# Running a 2D Model

Cameron Ackerman, P.E., D.WRE

USACE, Institute for Water Resources, Hydrologic Engineering Center

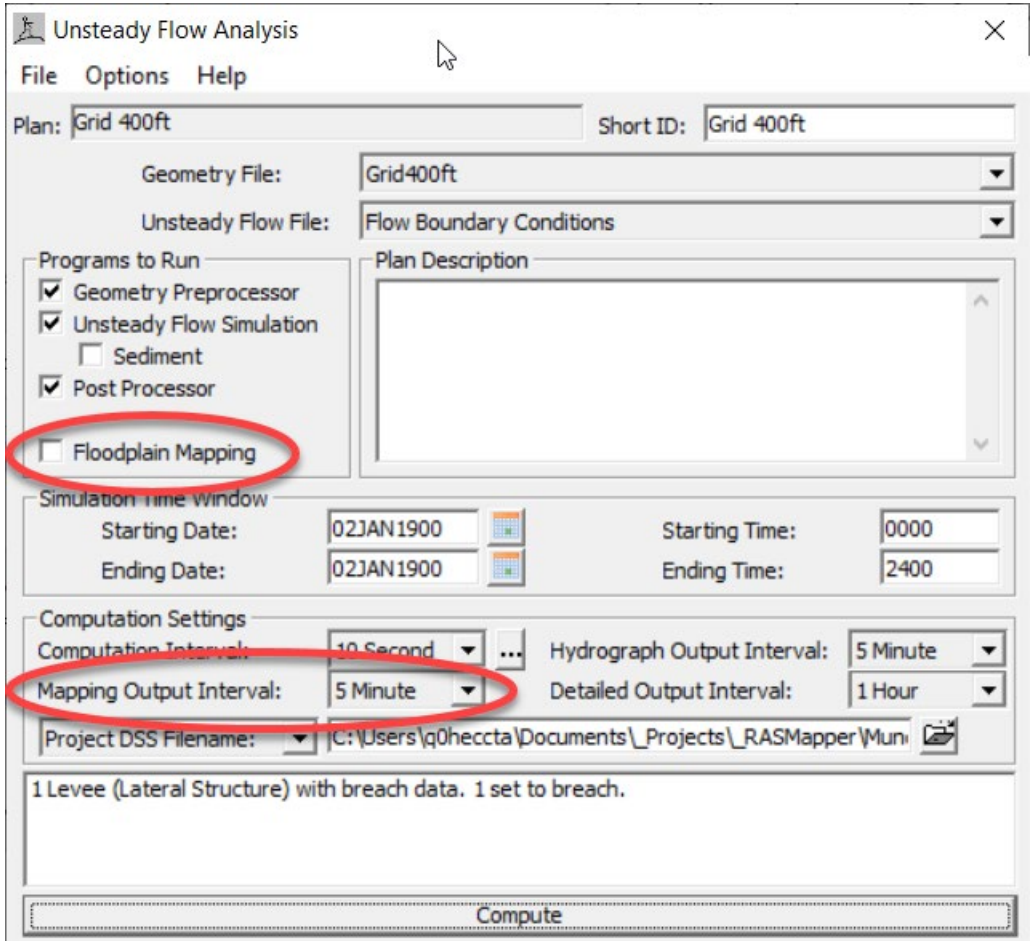
US Army Corps of Engineers

# Overview

- Performing Computations
  - 2D Preprocessor
- Computation Options
- Cell Size Considerations
  - Associating a Terrain Model
- Time Step Selection

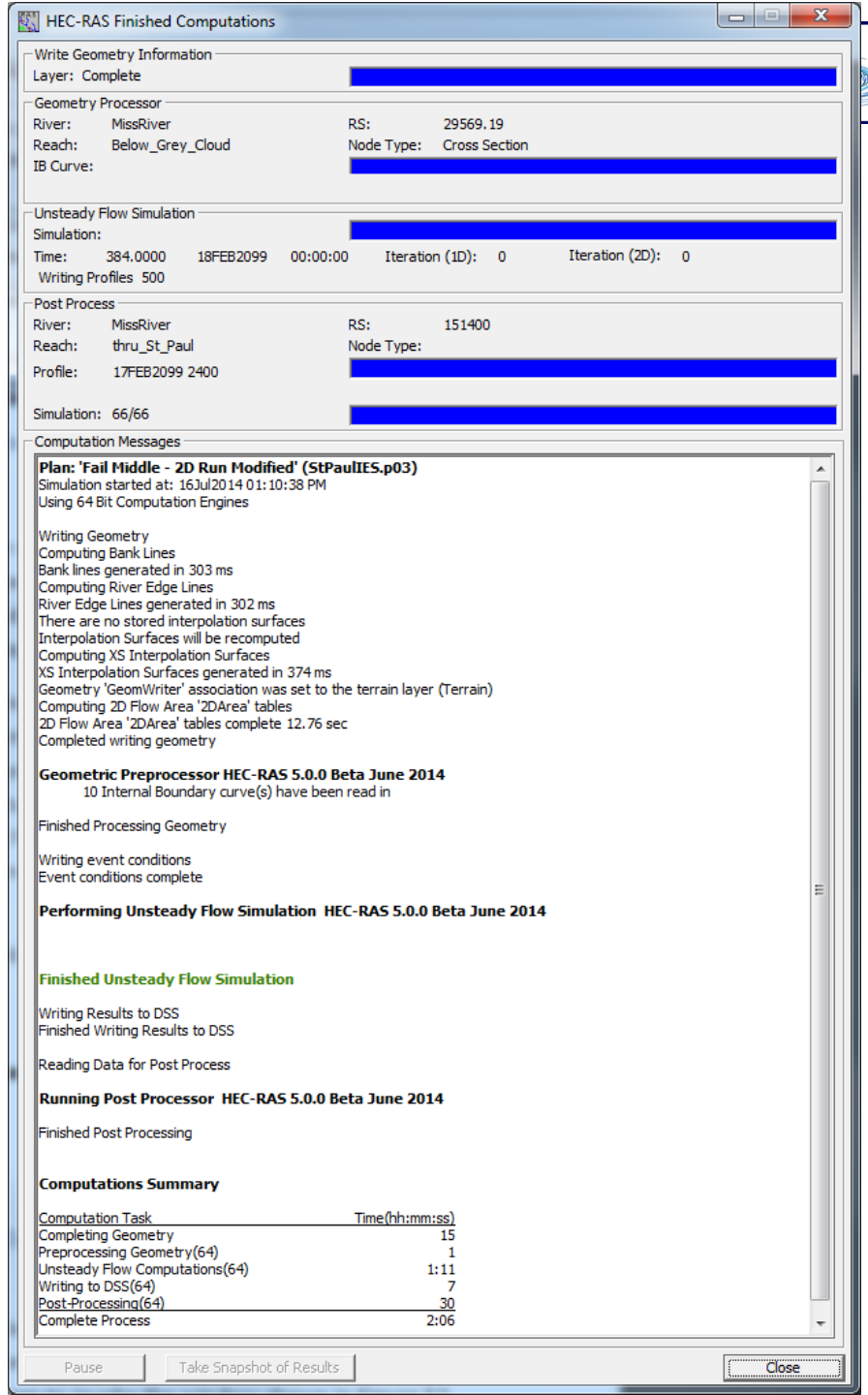
# Performing Computations

- Floodplain Mapping
  - Creates a stored map
  - Must set up map in RAS Mapper prior to run
- Mapping Output Interval
  - Time Series Data written to HDF file at Cross Sections, Storage Areas, and 2D Cells
  - XS
    - WSE, Flow, Velocity
  - Cells
    - WSE, Depth cell center
    - Velocity at cell faces



