Model State Updating, VAR Project, Where do we want to go?

D.-J. Seo

Hydrology Laboratory
National Weather Service

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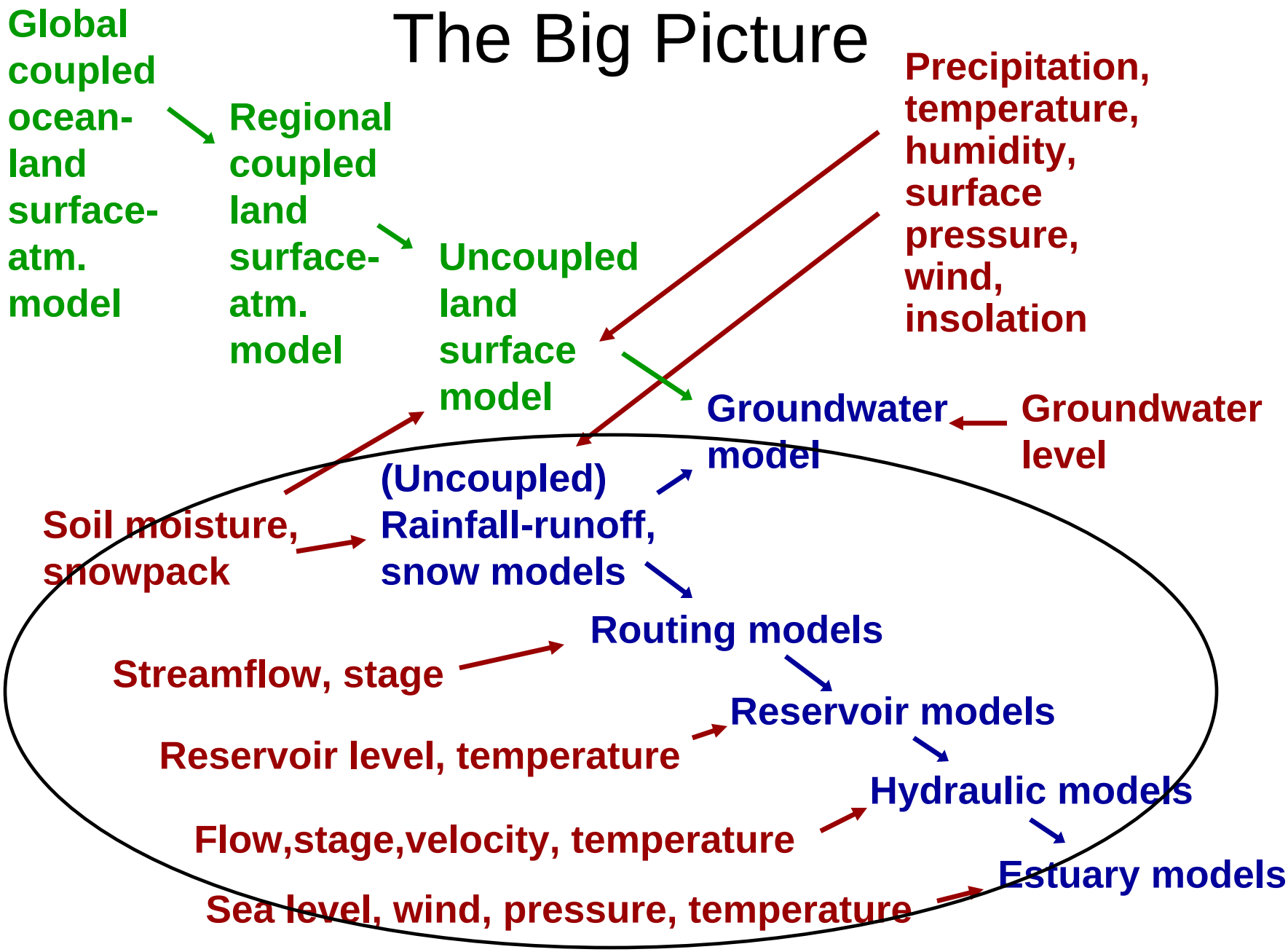
The Big Picture



Where do we want to go?

- Comprehensive soil and surface-water data assimilation for monitoring and prediction of terrestrial water in the ensemble paradigm
- Close the terrestrial water budget as closely as possible across scale
- Produce the “best” analysis of soil and surface water storage and flux/flow with uncertainty information
  - Reanalysis capability
- Provide more accurate initial and boundary conditions for (ensemble) forecast runs
- Help understand model errors, improve model physics and uncertainty modeling
- Help identify, assess and quantify observational/data needs (in-situ and remotely sensed)

The VAR Project

- A small but important piece in the comprehensive DA system
- Runoff production from headwater basins is subject to large input uncertainty (e.g. precipitation) and hydrologic uncertainty (model states, model errors)
- Test and improve a methodology (variational assimilation) in an operational environment
- Demonstrate operational worthiness

DA methodologies

- Variational assimilation (VAR)
- Ensemble Kalman filter/smoother (EKF/S, sequential assimilation)
- They are, under certain conditions, the same
- Depending on the nature of the problem, one may be better-suited than the other
- VAR is good for development (variational or sequential) and piecewise DA
- EKF/S is better-suited for end-to-end ensemble DA

