

Science AMA Series: We're scientists on a boat in the Southern Ocean (Antarctic Ocean) studying climate change, ocean physics and marine biology, Ask Us Anything!

SouthernOceanScience¹ and r/Science AMAs¹

¹Affiliation not available

April 17, 2023

Abstract

Hi reddit, I'm Greta Shum, and I work as a science communicator at Climate Central. I'm out here on a boat off the coast of Antarctica with other scientists who are studying different aspects of the Southern Ocean. In my usual work, I try to communicate the facts about climate change (causes and effects) at Climate Central. As part of that mission, I'm following three science projects that are focused on the state of the Southern Ocean and how it will change in the future. One group is studying ocean physics along the shelf of the Amundsen Sea; one group studies the microbiology and consequent evolution of the phytoplankton in the Southern Ocean, and one group (SOCCOM) studies the carbon chemistry of the Southern Ocean and how it will change in the future. With me are the following scientists: Professor Stephen Riser is a Professor of Physical Oceanography at the University of Washington, interested in the ocean's role in climate, and in deducing the general circulation of the ocean and ocean/atmosphere/ice interactions through direct observations of the ocean circulation. Caitlin Whalen, PhD of the University of Washington Applied Physics Laboratory (APL) is an expert in ocean mixing. Professor Tatiana Rynearson from U. of Rhode Island: My area of research is in marine genomics and population genetics. My goals are to understand the ecological and evolutionary processes shaping genetic diversity in the plankton and to examine how those processes affect plankton community structure, function and productivity in coastal regions. My approach is to identify and exploit the genetic variation that exists within and between individuals to examine how plankton respond to their environment. Professor Sinead Collins from the U. of Edinburgh: I'm interested in how large populations of small organisms adapt to complex environmental changes. Since that's a bit too vague, I focus on how marine phytoplankton adapt to ocean acidification. I use experimental evolution in the lab to figure out the basic theory involved, and then head off to collaborate with oceanographers to apply it to marine systems. We'll be back at 1 pm EST (10 am PST, 6 pm UTC) to answer your questions, ask us anything! Thanks for all the excellent questions! We had a terrific time! If you're looking to keep following us online, check out our blogs here or here.

[REDDIT](#)

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SOUTHERNOCEANSCIENCE [R/SCIENCE](#)

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CORRESPONDENCE:

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Hey! Ive heard that to fund these expeditions, sometimes you will sell cabin space on your vessel. Is This true? And if so, how much would something like that cost? Best of luck in your studies! I am excited to read about your findings!

[A Wandering Quarian](#)

Not true that cabin space is sold on these vessels. But in order to be able to conduct science at sea, teams of scientists submit proposals to the National Science Foundation (NSF). The NSF assembles panels for a peer-review process to review and rank them on scientific merit. Successful proposals are

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awarded grants and ship time in order to conduct their research. This process is very competitive, and it speaks to the caliber of these scientists' work that their proposals were selected for funding. When the lead scientists assemble their teams, there are often opportunities for student scientists or outreach teams to come on board and participate in the research. That's actually a vital part of training future scientists and communicating our research to the general public. In fact, I myself was able to join this cruise because the NSF values these broader impacts of scientific research. It should also be mentioned that this particular cruise is a good example of the NSF's attempt to team together different scientific groups that have differing but compatible goals to make efficient use of limited resources. Often important breakthroughs in science come from these interactions! Greta

For several years, the sea ice in the Arctic has been decreasing. I understand that this is to be expected because of global warming. At the same time, the amount of sea ice around the Antarctic has been increasing. At first glance, this is counterintuitive, and as far as I know there has been various attempts to explain this. This year, the situation is dramatically different, because the sea ice around the Antarctic is very low.

Do you know a theory about the behavior of the Antarctic sea ice that explains both why it has been comparatively high for a number of years, and also why it has plummeted to extremely low values in this Antarctic Summer? Why are things suddenly different?

