HLWYM HEmails

From: Jin-Ping Gwo
Sent: Wednesday, August 08, 2007 8:46 AM
To: John Stamatkos; James Winterle; Olufemi Osidele; Osvaldo Pensado; Ronald Janetzke; Sitakanta Mohanty; Abou-Bakr Ibrahim; Brittain Hill; Bret Leslie; Christopher Grossman; Eugene Peters; John Trapp; Jin-Ping Gwo; Keith Compton; Philip Justus; Richard Codell; Randall Fedors; Tina Ghosh; Timothy McCartin; Richard Codell
Subject: volcanism convoluttion method seminar
Attachments: Volcanic Convolution Method.ppt

Folks,

Since Dick is here at the HQs and we'd like to 'drain' his brain as much as we can, we'll have another seminar (discussion) about a convolution method to calculate extrusive volcanism doses. His slides are attached. Since it's a short notice, please come join us if you can. Please forward the message to whoever interested that I did not include in the distribution. Thanks.

Place: EBB-1B11
Time: 2:00pm - 3:00m
Bridge line: 1-888-469-1667
passcode: 69632#
# of lines: 3

Regards,
Jack

Jin-Ping (Jack) Gwo
Systems Performance Analyst
U. S. Nuclear Regulatory Commission
Phone: 301-415-6246
Fax: 301-415-5399

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Subject: volcanism convoluttion method seminar
Sent Date: 8/8/2007 8:45:30 AM
Received Date: 8/9/2007 9:36:35 AM
From: Jin-Ping Gwo

Created By: Jin-Ping.Gwo@nrc.gov

Recipients:
"John Stamatkos" <jstam@cnwra.swri.edu>
Tracking Status: None
"James Winterle" <jwinterle@cnwra.swri.edu>
Tracking Status: None
"Olufemi Osidele" <oosidele@cnwra.swri.edu>
Tracking Status: None
"Osvaldo Pensado" <opensado@cnwra.swri.edu>
Tracking Status: None
"Ronald Janetzke" <rjanetzke@cnwra.swri.edu>
Tracking Status: None
"Sitakanta Mohanty" <smohanty@cnwra.swri.edu>
Tracking Status: None
"Abou-Bakr Ibrahim" <AKI@nrc.gov>
Tracking Status: None
"Brittain Hill" <Brittain.Hill@nrc.gov>
Tracking Status: None
"Bret Leslie" <Bret.Leslie@nrc.gov>
Tracking Status: None
"Christopher Grossman" <Christopher.Grossman@nrc.gov>
Tracking Status: None
"Eugene Peters" <Eugene.Peters@nrc.gov>
Tracking Status: None
"John Trapp" <JST@nrc.gov>
Tracking Status: None
"Jin-Ping Gwo" <Jin-Ping.Gwo@nrc.gov>
Tracking Status: None
"Keith Compton" <Keith.Compton@nrc.gov>
Tracking Status: None
"Philip Justus" <Philip.Justus@nrc.gov>
Tracking Status: None
"Richard Codell" <Richard.Codell@nrc.gov>
Tracking Status: None
"Randall Fedors" <Randall.Fedors@nrc.gov>
Tracking Status: None
"Tina Ghosh" <Tina.Ghosh@nrc.gov>
Tracking Status: None
"Timothy McCartin" <Timothy.McCartin@nrc.gov>
Tracking Status: None
"Richard Codell" <richardcodell@yahoo.com>
Tracking Status: None

Post Office:

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Volcanic Convolution Method.ppt	625216	

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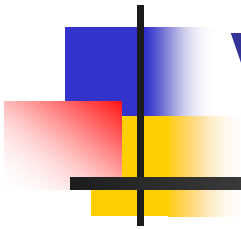


