HLWYM HEmails

From: John Bradbury
Sent: Monday, March 03, 2008 4:50 PM
To: LSNReviews
Subject: Fwd: A GoldSim model comparing Peak of the Mean to Mean of the Peaks
Attachments: TEXT.htm; Peak of the Mean versus Mean of the Peaks.doc

>>> John Bradbury 11/02/2007 1:38 PM >>>
Jack: See attached. Hope this helps explain the difference between the two approaches.

John

Hearing Identifier: HLW_YuccaMountain_Hold_EX
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Subject: Fwd: A GoldSim model comparing Peak of the Mean to Mean of the Peaks
Sent Date: 3/3/2008 4:50:00 PM
Received Date: 3/3/2008 4:50:31 PM
From: John Bradbury

Created By: John.Bradbury@nrc.gov

Recipients:
"LSNReviews" <LSN.Reviews@nrc.gov>
Tracking Status: None

Post Office:

Files	**Size**	**Date & Time**
MESSAGE	145	3/3/2008 4:50:31 PM
TEXT.htm	539	
Peak of the Mean versus Mean of the Peaks.doc	86592	

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Priority: Standard
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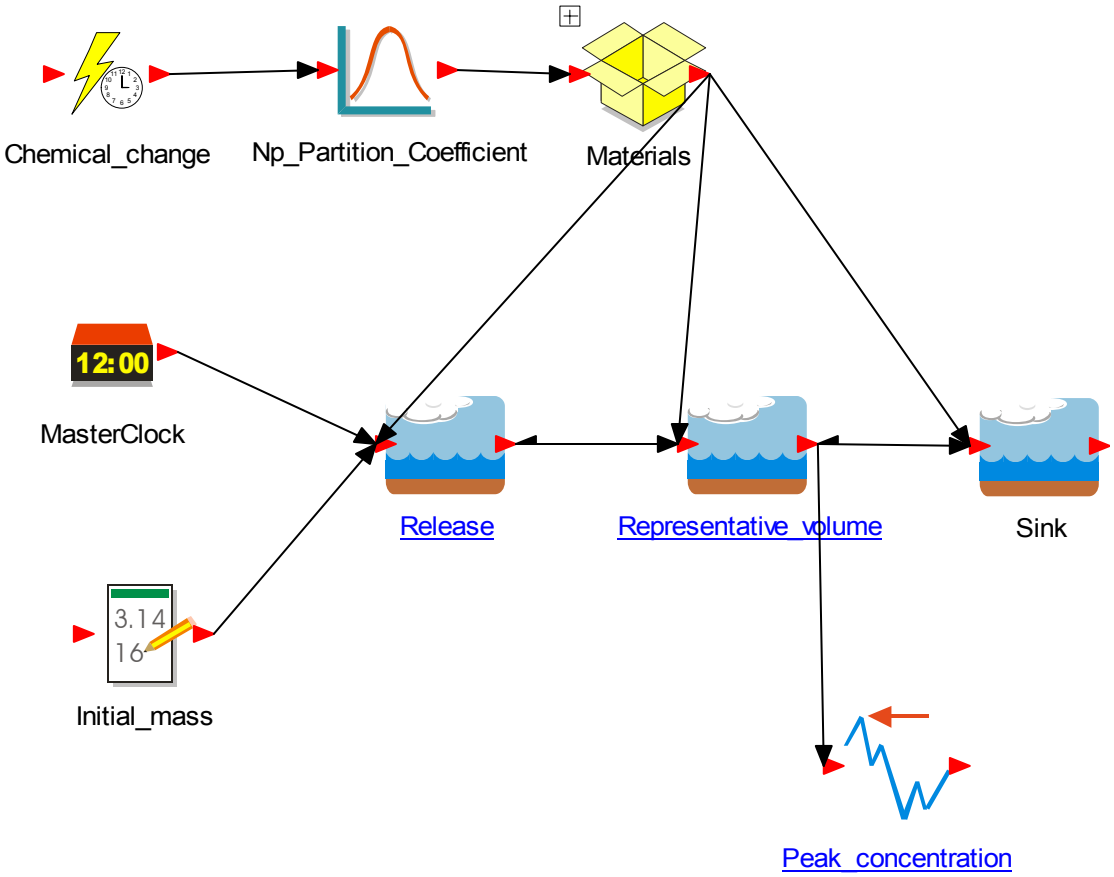
>>> John Bradbury 11/02/2007 1:38 PM >>>
Jack: See attached. Hope this helps explain the difference between the two approaches.