# Performing Computations

1. Writing 1D Geometry
   - Bank Lines, Edge Lines (1D)
   - Interpolation Surface (1D)
2. 2D Geometry Preprocessor
   - Process 2D Cells and Faces
3. 1D Geometry Preprocessor
   - Hydraulic Tables for Cross Sections
4. Unsteady Flow Simulation
5. Post Processor (1D only)

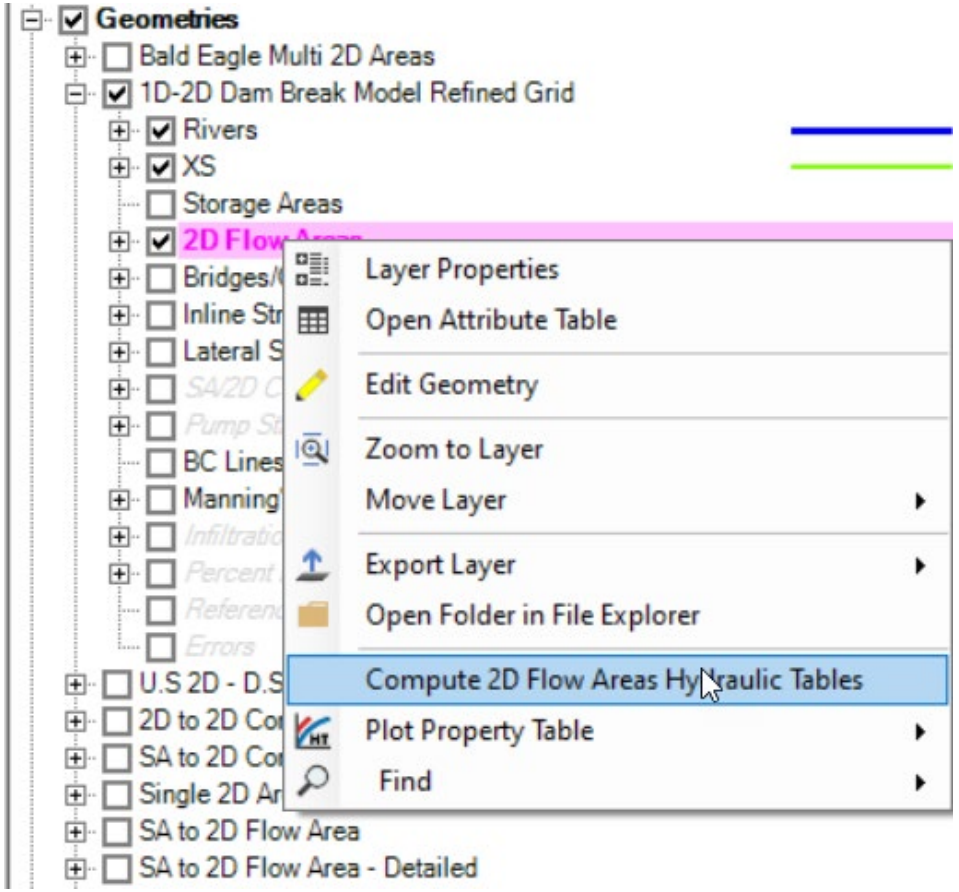


# 2D Pre-processor to compute cell information

## Unsteady-flow Simulation

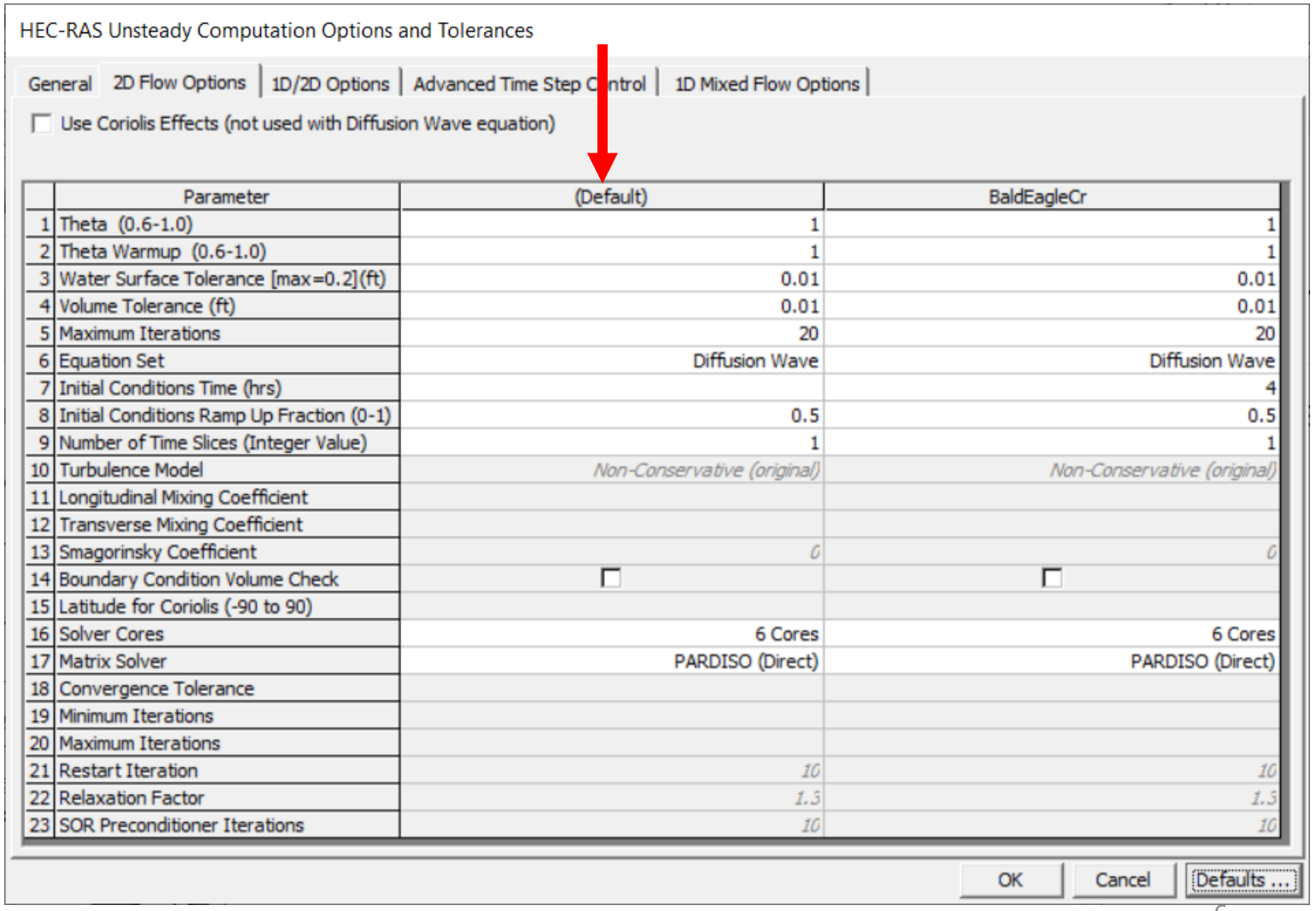
```
Writing Geometry
Computing Bank Lines
Bank lines generated in 303 ms
Computing River Edge Lines
River Edge Lines generated in 302 ms
There are no stored interpolation surfaces
Interpolation Surfaces will be recomputed
Computing XS Interpolation Surfaces
XS Interpolation Surfaces generated in 374 ms
Geometry 'GeomWriter' association was set to the terrain layer (Terrain)
Computing 2D Flow Area '2DArea' tables
2D Flow Area '2DArea' tables complete 12.76 sec
Completed writing geometry
```

