Exploring the WRF-Hydro Flow Routing Option

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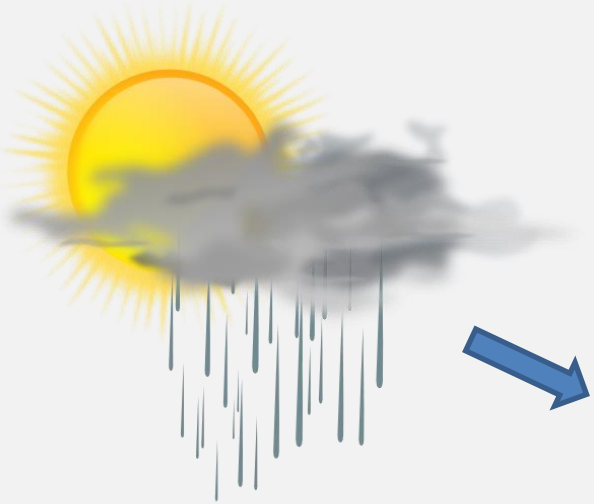
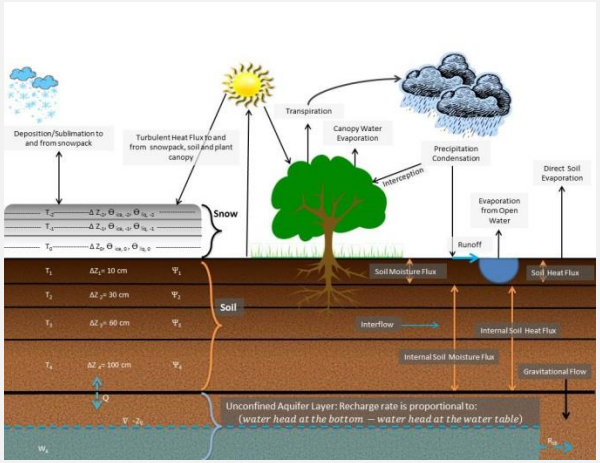
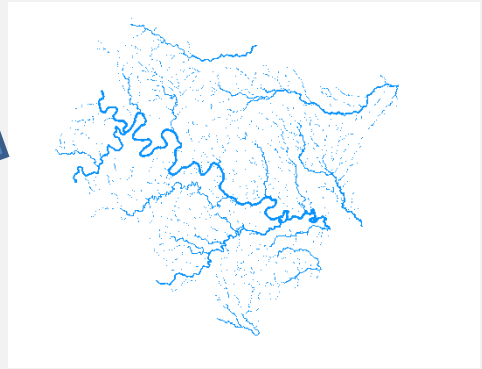
CE 397 Class Project

WRF Hydro is a model architecture

- Atmosphere, land surface, and hydrology



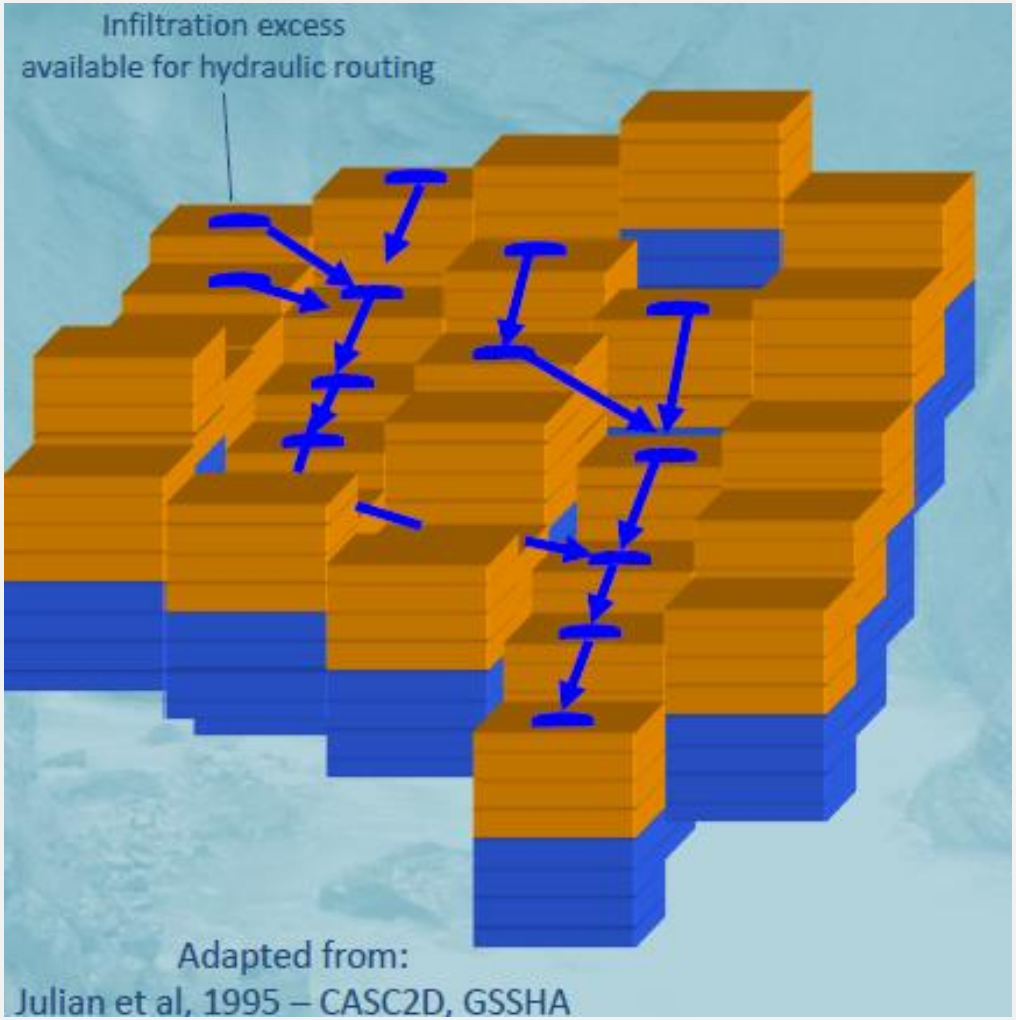




WRF Hydro Within NFIE

- Currently, NFIE HYDRO uses WRF-HYDRO as a land surface model
- Routing is done in RAPID
- What about WRF-HYDRO's routing scheme?

