Teacher at Sea Log: Leyf Peirce

Day 1: Tuesday, July 2, 2004

Time: 20:00

Latitude: N 59°03.205

Longitude: W 150°41.139

Visibility: 10 + mi

Wind direction: 280

Wind speed: 11 knots

Sea wave height: 0 – 1 foot

Swell wave height: 3 – 4 feet

Sea water temperature: 12.2 °C

Sea level pressure: 1016.0 mb

Cloud cover: 4/8

Science and Technology:

We left Seward today and are headed toward the Shumagin Islands to conduct hydrographic surveys to map the ocean floor and the coastline. The overall goal of this research is to update existing nautical charts. Most of the charts that are currently used have not been updated since the early 1930's. After talking with ENS Brent Pounds, ENS Nicole Manning and P.S. Shyla Allen, I learned more about the tools and techniques used to map the ocean floor. Steve Foyd also provided me with an excellent pamphlet titled "Nautical Chart Programming". From these sources, I learned the following information about data acquisition and analysis. The Rainier will first be positioned using the Differential Global Positioning System (DGPS) near the desired area to be mapped. Then, the Rainier launches up to 6 research vessels, each equipped with two main measuring devices. One device, the ELAC C-Beam 1180, is basically a side scanner that can scan a swath of the bottom of the ocean up to 200 meters using 180 individual sound beams. Any depth change will appear to be different shades on the sonogram. The heights of different points can then be calculated from this sonogram. In conjunction to the ELAC C-Beam 1180, the launch boats use an echo sounder mounted to the ship's hull. While this can retrieve more accurate data, data with only a 0.1 m margin of error, it can also only scan an area up to 5 meters. However, using these two systems combined produces the most accurate data. The Rainier also installs tide gauges that produce accurate data that can be added to the resulting nautical charts. Researches aboard the Rainier take this data, "clean it", and eventually send it to the mainland to be used to create the new updated charts.

Personal:

This day has been full of excitement as we are finally underway! The scenery is absolutely beautiful here, and the wild life is truly fascinating. The snow covered mountains dip into the water with an awesome power as sea otters and puffins play in that same water below. We have also seen several porpoises and one crewmember claimed he saw a whale. I am overcome with awe at how this ecosystem is filled with so much wonder and unknown as the mountain goats and moose mirror the whales and sea lions only to be separated by where the land and water meet. Life aboard ship is similarly full of excitement. It is like a finely tuned machine how well everyone works together to make this boat maneuver. As much as I am enjoying the sight seeing, I can't wait for the research to begin. I am excited to have my engineering background meet my teacher profession!

Question for the day:

It is summer here, and the tilt of the Earth causes the "sun to never go down". One could even read a book in the middle of the night with no flashlight! As I was thinking about navigational techniques and the history of navigation, I couldn't help but reflect on the importance of using the stars for guidance at night. The question for the day is: What did sailors use, before all of the GPS technology we have now, to navigate at night in these upper latitudes when it never got dark enough to see the stars at night?

Day 2: Wednesday, July 7, 2004

Time: 10:15

Latitude: N 57°31.730

Longitude: W 154°58.325

Visibility: 10 + m

Wind direction: 250

Wind speed: 18 knots

Sea wave height: 2 - 3 feet

Swell wave height: 2 – 4 feet

Sea water temperature: 10.6 °C

Sea level pressure: 1020.1 mb

Air temperature: 12.2 °C

Cloud cover: 2/8

Science and Technology:

I talked more with P.S. Shyla Allen about how the multibeam echo sounders work on the ship to gather data about the depths of the ocean. Both the Rainier and the launch ships use the following method to gather data. All of these vessels use echo sounders with anywhere from 120 to 240 beams that scan the ocean floor. The following diagram illustrates how this is done:

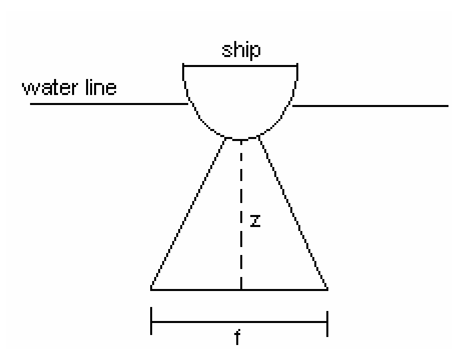


Figure 1: Multibeam Echo Sounding

Here, “z” is an echo sounding two-way travel time beam, and the multibeams are spread over the footprint distance of “f”. The size of the sound footprint, “f”, depends on the depth at which the measurement is taken, “z”. The greater the depth is, the greater the footprint is. However, the greater the footprint is also means less accuracy on the outer edges of the footprint. Therefore, the ship will run a “mowing the lawn” pattern across the given section to get desired overlapping of data:

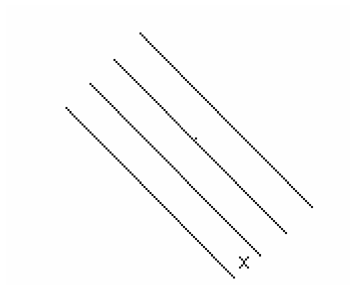


Figure 2: Mowing the Lawn Pattern

The width of these lines is determined by: width of x = 3 * z. By using this rough equation, the ship will be able to overlap the areas of least accuracy, i.e. the areas on the outer range of the footprint:

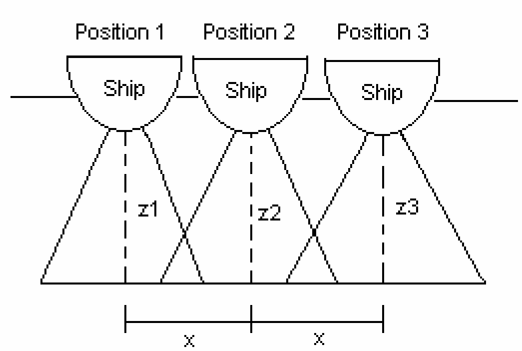


Figure 3: Ship running mowing the lawn pattern so the footprints overlap.

From this data, the depth and contours of the ocean floor can be determined. I also asked P.S. Shyla Allen about the problems and sources of error associated with this data collection. She responded by detailing three main issues that must be corrected when cleaning the data, i.e. the data must undergo three main correction factors before accurate readings can be analyzed. These three factors include: a) tide changes, b) sound velocity, c) the motion of the ship and GPS positioning. To correct for tide changes, the researchers must have accurate readings of the tides. Tide gauges are installed along the coastline at various points, and all readings are reduced to Mean Lower Low Water (MLLW). This basically gives the average of the lowest possible depth at a given location. To correct for sound velocity changes, which is the most important correction factor dealt with, researchers take measurements of water temperature and salinity level at the given depth reading. For every change of 1 ppm in salinity, there is a change of 3 m/s in sound velocity. Therefore, salinity is perhaps one of the most important factors. Finally, the motion of the ship and GPS position need to be corrected for. This includes correcting for the pitch, roll, and gyration of the ship as well as error in the GPS system. Because the ship uses Differential GPS (DGPS), this error is already accounted for. However, for the pitch, roll, and gyration of the ship, two antennas are used to on the port and starboard sides. These antennas, often referred to as Motion Reference Units (MRU), are very stable feed into the same computers that process the data. Therefore, the computer takes into account the readings from these antennas and combines this information with the corrections made for the tidal changes, sound velocity factors, and positioning of the ship. After cleaning the static from the data, a nautical chart can be produced. This method of charting the ocean floor is definitely more efficient than when researchers used lead lines—long ropes with lead that would be dropped down and then measured to determine the depth!

Personal:

I woke up this morning after sleeping for about 12 hours—I think the seasickness medicine I took last night made me very sleepy. Luckily, however, all traces of seasickness are gone; I can even sit here at the computer and type without noticing the pitching of the ship very much at all. I think all of my muscles must be getting stronger as a result of reacting to the changing ground and all of the stairs I go up and down every day. I spent some time on the bridge this morning mostly asking questions about the tools used there and what various measurements mean. I find it very interesting that simply reading tiny numbers and using small switches and knobs will run this 231 foot ship. However, my experience aboard ships tells me that it is not even close to impossible. I know that even the slightest adjustment at the helm on a sailboat can change the course of the boat. I am reminded of sailing in the British Virgin Islands and the dispute over if it was more important to maintain the way point or try to make the boat go very fast. However, that is not an issue on this boat. We are supposed to reach the Shumagin Islands tonight, and tomorrow we will start the launches—I can't wait!

Question for the day:

How many sets of data points must be filtered out before the data is considered clean? On what does this number depend? How does one determine if a data point is an outlier or and actual reading?

Day 3: Thursday, July 8, 2004

Time: 09:00

Latitude: N 55°41.71

Longitude: W 158°03.81

Visibility: < 1 foot

Wind direction: 230

Wind speed: 10 knots

Sea wave height: 0 – 1 feet

Swell wave height: 0 – 2 feet

Sea water temperature: 10.0 °C

Sea level pressure: 1021.3 mb

Air temperature: 10.0 °C

Cloud cover: fog

Science and Technology:

As I am typing my journal entry, I learn there are several good pictures on the network server of the Rainier and its crew. Here is just one that I found:

The Rainier Underway; Photographer Unknown

From this picture, I can see that the aft most launch ship has been launched for survey, for there are 3 launch boats on either side of the ship. I talked further with the crew today about interesting characteristics of this ship, including a "field trip" with Lt. Kevin Slover to inspect the hulls of the launch boats to see the echo sounding devices. I learned that there are actually 3 different types of these devices: one with low resolution for very deep water, one for a little higher resolution of deep water, and one with high resolution for shallower water. These devices cost up to $25,000! I was able to get pictures of the three types; however I am not able to download them onto the computer yet. Lt. Slover also showed me more of the Caris program, the most recent computer program used to collect and analyze the data. I say most recent used, because these programs are constantly being changed and updated to be more accurate, user-friendlier, and display better graphics. One of the most interesting features of this program is not only its accuracy, but also the ability to look at the computer created images of the ocean floor from any angle. One of the images pulled up as an example showed a shipwreck off of the coast of Seward in about 38 meters of water. The details of this sunken ship were almost crystal clear! Of course, this is after the data has been corrected and cleaned. I hope to work more with this program as we start the launches tomorrow and Saturday.