[MarcelBdt](#)

Hi MarcelBbt,

This is an extremely good question and it is an area of current research. I am not an expert in this field, but I will try to give you a sense for the complexity of the problem and the range of possible factors involved.

To clarify the state of the science mentioned in your question, for a number of years the sea ice extent around Antarctica has been growing in some regions, and shrinking in other regions, with a slightly positive net result. Note that sea ice extent - the area that sea ice covers - is what is often reported in the media. This is different than the thickness, or total mass of the sea ice that is more difficult to measure than sea ice extent.

Sea ice extent in general is dependent on a number of different factors including the air temperature, ocean temperature, ocean salinity, snowfall, strength and directions of the winds, and the strength of the ocean circulation. Some of these relationships are very direct. For example, if the ocean is warmer it will have a tendency to melt the sea ice. Some relationships are less direct, including what we call feedback mechanisms. One of example, less ice could lead to more open water, leading to sunlight warming more of the water, which could in turn lead to less ice. Another example of a complex relationship is that stronger winds could blow sea ice further from the continent opening water for new sea ice to form.

Climate change is affecting many of the different factors that determine sea ice extent. It is warming and freshening the ocean, but also is likely to be changing the winds and ocean circulation to some extent as well. Due to the complexity of the physics it is hard to understand why we are seeing these trends with only a decade or two of information. Anomalous years within a changing climate are also very difficult to explain.

Again, I am not an expert in this particular field - but I hope this provides you with some additional insight into the problem.

Caitlin

What's the most fascinating thing you've learned about the ocean that we wouldn't have heard about?

[Endless_Vanity](#)

One of the most fascinating things I've learned after being ON the ocean is how much is actually moves. When on land, you don't think of it as a churning, moving thing, but when you're out on a boat (that's over 300 ft long!) you realize how active it is. Deep water in the North Atlantic is actually carried all the way to the Southern Ocean, where it upwells and rises to the surface.

Another thing - phytoplankton in the world's oceans produce 50% of the oxygen that we breathe! (Fun fact courtesy of Dr. Kerry Whittaker of Bates College, who is also aboard this ship!) Another cool thing I've learned is how under-observed the Southern Ocean is—especially during the wintertime. That's where floats really shine! They don't care if it's winter or summer, raining or snowing! They keep doing their job even when they go under the ice! Greta

What's the most fascinating thing you've learned about the ocean that we wouldn't have heard about?

[Endless_Vanity](#)

Sinead: One of the coolest things I've learned recently is that phytoplankton are trapped in currents of water, so that they are on an environmental roller coaster around the globe, and they experience a much wider range of environments than you would think based on where you find them. ... unless of course they're stuck in the ACC. I find this cool because the range of environments organisms experience affects how much they can evolve.

Tatiana: The staggering amount of diversity that's present in plankton. In a cup of seawater has dozens of very distinct organisms, which is different from what we observe on land, where we have only plants, animals, and the occasional fungus.... There are also a lot of organisms that can act like plant or like an animal depending on the circumstances - this is like being able to choose between photosynthesizing like a blade of grass, or being a predator, like a lion.

What's the most fascinating thing you've learned about the ocean that we wouldn't have heard about?

[Endless_Vanity](#)

Everyone is familiar with the variety of ways air moves. People experience a gusty wind, feel cold air sliding underneath a door and along the floor into a warm room, or see thunderstorms being blown across a field. As I've spent more time studying the physics of the ocean I've been continually amazed by the diversity of ways water moves in the sea. Only instead of sensing the movement with our eyes or touch, we sense the movement using a vast array of instrumentation and interpret what we see using physical equations. With a little imagination I find it no less breath-taking than seeing the affects of wind with my own eyes.

Caitlin

Dr. Collins: what has been the most notable adaptation you've seen in the phytoplankton in the last several years? Have you observed an expression in nature that you never expected to see out of the lab, whether related to climate change or not? What are the implications of that adaptation, if it exists?

