

Lessons learned from North Pacific Volcanoes: AVO, KVERT and SVERT

P.W. Webley, J. Freymueller, and P. Izbekov

Geophysical Institute/Alaska Volcano Observatory



Alaska Volcano Observatory - AVO

<http://avo.alaska.edu/>

- Joint Program
 - United States Geological Survey (USGS)
 - Geophysical Institute of the University of Alaska Fairbanks (UAFGI)
 - State of Alaska Division of Geological & Geophysical Surveys (ADGGS)
- Formed in 1988
- Three primary components:
 - Geophysics/Geology/Remote Sensing



Kamchatka Volcanic Eruption Response Team - KVERT

- Established 1993
- IVS FEB RAS, KBGS along with AVO
- Uses webcam, seismic and satellite remote sensing data
- Responsible for N. Kuriles since 1998
- 700+ information statements

http://www.kscnet.ru/ivs/kvert/index_eng.php



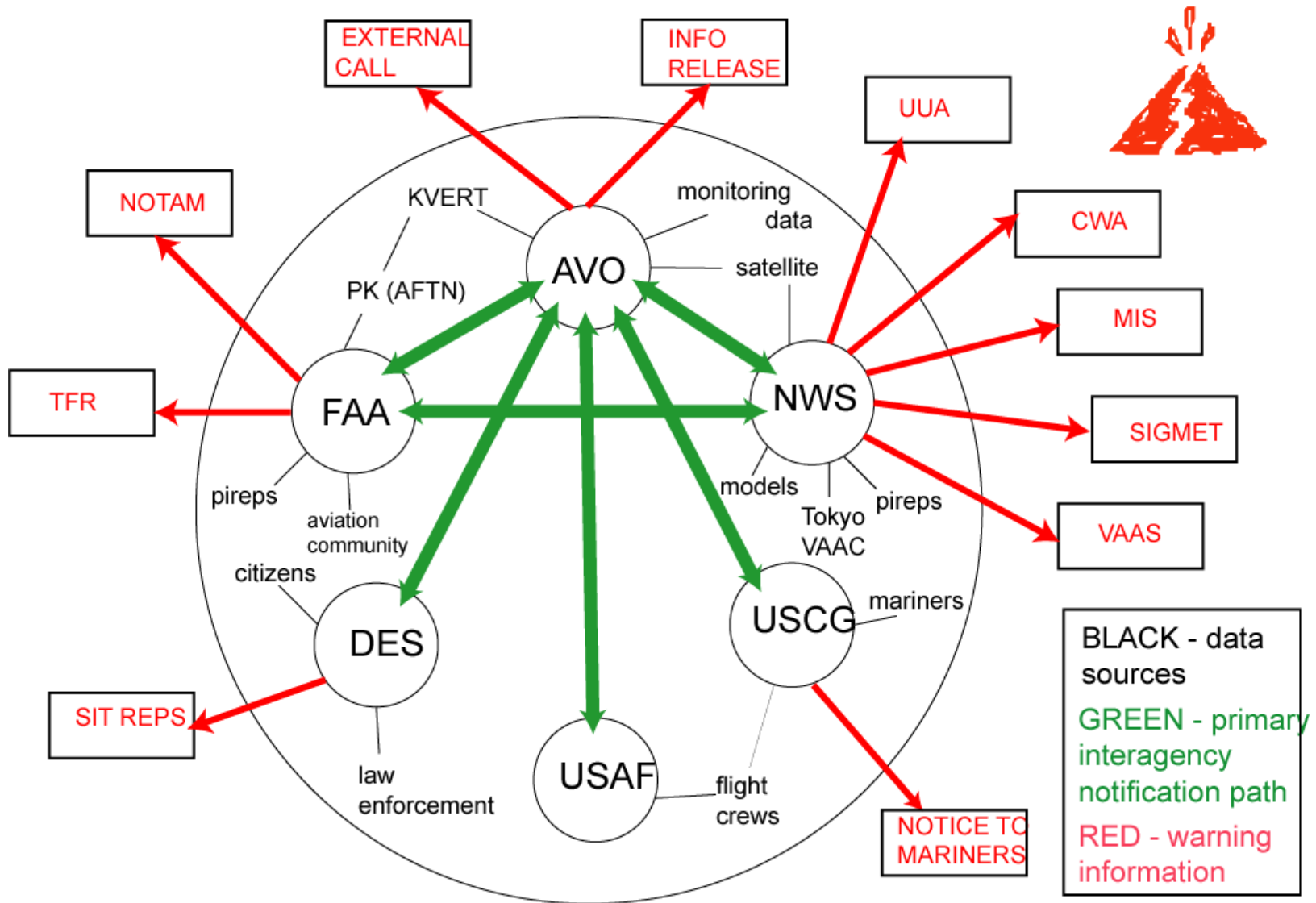
Sakhalin Volcanic Eruption Response Team - SVERT

- Established in 2004
- Share timely data on active volcanoes in the Kurile chain
- Satellite and seismic data used for monitoring
- Issues daily and weekly summaries as well as VONAs

