



The Pacific Tradewinds Quarterly

The official newsletter of the Schools of the Pacific Rainfall Climate Experiment

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Earthquake Alley?

Tuesday, December 20, 2011

Norman, Oklahoma—

“Tornado Alley” is the area in the central United States known for its strong thunderstorms and tornadoes. Oklahoma, in the heart of Tornado Alley, is famous for our violent weather. The School of Meteorology here at the University of Oklahoma specializes in tornado research, and scientists and even tourists come here from around the world each Spring to go “storm chasing”. The good thing about tornadoes—if such a thing can be said—is that their damage is usually very isolated. Also, with modern weather forecasting technology we usually have a warning and time to seek shelter before a tornado strikes.

While we are accustomed to danger from above, Oklahoma is also vulnerable to danger from below in the form of earthquakes. That’s right—earthquakes. While California is the state most well-known for earthquakes, they can occur almost anywhere in the United States. Most earthquakes are too small to be felt, and can only be detected by sensitive instruments called *seismometers*. In some areas of the country, earthquakes large enough to be felt are more common. The middle of Okla-



Earthquake damage to St. Gregory’s University
AP Photo/Sue Ogrocki

homa is one of those areas, although our earthquakes are relatively small. But if you have never felt an earthquake before, even a small one is quite an experience!

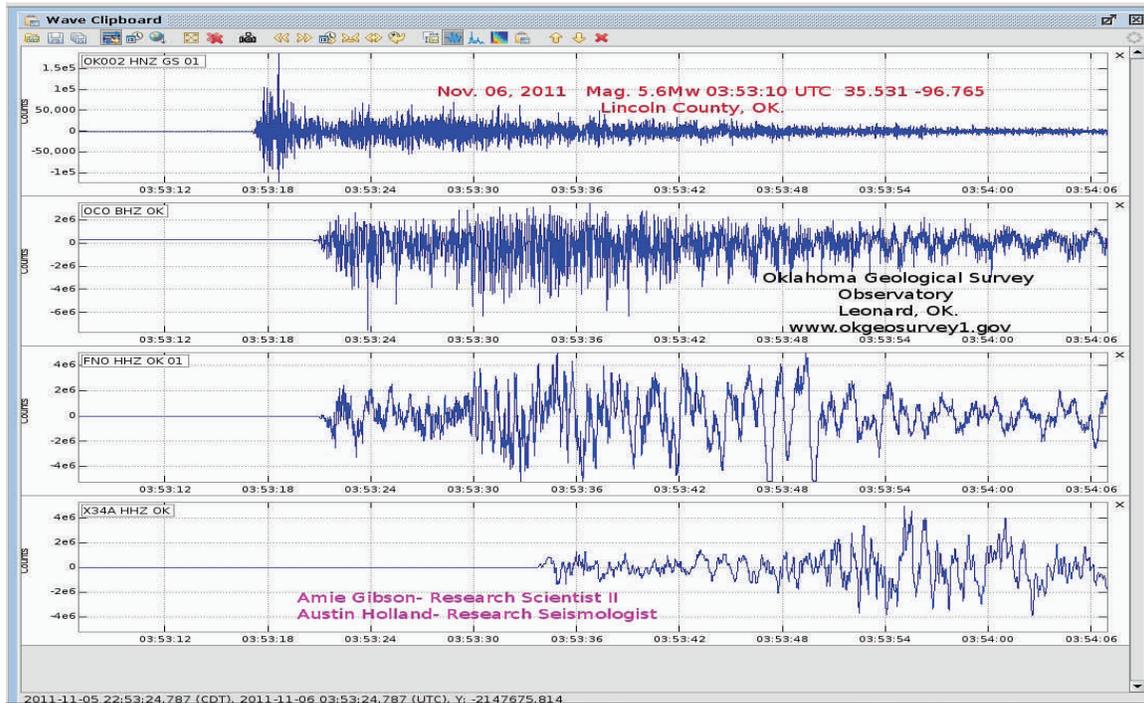
There have been a number of earthquakes large enough to be felt in Oklahoma since I have lived here, but for one reason or another I never felt them. That all changed last year on October 13 when a 4.7 M_w (magnitude) earthquake shook SPaRCE headquarters for approximately 15 seconds. The *epicenter* [the point on the surface closest to the source of the earthquake] was only 7 km away in the town of Noble. This was, at the time, the second largest earthquake ever recorded in Oklahoma. It was widely felt across the central United States, with some re-

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Earthquake Alley?



