



**NOAA Teacher at Sea
Beth Carter
Onboard NOAA Ship RAINIER
June 25 – July 7, 2007**

NOAA Teacher at Sea: Beth Carter

NOAA Ship RAINIER

Mission: Hydrographic mapping in Gulf of Esquibel, Alaska

Days 2, 3

Weather Data from Bridge

Visibility: 6 miles
Wind direction: 034 degrees
Wind speed: 5 mph
Sea Wave Height: none
Swell Wave Height: none
Seawater temperature: 12.2 degrees C
Sea level pressure: 1017.2 mb
Dry Bulb Temperature: 12.2
Wet Bulb Temp: 11.7
Cloud cover, type: 8/8, stratus and cumulus
Depths: 31 fathoms

Science and Technology Log

On Tuesday afternoon, June 26, I went out with a crew of researchers to check the equipment that collects tidal data for Esquibel Bay. There are six main pieces of equipment used to collect this data: 1) a cylinder of nitrogen, 2) a hose attached to the nitrogen cylinder that emits small bubbles of nitrogen into the water, 3) a computer that collects and records data, 4) a solar collector to power the computer's battery, 5) a transmitter that sends the data to a satellite, and 6) the tide staff (an actual wooden staff in the water), and GPS benchmarks.

The staff is set and readings taken so that the vertical measurements of the staff are linked to the benchmarks. The gage, which is officially a "tertiary" gage, is set up concurrent with a "primary" gage that has been acquiring data for over one epoch (19



Researchers are kneeling in a sitka spruce forest as they check the computer that collects and records tidal data on a small island in Nossuk Bay, Alaska.

years or more). Sitka, Alaska, is the site of NOAA's primary gage, which has similar tidal characteristics to the area that we are working now. Thus, only an amplitude and phase differential must be applied to the Sitka gage to get a water level for this area. Without the staff readings, there would be no way to tie the "bubbler" level to the ground surrounding the gage site, and thus no way to recover the actual local vertical datum (water level) relative to the gage in Sitka.]

The nitrogen cylinder slowly leaks bubbles through the hose, which are released into the water. When the tide is high, there is more water and pressure above the hose which makes it more difficult for the bubbles to escape the hose. When the tide is low, there is less water above the hose, and therefore less pressure, which makes it easier for the bubbles to escape. Readings are recorded digitally every six minutes, averaged every six seconds. Staff-to-gage measurements are also recorded every six minutes whenever the



ENS Meghan McGovern, Junior Officer of RAINIER, and Shawn Gendron, survey technician, position the tripod which will hold the transmitter to collect the GPS information needed by the RAINIER.

site is visited, and 3 hours' worth are recorded at installation and removal, so that the vertical measurements of the station are effectively "tied" to the measurements at the primary water level station at Sitka. (Good Working Question: Download data from both stations and compare the two – are there differences? Next, compare Sitka and Ketchikan and Kodiak – are there bigger differences?)

For some reason, the transmitter is not emitting signals that can be read by the satellite, and therefore by the scientists at NOAA headquarters. This is why the skiff took several technicians over to check the equipment to see if it is still functioning and recording properly. They downloaded the water level data to send to

headquarters via email while also setting up GPS equipment so that an ellipsoidal (GPS-relative) height can also be linked to the orthometric (gravitational) elevation determined through water level measurement, and will return to the ship and process the GPS data.

The tides are important to hydrographic surveying, because obviously, the water is deeper at high tide than at low tide. The goal is to collect accurate information on tides, and then combine that with the data collected by the launches, in order to get accurate depth information. The tide-corrected depths on the chart they want to show are relative to the mean low low water, which is the average of the lowest of daily tides taken over the last

19 years. On the Atlantic Ocean, tides are semi-diurnal. This means that there are two high tides and two low tides per 24 hours. But, on the Northeastern Pacific, tides are mixed. See: <http://co-ops.nos.noaa.gov/restles4.html> for more details.

Today, (Wed. June 27), the crew returned to the small island to check on the HorCon station, which stands for Horizontal Controls. The RAINIER established this water level station in April of 2007, and set into place 5 benchmarks which are tied into the international framework of benchmarks that make it possible to utilize GPS, or Global Positioning Satellites to determine one's exact location.

RAINIER's researchers placed a receiver antenna on top of a tripod, which was positioned exactly above the center of the metal disc benchmark cemented into a rock. The antenna receives from some of the 11 Global Positioning System satellites that orbit the earth and constantly change their relative positions. For a final position to be accurate, at least four satellites must be recorded in two different sessions of more than six hours duration separated by at least one day.

They connected the cables, turned on the GPS receiver and then waited for the satellite constellation (also known as the ephemeris) to be downloaded so that all available satellites could be tracked. The first satellite was tracked around 1 hour later, and then we left the island, as the equipment was to be left in place for at least 6 hours. When we returned 6 hours later, 8 satellites had made contact, and the recordings were noted and will be taken for evaluation onboard the ship.

Anna-Liza Villard-Howe, the Navigation Officer of the RAINIER, explained to me that the GPS measurements of benchmarks are being conducted in order to get as precise a determination of sea level as is possible, so that all the hydrographic information collected by the RAINIER can be referenced to the ellipsoid. Sea level has changed in Alaska in the recent past due to glacial rebound, which means that as the glaciers recede, the land is actually rising. Also, many large earthquakes have occurred in Alaska in the last century, which also changed the shape of some landforms and affected sea level readings.

For hydrography, there's a new site that NOS made for elementary students:

Online Sea Floor Mapping Activity Targets Kids (CED, OCS).

In celebration of World Hydrography Day, NOAA's Ocean Service Communications and Education Division, in cooperation with NOAA's Office of Coast Survey, launched a new educational offering — Sea Floor Mapping — on the National Ocean Service Education Web site. It is designed for students at the 3rd - 5th grade level, and the media-rich activity teaches young people about mapping the seafloor and why it is important. This activity also conveys information about NOAA's missions of discovery and service. The Sea Floor Mapping Activity is available online at: http://oceanservice.noaa.gov/education_new/seafloor-mapping.

Questions of the Day

1. Why are tides in the Pacific and Atlantic different? What are the factors that affect tidal changes?
2. Look up a tidal chart for the inlet or beach nearest to your home. How far apart are the high and low tides?
3. Who (which country or countries/which agencies) is responsible for the maintenance of the 11 Global Positioning Satellites that are now orbiting the earth? If a satellite fails, would it be replaced? By what agency?

Personal Log

While on the tiny island, one of the officers carried a shotgun...in case we met a bear! I'm pleased to say we didn't encounter a bear, but did discover animal scat, and two eagle feathers. One was a tail feather – beautifully white – and we didn't collect the feathers because it is illegal to collect eagle feathers. We also saw 7-8 harbor seals on a rock outcropping. We tried to sneak up on them to get good photographs, but they bobbed and rocked and slipped into the water before we got very close.

Also, on the island I was surprised to find many clumps of saltwort, which Eastern coast students (and my first grade class!) should recognize from the mud flat near the salt marsh. It tastes....salty! No surprise there.

On Wednesday, there were so many white gnats that we sent the skiff back to the ship for bug repellent. They were like No-See-Ems, only we could See Em and Feel Em! We built a small, smoky fire, which made things somewhat better. The highlight of the day for me was kayaking after dinner with the XO (Executive Officer) of the ship, and Ian Colvert, an assistant survey technician. We saw a rainbow and paddled through a misty rain, then sunshine...a beautiful evening.