Stanford Palmer Visit 2000

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Contents

1 Tasks v1.4

1.1 Maintenance

1. Glacier / structural: 6 days
   (if all tools, parts, equipment needed are lined up)
   (You can count on ∼half of the days being bad weather.)

    (a) check cables to antenna (This involves opening the connectors and checking for corrosion, replacing pins or connectors as required)

(b) re-drill all posts for cable along glacier path
(still worthwhile in March) In any case, be sure that someone there has the Jiffy drill ready to go before you get there.

(c) remove ice beneath wooden base of antenna.
(Generally, you may need to lift/move the antenna tower and also redrill the holes into the ice that have pipe posts to position and locate the tower base so it doesn't slide around. This requires re-laying out the base of the antenna array to IGY spec. and the guys.) first thing to do is to fix/measure the antenna loops, and this would take 2 full days.
The new base has sides that make it difficult to just beat directly on the ice under the base (with, say, a crowbar), and it will indeed probably need to be lifted to mess with the underlying "foundation".

(d) replant guy lines and posts for antenna

(e) Decide what orientations we want for the antenna loops, and implement and document them.

2. Sea Ground (1 day)
The special sea ground for the VLF hut needs to be serviced. This requires having a Zodiac (1 day training required) or having someone else to the boat work to lift the cable and copper pipe out of Hero Inlet.

3. etch N/S and E/W on the preamps; replace the "guide key" on the E/W preamp connector.

4. relabelling faded stuff in the hut

5. Repair connections, mechanics as required. Electrolytic corrosion is vicious on this particular element of the system.

6. You should check the integrity of isolation between the VLF hut sea ground and everything in the hut. See my video from Palmer as to a quick way to do this (basically short station ground to sea ground in the electric panel and see if the hum gets worse. If the hum level doesn't change, there is a problem and some forensic work will be required to find where the connection has been made.

7. Make sure you have the science tech look at the posts before you go, so that the antenna is not leaning.

8. see whether ASA can do glacier work before I arrive? At least, arrange jiffy drill, etc tools' availability in advance.

9. New batteries for UPS should only need to be sent down in ∼2002.

1.2 Upgrade

1. Reorganise all the connections through the new interface box built by Trabucco.

2. Digital snapshot system, to be installed on a new rack-mounted p.c. with a National Instruments 6034E card. (4 days)
   Chuck is working on this software; it's not yet ready

3. Remove the TVLF amplitude/phase receivers, the 486 computer, the Exabyte tape, the goniometer, the omega receiver, and possibly even the Frequency standard. The Ampex will be removed in 2001. In general, thoroughly sort everything in the hut to see what is to be kept.

4. The existing HAIL machine will become HAIL-E/W, and the second existing, unused machine will become HAIL-N/S. These will both have a slightly modified (by cPbL!?) version of HAIL running on them, one listening to 4 or 6 transmitters from N/S antenna, and the other 4 or 6 from the E/W antenna.

5. Implement the multiplexed/switched user interface so that one monitor/keyboard/mouse controls all three p.c.'s.

6. The programmer clock will have to be synchronized by hand (and scope) every day by the science tech in order to keep the Ampex going.

7. Here are some modern transmitters and suggested recording schedule:

CALL	Location	f (kHz)	Latitude	E. Longitude	Antenna	
NAA	Cutler, Maine	24.000	40.65000	-67.28333	NS	
NLK	Jim Creek, Washington	24.800	48.20000	-121.91667	NS	EW
NPM	Lualuaiei, Hawaii	21.400	20.41667	-158.15000		EW
NAU	Puerto Rico	40.750	18.00000	-67.00000	NS	
GBR		16.000	52.36667	-1.18333	(NS)	EW
ANT	Anthorn, England	19.600			(NS)	EW
RHA	Rhauderfehn, Germany	23.400	53.10000	7.58333		EW
NWC	N.W. Cape, Australia	19.800	21.81694	114.16389	NS	
RPS	Eastern Siberia, Russia	16.200	43.00000	135.00000	(NS)	EW
UMS	Gorki, Russia	16.200	56.00000	44.00000		EW
FRA	France	18.300	40.70000	1.24167		EW
	Noviken, Norway	16.400				
"UNK"	USA	25.200			NS	
		20.2?				
		20.9?				

