

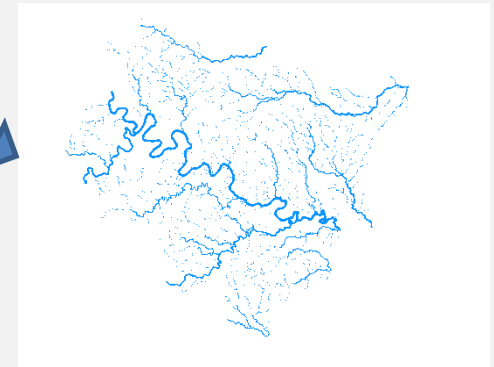
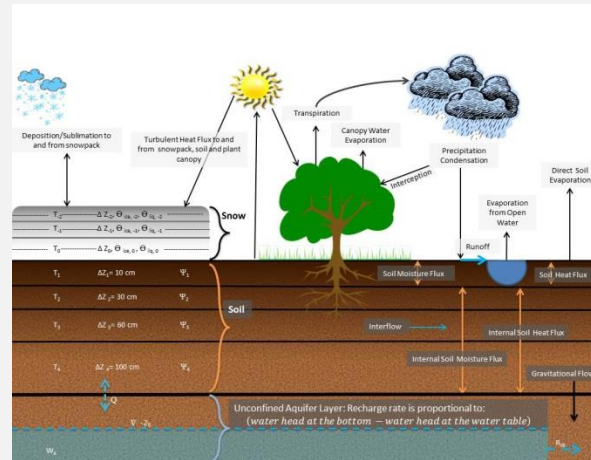
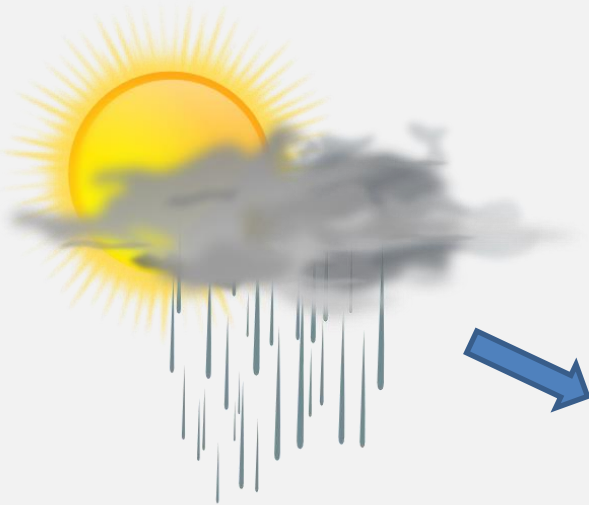
# Exploring the WRF-Hydro Flow Routing Option

Matt Hiatt  
CE 397 Class Project



# WRF Hydro is a model architecture

- Atmosphere, land surface, and hydrology

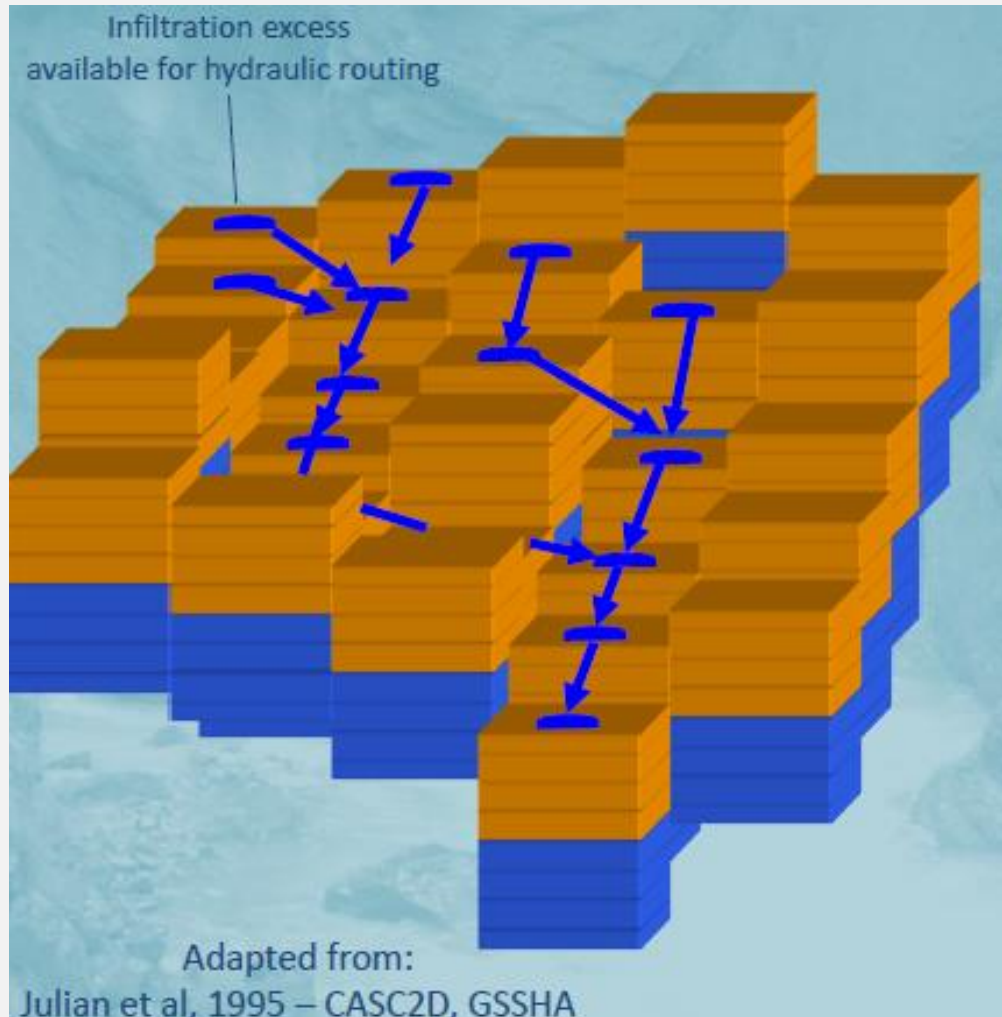


# WRF Hydro Within NFIE

- 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)

