The IceWeb System

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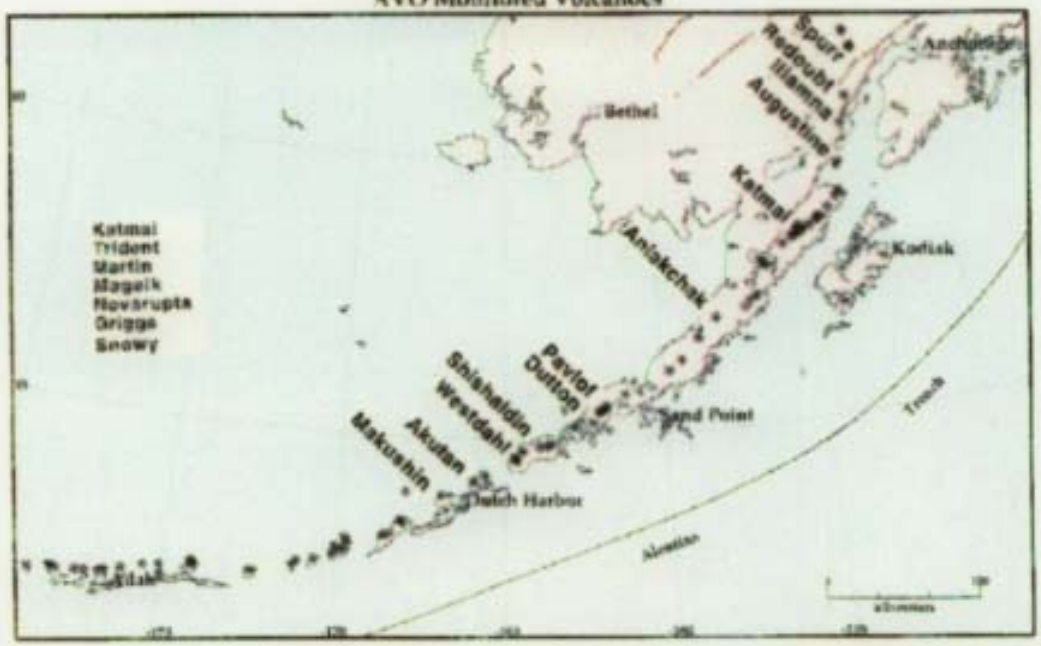
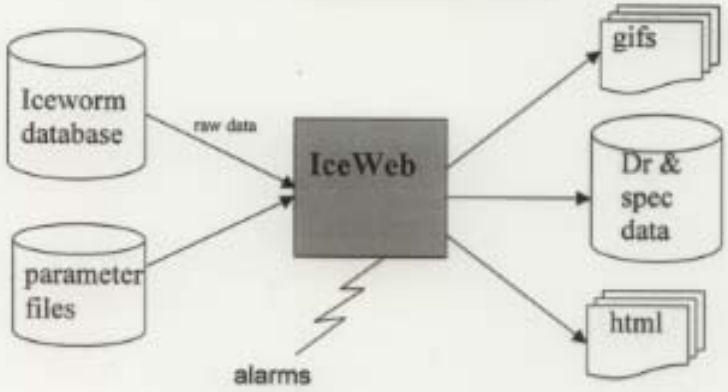
AVO Monitored Volcanoes



Current System



PLOTS

- 3 day reduced displacement plots
- 10 minute spectrograms
- 2 hour mosaics of spectrograms
- daily spectrograms

OTHER

- alarm system
- 3 day archive of 10 minute spectrograms & "Mosaic Maker"
- archive of daily spectrograms & "Daily Archive"
- archive of reduced displacement & spectral data + tools

Why part of the main show?

1. Proved itself enormously useful during Shishaldin unrest
2. Core part of AVO's monitoring efforts
3. Not just for seismologists!