<http://www.avo.alaska.edu/activity/svert.php>

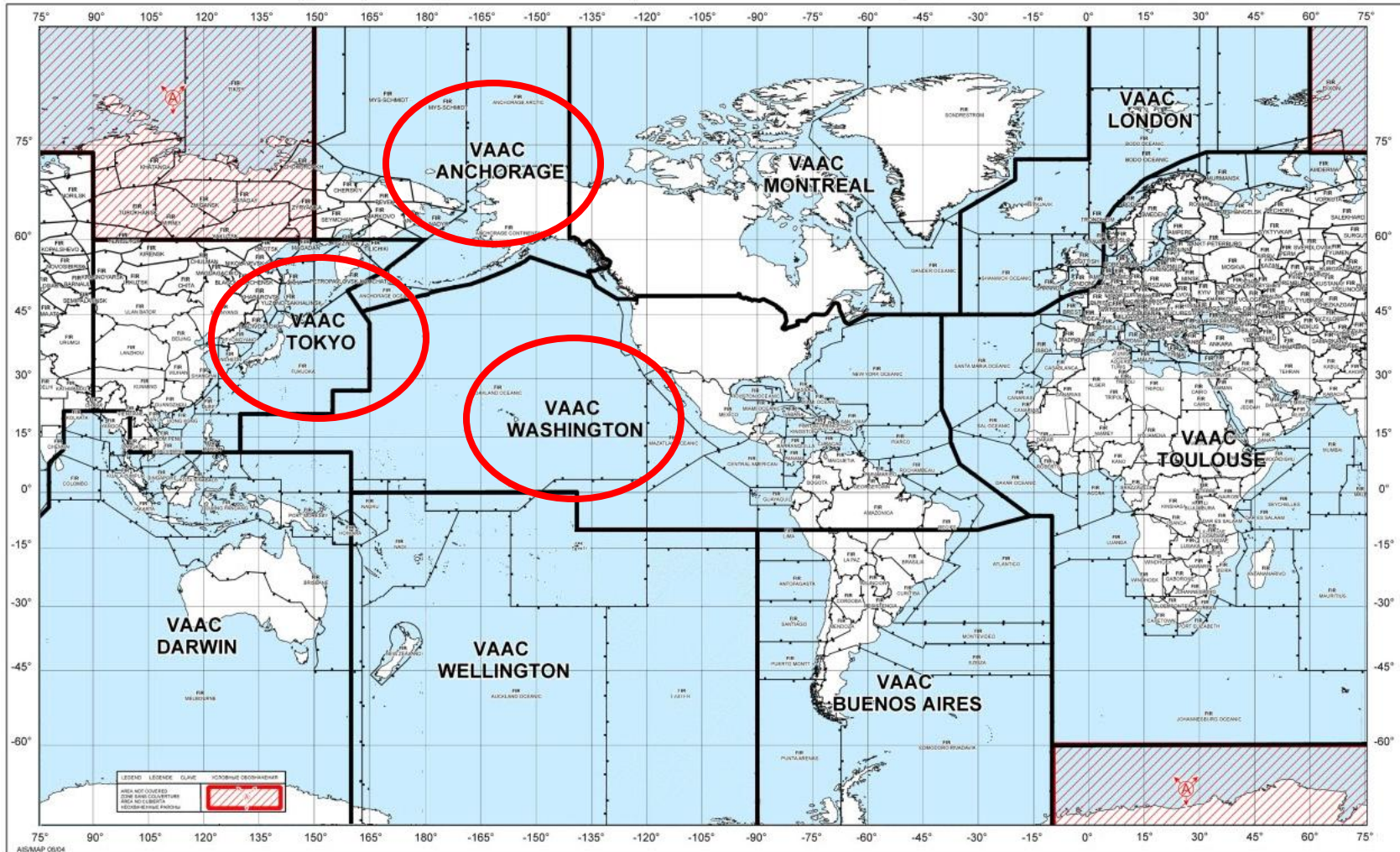


The communications pathways - Alaska



NORAC VAAC's

CURRENT STATUS OF ICAO VOLCANIC ASH ADVISORY CENTRES (VAAC) - AREAS OF RESPONSIBILITY
SITUATION ACTUELLE DES CENTRES D'AVIS DE CENDRES VOLCANIQUES (VAAC) - ZONES DE RESPONSABILITÉ
ESTADO ACTUAL DE LOS CENTROS DE AVISOS DE CENIZAS VOLCÁNICAS (VAAC) DE LA OACI - ÁREAS DE RESPONSABILIDAD
СУЩЕСТВУЮЩЕЕ РАСПРЕДЕЛЕНИЕ КОНСУЛЬТАТИВНЫХ ЦЕНТРОВ ИКАО ПО ВУЛКАНИЧЕСКОМУ ПЕПЛУ (VAAC) - РАЙОНЫ ОТВЕТСТВЕННОСТИ



VO – VAAC - MWO

- Alaska
 - AVO → Tokyo, Anchorage, Montreal, Washington VAACs
 - AVO → MWO (Anchorage office of NWS)
- Kamchatka
 - KVERT → AVO, Tokyo, Anchorage, Washington VAACs
 - KVERT → MWO (this is Yelizovo Airport Met. Center)
- Sakhalin
 - SVERT → AVO, KVERT, Tokyo, Anchorage, Washington VAACs
 - SVERT → MWO and ATCC in Sakhalin

(1) **VOLCANO OBSERVATORY NOTICE FOR AVIATION (VONA)**

(2) Issued: 20131015/0111Z

VONA

(1) **VOLCANO OBSERVATORY NOTICE FOR AVIATION (VONA)**

(2) Issued: (20130308/1940Z)
(3) Volcano: Cleveland (CAVW# 1101-24-)
(4) Current Color Code: **YELLOW**
(5) Previous Color Code: orange
(6) Source: Alaska Volcano Observatory
(7) Notice Number: 2013/A4
(8) Volcano Location: N 52 deg 49 min W 169 deg 56 min
(9) Area: Aleutians Alaska
(10) Summit Elevation: 5676 ft (1730 m)

(11) Volcanic Activity Summary: The summit lava dome extruded in late January 2013 has remained unchanged since the last color code change on February 6, 2013. Anomalous surface temperatures prevalent in late January through mid-February declined and the last thermal anomaly observed in satellite imagery was reported on February 26. Although satellite viewing conditions at Cleveland are typically cloudy, clear views between March 1 and 5 indicate no change has occurred in the summit dome and thermal anomalies no longer are present. Therefore, the Aviation Color Code and Volcano Alert Level for Cleveland is lowered to **YELLOW/ADVISORY**.

