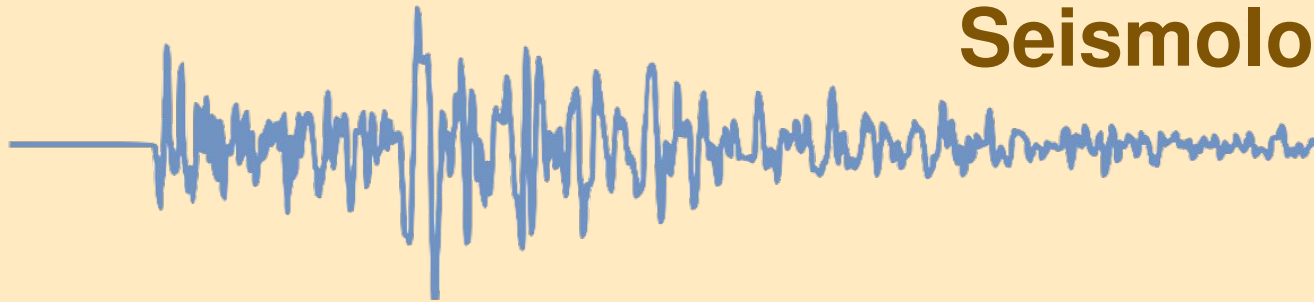




**Newsletter of the  
Seismological Association  
of Australia Inc. Mar-Apr 2020**



# Seismological Association of Australia Inc.

Newsletter of the  
**Seismological Association of Australia Inc.**  
PO Box 682, Mylor SA 5153

## **Your Committee**

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The SAA can be contacted by post to the  
address above, or by email to any member of  
Committee, as listed above

**Membership** of the SAA is open to all, with the  
only prerequisite being an interest in seismology.  
Membership applies for the calendar year  
(January through to December)

Membership fees are:  
Full member \$50

A Membership application form can be obtained  
from the Treasurer by email or [download it here](#).

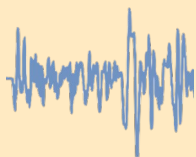
## **Member Submissions**

Submissions for inclusion in the Newsletter are  
welcome from all members; please note that  
submissions may be held over for later editions.  
Wherever possible, text submissions should be  
sent via email in almost any word processing  
format. Your name may be withheld only if  
requested at the time of submitting. Images  
should be high resolution and uncompressed,  
although high resolution JPEGs are acceptable.

All enquiries and submissions should be  
addressed to the Editor and preferably sent by  
email to weaksignals@iinet.net.au

## **On the Front Cover**

Dr David Sutton (Adelaide University Physics  
Department) at Mount Bonython in 1959.  
Mount Bonython was the first 'modern' station in  
SA, and ran from 1958 to 2017. The remaining  
equipment was removed by SAA members  
(Newsletter 4, p11). The drums in this photo were  
then moved to the Cleve and Hallett vaults when  
newer equipment was organised. Dr Sutton built  
up the SA network to about 12 stations before his  
untimely death.



# SAA News

## **You know winter is just around the corner when...**

Let's face it, we had it pretty easy for a while. Last year we had to change a couple of batteries at various sites but as I recall from our Treasurer's report at the AGM, we only paid for the one at Willalooka (WKA). Several of these battery changes (THS, TPSO & STR2) were swapping out bad batteries with better batteries, not new ones. So, just under a year on and we've had to install a new battery at Sampson Flat (THS) and more recently, Cleve (CLV2). Strathalbyn (STR2) is in need of a new battery and a new N70ZZMF has been purchased for the job.

Century Yuasa, shut up and take our money.

## **Our last Bunnings BBQ for 2020??**

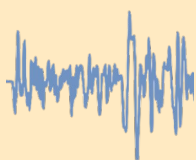
It was probably a good thing that we took up the opportunity offered in January to run a fundraiser at Mt. Barker Bunnings. We recently received advice from Bunnings that all Bunnings Community Events had been cancelled until further notice, due to the COVID-19 situation. In case you were wondering, I had already taken the view that were we to receive another invitation to participate, I would politely decline the offer and leave it at that for the foreseeable future.

## **A web link that you may have missed**

In the search for relevant material to bring to you in this newsletter, occasionally there is a flower amongst the weeds. Joe Grida has graciously passed on this link to a [Geology website](#) that you might find interesting. While I prefer to choose not to publish material that is in the public domain and readily available to everyone, I am happy to occasionally pass on your suggestions of websites which members may appreciate.

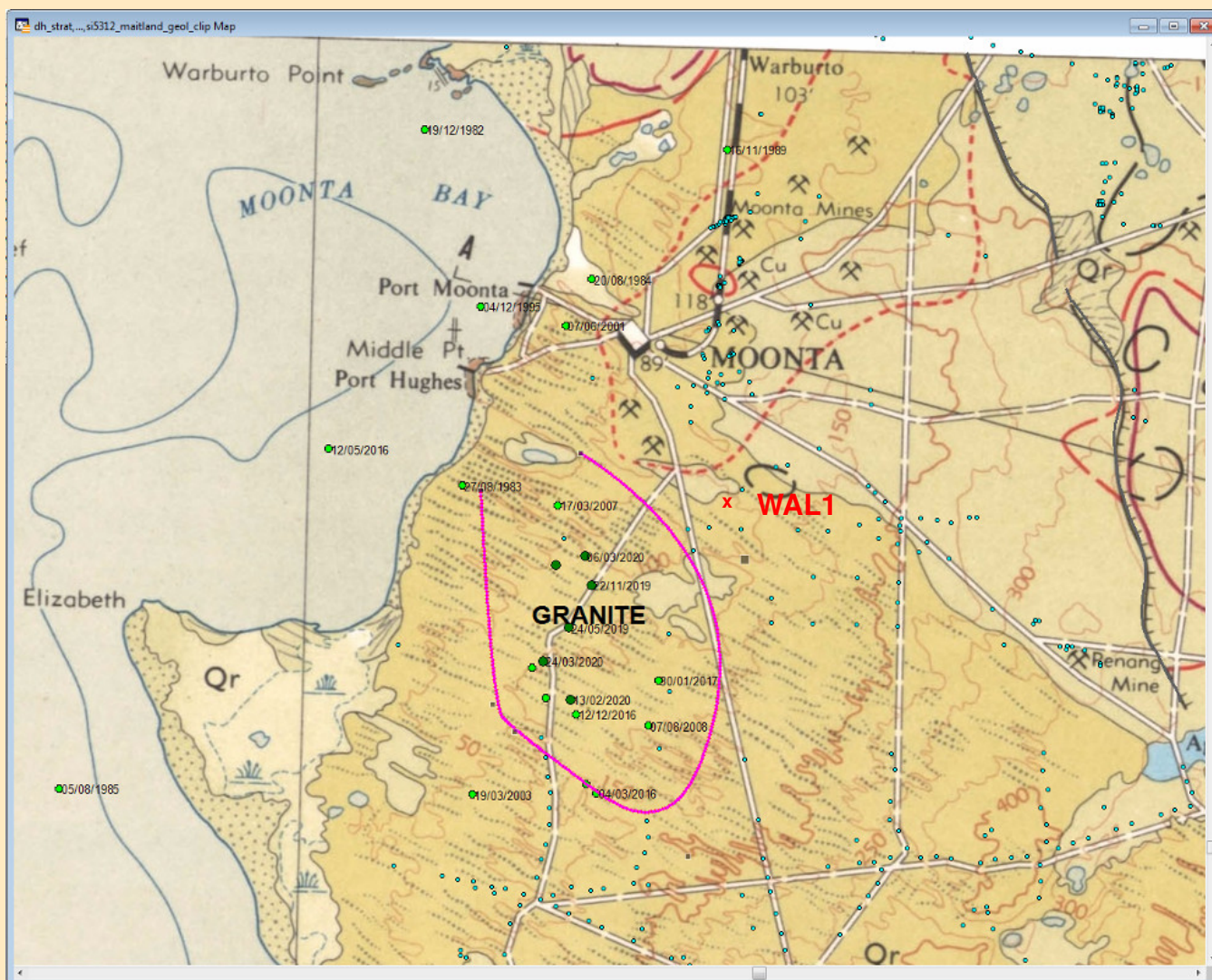
**In the interests of public health, this page is a futile example of social distancing.**





# Moonta WAL1 deployed

Kindly submitted by David Miller



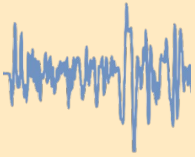
**Location of WAL1, green dots cluster of recent seismic events. Magenta polygon is approximate extent of granite pluton.**

## **An interesting cluster of low magnitude tremors are apparent in a small region south of Moonta on the Yorke Peninsular.**

Events at this location have been recorded from as early as the 1980s. Seismic events in this area from the 1980s to the mid 2000 piqued my interest. Seismic events in the stable cratonic rocks of the peninsula are infrequent and generally don't display clustering characteristics. This unusual seismic cluster was, in part, one of the reasons for establishing the WALR seismic station south of Wallaroo. Observations from WALR, MRAT and others have confirmed the existence of an interesting area of low magnitude seismic activity. The occurrence of several events over the past 18 months has aroused the curiosity of myself and other members of the association. It was the impetus to build a robust portable seismic station (on a budget).

The portable station (WAL1) was deployed 2 weeks ago approximately, 4km south of Moonta. Within a week, a small 1.1 ML event was recorded from within the cluster area. Signal strength and clarity was good even though the seismometer was positioned on a hard calcrete layer within recent Quaternary sandy loam.