Volcanic Convolution Method

Richard Codell

USNRC

August 8, 2007

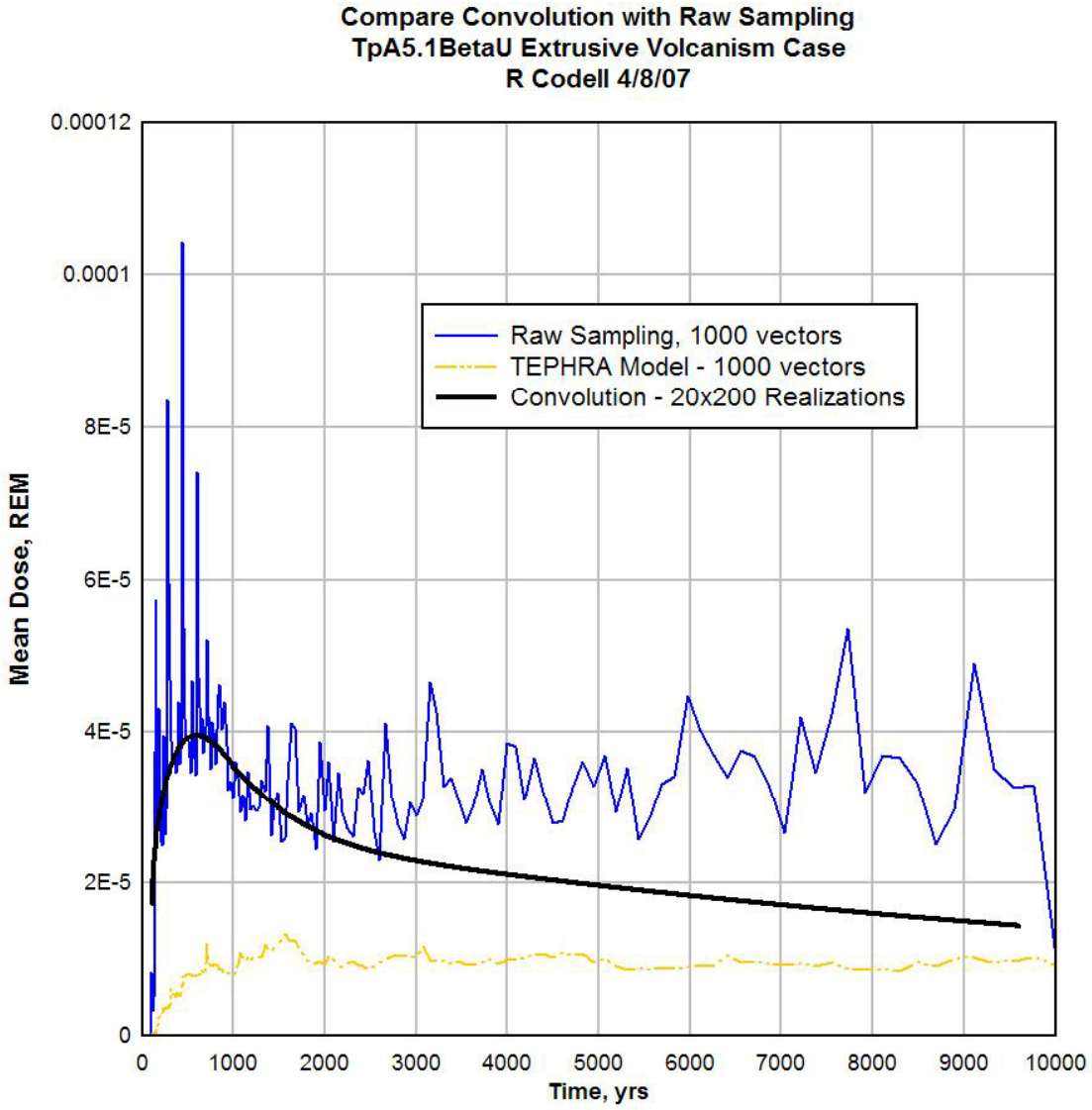
Problem Statement

- Latin Hypercube Sampling (LHS) works well for nominal release scenario, for which processes evolve slowly and predictably.
- Disruptive events (e.g., seismicity, volcanism) occur with low probability and frequently produce large doses.
- Calculation of the mean dose for disruptive events by normal LHS procedure may require inordinate number of realizations to produce a smooth dose curve.

