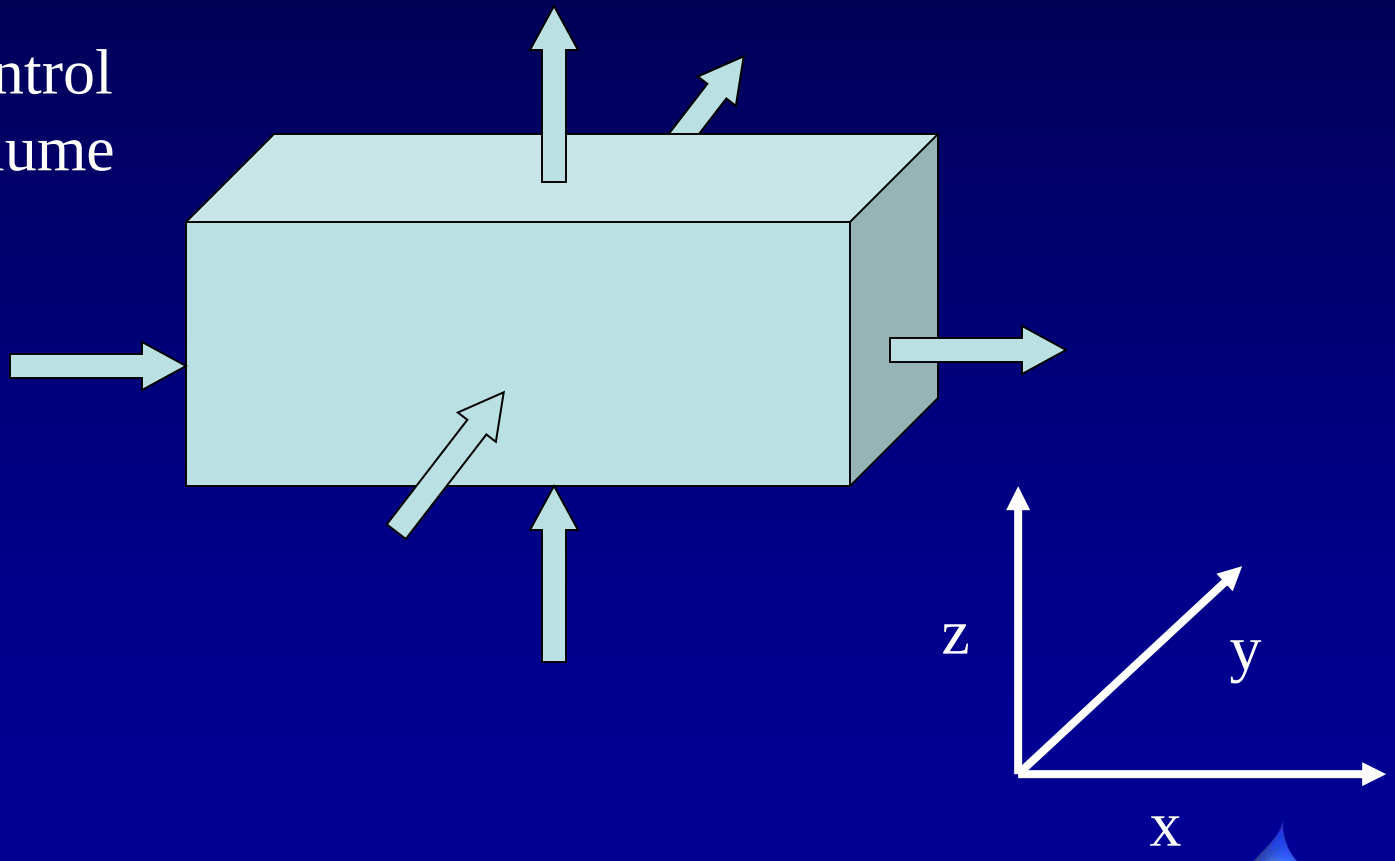
Introduction to the Water Quality Analysis Modeling System

WASP

Version 7.0

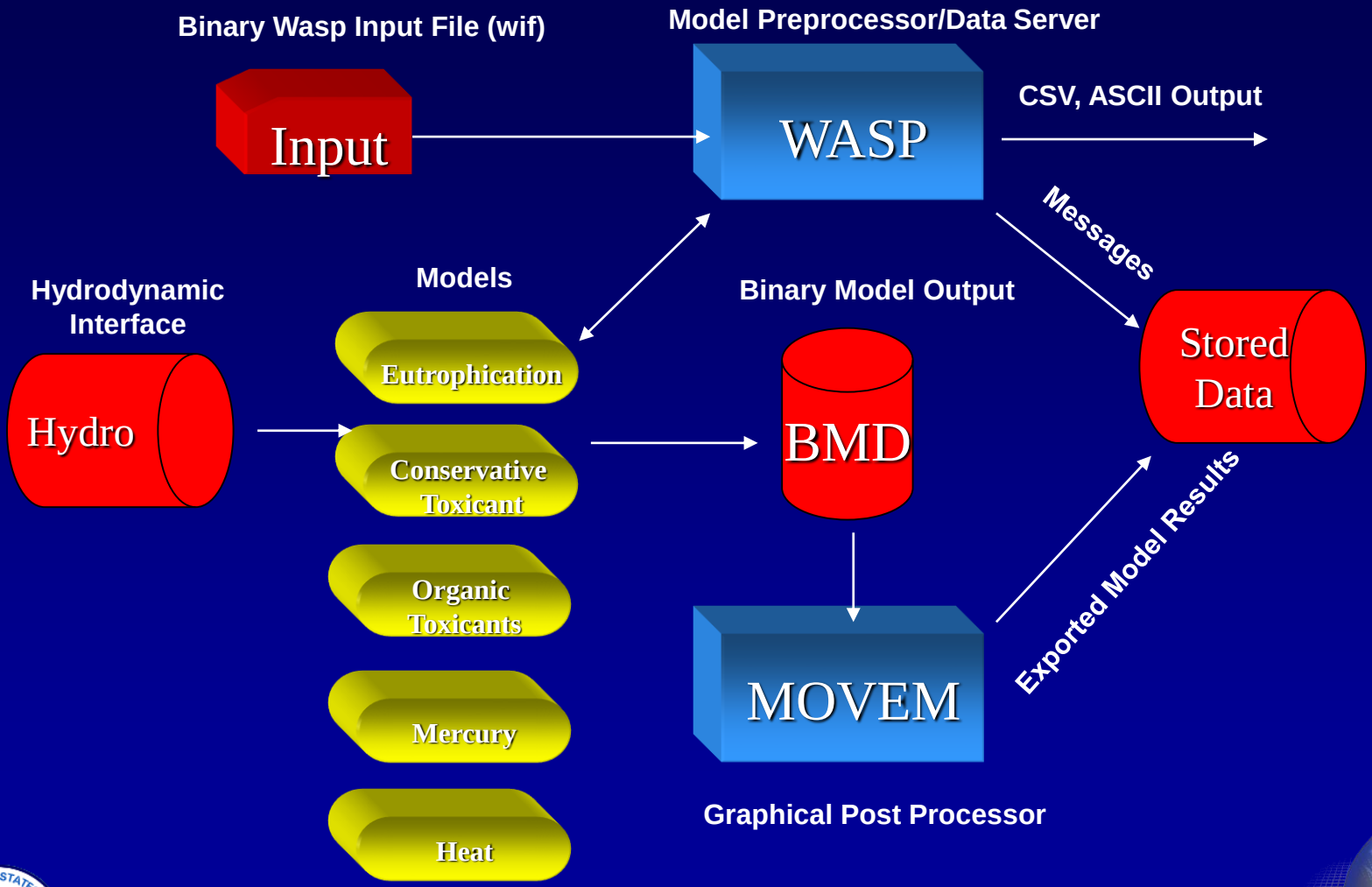
April, 2005

Three Dimensional Transport Equation



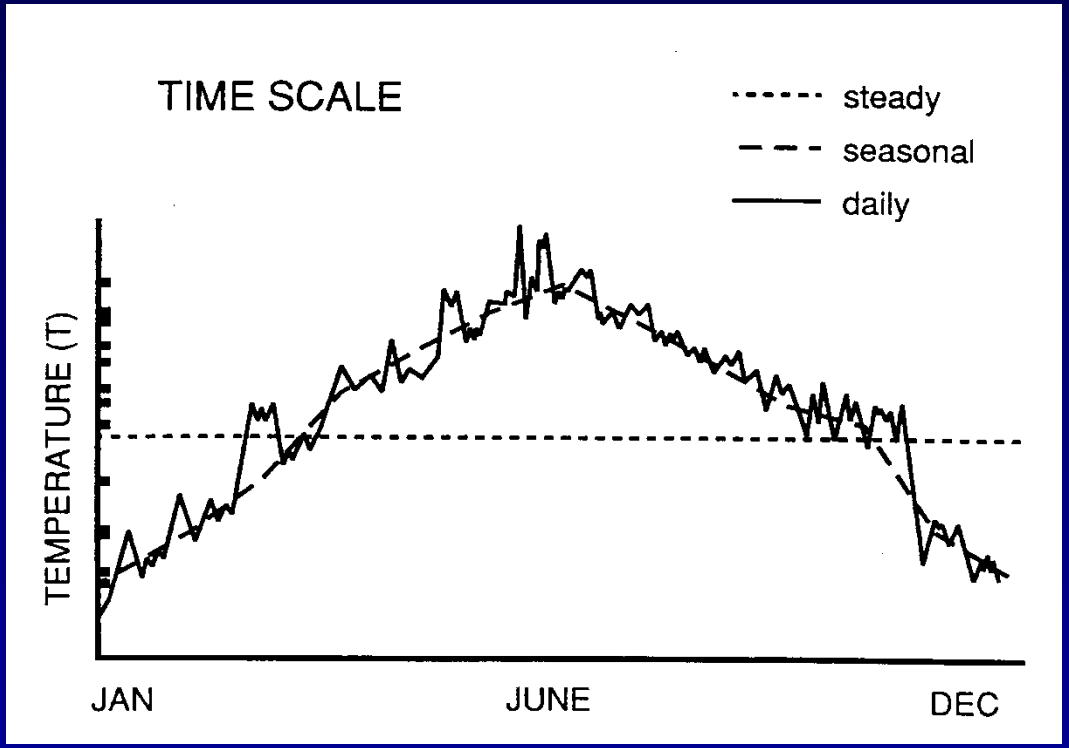
$$\frac{\partial C}{\partial t} = -\frac{\partial U_x C}{\partial x} + \frac{\partial}{\partial x}\left(E_x \frac{\partial C}{\partial x}\right) - \frac{\partial U_y C}{\partial y} + \frac{\partial}{\partial y}\left(E_y \frac{\partial C}{\partial y}\right) - \frac{\partial U_z C}{\partial z} + \frac{\partial}{\partial z}\left(E_z \frac{\partial C}{\partial z}\right) \pm Sources\ and\ Sinks$$

