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CLUSTER OF EXCELLENCE
CLIMATE, CLIMATIC CHANGE,
AND SOCIETY (CLICCS)

CLIMATE RESCUE ON THE SHOPPING LIST

TEN CLIMATE RESEARCHERS REPORT

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New Climate Stories from Hamburg

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NEW CLIMATE STORIES FROM HAMBURG

As many people know: food production places major strains on the climate and environment. But how important are climate protection and sustainability in our personal buying choices?

You'll also learn how we can make our forests "fit" for climate change, how much greenhouse gas is being released by thawing permafrost, and why it's so hard to establish climate protection as a societal norm.

Researchers are tackling these and other issues concerning climate change at Universität Hamburg's Cluster of Excellence CLICCS and Center for Earth System Research and Sustainability (CEN). Once a month, they discuss their work in the *Hamburger Abendblatt*. In the following pages, we have gathered ten of these articles.

Enjoy browsing!

OUR FORESTS: ON A COLLISION COURSE WITH CLIMATE CHANGE

Our forests make essential contributions to climate protection: they absorb carbon dioxide (CO_2) from the atmosphere, and store it. Further, many long-lived wood products store carbon over long periods of time and can be manufactured with comparatively low emissions.

Taken together, the forests and wood products store roughly 14 percent of Germany's annual CO_2 emissions, which we can't do without if our goal is to effectively reduce greenhouse gases. But vast expanses are now characterized by extreme dryness and dying trees.

At the Cluster of Excellence CLICCS, my team and I are investigating how our forests can be prepared for climate change. In this regard, rising temperatures – which shouldn't pose a problem for indigenous tree species, at least not initially – aren't the main problem; extreme dryness is. But forests have a tremendous ability to adapt. Why? The genetic material of a tree is up to eight times larger than that of a human being. As such, among the virtually innumerable

beech seedlings in a springtime forest, there could easily be some that can cope with extreme dryness. Nevertheless, if there are several dry years in a row, the situation can become critical: in 2018 more young trees than usual died because of the lack of rain.

That being said, at the moment the bark beetle is what's doing the most damage. It's especially a threat to spruces, which, at 28 percent, are the most common tree species in German forests. Thanks to the rising temperatures, this pest is now reproducing faster. To make matters worse, the trees, weakened by heat, are now less able to withstand its attacks. Important forms of direct action to be taken include checking forests for these beetles on a weekly basis, and promptly removing any infested wood.

At the same time, forestry experts need to refine adaptation strategies for forests. Climate simulations show that future summers will likely be even hotter and drier. If emissions continue to rise at the current rate, by the year 2100 we can expect to see up to five additional heat events in Northern Germany, and as many as 30 more in Southern Germany, per year. During these events, temperatures break the 30-degree mark for at least three consecutive days. Moreover, future scenarios call for much less rain in Southern Europe, and more in Scandinavia. Storms and heavy rains could also become more frequent.

Yet the latest simulations only reach to the end of the century. Forests require extremely long-term planning – after all, by 2100 the trees planted today won't even have completed their rotation period: the time that a tree needs before it can be considered ready for harvesting from a forestry perspective. Accordingly, in a sense researchers are "flying blind" in this regard, and have to bear a broad range of potential developments in mind.

One thing is certain: some regions will no longer be suitable for our native tree species in the future. Consequently, the beech will most likely migrate to higher elevations in the low mountain ranges, while the oak will expand into lower-lying regions. Spruce and pine forests will gradually but completely disappear from increasingly dry regions. But we can't expect the trees to accomplish this massive migration on their own: their lifecycle is too long for their natural adaptation to keep pace with climate change. As such, we need to lend a helping hand – by planting a site-specific and climate-adapted selection of tree species, and by adopting forestry approaches that also reflect forests' vital role as guardians of the climate.

Prof. Michael Köhl conducts research on sustainable forest management and international forest policy in the Cluster of Excellence Climate, Climatic Change, and Society (CLICCS) at Universität Hamburg.

PESTICIDES: IMPROVING HARVESTS, OR A HAZARD IN OUR CROP FIELDS?

What can farmers in Europe or Africa do when the temperatures climb or extreme downpours become more frequent? Should they adapt by switching the crops they grow? Or invest in new technologies like overhead irrigation?

To identify suitable plants and intelligent techniques, we at the Cluster of Excellence CLICCS work to develop special-purpose computational models, which allow us to simulate the future yield for large plots of farmland. In this way we can estimate how higher temperatures and more rainfall will affect the potato crop in a given location. The models also help us find the best mix of irrigation and fertilization – plus I can try out new techniques without having to test them in an actual crop field.

However, one central factor is missing from our calculations: the use of pesticides. While we in Europe tend to think of toxic residues on fruit and vegetables, pesticides are almost luxury goods in other countries. Smallholder farmers in Africa, for example, suffer major crop losses from insects and fungi. A certain pesticide could prevent these losses, but is usually

too expensive. Global crop losses due to pests and fungi are roughly 20 percent for maize, potatoes and soybeans, and ca. 30 percent for rice. Preventing these losses would help in the battle against hunger.

That being said, pesticides can also do serious damage, as can be seen in a series of deaths and poisonings in connection with cotton farming in India. Their use is also critical for species conservation.

