



USGS Next Generation Water Observing technologies

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The Nation's Water Observing Backbone

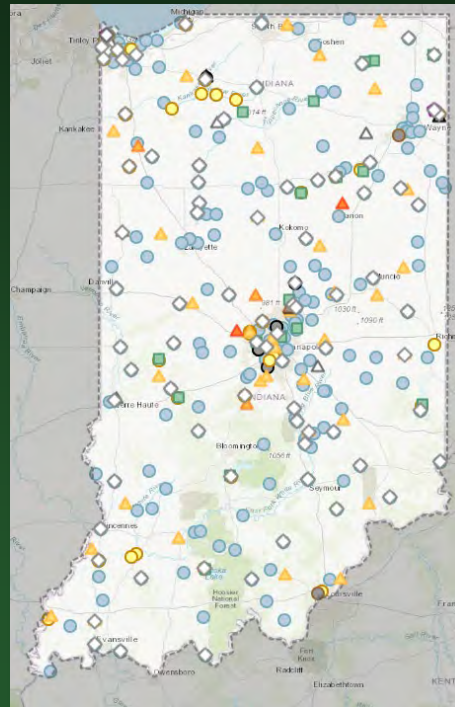
USGS operates the Nation's largest water observing system:

- 11,800+ real-time streamgages
- ~80,000+ streamflow measurements per year
- Monitors groundwater conditions at 19,000+ wells
- Monitors long-term surface-water quality at 109 stations
- Discrete water-quality monitoring in 80+ groundwater networks
- 2,500+ continuous water-quality monitoring stations
- 2.5 billion data requests last year through NWIS web
- Funded by USGS and over 1600 partners



USGS Indiana Monitoring Network

- 262 Surface Water Gages
- 59 Continuous Groundwater Wells
- 48 Continuous Water Quality Locations
- 93 Precipitation Gages



USGS Priority Goals (2026-2030)

Based on input from Subject Matter Experts, internal/external stakeholders, and 2018 National Academies report, five priority goals over the 2026-2030 period were established:

Goal 1: Strategically Manage Products and Underlying Cyber Infrastructure and Services

Goal 2: Deliver Data that Meets User Needs

Goal 3: Improve Operation and Design of Observing Systems

Goal 4: Expand Monitoring Extent and Resolution

Goal 5: Enhance Monitoring with New Types of Observations



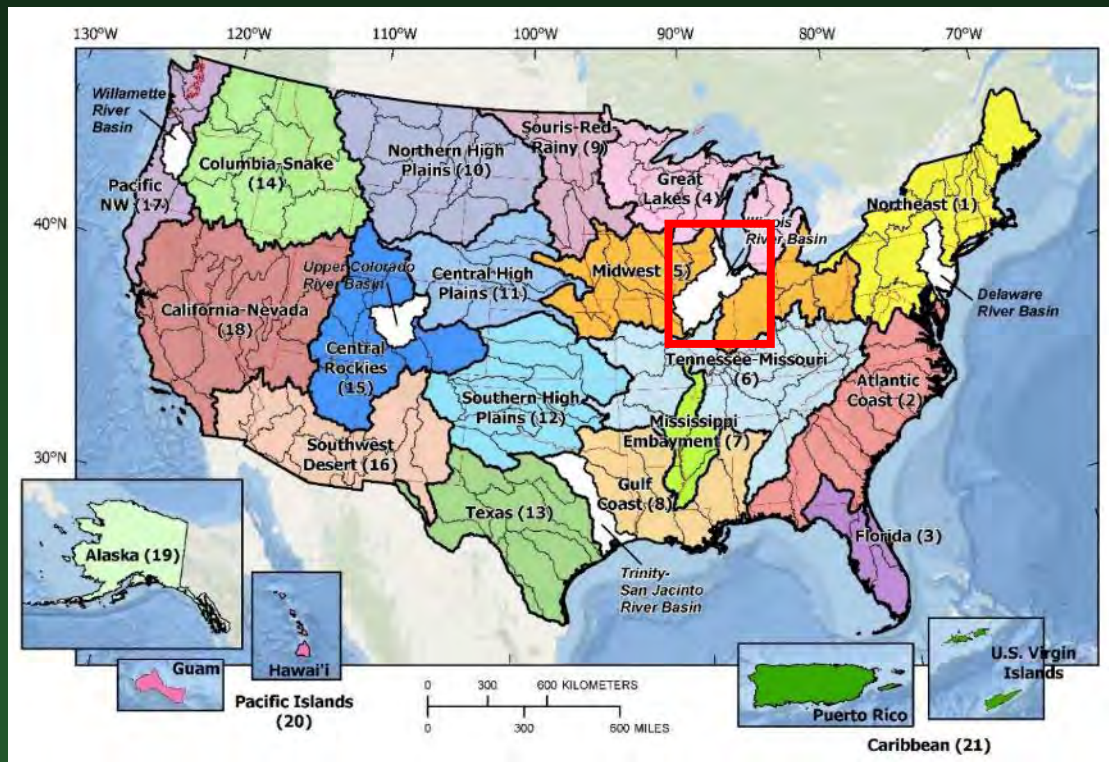
Next Generation Water Observing System (NGWOS)

