ICEWEB TALK

Japan, March 1999

THE ICEWEB SYSTEM

Near-Real-Time Seismic Monitoring of Alaskan Volcanoes on the World-Wide-Web

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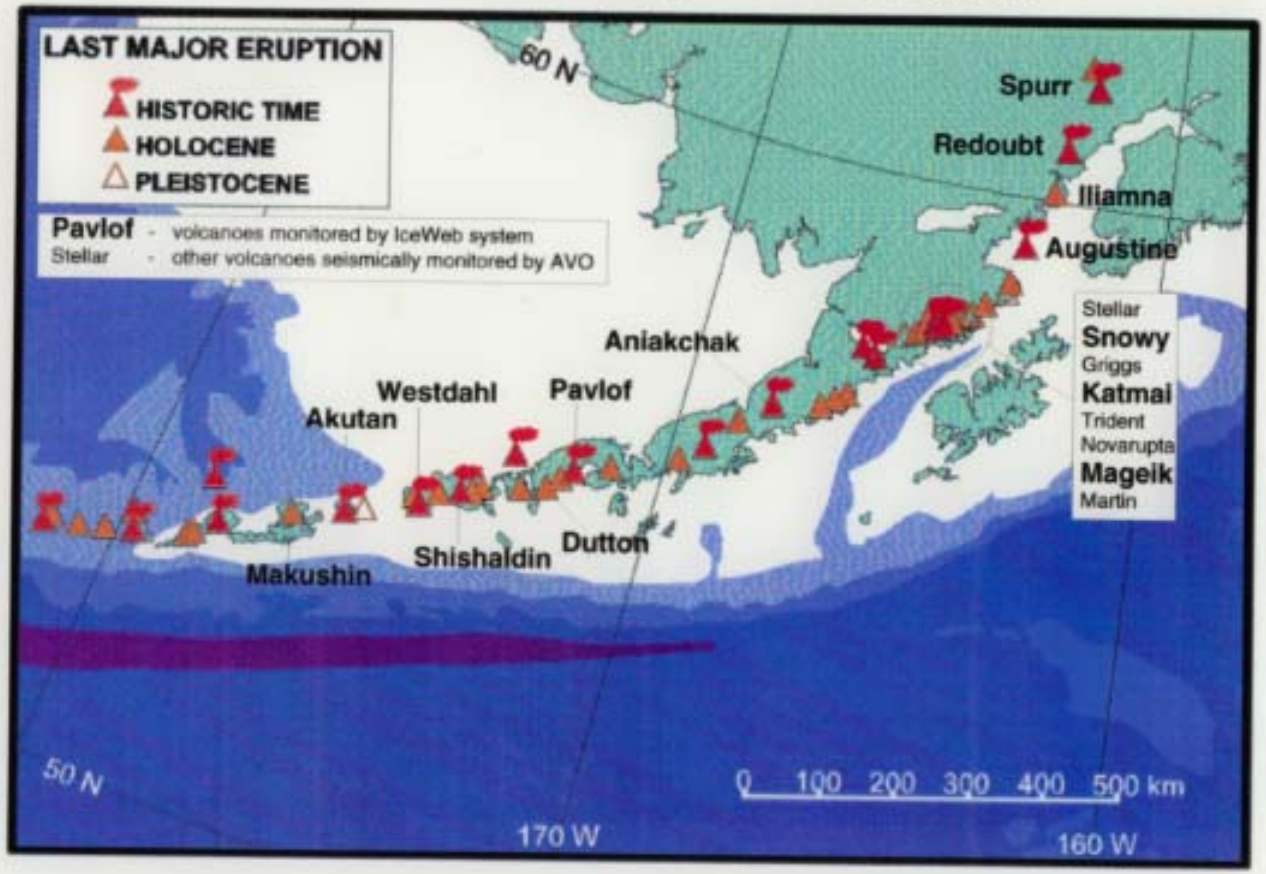
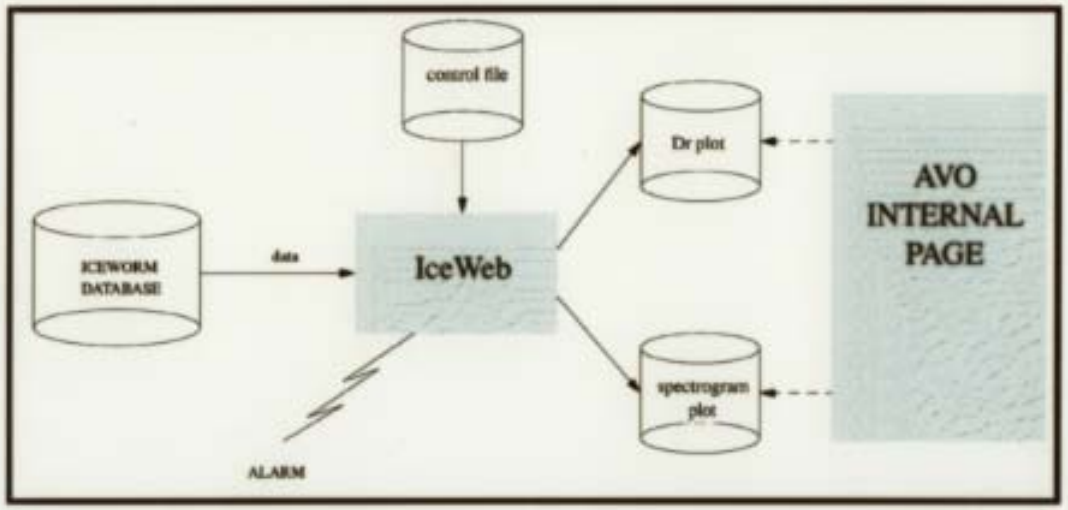
Introduction

- Alaska Volcano Observatory (AVO) seismically monitors 19 volcanoes in Alaskan Peninsula and Aleutian Islands
- Main threat is from volcanic ash to air traffic travelling between North America and Asia
- AVO is not a 24-hour operation, so need an automated system that monitors seismic signals from these volcanoes in near-real-time

Volcanoes monitored by the IceWeb system





IceWeb takes the last 10 minutes of data from the ICEWORM Database every 10 minutes, and produces a reduced displacement and a spectrogram plot for every volcano listed in the IceWeb control file. These plots are linked to the AVO internal page (along with other near-real time seismic, satellite and weather data) enabling scientists to monitor activity whether they are in the office, at home or elsewhere. Alarms are automatically paged to a scientist on 24-hour duty whenever a significant increase in reduced displacement is detected.

