Report on Coordinated Observations 4/98

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 that time that would be whistlers, but other sounds such as tweeks, chorus, triggered emissions and even hiss are also interesting. Whistlers, however, remain 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. Spring (April 25 and 26) provided abundant whistlers for several observers. The following report includes sample spectrograms from contributing observers.

This table summarizes the sessions monitored by observers.

Date	4/25						4/26					
Time	1100	1200	1300	1400	1500	1600	1100	1200	1300	1400	1500	1600
Team												
5	E	E	E	E			E	E	E	E		
6					P	P					P	P
7					P	P					P	P
15			M	M	M							
21			C	C								
25									C			

The times indicated are UT times.
The letter in the box indicates the time zone of the observer:
E = EDT = UT-4, C=CDT = UT-5,
M = MDT = UT-6 and P = PDT = UT-7

Observers:	Team 5	Jean-Claude Touzin, St. Vital, Quebec, CANADA	(EDT)
	Team 6	Bill Pine, Chaffey High School, Ontario, California	(PDT)
	Team 7	Dean Knight, Sonoma Valley HS, Sonoma, California	(PDT)
	Team 15	Robert Bennett, Las Cruces, New Mexico	(MDT)
	Team 21	Phil Hartzell, Aurora, Nebraska	(CDT)
	Team 25	Norm Anderson, Cedar Falls, Iowa	(CDT)

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.

4/25/98

Jean-Claude Touzin, in St. Vital, Quebec, started off the day at 0700 EDT (1100 UT) and monitored each of the next four hours.

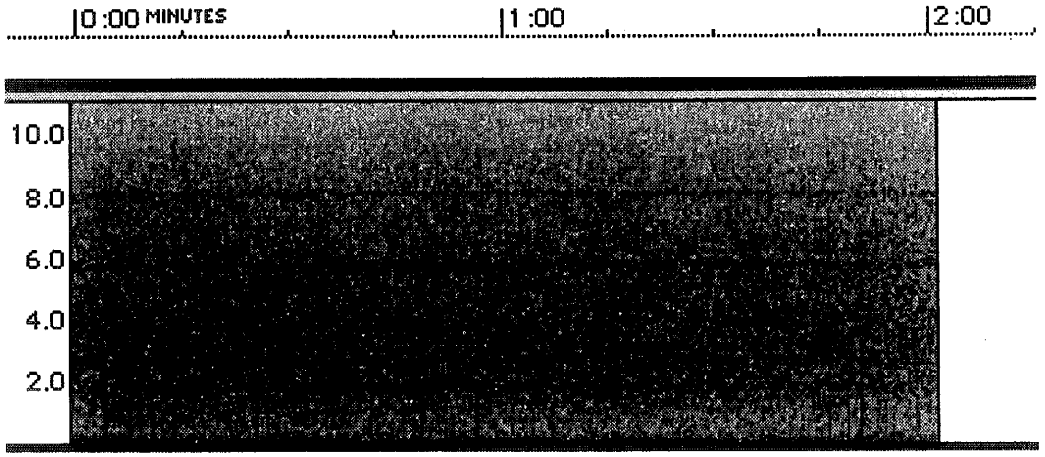
Team 5

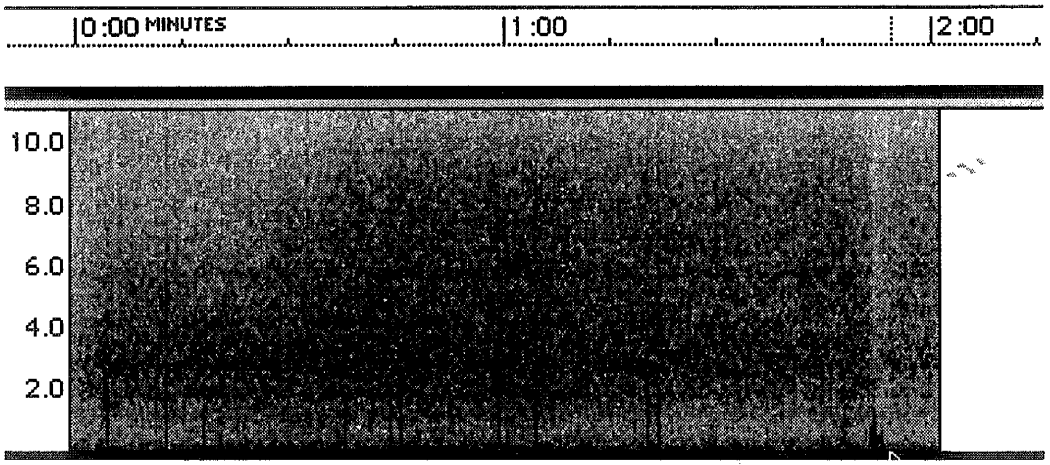
St.Vital, QC

4/25

0700 EDT
1100 UT

Low level of sferics.
Some hiss.





Team 5

St.Vital, QC

4/25

0800 EDT
1200 UT

Hiss more pronounced.

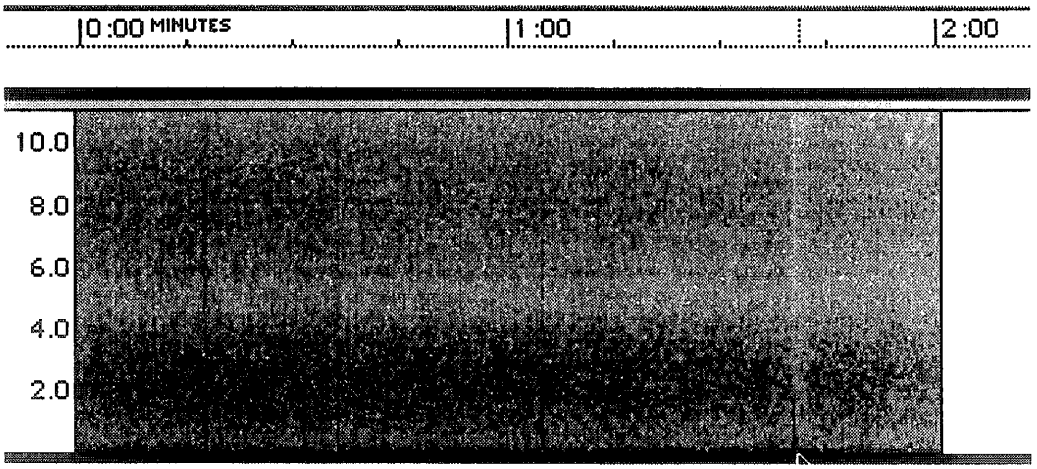
Team 5

St.Vital, QC

4/25

0900 EDT
1300 UT

Hiss shows up strongly below
4 kHz.



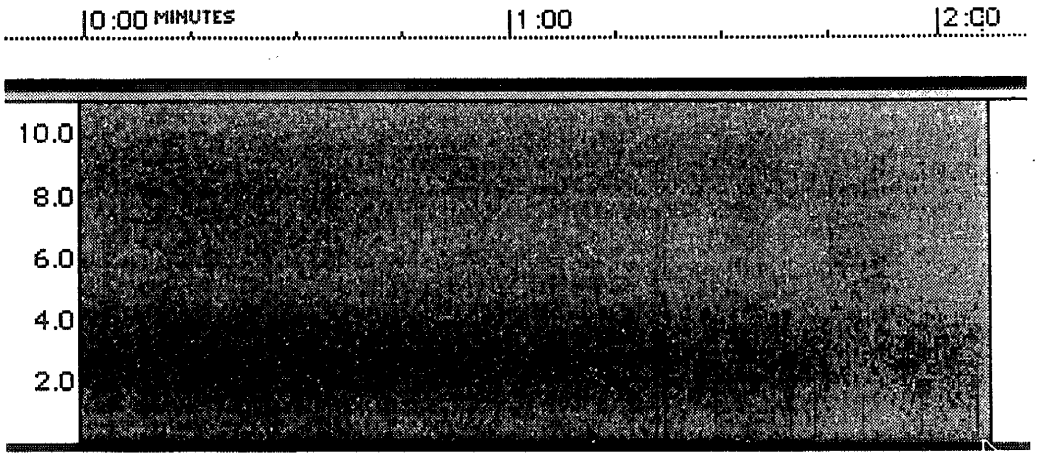
Team 5

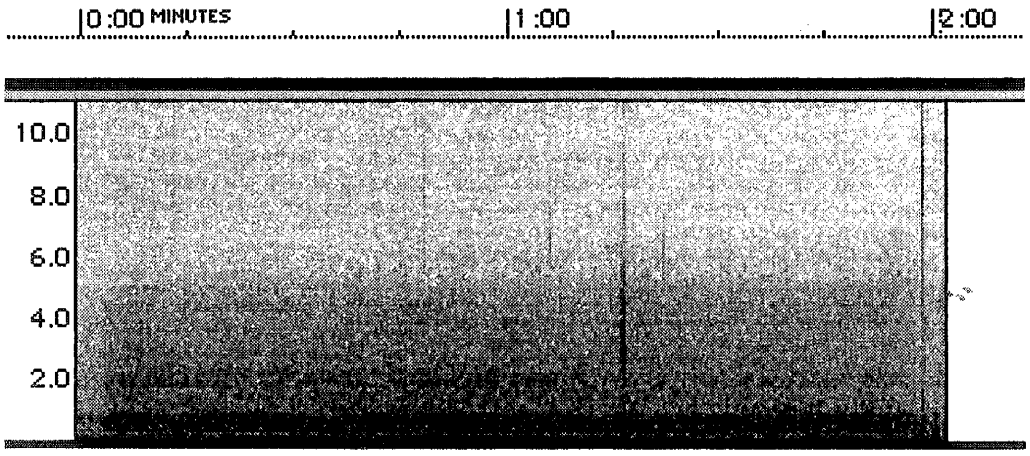
St. Vital, QC

4/25

1000 EDT
1400 UT

Pretty strong chorus has developed..





Team 21

Aurora, NE

4/25

0800 CDT
1300 UT

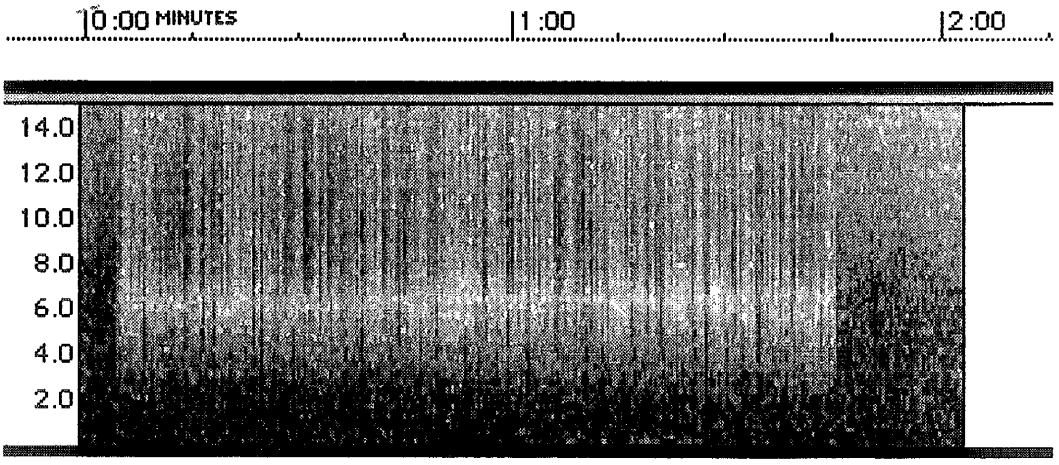
Conditions similar to those in Quebec...