Near-term plan

- Evaluate and improve VAR for lumped 1-hr SAC-UH (see Bob Corby's presentation)
- Generate and present verification statistics
- Develop a prototype state updating for HL-RMS (see illustration)
- Start R&D for assimilation of soil moisture (and other observations)
- Develop a comprehensive DA science plan (a product of the NWS Integrated Water Science Plan)

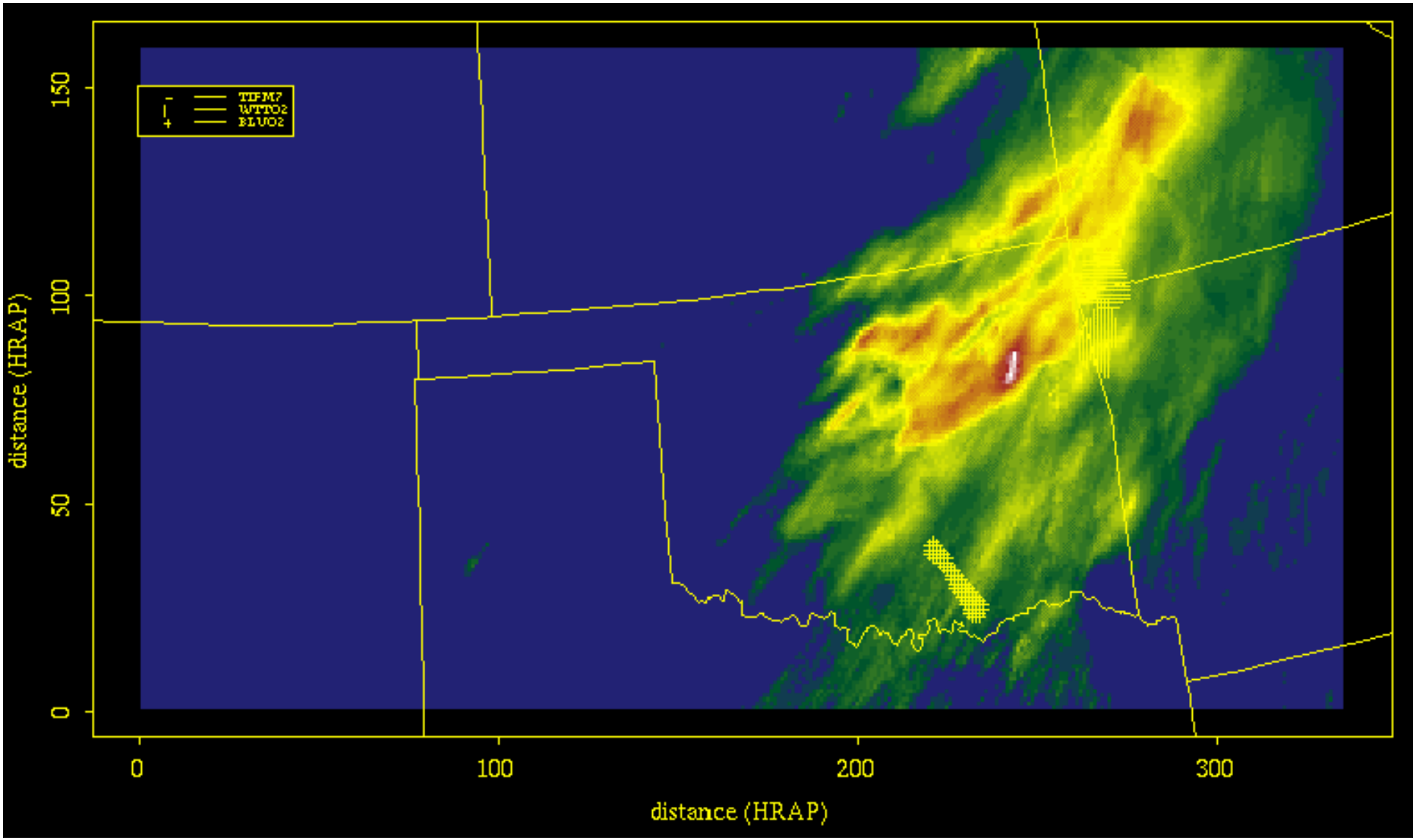
Mid-term plan for VAR

