Chilling Research
ODU oceanography professor investigates the cause of rapidly melting arctic ice

By Jeff Maisey
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As Republican presidential nominee Mitt Romney sarcastically poked fun of President Obama's concern about global warming and rising sea levels, an alarming event was occurring in the northern hemisphere: the sea ice in the Arctic Ocean had melted to its smallest point ever breaking a record set in 2007, according to the National Snow and Ice Data Center and the NASA space agency.

Dr. Victoria Hill, an assistant research professor in Old Dominion University's Oceanography department, is among a small contingent of scientists attempting to determine why sea ice in the Arctic is melting much faster than earlier predicted.

Dr. Hill's area of expertise is specifically in optical oceanography – the study of how sunlight is absorbed.

She received her under graduate degree at Bangor North Wales and graduate degree is oceanography at Southampton, both in Great Britain. She arrived at Old Dominion University in the spring of 2003. She has made three research explorations thus far to the Catlin Arctic Survey, a research camp in the Arctic Circle – twice in 2004 and once in 2011.

I recently spoke with Dr. Hill to learn more about her crucial research and its potential impact.

What spurred your interest in the Arctic region? Was it Britain's relatively close proximity to the Arctic?

Not really. I just found the Arctic to be an interesting environment because the ecology is so different from more temperate oceans; obviously with the icepack and the polar bears and walruses. And I don't mind the cold. It's not something a lot of people get to see.

Can you explain a little about your field: optical oceanography?

There are a couple aspects to optical oceanography. You can either use light to tell you what's in the water. For example, when you go to the Chesapeake Bay the water can look very green or brown depending on how close to the river you are, and as you get further off the coast and into the Atlantic the water begins to look very blue. Those colors are because of the different components in the water, whether a lot of sediment (looks brown), algae (green), or hardly anything but water (blue). So you can use the color of the water to tell you what's there.

On the flipside, you can look at just how much sunlight is absorbed, especially in the Arctic Ocean, and how that leads to heating. That's what led by up there in 2010.

What role is Chromophoric dissolved organic material (CDOM) having on the accelerated melting of Arctic ice?

It's a very interesting question because right now we don't really know. We don't understand the process. What we do know is that the sea ice is melting much faster than we have been able to predict. When you look at the models they show we should have more sea ice. So we're obviously missing some part of the equation. One of the things we think it could be is how much sunlight is absorbed. We're underestimating that. So my theory is this CDOM can have a

really large effect. We now know it is almost the only thing in the water that absorbs water in the early spring. When I was up there at the ice camp (Catlin Arctic Survey) I was looking at where the CDOM is produced and I found it is being produced within the sea ice.

My next step, which I hoping to go back next spring, is to leave an instrument in the sea ice that has temperature and light sensors. Then I'll be able to get a really good seasonal record of just how much sunlight is being absorbed and also what's absorbing it. I'll be able to see that it is CDOM, and then maybe it has switched over to algae later in the season.

Right now we can't really quantify the impact but we know that it has to be significant.

Let's say your research confirms your theory that CDOM is the culprit, how would you reverse its affect?

There's not really anything we can do about it. It's a naturally occurring compound. But if we can quantify it and if we can understand the mechanisms for its production and how much it impacts heating, then we can more accurately predict what's going on in the Arctic in terms of heating of the water and melting of sea ice. If we can accurately predict that then we can say this is what we expect to see in the future.

Do you suspect the presence of this material being as result of global warming itself? Was CDOM present 100 years ago?

It's probably always been there. We haven't been measuring it for very long because we didn't really think it would be there. It's been logistically very hard to get to the Arctic in the past. What we do expect is as the ice becomes thinner – because now the average thickness of the icecap is several meters thinner than

it was 50 years ago – more light can penetrate through the ice, and that means you should see more algal growth within the bottom layer of the sea ice, and that's the algal growth that produces CDOM in the spring.

As we see more melting on the permafrost on land that is releasing a lot of organic material that's coming into the Arctic. What we're thinking is that we may see more CDOM in the summertime as the rivers melt and they bring this material in, and also with the thin ice we'll see more production in the early spring.

As the Arctic sea ice melts there is more competition between countries such as Canada, Russia, United States, Sweden and Norway laying claim to those exposed areas with naval forces in an effort to gain natural resources. Can this activity inevitably accelerate the melting of sea ice in the Arctic?

I think the biggest problem with ships gaining access to the central Arctic during the summer, and if you get people coming in trolling for fish or drilling for oil that all starts to have a negative impact on the environment. You could get overfishing in the Arctic and that would cause damage. Most of the biomass is actually on the seabed and it is really productive. For example, the walruses feed on the clams in the seabed and if people start dredging that it would have a severe affect on walruses, and then goes on to polar bears. Obviously if people start drilling you can have all sorts of environmental nightmares. You have to remember in the winter the ice is always going to come back.

What do you think of the theory that hypothesizes the melting of Arctic sea ice and ice from Greenland would actually enter cold water into the warm Gulf Stream flow and thus cause a reversal of global warming and potentially lead to another Ice Age for Europe?

While it certainly wouldn't be as dramatic as the movie, *The Day After*, we do

worry about that influx of fresh water from the melting ice will slow down the thermohaline circulation, which is what drives the major ocean currents. If that slows down or changes direction slightly it could have a really big effect for European climate. Also, if we don't have as much ice formation on the European side of the Arctic in the winter that too will slow down the thermohaline circulation, because the formation of the ice causes the water to become incredibly salty. The ice rejects the salt. If it's salty and cold it becomes really dense and it sinks and that's what shuts this circulation off. So we could definitely see some effect. How much it will be we don't know. It is a real danger.

How far off the mark have scientific projections been thus far in regard to the melting of Arctic ice? Will it accelerate to a dangerous level?

I definitely think in the coming two decades we won't have any ice in the summer. This year will break the 2007 record for melting of sea ice. So it's progressively getting worse. Once you lose the multi-year sea ice, which is really thick and use to make up a majority of the pack, it's really easy to melt that again the next spring. It's reached the tipping point now.

Do you feel a sense of urgency in your research?

Yes, definitely. The measurements I want to be able to make next year are in the multi-year icepack, but you start to think there might not be any multi-year ice in the next few years. We're losing the opportunity to make measurements before this tipping point.

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