A Generic Performance Assessment (PA) GoldSim Model

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Objective

Objective: Introduction to probabilistic performance assessment (PPA) models in GoldSim so that the West Valley PPA GoldSim Model is easier to understand.

When the West Valley PPA Model is released, a GoldSim Player model version will be available to everyone to open and examine.

Before the West Valley PPA Model is available, anyone can view the Generic PA Model as an example of a performance assessment model in GoldSim.

Agenda

1. Performance Assessment Overview
2. Generic PA Conceptual Site Model
3. Structure of the Generic PA model
4. Dashboards in the Generic PA model
5. Generic PA model results

What is a Performance Assessment?

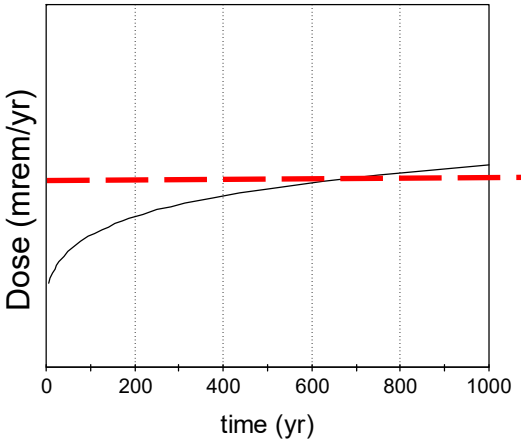
- Performance Assessments evaluate potential future impacts of radionuclides to human and ecological health.
- Health impacts are compared to regulatory requirements for site closure and license termination.
- For the West Valley Site, the Performance Assessment will be used to support Phase 2 decisionmaking.

What is a Probabilistic PA Model?

- Performance Assessment models evaluate the release and movement of radionuclides from a site into the environment, in soil, water, and air.
- They also estimate the potential exposure and risk to humans from these radionuclides for long times into the future.
- Probabilistic models include uncertainty in the model inputs that gets carried through the model to provide uncertainty in the output.

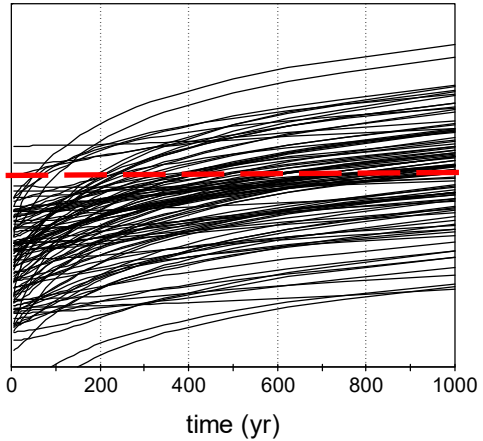
Deterministic vs. Probabilistic Models

Single deterministic realization



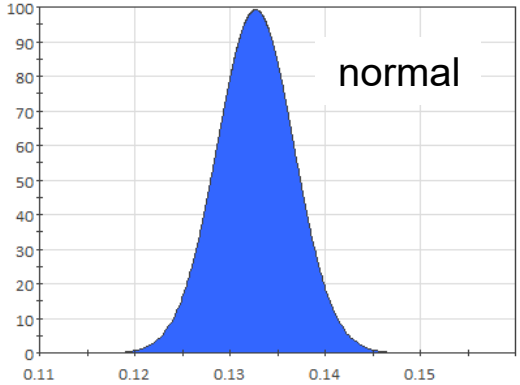
- Does not represent uncertainty
- Decision appears clearer than it really is

Many probabilistic realizations

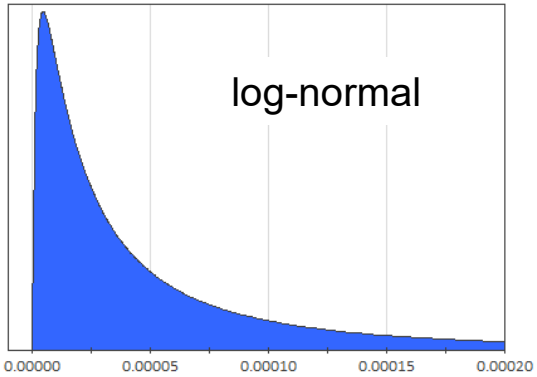


- Reflects uncertainty clearly
- Decision maker has to evaluate comfort level

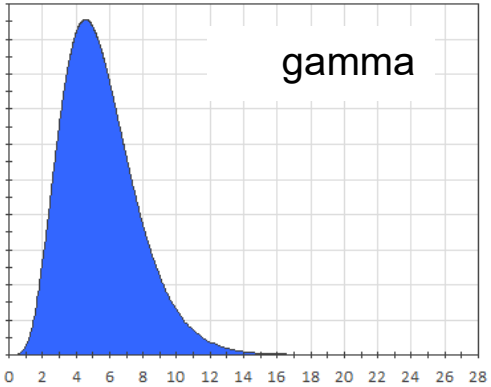
Many Types of Distributions are Available to Represent Uncertainty



