Hypotenthuse Ep 3 - Julienne Stroeve

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SPEAKERS

Sophie Lane, Laura Hewison, Julienne Stroeve

L **Laura Hewison** 00:01

Hello, and welcome to Hypot-enthuse, a podcast all about science, maths and the world around us from Mathematical and Physical Sciences faculty at UCL, or as we like to call it MAPS. I'm your host, Laura Hewison, and I am completely unqualified to be here, but very enthusiastic. With me, as always, for maps is my excellent co host, the much more qualified Sophie Lane. And our guest today is extremely qualified to be here. She's professor of polar observation and modeling. Julienne Stroeve, welcome. Thank you for being here.

J **Julienne Stroeve** 00:34

Thank you for having me.

L **Laura Hewison** 00:36

Well, just to kick everything off, what is your area of study?

J **Julienne Stroeve** 00:41

Well, I'm really interested in what's happening to our polar regions. And I've been studying the polar regions for about 20 years now. And mostly what I do is I work with satellite

data. So I'm trying to understand the changes that are happening in the polar regions, over the sort of the last 40 years of observations that we have from satellites. And the reasons I work with satellite is because it actually allows us to see these really inhospitable regions, every day, pretty much where you can't really do that so easily by working in the field, especially in the polar night. So satellites give us this broader perspective of changes that are happening in these regions that are very difficult to access.

L Laura Hewison 01:20
What what are you actually physically seeing from the satellites? Is it kind of a 3d image? Or is it a series of kind of models or data,

J Julienne Stroeve 01:29
it really depends on what satellite systems you use. So what might be most familiar to most people would be visible satellite images, so what you can see with your eye, but we also develop satellite systems that monitor energy in different parts of what we call the electromagnetic spectrum. So not just what we see with our eyes, but also what we can sense for example, temperature, or we can also look further out in the spectrum and look at microwave energy, which is very small, but there's still information carried at really long wavelengths.

S Sophie Lane 01:59
With you, when using satellite based data, I mean, that technology must have accelerated massively in the past, like 20, 30 years, has it changed a lot? From previous studies?

J Julienne Stroeve 02:13
In some sense, yes. But also, you know, when we're thinking about trying to produce a long data record, then we really want consistency in our satellite observations. And so starting in October 1978, there was a launch of a satellite system that looked in different wavelengths in the microwave part of the electromagnetic magnetic spectrum. And they've continued the same sort of satellite for 40 years now. And this is really key because it allows us to compile a long term climate data record from this instrument, whereas if you're blending newer or different technologies, it's a little bit more difficult to ensure that your data record is consistent over time.

L Laura Hewison 02:54

So what have you been finding, especially with something that's been going for 40 years? What have what's the kind of big trends? I think I know the answer.

J Julienne Stroeve 03:04

Well, you know, it's funny, because when I started studying the polar regions, I was focused on Greenland, and I understood the importance of places like Greenland and the Arctic to our overall climate system. But I didn't think I'd start to see any changes, at least in my lifetime, that were really noticeable. But then, in about 2000, when I was more focused on the Arctic Ocean and looking at the sea ice cover, I noticed that all of a sudden, we kept having these record low sea ice minimums. So in September, we usually hit the least amount of sea ice in the Arctic Ocean. And we kept having new record lows, that kept happening consecutively. And we're not seeing any sort of recovery to conditions that we saw even in the 1990s or all the way back to the 1970s. So there's a real transformation happening right now in the Arctic Ocean. And when we try to understand the drivers behind this ice loss, it's become increasingly clear that it's mostly driven by warming from anthropogenic sources rather than natural climate variability.

L Laura Hewison 04:05

When you say anthropogenic sources, we're talking us, aren't we? We're talking we're talking the wonderful human being.

J Julienne Stroeve 04:15

We're talking us and we're talking mostly about co2. So in a study that I published a couple years ago, with another colleague in Germany, we were able to quantify how much Arctic sea ice we melt per metric tonne of co2. So basically, we melt about three square meters, for every metric tonne of co2 we put in the atmosphere, which would be equivalent, for example of me flying from London to New York.