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

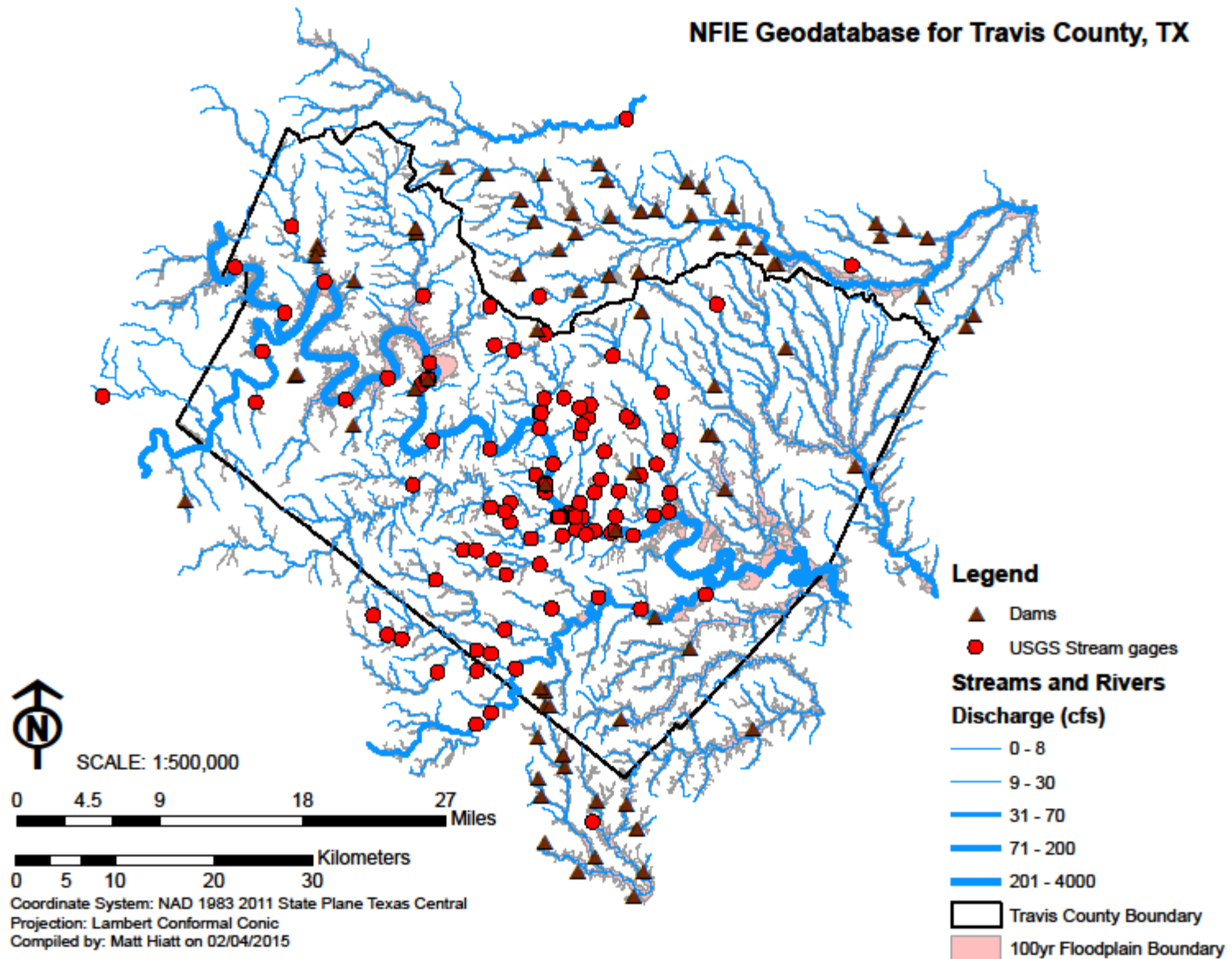
- Muskingham Cunge Method (Reach-averaged)

