VOLCANO RISK WORKSHOP 2017

SUMMARY REPORT

May 31, 2017. Cascades Volcano Observatory, 1300 S.E. Cardinal Ct, Vancouver, WA

Introduction

The primary goal the workshop was to share the existing status of risk science and assessments for 13 high-risk volcanoes in FEMA Region X, by brining together stakeholders and participants from agencies, organizations and communities working on volcano risk and preparedness in the region. Participants included representation from the Cascades Volcano Observatory, Alaska Volcano Observatory (online), FEMA Region X, and Emergency Management Dept. from Regional Counties, USGS and UW Institute for Hazards Mitigation Planning and Research. (Refer to the appendix for list of all participants). FEMA Region X, and the UW Institute for Hazards Mitigation Planning and Research, with support from the USGS Volcano Hazards Program is producing a comprehensive risk awareness and assessment compendium to help local stakeholders plan for and educate their communities about their risk of losses from volcanic eruptions and what can be done to mitigate that risk. All attendees of this workshop are expected to review, comment and share feedback on the latest draft progress of this initiative. Online link for comments is posted on the website of UW Institute for Hazards Mitigation Planning and Research.

Format

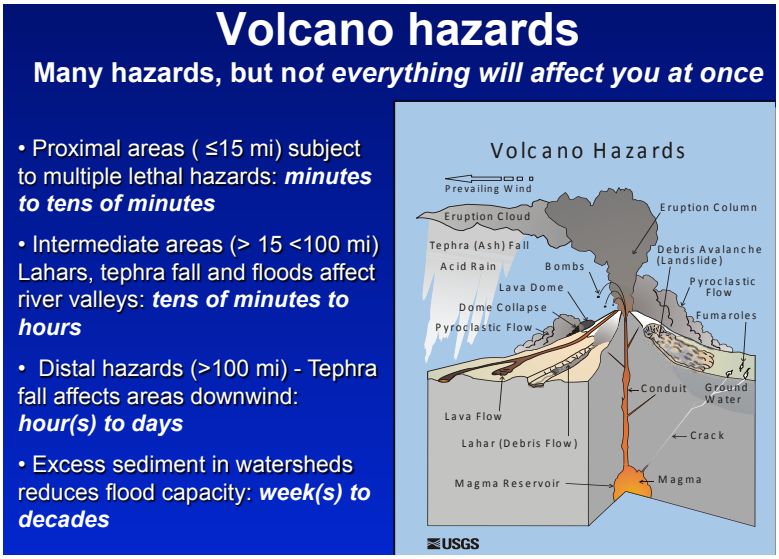
The full day workshop mainly comprised of two parts; knowledge building on Volcanic Hazards, Vulnerabilities and Risk, with presentations by expert speakers, and second part was a working session engaging all participants through a World Café format. This summary report is compilation of notes organized along the workshop format: Part 1 Understanding Volcano Hazards, Vulnerabilities and Risk, Part 2 Discussions from World Café Format.

Part 1: Understanding Volcano Hazards

Volcano Hazards

John Ewert, USGS

- While the volcanoes provide scenic and recreational destination, there is **little awareness of the fact that these are all active volcanoes** and can turn on us quite quickly. They will be affecting us downslope, outside of the national park areas.
- There are about **160 active volcanoes in the US. USGS Volcano Hazards Program (VHP) operates 5 volcano observatories**, Cascades Volcano Observatory (CVO), Alaska Volcano Observatory AVO, Hawaii Volcano Observatory (HVO), California Volcano Observatory (CalVO) & Yellowstone Volcano Observatory (YVO). Four strategic objectives of the VHP— **Volcano Monitoring,**