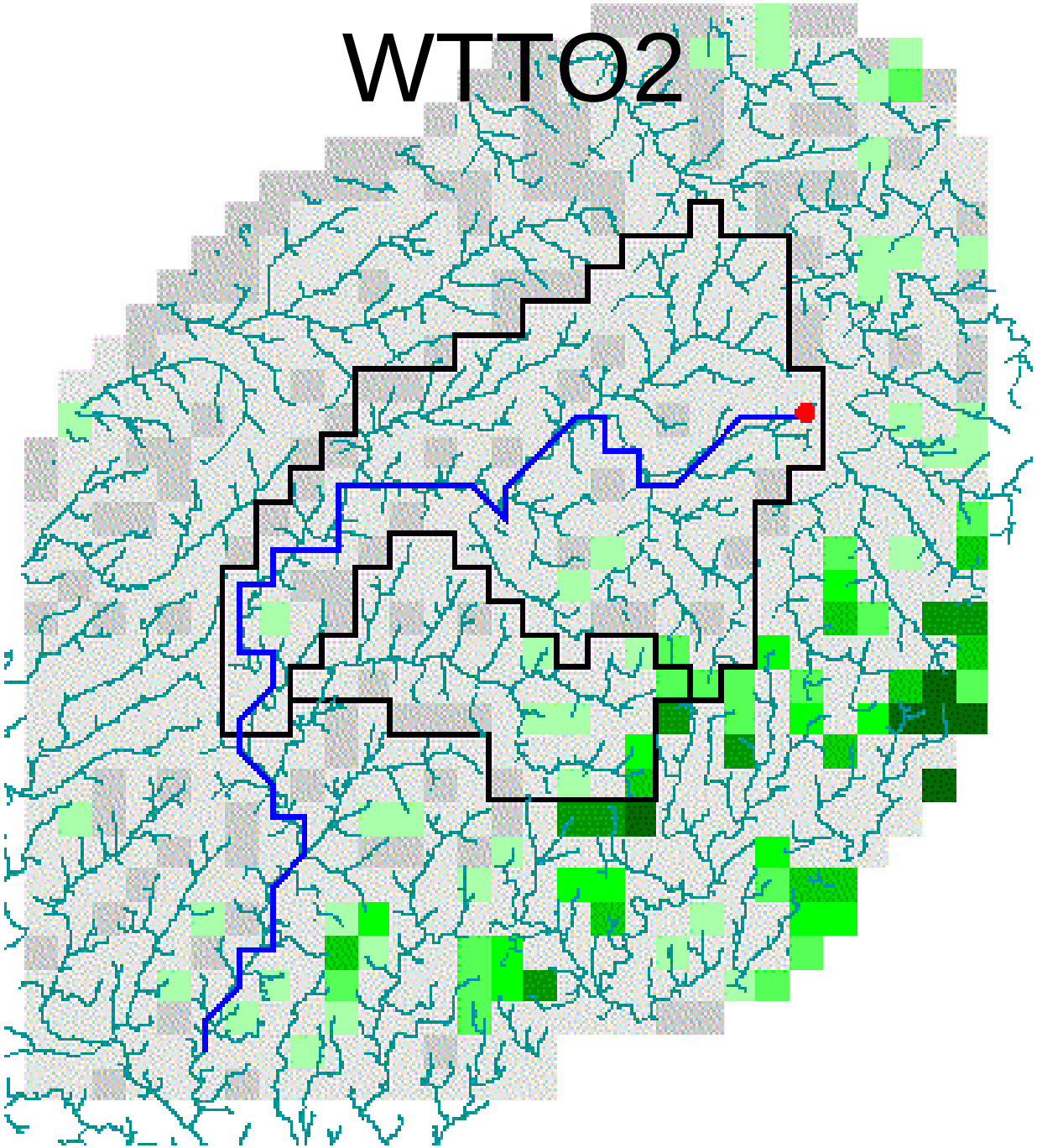
- Continue science validation through HOSIP
- Initiate operational software development through HOSIP

In closing

- VAR
  - a DA tool for headwater basins
  - a small but important piece in the terrestrial water DA system
  - Being experimented at WGRFC for science validation
- A comprehensive DA science plan to be developed
  - To include DA strategies for ESP, snow, site-specific, distributed, routing, hydraulic and reservoir models