# Moonta WAL1 deployed

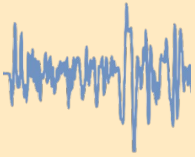
A preliminary review of the local geology and drill data suggests that the tremor cluster occurs within an area of granite situated at a depth of approximately 50m below cover. Low magnitude seismic events within an area of Hiltaba Suite granite perhaps points to brittle fracture (rock burst) within the upper shell of the pluton. It seems reasonable to postulate that the cluster of seismic events are related to possible exfoliation or other brittle fracture stress relief within the upper layers of the granite pluton. The exact trigger is unknown but may be caused by changes in subsurface groundwater – weathering conditions (there are some unusual shallow playa lakes close to this location) or to larger stress fields.

There are a number of unanswered questions. In short, further investigation is required to improve the estimates of epicentres and focal points of the events and to start to integrate geological and other geophysical data to resolve this most intriguing seismic problem. This will open up the opportunity to undertake more detailed geophysical investigations in the future.



**WAL1, a palletised portable seismic station made up of the usual suspects. 2 x 80W solar panels, a 12V 110AH lead acid battery, EchoPro recorder and Vodaphone network with an external antenna.**





# Moonta WAL1 deployed

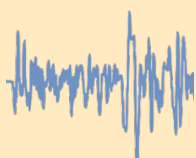
The L4C-V downhole seismometer is located off to the side of main unit at depth of 300mm, covered with soil. Location is composed of sandy loam with an underlying calcrete horizon (too thick to break through by hand). Crystalline basement at a nominal depth of 10 metres.

This is a temporary station, although perhaps a little cumbersome it can be deployed - setup in under 2 hours. Has been placed on a shipping pallet in an effort to make it easy to handle with a fork lift or small portable crane, pallet makes it less easy for unauthorised people to steal, also designed to cope with typical high wind conditions in the local area.

Selected higher wattage panels and larger capacity battery to deal with long periods of overcast weather and for expansion if additional current loads are added to the station. All a compromise.



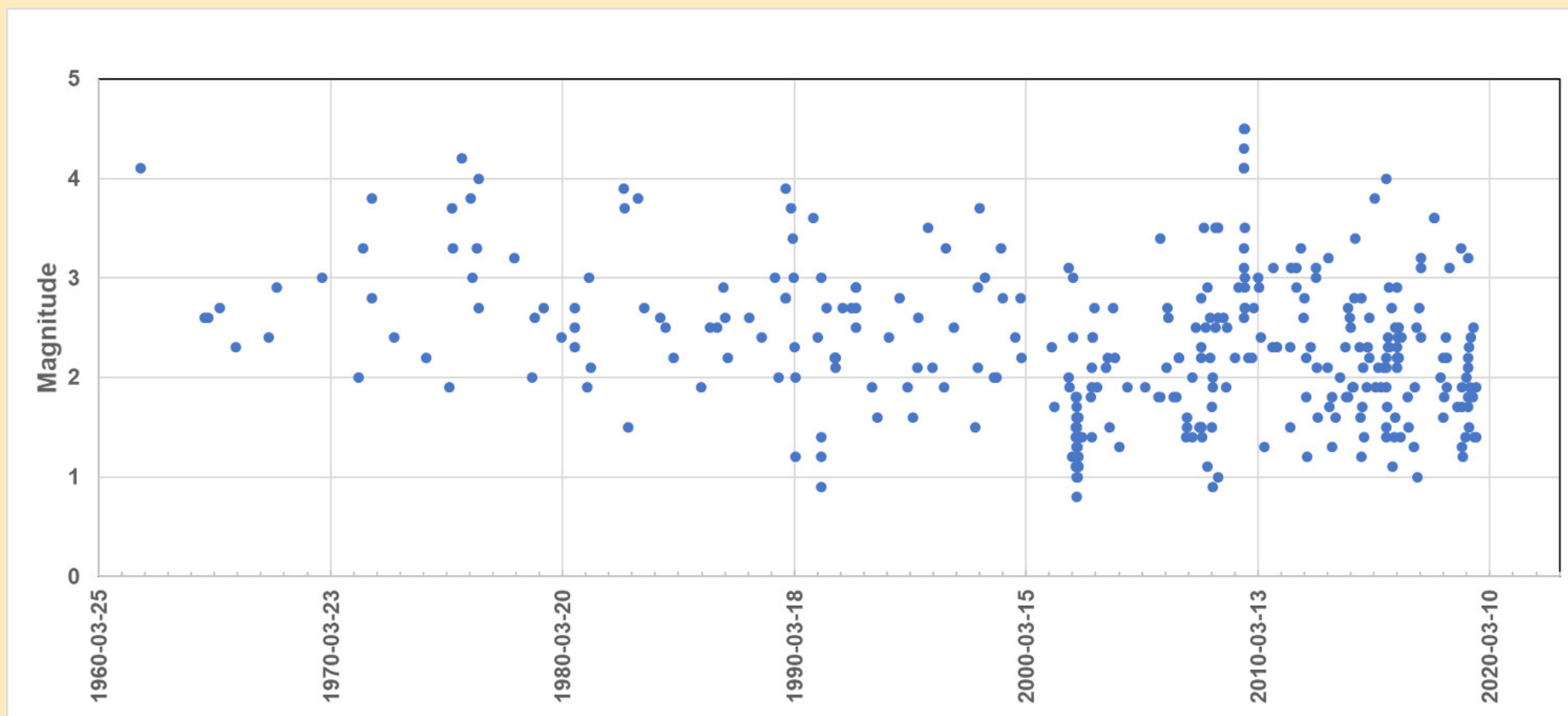




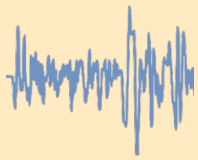
# South-East South Australia

Kindly submitted by David Love, SAA Chief Seismologist

Wow David,  
What's happening off Kingston Beachport?? I have never seen so much activity there. Do you think it's special or just the result of the better network?  
Cheers Kevin



This short email (above) from Kevin McCue prodded me to plot the data on a spreadsheet.  
Limiting the area to latitudes  $-36^{\circ}$  to  $-40^{\circ}$  and longitudes  $137^{\circ}$  to  $142^{\circ}$  produces this chart.



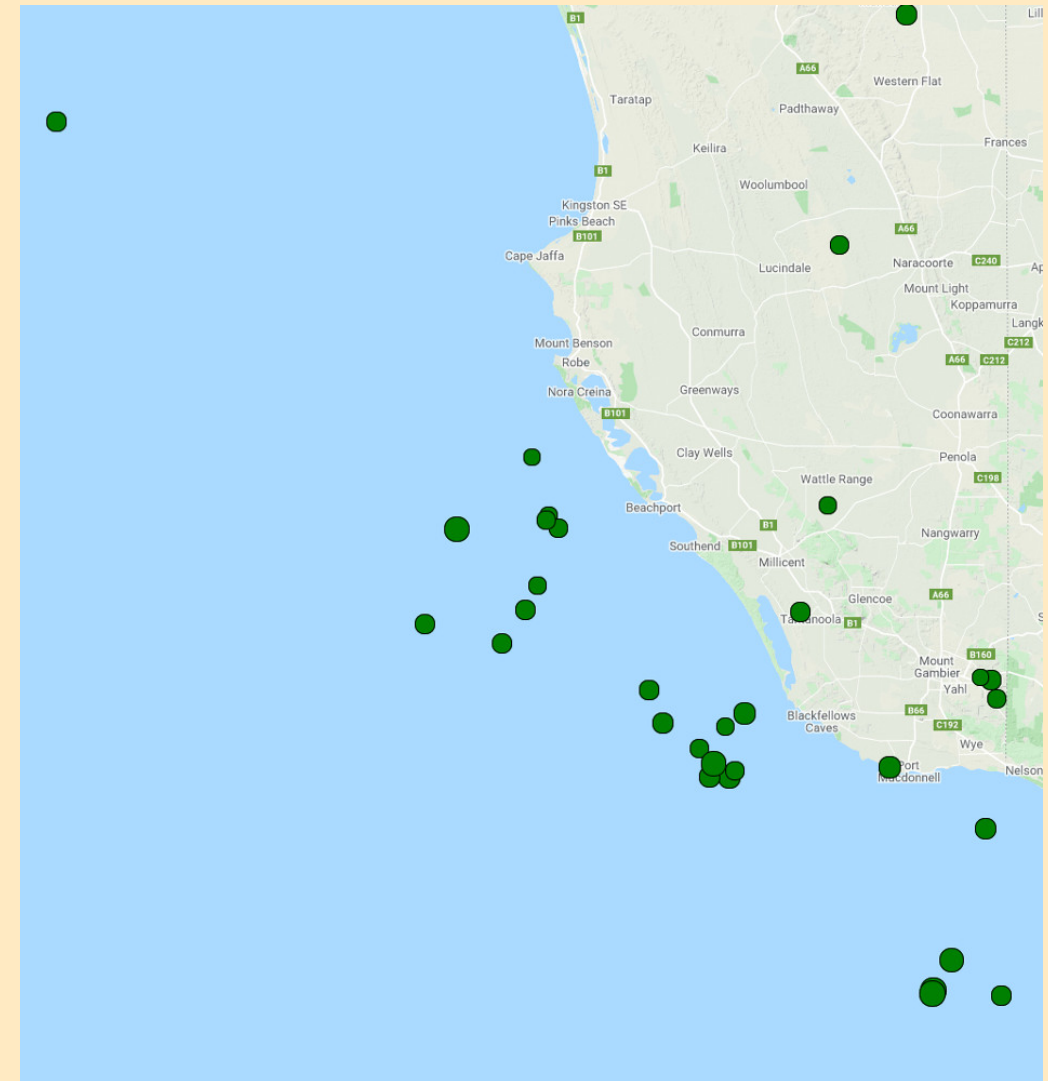
# South-East South Australia

The Willalooka Station (WKA) started in 1979, and Mount Gambier (MGR) in 1980, when the network was operated by Adelaide University. WKA was a quiet station on granite, but MGR was poor, being on soft material on top of the windy bluff. In 1989 a triggered digital station was installed near Naracoorte, but this only recorded occasional events. A significant change at MGR came in about 1996 with a borehole on The Bluff site. This went into basalt, and resulted in more earthquakes being seen, improving locations. In 2011 WKA became continuous digital, with MGR (now MGBR) being converted the following year. ROBE station was installed that year also.

