The INSPIRE Journal

THE INSPIRE PROJECT, INC | VOL. XVII | JULY/AUGUST 2008

Welcome to all of you on my maiden voyage as Managing Editor of the INSPIRE Journal!

You will notice some changes with this issue of *The INSPIRE Journal*. Just as The INSPIRE Project, Inc. has been broadening our mission as we continue to navigate our way through the many leadership changes that we have experienced these past few years, we are broadening the scope of the content of the Journal articles. Please continue to visit our current website for all INSPIRE news including the latest edition of *The INSPIRE Journal*.

~ Kathleen Franzen, President of The INSPIRE Project, Inc.

In This Issue

Contents

The INSPIRE Journal is a publication of The INSPIRE Project, Inc., a 501(c)(3) nonprofit educational scientific corporation. The INSPIRE Project, Inc. has both federal and tax exempt status (FEIN 95-4418628).

Letters to The INSPIRE Journal should be submitted to Kathleen Franzen, The INSPIRE Project, Inc., 518 Sixth Street SE, Washington, DC 20003 or emailed to: Kathleen@womanfriday.com

MISSION
The INSPIRE Project, Inc. is a non-profit scientific, educational corporation whose objective is to bring the excitement of observing natural and manmade radio waves in the audio region to high school students. Underlying this objective is the conviction that science and technology are the underpinnings of our modern society, and that only with an understanding of science and technology can people make correct decisions in their lives, public, professional, and private. Stimulating students to learn and understand science and technology is key to them fulfilling their potential in the best interests of our society. INSPIRE also is an innovative, unique opportunity for students to actively gather data that might be used in a basic research project.

William W. L. Taylor and William E. Pine, Founders of The INSPIRE Project, Inc.

In 2006, The INSPIRE Project Inc. mission was expanded to develop new partnerships with multiple science projects. Links to magnetospheric physics, astronomy, meteorology, and other physical sciences are being identified.

INSPIRE'S LEGACY
Dr. William (Bill) W. L. Taylor was a leader in the field of space science education and public outreach. He co-founded and was president of INSPIRE, one of the pioneering successes in NASA Sun Earth Connection Education. In July 2005, Goddard Space Flight Center honored the late William W. L. Taylor with an Excellence In Outreach Award for his accomplishments.

To Our INSPIRE Journal Readers

Kathleen Franzen, Managing Editor

“We must not ask where science and technology are taking us, but rather how we can manage science and technology so that they can help us get where we want to go." Rene Jules Dubos, 1901-1982, American-French microbiologist, environmentalist, humanist, experimental pathologist and Pulitzer Prize winner.

Dr. Dubos succinctly stated what many of us have debated. His maxim describes the diligence with which the majority of us have worked on to facilitate the incorporation of available science disciplines when continuing our education in research projects, classes’ environment or simply on a very personal level.

I have always viewed science as a serious discipline that can be richly creative and potentially filled with lots of exciting results. The very large and extremely cumbersome first prototype of INSPIRE's receiver antennae looked like it had come from outer Space. It was a contraption built out of PVC piping with some recorders attached and about 5 feet tall. Not pretty, hysterical to look at and truly amazing that it was a scientific instrument.

Our INSPIRE participants are changing. We are globetrotting around the world answering requests for INSPIRE information and filling receiver orders. When I am able to correspond with INSPIRE participants I ask them how they have heard about INSPIRE and if they are purchasing kits how will they be using the data that they gather in their work or project. Much of the data that is gathered by using the INSPIRE receiver is no longer specific to just VLF frequencies study. Artists, musicians and writers are using the sounds or INSPIRE references in their works. We are continuing to generate interest and grow as a non-profit science and technology corporation. We are looking at and planning for the contribution we can make in the future to make a difference in science, technology, engineering and math education.

We are heading into the third Dr. Bill Taylor Scholarship and Internship programs cycle. This year we have added two additional competitions. Space Camp for Educators and Robotics Camp both held in Huntsville, Alabama. More details on these Memorial Programs can be found in the article in this Journal on page nine (*see Page 4*).

Adding Memorial Programs involve fundraising activities. I truly am enjoying making presentations to possible sponsors: both Corporate and Private. I would like to ask all of you to keep INSPIRE in mind when you are meeting or talking to someone who may be a possible project partner or sponsor to our organization. I am available to speak to or make a presentation to any appropriate audience. If you or your company would like to make a tax-deductible donation to The INSPIRE Project, Inc. please see the back cover for more information.

A new INSPIRE website and URL will be launching in August. When this site is launched we will issue a press release. My goal is to have an award winning website within the next three years. I continue to have requests for assembled INSPIRE receiver's. I am hoping to be able to offer this kit option by 2009.

In the next Journal we will be reading a few notes from the Journal's Editor and Board member, Fatima Bocoum. Fatima was brought on the INSPIRE team by Dr. Taylor. She reflects project continuity and is currently rounding her first master degree in Electrical Engineering (MSEE) by a second master in Business Administration (MBA). Ms. Bocoum is also a computer genius to whom I have found myself saying, "thank you, thank you many times!”

I look forward to you reading this issue of the INSPIRE Journal. As always, if you would like to contribute articles, pictures or send observation information to the Journal, please contact INSPIRE.

Thank you for your continuing interest, work and support to INSPIRE. To say it means so much to The INSPIRE, Inc. is a grand understatement.

The INSPIRE Project, Inc. to Celebrate its 20th Anniversary in 2009

In celebration of INSPIRE’s 20th anniversary, we would like to update the INSPIRE map that was produced in the early 1990's that showed where receivers were in the US and beyond. If you have purchased an INSPIRE receiver starting in 1989, please send an email with your contact information to kathleen@womanfriday.com. As plans coalesce for this celebration, information will be available on the website.

INSPIRE Opportunities, Events & Programs

DR. WILLIAM W.L. "BILL" TAYLOR MEMORIAL SCIENCE SCHOLARSHIP COMPETITION

Application Deadline: February 16, 2009
Scholarship Awards: $5,000 per recipient

In honor of The INSPIRE Project, Inc.'s Dr. Bill Taylor, The INSPIRE Project, Inc. with its partners at the DC Space Grant Consortium, NASA/Goddard Space Flight Center and other science and technology organizations established this annual science scholarship competition. Scientifically oriented undergraduate and graduate college students and high school seniors who will be attending a DC metro area college or university in Fall 2009 are encouraged to apply.

Competition Objectives
This competition seeks to encourage students to conduct individual or group research that will focus on Space Physics, Astronomy, Meteorology, Geology and other Earth Sciences. While designing projects identify how it has a connection to INSPIRE's Very Low Frequency study of natural or manmade phenomena. Judging of research projects based on the criteria below:

- Creativity and design of the project
- Clear project goals and the methods used to accomplish those goals
- Analysis of project results and their relationship to project goals
- Clarity and quality of the project's written report
- Clarity and quality of the project's presentation (finalists only)

Complete information and application are available on the INSPIRE website.

