

U.S. Department of Homeland Security | Science and Technology Directorate

Nuclear Regulatory Commission: Probabilistic Flood Hazard Assessment Workshop:

Flood and Fire Sensors for Resilient Communities



Science and
Technology

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Science and Technology Directorate

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Executive Summary

Flood and Fire Sensors for Resilient Communities

Flooding and Wildland Fires are the nation's leading natural disasters, accounting for the greatest loss of life, property damage and economic impact while threatening the resiliency of communities across the country.

Current flood damage is estimated at \$5 billion per year and wildland fires annualized losses are estimated to range from \$63.5 billion to \$285 billion.

The human cost is much greater.



*Ellicott City, MD
May 27, 2018*



2017. (Santa Barbara County Fire Department)

Low-Cost IoT Flood Sensors



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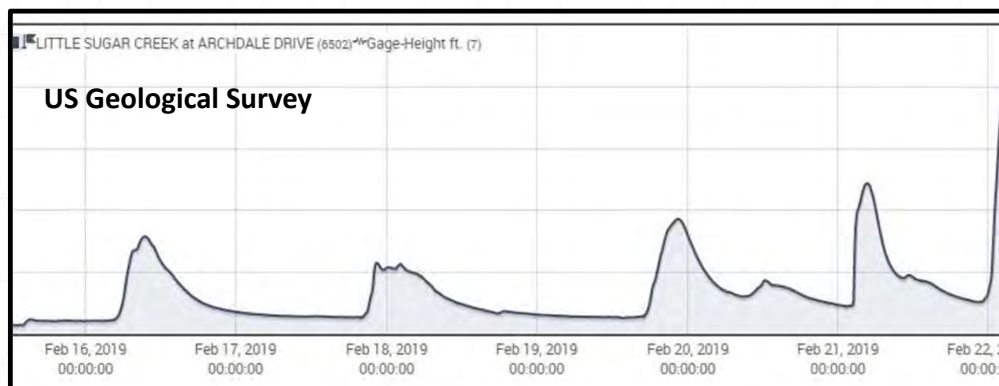
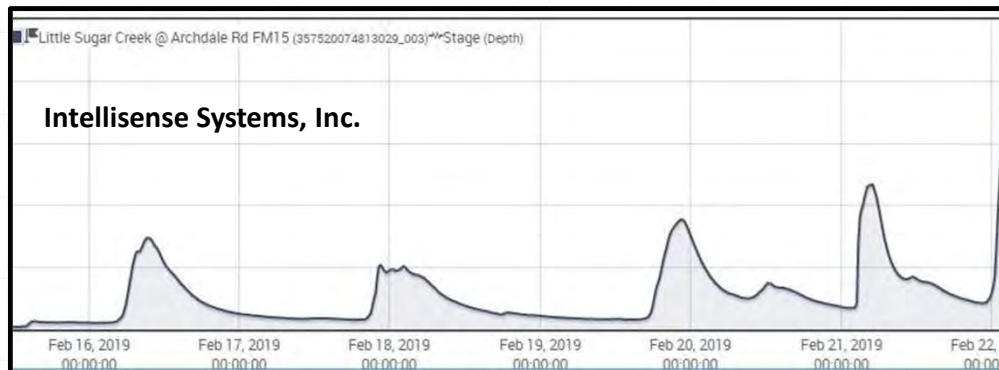
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Low-Cost IoT Flood Sensors: Phased Approach



