Performance Assessment Modeling with GoldSim

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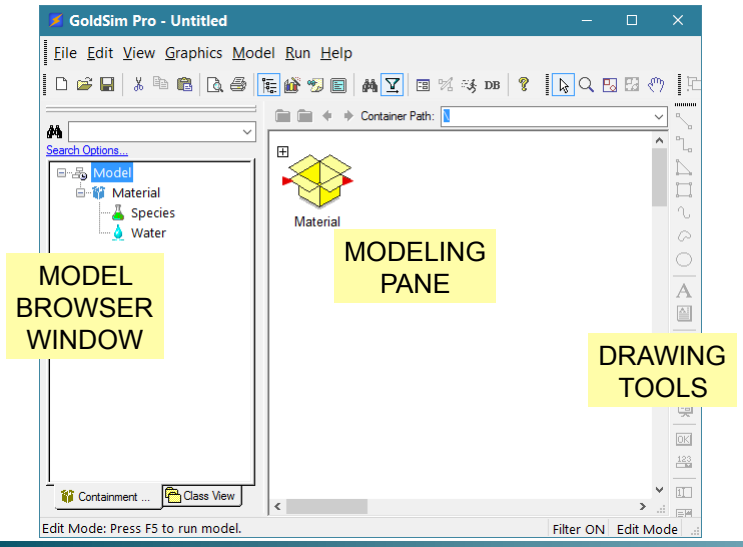
Presentation Outline

- Introduction to GoldSim
- Handling Uncertainty
- A GoldSim PA Example

The GoldSim Interface



GoldSim Basic Model Elements

Data: input of a fixed value

Stochastic: input of a distribution for a value

Expression: a mathematical expression

Selector: for building complex conditionals

Event: timed or triggered event and consequences

Extremum: for tracking maximum values

Lookup Table: input of a table of values

GoldSim PA Model Elements

Species: input of chemical and rad species

Fluid: definition of a fluid (in this case, water)

Solid: definition of a porous solid

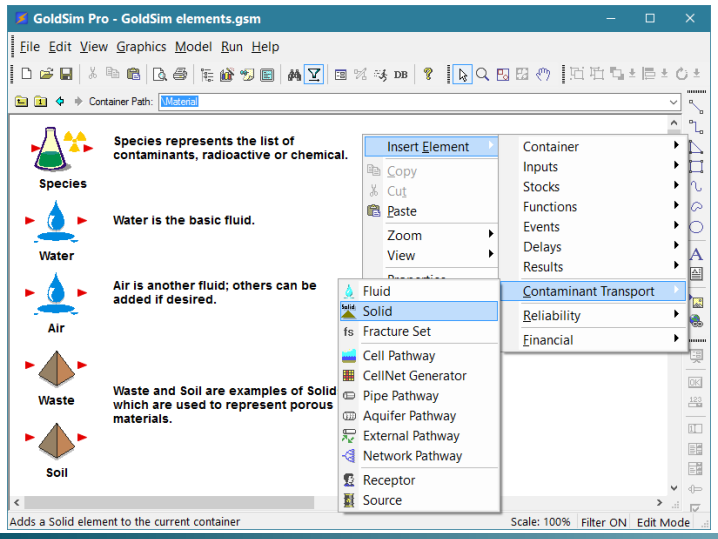
Source: contaminant source

Cell: compartment containing materials

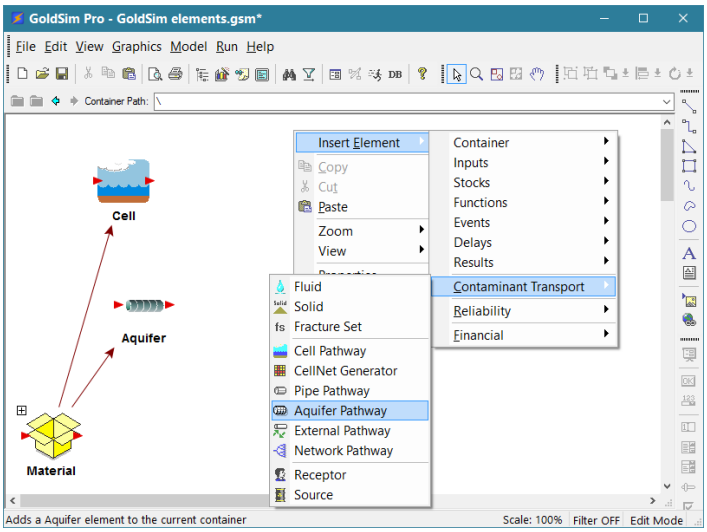
Aquifer: definition for simple groundwater transport

