

**Scientists advising decision-makers  
– experiences from Mount St.  
Helens and Mount Pinatubo**

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# Factors in decision-making during volcanic crises at Mount St Helens and Pinatubo



# MSH volcanic facts:

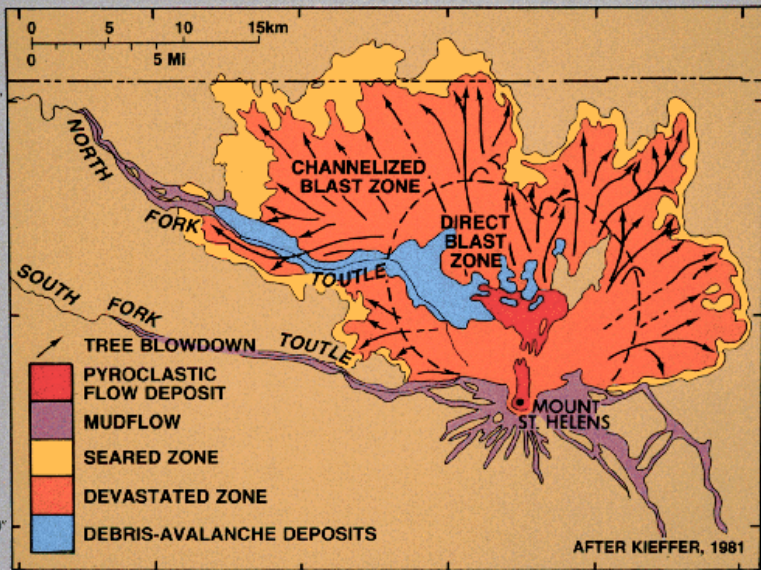
- History of VEI 5 plinian eruptions, & domes
- Dramatic bulge in April-May, > 1 m/d
- No KNOWN sector collapse; only hint of small blast





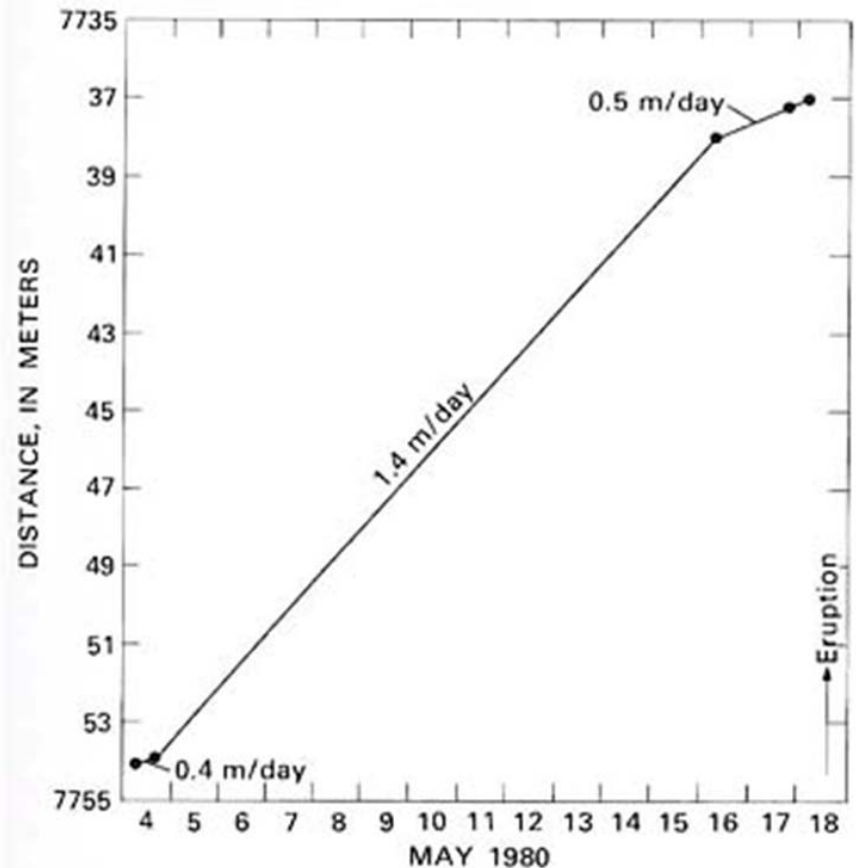
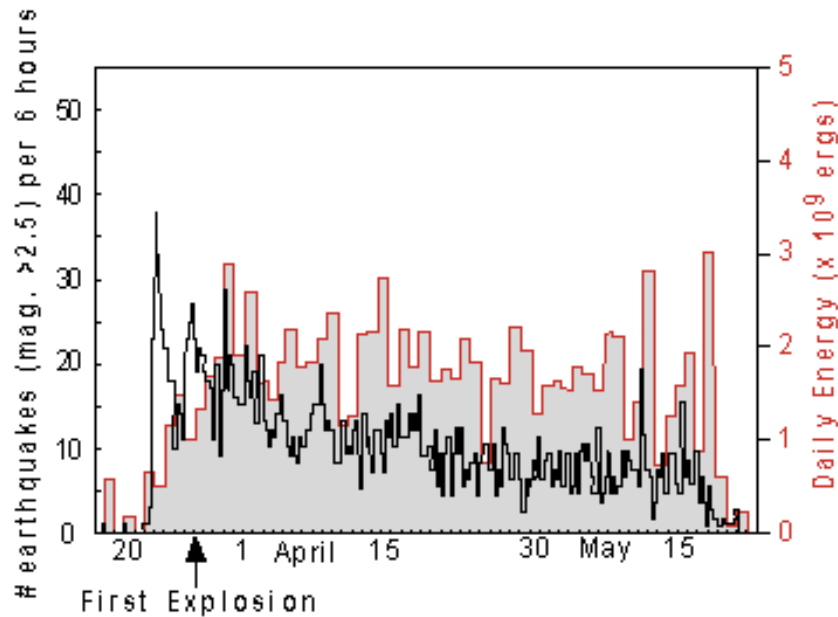
# Debris avalanche and blast

