U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: PACE-90 FLOW AND TRANSPORT RESULTS

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PACE-90
Flow and Transport Results

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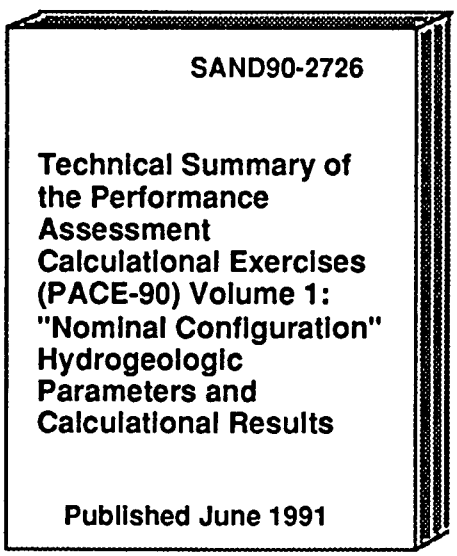
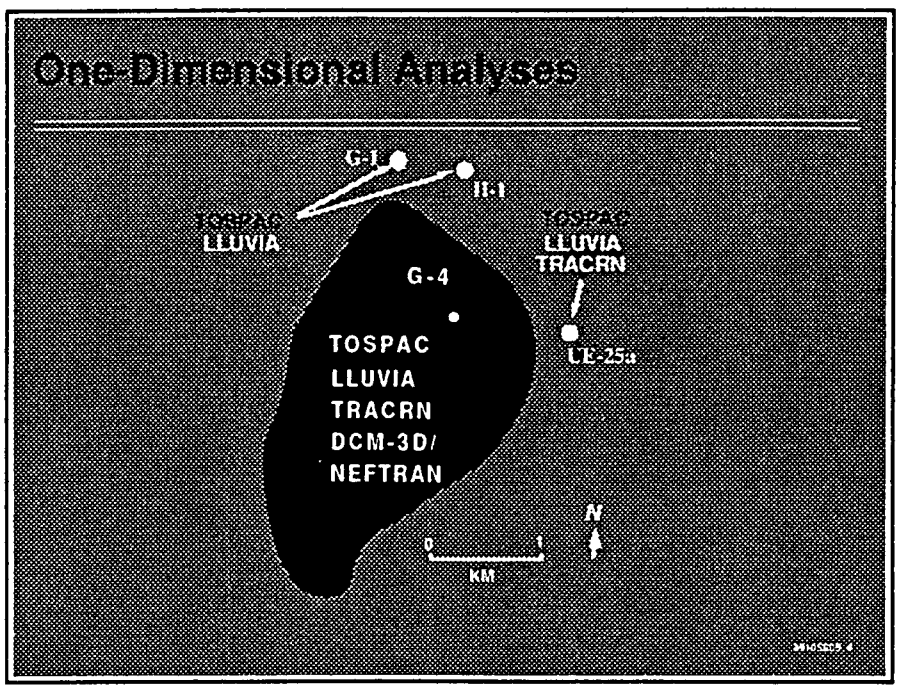
20 May 1991