Philosophy

"to enable scientists to quickly evaluate the current level of activity at a volcano from anywhere, at anytime, from any type of computer"

"to alert scientists to potentially significant changes in volcano tremor"

My Goals

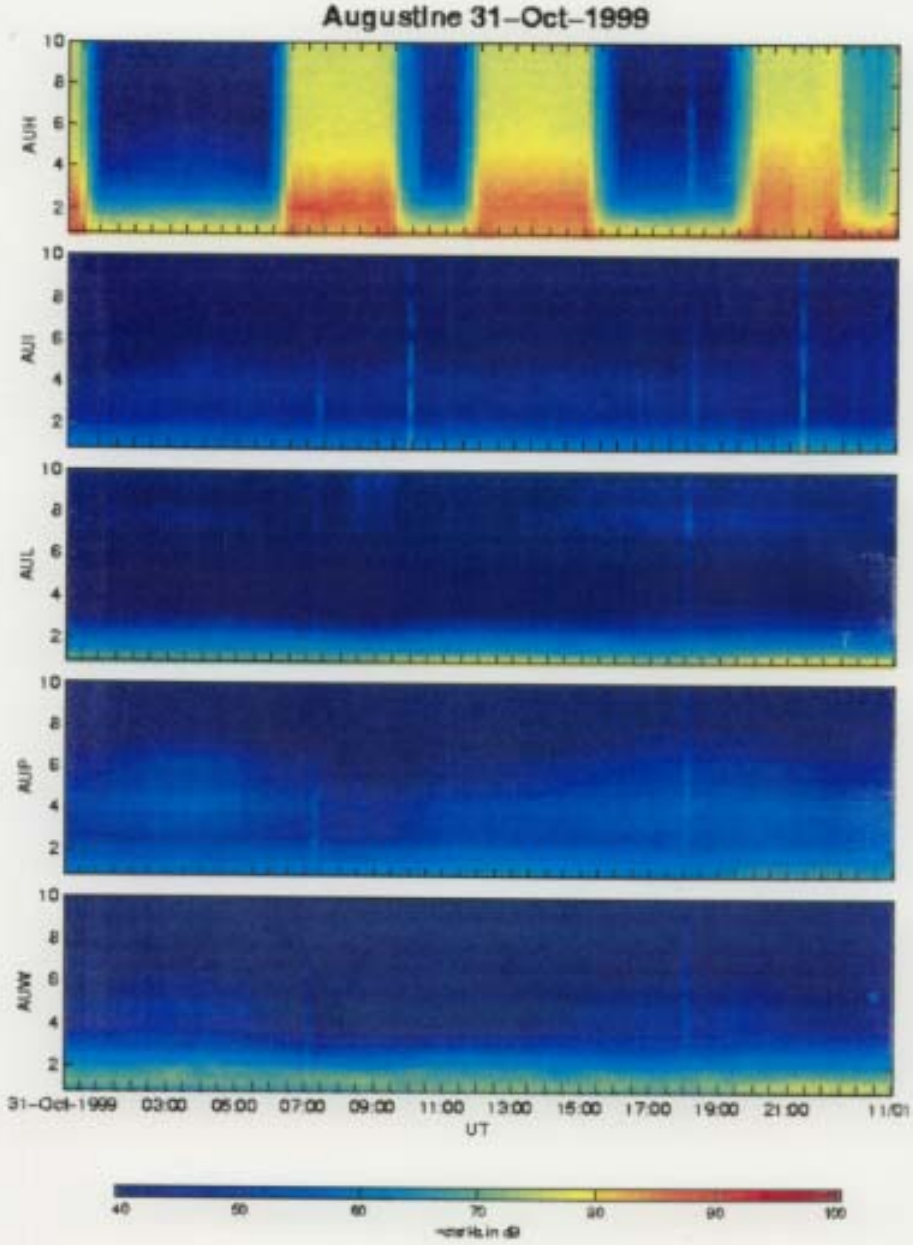
- reliability
- efficiency (more volcanoes)
- flexibility & user friendliness

