# 25 Years of GIS and Water with the ESRI Community

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ESRI GIS Hydro Meeting
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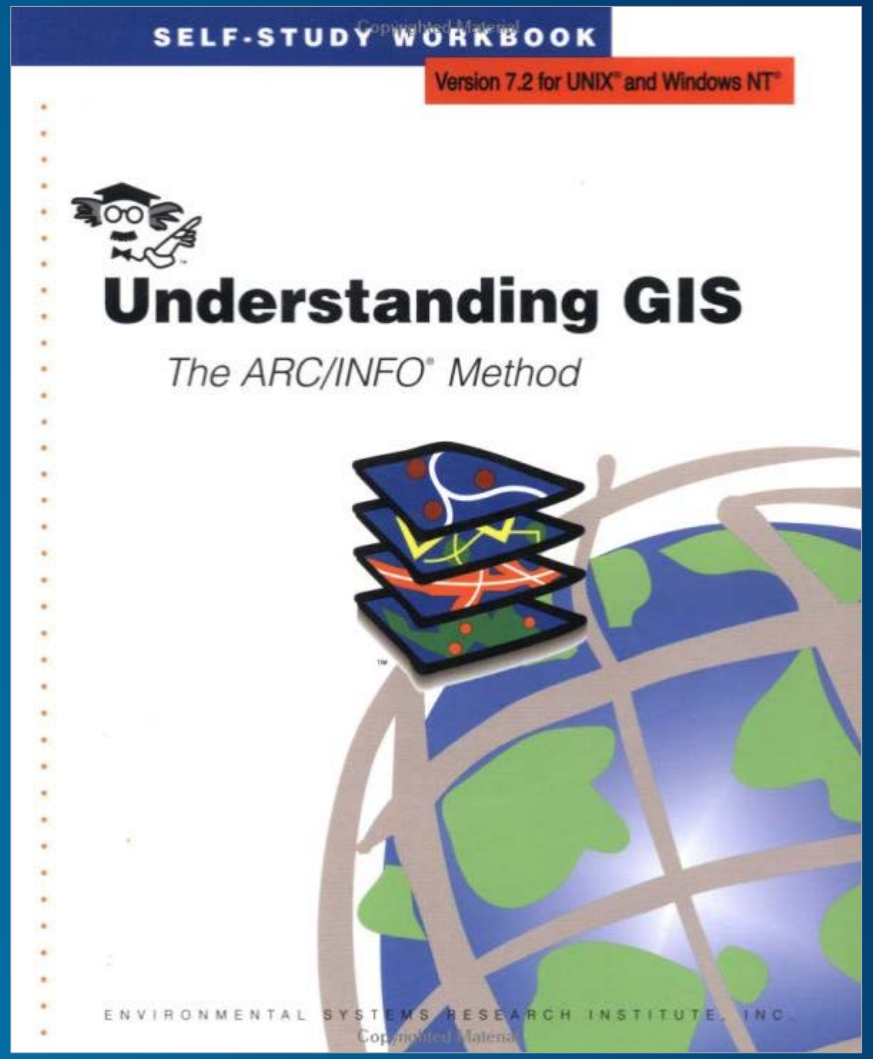
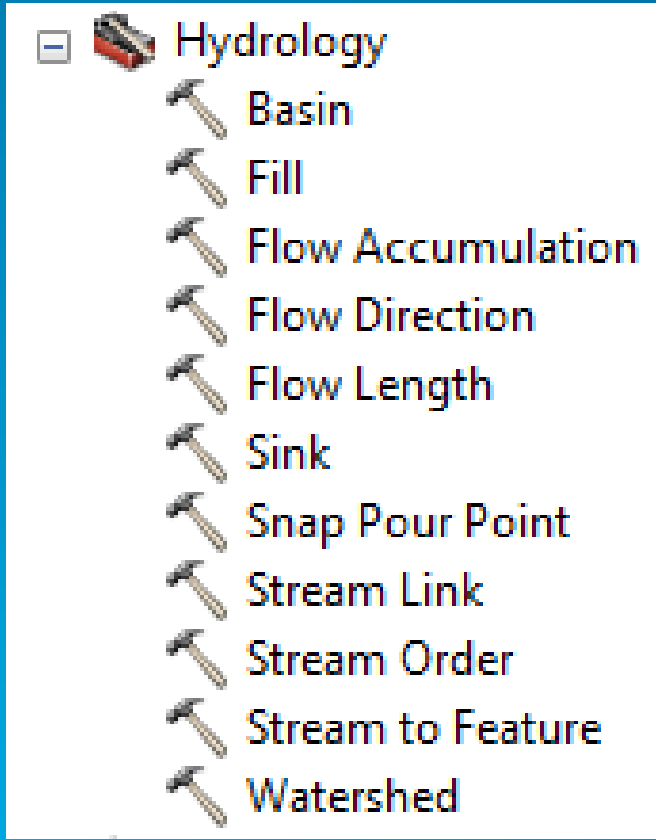
# In the Beginning …

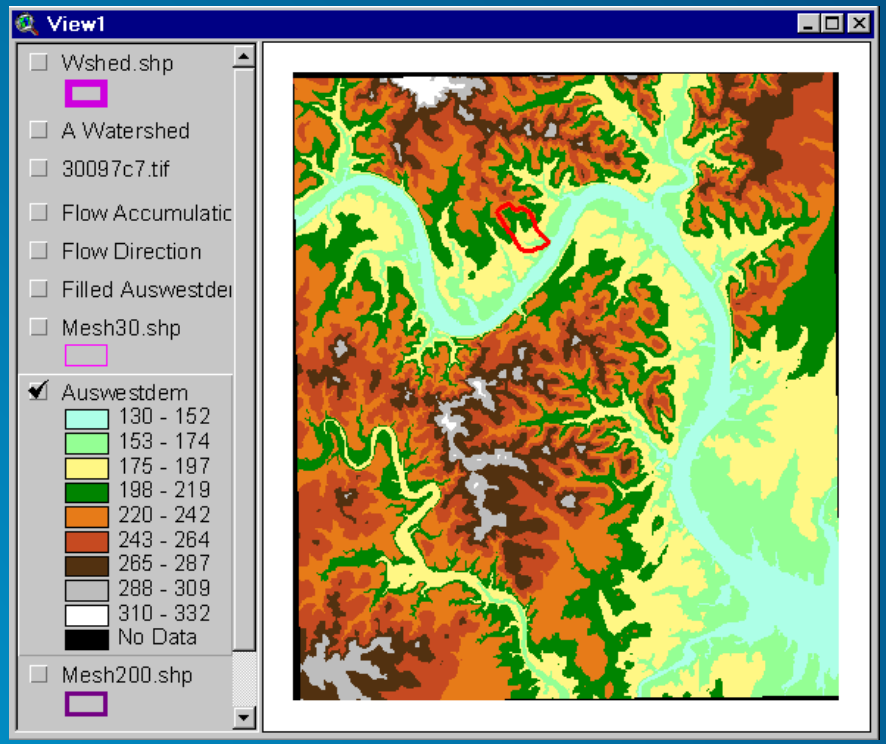
- 1988 – I first learned about GIS
- 1989 – First PhD student in GIS applied to Water Resources (Dean Djokic)
- 1990 – My first ESRI User Conference
- 1991 – First time I taught a graduate course in GIS in Water Resources
- 1994 – First Preconference GIS Hydro Workshop (Steve Kopp)