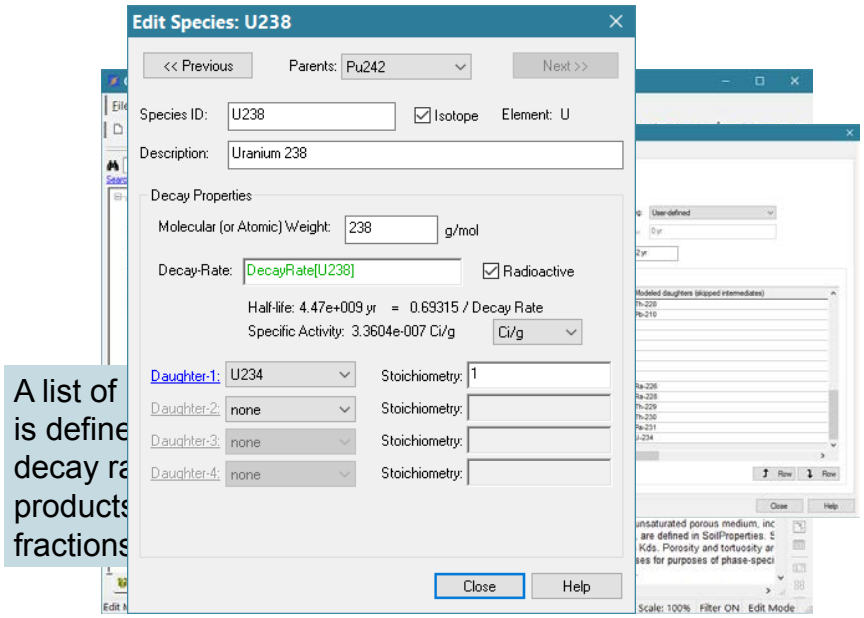
Receptor: definition of an exposed receptor

Model Elements: Materials



Model Elements: Pathways





A list of
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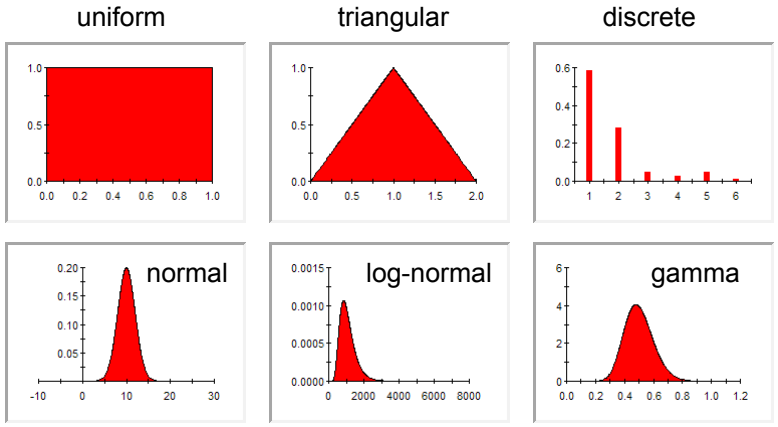
fractions

Many Types of Distributions are Available to Represent Uncertainty

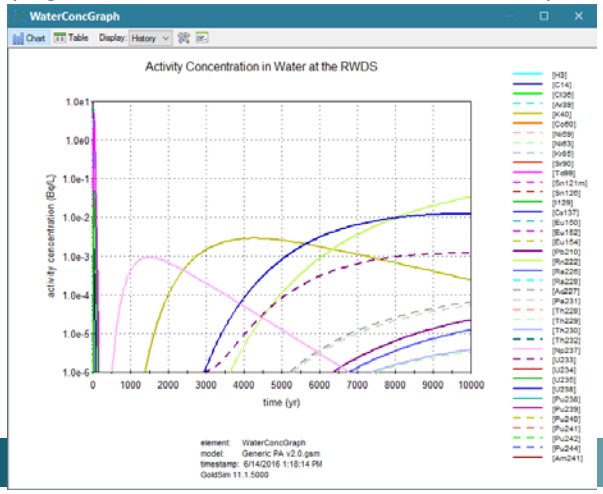


What is chosen must have some basis in reality.

