NAS Board on Earth Sciences and Resources
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Volcano Hazards Program

**Mission:** The Volcano Hazards Program (VHP) enhances public safety through forecasts and warnings of volcanic activity.

**Core Responsibilities:** Hazard assessments, monitoring of potentially active volcanoes, research and communication.

**Impact:** We give people time to prepare. Information to increase their resilience, and reduce their vulnerability.

Kelly Reeves, Alaska Airlines
Hawaiian Volcano Observatory monitors Hawaiian volcanoes, recent Centennial anniversary in Jan. 2012

Alaska Volcano Observatory monitors Alaskan and CNMI volcanoes

Cascades Volcano Observatory Monitors WA, OR, ID volcanoes

California Volcano Observatory monitors CA and NV volcanoes, as of February 2012.

Yellowstone Volcano Observatory, YNP, ID, NM, AZ, CO, UT

Volcano Science Center in Menlo Park, CA
Volcano Disaster Assistance Program
Working “behind the scenes” in the developing world since 1986

- 28 major crisis responses
- Infrastructure in 12 countries

(FY-03-11): 53 infrastructure missions, 14 crisis responses, 15 countries
Volcano Monitoring

Fortunately, volcanoes exhibit precursors typically weeks to months before eruption, though some that erupt often can be reactivated quickly (hrs. – days).

Precursors include:

- Volcano deformation
- Changes in snow or ice cover
- Increased seismicity
- Changes in gas emanation
- Anomalous high temperature pixels in TIR remote sensing imagery
- Changes in groundwater and stream geochemistry

Ground-based instrumentation is crucial for detection of unrest at the earliest stages. All data available are utilized.
### Recent Unrest and Eruption Lead Times

<table>
<thead>
<tr>
<th>Eruptive Event</th>
<th>Lead Time</th>
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</thead>
<tbody>
<tr>
<td>Mt. St. Helens 2004-2006</td>
<td>1 week</td>
</tr>
<tr>
<td>Augustine 2006</td>
<td>6 months</td>
</tr>
<tr>
<td>Kasatochi 2008</td>
<td>2 days</td>
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<tr>
<td>Okmok 2008</td>
<td>62 minutes</td>
</tr>
<tr>
<td>Redoubt 2009</td>
<td>5 months</td>
</tr>
<tr>
<td>Kilauea, Kamoamoa 2011</td>
<td>24 hours</td>
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</tbody>
</table>

Eruption forecasting requires ground-based instrumentation on active volcanoes
USGS National Volcano Early Warning System (NVEWS)

• Consists of the volcano monitoring and notification systems and expertise at five volcano observatories and federal and state partners

• NVEWS guides strategic long-term improvements to monitoring infrastructure and volcano hazard information products and services

• Assures that volcanoes are monitored at levels commensurate with their threat, very high threat to high threat volcanoes will be the focus in near term

• NVEWS seeks to make all observatories interoperable with redundant data access and ability to tap scientific expertise from multiple locations with a standardized suite of analytical tools

• NVEWS must be adaptable to newly developing monitoring technologies that may be more cost-effective in long-term
Alaska Volcano Observatory

*Volcano Hazards
* Monitoring and Communication

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U.S. Department of the Interior
U.S. Geological Survey
52 Historically active volcanoes
Primary hazard: ash clouds, ash fall

- More than 100 volcanoes from Alaska to the Kuriles
- 5-6 explosive eruptions per year
- Ash reaches altitudes to be of concern to aviation 10-12 days per year
Proximal Hazards: lahars, PDCs
Volcano Monitoring Program - 2014

DATA STREAMS:

- Seismology
- Continuous & Campaign GPS
- Remote Sensing, Satellite
- Webcams
- Airborne gas, FLIR
- Infrasound/pressure
- Lightning
- Geology
- Water sampling

Seismic Stations in Alaska

Red = AVO, Yellow = AEC, Purple = WCATWC, Black = GSN
Interagency Coordination: critical

- NOAA/NWS, FAA, AFWA, state and local agencies use Volcano Observatory alerts to inform their formal warning messages
- Alerts via telephone contact with key agencies immediately and internet text message by subscription
- Written interagency plans document this communication process with an emphasis on consistent messaging
### Volcanic Activity Notice

**AVO/USGS Volcanic Activity Notice**

**Volcano:** Redoubt (CAVW #1103-03-)

**Current Volcano Alert Level:** WARNING

**Current Aviation Color Code:** RED

**Issued:** Saturday, April 4, 2009, 6:51 AM AKDT (20090404/1451Z)

**Source:** Alaska Volcano Observatory

**Notice Number:** 2009/A33

**Location:**
- N 60 deg 29 min W 152 deg 44 min
- Elevation: 10197 ft (3108 m)
- Area: Cook Inlet-South Central Alaska

**Volcanic Activity Summary:** Another significant explosive event occurred at Redoubt Volcano at approximately 5:58 am AKDT (13:58 UTC). At this time, the cloud height is estimated to be 50,000 feet based on National Weather Service radar. The cloud is drifting to the southeast of the volcano. AVO seismometers indicate a lahar has developed in the Drift River Valley.

### Ashfall Advisory

**URGENT - WEATHER MESSAGE NATIONAL WEATHER SERVICE ANCHORAGE AK 628 AM AKDT SAT APR 4 2009**

**WESTERN KENAI PENINSULA- INCLUDING THE CITIES OF ...KENAI... SOLDOTNA... HOMER... COOPER LANDING 628 AM AKDT SAT APR 4 2009**

...ASHFALL ADVISORY IN EFFECT UNTIL 10 AM AKDT THIS MORNING...

**THE NATIONAL WEATHER SERVICE IN ANCHORAGE HAS ISSUED AN ASHFALL ADVISORY WHICH IS IN EFFECT UNTIL 10 AM AKDT THIS MORNING.**

**REDOUBT VOLCANO ERUPTED AROUND 600 AM THIS MORNING AND THE ASH CLOUD IS MOVING TO THE SOUTHEAST. MINOR ASHFALL CAN BE EXPECTED FROM NINILCHIK SOUTHWARD THROUGH MID MORNING.**
Principal challenges

- Distance, remoteness, cost of access
- Power system limitations
- Telecommunications
- Harsh environment, weather
- Few mature alarm systems
- Availability of synoptic monitoring data (satellite) with high temporal/spatial resolution
- Increasing data management, IT and computer science load
Looking ahead

- *VolcView* satellite analysis tool; new satellite data sources
- New ‘remote’ monitoring tools with more synoptic views: infrasound, InSAR, lidar, radar
- Smaller, more nimble instrument packages
- Integrated alarm systems
- Fuel cell, wind, and other power system improvements
- Physics-based model development and dynamic hazard assessments using monitoring data
- More collaborative efforts to share remote field site installations (multi-purpose, e.g. climate monitoring)
- Unmanned aerial systems?