L Laura Hewison 04:44

Wow. Oh my God, I've melted so much sea ice.

S Sophie Lane 04:50

Oh, God, I wish I didn't know that. Oh, how do you like how do you cope with having such

a strong idea of what's going on? A lot of the time, I think I've my heads in the sand.

J Julienne Stroeve 05:03
Well, I think in some ways this study was really helpful because it's a bit, you know, often we get asked these questions of when do we expect the Arctic Ocean to become ice free the for the first time. And it's, it's not really about time the sea ice doesn't care about time. But what it cares about is how much more co2 we put in the atmosphere. So by being able to quantify how the sea ice is changing with co2 amounts, that also then provides a better sort of metric for policymakers to focus on when they're thinking about what do we need to do to limit our co2 emissions to not have the Arctic Ocean become ice free in summer?

L Laura Hewison 05:39
So this was going to be one of my questions to you is, how important are policymakers in all of this? And what can we be doing to inform that policy change?

J Julienne Stroeve 05:50
Well, it's it's incredibly important, because what we're finding is many aspects of the climate system, especially the Arctic sea ice, are the changes that we're seeing are largely driven by the warming from co2. And so putting concrete limits on the amount of extra co2 we put in the atmosphere can help, you know, slow down the ice loss and can actually not make it so that we have ice reconditions. But the reality is, is our current emission rates are about 40 gigatons of carbon per year, around the world. And this would mean that in the next sort of 20, 25 years, we will start seeing ice free conditions happening in September. And if we keep putting more carbon in the atmosphere, we'll start seeing ice free conditions extending to October and also happening earlier in August. So basically, we're going through this transitional period, and we can do something about it. But that would require very aggressive measures to not only reduce the amount of co2 we keep adding, but also start having negative emissions.

S Sophie Lane 06:54
Do you like- do you think it's like possible do you have? Do you have hope? Or do you feel a bit..?

J Julienne Stroeve 07:02
I feel a little bit pessimistic, I think the what we've kind of gotten to the point where I

mean, it's it's such drastic measures are needed to reverse the changes that we're seeing that, you know, it's just hard to imagine that all the countries are going to get on board to do this. I mean, I think it's great that with the Paris Agreement, we're trying to limit the warming to 1.5 degrees Celsius. And if we do that, we will likely have sea ice remaining, although there still be instances where it might become ice free, because everything in our climate system is a function of both natural climate variability and the sort of background warming from greenhouse gases. So even if you get to the 1.5 degrees Celsius, we'll have a lot less sea ice. And it could be that we'd even have ice free conditions, if natural climate variability were to be in phase to help remove a bunch of ice in one particular year.

L Laura Hewison 07:57

So what does it actually mean, for us, for animals for kind of, you know, local populations in these areas to have an ice free Arctic?

J Julienne Stroeve 08:11

Well, there's there's many, many implications of this.

L Laura Hewison 08:14

We've got time - over to you Professor Stroeve (laughs)

J Julienne Stroeve 08:18

Well, I mean, one of the issues is that, of course, the sea ice helps to keep the Arctic cool, it reflects most of the sun's energy back out to space. So if you remove that reflective barrier, basically, then the oceans gonna absorb that heat instead. And so what we're already seeing is that the warming that's happening in the Arctic is more than twice what we see in the rest of the planet. And this is because we've been losing the sea ice. So the oceans are absorbing a lot more heat during summer. But before the ice can freeze again, in winter, all that heat that the oceans gained has to get re released back to the atmosphere. And so if you were to look out and and say, Okay, well, at two degrees global warming, what does the Arctic look like? Well, under two degrees of global warming, the Arctic will be an annual mean temperature will be at four degrees, so twice as much. But in autumn and winter, it can reach seven degrees Celsius above of warming, so it's actually so much more amplified up in the Arctic. And this, of course, would have implications on biodiversity ecosystem functions, coastal communities that are normally protected from waves by the sea ice being present, but then it would be gone. So then waves from storms can do a lot more damage on these coastal communities. At the same