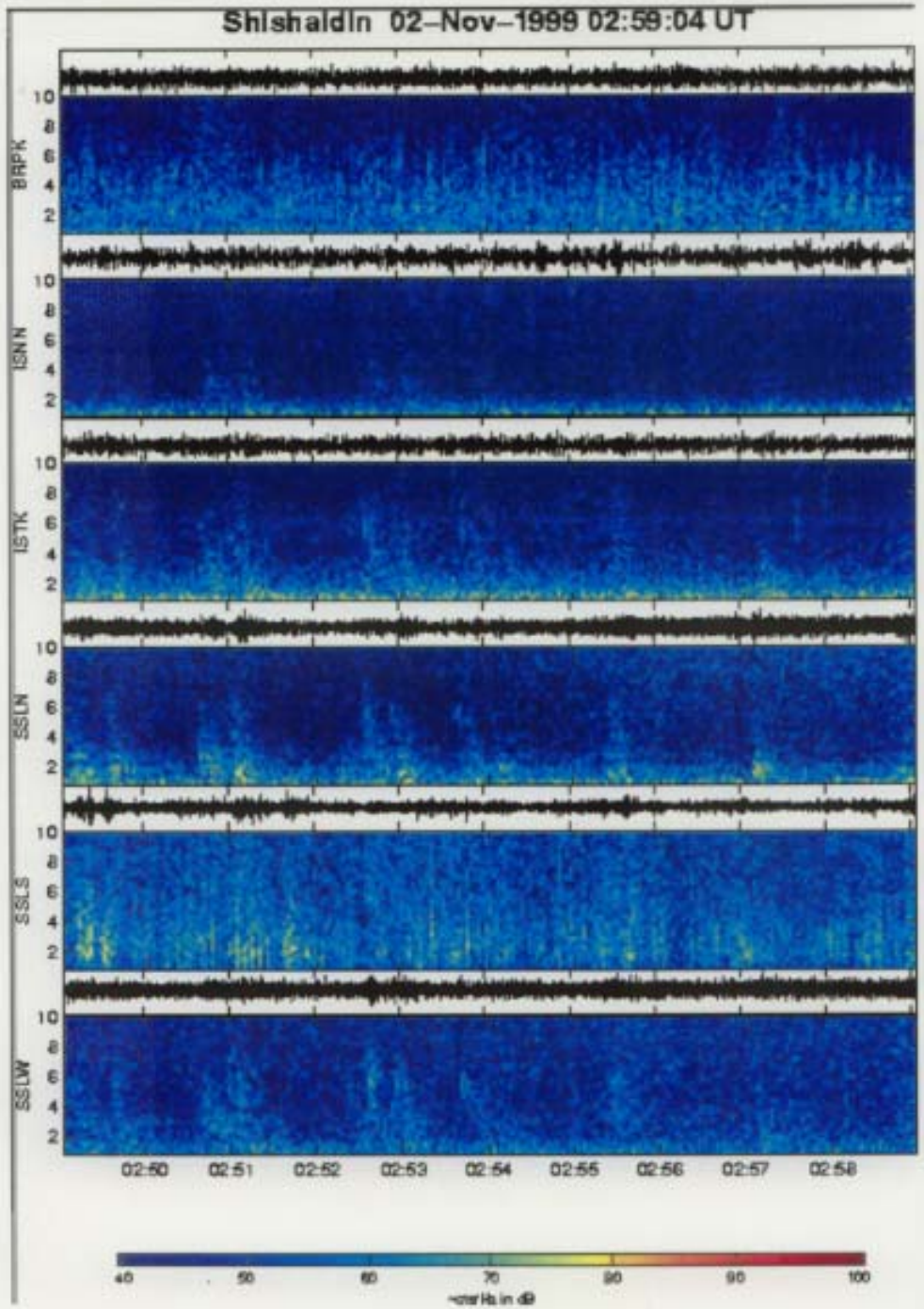
Spectrograms

- Plots of spectral amplitude versus frequency through time
- Calculated using FFTs of 10-s moving windows with 5-s overlap
- Colour coded according to spectral amplitude
- Frequency resolution is 0.1 Hz

Every 10 minutes:

- Spectrogram plot for up to 5 stations per volcano produced in a single panel for last 10 minutes of data
- For each station, corresponding seismic trace is plotted above the spectrogram for comparison
- Smaller versions are created and pasted together to form 2-hour and 12-hour mosaics
- SSAM data is archived (0.1 Hz, 600 s)


Augustine 31–Oct–1999
AUH
AUI
AUL
AUP
AUW
10
8
6
4
2
31–Oct–1999
03:00
05:00
07:00
09:00
11:00
13:00
15:00
17:00
19:00
21:00
11/01
UT
40
50
60
70
80
90
100