WASP Modeling Framework

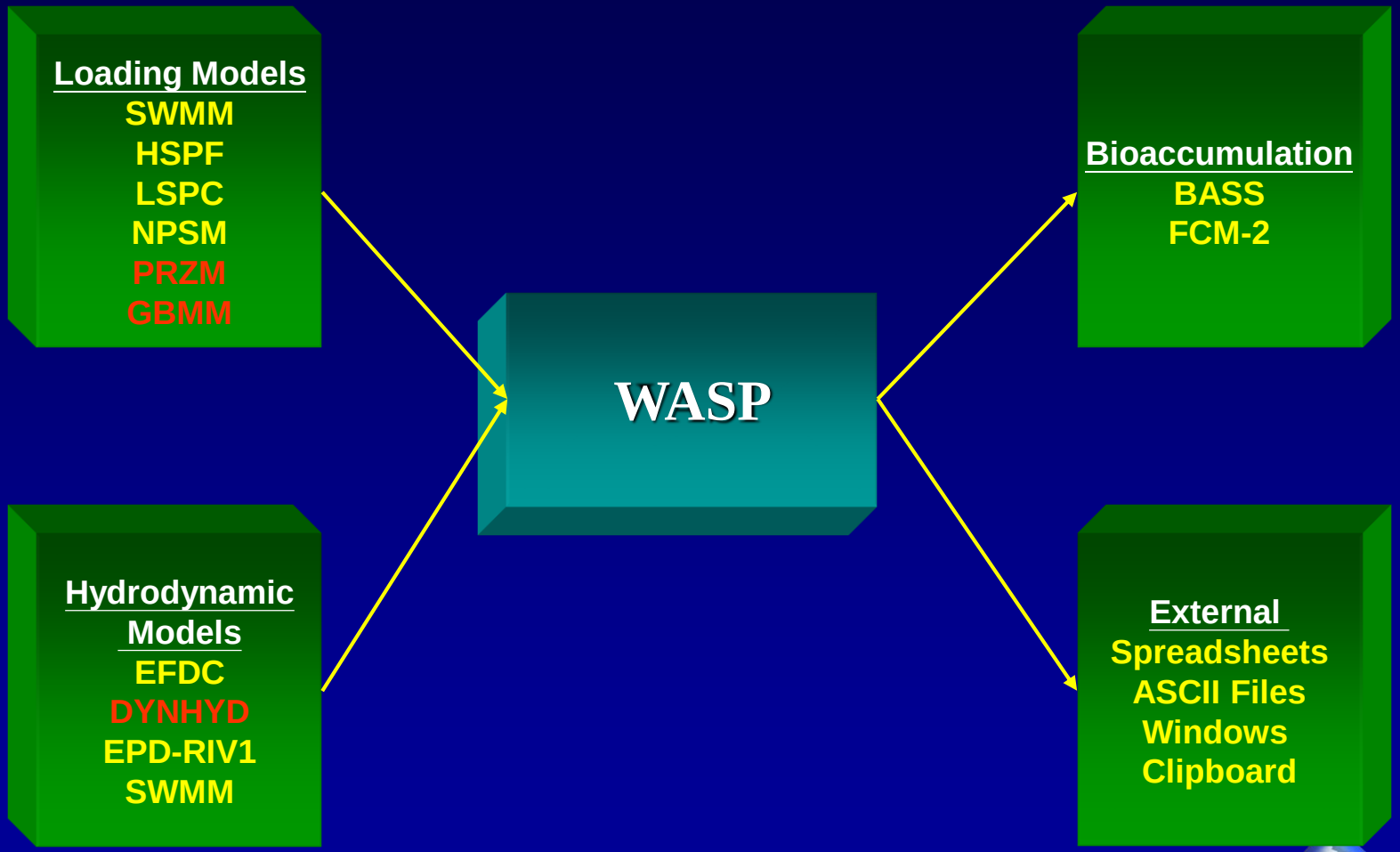


Potential WASP Time Scales

- Steady
- Seasonal
- Monthly
- Daily/Hourly

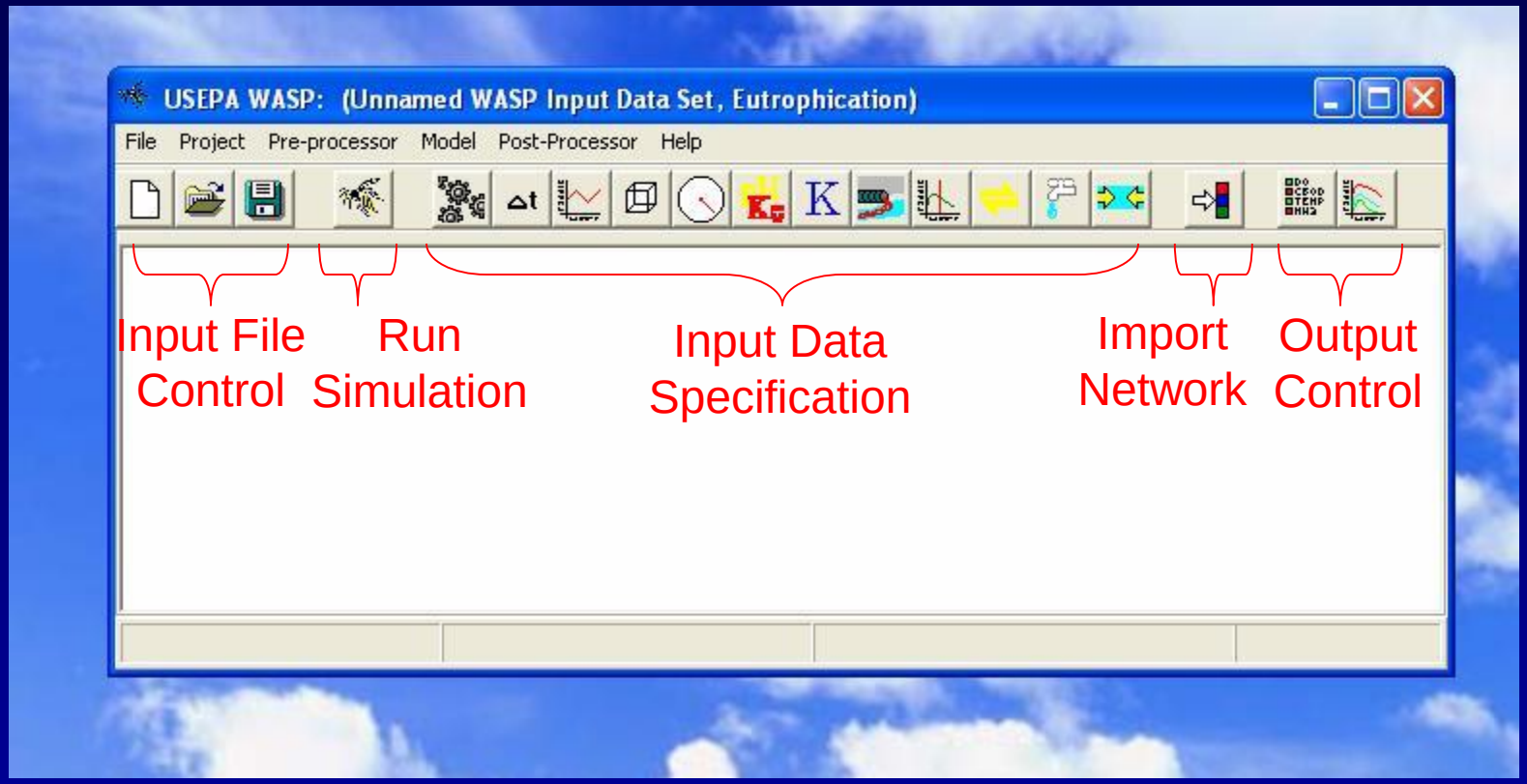


WASP External Linkages

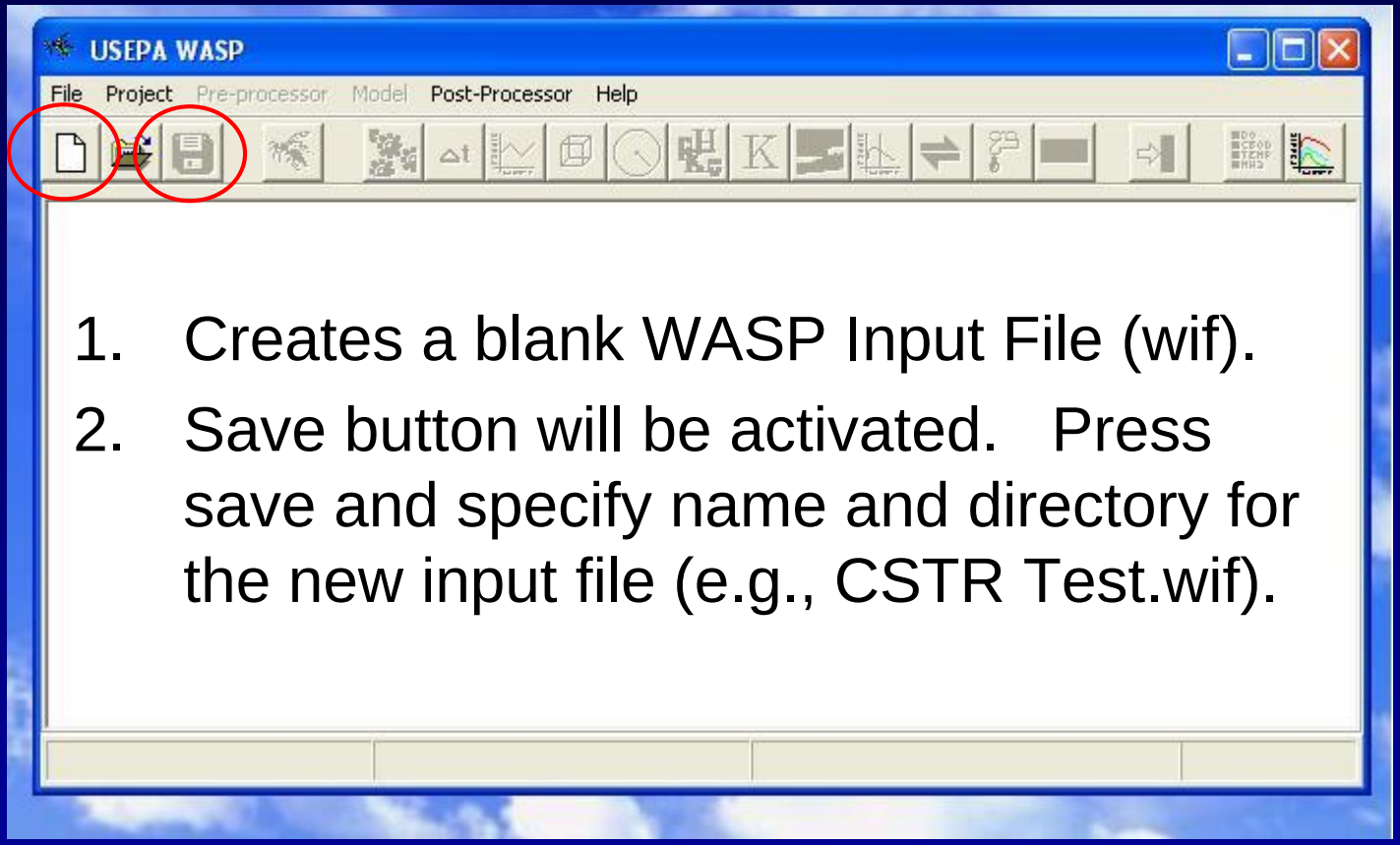


Introduction to the WASP Interface

Introduction to WASP Interface

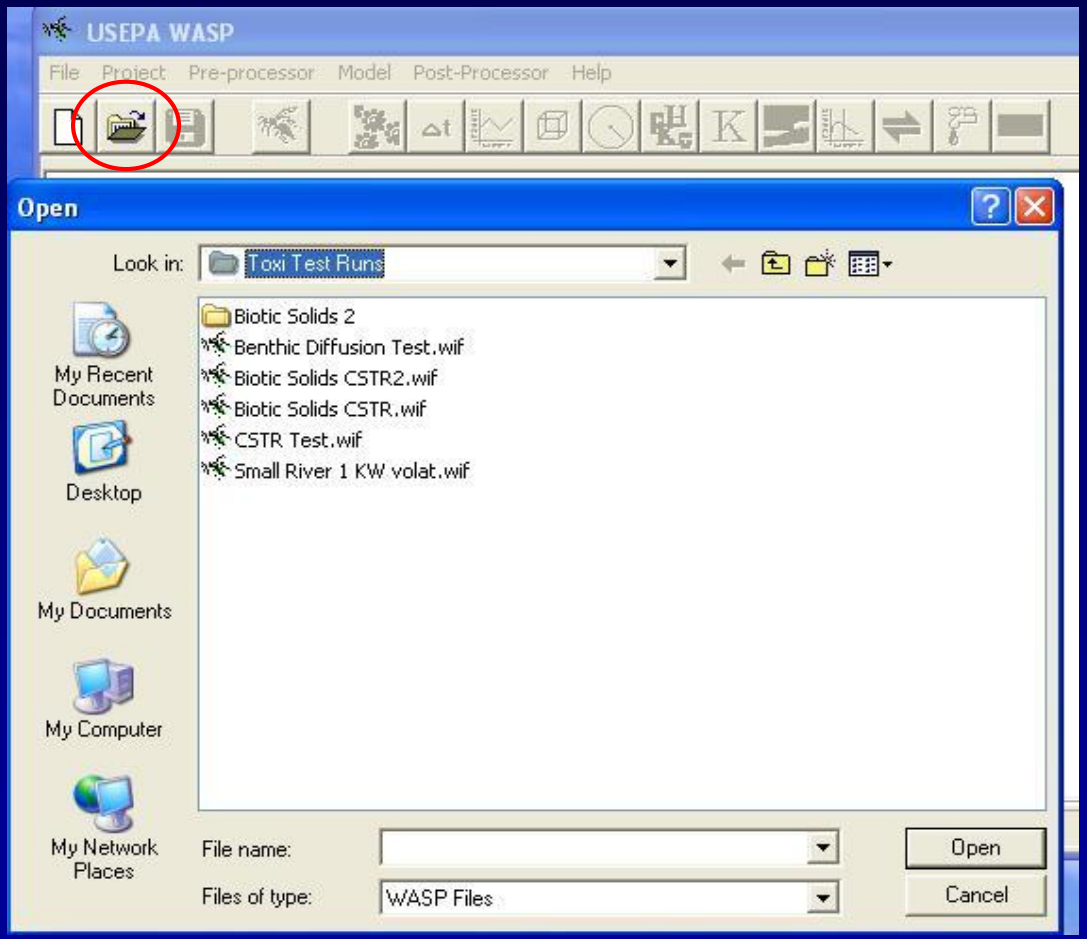


Create New WASP Input File



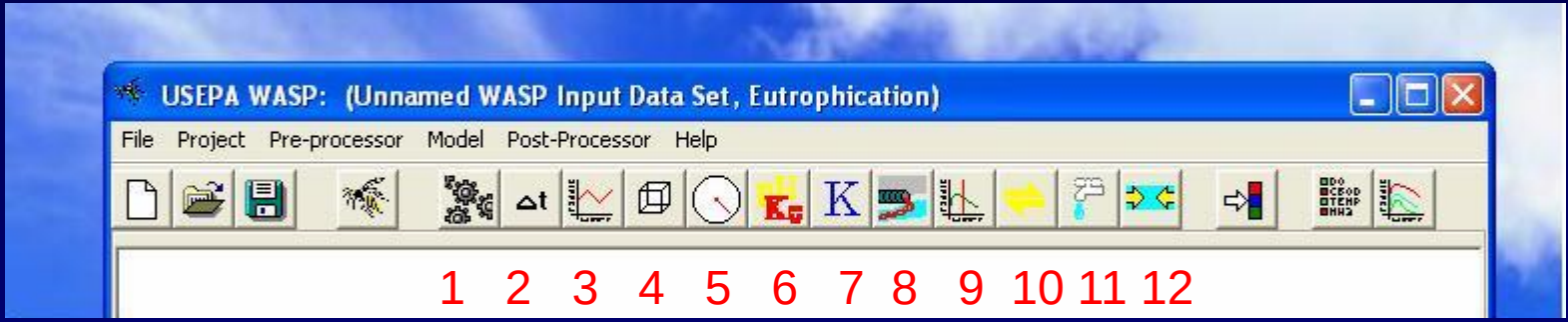
1. Creates a blank WASP Input File (wif).
2. Save button will be activated. Press save and specify name and directory for the new input file (e.g., CSTR Test.wif).