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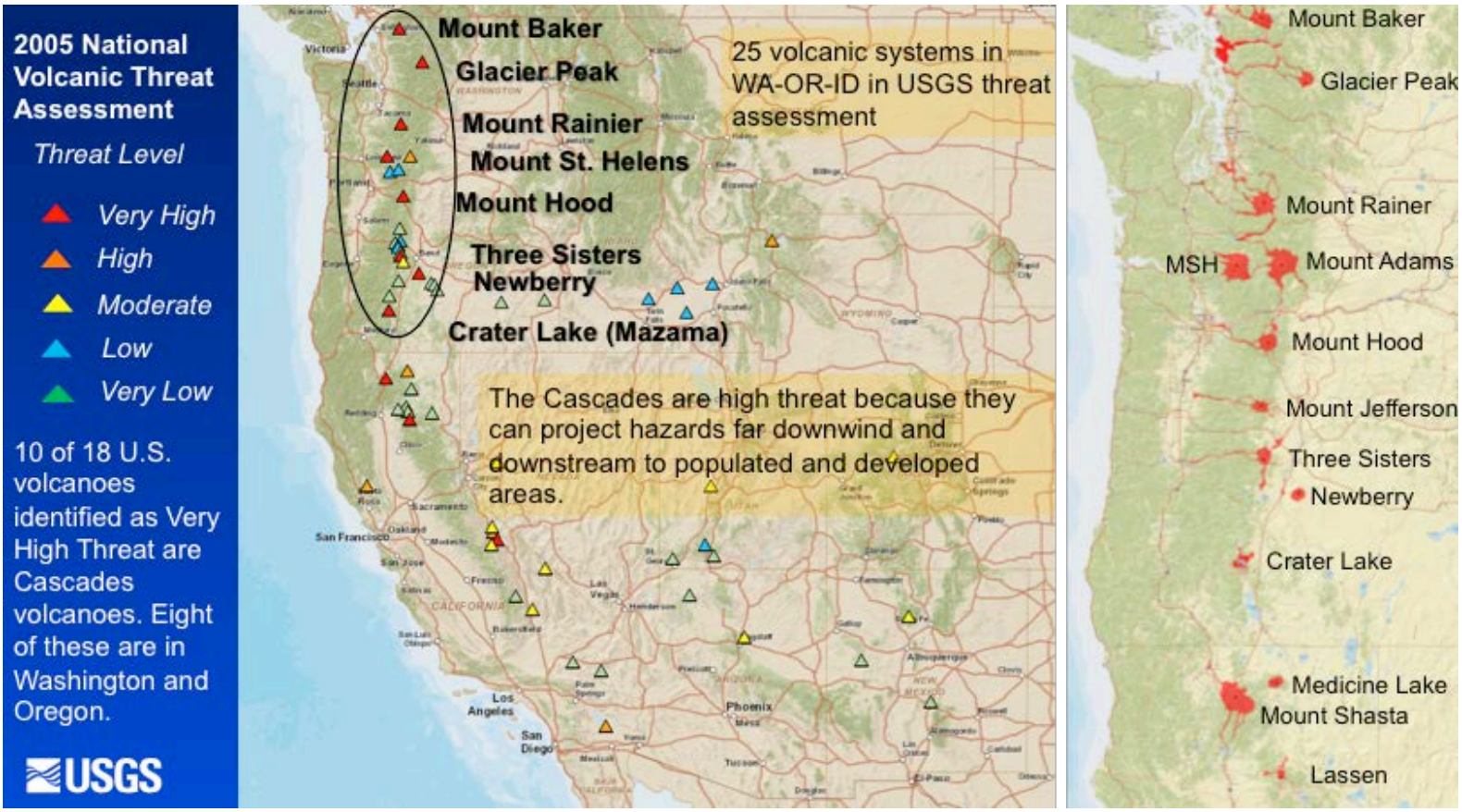


Hazards Assessment, Research, and Mitigation.

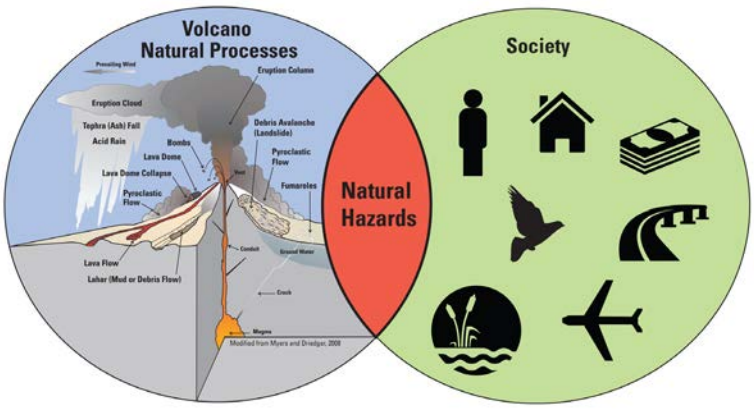
- **Volcano Hazards have different impacts with time**, ranging from minutes to weeks, years and even to decades.
- Small eruptions can have devastating consequences
- **Aircrafts are highly susceptible to volcanic ash cloud**s, can cause catastrophic failures. Ash fall can close down airports
- Explosive eruptions can have wide-ranging physical and economic impacts (2010 volcanic eruption in Iceland caused air traffic closure, estimated 10 billion dollars of loss)
- National Volcano Early Warning System (NVES) report, 2005 by USGS is guiding and prioritizing threat assessment for volcanoes
- **10 of the 18 very high threat volcanoes are in the Cascades**, since they can project effects far downstream affecting populated and developed areas. Alaska has 5 very high threat volcanoes that can majorly affect aviation.
- **190,000 population, 8800 business in WA state under Lahar footprints**
- USGS is trying to address **large gaps in monitoring capabilities.** Like Mt. Adams and Glacier Peak one seismic station each, Mt. Baker has 2 stations. Mt. Rainier monitoring needs improvement, OR volcanoes have better monitoring capabilities—Newberry volcano, Crater Lake and Mt. Hood. In AK, 30 volcanoes have relatively advanced monitoring, rest 50 have no monitoring.