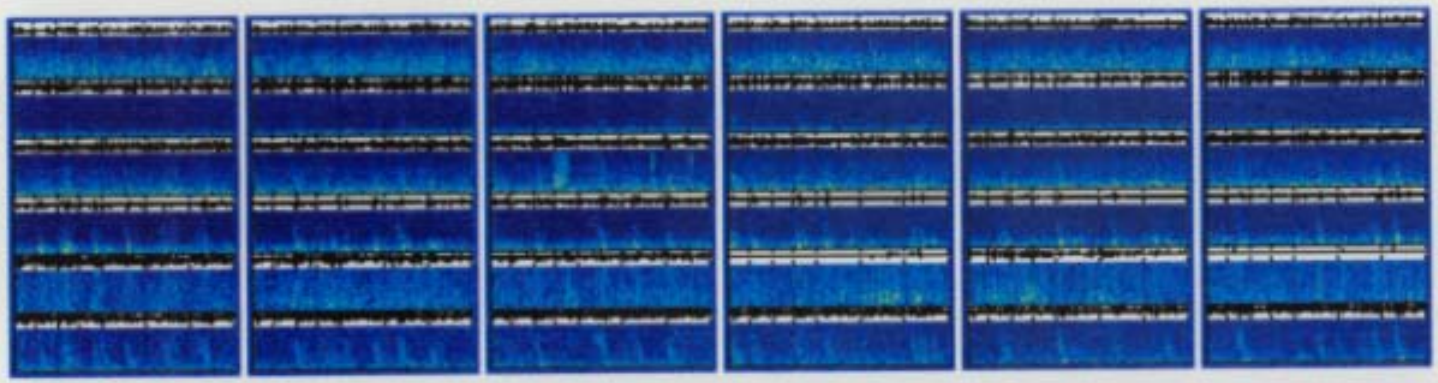

Shishaldin 02-Nov-1999 02:59:04 UT
BRPK
ISNN
ISTK
SSLN
SSLS
SSLW
10
8
6
4
2
02:50
02:51
02:52
02:53
02:54
02:55
02:56
02:57
02:58
40
50
60
70
80
90
100

Shishaldin Volcano IceWeb Spectrograms

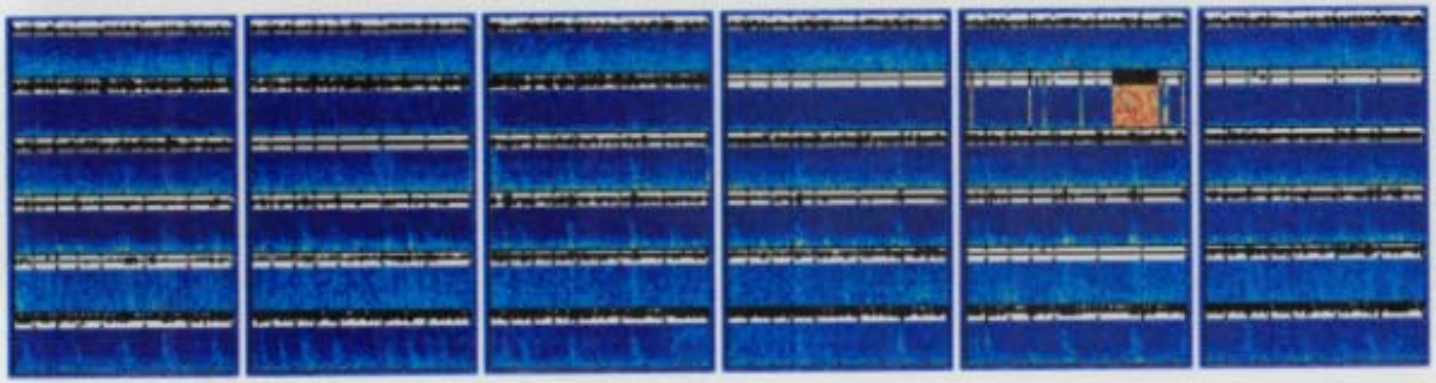
Last updated 15:45 (Alaskan time) on 01/11/1999

2 to 0 hours ago 10 minute spectrograms for Shishaldin; details are available by clicking each frame. Oldest panel is upper left, youngest is lower right.

