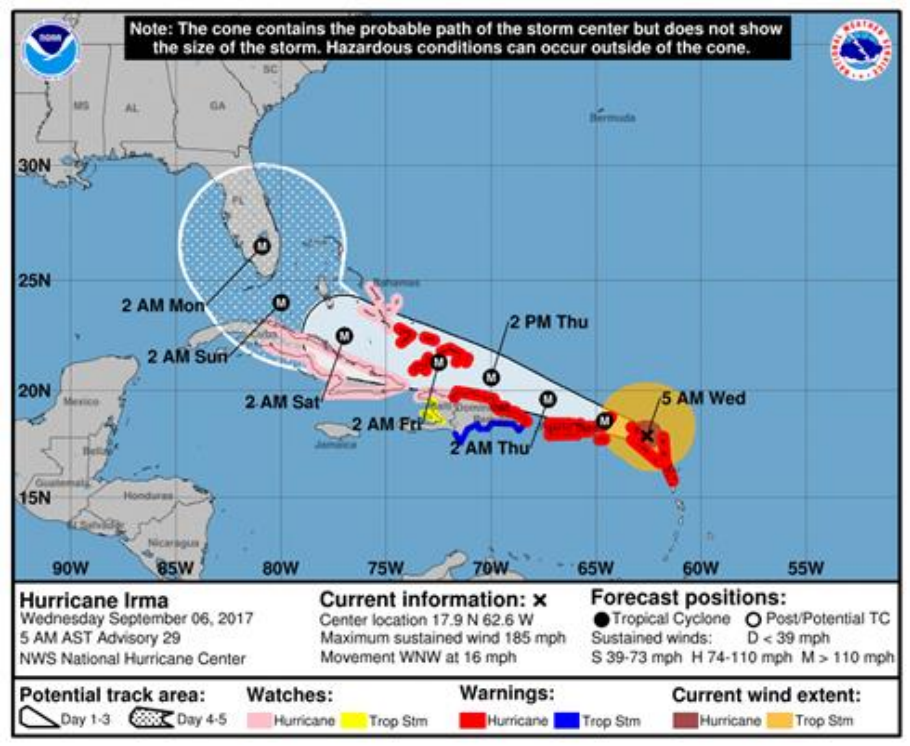
(5) Is there a request for NIST to conduct a study by others (local, state, Federal)? If so, would NIST provide complimentary expertise or would NIST have primary expertise?

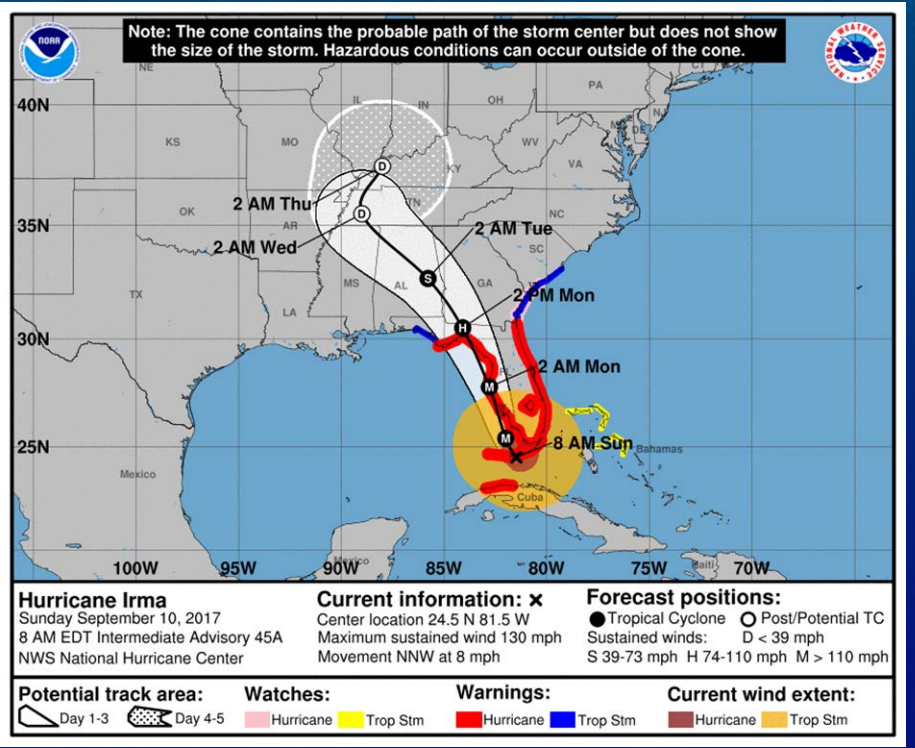
(6) Does NIST have primary authority? If so, would NIST collaborate with other agencies where NIST provides complimentary expertise or would NIST have primary authority and/or expertise?