- **Targeted Basin Monitoring**: Provide high-resolution, real-time data on water quantity, quality and use in select basins to support assessments, management and, ultimately, improve water prediction;
- **R&D**: Provide an innovation incubator for water observing methods and instrumentation development that can be transitioned to National network operations;
- **Data Delivery**: Modernization of the NWIS data telemetry, storage and delivery system to improve integrated data delivery to resource managers and the public.



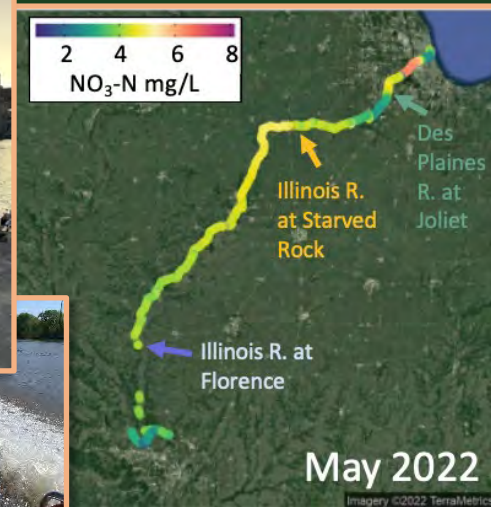
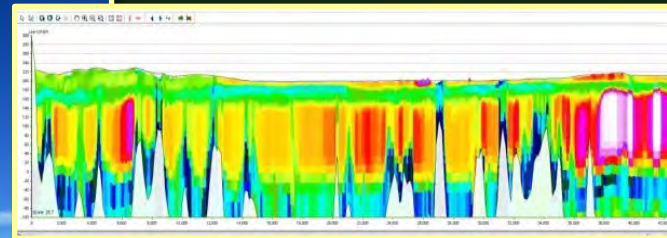
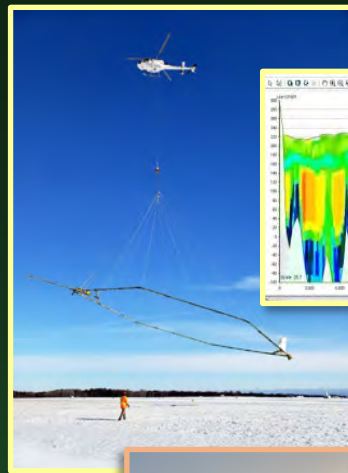
USGS NGWOS Basins

- Integrated Water Science Basins are regional focus areas for intensive observation, assessments, modeling, and prediction
- **Illinois River Basin:** Improve understanding of **nutrients and HABs** and their potential to limit past, present, and future water availability



Basin wide investigations

- **Aerial Electromagnetic (AEM) survey** - geophysical technique used to map subsurface geology by measuring the electrical conductivity of the ground for use in regional modeling
- **Fast Limnology Automated Measurement (FLAMe) trips** - used to generate detailed, spatially-explicit, real-time observations of surface water quality

