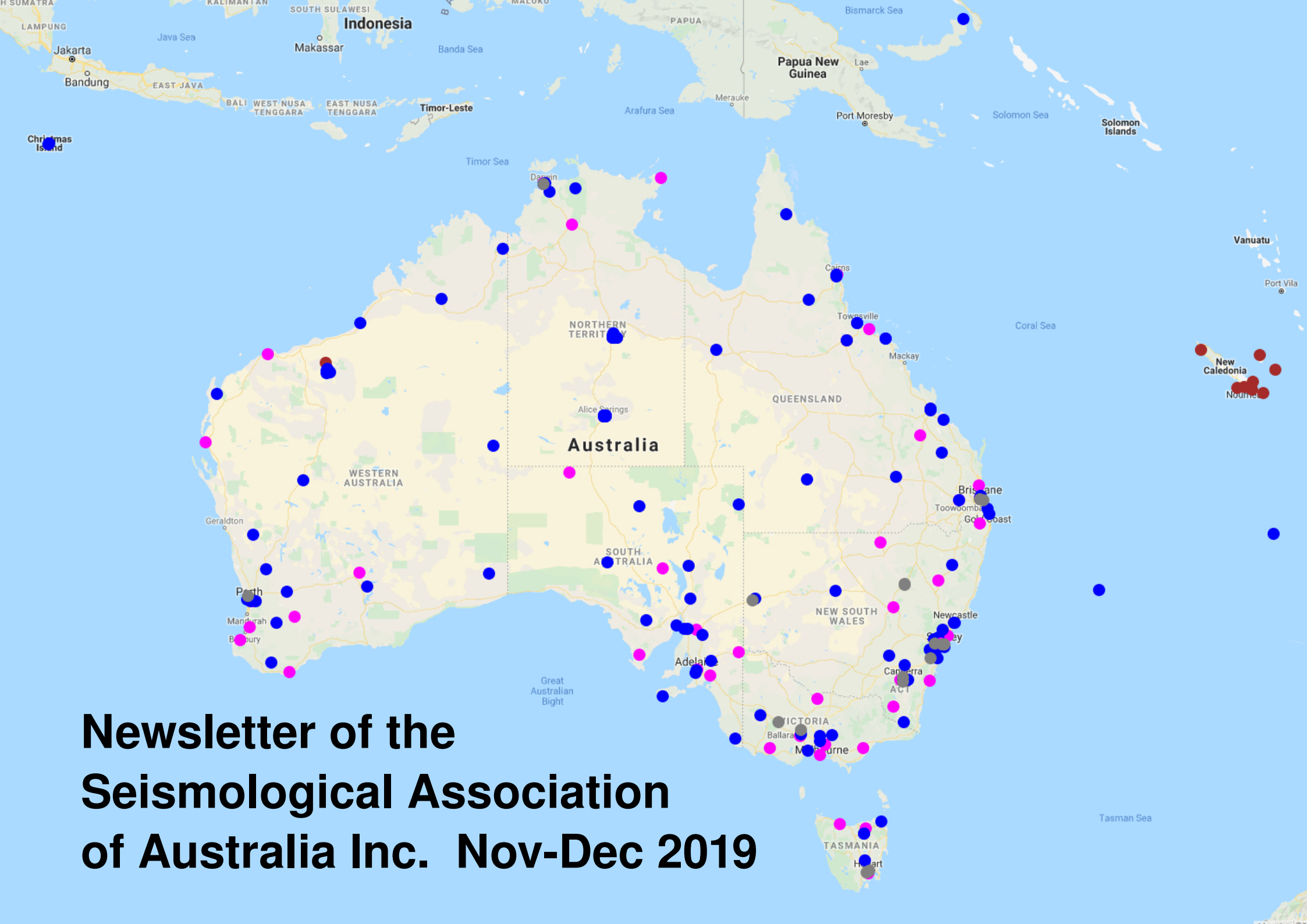

Newsletter of the Seismological Association of Australia Inc. Nov-Dec 2019

Seismological Association of Australia Inc.

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

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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.

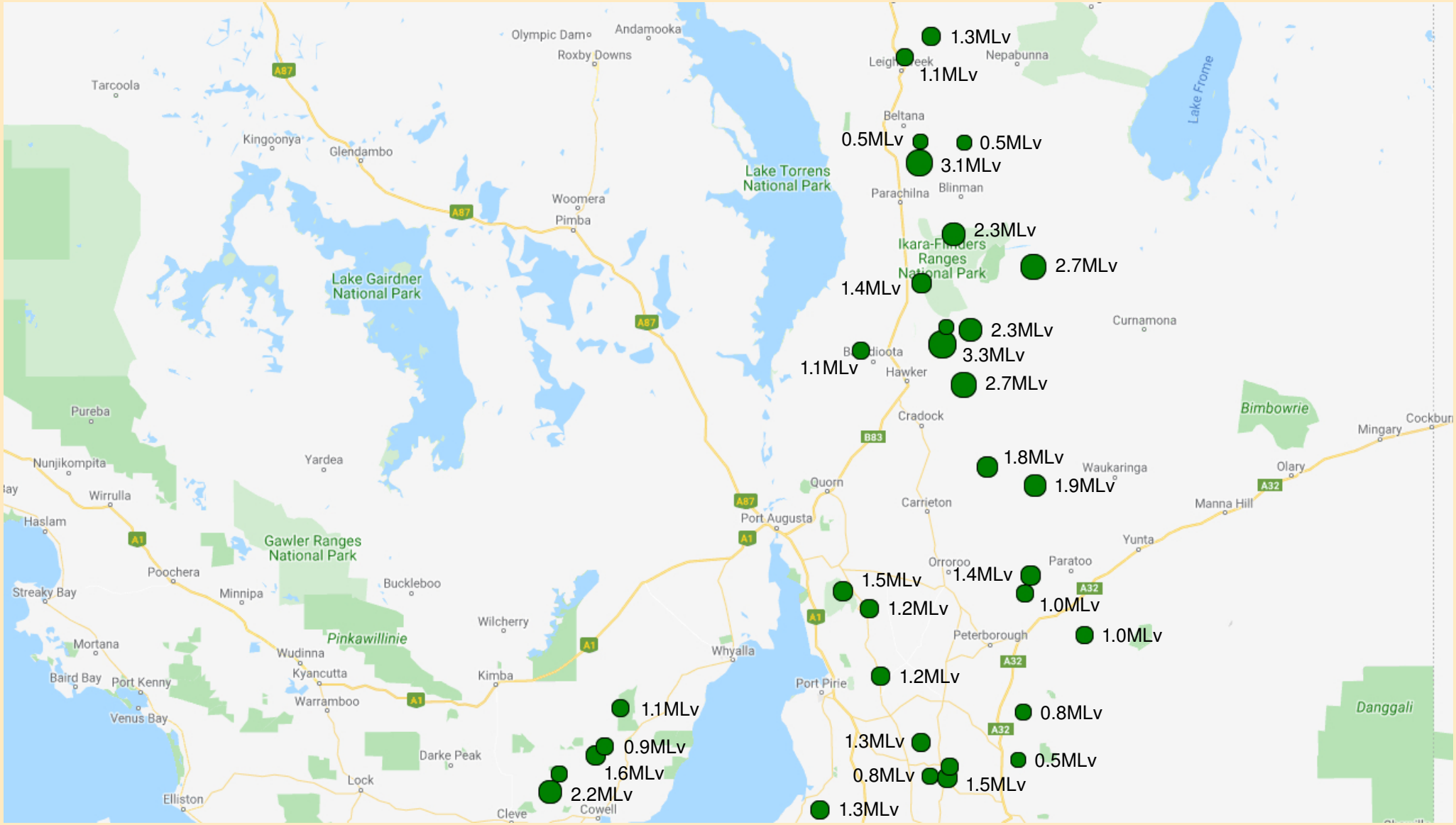
Member Submissions
Submissions for inclusion in the Newsletter are welcome from all members; please note that submissions may be held over for later editions. Wherever possible, text submissions should be sent via email in almost any word processing format. Your name may be withheld only if requested 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

A word from the Editor
It's just about crunch time, a decision on where the National Radioactive Waste Management Facility (the dump) site is close to being made. On November 8th, the District Council of Kimba Community Ballot returned 734 formal votes. 452 (62%) voted Yes and 282 (38%) voted No. The following can be attributed to a spokesperson for the Department of Industry, Innovation and Science: “The department has said on numerous occasions that the facility will only be delivered alongside a community that broadly supports it, that no single metric or number will determine the level of support, and that no one group or individual will have a right to veto the facility,” “The government will consider all of the available technical and community sentiment information, including from Traditional Owners, once the results of both local community ballots are known" On the following page is an image of earthquakes in northern SA between October 1st & November 27th, 2019. There's not been much seismic activity around Kimba during this period but that can hardly be said about the area around Hawker? Where would you put the dump?

Now it's time for the people of the Flinders to vote, the Hawker ballot concludes on December 12th.

Recent Seismic Events



Seismic activity in the north of SA since our last SAA Newsletter, magnitudes indicated next to markers

SAA News and upcoming activities

2019 SAA AGM

For those members that were unable to attend the SAA Annual General Meeting, it went very well. In addition to members who did attend in person, we were joined by Chris Chapman in the UK via Skype for the whole of the meeting. Blair opened the meeting and reflected on the association's achievements for the year. Joe Grida presented the association's financial report for past 12 months. David Love gave the meeting a powerpoint presentation on "How we are going on locating earthquakes. Chris Chapman gave a short overview of the UK School Seismology Project. Colin Love brought along his current FPGA digitizer prototype for a capability demonstration. Using a Ranger SS-1 connected to the front end, it was very impressive.

