

# Science for Environment Policy

## Peak warming effects of today's CO<sub>2</sub> emissions may be as soon as 10 years from now

**The benefits of CO<sub>2</sub> cuts** made now, such as avoided floods and droughts, will be felt within the lifetimes of most people alive today, new research indicates. The study's authors say their work dispels myths that the main effects of CO<sub>2</sub> emissions will not be felt for many decades. They estimate that it could take 10 years for the maximum warming effects of a one-off CO<sub>2</sub> emission to occur.

**The misconception that CO<sub>2</sub>'s greatest effects** will not occur for many decades is widespread in both scientific and policy discussions, the researchers say. Although their study supports claims that its effects will be felt far into the future, it also suggests that its greatest impacts on the Earth's temperature could be much sooner than previously thought.

The study investigated when the warming impact of an emission of CO<sub>2</sub> will be strongest, and the corresponding increase in temperature. Using a total of 55 computer models, the researchers simulated the effects of a one-off release of 100 gigatonnes of carbon (GtC) into the atmosphere. They assumed the background concentration of CO<sub>2</sub> was 389 ppm (parts per million), which was the actual concentration in 2010–2011.

There were 6000 model runs altogether; each run was a different configuration of three of the 55 models and each produced a possible picture of how the climate would respond to the emission within the next 100 years.

The models considered three key influences on the emission's impact: 1.) the carbon cycle, that is, the natural uptake and release of carbon by the oceans and life on Earth; 2.) climate sensitivity, i.e. the ultimate balance between the temperature effects of heat received from the sun, the amount reflected back from the atmosphere and 'feedback effects', such as increases in atmospheric water vapour in response to warming; and 3.) thermal inertia, which is the exchange of heat between the atmosphere and oceans.

The results suggest that there will be immediate warming effects of the emission, and that maximum warming, i.e. the greatest increase in temperature, will occur 10.1 years after the CO<sub>2</sub> was released. This was the median average result, and the researchers suggest that it is also 'very likely' that maximum warming could occur at any time between 6.6 to 30.7 years post-emission.

The maximum warming effect was projected to be 2.2 millikelvin (mK: 1 mK = 1/1000<sup>th</sup> of 1 kelvin) per GtC. Again, this is a median estimate, and they also consider a temperature rise within the range of 1.6–2.9 mK/GtC to be very likely.

After the early peak in warming, the emission's effects on temperature will slowly fall as CO<sub>2</sub> is absorbed by oceans, forests and other natural sinks. However, the fall is relatively small and drops to a median warming effect of around 1.9 mK/GtC after 100 years. Indeed, the researchers believe that the warming response will persist well beyond 100 years.

The researchers point out that the worst effects of [climate change](#), such as maximum sea level rise, will not occur within the next century. However, there are other impacts that will be felt much sooner, such as [droughts, heatwaves and flooding](#), which are expected to increase with changes in temperature. Therefore, they say their study indicates that cuts in carbon emissions now will benefit not just future generations, but current generations too.



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**Source:** Caldeira, K. L. and Ricke, K. (2014). Maximum warming occurs about one decade after a carbon dioxide emission. *Environmental Research Letters* 9(12): 124002. This study is free to view at:  
<http://iopscience.iop.org/1748-9326/9/12/124002>

**Contact:**  
[kricke@carnegiescience.edu](mailto:kricke@carnegiescience.edu)

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