Team 15

Las Cruces, NM

4/25

0700 MDT
1300 UT

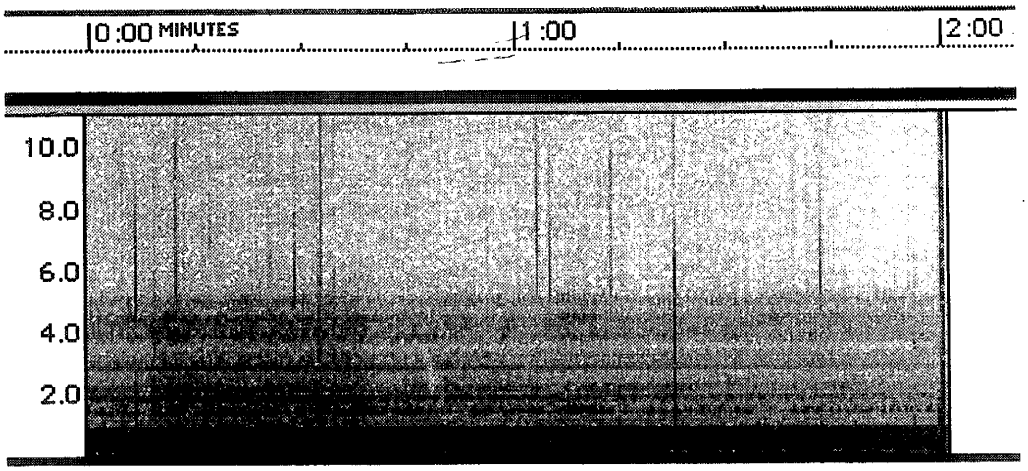


Team 21

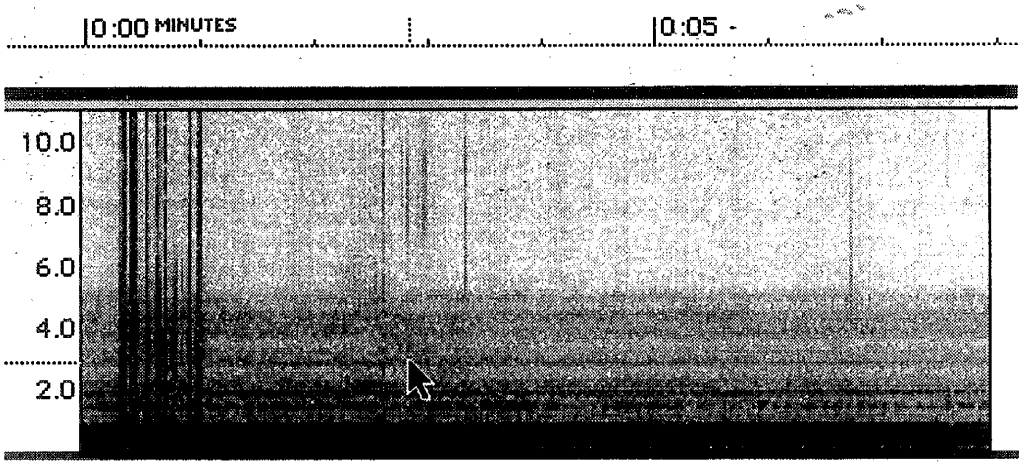
Aurora, NE

4/25

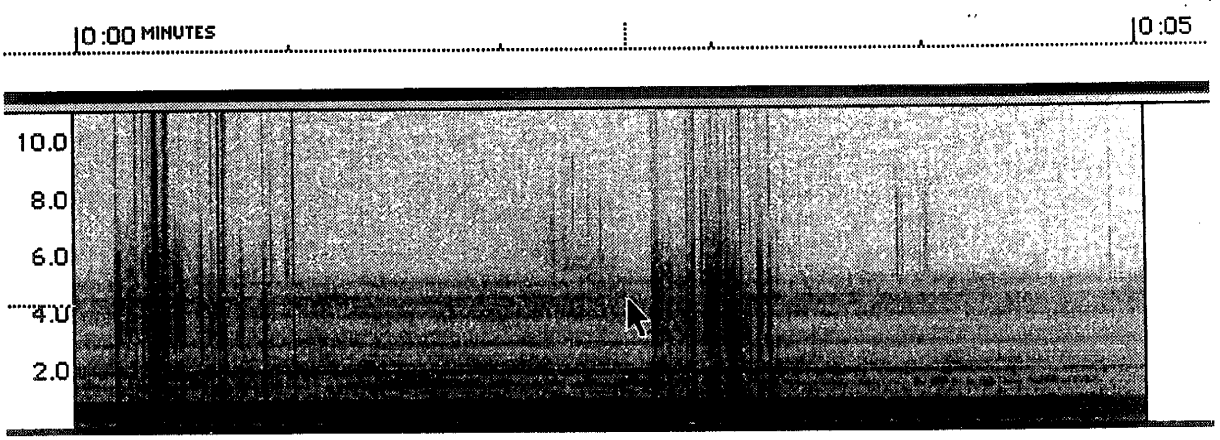
0900 CDT
1400 UT
Still quiet, but occasional whistlers are heard.



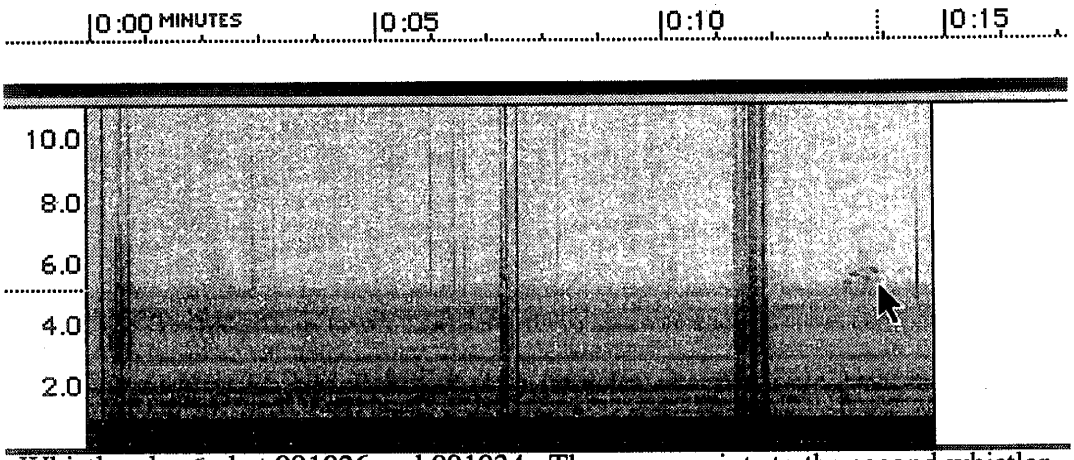
The whistlers recorded by Phil Hartzell in Nebraska are two-hop whistlers. These originate with "local" lightning discharges. "Local" means within 2000 kilometers of the observer - Phil reported clear skies where he was, but the occasional strong bursts indicate strong lightning within VLF range. Two-hop whistlers consist of VLF signals which originate locally and propagate along a magnetic field line to the southern magnetic hemisphere, reflect from the top of the ionosphere and return along the magnetic field line to the northern magnetic hemisphere where they are heard near the point of the original lightning discharge. Since they were returning to the lower atmosphere near Nebraska, they were not detected in Quebec.



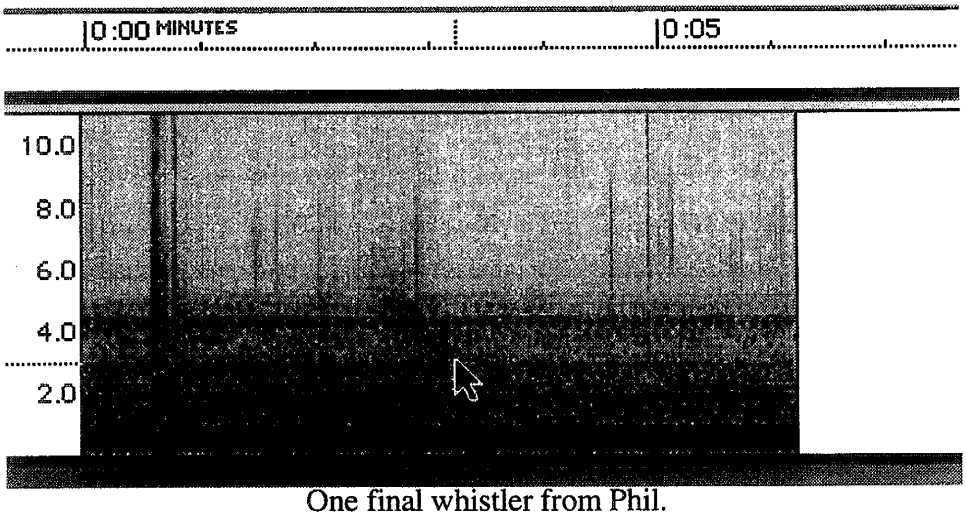
Strong whistler logged at 090531.
The "local" sferic that generated the two-hop whistler appears as a burst in the first second.



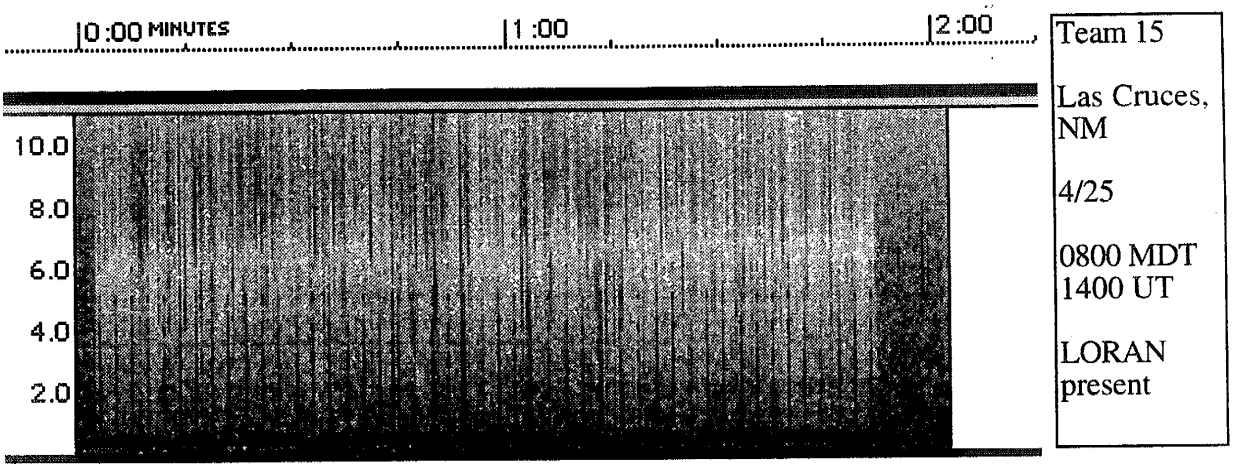
Arrow shows whistler logged at 090922; second whistler (090924) may be at the far right. The strong sferics that generated the whistlers are prominently visible.

