The INSPIRE Journal

Volume 4 Number 1

November 1995

INTMINS-November/95 Schedule Announced!

The schedule of INTMINS observations for November 1995 has been determined and details are contained in an article that begins on Page 5. There will be a total of 14 operations conducted: 2 for Europe on November 17 and 14 for the United States: 7 on November 19 and 7 on November 26.

INSPIRE observers will be recording VLF radio signals in an attempt to detect the electromagnetic waves emitted when the electron gun on board the MIR Space Station is modulated at a 1000 hertz frequency. If these electromagnetic waves can be detected, it will be the first time ever that this type of emission has been received on the ground.

This is an exciting opportunity to participate in real scientific research. It is hoped that all INSPIRE participants will support this important endeavor. Data will be analyzed by INSPIRE volunteers and reports will be sent to all observers who contribute data. The results of the analysis will be reported in an article in the April 96 edition of *The INSPIRE Journal*.

Table of Contents

The INSPIRE Journal

Volume 4 Number 1
November 1995

The INSPIRE Journal is the 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 physics 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. *The Journal* is published two times per year: November and April.

Contributions for the Journal may be sent to the editor at:

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

e-mail: pinebill@aol.com
Deadlines: October 1 and march 1

Field Observation "Loaners" Available

Several complete VLF field setups have been assembled and are available for loan to INSPIRE participants. The setups include and RS4 receiver with antenna, a cassette recorder with headphones and microphone, an audio tape and a connecting cable. All you need to provide is a ground rod. (A 3/4" metal pipe or EMT conduit is recommended.)

You may borrow a field setup for 1-2 months and use it as often as you want. You will have only three obligations:

1. Provide return postage (about $5) and return the equipment when done.
2. Record an audio tape of one or more of your field observation sessions and send the tape to INSPIRE.
3. Write a short (1-2 pages) note for the *Journal* about your experiences.

This is your opportunity to find out if you want to build a kit for yourself. If you have a setup, this can provide you with a second field station to allow you to check out your components. If you would like to borrow a field setup, send your request to Bill Pine at the address shown on Page 2 (USMail or email).

Special Observations

A complete one-year cycle of quarterly observations has been concluded. Data tapes from INSPIRE observers have been received and analysis is under way. Individual reports will be sent to the participants as soon as analysis is complete. A summary report will be included in the April 96 *Journal*. Since we are now involved in INTMINS observations, we will not schedule and more Special Observations at this time.

New Journal Mailing Date

Since we will now be scheduling INTMINS observations in April of each year, the mailing date for the spring *Journal* has been changed from May 1 to April 1 (no fooling!). This will allow the observation schedule to be sent out as part of the *Journal*. The deadline for submissions to the spring *Journal* is March 1.

Receiver Kits and Assembled Receivers Available Now:

INSPIRE RS4 receiver kits and assembled receivers are now in stock and available for immediate delivery. Please use the INSPIRE order form on the last page of the *Journal*.

Host an INSPIRE Workshop:

Thanks to a grant from NASA matched by a generous grant from Hughes STX Corporation, INSPIRE will be able to offer INSPIRE VLF radio workshops in your local area. The following describes what is involved in acting as local host for an INSPIRE Workshop.

INSPIRE Workshop Host Responsibilities:

1. Apply to INSPIRE for a Saturday date at least three months in advance.
2. Arrange for Workshop facilities:
   - A. Classroom, multipurpose room or auditorium.
   - B. Overhead projector and screen.
   - C. VCR and monitor(s).
3. Publicize the Workshop to area schools.
   INSPIRE will provide school addresses and addresses of INSPIRE participants in your area.
   INSPIRE will also provide flyers, envelopes and stamps.
   Suggested workshop hours are from 9:00 AM to 5:00 PM with breaks between one hour sessions and a lunch break.
4. OPTIONAL: Provide refreshments on the day of the Workshop.

If you would like an application or more information, please contact Bill Pine at the address shown on Page 2.

Free Data Analysis Available:

Chaffey High School is offering free data analysis to all INSPIRE participants. Just send your data tapes and logs to Bill Pine at the address listed on Page 2. Include any notes or comments that will help the analysts provide what you want. A written report complete with spectrograms will be sent. If you want your tapes returned, please include an envelope with the appropriate postage. Estimated turnaround time is 3-4 weeks. Please use this opportunity to find out how your receiver is working so that you can be ready for future data taking opportunities.

Data may be recorded at any time. If you follow the "Special Observation Schedule - MODIFIED" listed at the top of this page, your data will be included in a report in the *Journal*.

INSPIRE Is Now on World Wide Web:

The INSPIRE home page URL is:

http://www.gsfc.nasa.gov/education/inspire/inspire.html

INTMINS-November/95 Operations Schedule

By Bill Taylor, Washington, DC
Stas Klimov, Moscow, Russia
Bill Pine, Ontario, CA

The November 1995 INTMINS Operations schedule has been determined. Operations will occur on November 17 in Europe and on November 19 and 25 in the United States. Data gathered during the fall observations will be analyzed and reported on in the April 1996 Journal. That edition will also have the planned schedule for the INTMINS-April/96 operations.

Gathering Data:

The data gathering plan will be to record from 5 minutes before the start of instrument operation on board MIR and to record for a total of 18 minutes. Since the operating time for Ariel is 5 minutes and the operating time for ISTOCHNIK is 2 minutes 40 seconds, the 18 minutes will cover the total operating time with a 5 minute margin on each end of the operation. That margin is necessary because the actual start time may vary due to small changes in the orbit of MIR between now and the time of the operations.

The following procedure should be followed:

1. Set up your equipment far enough in advance to allow you to check everything.

2. Place a voice introduction at the start of the tape identifying yourself and the pass being monitored.

3. Put a time mark on the tape five minutes before the operation is scheduled to start and very five minutes after that. Put a final time mark at the 18 minute mark and announce "End of Data". Use only 60 minute tapes and put one operation on each side. Do NOT use longer tapes and combine two operations on one side.

4. Keep detailed logs. Review your tapes and check your logs.

5. Mail your data tapes and logs to Bill Pine at the address on Page 2. If you would like your tapes returned, include a self-addressed, stamped envelope with the appropriate postage. You will receive an individual report of the results of the analysis of your data and your data will be incorporated in the INSPIRE Journal article.

Mode of Operation:

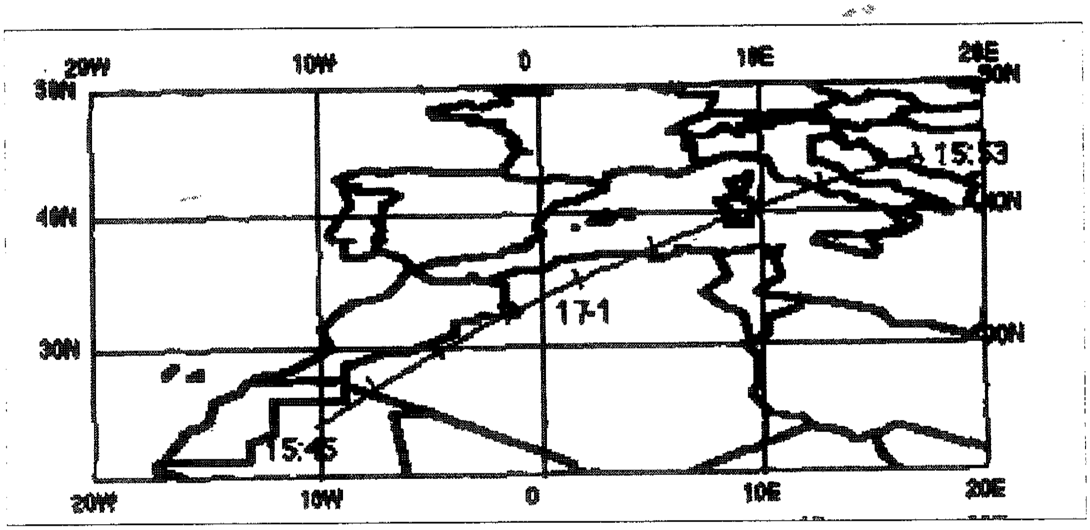
A standard mode of operation has been proposed and will be implemented on this series. The modes for the two instruments are:

Ariel mode:	alternate between plasma generators
ISTOCHNIK mode:	10 seconds modulate at 10 Hz 10 seconds modulate at 1000 Hz 10 seconds modulate at 10 Hz 10 seconds modulate at 1000 Hz repeat for 2 minutes 40 seconds of operation

There will be two types of passes. On some passes, Ariel will operate first followed immediately by ISTOCHNIK. On others, ISTOCHNIK will operate first followed immediately by Ariel. All times are Coordinated Universal Time (UTC).

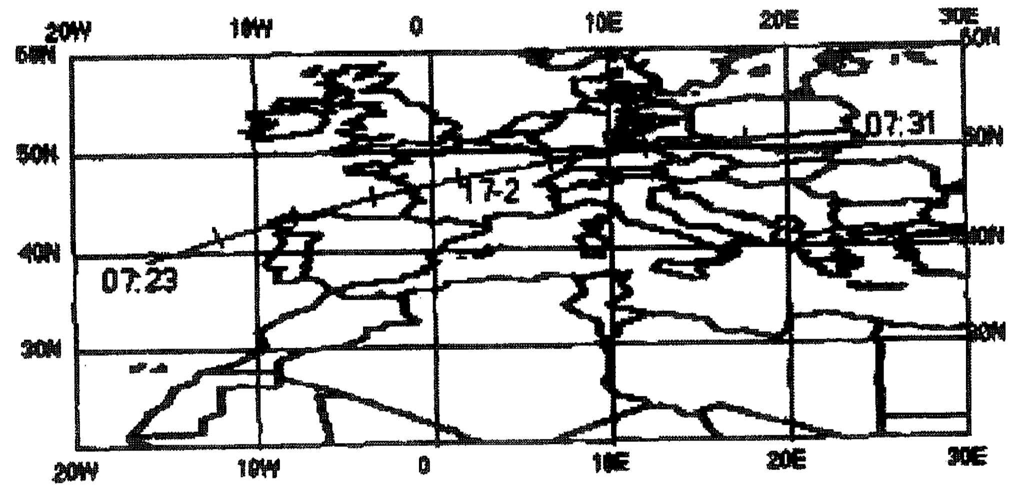
INTMINS Schedule:

November 17 (Europe)



