ISSN 2262-9754

GEO

THE QUARTERLY NEWSLETTER OF
THE EUROPEAN GEOSCIENCES UNION

ISSUE 8, DECEMBER 2013

THE CLIMATE ISSUE

HOW TO NAVIGATE THROUGH THIS NEWSLETTER

Due to its interactive features, this PDF file is best viewed with Adobe Acrobat Reader.

(Note that, while a purple bar may appear at the top of the PDF when you open it with Adobe Reader, the document does not have any form fields, only interactive buttons that Adobe mistakes for form fields.)

Use the navigation bar on the right to move between sections

Click on the links (in blue and underlined) to direct you to a webpage
or to compose an e-mail

Click BACK TO CONTENTS to go to the Table of Contents page

EDITORIAL

The Intergovernmental Panel on Climate Change (IPCC) published the first part of its 5th Assessment Report in late September this year. The document provides the most comprehensive assessment to date of the state of climate change knowledge. It strengthens the message, expressed in previous reports, that the warming of the climate system is unequivocal and that humans have been the dominant cause of climate change since the 1950s.

Following on from this report, we are dedicating this issue of GeoQ – the first edition of the EGU newsletter with a scientific theme – to climate. We feature a piece, previously published on the EGU blog, GeoLog, summarising the results of the Working Group I report, but the focus of this newsletter goes beyond the IPCC. The articles section includes features on research on the mechanisms that govern the Earth's ice ages, on soil organic carbon and climate change and on Atlantic meridional overturning circulation during the Holocene. It also features an article on the history of climate change discovery.

Continuing on the climate theme, the External News section highlights a great "climate science and public interaction initiative" called Climatica. This is an online platform where climate experts write about climate-related topics in a language suitable for a general audience. The same section also features a piece on the excellent 'A world you like. With a climate you like' campaign from the European Commission Directorate-General for Climate Action.

Moving to the Education section, this issue of GeoQ introduces an exciting new partnership between the EGU, UNESCO and ESA to bring GIFT (Geosciences Information For Teachers) workshops to Africa. The first workshop will take place in Port Elizabeth, South Africa from 26–28 February 2014 and will be on Climate Change and Human Adaptation.

This newsletter also features other new EGU developments. As detailed in the EGU news section, we have recently announced the recipients of EGU 2014 awards and medals. The winners, awarded for their important contributions to the Earth, planetary and space sciences, will receive their prizes at the EGU 2014 General Assembly. On other exciting news, Copernicus Publications, the publisher of EGU open access journals, has recently launched article-level metrics, which allow assessment of the overall influence and reach of individual research papers, for all its journals.

In the Young Scientists section, the readers have the opportunity to meet Sam Illingworth, the new young scientists representative for the EGU General Assembly. The same section also features an exciting climate communication initiative for and by early career researchers called ClimateSnack.

Finally, a quick note to announce yet another exciting development: the EGU is getting ready to launch the new Imaggeo site. The redesigned version of EGU's online image database will be available very soon at imaggeo.egu.eu.

Until then, enjoy this issue of GeoQ!

Bárbara Ferreira

GeoQ Chief Editor & EGU Media and Communications Manager

The current and previous editions of the EGU newsletter (GeoQ and The Eggs) are available online at www.egu.eu/newsletter.

CHIEF EDITOR: Bárbara Ferreira – EGU Executive Office, Luisenstr. 37, 80333 Munich, Germany | Phone: +49-(0)89-2180-6703 | media@egu.eu
CONTRIBUTORS: Sara Mynott, Jane Robb, Jennifer Young, Charlotte Krawczyk, Artemi Cerdà, Norma B. Crosby, Susanne Buiter, Directorate-General for Climate Action, Kathryn Adamson, Tim Lane, Selwyn Jones, Carlo Laj, Sarah Gaines, Abigail Morton, Sam Illingworth, Marion Ferrat, Tobias Gerken, Oliver Knevitt, Eline Vanuytrecht and Holly Ferrie
DESIGN: André Roquette

COVER PHOTO: The beauty of ice (Credit: Romain Schläppy, distributed by EGU via imaggeo.egu.eu under a Creative Commons licence)

GEOQ ISSUE 8
DECEMBER 2013

Unpredictable ice ages?

Ice and sediment cores store excellent records of the Earth's history and the isotopes within let geoscientists pin down how global temperature has changed over time. These records show the Earth has alternated between periods of intense cold and warming. But while there are clear patterns in the climate record, the frequency of ice ages is not always constant. Scientists are working to find out why.

The Earth's climate is controlled by astronomical phenomena that operate on timescales tens to hundreds of thousands of years long. One of these phenomena is the variation in the Earth's obliquity – the angle the Earth tilts on its axis. The inclination of the Earth's axis varies from approximately 22 to 24.5 degrees over the course of 41,000 years and the greater the tilt, the stronger the difference between seasons. Thus, when the winter is warmer, there is more moisture available for snowfall, and when the summer is cooler, the winter ice persists longer into the season, stimulating the start of a glacial period.

The other phenomenon is climatic precession, also known as precession index. It combines variations in eccentricity – how elliptical the Earth's orbit is and how that changes over thousands of years – with a parameter known as the longitude of perihelion. The longitude of perihelion controls the time of year at which the Earth is at its closest point to the Sun. At present, the Earth reaches this point in January, but when the closest approach happens in June (as it did 11,000 years ago), the Earth and the Sun are significantly closer. This close proximity causes the Earth to receive more energy, negatively affecting glacier mass balance and preventing glaciation. The changes in the longitude of perihelion occur over timescales of about 23,000 years. Changes in eccentricity, on the other hand, occur over much longer periods and every 100,000 years the Earth's orbit is almost circular.

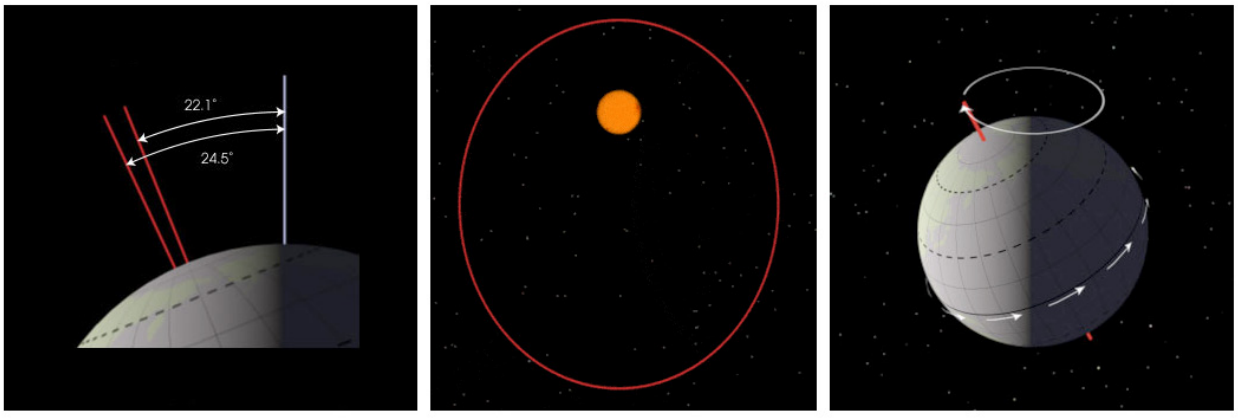
Combined, these changes in orbital parameters and obliquity are known as 'the astronomical pacemaker', a well-known control on the timing of glacial-interglacial cycles. However, the pulse of the Earth's climate is barely regular – in fact, we don't yet know how tightly these astronomical phenomena control the Earth's climate.

Recently, researchers have begun investigating what could cause delays in deglaciation and shifts in the sequences of ice ages in an effort to assess the strength of the astronomical pacemaker. One such scientist is Michel Crucifix, from the Georges Lemaître Centre for Climate Research in Belgium.