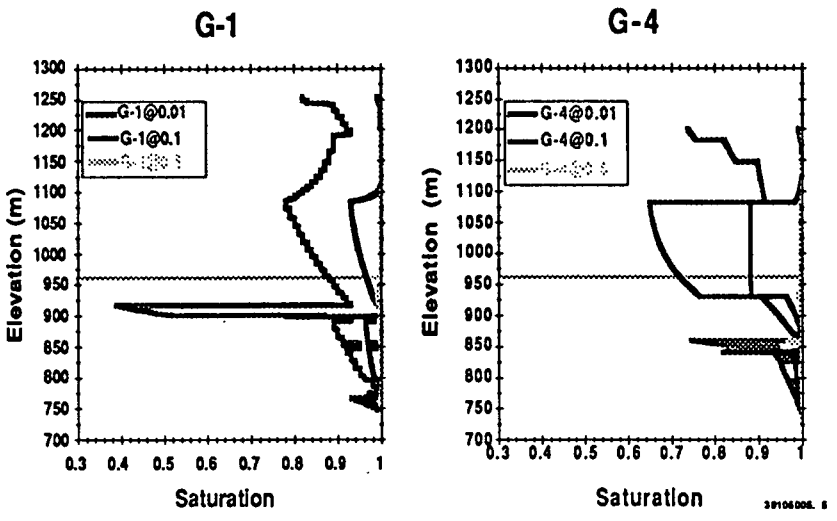


PACE-90 Flow and Transport Results

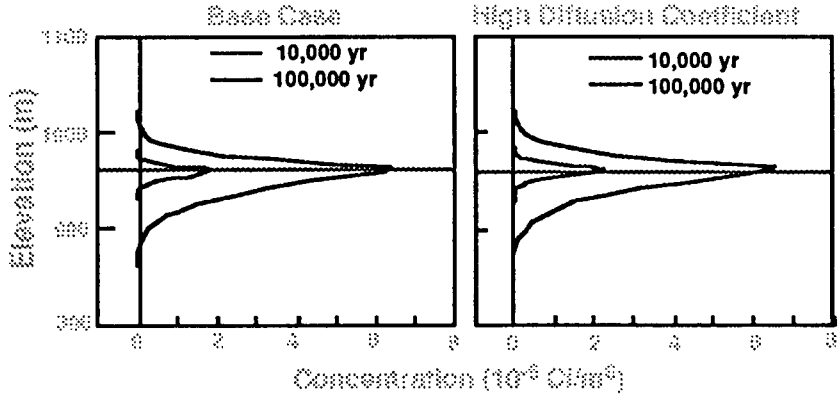
- One-Dimensional Analysis
  - TOSPAC Nominal and Climate Change
  - TOSPAC Source Term Comparison
  - PACE versus COVE
  - Inverse Problem
- Two-Dimensional Analysis
  - SUMO Nominal and Climate Change
  - SUMO Radionuclide Transport
  - HYDROCOIN
- Travel Time Results
- Important Issues Identified



TOSPAC Nominal and Climate Change Comparisons



TOSPAC ^{129}I Concentration (Ci/m^3) Moist-Continuous Source Terms



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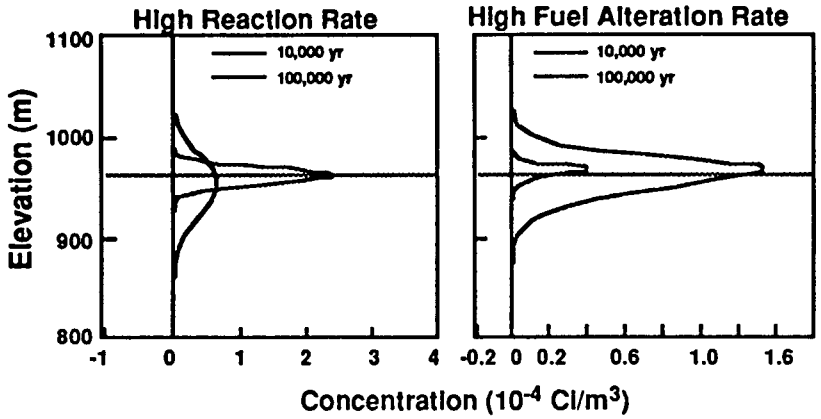
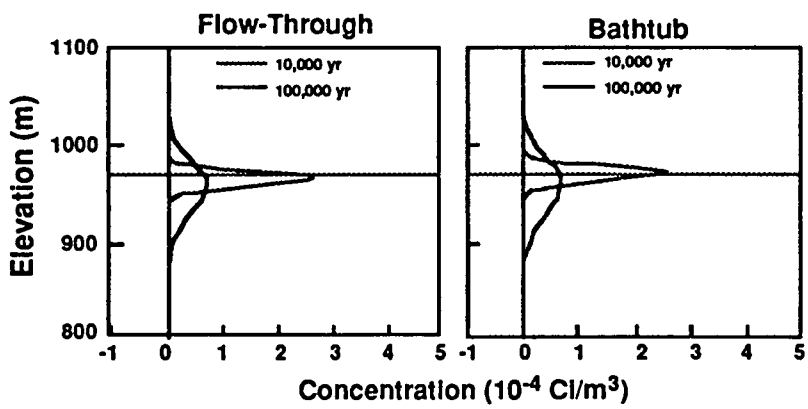
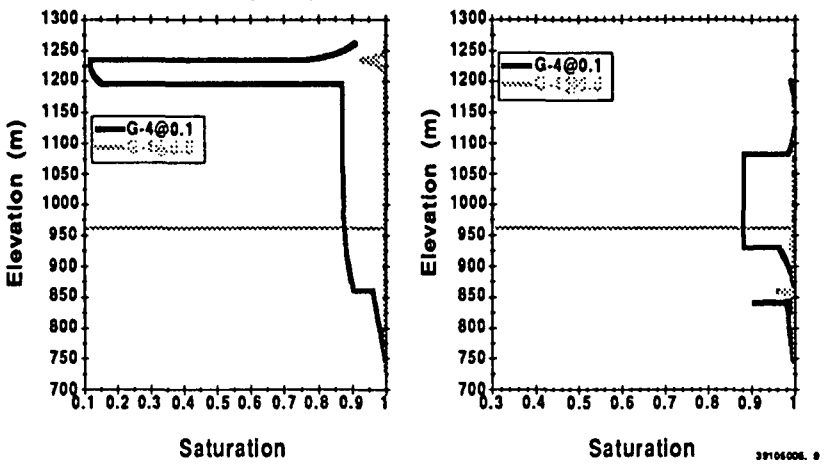