BLAST DEPOSITS AND EFFECTS MOUNT ST. HELENS



# MSH volcanic facts, cont.

- No useful, last-minute precursors



# Volcanic facts, MSH (cont.)

- No quantification of hazard before climactic events of May 18, 1980. Instead, approaches were (a) follow past history, OR (b) deterministic forecast based on monitoring
- Incipient, incomplete thoughts re: Bandai, Bezymianny
- Perfect place for event tree with multiple scenarios, but apparently not considered.
- Probabilistic quantification of hazard (and risk) began during later dome-growth events



# Socio-economic facts, MSH

- Dominant economic activity was logging
- Land management split between private (esp. Weyco), State of WA, and US Forest Service
- Restrictions on access vs. logging and curious sightseers; major difference between W and E



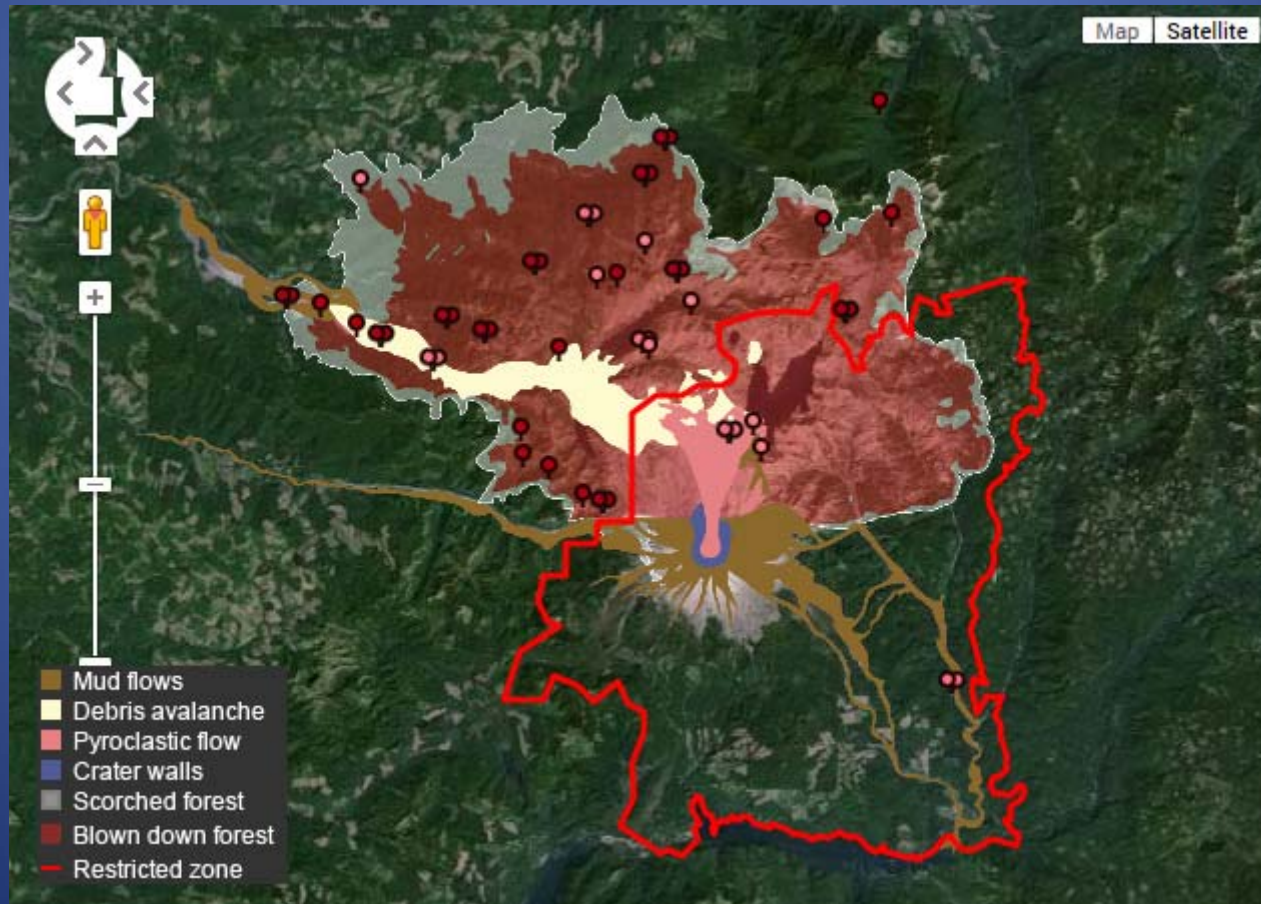
# Personal factors, MSH

- Generally good trust between scientists and decision-makers, best w/ USFS.
- Some frustration about waffling ... “trying to get an answer from geologists is like trying to corner a rat in a round house.” (Sheriff Les Nelson, Cowlitz County)



# Were access restrictions enough?

- Red and blue zone restrictions saved hundreds; still, 57 killed



