CHEMISTRY

Sugar power

©PUNCHSTOCK

Nature **447**, 982–986 (2007)

Fructose — a carbohydrate commonly found in packaged foods — could supplant ethanol as a fuel additive thanks to a new chemical process that transforms it into 2,5-dimethylfuran (DMF). DMF is superior to ethanol in several important ways: it releases 40% more energy on combustion, it blends more easily with petroleum and, unlike ethanol, it does not absorb water from the atmosphere. But, it has been difficult to produce economically, until now.

James Dumesic and engineering colleagues at the University of Wisconsin-Madison, USA, have developed an efficient two-step process that removes oxygen atoms from fructose, converting it to DMF via an intermediary compound, 5-hydroxymethylfurfural. Their novel approach makes use of chemical catalysts.

The combustion of fuels such as ethanol and DMF, which are made from plants, adds no net carbon dioxide to the atmosphere and therefore does not contribute to global warming, as fossil fuels do. Dumesic and colleagues say that a similar catalytic process might produce DMF from glucose found in woody stems and plants that are not usually consumed, which could be even more efficient than starting with fructose. Before DMF can be considered as a fuel additive, its toxicity must be determined as currently this is not understood with precision.

Harvey Leifert

BIODIVERSITY AND ECOSYSTEMS

Arctic response

© TOKE HØYE

Curr. Biol. **17**, 449–450 (2007)

In northern Greenland, just 1,700 kilometres from the North Pole, flowers are blooming, insects are emerging and migratory shorebirds are laying eggs an average of two weeks earlier than they were just a decade ago. Some plants, such as Moss Campion, now bloom a full month earlier. These and other Arctic species are responding quickly to their warming environment, according to new research.

Toke Høye of the University of Aarhus, Denmark, and colleagues examined the effect of earlier springtime on common local plants and animals at Zackenberg, Greenland, from 1996 to 2005 in the first study to document these effects in the High Arctic. Studies at temperate latitudes have recorded the advancing dates of periodic biological cycles in relation to increased temperature, but in Greenland, these events relate directly to the onset of snowmelt, the researchers found.

Høye and co-workers consider the changes to be dramatic, given the short Arctic summer and the number of organisms observed. As the Arctic continues to warm, interactions between species could be weakened or disrupted, he says, because their breeding cycles may respond to climate change at different rates.

Harvey Leifert

EXTREME EVENTS

Dangerous hotspots

Geophys. Res. Lett. **34**, L11706 (2007)

The number of dangerously hot days in the Mediterranean is expected to increase by 200–500% during this century, if greenhouse-gas emissions continue to rise, according the new research. Led by Noah S. Diffenbaugh from Purdue's Climate Change Research Centre in Indiana, the study is the first detailed projection of future extreme temperatures in the climate-change hotspot.

Diffenbaugh and colleagues simulated climate change from 1961 to 1989 and 2071 to 2099 for 21 countries at an unprecedented spatial resolution of 20 kilometres. Extreme events, such as summer heat waves, will become much more common in this region in the future if CO_2 emissions continue to rise, they found, with the greatest increase in extreme temperatures expected to occur in France and the Iberian Peninsula.

Coasts in the west and south of the Mediterranean will experience the greatest increase in days per year with dangerous heat and humidity, under both low and high fossil-fuel emission scenarios.

But the researchers also show that lowering emissions to achieve atmospheric CO_2 levels of 600 p.p.m.v. by the end of this century would curb the increase in extreme temperatures by up to 50%.

Samia Mantoura

© GETTY

CRYOSPHERE

Ice-cold hotspots

Science doi:10.1126/science.1142834 (2007)

Rising global temperatures are causing Antarctic ice shelves to disintegrate, creating thousands of free-drifting icebergs in the nearby Weddell Sea. A novel study has now found that these migrant icebergs serve as hot spots of ocean life, enhancing local primary production, which could increase the export of organic carbon to the deep sea.