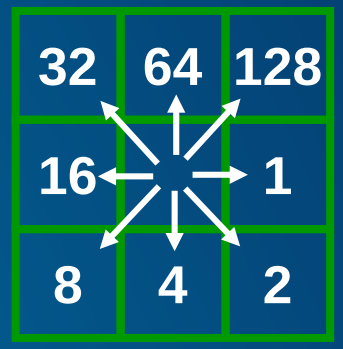
- Today we are participating in the 25th GIS Hydro Preconference Workshop



# 1994 – 1999: Watershed and Stream Network Delineation



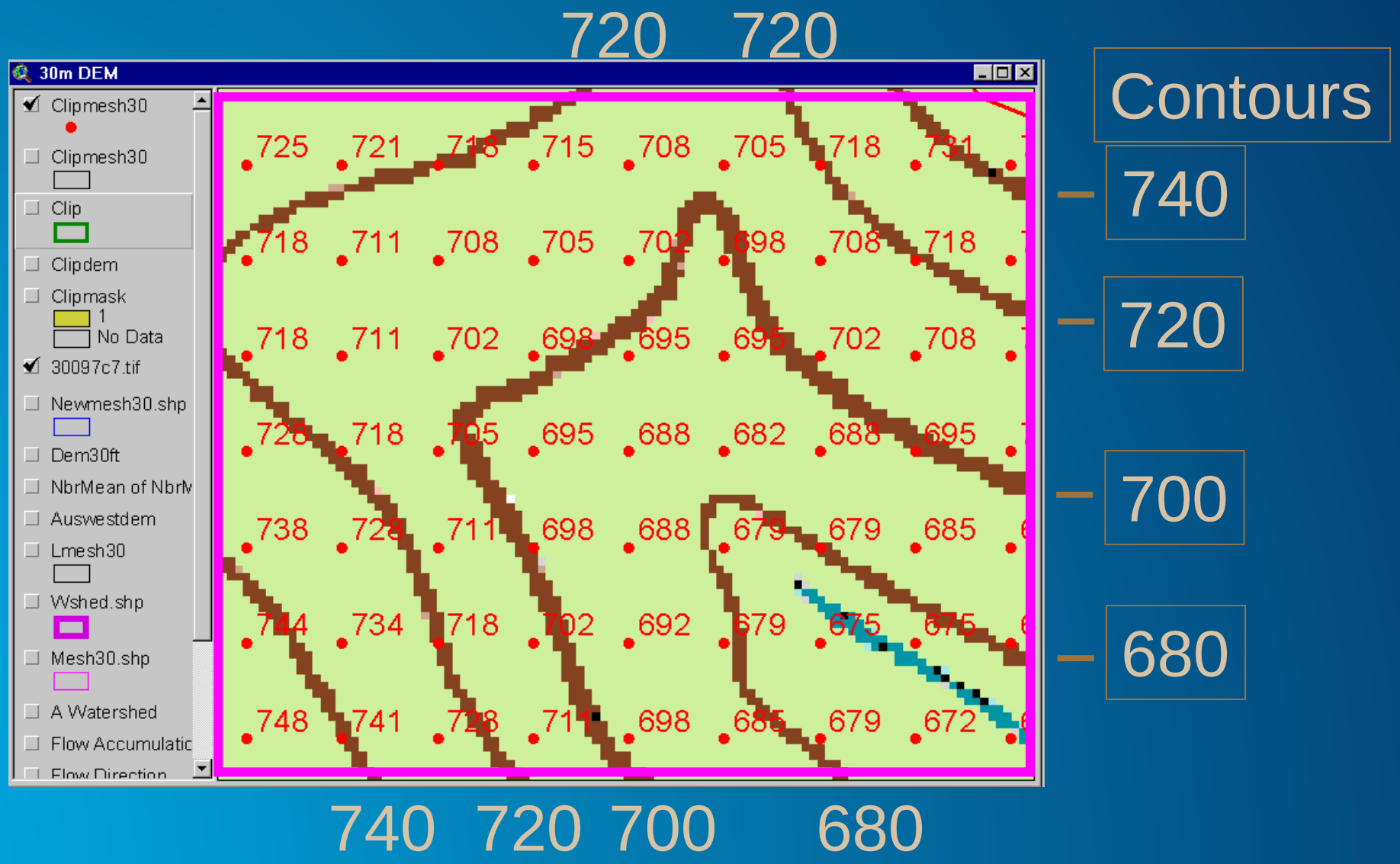



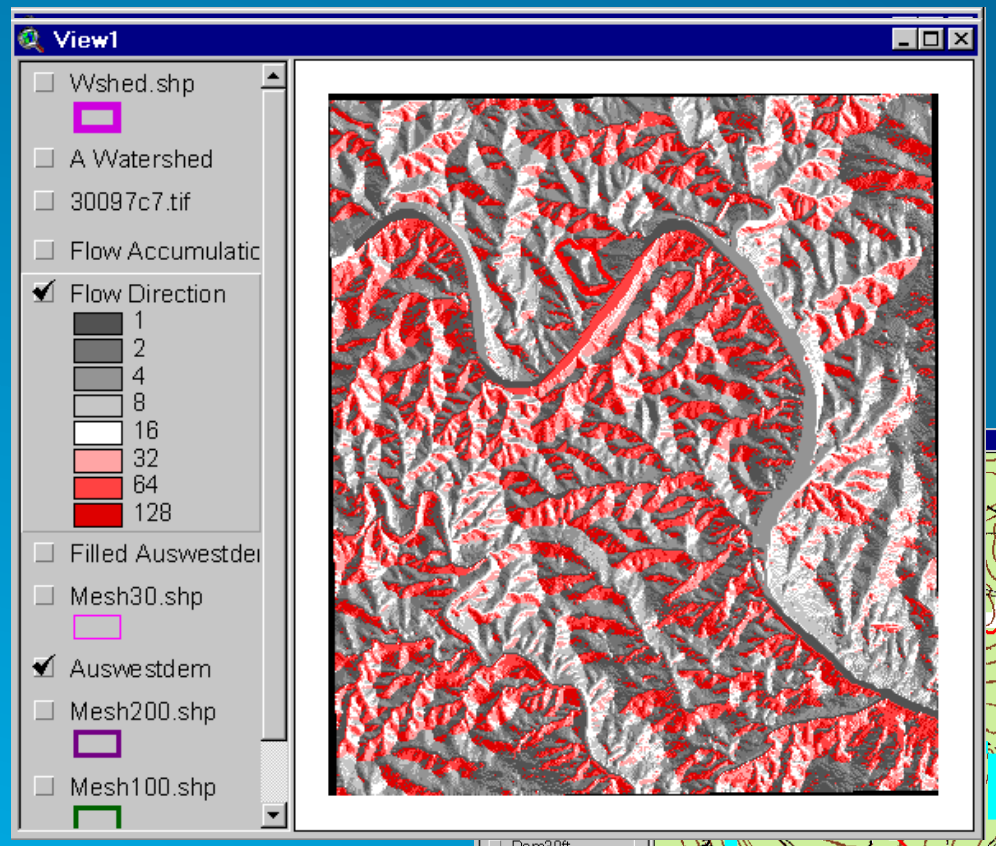

**Eight direction pour point model for flow direction on Digital Elevation Models**

**Hydrology tools in workstation ArcInfo, Spatial Analyst extension of ArcVIew**

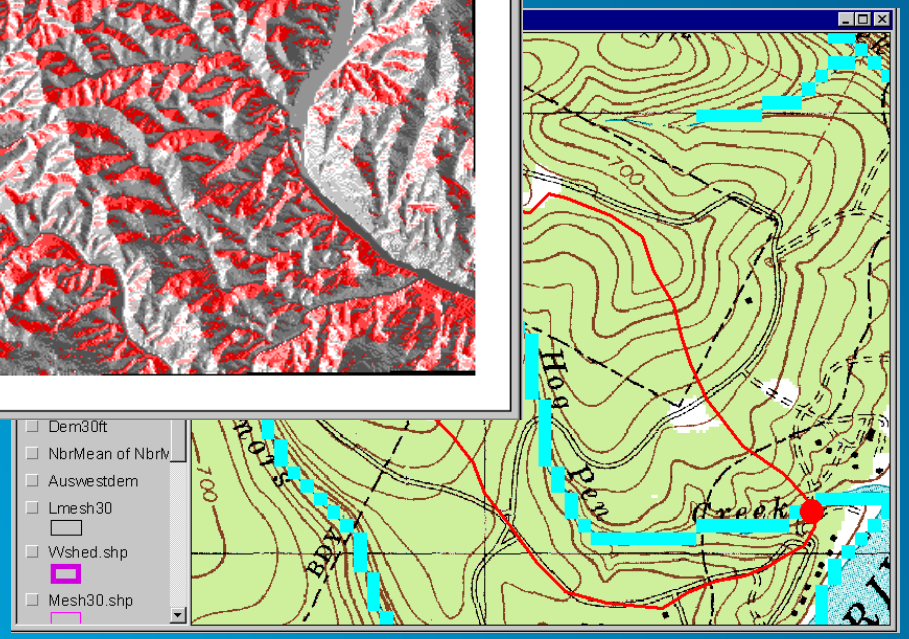