IceWeb

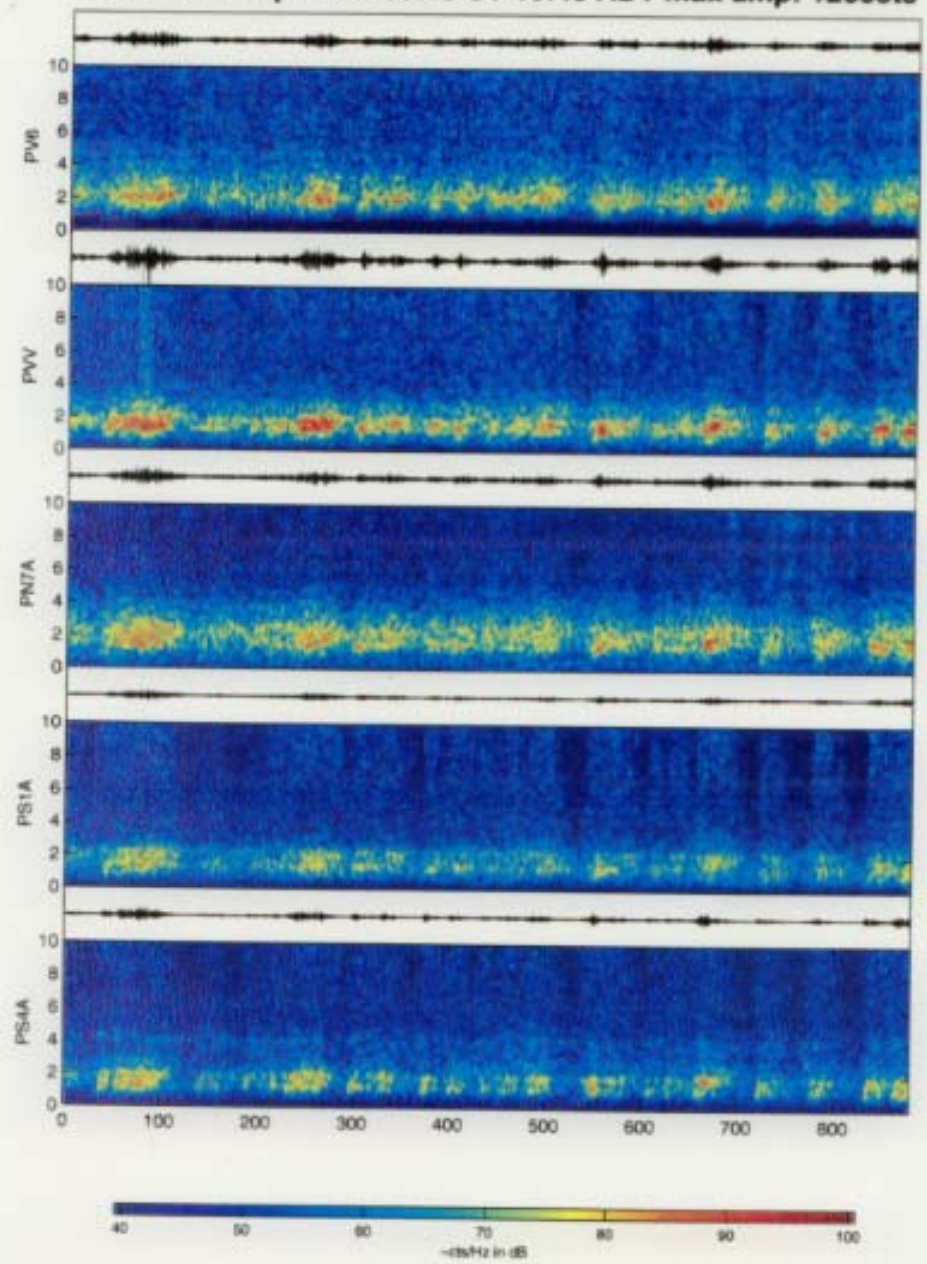
IceWeb is a near-real-time system for monitoring the seismic activity at Alaskan Volcanoes. The system has two main parts:

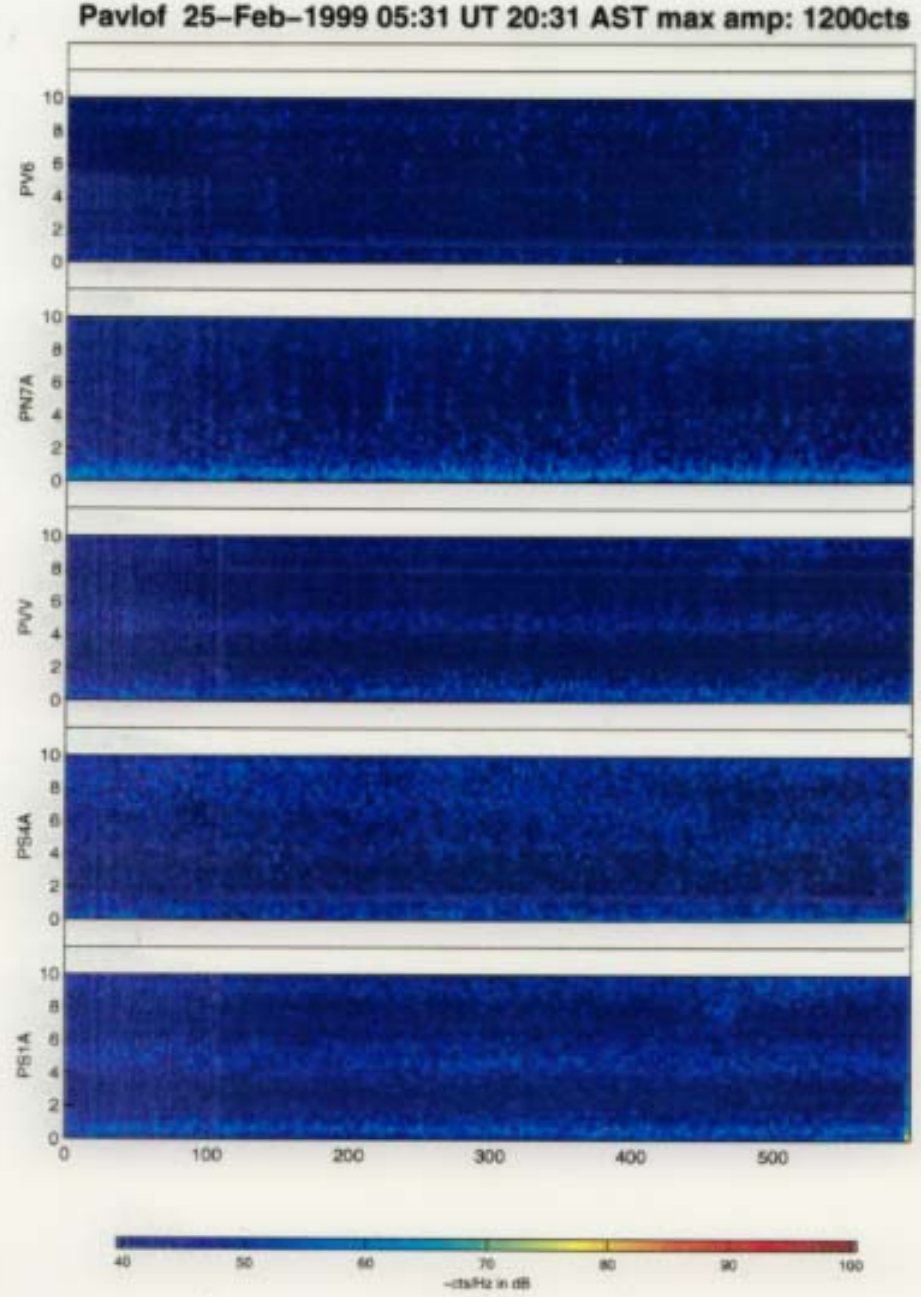
1. Plots of Reduced Displacement and Spectrograms and Filtered Helicorders on the World-Wide Web, updated every 10 minutes.
2. An alarm system that monitors the amplitude of reduced displacement and sends alarms by beeper to a seismologist on 24-hour duty when significant increase in this signal occurs.

