User Interfaces:
Workflow Control and Automation

FLOW-3D FLOW-3D CAST
FLOW-3D MP FlowSight™

Workflow Control and Automation

- Setup
- Simulate
- Post-process

Expanding Geometry Import Functionality

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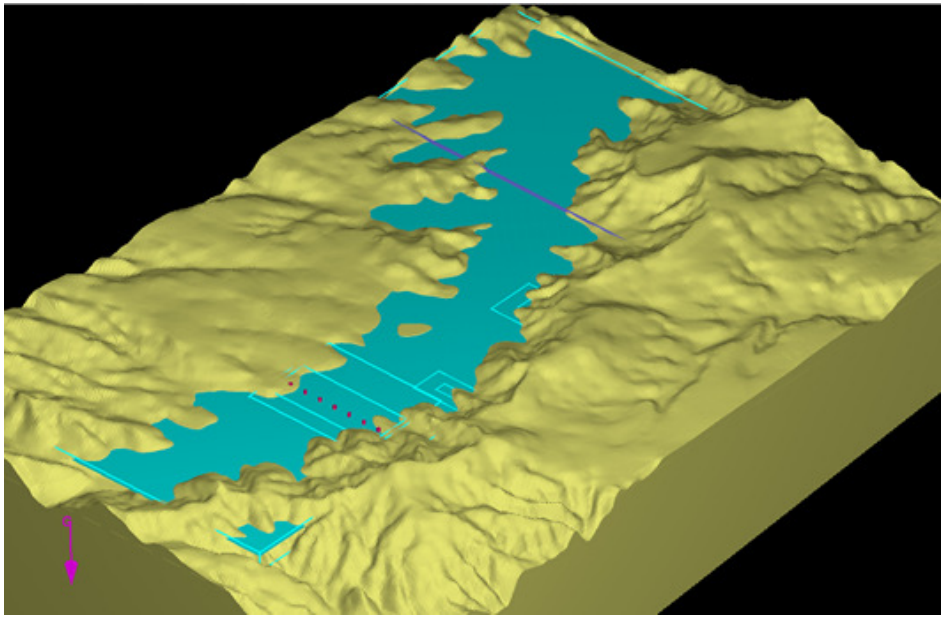
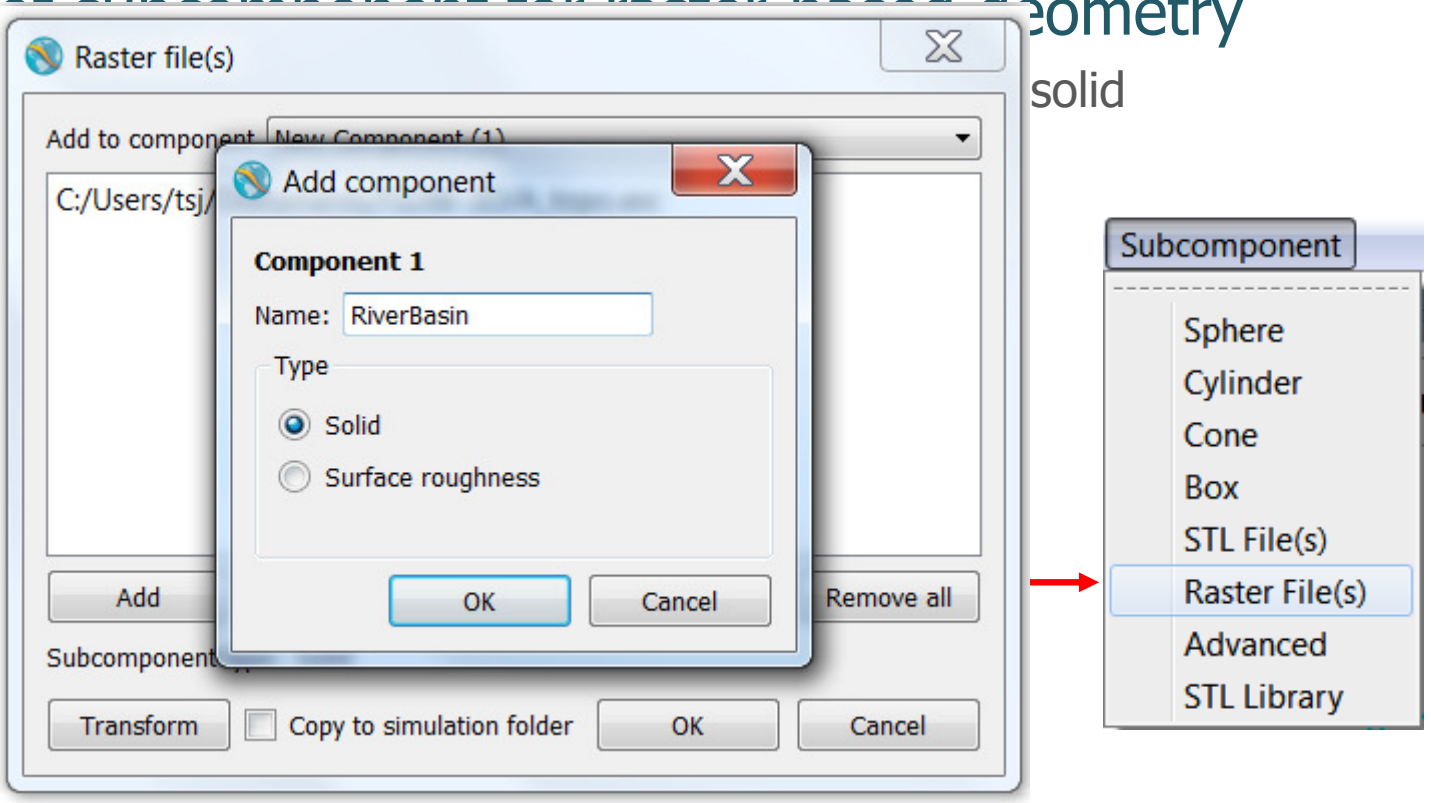
Motivation

- Water & environmental users typically deal with topography files, not STLs, but ***FLOW-3D*** solver requires STL format.
- Raster files are commonly used in GIS programs to encode geographic data
  - Topography
  - Roughness
- Converting raster files to STL is not simple