THE INSPIRE PROJECT, INC.
SPRING 2009 ACADEMIC YEAR PAID NASA INTERNSHIP PROGRAM

Application Deadline: December 1, 2008
Internship Awards: $5,000 per recipient, plus travel stipend

With support from NASA Goddard Space Flight Center, The District of Columbia Space Grant Consortium, Aries Scientific and Woman Friday, LLC, The INSPIRE Project, Inc. in conjunction with the Dr. Bill Taylor Memorial Science Competition is proud to announce the Spring 2009 Academic Year Paid NASA Internship Program.

Internship Description
The INSPIRE Project, Inc. is sponsoring part-time, paid internships at NASA Goddard Space Flight Center for the Spring 2009 academic year – mid-January 2009 through mid-May 2009. Two (2) part-time paid internships are available.

Students will be paired with a mentor at NASA Goddard Space Flight Center. Each student will work with their mentor to design a project that they will work on throughout the duration of the internship. Internships at NASA Goddard Space Flight Center will be focused on science and engineering research.

Hours & Compensation
Interns will work approximately 15-20 hours per week, and will be paid $5,000 after successful completion of the internship. Additionally, interns will receive a $400.00 travel stipend to aid in their commute to NASA Goddard Space Flight Center.

For complete information on INSPIRE opportunities, events and programs, please visit: http://image.gsfc.nasa.gov/poetry/inspire/.
Questions? Email Kathleen Franzen at Kathleen@womanfridaycom or call 202.547.1364.

The INSPIRE Project, Inc.
SPACE ACADEMY FOR EDUCATORS SCHOLARSHIP PROGRAM

JULY 2009 NASA Marshall Flight Center, Huntsville AL
Application Deadline: February 16, 2009

The INSPIRE Project Inc. has teamed up with the NASA Marshall Space Flight Center and the U.S. Space & Rocket Center in Huntsville, AL and is offering two full scholarships to Space Academy for Educators.

Space Academy for Educators is a 5-day program offered every summer in July for teachers from around the world to come and participate in 45 hours of intensive classroom, laboratory and training time, focusing on space science and space exploration. Teachers also take part in astronaut-style training and simulations, as well as activities designed to promote life-long learning in a classroom setting. All lessons and activities link to National Science and Math Standards and are ready to use in the classroom.

Workshop topics/activities include:

- Engineering Design Challenges
- Rocket Construction
- Math Workshops
- Living and Working in Space
- Orion Spacecraft and Ares Launch Vehicles
- Space History
- Hydroponics
- Mars & the Moon

Teachers participate in two simulated Space Shuttle Missions, simulate walking on the Moon and working in the frictionless environment of space on Astronaut Simulators, and weather permitting spend an afternoon at Aviation Challenge simulating parachute landings and helicopter rescues in the water.

INSPIRE Scholarship Includes:

- Roundtrip airfare from the DC metro area
- 6 Nights lodging & meals
- Meals (Monday breakfast through Friday dinner)
- Program materials, flight suit, t-shirt and tote bag
- Transportation *to/from the airport*

For more information on the Space Academy for Educators program, visit: http://www.spacecamp.com/educators/profdev/weeklong/eduacad.php.

The INSPIRE Project, Inc.
ROBOTICS WEEKEND WORKSHOP SCHOLARSHIP PROGRAM

JULY 2009 NASA Marshall Flight Center, Huntsville AL
Application Deadline: February 16, 2009

The INSPIRE Project Inc. has teamed up with the NASA Marshall Space Flight Center and the U.S. Space & Rocket Center in Huntsville, AL and is offering two full scholarships to their Robotics Weekend Workshop in July 2009.

As part of the Education Department of the U.S. Space & Rocket Center's professional development program, the Robotics Weekend Workshop is the perfect way to learn how to incorporate Lego Mindstorm / NXT Robotics equipment into your curriculum or as an after school program. This workshop is intended for teachers with very little experience in robotics.

For more information on the professional development opportunities and other resources offered by the U.S. Space & Rocket Center, visit: http://www.spacecamp.com/educators/profdev/.

INSPIRE Scholarship Includes:

- *Roundtrip airfare from the DC metro area*
- *3 Nights lodging & meals*
- *Program materials*
- Transportation to/from the airport

INSPIRE opportunities, programs and events are made possible through the generous support of the following organizations:

An Online INSPIRE VLF-3 from Cape Coral: Lightning, Sun, Rain, Hum and TWACS

Tom Becker, July 31, 2008

From Cape Coral

After a few months of a variety of delays, on July 7th I put the audio from my INSPIRE VLF-3 receiver online. Mine is the fourth streaming VLF monitor built and operated by amateur enthusiasts (currently there are two in the UK, one active in Germany, and mine in Florida; NASA's Huntsville INSPIRE monitor audio is also available). Each of these streams is usually available continuously, and - if an adequate sferics correlation permits - pairs of streams are also presented in synchronized stereo. This permits direct comparison of two locations – even trans-Atlantic locations simultaneously – so the occasional whistler that reaches both sites, imaged in stereo, can move across the sound field, a new sonic experience.

Paul Nicholson, of Todmorden, UK, generously provides a common streaming server for this experiment, and he has written excellent Linux software that makes it possible. His Live VLF Natural Radio website can be found at http://www.abelian.org/vlf/, where the pseudo-real-time (usually delayed 10 seconds or so) VLF streams are available.

If others want to provide their VLF audio (requiring 64kbs of continuous Internet bandwidth), the software necessary to do this is free:

> For Linux users, Paul has produced a single application http://abelian.org/rxvlf, which will process VLF audio and feed an MP3 stream to his server where it is further processed and replicated to listeners.
>
> Windows users can use a small collection of tools to achieve a similar function:
>
> > "Wolf" Büscher, DL4YHF, has developed a superbly flexible audio processing application, Spectrum Lab http://freenet-homepage.de/dl4yhf/spectra1.html, which can very effectively remove hum and harmonics and further filter the audio as desired, and simultaneously make the audio visible in spectrograph form. His Audio I/O Library http://freenet-homepage.de/dl4yhf/AudioIO/index.html will pipe the processed audio data from Spectrum Lab to a suitable streaming client application, like Winamp with Oddcast.
> >
> > Winamp http://www.winamp.com/, with the Oddcast plugin http://www.oddsock.org/tools/oddcastv2_wa2/, will accept the audio data from Spectrum Lab and send it to Paul's server as an MP3 stream.

Ongoing discussions of this project are on the Yahoo VLF_Group forum http://tech.groups.yahoo.com/group/VLF_Group/.

My effort started with the purchase of a VLF-3 receiver kit. As an experienced kit builder, I found the assembly easy, the component quality very good, and the instructions adequate. With headphones attached, the radio worked at first power-up, screaming mercilessly – which was expected without its required antenna and ground. With a meter of wire as an antenna, I went outdoors and with a simple ground heard the crackling of sferics buried in lots of powerline hum. The receiver was ready – for a short while.

Lightning

I put the radio in a plastic container and pulled a cable to a convenient location to try it. The following night one of our palm trees was apparently struck by lightning and the VLF-3 was silenced. Fortunately – a tribute to the design – only a few front-end components were damaged by the indirect jolt the receiver took. I replaced them and was amazed to find the FET still worked. Mellowed some by that experience, I subsequently took my time to build a more proper housing for the radio.

