

Editorial

Welcome to the winter issue of *Planet Earth*. In this issue we've focussed on some of the key questions that keep coming up around flooding in the UK.

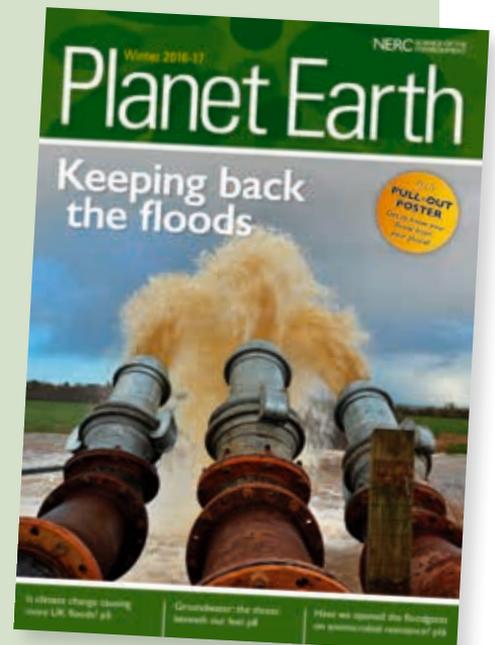
We spoke to experts at the NERC British Geological Survey on the rising problem of groundwater and efforts to understand and manage it. We also cover a new report on last winter's flooding and ask 'Is climate change making it worse?'

Researchers bring us up to date on whether natural flood management techniques are the future and talk about an ambitious project to equip the UK to deal with coastal erosion. For those

of you who want to know your fluvial from your pluvial, we've got a great pull-out poster to help you tell the difference.

Meanwhile, have you ever wondered what heavy rainfall might do to our sewers? Read about the drug-resistant bacteria that could make you think twice before swimming in the sea after a storm. Once you've caught up with flood research, see an amazing project in Ethiopia using roads to manage water that's already benefitted more than a million people.

Round off with tales of the coral that could give us a detailed history of climate change and of the map of what exactly lies beneath the UK.



African swamp locks in 30 billion tonnes of carbon

A vast peatland in the Congo Basin has been mapped for the first time, revealing it to be the largest in the tropics.

Because of their remote location, the peatlands in the Congo Basin are relatively undisturbed. But they could face threats from drainage for agricultural plantations, particularly for palm oil, as is happening in Indonesia.

If peatlands dry out, either through changes in land use such as drainage for agriculture or reduced rainfall, further decomposition resumes, releasing carbon dioxide into the atmosphere.

Peat is a wetland soil made from part-decomposed plant debris, more commonly found in cool environments such as parts of Scotland and Ireland. Healthy peatlands act as carbon sinks, removing carbon from the atmosphere through plant growth. The peat's waterlogged environment prevents it from breaking down further, locking up carbon. Year-round waterlogging is needed for peat to form in the tropics.

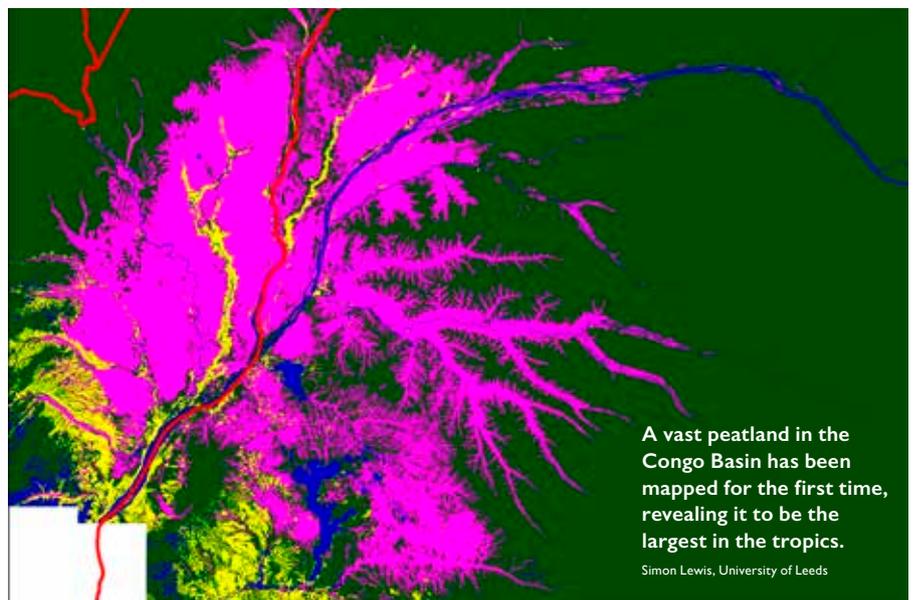
The Cuvette Centrale peatlands in the central Congo Basin, which we didn't know existed five years ago, cover

145,500km² – an area larger than England. They lock in 30 billion tonnes of carbon, making the region one of the most carbon-rich ecosystems on Earth.

