The New York Times

Scientist at Work
Notes From the Field

Posts published by *Jim Thomson*

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Feb 27, 1:38 pm 1

A Tide of Local Influences

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes and wrote about his expedition to the North Pacific in the fall. This is his last post from Chile.

Monday, Feb. 18

We've been loading up our gear and shuffling customs paperwork. In the evenings, I've been looking through the new data. They show some remarkable stuff. The turbulence we have recorded at the Canal de Chacao in Chile is similar to what we've seen at other sites, but stronger.

The similarities are in the structure and size of the motions. The energy in the turbulence starts at large scales and goes to small scales. The idea was famously described by Lewis Fry Richardson, who said that "big whirls have little whirls, that feed on their velocity…".

Kolmogorov derived a mathematical form in 1941, and evidence, in the form of measurements, has been accumulating ever since. The turbulence in Chacao has these properties, but with enhancement from the shape of the channel. It is a combination of a process that is both general and local. The data we have generated will be used to decide whether the tidal currents are suitable for electricity-generating turbines.

In addition to the turbulence, our other measurement on the mooring was the ambient noise. These data look familiar as well and will become part of Chris Bassett's Ph.D. dissertation on underwater sound. In looking, or listening, through the data, he hears the same things we hear in Admiralty Inlet in Washington: ships, sonars, waves breaking on the beach and the turbulence itself.

Chris says it is like listening to Chilean Spanish: on the surface, it is familiar Spanish. As you learn it, the differences reveal a rich language all its own. The fundamentals are the same, but the local influence is strong.

Read more...

Feb 25, 7:08 am Comment

Catching the Slack Tide

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes and wrote about his expedition to the North Pacific in the fall.

Thursday, Feb. 14

While the mooring has been collecting data, we have been surveying. For a few days, we have fallen into the daily cycle of Carelmapu, Chile. The fishing boats come and go en masse, working each estoba (slack tide). We alternate with them, departing each day as they return so that we can measure the strong currents near the peak tide.

The research vessel Jurgen Winter is proving to be a great boat for the survey work, if one ignores the occasional loss of steering. That's right: at least once per day we lose the ability to steer the vessel. The cable connecting the rudder to the helm slips off its track, and we are momentarily at the whim of the currents.

When it happens, Eduardo, the steward, calls into the small chart room where I am watching the survey data: "Jim, tengo un problema. Un momentito." More recently, his sense of humor is coming out: "Houston, tengo un problema." Usually things are working again in a matter of minutes.

One can forgive some glitches; the Jurgen Winter was sunk in the 2010 tsunami and since restored with much care. It's a great boat.

Yesterday, we planned a late survey and had some free time in the morning. We went ashore. Joe and I hiked out to the end of the peninsula to watch the tide rips, while Alex and Chris borrowed some fishing rods to cast from the beach. Both were successes, which were then topped off with Eduardo's purchase of fresh urchins from the locals.

Read more…

Feb 15, 7:35 am 3

Mooring Deployed, Now We Wait

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes and wrote about his expedition to the North Pacific in the fall.

Monday, Feb. 11

This project wasn't supposed to be about waves; it was supposed to be about tides. With the wind blowing 30 knots and whitecaps spanning the horizon, both were in sharp focus today as we deployed our mooring in Chile's Canal de Chacao (i.e., Plan A).

The rough water at the surface was obvious enough, but the fast water below was more subtle. We planned our deployment for the time of slack water — the brief moment of stillness between the flood and ebb currents — so that the mooring (and the boat) would not be carried away from the mark as we struggled to get 3,500 pounds of gear off the deck.

The captain taught me the Spanish word for slack tide ("estoba"), and a local fisherman explained that it happens a bit early at the site we wanted. He was right, and we were ready.

We started downstream of the mark and shuffled equipment off the deck until the mooring was trailing behind us. As the boat neared the site, we moved the final piece, the anchor, to the edge of the deck.