8. Continuous recordings:
   2+ weeks of 24-hr recordings, after calibration etc.

9. Send home broadband recordings of the 25.2 kHz signal for triangulation.

10. Further work on the PalmerBB software: Convert Matlab routines to Matlab's own package. Improve error codes. More verbose output? Fix over-midnight bug.

11. ensure pc's have fixed (ie max and min) 300 MB of virtual memory (MikeJ's suggestion)

1.3 Calibration

1. antenna and BB receiver: (2 days)
   MikeJ: spending 1 full day when you get there learning all the knobs and switches will really help. You need good weather to do the calibration.

2. measure antenna position / dimensions (climb tower to locate upper insulators or triangulate with a transit.)

3. Ampex: service. (1 day)

4. calibrate all βmax timing (Troy's method is to use a 25Hz oscillator into left audio of PCM and into either βmax audio in; take video out of PCM into line in of βmax. [Note: βmax has two audio in; we have IRIG-B on BOTH of them at Palmer]. Use Acquire software at 10 kHz to make a .tr file; in Matlab, fopen(,'r'); fread(fid,[2 5000], 'int16'); Note that there's a 180 degree phase shift in the PCM. Here the βmax's have $\sim$6 ms delay: Video signal leads audio signal – i.e. a pulse shows up in video first.)

5. do NB calibration as in the past.

1.4 Jobs at Stanford

1. buy coloured cable ties to label cables

2. buy 50-pin MS connectors, both male and female, for spares – talk to Bill.

3. there are some missing log-book entries – get these copied and sent?

4. bring a serial cable? with which to set up software to monitor UPS?

5. investigate magnetic declination at Palmer?

6. HAIL needs hardcoding changes. Upgrade to 6 channels. Name them. Add data output variable for antenna orientation. N/S will record NAA, NAU, NLK, NPM, and maybe GBR and NWC. E/W will record NPM, NLK, GBR, NWC, and maybe German and Russian transmitters.

7. Watch Trabucco's Palmer video

8. get shipping boxes

1.5 What is currently at Palmer?

1. There is already a second computer at Palmer, waiting for the broadband software. It is a Pentium II, etc. with a PCI-MIO-16XE10.

1.6   Packing List

1. Digital scope

2. spare BNC barrels

3. Software: D:/users/twood/acquire on Sprites.

2   Trip Report

During the month of April, Chris Barrington-Leigh (Stanford University) conducted a site visit for AO-106-P. A major upgrade to the VLF equipment in the Clean Air/VLF hut was undertaken. Nearly half of the old rack equipment was removed for retrograde and replaced with two new computers, a new piece of software, and an upgrade to existing software. Of the three computers in the hut, two are now surveying narrowband VLF transmitters in order to record ionospheric modifications due primarily to lightning electron precipitation from the inner radiation belts. The third computer will for a year duplicate the function of the reel-to-reel Ampex recorder by recording full-spectrum broadband data for 1 minute of every 15. In 2001, the Ampex unit and programmer clock will be retired, and one of the three equipment racks in the hut can be sent north. The new computer based system is accompanied by a new filter / interface box which passes twice the frequency bandwidth that was available to the previously existing equipment. This may allow new new exploration in the lower LF band.

In addition, a new geographic axis alignment was implemented for the VLF antenna on the glacier, and routine maintenance was conducted to the antenna and the feed-line running between the hut and the antenna. The antenna is now ready for winter and is aligned more accurately than ever before.

See the 16 pages of lab notes for details on the following items.

2.1   Antenna and Preamp

Much of the drilling and feedline work was already done by Johan.

