Palmer Station Site Visit Diary Day 1: March 26, 1998

Hello from Punta Arenas, Chile! I am just beginning my trip to Palmer Station, Antarctica, and I thought that I would share some of the pictures from the boat and from my travels up to this point.



Figure 1: Punta Arenas

First, I'd like to say hello to the teachers and students who are following this trip, particularly to those whom I have had the chance to meet and talk with about the VLF Group's research. These schools are participating in the Holographic Array for Ionospheric Lightning (HAIL) research project and the recently set up Electrojet Monitoring system. Visit those sites to learn about the participating high schools.

During my trip, I'll try to download sights and sounds within a day after experiencing them myself. I will show some interesting photos from the various science projects at Palmer station, and I will also sometimes pose questions and research topics that aspiring young scientists will want to challenge. For example, on my flight from Santiago to Puenta Arenas the terrain was quite clouded over in one particular spot. As we flew near a lake, the clouds disappeared just

above the lake but were present everywhere else. Why would there not be clouds over this water?



Figure 2: The terrain was quite clouded over in one particular spot

The town of Puenta Arenas does not attract many tourists because it is so far south that people think that it will be cold. In fact, it is quite warm in the summer and has several spectacular national parks nearby, including Torres del Paine and Tierra del Fuego. Most of the population here do not speak English, so I've had to get by on my small Spanish vocabulary. On the 24th of March, I had two days to join a couple Americans and a guide for a fly-fishing/camping expedition. Here we are with a couple Chileans who operate a ferry that we had to take to the island to which we went.

The Lawrence Gould is a brand new science vessel commissioned to support the United States Antarctic Program. It is 230 feet long and supports a population of about 40. Here is a picture of Dean (my roommate) and me in our room aboard the ship. Dean is also going to stay at Palmer station, but he will be "wintering over", or spending the Austral winter at the station.

Some more views of the ship include a life boat and the captain's chair. I'll try to take a picture of the galley and the sauna (!) later... I hope I don't get seasick.



Figure 3: Here we are



Figure 4: The Laurence Gould



Figure 5: Life boat



Figure 6: Captain's chair



Figure 7: Dean (my roommate) and me in our room aboard the ship

Day 2: March 27, 1998

Today, we traveled out of the Straight of Magellan and around the southern most point of South America. Most of the time, we were too far from land to see anything. The seas were calm for this part, and people have been enjoying their time on the ship. There is a collection of movies to watch, and everybody has brought a couple books with them. The lull of the moving boat encourages sleep, and everybody seems to be resting up for work at Palmer station.

I met some of the ship's engineers today, and had a tour of the engine room. Since the boat is so new, many of the engines and systems are computer monitored. However, even if the computers fail, they can still operate the systems as they did in the past. For example, there is one computer system which monitors all of the levels in the various water and gas tanks. In the past, they have had to monitor the levels in these tanks manually, which took quite a bit of time. Now, there are electronic sounders on all of the tanks, and they can view the levels from the engineering room. Tomorrow, I'll take pictures of the engineers and also record the sound of the engine room.

Late in the evening, I took a walk on the upper deck of the boat. At this point, we entered the Drake Passage. All of a sudden, in front of the boat, there were these strange breaking waves

happening. These were not all going in the same direction, but it almost looked like a large group of dolphins bubbling to the surface. The ship slowed down and the bridge shined the spotlight on the disturbed waters. After a couple minutes it ended and the ship sped up again. I went to the engineering room and asked them if that was a from dolphins, and they told me that it was a naturally occurring phenomena. The mate had not seen this in 5 years, since a previous science cruise had gone out to study such occurrences. He told me that sometimes, unusual currents in the Drake Passage produce these waves within the swells. We could see them with one of the ship's radar screens. I wasn't able to photograph them. I think that this is the type of thing that you have to be there to marvel at. I love grad. school.

Day 3: March 28, 1998

Half Way There

Today has been more rough on the water than before, but I hear that it can be much worse than this sometimes. Luckily, I have not been sea-sick. Maybe spending hours typing on the computer helps? Anyway, ships travel (see day 5) along lines of constant heading, or "rhumb lines." Along a plane, the shortest distance between two points is a path of constant bearing, but on a sphere one has to travel along a "great circle path" in order to reach the destination in the shortest distance. In other words, if you had two points on a sphere, and you wanted to find the shortest distance between them, you could tie a string around the sphere, intersecting those two points and also having the maximum circumference. The string would then trace out a great circle path, and the length between those points would be the shortest length possible (without cutting through the sphere). Navigators attempt to approximate a great circle path by breaking their journey into several legs connected by "way points." In this way, they can head in a constant direction in each leg and approximate the shortest distance.

Here is a sound file in the .wav format of <u>the ship cutting through the water</u>. While standing outside, the ship crashing through the waves makes about as much noise as the rumble of the engine. (Please note that recording these sounds with my little tape recorder is difficult to do. The wav files do not sound very clear, but I will improve on this in the future.)

Yesterday, during my tour of the engine room, I asked if I could take a couple photos today. We made a deal, I could show you the control room and the operators this time (see tomorrow's entry for these pictures), and I'll take pictures of the engine room on the way back (in about a month). The engine room consists of two diesel engines producing a total of about 6000 horse power and consuming about 5000 gallons of diesel per day of full use. In addition to spinning the propellers, this power also is used for desalinization of ocean water, purification of waste, generation of electricity for the electrical systems on board, and mechanical uses such as controlling the rudders.

Here is a picture of the desktop that my roommate and I share, with the VLF group laptop computer and cables going all over the place.



Figure 8: The desktop that my roommate and I share

Day 4: March 29, 1998

Today we finished crossing the Drake Passage. Life on the boat is peaceful, and people are preparing for arrival. The seas have been unusually calm. Apparently there is a statue of Magellan in Puenta Arenas which will give good luck to people crossing the Drake if you touch the feet. One of the toes is very shiny from all of the touching.

I finally caught up with the engineers with whom I had spoken the other day. They had been busy yesterday working on the engine room. Paul Waters is the First Engineer aboard, shown here in front of the main generator panel. Paul, who is from Pickens, South Carolina, has been working on ships for 25 years and has been able to travel the world. Here he is next to the main engineering console. Paul works with the 2nd engineer Steve Miller from Davenport, Iowa who is shown in front of the tank-level monitoring equipment. The engineers are responsible for all of the mechanical, engine, and electrical systems on the ship. When I asked them why they would want to work in such remote locations, they both said that they love the adventure and enjoy participating in science explorations. Steve, who has worked on ships for twenty years, loves to have the opportunity to "see things here that only a few people in the world see." Tomorrow we arrive at Palmer Station.



