



25 Years of GIS and Water with the ESRI Community

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ESRI GIS Hydro Meeting

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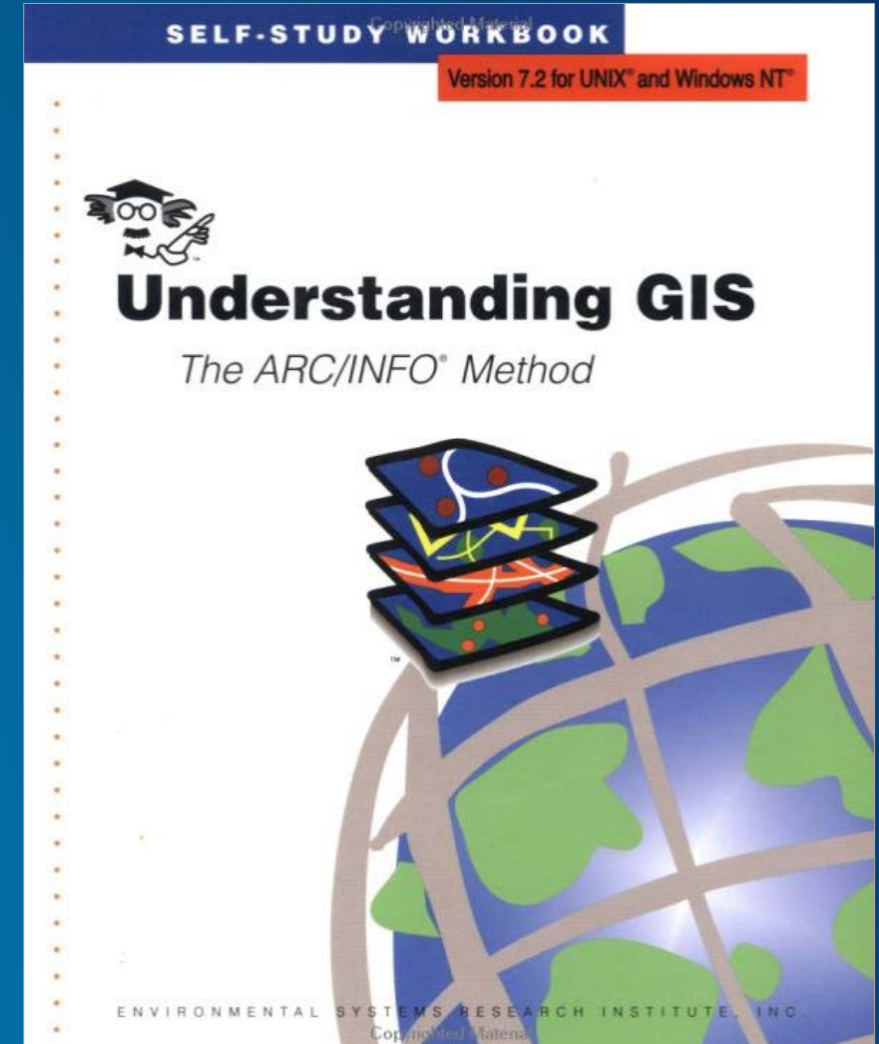
An abstract graphic on the right side of the slide. It features a blue background with various geometric shapes and patterns. A prominent feature is a topographic map with contour lines, overlaid with a grid of orange and red dots, suggesting data points or a spatial analysis. The overall style is modern and technical.

**GIS
INSPIRING
WHAT'S
NEXT**

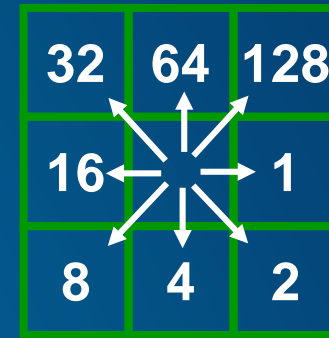
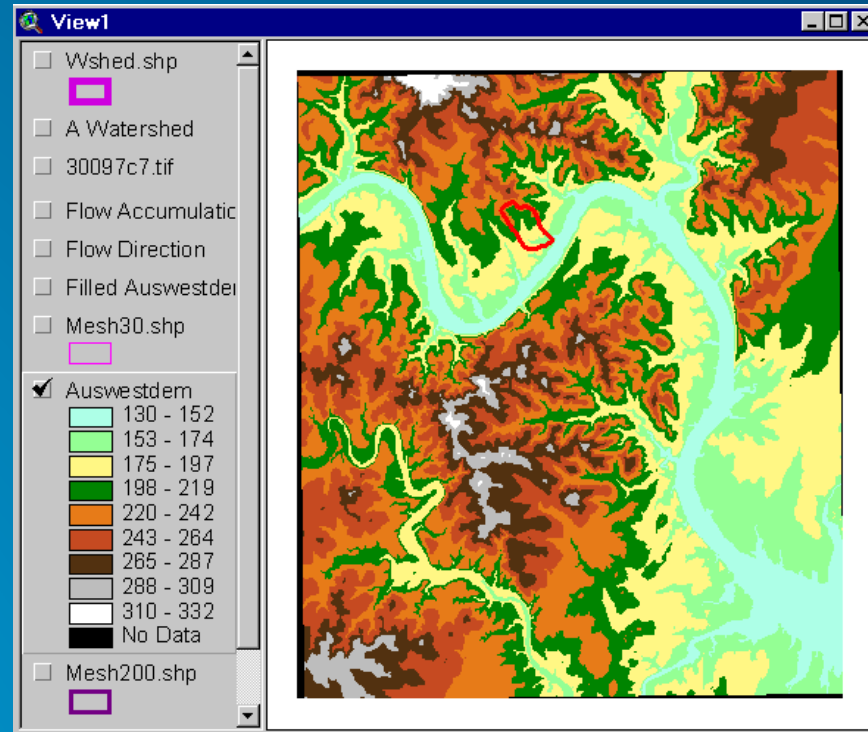
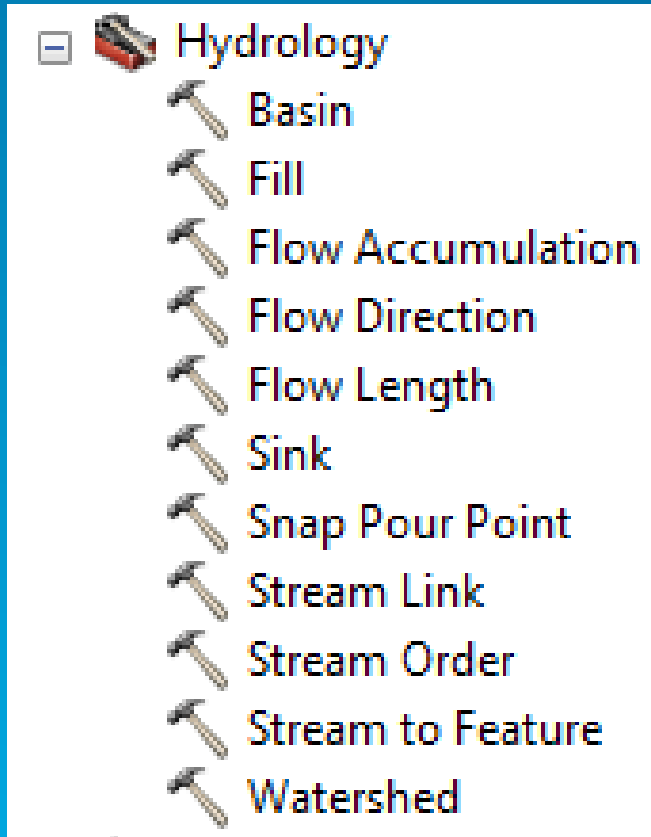
In the Beginning ...