Track of Pass 17-1

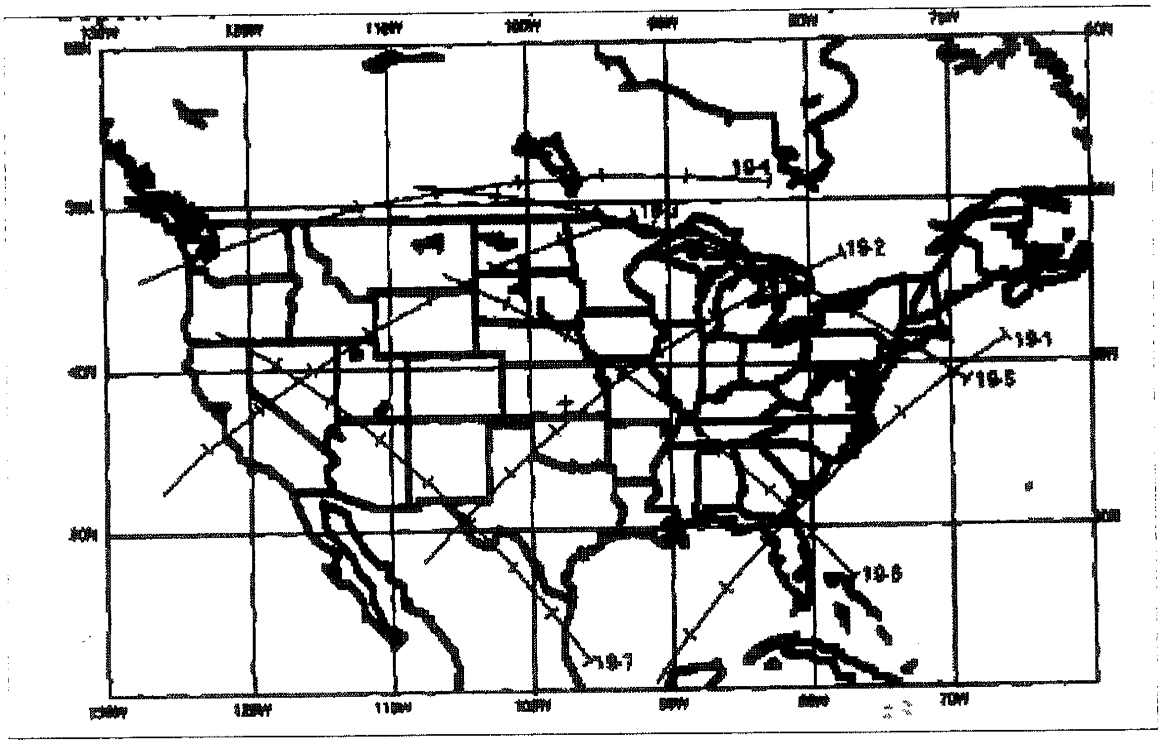
Date:	95- Nov-17
Pass Number:	17-1
Tape Start Time:	05:40
Operation Start Time:	05:45
Pass Type:	Ariel first.
Operation End Time:	05:52:40
Tape Stop Time:	05:58



Track of Pass 17-2

Date:	95-Nov-17
Pass Number:	17-2
Tape Start Time:	07:18
Operation Start Time:	07:23
Pass Type:	Ariel first
Operation End Time:	07:30:40
Tape Stop Time:	07:36

November 19, 1995 (USA)



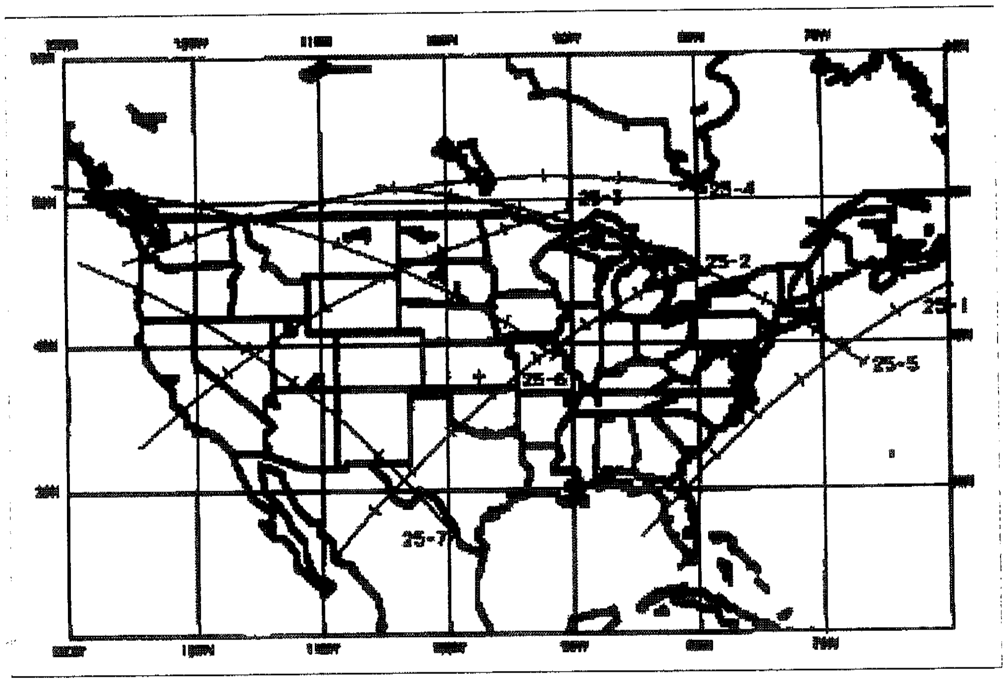
Map of Passes 19-1 to 19-7

Date:	95-Nov-19
Pass Number:	19-1
Tape Start Time:	09:58
Operation Start Time:	10:03
Pass Type:	Ariel first
Operation End Time:	10:10:40
Tape Stop Time:	10:16

Date:	95-Nov-19
Pass Number:	19-2
Tape Start Time:	11:33
Operation Start Time:	11:38
Pass Type:	Ariel first
Operation End Time:	11:45:40
Tape Stop Time:	11:51

Date:	95-Nov-19
Pass Number:	19-3
Tape Start Time:	13:07
Operation Start Time:	13:12
Pass Type:	Ariel first
Operation End Time:	13:19:40
Tape Stop Time:	13:25
Date:	95-Nov-19
Pass Number:	19-4
Tape Start Time:	14:45
Operation Start Time:	14:50
Pass Type:	Ariel first
Operation End Time:	14:57:40
Tape Stop Time:	15:03
Date:	95-Nov-19
Pass Number:	19-5
Tape Start Time:	16:25
Operation Start Time:	16:30
Pass Type:	Ariel first
Operation End Time:	16:37:40
Tape Stop Time:	16:43
Date:	95-Nov-19
Pass Number:	19-6
Tape Start Time:	18:02
Operation Start Time:	18:07
Pass Type:	Ariel first
Operation End Time:	18:14:40
Tape Stop Time:	18:20
Date:	95-Nov-19
Pass Number:	19-7
Tape Start Time:	19:36
Operation Start Time:	19:41
Pass Type:	Ariel first
Operation End Time:	19:48:40
Tape Stop Time:	19:54

November 25, 1995 (USA)



Map of Passes 25-1 to 25-7

Date:	95-Nov-25
Pass Number:	25-1
Tape Start Time:	07:34
Operation Start Time:	07:39
Pass Type:	ISTOCHNIK first
Operation End Time:	07:46:40
Tape Stop Time:	07:52

Date:	95-Nov-25
Pass Number:	25-2
Tape Start Time:	09:06
Operation Start Time:	09:11
Pass Type:	ISTOCHNIK first
Operation End Time:	09:18:40
Tape Stop Time:	09:24

Date:	95-Nov-25
Pass Number:	25-3
Tape Start Time:	10:41
Operation Start Time:	10:46
Pass Type:	ISTOCHNIK first
Operation End Time:	10:53:40
Tape Stop Time:	10:59
Date:	95-Nov-25
Pass Number:	25-4
Tape Start Time:	12:19
Operation Start Time:	12:24
Pass Type:	ISTOCHNIK first
Operation End Time:	12:31:40
Tape Stop Time:	12:37
Date:	95-Nov-25
Pass Number:	25-5
Tape Start Time:	13:59
Operation Start Time:	14:04
Pass Type:	ISTOCHNIK first
Operation End Time:	14:11:40
Tape Stop Time:	14:17
Date:	95-Nov-25
Pass Number:	25-6
Tape Start Time:	15:31
Operation Start Time:	15:36
Pass Type:	ISTOCHNIK first
Operation End Time:	15:43:40
Tape Stop Time:	15:49
Date:	95-Nov-25
Pass Number:	25-7
Tape Start Time:	17:08
Operation Start Time:	17:13
Pass Type:	ISTOCHNIK first
Operation End Time:	17:20:40
Tape Stop Time:	17:26

Remember, it is very unlikely that you will actually hear the signal from MIR. Send in all tapes regardless of quality. If you think there is a problem, describe the situation on your log. If there is anything in particular that you would like the analyst to look at, please indicate that on your log

GOOD LUCK!

DATA PROCESSING TECHNIQUES I USE ON INSPIRE DATA
(AS APPLIED TO INTMINS DATA TAKEN ON AUGUST 4, 1995)

by
Bill Taylor
Washington, DC

Identifying and verifying the existence of radio waves observed by INSPIRE receivers can be easy or challenging. OMEGA and sferics are always heard in the recordings of INSPIRE receivers in good observing locations. Power line noise is heard in unsuitable locations, and sometimes even in very good locations. This article will give a brief description of three data processing techniques that I use, some of which are also used by the other volunteer data analysts, and that you can use, if you have the proper hardware and software. There are even more exotic data processing techniques, but for the present they are not available for analysis of INSPIRE data. The simplest technique is inexpensive, uses that wonderful data acquisition and processing system, our ears and brain, but requires considerable training to be most effective. The second technique is to produce spectrograms with a computer and inspect them visually. The third technique is to take the numerical values that make up a spectrogram, and process those numbers further.

Manmade audio frequency radio waves transmitted from space have not been observed on the surface of the earth. One of the objectives of INSPIRE has been to observe such waves, first in 1990 from the ACTIVE satellite, second in 1992 from SEPAC's electron gun on ATLAS 1, and currently from the electron and plasma guns on MIR. Receiving these waves would be a breakthrough in the study of the propagation of these waves. Since the wavelengths of the waves are so long, any physical antenna is much smaller than the wavelength and therefore inefficient. This is why the virtual antenna of electron beams is thought to be more efficient for transmitting than a real antenna at these frequencies.

The reason these waves have not been observed yet is that their amplitudes, after propagation to the surface of the earth, is probably very small. The electromagnetic or radio noise level on the ground is set by sferics from lightning all around the globe, propagating in the earth/ionosphere waveguide and by power line and power line harmonics (50, 100, 150, . . . Hz and 60,120,180, . . . Hz). Near power lines, power line harmonics dominate; far from power lines, sferics dominate. From estimates of the atmospheric noise level at audio frequencies, INSPIRE was able to set an upper limit on the magnetic field of the waves radiated by SEPAC.

HUMAN EAR LISTENING ANALYSIS

The first and most basic data analysis technique is to listen to the data as it is being recorded or as the recording is played back on a tape recorder. With practice and intense concentration, a listener can pick tones out of the noise, such as the 1000 Hz tone expected from ISTOCHNIK on MIR at low levels. The human ear and brain is probably never as good as inspecting a spectrum. We all use this data analysis technique when we listen to INSPIRE data live or on tape. We are sometimes rewarded by hearing tweaks or occasionally whistlers or chorus.

Mike Aiello, one of the INSPIRE observers from Long Island, New York, heard a tone around 800 Hz when making a MIR recording in August, 1995. Wisely, he noted it in his log, and Bill Pine is now investigating the data to see whether it might be the MIR signal. The nominal modulation frequency for ISTOCHNIK is 1000 Hz, but we do not yet have an understanding of the exact frequency, or even how much the frequency can vary from the nominal 1000 Hz. Being exposed to space as the MIR instrumentation is, means that its temperature can vary widely. Such a temperature variation could easily cause a variation of modulation frequency.

To become a very good listening data analyst requires years of practice. The best one I know is Mike Mideke, one of the original organizers of INSPIRE, who has listened to thousands or perhaps tens of thousands of hours of data. As an amateur radio operator, he also has many hours of experience in listening to radio communications, which are often garbled and extremely difficult to understand. Even with Mike Mideke's skill, he used spectrograms to analyze the SEPAC INSPIRE data. He was the primary data analyst for that data and felt that at his best his ears could do almost as good as a spectrogram analysis.

If you plan to do data analysis by listening, use headphones and use a stopwatch to measure time between WWV or other time marks on the tape. Note on paper every interesting noise you hear the first time you listen to the tape. Then go back and listen to the interesting periods over and over until you can describe them well. All distractions should be minimized, certainly from your sense of hearing, but also from your other senses as well. For example, listening in a dark room helps your concentration.

