DHS SCIENCE AND TECHNOLOGY

Flood Apex Research Program

Findings and Progress

Homeland Security

Science and Technology

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Science and Technology Directorate

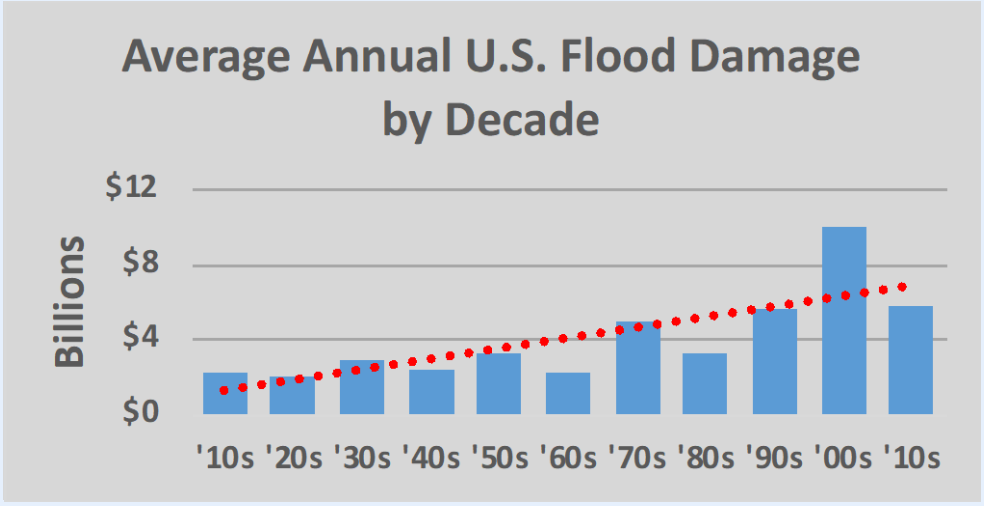
U.S. Flood Risk Today

All 50 States
have Experienced Floods
or Flash Floods
in the Past 5 Years

About **9 Million People**
Live in Flood Hazard Areas,
50% are **Uninsured** or **Under-Insured**

More than **20% of Flood Claims** are for Properties **Outside of known High-Risk Flood Areas**

Floods are the
#1 Natural Disaster in the U.S.