Figure 9: Paul Waters



Figure 10: Here he is next to the main engineering console

Day 5: March 30, 1998 Arrival at Palmer Station



On March 30th, I awoke to the sound of people leaving their room to watch our arrival at Palmer station. I put on a cap and brought my camera out to the deck, and was breathtaken by the view. Here are a few pictures that I took:



Figure 11: Palmer station as seen from the boat



Figure 12: A view of a mountain



Figure 13: Various icebergs



Figure 14: A big Iceberg with the sun poking through the clouds



Figure 15: Iceberg from above showing how clear the water is



Figure 16: Hero Inlet



Figure 17: A stowaway on the ship

Day 6: March 31, 1998 Palmer VLF

I'm writing this in the hut now. I'm listening to the VLF (Very Low Frequency electromagnetic signals from our antenna) and it sounds really good to me. There are multiple ducted whistlers now - I will try to make a spectrogram for everybody to look at. Also, there are a lot of tweeks and the hum is at a very low level. I'll try to go up to the antenna to put some more tension on the guy wires so that it is not leaning over as much, and we'll do the final mounting in a couple weeks.



Figure 18: Our VLF recording system in the "clean air hut"



Figure 19: The "clean air hut"



Figure 20: Our antenna tower which is leaning a bit now



Figure 21: A Portion of cable near a junction box with exposed ground wires



Figure 22: Connectors at the base of the pre-amp



Figure 23: The Gould docked at Palmer



Figure 24: A really nice perspective of the mooring line from the ship to the station.

Day 7: April 1, 1998

Hurricane (not an April fool's joke)



Today, we had a hurricane. Winds of more than 90 knots were recorded. I'll be fixing our antenna for the next couple weeks.

<u>Here</u> is a sound recording of the hurricane. My little recorder was saturated and I've sampled the sound at a low rate, so it doesn't sound so clear, but it does capture the feeling a bit.

Day 8: April 2, 1998

Damage Assessment



Above is today's view of the antenna on the glacier. The winds died down to about 30 knots on station, so Kevin, Glen (science technicians), and I strapped chains on our boots and walked up. The ice on the surface of the glacier was a bit wet and slippery and we walked up into the wind, so we went slowly. Once at the top, we noticed that all of the antenna cables were in tact and that one of the guy ropes had pulled it's stake out. The base of the tower was made out of wood, so it cracked rather than the antenna base, which was a good thing. Now that we are not recording, I am spending time cleaning the Betamax recording units. Here are some antenna images:



Figure 25: Betamax recording units



Figure 26: Close up of the antenna base



Figure 27: Close up of the antenna top



Figure 28: View of the antenna curvature (it has been curved before)



Figure 29: Kevin and Glen at the antenna base



Figure 30: Kevin and Glen showing how they lifted the antenna to relieve some tension



Figure 31: Me, in front of the fallen antenna

Day 9: April 3, 1998 Bonaparte Adventure

Today, we moved our things into our rooms on the station. The ship will leave on Saturday to bring some people back to Puenta Arenas (I have now added a picture of Puenta Arenas to the Day 1 page). Last night, it snowed about an inch so the whole base looks quite a bit different. Since our VLF antenna is down, I am servicing the equipment and also determining with our Stanford engineer, Bill, as to whether we should re-design the antenna. Because we like to be as far away from the station as possible to reduce our noise environment, the antenna is 2000 feet from the VLF hut, on top of a glacier. The problem is that mounting guy wires on top of ice is not as permanent as mounting them to ground structures. The science technicians here have to tighten the guy wires and re-do the posts every few weeks during the summer here.

This afternoon, I had the pleasure of taking a "trolley" to Bonaparte Point, which is also located on Anvers Island, but across a glacier which we can not walk to. I went with James Robertson who is servicing an instrument for Biospherical Instruments, Inc, out of San Diego. Biospherical runs and operates the National Science Foundation's Polar Regions Spectroradiometer Network. This network monitors UV radiation from the sun for these parts of the world. James believes the most stressful aspect of the Antarctic environment (besides the intense UV radiation) to be the wildlife.



Figure 32: Taking a "trolley"



Figure 33: James Robertson

"I've seen an orca bust through 20 feet of sea ice and swallow a full grown elephant seal whole!"

James was very cautious when we stumbled upon a group of penguins at Bonaparte point. "Antarctic birds have been known to fly as far north as Chile to feed on young children," he warns. After a while, even James couldn't resist the company of these cute Antarctic lumps of joy. "Well, I guess these guys are just down right adorable!" James is one of those rare scientists who still appreciates the absurd.



Figure 34: "Well, I guess these guys are just down right adorable!"



Figure 35: Penguin footprints



Figure 36: Scientific Penguins



Figure 37: James keeps his distance

Day 10: April 4, 1998 The Sun Comes Out

For some reason, I awoke at 6:30 am today and couldn't get back to sleep. I decided to walk up to the VLF hut and had a fantastic view with the morning sun. Here is another shot with a close up of the typical "beach" surface. Looking to the right, you can see Arthur Harbor with the blue face of the calving glacier behind it. This glacier continues to advance at the head of that harbor, while it retreats from behind the station. The advancing glacier crumbles into the ocean and creates thunderous sounds, like a jet aircraft, that happen a few times a day.



Figure 38: Fantastic view with the morning sun


Figure 39: Another shot with a close up of the typical "beach" surface



Figure 40: Arthur Harbor

We have an Internet connection here for two 5 hour periods which depend on the location of a satellite. Right now, one of the connection periods is early, so I was able to work on the diary a

bit. I've placed a perspective view from the boat back in day 6 and I also finished plotting the Gould's course which I have put in day 5.

Saturdays on station are usually days where people work for the first half and then take part in a big group clean up later in the day. In addition, we had to help load some supplies into the station store area. For the replacement antenna tower, we'll try to use an aluminum tower which is already on the station. James and I went up on the glacier to get a part of the old antenna for the machine shop, and had a bit of good luck when the sun came out. The weather changes quite quickly - it can be raining one minute, snowing the next, and then sunny after that. As a result, we have to carry radios with us and sign out on a board when we go outside of the station. An example of the varied weather can be seen in this image from the glacier, showing snow, melted ice, dark skies and the sun all at one time. At the first summit of the glacier, we had our picture taken from one of the ship's coordinators who was also taking a walk. From that vantage point, we could see water in almost all directions, and only more ice up to one side.



