Hydrodynamic Modeling

Models

- Regression
- Genetic
- Neural Networks
- PHYSICS MODELS

Strictly limited to their training

Physics Models

- Equation Set
- Computer Code
- Discrete Model

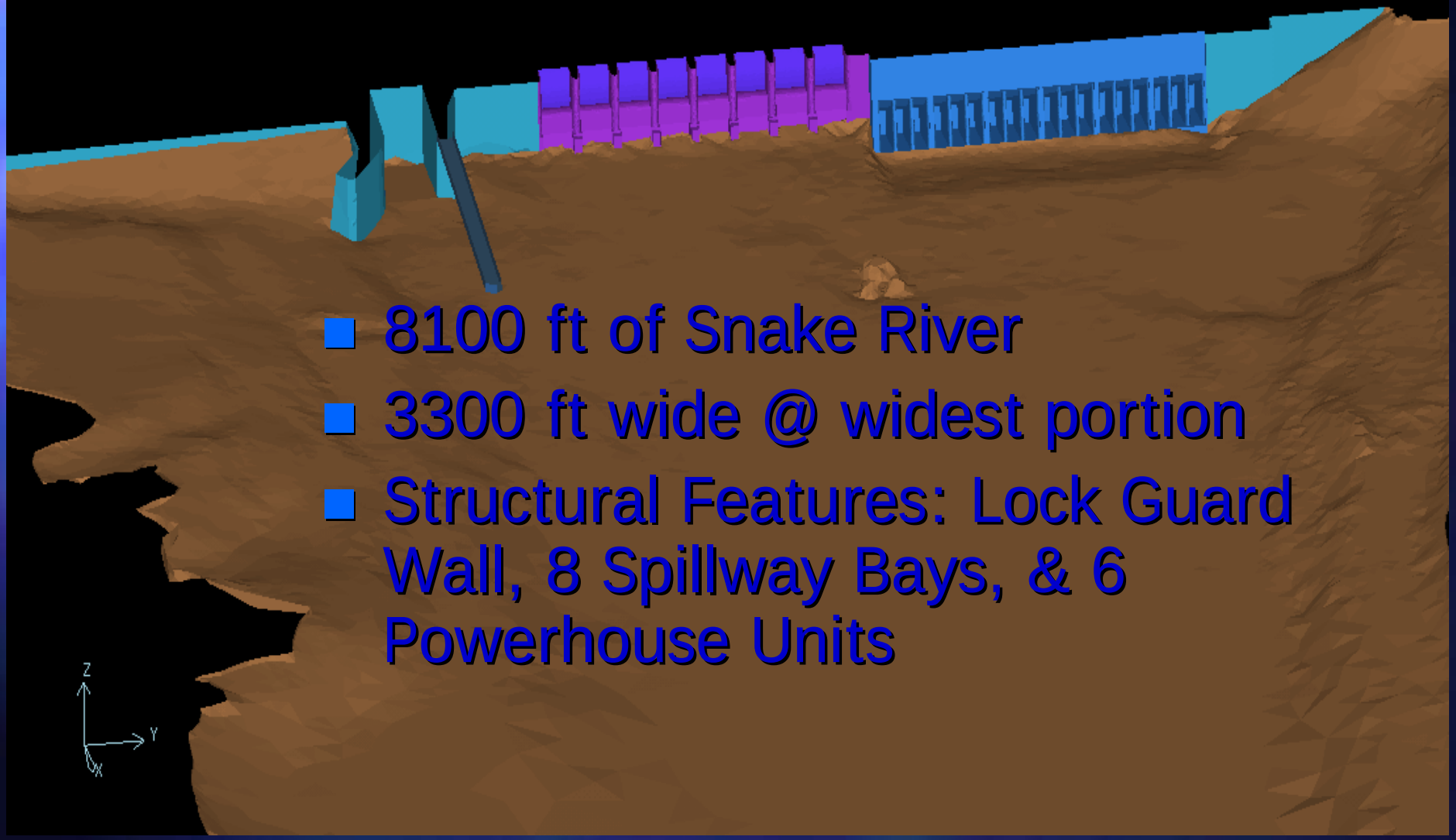
Physics Models

- Diagnostic Modeling
  - Qualitative Behavior?
  - Parameters artificially adjusted
    - Right answer for the wrong reasons
  - Limited utility
    - Within training data limits
- Predictive Modeling
  - Qualitative Behavior
  - Parameters adjusted within uncertainty
  - Physics represented

Hydrodynamic Model Equation Sets

- Navier Stokes – Nonhydrostatic
  - Typically near structures
  - Fine details of flow
- Shallow Water – Hydrostatic
  - 3D Salinity intrusion, open channel currents
  - 2D Elevation – horizontal distribution assumed
  - 2D Plan – vertical distribution assumed
  - 1D Cross-sectional information
- Hydrology
  - Velocity determined only by water surface or bed slope

