

Editor's Note

Dear ECR Community,

We come to you with our very first issue of 2025 with special focus on ocean warming. The unabated warming of the planet is pushing all components of the climate system into new, never-before-seen territory. Dramatic changes to the oceans are now taking place, including the continued warming of waters across the global ocean. The ocean, with its tremendous thermal inertia, provides the decadal and centennial time scale memory to the climate system. Remarkably, 67% to 98% of all anthropogenic heat has been absorbed by the Southern Ocean alone!

This warming of the ocean directly impacts the planet's temperature and sea level rise, underscoring the critical role our oceans play in regulating Earth's climate. In this issue, we feature four interviews with early career researchers who specialize in studying ocean warming. They discuss their work, inspirations, career pathways in science, future directions for the field, and their roles within it!

Aditya Narayanan

Narratives of Outgoing ECS members

"I joined the IAPSO ECS committee in July 2019, during the 27th IUGG General Assembly in Montreal. The committee has been a place of friendship since. A group of people I like to see again—at our quarterly visio meetings and above all at IUGG / IAPSO in-person conferences. A team that makes you feel part of a community. That gives meaning to our sometimes lonely scientific work—it has even been a safety net during covid lockdowns. The committee's concrete achievements towards helping early-career oceanographers are many. Realizations include social events at conferences, dedicated channels communicating relevant news and opportunities, and cooperation with the IAPSO Executive Committee, all contributing to a more welcoming and diverse ocean science community. I have learnt a lot from these activities. I have also learnt that friendships and teamwork are what keeps us stubbornly alive."

- Casimir de Lavergne, LOCEAN Laboratory, Sorbonne University, Paris

Ocean Warming: Narratives of Early Career Scientists

Svenja Ryan

Scientist at the Woods Hole Oceanographic Institution

Introduction to Oceanography or Earth Science: What sparked your interest in the ocean? Were there any key influences or events that directed you toward this field? I somehow always liked the ocean, despite not growing up

close to it. Family vacations typically involved being near the



ocean. I learned how to windsurf when I was eight years old. Not coming from a family with an academic background, however, being a scientist or even the fact that there is a job called 'Physical Oceanographer' was not something that I thought about until after I finished school. I always liked physics and math at school, so when I started looking for potential subjects to study, while I took one year off after school to do work-and-travel, I came across the undergraduate program 'Physics of the Earth System' in Kiel, Germany, which sparked my interest. Then it became obvious to me fairly quickly that I wanted to do oceanography. I was fascinated by how much there is still to explore in the ocean and the many unknows.

Motivation and Inspiration: What motivates your research? Is it curiosity, the beauty of the ocean, its impact on society, or another reason?

A large part of it is curiosity and fascination with the ocean. I still think it is so cool, when you go out to sea on a research vessel, take deep CTD profiles and see how temperature and salinity change rapidly at hundreds or thousands of meters in depth, indicating transitions between water masses.

During my PhD, where I worked on warm water transport toward one of the largest Antarctic Ice Shelves and was lucky enough to join three expeditions to the Weddell Sea on the German icebreaker *RV Polarstern*, I was certainly hooked by the beauty of the polar regions including their sea life but also their role in the global systems. Again, it is unimaginable but also so cool that the waters that are being formed on the continental shelf – the Filchner Ronne Shelf – are amongst the densest waters in the global ocean, ultimately occupying the abyss.

How have these motivations evolved since your early days in the field?

For my postdoc, I purposely shifted my research focus to Marine Heatwaves, in order to do science with a more direct impact on society. Being located on Cape Cod, or the Northeast U.S. in general, where fishing plays an important recreational and commercial role in society allows me to do that, which is great.

Details on Current Research: Can you discuss your current and past work on ocean warming?

From the beginning on, I was interested in investigating the depth structure of marine heatwaves and associated drivers, as the majority of studies at that time had focused on surface properties and statistics of marine heatwaves



due to the continuous satellite records of sea surface temperature.