Steepest descent for overland routing



WRF Hydro Channel Routing Options

- Muskingham Method (Reach-averaged)

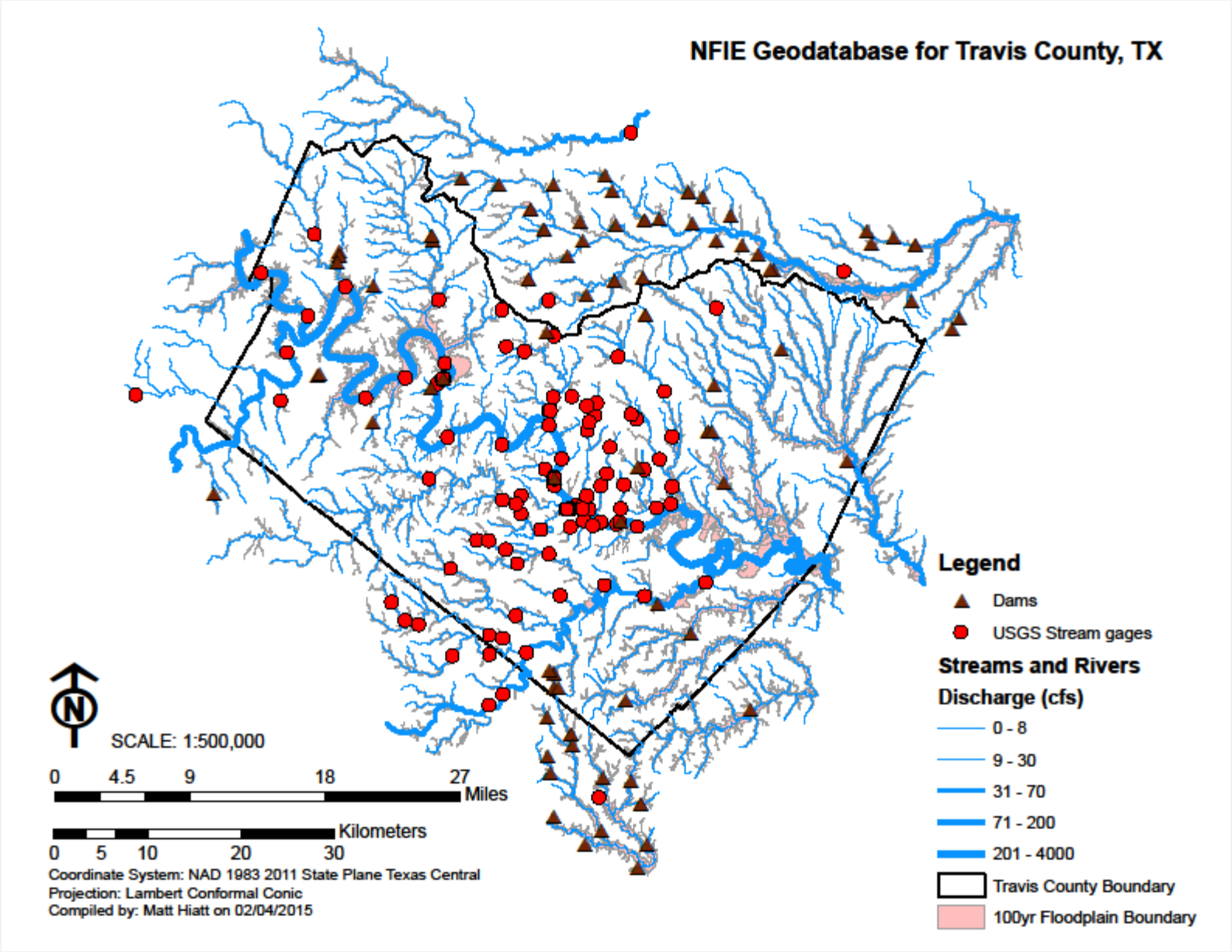
$$S = KO + KX(I - O)$$

- Muskingham Cunge Method (Reach-averaged)