Using seven published models, Crucifix set out to see what could disrupt the ice age sequence from the pace set by the Earth's orbit and obliquity, and found that small changes in the amount of solar radiation the Earth receives, or the amount of heat it retains, could cause big shifts in the occurrence of ice ages. "I started playing with simple models of ice ages and it became pretty clear to me that the sequence of ice ages in these models was quite sensitive to parameters…I took this sensitivity issue as a starting point: what are the mathematical mechanisms at work; is this an artefact or does this sensitivity actually tell us about the real world?"

As is often the case, the devil is in the detail and it is random events that affect the climate on short timescales that are responsible for this irregularity. "I really like this idea of a system that is being intermediate between 'chaotic' and 'fully predictable'," Crucifix says. He considered the climate record from the 3.2-km-long ice core at Dome Concordia in Antarctica, which records 800,000 years of climate history: "there is regularity, but there are also a many rapid and not-so-well organised variations that seem to be incompatible with the presence of a nice, solid, pacemaker."

So what could cause the Earth to 'skip a beat' in a glacial cycle? Possible causes are volcanic eruptions and interactions between the ocean and atmosphere that are capable of perturbing the Earth's climate. Volcanic eruptions, for example, emit large quantities of sulphate aerosol into the upper atmosphere – particles that are a starting point for clouds. Clouds reflect solar radiation back



Components of the astronomical pacemaker: the Earth's obliquity (tilt on its axis), eccentricity (elliptical character of the Earth's orbit) and precession (the wobble of the Earth's axis that controls the time of year the Earth is closest to the Sun). (Credit: modified from NASA)

into space and cause the Earth to cool – such a change could be enough to stimulate the start of an ice age.

Records of what caused these climate perturbations, as well as what their effect on climate was, are recorded in ice cores. In the case of a volcanic eruption, you might find a layer of ash or sulphate that indicates a large volcanic event in an ice core, and can correlate this with changes in temperature on short – and possibly longer – timescales when looking at isotope data.

But the factors that cause these shifts are not yet known. "My intuition is that very small perturbations could do the job (as small as atmospheric perturbations), but which magnitude is needed and when they actually matter is not yet quantified," says Crucifix.

Indeed, Crucifix's findings show just that: small perturbations can alter the rhythm of glacial cycles. This lends support to a theory put forward by Eric Wolff known as 'the proximal cause of terminations': that the timing of the end of a glacial period can be influenced by the occurrence of abrupt climate events in the thousands of years that precede its termination. The research also builds on the findings of pioneers in climate theory such as Barry Saltzman and Ed Lorenz, who first considered the role of chaos in climate modelling. Crucifix shares his enthusiasm for his work: "I really feel like I am standing on the shoulders of giants…being able to borrow concepts introduced by these great scientists and extract an idea that was latent in their work but not explicitly formulated is thrilling."

Even small variations of climate model parameters can mean the difference between an ice age and an interglacial period, what we need to know now is when in the astronomical cycle can small changes in solar radiation lead to big changes in climate.

Sara Mynott
EGU Communications Officer

Acknowledgement

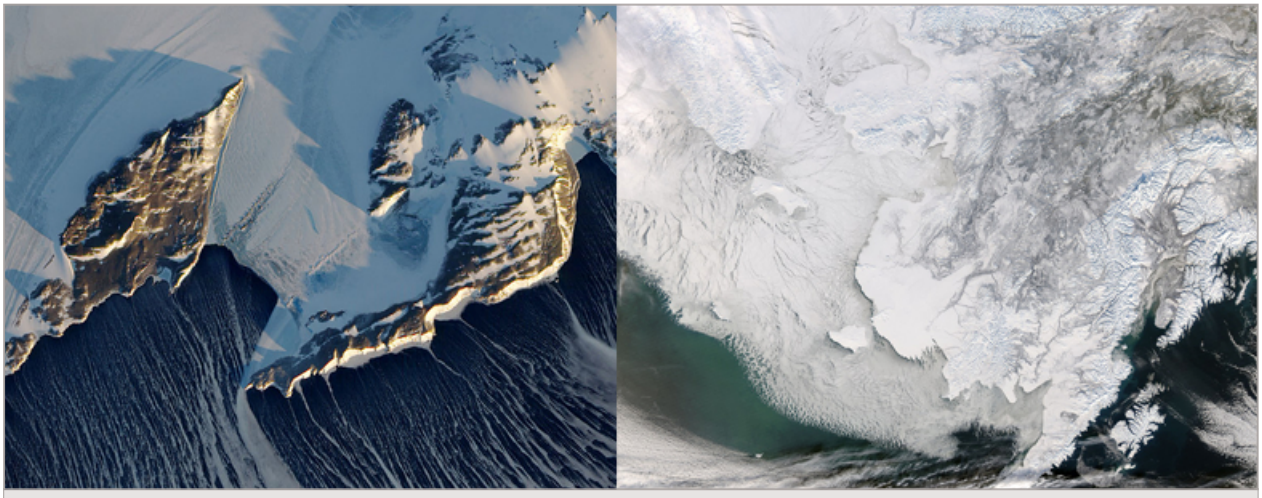
Michel Crucifix's research was funded by the European Research Council.

References

Crucifix, M.: Why could ice ages be unpredictable?, Clim. Past, 9, 2253–2267, 2013

De Saedeleer, B., Crucifix, M. and Wieczorek, S.: Is the astronomical forcing a reliable and unique pacemaker for climate? A conceptual model study, Clim. Dyn., 40, 273–294, 2013

European Project for Ice Coring in Antarctica (EPICA): Eight glacial cycles from an Antarctic ice core, Nature, 429, 623–628, 2010



Left. The Nansen Ice Sheet, shortly before the onset of the Southern Hemisphere spring. (Credit: NASA) Right. Sea Ice in the Bering Strait. (Credit: J. Schmaltz/NASA)

Misunderstood? Soil organic carbon and climate change

Soils are essential to global development. They are the sustaining force that keeps communities alive globally and locally; without soil we would not have the ability to grow crops that feed the majority of the world's population. But soil also has another crucial role related to the Earth and its present and future populations: the storage of organic carbon. The importance of this, in relation to climate and development, has only recently been recognised.

Up until 2010, most climate models attributed the majority of carbon storage during glacial periods to the oceans. However, there has been no success in finding sinks of 'old radiocarbon' in the oceans to support this widely accepted hypothesis. In 2011, Roland Zech and his team investigated a key question that this idea raised: can the change in carbon pools over glacial-interglacial periods be quantified more accurately across the marine and terrestrial realms? Zech noticed that terrestrial estimates for carbon assumed that there was a decrease in stored organic carbon on the continents during glacial periods, meaning that the oceans take up somewhere in the region of 300–800 Pg C (petagrams of carbon, where 1 Pg is equal to 10^{12}

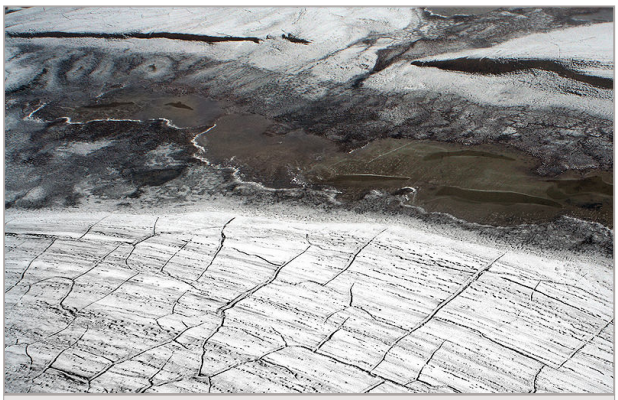
kg of carbon) from terrestrial sources in addition to the 200 Pg C from the atmosphere during glacial periods.

Yet Zech noticed that something had been overlooked: permafrost. Permafrost is soil and sediment that remains, and has remained, frozen for more than two years. In the Northern Hemisphere alone, permafrost occupies around 22.79 million square kilometres of exposed land surface. Zech noted that current organic carbon estimates do not explicitly consider the organic carbon stored below ice sheets in permafrost and new estimates suggest that soil organic carbon (SOC) in the Northern Hemisphere may exceed 1670 Pg C. Zech's research shows that this carbon is repeatedly stored in permafrost during glacial periods and, if not taken into account, it could significantly affect the reliability of climate models.

