LSNReviews

From: Roland Benke
Sent: Thursday, March 23, 2006 10:47 AM
To: Brittain Hill; Donald Hooper; Keith Compton
Subject: accelerated erosion in ASHREMOB
Attachments: draft response for TPA code comments in Section E (325 KB); draft response for TPA code comments in Section E (additiona... (178 KB); Final summary of Redistribution meeting, Sept 29, 2005 (18.0 KB)

Currently the resuspendible layer thickness is accounted for by 2 of the 3 ASHREMOB source regions (initial deposit at the receptor location & eolian redistribution). Because ASHREMOB never got to calculate thicknesses of fluvial deposits, the resuspendible layer thickness is not accounted for in the fluvial redistribution calculations. By not accounting for resuspendible layer thickness, each fresh fluvial deposit is effectively assumed to be greater than the resuspendible layer thickness (default = 3 mm) for the entire duration that Fortymile Wash yields contaminated sediment.

When accelerated erosion at early times is considered in estimates of deposit thicknesses over the depositional area, I recall Don estimating fluvial deposit thicknesses less than 3 mm. Considered together with the accelerated erosion at early times, accounting for the resuspendible layer thickness in the fluvial source region would tend to constrain the effect of early tephra-rich floods to bumping up the dilution factor to values closer to unity. Any underestimation with the current model and input data set would probably be limited to within a factor of 2, and it's possible that modeling both effects could decrease doses and risk. This is an excellent issue for the TPA code validation activities, which should commence shortly after the TPA Version 5.1beta code is delivered.

By the way, a coding solution to this issue was proposed under "TPA Code Action Item 4" (see 2 attached emails sent to D. Codell as lead for TPA code action item discussion and path forward in September 2005). Since consensus was not reached, within the larger group, on moving forward with the proposed changes for this item (see Dick's summary as the last attachment), the changes were not included in the SRD and were not pursued for the TPA Version 5.1beta code.

Roland

-----Original Message-----
From: Brittain Hill [mailto:BEH1@nrc.gov]
Sent: Thursday, March 23, 2006 6:44 AM
To: dhooper@cnwra.swri.edu; Keith Compton
Cc: rbenke@cnwra.swri.edu
Subject: Re: accelerated erosion figure

While I agree that understanding the lifetime behavior of the deposit is important, the risk-significance driver is the evolution of the deposit during the first 1,000 years post-closure. If we underestimate tephra deposit yield during that time, we may be underestimating tephra (i.e., HLW) concentrations in the fan deposit by 2-4x. Although a long-term average may accurately integrate the total yield under the curve, it may be a poor abstraction of yield during those critical 1,000 years.

We can do exploratory analysis with the 5.1 model using the current approach. But I am much more concerned with realistic HLW concentrations during the period of peak risk, rather than how long the deposit may exist on the proximal slopes. I don't favor randomly sampling the increase in tephra yield, unless we have a strong technical basis to constrain the range based on YM characteristics. Paricutin, Sunset, Cerro Negro, MSH etc provide insights, but are poor analogs for constraing this YM-specific parameter.

I think we're good to go for ACNW tomorrow, but need to chew on this a bit more during Keith's tech exchange.

Thanks-
Britt

>>> Don Hooper <dhooper@cnwra.swri.edu> 03/22/06 7:19 PM >>>
Keith,

About that figure 4-4 from the Hooper redistribution report. My fault for not better explaining accelerated erosion as computed by a diffusion model.
I think that shows it could be replaced (one of my possible paths forward).
Recall that you could draw a straight line across it at a relative sediment yield of 2 (which is what TPA does) for the lifetime of the deposit. This may account for the volume (mass) of sediment transported over time about as well as any other (more elegant) method. The problem with 2X is that it fails to account for the critical (risk-significant) early years immediately after the eruption. I need to revisit that as an offline calculation.
Maybe we can uniformly sample this between 1 and 10 or 1 and 50, etc. But we're only varying one poorly known parameter (relative sediment yield) as this is currently set up.

