

# **National Flood Interoperability**

## **Experiment:**

***Leveraging National Hydrography Dataset  
to explore the future of flood forecasting***

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**NOAA National Weather Service**

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# Goals

## National Flood Interoperability Experiment

Close the gap between national flood forecasting and local emergency response

- Impact at the street level

Create real-time flood information services

- Shared among organizations, geographies, people

Engage academic community through the National Water Center

- Innovation for transformative change
- Glimpse the future of hydrologic forecasting



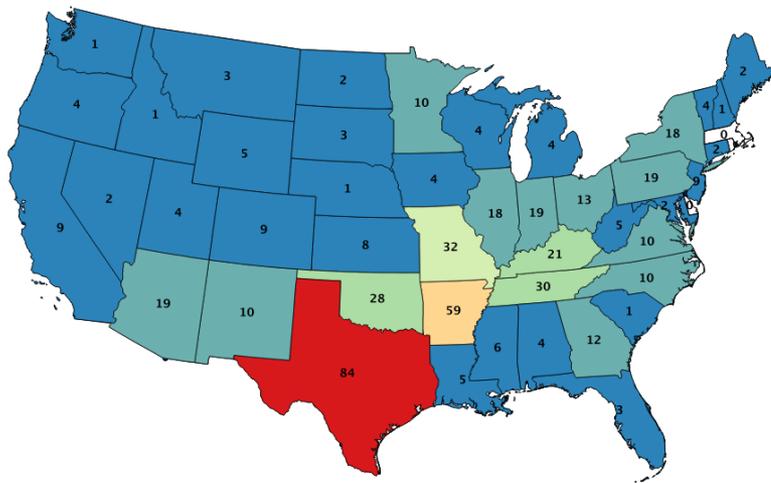
# Why – People

On Average, more people die annually from flooding than from any other form of natural disaster

Home TV & Video U.S. World Politics Justice Entertainment Tech Health

## 2 dead as flash floods slam Arizona, Nevada

By Josh Levs, Catherine E. Shoichet, and Amanda Watts, CNN  
updated 11:09 AM EDT, Tue September 9, 2014



Spatial Distribution of  
Flood Fatalities 2007-2013  
(source: NWS StormDat)

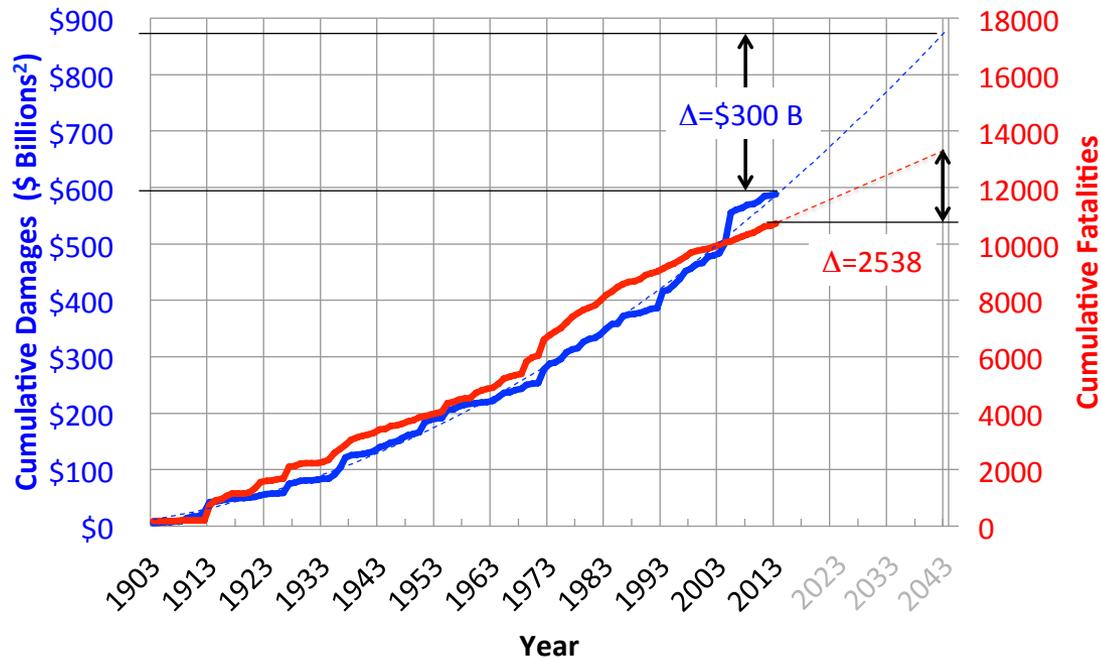


Low water crossing

# Why – Cost

More cost to federal government from flooding than any other form of natural disaster