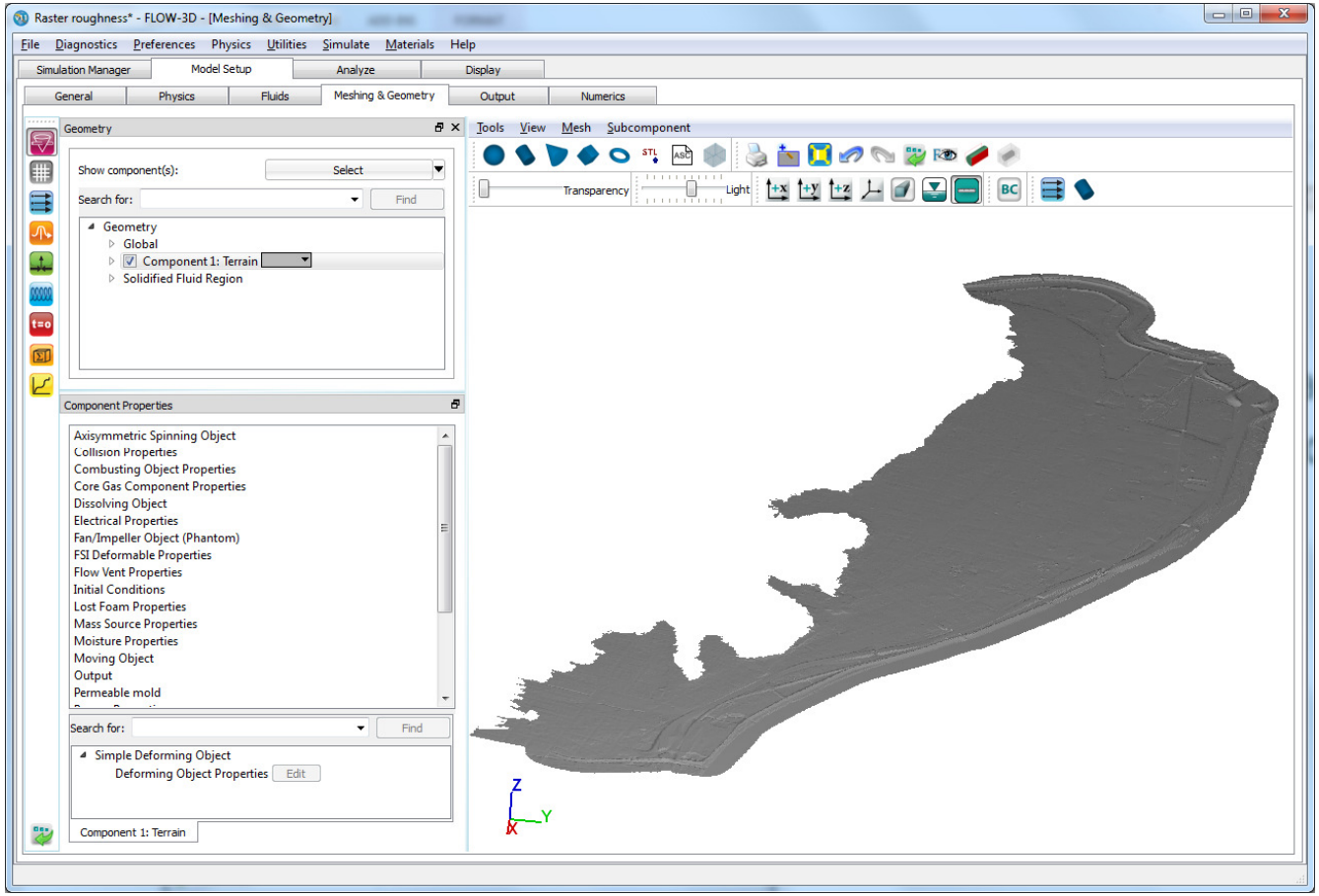


Using Raster-Based Geometry

- New type of subcomponent for raster-based geometry
  - Primitives solid componer
- Adding ras
  - New Subc
  - New icon



Display of Raster-Based Geometry



Raster points are triangulated and used to display a raster-based component.

Raster-Based Roughness

- New raster-based roughness component
  - "Projects" roughness to underlying geometry
  - Does not occupy volume
- Creates a virtual component
- Raster-based roughness ≠ "***FLOW-3D*** roughness"
  - Requires (simple) conversion to global roughness map

Conversion

Description of indices (not used by the solver, for information only)

```
NLCD Land Cover Clasification Legend
Code data:
11 Open water
12 Perennial Ice/snow
21 Developed, Open space
22 Developed, Low Intensity
23 Developed, Medium Intensity
24 Developed, High Intensity
31 Barren Land (Rock/Sand/Clay)
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Dwarf Scrub
52 Shrub/Scrub
71 Grassland/Herbaceous
72 Sedge/Herbaceous
73 Lichens
74 Moss
81 Pasture/Hay
82 Cultivated Crops
90 Woody Wetlands
95 Emergent Herbaceous Wetlands
```

Conversion of indices to ***FLOW-3D*** surface roughness.

E.g. index 43 of land coverage (mixed forest) becomes surface roughness of 7.5 in ***FLOW-3D***

```
Code value      FLOW-3D Roughness value (SI units)
11,0.1
12,0.2
21,1.0
22,2.0
23,3.0
24,5.0
31,0.7
41,5.0
42,10.0
43,7.5
51,1.5
52,2.0
71,0.25
72,0.4
73,0.15
74,0.1
81,0.2
82,0.4
90,,2.5
95,1.5
```

Pre-processed Roughness Map

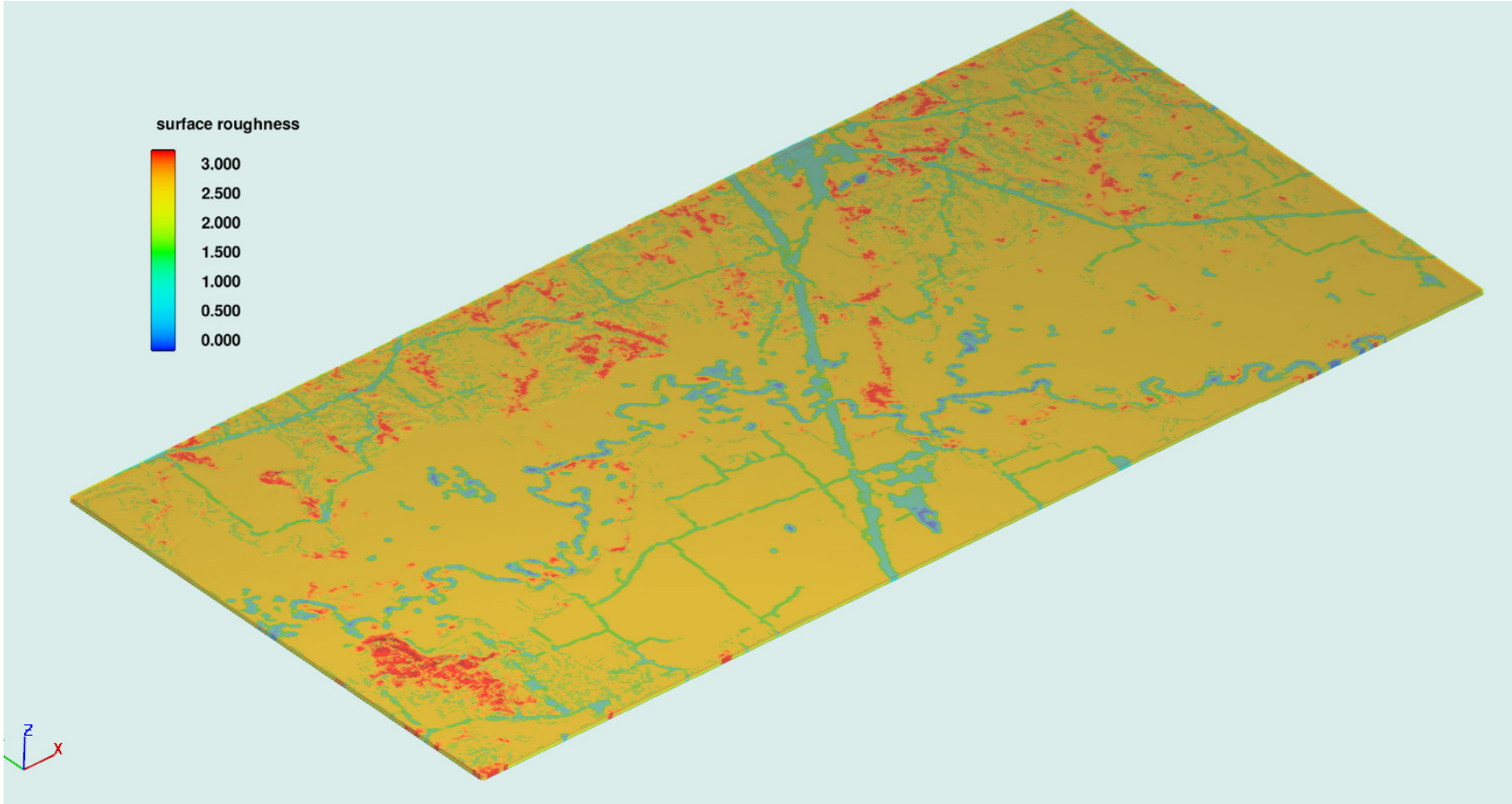
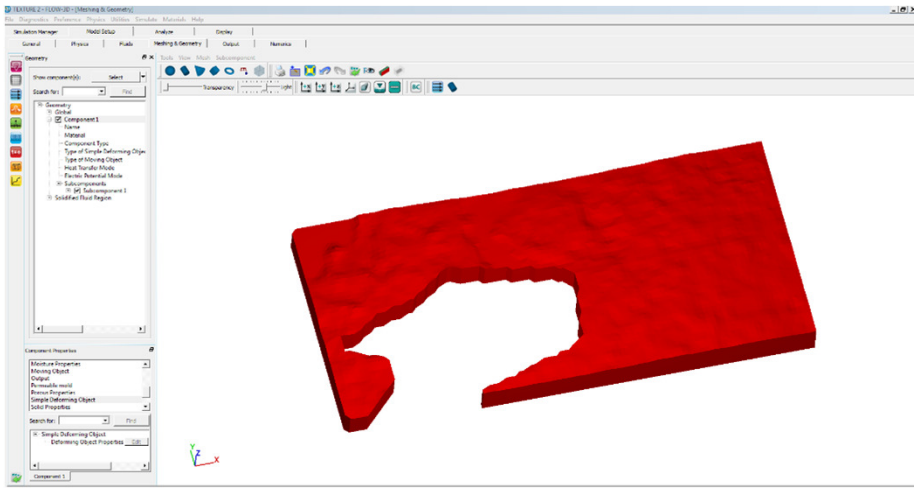
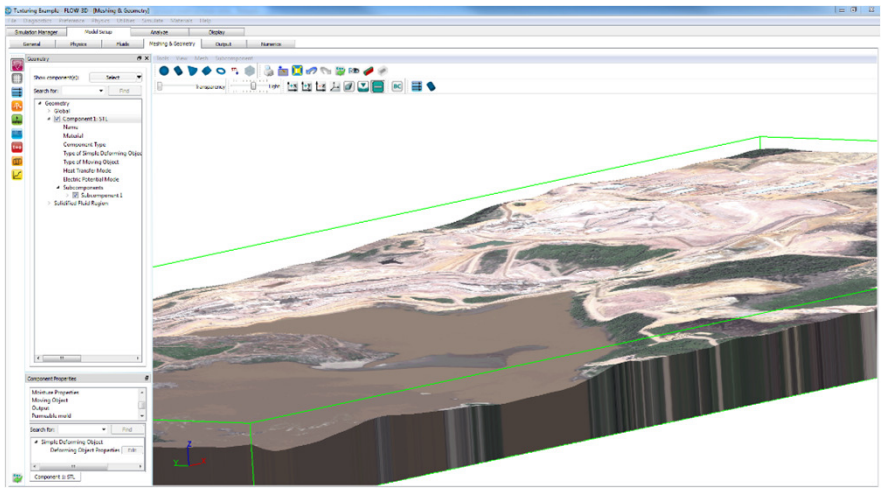