State Updating for RMS – An illustration

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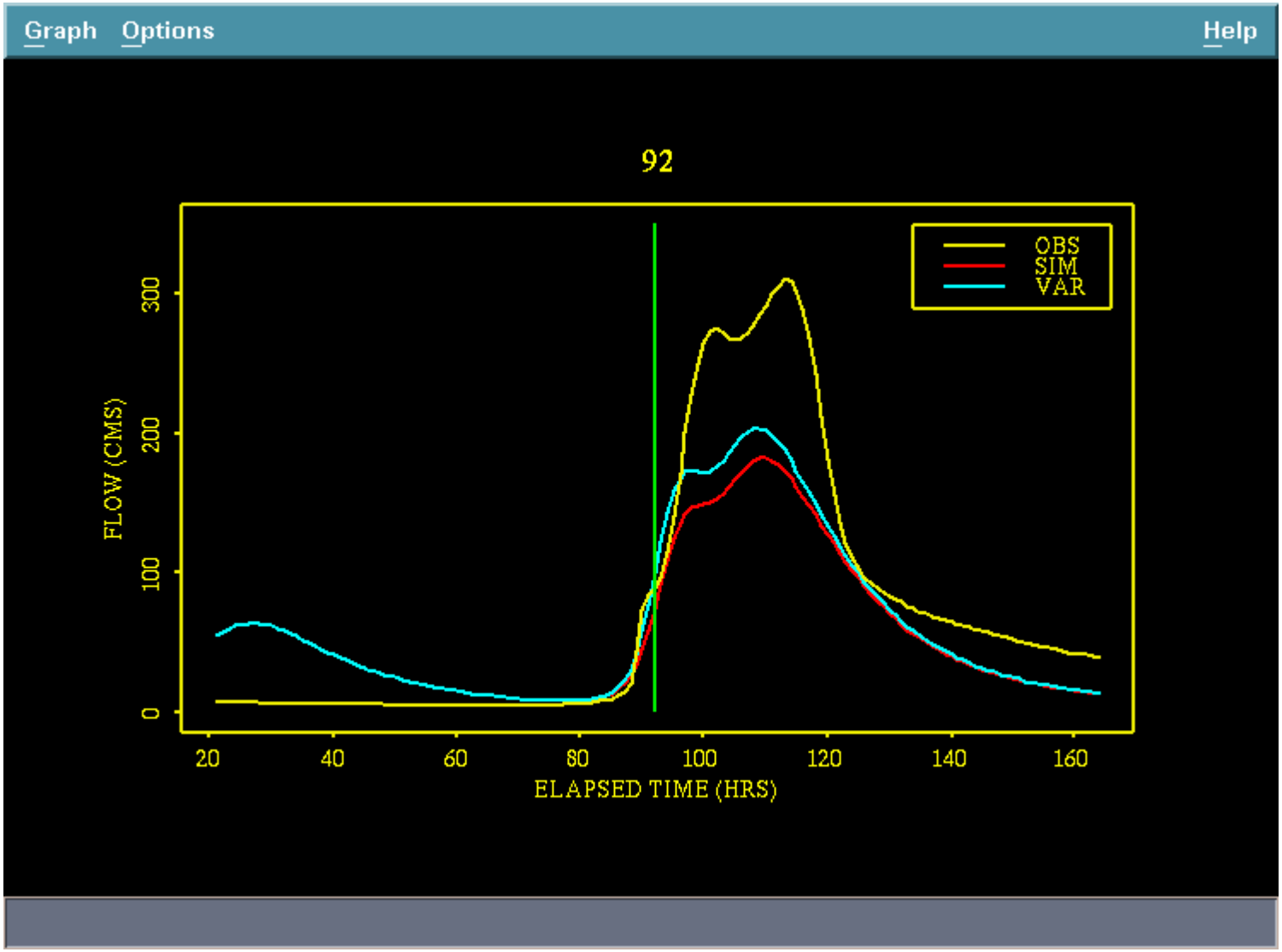