So what quantities increase the yield – and what's the price tag in terms of health and preserving nature? To find that out, pesticides have to be integrated into agricultural models. But the complicated lifecycles of pests have made doing so infeasible to date. It's extremely difficult to reflect the effects of a given insect species in a computer model. On the one hand, that's because they don't constantly do harm: though insect eggs are harmless, caterpillars and larvae usually have a healthy appetite. In turn, adult insects eat less.

On the other, different insects attack different parts of the plants: if they chew a bit on the leaves, that's not particularly tragic. But if they gnaw on the stalk, the plant will die. Bearing these factors in mind, with the help of an entomologist I dug deep into the biology of the European corn borer and potato leafhopper, so that I could ultimately represent their influence in mathematical formulas.

But was my new model accurate? To test it, I analyzed scientific field experiments with maize, soybeans and potatoes conducted in the USA, where crops were cultivated in various climate zones from 1985 to 2014. All of the data gathered is well documented: planting, growth, fertilizing, spraying with pesticides, pest density and crop yield. These were the types of control data that I needed from the real world. I then simulated the yield for 14 crop fields, and added weather data for the respective year and the documented measures the farmers took. The result was a success: the calculated yields matched very well with the actual harvests! That showed me that the new tool could make reliable forecasts on pesticides and crop yield.

What I'm now focusing on are the actual costs that pesticides entail. In addition, the consequences for the environment and human health should be considered. To date, the increased revenues have only benefited the producers, while all of society has had to bear the long-term costs. My agricultural model can help to find and quantify those costs.

Dr. Livia Rasche is an environmental scientist and expert on sustainable agriculture in the Cluster of Excellence Climate, Climatic Change, and Society (CLICCS) at Universität Hamburg.

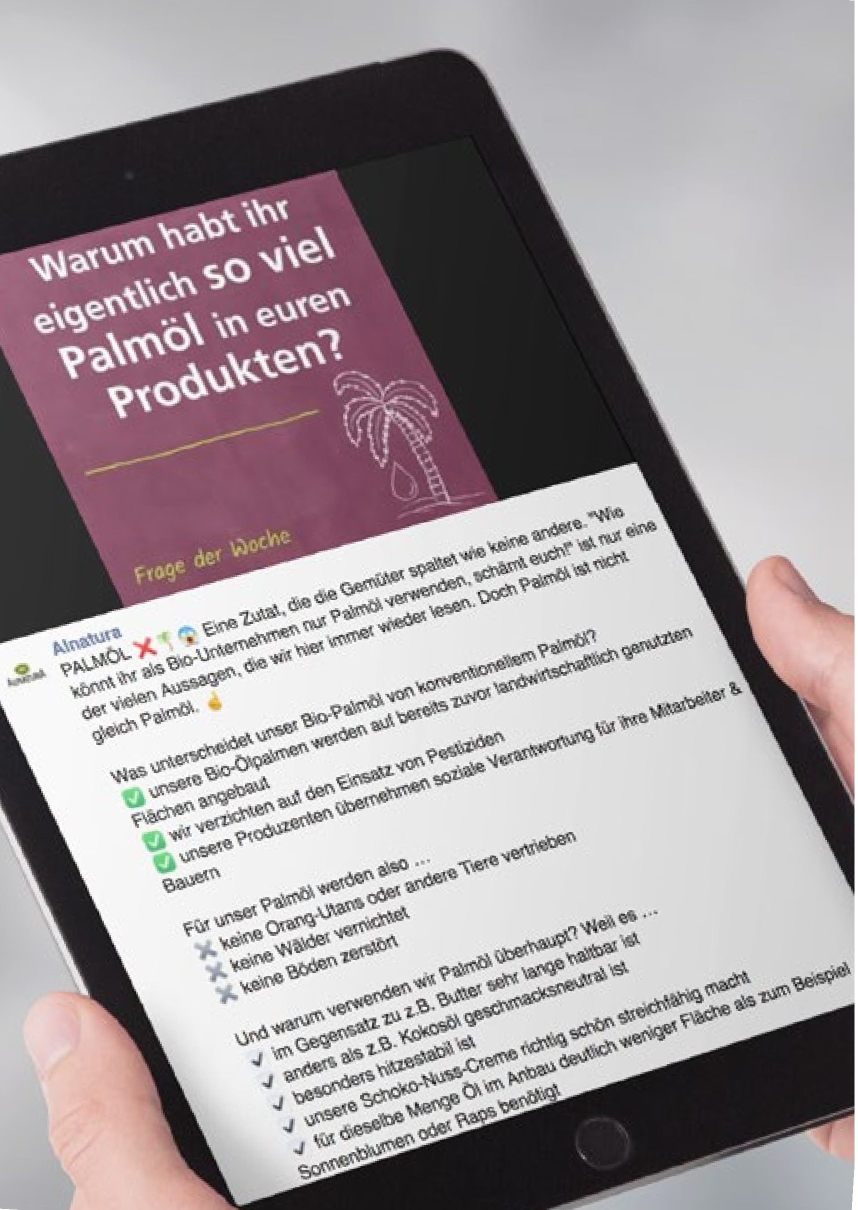
CLIMATE RESCUE ON THE SHOPPING LIST

Meat or vegetables? Packaged or loose? When it comes to food, our choices are endless. But how do we make our buying decisions and what role does sustainability play?

Together with my colleague Imke Hoppe, I'm analyzing the debate surrounding sustainable diets on social media. To do so, for a month we evaluated posts and comments on the Facebook pages of the biggest supermarkets in Germany, Great Britain, the USA, Canada and South Africa.

