

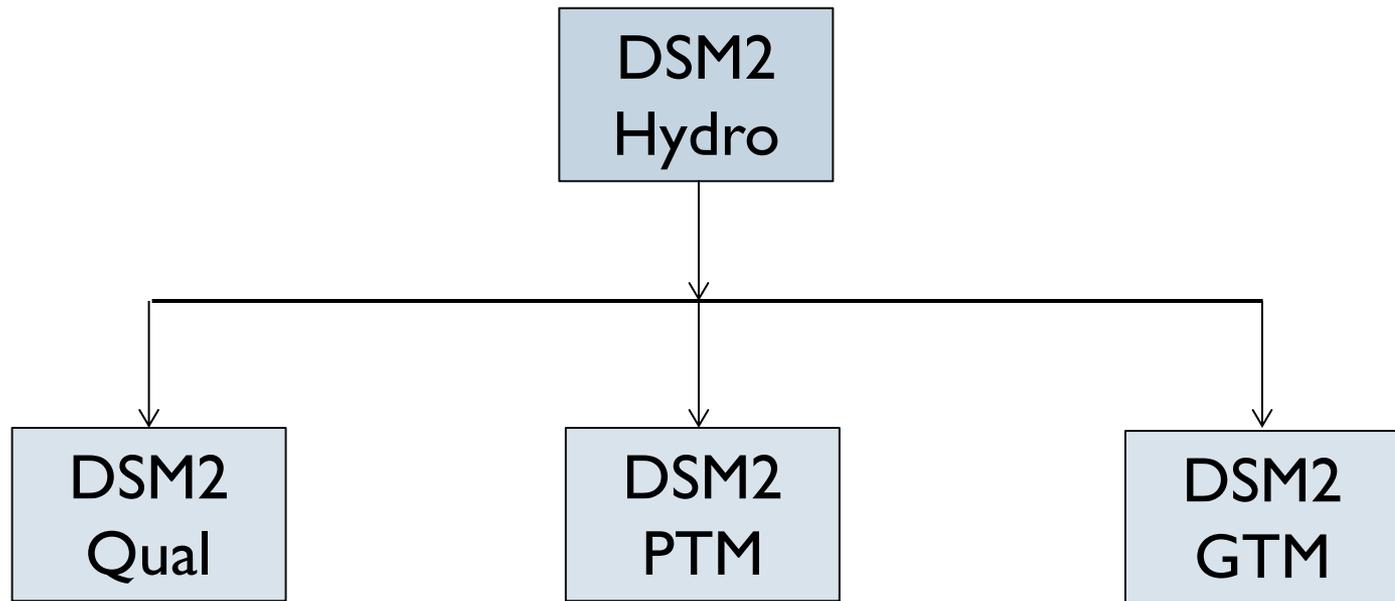
DSM2 General Transport Model (DSM2-GTM) Development Status Update

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What is GTM?



**Lagrangian
Reference**



**Eulerian
Fixed-frame
Reference**



Why GTM?

- ▶ Generalized Eulerian transport coding is adaptable to other constituents.
- ▶ Modular design
- ▶ Separation of I/O routines to aid generalizing to other codes
- ▶ A self-documenting code using Doxygen
- ▶ Companion testing routines using FRUIT (Fortran Unit Testing Framework)



Eularian ADR Transport Module

- ▶ The Eularian Advection-Diffusion-Reaction Transport Module for a single channel network as well as its unit-test has been completed in 2012 by:

Eli Ateljevich (DWR)

Jamie Anderson (DWR)

Fabian A. Bombardelli (UC Davis)

Kaveh Zamani (UC Davis)



Eularian ADR Transport Module

- ▶ The only change that has been made to the transport module is allowing varying dx .