I also spent some time on the bridge again today. There, I learned a few interesting trivia facts about this ship:

- The Rainier was built in 1968 along with 2 other identical ships, .the Mt. Mitchel and the Fairweather, all specifically for NOAA; these three were commissioned in 1969
- There are 2 main engines aboard this ship, both have 1200 Horsepower and they are the same type of diesel engines as those used in locomotives
- To figure out the cloud height, one can apply the equation: (wet bulb temp – dry bulb temp)*126.3; there was some dispute on how accurate this is, but for today it works since the wet bulb temperature = dry bulb temperature, so the cloud cover, according to this equation, is at 0 feet which is true since we are in a cloud today with all of this fog
- The boat was originally built to support 4 launch boats and 2 life rafts, however it was recently modified to have 6 launch boats on it; to counteract this weight up top, more ballast had to be added to the bottom

A launch boat also left today at 08:00 to conduct further hydrographic research, and the Rainier maintains her course, "mowing the lawn" in a section of uncharted waters between Kodiak and the Shumagin Islands. Once this area is completed, we will head to the Shumagin Islands to anchor and send more launch boats throughout the next week before we return to Kodiak. This is such an adventure!

Personal:

The foghorn blows every 2 minutes on this ship, and it acts as a great wake up call. This morning, the horn reminds me that we are sailing in a sea of uncharted and now seemingly invisible territory. I feel like an explorer thrown into the time of Captain Cook, half expecting to see a pirate ship immerge from the eerie blanket that surrounds us. However, the multitude of technology aboard this ship flaunts the modern times in which we live and, in doing so, destroys any hope of true exploration of the unknown. Still an explorer at heart, I also still find adventure in what we are doing. We are still conducting hydro research aboard the Rainier, "mowing the lawn" across uncharted territory, so we are only moving at about 7 knots. A launch boat was also sent out today to investigate near by waters. As I sit here responding to emails and learning even more about how this ship works, I am anxious to see the data that is collected now be processed.

Question for the Day:

In talking with P.S. Shyla Allen and Lt. Kevin Slover, we discussed the rewards of this job—how does this work help society? Both agreed that one of the most rewarding, but somewhat scary, aspects of this job is being able to accurately chart and re-chart high traffic waters. They both said that there are often calls from local fisherman demanding more detailed and more accurate charts. P.S. Allen informed me that there is a group of retired U.S. Coast Guard members that will conduct their own charting research in order to expedite the charting process. While helpful, this is not always the most accurate information. However, I did begin thinking about ways to include local fisherman in the research; to ensure the data that they collect is more accurate. My question for the day is more of an engineering design problem and proposed solution defined:

Problem: Local fishermen travel the coastal waters along Alaska to make a living. However, these waters are poorly charted, if charted at all. As of now, fishermen use a "Hummingbird" device to measure the depth of water where they travel, but there is no electronic device that can record this data accurately, correct this data for margins of error, and combine this data to produce an accurate nautical chart aboard these fishing vessels. While boats such as the Rainier have this capability, expanding the number of vessels capable of collecting and analyzing such data would expedite the nautical chart updating process.

Proposed Solution: Design, test, and implement a device that abides by the following parameters: not very expensive, accurate, maintains the same abilities as the multibeam echo sounding devices aboard the Rainier, has the capability of communicating with the computers aboard the Rainier to share information collected, and can be mounted on the fishing vessels in such a way that it will not alter steering or speed.

I asked Lt. Slover if there is much government funding for such engineering projects, and he assured me there is—most of the U.S.'s imported goods arrive by ship, so more accurate and up to date nautical charts are a large priority.

Day 4: Friday, July 9, 2004

Time: 16:00

Latitude: N 55°26.60

Longitude: W 159°33.97

Visibility: < 1 foot

Wind direction: 221

Wind speed: 13 knots

Sea wave height: 0 – 1 foot

Swell wave height: 1 –2 feet

Sea water temperature: 10.6 °C

Sea level pressure: 1016.0 mb

Air temperature: 11.7 °C

Cloud cover: fog

Science and Technology:

Most of my day was spent exploring the pages within Nathaniel Bowditch's *The American Practical Navigator; An Epitome of Navigation.* I took notes mostly from a chapter titled "The Oceans". It primarily discussed oceanography and the branches that are studied as a part of oceanography: geography, geology, chemistry, physics, and biology, "with their many subdivisions, such as sedimentation, ecology, bacteriology, biochemistry, hydrodynamics, acoustics, and optics" (427). With the main focus on the physical characteristics of the ocean, this chapter further detailed the importance of understanding salinity, density, temperature, and pressure—the main factors that affect most of the oceans' behavior. There are several concepts within this chapter that can be watered down for my sixth, seventh, and eighth graders, however the one most applicable to hydrographic research is the study of the speed of sound waves within salt water. Because echo sounding is used to chart the ocean floor, the speed of sound within saltwater is essential to ultimately creating nautical charts. According to Bowditch, the speed of sound within a given fluid can be calculated using the following equation:

$$U = 1449 + 4.6T - 0.055T^2 + 0.0003T^3 + 1.39(S - 35) + 0.017D$$

In this equation: U = sound of speed (m/s)

T = temperature (°C)

S = salinity (psu)

D = depth (m)

Using this information, one can calculate the speed of sound given different parameters. These measurements are determined using a CTD test (conductivity—which correlates with salinity, temperature, density test) and a depth probe about every 4 hours that we are conducting hydrographic research. This information is then accounted for when employing the echo sounding devices. This equation can also easily be used by 7th and 8th graders. I plan on gathering real data and using these concepts in my classes along with graphing the data and outcomes.