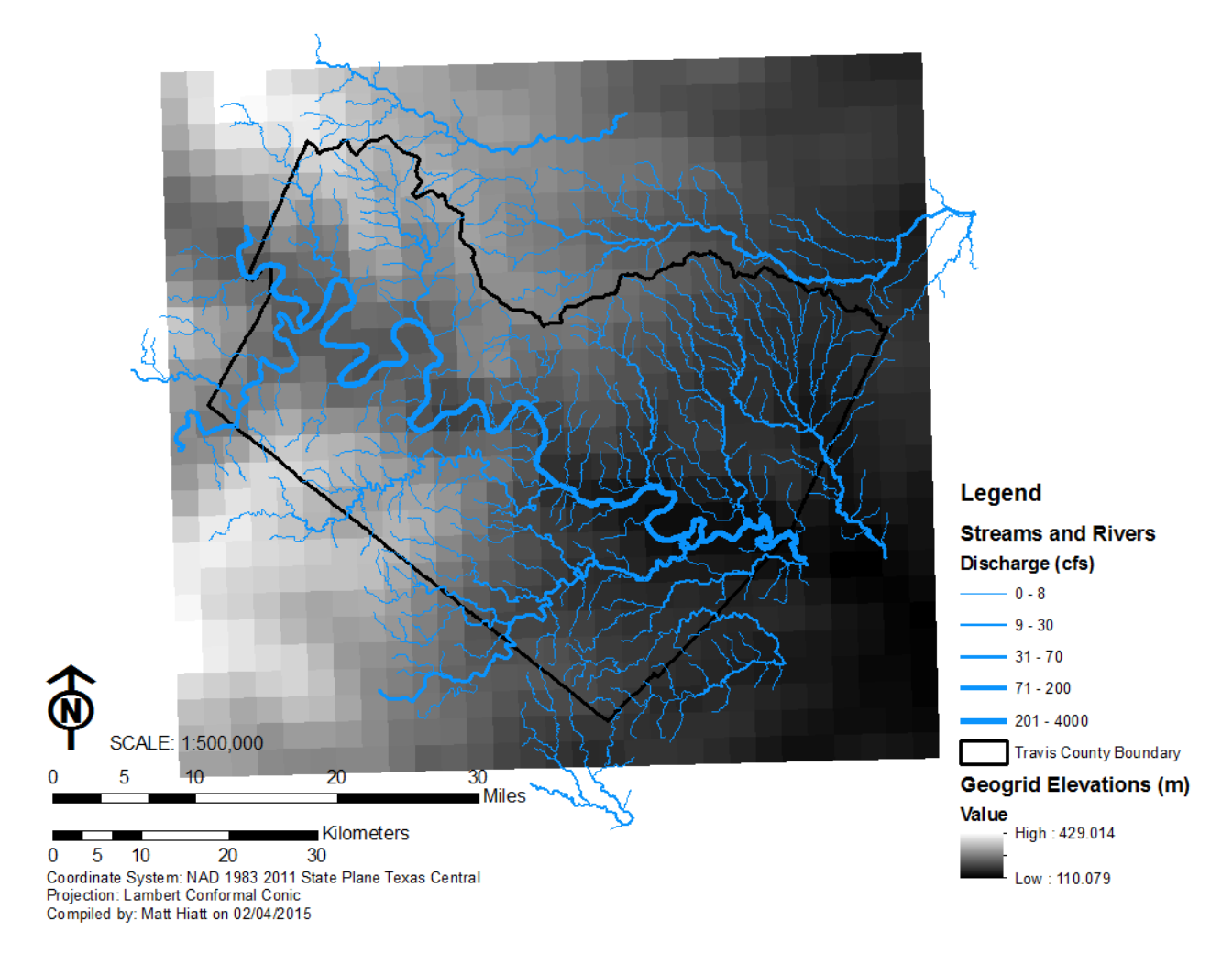
$$S = K[XI + (1 - X)O]$$

- Diffusive Wave (Gridded)

$$\frac{\partial Q}{\partial t} + C_d \frac{\partial Q}{\partial x} = \mu \frac{\partial^2 Q}{\partial x^2}$$


NFIE Geodatabase for Travis County, TX
Legend
Dams
USGS Stream gages
Streams and Rivers
Discharge (cfs)
0 - 8
9 - 30
31 - 70
71 - 200
201 - 4000
Travis County Boundary
100yr Floodplain Boundary
N
SCALE: 1:500,000
0 4.5 9 18 27 Miles
0 5 10 20 30 Kilometers
Coordinate System: NAD 1983 2011 State Plane Texas Central
Projection: Lambert Conformal Conic
Compiled by: Matt Hiatt on 02/04/2015