SPECTROGRAMS

I use SoundEdit Pro on a Macintosh to make spectrograms. Therefore I will describe what I do with that configuration. There are other hardware and software combinations that will work, of course. I believe that the procedures for other hardware and software combinations are similar. SoundEdit Pro is from Macromedia and I use it to digitize INSPIRE data and produce spectrograms with my Macintosh LC II. Sometimes I use the digitizer built into the Mac, sometimes MacRecorder, a small digitizing box that plugs into one of the serial ports on a Mac and is available bundled with SoundEdit Pro, and sometimes ProAudio Spectrum 16 (PAS 16), a digitizing box from Media Vision. SoundEdit Pro controls the Mac during the recording process, no matter what digitzer hardware you use.

The first step is to set the sound input to Built-in, MacRecorder or PAS 16, using the Sound Control panel. Then start SoundEdit Pro and connect your recorder output to the input you are using. Adjust the level correctly and then digitize. You can then look at the waveform (amplitude or data number) and by pulling down View and releasing on Spectrum, see the spectrum of what you have recorded. You can also see both by releasing on Both.

Figure 1 shows data that I recorded during the INTMINS pass over Washington, DC on August 4, 1995. The waveform (signal amplitude as a function of time) is on the top, and the spectrogram (amplitude, coded as darkness - darker is stronger, for each frequency as a function of time) is on the bottom. Time in minutes and seconds is shown at the top. The left hand scale for the waveform is data number, -2^{15} to $+2^{15}$, since the data was digitized with 16 bits. The left hand scale for the spectrum is frequency in kilohertz. The spectrogram is calculated by SoundEdit Pro by taking about 46 milliseconds of data (1024 points, sampled 22,254 times per second) and performing a fast Fourier Transform. The result is 512 measurements of amplitude, for 512 frequencies from 0 to 11,127 Hz, each frequency range about 22 Hz wide. So the frequencies are 0 to 22 Hz, 22 to 44 Hz, . . . , 11,105 to 11,127 Hz. The amplitudes are plotted as a series of vertical lines, with the darkness indicating amplitude.

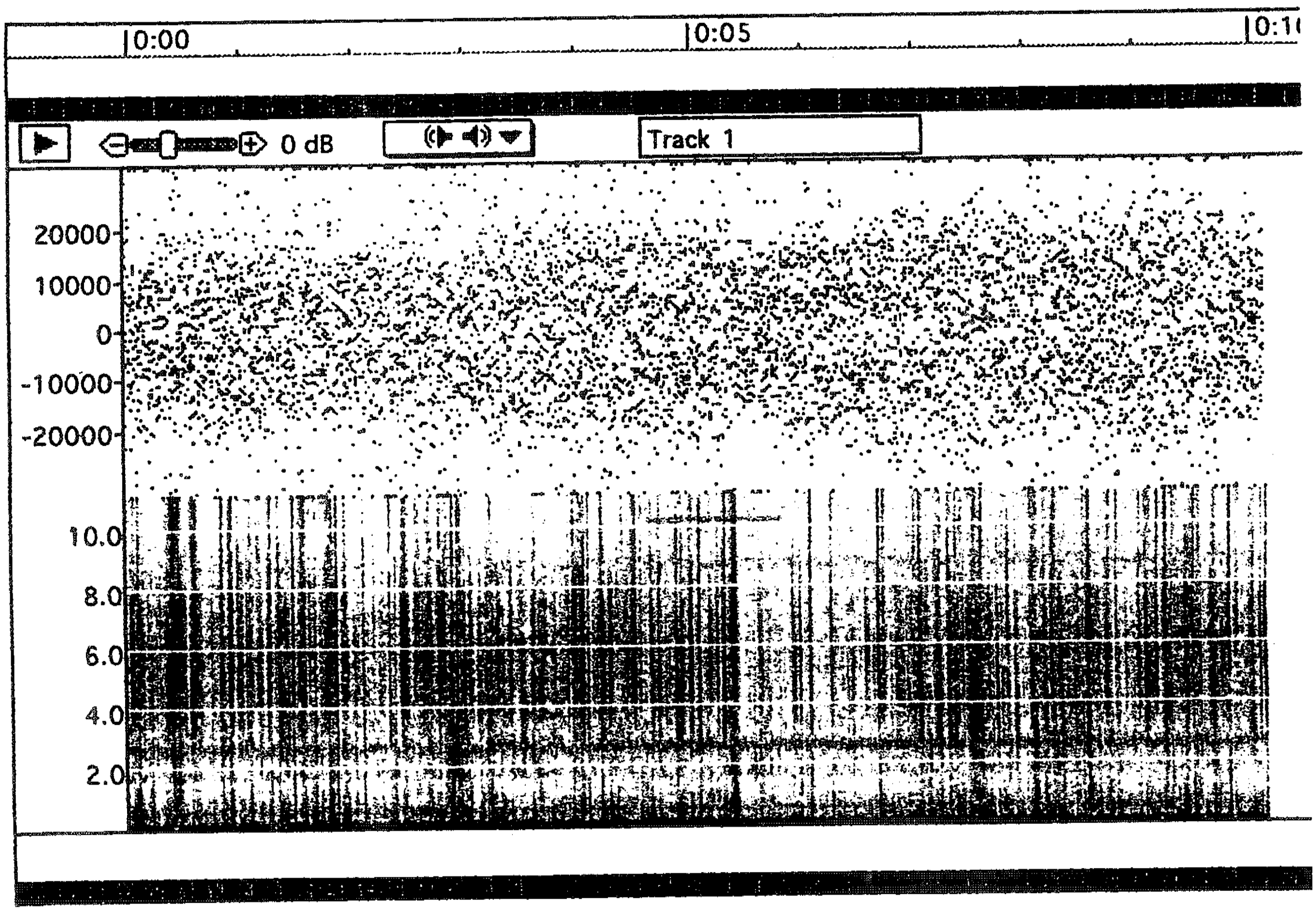


Figure 1. Amplitude and spectral displays from SoundEdit Pro.

An OMEGA signal is visible at 10.2 kHz in the spectrogram, but the waveform just looks like random noise. A waveform plot is not very useful, except to see if the signal amplitude is too low or too high. Interference lines, perhaps from transmitters is also visible at about 600 Hz, 2.6 kHz, and 8.8 kHz. Note that there appear to be no dark horizontal bands at 1, 3, 5, 7, 9, or 11 kHz, even though ISTOCHNIK was pulsing and MIR was overhead. If there were, we would be seeing the MIR signal at a fundamental of 1 kHz or at harmonics at odd multiples of the fundamental. So we need to look more closely at the spectrogram. The first thing we can do is to expand the frequency scale, and ignore the waveform, since it seems to be properly adjusted.

By viewing only the spectrum and pulling down View to Spectrum Options, I next changed the upper frequency limit to 4000 Hz, resulting in Figure 2. I also turned off the Grid in Spectrum Options so that the horizontal white lines that can be seen in Figure 1 won't interfere with the data. Power line harmonics are now visible at the bottom, as is what appears to be interference at about 600 Hz, 1.7 kHz and 2.6 kHz. But still nothing at 1 or 3 kHz!

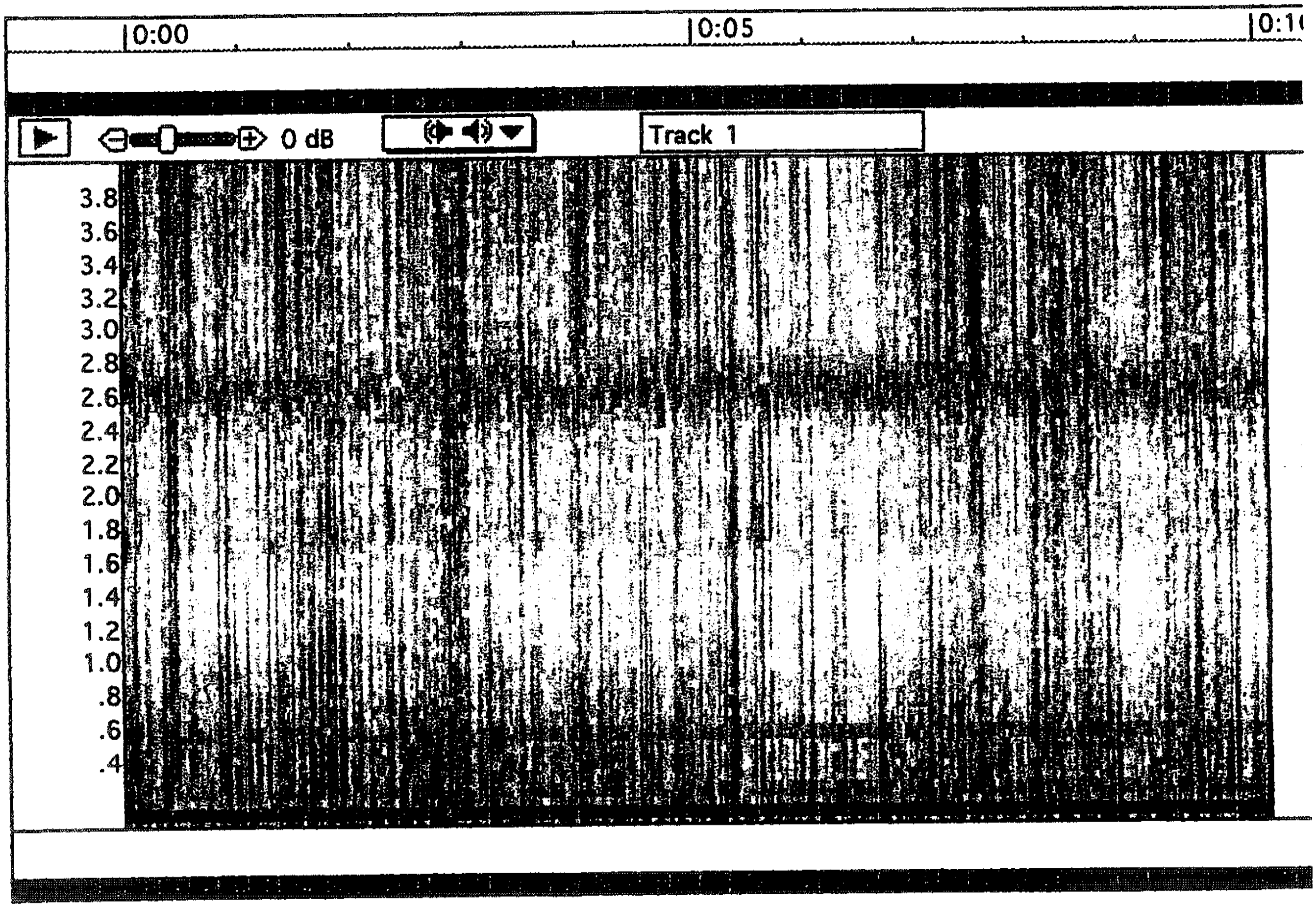


Figure 2. Spectrum from 0 to 4 kHz.

Another useful technique for spectral analysis of low frequencies is to reduce the sampling frequency. This can be done during data digitization or later. For Figure 3, I changed the sampling frequency to 5564 samples per second by pulling down Sound, releasing on Sound Format and changing the Sampling Rate to 5 kHz. Figure 3 clearly shows the 60, 120, 180, and 540 Hz harmonics of the power line. But still no signal at 1000 Hz!