Figure 41: Supplies



Figure 42: Image from the glacier

Day 11: April 5, 1998

Sundays, people here mostly take the day off. They lounged around the common areas reading, talking, and playing pool. This morning, the sun was out again - just long enough for me to attempt to climb the glacier again. Of course, by the time I got up there a blizzard started and I had to make quick measurements and head back down. We took down the antenna mast on station which was no longer being used, and we've started to prepare it to replace our old mast. All of the posts for the antenna are firmly in place, except for one which flew out during the storm. Tomorrow, if the weather is good I'll try to survey the current posts to make sure that they are aligned with magnetic North/South and East/West. With differential GPS receivers, I can determine my position very accurately. They use these in Antarctica to make accurate position measurements and we use it to give us the time within a millionth of a second so that all of our receivers are synchronized.



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Figure 43: Playing pool
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I finally got around to taking a picture of my room on station.



Figure 44: My room on station

Day 12: April 6, 1998 Half Way There...

Today was a good day. The weather was better than ever when I woke up this morning. There were only a couple clouds in the sky. While walking up the glacier, I for the first time had a nice view of the mountains on the mainland. It was peaceful on the glacier, and with no wind there was almost no sound at all (except for the calving glaciers every once in a while).



Figure 45: Mountains



Figure 46: Glacier

There are a few guys here on station helping with construction of the new antenna tower. Here is Bill in the "garage" with half of the tower. We've completed the tower and a wooden base which I'll paint tonight.



Figure 47: Bill in the "garage" with half of the tower

Science question: Our cables going to the antenna melt into the ice after a couple days and the wooden stakes going into the ice for the guy ropes are in a puddle of water while the rest of the glacier is frozen pretty solid. Why does this happen, and what would be a way to help prevent it?

Anyway, we got out the ATV and actually used it to cart the antenna parts up the glacier. This is quite a bumpy ride, but we made it.



Figure 48: Bumpy ride



Figure 49: We made it

Day 13: April 7, 1998 Fixing the Ampex, Part 1

We had hoped to put the new antenna mast up today, but there was a snow storm and high winds. We will have to wait until the weather is better to attempt to raise it.

Here is a Leopard Seal sleeping on an iceberg with a bird keeping him company and another flying above.



Figure 50: A Leopard Seal sleeping on an iceberg with a bird keeping him company and another flying above

I began working on servicing our Ampex Tape recorder. We have used these machines for many years now, and they have worked well. The VLF signals are saved onto magnetic tape reels and contain analog information from about 50 Hz to 20 kHz. Until recently, all music in studios was recorded onto magnetic tape. This enabled long recordings which had enough "bandwidth" to reproduce the audio range. VHS cassettes also save sound and images with magnetic tape. An entire 3 hour movie contains an incredible amount of information. Every frame must be saved and reproduced so that when played it does not look grainy or fuzzy. Recently, digital technology has just begun to be able to record sound and images on digital media such as CDs, DVDs, and DATs. However, it is not yet nearly as inexpensive to record a movie onto a DVD disk as it is to record it onto a VHS cassette. For example, the magnetic tapes that we record on save information up to about 20kHz, and record 1 minute in every 15 minutes, 24 hours a day. If we were to digitize this information, it would take up (about):

Sample Rate	Seconds per day	Synoptic Interval		Sample size
20,000*2 Samp/sec. *	3600*24 sec. *	1/15	*	2 bytes

which is 460 MegaBytes per day. We record two channels, one for each antenna and our current tapes can do that for 2 days! This means that we have been recording the equivalent of nearly 2 Gigabytes worth of information on a single tape with technology which is more than 30 years old. The difference is that the tape is an analog recording, so we need to feed that into a computer later in order to plot and analyze the data. In the past, they studied data with electronics that only used the data in the analog format, like playing the data through a speaker and looking

at it on an oscilloscope or a spectrum analyzer. We are just now becoming able to directly digitize 2 Gigabytes easily enough (4 writeable CDroms or a writeable DVD).

Day 14: April 8, 1998 Antenna's Almost Up Again...

Today was another strange weather day. It was nice in the morning, and then it snowed off and on for the rest of the day. We brought the new wooden base up which the tower will stand on. At this point I had not yet leveled it properly, but later when we did get it level we put 2 inch steel pipe at four places in the corners, about 3 feet deep. We have ice drills of different diameters. For the guy posts, here are Kevin and Dave drilling with the large bit to put a post in.



Figure 51: The new wooden base



Figure 52: Kevin and Dave

I did have some nice views while walking up and down the glacier. I have many images, but I only choose the best ones to show on the web page. Here is a view from the glacier of Arthur Harbor. At the end of the day, I took a shot of the station "backyard".



Figure 53: A view from the glacier of Arthur Harbor



Figure 54: The station "backyard"

There is a station meeting in about 5 minutes, so I'd better go!

Day 15: April 9, 1998

William's Birthday

Last night, a number of the more contemplative members of the staff met to philosophize about metaphysics. I wasn't in that time, but maybe this weekend. While walking from one the dining hall to my quarters later in the evening, I suddenly realized that there was a penguin right next to me! The little guy didn't even look up from his cleaning duties, and I don't know if he even saw me.



Figure 55: A number of the more contemplative members of the staff met to philosophize about metaphysics

It snowed and rained today, so we couldn't go up to the antenna on the glacier. Instead, I worked on our Ampex calibration some more. I had to take apart one of the amplifiers and replace a variable resistor. This required some drilling and soldering - luckily everything worked after I put it back together!



Figure 56: Drilling and soldering

Also, yesterday one of our motors for the ice drill had a problem, so I went to the Carpenter shop and got equipment to clean the air filter. That's where I ran into Dave and Dave who were looking for some equipment to replace Ethernet line between the VLF hut and the T5 Science office. My line is still down, so I have to use another PC to send this page back to Stanford tonight.



Figure 57: Dave and Dave

William, one of the several local electronics experts (and also a former VLF science Tech at the South Pole), had his birthday today and is shown distributing it after dinner tonight.



Figure 58: William

Day 16: April 10, 1998

Good Friday at Palmer Station

The weather is getting a bit better, but it still was windy and cloudy today and we did not have enough volunteers to help with the antenna. I think that I need to do some more adjustments on

the Ampex recorder since the middle head seems to be off to one side a bit. I was "checked out" for driving the ATV four wheel drive vehicles today. They're really fun to drive with all the snow and rocks around. I'll need it for the next couple weeks while I go back and forth to the antenna.



