



A Day in the Life of a Volcano Observatory

Green	No eruption anticipated. Volcano is in quiet, "dormant" state.
Yellow	An eruption is possible in the next few weeks and may occur with little or no additional warning. Small earthquakes detected locally and (or) increased levels of volcanic gas emissions.
Orange	Explosive eruption is possible within a few days and may occur with little or no warning. Ash plume(s) but expected to reach 25,000 feet above sea level. Increased numbers of local earthquakes. Extrusion of lava dome or lava flows (non-explosive eruption) may be occurring.
Red	Major explosive eruption expected within 24 hours. Large ash plume(s) expected to reach at least 25,000 feet above sea level. Strong earthquake activity detected even at distant monitoring stations. Explosive eruption may be in progress.

Level of Concern Color Code

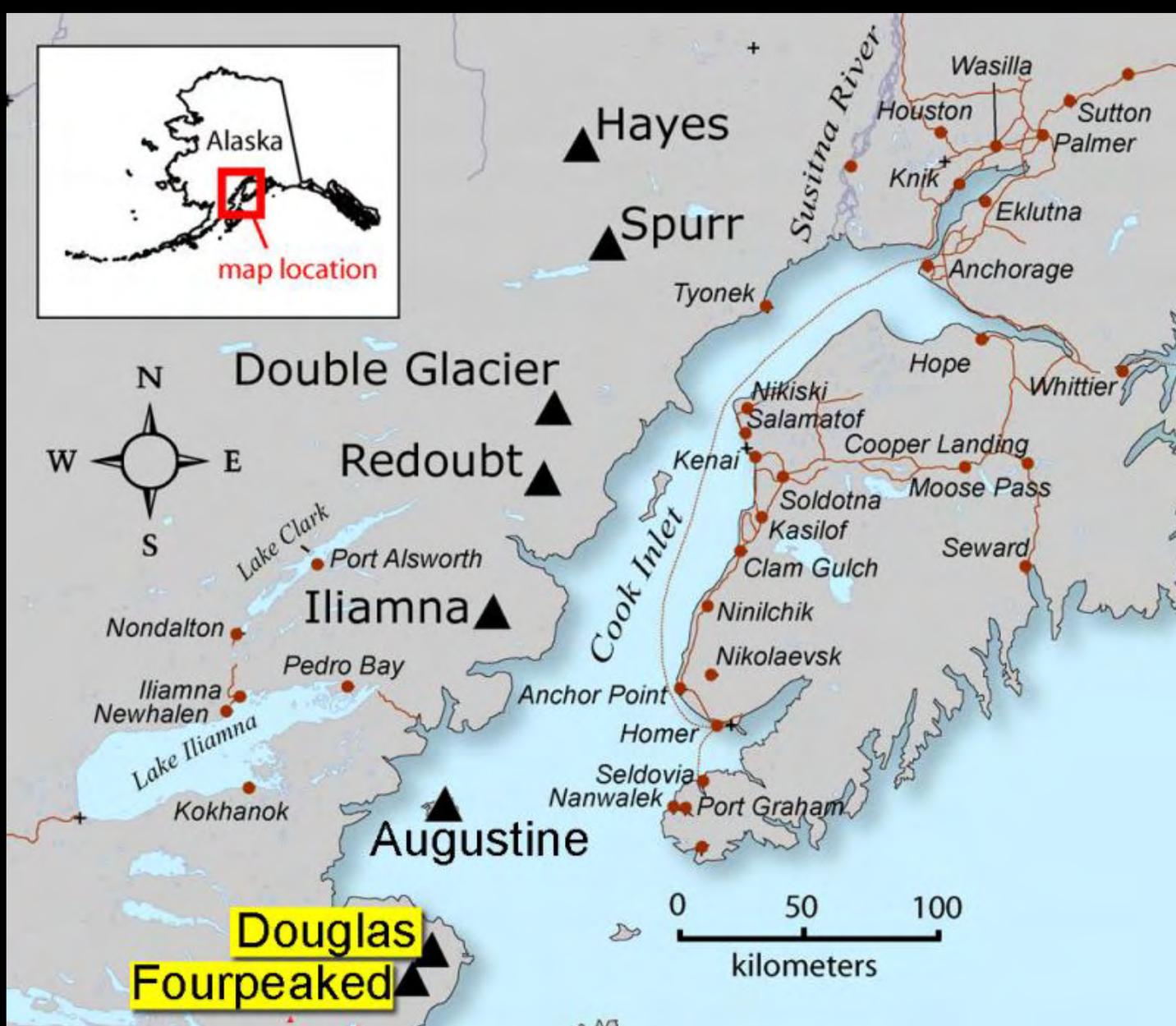


Discussion 1 (D1)

(Sept. 17 - 19)



It is September 17, a fine, crisp Sunday evening, and beginning at ~8:15 PM and over the next several hours, AVO received reports of two discrete plumes rising from the Cape Douglas area on the Alaska Peninsula within Katmai National Park and Preserve. The plumes reached approximately 20,000 ft above sea level. Cape Douglas from Main Street, Homer, Alaska, September 17, 2006. Photograph by Lanny Simpson, Alaska High Mountain Images, used with permission.