John

John Bradbury Nov2, 2007

Peak of the Mean versus Mean of the Peaks

Problem: Effect of Temporal Changes of Kd on Neptunium Concentration in Representative Volume



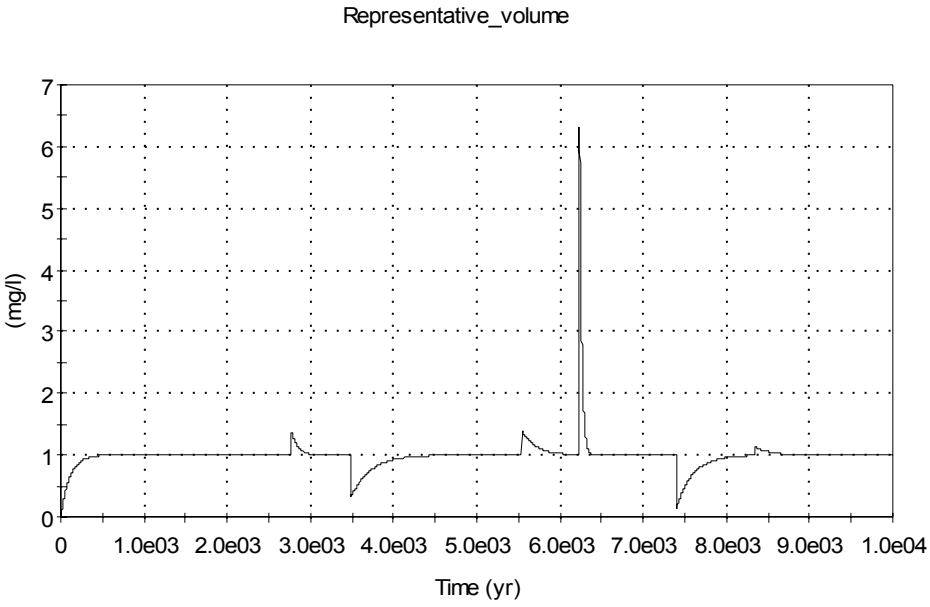
GoldSim Model

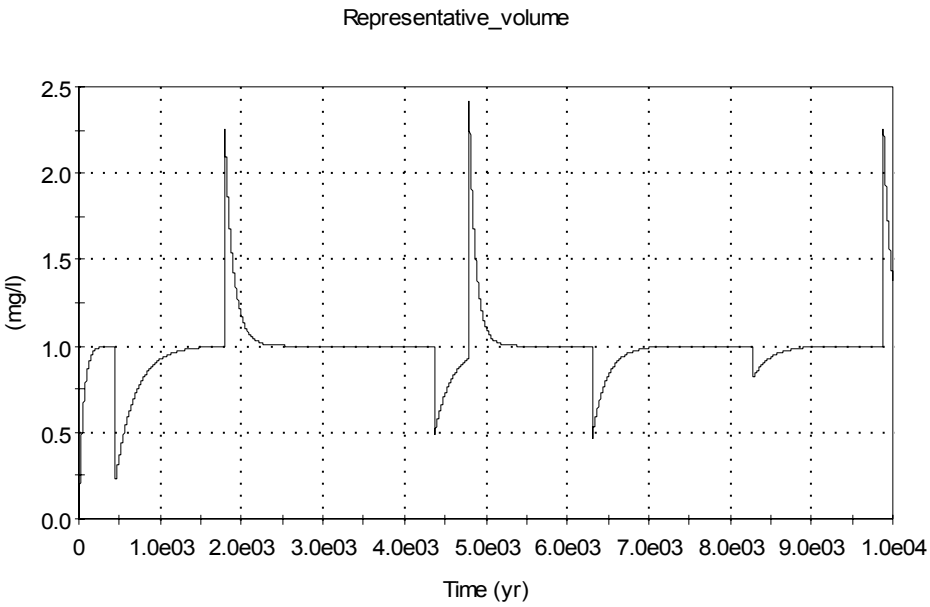
This model simulates random changes of Kd of neptunium over 10,000 years in a representative volume that contains 3000 acre feet of water and 2.96E10 Kg of solid. These changes result from the sampling of the Np_Partition_Coefficient distribution. This distribution is uniform with maximum of 30 mL/g and minimum of 0 mL/g. The random sampling occurs in a probabilistic fashion with a mean rate of 0.001 per year. The initial mass of Np is 3.7E6g. Each year another 3.7Eg is added to the representative volume. Water flows through the representative volume at a rate of 3000 acre feet/yr. Consequently, radionuclides that are not sorbed will pass into the sink in the next year.