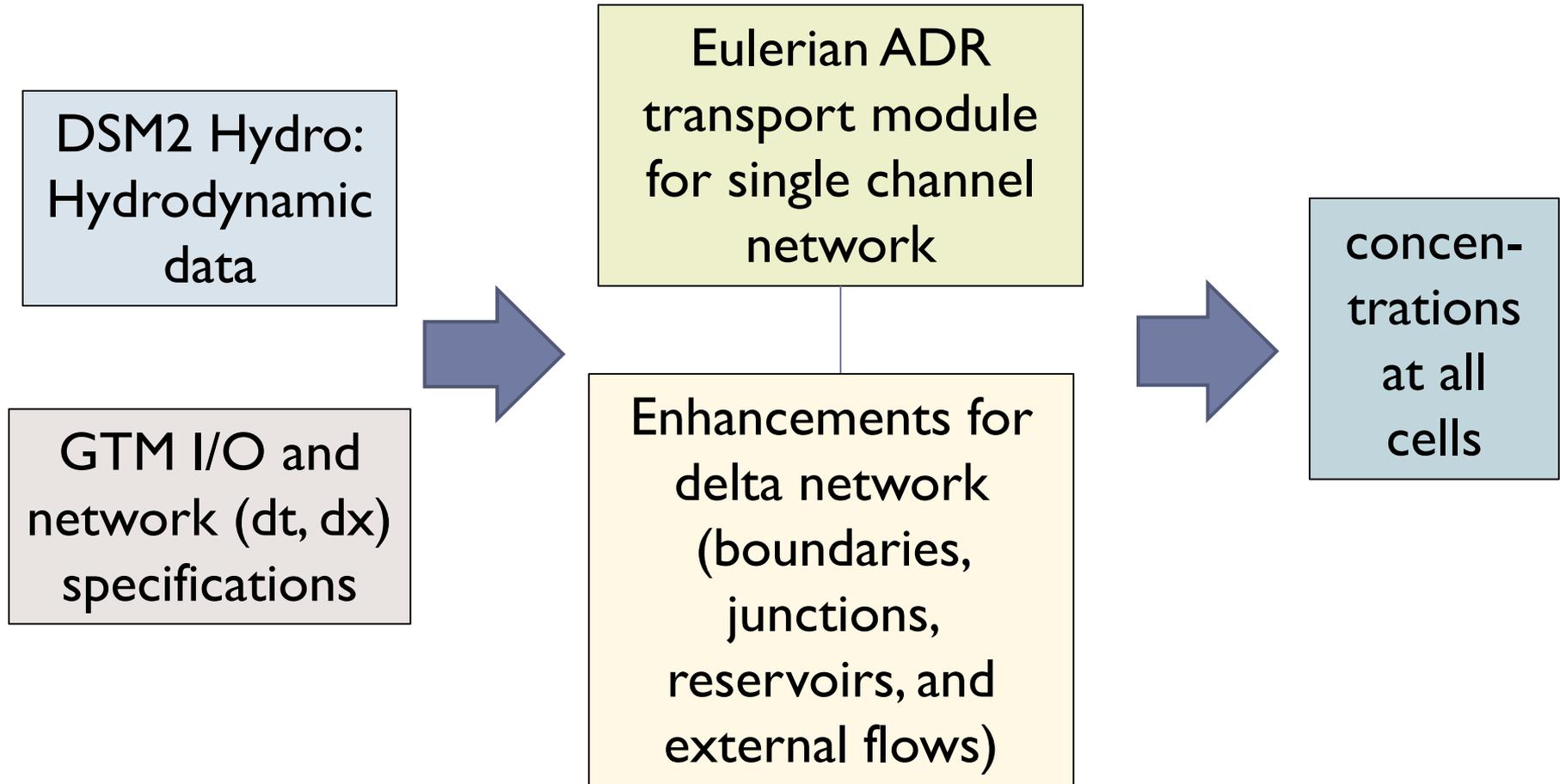
- ▶ Uniform dx :



- ▶ Varying dx



Linkage to DSM2-Hydro and beyond



1. DSM2-Hydro: Hydrodynamic Data

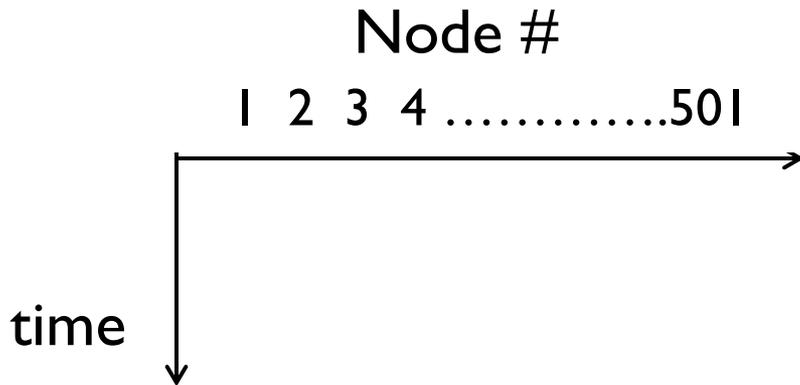
- ▶ Implementations on DSM2-Hydro HDF5 outputs (new Hydro Tidefile)
 - ❑ Spatial resolution from node to computational points
 - ❑ Temporally output instantaneous values instead of theta average quantities
 - ❑ Delete redundant information (either water surface or area)
 - ❑ Output useful information (virtual cross section)