As permafrost provides an excellent environment for long term carbon storage during glacial periods, there have been increasing concerns about the effects of thawing of permafrost on climate. In a separate study undertaken in 2011, Charles Koven found results in contention with the IPCC 4th Assessment Report. Using a terrestrial ecosystem model of permafrost carbon dynamics, Koven found that Arctic ecosystems warming could shift from being a carbon sink to a carbon source by the end of the 21st century.

Now recognised as an active and crucial component of the carbon system, it is important to map SOC pools accurately. Although researchers have attempted to map SOC behaviour before, they have had little success in producing detailed, high resolution maps until recently. In 2012 Jeroen Meersmans undertook a national soil survey across France, analysing over 2000 soil samples in an effort to measure soil properties and factors controlling SOC and went on to develop a model for predicting spatial and temporal distribution of SOC across France. The resulting model allowed detailed projections of land that will be characterised by a gain or loss in SOC, as well as the possible outcomes of land management decisions – such as whether to farm the land and what should be grown there. This type of tool is extremely important in managing SOC as it allows people to optimise carbon storage in soils and minimise soil-related CO_2 fluxes (that could cause increased global warming).

Understanding SOC storage is also the basis for sustainable agriculture. SOC is an important component of the three main aspects of soil fertility: helping release nutrients such as nitrogen and phosphorous, binding soil mineral particles together for increased water holding and infiltration capacity, and providing a key food source for flora and fauna. Increasing and retaining SOC content is therefore



Arctic permafrost. (Credit: Wikimedia Commons user Broken Inaglory)

Black carbon rich soils on an Icelandic farm. (Credit: Ragnar Sigurdsson/www.arctic-images.com)

an important mechanism for improving soil 'health' as well as mitigating climate change.

Earlier this year Kathryn Page investigated the effectiveness of agricultural techniques in retaining SOC and found that 'no-till' management (planting crops without disturbing the soil through digging and overturning) is more effective than conventional methods. Research has also shown that other techniques including improved crop residue management, crop rotations and conversion of marginal cropland to native vegetation or permanent grassland can increase SOC content.

It is important to transfer land management research to decision making tools for land use. Tools such as the Global Biosphere Management Model (GLOBIOM) are a step towards this goal. GLOBIOM tracks effects of land use change and trade, going beyond traditional land management tools by modelling both changes in demand for land use, and changes in land profitability – key determinants of real world land use change.

Despite the breadth of research going on in this area, there remains much to be understood about the nature of SOC, such as how it binds to other minerals inside the soil and how this will affect the stability of SOC as the climate changes.

Jane Robb
EGU Educational Fellow

Reference

Koven, C.D. et al.: Permafrost carbon-climate feedbacks accelerate global warming, Proc. Natl. Acad. Sci. USA, 108, 14769–14774, 2011

Page, K.L. et al.: Organic carbon stocks in cropping soils of Queensland, Australia, as affected by tillage management, climate, and soil characteristics, Soil Research, 2013

Zech, R. et al.: High carbon sequestration in Siberian permafrost loess-paleosols during glacials, Clim. Past, 7, 501–509, 2011

Atlantic meridional overturning circulation during the Holocene

Implications for understanding modern climate

Over the past 25 years scientists have drawn on a variety of sources to identify periods and forcers of change in global climate. In the 2013 study 'Long-term variations in Iceland–Scotland overflow strength during the Holocene', David Thornalley and his team added another significant piece to the puzzle of deep water formation, a system that is crucial to the transport of heat around the globe.

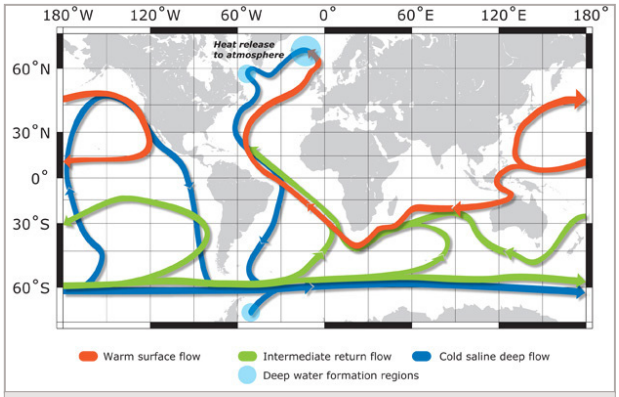
By assessing the grain size of 13 sediment cores, Thornalley and collaborators were able to reconstruct the overflow of dense bottom waters from Nordic seas across the Iceland–Scotland undersea slope to the North Atlantic during the Holocene. Overflow strength is determined by ocean bathymetry (the topography of the ocean floor) and the difference in density between the Nordic and North Atlantic waters. Factors influencing seawater density include temperature and salinity, and as high winds blow across Nordic waters, more water is evaporated, leaving denser, more saline water behind. Winds also contribute to the effects of ocean bathymetry, forcing waters across undersea barriers.

Thornalley's team was able to obtain a measure of the strength and depth of the Atlantic meridional overturning circulation (AMOC) – an essential component of the Earth's climate system that allows the formation of the North Atlantic Deep Water. Their results showed that overflow strength was weaker in the early and latter part of the Holocene and strongest due to a deepening of the overflow path around 7,000 years ago – coinciding with a period of regional high temperatures.

Deepening overflow of the Nordic waters contributes to a complementary strengthening in the inflow of North Atlantic waters northwards. This results in regional warming that helps to control the balance of ice sheets and overall climate of northwestern Europe. Large freshwater influxes from melting of ice sheets due to global warming are suspected to weaken the AMOC by raising the depth of overflow in the North Atlantic and decreasing both the regional warming and balancing effect of the North Atlantic waters on northwestern Europe.

Although current forcing factors of climate change are primarily anthropogenic rather than natural, and expected to remain so in the future (the projections by the International Panel on Climate Change look to the end of the current century), research on the past can help us understand the future.

In his paper, Thornalley also ran model simulations that showed a predicted reduction of around 40% in the maximum winter overflow depth by the end of the 21st century, broadly in line with the results from other studies reviewed in the IPCC Working Group I report. Previous palaeoclimate reconstructions have shown that reduction or cessation of Nordic overflow would have resulted in extreme



Warm water produces warmer air and increases atmospheric moisture. Therefore, regions affected by warm currents such as the Gulf Stream are characterised by milder, moister climates. (Credit: Thornalley et al., 2013)

widespread climate impacts, including increased instability of climate and ice sheets in the North Atlantic.

Although past events aren't directly analogous to present changes, Thornalley identifies in an interview two key benefits from a deeper understanding of pre-anthropogenic change. First, he says, it allows us to identify the range of climate impacts and build up our understanding of the past: "It's not until relatively recently that we knew that climate could change so abruptly", a statement mirrored in the IPCC's recent Working Group I report where they referred to 'unprecedented changes' in climate. And second, Thornalley believes that if we can use models to replicate past variation, we can gain confidence in the predictions made by the same models for future climate change.

Given the multiple feedbacks associated with the climate system, both positive and negative, the regional climate implications of a reduction in overflow depth in the North Atlantic are not obvious. What is clear is that current levels of anthropogenic CO_2 emissions are likely to have far-reaching changes that we don't yet fully understand. As Thornalley puts it: "There's a lot we still need to learn about the Atlantic meridional overturning circulation and the complexities of climate."

