Antarctic Peninsula Is Melting - And So Is Arctic Ice

"This was the warmest summer (2002) in the Antarctic Peninsula to date. The Antarctic Peninsula has one of the steepest warming trends of anywhere on earth and this event, the collapse of the Larsen B ice shelf, was the largest event of its kind in the last 30 years."

- Ted Scambos, Ph.D., Glaciologist, Univ. of Colorado

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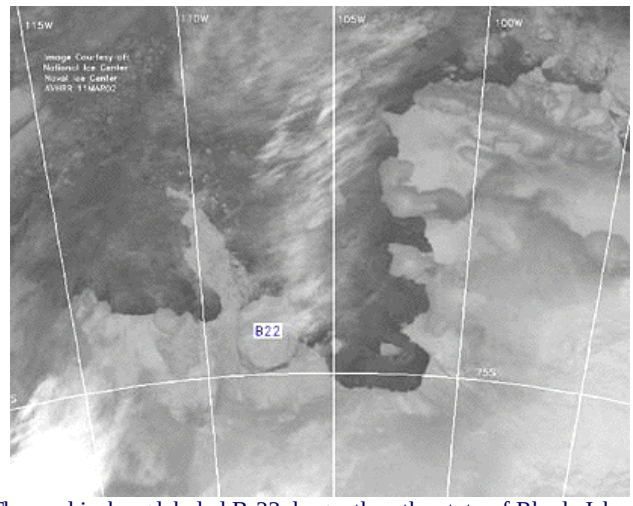
The Antarctic South Pole is covered by a continent the size of the United States. The Antarctic ice sheet which is 1.5 miles thick in some places, contains over 90% of the world's fresh water. The Antarctic Peninsula ice sheets that extend into the surrounding seas are melting rapidly, whether from global warming or local climate variations.

March 21, 2002 Boulder, Colorado - Scientists have been warning since 1997 that the Antarctic Peninsula and its Larsen B ice shelf were melting, but no one expected that by March 2002 the Larsen B would have disintegrated to only 40% of the size it was five years ago. But it has and in its collapse, one of the largest floating ice masses of the past thirty years has broken off. Nearly twice the size of Rhode Island covering 2,160 square miles (3,250 square kilometers) and 750 miles thick, iceberg B-22 was photographed on March 11, 2002 by the AVHRR satellite and reported by NOAA, the National Ice Center (NIC) and the University of Colorado's National Snow and Ice Data Center. The ice shelf has existed since the last ice age 12,000 years ago, and yet it disintegrated suddenly over a 35 day period that began the end of January 2002.

According to the NIC, the shattered ice has set thousands of icebergs adrift in

the Weddell Sea east of the Antarctic Peninsula. Scientists are not certain if the melt of Larsen B has been accelerating as a consequence of global warming or more localized climate variations at the South Pole. However, at the same time, the North Pole ice cap is also melting more rapidly than anticipated and some scientists calculate there could be open water during Arctic summertimes by 2015 to 2030.

This week I interviewed Ted Scambos, Ph.D., a glaciologist at the University of Colorado's National Snow and Ice Data Center in Boulder, Colorado who has been studying Larsen B. I asked him to explain the controversy about whether or not the sudden ice shelf collapse can be linked directly to global warming.



The oval iceberg labeled B-22, larger than the state of Rhode Island, broke off the Larsen B ice shelf at the South Pole which is rapidly disintegrating. Image courtesy of NOAA's AVHRR satellite on March 11, 2002.

Interviews:

Ted Scambos, Ph.D., Glaciologist, National Snow and Ice Data Center, University of Colorado, Boulder, Colorado: "We use the term global warming to refer to average warming trend we have seen when we take all the different regions of earth and try to determine an average or general trend. The Antarctic Peninsula which has seen a very profound warming trend, one of the strongest in the world and I guess the controversy is whether there is any relationship to greenhouse gas increases in the atmosphere. Now, what we are seeing is an unprecedented warming in the Antarctic Peninsula, but the things we can observe by watching the ice sheet itself and the sea ice around it don't give us the kind of information or proof that we need to relate it to a specific cause like greenhouse gas warming. We can talk about the immediate relationships between what changes climate in the Antarctic Peninsula, but linking it to some broader cause is going to be tough. It's going to be a topic of research for the next couple of years.