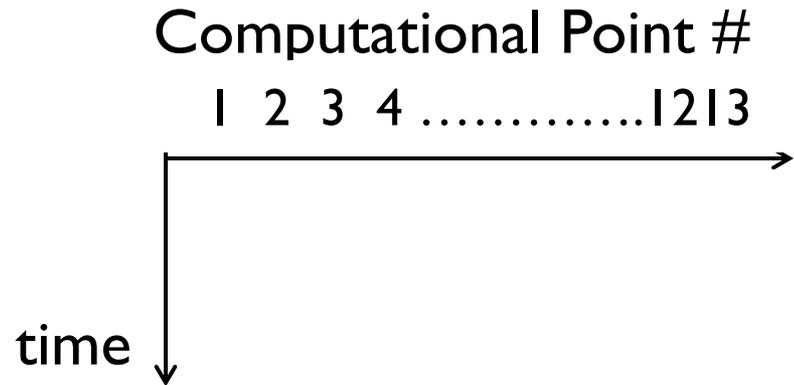
1. DSM2-Hydro: Hydrodynamic Data

- ▶ Spatial resolution from node to computational points

Current Hydro Tidefile

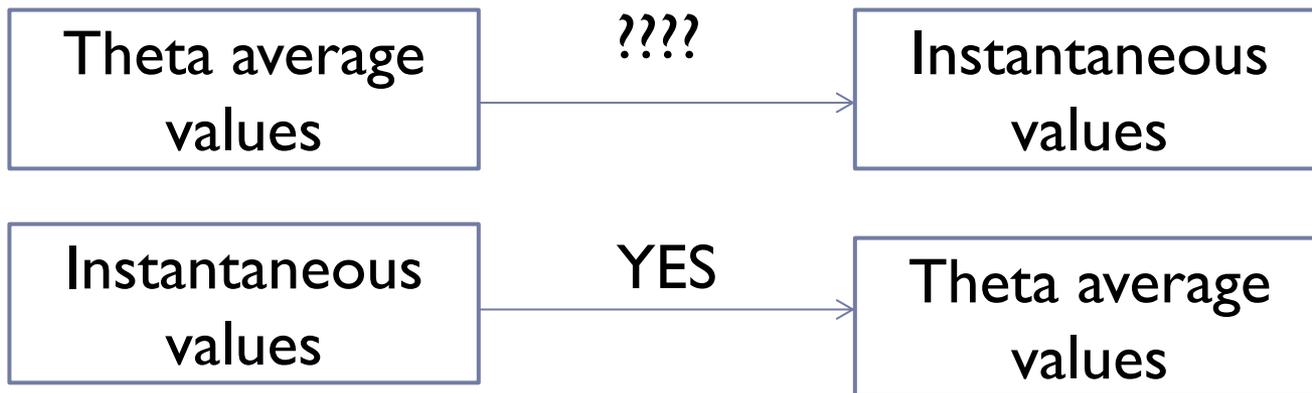


New Hydro Tidefile



1. DSM2-Hydro: Hydrodynamic Data

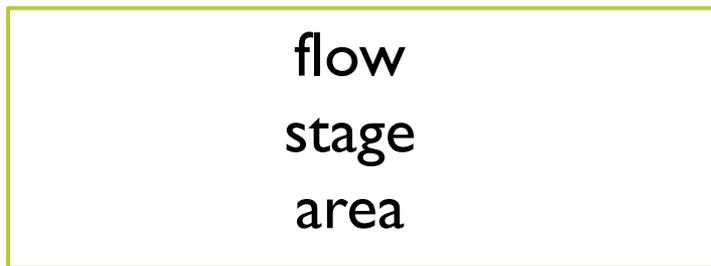
- ▶ Temporally output instantaneous values instead of theta average quantities.