time, the warming from the loss of sea ice will enhance permafrost thaw. So you also have a lot of coastal erosion already happening in these areas from a combination of sea ice loss and permafrost temperatures falling. And then of course, is that big feedback that is looming where there's more carbon today stored in the permafrost than what's in our atmosphere. And so by warming up the Arctic even more, you will have this massive release of carbon in the forms of methane and co2 that will further amplify the warming. And a lot of this is not accounted for in our current current climate model projections.

S Sophie Lane 10:09
How come?

J Julienne Stroeve 10:11
Because it's a bit of unknown still, first off, scientists are still trying to figure out how much carbon is actually stored in the permafrost. This isn't that easy to determine for the whole Arctic region, and also how the plant functions and how the microorganisms and all of that will change. As the permafrost thaws, and these critters get active, and how plants and everything uptake, carbon, so it's a very complex cycle. And so there's a lot of people trying to figure that out. But it's still not all that certain.

L Laura Hewison 10:46
How terrifying.

S Sophie Lane 10:48
I have to say that. So those are the impacts, sort of to the communities and the systems that are based around the ice. How far do the consequences of like an ice free Arctic reach? will it impact people, you know, like in Africa and Asia, here?

J Julienne Stroeve 11:06
Well, certainly I think when I think about climate change, I think there's two main things that people should worry about. One is sea level rise. And the other is changes in precipitation patterns. So when we think about sea ice loss, it doesn't directly affect sea level, because it's like an ice cube in a glass of water. So if you melted, it's not going to really change the level of the water in the glass, for example. But by warming up the Arctic, of course, then you start impacting on glacier melt and ice sheet melt from Greenland, which does contain a lot of sea level rise, potentially. So in that regard, it does

influence sea level. At the same time, the reason we have a lot of our atmospheric circulation patterns in ocean circulation patterns are because the equator receives more heat, more energy from the sun than the poles. And so the purpose of our large scale atmospheric and ocean circulation patterns is to bring the excess heat from the equator to the poles. And so if you warm up the Arctic, and you change the temperature difference between the equator and the poles, you're changing all of your large scale weather patterns. And so a lot of science has been going into just trying to unravel how changes already happening in the Arctic are influencing, for example, extreme weather events. And these links are becoming increasingly clear that there are links between them. How this will also impact larger scale ocean circulation, I think remains still a bit unclear. But obviously, everything in our climate system is connected. So if we change one part of the system so dramatically, the rest of the climate system is going to respond.

L Laura Hewison 12:42

Equally terrifying. So two, ocean circulation patterns. Is that kind of to do with say, cyclones, hurricanes, or even? I know, there's huge droughts at the moment in Australia, the is that all going to become more prevalent?

J Julienne Stroeve 13:00

Well, I would say that's, I would frame that more in terms of changes in the atmospheric circulation patterns. So one of the things that we have been able to see is that because the the difference in temperatures between the pole and the equator are weakening, so it's not such a great difference, that has been slowing down the zonal wind speeds. And where there's a bit of debate still is how that then influences the jet stream. So there are some studies that have suggested that the jet stream is going to become a bit wavier and moving more slowly. So then whatever weather systems are on the other sides of the these waves, so either high pressure or low pressure, or really hot dry conditions, or really wet, cold conditions, those are persist for longer at a time. And there was a new study that came out this year that was showing just in the United States that the frequency or duration of extreme weather events is directly tied to this amplified warming that we're seeing in the Arctic.

L Laura Hewison 14:00

Wow. People are suffering incredibly tragic fires at the moment in California, which have been attributed by some camps to some kind of climate change. Is that a direct correlation or is?

