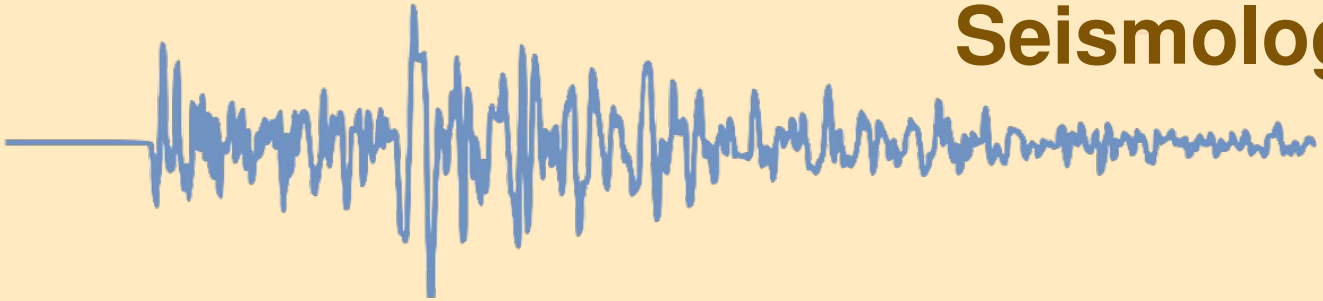
Newsletter of the Seismological Association of Australia Inc. Jul-Aug 2019



Seismological Association of Australia Inc.

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

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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 been a busy couple of months since the last edition, having visited several of our seismic sites for various reasons. I do enjoy getting out to see these facilities, it gives me a better appreciation for the work that has been done over the years to develop a robust network of sites and if necessary, I get to make a contribution toward it. It is also a chance to audit the installed equipment for model / part numbers and serial numbers. This is important for the SAA Asset Database, a resouce being developed to help identify and manage the significant amount of hardware located at various sites scattered around the countryside.

The WNRO problem mentioned elsewhere is a problem because we don't know which modules are in many of our EchoPro recorders and which are likely to fail. That means we can only guess how many replacement modules need to be purchased, reprogrammed and replaced.
We lose any bulk buy pricing advantage by purchasing in small batches or risk buying too many. The SAA can't afford mistakes like that. Perhaps we'll be back to Bunnings for a cash recharge, sooner rather than later.

Peter Gray

SAA News and upcoming activities

Bunnings Fundraiser BBQ
Our second fundraiser was a great success, the results were even better than the first BBQ. My thanks to Bunnings Mount Barker for their ongoing support and we look forward to participating again in the near future.

Science Alive 2019
Activities for this year's Science Alive event in Adelaide are well underway with a functional Slinky having been constructed and operating under jAmaseis on an Arduino for that 'live action' experience, along with the displays presented last year.
This edition has been published a few day early, just to remind you all that your assistance on any or all of the following days would be appreciated, to ensure this event is a success.

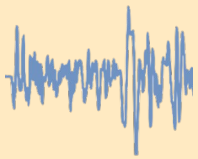
Thursday, August 1st is a setup day
Friday, August 2nd is a Schools only day
Saturday, August 3rd is general public day
Sunday, August 4th is a general public day

A new Aust. Public Seismic Network Website
Since the passing of Dale Hardy and the eventual demise of both websites that Dale developed and managed, many of the local PSN operators and contributors have been looking for an alternate site to publish their gif images. MIke Turnbull from the Central Queensland Seismic Research Group (CQSRG) has made available a new page for publishing gifs generated by WinSDR software. You can contact Mike via the link above to arrange the details, should you wish to do so.
The Resources & Links page at the end of this and future newsletters has been amended to take you to the gif images directly, for future reference.

British Seismology Meeting 2019 : Frontiers of Seismology
Should you happen to be in Edinburgh in early September, make sure you save a couple of days for BSM 2019. Kevin McCue suggests that this symposium will have some interesting articles for our members, the link should provide access.

SAA Newsletters are now on Trove
One of the resposibilities that associations such as ours need to address is to submit our newsletter publications to the National Library of Australia. The Trove online resource can be found here and should you wish to find the our newsletters, all that you probably need to do is search using "SAA Newsletter" or "Seismological Association of Australia"
Prior to submission to Trove, any encryption on the pdf had to be removed from each file. I had previously used some encryption to restrict some content use. This will no longer be applied to future SAA Newsletters and the earlier editions have been recompiled without encryption prior to submission. I also took the opportunity to review each edition for "sensitive" information such as GPS co-ordinates with more than 3 decimal degree precision.