# After May 18... smaller eruptions and quantification of risk

- VEI 3 scale explosive events after May 18, then episodes of dome-building
- Loggers and lawyers wanted to know exactly HOW DANGEROUS, because Weyerhaeuser Company wanted to salvage timber blown down by the blast.
- Adjectives were useless, but so too were probabilities for loggers and lawyers.
- SOLUTION: Carry probability estimates all the way to individual risk of death, and use chart of comparable risks.



# Annual risks of death (U.S.)

Annual Risk	Age	Occupation	Disease	Accident
$10^0$				
	90			
$10^{-1}$	80	Soldier in war		
$10^{-2}$	60			
	50	Helicopter pilots Logging	Heart disease Cancer	
$10^{-3}$	20		AIDS, Sub-Saharan	
		Mining Agriculture		All accidents Car accidents
$10^{-4}$		Transport, construction All workers (avg.) Manufact'g, retail, gov't	AIDS, industrial'zd	
$10^{-5}$				Drowning
...				Hurricanes
$10^{-7}$				Volc erupt <i>world</i>

# Judging acceptable risk

- If you ask officials what level of risk they are willing to accept, or to let the public accept, most either don't know or won't go on public record.
- However, if you show them their risk as cross-bar on the chart of familiar risk, they can tell you immediately if that's ok or not.