Typical Results

Any state or condition of the model can be tracked and graphed through time (*e.g.* concentrations, flow rates, doses).

This could be concentration or dose.



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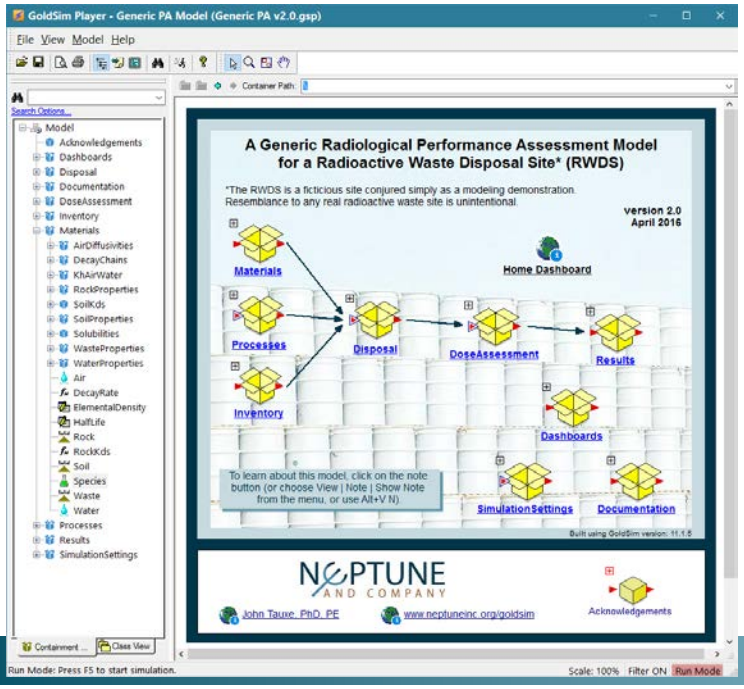
A Screenshot Tour of Neptune's Generic PA Model



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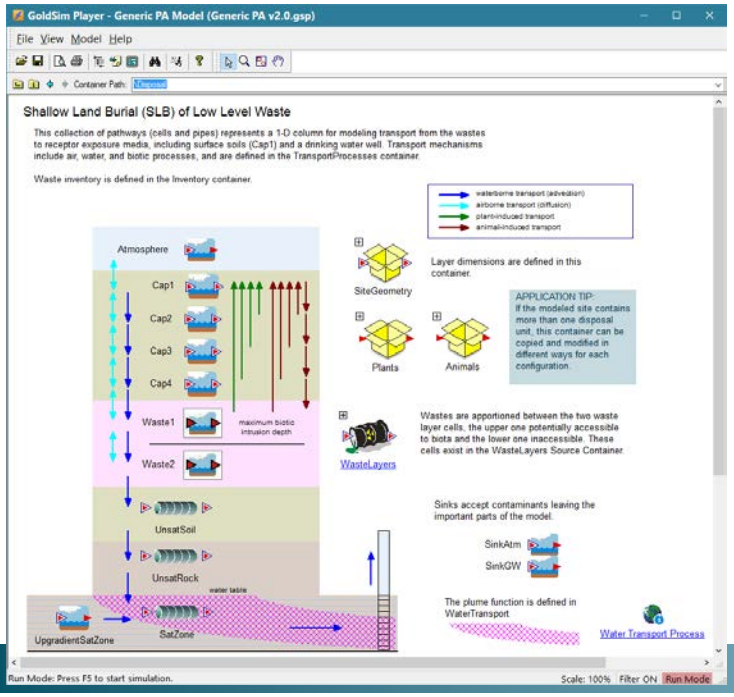
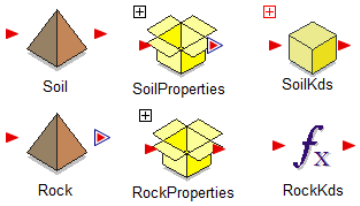


Modeling elements are logically organized on the page, with clear naming and accompanying text.

