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Irminger Sea: Oct 16 - The Computer School

Questions from the students at The Computer School

Answers from Captain Kent Sheasley

1. Marley: What caused the ship to not sink, when the 30ft tall wave hit it?
Very good question Marley. This is one of the most important concerns of mine when the ship goes to sea. The quick answer is that it is all about "stability", but that is a fairly complicated topic involving math and physics. Ships are designed in a way that they both want to float, and that they want to stay upright.
The way a ship is loaded with weight, and how much weight—whether it is cargo, fuel, water, food, or scientific equipment—can affect how well (or if at all) a ship continues to want to stay upright. If we make sure the majority of weight is lower in the ship (basically a low center of gravity), then even when a big wave pushes us over, the forces of the water on the ship's hull (buoyancy) push up on the lower side to straighten the ship up again. Because of momentum we may roll the other way first, but then the force pushes on that side—and back and forth, all the while waves keep the motion going. As a matter of fact, if the stability is proper for a ship, the more a ship gets pushed over (to a certain point) the harder that force pushes to straighten her up again. So when waves, even very large ones, push us over, the ship wants to come back up to floating upright.
All this works fine, as long as we follow some rules about ships. One of those rules is that we keep sea water from getting inside the ship (keeping her "watertight"), and another is that we don't load more weights than (or in places where) the ship was designed to handle. Regards, Capt. Kent

2. James: Do you often experience such high waves at sea?
Well James, luckily for us there are plenty of times that we don't see large waves at sea. I could ask you the same question, except about how often it rains where you live. It depends partly on where you live, and what season it is. It's the same thing with "weather" at sea. Some areas where we do science are more prone to high wind and waves than others. The area here in the Irminger Sea has the right combination (season, location) for mostly strong weather, which leads to high waves. There are also times when we spend time in normally gentler areas that don't have such strong currents and wind (two important elements to high waves). We have been on trips when it was fairly flat calm for the majority (or all) of the trip. We have also been on trips when it stayed very rough the entire trip. It depends on where we are, and the season. Regards, Capt. Kent

3 and 4. Emila & Kyle: Its very risky to be out at sea, Why are you doing it, what influenced you into doing it? Have you ever gone on a ship with this many risks before? Can you tell me a little bit about it?
Emila and Kyle, I suppose it does seem that what we are doing is risky, in particular being here at sea in this area and with this weather. As far as that goes, there can be rough weather most places on the earth (or above in an aircraft), and this is not the first time this ship has seen very bad weather for long periods of time. For that matter, this is certainly not the only ship that does this kind of work. Yes, going to sea can be risky, and one does not casually jump on a ship and head out, especially to remote places, without years of studying, training, and experience. That includes ship's crews as well as scientists. That is why we spend a lot of time preparing for such trips, whether it is studying (even the topics we don't enjoy), or practicing and training (continuously) for emergencies.
It really doesn't matter where the ship is, we are always practicing as if we are in the most dangerous place on earth. We learn from the experience of all the mariners that came before us. Just like the mariners, the scientists have studied the folks that came before them, and they keep working to improve the knowledge (and occasionally correct it, when they learn new things) that we have about the earth and how it works. That is why we are here, in this area that seems so risky.
Doing this kind of work takes being very aware ALL the time about what is going on around us, but it certainly has its rewards as well. As Dr. Bob and I, and for that matter most folks out here, agree on together—there is a sense of adventure in being here trying to find more pieces of the big puzzle of how the environment works. Sometimes you have to go where it isn't so comfortable in order to find that information. Regards, Capt. Kent