I still feel that 4.6X is too low of an accelerated erosion value and that 25,000 years is too long (even for an arid environment). I think the shape of the curve is basically correct. And we're not even delving into geomorphologic issues, such as soil stabilization, changing slope angle, and diminishing size of the initial deposit. Perhaps part of the problem lies with what I would call relative time vs absolute time. Figure 4-4 is describing a sediment transport process, a proxy for a potential tephra deposit in the YMR. The deposit may be depleted before you reach 25,000 years. To start compressing or extending the curve to fit a deposit of a certain size becomes a priori. Although this curve has the opposite slope, do we reach our monetary retirement goals before actual retirement? How well do we follow that mean curve set up by our financial advisor?

And I still need convincing that [tephra] vs [tephra + ambient sediment] is an issue (you still have normal "ambient" erosion occurring in the tephra-affected basin). (This is your sed yield minus 1 solution.) I'm rambling, time to end this ...

I look forward to discussing this with you during your staff exchange next month.

We have the bridge number for Friday morning. Good luck,

-Don

Properties Page

Return-path: <rbenke@cnwra.swri.edu>
Received: from PHOENIX ([129.162.200.28])
 by rogain.cnwra.swri.edu (Sun ONE Messaging Server 6.0 (built Oct 29 2003))
 with ESMTP id <0IWL00I5W5574K40@rogain.cnwra.swri.edu> for
 dhooper@cnwra.swri.edu; Thu, 23 Mar 2006 08:48:45 -0600 (CST)
Date: Thu, 23 Mar 2006 08:47:25 -0600
From: Roland Benke <rbenke@cnwra.swri.edu>
Subject: accelerated erosion in ASHREMOB
In-reply-to: <s42251d9.061@NRNWMS05.NRC.GOV>
To: 'Brittain Hill' <BEH1@nrc.gov>, dhooper@cnwra.swri.edu,
 'Keith Compton' <KLC@nrc.gov>
Reply-to: rbenke@cnwra.swri.edu
Message-id: <01aa01c64e88$b3dbc0c0$1cc8a281@cnwra.swri.edu>
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Importance: Normal
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X-MSMail-priority: Normal
Original-recipient: rfc822;dhooper@cnwra.swri.edu

LSNReviews

From: Roland Benke
Sent: Sunday, September 18, 2005 10:07 PM
To: Richard Codell
Cc: Bret Leslie; Christopher Grossman; Donald Hooper; James Winterle
Subject: draft response for TPA code comments in Section E
Attachments: TPA501_CommentResolution_SectionE.wpd; Figure_E-1.doc

Dick,

As the NRC lead for the section on redistribution and mass loading for the igneous eruption scenario, please find the draft responses attached for your review and further discussion. For item 2., let me know if you think any other VOLCANO parameters need to be considered to establish links with the ASHREMOB calculations.

Don will be covering the ACNW meeting in Las Vegas on Tuesday and Wednesday of this week. We'd be happy to discuss the proposed responses and TPA code modifications with you as early as Thursday this week.