Porous media Soil and Rock



Properties of the unsaturated porous medium, including porosity, bulk density, etc., are defined in SoilProperties. Soil/Water partition coefficients are in Kds. Porosity and tortuosity are defined for the air and water phases for purposes of phase-specific advective and diffusive transport.

Similar properties are defined for Rock. If different Kds are to be used for Rock, then a separate (localized) container should be used for their definition.

Waste - a specialized solid medium

The Waste medium occupies the waste cells. For now, it has the same properties as Soil, but this can be changed in WasteProperties.

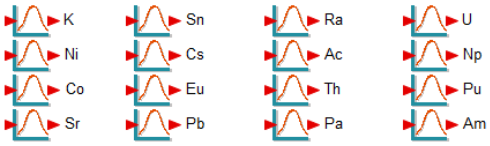
This example shows how soil/water partition coefficients (K_ds) are defined.

Soil/water partition coefficients

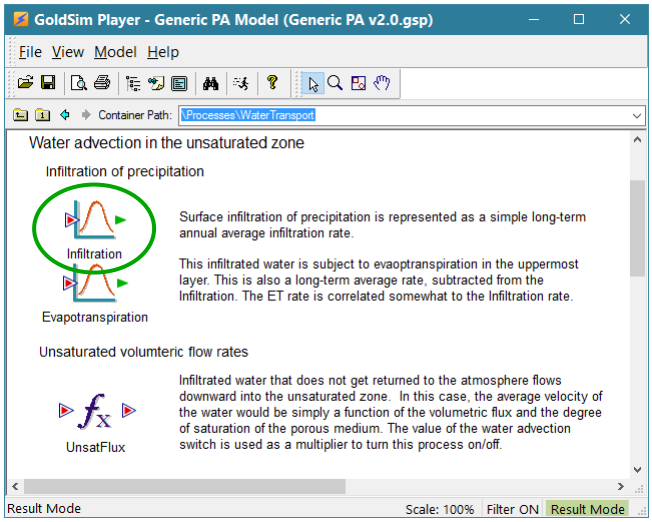
A soil/water partition coefficient (Kd) is defined for each chemical element in the model (not each radionuclide Species). Units are from the original references, but GoldSim takes care of the conversions.

The following Kd values are assumed to be zero (no retardation):

The following Kd values are from Sheppard and Thibault (1990) for sand, with log-normal distributions applied as suggested in the paper:



Here's an example of how the rate of water flow into the ground is calculated.



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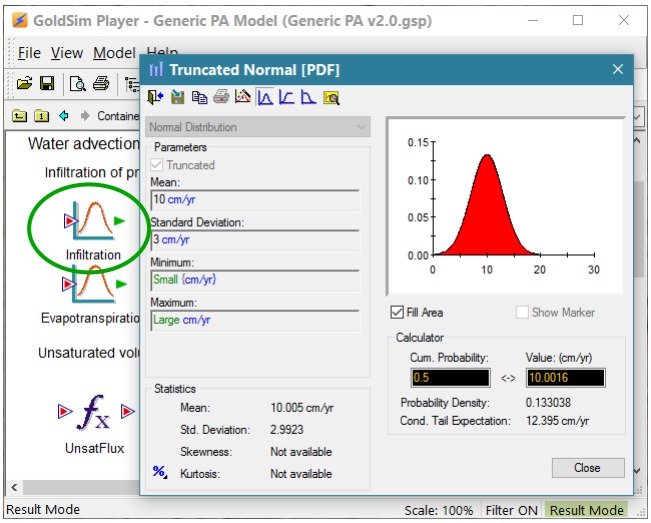
Infiltration is defined with some uncertainty, since we do not know the value perfectly.



Detail of the definition of UnsatFlux. Note that names that make sense are used.

Element ID: UnsatFlux Appearance...

