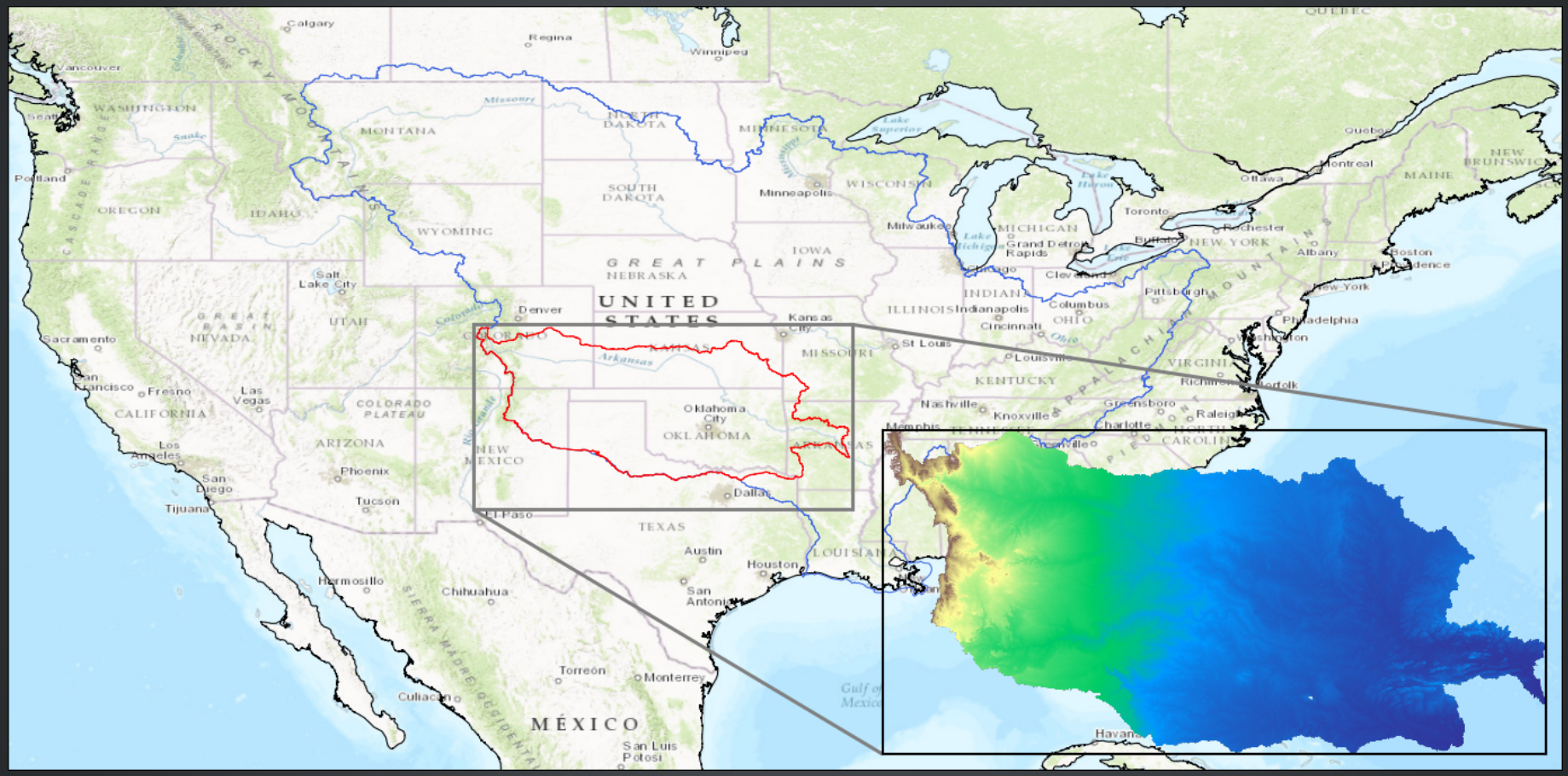
SWOT ST MODEL INTER-COMPARISON LISFLOOD-FP: Preliminary Results

