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CLIMATE, CLIMATIC CHANGE, AND SOCIETY (CLICCS)

WHAT MATTERS MOST IS WHICH PATH WE'RE ON

GO FOR NET ZERO EMISSIONS – OR JUST BUSINESS AS USUAL?

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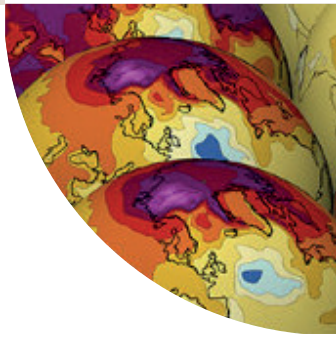
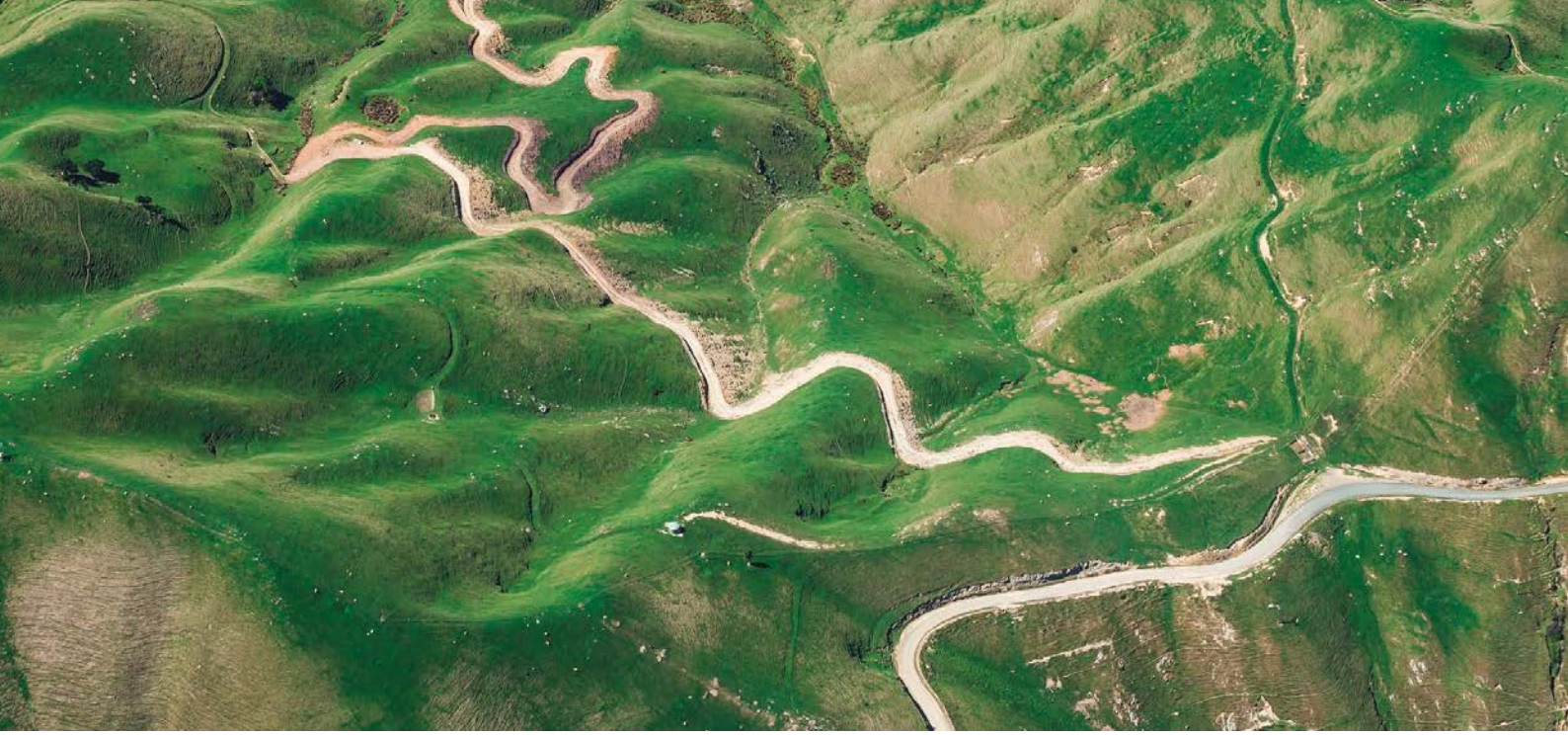


CLICCS QUARTERLY

NEWS FROM CLIMATE RESEARCH



WHAT MATTERS MOST IS WHICH PATH WE'RE ON

Strict climate protection measures, net zero emissions, or simply business as usual? When it comes to the future climate, there are a number of possibilities. But not all of them are plausible. For some developments, we lack the requisite know-how. For others, time is running out.

"We will have to actively remove greenhouse gases from the atmosphere if we want to achieve the Paris climate goals and limit global warming to two degrees," says CLICCS Spokesperson Prof. Detlef Stammer. "Unfortunately, emissions aren't declining quickly enough, which means that plants, forests and soils, our natural carbon sinks, aren't enough. And the clock is ticking. As such, we also have to consider technological – large-scale technological – solutions."