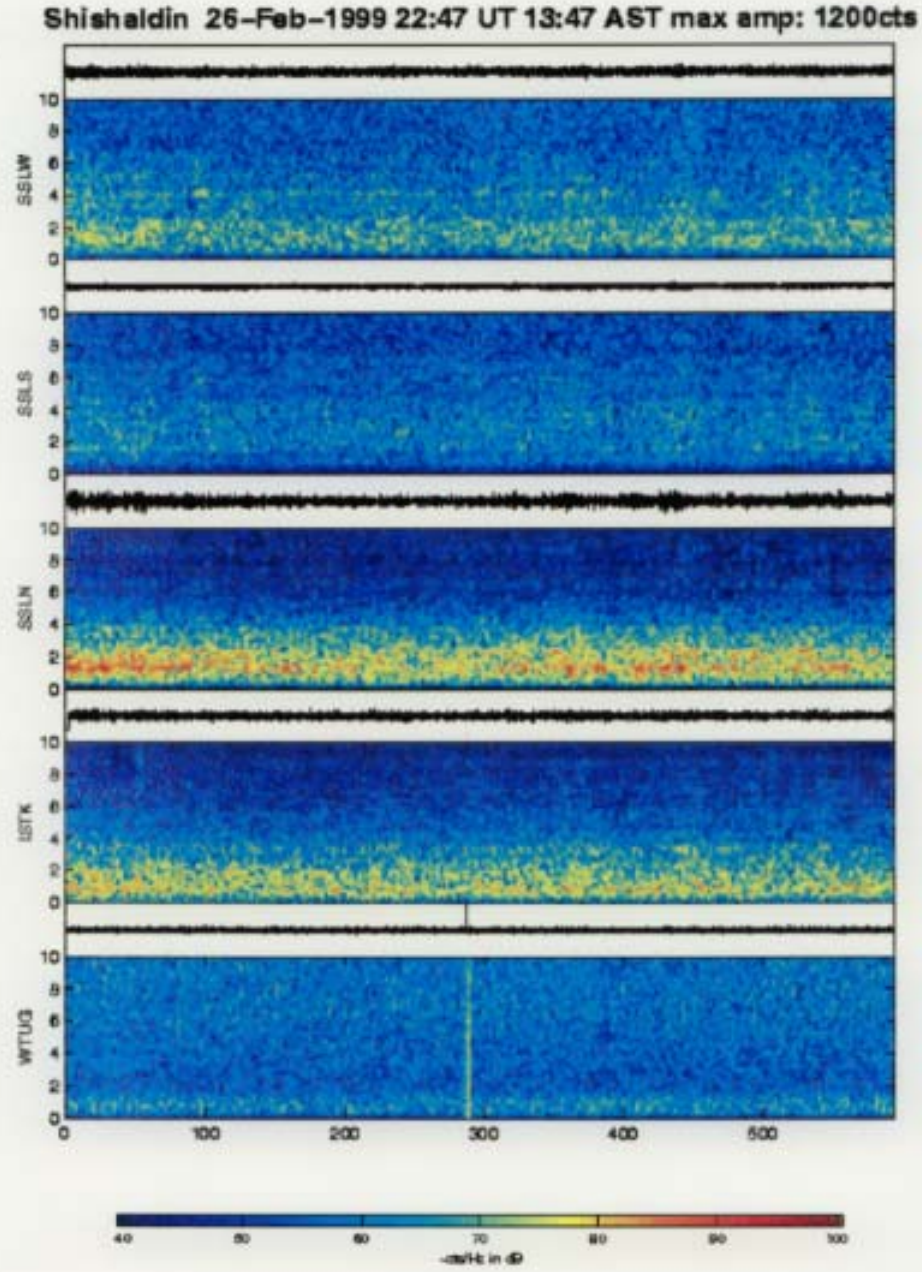
IceWeb and AVO

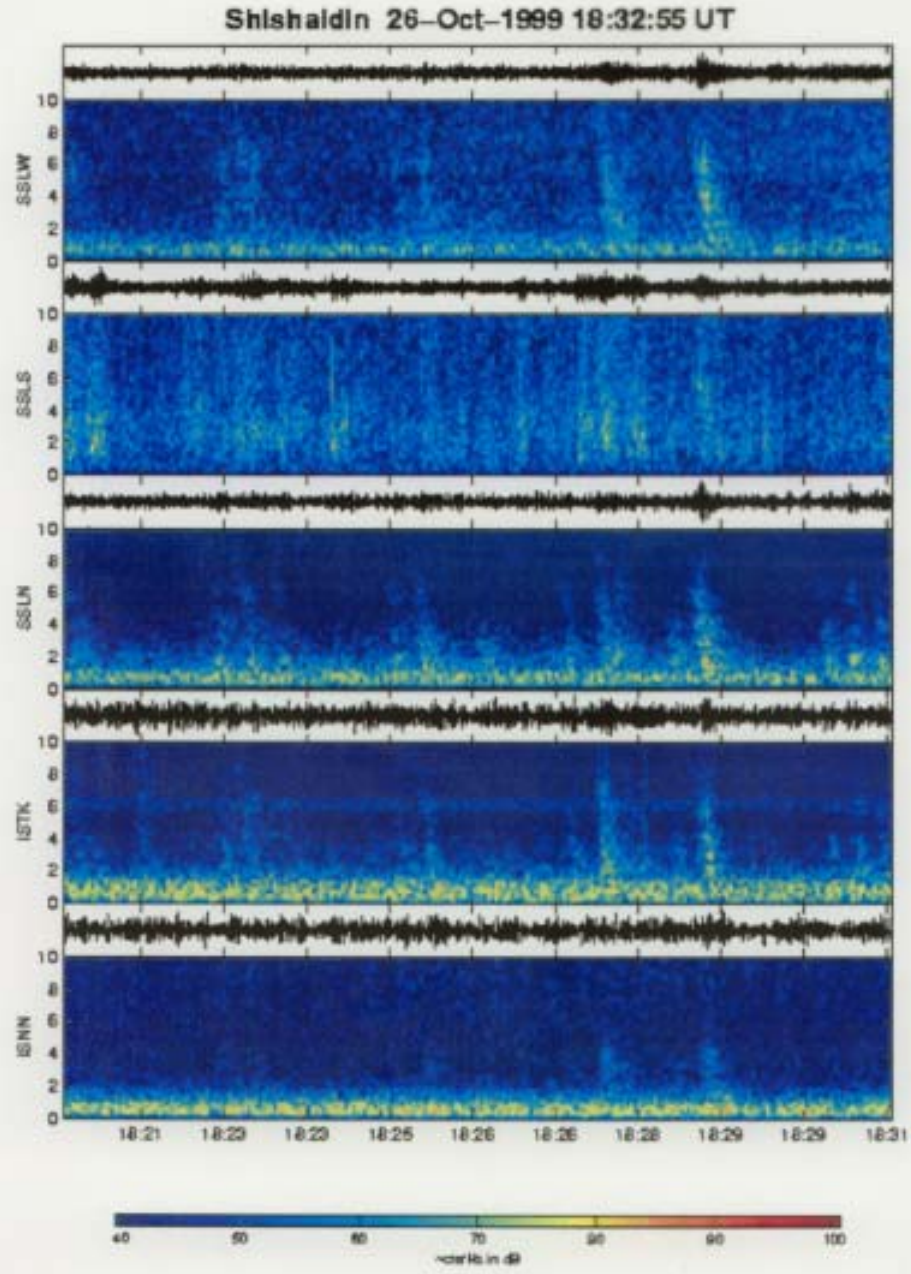
IceWeb was developed during the Pavlof 1996 eruption, and proved to be a very useful tool. AVO seismologists now depend on it:

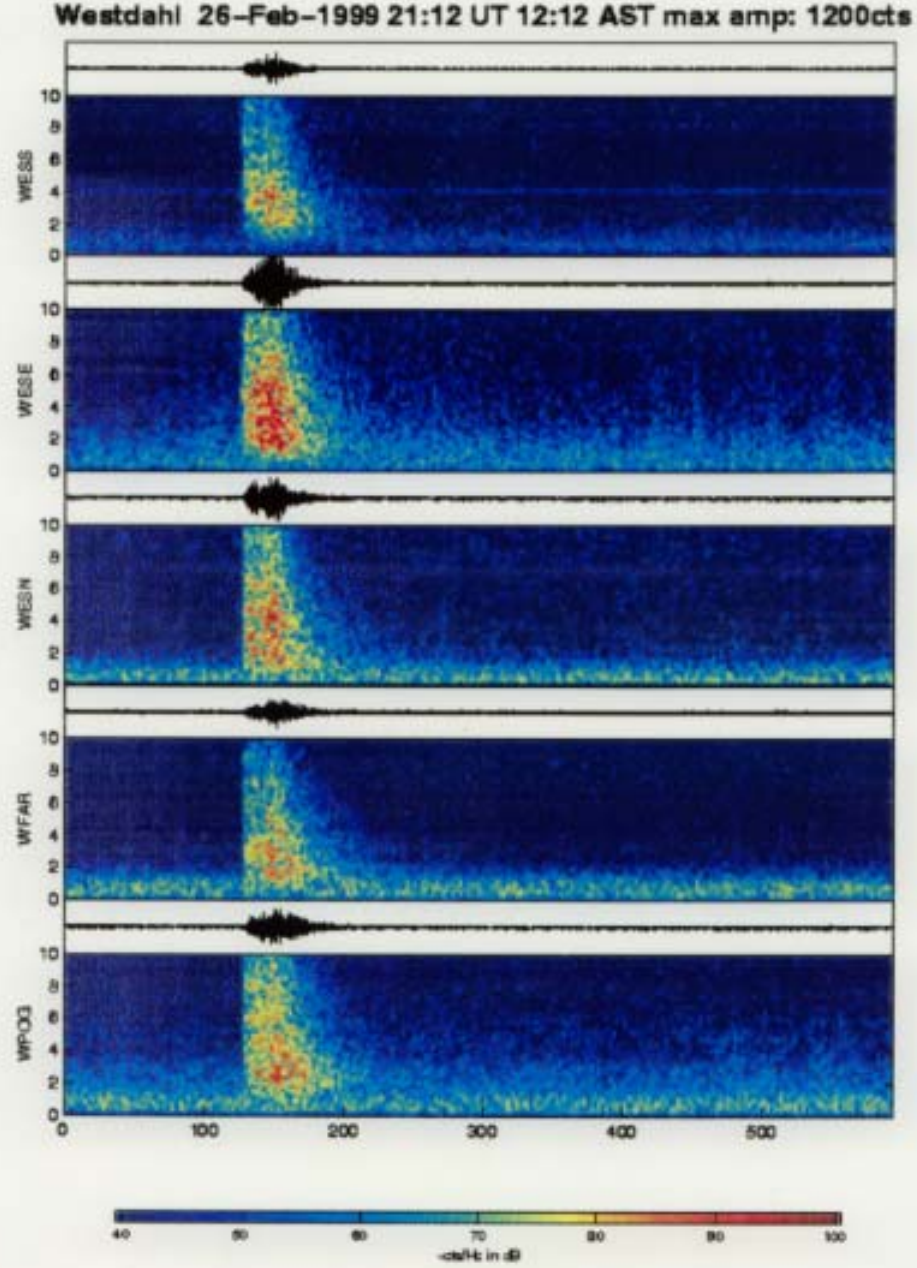
- Can keep web-page running while working – it updates
- Can check seismicity from home, during the night (e.g. Shishaldin now)
- Can check while travelling (e.g. me here)
- Scientists around the world can examine data