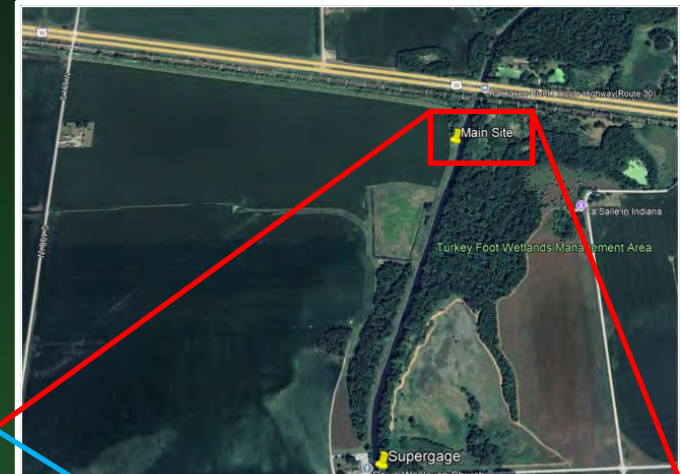
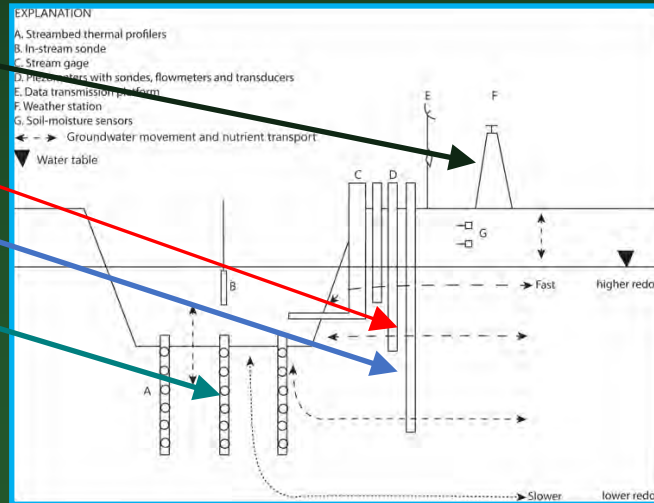


NGWOS Groundwater / Surface-Water interaction study

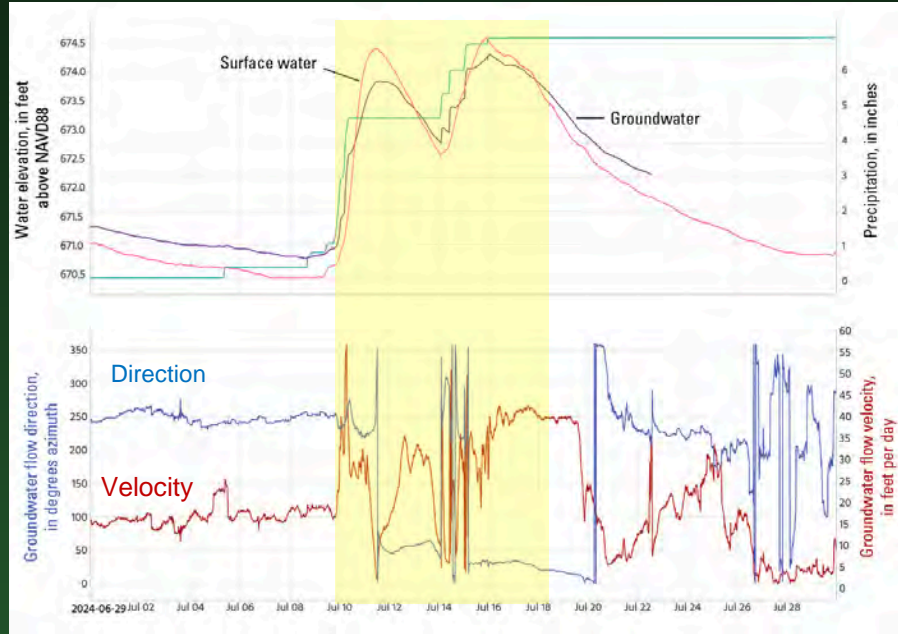
- Through the USGS Next Generation Water Observing Systems program, the OKI WSC has instrumented a site near the Kankakee River at Davis Super Gage to monitor connections between groundwater and the river.