- 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



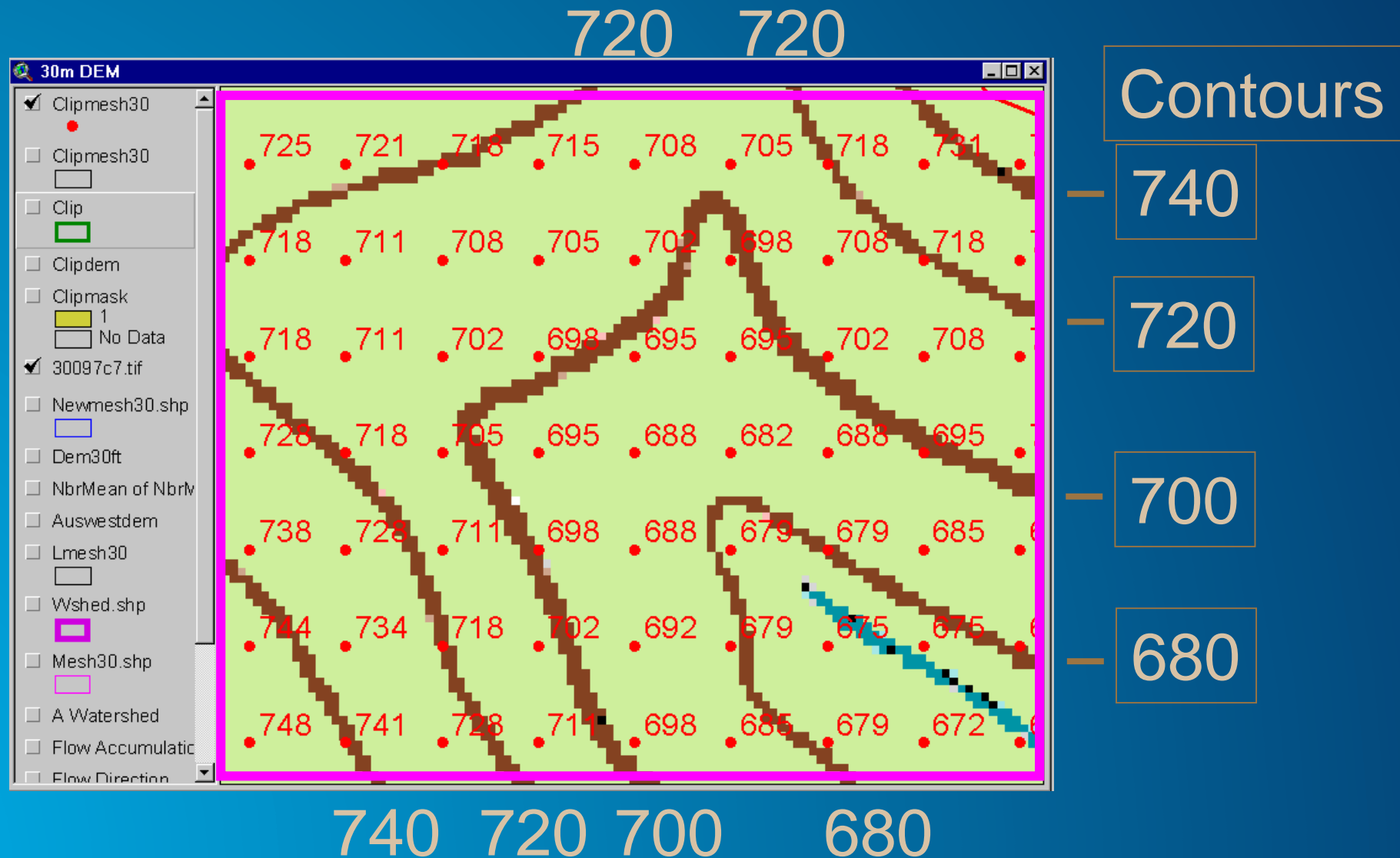
1994 – 1999: Watershed and Stream Network Delineation



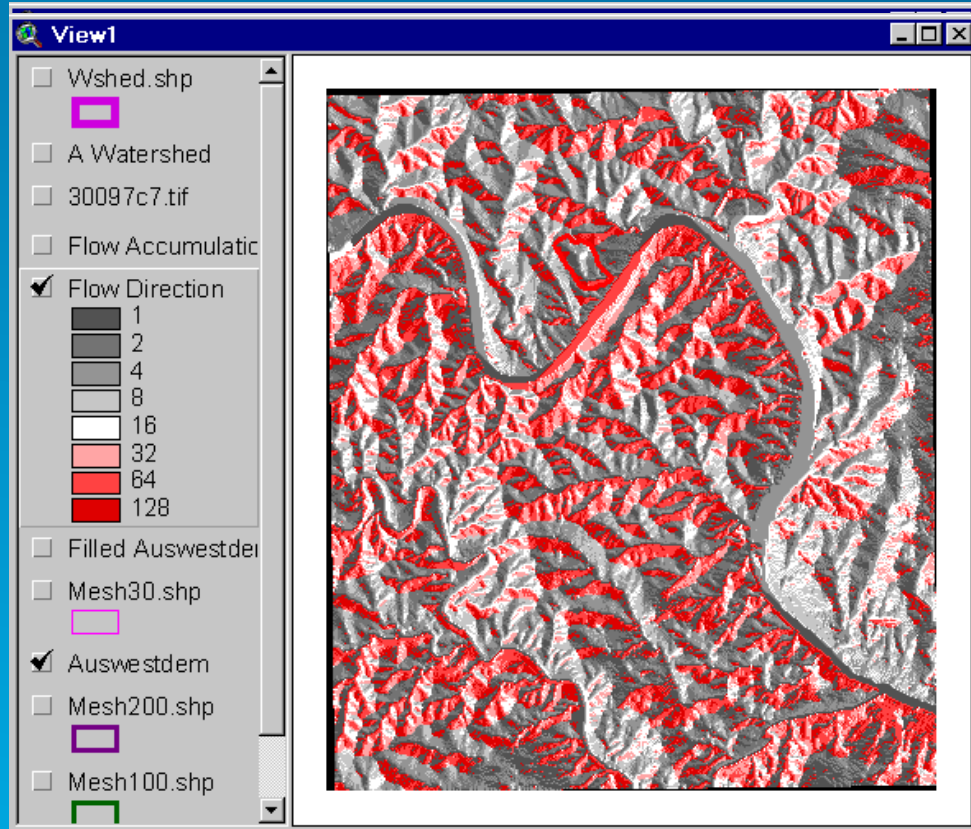
Eight direction pour point model for flow direction on Digital Elevation Models

Hydrology tools in workstation ArcInfo, Spatial Analyst extension of ArcView

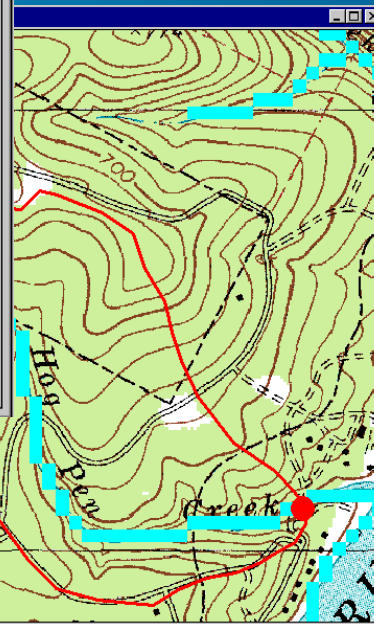
Digital Elevation Model produced from Contours