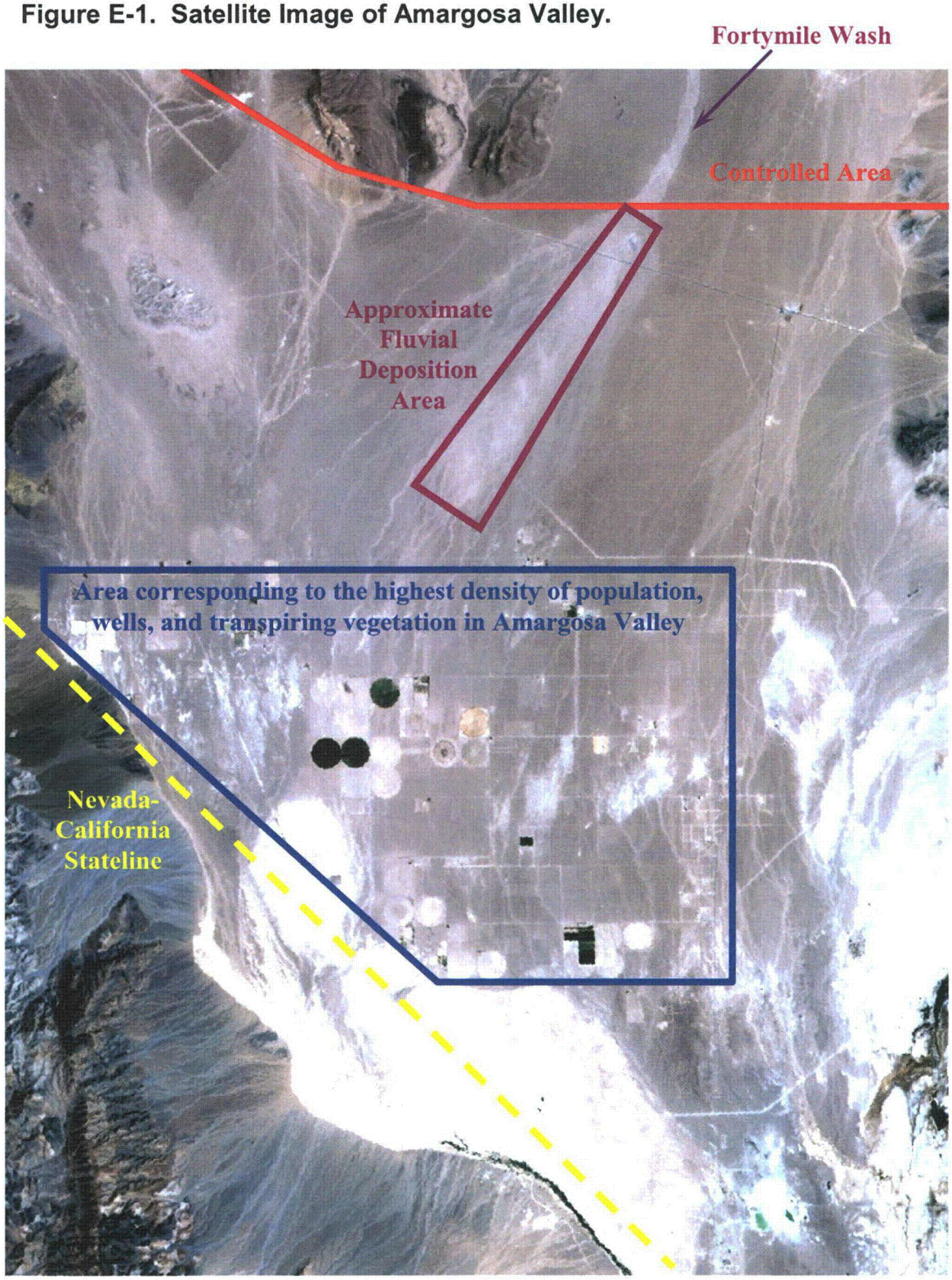
Roland

E. Redistribution and Mass Loading Associated with the Igneous Extrusive Scenario **Proposed NRC Lead: Dick Codell**		
Comment	*Proposed Response*	*Description of Proposed Code Modifications*
1. Abstraction should be consistent with 10 CFR 63 concept of the reasonably maximally exposed individual and not presume the location of the individual in, or directly adjacent to, the depositional fan of Forty Mile Wash.	The area for the receptor location will be based on the highest density of population, wells, and transpiring vegetation in Amargosa Valley (see Figure_ E-1.doc).	1. Modify the TEPHRA code algorithm to compute the average initial tephra-fall deposit (mass ash or HLW per unit area) for the nodes located within the receptor area (see Figure_E-1.doc). 2. Recompute the TEPHRA look-up table. 3. For consistency, modify ASHPLUME and ASHPLUMO to compute an average initial tephra-fall deposit for the same receptor area.
2. Address the apparent disconnect of ASHREMBO from VOLCANO. Consider re-scaling TEPHRA runs to a single waste package and then use that to extrapolate for the number of waste package damaged, as determined by VOLCANO. Identify what other parameters from VOLCANO will need to be considered for consistency.	The number of waste packages (or mass of high-level waste) erupted will be passed from the VOLCANO module for use in the ASHREMOB calculations. Eruption characteristics modeled by the TEPHRA code for generating the look-up table will not be made dependent on the parameters or results of the VOLCANO module.	1. Recompute the TEPHRA look-up table for a unit source term (i.e., one waste package). 2. Modify ASHREMOB calculations to scale the look-up table parameter values for high-level waste ($c_{HLW,i}$; $m_{HLW,f}$; $m_{HLW,e}$) by the number of waste packages erupted, as determined by the VOLCANO module.
3. Address the basis for only including inhalation dose estimates for ASHREMOB.	Inhalation of resuspended volcanic ash has been shown to be the dominant pathway in the direct release scenario (Section 4.3.11 of Appendix D — Risk Insights Baseline Report, NUREG–1762, Vol. 2, Rev. 1, April 2005).	None.