Not surprisingly, there were no fresh nominations for any of the committee positions, so the incumbents were re-elected for another year. We will take this lack of change as an endorsement of the future direction that the association is heading toward and a pat on the back for past performance.

Following the meeting we were given a tour of the Space School. While a detailed article on this was to be included in this Newsletter, it was not meant to be. I will reserve some pages of the next edition for this, as the school is an exciting and important one, helping to secure future growth opportunities for students and our economy. Our thanks go to the Director and staff of the Hamilton College Space School for allowing us to visit and use their facilities.

Seismology or Astronomy meeting? Just pick a topic

The SAA was pleased to welcome Michael Andre Phillips back to Adelaide for a short but productive visit in November. A local members meeting was quickly convened at the Grida's in Mount Barker so that we could say hello and have a look at his Raspberry Shake 3D seismometer. We're not sure if there are any other 3D Shakes in the country so this was an opportunity to see what the fuss is about. There are quite a few SAA members interested in using the Shake platform, in several of the many variants available from OSOP in Panama. The instrument and it's capabilities were discussed at length, with pros & cons from members keeping the conversation brisk. Andre and Laurie were heading back to Coonabarabran, NSW the following day so we called it quits around 9:30pm.

Left to Right: Michael Andre Phillips, John Duffield, Ian Anderson, Luke Van Den Bos', David Love, Peter Gray, Joe & Lyn Grida and Colin Love. Image courtesy of Laurie Campbell

SAA News and upcoming activities

What's on the Cover?
Are you looking for some seismic data to process or analyse? The cover image is a relatively new addition to the earthquakes mappage website that allows you to download miniseed files from one or more seismic stations. Several Data Management Centres (IRIS, FDSNWS) are queried based on date, time and seismic site as indicated by the coloured dots. Each colour represents a seismic network, Blue for GA, Pink for ANU Schools, Grey for Raspberry Shakes and others etc. Use this link to access the webpage which does not require a password.

The strange case of a couple of very talkative modems - by Joe Grida, Secretary/Treasurer SAA
Thursday, November 14 I attended the Mylor Post Office to collect our monthly SAA invoice for the 8 field stations running on the Telstra Mobile Network. The invoice is usually due for payment on the 15th of each month. I had been ill with a heavy cold/flu and had been unable to get there any sooner.

I checked the PO box and the envelope from Telstra wasn't there. I went into the office to speak to the Postmaster. I've known Martin for many years and joked with him about him losing our invoice. Instead he handed me a very heavy post-pack that didn't fit into the PO Box. There were no markings to identify where it came from, other than it was addressed to SAA.

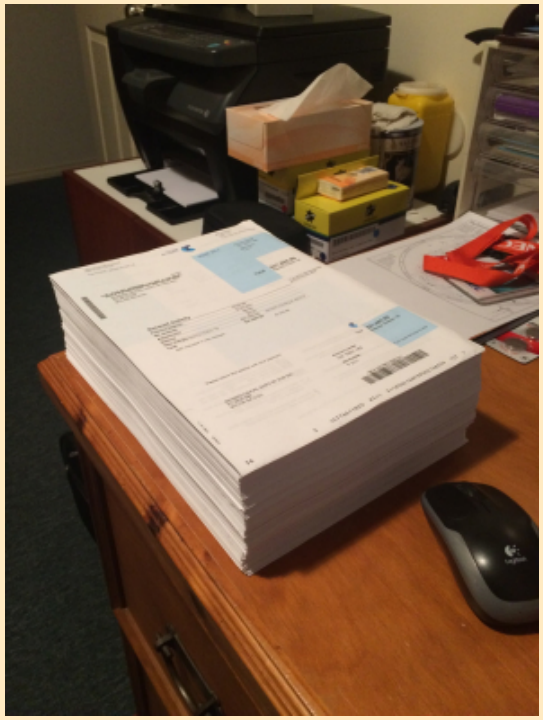
When I arrived home, I opened the envelope to find it indeed did contain our Telstra invoice. All 1530 pages of it!!!

After getting over the surprise of the sheer volume of pages, I looked at the total amount owed: $21,685.99!!

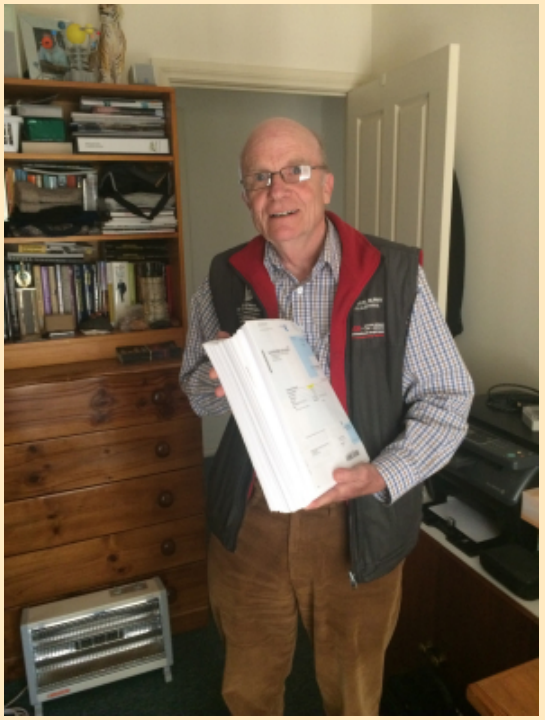
You read it right, members. It's not a typo. Our monthly invoice went from $129.98 to over $21,000!!

I cast an eye over the invoice, and found that 2 of our stations, MRAT on Yorke Peninsula, and TPSO at Hindmarsh Valley had clocked up over 85,000 outgoing SMS messages between them just in 4 weeks. None of the other stations appeared to have been affected.

As any good Telstra user does in times of trouble, I rang their help line. Over 2 days I spent over an hour and a half to get them to understand what I was ringing about. On Thursday evening, the help desk officer said she was passing the problem to the



It's thick ...



... and heavy too!

SAA News and upcoming activities

The strange case of a couple of very talkative modems - continued

technical support people, who would ring me shortly. I called back 24 hours later, not having received a call-back in the meantime. Again, they tried to handball me between the Billing Dept and the Tech Support Dept. Eventually, I tired of the whole game, and told them I would deposit the entire 1530 pages of invoice on the front desk at Telstra Head Office in Pirie Street, Adelaide at 9:00am on Monday morning and they could sort it out. My Sicilian heritage was coming to the fore quite strongly by then, and I was making all sorts of plans to clear up the matter!

Our Chief Seismologist David Love suggested that he would accompany me to visit Telstra on Monday morning. We duly arrived there about 9:30am, and we were quickly introduced to one of their officers, Ryan, who to his credit, patiently listened to our tale and then announced he would investigate and let us know. He did indicate that his first thoughts were that the modems had been hacked.

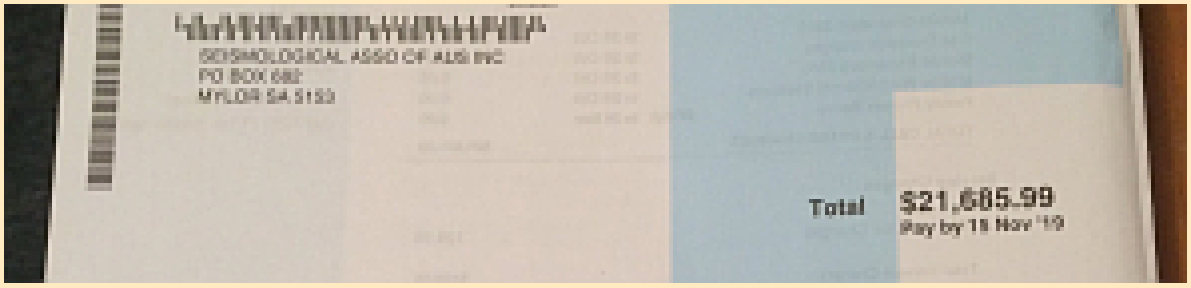
This turned out to be a correct prediction. David contacted the modem manufacturer, who advised that they had become aware of a vulnerability in their firmware and were developing a permanent fix. They provided a temporary fix for David to apply to ALL the modems immediately.

In the meantime, I made our normal monthly payment to ensure the continuity of service.

Telstra rang me a few days later to say that they were processing a credit to reverse the charges.

When the next invoice arrives, I'm sure I'll need to ring Telstra again to fix the accumulated 2 weeks' worth of SMS message logged between the last invoice and when the modems had the firmware fix applied.

Time will tell.



Around the seismic sites

Article submitted by Peter Gray

Battery upgrade for Robe

For most of the past winter, the site at Robe (ROBE) struggled to stay online as the 12V 95AH lead acid battery continued to deteriorate. Since handing over the Mt Gambier station to Geoscience Australia last year, Robe became our most southern station and a trip there to change the battery has been on the cards for quite a while. We recently took delivery of a 12V 230AH SLA from GA, a gift from the Yappala site (YAPP), south-west of Hawker. While it barely fitted into the Ericsson enclosure, this battery should make the Robe site significantly more reliable for the next couple of years.