For my work off Western Australia, I used global hindcast simulations from the ocean model NEMO (Nucleus for European Modelling of the Ocean; provided by Geomar in Kiel, Germany), which included sensitivity simulations that allowed a separation of wind-induced forcing and buoyancy forcing. A composite analysis revealed a strong symmetry in the vertical structure between cold and warm extreme events. Temperature anomalies are largest at the surface, where buoyancy forcing is dominant, while wind forcing drives anomalies at depths up to 300m. I show that large-scale subsurface anomalies associated with Ningaloo Niño arise from a vertical modulation of the thermocline during La Niña superimposed by a local thermocline deepening due to a coastal downwelling wave generated by the seasonal reversal of monsoon winds. Warm events during neutral or El Niño phases are predominantly limited to the surface and driven by local ocean-atmosphere feedbacks.

Later, my research focus shifted to the Northeast U.S. continental shelf and Gulf Stream region, which experienced accelerated warming over the last decade, resulting in multiple marine heatwaves with severe impacts on the ecosystem as well as the economy. Here I utilized NEMO simulations, with a high-resolution nest over the Atlantic, as lower resolution simulations were not capable of capturing key dynamical ocean features in the region. We found distinct types of events, from surface-intensified to full depth to subsurface intensified events. Intensities at depth are generally about twice as large as at the surface and co-occur with positive salinity extremes about 80% of the time. These marine heatwaves are associated with warm intrusions of waters originating from the Gulf Stream due to the interaction of warm core rings with the shelf break.

What unexpected challenges or findings have you encountered, and how did you address them? Could you describe the journey your studies generally took from start to finish?

Overall, I quickly realized that I needed to understand the regional oceanography, it's variability from seasonal to decadal variability and long-term trends, in order to really understand drivers of marine heatwaves, which has shaped my research since. Furthermore, to me now the definition of marine heatwaves poses many challenges which need to be weighed carefully depending on one's application. Hence, my interest has evolved to understanding the Northeast U.S. continental shelf as an integrated system. Currently, I am working on a NASA project, investigating the role of salinity for the stratification on the Northeast U.S. continental shelf and just recently funded NASA project will focus on the use of SWOT (Surface Water and Ocean Topography) to study to coherence/leakiness of the shelf circulation spanning from the Labrador Sea down to Cape Hatteras. Furthermore, we started collaborating with regional fishermen, who will be equipped with CTDs to collect hydrographic data in our coastal ocean and we can hopefully help the fisherman by providing information about ocean conditions, potential climate change signals but also variability on various timescales.

Did you begin with clearly defined research questions and systematically address them, or did your study evolve more exploratorily, with adjustments to your questions and methodologies along the way?

In the past, my studies have often evolved from exploratory analysis, which, I believe, stemmed a little bit from the nature of the observational data that I used during my PhD, which was sparse and allowed the exploration of every detail in the dataset. However, it was and is very important to me, to always find a coherent story in my studies, even if that meant leaving out some analysis that actually showed some interesting results. When I started working with model output, I faced the challenge of having to be a little bit more strategic in my data analysis, because it is very easy to get lost in such a dataset. Carefully drafting research questions and a strategy plan for analyses is still something I want to get better at in the future.



Image: Svenja at an art show by Deb Ehrens. This was a collection inspired by the scientific work on marine heatwaves. Image credits: Deb Ehrens. To learn more, see here: <u>https://debehrens.com/marine-heatwaves</u>

Career Path and Challenges: Describe your career path in science. What significant challenges have you faced, and what successes have you celebrated?

I did my Bachelor in 'Physics of the Earth System' and Master in 'Climate Physics', both in Kiel, Germany. Those programs were tailored to do academic research, where we had to go through the necessary math and physics in the beginning (about 50% of the class dropped out during that) but then had early introductions to

oceanography, fluid dynamics etc. as well as learning to code. The program was great but also required a lot of studying and weekly mandatory assignments. Furthermore, I had to work as well during that time and got married during my Master's – which sometimes was a challenge to juggle everything.