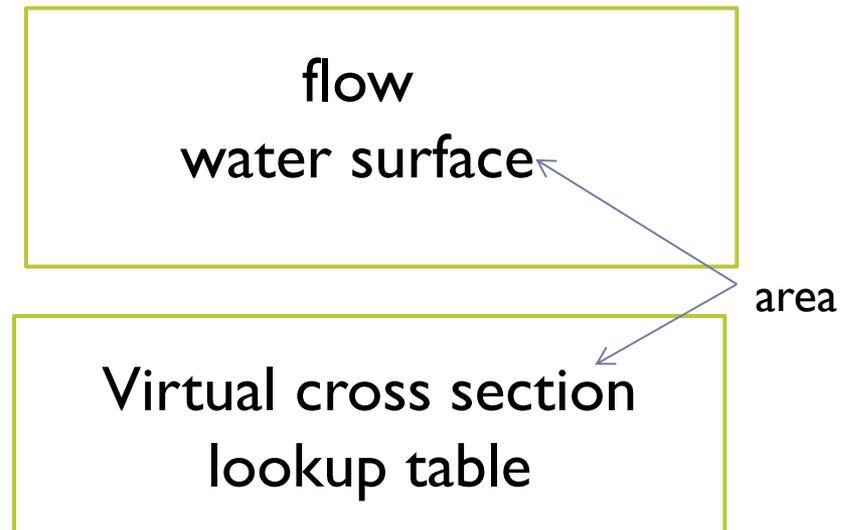
1. DSM2-Hydro: Hydrodynamic Data

- ▶ Delete redundant information (either water surface or area)
- ▶ Output reusable information (virtual cross section)

Current Hydro Tidefile



New Hydro Tidefile



2. GTM Development – I/O system design

- ▶ Modular design for all components
- ▶ Used similar input system as DSM2-Hydro and DSM2-Qual

Developers: no need to duplicate the effort and testing

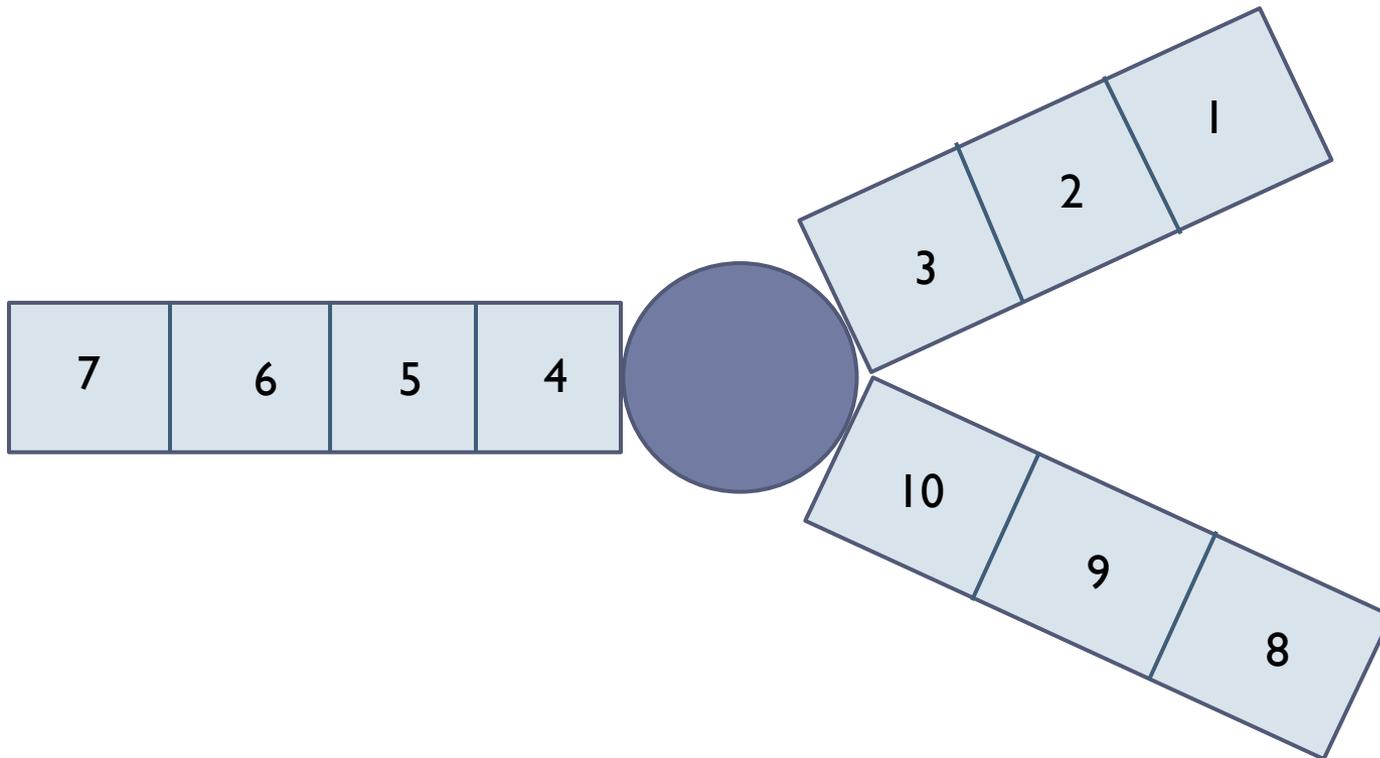
Users: no need to learn a new input system