Jennifer Young

UK-based freelance science writer

References

Oppo, D. W. & Curry, W. B.: Deep atlantic circulation during the Last Glacial Maximum and deglaciation, Nat. Edu. Knowledge 3(10), 1, 2012

Thornalley, D. J. R. et al.: Long-term variations in Iceland–Scotland overflow strength during the Holocene, Clim. Past, 9, 2073–2084, 2013

Working Group I, IPCC 5th Assessment Report: Climate Change 2013: The Physical Science Basis – summary for policymakers, 2013

The slow discovery of human-induced climate change

"Few of those familiar with the natural heat exchanges of the atmosphere, which go into the making of our climates and weather, would be prepared to admit that the activities of man could have any influence upon phenomena of so vast a scale."

Weren't it for the old-fashioned language, climate sceptics, who believe there is no scientific consensus on human-made climate change, would readily place this sentence in a 2013 paper. However, the statement belongs to a landmark study published by Guy Stewart Callendar in 1938. He carries on with: "In the following paper, I hope to show that such influence is not only possible, but is actually occurring at the present time."

Seventy-five years later, the world's biggest carbon emitters are now taking action. China, who alone emits nearly a quarter of man-made emissions, agreed to implement emission caps earlier this year. The US, the second largest CO_2 emitter, followed suit with US President Obama issuing regulations to limit carbon-dioxide emissions from power plants in the country. The European Union also considers preventing dangerous climate change a strategic priority, and has recently committed to spend at least 20% of its 2014–2020 budget on climate action.

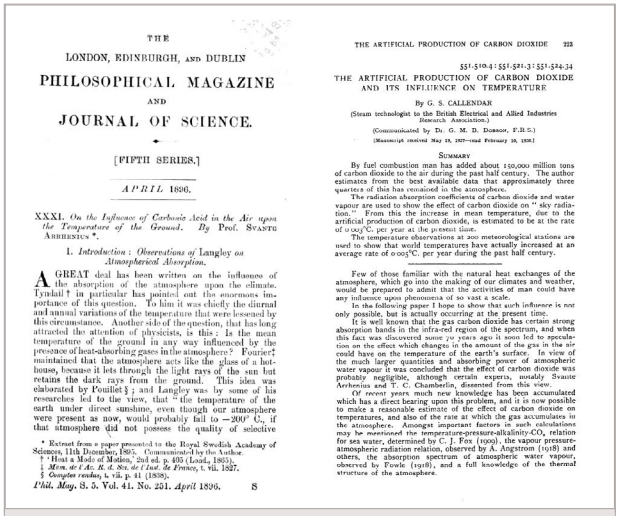
These measures follow a long-standing consensus by the climate-science community who now overwhelmingly agree that climate change is real and that greenhouse gases emitted by human activities are the main cause. The recently released report on the physical science basis of climate change by the Intergovernmental Panel on Climate Change (IPCC) summarises this agreement by stating: "It is *extremely likely* that human activities caused more than half of the observed increase in global average surface temperature from 1951 to 2010."

The consensus of the scientific community on climate change and its severe consequences is now clear, and is pushing policymakers to finally take action. But the history of climate change science tells us that wasn't always the case.

The deadly glaciers and the relation between CO_2 and temperature

Callendar's 1938 paper was ground-breaking: it was the first to demonstrate the warming of the Earth's surface and to suggest this warming was related to fossil-fuel burning. But it was not without errors. Fearing "the return of the deadly glaciers", Callendar believed that a human-generated temperature increase would be beneficial. The 'deadly glaciers' were a reference to the ice ages of the Earth's past, when glaciers had covered Europe and much of North America.

In the late 19th century, Svante Arrhenius calculated the influence of atmospheric carbon on ground temperatures in an attempt to explain the Earth's ice ages. Physicist John Tyndall had earlier found out that water vapour, methane and carbon dioxide strongly



THE
LONDON, EDINBURGH, AND DUBLIN
PHILOSOPHICAL MAGAZINE
AND
JOURNAL OF SCIENCE.

[FIFTH SERIES.]

APRIL 1896.

XXXI. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.* By Prof. SVANTE ARRHENIUS *.

1. *Introduction: Observations of* Langley *on Atmospherical Absorption.*

A GREAT deal has been written on the influence of the absorption of the atmosphere upon the climate. Tyndall † in particular has pointed out the enormous importance of this question. To him it was chiefly the diurnal and annual variations of the temperature that were lessened by this circumstance. Another side of the question, that has long attracted the attention of physicists, is this: Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere? Fourier‡ maintained that the atmosphere acts like the glass of a hot-house, because it lets through the light rays of the sun but retains the dark rays from the ground. This idea was elaborated by Pouillet §; and Langley was by some of his researches led to the view, that "the temperature of the earth under direct sunshine, even though our atmosphere were present as now, would probably fall to −200° C., if that atmosphere did not possess the quality of selective

* Extract from a paper presented to the Royal Swedish Academy of Sciences, 11th December, 1895. Communicated by the Author.
† 'Heat a Mode of Motion,' 2nd ed. p. 405 (Lond., 1865).
‡ *Mém. de l'Ac. R. d. Sci. de l'Inst. de France*, t. vii. 1827.
§ *Comptes rendus*, t. vii. p. 41 (1838).

Phil. Mag. S. 5. Vol. 41. No. 251. *April* 1896. S

THE ARTIFICIAL PRODUCTION OF CARBON DIOXIDE 223

551·510.4:551·521.3:551·524.34

THE ARTIFICIAL PRODUCTION OF CARBON DIOXIDE AND ITS INFLUENCE ON TEMPERATURE

By G. S. CALLENDAR
(Steam technologist to the British Electrical and Allied Industries Research Association.)
(Communicated by Dr. G. M. D. Dobson, F.R.S.)
[Manuscript received May 19, 1937—read February 10, 1938.]

SUMMARY

By fuel combustion man has added about 150,000 million tons of carbon dioxide to the air during the past half century. The author estimates from the best available data that approximately three quarters of this has remained in the atmosphere.

The radiation absorption coefficients of carbon dioxide and water vapour are used to show the effect of carbon dioxide on "sky radiation." From this the increase in mean temperature, due to the artificial production of carbon dioxide, is estimated to be at the rate of 0.003°C. per year at the present time.

The temperature observations at 200 meteorological stations are used to show that world temperatures have actually increased at an average rate of 0.005°C. per year during the past half century.

Few of those familiar with the natural heat exchanges of the atmosphere, which go into the making of our climates and weather, would be prepared to admit that the activities of man could have any influence upon phenomena of so vast a scale.

In the following paper I hope to show that such influence is not only possible, but is actually occurring at the present time.

It is well known that the gas carbon dioxide has certain strong absorption bands in the infra-red region of the spectrum, and when this fact was discovered some 50 years ago it soon led to speculation on the effect which changes in the amount of the gas in the air could have on the temperature of the earth's surface. In view of the much larger quantities and absorbing power of atmospheric water vapour it was concluded that the effect of carbon dioxide was probably negligible, although certain writers, notably Svante Arrhenius and T. C. Chamberlin, dissented from this view.

Of recent years much new knowledge has been accumulated which has a direct bearing upon this problem, and it is now possible to make a reasonable estimate of the effect of carbon dioxide on temperatures, and also of the rate at which the gas accumulates in the atmosphere. Amongst important factors in such calculations may be mentioned the temperature-pressure-alkalinity-CO_2 relation for sea water, determined by C. J. Fox (1909), the vapour pressure-atmospheric radiation relation, observed by A. Angstrom (1918) and others, the absorption spectrum of atmospheric water vapour, observed by Fowle (1918), and a full knowledge of the thermal structure of the atmosphere.

First pages of Arrhenius's 1896 (left) and Callendar's 1938 (right) seminal papers.

block radiation coming from the Sun. Inspired by this, Arrhenius calculated that cutting atmospheric carbon dioxide by about half would return the Earth to the ice ages. Using the same crude atmospheric model, he estimated that by doubling the CO_2 in the atmosphere, the global temperature would increase 5 to 6 °C. But at a time when the industry was burning fossil fuels at a negligible rate, he thought it would take thousands of years for that much CO_2 to be added to the atmosphere.