1. Rotated the antenna tower $60°$ right hand upwards in order to distance the antenna cable from a guy line (it was rubbing in the wind) and to allow antenna realignment. Guy attachment points on the tower were moved, and bolts replaced, as appropriate.

2. The antenna loops were rotated $\sim 22°$ right hand upwards by staking out north-south and east-west lines with a differential GPS unit. Precise antenna positions are recorded in the notes. $40°$ wooden wedges were installed to rotate the post holding the bottom center insulators.

3. An ice platform was prepared underneath the tower base, guy lines adjusted, and the preamp reerected, to prepare for winter.

4. Added a pin to prevent relative rotation of the tower's wooden and metal bases.

5. Greased threads on the preamp MS connectors, and crudely etched "NS" and "EW" labels on the pream box.

6. Resuspended the feedline, using a new system superior to plastic cable ties. See Operations section, below.

7. Here are the GPS locations, in meters, relative to the local PALM base station, as measured by Johan Booth in mid-May. Comments also from Johan:

Loop	dE	dN	dU	(inferred length)
Center	846.48	130.83	74.98	
W	837.87	130.85	74.74	8.61 m
N	846.42	139.56	74.27	8.73 m
E	855.05	130.80	75.02	8.57 m
S	846.45	122.12	74.82	8.71 m

   The insulators that mark the inner boundary of the loops are below the center post top, of course, by 15 cm for N/S and 20 cm for E/W, and in fact they are not centered perfectly in the horizontal plane, either, being slightly offset (circa 3 cm) to the north and to the east.

   The bottom line is that the loops are well oriented (within the error of the measurements) along geographic axes and are essentially equal.

2.2 VLF Hut

1. Dismantled the HAARP machine, GOES antenna and clocks, VLF phase and amplitude receivers, the 1999 narrowband VLF clip/filter box, the HAARP UPS

2. Replaced the GOES 1pps signal going into the programmer/clock with the 50% duty cycle 1 pps from the "L-board" of the GPS receiver.

3. Tested for a week the computer control of the preamp cal tone. The cable is made and ready to replace the programmer/clock's. Interface 2000 documentation was corrected for the cal relay control (pins 2 and 3 reversed).

4. New computer names (in domain `palmer.usap.nsf.gov`) and IP addresses are:
   Broadband: 204.145.215.169 (2000 PIII. PCI-6034E)
   VLF-NS: 204.145.215.103 (1998? P? PCI-MIO-16XE10)
   VLF-EW: 204.145.215.102 (1999 PII. PCI-MIO-16XE10)

5. Executed VLF calibration for the preamp/line receiver as well as the new narrowband and broadband signals (for which gains were adjusted on the

Interface 2000). Here are the data, with the Interface 2000 gain pots in their final positions. These date are also available online.

Freq	Time (minute)	Vinj	2Vlab	2Vcal	N/SAux2	EWAux2	NS_BB	NS_NB	EW_BB	EW_NB
40	1838	100.5	226.6	72.2	91.7	46.5	11.9	1.6	11.2	1.5
70	1842	101.9	230.4	80.2	95.9	94.2	23.3	1.5	23.1	1.5
100	1844	101.8	230.5	82.7	123.6	120.7	30	1.5	29.8	1.5
200	1846	101.8	231	85	174.8	163.7	42.6	1.5	40.6	1.5
500	1850	101.7	231.1	85.8	244	233.3	60.4	1.6	58	1.6
1000	1852	101.5	230.9	86	272.7	274.7	68.2	2.9	68.7	2.6
2000	1856	101.5	230.8	86.1	284	288	71.3	9.7	71.4	8.1
4000	1858	101.3	230.3	86	277.9	287.4	73.3	35.8	75.9	19.8
8000	1900	101.2	229.7	85.5	267.1	280.2	73.6	115	76.1	96
12000	1902	101.2	228.6	8	252.6	268.1	65.8	164.8	68	138.5
16000	1904	101	228	81.2	232.3	249.2	59.6	178.8	61.6	151.2
18300	1908	100.9	227.7	78.6	218.1	234.7	57.7	184.7	59.7	156.3
21400	1910	101.5	228.6	74	194	210.3	54.5	184.9	56.4	157.1
24000	1912	101.5	229.4	69.7	171.8	188.9	48.2	169.7	49.9	144.5
24800	1914	101.6	229.7	68.3	165.4	182.2	45.6	162.7	47.3	138.6
28500	1916	101.6	231.8	61.3	135.5	151.2	34.7	131.3	36.2	112
34000	1920	101.6	236.4	51.2	97.7	110.7	26.8	110.8	28.4	94.9
40800	1922	101.5	244.1	39.7	62.8	72.7	12	66.4	14	61
45000	1924	101	248.2	34.1	48.7	56.9	1.7	1.5	1.7	1.5
60000	1928	98.8	265.8	17.5	17.1	20.5	1.6	1.5	1.7	1.5
100000	1930	77.7	300.4	2	7	2.9	1.6	1.5	1.6	1.5
5000	1940	102	231.9	86.5	277.2	287.2	74.5	55	77.2	45.8

