

The INSPIRE Journal

Volume 10

Number 2

April 2002

The Newly Redesigned INSPIRE Receiver is Coming!

The design phase of the INSPIRE VLF3 receiver is nearing its end. This process has included input from our kit supplier John Kohus, veteran INSPIRE observers and INSPIRE organizers with suggestions about new features and effective ways to increase the performance of the receiver. Once the new design is finalized, the first 100 kits will be ordered. The price will be determined after the components are identified and priced. The availability of the new receiver will be publicized on the INSPIRE web site:

<http://image.gsfc.nasa.gov/poetry/inspire>

A description of the new receiver will appear in the next *Journal*.

In this issue Robert Bennett reports on his efforts to monitor the signals from the IMAGE satellite, Flavio Gori brings us up to date on his investigations of the "HessDalen Lights" of Norway and Jill Marshall describes how the INSPIRE receiver picks up AM radio stations.

Table of Contents

| | |
|---|----|
| Miscellaneous Notes | 3 |
| UNCoordinated Observations are a Way to Participate! | |
| The INSPIRE VLF3 Receiver is on its Way! | |
| INSPIRE VLF2 Receivers No Longer Available | |
| Subscription Information Included on the Address Label | |
| Write for <i>The INSPIRE Journal</i> | |
| Coordinated Observation Schedule April/2001 | 4 |
| Bill Pine, Ontario, CA | |
| Coordinated Observers – Roster Update | 5 |
| IMAGE Satellite VLF to Ground Propagation Experiment – Monitoring Results | 6 |
| Robert Bennett, Las Cruces, NM | |
| INSPIRE Radios as AM Receivers? | 14 |
| Jill Marshall, Austin, TX | |
| HessDalen EMBLA 2001 | 16 |
| Flavio Gori, INSPIRE European Coordinator, Florence, ITALY | |
| Report on Coordinated Observations 4/2001 | 23 |
| Bill Pine, Ontario, CA | |
| INSPIRE Log Forms | 41 |

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The INSPIRE Journal is a publication of The INSPIRE Project, Inc., a nonprofit educational/scientific corporation of the State of California. The purpose of the INSPIRE Project, Inc., is to promote and support the involvement of students in space science research. All officers and directors of the corporation serve as volunteers with no financial compensation. The INSPIRE Project, Inc., has received both federal and state tax-exempt status (FEIN 95-4418628). The *Journal* is published two times per year: November 1 and April 1. Submission deadlines: October 1 and March 1

Contributions to the *Journal* may be sent to:

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billpine@earthlink.net
Fax: 909 931 0392

UNCoordinated Observations are a Way to Participate!

Everyone is invited to participate in “uncoordinated observations” Unlike coordinated observations, which are scheduled as an opportunity for observers to record data at the same times, uncoordinated observations may be made at any time. Simply follow the instructions for time marks and logging found in the article on the April/2002 Coordinated Observations found on Page 4 of this issue of the *Journal* and send in your data tapes. You will receive spectrograms of your data and a commentary. A report will appear in the next edition of the *Journal*.

The INSPIRE VLF3 Receiver is STILL on its Way!

The redesign process is underway for the new VLF3. This will represent a major change in design and performance. The price of the VLF3 has not been established, so there is no way to order early. Watch the INSPIRE web site for an announcement, but it is not expected that the VLF3 will be ready before summer 2002.

INSPIRE VLF2 Receivers No Longer Available

Our supply of assembled VLF2 receivers has been exhausted and this product will no longer be offered. Our limited number of VLF2 kits will be all sold by the time you receive this *Journal*.

Subscription Information Included on the Address Label

You can determine the status of your subscription to *The INSPIRE Journal* by looking at the address label. In the upper right corner of the label is a 2-digit number that indicates the year your subscription will expire. All subscriptions expire with the November issue. If your label shows “02”, then next November’s issue will be the last under this subscription. If your label shows “03”, then your subscription is good through the November 2003 issue. If you have any questions or if you feel that the information shown is incorrect, please contact the editor.

Write for *The INSPIRE Journal*

The procedure for contributing articles for *The INSPIRE Journal* could not be simpler! Just send it in! Any format is acceptable. Electronic format is easier to work with. A Word file on disk for either the PC or Mac platform is preferred. An email message will work, too. If that does not work for you, a paper copy will do. Any diagrams or figures can be scanned in.

What about topics? Anything that interests you will probably interest most INSPIRE participants. As long as the topic is related to natural radio or the equipment used, it will get printed. The deadlines for submissions are March 1 for the spring edition and October 1 for the fall edition. Don’t worry about the deadlines, though. If you miss a deadline, you will just be very early for the next edition!

We at INSPIRE are looking forward to hearing from you.

Coordinated Observation Schedule April 2002

By Bill Pine Ontario, CA

The Coordinated Observations for April/2002 will be held on April 27 and 28. All data is welcome and should be submitted even if the conditions are quiet. It is not required that you observe on both days. 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 (and number, if assigned), 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:

Bill Pine
Chaffey High School
1245 N. Euclid Avenue
Ontario, CA 91762

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).

Specified Coordinated Observation Dates for April/2002:

Saturday, April 27

Sunday, April 28

INSPIRE COORDINATED OBSERVERS

November/2001

New to the roster of observers is Mitchell Lee, Team I-1

(Unless noted otherwise, all longitudes are West and latitudes are North.)

| Team # | Observer | Location | Longitude/Latitude |
|--------|--|-----------------|--------------------|
| S-1 | Kathryn Robinson. O'Connor High School | Helotes, TX | 98° 47' / 29° 35' |
| S-2 | Mark Mueller Brown Deer High School | Brown Deer, WI | 87° 56' / 43° 10' |
| S-3 | Elizabeth Quick John Marshall High School | San Antonio, TX | 98° 72' / 29° 54' |
| S-4 | Bill Pine Chaffey High School | Ontario, CA | 117° 41' / 34° 14' |
| S-5 | Jim Hoback John Jay High School | San Antonio, TX | |
| I-1 | Shawn Korgan | Gilcrest, CO | 104° 67' / 40° 22' |
| I-2 | Linden Lundback | Watrous, Sask, | 105° 22' / 51° 41' |
| I-3 | Robert Bennett | Las Cruces, NM | 106° 44' / 32° 36' |
| I-4 | Mitchell Lee | San Jose, CA | 120° 40' / 39° 16' |

IMAGE Satellite VLF to Ground Propagation Experiment

Monitoring Results

Robert Bennett
Las Cruces, New Mexico
9 December 2001

PURPOSE This note summarizes my attempt to intercept the VLF to Ground transmissions from the IMAGE Satellite during the period 21 November to 4 December 2001. In this note, I briefly cover the background of the experiment, monitoring equipment set-up, data analysis techniques, and finally the results obtained.

BACKGROUND The background, purpose and the schedule of events for the experiments are well covered in an email message by Dr. Taylor from NASA dated 15 Nov 2001. Basically, the IMAGE Satellite carries the Radio Plasma Imager instrument capable of emitting radio signals in the VLF, LF, and HF frequency bands (3 kHz to 30 MHz). The instrument was turned on during the satellite's approach toward perigee. Two different experiments were conducted.

The first was the VLF satellite to ground tests. These occurred on every orbit, starting when the satellite crossed 50° North Latitude and continued until the satellite was four minutes from the South Pole. The transmission consisted of 0.125 seconds of transmitter-on then 0.375 seconds of transmitter-off. The first transmission was on 5 kHz, and each succeeding transmission 2 kHz higher in frequency. 12 seconds after the first transmission, the last one occurred on 15 kHz. This pattern repeated for approximately 35 minutes. The frequencies used were 5, 7, 9, 11, 13, and 15 kHz.

The second experiment started when the satellite was four minutes from the South Pole and lasted until the satellite was four minutes past the South Pole. The same transmission on-off pattern was used and the transmission frequencies were 130 and 380 kHz.

BOTTOMLINE The overall results of my effort are disappointing. I do not believe that I detected any IMAGE transmissions. The IMAGE transmission could be on the tapes but below the noise level. If this is the case, then autocorrelation and cross correlation techniques will be required to pull the signal out of the noise. I plan to explore this when time permits.

EQUIPMENT SET-UP I attempted to intercept both the VLF and the LF transmissions over the South Pole. I used two different sets of equipment.

For the VLF transmissions, I operated from a relatively RF quite remote area on the Jornada Experimental Range about 20 miles northeast of my home. The experimental range is operated by the US Government and is used to study various desert conservation issues. The range is mostly devoid of houses, power lines, roads and other sources of radio noise. My receivers were the INSPIRE VLF-2 and the older RS-4. I recorded the receiver output on a stereo cassette recorder, placing the VLF signals on the left channel and a WWV time marker on the right. I used a 120-foot sloping long wire antenna for most of the missions. I attempted to orient the antenna toward the satellite ground track. On two of the missions, strong winds didn't permit me to erect the long wire so I used a six foot long vertical whip elevated about three feet above the ground.

I made three attempts to intercept the 130 and 380 kHz transmissions. For these, I operated from home and used two receivers, a Drake R-8 and a vintage RCA AR-88. I drove both receivers through a multicoupler from a common 240 foot dipole orientated approximately North-South. One receiver was tuned to 130 kHz (the RCA) and the other to 380 kHz. Again I recorded the receiver outputs on a cassette recorder.

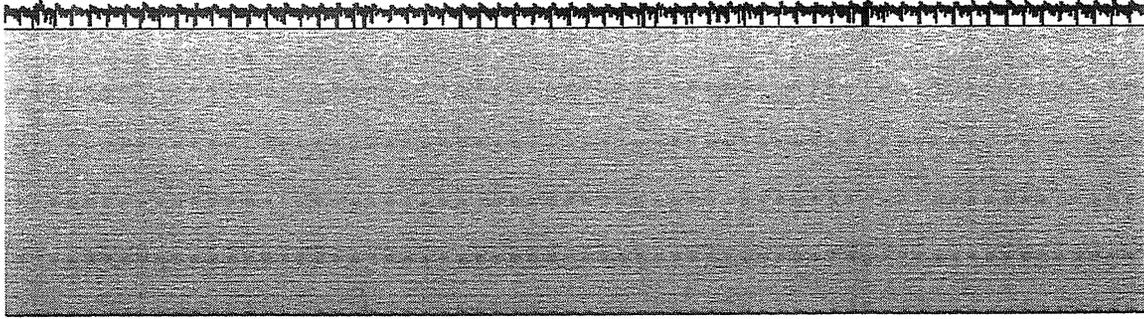
ANALYSIS I used a three-step procedure to analyze the collected data (audio tapes). During each mission, I kept careful notes of everything of interest I heard, including such things as whistlers and other natural radio signals. The first step in the analysis was to play back each tape and compare with my logs to insure that I didn't miss anything and make sure that I had noted the recorder counter setting for all the WWV timing marks. Next, I used a commercial spectrum analysis program called SpectraPlus by Pioneer Hill Software. I used the software in the real-time mode and processed the whole 45-minute recording from the VLF receiver. I carefully watched the evolving spectra for any signal lines on 7, 9, 11, 13 or 15 kHz. I was hoping to see spectral lines on some or all these frequencies emerge from the background, increase in magnitude and then fade away. Such a pattern would indicate that I might have detected the satellite. If I observed such a pattern, I would then analyze the segment in detail using the Gram shareware program. In the resulting Gram spectrogram, I would look at the spectral lines I observed in the Spectraplus program and see if they exhibit the on-off pattern of 0.125/0.375 seconds and the frequency stair step. If the signal had this period, I could then be reasonably sure I had detected the satellite.

RESULTS The following table shows the IMAGE missions I was able to monitor. The missions labeled VLF indicate that I attempted the 5/7/9/11/13/15 kHz transmissions. Those labeled LF indicate that I attempted the 130/380 kHz transmissions. Note that two start times are given. The first is the projected start time and is the time I started data collection. The second time is the actual time the transmission start.

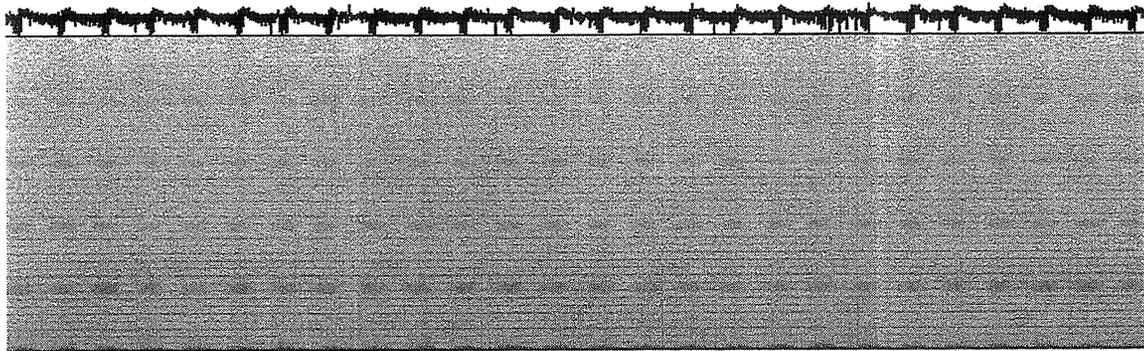
| MISSION | DATE | Start Time (Z) Estimated | Transmission | Start Time (Z) Actual |
|---------|-------------|-----------------------------|--------------|--------------------------|
| 330-A | 26 Nov 2001 | 0120 | VLF | 0118 |
| 330-B | 26 Nov 2001 | 1534 | VLF | 1532 |
| 331 | 27 Nov 2001 | 2001 | VLF | 2000 |
| 333-A | 29 Nov 2001 | 0029 | VLF | 0027 |
| 333-B | 29 Nov 2001 | 1529 | LF | 1531 |
| *334-A | 30 Nov 2001 | 0457 | VLF | 0455 |
| 334-B | 30 Nov 2001 | 1910 | VLF | 1909 |
| 336 | 2 Dec 2001 | 0024 | LF | 0023 |
| *337-A | 3 Dec 2001 | 0406 | VLF | ? |
| 337-B | 3 Dec 2001 | 1820 | VLF | ? |
| 338 | 4 Dec 2001 | 2334 | LF | 2334 |

The mission numbers with an asterisk in front of them were the ones closest to my location and hence I had the best chance of detecting the satellite. The following paragraphs summarize my observations and things I found interesting.

ALL LF ATTEMPTS I observed consistent results on every attempt at intercepting the South Pole LF transmissions. The 130 kHz frequency had heavy interference on it from Loran. Gram spectrograms of 130 kHz (see following figures) only show the strong dashed lines indicative of Loran. (*Possibly a little explanation is in order here. Detection of the LORAN carrier, one of its harmonics or a heterodyne would result in a horizontal line on the Gram chart. The line would be dashed, as the LORAN signal is pulse modulated. The spectrum of the LORAN signal has a SIN(X)/X envelope and is comprised of discrete spectral lines spaced above and below the carrier with the distance between the lines being the reciprocal of the pulse repetition interval, which is 1 kHz. However, none of the receivers I used were tuned close enough to the 100 kHz LORAN carrier frequency to receive it. In the case of 130 kHz, the receiver is detecting some LORAN spectral components, which appear on Gram as short vertical dashes at multiples of 1 kHz.*) The 380 kHz frequency has several navigation beacons within 6 kHz of it. The Gram plots didn't show any on/off periodic signal. I usually detected 3 or 4 beacons, two of which were strong enough to read their CW ID. I saw no indication of the IMAGE signal.



Spectrogram of 130 kHz using a resolution of 10 MS. The individual LORAN pulses are resolved.