Early 20th century scientists criticised Arrhenius' calculations and ignored that variations in atmospheric CO_2 – those of human origin in particular – could alter the climate. Callendar's paper was met with similar scepticism. It took another few decades for consensus to start forming around the idea that human-made climate change was real.

The Keeling Curve and ice cores

Following the Second World War and well into the Cold War, there was a sharp increase in research funding from US military and other government agencies, giving many American scientists – including Charles David Keeling of Keeling Curve fame – the chance to make detailed measurements of carbon-dioxide levels in the atmosphere. These showed CO_2 concentrations were increasing steadily each year. Now, over 50 years later, the levels approach 400 parts per million (ppm), an increase of over 40% since the industrial revolution. While it was clear that atmospheric CO_2 was rising, it was still hard for some scientists to accept that the Earth's climate – a complex system influenced by many variables – could be dangerously warmed by this.

The 1980s brought fresh and critical discoveries from ice-core research, yielding information on local temperatures and atmospheric composition in the past few thousand years. Researchers, such as Hans Oeschger and Willi Dansgaard, discovered that the

Earth's temperature had abruptly changed various times in the past and that the changes in temperature and CO_2 had mostly moved in lockstep.

The scientific consensus had begun to form: the rapid concentration of atmospheric CO_2 prompted by fossil-fuel burning could drastically change the climate.

Climate change gets political

In the hot year of 1988 the consensus was strong enough for the discussion on human-induced climate change to enter the realm of politics. In June that year, climatologist James Hansen (then of the NASA Goddard Institute for Space Studies) testified before the US Congress, alerting decision-makers and the public to the dangers of climate change:

"I would like to draw three main conclusions. Number one, the earth is warmer in 1988 than at any time in the history of instrumental measurements. Number two, the global warming is now large enough that we can ascribe with a high degree of confidence a cause and effect relationship to the greenhouse effect. And number three, our computer climate simulations indicate that the greenhouse effect is already large enough to begin to [a]ffect the probability of extreme events such as summer heat waves."

In the same year, the World Meteorological Organization and the United Nations Environment Programme established the IPCC "to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts."

Twenty-five years, and five Assessment Reports later, the "[w]arming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased," as stated in the latest IPCC's report's summary for policymakers.

Climate change is in our hands. (Credit: Stephanie Flude)

If the discovery of human-induced climate change was slow, slower still – at a time of urgency – has been the implementation of concrete and efficient measures to fight it.

As University of East Anglia's Corinne Le Quéré wrote in The Guardian following the release of the IPCC summary for policymakers, "[the scientists'] job is done now and it is time to let the policymakers do theirs." The scientific community, and the world, waits to see how political leaders will respond.

Bárbara Ferreira

GeoQ Chief Editor & EGU Media and Communications Manager

References

Arrhenius, S.: On the influence of carbonic acid in the air upon the temperature of the ground, Phil. Mag. J. Sci., series 5, 41, 237–276, 1896

Callendar, G. S.: The artificial production of carbon dioxide and its influence on temperature, Q.J.R. Meteorol. Soc., 64, 223–240, 1938

Weart, S.: The Discovery of Global Warming, American Institute of Physics, 2013

Division reports

News brought to you from four EGU divisions

In each edition of GeoQ division presidents contribute reports updating EGU members with news from their divisions. Issue 8 gives voice to Charlotte Krawczyk (Seismology), Artemi Cerdà (Soil System Sciences), Norma Crosby (Solar–Terrestrial Sciences) and Susanne Buiter (Tectonics and Structural Geology).

Seismology

The ongoing work of the EGU Seismology (SM) Division is guided by the idea that a broadening of our research topics and an opening to wider, interdisciplinary collaborations within the EGU will foster scientific exchange and will address the growing need for the combination of basic science and applied topics. Here, seismology as a discipline is significant, since it contributes to a large variety of both basic and applied thematic fields and urgent questions. The SM Division, therefore, wants to strengthen its value by enhancing the development from static to dynamic models, from acquisition parameters to petrophysical properties, and from geomodels to geotechnical applications. Thereby, our ability to make relevant predictions for the future is also growing.

This concern shaped the SM Division programme at the EGU 2013 General Assembly and also finds its way in the call for abstracts for the 2014 meeting. Here, we give particular emphasis to new sessions dealing with the connection from depth to surface, thereby also allowing for co-organised sessions with hydrology, geomorphology, cryospheric or soil system sciences. You will also find a new sub-category – 'Education and outreach' – in our programme that should help increase awareness for explaining and transferring our knowledge to different groups and using different tools. For this topic, as well as for non-seismic methods and receiver functions, the division could benefit from having volunteers who could foster these parts of our scientific portfolio.

Highlights at the 2013 General Assembly included the Beno Gutenberg Medal Lecture by Jeroen Tromp and the Great Debate on 'Shale gas: to frack or not to frack?', which was organised under the leadership of the Geochemistry, Mineralogy, Petrology & Volcanology Division with seven other divisions. Two outstanding student posters were identified this year and will be awarded during the Division Meeting next year.

The community itself drives the division forward. Therefore, please don't forget to leave a time slot free in your 2014 General Assembly schedule for the Division Meeting, which will be held during the lunch break immediately preceding the Beno Gutenberg Medal Lecture.

Charlotte Krawczyk
SM Division President

The SSS Division is a strong contributor to EGU's open access geosciences image repository, Imaggeo. This photo shows peaty soil in the Andean highlands of Ecuador (Credit: Martin Mergili)

Soil System Sciences

The Soil System Sciences (SSS) Division has been very active during the last six months trying to show that soil science is an interdisciplinary research topic within the EGU, with implications to the wider society. The SSS Division have proposed 149 scientific sessions for the EGU 2014 General Assembly with a large number of co-organised and co-listed sessions with other EGU divisions. This reflects the interdisciplinary nature of soil science, which lies at the interface between water, rocks, biota, atmosphere and human activity.

The SSS Division is also busy leading the launch of a new EGU–Copernicus publication: an innovative open access journal, called SOIL, dedicated to soil science and all the related disciplines that work on the soil system. This journal will be edited by Johan Six, Eric Brevik, Jorge Mataix-Solera, John Quinton and Kristof van Oost, who will be the journal's executive editors, as well as 50 active and well-known associated editors. The journal SOIL will be launched at the EGU 2014 General Assembly and we expect the first issue to be published in 2015.

The SSS Division is also organising contests to find the best speaker, the best poster, the best convener and the best session flyer at the EGU 2014. Antonio Jordán is leading this dissemination and awards programme, which will be launched soon. We are making a huge effort to improve our outreach programme, which already involves the use of Twitter, Facebook, Google+, as well as a blog, a newsletter and a webpage.

On other news, the SSS Division is happy to announce that the recipient of the Duchaufour Medal 2014 is Johan Six and the Division Outstanding Young Scientist award 2014 goes to Markus Steffens. Both of them will be honoured at the next EGU 2014 General Assembly in Vienna. We have also recently presented Outstanding

Student Poster Awards relating to the 2013 General Assembly. The four winners are: Andra-Rada Iurian, Claudia Guidi, Stuart Rae and Alexander-André Remke.

The EGU 2014 General Assembly has a promising set of proposals that bring together the traditional topics of soil science with new and challenging ideas for an active and cooperative scientific society. We look forward to your participation in the meeting!

Artemi Cerdà
SSS Division President

Solar–Terrestrial Sciences

The Solar–Terrestrial Sciences (ST) Division covers the physical processes occurring on the Sun and in the solar wind, as well as in the Earth's magnetosphere and ionosphere. In 2013, the EGU General Assembly in Vienna included a wide range of inter-disciplinary ST sessions on data analysis and the interpretation of space-borne and ground-based data, as well as theoretical studies and different modelling techniques. ST oral sessions were very well attended and the atmosphere during the ST poster sessions was excellent. In 2013, PICO (Presenting Interactive COntent) sessions were held for the first time at the EGU meeting and one of these sessions was included in the ST programme.