- ▶ Read time series input from HEC-DSS and HDF5
- ▶ Parsed network information
(boundaries, channels, junctions, reservoirs, etc.)
- ▶ Assigned time varying data to network



2. GTM Development – Delta Network

- ▶ Assigned boundary conditions and performed junction mixing to accommodate delta network
- ▶ Added reservoirs and external flows to the network



2. GTM Development – Runtime

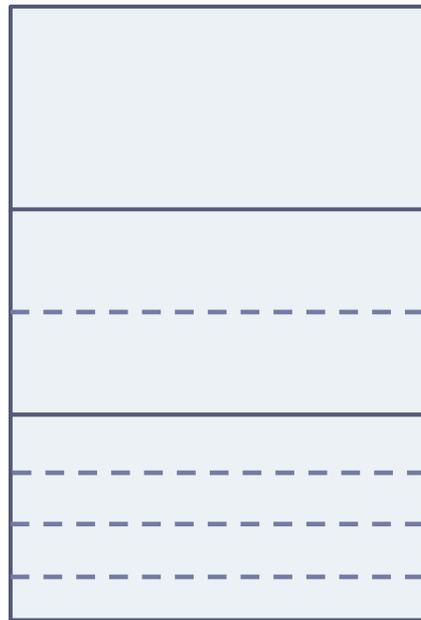
- ▶ Added sub time stepping to make sure Courant Number always less than one for stability

$$C = \frac{u\Delta t}{\Delta x} \leq 1$$

GTM $\Delta t=4\text{min}$

GTM $\Delta t=4\text{min}$

GTM $\Delta t=4\text{min}$



Network Max. CFL number < 1
→ OK

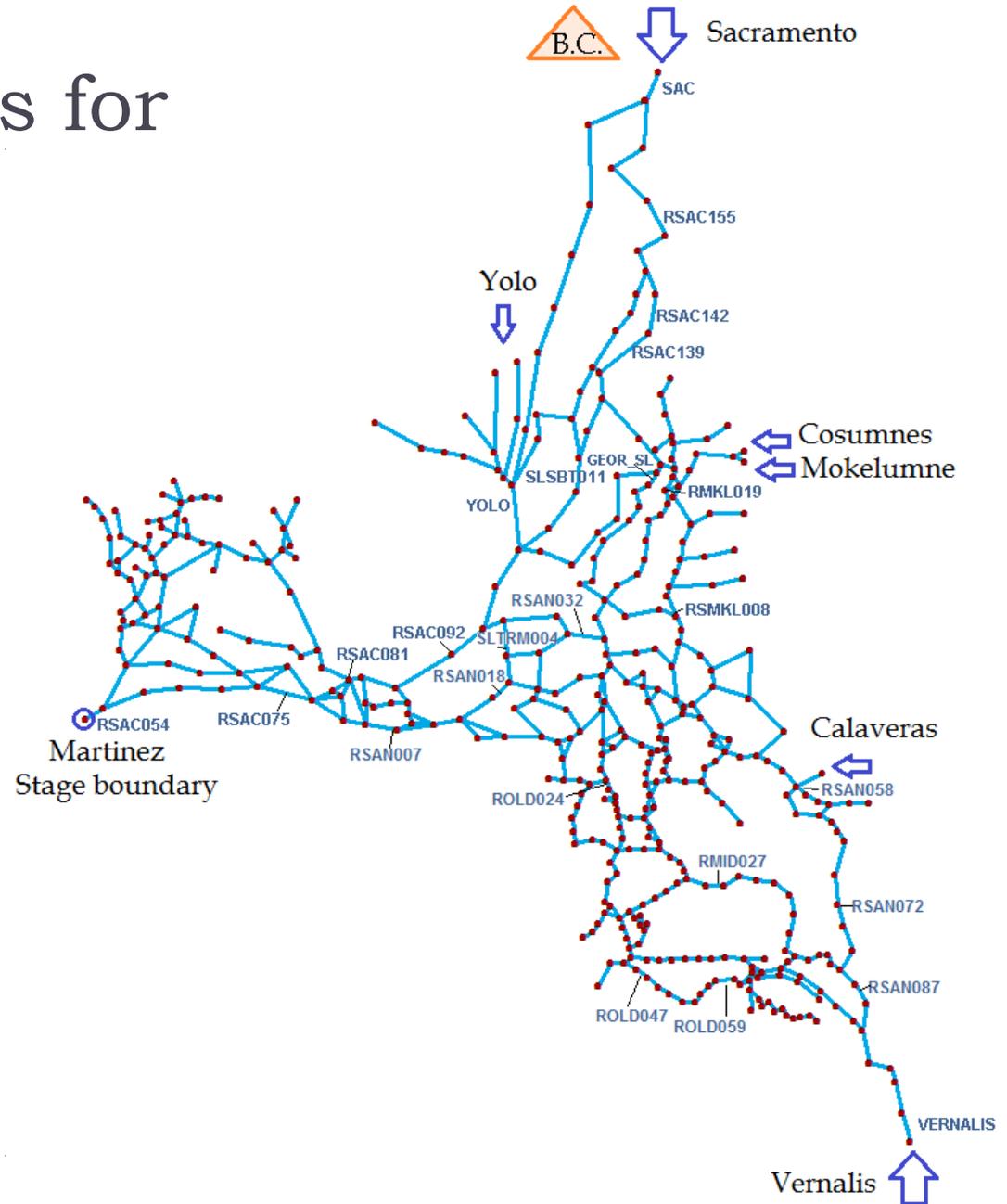
Network Max. CFL number = 1.98
→ Sub time step = 2min