Description: Volumteric flux of water through the unsaturated zone per

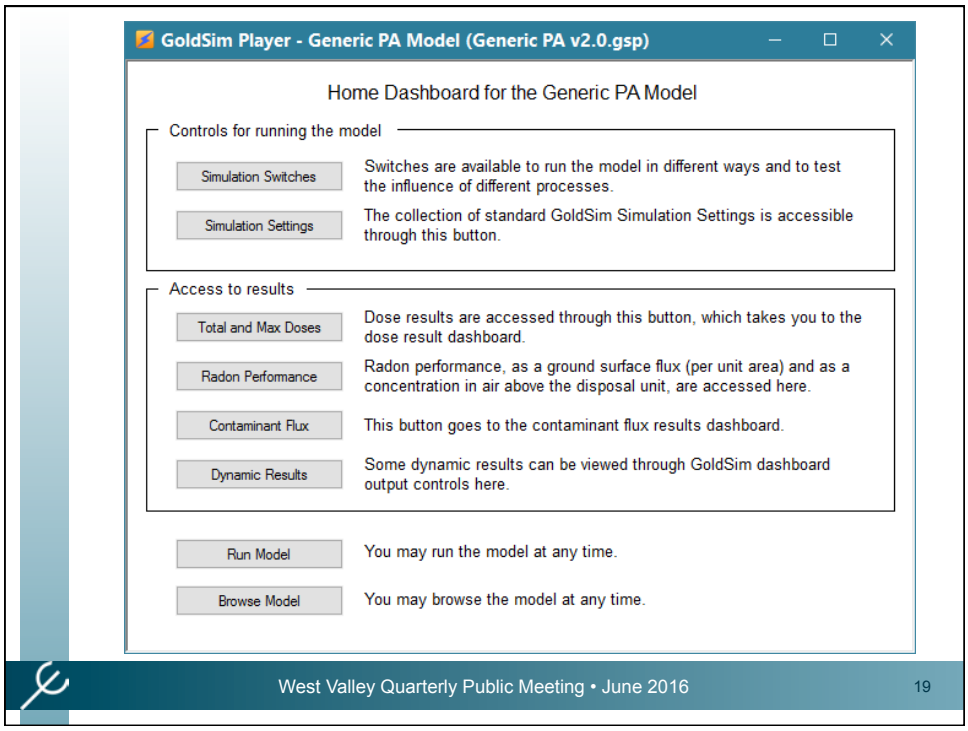
Display Units: cm/yr Type... Scalar

Equation

```
WaterAdvection_Switch * max( Small cm/yr, ( Infiltration -
Evapotranspiration ) )
```

UnsatFlux

Infiltrated water that does not get returned to the atmosphere flows downward into the unsaturated zone. In this case, the average velocity of the water would be simply a function of the volumetric flux and the degree of saturation of the porous medium. The value of the water advection switch is used as a multiplier to turn this process on/off.