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

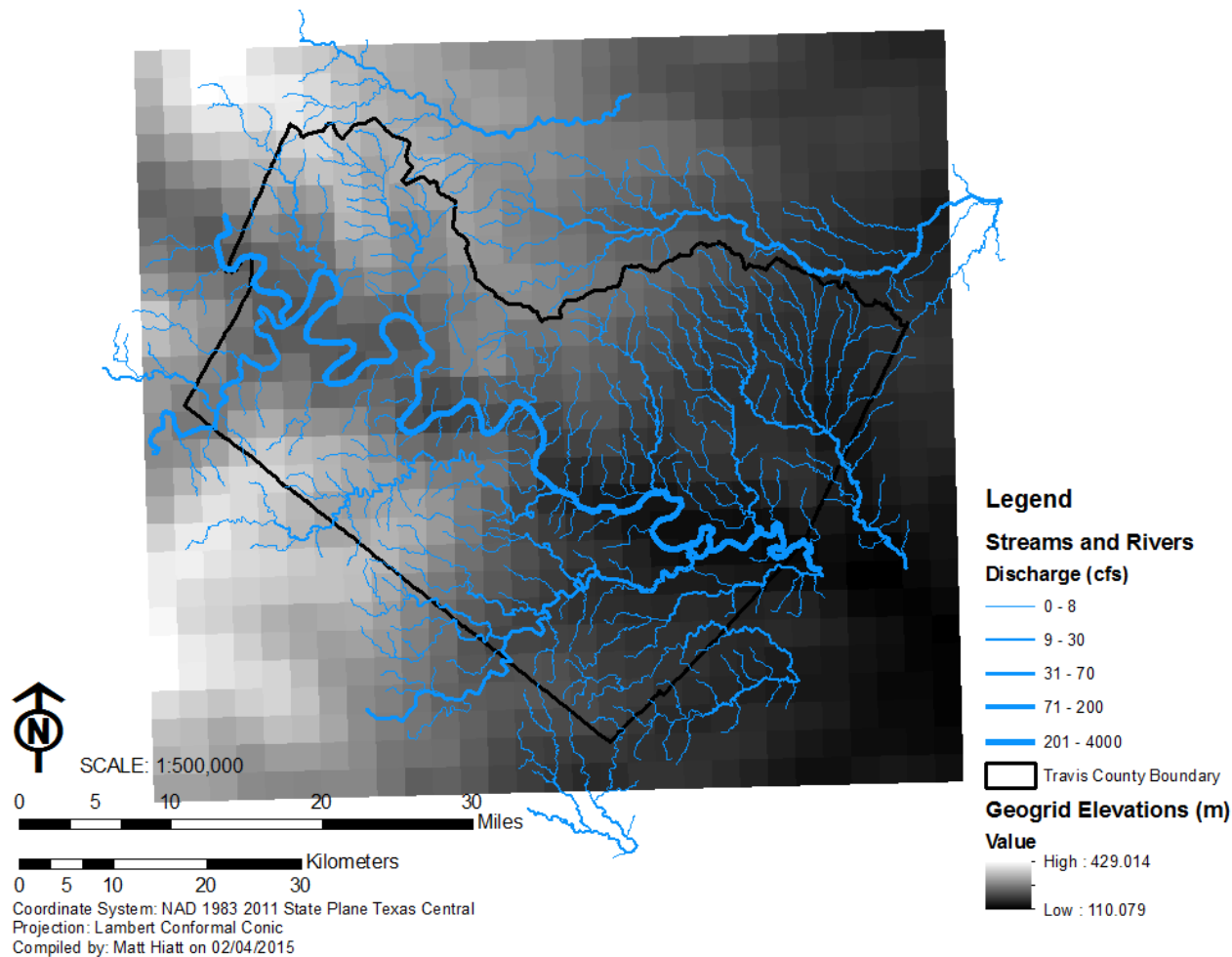
- Diffusive Wave (Gridded)

