MONTSERRAT VOLCANO OBSERVATORY

GOVERNMENT OF MONTSERRAT

Seismic software at MVO, January 2002

Glenn Thompson

MVO Open File Report 02/01

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Executive Summary

This main purpose of this document is to give some information about the main programs that have been written by me (some by Patch and Art are also included and credited appropriately) for collecting raw data, processing event files, turning continuous data into various other datasets, and analyzing these data with Linux tools and Matlab, though its not well organized yet. Third-party software such as Seisan, EarthWorm, Seislog and RSAM are not covered here, nor are systems administration and networking tools, although these are all essential to correct running of the seismic acquisition, analysis, archival and alarm systems.

As can be appreciated a huge amount of software has been developed in the past two years, in conjunction with the installation of new acquisition systems. Some of this software is the glue that holds the data acquisition, analysis, alarm and archival systems together, and much of it are new data analysis tools. Undoubtedly over the next year or two, there will be further development as the seismic monitoring is stabilised and graphical user interfaces will be added to the most useful tools to make the analysis software easier for all MVO staff to use. A remote monitoring webpage will hopefully also be established with live data feeds from some of these tools.

1 QUICK GUIDE TO THE SEISMIC COMPUTERS

RSAM – this runs the RSAM alarm software (and records data to 1-minute files). Event alarm and tremor alarms thresholds and durations, number of triggers and a list of pages & telephones can be set. It can be a bit flaky at times (but there is now a 'BSAM' alarm system which works on data from the digital seismic network, now running on Seisan, though it has a 3-minute delay).

QNX – this runs Seislog and acquires data from the analog seismic network. Events are recorded to /home/events and must be manually deleted under the root account to prevent disk filling. Rbuffers are stored under /home/buffer, and are deleted after a couple of days. OS is QNX.

SA24 – this runs SA24 software from EarthData which converts data (from the digital seismic network) from ILI and stores in 1-minute files. SA24 crashes occasionally, usually with some memory access problem. OS is Win98.

EarthWorm – this runs EarthWorm software from USGS. Simon Flower of BGS wrote modules to import data from the SA24 (mapped as L:), and export events and rbuffers in Seisan format (these are copied to mapped drives on Seisan by the archive module). To run EarthWorm an EarthWorm MS-DOS window is opened, then <ew_nt> is typed to set EarthWorm environment variables, and <startstop> to start EarthWorm. Lots of messages fly through this window. Hitting <return> gives a list of modules and whether they are 'Alive' or 'Dead'. If modules are dead, EarthWorm must be stopped with <quit> then restarted with <startstop>. If problems persist, its worth rebooting and restarting SA24 and Seisan, and then rebooting and restarting EarthWorm. Modules sa242ew, trig2disk and archive are the ones that usually die. OS is WinNT.

Seisan – this is the data processing PC. Collection software <getdata.pl> is run on a cronjob. <Demux>, <mulplt> and <s2bob> are used in that order for processing events. <mulplt> is part of the Seisan analysis software, installed under /home/seisan, but about the only other program used from Seisan is <os9sei> (which is run automatically to convert data from Seislog to Seisan format). <Quickchecks> is used for seeing if things are running okay, and to flag up when data archiving needs to be done. Data archiving is to DDS-3 tape, and must be done under the root account using <archive2dat>. OS is RedHat Linux 7.2.

EarthWorm2 – intended to run EarthWorm in parallel with the EarthWorm computer. But this PC has weird hardware problems and is basically only good for MSOffice & internet type stuff. Log on as seisan. OS is Windows 2000.

Seisan2 – intended to run in parallel with the Seisan computer, but Patch has colonized it for his development work. Could be set up very quickly in the event of failure of Seisan though from the tar files created every night on /dome/seismicfiles (mapped as /backups on the Linux PCs). OS is also RedHat Linux 7.2.

Seismologist – where the brainy stuff happens. This can boot to RedHat Linux 7.2 (connection to Seisan can then be made with <ssh 192.123.0.83>) or Windows 2000. The main use under Linux would be to process events in the 'quality checking queue', or software development. The main use under Windows would be Admin (regrettably there is a lot!) or running seismic data analysis tools written in Matlab. If there is an analysis tool you want, its probably already been written (see software documentation).