Location map of Fourpeaked and Douglas volcanoes. Image created by Seth Snedigar and J.R. Schaefer, Alaska Volcano Observatory/Alaska Division of Geological & Geophysical Surveys, dated September 18, 2006. <http://www.avo.alaska.edu/image.php?id=11079>



Discussion 2 (D2) **(Sept. 20 – 23)**



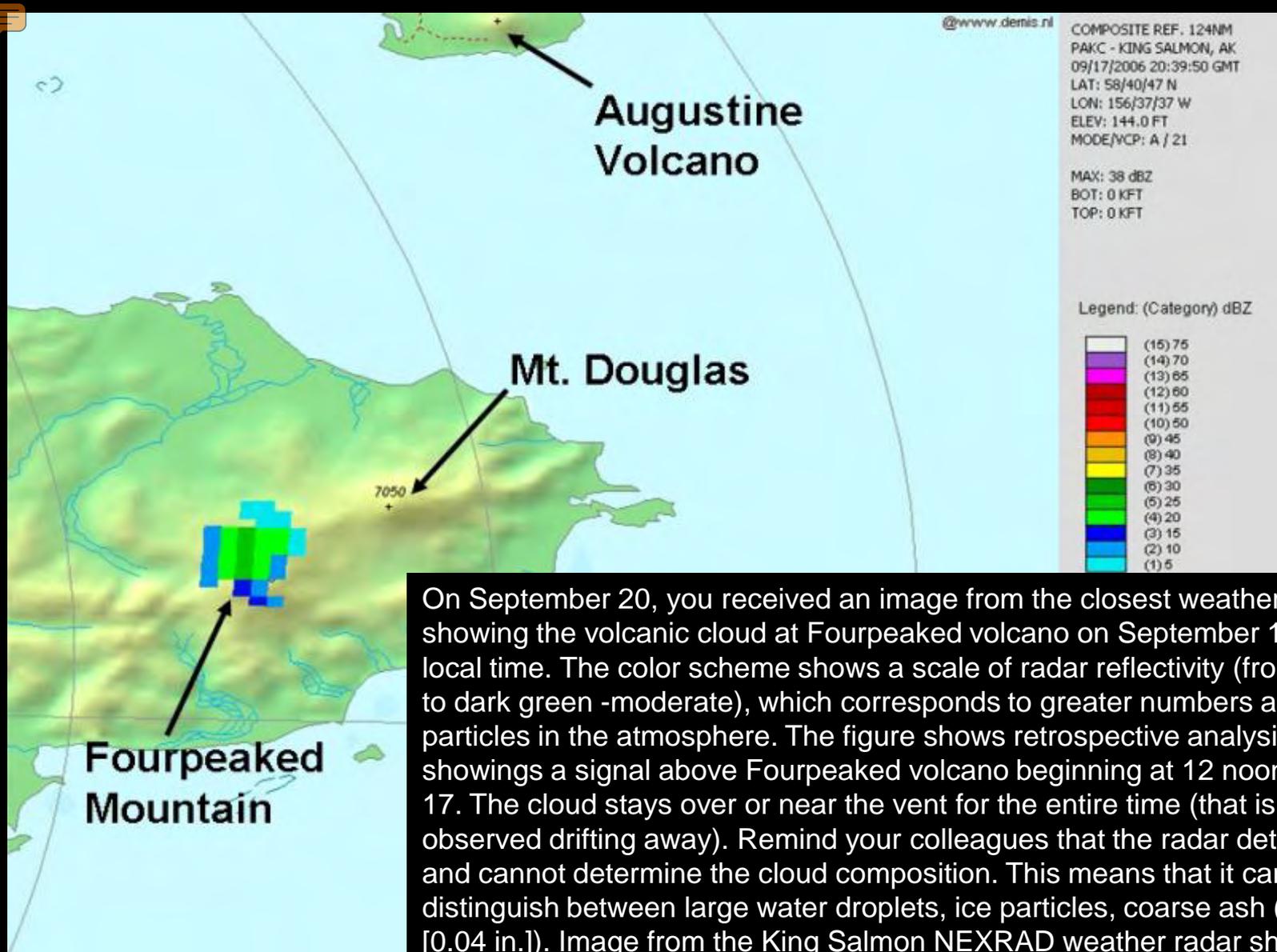
D2. Geophysicists



You also observed two steam plumes at Fourpeaked. The two steam plumes appeared, vigorous, similar in size, white (no evidence of ash) and were rising to ~ 11,000 ft. Photograph taken by Guy Tytgat, Alaska Volcano Observatory/University of Alaska Fairbanks Geophysical Institute, September 20, 2006.