4. Address the need for a strengthened technical basis or revised conceptual model to address for the lack of decay related to fluvial remobilization.	Reduction in mass load for the fluvial source region will be included for time periods in between significant flow and depositional events.	1. Modify ASHREMOB module to calculate a time-dependent fluvial mass load fraction accounting for (i) exponential decay of mass load between significant flow events using the `RateOfReductionOfMassLoadingFactor[1/yr]` parameter, (ii) the thickness of fresh fluvial deposits covering older fluvial deposits, and (iii) dilution from resuspending deposits, thinner than the resuspendible layer depth, which are overlying aged deposits or clean soil. Illustrative examples are provided for two cases: (a) "thick" fluvial deposits, see CaseA_ThickDeposits.jpg, and (b) "thin" fluvial deposits, see CaseB_ThinDeposits.jpg. 2. Modify ASHREMOB module to calculate the time-weighted average of mass load fraction between the present and next TPA time steps. Multiply the mass load for ash under light disturbance parameter value by this average value to determine the mass load used for the fluvial source region at the present TPA time step.

5. Address, or otherwise develop, a technical basis for the three weighting factors (initial, fluvial, and eolian).	The place-holder values for the weighting factors will be replaced. The weighting factors represent how much resuspension and airborne mass loading from a particular source region affect the airborne particle concentration at the receptor location. The weighting factors are viewed as quantities that range from 0 (no effect) to 1 (direct effect). Since resuspension of the deposit at the receptor location directly affects the airborne particle concentration at the receptor location, the weighting factor for the initial deposit source region is assigned a value of unity. In contrast, airborne resuspension from the fluvial and eolian source regions indirectly affects the airborne particle concentration at the receptor location. The fluvial and eolian weighting factors will be determined by offline calculations, based on the probability that near-surface winds are directed so that the wind can blow resuspended material from either the fluvial or eolian source region downwind to the receptor location. For example, the fluvial deposition area is located to the north of the area occupied by the receptor (see Figure_ E-1.doc). Because the fluvial deposition area is close to receptor location, winds blowing southwest, south, south-southeast, and south-southwest would blow material resuspensed from the fluvial region over the area occupied by the receptor. The weighting factor will be assigned a value equal to the sum of probabilities for wind directions that would blow resuspended material downwind to the receptor location. Unlike the fluvial source region with a fixed location, the spatial extent of eolian source region changes with each realization based on the initial tephra-fall deposit. The look-up table will be expanded to include calculations for the eolian weighting factor.	1. Modify TEPHRA code algorithm to calculate the eolian weighting factor separately for each realization. For the purposes of calculating weighting factors, the area of eolian source region is the entire domain outside of both the fixed fluvial depositional area and the receptor area (i.e., fluvial ash still in Fortymile Wash can contribute only as part of the eolian source prior to reaching the fluvial depositional area). 2. Recompute the TEPHRA look-up table including the new parameter for the eolian weighting factor. 3. Add a new TPA input parameter for the ASHREMOB module, named FluvialDepositionalArea[m2] with a default constant value of $2.4 \times 10^{+7}$ m^2. 3. Modify ASHREMOB module to calculate the thickness of fluvial deposits by (i) computing the total fluvial volume as the sum of the volume of clean sediment yielded per significant flow event and the volume of fluvial ash yielded per significant flow event, both of which are already calculated, and (ii) dividing the total fluvial volume by the FluvialDepositionalArea[m2] parameter value. 4. Modify the TPA code to accept the eolian weighting factor from revised look-up table. Delete the eolian weighting factor from the TPA input file.