A new PSN site at Sunnydale

Plans are in place to beef up the network with a couple of new sites in the Murraylands. Mannum is on the books for an installation early in the new year but after a short trial period, Sunnydale (SUND) has now been added to the ACG's Regional Seismic Network website. The use of Webtronics A/D recorders and short period vertical seismometers, located between core seismic sites, can provide valuable information in determining earthquake characteristics.

Mt Rat is offline

In early November, the EchoPro at Mt Rat (MRAT) stopped recording. A quick check and image from the property owners revealed some moisture damage inside the recorder, possibly caused by condensation. A solution has yet to be implemented but a replacement unit will be need to be taken over to the site and swapped out. Repairs may be possible but potential reliability issues will mean the damaged recorder may never be deployed to remote sites again.

Tennis-ball ‘Popper’
- an example of metastable catastrophes

Randall D. Peters, Prof. Emeritus of Physics Mercer University, Macon, Georgia USA

ABSTRACT:
A cupped piece of rubber taken from a tennis-ball, is with the hands ‘inverted’ from its usual configuration. In the resulting state of elevated potential energy, creep of the material immediately ensues. Being short lived, the creep endures for only a few seconds, until this ‘popper’ transitions rapidly back to the ground state. Described in this article are two remarkable precursory ‘warnings’ of impending catastrophe -- exhibited by the popper before it unloads from the final metastable state. They were discovered by monitoring a component of its motion using a state-of-the art capacitive sensor. The system shows some similarities to what happens through energy imparted to the Earth by the Moon and Sun. The study thus suggests that ‘earthquake predicting identifiers’ of life-saving quantitative type just might eventually become commonplace.

BACKGROUND:
To illustrate cyclic conversion between potential energy and kinetic energy – nothing has excited the present author’s students over the last half-century -- more than a simple piece of demonstration equipment. The simplest homemade version is made by first cutting a common tennis ball into two equal parts using a sharp (saw-blade type) knife. Then the strongly bonded felt is removed by gripping and pulling with pliers in a rolling motion (which is not easily done). A pair of poppers is finally produced by further size-reduction using scissors applied to each rubber piece. A photograph of three of the four end-result pieces is provided in Fig. 1

Figure 1 - Image showing stripped felt-halves and one of the two poppers. To arrive at the end state, the rubber was cut with scissors by trial and error. Cutting by small amounts fully around the rim continued until it reached a ‘workable’ size. One must be careful with each rim-cut transit, not to remove too much material – lest it turn into a piece of trash.

Tennis-ball ‘Popper’ - an example of metastable catastrophes

DEMONSTRATION of Energy Conversion
The following link is a short video that vividly illustrates the propulsion capability of the device.

Flight of a Popper launching itself vertically from the floor

Cyclic conversion among energy types is clearly recognized from this video.
After being inverted, the popper was placed on the floor with its center higher than the rim. Following the last catastrophe, the un-load of energy that was stored internally by cocking, (i) potential energy of the popper is converted impulsively to kinetic energy. Then there is a progressive (ii) conversion of kinetic energy to gravitational potential energy, which is greatest at the highest point in the trajectory. Thereafter, (iii) gravitational potential is converted back to kinetic until it collides with the floor. Conservation of total energy requires that there be an infinitesimally higher temperature of the system at the end of the video, as compared to the start.

APPARATUS
Precursor warnings of catastrophe in the popper were made possible in this study by using a state-or-the-art sensor. SAA member Eric Daine created the one used in the present experiment, which is shown in Fig. 2

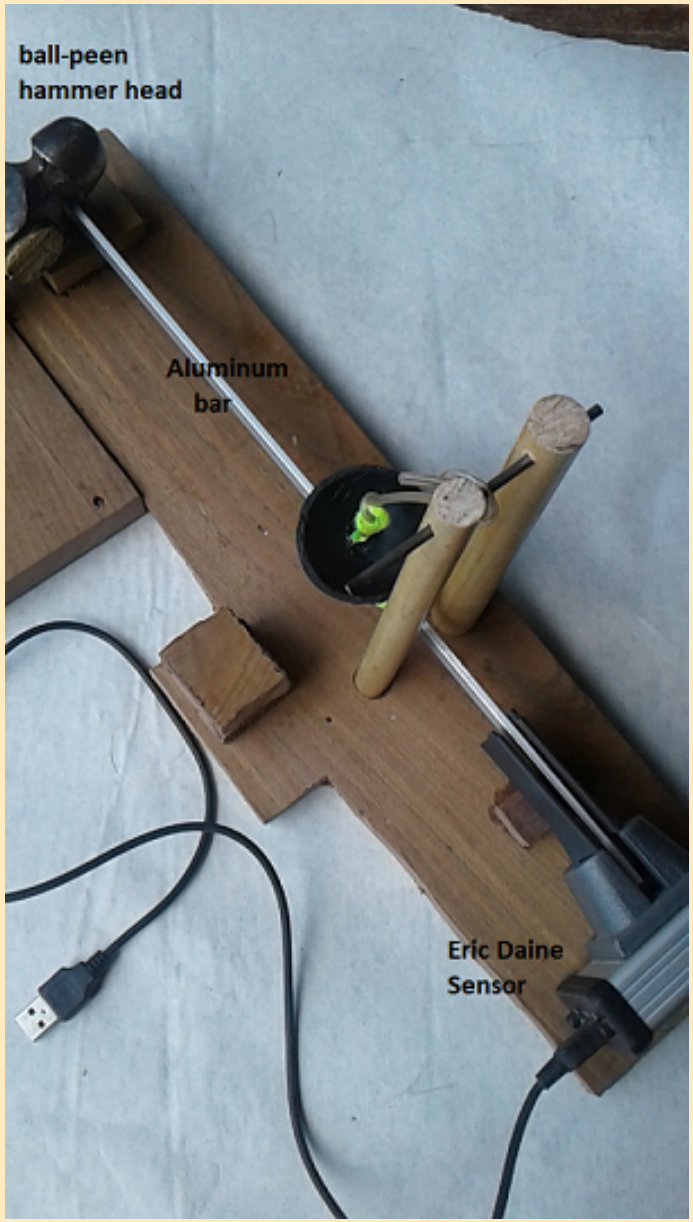


Figure 2: The sensor is commercially available from Tel-Atomic Inc. Features of the science with which it functions are to be found by way of http://symcdc.com, for which Eric is the webmaster. The website also speaks to a variety of research activities by Peters & Daine (much of which was performed when both were still on campus at Mercer University).

Tennis-ball ‘Popper’ - an example of metastable catastrophes

Figure 3: Seen here cocked and ready for data collection, the popper is constrained by two glue-joints. One is to a bottom-edge segment of the Aluminum bar, and the other is to the yellow thread at its top-center. (The apparatus can also be used to study the creep of solder wire, by placing the hammer head at the position of the square wooden block). Data generated thereby are like what was obtained in the experiment that resulted in the article by Peters, La Berre and Pomeau, titled “Prediction of Catastrophes - an experimental model” (which is readily available as a download from arxiv.org).

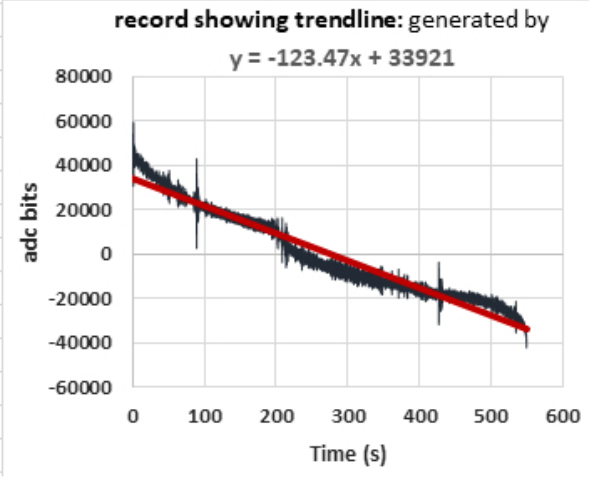
MEASUREMENT Preparation

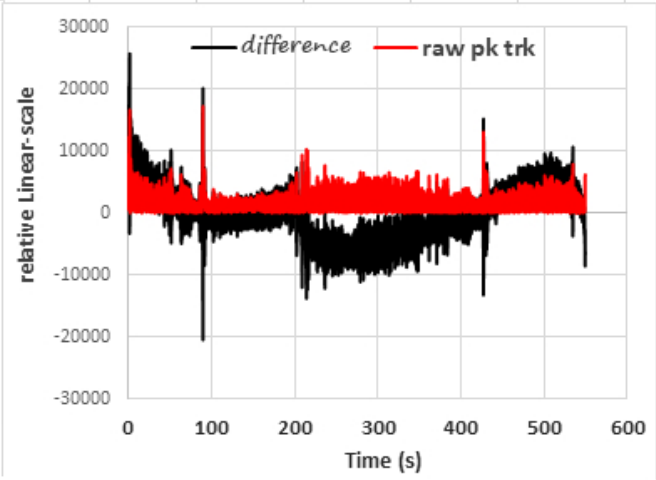
In Fig. 1 the popper is seen to be in the un-cocked state. A close-up photo following its change to the inverted state and thus ready for data collection is provided in Fig. 3.

