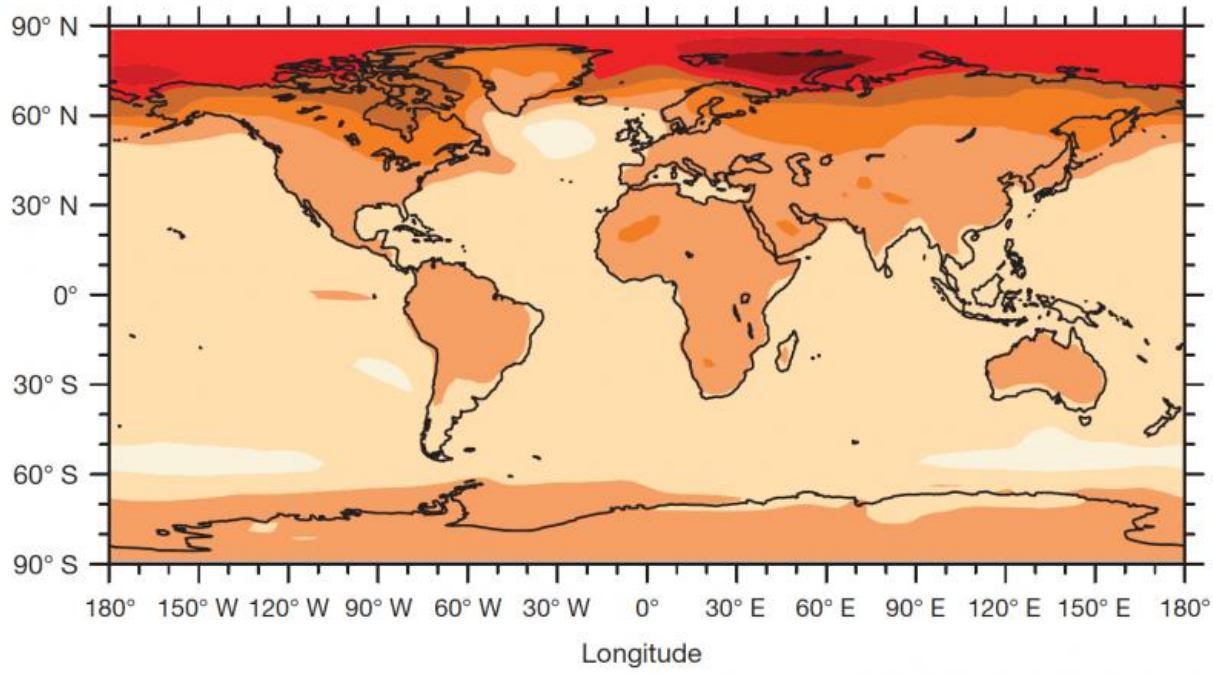
# How 2 degrees rise means even higher temperatures where we live

January 20 2016




The increase in regional average temperatures around the world when global average temperatures reach 2°C above pre-industrial levels. Credit: From authors' *Nature* paper, Allowable CO2 emissions based on regional and impact-related climate targets

At the recent COP21 climate conference in Paris, delegates reached an agreement that plans to limit global warming to "well below" two degrees Celsius. This stems from the fact that scientists and politicians now

agree: the global average temperature must rise by no more than two degrees if we are to prevent serious, irreversible damage to humans and the environment.

"However, this climate target is abstract and invites misunderstanding," says Sonia Seneviratne, Professor of Land-Climate Dynamics at ETH Zurich. According to Seneviratne, many people will interpret two degrees globally as two degrees of warming in their region and, accordingly, will not be proactive enough about reducing CO2 emissions in their countries.

The problem is that, according to various climate models, the temperature will rise more sharply over land than over oceans. The big question is therefore how a maximum of two degrees global warming will affect individual regions of the world.

## First quantitative treatment

A team of climate researchers from Switzerland, Australia and the UK led by Seneviratne has now addressed this question. For the first time, the scientists have calculated the levels of extreme and average temperatures, as well as of heavy precipitation, that will occur in individual regions if the average global rise in temperature is taken as a reference.

Recently published in *Nature* as a "Perspective", this study constitutes one of the first quantitative treatments of this issue. Several qualitative examinations have already been carried out on the relationships. This study was supported by Seneviratne's ERC Consolidator Grant project "DROUGHT-HEAT".

The research team based their calculations on several existing climate scenarios, as well as on the assumed and effective development in

atmospheric CO2 concentration.

New graphical depictions were a key result of the calculations. They show at a glance how average temperatures respond to the overall quantity of CO2 emitted and in relation to average global warming in major geographical regions.

## Four model regions tested

The depictions are easy to interpret: the graphical representation is like a type of ruler on which the envisaged target value - such as the global two-degree target - can be set; a linked warming value can then be identified in the corresponding region.

The scientists tested their new model using four examples: the Mediterranean, the USA, Brazil and the Arctic. For each of these regions, the researchers computed a separate graphical representation.

For the Mediterranean, the results reveal the following: if the global average temperature increases by 2°C, the region will see mean temperatures increase by 3.4°C on average. If, however, our aim is to limit warming in the Mediterranean to 2°C, then the global temperature must rise by no more than 1.4°C. The most extreme changes could be seen in the Arctic: with global warming of 2°C, the average temperatures in the far north increased by 6°C. The 2°C target for the Arctic had already been exceeded when global warming reached 0.6°C on average (this figure is now approximately 1°C).

## "Clear-cut effects"

The study conducted by Seneviratne and her colleagues illustrates that the 2°C target cannot be met in many regions of the world, even if it

were adhered to on a global scale. "We wouldn't have expected the effects to be so clear-cut," emphasises Dr Markus Donat, a researcher at the ARC Centre of Excellence for Climate System Science in Australia, and co-author of the study. "Moreover, the connections between extreme temperatures and the global temperature targets are largely linear and independent of the emissions scenario."

For the ETH climate researcher, the study is a practical aid - "a communications measure," as she puts it - for defining regional emissions targets. "The regional impacts of global warming are far more important," she says. The study could be helpful during negotiations, as it would quickly show the significance of climate change for the various parties, adds Seneviratne. This could also help citizens and decision-makers of individual countries to understand why it is important to rapidly reduce CO2 emissions and, specifically, to below the global 2°C target if possible.

## Valuable tool for everyone

According to Seneviratne, anyone can use these calculations to see how 2°C of warming would affect their region; this makes them a valuable tool for politicians and decisions-makers, as well as for civilians, agriculture and the tourism industry.

However, the scientists also point out that the calculations have their limitations. For example, they only provide statements on climate evolution for major regions. "The diagrams cannot be used to deduce what temperatures will be like in the city of Zurich if we reach two-degrees of warming on a global scale," says the ETH professor.

**More information:** Sonia I. Seneviratne et al. Allowable CO2 emissions based on regional and impact-related climate targets, *Nature* (2016). DOI: 10.1038/nature16542

Provided by ETH Zurich