Floods Claim
80 Lives per year —
50% Vehicle-Related

More than
53% of U.S. Voters
have been **Personally Impacted by Floods**

Flood Damages Average **$7.9 Billion Annually,**
Rising Almost **2% per year**

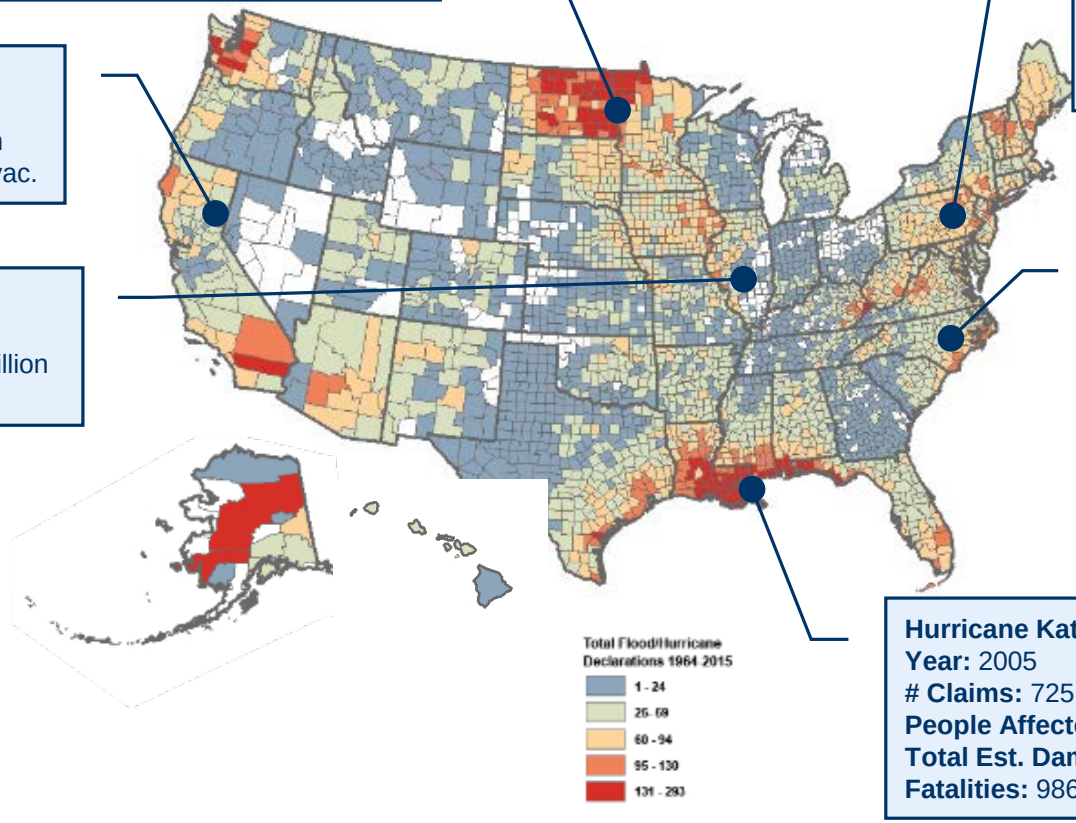
Flood/Hurricane Declarations

1964-2015

Red River Flood
Year: 1997
Total Est. Damage: $5 Billion

California Floods
Year: 2017
Total Est. Damage: $1 Billion
People Affected: 188,000 Evac.

Mid-West Floods
Year: 1993
Total Est. Damage: $15 Billion
Fatalities: 52



Superstorm Sandy
Year: 2012
 # Claims: 1.58 Million
People Affected: > 8 Million
Total Est. Damage: $48.7 Billion

Hurricane Matthew
Year: 2016
 # Claims: 15,000
People Affected: > 8 Million
Total Est. Damage: $12 Billion

Hurricane Katrina
Year: 2005
 # Claims: 725,000
People Affected: > 1Million
Total Est. Damage: $135 Billion
Fatalities: 986

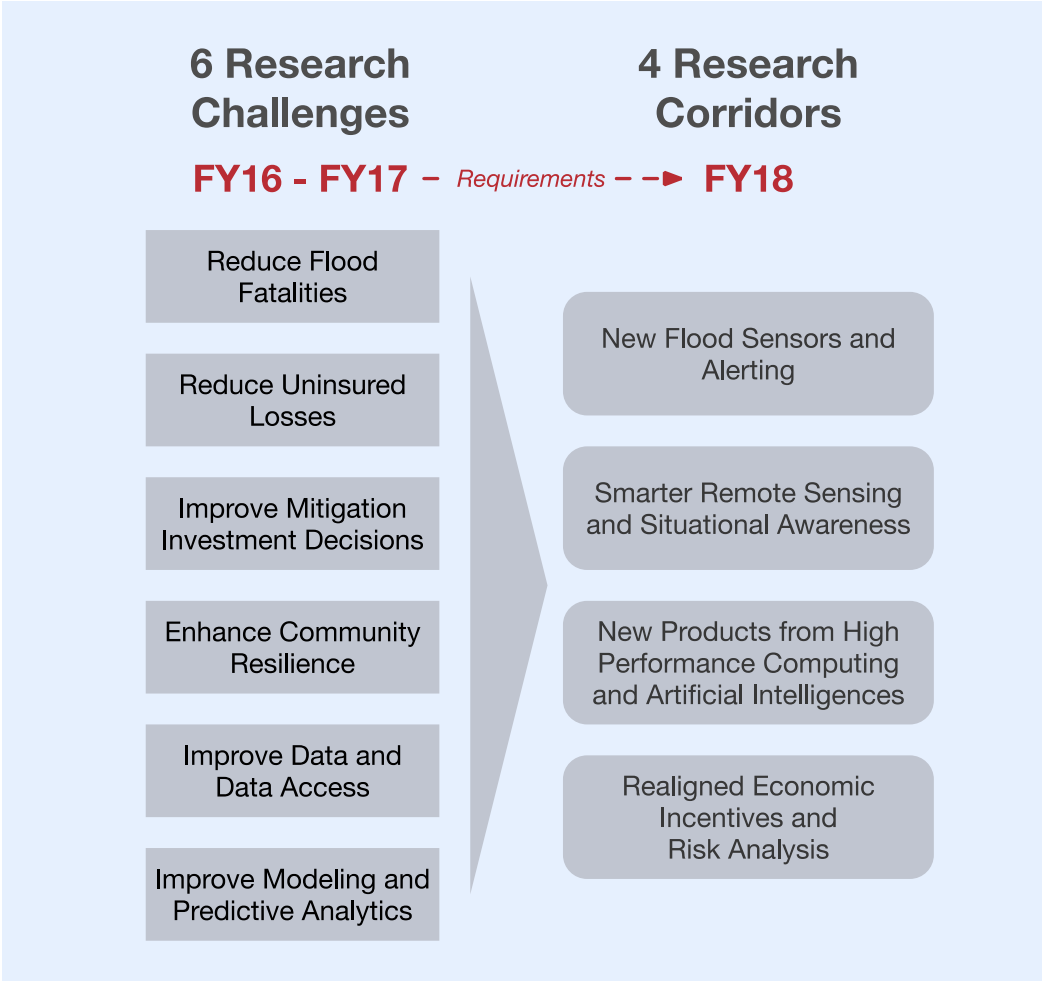
Flood Apex Overview

Flood apex video link:

https://www.dhs.gov/science-and-technology/flood-apex-video

Flood Apex Technical R&D

- Program was requested by FEMA Administrator
- Focus has been refined over time to respond to emerging needs and research results
- Events of 2017 underscore the need for new approaches to managing floods



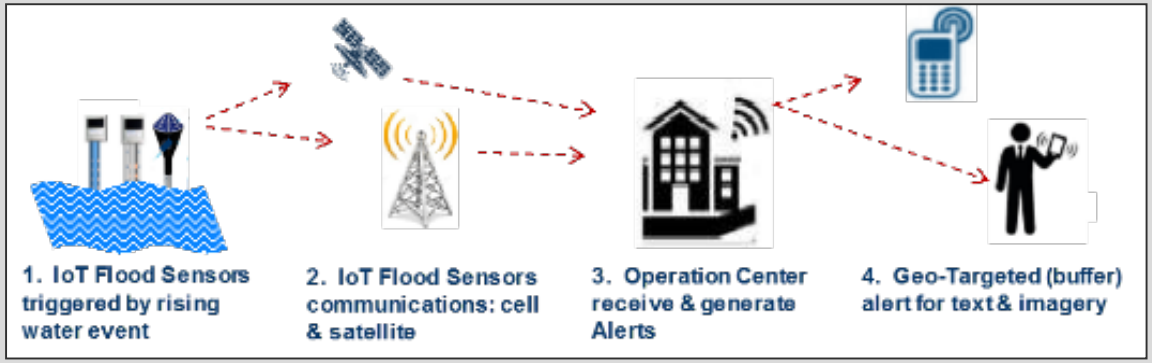
New Flood Sensors & Alerting

Traditional Stream Gauge
$25,000 + $6,000 maintenance

Deployable Sensors
< $1,000 +
$0 annual maintenance

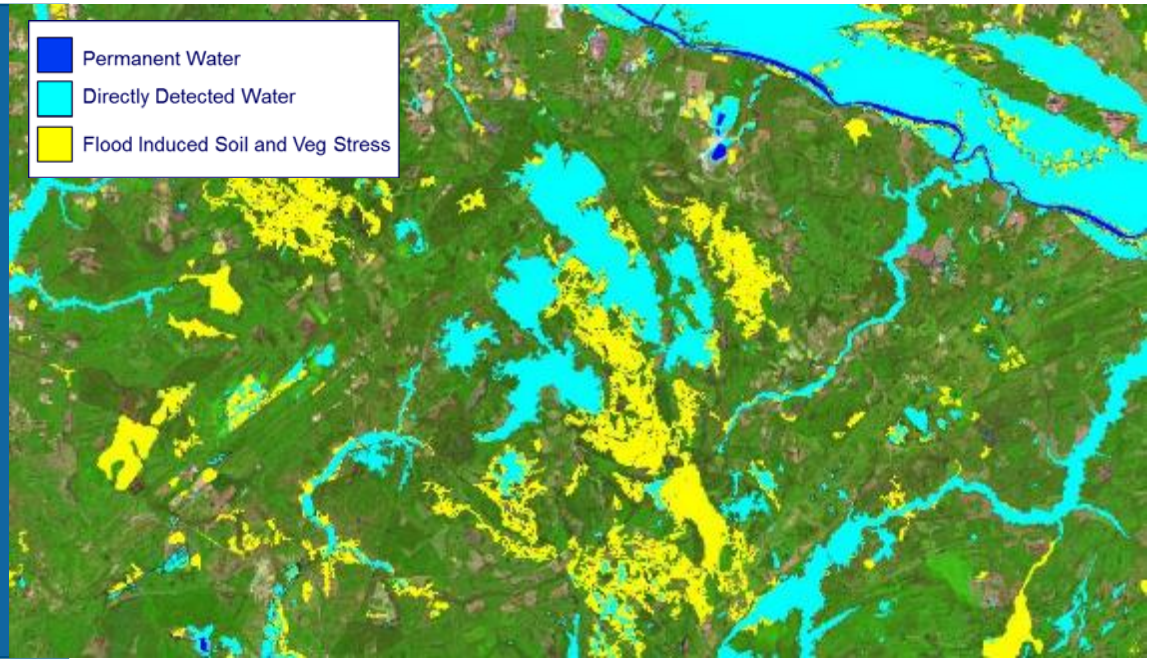
New sensors currently under test in the Flood Apex Program cost a few hundred dollars and can be deployed anywhere