The analysis shows what people find important when it comes to food and how significant the topic is in their social environment. We were especially interested in to what extent consumers make a connection between food and sustainability, and with it the responsible use of economic, ecological and social resources.

The results show: The Germans and the British discuss the sustainability aspects of food the most intensively. In Germany, we looked at the Facebook discussions for the supermarket chain Edeka and the organic supermarket Alnatura. We



found that while on Alnatura's page, environmental experts enter into heated exchanges and provide numerous sources for their posts, discussions on Edeka's page remain more general. But here, too, there are critical comments referring to the responsibilities of the supermarket and its customers – for example in the context of the environmental problems caused by the palm oil industry or plastic waste. Furthermore, the issue of social exclusion is mentioned: Is buying organic food a luxury only the wealthy can afford?

The topic of plastic waste also dominates the online discussions on the pages of the Tesco supermarket in Great Britain. Although the British consume far more packaged than unpackaged fresh food, many of them are aware of the problems this leads to and are demanding supermarkets get rid of plastic packaging.

In the USA and Canada, the debates on the Facebook pages of the supermarkets Loblaws and Kroger are much less political. In Canada, sustainability is a topic in just six percent of the comments. Customers in both countries talk more about personal experiences concerning buying decisions or health. The importance of food in traditional celebrations like Thanksgiving is also a common subject of discussion. Meat consumption is a central part of these traditions – and is only rarely called into question.

In South Africa, too, customers of the supermarket Shoprite talk little about sustainability, and it was only addressed in about five percent of the posts. Value for money is the most common topic. However, there are some people seeking alternatives. For instance on the Facebook pages of a South African organic weekly market there are discussions on alternative diets and regional solutions beyond the global food industry.

Although the intensity of discussions on sustainability varies in the countries studied, social networks provide an important and low-threshold platform to motivate people to adopt a more sustainable diet. Influencers in this area know this, and they play a key role in drawing attention to environmental issues. On YouTube, Instagram and in numerous blogs they put these new ideals into practice and motivate others to live more environmentally friendly lives.

Prof. Katharina Kleinen-von Königslöw conducts research on digital communication and sustainability in the Cluster of Excellence Climate, Climatic Change, and Society (CLICCS) at Universität Hamburg.

TAKING A CLOSER LOOK AT OUR OCEANS

According to the targets set by the European Union, our oceans are meant to be clean, healthy and productive; a laudable goal. In order to reach that goal, the EU's Member States have to first know what state the oceans are in.

How can they best find this information? And how can they translate what they learn into suitable measures and policies? These are the types of questions that my colleagues at the Center for Earth System Research and Sustainability (CEN) and I are investigating.

The EU has subdivided the ecosystem "oceans" into various components: just like a doctor, who examines a patient's cardiovascular system, digestive tract and immune system separately. In turn, the EU has defined the ideal state for each component. For example, there should be a diverse range of flora and fauna, and as many edible fish as possible. In addition, all parts of the food web – animals, plants, bacteria and many more – should be sufficiently abundant to ensure their long-term survival.

The food web also includes all predator-prey relations: fish feed on microorganic fauna called zooplankton, which in

turn feed on algae. Bacteria feed on and decompose all dead organic material. The component “food web” is an important one in terms of assessing the overall state of the oceans. Nevertheless it remains difficult to find indicators that offer clear information on the oceans’ status. For human beings, body temperature is a good indicator: if it’s too high, we know the person in question has a fever – and their health status is poor.

We tested 13 common indicators for three regions of the Baltic Sea. Scientists frequently use all 13 to assess the status of the food web – but are they actually suited to the task? Seven of the indicators concern fish; the remaining six focus on zooplankton: How many are there? And how large are they on average?

To determine how well the indicators work, we’ve developed a computer model, which we supply with data on the indicators, and on environmental influences like climate change or overfertilization. A good indicator shows us the current state of the food web, and can quickly and clearly react to specific environmental influences. If the zooplankton are becoming smaller on average, it indicates that the food web is in poor shape. One possible cause is overfertilization – if we can verify this connection with proof, the remedy is clear: less fertilizer in the water.

Despite countless calculations, there’s no such thing as a single, universally applicable indicator. For example, the total amount of zooplankton was a good indicator for the state of the food web in the Bornholm Basin and the Bothnian Sea between Sweden and Finland, yet proved wholly unreliable for the Gotland Basin. Further, in the Bornholm Basin the average size of the zooplankton showed only a minimal change in response to certain environmental influences. Depending on the region, up to half of the indicators failed to respond as expected to changes in the environment. For the Bornholm Basin, six of the indicators proved to be suitable for evaluating the status of the food web; for the other two regions, other combinations proved to be a better fit.

Accordingly, suitable indicators have to be selected for each individual region. Our model can help members of the research and political community to identify the best candidates, ensuring that it will be easier to assess the state of our oceans in the future – the first step toward achieving the goal of cleaner and healthier oceans.

Dr. Saskia Otto is a biologist and works at Universität Hamburg’s Institute of Marine Ecosystem and Fishery Science.

CLIMATE PROTESTS REVEAL WHERE NORMS ARE VIOLATED

To date, climate protection can only report limited successes. Despite the warnings of the scientific community, climate objectives are not being reached, and decisions are being delayed. As the Fridays for Future demonstrations show, something has gone very wrong.