Real Time Data

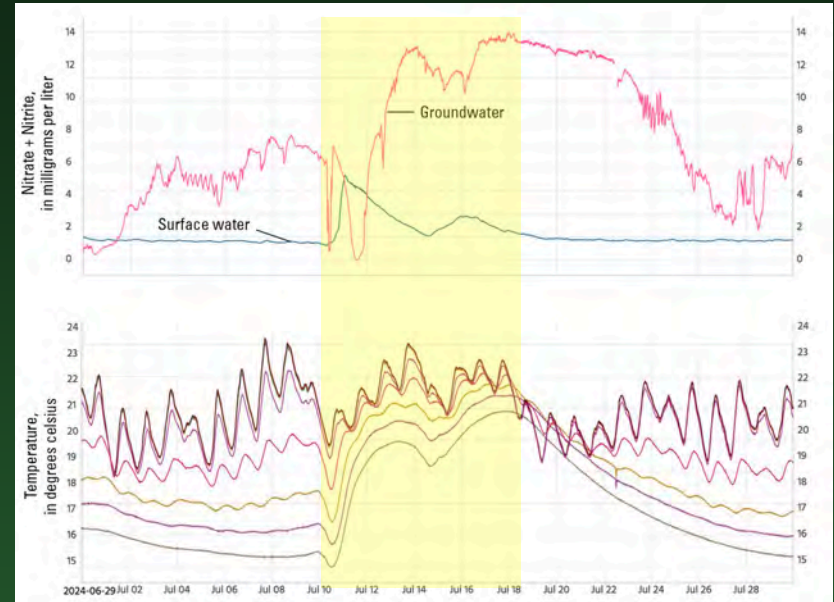
- Weather and Soil Moisture
- Nutrients
- GW Flow
- Streambed Temperature



NGWOS GW / SW interaction study



- Change in GW flow direction verified by GW and SW difference during storm
- Increased GW velocity during event.



- Nutrients in GW initially dilute then increase in concentration. Opposite in SW.
- Streambed temperature shows infiltration of warmer SW into subsurface.

NGWOS Research and Development

Internal and external R&D

- FY 22-24 Appropriations: “Funding for NGWOS includes \$4,500,000 to work with universities and other partners to develop innovative water resource sensor technologies that are scalable to regional and national monitoring networks.”

30+ agreements with universities and private sector on water monitoring R&D needs including:

- Camera-based monitoring**
- Airborne and satellite remote sensing**
- Low-cost autonomous underwater vehicles**
- Water quality (eDNA, suspended sediment, PFAS, microplastics)
- Soil moisture
- Evapotranspiration
- Groundwater flow meters
- Power systems



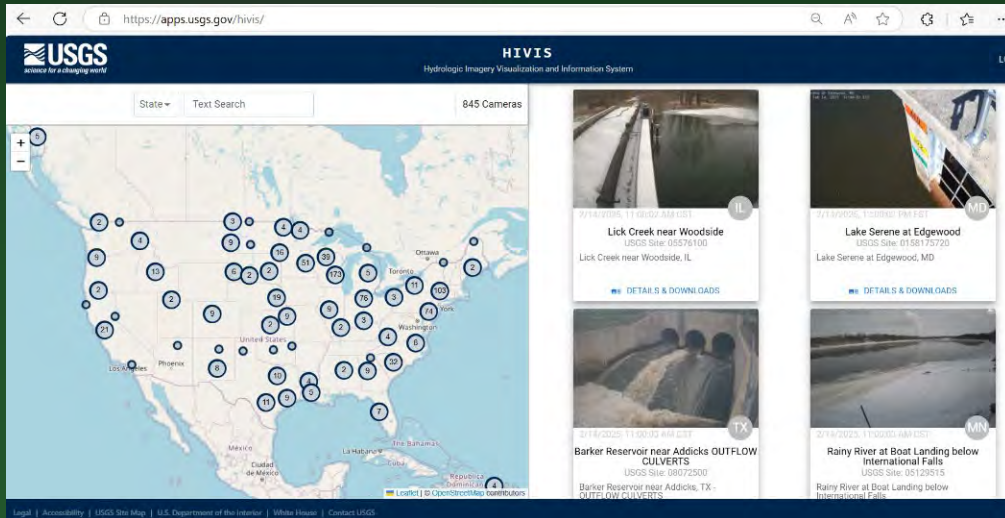
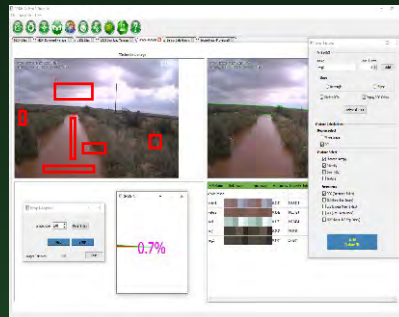
Camera-Based Monitoring