Hurricane Irma (Florida)

Judith Mitrani-Reiser, *Director*
Disaster and Failure Studies Program

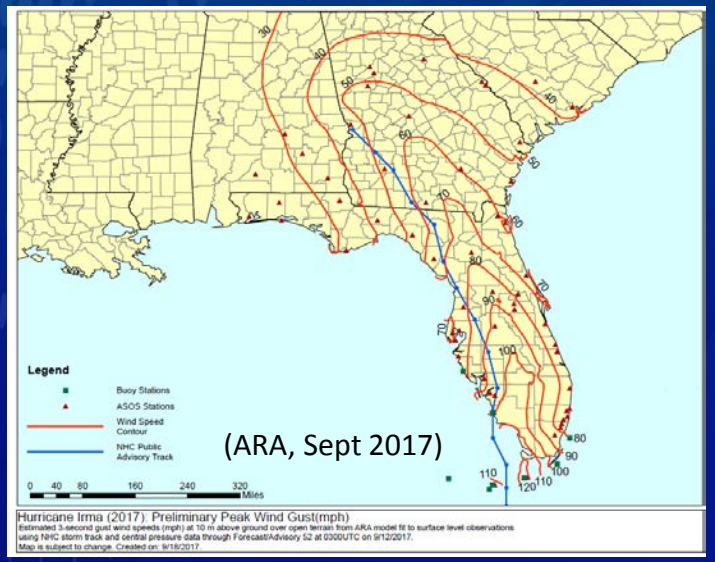
Caribbean and mainland storm path

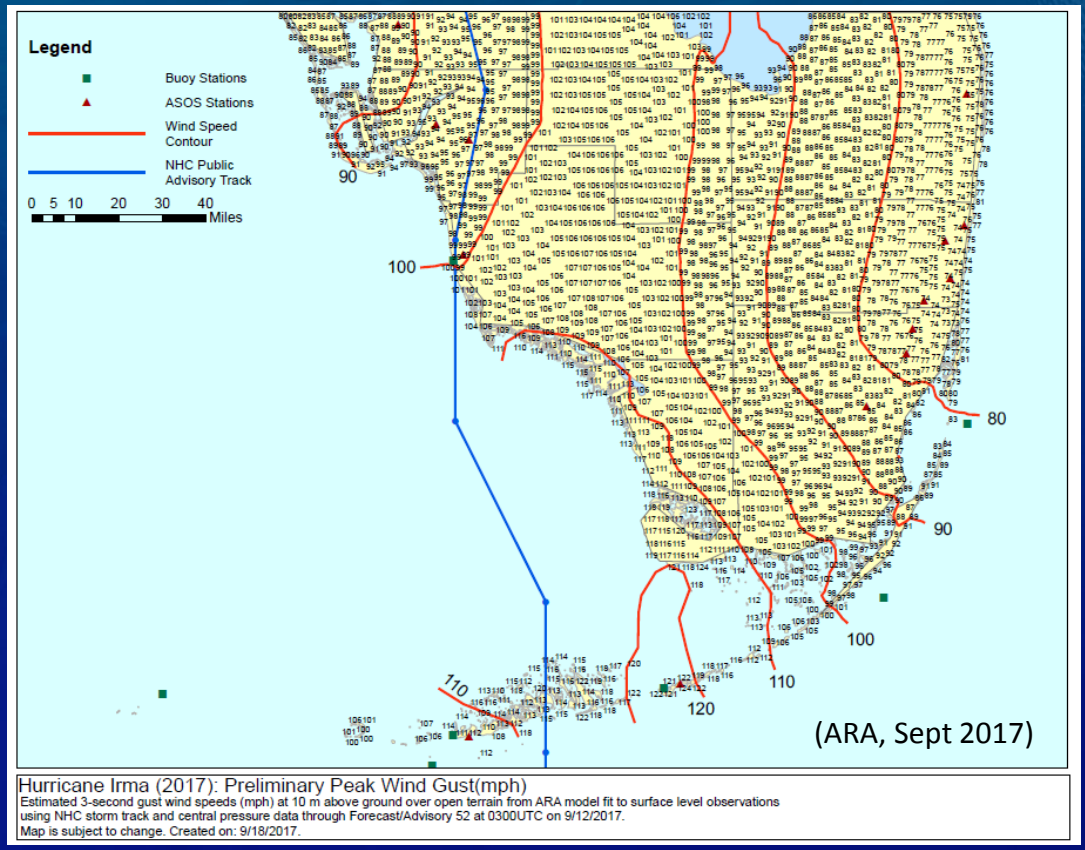




Wind Speeds Estimation (9/18/2017)

- **Mainland**: Peak wind gust
  - — 124 mph (lower Keys)
- **USVI**: Approximately 150 mph*
