



# Operative remote monitoring of Kamchatkan volcanoes using the information system VolSatView

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**October 2015**

# **Volcano Danger at Kamchatka and Kuriles**

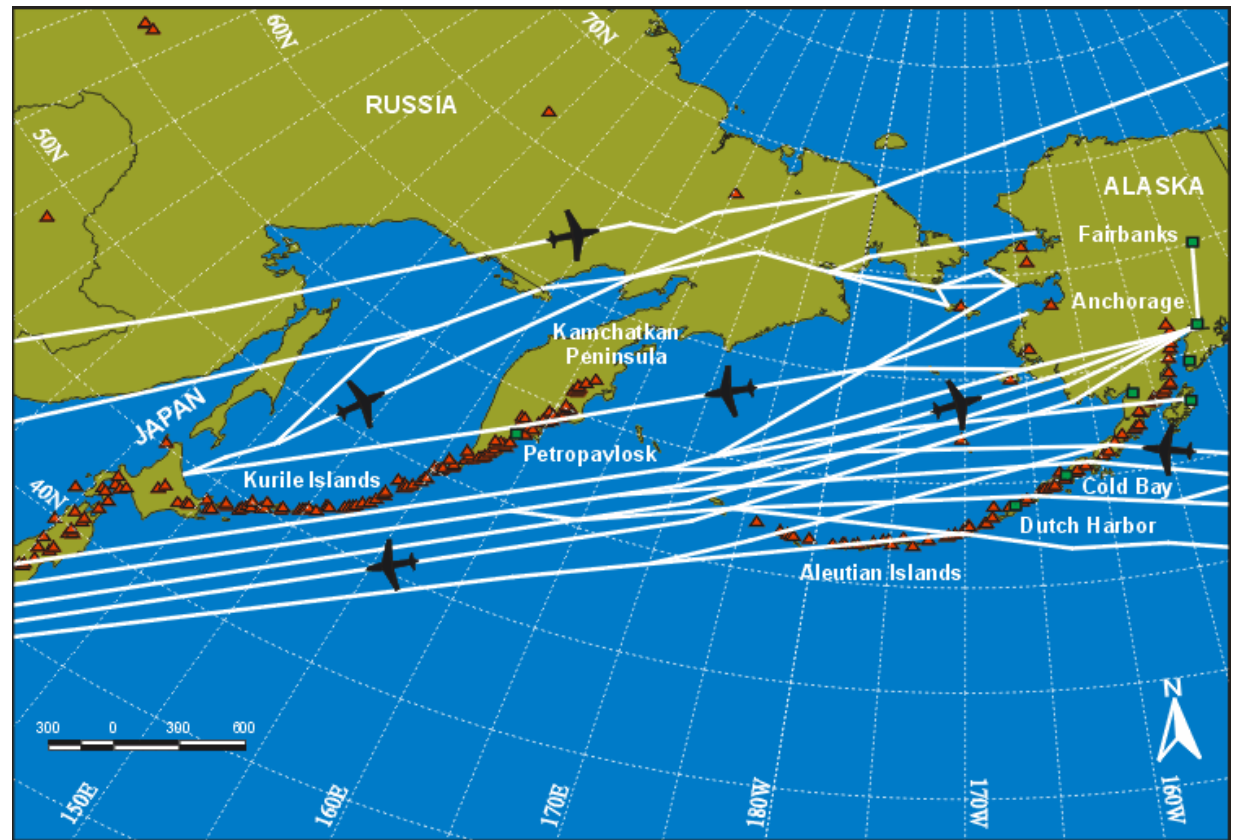
**In Kamchatka there are ~ 7100 volcanic structures that have emerged in the past 2-2.5 million years, in the Kuril Islands - 800 (Newest volcanism..., 2005).**

**The Kurile-Kamchatkan volcanic arc contains 70 active volcanoes that make up ~ 15% of the total number of active volcanoes in the Pacific Ring of Fire.**

**The average productivity of volcanoes of the Kuril-Kamchatka arc - 240 mln. tons, or 16-17% of the total productivity of terrestrial volcanoes in the world [Guschenko, 1979].**

**Most volcanoes in north-west part of Pacific ocean represent a hazard to aviation.**

**According to information by the Federal Aviation Administration, about 80,000 large aircraft per year, and 30,000 people per day, mostly traveled great-circle routes between Europe, North America, and Asia.**



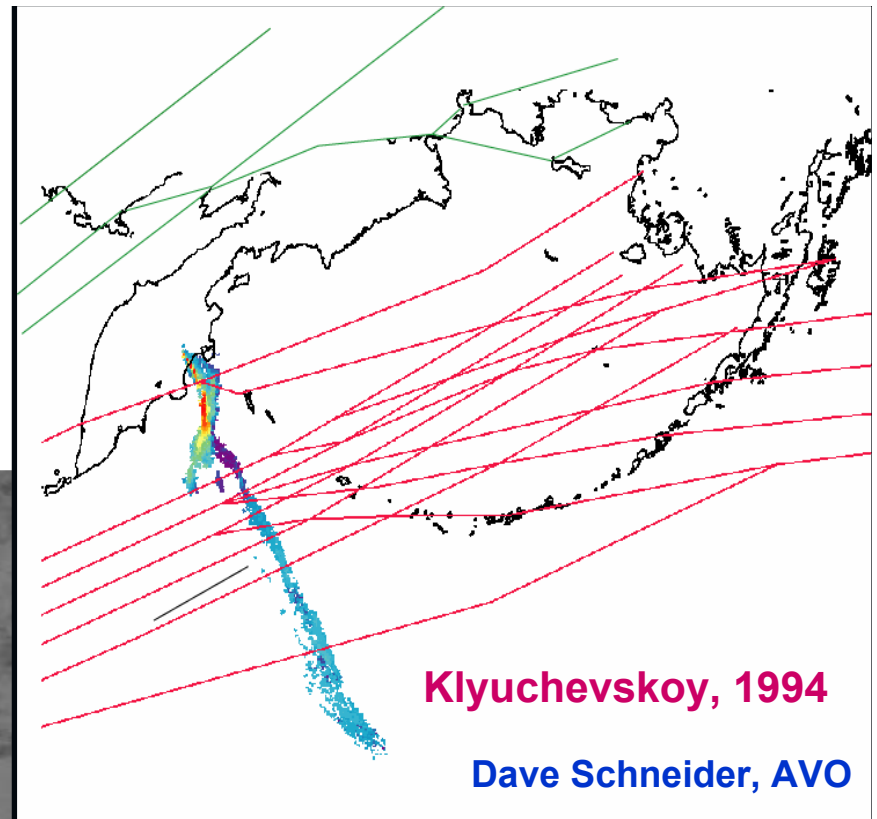
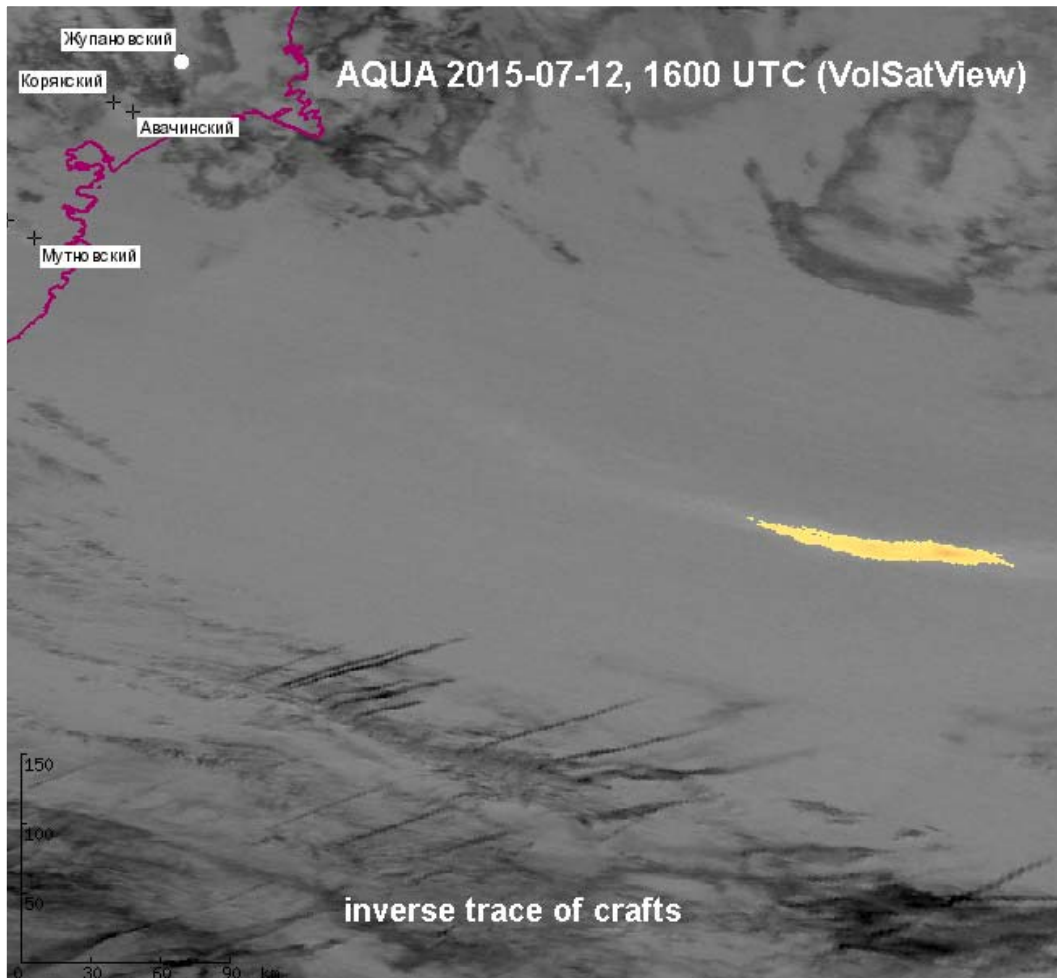
**Risk of engine failure and other damage during an encounter with volcanic ash is severe.**