## RAS Mapper – 2D Flow Areas



# Computation Options

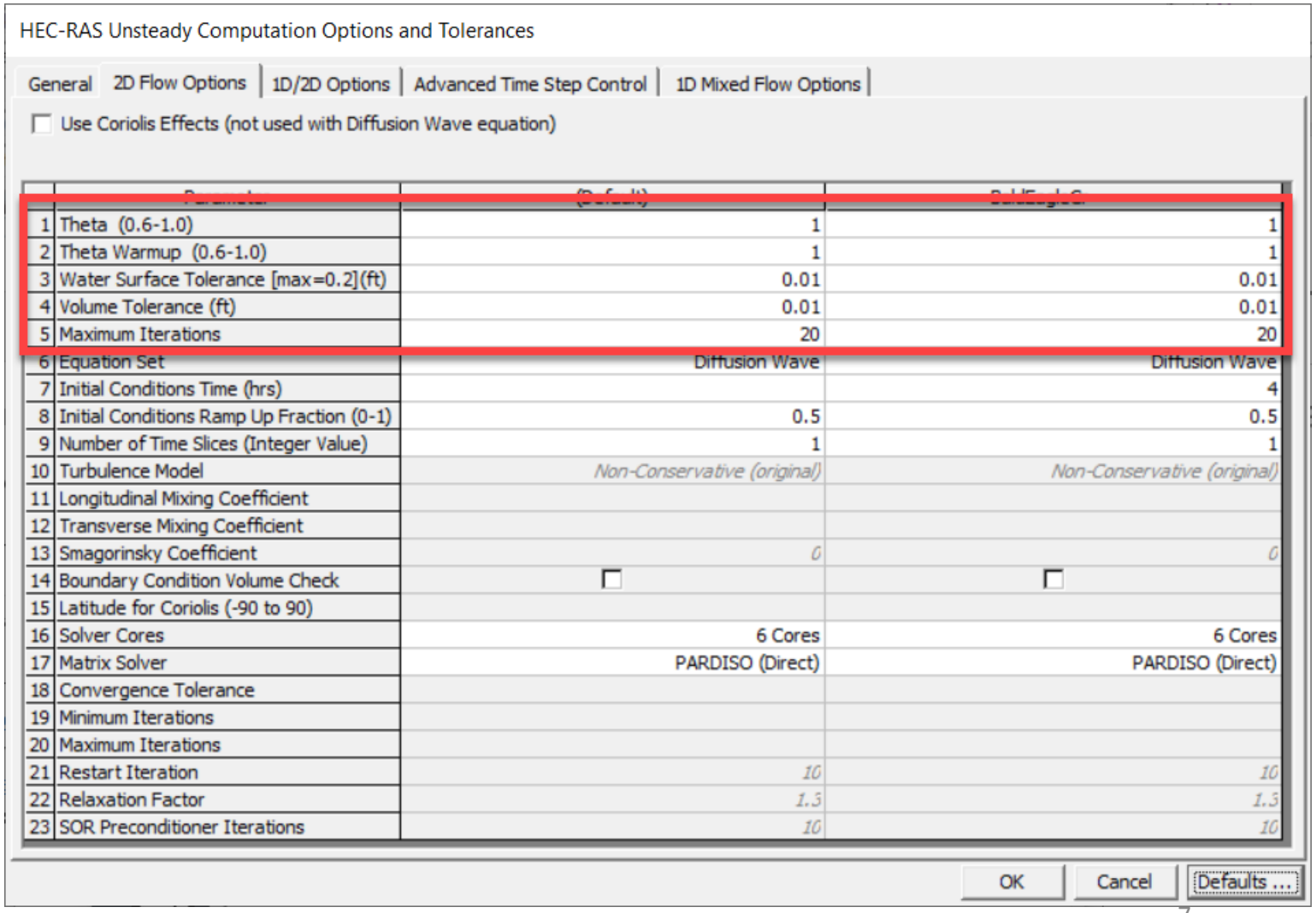
- Defaults
- Per 2D Flow Area




| | Parameter | (Default) | BaldEagleCr |
|---|---|---|---|
| 1 | Theta (0.6-1.0) | 1 | 1 |
| 2 | Theta Warmup (0.6-1.0) | 1 | 1 |
| 3 | Water Surface Tolerance [max=0.2](ft) | 0.01 | 0.01 |
| 4 | Volume Tolerance (ft) | 0.01 | 0.01 |
| 5 | Maximum Iterations | 20 | 20 |
| 6 | Equation Set | Diffusion Wave | Diffusion Wave |
| 7 | Initial Conditions Time (hrs) | | 4 |
| 8 | Initial Conditions Ramp Up Fraction (0-1) | 0.5 | 0.5 |
| 9 | Number of Time Slices (Integer Value) | 1 | 1 |
| 10 | Turbulence Model | *Non-Conservative (original)* | *Non-Conservative (original)* |
| 11 | Longitudinal Mixing Coefficient | | |
| 12 | Transverse Mixing Coefficient | | |
| 13 | Smagorinsky Coefficient | *0* | *0* |
| 14 | Boundary Condition Volume Check | ☐ | ☐ |
| 15 | Latitude for Coriolis (-90 to 90) | | |
| 16 | Solver Cores | 6 Cores | 6 Cores |
| 17 | Matrix Solver | PARDISO (Direct) | PARDISO (Direct) |
| 18 | Convergence Tolerance | | |
| 19 | Minimum Iterations | | |
| 20 | Maximum Iterations | | |
| 21 | Restart Iteration | *10* | *10* |
| 22 | Relaxation Factor | *1.3* | *1.3* |
| 23 | SOR Preconditioner Iterations | *10* | *10* |