While I read a lot today, I also got to tour the engine room. I have seen many engines and know the basics of how they work, thanks to my Mechanical Engineering degree, but I have never seen one so powerful! The twin 1200 horsepower engines can have up to 210 RPM. There are also two generators aboard the ship. What amazed me most on my tour was the control room where the control board looked like ones I have seen in museums—I thought that they would have moved to computers by now! One of the engineers assured me that this switch would be made in the near future.

Personal:

I woke up this morning to what seemed like even thicker fog—this is the third foggy day in a row! Feeling a new energy from sleeping so well, I decided to try to work out on the treadmill in the ships workout room. I was told about there being a TV and VCR, and knowing that the workout room is on the same level as the engine room, I decided to take a movie with me and play it very loud. While the movie and TV worked great, the treadmill was a whole new experience. In all my years of exercising and training, I have never been on a treadmill that pitches and rolls with a boat! I felt as if my running counted as twice the exercise since I was not only running forward on the treadmill, but I was also adjusting every step with the motion of the ship—a very odd experience! After 45 minutes of exercise, I decided I had enough. The rest of the day was spent reading Nathaniel Bowditch's *The American Practical Navigator; An Epitome of Navigation*, thinking of ideas for incorporating the concepts into next year's curriculum, and playing cribbage, a card game the other teacher at sea, Sena Norton, taught me. Lt. Slover also informed me that I will be going on one of the launches tomorrow to help conduct research! While he was reviewing the small boat safety, the fog lifted to reveal beautiful snow covered mountains and islands—we had stopped the hydro research with the Rainier and were headed to our anchor point near Egg Island. We are expected to anchor around 21:00, with a possible stop for fishing along the way. Just finished dinner, I am now sitting in the chart room, looking out the window at dramatic cliffs plummeting into the sea—a reminder that these islands are, in fact, formed from a volcanic chain. I can't believe how green these islands are—I must be sure to take plenty of pictures. As I day dream at these islands that are reminiscent of the islands in the BVI's, the fog horn goes off again—the first time in a few hours. I guess this is the changing weather of the Alaska coast line; I just hope that tomorrow there is no fog when we are out on the launches.

Question of the Day:

My sister, Dr. Shayn Peirce at the University of Virginia, emailed me some interesting questions. P.S. Shyla Allen was a great source for these answers:

Dr. Peirce's questions: "My questions for you...can the echo scanner detect a whale on the bottom of the ocean? If so, how do they know it's a whale and not a rock bump in the ocean floor or something else.

2nd question: what is the difference in echo scanning that you're doing on the boat and ultrasound that they use in biomedical diagnostics...(to image babies in the womb or ovarian cysts?) Both involve acoustic imaging...is the frequency or wavelength of the sound emitted and detected different? Obviously the biomedical application requires a much smaller resolution with less depth penetration while the ocean application requires large penetration depth and not as much resolution...by the way what is the resolution of the echo signal...a few square feet of the ocean floor? Could you pick up the signal of that 1 foot long wench you dropped in the BVIs at 150 ft ocean depth?"

Answers:

1) Yes, the equipment here can detect a whale at the bottom of the ocean. In fact, it can even detect a wreck very well! I saw an image yesterday of a wreck and you could see the mast and bowsprit and everything—very detailed! I am trying to get a copy of that picture. Usually the whale will be moving, so that motion will also be picked up and cause more "static" in the data that needs to be cleaned. This rarely happens though.

2a) The echo sounding aboard the Rainier and ultrasound that they use for biomedical diagnostics are actually the same process, just with different frequencies!

2b) The resolution of what is done aboard this ship depends on water depth and the size of the footprint left by the scanner; the deeper the water, the larger the footprint, and the less resolution. However, they are required to have a resolution of 3 pings per 2 square meters in a depth of 40 meters or less (given the equipment used, there are up to 240 pings in a 160 degree swath). 40 meters is chosen because that is the maximum draft of a tanker vessel. P.S. Allen told me that, unfortunately, the 1 foot wench I lost somewhere in the BVI's is probably long gone and undetectable by the equipment used aboard this ship. However, in shallow water, she has been able to see not only lobster pots, but their mooring lines as well. Their mooring lines have about the same diameter as the mooring line we descended in the Caymans on our dive trip. I also asked if the equipment could pick up a diver. P.S. Allen said yes, but that it is VERY bad for your body—so much power!