You also observed a surface flow on the glacial ice on the northwest side of the mountain. It appeared as mud flows coming out of the glacial crevasses and extending for quite a distance down the glacier. Photograph taken by Guy Tytgat, Alaska Volcano Observatory/University of Alaska Fairbanks Geophysical Institute, September 20, 2006.

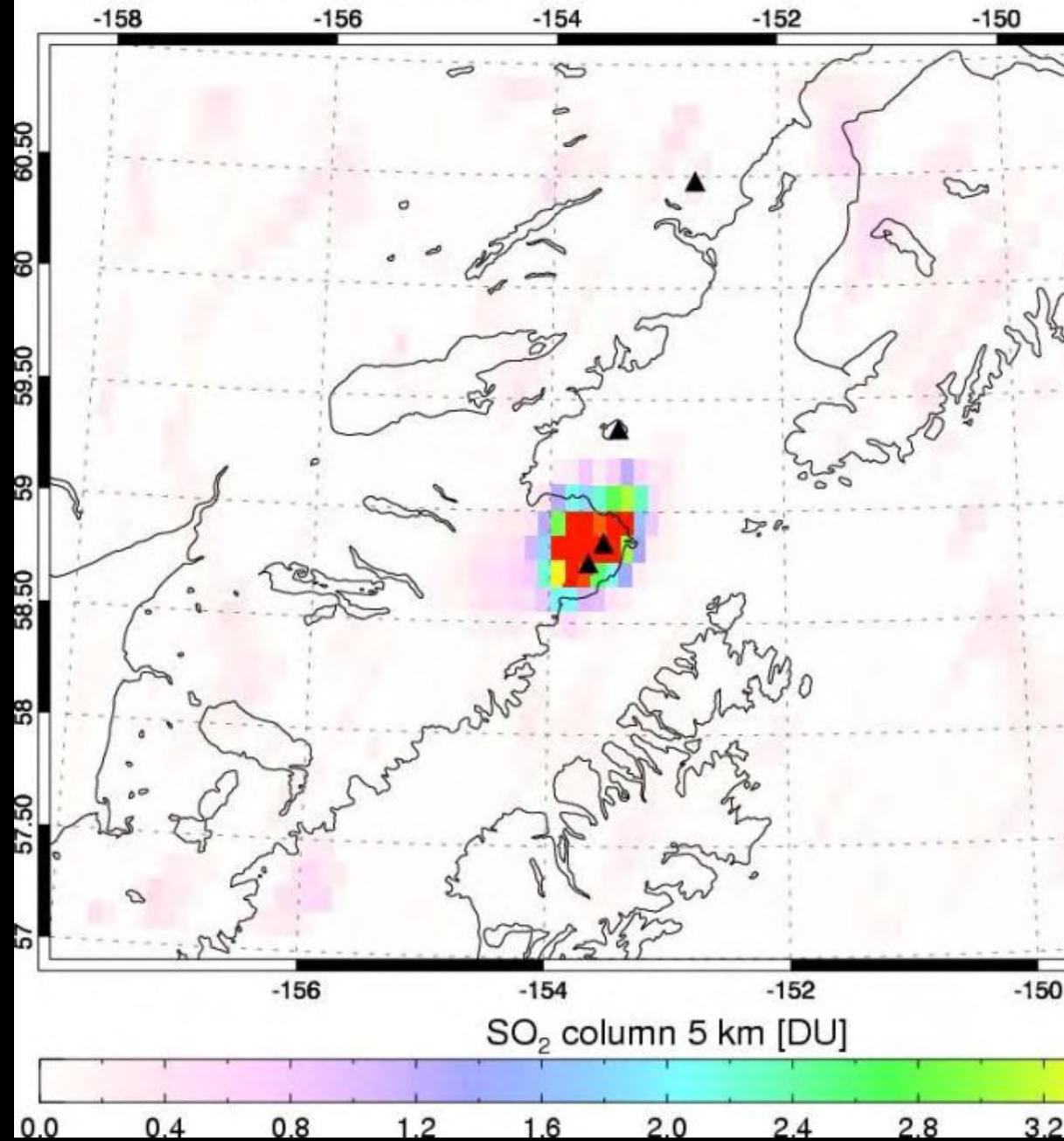


On September 20, you received an image from the closest weather radar station showing the volcanic cloud at Fourpeaked volcano on September 17 at 12:40 PM local time. The color scheme shows a scale of radar reflectivity (from light blue-low, to dark green -moderate), which corresponds to greater numbers and/or sizes of particles in the atmosphere. The figure shows retrospective analysis of radar data showings a signal above Fourpeaked volcano beginning at 12 noon