TOSPAC ^{129}I Concentration (Ci/m^3) Flow-Through and Bathtub Source Terms



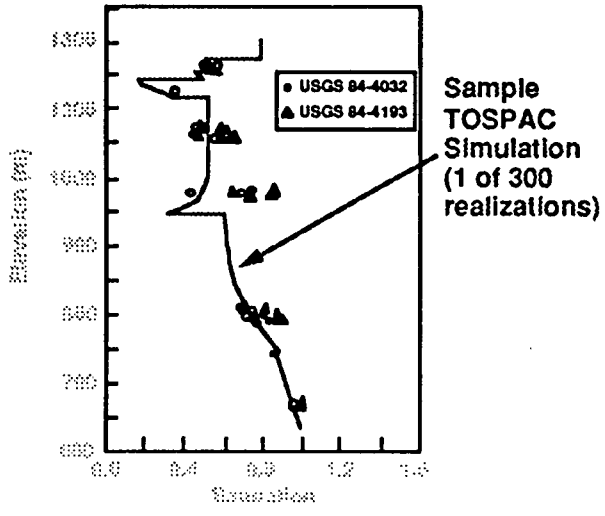
TOSPAC Climate Change Comparisons



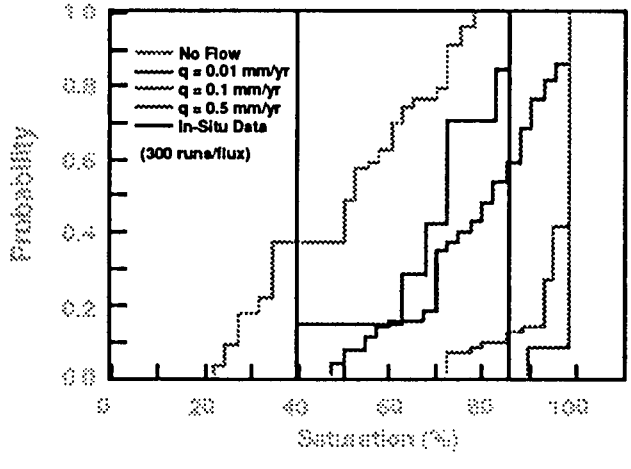
The Inverse Problem

Can a one-dimensional steady-state flow calculation match the in situ saturation measurements taken at Yucca Mountain by the USGS?

Partial Data Used for Inverse Problem (Flux = 0.01 mm/yr)



Inverse Solution of Saturation Profiles for Topopah Spring Member (elev.,1082 m)