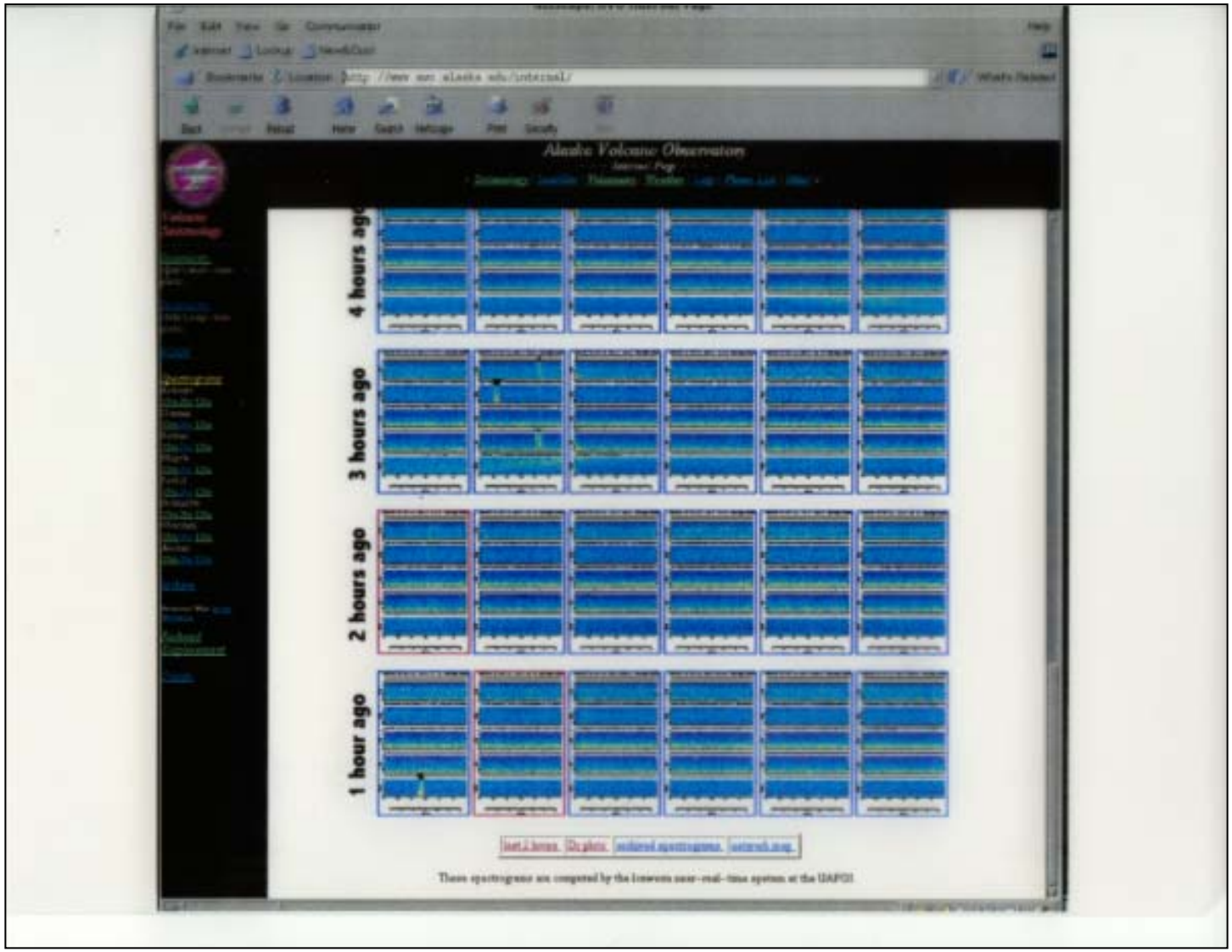

Pavlof 28-Sep-1996 03:45 UT 19:45 ADT max amp: 1200cts
PVB
PVV
PN7A
PS1A
PS4A
0
2
4
6
8
10
0
100
200
300
400
500
600
700
800
40
50
60
70
80
90
100
~cts/Hz in dB


Pavlof 25–Feb–1999 05:31 UT 20:31 AST max amp: 1200cts
PV6
PN7A
PVV
PS4A
PS1A
0
2
4
6
8
10
0
100
200
300
400
500
40
50
60
70
80
90
100
–cts/Hz in dB


Shishaldin 26-Feb-1999 22:47 UT 13:47 AST max amp: 1200cts
SSLW
SSLS
SSLN
USTK
WTUG
0
100
200
300
400
500
40
50
60
70
80
90
100