Figure E-1. Satellite Image of Amargosa Valley.



LSNReviews

From: Roland Benke
Sent: Sunday, September 18, 2005 10:12 PM
To: Richard Codell
Cc: Bret Leslie; Christopher Grossman; Donald Hooper; James Winterle
Subject: draft response for TPA code comments in Section E (additional files)
Attachments: CaseA_ThickDeposits.jpg; CaseB_ThinDeposits.jpg

I hope you find the 2 illustrative mass load examples helpful (see attached).

Roland

-----Original Message-----
From: Roland Benke [mailto:rbenke@cnwra.swri.edu]
Sent: Sunday, September 18, 2005 9:07 PM
To: Richard Codell
Cc: Bret Leslie; Chris Grossman; Donald Hooper; James Winterle
Subject: draft response for TPA code comments in Section E

Dick,

As the NRC lead for the section on redistribution and mass loading for the igneous eruption scenario, please find the draft responses attached for your review and further discussion. For item 2., let me know if you think any other VOLCANO parameters need to be considered to establish links with the ASHREMOB calculations.

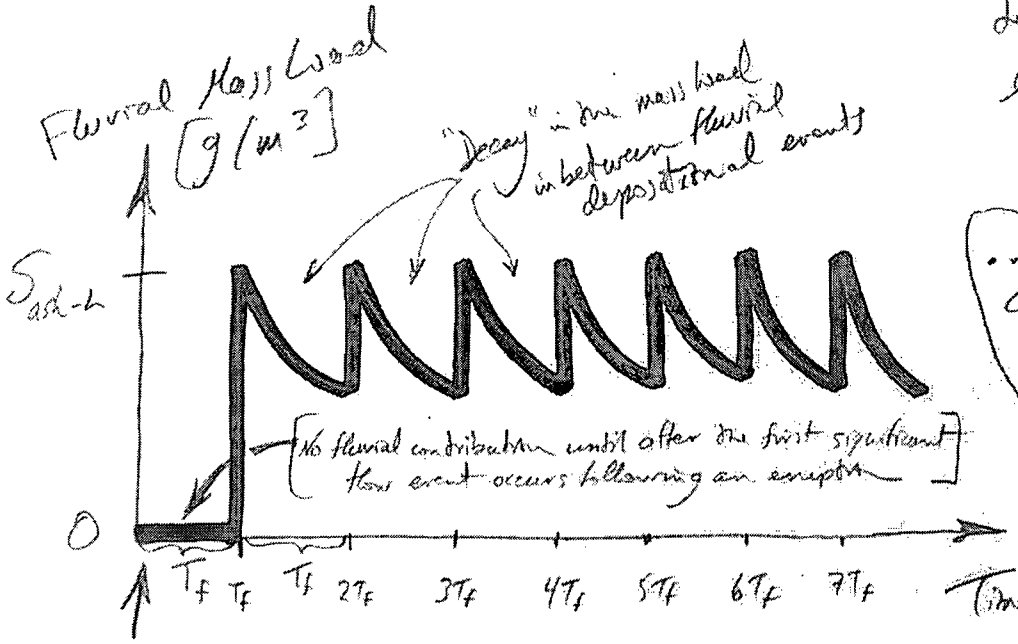
Don will be covering the ACNW meeting in Las Vegas on Tuesday and Wednesday of this week. We'd be happy to discuss the proposed responses and TPA code modifications with you as early as Thursday this week.