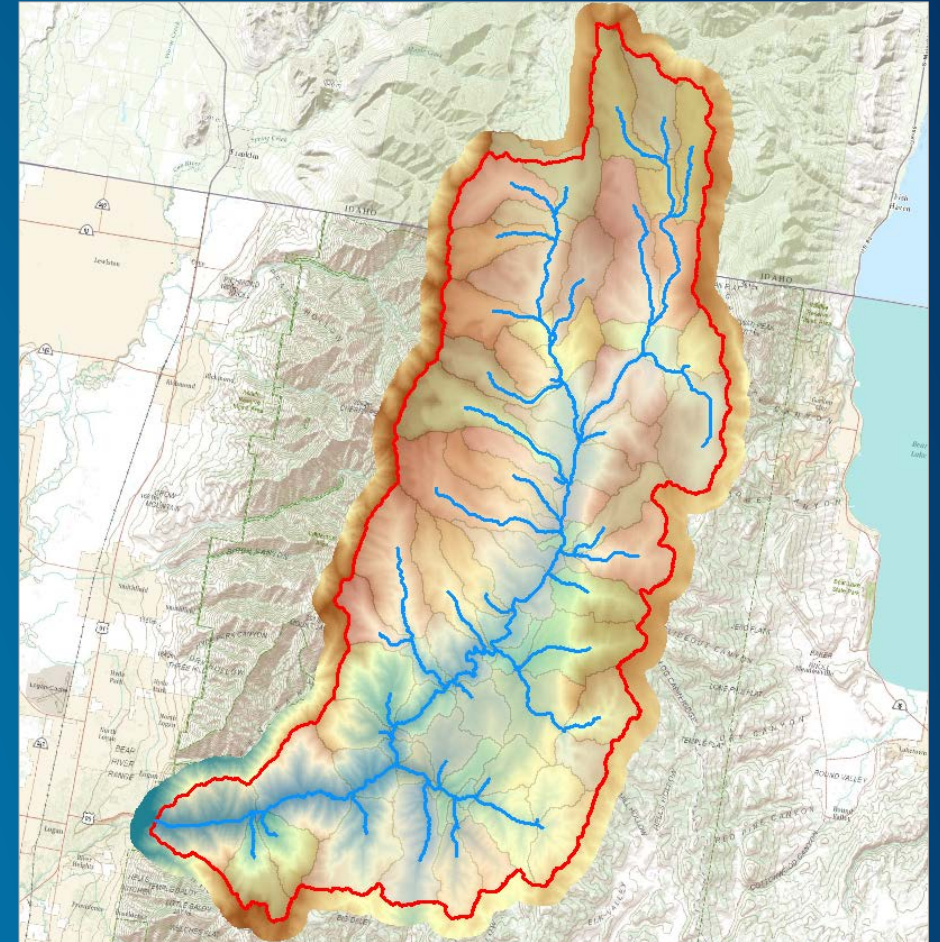
Watershed and Stream Network Delineation – then and now



Flow Direction

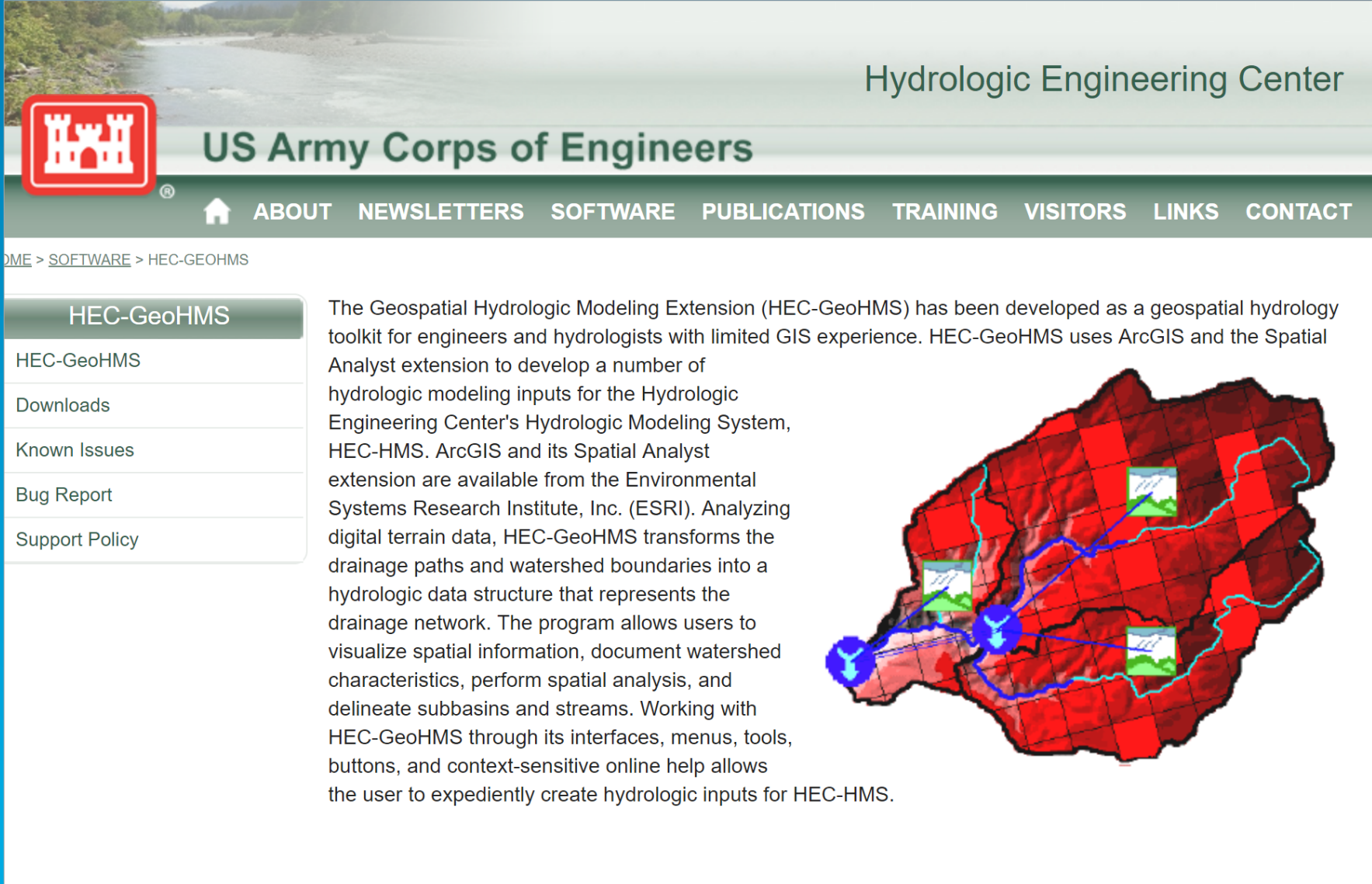


Flow Accumulation and Stream Definition




Watershed Delineation (David Tarboton)