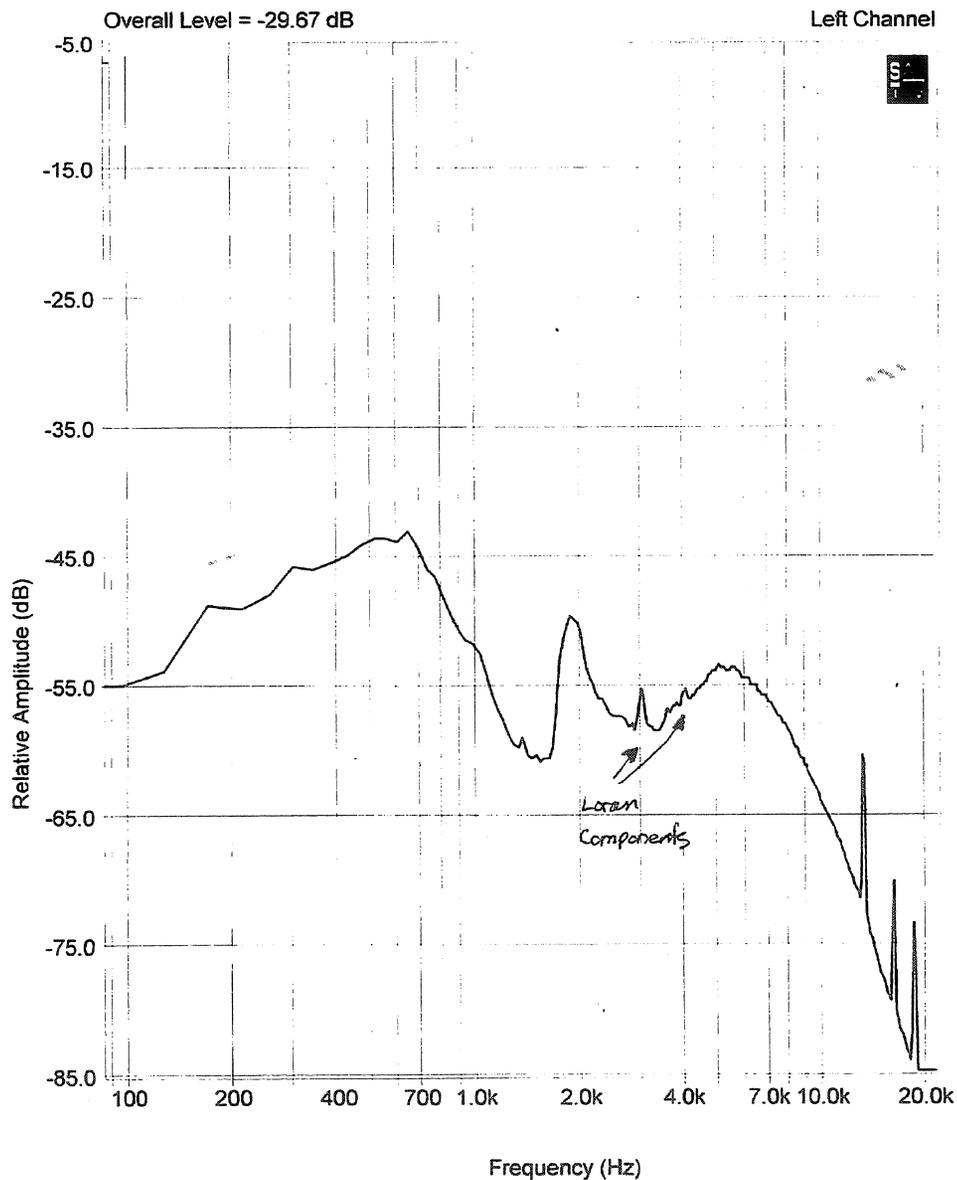


Spectrogram of 130 kHz using a resolution of 100 ms. the individual pulses cannot be resolved but the pulse groups can be. The pulse group repetition is about 2.2 seconds. Each group contains 11 pulses.

MISSION 330-A I used the 120-foot long wire antenna oriented toward the West. A copy of the spectrum plot follows. I noted that the usually strong Loran signal was much weaker than normal. This might indicate that abnormal propagation existed. Also, I was receiving much stronger than normal 60~ odd-harmonic interference. I noted a lot of strong tweeks, strong dense sferics and one whistler. The three strong signals between 10 and 20 kHz (13.155, 16.262 and 18.511 kHz) are communication signals.

Sampling: 44100 Hz
FFT size: 1024
Averaging: Infinite
Window: Uniform

Printed by: SpectraPLUS - FFT Spectral Analysis System
26 Nov IMAGE SAT VLF to GND, Mission 330-A
Licensed to: Robert Bennett
Tue Nov 27 16:57:39 2001

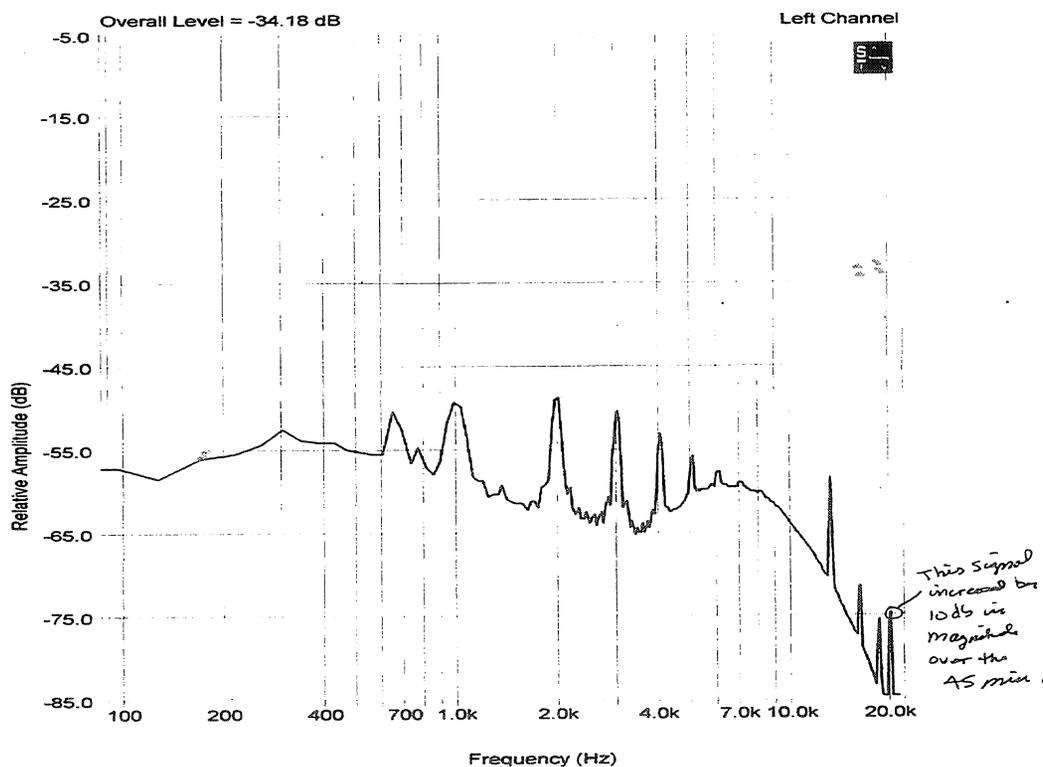


MISSION 330-B I used a 6-foot vertical antenna on this mission. Not much in the way of natural radio signals were detected. The following figure shows the spectrum. The 60~ interference was much less than in Mission 330-A (this can be seen by comparing the 100 to 1000 Hz areas of the two charts). Also, the Loran signal was about its normal value. LORAN components are at multiples of one kHz and are caused by LORAN overload and nonlinear response of the VLF-3 detecting the envelope of the LORAN signal. My monitoring site is about 30 miles from a 500 kW LORAN transmitter. I noted that the communications signal at about 20 kHz increased in magnitude by 8 – 10 dB over the 45 minutes of monitoring. The magnitude of the other communications signals did not change. This implies that the source is either moving toward me and usually implies an airborne emitter or else is increasing its output power.

Sampling: 44100 Hz
 FFT size: 1024
 Averaging: Infinite
 Window: Uniform

26 Nov IMAGE SAT VLF to GND, Mission 330-B
 Whole Mission (45 Min)

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 Licensed to: Robert Bennett
 Tue Nov 27 17:47:50 2001



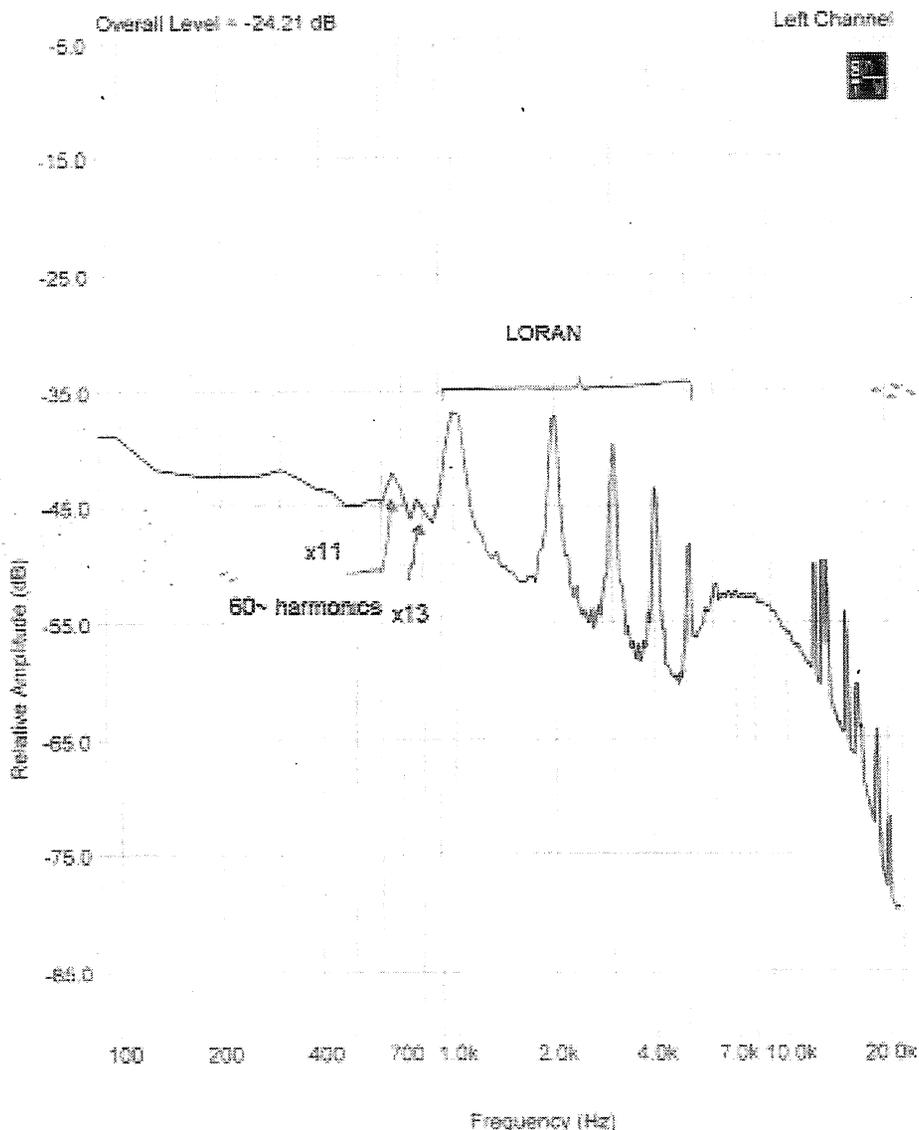
MISSION 334-A The 120-foot long wire antenna oriented to the west was used. This was a very good night for natural radio signals. I detected 15 whistlers, several whistler echoes, and observed many strong tweeks along with dense sferics. I also detected several communication signals between 10 and 20 kHz. The spectrum plots didn't reveal much and are not included.

MISSION 334-B I used the 6-foot whip during this mission. This mission took place at noon local time. I didn't observe any natural radio signals at all. The Loran signal was the strongest that I have ever seen it. The following spectrum plot shows that signal. Note that the Loran components are 15-20 dB above background.

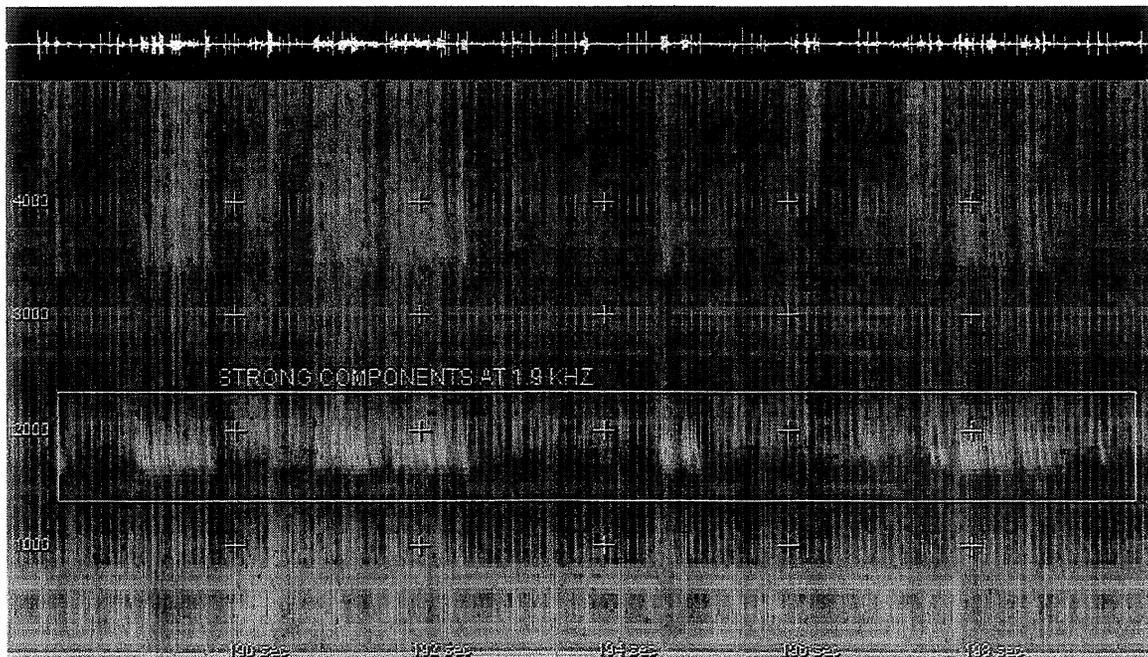
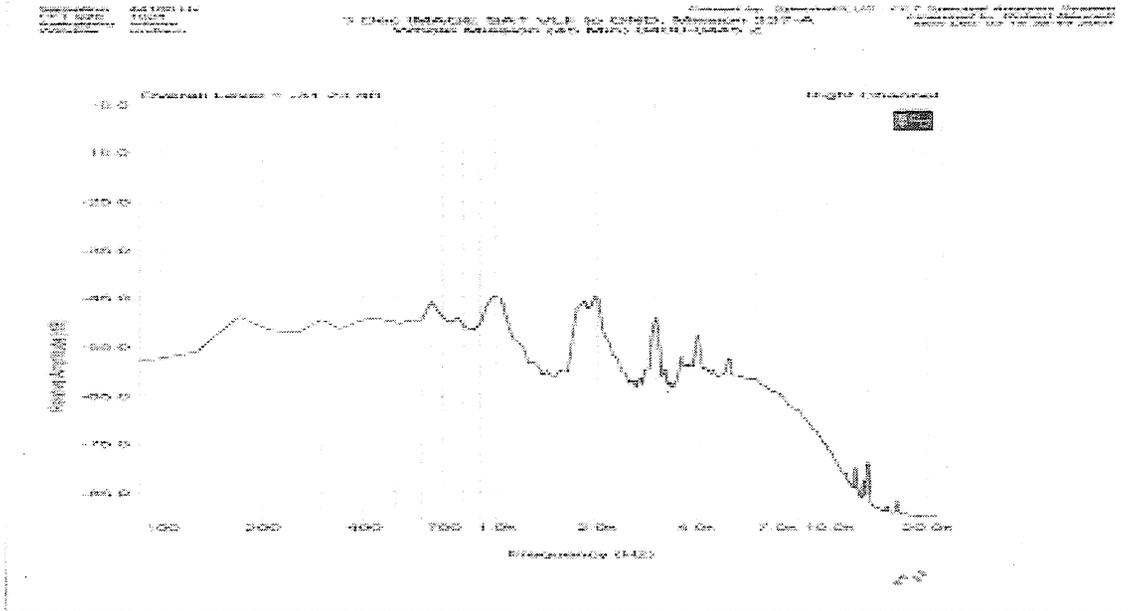
Samples: 44100 Hz
 FFT size: 1024
 Averaging: none
 Window: Uniform

