A seismological interest group in South Australia

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Abstract

One year after a small, but widely felt earthquake near Adelaide in 2010, several people interested in seismology met together for an evening meal. The meeting was quite memorable. Since then there have been a few meetings each year, and the group is slowly growing.

The success of the group so far has been due to a range of factors. We have benefited from the designs, assistance, efforts and progress of other people and groups, particularly the Australian Centre for Geomechanics, which has allowed use of its website. This made it possible to submit continuous data from PSN seismographs to a central location. Some members now run their own seismographs, with more in planning. The Geological Survey of South Australia uses data from the website to substantially improve hypocentre calculations and produce occasional focal mechanisms.

Some members have skills in electronics. A calibrator for use with signal coils has been built, also a broadband seismometer, and equipment to check time. We have acquired various old seismometers, which are slowly being checked and repaired. One member is developing a cheap seismograph based on a raspberry pi. Two members have expended significant amounts to build vaults and purchase quality equipment. A few members have a strong interest in astronomy, while others have a background in teaching.

Meetings are only slightly formal, usually at a member's house. Proceedings begin with a barbeque or meal, then we have a few presentations with discussion, and possibly a demonstration. A formal association has not yet been formed.

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Introduction

A seismologist is always wanting to talk about 'his' earthquakes, and wanting more data to improve his solutions. And following an earthquake is the most likely time for people to appear and meetings to happen. Earthquakes seem to attract and collect interesting people. As part of my job, managing a small observatory network for the state government in South Australia, I have come in contact with some of these. On occasion, I have spent extra time reviewing their efforts and supplying direction and encouragement. This has generated an interested group of people, and resulted in useful developments for seismology in the state.

Early contacts

In 1989, Paul, who had a past life in PNG, built a Lehmann seismometer in his cellar, and a recorder from odd parts. A few hours later, a magnitude 8.3 occurred south of New Zealand. I heard him talking about it on the radio before I was aware that an earthquake had occurred. We met. In 2008, I heard (via the USGS) that a man in South Australia was wanting to set up a monitoring station for tsunamis! We met again and had more discussions. Soon Paul had purchased some expensive equipment, built a solid pit, and was sending valuable real-time data to our newly established government digital network.

Blair first contacted me in 2007 when DSTO (Defence Science Technology Organisation) were planning to record impacts from test firings of a scram jet. The first test was successful. He had also been involved with the running of a seismograph we had installed in an observatory at a metropolitan school. With budget cuts, we were considering closing down the station. Blair suggested that he would be interested in taking over its operation, as he had previously worked at the Warramunga seismic array.

In 2010 a small earthquake was widely felt across the Adelaide metropolitan area, causing a fair amount of consternation, resulting in many calls from the public. John rang, and after answering our intensity questions, asked if we were interested in the recording he had from his Lehmann digital seismograph. Shocked silence. We met, and apart from some discussion and direction, I put him in touch with Vic and others around the country.

Vic Dent, a retired seismologist living in Western Australia, has worked for many years to increase the number of PSN (Public Seismic Network) seismographs (PSN, 2016) around Australia. He has been attempting to improve earthquake locations in the South West Seismic Zone of Western Australia.

First meeting

One evening in June 2011, a year after the widely felt earthquake, a motley group of men met at my house. We had introductions over takeaway Chinese. This took some time, but we eventually got to the main business of the evening. Blair, using Amaseis software, showed how he had adjusted a reburbished Willmore to get exactly 1 Hz and fine tuned damping. Vic demonstrated PSN hardware and software, and the ACG (Australian Centre for Geomechanics) website. Vic and John were about to travel north the next morning to install

PSN seismographs in two country schools. My wife and daughter cleaned up in the kitchen while the rest of us talked late.

Early success

About two months later, a swarm of events hit, half way between those same two country schools. Our office mounted an aftershock survey, putting out five instruments. When the activity continued, Blair arranged for the use of an extra four recorders from DSTO, and came out to install them in his own time. With all this instrumentation and a few permanent recorders, it was possible to get accurate locations and a few focal mechanisms for small aftershocks.

In October 2011 another small, but widely felt earthquake occurred.

In November, a half day meeting of Australian Seismologists was organised to coincide with the annual AEES (Australian Society of Earthquake Engineering) conference. The local contacts came, and more than the usual number of seismologists from interstate. We packed out the small meeting room, but had a worthwhile time.

Meetings and growth

Since then we have gathered about three times a year. Meetings usually begin with a meal or barbeque. Following this two or three people present talks or start discussions. Practical demonstrations are of particular interest. I have usually presented something, often a version of a previous or planned conference paper or poster. Meetings have usually been on a weekday in the evening, but a few Saturday lunch and afternoon meetings have been popular. One early meeting was in a cold garage, checking and hands-on learning about equipment.

We have slowly grown in numbers. At each meeting, I have tried to invite a couple of other people. At our first meeting we had one person involved in teaching geology, and a few others have attended some meetings. Some are interested in astronomy. Earthquakes seem to make a good companion interest to astronomy or meteorology. We have been on the lookout for possible future seismograph sites.