To any of you: if you had thirty seconds to try and convince a denier that they're wrong, what would you say to them? How would you compel them to forsake their conspiracy theories and trust the experts?

[shh_Im_a_Moose](#)

Sinead and Tatiana: The most remarkable thing from laboratory studies we've seen is that phytoplankton have an amazing capacity to adapt to environmental change. So the questions we ask are not whether phytoplankton adapt, but how, and what the repercussions of that could be for food webs and nutrient cycles.

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One thing we were taught regarding marine life in the Arctic is that with the shifting temperatures, the seasonal blooms of algae are occurring at different times than they used to, causing issues with the structure of the food web given the missed timing for other organisms.

How strong is this effect (if present) in the Antarctic, and if it is there, what seems to be the organism most impacted by this?

As a side note, phytoplankton is really cool and I wish more people studied it, especially given its importance.

Good luck with the studies!

[mpcfuller](#)

Sinead and Tatiana: Yes! Phytoplankton are really cool! There is certainly a timing issue for organisms that depend on phytoplankton and their productivity. For example, krill have an annual reproduction cycle, and they rely on food stores (phytoplankton) at specific times in that cycle. The krill have evolved to be at the right place at the right time, so if the phytoplankton show up earlier or later than expected, the krill have a big problem.

1. What kind of boat (pics?) do you have and how long at a time do you stay on it at a time?
2. Is there any chance for the mankind to breed plankton as they currently have fish farms so the world's oceans do not run out of them? If so, and if you are aware of the research that is taking place related to that, can you tell us how far out do you think we are from deploying something like that?
3. What can we do to educate others when it comes to pollution and how it affects our oceans and seas with all the life that is within it? How can we show that it is something that needs to be addressed today rather than several generations from now?

[duniyadnd](#)

Sinead and Tatiana: We're on the Nathaniel B Palmer - you can google for photos. It's about 300 feet

long. Our cruise is about a month. So far we still like each other.

We already grow plankton for human food, and also to support aquaculture. Phytoplankton, like grass, grow quite happily with enough light and nutrients. The ocean is in no danger of running out of them, though the types of phytoplankton found in specific places have a strong influence on food webs and nutrient cycles, and this has the potential to change with climate change.

As for education - stronger engagement with the environment (go outside!) seems to get people interested in learning about conservation. Strong leadership from legislators can also make a big difference.

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I have been waiting for an AMA like this for ages! I actually studied Oceanography and Physical Geography at university!

1. What are the main instruments that you use? What one's are the most useful/least useful?
2. Have you found evidence that suggests that the topographic features of Antarctica can alter mixing?
3. Do you think that climate change will slow down or speed up the Antarctic Circumpolar Current?
4. What immediate effects of rapid ice melting are you noticing?

[satansmum](#)

Hi satansmum, I have answers to your first two questions.

- 1) On this research cruise we are using a number of instruments.

The primary tool is a frame that we lower from a wire from the ship. On this frame we mount a CTD (which gives us temperature, depth and salinity information), fluorometer (measures fluorescence), and

a PAR sensor (measures photosynthetically active radiation). This frame also has 24 bottles that we can close at any depth to collect water samples.

Another tool is ARGO floats. These are autonomous instruments that generate an ocean profile down to 2km every 10 days, and have a lifetime of 2 or more years. They also have a CTD on them. The floats we are deploying on this cruise also have a PH, oxygen, nitrate, and chlorophyll sensors.

The group I am part of is using EM-APEX floats. Like Argo floats, they are also autonomous instruments that collect profiles of ocean properties. They have a lifetime of about a year. These floats can use the electromagnetic field of the earth and the ions in the seawater to measure the velocity of the water. They also have a CTD, and a sensor that measures tiny, centimeter-scale temperature fluctuations.

Each tool is useful for answering particular scientific questions.