Roland

<< File: TPA501_CommentResolution_SectionE.wpd >> << File: Figure_E-1.doc >>

Case A : "Thick" fluvial Deposits

Fluvial Redistribution for Case A: a deposit with a thickness greater than or equal to the resuspendible layer depth (3 mm)



... continues until the contaminated tephra in Fortymile Wash is depleted, after which time the contribution from fluvial redistribution is set to zero.

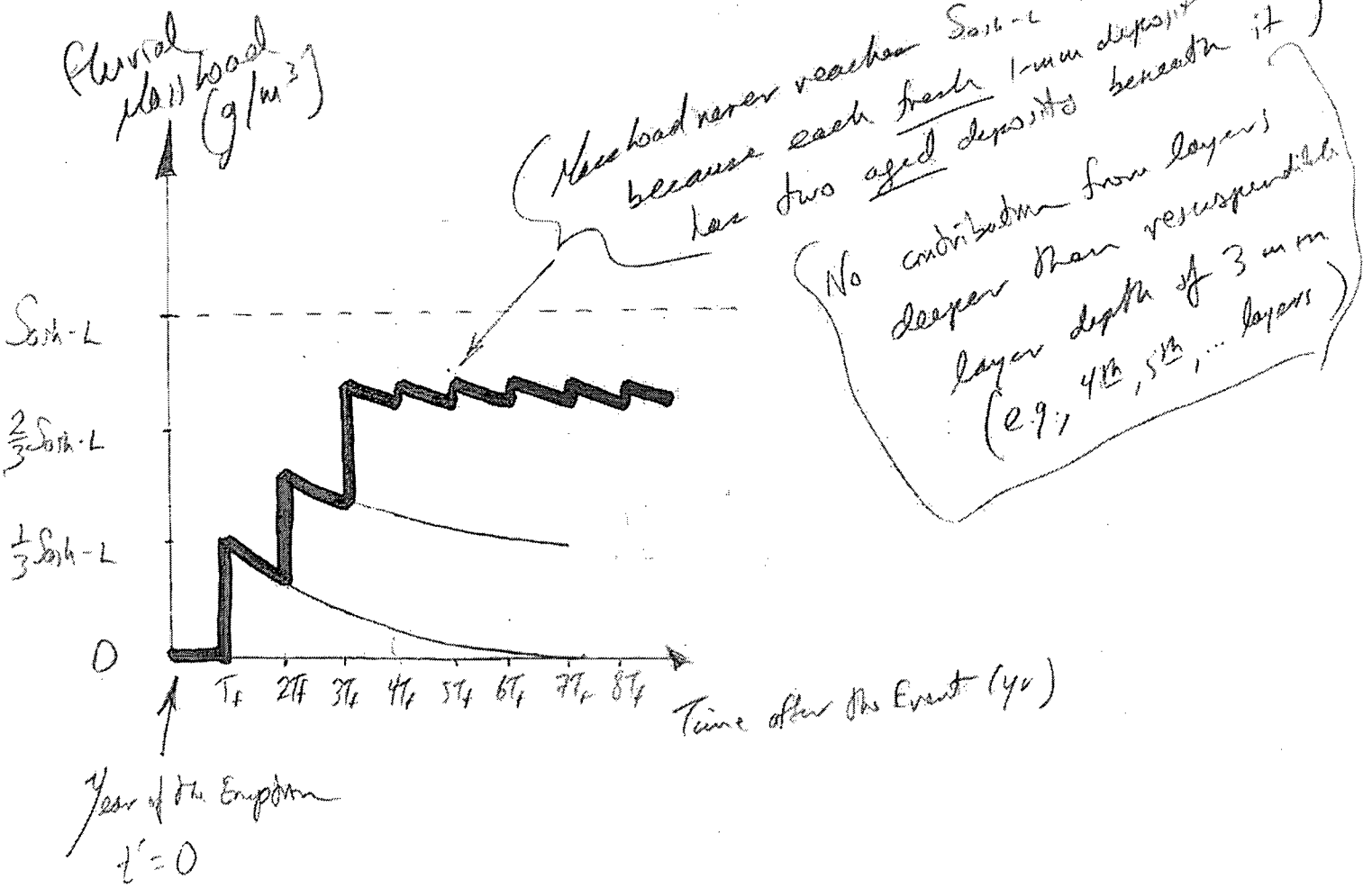
S_{ash-A} – TPA parameter 'Mass Load Above Each Ash Light Disturbance [g/m3]'