**Famous example: On December 15, 1989, a Boeing 747 had suffered about \$80 millions in damage (Brantley, 1990).**

**Financial impacts of reroutes are significant: every extra minute of flying costs several hundred US\$.**

**Aviation needs to know where the danger is and when it has passed.**

# Ash clouds and plumes can cross international air routes



Zhupanovsky, 2015



# 30 active volcanoes at Kamchatka and 6 – at Northern Kuriles

<http://www.kscnet.ru/ivs/kvert/volcanoes/>



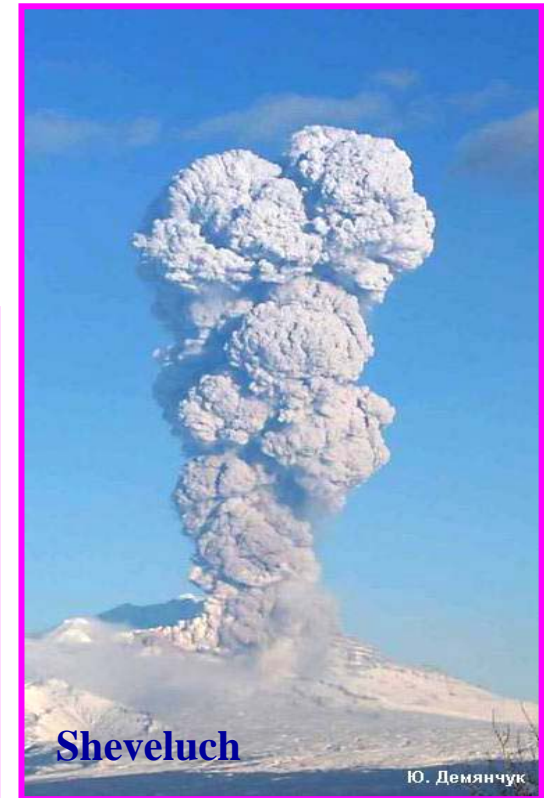
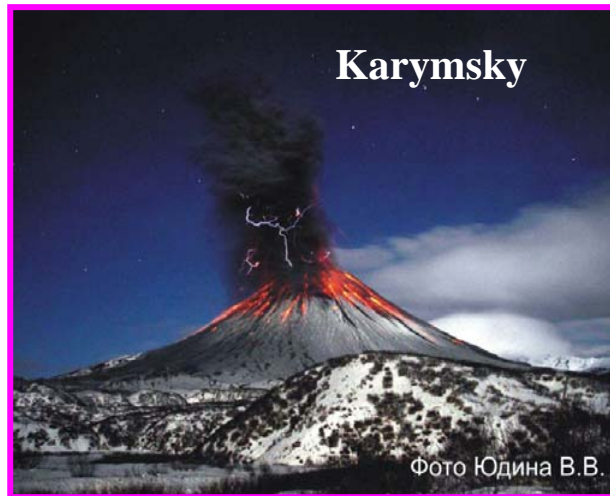
## KVERT: ACTIVE VOLCANOES OF KAMCHATKA AND NORTHERN KURILES

IVS FEB RAS Main Aviation color codes Catalogue of active volcanoes Map of active volcanoes About KVERT Search

№	Name	GVP Number	IAVCEI Number	Latitude	Longitude	Elevation	Last Eruption
<b>KAMCHATKA</b>							
<b>North Kamchatka</b>							
1	Sheveluch	300270	1000-27-	56°38'10" N	161°18'54" E	3283 m	2015
2	Ushkovsky	300261	1000-261	56°4'12" N	160°28'16" E	3943 m	1890 (?)
3	Klyuchevskoy	300260	1000-26-	56°3'20" N	160°38'31" E	4750 m	2015/1/1 - 2015/3/24
4	Bezymianny	300250	1000-25-	55°58'19" N	160°35'43" E	2882 m	2012/9/1
5	Plosky Tolbachik	300240	1000-24-	55°49'44" N	160°23'25" E	3085 m	2012/11/27 - 2013/9/10
6	Ichinsky	300280	1000-28-	55°40'39" N	157°43'6" E	3621 m	~ 1650
<b>Center Kamchatka</b>							
7	Kizimen	300230	1000-23-	55°7'51" N	160°19'12" E	2485 m	2010/12/9 - 2013/12/9
8	Vysoky	300221	1000-221	55°3'51" N	160°45'54" E	2161 m	~ 100 BC
9	Komarov	300220	1000-22-	55°2'0" N	160°43'30" E	2070 m	?
10	Gamchen	300210	1000-21-	54°58'27" N	160°42'12" E	2576 m	?
11	Khangar	300272	1000-272	54°45'41" N	157°24'24" E	2000 m	~ 1600
12	Kronotsky	300200	1000-20-	54°45'11" N	160°31'58" E	3528 m	1922 - 1923
13	Krasherinnikov	300190	1000-19-	54°35'45" N	160°16'12" E	1856 m	~ 1600
14	Taunshits	300160	1000-16-	54°31'41" N	159°48'15" E	2353 m	~ 400 BC
15	Kikhpinych	300180	1000-18-	54°29'20" N	160°15'5" E	1552 m	~ 1400
16	Maly Semvachik	300140	1000-14-	54°8'7" N	159°40'26" E	1560 m	1952/12

Volcanologists study of Kamchatkan volcanoes since 1935.  
Seismologists study Kamchatka and Northern Kuriles since 1946.  
KVERT monitors active volcanoes of Kamchatka and Northern Kuriles since 1993 (visual, video, satellite monitoring).  
Daily monitoring and detail research of active Kamchatkan volcanoes allows to predict eruptions of some from them.

# 5 volcanoes of Kamchatka and Northern Kuriles have eruptions in 2014-2015:





# The Kamchatka Volcano Eruption Response Team (KVERT)



- KVERT was formed in 1993
  - KVERT is the formal and authoritative source of volcanologic information for Kamchatka and the North Kuriles.
  - At present, KVERT, on behalf of the Institute of Volcanology and Seismology (IVS) FEB RAS, is responsible in Russia for providing information on volcanic activity to international air navigation services for the airspace users.
- The goal of **KVERT** is to reduce the risk of aircraft encounters with volcanic ash clouds in the North Pacific region through timely detection of volcanic unrest, tracking of ash clouds, and prompt notification of airline authorities and others about volcanic ash hazards.

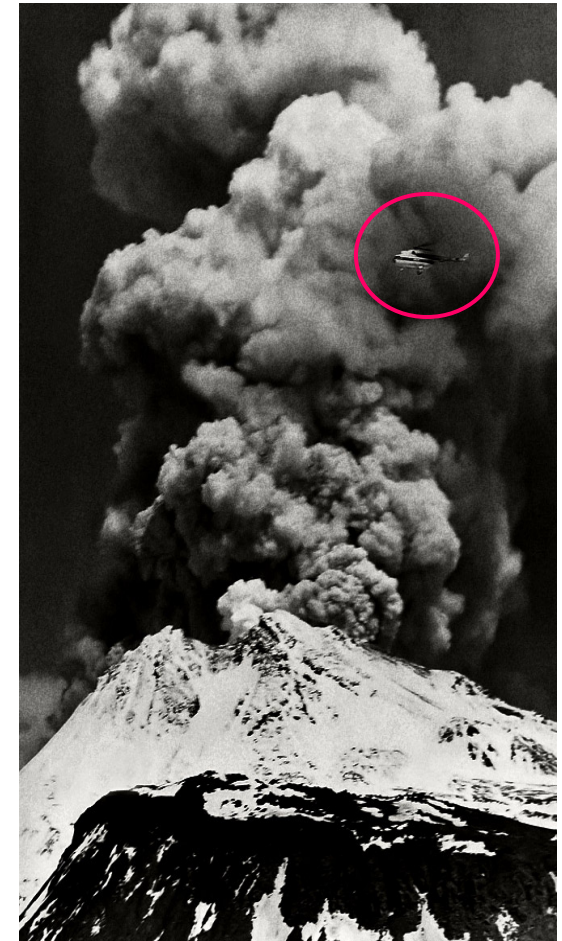


**Volcano hazards and risk in Kamchatka and Kurile Islands are similar in Japan and Alaska USA. In addition, submarine, Islands, and near-coastal volcanoes pose a tsunami hazard.**

## **Role of the KVERT**

- 1) Issue timely warnings of volcanic unrest and eruptions with Aviation color code (VONA in ICAO format).**
- 2) Assess volcanic hazards.**
- 3) Investigate volcanic processes.**

**KVERT have both a basic research and an applied hazard science component.**





# Monitoring volcanoes in Kamchatka



10.07.2014., Landsat 8, USA

## KVERT processes :

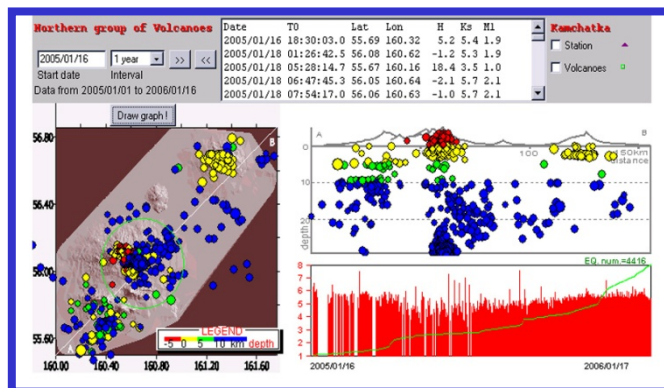
- satellite data (**volcanic ash and thermal anomalies**) (NOAA (AVHRR), MTSAT, TERRA & AQUA (MODIS), Канопус-В, Метеор-М & others)