## National Flood Loss<sup>1</sup> Water Year 1903-2013



<sup>1</sup>National Weather Service Hydrologic Information Center ([www.nws.noaa.gov/hic/](http://www.nws.noaa.gov/hic/))

<sup>2</sup>Damages are adjusted for inflation to 2013. Damages are considered to be minimum estimates.

# Why is NFIE a Use-case for Hydrography dataset

Build a national high spatial resolution, near real-time river and stream model

- The National Hydrography Data provides the data infrastructure to facilitate next-generational hydrologic modeling
- Adopting NHDPlus as the frame work for data conflation facilitates interoperability across the federal water enterprise
- Provides a common frame of reference for research and academic communities

# Why – Transform the NOAA and NWS Forecasting paradigm

- Forecasts produced by River Forecasts
  - **Current system** – 3600 locations
  - **NFIE system** – 2.67 million locations **700 times more**
- **New Information** to help emergency managers to save lives and keep people safe

Current



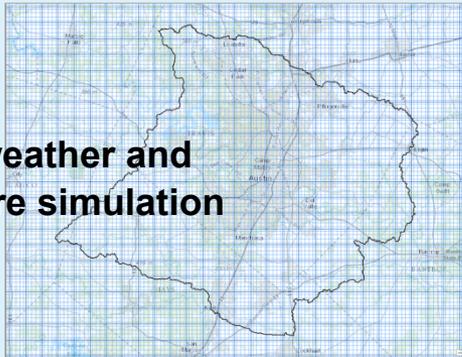
Proposed



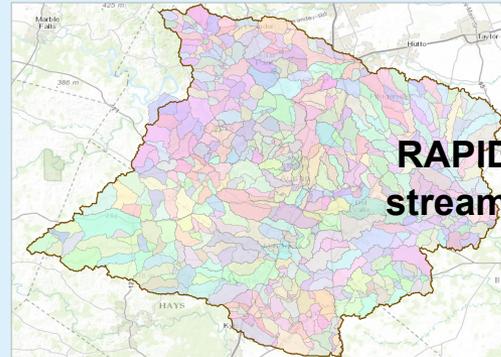
# National Available Hydrography Data allows the community to explore new concepts

1. How can near-real-time hydrologic simulations at high spatial resolution, covering the nation, be carried out using the NHDPlus?
2. How can this lead to improved emergency response and community resilience?
3. How can an improved interoperability framework support the first two goals and lead to sustained innovation in the research to operations process?