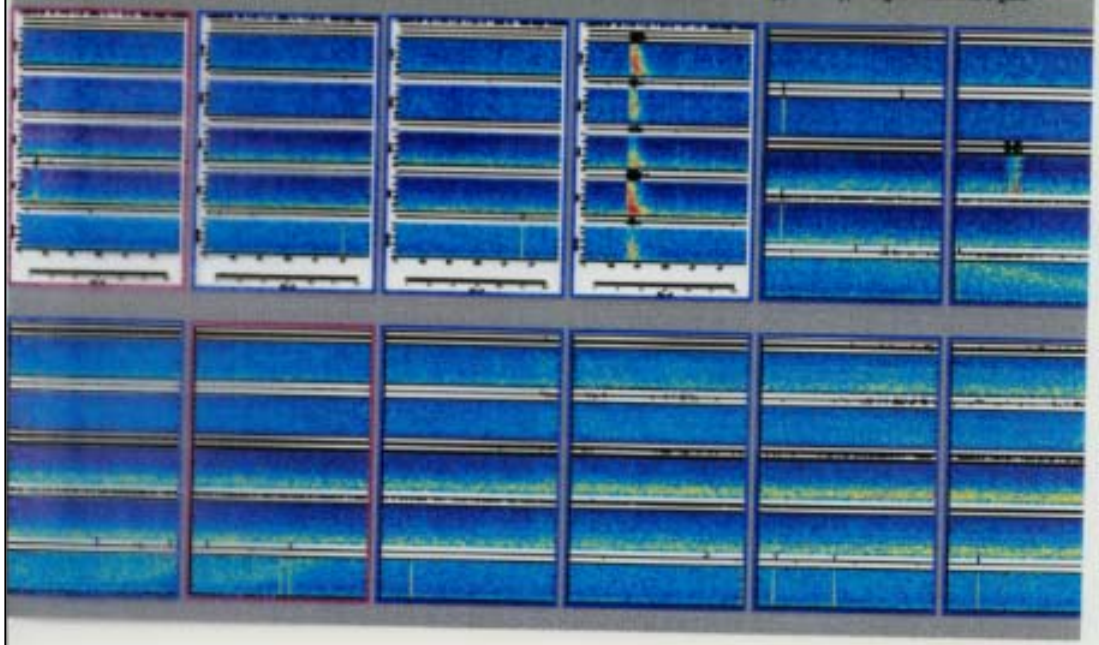

Shishaldin 26-Oct-1999 18:32:55 UT
SSLW
SSLS
SSLN
ISTK
ISNN
0
2
4
6
8
10
18:21
18:23
18:25
18:27
18:29
18:31
40
50
60
70
80
90
100

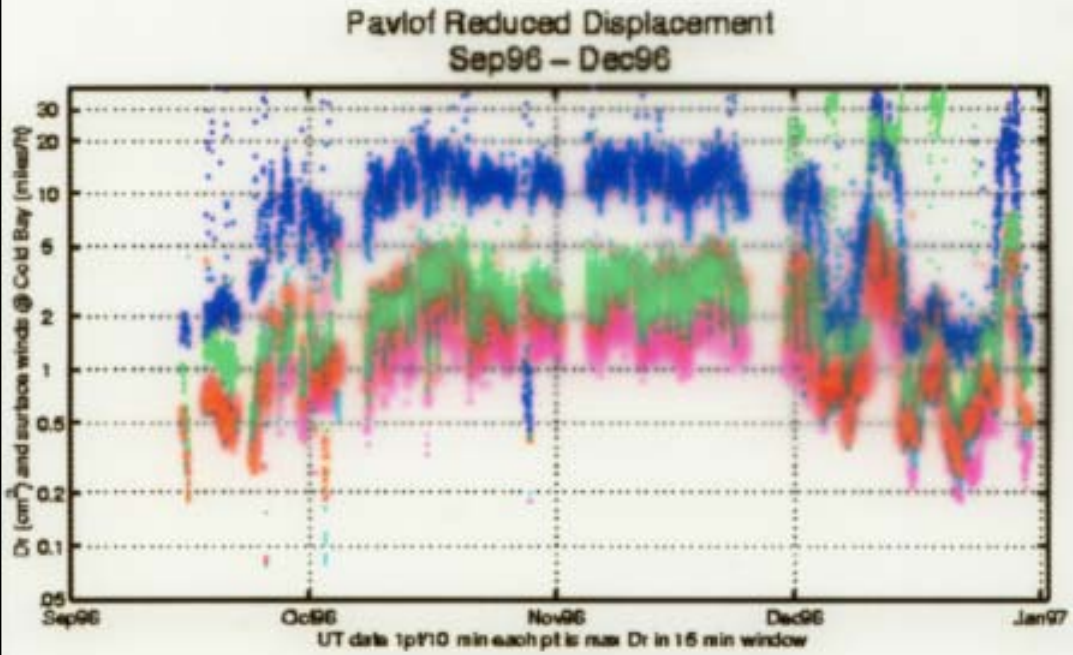

Westdahl 26-Feb-1999 21:12 UT 12:12 AST max amp: 1200cts
WESS
WESE
WESN
WFAR
WPOO
0
100
200
300
400
500
40
50
60
70
80
90
100
<cts/Hz in dB