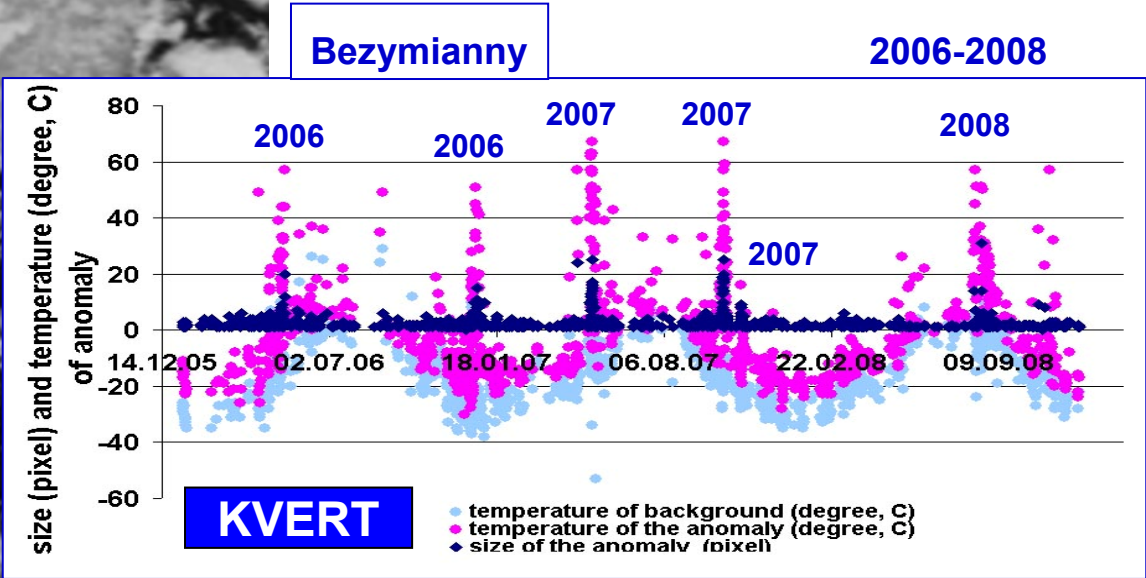
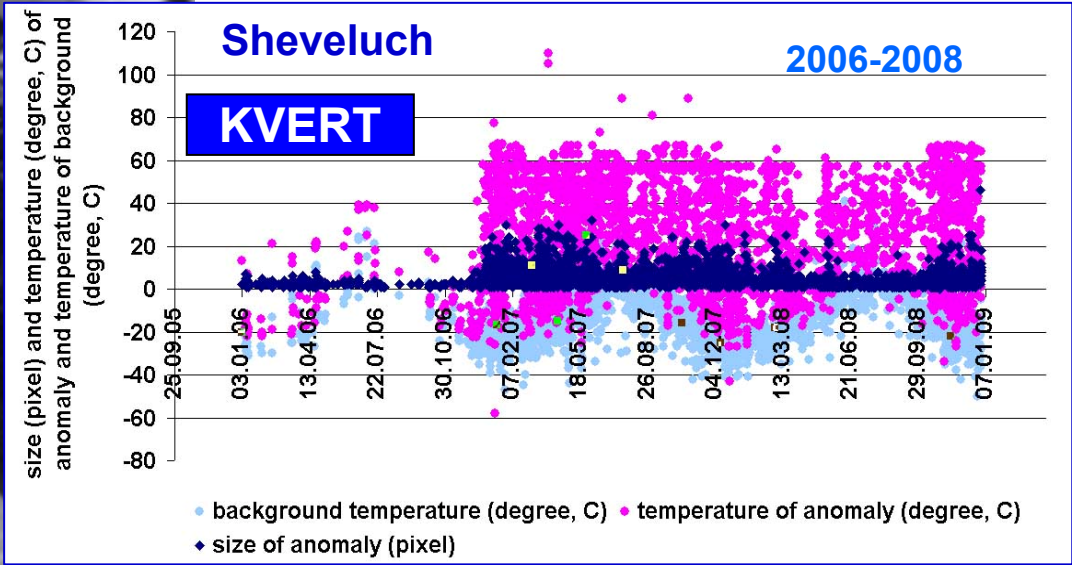
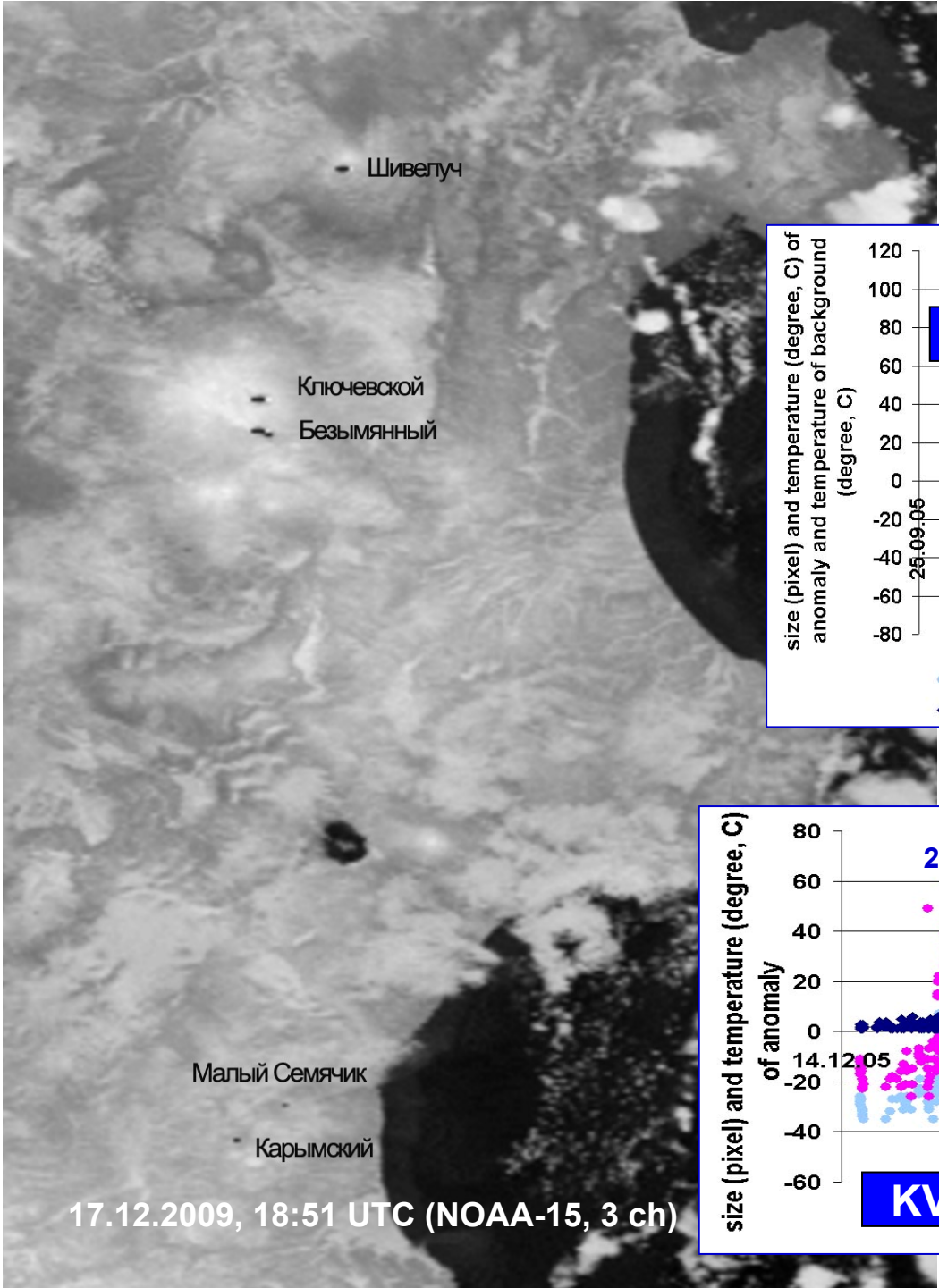
Institute of volcanology and seismology, KVERT & Weathernews Inc. 2013-10-18 19:14:16

## KVERT analyses:

- Visual data of Koryaksky, Avachinsky, Gorely, Mutnovsky
- Video data of Klyuchevskoy, Sheveluch, Bezymianny, Koryaksky, Avachinsky, Gorely, Kizimen
- Seismic data (from KBGS RAS) (Klyuchevskoy, Sheveluch, Bezymianny, Koryaksky, Avachinsky, Gorely, Karymsky, Kizimen, Plosky Tolbachik, Ushkovsky) <sup>9</sup>

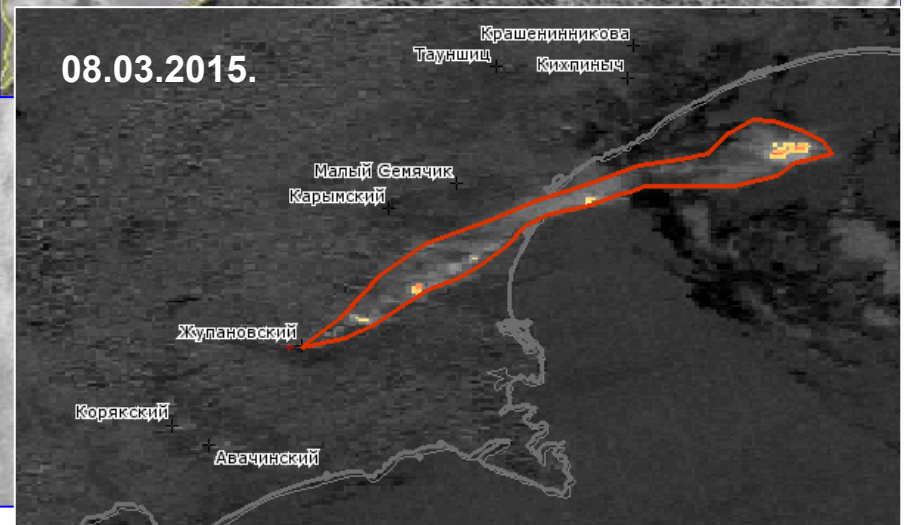
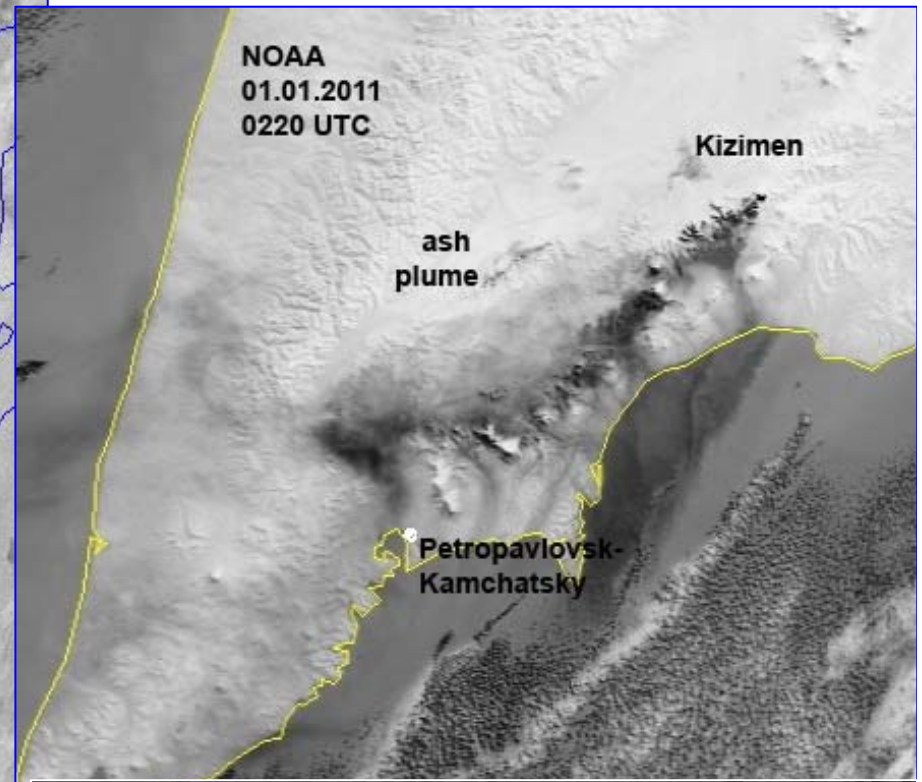
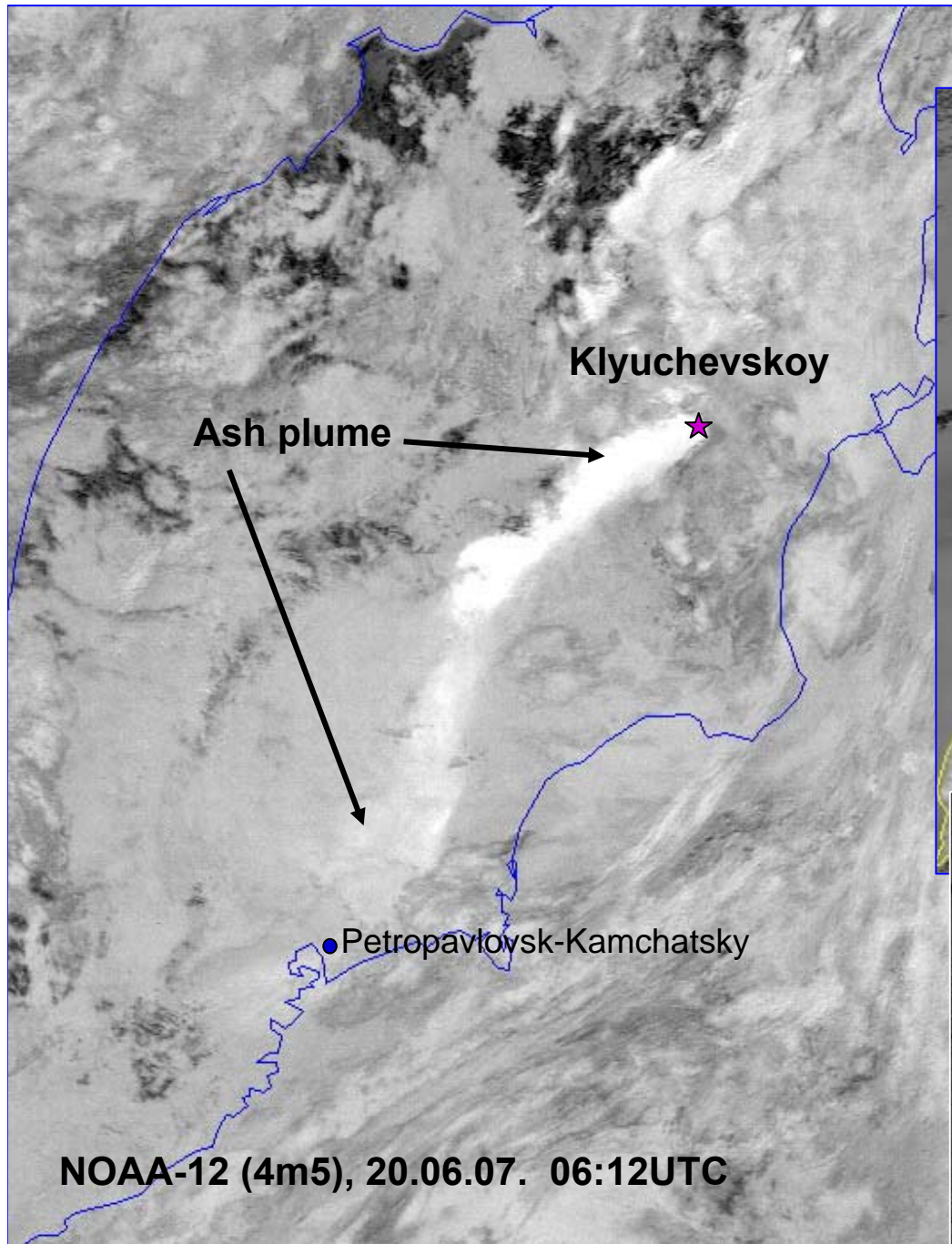