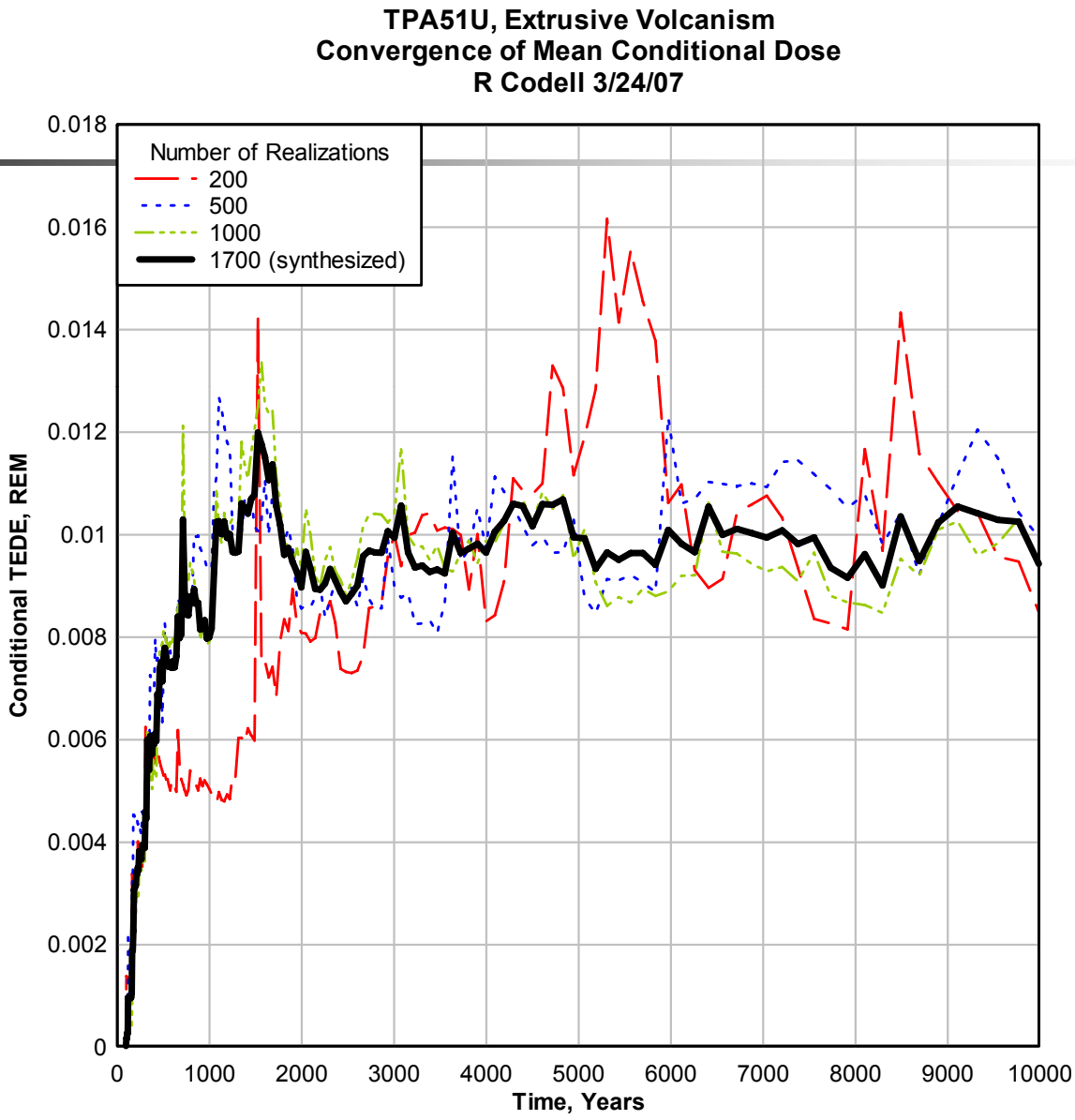
Disruptive Event Procedures

- Seismicity – Low-probability, large earthquakes can lead to relatively large doses. Procedures developed by CNWRA and NRC for this problem.
- Extrusive volcanism – Low-probability basaltic volcanism can lead to relatively large doses, with relatively short time constants. Procedure developed by NRC.

