YUCCA MOUNTAIN PROJECT

Studies

Uncertainty/Sensitivity Analysis for TSPA-VA

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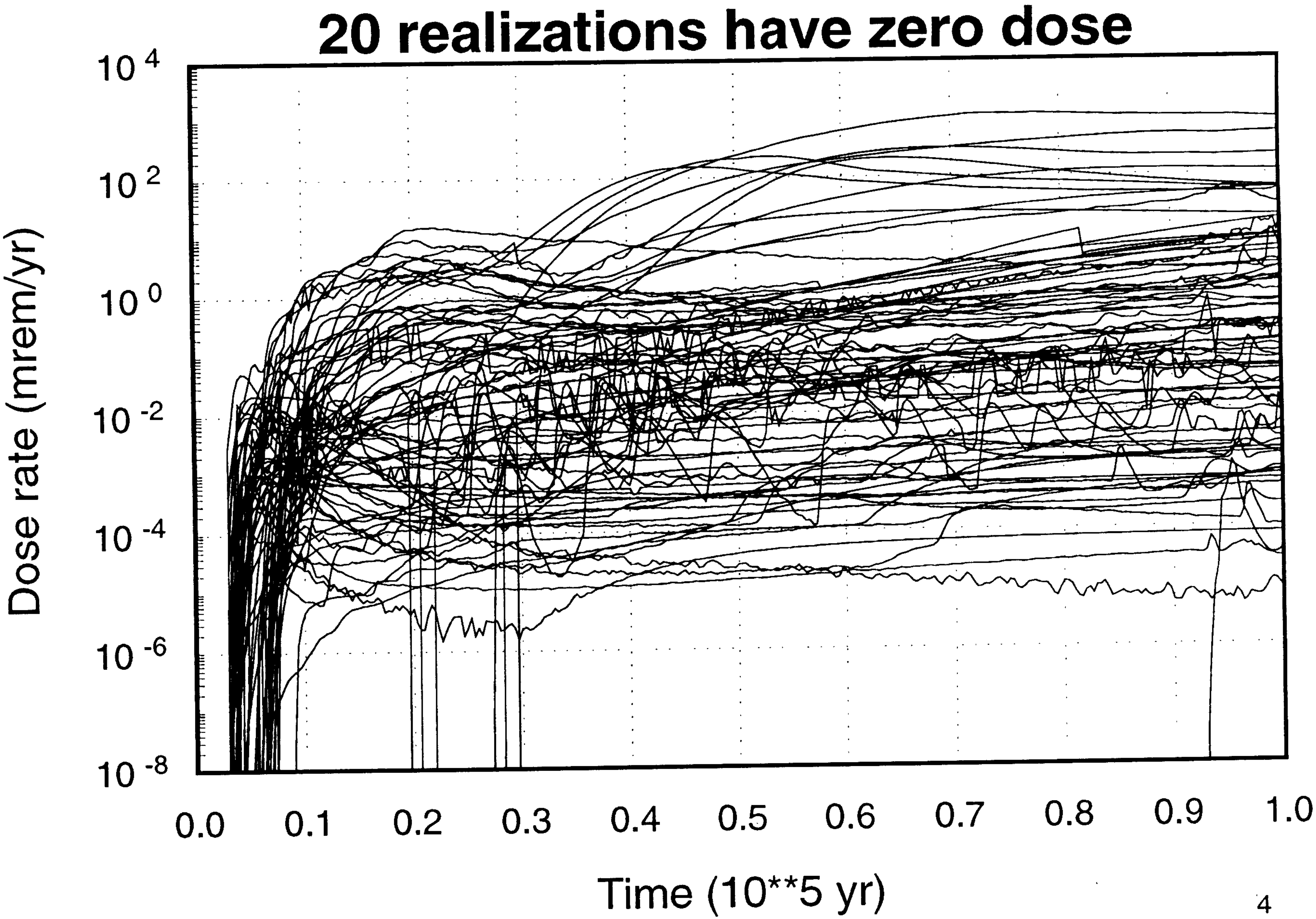
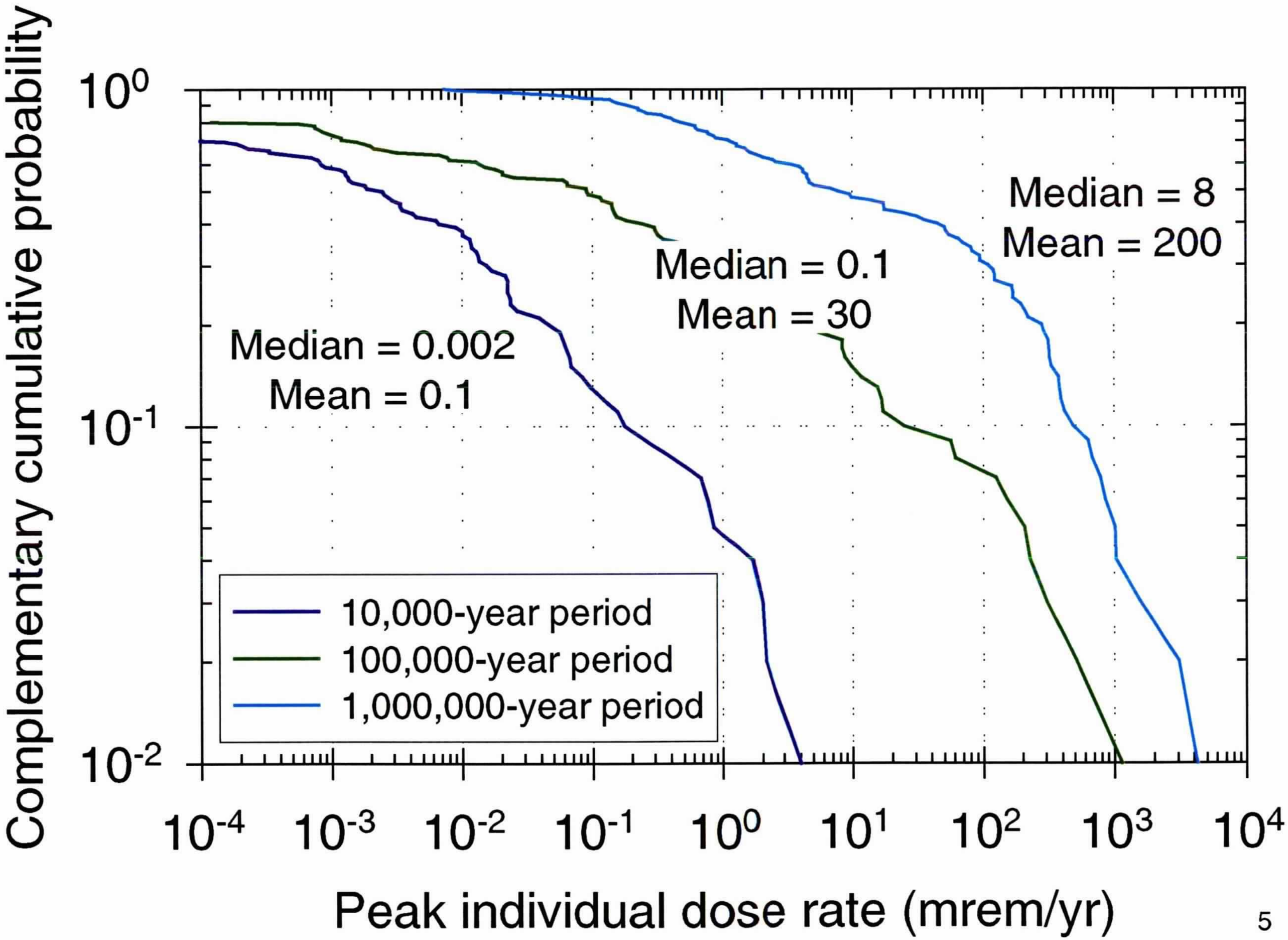
Uncertainty Analysis