The last confirmed explosion at Cleveland occurred in November, 2012. The presence of a lava dome in the summit crater means that explosions of blocks and ash could occur with little or no warning. Ash clouds, if produced, could exceed 20,000 feet above sea level. If a large ash-producing event occurs, nearby seismic, infrasound, or volcanic lightning networks should alert AVO staff. However, for some events, a delay of several hours is possible. There is no real-time seismic monitoring network on Mount Cleveland and AVO is unable to track activity in real time.

(12) Volcanic cloud height: Unknown

(13) Other volcanic cloud information: Unknown

(14) Contacts: Chris Waythomas, Acting Scientist-in-Charge, USGS
chris@usgs.gov (907) 786-7497

Jeff Freymueller, Coordinating Scientist, UAFGI
jeff.freymueller@gi.alaska.edu (907) 378-7556

(15) Next Notice: A new VONA will be issued if conditions change significantly or alert levels are modified. While a VONA is in effect, regularly scheduled updates are posted at <http://www.avo.alaska.edu>

In Russia, KVERT, on behalf of the Institute of Volcanology and Seismology (IVS) FED RAS, is responsible for providing information on volcanic activity to international air navigation services for the airspace users.

VONA/KVERT WEEKLY INFORMATION RELEASE 43-2013
Kamchatkan and Northern Kuriles Volcanic Activity
October 24, 2013, 23:04 UTC (October 25, 2013, 11:04 KST)

KVERT monitor 30 active volcanoes of Kamchatka and 6 active volcanoes of Northern Kuriles. Not all of these volcanoes had eruptions in historical time, however they are potentially active and therefore are of concern to aviation.

SUMMARY OF AVIATION COLOR CODES:

KAMCHATKA

Real-time seismic data from the Kamchatkan Branch of Geophysical Survey RAS: <http://www.emsd.ru/>
SHEVELUCH, KLYUCHEVSKOY, KARYMSKY: **ORANGE**
BEZYMANNY, PLOSKY TOLBACHIK, KIZIMEN, GORELY: **YELLOW**
USHKOVSKY, KORVAKSKY, AVACHINSKY, MUTNOVSKY: **GREEN**

No seismic data:

ZHUPANOVSKY: **ORANGE**
IOCHINSKY, VYSOKIY, KOMAROV, GANCHEN, KHANGAR, KRONOTSKY, KRASHEINIKHOV, TAUNSHITS, KIKHPIYCH, MALY BEHVACHIK, OPALA, KHODUTKA, KSUDACH, ZHELTOVSKY, ILIINSKY, DIKHY GREBEN, KOSHELEV, KAMBALNY: **GREEN**

NORTHERN KURILES

No seismic data:
ALAI, EBKO, CHIKURACHKI, TATARINOV, FUSS PEAK, KARPINSKY: **GREEN**

SHEVELUCH VOLCANO (CAVV #1000-27-)

56.64 N, 161.32 E; Elevation 10768 ft (3283 m), the dome elevation ~8200 ft (2500 m)
Aviation Color Code is **ORANGE**

Explosive-eruptive-effusive eruption of the volcano continues. Ash explosions up to 32,800 ft (10 km) a.s.l. could occur at any time. Ongoing activity could affect international and low-flying aircraft.

Eruption of the volcano continues. There was a very strong explosive activity of the volcano last week: on October 18, there were 22 ash explosions that sent ash up to 24,600-32,800 ft (7-10 km) a.s.l. Ash plumes extended about 124 mi (200 km) to the south-east of the volcano. According to visual and satellite data, a viscous lava block continues to extrude on the north-eastern and northern flanks of the lava dome, strong and moderate ash explosions, fumarolic activity and incandescence of the dome summit and hot avalanches accompanies this process. Satellite data showed a thermal anomaly over the lava dome all week.

http://www.kscnet.ru/ivs/kvert/volcanoes/Sheveluch/index_eng.php

KLYUCHEVSKOY VOLCANO (CAVV #1000-26-)

56.06 N, 160.64 E; Elevation 15580 ft (4750 m)
Aviation Color Code is **ORANGE**

Explosive-effusive eruption of the volcano is gradually finishing. Ash explosions up to 26,200 ft (8.0 km) a.s.l. are still possible. The activity of the volcano could affect international and low-flying aircraft.

Probably the eruption is gradually finishing. Culmination phase of the eruption occurred on October 18-20. Seismic activity of the volcano was very high in these days. Video data showed a very strong Vulcanian explosive activity of the volcano: ash column rose up to 32,800 ft (10.0 km) a.s.l. and extended mainly to the south-east and east of the volcano. Strombolian activity of the volcano was observed: lava fragments rose up to 500-800 m above the summit cinder cone. Strong incandescence of the volcano summit and the western volcanic flanks was noted at nights - several lava flows are effusing on the western, south-western and south-eastern volcanic flanks. Sometimes phreatic plumes were observed on the fronts of lava flows - ash plumes rose up to 16,400 m (5 km) a.s.l. Culmination of the eruption finished at 13:00 UTC on October 20, but the eruption was not ending: moderate Strombolian activity of the volcano and an effuse of several lava flows are continuing. Satellite data showed a thermal anomaly over the volcano all week, and aerosol plumes of Klyuchevskoy volcano over the Northern Canada on October 20-23.