Lower Monumental Model



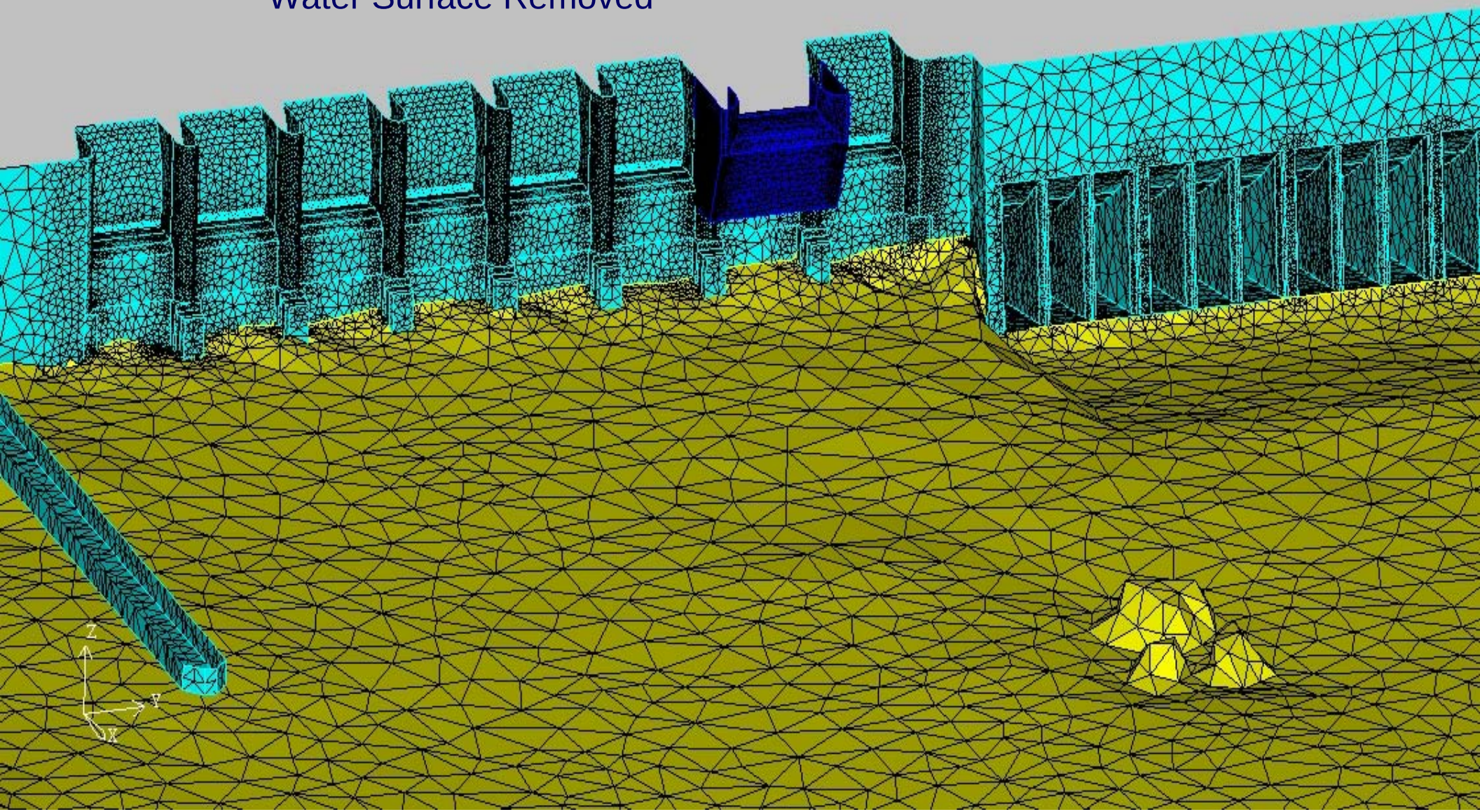
- 8100 ft of Snake River
- 3300 ft wide @ widest portion
- Structural Features: Lock Guard Wall, 8 Spillway Bays, & 6 Powerhouse Units