Germany and many other countries won't reach their climate goal. This has provoked so much unrest, especially among young people, that they are publicly protesting on a regular basis. I'm currently investigating the background of these protests. Conflicts like this one are nearly always a sign that a norm has been violated or ignored. I focus on these norms. Where do they come from? What norms are legitimate – and for whom? Who violates them, when, and why?

In keeping with these questions, I've explored three very different norms in international policy: the ban on torture; the basic rights of individuals in connection with sanctions; and the ban on sexual violence perpetrated against women and girls in war. Based on my analyses, I can identify basic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patterns that can be applied to other, similar norms. Why does one norm work well, but another one doesn't? Norms are deemed successful when as many people as possible consider them to be legitimate.

Climate justice as a norm is a virtually unresearched topic. What can it be compared to? One of the three norms mentioned above in particular offers a number of similarities: the ban on sexual violence. Both norms have emerged in the span of several decades, are internationally well-known, are supported by a broad network, and have to a great extent been promoted by local groups and non-governmental organizations (NGOs).

Women's organizations and NGOs around the globe fought for a ban on sexual violence for more than five decades. In 2000 it was finally codified in a UN resolution; many countries subsequently developed protection plans. For the victims of sexual violence it was important that the crimes be written down in detail and therefore officially documented; in fact, this was even more important to them than a court verdict. Today there are still some countries in which sexual violence is not systematically prosecuted. Nevertheless, the norm officially enjoys a high degree of legitimacy, and is considered to have been successfully established in many nations.

The climate norm, too, has a long history. Scientists began stressing the dangers of global warming back in the 1960s, and the first global climate conference was held in Geneva in 1979. Thanks to various actors, climate-related topics have since repeatedly attracted public attention. And today, NGOs continue to uncover cases of insufficient climate protection and global climate injustice, and to publish the details, helping document them in the process. The topic has since become internationally established, and in some cases, embedded in legislation.

How are viable norms created? The more people from different groups who have negotiated them, the more legitimate they become. In brief: a successful norm is the product of a lengthy struggle.

Based on this criterion, the climate norm should have good chances of success. So why isn't it working? Apparently, the political community is failing to support its own norm. Members of federal governments are either unconvinced of the urgent need to take action – or they're afraid that their voters aren't convinced. But stable norms can only be created by working hand in hand with society. In this regard, society must not only be actively involved in the development of climate plans, but also help shape their implementation.

Prof. Antje Wiener is a political scientist at the Cluster of Excellence Climate, Climatic Change, and Society (CLICCS) at Universität Hamburg.

THE BREATH OF THE TUNDRA

In northern Siberia, the effects of climate change can be seen with the naked eye: previously frozen soils are now thawing, houses and railroad tracks are sinking into the mud, and coasts are being washed away.

Because temperatures are rising twice as fast as the global average in the Arctic, the region is far more prominently affected by global warming. At the same time, its own warming is likely to have massive effects on the global climate.

The most problematic aspect: the large quantities of carbon that are stored in the soil, in the form of dead organic material. When temperatures rise, this material begins to thaw, and microorganisms in the soil begin breaking it down. In the process, they produce carbon dioxide and methane: but how much of these greenhouse gases are released is something we can currently only guess.

Together with my colleagues at the Center for Earth System Research and Sustainability (CEN), I'm working to gain a better understanding of the processes active in the soils of the tundra. In this regard, I've also joined several expeditions to Siberia. On one of the 1,500 islands in the Lena Delta, 650 kilometers

north of the Arctic Circle, I took readings of how much methane the soil is releasing.

Researchers need this type of observational data, e.g. to create climate forecasts with the aid of computer models. Yet we still have very little data from Siberia; simply because it's so huge, and at the same time so inaccessible. There are no roads or cities, and also research stations are a rare sight. The resultant lack of data limits the accuracy of climate forecasts.

In order to obtain additional data, I took my readings in an ecosystem that had never been investigated before: the floodplain of Samoylov Island. To do so, I set up a 2.5-meter-tall "tower" bristling with measuring equipment, which I had to dismantle again before the spring floods that come in May. I was only able to set it up again once the meltwater from the Lena's catchment, which is seven times the size of Germany, had found its way to the Arctic Ocean.

All the while the tower was in operation, its systems measured turbulences in and the methane concentration of the air, twenty times every second. Using the results, I was able to calculate the methane emissions from the soil. What's more: I was able to filter the data to determine how much methane each vegetation zone on the floodplain contributed. After all, zones characterized by bushes and shrubs put out different emissions levels than those dominated by grass and moss.

Using the method I developed here, other researchers will now be able to distinguish between emissions produced by different types of landscape, and more reliably estimate how much methane each type puts out. In contrast, if the landscape diversity typical of the tundra isn't taken into account, the methane emissions can be significantly underestimated or overestimated – on Samoylov, for example, this would produce a discrepancy of ca. 40 percent.

Accordingly, my work can help improve the accuracy of climate models; yet it does nothing to change the global problem of climate change. For me, it is sobering to see how rapidly the Arctic is changing, and how little is being done at the political level in Germany to protect our climate. We still have a chance to limit the effects of global warming – but only if we take far more meaningful steps than we have in the past. If we do, future generations will thank us for it.

