From: Brittain Hill
Sent: Monday, July 17, 2006 11:58 AM
To: Donald Hooper; Roland Benke
Subject: Re: wind speed
Attachments: SN88_BEH_winds.pdf

Guys - Sorry this took so long to reply, but I was out on annual leave all last week (automated reply apparently doesn't work for CNWRA emails) and got seriously time crunched before leaving.

I dug through my sci notebook and the answer to the wind speeds is attached. I have copies of the data files on my portable disk, but they are also in the QA records. The sci notebook page is approximate, as it always changes with different printers.

The parameters are the 3 sigma log-values from the mean for the 3-4km Desert Rock data, which were the parameters needed for the log-normal distribution in TPA. I recall going over all this with Ron Janetzke to make sure these were the correct parameters for this distribution. Apparently, something is amiss? Hopefully the attached info will clarify what was being done. If not, give me a call. I will be in all week.

Thanks-
Britt

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>>> Don Hooper <dhooper@cnwra.swri.edu> 7/11/2006 12:44 PM >>>
Britt:

To quickly return to our phone conversation from last week on wind speed, the pdf with lognormal values of 2.013, 3.909 doesn't seem to match any of the data sets or elevation ranges that I've looked through. Even the lognormal relationship seems like it is out-of-place. I realize you're moving on to other issues, but can you spare any thoughts on how you came up with these? Thank you.

-Don

#EXTRACTED FROM COPIES OF THE HISTORICAL NATIONAL CLIMATIC DATA
#UPPER AIR DATA TAPES FOR DESERT ROCK, NEVADA
#LISTED BY THE WESTERN REGIONAL CLIMATE CENTER
#DATED: OCTOBER 3, 2000

#:G.M.T.	pres	hite	temp	rhum	wdir	wspd	theta
#:ymmddhh	mb	m	Cx10	pct	deg	m/s	deg K
#:							
78051600	890	1007	274	11	200	13	310.7
78051600	886	1046	248	19	197	13	308.4
78051600	869	1215	229	20	193	14	308.2
78051600	850	1407	214	20	191	14	308.6
78051600	800	1927	165	21	192	16	308.7
78051600	750	2471	113	24	198	15	308.8

etc.

stats:

height(m)	0-1000	1000-2000	2000-3000	3000-4000
min (m/s)	0	0	0.4	0.7
max (m/s)	25.2	32.2	42.6	58
mean (m/s)	6.13740234	7.6706543	9.42075195	11.6086426

4000-5000	5000-6000	6000-7000
0.7	1	0
58.5	58.5	60
13.9025879	16.2230957	18.5021484

7000-8000	8000-9000	9000-10000
0	1	1
62	63	63
20.7712402	22.9358887	23.9820313

Hearing Identifier: HLW_YuccaMountain_Hold_EX
Email Number: 104

Mail Envelope Properties (Brittain.Hill@nrc.gov20060717115756)

Subject: Re: wind speed
Sent Date: 7/17/2006 11:57:56 AM
Received Date: 7/17/2006 11:57:56 AM
From: Brittain Hill

Created By: Brittain.Hill@nrc.gov

Recipients:
"Donald Hooper" <dhooper@cnwra.swri.edu>
Tracking Status: None
"Roland Benke" <rbenke@cnwra.swri.edu>
Tracking Status: None

Post Office:

Files	**Size**	**Date & Time**
MESSAGE	2739	7/17/2006 11:57:56 AM
SN88_BEH_winds.pdf	30756	

