

MVO Procedures No. 44

RSAM alarm thresholds at MVO

Paddy Smith, Seismologist, MVO.

`paddy@mvo.ms`

1st February 2019

1 Overview

This quick document (originally written in January 2012) describes the systematic method that was developed to determine the RSAM threshold values used for triggering alarms by MVO seismic system.

2 Problem:

Existing RSAM thresholds for the alarm (in earthworm config files `rsam2alarm.d` and `rsam2alarm_trem.d`) were a mess, with edit history suggesting an arbitrary and ad-hoc approach to determining the values for several stations. This meant some stations were set far too sensitive and were constantly triggering (e.g. MBWH), while others were set too high and never contributed to the triggering.

3 Solution:

Determine RSAM thresholds based on a single amplitude (velocity) threshold, taking into account:

- Instrument gains (up to date!)
- Digitiser calibration factors (up to date!)
- Site effects

4 Benefits:

- Should provide a more robust and reliable way of determining the thresholds
- Includes stations which were previously ignored/not used!
- Should be easier to adjust (depending on the level of activity) as only a single number needs to change to recalculate the values

5 Details of Method

5.1 RSAM (60) thresholds

So, to calculate the threshold values, run the matlab script/function “RSAM_alarm.m” in this directory (*/home/seisan/WOR/RSAM_alarm* on **piton**))

This takes a single amplitude threshold in $\mu\text{m/s}$ and returns a value in counts for each station, based on the station instrument gains and digitiser calibration factors. (NB. this AS-SUMES these values are kept up to date!)

The threshold value used is currently 10 $\mu\text{m/s}$ (in file: “microm_per_sec_value.txt”) This was determined, to some extent, by looking at the current/old values for the thresholds and trying to match up the ones which were felt to be reasonable. Although this can now be easily adjusted if it is felt to be under/over sensitive.

The triggering can be tested for certain past events/time periods by running the matlab script: “**rsam_trigger_test.m**”

This uses the 60 second RSAM data files and the calculated thresholds to check for any triggers in the specified time period.

Extensive testing of events which did trigger the alarm within the last few months (including examples of Regional, Teleseismic and large VT events), showed the new algorithm could be successfully tuned to trigger for these past events. And the ability to test past events/examples in this should allow much greater control of the process.

The site effects factors were calculated by normalising the peak (gain/calibration corrected) amplitudes (Z component) of all stations to MBLY (assumed the closest to the volcano), for 5 teleseismic and 5 regional events in 2011:

Regionals:

- 2011-10-06
- 2011-09-06
- 2011-07-06
- 2011-06-20
- 2011-04-13

Teleseismic:

- 2011-08-24
- 2011-07-06
- 2011-06-24
- 2011-03-09 03:46
- 2011-02-11

These site effect scaling factors were averaged over the 10 events, and are stored in “scale_factors_rel2MBLY.txt”. (note MBHA is currently set to 1, as there was no data available for these events during 2011)

A distance correction factor, to account for decay of amplitude with distance from the volcano has also been included. Currently calculated for each station (s) using:

$$\frac{1}{distance_factor(s)} = \frac{dist(s)}{8} + \frac{3}{4}$$

for distance $dist(s)$ from the volcano in km. Although this could be adjusted if necessary.

Finally, the determined thresholds are then rounded to the nearest 500 counts.

5.2 RSAM (1800) i.e. tremor alarm

This was determined using the exact same method, but with the threshold chosen rather arbitrarily to be 1/3 of the RSAM (60) threshold, based on existing values in the earthworm rsam2alarm_trem.d file, so currently $3.33 \mu\text{m/s}$. This will probably need adjusting as I think it may not be sensitive enough...

Unfortunately this cannot be tested as easily as the 30 min RSAM data generated within earthworm is not currently stored and would have to be recalculated for each time period if this was to be tested.