# Computation Options

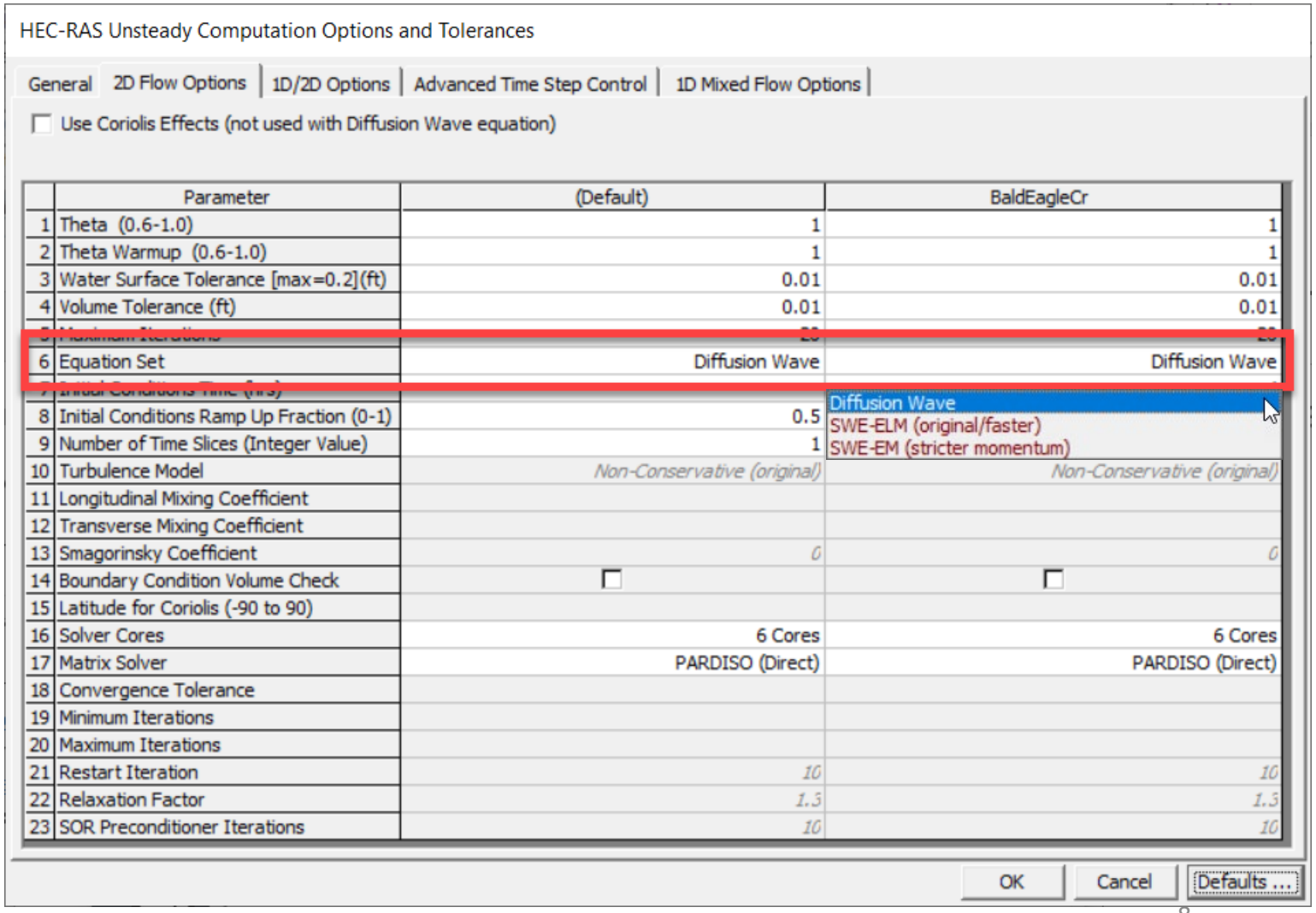
- Theta
- Theta Warmup
- Water Surface Tol
- Volume Tolerance
- Max Iterations



# Computation Options

- Equation Set

- Diffusion Wave
- Shallow Water Eqn (faster)
- Shallow Water Eqn (conservative)



# Computation Options

## Initial Conditions

- Time
- Ramp Up Fraction

HEC-RAS Unsteady Computation Options and Tolerances

General | 2D Flow Options | 1D/2D Options | Advanced Time Step Control | 1D Mixed Flow Options

Use Coriolis Effects (not used with Diffusion Wave equation)

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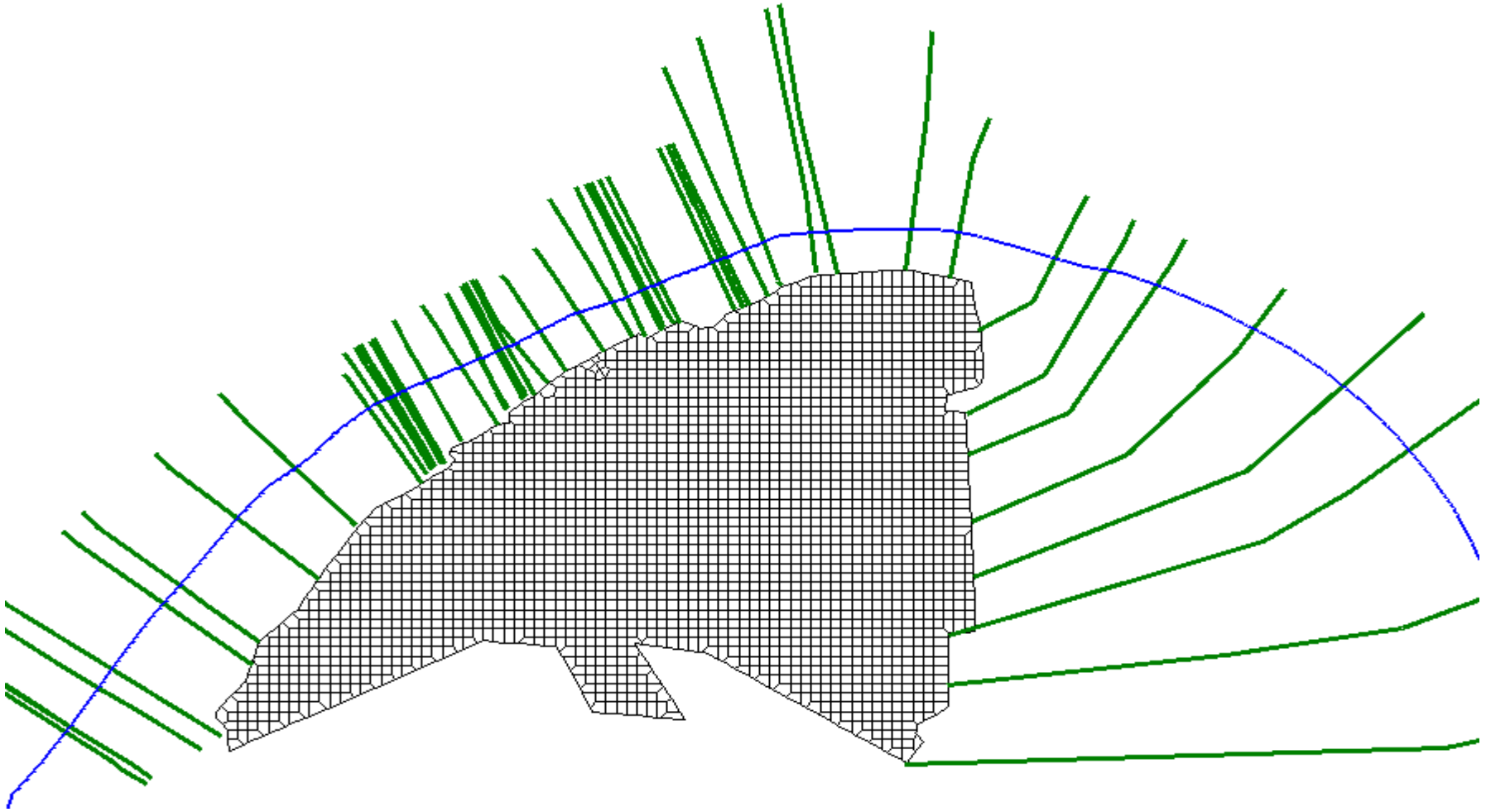
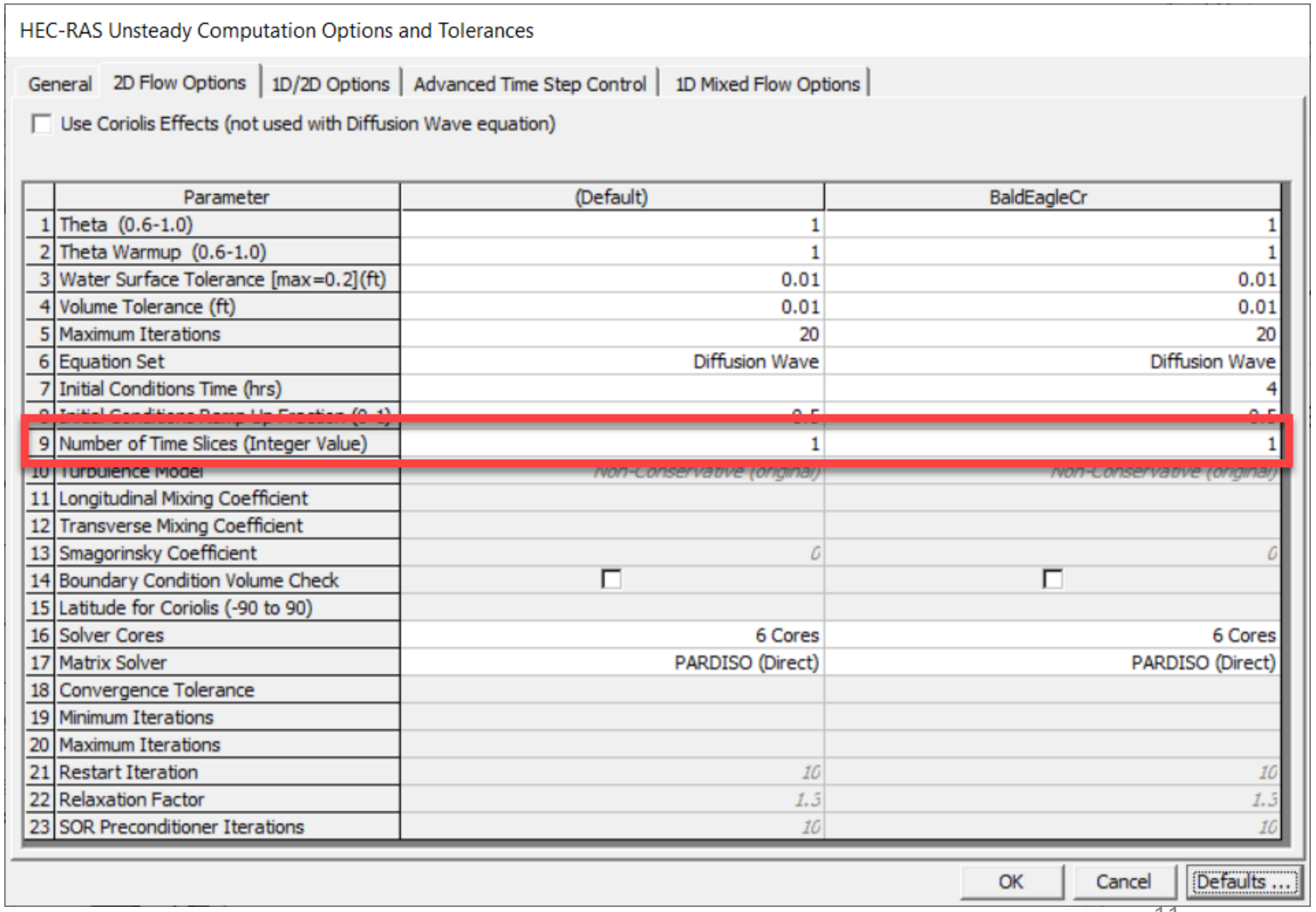
OK | Cancel | Defaults ...