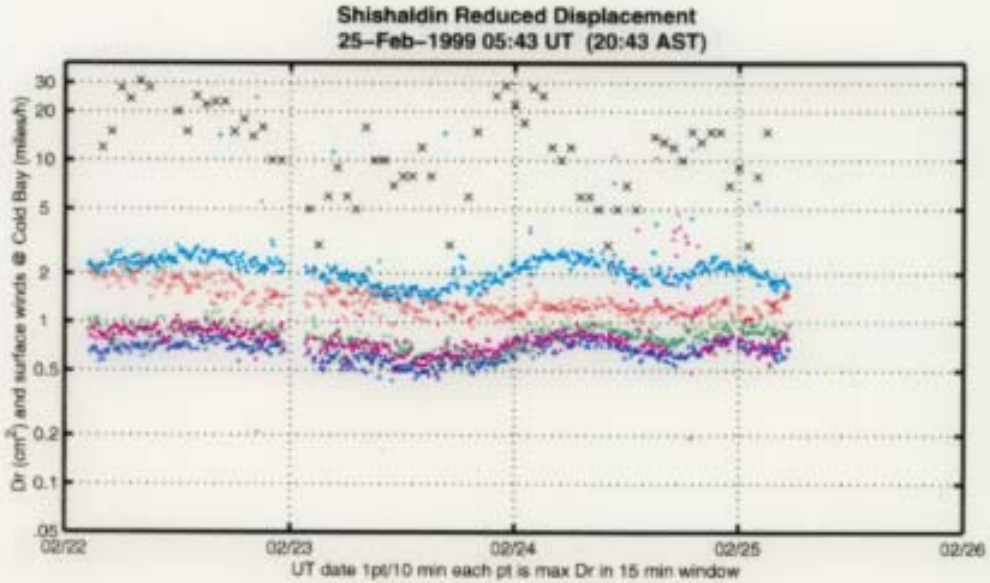

Alaska Volcano Observatory
4 hours ago
3 hours ago
2 hours ago
1 hour ago

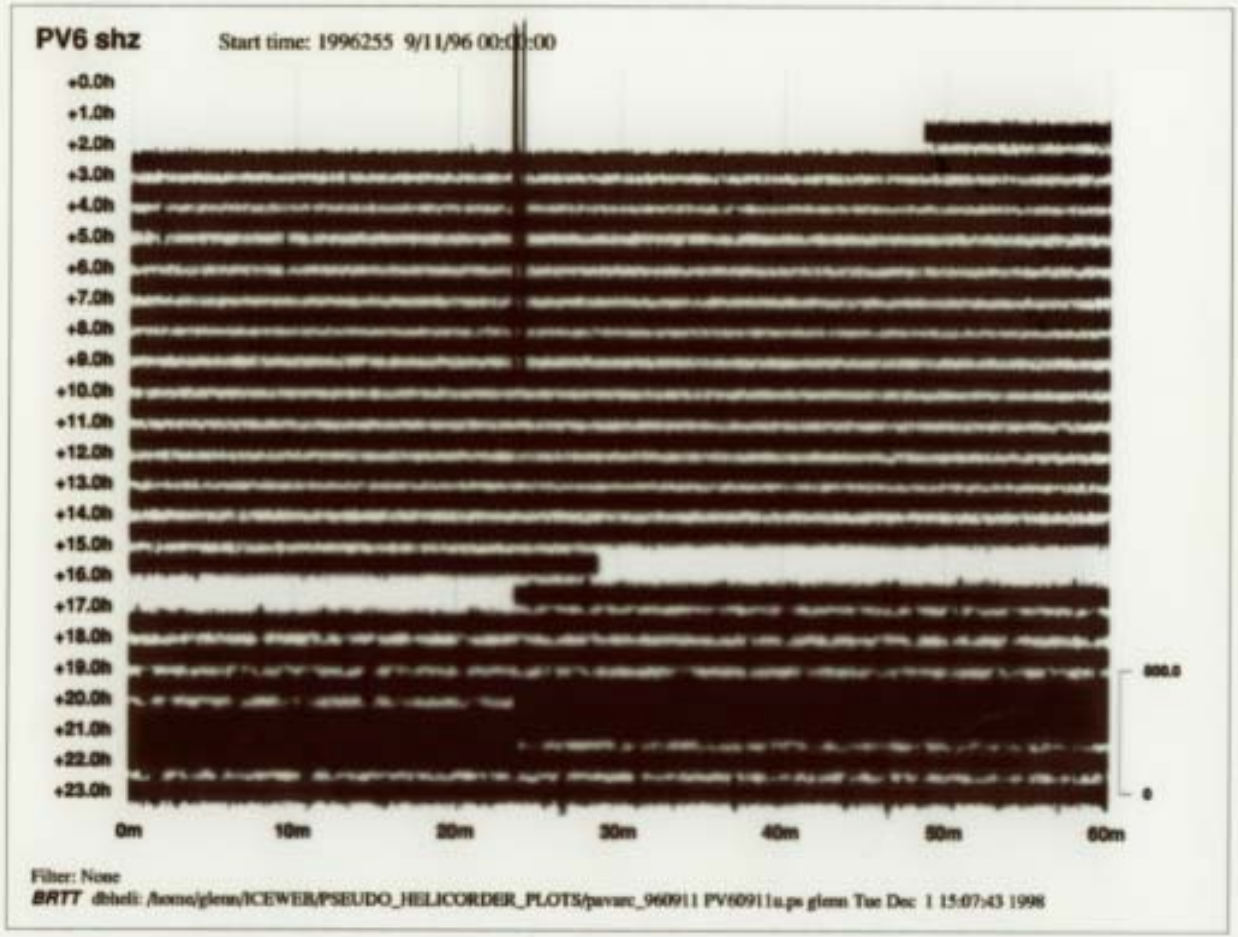
Shishaldin Volcano Iceworm Spectrograms
Last Updated 2/26/99 13:35

