

Eruption to Dose: Coupling a Tephra Dispersal Model Within a Performance Assessment Framework

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The tephra dispersal model used by the Yucca Mountain Project (YMP) to evaluate the potential consequences of a volcanic eruption through the waste repository must incorporate simplifications in order to function within a large Monte-Carlo style performance assessment framework. That is, the explicit physics of the conduit, vent, and eruption column processes are abstracted to a 2-D, steady-state advection-dispersion model (ASHPLUME) that can be run quickly over thousands of realizations of the overall system model. Given the continuous development of tephra dispersal modeling techniques in the last few years, we evaluated the adequacy of this simplified model for its intended purpose within the YMP total system performance assessment (TSPA) model. We evaluated uncertainties inherent in model simplifications including 1) instantaneous, steady-state vs. unsteady eruption, which affects column height, 2) constant wind conditions, and 3) power-law distribution of the tephra blanket; comparisons were made to other models and published ash distributions. Spatial statistics are useful for evaluating differences in these model output vs. results using more complex wind, column height, and tephra deposition patterns.

However, in order to assess the adequacy of the model for its intended use in TSPA, we evaluated the propagation of these uncertainties through FAR, the YMP ash redistribution model, which utilizes ASHPLUME tephra deposition results to calculate the concentration of nuclear waste-contaminated tephra at a dose-receptor population as a result of sedimentary transport and mixing processes on the landscape. Questions we sought to answer include: 1) what conditions of unsteadiness, wind variability, or departure from simplified tephra distribution result in significant effects on waste concentration (related to dose calculated for the receptor population)? 2) What criteria can be established for the adequacy of a tephra dispersal model within the TSPA framework?