This year several EGU medals in the solar-terrestrial sciences were awarded at division level. Göran Marklund received the 2013 Hannes Alfvén Medal for his outstanding contributions in auroral physics, especially his discovery of downward directed magnetic-field aligned electric fields, an essential feature of the auroral circuit, and their association with black aurora. Nikolai A. Tsyganenko was awarded the 2013 Julius Bartels Medal for his pioneering contributions to modelling the near-Earth magnetic field and his unflagging commitment to supporting the research community in the application of these models to solving key problems in magnetospheric physics.

At Union level, Alexis P. Rouillard was awarded the 2013 Arne Richter Award for Outstanding Young Scientists for his innovative studies of the solar atmosphere, the interplanetary medium, the shielding of the Earth from galactic cosmic rays, centennial variations of the Sun, the generation of energetic particles, and the impact of interplanetary disturbances on Earth. Furthermore, the 2013 Jean Dominique Cassini Medal & Honorary Membership was awarded to Roger-Maurice Bonnet in recognition of his visionary and inspirational leadership at the heart of the establishment of space science in Europe.

The ST Division continues to promote, support and inspire scientists in the beginning of their career. Two 2012 General Assembly Outstanding Student Poster (OSP) Awards for ST were awarded during the 2013 ST Division Meeting: to Ivana Richterova for the poster entitled 'Model of secondary electron emission from small dust grains – shape influence' and to Shiyong Huang for the poster entitled 'Electron acceleration in the reconnection diffusion region: Cluster observations'.

The 2014 EGU medallists and 2013 OSP awardees, including those who were honoured for research in the solar-terrestrial sciences, were also recently announced on the EGU website. They will receive their prizes during the EGU 2014 General Assembly.

Norma B. Crosby
ST Division President

Find out more about Presenting Interactive COntent on the EGU 2014 website.

Tectonics and Structural Geology

The Tectonics and Structural Geology (TS) Division focuses on rock deformation at all scales, aiming to decipher its complex relationships with Earth dynamics. The division is highly interdisciplinary and this is reflected in our methods and in our close ties with many of our fellow EGU divisions. I am very pleased to see that the wide interests of TS are reflected in our session programme for the 2014 General Assembly! New features for the TS Division in the 2014 meeting include several poster-only sessions, daytime poster sessions and PICO sessions. I hope everyone will engage actively to make all TS sessions buzzing and the place to be!

We are currently exploring closer ties with the Tectonophysics Section of the AGU and the Structural Geology and Tectonics Division of GSA. In practice this will become visible through co-sponsoring of sessions at our respective meetings, but we are open to suggestions for other means of widening the scope of such collaborations.

The former workshop series on Alpine Geological Studies is now part of the EGU conference series and in early September 2013, the first Emile Argand Conference on Alpine Geological Studies was held in Graz, Austria. Other workshops with close ties to our community include the GeoMod meeting (September 2014 in Berlin) and the Deformation Mechanisms, Rheology and Tectonics Meeting. Keep an eye on our meeting calendar at http://ts.egu.eu to find tectonics and structural geology meetings of interest.

The TS Division is looking for a young geoscientist to work with us in setting up a TS young scientist network, help with involving young scientists in sessions, and represent TS in the EGU young scientist platform. Please contact me (ts@egu.eu) if you could see yourself in this role.

Information on the TS Division, including the committee that builds the TS programme for the EGU 2014 General Assembly and the awards & medal committees, can be found on http://ts.egu.eu. Follow us for division news!

Susanne Buiter
TS Division President

EGU announces 2014 awards and medals

The EGU has named the 43 recipients of next year's Union Medals and Awards, Division Medals, and Division Outstanding Young Scientists Awards. These individuals, honoured for their important contributions to the Earth, planetary and space sciences, will receive their prizes at the EGU 2014 General Assembly, which will take place in Vienna on 27 April – 2 May. The EGU has also announced the winners of the Outstanding Student Poster (OSP) Awards corresponding to the 2013 General Assembly.

The following individuals will receive 2014 Union medals and awards:

- **Pradeep Mujumdar** – Alexander von Humboldt Medal
- **Eric F. Wood** – Alfred Wegener Medal
- **Kevin C. A. Burke** – Arthur Holmes Medal
- **Stamatios Krimigis** – Jean Dominique Cassini Medal
- **Sebastian Watt, Peter Bijl, Noé Lugaz** and **Matthias Huss** – Arne Richter Award for Outstanding Young Scientists
- **Thomas Hofmann** – Union Service Award

The following individuals will receive 2014 division medals:

- **Shun-Ichiro Karato** – Augustus Love Medal
- **Gregory Beroza** – Beno Gutenberg Medal
- **François Forget** – David Bates Medal
- **Stephen Matthew Griffies** – Fridtjof Nansen Medal
- **Karl Schindler** – Hannes Alfvén Medal
- **Sherilyn Fritz** – Hans Oeschger Medal
- **Upmanu Lall** – Henry Darcy Medal
- **Isabella Premoli Silva** – Jean Baptiste Lamarck Medal
- **Hoshin V. Gupta** – John Dalton Medal
- **Rumi Nakamura** – Julius Bartels Medal
- **Olivier Talagrand** – Lewis Fry Richardson Medal
- **Dorthe Dahl-Jensen** – Louis Agassiz Medal
- **Ian Main** – Louis Néel Medal
- **Maureen Raymo** – Milutin Milankovic Medal
- **Rob van der Voo** – Petrus Peregrinus Medal
- **Johan Six** – Philippe Duchaufour Medal
- **Hermann M. Fritz** – Plinius Medal
- **Peter van der Beek** – Ralph Alger Bagnold Medal
- **Chris Hawkesworth** – Robert Wilhelm Bunsen Medal
- **Costas Synolakis** – Sergey Soloviev Medal
- **Claudio Faccenna** – Stephan Mueller Medal
- **Reinhard Dietrich** – Vening Meinesz Medal
- **Urs Baltensperger** – Vilhelm Bjerknes Medal
- **Klaus Butterbach-Bahl** – Vladimir Ivanovich Vernadsky Medal

The following individuals will receive 2014 Division Outstanding Young Scientists Awards:

- **Nick J. Dunstone** – Climate: Past, Present & Future (CL) Division
- **Tabea Lissner** – Energy, Resources and the Environment (ERE) Division
- **Roelof Rietbroek** – Geodesy (G) Division
- **Rhodri Davies** – Geodynamics (GD) Division
- **Robert Hilton** – Geomorphology (GM) Division
- **Fubao Sun** – Hydrological Sciences (HS) Division
- **Nicolas Eckert** – Natural Hazards (NH) Division
- **Christina Plainaki** – Planetary and Solar System Sciences (PS) Division
- **Markus Steffens** – Soil System Sciences (SSS) Division
- **Stacia Gordon** – Tectonics and Structural Geology (TS) Division

The EGU Awards Committee received 123 applications for the 2014 awards, with 20% of them nominating female scientists (about 19% of this year's awardees are female). For more information about the awards above, including application and selection criteria and how to apply, check the Awards & Medals page on the EGU website.

In addition to the Union and division awards and medals, the EGU also gives away a number of poster awards to students taking part in its annual General Assembly. These OSP Awards aim to further improve the overall quality of poster presentations and foster students' excitement to present posters at a large scientific conference. The list of recipients of the 2013 OSP Awards is now available online. For more information about the OSP awards, including application criteria and how to apply in 2014, check the OSP page.

An earlier version of this article was published on the EGU website

EGU 2013 Award Ceremony: Arne Richter awardees and their nominators.

ARTICLES
EGU VOICE
EGU NEWS
PRESS RELEASES
JOURNAL WATCH
EXTERNAL NEWS
EDUCATION
YOUNG SCIENTISTS
BOOKS
EVENTS

BACK TO CONTENTS

Article-level metrics now available in EGU journals

Article-level metrics: HTML views (green) and PDF and XML downloads (red and blue, respectively).

Copernicus Publications, the publisher of the EGU open access journals, has launched article-level metrics (ALMs) for all its journals.