Solutions for which there are now concepts, but few established procedures. According to Stammer: "We're calculating on the basis of technologies that we don't even have yet, for instance, to remove relevant amounts of CO_2 from the atmosphere. Therefore, it's doubtful whether we'll be able to use them in the next decade." While it's not completely impossible, he argues, it's not plausible. However, the more investments are made, and the more corresponding laws are introduced, the more achievable the goal becomes: "What matters most is that the necessary framework conditions are met. They define which path we're on."

CLICCS Spokesperson Prof. Detlef Stammer

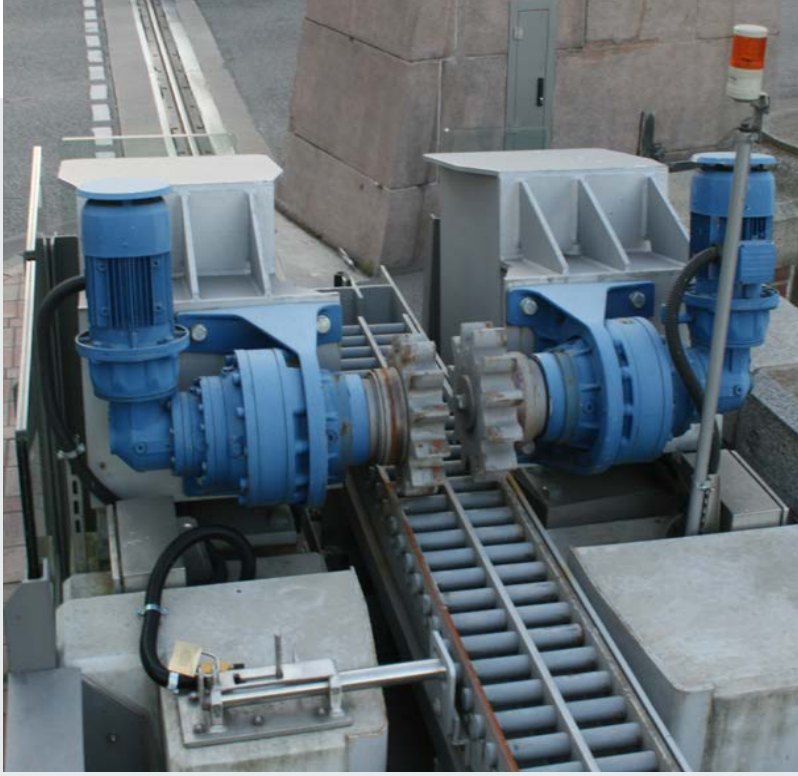
Further, the climate itself not only depends on the intensity of drivers like solar radiation and the amount of greenhouse gases in the atmosphere, but also fluctuates within certain limits, which are determined by the climate's natural variability, and by fundamental laws of physics. Accordingly, some potential scenarios can be ruled out. For example, even if global warming accelerated rapidly, Greenland's continental shelf couldn't realistically suddenly melt. In reality, due to the enormous volume of ice involved, the process would still require a certain minimum time.

The real climate isn't an average

As such, the future climate isn't simply the average of all possibilities. Instead, it's important to identify scenarios that are plausible – and to provide a basis for political decisions. "With our understanding of the climate system and the influence of human beings, but also natural variability, today we can better assess potential developments," says Stammer. "At the same time, certain scenarios aren't plausible, because the physical or social prerequisites can't be met."

WHEN WATER COMES FROM FOUR SIDES

Coastal cities have to face a unique set of challenges. Climate change means that sea and river levels are rising. In addition, hinterland floods and heavy rain are becoming more frequent, and the groundwater level is changing. Prof. Heinke Schlünzen and her team are investigating how cities can sensibly adapt.
"We have to make cities more climate-change-proof and sustainable. We need clear strategies for reducing emissions, combined with restoration, renovation and new development for adaptation," says Schlünzen. In this context, reducing sealed surfaces is an important topic. Even today, when there is extreme precipitation in Hamburg, the water is often unable to drain off adequately. "It is essential to reduce the percentage of sealed surfaces in the city. In some other regions, it's common practice to install water-collection systems on every property," says Schlünzen. Parking lots could be equipped with grid pavers, while roofs offer space for adding plants and solar panels, which would allow rainwater retention and generate energy.



Flood protection in Hamburg's warehouse district (Speicherstadt): in the event of a storm surge, the motorized sliding gates at Kornhausbrücke can be closed.