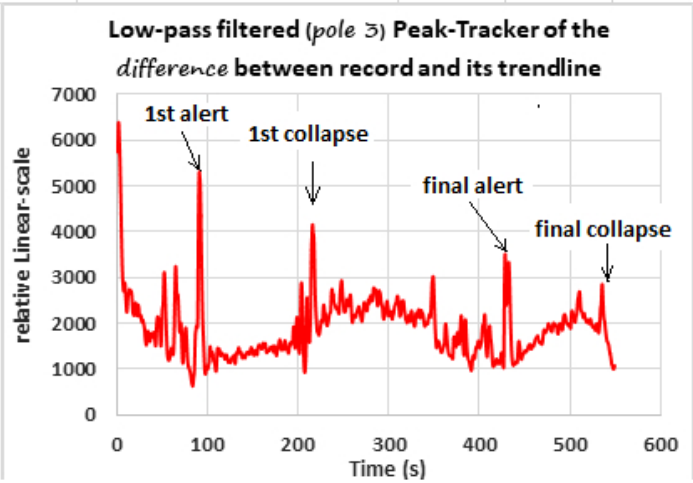
ANALYSIS RESULTS

Tennis-ball ‘Popper’ - an example of metastable catastrophes

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Time (s)	raw sig total	record	trend line	*difference*	raw pk trk	LP pole 1	pole 2	*pole 3*		0.97		The 2nd row values of F, G, H, & I are constants					
2	0	8146143	47034.23	33921	13113.233	5000	5800	5800	5800		filter constant		put in by hand. It is interesting to watch how the					
3	0.02	8150380	51271.23	33918.53	17352.702	9487.0485	5910.611	5803.318	5800.1				right-hand plot changes as one alters the value of					
4	0.04	8149124	50015.23	33916.06	16099.172	9023.7728	6004.006	5809.339	5800.377				the filter constant K1.					







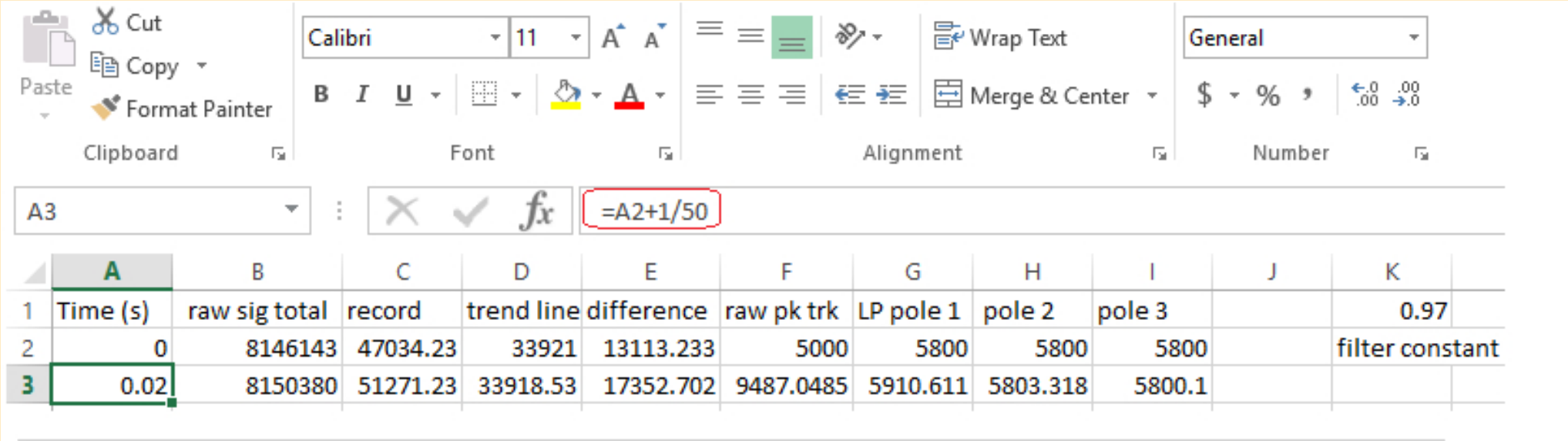
The 1st alert to a pending metastable collapse occured at 92 seconds -- preceding that 1st collapse at 216-s (due to a change in creep form, with the earliest creep being of exponential type called primary). The final alert occurred at 429-s, preceding the final collapse to the ground state at 549-s.

Figure 4. There is a treasure trove of information contained in the graphical package that was inserted into this document to yield this Fig 4. It is a screen-print copy of a portion of the Excel file that was used to analyze the acquired record. Events with which to predict the two catastrophes result from evolving shape-change of the rubber. The graphical plots reveal that it transitioned through two clearly different stages of creep (perhaps even more than just two). Creep persisted from the start of record acquisition, all the way unto the place of the final catastrophic collapse; where the popper returned to its un-cocked ground state. Before the final catastrophe there was a smaller 1st collapse at 216-s; where a change in nature of the creep took place.

Tennis-ball ‘Popper’ - an example of metastable catastrophes

NOTE:
To understand the details of what is displayed in Fig. 4, as well as to provide the reader with the means to create such an Excel spreadsheet file for themselves - an un-labeled figure is provided on the pages which follow.

Consider the sequence of nine components of the unlabeled figure.
These provide details concerning ‘operators’ of Excel type that were employed in the analyses used to generate Fig. 4 They were the means with which all of the temporal properties of the variables could be quantified and subsequently plotted.



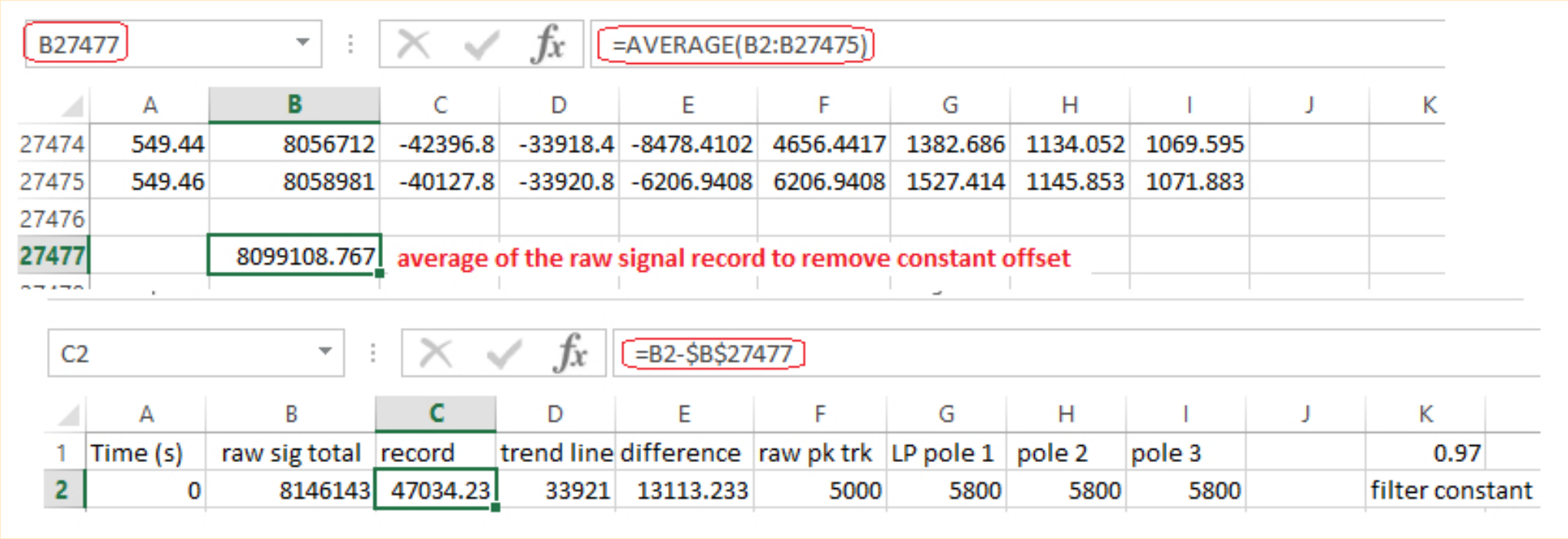
	A	B	C	D	E	F	G	H	I	J	K
1	Time (s)	raw sig total	record	trend line	difference	raw pk trk	LP pole 1	pole 2	pole 3		0.97
2	0	8146143	47034.23	33921	13113.233	5000	5800	5800	5800		filter constant
3	0.02	8150380	51271.23	33918.53	17352.702	9487.0485	5910.611	5803.318	5800.1		

To begin with an understanding of what has been provided by the figure, consider the time values that are located in column A. The column contains a total of 24,474 values, same as the record length. To generate this column, a zero was placed in A2 and then ‘= A2+1/50’ was typed into A3 (without the apostrophes) to yield the 0.02 that is shown there. Notice also that A3 is highlighted by a black rectangle surrounding the cell. It is associated with a closed red curve surrounding what got displayed adjacent to fx (showing the form of the operator that was typed into A3 to yield the 0.02). This increment is the reciprocal of the data acquisition rate that Eric built into his sensor, being 50 samples per second.

Tennis-ball ‘Popper’ - an example of metastable catastrophes

The A column was filled rapidly to its 27,474 values in ‘one fell swoop’, by using the mouse’s left-button switch. For such a capability, one goes to the lower right corner of A3 where an ‘open’ cross is initially displayed. When it changes to a ‘closed-line’ cross, the mouse button’s left switch is double clicked rapidly.