2) The topographic features in the ocean surrounding Antarctica definitely do alter the mixing in the Southern Ocean. When mixing is measured in the ocean it is generally stronger near rough bottom topography. In the southern ocean, oceanographers think this happens in two ways:

There is a strong current in the Southern Ocean that circles Antarctica. When this current flows over a seamount this generates waves called lee waves. These waves are thought to help mix the water. Similar waves occur in the atmosphere when air flows over mountains, which people in Colorado can sometimes see these waves in the clouds.

The tides can also slosh water across seamounts, generating what are called internal waves. These waves can then mix the water. The waves you see at the beach exist due to the density difference between the water and the air. The ocean is made up of layers of different density water, with the densest water at the bottom. This allows waves to exist along all this little density interfaces, which we call internal waves.

Caitlin

What are the main goals you want to accomplish with the SOCCOM group?

Also, who approved of that acronym?

[J4CKR4BB1TSL1MS](#)

The ocean is absorbing CO₂ in many places, and the atmospheric concentrations would be much higher without the oceanic sink. Over half of the total CO₂ absorbed by the ocean is taken up south of about 40 degrees S, in the Southern Ocean. This is because the water is cold and comes from great depths in this region, where the water is undersaturated in CO₂. So, it can take up more from the atmosphere. We don't know much about this relatively unexplored region, and we are especially lacking observations in the winter, when much of the action probably occurs. The relationship between the physics and thermodynamics of the circulation and ocean/atmosphere interaction, and the chemistry and biology is the main thing SOCCOM is looking at. The acronym was suggested by our research group and approved by NSF; at the time we were not aware of any other group with the same acronym. Steve Riser

Geochemist here. How closely, if at all, are you monitoring pH levels of the water as you traverse the ocean?

[DoNotTrustMyWord](#)

We have pH sensors on all the SOCCOM floats. Read more about them [here](#). Also, as we sail along toward Antarctica, we're stopping throughout the cruise to do what are called "hydro-casts" or CTD casts. This instrument can collect water from different depths - anywhere from 200 meters deep to 4000 meters - and our scientists measure the pH of the water at that depth. Greta

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[DoNotTrustMyWord](#)

Tatiana and Sinead: We're continuously monitoring the pH levels as we go for the surface ocean, using a sophisticated flow-through system on the ship. We pair this with discrete measurements that allow us to measure vertical profiles going down hundreds or thousands of meters.

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(This question is mainly directed towards Professor Riser and Caitlin)

Hello! I am a hopeful Oceanography PhD applicant, and I am wondering how large an impact the incoming Trump administration will have on the ability to successfully complete a PhD and go onto further research. What are your current views as researchers within the field concerning the future of funding etc. with Trump?

[Crimmy12](#)

In my experience with graduate students, the ones who do the best have a degree in a basic science such as physics (or astrophysics), chemistry, or biology. Most good graduate programs in climate science don't assume you know very much, but that you have a good basic science and mathematics background. It is much easier for me to teach you climate science if you already understand physics than it is for me to teach you physics itself. I think your background is ideal for a graduate degree in climate science. If you have a chance for some summer internships involving climate in some way that would be a good way to get into the field and make a link between your background and climate science. Steve Riser

If someone wanted to follow in your footsteps, what are some things they would need to do in terms of schooling and education. I've always been fascinated with the ocean and climate change.

[Leethorne](#)

If you're interested in pursuing scientific research as a career, you can look for opportunities to get involved in research as soon as high school or undergraduate studies. That kind of experience helps when applying to graduate programs in earth and ocean sciences. For example, there's one undergraduate student aboard the N. B. Palmer right now funded by [this program](#). Take every

opportunity you can to explore the fields that you like, and getting out in the field can help you determine exactly which area of study is right for you! The scientists on this cruise are from all different academic backgrounds and departments. You can choose to take courses in biology, chemistry, physics, oceanography, or geosciences. All of the fields overlap and earth and ocean sciences are very interdisciplinary. As a chemist, you'll be learning a lot of physics and biology along the way... just keep an open mind! Greta

Hi, I'm from New Zealand!