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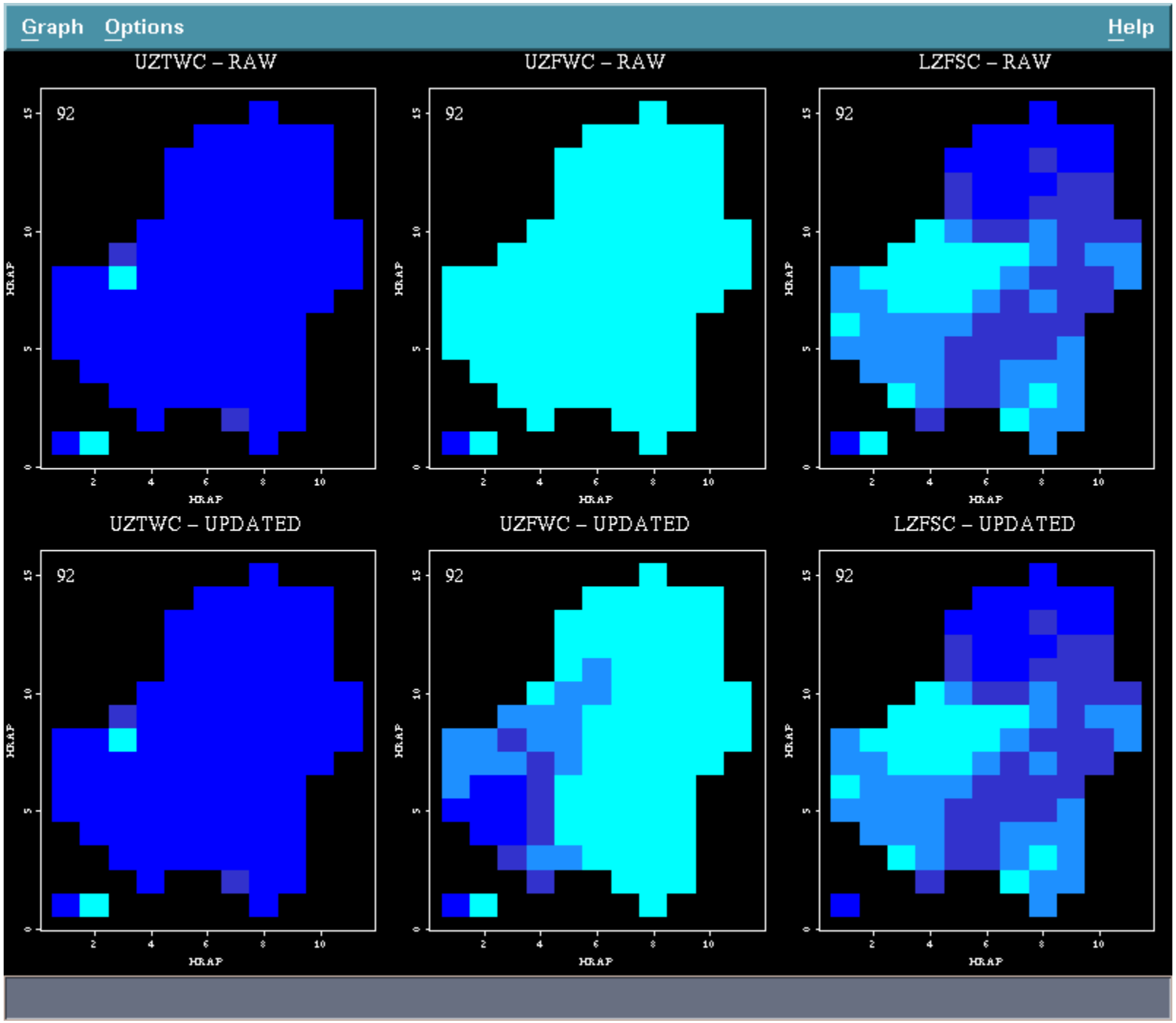
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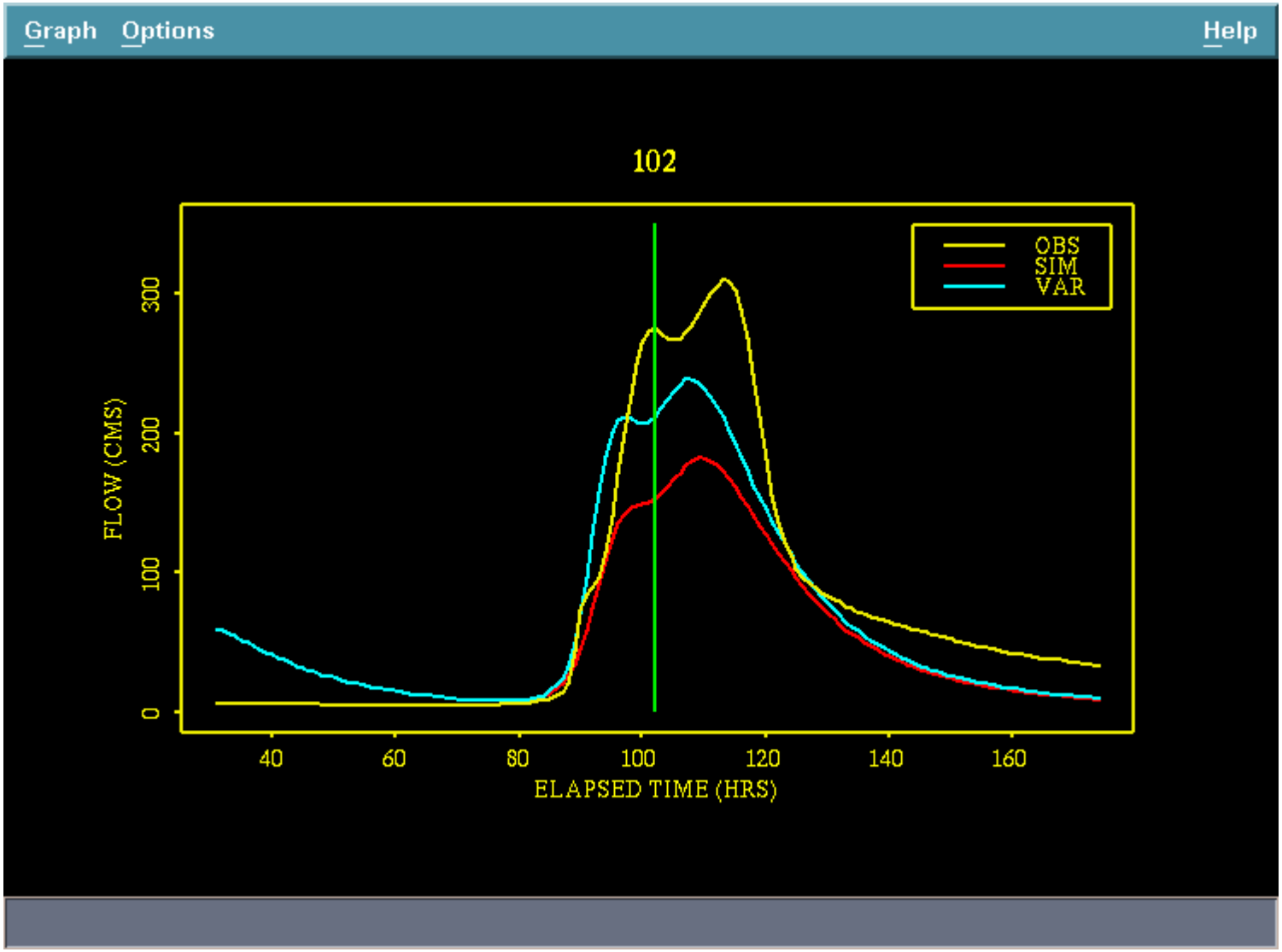