T_f – TPA parameter 'Time Between Flow Events [yr]'

Case B: "Thin" Fluvial Deposits

Fluvial redistribution yields a deposit with a thickness <u>less than</u> the resuspendible layer depth (3 mm)

Example shows the change in airborne mass load assuming each significant flow event yields a 1-mm fluvial deposit



LSNReviews

From: Richard Codell
Sent: Tuesday, October 04, 2005 2:57 PM
To: Donald Hooper; Roland Benke; Andy Campbell; Brittain Hill; Bret Leslie; Christopher Grossman; John Trapp; Keith Compton; Timothy McCartin
Subject: Final summary of Redistribution meeting, Sept 29, 2005
Attachments: redist_1.wpd; ashremob_POP.wpd

See attached summary and the POP for the meeting.
Dick

Richard B. Codell, Ph.D.
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From: Richard Codell
To: Attendees, volcanic redistribution meeting
Date: 9/29/05
Subject: POP for redistribution meeting
Purpose: Discuss questions on volcanic redistribution models
Outcome: Perfect harmony and world peace. Also, direction to CNWRA for future work.
Process: Telephone conference to discuss questions arising from TPA5 model and recent CNWRA reports

Topics: Discuss questions on CNWRA redistribution model including but not limited to the following:

1. Abstraction should be consistent with concept of REMI and not presume location of the individual in or directly adjacent to the fan.
2. Address the disconnect of ASHREMOB from VOLCANO. Rescale TEPHRA to single waste package. Identify other parameters from VOLCANO needed for consistency.
3. Address basis for only including inhalation.
4. Address need for strengthened tech basis or revised model to address lack of decay related to fluvial remobilization.

a. Would fluvially remobilized ash have same potential for airborne transport as freshly deposited ash? Would soil-forming processes from degradation of silicic minerals in ash alter properties of ash? Would heavier uranium oxide segregate by gravity from ash?

5. Address tech basis of three weighting factors.

Comments on CNWRA Milestone 06002.01.362.530 sent by Bret, e.g.,
1. Use of western wildfire data as analog to ash redistribution.
2. Recent wet-year data in Nevada.
3. Possible improved use of flood frequency results in model
4. Diffusion analogy for sediment transport. Determination of parameters in model used.
5. Boundary conditions for diffusion model.
6. Ash falling close to volcanic vent and its ability to be transported by water and wind.
7. Use of less than total area in Fortymile Wash catchment.
8. Show that amount of remobilized tephra could significantly affect airborne concentrations.

Other comments
1. Should we consider use of HYSPLIT or at least a comparison to TEPHRA?

Note to: Attendees, volcanic redistribution meeting, Sept 29, 2005
From: Richard Codell
Subject: Summary of discussions

We met on September 29 to discuss several issues regarding possible changes to the TPA 5 code with regard to the volcanic ash redistribution model. See the attached POP for the meeting, although we did not have enough time to cover all of the listed items.

Item 1 - "Abstraction should be consistent with concept of RMEI and not presume a location of the individual in or directly adjacent to the depositional fan of Fortymile Wash."

Spatial dimensions of the RMEI location are unclear. The RMEI must be a representative person exposed to potential contamination in water and air, located at the highest concentration of contamination in the groundwater plume. Although all participants agreed the RMEI is not reasonably located within Fortymile Wash, additional consideration is needed to appropriately define the spatial extent of the RMEI location. This extent affects i) likelihood and conditional dose for initial tephra-fall deposits, and ii) proximity to Fortymile Wash and elevated mass loads from potentially contaminated tephra fall deposits. Primary uncertainties are the attenuation of mass load with distance from Fortymile Wash, proportion of airborne particles from sources with noncontaminated dust, and sources of redistributed tephra from drainages adjacent to Fortymile Wash.