This was the warmest summer in the Antarctic Peninsula to date. The Antarctic Peninsula has one of the steepest warming trends of anywhere on earth and this event was the largest event of its kind in the last 30 years.

Does that mean that there is accelerated melt at the Antarctic that could continue and that more of these Rhode Island-sized icebergs could keep coming off, even perhaps from the land of Antarctica?

What we would expect to happen next if the warming trend continues on the Peninsula is that the ice shelves that are further south and somewhat larger to begin to go down the same process.

From where those ice shelves are currently, it will take a few years for them to

reach the point where the Larsen B reached. But more importantly, what we think we understand now is how this process works, how the ice shelf is weakened, we understand pretty visibly how rapidly this can all happen.

The ice shelf is floating, so what happens is that you'll get a little bit of melt pooling on the surface. What that means is that any small crack that forms on the surface can fill all the way to the top with water. And because the water is denser than the ice, you actually get pressure at the tip of that crack. And that pushes these cracks deeper into the ice than they ordinarily go. And because there's actual ponds of melt, not just wet snow, but ponds of melt on the surface, you've got a reservoir of water so you can keep these cracks full as they start to open. That seems to be the major step that sends all these rifts racing across the ice shelf and fracturing it sort of in place. There are probably some other processes that are involved as well, but once it is weakened like that, any storm or tide surge or wind surge comes along and just blows the smaller pieces out of the way. That's very different looking from how ice shelves normally behave. Normally they are sort of like this large fingernail growing off the edge of the Antarctic and every ten, thirty or fifty years, a large area will calve off into one or two or three very large icebergs. But not when an ice shelf is just sort of disintegrating - then it just sort of splinters and shatters and it retreats all the way back to the coast line. What Larsen B just showed us is that it can happen really very fast.

So we want to take what we've learned from the Antarctic Peninsula where the consequences of a real change in large masses of ice and sea level, the consequences in terms of sea level are pretty small. We can take what we've learned in the Antarctic Peninsula and look around the rest of Antarctica and see how close other ice shelves might be to going down this same sort of process.

Is it true that the Larsen B Break-up and disintegration is not yet contributing to sea level rise?

That is true. What we will look for in coming years is the glaciers that used to feed the Larsen B ice shelf, we will look for them to pick up speed as a result of them not having this large mass of ice in front of them. That's the process that can contribute to sea level rise. Now, in the Antarctic Peninsula, the amount of ice that's up on the peninsula is pretty small. So, we don't think there is any way that sea level could change measurably even as a result of this particular break up. Other ice shelves, even though they are not showing any indications of being unstable, it's been fairly stunning what has happened in the Peninsula, so this causes us to take a closer look at what it would take to push those ice shelves down the same road. And they back up larger masses of ice that really would have an impact on sea level.

Meaning that ice is melting much more rapidly than anybody had ever anticipated, right?

In the Peninsula, I would say that is a fair statement. We're surprised at how quickly warm summers can lead to the break up of an ice shelf. I would say it's not by direct melting that is part of the issue. It turns out that only a little bit of melting actually weakens the ice tremendously and then it fractures away.

But I don't want to get too alarmist about this. I think it would take a trend of several decades in these other areas in Antarctica to even begin to bring the other ice shelves to the point that the Antarctic Peninsula is currently at.

But isn't that what scientists were saying just about a decade ago about Larsen B?

We noticed there was some retreats of other ice shelves in the Antarctic Peninsula in about the mid 1990s. The pace and the areas that were being affected really started to pick up and in particular the Larsen B did a pretty fast turn around from what we call stable behavior to retreating all the back, well, to disappearing essentially. And that's a stunner. That's interesting, so we want to

take what we've learned. We did have our eyes trained on the Larsen B and had people out there in Argentina out there in the field in November making measurements. They sort of alerted everyone that this might be the last year it would be around.

When do you think ice on land in Antarctica will perhaps start moving outward and into the sea?

Ice is fairly stiff, thick, cold substance you can't suddenly accelerate it by too much. There's just too much resistance to flow there. But within the next few years, you'll see the glaciers that fed the Larsen B begin to pick up speed. What happened in the Larsen B caused us to take a second look at areas that we thought were stabile because it turns out that the summer temperatures and this very minor amount of melt really can have a profound effect. That means that things progress more non-linearly than we thought before.

What do you think is most vulnerable next in ice shelves?