Image Overlay

- Simulations are easier to setup when the users sees the visual context
- Ideally, images used will have same aspect ratio as the geometry, but can be adjusted.

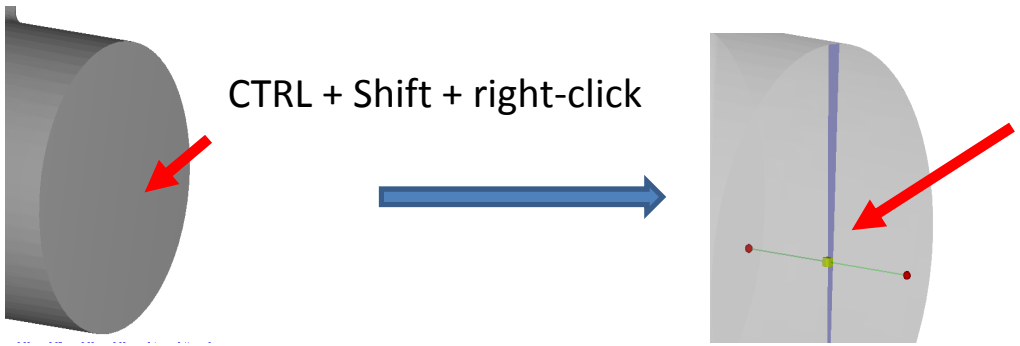




Interactive Model Setup

Interactive Probing

- **Version 11**: Shoots a ray from the eye
  - Probe line follows the ray trace through all intersected surfaces
- **New**: Probe line created normal to surface probed
  - Selects probed surface only
  - Probe line can be extended on both sides of probed surface
  - Probe can be rotated about the probe location



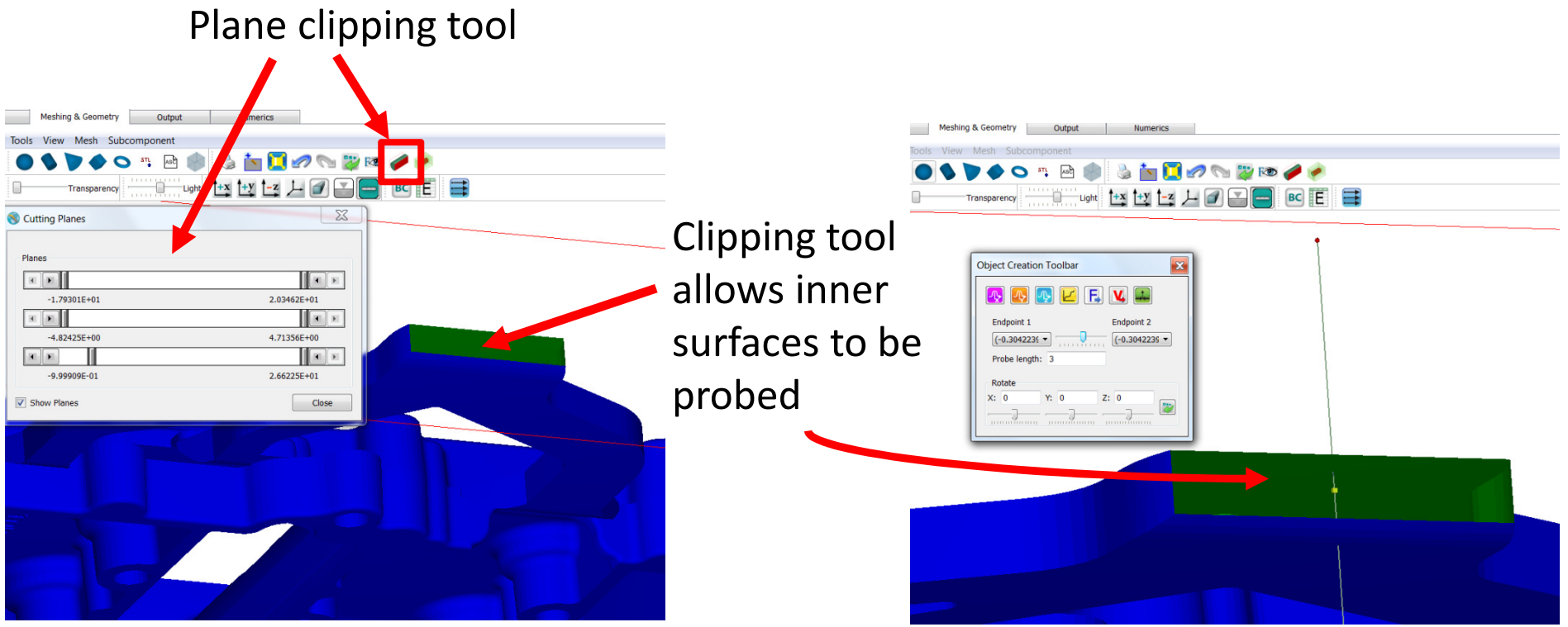
Probe line is created normal to the probed location. The triangle selected is highlighted.

- Existing ray-tracing method remains available.

Interactive Probing: What Can be Created?

- History probes
- Baffles
- Valves/vents
- Void/fluid pointers
- Mass/momentum sources

Probing for Internal Surfaces Using Clipping Planes



Inner surfaces in complex geometries can now be probed directly by opening the geometry using the clipping tools

General Enable/Disable

- Existing: Enable/disable for geometry only
- New enable/disable functions:
  - Mesh blocks
  - Valves
  - Fluid regions
  - Baffles and baffle regions
  - Pointers
  - Particles (all or individual)
  - Probes
  - Springs

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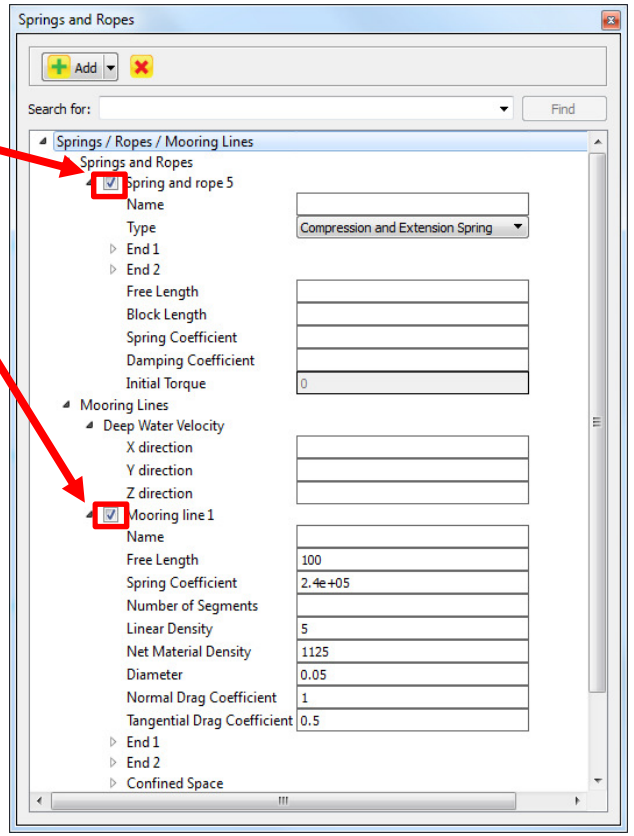
Checkbox Provides General Enable/Disable