GoldSim Player - Generic PA Model (Generic PA v2.0.gsp)
Home Dashboard for the Generic PA Model
Controls for running the model
Simulation Switches
Switches are available to run the model in different ways and to test the influence of different processes.
Simulation Settings
The collection of standard GoldSim Simulation Settings is accessible through this button.
Access to results
Total and Max Doses
Dose results are accessed through this button, which takes you to the dose result dashboard.
Radon Performance
Radon performance, as a ground surface flux (per unit area) and as a concentration in air above the disposal unit, are accessed here.
Contaminant Flux
This button goes to the contaminant flux results dashboard.
Dynamic Results
Some dynamic results can be viewed through GoldSim dashboard output controls here.
Run Model
You may run the model at any time.
Browse Model
You may browse the model at any time.
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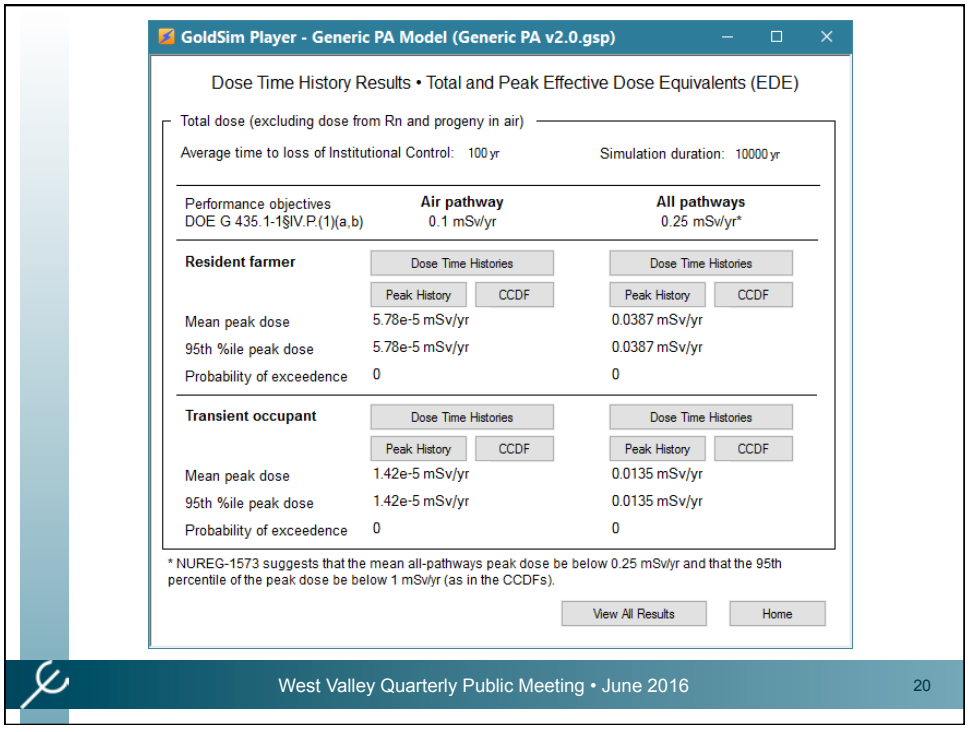
GoldSim Player - Generic PA Model (Generic PA v2.0.gsp)
Dose Time History Results • Total and Peak Effective Dose Equivalents (EDE)
Total dose (excluding dose from Rn and progeny in air)
Average time to loss of Institutional Control: 100 yr
Simulation duration: 10000 yr
Performance objectives DOE G 435.1-1§IV.P.(1)(a,b)
Air pathway 0.1 mSv/yr
All pathways 0.25 mSv/yr*
Resident farmer
Dose Time Histories
Peak History
CCDF
Mean peak dose 5.78e-5 mSv/yr 0.0387 mSv/yr
95th %ile peak dose 5.78e-5 mSv/yr 0.0387 mSv/yr
Probability of exceedence 0 0
Transient occupant
Mean peak dose 1.42e-5 mSv/yr 0.0135 mSv/yr
95th %ile peak dose 1.42e-5 mSv/yr 0.0135 mSv/yr
Probability of exceedence 0 0
* NUREG-1573 suggests that the mean all-pathways peak dose be below 0.25 mSv/yr and that the 95th percentile of the peak dose be below 1 mSv/yr (as in the CCDFs).
View All Results
Home
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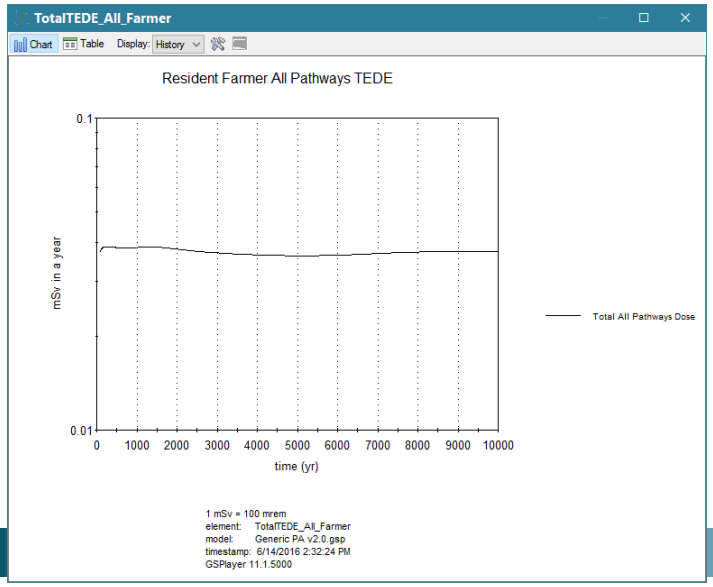
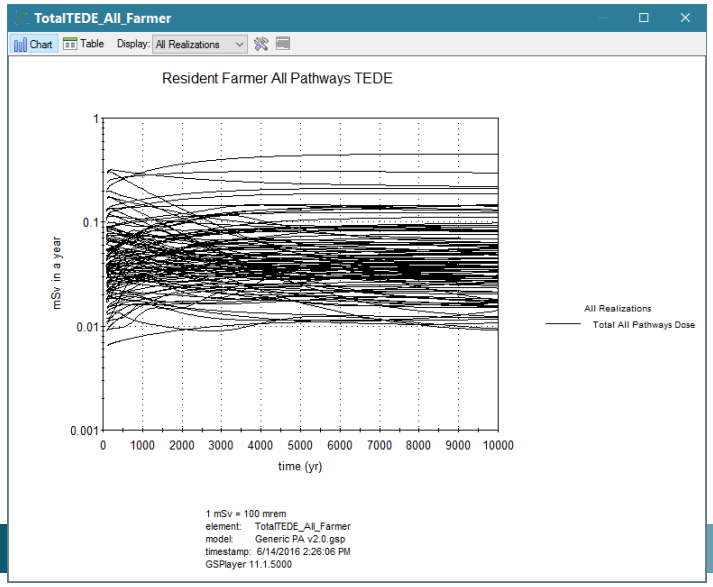
A single run (deterministic) simulation will generate a single time history of dose.