Desired Capabilities

- Low cost, low power and real-time
- Fixed mounted and mobile
- Situational awareness (ice, debris, sensor operations)
- Water quality and quality
- Enterprise delivery system

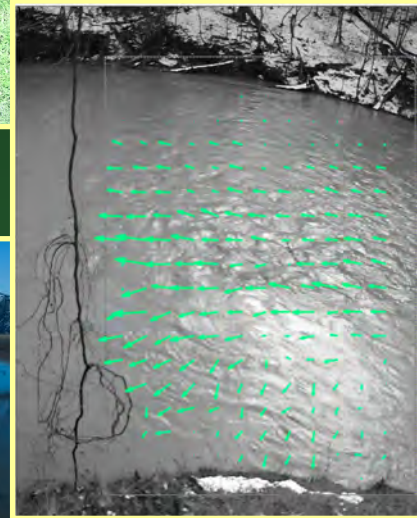
Work in progress

- LSPIV
- HIVIS remote monitoring
- Flow Photo Explorer



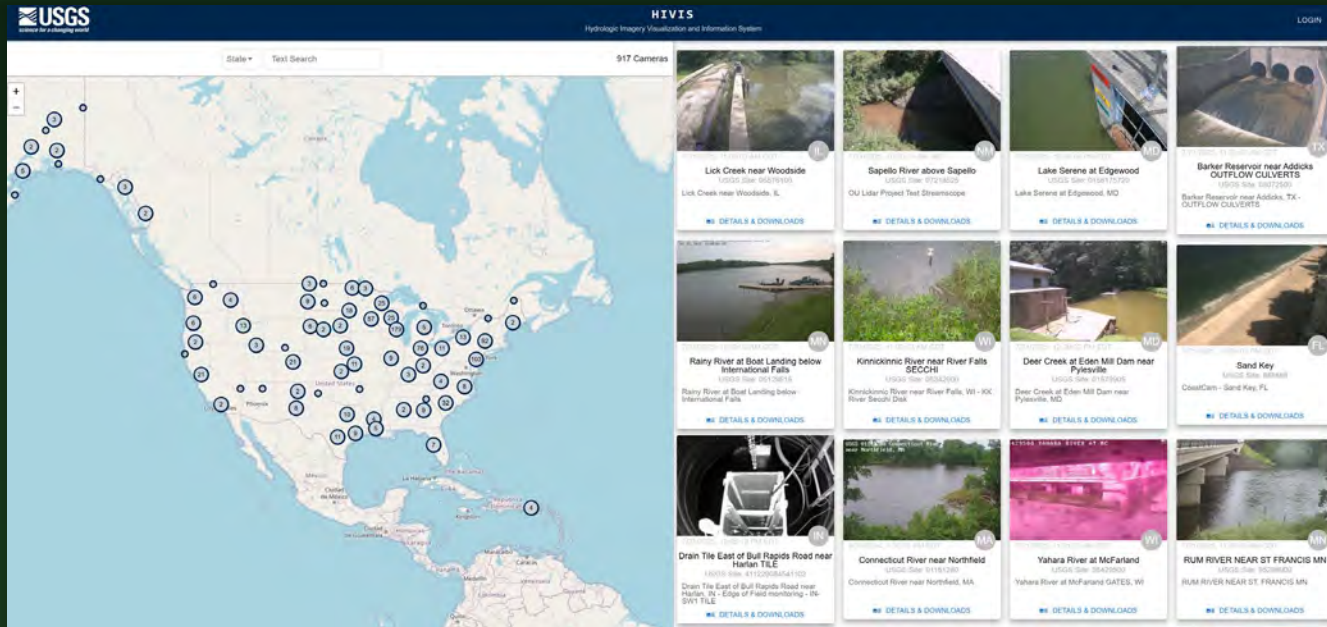
Large Scale Particle Image Velocimetry (LSPIV)

- An emerging technique to measure surface velocity in streams where the flow and channel conditions make conventional measurement difficult.
- Every 5 minutes, a 60-second downward-looking video of the moving water surface is processed to estimate the velocity of water in the stream.
- Additional uses for data are being researched that include river traffic management.