Poor Convergence with ASHPLUME Model



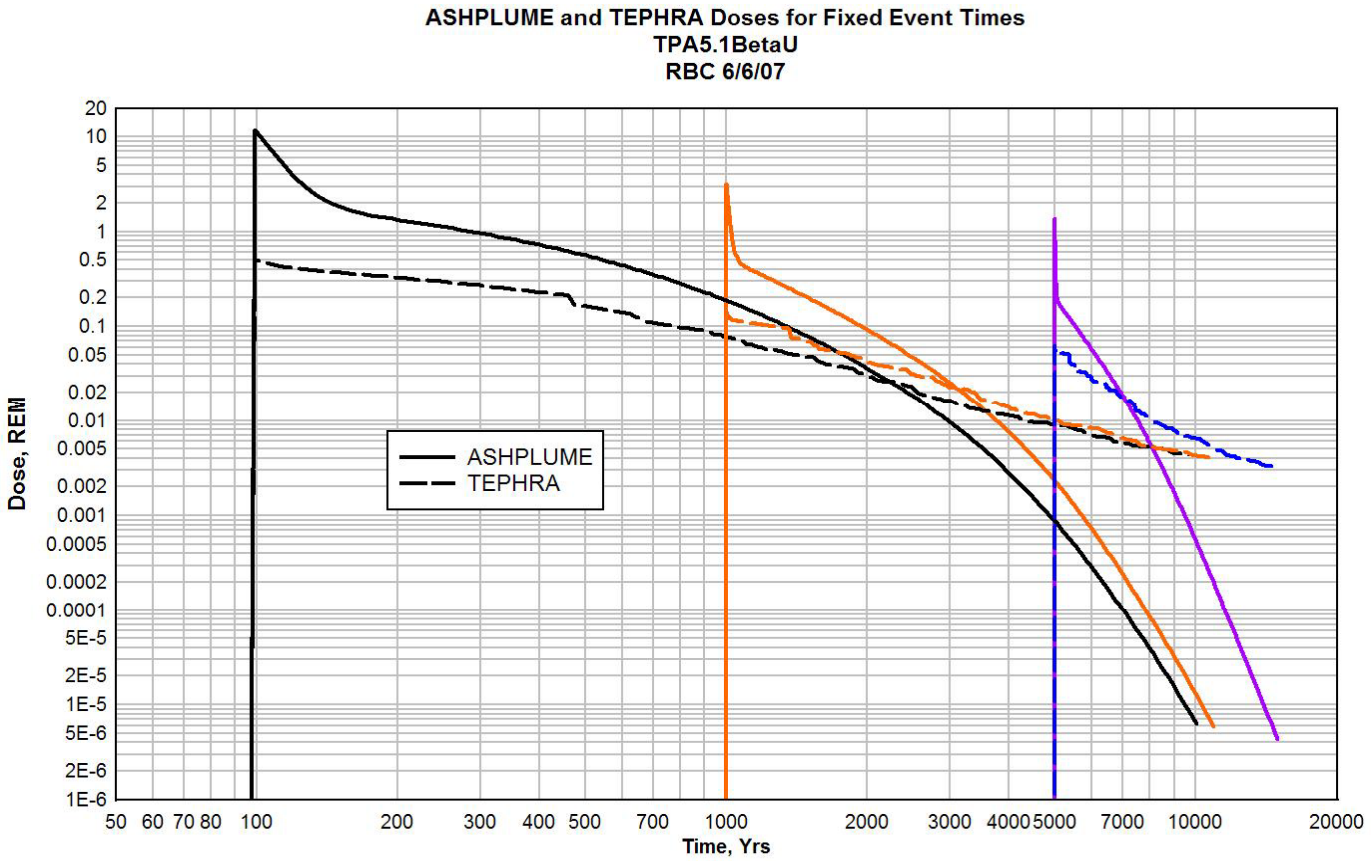
Better Convergence with TEPHRA Model



Convergence of Extrusive Volcanism Models with LHS

- TEPHRA results for mean dose reasonably converged within 1700 realizations (but hardly smooth).
- ASHPLUME results not well converged, even for many realizations.
- Difference in results because of longer time constant for TEPHRA model (i.e., redistribution processes relatively slow)