Kostas Andreadis

STUDY AREA



Arkansas River basin

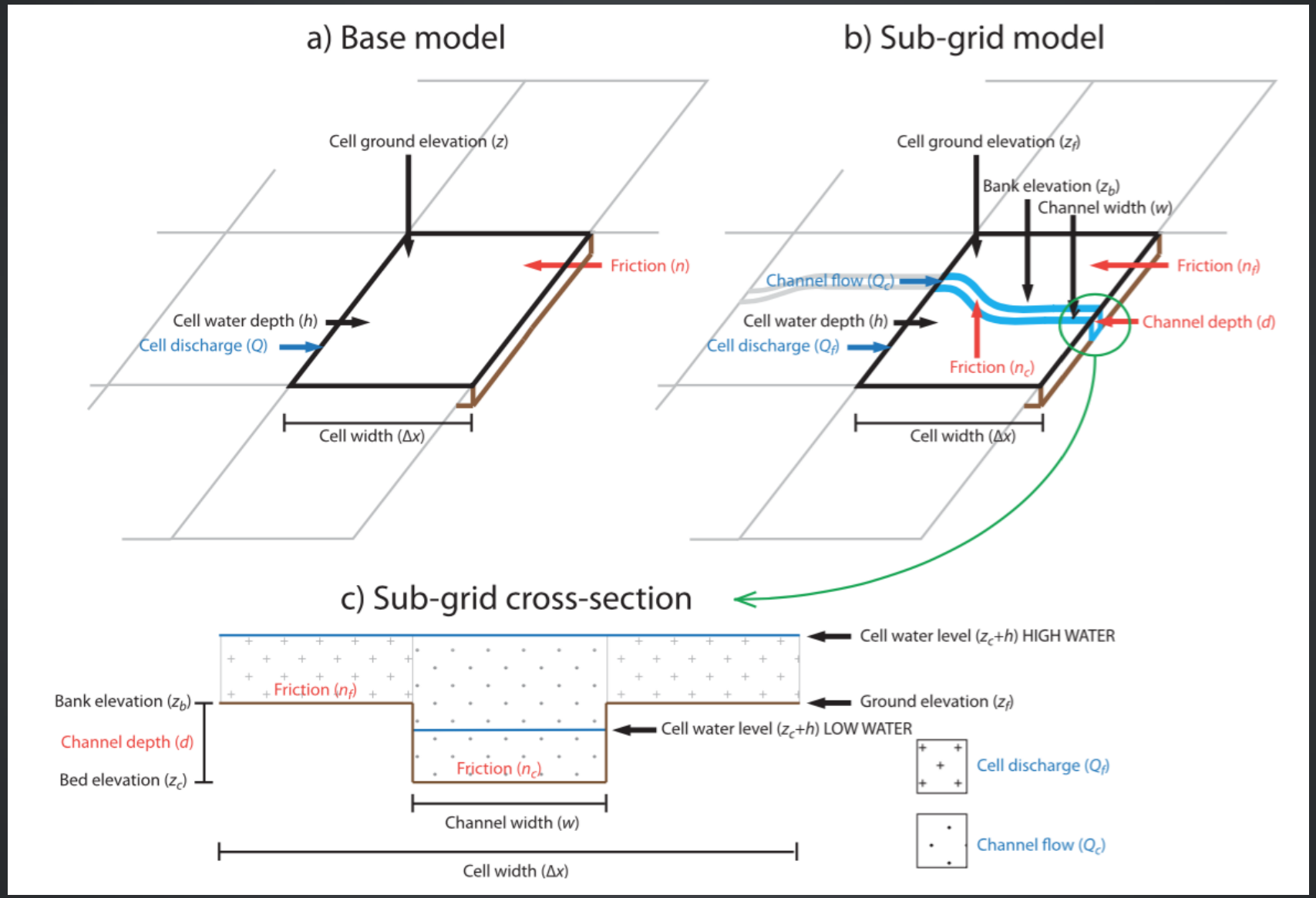
MODEL DESCRIPTION

- LISFLOOD-FP, a raster-based hydrodynamic model
- Adaptive time stepping to improve stability
- Implemented over numerous rivers at various spatial resolutions