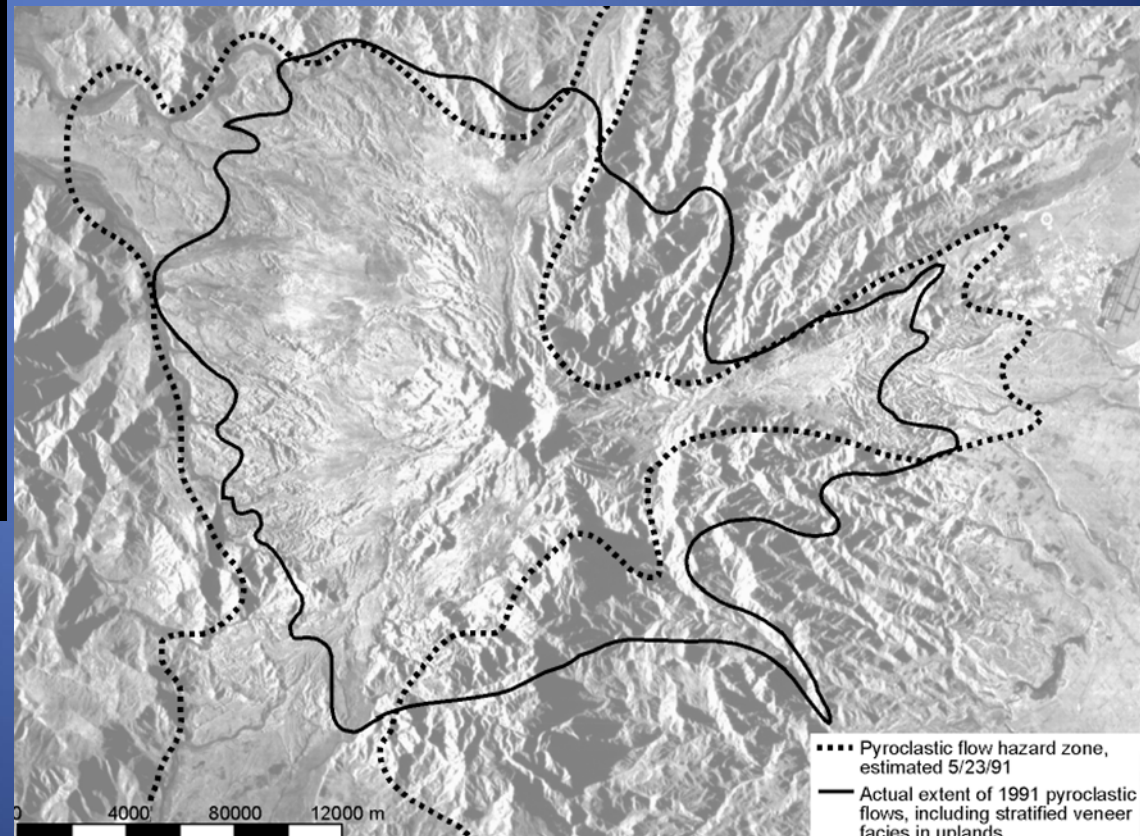


# Interesting point on $\pm 1-2$ orders of magnitude uncertainty in risk

- Local officials said, “Don’t worry about the uncertainty,” because
  - “We are accustomed to making decisions under uncertainty”
  - “Anyway, your guess is better than our guess.”