Signals can be processed to produce flood alerts to send to smartphones in areas of immediate danger



Historically Observed Flood Events (OFE)

Historical floods leave detectable changes in the landscape that can be picked up by satellites. Flood Apex is using LANDSAT imagery to detect areas **outside** of designated high risk flood areas that have experienced flooding in the past. This provides the means to make our flood hazard maps more accurate and emergency managers better prepared.



MDA
MDA INFORMATION SYSTEMS LLC
a U.S. company

OFE Application

Left image: Historical flooding prior to development in Katy, TX.

Center image: Same area since being developed.

Right image: On April 18, 2016, the area is flooded in torrential rains.

OFE Application

Potential loss avoidance (preventable damage) in relation to actual flood events identified using OFE data

Study Areas of Interest (98,000 sq mi)	$ Claims NCRF Outside SFHA	# of Claims	Rough Average Claim $ represented
Austin	$15,120,000	291	$51,940
Charleston	$24,766,000	1485	$16,678
Houston(pre Harvey)*	$202,472,000	5303	$38,177
Jacksonville	$21,757,000	1407	$15,464
Phoenix	$66,000	6	$11,126
Shreveport	$5,675,000	132	$42,838
St. Louis	$29,492,000	1067	$27,643
Tuscaloosa	$320,000	26	$12,389
			Total Average
Total	**$299,668,000**	9717	$27,032

Data based on National Flood Insurance Program (NFIP) policy claims processed on New Construction at Risk of Flood (NCRF) outside the SFHAs during 33-year study period.

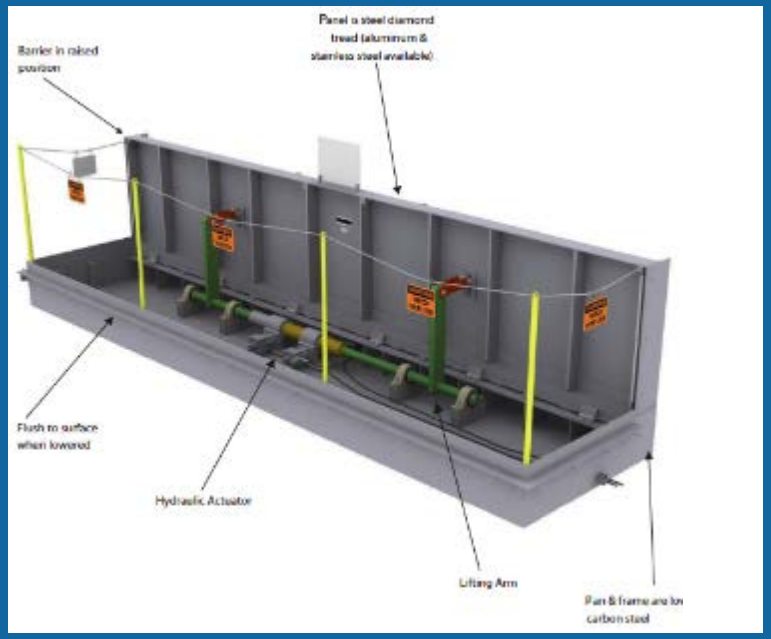
New Products from High Performance Computing

Artificial intelligence image processing running on supercomputers can reliably identify structures from aerial and satellite photographs.

Flood Apex is linking building and infrastructure footprints with flood risk maps and forecasts to produce new products and services for the flood insurance markets and gives property owners individualized information about their vulnerability to floods.