gully advance rate



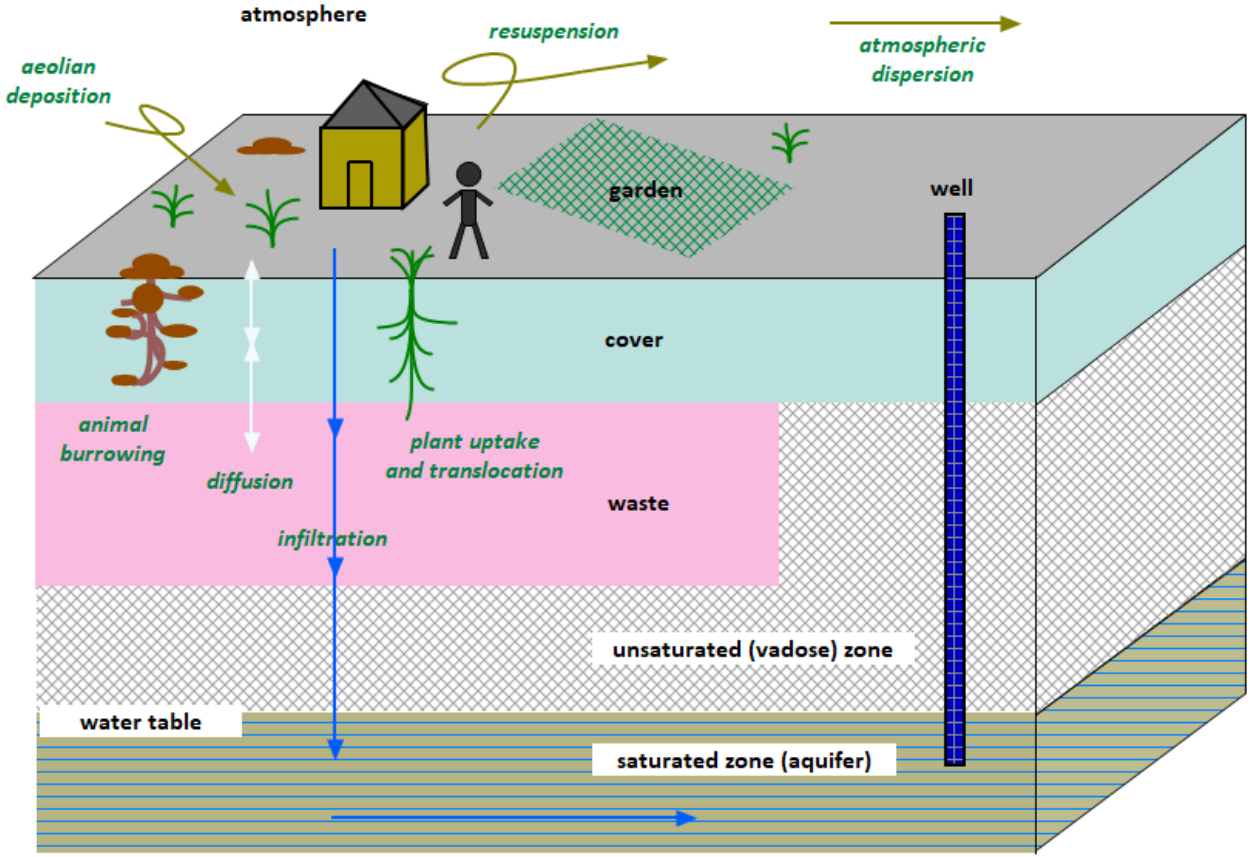
uranium solubility

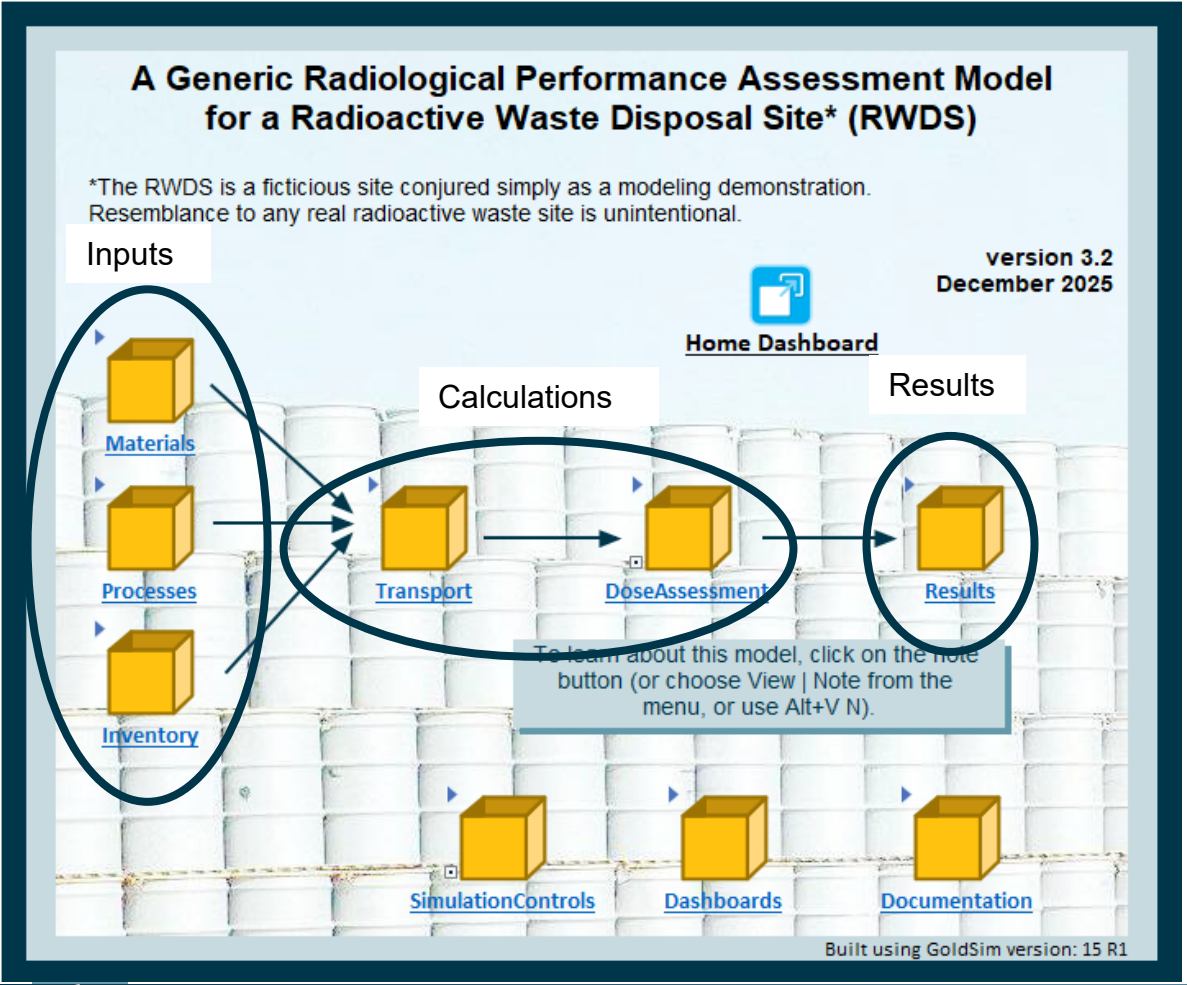


Pu-242 inventory

Distributions are developed based on site and other representative data.