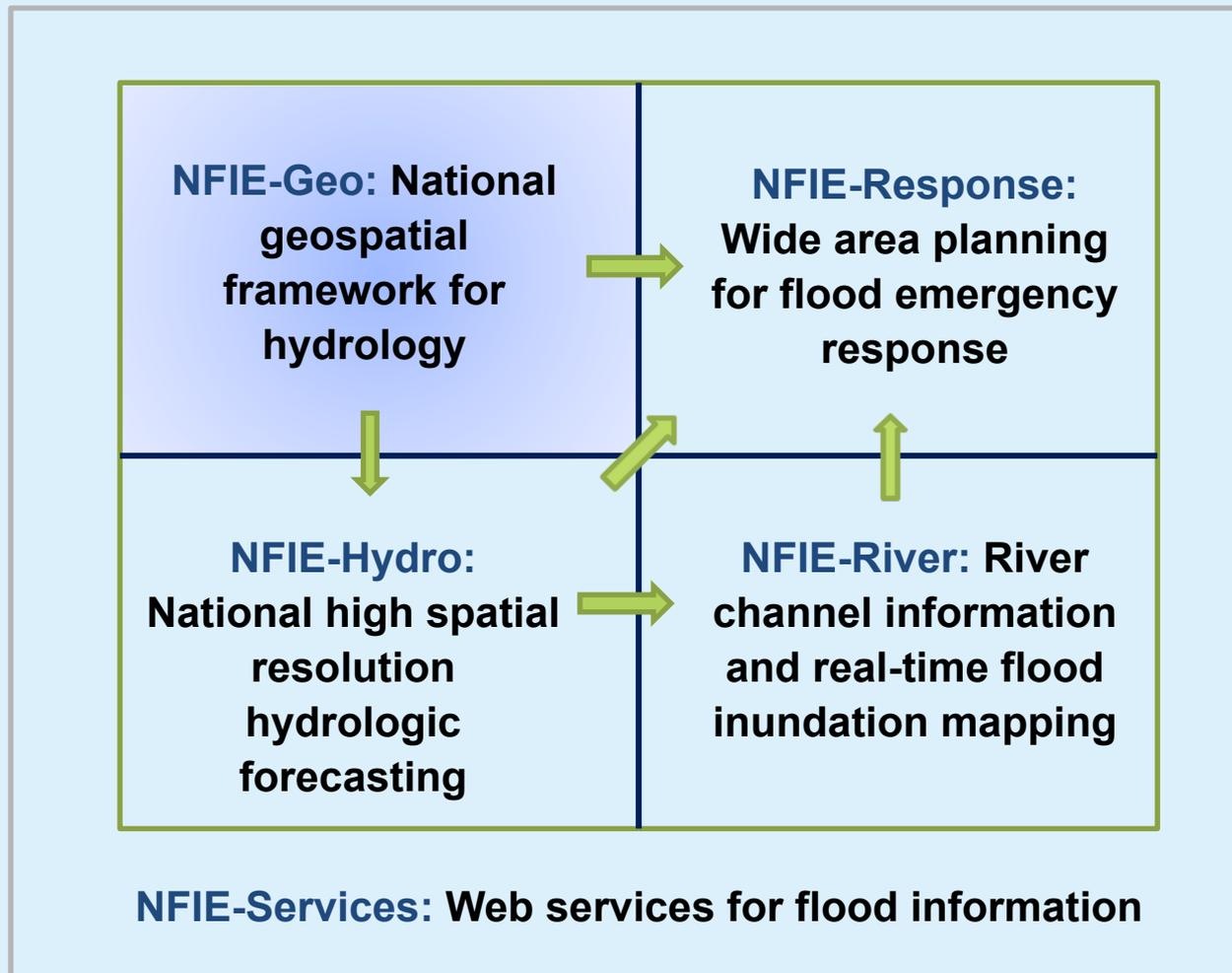
**WRF-Hydro weather and land-atmosphere simulation**



**RAPID modeling of flow in stream reaches of NHDPlus**



# National Flood Interoperability Experiment (NFIE): Five Components



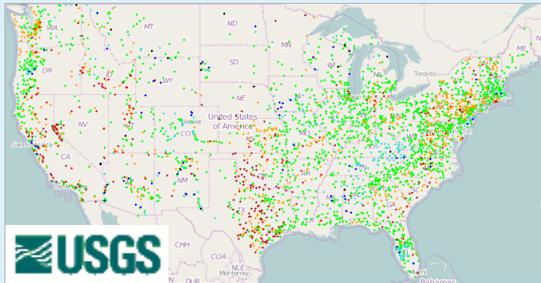
# NFIE-Geo for National Flood Interoperability Experiment