# Digital Elevation Model produced from Contours



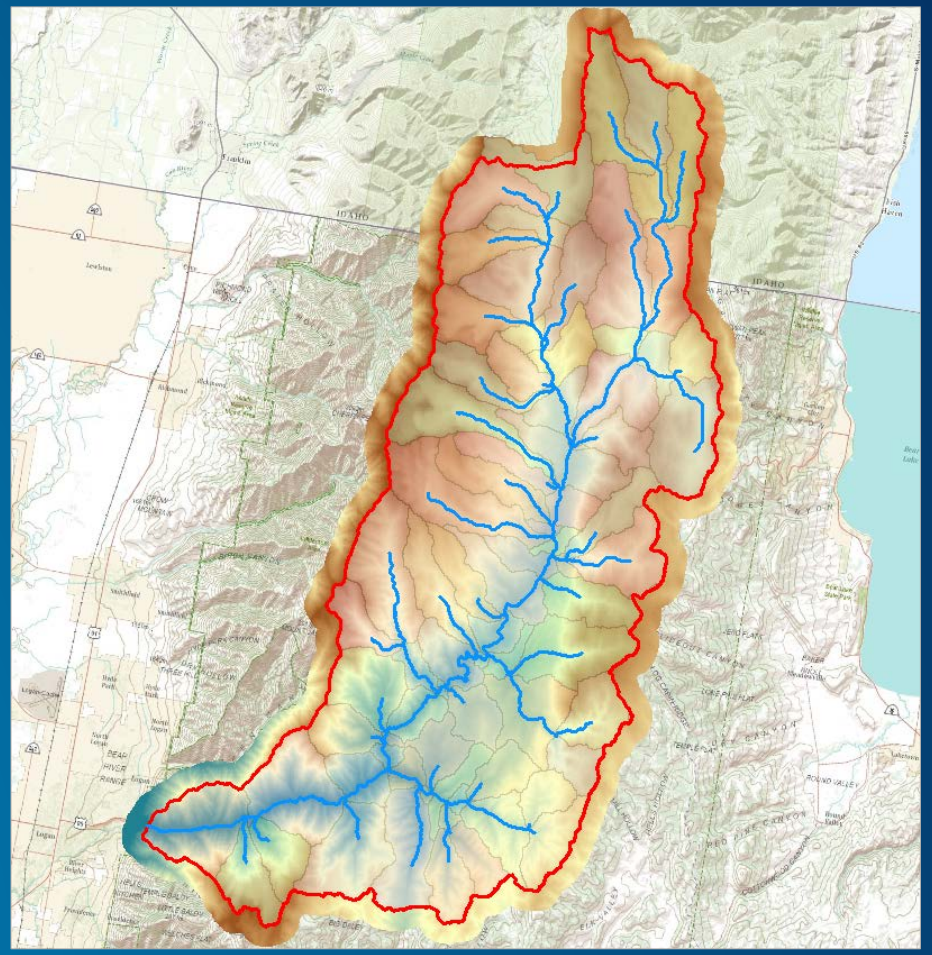
# Watershed and Stream Network Delineation – then and now




Flow Direction




Flow Accumulation and Stream Definition



Watershed Delineation (David Tarboton)

# GIS Preprocessors for Hydrologic Models

Hydrologic Engineering Center

US Army Corps of Engineers

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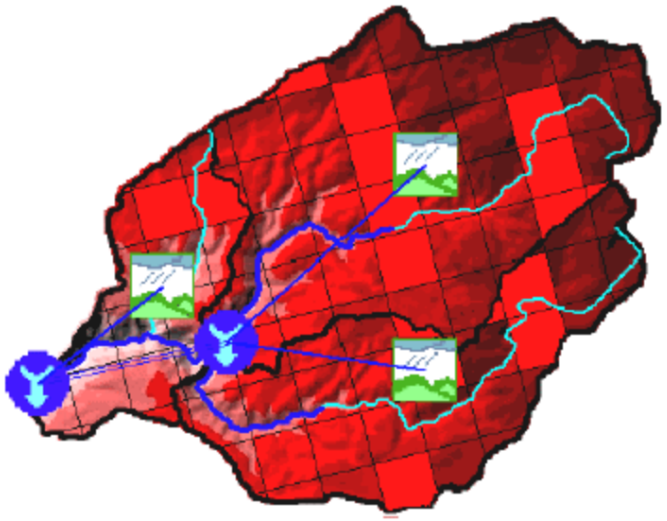
ME > SOFTWARE > HEC-GEOHMS