OAK RIDGE National Laboratory

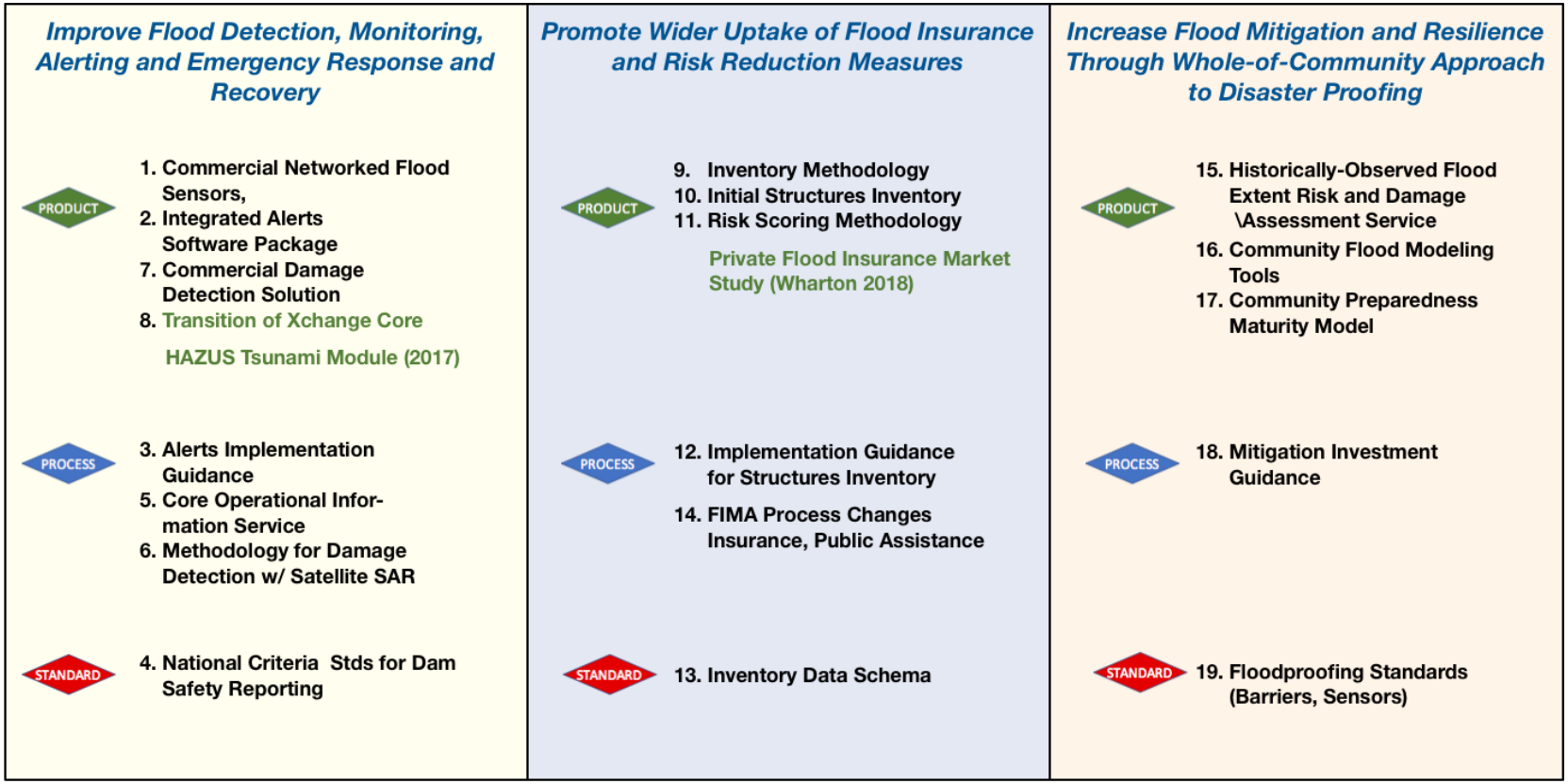
Realigned Economic Incentives & Risk Analysis



Flood Apex is investigating new ways to incentivize the private sector and individuals to take a more vital role in flood management and reducing risk