GIS Preprocessors for Hydrologic Models



The screenshot displays the website for the Hydrologic Engineering Center, part of the US Army Corps of Engineers. The page features a navigation menu with links to 'ABOUT', 'NEWSLETTERS', 'SOFTWARE', 'PUBLICATIONS', 'TRAINING', 'VISITORS', 'LINKS', and 'CONTACT'. The main content area is titled 'HEC-GeoHMS' and includes a sidebar with links to 'Downloads', 'Known Issues', 'Bug Report', and 'Support Policy'. The main text describes the Geospatial Hydrologic Modeling Extension (HEC-GeoHMS) as a geospatial hydrology toolkit for engineers and hydrologists with limited GIS experience. It explains that HEC-GeoHMS uses ArcGIS and the Spatial Analyst extension to develop hydrologic modeling inputs for the Hydrologic Engineering Center's Hydrologic Modeling System, HEC-HMS. The text details how HEC-GeoHMS transforms digital terrain data into a hydrologic data structure representing the drainage network, allowing users to visualize spatial information, document watershed characteristics, perform spatial analysis, and delineate subbasins and streams. A 3D topographic map of a watershed is shown on the right, with a blue stream network overlaid on a red terrain grid. Several small inset images of the software interface are also visible on the map.

Hydrologic Engineering Center

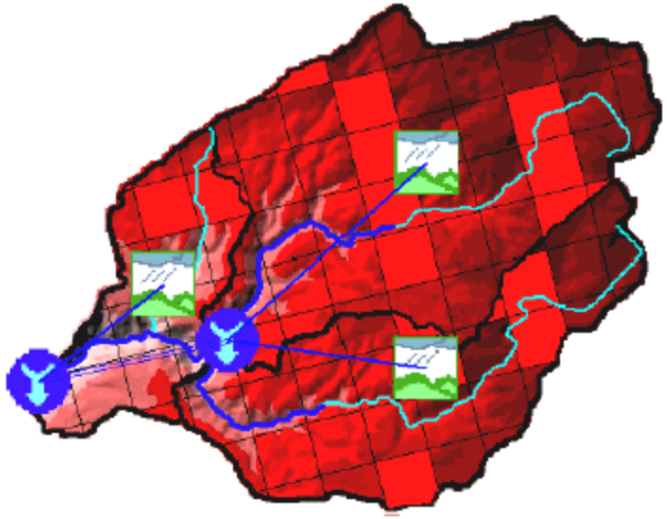
 **US Army Corps of Engineers**

HOME > [SOFTWARE](#) > HEC-GEOHMS

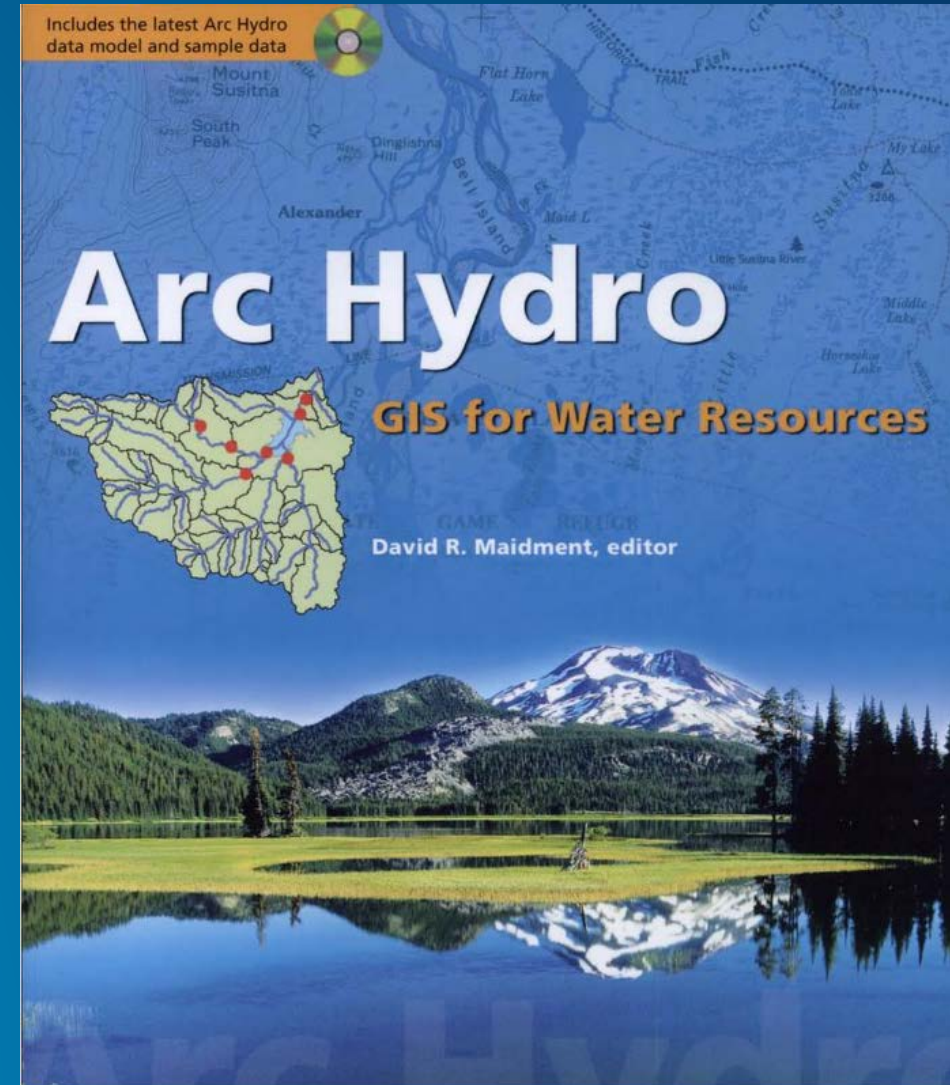
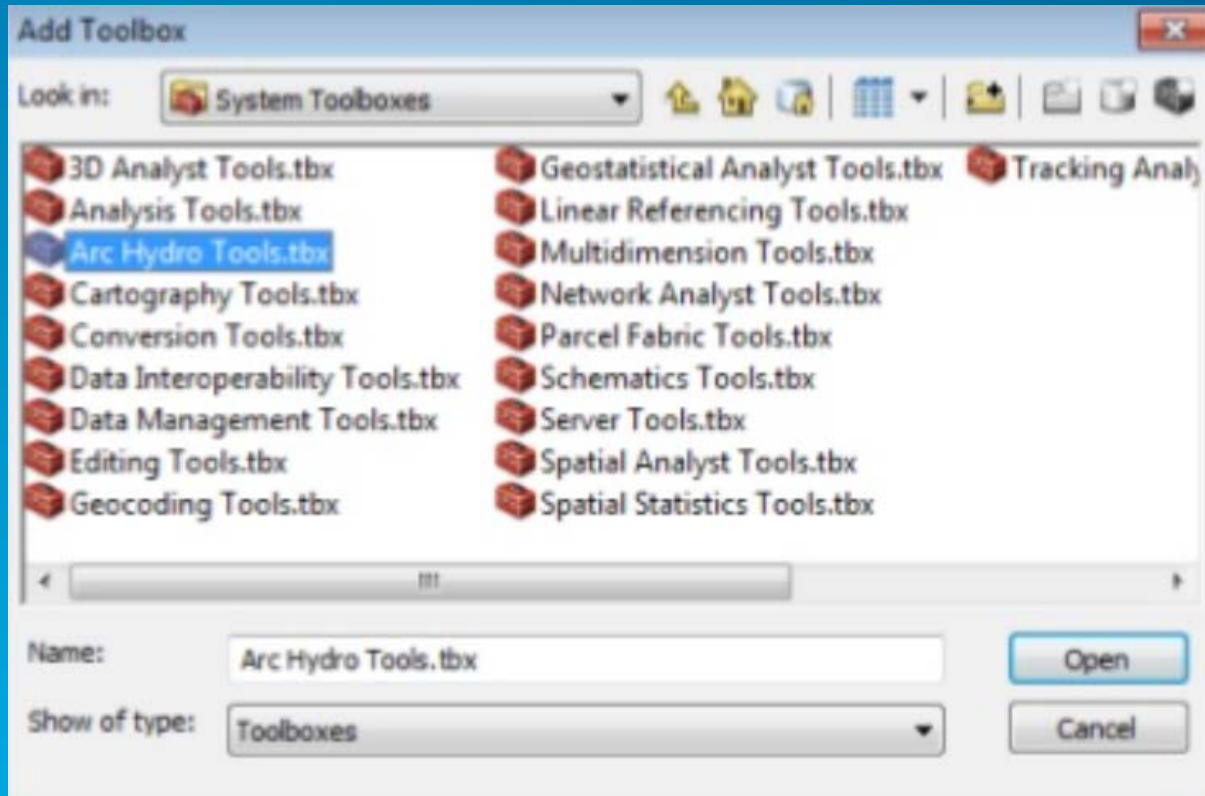
HEC-GeoHMS