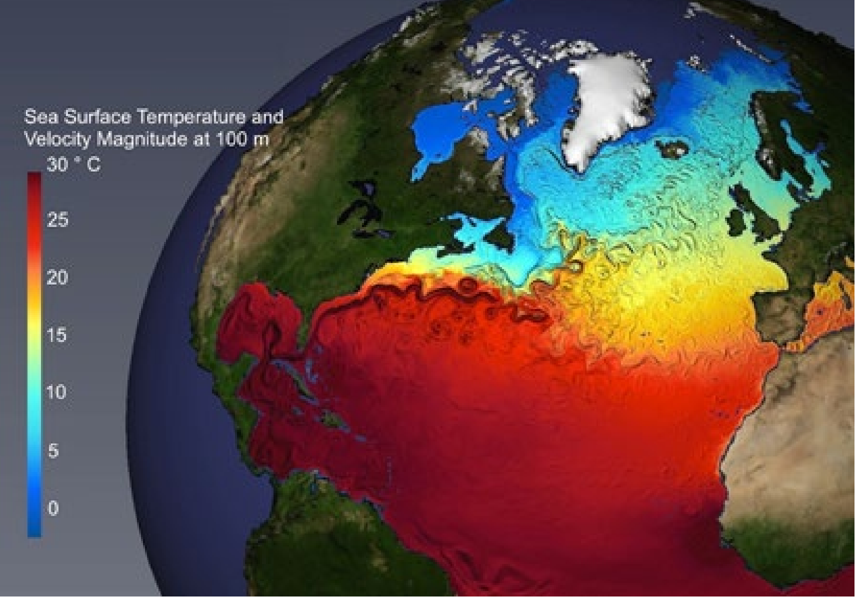
Dr. Norman Rößger completed his doctoral studies at Universität Hamburg's Institute of Soil Science and was a member of the Center for Earth System Research and Sustainability.

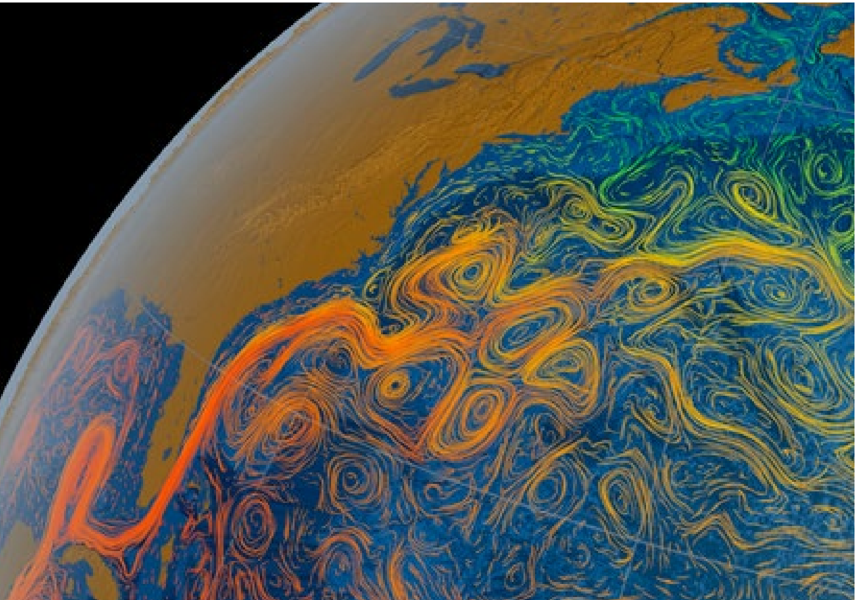
HOW MUCH IS THE ATLANTIC HEATING UP OUR WEATHER?

The Atlantic is generally considered to be Europe's "weather kitchen" – bringing heat from the tropics to our coasts, it plays a critical role in predicting the weather.

Nevertheless, it usually takes a backseat when it comes to forecasting: though atmospheric processes are closely monitored and thousands of corresponding data points are calculated, the ocean and its heat input are often represented with just a single parameter.

Granted, sometimes the Atlantic is warmer, and sometimes cooler. But in comparison to the atmosphere, it responds only sluggishly: for instance, it can absorb a great deal of energy without any noticeable change in surface temperature. And it can store heat for extended periods of time, releasing it only gradually. Consequently, for short-term forecasts, only the initial value is used – since the water temperature isn't likely to change appreciably in such a short timespan. And it works: if we compare the forecasts with the actual weather after the fact, we can see that, despite this simplification, the two largely match.





But things look quite different when it comes to forecasts for one or more years, e.g. questions like whether next winter will be a harsh one, or whether next summer will be an especially hot one. My team and I prepare these forecasts at CLICCS – and they're particularly challenging. It's a bit like working on a group project at school: just because the average grade was a C, it doesn't necessarily mean that Tom or Julia will both get a C. Instead, the final outcome depends on how well the requirements are fulfilled – whether Tom studied the right material, or whether Julia went to a party the night before. In the same way, for our medium-scale predictions, we need to know how much heat the Atlantic actually contributes at the beginning of the forecasting period in May.

To date, these forecasts have been extremely unreliable; as a rule, they're only right just over half of the time. But if we take into account how the current water temperature deviates from the long-term average, that is, whether the initial temperatures in May were high or low in comparison, the accuracy rate jumps to 80 percent. In fact, our predictions are most accurate when the initial temperature substantially deviates from the long-term average – so when the Atlantic is unusually warm or cold in May, we can predict what will happen in the next several months and years even more accurately.

