Nature Podcast

Introduction

This is a transcript of the 24th May 2018 edition of the weekly *Nature Podcast*. Audio files for the current show and archive episodes can be accessed from the *Nature Podcast* index page (http://www.nature.com/nature/podcast), which also contains details on how to subscribe to the *Nature Podcast* for FREE, and has troubleshooting top-tips. Send us your feedback to podcast@nature.com.

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Interviewer: Benjamin Thompson
Welcome back to the *Nature Podcast*. This week, we're learning about the multitude of applications for muons, finding out about the Minimal Fleet Problem…

Interviewer: Adam Levy
Plus, estimating the cost of climate change. This is the *Nature Podcast* for the 24th May 2018. I'm Adam Levy.

Interviewer: Benjamin Thompson
And I'm Benjamin Thompson.

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Interviewer: Benjamin Thompson
Now, we all know how frustrating it can be to wait ages for a taxi. And we all know about the traffic problems in a lot cities. What if there was a solution to both? Ellie Mackay has been finding out about the latest research into optimising city vehicle networks.

Interviewer: Ellie Mackay
I'm standing outside King's Cross train station here in the heart of London. It's a busy morning, and as I'm sure you can hear there is a lot of traffic about. I can see a fair few taxi cabs too, and no doubt many of the people who've ordered them have done so via an app on their phone. Now, waiting for a taxi to pick us up is a minor inconvenience. But how do the dispatch systems calculate how many vehicles are needed at any given time? And how do taxi company owners juggle the demand for rides with the cost of keeping countless cars and drivers on the road? Their daily challenge is to make sure there are enough vehicles in their fleet to serve all their customers without delay, but not have so many that they're losing profits. And of course, an excess of vehicles also creates traffic and pollution problems. It's a mathematical conundrum known as the Minimum Fleet Problem, and it's something that Moe Vazifeh from the Senseable City Lab at MIT has been trying to solve. His team have developed a new solution to this urban traffic puzzle - a computer algorithm they've been testing in New York, which they say could make taxi networks much more efficient. So Moe, when you're looking at a city like New York, for example, why is this Minimum Fleet Problem so difficult to solve?

Interviewee: Moe Vazifeh
So when you look at New York City, there are around 300,000 to 400,000 taxi trips a day, served by around 13,000 cabs on the road. Traditional optimisation approaches are not designed to be able to handle such a huge number. You can only solve this problem for a few thousand trips considering the frameworks which have been designed in the literature so far. So, if you want to solve this problem in real world scenarios, you have to like rethink the problem and design it in a way that is scalable and accurate.

Interviewer: Ellie Mackay
So your solution is different because it's designed to handle these huge numbers of trips, and you call it a network-based solution. What does that mean?

Interviewee: Moe Vazifeh
So, we have reformulated the problem in a way that the problem becomes a network science problem. So basically, we have a fleet of vehicles that are being shared by all these trips, but all the trips remain independent. And the way we construct this network, is each node is a trip, and the links between the nodes represent whether trips could be shared by the same vehicle. So if you consider a pair of nodes, and there is a link from node A to node B, it means that a vehicle can serve first the trip A, and then go and serve trip B.

Interviewer: Ellie Mackay
So the computer algorithm then finds the best pathway through that network?

Interviewee: Moe Vazifeh
Yeah, so it's decisions that we make for each individual car is affected by the whole system. So the problem of finding the minimum fleet size, becomes finding an efficient set of paths, chains on this network that connect all these dots, all these nodes, and they cover all this network.

Interviewer: Ellie Mackay
So in your paper you discuss some of the complexities that you include: the ride duration, the trip frequencies, the locations, and the distances. How long does it take for the computer to run these simulations and how does it respond to the fact that you've got new requests coming through all the time?

Interviewee: Moe Vazifeh
So we have two scenarios, we have offline and online optimisations. So for the offline, we have the knowledge of trips one day in advance. So this could be used, for example, for a delivery service. But in the online case, which is more relevant to on-demand mobility services, you have to assign vehicles to rides where you only have trip information in the next minute or so. And we show that in this paper, on a very simple desktop computer you can solve this in a very short time, like in the order of half a second.

Interviewer: Ellie Mackay
And so to test this algorithm, you've applied it to a year's worth of data from New York City, so this is 150,000,000 previous taxi trips, which is about 3-400,000 a day. And you've looked at both offline and online systems, so that's trip you know in advance, as well as live bookings. What did the algorithm show?