# Thermal anomalies at Kamchatkan volcanoes



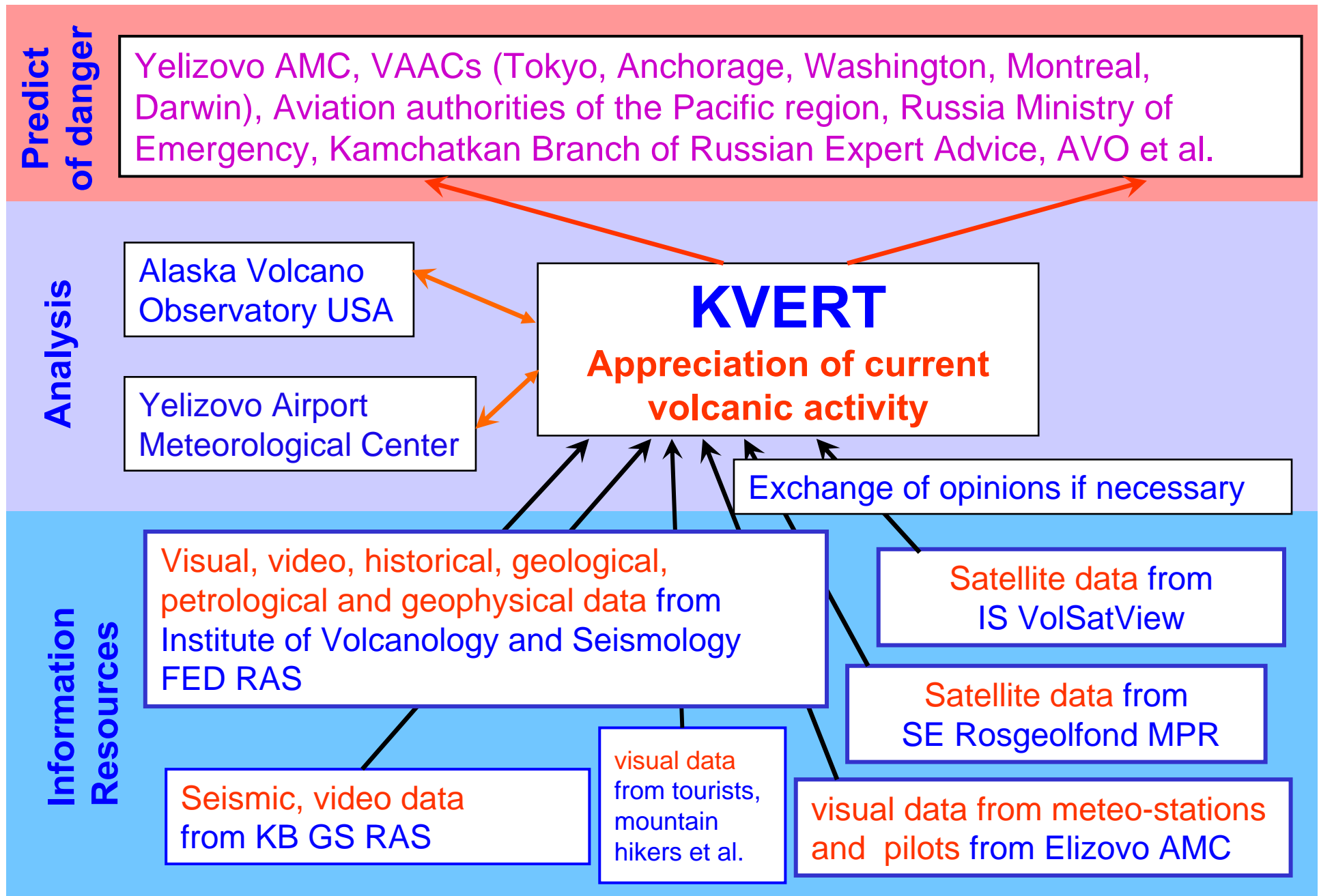


# Ash plumes





# Scheme of monitoring volcanic danger at Kamchatka and Northern Kuriles



# **KVERT: warning about the dangers**

**KVERT: duty scientist by telephone - 24/7 since 2005**

**Basic information about the active volcanoes of the region and their potential hazard to aviation, Aviation color codes and others are presented in the electronic catalogue:**

[www.kscnet.ru/ivs/kvert/volcano.php](http://www.kscnet.ru/ivs/kvert/volcano.php)

**Since 2012, KVERT releases are preparing and mailing to users with help of the computer-aided web-system and posting on KVERT website: [www.kscnet.ru/ivs/kvert/](http://www.kscnet.ru/ivs/kvert/)**

**KVERT issues the VONA, Weekly and Daily releases about activity of Kamchatkan volcanoes: [www.kscnet.ru/ivs/kvert/van/](http://www.kscnet.ru/ivs/kvert/van/)**

Information about the state of the volcanoes, and volcanic events (ash explosions, clouds and plumes) and their characteristics (date, height, directions and the others) are stored in Activity of Kamchatka and Northern Kuriles volcanoes database. Current and archive data are available at KVERT-website and in the Volcanoes of Kurile-Kamchatka Island Arc (VOKKIA) Information system on the IVS FEB RAS Geoportal (<http://geoportal.kscnet.ru/volcanoes/van/>).

# KVERT: warning about the dangers



**KVERT**

Google™ Custom Search

## Kamchatka Volcanic Eruption Response Team

IYS FEB RAS | Aviation color codes | Catalogue of active volcanoes | Map of active volcanoes | About KVERT | Search
Russian

**Main**

- Aviation color codes
- Volcanic danger prognosis for aviation (in Russian)
- Current activity of the volcanoes (photos)
- KVERT/Volcano Observatory Notification to Aviation (VONA)
- VONA/KVERT Information Releases
- KVERT Weekly Releases
- KVERT Daily Reports
- KVERT Operative Reports

**Kamchatka and the Northern Kuriles volcanoes: Erupting or Restless**

Sheveluch	Karymsky	Alaid	Bezymianny	Klyuchevskoy
				
8/10/2015	10/2015	8/10/2015	24/9/2015	24/9/2015

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**KVERT/Volcano Observatory Notification to Aviation**

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

(2) Issued: 20151009/0004Z

(3) Volcano: Sheveluch (CAVW #300270)

(4) Current Aviation Color Code: **ORANGE**

(5) Previous Aviation Color Code: orange

(6) Source: KVERT

(7) Notice Number: 2015-200

(8) Volcano Location: N 56 deg 38 min E 161 deg 18 min

(9) Area: Kamchatka, Russia

(10) Summit Elevation: 10768.24 ft (3283 m), the dome elevation ~8200 ft (2500 m)

(11) Volcanic Activity Summary: Explosions from 2347 UTC on October 08 send ash up to 4-4.5 km a.s.l., and ash plume drift about 25 km to the south-east of the volcano.

Explosive-extrusive 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.

(12) Volcanic cloud height: 13120-14760 ft (4000-4500 m) a.s.l. Time and method of ash plume/cloud height determination: 20151008/2358Z - Video data

(13) Other volcanic cloud information: Distance of ash plume/cloud of the volcano: 16 mi (25 km)  
 Direction of drift of ash plume/cloud of the volcano: SSE / azimuth 164 deg  
 Time and method of ash plume/cloud determination: 20151008/2358Z - Video data

**Webcams:**

- Plosky Tolbachik volcano
- Klyuchevskoy volcano
- Sheveluch volcano
- Bezymianny volcano
- Kizimen volcano
- Gorely volcano
- Avachinsky volcano
- Koryaksky volcano
- All webcams

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**Active Volcanoes in Google Earth**



<http://www.kscnet.ru/ivs/kvert>



# KVERT: warning about the dangers

Russian

**VONA/KVERT DAILY REPORT**  
**Kamchatkan and Northern Kuriles Volcanic Activity**  
 October 09, 2015, all times in UTC

**SHEVELUCH VOLCANO (CAVW #300270)**  
**56.64 N, 161.32 E; Elevation 10768 ft (3283 m)**  
**Aviation Color Code is ORANGE**

A growth of the lava dome summit and hot avalanches over the volcano. Gas plumes extended about 66 km to the southeast of the volcano.

**KARYMSKY VOLCANO (CAVW #300130)**  
**54.05 N, 159.44 E; Elevation 4874 ft (1486 m)**  
**Aviation Color Code is ORANGE**

Moderate explosive eruption with ash clouds.

**KLYUCHEVSKOY VOLCANO (CAVW #300270)**  
**56.06 N, 160.64 E; Elevation 10768 ft (3283 m)**  
**Aviation Color Code is ORANGE**

A weak explosive eruption of the volcano was noted. Gas plumes extended about 66 km to the southeast of the volcano.

**BEZYMIANNY VOLCANO (CAVW #300270)**  
**55.97 N, 160.6 E; Elevation 10768 ft (3283 m)**  
**Aviation Color Code is ORANGE**

A gas-steam activity of the volcano.