I found a new "Fat 50" steel ammunition box for $10 at a gun show (also available online, of course). The ammo box is the perfect width for the VLF-3, has a levered-latch gasketed lid that seals the box well, making it suitable for Florida outdoor summer weather, and it provides plenty of room to place the VLF-3, a 12V 12AH AGM battery and some electronics or a transformer to drive a length of cable. I placed a CB antenna mount on the lid of the box and, initially, a four-foot-long fiberglass CB whip and a five-pin weather-resistant trailer light connector through a box side.

Sun

A plywood shelf that stands 2"/5cm above the box bottom holds the receiver and the battery (through a centered cutout, the battery sits on the box bottom) and provides mounting for an audio isolation transformer. There is plenty of space remaining for a container of silica gel adsorbent (I use Crystal Fresh cat litter, dried in a 265°F/130°C oven) or other small devices like a recorder and headphones if the box travels. With the battery centered, the box carries comfortably with its built-in handle on the lid. The box color helps the lid get uncomfortably warm in direct overhead sunlight; I measured 138°F/59°C one 88°F/31°C afternoon. The internal temperature was at the same time about 119°F/48°C, pretty warm. Temporarily, I've covered the lid with aluminum foil, which has reduced the temperature inside dramatically; a coat of bright white or reflective silver paint should also reduce the internal temperature.

At its current position on our seawall the receiver box is grounded via an eight-foot stainless-steel rod (actually, it is a ~6mm U-channel intended as a sliding door track replacement) in the brackish canal water that surrounds our home. I've tried single and multiple ground spikes in moist soil, which have worked well, too. In fact, if the ground is moist, simply resting the box on soil or grass will provide a sufficient ground in most instances.

Rain

The fiberglass CB antenna failed after one night of heavy rain. I discovered in its autopsy that the bottom of the fiberglass rod is adjustable, forming a variable capacitor that can tune the antenna to CB-channel resonance, and that there is no ohmic connection between the antenna and its hot mount. Why it ever worked is a mystery. The antenna is now an eight-foot stainless-steel rod, the same as the ground rod; it has served well, and it remains in place. Since it is raw metal it audibly detects rain droplets that hit it. It has been suggested that the antenna should be shielded from rain and insects, perhaps by placing it in a PVC pipe.

A week of rain also tested the weather-readiness of the box. The CB antenna mount proved not to be watertight, allowing a slow drip to enter the box, fortunately running down the inside box wall to the sump in the bottom; no electronics got directly wet. After thoroughly drying everything, I remounted the antenna mount by embedding it in 3M 4200 marine silicone sealant. That worked great – for one night. As soon as the sun warmed the box in the morning, apparently a shard of metal, cut by the mounting lock washer, shorted the hot side of the mount to the case. A few hours later, it was remounted successfully, and the box has remained dry since.

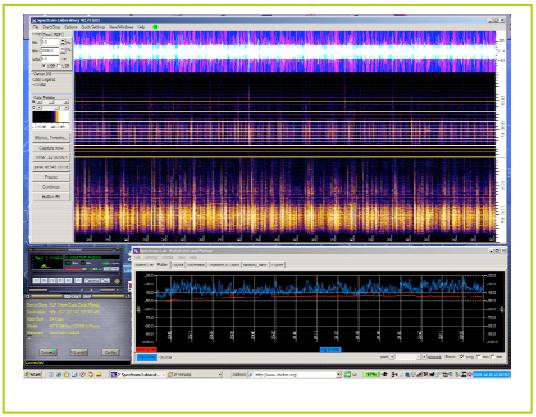
It is possible that, at least in Florida, eight feet of antenna is too much for this radio. Although I no longer use it, the LM386 output stage of the VLF-3 clips at only a moderate gain setting with common and frequent sferics levels here. Two opamp stages ahead of it, though, do not clip at the same time, so I use the low-level audio output of the VLF-3, which is taken ahead of the LM386, with its control wide open. This provides a much better dynamic range, and a lower noise floor, at the cost of higher output impedance.

The output currently feeds a transformer that isolates the receiver from the indoor equipment and balances the audio for a long cable run. I use a self-dispensing box of 1000' of four-pair CAT5 networking cable to connect the receiver to my home lab. The long cable's capacitance soaks up some audio high-end, but the receiver/transformer combination is quite capable of driving this very long audio transmission line. Indoors, an identical transformer accepts the balanced signal and provides ground-referenced audio to an IBM T30 laptop I use for processing. In normal service a laptop is not usually grounded; its power supply provides no ground continuity, so I found it necessary to connect a ground to a DB-15 video monitor output screw. Power supply switching noise significantly degrades the audio if the machine is not grounded. With the receiver and computer grounded at their respective ends, and with transformer isolation on the audio pair and no ground continuity between the receiver and computer, the cable signal-to-noise ratio exceeds 85dB. Signal peaks (strong sferics) have reached -6dBV on the cable as I have it connected, so the dynamic range of the system well suits 16-bit digital conversion, which has a 96dB dynamic range.

I intend to use center taps on the transformers to provide the operating (and battery floating) current to the box with a third-wire (another CAT5 pair), a la microphone phantom power. A first attempt at that was disappointing; the audio

suffered, I believe because the transformer impedances are too high. I'll try again with either different transformers or an active cable interface, which I expect will also restore the reduced high audio frequencies. Meanwhile, with the LM386 output amplifier switched off, battery consumption is very low so changing out the AGM battery with a fresh one only weekly is feasible. While the battery is being changed, the VLF-3's internal 9v battery powers the receiver so audio need not be interrupted.

Installing the software and configuring it was not difficult. The laptop is configured for dual-boot (Microsoft Windows XP SP2 and Ubuntu Linux), so I have some flexibility in applications. I am currently using XP for the project with the SpectrumLab/AudioIO/Winamp/Oddcast tools. Details on configuring the system can be found on the VLF_Group forum and coordination with Paul Nicholson is required, but I had my stream up in a few hours once the hardware was initially ready.

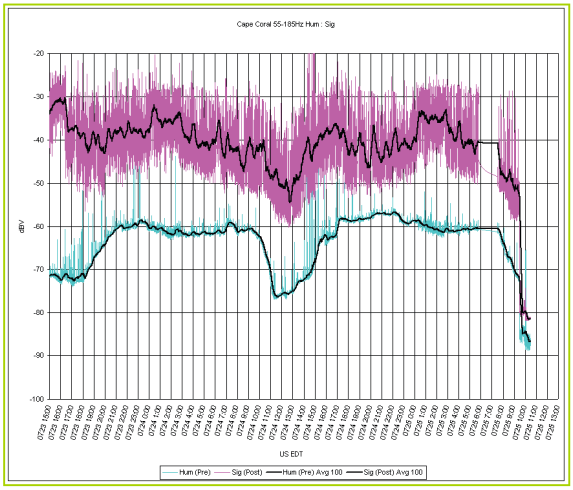


My Windows XP desktop looks like this when streaming.