Vulnerability and Risk

Nate Woods, USGS

- **Hazards are natural processes**
- **Vulnerability, Risk and Hazards are different**
- **Vulnerability/risk are context specific**, scale is a very important factor —People, economic (scale dependent), ecosystem
- Political will, and strong community networks are very important factors impacting community resilience.
- **Vulnerability tries to understand the system as a whole; helps understand the Adaptive Capacity of a community. Therefore more useful.**
- Volcano exposure studies to understand vulnerability.
- Need for further systematic study of demographic and economic sensitivity, and pedestrian and vehicular evacuation modeling.
- **Risk** is about "choice" ultimately. **Risk analysis includes probabilities and C-B analysis; it is more limited compared to vulnerability.**
- Vulnerability and risk analysis is critical in providing basis for understanding hazard responsive capabilities of targeted

Natural hazard: a natural event that threatens lives, property, and other assets



Characterizing hazard attributes to support risk reduction efforts

- Magnitude (small, large)
- Speed of onset (slow, fast)
- Duration (short, long)
- Frequency (rare, frequent)
- Temporal spacing (cyclical, random)
- Areal extent (limited, widespread)
- Spatial distribution (specific, random)

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Factors that influence vulnerability and risk

Natural and physical systems

- Engineering resilience (redundancy, robustness)
- Ecological resilience (functional adaptation)

Social systems

- **Demography** (age, gender, race)
- **Health** (physical abilities)
- **Psychology** (risk perception, individual psychology)
- **Social capital** (beliefs, culture, customs, social networks)

Economic and political systems

- Access to resources (e.g., information, technology)
- Risk tolerance
- Willingness and ability to pay for risk reduction
- Access to political representation

population, and provides strategic guidance on where more assessments are warranted.

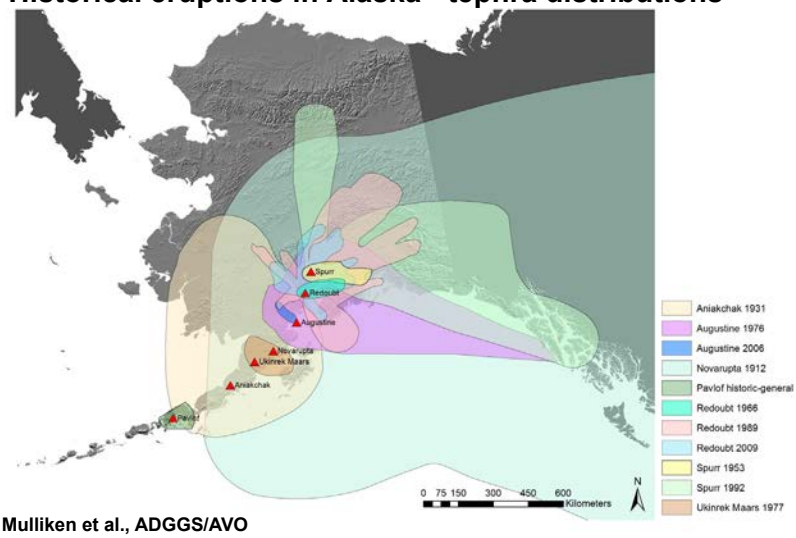
Volcano Risk Overview—
Ash, Lahars & Landslides, Pyroclastic Flows and Community Concerns

