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## No rainforest, no monsoon: get ready for a warmer world

18:00 30 September 2009 by [Shanta Barley](#) , [Nigel Hawtin](#) , [Catherine Brahic](#) and [Tom Simonite](#)

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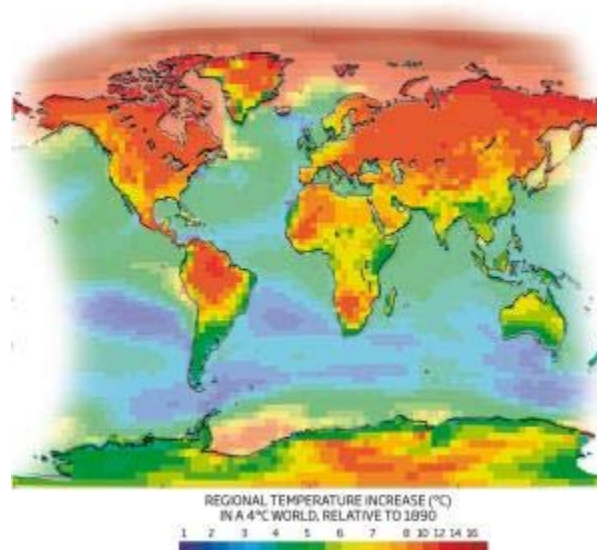
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**Interactive feature:** [Explore the 4 °C world in Google Earth \(.kmz file download\)](#)

BY 2055, climate change is likely to have warmed the world by a dangerous 4 °C unless we stop pumping greenhouse gases into the atmosphere the way we do now. This is the startling conclusion of a study by the [UK Met Office](#), unveiled at a [conference in Oxford](#) this week.

Why so soon? Because temperature rises caused by greenhouse gas emissions are expected to trigger dangerous feedback loops, which will release ever increasing amounts of greenhouse gases. The nature and scale of these feedback loops is a subject of vigorous debate among climate scientists, but warmer oceans, for instance, may liberate more dissolved CO<sub>2</sub>, and plants may decay faster in a warmer climate. The Met Office ran 17 different models with these feedbacks. All concluded a 4 °C world by 2055 was likely if emissions continue to rise. Even if we are lucky, we are still likely to hit 4 °C by 2070.

What will a 4 °C world look like? Brace yourself: the picture painted by the 130 climate researchers at the Oxford conference is not pretty. An average global increase of 4 °C translates to a rise of up to 15 °C at the North Pole. Summers in parts of the Arctic would be as balmy as California's Napa valley. Sea levels would rise by up to 1.4 metres, according to [Stefan Rahmstorf](#) at the Potsdam Institute for



The average global temperature is likely to be 4 °C higher than in pre-industrial times by 2055 if greenhouse gas emissions are not slowed – that means a 16 °C rise in the Arctic (Source: Met Office Hadley Centre)

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Climate Impact Research, Germany. Even the less pessimistic estimate of a 0.65-metre rise by 2100 would put at least 190 million people a year at risk from floods, says Rahmstorf's colleague [Jochen Hinkel](#).

The glimmer of hope? It doesn't have to be this way. If politicians at the UN climate change talks in December agree to cut emissions by 3 per cent every year, the world can limit temperature rise to a "safe" 2 °C, the Met Office says.

## **The Amazon - gone**

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In a 4 °C world, climate change, deforestation and fires spreading from degraded land into pristine forest will conspire to destroy over 83 per cent of the Amazon rainforest by 2100, according to climatologist [Wolfgang Cramer](#) at the Potsdam Institute for Climate Impact Research in Germany. His climate models show global warming alone converting 30 per cent of the Amazon into degraded shrub land and mixed woodland by 2100. Even this grim estimate is based on the hopeful assumption that extra CO<sub>2</sub> in the atmosphere will "fertilise" the forest, buffering it from drought. But we can't be sure this will happen, says Cramer. "If we've overestimated the magnitude of CO<sub>2</sub> fertilisation, we risk losing the entire Amazon."

## **Water lifeline cut**

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Millions of people in India and China depend on monsoon rains to water their crops and for drinking water. Climate change could sever this lifeline. [Anders Levermann](#) at Potsdam University in Germany has developed a model which reflects the physics that drives monsoons. His simulations suggest that in a 4 °C world there will be a mix of extremely wet monsoon seasons and extremely dry ones, making it hard for farmers to plan what to grow. Worse, the fine aerosol particles released into the atmosphere by burning fossil fuels could put a complete stop to the monsoon rains in central southern China and northern India. Monsoons are generated by sharp heat gradients in the atmosphere where warm land meets cool ocean. By blocking solar energy, aerosols cool the coastal atmosphere and sap monsoons' strength.

## **Trapped!**

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Lack of water, crop failure and rising sea levels could force up to 200 million people from their homes by 2050. Attention in rich western nations has focused on the prospect of millions of climate migrants clamouring at their borders. The reality is likely to be harsher, says [François Gemenne](#), a migration expert at the Institute of Sustainable Development and International Relations in Paris, France. From a study of the impact of 23 recent environmental disasters he concludes that the people most vulnerable to a 4 °C rise are also least able to escape it. "At 4 °C, the poor will struggle to survive, let alone escape," he says. Invariably, the poor can't afford to flee, and they lack the social networks which would



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otherwise facilitate migration, Gemenne says.

Climate change is already forcing people to migrate, says Gemenne. Sea level rise is driving an exodus from Tuvalu, Kiribati, Papua New Guinea and the low-lying Carteret Islands, while water stress is forcing people in Mauritania, Sudan, Ghana and Kenya to migrate. Melting permafrost is pushing people out of parts of Alaska and floods are forcing others out of the delta regions of Bangladesh and Vietnam.

Gemenne's research, conducted in conjunction with the EU Commission's [EACH-FOR](#) project, will be published in the *Journal of International Migration* next year.

## Fire down under

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Projections for Australia present a conundrum. It looks likely to escape extreme temperatures rises of 10 °C or more seen elsewhere (see map, top right), but rainfall projections paint a more troubling picture. There was very little consensus between the different models run by the UK Met Office. More alarmingly, a study of the probability of forest fires suggests that the number of "extreme fire danger days" per year - when uncontrollable fires are likely to break out as a result of low humidity, strong winds and high temperature - will treble by 2050. "Even under a low warming scenario, the frequency rises by 10 to 50 per cent," says [David Karoly](#) of the University of Melbourne, who reviewed a range of wildfire projections. "We are unleashing hell on Australia."

**Interactive feature:** [Explore the 4 °C world in Google Earth](#)

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