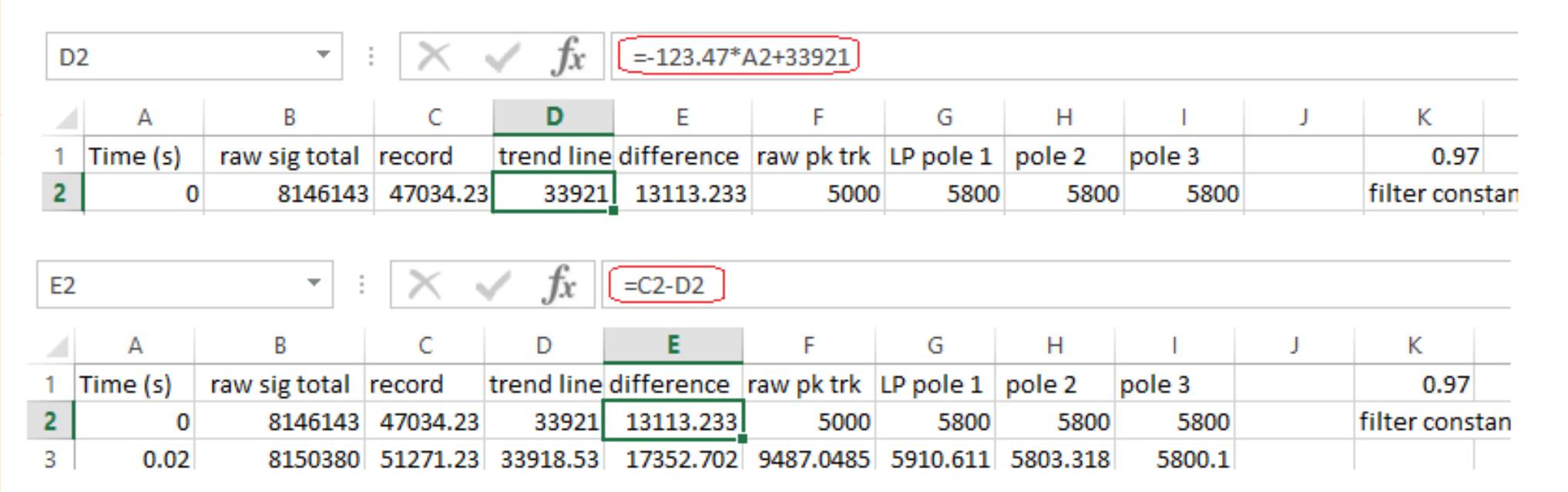
Following acquisition the raw-signal record was placed in column B. Then an ‘offset’ corrected form was placed in column C. It was obtained using the ‘average’ function of Excel. The details are shown in the 2nd piece of the nine-piece set treated by the figure. The 3rd piece shows how the computed average was subsequently used to generate the ‘corrected’ record that is displayed in column C.



Trend-line analysis:

The methodology presently used to obtain the two obvious quantitative precursory warnings of catastrophe that were generated - relies on the trendline function of Excel. One plots the record and then ‘clicks’ on it using the mouse’s right button switch. From the menu thereby presented, the trendline option is selected, along with ‘display equation’. The equation that resulted was then used to generate column D - as shown in the 4th piece of the set.

Tennis-ball ‘Popper’ - an example of metastable catastrophes



Heart of the Final Operations:
The prediction methodology described in this article employs a record ‘peak tracker’ invented by the author. It is based on his 2010 arxiv.org publication titled “Signal peak tracker based on the Teager-Kaiser Energy (TKE) Operator”. A pdf version can be easily downloaded by typing the first three words of the title into any of the web’s search engines.

A numerical measure of an article’s web-popularity is inferred by means of Bing.com and noting the following. Where does it show up in terms of (i) page-number & position on the page, along with (ii) the pool-size of URL sites that responded to the key words that were entered?

Because of the importance of the peak tracker for the present case study, the reader is encouraged to pay special attention to the 6th piece of the figure set. From among several version possibilities, it is the simplest that is well suited to present purposes.

Tennis-ball ‘Popper’ - an example of metastable catastrophes

F3 =SQRT(ABS(E3^2-E4*E2))

	A	B	C	D	E	F	G	H	I	J	K
1	Time (s)	raw sig total	record	trend line	difference	raw pk trk	LP pole 1	pole 2	pole 3		0.97
2	0	8146143	47034.23	33921	13113.233	5000	5800	5800	5800		filter constant
3	0.02	8150380	51271.23	33918.53	17352.702	9487.0485	5910.611	5803.318	5800.1		

G3 =$K$1*G2+(1-$K$1)*F3

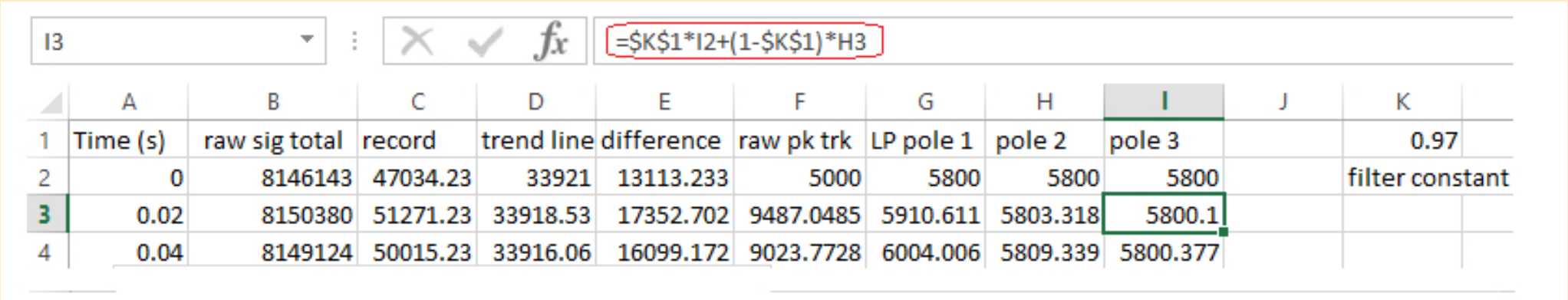
	A	B	C	D	E	F	G	H	I	J	K
1	Time (s)	raw sig total	record	trend line	difference	raw pk trk	LP pole 1	pole 2	pole 3		0.97
2	0	8146143	47034.23	33921	13113.233	5000	5800	5800	5800		filter constant
3	0.02	8150380	51271.23	33918.53	17352.702	9487.0485	5910.611	5803.318	5800.1		
4	0.04	8149124	50015.23	33916.06	16099.172	9023.7728	6004.006	5809.339	5800.377		

H3 =$K$1*H2+(1-$K$1)*G3

	A	B	C	D	E	F	G	H	I	J	K
1	Time (s)	raw sig total	record	trend line	difference	raw pk trk	LP pole 1	pole 2	pole 3		0.97
2	0	8146143	47034.23	33921	13113.233	5000	5800	5800	5800		filter constant
3	0.02	8150380	51271.23	33918.53	17352.702	9487.0485	5910.611	5803.318	5800.1		

Tennis-ball ‘Popper’ - an example of metastable catastrophes

The final three pieces of the set involve low-pass filtering, done sequentially so as to yeild the final pole-3 result that is plotted in Fig.4



I3 =$K$1*I2+(1-$K$1)*H3

	A	B	C	D	E	F	G	H	I	J	K
1	Time (s)	raw sig total	record	trend line	difference	raw pk trk	LP pole 1	pole 2	pole 3		0.97
2	0	8146143	47034.23	33921	13113.233	5000	5800	5800	5800		filter constant
3	0.02	8150380	51271.23	33918.53	17352.702	9487.0485	5910.611	5803.318	5800.1		
4	0.04	8149124	50015.23	33916.06	16099.172	9023.7728	6004.006	5809.339	5800.377		

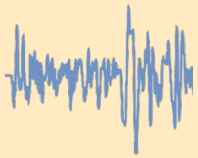
Conclusions:

Pay special attention to the parts of Fig. 4 that are colored red. Note first that in addition to the final catastrophe, there is also at least one intermediate catastrophe. It is associated with a change in the nature of creep before the popper’s final collapse to the ground state. One has to wonder if materials that evolve from primary creep to secondary creep (common to metals when greatly stressed) could show similar features. In other words, could the critical slowing down cases that were seen in the solder wire experiment mentioned earlier - be associated, at least in part, with a creep conversion process?

Unknown properties:

The scientific basis with which to understand (from 1st principles) the complexities of various mechanical oscillators (including the Earth) is woefully inadequate. When the present author became a Professor about a half-century ago, his field of specialty was called ‘Solid State Physics’. After startling later developments, that label has been replaced by ‘Condensed Matter Physics’. It is a field in desperate need of much greater scientific attention (especially by the inclusion of talented theorists). To validate this claim, the following quote of Richard P Feynman (1918 – 1988) is here provided. At the time this was stated, the highly esteemed Feynman was talking about the fine structure constant α:

“It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it. Nobody knows. It’s one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding from man. You might say the “hand of God” wrote that number, and “we don’t know how He pushed his pencil.” We know what kind of a dance to do experimentally to measure this number very accurately, but we don’t know what kind of dance to do on the computer to make this number come out, without putting it in secretly!”