# 1D/2D Model and Computational Time Step



# Computation Options

- Time Slices

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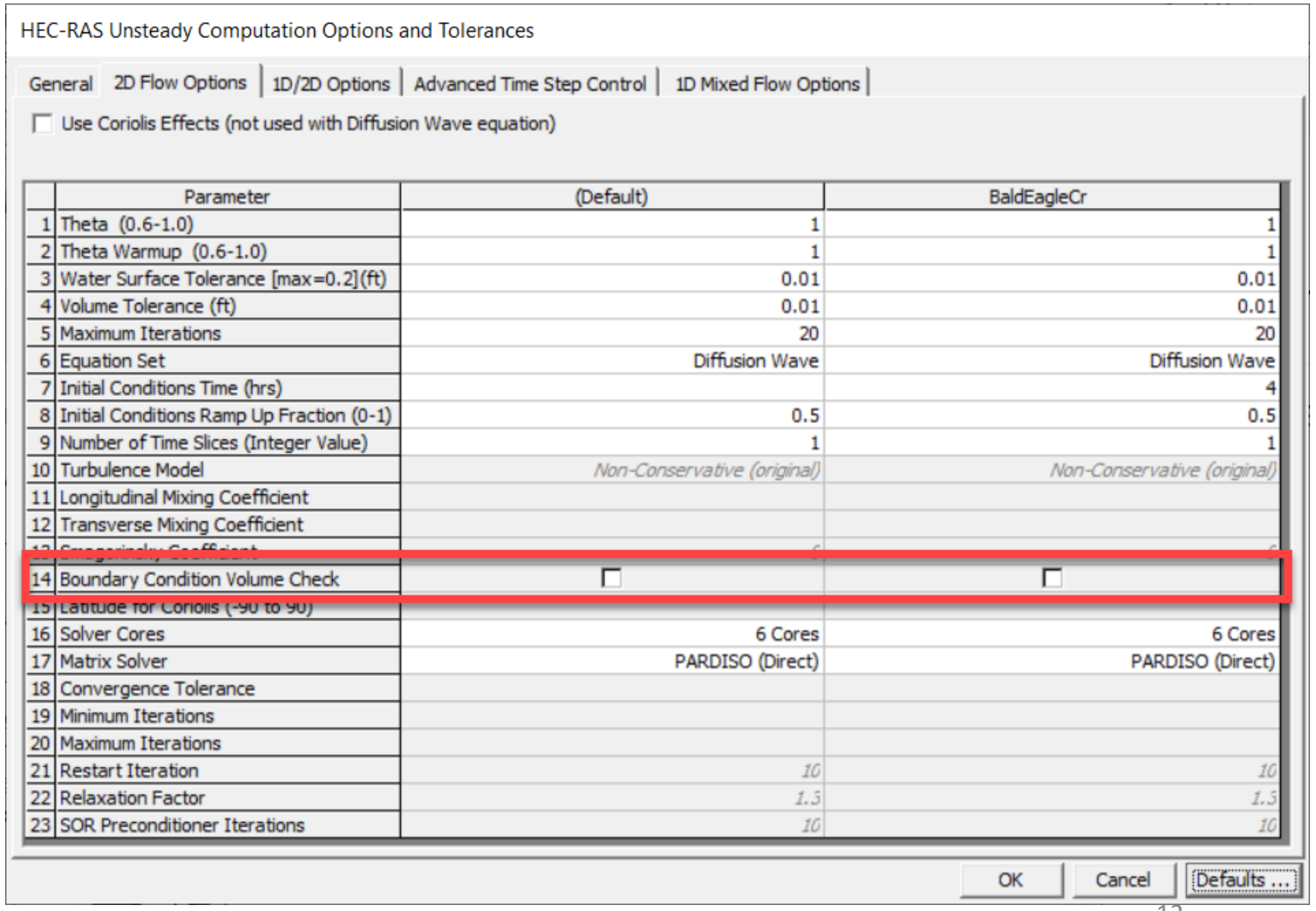
# Computation Options