Hum

Because this receiver is in a residential neighborhood, removing power line hum from the audio is mandatory. The VLF-3 antenna input signal is internally rolled off below 300Hz, which helps, and Spectrum Lab provides several types of filtering mechanisms; two are specifically provided to remove hum and its harmonics, and they do it exceedingly well. Some artifacts remain, so it is always better to start with less hum by finding a better receiver location - or selling the house and moving to the country. Finding a place with no nearby power lines and broadband Internet service is unlikely, though, so hum is a reality to be accepted. With the help of these filters, though, it is quite possible to succeed at a populated location. Spectrum Lab permits measuring separate segments of the audio.

Other man-made sounds will very likely also be heard, and some of the fun of listening comes from trying to identify the origins of these strange sounds. Ramping tones are common, perhaps from heavy motors spinning up like an elevator or lift, and industry can generate some intriguing noises that can often be easily ignored or tolerated. A new sound appeared just this morning, a ~two-second burst of apparent data at the top of each minute; I have no idea yet where that is from.



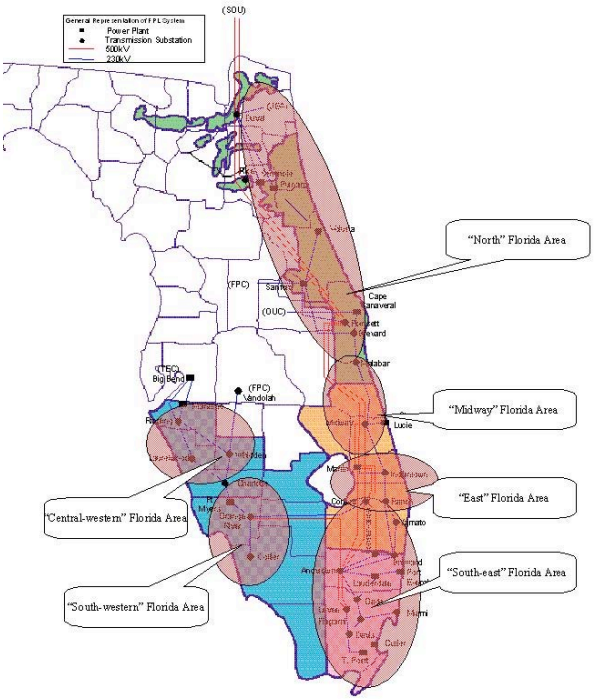
Here is a graph of VLF audio above 300Hz and the 60/180Hz hum component levels over two days, ending with a shorted and grounded cable to test the noise floor.

And TWACS

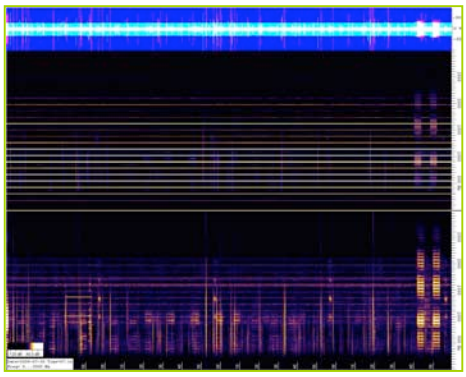
Some other sounds are not so much fun and constitute genuine interference. LORAN, of course, is one that the VLF-3 is designed to selectively minimize. Worse, at least here, I've learned that power lines are sometimes used for communications. Several methods to control switching on an electric utility network via the power lines themselves are in use, and a few systems use the power line to read meters remotely. In Florida, one such system used is Aclara's Two-Way Automatic Communications System, or TWACS. In fact, Florida Power and Light (FP&L) has the largest such system in the world, using some 800,000 TWACS transponders to control its network and read its customers' meters.

We are not served by FP&L, but their 500kV transmission lines run through our county. FP&L's network is large and TWACS is everywhere it is. Our local utility, LCEC in Fort Myers, uses TWACS for AMR, Automatic Meter Reading. The unfortunate consequence is the loudest, most annoying sound I have ever heard on any radio and it occurs every day, all too frequently. It is sufficiently annoying that I might eventually need to find a distant relative to host my VLF-3 or, again, move to the powerless-but-Internet-connected country.

Transmission Interconnection & Integration



Here is what TWACS sounds like in the worst case, my meter responding to an arranged meter-reading inquiry (turn your volume down; the response is ugly and loud): http://rightime.com/VLF/TWACS_Out_In.mp3. LCEC engineers have been very cooperative and helpful in positively identifying the TWACS interference - and they admit this is the first time they have ever heard it, conveniently from their own office desktops. It might be possible to remove TWACS with smart audio-processing code, but that will probably be a challenge. Still, there are blissful periods of TWACS-lessness here, enough to keep me listening for the elusive whistler.



This spectrogram shows VLF-3 audio before and after filtering by Spectrum Lab. 60Hz is reduced by the VLF-3, but 120Hz (and sometimes 180Hz) multiples on top of 60Hz are clearly visible in the top spectrum. The lower spectrum is after filtering, with 12dB gain, showing a motor startup and 12-second run, several one-minute data bursts, and a pair of moderate TWACS messages; lesser TWACS data is visible throughout the chart. Vertical lines are, of course, sferics.

I intend to take the receiver for two trips, one on land to determine the extent of TWACS interference, and one on water to see what 20 miles of separation at sea yields - as soon as my next project, getting the boat engine healthy, is complete. UPS arrived today with a pair of engine exhaust risers - the last parts to replace, uh, I hope - so I am close to making that trip. Details and recordings will follow.

The INSPIRE VLF-3 has done very well, and the spectacular performance of Paul's and Wolf's software is most impressive. I have not yet heard my first whistler from this installation, although tweeks, rumbles, growls and other natural flatulence are plentiful - but it is summer and the gods are noisy here during the summer; I hastily await the relative quiet of winter and the sounds revealed. As more receivers are added to this network a new perspective of VLF listening will emerge, we expect, and a better understanding of some of the dynamics of our world will unfold. *Join us.*

INSPIRE Transforming Music & Art Overseas

Since 1989, The INSPIRE Project, Inc. has provided VLF radio receiver kits to over 2,500 students and other groups internationally to make observations of signals from sources in the ionosphere at audio frequencies. In Sweden and Greece, the scientific data is being utilized in new applications – Music and the Arts.

Nature into Sound

Georgios Pagkas
Athens, Greece

The human senses are the gate in understanding the natural and significant factors in the evolution of human civilization. The taxonomy of the stimuli caused by our emotions and daily experiences represent the first samples of personal creation and dictate the evolutionary patterns of the human race. These expressions are also known as arts, including music, sculpture, poetry, dancing, painting and many more.

Georgios Pagkas *(Yorgosilion) born in Athens in September 1982 is a self-taught musician of the traditional Greek musical string instrument called bouzouki. He lives in a suburb of Athens (Ilion). Georgios is a graduate of the Technological Institute of Piraeus and has a Masters Degree in Computer Science from Kingston University. His forthcoming projects include collaborations with scientists and revolutionary artists.*

Music is a sum of frequencies that result in the stimulation of hearing through melody. The way through which every single artist expresses his emotional world on the physical one differs and is derived from his inner moral standards. The emotional touch with nature as an endless source of inspiration and action drives the composer into visualizing those very ideas and messages that will later embody with his own unique way in his work.