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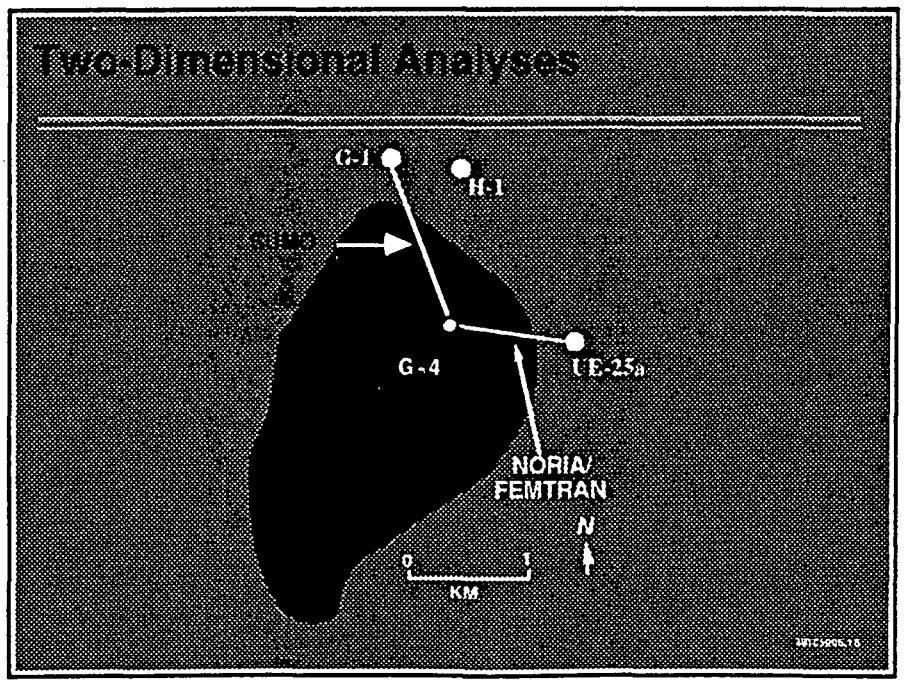
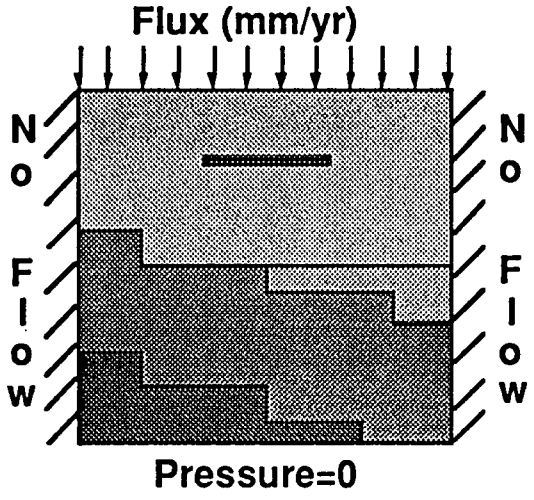
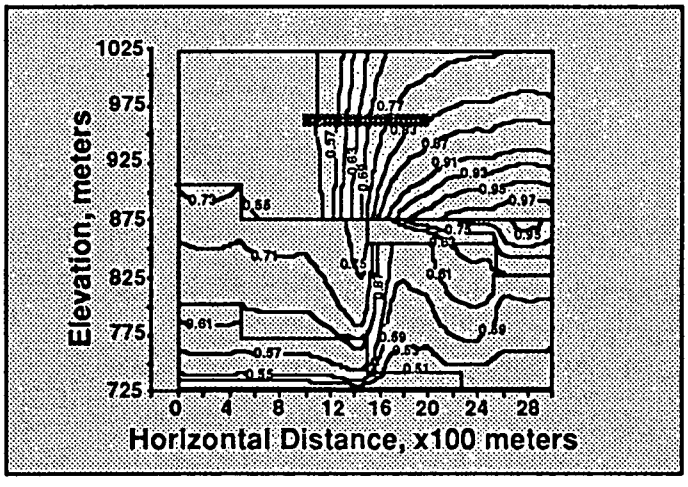