Well, the next ice shelf to the south is probably the next one that would be liable to go down the same road. There are also some ice shelves on the opposite side of the Peninsula that have already shown signs of minor break up that may do something dramatic again like the Larsen did. I think the next time we would make any major announcement or attempt to call attention to what's going on, we'd need to see it in a different area because the story in the Peninsula is being written down pretty well right now. We think we understand what's going on there.

Will Larsen B be gone completely in the next year or two?

I don't know the remaining 40% isn't quite as close as the northern two-thirds was. So, I think two, three, five more warm summers before that area disappears. Further to the south, maybe a decade or so from now, there might be a change. That's just me speculating. I wouldn't want to have anybody mark it on their calendar or anything.

When Larsen B is completely gone, what happens when that opens up more of the remaining ice shelf to melt?

It will change the climate locally. There will be ocean in areas that used to be covered with a thick plate of ice. It will change the climate on the glaciers that used to feed the ice shelf. You might get some more snow fall which might actually counteract any contribution to ocean sea level rise, at least partially counteract it.

Because of more moisture?

Right, reaching the coast line and blowing up over the colder, higher areas.

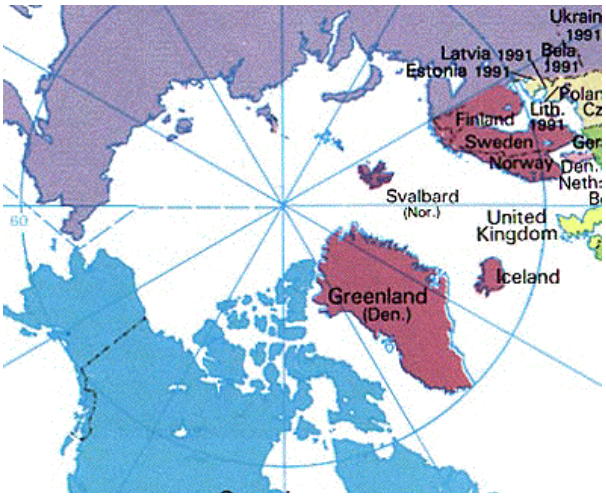
Isn't that one of the confusions about the fact that the Ross Ice Shelf has been building up snow and ice while icebergs still calve from it in a general global warming?

That's true. Most of the rest of the Antarctic is still reacting to more or less the end of the last Ice Age. It's a very slow moving, ponderous system. It takes a long time to perturb it. As far as the (Ross) ice sheet is concerned, most of the things we are seeing are really inherited from climate, major climate change, that occurred 12,000 years ago. The point is that what happened in the Peninsula with these ice shelves shows us a way where recent, fairly sudden climate change could sort of reach out and upset that more slowly progressing system and cause things to change faster than we had thought, well, faster than we had seen up to now.

But the main point about climate change in general and sea level rise in particular is that it's going to be a very expensive thing to deal with. We're going to have areas that are going to need to be protected more often than they used to be. Or we're going to have to start thinking about building earthworks or dikes or

whatever in order to hold back areas that occasionally flood nowadays and they will start to flood more frequently in the future."

The North Pole Is Melting, Too



The North Pole's Arctic ice floats on water, so its melting does not contribute to sea level rise.
But if Greenland's land based ice sheet began to disintegrate and fall into the ocean, sea level rise would accelerate.

Since 1979 and improved satellite records for the Arctic, scientists have reported a general decline in the extent of Arctic sea ice cover. That downward trend has been roughly 3% a year. While the area of ice cover has gotten smaller, the ice has also thinned, losing an estimated 42% of its mass. The biggest change occurs in the Arctic summer months which have been progressively warmer the past few years. Some scientists project that the Arctic Sea could be entirely ice-free during the summer as early as 2015 to 2030. I asked a research scientist at the University of Colorado's National Snow and Ice Data Center (NSIDC) who studies the Arctic if he agrees that an ice-free ocean at the pole is in the near future and if so, what effect might that have on North American climate.

Mark Serreze, Ph.D., Research Scientist, National Snow and Ice Data Center (NSIDC), CIRES, University of Colorado, Boulder, Colorado: "I am skeptical to see in 2015 to 2030 that we would see the complete ice cover disappear in summer. It's still cold in winter so some ice is going to form. And certainly it will melt more if we continue current warming trends. But I would be skeptical to see it happen that early.

But, let's say we did lose the ice cover. One of the things it does is exacerbate the warming, the global warming. Amplifies it.

Meaning, increases global warming.