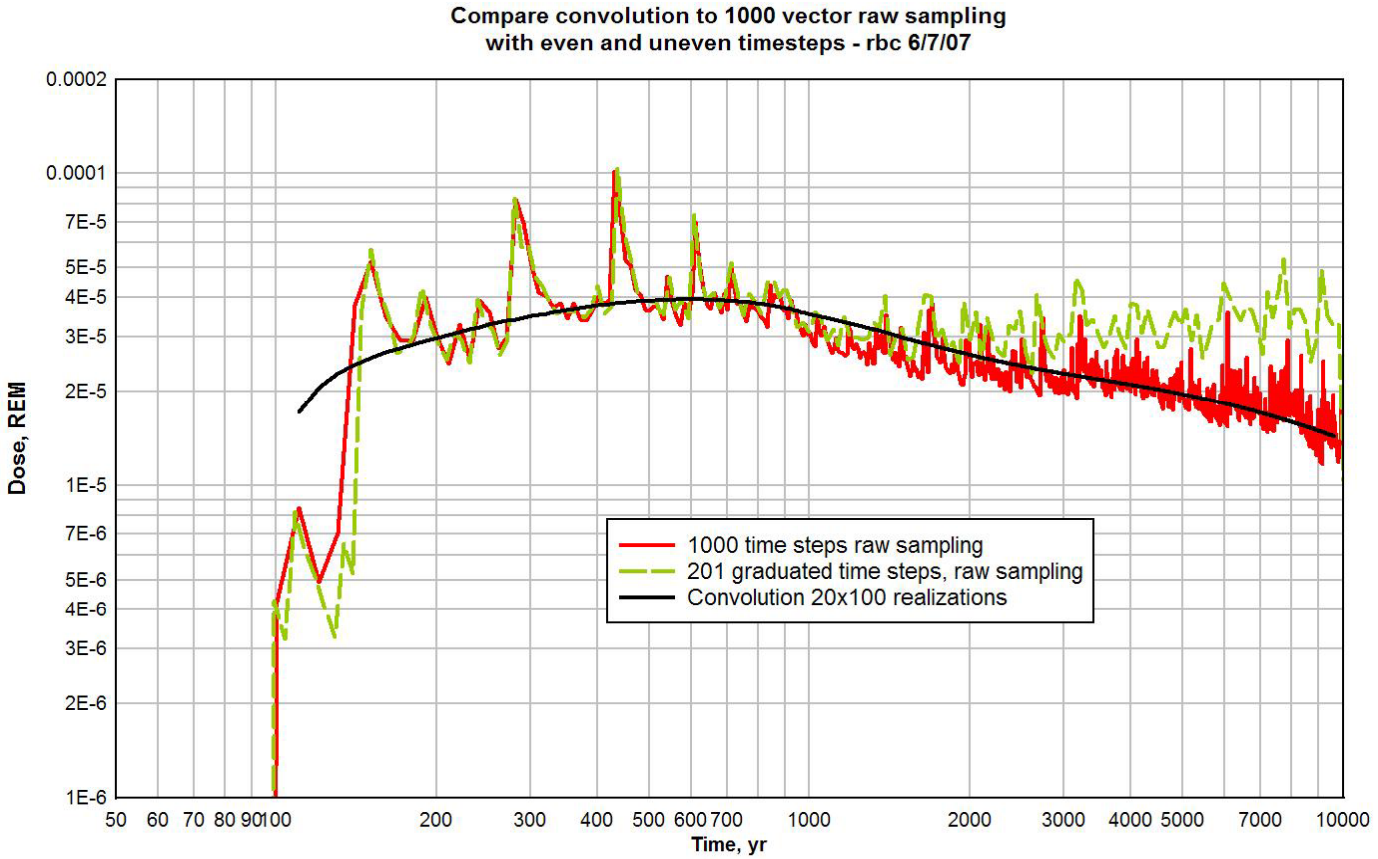
Conditional Doses for ASHPLUME and TEPHRA Models Showing Different Time Constants



Additional Problem with Straight LHS for Extrusive Volcanism

- Calculation of mean dose with LHS leads to appearance of mean remaining high at long times.
- Result is an artifact of default sampling with increasing time step length in TPA.
- Results improved by specifying fixed rather than variable time steps for extrusive volcanism.

Fixed vs Variable Time Steps for Extrusive Volcanism with ASHPLUME Model



Convolution Procedure

- A person living at time t' will only be at risk from events taking place prior to t'.
- Average annual conditional dose at time t' for and event at time t_e:

$$\overline{D}(t' \mid t_e) = f(t_e, t' - t_e)$$

$$\overline{D}(t' < t_e) \equiv 0$$

Convolution Procedure (Cont'd)

