Windows-Based, 
PC-Based Supercomputing for Uncertainty and Sensitivity Analysis of Models
Justin Babendreier, Rajbir Parmar, Kurt Wolfe
Office of Research and Development, National Exposure Research Laboratory, Ecosystems Research Division, Athens, Georgia

Uncertainty Analysis
...describing potential differences between model predictions and nature.

Uncertainty (UA): due to lack of knowledge and data. Many techniques and methods available, improving constantly.
Current knowledge and execution capabilities usually limited to a select few, out of reach from most model developers and model users. An "embarrassingly parallel" computational problem; solutions involve running a model over and over with slightly different inputs. Many EPA models written for Windows, but most supercomputing solutions today require "mainframes" or Linux-based PC clusters.

Sensitivity Analysis
Æ given uncertainty in both models and their inputs, quantify/qualify uncertainty in model output(s).

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Sensitivity Analysis & Parameter Estimation
Æ discovering relationships between model predictions and unit changes in input variables.

Sensitivity (SA): finding the subset of input variables that are most responsible for variation in model output. Analyzing Æ relate importance of uncertainty in inputs to uncertainty in model output(s).

Parameter Estimation (PE): use measured output(s) to back-calculate best estimates of (some) model inputs.

Input Space Assessment Techniques
Local works intensely around a specific set of input values (i.e., the local conditions).
Global quantifies scale & shape of the I/O relationship, all input ranges, assessing parameter interactions.

Screening quick, simple, ranks input variables and ignores interactions between variables.

Conceptual Layout of SuperMUSE
Hardware & Software Solution
Æ tools to parallelize stand-alone PC-based models

Why Facilitate Use of Model UA/SA/PE?
Æ Communicate prediction uncertainty to decision makers.
Æ Identify critical gaps in knowledge and data.
Æ Increasing technical focus for regulatory-driven litigation.
Æ We are called upon to establish validity, trustworthiness, and relevance in model predictions. (Chen and Beck, 1999)

Beneficial Impacts of PC-Based SuperMUSE
Æ SuperMUSE is scalable to individual user (or program & regional office) needs; clustering from 2 to 100+ PCs.
Æ Supports Windows or Linux-based modeling systems.
Æ Can handle PC models with 10’s to 1000’s of variables.
Æ Solves "embarrassingly parallel" computing problems.
Æ A local solution Æ empowers model developers and users.
Æ Autonomy from supercomputing centers, removes barriers.
Æ Simple, inexpensive, can be built/operated by PC novices.
Æ Ideal for debugging models and performing UA/SA/PE.
Æ Research effort at ERD delivers software tools that can tap the power of other internal/external PC hardware grids.

Collaborations
Æ Office of Solid Waste, Hazardous Waste Risk Assessments
Æ Drs. Beck and Osidele, UGA; global sensitivity analyses
Æ Dr. Hill, USGS; inverse problem software technologies
Æ Multi-agency workgroup DoE, DoD, NRC, USDA, NOAA