J Julienne Stroeve 14:15

Yeah, I mean, there was a study that came out. I don't think it was last year that was suggesting that the drought in California is definitely linked to Arctic warming. What becomes difficult, I think, in entangling all of these processes is that there's so many things happening in the climate system at the same time, and how to decide, okay, this is from Arctic warming versus an El Nino or La Nina event or other circulation patterns, I think, is tricky. And so one way scientists try to get around that is running climate models and trying to do the simulations where they take away the ice and see what happens. But different models can give different results. And so it's a bit you know, still unclear how robust these linkages are. But so many more studies are highlighting that these linkages are there and I I do believe they're there. Whether they rise above the noise in the climate system at this point is not quite clear. But there is some consistency for sure that loss of winter ice in the Barents Sea sector, that that is weakening the polar vortex. And so when the polar vortex weekends, then you have more cold air spilling out of the Arctic. And so for example, the cold weather we had in the UK last winter was in part due to a breakdown of the polar vortex

L Laura Hewison 15:25

The Beast from the East.

S Sophie Lane 15:27

It ruined my birthday. So I think we should be really concerned. I think like, yeah, cuz I always think it's about climate science. Cuz like when I studied physics, a lot of the time we'd look at things and we'd look at like particles and about right, there's this force, and this force, and this was this force. And it was all very, like, a lot of time on a very micro level. And you could kind of account for everything you were looking at, like climate, like it's just such a mess, like, how do you like, how do you even start to separate out data? You know, when you've got like, you know, you've got, like, local weather, and then you've got to write like long term trends. And then you've got us making this giant mess, like, we learned about space weather in a previous episode. Yeah, like, there's so much going on, like, how do we how do we even begin to?

J Julienne Stroeve 16:12

Well I mean, I guess the real difficulty is, we only have one set of observations. And obviously, natural climate variability is happening together with anthropogenic warming. And so it's hard to separate those out just from data alone. And so that's why we try to do

these experiments with climate models. We try to model all the processes in the climate system. And then you can try to do these sort of sensitivity studies to look at, well, what would be the response if I take away the ice? Or what would be the response? if, you know, we adjust temperatures globally by this amount, so you can kind of look at these things in a modeling framework. But of course, that depends on the complexity of your models and the resolution of your models, especially if you want to get to the regional scale. If you want to see Well, what's it going to do to weather in my neck of the woods? Well, the the resolution of a lot of these models isn't sufficient for you to be able to answer those kinds of questions. But it's getting better. I mean, it's just that there's so many complexities that you can add, I mean, even just human population growth, and how we're changing the land cover of this planet, and how we're going to change our consumptions, all of these sort of projections, you know, trying to model all of that as well, because we, we run our models, and we make these assumptions about what we think the emissions will do out in the future. But all of that depends on humans, which is very unpredictable.

L Laura Hewison 17:33

there are people out there in this world that say that climate change isn't really a thing. Let's call them skeptical. What do you say to people who might think along those lines? Or say, Oh, well, you know, it doesn't really affect me?

J Julienne Stroeve 17:52

Well, I guess I would say that they have their head stuck in the sand a little bit still, it's really hard. I think now, to deny that human impacts are affecting climate, I mean, we, we can see the clear increases in co2. And this is due to anthropogenic activities. We know that from physics, if we get back to physics, what the co2 molecules will do in the atmosphere and how they will absorb heat, we can see a decrease from our satellites, actually an outgoing long wave radiation, which is a direct reflection of the co2 increases in the atmosphere. And so there's a lot of data that shows Okay, co2 is increasing, and it's actually warming the planet. I think where maybe people get stuck is, well, how much of the change is natural variability and how much of it is from anthropogenic warming. And really, the way to get at that is going to be through modeling. Because you, it's hard to separate that out and the observations, but we can deconstruct them. And we can look at solar variability, for example, we can look at variability and volcanic eruptions. And all of those different sources, I mean, you just trying to find the fingerprints of the warming that we're observing. And when you do that, it really becomes clear that co2 is a major cause of the warming. That doesn't mean that individual years like if you have a large El Nino year, you will definitely spike in your temperatures. And we can see that but it's the trends that we care about. It's not really those variabilities along the trend line, which are

definitely due to natural climate variability. It's a long term trends that are clearly being defined by co2.