Professors Collins and Rynearson, what is the process for determining the experimental pathways of evolution for plankton, which are you expecting to apply, and how would that affect the ecology of the Southern Sea?

And to you all, how is ocean acidification, ice melting, and overall warming shaping the new evolutionary options for the native inhabitants of those Oceans and the Antarctic continent?

Thanks! Super interesting work!

[lugong](#)

Sinead and Tatiana: To measure the evolutionary potential of Southern Ocean diatoms, we're isolating diatoms from many different parts of the Southern Ocean and bringing them into the lab to measure how they evolve in response to different environmental changes.

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I am curious about Coral Reefs and how they are affected by Ocean Acidification. Are we able to grow corals which are resistant to changes in ocean pH and can these replace the dead/bleached coral? Does the species of coral have a big effect on what fish populate the area? Also, how will the loss of coral affect the ecosystems throughout the ocean? Thanks :)

[Zero2Heroo](#)

Great question! Corals are very affected by ocean acidification. As you may already know, carbonic acid in the oceans makes it very hard for corals to grow; warmer ocean temperatures are also causing something called coral bleaching, which doesn't immediately kill the coral, but it keeps them from being able absorb nutrients. Already, 1/3 of the Great Barrier Reef is dead. There are some groups that are trying to find ways to solve this problem, as coral reefs are home to incredible biodiversity, including a

group at [Stanford](#). Here's a [video](#) I made that explains the problem and this attempt at a solution! Greta

Thank you for doing this AMA and for the incredibly important work you are conducting. My question is this: What can we ordinary folk do to combat climate change- in practice, and socially (what can we say to climate change deniers to get through to them?)

[9dot5](#)

It's important to stick to the science when it comes to climate change. There are a lot of reliable resources out there (and a lot of unreliable ones). NOAA and NASA have a lot of excellent publicly available data that you can use to refine your own understanding of what's going on right now. But, when it comes to "convincing others," it's best to lead by example, taking steps to reduce your carbon footprint and sharing information - scientific papers, reliable news sources, and objective science sources. Greta

Hello and thank you for doing this AMA!

What is it like to be on a boat in one of the harshest climates on Earth? Does it take a toll on you mentally? And what is one challenge that you face during your studies that the general public might not be aware of?

[D_C44](#)

The vast majority of the tools we're using - microscopes, computers, and test tubes - are all designed for use on land in laboratories. So it's definitely difficult especially if you've never been on a research vessel before. Seasickness is a real thing. We've just crossed the Drake Passage, a slice of the Southern Ocean where currents flow uninterrupted around Antarctica. They call it the "roaring 40s" for a reason. As we crossed this passage, we still performed hydro-casts and deployed floats. They had to be done at specific locations, which meant they took place at any and all hours of the day and night, and that can be exhausting, yes. But aboard the ship, you are able to spend time talking and sharing ideas with other people aboard the ship, which has been very rewarding. Greta

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Has the climate change had a positive effect on the population of any organism out there? If yes, then

how has it affected the rest of the ecosystem?

[nakoktee](#)

Tatiana and Sinead: Climate change affects organisms differently, so that the relative size of populations can shift. In the lab, we see that some phytoplankton (mainly cyanobacteria) grow faster when there is slightly more CO₂ in the environment, while other organisms, such as diatoms, are pretty insensitive to changes in CO₂. However, climate change is not only CO₂, so one of the big challenges we're facing is understanding how organisms respond to many aspects of the environment (temperature, CO₂, salinity) changing at once. Changing the composition of phytoplankton community can have large effects on food webs.

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My son is nine, and just getting into the majesty that is the oceans. He would like to know if you have come across anything unexplainable, or weird. I would like to know how awesome is your job? Do you love it?

[talyn5](#)

We do feel collectively that our job are awesome! It's especially great when you get to go to a place as important and un-observed as the Southern Ocean. Anything weird or unexplainable? Dr. Kerry Whittaker says, "studying extremely diverse organisms means that we come across many that we can't identify, especially on a moving ship!" Greta

Watched Antarctica: A Year on Ice. It is fascinating. Sorry to bombard you with a list of questions.