For the forseeable future you will still receive an email from me advising that a new SAA Newsletter is available. Depending upon the file size, it may be available as an attachment to the email. The link to my Dropbox account will also be there, regardless of the file size, this link is my primary mode of delivery.
You may also download the SAA Newsletter from the Astronomical Society of South Australia website, it will usually be available some undefined time later. The SAA Newsletter will be submitted to Trove about four weeks after you receive your email notification. As subscribed members of the association, you deserve to take precedence over the non-member public.



Why did Charles F. Richter and Beno Gutenberg Use a Base 10 Logarithmic Magnitude Scale, and what are the Implications of that Choice?

Article kindly submitted by Mike Turnbull, Central Queensland Seismology Research Group

Introduction

Why did Richter, who had a Ph.D. in theoretical physics from Caltech, express his formula for local earthquake magnitude in the manner he did? After all, he had an infinite number of ways to choose from, and the choice of the base 10 logarithmic formulation is not conducive to mathematical manipulation.

So why did he make it as follows (Richter 1958).

$M_L = Log_{10}(A) - Log_{10}(A_0)$ … (Eq. 1)

Some Historical Engineering Background

The source of Richter and Gutenberg's inspiration for their local magnitude formulation can be seen in the common practices being employed in the electrical engineering fields at the time and since; particularly in the telecommunication engineering discipline. Here we find similar formulations, used to express electrical power and voltage amplitude ratios

In electrical power terms, the logarithmic ratio of two power values P_1 and P_2 is expressed as follows.

$R = Log_{10}(P_1/P_2)$ … (Eq. 2)

Using this formulation, the electrical power at one point in a system can be expressed relative to that at a different point; or, relative to a standard power. The standard power in the telecommunication industry was chosen to be 1 mW, given the designation P_0.

In this standard scheme an arbitrary power P could be expressed as a logarithmic ratio compared to P_0 as follows.

$R = Log_{10}(P/P_0)$ … (Eq. 3)

The dimensionless logarithmic ratio thus produced was given the unit name Bell (in recognition of the contribution to telecommunication engineering made by Alexander Graham Bell). The acronym used for the Bell unit was B [1].

Richter Magnitudes Expressed as Bell Units.

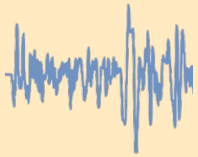
The use of base 10 logarithmic ratios (i.e. dimensionless Bell units) is found in many engineering areas – including sound level measurements (expressed as the base 10 log ratio of sound pressure).

Eq. 1 can be expressed as follows..

$M_L = Log_{10}(A/A_0)$ … (Eq 4)

This clearly shows that Richter's local magnitude is, in fact, a dimensionless Bell measure, with A_0 used as the reference value.

[1] It turned out that the Bell unit was inconveniently too large for practical use with the levels of electrical power commonly found in the telecommunication industry. Consequently, a factor of ten was applied to the logarithmic ratio to arrive at the decibel, with the acronym of dB. When used in the formulation expressed by Eq. 3, where P_0 is set to 1 mW, the logarithmic ration is expressed in units of the dBm.



Why did Charles F. Richter and Beno Gutenberg Use a Base 10 Logarithmic Magnitude Scale, and what are the Implications of that Choice?

Only someone with an engineer's perspective would express a logarithmic ration in this manner, at that period of time. A mathematician would never have used a base 10 logarithm, because such formulations are not conducive to manipulation in calculus. For instance, Richter's formulation can neither be directly differentiated nor integrated.

It would seem that Gutenberg and Richter biased their choice of using base 10 logarithms to make their formulation of earthquake magnitudes more understandable to engineers, rather than physicists or mathematicians. The point is that, at the time they were involved, the engineering viewpoint was so overwhelmingly influential, that, if they had formulated their magnitude in a mathematically acceptable manner, it would not have been well received by the engineering community – which would have been a disaster for them. They were pragmatic enough to see which way the wind was blowing, and that is the direction they took. More power to them (if you will forgive the deliberate pun).

Non-Calculus Manipulation of G-R Formulae

A good example of this type of mathematical manipulation is seen when dealing with the Guttenberg-Richter (G-R) seismicity relation of cumulative earthquake frequency versus magnitude.