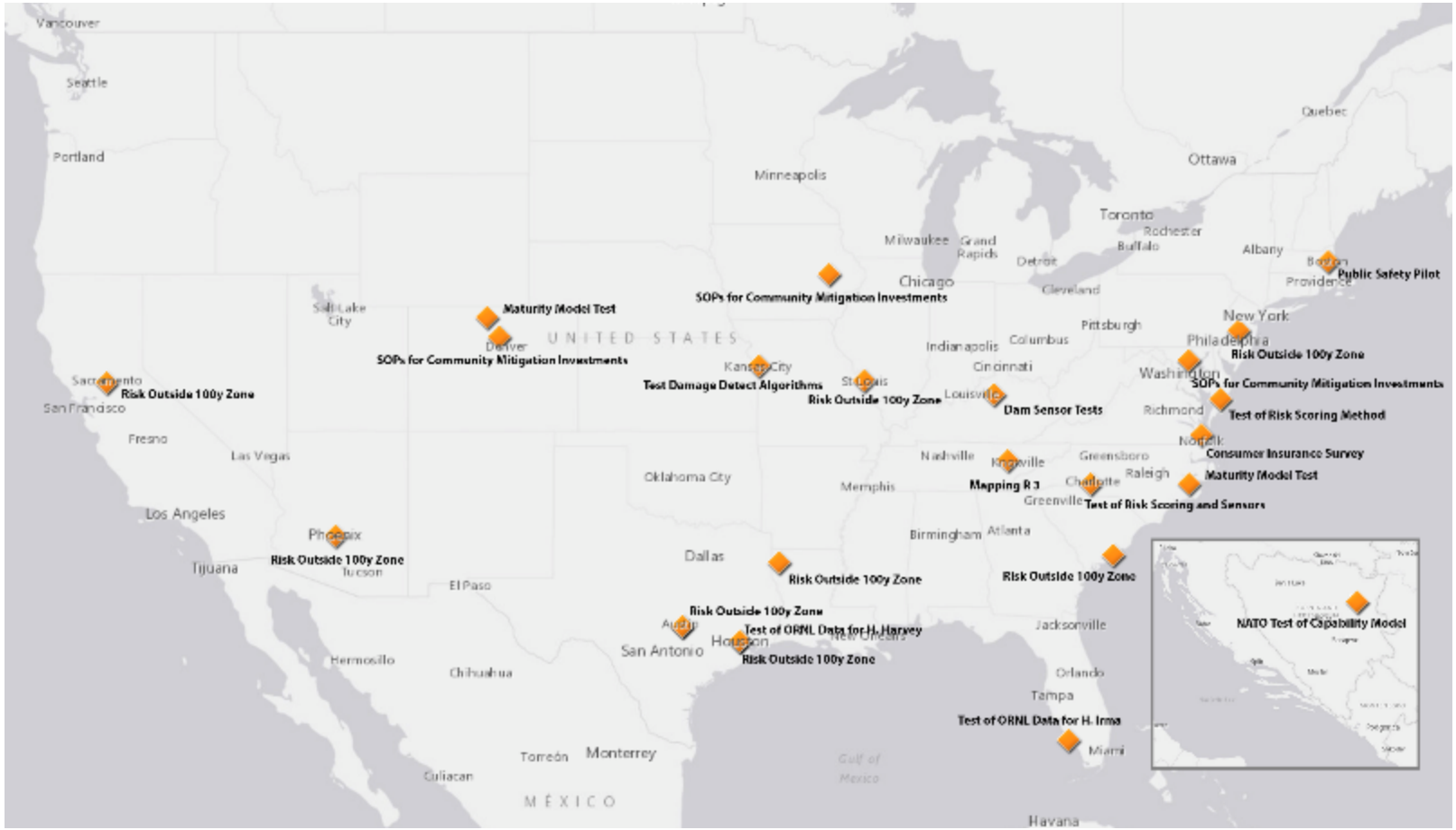
One strategy is to develop national standards for flood proofing products, such as waterproofing materials and semi-permeable barriers

Flood Apex Program Outputs



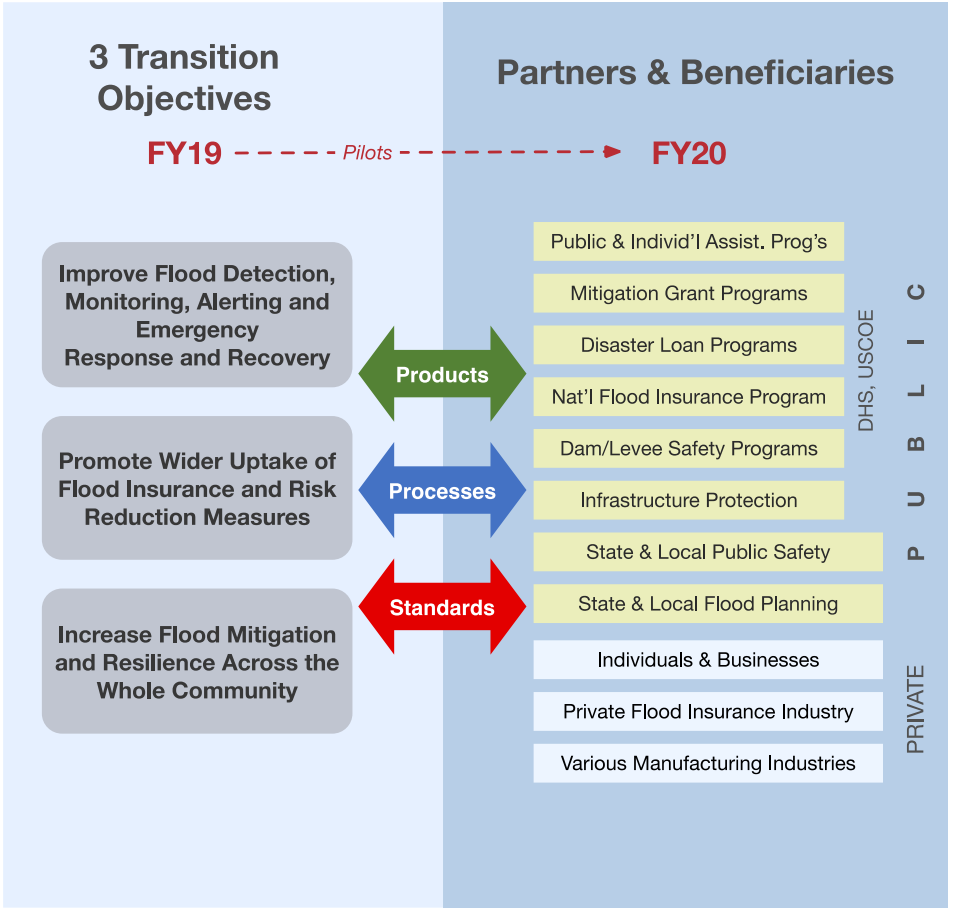
In all, Flood Apex currently plans to transition 19 different products, processes and standards to its stakeholders by 2020