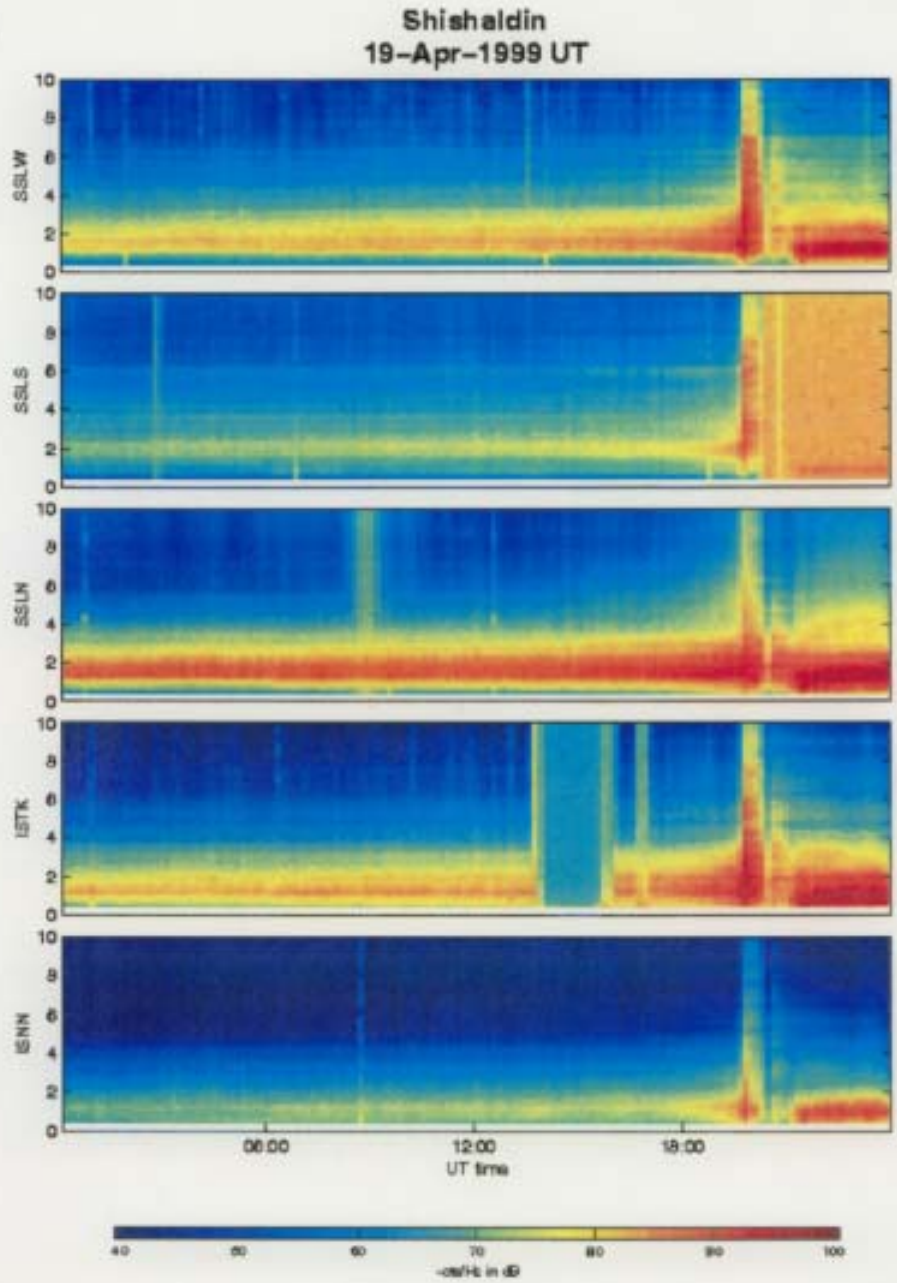
2 hours ago



1 hour ago



These spectrograms are computed by the IceWeb system using near-real-time data from the Iceworm system at the University of Alaska Geophysical Institute.