A seismograph of the main November 5th earthquake. (Oklahoma Geological Survey)

ports coming from over 1000 km away. Many people in our building were startled, but I am very interested in *seismology* [the science of earthquakes] as well as meteorology, so I was excited to be experiencing my first earthquake. Fortunately, this earthquake did little damage and caused only minor injuries.

While 2010 was a notable year in Oklahoma's earthquake history, we had no idea what 2011 would bring. That's the thing about earthquakes—you never know when one is going to strike (and you can't get out of the way like you can with a tornado). Seismologists can predict where earthquakes are more likely to occur based on geological analysis and earthquake history, but they cannot predict a specific time or location for any earthquake. So, there was no warning when another significant earthquake shook Oklahoma early in the morning on November 5 of this year. This earthquake was the same magnitude as last year's (4.7 M_w), but had a different epicenter, 75 km east-northeast of Norman. Many people, including me,

slept through this one, and were surprised to hear about it later in the day. The biggest surprise, however, was still waiting.

Many earthquakes are referred to as *foreshocks* or *aftershocks*. Foreshocks are smaller earthquakes leading up to a large earthquake in the same area, and aftershocks come after the large earthquake. Of course, there is no way to know if an earthquake is a foreshock until you know what comes after it. So, we didn't know that the early morning earthquake was just a foreshock of an even larger earthquake that would occur just before 11:00 that night. This earthquake, the largest in Oklahoma history, had a magnitude of 5.6 M_w (the previous record was 5.3 M_w). I definitely felt this earthquake, which shook my apartment for about 30 seconds. Dishes were rattling, furniture was rocking back and forth, and the floor was shifting beneath me. As I moved to a doorway it felt like trying to walk on a sailboat that's crashing through the waves. This earthquake was felt throughout Oklahoma and the rest of Tornado Alley. Minor

Earthquake Alley?



A large tornado in southwest, Oklahoma just hours before a 4.8 M_w aftershock rattled the state. (Wikipedia Commons)

structural damage was widely reported, but there were no fatalities.

An earthquake of this size will almost certainly have aftershocks large enough to be felt. Almost 48 hours after the main earthquake a 4.8 M_w aftershock occurred—the third largest earthquake in Oklahoma history. This one earthquake sequence was responsible for three of the five largest earthquakes (4.7 M_w , 4.8 M_w , and 5.6 M_w) in Oklahoma. With the October earthquake of last year, four of the five largest earthquakes have occurred in less than 13 months. Maybe we should call it “Earthquake Alley”? Some have speculated that the number of earthquakes is increasing globally, but seismologists say this is not so. There may be a burst of earthquake activity in a specific region from time to time, but the long-term global earthquake pattern is steady.

Just how big were the Oklahoma earthquakes, anyway? I’ve been talking about earthquake *magnitude*, which is the number commonly used to express an earthquake’s size. A magnitude scale for earthquakes was first created by seismologist Charles Richter. While many people still refer to the *Richter scale*, this is no longer used in practice. Seismologists now use one of several modern magnitude scales, with the *moment magnitude* (abbreviated M_w) being the most common. The moment magnitude is a measure of the energy released by an earthquake. This energy creates waves inside

the earth itself, which is what we feel during the earthquake—picture the waves that form when a stone is dropped into a pool of water.

Because the smallest earthquakes are really small compared to the largest, all magnitude scales are *logarithmic*; this means that units on the scale do not increase in a linear fashion. Earthquakes get 1000 times larger for every two whole steps you move up the scale, so a 6.0 M_w earthquake releases 1000 times more energy than a 4.0 M_w earthquake. The devastating 9.0 M_w earthquake off the coast of Japan in March was 125,000 times larger than the 5.6 M_w Oklahoma earthquake. Many Pacific Islanders live in areas prone to volcanic and *tectonic* [the movement of the individual slabs or *plates* that make up the earth’s crust] activity, and are familiar with large and sometimes devastating earthquakes. Earthquakes of magnitude 6 M_w to 7 M_w (4 to 100 times larger than the Oklahoma earthquake) are common in the region. Pacific Islanders also have to worry about the threat of tsunamis, which can be more devastating than the earthquake that caused them.