Interviewee: Moe Vazifeh
In the offline model, we show that consistently throughout the year you are able to provide the same level of service, reducing the number of cabs by 40% compared to what we have on the road today. And in the online model, we still have 30% reduction in the number of cabs while maintaining the level of service, and the level of service means the percentage of people served within a certain delay remains the same as the original.

Interviewer: Ellie Mackay
So essentially according to your algorithm, New York City could function fully with several thousand fewer taxis on the road.

Interviewee: Moe Vazifeh
Yes, that's correct.

Interviewer: Ellie Mackay
Okay, so these reductions of 30 and 40% are pretty big numbers. But you discuss in the paper some of the factors that may limit us from achieving this maximum efficiency. What about driver behaviour, what if someone decides to collect the closest person to them, or take their preferred route rather than what the algorithm tells them?

Interviewee: Moe Vazifeh
So we are limited by the behaviour that we are observing in this historical data, but this is still, I would say, would be applicable. One year is long enough to capture most of the cases, but there still may be actually fundamental problems. I'll give you an example, so if you have a sport match, and after the match suddenly you have huge number of diverging requests, then you have to add more vehicles to the system to be able to serve these trips.

Interviewer: Ellie Mackay
And also, this system is assuming one central dispatcher for a single large fleet, so doesn't that encourage a monopoly in the market?

Interviewee: Moe Vazifeh
Not necessarily. This could be an agreement between companies for efficiency. As we have shown in the paper, even if you have a few players, you still get most of the efficiency that you expect. So we have considered 2 and 3 in the paper, and it shows that you only have 6-7% reduction in efficiency.

Interviewer: Ellie Mackay
Okay, so you're still looking at 20-25% fewer vehicles required than currently, even with several competitors all sharing that information.

Interviewee: Moe Vazifeh
That is correct.

Interviewer: Ellie Mackay

Okay, so that's great for taxi companies and could help traffic problems in big cities, but thinking ahead, you also think this algorithm could be especially relevant for maintaining sustainable cities in the future.

Interviewee: Moe Vazifeh
Sure, so we have a self-driving revolution ahead of us, and I think this work becomes even more relevant in that scenario. You're directly translating these algorithms suggested decisions into a fleet of autonomous vehicles, serving these trips while keeping the footprint in the city as low as possible.

Interviewer: Benjamin Thompson
That was Moe Vazifeh from the Senseable City Lab at MIT, speaking to reporter Ellie Mackay. You can read the full paper over at nature.com/nature.

Interviewer: Adam Levy
Next up, reporter Lizzie Gibney has been getting to grips with an emerging measurement method – muography.

Interviewer: Lizzie Gibney
When X-ray radiation was discovered in 1895 it revolutionised medicine. For the first time, doctors could see inside the body without cutting it open. Now scientists are harnessing another kind of radiation to peer inside much larger structures, in ways that have never been possible before. This time, the radiation is made up of particles known as muons. Heavier cousins to electrons, which are produced naturally when energetic cosmic rays slam into atoms in Earth's atmosphere. Muons can pass through hundreds of metres of rock unhindered, and by observing how the particles interact with the matter they pass through, scientists can see inside otherwise impenetrable objects without damaging them. For years detector technology wasn't good enough for the technique to be very practical, but that's now changing. Scientists last year used muons to discover a new chamber hidden inside the Great Pyramid at Giza. And now the method - known as muography - is booming. I headed down to a conference where a who's who of muographers gathered to discuss the rapidly growing range of applications, as well as how companies try to get in on the game. Here's Cristina Cârloganu from the Laboratoire de Physique de Clermont-Ferrand, who's using muons to image volcanoes.

Interviewee: Cristina Cârloganu
The process is precisely the same as when you make an X-ray in a hospital. So you just have your volcano, and you put a detector, and you see how transparent the volcano is in terms of muons. So you know the flux of muons that are produced in the atmosphere, there are normally, well there are lots muons produced in the atmosphere, there are natural radiation, and when they propagate, some of them are stopped by during the propagation of the volcano. And the number of muons that are stopped, tells us something about the density distribution in the volcano. Denser, voilà, more stopped.

Interviewer: Lizzie Gibney

Muography allows Cristina to see deep inside volcanoes, gaining vital information about their density and therefore their structure. By mapping where lava channels lie within the mountain for example, scientists may eventually be able to better predict eruptions.