*Enhanced geospatial database for a national water data infrastructure*

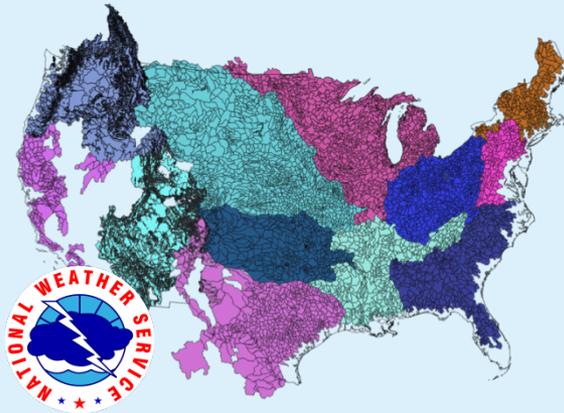
## NFIE-Geo

9 feature classes

- 4 from NHDPlus
- 4 from IWRSS



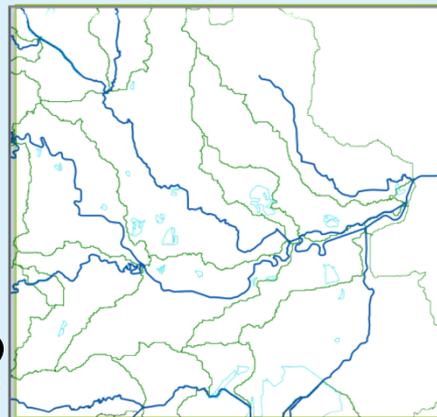
**USGS Water Watch Points**



**NWS Basins and Forecast Points**



**National Flood Hazard Layer**



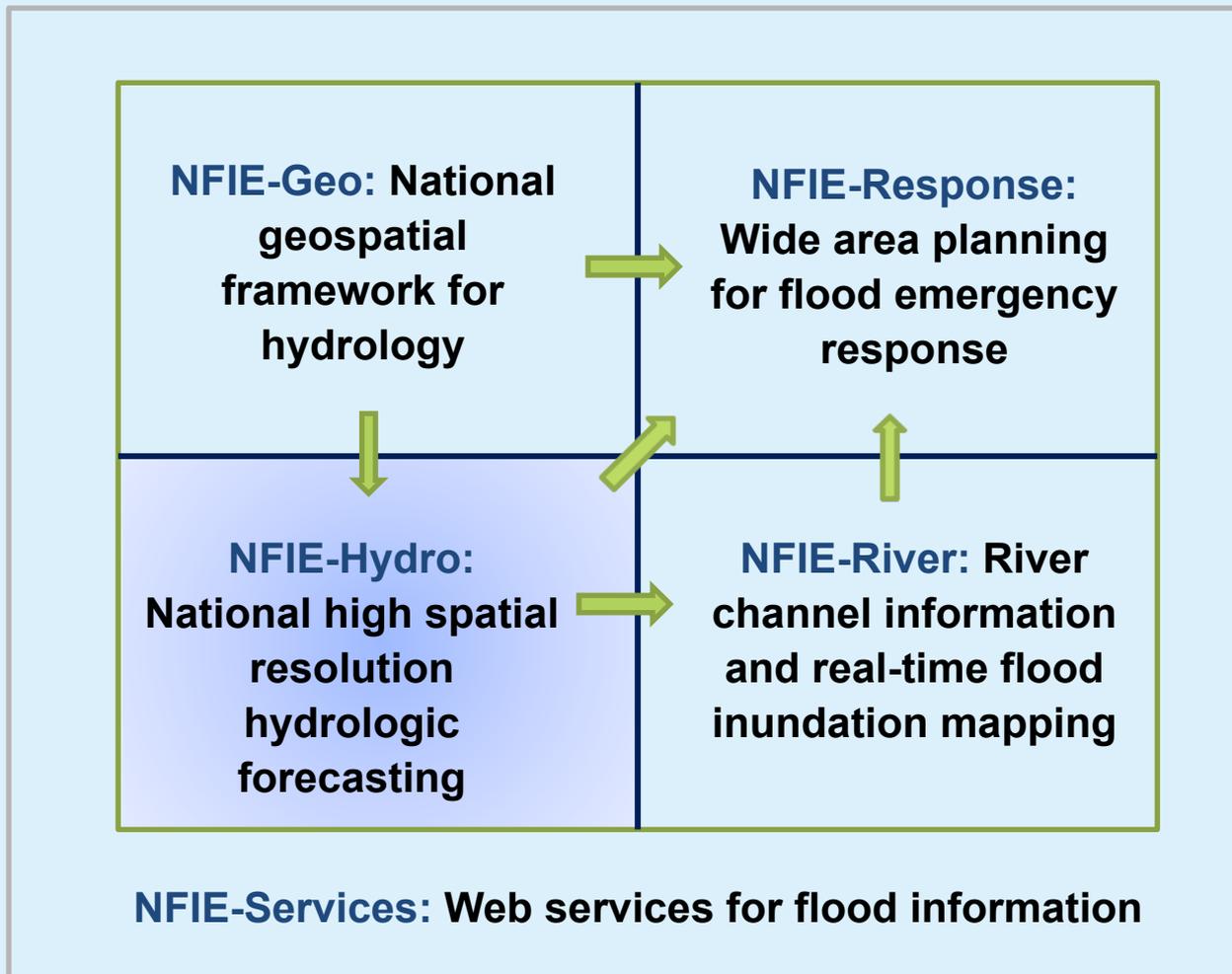
**NHDPlusV2**

**Feature classes:**

- Subwatershed (HUC12)
- Catchment
- Flowline