In the musical project called “vouloir, c’est pouvoir”, in Greek “ΒΟΥΛΕΤΑΙ ΕΣΤΙ ΔΥΝΑΤΑΙ” (where there's a will, there's a way), the leading melodies are a consequence of various experiences and emotional disposals that tangle up with natural sounds of the every day life reminding us of former moments and beautiful senses. The project also encapsulates mathematical functions turned into sound, linguistic and acoustic symbolisms that refer to physical phenomenon and procedures of the macrocosm and microcosm. One such symbolism is the acoustic imprint of very low frequencies (VLF), which derive from the various physical phenomenons (solar wind, thunderstorms etc). The characteristics of those frequencies and their spectral analysis comprise an object of research among scientists. More than a thousand thunderstorms occurring on Earth simultaneously at any time and their tremendous electromagnetic energy is audible in the 0-10kHz frequency range. Their use in this musical project though, aims at the description of the same physical phenomenon from another point of view.

In general, those frequencies compose earth’s natural identity, describing natural activities, on the moving “sphere” called Earth inside this very universe. Just like genetic code encapsulates encrypted information valuable for our safe presence on a spaceship in the same way that Earth’s perpetual mechanisms maintain a sense of balance that create ideal conditions for progress and development.

I am currently on tour in Greek islands to collect sounds of nature in order to include them into my latest project. I hope to complete the recordings (both from nature and the ionosphere) by the end of August, and submit the finished project for the upcoming journal. I am also planning to include VLF sounds recordings from Olympus Mountain at 2,918m altitude (no interference there) and high-energy areas such as ancient Greek sanctuaries.

For more information about Georgios Pagkas’ music, visit his website: www.yorgosilion.com.

Natural Phenomena in Art

Lena Bergendahl
Student at the Royal University College of Fine Arts
Stockholm, Sweden

For many years I have had a great interest in natural phenomena and the structures of nature. That is also where many of my works of art, mainly based on video and sound, originate from. I find it interesting to put natural science in a different context. An important aspect of my work, which sometimes is recreations of earlier research, is to avoid working with specific goals or hypothesis. My intention is rather to work with guidelines that are open for a change, and create a different focus. My way of procedure often includes investigating and visualizing interferences to displace or increase natural courses of events, transformations and processes.

In my work of art I have approached natural phenomena in different ways. In my project “Nimbostratus”, which is a two channel video piece, I investigate and recreate cloud structures by pouring different fluids, for example milk and cream into water. I have also worked a lot with an underwater camera where I, among others, have captured the movements of a swimming horse. I find it interesting to see how the weightlessness that is experienced under water can be used to stage new worlds not possible to achieve above the water surface. I have also done a study of different types of clouds, by painting them, above all Cumulonimbus Clouds, i.e. thunderclouds and Lenticular clouds.

When reading about the qualities of natural crystals I learned about crystal radios and built one of my own, a construction which is very low-tech. The radio transforms the radio waves into audible sound without any need for electric supplies. This work brought me into the world of radio waves and electromagnetic waves generated by lightning.

Nimbostratus, a two channel video installation, 2007

In my ongoing project “Stormtracker”, I have done field recordings with an Inspire VLF-3 receiver. The recordings were carried out in the nature reserve Alvaret at the Swedish Island of Öland. Alvaret is an area of 260 square kilometers of flat ground, totally free from electric disturbances and perfect for VLF-listening. The recordings so far mainly consist of Tweeks, and a few haphazard Whistlers.

In this highly technological age where we are constantly surrounded by electronic devices, and most of us consider it part of our environment since we are so used to having them around, the thought of radio signals which has our planet as a source instead of being emitted by electronic devices may be mind-bending. Similar to the way that we are connected in real-time to what is happening on our planet through the Internet, radio communications, telephones and so on, being able to listen “live” to the signals with the VLF receiver gives a feeling of somehow being connected to space.

The sounds of radio waves generated by lightning are also very different from the “normal” audible sounds of lightning. People seem to think that they almost can feel that they originate from a very distant place, like transmissions from another world. I find it interesting to see how paranormal phenomena and experiences become a projection surface for utopias or dystopias. And space seems to be perfect for this matter.

Field recording with VLF-receiver, 2008

For more information about Lena Bergendahl’s work, email her at: lena.bergendahl@stud.kkh.se or visit her website: www.lenabergendahl.se.

INSPIRE NASA Internship at Goddard Space Flight Center

David Piet is in the Masters Degree in Applied Mathematics & Statistics program at Georgetown University. He received a Bachelor of Science in Applied Mathematics from the University of Illinois (Champaign-Urbana).

David Piet

In 2007, The INSPIRE Project introduced the NASA Internship Program. David Piet was the recipient of the first award. Below is his account of the internship.

For as long as I can remember, I have always wanted to work for NASA. To me, it meant exploring places that only few have seen and doing so with cutting edge science and the finest resources available. As I got older, I began to view it as a way to contribute to the greater cause. I can say with experience now that after touring and working here at Goddard Space Flight Center, NASA does not disappoint.

When one hears mention of NASA, the first thing that comes to mind is probably the manned shuttle missions, followed perhaps by Mars rovers or breathtaking images sent down from Hubble. It is easy to overlook their significant contributions to the study of Earth in all its complexity. I know I did. So when I found myself working on a project whose focus was right here in our own cosmic backyard, I was slightly surprised. I was assigned to the Microwave Instrument Technology Branch. The mission of this particular group is to design, build and test radars and/or radiometers that operate using microwave frequencies. These instruments have a wide variety of implementations that mostly revolve around water detection. My time has been spent working on one instrument in particular whose objectives, among other things, are to survey glacial and snowcap melting rates, soil moisture, effects of seasonal weather in dense forest or jungle areas, and coastal salt/fresh water tracking. With the current widespread growing concerns about the state of the global environment, I had no doubt satisfied my own objective in contributing the greater cause.

There is one very interesting dynamic about the interactions here at Goddard. The workers fall into one of two categories, they are either a scientist or an engineer. The instrument that I have been working with has the aforementioned scientific goals but my efforts have been on the engineering side. In particular, I have been working on the post processing of the data. Essentially, once the instrument is taken out and collects data, it gets transformed into a presentable, product by way of the computer programs that I have written. My goal is to manipulate and present the data in such way that is efficient while offering it up in the most accurate and easy to understand form. Once that happens, the scientists will take over and use it gather data on regions of interest and interpret that data.

Before the radar gets put to use, it has to undergo a series of tests to verify that it is working properly and accurately performing the tasks it has been designed to do. Currently there are two major tests on the horizon. The first of which will take place in a softball field. The instrument will be mounted at the top of a 50-foot tower and it will scan a pie slice-shaped strip of ground. It will make several passes over the same strip of land and we will be placing certain objects, such as a baby pool filled with water, to determine whether the radar can 'see' them. The second test will be similar to the first except that we will have a second radar, nearly identical to the first, located at the top of a moving boom truck. This allows for the scan of a larger area with an increased resolution.

I have found this project both interesting and rewarding. There is no doubt that once it is complete and the radar is put to use, it will turn over myriad of scientific data on the global environment and our impact on it. Seeing as how this is a major topic of discussion in the world today, I am grateful to know that I have been able to take part. What's even more comforting is that there are several other projects that are being designed here to study Earth science as well as many other ventures being put together here that will do everything from putting man back on the moon to building instruments that will explore the furthest bounds of the universe. Such a large scope of modern science is guaranteed to appeal to the scientist in everyone.