- **Puerto Rico**: Not avail. (less than USVI)

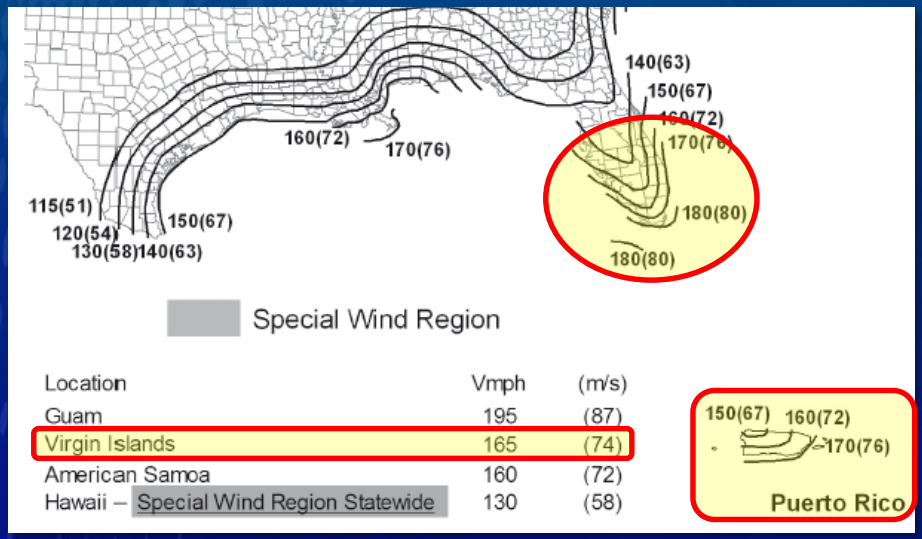




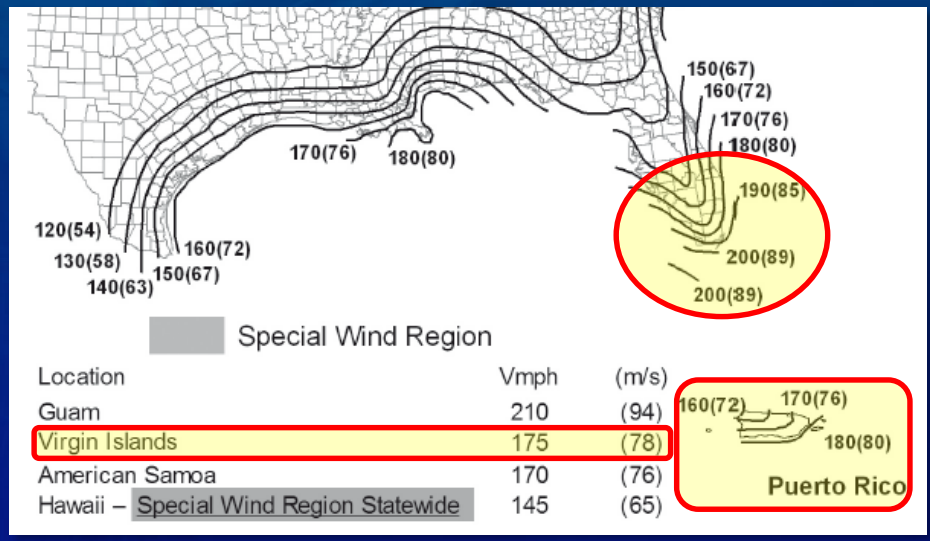
Current basis design wind speeds

ASCE 7-10

Category II Buildings



Category III and IV Buildings



- Florida: Estimated wind speeds are significantly less than design wind speeds
- USVI: Estimated wind speeds are closer to design wind speeds