Printed by SpectraPLUS - FFT Spectral Analysis System
 30 Nov IMAGE SAT VLF to GND, Mission 334-B
 Whole Mission (45 Min) 1910-1950 Z

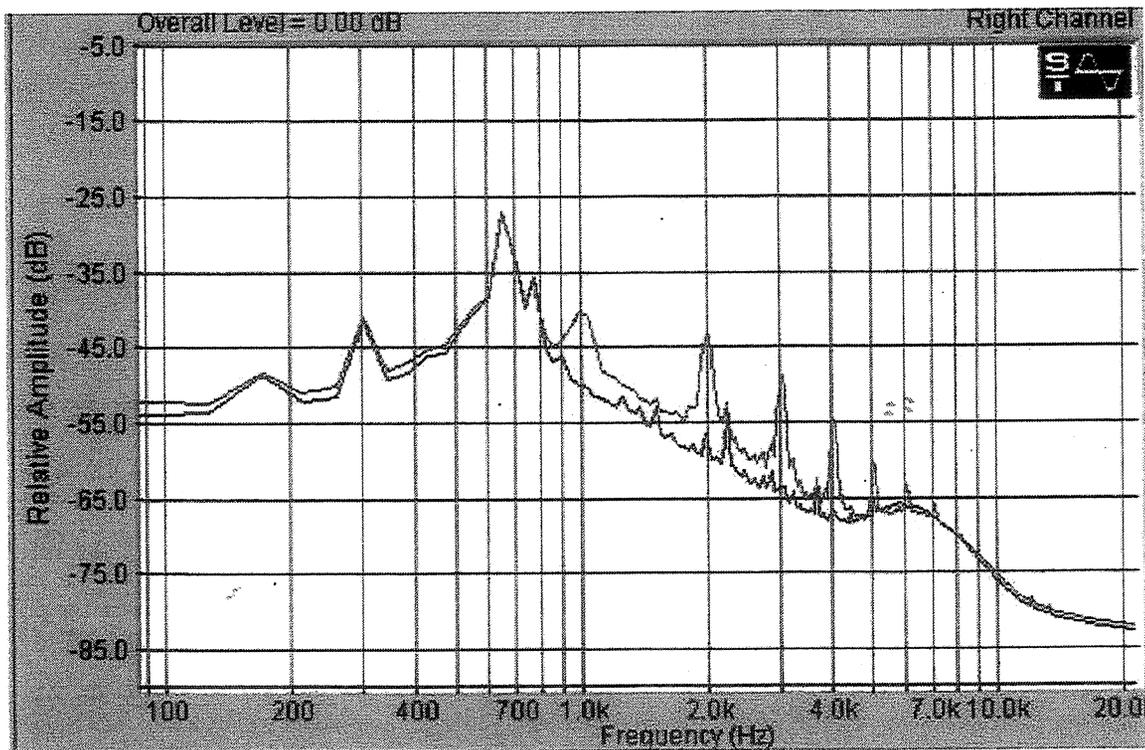
Copyright © Richard Bennett
 Fri Nov 30 20:02:01 2001



MISSION 337-A I used the 120-foot long wire antenna with a westward orientation. In this mission I used the RS-4 INSPIRE receiver. I detected a lot of very strong tweeks. The spectrum is shown in the following figure. Note the twin peaks at approximately 2 kHz. The first at 1.9 kHz is caused by the strong tweeks while the second at 2 kHz is a Loran component. The tweek energy is better represented in the Gram spectrograph, which follows. Note the strong component at about 1.9 kHz.



MISSION 337-B This is a daytime mission and I used the 120-foot long wire oriented toward the north. I didn't detect any interesting natural radio signals except for infrequent tweeks. In this mission, I experimented with the effect that the longwire/whip setting on the RS-4 has on the recorded signal. The following figure shows the result. The figure shows two traces, the top one is with the RS-4 set for whip (but a long wire antenna was used) and the lower one is for longwire setting. Note the major impact on the Loran signal! Also, there are signals present at 2.1 and 3.7 kHz (origin unknown) that are very clear on the lower trace (long wire setting) and all but disappear on the upper trace. The RS-4 circuit diagram indicates that setting the switch to longwire places a 470Kohm resistor in series with the antenna. This simple experiment indicates that the long wire antenna is coupling sufficient LORAN signal energy into the receiver to overload the input FET stage producing rectification and detection of the LORAN signal envelope. I will have to do some more experimentation on this.



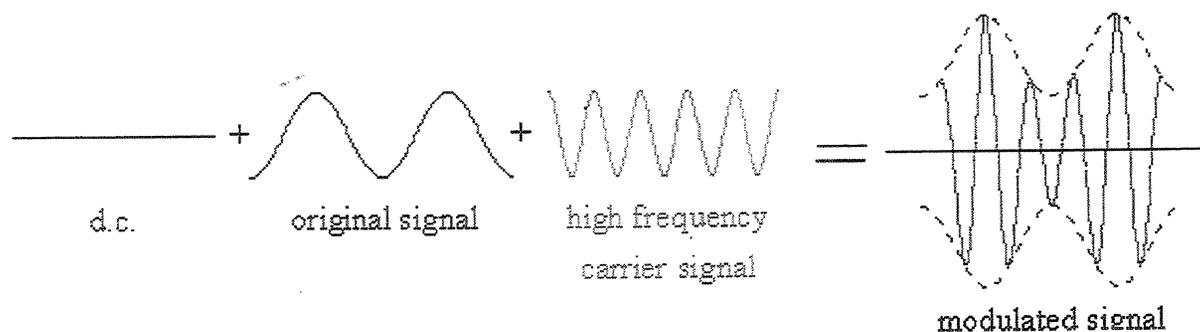
ACKNOWLEDGEMENT: I would like to thank Mr. Pine and Dr. Taylor for their review of this article and the useful comments they provided.

INSPIRE Radios as AM Receivers?

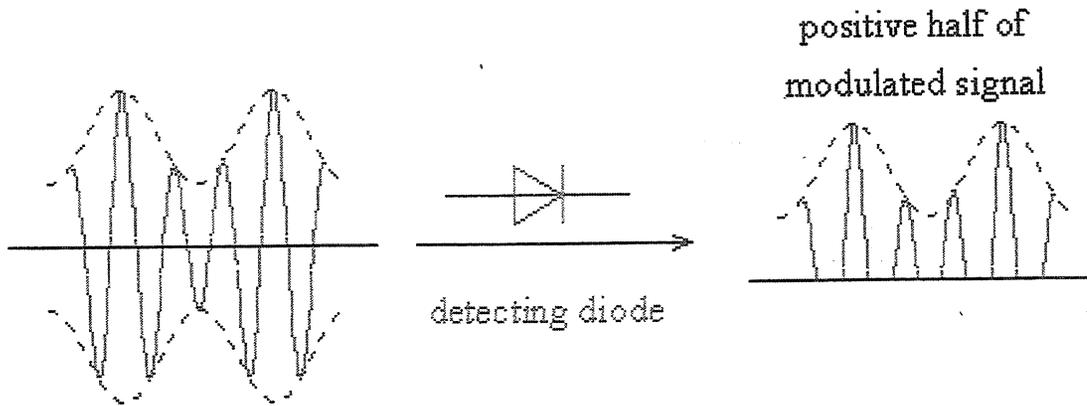
By Jill Marshall
Austin, Texas

In February of 2001, a group of Central Texas physics teachers participated in an INSPIRE workshop. The group had taken an INSPIRE receiver into the hill country near Helotes, Texas, at the end of the day expecting to hear tweaks and whistlers, or sferics at the very least. What we heard instead was a surprise to some of us: an AM radio station. Knowing that AM frequencies were well above the range of the INSPIRE receiver, we wondered how it was that the VLF2 was receiving the Hit Parade. Then someone made a comment to the effect of "It must be the same way that a crystal radio does it", and that seemed to make sense. But how would this work exactly? We thought some of the other INSPIRE participants might have had the same experience and wondered the same thing.

The answer lies in the way AM (amplitude modulated) signals are constructed and how AM receivers (the VLF2 and crystal radios included) work. As its name implies, an AM signal modulates the amplitude of a wave of a given (constant) carrier frequency to encode the sound wave produced by the DJ's voice or music. For example, the amplitude of a 1000 kHz carrier wave (the station frequency) is varied at the lower audio frequency of the sound being transmitted. In the following diagram a 10 kHz sound (in the middle of the audio range) is shown modulating the 100 kHz carrier. (The waves are not drawn to scale.)



Electrons in the antenna of your VLF2 are stimulated to oscillate according to this modulated wave, producing a modulated, oscillating input current to the receiver. The receiver, as we all know, is simply not fast enough to pick up on the high frequency oscillations of the carrier wave. These are averaged out over time by the capacitor in the circuit so that the incoming signal varied with the original modulation only. If the complete signal is averaged over time, the symmetric positive and negative peaks will cancel out to zero amplitude, as will any sine wave. This is where the diode in your VLF2 circuit comes in. This device transmits only positive current (only the positive half of the wave form) as shown in the following diagram. (That's why the orientation of the diode in the circuit was so important!)



When the positive portion of the wave is averaged over time, it reproduces the original sound wave that the radio station used to modulate its carrier frequency wave. If it is strong enough, that wave can drive a speaker or recording device just as any incoming radio wave in the audio range would.

You might ask how the receiver is tuned to a particular AM station. The answer is: it isn't. The VLF2 will only pick up very nearby stations, which are strong enough to drive the circuit directly. So, you can listen in with the VLF2, but you won't get your choice of stations.

HESSDALEN EMBLA 2001

VLF Radio Report and Some Further Proposals for the Next Missions

By: Flavio Gori
INSPIRE European Coordinator
Florence, Italy

In this report, I'll give some basic information about the work done in the Hessdalen Valley in Norway. First of all I'll take this opportunity to recall what we were looking for from VLF research in the field. The most important fact was to realize which kind of VLF electromagnetic natural noise situation should be defined as standard in order to understand if and when something may arise to influence in any way the local EM environment, in particular when Hessdalen Phenomena lights are appearing. This job was done using two VLF receivers: ELFO, with 2 square antennas, 2 meters long each arm¹, and the portable WR3 with its 60 cm whip antenna. Moreover an Inspire VLF receiver (<http://image.gsfc.nasa.gov/poetry/inspire/>) was set up in the Blue Box station, connected to a 50m dipole. Both the WR3 and the Inspire are broadband audio amplifiers, able to deal with about 12 kHz down to 300 Hz.

The first two nights, at Vista Point-Aspaskjolen², the WR3 receiver was used since ELFO was not ready to work. In the first recording session we experienced a very particular "whistler battle". Seldom was it possible record so many whistlers in just one night. This was probably due to the very rainy local night and, moreover, a similar weather condition was probably happening at the magnetic conjugate point in the Southern Hemisphere. These two special conditions at the same time, and at this high latitude, created a lot of whistlers and 2-hop whistlers³.

The second night was a more usual one, since the weather turned clear with small electrical activity in the atmosphere. Both nights were free from Hessdalen lights, at least from our eyes, so was not possible to determine if the lights have any connection in VLF/ELF.

In the further nights recording sessions, we used the ELFO system in order to collect VLF /ELF data, from the BlueBox, the metallic box where are sited radio and optical instruments. Antennas used were the two square: the first directed toward 203° and the second toward 40°. During these sessions, most of them with Eng. Andrea Cremonini from CNR/IRA of Medicina Italy, two portable computers were used to store data digitally directly. These were a GEO PC Pentium 3/700 MHz (Andrea) using Spectrogram software (in addition to the ELFO software), while the other was an Apple Power Book 3400/180 MHz (myself) with SoundEdit software to create and analyze as a spectrogram the audio file recorded. Since SoundEdit is not able to show spectrograms in real time, when the system is recording, sometime we have used MacTheScope software, which is able to create displays a real time in spectrogram mode (time vs. frequency) as well as spectrum analyzer (frequency vs. amplitude).

During these ELFO recording sessions, a very high number of unknown digital manmade signals were recorded. Most of them have nothing in common with the ones recorded during EMBLA2000 Mission. Very unfortunately these signals hide frequencies between 2.5 to 8 kHz most of the time and sometime even 10 kHz. Therefore the very low amplitude emissions we were looking for, resulted almost invisible, if present. Since ELFO has a filter to cut away all below 1 kHz, the frequencies range we can analyze in a good shape are between 1 and 2.5 kHz (ELF) and, sometimes even up to 8 to 12 kHz (VLF). The lowest range appears to be the most interesting for our purpose. Anyway we are analyzing it at our best, in order to discover any signal that might be correlated with Hessdalen Phenomena.

Sometimes the very first impression about recording sessions was later changed and, after many weeks spent analyzing those files, I think we don't need to analyze in the closest detail any manmade or natural known emissions. We need to monitor the natural standard white noise, that has to be seen as a "carpet" where something will walk on. This is the situation that may arise in the Hessdalen Valley in the VLF/ELF radio range. We have to observe what is arriving to influence the local EM environment, though it may be extremely faint and not so easy to be recognized. In my opinion these influences may be very important to understand the Hessdalen Phenomena.

During our very useful group conversations at the school where we lived, Eng. Bjorne Gitle Hauge⁴ told me about a Dr. Massimo Teodorani's interesting Hypothesis⁵: lights, as self-contained energy balls, may exist even when not visible. They should turn visible when "something" happens. Many hypothesis we can add to understand what are the particular phenomena that "break" those balls, though at this time it is not understood, for sure, why that break is happening.

Hypothesis

I'd like put our attention on Massimo Teodorani's hypothesis of self-contained energy balls that may be around us though not visible⁵.

This intriguing idea has been with me since I first heard it. And that's the way I'm thinking. If such a ball (a Self-Contained-Energy-Bag or SCEB) is around me, it is probably moving randomly as it does when it is visible. Its speed is random as are its colors and altitude. But, as happen when the lights are visible, there may be more than one SCEB moving together as each SCEB may be composed of more than one internal light rolling together inside⁵. If it is and all conditions just mentioned exist, we may consider that such a SCEB may influence the very local EM standard condition though with an intensity that is even lower than when SCEB turn to visible lights. It is important to emphasize that the inside composition of the SCEB, beyond what appears to be the external light, is very important in order to detect them in VLF, or in any other range. Optical, infrared and physics research will give us decisive help. We like to propose an model as follows: we should think of a still sea-water surface representing the local EM field; when a fish passes close to our position we cannot see the fish (representing the SCEB/signal, but we will see the disturbance in the sea surface created by the fish passing. This is just the way we are expecting to find SCEB. They are invisible to our eyes but their passage can create some perturbations in the local electromagnetic field that we are trying to detect. If SCEB may be

detected in VLF, we should observe, in the spectrogram (time vs. frequency), unusual emissions such as Doppler shifts (when SCEB approaches or is outbound from the antenna site), or a whirl when a rotating SCEB, is in the near vicinity of antenna. Sometimes the spectrogram appearing as a ball, all noise-like, as if noise appearing around particular spectrogram points, creating no sharp “ruffles”, due to the very low amplitude of the signals from the random motions of the SCEB. It would be as if the EM environment is tracking a SCEB flight and its behavior, though such a SCEB is not creating a "real" VLF/ELF signal, just a perturbation in that low EM field. We should observe SCEB intermodulating with standard natural noise conditions in a that creates such very faint geometrical figures/perturbations described earlier.