Open Existing WASP Input File



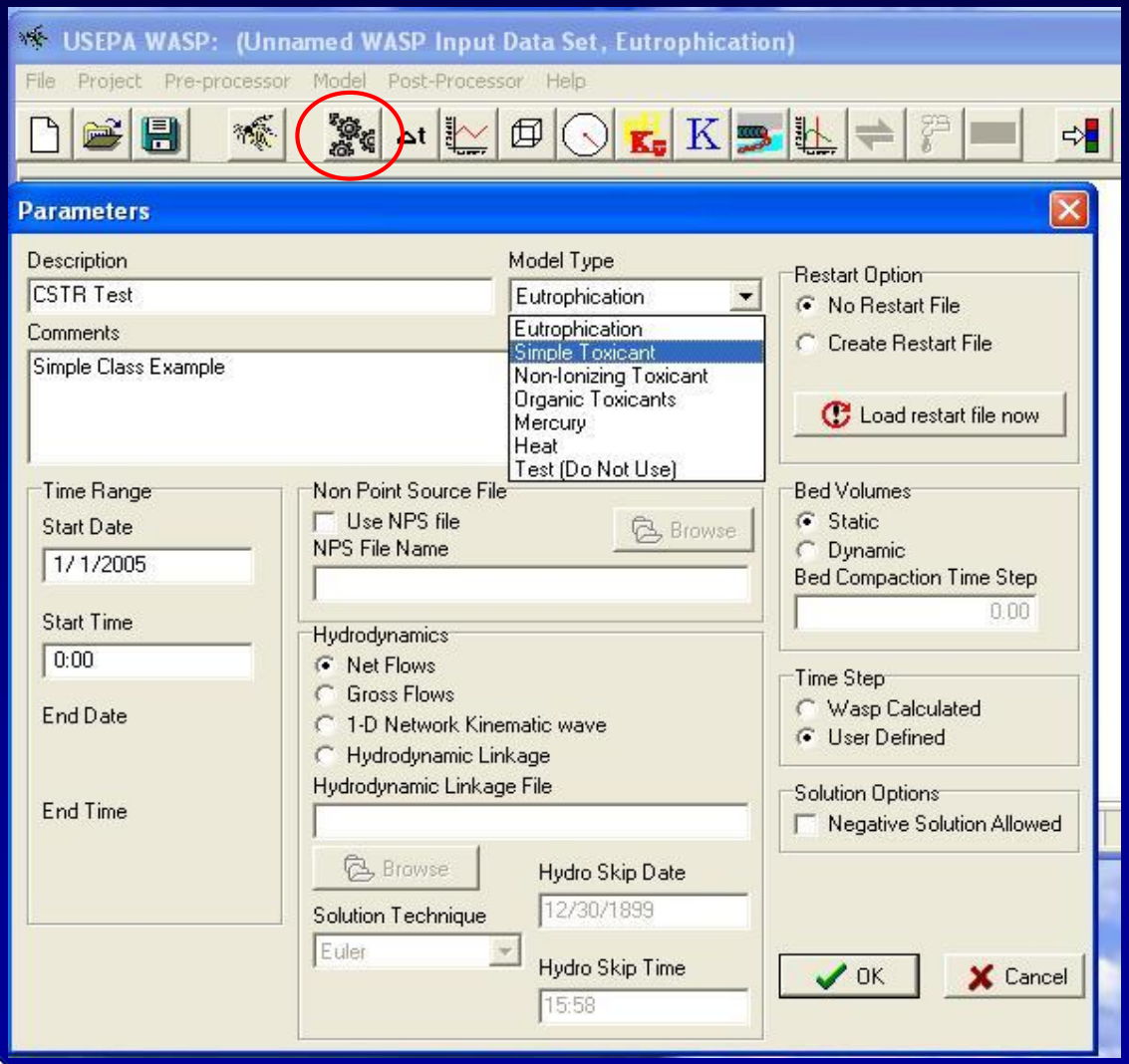
- Browse and select an existing Wasp Input File
- WASP provides a listing of *.wif in the current directory.

WASP Input Data Categories



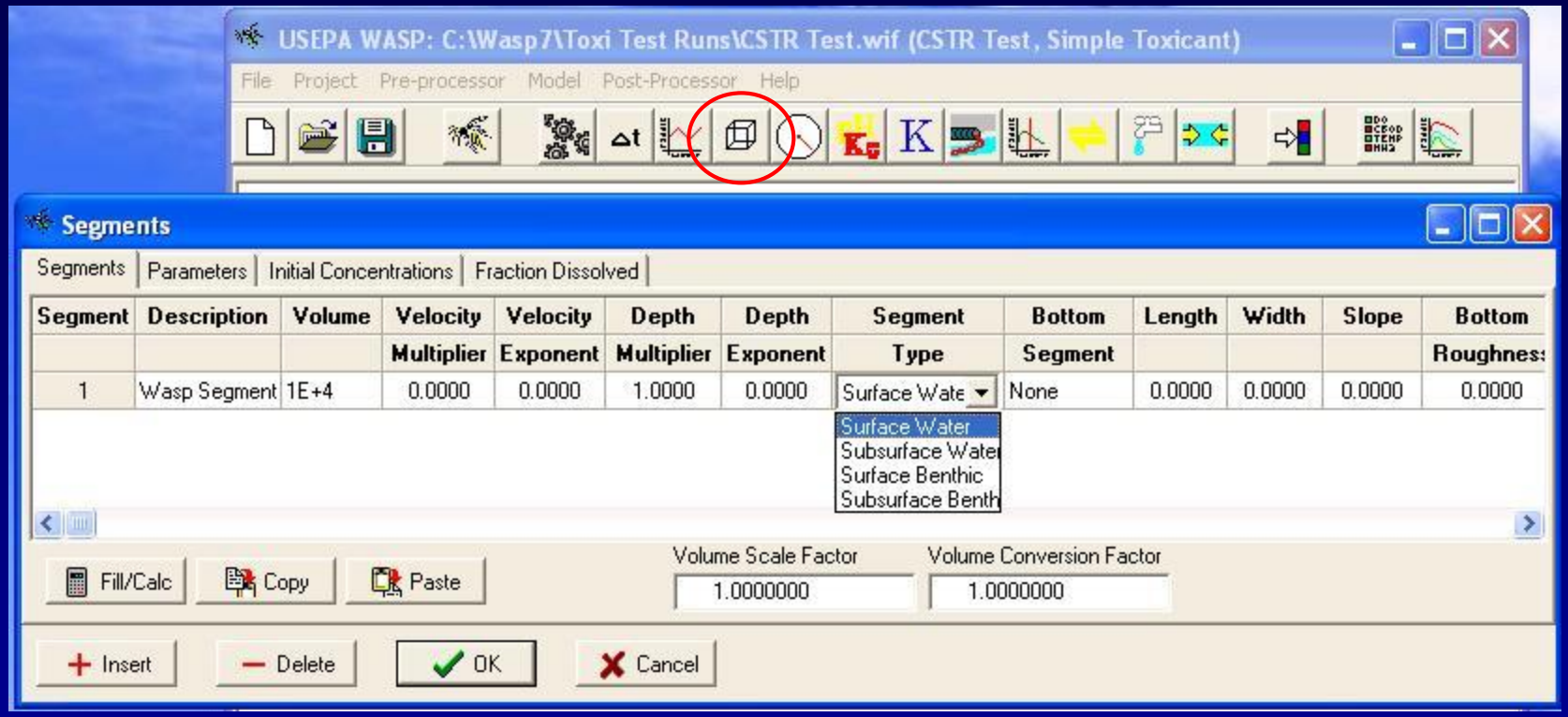
1. Simulation Control
2. Time Step
3. Print Interval
4. Segment Properties
5. System Properties
6. Parameter Switches
7. Constants
8. Loadings
9. Kinetic Time Functions
10. Dispersive Exchanges
11. Advective Flows
12. Boundary Concentrations