Passing over the site, we used the hydraulic winches to move the anchor up and out — then released it. When we release anchors like this, I often perceive that it pauses for a moment, then dives to the depths and takes the instruments with it. Today, there was no pause. The drop was swift and true, and the deployment was sharp. I like to think of it as an air drop by a bush pilot: you might get only one pass, so make it good. Read more…

Feb 13, 8:46 am Comment

Leaving the Choppy Waters

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal *processes and wrote about his expedition to the North Pacific in the fall.*

Thursday, Feb. 7

Today, finally, we arrived in Puerto Montt, Chile. Sure, the 24 hours of total travel time was long, but the three-week delay of the original departure was much longer. Our equipment became stuck in a maze of customs and hazmat regulations, still not quite resolved, and we are just now executing Plan B.

We are here in Chile to measure the turbulence as the tides rush through the Canal de Chacao. That turbulence will be a key driver for the design of underwater turbines that may one day harness the power of those currents to make electricity. Plan A is a mooring of specialized sonar instruments, which was packed neatly into a shipping container last November. Plan B is a bunch of spare instruments that we lugged onto the airplane with us.

Read more…

Jan 21, 10:20 am 7

In Land of Lithium, Batteries Not Included

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes and wrote about his expedition to the North Pacific in the fall.

Monday, Jan. 14

One of the many quirks in renewable energy research is the amount of energy it takes to conduct the research. A senior colleague of mine likes to joke that marine renewable energy, in particular, is very likely to run at a deficit of watts for some years to come.

He is mostly thinking of the jet fuel used by people flying around in airplanes to meetings and such, but he would do well to consider the batteries in all of my instruments. The instruments we will deploy to measure turbulence in Chacao Channel, Chile, and assess the prospects for turbines to generate electricity from currents, are all autonomous; they are powered internally by batteries and record data to flash memory. The obvious choice for battery type is lithium, because of higher energy density and steady voltage during discharge.

The lithium battery is not without problems, however. Lithium is a hazardous material, both by regulation and by reality. Early in graduate school I had a near miss with a lithium battery inside an instrument case that leaked and filled with seawater. Lithium + water = explosion.

Now, lithium is causing problems again (and not just for Boeing). The last report on our shipment of equipment to Chile was "arriving in port, all well." The update now, 24 hours before we were to board a plane, was not well at all.

Read more…

Jan 14, 6:01 am Comment

In Chile, Turbulence Ahead

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes and wrote about his expedition to the North Pacific in the fall.

Jan. 9, 2013

For thousands of years, the tides have fascinated and vexed civilizations around the world. In classical Greece, Seleucus of Seleucia was the first to relate the pull of the moon with the rise and fall of the ocean. In the 19th century, William Whewell mobilized the global British empire to gather data for the first "cotidal" charts, only to find that local phenomena often trumped global tidal predictions where and when the British Navy needed them most.

My own small fascination with the tides began as a boy learning to sail on the coast of Maine. Our local harbor, Biddeford Pool, had a huge expanse of mud flats at low tide that became a square mile of good sailing water at high tide. All that water came and went thru a small opening that we called, simply, the "cut" (or, as the old timers referred to it, the "gut"). The water would rip through the channel at speeds that alternately terrified and excited me, depending on whether I was in a boat or on the nearby pier.

When my parents moved recently, I cleaned out the closet of my childhood bedroom and found a hand-written logbook of Biddeford Pool tides that I had made for a school project.

Now, 30 years later, I am studying the tides again. As part of a large, collaborative team within the Northwest National Marine Renewable Energy Center, I've been measuring the tides in Admiralty Inlet near Seattle for the pilot installation of "hydrokinetic" turbines to generate electricity from tidal currents. These turbines are analogous to wind turbines, in which rotating blades convert the kinetic power of the moving air.
Read more…

Scientist at Work Oct 17, 5:11 pm Comment

Heading Home, and Hanging Ten

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes.

Tuesday, Oct. 16
32.7153 degrees north latitude, 117.1564 degrees west longitude

We finished our last days at sea with more strong winds and another great set of buoy measurements. During the night, the ship made steady progress back to San Diego. Abruptly, after three weeks with a blank horizon, land was there in front of us. A few hours later, the ship was tied up at the pier and the frenzy of offloading was in full swing.