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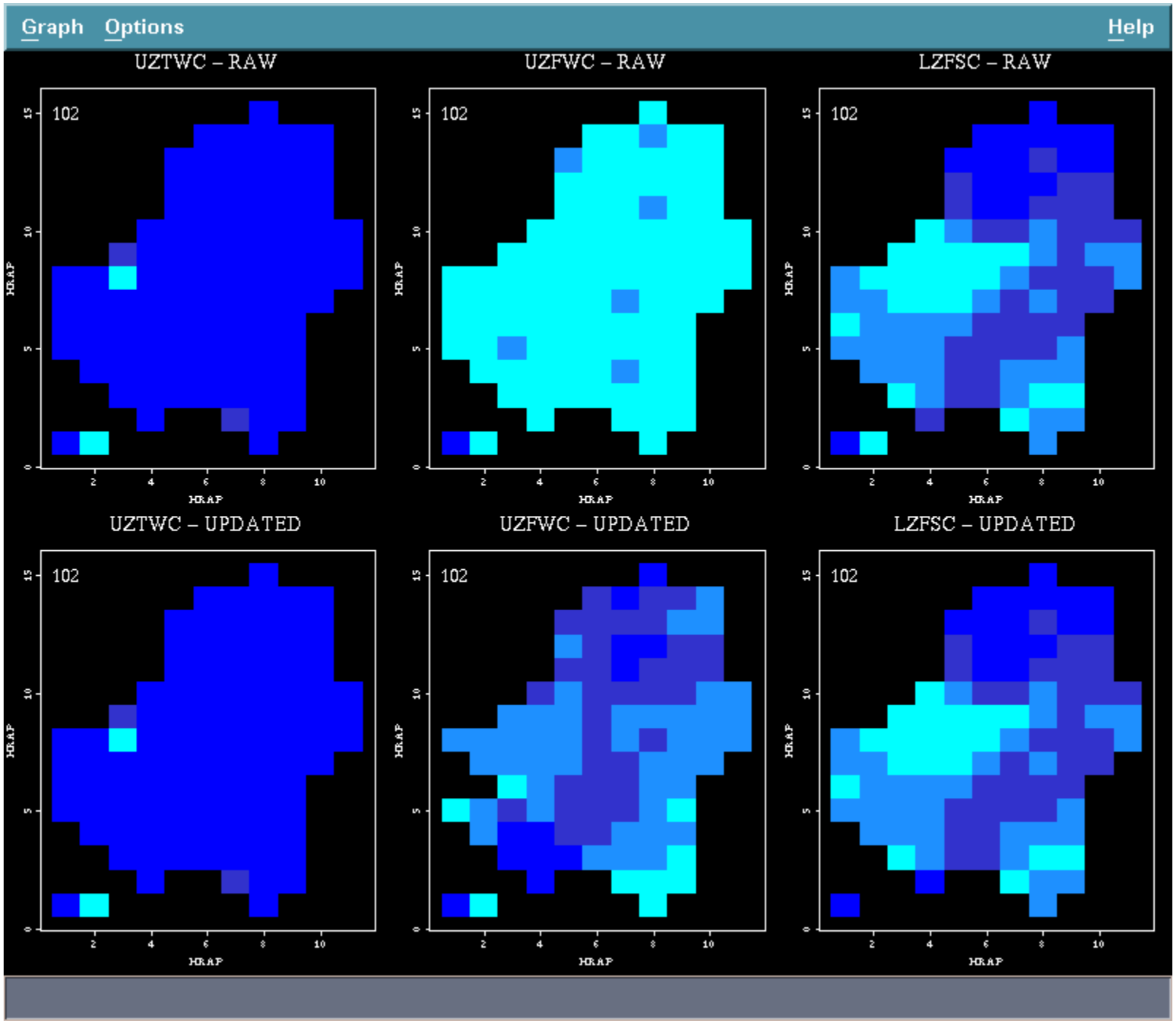
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