# Natural Radio

*News, Comments and Letters About Natural Radio*

**July 2008**



The summer solstice arrived this weekend. Before finishing this article I decided to sit out on the deck and watch the show from the recently emerged fireflies as the summer solstice twilight faded off into the far north sky. Since my studio & office is windowless and below ground (which makes for a great studio) I take every opportunity in summer to be outside. We usually eat supper out on the deck and I typically remain outside until after dark, assuming I can deal with the mosquitoes. The first appearance of fireflies is always welcome as it signals the beginning of summer and brings back many wonderful childhood memories.

Sadly, because of television, air-conditioning and our over-stimulated media culture, many people miss out on these simple pleasures of life and lose almost all connection with the natural cycles and rhythms that surround us. Many are conditioned to respond only to the sensational, and the subtle things of life totally pass them by.

A few weeks ago we had several days without sunspots on the surface of the sun -- not an unusual occurrence for the beginning of the solar cycle. The news media picked up on it and had us heading into another ice age. They found an 'expert' who expected this cycle to be very inactive and of course predicted we were heading into another Maunder Minimum. I suppose this type of reporting played very well as it provided a counterpoint to the talk of global warming.

Of course it was the same news media that not too long ago hyped sensational predictions of the disasters that will be caused by the next solar cycle which was predicted to be one of the largest on record. I loved listening to *Coast to Coast AM* with George Noory during the waning days of the last solar cycle where every M-class flare or greater was billed as a massive solar explosion of historical proportions.

It seems like the news media are so obsessed with market share that they will sensationalize any minor event just to grab a few more viewers or listeners. Even the Discovery Channel and other science shows look more like *Survivor* than they do like an educational program. It's not that science programs shouldn't be interesting and engaging, but do we really need to pander to the *Survivor* and *Lost* mentality?

I can't wait for the media circus that will surround this year's elections. It should be an interesting fall.

***Earthquake Precursors –*** Last year, I joined the American Geophysical Union (AGU) and as part of the deal receive *EOS*, The Newspaper of the Earth and Space Sciences. This is a weekly publication of about eight pages or so that highlights some of the important research that AGU members are working on. Many of the articles are scholarly and cover fields where I barely understand the vocabulary, but I usually scan through it quickly to see if there is anything that relates to Natural Radio. A couple of

weeks ago I found an article about ULF fields and large earthquakes. So, I delved into the field a little further and that's the subject of this month's column.

One of the longtime hopes and subject of research of many involved in Natural Radio has been that we would find some type of VLF, ELF or ULF signals that are generated as a precursor to earthquakes. If we could reliably identify and monitor these signals, we might have some advance warning of an impending earthquake which could help save lives and minimize damage. It would be important that these predictions be highly accurate as too many "false alarms" would render future warnings useless.

Occasionally, in the VLF_Group discussions, I will see reports of possible precursor signals when an earthquake happens, or conversely someone may note the absence of any unusual signals before an earthquake. Renato Romero resides in an earthquake prone area in northern Italy and has done some ULF & ELF observations, as have other amateur researchers living in earthquake prone locations. They are documented on Renato's site at www.vlf.it. But the evidence for EEP (Electric Earthquake Precursor) signals remains largely anecdotal.

According to the EOS Forum article "Ultralow-Frequency Magnetic fields Preceding Large Earthquakes" by Antony C. Fraser-Smith, (Departments of Electrical Engineering and Geophysics, Stanford University, Stanford, Calif.), one of the first measurements of a magnetic field disturbance associated with a large earthquake occurred before the Great Alaska Earthquake (M9.2) of March 27, 1964. In what Fraser-Smith calls "a surprisingly rarely cited paper", G.W. Moore reported "the occurrence of strong ultralow-frequency (ULF;<10 hz.) magnetic disturbances at Kodiak, Alaska, in the 1-2 hours before the earthquake." (1964, *Nature*, 203, 508-509, "Magnetic disturbances preceding the 1964 Alaska earthquake") Fraser-Smith goes on to describe four other similar observations by four different groups in the early 1990s of ULF magnetic field fluctuations before other large (Magnitude of 7 or greater) earthquakes. This research has convinced him that there is sufficient evidence to recognize the existence of significant ULF magnetic field variations before large earthquakes.

In another paper published in 2001, two authors reviewed the current theories and studies on EEP signals and the methods that might generate them. "A critical review of Electric Earthquake Precursors", by Andreas Tzanis (Department of Geophysics and Geothermy, Athens, Greece) and Filippos Vallianatos (Technological Educational Institute of Crete, Chania Branch, Chania, Greece), was published in Annali Di Geofisica, Vol. 44, No. 2, April, 2001. This paper is available over the Internet and is contained in a couple of .pdf files. It is well worth the read if you want a good overview of the research done on EEP prior to 2001, as well as a very good list of references.

I found several things interesting in this paper. The first was that the generation of transient electrical signals before rupture in both wet and dry rock specimens has been demonstrated in several laboratory experiments. There are a variety of theories as to how these transients are generated, piezoelectricity being one, but not the leading one.

What is not known is how these lab experiments will scale up in real-world conditions to produce observable signals.

This leads to the problem that since we don't have a good theory of how the signals are generated, we really don't know when we have detected an earthquake precursor signal. Most candidate signals are identified by coincidence. In other words, "I recorded a ULF signal I can't identify, and the next day there was an earthquake. Could this be an EEP?" A variety of methods, often conflicting, were used to try to explain the observations and statistical methods were used to try to eliminate observations that might have shown up "by chance". This created a lot of debate, but no clear answers. By the mid 1990's, the actual existence of EEP was being debated.

Another interesting item was the strange fact that most of the cited research done in the 90's measured only the electrical field in spite of the fact that earlier research noted magnetic field variations. The authors suggest that in the future, more broadband measurements should be made and that magnetic fields be measured as well as electrical.

By the late 1990's, better models for the generation of EEP were being constructed, and observational techniques were improving and as of 2001 when their paper was written the authors felt that we were on the right track, but definitely at the very beginning of the process of understanding EEP.

I get the impression that in the seven years between this paper and Fraser-Smith's article in *EOS*, not a lot has happened. While hopeful of future progress, Fraser-Smith's concern is that there is no federal program to fund the needed research and data collection to better understand this phenomenon. And as stated by Tzanis and Vallianatos, one of the major research needs is a larger and better data set of observations.

At this early stage of the research process, since we don't quite know what signals we are looking for and exactly what frequency bands to look in, a very large bank of observations that span the entire ELF and ULF range will be needed to produce significant results.

Fraser-Smith's concern goes beyond EEP. He states, "There is even more significant loss for the Earth sciences: Given that the earthquake measurements suggest that ULF magnetic signals can emerge from within the Earth under certain circumstances, there is a possibility that ULF magnetic signals may be emerging from the Earth from more general processes than those involving earthquakes and that their measurement could provide new information about these processes and about the interior of the Earth."

So it appears that Natural Radio is on the cutting edge of potential new discoveries. Let's hope that the research and measurements of some of the amateur observers will add to the data bank that will eventually lead to the prediction of earthquakes. We also hope that *The Lowdown*, INSPIRE and member websites will inspire the next generation of geomagnetic and Space Weather scientists.