- Boundary Condition Volume Check

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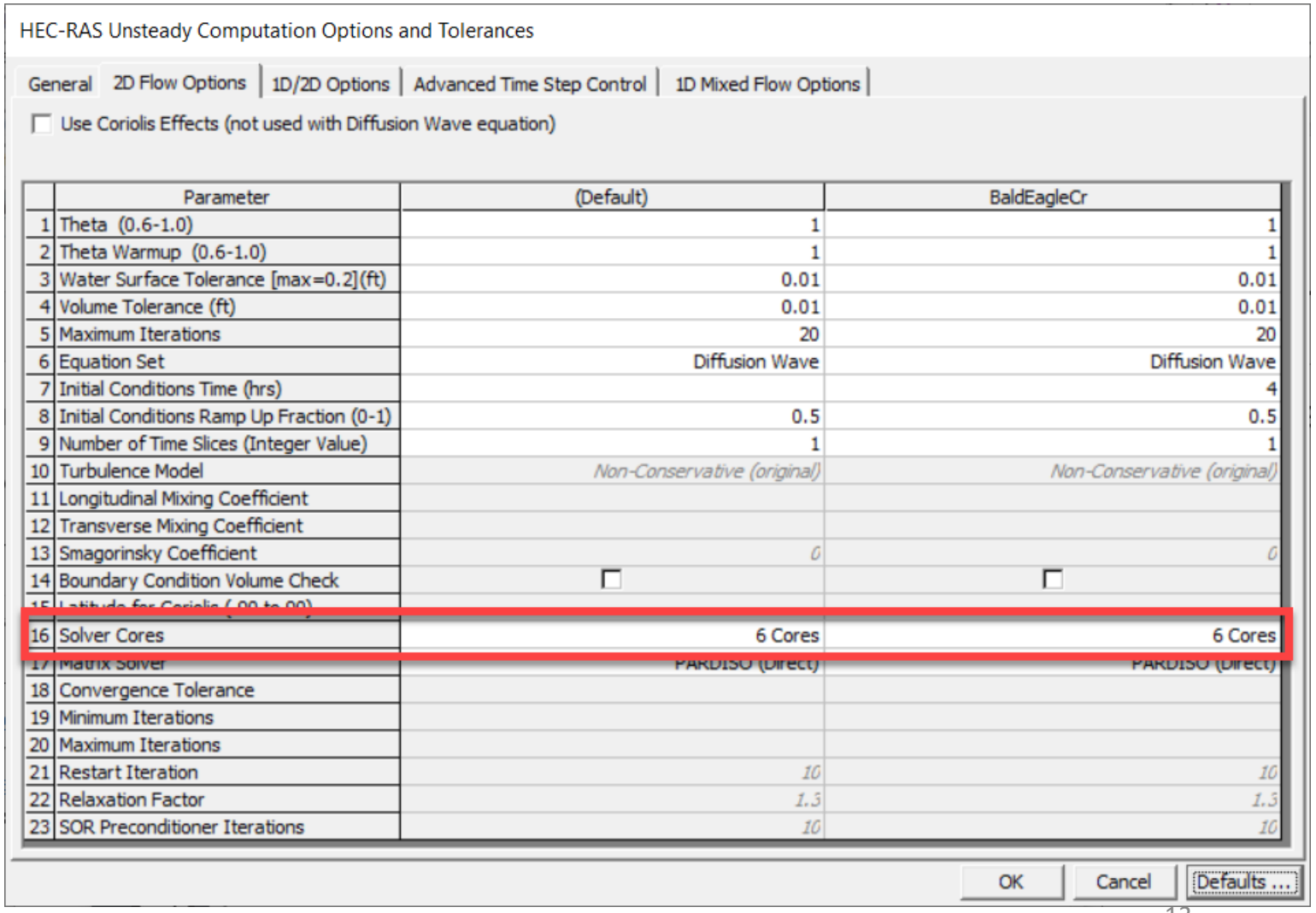
# Computation Option

- Number of Cores

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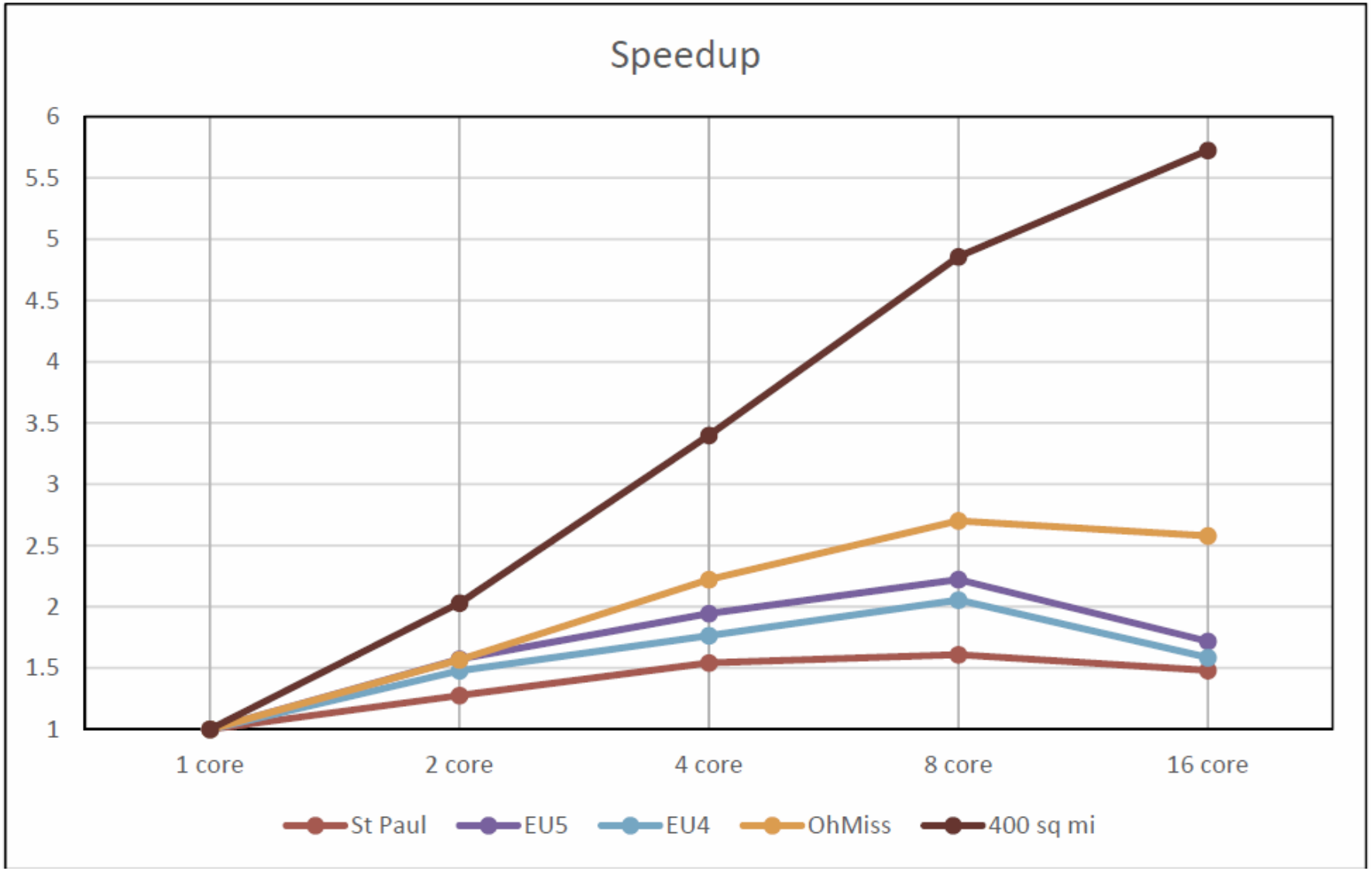
# Processing Time vs Number of Cores



# Cell Size

- Cell size determination is based on
  - Land surface features of the Terrain
    - Faces control water movement
  - Water Surface Slope
    - Capturing localized effects in model requires smaller cell sizes (analogous to cross section spacing for rapidly varied flow).
- Start with a “large” cell size and refine the model through iteration.
- You always test different cell sizes to see what affect they have on water surfaces and velocities.