$$\frac{\Delta h}{\Delta t} = \frac{\Delta Q}{\Delta x \Delta y}$$

$$\underbrace{\frac{\partial Q}{\partial t}}_{acceleration} + \underbrace{\frac{\partial}{\partial x}\frac{Q^2}{A}}_{advection} + \underbrace{\frac{gA\partial(h+z)}{\partial x}}_{water\ slope} + \underbrace{\frac{gn^2Q^2}{R^{4/3}A}}_{friction\ slope} = 0$$

SUB-GRID CHANNEL FORMULATION



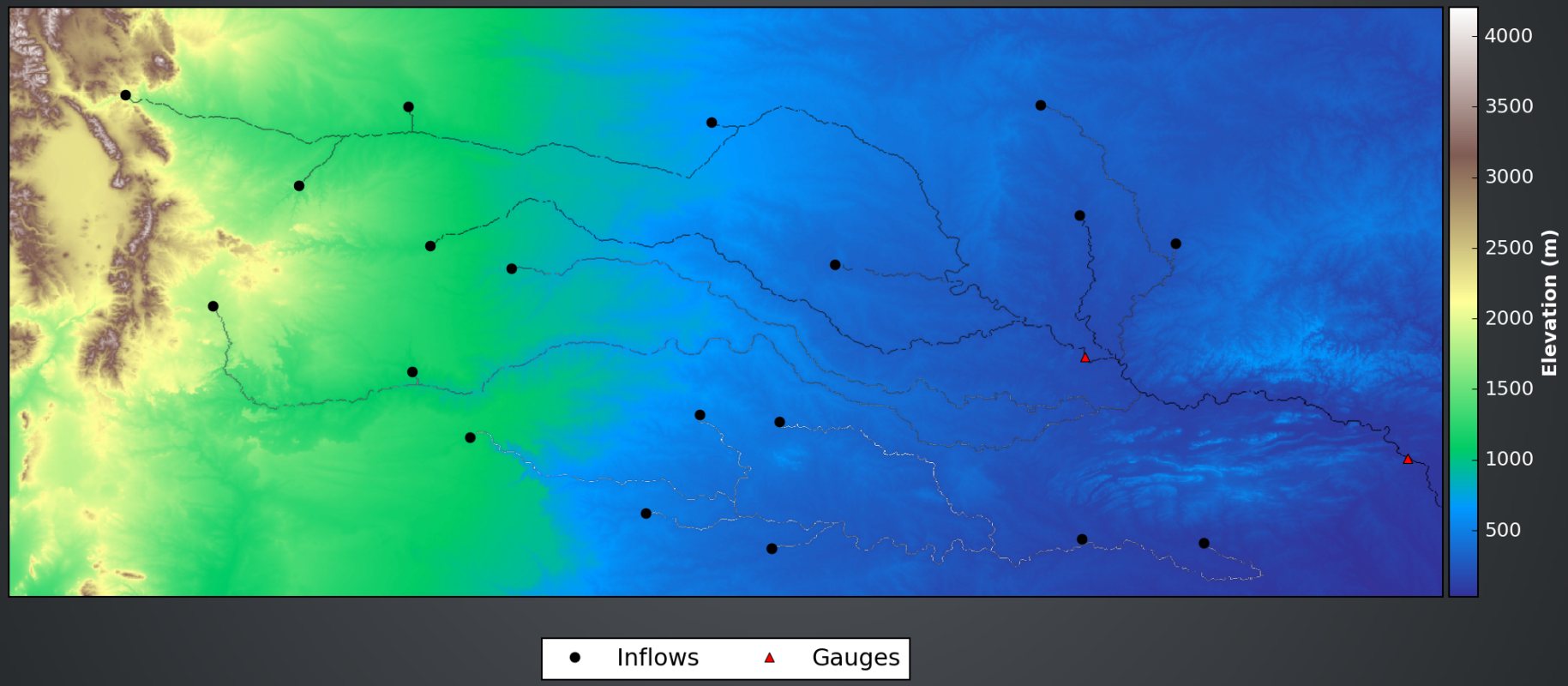
MODEL CONFIGURATION

- Inputs required
  - Floodplain topography
  - River channel widths and bank heights
  - Model parameters