6. VLF ground in Hero Inlet inspected (good condition) and scrubbed. Pier protection issue is unresolved, but the system is off indefinitely.

7. Peripheral switchbox and extender set up so that one user interface controls all three computers. The extender failed on the last day and is being retrograded.

8. Annual Ampex servicing. Mechanical aspects were in good order. See notes.

9. Installed Interface-AD-2000 box. To help eliminate a parasitic 200kpps spike noise on signals in the Interface 2000 box, fitted a BNC tee with a 0.0022μF capacitor across the 100 kpps signal entering the Interface 2000. More importantly, the 74LC125 PPS buffer circuits and DIP switches in the Interface 2000 were replaced with straight-through wires.

2.3 Narrowband

1. Implemented the Interface2000 box for narrowband signals.

2. Removed DC offsets on two of the narrowband outputs from Interface 2000.

3. Modified the narrowband software to: (details of changes are in a readme file in the source directory)

- use longer filenames, allowing use of new VLF frequencies outside the previously existing restrictive code
- allow a choice of A/D conversion gains (gain of 50 implemented),
- record the antenna name / direction and the software version in data files

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4. Implemented six-channel acquisition in each of two narrowband computers:

   - North/South: NLK, NAA, NWC, NAU, UNK, RPS
   - East/West: NLK, RHA, NPM, NAU, GBR, FRA

5. Somewhat cleaned up the hard-drives on the p.c.'s.

2.4 Broadband

1. Finished development of a new broadband acquisition software, "StanfordBB" and began digital two-channel broadband synoptic recording with CD archiving.

2. Corrected documentation for the box detailing the DIP switch assignments (Broadband channels 1 and 2 are backward at the DIP).

2.5 Analysis Software

1. Began development of a new modular set of menu-driven tools for accessing VLF NB and BB data, and trained the science technician (John Booth) in their use.

2.6 Whistler report

The following periods were noticed as active whistler periods:

- 2000-096: ∼2/minute at 00:51:00 UT; ∼4/minute at 01:03:00

- 2000-108: ∼60/minute at 21:30 UT; ∼80/minute at 00:10 on 2000-109 (note: antennae now in new geographic alignment)

- 2000-109: still active: >30/minute at 15:27. High wind noise. Whistlers are loud and long at 18:00 UT, until ∼19:30.

- 2000-112: Increasing activity; active at 17:00 UT

- 2000-115: Rising tones and short whistles (?) at 18:00 UT.

- 2000-116: >200/minute, not intense, at 01:00 UT.

