

Three questions climate science must answer

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Credit: University of New South Wales

The signing of the Paris agreement in 2015 may give the impression that the major questions concerning climate change have at last been answered and that climate science has met its challenges.

But a new Perspective article in *Nature Climate Change* today begs to differ, defining three key questions vital for society and calling for an international [climate](#) change research effort on par with the investment in the International particle physics laboratory, CERN. These questions are:

- Where does the carbon go?
- How does weather change with climate?
- How does climate influence the habitability of the Earth and its

regions?

Knowing human caused global warming is occurring is only the beginning of important climate research, according to the authors. Focusing climate science on these three questions tackles new frontiers of climate research and is the next logical step to serve society.

"Knowing that the globe is warming through human activity is like understanding that cancer is caused by runaway cell division. It is just the start of the challenge," said one of the authors of the article Prof Christian Jakob from the ARC Centre of Excellence for Climate System Science.

"While global mean temperature provides the canvas, the details of future changes will emerge at regional levels. It's at these levels that we will feel and need to adapt to the impact of [climate change](#), economically and socially.

"To put it in a particularly Australian way, we don't plan for a bushfire season based on what is happening with global average temperatures, we look at temperature and humidity in our area instead."

Climate researchers and their models have been very good at determining the impacts of human caused [global warming](#) at global and continental levels. However, at regional and local levels—such as the size of large capital cities—there is still a long way to go.

The question of where the carbon goes is equally challenging. If we are to know in real time what is happening to the carbon in our atmosphere, how different parts of the system can take it up and to accurately determine the carbon emissions of each country, there needs to be a concerted, international effort.

Achieving the ambitious goals the article sets out, will require a quantum leap in our understanding and our ability to observe and compute the climate. Enormous computing power is required to capture the detailed processes that go into the formation of clouds, the impact of landforms and vegetation and a host of other climate processes that occur at regional levels.

Good quality and long-term observations both globally and in many parts of the world are needed to unravel the key process interactions involved in determining regional climates.

"Until we focus on regional phenomena, in a place like Australia we may struggle to know exactly how rainfall, heatwaves and sea-level rise will change in different parts of our country, especially our cities," said co-author Dr Sarah Perkins-Kirkpatrick.

"We need to reveal these impacts so we can protect regional agriculture, infrastructure and the Australian environments we have all come to know and love—such as the Great Barrier Reef."

To overcome the lack of regional understanding, the authors are calling for new and enhanced internationally co-ordinated research efforts supported by large computational infrastructure, much like the International particle physics laboratory CERN.

"Better information and understanding at a regional level will allow each country to respond effectively and economically, which is vital to our future prosperity," said Prof Jakob.

"The job for [climate science](#) is far from done. We are one of the most collaborative international fields of science and our future lies in strengthening this collaboration through flagship projects that tackle the most urgent questions. Society depends on the basic science we do.

Answering the three questions will allow us to be ready for the challenges and surprises ahead."

More information: Jochem Marotzke et al. Climate research must sharpen its view, *Nature Climate Change* (2017). [DOI: 10.1038/nclimate3206](https://doi.org/10.1038/nclimate3206)

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