- [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



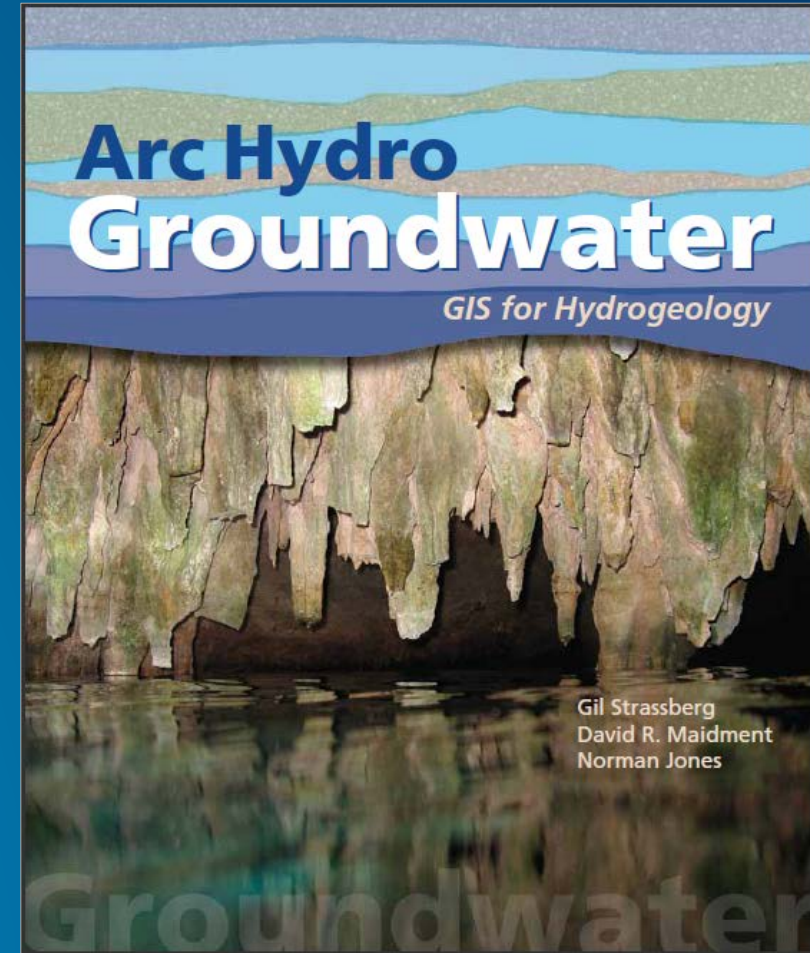
Merging of Arc/Info and ArcView into ArcGIS

Arc Hydro Groundwater: GIS For Hydrogeology

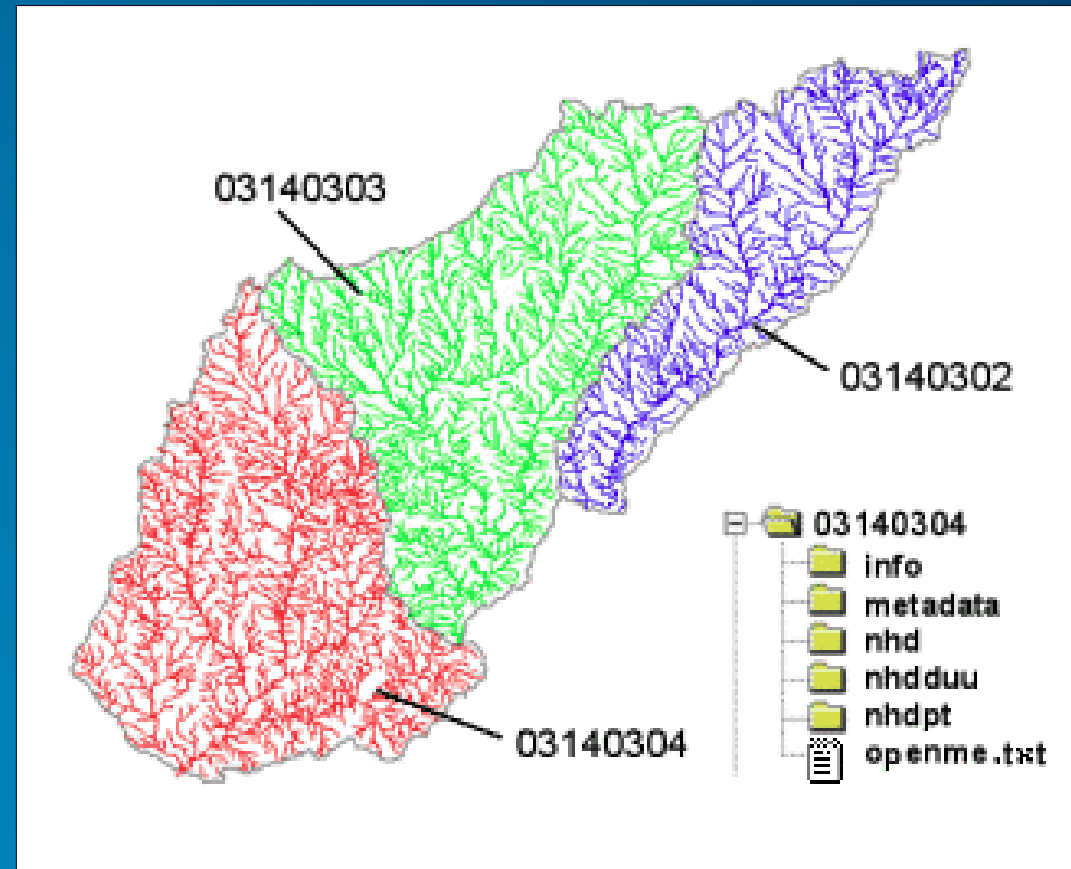
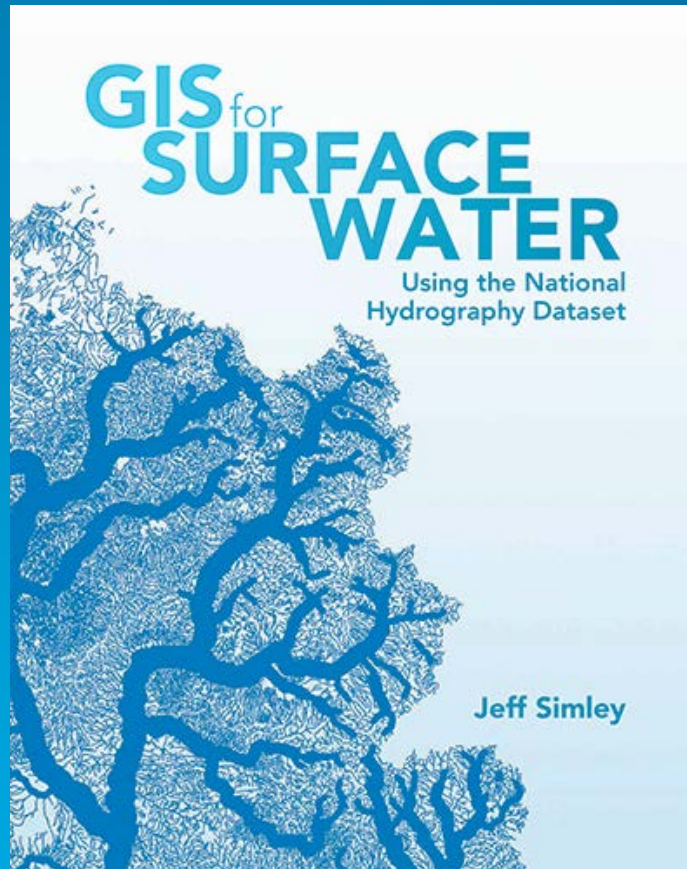
(2011)