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

# NFIE Geodatabase for Travis County, TX



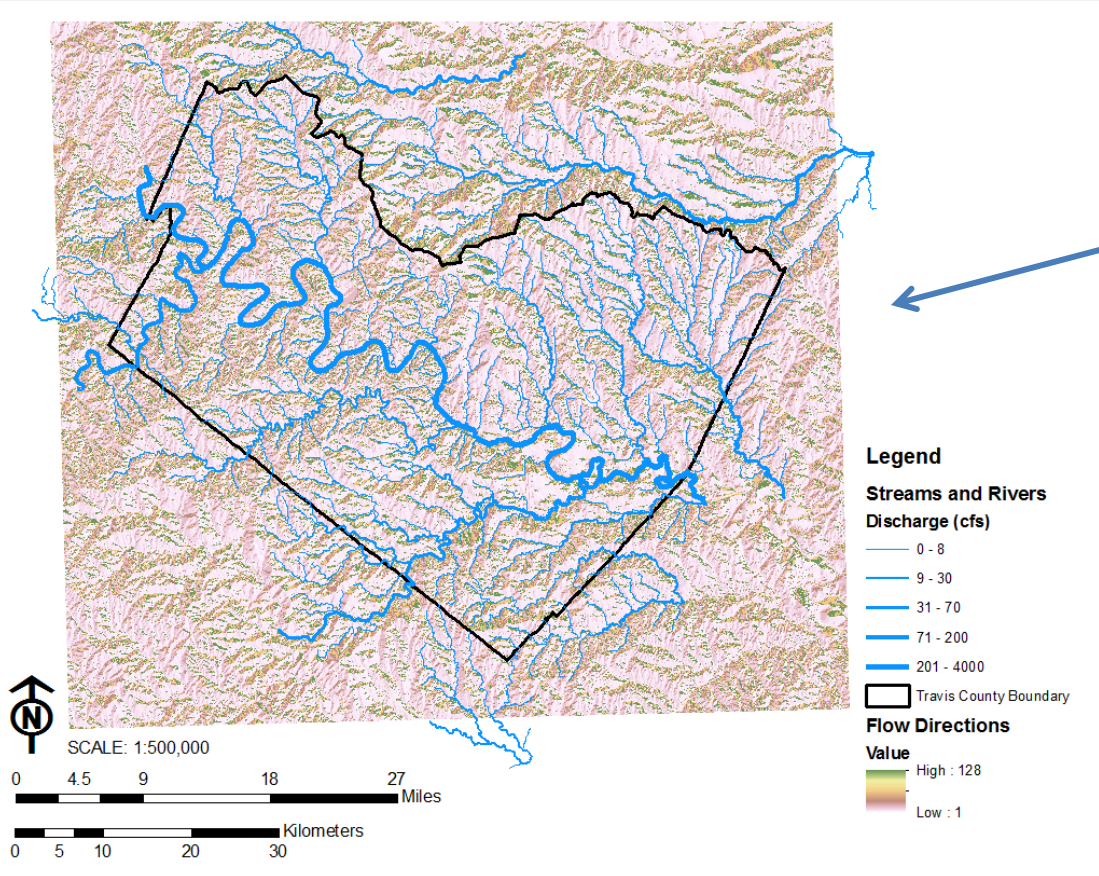
# Development of channel routing input



3 km GEOGRID surface

Used in conjunction with 30 m NED to create "terrain" files

# Terrain Files



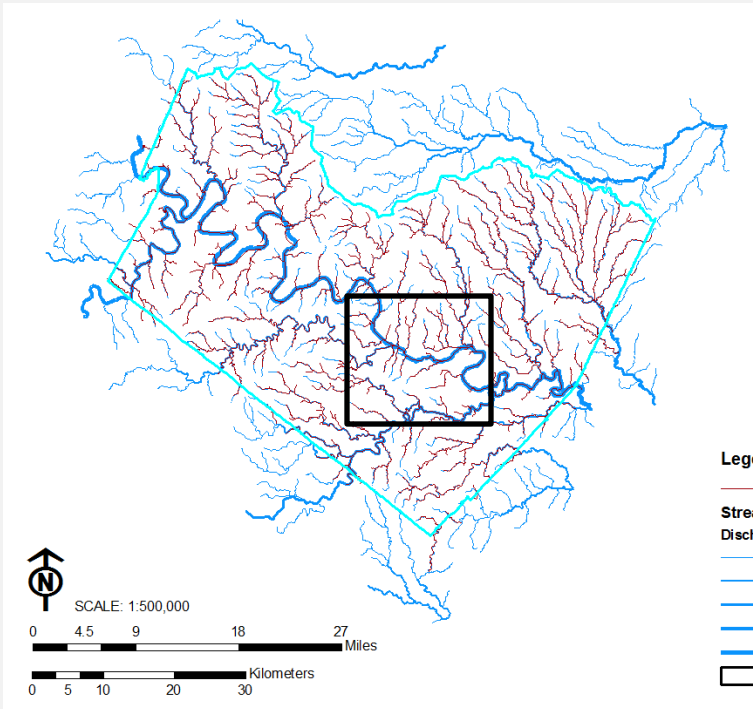
- Topography
- Flow Directions
- Channel Grid (next slide)
- Stream Order
  - Strahler Stream Order
- Lake Grid (optional)
- Basin Files
- Roughness and Retention factors





# Stream files

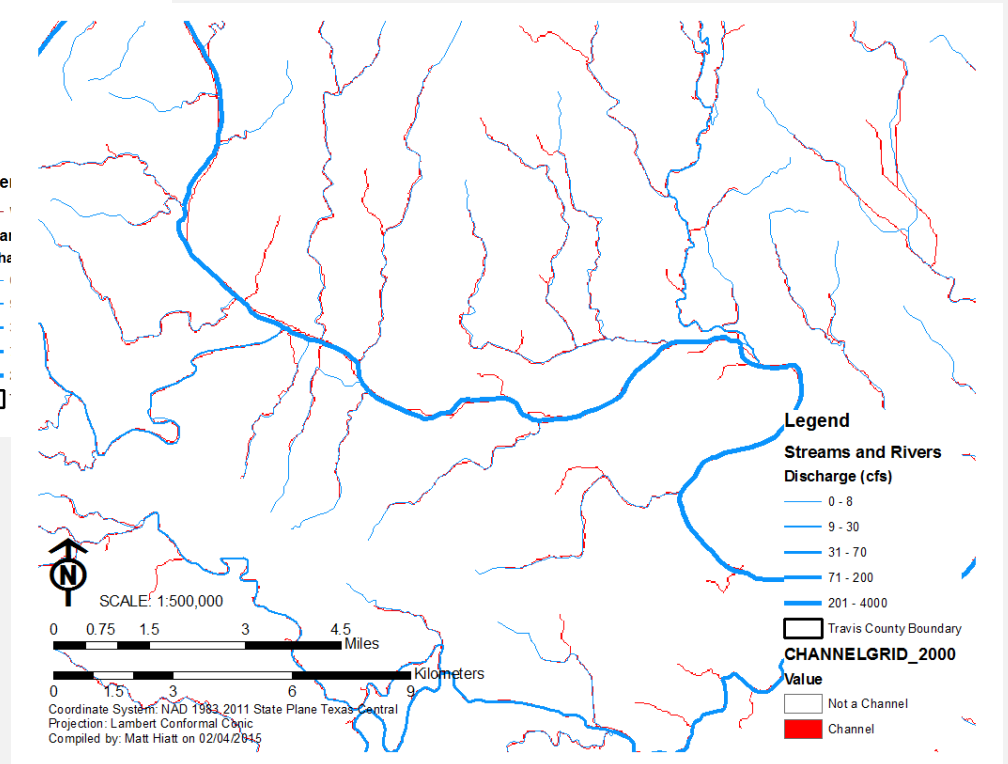
Channel delineation based on drainage threshold