Lower Monumental Dam

Case 2 - RSW in Spillway Bay 7

Surface Mesh Near Structure

Water Surface Removed



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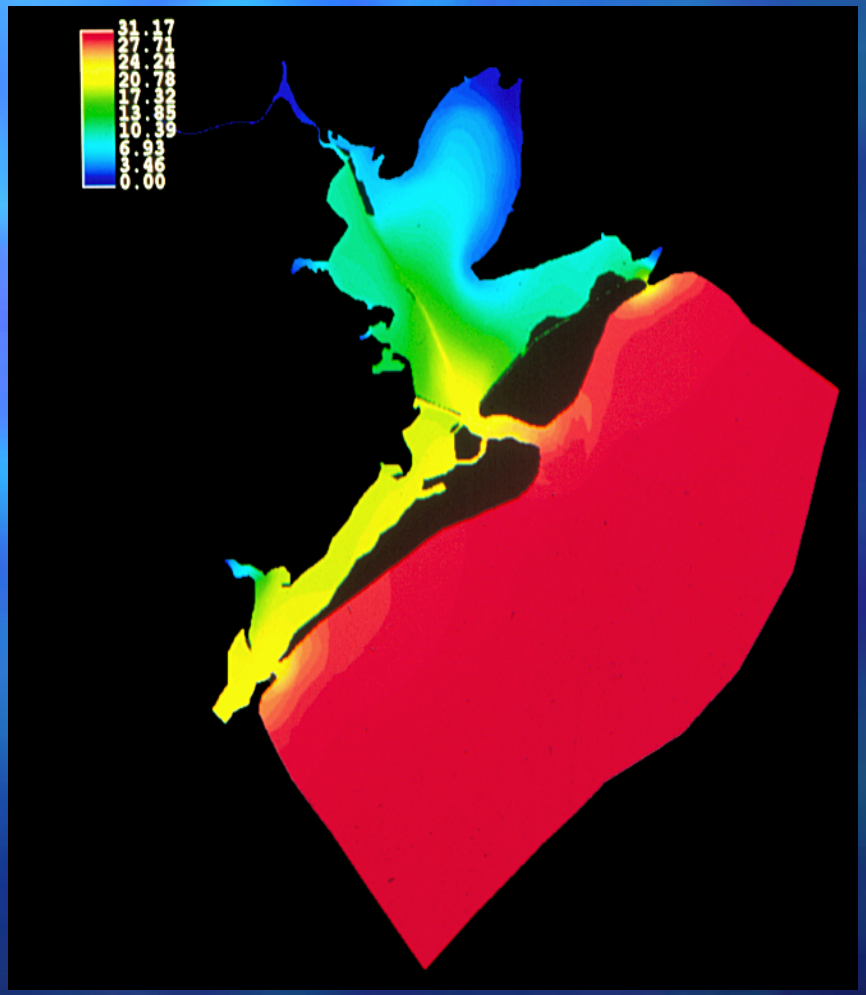
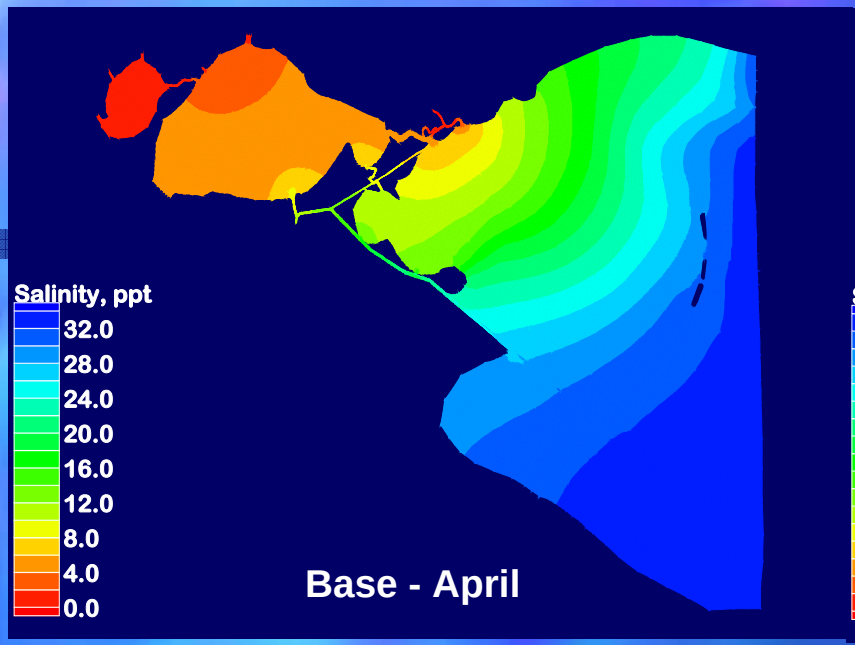
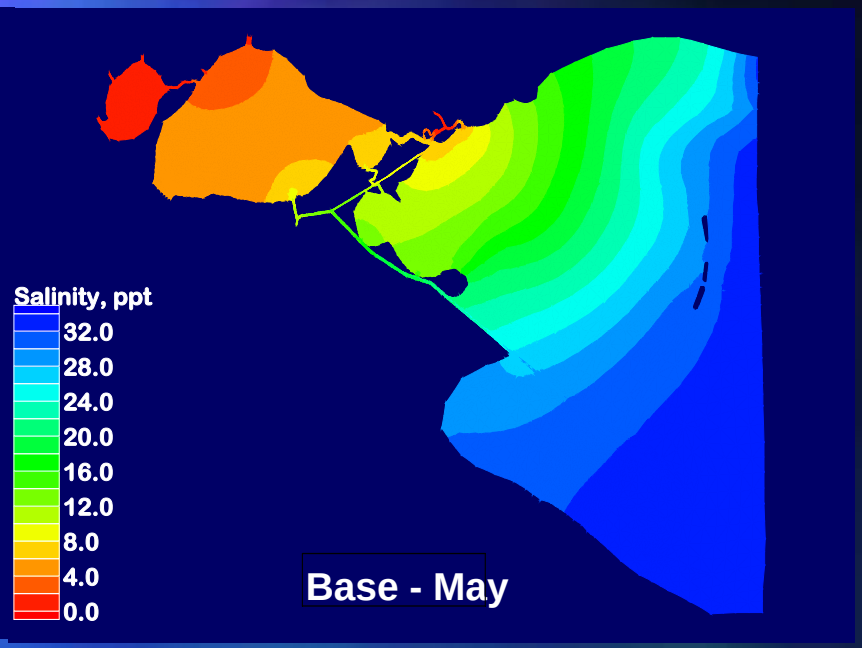
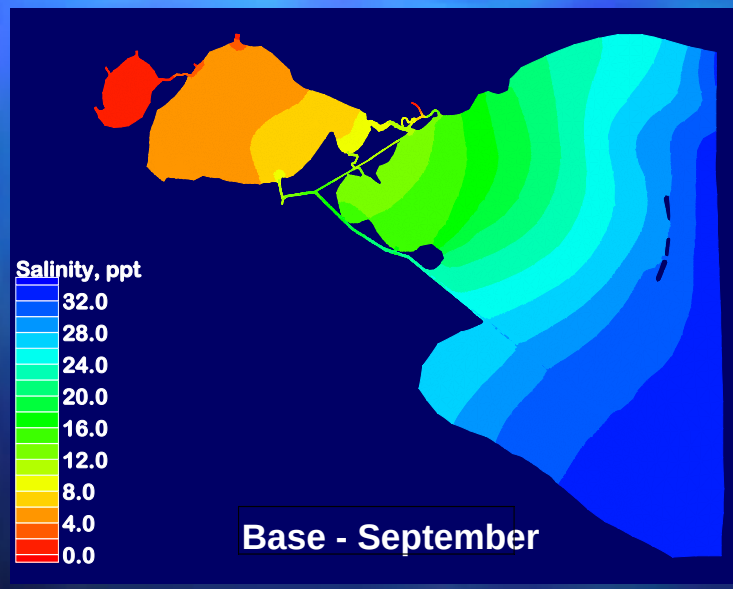
Galveston Bay Salinity Intrusion