Tennis-ball 'Popper' - an example of metastable catastrophes

Other experiments conducted by the present author focused on trying to improve 1st principles understanding of various systems falling in the category of his specialty. He has performed many experiments with a host of different mechanical oscillators. The majority of those involved some form of a pendulum; and details are to be found at his Mercer webpage http://physics.mercer.edu/hpage/peters.html

Final comments:
Because of a treasured friendship with the individual next mentioned, the remaining part of this document is composed in the style of 1st person personal.

The study of a long-period pendulum in 1987 resulted in my publication of an article titled "Non-classical Pendulum", which appeared in a Texas Section of the American Physical Society. It was read by Distinguished Professor Emeritus Thomas Erber (born Dec. 6, 1930), a theoretical physicist with the Illinois Institute of Technology. He subsequently wrote a letter to me, requesting details of the experiment. After I sent those to him, Tom informed me that the lowest measured persistent energy state exhibited by my pendulum (behaving like a quantum state) - was in magnitude the same as the rest energy of the electron divided by the fine structure constant (11 pJ).

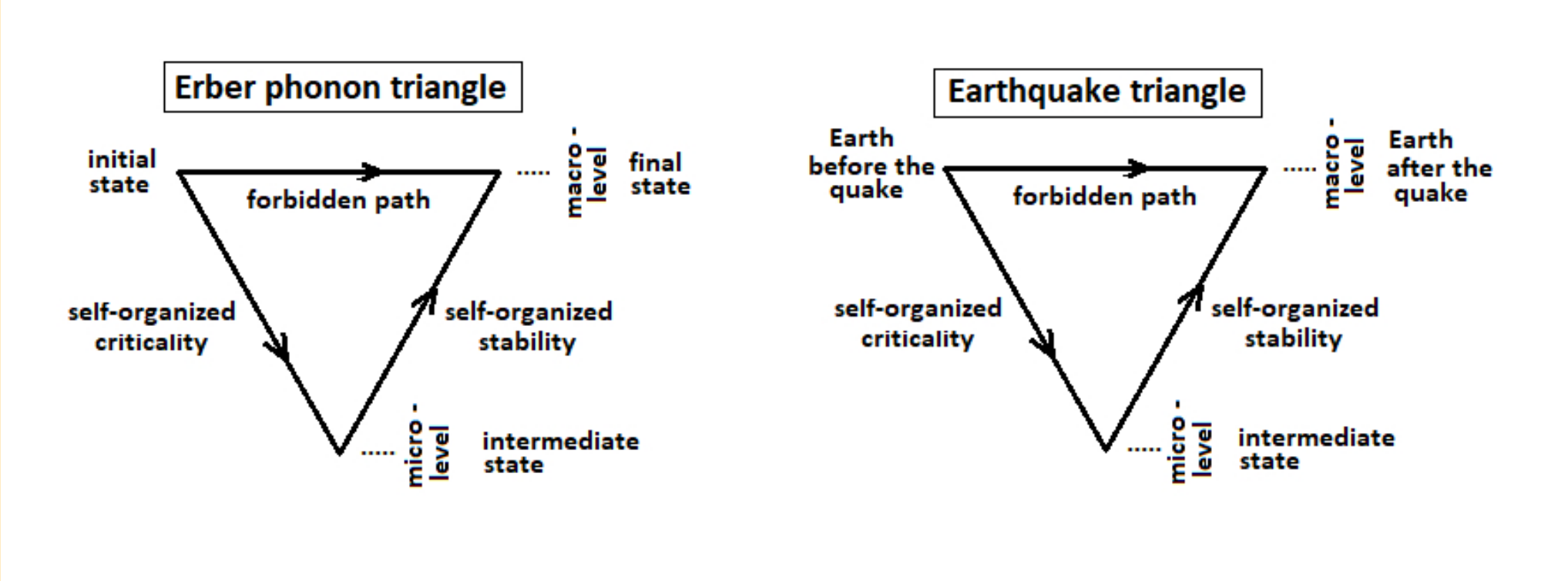
I participated with a large number of others in honoring Dr Erber - by providing a contribution (pp 225-228) to the IIT Press 2010 publication titled Doing Physics: A Festschrift for Thomas Erber. This paper-back book was edited by Porter Wear Johnson, one of his colleagues who is a quantum field theorist. A photograph of Tom appears on the outside back cover - to accompany several personal comments written about him by Professor Emeritus Johnson. I whole-heartedly agree with everything written there. Being one of the world's most talented physicists, the last part of that cover reads as follows: "Tom definitely sees the big picture in science, and many who have known him or have worked with him have been infused with his zest for exploration".

The most important of my articles to derive from Tom's influence is the one titled "Compton Energy Scale of Friction Quantization". It was published in arXiv.org in 2006; and an html version is available at http://physics.mercer.edu/hpage/compton/compton.html.

The events mentioned above also figured into my extrapolation of one of Tom's well known contributions to materials science, called the 'Erber phonon triangle'. Just one example is provided here to show the use of his triangle to better understand something. It is a description of what happens when some section of a common steel clothes-hanger wire is bent back and forth repeatedly beyond the elastic limit. There is a progressive temperature increase before a final break of the wire into two pieces. Avalanche processes associated with self-organized criticality characterize the downward path. It involves transitions from macro - states through meso-levels to the place of micro - states. From the micro-level back up to the highest macro-level, there is a presence of self-organizing physics that is given to the increase of stability.

Tennis-ball ‘Popper’ - an example of metastable catastrophes

By analogy, an expression of my personal opinion concerning the processes responsible for earthquakes is provided in the right-hand part of the following figure.



ACG Regional Seismic Network

A dummies guide to using the website - submitted by Peter Gray and edits by Vic Dent

Introduction

For many years the Regional Seismic Network website, developed by Paul Harris and hosted by the Australian Centre for Geomechanics (ACG), has been the only data management centre for collating and displaying public seismic network (PSN) data in Australia. Data collection and processing is based primarily upon Larry Cochrane's Webtronics digitiser cards and initially reliant upon Larry's WinSDR software. Paul was clever enough to create a "direct recording mode" capability that made the use of WinSDR somewhat obsolete (along with it's reliance on the various Microsoft Windows Operating Systems). The ability to use WinSDR is still available to users if they want to maintain a local, real time display of data.

Direct Mode operation allows a small client script to take the data and timing information from the Webtronics digitizer card and send it to the ACG in a suitable format. In doing so, Direct Mode opens up the ability to use different computer O/S's by modifying the client script only. Debian Linux on PC's, notebooks and Raspberry Pi single board computers are suitable candidate replacements to M$ Windoze.

Logging In

There are different levels of user login. To access the public access level of the website, enter the User Name "**cadoux**" & Password "**op6aeSie**"

Regional Seismic Network

ACG AUSTRALIAN CENTRE FOR GEOMECHANICS

SAA_User | Status | Settings | Log out

Status as of 2019-11-20 01:19:27 UTC

Central Australia

Site	Mag 1 Add	Mag 2 Mult	General Status	Last Communication	Last Reading	GPS lock	When Lo-Q Uploaded	What Lo-Q Uploaded	When Hi-Q Uploaded	What Hi-Q Uploaded	rsn_client Version	Recording Mode
Gladstone	0.0	1.0	No comms for more than a day Check network and computer	about 1 year ago	over 49 years ago	GPS ok	about 1 year ago	about 1 year ago	about 1 year ago	about 1 year ago	26	WinSDR
Modbury Heights	0.0	1.0	Ok	4 minutes ago	over 49 years ago	GPS ok	18 minutes ago	about 1 hour ago	27 minutes ago	1 day ago	26	WinSDR
Lobethal SA	0.0	1.0	Ok	2 minutes ago	over 49 years ago	GPS ok	18 minutes ago	about 1 hour ago	30 minutes ago	1 day ago	29	WinSDR
Mt Barker	0.0	1.0	Ok	2 minutes ago	over 49 years ago	GPS ok	18 minutes ago	about 1 hour ago	31 minutes ago	1 day ago	26	WinSDR
Morphett Vale SA	0.0	1.0	Ok	4 minutes ago	over 49 years ago	GPS ok	17 minutes ago	about 1 hour ago	32 minutes ago	1 day ago	26	WinSDR
Peake SA	0.0	1.0	Ok	1 minute ago	over 49 years ago	GPS ok	16 minutes ago	about 1 hour ago	29 minutes ago	1 day ago	26	WinSDR
Victor Harbor (ret)	0.0	1.0	Retired	2 months ago	over 49 years ago	GPS unlocked	over 4 years ago	over 5 years ago	over 4 years ago	over 5 years ago	29	Direct
Middleton	0.0	1.0	Ok	5 minutes ago	8 minutes ago	GPS ok	16 minutes ago	about 1 hour ago	31 minutes ago	1 day ago	34	Direct
	0.2114	0.689893	Ok	less than a minute ago	3 minutes ago	GPS ok	17 minutes ago	about 1 hour ago	27 minutes ago	1 day ago	25	Direct
Central Pending	0.0	1.0	Ok	4 minutes ago	6 minutes ago	GPS ok	17 minutes ago	about 1 hour ago	29 minutes ago	1 day ago	34	Direct
Aberfoyle Park ABFP	0.0	1.0	Ok	2 minutes ago	5 minutes ago	GPS ok	17 minutes ago	about 1 hour ago	28 minutes ago	1 day ago	31	Direct
Hindmarsh Valley	0.0	1.0	No comms for more than a day Check network and computer	about 1 month ago	over 49 years ago	GPS unlocked	about 1 month ago	about 1 year ago	about 1 month ago	about 1 month ago	29	Direct
Payneham	0.0	1.0	No GPS lock, check GPS	3 minutes ago	over 49 years ago	GPS unlocked	17 minutes ago	about 1 hour ago	30 minutes ago	1 day ago	29	WinSDR
Mannum	0.0	1.0	Never received LoQ data Check digitiser	over 4 years ago	over 4 years ago	GPS ok					25	WinSDR