- Enable/disable checkboxes in front of objects in trees
- Disabled objects are always written to *prepin* file
- Numbering of objects (whether enabled and disabled) does not change



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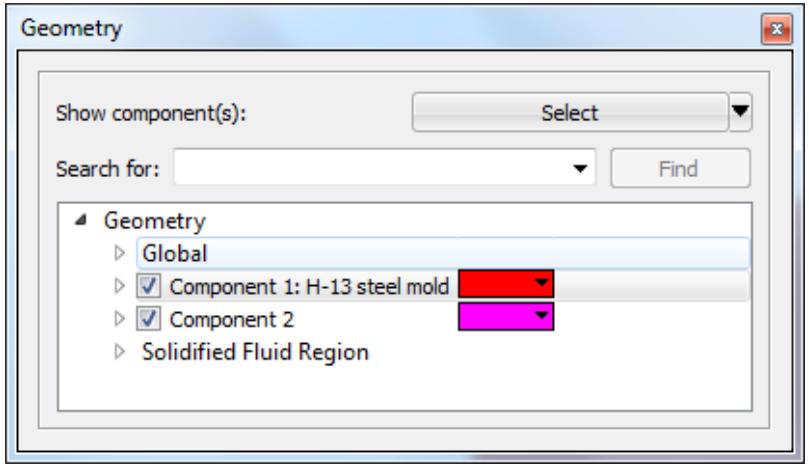
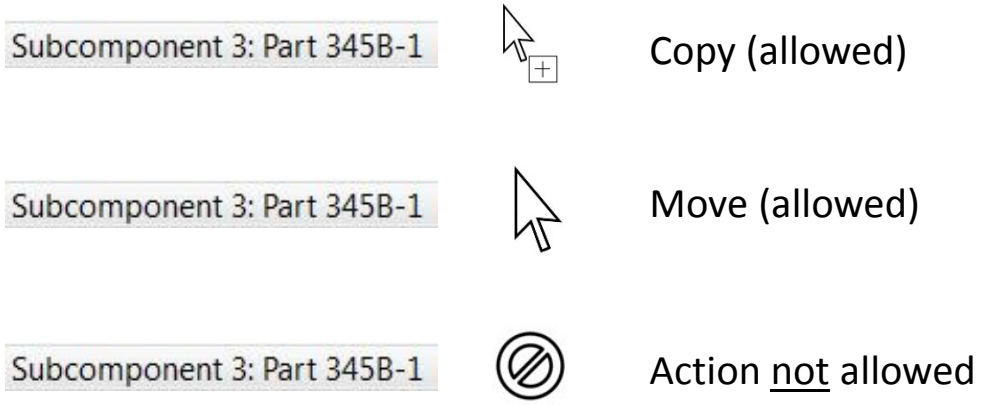
Drag & Drop Reordering

- Components, subcomponents, and mesh blocks can be reordered in the Meshing & Geometry tree structure
- Cursor indicates if the action is allowed during drag





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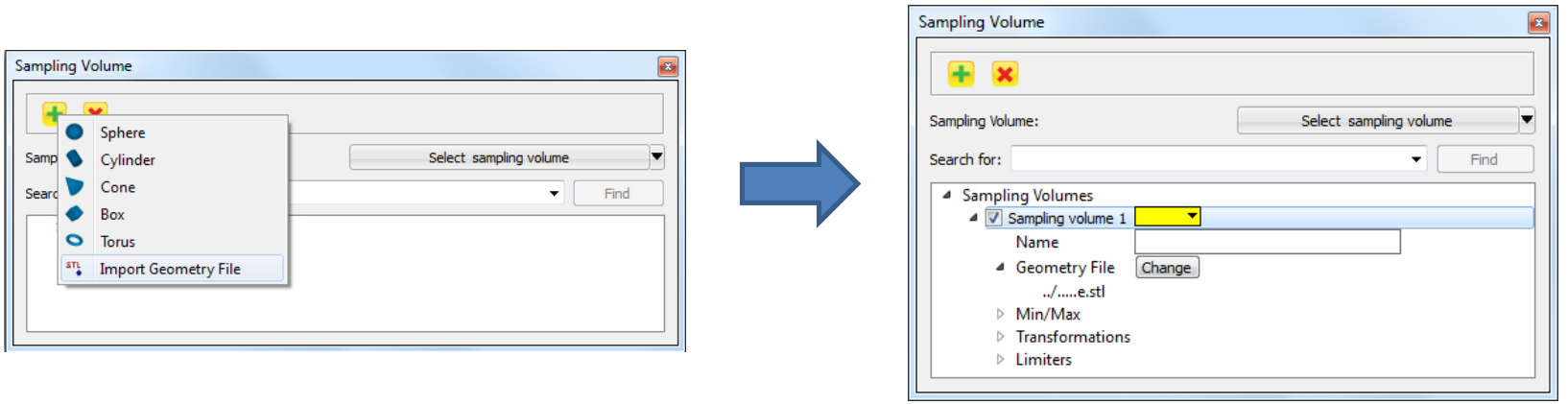
Component-based Sampling Volumes

- Sampling Volumes can now be added in same way as adding components



- Sampling Volumes in existing input files will be converted to components

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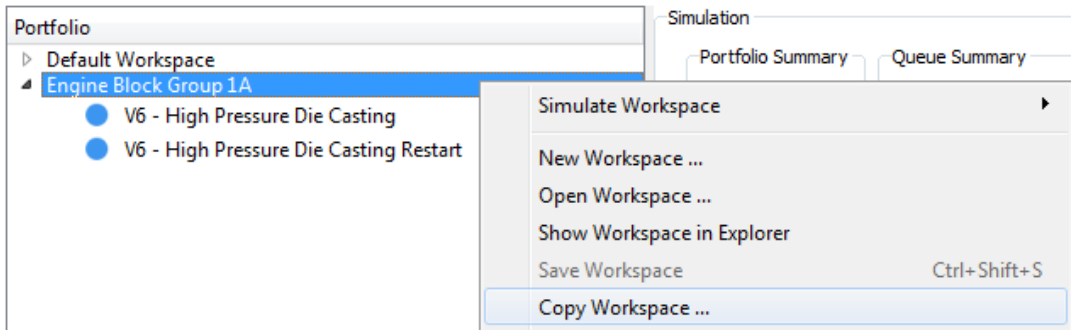
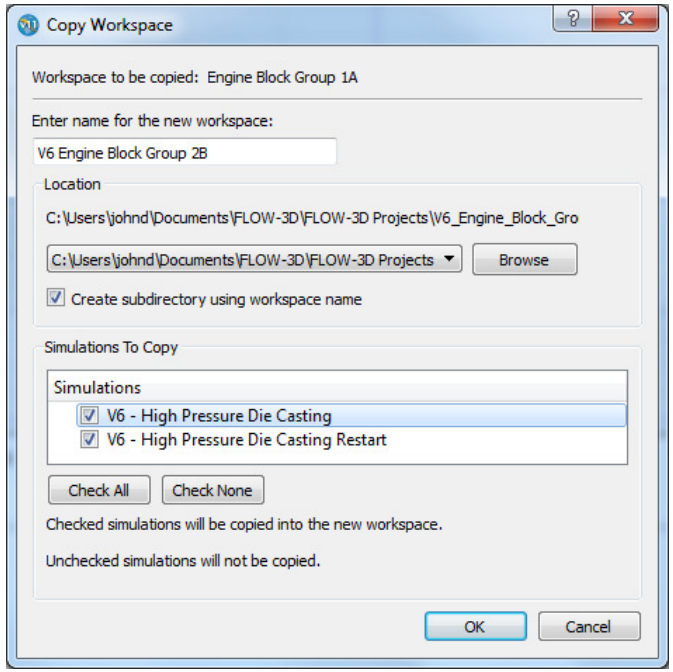
Workspace Copy





- Functionality:
  - Creates copies of selected simulations in a workspace
  - Relative links to external files (*e.g.* STL files) are maintained in copies
  - Links to restart results are updated
- Facilitates parametric studies