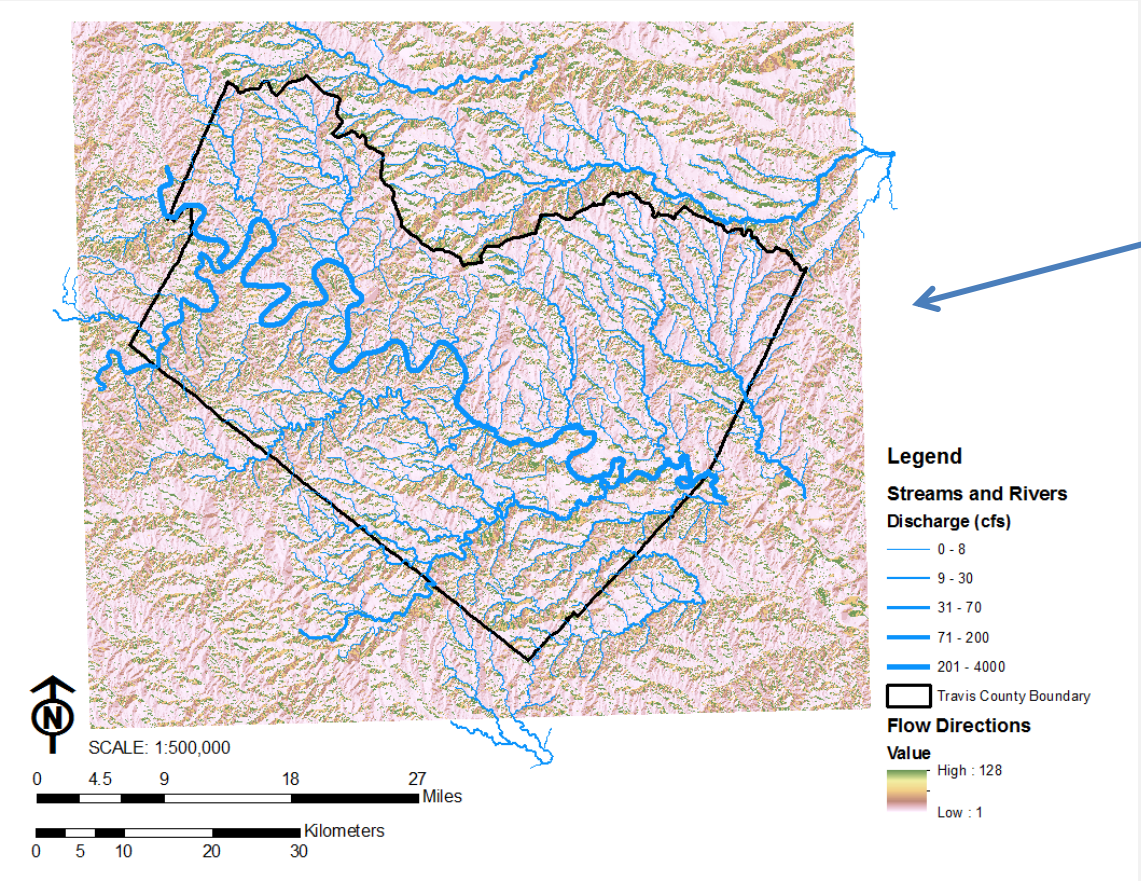
Development of channel routing input



3 km GEOGRID surface

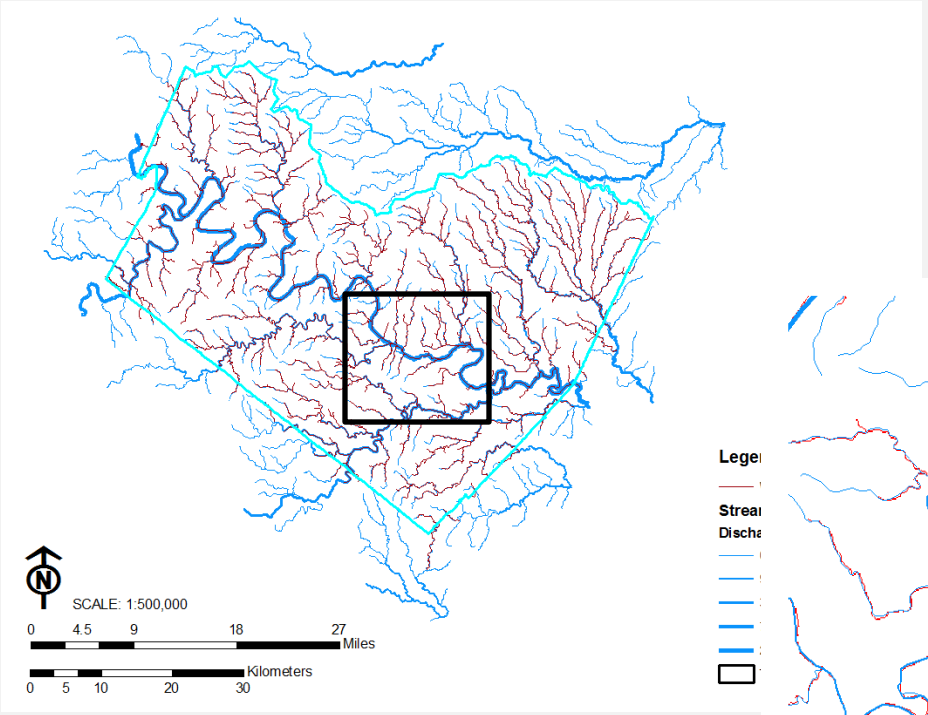
Used in conjunction with 30 m NED to create “terrain” files

Terrain Files



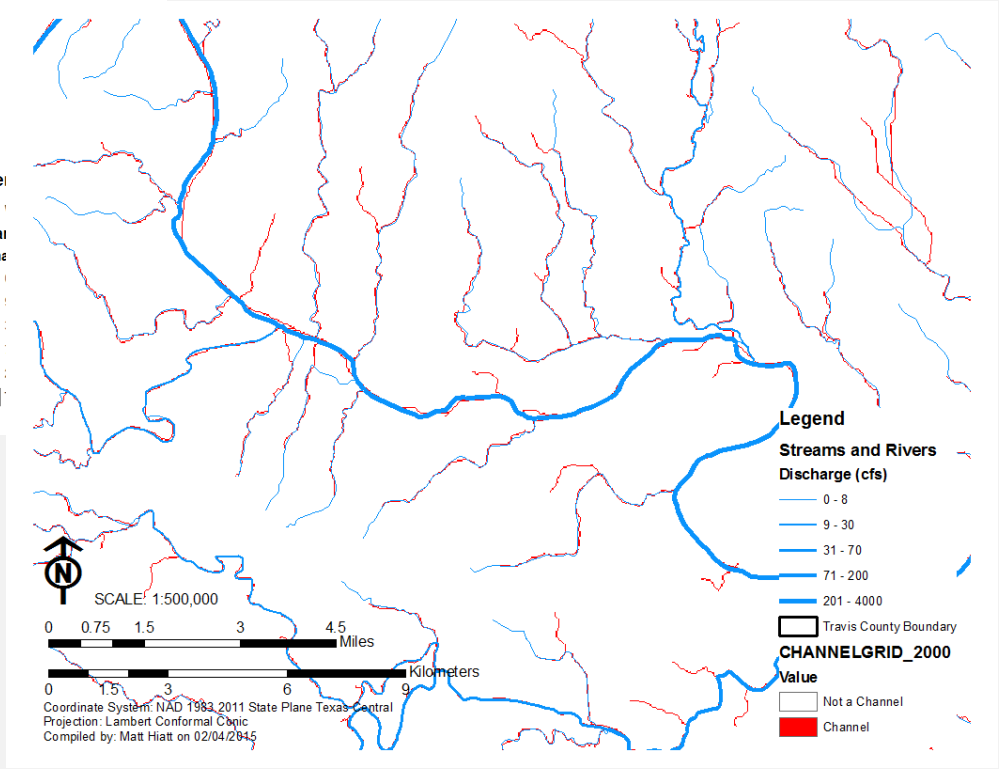
- Topography
- Flow Directions
- Channel Grid (next slide)
- Stream Order
  - Strahler Stream Order
- Lake Grid (optional)
- Basin Files
- Roughness and Retention factors