L Laura Hewison 19:30
I grew up hearing a lot about El Nino as a rural farming girl in Australia. And as a small child, I thought it was a person was controlling the weather. And I didn't really like them very much. Because they were on the news all the time.

J Julienne Stroeve 19:47
And it doesn't do well for Australia when there is an El Nino, you go have serious drought.

L Laura Hewison 19:53
Yeah, so bad news would just be on the news all the time. There'd be El Nino, El Nino weather and I'd be like "ugh they're at it again"

S Sophie Lane 20:00
Yeah, so you must find it quite frustrating in the media the way science is portrayed as being and things, you know, regularly misunderstood. How do you think we can like, improve the dialogue between scientists and the public and improve public trust in science?

J Julienne Stroeve 20:16
I think maybe part of it is definitely that what the way, I think the general public is mostly confused the difference between climate and weather. So that's one issue. And I think the media doesn't help with that. Because if there's an extreme event, so say, in 2012, and the Arctic sea ice extent dropped to its absolute lowest levels we've seen yet which was quite low. That made a big deal, of course, in the media, or alternatively, if you have Snowmageddon where you had this massive snowstorm in the East Coast, United States, which happened during a time when the polar vortex had weakened, as well as warm, Pacific moist air coming up from like the Gulf of Mexico, into the east coast of United States, those two things hit together and created this massive snowstorm. And then these sorts of events are always then portrayed as climate change. And yes, they climate change has a fingerprint on that, but they're also largely just a natural, extreme natural variability event. And what the media probably should do better is really convey the message that there's these long term changes happening in the climate system that is due

to human activity. But that's not the same thing as necessarily extreme event. If the extreme events are happening more frequently, related to a warmer planet, then we can link them more directly with climate change. But I think that's really difficult with individual storms. And obviously, I mean, media wants to have kind of sensationalist stories that get, you know, people excited, but yet, it doesn't necessarily help with climate change sort of dialogues, I think we just need to frame it better about it's these long term changes. And the reality is, I mean, the public should be very worried that if we get to two degrees Celsius, I mean, you can look at forecasts for sea level rise under these conditions, I mean, London would be underwater. So it's not something that should be taken lightly. And especially with the way that we're coming to understand ice sheet responses. I mean, they are responding much quicker than we ever thought they would to climate change. I mean, Greenland, we don't really worry about, you know, 20 years ago, now, all of a sudden, that one's really waking up a lot. And it's contributing a lot more to global sea level rise than it once did. The West Antarctic ice sheet is becoming unstable. And so we're looking at probably two meters of sea level rise by the end of this century. That's massive. And I don't think that the public really understands how risky This is.

L Laura Hewison 22:49

We need another David Attenborough documentary. He just needs to get out there and be like, right, stop it, guys. And everyone will listen like they did with the ocean plastic.

J Julienne Stroeve 22:58

I guess maybe people just feel like, well, I don't know what to do. And I think maybe that's also the messaging is, is how do we change things? I mean, obviously, we don't want to reduce our quality of life, we still want to travel. I mean, I travel a lot for work, and also for pleasure, and but we need to have these alternative energy sources to fuel our way of life that we all want. And then you also have to think that always developing nations, of course, they want a good quality of life, and they deserve that. So how do we do that? And still preserve the climate system at the same time?

L Laura Hewison 23:31

Do you think there's a bigger impetus on on industry to try and make a change?

