Topic 3e - Long term implications of ice sheet melt

This is my 40th field season in Arctic or Antarctic. It was actually 15 or close to 20 years ago when I analyzed my data from my network here in Greenland, but also the data from Canada, since I have done these measurements for 40 years. I realized there was a very strong temperature increase. I just couldn't believe it. It was 2 and 1/2 degrees.

And I had like NASA program managers visiting me at the university, and that was the start of a very large campaign we started. It's called PARCA, Program for Regional Climate Assessment in Greenland. It was only two groups in 1995. By now, PARCA still exists. We are about 20 different universities making measurements in Greenland, making models, validations, aircraft.

We have a huge aircraft mission called Ice Bridge that flies every spring with a P-3 airplane and a DC-8 over the entire Greenland ice sheet. So millions of dollars are being spent today to make the assessment what is changing, why it is changing. But it goes back to the time where we, as a small group, were trying to understand data we measured and we couldn't believe. And it is true. Greenland is changing much faster than we anticipated.

In addition to the monitoring that goes on here, what we try to understand is how the ice sheet has changed over longer time scales. So we know that there's been an enormous amount of warming here in the last 10 years, for example, over the context of 30 years. But if we want to know further back, is the change that we see now unprecedented in the last 200 years, or 1,000 years, or 10,000 years, we need to start looking at other ways of monitoring, because there was obviously no weather stations or satellite measurements going back centuries and millennia.

Basically what we try to do is come up with ways of finding climate records in natural archives. So one of the great examples is the work that's done here on the Greenland ice sheet looking at ice cores. And they take ice cores back through the last 125,000 years, look at the chemistry of the air bubbles, and they can tell how warm it's been, they can tell how stormy it's been, and they can give us a general picture of how the Greenland ice sheet has changed over time.

We take a lake sediment core because it's in stratigraphic order. We know that the bottom is, say, 10,000 years ago. We can date it all. And then we look at how the chemistry in the cores has changed, we look at how the biological remains like pollen, insects, algae have changed, and that gives us a picture of how the environment's changed over the last several thousand years.

And what we know from the work that we've done along the West Coast is that the Greenland ice sheet was way out past its current margin 13,000 years ago sort of at the height of the last glacial maximum. And around 13,000 years ago, it started to retreat very rapidly from the coastal margin and has come inland. It actually came past its current margin

and then re-advanced during what was called the Neoglacial around 4,000 years ago, and then now it's been steadily retreating backwards.

Right where we are right now on the edge of the Jakobshavn isbrae is one of the most iconic glacial retreats of the last decade, essentially. You can see, because there was a community always there, they've known where the ice margin's been for the last 100 or so years, and so they've documented the retreat of this ice margin and it took, basically, a century to move several kilometers. And in the last decade, it's moved 20 kilometers, and you can see every year just this huge collapse of this huge ice sheet which is basically spilling all of the Greenland ice sheet, or a huge portion of it, out into the sea.

People in the community, down in Uummannaq which is just to the west of here, every year the sun comes up over the horizon a certain date in February, and it's cause for major celebration, and it's the return of spring, and hunting. And they've actually noticed that the sun now comes up a whole day or two earlier than it used to, basically because the Greenland ice sheet is thinning down, and so it's kind of a remarkable human evidence of climate change.

Often, we talk about the Arctic as being a bellwether for climate change or a canary in the coal mine, and certainly, what you see on the Greenland ice sheet now in terms of these huge changes fits in with that idea of arctic amplification. We can monitor climate change and show that actually, what we're doing to the planet is unprecedented in several centuries, and, in fact, millennia.

It makes it relevant for policy and communities, what we see in the Greenland coast. People are experiencing really rapid changes in their livelihood. We also see that it has huge impacts on the ecosystems as well. In the last 30, 40 years, we've seen massive changes in the lakes. As the lake ice comes off, we have longer growing seasons. We see the migration of plants moving further northward.

In communities, such as Uummannaq to the west of us here, they have had very little sea ice in the winter, which means that all of the subsistence activities that are normally their livelihood have been greatly reduced.

As well as being able to measure Greenland's own contribution to global sea level rise, we're also able to calculate its contribution relative to other sources, and we know that, together with Antarctica in the 1990s, the ice losses from the two continents were responsible for about 10% of all sea level rise. Today, it's more like 40%. And so the contribution is on the up. They're more important parts of the climate system than they were 20 or 30 years ago.

The challenge for us is to be able to continue to measure these changes into the future. And so we're really keen to work with the space agencies to build satellite missions that can repeat these kind of observations into the future so we have secure measurements in the coming decades.

Seeing these changes, sometimes, I must say, it's scary. Sometimes, as a scientist, I have to say it's very interesting because we are trying to make assessment and give the information to the policymakers, give the information to the public to show, you see, we are actually affecting our climate.

It's in some way rewarding. But on the other way, it's also very hard to understand that so few people care about it, do something about it. Because we can predict the changes will affect humanity in the centuries to come, not just the next few years. If we don't respond now, our future generations will actually have the effect of an enormous climate change.