But don’t discount our “little” Oklahoma earthquakes. Earlier, I pointed out that Spring is the most active time for tornadoes, but in Oklahoma we can have tornadoes any time of year. As the 4.8 M_w aftershock was occurring on November 7, a line of severe thunderstorms and possible tornadoes was moving into the area. These storms had produced damaging tornadoes 120 km southwest of Norman earlier that day. When the first *P-waves* [the fastest moving earthquake waves, similar to sound waves] from the aftershock arrived, I wasn’t sure if the loud noise and rumbling was from another earthquake or thunder from the storms—or maybe both. Many other places have larger earthquakes than Oklahoma, but they don’t have worry about the dreaded “quakenado”!

Article by: Mike Klatt

Mike Klatt is a contributing editor to the *Pacific Tradewinds Quarterly*.

Israel to Build Hydro-Electric Dam in PNG

Project to bring Israel and PNG closer together.

Monday, November 14, 2011

Port Moresby, Papua New Guinea—The people of Hela and the Israelis will work in partnership to develop a major hydro-electricity project, to cost PGK300 million or around US\$136.9 million, using the mighty Hewaii Falls of the Tagali River in Tari.

Southern Highlands Governor Anderson Agiru announced this during an awareness visit on Tuesday to the Hapono and Mapana villages near the Hewaii Falls in the Hayapuga Local Level Government (LLG) area in Tari District.

Governor Agiru said he would lead a delegation to Jerusalem, Israel on Christmas Eve to sign the agreement between the people of Israel and Hela. This announcement was met with the applause of a huge crowd that had gathered for the occasion. Governor Agiru said the Hewaii Falls hydro plant would be constructed over a period of six years and would provide power just like the Yonki hydro plant in the Eastern Highlands Province. Governor Agiru said landowners would also have 'equity' in this hydro-electricity project just like the landowners of the hydro carbon industries in the multi-billion kina PNG LNG project like Hides PDL1, Hides 4 PDL 7, Angore, Juha, and Komo LNG International Airport. He said the PNG LNG project has a lifespan of 30 years, but the Hewaii Falls hydro project would be everlasting and is expected to bring in more benefits and developments to the landowners now and in the future. Governor Agiru, who was accompanied by engineers, investors, and officials from the Israeli Government and PNG's Mineral Resources Authority (MRA), said the pre-feasibility study work on the hydro project would start this week including identification of possible construction site before actual design and construction begins.



Hydro-Electric Dam in Papua New Guinea
Image from: Spasifikmag.com

He said as this is a project of huge magnitude, it would take time. He has urged his people for patience as they embrace this huge development coming into their area which is also situated a few kilometres away from the Nogoli, Kobalu, Hides PDL 1, and Angore hydro carbon project areas. Governor Agiru urged his people to look after the engineers and experts who would come and develop this hydro-electricity project. The Governor further added that with this major hydro-electricity project in Hela, he has created a "bridge and an everlasting relationship" between his Hela people and people of Israel, the "Biblical Promised Land". He said apart from the hydro-project at Hewaii Falls, Israeli food technologists and investors have also signed agreements with the provincial government to develop three major agro-industrial centers (AIC) in the province at Hulia in Tari, Koroba and Tente in Mendi. Governor Agiru said with these AIC and factories, food, cash crops, vegetables, animals, livestock, poultry and all agricultural produce would be produced, processed and packaged

for both commercial and domestic consumption. He said AIC would involve the development of barren and waste land in the province into plantations like the huge Hayapuga swamp in Tari and others while there will also be arrangement with landowners to work their own land and grow products and animal husbandry to supply to the AIC as a food security project.

From: <http://www.pidp.org/pireport/2011/November/11-14-10.htm>

PNG Post-Courier:

<http://www.postcourier.com.pg/>

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Tonga to Build \$12 Million Solar Plant

Funding Provided by New Zealand

Sunday, November 13, 2011

Nukualofa, Tonga – The construction of a 20 million pa'anga (US\$11.8 million) Solar Farm on Tongatapu began with an official groundbreaking ceremony at the Popua Power Station on Thursday, the 10th of November.

When the Popua Solar Farm is completed and goes into full operation in July 2012, Tonga Power Ltd. expects it to generate 1,880 megawatt hours of electricity per annum. This is equal to approximately 4 percent of Tongatapu's total electricity demand.

The Solar Farm is a step toward the Tonga Government's target, set in its Energy Roadmap 2010-20, to produce 50 percent of its electricity from renewable sources.