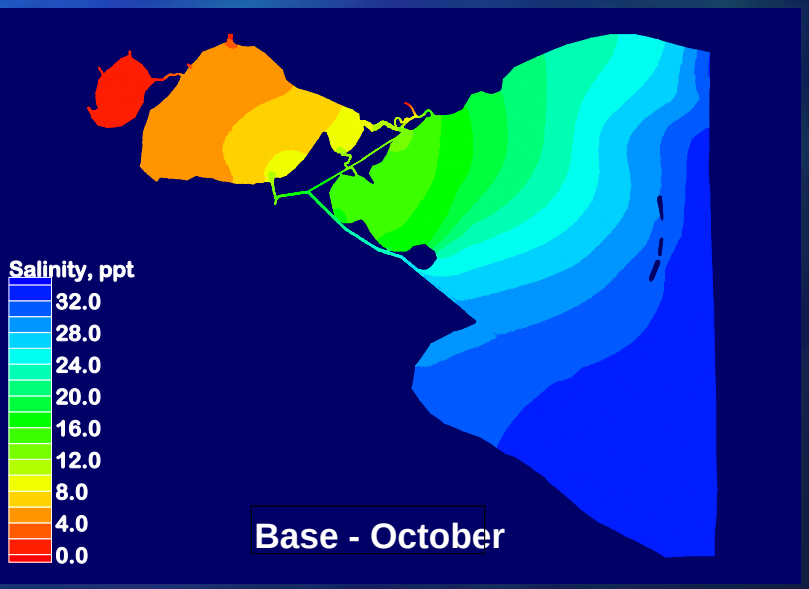


Salinity Concentration – Base Conditions









Do the equations apply?

Hydrostatic Assumption

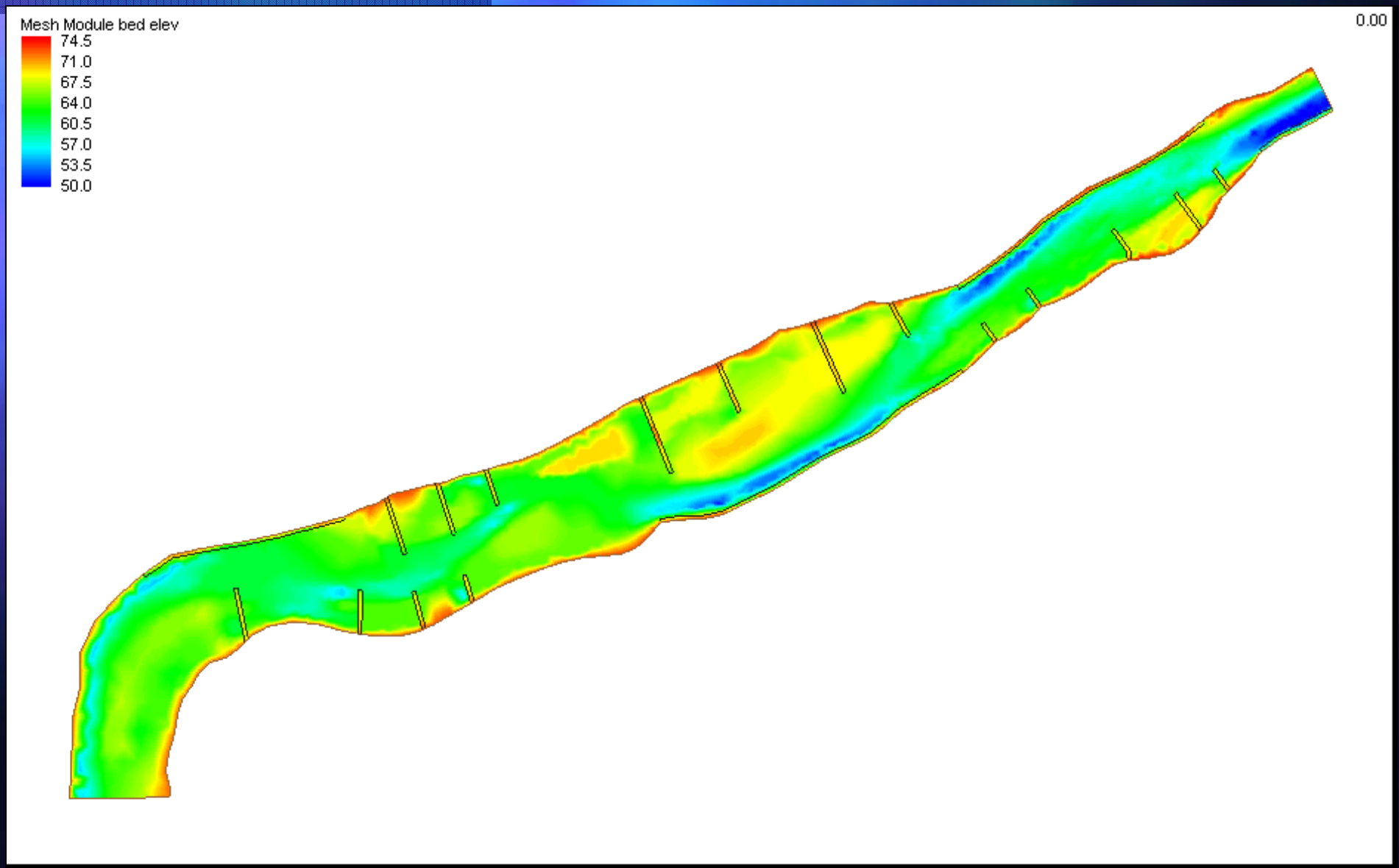
Density Effects

Hydrostatic Fluid Spreads

Real Fluid Drops

Kate Aubrey – Bed Elevation

(Click image to run video.)