Topics for Preliminary Reconnaissance

1) **Performance of residential (including manufactured homes), commercial, and critical facilities**
   - envelope, MWFRS and connection, and materials
   - Building age
   - With/without code. Code versions.
   - the performance of roof-mounted PV and other mechanical systems in high wind
2) **Damage to infrastructure systems, the rate at which they recover, how they affect functionality of commercial and critical facilities**
   - Business/occupancy type (size, retail, industrial, dining, school, etc.)
   - Power and Backup power system (microgrid, siting)
   - Critical facilities – Shelter, police and fire stations, emergency call center, health care facilities
3) **Improved hazard characterization and better engineering correlation between the hazard and any observed structural and/or envelope damages**
4) **Effectiveness of emergency communications in producing protective actions by citizens**
   - Shelter-in-place, sheltering versus evacuation
5) **Interdependencies between infrastructure and social functions and the relationship between these dependencies and recovery rates**
   - School, governance, and healthcare

Preliminary Reconnaissance Teams

Irma Team 1* (Keys)

- Long Phan (Structures)
- Steve Cauffman (Resilience)
- Erica Kuligowski (Sociology, Emergency Communication)
- Carmen Martinez (IT)

Irma Team 2* (Southern Florida)

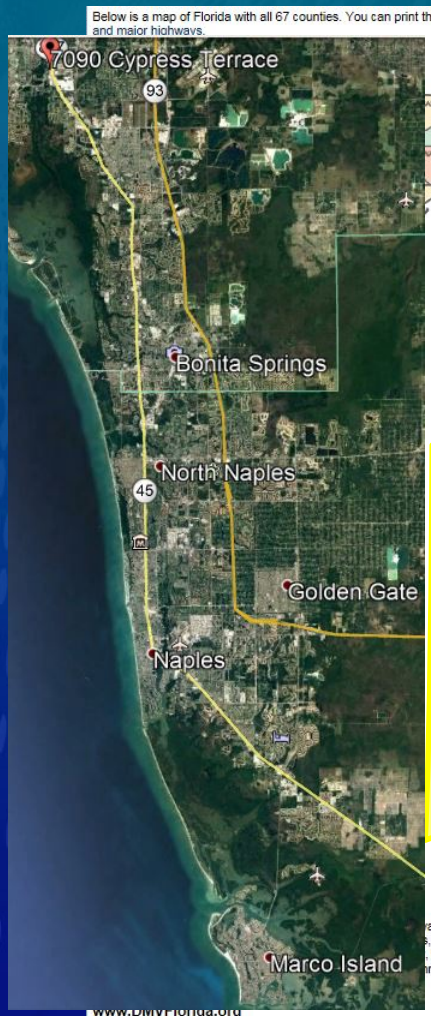
- Terri Mcallister (Resilience)
- Fahim Sadek (Structures)
- Jazalyn Dukes (Structures)
- Jen Helgeson (Economics)