This aspect is also interesting because it entails adopting a new philosophy. So far, the assumption has been: the more initial data points that we take the average of, the more accurate the forecast will be – because "outliers" will have virtually no effect on the outcome. This is an approach we researchers have been using for years. But now we're starting to learn: sometimes less might be more. In other words: determining whether or not a given initial value was unusual or not can sometimes yield better results than using the statistical mean – depending on the timeframe being considered.

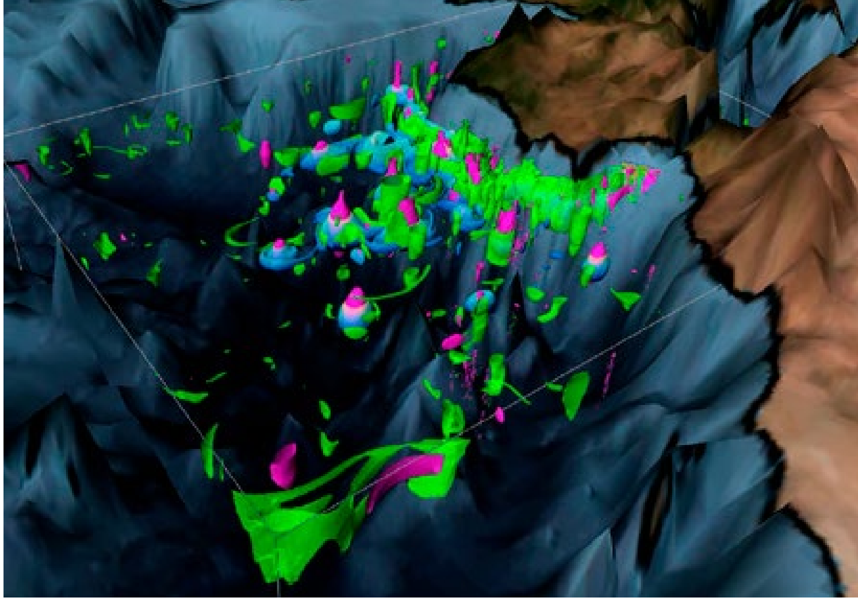
Therefore, it can be advisable to select certain individual factors and assign them more weight, essentially treating them as individual cases. According to this approach, a general rise in temperatures doesn't mean that there can't be a cold year now and then; similarly, a general increase in precipitation does not mean that droughts will not occur temporarily. Consequently, we're now taking a closer look at which parameters are best suited for different types of prediction, so as to ultimately arrive at more reliable forecasts.

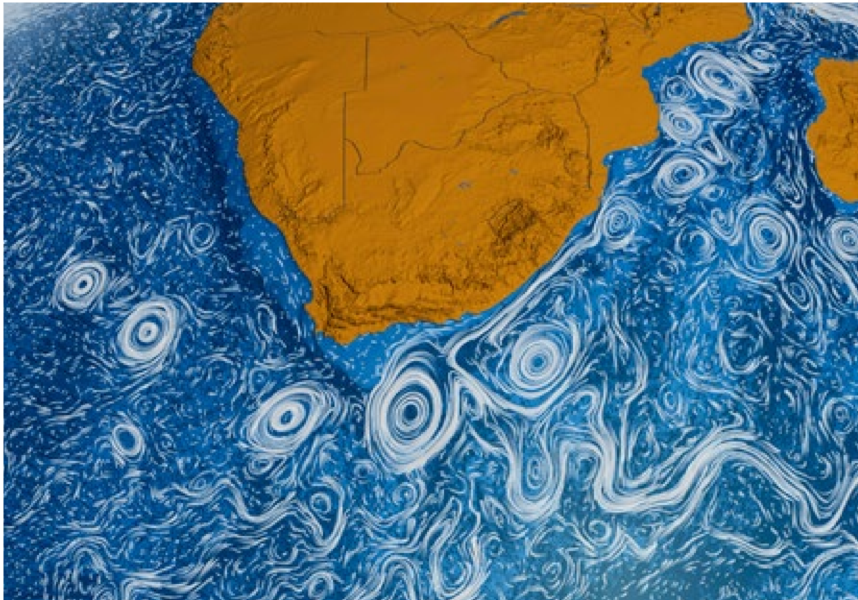
Prof. Johanna Baehr is the head of climate modeling in the Cluster of Excellence Climate, Climatic Change, and Society (CLICCS).

A PICTURE SAYS MORE THAN A THOUSAND NUMBERS

As an oceanographer, I'm interested in the physics of the oceans. Which forces set the waters of the world in motion? What patterns are found in ocean currents? There have been many new discoveries in the field over the last 50 years: e.g. internal waves, which can travel hundreds of kilometers under the water's surface, or rapidly occurring eddies that disappear again just as quickly, and which briefly incorporate tremendous volumes of water.

Like the well-known Gulf Stream and other ocean currents, they are a part of our climate system, transporting and distributing heat and energy. Together with colleagues from Universität Hamburg's Center for Earth System Research and Sustainability (CEN), I am closely examining these eddies. I actually first came across them a few years ago. Back then, I was investigating the salty and warm currents that flow from the Mediterranean into the Atlantic off the southern coast of my home country, Portugal. On some days, this current creates





a clearly recognizable layer that is up to 200 meters thick and three degrees Celsius warmer than the water above it. On other days, the layer is thinner, and on some, it's not there at all.

To understand why that is the case, I made computer simulations of the currents. To do so, I incorporated information on local conditions, like the shape of the coastline and bottom topography, as well as my own-recorded temperature and salinity data, and the physical laws that apply on Earth. In return, the computer churned out columns of difficult-to-interpret numbers. However, they all started making sense when I began converting them into pictures, putting together several "snapshots" of the water properties and currents to make a film.