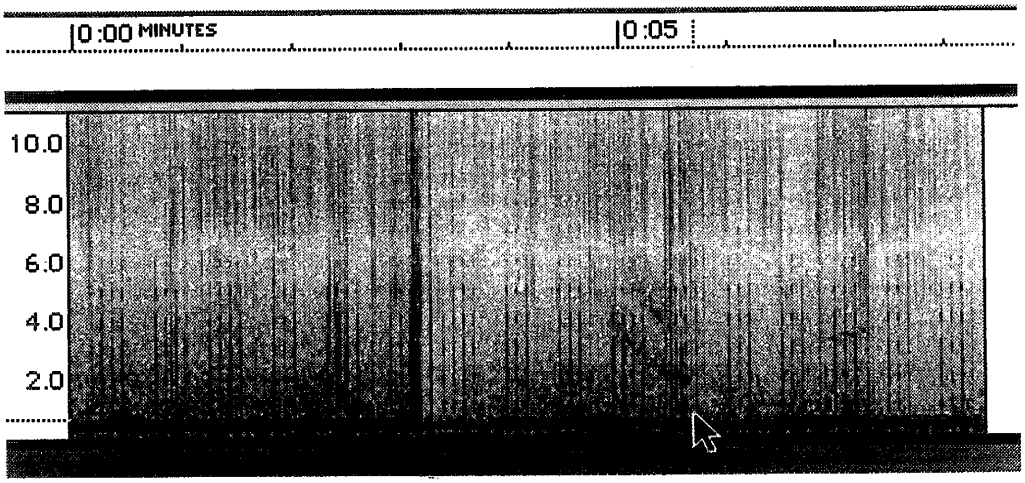


Whistlers logged at 091026 and 091034. The arrow points to the second whistler. The first whistler appears at the 2-second location.

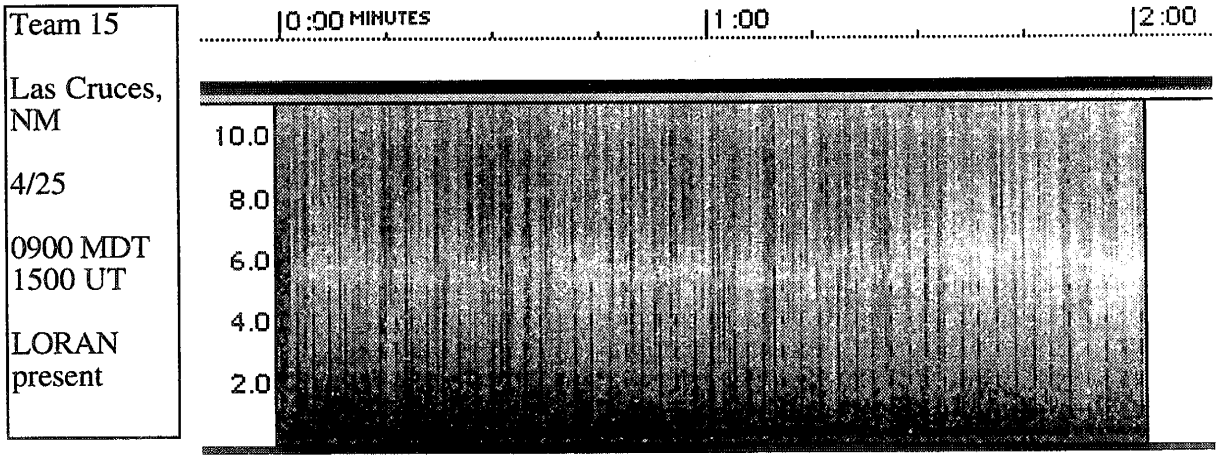


One final whistler from Phil.





Whistler captured by Bob Bennett on 4/25/98



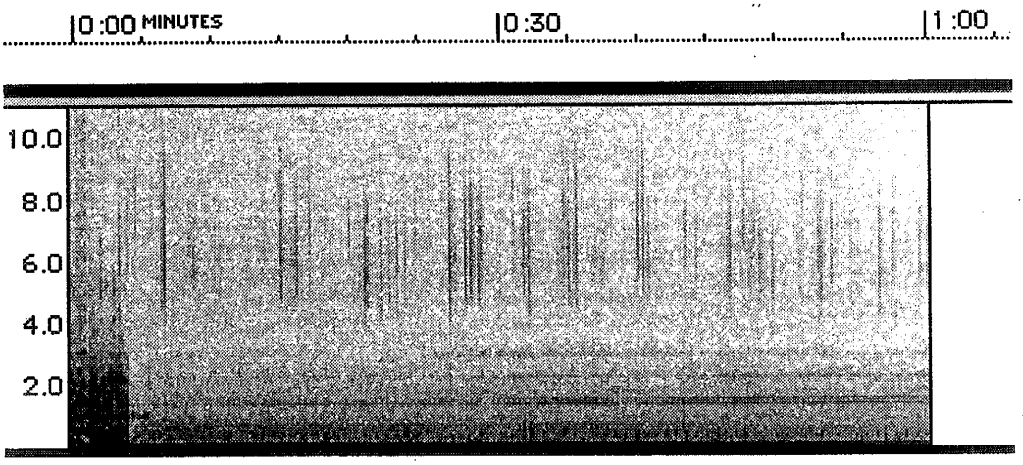
Team 7

Sonoma, CA

4/25

0800 PDT
1500 UT

Medium density sferics



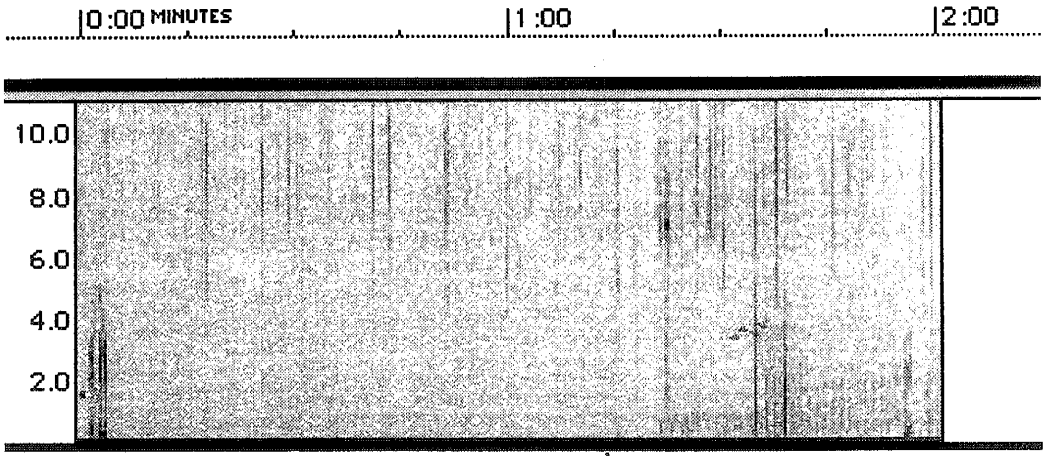
Team 6

Ontario, CA

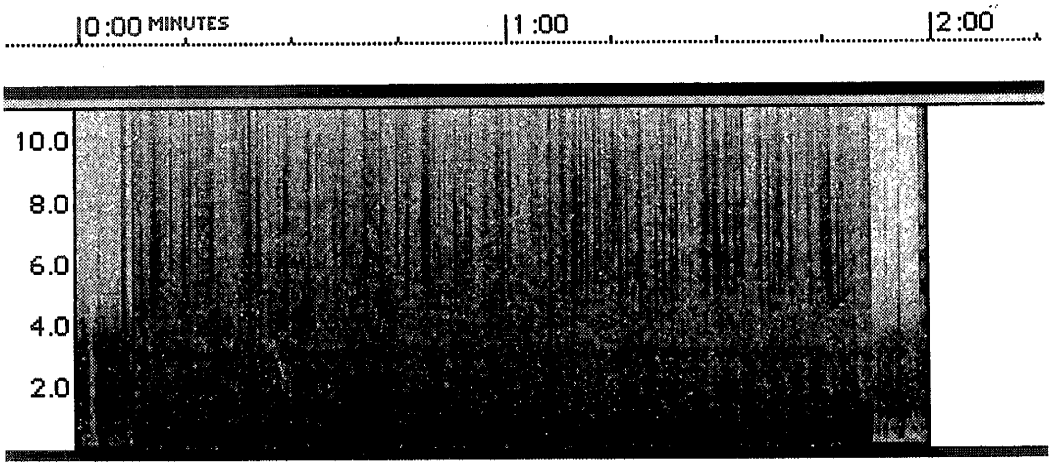
4/25

0800 PDT
1500 UT

Similar conditions to the above.



Simultaneous observations from Northern California (Team 7, Dean Knight) and Southern California (Team 6, Bill Pine). Fairly quiet conditions with some prominent sferics. The mark at time 1:20 at about 7 kHz in the Team 6 spectrogram was a momentary oscillation in the receiver as the receiver gain was adjusted up. Note that the signal is clearer after the adjustment.



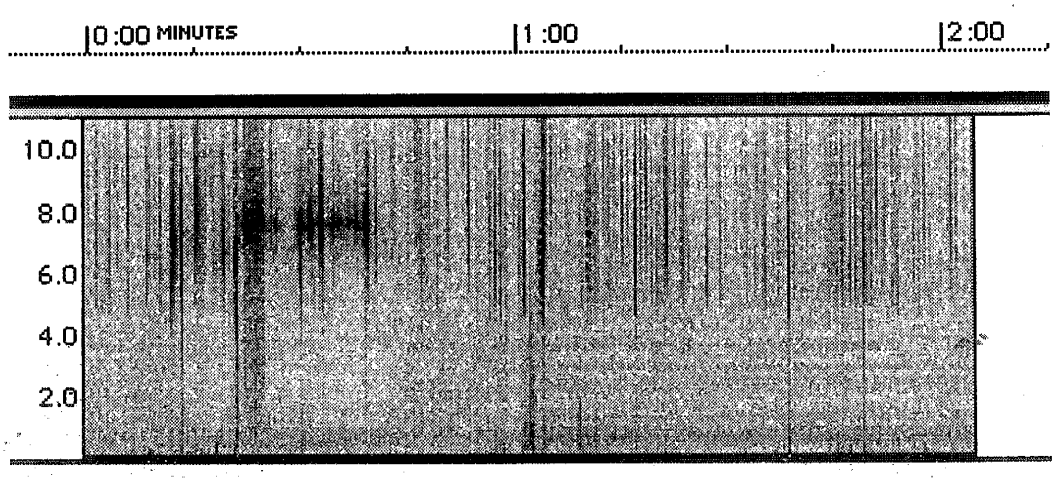
Team 7

4/25

0900 PDT

1600 UT

Density of sferics increases. LORAN present.



Team 6
4/25
0900 PDT
1600 UT

Quiet conditions lead to another adjustment of the gain - and another oscillation!