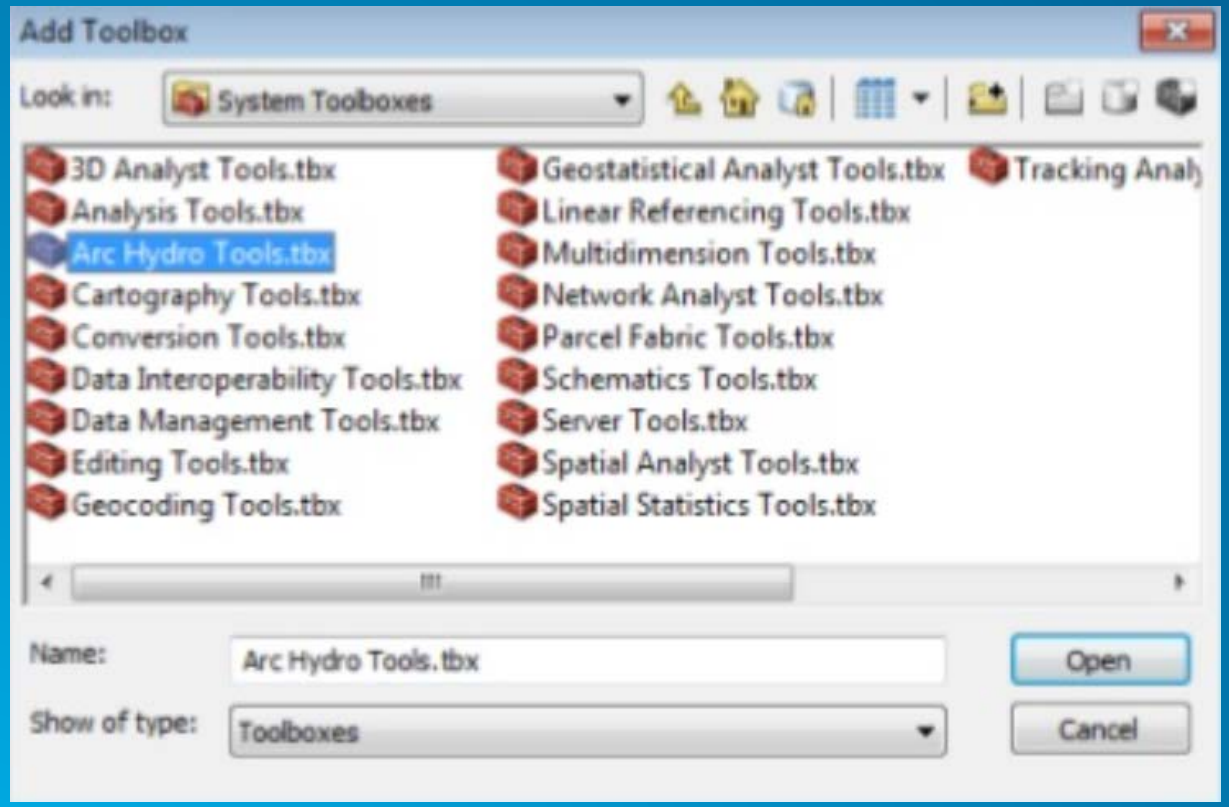
HEC-GeoHMS

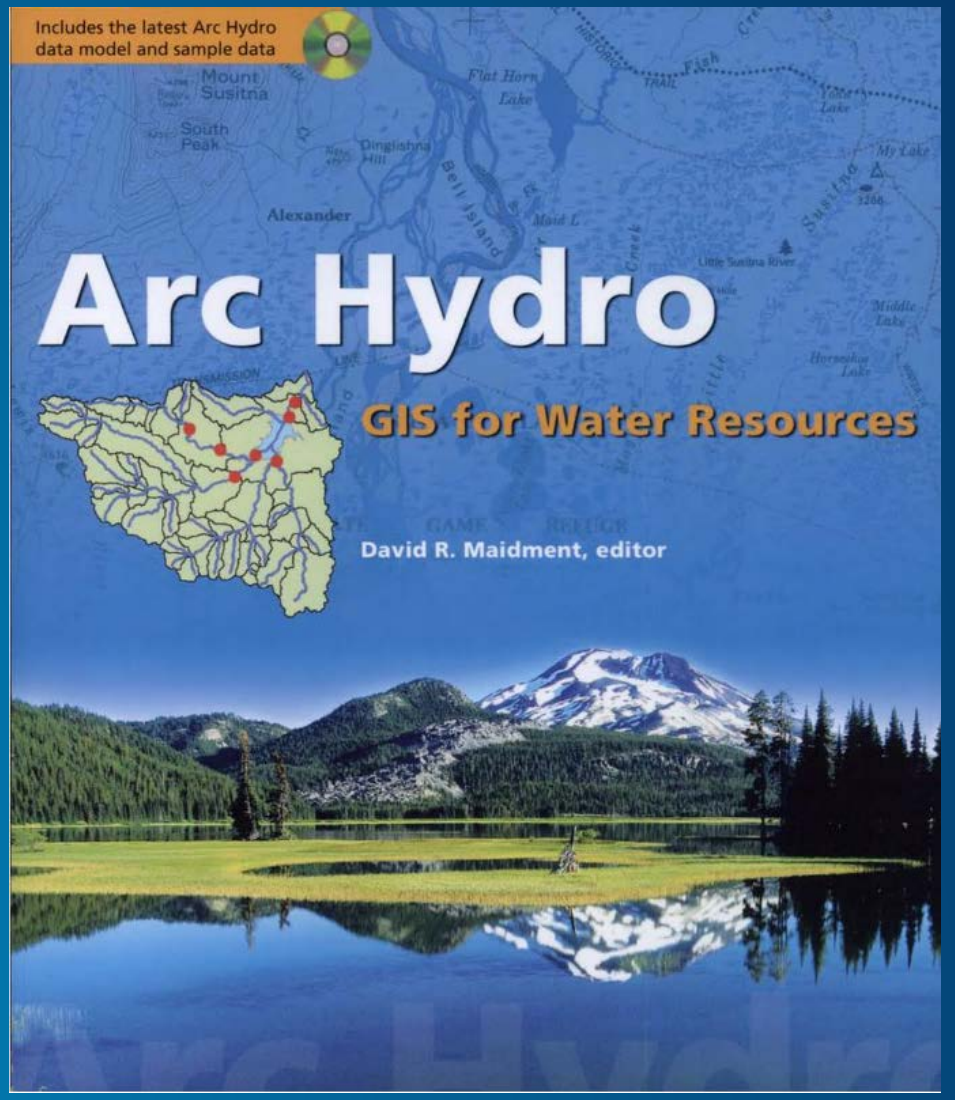
- HEC-GeoHMS
- Downloads
- Known Issues
- Bug Report
- Support Policy

The Geospatial Hydrologic Modeling Extension (HEC-GeoHMS) has been developed as a geospatial hydrology toolkit for engineers and hydrologists with limited GIS experience. HEC-GeoHMS uses ArcGIS and the Spatial Analyst extension to develop a number of hydrologic modeling inputs for the Hydrologic Engineering Center's Hydrologic Modeling System, HEC-HMS. ArcGIS and its Spatial Analyst extension are available from the Environmental Systems Research Institute, Inc. (ESRI). Analyzing digital terrain data, HEC-GeoHMS transforms the drainage paths and watershed boundaries into a hydrologic data structure that represents the drainage network. The program allows users to visualize spatial information, document watershed characteristics, perform spatial analysis, and delineate subbasins and streams. Working with HEC-GeoHMS through its interfaces, menus, tools, buttons, and context-sensitive online help allows the user to expediently create hydrologic inputs for HEC-HMS.