- Waterbody

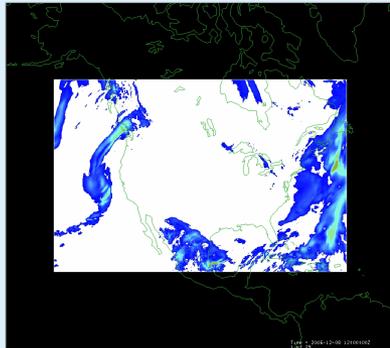
# National Flood Interoperability Experiment (NFIE)

## Component Two: NFIE-Hydro

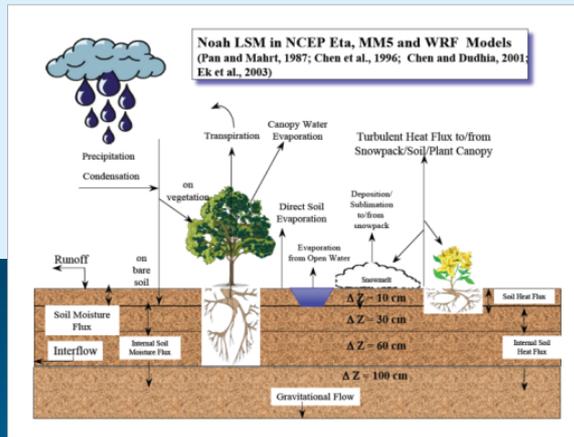


# Forecasting Model Components...

Weather model and forecasts



Weather ↓ Precipitation

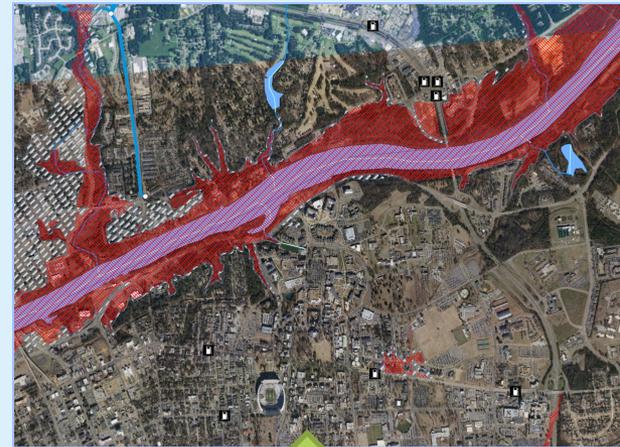


Land-Atmosphere Model

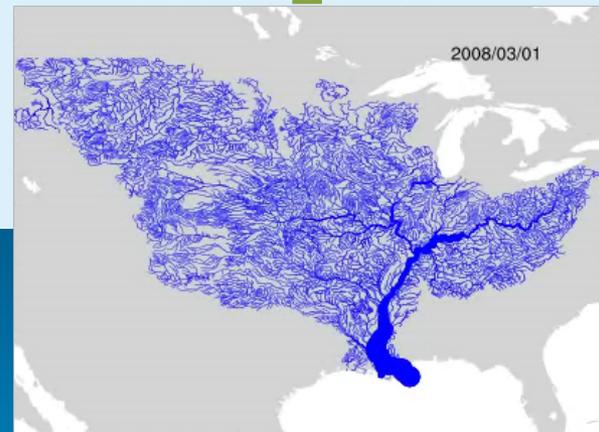


Runoff

Impacts



Streamflow



Channel flow routing (for all continental US)