Figure 59: The middle head seems to be off to one side a bit

Day 17: April 11, 1998 Group Picture

Saturday at Palmer is a cleanup and station meeting day. The weather is looking a bit better, but the ground is covered with slush where there was snow. I have asked for helpers for raising the antenna tomorrow if it does not snow. Now that the boat has been gone for a week or so, people are settling in to their jobs. About half of the people here will be staying over the Austral winter season while the other people mostly have been here for several months. Not many people come just for a month like I have done.

Here are the people at the station.



Figure 60: The people at the station

Since the cook does not work on Sundays, we're having Easter dinner tonight with Prime Rib and roasted turkey.

Pictures From The Summer Staff



Figure 61: Scuba Diving



Antarctica: site of shopping carl found greatest distance ever from a grocery store.



Figure 62: Comic Strip



Figure 64: Lots of Adelies!

Day 18: April 12, 1998 Raising The New Mast



For Easter, we had nice weather. Some people cooked a brunch in the morning, and we tried to round up as many people as we could to raise the new mast. At about 11am, we all walked up the glacier together with radios, footballs, tools, and some snacks. We had about twelve people, so we split up jobs and work went quickly. Some of the old ropes used to guy the old antenna had been spliced, so we brought up new rope and cut it to the right length. We also used the ice drill to make some mid guy holes. These are temporary and we'll make new holes for permanent mounting later this week.

Here's the crew holding the mast just after it was raised (note the cave in the glacier off to the left). We then tied the ropes down and added the mid-guys. Then, Harry (shown at left), climbed the tower to attach the pole at the top which will support our antenna.

When we finished for the afternoon, I took a picture of the mast on the walk down. Because we had so many people to help, it all went quickly and it seemed like everybody had a good time. During our work, the glacier calved several times. It seems that even people who have been here a long time still enjoy seeing the calving glaciers and the large waves that they make. A couple people saw an iceberg split in half under its own weight.

In the next few days, if the weather is good I'll be returning to the mast to mount the antenna and to replace some of the guy holes.

If you like Oceanography, check out my friend Dave's group in the Ocean Physics Lab at the University of California, Santa Barbara. Although his son (my Godson) is only about a year and a half old, he already has a home page!



Figure 65: Ice drill



Figure 66: Holding the mast



Figure 67: Mast

Day 19: April 13, 1998 Boating and VLF in the Same Day!

I had a great time today! First, the weather was fine this morning, and I drove a four wheeler up to the VLF antenna. It had snowed about an inch last night which was perfect for driving on the ice. I put the orthogonal crossed triangular loop antennas up only about 10 feet (usually they're about 30 feet up) because I'll have to do some adjustments before I put them all the way up. Here is a view of the apex of the antennas and here is a view of how complicated the wires get at the bottom, which is what I'll be fixing in the next few days. In any case, when I got back to the VLF hut and turned the instruments back on, I heard the refreshing sound of VLF with whistlers, tweeks, and sferics.



Figure 68: Apex of the antennas



Figure 69: A view of how complicated the wires get at the bottom

In the afternoon, I took the second boating class with Laura, William (the instructor), and Mark. It is incredible taking the Zodiac boats out and seeing things the clear water and ice formations from so close. We all took turns learning how to operate the boats and how to land them on the local islands. Here I am in front of a nearby glacier. On the way back, I took this shot of an iceberg which had quite a bit of structure to it. After getting back, I took a picture of a elephant seal relaxing.



Figure 70: Laura, William (the instructor), and Mark



Figure 71: Clear water and ice formations



Figure 72: Here I am in front of a nearby glacier



Figure 73: Iceberg



Figure 74: A elephant seal relaxing

Day 20: April 14, 1998 ATVs

Today was another good day. Although grad school is hard work, it is rewarding to do a project like the VLF antenna repair. Today, one of the science techs and I cautiously drove the ATVs up the glacier and drilled new holes to mount the posts which guy the antenna tower down. We then raised the two antennas (the magnetic loops) so that the apexes are about 30 feet above the ground. I have to make a new structure to hold the antennas at the bottom, and then I have to secure the mast guy posts before I am all done. Now I'm sitting in the VLF hut listening to the VLF sounds, and they sound really clear like they did before the antenna fell.



Figure 75: Grad school is hard work



Figure 76: I cautiously drove the ATVs up the glacier

I wanted to say hi to Stanford today. It's not quite as warm here as it is there, but I think that it rains a bit less. Still, I miss campus and my friends. I should also take a minute to let undergraduate students know that there may be opportunities for enthusiastic physics, computer science, and engineering students to intern in the VLF group and work on data from Palmer as well as other Antarctic data, and data from field programs in North America.

Please feel free to email me with any questions or comments that you have about the diary.

Day 21: April 15, 1998

I Lost My Backpack



Above is the sunset from last night. Looking from the top of one of the buildings, you can see some of the station buildings and a nice iceberg.



Figure 77: Some of the station buildings and a nice iceberg

Today I awoke to a fire drill. I then figured out that I lost my backpack with some tools in it. I'm sure it will turn up. I did some more adjustments on the VLF antenna. In the afternoon, I had another look at data that I recorded from last night. It seemed fine when I looked at it first, but I realized that there were a number of events on the NPM path. For those not familiar with our "narrowband" recordings, we record amplitude and phase of four transmitters located in North America. NPM, for example, is in Hawaii. Other sites linked to the VLF home page contain more information about these transmitters. Because they have a high power output and a low operating frequency (~25kHz), their signals travel around the earth. By monitoring these signals, we don't see the perfectly flat amplitude and phase that is transmitted, but we see a disturbed signal due to its propagation through the earth/ionosphere waveguide. For example, if there is lightning between here and Hawaii, that lightning might disturb the ionosphere and thus perturb the amplitude and/or phase of the signal propagating below. We can then try to understand the physical processes going on in the ionosphere by looking at the perturbations.

Today is high bandwidth day. Sorry. I just think that these images are so important to what we are doing, that I will put them inline with the text. Here is the amplitude and phase recorded from



NPM (Hawaii transmitter at 28.5kHz):





Notice that the amplitude always decreases while the phase always increases. This happens with perturbed data in Antarctica most of the time. The theory is that because of the long length of the path, there is only one "mode" (or electromagnetic orientation) of the wave by the time it gets to Palmer. An increase in the electron density of the ionosphere makes the wave propagation harder (for example, the daytime levels are much lower) and we get a drop in amplitude. At the same time, the equivalent path length of the wave, which is bouncing between the earth and the ionosphere between the transmitter and Palmer, decreases causing an increase in the observed phase.