The plot shows improvements over decades in the ability to locate smaller events. It does not seem to show any increase in the number of larger events, say over magnitude 3.5.

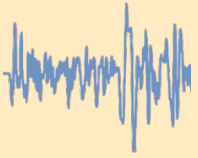
The most interesting area in the South-East is offshore, where a band of events appears to follow the edge of the continental shelf. Many of these have calculated depths over 30km. However it must be remembered that the location program only uses a simple layered model, assuming the Moho (bottom of the crust) to be 38 km deep. However the Moho varies dramatically from around 35 km deep onshore (continental crust) to about 10 km deep offshore (oceanic crust at surface). Hence the locations will be only approximate, and the depths cannot be trusted at all.

The 1897 earthquake (about magnitude 6.5) probably occurred in this offshore area, but in the absence of a good monitoring network, we cannot be sure. The earthquake was felt from Port Augusta to Melbourne, and caused some damage even in Adelaide. In the South-East there was significant damage, and descriptions of large scale liquefaction. A rupture from this sized earthquake could be 20 to 60km long. In 1948 there was another large event, estimated at magnitude 5.6 in the same area.



**From the [earthquakes.mappage.net.au](http://earthquakes.mappage.net.au) website, recent quakes (2017 & later) in the area of interest.**



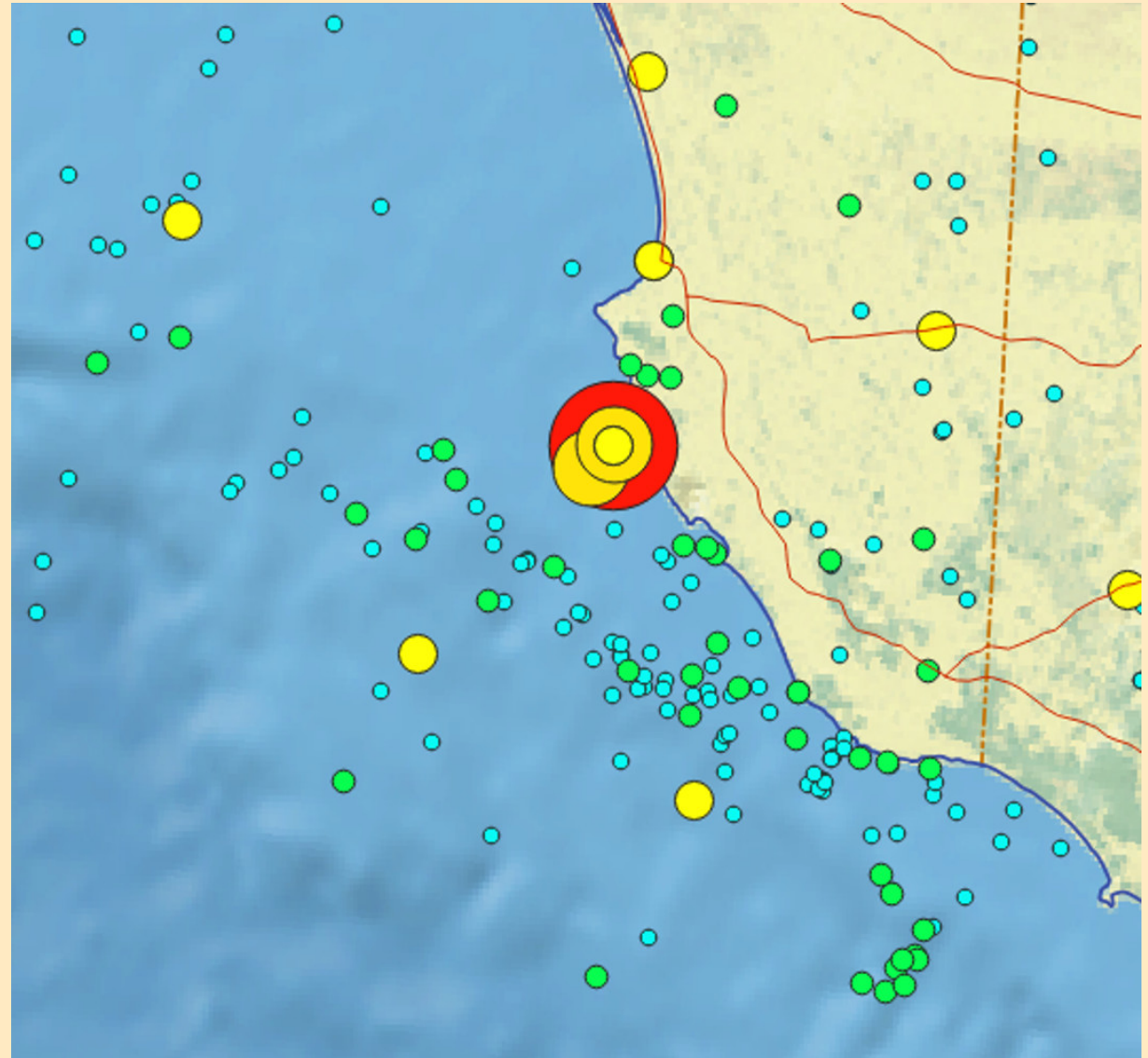


# South-East South Australia

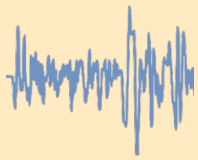
Is it possible that much of the current activity is happening in the same area as the main rupture and this aftershock?

There are far fewer earthquakes onshore, and not many have reliable depths.

Western Victoria is also the site of a number of volcanoes, considered to be some of the youngest in Australia. Aboriginal stories describe ovens, suggesting that some volcanic activity was actually seen. Thus a common question is whether the earthquakes are related to volcanic activity. The offshore activity is almost certainly tectonic, and onshore activity has normally been single events, suggesting that it is also tectonic. In the late 1990s, a large number of small shakes were felt on the edge of Mount Gambier. These were too small to locate, but caused media interest. They were eventually tracked to problems with a large pump causing vibrations at a bend in an outlet pipe! Gary Gibson has plotted earthquakes and volcanoes in the western Victoria area, and there is a suggestion that the earthquakes do not happen in the volcanic areas, however more detailed monitoring is required to demonstrate this clearly.



Gary Gibson's map of seismic events in South-East South Australia



# Week Number Roll Over update

Kindly submitted by Blair Lade,  
SAA Chairperson

## A WNRO Solution for the Kelunji Echo

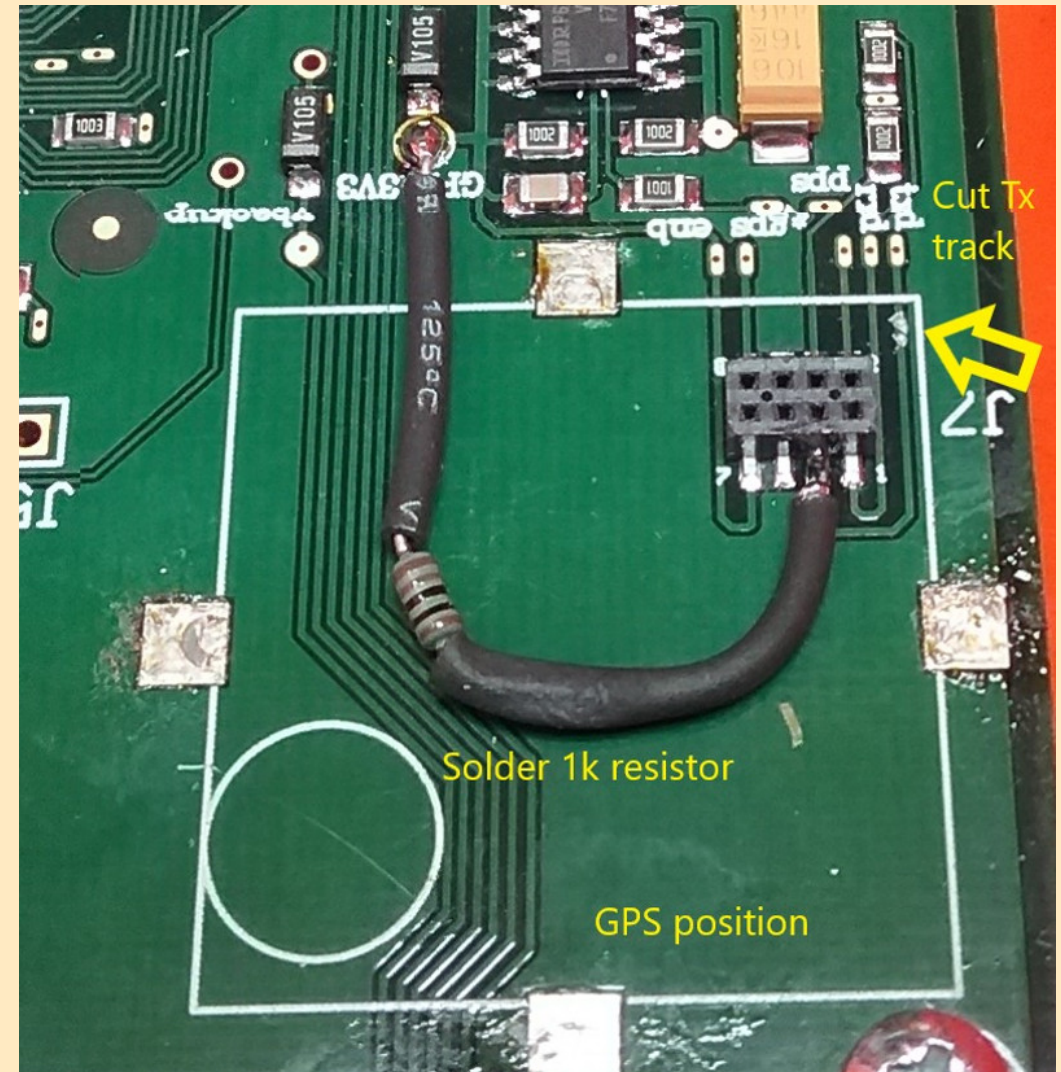
All was still not well with the Echo recorders, further investigations revealed that the Echo is sending some data. I don't know what it is because I've not been able to read it, but I can see it on an oscilloscope, each time the Echo powers up the GPS module. This is causing the GPS module to either be reset back to some 'default' configuration or to just send strings that we don't want.