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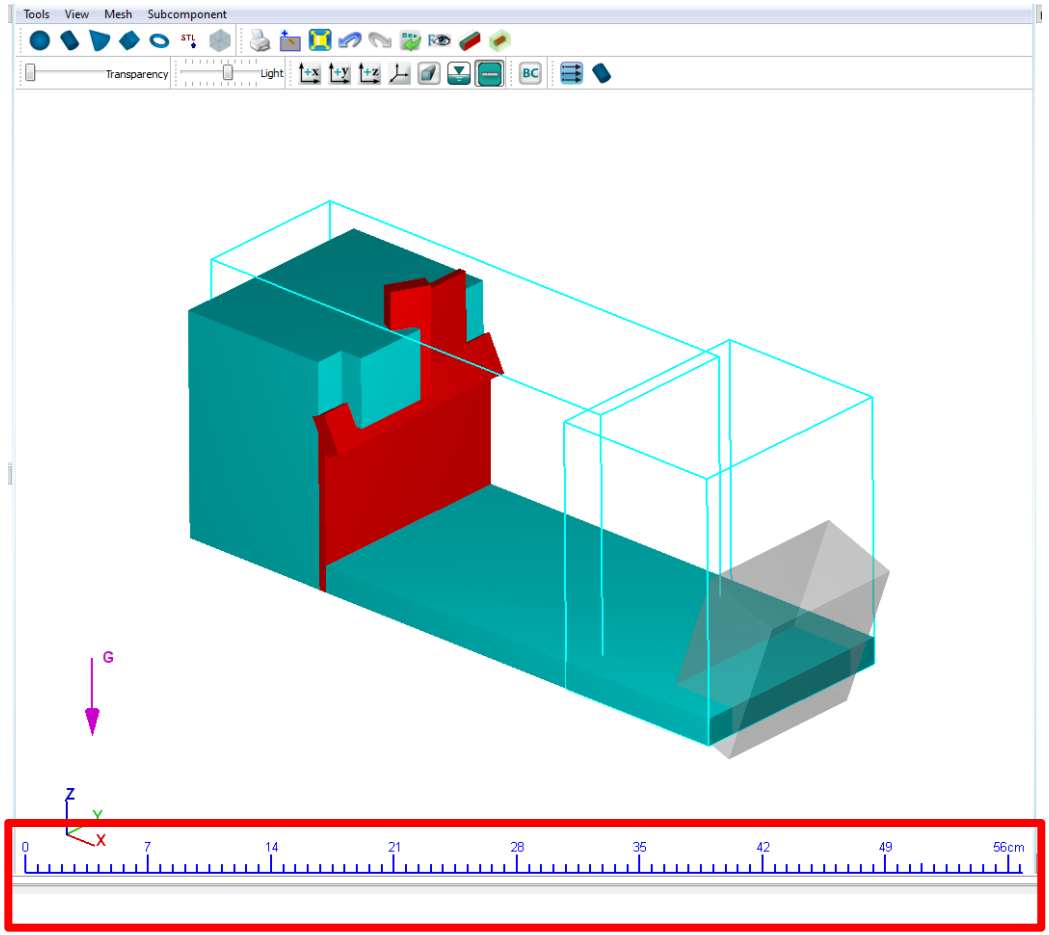
Ruler

- Ruler indicates units
- Accurate for measuring
- Useful for checking scaling



Workflow Control and Automation

- Setup
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Active Simulation Control

Active Simulation Control

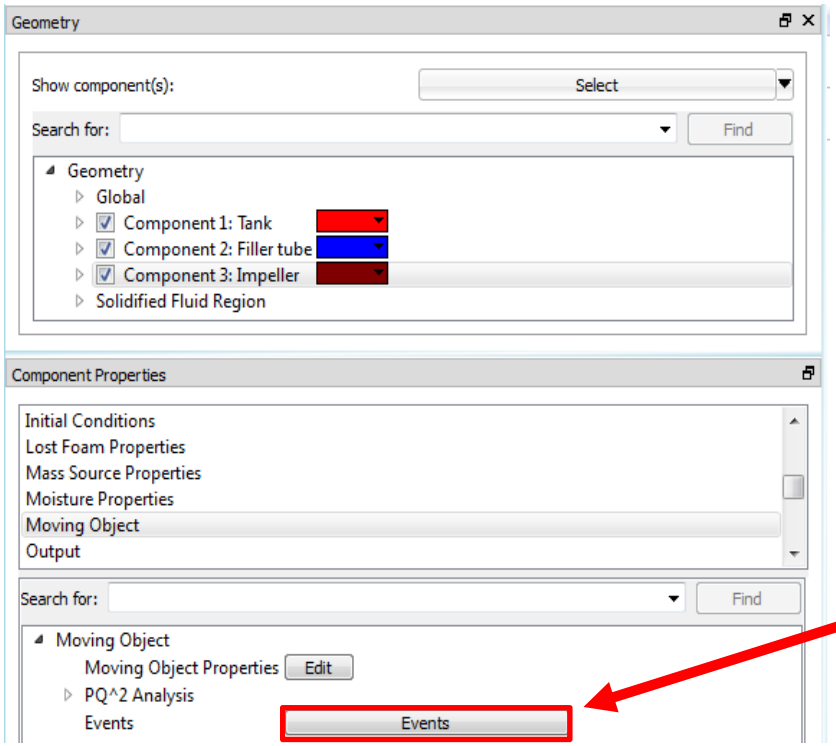
Terminology & Requirements

- Important terminology:
  - Events: An event occurs when a user-defined condition (or conditions) are met at probes.
  - Actions: An action is a type of change to a component/object status or property
- Requirements:
  - At least one probe must be defined in the simulation