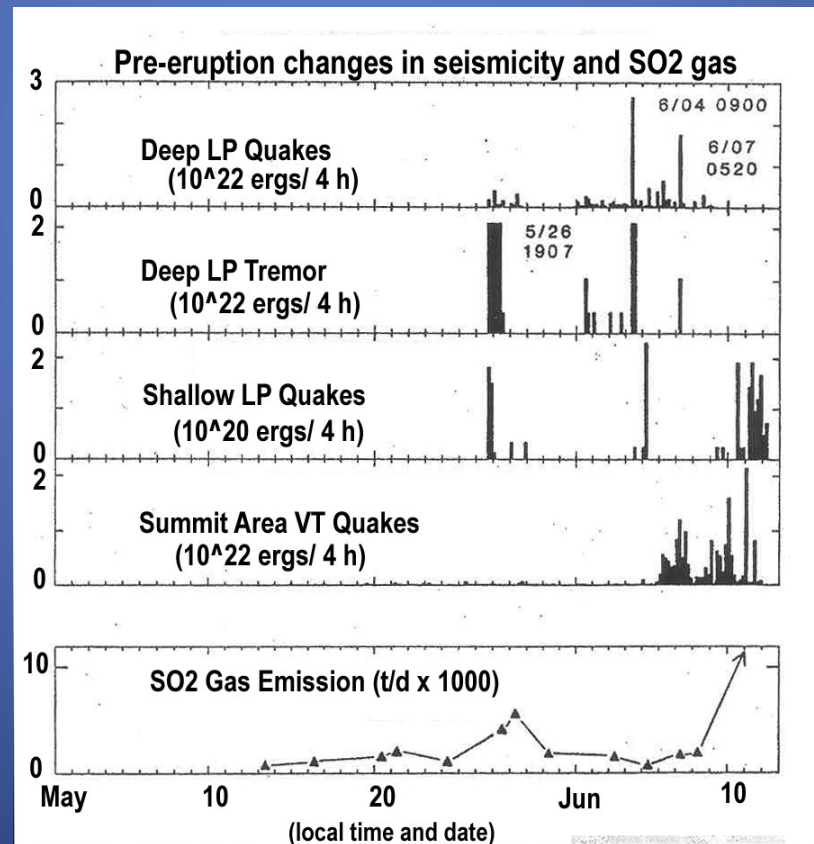
# Pinatubo: volcanic facts

- Long-dormant volcano, no monitoring history but geology → if it erupts, probably a VEI 6