Simulation Control



- Description and Comments
- Model Type
- Simulation Start Date & Time
- Non Point Source Linkage
- Hydrodynamic Option and Linkage
- Restart Option
- Bed Volume Option
- Time Step Option
- Negative Solution Option

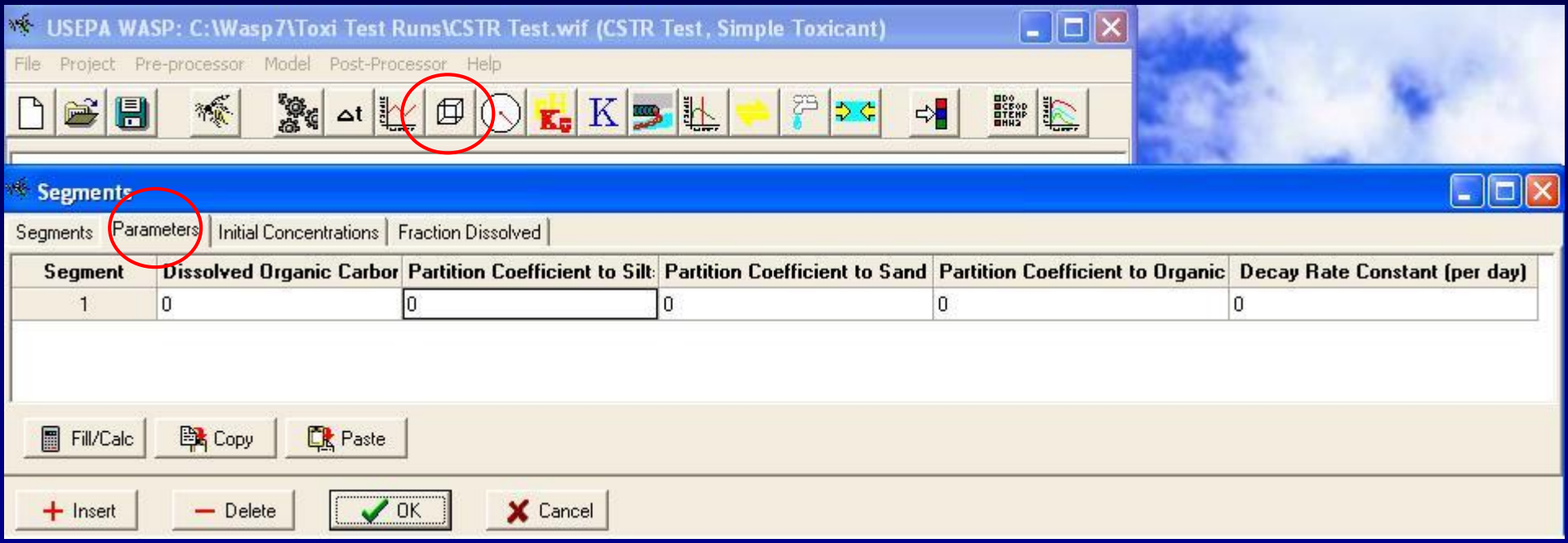
Segment Properties - Geometry



Segments Tab:

Spatially-Variable Physical Properties

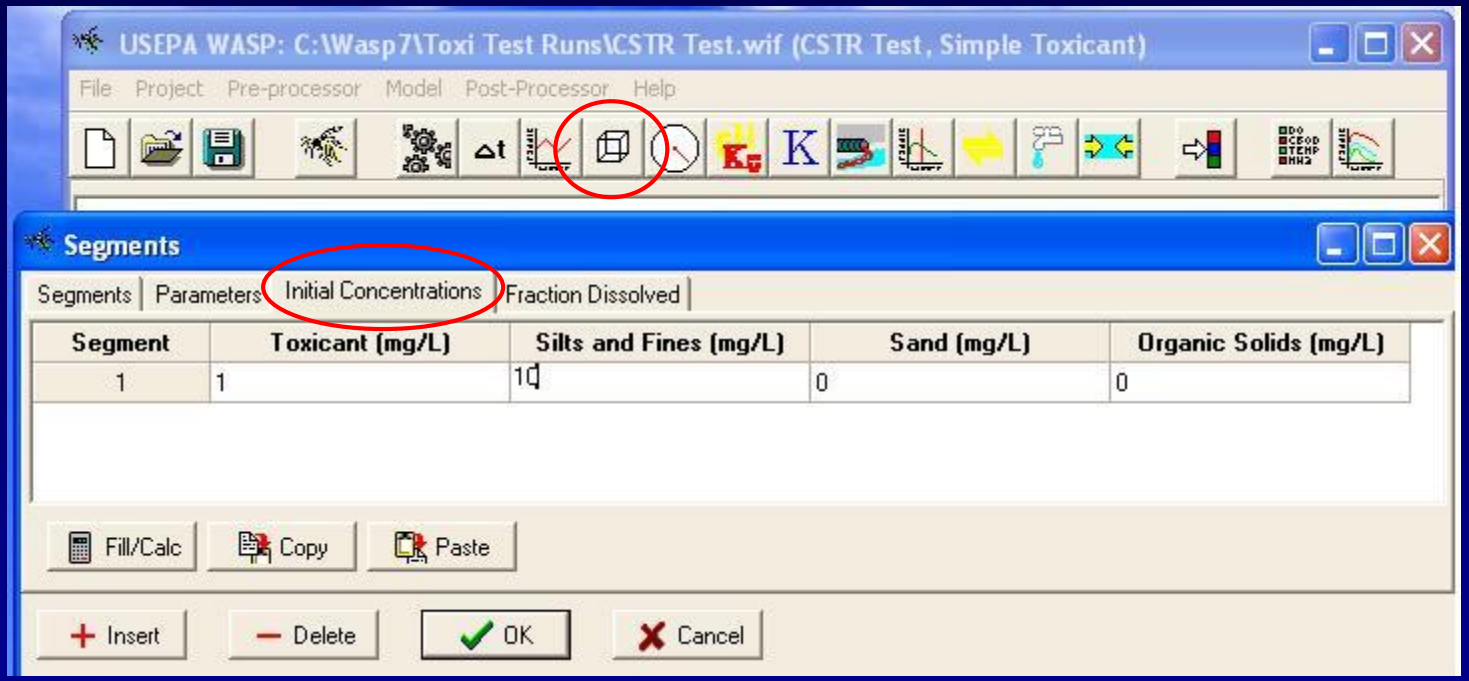
Segment Properties - Parameters



Parameters Tab:

- Values for Spatially-Variable Environmental Properties or Model Coefficients
- ***Note*** – to be used in a simulation, parameters must be enabled under the Parameter Control button

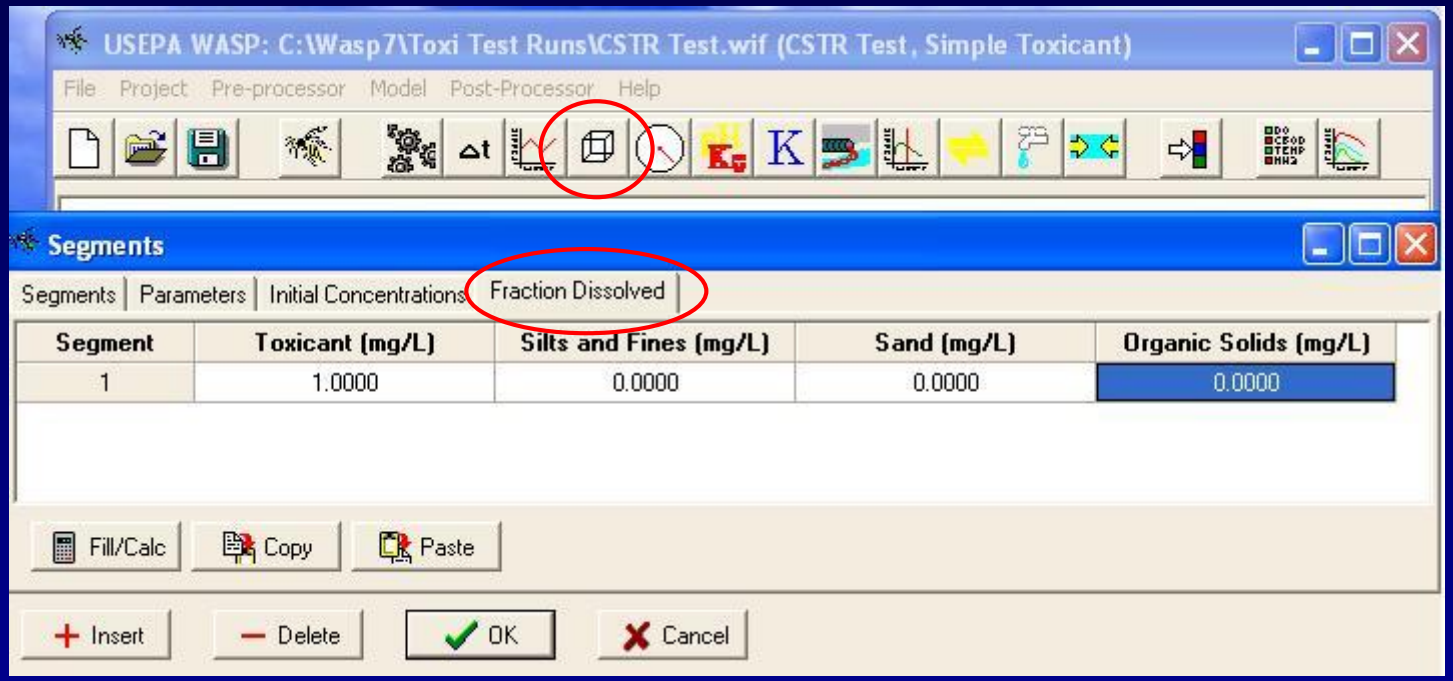
Segment Properties – Initial Concentrations