Dial-in-PC – this is the PC at the Seismologist's house which is mostly used for alarm response. Under Windows ME, there is a desktop icon 'qnx dial-in'. Starting this will dial you in to the QNX computer, from where commands like <dpl>, <rtp> and <plt> can be used to analyse events, rbuffers and live data. From there you can telnet 192.123.0.83 to get into the Seisan machine, and use <vi> to develop software, or check that things are okay by running <quickchecks> or <df>. Note commands like <kedit> and <mulplt> will not work, since you will not be able to open a new window. It is hoped that Dave will shortly make it possible so that the Seismologist can dial-in to Windows PCs in the Ops Room, which would allow the Seismologist to check that EarthWorm & SA24 are running properly (they crash a lot) and restart them remotely if necessary. It would also allow the Seismologist to run Java and Matlab programs to remotely check rsam data, and events and rbuffers recorded on the digital seismic network. The Dial-in-PC also has RedHat Linux 7.2, though this isn't used for anything presently (cannot dial-in to MVO through this OS).

2 ORGANISATION

2.1 Linux systems

Programs

All programs developed by MVO that run under Linux are stored under /home/programs on Seisan. Languages used are Perl, C-shell, Java and C. Seisan is installed under /home/seisan. All commands under Linux are enclosed in <brackets like this> to distinguish them from Matlab programs (which are run under Windows).

Config files

Configuration files such as .cshrc, .paths.pl, .netrc and .remotedrives are installed under /home/seisan.

Cronjob

Several programs are run automatically on MVO-BB3 using the Unix crontab facility. For a listing of these programs log on as Seisan and type <crontab –l>. To edit type <crontab –e>.

Data

Raw data (events and rbuffers) are collected under /data. Events are stored under /data/$SYSTEM/EVENTS/ARCHIVE/YYYY-MM-DD where $SYSTEM=QNX, EARTHWORM or VME. Rbuffers are stored under /data/$SYSTEM/RBUFFERS/ARCHIVE/YYYY-MM-DD. All these data are put there by <getdata.pl> and archived from there to DAT using <archive2dat>.

The SFILE database is stored under /home/seisan/REA. Other derived data (e.g. SPADE data, BOB data including BSAM, CSAM and spectral data) and events for quality checking or rockfalls for locating with ampmap are stored under /data3.

2.2 Windows (Matlab) tools

Programs

All Matlab programs are stored on \\DOME\SEISMOLOGY\MATLAB\MFILES. Matlab is installed on all Windows 2000 PCs and a <startup.m> in your local work directory is run to set paths. Make sure you understand the 'datenum' command (type <help datenum>. This is the way Matlab specificies dates & times. Most programs use snum & enum to represent the start & end dates/times for extracting & plotting data.

Data

Some Matlab programs access data stored on SEISAN (e.g. SPADE files, WAV files, RBUFFERS, BSAM data etc). Others access data under \\DOME\SEISMOLOGY\MATLAB\DATA (e.g. <plots>).

3 EVENT & RBUFFER TRANSFER FROM QNX, VME, EARTHWORM

This is done by a single Perl program called <getdata.pl>. It is run with the arguments TYPE and SYSTEM where TYPE = EVENTS or RBUFFERS and SYSTEM = EARTHWORM, QNX or VME. The program handles any y2k corrections, demultiplexing, copying to the pickingq and saving to a directory reading for archiving.

<getdata.pl> also runs the program <fixewdata.csh> which corrects Seisan headers created by EarthWorm.

4 DIAGNOSTIC CHECKS

Each day the program <**checks**> should be run. It automatically runs some checks on the health of MVO-BB3 and also prompts the Seismic Technician to do some manual checks and answer questions. The aim is to ensure that checks are performed each day in order to keep seismic monitoring in good health, and to keep a record of these checks that can then be interrogated. For example, the command:

```
cat /data3/DAILYCHECKS/*.txt | grep crash | grep SA24
```

will produce a dated log of all times when the SA24 crashed (providing checks have been performed each day).

Throughout the day the command <**quickchecks**> is very useful, in particular because it shows the times of the last events transferred from EARTHWORM and QNX. <quickchecks> will automatically start <checks> if <checks> has not already been run today.

There is also a program called **<overnight>** which shows the rbuffer from the digital seismic network from 0800 UT today. This is used to assess if there is a power problem at stations, since this is most likely to reveal itself just before dawn when there has been no charging of the batteries by solar panels for several hours. <checks> runs <overnight>.

The Unix command **<df>** is useful for seeing what space is available on different disk drives.

Other useful diagnostic checks are to check the latest bsam data by double-clicking the bsam icon on the MVO-BB Desktop, or by typing **bsam** at the command prompt on Unix.

Its useful to check that disk shares are running, in particular that \192.123.0.83\data can be seen from the EARTHWORM PC. If it cannot, data will accumulate under D:\EARTHWORM\DATA rather than be transferred to MVO-BB3. To fix this, make sure Samba is running or reboot EARTHWORM and MVO-BB3.