# Pinatubo volcanic facts, cont.

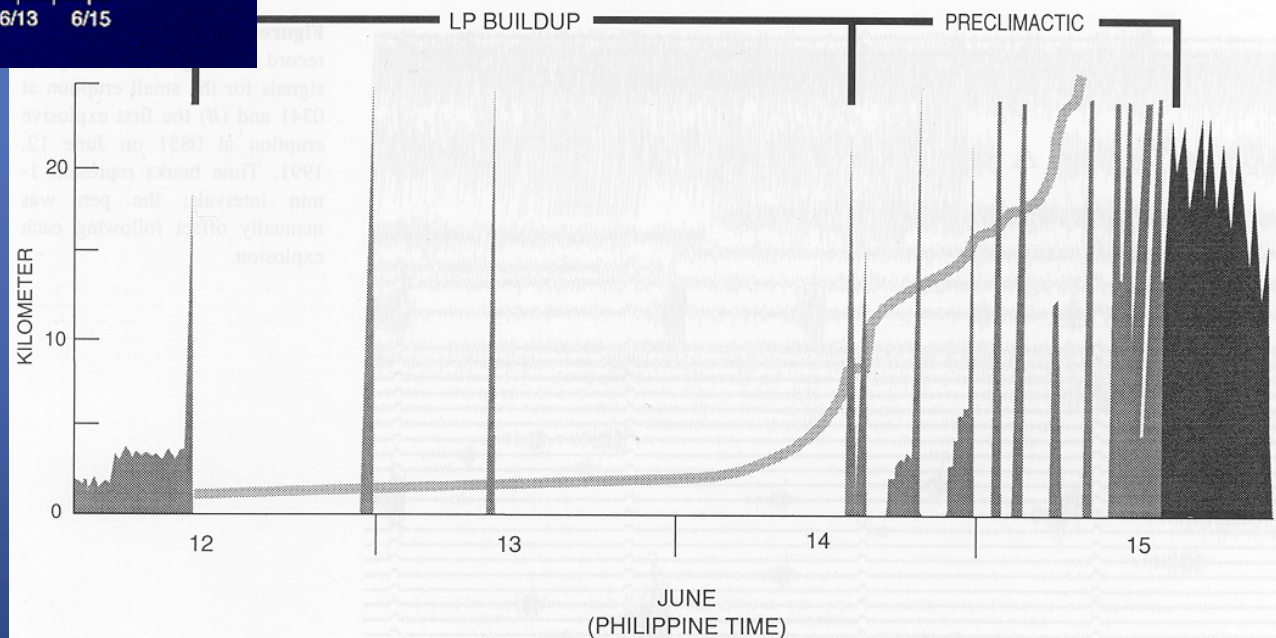
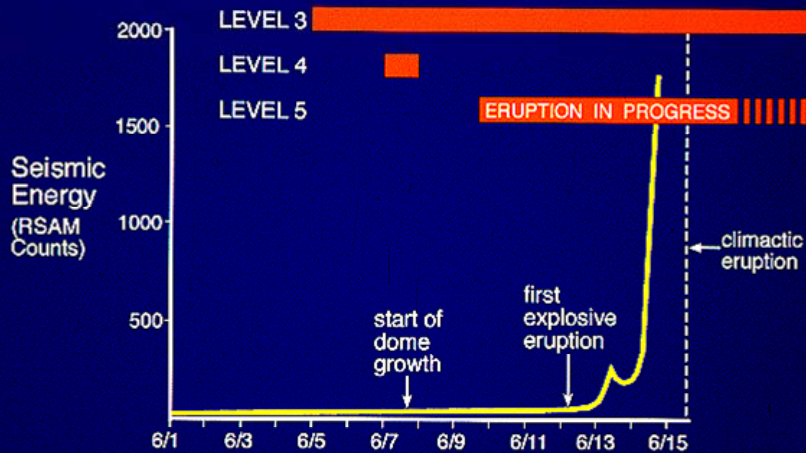
- Newly monitored precursors quite ordinary until VEI 3 eruptions had already begun!





# Pinatubo volcanic facts, cont.

MOUNT PINATUBO June 1991





# Pinatubo: Socio-economic facts

- Economy: Agricultural + US military
- Tense relation with the US bases, under re-negotiation at the time
- Complex politics, international (re: US bases), national (w/ NPA); local (3 provinces, 2 large independent cities);
- Isolated, indigenous Aeta population at highest risk
- General, widespread skepticism and unfamiliarity with anything volcanic

# Pinatubo: relationship, trust factors

- Good PHIVOLCS-National Civil Defense relation, but no prior scientist-civil defense relations at local level
- Scientist-US military relation was initially awkward because of Vietnam-era histories. Good advice from a colonel: convince the General with hard data. Gradually, one-day at a time, we built trust.
  - One seemingly small but important turning point- May 18 BBQ and beer
  - Another, during climactic eruption– Andy to Gen Studer
- Other networks of trust (UP-NPA, Aetas-nuns & pastors)
- Good cop/ bad cop (diplomatic/ blunt)

# Overcoming unfamiliarity and skepticism re: volcano

- Very strong, widespread initial skepticism. Expect it and attack it early and often, and from every angle you can imagine!
- Krafft video, especially clip of young girl trapped and shivering in Armero .... Highlighted even more by pyroclastic flows and Krafft deaths at Unzen, June 3
- Video was MUCH stronger than either maps or probabilities.

# Skeptics from Long Valley

- Geologists warned to “get out of town”
- Greatly improved after USGS-sponsored visit of Mammoth Lakes officials to their counterparts around Mount St. Helens
- Police chief met with police chief, engineer with engineer, doctor with doctor, etc.