The Gutenberg-Richter (G-R) seismicity relation of cumulative earthquake frequency versus magnitude may be expressed as:

$$N(m \geq M) = 10^{(a - b\,m)} \ldots \text{(Eq. 5)}$$

where $N(m \geq M)$ is the number of earthquakes observed having magnitudes greater than or equal to M; and a-value and b-value are parameters specific to the observed data set. As a pragmatic mathematical and practical choice, the lower limit of M, M_0 is usually assigned the magnitude value zero. In that formulation, the a-value represents the logarithm to the base 10 of the number of independent earthquakes in the observation period with magnitude greater than or equal to zero.

$$a = \log_{10} N(m \geq M_0) \ldots \text{(Eq. 6)}$$

therefore

$$N(m \geq M_0) = 10^{a} \ldots \text{(Eq. 7)}$$

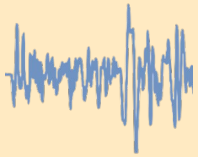
If it is assumed that all earthquakes included in the data set are independent [2], and that each event has equal probability of occurring, then Eq. 7 can be normalised to produce a probability relation as follows,

$$Pr(m \geq M) = N(m \geq M)/\, N(m \geq M_0) = 10^{(a - bm)}\, 10^{-a} = 10^{-bm} \ldots \text{(Eq. 8)}$$

where $Pr(m \geq M)$ will range from unity to zero, as M ranges from M_0 to infinity.

It can be seen from Eq. 8 that the value of the b-value determines the propensity for lower or higher magnitude earthquakes. Smaller b-values model a system that has a greater propensity for larger magnitude earthquakes.

[2] The assumption that one earthquake in a local zone is independent of subsequent others within the same zone can rarely be adequately and scientifically justified. There are recent examples in Australia (e.g. the Bowen 2016-08-18 ML 5.7 earthquake and aftershock sequence; the Tennant Creek 1988 ML 6.6 and subsequent events) where many subsequent years of earthquake events can be shown to have been dependent on the instability precipitated by the initial major event.



Why did Charles F. Richter and Beno Gutenberg Use a Base 10 Logarithmic Magnitude Scale, and what are the Implications of that Choice?

It also demonstrates that magnitude range of the earthquakes is not dependent on the a-value, but is dependent only on the b-value parameter.

The G-R cumulative distribution function (cdf) formulation is as follows.

$$Pr(m \leq M) = 1 - 10^{-bm} \ldots \text{(Eq. 9)}$$

Calculus Manipulation of G-R Formulae

Either Eq. 8 or Eq. 9 can be used to estimate the b-value parameter, from an ensemble of earthquake magnitudes, using the maximum likelihood method. However, in order to do that we need to transform the formulae in terms of the b-value, and then partially differentiate them to find the optimisation turning point. However, if we use the base 10 logarithm formulation, this cannot be done!

In order to differentiate or integrate Eq. 4, it first needs to be translated from the base 10 domain to the base e domain. In other words, if we want to perform calculus manipulations on G-R local magnitudes we need the formulation in terms of natural logarithms, not base 10 logarithms; and that is why the maximum likelihood equation for the b-value is as follows (Aki 1965).

$$b = \text{Log}_{10}e/(M_{avg} - M_{min}) \ldots \text{(Eq. 10)}$$

Gumbel and Lomnitz didn't fall into this trap when they developed the cdf for the statistics of extreme events as applied to extreme annual earthquake magnitudes, (Gumbel 1954, 1958) and used it to analyse earthquake risk (Lomnitz 1974). What they did, in fact, was to transliterate the G-R formula (Eq. 9) from the base 10 logarithm domain to the natural logarithm domain.

Cinna Lomnitz (1974) showed that if an homogeneous earthquake process with cumulative magnitude distribution

$$F(m; \beta) = 1 - e^{-\beta m}; m \geq 0 \ldots \text{(Eq. 11)}$$

is assumed (compare with Eq. 9), where β is the inverse of the average magnitude of earthquakes in the region under consideration; and α is the average number of earthquakes per year above magnitude 0.0; then y, the maximum annual earthquake magnitude, will be distributed according to the following Gumbel cdf.

$$G(y; \alpha, \beta) = \exp(-\alpha \exp(-\beta y)); y \geq 0 \ldots \text{(Eq. 12)}$$

From Eqs. 11 and 9, and the fact that α and 10^a specify the average time between events in the Gumbel and G-R formulations respectively, the relationships between the Gumbel parameters α and β and the G-R parameter a and b are seen to be