Legend

Stream Discharge

- Red line
- Light blue line
- Medium blue line
- Dark blue line
- Black box



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

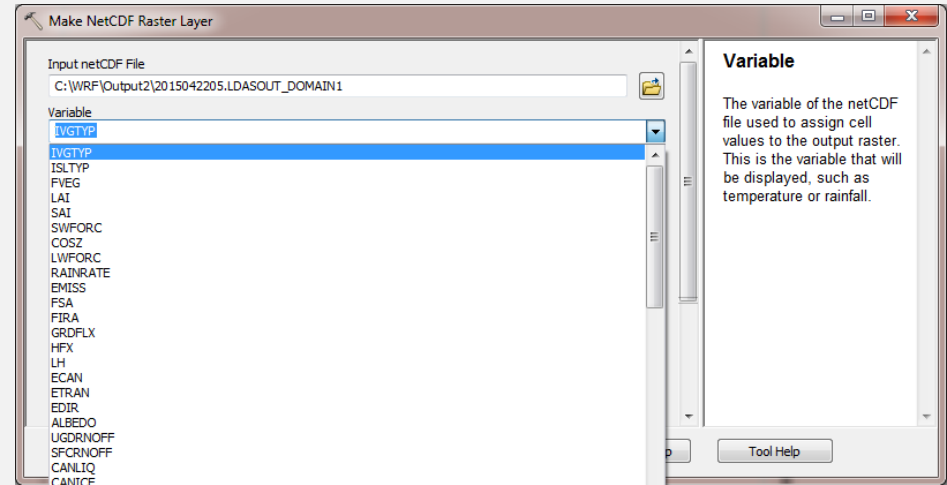
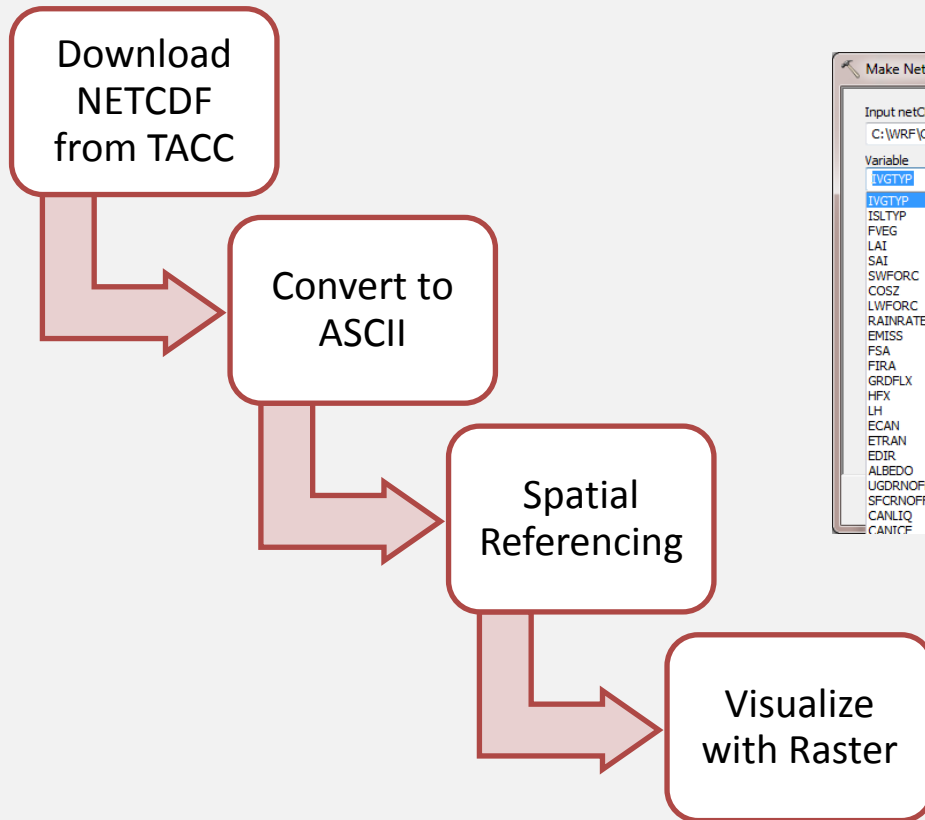


# Running and parameterizing WRF-Hydro



- 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

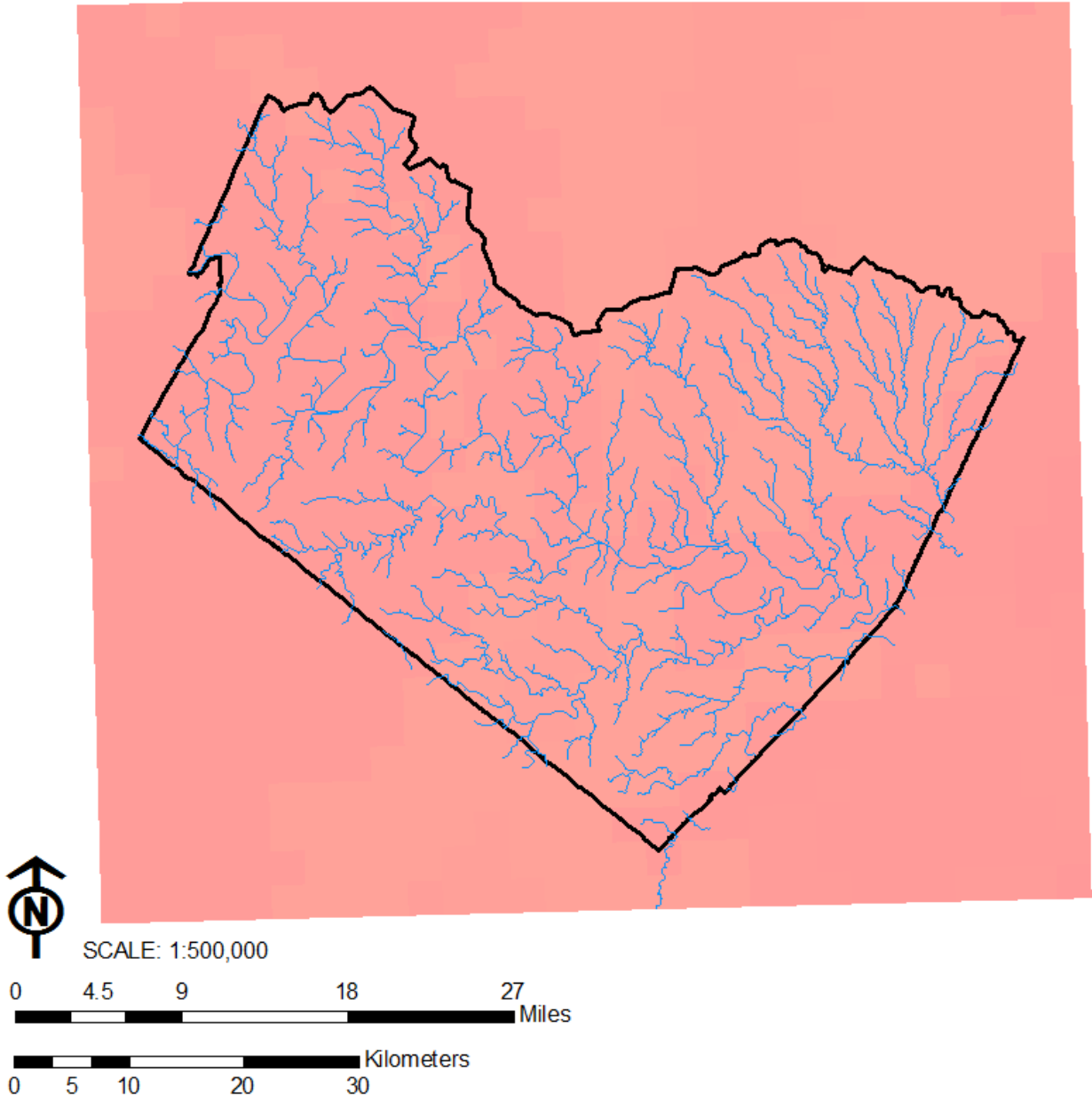
# Visualization workflow



Output metadata is unclear...  
Discovered ncinfo (matlab)!

