Growth of International Collaboration in Monitoring Volcanic Ash Eruptions in the North Pacific

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U.S. Geological Survey
The northern Pacific “Ring of Fire” is a dangerous place

Kodiak, Alaska, 1964

Sarychev, Kurils, 2009

Tohoku, 2011
Recent Lessons

• Extreme geophysical events have international impact.

• Even the most capable countries need help sometimes.
VIEW FROM VESUVIUS TODAY:
We are becoming much more vulnerable
Hyogo Framework for Action

• Priority Action 1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.

• Priority Action 2: Identify, assess and monitor disaster risks and enhance early warning.

• Priority Action 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

• Priority Action 4: Reduce the underlying risk factors.

• Priority Action 5: Strengthen disaster preparedness for effective response at all levels.
This paper: Volcanic ash hazard to aviation
Priority Action 1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.

- A crisis opens a window of opportunity to prepare for the next event.
December 15, 1989: Anchorage, Alaska

- KLM 747 landed safely after in-flight failure of all four engines
- Melted ash on turbine blade
Since 1973, there have been ~125 encounters of aircraft with volcanic ash clouds reported worldwide. 60% involved aircraft damage, including ten incidents of in-flight engine flame out.
Priority Action 2: Identify, assess and monitor disaster risks and enhance early warning.

• Understanding the problem and focusing the resources.
Cost of encounters

- Cost of an engine inspection is ~$30k.
- Cost of complete engine overhaul is ~$3M.
- Cost of an engine replacement >$10M.
- Possibility of loss of aircraft, passengers, and crew.
Until Eyjafjallajokull, no one realized that volcanic ash could cause an international financial disaster
April 17, 2010

What’s wrong with this picture?
Mitigating the ash risk to aviation over Alaska:

• Even remote volcanoes under active air routes should have monitoring networks because satellites detect an eruption only after the hazard exists.
• Warnings are not enough: they must be delivered in the right way at the right time through an established relationship—i.e., they must be actionable.
• Much of the ash on the North Pacific air route comes from Russian volcanoes.
Cooperation with Russia

- **Ash clouds:** More than 20,000 passengers/day transit the northern Pacific where ash frequently reach flight levels.

- **RFE volcano observatories:** Russian scientists, assisted by USGS colleagues, established the Sakhalin Volcanic Eruption Response Team (SVERT) and Kamchatka Volcanic Eruption Response Team (KVERT).

- **Warnings to airlines:** AVO, KVERT, and SVERT work closely together to detect volcanic activity and provide air carriers with timely ash warnings.
Volcanic Ash Advisory Centers (VAACs)
Where Network Funds Go

- Aviation needs – helicopter and fixed wing support
- Logistics – Shipping, freight, transportation
- Instrumentation, batteries, solar panels, etc.
- Data processing
• Priority Action 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
• Priority Action 4: Reduce the underlying risk factors.
Warning

If you inadvertently enter a Volcanic Ash Cloud:

Indications:
- Smoke or very fine dust in cabin
- Acrid odor (like electrical smoke)
- Low airspeed indications
- Cargo fire warnings (caused by Volcanic Ash triggering smoke detectors)
- Static discharges (St. Elmo's Fire) around windscreen or on wing/stabilizer/fin tips
- White glow (searchlight effect) shining out of engine inlets
- Multiple engine malfunctions (increasing EGT, power loss, stall or flame out)

Your weather radar will not detect volcanic ash clouds.