$$e^{-\beta} = 10^{-b} \Rightarrow b = \beta \log_{10}e \ldots \text{(Eq. 13)}$$

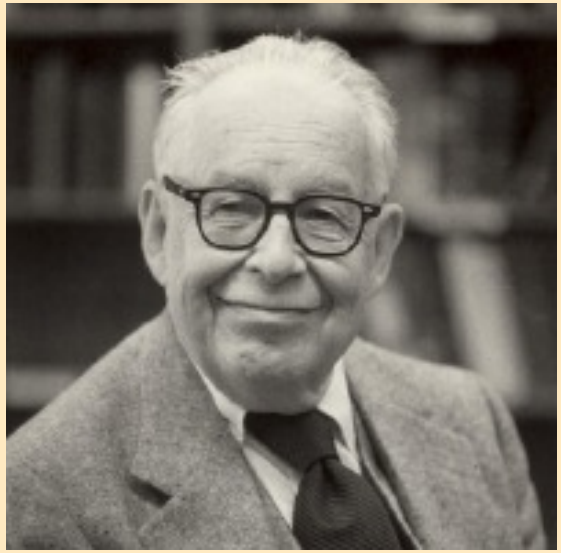
$$\alpha = 10^a \Rightarrow a = \log_{10}\alpha \ldots \text{(Eq. 14)}$$

Conclusion

In the 110 year period that has elapsed since Gutenberg and Richter developed their earthquake magnitude formulae the seismological community has grown accustomed to using base 10 logarithm dimensionless Bell units to express earthquake magnitudes. This ingrained baggage from the mid-twentieth century has flavoured attempts to develop the evolution of earthquake magnitude scales in that all current scales aim to produce magnitude values that are comparable to the G-R magnitude values.

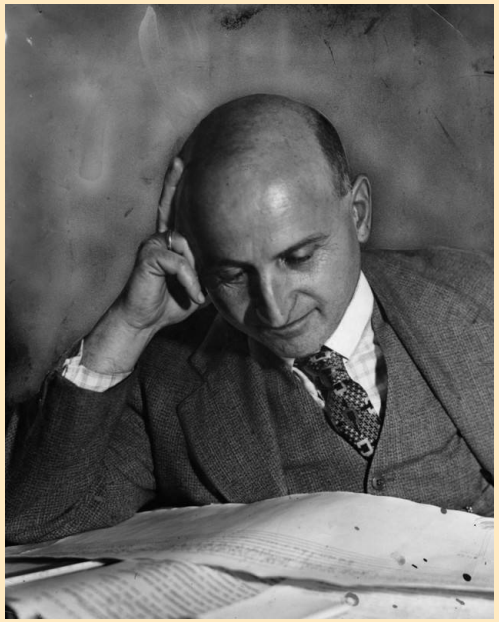
Why did Charles F. Richter and Beno Gutenberg Use a Base 10 Logarithmic Magnitude Scale, and what are the Implications of that Choice?

In the context of the mathematical manipulations required for ongoing earthquake risk analysis and seismicity research, the use of Bell units is anachronistic and unhelpful because base 10 logarithmic values and ratios are not conducive to calculus manipulations, and need to be converted to the equivalent natural logarithm values in order to be mathematically universal.



Charles F Richter

April 26, 1900 - September 30, 1985



Beno Gutenberg

4 June, 1889 - 25 January, 1960

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THS Solar Power Upgrade

Article submitted by Peter Gray

THS: Sampson Flat, South Australia
LOCATION: 34.742S, 138.773E, 340m

The Heights seismic site has been a core site of the network for many years. The seismometer and it's support services are located close to the town of One Tree Hill, SA. A UHF radio link is used to transmit the seismic data to a base station. Originally, the base station was located at the Heights School in suburban Modbury, NE of the city. The base station currently resides in the suburb of Blair Athol, at the residence of Blair & Nina, who are the custodians of both THS and UTT sites.

It has only been two years since the battery was replaced at the seismic site yet data collection had recently become sporadic and even when it was online, very noisy. Something had to be done to rectify the situation so a two pronged plan was hatched, add another solar panel and change the solar controller. Another 80W BP panel was "found" and in an attempt to further increase the solar harvest, a maximum power point tracking (MPPT) controller from Victron Energy was selected over the usual pulse width modulation type. So not only would we need to modify the existing modest aluminium stand to accomodate the additional panel, there would be some wiring configuration changes too.

June was drawing to a close, the weather was cold and getting colder. It hadn't rained for a few days so once we had the farmer's permission to proceed, things got moving. On the assumption that the existing battery was only lacking charge and still ok, the first task was to start a generator and connect a charger to it. Not only was it cold, it was quite overcast and dull, ideal conditions for solar panel work. Blair had bought along a 4m length of 6060 Aluminium angle,

As one of our 'core' sites, the continuous operation of THS is a priority. Blair along side the electronics box, the seismometer borehole is to the left of image.

THS Solar Power Upgrade

Article submitted by Peter Gray

3mm thick for upgrading the stand. Out with the hacksaw, cordless drills and all the other stuff we had dragged along with us. The existing wiring was adequate for a few more years service so with some small modifications, both panels were wired in series to provide a maximum 44.2VDC into the 75V/15A MPPT controller. We were not expecting to see much power generated that day but there was sufficient to catch the Banda Sea event some 12 minutes after we had packed up.