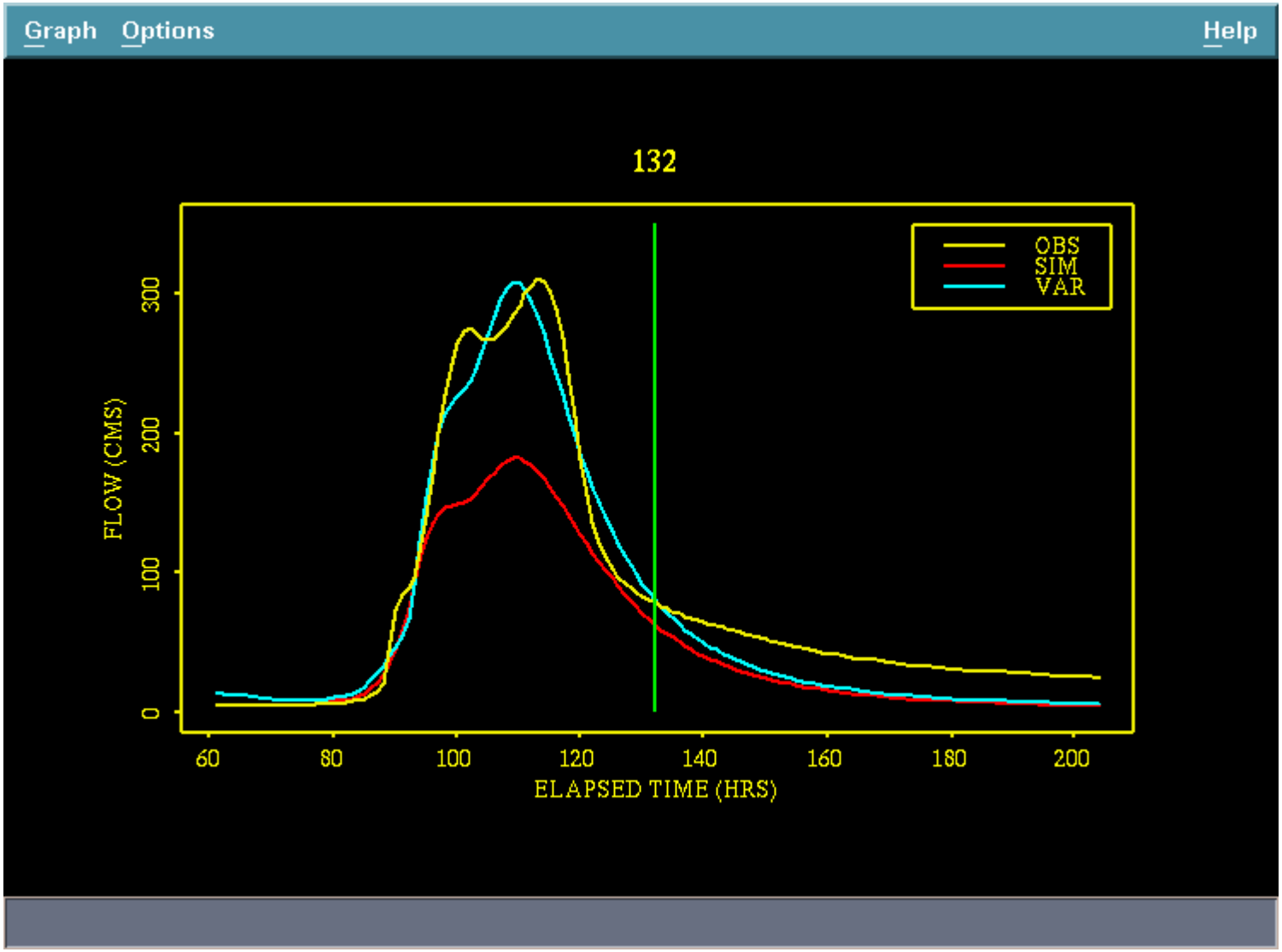
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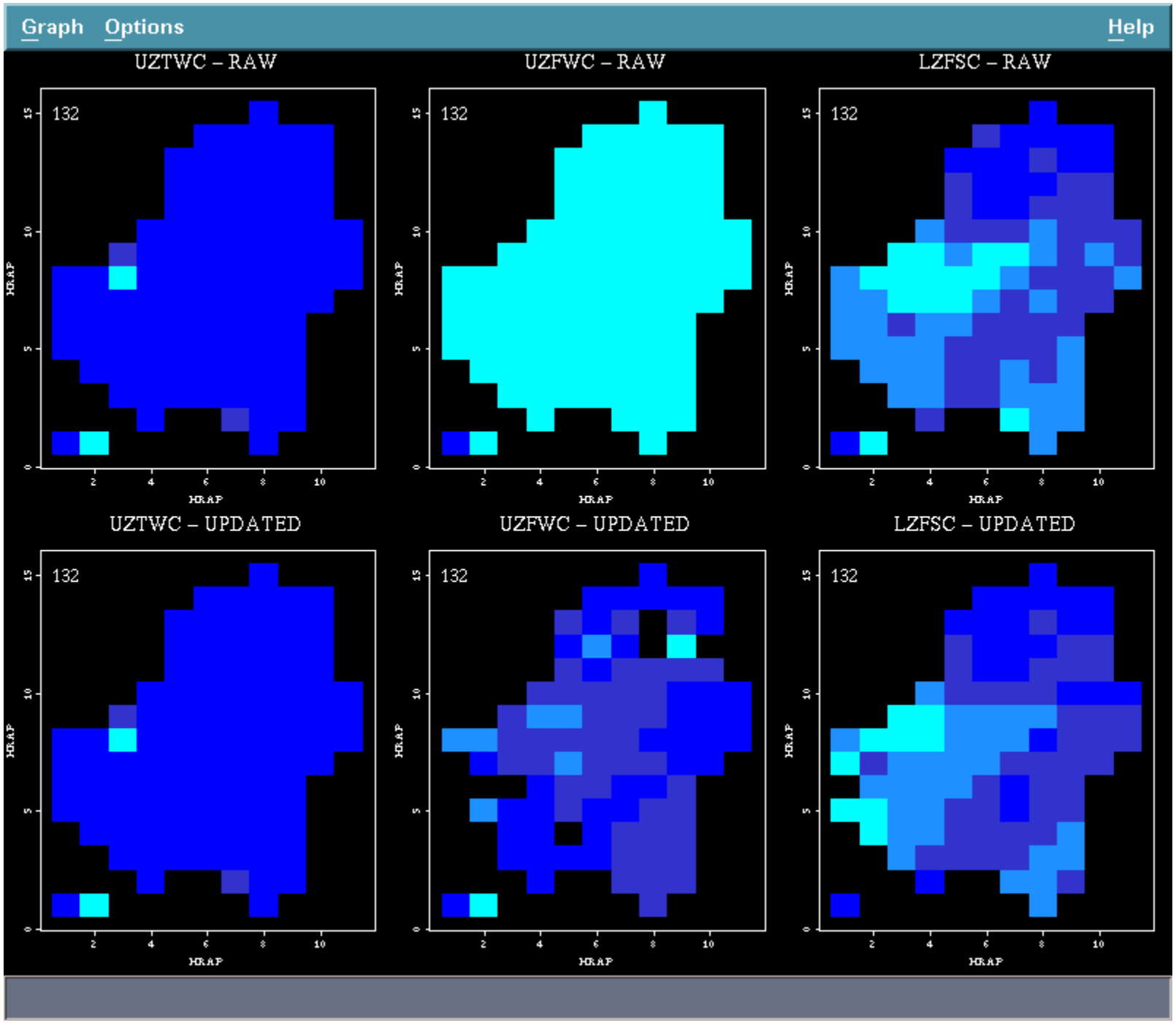
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