

# First Responders Group FLOOD APEX PROGRAM



Homeland Security

Science and Technology

## RETHINKING AMERICA'S COSTLIEST DISASTER

### U.S. FLOOD RISK TODAY

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

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

Flash Flooding Causes the Most Weather-Related Fatalities **200 Lives per year – More than Tornadoes**

Other Types of Floods Claim **80 Lives per year – 50% Vehicle-Related**

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

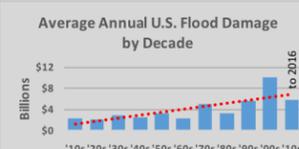
More than **53% of U.S. Voters** have been Personally Impacted by Floods

More than **500,000 Bridges** in the U.S. Cross Water. **9% are Structurally Deficient** and Subject to Increased Flood Damage

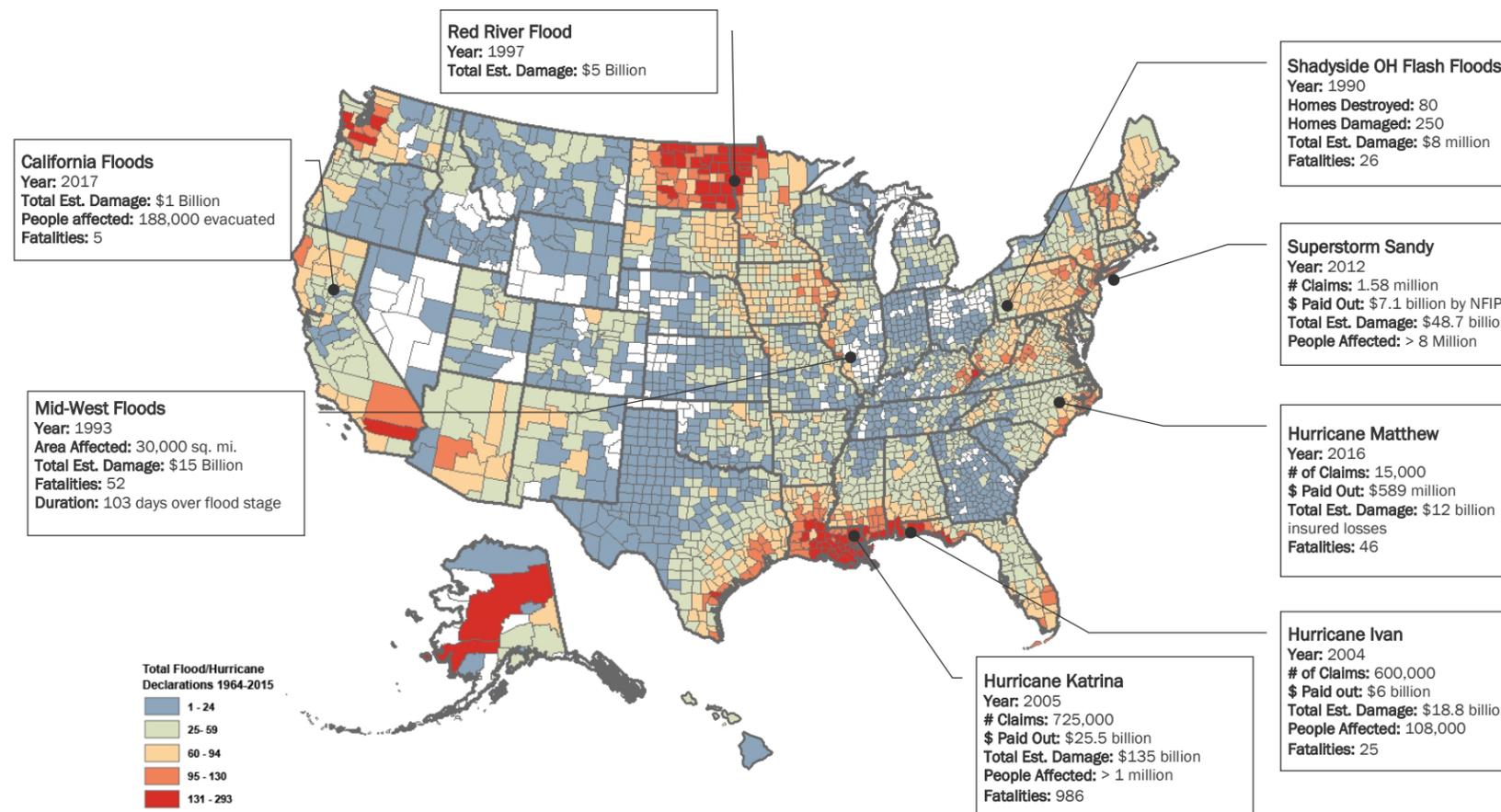
More than **27,000 U.S. Dams** are “high-hazard” (dam failure would cause deaths or serious economic loss). **>14% of these are “deficient” and in need of repairs**

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

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



Each year, floods kill more people and cause more economic damage than any other natural disaster. Every state suffers from at least one form of flooding—coastal, riverine or flash floods—and many are vulnerable to all three. In **2016, the U.S. experienced 32 Major Disaster declarations and 6 Emergency Declarations involving flooding**. As more people and more development move into flood risk areas, the numbers are rising. The Flood Apex is using new technologies and new approaches to turn this situation around.