The End Result

The overnight battery life has been improving since the upgrade, data loss gets shorter every night and will continue to do so as the days get longer ...and the data looks much better.

Inside the electronics box, the original equipment (inc. controller) the MPPT is above the battery.

STR2 Solar Power Upgrade

Article submitted by Peter Gray

STR2: Strathalbyn, South Australia - LOCATION: 35.287S, 138.848E, 195m

The Strathalbyn seismic site was suffering similar problems to the Heights, not enough sun and ageing batteries. David and I visited recently to address both issues by ading an additional solar panel and battery. The site has been reasonably stable since the upgrade carried out in mid June.

STR2, another of our 'core' sites. The fences might slow the cows down but the sheep are not too bothered by it.

WKA Battery swap

Article submitted by Peter Gray

WKA: Willalooka, South Australia
LOCATION: 36.416S, 140.323E, 45m

Willalooka has been bordering on failure for quite a while. The battery was replaced in 2016, it was a bit of a surprise that the site was on the verge of failing on the basis that there was insufficient DC power to run everything. The 135W solar panel should have been up to the task, there is a modest installation configuration consisting of a Kinemetrics Ranger SS-1 seismometer, EchoPro recorder, Unimax 3g router /Internet AP and BP PWM Solar Controller. No fat in there. Having one of the few 4x4 vehicles available, I was asked if I could take a trip down the South-East to change the battery. Blair came along for moral support, we also planned to viist Peake on the way back, it was offline and required a reboot. On arrival, it was fairly obvious what the problem was.
The image to the right was taken at 1pm, the panel already had significant shade from a couple of trees that had become taller than anyone had expected. While I changed the battery, Blair took a rope to the top branches and simulated some storm damage. It wasn't an optimum solution but the best we could do under the circumstances. My Mitsi Triton was full of stuff to cover some probable contingencies but there wasn't a chain saw in sight.

After packing up, we dropped in to see SAA member Elaine Fraser who lives just down the road. Elaine has graciously agreed to write up an account of the establishment of the Willalooka Seismic Station when the Uni of Adelaide set it up back in the late 1970's. I look forward to presenting it to you in an edition soon.

Nature always finds a way, why are we ever surprised by it?

GPS Week Number Rollover - a more detailed report & it's impact on SAA

Article kindly submitted by Blair Lade

The GPS problem
It's quite simple actually, the GPS system was designed in the 1970's and as part of how it works, the satellites transmit the time and date not as we expect it in UT 'hours minutes seconds, day, month year ' but in GPS 'seconds since time x' and 'weeks since date y' and then expecting the GPS receivers to know when x and y were, work out the correct time and date in GPS time and then add or subtract the number of leap seconds since date y from that to arrive at the current UT (universal time) that we want.
Ok, it's only maths and if you know everything then it's relatively easy to work it out.

From the GPS Wikipedia, it's put in a slightly different way.
"As opposed to the year, month, and day format of the Gregorian calendar, the GPS date is expressed as a week number and a seconds-into-week number. The week number is transmitted as a ten-bit field in the C/A and P(Y) navigation messages, and so it becomes zero again every 1,024 weeks (19.6 years). This is known as the Week Number Roll Over issue or WNRO. GPS week zero started at 00:00:00 UTC (00:00:19 TAI) on January 6, 1980, and the week number became zero again for the first time at 23:59:47 UTC on August 21, 1999 (00:00:19 TAI on August 22, 1999). It happened the second time at 23:59:42 UTC on April 6, 2019. To determine the current Gregorian date, a GPS receiver must be provided with the approximate date (to within 3,584 days) to correctly translate the GPS date signal. To address this concern in the future the modernized GPS civil navigation (CNAV) message will use a 13-bit field that only repeats every 8,192 weeks (157 years), thus lasting until 2137 (157 years after GPS week zero)."

So, everything was fine for the first 19.6 years (1st epoch) which ended on the Aug 21 1999. All we had to do for the 2nd epoch was to start from the end of the 1st epoch (23:59:47 UTC on August 21, 1999) and for the 3rd epoch, start from 23:59:42 UTC on April 6, 2019.

GPS Block IIR-M satellite - it's all good up here (not our problem)

Well sort of.
The problem arises when an old GPS unit, that worked fine in 2nd epoch is expected (by us the user) to work properly in 3rd epoch.
How does an old GPS know it's now in epoch 3 and not in epoch 2? The simple answer is 'It doesn't'! It gets the date wrong by 19.6 years and that's where the start of the problem(s) lie.