The fix is to stop the Echo from actually sending the strings to the GPS, which is very easy to do. A little pcb surgery is required, a steady hand, a very sharp knife and a bit of courage (not too much) is used to locate and cut the Tx track from the Echo FPGA to the GPS. A 1k to 4k ohm resistor is then connected from the GPS receive line to the GPS power supply (this is actually recommended by Trimble, to hold or bias the Rx line high) if you aren't going to send data to the GPS. When this is done, the GPS 'behaves' as we expect and want it to. Ie, it only outputs the strings that we tell it to in the configuration setup application (via Trimble Studio)

Well almost!

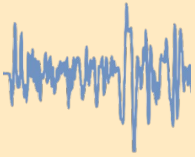
The GPS module does output the 8F strings each time it's started up by the Echo and apparently (according to Trimble Support) they can't be turned off. However, the Echo seems to be able to handle the occasional 'unwanted' strings.

I've 'done' a couple of Echo's with this fix and they have run for a few days without rebooting, so it looks like we finally have a fix!



The image shows the part of the Echo recorder PCB where the GPS module is attached (inside the white square). The arrow shows which track to cut and where to solder the 1k - 4k ohm resistor.



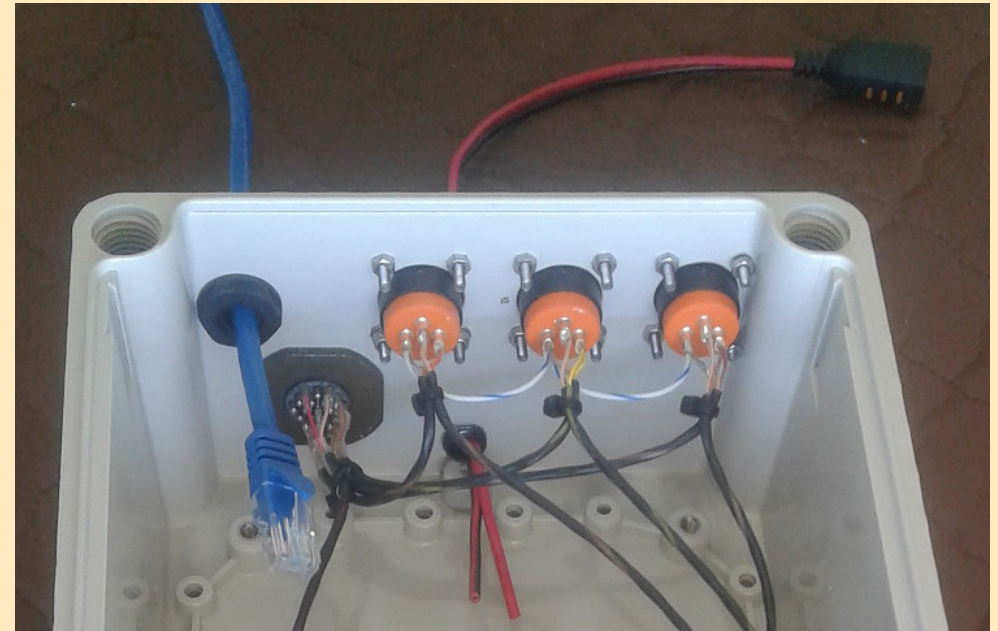
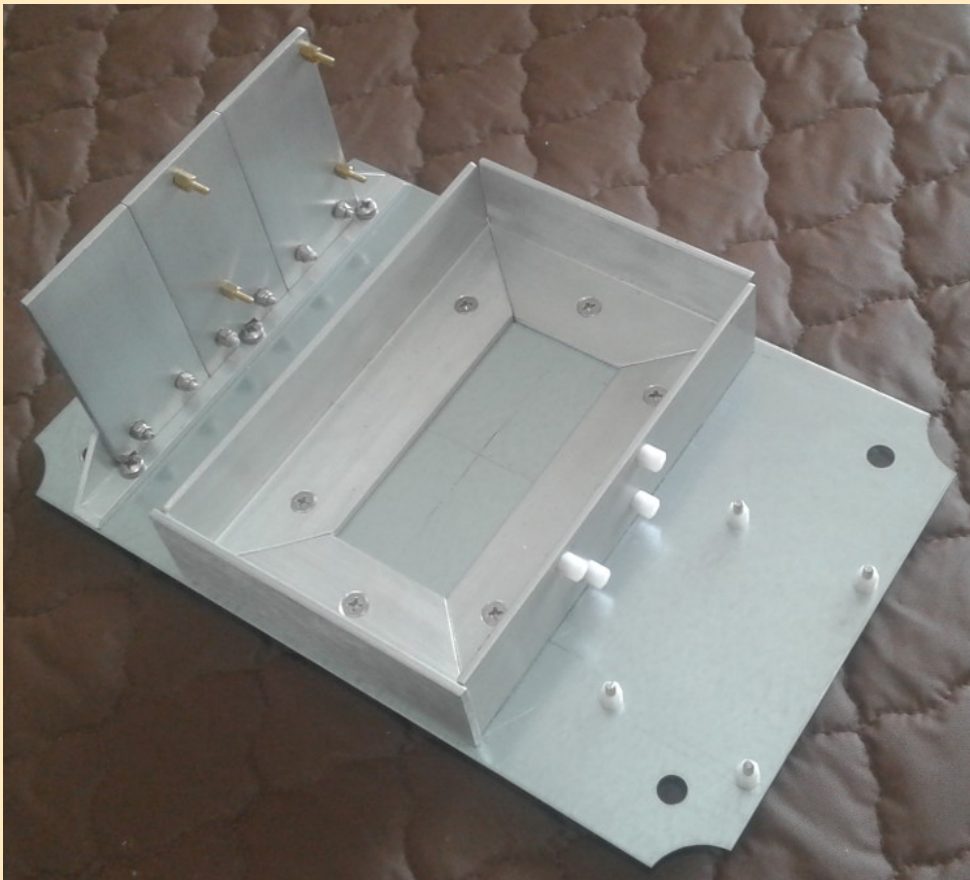


# Six weeks on, introducing RJAM 2.0

Submitted by Peter Gray

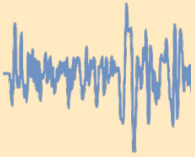
## It only seems like yesterday

You might remember that in the last newsletter I introduced you, dear reader, to my new Raspberry JAM digitiser. Where has that six weeks gone? Since taking delivery of my OSOP RJAM, much has happened (like I need to remind anyone) but in the midst of of this latest global calamity, I have had the opportunity to distract myself with this new device.



I originally had thought the orange Pelican case would be a useful housing to keep the elements and bugs out for the new RJAM, but there were so many large open openings to fill. DSE Hibox have a similar sized enclosure (280x190x130mm) to the orange Pelican case and available in IP67 rated polycarbonate (\$39 +GST), so I went off to Cookson Controls for a new case. Happy with the original internal layout, I proceeded to replicate it on the optional metallic baseplate (\$12 +GST) that was available for the enclosure.

This time, I wanted to maximise the seismometer input configuration. All three channels are available by either the MS3112F14-19S circular MIL connector or by individual channel XLR connectors. Again, the MIL connector provides +12V DC for active sensors, such as my Kinometrics WR-1 Ranger or Guralp CMG-5 Triaxial Accelerometer.

