

Below the Surface

An interview with Sabrina Speich

by Kristel Chanard & Mélanie Cournil

The havoc wreaked last year by Hurricane Harvey was yet another example of the devastating effects of climate change. Many ignored the role of the ocean in fueling the tropical cyclone. Yet acknowledging its importance in climate change is vital if we want to save our planet.

Sabrina Speich is a Professor in Ocean, Atmosphere and Climate Sciences at the École Normale Supérieure (ENS) in Paris (France) where she is also the Dean of Studies of the Department of Geosciences. She is a member of the Laboratoire de Météorologie Dynamique of the Institut Pierre-Simon Laplace (IPSL). Her research focuses on the uncovering and understanding of ocean dynamics and air-sea interactions and their role in the Earth's climate system. She is an internationally recognised expert in ocean modeling as well as in organising wide programs of in situ observations.

Books & Ideas: Could you explain the role of oceans in our climate system?

Sabrina Speich: When you think about the climate, you think about the weather, the atmosphere, the winds, the temperature, the precipitations. Yet the climate is a much more complex system. It includes different subsystems, such as the ocean, the cryosphere – the ice –, the land system, and even the biosphere – the living beings. In terms of climate, the ocean probably plays the most important part because it absorbs all the radiations from the sun, transforming them into heat, and in turn releasing part of it back in the atmosphere.

The air temperature we experience every day is essentially due to the atmosphere that has been heated by the ocean. Human activity has also been releasing greenhouse gases for years in the atmosphere, which has led to an increase in air temperature. But this rise in air temperature is only a fraction of the total rise in heat due to human activity. The ocean absorbs most of the heat, around 90% of it. As a consequence, the sea level rises, not only because of the melting of the land ice but also because the heat absorbed by the ocean increases its volume.

Books & Ideas: How do scientists monitor the ocean ?

Sabrina Speich: The ocean occupies two thirds of the world surface and is extremely deep. We use satellites to observe the ocean, but the problem is that they are only able to observe the surface. We are interested in measuring various variables such as the temperature, the salinity and the pressure, and for this, we have to go deep in the ocean. This requires the use of ships, that stop every 20 miles to take these measures. It therefore takes weeks to do one section from one continent to another and it also costs a lot of money. In the last 20 years, we have developed robotic instruments that go into the ocean to take measures of vertical temperature and salinity in the first 2,000 meters below the surface. This has yielded a lot of new information , in particular regarding the increase in ocean heat and in terms of energy.

Books & Ideas: What conclusions has your research yielded on the impact of climate change on the oceans?

Sabrina Speich: The major impact of climate change has been measured in the ocean. It is invisible because it is diffused in the extremely high volume of water. Not only has the increase in energy risen the sea surface temperature, but it has expanded the sea surface as well. This explains around 30% of the sea level rise. Moreover, marine biodiversity and ecosystems have been reacting to this warming, that may not seem that high but that is still quite intense to them. There is therefore a general displacement of marine life towards the pole. As such, there has been a new adjustment in terms of marine biodiversity that has affected local ecosystems as well as local economies (such as fisheries).

We have also observed another impact of climate change on the ocean with the emission of greenhouse gases, such as CO₂. When CO₂ is absorbed by the ocean, it

changes the pH, the acidity: this has a momentous impact on ecosystems. These particular problems of temperature and acidification are already visible in the tropics where the coral reefs suffer from this more and more every year. The increase in heat is however variable: some years, the temperature is higher than others. As a consequence, a great part of the coral reefs is affected by this. This then impacts biodiversity, which in turns negatively affects the economy of local fisheries, and ultimately the food capability for local populations.

Thanks to the recent use of robotic instruments in the oceans, we have been able to observe very precisely this increase of energy of the ocean. We have less uncertainty and we can pinpoint the origin of this heat. Moreover, we have been able to evaluate more accurately the increase in sea level as well as the distribution of this heat in the ocean. The process is not perfect yet; we need to get more information, more data. It is especially the case near the coasts where access to data is more difficult: our robotic instruments are designed to go into the deep ocean and cannot go over continental slopes.

We are encouraging international cooperation to improve the accuracy of these observations. These will be of great significance because they will allow us to measure more precisely the impact on marine life and better forecast the weather, especially regarding extreme events like hurricanes.

Books & Ideas: Do you think that the role of oceans in climate change has been largely ignored?

Sabrina Speich: It is true that it is difficult to think that the ocean is an element of the Earth's climate, because you don't see its immediate impact. Of course, the air temperature and sea surface temperature have been measured for years, but even within our scientific community, which is composed of atmospheric scientists, researchers often forget about the role of the ocean.

Still, because we need to adapt to climate change, we have to take the ocean into account as it is releasing energy into the atmosphere. A concrete example of this would be hurricanes and storms that are fueled by water vapour and energy directly coming from the oceans. During Hurricane Harvey in 2017, we observed the release of an incredible amount of heat by the ocean as well as water vapour that had been released afterwards, in the form of precipitations inland.

This has prompted scientists to consider more seriously the role of the ocean. For its part, the ocean community is organizing itself to cooperate internationally and willingly release and share data as soon as they are available. This is particularly rare in science, where one specific data is owned by one scientist or one research laboratory. So for me, this cooperation gives hope for the future.

Books & Ideas: What is the economic and social cost of sea level rise?

Sabrina Speich: There have been studies that tried to measure the economic impact of climate change. A study that was published last year has evaluated that the increase of sea level combined with extreme events that trigger flooding inland will amount to one trillion US dollars per year by 2050. One hundred thousand more by the end of the century. It is therefore extremely significant. When we talk about the economic cost of ending the use of fossil fuels, that bears absolutely no comparison to the actual cost of climate change. And we are here only talking about the impact of sea level rise; we are not even talking here about the loss of many lives that will occur during extreme events in the future.

Books & Ideas: What plans are public authorities and/or scientists implementing to reduce the consequences of sea level rise?

Sabrina Speich: The problem with climate is its global nature, it is not limited to one region, one nation. It is thus difficult to achieve anything in terms of governance. As for the sea level rise issue, I think most nations have tried to put up some barriers, but these will amount to nothing compared to what is going to happen, with storms and hurricanes. In some places, the erosion of coasts has accelerated and it has claimed lands that before were located 100 meters removed from the sea. This phenomenon will increase in the future. I think that very practical things have not yet been implemented. Focus has only been put on attempts to mitigate, such as with the COP21 and the Paris Agreement. But the last evaluation that came out today [30 May 2018] reveals that we are definitely not in a good shape. Our greenhouse gas emissions have increased by 2% instead of decreasing.

Books & Ideas: As a scientist, what are your recommendations to effectively address climate change?

Sabrina Speich: First of all, the best thing would probably be to take it more seriously. The way to go forward is to ally science and adaptation. We need firm numbers, firm forecasts and scenarios that only scientists are able to provide. I suggest creating a climate service that would accompany organisations, populations and governments and help them adapt to climate change. This in turn could help them try to mitigate the effects of climate change by changing the economy.

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