Volcanic Ash

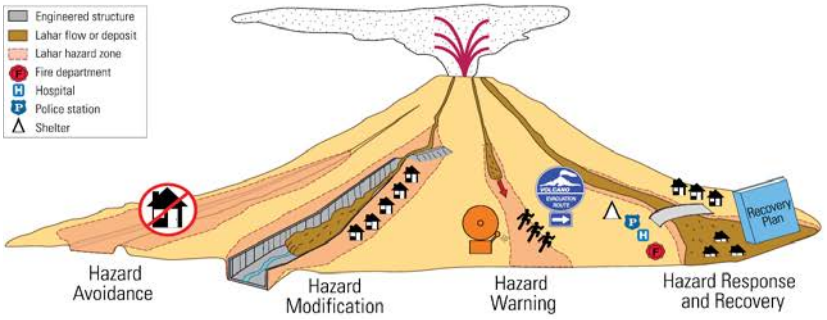
Janet Schaefer, ADGGS

- All detailed information and resources on ash fall hazards available on this webpage https://volcanoes.usgs.gov/volcanic_ash/
- **Volcanic ash is hard, very abrasive, chemically corrosive, electrically conductive, easily remobilized, can melt in jet engines, can block sunlight.**
- **Detail study** underway in AK of all historic Ash fall eruptions over last 200 years **to understand tephra distributions**.
- **Aviation sector is very vulnerable**, both air and ground ops.
- Mitigation measures for transportation include situational awareness, planning, avoidance, discouraging driving, and measures like checking, cleaning air oil filters, checking of engine

Historical eruptions in Alaska - tephra distributions



Mulliken et al., ADGGS/AVO



Types of Lahar risk reduction efforts

wear, washing windshields instead of wiping, etc.

- **Structural loading** can be a problem in cases of 4-5 inches of ash fall
- Most common are shoulder injuries during volcanic event, from people slipping or falling during cleaning.
- Ash fall can affect **public health**, particularly the respiratory system, cause eye irritation, poisoning, and causing social anxiety (this can be mitigated by educating the communities, sending out regular alerts, guidance and precautions pertaining to response in specific circumstances).
- **Surface water supply systems** are affected from asfall, including physical, chemical and supply issues (especially since water will be majorly used for cleaning purposes, affecting supplies). All these scenarios need to be planned for in advance
- **Waste water systems** are affected by ash fall, particular care needs to be taken for **ash disposal**.
- **Electricity and HVAC systems** affected by ash fall, cleaning after ash fall may require power shutdowns. Therefore monitoring and planning for fast response is critical for the power systems.
- **Telecommunications, IT systems** affected by ash fall, particularly phones, radios, GPS systems, laptops, indoor electronic items, etc.
- **Ash fall cleanup must be planned for well in advance**.
- **Ash detection/ tracking capabilities**: Satellite remote sensing, weather radar, citizen reporting and instruments like particulate collectors stationed in locations.
- **Communication** is a very critical aspect of ash fall hazard mitigation. People can signup online for email, web notifications for volcanic activities from AVO, National Weather Service (NWS), for ash fall forecast, advisories etc.
- **Insurance** for loss and coverage is not always aligned with volcanic hazards, especially the ones that continue over many years.

Wet Flow Hazards at Volcanoes: Lahars, Landslides and Sedimentation

Tom Pierson, USGS, CVO

- **Lahars** are highly destructive rapid, highly concentrated, gravity driven flows of rock, mud and water from volcanoes (2/3 solids, 1.3 water). **Looks almost like wet concrete.**
- Can flow faster than water on some slopes, upto 50 mi/ hr, upto more than 100 mi/hr
- **Volcanic Landslides move down as debris avalanches**. Occur when a choke of the volcano breaks loose and slide downstream. **Can turn into lahars**, once they start flowing. Flow at 100-150 mi/hr downstream. They are highly destructive.