1. How big is the boat?
2. How many people are there on the boat?
3. How long do you stay on the boat at a time?
4. How do you deal with the rubbish?
5. What do you do during your free time?

[-LifeOnHardMode-](#)

the ship we are on, the Nathaniel B. Palmer, is 300 feet long and displaces about 6200 tons. there are about 20 scientists and 25 crew members. we will be on the ship for about one month. dealing with waste is a big issue, and great care must be taken with it. all waste is separated into several varieties

and saved, then eventually taken to New Zealand where it will be disposed of. Nothing gets disposed of in Antarctica. There is not much free time. Eat/sleep/work is the cycle, with lots of 19-hour work days. We can sleep when we are finished. Steve Riser

Woohoo, finally! An AMA relating to my career path! :D

(My question may be fairly long, but I'll try my best to condense.) Given that climate change has absolutely devastated not only our land but our oceans as well, it's been said that the levels of ocean acidification caused by our increase in carbon dioxide emissions has not only begun to wipe out even the smallest (and most important) ocean life such as plankton/zooplankton, but even species such as coral reefs and starfish. What is our current prediction on how much time we have left before these creatures are completely wiped, and how badly will this affect our research on the discovery of new ocean life in parts of the ocean we haven't even explored yet?

[mermaidmel16](#)

Sinead and Tatiana: While we don't expect phytoplankton to be wiped out, the prevalence of some species will probably change, which can have huge impacts on food webs. Given what we know about plankton evolution, they're already evolving to respond to climate change.

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(My question may be fairly long, but I'll try my best to condense.) Given that climate change has absolutely devastated not only our land but our oceans as well, it's been said that the levels of ocean acidification caused by our increase in carbon dioxide emissions has not only begun to wipe out even the smallest (and most important) ocean life such as plankton/zooplankton, but even species such as coral reefs and starfish. What is our current prediction on how much time we have left before these creatures are completely wiped, and how badly will this affect our research on the discovery of new ocean life in parts of the ocean we haven't even explored yet?

[mermaidmel16](#)

Sinead and Tatiana: While we don't expect phytoplankton to be wiped out, the prevalence of some species will probably change, which can have huge impacts on food webs. Given what we know about plankton evolution, they're already evolving to respond to climate change.

Is there evidence of Antarctic sealife evolving in response to climate change?

Given the predicted temperature rise of 2-3 degrees Celsius by 2100, how much of Antarctic wildlife is expected to survive climate change?

Thanks for holding this AMA :)

[ReconWhale](#)

Sinead and Tatiana: There is very little work looking at evolution in Antarctic sealife. The Antarctic is an extreme environment, and hard to get to (and hard to work in). Most studies look at physiology, but ours is one of the first projects that is studying evolutionary responses to climate change in Antarctic sea life.

Can you tell me anything about the role the Milankovitch cycle plays a role in changing the

earths ocean climates and patterns

[potheticjustice](#)

it is generally thought that the milankovich cycles have a lot to do with non-anthropogenic climate changes. glacial cycles seem to correlate somewhat with these cycles. the 3 parts of the MC are the change in the tilt of earth's axis, the ellipticity of earth's orbit, and the phasing between the earth's distance to the sun and the tilt (the so-called precession of the equinoxes). these cycles occur on time scales of 20 thousand to 100 thousand years. sediment cores, ice cores, and tree rings can be used to examine these questions. Steve Riser

I'm a physics with astrophysics undergraduate with quite an interest in both the climate and biology, but I don't have any formal qualifications or experience in either of these fields. How did you folk (in particular those specialising in physics) get to where you are now? Any tips or suggestions for ways that somebody like myself could perhaps get themselves involved in this sort of area?