Field Observations, 27 April 2008

Field Logs and Data Recording:
Shawn Korgan, Gilcrest, CO

Data Analysis and Spectrogram:
Fatima Bocoum, Greenbelt, MD

My observations on April 27, 2008 were conducted upon the open prairie approximately seventy (70) miles NNE of Denver. I really enjoy the prairie and grasslands of Colorado as they are very peaceful and relaxing. It is a delightful pleasure watching the sunrise, listening to the birds singing their lovely carols and being out in the quiet of nature while also partaking of the delightful sounds of VLF radio.

The weather this particular day was calm and dry with a temperature in the mid 40's.

The most amazing VLF sounds to me are whistlers. I enjoy dawn chorus (some of which was faintly noticeable during this session) and risers however I just cannot get enough of the whistlers. What is really spectacular are those rare occasions when the background noise level is very low and the whistlers come screaming through the receiver! We did not have quite this type of morning however there were several lovely whistlers captured during this session (see data analysis below).

My hopes are to record atop Trail Ridge Road at an elevation of over 12,100 feet above sea level during the fall recording session. Trail Ridge Road is my favorite recording location. The scenery is breathtaking; the drive very beautiful and best of all the VLF audio signal strength is at least 10 dB greater than upon the flat terrain outside the mountains.

How to Isolate an Antenna from Corrosion causing White Noise in the VLF Kit Receiver

Shawn Korgan

There were no real surprises this trip however I did make an important discovery. I found that the smallest amount of corrosion had built up between my 72" antennas and the vehicle brace they are mounted upon. This corrosion was creating a very noticeable amount of white noise in the receiver as it created a path for signal to travel from between the antenna and vehicle ground (the mount).

Upon arriving back at the house and after several days of experimenting I discovered the best solution was to simply place several hard plastic washers on both the top and bottom of the mount to completely isolate the antenna from the mount.

This corrosion was creating a very noticeable amount of white noise in the receiver as it created a path for signal to travel from between the antenna and vehicle ground (the mount).

April 27, 2008 0500 MST 1100UT

INSPIRE Data (copy as needed)

INSPIRE Observer Team: Dawn Risers Team Number: I-1

Coordinated Observation Date: 4/27/08 Receiver: Sk-1

Tape Start Time (UT): 1100 Tape Start Time (Local): 5Am MST

Local weather: 40°, slight breeze, clear skies

Code: M - Mark (WWV or Voice) S - sferics T - tweek W - whistler A - Alpha C – chorus
Sferic Density: D: 3 Scale of 1-5 (1 – Very Low, 3 – Medium, 5 – Very High)

Time (UT)	Entry	Observer
11: 02 50	M-WWV M-V S T C (W) D: 2	
11:09 56	M-WWV M-V S T C (W) D: 1	

April 27, 2008 0500 MST 1100UT

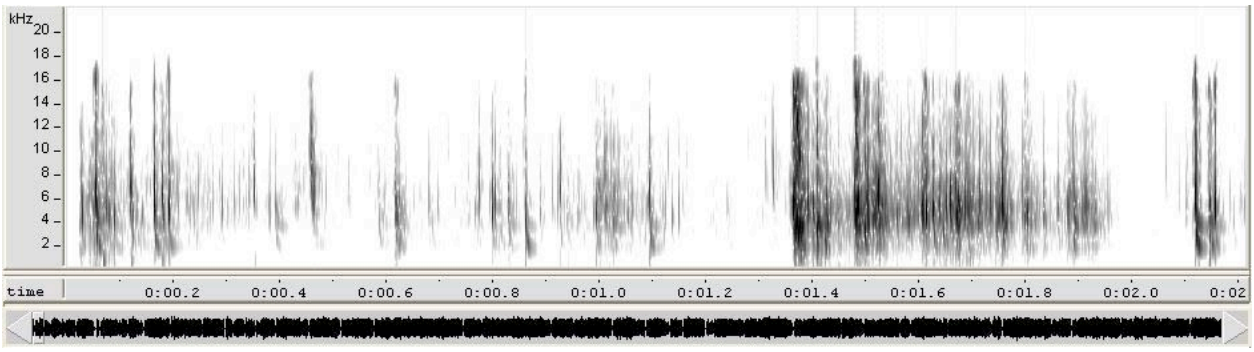


Figure 1 - Session features Tweeks

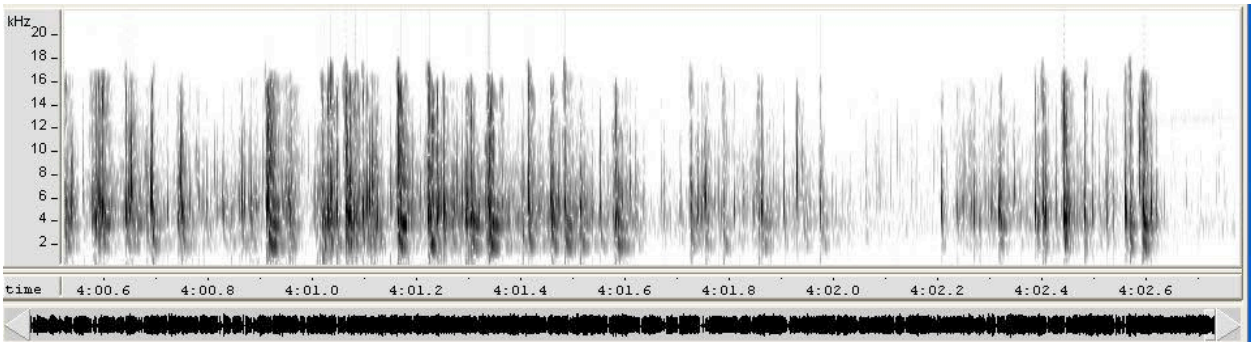


Figure 2 – End of recording session

April 27, 2008 0600 MST 1200UT

INSPIRE Data (copy as needed)

INSPIRE Observer Team DAWN RISERS Team Number: I-1

Coordinated Observation Date: 4/27/08 Receiver SK-1

Tape Start Time (UT) 1200 Tape Start Time (Local) 6:00 AM MS

Local weather: 40°, Slight breeze, clear skies

Code: M - Mark (WWV or Voice) S - sferics T - tweek W - whistler A - Alpha C – chorus
Sferic Density: D: 3 Scale of 1-5 (1 – Very Low, 3 – Medium, 5 – Very High)

Time (UT)		Entry		Observer
12: 01	09	M-WWV M-V S T C (W)	D: 2	
	11	M-WWV M-V S T C (W)	D: 1	
02	26	M-WWV M-V S T C (W)	D: 1	
	37	M-WWV M-V S T C (W)	D: 1	
03	08	M-WWV M-V S T C (W)	D: 1	
	30	M-WWV M-V S T C (W)	D: 1	
	52	M-WWV M-V S T C (W)	D: 1	
04	24	M-WWV M-V S T C (W)	D: 1	
05	22	M-WWV M-V S T C (W)	D: 1	
07	10	M-WWV M-V S T C (W)	D: 1	
	42	M-WWV M-V S T C (W)	D: 1	
08	26	M-WWV M-V S T C (W)	D: 1	
	40	M-WWV M-V S T C (W)	D: 1	
09	51	M-WWV M-V S T C (W)	D: 2	
11	52	M-WWV M-V S T C (W)	D: 1	
		M-WWV M-V S T C W	D:	
		M-WWV M-V S T C W	D:	
		M-WWV M-V S T C W	D:	