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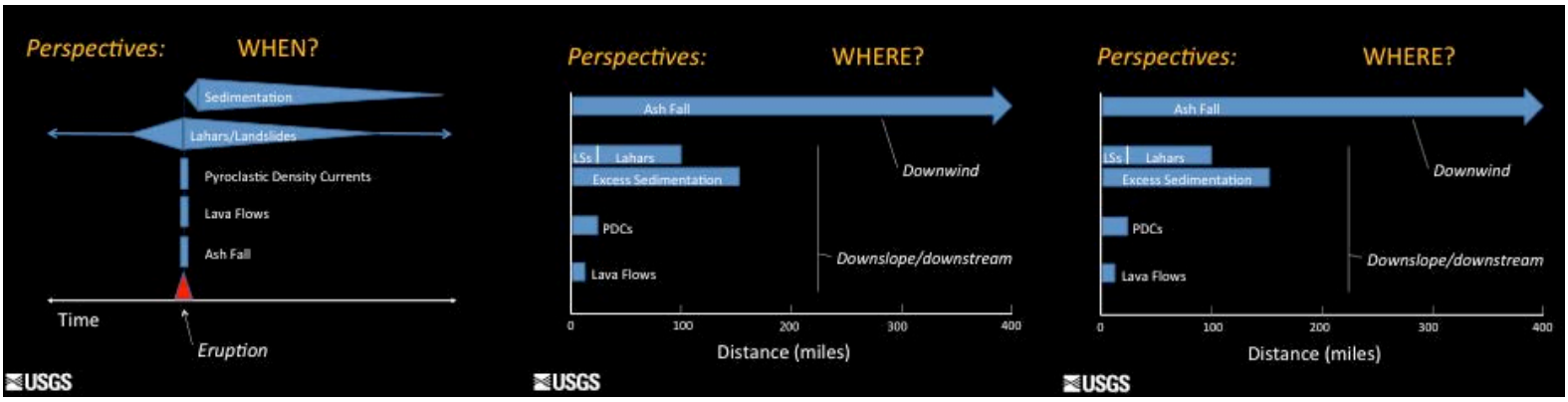
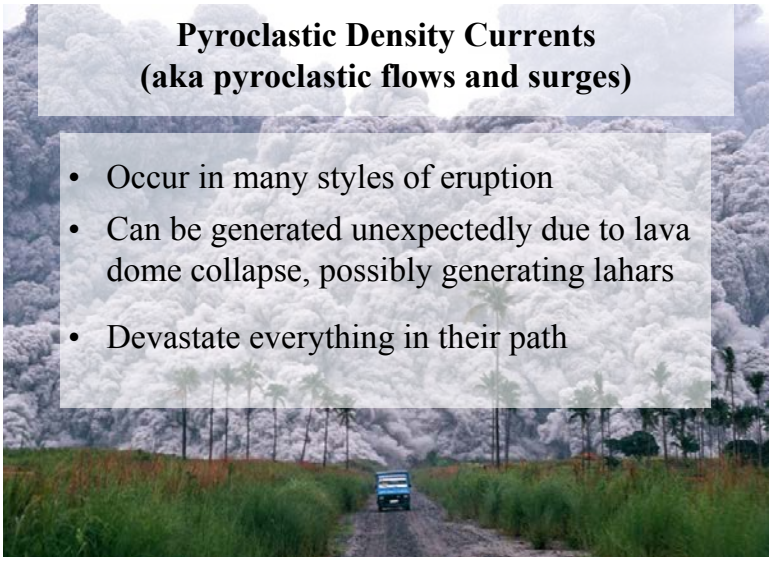


- **Excess Sedimentation in massive volume of sand and gravel is flushed downstream by rainstorms.** As a result, more sedimentation is dumped into a river than can be transported, and riverbeds aggrade (build up vertically). Can also occur over months and years
- **Time factor**: While ash fall, lava flows and pyroclastic density currents occur at the time of eruption, landslides can occur even before an eruption, and can go on for years after, sedimentation can start during an eruption and continue over long periods.
- **Distance factor**: Ash can flow long distances through downwind, LSs/Lahars and excess sedimentation can also flow through long distances downstream.
- **Catastrophe over relative scale**: Lahars and landslides can be very damaging, occurring at very high impact rate.
- **Small lahars occur relatively frequently**, big lahars occur less frequently.
- Community Exposure to Wet-flow Hazards in Region X: Due to the presence of highest number of high threat volcanoes, **Lahars threaten downstream communities at many Cascade volcanoes in Oregon and Washington**.
- Reference for **community exposure to Lahar Hazards study**: Diefenbach, A.K., Wood, N.J., Ewert, J.W., 2015, VariaHons in community exposure to lahar hazards from multiple volcanoes in Washington State (USA): Journal of Applied Volcanology, 4:4, doi 10.1186/ s13617-015-0024-z. This paper shows three of the volcanoes—Baker, Rainier, Adams have significant large volumes of altered rock in edifice. It is chemically altered, weakened, and is highly susceptible to failure.
- **Ways to reduce risks:** Hazard Avoidance (not always possible especially in inhabited areas), Modification (infrastructure engineering methods), Warning (Detect-Alert-Evacuate) and Response & Recovery (plan for search and rescue in extreme conditions, process of returning to normalcy) system in place.
- **One of the biggest recovery challenges can be insurance**—people who are displaced don't get any federal compensation until after the hazard event is over. Which means for hazard events like these volcanic eruptions that go on for years (unlike earthquakes), there is lack of mechanism for helping them financially.
- **Volcanic Tsunamis triggered by debris avalanches are a very big threat in areas like AK.**
- Suggestion to research "seasonality", in order to understand water systems, dam failures in different seasons. This information is helpful for facilities managers and emergency preparedness agencies.