Stream files



Channel delineation based on drainage threshold

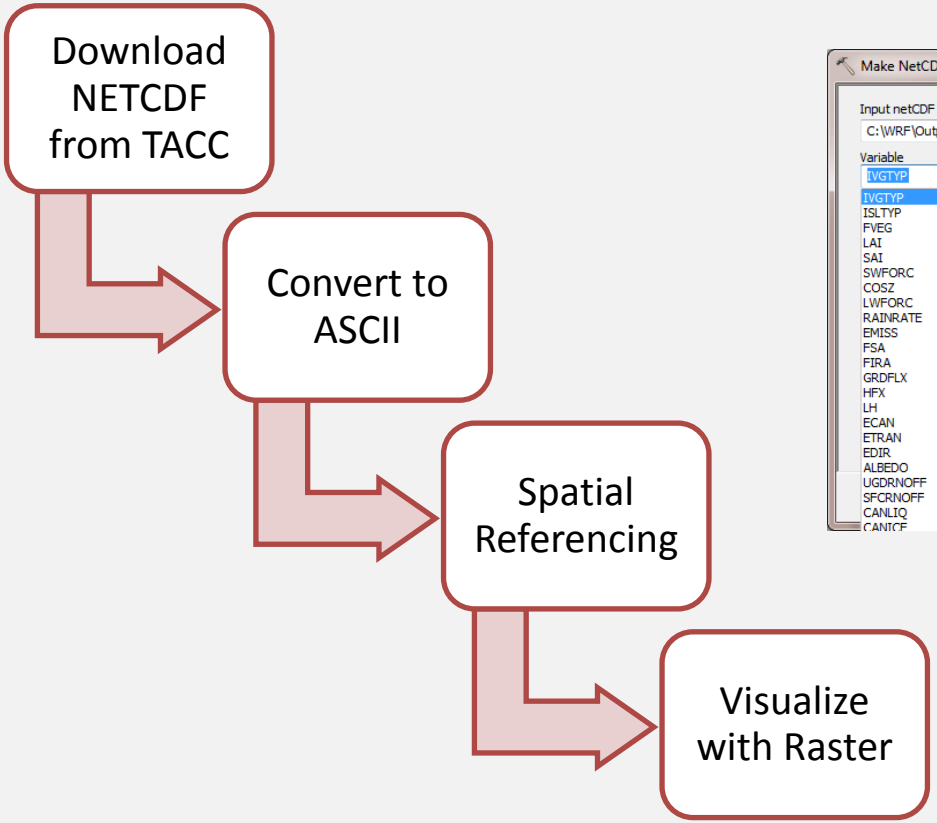
Parameterized to 2000 pixels (30 m) to closely match NHD PLUS

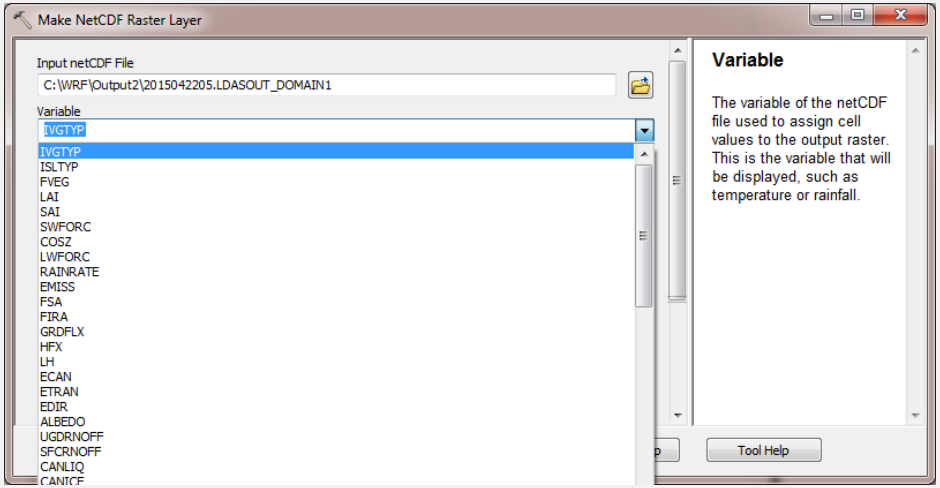


Running and parameterizing WRF-Hydro

- 22-hr run
- Idealized precipitation
- Channel routing on
- Groundwater routing turned off
- Lonestar
- CPU time: 10 seconds / Wall time: 11 min
- 12 cores – 24 processors