Answers from writer Dallas Murphy

5. Criselda: What are some tools you use for research?
Dear Criselda, We discuss some of the tools for ocean research in the Oct.13 dispatch, as well as on the Science Tools page, such as the ADCP, Moored Profiler, and VPR (Do you know the word acronym?), but there are many others. Some of the neatest are those that measure a current by drifting with it and reporting their data back to computers onshore.
For instance, there's the ARGO float. That's a general name for various, slightly different kinds of floats, but all of them are electronic versions of the "notes in a bottle." Not long ago before the advent of electronics, oceanographers actually put notes in thousands of bottles and threw them overboard. The notes asked people who found them to notify the scientists when and where they were found. This has obvious disadvantages. Scientists knew when and where they put the bottles in the water. And based on where the notes were found, scientists could learn the general direction of the currents, but that's about it. There was no way of knowing how long the bottles lay on the beach before they were found. And of the thousands pitched overboard only an average of 10 percent were ever returned. That was better than nothing, but not much. Modern electronics liberated oceanographers.
ARGO floats are strong plastic cylinders about as big around as a dinner plate and about four feet long containing the actual devices for measuring temperature, salinity and other things and mechanisms to control its buoyancy, and a GPS receiver. You can program the ARGO as you wish, but generally they float with the current collecting data at a given depth. Then about every ten days, they rise to the surface and collect a vertical trace of the water. Once on the surface they report their position and their data, via satellite, back to shoreside scientists.
Among the newest devices is the "glider". It collects essentially the same information as the ARGO float, but in a different way. Gliders are shaped like a torpedo with wings that enable it to travel efficiently through the water. Some have power to propel them, while others have no power and ride with the currents. But they can change their buoyancy by pumping a few quarts of oil from one position to another inside and outside the glider's body. By doing so, it can be made to swoop and climb and dive. Scientists are now experimenting with

using gliders under ice.
All these tools are variations on a theme: Get your instruments into the ocean, let them stay there, and report their data back to computers onshore or aboard ship.

6. Gabby: How much freshwater will be transferred off the Greenland shelf?
Dear Gabby, You ask one of the most important questions in oceanography/climatology today. Please see the Oct. 17 dispatch for a full explanation. But here's an example: In 2007, the Greenland Ice Cap shed enough ice to cover the United States twice. The Jakobshavn Glacier, one of the largest in Greenland, has retreated further inland than at any time in 150 years of measurements, and scientists think this is the farthest the glacier has retreated in the last 4,000 to 6,000 years.
Over 130 large glaciers flow from the Greenland Ice Sheet to the sea, and all, even those in the far north, are flowing faster than ever before. On another of the largest, the Petermann Glacier, a massive crack was discovered by NASA satellites this year. If it breaks away as an iceberg, the glacier will lose another 500 square miles of ice.
This loss of ice in such large volume is not good news. The freshwater spilling off the glacier might disrupt ocean circulation in this vital region, and that in turn will change our climate.
Try logging on to websites such as Climate Change News, Real Climate, and Grist that send you daily dispatches for free. Everyone who is paying attention is concerned about what the breakup of the Greenland Ice Sheet will do to the ocean and, therefore, the climate. And we've been talking only about The Greenland Ice Sheet. A similar breakup is happening on the Antarctic Ice Sheet. It's well worth keeping up with the story, since it will directly affect the future of people your age.

7. Nazamus: How cold is the water on an average day?
Dear Nazamus, There are computer screens set up all around the ship that report pertinent information such as wind speed and direction, ship's heading, and water temperature. The one above my desk says the water is 31.68 degrees F. I've looked most every day, and typically found the temperature hovering right around freezing. The salt in the water prevents the water from freezing until the temperature drops a few degrees lower and stays there for a while.
As we've said in several posts, the water temperatures vary throughout the world ocean, and that has significant affect on ocean circulation. Water temperature is of vital importance in this northern region, as we've said, because if the freshwater dilutes the local salinity, then the water will not sink, but will freeze instead.

8. Kyle: Can you see Polaris from where you are?
Dear Kyle, During this entire trip, we'd seen nothing of Polaris, the North Star, or any other celestial body because the sky has been constantly overcast. Then, on Saturday, a cloudless night, we saw it—directly overhead. Though it's hard to star gaze in New York, you can see Polaris if you can find a place where the lights aren't too bright and buildings aren't in the way. Do you know about the Big Dipper and the "Pointers" that show the way to the North Star? Have you heard the memory aid: "Arc to Arcturus; speed on to Spica" referring to the stars beyond the handle of the Dipper?
And then, last night, we were treated to a display of the Northern Lights, the Aurora Borealis. It was magnificent, and it was particularly exotic to see the North Star—directly overhead—as the curtain of light shimmered around it.