During my Bachelor's, I did an internship at the Alfred-Wegener-Institute, from which the chance arose to go to Antarctica for fieldwork on the *RV Polarstern* twice during my studies and ultimately also lead me to my PhD position. It was not until probably the second half of my PhD, that I really started thinking about how to actively shape my career in science or if academia was even the right path. I recall many, many discussions with my office mates and other peers about challenges of academia, both from a professional but also a personal aspect. I believe having a good support system, where you can openly discuss challenges is very important – you will be surprised how many of your peers have similar concerns and challenges that they are facing. Finishing your PhD often mainly takes perseverance. It helped me to tell myself that it did not have to be perfect, our work is never finished.

For my postdoc, I knew that I wanted to go abroad. It would have been the easier /more comfortable route at that time to stay in Germany. However, it was often communicated that you have to leave in order to come back. This is certainly true for professor positions in Germany, which has a kind of strongly hierarchical academic system. I was lucky that I have a partner who was going to follow me wherever I was going to end up, but I understand that not everyone can just leave their country for various reasons. I started looking for advertised postdoc positions and also used conferences, in particular the Ocean Sciences meeting in the final year of my PhD, to reach out to people about postdoc opportunities. I had done some research online to find people, who I would be interested in working with and contacted them before the meeting. That was kind of daunting, but it worked very well and I can advice everyone to not be too shy to just introduce yourself. In the end, I would have had the chance to go to Hawaii, Scotland or the U.S. for a postdoc. I chose the U.S. because I received a fellowship from the Alexander von Humboldt foundation, which just offered the best package, in particular in terms of family support and I guess was the most prestigious option for my CV.

Soon after I started my postdoc, I had to again think about next steps – it gets tiring. Trying to figure out where one wants to live, where one might get a job, will the partner/family be happy and so on... I ended up applying for only the jobs that I really was interested in, which was three at that time. 1) A Junior Professorship at Geomar in Kiel, Germany, where I studied 2) An Assistant Professor Position at the University of Maine, in the U.S. and 3) An Assistant Scientist position at the Woods Hole Oceanographic Institution, where I did my postdoc. I am not going into all details here, but I did end up getting an offer for all three positions (not all at the same time though) and had to make choices. I did end up staying in Woods Hole.

Just like many, I believe, I often think that everyone else around me is much smarter than I am but at this point I was proud and had gained confidence by going through the applications and interviews and having positive outcomes.

Reflecting on your journey so far, what advice would you give to yourself at the start of your career?

Looking back so far it is easy to say that things somehow will work out in the end. The main advice I can give is to try and pave different paths and keep options openmany factors influencing which path we follow are actually out of our control. Furthermore, I realized that each path likely looks very different and it is hard to decide which one would be better than the other, they are just different with different pros and cons, but likely they all will be fine, we simply have to try to find out. This sounds easier said than done, it takes courage to make an active decision.

Future Directions: What future directions are you considering for your career, and what goals do you aim to achieve?

I am now on a tenure-track position and am starting to build my own lab. I still feel like I need to find my niche in the field but am hoping to refine that over the next few years, where I am writing my own research proposals, including field work. I am hoping to have a small group with students and postdocs, which combines sea-going oceanography with the use of other datasets, such as remote-sensing products, output from ocean models and other gridded datasets. I also hope to become more interdisciplinary, allowing to really tackle the impact side of ocean warming and other changes in the climate system.

Where do you see the field of oceanography heading in the next decade, and what role do you hope to play in it?

I believe more interdisciplinary work is needed as well as large group efforts. We need big, coordinated programs that advance our capabilities to observe the ocean in a sustainable way. Observations continue to be a crucial part of understanding our climate system, despite the growing computational resources. I hope to act as a link between the observational and modelling communities.

On the regional scale, I hope to contribute to regional observatories with an adaptive sampling component, such as gliders or AUVs which can target certain transient oceanographic features but also contain biogeochemical measurements to advance our understanding of ecosystem impacts and hopefully contribute to a more efficient and flexible ecosystem management.