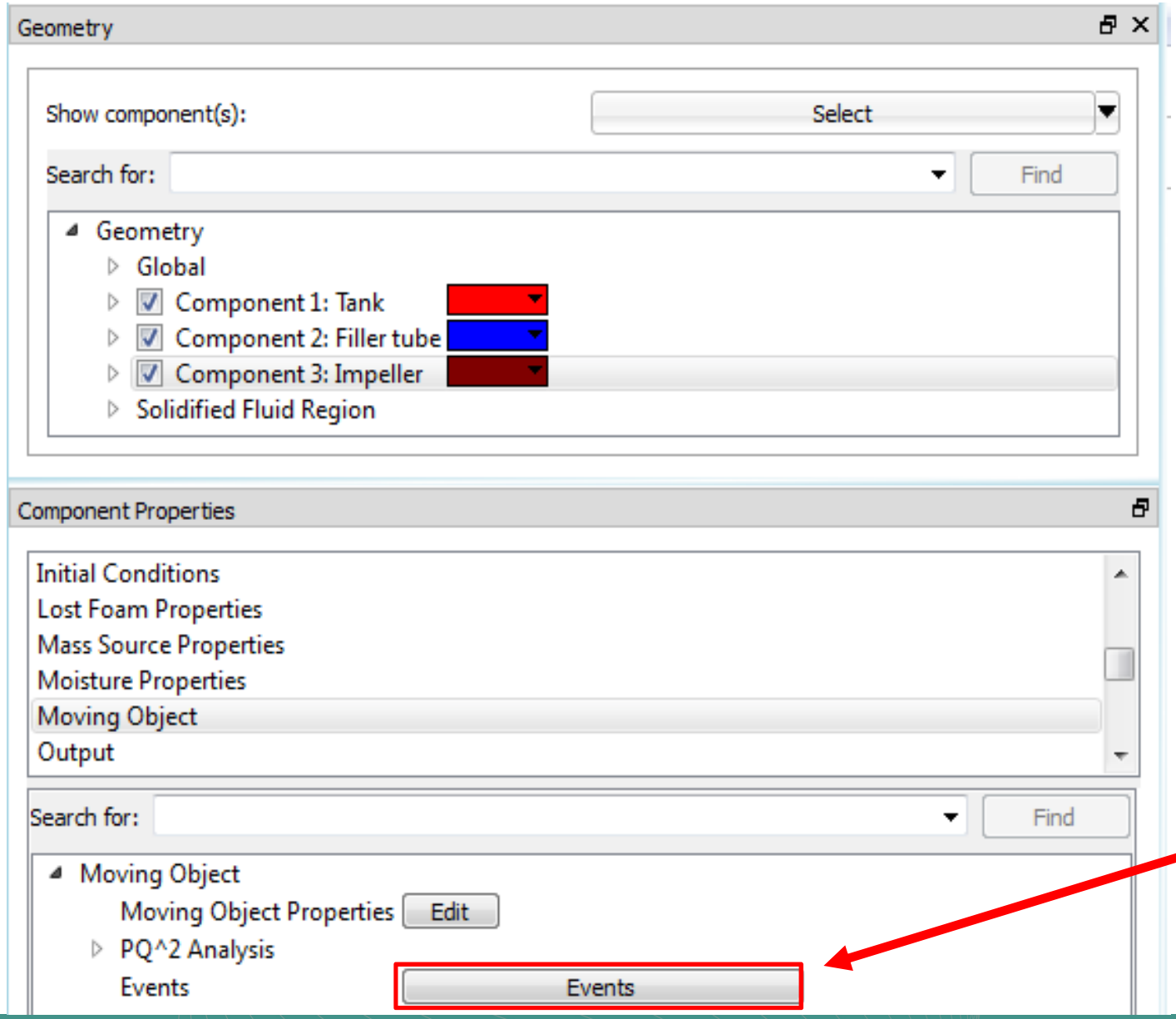
Active Simulation Control

Creating Events

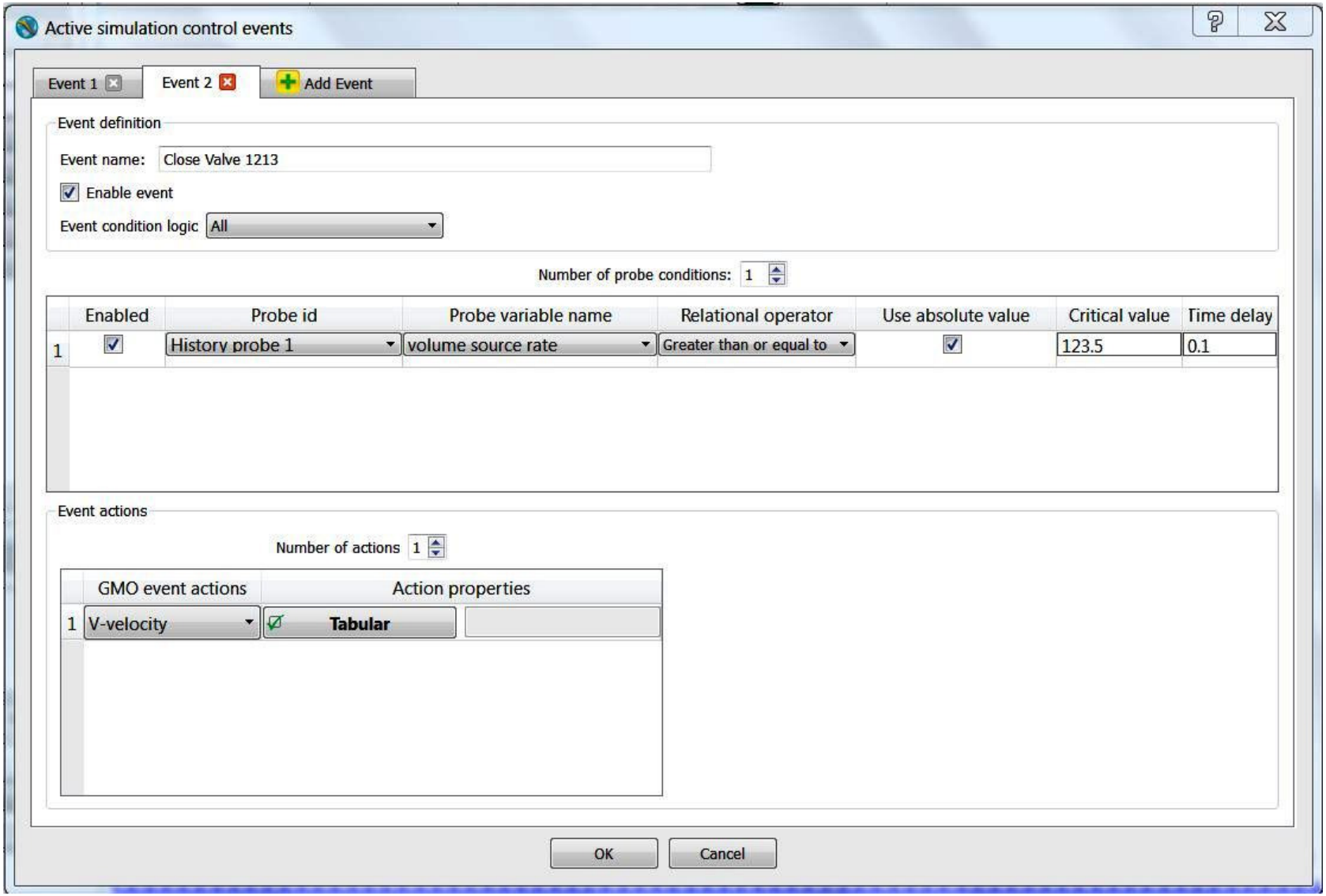
- Step 1 - Create a probe where an event will be defined
- Step 2 – Define events



Event controls



Event controls


Active simulation control events
Event 1
Event 2
Add Event
Event definition
Event name: Close Valve 1213
Enable event
Event condition logic All
Number of probe conditions: 1
Enabled
Probe id
Probe variable name
Relational operator
Use absolute value
Critical value
Time delay
1
History probe 1
volume source rate
Greater than or equal to
123.5
0.1
Event actions
Number of actions 1
GMO event actions
Action properties
1
V-velocity
Tabular
OK
Cancel

Active Simulation Control

General Rules for Events

- Multiple events can be defined for an object
- An event can be triggered by multiple probe conditions
  - Logic condition between multiple probe conditions: ANY or ALL
- An event can trigger multiple actions

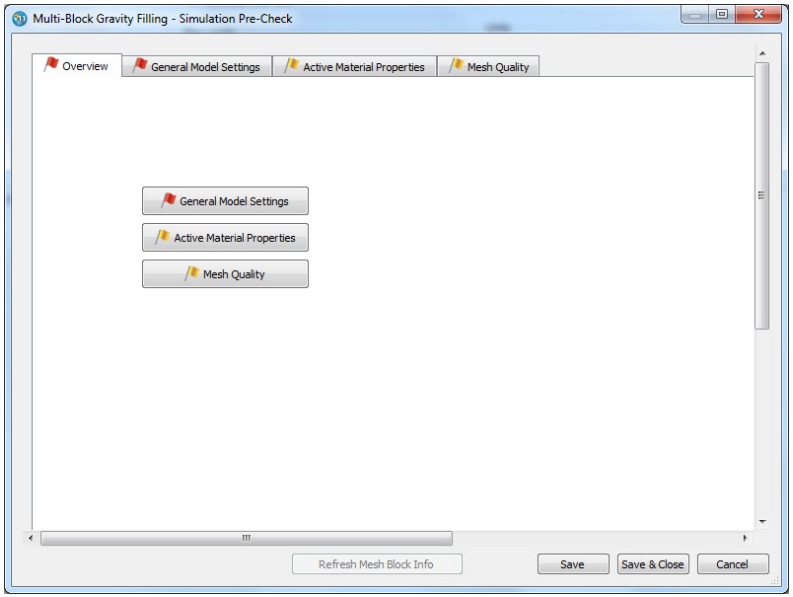
Examples of Potential Controls

- Open spillway gates when flow depth in reservoir exceeds a specified value.
- Change Selected Data output frequency when flow velocity exceeds a given speed
- Turn vents/valves on and off when pressure goes above or below a specified range
- Change volume flow rate on a boundary when depth drops below a specified threshold

Simulation Pre-check

Simulation Pre-check

- Expanded to include pre-processor checks
- Overview tab summarizes identified issues