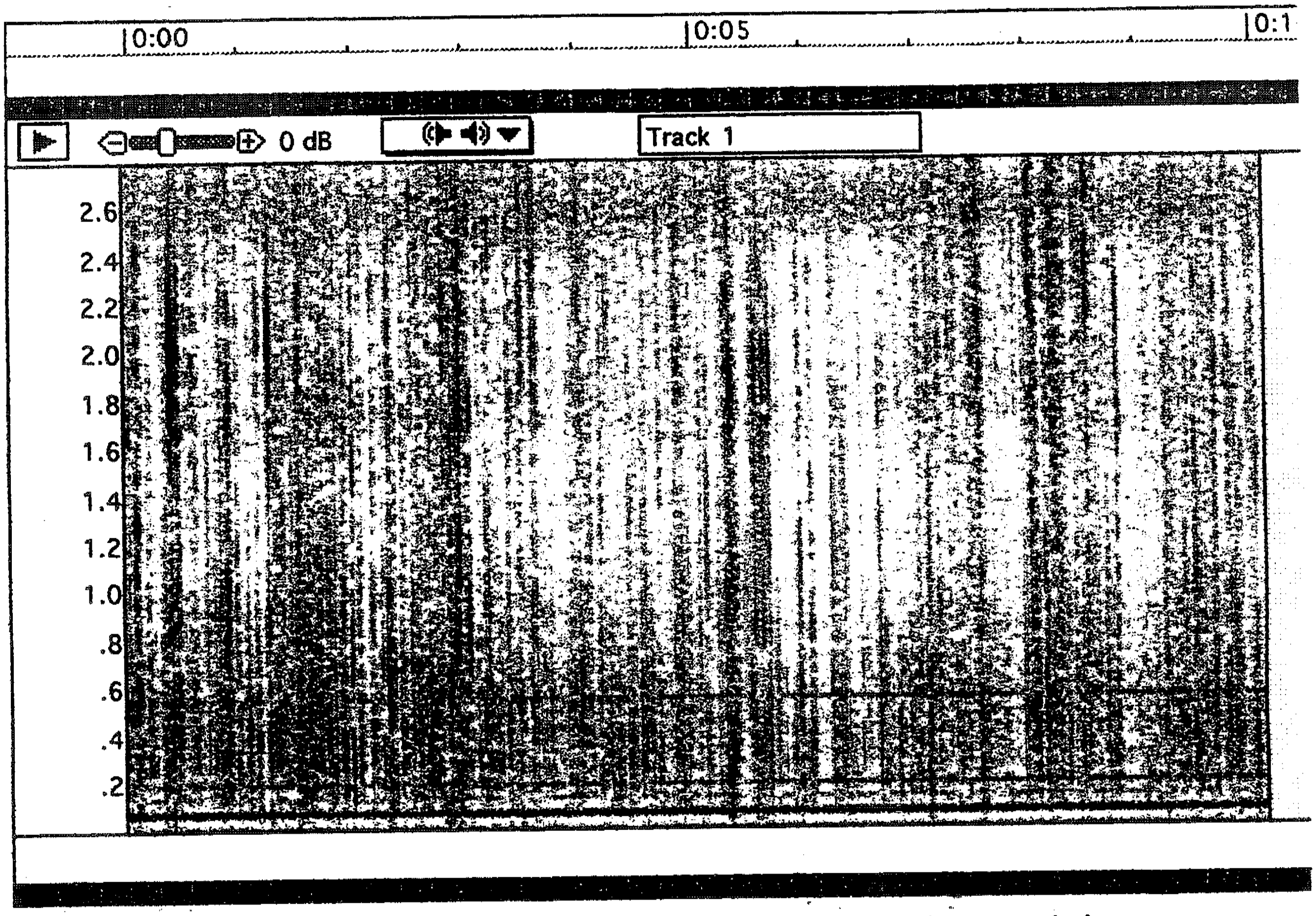


Figure 3. Spectrum from 0 to 2782 Hz with enhanced frequency resolution.

Figure 3 is beginning to show the discreteness of the data, the fact that the spectrogram is made up of individual pieces of data, the amplitude of the wave at a particular time and frequency. So the next step is to look at each of the pieces of data.

PROCESSING SPECTRAL NUMBERS

SoundEdit will export the actual numbers of the Fourier Transform into a tab delimited file which can be additionally processed with a spread sheet such as Excel, which is what I use. You may limit the frequency range of the exported data by pulling down View to Spectrum Options and changing the Frequency Range. To export the Fourier Transform, pull down File to Export Spectral Data and release. The dialog will allow you to assign a file name to the file. Figure 4 shows a portion of such an exported file.

Averages of the spectra can now be taken, using for example, Excel. Figure 5 shows an Excel plot of the average amplitude (average, power spectral density) and its standard deviation (sd, a measure of its statistical significance) as a function of frequency for two periods. The two periods are 140 seconds before and 140 seconds during the ISTOCHNIK operations on August 4. There is a peak in the spectrum at about 1030 Hz, but it occurs for both periods, ISTOCHNIK on and off, suggesting that the peak is environmental, not due to ISTOCHNIK operation. In addition, the standard deviation is larger than the average when ISTOCHNIK is off and is almost as large as the average when ISTOCHNIK is on. This indicates that the peak is not significant.

972h	977h	983h	988h	993h	999h	1004h	1010h	1015h	1021h	1026h	1032h
63	99	138	186	196	105	41	61	112	203	203	222
120	81	189	83	12	3	9	4	27	34	96	73
314	462	60	118	297	66	46	219	373	252	27	246
77	113	49	12	32	95	12	12	10	9	5	25
60	28	93	29	42	87	27	39	73	1	57	55
493	683	373	588	276	583	921	916	1215	588	729	792
33	65	15	42	8	24	24	2	12	9	32	4
14	101	109	21	60	106	40	117	19	36	57	17
164	96	15	11	369	555	70	16	15	221	157	164
85	36	5	61	426	214	514	85	499	729	388	34
14	138	274	372	248	265	190	92	60	255	153	136

Figure 4. Portion of the exported spectra for eleven time steps.
Each of the time steps is shown on a separate line.
(The "h"s on the first line indicate the lower frequency of the frequency range in Hz.)

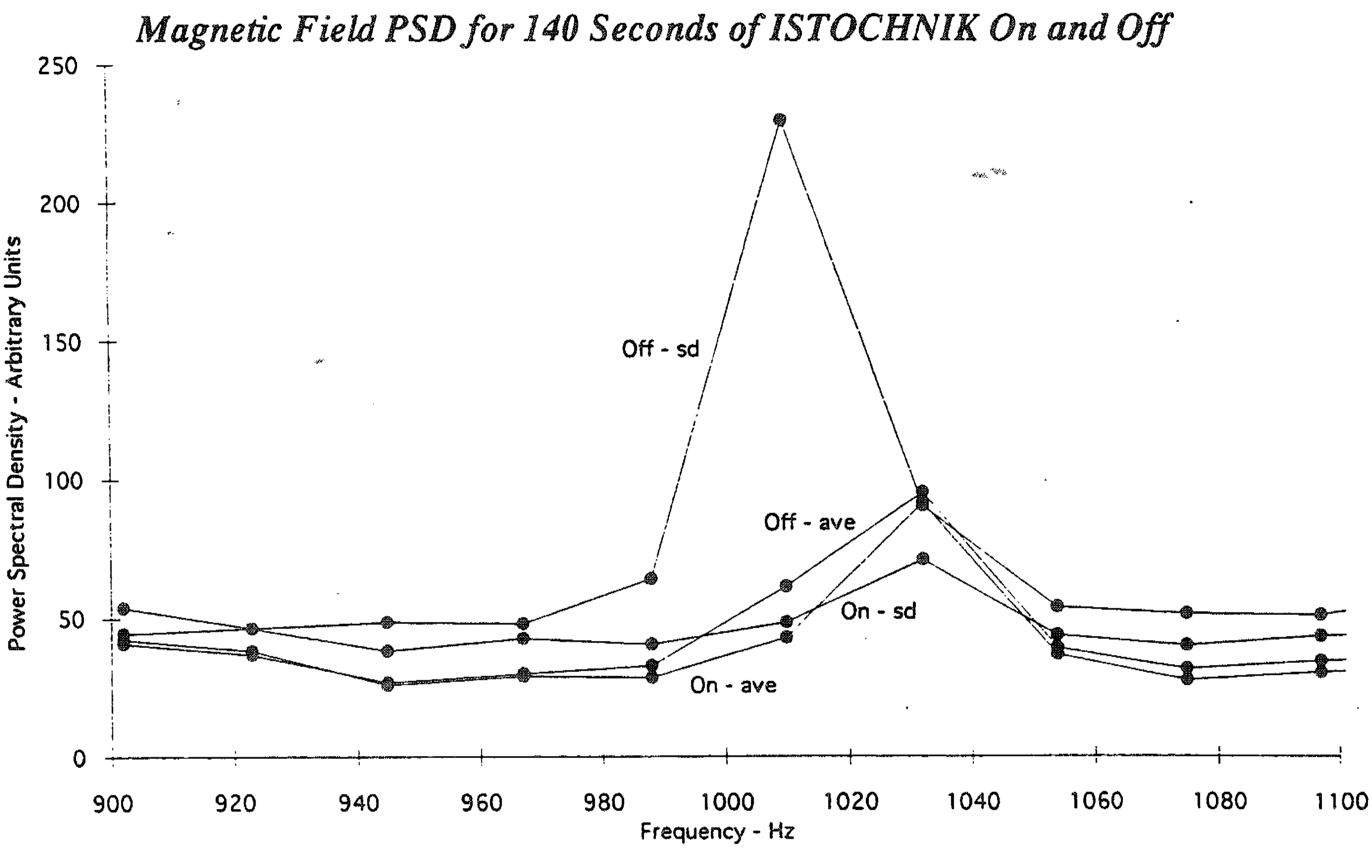


Figure 5. Magnetic field power spectral density for 140 seconds of ISTOCHNIK on and off.

I hope this summary of data processing techniques will be useful for you. If you create new techniques, let the Editor of INSPIRE Journal know and he will invite you to describe your technique in an article for the Journal.

Listening to WWV

by Steve Ratzlaff
East Palo Alto, CA

When you go out into the field to do VLF monitoring, you want to know the correct time for your log keeping. You probably turn on a shortwave radio and tune into the time broadcasts by station WWV in Colorado, or its sister station WWVH in Hawaii. Did you know that several other pieces of information besides the time is also broadcast? Omega ship navigation reports, geoalerts, marine storm warnings and Global Positioning System status reports are also included.

Background.

Currently operating under the U.S. Department of Commerce funding, the National Institute of Standards and Technology (NIST) (formerly the National Bureau of Standards) established shortwave radio station WWV, Fort Collins, Colorado in 1923. In 1948 WWVH, in Kauai, Hawaii, was added to expand coverage in the western Pacific Ocean region. Both broadcast simultaneously on frequencies of 2.5, 5, 10, and 15 MHz. WWV is also on 20 MHz. Both broadcast voice time signals. (Low-frequency station WWVB, Colorado, on 60 kHz, was established in 1956. It only broadcasts code signals, no voice. I will not deal with it in this article.)

Format.

Voice time signals are announced once per minute. WWV uses a male voice; WWVH uses a female voice--you can identify which station you are receiving this way. Note that this only applies to the minute announcements; other information can be in either male or female voices. Other information, such as geoalerts, is given hourly, but each station gives that information at separate times, roughly 30 minutes apart. This means, if radio propagation allows you to hear both stations, you can receive the same report twice an hour, or if you miss one report you don't have to wait a whole hour to get it again. The following chart shows the format.

	WWV	WWVH
Marine Storm Warnings	08--10	48--51 min. after hour
GPS Reports	14--15	43--44
Omega Reports	16	47
Geo alerts	18	45
Station Identification	00,30	29,59

Receiving WWV/WWVH.

