Biomolecules allow chemists to read 'history book of the sea'

01 October 2012 – A chemist at the Alfred Wegener Institute for Polar and Marine Research is studying how dissolved organic matter acts as a 'history book of the sea.'

Professor Boris Koch and colleagues are using a combination of techniques to identify and retrace the biomolecular tracks left by sea phenomena such as algae blooms, schools of dolphins and the warming impact of the Sun.

It is this dissolved organic matter (DOM) that can help reveal the history of the ocean. Using a mass spectrometer at the Helmholtz Zentrum München, a team of researchers have identified thousands of individual components contained within the dissolved organic matter. By looking at the chemical formula of each molecule (and the amount of carbon, oxygen, hydrogen and nitrogen contained within it) the team can assess where an individual molecule might have come from.

Dissolved organic matter in the ocean is one of the largest active, organic carbon reservoirs on earth. There is an estimated 662 billion tonnes of carbon stored in the sea in this way. Some of the DOM is quickly broken down by bacteria into its most basic components, releasing the stored carbon dioxide in the process, allowing it to escape back into the atmosphere. However some of it is not broken down, rather it becomes chemically modified and withstands the decomposition process for up to 5,000 years. The interruption of the degradation process means that marine DOM acts as a buffer in the organic carbon cycle.

By analysing the DOM, the chemists can gain a 'chemical fingerprint' which, when statistically analysed, can allow the team to draw conclusions about the water in which the dissolved organic matter once swam in. They can work out how old the dissolved matter is, whether it was exposed to strong sunlight along its path through the ocean or which bacteria and types of plankton once swam in the same body of water.

"We are just beginning our studies. However, it would appear that, using this method, we have discovered a new way of exploiting the water's chemical memory," says Boris Koch.

The team can even trace which share of the dissolved organic matter leaves its tracks in the atmosphere. "Foam and waves can transport DOM into the air where it has a considerable influence on climate," adds Dr Philippe Schmitt-Kopplin from the Institute of Ecological Chemistry at Helmholtz Zentrum München.

The team now hopes to find out more about the role of this dissolved organic matter in the global carbon cycle. They believe that oceanographers could supplement temperature and salt content data with DOM data to enrich their studies. The team is planning to study the DOM along migration routes of southern elephant seals to see if the waters demonstrate any chemical commonalities. "Perhaps we will find evidence that these marine mammals find their way using 'water odour'," Koch says.

The team's work has been published in a special volume of *Biogeosciences*. Wired.co.uk sincerely hopes that this evidence of a chemical memory in the sea is not exploited by homeopaths.

This news item, featuring research published in EGU's Open Access Journal Biogeosciences, *was originally published by Wired.co.uk*

Britain could suffer smog worse than Beijing

03 August 2012 – Britain could be blanketed with thick fog worse than Beijing if carbon emissions are not slashed, scientists have warned.

The thick smog that has come to symbolise Asia's rampant air pollution could come to the UK if carbon emissions are not slashed, scientists have warned.

A rapid rise in air pollution caused by burning fossil fuels, oil, gas and coal poses a major health risk and claims up to 1.3 million lives a year globally, according to the World Health Organisation.

But scientists have warned that with government negotiations to limit our carbon output stalling, emissions could continue to grow at their current pace.

A team of researchers in Italy and Germany say that if this "business as usual" approach continues, by 2050 the UK will have the same levels of thick air pollution as Asia has today.

Scientists hope the startling findings, which appear in *Atmospheric Chemistry and Physics* journal, will spur governments to get around

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Building clouded in heavy smog in Beijing, China. Credit: Diego Azubel/EPA

the negotiating table and come up with new strategies to limit our carbon footprint.

But they warn that with much of Europe and the United States struggling through the largest economic downturn since the depression, political will to strike a fresh deal may be lacking.

The report's lead author, physicist Andrea Pozzer, from the Max Planck Institute of Chemistry in Germany, said: "Strong actions and further effective legislation are essential to avoid the drastic deterioration of air quality, which can have severe effects on human health. "We show that further legislation to control and reduce man-made emissions is needed, in particular for eastern China and northern India, to avoid hot-spots of elevated air pollution."

The picture is even grimmer in East and South Asia, where pollution is set to triple over the next four decades unless drastic action is taken.

Researchers working on the study estimated air quality in 2005, 2010, 2025 and 2050 using an atmospheric chemistry model.

The results show that in 2025 and 2050, under the business-as-usual scenario, East Asia will be exposed to high levels of pollutants.

These include nitrogen dioxide and sulphur dioxide, which cause breathing problems, and fine particulate matter which causes lung and heart disease.

Northern India and the Arabian Gulf region, on the other hand, will suffer a marked increase in ozone levels, which are linked to asthma, bronchitis and heart attacks.

Co-author Greet Janssens-Maenhout, of the European Commission Joint Research Centre in Italy, said: "At present the post-Kyoto climate negotiations are progressing slowly, and it is unclear how air quality policies will develop globally.