  - Boundary conditions
- Spatial resolution of 1 km
- Model initialized at 80% of bankfull depth
- **No calibration** performed, default parameters used
  - Rectangular channel
  - Roughness coefficient = 0.035

PRE-PROCESSING STEPS

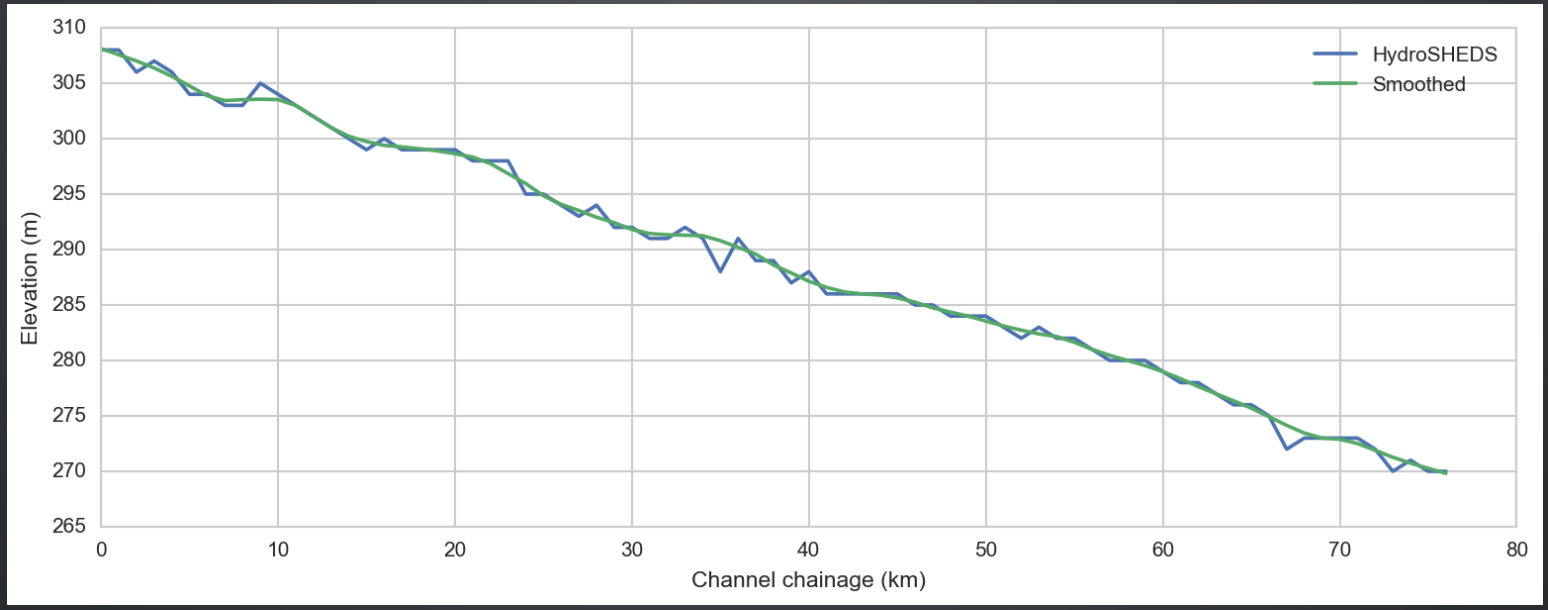
1. Resample DEM to 1-km resolution
2. Generate the river network and chainage
3. Estimate and smooth river bank heights
4. Identify upstream and lateral boundary locations
5. Generate boundary inflows
6. Derive river channel cross-sections