KARYMSKY VOLCANO (CAVV #1000-13-)

54.05 N, 159.44 E; Elevation 4874 ft (1486 m)
Aviation Color Code is **ORANGE**

Moderate explosive eruption of the volcano continues. Ash explosions up to 19,700 ft (6 km) a.s.l. could occur at any time. Activity of the volcano could affect low-flying aircraft.

Moderate seismic activity of the volcano continues. Probably Strombolian and weak Vulcanian activity of the volcano occur because satellite data showed a bright thermal anomaly over the volcano all week; ash plumes extended about 106 mi (170 km) to the south-east of the volcano on October 20 and 22; the volcano was obscured by clouds in the other days of week.

http://www.kscnet.ru/ivs/kvert/volcanoes/Karymsky/index_eng.php

ZHUPANOVSKY VOLCANO (CAVV #1000-13-)

53.59 N, 159.15 E; Elevation 9702 ft (2958 m)
Aviation Color Code is **ORANGE**

Moderate explosive eruption of the volcano continues. Ash explosions up to 26,200 ft (8.0 km) a.s.l. could occur at any time. The activity of the volcano could affect international and low-flying aircraft.

Explosive eruption of the volcano began at ~13:00 UTC on October 23, 2013. Ash plumes rose up to 16,400 ft (5 km) a.s.l. and extended to the south-east of the volcano. Ash covered Nalychevo Valley about 1 mm of layer. Satellite data showed a weak thermal anomaly over the volcano on October 22 and 24; ash plumes extended 75 mi (120 km) to the south-east of the volcano on October 23-24. Last eruption of the volcano occurred in 1956-1957: there were moderate phreatic explosions.

http://www.kscnet.ru/ivs/kvert/volcanoes/Zhupanovsky/index_eng.php

BEZYMANNY VOLCANO (CAVV #1000-25-)

55.97 N, 160.6 E; Elevation 9453 ft (2882 m)
Aviation Color Code is **YELLOW**

Moderate activity of the volcano continues. Ongoing activity could affect low-flying aircraft.

A weak seismic activity of the volcano was registered. Moderate fumarolic activity of the volcano was observed or the volcano was obscured by clouds. Satellite data showed a weak thermal anomaly over the lava dome all week.

http://www.kscnet.ru/ivs/kvert/volcanoes/Bezymanny/index_eng.php

PLOSKY TOLBACHIK VOLCANO (CAVV #1000-24-)

55.83 N, 160.39 E; Elevation 10119 ft (3085 m)
Aviation Color Code is **YELLOW**

Moderate activity of the volcano continues. Ongoing activity could affect low-flying aircraft.

Probably explosive-effusive Tolbachik fissure eruption is gradually finishing but a weak and moderate seismic activity of the volcano continue to registering. A weak thermal anomaly was noting on satellite images at the northern area of Tolbachinsky Dol all week.

http://www.kscnet.ru/ivs/kvert/volcanoes/Plosky_Tolbachik/index_eng.php

KIZIMEN VOLCANO (CAVV #1000-23-)

55.13 N, 160.32 E; Elevation 8151 ft (2485 m)
Aviation Color Code is **YELLOW**

Eruptive eruption of the volcano probably gradually finishing. Ash plumes from hot avalanches up to 19,700 ft (6 km) a.s.l. are still possible. Activity of the volcano could affect low-flying aircraft.

Probably the eruption is gradually finishing but a weak seismic activity of the volcano continue to registering. Video data showed sometimes an incandescence of the volcano summit and strong gas-steam activity of the volcano. Satellite data showed a very weak thermal anomaly over the volcano on October 18, 21-22 and 24; clouds obscured the volcano in the other days of week.

http://www.kscnet.ru/ivs/kvert/volcanoes/Kizimen/index_eng.php

GORELY VOLCANO (CAVV #1000-07-)

52.56 N, 158.03 E; Elevation 5996 ft (1828 m)
Aviation Color Code is **YELLOW**

Moderate activity of the volcano continues. Ongoing activity could affect low-flying aircraft.

Moderate seismic activity of the volcano continues. Video data showed a strong gas-steam activity of the volcano on October 24; in the other days video and satellite data showed the volcano was quiet or obscured by clouds.

http://www.kscnet.ru/ivs/kvert/volcanoes/Gorely/index_eng.php

IF YOU HAVE ANY QUESTIONS OR CONCERNS, PLEASE CONTACT:

Dr. Olga A. Grina, Head of KVERT, IVS FEB RAS

VENIAMINOF VO
56°11'52" N 159°
Current Volcano A
Current Aviation C

Seismic activity has
been obscured by clouds

It is possible that
eruptive activity is

Mount Veniaminof
is located southwest of
And has erupted at least
eruptions produced
the 1993-95 activity
early 2005, November
fallout that blanketed

CLEVELAND VOL
52°49'20" N 169°
Current Volcano A
Current Aviation C

Satellite and web
(pressure sensor)

OTHER ALASKA

Seismic activity is
elevated surface
Aniakchak, August
Pavlof, Redoubt, and
Normal. All are at
these volcanoes.

Please see <http://>

VOLCANO INFORMATION
RECORDING ON TIT

CONTACT INFORMATION

es were mostly

Pauses in
volcano closely.