Tests & Experiments



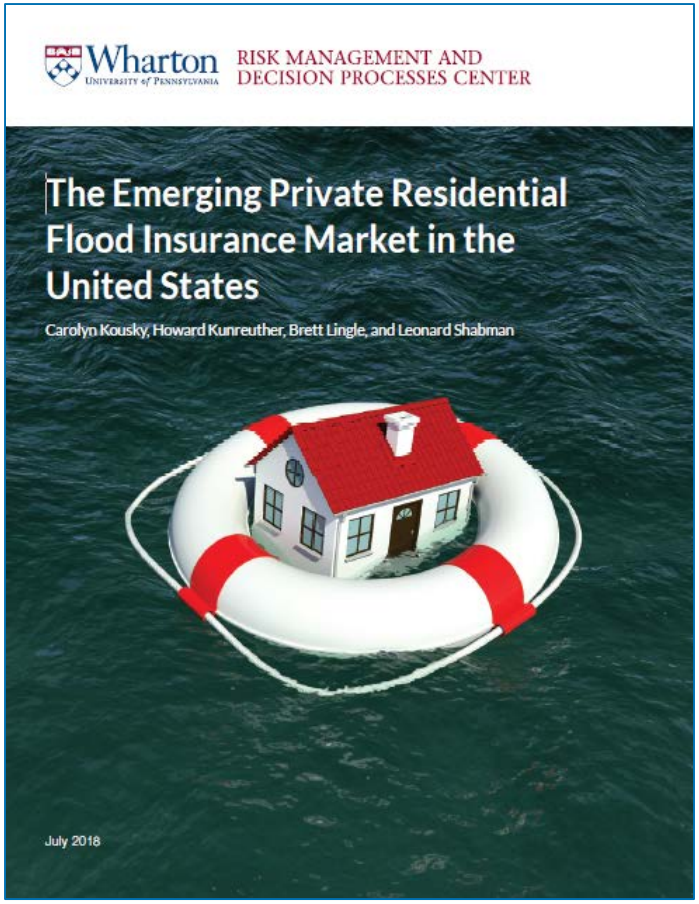
Flood Apex Transition to Use

- Flood Apex is programmed for funding through FY2020
- 22 projects in progress:
  - 11 continuing
  - 11 new
- Completed first year of execution, now pivoting to transition and stakeholder adoption
- Working with agencies at all levels, NGOs and private industry



Wharton Study

- "The Emerging Private Residential Flood Insurance Market in the United States" Report, published on July 23, 2018
- Funded by S&T and supported by FEMA
- Provides key findings to stakeholders on the current status of the private residential flood insurance market and its relationship to the NFIP



https://riskcenter.wharton.upenn.edu/wp-content/uploads/2018/07/Emerging-Flood-Insurance-Market-Report.pdf

Wharton Study: Key Findings

1. Flood is insurable: Historically, residents were told by the insurance industry that floods were uninsurable. As many companies invest in the technology and infrastructure to support flood products, this perception is changing. More insurance companies are willing to underwrite flood insurance.

2. Continuing role for the NFIP: The private market will not be able to write all risks, especially for severe repetitive loss properties or high-risk areas. These areas will remain under NFIP policies.