It gets worse…
Manufacturers of GPS units realised that this could happen and things were done to mitigate the space segment WNRO issue. Each GPS unit has a 'built' date (actually it's the date when the GPS receiver's micro code is compiled) and that's taken into account in the calculations within the GPS, so instead of the GPS 'rolling over' at the end of the satellite's epoch, the receivers 'roll over' 19.6 years after their 'rom date'.

GPS Week Number Rollover - a more detailed report & it's impact on SAA

This simple method extends the usefulness of the GPS receivers for the manufacturers.

i.e. a GPS built a year before the satellite WNRO, 'knows' that it was built a year before, and that extends its usability from 1 year (to the satellites next WNRO) by 19.6 years and that date then become the GPS's WNRO. After that (i.e. 1 year before the satellites 2nd WNRO) the GPS receiver has its own WNRO issue.)

But we, the end user (usually) doesn't know what that date is so we actually have different WNRO issues, some we know about (the satellite ones occurring every 19.6 years) and some we don't (the GPS receiver ones which still occur every 19.6 years but on a different date) which are all different as that depends on who and when the GPS receiver was made. The simple answer it to just replace the GPS receiver before it suffers from its WRNO, but we don't know when that actually is and typically, neither does the supplier of the equipment that uses the GPS for timing and in some cases, neither does the manufacturer of the GPS any more.
Oh, and, that can only work IF you can get a replacement GPS that fits your bit of kit (equipment) which outputs data in the format that your piece of kit understands.

Enter the Kelunji ECHO digitizer.
The old Echo seismic recorders use a Trimble made Lassen SQ GPS, the data format the ECHO recorder needs is a serial data stream in TSIP (Trimble proprietary binary format) with the serial communication set to 4800 baud at 8 data bits, ODD parity and 1 stop bit. The actual TSIP strings produced by the Lassen SQ GPS originally installed in the Echo start with the identification of hex (0xAA) and are listed here so that I and others know for future reference.

0x41 : GPS time

0x4A : Position

0x46 : Rx Health

0x4B : machine code / status

0x6D : Mode packet

0x82 : DGPS position fix

.....

0x41 : GPS time

0x4A : Position

0x46 : Rx Health

0x4B : machine code / status

0x6D : Mode packet

0x82 : DGPS position fix

0x5F : maintenance / test

0x5C : satellite details

Trimble no longer manufactures a GPS module that does ODD parity anymore, so there is no direct replacement available from Trimble. No one else makes GPS receivers that output TSIP, the Trimble proprietary binary protocol.

Trimble do make GPS modules (Copernicus II for example) that do have the right TSIP strings, but the wrong parity. So, if we could get a 'parity changer' the Copernicus II GPS receiver might work. The TSIP strings sent from the Copernicus II GPS (if I turn off double precision mode) are listed here for reference.

The **0x5F** string is a 'new, poorly documented / unwelcome feature' and a major concern as it is a very long string and the Echo wouldn't be able to deal with it.
The **0x5C** string can be switched off.

GPS Week Number Rollover - a more detailed report & it's impact on SAA

Communicating with Julian Dortort (tech support at Trimble) suggested that I should be able to turn off the 0x5F message by sending "0x3F--03-11-00" packet (10 3F 03 11 00 10 03) (not in the documentation!) so we now have a module that provides the right strings, it's just that it can't talk to the Echo.

Keluji Echo - while obsolete, still a good seismic workhorse

This merry-go-round sounds familiar

About 4 years ago, I had a WNRO issue with my Symmetricon TS2100 NTP time server (as did thousands of people around the world who had these units mainly in astronomical observatories) which uses the TSIP protocol with ODD Partity. Again, Trimble no longer made a GPS receiver that supported that serial format. Information from within the 'TimeNuts community' (these are people who play around with high accuracy timing systems) revealed there was a company in France, Heol Designs, who wrote some software and developed a mechanism to make an existing modern GPS receiver have the correct serial protocol to fix the issue with the Symmetricon time servers. I 'fixed' my TS2100 with one of their modules (as did many other people) and we were all spared the expense of replacing our NTP time servers (typically around US$10k-15k) for the cost of one of their modules (~US$400).

I contacted Olivier DeScroubes, whom I had dealt with before at Heol Designs and discussed the possibility of developing a replacement for our Echo recorders. After about 5 weeks of effort with Adam Pascale from ES&S and Olivier, we have been able to sort out what is required (all the right serial strings and communication protocols) and Olivier has come up with a replacement 'plugin' GPS receiver.

