of aspen was variable throughout the past few decades, but overall it rose by 50 per cent between the 1960s and the present day. The team looked at whether genetic diversity or regional changes in precipitation and length of the growing season could have caused the trend. Comparing tree-ring data, a measure of annual growth, with records of atmospheric carbon dioxide, they found that a substantial amount of the increased growth was spurred by elevated CO_2 concentrations.

The findings suggest that aspen forests will continue to be important sinks for carbon dioxide, at least in the short term. But rapid expansion of these pioneering trees could have untold ecological consequences, say the researchers.

Alicia Newton

ATMOSPHERIC SCIENCE

The long and the short

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Climate scientists have long held that the global temperature would rise by about 3 °C if atmospheric concentrations of CO_2 doubled from pre-industrial levels. But new research suggests that the Earth's temperature might be as much as 30–50 per cent more sensitive to atmospheric greenhouse gases than previously thought.

While conventional estimates of climate sensitivity have focused on factors that influence temperature in the short term, such as cloud and snow cover, a team of scientists led by Daniel Lunt at the University of Bristol, UK, have devised a new estimate — termed 'Earth system sensitivity' — that also accounts for factors that affect temperature in the long term, such as land ice and vegetation. They used a state-of-the-art climate model to analyse the events that gave rise to a warm period about 3 million years ago, and they then compared these to actual temperature reconstructions derived from 3-million-year-old sediments on the ocean floor. Their analysis suggests that fast- and slow-adjusting components of the climate system will have an important influence on the extent of warming.

The findings should send a strong message to policymakers, as they show that deeper emissions cuts will be needed to avoid dangerous climate change in the long term.

Olive Heffernan

CRYOSPHERE

Arctic mix-up

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The traditionally quiescent Arctic Ocean may soon become a more active environment owing to its diminishing sea ice. Floating ice impedes winds from transferring energy to the ocean, thereby minimizing waves both on and beneath the surface. Subsurface internal waves have an important role in mixing water between various depths, but this process occurs less in the Arctic than in other ocean basins.

In 2002 and 2003, University of Washington researchers Luc Rainville and Rebecca Woodgate moored instruments at 70 and 110 metres below the surface in the Chukchi Sea, north of the Bering Strait, an area typically iced over in winter and ice-free in summer. They found that storms with winds stronger than ten metres per second occurred all year, but they generated significant internal waves only in the absence of sea ice. The mixed layer of water resulting from those waves grew rapidly during summer.

As Arctic ice continues to decline year-round, the researchers anticipate increased mixing from internal waves. This could affect the success of phytoplankton blooms, the base of the Arctic food web. It may also affect exchanges of water between the Arctic and other oceans, with implications for climate connections to more southerly regions.

Harvey Leifert