General Recommended Pilot Actions:
- Exit Ash Cloud as quickly as possible (180 degree turn)
- Do Not Attempt to Climb Out of the Ash Cloud
- Auto-throttle............................................Disconnect
- Throttles..................................................Minimum
  (Terrain permitting)
- Ignition....................................................On
- Bleed air systems.................................Full on
  (Air conditioning, engine and wing anti-ice, etc.)
- APU (If available).................................Start
- Engine EGT limits....................................Monitor
- Engine re-start........................................If Required
- Airspeed and pitch attitude........................Monitor
- Crew oxygen masks (If required)...............On/100%
- Transmit Special Air Report of Volcanic Activity
- Land at the nearest suitable airport

Note: Consult your Aircraft Operating Manual for specific procedures.
EXPLORE the United States volcanoes.

www.volcanoes.usgs.gov
(1) VOLCANO OBSERVATORY NOTICE FOR AVIATION (VONA)

(2) Issued: 20120218/2211Z
(3) Volcano: Kanaga (CAVW# 1101-11-)
(4) Current Color Code: YELLOW
(5) Previous Color Code: green
(6) Source: Alaska Volcano Observatory
(7) Notice Number: 2012/A3
(8) Volcano Location: N 51 deg 55 min W 177 deg 9 min
(9) Area: Aleutians Alaska
(10) Summit Elevation: 4288 ft (1307 m)
(11) Volcanic Activity Summary: Possible explosive activity and a likely ash cloud indicate new unrest at Kanaga Volcano. AVO is increasing the Aviation Color Code to YELLOW and the Volcano Alert Level to ADVISORY.

Volcanic tremor was detected from 15:23-15:27 UTC (6:23 AM AKST) followed by numerous small events for about an hour at Kanaga Volcano. A possible weak ash cloud was also detected in AVHRR satellite data from 15:35 UTC about 39 km (24 mi) NE of the volcano.

This new unrest indicates a possibility for sudden explosions of ash to occur at any time, and ash clouds exceeding 20,000 feet above sea level may develop. If a large, explosive, ash-producing event occurs, the local seismic network, satellite ash alarms, infrasound, and volcanic lightning will alert AVO to the new activity.

(12) Volcanic cloud height: Unknown
(13) Other volcanic cloud information: Unknown
На предстоящую неделю от 20 февраля 2012 г.

На Камчатке и Северных Курилах (о. Парамушир и Атласова) находится 36 активных вулканов. KVERT проводит ежедневный мониторинг вулканов с 1993 г.

Камчатка:

Вулкан Безымянный
Авиационный цветовой код: Оранжевый

Активность вулкана постепенно повышается. Сильное эксклюзивное извержение вулкана с подъемом пепловой тучи до 13 км н.у.м. возможно в течение следующих 2-х недель. Аэрозольные и пепловые шлейфы могут представлять опасность для полетов по международным и местным авиалиниям.

Вулкан Шивелуч
Авиационный цветовой код: Оранжевый

Эксплозивно-экструзивно-эфузивное извержение вулкана продолжается. В любое время возможны пепловые выбросы выше 10 км над уровнем моря. Аэрозольные и пепловые шлейфы могут представлять опасность для полетов по международным и местным авиалиниям.

Вулкан Кизимен
Авиационный цветовой код: Оранжевый

Эфузивное извержение вулкана продолжается – мощный вязкий лавовый поток выжимается на его склон. Пепловые выбросы до 8-10 км н.у.м. возможны. Аэрозольные и пепловые шлейфы могут представлять опасность для полетов по международным и местным авиалиниям.

Вулкан Карымский
Авиационный цветовой код: Оранжевый

Эксплозивное извержение вулкана продолжается. Существует опасность пепловых выбросов выше 6 км над уровнем моря. Аэрозольные и пепловые шлейфы могут представлять опасность для полетов по местным авиалиниям.