5 ROUTINE PROCESSING OF EVENTS

The programs used for routine processing of events are:

1. **<Demux>** – merges events from both networks and puts into picking queue

2. **<Mulplt>** – for processing events

3. **<S2bob>** – updates SFILE & SPADE databases (described in full below)

These should always be run in this 1,2,3 order. Events files from both QNX and EARTHWORM (or VME) are queued in /home/seisan/WOR/SOURCE. <Demux> merges these events and puts the merged files in /data/SEISAN/WOR, which is also called the PICKING QUEUE.

<Demux> is a shortcut to pick.csh, which runs dirf.pl (better than the Seisan dirf program).

6 OTHER USEFUL PROGRAMS

<summary> - gives amp, eng & ssam data for every event in the PICKING QUEUE.

<summary YYYY MM DD> – gives amp, eng & ssam data for each event for a given day.

<countday YYYY MM DD> – adds up events correctly for one day.

<countweek [SYYY SM SD EYYY EM ED]> – adds up events for the past week (or week ending at specified date/time). Misses a few events (check out the Matlab program 'report').

7 DATA ARCHIVING

Routine archiving of event files and rbuffers is done with the program **<archive2dat>**. First log on as root (seisan doesn't have access to the DAT drive). Then run:

```
<archive2dat SYYY SM SD EYYY EM ED TYPE>
```

where TYPE is either EVENTS or RBUFFERS.

8 EXTRACTION & ARCHIVING OF DATA FROM/TO DAT TAPE

<Extractdatafromdat.pl> is a simple program which just grabs all data from a tape. It will not terminate so must be stopped with <CTRL-C>.

<Extract4art.pl> is more intelligent, giving some options. (<Extract4phi.pl> is another version of this).

<Tape2tape.pl> copies the contents of one tape to another (might need two dat drives).

<Archive4art.pl> tars files to dat tape.

Unfortunately the VME_COLLECT software used on the SUN from 1996-2000 performed no error checking, and this resulted in perhaps as much as 50% loss of rbuffer data.

9 SYSTEM BACKUPS

The program <**autobackup2.csh**> is run as a cronjob every night. It creates tar files of all important programs, config files, documents and data on the seismic computers and stores them under /backups (which is a Samba mount of \\dome\seismicfiles).

10 ANALYSIS OF SFILE & SPADE DATABASES

An SFILE is created for every event when it is classified by Team Seismic. If phase picks are made, and if a location is computed, this information is added to the SFILE. The program <s2bob> adds amplitude, energy and fft data for each channel included in the event file – this SFILE database is essential to seismic monitoring. <s2bob> also creates SPADE (one per month) and DAY files (one per subclass). These programs are run as cronjobs to create event plots on the internal MVO website.

plotDAY(fignum,subfignum,numsubfigs,subclass,snum,enum,param[,binsize])

Used for creating plots from the DAY files in \\dome\seismology\matlab\data\daily. Param can be any one of 'amp', 'cts', 'eng', 'f', 'maxf' or 'dur'. So to produce a plot of rockfall durations, averaged over a week, for the whole of 2001, this would work: plotDAY(1,1,1,'r',datenum(2001,1,1),datenum(2002,1,1),'dur',7);

plots(snum,enum,fignum,binsize)

The program calls the plotDAY function with subclasses r,e,l,h & t in turn. The program is very useful for looking at long-term trends in activity. Defaults for snum and enum are now-365 & now.

<query.pl>

Extracts data for all subclasses. Arguments are SYYY SM EYYY EM min max. Creates files like query_r.out in local directory. These should be read into a Matlab program for doing the statistics.

plotSPADE(snum,enum,type,plottype,subclasses,fignum,binsize)

This Matlab program will extract spade data for the date range specified by snum and enum. The type of data to plot should be 'cts' (counts), 'eng' (energy), 'mag' (magnitude) or 'amp' (amplitude). The plottype should be 'stem' (for stemplot – this is broken) or 'bin' for binned data. Subclasses can be any combination of 'r' (rockfall), 'e' (lprf), 'l' (lp), 'h' (hybrid) or 't' (vt), or 'a' (all events regardless of subclass) – these will be plotted as separate traces (subplots). Binsize is given in days (e.g. 4/24 is 4 hours). To plot amplitudes of

rockfalls and hybrids grouped in 12 hour bins for the month of November 2001, the following would work:

plotSPADE(datenum(2001,11,1),datenum(2001,12,1),'rh',1,0.5);

report(enum,numweeks)

Very useful for weekly reports. Provides more detailed statistics than <countweek>. Lists biggest events, counts & magnitude by day and by week. Defaults arguments are enum=now and weeks=10.