**ALAIID VOLCANO (CAVW #300130)**  
**50.86 N, 155.56 E; Elevation 4874 ft (1486 m)**  
**Aviation Color Code is ORANGE**

Moderate eruptive activity with ash clouds.

**CONTACT INFORMATION**

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 E-mail: girina@kscnet.ru

Tel. Duty scientist: +79 172 52 31 11

- Main
- Aviation color codes
- Volcanic danger prognosis for aviation (in Russian)
- Current activity of the volcanoes (photos)
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**VONA/KVERT Releases**

- VONA/KVERT Information Releases
- KVERT Weekly Releases**
- KVERT Daily Reports
- KVERT Operative Reports
- All VONA/KVERT Releases

- 2015
- 2014
- 2013
- 2012

**Archives in the old format**

- VONA/KVERT Information Releases (01.2005-05.2012)
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012

**VONA/KVERT WEEKLY INFORMATION RELEASE 41-2015**  
**Kamchatkan and Northern Kuriles Volcanic Activity**  
 October 08, 2015, 22:39 UTC (October 09, 2015, 10:39 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**

KARYMSKY, SHEVELUCH: **ORANGE**  
 BEZYMIANNY, KLYUCHEVSKOY: **YELLOW**  
 AVACHINSKY, DIKY GREBEN, GAMCHEN, GORELY, ICHINSKY, ILIINSKY, KAMBALNY, KHANGAR, KHODUTKA, KIKHPINYCH, KIZIMEN, KOMAROV, KORYAKSKY, KOSHELEV, KRASHENINNIKOV, KRONOTSKY, KSUDACH, MALY SEMYACHIK, MUTNOVSKY, OPALA, PLOSKY TOLBACHIK, TAUNSHITS, USHKOVSKY, VYSOKY, ZHELTOVSKY, ZHUPANOVSKY: **GREEN**

**NORTHERN KURILES**

ALAIID: **YELLOW**  
 CHIKURACHKI, EBEO, FUSS PEAK, KARPINSKY, TATARINOV: **GREEN**

**SHEVELUCH VOLCANO (CAVW #300270)**  
**56.64 N, 161.32 E; Elevation 10768 ft (3283 m), the dome elevation ~8200 ft (2500 m)**  
**Aviation Color Code is ORANGE**

Explosive-extrusive 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.

A growth of the lava dome continues (a viscous lava flow extrude on the northern its flank), fumarolic activity and an incandescence of the dome blocks and hot avalanches accompanies this process. Satellite data by KVERT showed a thermal anomaly over the lava dome all week. Explosions and hot avalanches from the lava dome sent ash up to 2.5-5.5 km a.s.l. and the ash plumes drifted about 400 km to the southeast of the volcano on October 02 and 07-08.  
<http://www.kscnet.ru/ivs/kvert/volc.php?lang=en&name=Sheveluch>

**KARYMSKY VOLCANO (CAVW #300130)**  
**54.05 N, 159.44 E; Elevation 4874 ft (1486 m)**  
**Aviation Color Code is ORANGE**

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

Moderate explosive eruption of the volcano continues. Satellite data by KVERT showed a thermal anomaly over the volcano on October 04 and 08; ash plume extended about 50 km to the southeast of the volcano on October 08.

Aviation Color Codes
<p><b>GREEN</b></p> <p>Volcano is in normal, non-eruptive state</p> <p><i>or, after a change from a higher level:</i></p> <p>Volcanic activity considered to have ceased, and volcano reverted to its normal, non-eruptive state.</p>
<p><b>YELLOW</b></p> <p>Volcano is experiencing signs of elevated unrest above known background levels.</p> <p><i>or, after a change from higher level:</i></p> <p>Volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.</p>
<p><b>ORANGE</b></p> <p>Volcano is exhibiting heightened unrest with increased likelihood of eruption.</p> <p><i>or,</i></p> <p>Volcanic eruption is underway with no or minor ash emission.  <i>[specify ash-plume height if possible]</i></p>
<p><b>RED</b></p> <p>Eruption is forecast to be imminent with significant emission of ash into the atmosphere likely.</p> <p><i>or,</i></p> <p>Eruption is underway with significant emission of ash into the atmosphere.  <i>[specify ash-plume height if possible]</i></p>



kamchatka.volcanoes.smislab.ru/static/index.shtm

Информационный сервис  
«Дистанционный мониторинг активности вулканов Камчатки и Курил»  
VolSatView

Вход в систему

Login пользователя:

Пароль:

Основной задачей создающегося сервиса VolSatView является обеспечение специалистов-вулканологов оперативными спутниковыми данными и различными информационными продуктами, получаемыми на основе их обработки, для мониторинга вулканической активности Камчатки и Курил.

На первом этапе работ сервис рассчитан на работу с данными поступающими со спутников NOAA, Terra, Aqua, Meteor M №1 и LANDSAT. Сервис создается и поддерживается специалистами:  
[Институт вулканологии и сейсмологии Дальневосточного отделения РАН \(ИВиС ДВО РАН\)](#)  
[Вычислительный центр Дальневосточного отделения РАН \(ВЦ ДВО РАН\)](#)  
[Институт Космических Исследований РАН \(ИКИ РАН\)](#)  
[Дальневосточный Центр НИЦ "Планета" \(ДЦ НИЦ "Планета"\)](#)

Сервис развивается с на основе многолетнего опыта мониторинга вулканической активности накопленного в ИВиС ДВО РАН. Сбор и обработка спутниковых данных поступающих в сервис осуществляется в ДЦ НИЦ "Планета" и ИКИ РАН. Для работы с данными созданы информационные сервера в ВЦ ДВО РАН, ИВиС ДВО РАН и ИКИ РАН. Для обеспечения оперативного обмена данными в сервисе использованы ресурсы Региональной компьютерной сети ДВО РАН и Корпоративной сети РАН.

Сервис создается на основе технологий автоматической обработки данных созданных в ИКИ РАН и НИЦ "ПЛАНЕТА". Интерфейс предоставления данных создается на основе технологии [GEOSMIS](#). Для обеспечения оперативного обмена данными между центрами сбора данных и базовыми узлами системы (ИКИ РАН, ВЦ ДВО РАН, ИВиС ДВО РАН), использованы ресурсы Региональной компьютерной сети ДВО РАН и Корпоративной сети РАН.

Сервис создается при поддержке проекта РФФИ проект 11-07-12026-офи-м-2011 и Комплексной программы фундаментальных научных исследований ДВО РАН "Современная геодинамика, активные геоструктуры и природные опасности Дальнего Востока России"

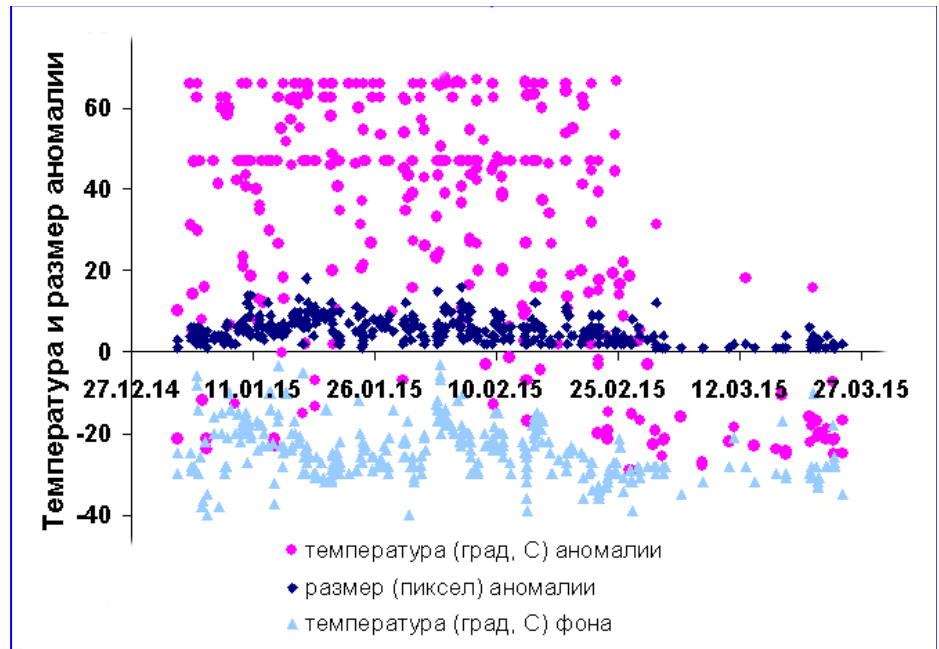
© ИКИ РАН, ИВиС ДВО РАН, ВЦ ДВО РАН, ДЦ НИЦ "Планета", 2011-2013

In 2011-2015, the combined efforts of experts from IVS FEB RAS, SRI RAS, CC FEB RAS and FEC FSI RCSH Planeta led to the development of the information system (IS) called **Monitoring of Activity of Kamchatkan Volcanoes: VolSatView**, <http://volcanoes.smislab.ru> IS allows working with various satellite data of middle to high resolution, meteorological and instrumental information from on-ground observation networks and to conduct combined analyses of diverse data.