The Status page showing a snapshot of the PSN seismic stations on the Central Australian Time zone

ACG Regional Seismic Network

The Status Page

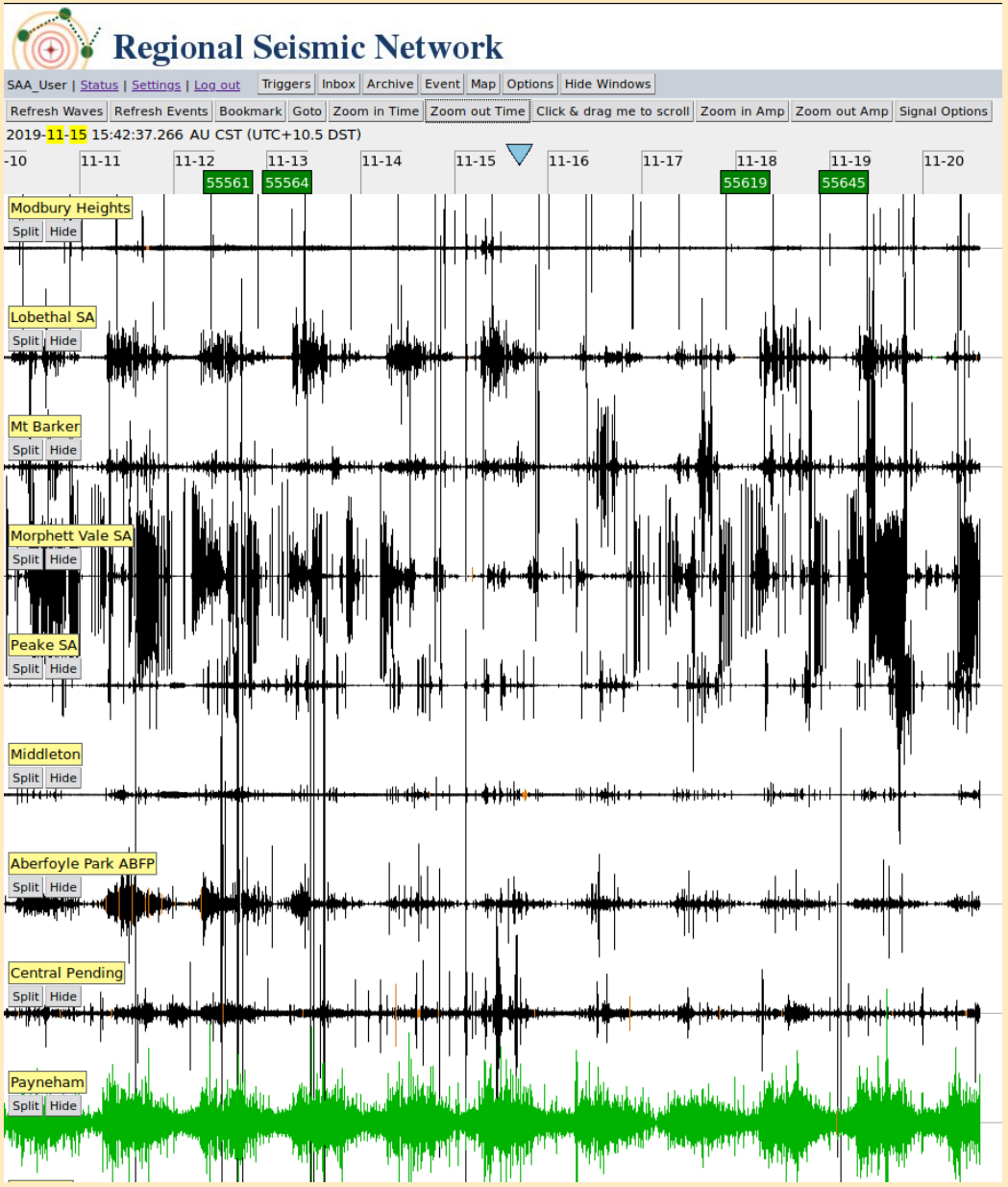
Upon logging in, it's a good idea to check the Status page. Here you will be able to determine which stations are operating and able to send data, if the GPS is present and functional, which version of rsn_client is running (the client script) and the Recording Mode in use.

Network Page(s)

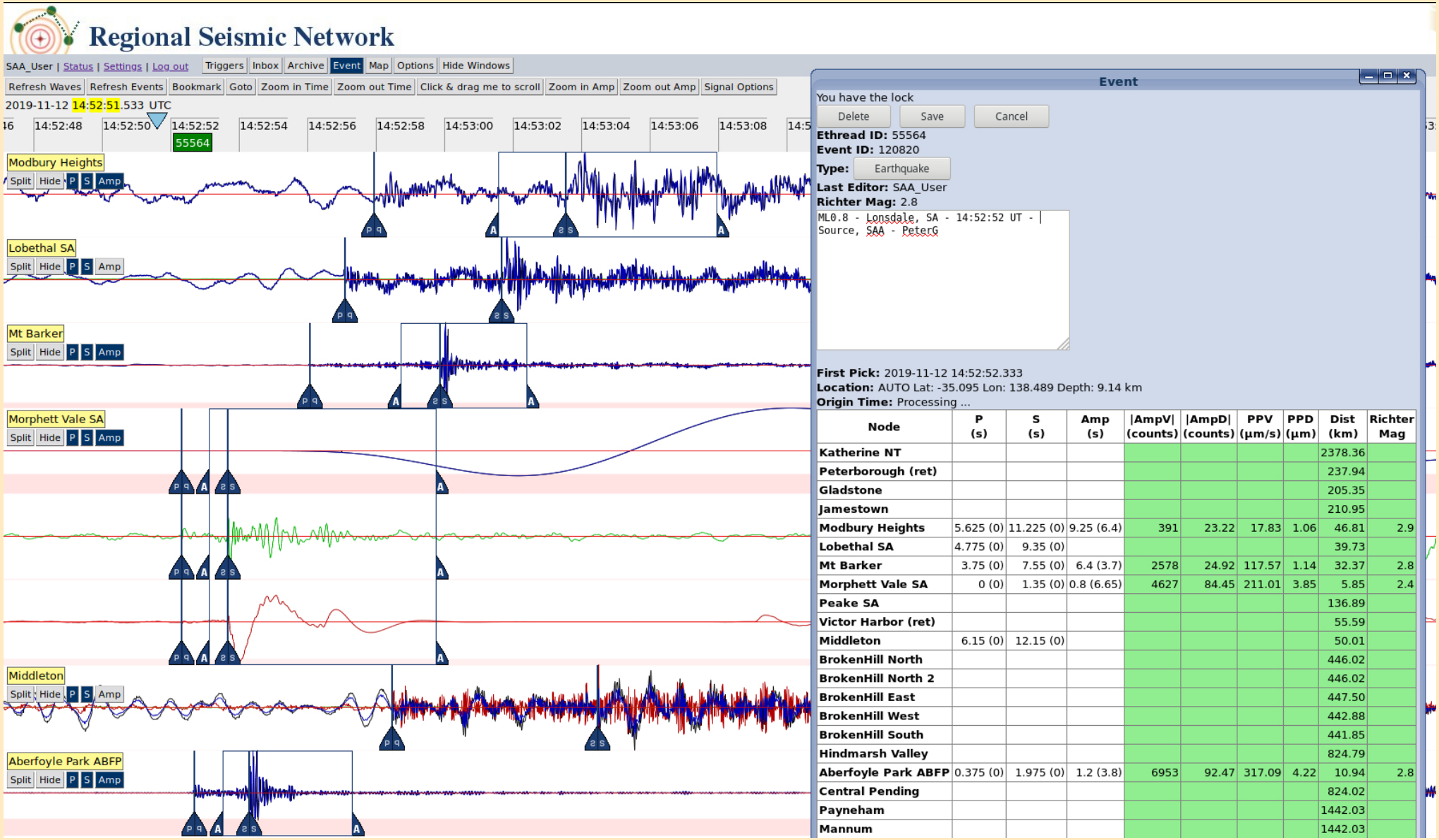
There are three Network pages that you can browse, Central, Eastern and Western Australia. To choose one from the Status page, position your pointer over the bullseye located to the left of the Regional Seismic Network header (top left of page) and select to return to the main page.

For this exercise, we'll use Central Australia for the following examples. The image on this page is a time slice of approx. 10 days for the nine stations currently sending data to the Central network. Several things to note in this image are applicable to using any of the network pages:

* The blue inverted arrow in the centre of the page is the active selected date & time, as indicated between the menus and the traces at the top of the screen.
* You can move the blue arrow anywhere along the timeline with your pointer, the Zoom time & amplitude functions centre around this arrow.
* The numbered green boxes are marked "events" as determined by users such as yourself, if logged in at the approriate user level.
* The seismic stations and their respective trace(s) are shown down the screen, in no particular order.
* If you want to remove one or more stations, the Hide button will assist remove some clutter.
* Should you have a triaxial seismometer (or want to use someone elses) to determine s wave arrivals, the Split button will expand the display. CH1 on the Webtronics ADC cards are the default trace displayed when in Direct Mode, Vertical (Z) is assumed to be on CH1.