Initial Concentrations Tab:

Concentrations of each state variable (system) at beginning of simulation

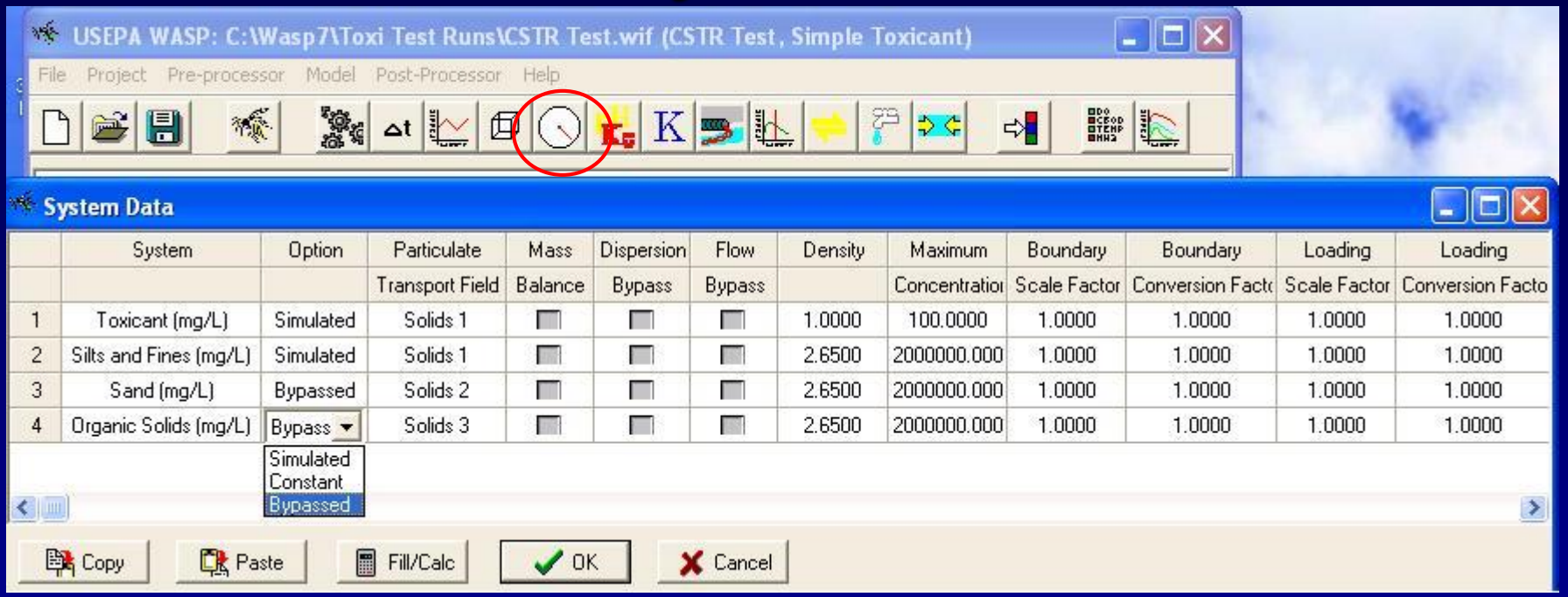
Segment Properties – Fraction Dissolved



Fraction Dissolved Tab:

- Fraction of total constituent concentration that is dissolved.
- Dissolved fractions for solids must be set to 0.
- Dissolved fractions for toxicants do not need to be reset.

Systems



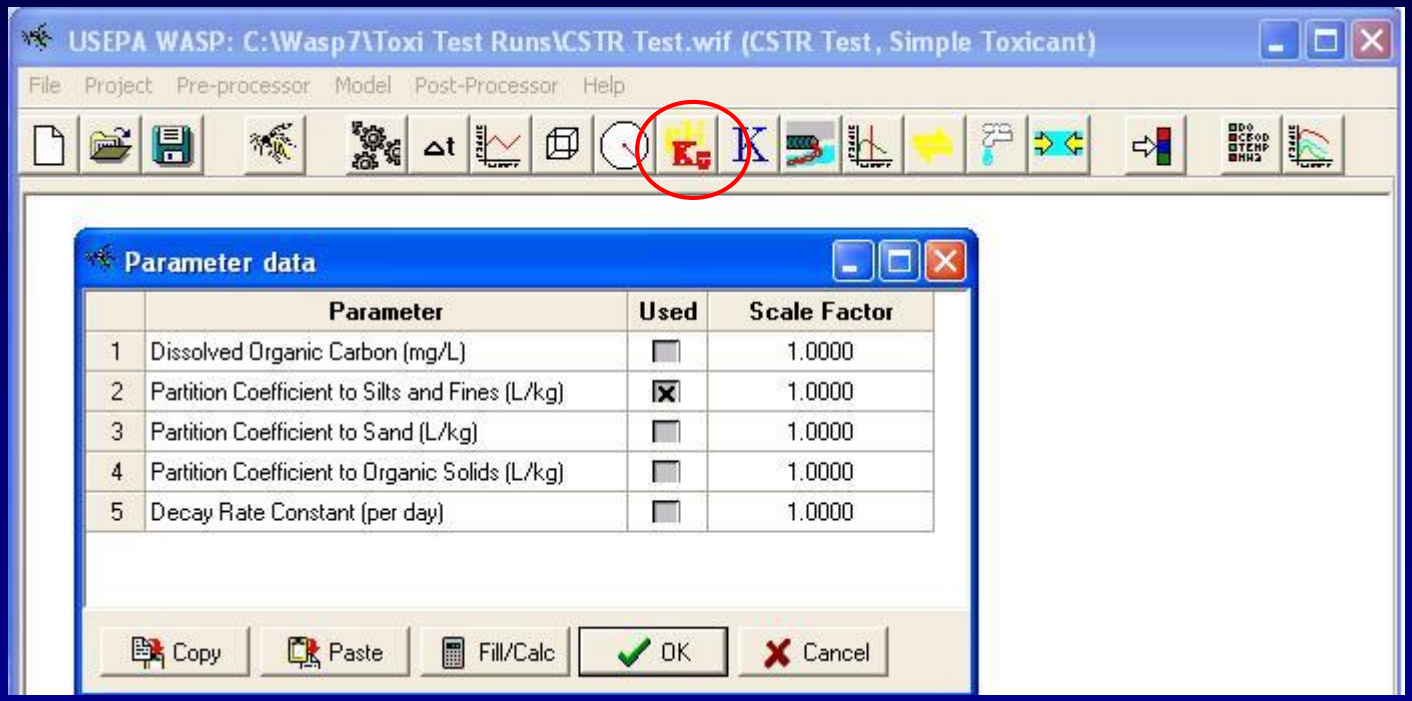
	System	Option	Particulate Transport Field	Mass Balance	Dispersion Bypass	Flow Bypass	Density	Maximum Concentratio	Boundary Scale Factor	Boundary Conversion Facto	Loading Scale Factor	Loading Conversion Facto
1	Toxicant (mg/L)	Simulated	Solids 1	☐	☐	☐	1.0000	100.0000	1.0000	1.0000	1.0000	1.0000
2	Silts and Fines (mg/L)	Simulated	Solids 1	☐	☐	☐	2.6500	2000000.000	1.0000	1.0000	1.0000	1.0000
3	Sand (mg/L)	Bypassed	Solids 2	☐	☐	☐	2.6500	2000000.000	1.0000	1.0000	1.0000	1.0000
4	Organic Solids (mg/L)	Bypass	Solids 3	☐	☐	☐	2.6500	2000000.000	1.0000	1.0000	1.0000	1.0000

Simulated
Constant
Bypassed

System (state variable) properties and controls:

- Switch to simulate or bypass state variables
- Switch to select particulate transport fields (for silt, sand, and organic solids)
- Solids particle densities (g/mL)
- Maximum allowable concentrations
- Boundary and loading scale factors

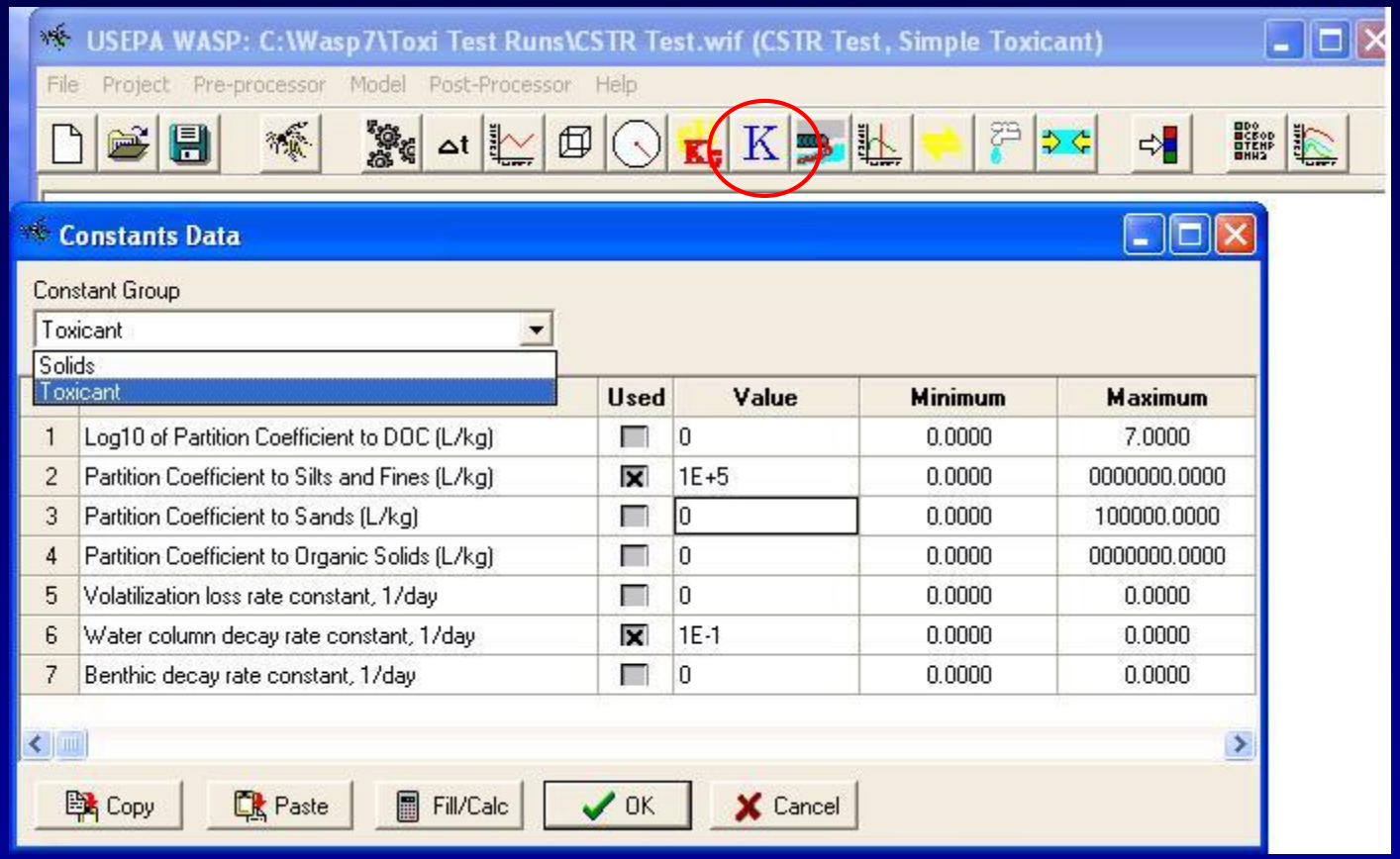
Parameter Control



Parameter Controls:

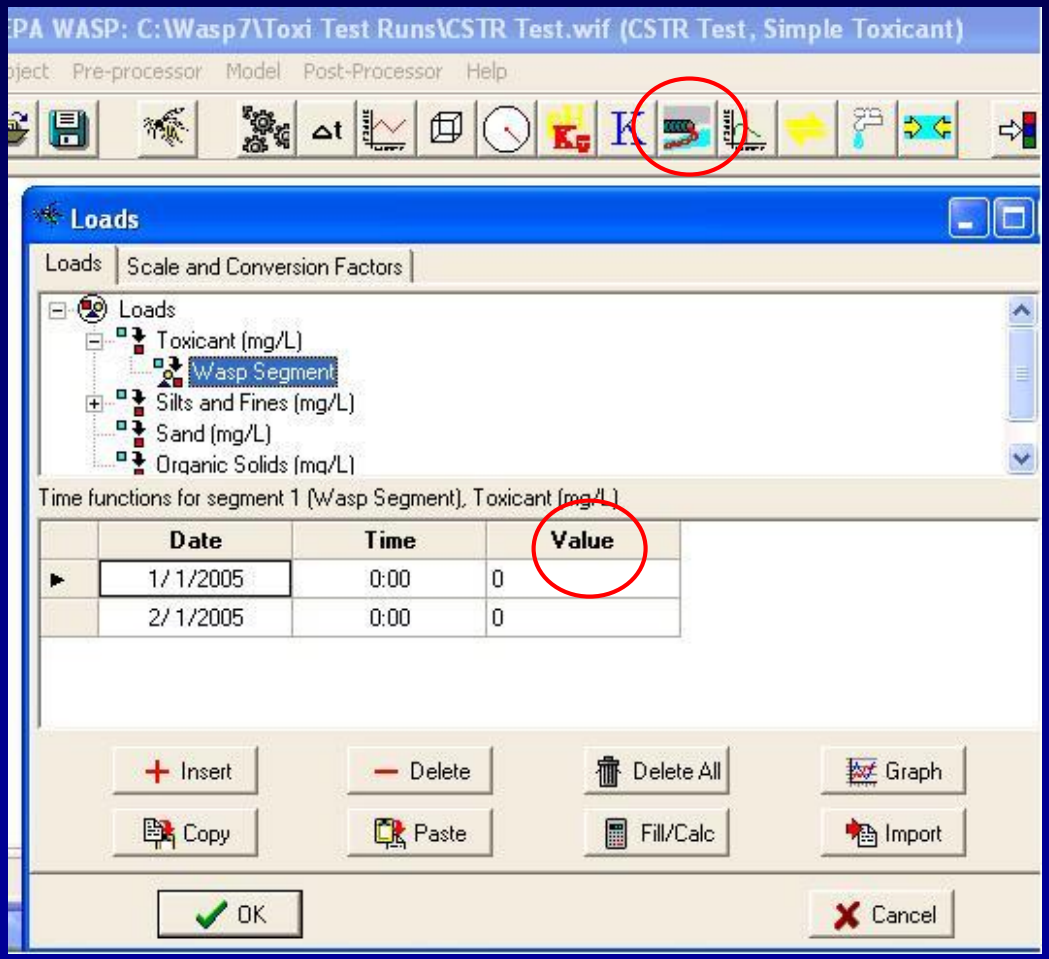
- Switch to turn on parameters for the simulation
- Scale factors to adjust parameter values for all segments.
- ***Note:*** Parameter values are specified under Segments, but will not be used unless selected here

Constants



Environmental and system properties or model settings that are constant in time and space

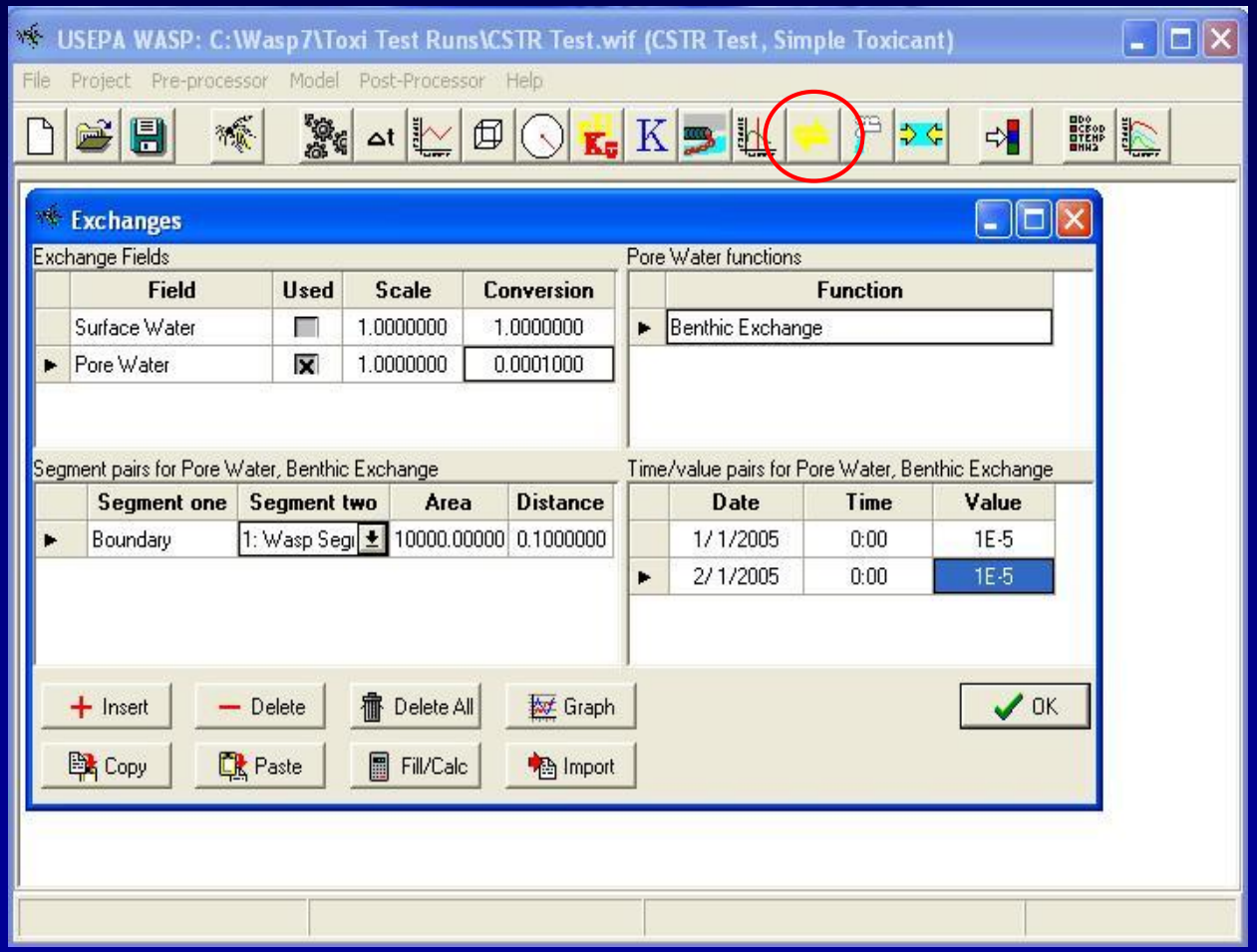
Direct Loads



External input of variable mass to segments.

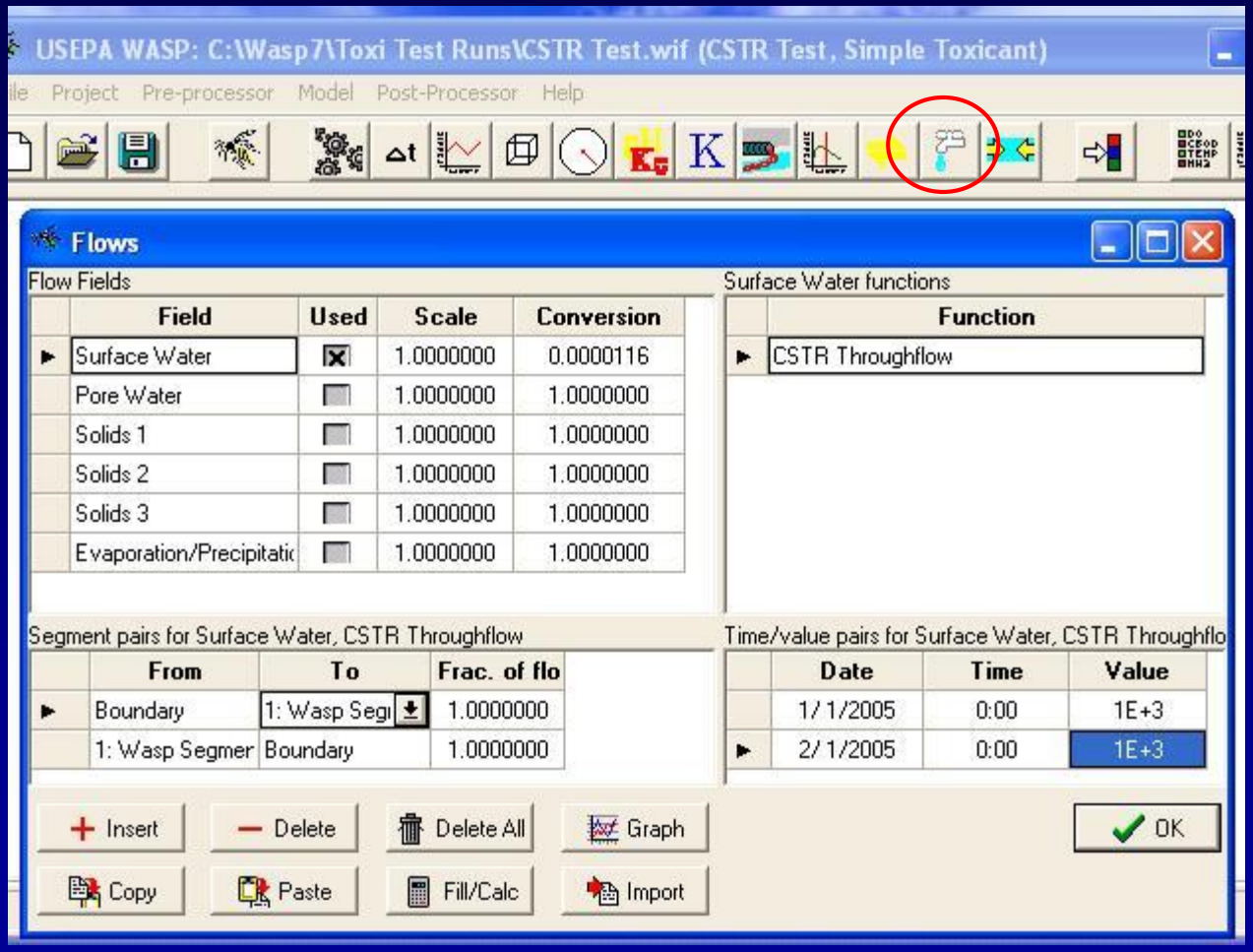
Note: variables with concentration in mg/L require loading values in kg/day.