Вулкан Горелый
Авиационный цветовой код: Желтый
Priority Action 5: Strengthen disaster preparedness for effective response at all levels.
Beyond Geo-Hazards:

“Since we’re neighbors, let’s be friends”
Japan-Kamchatka-Alaska Subduction Processes Workshops

A trilateral geohazard science community rotates meetings ~biennially through Kamchatka, Alaska, Hokkaido

7th Meeting: Kamchatka, 25-30 August 2011
Next: Hokkaido 2014!
University of Alaska Fairbanks and Kamchatka State University announce:

**International Volcanological Field School**

GEOS 495/695, 3 credits UAF, Summer 2010

**Session A:** June 6-19 - field trip to Katmai National Park, Alaska

**Session B:** August 6-19 - field trip to Mutnovsky and Gorely volcanoes, Kamchatka, Russia

**Objectives:**
- Understanding basic processes of physics and chemistry through direct examination of active volcanic phenomena.
- Knowledge of the eruptive behavior of volcanoes and resulting products.
- Experience with different cultures and languages, and with the conduct of scientific field work in a harsh environment*
- Introduction to techniques of geology, geochemistry, and geophysics.
- Introduction to a wide range of volcanic phenomena and research opportunities in the North Pacific subduction region.
- Discussion of current controversies and themes in volcanology.

* Students must be in good health, be capable undertaking long, strenuous hikes carrying substantial loads, and be willing to camp under primitive and remote conditions.

For further information and application forms (US students): www.uaf.edu/geology

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US-Russia partnership in volcano research
RAS – NSF - USGS

Russian-American volcano twins

Before

After

Bezymianny    Mt St Helens

• Joint field team installing seismic/GPS station on Bezymianny
Which is a better way to study Aleutian subduction?

A. 

B. 

If your answer was “B”, you are correct.
Bi-Presidential (Obama-Medvedev) Commissions

• Science and Technology: MES, RAS, NSF, USGS

• Emergency Situations: FEMA, EMERCOM

• Why not create a working group or agreement on Geo-Hazards?
Reasons for a bilateral working group and agreement

• High-level attention (P.A. #1)
• Identify most promising areas for collaboration.
• Resolution of obstacles to cooperation (e.g., data, sample, site access, permitting)
• Facilitate broad participation through government endorsement (“What I want to do is part of…”)
US-Russia Geo-Hazards Workshop: Linking Geo-Science and Technology with Management of Emergency Situations

Leaders: MES+RAS and USGS+NSF
EMERCOM and FEMA

Others: ROSHYDROMET AND NOAA
ROSCOSMOS AND NASA

MOSCOW, JULY 17-19, 2012
Outcomes?

- Expansion of monitoring networks
- Joint geo-hazards research
- Sharing experiences and identifying best practices
- Sharing real-time data
- Joint response exercises and joint responses
JG-EVER, JKASP (and other Asia-Pacific countries)
Summary: To do list for volcanologists

• Bilateral agreements to share expertise, technology, real-time monitoring data, and lessons learned.

• Develop a consistent format and reliable mechanism for global daily volcano observatory reporting.

• Collaborate to increase access to satellite remote sensing data from all international sources in as near real-time as possible (GEOSS).

• Involve young scientists and students to ensure continuity and vitality of volcano hazard science.
Thank you for your attention!
Russia-United States Bilateral Workshop on Geohazards and Disaster Risk in the North Pacific Region

1964 tsunami, Kodiak, Alaska, USA

2011 seismic retrofitting in Petropavlovsk-Kamchatsky, Russia
What's wrong with this picture?
### Volcano color code

<table>
<thead>
<tr>
<th>Color</th>
<th>Status</th>
</tr>
</thead>
</table>
| **GREEN** | Volcano is in typical background, noneruptive state.  
*Or, after a change from a higher level:* Volcanic activity has ceased and volcano has returned to noneruptive state. |
| **YELLOW** | Volcano is exhibiting signs of elevated unrest above known background level.  
*Or, after a change from higher level:* Volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase. |
| **ORANGE** | Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain.  
*Or,*  
Eruption is underway with no or minor volcanic-ash emissions [ash-plume height specified if possible]. |
| **RED** | Eruption is imminent with significant emission of volcanic ash into the atmosphere likely  
*Or,*  
Eruption is underway or suspected with significant emission of volcanic ash into the atmosphere [ash-plume height specified if possible]. |