The screenshot shows the AQUAVEO website interface. At the top, there is a navigation menu with links for Software, Services, Support, Downloads, and About. Below this, a secondary menu features the Arc Hydro Groundwater logo and links for Introduction, Groundwater Analyst, MODFLOW Analyst, and Subsurface Analyst. The main content area has a background image of layered rock strata with the text: "ArcGIS extensions to display, analyze and archive groundwater & subsurface data". Below this, the title "Arc Hydro Groundwater 3.4" is displayed. At the bottom, there are three overlapping screenshots of the software's user interface, showing a map, a cross-section, and a data plot.



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 Elevation Dataset

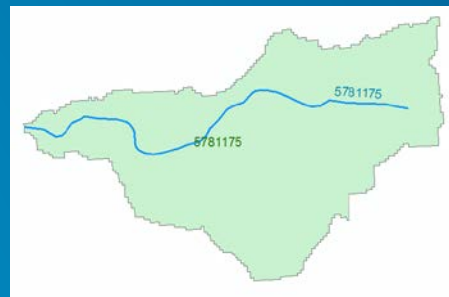
NHDPlus

2.7 million reach catchments in US
average area 3 km²
reach length 2 km
Uniquely labelled

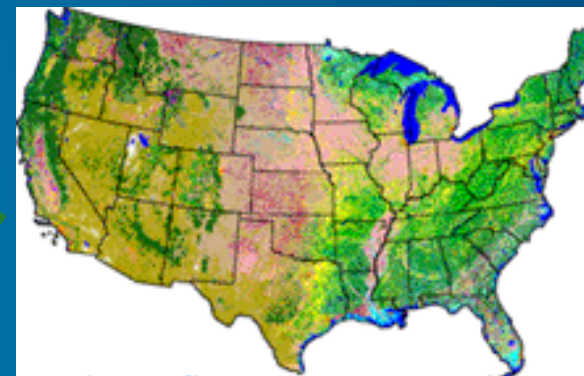


Watershed Boundary Dataset

National Hydrography Dataset



National Land Cover Dataset



2009 – 2014: LIDAR-based Flood Inundation Mapping

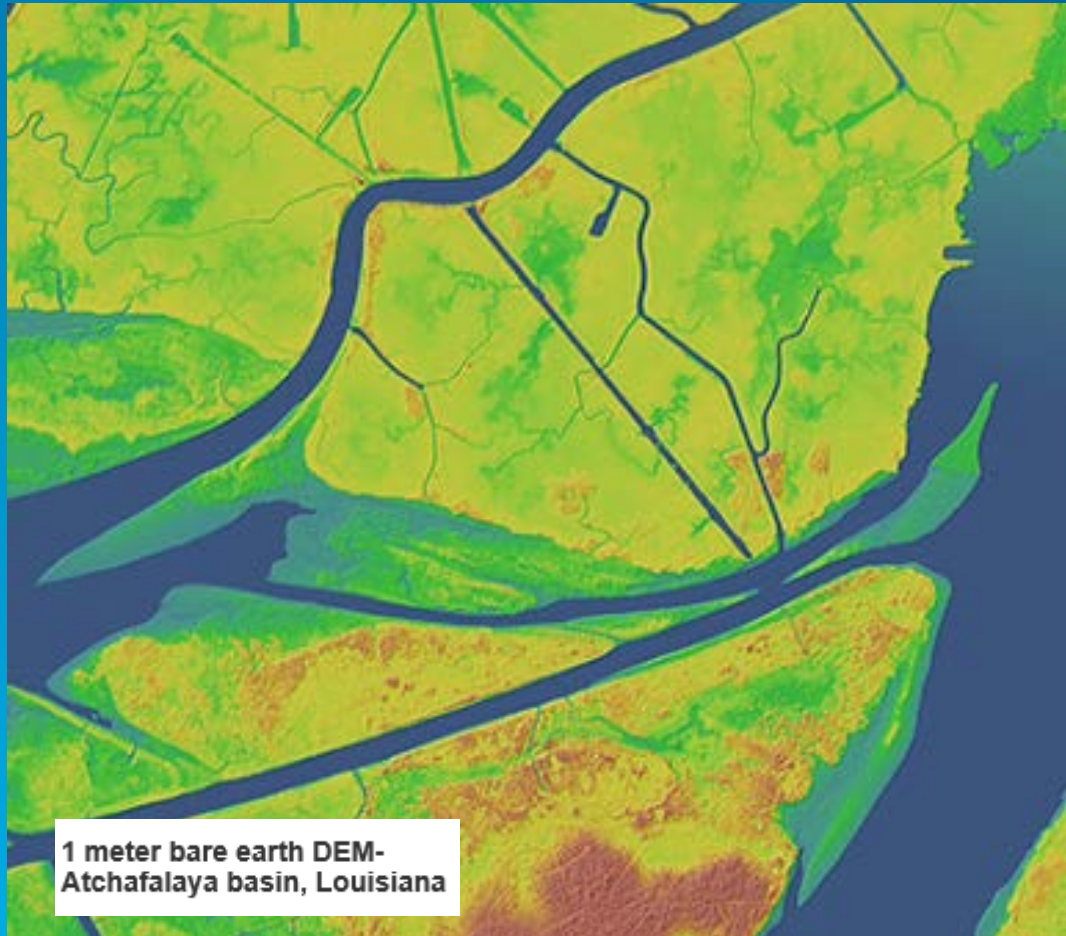
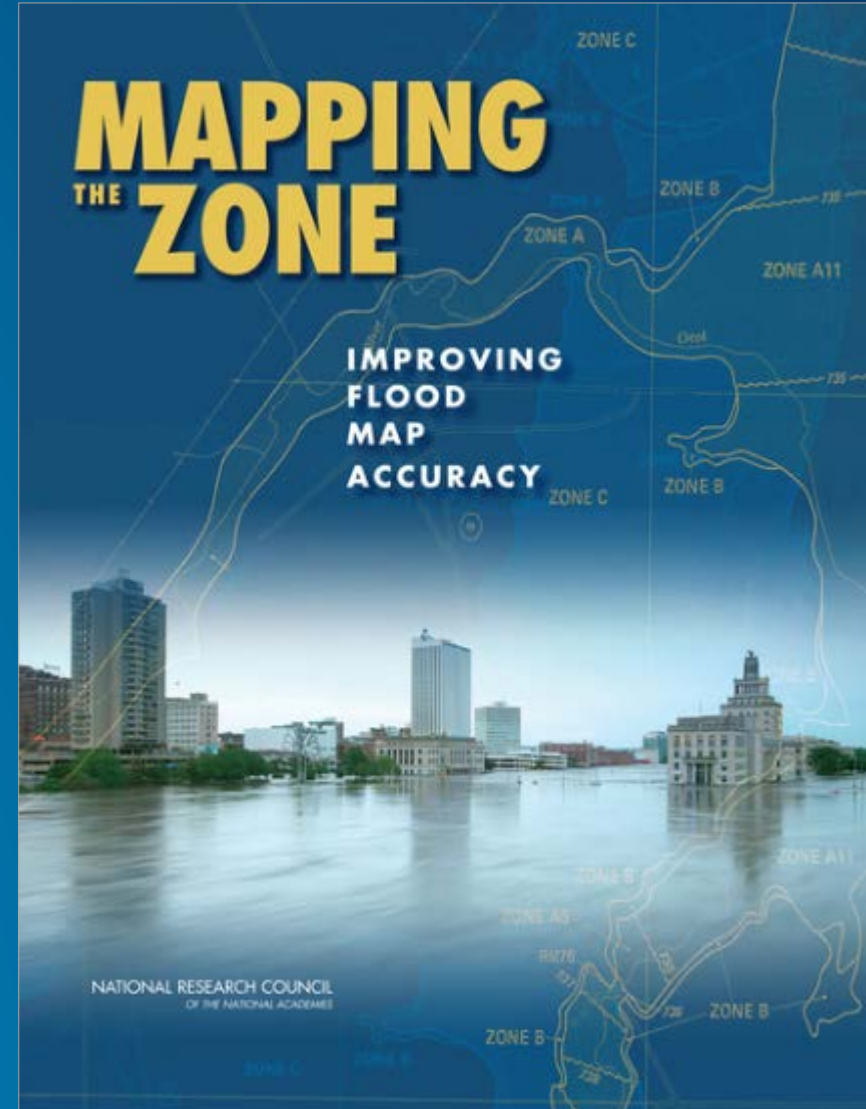