Interviewee: Cristina Cârloganu
If you think in terms of cities like Naples, which might be very well affected by explosions and eruptions by Vesuvio, you understand it's very important to understand how such eruptions could occur and behave in order to limit the risk for people living there.

Interviewer: Lizzie Gibney
It's not just volcanoes that muographers are studying in Naples. Physicist Giulio Saracino from the University of Naples Federico II [and the National Institute for Nuclear Physics] in Italy is using the technique to probe deep inside a different aspect of Neapolitan geology.

Interviewee: Giulio Saracino
First of all, we started to measure known cavities.

Interviewer: Lizzie Gibney
The cavities he's talking about lie beneath an area of Naples known as Monte Echia, a settlement that dates back to the 8th century BC. Some cavities came from locals excavating rock to make their houses, but they ended up serving as temples and water storage. Others were purposefully built - there was even an escape tunnel from the royal palace. By studying how muons pass through the rock from multiple vantage points, Giulio was able to find signs of new cavities within the complex structure.

Interviewee: Giulio Saracino
In the last mission we believe that we discovered cavities that people that work there suspected to be there, but they were not to prove.

Interviewer: Lizzie Gibney
Similar techniques are already being used in mining, to reveal underground reservoirs and unknown deposits of ores. Here's Cristina again.

Interviewee: Cristina Cârloganu
I think it's already used in geophysical exploration, mining, and it's a slightly different application but there are lots of industrial applications also. So there were lots of presentations today about those industrial applications, so I think it the field is huge actually.

Interviewer: Lizzie Gibney
Another potential industrial use is in the management of nuclear waste. For safety reasons, these potentially dangerous by-products of generating nuclear energy are stored in impenetrable containers, but this raises the question: how do you keep an eye on the material once it's sealed off? One answer could be… you guessed it: muography. David Mahon from the University of Glasgow, and a founder of spinoff company Lynkeos explained.

Interviewee: David Mahon
The containers themselves are self-shielded so they're designed to keep the radiation from within, from getting out into the environment. So that naturally stops X-rays and gamma rays from penetrating. But to get information about what is deep in the centre, muons are pretty much the only radiation which can do that. So we can pick out instances where there's a piece of uranium fuel that is inside this drum, which perhaps it shouldn't be.

Interviewer: Lizzie Gibney
So muons can help to spot stray uranium that might accidentally corrode the containers and cause leaks. But they can also help to avoid deliberate catastrophes.

Interviewee: David Mahon
There's a lot of work in international safeguarding as well. So for a particular waste form you can dry store it in large storage casks, and it's important to know that what individual country says is in that container, is actually in there, and no one has diverted some of the radioactivity, for example, for making bombs.

Interviewer: Lizzie Gibney
All of these emerging applications of muography have been made possible in large part by the growth of fundamental research. Detectors have shrunk from the size of a room to a table top, and now run on very little energy.

Interviewee: Cristina Cârloganu
We had huge progress in detectors, and those were very much improved by experiments like the experiments on LHC, Large Hadron Collider, so that was the first thing. And now we have also much better understanding of the atmospheric muon flux, the cosmic ray flux and so on, because there was also huge progress in what we call astroparticle physics. So now we can put everything together and try to make imaging.

Interviewer: Lizzie Gibney
But merging techniques from high-energy physics with new fields such as geology or archelogy is not always easy. Here's Giulio again.

Interviewee: Giulio Saracino
Of course it's a new technology, it comes from high-energy physics work, so this is something, of course when I first time I say to people, to geologists, we have muons technology, what muons are so we have to start from very beginning.

Interviewer: Lizzie Gibney
Muography still has a way to go to prove itself, but there's a real sense of excitement surrounding the field, and no one knows quite where muon imaging might find itself useful.

Interviewee: David Mahon
Muography is addressing challenges which until now have never had a solution. So in many ways muography is creating a lot of different markets, and I can only imagine in the future that lots more companies will enter the field as well.

Interviewer: Adam Levy
That was Lizzie Gibney speaking with David Mahon, Giulio Saracino and Cristina Cârloganu.

Interviewer: Benjamin Thompson
Later in this week's show, we'll be finding out how much money the world could save by halting global warming. Before then though, Shamini Bundell is here with this week's Research Highlights.