Dispersive Exchanges



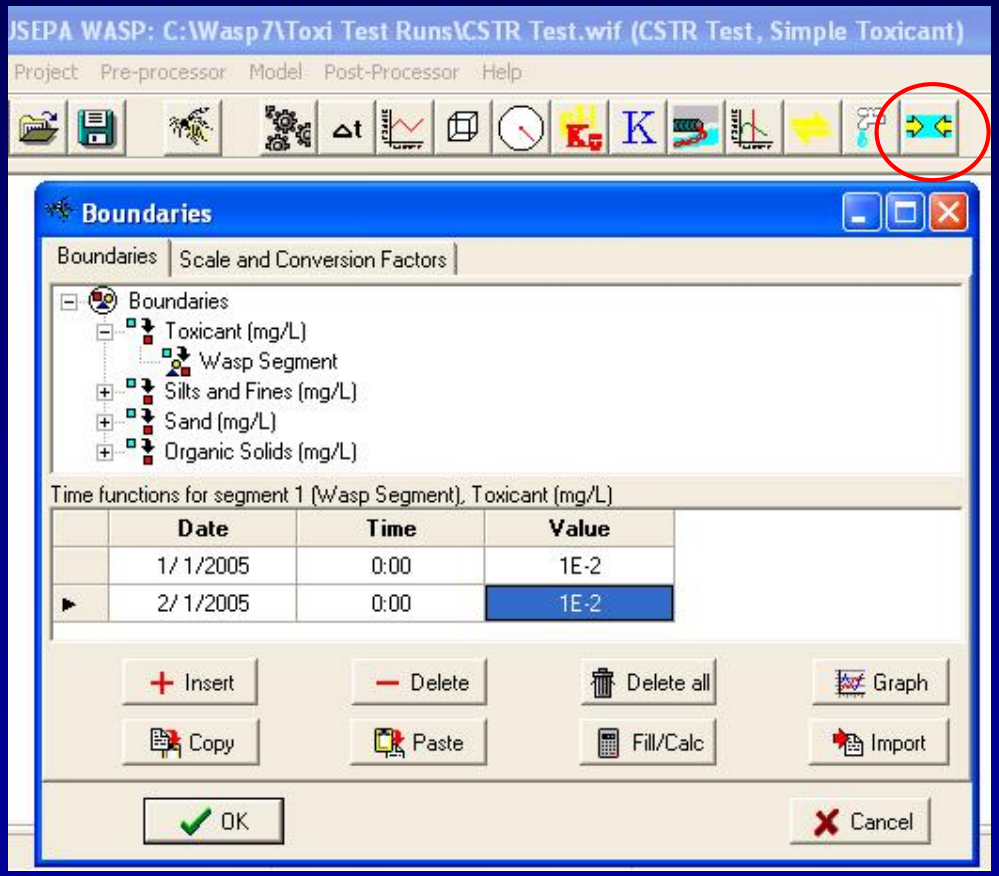
Bulk dispersive exchange flows among model segments

Advective Flows



Movement of water and solids among model segments

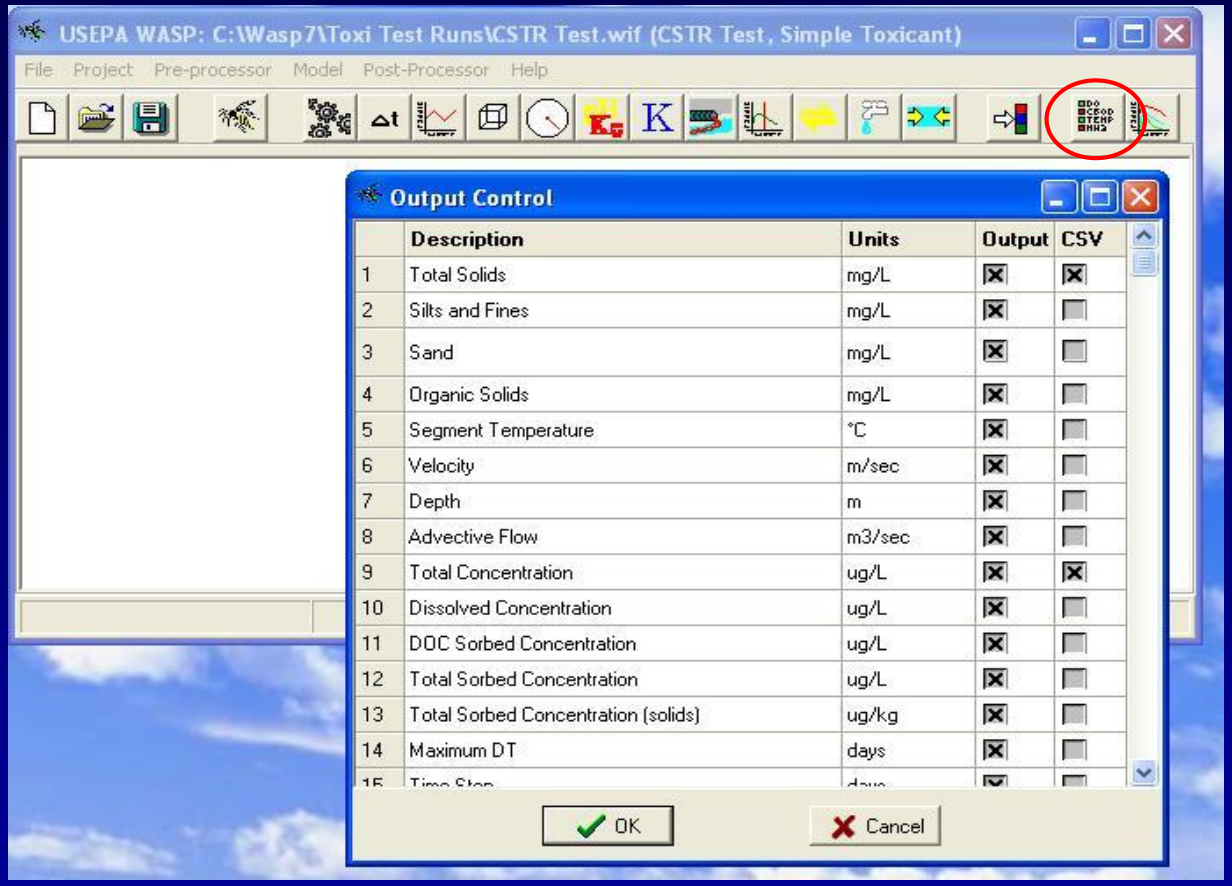
Boundaries



- Concentration of each system in flows entering model network.
- BCs must be specified for upstream and downstream advective flows and dispersive exchanges.

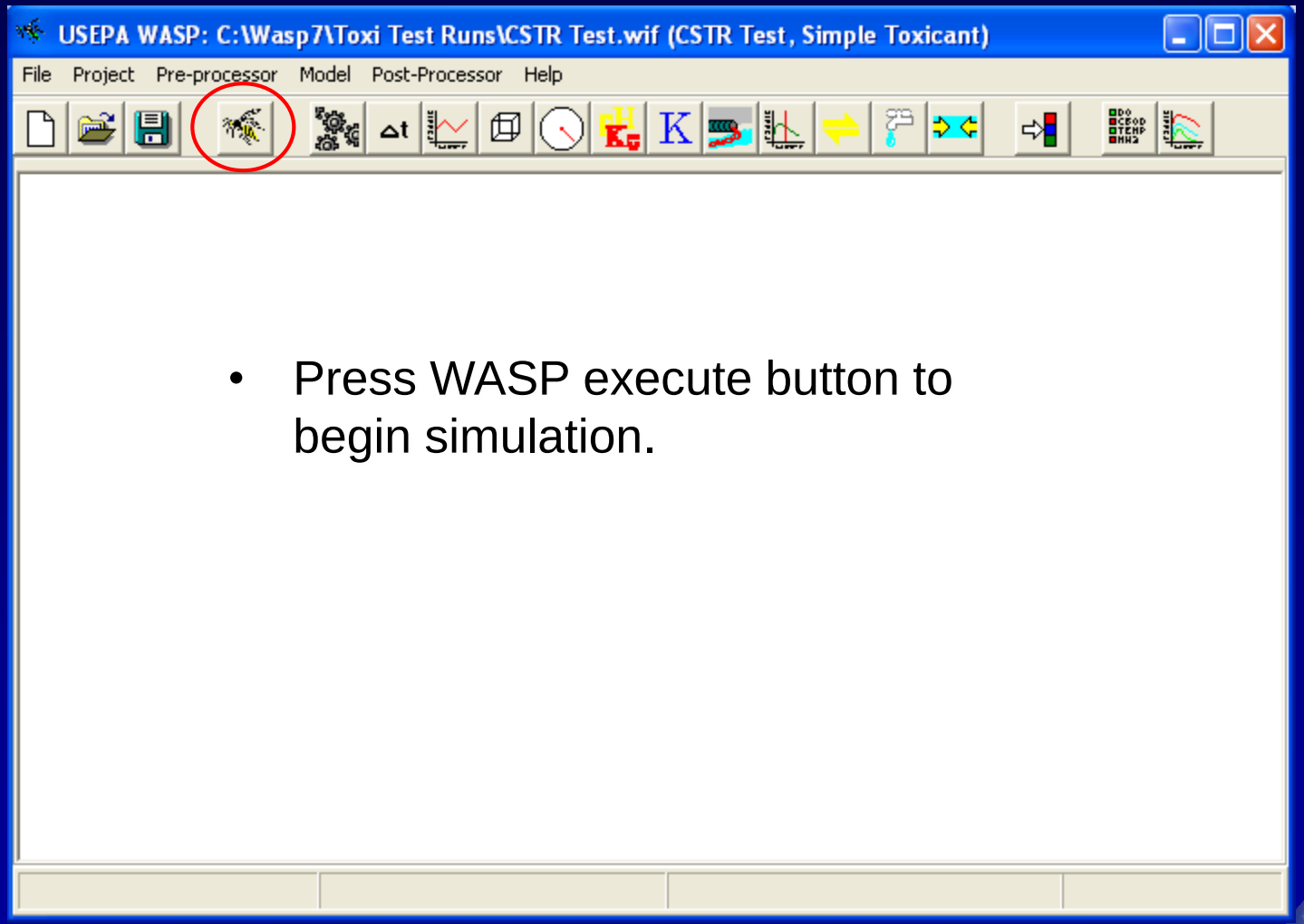
WASP Output Variable Selection

Selects variables that will be saved to the WASP output file (bmd), and variables that will be saved in a set of comma-delimited files (*.csv)