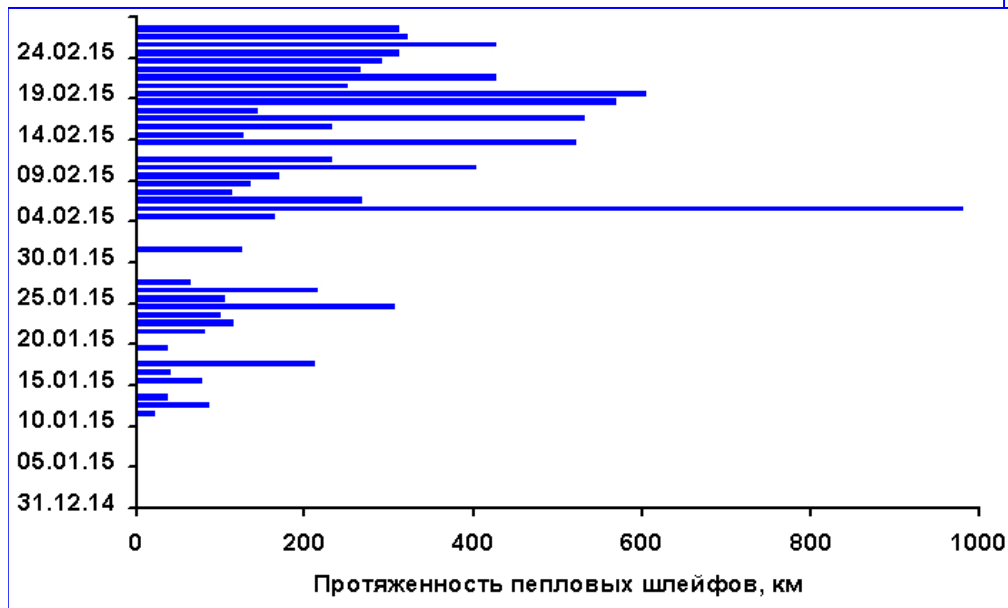
# Klyuchevskoy

Explosive-effusive eruption

01.01.- 24.03.2015



The thermal anomaly over the volcano, data from IS VolSatView



Distances of ash plumes in 2015, data from IS VolSatView



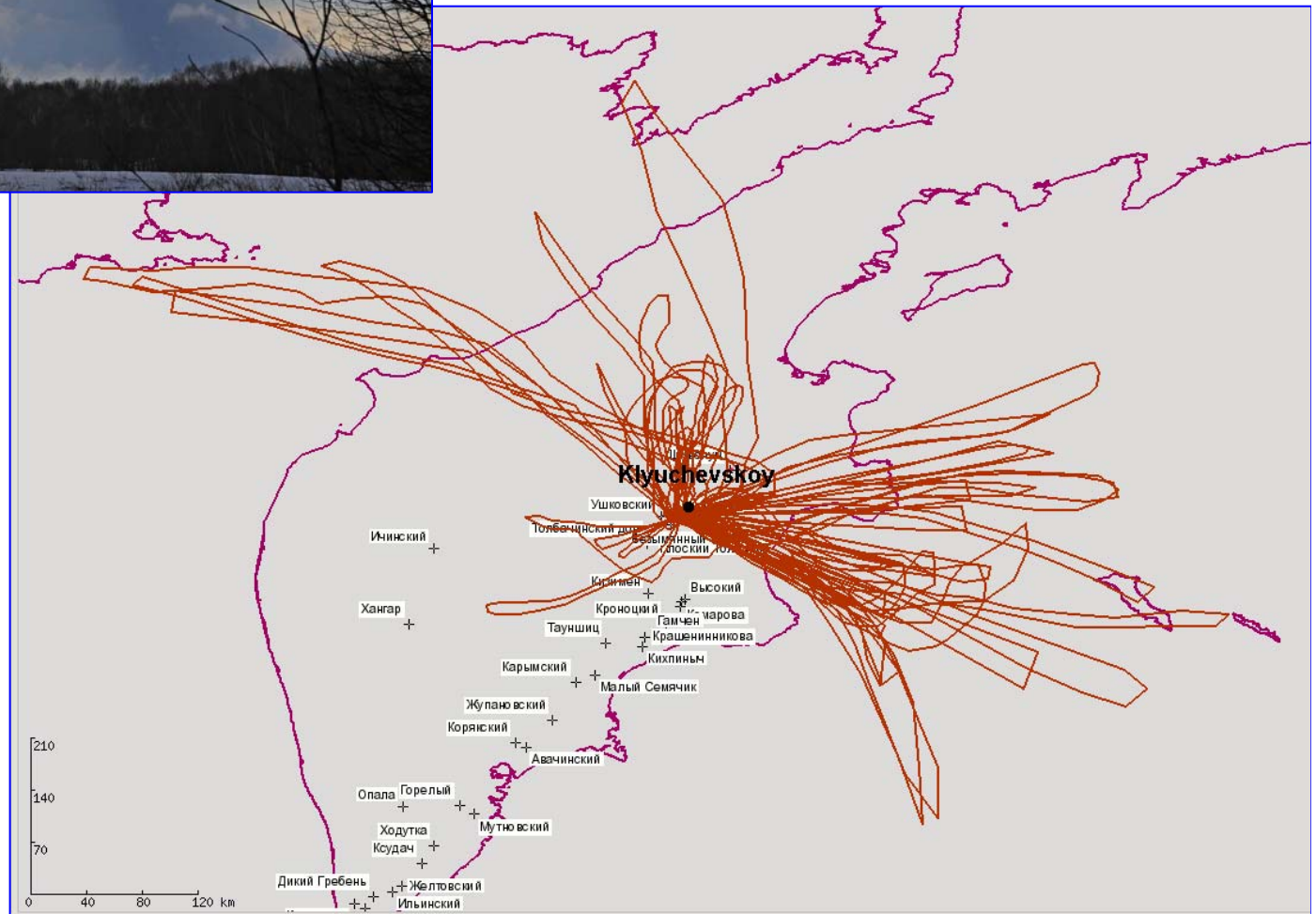




# Klyuchevskoy

Paroxysmal phase  
of the eruption  
15.02.2015.

Ash plumes of  
Klyuchevskoy  
volcano  
in 2014-2015, data  
from IS VolSatView



## Sheveluch volcano

The eruptive activity of Sheveluch Volcano began since 1980 (growth of the lava dome) and is continuing at present.

A growth of the lava dome continues (a viscous lava extrude in the northern its part), fumarole activity and an incandescence of the dome blocks and hot avalanches accompanies this process.

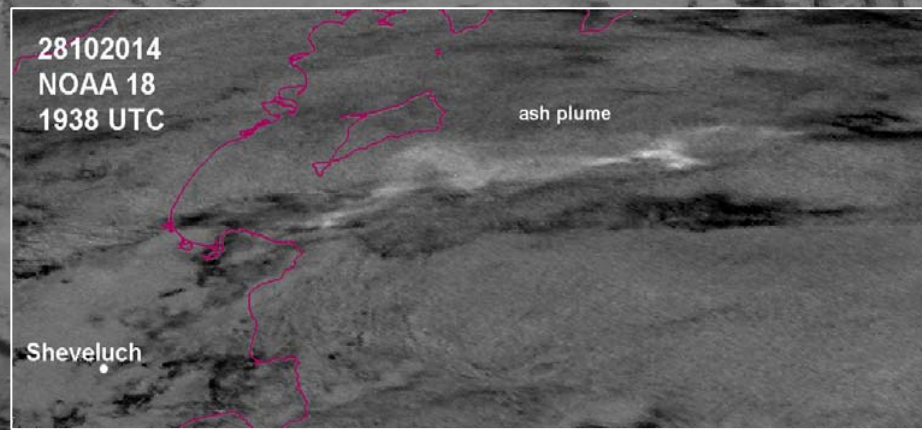
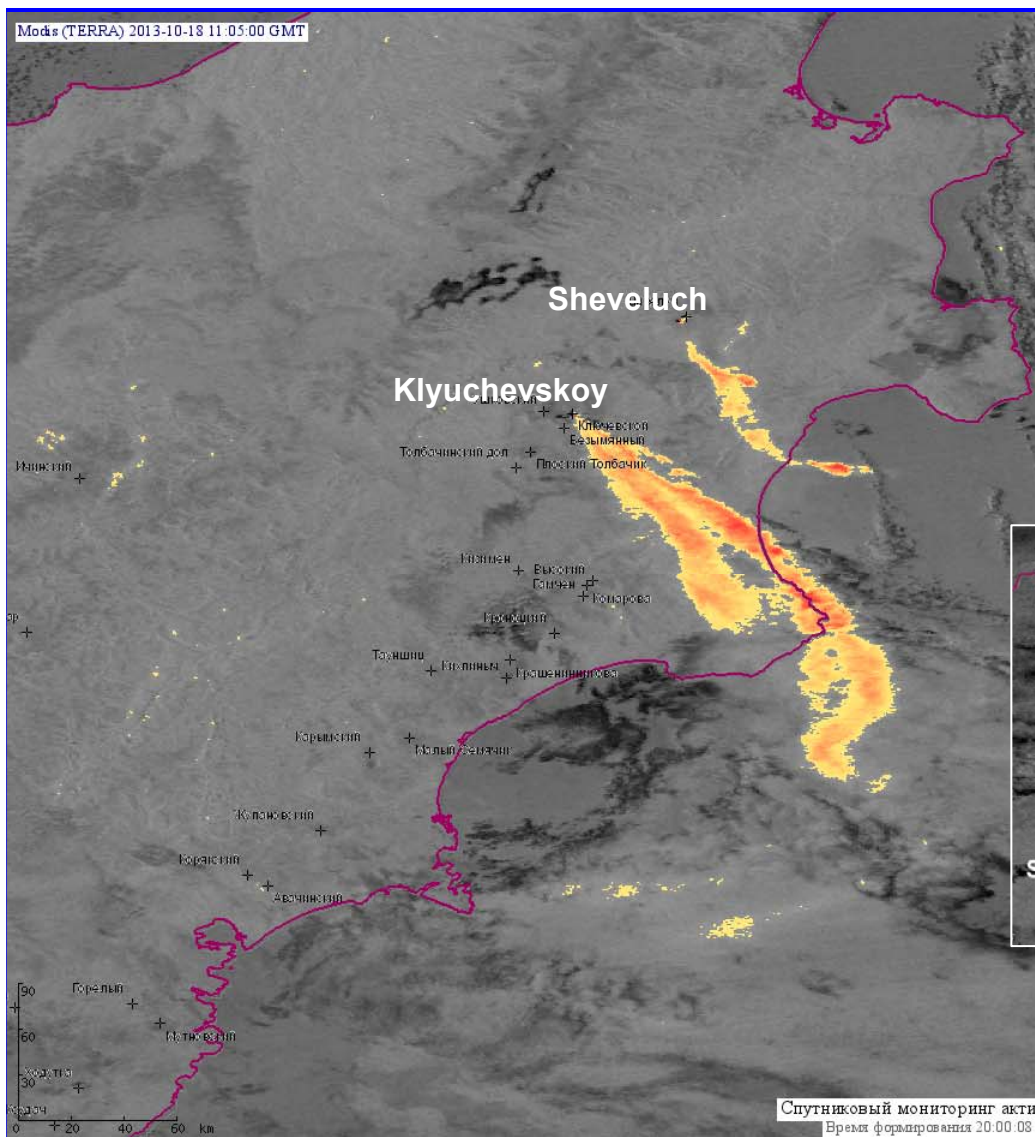