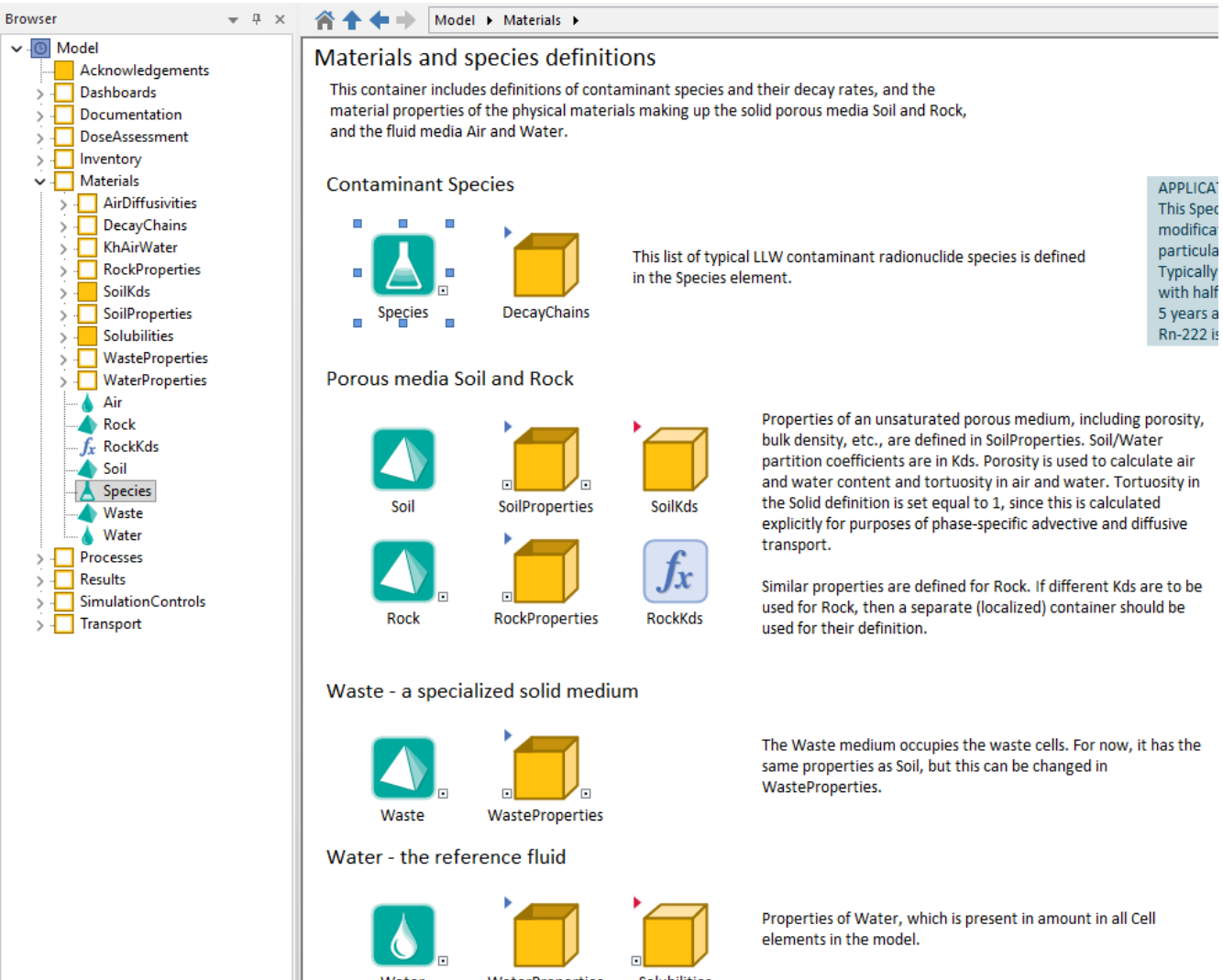
Generic PA Conceptual Site Model





Generic PA GoldSim Model

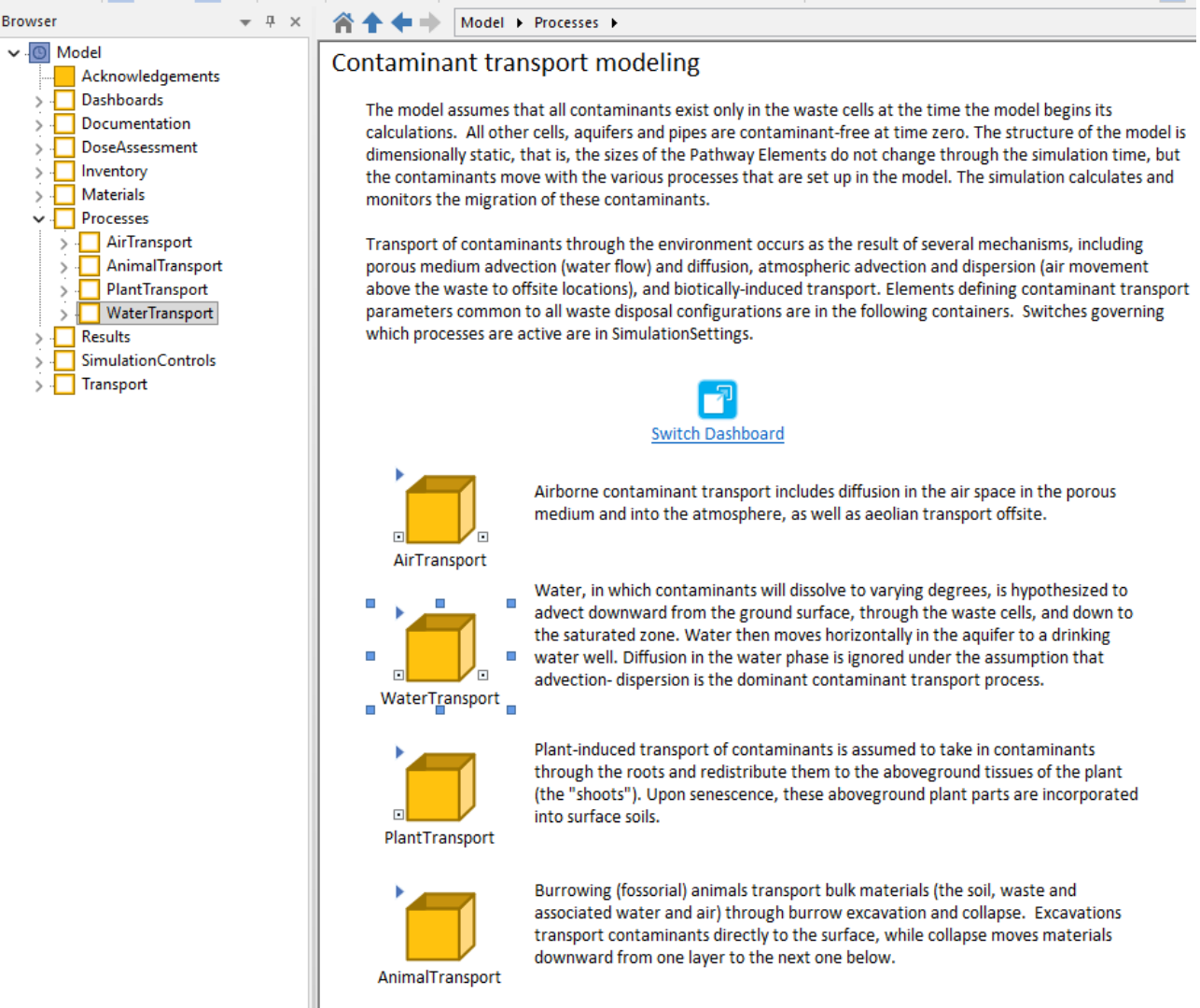
The Generic PA model main page shows a high-level view of the model via the yellow GoldSim containers.



Model Inputs: Materials

This container holds the input values and distributions for properties of the water, air, natural materials, and the waste.

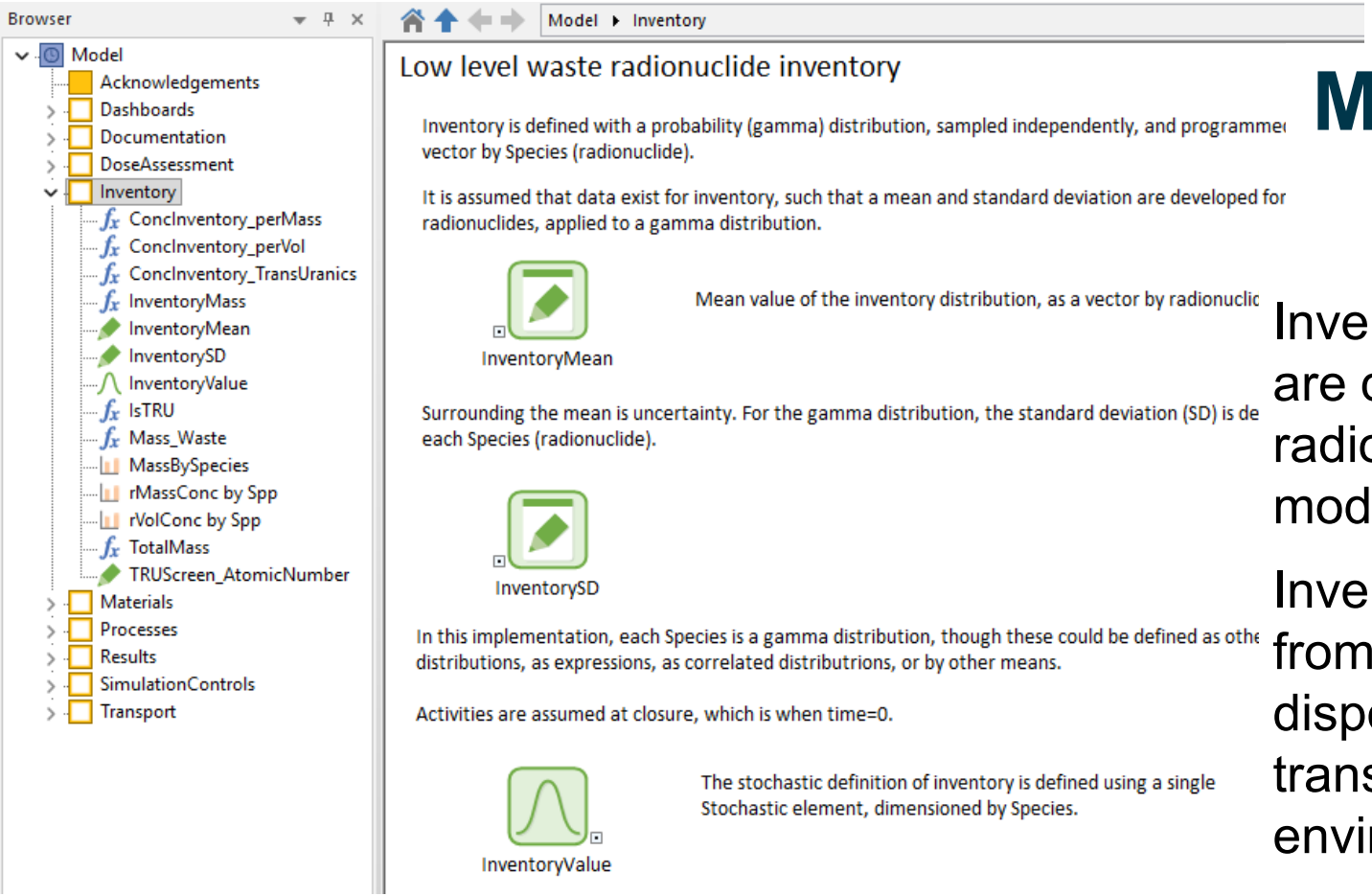
The Species element includes all the radionuclides in the model.