Pyroclastic Density Currents (Pyroclastic flows and surges)

Brittany Brand

- Pyroclastic Density Currents (PDC) is the broad term that encompasses flows and surges.
- Pyroclastic essentially means "Ash," Pyroclastic Currents means that the ash is travelling. **PDCs are very destructive**.
- Term density is important, they are denser than the air because they have more ash and rock in them. PDCs will continue to travel for as long as they are denser than the atmosphere.
- **PDCs as they travel get very turbulent, sucking ambient air and thickening in the process**. Heavy material is down in the base, and upper part is ashy gas. Ash and rock will fall out reducing the density, eventually when it becomes less dense as it continues to travel down the sediment load decreases. **Ending up in hot ash and gas lifting up in sky, causing ash fall.**
- 1980 eruption at Mt. St. Helens had a big pyroclastic eruption, triggering number of smaller eruptions, some continuing into following months
- Column collapse-- discrete eruptions or Lava dome collapse can produce pyroclastic flows.
- Lateral blast produce pyroclastic flow, like in Mt. St. Helens, releasing the magma beneath the surface in high pressure, erupting out laterally (instead up in sky)
- Smaller ones can be confined to drainages
- Hazards associated with pyroclastic flows are pretty narrow in



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extent (?), at most **affect areas within tens of kilometers**.

- Most famous example of extreme impact is Pompeii, Italy suffocating people.
- Dome eruptions can happen after tens of years
- **Mt. Hood is susceptible, will produce lahars**.
- PDCs can generate lahars, devastating everything in their path.

Community Concerns

Jason Biermann, Snohomish County Emergency Management

- **Snohomish County has one of the highest increasing population projections.** Volcano is one of the major hazards in this county. People migrating to the region have no idea that there is a volcanic mountain.
- **Challenge is to educate the community and business, and not scare them off.**
- Tourism, logging along Skagit, other business and communities are at risk.
- OSO landslide that caused 1 sq mile of debris flow killed 43 people. Nearly ended town of Darrington, months spent in recovery, still ongoing.
- In Snohomish Country **15,000 people live in lahar zone, 5000 structures and about 1.2 billion dollars in infrastructure.**
- **Regional approach and perspective is critical**, these are all macro level hazards that affect cross-regions. For example, Snohomish County is part of Homeland Security Region1, part of Skagit county, San Juan County and Island County, Mt. Baker Part of Whatcom County; part of Urban Area Security Region. **All interconnected systems in the region, we are remiss if we don't look at these as macro level problems.**
- How we get the information on risk and vulnerability out to the growing community is a big challenge—raise awareness, effectively tailor educate diverse demographics
- Challenge to have Policy makers address macro level issues
- Challenge is to create a coherent strategy that addresses all phases of emergency management (recovery can take decades)
- Another challenge is to **develop collaborative cross-jurisdictional and cross-disciplinary relationships**.
- Opportunity for increased collaboration, bring tribal communities on the table. Challenge is taking all the information, translation of science to lay audience is needed (Scott Heinze, Pierce County EM)
- **Need for Comprehensive Vulnerability Maps** that look at overall vulnerability—social, physical and economic. These will help understand interdependencies.

Part 2: Workshop Session Discussions

World Café working session was organized along same four thematic groups of Volcano Risk, alongwith the online working group from Alaska.

Handout distributed to all participants by FEMA for inputs called the **Volcanic Event Core Capability Crosswalk exercise**. Each participant is requested to review and respond to this exercise.

Alaska Group

- 12 participants focused on Ash Hazards and Community Response
- 5 very high threat volcanoes in AK, amongst several other active volcanoes that also need attention. Therefore in AK, volcano assessment needs to be more flexible.
- **Two basic kinds of volcanoes—Urban** (e.g. Spurr, Augustine and Redoubt that affect Anchorage, South Central AK) **& Remote/ Rural volcanoes**. Impacts for urban volcanic events are different from rural volcanic events.
- Information products/ handouts developed must be improved and vetted by **engaging the local community members** (for language, legibility, including tribal groups, additional missing information)
- Akutan and Makushin volcanoes are not just near communities but also near major ports and fish processing plants with large, diverse and transient population. These groups also need to be engaged while vetting information products.


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(Bill Steele)

- Issue of **engaging and outreach of tribes**.
- **Radius of Risk**: Each individual volcano has a radius of risk; they need to be carefully and individually recognized (Comments for edits on the draft products for communities identified "at risk").
- **Ash is a big hazard in AK region**, both airborne and on ground. Critical vulnerability for not just aviation but also for all the local communities. Especially since most of the communities are off the road-systems, impacting critical infrastructure for getting supplies in and out.
- In terms of information products, suggestion of "one stop shop" for communities, emergency managers, aviation, like a webpage. Importance of information flow between different groups, communities and agencies.