Image: USGS



The challenge of increasing Digital Elevation Model (DEM) resolution

1980's DMA 90 m

10^2 cells/km²

1990's USGS DEM 30 m

10^3 cells/km²

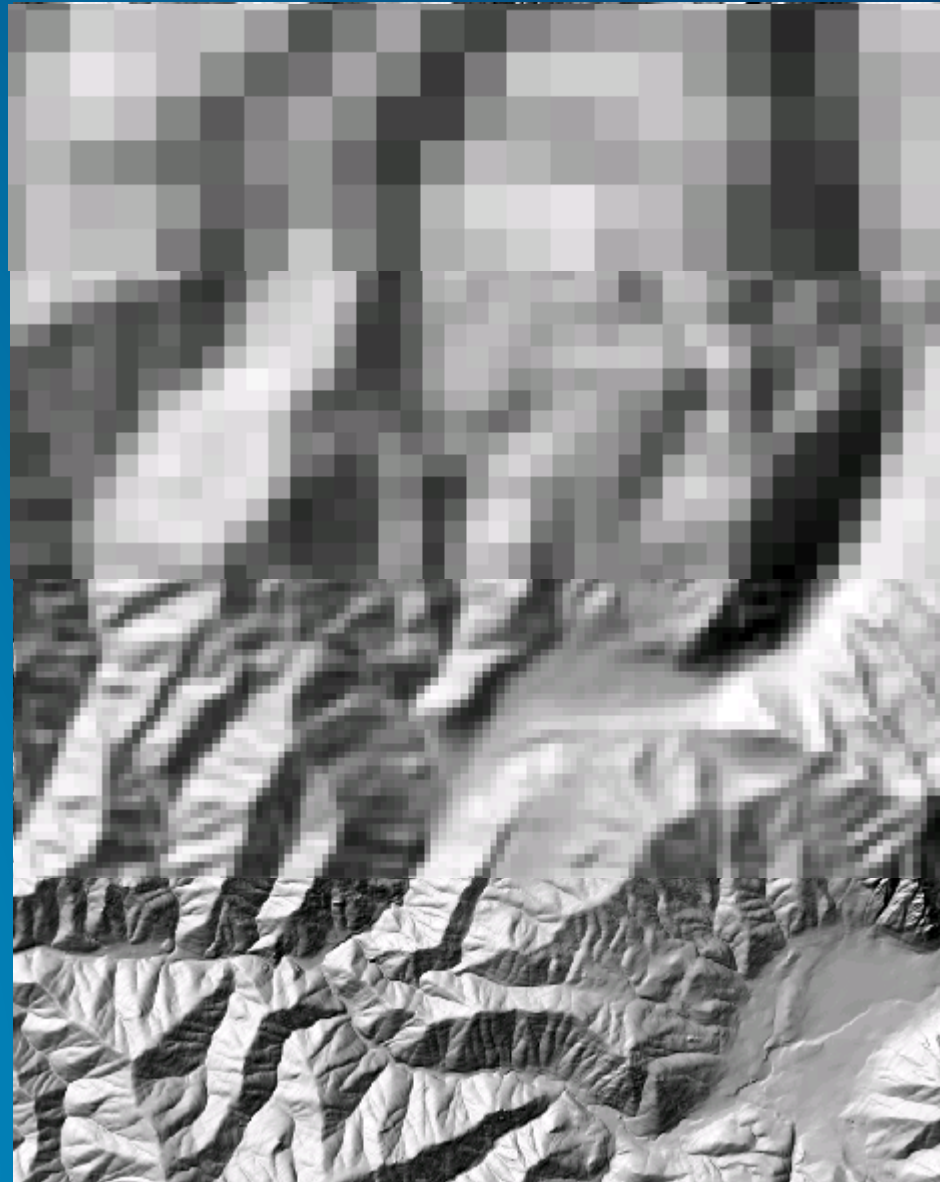
2000's NED 10-30 m

10^4 cells/km²

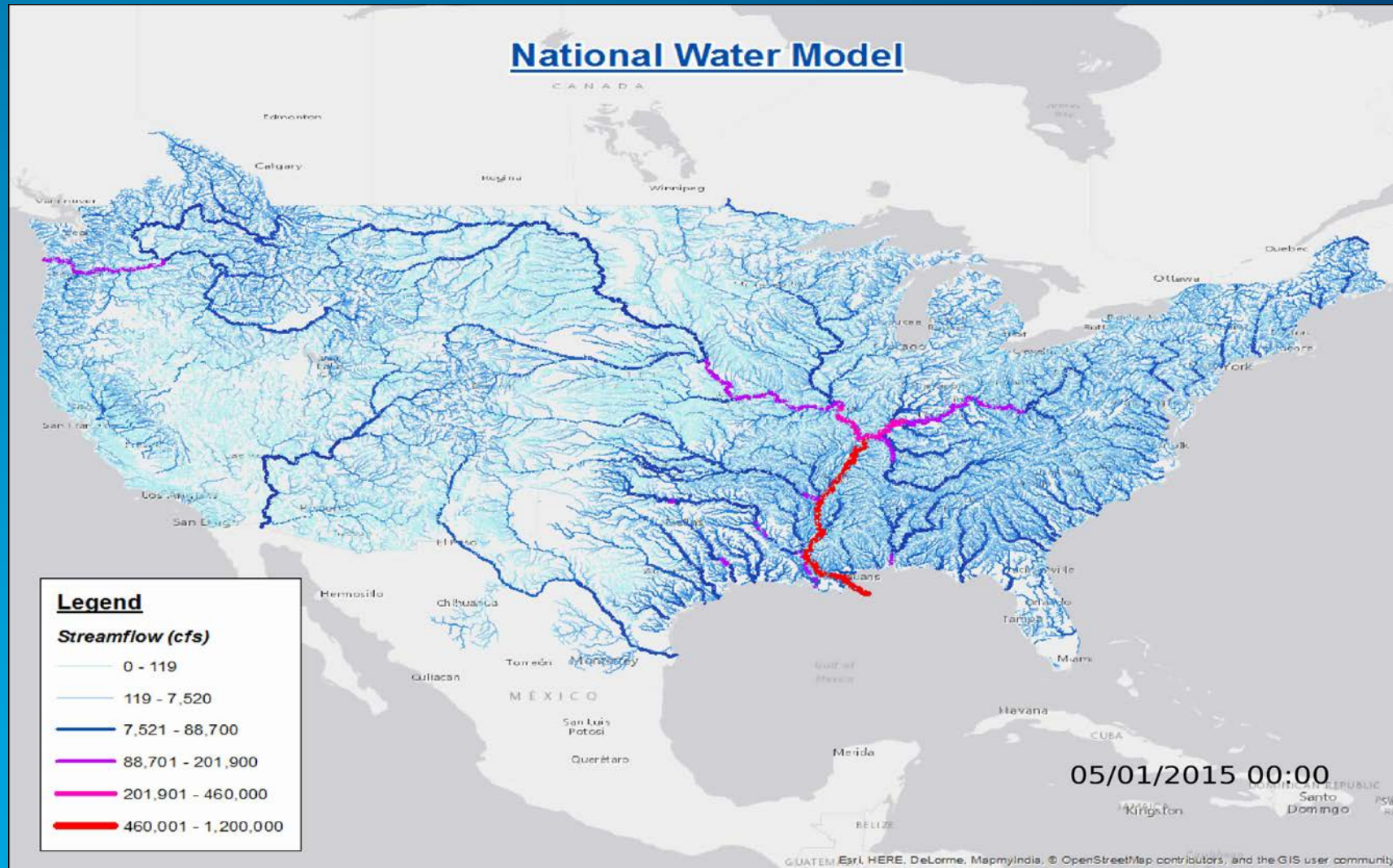
Slide: David Tarboton