Day 5: Saturday, July 10, 2004

Time: 18:00

Latitude: N 55°17.29

Longitude: W 160°32.13

Visibility: 6 nm

Wind direction: 110

Wind speed: 12 knots

Sea wave height: 0 – 1 foot

Swell wave height: ---

Sea water temperature: 10.6 °C

Sea level pressure: 1016.3 mb

Air temperature: 13.3 °C

Cloud cover: 3/8

Science and Technology:

Today was the first day we launched the survey boats. I was assigned to a boat with SS Foye, ENS Welton, and ENS Samuelson. A very interesting and eventful day, the best way to describe it is with a timeline:

08:00 board 5 boat with SS Foye, ENS Welton, and ENS Samuelson; Lt. Slover (the FOO—Fieldwork Operations Officer) came aboard for about 20 minutes to run tests on the Reson 80101 multibeam echo sounding equipment we are using (soon dropped Lt. Slover back at the Rainier); NOTE: Reson 80101 is used primarily for shallower water, for it has better resolution at depths less than 75 meters

08:45 arrived at our first way point near Halfway Rock; took first cast with the CTD (testing for conductivity, temperature and depth—all things that factor into velocity speed profile) and found an average depth of about 65 meters

09:00 started doing lines (mowing the lawn pattern) around Halfway Rock; after about 3 lines, Lt. Slover called us back in because the data he had taken did not process correctly—the new programs aboard the ship were not working as well as they had thought

11:25 board the Rainier while FOO checked our equipment; turned out we had to switch to 6 boat—including downloading new maps and figuring out a new system

11:45 board launches 6 boats and sets out for new set of lines at deeper water than the morning; this boat uses the ELAC multibeam systems which are better for deeper waters (up to 400 meters)

12:00 arrived at new line destination (lat: N 55/14/54, long: W 160/27/43) and ate lunch before doing our CTD cast

12:30 conducted first CTD cast, but computer messed up, so had to repeat the cast and got a better reading (average depth = 150 meters) began line pattern

** After a few lines of learning the computer program, SS Foye allowed me to drive the boat for almost the rest of the time—my experience on boats made this part so much fun—especially using the computer imaging as a navigational chart**

17:30 arrived back at Rainier for dinner

I was truly impressed with the amount of different technology aboard these ships: 5 computer screens, 2 key boards, and a lot of different software programs used to immediately process the information we were gathering. This was also a great change from being on the big ship all day!

Personal:

This was definitely my favorite day on the ship so far! The fog lifted early this morning to reveal beautiful islands, puffin, sea gulls, kelp, and even a whale! I was able to experience what it is like to have to make computer programs do what you want them to do (any researcher knows this isn't always easy), and I had to do this on a rocking boat (for all of you "land researchers", I suggest you trying it once!). SS Foye, ENS Welton, and ENS Samuelson were all extremely helpful and very good at explaining the technology and theory behind what we were doing. I was extremely impressed with how everyone handled various problematic situations. Computers and technology can be very frustrating sometimes, and the crew aboard the boat handled everything optimistically and professionally. SS Foye asked if I ever would consider giving up teaching and join NOAA—after my experience today, I said I would definitely consider it!

Question of the Day:

What is the effect of different densities of water on sound waves?

Day 6: Sunday, July 11, 2004

Time: 21:00

Latitude: N 55°17.27

Longitude: W 160°32.16

Visibility: 4 nm

Wind direction: 095

Wind speed: 10 knots

Sea wave height: 0 – 1 foot

Swell wave height: ---

Sea water temperature: 10.6 °C

Sea level pressure: 1017.0 mb

Air temperature: 12.8 °C

Cloud cover: 4/8

Science and Technology:

Today was my second day aboard a launch boat. With SS Foye, ST Taylor, and ENS Samuelson, we continued to follow lines to chart the ocean floor just south of Egg Island. Today we were on launch boat 5, and luckily everything was working great! We were working with the Reson 8101 again. It should be noted that in previous journal entries I have been misnaming some of the equipment used. Today, I finally got the nomenclature correct. Here are the basics:

1) ELAC multibeam system is used for deep water, with best resolution over 30 meters
2) There are two shallow water mulitbeam (SWMB) systems:
    a) Reson 8125 is used with a higher frequency and has better resolution in depths of 0 – 30 meters
    b) Reson 8101 is used for "middle depths" of 0 –120 meters (mostly 30 – 120 meters)