Model Inputs: Processes

This container holds the inputs for transport processes included in the Generic PA model.

Transport processes include contaminant movement in air and water, and by plants and animals.

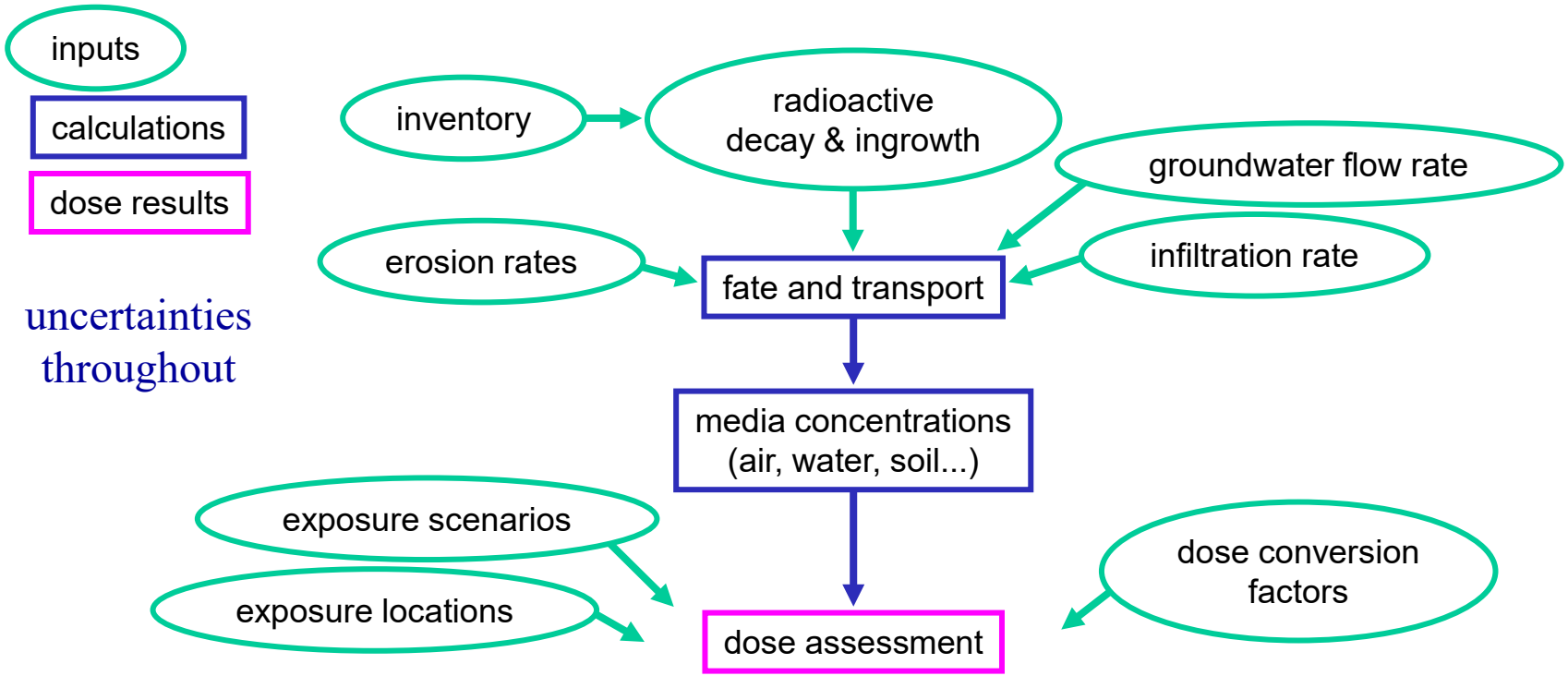


Model Inputs: Inventory

Inventory distributions are developed for each radionuclide in the model.

Inventory is tracked from the time of disposal to release and transport through the environment.

Example PA Influence Diagram



Transport Column

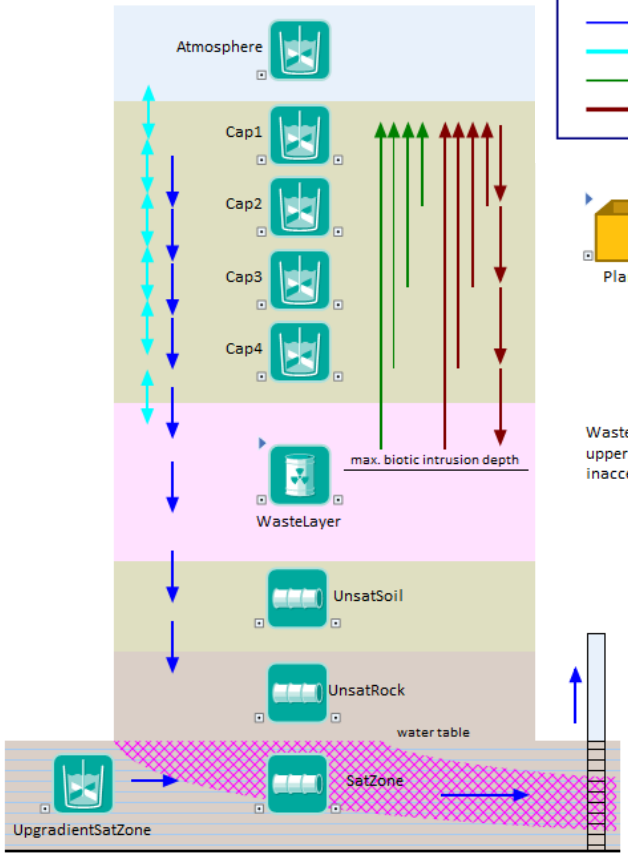
Contaminants are allowed to move upwards and downwards in this 1D column of teal cells.

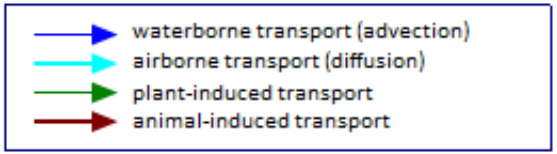
Visually see what calculations are being done in the model through the use of graphics.