Network Max. CFL number = 3.56
→ Sub time step = 1min



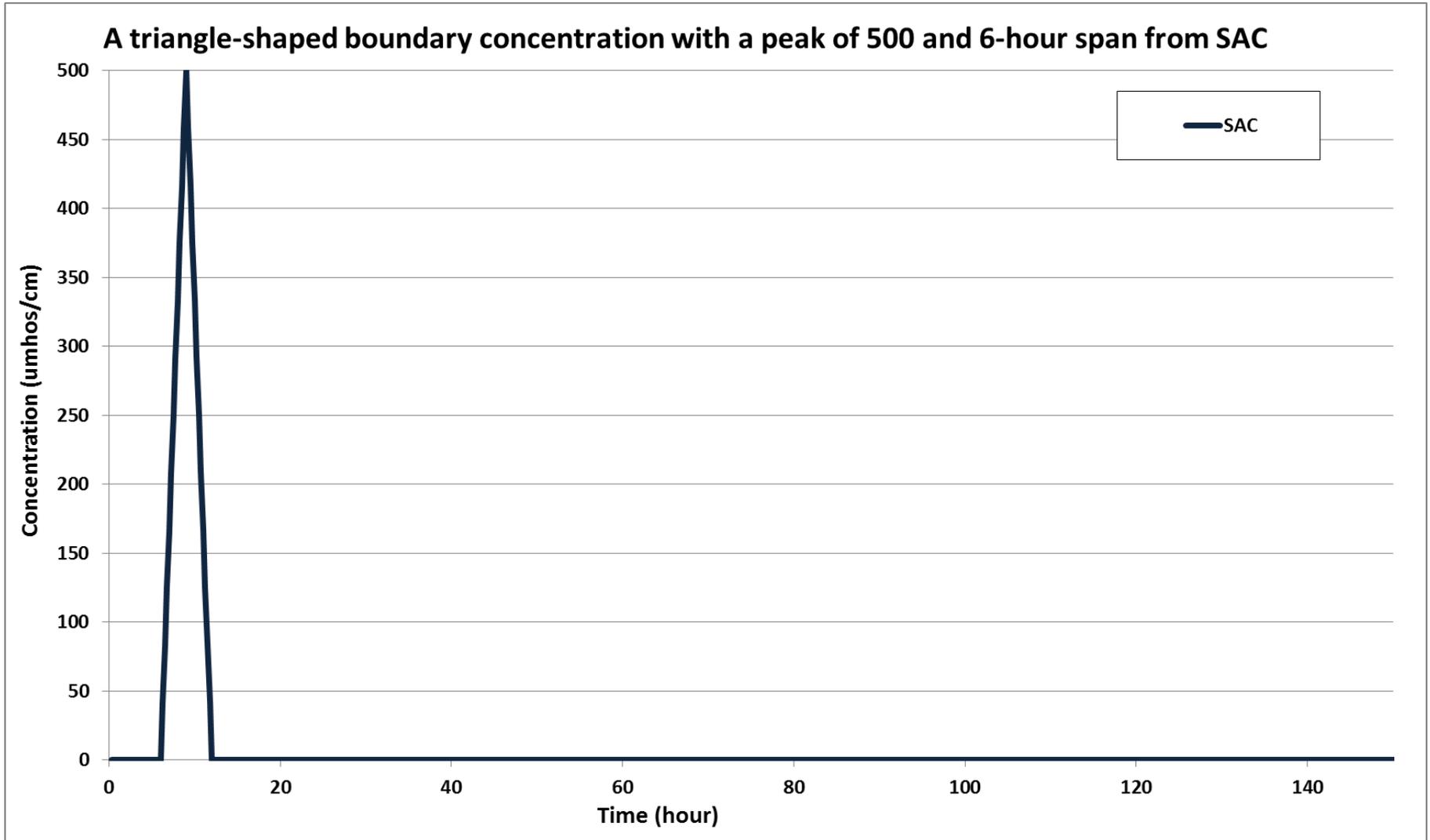
3. Enhancements for Delta Network

With all boundary flows and a triangle plume from SAC



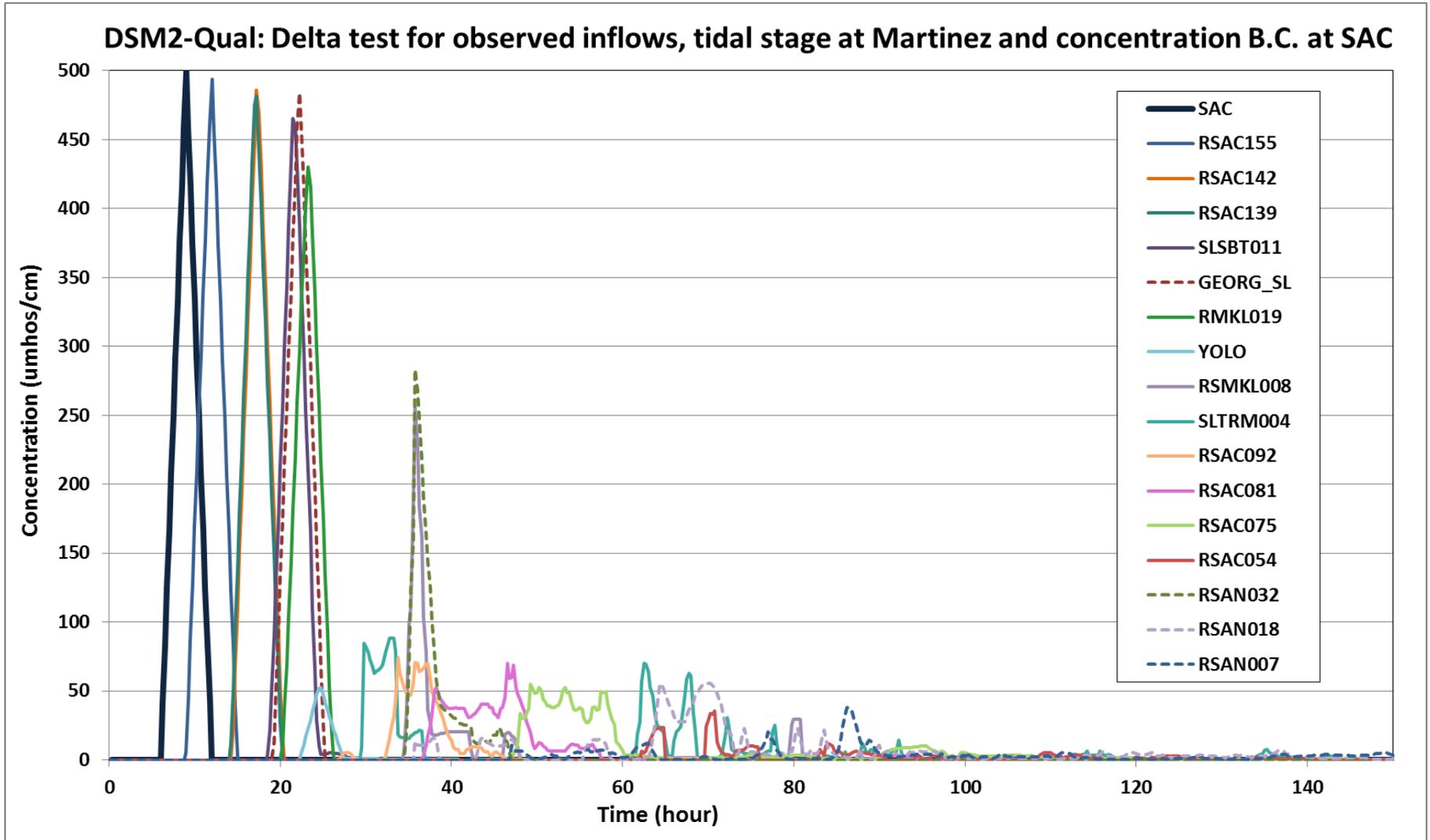
DSM2-Qual

A boundary concentration at SAC