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Interviewer: Shamini Bundell
Some feathered dinosaurs may have deliberately designed their nests in a doughnut pattern in order to avoid crushing their own eggs, according to new research. A team of scientists looked at the layout of over 40 fossilised nests, made by different types of oviraptorosaurs. The nests were arranged with the eggs laid out in a ring, and a space in the centre. The larger the dino, the larger the ring. Some of the biggest oviraptorosaurs weighed in at over a ton, but laid eggs with very weak shells. The researchers suggest that the empty centre of the doughnut shape may have supported the bulk of these hefty dinosaurs, preventing them from crushing their future offspring. Dough-not forget to read more of that egg-cellent research over at *Biology Letters.*

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Interviewer: Shamini Bundell
The secret to what makes ice so slippery may have been solved, thanks to a team of European researchers. They measured the friction of a steel ball sliding over some ice at temperatures ranging from -100 to 0°C. At the coldest end of the scale, the ice demonstrated a high level of friction, but this friction decreased as the temperature warmed up, with the ice being its slippiest at -7°C. Investigating the slidy surface, revealed water molecules weakly bound to the surrounding ice. These molecules roll like tiny spheres along the top of the ice, helping speed skaters to glide effortlessly along, or propelling unsuspecting pedestrians to a tumble. Slide over to the *Journal of Physical Chemistry Letters* for more.

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Interviewer: Adam Levy
How much money will climate change cost? This simple question is crucial in deciding what action needs to be taken. Take the Paris Climate Agreement formed in 2015…

Interviewer: Marshall Burke
So what we do in these agreements is we set out these very specific targets and when we do that we really want to understand okay, what are going to be the benefits of actually achieving these targets, and how do those compare to the costs?

Interviewer: Adam Levy

This is Marshall Burke, a climate economist at Stanford University in the US. He's interested in how the costs of climate change stack up depending on what our targets are. The Paris Agreement's target is to limit the world's warming to well below 2°C above preindustrial levels, and to pursue efforts to limit the temperature increase to 1.5°C above preindustrial levels. What's the impact of limiting warming to 1.5 versus 2°C? Well, Marshall has just published a study that estimates how the global economy would be affected by these different levels of temperature rise. But how do researchers get from a physical understanding of climate change to its impacts on goods and services around the world.

Interviewer: Marshall Burke
The way we do it in our study, is we first use history as a laboratory. We use almost a half century of data on economic output from countries around the world, and we use these data to study how have countries responded historically to increases in warming. And what that allows us to do is then say okay, moving forward, if we plan to experience 1.5°C of warming or 2°C, how will countries respond?

Interviewer: Adam Levy
This approach avoids having to simulate how economic behaviour responds to climate change. Instead, it looks to the past, using historical responses to temperature variations to infer what might happen in the future.

Interviewee: Max Auffhammer
It's very clever, so the advantage of this method is it folds all good and services into one number.

Interviewer: Adam Levy
This is Max Auffhammer, an environmental economist at UC Berkeley, who wasn't involved in this study. Both Max and Marshall point out that despite this study's advantages, it has important limitations. For one, its historical approach can't account for unprecedented changes to the climate, things that may happen in the future that the economy hasn't seen before. For example, if sea level rise floods coastal cities around the world. Max also points out that historical responses to various temperatures might not be indicative of what humans do in the future, as the planet continues to warm. If humans come up with new ways to adapt, that could drive down the costs of climate change.

Interviewee: Max Auffhammer
So trying to figure out what the consequences of adaptation are is really difficult. You need a crystal ball to figure out what technologies are by end of century, and as a card-carrying scientist I just don't believe in crystal balls.

Interviewer: Adam Levy
With these limitations in mind then, does Marshall think that his model is likely to give an estimate of impacts that is too high or too low?

Interviewer: Marshall Burke
My gut instinct is that are numbers might be too low. Historically we have not seen a lot of evidence of adaptation. On the other hand, climate change is going to bring a lot of things that we have not seen historically, again sea level rise probably being the best example, and these things are going to be really hard to deal with and we're going to have to spend a lot of money to adapt to these things. So, my gut feeling is that our numbers, as large as they are, could even be a lower bound on the overall damages.

Interviewer: Adam Levy
So how large are we talking? What would be the difference between limiting global warming to 1.5°C versus 2°C?

Interviewer: Marshall Burke
So our main estimate is that by 2100, so by the end of this century, the world will be about 3-4% wealthier, under the most ambitious target, the 1.5°C target as compared to the 2°C target. That might not sound like much, but it represents about $20 trillion in cumulative benefits between now and the end of century.