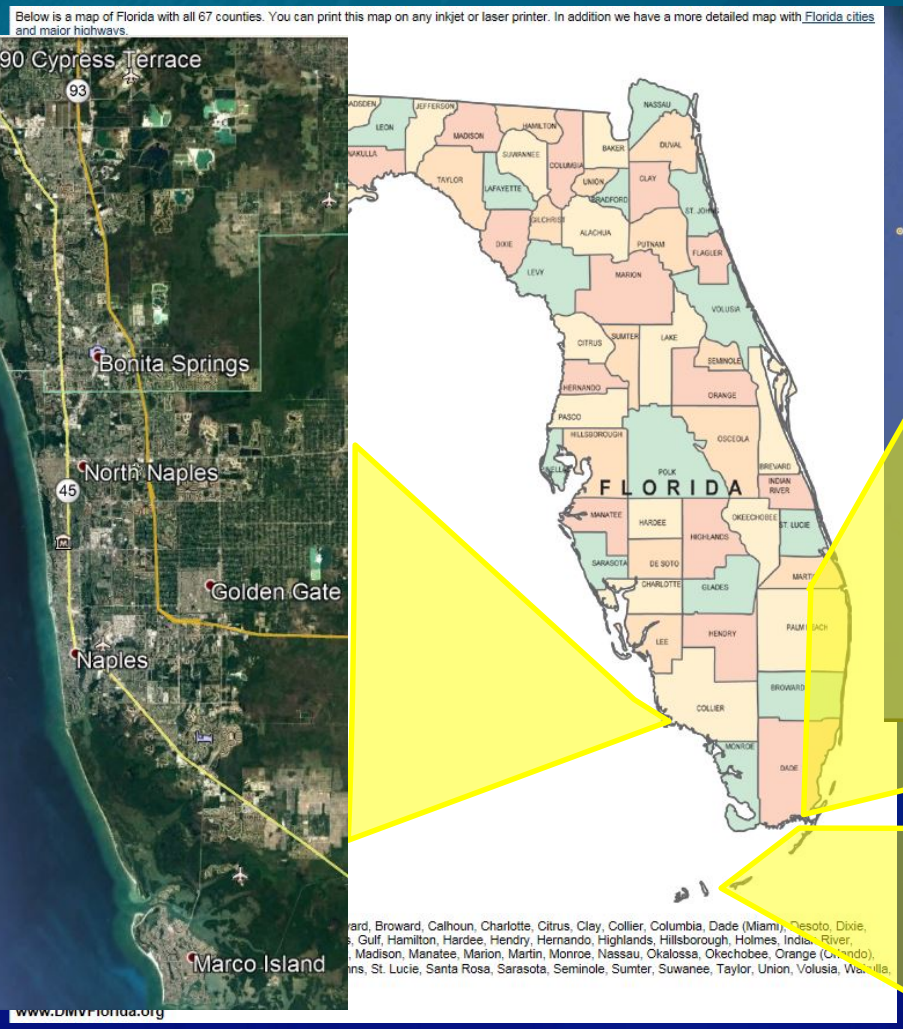
*All deployed team members are full-time NIST employees.

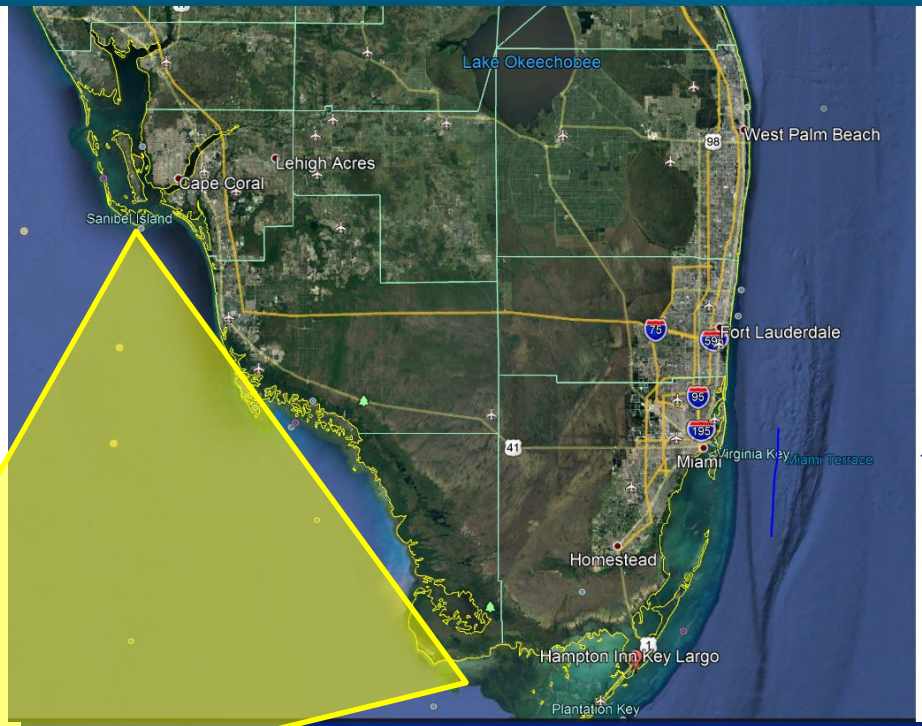
Areas for Preliminary Reconnaissance in Southern Florida