### RETURN ON INVESTMENT

Floods cannot be prevented, but today's technology offers a surprising array of opportunities to rethink how we plan for, and respond to, these disasters. Flood Apex is focusing its R&D efforts on returns in three areas.

#### Maximizing Mission Impact While Reducing Costs

- Supporting disaster assistance programs with new technology to reduce operating costs for emergency management.
  - New tsunami flood risk analysis model — recently added to the HAZUS system — assisting >10,000 planners with economic and structural hazard and damage assessments.
  - Regional extracts of the Social Vulnerability Index (SoVI) — helping managers with evacuation and community disaster planning.
  - Hurrevac-X model (HVX) and SUMMIT unified mapping system to support emergency managers.
- Assisting critical infrastructure programs with new technology to detect threats of rising water and broadcast geo-targeted alerts and warnings.
- Extending Flood Apex techniques to other hazards.

#### Expanding the First Responder Industrial Base

- Partnering with small businesses to develop new, low-cost smart sensors to detect flood conditions and risks to public safety.
- Collaborating with industry to produce new data products for the insurance, banking, real estate and infrastructure sectors to help reduce risk and uninsured losses.
- Spurring new development in the small satellite industry to enhance situational awareness capabilities for first responders and emergency managers.

#### FRG Technologies Get Results in Your Communities

- Conducting community pilots across the country to ensure new innovations work for those on the front lines, advancing state and local capacity for flood emergencies.
  - Working with national associations to promulgate standards and best practices to improve flood management practices, flood proofing options and mitigation decisions — to strengthen community resilience.

Flood Apex is a cross-cutting program sponsored by FEMA to reduce flood fatalities, lower economic losses and increase community resilience. “Smart” flood alerts, data analytics and new remote sensing systems are technologies behind the Flood Apex program.

### MAKING FIRST RESPONDERS SAFER AND MORE EFFECTIVE

As development increases in flood-prone areas, more people — and more first responders — are at risk. The Flood Apex is developing **new ways to share data** with first responders and **new ways to send warnings** to evacuate more quickly, respond faster, save lives and protect property.

### POWERING INDUSTRY AND SPURRING INNOVATION

The Flood Apex is sponsoring innovative, **network-connected flood sensors** that will bring flood warning system costs down by orders of magnitude while improving accuracy and reliability. The Flood Apex is also **working with industry** to adapt new satellite systems and remote sensing data to **advance national capabilities for flood hazard identification and damage assessment**.

### SECURING COMMUNITIES ACROSS AMERICA

The Flood Apex is working with the insurance and real estate industries to design and build **next-generation data and analytics to support wider participation** in flood insurance, provide analytical techniques to improve mitigation investment decisions, **make communities less dependent on public funding for flood disaster recovery and improve mitigation investment decisions**.

# FLOOD APEX PROGRAM RESEARCH AND DEVELOPMENT

# PARTNERSHIPS

## NEW FLOOD SENSORS AND ALERTING

Traditional stream gages to measure the height of streams are expensive permanent installations costing many thousands of dollars.

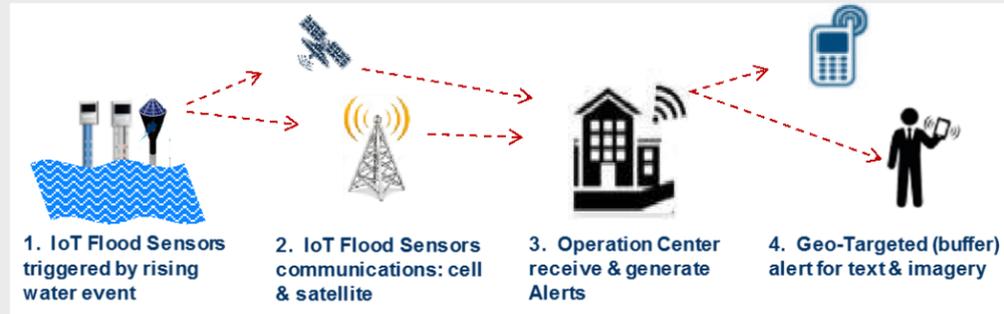
Advanced manufacturing techniques can be used to produce light-weight, cheap, deployable, configurable and internet-connected sensors to improve flood detection, monitoring and local flood safety programs.



Credit: USGS



New sensors like the one on the left, currently under test in the Flood Apex program, cost a few hundred dollars and can be deployed anywhere. Signals from sensors like these can be processed to produce flood alerts and warnings to send to smartphones carried by people in immediate danger in flood risk zones.