The Acting New Zealand High Commissioner to Tonga, Mr Dominic Walton-France, said that the New Zealand government fully supported Tonga's Energy Road Map, and it had allocated \$12 million pa'anga for the construction of the Popua Solar Farm, and another \$8 million pa'anga for the replacement of power lines and power poles, to improve the distribution of electricity throughout Tongatapu. The New Zealand government allocated \$20 million pa'anga toward Tonga's Renewable Energy Roadmap because it recognized the



Solar Panels From: Office Commons

high price of electricity in Tonga, and the importance of electricity to the everyday lives of the people and businesses. The construction was to start immediately following the ground breaking ceremony, reported Mr. France.

The Popua Solar Power Plant will be constructed by Meridian Energy, a leading New Zealand developer in renewable energy projects. Carl Sanft, the Chairman of the Board of Directors of Tonga Power Ltd., said that following the completion of the Popua Solar Power Plant next July, Tonga Power will pay Meridian an annual fee of about \$20,000 for the maintenance of the farm for the next five years. After that Tonga Power Ltd. takes over the running of the farm. The life span of the 5,760 photovoltaic solar panels that will be installed at the farm is 35 to 40 years. He said that a similar solar plant is also planned for Vava'u.

The Minister for Public Enterprises, Hon. Clive Edwards, told the gathering that the Government was also pursuing other avenues to bring down the cost of electricity, and that by early in the New Year it would announce a project to cut down on the price of imported fuel. The minister did not go into details, but government made a statement at the closure of parliament last month, that Tonga is planning to establish a tank farm [fuel reservoir], so that it could store fuel in bulk, and oil tankers could come directly from Singapore to Tonga, instead of Tonga having to get its fuel via Fiji.

From: <http://www.pidp.org/pireport/2011/November/11-15-11.htm>

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www.matangitonga.to

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Contribute to the Newsletter!

Put Your Story in the SPaRCE Newsletter!

In order to get to know our schools and participants a bit better, please send us items to be published in the SPaRCE newsletter.

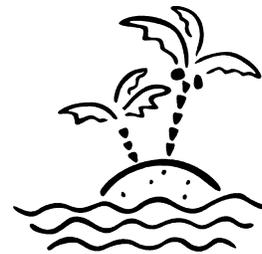
Here is a list of ideas:

- Accounts of extreme weather events
- School history
- Pictures of students taking measurements
- Activities using SPaRCE data
- Songs or poems about weather
- Any other interesting facts about your school or culture.

Do You Have Questions?

We Want To Answer Them!

If you or your students have any questions relating to science please send them to us here at SPaRCE. Once we receive a question we will publish the question and an answer in the next newsletter.



Brain Teasers

Sudoku

Complete the grid such that every row, every column, and the nine 3x3 blocks contain the digits from 1 to 9.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 7 | 5 | | | | 3 | 2 | |
| 9 | | | | 5 | | | | 8 |
| 4 | | | 8 | | 9 | | | 5 |
| | | 4 | | 8 | | 2 | | |
| | 9 | | 2 | | 3 | | 8 | |
| | | 8 | | 9 | | 6 | | |
| 5 | | | 9 | | 7 | | | 1 |
| 1 | | | | 2 | | | | 6 |
| | 4 | 3 | | | | 9 | 5 | |

Puzzlers



1. Name three consecutive days without using the words: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, or Sunday.
2. If you are in a dark room with a candle, a wood stove, and a gas lamp. You only have one match, so what do you light first?

Look for answers in the next newsletter!

Previous newsletter puzzle answers:

Sudoku

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8 | 7 | 1 | 4 | 6 | 5 | 3 | 2 | 9 |
| 3 | 4 | 5 | 2 | 1 | 9 | 7 | 8 | 6 |
| 6 | 2 | 9 | 7 | 3 | 8 | 5 | 4 | 1 |
| 4 | 1 | 6 | 3 | 9 | 2 | 8 | 7 | 5 |
| 2 | 8 | 3 | 6 | 5 | 7 | 1 | 9 | 4 |
| 5 | 9 | 7 | 8 | 4 | 1 | 6 | 3 | 2 |
| 9 | 3 | 2 | 1 | 7 | 6 | 4 | 5 | 8 |
| 7 | 6 | 8 | 5 | 2 | 4 | 9 | 1 | 3 |
| 1 | 5 | 4 | 9 | 8 | 3 | 2 | 6 | 7 |

Math Quiz

1. In one hour, Fred eats 27 chocolates, Alice eats 12, and Kelly eats 21. A Total of 60 chocolates. Therefore 120 Chocolates would take $120 / 60 = 2$ hours.
2. The answer is: 3211000