11 ANALYSIS OF EVENT FILES

To load a SEISAN file:

```
[t,d,snum,fs,ns,get_id,fname]=load_pcseisan(path);
```

and select the file you want to load. Load_pcseisan now loads VME, EARTHWORM, QNX & merged Seisan files.

To plot a SEISAN file:

```
mulplt(t,d,get_id,fname);
```

this will plot the file is a similar way to the Seisan program mulplt. Numbers on the left are the trace averages. Numbers on the right are trace maxima.

plot_pcseisan; % plots each channel (chosen from a menu) in an event (or rbuffer) file.

12 ANALYSIS OF RBUFFER FILES

rbuffer(stations,snum,hours,rbufferpath[,saveflag])

This loads 'hours' hours of continuous data from the digital seismic network for the specified stations, from the start time defined by snum. The path to the rbuffer files must be specified. If saveflag is omitted, the user can interactively plot data as helicorder, spectrograms or listen to the data. If saveflag=1, helicorders, spectrograms and WAV files will be created and saved *(the program is usually run in this mode by cron, which calls rbuffer_wrapper and creates plots and WAV files for the internal web page).* If saveflag=2, spectral data will be produced, but no plots or WAV files made (this option is now redundant since spectral data are created by <rbuffers2csam.csh>).

plot_pcseisan; % plots each channel (chosen from a menu) in an rbuffer (or event) file.

spectrogram2(statio n, snum, enum…)

This will plot 1-minute spectral data created by <rbuffers2csam.csh>.

spectrogram3(statio n, snum, enum…)

This will plot a raw spectrogram from the rbuffer data files directly. The resolution is better than spectrogram2, but it cannot be used on time windows of greater than about an hour (due to problems with computer memory). Spectrogram2 however works fine for spectrograms of up to weeks in length.

seisan2audio(stations,speed)

This loads a Seisan file (using load_pcseisan) and converts it to a WAV sound file, and plays it.

13 THE ROCKFALL LOCATION SYSTEM

locate_bsam(snum,enum)

This was the original proof of concept in 2000. Near-real-time bsam data was located assuming surface wave spreading in a homogeneous half-space.
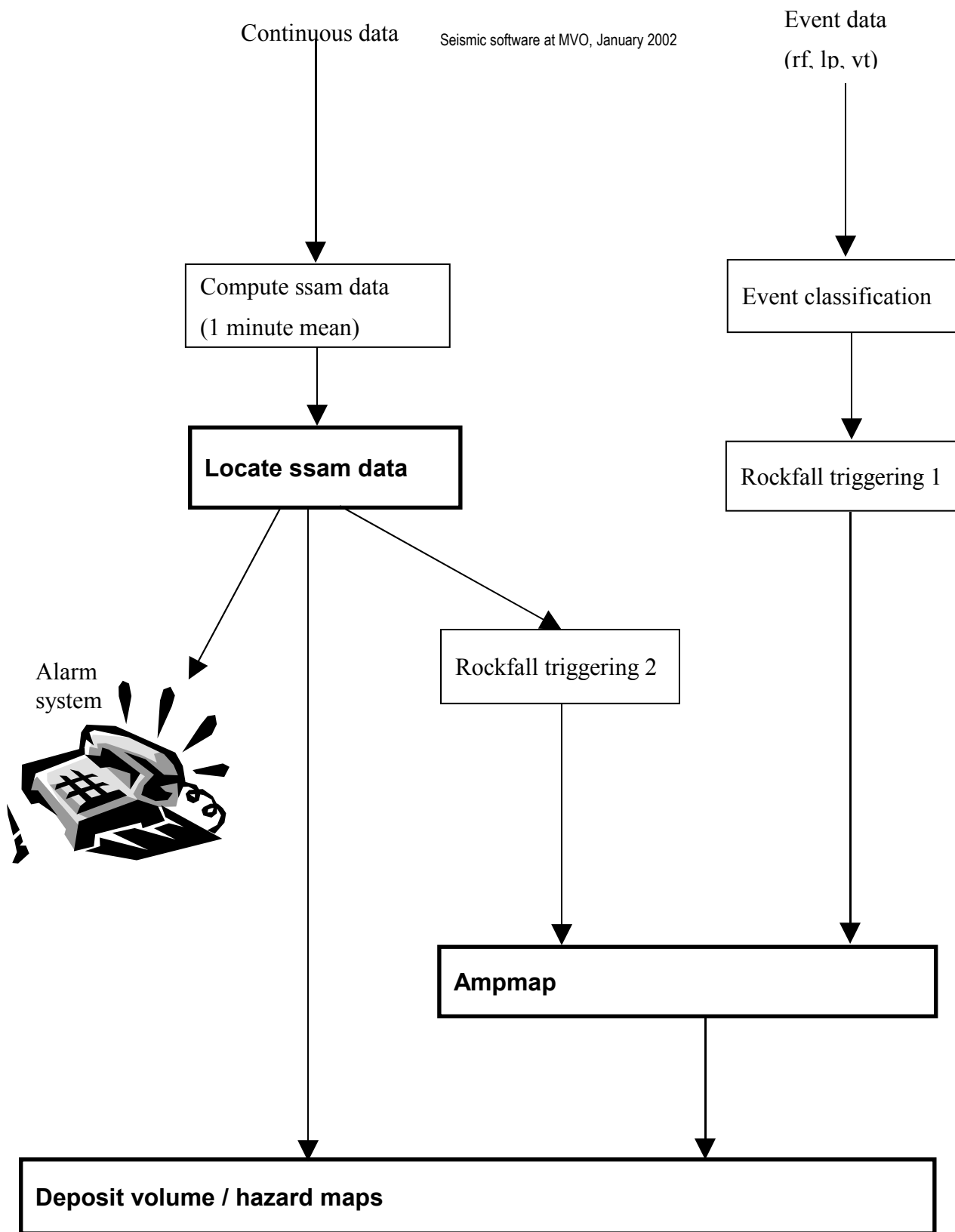
amp_map