For the VLF group people, here is a view of the conical monipole antenna (the shorter one) which has been set up about 150 meters from the VLF hut, rather than the 10 meters that it was going to be away. It's only a couple hundred watts peak, but I'll try to do tests with it on and off. I'm quite sure that it won't be a problem.



Figure 78: a view of the conical monipole antenna (the shorter one) which has been set up about 150 meters from the VLF hut

Day 22: April 16, 1998 Shameless Self Promotion Day

Hi. Today was an ordinary day, if you can call any day here ordinary here. I did some more work on the antenna tower and also looked at more data from last night which was also really good.

Since I have no nice pictures to show today, I thought that I would give links to my home page and two field projects that I have worked on. First, the Holographic Array for Ionospheric Lightning research (HAIL) project is a set of five narrowband VLF receivers in Colorado and New Mexico. Paths from the four VLF transmitters to the HAIL receivers often travel directly through the large thunderstorms in the central part of the contiguous United States. By having an array of five receivers placed about 150 km apart, our VLF receivers record different perturbations from an ionospheric disturbance located somewhere in between the them and a particular transmitter. By looking at these perturbations and how they change along the array, we are trying to understand the size, shape, and temporal evolution of lightning induced ionospheric disturbances.

A recently deployed project is the Electrojet Monitoring array which now consists of a narrowband receiver in Newfoundland, two in Nova Scotia, and one in Boston. By tracking the amplitude and phase of the signal from the NLK transmitter in Washington state, we are trying to study the effect of the Auroral Electrojet on the signals and to be able to predict a large Electrojet disturbance when one happens. This Electrojet is associated with the Aurora Borealis and is caused by large solar storms which affect the ionosphere at high latitudes. The Electrojet receiver paths from NLK pass over northern Canada which is a particularly active region. One example of the effect of a large Electrojet disturbance would be the Quebec power outage in 1989 when many thousands of people were left without power because the electrojet induced large voltages in the power grid and destroyed some very expensive transformers. We will be placing four more receivers in Alaska in the fall to monitor signals from the NAA transmitter in Maine.

Both of these projects also can utilize data collected from Palmer station. The earth's magnetic field, similar to a dipole magnetic field, has field lines which particles travel along in the radiation belts. These field lines come out of the surface of the earth in one hemisphere and come back in to the other hemisphere. Two points on the surface of the earth which have the same magnetic field line are called "geomagnetically conjugate" points. Palmer station is conjugate to a point in the north east of the US, so when there are disturbances there produced by lightning via whistler-mode waves, they may travel along the magnetic field line and be measured at Palmer station. By measuring these signals at Palmer, we can tell the time delay (between the subionospheric wave from the lightning that travels at the speed of light over the surface of the magnetosphere) that was taken to get here and also the amount of distortion that happened as a result of the whistler's traveling through the earth's magnetosphere. Much effort in the past has gone into understanding the properties of the magnetosphere from these signalures measured from Antarctica. In fact, it is now a diagnostic tool for understanding the magnetosphere.

Day 23: April 17, 1998 Animation

Because the ship is returning tomorrow and people will have to work then (Saturday), today was a Saturday schedule, so we had a station meeting and helped clean up. The winds were back up today, maybe around 40 knots which was a little scary since it reminded me of the hurricane. However, the antenna seems to be fine. Most of the snow has melted around the station and the glacier is pretty slippery. It's actually easier to work when there is some snow on the ground.

I wanted to take another picture of the VLF hut. If the winds go down tomorrow, I'll attach the GPS antenna with a more permanent method and then take a picture of that. When I first got here, it took more than a day for the GPS receiver to lock, but it has been locked ever since.