# 1999 – 2004: Arc Hydro – Data Model and Toolset

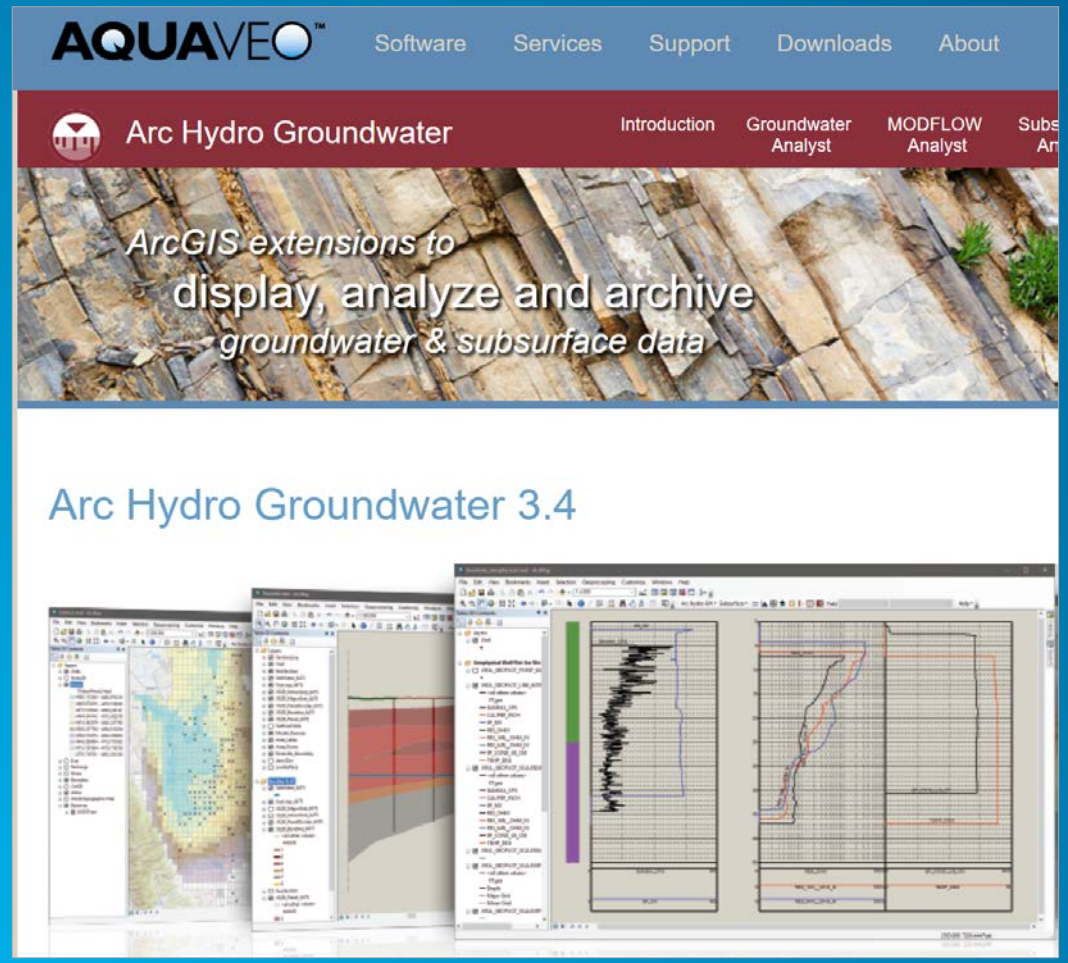


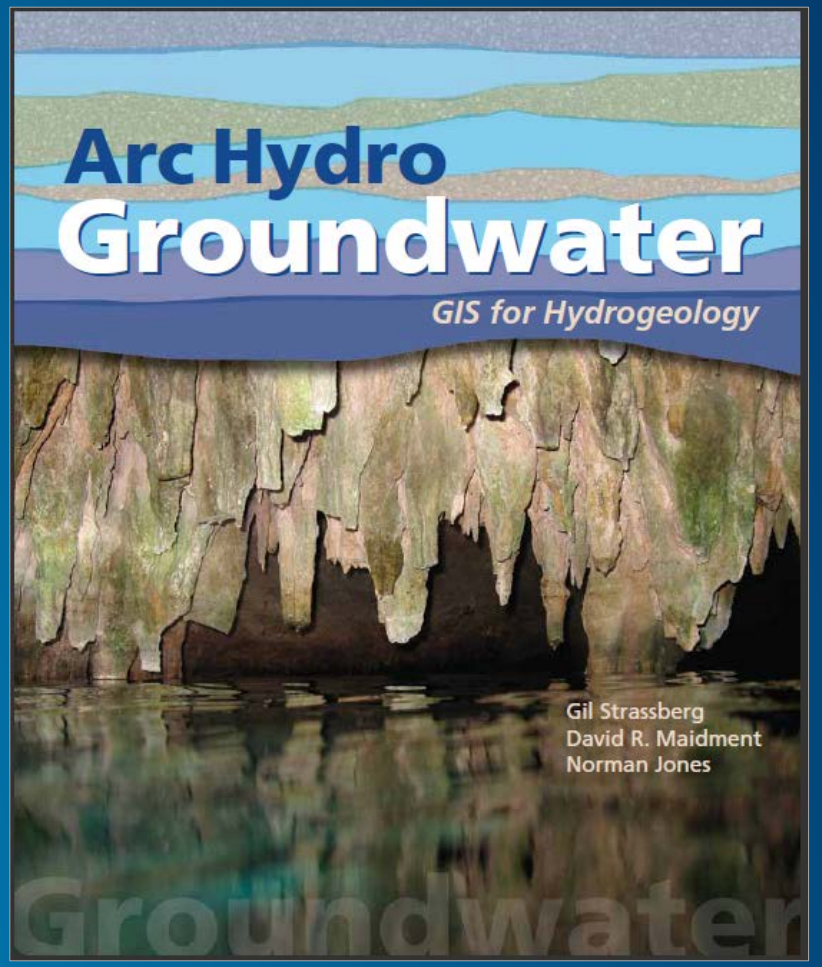




**Merging of Arc/Info and ArcView into ArcGIS**

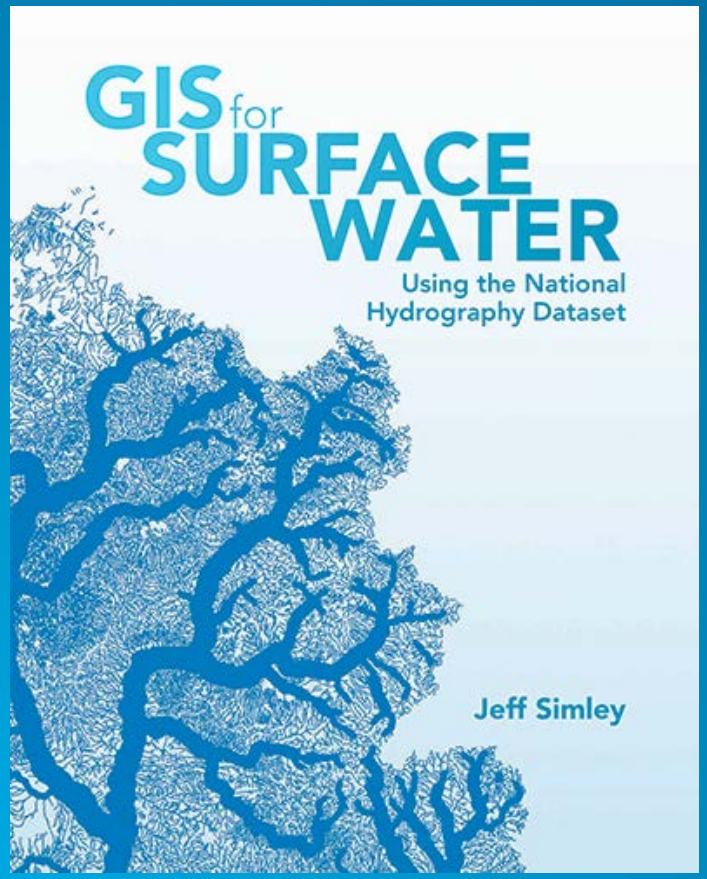
# Arc Hydro Groundwater: GIS For Hydrogeology