At least one frequency should be usable at all times. As a general rule, frequencies above 10 MHz work best in the daytime, and the lower frequencies work best at night. Shortwave radio reception conditions vary greatly with factors such as location, time of year, time of day, the particular frequency being used, atmospheric and ionospheric propagation conditions, and the type or receiving equipment used. In mid-1995, we are currently at the very bottom of the solar sunspot cycle. This means that the higher shortwave frequencies are hardly propagated at all, and the lower frequencies are favored. Currently, I rarely hear WWV on 20 MHz, but 10 and 15 are good during the day and 5 MHz is good at night.

Marine Storm Warnings

Marine storm warnings are broadcast for the marine areas that the United States has warning responsibilities for under international agreement. The storm warning information is provided by the National Weather Service. Storm warnings for the Atlantic and eastern North Pacific are broadcast by WWV. Storm warnings for the western, eastern, southern, and north Pacific are broadcast by WWVH. The brief voice messages warn mariners of storm threats present in their areas.

GPS Reports

The Global Positioning System allows you to precisely find your location, altitude and course (if you're moving), based on a series of satellites in space. Commercial handheld models are currently available for about $400.

Since March 1990 the U.S. Coast Guard has sponsored two voice announcements per hour on WWV/WWVH, giving current status information about the GPS satellites and related operations.

Omega Reports.

The Omega Navigation System consists of eight radio stations transmitting in the 10- to 14 -kHz frequency band. These stations serve as international aids to navigation. Ships at sea can use the Omega System to calculate their position. Its accuracy is very poorer than the latest satellite GPS system, which can give an accuracy of about 100 meters.

We VLF listeners can receive the 10.2 kHz Omega stations on our whistler receivers. Those with large loop antennas or long wire antennas have discovered that Omega signals are strong enough to overload our tape recorder and have had to take measures to reduce the high frequency response of the VLF receiver when making recordings.

Geo Alerts.

Current geophysical alerts are broadcast, with hourly updates given when necessary.

Part A of the message gives the solar-terrestrial indices for the day: specifically the 1700 UTC solar flux from Ottawa, Canada, at 2800 MHz, the estimated A-index for Boulder, CO, and the current Boulder K-index.

Part B gives the solar-terrestrial conditions for the previous 24 hours.

Part C gives optional information on current conditions that may exist (that is, major flares, proton or polar cap absorption (PCA) events, or stratwarm conditions).

Part D gives the expected conditions for the next 24 hours.
An example : A) "Solar-terrestrial indices for 26 October follow: Solar flux 173 and estimated Boulder A-index 20; repeat: Solar flux 173 and estimated Boulder A-index 20. The Boulder K-index at 1800 UTC on 26 October was four; repeat: four." B) "Solar-terrestrial conditions for the last 24 hours follow: Solar activity was high. Geomagnetic field was unsettled to active." C) "A major flare occurred at 1648 UTC on 26 October. A satellite proton event and PCA are in progress." D) "The forecast for the next 24 hours: Solar activity will be moderate to high. The geomagnetic field will be active."

Definitions.

SOLAR ACTIVITY is defined as transient perturbations of the solar atmosphere as measured by enhanced x-ray emission, typically associated with flares. Five standard terms are used to describe solar activity: Very low, Low, Moderate, High.
The GEOMAGNETIC FIELD experiences natural variations classified quantitatively into six standard categories depending upon the amplitude of the disturbance. The Boulder K- and estimated A-indices determine the category according to the following table:

Condition	A-index range	Typical k-indices
Quiet	0--8	0--2
Unsettled	8--16	0--3
Active	16--30	3--4
Minor Storm	30--50	4--5
Major Storm	50--100	6 or greater
Severe Storm	100 and greater	7 or greater

SOLAR FLARES are classified by their x-ray emission as Class A,B,C,M,X. The letter designates the order of magnitude of the peak value. Following the letter the measured peak value is given, as a number from 1.0 to 9.9, which acts as a multiplier. For example, a solar flare might be classified as a "C3.2" event. A Major Solar Flare produces some geophysical effect with x-rays M5 or greater. A Proton Flare--protons by satellite detectors associated with an H-alpha flare. A Satellite Level Proton Event--proton enhancement detected by earth-orbiting satellites with a certain level of measured particle flux. Polar Cap Absorption--proton-induced absorption as measured by a 20-MHz riometer located within the polar cap. Stratwarm--reports of stratospheric warmings in the high latitude regions of the winter hemispheres of the earth, associated with gross distortions of the normal circulation associated with the winter season.

Station ID. Both stations identify with a voice announcement on the hour and half-hour, giving call sign and mailing address.

Each minute the time is announced as Coordinated Universal Time (UTC). UTC was established by international agreement in 1972, and is governed by the International Bureau of Weights and Measures (BIPM) in Paris, France. Coordination with the international UTC time scale keeps NIST time signals in close agreement with signals from other time and frequency stations throughout the world. (Prior to 1972 the time was announced as "Greenwich Mean Time", GMT. GMT and military "Zulu" time are still frequently heard, and are equivalent to UTC.)

UTC differs from your local time by a specific number of hours. The number of hours depends on the number of time zones between your location and the location of the zero meridian (which passes through Greenwich, England.) When local time changes from Daylight Saving to Standard Time, or vice versa, UTC does not change. However the difference between UTC and local time does change--by 1 hour.

UTC is a 24-hour clock system. The hours are numbered beginning with 00 hours at midnight through 12 hours at noon to 23 hours and 59 minutes just before the next midnight.

Other than using WWV to find the correct time, I believe the VLF listener can obtain some benefit from the Geo alerts, specifically the Geomagnetic Field conditions. Since all natural VLF phenomena we hear is associated with the earth's geomagnetic field, anything that affects that field can influence what we are going to hear on VLF. For several years I have been attempting to obtain some correlation between the Geo alert A-indices and what I actually hear during a VLF monitoring session. I have a rough rule of thumb that A-indices over 10 should indicate some kind of probable VLF activity, such as enhanced whistler activity. My records so far don't show any definite correlation, though. Sometimes I've heard lots of whistlers and other phenomena when the A-levels were above 10; I've also heard lots of whistlers when the reported A-indices were 3 or 4. Just this past 1995 fall equinox I was listening during a reported geomagnetic Minor Storm which seemed to be the cause of some very fine VLF phenomena--whistlers with long echo trains, nice chorus, which lasted throughout the daylight hours (normal whistler and chorus activity fades away soon after sunrise). I have no way to prove the minor storm was the cause of the unusual conditions I experienced. I believe it was. This is all part of the fascination to me of listening to Natural Radio. You never know what you will hear when you go out. But, if you tune into the Geo alert on WWV and you hear them announcing a Major or Severe storm, pack your VLF gear and head to your quietest site and hope for unusual conditions!

This article was prepared mainly from NIST Special Publication 432 (Revised 1990) available for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Fall Equinox VLF Monitoring

by Steve Ratzlaff
East Palo Alto, CA

I arranged to have a 2-week vacation with the autumnal equinox (Sept. 23) in the middle of it so I could do some VLF monitoring, hoping the equinox would produce some good listening. I set up my equipment near my parent's home in NE Oregon. I used the same site and antenna as for the Spring equinox. (See INSPIRE Journal, Vol. 3, No. 2). I listened 11 mornings (9/19--9/29).

Sunday, 9/17, about 1700UT (10 a.m. PDT)

This was not a listening session, but I took a relative to the site to show off the setup. There happened to be a whistler storm going on, fairly strong level, about 5-20 whistlers per minute. During the 10 minutes I had the equipment on, a very loud pure-note whistler came screaming through--giving the best demonstration possible of why I get up early and "go listen to the static crashes"! My cousin was very impressed. (So was I. That was the loudest whistler I heard the whole time I was home.)

Monday, 9/18, 1300UT start. (0600 PDT).

278 whistlers heard in 60 minutes monitoring. Weak chorus at 1301UT, fading out and returning every few minutes for about 10 minutes. Whistlers were mainly hissy, diffuse,1-2 seconds long. There were a few fast low-dispersion whistlers. Most were weak to faint in level. Most were single-hop (no crash heard before the whistler.) Toward sunrise (1347UT) double-hop whistlers occurred, being very long,2-4 seconds, and very hissy and diffuse. Some had almost no dispersion, being just a long hiss. 1332UT--a long semi-pure whistler, loud, with a hissy echo. 1350UT--a loud whistler and hissy echo. WWV propagation at 1318UT solar flux 70, A3,K1.

Tuesday, 9/19, 1250UT start.

149 whistlers in 60 minutes. 1250UT--weak to medium chorus, long slowly rising tones with fast chirps mixed in, lasting about 10 minutes, fading out, then fading up briefly for the next 15 minutes. Whistlers were mostly weak to faint, single-hop, 1-2 seconds, semi-pure note. Near sunrise, some double-hop with echoes were heard. 1304UT--loud single-hop whistler, fast with a fluttery trail. WWV propagation F72,A1,K1.

Wednesday, 9/20, 1242UT start.

100 whistlers in 70 minutes. Lots of tweeks today. All whistlers are weak to faint. Many were high-pitched, almost pure-note, fast, single-hop. From 1342UT on, sometimes 3-4 minutes would pass without a whistler. WWV propagation F74, A2, K2.

Thursday, 9/21, 1238UT start.

18 whistlers in 45 minutes! Nothing much happening this morning. Whistlers were mostly pure-note, fast 1/2 second to 1 1/2 seconds long, single-hop and weak to faint. I stopped monitoring after the 45-minute tape recording finished. WWV propagation F76, A7, K1.

Friday, 9/22, 1242UT start.

5 whistlers in 60 minutes. Few tweeks, quiet background, except for the hum level. Brief chorus, weak, at 1259UT consisting of long 2-second rising tones, with some descending before rising. Chorus faded out and reappeared several times through 1304UT. WWV propagation F74, A7, K0.

Saturday, 9/23.

The start of the autumnal equinox. Did not go out this morning. (Stayed up too late the night before!)

Sunday, 9/24, 1241UT start.

211 whistlers in 70 minutes. Several types of whistlers noted: A single-hop type, high-pitched, low-dispersion, 1/2 second; a single-hop, high-pitched, descending to a low pitch, 1/2 second; a single-hop, diffuse whistler, 1/2 second; a double-hop type with a second whistler stronger than the first, 1/2 second apart. WWV propagation F75, A8, K3. (Sunrise at 1346UT.) A few whistlers medium loud, otherwise weak to faint.

Monday, 9/25, 1241UT start.

505 whistlers in 70 minutes.This was Whistler Morning. All but a few were weak to faint. All were semi-pure note, fast, 3/4 to 1 second long. All but about 5 were single-hop. During some periods I counted 13 whistlers per minute. WWV propagation F74, A8, K2. I saw 2 deer at the site this morning. Going home, I saw an old fat porcupine loping down the dirt road. I stopped the car, got out and chased it off the road. Its back was almost absent of quills and the skin was a strange mottled yellow coloring. It was most anxious to hurry away from me. I've never seen one going down the middle of the road before.

Tuesday, 9/25, 1242UT start.

39 whistlers in 60 minutes. Very faint chorus bursts starting 1248UT, coming and going for several minutes. Chorus was high-pitched rising tones. Whistlers were mostly single-hop with semi-pure notes, varying from 1/2 second high-pitched ones with low-dispersion to 1 1/2 second whistlers fairly diffuse. Other than several medium-loud ones, they were weak to faint. This session was very different from the previous morning. WWV propagation F74, A6, K3.

Wednesday, 9/27, 1243UT start.