ACG Regional Seismic Network



Node	P (s)	S (s)	Amp (s)	|AmpV| (counts)	|AmpD| (counts)	PPV (µm/s)	PPD (µm)	Dist (km)	Richter Mag
Katherine NT								2378.36	
Peterborough (ret)								237.94	
Gladstone								205.35	
Jamestown								210.95	
Modbury Heights	5.625 (0)	11.225 (0)	9.25 (6.4)	391	23.22	17.83	1.06	46.81	2.9
Lobethal SA	4.775 (0)	9.35 (0)						39.73	
Mt Barker	3.75 (0)	7.55 (0)	6.4 (3.7)	2578	24.92	117.57	1.14	32.37	2.8
Morphett Vale SA	0 (0)	1.35 (0)	0.8 (6.65)	4627	84.45	211.01	3.85	5.85	2.4
Peake SA								136.89	
Victor Harbor (ret)								55.59	
Middleton	6.15 (0)	12.15 (0)						50.01	
BrokenHill North								446.02	
BrokenHill North 2								446.02	
BrokenHill East								447.50	
BrokenHill West								442.88	
BrokenHill South								441.85	
Hindmarsh Valley								824.79	
Aberfoyle Park ABFP	0.375 (0)	1.975 (0)	1.2 (3.8)	6953	92.47	317.09	4.22	10.94	2.8
Central Pending								824.02	
Payneham								1442.03	
Mannum								1442.03	

ACG Regional Seismic Network

* The green trace on the Payneham seismic station indicates that GPS timing accuracy is not available at this location & should not be relied upon for determining locations. The colour of the traces are related to the status of that trace's "GPS time lock". Black means "locked", Brown means "was recently locked" and Green means "unlocked".

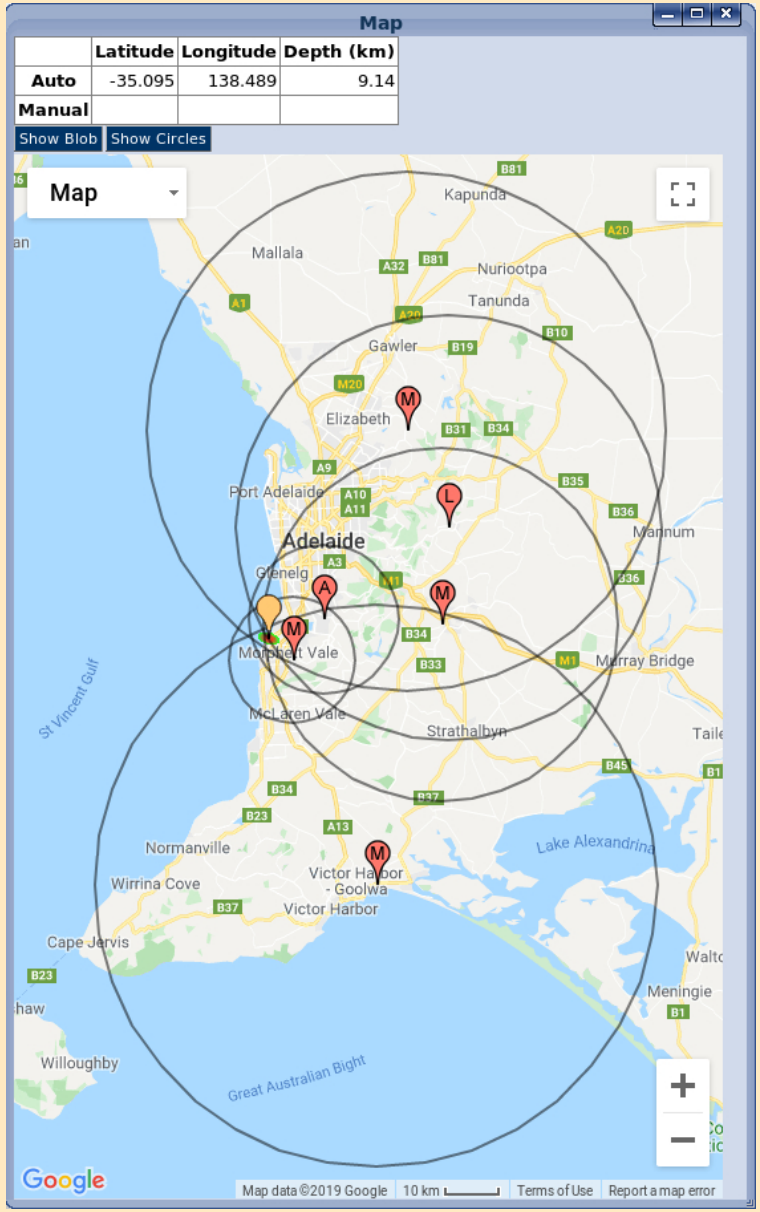
Example: Lonsdale 2019-11-15 14:52:52 UT ML0.8 (refer image on previous page)
A recent quake that may have gone unnoticed is a good example to use for this exercise. I usually **Zoom in Time** for about an hour's trace across the screen. Scrolling through the traces, you may notice a response amongst the noise. If a response is noticeable over some or many of the seismic station traces, you may have found an earthquake.

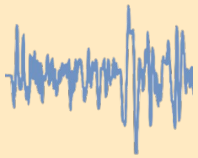
Zoom in Time and enable **Autoscale** from the **Signal Options** menu. At this point, I deselect **Local Time Zone** from the **Options** menu to change to UTC. Once an **Event** has been created from the top menu, a new window opens as shown on the right of the image. Also notice that three new buttons have been created under each seismic station: **P, S & Amp.**

Pick a station to begin with and select the **P** button. A splittable pair of marker flags will appear, move them to pick the moment the P wave occurs. Repeat the process for all stations with a discernable P wave response.

Pick a station to begin with and select the **S** button, a splittable pair of marker flags will appear**.** Move them to pick the moment the S wave occurs. Repeat the process for all stations with a discernable S wave response.

You should use any unlocked GPS (green) waveforms for picking P and S picks, but you should try to pick BOTH P and S waves. Unlocked GPS waveforms have a reliable relative time period between P and S picks, but an unreliable absolute time (so can't be accurately compared with other stations). When BOTH P and S are picked, the circles (on the map) will only show the grey (relative) circle, and the location algorithm uses the relative time between P and S (which IS accurate). If there is no GPS lock, then a single P and S pick is not used in the event location calculation.





ACG Regional Seismic Network

Location algorithm

The circles on the map are used ONLY for visualisation, and are drawn based on a primary 3D location algorithm (NNLoc). The primary location algorithm uses the picks (relative time between P and S), and the absolute time of P and S (if the digitiser had a GPS lock).
When you pick a P and S, and the arrival isn't certain, you can open up a little box by seperating the two marker flags. Put the middle of the little box where you think the arrival is, and imagine a bell curve in the box. The wider the box, the wider the bell curve.

This will tell the algorithm the uncertainty of the time of the pick, and is included when fitting the time models.

As this timing information is entered, calculations will be made by the website. When the calculations are complete, the columbs will turn green.

Amplitudes/Magnitude algorithm

To obtain an estimate of magnitude for the event, pick the station with the best defined S wave and select the Amp button, a splittable pair of marker flags will appear. Move the leading marker flag to the left of the beginning of the S wave, then split the marker pair and move the trailing marker flag well past the peak of the S wave.

The system finds the peak velocity within the AMP time box and displays that in the table, integrates the wave to get displacement and finds the peak displacement. It uses the peak displacement in an equation to compute the magnitude. Each wave can provide its own estimate of magnitude (as displayed in the table).

All these magnitudes are averaged together with a method that also removes outliers (if there are enough magnitudes) to compute the final "average" magnitude.

Interpreting the Map

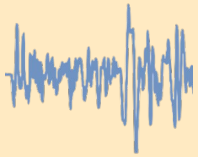
Select Map to see the estimated epicentre, you may need to rescale and resize the map to optimise it. The teardrop blob is an estimate of the epicentre, the circles are the P to S wave time differences radiating away from each seismic station. Carefully review your picks if there are instances of large errors evident.

Event Time

The time listed in the Inbox is the time of the FIRST PICK, which might be an Amp pick or a P pick or an S pick. It is not the event occurrence time, but rather the time of the first recorded arrival of a wave at a sensor.
The 3D location algorithm computes both an event location and time (time the event occurred in the rock). The circles on the map are drawn very roughly by using the event location, time, a network-wide guessed velocity, and the time of the picks.
Red circle: P pick's absolute time subtract event time. Green circle: S pick's absolute time subtract event time. Grey circle: P and S relative time.
Note that if there is no location computed, or you set a "manual" location (using the map), then there is no "occurrence time" and so only the Grey circle (relative time) is drawn.

"GPS LOCK" and time

If the GPS loses its view of the satellites, its clock will slowly drift away from UTC and the digitiser marks the data as "not locked". But, the clock is probably still very close to the real time, so those waveforms are marked brown. If the GPS never gets a satellite lock, or has lost it for a long time and we don't know if our time is correct, the waveforms are marked green.
Some digitisers may not have a GPS, so instead they rely on the computer's time which may be synced with NTP (network time protocol). So even if the network is down, once the NTP client knows how much the computer's clock USUALLY drifts, it can continue to adjust the clock and be reasonably good.



Resources & useful links

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