Professor Simon Lewis, University of Leeds, said: "These peatlands hold about 20 years of the fossil fuel emissions of the United States of America. If the Congo Basin peatland complex was to

be destroyed, this would release billions of tonnes of carbon dioxide into our atmosphere."

Tropical peatlands across the islands of Borneo, Sumatra and New Guinea have suffered damage or loss to about 94,000km² of peatland – mostly by forest fires or being drained for agricultural use over recent decades.



A vast peatland in the Congo Basin has been mapped for the first time, revealing it to be the largest in the tropics.

Simon Lewis, University of Leeds

How does living in a polluted city affect your health?



Joann Pitman/Flickr

Impact of living in pollution blighted megacities to be probed

Scientists are examining the health effects of air pollution blighting Beijing in a major new international study.

Chinese and UK scientists will use cutting-edge technology, including personal pollution monitors for the first time, to gain a wider picture of what living in highly-polluted air conditions does to people's health.

Air pollution is a leading cause of disease in China with high numbers of children with asthma and other respiratory illnesses and high risks of heart disease, strokes, cancer and early death.

The Chinese government has made moves to reduce pollution, but 2017 has already seen cities blanketed in smog and authorities cancelling flights, shutting highways and imposing emergency factory closures.

The new research will track 120 people in the centre of Beijing and 120 residents of a small village, Pinggu, north-east of the city, to compare urban and rural areas.

Pollution measurements and health assessments will be made in summer and winter when air quality deteriorates as demand for heating, mainly supplied by coal-fired plants, soars.

Each person will be tracked for a week, with a monitor measuring exposure to pollutants, and a GPS recording whether they are at home or work, walking, cycling or in a vehicle.

Professor Frank Kelly of King's College London, one of the lead researchers, said: "The findings of this study can have an immediate impact on both the strategies for reducing air pollution levels and exposures, and for other public health and clinical approaches to alleviate its impact upon health."

The study is part of a wider programme of five NERC/MRC/NSFC-funded projects due to run until 2018. Read the abstract here: bit.ly/pollutedmegacities

Birds and butterflies struggle with climate change

Some of Britain's much-loved birds and butterflies could become extinct in areas where there is not enough natural habitat to allow them to adapt to warming temperatures.

Scientists looked at data obtained between 1964 and 2009 from more than 600 monitoring sites around England to find out how birds and butterflies reorganised themselves in response to climate change.

They found that when birds and butterflies lost parts of their habitats, the effects of climate change were worse. They also concluded that larger declines were caused in birds and butterflies that are used to cold temperatures and prevented increases in birds adapted to warm weather.

Dr Tom Oliver, who led the research at the NERC Centre for Ecology & Hydrology (CEH), said: "Although butterflies are coping much better, in both cases a lack of natural habitat in our landscapes is putting species used to colder climates between a rock and a hard place by limiting their ability to find resources and survive."

Dr David Roy, Head of the Biological Records Centre at CEH, said: "There is increasing evidence of the impacts of climate change on wildlife. Our wildlife is more resilient to negative effects of climate change if larger and better connected natural areas are available."

Read more at www.ceh.ac.uk



Aleksy Gnilenkov/Flickr

Halley Research Station Antarctica to close for winter



NERC and British Antarctic Survey (BAS) have decided not to winter at Halley VI Research Station for safety reasons. The station, which is located on the floating Brunt Ice Shelf in Antarctica, will shut down between March and November 2017. Changes to the ice, particularly the growth of a new crack, presents a complex glaciological picture that means BAS scientists are unable to predict with certainty what will happen to the ice shelf during the forthcoming Antarctic winter. As a precautionary measure BAS will remove its people before the Antarctic winter begins.

For more info visit www.bas.ac.uk

2016 was the world's hottest year on record

Earth's 2016 surface temperatures were the warmest since modern recordkeeping began in 1880, according to independent analyses by NASA, the US National Oceanic and Atmospheric Administration (NOAA) and the Met Office.

Not only was last year the hottest on record, it was the third year in a row to break that record. This continues a long-term warming trend, according to analyses by scientists at NASA's Goddard Institute for Space Studies in New York.

Because weather station locations and measurement practices change over time, there are uncertainties in the interpretation of specific year-to-year global mean temperature differences. However, even taking this into account, NASA estimates 2016 was the warmest year with greater than 95 per cent certainty.

"We don't expect record years every year, but the ongoing long-term warming trend is clear", said Gavin Schmidt, director of the institute.