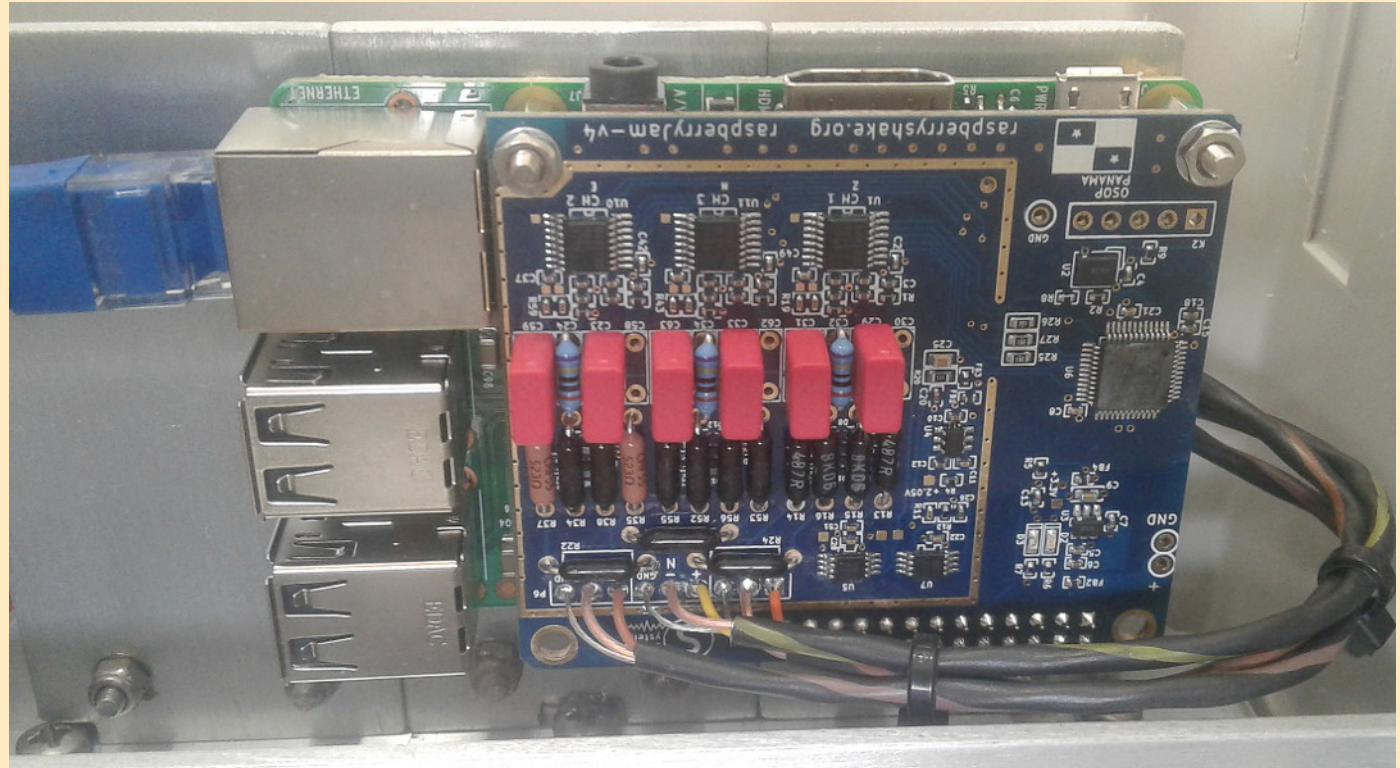


# Six weeks on, introducing RJAM 2.0

## RJAM Channel (Seismometer) Inputs

There are a couple of ways that OSOP configure the RJAM input wiring, depending upon how you order their product. Having ordered an RJAM DIY (not in their enclosure), you will receive a board with a 9 way, 0.1" header and sufficient Molex crimp contacts to connect your seismometer with. My personal opinion of such connectors is they're a failure point waiting for an opportunity to happen. The header was removed and the wiring from the input connectors were soldered directly to the RJAM PCB.

With any handling of an electrostatic discharge (ESD) sensitive device, you should take precautions to avoid ESD while mounting, modifying, soldering etc... There shouldn't be any problems modifying the RJAM input configuration, if you have good soldering tools, suitable skills and take the appropriate ESD precautions.



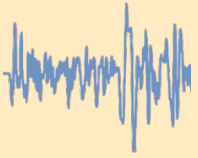
**Raspberry Pi and RJAM hat mounted onto the baseplate/frame.**

There it is, the same components in a new enclosure and far fewer holes for the bugs to get in and the smoke to get out. **SO WHAT CAN THIS THING DO?**

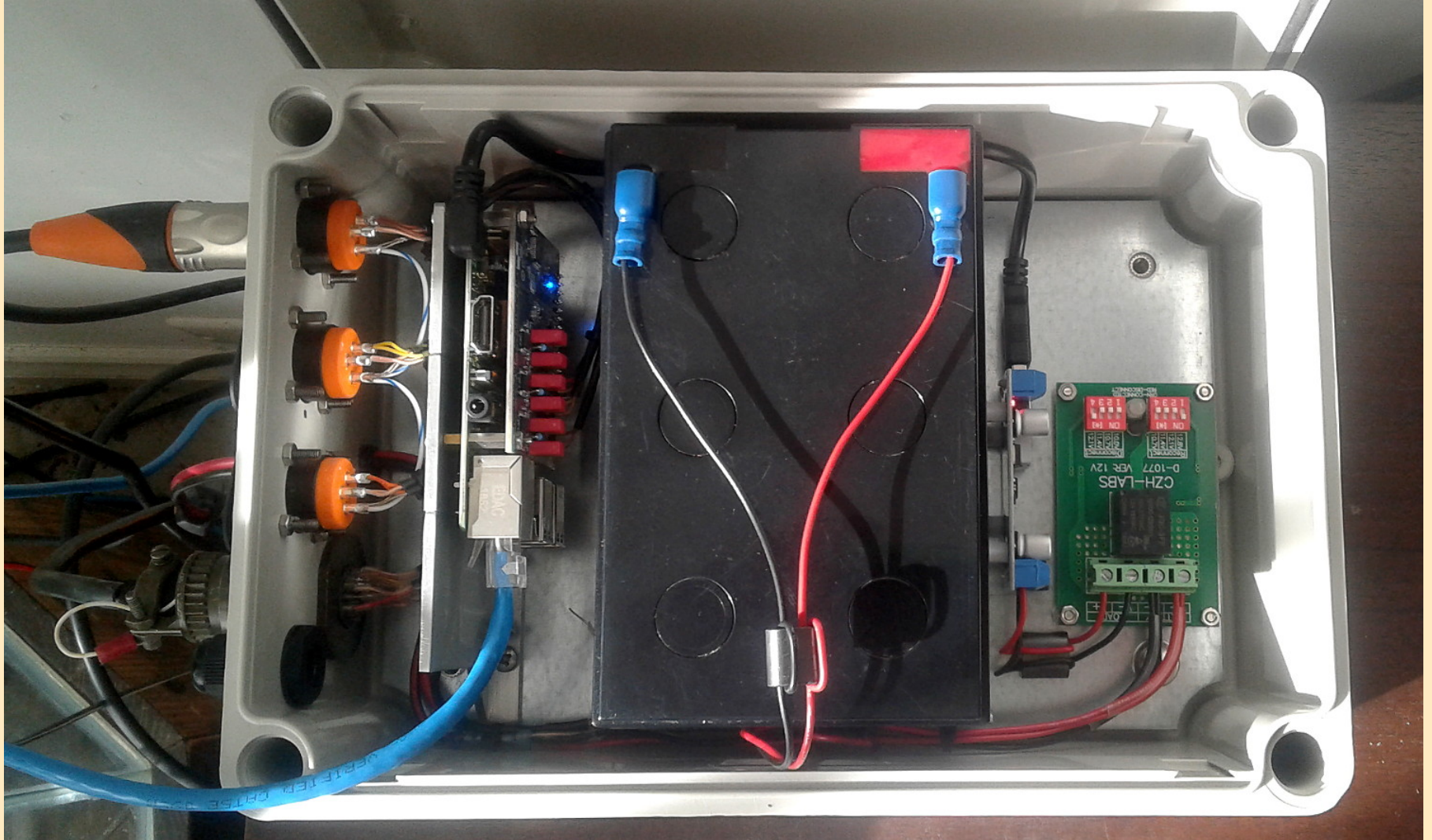
Before I get into that, there are a couple of limitations (that I am aware of), potential owners need to know prior to investing into this OSOP product.

**1. The Station identifier code is determined by the Raspberry Pi MAC address.** What does that mean? If you happen to change the Raspberry Pi Single Board Computer for whatever reason (failure, RPi model change/upgrade etc...) your station name will change to a different code. My original RPi 3B+ was fitted for testing purposes only, the station code was RA373. When I changed over to the intended RPi 2B, the station code became R3EA4. This is evident in some of the following images, depending on when they were created, either before or after the RPi changeover. This may be a problem if you expect to maintain consistent data retention over a period of time.

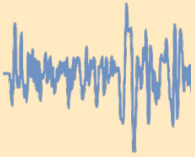




## Six weeks on, introducing RJAM 2.0



As the sun sets outside, you should be able to work out what's where. All the connectors and stuff are at one end so that the baseplate/frame can be easily removed, should the need arise.



# Six weeks on, introducing RJAM 2.0

**2. RJAM Seismic Sensor gain is assumed to be 1.** What does that mean? I don't really know the answer but I can show you the effect it has. [Follow this link to my RS StationView](#). The Ground motion numbers are millions of times greater than they should be. If you follow the Download instrument response link, you will see why. So by comparison with the other Raspberry Shake products, Acceleration, Velocity and Displacement measurements from an RJAM will be useless. It may be possible to correct this but I don't know how to do it, yet. On a bright note, I do find it useful to identify other RJAM users. Come the revolution, we all know who'll be up against the wall first.

## Images on the following pages

If a picture is worth a thousand words, I'll shut up now and let you draw your own conclusions about what capability you can get from this product.

**Page 15 MyShake:** Once logged into MyShake, you get to see your current datastream and access all member areas of ShakeNet

**Page 16 Swarm Example:** Swarm is a java based waveform viewer from the USGS. This image shows a recent 2.1MLv event near Cape Jarvis, SA. The data was downloaded from the RS datacentre.

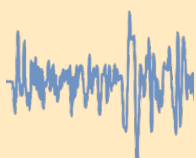
**Page 17 Waves Example:** The same event as the previous page displayed in a possibly more familiar software package. The data was downloaded from the RPi as a 24hr datafile and massaged to the size shown.

**Page 18 Swarm Example:** This image shows a large event off the coast near Russia (north of Japan). The surface wave response was much larger than the p wave.