- Uncertainty analysis is used to quantify the uncertainty in the system
- Our primary method of uncertainty analysis is Monte Carlo simulation
- Probability distributions are assigned to uncertain input variables, and a resulting probability distribution of the performance measure is computed
- Performance distribution is usually presented as a CCDF (complementary cumulative distribution function) on a log-log plot, which emphasizes the high-release tail
- Peak individual dose rate at 20-km distance is the performance measure being used
- Most simulations are being done for 100,000 years, with some for 10,000 years or 1,000,000 years

80 Dose Time Histories for the Base Case

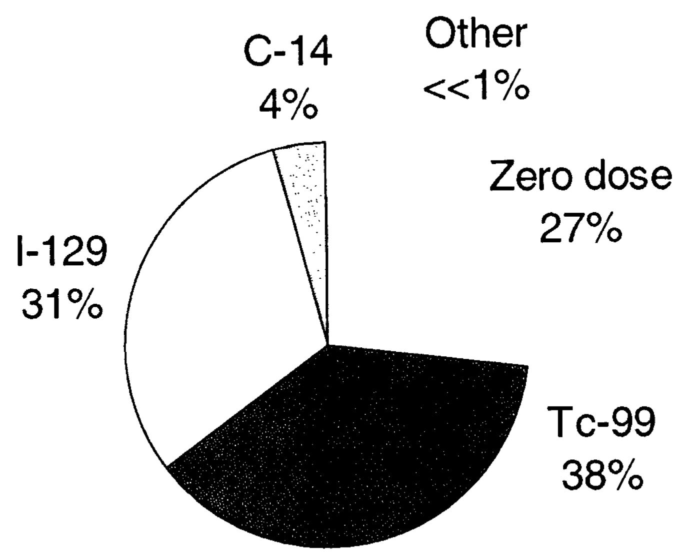


Base Case CCDFs of Peak Dose Rate

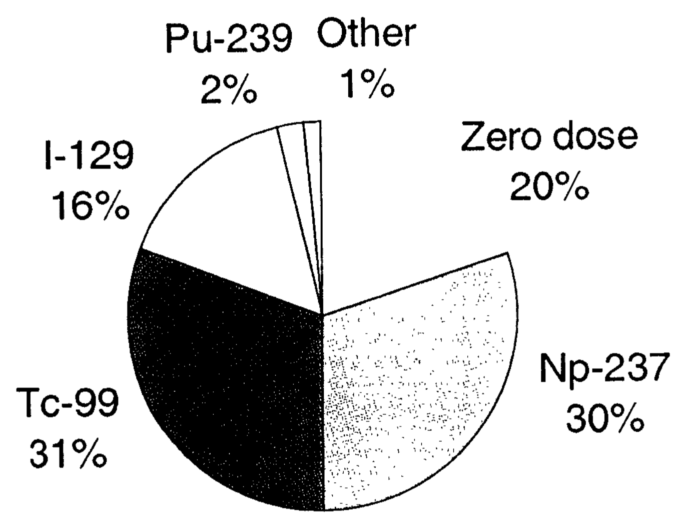


Average Radionuclide Contribution to Peak Dose Rate

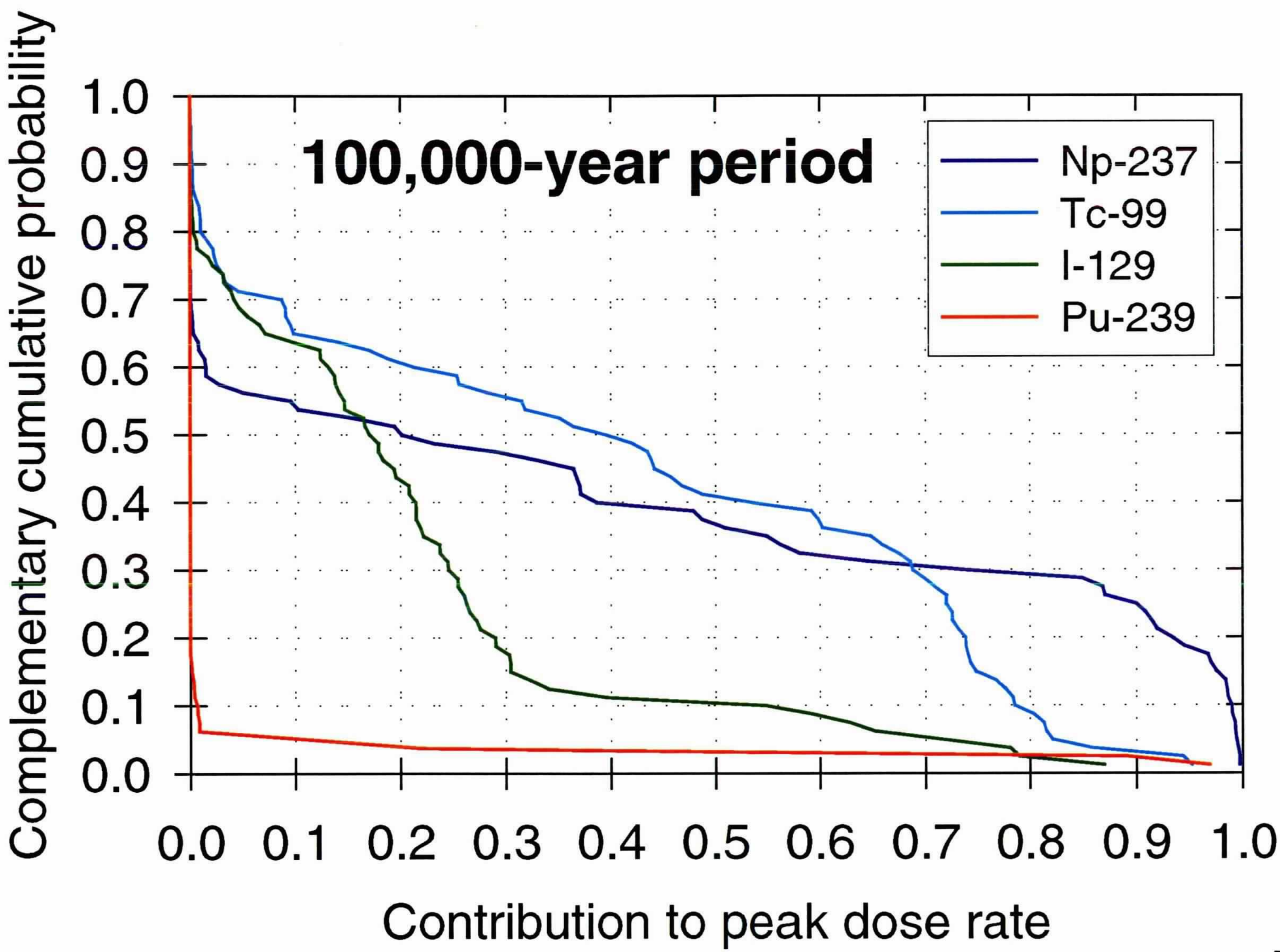
10,000-Year Period



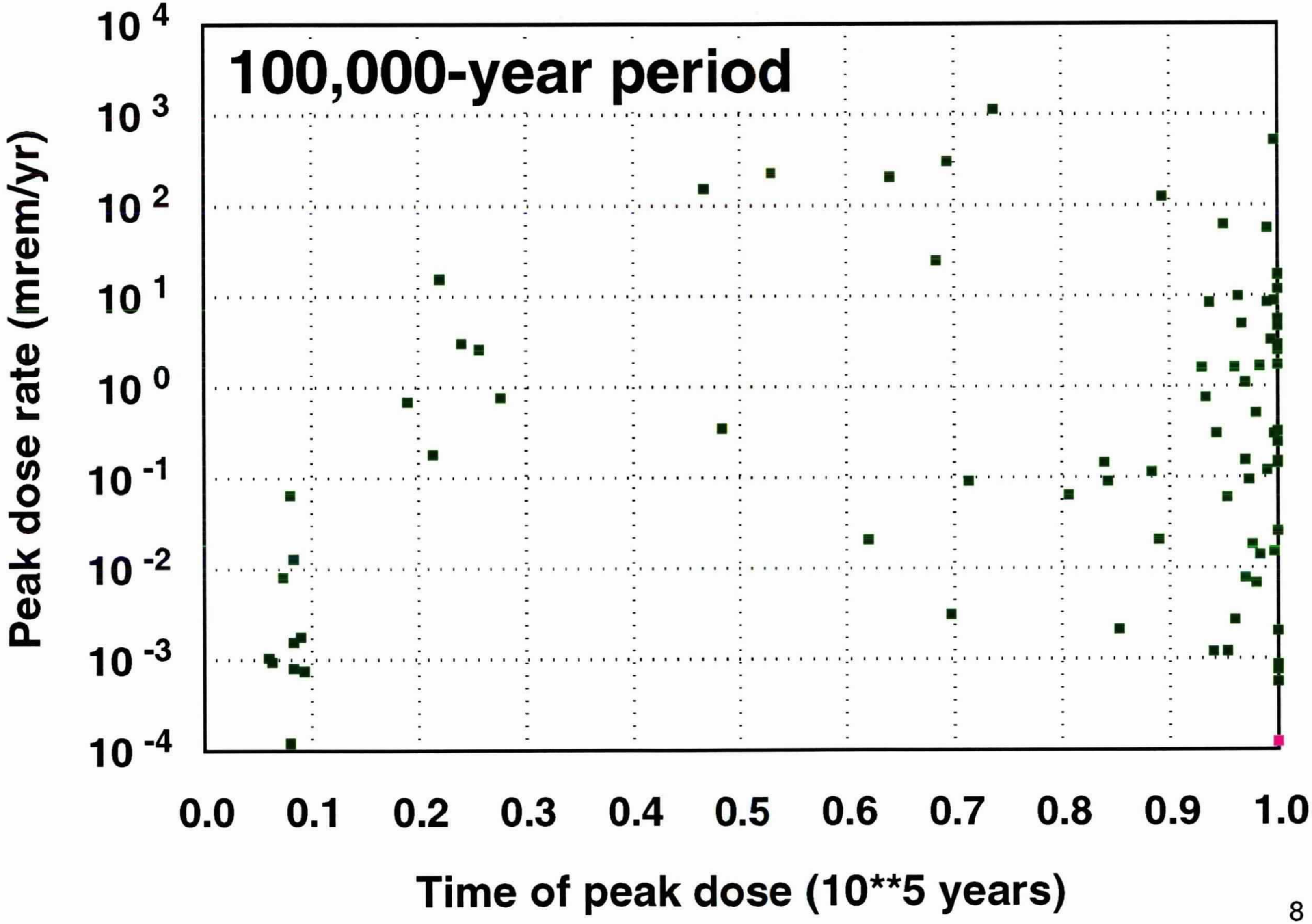