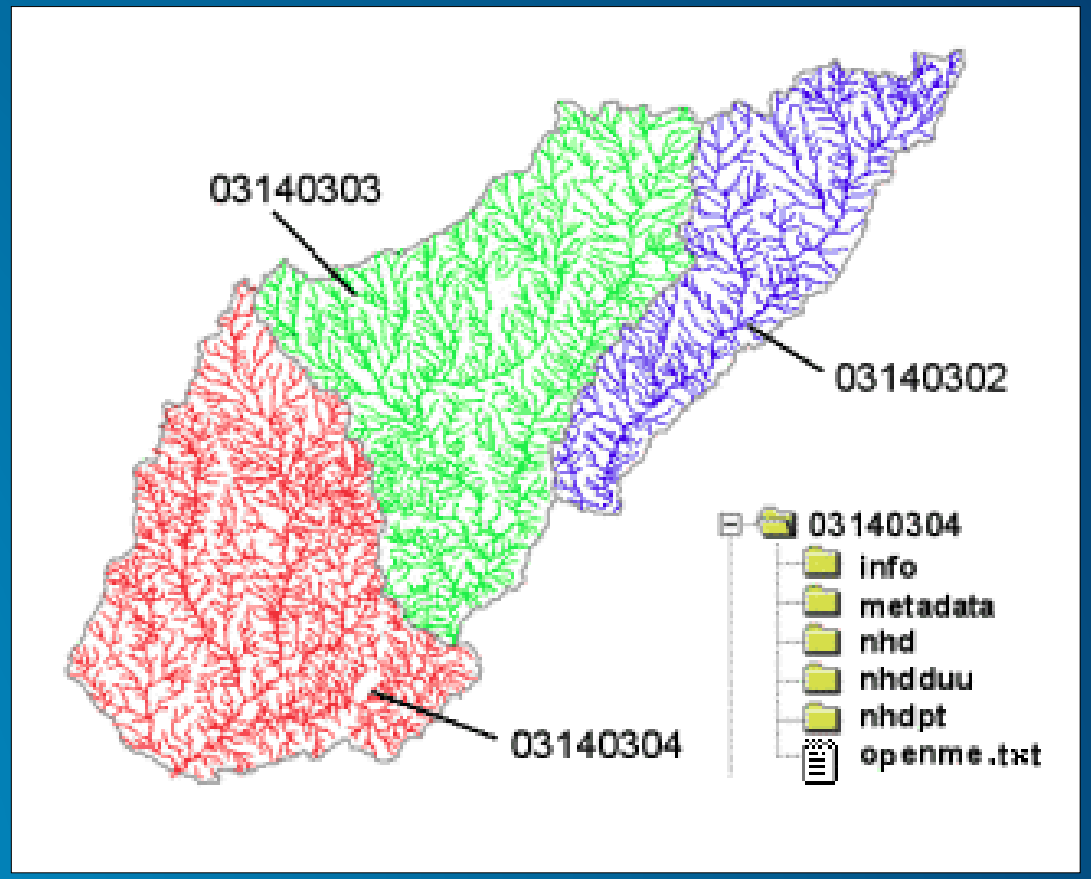
(2011)



# New book about National Hydrography Dataset from ESRI Press



# 2009 – 2014: NHDPlus bringing together the national datasets

Foundation for a Geospatial Hydrologic Framework for the United States

National Hydrography Dataset Plus

National Elevation Dataset

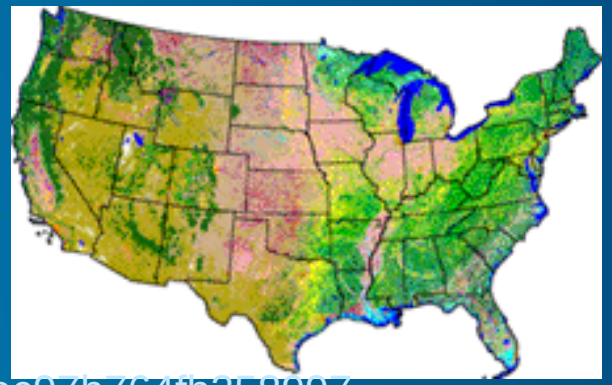
NHDPlus

2.7 million reach catchments in US
average area 3 km$^2$
reach length 2 km
Uniquely labelled

Watershed Boundary Dataset


National Hydrography Dataset


National Land Cover Dataset



http://www.arcgis.com/home/item.html?id=5600cf6b463043ec97b764fb258997

# 2009 – 2014: LIDAR-based Flood Inundation Mapping

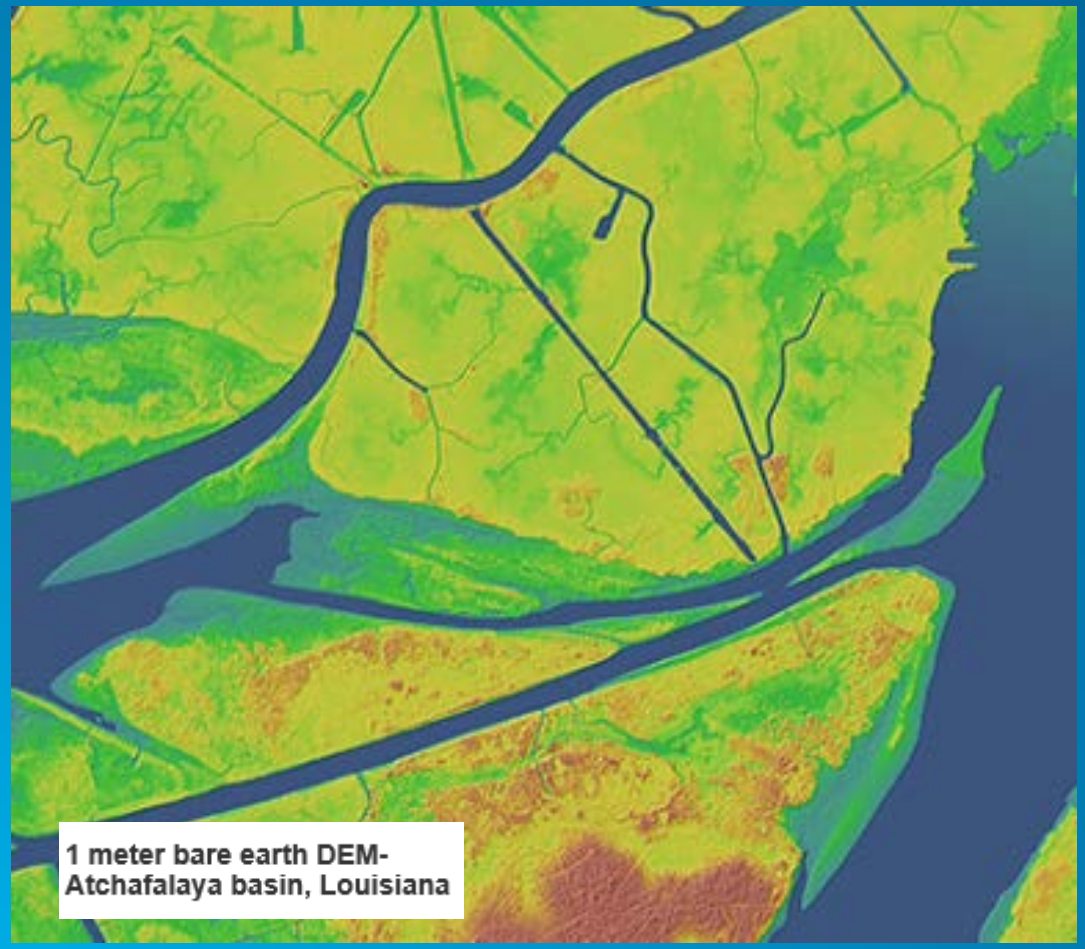
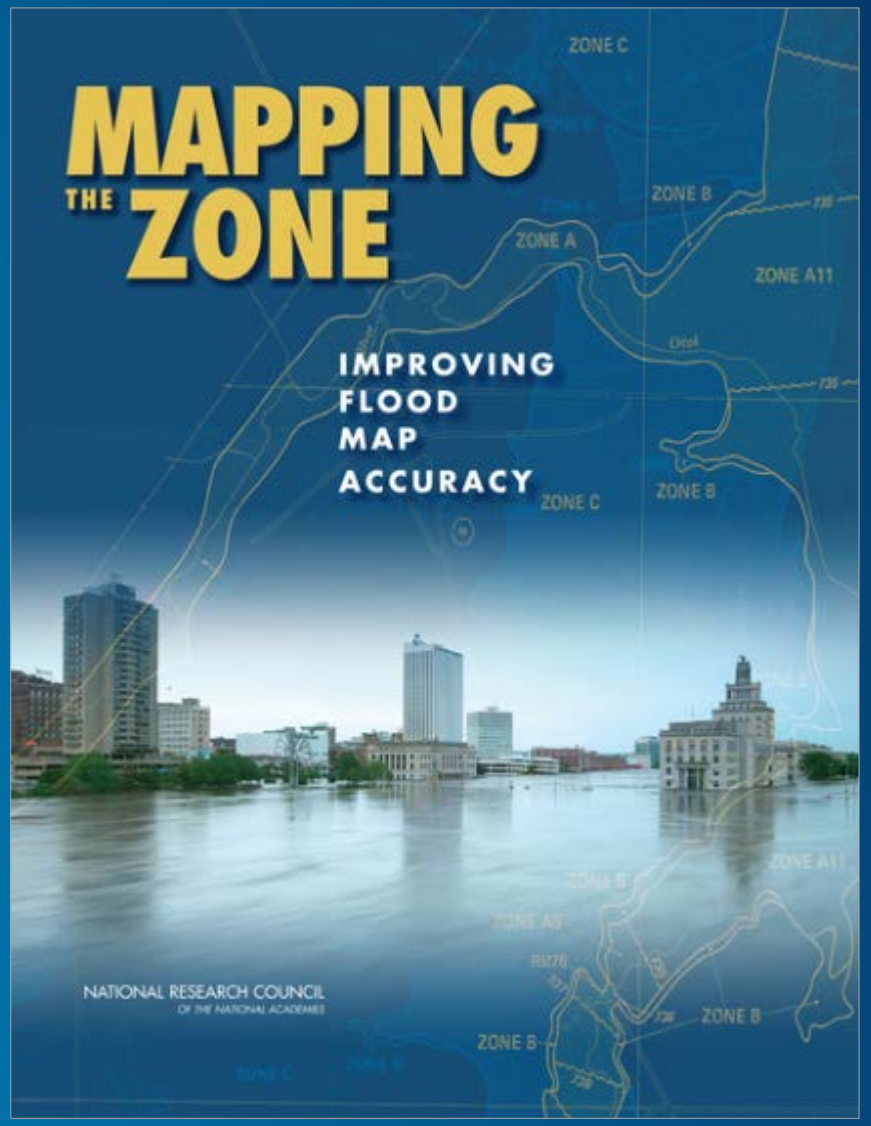