Interviewer: Adam Levy
$20-trillion - the extra 0.5°C of warming between 1.5 and 2°C might not sound like much, but studies like Marshall's suggest just how big an impact it could have on the world. But how do the costs of this extra 0.5°C of warming compare to the costs of preventing it?

Interviewer: Marshall Burke
Some scholars estimated that it will cost an additional nearly $0.5 trillion to achieve the 1.5°C target, compared to the 2°C target. So, by our calculations, the benefits of achieving these ambitious targets vastly outweigh the costs.

Interviewer: Adam Levy
At the moment though, the world isn't looking like it's heading to either the 1.5 or the 2°C target. Temperatures have already increased by about 1°C, and even if every country sticks to its Paris Climate pledges, our best guess is that the world will warm by about 3°C.

Interviewer: Marshall Burke
If we get 3°C by end of century, that's going to cost another 5% of global GDP, and in an unmitigated climate scenario world, so in a world in which we fail to mitigate at all, sort of a business-as-usual scenario, again that's going to cost an additional 5-10% of GDP. So the consequences of not limiting warming start to stack up pretty dramatically.

Interviewer: Adam Levy
And these are just the consequences that studies like this can capture. This study assesses how GDP may be affected by climate change, but GDP – gross domestic product – is just an assessment of a country's goods and services. And Max stresses that there's some impacts of climate change that GDP doesn't easily describe.

Interviewee: Max Auffhammer

How do we put a dollar value on the increased incidents of conflict? How do we put a value on biodiversity? So, if climate change wipes out species because their habitats get destroyed or changed, what's the value of that? That's to me the next frontier of the research in climate change impact.

Interviewee: Adam Levy
Any study that looks into the future will have limitations and uncertainties, and this paper is no exception. But it joins a body of literature, showing that the costs of climate change dramatically outweigh the costs of halting it. In spite of the Paris Agreement, emissions are still rising and the world is still warming. And for Marshall, his own results are a serious cause for concern.

Interviewer: Marshall Burke
You know, I'm the dad of young kids, and this is the Earth that they're going to inhabit in the future, and when we see what an unmitigated climate change scenario will do to economic output to and livelihoods around the world, I absolutely worry about that.

Interviewee: Adam Levy
That was Marshall Burke who's at Stanford University, and before him Max Auffhammer who's at the University of California, Berkeley, both in the US. You can read Marshall's study over at nature.com/nature. You'll also find a News and Views Forum, where Max and another economist offer their differing views on Marshall's approach. Plus, a Nature editorial on the topic.

Interviewer: Benjamin Thompson
Right then listeners, it's the end of the show and of course that means it's time for the News Chat, and I'm joined here in the studio by Davide Castelvecchi, the physical sciences reporter here at *Nature.* Hi Davide.

Interviewee: Davide Castelvecchi
Hello.

Interviewer: Benjamin Thompson
Right, for our first story then we're going to blast off into outer space and to the far side of the Moon.

Interviewee: Davide Castelvecchi
Yes, this is a very ambitious mission, and it's only the first leg of it. It's a probe that will basically hover above the other side of the Moon, the one that's not visible from Earth, waiting for the second part which is a lander, which will get there sometime around the end of the year and will deploy also a rover.

Interviewer: Benjamin Thompson
So yeah, so who's been developing this probe then, and what's it called?

Interviewee: Davide Castelvecchi

It's primarily the Chinese Academy of Sciences. I hope I'm not going to butcher the pronunciation – it's called Queqiao, which means 'Magpie Bridge' - it's the name of a traditional folktale, and also the name of the Chinese equivalent of Valentine's Day. And interestingly, it also carries a number of international experiments, one in particular which is very interesting is a cosmology experiment from the Netherlands.

Interviewer: Benjamin Thompson
Yeah, and that's the snappily titled Netherlands-China Low-Frequency Explorer then, and what's that going to do, Davide?

Interviewee: Davide Castelvecchi
So it will take advantage of the fact that when you're on the other side of the Moon, you are not exposed to the radio noise that comes from the Earth, which tends to leak out, and in fact sometimes in the past there's been reports, for example that the Cassini mission picked up BBC Radio 4 on its way to Saturn.

Interviewer: Benjamin Thompson
Goodness, well what will this protection from radio noise help us understand better?

Interviewee: Davide Castelvecchi
The idea is that from outer space in general you can access frequencies of radio waves that are not accessible from the Earth's surface because they tend to get blocked by the atmosphere. And in addition to that, there's all the radio noise that you would still get in Earth orbit. And these wavelengths are supposed to contain information about the very first 200 million years of the Universe's evolution.