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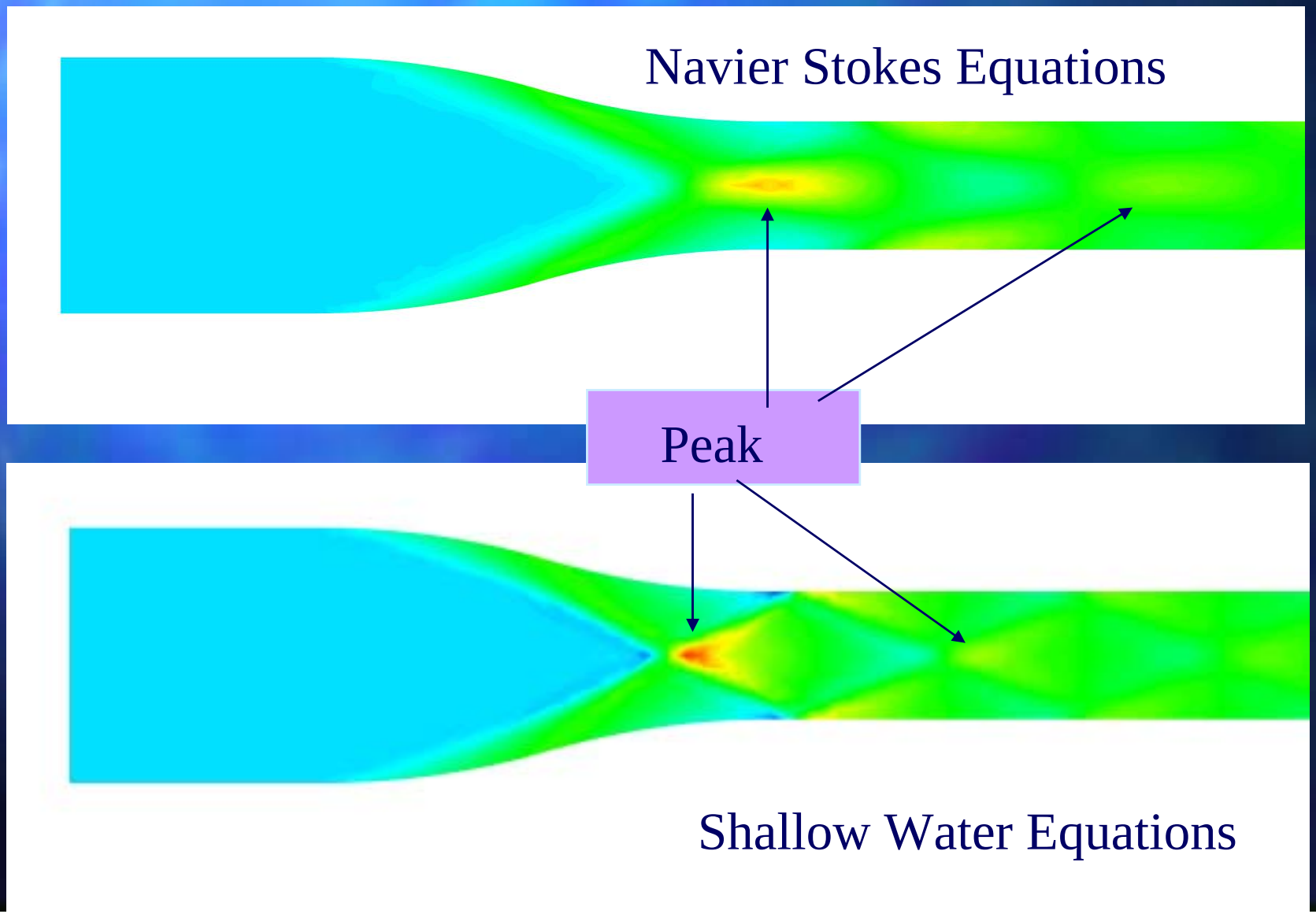


Sediment Properties Editor: Sediment Reach

Sediment Transport

File Options View Help

Sediment Reach | Cross Sections | Sediment Boundary Condition

Sediment Reach: Upper Main

River: Main US RS: 8500

Reach: Upper DS RS: 5500

Class	diam (mm)	% finer
1. Clay	0.004	10
2. VFM	0.008	15
3. FM	0.016	17
4. MM	0.032	35
5. CM	0.0625	43
6. VFS	0.125	52
7. FS	0.25	61
8. MS	0.5	68
9. CS	1	74
10. VCS	2	85
11. VFG	4	94
12. FG	8	97

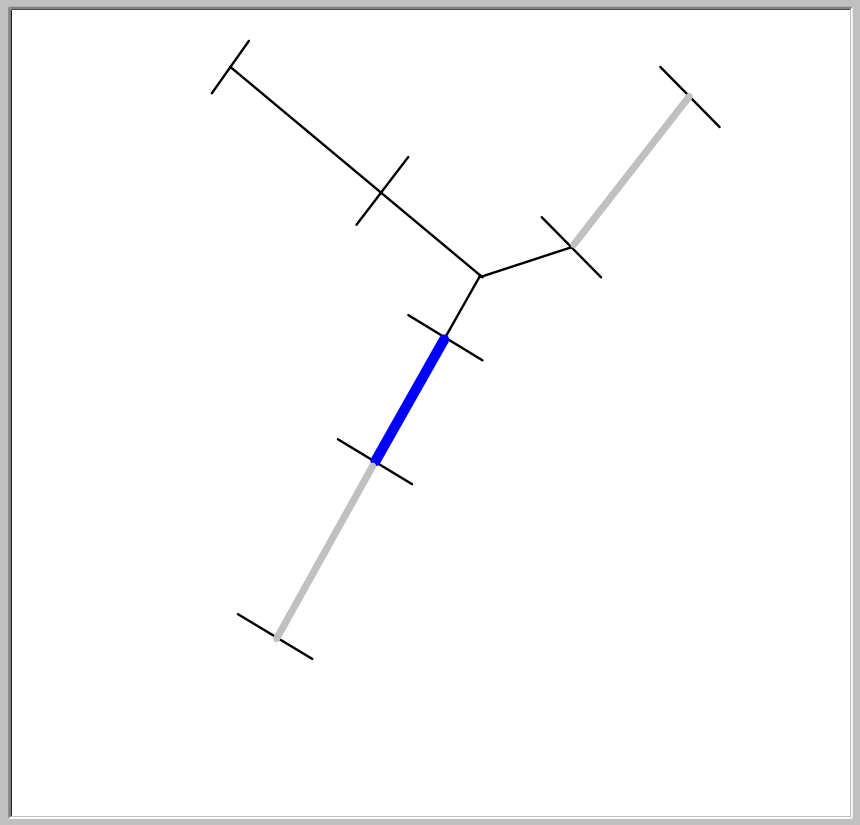
a-b

Set Clay Properties

Set Silt Properties

Transport Functions

- Ackers - White
- England - Hansen
- Laursen (Copeland)
- MPM
- Toffaleti
- Yang