on September 17. The cloud stays over or near the vent for the entire time (that is, it is not observed drifting away). Remind your colleagues that the radar detects reflectors and cannot determine the cloud composition. This means that it can see but not distinguish between large water droplets, ice particles, coarse ash (like mm size [0.04 in.]). Image from the King Salmon NEXRAD weather radar showing the volcanic cloud at Fourpeaked Mountain volcano on September 17, 2006, at 12:40 ADT (20:40 UTC). Image dated September 19, 2006. This image was produced by David Schneider, U.S. Geological Survey/Alaska Volcano Observatory, using data and software provided by the NOAA National Climatic Data Center.

<http://www.avo.alaska.edu/image.php?id=11086>.

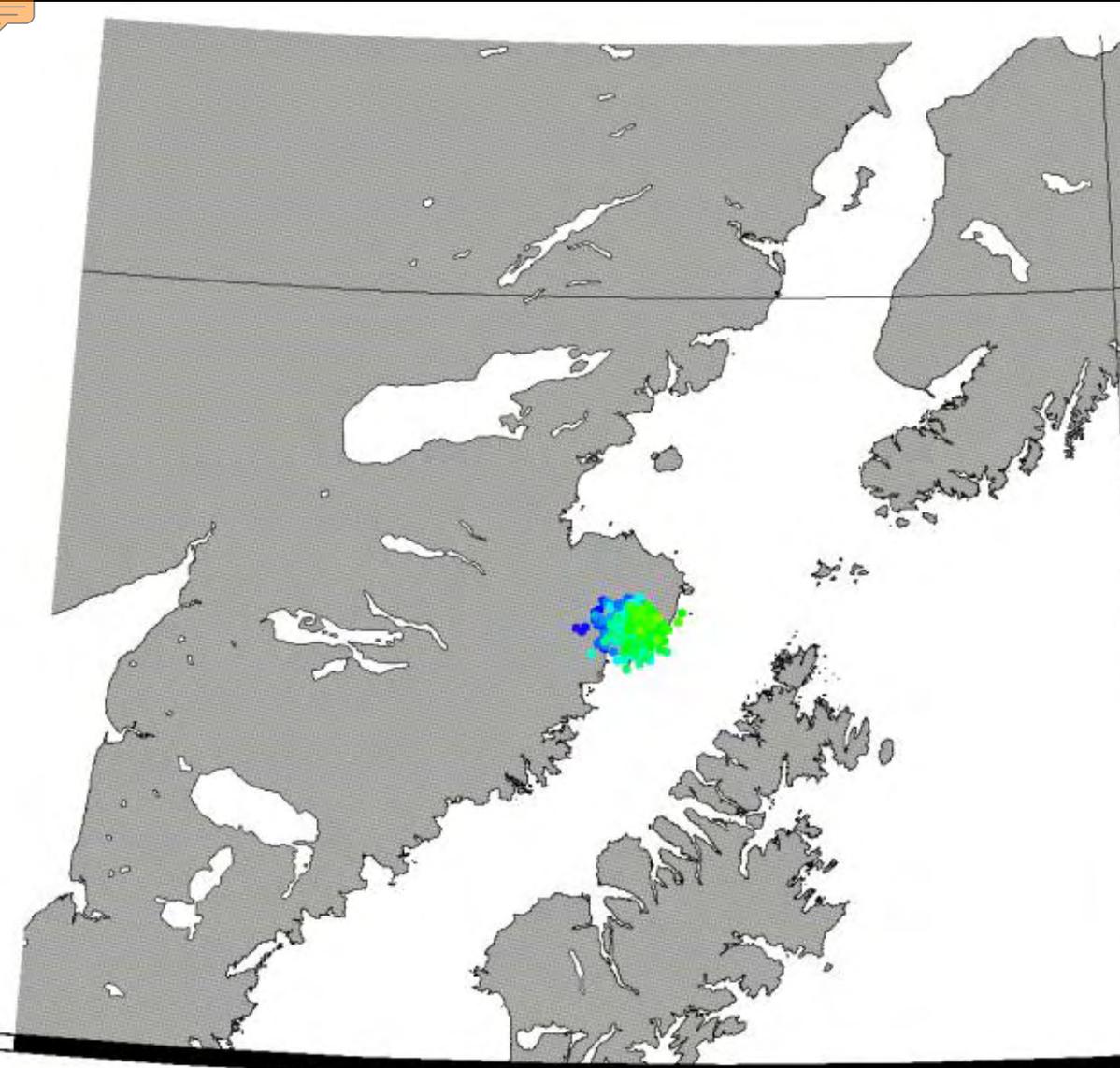
Aura/OMI - 09/17/2006 00:40-23:02 UT - Orbit 11573