It went quickly, and by 10 the next morning, everything was back in our steel shipping container. Our flight home to Seattle wasn't until 6 p.m. We tried to get on earlier flights, each of us weary and ready to see family and friends. Every flight was full, and thus we had an afternoon to kill in San Diego. What to do?

Go surfing, of course.

I called some old friends at the Scripps Institution of Oceanography in La Jolla. We met for lunch and talked shop over some sandwiches. After lunch, they went back to work and we borrowed some boards to surf at the foot of the research pier.

The breaking surf at a beach is a distant cousin to the breaking waves we have just been studying in the open ocean. Both types of waves break because they become too steep, but the reasons for the steepness differ. In the open ocean, waves become steep when the wind blows, and they break when too much energy accumulates in one spot.

In the surf zone, waves become steep because they run out of water, condensing all their energy into one spot, with a similarly turbulent result.

I am not a good surfer. I caught a few waves and stood up, but it wasn't pretty. It was humbling. That's fine with me.

There are two things that are central to my love for science. The first is the process of solving a puzzle. A new data set is a puzzle: To understand it, the pieces must placed again and again, until the whole of it begins to take shape.

The second is the humbling effect of this process, the acute realization that the natural world has more complexity than we will ever fully describe in our precious journals and books.

A breaking wave is an awesome thing to behold (especially if you are on the wrong side of it with a surfboard). To get close to it, to stare into the chaos of the cresting foam, is to grapple with the unknown. And once you catch that wave, you just want another.

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Oct 15, 6:56 am 10

Time, Speed and Distance

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes.

Tuesday, Oct. 9
42.3 degrees north latitude, 144.9 degrees west longitude

Time is a strange thing at sea. Things blur together in the daily ritual of meals and watch changes. We keep a detailed log because we are constantly saying, “was that yesterday, or the day before?” Days of the week are gone, forgotten.

It is ironic, but time out here is also precious. We have to turn back toward San Diego soon. Although I would already count this trip a big success, I want to find some more storm conditions — some strong winds and big waves — to measure before we are done.

Shortly after finishing the mooring work at Station P, the ship's captain laid it out plain: it will take at least seven days to get back, and that leaves two days remaining for scientific work. Precious time, indeed. I have been addicted to the weather and wave forecasts — the very same forecasts our research aims to improve — and weighing options to spend these hours well.

On Saturday, we decide to leave Station P and chase a storm that was forecast to the south. On Monday, the gamble paid off. The winds got up to 30 knots, the seas got frothy, and we got data. About 80 GB of data, to put a number on it, and every byte well-earned.

The simplest things are tricky when the ship is rolling 30 degrees in a swell coming at right angles to the wind. The deck was awash while we worked the balloon and the buoys. The lab was a constant racket of shifting tools, electronics and coffee mugs. The radio tracking on the buoys faded, lost in the trough of each wave.

In the end, everything held and we had a good bit of fun measuring the wind and the waves.

Read more…

Oct 12, 3:30 pm 4

Dropping Anchor at Station P

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes.

Thursday, Oct. 4
50 degrees north latitude, 145 degrees west longitude

Today, we arrived at Station P (Papa), one of the oldest ocean measurement sites in the world.

In 1943, the Navy established an ocean weather station here as part of the war effort. The station was overseen by the Coast Guard cutter Haida and other United States weather ships until 1951, when funds ran out and Canadian vessels took over.

In 1981, Canada cut funding to its weather ship program. That marked the end of continuous manned observations at Station P, but that's also when the Canadian Institute of Ocean Sciences began regular research cruises to the site.

In 2007, autonomous observations were added with the deployment of a mooring from the United States National Oceanic and Atmospheric Administration. The mooring and the research cruises continue today as a United States-Canadian partnership.

Since 2010, there has been another mooring at Station P — our Waverider. That's the mooring we came to recover and to replace. Read more…

Oct 9, 6:14 am Comment

In the Wake of Our Forebears

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes.

Wednesday, Oct. 1
44.00 degrees north latitude, 134.84 degrees west longitude

The experience of an ocean transit has some similarities to driving across the continental United States. You realize just how big the place is, and you have a lot of time to think.

We have covered 1,000 nautical miles and have another 600 nautical miles to go. At 10 knots, that is a lot of time indeed.