9. David: Do you know the elevation of Iceland?
Dear David, The highest points on Iceland reach 10,000 ft., or 3,050 m. But most of Iceland is far lower. Compare this to Greenland where most of the island is about 3,000 m. Iceland is volcanic in origin, and those highest points are volcanoes. Some Icelanders build their houses on black lava nearly as hard now as rock. And the major source of electrical and other power comes by drilling down into the hot earth. It's called geothermal power.
To all the Computer School Students,
We really like to receive your questions; please keep sending them. At the same time you might also get in the habit if thinking how you can answer your own questions, not only about ocean research and ships at sea, but all questions. Where do you look for answers? The web offers easy access to information, but there are many other sources. Learn, learn. Try surfing around the WHOI website to find a lot more information about the world of oceanography.

Answers form chief scientist Bob Pickart

10. Avianca: How often do you plan on staying out in the ocean?
This is an interesting question, Avianca, and you'll get a very different answer depending on who you ask on the ship. The Knorr is a scientific research vessel and scientists from all over the world use it to conduct their experiments. Sometimes the cruises are short (only a few days to a week long), but often times they are longer. The longest cruise I've been on is 47 days. (By the way, that cruise was a wintertime cruise on the west side of Greenland, and the weather was harsher than what we're experiencing on this cruise. We only saw the sun a couple of times during those 7 weeks!) The length of a cruise, or a series of cruises, is dictated by the endurance of the ship. What that means is that we only have so much fuel and food on board so we have to periodically come into port. Some of the longest cruises occur on ice-breakers that go into very remote areas of the Arctic and Antarctic. The endurance of the *Knorr* is about 50 days.
So far in my career, on average, I have spent about a month a year at sea. Some of my colleagues at WHOI spend far more than this at sea, while others never go out on a ship (they choose to study the ocean using computers or by constructing mathematical models). You can think of the *Knorr* as a floating laboratory that scientists use on temporary basis. In any given year there may be up to two dozen or so different groups using the ship. The answer to your question is very different for a crew member on the ship. The *Knorr* has about 25 crew personnel who run the ship, see the Oct 8 dispatch for a discussion about this. For the crew, the ship is their home away from home and they typically spend about 8 months a year at sea. There is also a "relief crew" that rotates in for part of the year (often in summertime the relief crew will be on board so that the permanent crew can enjoy a summer vacation). We scientists are very lucky to have such talented and dedicated crew personnel running the *Knorr* so that we can successfully, and safely, carry out our experiment.

11. Damon: Out of all the things you are going to research on this trip, what are you most enthusiastic about studying?
Great question, Damon. We have collected so much information (data) on this cruise that I and others could easily spend the next five years doing nothing but trying to figure out what it all means. For me, probably the most exciting part is the information that we will learn about how the storms influence the ocean currents. If you've been following our website, you know that the area between Southern Greenland and Iceland is one of the stormiest places on earth (I think every single weather forecast that we've received on this cruise has mentioned a storm!). In fact, the southern tip of Greenland is THE windiest place in the world Ocean. While everyone knows that such storms create large waves (did you see the short video of the waves in the Oct 7 dispatch?), they also strongly influence the ocean currents in very strange and important ways. For instance, along southern Greenland the storms can actually cause the surface water to flow toward the coast, while at the same time the subsurface water flows in the opposite direction away from the land! This two-way exchange can have important consequences.
Last fall we placed instruments (called moorings) in the water to record how fast the water moves as well as its temperature and salinity. This area is such a harsh place that I was glad to get the moorings back. That's the good news. The bad news is that the ocean currents were so strong that they beat up the moorings, constantly knocking them over. But the moorings hung in there and returned very valuable information to help us understand just what these powerful storms do to the ocean—and in turn what this might mean for climate. One of the challenging things about oceanography (which makes it both exciting and frustrating at the same time) is that the ocean is very hard to measure. This is particularly true for the area near Greenland and Iceland. We often have to take risks, and sometimes we're not completely successful. (My first two moorings in this area a few years back recorded almost no data at all!) But you keep at it, and when you do succeed and learn something new about how the ocean works, this to me is as exciting as science gets.

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