SO₂ mass: 0.271 kt; Area: 3746 km²; SO₂ max: 6.52 DU at lon: -153.41 lat: 58.95



Also on September 20, colleagues (the volcanic emissions group at the University of Maryland Baltimore County, Baltimore, MD) emailed you an image showing the amount of sulfur dioxide in the atmosphere over Fourpeaked volcano at 3 PM on September 17. This image was created using data from the Ozone Monitoring Instrument (OMI) on NASA's EOS Aura satellite. This image confirms that the plume was volcanic! Nothing else you know of could produce approximately 300 tons of sulfur dioxide into the atmosphere except a volcano. Image showing the total amount of sulfur dioxide in the atmosphere over Fourpeaked Mountain volcano on September 17, 2006, as measured by the Ozone Monitoring Instrument (OMI) on NASA's Aura satellite. Image created by the volcanic emissions group at the University of Maryland Baltimore County, Baltimore, Md., USA, dated September 19, 2006 (S.A. Carn, N.A. Krotkov, A.J. Krueger, and K. Yang). OMI was built by a Dutch/Finnish collaboration and managed by KNMI and NIVR in the Netherlands.

<http://www.avo.alaska.edu/image.php?id=11085>.



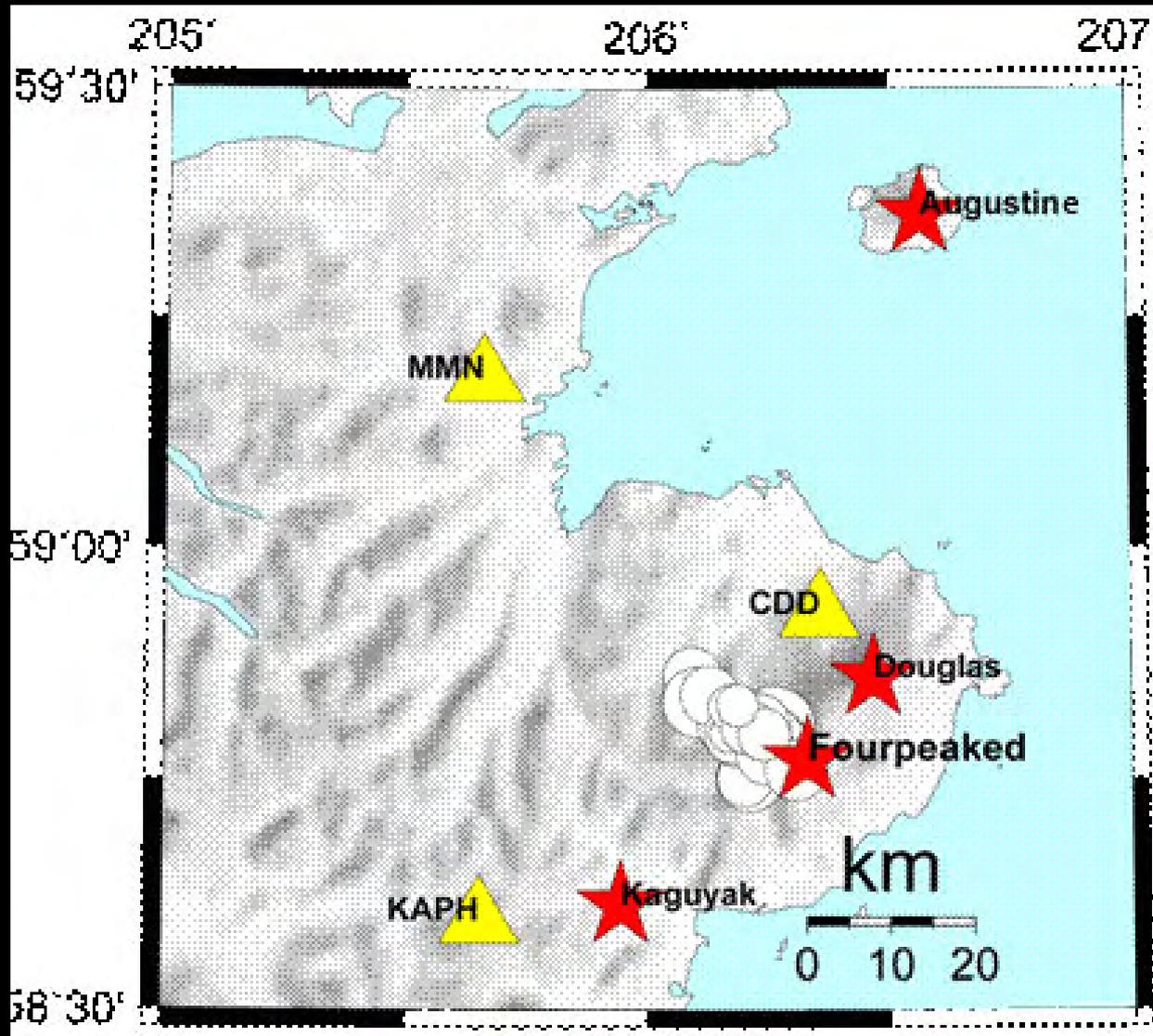
Fourpeaked
2006 09 17 23:00



Based on the satellite and weather radar data you now have, you ran the Puff volcanic ash dispersion model for the same time as the SO₂ OMI image you got from your colleagues in Maryland. The Puff generated image shows the predicted position of a volcanic cloud at 3 PM local time from Fourpeaked volcano on September 17. The Puff prediction showed the ash cloud to be 5 to 6 km asl. The color scheme at the bottom of the image shows the altitude scale (asl) for the ash cloud from 0 km (purple) to 8 km (red). Image from Puff volcanic ash dispersion model showing the predicted position of the volcanic cloud at 15:00 ADT (23:00 UTC) from Fourpeaked Mountain volcano on September 17, 2006. Image taken by Peter Webley, Alaska Volcano Observatory/University of Alaska Fairbanks, Geophysical Institute, dated September 20, 2006.

<http://www.avo.alaska.edu/image.php?id=11087>.

On September 21, you notice that a small swarm of earthquakes was detected on the regional seismic network from 11:48 AM to 3:50 PM on September 17. Sixteen of the earthquakes (white circles) were large enough to show up on stations in nearby Katmai, Oil Point, Augustine (yellow triangles), and in Kodiak (not pictured). The earthquakes magnitudes were between 0.8 and 1.8 and were clustered to the northwest of the Fourpeaked summit. The red stars are volcanoes (Alaska Volcano Observatory website).