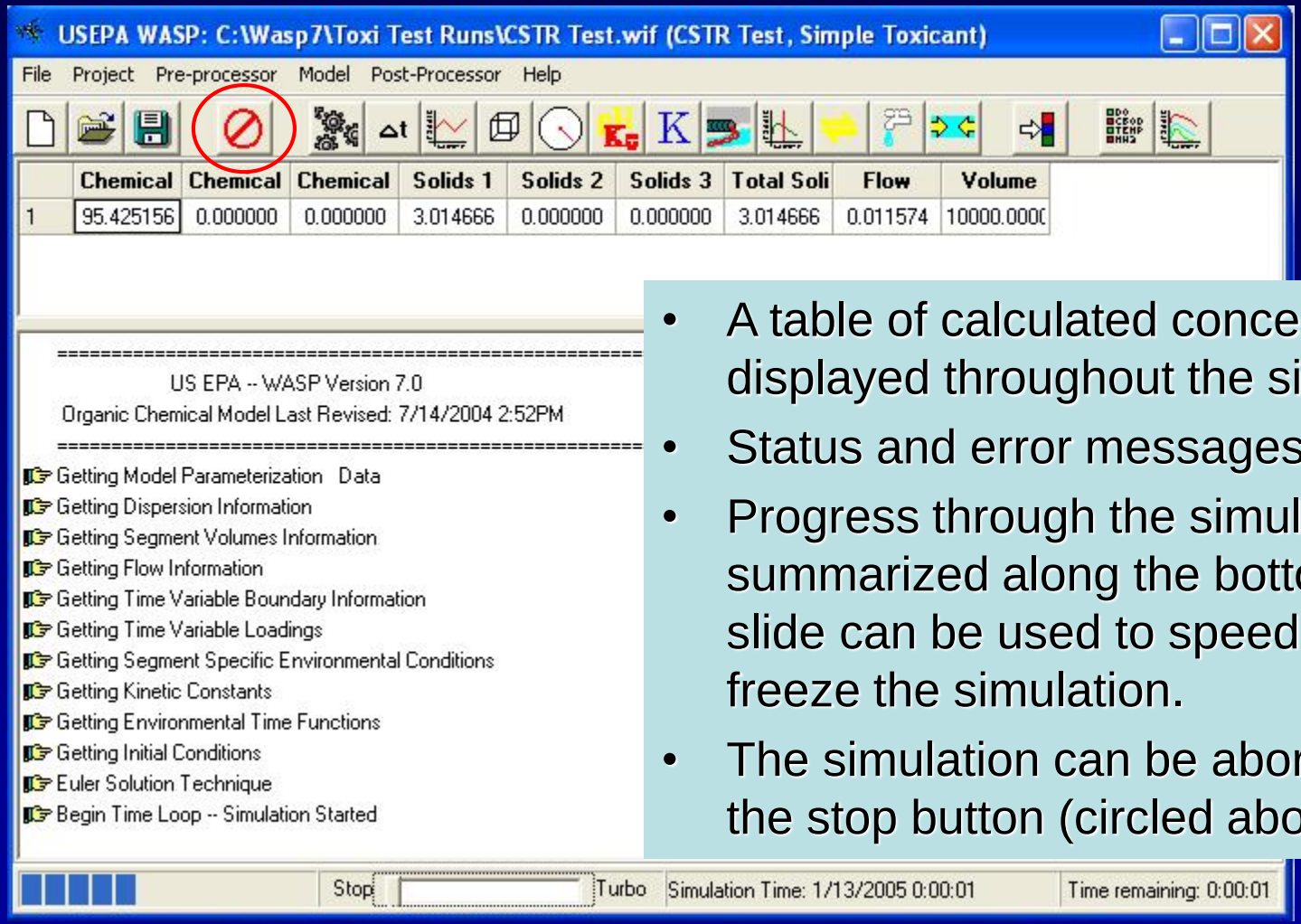
	Description	Units	Output	CSV
1	Total Solids	mg/L	☒	☒
2	Silts and Fines	mg/L	☒	☐
3	Sand	mg/L	☒	☐
4	Organic Solids	mg/L	☒	☐
5	Segment Temperature	°C	☒	☐
6	Velocity	m/sec	☒	☐
7	Depth	m	☒	☐
8	Advective Flow	m3/sec	☒	☐
9	Total Concentration	ug/L	☒	☒
10	Dissolved Concentration	ug/L	☒	☐
11	DOC Sorbed Concentration	ug/L	☒	☐
12	Total Sorbed Concentration	ug/L	☒	☐
13	Total Sorbed Concentration (solids)	ug/kg	☒	☐
14	Maximum DT	days	☒	☐
15	Time Step	days	☒	☐

Execute Model Simulation -1



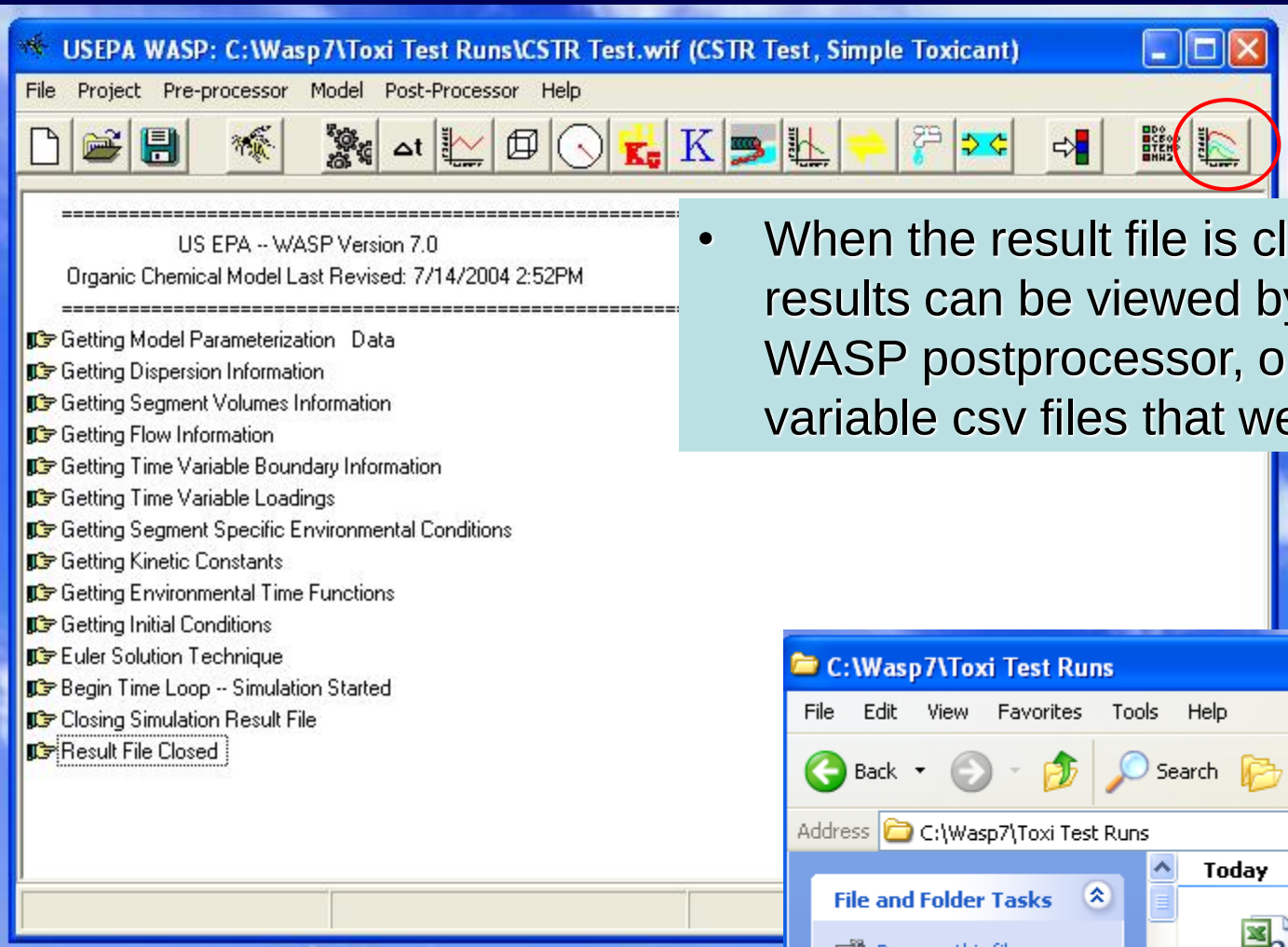
- Press WASP execute button to begin simulation.

Execute Model Simulation - 2

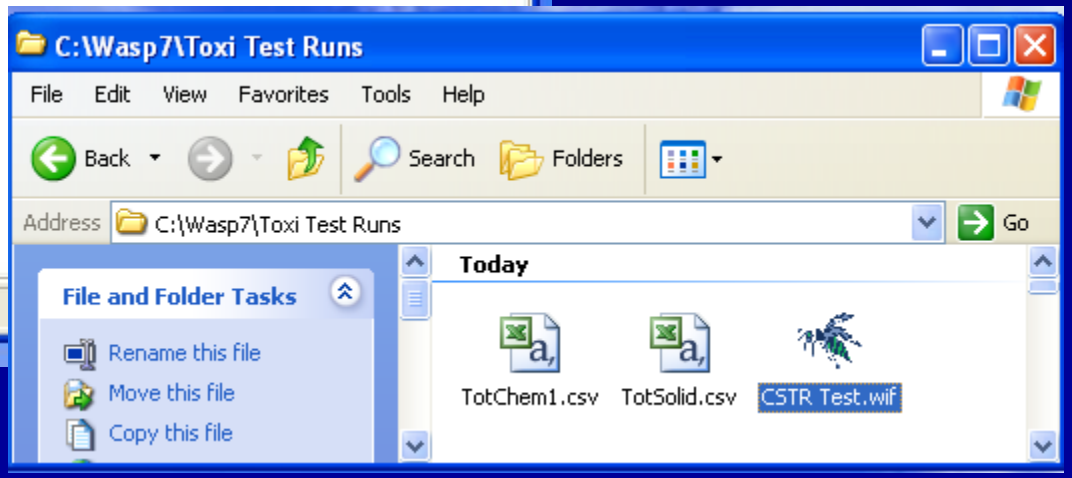


- A table of calculated concentrations will be displayed throughout the simulation.
- Status and error messages will be displayed.
- Progress through the simulation is summarized along the bottom bar. A control slide can be used to speed up, slow down, or freeze the simulation.
- The simulation can be aborted by pressing the stop button (circled above).

Execute Model Simulation - 3



- When the result file is closed, simulated results can be viewed by launching the WASP postprocessor, or by opening the variable csv files that were created.



WASP Output csv file

Microsoft Excel - TotChem1.csv

File Edit View Insert Format Tools Data Window Help

A1 Output Variable: Tot Conc ug/L Number of Segments 1

	A	B	C	D	E	F	G
1	Output Variable: Tot Conc ug/L Number of Segments				1		
2	0	1000					
3	1	817.9874					
4	2	669.2699					
5	3.1	536.9018					
6	4.1	439.6025					
7	5.1	360.1018					
8	6.1	295.144					
9	7.1	242.0688					
10	8.1	198.7025					
11	9.1	163.269					
12	10	136.9565					

Time, days

Output variable by segment in columns