Rockfalls above a certain amplitude threshold are saved in /data3/ROCKQ by s2bob after classification. Amp_map is a Matlab application which uses load_pcseisan to load event files, then provides various GUIs which allow Venus to locate rockfalls and save data. Rockfall locations have been rather dubious so far due to poor azimuthal station coverage (no data from MBBY, and intermittent data from MBSS). The frequency band of around 8 Hz was found to give the best results since long period earthquakes have little energy at these frequencies. Credit Art Jolly.

rock_map(snum,enum)

This plots all rockfall location data (generated by amp_map) between a given start & end date/time. This is more useful and simply than analyzing the data with Zmap. Eventually rock_map should provide contours of deposit volume (after a correlation study between dome collapses and seismic energy is complete).

<autolocate>

The plan is to eventually develop a near-real-time, automatic rockfall location system, which provides near-real-time graphical display of rockfall trajectories, so that field crews can be warned, and sends alarms (the alarm system already exists, the rest has been prototyped in Matlab).

Continuous data

Event data
(rf, lp, vt)

```
┌─────────────────────┐              ┌─────────────────────┐
│ Compute ssam data   │              │ Event classification│
│ (1 minute mean)     │              │                     │
└─────────────────────┘              └─────────────────────┘
          │                                    │
          ▼                                    ▼
┌─────────────────────┐              ┌─────────────────────┐
│ **Locate ssam data**│              │ Rockfall triggering 1│
└─────────────────────┘              └─────────────────────┘
```

Locate ssam data

Alarm
system

Rockfall triggering 2

Rockfall triggering 1

Ampmap

Deposit volume / hazard maps

PROPOSED ROCKFALL LOCATION SYSTEM

14 NETWORK MAPS / TELEMETRY

Original DEM is \\dome\volume\baseDEMs\Monty50m.grd. This is a Surfer binary file, which can be converted to surfer ascii using GRID/UTILITY/CONVERT menu in Surfer. This has been converted to monty50m.mat in \\dome\seismology\matlab\data\map using surferascii2latlonmat.m, which also calls x2lon & y2lat. The m-file stationtable provides comparisons between actual GPS coordinates of seismic stations, and those computed with the functions x2lon and y2lat (or their inverse functions, lon2x & lat2y) – agreement is good.

The .mat file is then used by programs contourmap, crosssection & computemesh. **Crosssection** is the most interesting of these as it calls the other two and allows telemetry profiles to be plotted interactively on the contour map.

Station coordinates are given in the file \\dome\seismology\matlab\data\map\stations.dat, which has the same format as STATION0.HYP in $SEISAN_TOP\DAT on the Linux PC.

Eventually these map programs could be used to make an improved version of ratmap, ampmap & bsammap. Zmap may also be a useful starting point for new version of ratmap.

15 ANALYSIS OF BANDED TREMOR

Tremor cycles can be automatically detected using:

detectcycles(dnum,data,type);

This will provide a graphically display of any triggers, which hopefully correspond to tremor cycles. The data must first be loaded using load_rsam.