I've been thinking about the science that has come before us. Knowledge is incremental, and everything we do out here is the result of generations of earlier research. I trace my own academic lineage back to a proud moment, though my connection is tenuous.

Read more...

Oct 5, 6:40 am 9

Wagering on Waves

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes.

Friday, Sept. 28
36.780 degrees north latitude, 123.878 degrees west longitude

I sleep well at sea, but only a few hours at a time. I wake up as the ship changes course (rare on this trip) or rolls over a big wave. The motion is both familiar and strange. Every wave is different, and every ship has a particular feel.

The waves we feel right now have come from thousands of miles away. They started as ripples on the water's surface on the other side of the Pacific Ocean. Once the ripples form, the wind has more to push on (more drag), and the ripples build. The feedback continues as long as there is wind, but the waves also begin to outrun the wind. Traveling at speeds of up to 30 miles per hour, the long waves travel the fastest, and the rest disperse according to their length and period.

A few days later, no longer ripples, these waves are the steady metronome of our northward march. But there are ripples here too, because the wind is blowing.

The swell, the ripples, and everything in between make up a whole spectrum of waves for us to observe (and to feel). The spectrum that comes from distant storms and local wind is what makes this interesting: Imagine a concert in Ohio where you hear a bass guitar from California and a piano from Maine.
Read more…

Scientist at Work Sep 27, 5:00 pm 9

Loading Up and Heading Out

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes.

Wednesday, Sept. 26
32.715 degrees north latitude, 117.156 degrees west longitude

It's been a rough start. The team flew to San Diego over the weekend to meet the ship and load our equipment. On Friday, before we left, someone e-mailed from the Marine Facility to say that our shipping container had not arrived yet — and did we know when to expect it? We expected it Friday, that's when.

That container was filled with more than $500,000 worth of equipment, the result of countless hours in the lab and many late nights writing grant proposals.

It was filled with everything we need for this expedition, and in large part what we need for many more years of wave research.

Then, on Saturday, the Waverider buoy at Station P missed its daily satellite transmission. Was the battery finally dead? If so, we would spend eight days traveling across the North Pacific to go find a needle in a haystack.

The Waverider buoy is 1 meter in diameter, and nearly invisible amid 10-meter waves. Sure, it's moored at a specific location, and we have those coordinates, but the "watch circle" that the mooring moves within is almost a mile across. (The large watch circle results from the 4,200-meter depth of the mooring, since even a small change in mooring angle results in large horizontal displacement.)

I have been expecting this cruise to be challenging. I did not expect the challenges to occur while we were still on land.
Read more…

Sep 24, 6:03 am 12

Getting Ready for the Storms of the North Pacific

By JIM THOMSON

Jim Thomson is principal oceanographer at the Applied Physics Lab at the University of Washington. He studies ocean surface waves and coastal processes.

Thursday, Sept. 6
47.601 degrees north latitude, 122.333 degrees west longitude

Ansel Adams always said that chance favors the prepared, but these days I wonder how far ahead he looked before taking his photos. Four years ago, my lab at the University of Washington started building a new buoy to measure the turbulence in breaking ocean waves. Now the chance to use it is fast approaching. Preparation is foremost on my mind.

Later this fall, we will embark on a research vessel toward an otherwise random spot in the north Pacific Ocean called Station P, more than 1,000 miles offshore. This station has a long history, with regular water samples from there going back 60 years. We'll be looking for storms and big waves. If the data we have from the past couple years are any indication, we should see waves more than 10 meters (33 feet) high. The new buoys have been tested only in waves up to three meters high. That's on my mind too.

It's not like we've been avoiding the bigger waves; in fact, we've spent two years looking for them. The new instruments, which we call Swift buoys (for Surface Wave Instrument Floats with Tracking), have logged more than 1,300 hours of water time.

We have broken, battered and crushed all manner of things while trying to get these buoys into the roughest conditions possible. We have even capsized a small boat in the process. Indeed, the boat is part of the problem: To operate in big waves, we need a big boat. We need a global-class research vessel, of which there are only a handful in the United States and which cost $30,000 a day. This fall is our chance to use one of these vessels. Read more…

There are no more posts to display.