100,000-Year Period



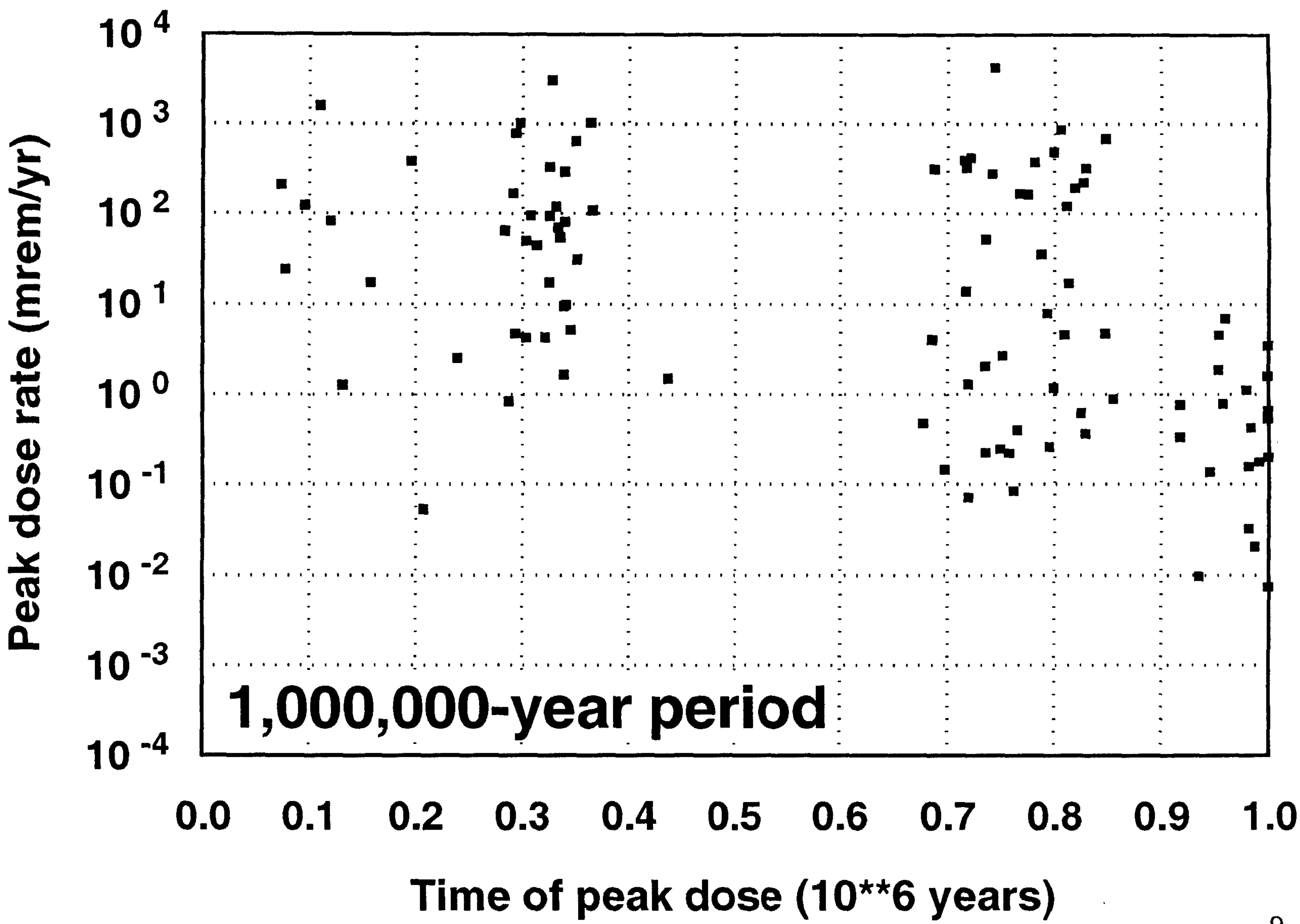
Radionuclide Contribution to Peak Dose



Scatter Plot of Peak-Dose Time



Scatter Plot of Peak-Dose Time



Sensitivity Analysis

- Sensitivity analysis is used to
  - Rank uncertain inputs according to their effect on repository performance measures
  - Guide future model development and data acquisition
  - Check consistency in results that are transferred between models

Sensitivity Analysis (cont.)