RIVER NETWORK AND DEM

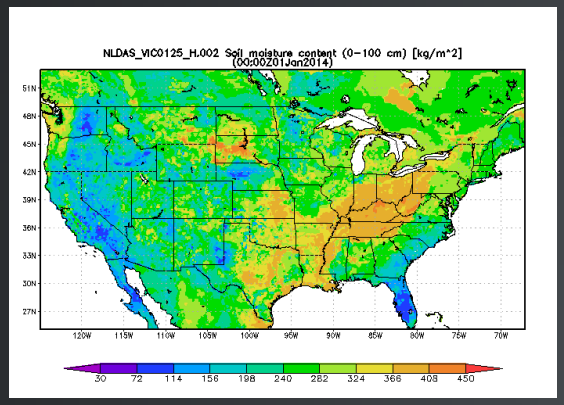


RIVER BANK HEIGHTS, WIDTHS AND DEPTHS

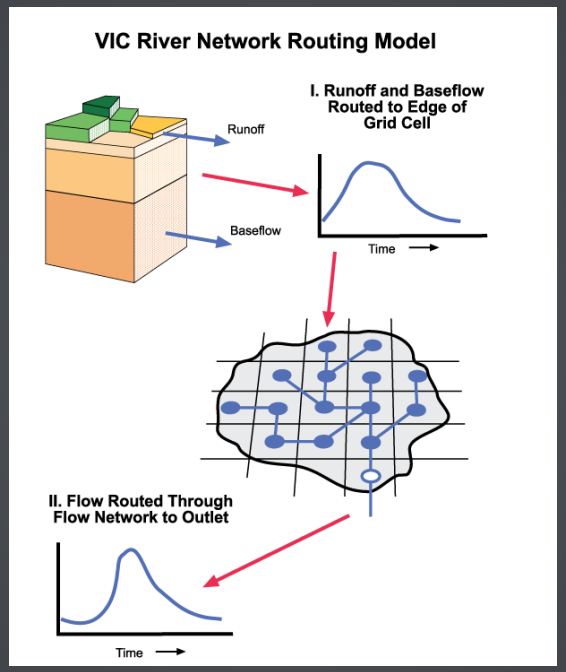
- Channel widths and depths are prescribed from HydroSHEDS database
- Bank heights needed for sub-grid model
- Assumption that HydroSHEDS DEM is bankfull elevation
- Locally weighted smoothing applied to avoid numerical instabilities