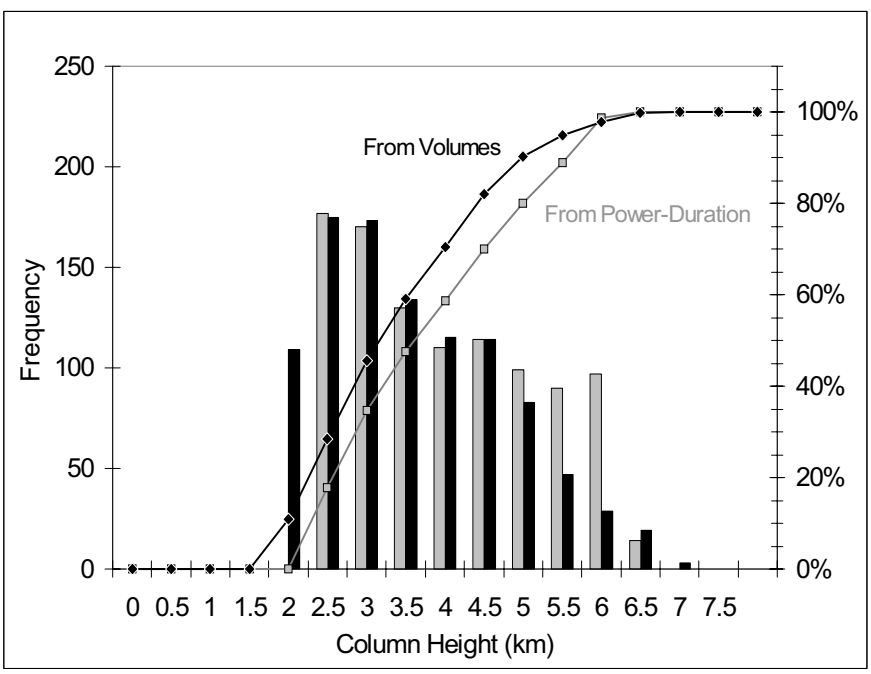
Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Project: 2 Jan 04 to 6 Jan 04. Evaluation of ASHPLUME model parameters for use in TPA 5.x code. Using Excel functions, I am able to generate probability distribution functions and sample these functions stochastically within an Excel spreadsheet. This permits more accurate evaluations than previously possible for TPA model parameter distributions. Calculations are documented in Micro$oft EXCEL 2000 worksheet TPA5_PARAMETERS.XLS, with the OR_MM add-ins activated.

ASHPLUME uses volcanic event power and duration to calculate column heights and tephra volumes (e.g., Jarzemba et al., 1997). Previous approaches (NRC, 1999) have used power and duration from historically active basaltic cinder cones to define TPA parameter ranges. Estimated Quaternary volcano tephra volumes are $1x10^6$ m^3 to $5x10^7$ m^3 (NRC, 1999). The 1-km basal diameter for the highly eroded cinder cone at Northern Crater Flat (w/ central plug) is about twice that of Lathrop Wells. Fall deposits 10-cm-thick also occur several km from the central Pliocene vents. Thus, tephra volumes up to twice Quaternary volumes may have occurred during Pliocene eruptions. A log uniform distribution of tephra volumes from $1x10^6$ m^3 to $1x10^8$ m^3 gives an average volume of ~$2x10^7$ m^3 and accounts for interpreted uncertainties in future tephra volumes. The current range in TPA4.1 for power of 3.5e9–5.3e11 and duration of 1.8e5–1.3e6, however, gives a range of tephra volumes of 9e5–6e8 m3. In addition, mass flow rates range from 4–300 m3/s; the upper range is unrealistic.

Using the estimated range for tephra volume of $1x10^6$ m^3 to $1x10^8$ m^3 and the eruption duration range of 1.8e5 to 1.3e6, calculated column heights are 1.4–6.5 km with average of 3.2 km. Power values calculated from these column heights [=(Height/0.0082)^4] are 8e8–4e11. However, if a log uniform distribution of Power of 8e8–4e11 is used with a duration distribution of 1.8e5–1.3e6, the resulting volumes of 2e5–5e8 m3 are still unrealistic.