If this hypothesis is right, we should observe the EM situation all day long, no matter if lights are visible or not, in order to realize if such “ruffle” emissions are really in the spectrogram. If this hypothesis is to be proven, we have to observe a dramatic change in such EM condition when SCEBs break themselves. Observing that sudden change in the radio wave spectrogram will help us to go one more step ahead. The VLF situation may change in this way: when SCEBs are going to break themselves, in the spectrogram may appear a blast-like signal, such as an EM bang all along the VLF frequency range. As soon as it happens we should observe everything just as before. It would be something like a seismogram during a quake event. Being, at that point, an optical emission, its likely that such a bang may lay in the UHF field, as well as in the VLF range, at least in very beginning. That's why we could set up a parallel UHF monitoring station as well as an infrared one, being a heat emission. Especially during the search for SCEB, it should be very important to measure the infrared emissions in a coordinated session with VLF/ELF radio range. In the VLF/ELF radio range, after such a blast-like emission, we should not observe any perturbation from that point on, being that the SCEB broke up, with no more energy inside to detect. At the same time we should still observe other SCEBs moving around. Are these SCEBs influenced in any way by such blast-like phenomena?

One more hypothesis arises, at this time: when lights turn off, disappearing optically, are they getting back in a way such as happens with SCEB? Can they be detected in VLF/ELF again?

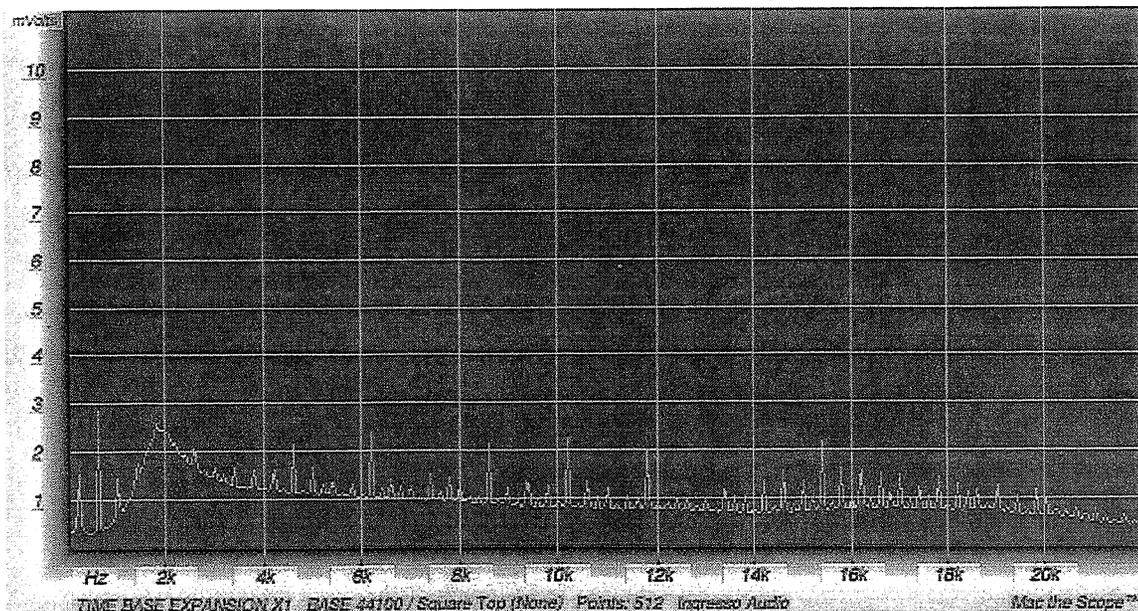
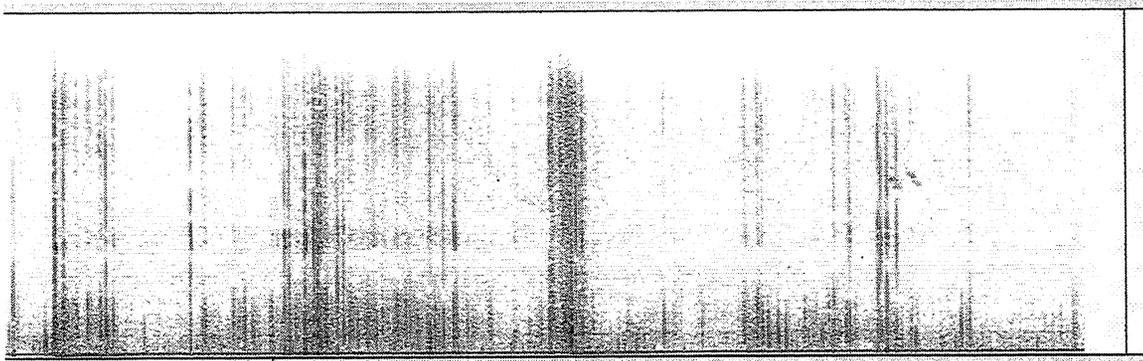
To observe these “ruffle” emissions (but also the blast event), the VLF /ELF receiving stations have to be established as close to the phenomena as possible. We'll need extremely well performing antennas and software to carefully reproduce those very faint signs. In this way our knowledge might get a quantum leap. I propose that two dipole frames antennas, formed by 5 wires each be installed at the site statistically more likely to be involved in the SCEB/lights appearance, at a distance of 1 meter from each other, in order to be hit by the SCEB/Lights to understand if such matter can create different situations when it is hit or not, though at very close distance. Each dipole has to be connected to one instrument, so when lights/SCEB hit one, the others can tell us such things as the amplitude/shape difference and to show us which kind of data are arising from them. Moreover if SCEB/lights will hit one more wire, after 1 meter, we can realize if and how anything has changed, in its energy, from the first hit to the second, as measured by our tools.

Also, a deep research has to be done in the software field. In our opinion, to determine if the SCEB hypothesis is correct (or just to find out how lights are working), we need a software filter able to understand background electromagnetic noise and filter it from any other perturbation

arising, even if much lower in amplitude. We need to go below the noise threshold as deep as we can, in order to better understand what it is in the very low amplitude EM field. Other manmade emissions are not important at this point and we have to coordinate our work looking at the “ruffles” in the noise carpet. Moreover it will be extremely important to understand the correct time-window in our spectrogram, in order to show the better way to evaluate those faint ruffles. If the time window is too small, ruffles will remain compressed in all the other noise and emission and will be invisible. On the other hand if the time window is too large, spectra will enlarge the ruffles too much making them again not visible at first sight.

Analysis

Our time spent over spectrograms for analysis purposes leads us to find out the right time-window to show such ruffles. We'll say again that such ruffles are extremely faint and we have to observe spectrograms very carefully to see them, at least with the instruments we are using at this moment. We have enclosed some VLF /ELF spectrogram recorded in the Hessdalen Valley where we can actually observe perturbations in that electromagnetic radio field.



We hope you will look very carefully at these spectra in order to understand what we mean. Watching and analyzing those recorded files, we can see Doppler shifts of incoming signals as well as outgoing signals. Sometimes as a singular wave, other as a multiple events, as if more than one SCEB may be travelling around.

Of course we are not in any position to affirm that these perturbations are from SCEB for sure, rather than some other origin, though it is an interesting starting point to realize that what we have believed as a theoretical possibility was actually observed, correct in all the conditions hypothesized.

More observations and more recording sessions have to be set up in order to confirm or disprove my hypothesis and that, anyway, may be an important EMBLA2001 result. In this way we have a real VLF (and lower) path to follow. After the needed time spent to analyze the incoming data, we could establish if this way is a self-sustained hypothesis or not. At that point we'll have real data to propose. Moreover this kind of VLF/ELF perturbations in the way we have proposed are, at the time we are writing, never before been reported in the open literature to our knowledge.

SCEB (as not visible energy bags) may be, at this point, a common world atmospheric condition, not confined in the Hessdalen Valley only. But in that place (maybe in some more sites) SCEB may get the particular environment that drive them to break themselves. Such an environment may be formed by a mix of conditions able to broke SCEB: space particles, atmospheric particles, and Earth geological composition. (In Hessdalen Valley there are copper mines and water streams flowing in and out of the ground.) In addition there is manmade activity in the area and it has consequences in the ground and in the atmosphere. We should also consider not just the present manmade activity but also a past manmade activity may create condition for later SCEB breaks. But we have another item to look for: is there a gravimetric anomaly able to contribute to SCEB breaks in some way? Are any measurements done in the gravimetric field in the valley or in any other area in the world where similar phenomena appear? We should work this way, with data collected by satellite directly over the sites as well as from the ground. Moreover we should ask for data from the southern Atlantic area, a well known area affected by a strong and large gravimetric anomaly. Satellites could again supply important data. Also it should be helpful to have a way to talk with ship crews usually travelling along that area. They could give us important information. In order to understand if different atmospheric condition can give different results about SCEB, we confirm that it would be extremely useful have one receiving VLF /ELF Station flying on a balloon, working at about 400/500 meters high from the ground, able to collect low end radio waves data over the ground station area. This receiver would xperience a different electron averaged content per meter/square, compared to the ground Station. Probably we should set up at least two more portable stations to be established in the valley in the sites where, statistically, lights has been observed more often. I believe that one more portable VLF/ELF receiving station should be established in another valley (not so far from Hessdalen, say 5 km), in order to compare the two EM conditions, in the same time. We should see about the same ruffle emissions, both in the Hessdalen station as well as in the other valley receiving station, though the supposed change in the spectrogram may be shown in the site where SCEB has broken, where the standard noise condition has been changed, only. We should also reach an agreement to use satellite data, obtained directly over the Hessdalen Valley, again for comparing purpose. T.E.C. (Total Electron Content) data from GPS satellites research may

supply useful data, too. All these kinds of data may be transmitted from the Valley through the Internet, in order to give to the research community involved important and real-time data to analyze. This will lead to a step ahead in all the research fields, giving us the possibility to grow in every field (optical, radio, infrared) at the same time. There would be no need to be there personally every day, except for instrument maintenance purposes as well as for scientific update and local community contacts.

In summary, what really arises from the Hessdalen Valley investigations is the realization that our knowledge about our atmosphere and its connections with space particles and Earth ground is not complete. When it is complete, the Hessdalen Phenomena may be understood or, if you prefer, the Hessdalen Phenomena may give important clues to understand aforementioned connections.

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- 1) A. Cremonini: "Ricevitore VLF a correlazione per monitoraggio di fenomeni elettromagnetici in atmosfera" Università degli Studi di Bologna, Anno Accademico 1999/2000; Tesi di Laurea in Ingegneria Elettronica
- 2) E. Strand: "Project Hessdalen" at <http://www.hessdalen.org>
- 3) R. Helliwell, "Whistlers and Related Phenomena", Stanford University Press 1965.
- 4) B.G. Hauge: Project EMBLA, Proceeding of the "International Conference on Engineering Education"; 6-10 August Oslo, Norway;
- 5) M. Teodorani; Erling Strand; Bjorn Gitle Hauge: The EMBLA 2001 Optical Mission; <http://www.itacomm.net/ph>

Acknowledgements

There are some people I would like thank, deeply. They are the persons who had the patience to listen to me and give me friendship, precious advice, technical assistance and even the financial possibility to be in the wonderful Hessdalen Valley. Here are their names:

Massimo Teodorani for his help to let me be in the EMBLA project and his great scientific assistance during the time I was in the Valley and during the data analysis;

Renzo Cabassi and ICPH/CIPH (Italian Committee for Project Hessdalen or Comitato Italiano per il Progetto Hessdalen), for their friendship, assistance and financial support to let me be in Hessdalen;

Erling Strand, leader of Hessdalen Project, for all the information he gave me during my days in the valley and during data analysis. Moreover he gave me the use of one car, as well as the place to live with my family in Hessdalen;

Andrea Cremonini, Bjorn Gitle Hauge, Simona Righini for their very important scientific conversations at the school. Moreover she gave us her help with sweet little Marina;

Dennis Gallagher from NASA Marshall Space Flight Center for his scientific advice;

William Taylor and William Pine from NASA-INSPIRE Project, Goddard Space Flight Center for their scientific assistance during data analysis;

Luigi Ciraolo, Luciano Cianchi and Paolo Moretti, all from CNR-IROE-Firenze; as well as Cesare Tagliabue, ISTGC; for their scientific support before and after my Hessdalen time;

Peder Skogaas for his friendship and important help to coordinate our work with the inhabitants, an important item to be more developed in the future;

Stelio Montebugnoli and Jader Monari from CNR-IRA-Medicina, Bologna, for their scientific assistance;

Jonathan Tisdall, AFTENPOSTEN daily Journalist, for his help in find out news about the Valley and Norway;

Caroline Korsvoll, DAGBLADET WEEKLY Journalist, for her fine article about our works in the valley;

Ellin Brattas with her husband Birger and Bjorne Lillevold with his wife Hallfrid, Hessdalen Valley residents, for giving us so much information about lights in the valley and how inhabitants feel about them, both now and in the past,

All the Norwegian people greeting us during our time in the Valley.

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Report on Coordinated Observations 11/2001

By Bill Pine
Ontario, California

The purpose of the Coordinated Observation Program is to provide an opportunity for INSPIRE participants to gather data at convenient times for purposes of comparing the resulting signals and attempting to interpret them. Since there is no manmade source of VLF that is being studied here, the signals of interest are those of natural origin. As in most natural radio listening, we would like to hear something “interesting”. Most of the time that would be whistlers, but other sounds such as tweeks, chorus, triggered emissions and even hiss are also interesting. Observing whistlers, however, remains the prize for faithful listening. The problem with whistlers is that they are not the most common natural radio signal. Since coordinated listening schedules are determined arbitrarily and in advance of the listening sessions, it is only a matter of luck if whistlers are available to be detected. The experience of the author is that whistlers are heard about once every four or five morning sessions. When they are present, you will probably hear a lot of them until the rotation of the earth carries the ducting magnetic field lines into an unfavorable alignment.

Conditions during November/2001 were mixed. Some observers were treated to an abundance of whistlers. This was especially true for those observers who listened earlier than just at the 8 AM and 9 AM times. When whistlers are present, it is more likely that they will be heard the closer to dawn that you observe. The following report includes sample spectrograms from contributing observers.

The following table summarizes the sessions monitored by observers.

| Date | 11/17 | | | | | 11/18 | | | | | |
|------|-------|------|------|------|------|-------|------|------|------|------|------|
| Time | 1300 | 1400 | 1500 | 1600 | 1700 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 |
| Team | | | | | | | | | | | |
| S-1 | C | | | | | | | | | | |
| S-2 | C | C | | | | | | | | | |
| S-4 | | | | P | P | | | | | P | P |
| I-1 | | | | | | M | M | M | M | | |
| I-3 | M | M | M | M | | | M | M | M | | |
| I-4 | | | | P | P | | | | | | P |

Times indicated are UT times.

The letter in the box indicates the time zone of the observer:

E = EST = UT - 5, C = CST = UT - 6,

M = MST = UT - 7 and P = PST = UT - 8

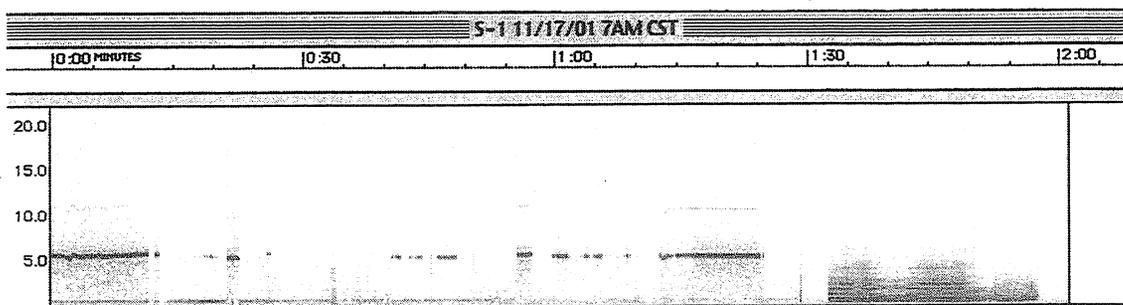
| | | | |
|------------|----------|--|-------|
| Observers: | Team S-1 | Kathryn Robinson, O'Connor High School Helotes, TX | (CST) |
| | Team S-2 | Mark Mueller, Brown Deer High School Brown Deer, WI | (CST) |
| | Team S-4 | Bill Pine, Chaffey High School Ontario, CA | (PST) |
| | Team I-1 | Shawn Korgan, Gilcrest, CO | (MST) |
| | Team I-3 | Robert Bennett, Las Cruces, NM | (MST) |
| | Team I-4 | Mitchell Lee, San Jose, CA | (PST) |

For analysis purposes, a spectrogram was made of the first two minutes of each 12-minute hourly session. Additional spectrograms were made of any items of interest and of any segments requested by the observer. Time marks were placed on the tape every two minutes and a complete log was made of each session.

