

Science Show

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Increased CO2 uptake in Antarctic waters

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Joellen Russell runs models showing coupled climate systems of winds and ocean currents around Antarctica. Strong winds are moving further south. Around the poles, and particularly Antarctica, the winds are causing more mixing between water and atmosphere. The Antarctic polar current brings water from 3,000m depth to the surface. This water is low in CO₂ and takes up the gas from the atmosphere. The southern ocean is warming faster than anywhere else. The result is a more acidic ocean. The affected organisms are the basis for food chains. The warmer oceans then expand causing sealevel rise.

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Transcript

Robyn Williams: New research in Arizona shows the ocean could be burying far more CO₂ than anyone imagined. Professor Joellen Russell has found that near our own region the system is having some really surprising effects.

Joellen Russell: Well, I actually run a global climate model attached to an ocean model. What we're looking at is the coupled climate system and how it interacts, which is these very big winds. They are the largest, strongest mean surface winds in the world. They're 30% higher than the jet stream in the Northern Hemisphere. So you have the strongest winds which is why you have the biggest storms, but these strong winds are actually moving towards the pole around Antarctica which means that that we're actually...we think, from our climate model results, getting increased mixing and a bigger Antarctic circumpolar current.

Robyn Williams: Why are they moving south?

Joellen Russell: Well, it's something that a lot of teams are working on, but I'll speculate because this is what we're doing, and in the models at least it's moving towards the poles because of global warming. As we're warming the troposphere, basically we're cooling that atmosphere that lies above the troposphere, the stratosphere. That gradient between these two is increasing, meaning the difference between the very cold air near space and the very warm air near the surface is getting bigger, and as that's getting bigger the winds are popping, the jet stream is moving towards the poles in both hemispheres, but particularly around Antarctica.

Robyn Williams: And what's the effect of that in terms of CO₂, do you think?

Joellen Russell: This is what's exciting, is that everywhere else in the world ocean we're expecting the surface ocean to warm and get very, very stable, and slow the amount of mixing which will slow the rate of uptake of CO₂. But in the Southern Ocean, because these winds are moving towards Antarctica, the mixing is increasing, and this is a very unexpected result because all the climate models in the last generation said, hey, it's all going to cap and get slow and kind of sluggish. But instead around Antarctica things are really starting to rip. And with that mixing we think the Southern Ocean will take up about 20% more carbon dioxide over the 100 years than would have been taken up without the wind shift, which is an astonishing result. I mean, 20% more CO₂ out of the total global, which is a big number.

Robyn Williams: But why would that happen? Because the ocean is warmer?

Joellen Russell: Mostly it's because the Antarctic circumpolar current, which is the ocean current that runs underneath the jet stream that's driven by the big winds around Antarctica, that circumpolar current brings water from about three kilometres deep to the surface. We expected that with time the warming would make that get shallower and shallower, a weaker current, but that's not what's happening. In fact the current has been strengthening; we've got more water coming to the surface which means water that has never seen all this man-made CO₂ is making it to the surface and then being sunk back to the depths, so basically producing this big sequestration of CO₂. We're pulling it out of the air and sinking it back to the deep ocean.

Robyn Williams: So this is the theory. Have you actually measured that this is going on in the real water?

Joellen Russell: I actually don't go out and make the measurements anymore...

Robyn Williams: Especially now you've about to have a baby.

Joellen Russell: That's right, I'm about one or two weeks away here, I wish he'd hurry up. Yes, NOAA, the National Oceanic and Atmospheric Administration, as well as other places like Australia and CSIRO have been going out and making lots and lots of measurements of the surface ocean carbon dioxide fluxes as well as the deep ocean carbon, and there have been several blockbuster papers recently saying, hey, did you know that the Southern Ocean is taking up about half of the global anthropogenic carbon dioxide? Which is very unexpected if it were capping. So we think actually that the model is actually representing what's really happening in the ocean.

Robyn Williams: What does this mean if something like half of the man-made CO₂...that's going to make a huge difference.

Joellen Russell: Yes, that's a huge amount, and what it does is there's two parts; one is not only is it carbon dioxide that's going into the ocean but it's all that man-made heat too, the heating in the atmosphere, some portion of that is going into the ocean. So we've seen from measurements...this is not my work, it's Sarah Gille at Scripps Institution of Oceanography, she showed that the Southern Ocean is warming faster than anywhere else on Earth and it's because of this great mixing that we think is going on. But second, when you remove all that CO₂ it's not in the air anymore to contribute to global warming. So we think we could basically slow global warming. We can't stop it, we can't reverse it but we can slow global warming significantly by this increase in the winds and the change in the mixing in the Southern Ocean.

Robyn Williams: Because one thing that your colleagues at the Scripps Institution of Oceanography did say, that as the CO₂ goes into the ocean it makes it more acidic which is a problem for corals and shellfish and all the rest of it, but in fact if you're sequestering...if the current is taking it way down deep, that isn't so much of a worrying effect, or what?

Joellen Russell: The problem is that the Southern Ocean tends to mix from the surface all the way to the deep, so it's not just the deep ocean that's getting this extra dose of CO₂. Unfortunately it probably does mean that we are making the ocean more acidic from top to bottom. This is one of the two big downsides, the first one being a more acidic ocean which means pteropods and corals and anybody who needs to make their architecture out of aragonite or calcium carbonate is under threat. Many of these organisms are the base of the food web globally in the ocean. This is very serious, and we're running new simulations with all the biology in it just to double check. We'd like to know what's going to happen next. But the second thing that's happening is that the more heat you put in the ocean, the faster sea level rises because warmer water expands and sea level will rise more quickly the more heat we pour in. So although this is good because it removes heat from the atmosphere and carbon dioxide from the atmosphere, the bad part is it's in the ocean now and there are consequences.

Robyn Williams: Indeed. Those aren't the air force planes going above us..?

Joellen Russell: No, that's just regular air traffic.

Robyn Williams: Because we're standing next to a place where in fact the Iraq troops are being debriefed.

Joellen Russell: Yes, some of them are debriefed just south of here. We have a couple of different military bases that are big hubs for that.

Robyn Williams: To sum up...you've obviously discussed this, but what really does it mean in terms of the good news about global warming? How much might it reduce the problem we've got and how much

time might it give us?

Joellen Russell: What it meant for our climate sensitivity in the model was that basically it took almost 20 to 40 more years to reach the same temperature in the atmosphere with the new model. If this is true, if we're right, then we're basically getting a little bit more grace time to get our act in order.

Robyn Williams: But the sea levels will still be going up?

Joellen Russell: Sea levels will still be going up, it will be still be warming in the atmosphere but more slowly than we might have thought.

Robyn Williams: It's a complex system you're dealing with isn't it.

Joellen Russell: It is, it really is.

Guests

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