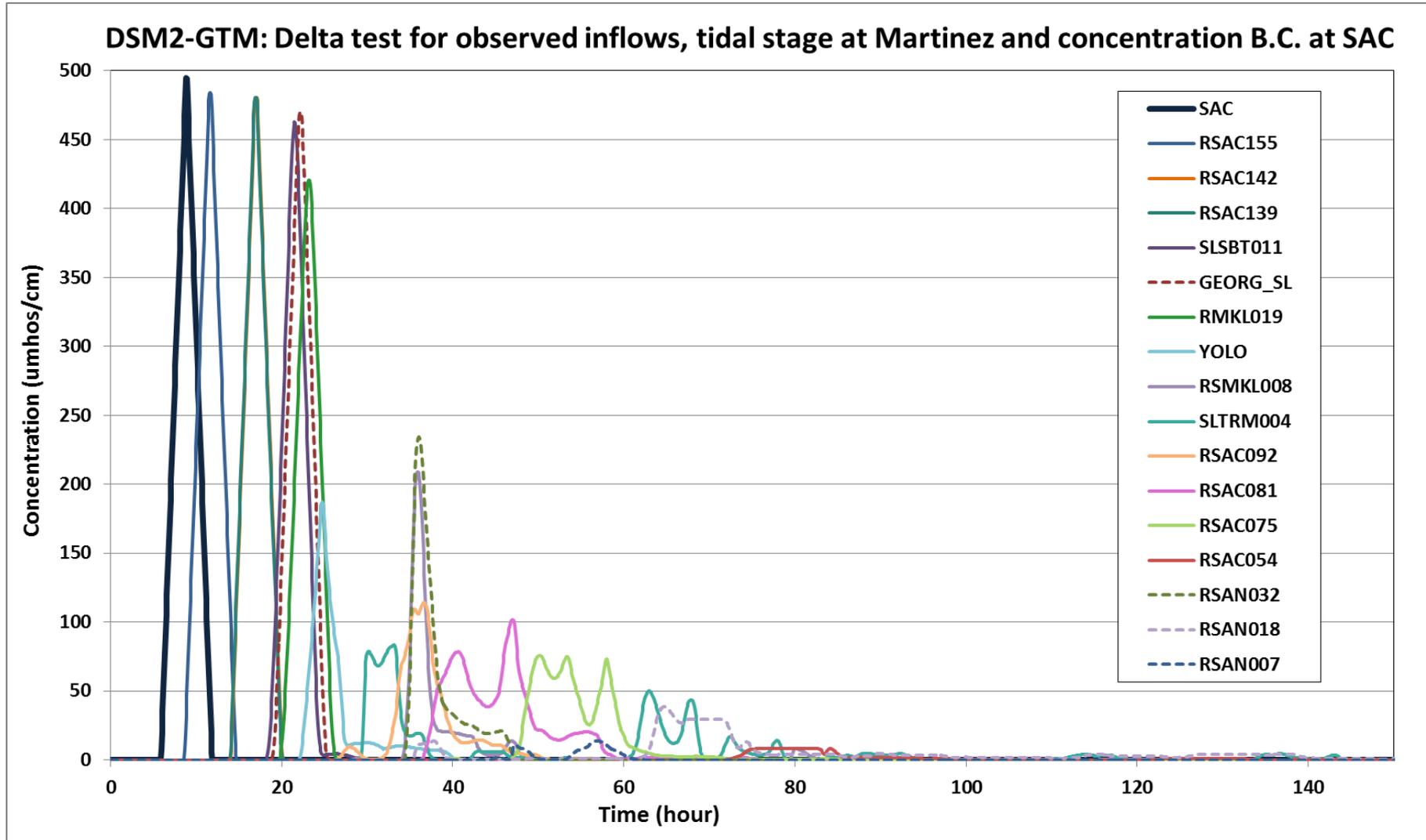


DSM2-Qual

A boundary concentration at SAC



DSM2-GTM: A boundary concentration at SAC (still under testing)



Still working on EC delta simulation...

- ▶ Checking several key locations and making sure they yield reasonable results
- ▶ Checking reservoir concentrations and DICU flows mixing



What are in working progress...

- ▶ Working on DO (dissolved oxygen) Module

Issues:

Input and output designs

Interface with GTM

- ▶ Once DO module is done, it can serve as a good example to design and integrate sediment module and mercury module



Questions?