Network growth

Vic Dent has generally worked through schools and community centres to expand the network of PSN instruments. In this state we have instead aimed more for private stations. As well as the original two stations in schools (one of which has now been replaced by a good broadband from ANU – AuSIS, 2106), we now have nine PSN instruments on private properties. All except one of these are sending data hourly, via home ADSL to the ACG server. Most are using refurbished Willmore seismometers.

The actual setups vary considerably, from equipment running in a garage, to well built pits, well insulated, with cabling to the house. We have two members who have built special vaults, one being quite elaborate.

Benefits for the observatory network

Feedback has been a two-way street.

We have been able to use phase times from the PSN network to significantly improve hypocentres in metropolitan and nearby hills areas. Prior to 2005, around Adelaide we were only able to locate earthquakes from three poorly positioned stations. Locations were poor, and depths were usually too inaccurate to be useful. The digital network was completed in 2007, allowing fairly good locations anywhere within 70 km of the city, as well as a significant improvement in detecting low magnitude events. The addition of private seismographs in the area has not improved the detection magnitude, but has improved the locations, and dramatically improved depth calculations.

The extra stations have also resulted in the ability to produce focal mechanisms when events are about magnitude 2 or above, near the city area. Prior to 2010 there were no focal mechanisms within 100 km of Adelaide. Now we can expect a couple a year in metro and near hills areas (Glanville, 2015). These factors open the way for progress in various areas, including hazard estimation.

The presence of stations on another network also means that on the odd occasion when our network goes down, there is another operating in the same region. In case of an event, the location may be poor, but not all is lost.

The use of the extra stations in day to day computation of hypocentres has been a spur to the group to encourage more stations, to run the existing ones properly, and make improvements. Members usually respond promptly to an email if there is any breakdown. One has contacted the local press when notable events occurred and another has spoken a couple of times at a local school.

Key components in the mix: help from outside

We are indebted to the Australian Centre for Geomechanics, at the University of Western Australia, for the ability to send data to their collecting server, and see it on their website. This has enabled Vic to foster many stations around the country.

We have benefited from the designs and creations of so many other people and groups: The PSN hardware and software, broadband seismometer design, the Lehmann seismometer, Seisgram2K, Amaseis.

We have made use of old seismometers discarded from Geoscience Australia and Australian National University, and various discarded parts from the state government network.

Key components in the mix: abilities and interests in the group

A few on us have worked in seismology for many years. This is one of the key components required to start a group.

A few of the group have skills in electronics. We have built a calibrator that sends a voltage step into a signal coil, and a time code generator. One member has built a seismograph on a Raspberry Pi. He is currently trying to reduce the power consumption. It is also always handy to be able to analyse faults on equipment.

One member has the skills to repair Willmore seismometers. A few have built Lehmann seismometers. Another has built a broadband seismometer.

In an assortment of different people, it is always advantageous to have those who are sociable and help to pull people together.

We have one person who has built a few web pages for us. The download page (Love, 2014) has helped many around the country to quickly get information from IRIS. We have two seismogram display pages, which copy our private server out to the public domain.

Scientific interests abound in the group. Four are members of the astronomical society, and one has had much connection with wind power. And as previously mentioned, some are interested in teaching.

Projects planned

One member is particularly interested in the long period of large earthquakes. As part of this, he is investigating a cheap displacement instrument, comparing it with better instruments in his vault. Four other people in the group have so far become involved in this exercise.

Another member has suggested researching what induced seismicity remains in an early mining area. After a group discussion, it was considered that we had sufficient equipment to tackle this project.

Liabilities, shortages

While we have two people working for government locating earthquakes, so far we have none outside the government locating events. This is a particular difficulty that will need addressing.

Initially we had only one person (myself) trained in geophysics. Recently another geophysicist has joined.

Most of our members are older, but this problem is no different to that faced by many other associations in Australia.

Further discussion

In 1986 when I began in seismology, there were about six universities involved in monitoring Australian earthquakes; by 2000 there were none. Government monitoring of earthquakes has had peaks and troughs also. There is definitely a place for public monitoring of earthquakes and other vibrations, to make the science more widely understood and supported, and "to keep the bastards honest".

Seismology, more than most sciences, requires open sharing of data. We do not always have that in Australia for a number of reasons. Likewise, any public monitoring needs to be as open as possible to stimulate the interest.

The most obvious nucleation point for an interest group is from within a government or university observatory. It requires that someone be outward looking, preferably as a result of management direction or strategic planning. Spare time and spare energy are needed to take advantage of opportunities. The integration of data from an observatory and public sources is a useful spur to drive both parties forward.

References

PSN, 2016. http://psn.quake.net/

AuSIS, 2016. http://ausis.edu.au/

Glanville, D.H. (compiler), Balfour N, Bathgate J, Borleis E, Dent V, Glanville DH, Hardy D, Love D, Luton G, Salmon M, Sambridge M, Sipl C, Stipcevic J, Turnbull M & Wallace A. 2015. Australian Seismological Report 2014. Record 2015/22. Geoscience Australia, Canberra. http://dx.doi.org/10.11636/Record.2015.022

Love, E. 2014. Download page: http://earthquakes.mappage.net.au/n.htm