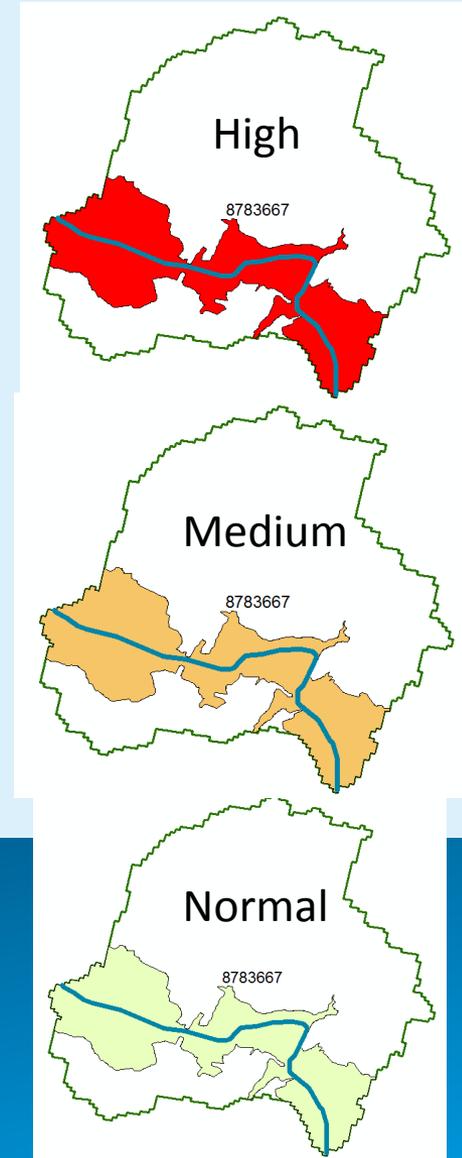
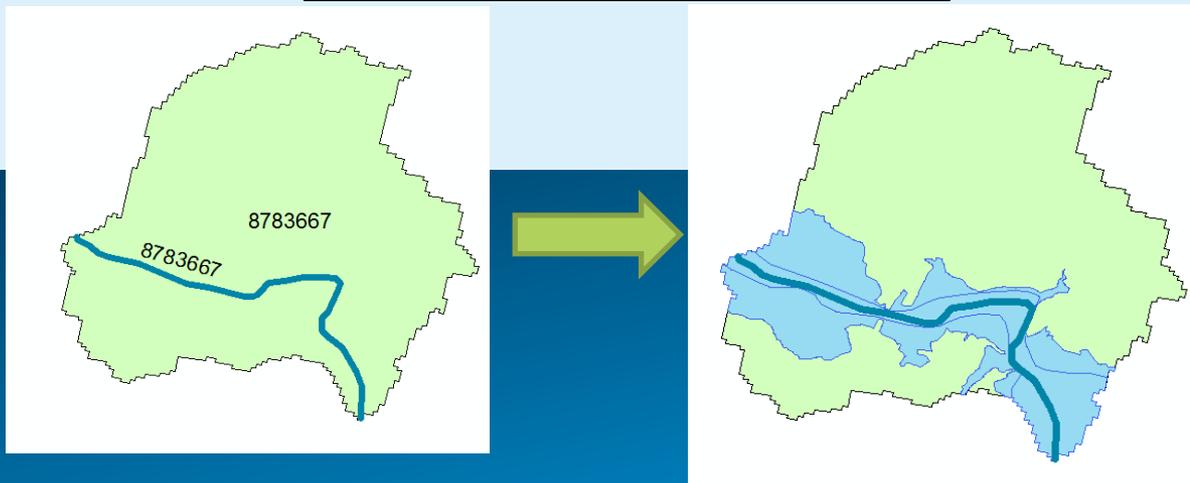
# Flood risk zones...