# An unintended, helpful move

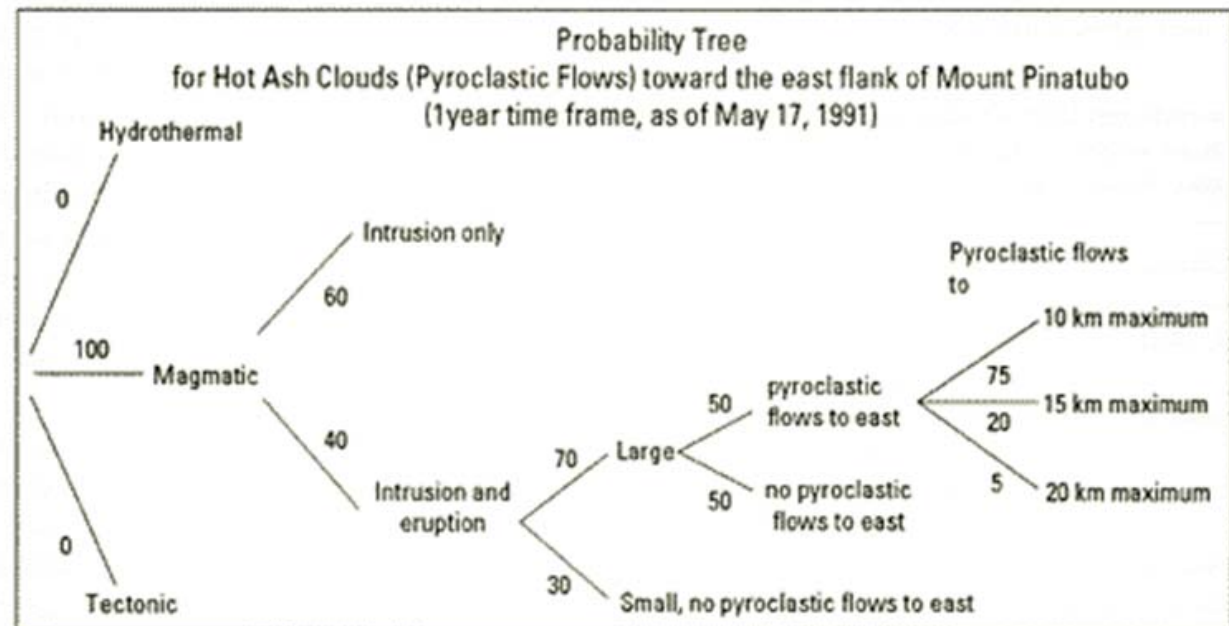


← To Pinatubo summit

**The 1<sup>st</sup> Pinatubo Volcano Observatory was near center of Clark Air Base. For safety, the team decided to move 5 km farther away from the volcano – to the far edge of Clark AB. This had the unintended effect of convincing USAF officials that the hazard was serious!**

# Did quantification of hazard and risk help?

- Key decisionmakers (Philippine NDCC, US military) understood probabilities
- First probability tree released May 17
  - Probability of pf onto Clark AB in “near future” ~ 3%
  - I worried commanders would find it too low; they judged it “too high”



# Use personal messages too!

## “Walk the talk”

- Decision-makers and the public are watching the scientists, for clues on their own discomfort
- Actions speak louder than words – e.g., scientists moving to safer ground, or not entering the risk zone
- Other things that work: body language, questions about willingness to expose oneself or family to risk

## Summary:

Quantified hazard and risk are very helpful for decision-making, but insufficient

Scientists must also:

- Help others judge their own risk tolerance by providing table of comparable, familiar risks
- Attack skepticism early and often, from all angles!
  - Show videos
  - Help decisionmakers meet their counterparts from previous volcanic crises
- Build personal relationships and trust with decisionmakers. Drink beer together.
- Convey risk in personal ways, in addition to the numbers, e.g., would you let your own family stay there?
- Where appropriate, estimate uncertainties. But don't get hung up on them. "Don't be such a scientist!"



# Even shorter summary:

- In addition to the best possible quantitative assessments of hazard and risk...
- Add PERSONAL touches that will really RESONATE, CONNECT with your audience