# Time Step

- Time Step selection will be based on the size of the grid cells and velocity of water in the cells.
- Dependent on Equation Set selected
  - Diffusion Wave approximation
  - Full Shallow Water Equations

$$S_f = S_o - \frac{\partial y}{\partial x} - \frac{V}{g}\frac{\partial V}{\partial x} - \frac{1}{g}\frac{\partial V}{\partial t}$$

# Time Step

- Full Shallow Water Equations
  - Experience shows, max C = 3.0

$$C = \frac{V * \Delta T}{\Delta X} \leq 1.0$$

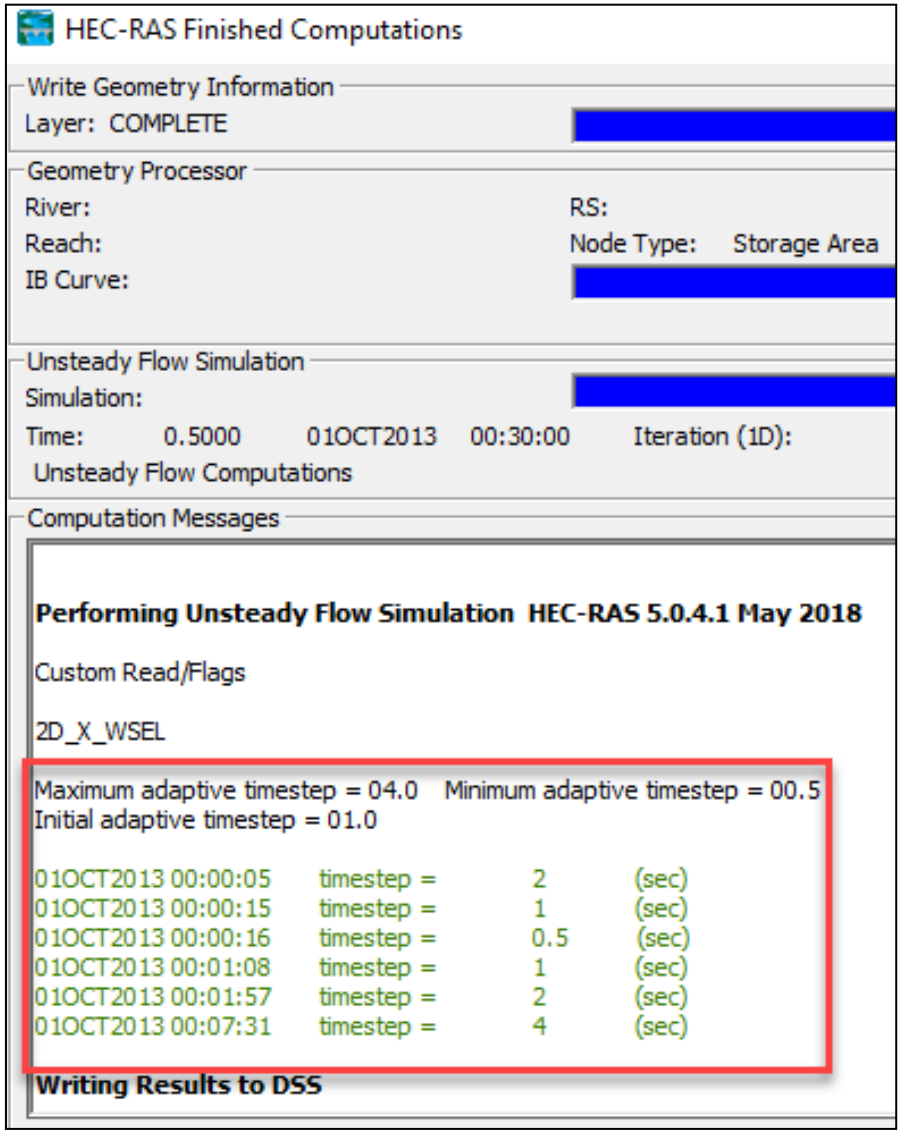
- Diffusion Wave Approximation
  - Experience shows, max C = 5.0

$$C = \frac{V * \Delta T}{\Delta X} \leq 2.0$$

| | | |
|---|---|---|
| C | = | Courant Number |
| V | = | Velocity of the Flood Wave (ft/s) |
| ΔT | = | Computational Time Step (seconds) |
| ΔX | = | The average Cell size (ft) |

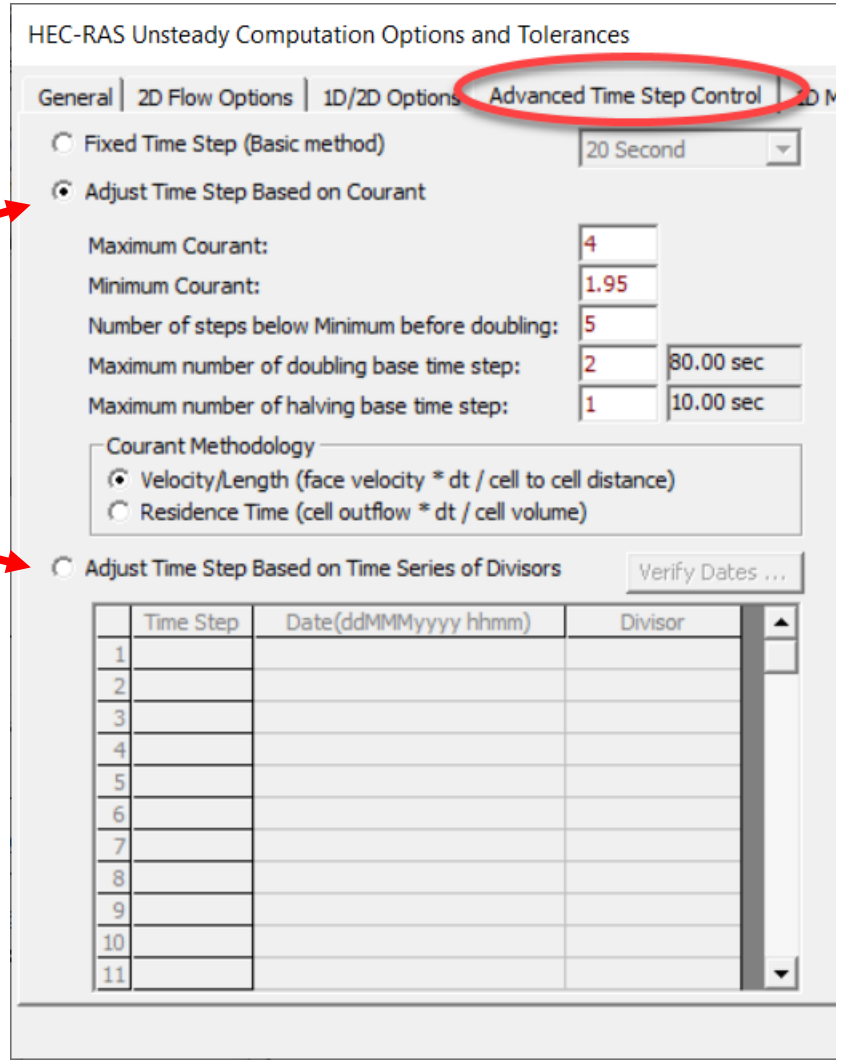
# Variable Time Step

- Reduce time step to improve accuracy
- Increase time step to reduce computation times