180 mi)
Aleutian Arc and
Strombolian
a cone. During
in 2002, 2004,
sea level and ash

infrasound

plumes and
rest. Akutan,
rupta, Okmok,
volcano alert level
vicinity of any of

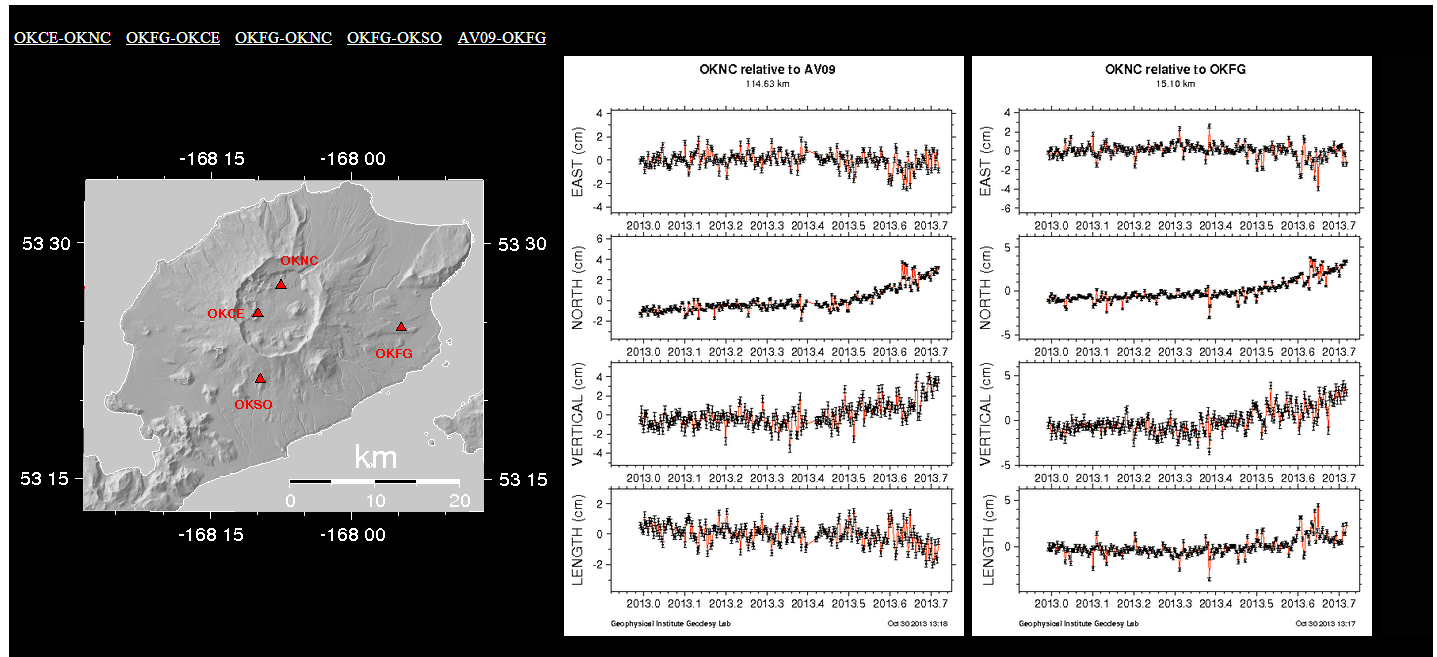
Weekly summaries

Data and technologies

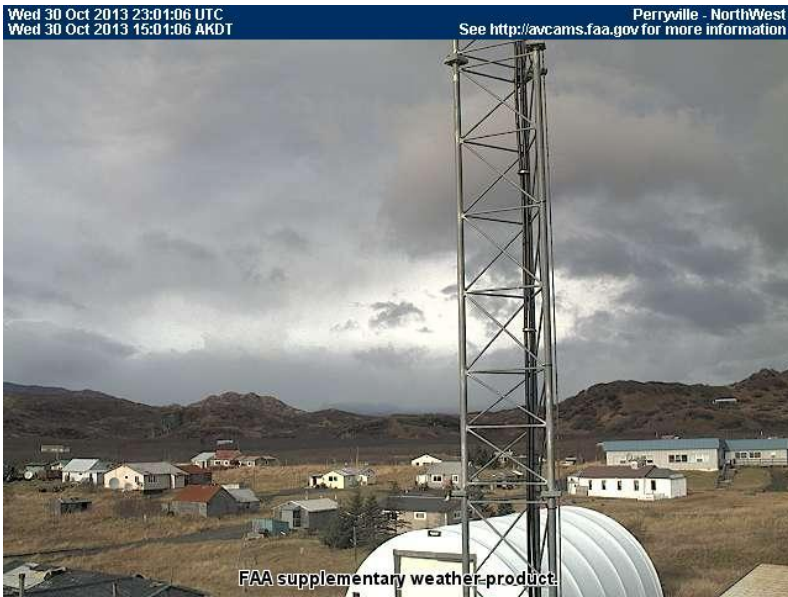
- Real-time data
 - Seismic
 - Not at all volcanoes, telemetry can be a problem
 - GPS
 - Campaign datasets as well as some continuous
 - Infrasonic
 - Used in Alaska for remote volcanoes