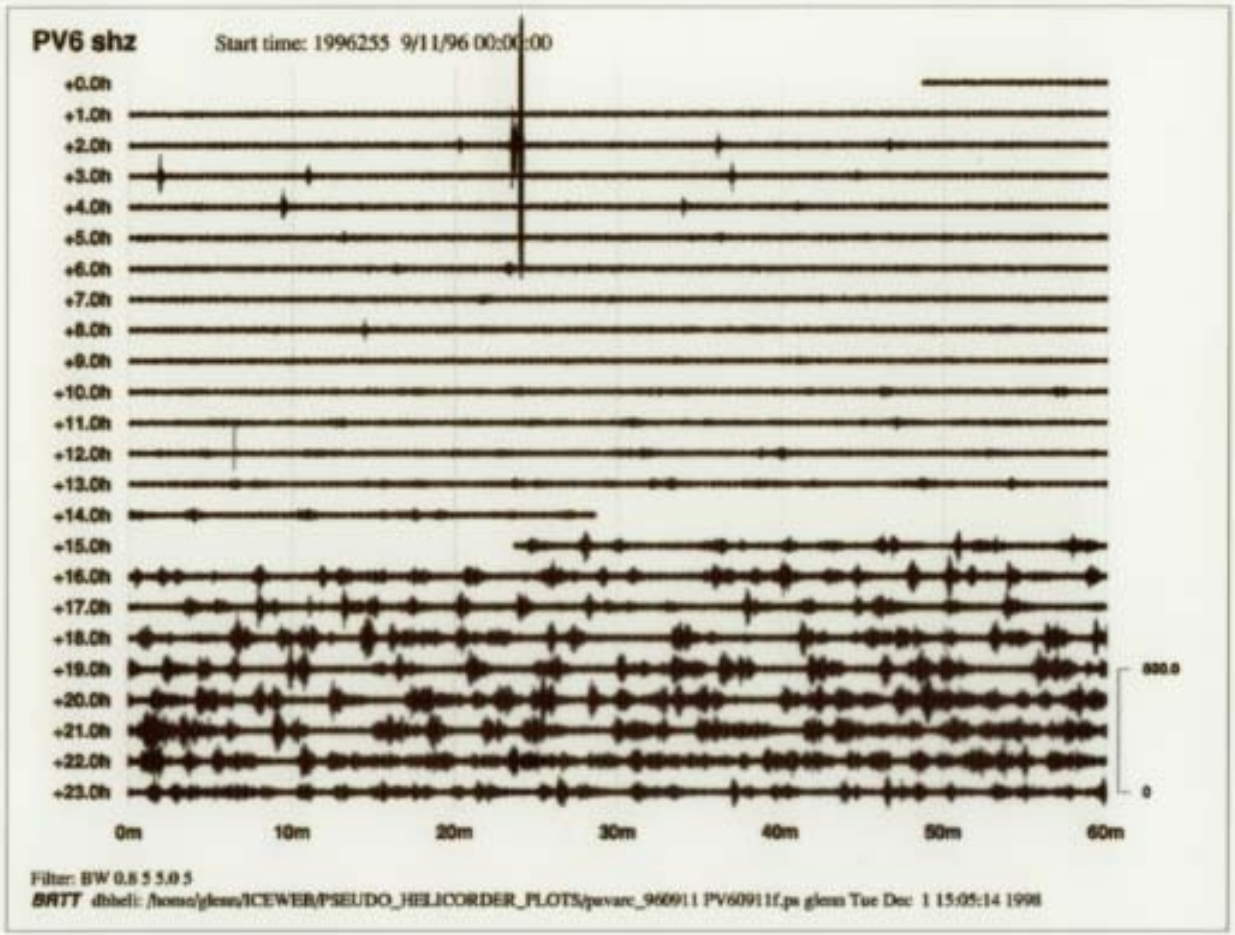
The last 2 hours are shown below; details are available by clicking each frame. Oldest panel is upper left, youngest is lower right.




Pavlof Reduced Displacement
Sep96 – Dec96
Dr (cm²) and surface winds @ Cold Bay (miles/hr)
20
10
5
2
1
0.5
0.2
0.1
.05
Sep96
Oct96
Nov96
Dec96
Jan97
UT data 1pt/10 min each pt is max Dr in 16 min window


Shishaldin Reduced Displacement
25–Feb–1999 05:43 UT (20:43 AST)
Dr (cm²) and surface winds @ Cold Bay (miles/h)
30
20
10
5
2
1
0.5
0.2
0.1
.05
02/22
02/23
02/24
02/25
02/26
UT date 1pt/10 min each pt is max Dr in 15 min window


PV6 shz
Start time: 1996255 9/11/96 00:00:00
+0.0h
+1.0h
+2.0h
+3.0h
+4.0h
+5.0h
+6.0h
+7.0h
+8.0h
+9.0h
+10.0h
+11.0h
+12.0h
+13.0h
+14.0h
+15.0h
+16.0h
+17.0h
+18.0h
+19.0h
+20.0h
+21.0h
+22.0h
+23.0h
800.0
0
0m
10m
20m
30m
40m
50m
60m
Filter: None
BRTT dbheli: /home/glenn/ICEWEB/PSEUDO_HELICORDER_PLOTS/pavarc_960911 PV60911a.ps glenn Tue Dec 1 15:07:43 1998


PV6 shz
Start time: 1996255 9/11/96 00:00:00
+0.0h
+1.0h
+2.0h
+3.0h
+4.0h
+5.0h
+6.0h
+7.0h
+8.0h
+9.0h
+10.0h
+11.0h
+12.0h
+13.0h
+14.0h
+15.0h
+16.0h
+17.0h
+18.0h
+19.0h
+20.0h
+21.0h
+22.0h
+23.0h
0m
10m
20m
30m
40m
50m
60m
Filter: BW 0.8 5 5.0 5
BRTT dbbeli: /home/glenn/ICEWEB/PSEUDO_HELICORDER_PLOTS/pwarc_960911 PV60911f.ps glenn Tue Dec 1 15:05:14 1998

Alarm System

IceWeb looks for significant trends in reduced displacement data and sends automated alarms by email and pager

Two step algorithm:

Station Triggering

Trigger if:

1. D_R now > average (D_R last hour)
2. D_R now > average (2 * D_R last day)
3. D_R now > average (2 * D_R last 3 days)
4. Maximum frequency in the signal > 0.8 Hz

Alarm

- Sent by pager to a seismologist on 24-hour duty if AT LEAST HALF of the stations trigger for any particular volcano
- Also sent by email

Subject: ICEWEB alarm at Shishaldin volcano

This is an automated alarm generated by the IceWeb system
Increasing Dr detected at SSLS SSLN SSLW

Av Dr(cm^2) over different time periods

STA	Now	hour	day	3days	f(Hz)
SSLS:	4.51	3.73	1.53	1.61	0.9
SSLN:	5.63	4.96	1.89	1.74	1.1
SSLW:	3.97	3.82	1.82	1.63	1.7
ISTK:	2.59	2.20	1.30	1.38	0.8
WTUG:	2.02	2.11	1.57	1.40	0.8

Further Work

- IceWeb has so far been applied to 14 volcanoes – limitation is processing speed (Sun Sparc Ultra 10) – apply to all volcanoes
- So far written primarily in Matlab – rewrite in Java and make it a true real-time system (applets)
- Add utilities to enable clients to request any type of data (reduced displacement, spectrogram, SSAM, filtered helicorder) for any volcano and any time period
- Improve the alarm algorithm using statistical tests to detect tremor signal from the background of storm and wind related noise