J Julienne Stroeve 23:38

Well, that's my pessimistic hat. I would say that nothing happens until it there's money to be made. And I do know that the Renewable Energy Industry and Energy markets are

really growing. And part of that is because it's becoming economically viable. But sadly, that is what drives most governments and most places in the world is all about money. So yeah,

L Laura Hewison 24:04
Yeah, you'd think that, you know, the impending doom of the planet might have some kind of driver, but

S Sophie Lane 24:10
That'd be nice. I was actually gonna be my question to you like, Is there anything you do in your day to day life? Are there changes that you've made that you think other people should make? Or do you think it's sort of all a bit a futile in the grand scheme of things and that the only thing that's going to change it as policy and industry?

J Julienne Stroeve 24:30
Well, I think for the large scale, I mean, policy and industry because if you think about what's contributing a lot to co2, obviously, our energy sources or coal fired power plants, you know, driving our cars, all of these things contribute quite a bit. So those are things that do require policy and industry to change those systems. It's really hard for one person to do I mean, you could individually try to get your energy from solar or from wind. I know my my mom when she was living on the island of Maui she, they worked really hard to get solar panels put on their property. And at first, the electric company wouldn't hook them up because they don't want to lose revenue. And so it also takes a bit of time to change the electric companies to be willing to hook up, for example, solar energy. They did get it, which was great. But it took some time. So those things do require policy and part on my own personal level, I guess I don't eat meat, which I think definitely can help contribute towards.

L Laura Hewison 25:31
People don't realize that that that is a huge, huge factor. I think it's becoming increasingly prevalent now in the media, but a lot of people are now vegan for

S Sophie Lane 25:42
Yeah, as well. Environmental raise I gave up me after I read an article about climate change. It just sent me into such a panic. And I could I read that it's the biggest individual,

like change your own personal co2 emissions is not eating meat.

J Julienne Stroeve 25:55
I think from personal Yes, probably,

S Sophie Lane 25:57
which is still like dropping the ocean, but I feel better about it.

J Julienne Stroeve 26:01
Yeah. And you know, I mean, obviously, we could just not do any transportation. But that's probably unrealistic

L Laura Hewison 26:08
Cycle, everywhere

J Julienne Stroeve 26:09
Cycle everywhere. And actually, it'd be really fantastic. If in London were to become a car free city, at least in the central part, that would be fantastic. Just ride our bikes instead.

S Sophie Lane 26:20
Amazing. Whenever I see people driving like normal cars in London, I'm always really like, Who are you? And where are you going? Like, why is this your best option? Because it's definitely miserable. I feel like they could stop.

J Julienne Stroeve 26:30
You're just stuck in traffic constantly.

L Laura Hewison 26:35
Yeah. I have a question, because I saw when I was doing some of my research that you work with kind of citizen journalists from communities that are around the areas that are going to be most directly affected. But I was just gonna say whether there's more of an

awareness of something that needs to be done within communities that are centrally, kind of around the Arctic and areas where they kind of see, well, being on a regular basis

J Julienne Stroeve 27:07

I would say that, in these indigenous communities that there's a lot of it's gonna vary from community to community. And part of that is is, is some communities are open to resource extraction, for example, because of the money it will bring. other communities want to maintain their subsistence way of life. And so obviously, these changes in the sea ice and just the Arctic environment in general, is having huge impacts on their ability to live the way that they used to live. So I, yeah, I'm not sure. To be honest. I don't remember what your question was

L Laura Hewison 27:46

question was that Yeah, no, it was about whether kind of local communities more aware of having to change things, or