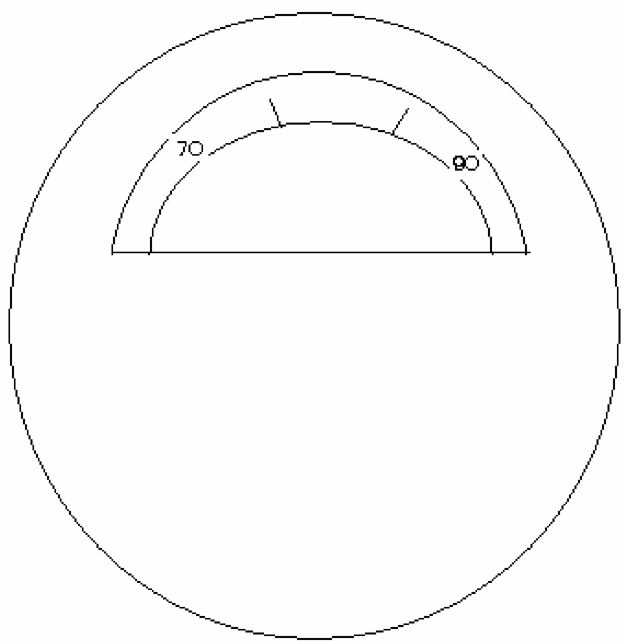
I also learned a lot more about how to use the software aboard the ship while we are taking data. For the Reson 8125 and Reson 8101, there are three computers aboard the ship that can talk to each other. Two are located in the cabin and one is located on the deck. One computer in the cabin is used primarily to navigate; the old charts are downloaded onto this computer and the lines on which we need to steer the boat (the lines for mowing the lawn) are superimposed on this chart. This computer is not only hooked up to the computer that gathers data, but is also connected to a computer that is mounted on the consol so the captain can see where he or she needs to go. The navigational computer in the cabin is also directly hooked up to the other computer in the cabin. This second cabin computer is connected to the actual multibeam echo scanner system that is mounted to the hull of the ship. When instructed to do so, the second cabin computer can record the data from this system. One of the researchers uses the navigational computer to tell the second computer when to start and stop recording the data. Because the second computer is hooked up to the multibeam system, it also is used to control the parameters of this system, including filters, range, frequency of "pings", and power. There are several different screens within the program used to control all of this, including a profile screen, which actually shows the profile of the ocean floor, a pitch/roll/heave screen to record that the POS/MV (the positioning device also hooked up to this computer that integrates with the data correcting for the gyration of the ship and it's position), and a control screen. There are several other screens which can be displayed on this computer, however these listed here are the most important to monitor while gathering data. The power of the multibeam system can be monitored and altered according to depth and profile of the floor; if you want the device to "listen to the pings better", you increase the power, and however, this also decreases resolution. You would want to do this in greater depths. You can also manually control the depth filter for the data. In order to do this, you change the range of the depths the multibeam system is looking for. This in turn changes the width of the footprint left by the data and thus the resolution. By doing this as you gather data, you are eliminating possible outlying points before ever having them recorded and you are allowing for better resolution at shallower depths. This makes the data processing and cleansing easier, yet it requires constant attention and anticipation while gathering data.

While this technology works relatively well in the field, it is still very expensive and time consuming. A possible design project for my students would be to analyze the existing system and brainstorm ideas for improvement. This would even include researching other systems used internationally.

Personal:

Today was yet another beautiful day once the fog lifted by mid morning. I am still enchanted by the concept of conducting research on a boat all day—it seems like a job I would love to pursue! Not only are you contributing to society, but you get to see wonderful sights—today we saw a bald eagle, lots of puffin, and two sea lions! I cannot help but laugh at the puffin, though. They eat so much and have such little wings and huge hearts that they try with all their might to fly, but they only become air born with the nudge of a wave. And even then they only maintain an altitude of about 6 inches before they crash into another wave. They are both very amusing and very inspiring. I keep thinking that they are thinking "I think I can, I think I can, Never give up!" With so many sights and things going on both on and off the research vessel, I was not at all disappointed when we were radioed that we were going to spend an extra hour collecting data because the weather was so good (slightly chilly, but the sun was out). When we returned I learned how to download the data to the computers aboard the Rainier, and then I saw the beginning steps for processing this data. I can't wait to learn more tomorrow!

Question of the Day: A design problem: a gyrocompass is used to determine bearing and relies on electricity (it has an internal electromagnet). The gyrocompass on the bridge



looks like this:

Notice that the angles visible here are 70 ° and 90 °, a difference of 20 °. However, this 20 ° difference is spread over what is actually about 100 °. How, then, does the gyrocompass span the full 360 °?

Day 6: Monday, July 12, 2004
Time: 18:00
Latitude: N 55°17.29
Longitude: W 160°32.13
Visibility: 2 nm
Wind direction: 115
Wind speed: 12 knots
Sea wave height: 0 – 1 foot
Swell wave height: 1 foot
Sea water temperature: 10.0 °C
Sea level pressure: 1011.0 mb
Air temperature: 12.2 °C
Cloud cover: 8/8

Science and Technology:

Today we took a field trip to Sand Point, AK, a small fishing town on Popof Island. It also happens to be a base for the TEXIX LADS, Inc. which is a research facility for airborne laser bathymetry. The goal of this research facility is the same as the Rainier's: to chart the ocean floor. However, this group gathers data using a laser attached to the bottom of an airplane as opposed to a boat. The advantage of this type of data collection is that coast line depths can be easily taken without the risk of a boat crashing into uncharted rocks. The technology used aboard the plane is similar to the multibeam sonar systems used on the Rainier, however instead of a multibeam sonar system, a laser is used. This laser has a pulse rate of 990 pulses per second, a depth range of 70 meters dependent on water clarity, a topographic range of 50 meters above sea level and a swath width that can range from 240 meters to 100 meters depending on flight velocity. And, to acquire the data, the plane travels at between 150 and 175 knots!

While this mode of data acquisition is faster than that aboard the Rainier, it can only accurately acquire data in shallower waters because of light refractions at deeper depths. Therefore, NOAA works in conjunction with this group to survey the ocean bottom in and around Alaska. While the Tenix LADS, Inc. surveys the coast line, and will warn NOAA ships of any bottom features that might protrude in deeper water, the Rainier charts the deeper waters (between 30 meters and 400 meters). The data will then be collaborated to produce accurate nautical charts.