# Cumulative Runoff

Hour 1

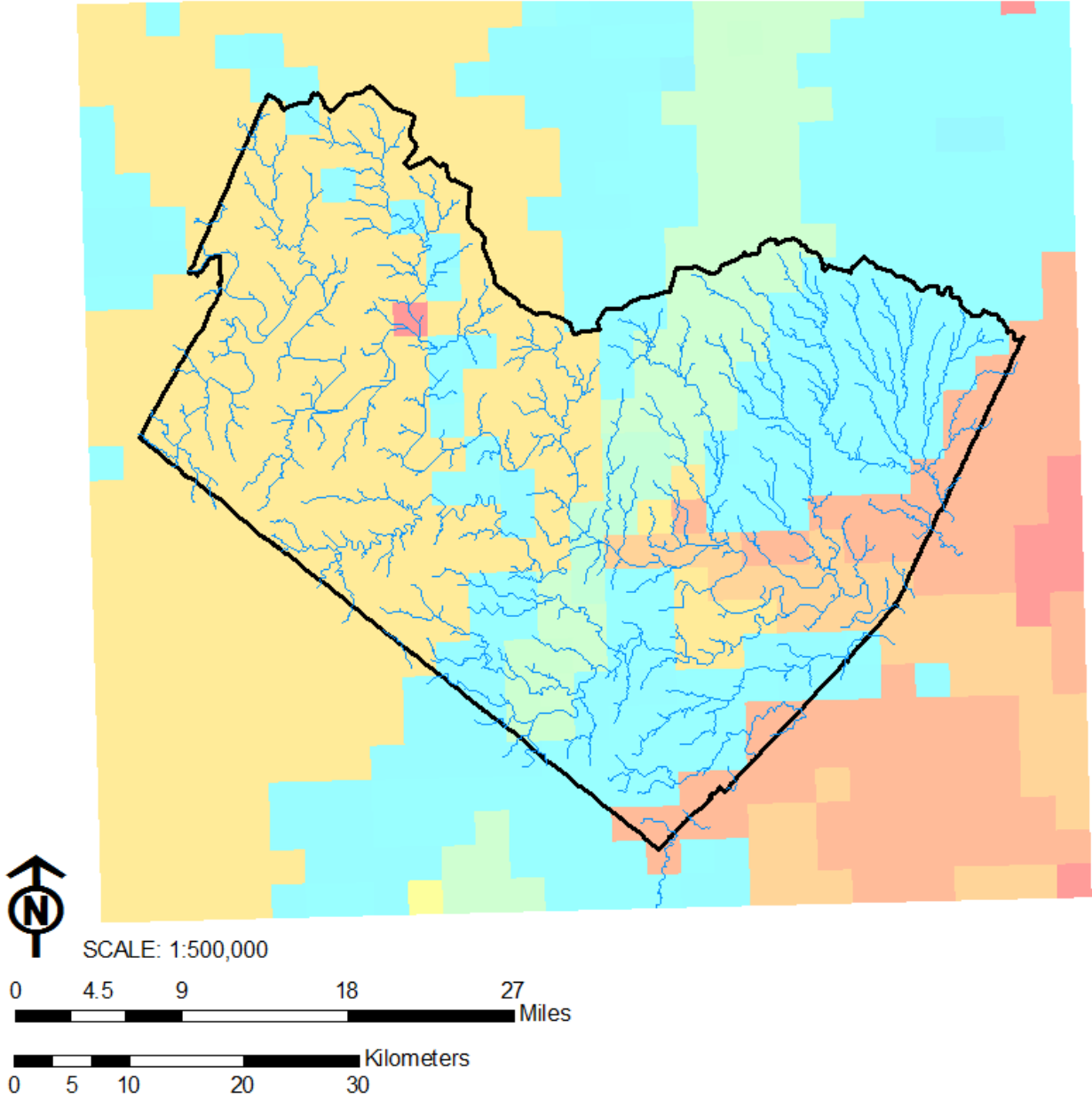


### Legend

- WRF Hydro Channels
- ▭ Travis County Boundary
- Acc. Surf. Runoff Hr 1**  
**mm**  
High : 84.5269  
Low : 0