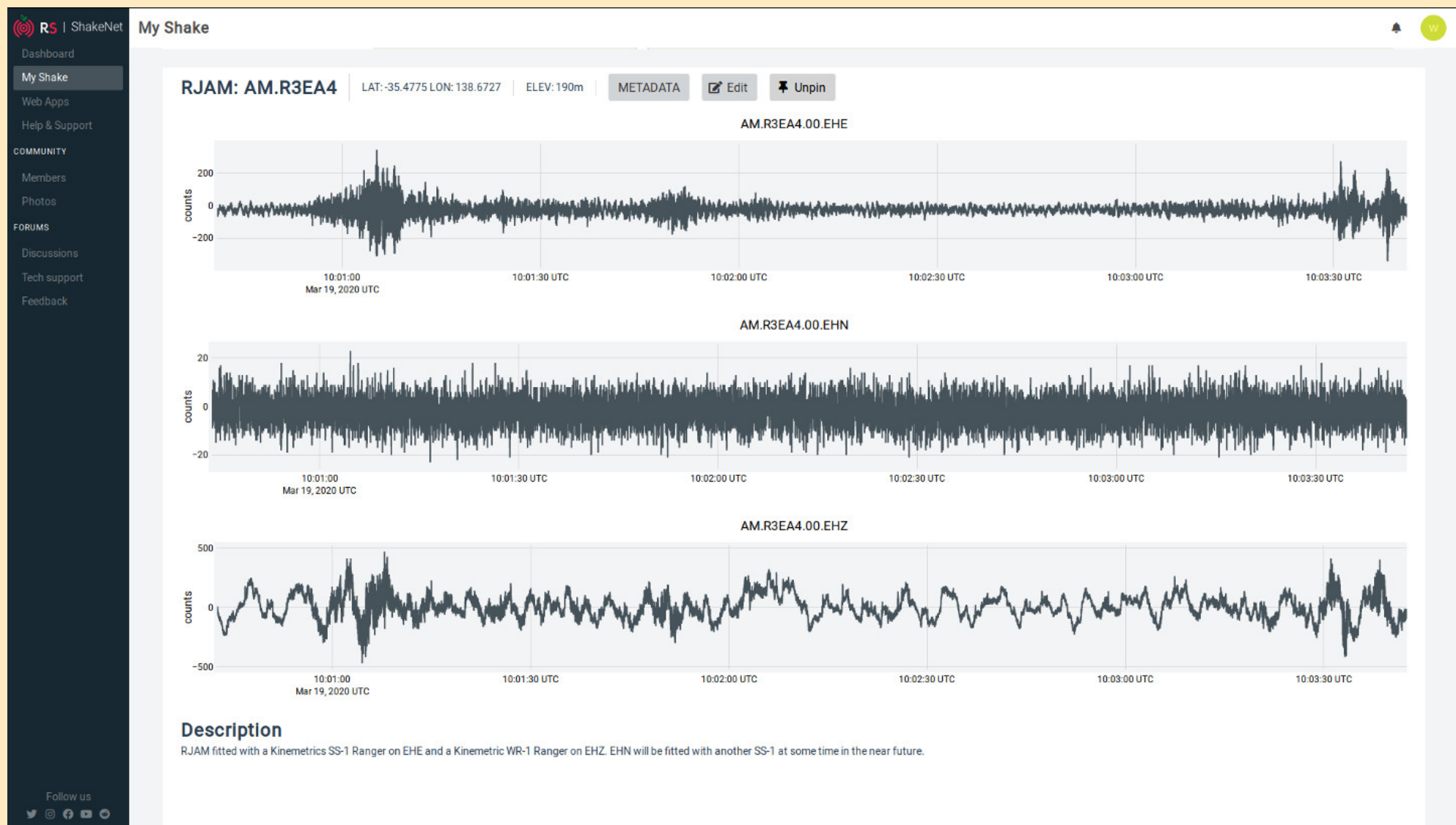
**Page 19 Swarm Example:** One of the SAA's SS-1 Rangers is connected to the East-West channel (EHE) this was a very recent 2.0MLv quake near Callington, SA

**Page 20 Kiosk Mode Example:** Kiosk mode is made for displaying a near realtime datastream from supported Data Management Centres, all you need is a computer (RPi), HDMI screen and internet connection. This might be useful for a Science Alive or any public outreach activity.

**My own conclusion:** I just have to temper my enthusiasm and wait for the Pacific Peso (AU\$) to recover back to an acceptable level before I get another RJAM for the Guralp CMG-5. In the meantime, there are lots of other features to explore and experiment with. I nearly wrote "play with" in that last sentence but I stopped myself, I really don't consider this digitiser and recorder to be a toy.



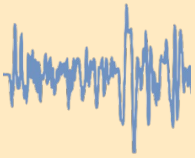
# Six weeks on, introducing RJAM 2.0



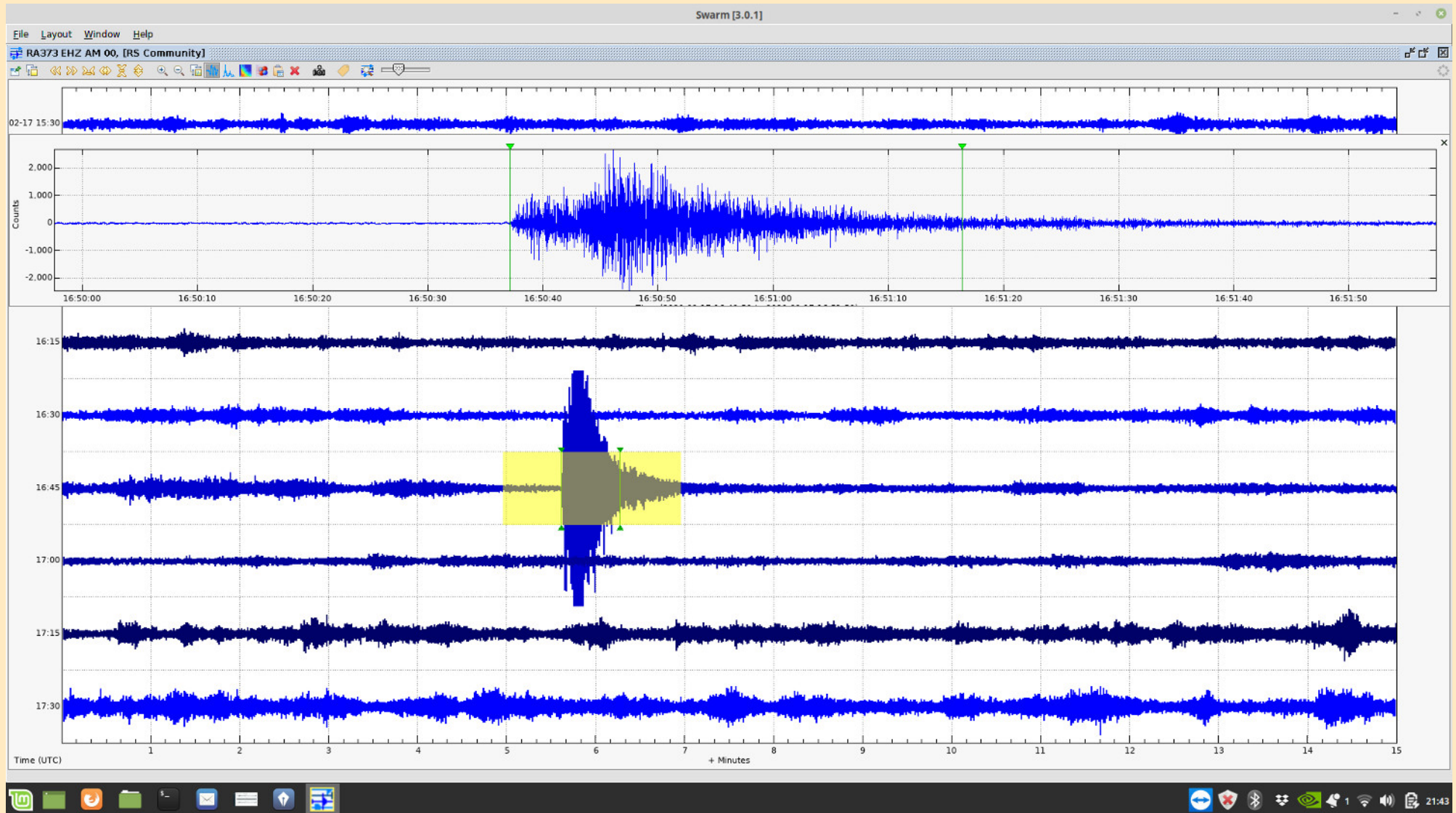
Each Shake Community member has a My Shake webpage, this primarily allows live views of all channels of data being produced.

My Shake also gives users access to the various sections of the Raspberry Shake network.