On September 23, you went on a gas flight (a small airplane flight to make observations and use equipment to determine the types and amount of volcanic gases coming from the volcano). You saw a linear series of vents to the north and just below the summit of Fourpeaked. Gas was abundant. You measured carbon dioxide (CO_2), and you measured and could smell sulfur dioxide (rotten egg smell— SO_2), and hydrogen sulfide (striking a match smell— H_2S). Photograph taken by P. Cervelli, Geological Survey/Alaska Volcano Observatory September 23, 2006.



D2. Geologists



Terminus of Fourpeaked Glacier. Notice the dark-colored sediment issuing from an elongate tunnel in the ice that is distinctly different than the color of the proglacial lake. Photograph taken by K. Wallace, U.S. Geological Survey/Alaska Volcano Observatory, September 20, 2006.

<http://avo.alaska.edu/images/image.php?id=11102>.



Looking toward the north-northwest, the southeast ridge of Fourpeaked volcano has distinct, white steam plumes. Photograph taken during the helicopter observation flight between 19:40 and 20:30 local time, looking NNW. SE Ridge in the foreground, top of the "headwall" at the extreme right of the photograph and both plumes in the background. Photograph taken by Guy Tytgat, Alaska Volcano Observatory/University of Alaska Fairbanks Geophysical Institutel, September 20, 2006. <http://avo.alaska.edu/images/image.php?id=11132>.



You observed the headwall of Fourpeaked Glacier just northeast of the summit of Fourpeaked volcano. Waterfalls were issuing from beneath the ice at the top of the headwall at an elevation of 5,000 feet (1,900 feet below the summit). Headwall of Fourpeaked Glacier NE of the summit of Fourpeaked volcano. Waterfalls were issuing from beneath the ice at the top of the headwall at an elevation of 5,000 ft (1,900 ft below the summit). A convective vapor plume was rising above the cloud deck between the summit (obscured by clouds) and the headwall region. Photograph taken by K.L., Wallace, Alaska Volcano Observatory/U.S. Geological Survey, September 20, 2006. <http://avo.alaska.edu/images/image.php?id=11099>.



Discussion 3 (D3)