# Cumulative Runoff

Hour 2

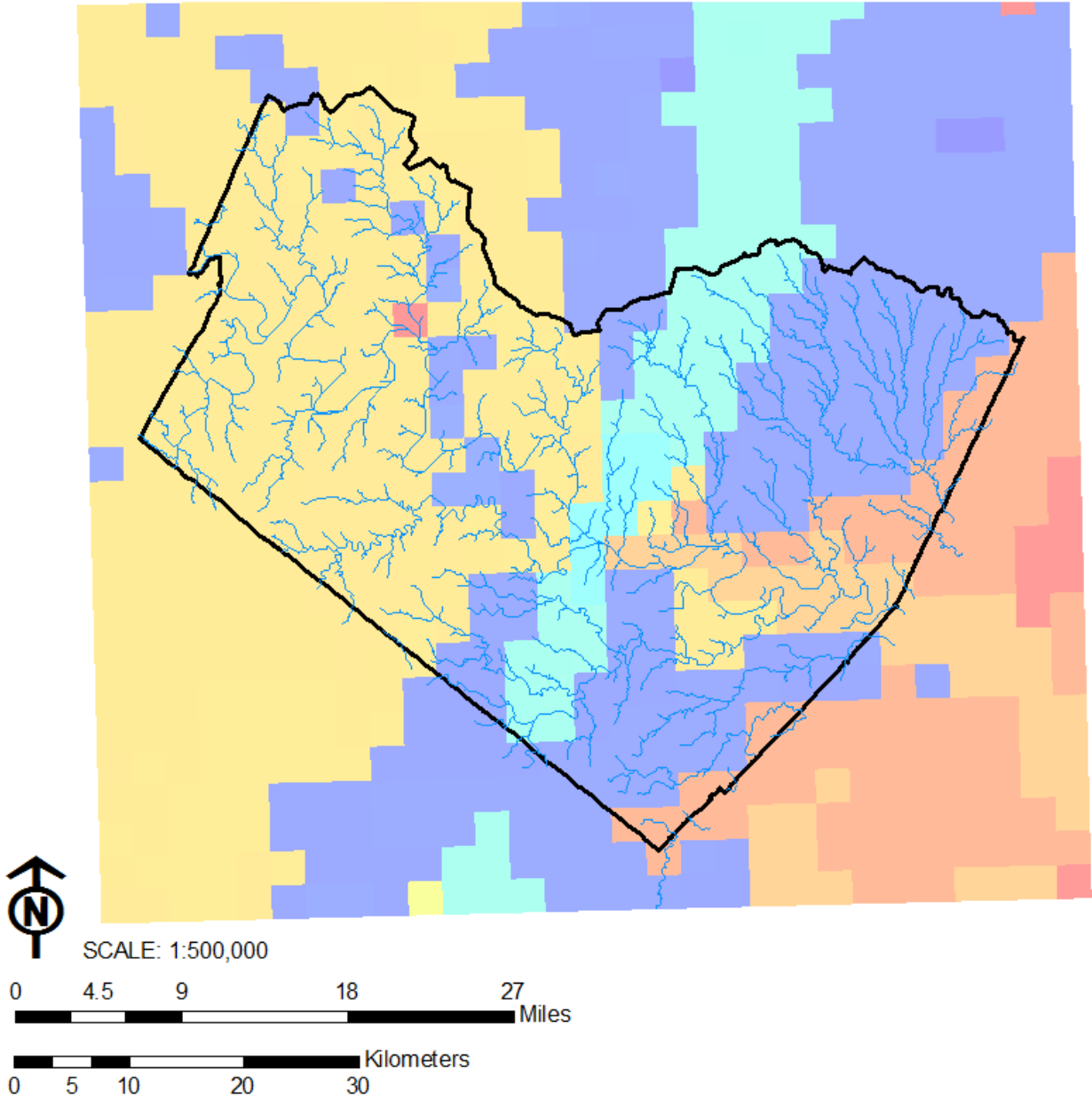


### Legend

- WRF Hydro Channels
- ▭ Travis County Boundary
- Acc. Surf. Runoff Hr 2**  
**mm**
  - High : 84.5269
  - Low : 0

# Cumulative Runoff

Hour 3

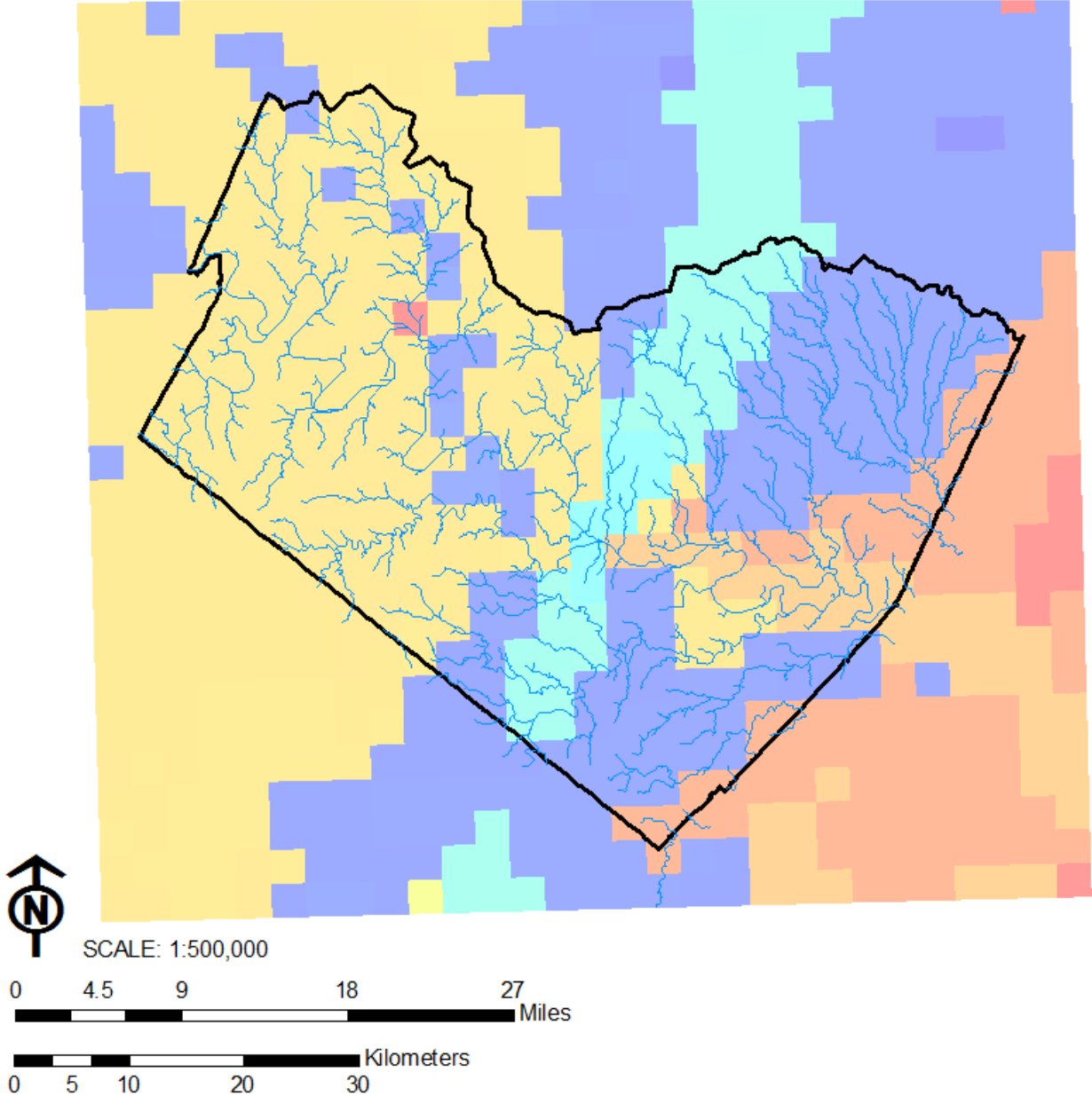


### Legend

- WRF Hydro Channels
- ▭ Travis County Boundary
- Acc. Surf. Runoff Hr 3**  
**mm**
  - High : 84.3875
  - Low : 0