# Ash plumes

Sheveluch

25.03.2015



Data from IS VolSatView



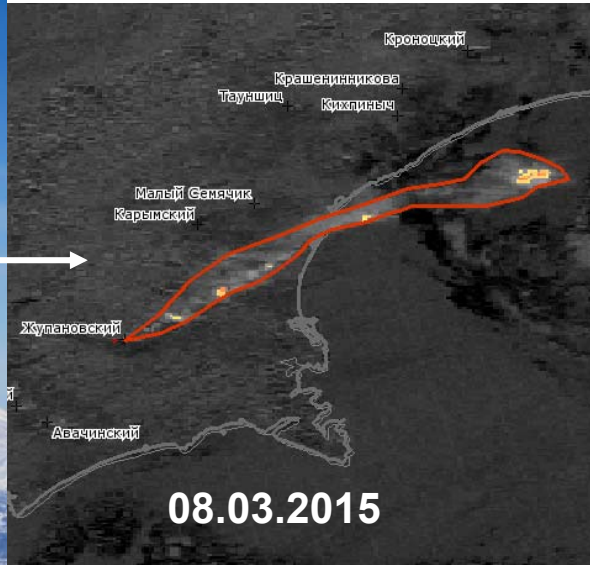
# Zhupanovsky volcano

08.03.2015



© A. Gavrilov

**Explosive eruption**  
**06.06.2014. –**  
**14.07.2015.**



08.03.2015

28.11.2014,  
00:12 UTC



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17.07.2014

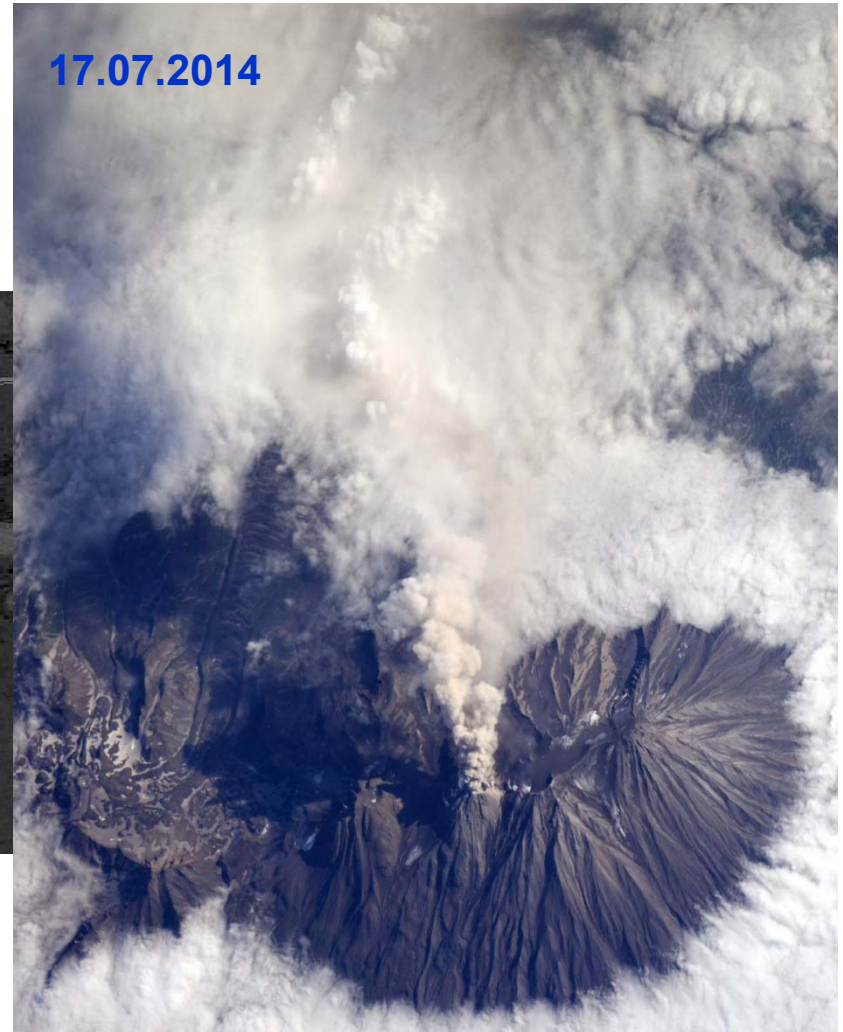
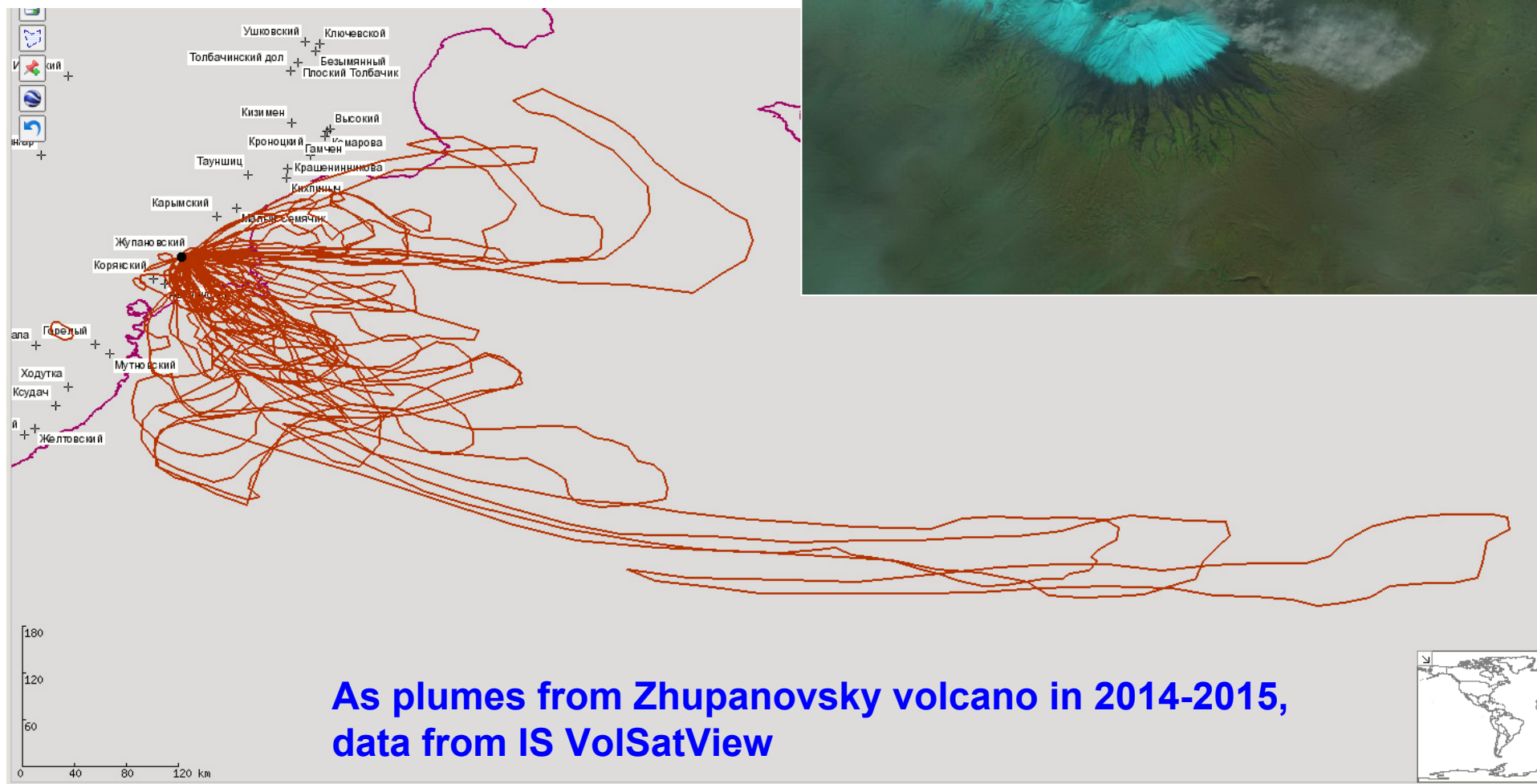
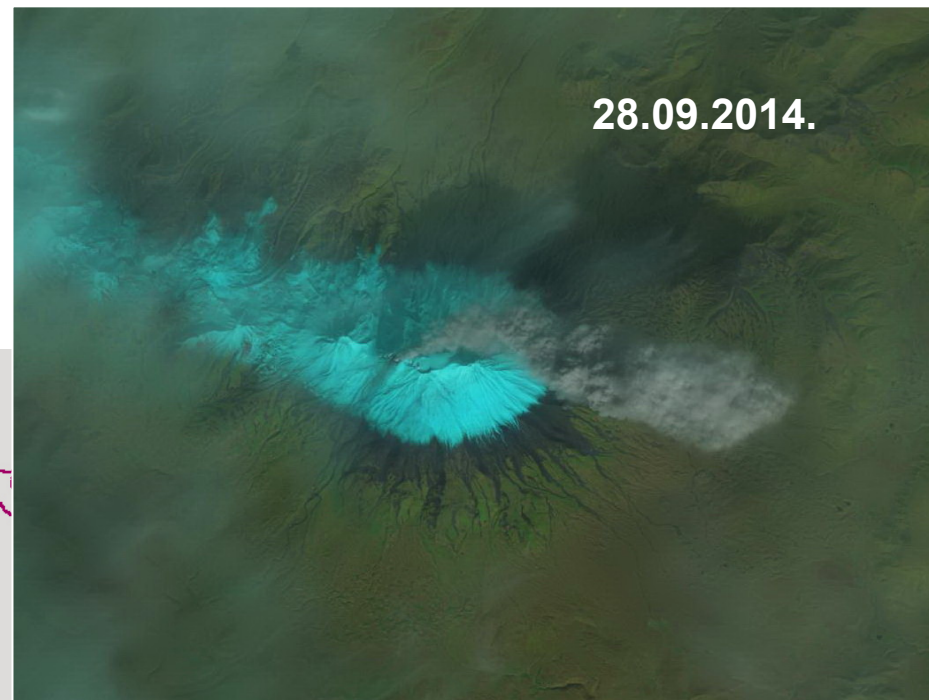
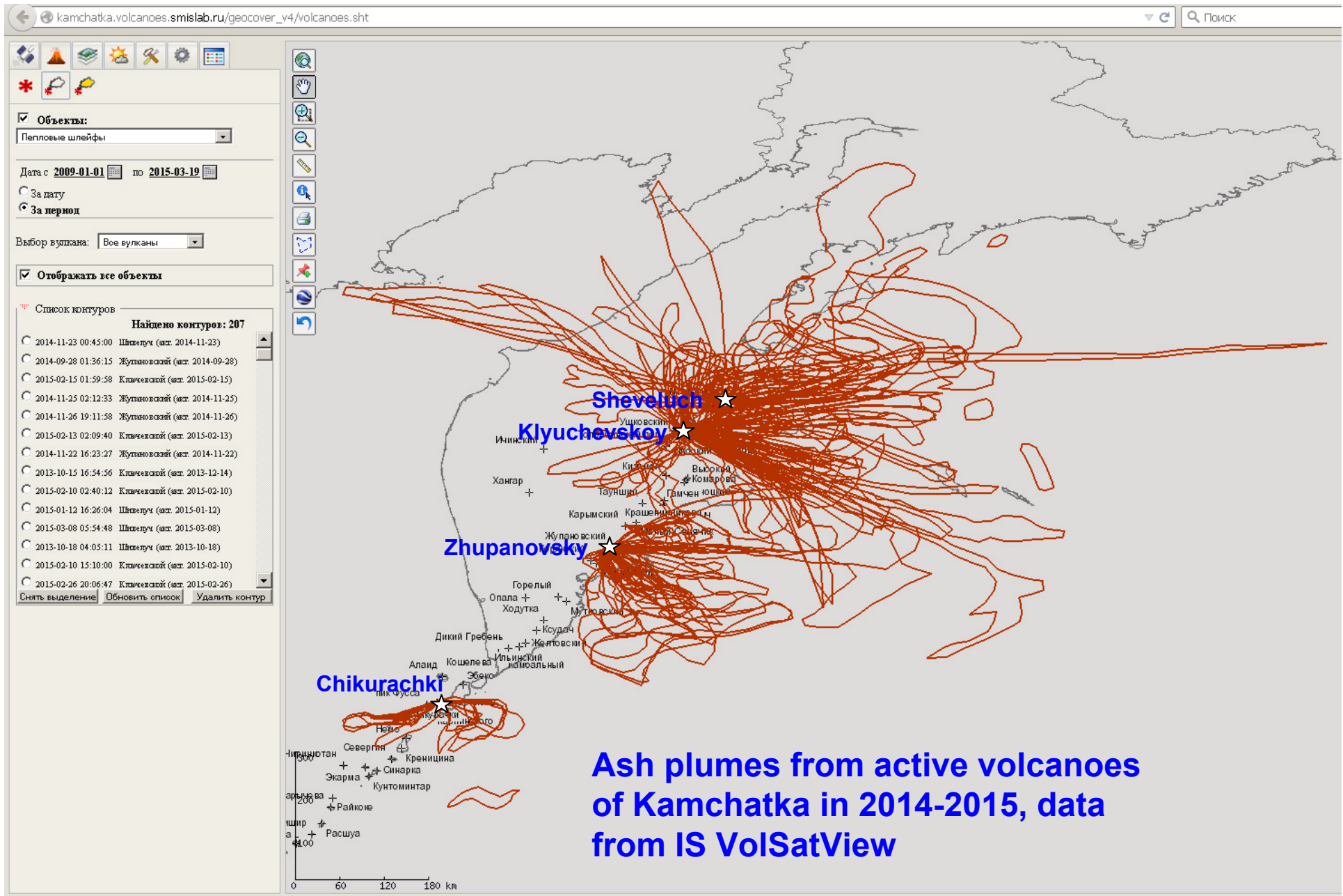


Photo by O. Artemiev (ISS - Expedition 39/40) on the project "Monitoring of Kurile-Kamchatkan volcanoes of island arc" (head Dr. A. Khrenov). Joint research of volcanoes is performing for the first time under the aegis of the Federal Space Agency - Roskosmos (RSC "Energia" and Yu. Gagarin CPC) and in collaboration with the Russian Academy of Sciences (IGEM RAS and IVS FEB RAS).