I also have the pleasure to be involved in a wonderful art-science collaboration, which has been a great tool to do community outreach. I am hoping to continue

Personal Interests: Outside of science, what hobbies or passions do you pursue? How do these activities influence or enrich your life? In your opinion, how does downtime impact creativity in your work?

During high school, Bachelor and Master I did track and field on a competitive level and in general I always loved sports. This helped me a lot by providing a community outside of school and university (in Germany sports are typically done on a club level) and obviously by keeping me fit physically. Furthermore, we have a dog, who always kept us busy and 'forces' us to spend a lot of time outside.

Now we also have a 3.5 year old son, who keeps us plenty busy. It is challenging working full-time, pursuing a career and making enough time for family, however, I think it helps me to come home in the evening and for the weekend and to kind of be forced to switch off my brain and not think about work too much. It helps me keep perspective of important things in life.

Two years ago, I started with CrossFit, which I really love, and which gives me a lot of strength, not just physically but also mentally. After not being so active during my PhD and becoming a mom, this has been a game changer. It takes some effort to make time to go regularly, since my days now are always packed with work, family and daily chores. However, when I go, I am much more energized afterwards, so I am trying to make room to take care of myself.

Saranya JS

Doctoral Candidate, Ocean Observation Laboratory at Seoul National University, South Korea

What sparked your interest in the ocean? Were there any key influences or events that directed you toward this field?



My association with the ocean was inevitable because I belong to the coastal state of Kerala, India, which has a long coastline along the Arabian Sea. Additionally, my home is very close to the coast, which led to my connection with the ocean from a very young age. From childhood, I've been mesmerized by the ocean's beauty. However, it was in my college years that I truly realized its profound impact on human life. During my studies, I explored the ocean's astonishing capabilities and pivotal role in shaping our daily existence. Learning about its crucial role in regulating global climate patterns and influencing weather phenomena sparked a deep curiosity and passion for ocean science within me. My focus shifted towards understanding ocean warming, a critical aspect of climate change. During this time, I came across Dr. Roxy Mathew Koll's research on Indian Ocean warming. I was inspired to reach

out to him. Dr. Roxy introduced me to the "Marine Heatwaves" concept, and his guidance paved the way for my research journey.

Motivation and Inspiration: What motivates your research? Is it curiosity, the beauty of the ocean, its impact on society, or another reason? How have these motivations evolved since your early days in the field?

Oceanography really grabbed my attention because of how mysterious and important the ocean is. Even though it covers most of our planet, there's still so much we don't know about it due to its inaccessibility. That's what keeps me interested. My advisors also encouraged me to explore this field more. When I started my PhD at Seoul National University, my advisor, Prof. Sung Hyun Nam, became a big inspiration. His passion for research pushes me to do my best. I learned that being motivated and doing good research is as important as communicating the research with society.

Could you describe the journey your studies generally took from start to finish? Did you begin with clearly defined research questions and systematically address them, or did your study evolve more exploratorily, with adjustments to your questions and methodologies along the way?

I began my research journey at the College of Climate Change and Environmental Sciences, where we explored the impacts of climate change on various sectors. Ocean warming and its significance always intrigued me, so I decided to focus my research on oceanography. That's when I reached out to my advisor, Dr. Roxy Mathew Koll at the Indian Institute of Tropical Meteorology, who introduced me to the concept of "Marine Heatwaves" – a relatively new idea at the time. I was particularly drawn to the framework provided by Hobday et al., 2016, as scientists were increasingly concerned about ocean warming and its effects on marine and human systems. Marine Heatwaves offered a fresh quantitative approach, and I began working on it in 2020.

Being new to the field of oceanography and Indian Ocean Marine Heatwaves, I thoroughly enjoyed the process of exploring them. My research questions were clear, and I embarked on the journey with an idea of what I wanted to achieve. Throughout my master's project, I found immense joy in the research process and even contributed to understanding Indian Ocean Marine Heatwaves. Fortunately, I also met my life partner, a passionate researcher in this field.