22 whistlers in 60 minutes. Medium to loud chorus was present at the start, with continuous high-pitched "bird chirps". 1247UT chorus strength fading. Chirps are now mixed with high-pitched whistling tones that wander in frequency. 1249UT chorus weak now, occurring in 30 second bursts before dying away for several seconds, then increasing again. Some short low-pitched "barks" are now present. Chorus continues growing weaker, coming and going throughout the session, even past sunrise at 1347UT. The whistlers are mixed single and double-hop, mostly semi-diffuse, 1 1/2 seconds long. There were several single-hop medium strength whistlers, 1 second long followed 3 seconds later by an echo. WWV propagation F74, A5, K5. The geomagnetic field was reported as varying from quiet to minor storm levels.
After going for a walk around the site I turned the equipment on again for a check of conditions. 1445UT (over an hour past sunrise). Chorus was still going at weak to faint levels, with high-pitched bird sounds mixed with low-pitched "seal" sounds. I continued listening until 1511UT (8:11 a.m.). Chorus was still audible. During this 26 minute segment I heard 23 whistlers--better

than the preceding 22 heard in 60 minutes. They were the same types heard in the earlier session.

Thursday, 9/28, 1246UT start.

1245UT propagation forecast F72, A28, K5, "on 1200UT 27 September a minor geomagnetic storm began." At the start of the session sferics were so loud and continuous as to be almost deafening. I had to turn the volume way down. Gradually the level and intensity of sferics reduced so the chorus and whistlers could be heard. This level of sferics activity must have due to the minor geomagnetic storm enhancing the ducting path, since there were no local storms. Chorus was continuous with high-pitched, medium and low-pitched sounds all present at once. At 1303UT the sferics loudness was reduced enough to hear the activity going on. I heard 292 whistlers the first 60 minutes. At the start, there were about 2 whistlers per minute, increasing as the session went on. Until 1309UT almost all were double-hop, semi-pure note,1-2 seconds long. From about 1309 to 1330UT whistlers were almost all single-hop. From 1330UT on, mixed single and double-hop whistlers were heard, with echoes starting to be produced also. High-pitched, low-dispersion pure-note whistlers with 1/2 second duration were also present frequently. Chorus continued at weak to medium strength throughout the entire session. By about 1330 sferics strength was much reduced, allowing the volume control to the headphones to be increased. Loud whistlers would produce 2 or 3 echoes now.

At 1401UT I started a second tape recording. Chorus was still continuous but weak. Sferic pops were producing medium to loud whistlers with echoes; I counted 5 very plainly audible. 1419UT chorus is weak to faint now with the high-pitched sounds mainly gone and the low-pitched sounds dominant. 1420UT--a lull in activity for several minutes. 1423UT--Chorus now has high-pitched tones added again but the pattern is different from before; instead of short bird sounds now there is a jumble of "wave-like"pulsations occurring in a "pumping" manner of 1-2 per second. Whistlers continue producing echoes from the medium-to-loud ones. 1453UT--background sferics are fairly quiet now, so whistlers stand out plainly. A double-hop whistler just produced 12 echoes! Chorus is faint now. Whistlers occur at only 1-2 per minute now. 1457UT--whistlers now up to 5-7 per minute. I stopped monitoring at 1500UT. (Whistlers were predominantly semi-pure note, 1 1/2 seconds long. The sferic crash would occur, 1 second later the whistler would occur, about 1 second later the echo would come, etc.)

Friday, 9/29, 1249UT start.

Sferics activity is fairly quiet. At the start, chorus is faint with high-pitched tones. Sferics pops produce double-hop whistlers, semi-diffuse, long 2 1/2 seconds. Chorus is a slow "tweedle-tweedle" pulsing at about 1 1/2 seconds cycle. 1254UT--loud pop with medium whistler and several weak echoes. Chorus faded out, then came back in short bursts for the next 30 minutes or so. Some high-pitched, low-dispersion, fast 3/4 second whistlers were produced occasionally. By about 1305UT the whistlers were becoming very diffuse, with less and less dispersion. Some whistlers would produce very hissy echoes, with no dispersion, just a steady hiss until the echo faded out several seconds later. 1319UT--chorus burst, mixed high-pitched bird sounds in a slow chirping along with descending then rising tones. 1330UT--sferic pop with a 4-second hissy slowly dispersing whistler and a hissy no-dispersion echo. 1336UT--sferic crash and a 2-second semi-pure whistler and several long hissy echoes. 1339UT--sferics pops are causing almost continuous hissing sounds. They have no dispersion, just a steady hiss lasting for seconds. 1348--sferics crash produces a long hissy whistler and also upward emissions (triggered emissions). This type of phenomenon continues for the next 5 minutes or so.
After a half-hour walk, the equipment is turned on again at 1430UT. Conditions are somewhat changed now. There are mixed double-hop whistlers, semi-pure note now and several echoes, along with the very diffuse, hissy whistlers and their hissy echoes. Triggered emissions are gone also. I stopped listening at 1435UT and began taking down the antenna and packing up the equipment. (1345UT propagation F73, A17, K2, "the geomagnetic field is quiet to unsettled."

The minor geomagnetic storm has ended.) No accurate count of whistlers heard is given; I had a hard time identifying just what was a whistler once they became very hissy and gave up trying to count them from the log notes.

Random comments.

1. I noticed I could always hear weaker activity from the receiver directly from the headphones output than from listening to the recorder output. This was verified by playing back a short recorded segment and comparing it to what I had just heard direct from the receiver. My recorder is a Marantz analog recorder. I don't have a DAT recorder.

2. After a session I like to go over my log notes and count the number of whistlers heard. I don't do this to "keep score" but to have an idea of how conditions were for that session, compared to other sessions.

3. Note that my loudness levels noted are relative, related to size of antenna. My site is fairly low in hum level so I can erect a large loop antenna, which is very sensitive. My small 10 foot square antenna used at another site with much higher hum levels is much less sensitive; I doubt I would even hear what I term as a "weak" whistler on the large loop.

4. I doubt the equinox had anything to do with the occurrence of a geomagnetic minor storm producing some great VLF listening. I think you should just go out whenever you can and set up your equipment and listen to what's currently happening, and hope for good conditions!

5. It seems that for morning listening, be ready to start taping at least one hour before local sunrise. That seemed to produce the best listening for me this time around. After sunrise, activity generally tapers off, sometimes dropping off to nothing, dramatically.

6. I was lucky this time at home to have a geomagnetic minor storm occur which produced some very fine VLF activity. But there were several days which were very quiet, with not much happening. Still, it's nice just to sit in the car, listening to whatever is occurring with Natural Radio at the moment, watching the false dawn come, then sunrise, sitting out in the woods all by yourself, enjoying the solitude, even if nothing spectacular is happening, VLF-wise.

INTMINS
(INTerball-MIr-INSpire)

By Bill Taylor
Washington, DC

INTRODUCTION

INTMINS is an acronym created out of the names of three projects that are working together to investigate electron beams and plasmas in space above earth's atmosphere.

The first, INTERBALL, is a Russian space physics program to investigate the physics of magnetospheric processes. It is sponsored by the Space Research Institute in Moscow, Russia. The Russian acronym for Space Research Institute is IKI (pronounced icky). INTERBALL consists of two satellites, Tail Probe and Auroral Probe. Each probe has a subsatellite, carried into orbit on the same rocket. Tail Probe was launched in August 1995 and the subsatellite was successfully separated shortly thereafter. All systems are currently working correctly.

The INTERBALL-Tail pair are in an highly elliptical orbit ranging in altitude from 200,000 km to 315 km. The inclination for both is 62.8 degrees. The two spacecraft follow each other in this orbit and are currently separated by 100 km. This spacecraft pair was launched into an orbit which will reach the high altitude cusp and subsolar magnetopause regions on the day side and then, the neutral sheet in the night side tail region of the magnetosphere. The INTERBALL-Tail spacecraft were designed to study various plasma processes in the Earth's magnetosphere and are well equipped to measure both natural and man-made radio waves. Between the two spacecraft there are 13 plasma and high energy particle experiments measuring electrons, protons and high mass particles from low to very high energies. In addition, there are 10 magnetic field, electrostatic, and electromagnetic wave instruments. The INTERBALL mission is truly international having investigators from over 10 countries. The experiments are designed to study the cause and effect relationships in the solar wind/magnetosphere interactions. In mid-1996 the INTERBALL-Tail pair will be joined by another pair called INTERBALL-Auroral which will have a 20,000 km apogee orbit. INTERBALL Auroral will orbit the over the Earth's poles and be equipped with similar instrumentation including auroral imagers.

The second is the Russian Space Station MIR that has been in orbit and manned for many years. The Russian organization, ENERGIYA, is in charge of MIR. Many scientific studies are being performed by MIR, from medical experiments to observations of gamma rays from stars and other astrophysical objects. The instrumentation on MIR includes an electron gun and a plasma generator.

The third, INSPIRE (Interactive NASA Space Physics Ionosphere Radio Experiments), is a project to interest students in science and technology by making it possible for them to observe very low frequency (VLF, 3 to 30 kHz) radio waves.

INTMINS experiments are conducted by having MIR fire electron beams and plasmas into the ionosphere and measuring the waves and plasmas that result.

SCIENTIFIC AND EDUCATIONAL OBJECTIVES

Each of the three INTMINS projects has its own objectives and INTMINS brings the common aspects of the projects together for its objectives. Using the electron and plasma generators on MIR and INSPIRE receivers, the scientific objectives of INTMINS are to:

- Observe radio waves on the ground in the audio frequency range generated by electron and plasma generators in space
- Understand how the waves are generated
- Determine how the waves propagate to the surface of the earth

The educational objectives of INTMINS are to:

- Provide a link between science and technology teaching in the classroom and the world outside.
- Give teachers a project that can be done by their classes
- Expose students to the excitement and accessibility of modern science and technology

The scientific objectives of INTERBALL, using instrumentation on the TAIL probe and its subsatellite, are to:

- Observe the phenomena that are occurring near the earth, as the solar wind interacts with the earth and its magnetic field
- Understand the processes that make up the interactions

Using the electron and plasma generators on MIR and the scientific instruments on INTERBALL the following scientific objectives will be met:

- Study the interactions between the ionosphere and the injected plasma and electrons
- Understand the dynamics of the injected, artificial plasma in the ionosphere
- Investigate the initial phase of plasma instabilities, the resulting electromagnetic emissions and their propagation in the ionosphere, magnetosphere, and atmosphere
- Investigate effects of wave particle interactions

DESCRIPTION OF EXPERIMENTS

MIR is in an orbit around the earth with an inclination of 52 degrees. This means that MIR will cross over every point on earth with a latitude between 52 degrees North and 52 degrees South. So it will go as far north as the Southern tip of Hudson's Bay, and as far South as the tip of South America. Its altitude is 300 km. Two of the instruments on MIR are ISTOCHNIK and MIR.

ISTOCHNIK is an electron accelerator somewhat similar to the picture tube in a television. Electrons are produced by heating a cathode, which boils them out of the hot metal. The free, negatively charged electrons are then accelerated by positive charges on an anode, just like the electrons in a TV tube are accelerated towards the screen. They are accelerated by 10,000 volts. An electrical current in the electron beam of 0.7 amperes is sustained for four microseconds. This pulse of electrons can be repeated 10, 140 or 1000 times per second. The electron beam is hundreds of meters long and resembles a bolt of lightning in space, moving at a speed of about 1/10 of light, along the earth's magnetic field. The net effect is like a series of lightning strokes, as many as 1000 per second, which can produce a radio wave with a frequency of 1000 Hz. The waveform will also have harmonics, so frequencies of 2000, 3000, . . . will also be produced. Some of these radio waves will travel downward through the ionosphere to the atmosphere. These are the waves we are trying to observe.