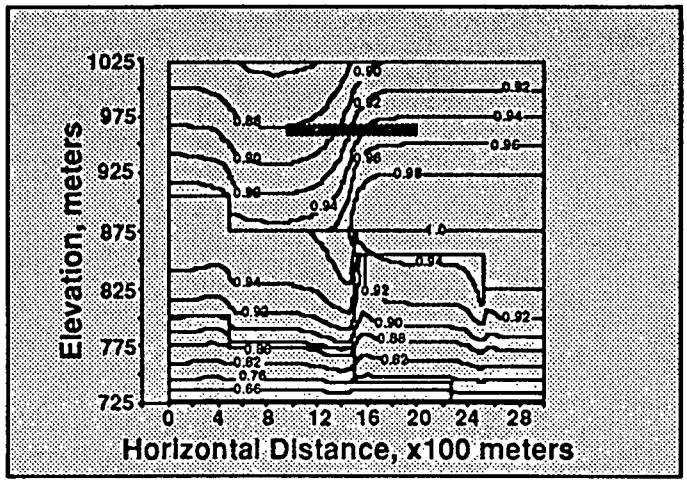
SUMO Problem Setup



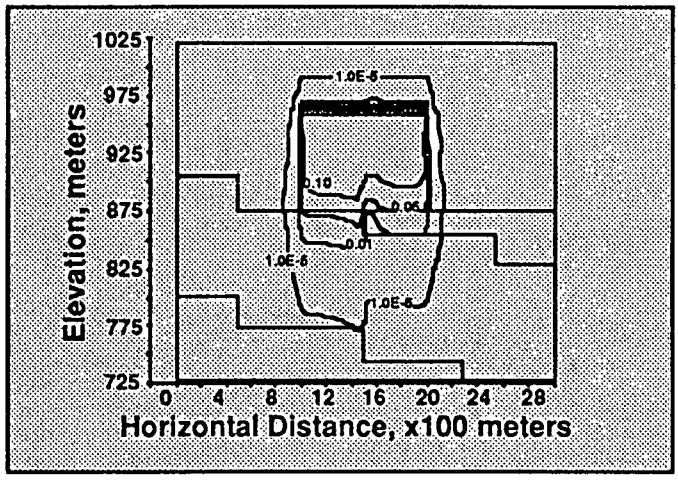
SUMO-Calculated Saturation Contours (infiltration = 0.01 mm/yr)



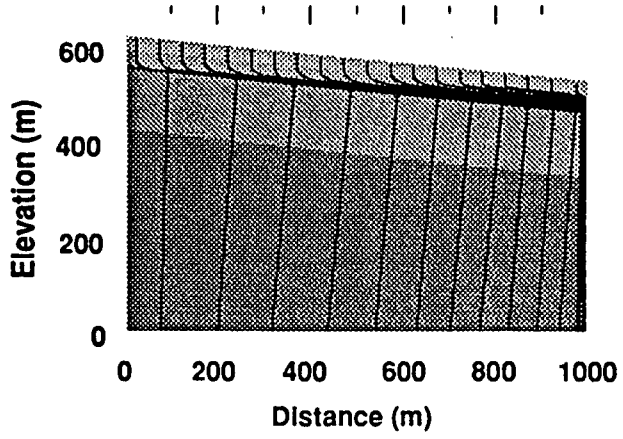
SUMO-Calculated Saturation Contours (infiltration = 0.1/mm yr)



SUMO-Calculated ^{129}I Concentration (Ci/m^3) Profile (infiltration = 0.1 mm/yr)



HYDROCOIN Water Flow Paths (infiltration = 0.5 mm/yr)



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Definition

Travel Time α 1/v

Saturated Zone

$$v = \frac{q}{n}$$

Unsaturated Zone

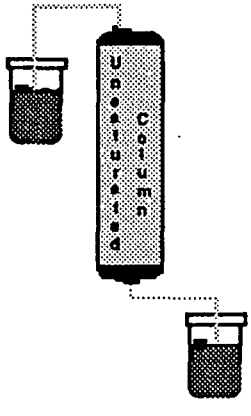
$$v = \frac{q(\theta)}{\theta}$$

$\therefore$ $\theta \rightarrow 0$

$v \rightarrow ?$

$TT \rightarrow ??$

Example



Particle

Travel Time = 1.6 yr

Advective Velocity

Travel Time = 1,000,000 yr

(after Kaplan, Klavetter, and Peters 1989)

Travel Time Results

TOSPAC (1-D)

Well	Travel Time (yrs) (0.01mm/yr)
(G-4)	4.2E6
(G-1)	4.9E6
(H-1)	4.6E6
(UE-25a)	3.0E6

SUMO (2-D)

Meters	Travel Time (yrs) (0.01mm/yr)	Travel Time (yrs) (0.1mm/yr)
0	3.8E6	4.4E5
500	3.2E6	3.9E5
1000	3.2E6	3.9E5
1500	2.0E6	3.1E5
2000	1.5E6	4.7E5

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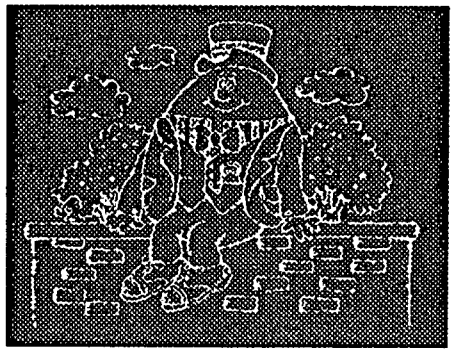


"When I use a word," Humpty Dumpty said in a rather scornful tone, "it means just what I choose it to mean - - nothing more nor less."