Shallow Land Burial (SLB) of Low Level Waste

This collection of pathways (cells and pipes) represents a 1-D column for modeling transport from the wastes to receptor exposure media, including surface soils (Cap1) and a drinking water well. Transport mechanisms include air, water, and biotic processes. These mechanisms are defined in the Processes container.

Waste inventory is defined in the Inventory container.

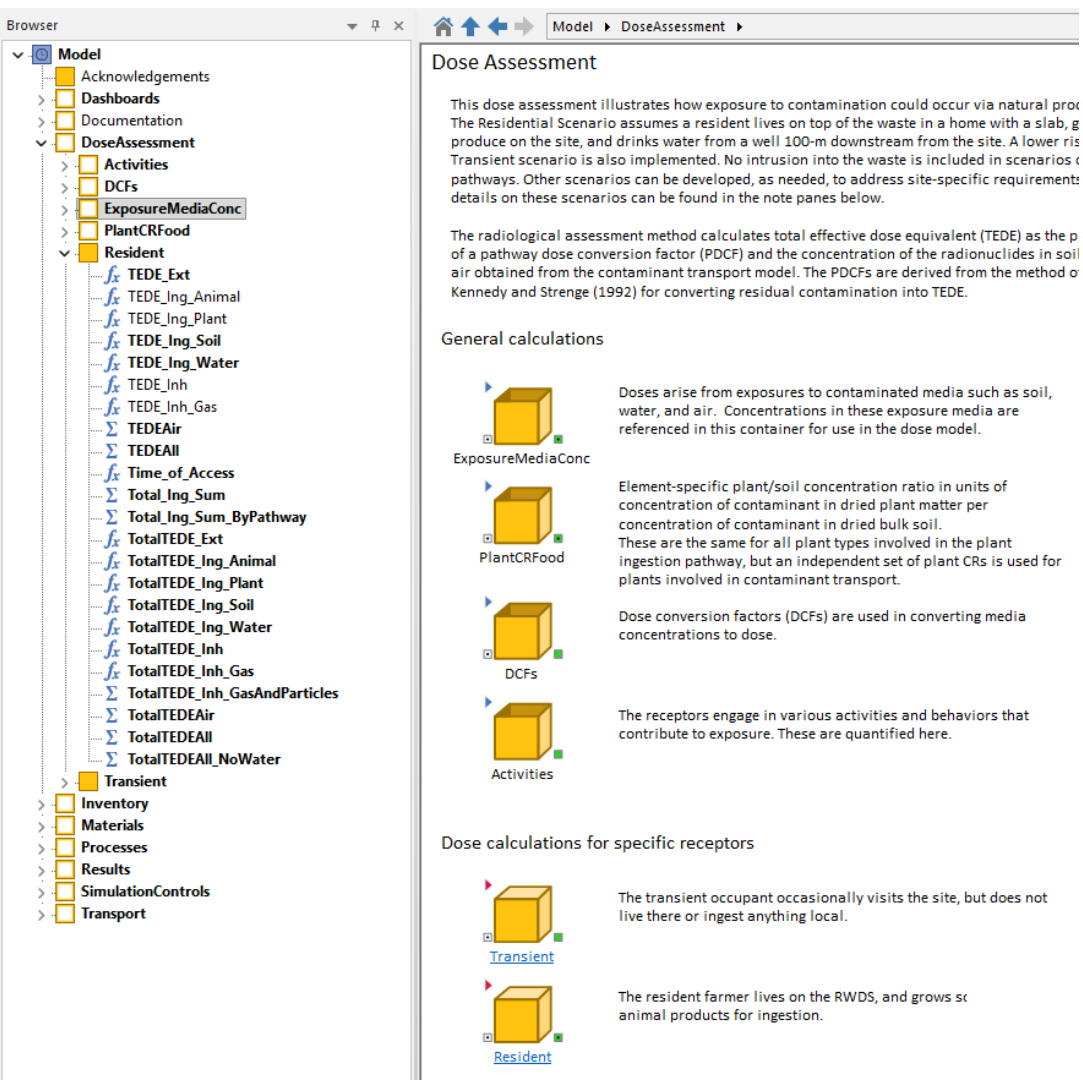




Wastes are apportioned between the two waste layer cells, the upper one potentially accessible to biota and the lower one inaccessible.

Sinks accept contaminants leaving the important parts of the model.

The plume function is defined in WaterTransport



Dose Calculations

This container holds the calculations for radionuclide concentrations over time in air, soil, water, and other media.

These concentrations are used in human health dose and risk calculations.

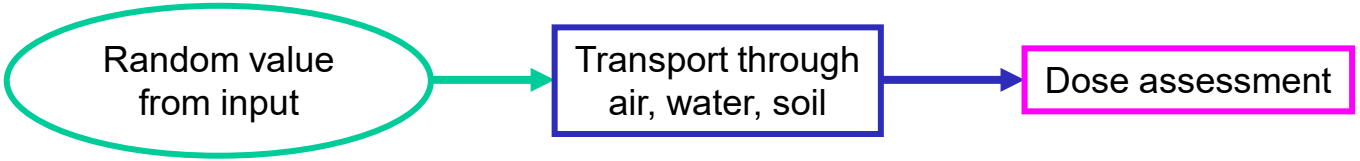
Dose calculations include inhalation, ingestion and external pathway doses.

Run the Model

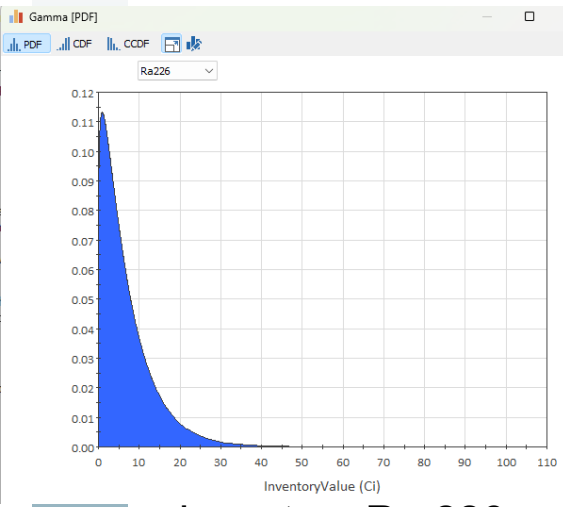
- Tell the GoldSim model how many years and how many realizations to run.
  - Run model simulations for 10,000 years
  - Run 1000 realizations of the model
- What is a realization?

What is a Realization?

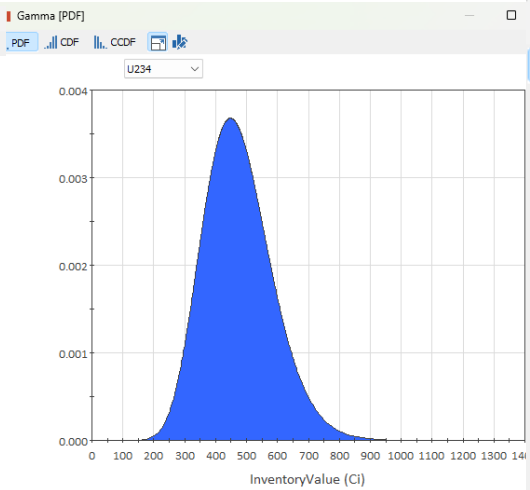
- A realization is a single run of the model through time.
- For each realization:
  - GoldSim chooses a random value from each input parameter distribution.
  - Calculations are performed in the model for waste moving in the soil, water and air.
  - Dose calculations are made each year after institutional control is lost.