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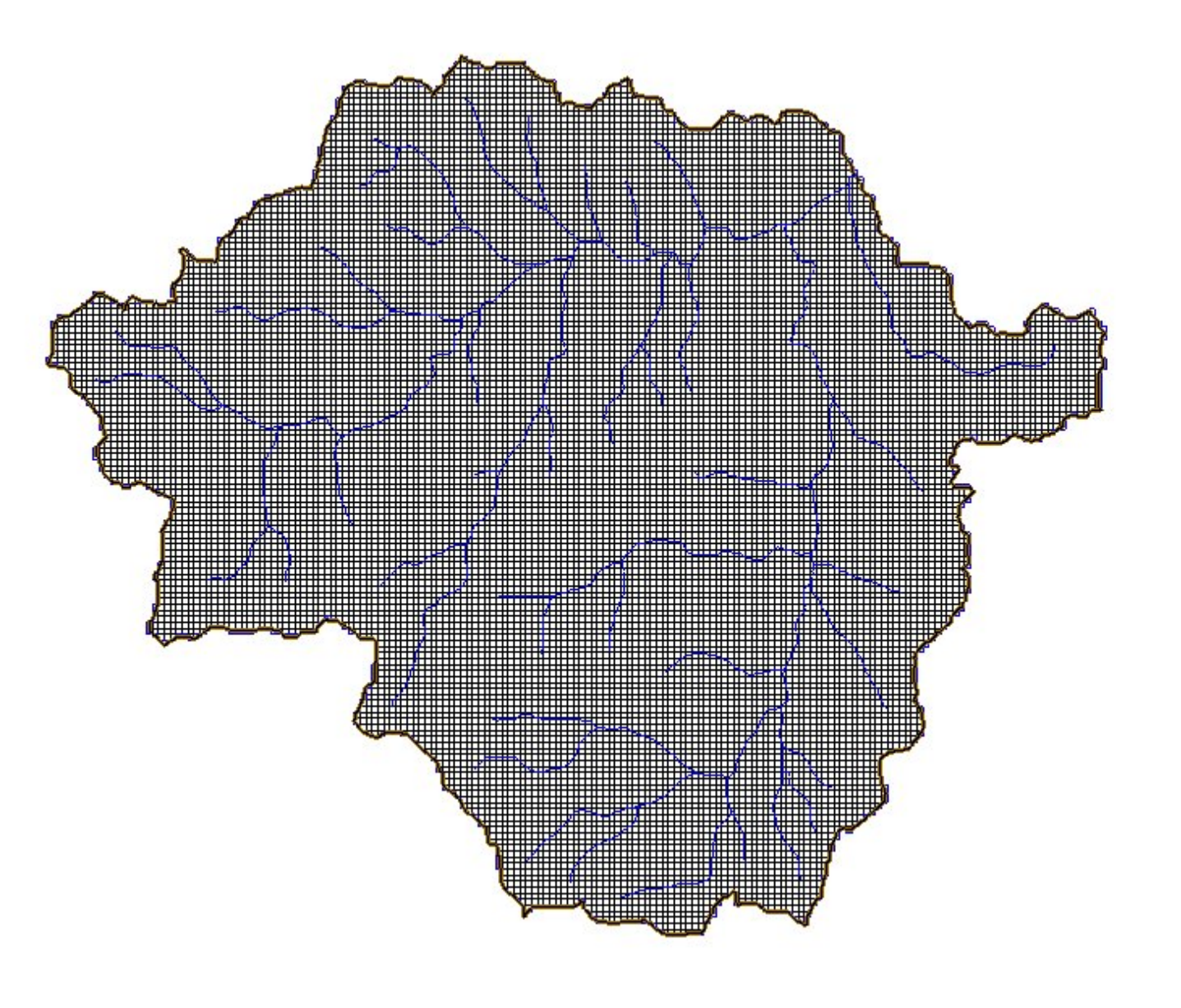