Tremor cycles can be manually picked using:

pickcycles_wrapper(snum,enum,rsamsta);

This will load rsam/bsam for the specified rsam station & tilt data for CHP3 (if there) and jump through the data in 4 day intervals allowing interactive picking of the on and off times of each tremor band. Data will be appended to files like rsam_MBWH.mat or tilt_CHP3.mat.

Cycle data can be plotted using:

statistics(snum,enum,rsamsta);

This will load data for any cycles picked using pickcycles. Data will be calibrated for scale.

16 HYPOCENTRAL DATA

For locating events, the procedure is to ignore phase picking on the first pass, then move WAV files to a new directory, pick phases and save location in a local database. Epicentres can now be plotted using the Matlab program 'hypocentre'.

Hypocentres are computed using the HYPOCENTER program, which is interfaced to SEISAN. Unfortunately this program, perhaps because of a poor velocity model, is very unreliable for locating events, often reporting the error message 'less than 3 valid phases at present location'. This needs looking into and fixing.

When hypocenters are determined successfully the picks will usually (not always) be appended to the S-file, and the location in the first few lines. A hypsum.out file is also made. There is no method for getting these data into a plotting program, and the hypsum.out file is replaced everytime mulplt is run on a new event. This also needs fixing.

Hopefully a visit by Lars Ottemoeller will be possible sometime this year, to fix problems these hypocentral problems with Seisan.

17 1-MINUTE BOB DATA (RSAM, BSAM ETC)

17.1 Creation of short-period RSAM data

The RSAM PC logs 1 minute RSAM data to binary files. These files are stored on the RSAM PC but this is generally mounted as /rsam on Linux and J:\ on Windows 2000.

17.2 Creation of broadband RSAM (bsam) data

BSAM data are created by a Java daemon that runs on the 1-minute rbuffer data files created by the EarthWorm module 'archive_1min'. This daemon (called oneMinSAM) runs on Seisan, and depends on the link /earthworm being available (alarms are sent when it is not). This daemon also checks to see if bsam data exceed thresholds and number of triggers defined in the 'thresholds' file under /home/programs/JAVA/binary and if it is, sends a page to all numbers listed under /home/programs/JAVA/http/number_list.

Old versions of BSAM data included 'ltamon' data and 'MAS' data. The former are corrupted, and the latter don't appear to have a 1-to-1 correlation with BSAM data, and so haven't been merged into the BSAM files.

BSAM data can be created from old rbuffers. To do this run <oldrbuffer2bsam_wrapper.pl RBUFFERDIR>.

17.3 Creation of CSAM, CSEM, MEANF, MAXF and SPEC data

These datasets are created by the cronjob <rbuffers2csam.csh>. This runs the program <rbuffer2csam_20min.c> on each file in the directory /data3/CSAM_QUEUE. CSAM is corrected seismic amplitude measurement (a reconstituted version of BSAM). CSEM is seismic energy rather than seismic amplitude. MEANF is the mean frequency. MAXF is the peak (dominant) frequency. SPEC is 85-point frequency data, used for producing spectrograms.

17.4 Analysis of rsam/bsam data

The following Matlab routines are used to load and plot rsam/bsam data. The 'type' variable must indicate 'rsam', 'bsam' or 'bmas'. The latter is used to plot data from the MAS system.

[dnum,data]=load_rsam(syyy,eyyy,station,type);

plot_rsam(snum,enum,binsize,subfignum,numsubfigs,ymax,station,dnum,data,type[,plottype,col])

Plottype is 0=standard rsam plot, 1=cumulative rsam plot, 2=collapse volume plot. Collapse volumes are only calibrated for MAS data so far, using a volume of 30 million cubic metres from 20 March 2000, and the equation collapse volume proportional to rsam energy (i.e. rsam squared) from Art Jolly's 1999 AGU Poster. Plottype is optional (default is standard rsam plot).

'col' is colour, e.g. 'k' for black. This is optional (default black).

bob(snum,enum,stations,type,processing,fignum,subfignum,numsubfigs,resampmethod,binsize,plottype,despiking,threshold);

This is a program for analyzing all 1-minute BOB data (except for SPEC) and uses load_rsam and plot_rsam. Type 'help bob' for details.

A graphical user interface to these programs has been developed called 'samgui':

18 ALARM RESPONSE

18.1 Dial-in to QNX

Double-clicking the 'dial qnx' icon on the desktop on the dial-in PC will connect to the QNX (this works by running the ttpmacro program with the qnx.ttl file). Once on the QNX the programs '**rtp**', '**dpl**', '**mon**' and '**plt**' can be used for data analysis, or telnet 192.123.0.83 will get you onto Seisan so you can run Linux programs (so long as they don't create new windows), or edit them with vi.