2.7 Retrograde

Sent north the following items:
- TVLF amplitude receiver
- VLF phase receiver
- Two (2) GOES clock receivers
- Allison Labs variable LP and HP filters
- Stanford "Omega Receiver"

- spare HAARP exabyte tape drive and rack (original is NSF's)
- VLF goniometer 1975 and cable
- HAARP 486 computer
- rack for HAARP
- Fluke 8060A
- mouse for HAARP pc
- keyboard for HAARP pc
- GOES helical antenna
- bag of wire ties (which break in cold weather)
- Betamax tapes: thirteen (13) boxes
- Stanford A/D interface
- GOES preamp and receiver
- GOES feed cable
- HAARP mouse pad
- GOES antenna base plate
- TVLF sideband cable
- hardware for the HAARP 486 pc
- spare phase detector
- spare leads for the DVM
- spare VLF RF board
- extra BNC cables
- documentation for the HAARP pc
- broken Pertec power supply
- rack mount rails
- rack for the HAARP monitor
- Box of CD data, and the last Exabytes
- Ampex tape: (1) (probably 4/6 ->)

2.8   Inventory

Here is a partial list of remaining spares and equipment in the hut:
- Tektronix 455 oscilloscope, handles broken off
- Tektronix 475 oscilloscope
- Large brown toolbox
- Four racks of components drawers – fairly well stocked. (Comms/Tech also has some simple components.)
- Carboard box of assorted cables
- Carboard box of various equipment for suspending the feed line on the glacier
- Wire, wire wire; transformer wire; wire-wrap wire
- Box of non-dedicated spares, including a variety of ICs
- Two head-demagnetizers
- Various calibration equipment (e.g. IGY dummy loops)
- Weller soldering iron
- Heat gun
- Three boxes of Ampex spare parts
- Instructions and box for the "Switchview" extender

- Spare oscilloscope tube
- Box of BNC connectors for RG-58 cable
- Spare +-15 V power supply
- Spare +5 V power supply
- Box of assorted dedicated spares (incl Spectracom oscillator) and 19" rack supplies
- Two boxes of spare MS-type connectors
- A breadboard
- A box of dedicated spares for the programmer clock
- Parts and software for the "Broadband" P.C.
- Floppy drive for the "Broadband" P.C.
- Two 19" rack shelves, to be used in 2001 for the betamax machines and PCM.
- Spare two-port P.C. peripheral (monitor, keyboard, mouse) switchbox
- 1999 Narrowband clip/filter circuit box
- Documentation

3   Recommendations

Immediate

- Order a new supply of blank CD's

- Order spares of the following items: GPS receiver, Switchview, Longview (replacement and spare), NI A/D card (PCI-6034E); 20 GB hard-drive; CD-writer

- Order a new stamp (designed by Johan) for labelling the betamax tapes

- Also order a new date stamp; the current one expires in 2000.

- Replace dessicant in preamp

- Replace NB software with simple and flexible software, the latest phase algorithm, and if wanted, an ISO9660-compatible directory and filename structure.

- (2001?) Replace one, two, or all of the National Instruments cables with shorter ones (1 m long)

- (2001?) Construct a signal conditioning box for the 1PPS and 100kPPS signals from GPS. The box would filter and buffer these signals before they entered the Interface2000 box. Then the 74LS125 buffers could, if desired, be returned to the Interface2000. Alternatively, another PPS Buffer card could be sent to Palmer for the Interface2000 which filters the PPS signals before buffering them. This circuitry could replace the PPS DIP switches.

2001 Site Visit

- Bring one replacement clasp for the preamp door

- Service the hinges on the preamp (?). The door is difficult to open, and the hinge beginning to break.

- Replace one of the two-conductor antenna loop panel-mount MS connectors, as it is missing its guide key.

- Bring one null-modem cable ($\sim$1.5 m) to replace existing splitter cable.

- Deal with the pier protection issue. Note also the possibility of a new pier in the (distant) future.

- Stock some black hookup wire.

- If appropriate based on poor narrowband performance this year, consider construction of a separate replacement to the narrowband half of the Interface2000 box.