That's right. It has a positive feedback process. For example, the ice is a very reflective medium which means that most of the solar radiation hitting the surface is reflected back out into space. This is one of the reasons why the Arctic is cold, along with its latitude.

Because it's white and reflective.

Because it's white and reflective, that's right.

If that white reflection goes away ...?

Then the warming becomes larger because there is a smaller area that is reflecting the solar energy.

Another effect is that one of the important roles of the sea ice cover is to insulate the relatively warm Arctic Ocean from the cold Arctic atmosphere.

Think of the situation in winter where the surface air temperature - that is the air temperature a few meters in the atmosphere that we might measure with a thermometer could be 30 degrees C., very cold. Now, underneath us is an ocean that is basically at about minus 1.8 degrees C. Now, it's a little less than 0 degrees C. because the salinity reduces the freezing point. But the point here is that you have a huge temperature differential between the ocean and the atmosphere. The ice decouples energy exchanges that would occur. In other words, the ice acts as an insulating cover to inhibit these big exchanges of heat between the ocean and the atmosphere.

If we were to have a thinner ice cover with more openings in it which might be a consequence of more thinning and reduction of ice, we could have much stronger release of heat and moisture into the Arctic atmosphere. Now what does that do? We say warming, certainly, because we are releasing heat. But we're having other effects as well. For example, if we release a great more moisture into the Arctic atmosphere, cloud cover is probably going to change. What will also probably change are participation patterns will change.

Now the sorts of changes we might see in patterns of precipitation and temperature would probably go well beyond the Arctic because the Arctic when we think about the tracks of storms, say. They are very strongly influenced by the fact that the polar regions are cold and the latitude regions are warmer. This is what sets up your storm track which tends to steer your storms and allows the creation of storms. If we change that equator to pole temperature gradient, we could impact the circulation of the atmosphere on a much larger scale. So, there are a number of effects that could be involved here.

Can you say what might be the worst case in terms of North American weather?

I think it would be extremely unpredictable, what would happen to North American weather. It would be very, very unpredictable. It is very difficult to say. I don't think it would be wise to say anything specific, but if you had a complete loss of the ice cover in summer which meant that, for example, the ice is thinner and less extensive, that it has more openings in it, and it's thinner. Yes, you could certainly have some wide reaching climate effects, but I am not prepared to state what those would be in terms of like weather patterns across North America.

You are a human being as well as a scientist living on this earth. What are your greatest personal concerns as you look out into the future in this global warming trend?

I think it's just an arrogance in considerable part by the United States to in considerable part to ignore the problem, at least under the current administration. I think the evidence is there that humans are having an impact on climate. It's difficult to say how much of an impact, but if you go with say, the findings of the IPCC. I think we could, most of the scientists are convinced there is a discernible impact of humans on climate. And we're conducting the grand experiment and we don't know what the outcome is. And I think there is an unfortunate arrogance and reluctance on the part of the current Administration to address the issue.

From your point of view as a scientist studying at least the Arctic climate, what is the worst case you would present to President Bush if he continues to ignore these patterns?

Well, I think there are several things: one of them is sea level rise. This is something that Mark Meyer from the Univ. of Colorado has done quite a bit of work on. If we would even raise sea level through the melt of glaciers and ice sheets by half a meter, this could have very, very considerable effect.

You're talking about only 18 to 20 inches rise?

Only about 18 to 20 inches, but think about places like Chesapeake Bay, for example. Great parts of that are essentially at sea level. A half a meter rise in a

mean sea level could basically lead to large reductions in coast line. It depends on where you are. Another problem would be larger storm surges, for instance. Take the case of New Orleans. New Orleans sits basically below sea level right now. Changes in storminess combined with even a modest rise in sea level could have quite considerable effects. I think there is a great deal of evidence as well that some of the effects of climate warming we've seen are being reflected in a changing frequency of extreme storm events. For example, extreme precipitation events, things like this. So, one of the things I think we're starting to see is an increase in these extreme precipitation events, extreme weather events, and we all know how economically significant these are.

So, will there be a possibility of more super storms with higher winds, more rain, more severity?

Yes, there's some evidence of that. Yes, there is a considerable body of evidence that that could be the case. The argument for that is that if we warm up the climate by a bit, the hydrological cycle becomes more vigorous. What I mean by that is if we warm things up, then we'll evaporate more water into the atmosphere. when we have a moister atmosphere, there's a lot more that can happen weatherwise. That's where that line of reasoning comes from.