Why did it take 5 weeks? There was a fair amount of learning, some modifications to an old Echo board that Adam sent me so that I could 'see' the data strings from an old GPS modules, a lot of testing, a lot of communication with Tech support at Trimble, Adam and Olivier.

Finally, we have a solution! It's in manufacture and will be sent to us as soon as possible.

Enter the EchoPro recorders.

These suffer WNRO issues as well and it depend on which GPS modules are fitted as to what the solution is. Luckily, ES&S changed the communication protocols for the GPS signals from what they did with the Echo recorders (TSIP strings and ODD parity) to NMEA 0813 protocol and no parity and that has made it a LOT easier.

GPS Week Number Rollover - a more detailed report & it's impact on SAA

If the EchoPro recorder has a GPS module that is identified as following:

Trimble P/N: 46240-00, 46240-05, 46240-10 or 46240-15
the module will need to be replaced

Trimble P/N: 46240-20, Model Lassen SQ
most likely will need to be replaced

Trimble P/N: 46240-25, Model Lassen IQ
the module will need to be replaced

Trimble P/N: 70896-00, Model Condor C2626
may require reprogramming (most likely unless it has been done)

Trimble P/N: 63530-00, Model Copernicus II
unlikely to be fitted to the EchoPro but if so, it's probably alright.

Luckily, the Condor C2626 modules are available from several sources, Diamond Point International is probably going to be our preferred supplier for these modules. Reprogramming is not difficult but we do need a 'test rig' or evaluation board to be able to do it.

So, a pile of headaches, a lot of long nights and a bit of light at the end of the tunnel.

Garmin GPS 18x-LVC Receiver
If you are running a PSN station using one of the Webtronics digitisers, you probably have a Garmin GPS 18x-LVC connected for timing and position purposes. Please be aware that Garmin released a firmware update, Version 4.20 on March 21, 2019 to address "Fixed GPS week number rollover for devices using older hardware".

There have been some isolated instances observed where the date is incorrect, but it may only occur when the device has not been powered up for a while (cold start) or the unit has been moved a considerable distance from it's last positional "fix". This may indicate that upon a full almanac update or "factory reset", the WNRO affects the receiver.

The Garmin installation instructions are basic, a little quirky to implement and the process requires some basic, but necessary, wiring set-up to power up and reprogramme. If it all gets too hard, we have the software and stuff to carry out the upgrade. It will only cost you the return postage and some time offline or running on computer time. There is the option of using NTP or if you're really keen, make yourself an NTP Time Server.

But that's another story for another issue.

Updating firmware on a Garmin GPS 18x-LVC

Some Winter Battery Tips

Article originally published in the Ample Power Primer, submitted by Peter Gray

Winter is the season that many battery users dread and the SAA is not immune to the problem. Other pages of this edition are testimony to this. So here are a few battery tips that you may or may not be aware of.

Break in those new (and old) lead-acid batteries

Do new batteries need to be broken-in? If so, how? Are gel batteries different?

Increasing Surface Area - New batteries often present problems for users. Because the battery doesn't accept charge current readily, and voltage may sag with even small discharges, many users think that other parts of the system have failed... after all, the batteries are new!
How well a battery accepts charge or discharge current is dependent on the surface area of the plates. You may not think you can change plate surface area, but you can. When a battery is discharged, plate surfaces are etched. This etching takes place on the smooth surface of a plate that came out of a mechanical press. Surface area is gained by this etching.
With additional surface area to conduct electrical ions, current passes more readily through the battery. High rate discharges, without excessive voltage loss, are made possible. Charge current is also accepted at greater values without overheating.
Old batteries can also benefit from the break-in process. Batteries that haven't been cycle for a few months may show resistance to high rate charges. Don't throw the batteries away until you have tried to rejunvenate them with a break-in process.

How To Break-In a Battery - Just like a car engine should be used moderately during the break-in period, so should a battery. High rate discharges and charges should be avoided. The first step to the break-in process is a good charge, including a short period of overcharge. The overcharge will tend to equalize the specific gravity in all the cells.

Now that the battery is thoroughly charged, turn on enough loads to approximate a discharge of 5% of capacity. That is, for every 100 Amp-hours of capacity in your bank, discharge by 5 Amps.
Assuming that your batteries have the expected Amp-hour capacity, the break-in discharge(s) will take about 20 hours. Let the discharge continue until the battery voltage reaches 10.5 Volts.
With a now depleted battery, recharge using a current of about 10-20% of Amp-hour capacity. Avoid high rate charging during the break-in period.