Interviewer: Benjamin Thompson
Oh really? And is this something we've not been able to necessarily look at before then?

Interviewee: Davide Castelvecchi
It is the black spot, it's the mystery period. We've been able to see, to observe, you know, the afterglow of the Big Bang, which is about 380,000 years after the Big Bang. But from that time to several hundred million years later, when ordinary astronomy picks up, that is completely terra incognita.

Interviewer: Benjamin Thompson
Alright, so if that's one of the experiments on the probe then, what else is it sort of taking with it?

Interviewee: Davide Castelvecchi
It is also releasing two smaller probes from the mothership, which will orbit the Moon itself, and they will also test technologies to study this, you know, the dark ages of the Universe.

Interviewer: Benjamin Thompson
And you said this is kind of a part one of kind of a two-parter then, what's part two?

Interviewee: Davide Castelvecchi

So part two is the lander, and sometime around the end of the year, it will land on the far side of the Moon. It will be the first spacecraft to get there, because you know, all the Apollo missions, and all the unmanned probes that have ever landed on the Moon always were within sight of Earth, because you can't have communications with the far side of the Moon directly, you need this additional probe which will establish a link.

Interviewer: Benjamin Thompson
So this is kind of a very ambitious sort of set of space missions then from China, why the Moon, why are we looking at it again?

Interviewee: Davide Castelvecchi
There is so much science to be done on the Moon. Lunar exploration has been done, I mean it started in the 1960s, but it mostly was done with prehistoric technology for current standards. And there's a lot to be understood about the geological evolution of the moon and for example, one mystery that is still unsolved is why the far side of the Moon is so different, looks quite different from the near side of the Moon, which has fewer and larger craters, whereas the far side is pockmarked with many smaller craters, and nobody knows why.

Interviewer: Benjamin Thompson
Okay then, well let's head back to Earth for our second story today, and in the podcast listeners you've already heard Adam talking about climate change and economics, this is also sort of a climate change-related story, but it couldn't be more different really, I suppose. It revolves around a special team of seal scientists, and that's easy for me to say. What's this story all about?

Interviewee: Davide Castelvecchi
It's about the deep ocean, which we actually know not as well as the surface of the Moon, it turns out. And so this is a group of scientists primarily from the UK, who recruited a number of seals from Antarctica, and they placed sensors, they glued sensors to their heads, and as the seals dived into deep waters the sensors recorded the conditions there.

Interviewer: Benjamin Thompson
And where specifically are these seals based?

Interviewee: Davide Castelvecchi
They're based in West Antarctica, and they swim in the Amundsen Sea, which the researchers are interested in because they want to look at how the deep ocean current, the Circumpolar Deep Water changes over the seasons.

Interviewer: Benjamin Thompson
Well why are they looking at this in particular, what is it about this deep water current?

Interviewee: Davide Castelvecchi
A lot of researchers expect that as the climate changes, these currents, these deep oceans currents, might hasten the melting of the West Antarctic ice sheet, and in particular of two very large glaciers there, accelerating the discharge of ice into the ocean.

Interviewer: Benjamin Thompson
Alright then, well I mean we can't skip around any longer, why are they using seals for this then?

Interviewee: Davide Castelvecchi
Because it is so damn hard to do research in that part of the world with oceanographic ships. You can go there when the weather permits, but the seals are there year-round and they dive year-round, so that way the researchers in 9 months were able to get more data than previous experiments got in the previous 10 years. The researchers revealed that the current is bigger and warmer and saltier in the winter months than it is in the summer, and this is research that came out in a paper last week.

Interviewer: Benjamin Thompson
And how will all this data be used then?

Interviewee: Davide Castelvecchi
Well the hope is that the data may help to refine the climate models that predict how fast the West Antarctic ice sheet will melt. If it were to melt completely, sea levels globally would rise an average of 3 metres.

Interviewer: Benjamin Thompson
Thanks Davide. Listeners, for all the latest science news, head over to nature.com/news.

Interviewer: Adam Levy
That's it for another show, but before we go there's just time to say hello and thank you to Claire Hews who said on Twitter that the *Nature Podcast* is one of her current favourite shows. Nice one Claire. Let us know your thoughts on the show: @NaturePodcast. I'm Adam Levy.

Interviewer: Benjamin Thompson
And I'm Benjamin Thompson. Thanks for listening.

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