Volcanic Ash

- Discussion concentrated on Cascades volcanoes
- Discussed about kind of information needed: where to get information, advisory, public health, social media, social networks, etc.
- **Identified need to customize information products for target audience.** Specific parts of the society need to know specific things about ash fall, like the specific infrastructure categories or health sector, etc.
- Communities must have access to translated messages in advance in key languages spoken in the region, as it is difficult to get translated material in an emergency.
- Need to identify specific ash fall concerns with different volcanoes versus the general concerns of volcanoes (Bob F.).
- **Explaining likelihood of ash fall in the community is complicated**, attempted to do this for Pierce County and Snohomish County. This information has to be explained in 2 steps—1. What is the type of eruption and how likely, 2. What is the likelihood of ash falling in the community that you care about. This was found to be useful, for example for Tacoma to understand they had 1% chance of ashfall, versus Everett has more than 1% chance. This nature of information is helpful for the communities, but the challenge is information/ number accuracy and diluting for public information legibility. It could be more helpful to understand relative risk, probabilities of occurrence, through a community centric perspective (Seth M.).
- Understanding priorities of threat for particular communities, and getting this information across is important. What the community does or how it responds to that information is their decision. Need to explain to the communities about the **"consequences of not acting"** (Nate W).

Lahars and Landslides

- The group discussion concentrated primarily on the Cascades region, mainly WA volcanoes with some discussion on OR volcanoes. WA volcanoes are generally taller, have snow and ice on them, which is critical in generating Lahars.
- **Hydrothermal alteration across most of the mountains pose common hazard, can produce big lahars.**
- Critical issues specific to volcanoes: Mt. Baker has 2 hydropower reservoirs at the base of the volcanoes, raising **concerns about how these reservoirs should be managed at time of an event (dam drawdowns timing)**. Flooding from release of water could impact downstream communities, therefore timing and planning for dam drawdowns is critical.
- In OR, Lahar issues are less, **critical highways will be affected by lahars**. Crater lake has negligible risk of lahars because of the geometry and depth of the volcano, and lack of infrastructure and population living in its proximity.
- **Lack of contingency plans for infrastructure and operations** affected, like fisheries, oil refineries, and port operations.
- **Lack of trust in education**, where some communities may not trust the education efforts or ignore warning information. Identifying and targeting these community groups is critical.
- Discussions about **innovative and alternative education models**, interesting proposition of a virtual reality model that lets people experience the level and areas of impact in their vicinity.
- **Need for scenarios**: it would be effective for communities to have scenarios written out ahead of time taking into account different magnitude of eruptions. Use of a story format to explain these scenarios in a step-by-step manner. People are known to respond better to stories. Sharing personal accounts of survivors

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can be very effective. Story telling can be very effective and strong strategy, using the town names, with more specifics. Also in video format.

- **Social acceptance of gaps** can be an issue. For example some schools or institutions refuse to publicize information that they have gaps or they are at high hazard threat. As a result limiting information to the public, eventually inhibiting the stimulus to take measures. There is a collective need to share this information on gaps with the public, in a responsible way.

Pyroclastic Flows

- **Pyroclastic flow hazards** can be of two types, **direct or indirect**. Most of the volcanoes under discussion are capable of producing direct pyroclastic flows.
- Volcanoes have different levels of infrastructure and communities that will be affected.
- There is a need to understand specific volcano hazards, hazard extent and communities that will be affected by direct impact. Also, systems that will be affected by indirect or secondary impact of pyroclastic flows. For instance, pyroclastic flows that accumulates in drainages and remobilized after a volcanic event, creating lahars and increased sedimentation in rivers.
- **Impacts**: Tourism, recreation, hiking activities will be affected. Evacuation plan and forecast plans are needed, depending on seasons and timing of the year (scenarios?)
- **Long-term displacement issues** for communities displaced around various uncertainties.
- **Capabilities**: most of the volcanoes have good documentation of geologic histories, which are helpful.
- Other capabilities that exist are search and rescue operations; also the national parks currently do a great job of informing visitors about volcanoes, acting as important education centers.
- **Gaps**: improved monitoring needed for many volcanoes
- Most of the communities have hazard mitigation plans, but **lack vulnerability analysis.**
- **Spirit lake tunnel can be greatly impacted,** pyroclastic flows entering Spirit lake tunnel are capable of producing small tsunamis. Pyroclastic flows can block the tunnels, affecting downstream communities including the emergency response team.
- There is an **increased need for cultivating relationships, not just between communities, but also experts.** This requires a lot of time and effort that needs to be accounted and planned for. Need to build trust, and creating a culture of collaboration of the experts and scientist with the communities through interaction and active learning methods.
- Need for getting information through classrooms to the K-12 groups, in the hope that kids will teach their parents.