3. Need for aggressive flood risk reduction: In order to expand private insurance, there is a need for more aggressive public commitments to risk reduction. These types of risk reduction investments will play a complementary role to insurance.

4. Easier access to flood insurance: Many participants also agree the flood coverage should be included in homeowners' policies to avoid confusion, ensure coverage and to be easier to administer.

5. Expanded education on flood insurance: There is a need for expanded insurance agent education about flood risk and flood insurance products, both for the NFIP and private policies.

6. Commitment to flood resilience: Flood insurance is only one component of flood resilience. Flood resilient communities will require commitments by both private and public sectors to a range of mutually beneficial activities.

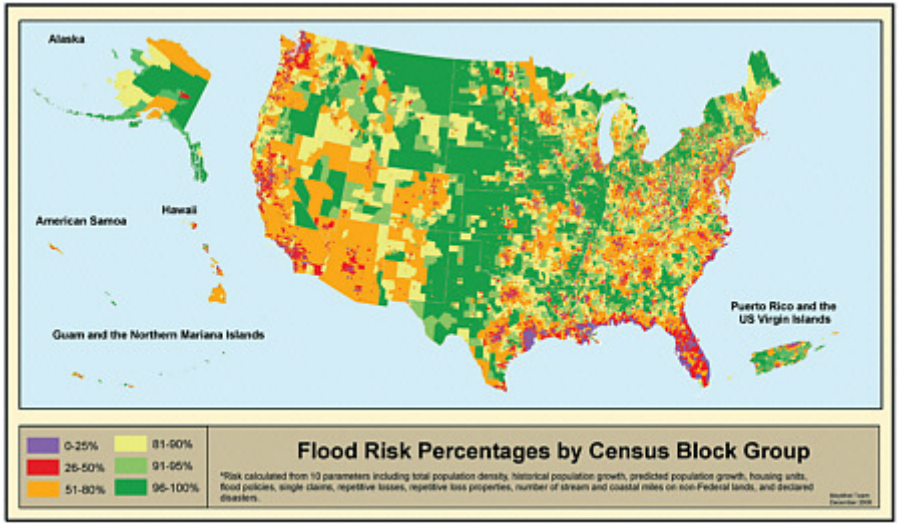
Modeling Flood Hazards and Risks

Two Overall Approaches

Detailed Engineering

What is the hazard at my location?

Generalized / Portfolio / Catastrophic



What is the exposure of my portfolio?

Traditional Engineering Approach

- **Detailed hydrologic and hydraulic studies**
  - Extensive use of physical modeling
  - Dependent on detailed land use, land cover, terrain (including bathymetric in coastal areas), channel, obstruction, bridge and similar data
- **Benefits**
  - Provide, within limits of engineering and scientific uncertainty, highly accurate understanding of flood hazards
  - End products are transparent, results repeatable and generally accepted within the scientific and engineering community
  - Can inform building codes and engineering design for mitigation at specific locations
- **Challenges**
  - Requires high quality data, which can be expensive to collect or gather
  - Data gathering and modeling process are labor intensive and time consuming
  - ***Generally does not address risk***

Portfolio / Catastrophic Approach

- **Portfolio / Catastrophic loss studies**
  - Heavy use of statistical and empirical data; may be integrated with “light-weight” hydrologic and hydraulic models
  - Spatial analytical methods
  - May include data on built environment
- **Benefits**
  - Allows for development of hazard information over wide areas
  - Can be readily combined with structure address and other information to allow assessment of portfolio risk
  - Can support catastrophic risk assessments on wide area and national level
  - Areas of hazard identified may extend beyond those of traditional mapping methods
- **Challenges**
  - While on the aggregate, results of a portfolio or catastrophic risk analysis may be of high qualify, results at a specific location may be questionable
  - This will be particularly true in boundary or transition areas from high flood risk to areas of little flood risk
  - Use for building codes and mitigation or engineering design is limited
  - Underlying analytical methods used may not be transparent nor well accepted in the engineering and scientific communities

Summary

- For detailed understanding of hazard and risks at a location, there is currently no substitute for the detailed engineering study
  - However, they are expensive, time consuming and imperfect
- Flood insurance applications and the emerging private sector flood insurance offering market have important use cases that can be supported by more generalized, statistical and empirical data, including:
  - Portfolio reviews
  - Catastrophic loss estimation
- As private flood insurance offerings grow, the need for non-traditional methods of assessing flood hazards and risks will continue to increase
- As the insurance and other communities becomes more comfortable with non-traditional approaches, their use will become more pervasive and accepted

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