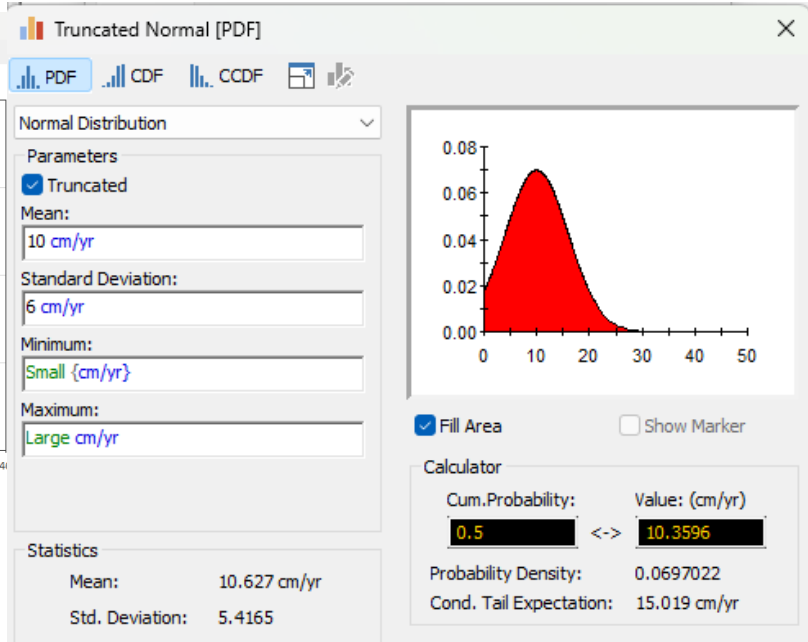
Input Distributions in the Generic PA



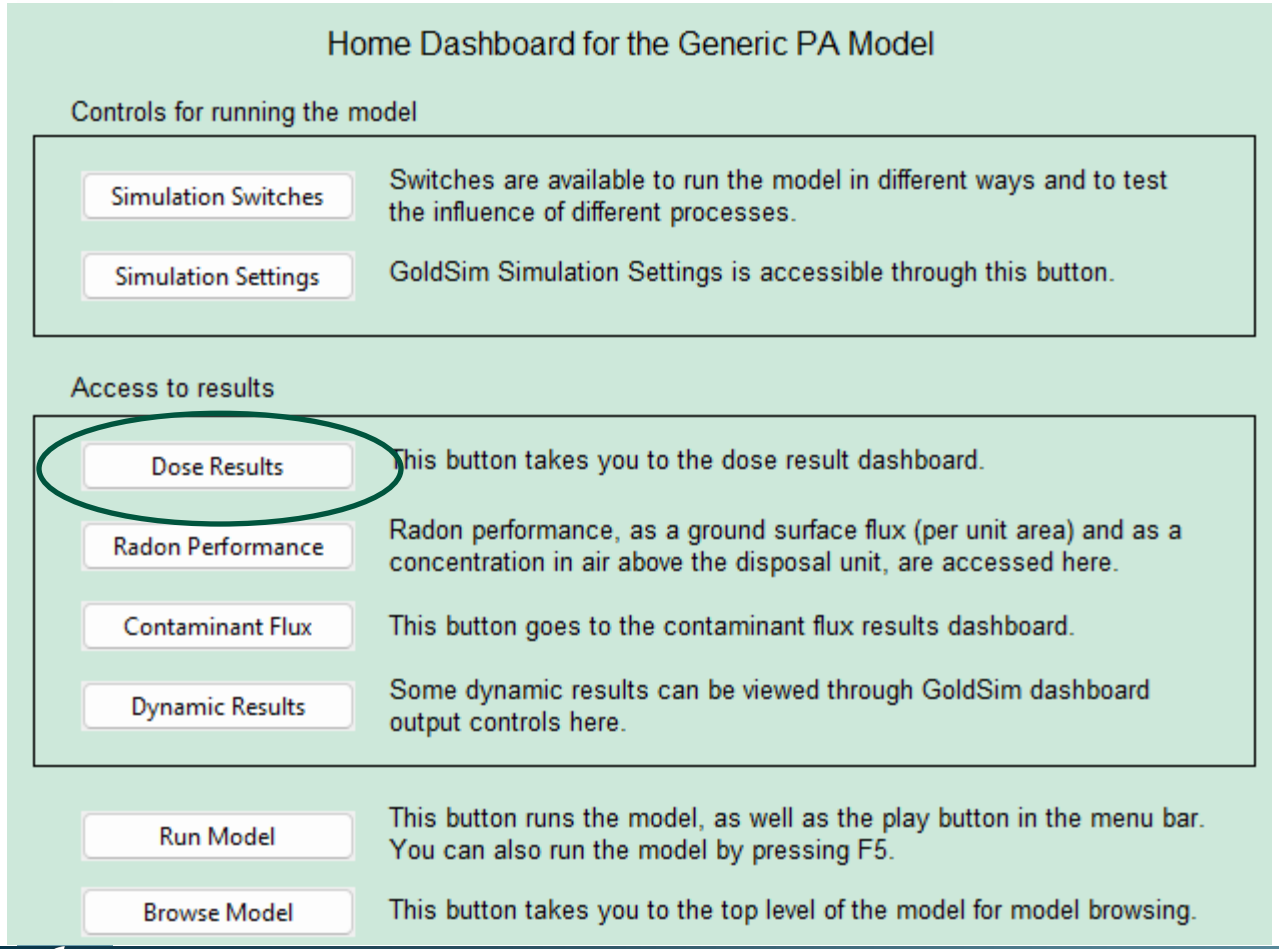
Inventory Ra-226



Inventory U-234



Infiltration



Home Dashboard

The Home Dashboard connects the user to model simulation options, result dashboards and other helpful model links.

Dose Results Dashboard
1000 Realizations

Dose Time History Results

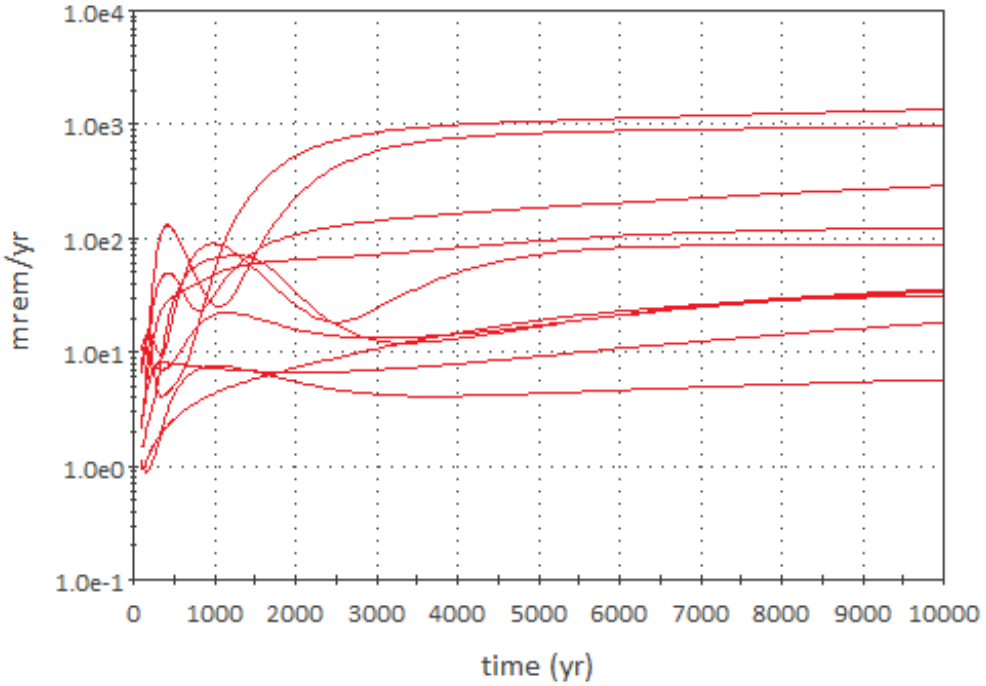
Total dose (excluding dose from Rn and progeny in air)