Shishaldin
19-Apr-1999 UT
SSLW
SSLS
SSLN
ISTK
ISNN
0
2
4
6
8
10
06:00
12:00
18:00
UT time
40
50
60
70
80
90
100
-cts/Hz in dB

Reduced Displacement

- a normalised measure of tremor amplitude
- equal to RMS displacement corrected for geometric spreading
- the same for all stations if site affects and attenuation negligible
- empirically related to ash column height and Volcano Explosivity Index (VEI):

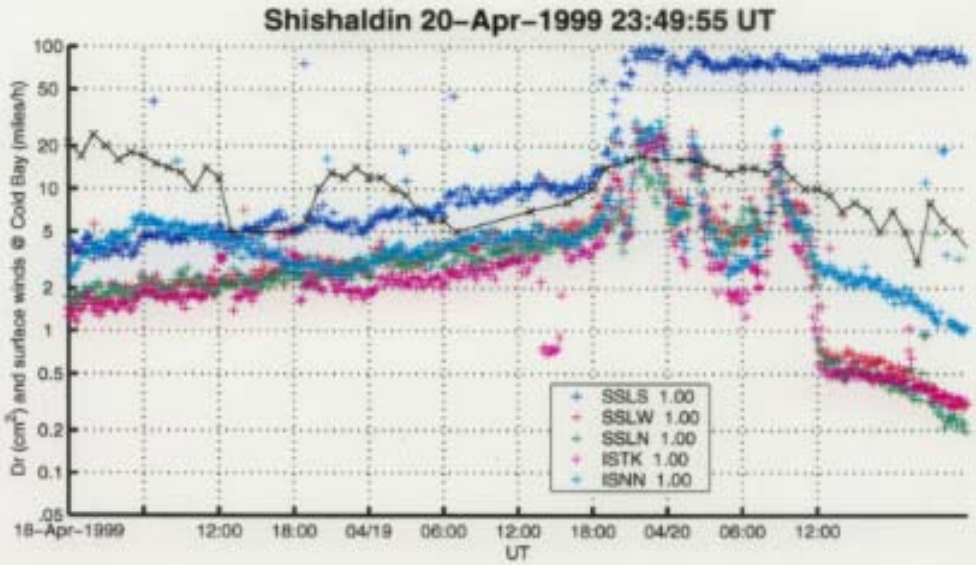
$$\log_{10}(D_R) = 1.80 \log_{10}(ash\ column\ height) - 0.08 = 0.46\ VEI + 0.08$$

D_R = Reduced displacement in cm^2

[*McNutt, S. R.*, Acta Vulcanologica, 5, 193-196, 1994]

Every 10 minutes:

- IceWeb calculates the maximum reduced displacement in a 0.8-10 Hz frequency band.
- Plots the last 3 days worth of reduced displacement data for each station & each volcano.


Shishaldin 20-Apr-1999 23:49:55 UT
Dr (cm²) and surface winds @ Cold Bay (miles/h)
100
50
20
10
5
2
1
0.5
0.2
0.1
.05
SSLS 1.00
SSLW 1.00
SSLN 1.00
ISTK 1.00
ISNN 1.00
18-Apr-1999
12:00
18:00
04/19
06:00
12:00
18:00
04/20
06:00
12:00
UT