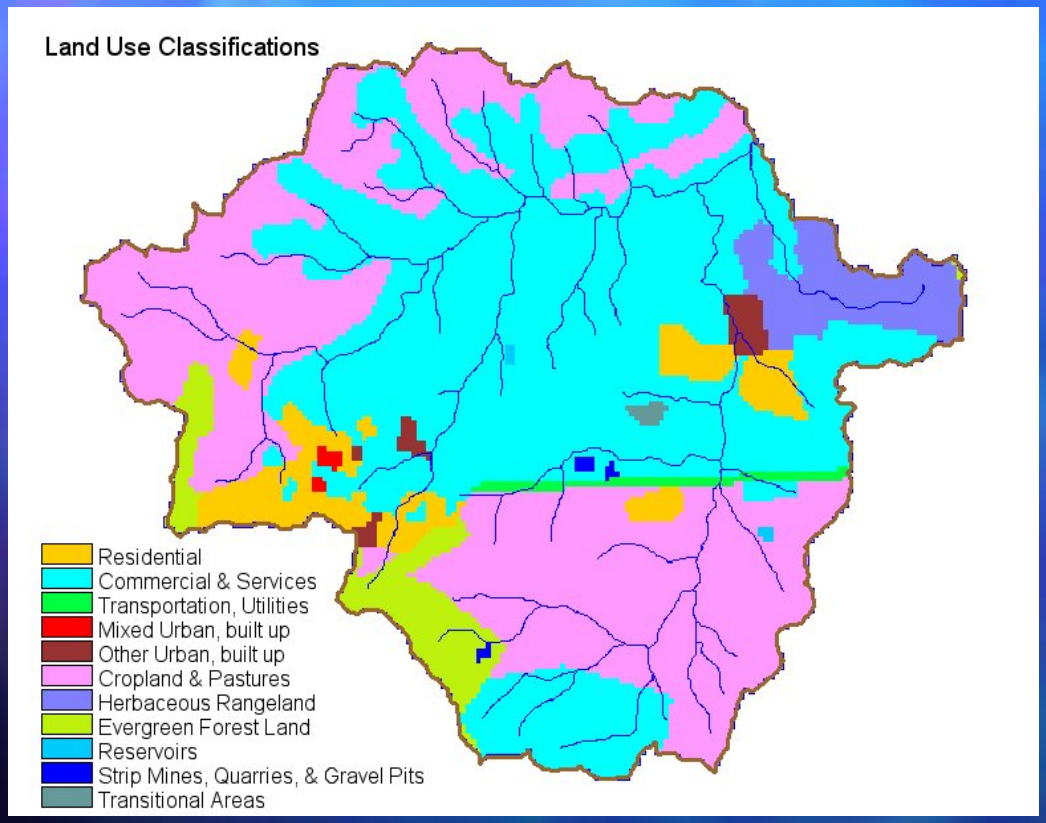
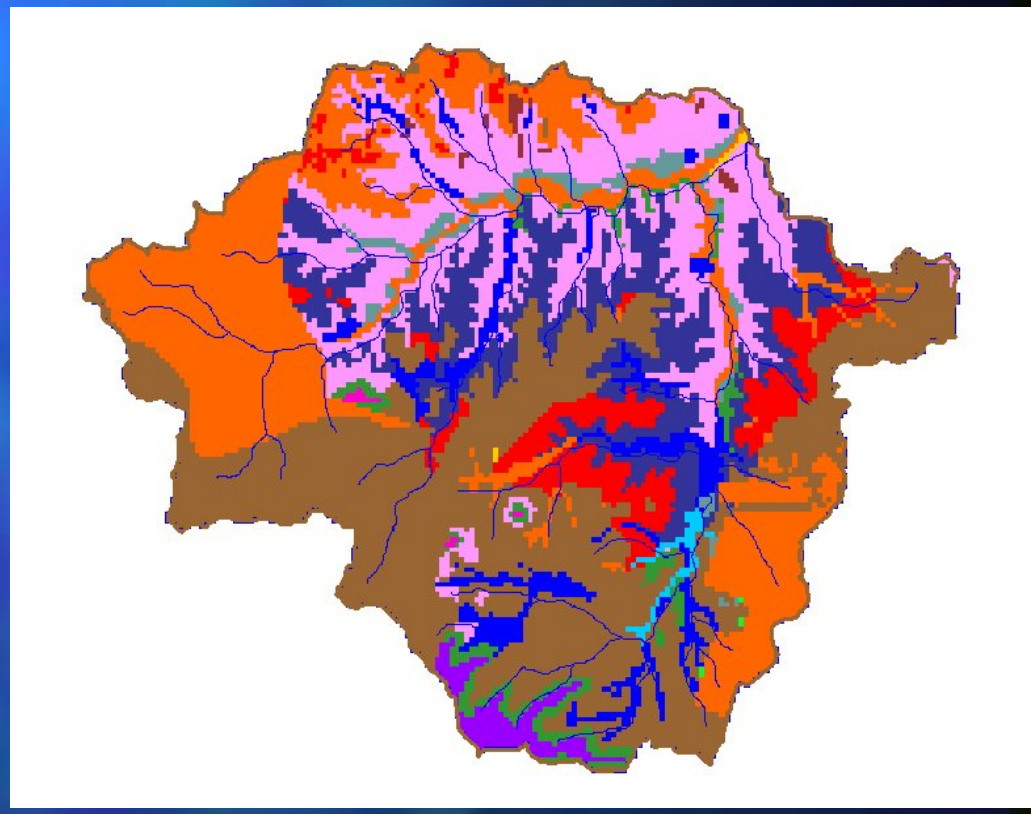
GSSHA Processes