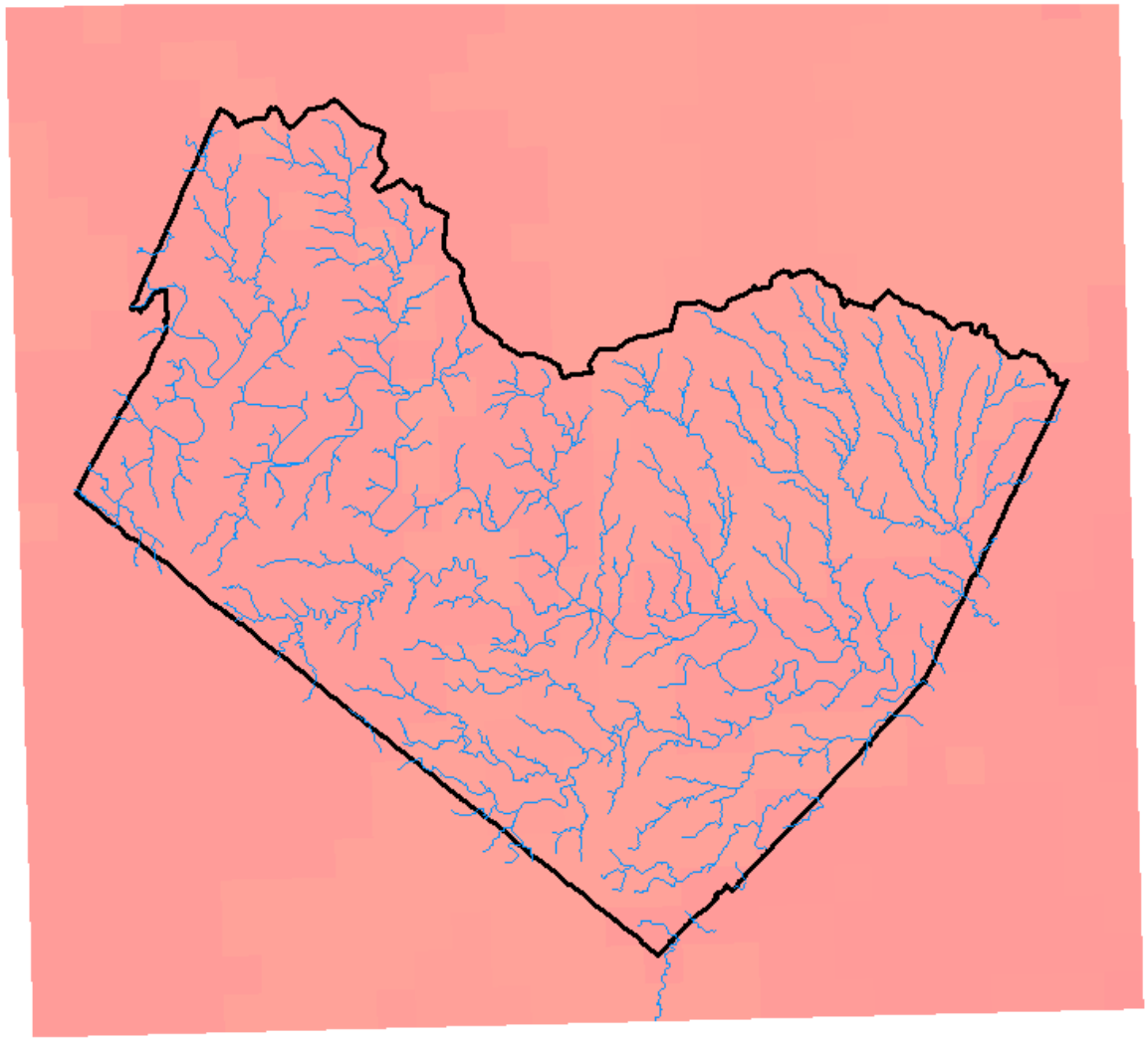
Visualization workflow





Output metadata is unclear…
Discovered ncinfo (matlab)!