- Sensitivity-analysis methods include
  - Scatter plots of Monte Carlo results
  - Stepwise regression analysis, primarily using rank values
  - Importance ranking of uncertain variables by partial correlation coefficients (PCCs), standardized regression coefficients (SRCs), and contribution to variance (ΔR^2s)
  - "One-off" sensitivity cases, in which all inputs are held constant except for one (or a related group of inputs)
  - Analysis of time histories of releases and/or concentrations of radionuclides at the waste-form/EBS interface, EBS/UZ interface, UZ/SZ interface, and at the receptor
  - Time histories of PCCs for important parameters

Most Important Parameters—10,000 Years

- Rank regression analysis of the base-case results shows the peak dose rate over a 10,000-year period to be most sensitive to:
  - Fraction of waste packages contacted by seeps (PCC = 0.68)
  - C-22 mean corrosion rate (PCC = 0.62)
  - Number of juvenile container failures (PCC = 0.60)
  - Saturated-zone dilution factor (PCC = –0.42)
  - Percolation flux (PCC = –0.37)

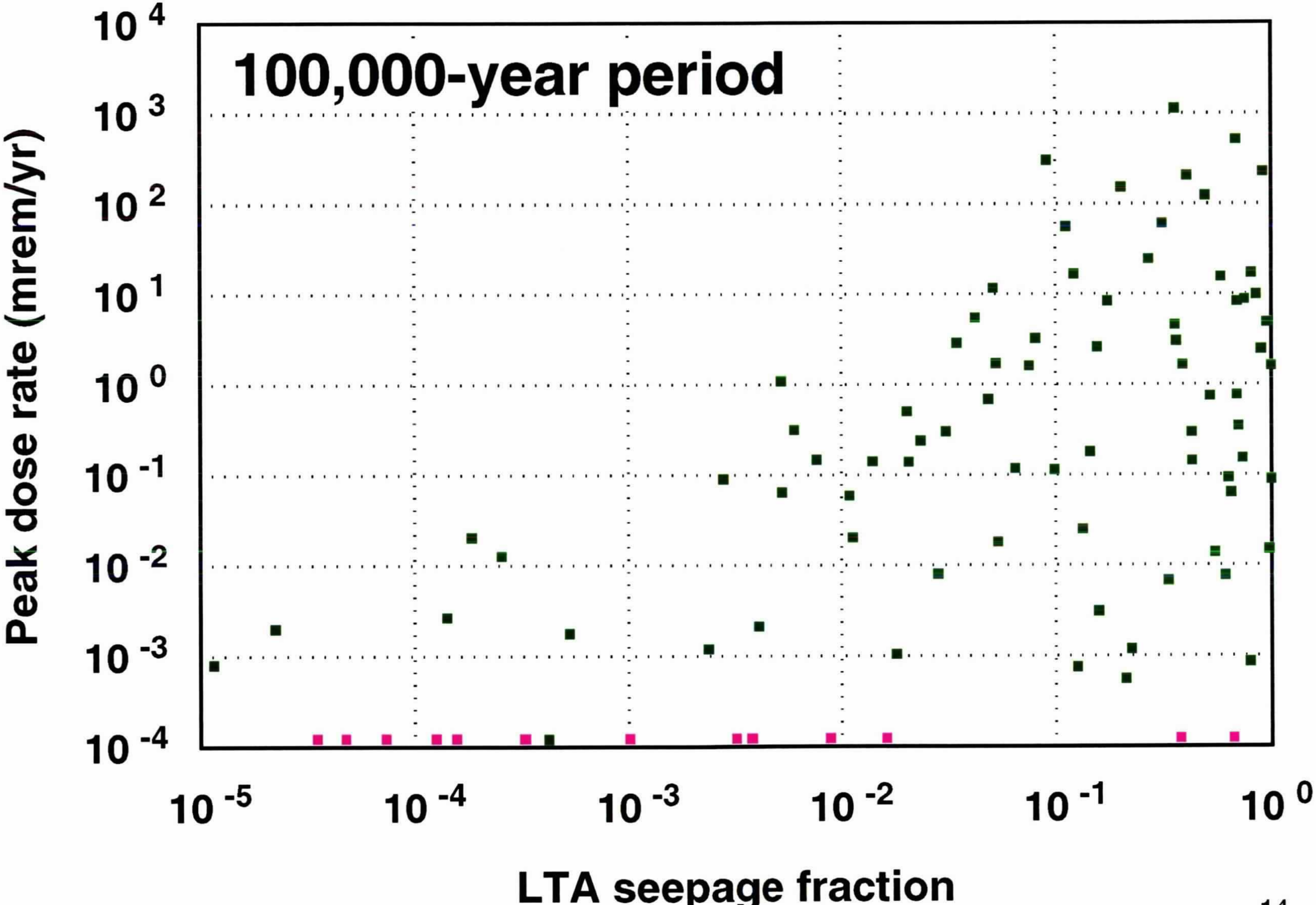
PCC = rank partial correlation coefficient with peak dose rate

