

# DHS Science and Technology Directorate

## Flood Apex Program: Automated National Structures Inventory Project

Each year, floods kill more people and cause more economic damage than any other natural disaster. In 2016, the U.S. experienced 32 major disasters and six emergency declarations involving floods. The Department of Homeland Security (DHS) Science and Technology Directorate's (S&T) Flood Apex program is using new technologies and approaches to better understand flood risks and build new tools to mitigate them.

One of the most serious flood-planning problems is the lack of accurate, current data on the precise location and elevation of buildings in relation to flood plains. Manual data collection is expensive and time consuming. Flood Apex is therefore using satellite imagery, coupled with high performance computing and artificial intelligence (AI), to automate a comprehensive inventory of at-risk buildings and infrastructure. This new data will allow companies to properly insure private and commercial property, and flood planners to design more effective flood-protection strategies.

DHS S&T is partnering with Oak Ridge National Laboratory (ORNL) to lead this effort.

### Traditional Methods

Conventional land surveys have used virtually the same technology for decades to map buildings and infrastructure. Private firms manually study and annotate aerial images, send field crews out to validate their interpretations and ultimately send their final results to state or local agencies. This is a long and expensive process: typically costing \$125 or more per square mile.

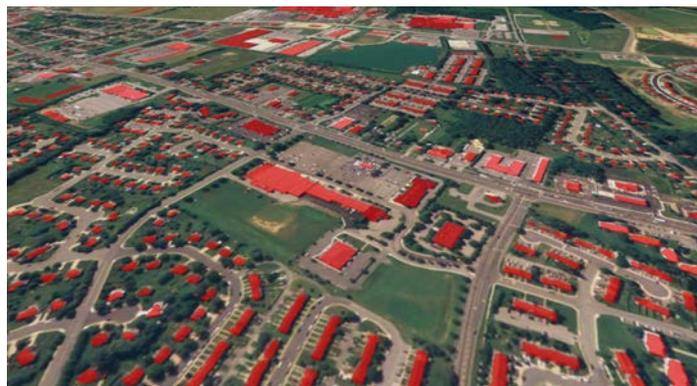
### A New Approach: Supercomputing and AI

ORNL is developing algorithms based on advanced deep learning techniques that are able to reliably and consistently detect all types of residential and commercial buildings from aerial and satellite photos: high rises, mobile homes, single family homes. The key innovation is to apply innovative computer vision technology to detect physical structures in the built environment. Because the process uses AI and super-computing techniques with algorithms that actually improve in accuracy the more they are used, inventories can be kept up-to-date much faster and at a far lower cost than before. The initial cost for mapping and annotating Texas building outlines for example, will be less than \$20 per square mile.



Satellites and drones are inexpensive sources of aerial imagery.

This data set, coupled with detailed risk information about local flood hazards, will help first responders predict where damages are most likely to occur, how extensive damages are likely to be and where agencies can deploy resources to best effect. Because the data will be linked to information on property ownership, tax assessments and current insurance, the inventory will also help the Federal Emergency Management Agency (FEMA) and local planners target flood mitigation investments more accurately and improve FEMA's related public assistance programs. Other beneficiaries will be the Army Corps of Engineers' capital investments in waterways and the National Weather Service's flood forecast modeling and planning for other types of large-area natural disasters such as earthquakes and wildfires.



Structures identified by automated photo interpretation

The project has already developed and tuned the initial algorithms needed to detect all buildings and their features in a pilot area. The next phase will scale the process to cover the entire country, while continuing to refine the algorithms. The goal is to complete the first inventory of the entire U.S. by the end of 2019.



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To learn more about Flood Apex, contact [first.responder@hq.dhs.gov](mailto:first.responder@hq.dhs.gov).