- Flags indicate severity of issues

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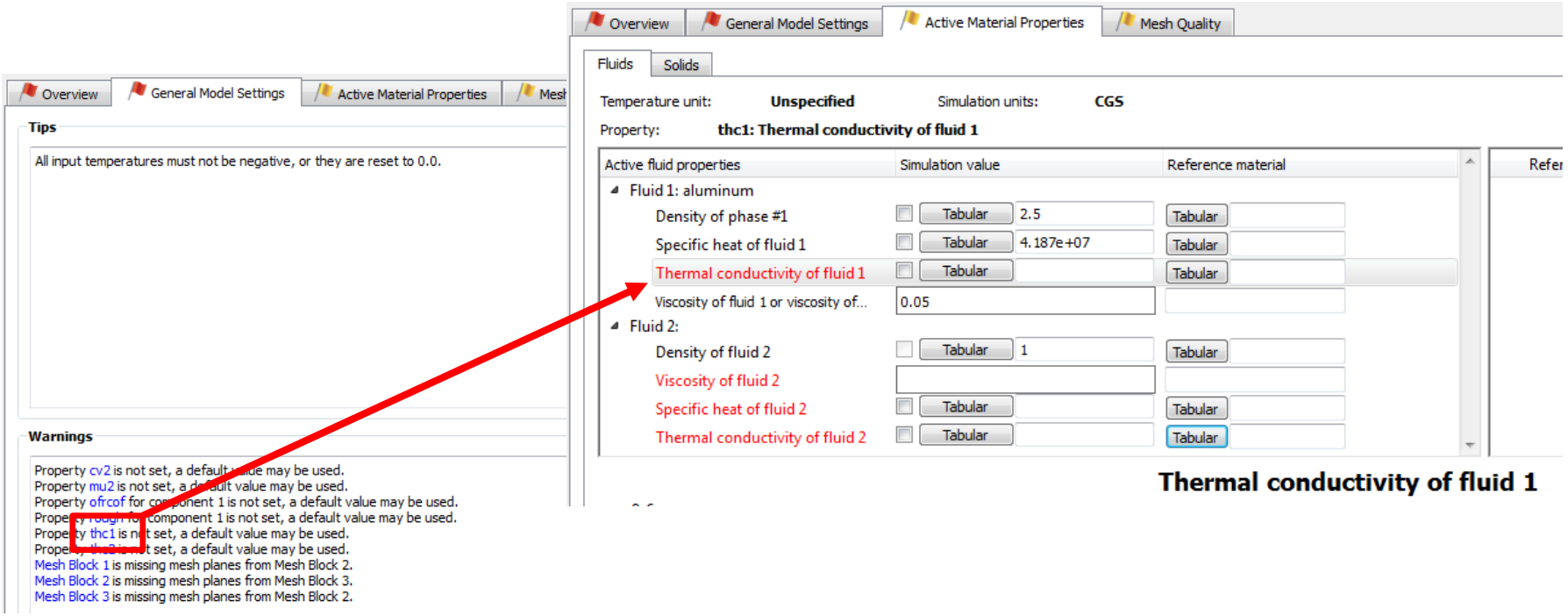
Simulation Pre-check General Model Checks

Hot-links on General tab take user to the tab where the problem is occurring



Workflow Control and Automation

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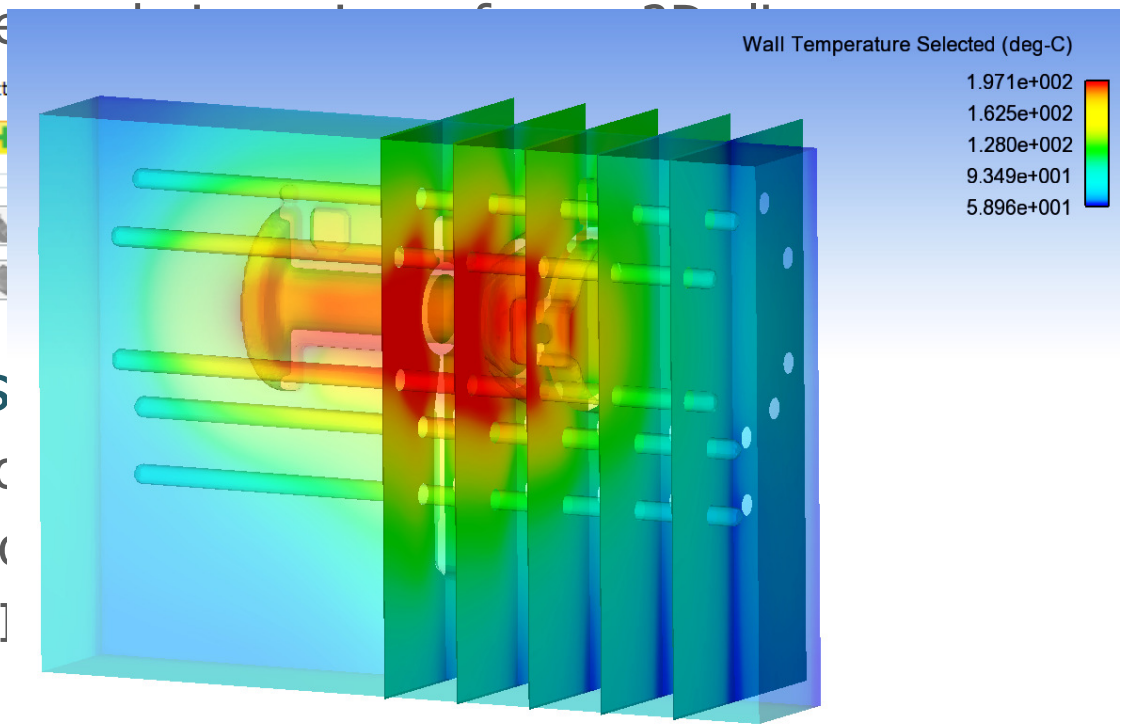
Batch Post-processing

Batch Post-Processing

- Motivation: Speed & Efficiency
  - Enables generation of multiple graphics automatically upon completion of a simulation
- Functionality
  - Allow users to define graphics to be generated in "batch"
  - Graphics requests include volume rendering, 3D, 2D, Line Plots, Text output
- Context files and Templates can be used to request results

Batch Mode Graphic Requests

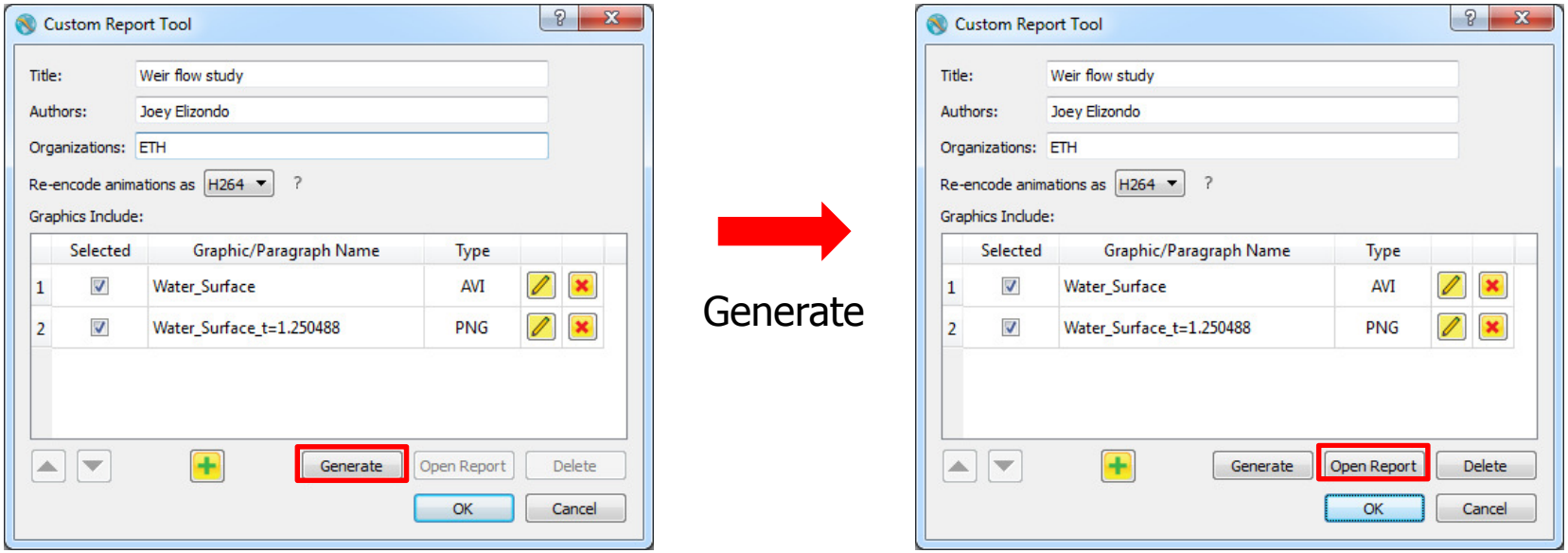
- 3D Graphic requests can be composite objects
  - Can be volume
- Graphic reques
  - 3D → Scenaric
  - 2D → Animatic
  - Line Plots →