The planet's average surface temperature has risen about 1.1°C since the late 19th century, a change driven largely by increased carbon dioxide and

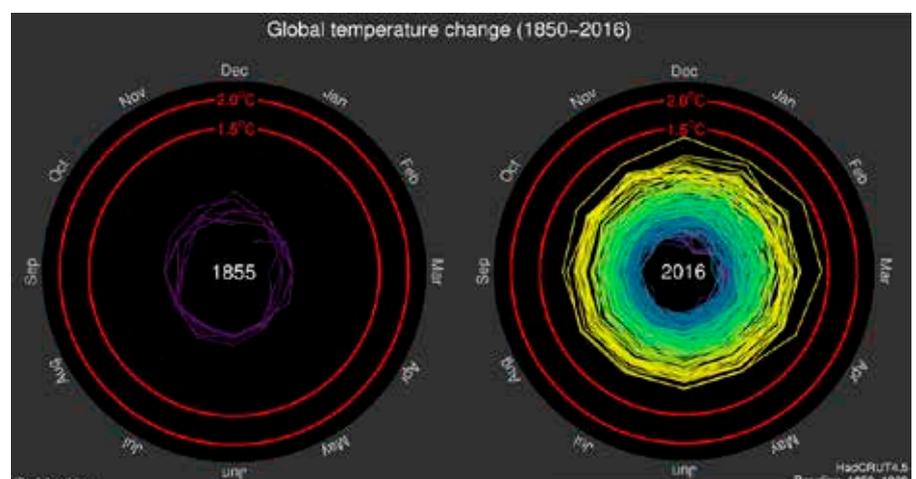
other human-made emissions into the atmosphere.

Most of the warming occurred in the past 35 years, with 16 of the 17 warmest years on record occurring since 2001. Not only was 2016 the warmest year on record, but eight of the 12 months that make up the year – from January through to September, with the exception of June – were the warmest on record for those respective months.

Phenomena such as El Niño or La Niña,

which warm or cool the upper tropical Pacific Ocean and cause corresponding variations in global wind and weather patterns, contribute to short-term variations in global average temperature. A warming El Niño event was in effect for most of 2015 and the first third of 2016. Researchers estimate the direct impact of the natural El Niño warming in the tropical Pacific increased the annual global temperature anomaly for 2016 by 0.12°C.

Dr Ed Hawkins' climate spirals show how temperatures have steadily increased.





Changing Arctic ecosystems could have far-reaching implications for the UK environment and economy. NASA/Kathryn Hansen

Shellfish production surges and marine ecosystems recover

The UK has seen £908m in positive net impacts as a result of a ban on anti-fouling chemicals. The bans were based on evidence produced by NERC researchers into the effects of chemicals such as tributyltin on shellfish. The UK shellfish industry and its supply chain saw a £331m benefit in the same period and the UK saw £718m in benefits such as value for anglers and divers. The NERC-commissioned analysis by Deloitte suggests that between £172.5m and £236.0m of these benefits is thanks directly to NERC-funded science.

Read more bit.ly/shellfishboost



£9m for research to boost UK local economies

NERC has funded two highly ambitious projects that will help two UK regions benefit from its world-class environmental science research.

The projects are funded under a new NERC scheme, the Environmental Science Impact Programme, which aims to translate excellent NERC-funded research into actions or policies that improve performance, resilience and sustainability, and support local growth.

The first two projects are led by University of Exeter and the University of Leeds.

Find out more at bit.ly/9mresearchforlocal

Ice melt impact on Arctic Ocean

A major UK research programme will investigate the impact of diminishing sea ice on the fragile marine environment of the Arctic Ocean.

The Arctic is the fastest-changing environment on the planet, supporting complex yet still poorly-understood ecosystems. Rising global temperatures have caused drastic thinning and decline in the extent of the Arctic summer sea ice. Some scientists have predicted an ice-free summer in the Arctic Ocean within a few decades.

We do not yet know exactly how this will affect the creatures, plants and habitats of the Arctic Ocean – but it is clear that changing these diverse marine ecosystems could have far-reaching implications for the UK environment and economy. This could include influencing UK climate, migratory species and having a knock-on impact on industries such as fisheries and tourism.

Scientists will start work on research projects on how life in the Arctic Ocean is coping with dramatic changes – including ocean acidification and pollution as well as sea-ice loss – by looking at key species in the food webs such as small creatures essential to the diet of whales and commercially-important

fish, studying the ocean floor and measuring the health and resilience of the environment. Understanding how marine life is responding today will help scientists predict future changes.

Funded under NERC's *Changing Arctic Ocean; Implications for Marine Biology and Biogeochemistry* research programme, 16 UK research institutions will take part in four research projects starting in February 2017.

The projects include research into how changes in sea-ice cover are affecting the productivity of the Arctic and, therefore, its ability to support marine life, and looking into past and future changes in the Arctic ecosystem by examining both the base of the food chain – marine phytoplankton – and key predators at the top – harp and ringed seal.

Other researchers will examine how the survival capacity of *Calanus*, a small shrimp-like animal, will be affected by changes to its food environment caused by changes in the Arctic Ocean, and examine how changing sea ice conditions impact biological communities on the Arctic Ocean's sea floor.

Read the full abstracts of each project here: bit.ly/GOTWchangingarctic