April 27, 2008 0600 MST 1200UT

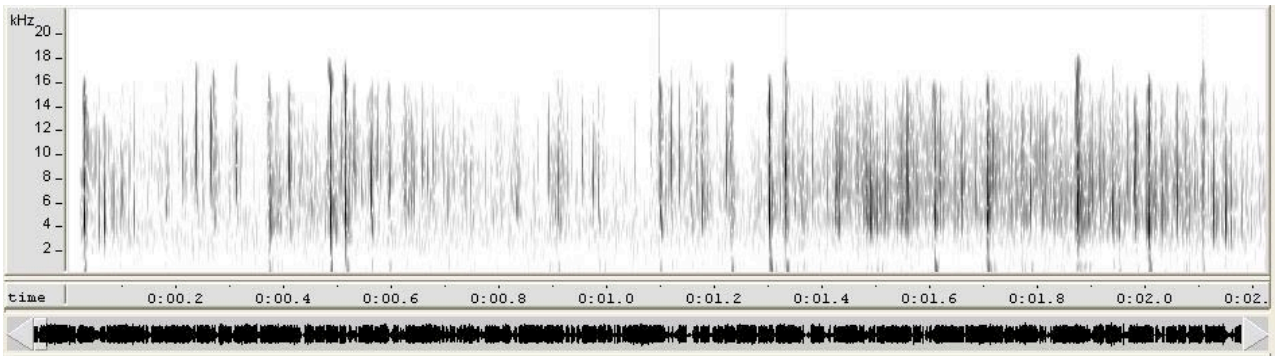


Figure 3 - Session features Sferics with some Whistlers
A total of 8 Whistlers were logged at: :03, :49, 1:02, 1:09, 1:11, 2:27, 2:37, and 3:09.

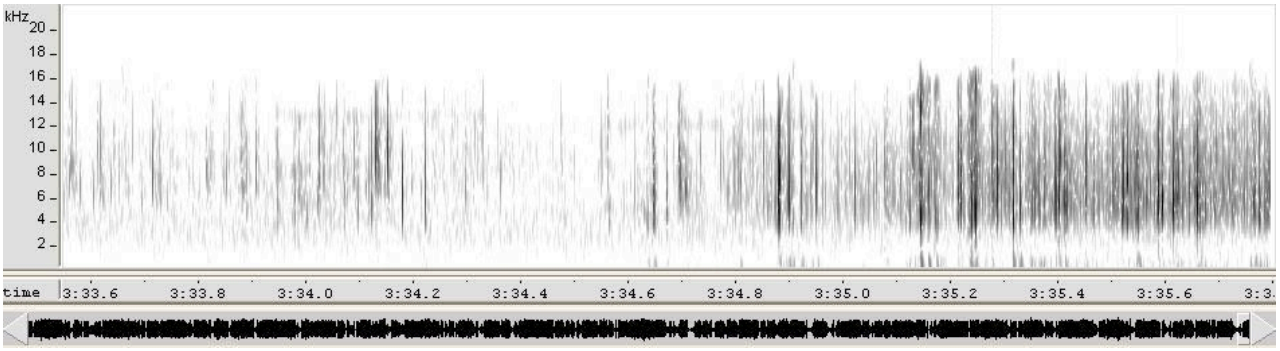


Figure 4 - End of recording session

April 27, 2008 0700 MST 1300UT

INSPIRE Data (copy as needed)

INSPIRE Observer Team: Dawn Risers Team Number: I-1

Coordinated Observation Date: 4/27/08 Receiver: Sk-1

Tape Start Time (UT): 1300 Tape Start Time (Local): 7AM MST

Local weather: 45°, slight breeze, clear skies

Code: M - Mark (WWV or Voice) S - sferics T - tweek W - whistler A - Alpha C – chorus
Sferic Density: D: 2 Scale of 1-5 (1 – Very Low, 3 – Medium, 5 – Very High)

Time (UT)		Entry		Observer
13 00	27	M-WWV M-V S T C (W)	D: 1	
02	03	M-WWV M-V S T C (W)	D: 1	
	25	M-WWV M-V S T C (W)	D: 1	
03	22	M-WWV M-V S T C (W)	D: 1	
03	53	M-WWV M-V S T C (W)	D: 2	
05	04	M-WWV M-V S T C (W)	D: 1	
06	03	M-WWV M-V S T C (W)	D: 1	
	27	M-WWV M-V S T C (W)	D: 2	
07	28	M-WWV M-V S T C (W)	D: 1	
08	02	M-WWV M-V S T C (W)	D: 1	
09	27	M-WWV M-V S T C (W)	D: 2	
	30	M-WWV M-V S T C (W)	D: 2	
10	14	M-WWV M-V S T C (W)	D: 1	
	37	M-WWV M-V S T C (W)	D: 1	
11	15	M-WWV M-V S T C (W)	D: 1	
	30	M-WWV M-V S T C (W)	D: 1	
	49	M-WWV M-V S T C (W)	D: 1	
		M-WWV M-V S T C W	D:	

April 27, 2008 0700 MST 1300UT

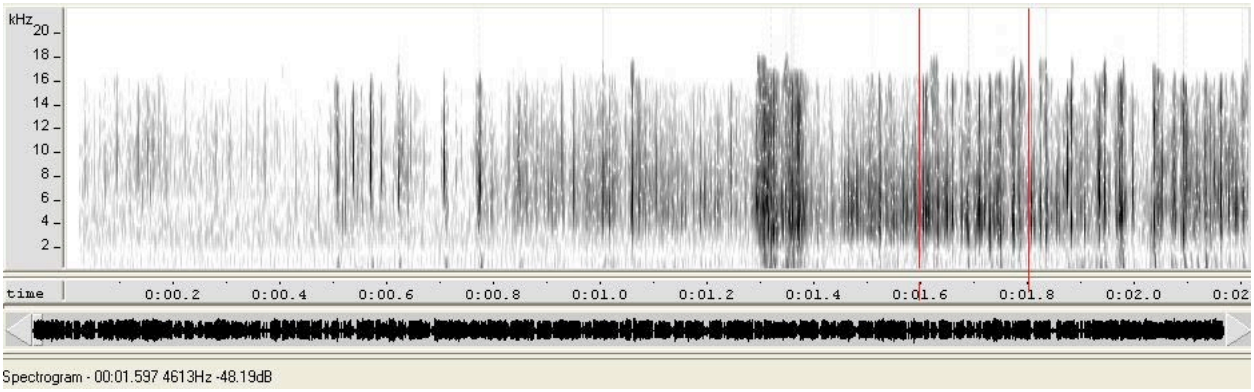


Figure 5 - Session features Dense Sferics with some Whistlers. In red is the first Whistler heard between 16s and 18s.