Input Parameters

GIS land use and soil type coverages are used to drive the spatial input of parameters.

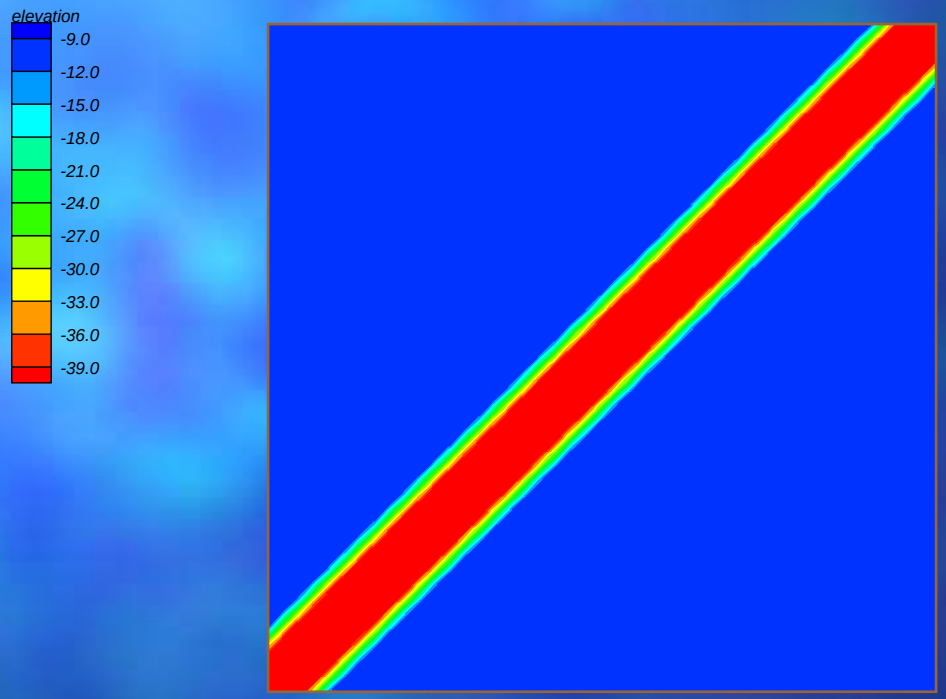




Common Features

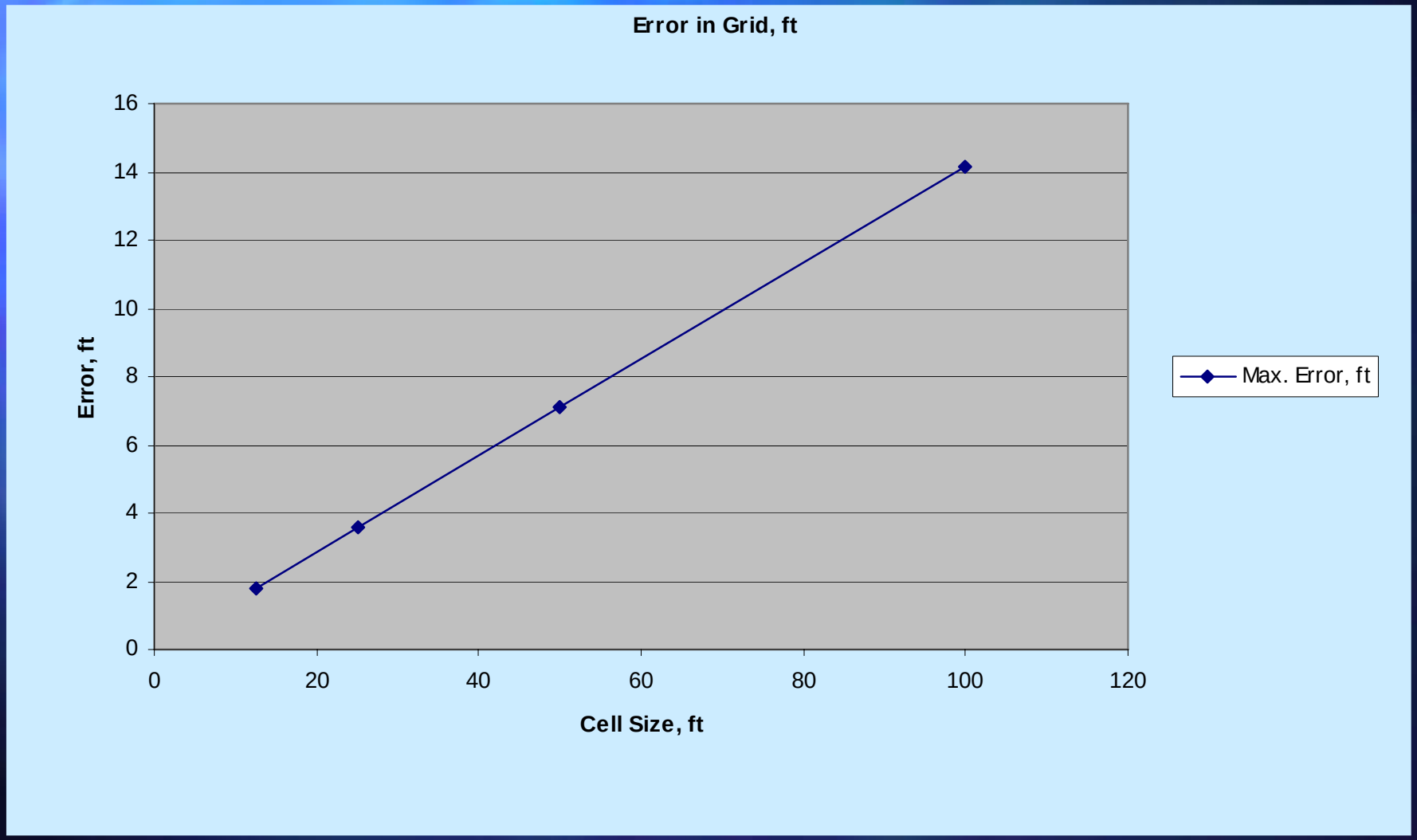
- Discrete nature requires sufficient resolution to reproduce model equations
- Predicting new condition (structures, channels, ...) requires higher level of simulation
- Reducing uncertainty

Discrete Model?
Example Channel Bathymetry

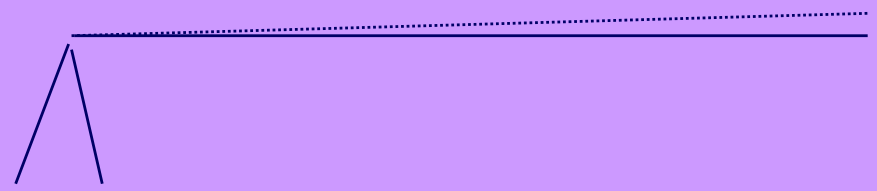


5000 ft square, with channel 400 ft wide, 1V:5H side slopes, at 45 degree angle.

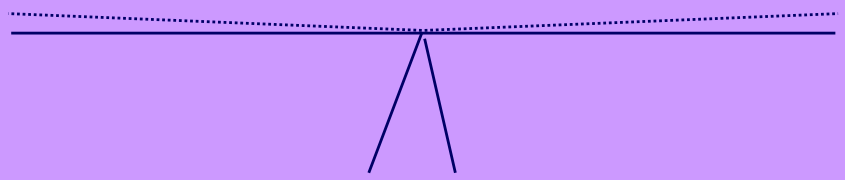
Discrete Model?
Error in Grid Depth



Testing
Reduce Uncertainty



One sided level



Balanced two sided level

Compare Model to Model (plan vs. plan, plan vs. base)

Modeling Checklist

- Discrete Model
  - Setup
    - Are the boundaries appropriate?
    - Does the grid adequately represent the equations?
  - Validation
    - Are the parameters selected based upon physical characteristics?
    - Are the parameters reasonable?
  - Sensitivity
    - Are the results highly sensitive to any of these parameters?
  - Testing
    - Is the testing setup to reduce uncertainty (plan vs. base style)?