A probabilistic simulation will generate several time histories of dose, showing uncertainty.



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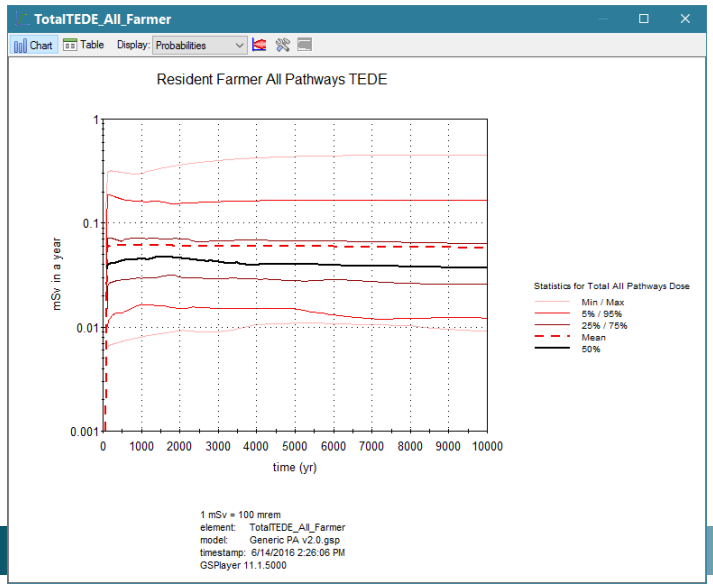
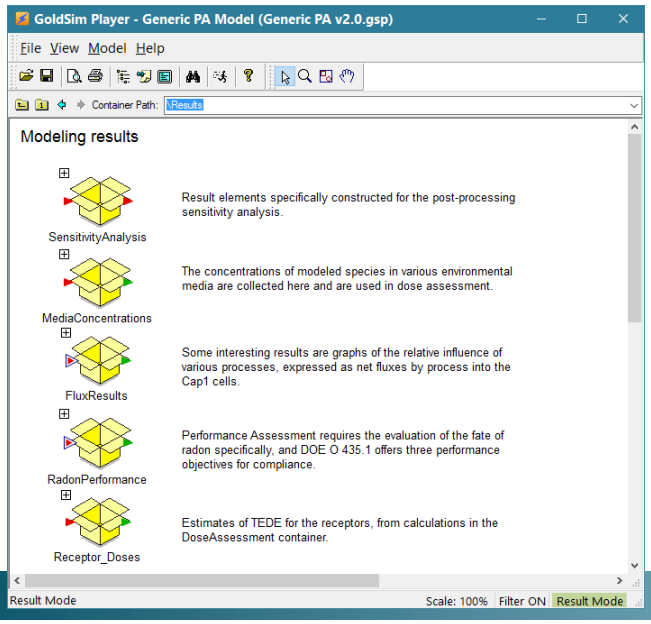
A probabilistic simulation can also be shown using a statistical summary.



Many types of results can be examined.



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The Generic PA Model is available here:

www.neptuneinc.org/genericpa

The GoldSim Player is available here:

www.goldsim.com/web/downloads