The duration of the simulation is 10,000 years. One hundred realizations are performed. Results are presented as concentration versus time. As Np is added to the representative volume, it partitions between solid and liquid controlled be the initial Kd. It takes time to reach steady state where the concentration of the water leaving the representative volume

equals the concentration of the water entering the representative volume. At some time, chosen randomly, a Kd change occurs. GoldSim samples again from the Neptunium Partition Distribution. The new Kd can be greater than, less than, or equal to the previous Kd. The situation when it is equal to the previous Kd is unimportant. However, when it is less than the previous Kd, the concentration of Np in the groundwater will increase. The increase depends on the amount of Np that was stored on the solid previously, a function of Kd, and the relative size of the new Kd. The extreme situation would be a maximum Kd followed by a minimum Kd.

The sampling however, can just as often occur where high Kds follow lower Kds. This results in decreases in concentration of Np in the groundwater. The residence time of the water in the representative volume is one year. Consequently, concentrations quickly revert back to the incoming concentration. Figures 1 and 2 illustrate two realizations.





Figures 1 and 2.

Figure 3 contains all one hundred realizations.

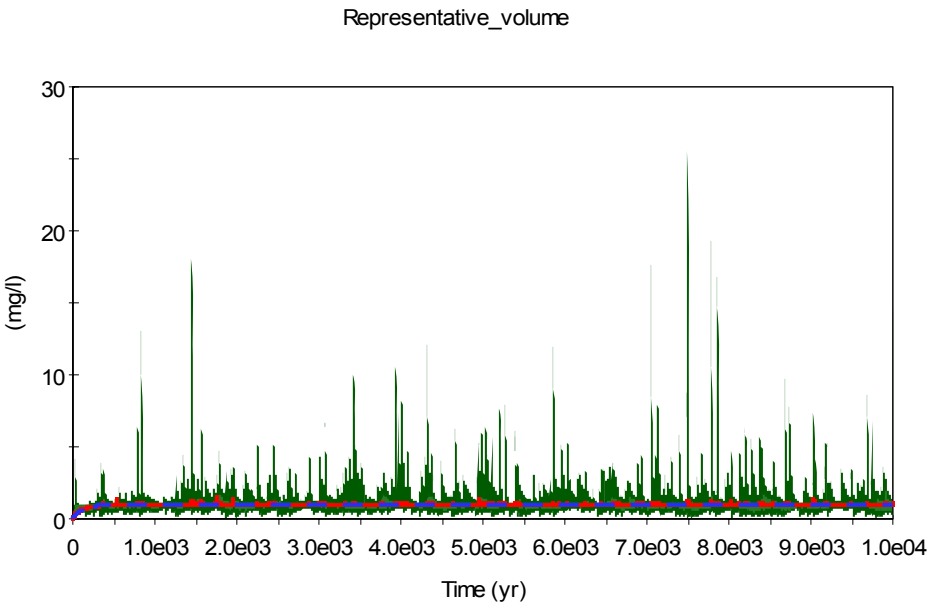


Figure 3.

The red curve in this figure is the mean concentration from all the 100 realizations. It quickly reaches a steady state at 1mg/L, the concentration of the input groundwater. That concentration is the peak of the mean. This result is comparable to a simulation where there were no sorption/desorption reactions. The use of peak of the mean tends to eliminate from consideration processes whose time of occurrence is uncertain, even though the existence of the processes is expected.

This simulation is unique because it attains a peak value over an extended period of time. If the mean curve were not flat, as it is in this simulation, the year in which the peak value occurred could be determined. It should be recognized that the Rule does not require that the year in which the peak occurs be known.

Using the same realizations, the results can be presented as extrema. One can show the highest concentration for each realization. Figure 4 is the extrema plot of Figure 2.