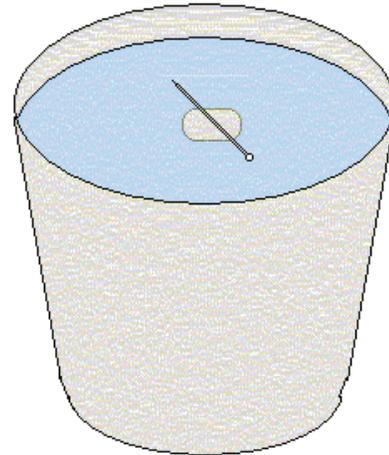
Puzzles devised by © Kevin Stone
www.brainbashers.com

Classroom Science Focus

Sewing Needle Compass

Materials Needed:

- ** A thin, lightweight sewing needle.
- ** A strong magnet, such as a refrigerator magnet.
- ** A piece of paper.
- ** A glass of water.



Procedure:

Step 1: Place a very small piece of flat paper on the water in the glass.

Step 2: Balance the needle on the piece of paper while the paper is floating in the water.

Step 3: Remove the needle from the paper and water, and stroke the needle with the magnet. Make certain that **all** strokes go in the **same direction**.

Step 4: Now place the needle back onto the piece of paper floating in the water. The needle should now always spin to point north.

WHAT IS HAPPENING?

The metal crystals in the compass are randomly aligned before you stroke it with the magnet. When you do this, the crystals become aligned and the aligned crystals generate a magnetic field. The chemistry of why this happens is very complex.

The needle is able to move to align its magnetic field with the earth's magnetic field due to the low friction offered by the paper on the water.

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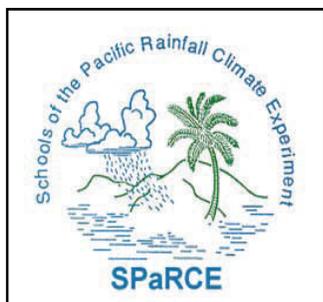
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Visit us on the web!

<http://sparce.evac.ou.edu/>



ENSO Discussion

Issued by The Climate Prediction Center/NCEP 8 December 2011

Synopsis: La Niña is to continue during the Northern Hemisphere winter 2011/12.

During November 2011, below-average sea surface temperatures (SST) associated with La Niña conditions continued across the eastern and central equatorial Pacific Ocean. The recent weekly SST indices in the Niño-3.4 and Niño-3 regions maintained levels near -1.0°C , indicative of weak to moderate La Niña. The oceanic heat content (average temperature in the upper 300 m of the ocean) weakened slightly, but still indicates a large area of below-average temperatures at depth in the eastern Pacific. Also reflecting La Niña, the atmospheric circulation over the global tropics featured anomalous low-level easterly and upper-level westerly winds in the central and west-central Pacific. Averaged over the month, convection was suppressed near and just west of the Date Line and enhanced over northern Australia and parts of Indonesia. Collectively, these oceanic and atmospheric patterns are consistent with the continuation of La Niña conditions.

A majority of the models predict a weak or moderate strength La Niña to continue through the Northern Hemisphere winter and then gradually weaken after peaking during the December – January period. The models are roughly split between those that predict La Niña to remain weak (3-month average in the Niño-3.4 region between -0.5 and -0.9°C) and those that predict a stronger episode. Over the last half-century, La Niña events that were preceded by ENSO-neutral conditions during the Northern Hemisphere summer (May-August) were less likely to attain strong amplitude (stronger than -1.5°C) the following winter. This observation, in combination with the model forecasts, favors a weak-to-moderate strength La Niña during the Northern Hemisphere winter, likely weakening with the onset of northern spring.

This discussion is a consolidated effort of the National Oceanic and Atmospheric Administration (NOAA), NOAA's National Weather Service, and their funded institutions. Oceanic and atmospheric conditions are updated weekly on the Climate Prediction Center web site ([El Niño/La Niña Current Conditions and Expert Discussions](#)). Forecasts for the evolution of El Niño/La Niña are updated monthly in the [Forecast Forum](#) section of CPC's Climate Diagnostics Bulletin. The next ENSO Diagnostics Discussion is scheduled for 5 January 2012. To receive an e-mail notification when the monthly ENSO Diagnostic Discussions are released, please send an e-mail message to: ncep.list.ens0-update@noaa.gov.