4/26/1998

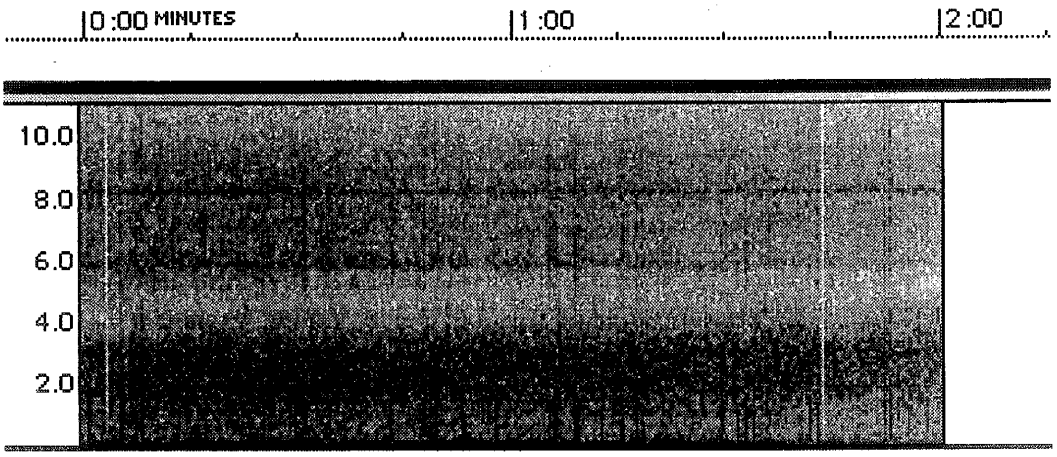
Team 5

4/26

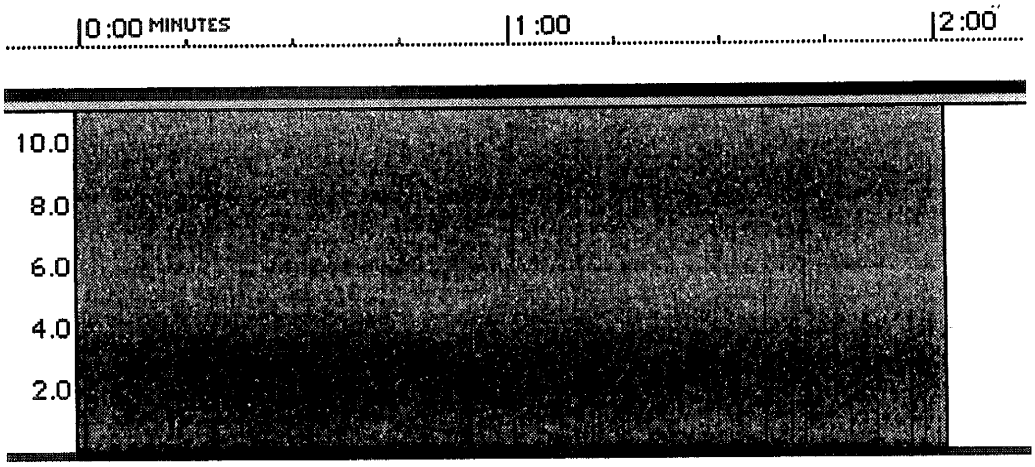
0700 CDT

1100 UT

Quiet conditions in Quebec.!



Again, Jean-Claude Touzin got the observations started in Quebec. Conditions were very quiet with isolated sferics and some hiss.



Team 5

4/26

0800 CDT

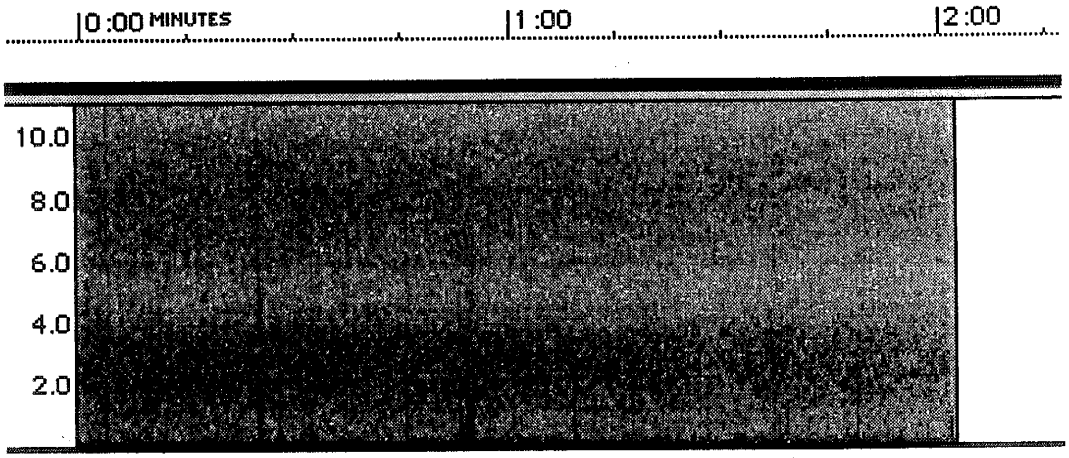
1200 UT

Team 5

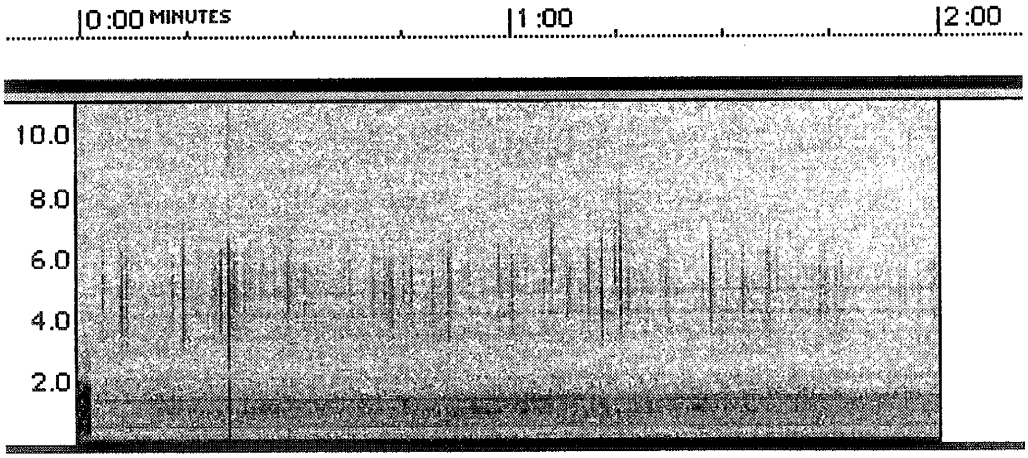
4/26

0900 CDT

1300 UT



The 1300 UT observation was also made by Team 25 (Norm Anderson, Cedar Falls, Iowa).



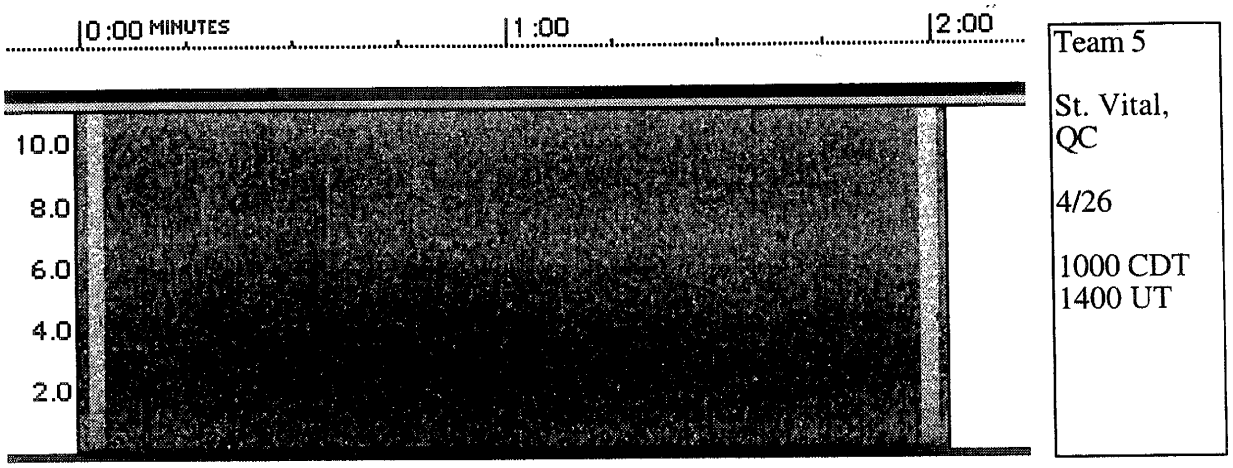
Team 25

Cedar Falls, IA

4/26

0800 CDT
1300 UT

Quiet.