Low-Cost IoT Flood Sensors: Relative Accuracy

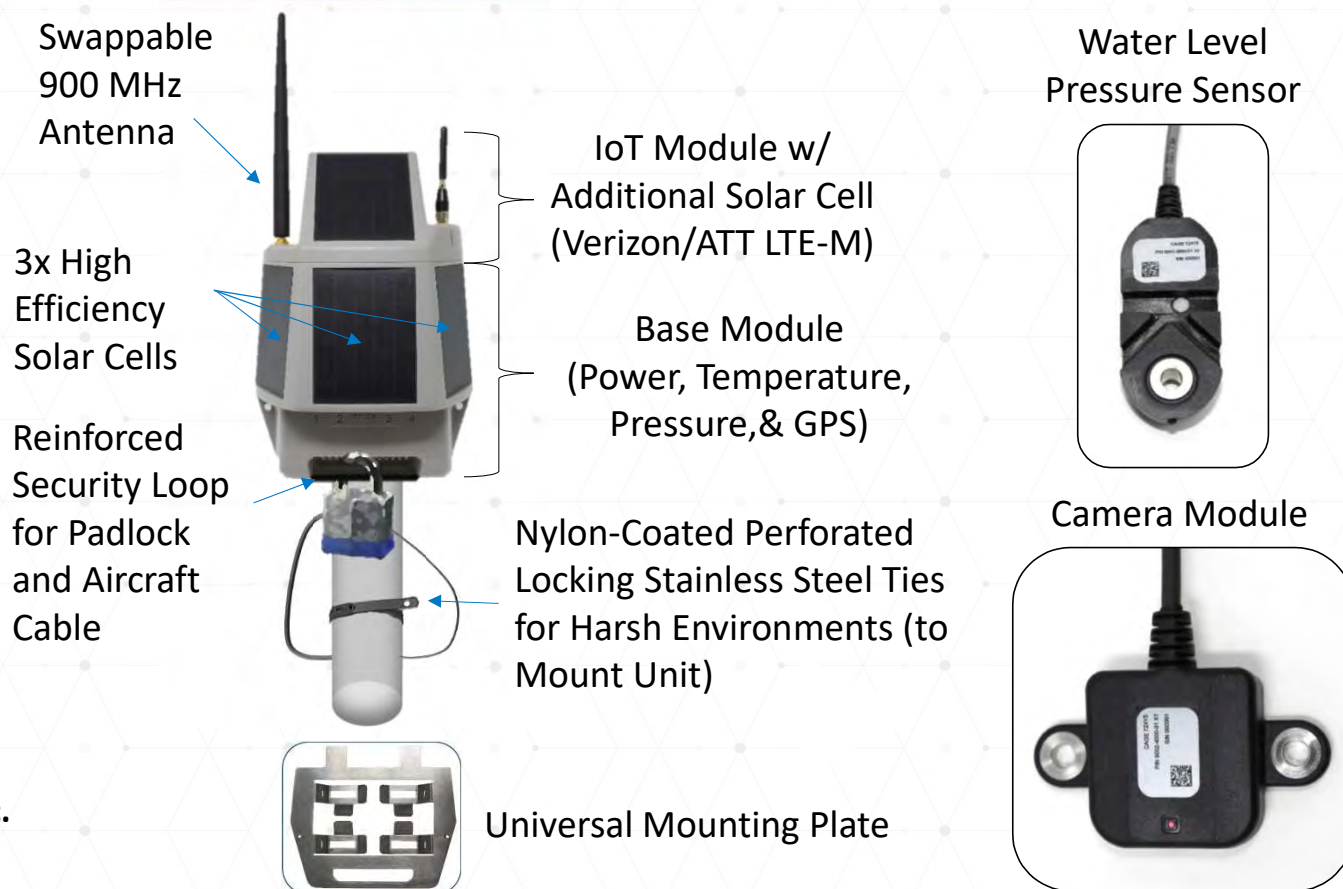


“The DHS APEX gauges have assisted Howard County In our efforts to improve and advance the flood warning system in Ellicott City.

Additionally, we shared data with US National Weather Service (NWS) and they indicated that among the gages there was data provided by the pilot program that could “absolutely” be accepted the into their system.”

- Brian Cleary, Howard County, MD
Storm Water Management Division

Low-Cost IoT Flood Sensors: Hardware Configuration



Intellisense Systems, Inc.

Flood Sensor Stakeholders and Use Cases

STAKEHOLDERS

- US Army Corps of Engineers
- US Geological Survey
- Kentucky
- North Carolina
- Texas
- Virginia
- Charlotte-Mecklenburg County, NC
- Montgomery County, MD
- Ellicott City, MD
- Nashville, TN
- Norfolk, VA
- Torrance, CA
- State University, Albany NY
- The Nature Conservancy

USE CASES

- Urban flash flooding
- Culvert runoff
- Coastal flooding
- Storm Surge
- Repetitive Loss valuation
- Dam Safety Monitoring
- Storm Water Management
- Water supply fire suppression
- Sheet wash over highways
- Critical Infrastructure shutdown
- Wetland mitigation monitoring
- Agriculture irrigation



Wildland Fire Sensors

National Fire Activity Synopsis

The 2020 fire season saw an increase in the annual number of acres burned with over 10 million acres. The large fire activity in 2020 was well above average.

A total of 17,904 structures were reported destroyed by wildfires in 2020, including 9,630 residences, 7,255 minor structures, and 1,119 commercial / mixed residential structures.