Details on Current Research: Can you discuss your current and past work on ocean warming? What unexpected challenges or findings have you encountered, and how did you address them?

I am fortunate to have joined as a doctorate student in the Ocean Observation Laboratory at Seoul National University, South Korea. Our lab works on collecting and analyzing in-situ data from the global ocean. After joining the lab, I became more attached to this field. My advisor, Prof. Sung Hyun Nam, and his passion for physical oceanography always inspired and motivated me. My current research focuses on the dynamics of Marine heat waves and how other ocean extremes interact dynamically with them, shaping the subsurface layers of the ocean. Currently, I am also in charge of monitoring the real-time ocean observation buoy (ESROB) on the east coast of Korea. As a member of the Ocean Observation Lab, I am fascinated by observation techniques and the importance of such knowledge in accurately representing and predicting the real situation of the ocean. I am proud to call myself an ocean researcher.

Career Path and Challenges: Describe your career path in science. What significant challenges have you faced, and what successes have you celebrated?

Transitioning to physical oceanography from an interdisciplinary background in climate change posed initial challenges. The significant obstacle I faced was bridging the knowledge gap and acquiring the necessary skills to become a researcher and ocean observer. However, my passion and the continued support from my advisors and life partner helped me overcome this challenge and publish my research articles in peer-reviewed journals. Contributing to ocean science has been one of the happiest moments of my life! I am very fortunate to live the life of an ocean researcher. Reflecting on my journey so far, I believe that the life of a researcher should be selfless and driven by pure passion and curiosity, with achievements being secondary. This approach makes the journey of being a researcher more fulfilling.

Future Directions: What future directions are you considering for your career, and what goals do you aim to achieve? Where do you see the field of oceanography heading in the next decade, and what role do you hope to play in it?

I aspire to establish myself as a dedicated and impactful ocean researcher, contributing meaningful insights and advancements to the scientific community. I aim to undertake in-depth and inspiring work across various domains within oceanography, spanning from physical oceanography to interdisciplinary studies. Looking ahead, I believe that the field of oceanography will experience a transformative decade characterized by significant progress in real-time ocean observations and innovative research methodologies. I am excited to be part of this new era in ocean sciences, leveraging my expertise and passion to contribute to

research. I am committed to continuous learning, growth, collaboration, and exploration in the dynamic field of oceanography.

Outside of science, what hobbies or passions do you pursue?

I enjoy drawing and painting. I believe that science should be accessible to everyone, not just scientists. That's why I use art to explain my research to people who might not have a scientific background. Schematics, in particular, allow me to convey scientific concepts without relying on technical jargon or complicated explanations. They help me see connections between seemingly unrelated ideas and inspire new thoughts in my research. Through art, I find a way to express myself, think, and communicate scientific ideas effectively to a broader audience.

Announcements

- <u>Postdoctoral Research Scientist Position</u>: Ocean Biogeochemical Modeling at NASA GSFC.
- EGU25 call for abstracts; deadline on the 15th of January, 2025.
- <u>Postdoctoral researcher position</u> available in the Complex Fluids Research Group at KTH, with application deadline on 31st January 2025.
- <u>GOOD-OARS Summer School</u> on ocean deoxygenation and acidification.
- <u>12 Postdoctoral/Researcher positions</u> at JAMSTEC, Tohoku Japan.
- Webinar on "<u>Ocean-Driven Solutions for a Sustainable Economy and Resilient</u> <u>Communities</u>" of the EU Ocean Data Series, scheduled for 15 January 2025.
- <u>Course on Ocean/Atmosphere Time Series Analysis</u> for PhD and Postdoc researchers by Dr. Jonathan Lilly, University of Hamburg.
- <u>Postdoctoral position</u> on "on the cycling of components of the labile dissolved organic matter (DOM) pool in the ocean" at the University of North Carolina.
- <u>Postdoctoral position</u> on the West Greenland Boundary Current at WHOI.