- Irma team 1:
  - Florida Keys: highest wind and flood forces/levels; Structural and envelope damage; infrastructure damage.
- Irma team 2:
  - South West (Naples, Marco island): impacted by eye of storm; high levels of wind and flood forces; Structural and envelope damage; infrastructure damage.
  - South East (Broward County, Miami-Dade county): similar wind and flood events; different preparedness and response levels; structural and envelope damage; infrastructure damage.

Areas for Preliminary Reconnaissance in Southern Florida







NIST Home-Based Team

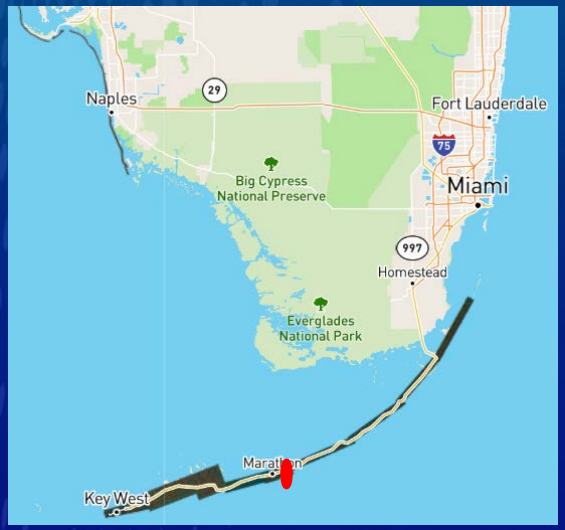
- Judy Mitrani-Reiser – D&FS Director
  - Marc Levitan – NWIRP Director
  - Ben Davis – Program Analyst
  - Steve Potts – Program Analyst
  - Chris Greer – Smart Grid
  - Laslo Varadi – Safety Liaison
  - Melissa Banner – Administrative Support
  - Jen Horning – Administrative Support

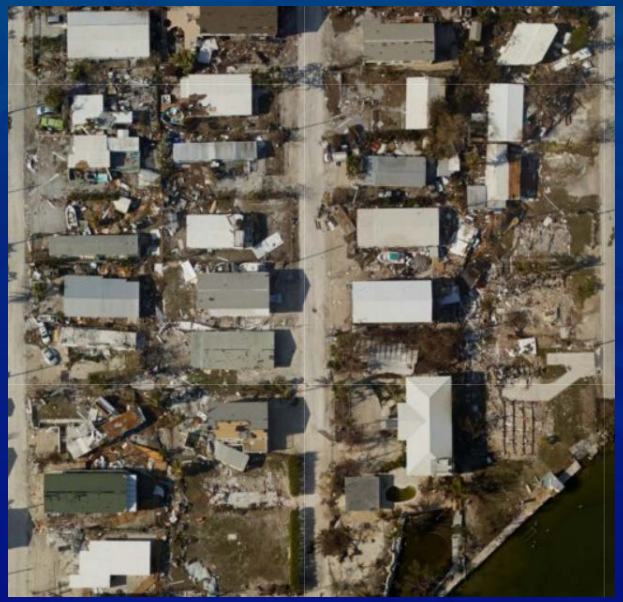
- Key Points of Contact across NIST
  - Mike Newman – Public Affairs
  - Melissa Lieberman – OCC/NIST
  - Linda Acierto – Congressional Affairs
  - Catherine Fletcher – FOIA, PRA
  - Cecilia Royster - AMD

- *EL/NIST Call for virtual team members*
  - *Assist with real-time information support needs for team members*

Consequences of Irma

- **Lower Keys Areas**: Roof damage (aerial photography provided by NOAA)





Marathon

Consequences of Irma

- **Lower Keys Areas**: Roof performance (photos from the field)

Consequences of Irma

- **Lower Keys Areas**: Manufactured home performance (photo from the field)