We also went to the office where the data collected aboard the plane is processed. While I did not get to study the software used, I did notice that the data processing was very similar to that on the Rainier; both require data processors to go through the data and filter any outlying points before the data can be applied to the nautical charts. The data is also collected according to "mowing the lawn" lines, similar to the Rainier. However, these lines are along the shore line as well as going about 250 meters onto the coast itself.

Personal:

Learning about data acquisition aboard a plane was very interesting today! It was also nice to go to land, where we got an excellent coffee at the only café in Sand Point. We also went on a tour of the town, seeing its one school, one restaurant, and one store. The small homes reminded me of those that sprinkle the south-west Swedish coast line—simple homes that beacon stories and the occasional wonderer. I am amazed at the amount of mystery such towns hold while also giving off such a welcoming, cozy feel. The weather today was the opposite, with the first rain we saw bringing larger swells and more fog. I really can't complain too much, though, for we have been here for almost a week and still hadn't seen rain until today. It did make for a very interesting small vessel ride to and from the shore!

I spent a lot of time today talking with Sena Norton, the other Teacher At Sea, about lesson plans and ideas for next year. We have both agreed it would be great for our students to establish a line of communication between our classes. In doing this, we can share various projects, such as an on-going weather project that we are planning to start in January—it will be very interesting to gather data in our own regions and then share and compare weather in Oregon and weather in North Carolina. We are also thinking about conducting a lab involving charting, navigation, and depth measurements where we have our classes work together to complete the final navigational chart of a large section. This is such a great opportunity to not only use the data and information gathered aboard the Rainier, but to also start establishing a connection with another class in another school! I can't wait to work on these ideas more tomorrow!

Question of the Day:

Given a different type of laser, could accurate data be collected from a plane at depths greater than 30 meters? Would this be a better way to conduct hydrographic research other than using boats?

Day 8: Tuesday, July 13, 2004

Time: 15:00

Latitude: N 55°17.29

Longitude: W 160°32.14

Visibility: 4 nm

Wind direction: 140

Wind speed: 6 knots

Sea wave height: 0 – 1 foot

Swell wave height: ---

Sea water temperature: 10.0 °C

Sea level pressure: 1007.8 mb

Air temperature: 12.2 °C

Cloud cover: 8/8

Science and Technology:

I awoke today to an announcement over the ships intercom saying, "Attention all hands, attention all hands, divers are in the water, please make sure all equipment is stored and locked". I first checked to make sure it wasn't me in the water, as exciting as that would have been, and then I raced out of bed to see what was going on. Apparently, since we have been anchored off the Coast of Egg Island, we have had a very small oil leak. It was believed to have fixed itself after the first few hours of anchoring; however, yesterday many of the crew noticed that there was still a slick on the water off the port stern. To investigate, three NOAA certified divers dove down about 15 feet and inspected the hull of the ship. They saw that the oil was in fact coming from the left propeller, yet they could not directly identify the source of the problem, but speculate that there is a small leak in one of the o-rings. The only way to truly fix this problem is to dry-dock the boat. The closest dry-dock is in Seward, but we are scheduled to go to Kodiak first. Therefore, the plan is to see if the problem takes care of itself and if it is not better by the end of the stay in Kodiak, then take the boat to Seward. The amount of oil that is leaving the ship is very small and is escaping at an extremely slow rate. However, if this problem persists, it could become very serious.

I talked with ENS Lominkey about his dive this morning and about other dives he has made recently. He informed me that once you are NOAA certified, the equivalent of becoming a PADI or NAUI dive master, you will be allowed to help with dives that involve ship repair, tide gauge installation, or wreck surveying. In fact, only two weeks ago the Rainier was performing hydrographic research and identified the fishing boat Conquest which sunk in 1994. ENS Lominkey and other certified divers dove the wreck to gather information about the wreck including its minimum depth which happened to be about 90 feet. To do this, they used a very sensitive depth gauge that relies on pressure changes. They would place this gauge at different locations on the wreck and record the various readings. ENS Lominkey also told me that they found another fishing boat wreck near the Conquest, but were unable to identify it. As I have developed my passion for diving over the past few years, I become more amazed at the opportunity to dive and explore uncharted waters knowing that the research you are conducting is contributing greatly to society. And, as technological advancements are made for both safer diving and better navigational charting, I can't help but wonder how these will be further combined in years to come—a very interesting engineering design problem!

Personal:

Today was mostly spent writing more lesson plans for my 6th, 7th, and 8th grade science classes as well as planning my 8th grade pre-algebra course. I also spent a lot of time talking with several officers about the amazing act of diving and how wonderful it would be to be paid to do something so adventuresome everyday. When sharing experiences, I did notice that the excitement of diving somewhat parallels the excitement of teaching; you never know what you are going to see, there are some dangers, but overall the experience is extremely rewarding. In both, you not only learn about other animals, or students as the case may be, but you also learn a lot about yourself, your goals and dreams, and your limits. While I am greatly enjoying my experience aboard the Rainier, the more I think about my different classes and the students that I will see in the fall, the more excited I get about returning to the classroom!