Some of the waves from ISTOCHNIK will also travel to higher altitudes along the magnetic field, as will the electrons, if ISTOCHNIK is pointed upward. INTERBALL will try to observe both the waves and the electrons as they pass the high altitudes where INTERBALL spends most of its time. Just as some INTMINS periods are chosen when MIR is above INSPIRE observers, other periods are chosen when MIR and INTERBALL are on the same magnetic field lines. The electrons fired from MIR follow the magnetic field lines and electron detectors on INTERBALL try to observe them. This scenario is even more complicated because electrons and waves interact, trading energy like a surfer capturing energy from a wave.

SCHEDULE

Item	Planned Date
Launch of the Tail Probe and its subsat.	August , 1995
First period of INTMINS operations	August 1-10, 1995
Second period of INTMINS operations	September 17, 1995
Third period of INTMINS operations	November 19 and 25
Fourth period of INTMINS operations	April 21 and 27, 1996
Launch of the Auroral Probe and its subsat.	March/April 1996

Italian Natural Radio Research
Goes in the Field

By Flavio Gori
INSPIRE European Coordinator
Florence, Italy

Since November 1994 (and probably earlier) until this January, here in Italy almost daily the newspaper and television brought us information about strange phenomena that appear to happen in all of Italy and beyond, from Israel to the Scandinavian peninsula. People reported seeing UFOs (as extraterrestrial crafts, but is really all of the unknown objects flying in the sky), Virgin Mary's statue crying and many other hard-to-believe phenomena.

The UFO reports were especially numerous between December and January, though I was unlucky and saw nothing - which seems to always happen in my life. It is not that I think that UFOs or other things are not real, it is just that I do not want to be part of the argument between the two groups: one that says "I believe in it" and the other that says "I don't believe in it".

At this time we have at our disposal a large amount of tools from science and technology and we should use them in the best way possible. Maybe in this way we could do some research to help understand these strange phenomena. We also should not avoid using any tools that are not part of official science. In unofficial science there are a number of useful tools. We should remember that the human eye and present research tools, at this time, can detect only 10-15% of the "real universe", the rest is black matter that we are unable to monitor.

I think it is a hard road for people to walk when people really want to know and understand but it is difficult to acquire the data that everyone needs. At this time, I believe that amateur researchers such as I will get better results is they stick to the kingdom of reality that we can observe and measure, leaving the new theories (so difficult to be accepted by scientists who have not had the new ideas - remember Einstein and Bohr and Heisenberg?) to the researchers who are able to discuss it with their colleagues.

Let's widen the argument a little bit. It seems to always happen that in the scientific community, which should be very open to the evolution of research, there is often (or always) a reluctance to accept change. This is probably because these new theories change the status quo in the academic institutions all over the world and change the economic situation, too. Some times a scientist leading the new paradigm is able to impose himself, but I wonder how many new good theories (and scientists) are put in the trash without good reason. One who was at least recognized later was Boltzmann.

A correct balance in the research is consequently hard to get (though necessary). This long preface (longer than usual) is to introduce you to a research project that our group decided to carry on in the field of strange happenings, searching for a little bit of (amateur) scientific light.

One of the interesting sides of studying natural radio phenomena is that here we can find evidence of more than one apparently unrelated phenomena. All of us know about researchers studying earthquake prediction, electrical propagation, sounds of natural radio, optical spherics, meteors scattered in the high atmosphere and so on. All of these events are probably detectable in the low part of the E.M. (electromagnetic) range. In order to make VLF/ULF research a little more practical, we decided to investigate some phenomena we usually read about in journals and magazines. We hope to help, in some way, to find a technical approach that could give a clue, in a positive way or negative way, about what is going on.

Of the large number of strange cases reported, one was an interesting situation not far from my Florence. About 25 kilometers from here, starting in December 1993, if we can believe it, a lady says she sees and talks with the Virgin Mary on the last Sunday of December, February, April, June, August and October, probably until the year 2000 or more. We decided to use VLF/ULF to investigate.

She is not the only one to make such claims in these not really happy times. But after some of her first visions and her reports to the bishop, the Vatican State decided to move two priest there to study the situation to try to prove her credibility. In our point of view the religious aspects are not so important, so I will spare you that discussion. I will point out that two doctors of medicine attend and keep the lady's heart and brain under control during the visions since her heart is beating so fast at that time. Each time the Virgin appears and gives a message and all but one of these messages has been made public.

One cold winter morning, December '94, my friend Nader Javaheri and I (Nader worked on the eclipse and the Space Bang with us last year) went to the small hill where the church is where the lady has her visions. We talked with a man living in front of the church who let us see two interesting color photographs. In these we could see two white globes of light seeming to be made by fog with no sharp bounds just over the bell tower. The man told us that the two globes were not visible to the naked eye but only appeared in the developed film. This was taken during the October vision.

Unfortunately, the man also told us about another "strange" phenomenon that happens only in film and is not seen by the naked eye. In the entrance of the church there is a picture of the Virgin Mary behind a glass. He said that in the developed film people can see a clear cloud in the low part of the picture that is not usually visible. Just looking through the camera, it was easy to understand that the "cloud" is simply the reflections of the light in the glass that protect the picture, that the human eye usually "cuts off" automatically.

Anyway, talking with the members of the INSPIRE group of mine here in Florence, we decided to investigate the situations from both sides: optical and electromagnetic. Being an old amateur photographer since 1977, I was happy to combine two hobbies of mine in order to develop, if possible, a cross reference for our job.

It was not difficult to find interested people who wanted to to investigate the visions, but in our first field research we were not able to record the VLF range because a very severe storm hit the site. The first time we went in the field was 30 April 1995. We arrived at 1600 local time, while the happening is always at 1800. It was very cold and rainy day with a black sky full of rain clouds all around as far as we could see. We stood in the field for 3 hours, preparing the video camera and still cameras: 2 Leica cameras with 35 mm wide angle lenses to catch the most sky we could over the church, while avoiding strong wide-angle distortions. with Kodak slide film, one of them infrared for eventual thermo-connections.

In the vicinity of "the Time", the sky suddenly was opened up in a large circle directly above the church where the lady was with 2000 waiting people. We were in a field about 600 meters away and 300 meters down, making a big portion of the sky over the church visible to us. There were not many electrical lines in the vicinity and (very important) not other people around. Unfortunately, the site is not so quiet for the VLF recording session, Also, I have to say that the electromagnetic situation was better in April than in June. Probably some electrical item was put in close by the location. That is an important consideration for our activity in Natural Radio Research.

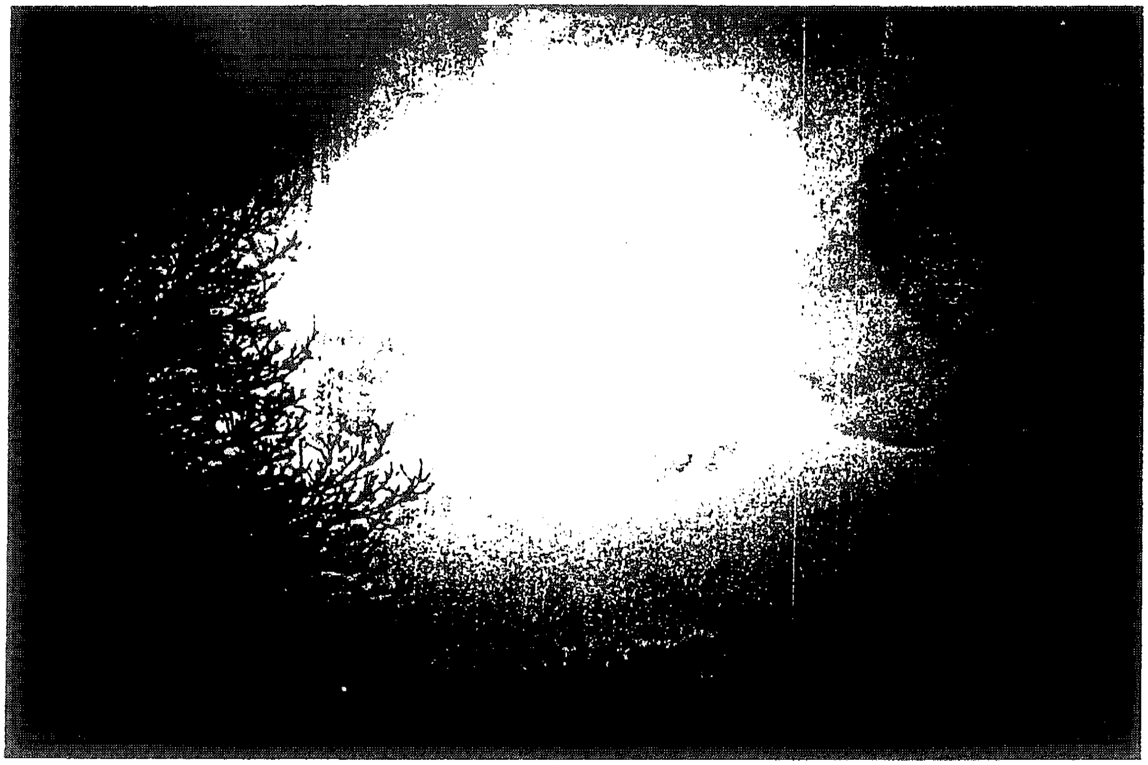
Some minutes after 1800, the sky over the church did turn cloudy and rainy. In all other parts of the sky that we monitored and over our head, too, it rained all of the time. I took 72 slides in 40 minutes (17.50 to 18.30). My friends, Massimo Mastrosimone and Dario Javaheri, took one hour of video from 17.30 to 18.30. Nader Javaheri took 36 photos. Developing all of the films we had one surprise. On only one slide of mine we saw an interesting blue/white ray of light with a small white sphere roughly in the middle of its length, right above the church and coming up (or down). Nothing unusual appears in all the other film, even the infrared. Nothing was seen by the naked eye, probably because of the high speed of the rays. What could it be?

I began by checking the slide with the technical support of the people at the developing laboratory. After four people examined it two times, nothing was understood. Then I showed the slide to a master photographer. His conclusion was that there was no technical mistake, no parasite light between the lenses, no apparent developing mistake. Remember, it appears on just one slide.

I also had the opportunity to talk with a priest (Philosophically Ph.D.) not involved in the case. He was absolutely skeptical about a religious explanation. I showed the slide to some professional researchers involved in the E.M. range to consider some electrical phenomenon relating to the weather and the lightning happening at that time, though not right over the hill. Nothing was determined for sure.

I enclosed a print of that slide and hope that Bill Pine will be able to print it in the Journal, though the black-and-white resolution is not the best solution. Maybe the POWER-MAC will do another "miracle"!

Since they think that the Virgin Mary appears in April and June, we organized ourselves to continue monitoring the situation. At these times I was able to record the VLF/ULF band with my WR3 radio with the small portable Sony TCM 38 recorder starting from 17.45 to 18.15 local time.



(The PowerMac was not able to work the desired miracle. This is a cut-and-paste of a xerox copy of the color print. In this you can see the bright area in the sky, but the bright streak of light extending upward from the center of the frame is not visible. ed.)

In April, the VLF recording did show some bips during the taping, especially around 18.00 local time. I am not able to explain why, though I would not be surprised if some electronic emission could be the source. In the first interval, the bips were 2 per second, in the second and third intervals they were 4 per second, and in all cases the bips were evenly spaced. I analyzed the tape with the software IROE/GREY 512 (which I mentioned in the last *INSPIRE Journal*).

As I said before, our goal was not to investigate the religious aspects, but only to understand if our tools are able to investigate this kind of supposed phenomenon. Since in the April session it seems that I did not record any VLF-vision related signals, I wonder if I can say whether there were signals connected to the vision or not.