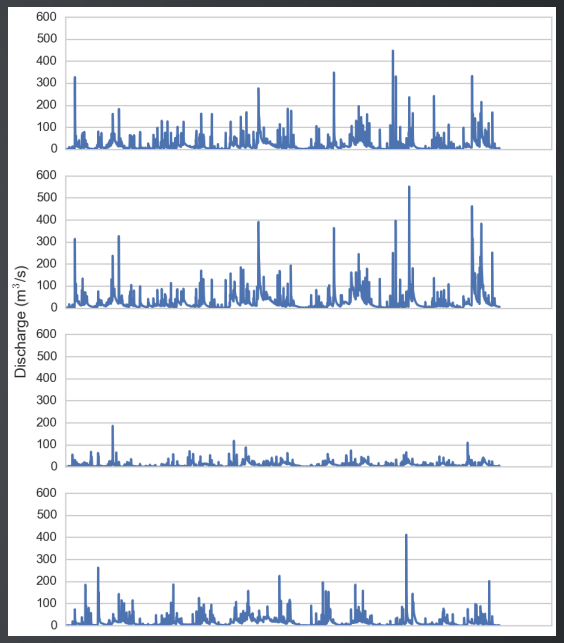
BOUNDARY INFLOWS



NLDAS-2 surface runoff & baseflow

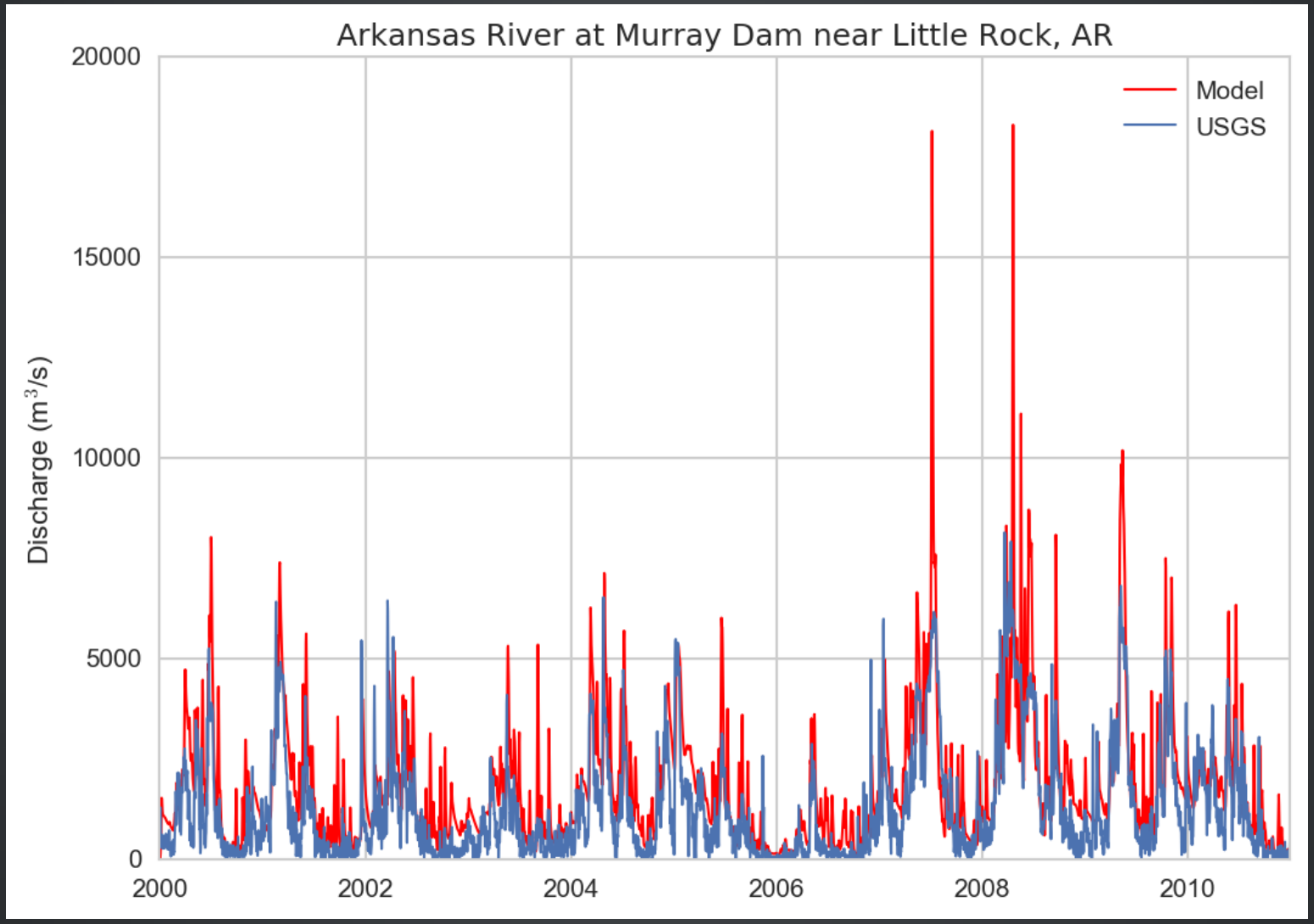


VIC routing model



Boundary inflows

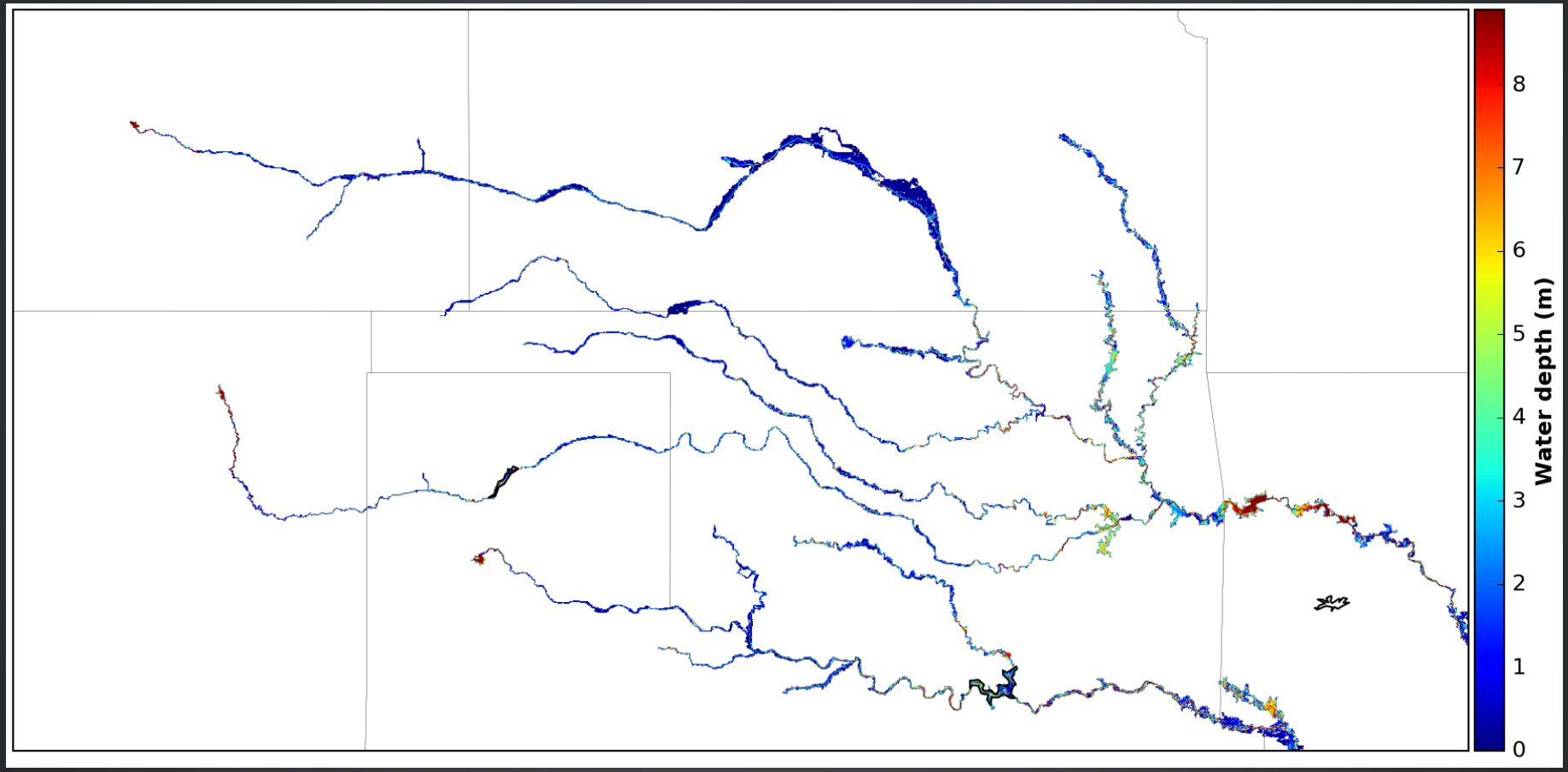
SIMPLE UNIT HYDROGRAPH ROUTING



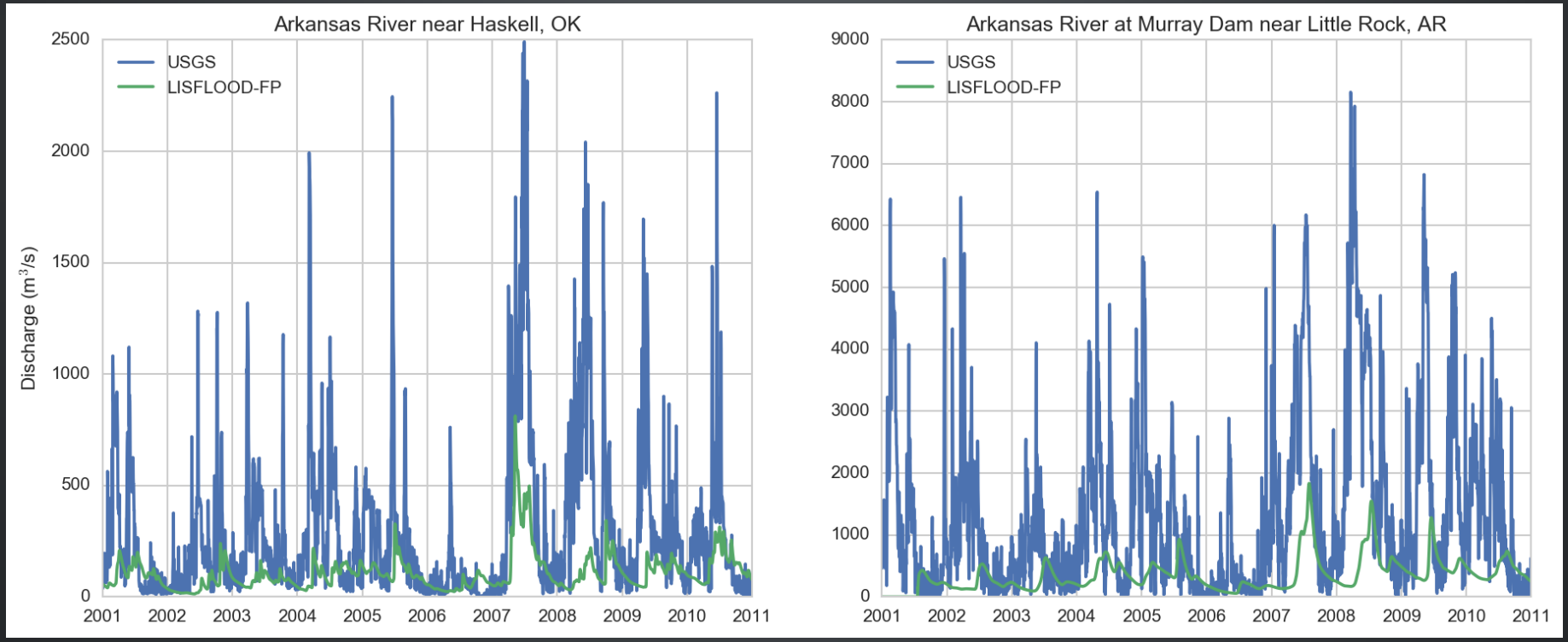
Simulation period: 1/1/2000 - 12/31/2010

```
**************************
LISFLOOD-FP version 6.1.2 (double)
**************************
Starting time steps: acceleration mode

SGC mode
Using sub-grid channels and acceleration formulation

OMP thread count: 16

  Total computation time: 1847.93 mins
```

MAXIMUM WATER DEPTH



COMPARISON WITH STREAMFLOW MEASUREMENTS



NEXT STEPS

- Model pre-processing has been automated
  - See blog post for details
- Extend simulation to entire Mississipi basin
- Use 95th percentile widths and depths
- Evaluate different channel shapes (e.g. parabolic)
- Data assimilation algorithms for generating Level-4 products being developed