Report Generation

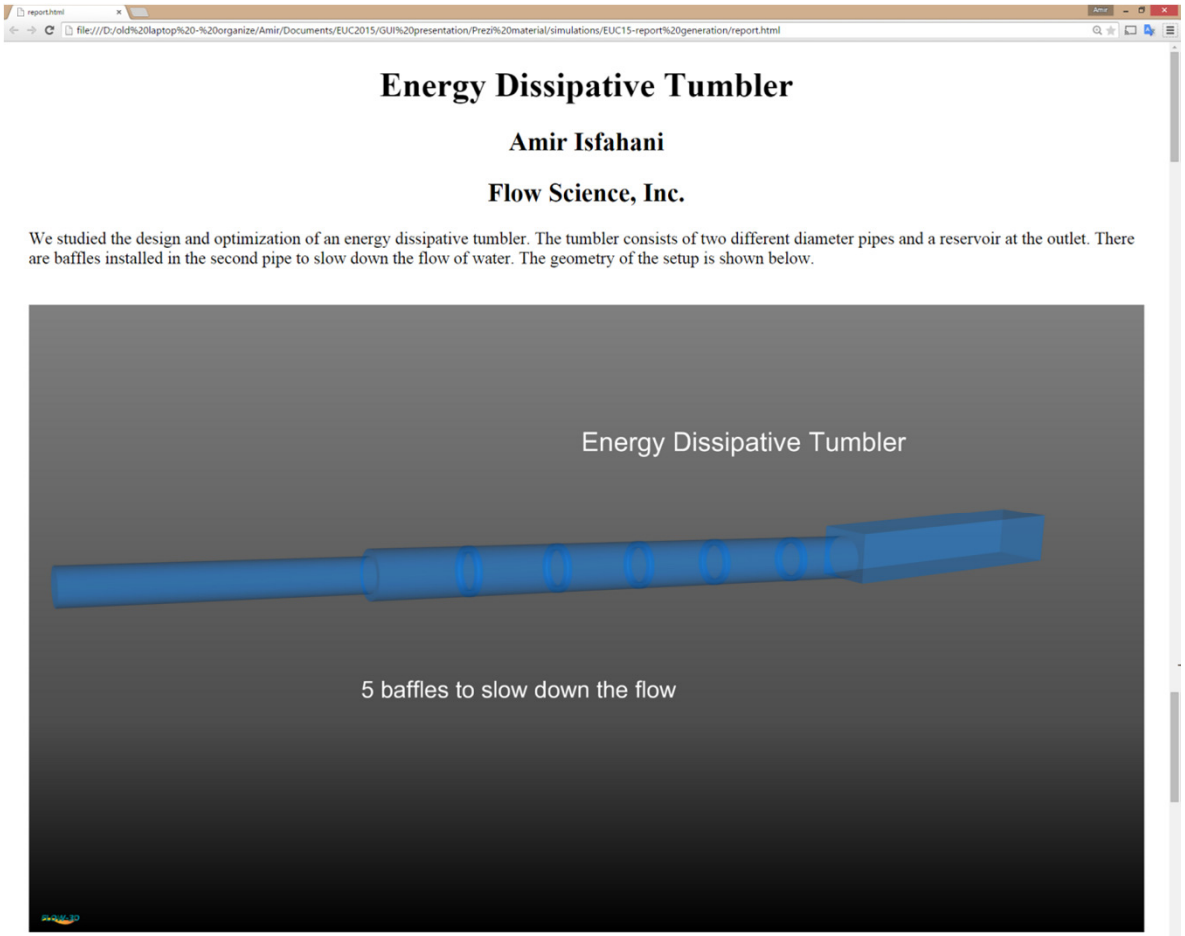
Report Generation

- Report generation requires "Batch results"



- Once completed, the resulting report can be viewed in any HTML 5 browser

Report Generation



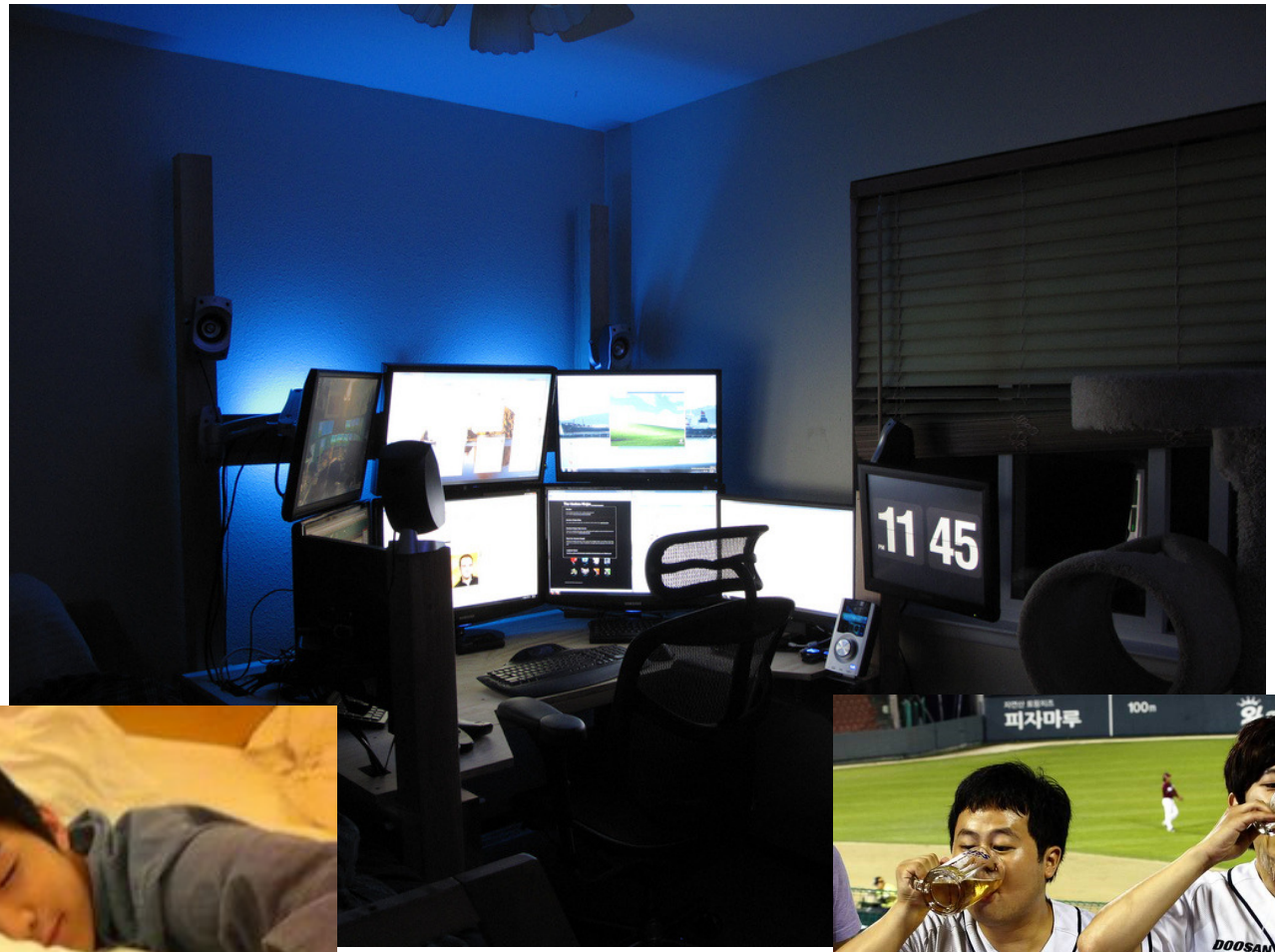
Energy Dissipative Tumbler

Amir Isfahani

Flow Science, Inc.

We studied the design and optimization of an energy dissipative tumbler. The tumbler consists of two different diameter pipes and a reservoir at the outlet. There are baffles installed in the second pipe to slow down the flow of water. The geometry of the setup is shown below.

Figure 1: The geometry of the tumbler.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피자마루
DOOSAN
BEARS
DOOSAN
BEARS

Other Post-processing Improvements

- Improved volume rendering
  - Better performance
  - Less memory
- Improved handling for:
  - 3D clipping
  - Box, Plane, Spline
- Ability to link results (*flsgrf*) files
  - Multiple results to one animation
  - Frame selection (remove timeframes)
- Streamlined Preference Editor

FlowSight

Questions?