Figure 79: VLF hut

I found that the digital camera has a sequence mode where 9 pictures are taken .1 seconds apart. I'll try to get a shot of a calving glacier with this mode, or I may try to digitize a video that someone else may have taken. When I take one of these pictures, I get a single jpg image with the 9 pictures in it like:

```
789
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I have an image of a flag blowing in the wind. I know that there is gif animator shareware out on the net, but I don't have any with me. A good project would be to cut up the image into 9 images and make a gif animation out of it. If anyone does this, let me know where I can look at it and copy if to the diary!

^{1 2 3} 4 5 6



Figure 80: A flag blowing in the wind

Day 24: April 18, 1998 The Lawrence Gould Returns

The Gould returned at about 8am this morning. There is a new crew to replace some of the people that were here in the summer and some people that are just going to be here for the remaining 12 days. Even though I have been here a very short time, it is strange to see new faces on the station. I know it sounds strange, but I only saw the same 28 people for a couple weeks and this morning there were all these new people walking around. I can't imagine what that must feel like to the people who winter over at stations and only see a handful of people for months at a time.

This afternoon, I drove the ATV up to the base of the glacier. It has rained and snowed so much over the past couple days that I have been unable to go up the glacier so instead I had been reading up on and preparing for our calibration. I did try to drive up the glacier, but the ATV slipped backwards. I had to walk slowly up the slippery ice to the antenna - all the snow had

melted. We now have a setup to hold the antenna off the ground at the base. I finished it today, but I'll have to put a picture up later.

Next Thursday, the ship will be taking a three day cruise to the mainland as a gift to those who were here in the summer season. They have invited me to come along, and I hear it is a trip of a lifetime. We'll be going to the old British station named Faraday. The station is now operated by the Russians, and I have lots of pictures and information when I go there.

Here is a picture of me next to my main computer in the VLF hut. I took this as I was writing this web page entry. You can see a metal cup with a metal straw on the desk. I am drinking Mate, which is a tea-like drink that the Argentineans and Chileans enjoy. It is usually consumed with a group of friends involving quite a ritual. There is usually a thermos of warm-to-hot water and a person will fill the cup with the herbs (or yerbas) and have a few sips out of the straw which has a screen filter on the end of it. When he or she is done, the cup is re-filled and passed with the right hand to the next person. Once a person has had enough, then he or she says "gracias" when they take it for the last time. Apparently, some of the people that I met in Chile say that Chileans never drink Mate from water that has been boiled. They say that ruins the taste, even if the water has cooled down a bit. I am sure that I missed a lot of Mate rituals - email me and let me know!



Figure 81: Me next to my main computer in the VLF hut

Day 25: April 19, 1998 Old and New Narrowband Systems

Today I had a good time comparing our analog narrowband receiver with the new digital narrowband receiver. If you look at the page that I put up showing the Palmer broadband data, then you can see several horizontal lines with names like NLK, NPM, and NAA. These are the VLF transmitters that my research employs. The HAIL project was the first project in our group to use a real time digital receiver to follow the amplitude and the phase of these transmitters. We have not yet replaced all of the previous systems, including the one at Palmer station. Last night, we recorded with both the new digital and the old analog system, and I made some comparison charts. The amplitude looks very similar (except from NAA where I had scaled them differently and they came from different antennas). The measured phases have a couple differences. First, the previous system did not use GPS as a time reference so the measured phase drifted with time if we didn't tune our local frequency standard. As a result, the old system phase was tilted by a constant amount. Both systems wrap the phase so that it stays within +/-180 or 90 degrees. I have a close-up showing some events that were seen with both systems, and I'll try to put that online soon. Notice that sometimes the new system's phase looks fine, and the old one is very noisy. Particularly for NAA which had the low signal level, the digital system was still able to track phase.



Figure 82: NPM amplitude and phase



Figure 83: NAA amplitude and phase



Figure 84: NLK amplitude and phase

Day 26: April 20, 1998

Checking the Sea Ground

Wow - what a great day! This is the nicest day that we've had since I've been here. The sun was out and there were few clouds. We had spectacular views of the nearby mountains and icebergs. I found out that my digital camera had a panoramic mode, so I took a panoramic picture of the area just outside my VLF hut. This will be a great picture! However, when I tried to download and process this panoramic shot, the camera software didn't seem to work. After some effort, I found the readme file and it said:

I'll try to download a new working version if there is one and get that picture on this page at some point.

I worked some more on the system things here and called Bill up at Stanford using a satellite phone patch. The HF radio here connects to Miami where a phone automatically dials and makes the connection. So when we talk, there is a radio connection going through a satellite and then a phone connection. It's not too bad though. Bill and I talk about the systems here and about the things I'm working on. He's spent many years in the Antarctic working on out VLF equipment and hearing him talk was one of the reasons I wanted to come here.



Figure 85: Bill

Well Kevin and I checked out a boat today to go and check the sea-ground cable. We passed the Gould on the way out and had an unusual view of the back. Our VLF hut electronics are extremely sensitive and measure signals that are in the same frequency range as power electronics (60Hz AC power stuff). If we connect our system power and ground directly to Palmer station then we get quite a bit of interference from noise on the station's power grid. Instead, we isolate the power coming to the VLF hut and have an isolated ground connection which is a cable going into Hero Inlet a few hundred feet from the shack.



Figure 86: We passed the Gould on the way out and had an unusual view of the back



Figure 87: Here I am holding the ground pipe. Notice how it is almost flat! We think that the icebergs must have crushed it



Figure 88: Close up of the ground connectors



Figure 89: Here's a sign saying something about the VLF ground cable. If I find out what it said, I can paint a new one.

Here's a picture of Kevin holding a Krill. The experts at UCSB say that Krill such as these are the primary food source for many of the large whales that frequent the waters around Antarctica, some of which travel thousands of miles to take advantage of the plentiful supplies of Krill here.



Figure 90: Kevin holding a Krill

Day 27: April 21, 1998

Back on the Boat

I and the other people on station who are returning to Punta Arenas on the May 1st departure have now moved on the boat. It's nice to have a boat room again. Even though we are docked, the boat does rock a bit and it is nice when I go to sleep.

Yesterday and today it has snowed off and on and has been quite windy. I found out that the gusts were only up to about 35 knots, and it was still so windy that I was almost blown over a couple of times! I can't believe that the wind was up to 90+ knots before. While on my way up to work on the antenna today, I got a picture of the harbor with some nice cloud formations. I re-adjusted the antenna and then took a picture of it to show the engineers at Stanford so that they can comment about it.



Figure 91: Nice cloud formations



Figure 92: Antenna

Day 28: April 22, 1998

Everything's Looking Up



Figure 93: Looking up

Today was very very busy. I am still in the middle of doing about 100 things. After waking up early (for me), I got a couple people together, fixed the ice drill motor, found out that one of the ATV's had a bad starter, and then headed up the glacier. We worked a bit in the morning until the pull cord on the drill motor pulled off. We're trying to get posts up so that the signal cable does not get frozen in ice over the winter here. These posts fall down every year during the summer, and actually that's the main reason that I came at this time.