# Cumulative Runoff

Hour 4

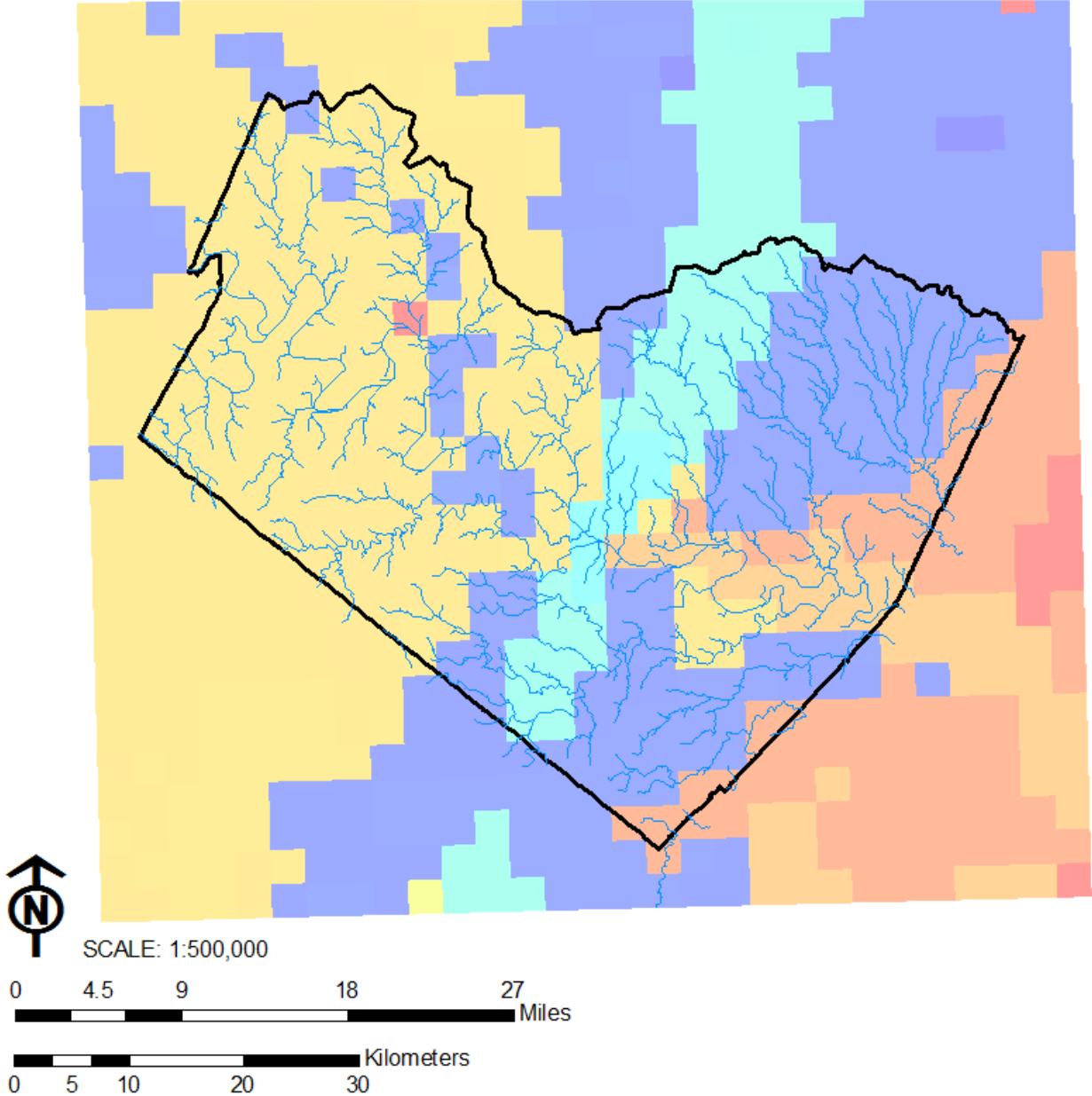


### Legend

- WRF Hydro Channels
- ▭ Travis County Boundary
- Acc. Surf. Runoff Hr 4**  
**mm**
  - High : 84.5269
  - Low : 0

# Cumulative Runoff

Hour 5



### Legend

- WRF Hydro Channels
- ▭ Travis County Boundary
- Acc. Surf. Runoff Hr 5**  
**mm**
  - High : 84.5269
  - Low : 0



# Conclusion and goals

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

A screenshot of an SSH Secure Shell window titled 'lonestar.tacc.utexas.edu - default - SSH Secure Shell'. The window displays the output of a command, which appears to be a series of 'd) \$jxrt' commands. The output shows a sequence of numbers and domain identifiers, such as 'rt\_domain(did)\$g\_IXRT, rt\_domain(did)\$g\_JXRT, rt\_domain(did)\$ixrt, rt\_domain(did)\$jxrt' followed by a list of numbers: '2900 2700 702 901'. The window also shows a menu bar (File, Edit, View, Window, Help) and a toolbar with various icons. At the bottom, it indicates 'Connected to lonestar.tacc.utexas.edu' and 'SSH2 - aes128-cbc - hmac-md5 - nr 113x57'. A small penguin icon is visible in the bottom right corner of the window.