Question of the Day:

How much oil would have to be in the water before it drastically starts harming marine life?

Day 9: Wednesday, July 14, 2004

Time: 10:00

Latitude: N 55°17.24

Longitude: W 160°32.17

Visibility: 6 nm

Wind direction: 060

Wind speed: 1 knots

Sea wave height: 0 – 1 foot

Swell wave height: ---

Sea water temperature: 10.0 °C

Sea level pressure: 1009.3 mb

Air temperature: 11.7 °C

Cloud cover: 7/8

Science and Technology:

This morning I went out on launch boat 1 to conduct shoreline hydrography. Shoreline research differs very much from the other research I have seen so far, for it does not require “mowing the lawn” lines. Instead, it is a technique that is used to check the data collected from the Lidar (airplane) labs. As I learned earlier this week, the data collected using a laser from the airplane primarily focuses on the shoreline and depths up to 30 meters. Today, we went along the shoreline checking questionable data points such as rocks and shoals that may have been confused with kelp or other variances in data collection. In order to do this checking, the survey technicians and officers conducting the research look at the Lidar chart the day before launching and determine where rocks might be misplaced or not including at all. During surveying, which is what we did today, the researchers take a boat with a single beam echo sounding system and go to the places of concern. With some one on the bow to look out for uncharted rocks, the captain then drives over the areas where there might or might not be a rock. Because all of this is done very close to shore, it is very important to drive slowly. There is also a lot of kelp that can get in the way. Once the boat has past over the area a few times, the true depth is recorded as well as the position and a note is made on the chart where any changes need to be made to the chart. A relatively simple procedure, this type of shoreline research is critical for anyone planning to go on shore on any of these islands. Once again I was able to see how important this work is!

Personal:

My morning was spent on the launch boat doing shoreline surveying. While the technology used was fascinating, I still did not hesitate to wonder at the naturally beauty of these islands. Almost completely uninhabited, these islands host wildflowers, puffin, gulls, and an occasional seal basking on a sandy or rocky beach. The green slopes are sharply cut by dramatic cliffs, creating a feeling of comfort and adventure at the same time. With the clouds dancing across these islands, I almost felt like I was about to see a dinosaur immerge from one of the cliffs—this looks very much like Hollywood’s rendition of “Jurassic Park”! This afternoon I plan on working on more lesson plans as well as a possible journey on another shoreline survey boat. With so much to see and

Day 10: Thursday, July 15, 2004

Time: 18:00

Latitude: N 56°22.60

Longitude: W 152°56.70

Visibility: 10 nm

Wind direction: 115

Wind speed: 8 knots

Sea wave height: 0 – 1 ft

Swell wave height: 2 – 3 feet

Sea water temperature: 12.2 °C

Sea level pressure: 1013.5 mb

Air temperature: 13.3 °C

Cloud cover: 5/8

Science and Technology:

We are still in transit today to Kodiak, with a planned stop for some "biological testing", a.k.a. fishing. About two hours before we were going to stop to fish, we heard the bridge announce, "Whales breaching off the port bow!" This is the call for everyone to rush to the portside to see the whales. And what an incredible sight! I was atop the fly deck with TAS Norton and ENS Slover, and none of us could believe the symphony of spray that lay 150 meters ahead of us. It seemed choreographed, almost, with one humpback whale to the right blowing spray into the air at the same time as a whale on the left side. The finale consisted of at least 3 whales breaching so far out of the water you could see their entire underside! Just when we thought the show was over, two whales came within 20 meters of the portside of the boat and breached, waving hello as they went under. Luckily, we had slowed the boat down, so the chances of hitting these whales were small. For such massive and mysterious creatures, these animals completed their whale ballet show gracefully!

We later started fishing, and this sight was yet another of awe at the creatures that inhabit this part of the world. After only 10 minutes, there were about 12 fish on the fantail, 3 of which were halibut that were over 125 pounds, one which was at least 5 feet! After another 10 minutes, the fantail was covered with fish and blood and guts, promising a feast for weeks to come. The birds circled above waiting in anticipation, arguing when a piece of fresh fish was thrown overboard. Again a new image to me, the albatross intimidated the other gulls with its large wing span and threatening call. This day was certainly full of wildlife!

Personal:

I have never seen whales breach in the wild before, and it truly was an amazing spectacle! Parallel to that, I have never caught a fish any bigger than a 20 inch rainbow trout. Catching a 25 pound black rockfish was extremely exciting, as well as seeing all of the halibut caught! I will say that while fly fishing takes a lot more patience and technique, the fishing that occurred today required more strength and team work. There were at least 4 people helping lug the largest of the fish onto the ship!

We are almost to Kodiak, should be there by morning, and I find myself sad to leave this boat. It has truly been an amazing experience, one in which I learned a lot about the wildlife, research, crew, and myself. I realize now that two weeks at sea really does allow for a lot of self-contemplation and growth. I am very thankful to have had this experience.

Question of the Day:

How big is the biggest humpback whale recorded? How big is the biggest whale recorded? How does this compare to the average sized person?