Each catchment has its own flood hazard zone (FEMA National Flood Hazard Layer

flood forecast + impacts define risk

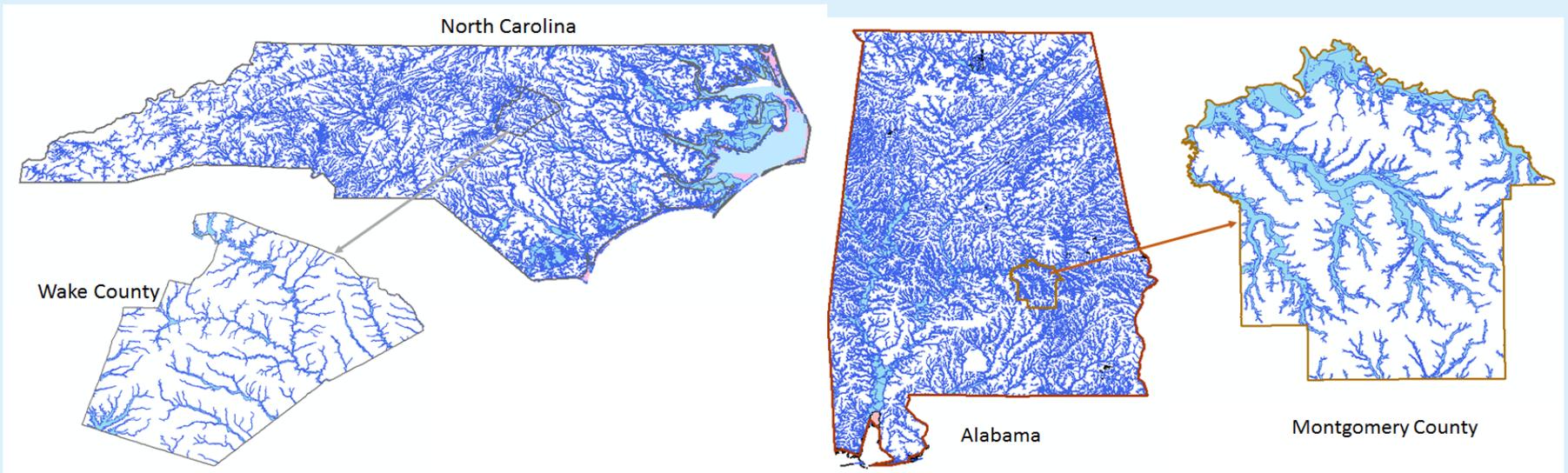
Color the zones according to risk

Provides flood warning  
at “stream and street level”



# Extend to a comprehensive solution...

- Dynamic flood modeling, forecasting and inundation mapping in space and time
- Requires LIDAR terrain data so can only be done for particular regions



# Interoperability enabled by web services enables us to establish a system combining multiple components

The screenshot displays the ArcGIS.com web map viewer interface. The browser address bar shows the URL <https://www.arcgis.com/home/webmap/viewer.html?w>. The page title is "ArcGIS - NFIE Hydro Regions". The interface includes a search bar with the text "Find address or place", navigation controls (Share, Print, Measure), and a legend on the left side. The legend is titled "NFIE Hydro Regions" and shows a cyan-colored region. A pop-up window is overlaid on the map, displaying the following information:

- Great Basin Region**
- Get the Data from HydroShare
- Zoom to

The map shows various hydro regions across the United States, including Pacific Northwest, Great Basin, California, Rio Grande, Texas-Gulf, South Atlantic-Gulf, Mid-Atlantic, New England, and Great Lakes. Major cities like San Francisco, Los Angeles, Dallas, Houston, Atlanta, Washington, Philadelphia, New York, Boston, Toronto, and Montreal are labeled. The map is powered by Esri and NOAA, EPA.