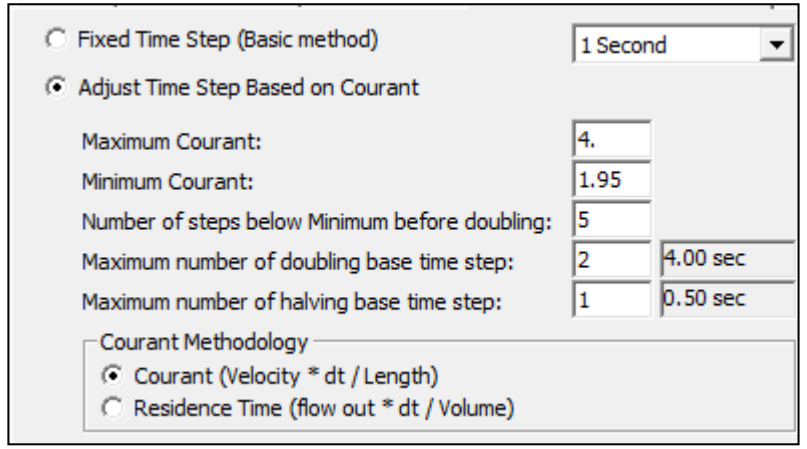
# Time Step Options

- Fixed Time Step (default)
- Adjust Time Step Based on
  - Courant Number
  - Date/Time and a Time step divisor



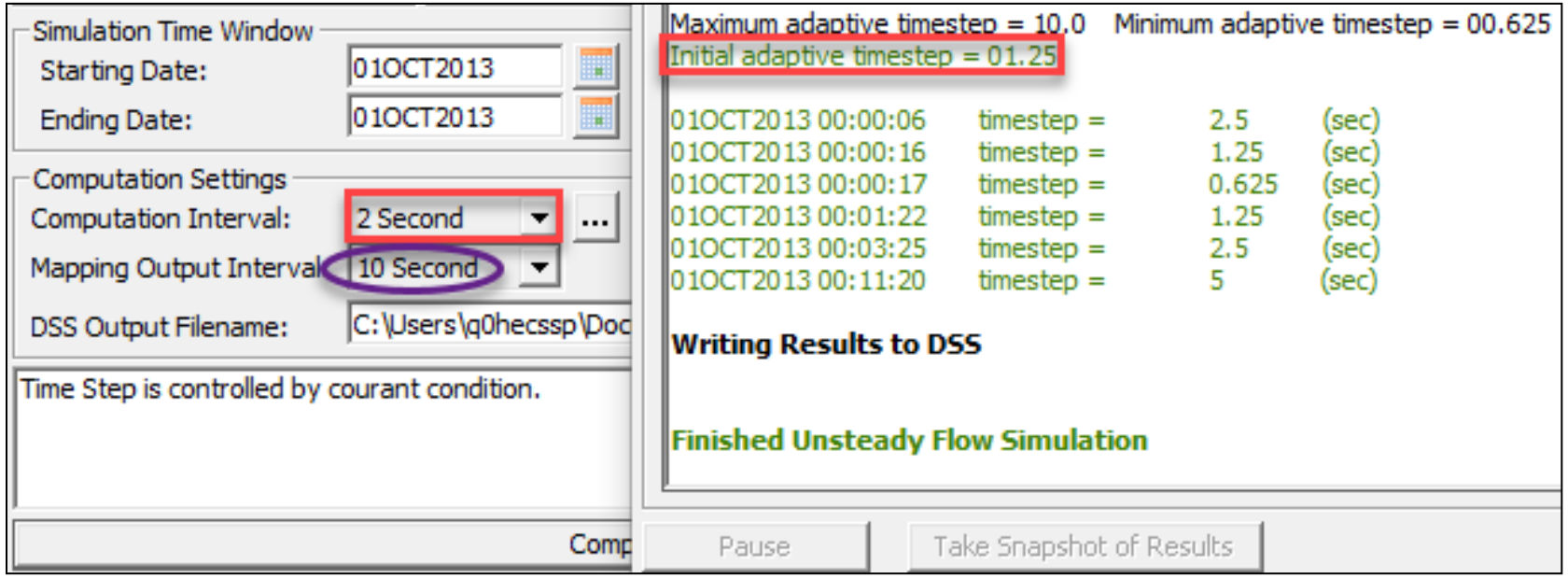
# Variable Time Step

- Maximum Courant before halving time step
- Minimum Courant before doubling time step
  - **Min < ½ Max !**
- Number of steps before doubling
- Maximum number of doubling
- Maximum number of halving
- Courant (default) or Residence Time



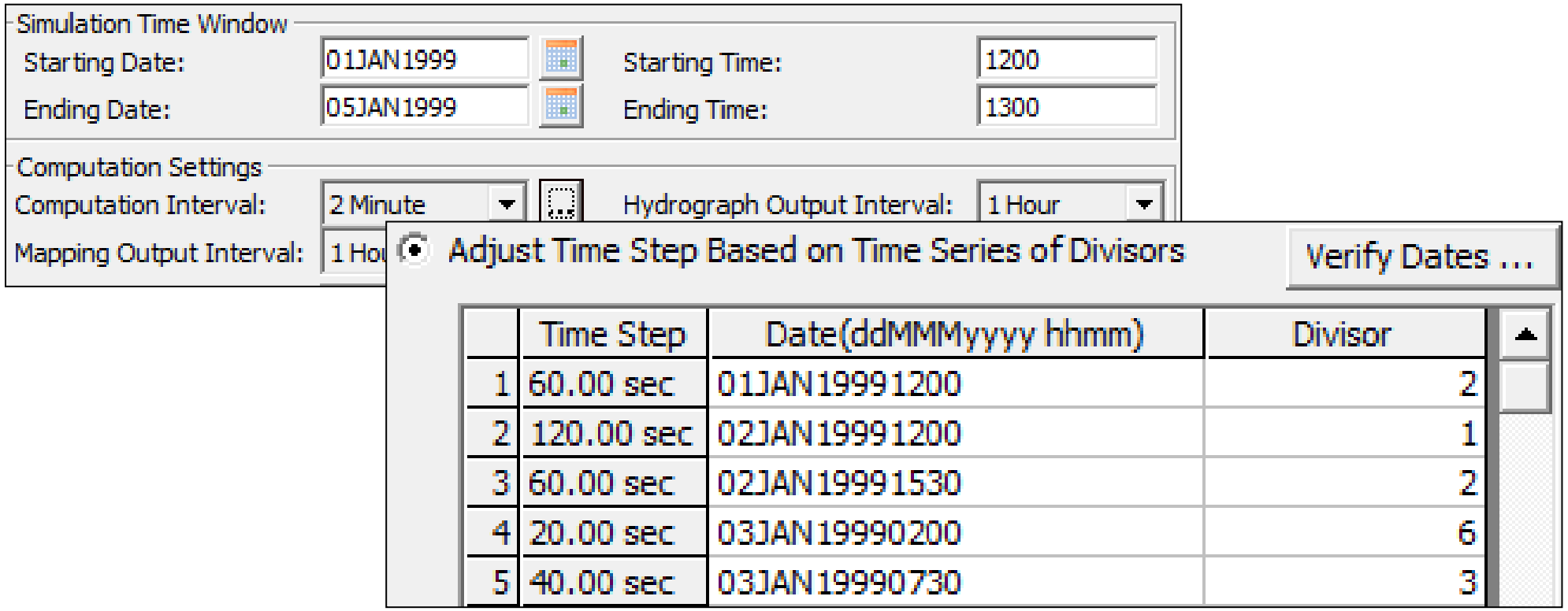
# Mapping Output Interval

- Adaptive time step is always integer interval of Mapping Output Interval, so Unsteady may need to adjust base Computation Interval



# Time Series of Divisors

- Control time step length by date
- Enter integer halving divisor to reduce time step



# Questions?

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