Regional change

Extreme measures

Geophys. Res. Lett. **34**, L19709 (2007)

Humans are primarily responsible for the increase in extreme temperatures observed over the US continent since the 1950s, a new study shows. Although the link between atmospheric CO_2 emissions from fossil-fuel burning and increased global average temperature is well established, whether humans are influencing extreme weather events, such as heat waves, has remained something of a mystery.

Now, Gerald Meehl from the National Centre for Atmospheric Research in Colorado and colleagues have simulated the number of frost days and warm nights as well as growing season lengths and heat-wave intensity that would have occurred in the US throughout the twentieth century both with and without human greenhouse-gas emissions. Using climate simulations with human and natural factors separately, they found that only by including human-generated emissions could the model results match the observed trends of fewer frost days, more warm nights, greater heat-wave intensity and longer growing seasons since the 1970s.

Extreme weather events have the greatest potential to cause climate-related damage. This study is just one of a number to show the influence of human activity on temperature extremes regionally.

Alex Thompson

Technology

Carbon capture vital

Geophys. Res. Lett. **34**, L19703 (2007)

Removal of carbon dioxide directly from the atmosphere is essential for combating climate change, suggests a new study. Most efforts to mitigate global warming focus on reducing emissions of greenhouse gases, most notably CO_2. But that in itself will not be enough, say scientists.

A team led by Andrew Weaver at the University of Victoria in Canada used a well-tested climate model of the oceans and atmosphere to simulate CO_2 emissions and global temperature over the next 500 years. They found that unless emissions are reduced by more than 40% over the next 40 years, the Earth will warm by more than 2 °C this century, breaching the temperature threshold beyond which many scientists think there will be dangerous consequences. Even if CO_2 emissions were stabilised to a tenth of current levels, temperatures would rise by more than 2 °C eventually. This suggests that nothing short of active removal of CO_2 from the atmosphere is necessary to avoid unmanageable warming.

Capture and sequestration of CO_2 directly from the atmosphere is not yet viable on a large scale. But this latest research suggests the need to develop artificial carbon sequestration methods, and fast.

Alex Thompson

PUNCHSTOCK

Technology

Nature's cure

Environ. Sci. Technol. doi:10.1021/es0701816 (2007)

Scientists have proposed a novel approach to removing carbon dioxide from the atmosphere based on the Earth's natural weathering process. Not only could the technology mitigate global warming, it could also counteract continued acidification of the ocean, which threatens marine life.

The technology, invented by Kurt Zen House, a PhD candidate at Harvard's Department of Earth and Planetary Sciences, and co-workers, involves electrochemically removing hydrochloric acid from the ocean, neutralizing it by reaction with silicate rocks and returning it to the sea. By increasing ocean alkalinity, the process would enhance the absorption of atmospheric CO_2. Over time, the CO_2 would mix throughout the ocean and eventually precipitate as calcium carbonate in ocean sediments. This method of carbon capture and storage could effectively transfer CO_2 from the atmosphere to the ocean for hundreds of years or longer. And unlike natural chemical weathering, in which weak carbonic acid slowly dissolves silicate rock, this process uses concentrated hydrochloric acid to dissolve silicate, thus accelerating the pace to industrial rates.

But the scientists acknowledge that offsetting even around 15% of global greenhouse-gas emissions would be a considerable task. They say that implementation of the technology would be ambitious and costly, and could have unknown environmental risks of its own.

Olive Heffernan

GETTY

Society

Unequal impacts

EcoHealth doi:10.1007/s10393-007-0141-1(2007)

The health burden of climate change will be greatest among those who have contributed least to the problem, finds a study that quantifies the growing ethical crises of global warming.

Led by environmental public-health researcher Jonathan Patz of the University of Wisconsin, Madison, the study compared per capita carbon dioxide emissions with the regional distribution of four climate-sensitive health effects: malaria, malnutrition, diarrhoea and inland flood-related fatalities. Overall, the researchers found a striking disparity between countries with the highest emissions and those with the highest disease burden. For example, per capita CO_2 emissions of the US are six times greater than the average among nations, yet the US also has a significantly lower disease burden than developing nations, some of which have per capita emissions 30-fold less than those of the US.

Notably, the study highlights that 88% of the disease burden attributable to climate change affects children less than five years old, who are a 'non-consenting' part of the population. The inequity of climate change further extends to some of the proposed solutions; the scientists caution that biofuels, for example, could worsen the health impacts of climate change by competing with food crops for land and rainforests for biodiversity conservation in developing nations.

Olive Heffernan

Climate impacts

Floods in a flash

Geophys. Res. Lett. **34**, L21503 (2007)

Glacier lakes bounded by natural ice dams can empty suddenly, causing massive flooding. The floods, which empty along subglacial paths and are known as jökulhlaups, can be very large and last from days to weeks. Predicting the timing and the peak flow of these floods has proven difficult, but now researchers have found that their occurrence is linked to air temperature.

Felix Ng from the University of Sheffield and colleagues have used thermochemical models to study 39 of these events at Merzbacher Lake in the Kyrgyz Republic, a lake that completely empties each time it floods. They found that the maximum flow of water out of the lake is greater when the air is warmer, owing to the faster rate at which meltwater enters the lake. Air temperature also controls the time it takes the lake to refill and therefore influences the timing of the next flood.

As air temperatures increase with climate change, glacier lake outburst floods may become more hazardous, the researchers warn. However, it is also possible that the timing of floods will shift to cooler months as the climate warms, or that the lakes may become smaller as glaciers thin.

Alex Thompson

Cryosphere

The big melt

Geophys. Res. Lett. **34**, L19505 (2007)

Open ocean waters absorb almost ten times more solar radiation than sea ice — a phenomenon known as the ice-albedo feedback. Recent declines in the extent of Arctic summer sea ice may partly be due to the increase in heat being absorbed by the newly uncovered ocean.

Donald Perovich at the Cold Regions Research and Engineering Laboratory at the US Army ERDC and colleagues used a series of satellite-derived measurements of ice cover and solar radiation in the Arctic from 1979 to 2005 to estimate the amount of heat the ice-free ocean was absorbing. Although scientists have predicted that diminishing sea ice would lead to increasing heat absorption in the ocean, few studies have been able to quantify the effects. The team, led by Perovich, found that most of the Arctic Ocean has steadily been absorbing more heat since 1979. Areas such as the Chukchi Sea near the coast of Alaska have experienced increases of up to 4% per year.

Over the 26 year period, the Arctic Ocean absorbed enough additional heat to melt up to 9,300 km^3 of sea ice. Large amounts of energy stored in the upper ocean could also delay or prevent the refreezing of sea ice during the following winter.

Alicia Newton