Average time to loss of Institutional Control: 100 yr Simulation duration: 10000 yr

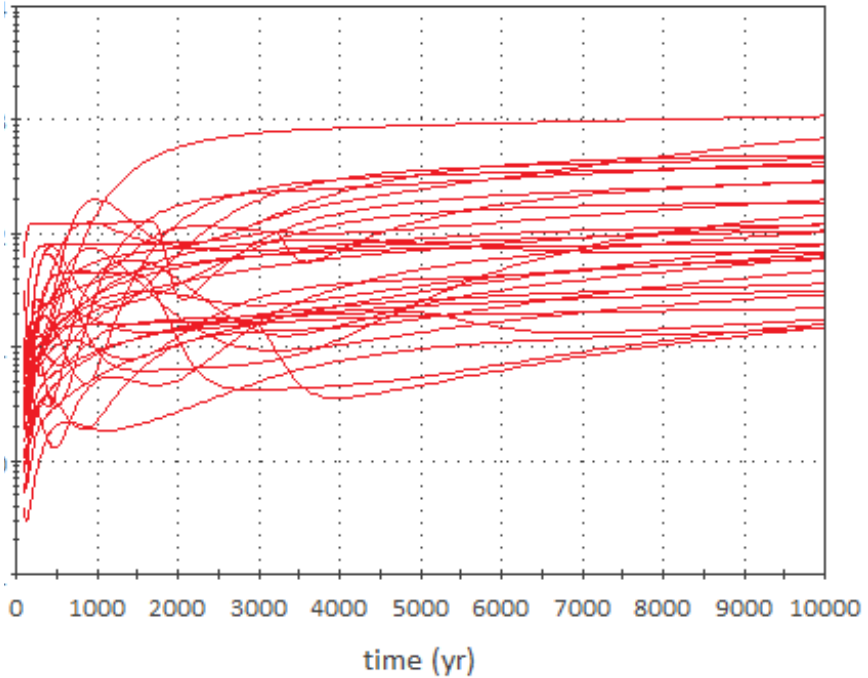
	Air pathway	Ingestion pathways	External pathways	Total dose
Resident farmer	Dose Time Histories	Dose Time Histories	Dose Time Histories	Dose Time Histories
	Dose by Radionuclide	Dose by Radionuclide	Dose by Radionuclide	Dose by Radionuclide
		Dose by Pathway		Dose by Pathway
Mean peak dose	0.0129 mrem/yr	222 mrem/yr	1.28 mrem/yr	223 mrem/yr
Mean peak time	3300 yr	8492 yr	8559 yr	8516 yr