– National Interagency Coordinating Center Wildland Fire Summary & Statistics Annual Report 2020



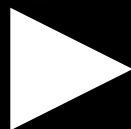
2017. (Santa Barbara County Fire Department)

Wildland Fire Sensors



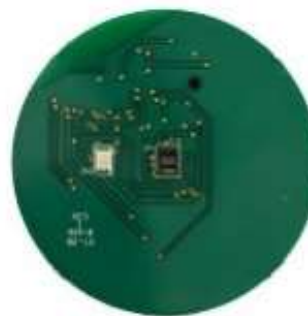
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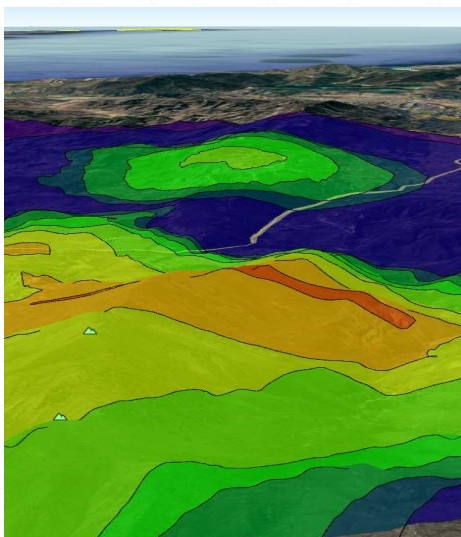
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Wildland Fire Sensors: Phase 1 Prototype



Wildland Fire Sensors: Phase 2 Modeling and Testing

Conducted **extensive modeling** to define and understand the level of concentrations of smoke composition and particulate matter at a variety of distances and wind conditions



Designed a Test Lab approach and mechanism to test the sensors at low levels of smoke concentrations in a repeatable manner using chaparral fuel



Tested many scenarios of different burn characteristics (ignition, smoldering, flaming combination, etc.) and different environmental conditions



Conducted test and demonstration at a prescribed burn over 2 days in Red Bluff, CA. Sensors repeatedly demonstrated ability to detect smoke, at ignition and at a distance



Wildland Fire Sensors: Stakeholders



Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES



U.S. Fire
Administration



FEMA



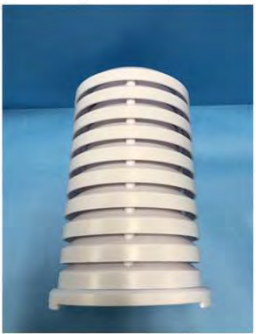
Thanks to our continuous Stakeholders from FEMA, Cal OES, Cal Fire, Cal OEIS, USFA, USFS throughout the Phases.

Wildland Fire Sensors: Phase 2 Findings

- Backend algorithms need revision and need to combine data from multiple sensors and meteorological conditions to provide greatest situational awareness of wildfires
- Multi-modal sensors are necessary to detect wildfires and avoid nuisance alarms (multiple gas types and multiple PM types)
- Multiple sensing algorithms should be developed for near vs. far detection (smoke particles clumped over longer distances and smaller particles traveled farther)
- Cellular data back-haul was most reliable with long-range radios, an option in cellular denied areas
- Initial ability to distinguish a new ignition vs. background smoke

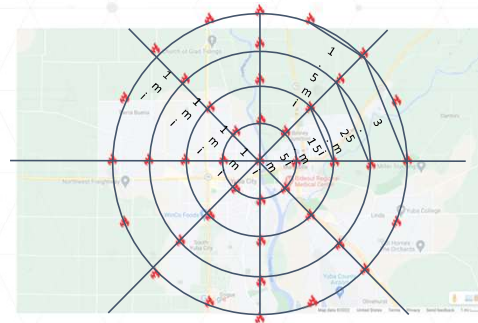


Wildland Fire Sensors: Phase 3 Next Steps



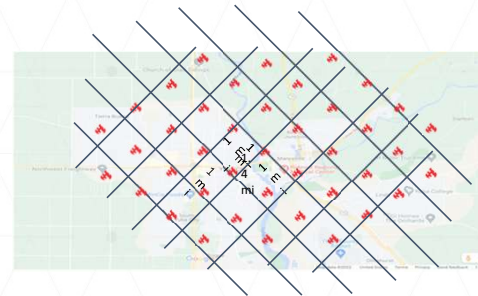
Breeze Technologies UG

- The sensors deployed in Phase 2 were spaced between 150 ft and 3 mi of the ignition sites. This led to the plan for Phase 3 sensors to be placed within 1 mile of each other to balance detection time vs. density



N5 Sensors, Inc.

- 100 sensors / performer to be deployed to determine optimal densification of sensors vs. detection
- Stakeholder infrastructure discussions for sensor installation & monitoring



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Low-Cost IoT Flood Sensors

QUESTIONS?

Wildland Fire Sensors



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