How Many Break-In Cycles? - The discharge and charge process should be done at least three times, preferably five times on new batteries. Old batteries can usually be rejuvenated with one or two break-in cycles

Stubborn Gel Batteries - You tried bringing an older gel battery back to life, but the break-in process has failed. Now what? Sometimes rejuvenating a gel battery takes extraordinary measures to bring it back to life . . . like operating it upside down! This is not for the weak of heart, and you should remove and isolate the battery from the installation first and do this procedure where an accident won't have ill consequences. We'd also advise wearing eye protection when working around the battery, and minimizing time around the battery while it is charging.
CAUTION!!!! The vent caps on gel batteries are supposed to be up so that if they do vent, no active material will be expelled.
If you're going to operate the battery upside down, you must make sure that the battery doesn't gas. To prevent gassing, you must apply the correct charge voltage for the battery temperature! This means using a charger with temperature compensation. If you're positively sure that you can charge the battery properly, proceed by turning the battery completely upside down. Discharge and charge it as described earlier. If you haven't noted a significant capacity gain by the third discharge, the battery is probably too far gone to recover.

Some Winter Battery Tips

Stubborn Liquid Batteries - We don't know of any process that will recover a liquid battery which has stopped accepting high rates of charge. As a rule, liquid batteries accept charge at about half the rate of a similiar capacity gel battery, so slow charge is part of the territory to begin with. If you tried the normal break-in process for a liquid battery and it hasn't helped, it's time to breakout something you can really charge with... a credit card!

The Overnight Test - One way to evaluate battery health is to fully charge the batteries and then disconnect them so that you know there is no way they can be discharged by sneak loads. After a resting period of 24 hrs, measure the voltage across the terminals with a good digital voltmeter. If the batteries aren't holding 12.6 Volts, (12.8 for gel cells), then they are in poor health.

Capacity Testing - The best way to determine the health of a battery is a full blown capacity test. As previously mentioned, this involves charging the battery fully, and then placing a load on the battery which is about 5% of the expected capacity. We suggest a capacity test at least once a year. Typically the test would be done prior to the winter season, and most certainly before one leaves for an extended trip away. Rembember to log the capacity tests so that you can compare capacity results later.

It's your choice - Instrumentation and regulation equipment is available to take the mystery out of battery management. Techniques are available to determine battery capacity and their ultimate health. The table below offers some battery capacity/charger suggestions. The nominal loads can be made up of LED strings or other low voltage lamp combinations, rather than resistor banks. Don't forget a low voltage disconnect relay/ isolator to ensure discharge stops at 10.5V.

12V Battery Break-In Table, based on battery capacity

Amp-Hour Capacity	Charge Current	Multistage Charger (* low power mode) with temperature compensation	Discharge Current	Nominal Load
7.2	720mA	Ctek XS 0.8 or Ctek MSX 3.8 (0.8A*)	360mA	33Ω / 4.3W
15	1.5A	Victron Blue Smart 12V/4A (2A*)	750mA	16 Ω / 9.0W
28	2.8A	Victron Blue Smart 12V/10A (3A*)	1.4A	8.6Ω / 17W
38	3.8A	Ctek MSX 3.8 or Victron 12V/4A	1.9A	6.3Ω / 23W
50	5.0A	Ctek MSX 5.0 or Victron 12V/5A	2.5A	4.8Ω / 30W
65	6.5A	Ctek MSX 7.0 or Victron 12V/7A	3.25A	3.7Ω / 40W
90	9.0A	Ctek MSX 10 or Victron 12V/10A	4.5A	2.7Ω / 54W

The Ctek models are an excellent, proven product (you should have received one with your latest Mercedes-Benz).

Victron Energy has recently introduced the Blue Smart range of battery chargers with Bluetooth, allowing settability and monitoring on your smart phone.

Both are worth a look.

Some Winter Battery Tips

Breaking-in a new battery for WKA

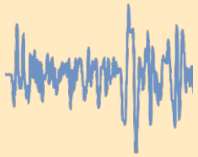
As always, the internet is full of lots of helpful articles on this subject and lots of similar ones. How to Charge Lead Acid Marine and RV Batteries in Parallel is particularly interesting. I have listed some below, rather than plagiarise and reguritate material from the internet. The links should get you to the original websites.

How to Charge Lead Acid Marine and RV Batteries in Parallel
Explains the differences between unbalanced and balanced battery configurations and why it is important that you get it right

Battery Conditioning - Battery Reconditioning
A list of useful suggestions from a 'local supplier' in Sydney, Battery Business

CTEK Skillbase Learning Resource - Charger & Battery
While CTEK still make (IMHO) the best battery chargers, Victron Energy are going to emerge as a serious player too

How to correctly connect Deep Cycle Batteries and choose the right cable sizing
A fairly comprehesive tutorial with quite a useful cable chart from Blue Seas Systems



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