USGS HIVIS Network

- Active cameras at gage locations and points of hydrologic interest



USGS HIVIS Network



HIVIS

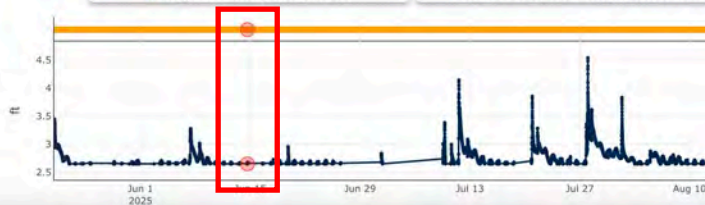
Hydrologic Imagery Visualization and Information System

Elkhorn Creek at Freedom Lane at Jenkins



Image: 6/14/2025, 15:00:03 EDT

Data: 2.65 ft, 6/14/2025, 15:05:00 EDT



HIVIS

Hydrologic Imagery Visualization and Information System

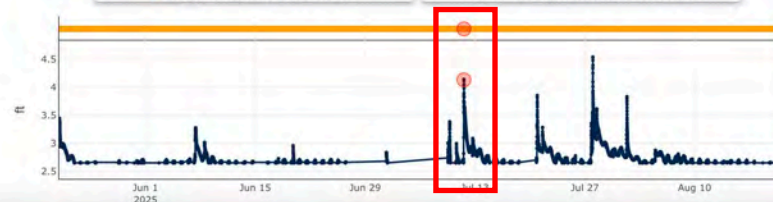
LOGIN

Elkhorn Creek at Freedom Lane at Jenkins, KY



Image: 7/11/2025, 14:00:28 EDT

Data: 4.14 ft, 7/11/2025, 14:05:00 EDT

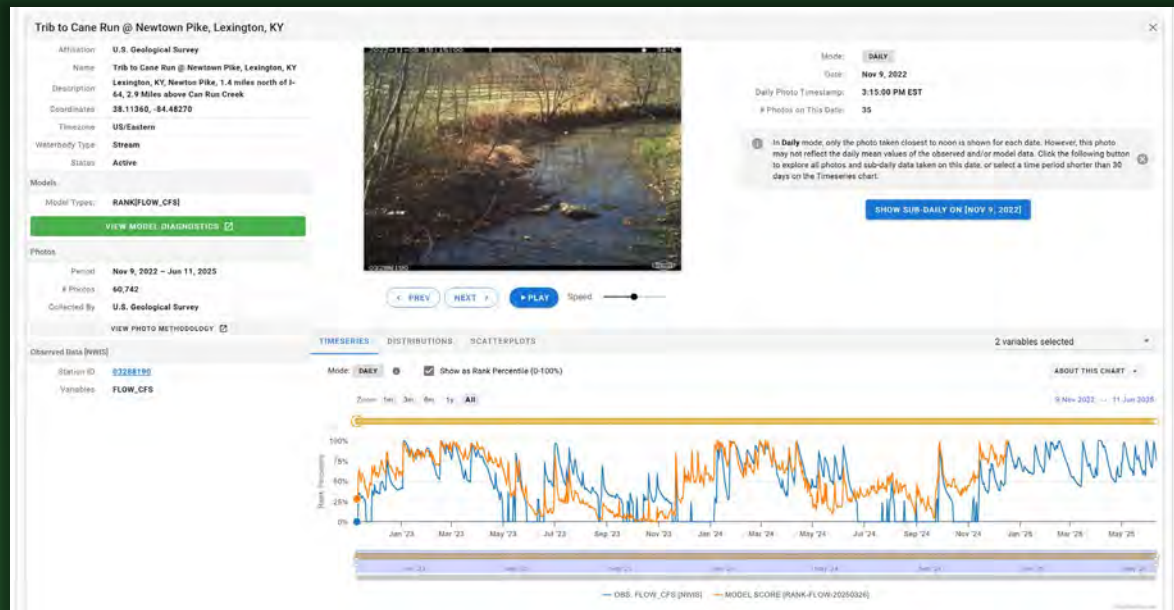


USGS HIVIS Network



Flow Photo Explorer

- Uses an artificial intelligence/machine learning (AI/ML) deep learning model to estimate relative streamflow using timelapse imagery.