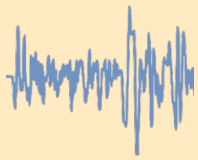


# Six weeks on, introducing RJAM 2.0

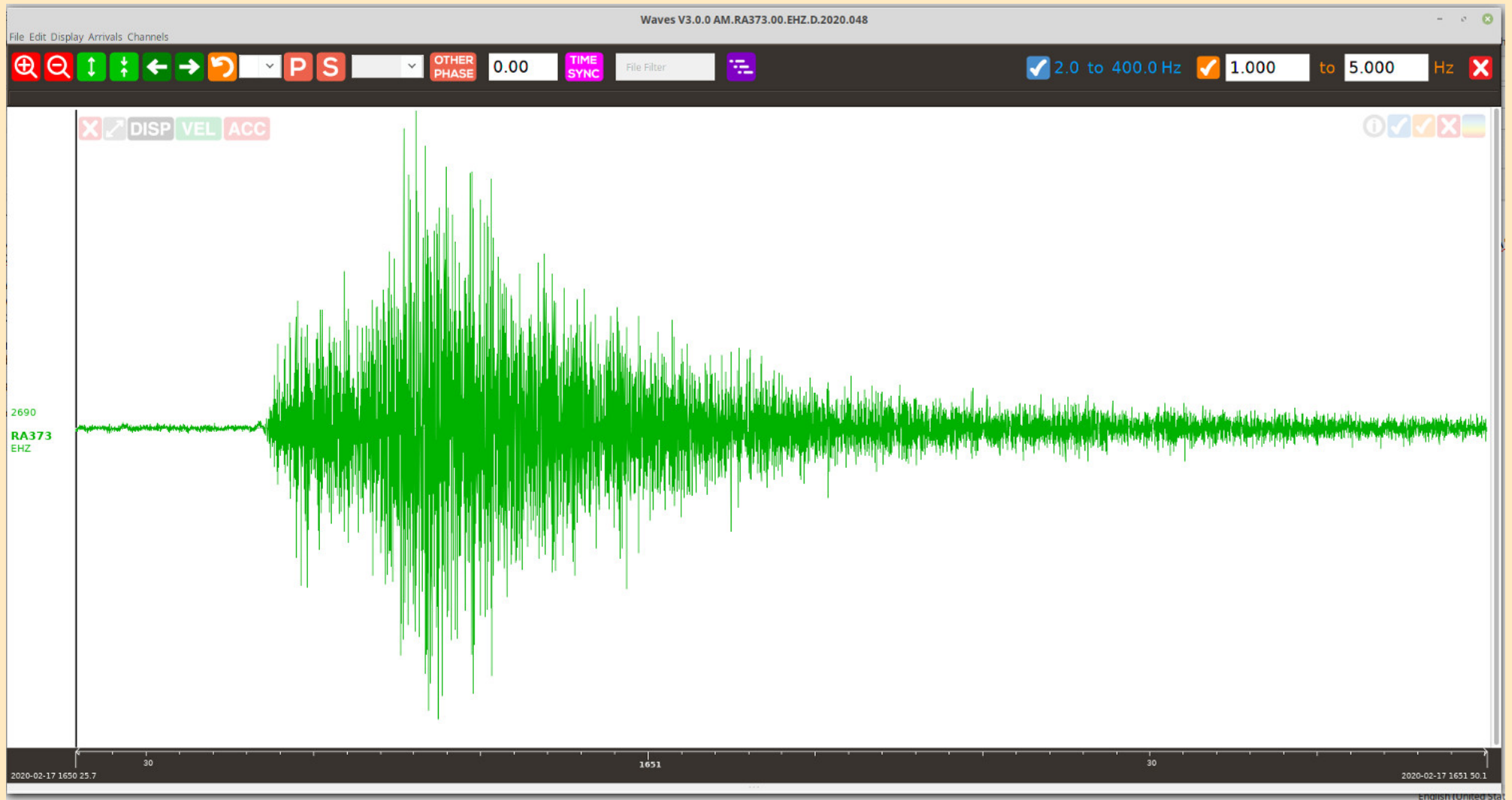


The only significant quake in the vicinity of Middleton recently occurred at 2020-02-17 16:15UTC, a 2.1MLv near Cape Jarvis, SA.

Swarm is the recommended software package for viewing and processing recorded events.

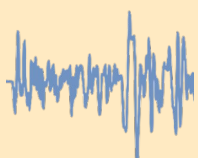


# Six weeks on, introducing RJAM 2.0

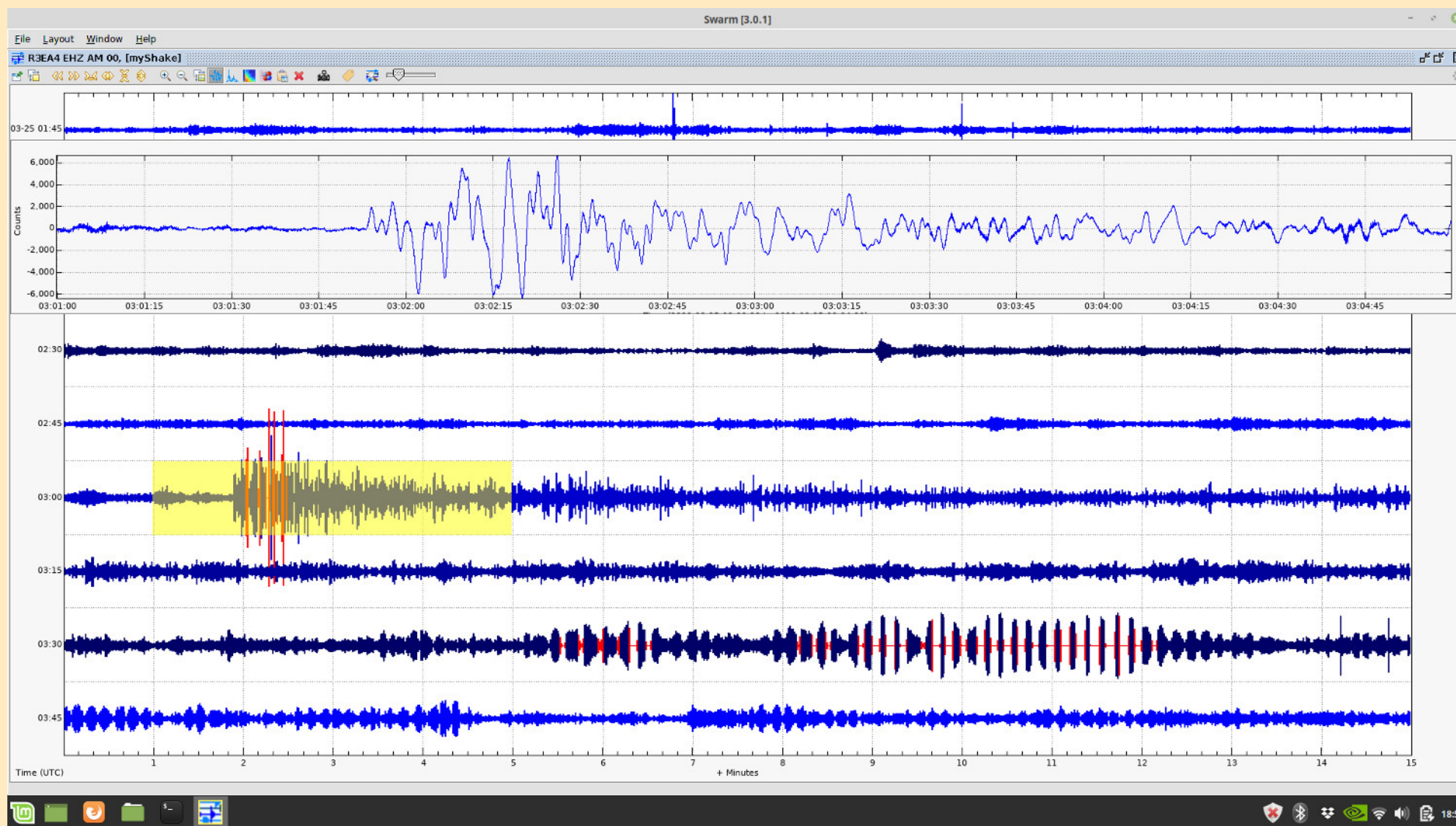


The only significant quake in the vicinity of Middleton recently occurred at 2020-02-17 16:15UTC, a 2.1MLv near Cape Jarvis, SA. Displayed in Waves from the Seismology Research Centre as a comparison.