Community Concerns

- **Hazards are regional** hazards, not single jurisdictional events.
- Need to **address interdependencies**, for e.g. impact on Port of Tacoma would mean impact on food supply to far off regions.
- Gaps: Communities are unique, therefore they **need uniquely tailored messages**. One approach could be to identify and train trusted agents of the communities. Need to develop capability of **working with trusted community agents**. Marketing strategy of advertising through agents of the communities would have to be developed, that can reach out to the communities and work with both sides including the agencies.
- How do you **capitalize on communities that are prepared**, can they be **incentivized**? Some communities are "ready"; some communities are "deniers". At the same time there are business communities that don't want to put out hazard information as it is seen as detriment to projects. Also, tribal communities need uniquely tailored methods for information sharing. Messages need to be tailored and bridged across to all communities.
- There is a **disconnect of terminologies** used between scientists, stakeholders and lay folks. Information needs to be made understandable. Teams must be put together from cross functional and cross- jurisdictional groups to vet information packets developed from USGS, tailored from end user perspective.
- How do we "modulize" (customize or make specific) s**ector specific impacts** (not only the messaging)?
- Discussions on role of municipalities in building permitting processes.

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Agenda

VOLCANO RISK WORKSHOP

Cascades Volcano Observatory
1300 S.E. Cardinal Ct, Vancouver, Washington

PROGRAM

9:00am – 9:30am	Continental Breakfast
9:30am – 9:45am	Welcome by Dr. Himanshu Grover Co-Director Institute for Hazard Mitigation Planning and Research Welcome by Dr. Seth Moran, Scientist in Charge CVO
9:45am – 9:55am	Volcano Hazards (Speaker: John Ewert)
9:55am – 10:15am	Vulnerability and Risk (Speaker: Nate Woods)
10:30am – 11:15am	Risk Overview Ash (Speaker: Janet Schaefer) Lahars and Landslides (Speaker: Tom Pierson) Pyroclastic Flows (Speaker: Brittany Brand)
11:15am – 11:25am	Break
11:25am – 11:40am	Community Concerns (Speaker: Jason Biermann)
11:40am – 12:30pm	Introduction to Cafe' Discussion Format and Lunch
12:30pm – 01:00pm	First round Cafe' Discussion
01:00pm – 01:30pm	Second round of Café Discussion
01:30pm – 02:00pm	Third Round of Café Discussion
02:00pm – 02:30pm	Final round of Café Discussion
02:30pm – 03:30pm	Summary presentations by each group
03:30pm – 04:00pm	Wrap-up

Attendees list

Name	Organization
Corina Forson	Dnr.wa
Chass Jones	Department Homeland Security Oregon District
Jay Wilson	Department Of Emergency Management, Clackamas County
John Ewert	U S Geological Survey
Carolyn Driedger	U S Geological Survey/ Cascades Volcano Observatory
Peggy Lovellford	Department of Emergency Management, Pierce County
Frances Burkhart	Whatcom County Emergency Management, Bill Elfo, Sheriff
Russell Wilstead	USDA Forest Service, Cowlitz Valley Ranger District
Thomas Pierson	USGS, Volcano Science Center, CVO
Brittany Brand	Boise State University
Jason Biermann	Snohomish County, Emergency Management
Nancy Bush	Department Of Disaster Management, Clackamas County
Dan Douthit	Portlandoregon
Pat Donovan	City Of Puyallup
Seth Moran	USGS, CVO
Jim Jaques	East Pierce Fire & Rescue
Celia Taylor	Department of Emergency Management, Pierce County
Wendy Freitag	University Washington
Rene Renteria	Forest Service
Ian Madin	Department Of Geology And Mineral Industries
Ernie Schnabler	Cowlitz County Sheriff's Office
James White	US Army North DCE Region X
Bryant Harrison	Department Homeland Security
Stacy Bernash	Department Homeland Security
Casey Beene	US DHS, Federal Emergency Management Agency
Lorrie Pahl	Idaho Office Emergency Management
Chris Strebig	Giford Pinchot National Forest
Andrew Kinney	EMERGENCY SERVICES Emergency Management, Thornton County
Bob Freitag	University Washington
David Bright	NOAA/NWS Portland
Laura Bruno	Regional Disaster Preparedness Organization
Mea Edmunds	University Washington
William Ekse	Snohomish County Office of Emergency Management
Peter Forbes	USFS Mt. Baker- Snoqualmie NF
Peter Frenzen	MSH National Monument
Zanr Gibson	City of Orting
Scott Heinze	Pierce County
Himanshu Grover	University of Washington
Jonna Papaefthimiou	Portland EM
Connie Lewis	Seattle Dept. of Labor and Industries
Althea Rizzo	OR Emergency Management
Janet Schaefer	Alaska Division of Geological & Geophysical Surveys
Bill Steele	University of Washington
Brian Terbush	WA Emergency Management
Nathan Wood	USGS