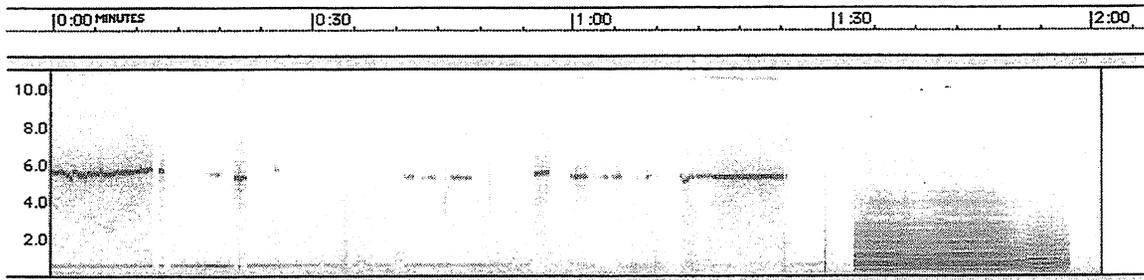
11/17/01 1300 UT 7 AM CST Team S-1 O'Connor High School, Helotes, Texas

Leading off the observations was the team from O'Connor High School in Helotes, TX. Physics teacher Kathryn Robinson was joined by Mark Bratton, Kelly Garrett, James Higdon, Kevin Lessard, Stacey McClister, Justin Warren and Karen Wood.

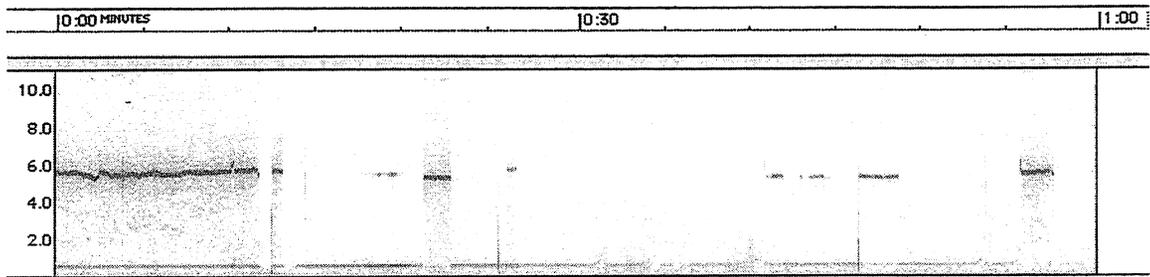
The O'Connor team experienced some intermittent problems with oscillation on the receiver, but sferics were clearly audible and powerline hum was very low.



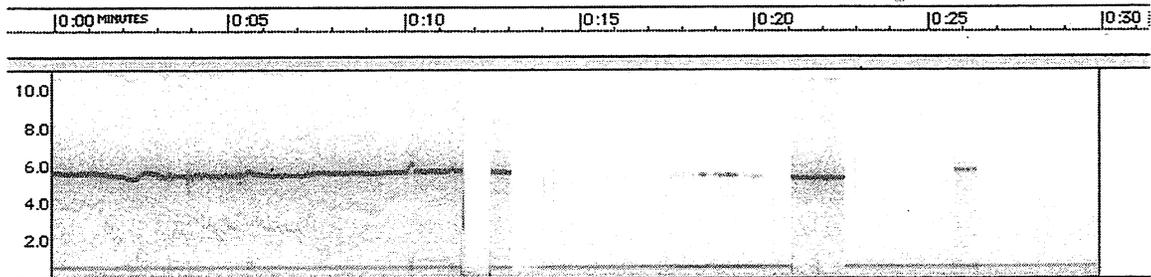
A spectrogram of the first 2 minutes. The receiver oscillation appears as a horizontal line above 5 kHz. The signal in the last 30 seconds is a "motorboat" sound of unknown, but probably manmade, origin.



The first 2 minutes using a frequency range of 0-11 kHz.

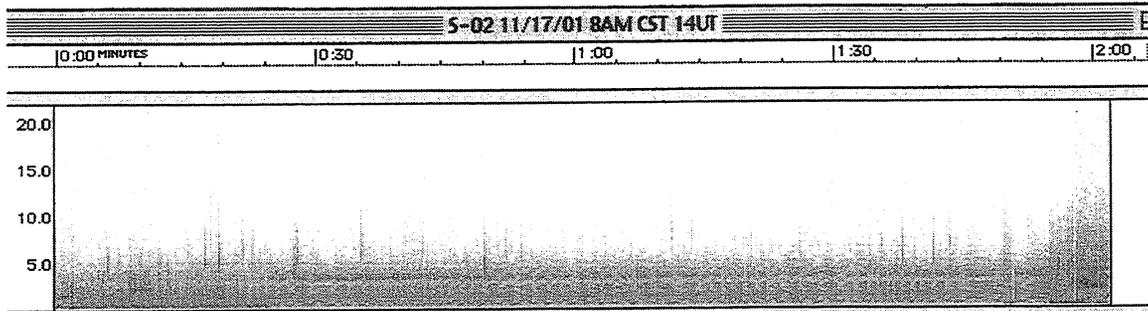


The first minute.

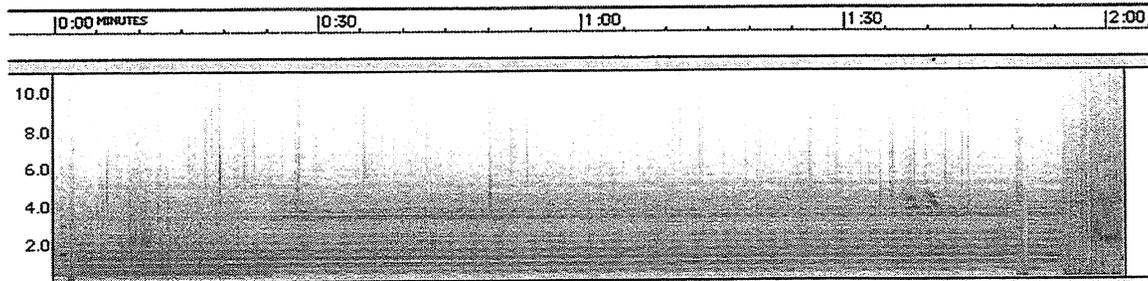


The first 30 seconds.

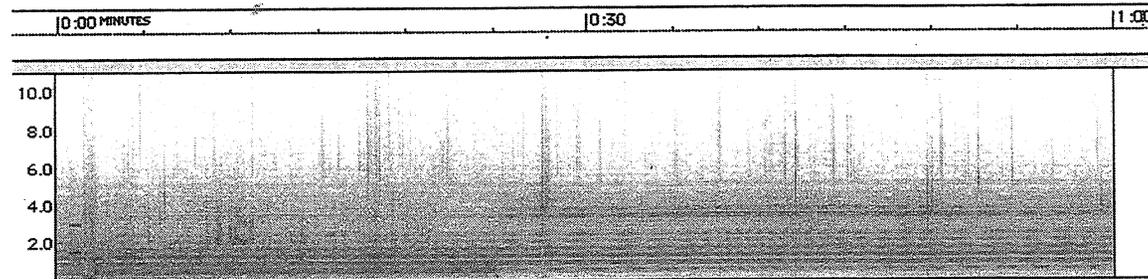
11/17/01 1400 UT 8 AM CST Team S-2 Brown Deer High School, Brown Deer, WI



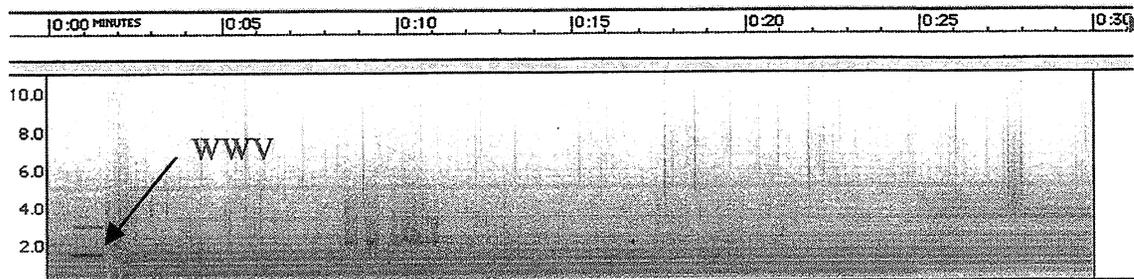
Mark Mueller observed from Brown Deer High School at 7 AM and 8 AM local. Above is the first 2 minutes at 8 AM. Lots of manmade hum at this site. Sferics are easily heard above the hum. Sferics can be seen on the spectrogram extending above the hum to above 10 kHz. Sferics were more dense at 7 AM.



0-11 kHz frequency range.



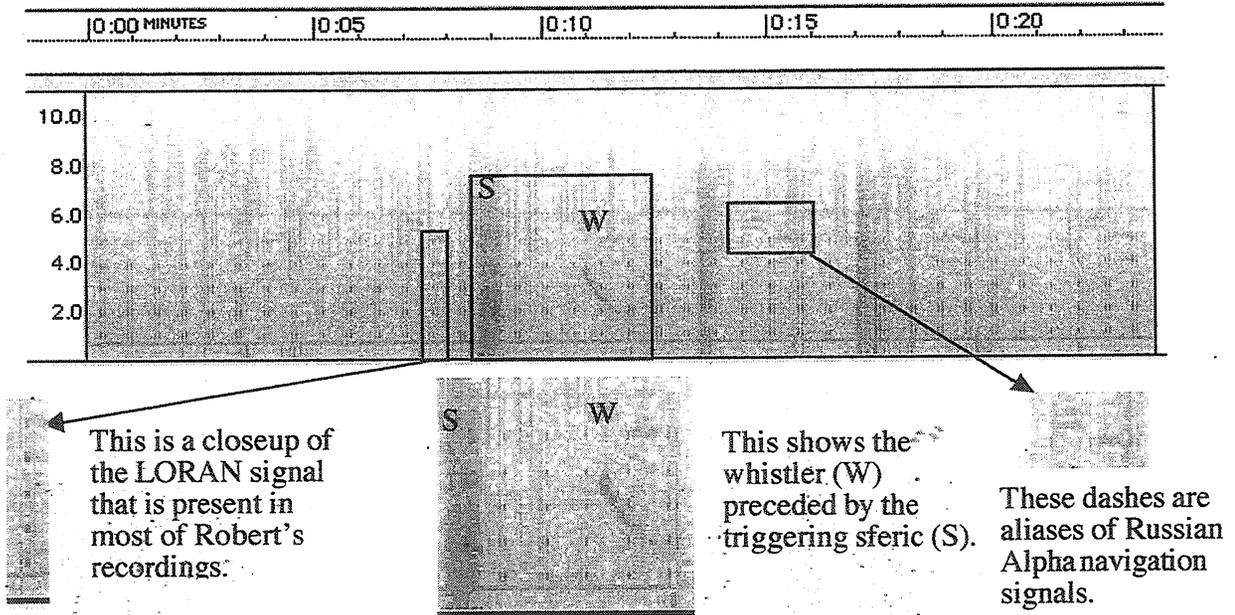
First minute.



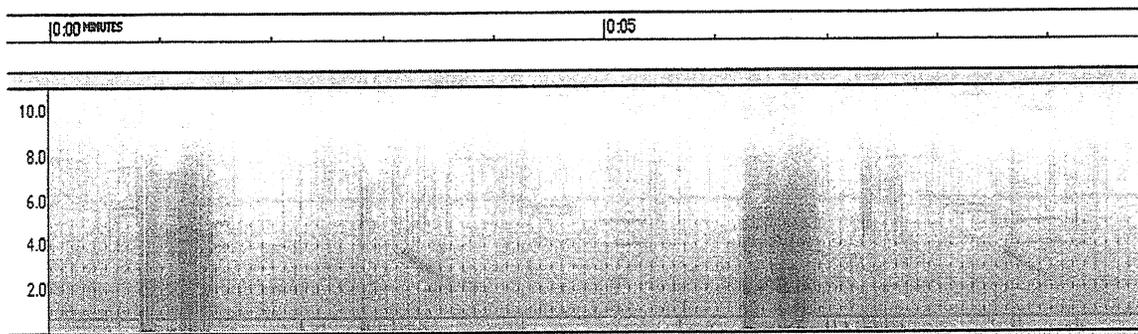
First 30 seconds. Note the WWV tones just after the start.

11/17/01 1500 UT 6 AM MST Team I-03 Robert Bennett, Las Cruces, NM

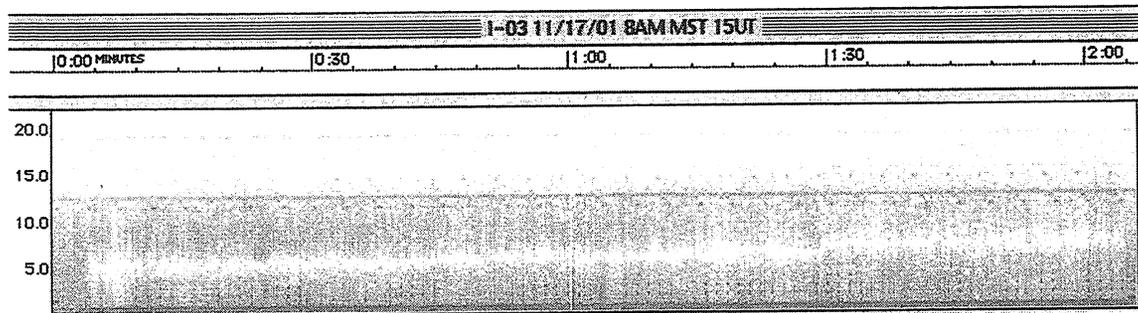
The 17th was a nice day for outdoor monitoring. There were rain showers in the area the previous day and the desert was damp but not wet enough to make the dirt roads impassable. I arrived on site at 0500 MT and there was ground fog all over, no wind and temperature about 30 degrees F. I setup and got ready to monitor by 0530 using a 6-foot whip antenna. When I tested my setup, I was hearing whistlers so I started recording. The first tape (side A) starts at 0540 MT and ends at 0609 MT. I would have recorded continuously until 0630, however I didn't have enough blank tapes. During the 30-minute period of the recording, I detected many whistlers, several whistler echo and some instances of strong static bursts (lightning) triggering a whistler. This is the first time I have recorded a whistler, its lightning trigger and the whistler echo. I recorded over 20 strong whistlers during this interval.



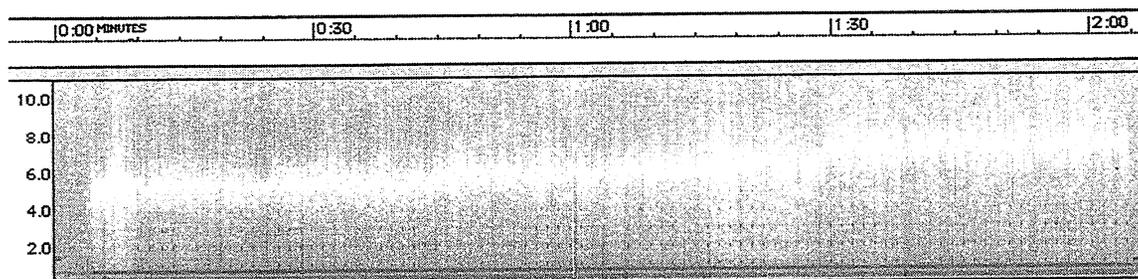
This whistler was recorded at 1241 UT. The sferic precedes the whistler by about 2 seconds.