After lunch, Kevin (one of the science techs) and I worked to calibrate the system. On my way up, I took this really cool picture of the harbor! Wow. The calibration involves injecting a signal in the VLF hut and recording the signal at the antenna which is then injected back across the cable and measured back at the hut. We measure this as a function of frequency and it's called the "system frequency response." I was up at the antenna reading values while Kevin injected the signal and recorded values in the nice warm hut. Brrrr.



Figure 94: Really cool picture of the harbor



Figure 95: At the antenna

The reason that I did so much today is that we'll be taking that 3 day cruise to the mainland starting tomorrow morning. During the cruise, I won't have Internet access! :(Last time I was on the ship, I emailed pictures and text to my buddy at Stanford who put these in the right directory. This time, I may just write the web pages on the boat and put all of them on line when I get back. Who knows - maybe they'll be up before I get back. We should have some fantastic views of mainland Antarctica and we'll get to meet Russian dudes from the station to which we're going.

Day 29: April 23, 1998

Holy Cow - It's Unbelievable

Today we left the station to visit Vernadsky station, operated by the Ukrainians.

First of all, let me apologize for my lack of HTML programming skills. I'm afraid that I have just used simple text documents and that I am rapidly running out of superlatives. Another passenger and I were talking today, and we both agree that we can't continue to have any credibility and

continue talking about how fantastic things look here. If I were an expert in HTML (and the English language), I'd have all sorts of fancy text fonts and words to describe my daily travels.

All that I can say about today's cruise is that I had best scenery that I have ever had in such a short time. We left Palmer and traveled through the Lemaire Passage, which is a channel near the Antarctic coast with mountains on both sides. If the scenery was not enough, we saw a number of different kinds of seals, groups of penguins swimming and jumping out of the water, numerous birds, and whales travelling in groups. Everybody aboard was simply mesmerized by these views - watching a huge iceburg, and then a thunderous cliff, and the a snow avalanche, and then iceberg fields, and on and on.

After arriving at Vernadsky, which is a Ukrainian station that used to be operated by the British (Faraday station), we had to take the ship back out of the channel to the open sea because the anchor did not sit properly. It was then three trips by Zodiac to take about 20 of us to the station where we met the Ukrainians and toured their station.

Because a picture is worth a thousand words, I'll just list them. (note - these will not appear on the web page until the 27th when I get back to Palmer to download them)



Figure 96: Palmer Station



Figure 97: Icebergs near Palmer



Figure 98: A Sheathed Gull



Figure 99: The first mate, captain, and chief engineer



Figure 100: Wow #1



Figure 101: Wow #2



Figure 102: Entrance to the Lemaire Passage



Figure 103: Wow #3



Figure 104: Two whales (in the distance)



Figure 105: Wow #4



Figure 106: Me



Figure 107: Wow #5



Figure 108: Area near Vernadsky



Figure 109: View from my room





Figure 111: Vladimir Vernadsky



Figure 112: An ionosound machine



Figure 113: Vernadsky engine room



Figure 114: Nice 'do!



Figure 115: Ukrainian Metaphysics

ABCOMATO, WERTHER SPATE OF MIDNIGHT MET OB. INSTRUCTIONS : DRINK 4 Pts GUINNELS, THEN SPIN SUNNY DIAL - SPECIALLY (NOT FOR CALIBRATED FOR 15015'S 12 AM M67) 64º16'W 75 HUMIDITY 6 OKTAS CLOND CONTA NWI WIND : BLOWING 1007 ms pressure WIND: 18 KHS , 27 GARE PREBACINTY 33% Prof of OF PREADTAMON. neccou 76mi - 11°C Barometer 0 WIND: YES. rising , BAROMETER : 9 CLOUD SUNSHINE: 1.27/00 RAIN: SOME CLEARING IN THE EAST WIND: QUITE CLOUD : YES WINDY. HAIL QWITE LIKELY RAINFALL: 2.6 cm3. IGMP : ZERDISH TEMP: WARM WIND: LALM RAUNFALL : NO FOR THESE TEMP : - 6°C. HW4 DITY: 43% (12) PARTS. PRESONAL 1034 mb. WIND : HOOLIE 2 OKTAS CLOND BARDMETER : LONLON Some CHANCE OF SHOW. Foor 0 PANIC AFTER & PAS BUTTON GUINNESS: (PRESS) SILIRAD

Figure 116: Automated weather station



Figure 117: Return in the night

Day 30: April 24, 1998

Port Lockroy, Part 1

This morning, the Ukrainians visited our ship and presented the Palmer station winter-over crew with a "diploma". They toured the ship and were quite impressed with our facilities. Of course, the ship was just commissioned in January so all the computers and engineering equipment is very up to date. I had more time to talk with a fellow post graduate student, Andrey Zalizovskiy, who comes from the National Academy of Sciences of the Ukraine. He is in the Ionospheric Radio Waves Propageation Group, lead by Prof. Yuri Yanipolski.



This certificate was issued on memory of visit american Palmer Base winterteam

> Ukrainian Antarctic Station "Academic Vernadsky" Galindez Isl. 65"15'S 64"16'W



Figure 118: A "diploma"



Figure 119: Andrey Zalizovskiy

We then sailed back through the Lemaire Passage, which was hard work. Today, the large cliffs of rock were masked by a light snow storm, which made them look mysterious. The animals were out in great numbers. I saw a school of penguins jumping just outside my cabin window!



Figure 120: Hard work


Figure 121: The large cliffs of rock were masked by a light snow storm



Figure 122: A school of penguins

We arrived at the next location - Port Lockroy, which is operated by the British Antarctic Survey in the summer. We'll take the Zodiacs there tomorrow to have a look around.



Figure 123: Port Lockroy

Day 31: April 25, 1998

Port Lockroy, Part 2

Holy Cow, Part 2 (the Neumayer Channel)

This morning, we woke up to the call that the Zodiacs would be leaving shortly to Port Lockroy. After jumping in the shower and grabbing some coffee, I put on my "float-coat" and headed out onto the deck. While yesterday was foggy, today was crystal clear. Well - as clear as it gets around here anyway.

The British Antarctic Survey spent several months last summer restoring Port Lockroy. It had been one of the first two British stations and was built in 1944. It is now a museum. A couple people live there during the summer to give tours, but there is no one there at this time of the year. There were signs in the rooms and some information sheets so we had a self-guided tour. The station had not been used in some time, and the canned food, books, electronics, etc were all quite old. They had even had an ionospheric station.

Although Port Lockroy is a Gentoo penguin colony, this is not the time of the year that they hang out there and there weren't many around. We saw them swimming in groups. The seem to have a couple different ways of swimming. When they are in the open ocean, they do collective hops out of the water and then dives under the water. When they are in shallow water, they swim at the surface with their heads cocked, almost like a duck. Then, when they walk on rocks, the waddle (slipping surprisingly often) and also hop with both feet at the same time.

After leaving Port Lockroy, we travelled through the Neumayer Channel which separates Anvers Island from the peninsula. The sides of the Channel are so steep that it looks like a valley. It reminded me of Yosemite. Maybe this was once land and was carved out by a glacier or maybe the islands separated from the coast due to some plate movement. I bet that information is out there for the Antarctic Peninsula - email me if you find out! Also, I could plot the path of the boat and label all these places, but I don't have a coastline database that has resolution better than 1 degree of latitude and longitude. If anyone has this information for this area, I'd love to find out.

We then travelled past an Argentinean station named Almirante Brown. There was no one there right now, so we kept going. We also passed a deserted Chilean base and there were many penguins walking around there. We may not land on any international station which is not inhabited. I guess since Port Lockroy is a museum, that is a special case.



Figure 124: Almirante Brown

I have a number of pictures from today. I really like pictures where the sun is behind an object in front of me, so there are a few of those. Also, sometimes the image is too dark, so I lighten the whole thing. This way, you can see the darker image but the bright part looks a little too bright.



Figure 125: Gary



Figure 126: View of the harbor



Figure 127: View of the ship from the Zodiac