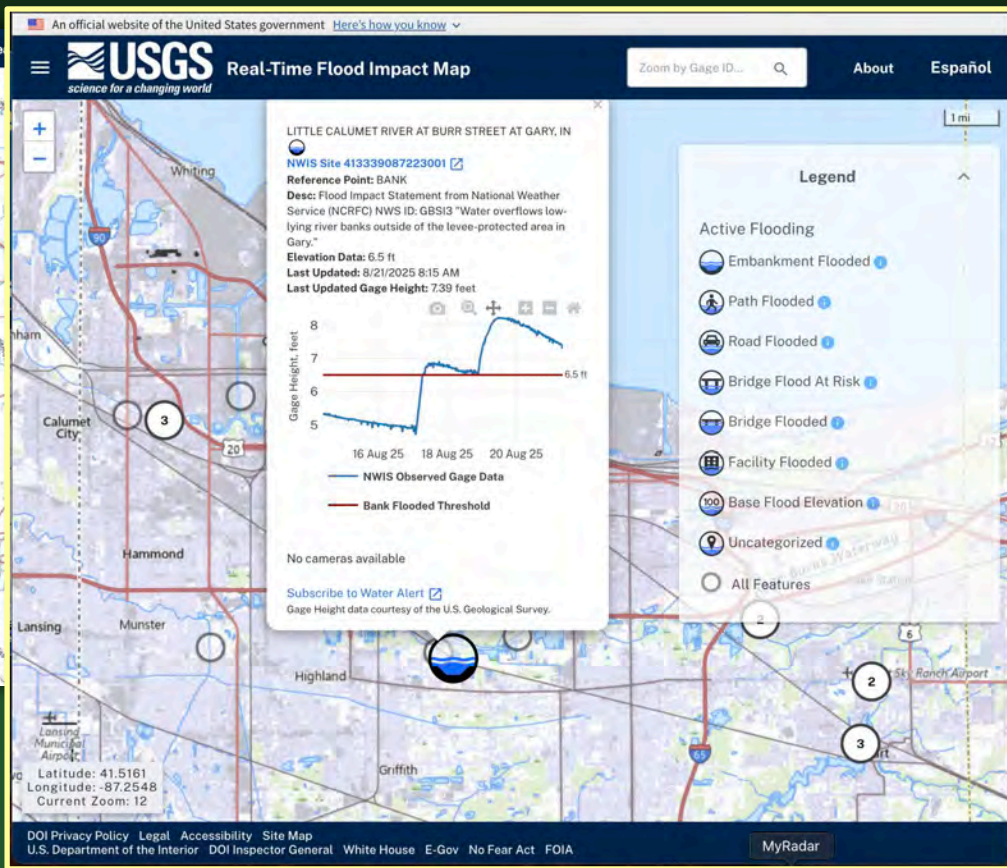


The data used to produce this plot are provisional and have not been reviewed or edited. They may be subject to change.



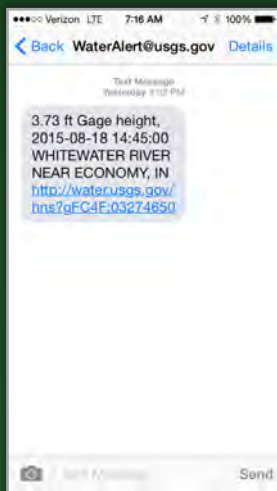
Realtime Flood Impact Map

- Includes surveyed points of interest
- National Weather Service impacts



Low-Cost Alert Systems (LoCAS)

- Low-Cost Alert Systems (LoCAS)
- Not a streamgage!
- Only provides data during an event at a rapid interval
- Tied to WaterAlert



Internet-of-Things Warning Systems

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CLIMATE

What are early warning systems and how are they saving lives?

Rosie Frost - 23/05/2023 10:42

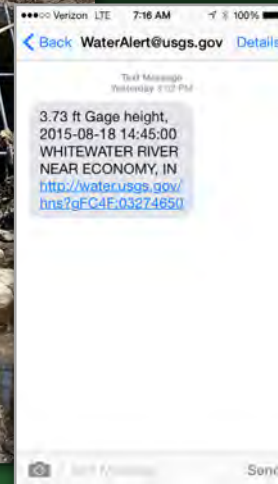
Over the past century, the number of deaths from extreme weather, climate and water-related events has dropped significantly.



Two children stand under a roadside shelter to protect themselves from the sun before Cyclone Mocha hits in Sittwe, Rakhine State.



- Pilot **low-cost, low-power**, autonomous sensor network
- Develop online dashboard for **rapid viewing** utilizing the USGS data backbone
- Automatically send alerts to critical response teams **before** flooding occurs
- Explore edge analytics for **early hyperlocal** warning systems



Thank you

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