Okmok volcano

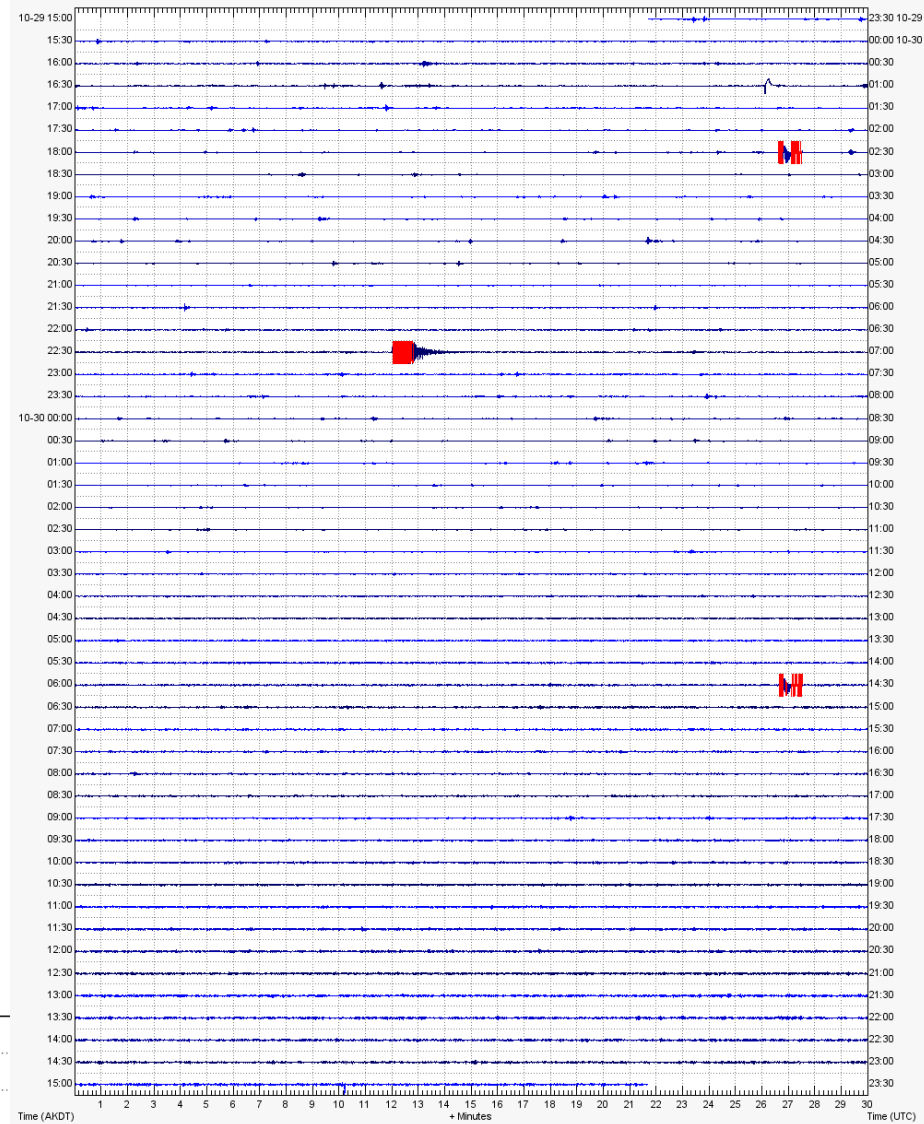
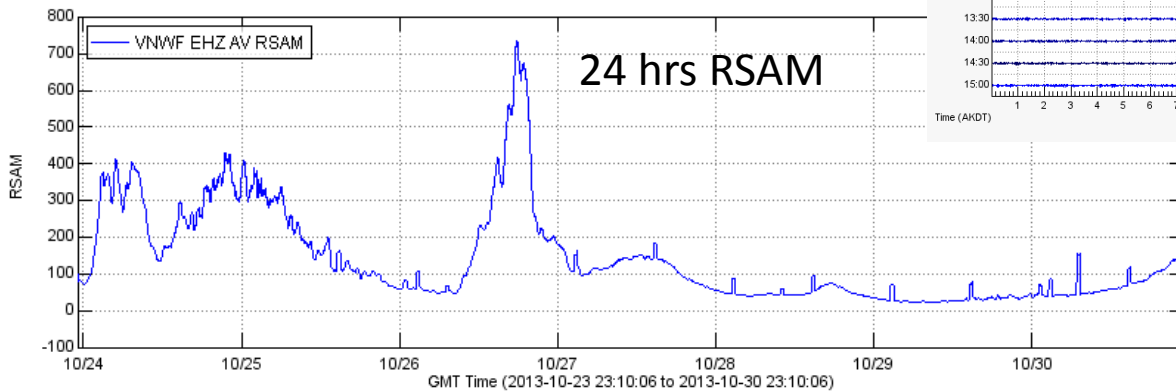
OKNC station
relative to AV09
base station



Veniaminof, Oct 30, 2013



Webcam from FAA



Web recorder - 24 hrs

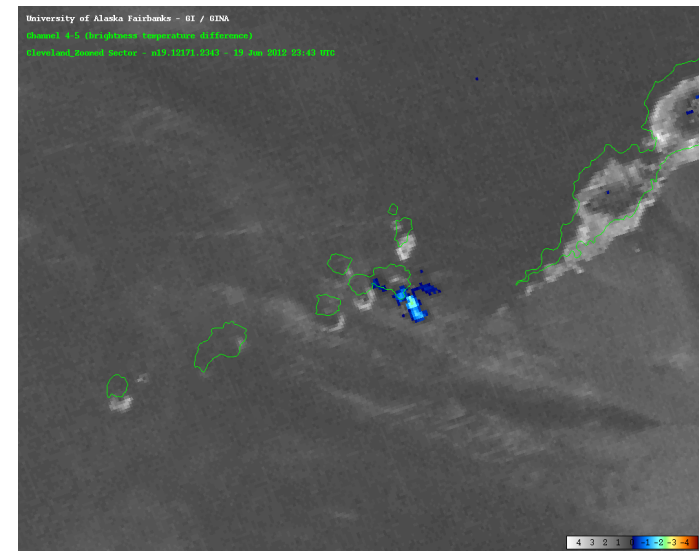
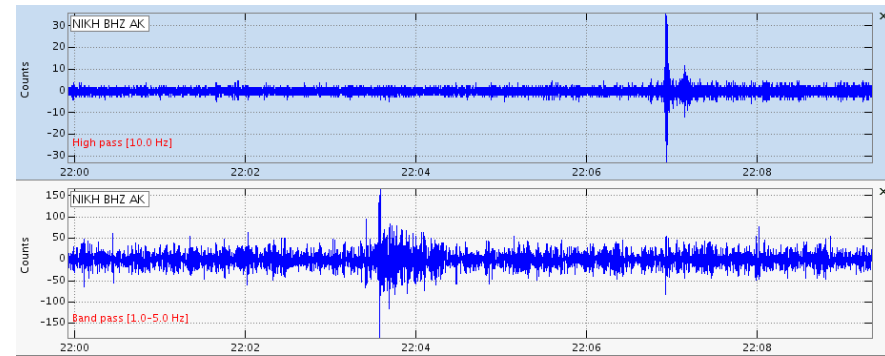
Data and technologies