After the first Whistler, a total of 17 Whistlers were logged at: :27, :44, :55, 1:04, 1:22, 1:34, 1:53, 2:03, 2:34, 2:50, 3:03, 3:11, 3:22, 3:41, 3:51, 3:53, and 4:06.

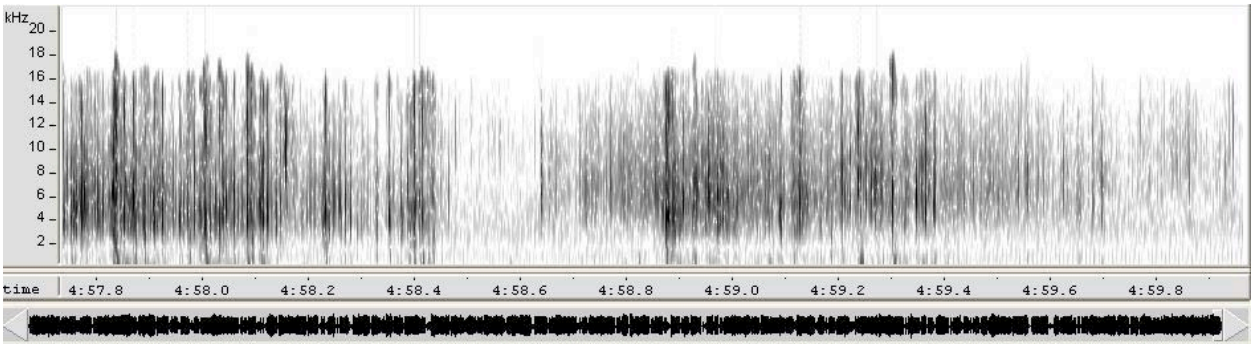


Figure 6 - End of recording session

Coordinated Observation Schedule

The Coordinated Observations will be held on the first weekend of October and the last weekend in April. This schedule will apply to all future Coordinated Observations. All data is welcome and should be submitted even if the conditions are quiet. Any data you can contribute is valuable. The procedure to use for coordinated Observations will be as follows:

1. Use the Data Cover Sheet and Data Log forms found at the end of the *Journal*. (Make copies as needed.)

2. Put a voice introduction at the start of each session indicating your name, your INSPIRE Team name, the date, local time and UT time.

3. Record for 12 minutes at the start of each hour that you can monitor on the specified days. Keep a detailed written log of all signals that you hear and indicate any items of interest. When you submit your tapes, spectrograms will be made of any parts of the tape that you indicate.

4. Place a time mark on the tape on the hour and each two minutes for the next 12 minutes. Use Coordinated Universal Time (UTC) for all time marks.

5. Record at 8 AM and 9 AM LOCAL time.

6. In addition, record on other hours to compare results with those in neighboring time zones. For example, an observer in the Central Time Zone might record at 7 AM (8 AM EDT), at 8 and 9 AM CDT and at 10 AM
(9 AM MDT).

7. Use 60 minute tapes (30 minutes per side) with two sessions per side. It is preferred that you record on one side of the audio tape only.

8. Label all tapes and logs to indicate the sessions monitored and send to:

   The INSPIRE Project
   518 Sixth Street SE
   Washington, DC 20003
   Attn: Kathleen Franzen

9. Your tapes will be returned with spectrograms of your data. An article reporting on the results will appear in the next *Journal*.

10. SPECIAL NOTE: If you are hearing whistlers, replace the data tape after 12 minutes with a “Whistler” tape and continue recording with time marks every two minutes. If we get whistlers, this would be a good opportunity to try to determine the “footprint” of a whistler (the “footprint” is the geographical area where a whistler can be detected).

Field Observation Schedule

Field observations may be made according to the following schedule: ANY TIME!

In addition to an article reporting on the Coordinated Observations, will be an article on Field Observations. These observations may be made at any time and submitted for inclusion in the next *Journal*.

Use the same procedure as described for Coordinated Observations (previous page). Since field observations can be made any time of year, the following table is provided for conversion from local time to Coordinated Universal Time (UTC).

Sample Spectrograms:

Local Time to UT Conversion Table

EDT + 4 = UT
CDT + 5 = UT
MDT + 6 = UT
PDT + 7 = UT
EST + 5 = UT
CST + 6 = UT
MST + 7 = UT
PST + 8 = UT

Frequency _____

Range _____

Time _____

Scale _____

Frequency _____

Range _____

Time _____

Scale _____

This spectrogram is for two minutes using a frequency range of 0 - 22 kHz.

This spectrogram is for 30 seconds using a frequency range of 0 - 11 kHz.

INSPIRE
INTERACTIVE NASA SPACE PHYSICS IONOSPHERE RADIO EXPERIMENTS

Data Log Cover Sheet

INSPIRE Observer Team _____

Equipment: Receiver _____

Recorder _____

Antenna _____

WWV radio _____

Site description: _____

Longitude: _____o _____.'W Latitude: _____o _____.'N

Personnel: _____ _____ _____

_____ _____ _____

Team Leader Name: _____

Mailing Address: _____

_____

City, State, Zip, Country _____

Email: _____

Local Time to UT Conversion Table

EST + 5 = UT EDT + 4 = UT
CST + 6 = UT CDT + 5 = UT
MST + 7 = UT MDT + 6 = UT
PST + 8 = UT PDT + 7 = UT

INSPIRE
INTERACTIVE NASA SPACE PHYSICS IONOSPHERE RADIO EXPERIMENTS

INSPIRE Data

INSPIRE Observer Team _____

Observation Date: _____ Receiver _____

Tape Start Time (UT) _____ Tape Start Time (Local) _____

Local weather: _____

Code:
M – Mark (WWV or Voice)
S – Sferics
T – Tweek
W – Whistler
A – Alpha
C – Chorus

Sferic Density: D: ___ Scale of 1-5 (1 – Very Low, 3 – Medium, 5 – Very High)

Time (UT) Entry Observer

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

INSPIRE VLF-3 Receiver Kit Order Form

INSPIRE VLF-3 Receiver Kits can be ordered online at: http://image.gsfc.nasa.gov/poetry/inspire/2006/orderform.html. Or please complete this order form and submit with payment to the address below.

INSPIRE VLF3 Radio Receiver Kit $85.00
(Includes assembly instructions, components and printed circuit board)

Item:	**Quantity**	**Price**	**Subtotal**
VLF-3 Receiver Kit	_____	$ 85.00	$ _____
Shipping Charge: US - $9.00 Canada - $9.00 Mexico - $12.00 All other countries $17.00	_____	_____	$ _____
Sales Tax *(CA residents please add 7.75% sales tax, $6.60 per kit)*			$ _____
		TOTAL:	$ _____

Ship To:
(Please allow 3-4 weeks for delivery)

Name: _____

Address: _____

_____

City, State, Zip, Country: _____

Email: _____

Payment may be made by check, money order or purchase order made payable to: The INSPIRE Project, Inc.

Send orders to:

The INSPIRE Project, Inc.
518 6th Street, SE
Washington, DC 20003

Attn: Kathleen Franzen

Questions? Email Kathleen Franzen at Kathleen@womanfridaycom or call 202.547.1364.

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fatima2ms@yahoo.com

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