While traditional ways of measuring impact operate at journal level, ALMs allow us to assess the overall influence and reach of each individual research paper. They do this by quantifying the usage (downloads and views), impact (citations), saves (bookmarks) and discussion (social media and blog coverage) at the article level.

In EGU open access publications, ALM information is visible under a Metrics tab available for final revised papers published in EGU journals (such as Atmospheric Chemistry and Physics), as well as articles under open review in EGU discussion forums (such as Atmospheric Chemistry and Physics Discussions).

Ulrich Pöschl, Chair of the EGU Publications Committee, said in an email statement: "For EGU publications, the introduction of article-level metrics is another important step in the endeavour of improving scientific communication and quality assurance. ALMs are important complementary elements in the successful interactive open access publishing approach of EGU, which features public review and interactive discussion on the internet (multi-stage open peer review)."

Copernicus Publications now track citations from CrossRef and Google Scholar (and will soon include Scopus and Web of Science citations), downloads and views since January 2013 and bookmarks in both CiteULike and Mendeley. In addition, mentions on sites such as Research Blogging, Facebook, ScienceSeeker, Nature Blogs, Wikipedia, Wordpress(.com), Reddit and Google Blogs are also tracked, and Copernicus plans to incorporate Twitter in the near future.

ALMs allow authors to stay up-to-date with the influence and reach of their published articles and share this information with peers, funding institutions and others. For publishers, and for the EGU, they provide critical insight into what articles generate the most activity, which can then be advertised via the journals' websites or on the EGU's social media channels.

The Public Library of Science (PLOS) launched ALMs in 2009 and made their app available to other publishers. Copernicus is implementing ALMs in all its journals using the PLOS open source app. Martin Rasmussen, the Managing Director of Copernicus, said in an interview with PLOS blogs: "We hope that more publishers will join this initiative and consider implementing it to enable direct comparison across journals."

An earlier version of this article was published on the EGU website

EGU 2014 call for abstracts is open!

Up until 16 January 2014, you can submit your abstract for the upcoming EGU General Assembly, taking place in Vienna, Austria, from 27 April to 2 May 2014. In addition to established scientists, PhD students and other early career researchers are welcome to submit abstracts to present their research at the conference.

Further, the EGU encourages undergraduate and master students to submit abstracts on their dissertations or final-year projects. The EGU recognises that there are many outstanding students who would benefit from attending and presenting at the General Assembly and, therefore, provides a discounted registration rate to this group. Interested undergraduates can apply to present a poster (or

ARTICLES
EGU VOICE
EGU NEWS
PRESS RELEASES
JOURNAL WATCH
EXTERNAL NEWS
EDUCATION
YOUNG SCIENTISTS
BOOKS
EVENTS

BACK TO CONTENTS

talk) on research undertaken in a laboratory setting, on a mapping or field project they've been involved in during their degrees, or any other research project of relevance.

You can browse through the EGU 2014 sessions on the General Assembly website. Clicking on 'please select' will allow you to search for sessions by Programme Group and submit your abstract to the relevant session either as plain text, LaTeX, or a MS Word document. Further guidelines on how to submit an abstract are available on the EGU 2014 website.

Last year we introduced an innovative presentation format – Presenting Interactive COntent, better known as PICO. PICO sessions bring together the advantages of both oral and poster sessions, allowing authors to present the essence of their work and follow it up with interactive discussion. Please note that some sessions are 'PICO only', meaning you cannot select oral/poster preference.

The deadline for the receipt of abstracts is **16 January 2014, 13:00 CET**. If you would like to apply for financial support, please submit an application no later than **29 November 2013**.

For more information on the General Assembly, see the EGU 2014 website and follow us on Twitter (#EGU2014 is the conference hashtag) and Facebook.

An earlier version of this article was published on the EGU blog

New Educational Fellow at the EGU Office

Jane Robb, the new EGU Fellow, started working at the EGU Executive Office as Educational Officer in September 2013. Her role is to help develop and implement the EGU's educational strategy and initiatives for formal and informal education as well as working on new education-related collaborations for the EGU.

Jane earned her BSc (Hons) Geology from the University of Edinburgh then went on to gain an MRes in Heritage Science from University College London. In her MRes research, she used social science techniques to understand the perceived value (i.e., educational, historical, uniqueness) of geological collections in museums. These insights were used to improve collections care in museums and enhanced her understanding of how people relate to science – knowledge useful when engaging audiences in science education.

In the past five years Jane has also worked as a science communication and outreach officer for Our Dynamic Earth science centre, the Scottish Earth Science Education Forum and Exscitec as well as volunteering for Rockwatch (a club for young geologists) and holding the communications officer post on the national committee for Geology for Global Development. Before she moved to the EGU she worked at University College London as a research assistant in pedagogy and student experience, a role that she says was incredibly useful in developing her knowledge of teaching and learning research and engagement.

Jane says: "I believe there is lots of scope for exciting new education initiatives across the EGU and look forward to getting stuck in. If you would like to know more about what we have to offer regarding our education strategy, or maybe have an interesting education-related collaboration in mind, get in touch with me at robb@egu.eu."

An earlier version of this article was published on the EGU blog

Key findings from the new IPCC report

"Human influence on the climate system is clear" was the key message from the report on the physical science of climate change from the Intergovernmental Panel on Climate Change (IPCC).

"We have come a long way since the first IPCC report was published in 1990," a statement reiterated throughout the press conference for the release of the report. The IPCC were keen to register the significance of the work and progress made in this report – an "assessment of a string of assessments from 1990," according to Thomas Stocker, Co-Chair for Working Group I, reporting on the physical science basis of climate change. The fourth IPCC assessment, published in 2007, was the first report to state that "warming

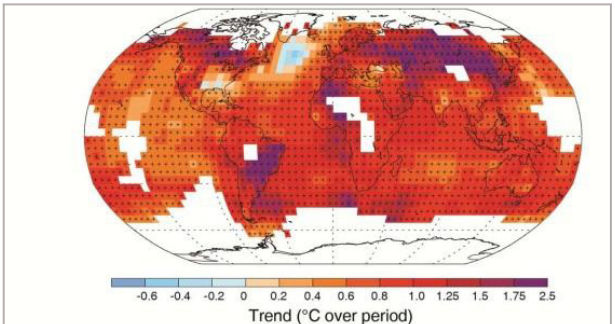


Figure 1. Observed change in average surface temperature 1901–2012. (Credit: IPCC)

of the climate system is unequivocal" and that "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."

In the fifth report, this message is heightened. Since the 1950s many of the changes observed and analysed in this report have been unprecedented including warming of the atmosphere and ocean, diminishing amounts of snow and ice, rising sea levels, and increases in the concentrations of greenhouse gases. With 259 lead authors citing 9200 papers in the report, two thirds of which have been published since 2007, the fifth assessment presents a strong message to policymakers across the world. Incredibly, this feat of scientific work has been approved and agreed upon by 110 governments across the world, with 1089 reviewers consisting of scientists, the public and governments from 55 of those countries offering a staggering 54,677 comments on the physical science basis report. Almost every word was commented on, disputed and discussed to come up with 18 headline messages – a first for the IPCC reports – that stated in simple language the report's key outcomes.

"If you look at temperature, it is red" stated Stocker in a press conference, describing one of several key images from the IPCC policymakers' summary (see Fig. 1).

This simple statement with clever wordplay not only elicits a global increase in surface temperature but also danger. Our planet is warming, and humans are the culprit. He goes on to say "…each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850…Global surface temperature change for the end of the 21st century is likely to exceed 1.5°C relative to 1850 to 1900 for all RCP scenarios." RCP stands for representative concentration pathways, four greenhouse gas concentration trajectory models used by the IPCC in its fifth report.

"In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1400 years." For the fifth assessment the IPCC have gone to great lengths not only to ensure consistency and reliability in scientific data and consensus, but also to outline the key points from their summary for policymakers: the use of simple language to describe the data that does not include hype or headlines but instead simple scientific language.