Suddenly I was able to see how the warm Mediterranean current becomes tangled in the Atlantic, creating eddies. Depending on their rotational speed, they can be wide and flat, or narrow and reaching great depths – similar to pirouetting ice skaters, who spread their arms in order to rotate slowly or hold them over their head to spin faster. My film revealed how rapidly turning surface eddies draw Mediterranean water at their centers, and how gaps filled with cold Atlantic water form between those eddies; there one will not find any warm Mediterranean water.

Since then, I have worked with visualizations whenever possible. They make it much easier for me to understand complex processes and draw conclusions about them. For instance, a recent film showed the ocean's behavior over the ridge between Greenland and Norway: a region where the Gulf Stream ends and the cold water from the north begins to sink into the depths of the Atlantic. The visualizations enabled me to understand why this does not occur continuously but in individual bursts. Once again, eddies come into play: whenever an eddy from the north crosses the ridge, a certain volume of cold water sinks down.

Today, visualizations have become crucial for climate and Earth system research. A number of my colleagues have even specialized in this area: at the CEN's Visualization Laboratory, they create animated journeys into fantastic worlds that can't be seen with the naked eye. These films are especially valuable for those researchers who deal with such transient and chaotic phenomena as eddies. They help us to refine our understanding of the physical processes at work on our planet – and with them, the climate system, its components, and potential future developments.

Dr. Nuno Serra is an oceanographer at Universität Hamburg's Institute of Oceanography and a member of the Center for Earth System Research and Sustainability.

USING WOTAN'S HELP TO SEE HOW THE WIND BLOWS

Sawing, gluing, and hunting down data: it took months before my miniature version of Hamburg was ready. First I had to find out what each and every building between the Elbphilharmonie concert hall and the wholesale market looked like – how tall it was, what its roof was shaped like, and whether it had any passages or overhangs.

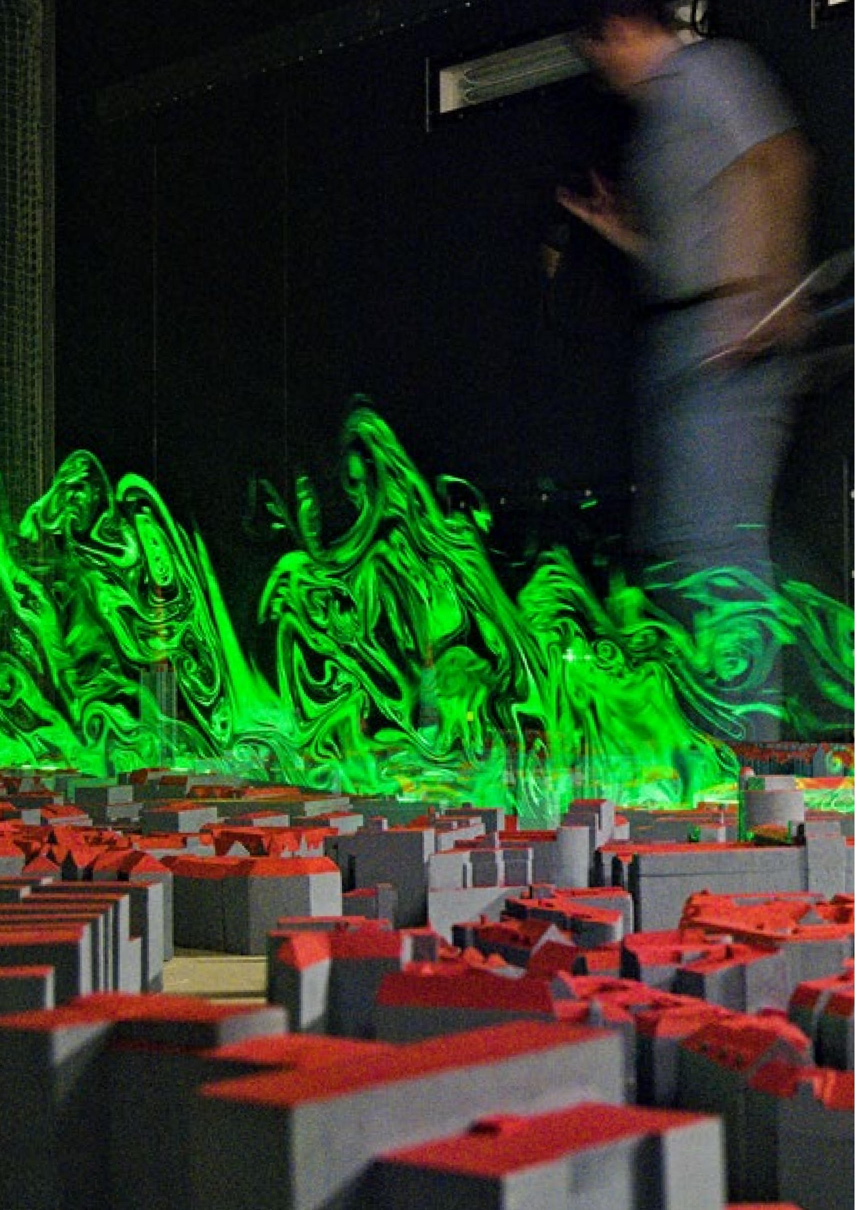
I requested blueprints from the city authorities and scouted out many locations on foot. I prepared detailed technical drawings, which I then sent to one of the engineering workshops at Universität Hamburg. Once their work was done, I glued the hundreds of tiny model buildings onto sheets of wood. At a scale of 1 to 500, three-story houses were only 2.1 centimeters tall, and the Elbphilharmonie was 22 centimeters. Then the moment finally arrived: I was ready to throw the switch on “Wotan”.