- Real-time data
 - Webcams
 - Used by all three organizations
 - Remote Sensing
 - Joint UAF-GI/USGS operational facilities, 1988 - 2013
 - Internalized to USGS – May 2013



Data and technologies

- Confirmation, confirmation, confirmation
- Cleveland Volcano, June 19 2012
 - Webcam at 22:30 UTC
 - Satellite at 23:32 UTC, but now detached
 - Nikolski broadband seismic station
 - Seismic & ground-coupled air wave
 - Air wave ~ about 200 s after the seismic wave.
 - The seismic wave gives an origin time of about 22:03:30 UTC
- VATD model showed 7 km ASL (used seismic/infrasound for start time)



Example events: Kliuchevskoi – October 2013

- KVERT sent VONA on Oct. 17 at 23:15 UTC
- Tokyo VAAC on Oct 17 at 20:18 UTC to FL330
- Tokyo again at 23:34 UTC

(1) VOLCANO OBSERVATORY NOTICE FOR AVIATION (VONA)

- (2) Issued: 20131017/2315Z
- (3) Volcano: Klyuchevskoy (CAVV #1000-26-)
- (4) Current Aviation Color Code: **RED**
- (5) Previous Aviation Color Code: orange
- (6) Source: KVERT
- (7) Notice Number: 2013-16
- (8) Volcano Location: N 56 deg 3 min E 160 deg 38 min
- (9) Area: Kamchatka, Russia
- (10) Summit Elevation: 15580 ft (4750 m)
- (11) Volcanic Activity Summary: Activity of the volcano continue to be high. Strombolian and Vulcanian explosive eruption continues. Ash plumes raise up to 29,500 ft (9 km) a.s.l. and extend > 100 km to the south-east of the volcano. Lava flows effuse on the south-western, western and south-eastern volcanic flanks.
- Explosive-effusive eruption of the volcano continues. Ash explosions > 32,800 ft (> 10 km) a.s.l. could occur at any time. Ongoing activity could affect international and low-flying aircraft.
- (12) Volcanic cloud height: 29520 ft (9000 m) a.s.l.
- (13) Other volcanic cloud information: Ash plumes raise up to 29,500 ft (9 km) a.s.l. and extend > 100 km to the south-east of the volcano.
- (14) Remarks: This explosive eruption of Kluchevskoy volcano began from August 15, 2013, and continue.
- (15) Contacts: Dr. Olga A. Girina, Head of KVERT, IVS FEB RAS
girina@kscnet.ru +74152297890
- Duty scientist: +79622825253
- (16) Next Notice: A new VONA will be issued if conditions change significantly or the Aviation Color Code is changes. VONAs are posted at http://www.kscnet.ru/ivs/kvert/index_eng.php.

In Russia, KVERT, on behalf of the Institute of Volcanology and Seismology (IVS) FED RAS, is responsible for providing information on volcanic activity to international air navigation services for the airspace users.

Volcanic Ash Advisory Text

FVFE01 RJTD 172018
VA ADVISORY
DTG: 20131017/2018Z
VAAC: TOKYO
VOLCANO: KLIUCHEVSKOI 1000-26
PSN: N5603E16038
AREA: RUSSIA
SUMMIT ELEV: 4835M
ADVISORY NR: 2013/31
INFO SOURCE: MTSAT-2 KBGS
AVIATION COLOUR CODE: NIL
ERUPTION DETAILS: ERUPTION AT 20131017/2000Z FL330 REPORTED
OBS VA DTG: 17/2000Z
OBS VA CLD: VA NOT IDENTIFIABLE FM SATELLITE DATA WIND FL330 050/19KT
FCST VA CLD +6 HR: NO VA EXP
FCST VA CLD +12 HR: NO VA EXP
FCST VA CLD +18 HR: NO VA EXP
RMK: WE WILL ISSUE FURTHER ADVISORY IF VA IS DETECTED IN SATELLITE IMAGERY.HEIGHT OF ASH ESTIMATED BY SEISMIC RECORD.
NXT ADVISORY: NO FURTHER ADVISORIES=