I understand that NOAA has recently changed - and it might be the IPCC - they have changed the estimate over this century to at least a meter rise in sea level because of increasing global ice melts.

That's right.

That's about twice what you have just said.

Yes, there have been some revisions on this and Mark Meyer at the Univ. of Colorado is one of the people involved in that, that the estimates we had could well be low. Let me reiterate that even a modest sea level rise could have very strong effect. It depends on where you are. Here in Colorado, we're probably not going to worry about it too much, right?

But if you're in New Orleans?

If you live in New Orleans, this is something you might want to worry about.

Do you think future sea level rise could make it impossible for New Orleans to survive as the city it is?

It's difficult to say. I'm sure they will try to make whatever adaptations they can. A lot of it reflects on our ability to adapt and one of the issues here is how rapid will the change be? If the changes are slow, we can adjust, we can adapt. However, if we have a fast climate change that we can't keep up with, so to speak, that's where a lot of the trouble may lie. It's our ability to adapt and a lot of that has to do with how rapid and how large will the changes be.

Isn't that why this Larsen B break off is so significant - because it happened so rapidly?

That's right. That's right. We've been seeing worldwide what you call kind of seemingly unique events, very unusual events. Now, are they happening more frequently? Maybe so. You have to realize also with something like the Larsen B or something like this that our ability to observe these things has increased tremendously over the years. For example, before the early 1970s and even in the mid-1970s, when we had satellite coverage, how much did we really know? so, one has to remember with respect in changes of extreme events, or events like Larsen B, one also has to remember that our ability to observe a number of these things has gotten a lot better.

Is there any upside to global warming?

You mean good parts about it?

Right.

Well, you have to remember in any kind of climate change, there will be winners and there will be losers. We talk about some of the doom and gloom, this is what you all hear in the newspapers. Sea level rise, coastal region inundated. Things like that. Not everyone is going to lose. Let's ask the wheat farmer in Saskatchewan, let's tell that wheat farmer that the temperature over the next few decades is going to rise by 5 degrees C.. That farmer would probably say, 'Well, bring it on! Bring it on! Because that means I have a longer wheat growing season. That means I can increase my crop yield.'

But it probably means there will be an accelerating extinction rate for polar bears.

Maybe so, but let's talk about another winner here. Let's talk about the reduction in sea ice. Let's say that in ten years, the shipping route along Siberia opens up. In other words, the coastal route along Siberia will become ice free. Now, let's think about the Japanese. Now, that means if they want to get down to Boston, instead of having to go down through Cape Horn or the Panama Canal, they could cut across the Arctic and greatly reduce their shipping time, greatly increase their profits by reducing their costs. So, there could be good things even there for some. So, there are winners and losers.

Your own personal concerns?

My personal concern is that I've said before I think that it's as a people, it's going to be very difficult for us to change. And I think the current administration needs to take a great deal more responsibility and be a leader on the issue. What's the number? The United States has 5% of the population and uses 25% of the oil, something like that. That's arrogance. And I think if we are going to push the agenda further, try and really address the global warming issue, the United States must take the lead. There is no ifs and buts about that. The United States is going to have to take the lead. And I don't see that happening. And I think to me that's my greatest frustration as a scientist.

If we don't and carbon dioxide increases beyond levels where it is now, what do you think will happen at those levels?

If the model projections are correct and there is a lot of difficulty in interpreting these models, we could be in for some very serious trouble. Global sea level rises now by a few meters (with much higher carbon dioxide levels in atmosphere). Now, we're talking big numbers. If we start to see, for example, significant loss of mass from something like the Greenland ice sheet or Antarctica, we could have greatly altered patterns of precipitation, for example. Areas that were good farm land could perhaps turn into drought areas. Or conversely, large precipitation increases in others. We could be in for a rough time. It's not going to be in my life time or your life time. But this is something our children and their children will have to deal with and it will be on us. It will be, the fault will lie with us.

The biggest problem is the unpredictability of what is coming.

That's right. That's right. If we look at the climate models, they can give us a general picture of what the changes are likely to be. but it is very difficult from these models to make specific statements about the magnitudes of changes in particular locations. We're not to that point yet in our understanding. And that's part of the problem: general unpredictability of the issue. We are conducting a grand experiment and we really don't know what the outcome is going to be."

Websites:

http://www.noaa.gov

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