Once I did, I could use the wind tunnel to observe how air currents flow through backyards and the alleys between houses, how pollutants spread, and how individual buildings slow

the wind: important information for planners whose job it is to make cities ready for the future. Metropolises will be especially hard-hit by climate change; for example, when heat waves transform them into ovens that barely cool down overnight. To help ensure that city dwellers can nevertheless breathe freely and stay healthy, my colleagues and I have joined in a countrywide research project on urban climate. After all, around the globe – and in Germany – half the populace now lives in cities.

The project's goal is to develop a software program that can calculate how the wind blows in a given city, and how great its cooling effect is – before the city, subdivision or building in question is ever built. To make the software as accurate as possible, the developers compare the outputs with actual readings. Though these real-world measurements reflect the reality, they can also be confusing, because there is a virtually endless number of factors to take into account: shifts in wind direction; air currents produced by warming as the day progresses; vehicles that create their own air currents, etc. In contrast, the wind tunnel allows me to gather data that solely represents the influence of wind.

In addition to Hamburg, I've also made models of other major urban areas and found that the air circulation in them differs considerably. Whereas, in Hamburg, the wind can blow in from across the expansive, open waters into the city's core,



in Stuttgart the air often becomes trapped between the surrounding hills. And in Berlin, the sheer distance makes it difficult for air to travel from the suburbs to the center.

In terms of modeling the cities, there were various aspects that I had to bear in mind: the surfaces of the tiny buildings couldn't be too coarse or too smooth; otherwise it could have skewed the outcomes. Here, I found the ideal material to be Styrodur: a type of polystyrene used for insulating buildings, it is sturdier and has finer pores than Styrofoam. Instead of blowing air into the wind tunnel, we suck it in, so that we can see how the current first hits obstacles before it reaches the city's core; this approach ensures that it circulates realistically.

With regard to ventilation for their centers, none of the three cities is ideally designed. And that's no surprise: they've all grown over time, and were first founded in an age in which no-one could have guessed that the temperatures would someday rise so dramatically. Just how hot it's going to get is something we can't yet say exactly. But one thing is clear: we need to be prepared, which we can do by planning cities so that they have sufficient ventilation.

Kerstin Surm is a doctoral researcher at Universität Hamburg's Center for Earth System Research and Sustainability.

WHAT MOTIVATES NORTH FRISIANS TO ENGAGE IN CLIMATE PROTECTION

"We're Frisians, you know? We have to prevent climate change, to fight it, limit it, and adapt to it". My conversation partner summarizes the pragmatism and resolve I found in many of the people I came to know while conducting research in North Frisia.

On North Frisian islands like Amrum and Föhr, the inhabitants can already feel the effects of climate change: they can see new patterns in the sand, which are the result of changed tides and rising sea levels. Sardines and mullets now end up in fishing nets – species that normally live further south. There are new plants to be found in the mud flats. Storms have intensified, and storm surges have become stronger and higher.

The island dwellers showed me some of these changes personally. And in interviews in their homes or in the great outdoors, they told me about which flowers now bloom earlier, and which bird species are newcomers to the islands. At the Cluster of Excellence CLICCS I'm investigating how connected people feel with their homes, and how perceived environmental changes motivate them to engage in climate protection.

In this context I pay special attention to the type of language they use, which shows me how they truly feel, and what they think about the climate change in their homes.

Especially by observing nature, they can transform the abstract phenomenon of climate change into something they can concretely grasp. For many of my interview partners, climate change has become – metaphorically speaking – the enemy. And stopping it is like a battle. They describe it e.g. as the Earth overheating, or in religious terms, as a “climate sin”. All of this imagery makes one thing clear: climate change represents a threat to their home.

In the course of my work, I have condensed these metaphors into six main concepts. They serve as interpretive patterns, which people use to assess climate change and decide whether or not to do somethingand if so, what. I combine linguistic analysis and geography to unlock the secrets of the islanders’ lifeworld. This allows me to analyze their knowledge and values, to respond to them, and to better understand the people I’m dealing with.

That’s important, because researchers often ask themselves why average citizens do so little to combat climate change, despite the wealth of facts and scientific information. But this impression is misleading, because many people address the topic in their day-to-day lives: they do without air travel or owning a car, travel by train, and keep their energy consumption to a minimum. They want to do their part, even if it's only in small ways. But the connection to their own life-world is an important motivator for their actions, not scientific facts alone.

My findings indicate that we absolutely have to take local knowledge into account when seeking to determine what level of climate protection is feasible. This will also involve negotiating on protective measures at the local level, because generally speaking, there is a great deal of interest in protecting the climate. And this motivation is to a great extent tied to people's love for and sense of home.

In my experience, in this regard the islands' local politicians are acting very prudently. They have strong ties to their island and the people living on it, take their concerns seriously, and are willing to go beyond the party line because they want to make their region "climate-fit". In turn, the North Frisians' enthusiasm has inspired me, because it showed me: Do something, even if it's only something small!

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