[poobatron](#)

In my experience with graduate students, the ones who do the best have a degree in a basic science such as physics (or astrophysics), chemistry, or biology. most good graduate programs in climate science don't assume you know very much, but that you have a good basic science and mathematics background. it is much easier for me to teach you climate science if you already understand physics than it is for me to teach you physics itself. i think your background is ideal for a graduate degree in climate science. if you have a chance for some summer internships involving climate in some way that would be a good way to get into the field and make a link between your background and climate science. Steve Riser

Howdy everyone!

Professor Sinead Collins; my goal as an up and coming chemical engineer is to break down plastics and overgrown algae in the Chesapeake Bay. How could breaking down such substances affect the ecosystems around the substances, and how hard would it be to keep those newly made compounds (from degradation) from messing up the water balances?

[squidgymon](#)

Sinead: Microbes can evolve to use almost anything as a food source, but this always produces some sort of breakdown product. One of the risks of bioremediation is that it is difficult to predict the effects on food webs, but we have to weigh that against the risk of not doing it.

Will rising sea levels affect us in our lifetime ?

[thatpersontho](#)

Rising sea levels are already affecting us. Some Pacific Island nations that are only a meter or two above sea level are already seeing their surface area decrease. In the US, there have been cases of flooding at high tide in Miami Beach and other east coast US cities. these events are unprecedented and are harbingers of things to come. if sea level continues to rise at the present rate, a lot of coastal cities will be affected in 25 years in some way. Steve Riser

How can I respond to conspiracy theorists who claim the ocean temperature readings over the last few decades are invalid? (They claim this invalidity is due to the temperature only being measured on the surface, being measured at different times of the year, etc.)

[Wolves2112](#)

my colleagues and i in the international Argo program have been measuring global ocean temperatures from the sea surface to a depth of 2000 meters for the past 15 years. we are honest people with no axe to grind. i'm interesting in finding out what the ocean is doing, whatever that might be. Argo data have shown unmistakably that the upper few hundred meters of the ocean have warmed in most places, although in a few places the ocean ocean has cooled. overall the upper 300 meters of the ocean is about 0.2 degrees C warmer than it was 30 years ago. there is no doubt about this, and there's no conspiracy. nobody has altered any data. i know that because i collected it myself. this change of 0.2 deg C over 30 years is equivalent to about 0.5 watts/meter² imbalance in solar radiation, about what the climate models show. i'm pretty confident in this result, and there's no deception here. Steve Riser

My question is for Prof Riser and Dr. Whalen...

We hear a lot about the melting of the undersides of the ice shelves, especially in West Antarctica, and the potential to 'unplug' glaciers and contribute to sea level rise. Apparently the melting is due to warmer currents coming up and flowing under the shelves. It seems like this may be a new effect, but I haven't seen a whole lot about the possible causes.

Do we have a good idea of why this is happening? Also, do we know how fast these currents flow, and whether there is a seasonal cycle?

[sciencemercenary](#)

there are a lot of people thinking about your questions right now. however, presently it is nearly impossible to observe things under the ice shelves in a way that is useful. it is possible to drill down from the surface of the ice and insert instruments into the hole, but this is really expensive and there's a limit to what it can tell us. i think your question is one that will likely be addressed in a significant way in the next 10 years using some type of deep-sea robotics, but the technology to do this is not quite there yet. stay tuned....this will happen in a few years. steve riser

Have you ever seen a narwhal?

[brandonasmith97](#)

I have never seen a narwhal - I would love to though! Maybe I'll do a project in the Arctic next....

Caitlin

Do you use big data methods? What fields of physics use it? Do you think it can be used for physics?

[not_a_fangirl](#)

"big data" and climate science are becoming more connected all the time. we have a tremendous amount of data available to us from satellites, ships, Argo floats, and coupled climate models, and figuring out how to use and combine all of this can be a daunting task. big data techniques are likely to be a big help here, but there are not many climate scientists trained in these topics. a number of

universities with climate programs have started big data programs in their computer science departments, with climate scientists starting to participate. in the future, new students will have the option of learning these things, and eventually this will be a major area in the study of climate.. Steve Riser

(These questions are for Professor Sinead Collins.)