Filtered Helicorder Plots

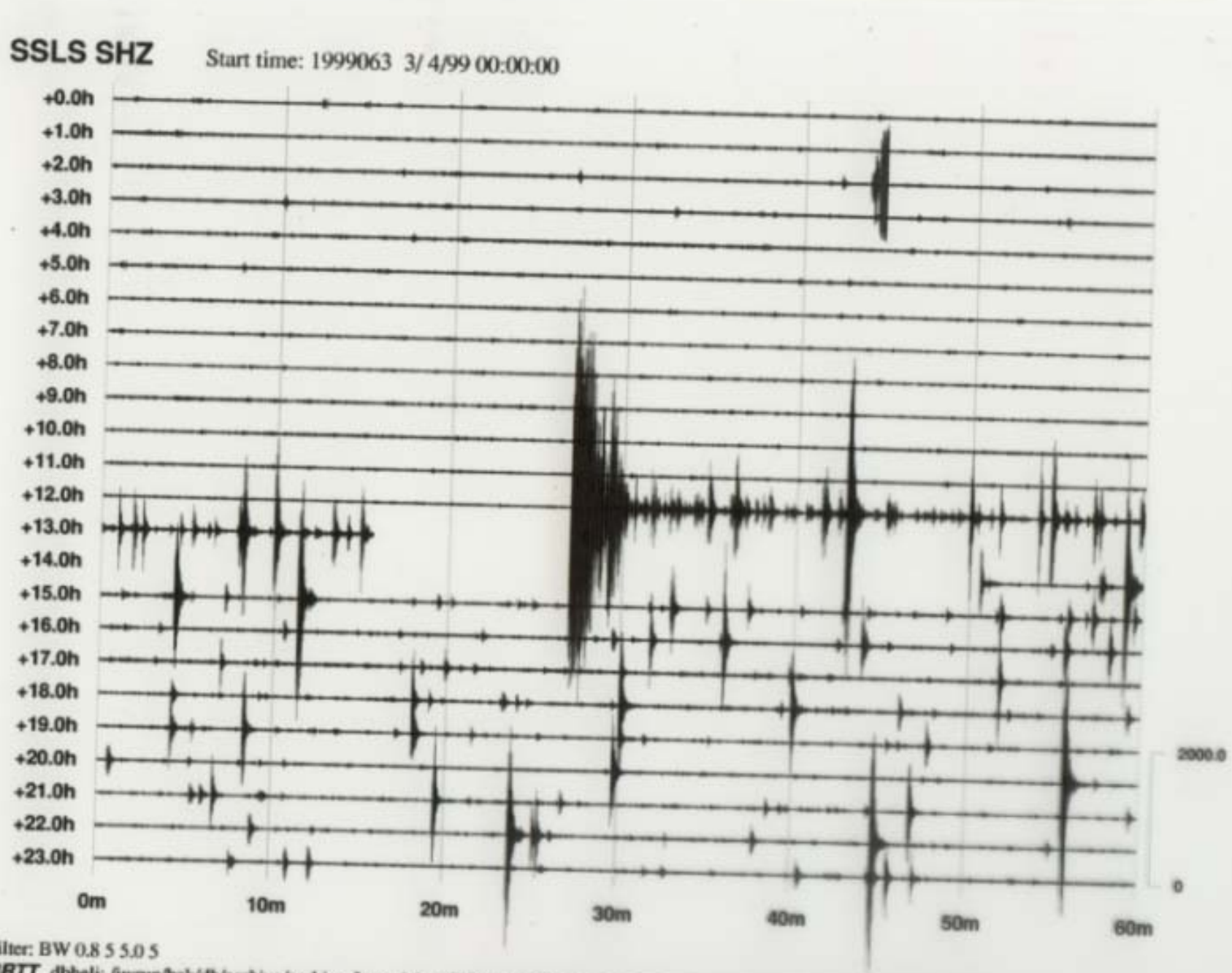
- seismic data plotted to resemble helicorder records
- filtered between 0.5 and 5 Hz to enhance tremor

Every hour:

- plot for last hour for each station produced

Every 3 hours:

- plots for last 24 hours for each station produced


SSLS SHZ
Start time: 1999063 3/ 4/99 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
2000.0
0
0m
10m
20m
30m
40m
50m
60m
Filter: BW 0.8 5 5.0 5
BRTT dbheli: /iwrun/bak/db/archive/archive /home/glenn/PSEUDOHELI/SSLS/SSLS0304.ps glenn Thu Mar 4 23:06:14 1999

IceWeb Spectrogram Mosaic Maker

Choose a volcano and time range below and then click "make mosaic"

Select a volcano

○ Redoubt ○ Spurr ○ Iliamna ○ Augustine ○ Snowy ○ Katmai ○ Mageik

○ Aniakchak ○ Pavlof ○ Dutton ◉ Shishaldin ○ Westdahl ○ Akutan ○ Makushin

Hours

Starting: 1 hours ago.

Ending: 0 hours ago.