I decided to coordinate the June recording with another colleague who does not live in the vicinity of the visions. I contacted Dr. Roberto Pozzo, chief of the Italian Integrated Meteo-Seismic Network, who has been involved with VLF research since the May 1994 eclipse project. I explained my research and asked him to record the VLF at his location in order to compare our two recorded tapes. Since one was recorded near the phenomenon and the other far enough away (Roberto lives about 200 kilometers northwest from the site) we should be able to tell if some effects in the low E.M. range are related to the visions.

Comparing the two tapes showed no difference. In this case, also, there appeared to be no signal related to the visions. The two tapes have virtually the same sferics and tweeks. There is nothing more on my tape. The April bips are no longer present. This news does not mean the end of the research.

Our plan is to continue observing during the visions until we have observed for at least one year. I have to say that our work is creating some interest in some people involved in paranormal research here in Italy. But, as I said before, we don't do paranormal research, we are not able to do that and we are not interested in that kind of research.

We don't have the presumption to explain anything. We are just trying to understand if our tools are useful to investigate some phenomena which are usually confined to the kingdom of strange things and are controlled by the so-called alternative research. We are curious to find out if we are able to produce some kind of research in these situation and we would like to propose that Natural Radio Research is also practical in these fields.

In the past months we have worked with E.M. and optical tools, just the tools we could afford. I have formed and registered our amateur Italian group as the "Natural Radio Research Association". In the near future we should be able to upgrade our shack with interesting items in order to give more instruments to use in our research. I will update you in the next *Journal*.

(Author's Note: In the early spring I received a letter from an *INSPIRE Journal* reader, Dr. Otha Vaughan from NASA in Huntsville, AL. He wrote that he had read my article about my work in the Maldives Atoll on coordinated observations with Jim Mandaville in Saudi Arabia in February 1993. Since Dr. Vaughan is involved electric-atmosphere research, he said he would like to coordinate something with me, especially to investigate the electric natural emissions on the equator during hard lightning conditions. He ended his kind letter by giving me his telephone and fax number and asked me to keep in touch.

As soon as possible I faxed him my pleasure about working with him and I sent him the photo with the rays and a summary of the situation. Could it be a Red Sprite or a Blue Jet that they are studying these days? Could it be something never before seen?

In his letter he wrote me about these flashes and he explained some aspects of this very interesting electrical subject which is also detectable in the 0-10 kHz natural radio range. Though Red Sprites and Blue Jets appear to be unexplained for the moment, some film and photos taken by NASA seem to confirm the possibility of a light burst created during a thunderstorm that starts from some distance above the clouds and rises up vertically to around 100 kilometers above the earth.

Hoping to get some more information, I sent him the all of the materials in the first week of May 1995. At the time I am writing this (July 1995) I have not heard from him. I hope this article will put me back in touch with Dr. Vaughan.)

Logging Natural Radio Data

By Bill Pine
Chaffey High School
Ontario, CA

One of the hardest parts of natural radio field research is to learn how to keep a data log. It takes experience to know what to write down and when to write it. Each year I get a new group if INSPIRE observers in my physics classes and none of them has any experience with field procedures.

In about an hour I can walk them through how to set up the receivers and operate the recorders. A few minutes on their first field trip is enough for them to learn how to set receiver output levels and recorder sound levels. Then we start recording and the fun begins! Sample dialogue:

Me:	The crackling is sferics. How would you describe the level?
Student:	The level?
Me:	Yes. How many pops or crackles do you hear?
Student:	Compared to what?
Me:	Well, would you describe it as light, medium or heavy?
Student:	I guess it is medium?
Me:	OK.

It is difficult to describe something you have never heard before especially when it seems that you are being asked to make a value judgment. Students (all people, in fact) are uncomfortable making judgments when they do not feel experienced. It is important to understand at this point that since they lack experience, any judgment they make is acceptable. Requiring them to keep a log encourages them to pay careful attention and think critically about what they are hearing. Experience comes as a natural consequence of this process.

It is important to assure them (and you, the reader) that their best effort at keeping a log is good enough - as long as it is their best effort. By the end of the year they are veterans of field work and they routinely and accurately make many judgments about what they hear based on their experience.

Why keep a data log?

It seems to me that the primary reason for keeping a data log is that researchers, in all areas of science, keep written records of all aspects of their research. I require my students to keep a lab journal, and field data logs are just a logical extension of that requirement. It is just plain good scientific procedure.

Data Log Cover Sheet (reproduce as necessary)

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 ______________________ WWV reception:

Recorder ______________________ ______________

Antenna ______________________ ______________

WWV radio ______________________ ______________

Site description: ____

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

Local weather: ____

Personnel: ______________ ______________ ______________

______________ ______________ ______________

Team Leader address: Name ______________________

Street ______________________

____

City, State, Zip, Country ______________________

In INSPIRE research, there is another good reason to keep a data log. Since someone else will be analyzing the data, you need to provide as much information as possible that might help in that process. The log does not have to be "professionally" done; whatever that might mean, because any information from the observer is helpful to the analyst.

The first step in data analysis is to listen to the entire data tape while following the log making note of time marks and other interesting events for future analysis. While listening, the tape counter is used to locate important points on the tape for future reference. It is then possible, using the tape counter, to quickly go to any time mark and then listen and time the progress to any desired time on the tape. The sound data files can be made and spectrographs generated.

What Should You Write in the Log?

At Chaffey we use two forms: a cover sheet and a log sheet. The cover sheet is reproduced as Figure 1.

The form is fairly self-explanatory. The part above the row of asterisks is read into the beginning of the tape as a voice introduction prior to data recording. For INTMINS operations, the number is used; for other sessions, we just indicate "morning", "evening" or "special observation". The operation details come from the INTMINS schedule.

We set up three receivers, each using different equipment, so that section varies from station to station. Under WWV reception, we note what frequencies are audible, which is the best, whether we can hear both WWV and WWVH and any changes in reception during the session.

I have the students list the names of everyone on the trip. This is a good way to make sure they all know everyone's name. We use these trips to socialize and this is a good ice breaker. The students rotate from station to station, so each will monitor on each station for part of the session..

Figure 2 shows a sample data log sheet.

We are trying a 0-5 scale for describing sferic density. "0" means no sferics - an indication that your receiver is probably not working! "1" means light sferics which means that the individual pops and crackles are separated by a second or so. "3" means medium sferics which occur several per second and in occasional bursts but with some quiet moments. "5" means heavy sferics which sound like an almost steady roar. This method seems superior to trying to describe the level in words - even though the most common entry is "3".

What Should You Log and When Should You Log It?

The first thing logged, and the most important from an analysis standpoint, is the time mark. Just note the time and write "M" as the entry. We put a time mark on the tape every five

INSPIRE Data (copy as needed)

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	______

minutes while recording data. Some INSPIRE participants have questioned the wisdom of interrupting the data stream to put in time marks. It seems that we might lose valuable data while recording the mark. While it is true that some data may be lost, without time marks the data is impossible to analyze. For accurate analysis we need to know not only what is on the tape, but when it occurred.

Since time marks are vital, it is a good practice to try to minimize the length of the interruption of the data stream. At Chaffey, we practice quick time marks and it is common for students to be able to fit the time mark into just 2-3 seconds. Even WWV time marks can be done in less than five seconds if you announce the time yourself just prior to the tone.

Each time we log a time mark, we continue on that line to describe the general conditions including:

sferic level	circle 0-5
OMEGA	present?, continuous or intermittent?, loud or weak?, more than one station?
tweeks	present?, how often?, bursts?
chorus	present?, intermittent?, constant?
whistlers	any?, how often?, how loud?, pure tone or diffuse?

As each of these notations is made, special attention is paid to describing any changes since the last time mark.

Between the time marks, anything unusual is time noted and described. If tweeks are rare, individual tweeks are noted. If whistlers are heard, the time is noted. If either of these starts happening often, a notation to that effect is made. A good rule of thumb is that if you find yourself writing the same thing over and over, you are probably trying to write too much. We have had times when all we could do is log something like “W : 7-10 per minute”.

The Benefits of Logging

All observers will benefit from keeping data logs because doing so requires them to pay critical attention to what they are hearing. We will all become better scientists if we keep careful records of our field studies and build on our experience listening to natural radio.

INTMINS - August/95
Data Analysis Report

By Bill Pine
Chaffey High School
Ontario, CA

From August 1 through August 10, 1995, the first series of INTMINS operations was conducted. Each operation consisted of activating two instruments on board the MIR Space Station as MIR passed over the United States.

ISTOCHNIK, the most powerful of the instruments, is a 10 keV electron gun that was modulated, or pulsed, at a frequency of 1000 pulses per second (1000 hertz, or 1000 Hz). The changes in electron flow should give rise to electromagnetic waves with a primary frequency of 1000 Hz. These are the waves we are trying to detect.

ISTOCHNIK also was modulated at 10 Hz for a brief period at the beginning and end of each session and as part of a 1000 Hz/10 Hz alternating sequence as one of the modes of operation. This avoided the necessity of turning the instrument off and on to create the sequence. The 10 Hz electromagnetic waves would be lost in the noise in most cases and is not expected to be observed. ISTOCHNIK can also be modulated at 140 Hz, but that modulation frequency was not used. Total operating time for ISTOCHNIK is 2 minutes and 40 seconds per pass.

ARIEL is a plasma pulse generator. It is used to generate a stream of positive ions of known energy. With a power rating of 130 watts, it is unlikely that any electromagnetic waves generated by ARIEL can be observed on the earth's surface. The maximum operating time for ARIEL is 8 minutes.

This data analysis report consists of three sections:

1. INTMINS Operations - a schedule of operations including a detailed description of instrument operations on each pass.
2. INTMINS Observers - a description of observers submitting data including locations and equipment used.
3. INTMINS Data - spectrograms and descriptions of data submitted by observers.

1. INTMINS Operations

ISTOCHNIK operated in two possible modes (with some variations noted later):
(Start times are given in hh:mm:ss UTC format.)

Mode A	Frequency (Hz)	Duration (min:sec)
	10	0:10
	1000	2:20
	10	0:13

Mode B	Frequency (Hz)	Duration)min:sec)
	10	0:10
	* 1000	0:03
	* 10	0:03
	10	0:10

** : cycle repeated 25 times (2:30 total)

Ariel operated in three possible modes. The channels specified indicate the orientation of the plasma stream relative to the magneitc field line: -Y is approximately perpendicular to the field line; -Z is approximately parallel to the field line.

Mode C	Channel	Duration
	-Y	4:05
	-Z	2:00
	-Y	2:00

Mode D	Channel	Duration
	-Y	2:05
	-Z	2:10
	-Y	2:00
	-Z	2:00

Mode E	Channel	Duration
	-Y	2:05
	-Z	2:00
	-Y	2:00

Table 1 shows the instrument operating times as received from telemetry equipment on board MIR. The format for the pass column is:

A.B where A = August date (UT) and B = pass number on that date.

Table Notes: (modes modified as indicated)

A1	final 10 Hz phase - :10
A2	1000 Hz phase - 2:23; no final 10 Hz phase
B1	1000 Hz - 2:23; 4 cycles 1000 Hz on/off; 10 Hz - :10
B2	1000 Hz - :03; OFF - 2:27; 1000 Hz - :13
B3	1000 Hz - 2:00; OFF - :30; 19 Hz - :15
B4	1000 Hz on time unknown
B5	1000 Hz - :13; 24 cycles 3 sec 1000/10 Hz; 10 Hz - :06
C1	final -Y phase - 4:37
D1	final -Z phase - :10
D2	second -Y phase - 1:50; final -Z phase - 2:10
D3	final -Z phase - 2:18