1. Is the experimental evolution in your laboratory in vivo or in silico?
2. What adaptations did you expect see in the phytoplankton?
3. Are there any adaptations you've observed so far since going there?

Hope you guys stay warm!

[pmmeurmoney](#)

Sinead and Tatiana: The experimental evolution in my lab at the University of Edinburgh uses both phytoplankton cultures and computer simulations. I've also done some work in natural populations enclosed in marine mesocosms that are close to shore.

Phytoplankton are very good at adapting to environmental change. Here, we expect that adaptations be directly related to being able to grow in warmer temperatures. We know that they'll adapt, but what we don't know is what the mechanisms are - so to us, the fascinating question is what mechanisms are going to be responsible. Here, we're looking at the joint roles of genetic diversity in populations and the ability of individual cells to respond to change in evolutionary responses.

So far, this is just the beginning. We're isolating diatoms to take back to our labs, but the whole project will take another 3.5 years of work to complete.

I've heard recently that Antarctic Ice is at an all time high.

- Is that true?
- What is the explanation for that compared to the shrinking of the Arctic Ice?

[doeldougie](#)

It's true that Antarctic sea ice has had an upward trend recently (although it [took a dip in 2016](#)), while Arctic sea ice has been declining dramatically. The scientific community has not reached a consensus on why that is. Greta

Has anyone on the crew ever seen a rare green flash at sunset?

How often does your crew experience strange encounters for which they have little or no explanation?

What is the most frightening thing about your expedition, for each crew member?

[Prankishbear](#)

yes, i have seen the green flash 4-5 times in the past 30 years. it is very rare. the sky has to be perfectly clear, with no clouds, even on the horizon. it is an interesting sight to see. after the green flash there is supposedly a purple flash, but i've never seen that one. here in antarctica there won't be a green flash because there are way too many clouds. steve riser

What evidence to back climate change have you found?

[MasterBet](#)

Evidence for climate change is extremely vast, spanning numerous fields. A synthesis can be found in the [IPCC summary for policy makers](#)

Have you made contact with Desmond yet?

[solvorn](#)

Not yet, Brother. Greta

Are you on the Palmer, or the Gould?

[Dame Juden Dench](#)

we are on the Palmer, presently just west of the Antarctic peninsula. steve riser

Dr. Whalen: What changes have you seen in the salinity and temperature difference of sea surface and deep sea levels. Are the ocean currents showing any signs of changing physical traits like speed or sinking?

[mapmaker1979](#)

In general the ocean is becoming fresher and warmer. We even see the ocean warming many kilometers down in the deep abyss! Ocean current changes are much harder to detect because the current strength can vary dramatically over even just a few weeks. We'll need more measurements to be sure of the overall trend in the changes in ocean currents.

Caitlin

Hi. Thank you for doing the AMA. I have just completed high school and would be going to college next year. I had a few questions I wanted to ask:

- 1) What is a day in the life on a boat like?
- 2) How often do these studies occur and how long do you stay on the boat at a time?
- 3) As someone from a country where ocean science is hardly emphasized, what could I be doing to follow your career path?

Also, 4) What is the most terrifying thing you have witnessed due to climate change?

[rainingnovember](#)

Best of luck at college next year! 1) A day in the life on a boat is always different. Specifically on the Palmer, now that we've begun to collect data, there are lots of samples to study, floats to prepare and deploy, and plenty of interesting people to talk with. It feels a little bit like doing science in space. 2) Some cruises are as short a few days or weeks, and some are as long as three months. You can find out more about them on NSF's website. 3) Really glad to hear you're interested in ocean science when

it's not emphasized. You might (or might not) be surprised to hear that many ocean scientists are from landlocked places where no emphasis was placed on ocean research! Reach out to organizations or people who are doing research you're interested in and try to find ways to participate if that's what interests you. Seek out professors at college who are doing work that you find exciting and ask about research opportunities. 4) Don't have an answer for this question. Greta