Most Important Parameters—100,000 Years

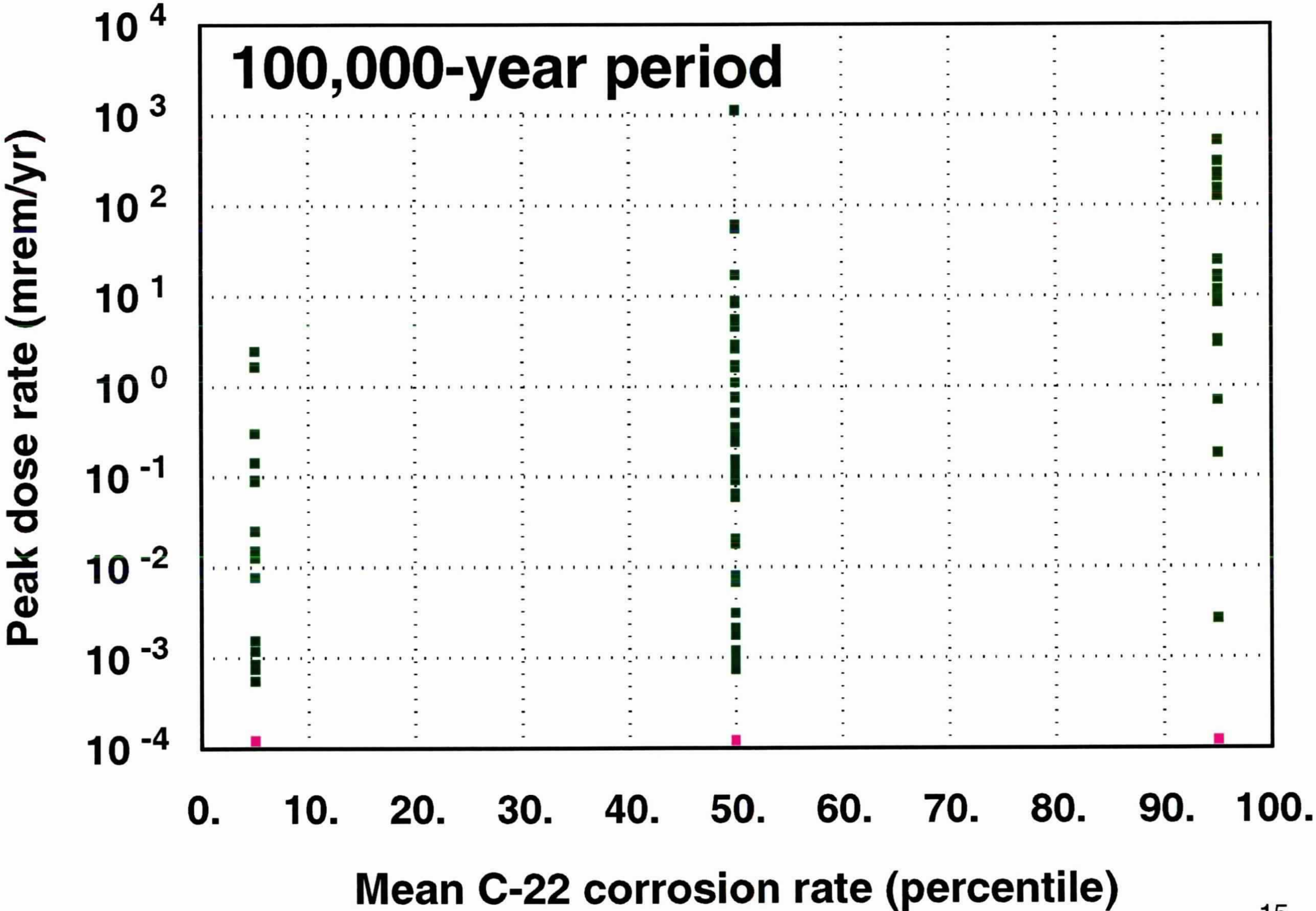
- Rank regression analysis of the base-case results shows the peak dose rate over a 100,000-year period to be most sensitive to:
  - Fraction of waste packages contacted by seeps (PCC = 0.77)
  - C-22 mean corrosion rate (PCC = 0.70)
  - C-22 corrosion-rate variability (PCC = 0.49)
  - Number of juvenile container failures (PCC = 0.36)