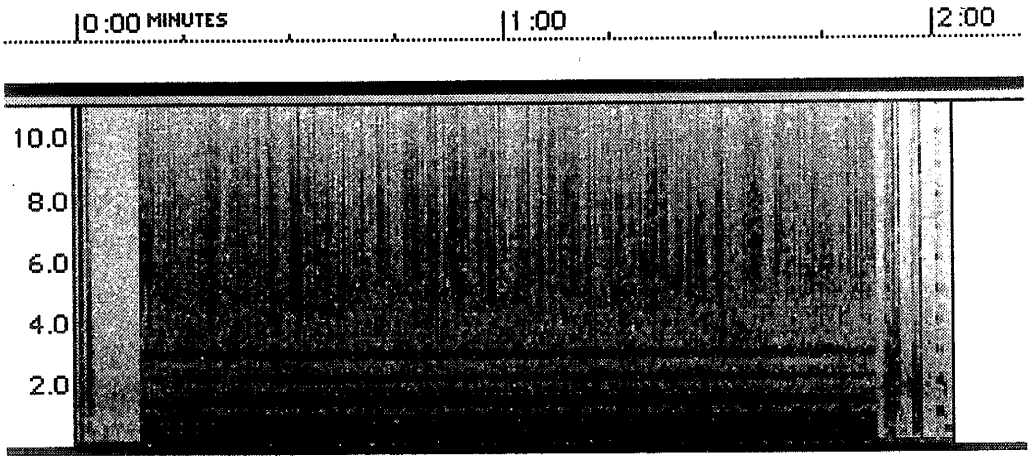


Team 5

St. Vital, QC

4/26

1000 CDT
1400 UT

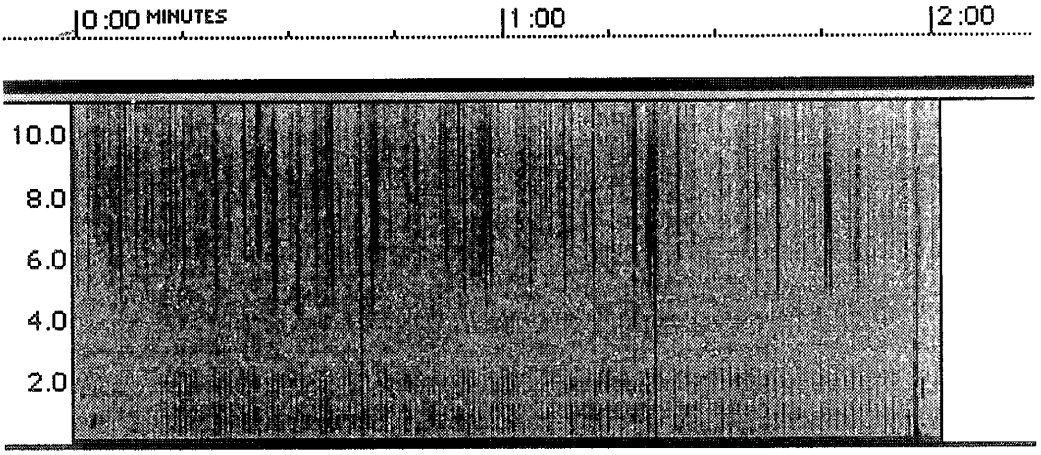


Team 7

Sonoma, CA

4/26

0800 PDT
1500 UT



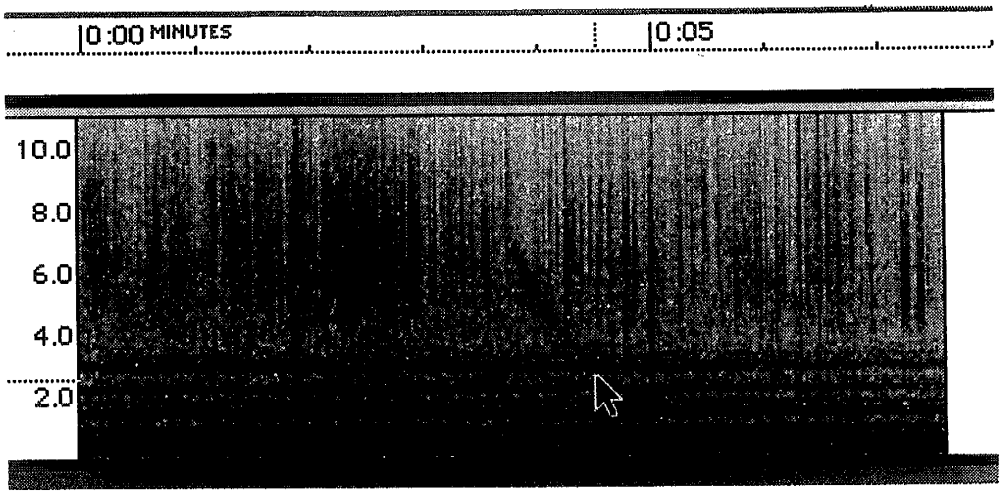
Team 6

Ontario, CA

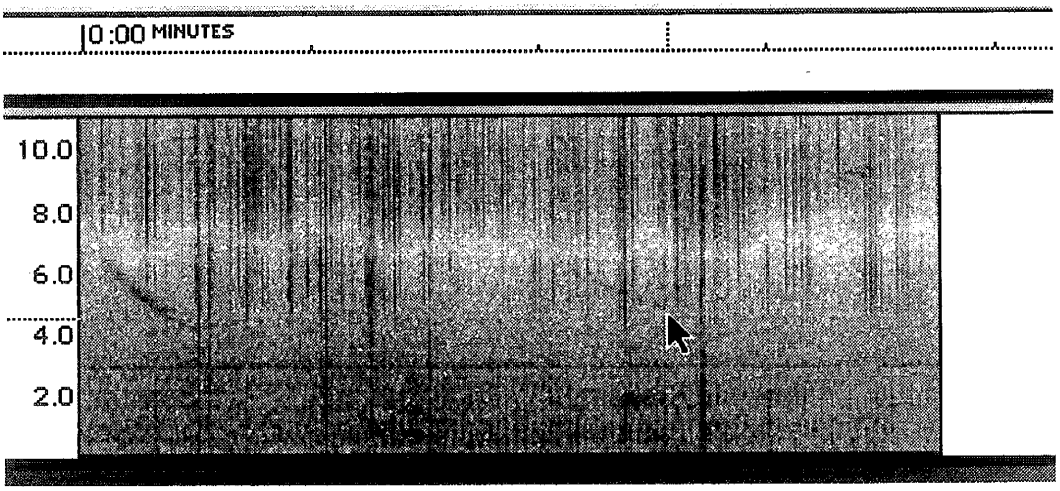
4/26

0800 PDT
1500 UT

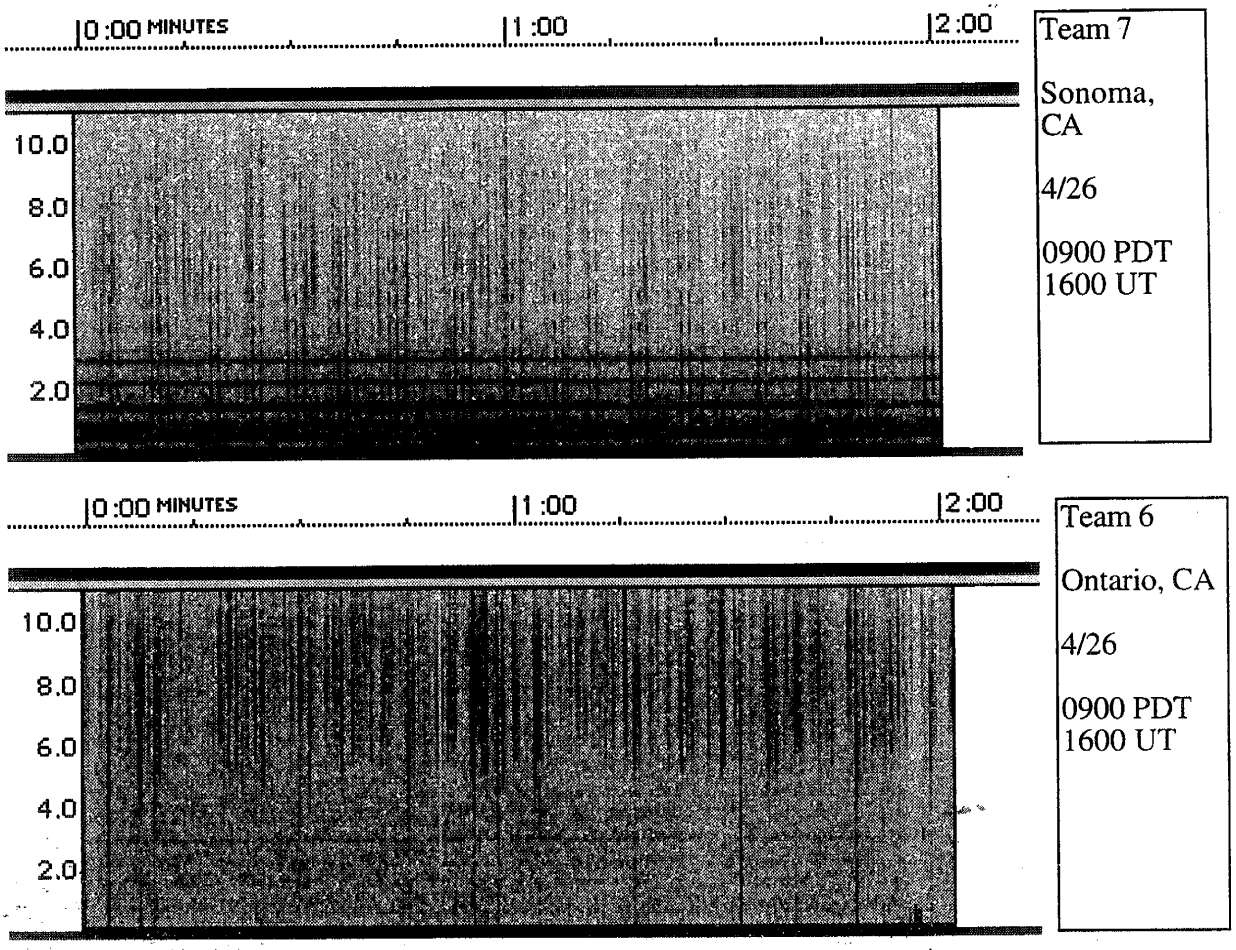
The first whistlers were heard at our Southern California location a few minutes before 8 AM. the whistlers peaked about 0845 AM when they were coming at the rate of several per minute. The same whistlers were recorded by the Sonoma Valley High School team (#7) lead by Dean Knight.



This was a strong whistler that is clearly heard above the loud hum. The presence of this amount of hum at the Sonoma Valley site is because a long wire antenna was used to increase sensitivity. This, of course, also increases the reception of hum.



At the left is the same whistler as in the previous spectrogram as recorded at the Chaffey High School site about 900 kilometers south of the Sonoma Valley site. Note that the local sferics conditions are different (and quieter) here. The arrow points to a 3-hop echo of the whistler which is not audible on the Sonoma Valley tape.



By 0900 PDT (1600 UT), the whistlers had died down and quiet conditions returned.

SUMMARY

The April/98 session of coordinated observations went very well. The participants included some long time observers and some who were submitting their first data to INSPIRE (though they have made natural VLF observations before). As INTMINS winds down with the deactivation of MIR, coordinated observations are a useful and enjoyable way to continue observations of natural radio and share the results. The November/98 Coordinated Observation Program schedule is described in another article in this edition of *The INSPIRE Journal.*

Notes From the Field

Communications from INTMINS Participants

Edited by Bill Pine
Chaffey High School
Ontario, CA

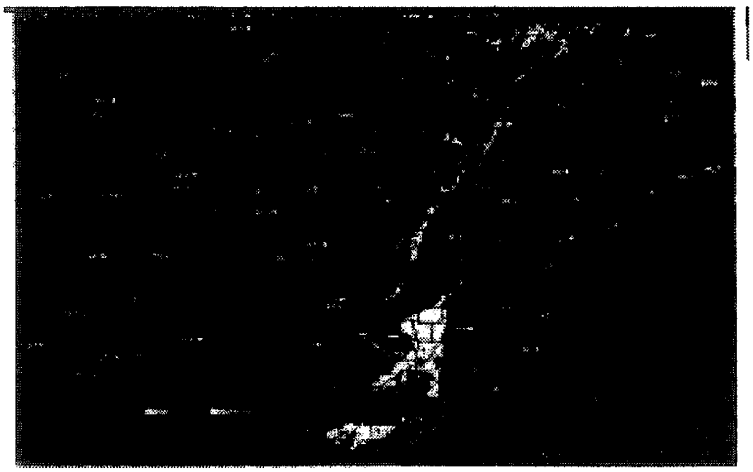
Data submissions are often accompanied by notes and messages from INTMINS participants describing various aspects of their experiences as observers. As an ongoing feature, some of these communications will be summarized in *The INSPIRE Journal*. The following summaries are in the approximate order in which the data was received by INSPIRE. In addition, some communications will be included from INSPIRE participants who did not record and submit data.

Team 26 Brian Page Lawrenceville, GA

Brian has been a participant in INSPIRE before, but this was the first time he has submitted data for INTMINS. He describes his site as:

> Approximately 1.5 kilometers south of Unicoi Gap on Highway 75 of White County, Georgia. This roadside pull-out is approximately 13 kilometers north of the town of Helen, Georgia, in the Chattahoochee National Forest.

This is another example of a truly scenic site for observing natural VLF! Brian included a color printout of a weather map from the web. The color image did not scan well, but I thought I would include it anyway. The light area in the bottom center is medium heavy rainfall very near Brian's site. The front extends to the north.