Cumulative Runoff



Hour 1

N

SCALE: 1:500,000

0 4.5 9 18 27 Miles

0 5 10 20 30 Kilometers

Legend

WRF Hydro Channels

Travis County Boundary

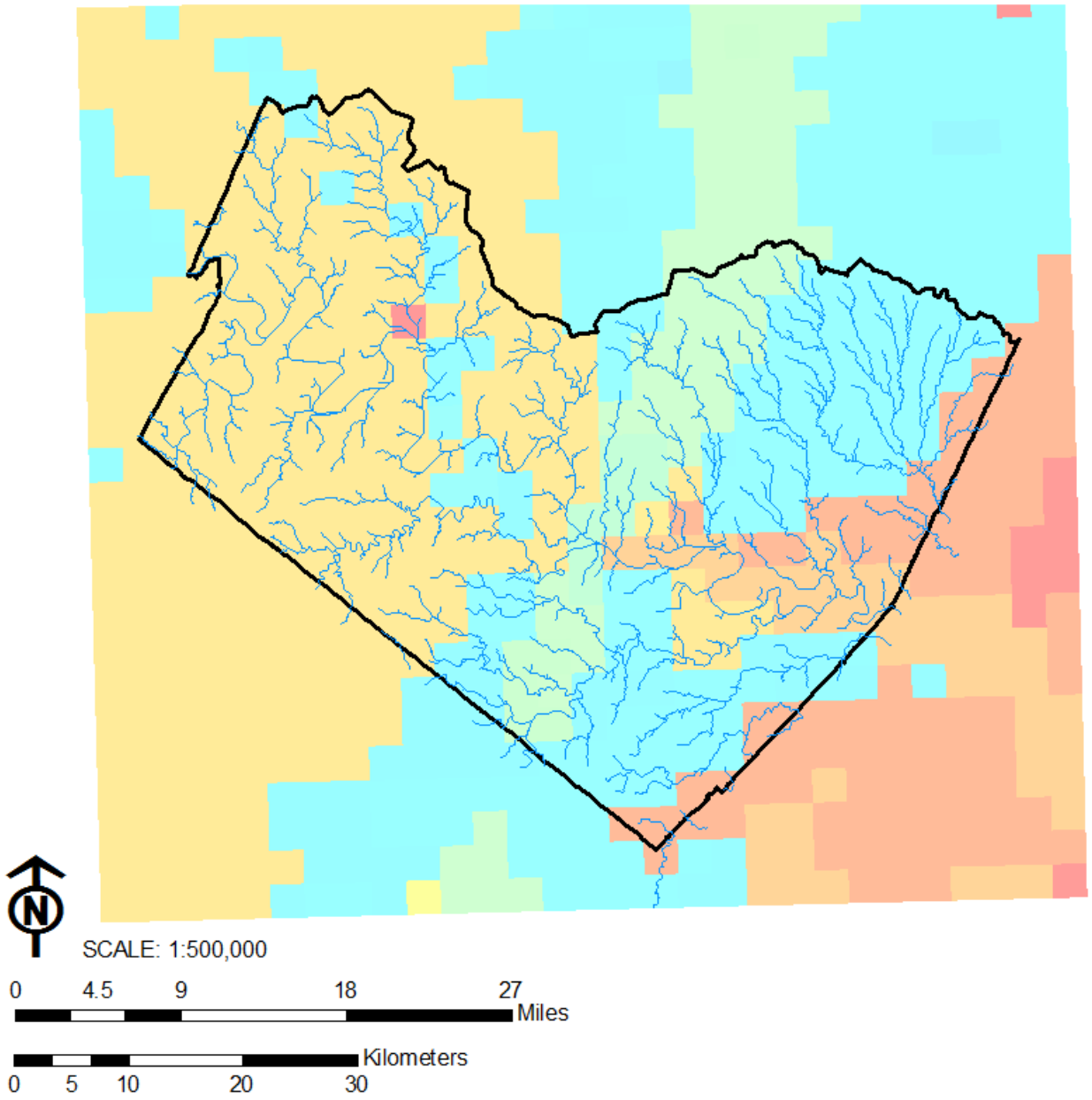
Acc. Surf. Runoff Hr 1

mm

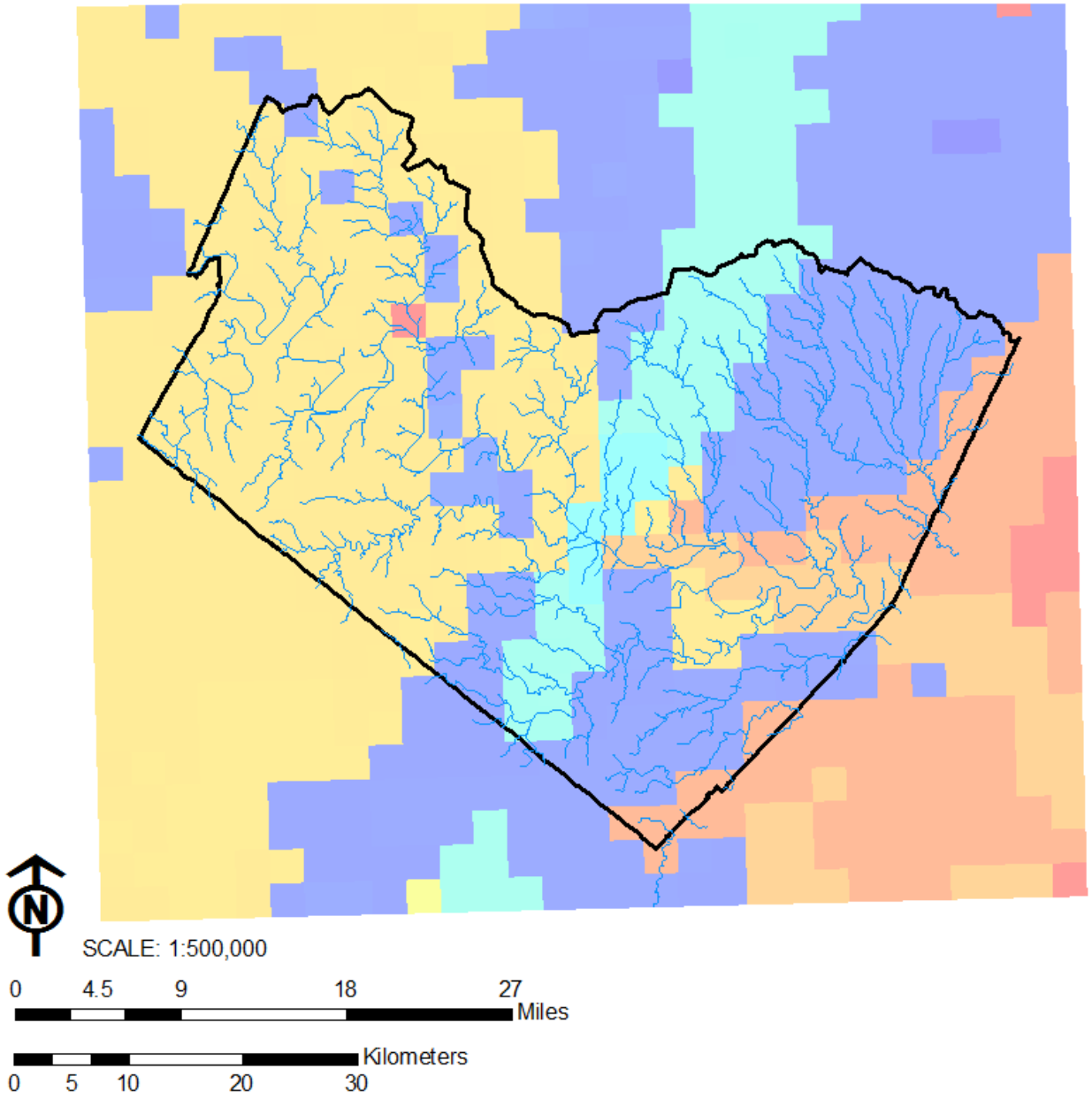
High : 84.5269

Low : 0

Cumulative Runoff