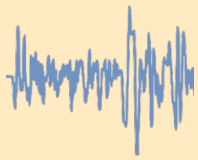


# Six weeks on, introducing RJAM 2.0

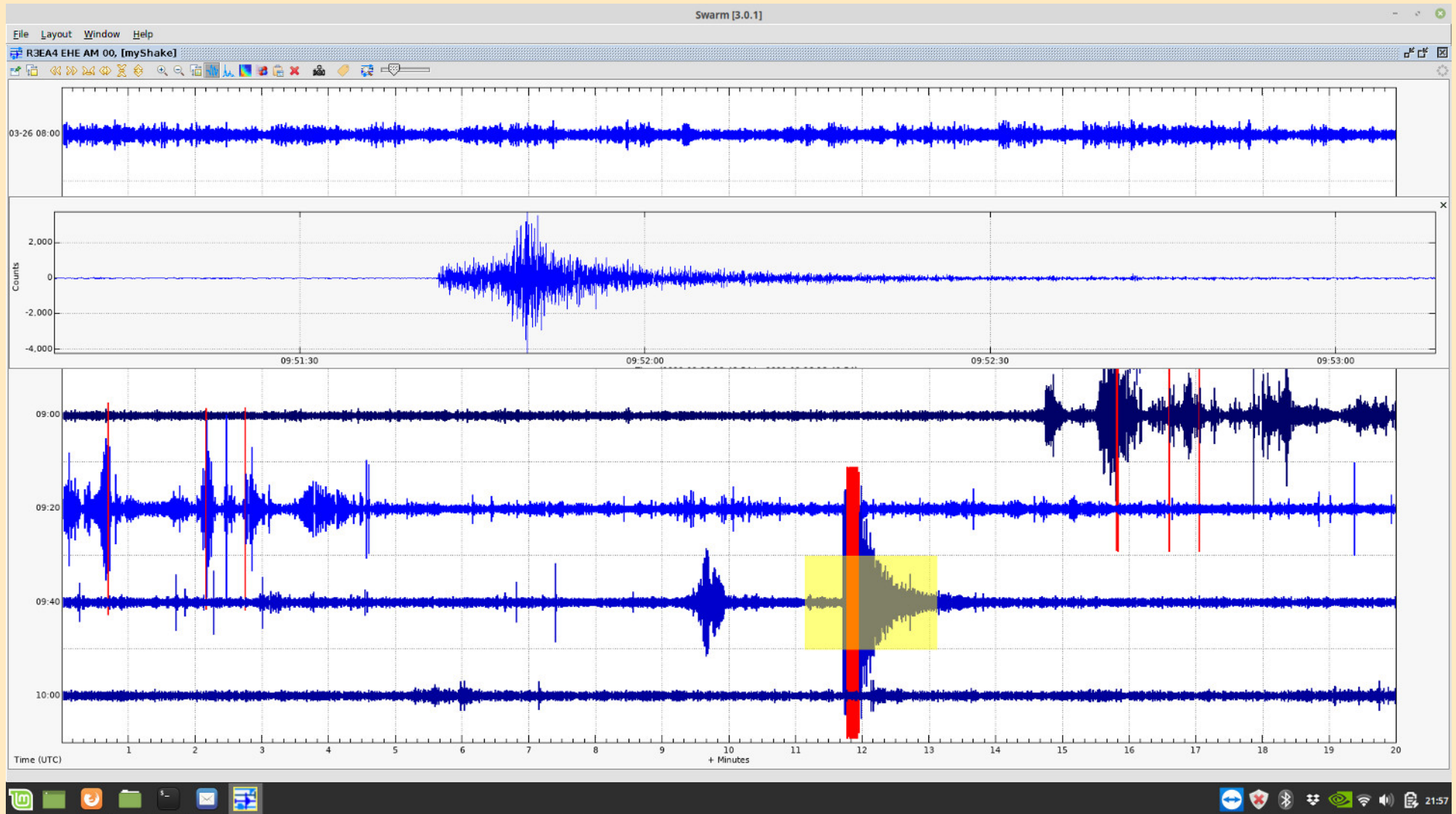


The Kinemetrics WR-1 Ranger response for the M7.5 quake 232km from Severo-Kuril'Sk, in Kuril Islands, 2020-03-25 02:49 UTC.

The red sections of the trace indicates clipping & forced centering of the offscale sections.



# Six weeks on, introducing RJAM 2.0

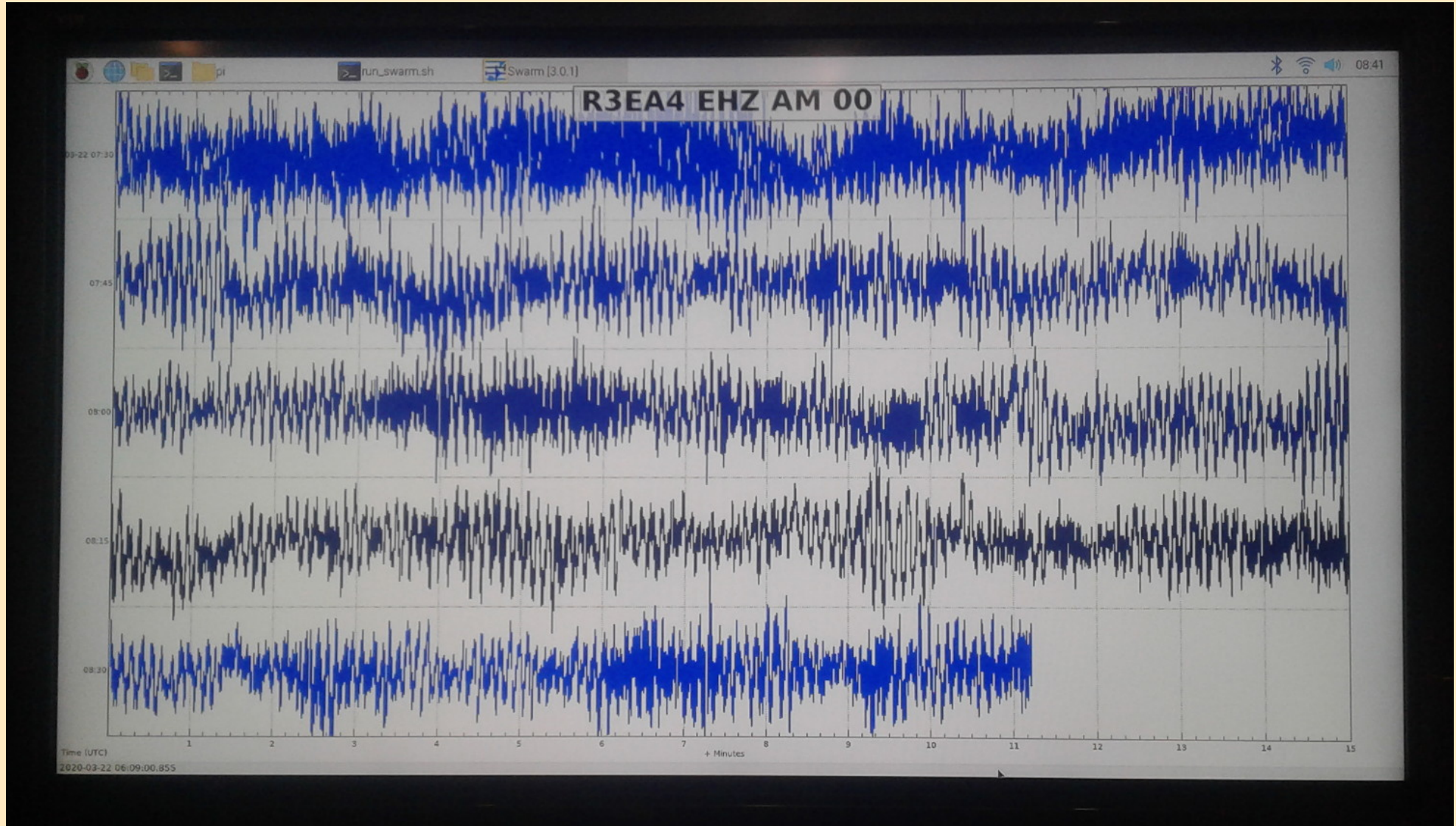


2020-03-26 09:51UTC, we had a 2.0MLv quake near Callington, SA.  
The Kinometrics SS-1 Ranger response on the East-West channel.

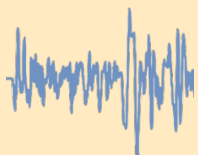




# Six weeks on, introducing RJAM 2.0



While all the Raspberry Shakes operate in headless mode (no GUI or display), with the addition of another RPi & a HDMI display, you can run Swarm and view in Kiosk mode. A 40" Panasonic TV showing 2Hrs of data.



# Resources & useful links

Description	URL / Webpage	Notes
<b>SAA Membership Application</b>	<a href="https://www.assa.org.au/media/74629/saa-membership-">https://www.assa.org.au/media/74629/saa-membership-</a>	Join up with the SAA using this form
<b>SAA Flier</b>	<a href="https://www.assa.org.au/media/74629/saa-membership-">https://www.assa.org.au/media/74629/saa-membership-</a>	Our current brochure - flier, saying what we do
<b>SAA Newsletters</b>	<a href="https://www.assa.org.au/resources/technical-special-">https://www.assa.org.au/resources/technical-special-</a>	Download any SAA Newsletter from this site
<b>SAA EqServer</b>	<a href="http://ade-eqserver.dyndns.org:8080/eqserver/">http://ade-eqserver.dyndns.org:8080/eqserver/</a>	South Australian miniseed seismometers
<b>Melbourne University EqServer</b>	<a href="http://meiproc.earthsci.unimelb.edu.au/eqserver/">http://meiproc.earthsci.unimelb.edu.au/eqserver/</a>	Australian miniseed seismometers
<b>Regional Seismic Network</b>	<a href="http://www.regional-seismic.net/">http://www.regional-seismic.net/</a>	PSN seismometers - Aust. Centre for Geomechanics
<b>Australian Public Seismic Network</b>	<a href="http://cqsrg.org/psn/stations/">http://cqsrg.org/psn/stations/</a>	Australian PSN seismometers
<b>Recent SA Earthquakes</b>	<a href="http://earthquakes.mappage.net.au/q.htm">http://earthquakes.mappage.net.au/q.htm</a>	Data & summaries of recent SA quakes
<b>Central QLD Seismology Research Group</b>	<a href="http://www.cqsrg.org/">http://www.cqsrg.org/</a>	CQSRG - Kevin McCue
<b>Astronomical Society of SA</b>	<a href="https://www.assa.org.au/resources/technical-special-">https://www.assa.org.au/resources/technical-special-</a>	ASSA - Seismology page
<b>Geoscience Australia</b>	<a href="http://www.ga.gov.au/earthquakes/initRecentQuakes.do">http://www.ga.gov.au/earthquakes/initRecentQuakes.do</a>	Our national authority on seismic events
<b>Earthquake Services</b>	<a href="https://www.researchgate.net/profile/Colin_Lynam">https://www.researchgate.net/profile/Colin_Lynam</a>	Citizen Science Consultant - Col Lynam
<b>Seismic Research Centre</b>	<a href="https://www.src.com.au/">https://www.src.com.au/</a>	OEM of seismic instruments & software
<b>symCDC</b>	<a href="http://symcdc.com/">http://symcdc.com/</a>	OEM of seismic instruments & software
<b>IRIS Seismic Monitor</b>	<a href="http://ds.iris.edu/seismon/">http://ds.iris.edu/seismon/</a>	Global seismic events
<b>Joint Australian Tsunami Warning Centre</b>	<a href="http://www.bom.gov.au/tsunami/">http://www.bom.gov.au/tsunami/</a>	Bureau of Meteorology site
<b>Australian Earthquake Engineers Society</b>	<a href="https://aees.org.au/">https://aees.org.au/</a>	An organisation with similar interests
<b>Atlas of the Underworld</b>	<a href="http://www.atlas-of-the-underworld.org/">http://www.atlas-of-the-underworld.org/</a>	Mapping the Earth's mantle
<b>Atlas of Living Australia</b>	<a href="https://www.ala.org.au/">https://www.ala.org.au/</a>	A Citizen Science initiative