**Web Maps in ArcGIS.com**



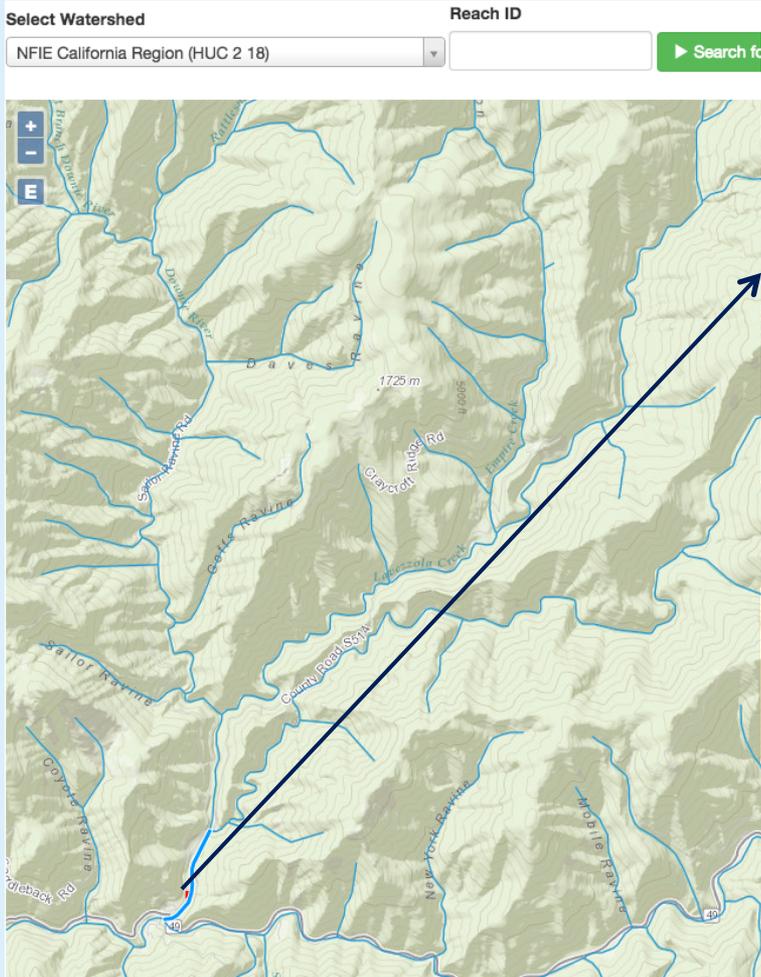
# Interoperability enabled by web services enables us to establish a system combining multiple components

The screenshot shows a web browser window with the following content:

- Browser tabs: ArcGIS - NFIE Hydro Regions, NFIE Great Basin Region | ...
- Address bar: beta.hydroshare.org/resource/33d822a2da7c46a28b3f95
- Page header: HYDROSHARE, RESOURCES, SUPPORT, SIGN IN
- Sharing status: Public
- License: This resource is shared under the Creative Commons Attribution CC BY. <http://creativecommons.org/licenses/by/4.0/>
- Keywords: NFIE Region 16
- Content list:
  - Weight\_table.zip (4.3 MB)
  - WBD\_Subwatersheds.zip (50.8 MB)
  - RAPID\_Parameters.zip (2.0 MB)

***Files in beta.hydroshare.org***

# Explore Dissemination



Select a Date

Nfie California Region  
Huc 2 18: 8058401

Flow (cfs)

**Flash Flood Warning**

@NWSShreveport

Valid until April 27th, 2015 at 9:30 AM CDT

Affected Population: 27,128	Miles of interstate: 0
Public Schools: 28	Airports: 2
Area: 1722 square miles	Miles of railroad: 41
Hospitals: 2	National Parks: 0

Created Monday April 27th, 2015 at 6:37 AM CDT



# NFIE Summer Institute Plan

- Establish a baseline end to end model
  - 2 week boot camp at beginning
- Form teams to focus on improving specific components
  - Iterative refinement
  - Metrics to quantify efficacy
- Daily “flood” briefing
- Report results weekly
- Capstone event 3rd CUAHSI conference on HydroInformatics, "Model and Data Interoperability: From Theory to Practice" July 15-17, Tuscaloosa Alabama. <https://www.cuahsi.org/Posts/Entry/26293>

# National Flood Interoperability Experiment: NWS Perspective

- Community Initiative: private sector, academia, federal agencies
  - Demonstrate initial set of water **data services** using community standards
  - Demonstrate the **future real time flood simulation and mapping** using cutting edge tools and techniques
  - Prototype a project-based interdisciplinary **education model** for emerging scientists and technologists
    - Semester curricula and NWC Summer Institute



# **Scientific excellence and innovation driving water prediction and decisions for a water-resilient nation.**

- **Collaborative R&D, Operations**

- **Support River Forecast Centers through robust data service**

- **Support mission-oriented research and development**

- **a catalyst for engagement with Academia**

- **Proving Ground Facility**

- **Science and Technology Transition**

- **Interagency Staffing**

**RESEARCH**

**OPERATIONS**



**Thank You**

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