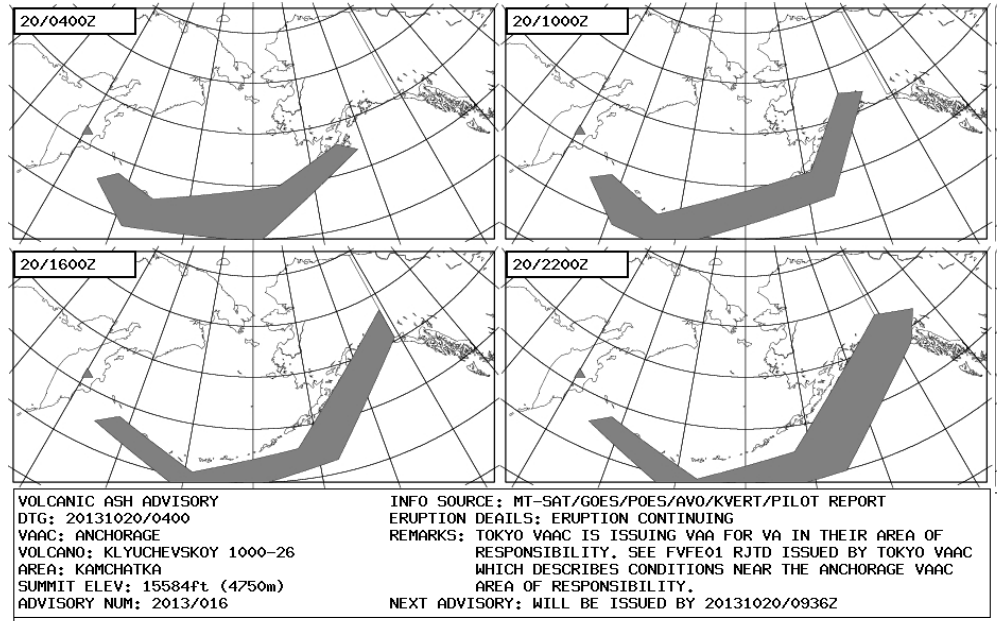
Example events: Kliuchevskoi – October 2013

- Tokyo VAAC sends out VAA
 - Oct 18 at 05:58, 11:51, 18:00, 21:38, 23:59
 - Oct 19 at 00:54, 04:45, 06:03, 12:03 17:54, 23:51
 - Oct 20 at 05:58, 12:01, 18:00
 - Oct 21 at 00:00
- KVERT sent VONA
 - Oct 18 at 08:22, 06:07, 08:38, 21:57
 - Oct 19 at 00:31, 03:50, 23:48
 - Oct 20 at 21:40
- Anchorage VAAC sends out VAA
 - Oct 18 at 05:14, 12:55, 18:06, 21:55
 - Oct 19 at 02:20, 04:15, 10:15, 16:15, 21:34
 - Oct 20 at 03:36, 04:00, 09:15, 14:40, 19:45
 - Oct 21 at 00:19, 03:30, 09:20

Example events: Kliuchevskoi – October 2013

Anchorage VAAC

 FVAK21 RAWU 200402
 VAAAK1
 VA ADVISORY
 DTG: 20131020/0400Z
 VAAC: ANCHORAGE
 VOLCANO: KLYUCHEVSKOY 1000-26
 PSN: N5602 E16023
 AREA: KAMCHATKA
 SUMMIT ELEV: 15584 FT (4750 M)
 ADVISORY NR: 2013/016
 INFO SOURCE: MT-SAT/GOES/POES/AVO/KVERT/PILOT REPORT
 AVIATION COLOR CODE: RED
 ERUPTION DETAILS: ERUPTION CONTINUING
 OBS VA DTG: 20/0400Z
 OBS VA CLD: SFC/FL330 N5343 E16802 - N5228 E17425 - N5451 W16553
 - N5756 W15443 - N5652 W15122 - N4947 W16902 - N4914 E17113 -
 N5228 E16515 - N5343 E16802 MOV ENE 60KTI.
 FCST VA CLD +6HR: 20/1000Z SFC/FL330 N5339 E16813 - N5122 E17646
 - N5546 W15854 - N6223 W15004 - N6139 W14507 - N5303 W15601 -
 N4826 E17844 - N4917 E17050 - N5236 E16515 - N5339 E16813.
 FCST VA CLD +12HR: 20/1600Z SFC/FL330 N5346 E16811 - N5032
 W17854 - N5254 W16258 - N6325 W14102 - N6018 W14059 - N5116
 W15715 - N4749 W17741 - N5228 E16451 - N5346 E16811.
 FCST VA CLD +18HR: 20/2200Z SFC/FL330 N5343 E16811 - N5003
 W17702 - N5234 W16226 - N6251 W14056 - N6119 W13330 - N5845
 W13726 - N5549 W14505 - N4956 W15521 - N4701 W17720 - N5231
 E16505 - N5343 E16811.
 RMK: TOKYO VAAC IS ISSUING VAA FOR VA IN THEIR AREA OF RESPONSIBILITY.
 SEE FVFE01 RJTD ISSUED BY TOKYO VAAC WHICH DESCRIBES CONDITIONS
 NEAR THE ANCHORAGE VAAC AREA OF RESPONSIBILITY.
 THIS ADVISORY CORRECTS THE VA CLD AREA OVER MONTREAL VAAC AREA OF
 RESPONSIBILITY AT +12HR AND +18HR FCST TIMES.
 NXT ADVISORY: WILL BE ISSUED BY 20131020/0936Z
 TRENZ OCT 2013 AAWU



33

21

3ES
 TY

1200Z.

ONS NEAR VOLCANO

October 20, 2013 at 02:00 Z



MAY 1, 2008

Summary

- Communication is the key
- Collaborations outside events so focused when event occurs
- JKASP – brings together community in the region
- Web-based products so can be working together
- Collaborative research
 - Kamchatka/Katmai field school
 - Joint projects to do fieldwork
- Common reporting from VO's → consistent data stream to VAAC's