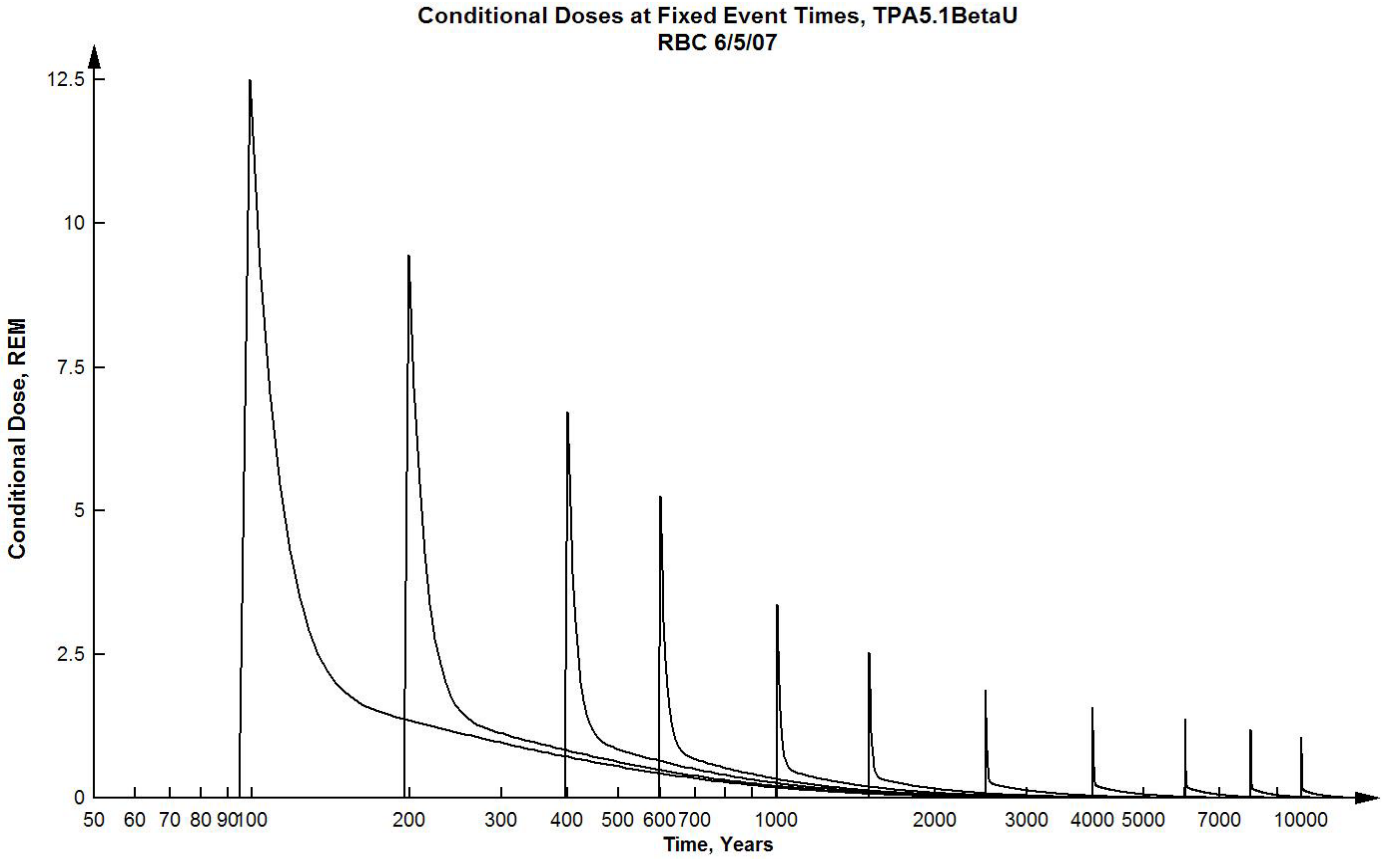
- Instantaneous dose to person living at time *t′* is convolution of all possible prior volcanic doses multiplied by probability of event:

$$\overline{D}(t') = p_r \int_{t_{\min}}^{t'} f(\tau, t'-\tau)\, d\tau$$

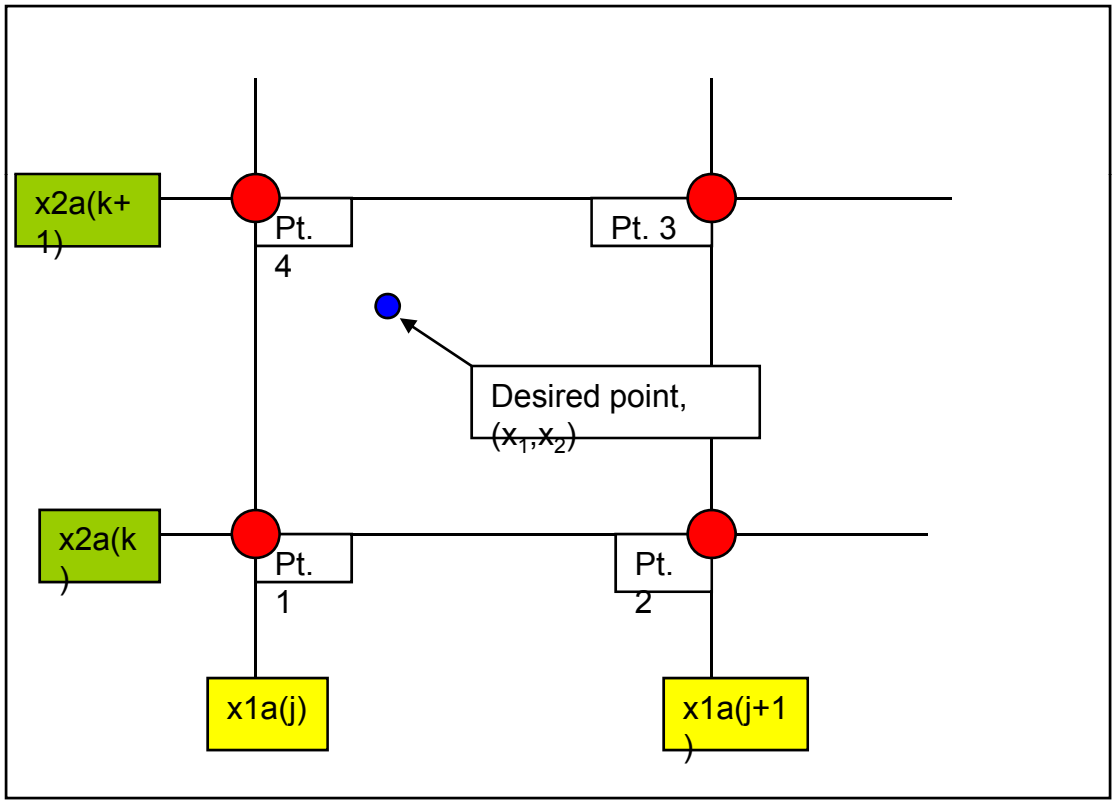
Implementation of Convolution Procedure

- Definition of main function $f(\tau, t' - \tau)$:
  - Mean doses calculated at discrete event times only, but function must be continuous.
  - Use bilinear interpolation (Press, 1994) to generalize function to any value of time of event and time after event.

Discrete Values of Mean Dose



Bilinear Interpolation



Program CVOLC7L – Main Convolution Procedure

- Combines mean dose files for fixed event times into a single dose vs. time curve for risk assessment.
- Uses log transform of time in all models for increased accuracy and efficiency of interpolation.

Manual Operation of Convolution Procedure

Multiple steps required to calculate mean dose by convolution:

1. Generate mean dose curves for fixed event times using
   AverageCalenderYearAssumedForEmplacement[A.D.]
2. Run TPA for 100 realizations. Get mean dose results from file RGSSA.TPA.

Manual Procedure (Cont'd)

3. Generate an input file specifying names of files containing mean dose information.

4. Run CVOLC7L to convolute mean doses into single overall mean dose curve.

Semi-Automated Procedure

- MS-DOS Script RUNVOLC.BAT to generate mean dose files from TPA:
- Uses program CHANGEAGE2 to modify burial date in TPA.INP file.
- When completed, run CVOLC7L to complete calculation of overall mean dose.

Fully Automated Procedure

Program CONVOTPA fully automates procedure:

- Generates mean dose files using CHANGEAGE2 and TPA
- Runs CVOLC7L to generate overall mean.
- Requires an input file CONVO.IN to specify model parameters.

File CONVO.IN for CONVOTPA Procedure

19 \nskip

1.0e-7,10,100,2033 \pvolc,dtlife,tmin,yrburied

tpa_volc_ashplume.inp \fname

volcte \root

12 \nevents

100,200,300,400,500,600,700,1000,2000,3000,5000,10000 \tevent

Conclusions

- LHS works well for nominal case with slow evolution of processes, but not well for disruptive events with low probability, high consequences and short duration.
- Convolution procedure developed for extrusive volcanism case to generate a smooth mean dose curve with relatively few realizations.
- Manual to fully automated procedures.