2010's LIDAR ~1 m

10^6 cells/km²

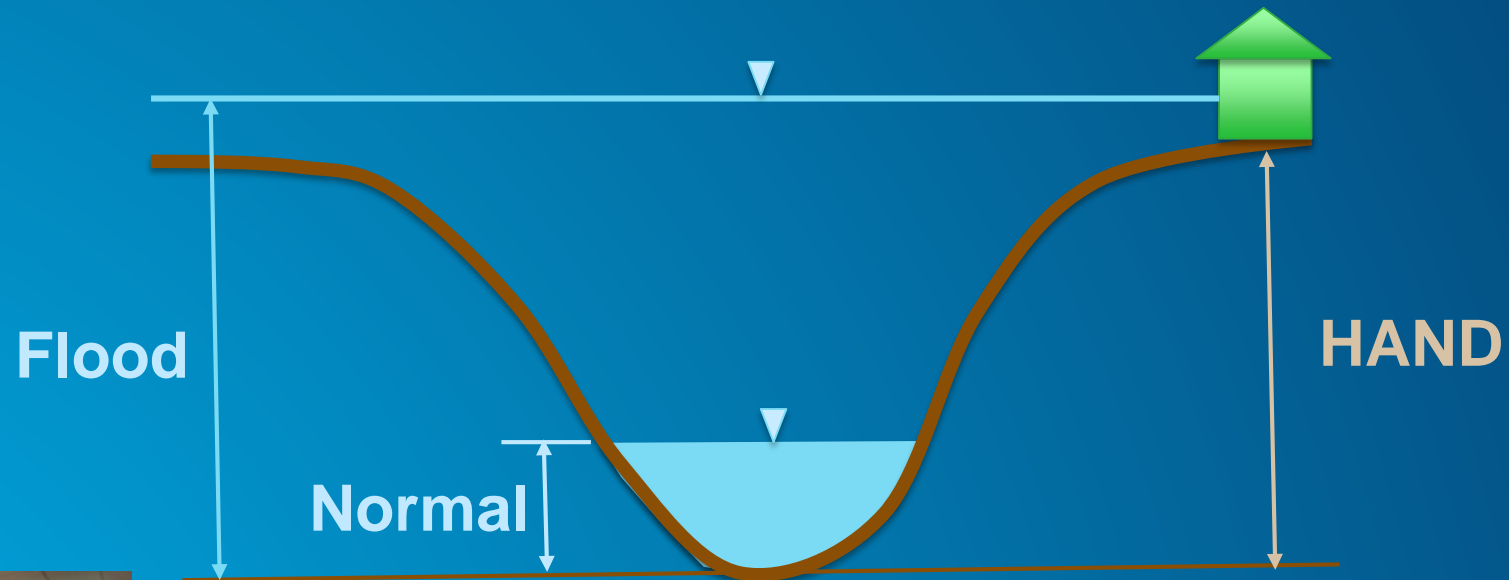


2014 – 2018: National Water Model Water in GIS

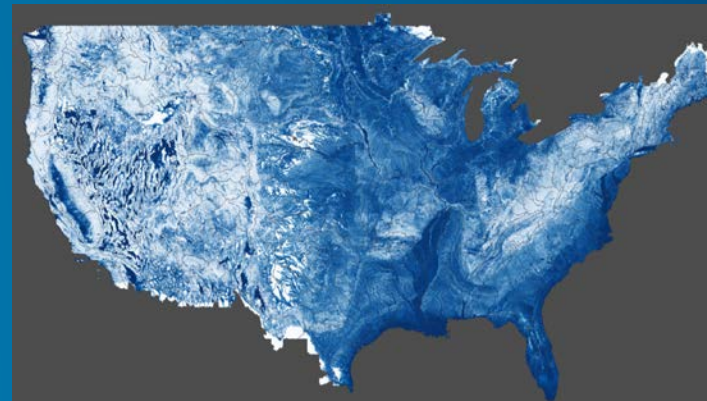


Method for Determining Flood Risk: Height Above Nearest Drainage (HAND)

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