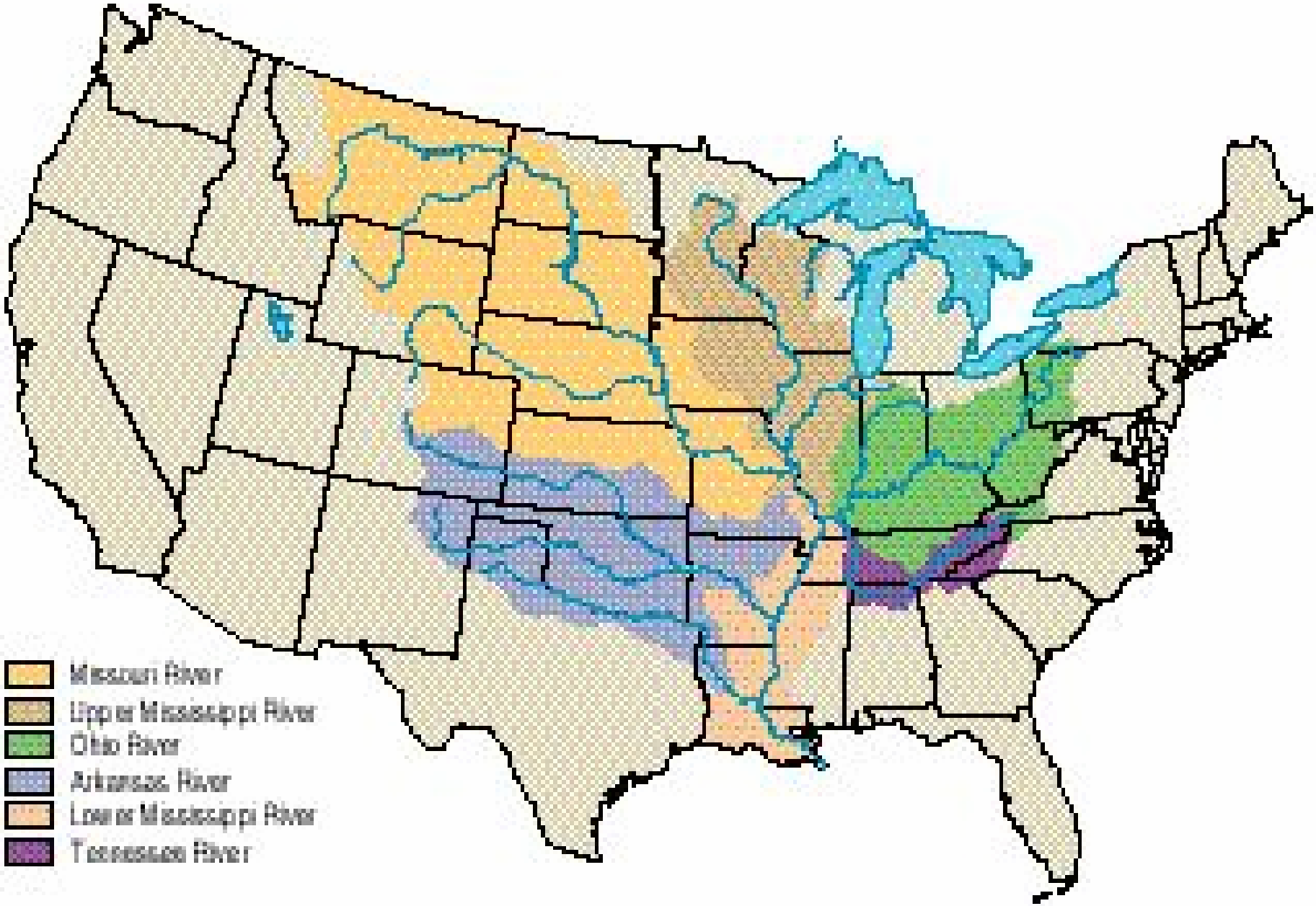
Missouri River
Upper Mississippi River
Ohio River
Arkansas River
Lower Mississippi River
Tennessee River