WSI Corporation http://www.wsicorp.com

Team 8 Mike Dormann Seattle, WA

Mike has been working on graphic and spreadsheet analysis of VLF radio. Here is a sample of his work. I do not understand how to do this process, but it is a valuable technique for finding subtle signals hidden in noise.

Chart 1

Wouldn't you like to know the Procedure to find a particular value of a point on a sonogram? This sonogram was taken directly from SoundEdit, and the picture below was taken as a picture from the SoundEdit recorded data. What we need is numbers associated with the below radio data, so we can perform a DFT, and thus make our own plot of a single point of the sonogram.

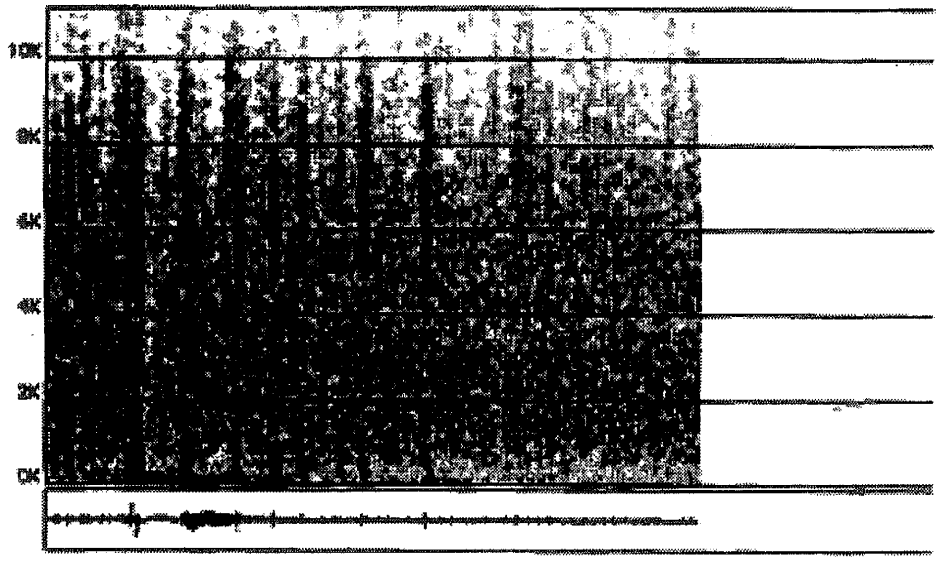


Chart 2

Chart 2 shows the EXCEL plot of the tweek of chart 1, after we have taken the MAC data file, loaded it into a PC, and operated on the file changing the binary format to an ASCII single row of numbers. The graph below is an EXCEL plot of raw data taken in SoundEdit, but after being transposed by "DUMP3.EXE" making a sequence of samples that can be read into a spreadsheet. With the numbers off the spreadsheet that made the below graph we can use our program to calculate the DFT. Lets take 32 numbers for our 16 frequency (32 point DFT), right about point *400. A good way to do this Is to make a spreadsheet containing the raw file data, and copy a 32 point segment into the main DFT program.

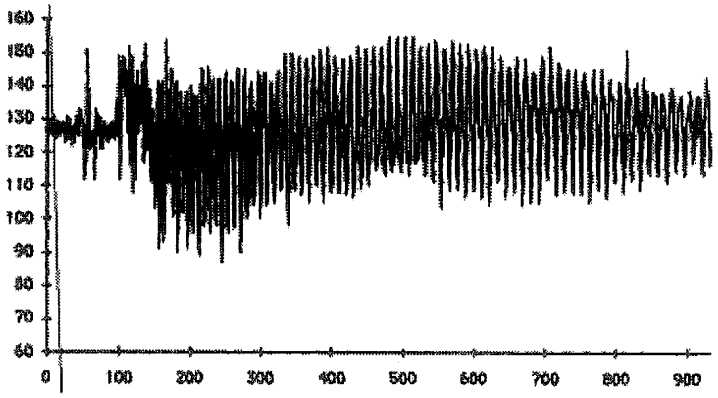


Chart 3

The spreadsheet program showing a 50 point DFT, with only 6 of the frequencies plotted out. To go from a sampled DFT to the outside world and the real frequency that you observe, make the calculation: Frequency I - # of points in calculation * sample time /point. So if you take 50 points in your calculation at a time value of each point of 1 millisecond, you have a first frequency time span of 50 milliseconds and a first frequency of 20 Hz.

RAW DATA	INDEX	WINDOW	SINE1	SINE2	SINE3
170 0.328125	1	0.008085	0	0	0
172 0.34375	2	0.031813	0.002044	0.002240	0.002400
148 0.15625	3	0.070809	0.010742	0.009895	0.008426
134 0.046875	4	0.124458	0.005330	0.001387	-0.00275
128 0	5	0.191915	-0.00214	-0.00449	-0.00573
122 -0.04687	6	0.272115	0	0	0
120 -0.0625	7	0.363794	0.010770	0.003173	-0.00614
106 -0.17187	8	0.465507	0.002851	-0.01556	-0.02269
88 -0.3125	9	0.575648	-0.05476	-0.07859	-0.02946
94 -0.26562	10	0.692481	-0.17953	-0.06624	0.123125
122 -0.04687	11	0.814164	-0.10813	0.108097	0.174946
158 0.234375	12	0.938778	0.009486	0.038089	0.004789
168 0.3125	13	1.064357	-0.19907	-0.10603	0.185752
154 0.203125	14	1.188922	-0.30097	0.160185	0.280869
140 0.09375	15	1.310506	-0.06009	0.241020	-0.03021
134 0.046875	16	1.427195	0.072197	0.072235	-0.11683
124 -0.03125	17	1.537146	0.066766	-0.02461	-0.04580
120 -0.0625	18	1.638626	-0.03288	0.047182	-0.01767

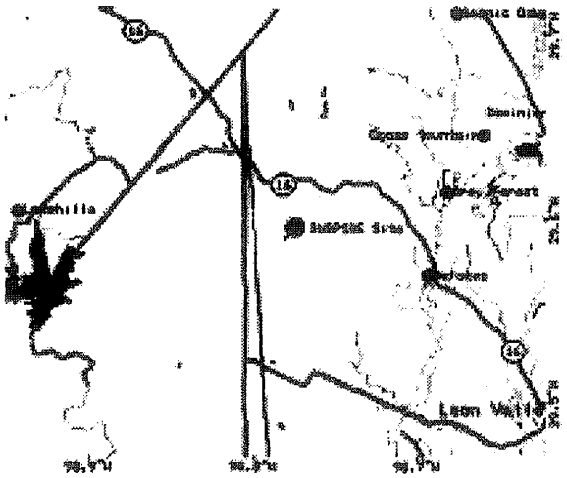
(Note: This is only the upper left corner of the spreadsheet.)

Team 25 Norm Anderson Cedar Falls, IA

Norm has submitted his first INTMINS data. He makes his observations from George Wyth State Park in Iowa.

Team 27 Ron Janetzke San Antonio, TX

Ron and Mike Miller have formed an INSPIRE team called "Amigos". They make their observations from a State Natural Area in Texas.



Team 11 Mark Mueller Brown deer, WI
Brown Deer High School

Mark made observations with the assistance of his students Mike Witnab, Kim Kartger and Dominick Taerin.

Team 7 Dean Knight Sonoma, CA
Sonoma Valley High School

A long time contributor, Dean has involved most of his students in the INSPIRE Project. The following table summarizes the participation of his students in INTMINS April/98.

	20-2	25-5	26-2		20-2	25-5	26-2
Evan Adams		x		Brian Israel	x	x	
Alicia Andrieux	x			Kate Jensen	x	x	x
Ethan Baldinger		x	x	Daniel Kane	x	x	x
Amy Barrett	x	x	x	Amy Kelly	x		x
Kerry Brady	x		x	Holly London			
Jenny Brocco	x	x		Cody Makiva	x	x	x
Brennan Chesley	x	x	x	Phillip McDaniel	x	x	x
Frank Dang	x	x		Lennon Molofsky		x	
Aaron Daniels	x	x	x	Kellie Morton	x		x
Jesse Day	x	x	x	Caitlin Morton	x		
Meghan Day	x	x	x	Ryan Muzzy	x		x
Genevieve Deignan	x		x	Amy Neilau	x		
John Denson	x	x		Michelle Novi	x	x	x
Gillian Dicker	x	x	x	Maylouise Pels	x	x	x
Amanda Dito	x			Drew Pickering	x	x	x
Jim Dougherty	x		x	John Pipkin	x	x	x
Leslie Ealy		x	x	Jenny Radloft	x		
Jason Ellis		x	x	Brian Rasmussen	x	x	x
Danny Fay	x	x	x	Brenda Reagan	x	x	x
Doug Gardner		x		Devin Roth	x	x	x
Gillian Goggin	x			Konstantin Sirotkin	x		
Ben Goldberg	x		x	Jessica Stinson	x		x
Brad Haley	x		x	Joey Tague	x		
Katherine Hanson	x			Ryan Van Fleet		x	
Will Hipkiss	x			Amanda Wayson	x		
Jordan Hale	x	x	x	Jesse Witkowicki	x	x	
Angela Hover	x	x	x				

Team 5 Jean-Claude Touzin St. Vital, Quebec, CANADA

One of the changes that I made to my set up is that this was the first time than I recorded with my receiver connected directly to my 2-3 ohms impedance square loop (without any matching impedance transformer). I use a so-called base grounded transistor circuit. This raised the gain. But this also raised "white hiss" or whatever you call it in English. I would like to know if this hiss interferes with tape analysis. *(Hiss does not interfere with analysis. - Ed.)*

On another subject, since there has not been very much snow this past winter and this springtime is rather dry, I had no trouble crossing the river on my bridge for a change. And since I built a small cabin near my square loop in which I can put a small propane heater, weather is not a problem any more. Guess that some things are improving after all and all is not lost!

Team 21 Phil Hartzell Aurora, NE

Hello Fellow Participants:

Well... disaster struck parts of my sessions. I had assembled the new VLF-2 receiver over the winter. I was ready for 19-2 when my receiver went dead. So 19-2 was a bust, I had power but no signal. I disassembled it, could not find anything wrong. It worked fine for my 2 sessions of coordinated observations on April 25. Not a fault of the receiver, I may have a cold solder joint during construction. Unfortunately because of other commitments I could not record any of the INTMINS operations. The VLF-2 seems to work great. My ac hum levels do change from time to time. Some days my listening has minimal noise, other days it is higher. I may have to search for a better site. I get higher noise with the longwire as expected, but my whistlers are louder also.

I am playing around with my 75 turn 4 ft. square loop. I used a 10 k to 8 ohm transformer to change the impedance. The VLF-2 wants to see a high impedance input whereas the loop has a lower impedance output. I have used test leads at this point and it does work in my yard. I will permanently solder it on and take some recordings- I like the loop to null the ac hum. I will let everyone know how it works a little later in the summer. Happy listening to all

KAOKST - Phil Hartzell

Team 28 Thomas Earnest San Angelo, TX

Tom is the newest contributor to INSPIRE. His observing site is on a public road through rolling pasture land about one half mile from 7200 volt lines and about two miles from 169 kvolt lines. This is a quiet site normally, but because of the extremely dry conditions, Tom indicated that there was more hum than usual. Analysis of Tom's tapes showed a very low level of hum which means there must be no hum under normal conditions!

