

Ocean warming can predict land warming with simple model

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Credit: Imperial College London

The temperature trend of continents can be estimated by measuring warming of nearby oceans, revealing a simple behaviour of the climate system.

Researchers from Imperial College London and MIT have discovered a link between land and ocean temperatures that allows them to estimate land warming on the scale of continents. This advances scientists' understanding of how climate change affects land and ocean regions differently.

Predicting changes in [temperature](#) and humidity over landmasses is difficult, because there are many different local factors affecting them and large-scale estimates rely on limited local weather stations. Over the ocean, however, surface temperature can be more easily measured with satellites and humidity is more closely controlled by temperature.

The new model, published today in the journal *Proceedings of the National Academy of Sciences*, uses a simple relationship between the humidity and temperature over ocean and land, and how [energy](#) and water vapour are transferred between them.

Lead author Dr. Michael Byrne, from the Department of Physics at Imperial, said: "Heat and humidity are important factors when considering the impacts of climate change. For example, heat stress can damage whole ecosystems.

"Together with data from satellites and [weather stations](#), this model can help to explain how land temperature and humidity have changed over the last 38 years for large areas of the globe."

Exchanging energy

The atmosphere directly above both the land and ocean has the same change in amount of energy as the climate warms. This energy is divided between the temperature and the specific humidity (the amount of water held in the air). Over the ocean, air is moist, meaning more of this energy is represented by the humidity of the atmosphere.

Over land, less water enters the atmosphere, so the humidity is less. In order for the change in energy of the atmosphere over land to match that over the ocean, the land has to put more energy into temperature increases. Therefore, the land warms faster than the ocean, but in a way that is proportional to the rise in [humidity](#) over the ocean.

In order to estimate warming over land using this principle, the team also had to take into account the exchange of energy as moisture moves from the ocean to the land. By comparing their model with historical data, they found they could predict continental temperatures well using [ocean temperatures](#).

Fundamental relationship

Dr. Byrne said: "Modelling land temperature changes has been a challenge for scientists trying to understand [climate change](#), because there are so many variables, like vegetation cover or topography.

"But what we have uncovered is a fundamental relationship between [ocean](#) and land, which doesn't rely on these smaller-scale factors that may be poorly understood."

More information: Michael P. Byrne et al. Trends in continental temperature and humidity directly linked to ocean warming, *Proceedings of the National Academy of Sciences* (2018). [DOI: 10.1073/pnas.1722312115](#)

Provided by Imperial College London

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