"The aim must be a city of short distances and plenty of green and open spaces," says Schlünzen. These areas provide recreational space and enable infiltration – at the same time shorter distances can reduce emissions. "Sensible design considers many factors at once."

http://uhh.de/cliccs-theme-c1-en

RECYCLING IN THE (CROP) FIELD

Crop fields release large amounts of climate-relevant CO_2 into the atmosphere. In the process, they lose organic carbon, making them less fertile. Such losses can be reduced by putting crop residues and other agricultural organic matter back onto the fields. However, in the soil these materials are rapidly broken down into CO_2.
Dr. Christian Knoblauch and his team recently tested a new recycling process that involves carbonizing agricultural plant waste and then working the biochar produced into the soil. The results are very encouraging: the carbon can enrich the soil on a long-term basis, since biochar does not break down readily. Furthermore, its surface binds nutrients such as nitrogen and phosphorus, preventing them from being leached into the groundwater. At the same time, biochar fixes harmful heavy metals, so that they cannot be taken up by plants.
Currently, biochar is expensive to make, and there are only a few production sites. Nevertheless, it can be worthwhile, since it increases crop yield. "A circular economy like this solves the problem at the source," says Knoblauch. "A practical solution with benefits for both soil and climate, the interest in it is growing exponentially."

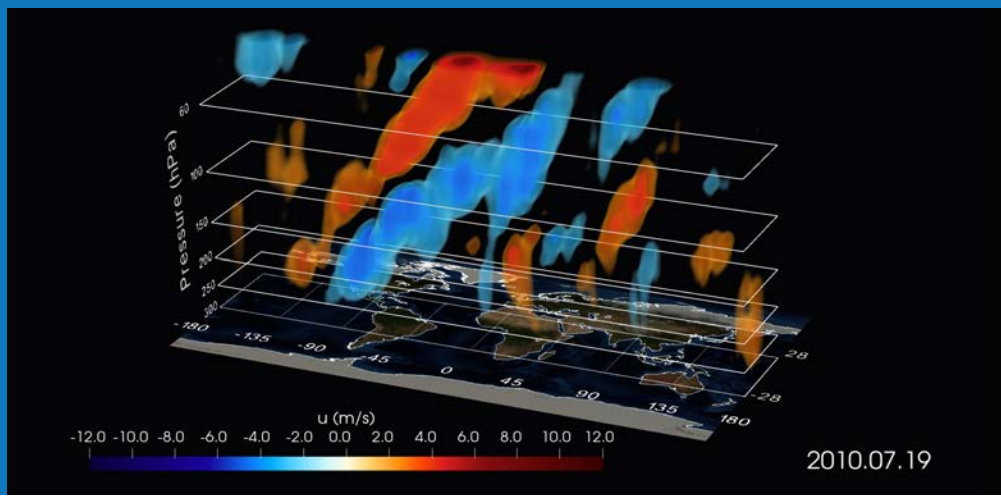
https://onlinelibrary.wiley.com/doi/full/10.1111/ejss.13088

TRAPPED AT THE EQUATOR, BUT WITH GLOBAL IMPACT

For the first time, the Kelvin waves of the Earth's atmosphere have been visualized in all three spatial dimensions, in contrast to the usual two-dimensional fashion. One major characteristic of the Kelvin waves is that in the atmosphere – unlike in the ocean – they only exist near the Equator, where they are virtually trapped. They propagate to the east along the Equator and upward, as we can see in the figure.

Though Kelvin waves have a major influence on the weather and climate around the globe, we still only partially understand them. In response, Prof. Nedjeljka Žagar and her team developed their own software to filter the Kelvin waves and other equatorial waves. They used reanalysis data spanning 40 years to quantify Kelvin waves up to the highest levels of the stratosphere. As a result, these waves can now be more accurately validated in climate models, helping to refine projections.
What we see here is the zonal wind speed from July 2010, a snapshot from an animation. The westerlies are shown in blue; the easterlies are in red, with speeds of up to 12 meters per hour. In the animation, a regular upward motion in the Kelvin waves can be clearly seen, reaching from the upper troposphere up to the stratosphere in a cycle that normally persists for 10 to 14 days.

Video: http://uhh.de/cen-kelvin-waves



Kelvin waves propagate along the Equator. Visualization by Dr. Felicia Brisc

NEWS IN BRIEF

CONSIDERABLE NEED FOR ACTION ON CLIMATE CHANGE

At the 12th German Climate Conference, CLICCS was represented with numerous contributions. According to Prof. Hermann Held, the Paris climate goals call for prompt action on the part of decision-makers, so as to ensure cost efficiency. In the short term, he claimed, there need to be far more investments in climate-friendly technologies, and the available instruments for doing so need to be used sensibly. https://www.dkt-12.de/

HOW MUCH DO WE KNOW ABOUT OCEAN SALINITY?

A team led by CLICCS Spokesperson Prof. Detlef Stammer has investigated the macro-scale structures of salinity and its variation over time, from the ocean's surface to a depth of 700 meters. Based on the status quo, how accurate are forecasts? This can be determined by comparing existing salinity analyses, ocean-based reanalyses and satellite data, and by calculating uncertainties in trends and estimates.

https://doi.org/10.1016/j.pocean.2020.102478

WELCOME TO THE SICSS GRADUATE SCHOOL!

Alexandra Franzke is the new Executive Head of the School of Integrated Climate and Earth System Sciences (SICSS) and Coordinator of the postdoc program, which she will also develop further. At CLICCS we look forward to working with her! http://uhh.de/cen-sicss-head

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