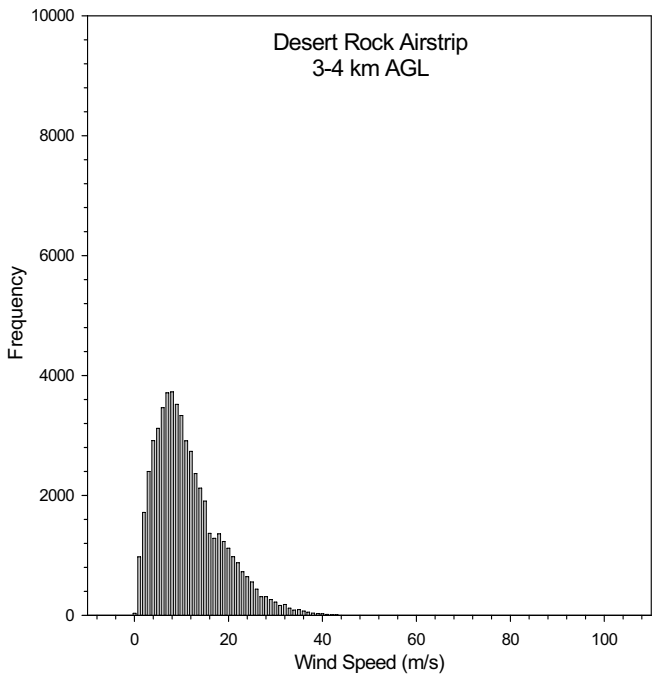
Clearly, Power and Duration must be conditioned so that appropriate eruption volumes and column heights are used in TPA5.x. With experimentation, a Power range of 4e9–3e11 and Duration range of 1.8e5–7.8e5 give eruption volumes of 9e5–2e8 m3 and column heights of 2.1–6.1 km. This also gives mass flow rates of 2–160 m3/s, with an average of 40 m3/s, which is consistent with cinder cone eruptions (e.g., Hill et al., 1998).



Note that each calculation of the TPA5_PARAMETERS spreadsheet will resample the parameters, and give slightly different results for the 1,000 realizations given in the sheet.

Ultimately, TPA5.x should use duration and volume as input parameters, rather than Power, as this provides a clearer comparison with DOE parameter ranges and YMR estimated data.

Wind speed is currently based on an exponential distribution with a mean value of 12 m/s. A large amount of data is now available from the National Climate Diagnostics Center (NOAA) for the Desert Rock Airstrip (see page 407, this notebook). The file DESERT_UAD.TXT was wholly read into SigmaPlot 8.0.2 for file DESERTROCK_WINDS.JNB, which contains 831,335 records of radiosonde data from 16 May 1978 to 31 Dec 1997. After parsing null (999) values, I sorted on altitude and parsed records into individual 1-km-altitude files (DR_##KWINDS.JNB). Data from 0–8km above ground level (AGL) also are contained in Excel2000 file DR_WINDS_ALL.XLS. Altitudes measured in the original data are relative to mean sea level, which are corrected to AGL by subtracting the elevation of Desert Rock (1007 m) from the radiosonde elevation.



As an example, wind speed data for 3–4km AGL are shown in this figure, which uses 1m/s bins for the histogram of 53,597 data points. The mean of these data is 11m/s. After converting the “0.0" values to 0.1m/s, these data fit a log-normal distribution with r^2=0.98

Based on analyses discussed above, modeled eruption columns have altitudes of 2–7km AGL with an average of 3.5km. Thus, wind speed and direction data for Desert Rock airstrip for 2–7km altitudes were combined into SigmaPlot file DR_WINDS_ALL.JNB.