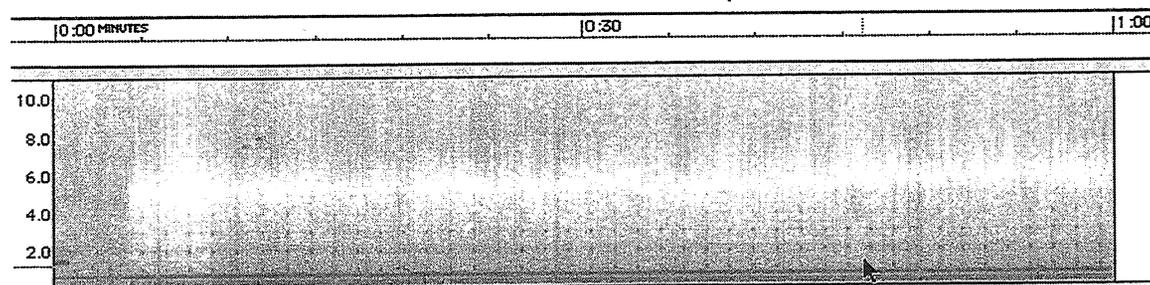
Two more whistlers each preceded by a strong sferic. Most whistlers recorded this morning were 2-hop whistlers originating with "local" lightning and bouncing off the ionosphere in the Southern Hemisphere and returning to be heard as a whistler.



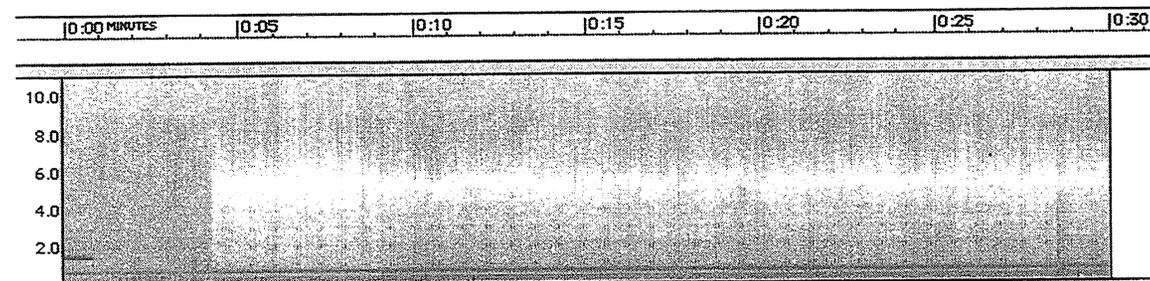
. In this spectrogram, Alpha dashes are visible as are a couple of horizontal lines at about 13 kHz and 19 kHz.



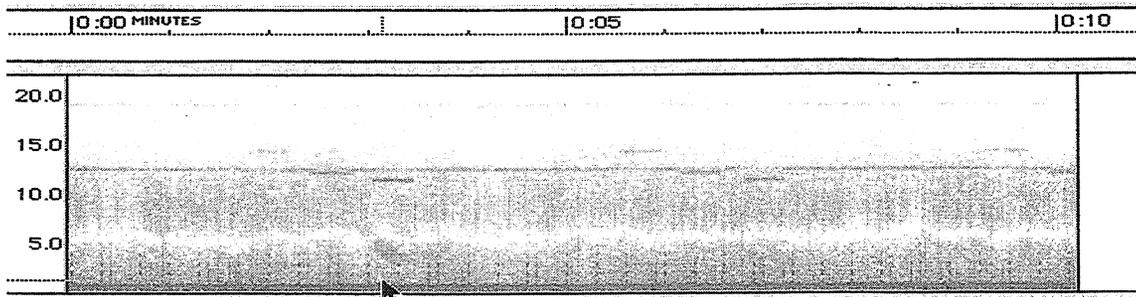
0-11 kHz.



Arrow points to whistler at 15:00:47 UT



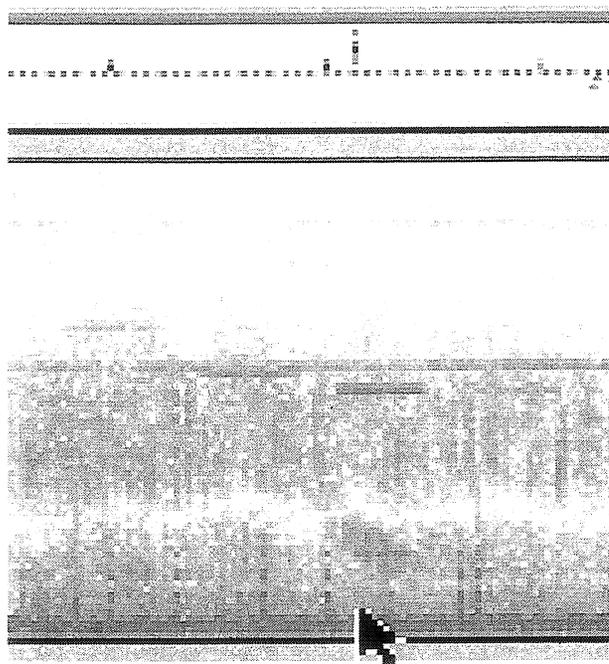
First 30 seconds. The 1500 UT WWV tone is the dash at the beginning.



The whistler at 15:00:47 UT. In this 0-22 kHz view, Alpha signals are prominent as are a couple of carriers at 13 kHz and 19 kHz.

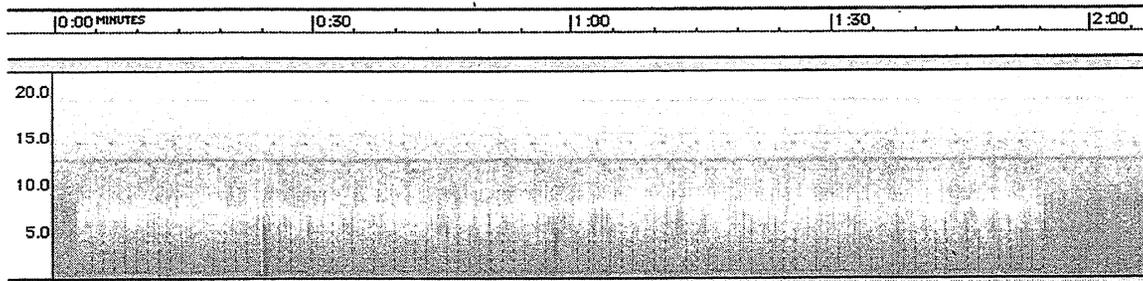


A closeup of the Alpha navigation signals. These signals consist of a three-tone sequence repeating every 4 seconds.

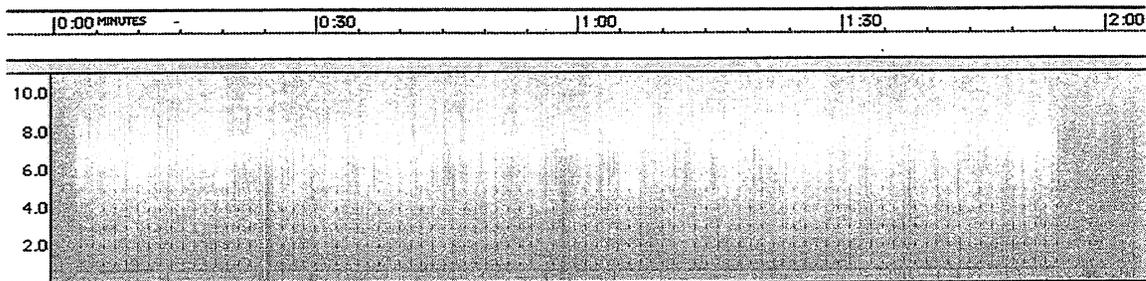


Enlargement of the whistler also showing one set of Alpha signals.

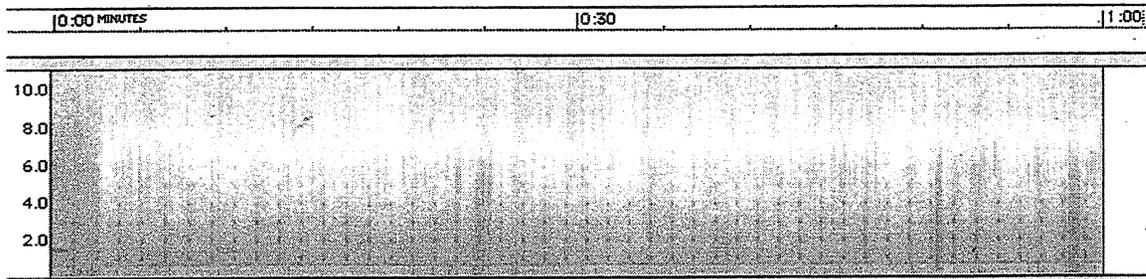
11/17/01 1600 UT 7 AM MST Team I-03 Robert Bennett, Las Cruces, NM



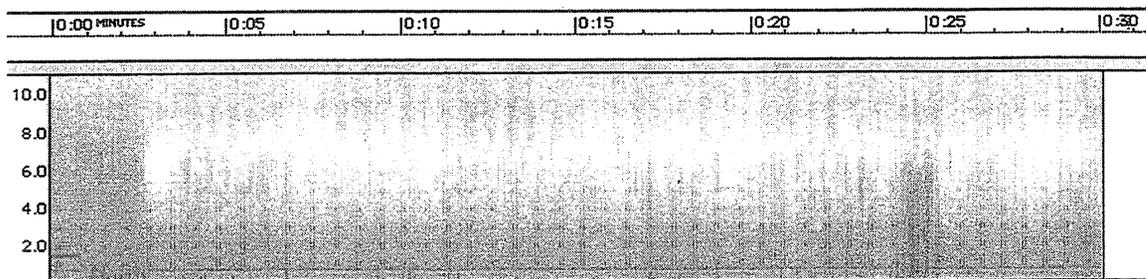
By 9 AM local time, the whistlers have stopped, but dense sferics continue.



0-11 kHz frequency range.



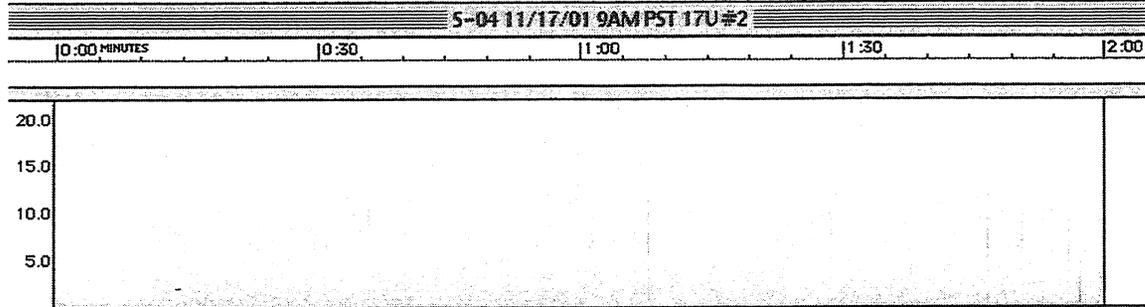
First minute. LORAN signals are easily visible – and the “clacking” sound is prominent!



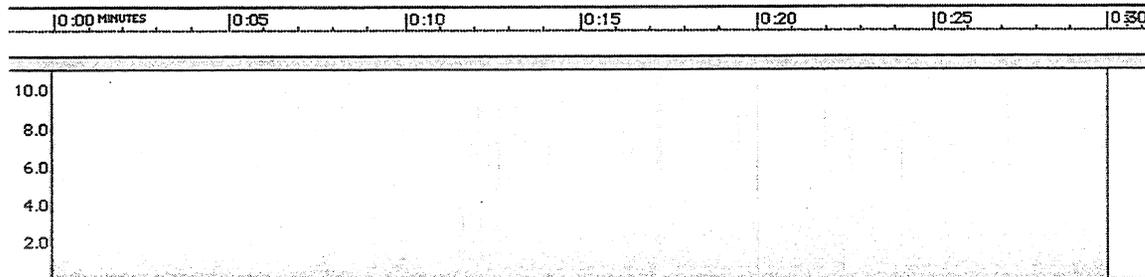
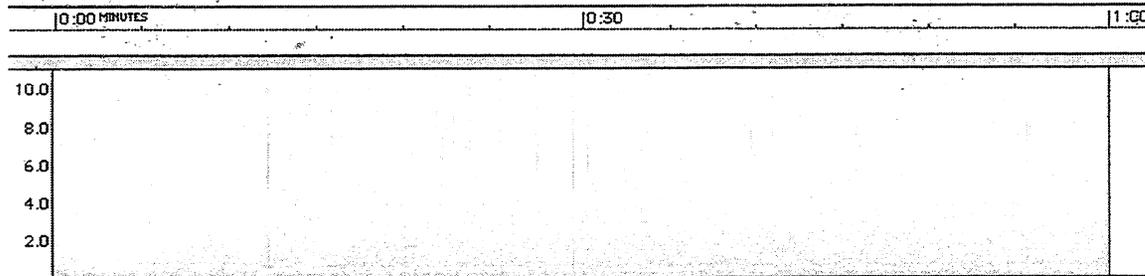
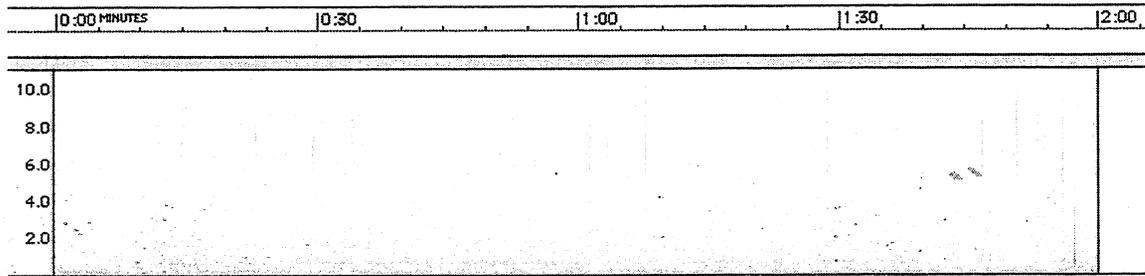
First 30 seconds. .

11/17/01 1700 UT 9 AM MST Team S-04 Chaffey High School, Ontario, CA

On the 17th, Bill Pine, Physics teacher, was joined by Lorena Flores, Zujeith Hernandez, Elizabeth Mercado, and Josh Miller. Conditions were quiet with sferics predominating.