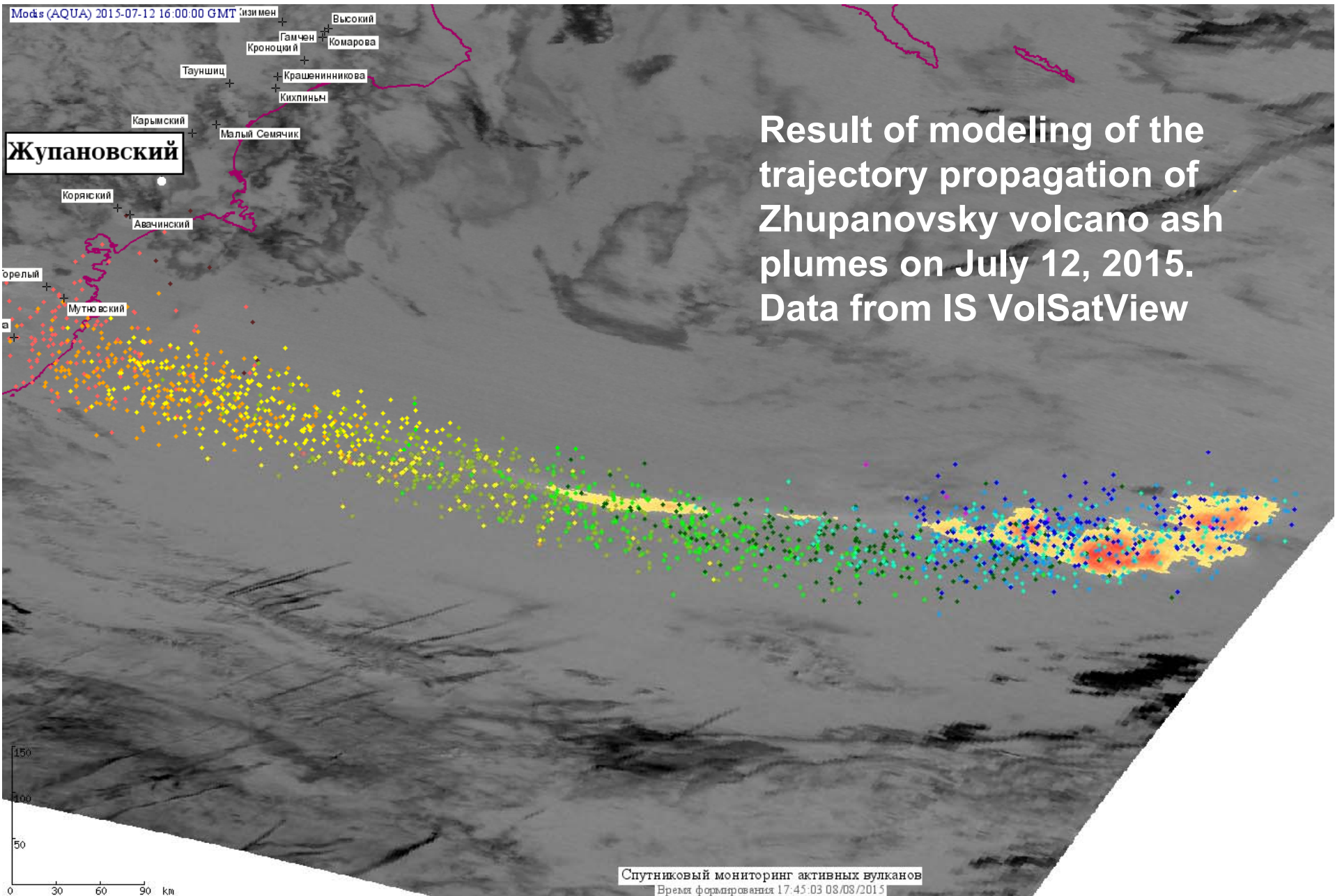
# Zhupanovsky volcano



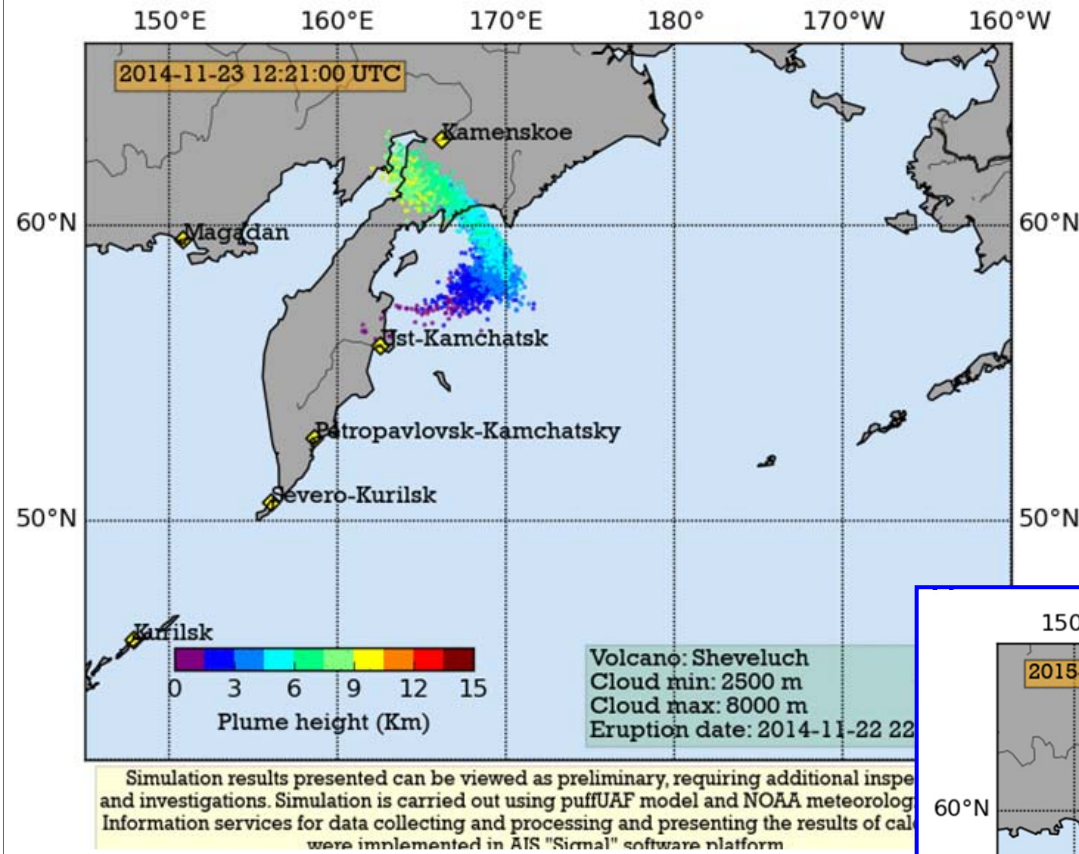




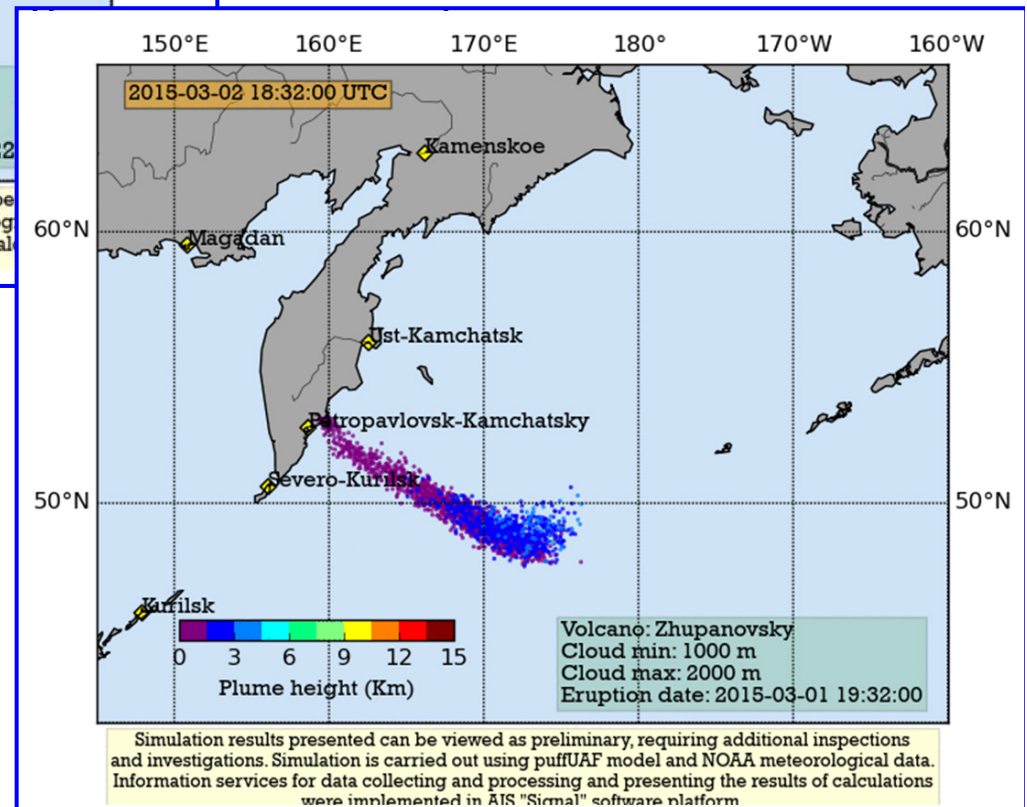




# Sheveluch



This PUFF made in Computing Center of FED RAS (Khabarovsk) on the base of model PUFFUAF, realized in University of Alaska Fairbanks (<https://www.uaf.edu/>)





**Thanks to Attention!**



**Zhupanovsky, 08.11.2014.**

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