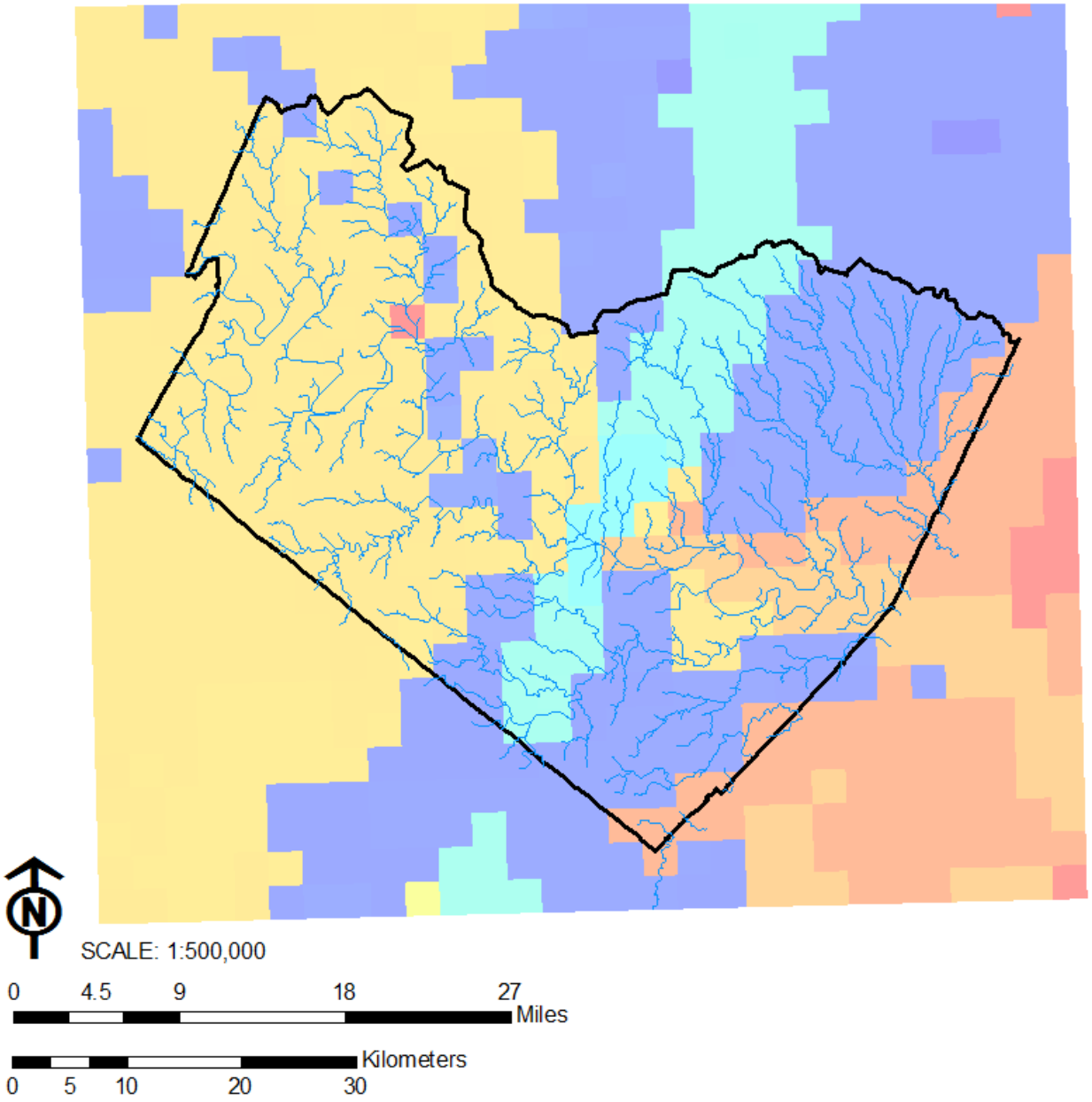


Cumulative Runoff

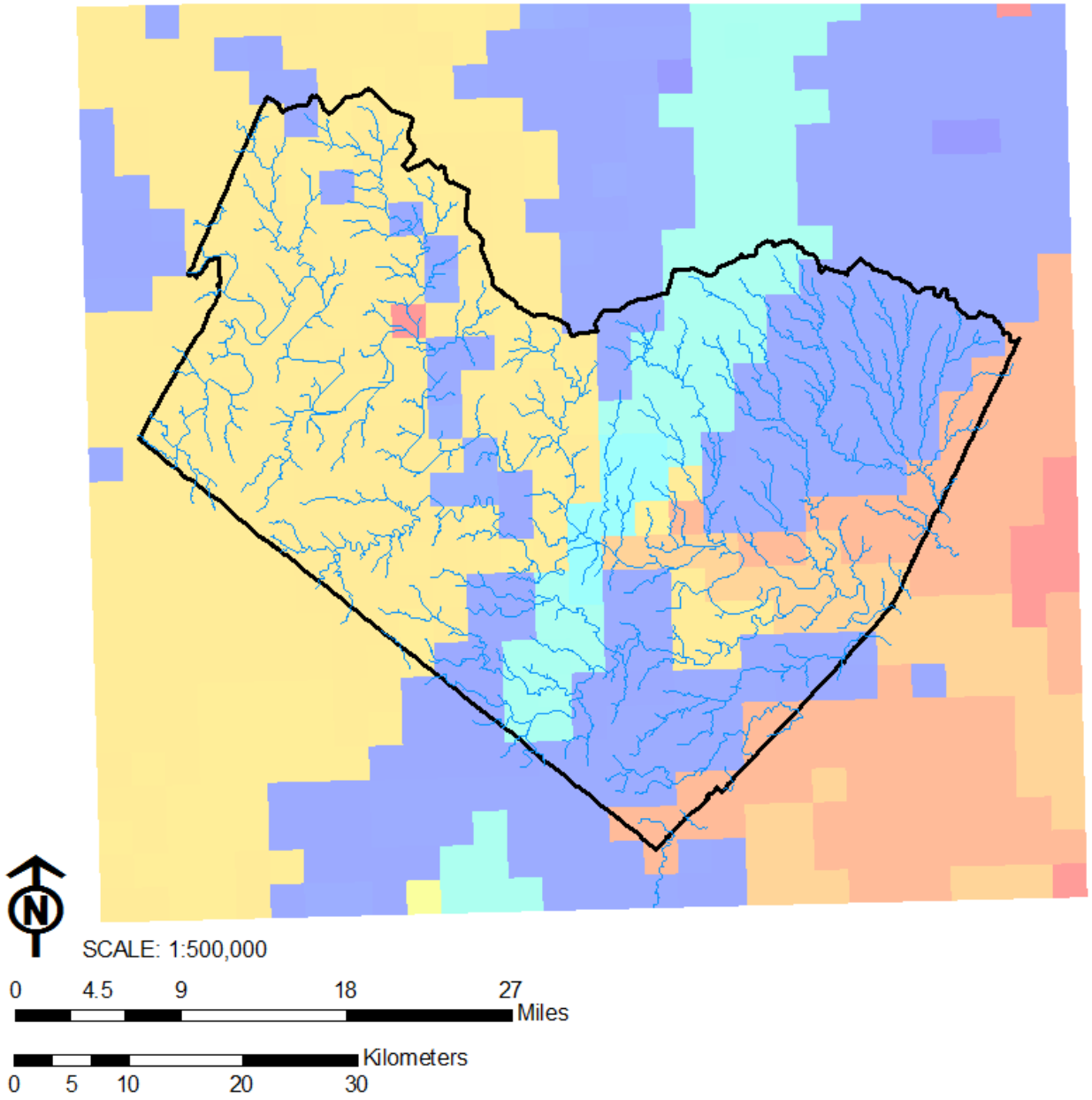


Cumulative Runoff

Hour 4



Cumulative Runoff



Conclusion and goals

- WRF-Hydro is complex
- Uniform rainfall does not produce uniform runoff
- Compare with channel routing
- Quantify runoff vs. infiltration