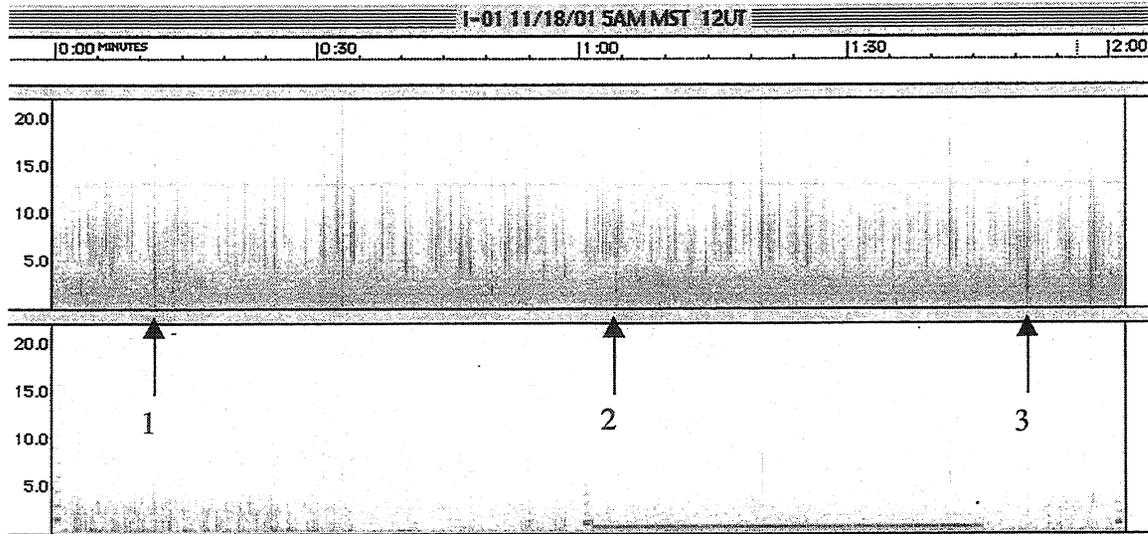


Receiver #2 Zujeith Hernandez

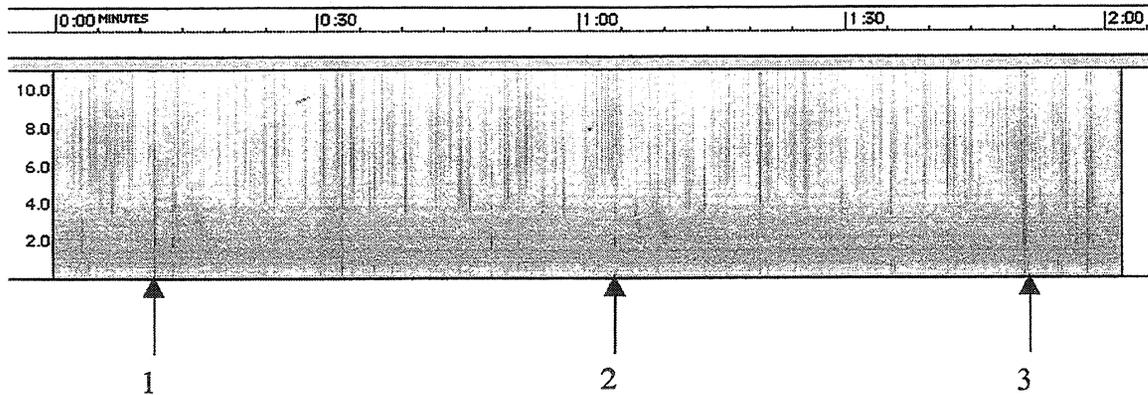


11/18/01 1200 UT 5 AM MST Team I-01 Shawn Korgan, Gilcrest, CO

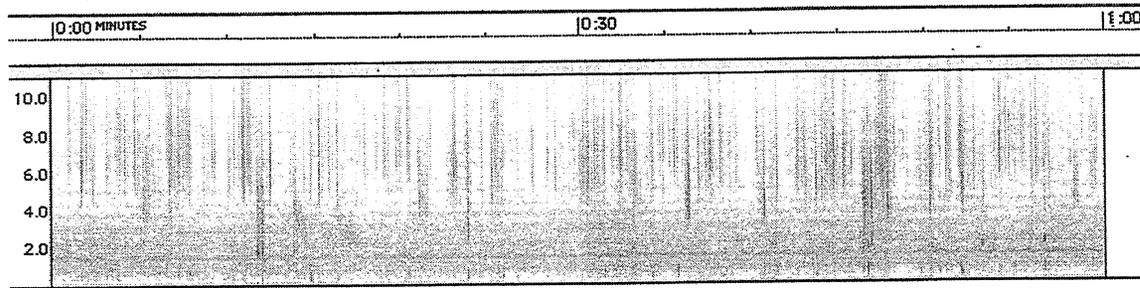
Shawn Korgan was up early at his prairie observing site.



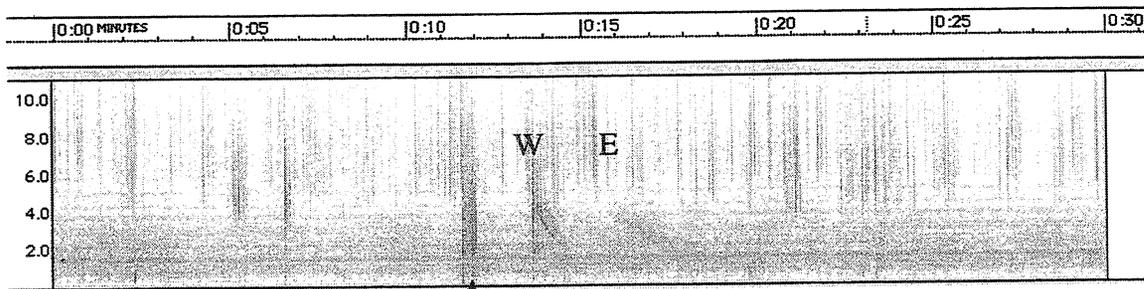
Data on top track, WWV on bottom track. 1, 2 and 3 point to strong sferics followed by strong whistlers and echoes. The whistlers may be 2-hop originating in the Northern Hemisphere. The echoes would be 4-hop.



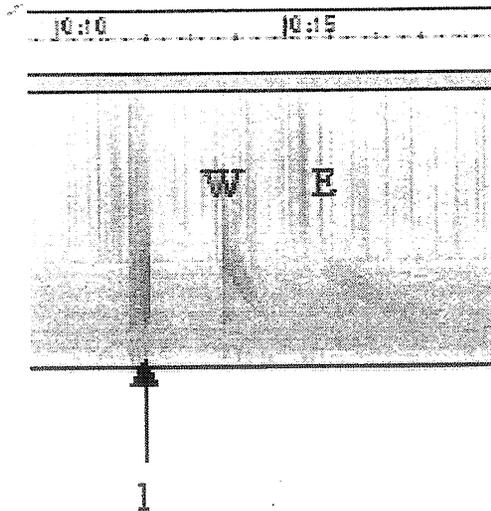
0-11 kHz frequency range. Whistlers and echoes are visible following the sferics.



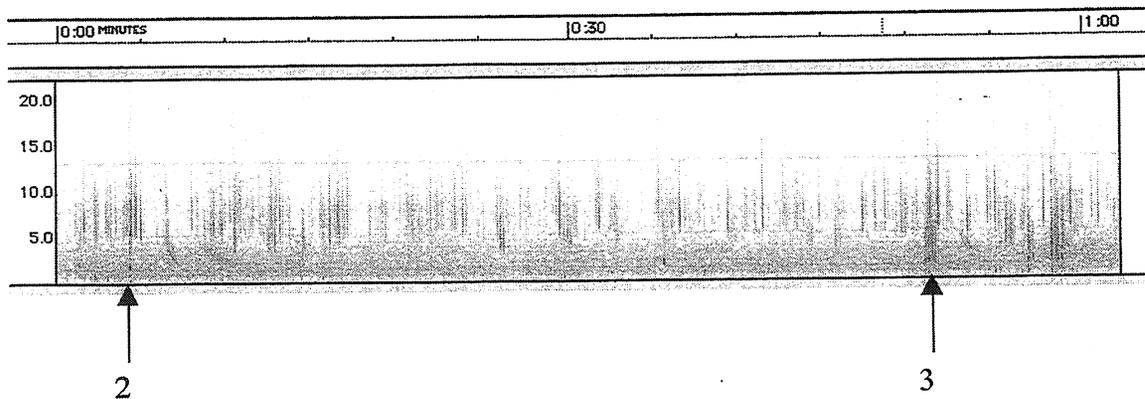
1
First minute showing sferic #1 that gave rise to a whistler followed by an echo.



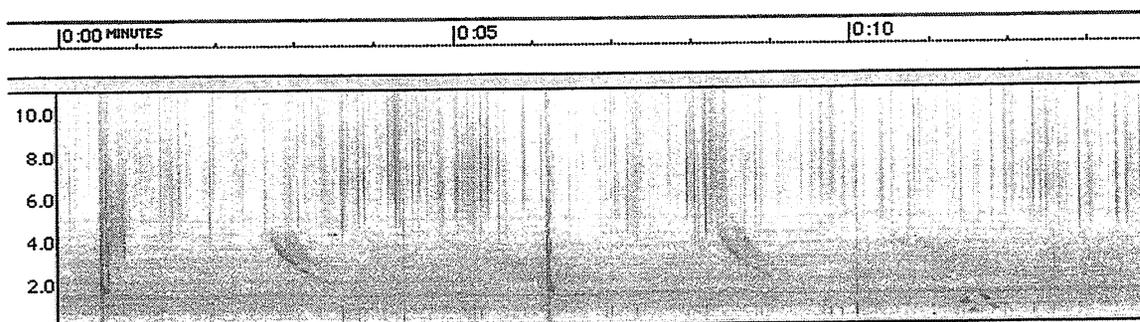
1
The first 30 seconds showing sferic #1 followed by the whistler (W) and echo (E).



Enlargement of the sferic, whistler and echo.

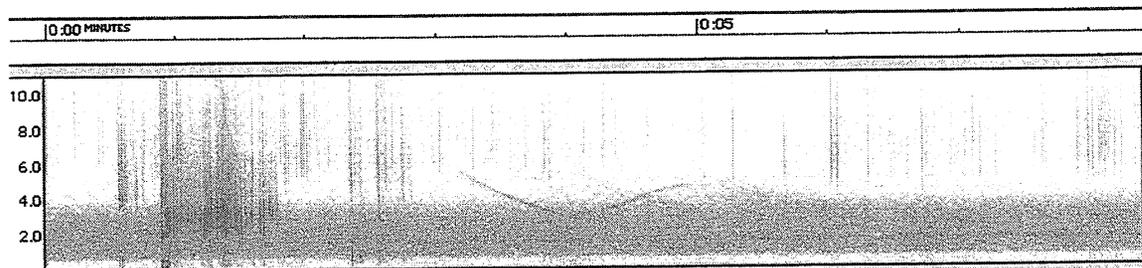


This is the second minute with sferics 2 and 3 indicated.



This shows two tweeks logged at 12:03:31 and 12:03:36. Note the whistlers follow after identical time intervals.

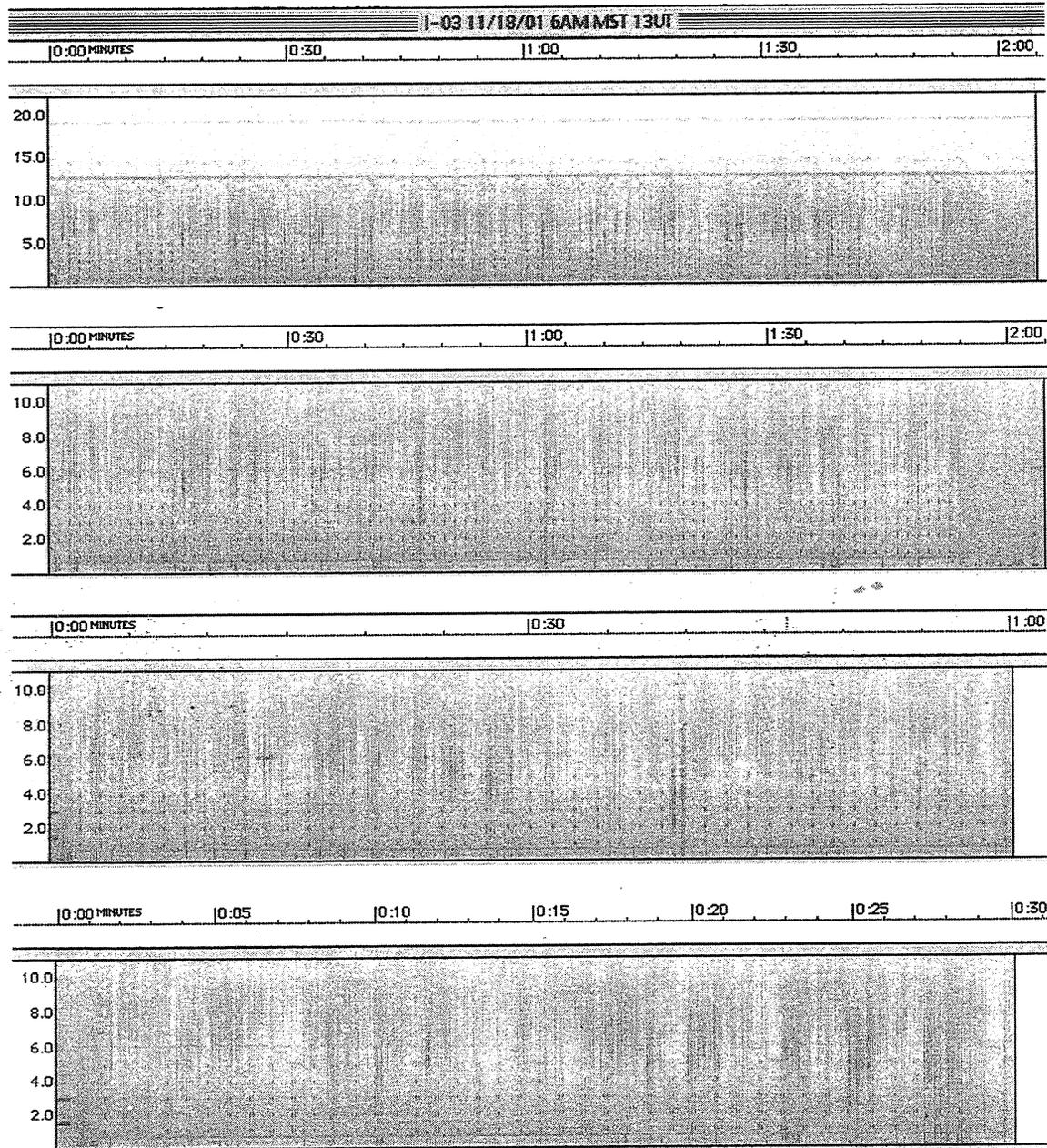
Later on the 18th, Shawn logged a strange sound. The spectrogram is also strange!



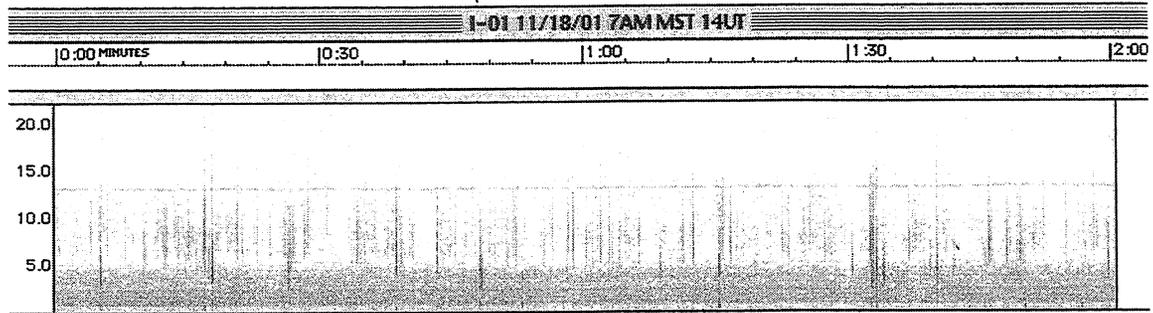
Shawn's guess is that this is a whistler blended with a riser with an echo of the whistler crossing the riser. Notice the combination extends over 2.5 seconds.