First value must be greater than second value!
A maximum of 3 days (72 hours) is available.
Only volcanoes currently on the IceWeb system are available.

make mosaic clear

Daily spectrogram plot archive

These spectrograms are for one UT day. They have a frequency resolution of 0.1 Hz, and a time resolution of 10 minutes. This shows tremor very well. One plot is created for each volcano for the UT day. The data is archived from the near-real-time spectrogram code.

Select a volcano

( ) Redoubt ( ) Spurr ( ) Iliamna ( ) Augustine ( ) Snowy ( ) Katmai ( ) Mageik

( ) Aniakchak ( ) Pavlof ( ) Dutton (•) Shishaldin ( ) Westdahl ( ) Akutan ( ) Makushin

Date

Day: 19 Month: 4 Year: 1999

show plot clear

IceWeb Setup for Shishaldin Volcano

This volcano is currently on IceWeb: Using current setup

Stations / Alarms

Select up to 6 stations that you want to appear on spectrograms and reduced displacement plots.
Then for each station, select a threshold level. An alarm will be sent whenever more than 1 station is above its threshold level.

To remove a station from the alarm (e.g. because it is noisy) turn it off or enter a large value for threshold (e.g. 99)

	Stations	Threshold (cm^2)	Use in alarm?
1	SSLN	10	☑
2	SNN	16	☐
3	SSLW	10	☑
4	STE	10	☑
5	SSLS	20	☑
6	SSPE	10	☐

Reduced Displacement Plots

Which of these dr plots do you wish to be produced for Shishaldin ?

☐ Last 1 days ☑ Last 3 days ☐ Last 10 days

Wind station

Select wind data from one weatherstation.
These data will be shown on reduced displacement plots.

○ None ◉ Cold_Bay ○ Dutch_Harbour ○ Homer ○ Iliamna ○ King_Salmon

Submit Reset

ICEWEB SETUP UTILITY

Inspiration:

1. Duty person needs to be able to change alarm thresholds in middle of night from home

2. "IceWeb Manager" needs a tool which makes setup easier

Some of the things that can be set over the Internet:

- which volcanoes are on IceWeb
- which stations are plotted
- alarm thresholds for each station (or OFF)
- how frequently dr / spectrograms computed (e.g. 10 minutes)
- range of frequencies plotted on spectrograms
- which dr plots are produced for which volcano – Shishaldin

Iceworm parameter files

Truly a Web-based system!

IMPLEMENT FOR ALL VOLCANOES

Ukinrek at maximum capacity

EFFICIENCY!

Different approach: GOD? no!

Short-term solution: n..re powerful computer

Long-term solution: make code more efficient – rewrite in C

Problem with Web - Gifs expensive –Luetgert code

SHISHALDIN 1999 LESSONS

- compute dr more frequently (once per minute)
- improved lab based tools would help
- need flexibility to add extra plots during crisis (done)

Future Plans / The Jim Luetgert system

- Written in C (plots spectrograms!)
- Updates rather than recreates gifs

→ efficiency

WE HAVE BEEN WANTING TO THESE THINGS FOR A *LONG* TIME!
THIS SYSTEM IS *EXACTLY* WHAT WE NEED, but...

We need to modify it because:

1. It takes too many clicks to get to the data
2. Sideways spectrograms hurt your neck
3. You can only see 1 station at a time (in crisis multiple stations rather than multiple days is best)
4. Spectrograms are to big to fit on screen, and 800k takes too long to download – will not cut it at 3 am!
5. Helicorder plots are large, unfiltered & there is no 1 hour snapshot

Short-term:

- Implement Jim Luetgert system from Earthworm server in Anchorage – JP has done it!
- Acquire new computer to implement (Matlab version of) IceWeb for all volcanoes

Long-term:

- Rewrite IceWeb in C, using Jim Luetgert code as a starting point, with the objective of reproducing the good points of the current IceWeb system

FUTURE WORK

1999

- Finish Matlab version of IceWeb
- Implement for all volcanoes on new computer
- Improve lab-based tools for analysing archived data
- Document as USGS open file report

2000

- Rewrite IceWeb in C (using Luetgert code)
- Document

LUETGERT SYSTEM CAN SERVE AS A BACKUP

Unresolved Issues (?)

- Who will take over IceWeb project?
- Is there a need for a new AVO computer guy?