Team 4 Mike Aiello Croton, NY

This is a true story: Last November's INTMINS passes all fell at times that I could not make, except for pass 29-1. 1 got my equipment all shaped up, got to the site on time, and had a great recording session. As I drove back into my driveway, I stopped to pick up the mail for the day. "Hmm.. a letter front INSPIRE..." I thought as I ripped open the long envelope - to reveal the note describing the time change for the pass I had just recorded. Nineteen minutes too late. Anyway, that is why I am not submitting a tape for the last INTMINS session. (I have the tape, but there is nothing remarkable on it, and I missed the pass completely.) I do however have a contribution which may be of some use.

With the sad passing of Omega, I started to think about how to provide accurate time marks on VLF recording tapes. This thought process quickly turned into a little programming project.

The enclosed diskette contains an install for a bit of freeware I have written for Windows95/NT computers that are sound-equipped, It is a digital clock, which outputs an audio time marker periodically, the interval being set by the user. My intent was to automate the voice time markers we use on the tapes, and to increase the precision (and eventually the accuracy) of the timer markers.

The program plays a sequence of six WAV files to encode the digits of the time, a few seconds before the marker tone. The marker tone (another WAV file) sounds, for .5 seconds at the appropriate time. My original concept was to use a set of pure sine wave tones at specified frequencies to encode the six time digits (HHMMSS.) This would result in a pattern in the sonogram that is readily readable by eye, placing a time-of-day reference in the sonogram. The marker tone is composed of a harmonic-rich square wave, which creates a broad, easy to see, band in the sonogram. You can see some example sonograms in the on-line help supplied with tile program.

After playing with the program for a bit, I decided it might be better if the automatic time announcement was verbal, rather than tone-encoded, since a lot of time is spent scanning the tapes by ear for a particular section. This proved to be no problem - I just recorded a set of WAV files of myself reciting the digits from zero to nine, and saved them under the appropriate names, to make a verbal time announcement. In fact, the help file includes directions on how to create your own WAV files for use with the program, and they can use any encoding scheme at all. The automatic tone can likewise be customized.

The time is obtained from the PC's clock, and the precision of the announcement is within about 50 milliseconds. The accuracy depends on the how carefully the PC clock was set, and you can input your offset from UTC so your PC can remain set to local time. Two future enhancements which I am considering adding are:

1) clock setting using the NIST ACTS dial-up service, which will get your PC set within about 50 milliseconds, and

2) using the time signals output from a GPS receiver. I am just starting to research this, but I think most of them output a message containing the local time with high accuracy.

The program comes with extensive on-line help, and a nice little installer. The install is Windows95/NT compliant, so you can un-install the software using the Add/Remove Software icon in the Control Panel. The hardware requirements are: any PC running Windows95 or WindowsNT, and a Windows compliant sound card.

One note on installation: this installer program seems to have some difficulty on NT systems, because path names are truncated to 8 characters (DOS style) when it updates the registry. If you install on an NT system, you may get an error the first time you run it, telling you it cannot find its media files. Go to the menu item File/Sound Directory, and browse until you locate the tone files in the directory \Program Files\atm\Tones. This will solve the problem - if you have difficulty with this check the help topic Changing Sound File Directory for more information.

I used the program on my laptop to time mark my ill-fated Pass29-1 and it worked very well. I did pick up a little computer noise at first, but positioning the laptop about five feet from the VLF2 receiver solved that problem.

Let me know what you think of this software. Right now it is only available by contacting me, but if there is any demand, I will put it up on a web page for downloading as freeware. If you have any questions on the install, use or other comments, drop me a line at:

n2htt@bestweb.net

I had hoped to put together a construction article on the antenna mod for the VLF2, and got as far as taking photos and making drawings, but it is not yet complete.

I'm looking forward to the Journal, and the next set of INTMINS sessions. I hope all is well with you, and at Chaffey High.

Best regards,
Mike Aiello

Team 15 Robert Bennett Las Cruces, NM

Dear Bill;

Attached are the notes and data collection logs from the monitoring session of last April. You should already be in receipt of the tapes as I sent them to you earlier in a separate package. I delayed sending the tapes and logs to you until now because I wanted some time to analyze them myself, I did some analysis but my job work schedule has left me little free time so I didn't get as much done as I would have liked

I recorded operations 20-1, 20-2, 25-4, 25-5, and 25-8. 1 also recorded during the coordinated monitoring sessions on 25 April at 0700, 0800, and 0900 MDT. During this period we were having standard spring time weather in New Mexico. That is very dry, temperatures in the 50 - 80 degree range, high winds and blowing dust with an occasional sand storm. This made monitoring an interesting and challenging event.

I did not detect the ISTOCHNIK operation (I don't believe). f did note a few things on the recordings that I would like for you to look at and give me your opinion.

A. On several of the tapes, (most notable 20-1, 25-5 and 25-8), 1 recorded several examples of what I call "Insect Noise". I call it that because it sounds like an angry bee buzzing close by. I believe these signals are either some form of static discharge or possibly generated by the wind.

B. I recorded quite a few whistlers on 25 April. Did anyone else note numerous whistlers. Isn't it a bit unusual to detect whistlers in the daytime, I thought they were mostly a night time event.

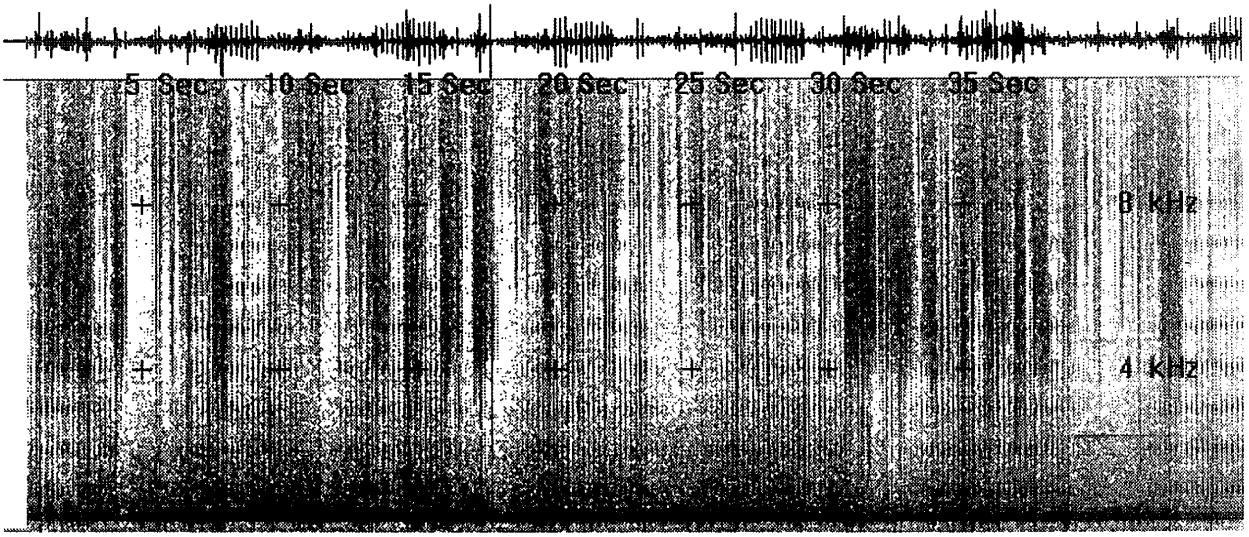
C. I also recorded what appear to be VLF communications signals and also the Russian Alpha navigation system. Also I am detecting what appears to be a steady carrier at about 10 kHz on recording 20- 1.

D. My most often used monitoring location seemed a lot nosier in terms of 60 cps hum than in past sessions. I did a little detective work and found that a new power line had been installed about a half mile from my location. It seems that the government decided to convert a wind mill driven water pump to electric. Hence the new power line. I discussed the problem with a friendly ranger who suggested a more remote location that is currently several miles front the nearest power line. Only problem is that the road to the new location is very bad and not maintained. It is passable only during dry weather. I used this new site during some of the missions on 25 April and was impressed with how quite it was. I intend to use this one in the future weather permitting.

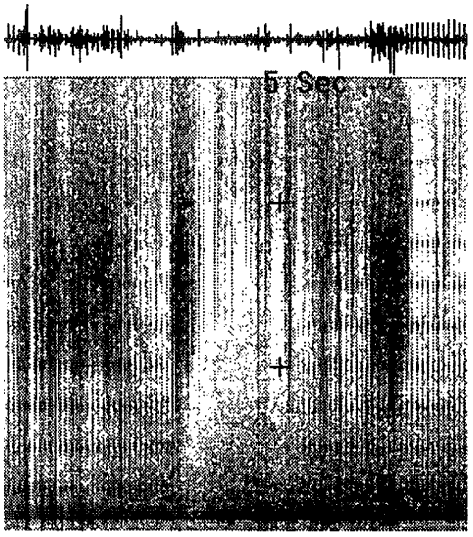
During this monitoring session, I continued to experiment with different antennas. I collected some useful data that I will add to my ongoing project. I still intend to write an article for the news letter soon as I get sufficient data and enough free time to draft the article. I have a couple of ideas for different antennas and filters that I will try during the November 98 session,

I have enclosed an Iomega 100 MB ZIP Disk with WAV and BMP spectrogram files from this session. I hope you have access to a ZIP Drive to read this disk. Please return the ZIP disk to me when you finish with it.

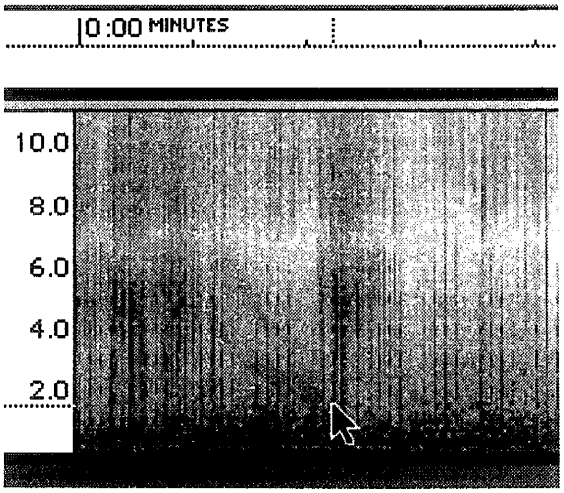
Sincerely;
Robert Bennett



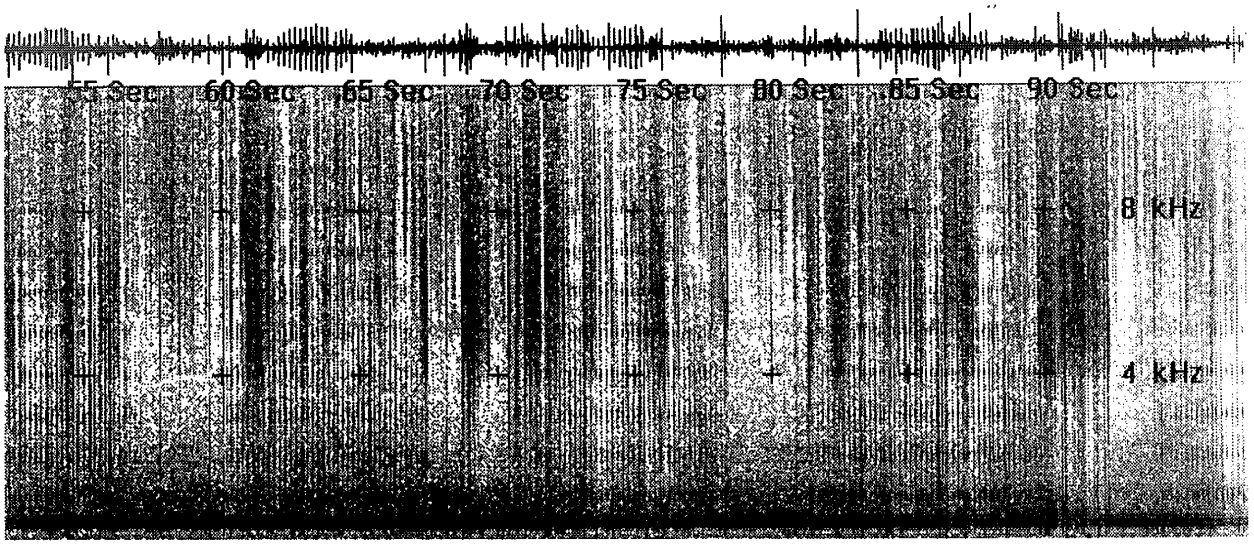
Whistler 1. Spectrogram by using GRAM analysis software for the PC.