Image: USGS



# The challenge of increasing Digital Elevation Model (DEM) resolution

1980's DMA 90 m

$10^2$ cells/km$^2$

1990's USGS DEM 30 m

$10^3$ cells/km$^2$

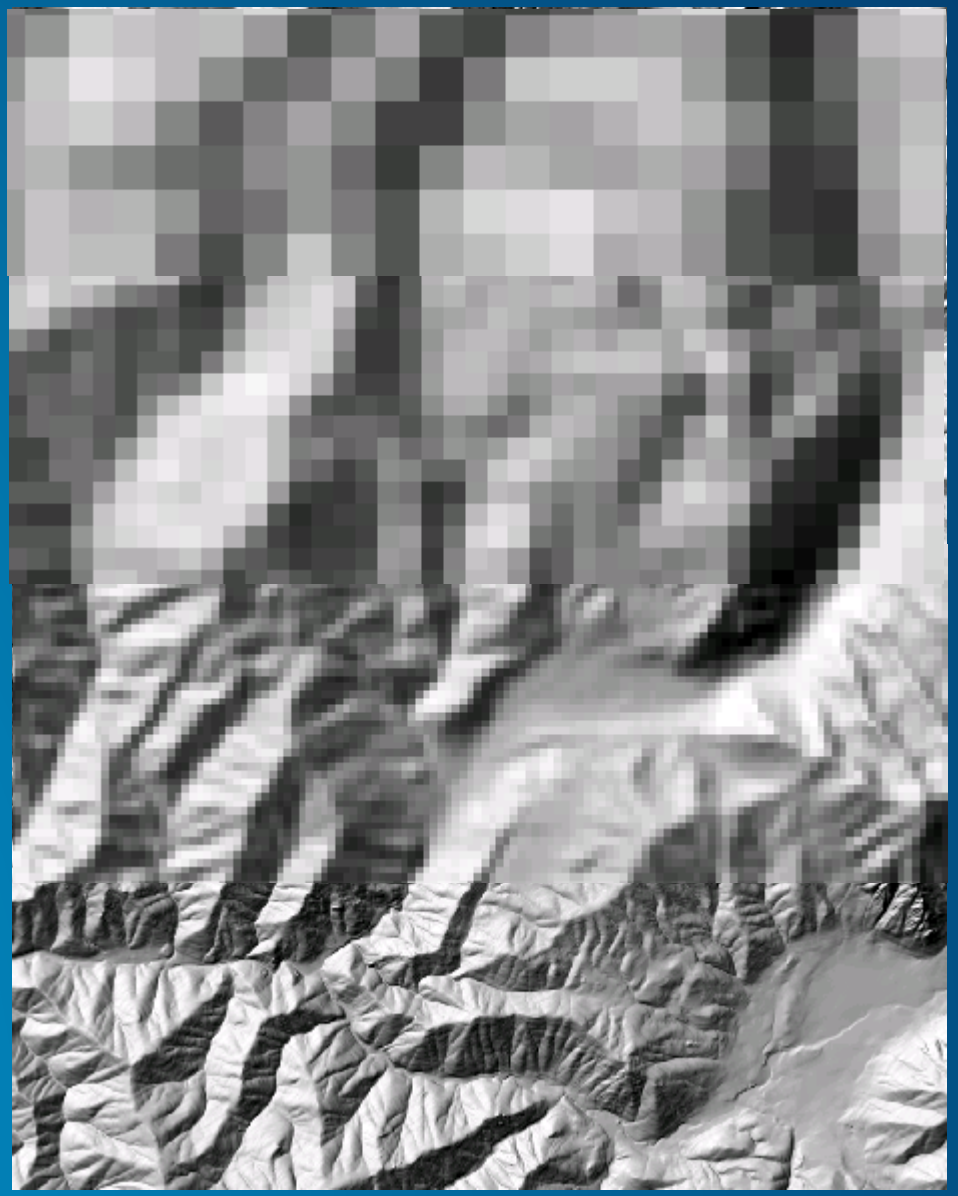
2000's NED 10-30 m

$10^4$ cells/km$^2$

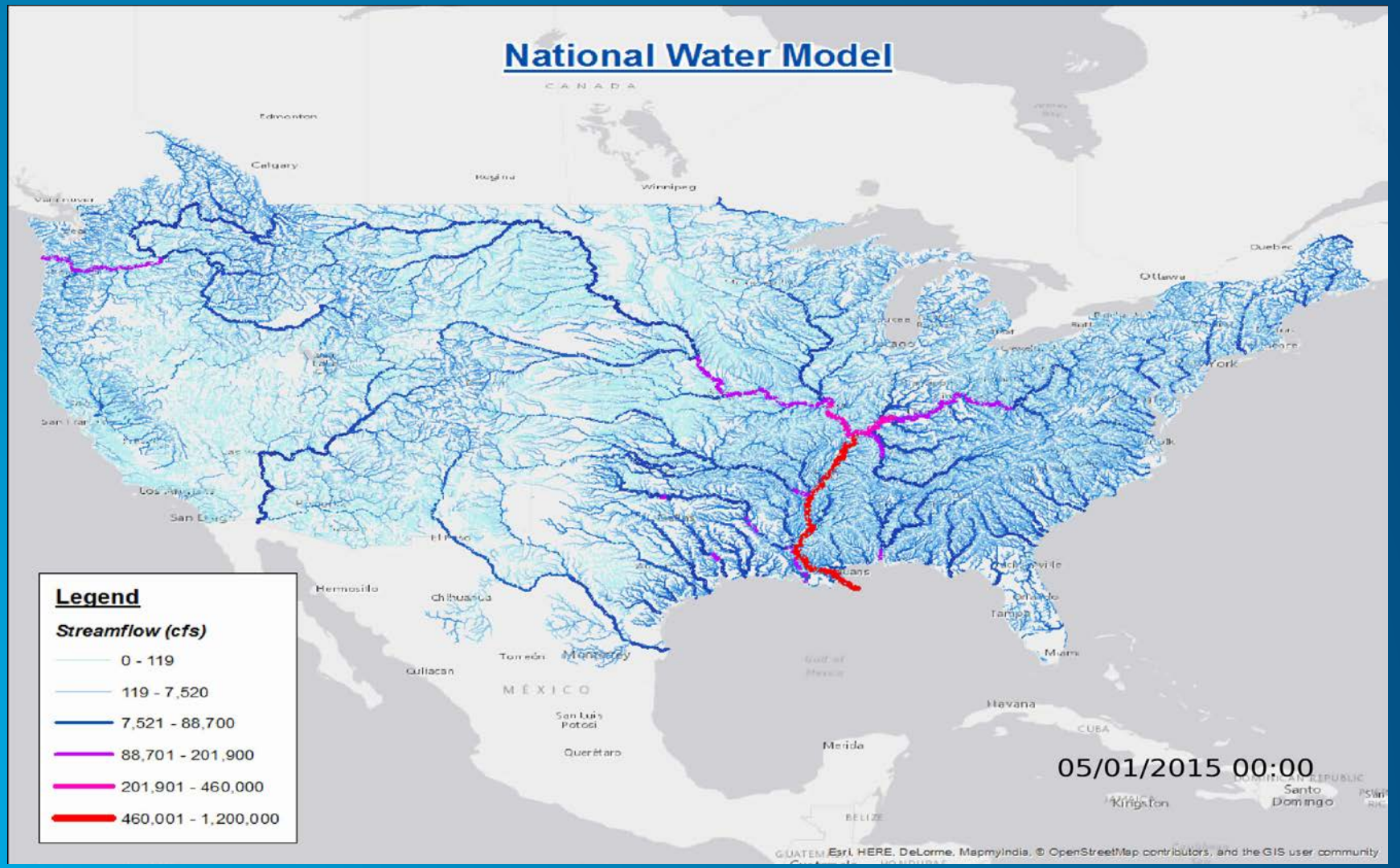
Slide: David Tarboton

2010's LIDAR ~1 m

$10^6$ cells/km$^2$

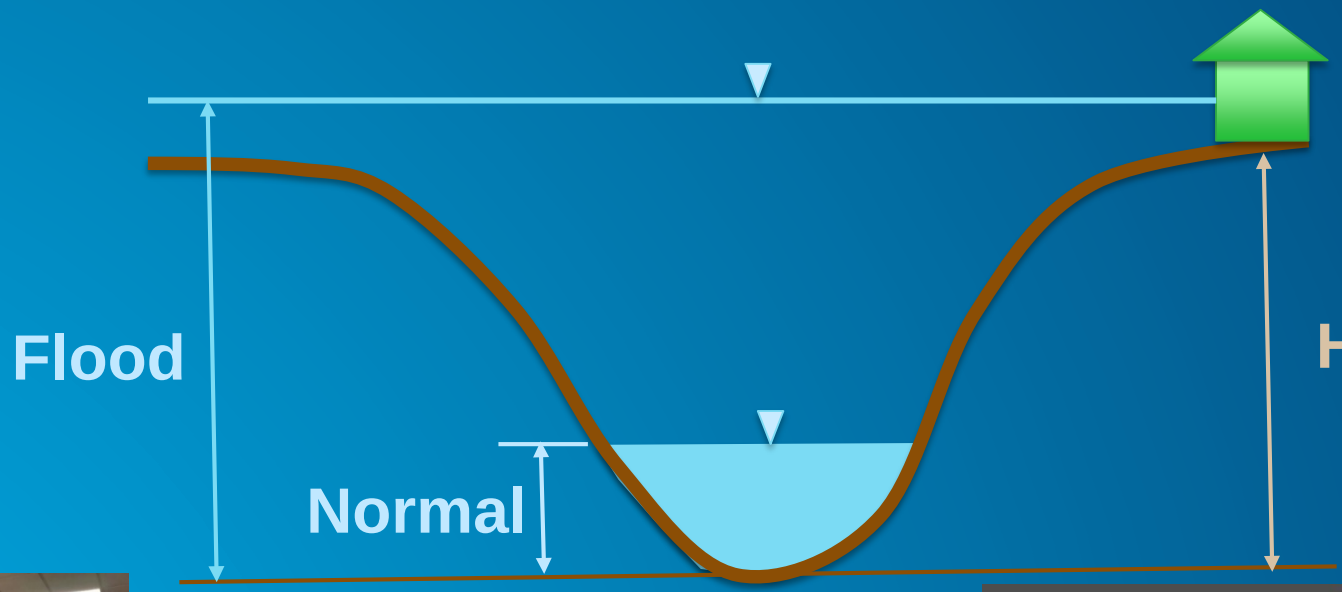


# 2014 – 2018: National Water Model Water in GIS



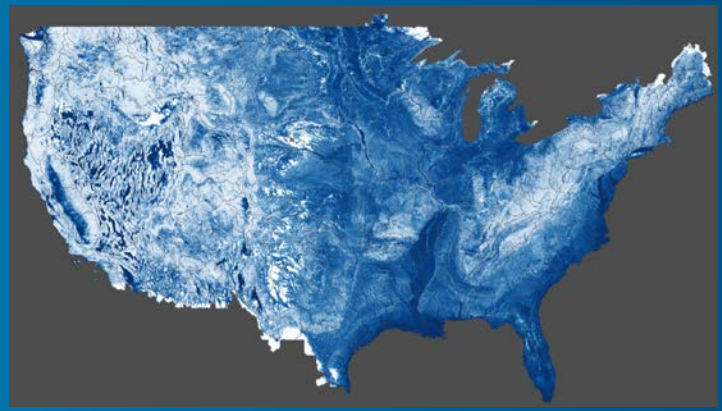
# Method for Determining Flood Risk:
## Height Above Nearest Drainage (HAND)

***Flooding occurs when Water Depth is greater than HAND***





***Computed for continental US***



# Conclusions

- What have we learned over these 25 years?
  - Development and sustainability of toolsets
  - Raster analysis of DEM's
  - Vector representation of stream networks
  - Formal data models for data integration
  - Development of National Water Model bringing water into GIS