Natural Radio

News, Comments and Letters About Natural Radio

April 2005

Winter refuses to relinquish its grip on Northern Illinois even though it is the first day of Spring. Fortunately, we traveled to Missouri last weekend to celebrate my youngest son's 21st birthday and were able to get a little spring preview as the daffodils and forsythia were already bursting into bloom down there.

Spring also brings daylight savings time, making sunrise an hour later. Take advantage of this in these early April days as you won't have to get up so early to catch the good listening time around sunrise.

I've read quite a few papers published recently concerning space weather topics of interest to Natural Radio listeners, and have reviewed a few in this month's column. For more information on these and other developments, check out the Space Weather News at http://www.spacew.com/news/index.php or the NASA Space Weather site at http://spaceweather.com/.

Lightning Induced Electron Precipitation – Probably the biggest space weather news was that NASA research has revealed that the "Van Allen Belt slot", the relatively radiation free zone between the two Van Allen Belts is cleared of energetic electrons by whistler propagated radio waves. These waves are triggered by lightning on the earth, thousands of miles below. This new research resolves a 40 year old debate as to how this "safe zone" is maintained.

This radiation free zone is a potential location for satellites that have Middle Earth Orbits (MEOs), making them cheaper to build because they would not require the shielding and hardening that satellites which inhabit the Van Allen Belts require.

Two theories evolved into how this zone was cleared. The more prominent theory hypothesized that radio waves from space, generated by turbulence in this zone cleared it of energetic electrons. The other theory, now confirmed by this new research, proposed that the whistler mode radio waves generated by lightning swept the zone free of these energetic particles.

Electrons in the Van Allen Belts, as they travel along the magnetic field lines of the earth, bounce back and forth between places called "mirror points" that are above the polar regions. Whistler waves traveling in this zone, interact with the particles causing them to lose a little bit of energy and change direction. This lowers their mirror point. When the mirror point becomes so low that it is in the earth's atmosphere, the electrons collide with atmospheric particles and dissipate their energy. This process is called "lightning induced electron precipitation" or LEP.

Geomagnetic storms replenish the supply of electrons in the "safe zone", but they are cleared in a few days by the whistler waves. However, other research has shown that a major geomagnetic storm can temporarily make the "safe zone" hot. The Solar, Anomalous and Magnetospheric Particle Explorer (SAMPEX) satellite observed a new

belt of radiation in the "safe zone" on Oct 31, 2003. The new belt made the zone hazardous for about five weeks until whistler waves caused the electrons to precipitate into the earth's atmosphere.

Cyclic Behavior of Solar Wind Shock Fronts – Researchers at the Geofisica Espacial, Instituto Nacional de Pesquisas Espacias, San Jose dos Campos (Brazil) and colleagues at the Jet Propulsion Laboratory in California, made an interesting and potentially important discovery from data buried in statistical space weather records.

They discovered an odd, cyclic behavior of shock fronts associated with strong coronal mass ejections (CMEs). The statistics indicated that strong shock waves were more likely to occur in July and November than other months of the year, with the strongest likelihood being in November.

The effect seems to be related to cyclic variations of the solar wind which would favor shock formation in July and not November. The solar flare H-alpha index peaks in the months of July and November, but this still doesn't give an adequate explanation of the increased shocks observed in November. The scientists indicate that further study is needed.

An interesting footnote is that Dr. Gonzales, one of the researchers, found that intense geomagnetic storms occurred most frequently in July and November. He discovered this in an earlier study conducted in 2004.

Solar Wind Velocity and Storm Strength – Those of us that monitor space weather often watch the velocity of the solar wind in addition to other factors when we try to anticipate an upcoming geomagnetic storm. We know for certain that the interplanetary magnetic field (IMF) is directed southward, the storm strength is strongest. But how does the velocity of the solar wind relate to stoem intensity?

According to a new study by Dr. R.P. Kane of the Instituto Nacional de Pesquisas Espacias, San Jose dos Campos (Brazil) -- not very well. Dr. Kane studied 30 years worth of data and found that the velocity of the solar wind had no relationship to the strength of the geomagnetic storm as expressed by the Dst index. The Dst index measures the strength of the ring current that flows around the equatorial regions of the earth.

He did indicate, however, that the velocity of the solar wind was a useful factor in predicting the time of arrival of a coronal mass ejection (CME), although these calculations were only accurate to within 24 hours.

Next Solar Max – I have seen several articles predicting the next solar max may be the smallest in a hundred years. The prediction scheme, called the "Precursor Method", examines the strength of the magnetic fields in the polar regions of the sun in the years leading up to the solar minimum and using that to predict the sunspot numbers for the next cycle. These polar magnetic fields are thought to provide the "seed" magnetic flux to drive sunspot activity for the next cycle.

Two more years of data are necessary to make an accurate prediction, but initial indications are that the next solar cycle (cycle 24) will peak in 2011 with a sunspot number of only 75.

The researchers are quick to point out that some of the most intense geomagnetic storms have occurred during cycles having low sunspot numbers. In any case the next solar cycle should be a good test for many of the new computer models that have been designed to predict space weather.

Your Much Appreciated Correspondence

• **Dave Laida <laida@nystec.com>** Read your article in Jan 05 *Lowdown* on vacuum tube amps. An article on tube amps used to detect vlf atmospherics appears in the March 1960 *QST* magazine on pages 50 - 54: "Amateur V.L.F. Observation" by W. C. Johnson. Even though the Dartmouth College receiver described used a one-of-a-kind transformer to impedance match a loop antenna to the first stage, I really recommend the article to all folks looking for material on tube vlf equipment.

Also, visit www.rexresearch.com/squier/squier.htm for a fascinating article titled "George O. Squire: Tree Antennas."

I like the idea that the *Lowdown* reprints articles from past issues. My strong candidate for republishing is "E Field Receivers for Whistlers" by G. William Forgey which appeared in the May 1992 issue. Bill's MK III receiver according to Mike Mideke outperformed the famous RS-4 .

• **Henry Lee III, KB1PE <hhl3tech@bcpl.net>** Mark, here are the results of some Natural Radio spectrum listening I did while at a campground in Cottonwood, Arizona (Dead Horse Campground) on a trip there this month:

Date: 7/11/2004 (Sunday)., Time: 0400 Arizona Time (Still dark, but just getting light; Arizona does not observe DST). Weather: Clear and 70 deg, F range; mosquitos! Interference: Very low AC hum level.

Equipment: Stereo 8-track tape player amp. with FET input stage, 100-foot insulated stranded wire antenna laid out on ground (E-NE/W-SW orientation), Sony Walkman headphones. Signals: Strong sferics and tweeks (Like the background on the Michael Mideke tape), but NO whistlers, dawn chorus, hiss, etc., were noted.

This equipment seems to make a great natural radio listening setup. Currently, I use a single FET amplifier feeding both channels of the 8-track player amp., but I want to add a second FET preamp for "stereo" natural radio listening. I think it would be great to receive spatial (directional) information.

I also acquired a "Project SEPAC/INSPIRE" receiver, but it has very low gain; is this normal? (HP filter section seems to work well). That's my report for now; happy listening to all!

(Editor's Note: Henry had originally sent this correspondence last fall when I was having Email problems. He resent it, and this time it arrived with no problem.)