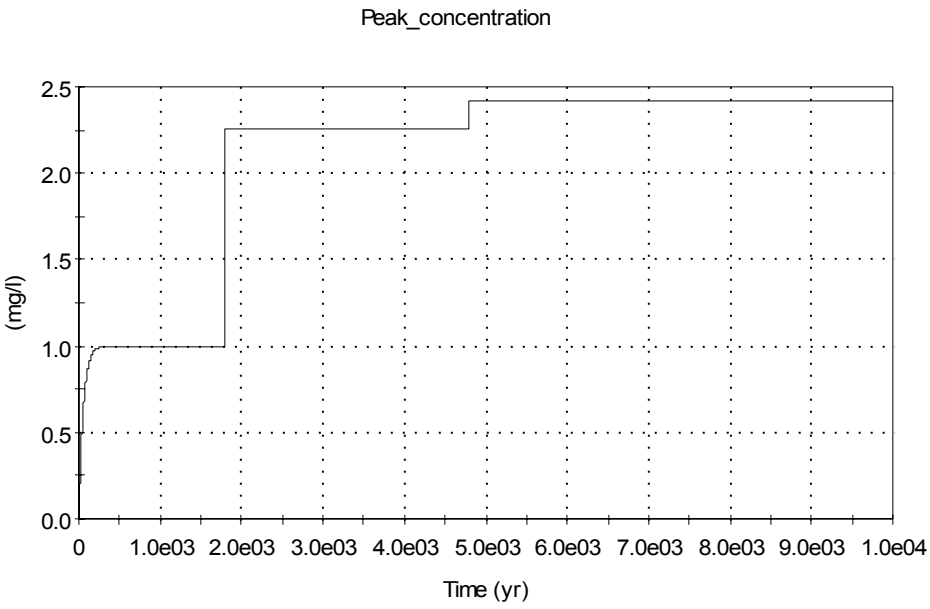
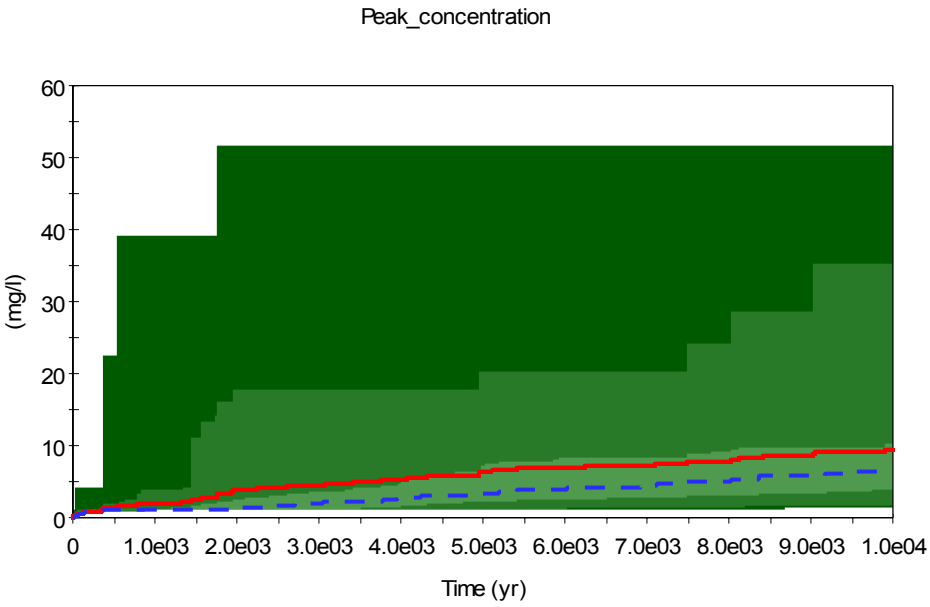


Figure 4.
This plot shows the maximum concentration as a function of time. The curves always increase with time. This plot shows that the highest concentration in the regulatory period was 2.45 mg/L but it took 4800 years before it reached that value. Figure 5 illustrates the extrema of all 100 realizations.



The red curve is the mean of the peaks. The blue dashed curve is the median of the peaks. Note that the mean of the peaks increases with time. This is reasonable as the time extends the chances of having the situation where a high Kd changes to a low Kd

increases. The mean of the peaks maximum value occurs at 10,000 years and is 9.33 mg/L. This value captures in a reasonable way the effect of changes in Kd on Np concentration in the representative volume. The maximum concentration is 51 mg/L that occurred in 1745 in one realization. This is the extreme of the extremes and would not be considered a reasonable measure of concentration in the 10,000 years.

GoldSim quickly produces results from the same set of realizations that can be displayed as peak of the mean or mean of the peaks. The peak of the mean suffers from risk dilution (or in this case, lower concentrations), whereas the mean of the peaks captures a reasonable representation of the highest concentration within the regulatory period. The mean of the peaks is more responsive to the requirements of the Rule.