- Pursue the possibility of building a new antenna at Old Palmer, possibly in conjunction with the infrasonic project. The distance between the current VLF feed line and the "black flags" (to the South) is down to less than $\sim$8 m in places, and there are cracks appearing right along it. This directs human and machine activity (noise) ever closer to the antenna. In addition, the antenna site is becoming steeper as the glacier recedes, making annual maintenance increasingly complex.

- Make sure not to rely on our digital oscilloscope for debugging and problem-seeking. I learned that the analog scopes (in the hut) are invaluable for seeing unexpected things.

4 VLF Operations Instructions / Notes (New for 2000 activities only)

Daily Operation

Execute Matlab on each of the narrowband (NB) machines. The recent night's data should display automatically. Check the amplitude data for coherence, and if there are interesting features, use the menu option to make a graphics (jpeg) imprint of the data. If 650 MB of data have accumulated, write them to CD. The CD label should include the words "Matlab format" and "Joliet," the latter signifying that long filenames exist and can only be read under Windows. (?) Reboot each machine if you make any changes to its narrowband settings.

Write the broadband (BB) data to CD. The data amount to nearly 3.5 CD's per day. Data from more than one day can be put on a CD. The CD labels should include the words "Matlab format" and "ISO9660." Once per week,

examine a spectrogram for coherence by choosing to view a BB file from the VLFtool. To add the menu to a broadband figure, just type "VLFmenu" at the Matlab prompt.

Notes

Switchview

Please look over the keyboard control commands which can be used to direct the switchview box. These commands are all initiated with Ctrl-Ctrl. If you notice that the lights on the keyboard are flashing, you have probably pressed "Ctrl" twice in a row, and need to press "Enter" in order to regain normal keyboard functionality.

If the left edge of your video looks strange, try cycling Switchview through the pc's, or power-cycling the monitor.

If the mouse misbehaves (hyper jumping and clicking), you need to reset the Intellimouse. This is accomplished by a Switchview key sequence.

CD Writing

Blow gently on the active side of a blank CD, as well as on the CD tray, to remove any dust before use.

The Broadband machine is capable of writing CD's at "6x" speed simultaneously with its data acquisition operations, since it is doing no realtime digital signal processing.

Glacier Work

Suspending the feed line when sections of it are melting into the glacier: I recommend you do NOT use plastic cable ties to attach the insulated cable to the suspension wire. The cable slips through them. If you choose to, please DO NOT use ties which have a plastic tongue (the element that grips the ties' teeth); metal ones are available and break off less often in cold weather / UV. Rather than plastic, tie a 65 cm length of ($\sim$4 mm) nylon string into a loop. Attach the loop with a prussik knot to the insulated cable. Leaving $\sim$2 cm between the cable and the suspension wire, tie the remaining nylon bight to the wire with a clove hitch, and then tie the nylon off to itself with two half-hitches. This way neither knot slips. Strong cotton string may work just as well, and be even less polluting when it falls off.

Troubleshooting

If you pull out the Interface 2000 box, you may find that the National Instrument cables fall out.

Setup of the switchview seems a bit mysterious; if all fails, unplug EVERYTHING from the Switchview box and reconnect it as per its installation instructions.

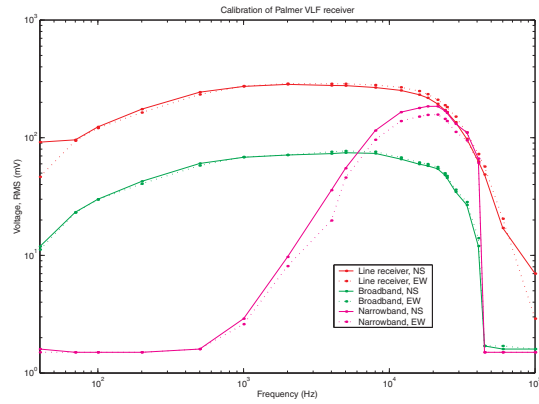If a computer doesn't see its GPS serial signal any longer, power cycle the GPS.

Figure 1: Calibration results from May 2000.