PCC = rank partial correlation coefficient with peak dose rate

Scatter Plot of Seepage Fraction



Scatter Plot of C-22 Corrosion Rate

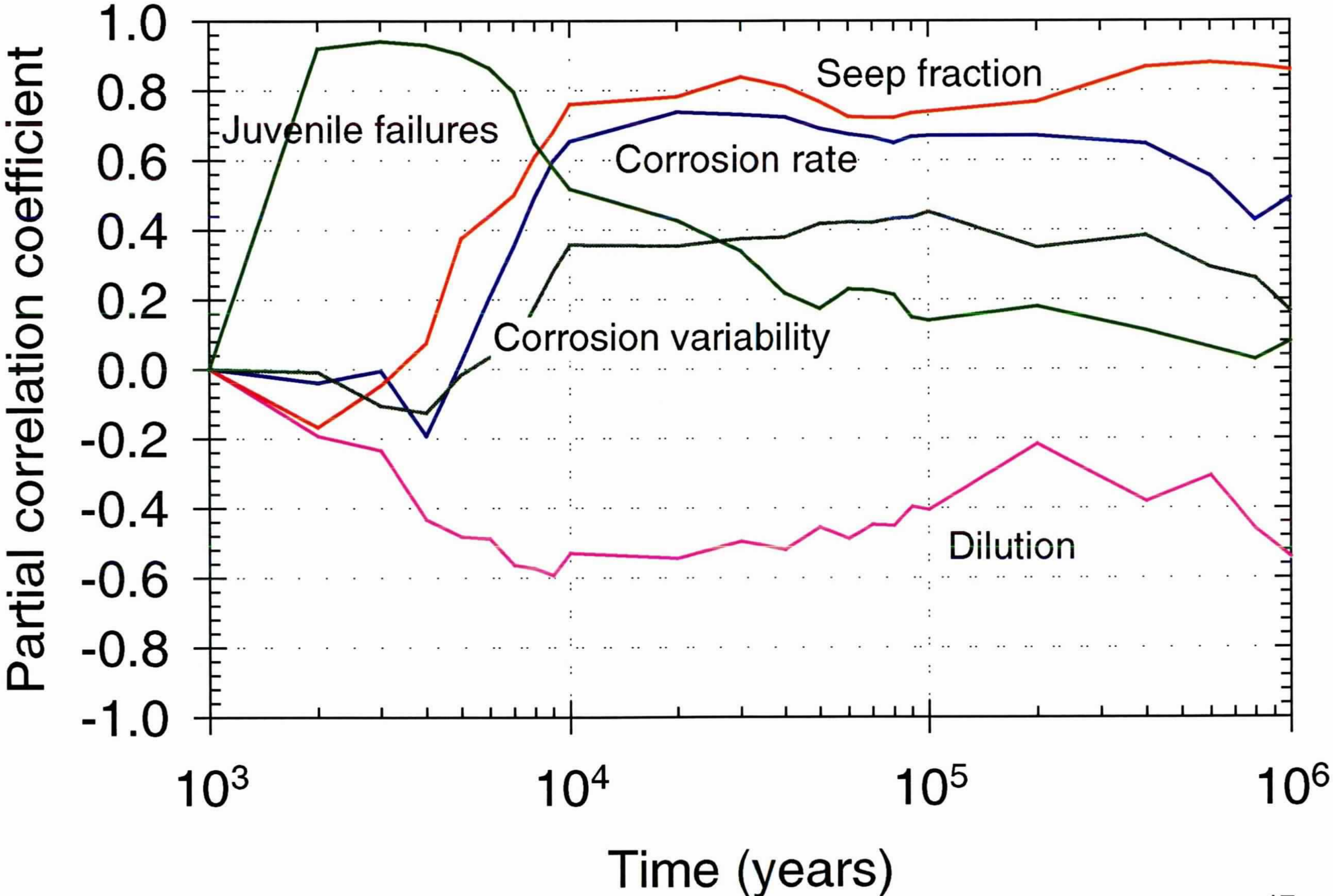


Most Important Parameters—1,000,000 Years

- Rank regression analysis of the base-case results shows the peak dose rate over a 1,000,000-year period to be most sensitive to:
  - Fraction of waste packages contacted by seeps (PCC = 0.86)
  - Saturated-zone dilution factor (PCC = –0.56)
  - Biosphere dose-conversion factors (PCC = 0.51)
  - C-22 mean corrosion rate (PCC = 0.41)

PCC = rank partial correlation coefficient with peak dose rate
Note that BDCFs for all radionuclides are correlated

Correlations Versus Time



Summary

- Dose history can vary considerably, depending on the combination of values of the uncertain parameters.
- For 100,000 years of simulation
  - Most peak doses occur after 90,000 years. Some of these are not really peaks (i.e., they are still increasing at 100,000 years) and some are local peaks caused by the change from LTA to dry climate.
  - Some peaks occur before 10,000 years, caused by juvenile container failures.
- For 1,000,000 years of simulation
  - Most peak doses are associated with superpluvial climates.
- Typically, early doses are dominated by Tc-99 and I-129; late doses are dominated by Np-237.
- A few percent of the time, Pu colloids dominate the peak dose.
- The most important uncertain parameters depends on the time period. For 100,000 years they are the fraction of waste packages contacted by seeps, the C-22 corrosion rate and its variability, and the number of juvenile failures.