J Julienne Stroeve 27:55

Oh, they're definitely aware. I mean, for example, they used to be able to, you know, keep their food in the ground, and it will stay frozen. But now the ground isn't staying frozen. So they have to buy refrigerators. Even simple things like traveling out on the sea ice, their traditional indicators of what the ice is going to be like, and the weather patterns, that's all changing. And so there's been a lot more accidents on the sea ice, we're hunters get stranded because ice breaks up and they didn't expect it to or it's thinner than they expected to be. So it's definitely impacting their lives and changes all the migration patterns to have the animals that they're hunting. So you know, for example, if if the sea ice breaks up early, and the seals give birth to their pups on the sea ice, but under the snow, then the seals are all drowned. The new pups are all drowned before they're fully weaned, because they're not ready, for example. And so that will have an impact. Of course, on the hunting of the seals. The whale patterns are changing as well. So certainly how the local communities access their food sources is changing. I mean, there's just so many species dependent on the sea ice. And so obviously, as a sea ice changes, it impacts all the species down from the like the small little plankton and ice algae that grow underneath the eyes to all the fish that feed off of that too, then the seals that eat that, then the polar bears that eat the seals, and then it just cascades up all the way through the food chain.

L Laura Hewison 29:19
The great circle of life. Well, there is one question that we ask all our guests on this podcast, and that is to talk about your science hero. Do you have one?

J Julienne Stroeve 29:34
Well, I never really thought about a science hero before. And I guess that term is a bit like hero, I don't know. But I do know who inspired me to do what I do. And that was a professor in the geography department at the University of Colorado that I just randomly took a class from him on climatology, and I had been in the engineering department and he did a lot of fieldwork in Greenland and elsewhere in our glaciers and the photographs that he showed were absolutely amazing. I mean, it just was like, it was awe inspiring. And I remember sitting in his class going, I want to go travel to these places and see these these parts of the world. So, I mean, he was the one who definitely inspired me to get into the research that I'm doing.

S Sophie Lane 30:20
So what are you off to do next?

J Julienne Stroeve 30:22
Well, one exciting project that I have coming up is that the there's this multidisciplinary effort to freeze a ship into the Arctic sea ice for a full year. So the German polarstern is going to be frozen into the ice starting September 2019. And I have a project to put a radar system out onto the ice to help us better understand where the radar signatures coming from as the snowpack evolves, and develops over the sea ice, because we can't retrieve how thick the ice is without knowing how much snow is on the ice. And we don't really know much about this, how the snow and sea ice is changing. And also how its physical properties are impacting radar returns, for example, from satellites. And so I'm bringing an instrument that will be on the ship for the full year. And I have two months of time that I'll be on the ship making these measurements.

L Laura Hewison 31:20
And you'll be snowed in on a ship for all that time.

J Julienne Stroeve 31:25

Yeah, I will be going during the polar darkness. So it'll be very interesting, because I haven't been to the Arctic during winter like that before.

L **Laura Hewison** 31:32
And how many kind of people will be on the ship with you? I'm just interested now.

J **Julienne Stroeve** 31:37
I don't know. Like, I don't know how many people actually it holds. But there'll be lots of scientists from from all different countries. And they, you know, everybody will have different projects, whether it's trying to understand, for example, how much light gets through the ice and how does that impact under ice algae growth of phytoplankton blooms, people that are sampling the water column to look at nutrient supplies, people that are measuring what's going on in the atmosphere. There'll be people from all disciplines coming together to study the Arctic Ocean and its Yeah, and its impacts.

S **Sophie Lane** 32:09
What's it like when you go on like those kinds of field trips Is it like, must be like a really intense community bond of people that

J **Julienne Stroeve** 32:18
it is you get to know people really well, because you're kind of stuck in this confined space and especially in winter isn't really not anywhere. You can go too much anyways, and it'll be dark. So it'd be very cold outside. So I think you're trying to get your research done quickly so that you don't have to freeze too much. But yeah, you it throws you into relationships with people really quickly that you get to know everybody really well. And those friendships can last for a long time, which is really nice.

L **Laura Hewison** 32:48
Well, I hope it is a community of people who are out there and can tell us how we can change the impending doom

S **Sophie Lane** 32:58
Or to work out how to fix it. And just relay that and get back to us.

L Laura Hewison 33:02

Make sure the message gets disseminated. Thank you so much Professor Stroeve for joining us today. That's all we have time for on Hypot-enthuse please join us next for some more maths and physics chat