Kenneth L. Smith Jr of the Monterey Bay Aquarium Research Institute and colleagues sampled two icebergs — one 0.1 km^2 and the other 30.8 km^2 in aerial surface area — and their surrounding waters in the Weddell Sea during austral spring 2005. They found a zone of enhanced marine life, including significantly increased phytoplankton, chlorophyll, krill and seabirds, extending almost 4 km from both icebergs.

The 'hotspots' of marine activity surrounding the icebergs thrive on land-based minerals and organic matter released from the icebergs as they melt. Using iceberg population estimates from NASA satellite

imagery, Smith and colleagues calculated that around 40% of surface waters in the region have enhanced productivity owing to this additional fertilizer. Climate models should include the influence of icebergs when calculating how much carbon the ocean sequesters, say the researchers.

Eric Smalley

©HENRYA. RUHL

OCEAN SCIENCE

Carbon export overestimated

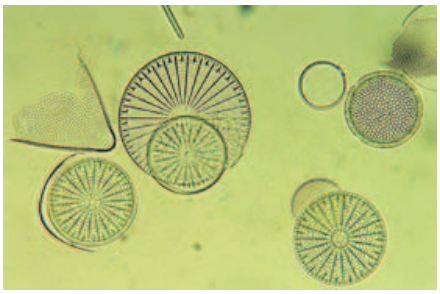
Nature **447**, 999–1002 (2007)

The method used to estimate how marine phytoplankton transports carbon to the deep sea has been challenged by a new study. Because it is difficult to directly measure the sinking of carbon, for over 20 years scientists have used an indirect measure called the *f*-ratio to estimate the strength of the so-called biological pump that brings carbon to depth. *f*-ratio measurements assume that what sinks down to the deep ocean — carbon-containing organic matter — equals what wells up, that is, nitrate.

Now, Andrew Yool of the National Oceanography Centre, UK and colleagues have calculated rates of nitrification — the process by which nitrate is formed — around the world by integrating open-ocean measurements in a global ecosystem model. Rather than being exclusively formed in deep water and welling upwards, as previously thought, the researchers found that nitrate is formed at all depths. About half of the nitrate phytoplankton consume is created in surface waters.

If less nitrate is welling up from depth then it follows that less carbon is reaching the deep ocean through the biological pump. The study suggests that the *f*-ratio cannot be used to reliably estimate carbon export production and storage in the deep sea.

Eric Smalley



©GETTY

CLIMATE IMPACTS

Arctic ponds disappear

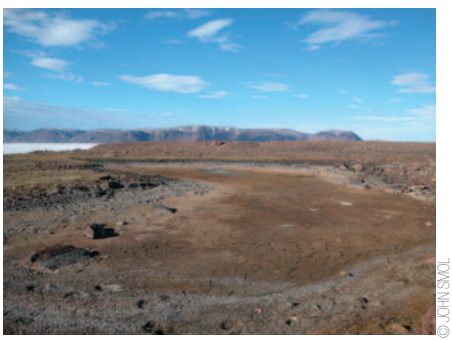
Proc. Natl Acad. Sci. USA
doi: 10.1073/pnas.0702777104 (2007)

Arctic ponds that have existed for thousands of years are now disappearing because of climate change, according to a study by John Smol from Queen's University in Ontario, Canada and Marianne Douglas from the University of Alberta, Canada.

The authors sampled a group of approximately 40 typical Arctic ponds in Canada every few years from 1983 to 2006 — the longest ever study of this kind. The shallow but ecologically diverse ponds are shrinking and becoming saltier because warmer temperatures are causing water to evaporate. In several cases they found that ponds previously tens of metres wide had vanished by 2006. More disturbingly, the surrounding wetlands, previously waterlogged and mossy, had become dry enough to ignite with a lighter. Sensors left by the researchers showed that similar drying occurred in 2005.

Evidence that these ponds have existed for thousands of years in a relatively stable state comes from paleoecology — the study of organisms preserved in layers of pond sediment. Worryingly, the authors think that the recent changes are probably widespread and might turn the region from a carbon sink to a carbon source.

Samia Mantoura



© JOHN SMOL