Resident Dose Results

10 Realizations



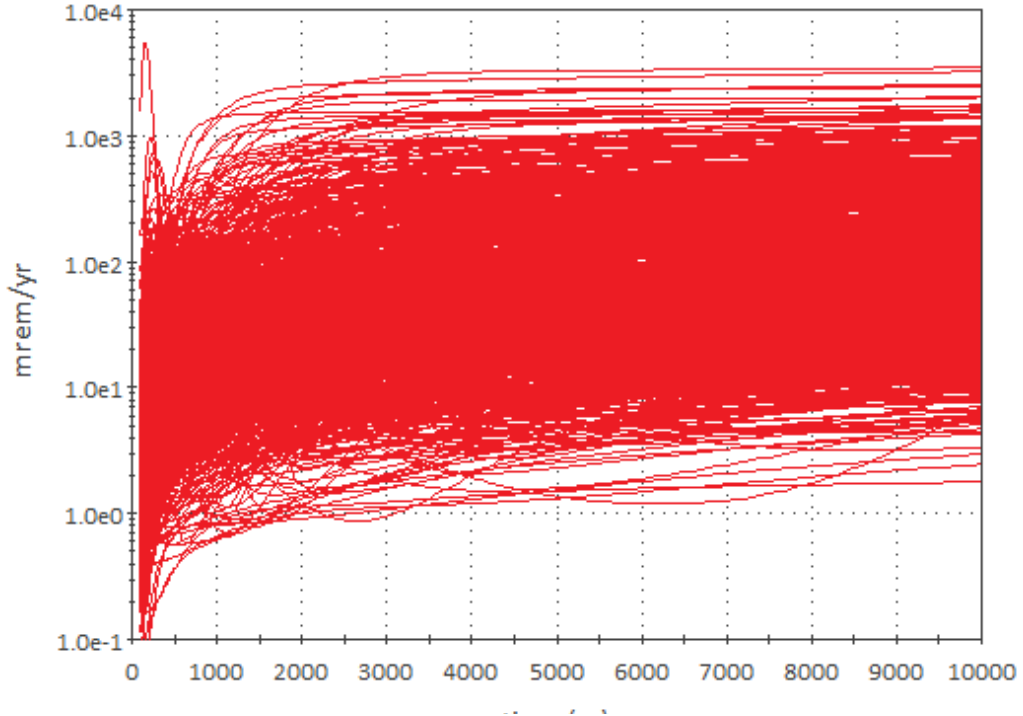
30 Realizations



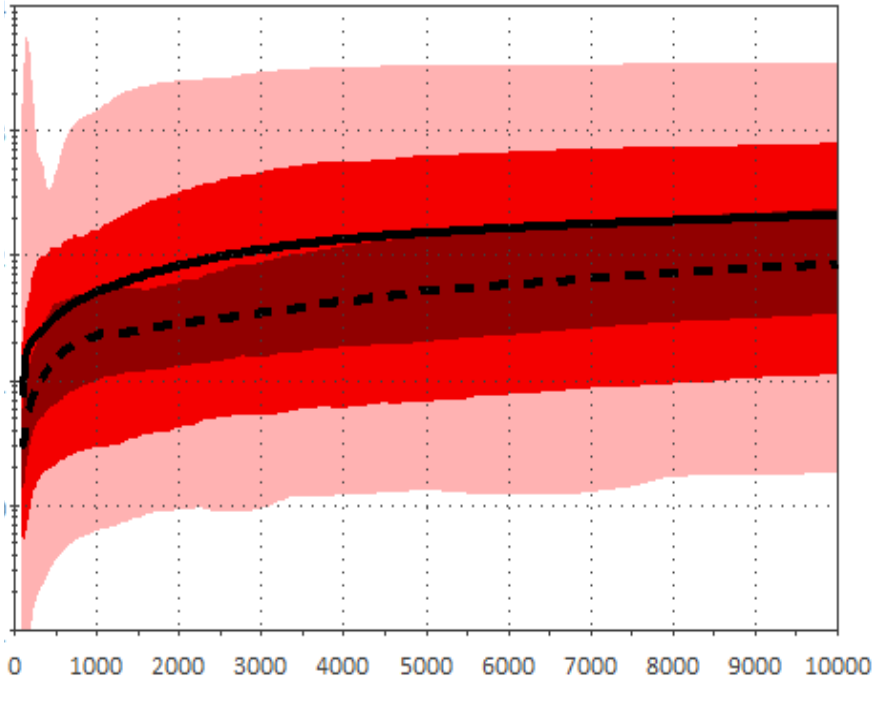
Resident Dose Results

1000 Realizations

All Realizations



Statistical Summary

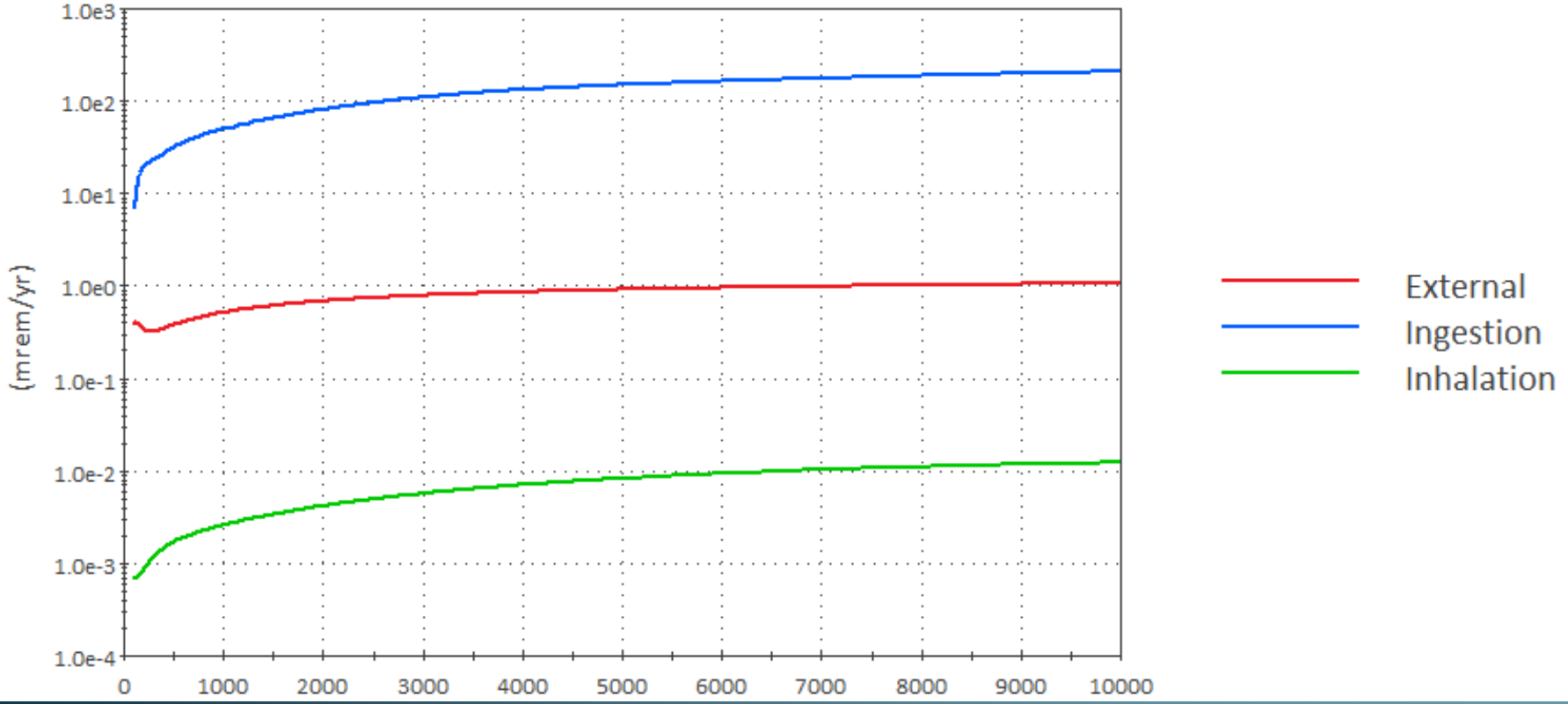


Statistics for Total All Pathways Dose

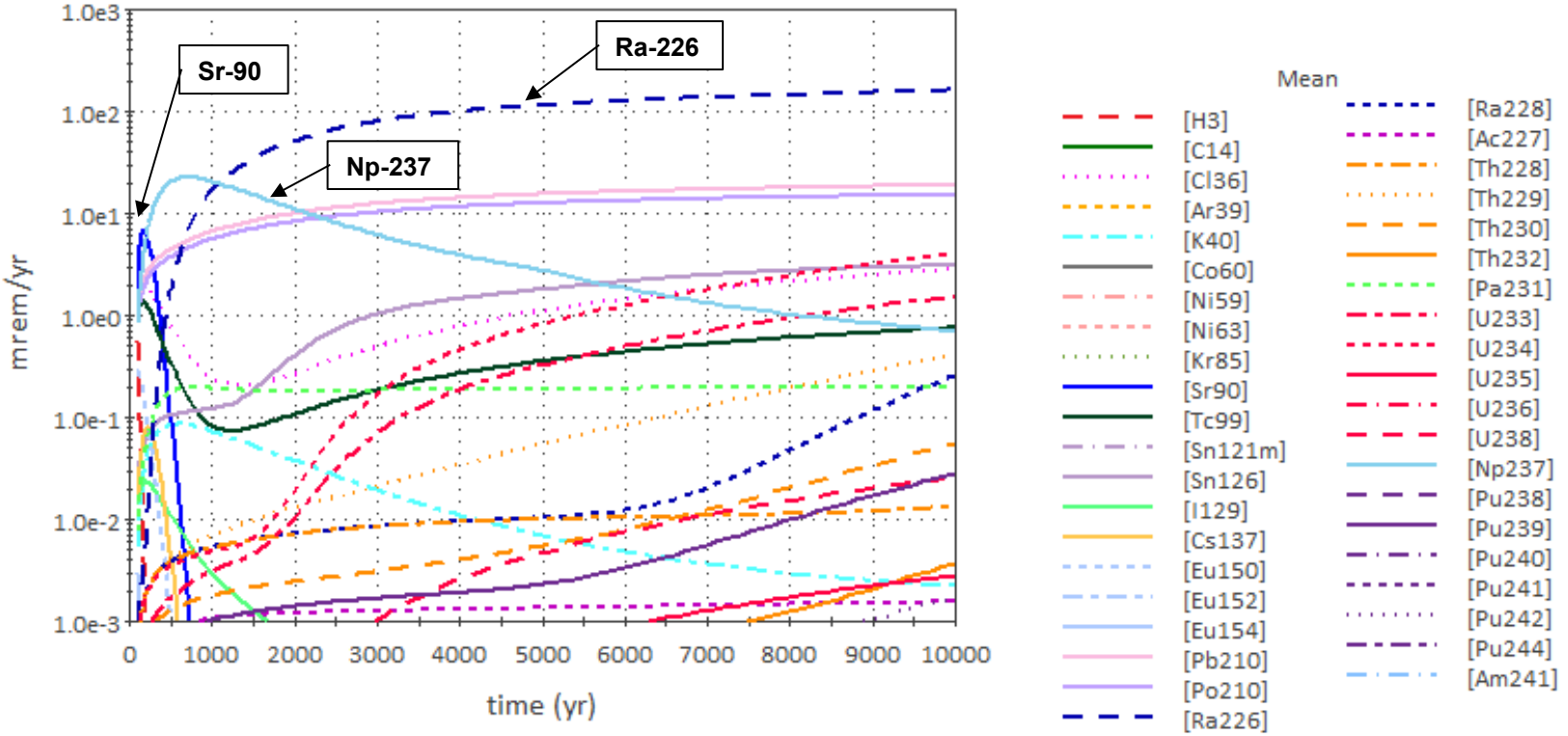
Min..5% / 95%..Max | 5%..25% / 75%..95% | 25%..75% | Mean | 50%

Average Dose Through Time by Pathway

1000 Realizations



Average Total Dose by Radionuclide
1000 Realizations



The GoldSim Player is available here:

www.goldsim.com/web/downloads

The Generic PA Model is available here:

www.neptuneinc.org/genericpa