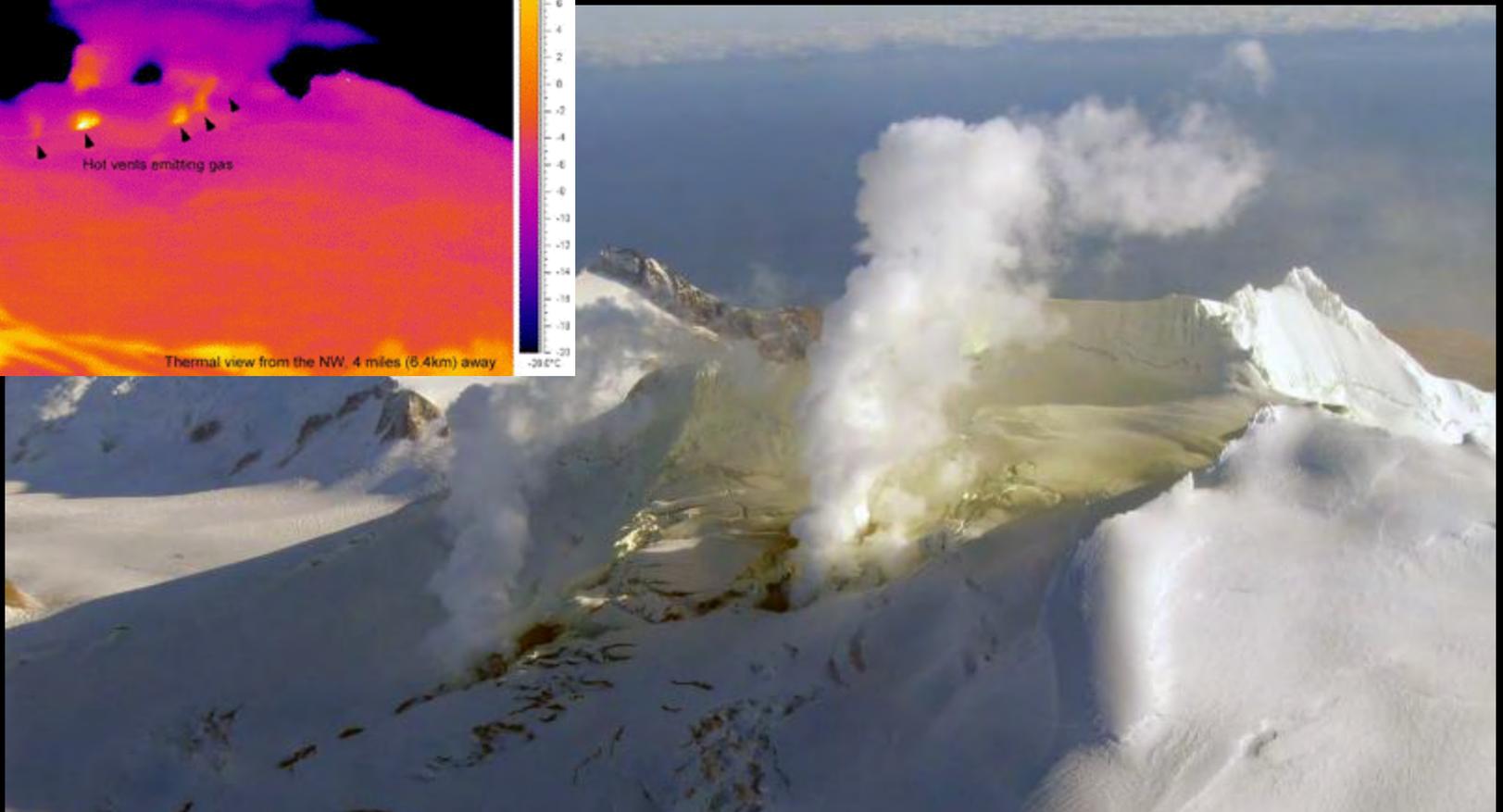
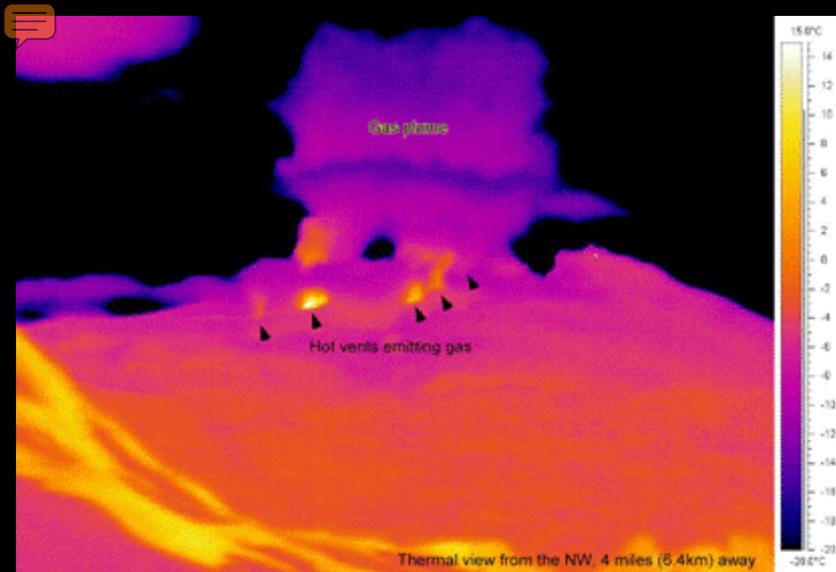
(Sept. 24 - 26)