18.2 Rapid analysis of Seisan events and rbuffers

This program needs updating and loading on \\DOME\SEISMOLOGY & new dial-in server.

18.3 Java applications for plotting 1-minute bob data & event/rbuffer files

David Silcott is working on these so they will work over a dial-in link…

19 ANALYSIS OF ALARM EVENTS

19.1 Analysing alarms that were sent

The RSAM system produces an alarm.log file. Programs have been written to extract useful data from these files and plot them.

The first step is to copy to alarm.log file to a floppy disk, and append it to the alarmall.log file under \\DOME\SEISMOLOGY. Then run the Matlab program 'process_alarmlog('alarmall.log')'. This produces a file called alarm.mat.

This file can be converted to an Excel file with 'alarm2excel'.

Or the number of weekly alarms can be plotted with 'plot_weeklyeventalarms'.

Finally the event thresholds over time can be plotted with 'plot_eventthresholds'.

19.2 Analysing alarms that should have been sent

numalarms=test_thresholds(snum,enum,type) – where type is 'rsam' or 'bsam' will give a list of alarms that should have triggered.

weekly_alarms(numweeks,type); - this plots a graph of alarms (of *type* rsam or bsam) per week over the last *numweeks* weeks.
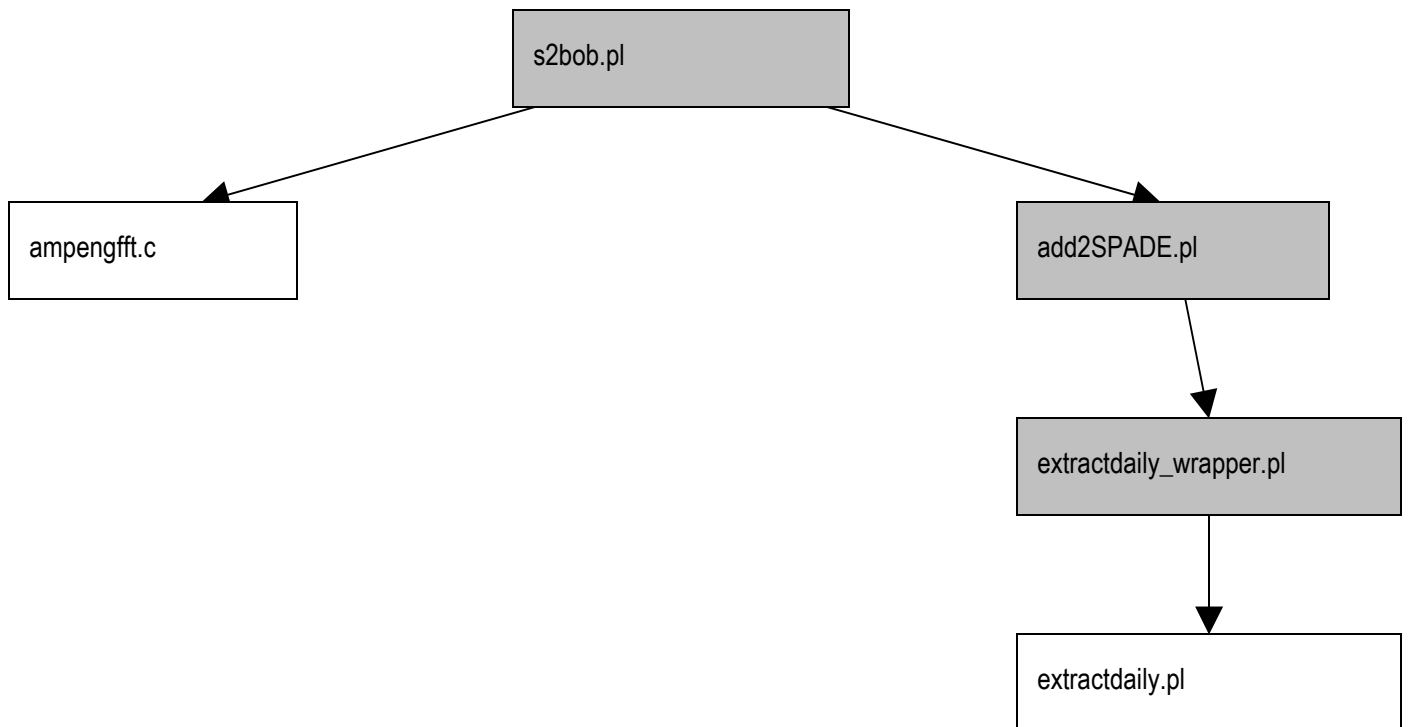
20 CREATION OF SFILE & SPADE DATABASES (A DETAILED LOOK AT S2BOB)

This is all handled by the <s2bob> command which the user runs after each mulplt session, although the file 'new_s_files.dat' could equally well be made manually, or each program could be used on its own.