ACTION: Don Hooper will evaluate existing TEPHRA realizations to estimate the amount of tephra potentially deposited outside the current Fortymile Wash drainage basin. ALL will continue to consider the technical basis to define the spatial extent of the RMEI location.

Item 2 - "Address the disconnect of ASHREMOB from VOLCANO. Rescale TEPHRA to single waste package release. Identify other parameters from VOLCANO needed for consistency."

TEPHRA is a stand-alone code, with volcanic parameters from TPA.INP used in TEPHRA realizations. Sensitivity studies must be conducted with the TEPHRA code. Presently the TEPHRA code samples from 1 to 10 waste packages entrained, separate from any sampling in the TPA code. The proposal is to conduct all TEPHRA realizations with a single waste package, and then multiply the tephra concentrations by a factor which is the sampled number of waste packages in TPA. There is only a very slight effect of waste entrainment on plume dynamics, so this is an acceptable procedure. CNWRA will recast the TEPHRA code results on this basis. Sensitivity studies for other volcanic parameters, such as eruption power or duration, will still need to use realizations from the TEPHRA code.

ACTION: Center will rerun the TEPHRA code using a single waste package as a fixed parameter and all other parameters sampled as before.

Item 3 - "Address basis for only including inhalation in the dose assessment."

Previous analyses using TPA 4.1j showed that inhalation dose was approximately 90% of the

total effective dose. All seemed to agree that the current analyses lead to the conclusion that inhalation is by far the largest dose contributor, and that other pathways can be ignored.

ACTION: None.

Item 4 - "Address need for strengthened technical basis or revised model to address lack of decay related to fluvial remobilization."

The model assumption on the initially deposited tephra is that the source remains approximately constant, releasing the same amount of contaminated tephra at each flood event, except for radioactive decay. This assumption could be partially supported by the observation that the mass of tephra from Cerro Negro hasn't changed significantly during 4 years of observation .Keith Compton asked if there should be negative correlation between mass load and the arrival time of the redeposited ash in the alluvial fan. Roland suggested that the model should calculate a time-dependent reduction in the mass load between flow events that also accounts for the thickness of the deposits covering older deposits.

It is not clear that mass is being conserved in the redeposition model. I don't think there is an actual accounting for the mass lost because of the loss of mass load in the air. There was a question about the degradation of tephra by soil-forming processes leading to a lessening of the suspendibility of the tephra in air, but evidence from Lathrop Wells does not seem to support alteration of tephra by soil formation. A process that might limit the resuspension of tephra are covering by wind-borne carbonate (non-contaminated) dust in flatter areas that armors the surface. However, only the steeper unstable slopes greater than 5 degrees of the depositional basin are considered for remobilization anyway. It isn't clear that the area of the steeper slopes is represented in the current model. Also, the tephra deposition covers only the area in the depositional basin up to 20 km from the volcanic vent. The reason for this limitation is that contribution for remobilization would be small from areas of the basin farther away, and keeping the depositional area small is with keeping with the lumped-parameter nature of the model for the depositional and fan regions.

ACTION: Don Hooper will check that deposition in the distal regions of the depositional basin is small by sampling at several points with the TEPHRA model. Additional discussions are needed to review the technical basis for time-dependent processes in the redistribution model.

Item 5 - "Address, or otherwise develop a technical basis for the three weighting factors (initial, fluvial and eolian)'"

Roland outlined proposed development of these areas for possible inclusion in TPA in a prior response to NRC questions, but we did not discuss his ideas except fleetingly in the meeting. Insufficient time remained to discuss several ideas for further work in subsequent TPA versions, including:

- Use of alternative plume models like HYSPLIT instead of TEPHRA.
- More complicated two-dimensional models of fluvial sediment transport based on an analogy to

diffusion.

The group was generally supportive of exploring these ideas further, primarily as confidence builders for the current TPA modeling approaches.