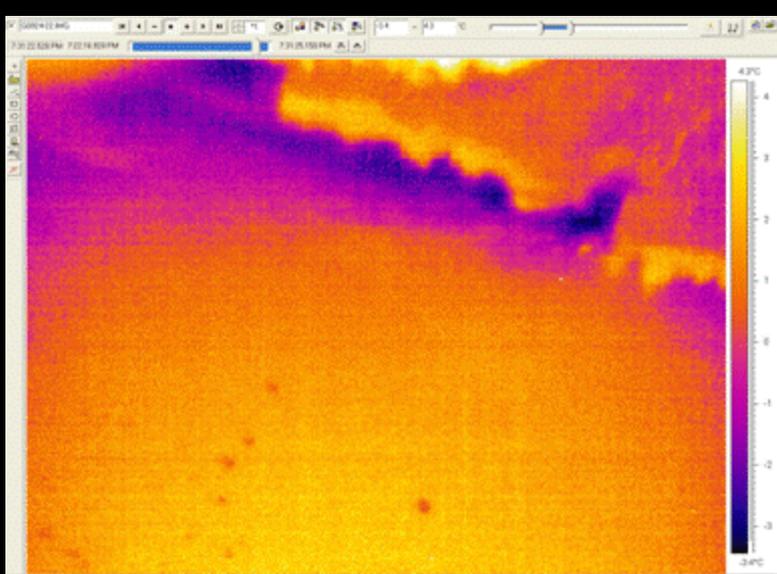
D3. Geophysicists

The nearest, but inoperable, seismometer (used to detect earthquakes) was repaired and a new station was installed 7 miles east of the volcano. Both instruments are now sending data to AVO. A campaign (non-telemetered) seismometer was installed 4 miles northwest of the summit. Photograph taken by Rick Wessels, U.S. Geological Survey/Alaska Volcano Observatory, September 25, 2006.





Along the 1 km long crack on the side of the summit glacier discrete vents are emitting gas. Using your Forward Looking Infrared Radiometer (FLIR), you determined these are the hottest surface areas along the crack and they reach temperatures $\sim 12^{\circ}\text{C}$ (54°F). Steaming on the uppermost section of the northern flank of Fourpeaked volcano. Photograph taken by Jennifer Adleman, U.S. Geological Survey/Alaska Volcano Observatory, November 4, 2006. <http://avo.alaska.edu/images/image.php?id=12359>. Inset: Thermal image of chain of vents on Fourpeaked summit from 6.4 km (4 mi) NNW of summit. Black arrows on inset map show approximate field of view. FLIR image created by Rick Wessels, U.S. Geological Survey/Alaska Volcano Observatory, September 24, 2006. <http://avo.alaska.edu/images/image.php?id=11462>.



You used the FLIR to look at the water draining from inside a glacier lobe of glacial ice (of the Fourpeaked Glacier), which drains into a proglacial lake and the end of the lobe. The geologists thought that the water might have been warm and anomalous. You determined that it was cool. FLIR by Rick Wessels, U.S. Geological Survey/Alaska Volcano Observatory, September 24, 2006. Terminus of Fourpeaked Glacier. Notice the dark-colored sediment issuing from an elongate tunnel in the ice that is distinctly different than the color of the proglacial lake. Photograph taken by K. Wallace, U.S. Geological Survey/Alaska Volcano Observatory, September 20, 2006. <http://avo.alaska.edu/images/image.php?id=11102>.



D3. Geologists



You had good views of the entire line of vents in the ice. You noted that the lower two pits were circular, the middle segment was elongate or maybe multiple, now coalesced vents, and it had multiple, vigorous steam sources and a fresh ring of ash around it. The upper region had at least three steam sources offset from the linear trend. There was no incandescence, although an outcrop of orange altered rock gave you a scare! Fumaroles on west side of Fourpeak Volcano. Photograph taken by Cyrus Read, Alaska Volcano Observatory/U.S. Geological Survey, September 24, 2006. <http://avo.alaska.edu/images/image.php?id=11205>



You collected samples from the lobate muddy surface flow and observed giant chunks of the glacier may have been ripped up during the formation of these flows (photographs taken by K.L. Wallace U.S. Geological Survey/Alaska Volcano Observatory, September 25, 2006).



Aviation Color Code and Alert Level

Color	Description
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 background state.
YELLOW	Volcano is exhibiting signs of elevated unrest above known background level or, after a change from a 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].

Term	Description
NORMAL	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 background state.
ADVISORY	Volcano is exhibiting signs of elevated unrest above known background level or, after a change from a higher level, volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
WATCH	Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain, OR eruption is underway but poses limited hazards.
WARNING	Hazardous eruption is imminent, underway, or suspected.

USGS Aviation Color Code (top) and Volcanic Alert Level (bottom), 2006.