PROGRAM	BRIEF DESCRIPTION	arguments
s2bob.pl	Loops through Sfiles listed in 'new_s_files.dat', appends ampengfft data for each broadband file, then deletes any version of the event in the picking queue and the source directory.	None
add2SPADE.pl	Add data for each event to the SPADE database. Also copies large events, regionals, undetected regionals and spiky events to the quality checking queue for later re-analysis by the Seismologist. Also copies large rockfalls to the rockfall picking queue.	None
ampengfft.c	Reads a BB wavfile and produces amplitude, energy and fft data for each channel. It will read calibration data from calibration file if they are not already included.	OUTFILE WAVFILE
extractdaily_wrapper.pl	Runs extractdaily.pl for each subclass for a given month, and then cats *.day files to produce SUBCLASS.DAY files	YYYY MM
extractdaily.pl	Computes daily event counts, energy & average frequency & duration data for a given month from a MBWHYYYYMM.aef file. Computed data is displayed on screen.	YYYY MM subclass

The program extractdaily_wrapper_wrapper.pl can also be used to run extractdaily_wrapper.pl for a range of months, e.g. to update the entire DAY part of the SPADE database.

Similarly, updateSPADE_wrapper.pl can be used as a wrapper for updating the entire SPADE database (AEF & DAY files).

```
           ┌─────────────┐
           │  s2bob.pl   │
           └─────────────┘
          /               \
         /                 \
┌──────────────┐      ┌──────────────┐
│ ampengfft.c  │      │ add2SPADE.pl │
└──────────────┘      └──────────────┘
                             │
                             ▼
                   ┌──────────────────────┐
                   │ extractdaily_wrapper.pl │
                   └──────────────────────┘
                             │
                             ▼
                   ┌──────────────────┐
                   │ extractdaily.pl  │
                   └──────────────────┘
```

21 SOFTWARE BACKUP PLAN

Software	Status	Backup media	Periodic backups	Installation instructions
OS9	Soon to be obsolete (VME).			
QNX	critical			BGS guide?
Windows 98, NT, 2000	critical – SA24, Earthworm & analysis PCs	CDs downstairs		Dave Williams will install
DOS 6	Used only on RSAM PC			Dave Williams will install
Win 3.1	Used only on RSAM PC			Dave Williams will install
Red Hat Linux 7.2	critical – routine analysis	CDs & boot disk in data safe		**Ask Patch to write a manual, including disk partitioning, mounts, samba and dat drive installation**
VME Seislog	Soon to be obsolete			
QNX Seislog	critical –short-period data acquisition	Floppy disks in data safe		BGS guide?
SA24	critical – broadband data acquisition	CD in data safe labeled "Earthworm 5.1 + BGS extensions'	Configuration files are backed up nightly	BGS guide?
EARTHWORM	critical – broadband data acquisition	CD in data safe labeled "Earthworm 5.1 + BGS extensions'	Configuration files are backed up nightly	BGS guide?
GLOWWORM	No longer planning to use it			GlowWorm manual is poor. Need to write an MVO manual when this installation is performed.
RSAM	critical, though may eventually be phased out by GLOWWORM	Have asked Jeff Marso & Tom Murray, but nothing received.		Ask Dave. VDAP manual?

Perl (for Windows 2000)	Not currently used	Downloads CD		Auto-install
Matlab (for Windows 2000)	Essential for analysis tools under Windows.	CDs in data safe.		Auto-install
Visual C++ (for Windows NT)	Essential for recompilation of EARTHWORM	CDs in data safe.		Auto-install
Visual Basic (for Windows NT)	Essential for recompilation of GLOWWORM	CDs in data safe.		Auto-install
Seisan (for Linux)	Critical for routine data analysis	CD labeled "Seisan 7.1 for all platforms". Version 8 now available – download.		Reload and re-configure. Only do this if the tar files (see next item) don't exist
Routine analysis & archival software written by Glenn & Patch	Critical for routine data analysis & archival		Automatically backed up each night.	Unzip tar files
Matlab analysis tools written by Glenn	Essential – stored on /DOME/SEISMOLOGY		Automatically backed up each night.	Reload off zip disk and set paths.
Alarm response tools	Need writing.		Should be periodically backed up to zip disk	Reload off zip disk and set paths.