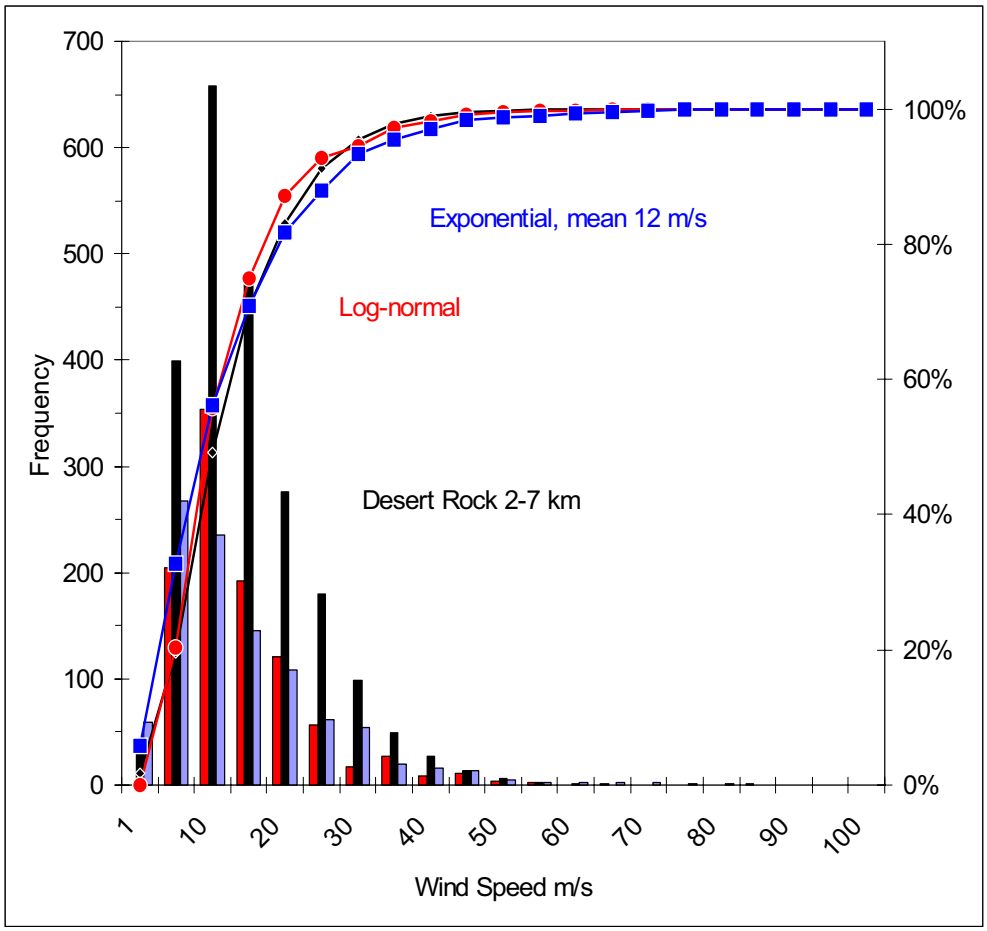
Summary of DR_WINDS_ALL.XLS data for individual altitudes. Note the general 2m/s increase in average wind speed with increasing altitude. All of these intervals bin to log-normal distributions with high goodness-of-fit.

		Avg	Min	Max	# obs
0-1k	Altitude (m)	282	0	992	65500
	Direction	156	0	360	
	Speed (m/s)	5	0	31	
1-2k	Altitude (m)	1454	993	1992	46397
	Direction	186	0	360	
	Speed (m/s)	7	0	47	
2-3k	Altitude (m)	2493	1993	2992	53693
	Direction	212	0	360	
	Speed (m/s)	9	0	39	
3-4k	Altitude (m)	3493	2993	3992	53597
	Direction	227	0	360	
	Speed (m/s)	11	0	64	
4-5k	Altitude (m)	4456	3993	4992	45485
	Direction	229	0	360	
	Speed (m/s)	13	0	77	
5-6k	Altitude (m)	5507	4993	5992	40063
	Direction	237	0	360	
	Speed (m/s)	16	0	105	
6-7k	Altitude (m)	6471	5993	6992	30263
	Direction	239	0	360	
	Speed (m/s)	18	0	107	
7-8k	Altitude (m)	7445	6993	7992	34083
	Direction	241	0	360	
	Speed (m/s)	20	0	103	

Note that there is a bias in the data towards lower altitude measurements, and that directions are more southerly <=2km whereas they are more westerly >2km. Thus, simply combining all the data into a single distribution will result in mean speeds and directions that are biased towards more frequent, low altitude measurements.

For current TPA exercise, the average column height of 3.7 km corresponds well to the average altitude of 3.5km in the 3–4km bin, which is shown in the figure above. These data are compared with current TPA parameter for wind speed on the next page.

Using the distribution functions in Excel2000 file TPA_PARAMETERS.XLS, I generated an exponential function for wind speed with a mean of 12m/s and plotted this distribution. I binned the DR_4KWINDS.JNB data to the same bin ranges and generated the additional distribution, which is scaled to 1% of original values to compare with the parameter distribution.



Note that there are small differences between the exponential distribution and the log-normal actual data distribution, the latter having a slightly higher median wind speed but a somewhat lower percentage of higher velocity speeds.

Convert the Desert Rock wind speeds from m/s to cm/s, which is value needed for TPA. After taking the log of the 3–4km wind speeds in cm/s, the mean of the logs is 2.961 with a standard deviation of 0.316. Using those values, generate a new parameter Log_Wind and plot frequency of 1000 realizations. This distribution matches the Desert Rock wind data more closely than the exponential distribution used previously. Thus, a log-normal distribution with -3s of 2.013 (1.03 m/s) and +3s of 3.909 (81.03 m/s) best corresponds to the observed Desert Rock wind data.