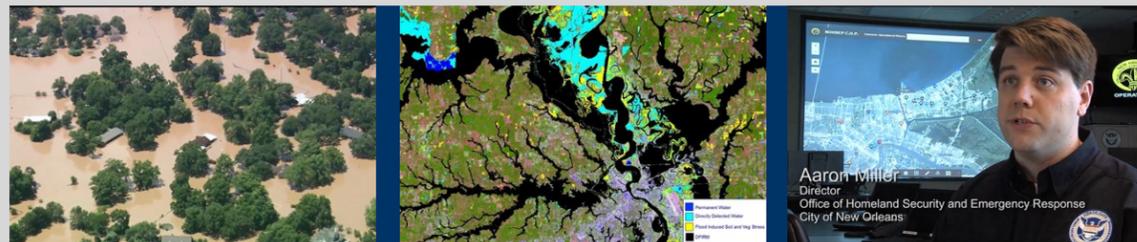
## SMARTER REMOTE SENSING AND SITUATIONAL AWARENESS



Credit: NASA

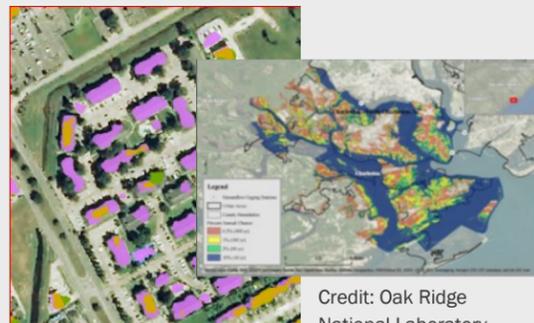
Today's technology can deploy many new sensors into the skies and space — LiDAR to map the elevation of flood-prone areas down to the inch, high-resolution photography to identify vulnerable structures and multispectral sensors to detect changes in the environment. Smarter exploitation of these capabilities will improve the detection of flooded areas, damaged structures and at-risk infrastructure, reducing uninsured losses and shortening response times for public safety.

Historical floods leave detectable changes to the landscape that can be picked up by satellites. Flood Apex is using LANDSAT imagery to detect areas outside 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 our emergency managers better prepared.



## NEW PRODUCTS FROM HIGH PERFORMANCE COMPUTING AND ARTIFICIAL INTELLIGENCE

Supercomputing can do in minutes what old computers took months to finish. Combining this super processing power with artificial intelligence can produce new insights on human settlement patterns and insurance and property losses. These insights help emergency managers better understand flood risk and shorten their decision times during an emergency. They can also improve local protective measures and support faster, more informed decision-making by citizens and businesses before and after a flood event.



Credit: Oak Ridge National Laboratory

These same technologies, when applied to data from satellites, aerial photography, social media and insurance claims, can also enhance our understanding of the nation's building stock. Linking building and infrastructure footprints with flood risk maps and forecasts produces new products and services for the flood insurance market and gives property owners individualized flood risk information about their vulnerability to coastal, riverine or flash floods.



## REALIGNED ECONOMIC INCENTIVES AND RISK ANALYSIS



More powerful analytics, fueled by new data, technology and standards, allow us to rethink the roles of government, the insurance industry, non-profits and the private sector in mitigating the consequences of floods and disaster-proofing society.

New ways to incentivize the private sector and individuals to take a more vital role in flood management and reducing risk, which strengthens community resilience and our ability to rebound from disaster.



Credit: Presray Corporation



The result: Communities that are inherently more resistant to flood damage, better insured against loss and able to restore their homes, businesses and infrastructure faster.

- **FEMA:** Sponsor of the Flood Apex program
- **National Weather Service:** National Water Model and National Water Center initiative; Partnership to reduce flood fatalities and improve flood warnings; Coordination with partners including the United States Geological Survey; the U.S. Army Corps of Engineers and FEMA
- **National Academy of Sciences:** Collaboration with the Resilient America Roundtable community pilots
- **Greater New Orleans:** Partnership Intermediary Agreement to perform research on flood resiliency
- **Flood Apex Research Review Board:** Provide recommendations and subject matter expert insights
- **Association of State Floodplain Managers:** Provide focal point for collaboration with state floodplain managers
- **Lower Colorado River Authority:** Build and test flood sensor network for geo-targeted alerts and warnings
- **National Dam Safety Program:** Collaboration on risk perception and warning systems
- **National Alliance for Public Safety GIS Professionals:** First responder collaboration on the use of spatial analytics to reduce flood fatalities and damages
- **Central United States Earthquake Consortium:** Decision support analytics and regional information sharing / interoperability
- **Housing and Urban Development:** Flood Disaster Resilience Grant Programs
- **Resources for the Future:** Analysis of the involvement of private companies in flood insurance
- **Commonwealth of Kentucky:** Post disaster mitigation grant decision support tools
- **Commonwealth of Virginia:** Partnership to explore causes of, and solutions for, lack of insurance coverage
- **Private Sector (ongoing):** Long Range Broad Agency Announcement / Broad Agency Announcement and Small Business Innovation Research awardees; realtors, bankers, insurance, builders and renters trade associations; technology