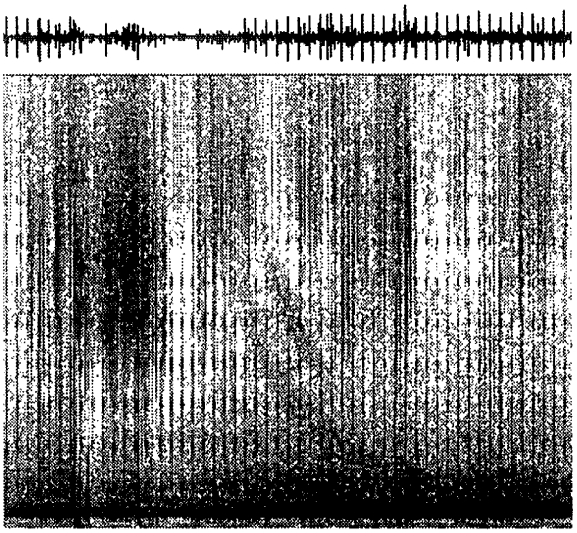
Whistler 1. Closeup



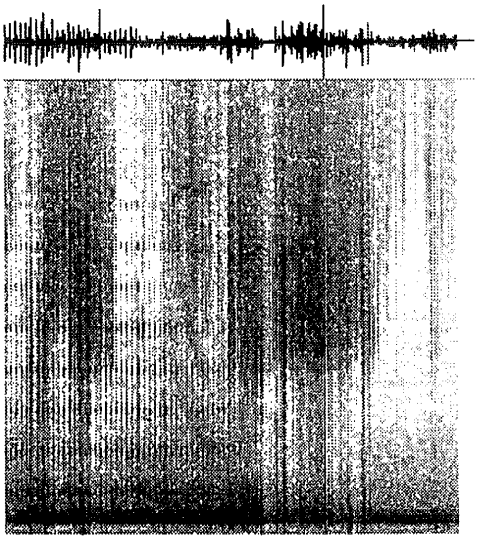
The same whistler using Soundedit 16 analysis software for the PowerMac.



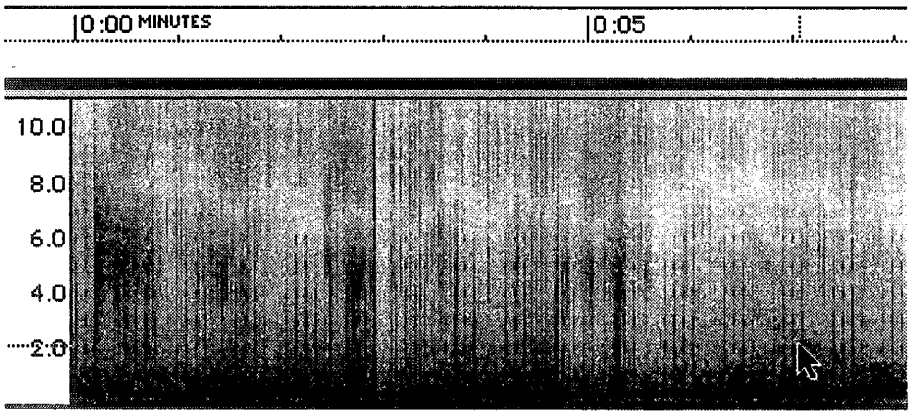
Whistlers 2 and 3. Whistler 2 at 65 seconds, Whistler 3 at 88 seconds.



Whistler 2. Using GRAM



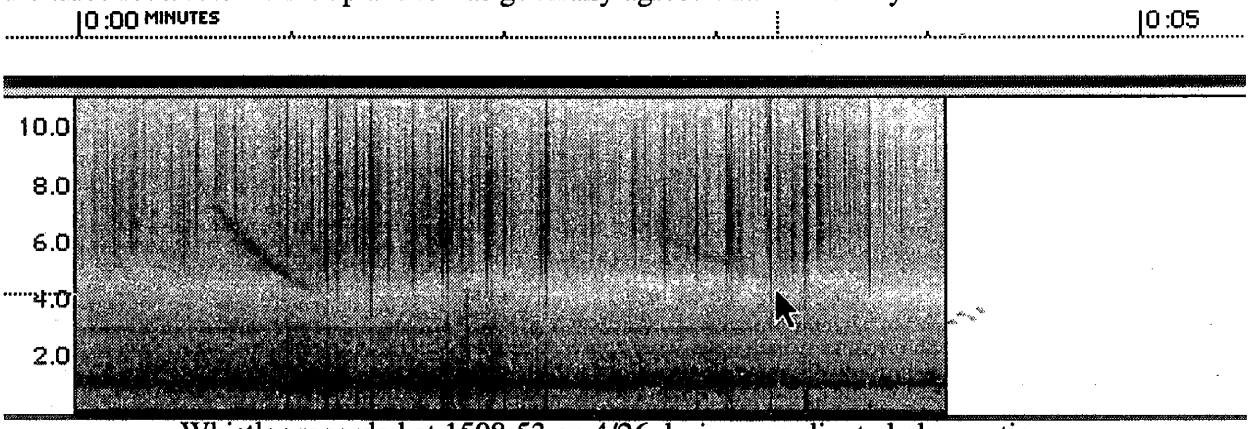
Whistler 3. Using GRAM



Whistler 3. Using Soundedit 16.

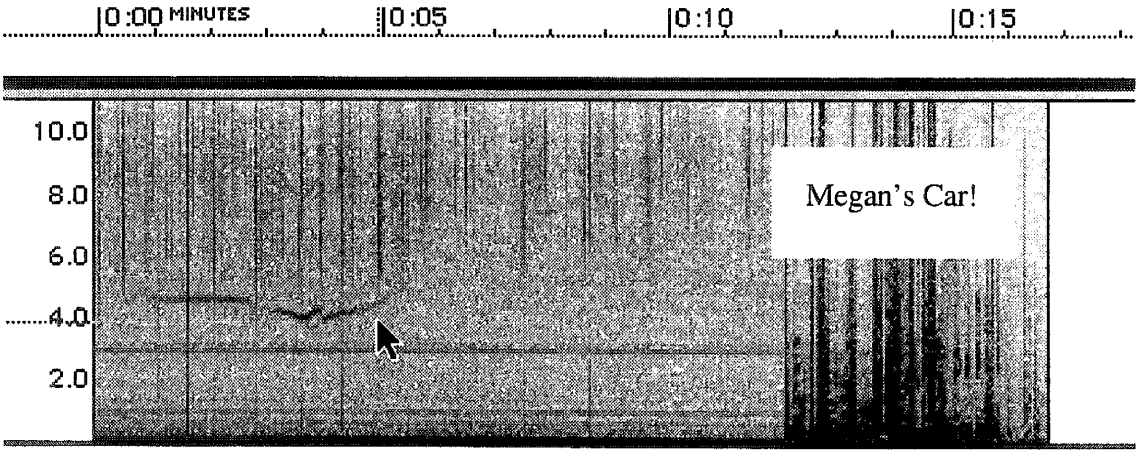
Team 6 Bill Pine Ontario, CA
Chaffey High School

Chaffey students on the INSPIRE team included Chris Chapman, Maria George, Daniel Jones, Eric Reed, Sarah Somorai and Megan Souter. What the team lacked in numbers it more than made up for in faithfulness - all students made most of the trips all year. As luck would have it, whistlers were scarce for most of the year. On five separate trips in the fall, four of which were morning trips, no whistlers were heard or found on further review of the tapes. Lots of tweeks and sferics, but no whistlers. In the spring, the first weekend of observations coincided with the National Science Teachers Convention in Las Vegas which my wife and I attended. That left one last weekend for whistler hunting. Our perseverance was rewarded on April 26. As the tapes were being set up and introductory remarks were being recorded, someone said "What was that?" Less than a minute later, "That sounds like a whistler!" And it was. We heard whistlers at the rate of several per minute for almost an hour. Every student had a chance to hear whistlers on each of the three receivers we set up and it was generally agreed that it was very "cool".



Whistler recorded at 1508:53 on 4/26 during coordinated observations. Initial whistler is at the 1-second mark with a three-hop echo showing up at the 3-second mark (arrow).

After the whistlers died down and we were getting ready to pack up, Megan mentioned that she had never been on the B-field receiver when a car had gone by on the road near our site. The B-field receiver/loop antenna combination is much more sensitive to passing automotive electromagnetic waves than the E-field receivers with their whip antennas. Right about then, as if on cue, a car approached. Megan heard the ignition system signal and it was time to call an end to another VLF observing year.



Data Log Cover Sheet (copy as needed)

INSPIRE Observer Team _____ Receiver _____

Operation _____

Date _____ Tape Start Time (UT) _____

****

Operation details: Tape start time: _____ UT _____ local

Operation start time: _____ UT _____ local

Operation type: _____

Operation stop time: _____ UT _____ local

Tape stop time: _____ UT _____ local

Equipment: Receiver _____ WW V reception:

Recorder _____ _____

Antenna _____ _____

WWV radio _____ _____

Site description: _____

Longitude: _____° _____ ' W Latitude: _____° _____ ' N

Local weather: _____

Personnel: _____ _____ _____

_____ _____ _____

Team Leader address: Name _____

Street _____

_____

City, State, Zip, Country _____

INSPIRE Data (copy as needed)

INSPIRE Observer Team _____ Receiver _____

Operation _____

Date _____ Tape Start Time (UT) _____

****

Code: S - sferics 0 1 2 3 4 5 M - Mark T - tweek W - whistler O - OMEGA C - chorus
L M H

Time	Entry	Observer
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____
_____	_____ S: 0 1 2 3 4 5	_____