"In regions with economic growth, it might be less effective to implement emission-reduction measures due to strong growth in activities in particular sectors; in countries suffering from the economic downturn, implementing expensive air-quality measures could prove difficult in coming years."

This news item, featuring research published in EGU's Open Access Journal Atmospheric Chemistry and Physics, *was originally published by The Telegraph*

Europe Considers $1.1 Billion 'Juice' Rocket to Habitable Worlds

26 April 2012 – The European Space Agency will decide next week whether to launch an 830 million-euro ($1.1 billion) mission to explore habitable worlds around Jupiter.

A successful mission would enable scientists to learn more about Jupiter's habitable moons, according to Imperial College of London space physicist Michele Dougherty, who spoke today at a European Geosciences Union press briefing in Vienna. The Paris-based agency is scheduled to decide on May 2.

The Jupiter Icy Moon Explorer, or 'Juice' mission, would be "the first to send an orbiter to an icy world," said Dougherty, who also leads the ESA's mission-study team. "Juice will address the question whether there are habitats elsewhere in the solar system with the conditions to sustain life."

The European satellite would orbit Jupiter's Ganymede, the gaseous planet's largest moon, for about three years beginning in 2030. Ganymede is the only moon in the solar system with its own magnetic field, along with an atmosphere and subsurface ocean. The Juice rocket would lift off in 2022 for the eight-year journey to Jupiter.

Europe's space agency is in talks with the US National Aeronautics and Space Administration about sharing instruments on the Juice mission. A single instrument can cost 30 million euros and the array of measurement and tracking devices that would be loaded onto the orbiter aren't included in the headline cost, Dougherty said.

This news item, featuring research presented at the 2012 EGU General Assembly, was originally published by Bloomberg

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World's glaciers 'out of balance'

26 April 2012 – Earth's glaciers are seriously out of balance with the global climate and are already on their way to losing almost 40% of their volume.

The retreat of McCall Glacier in North Alaska. The left panel is 1958; the right panel is 2003. Credit: M. Nolan/UAF

That is the assessment of scientists after studying a representative group of 144 small and large glaciers around the world.

Their figure assumes no further warming of the climate.

However, if temperatures continue to rise as models predict, the wastage will be even higher, the team says.

"When we look at the data, we can see that the glaciers are out of balance, meaning the climate has actually changed faster than the changes we've seen in ice area and volume," explained Sebastian Mernild from Los Alamos National Laboratory, New Mexico, US.

"Our data suggests the glaciers will commit about 30% of their area and about 38% of their volume to global sea level rise."

Dr Mernild's group calculates this figure to be on the order of 22cm.

"This will happen in the next decades to centuries," he told BBC News.

Dr Mernild, from the Climate, Ocean, and Sea Ice modelling (COSIM) Group at Los Alamos, was describing his team's work here at the European Geosciences Union (EGU) meeting in Vienna, Austria.

A glacier is in balance when the snow at higher, colder elevations equals the volume of snow and ice lost through melting at lower, warmer elevations.

If precipitation is greater, the glacier will increase its mass; if melting dominates, the glacier will thin and retreat until it reaches a state of equilibrium again.

Dr Mernild's team says its assessment of the glacier sample indicates climate conditions have changed so fast that many ice bodies have not yet had time to fully adjust to their new equilibrium position.

This means a certain amount of mass loss is already locked into the system even if there is no further warming.

"Glaciers will move up in the terrain, they will become smaller and thinner and they will adjust to the climate conditions.

"On the other hand, we expect the climate will warm continuously in the future, meaning that the glaciers will become even more out of balance, and that means the glaciers will commit even more volume to sea level rise."

If the models are correct and further warming is seen during the next several decades and longer, the study projects that the Earth's glaciers could ultimately lose more than half their mass.

The picture is described as regional, with some areas said to be more out of balance than others.

Dr Mernild cites the Alps as one glacier group that is farther from balance than the global average.

He says alpine glaciers are likely to lose most of their mass by 2100.

"But if you take into account the volume of ice in the glaciers here in the Alps, it won't have the same impact on the global sea level rise compared to if we see the same out of balance conditions in other places on the globe where we know there is more ice located.

"So, the contribution to sea level rise will not be that big from the Alps region."

The COSIM assumption is that there is a sea level equivalent of 60cm locked away in all the world's glaciers (the number excludes the ice sheets of Antarctica and Greenland).

That figure has been debated here at EGU. Dr Matthias Huss, from the University of Fribourg, Switzerland, presented new data suggesting there was only 48cm of sea level tied up in all the world's glaciers (and the larger glaciers referred to as ice caps).

"Our number is 192,000 cu km. This is about 25% less than some previous estimates. It is a total potential sea-level rise of 0.48m," Dr Huss told BBC News.

"We're using a physically based approach. Until now, people have relied on simple statistical methods."

The Fribourg researcher said his team's work captured much better the range of thicknesses in the world's glaciers, of which there are estimated to be about 160,000.

This news item, featuring research presented at the 2012 EGU General Assembly, was originally published by the BBC