Figure 128: The old engine room



Figure 129: Old fashioned kitchen shelves



Figure 130: Old fashioned kitchen stove



Figure 131: Workshop



Figure 132: Various tubes in the old ionospheric lab



Figure 133: Kevin with a mountain



Figure 134: The sun #1



Figure 135: The sun #2



Figure 136: The sun #3



Figure 137: The sun #4



Figure 138: The sun #5

Day 32: April 26, 1998

Return to Palmer

Our antenna is still standing. :) We got back around 4pm local time after travelling most of the day. The captain stopped for a while to practice lowering the emergency lifeboats and some people took a raft out early. It was cloudy so we couldn't see much from the boat on the trip back, and we all relaxed. When we returned, I got a photo of a piece of glacial ice floating in the water. For scale, this photo was taken from a height of 40 feet and the ice is about 8 feet across. Notice how stratified the ice is. It may have taken thousands of years to form like that. They like to put glacier ice in their drinks here. I'm sitting in the VLF hut now, and the signals sound very clear with a few whistlers here and there. In the next few days, I'll be finishing up with things and packing up. I have to get all the equipment ready and organized for the next year of recordings. That's mostly done, but I also have to organize my documentation and prepare for a talk that I am giving to the station this next Wednesday.



Figure 139: Piece of glacial ice

Day 33: April 27, 1998

I Found My Backpack



Figure 140: I Found My Backpack

Yesterday, I put up a note saying that I had lost my backpack. The station is pretty small, and it seems hard to believe that I could have just lost it. Anyway, someone spotted it and I got it back :).

I'm preparing documentation now on our systems here. I have finished with all the major repairs and jobs that I have to do. I have to make a couple more trips up the glacier before we leave, which is now scheduled for Thursday night at 9pm local time. I think that Thursday will be the last day of the diary that I will do; the ride home should be similar to the ride here. I will be putting some pictures of the engine room online in the next couple days.

Day 34: April 28, 1998

Nice Sunset!

Well time is starting to run out now. I finished a couple more jobs so far today, but I still have a few things to do. Tomorrow is my talk, but I finished preparing for it yesterday. I think that after my talk they are going to have a "Palmer Station Funniest Home Videos" competition.

I'm making plans to set up some extra experiments which we'll have running after I leave. Also, I climbed up the glacier with Dave and Erica today to drill a couple more holes at the antenna base. That photo is the two of them chipping the ice drill bit out of the ice - it had frozen in. It took the three of us a half hour to get it out! It was a really nice day though. I climbed the antenna tower again. It was a bit scary at the top because the winds were strong. However, I had a climbing belt with me so it was safe. The antenna is pretty solid - even in the high winds with me at the top, it didn't move much. On the walk back, we had a really nice sunset.



Figure 141: Dave and Erica



Figure 142: Sunset

I took a handheld GPS receiver to our antenna and recorded the position as:

LAT S64 46.406 LON W64 02.015 Which should be good to 100 meters.

Day 35: April 29, 1998

Homeward Bound

You may be wondering how come this diary entry is late. Well - we left Palmer! It was a close one too. Two icebergs were being blown toward the dock and almost blocked our exit! The gap between them was just about the same as the width of the boat.



Figure 143: Two icebergs were being blown toward the dock and almost blocked our exit



Figure 144: The gap between them was just about the same as the width of the boat

We left at 4pm, which gave me the morning to organize our things in the VLF hut, make final entries into our log book, and pack. We had no time to make it up the glacier one the last time! I spoke with the new science tech, and he'll be able to make the final measurements and corrections to the antenna configuration. I think that our electronics are in good shape, and that the antenna will make it at least year (at which time the guy posts will have to be re-drilled due to their melting out of the ice).

One thing that I didn't mention was how rapidly winter was coming. The sun did not seem to rise very high over the horizon. One day, at about noon, I looked to see the sun just above a cloud which was just above the horizon. However, that's not so bad because we then have sunset/sunrise almost all day long. When the boat left at 4pm, it was the actual sunset time and we were lucky to have great weather. I was a bit sad to leave the station because I was there for such a short amount of time. Some people had been at Palmer continuously for many months (as many as 13!) and were happy to be going back to civilization. People on the shore and the ship waved and yelled.

I have forgotten to take you on a tour of Palmer station! I do have a few images now. I may add to this when I get back to Stanford and sort through all of my pictures. When we walk off the boat, we can see the Bio Lab building to the left and the boat house to the right. The Bio Lab has

float coats which must be used when going around water. On the second floor of the Bio Lab building, there is the kitchen, eating area (see group picture), communication room, a couple other offices, and office of the lab manager, Ron Baltz, who always has free time on his hands. I have already shown the carpenter shop and the GWR building where we slept and where the pool table is. On top of this building, you can see the road which leads to the T5 science building and the VLF hut. From the roof, I also had a view of the ship lifting cargo with its crane. You can see that the station is not huge. It supports a population of a little more than 40 people or so, which is much smaller than the summertime population of 1200+ at McMurdo Station.



Figure 145: Bio Lab building to the left and the boat house to the right



Figure 146: Float coats



Figure 147: Kitchen



Figure 148: Communication room



Figure 149: Ron Baltz



Figure 150: The road which leads to the T5 science building and the VLF hut



Figure 151: The ship lifting cargo with its crane

Oh yeah - at night in the VLF hut, the equipment LEDs and various other instruments light, flash, and glow like a Christmas tree. It's a bit hard to make out (and this file really compressed well!) but I took a picture of it without the lights on.



Figure 152: At night in the VLF hut

Here are some other nice pictures:



Figure 153



Figure 154



Figure 155

Day 36+: After April 29, 1998

Torres Del Paine

I'm back at Stanford writing this entry. I'll try to add to this last entry over the next couple weeks.

Remember way back when I promised to show some pictures of the engine room on the ship?? Well, they had painted it and made it look really nice. Here is one of the diesel engines. Here is one of three generators and one of the mechanics holding an intimidating wrench. Four days on the ship back was quite a long time. The sea was calm, and there were some nice sunsets.



Figure 156: One of the diesel engines



Figure 157: One of three generators



Figure 158: One of the mechanics holding an intimidating wrench



Figure 159: Some nice sunsets

I had a safe and fun trip back to Stanford, including a visit to the Torres Del Paine National Park in Chile. I also visited Santiago and had quite a nice time wandering around the city. I'll try to elaborate on these trips within a couple weeks - I have to do all this work now that I am back! For now, I'll just say that I have really enjoyed writing the diary and that I've received a number of nice emails from people around North America who have been following it. I hope that it has sparked some interest and that you have enjoyed looking at the pictures and learning about VLF research.



Figure 160: Torres Del Paine National Park


Figure 161: Santiago

I would like to dedicate this diary to several past and present members of the Stanford VLF group who have spent many years working in and researching data from the Antarctic. They have had the distinction of having locations in Antarctica named after them!

William TrabuccoTrabucco Cliff, AntarcticaEvans PaschalPaschal Glacier, AntarcticaJohn KatsufrakisMount Katsufrakis, Antarcticaand Robert Helliwell (Prof. Emeritus) Helliwell Hill, Antarctica

While travelling in Chile, my friend Dave and his wife Marin were blessed with a new baby, Paul Eric.

It's nice to be back, California's not so bad!



Figure 162: It's nice to be back



Figure 163: California's not so bad