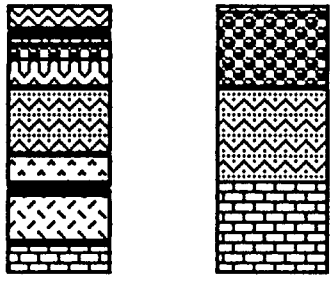
Issue

What is the definition of ground water travel time?

Important Issues Identified in PACE

- Material properties
  - Matrix
- Radionuclide transport
- Modeling artifacts
  - Geometry
  - Homogeneous zones
  - Boundary conditions
- Incorporation of probabilities

Matrix Material Properties



Multiple Layers

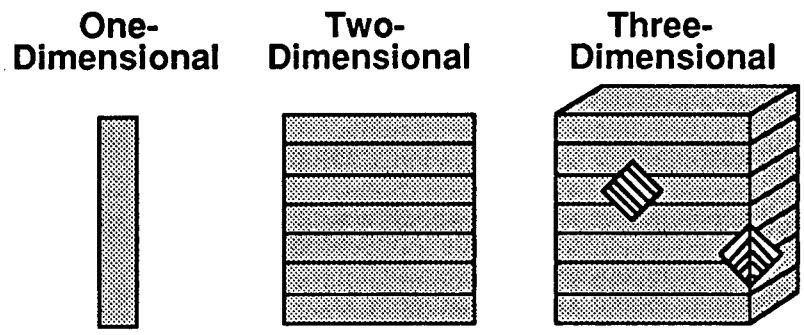
Considerations

- Simulation time
- Complexity
- Travel time
- Precision

Transport of Radionuclides

- Need to consider interaction of
  - entire EBS
  - near-field
  - far-field
- Source term release mechanism must be consistent with far-field processes
- Retardation/dispersion must be consistent with transport models

Geometry



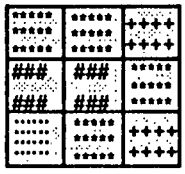
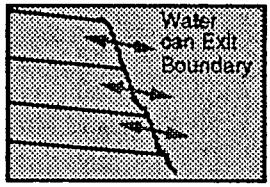
Decrease in Travel Time

1 64x 82x

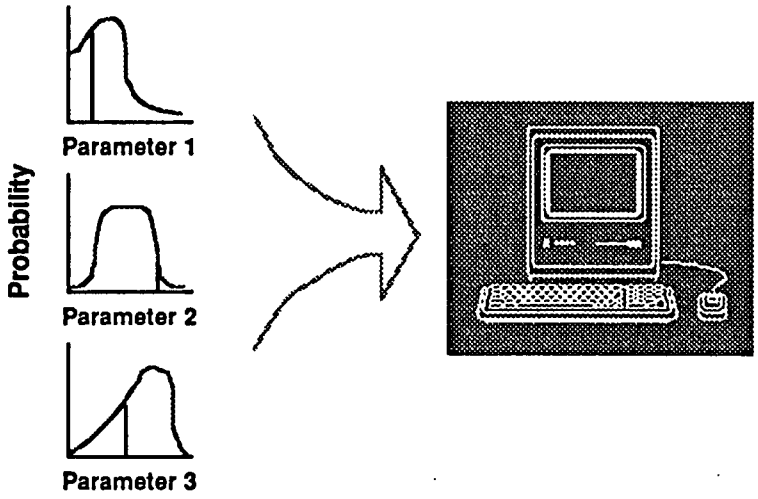
Modeling Artifacts due to Homogeneous Zones and No-Flow Boundary Conditions

- Creates unrealistic ponding
- Not consistent with observed data

Need to Consider

Dimensionality	Heterogeneity	Pressure Boundaries
1-D		
2-D		
3-D		

Probabilities (Sampling)



Accomplishments

- Developed new hydrostratigraphy
- Realized value of both "hard" and "soft" data
- Identified need to be more systematic
- Computed one realization for several conceptual models
- Enhanced computer codes and techniques