11/18/01 1300 UT 6 AM CST Team I-03 Robert Bennett, Las Cruces, NM

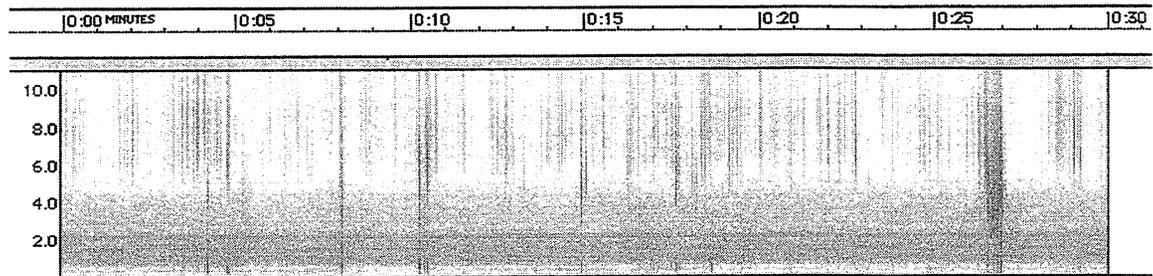
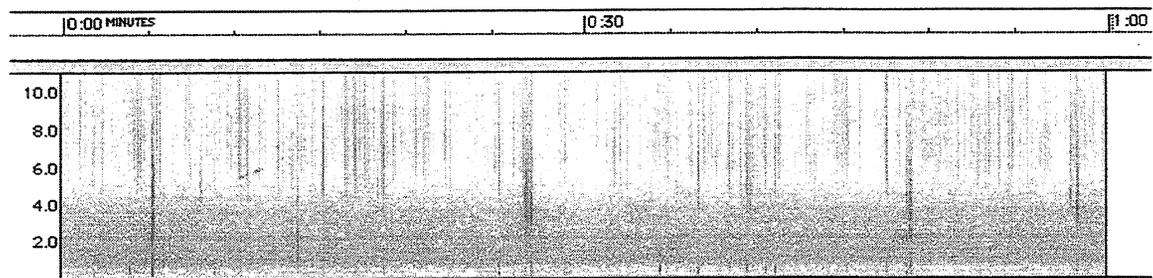
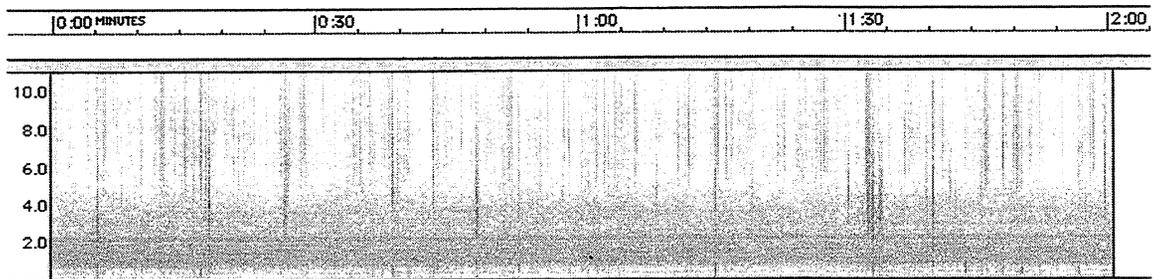
Strong, dense sferics were the rule on the 18th in New Mexico.



11/18/01 1400 UT 7 AM MST Team I-01 Shawn Korgan, Gilcrest, CO

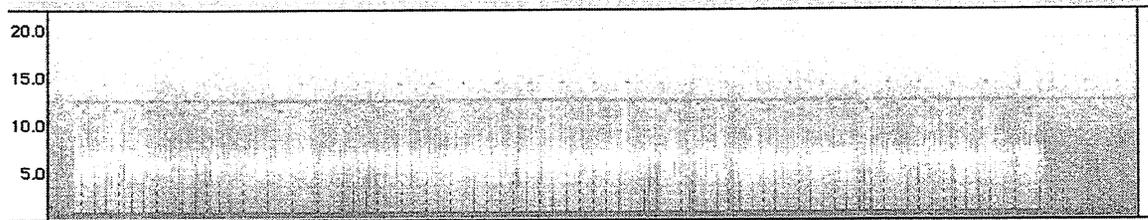


The band below 5 kHz is hiss, which sounds like white noise with varying loudness..

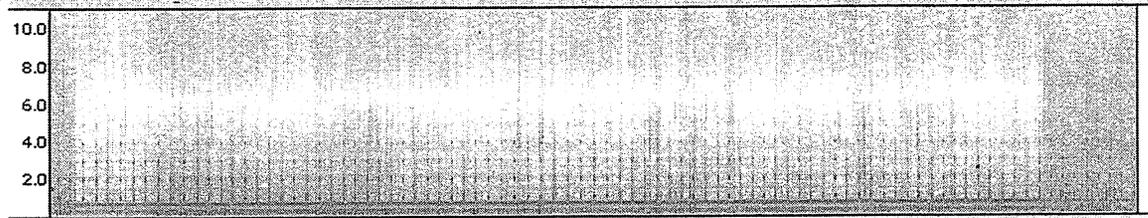


11/18/01 1500 UT 8 AM CST Team I-03 Robert Bennett, Las Cruces, NM

I-03 11/18/01 8AM MST 15U
0:00 MINUTES 0:30 1:00 1:30 2:00



0:00 MINUTES 0:30 1:00 1:30 2:00



0:00 MINUTES 0:30 1:00

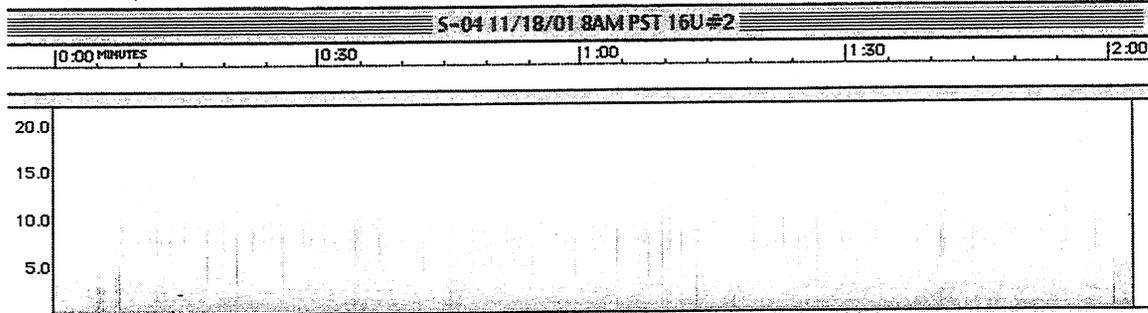


0:00 MINUTES 0:05 0:10 0:15 0:20 0:25 0:30

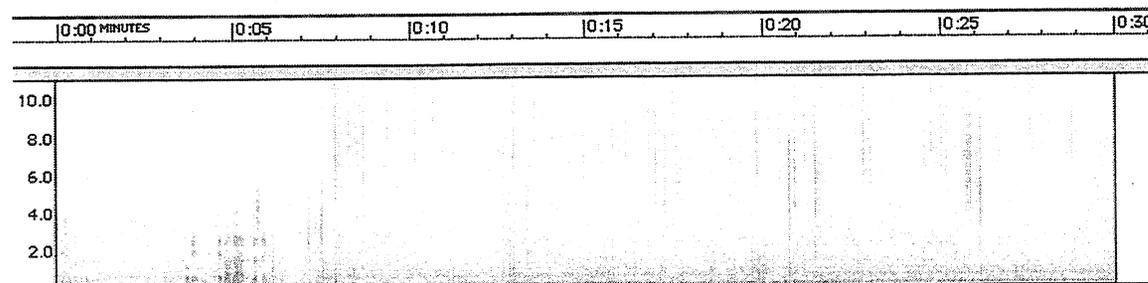
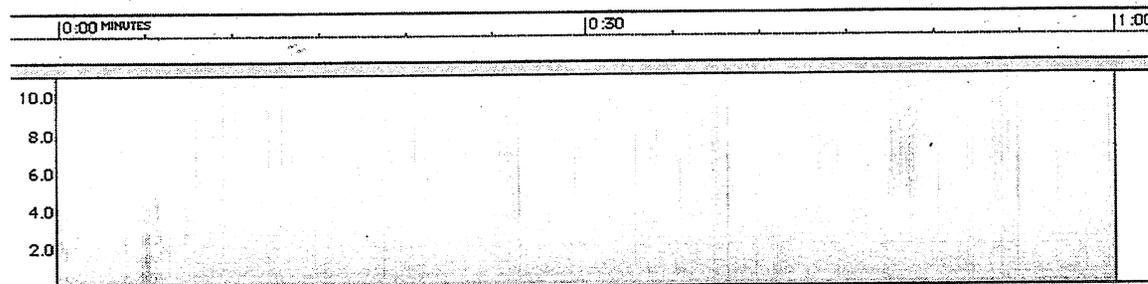
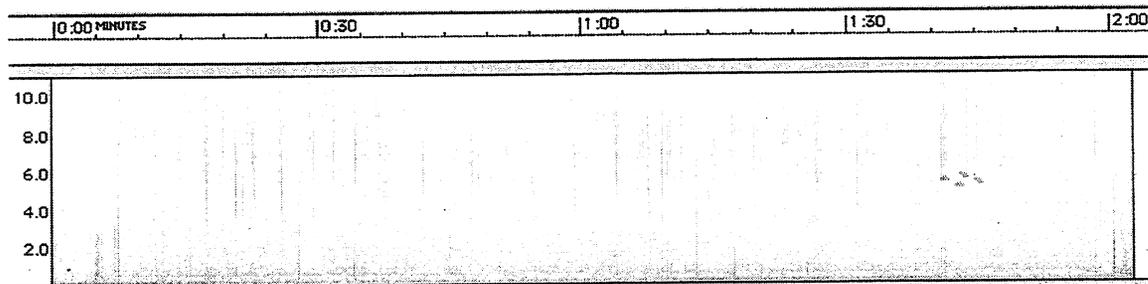


11/18/01 1600 UT 8 AM PST Team S-4 Chaffey High School, Ontario, CA

Chaffey observers on November 18 included Anna Choe, Lorena Flores, Daisy Medina, Elizabeth Mercado, and Shelley Su.

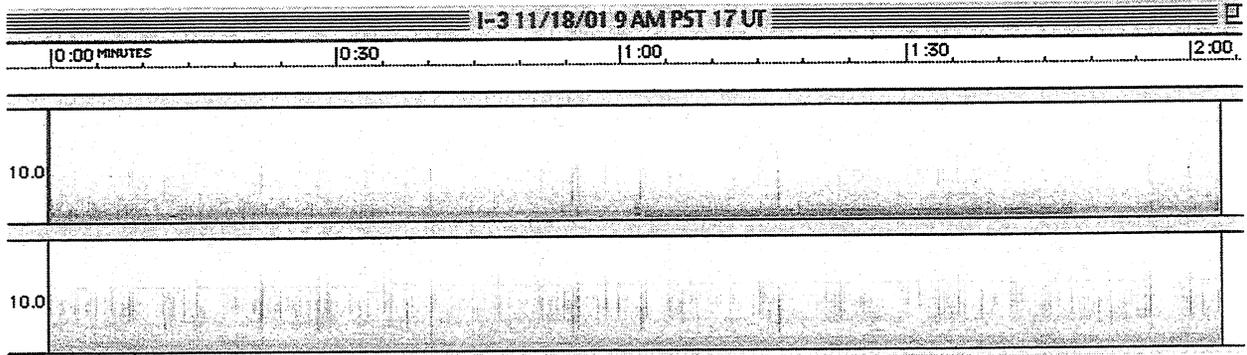


Conditions were again quiet with medium density sferics.

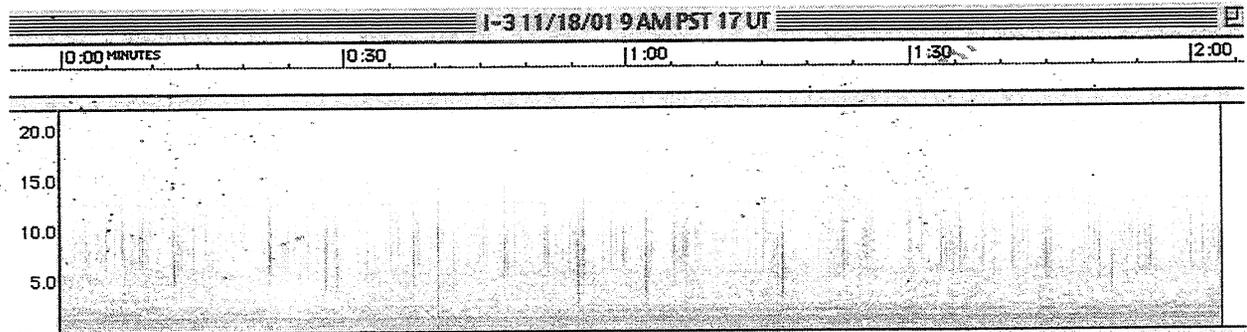


11/18/01 1700 UT 9 AM PST Team I-4 Mitchell Lee, San Jose, CA

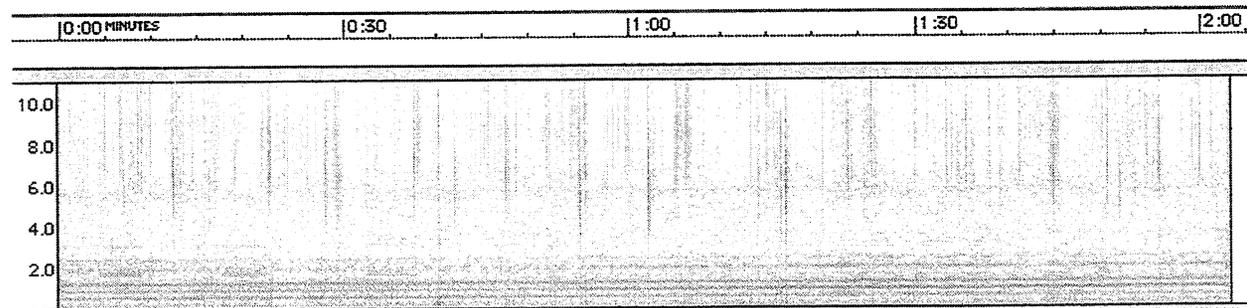
New observer, Mitchell Lee of San Jose, California, was observing from Onion Valley in the High Sierras. Conditions in Northern California were very similar to those recorded in Southern California. Mitchell logged occasional tweeks and a couple of whistlers. No whistlers were detected in Southern California.



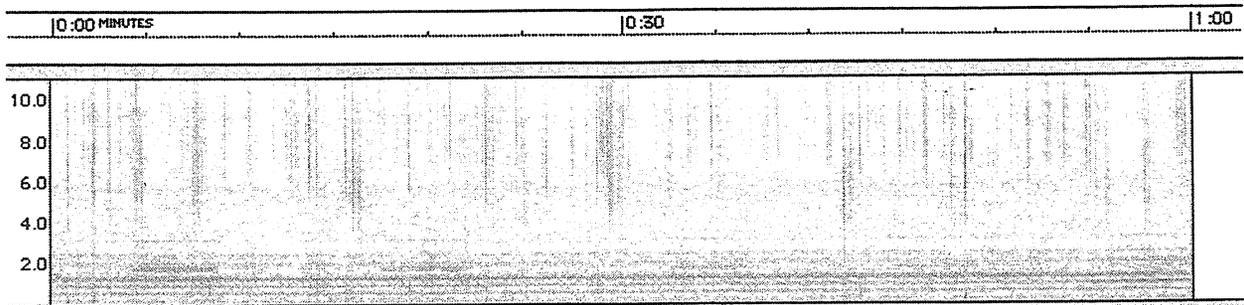
WWV is on the top channel, natural radio on the bottom channel.



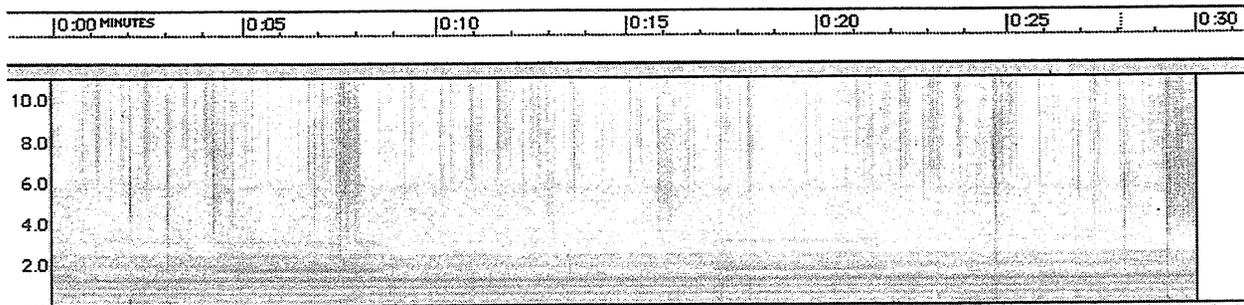
This is the data channel using a 0-22 kHz frequency range and showing the first two minutes.



The first two minutes using a 0-11 kHz frequency range. Horizontal bands below 2 kHz show a low level of 60 Hz hum and harmonics. The sferics are easily the predominate signal on the tape.



The first minute.



The first 30 seconds.

The conclusion of the 1700 UT observations marked the end of the November 2001 Coordinated Observing schedule.