The report also highlights the increase in global mean sea level rise (see Fig. 2), with a key headline stating "…the rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia (high confidence). Over the period 1901–2010, global mean sea level rose by 0.19 [0.17 to 0.21] m".

The summary for policymakers states: "…cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond" (see Fig. 3). "Most aspects of climate change will persist for many centuries even if emissions of CO_2 are stopped. This represents a substantial multi-century climate change commitment created by past, present and future emissions of CO_2."

Dominique Raynaud, review editor of chapter five (on palaeoclimatology) of the report and officer on the EGU Climate: Past, Present and Future Division in an interview with the EGU Educational Fellow commented on the most important aspect of this report: "For the first time the scientific community has defined a set of four [RCP] scenarios which represent a range of 21st century climate policies. Only one scenario suggests that the global mean temperature change for the end of the 21st century will not exceed 2°C."

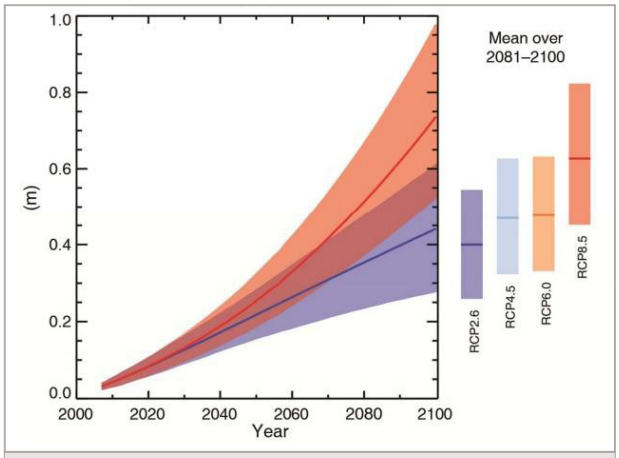


Figure 2. Global mean sea level rise. (Credit: IPCC)

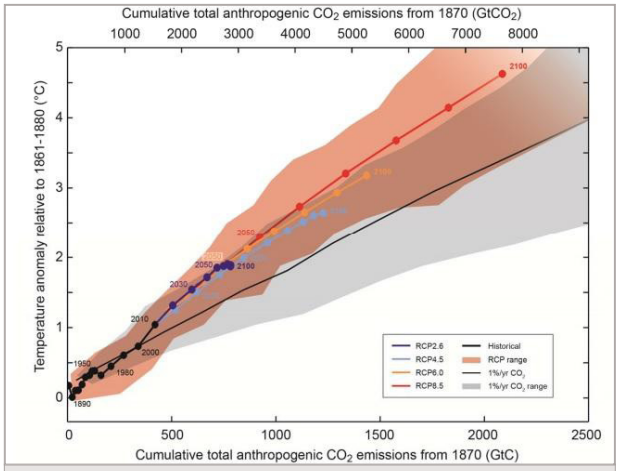


Figure 3. Variation of temperature with cumulative total anthropogenic CO_2 emissions from 1870. (Credit: IPCC)

Raynaud went on to say "With this scenario, we still have a hope to keep [to the] reasonable expected warming for this century…policymakers should obviously consider such a possibly."

In some ways, the outcomes of this report are a repetition of what the public have already been hearing: humans are influencing climate change. But what is crucial to note about this fifth assessment report is the huge consensus among scientists, public and governments about this statement.

"This is not about ideology, this is not about self-interest" was a quote from Achim Steiner, the head of the UN's environment programme, UNEP – a comment that will resonate with many through the 'unequivocal' status of the report's conclusions. And a statement that Stocker echoed later "it threatens our planet, our only home," clearly urging policymakers across the globe to take combined action on climate change.

An earlier version of this article by Jane Robb, the EGU Educational Fellow, was published on the EGU blog

The oldest ice core: finding a 1.5 million-year record of Earth's climate

EGU press release on research published in Climate of the Past

How far into the past can ice-core records go? Scientists have now identified regions in Antarctica they say could store information about Earth's climate and greenhouse gases extending as far back as 1.5 million years, almost twice as old as the oldest ice core drilled to date. The results are now published in Climate of the Past, an open access journal of the European Geosciences Union (EGU).

By studying the past climate, scientists can understand better how temperature responds to changes in greenhouse-gas concentrations in the atmosphere. This, in turn, allows them to make better predictions about how climate will change in the future.

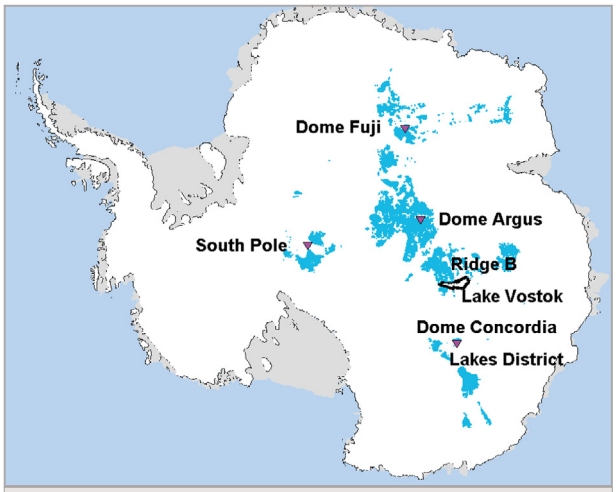
"Ice cores contain little air bubbles and, thus, represent the only direct archive of the composition of the past atmosphere," says Hubertus Fischer, an experimental climate physics professor at the University of Bern in Switzerland and lead author of the study. A 3.2-km-long ice core drilled almost a decade ago at Dome Concordia (Dome C) in Antarctica revealed 800,000 years of climate history, showing that greenhouse gases and temperature have mostly moved in lockstep. Now, an international team of scientists wants to know what happened before that.

At the root of their quest is a climate transition that marine-sediment studies reveal happened some 1.2 million years to 900,000 years ago. "The Mid Pleistocene Transition is a most important and enigmatic time interval in the more recent climate history of our planet," says Fischer. The Earth's climate naturally varies between times of warming and periods of extreme cooling (ice ages) over thousands of years. Before the transition, the period of variation was about 41 thousand years while afterwards it became 100 thousand years. "The reason for this change is not known."

Climate scientists suspect greenhouse gases played a role in forcing this transition, but they need to drill into the ice to confirm their suspicions. "The information on greenhouse-gas concentrations at that time can only be gained from an Antarctic ice core covering the last 1.5 million years. Such an ice core does not exist yet, but ice of that age should be in principle hidden in the Antarctic ice sheet."

As snow falls and settles on the surface of an ice sheet, it is compacted by the weight of new snow falling on top of it and is transformed into solid glacier ice over thousands of years. The weight of the upper layers of the ice sheet causes the deep ice to spread, causing the annual ice layers to become thinner and thinner with depth. This produces very old ice at depths close to the bedrock.

However, drilling deeper to collect a longer ice core does not necessarily mean finding a core that extends further into the past. "If the ice thickness is too high the old ice at the bottom is getting so warm



Antarctic locations (in bright blue) where 1.5-million-year-old ice could exist. The figure is modified from Van Liefferinge and Pattyn (Clim. Past., 2013).

by geothermal heating that it is melted away," Fischer explains. "This is what happens at Dome C and limits its age to 800,000 years."

To complicate matters further, horizontal movements of the ice above the bedrock can disturb the bottommost ice, causing its annual layers to mix up.

"To constrain the possible locations where such 1.5 million-year old – and in terms of its layering undisturbed – ice could be found in Antarctica, we compiled the available data on climate and ice conditions in the Antarctic and used a simple ice and heat flow model to locate larger areas where such old ice may exist," explains co-author Eric Wolff of the British Antarctic Survey, now at the University of Cambridge.

The team concluded that 1.5 million-year-old ice should still exist at the bottom of East Antarctica in regions close to the major Domes, the highest points on the ice sheet, and near the South Pole, as described in the new Climate of the Past study. These results confirm those of another study, also recently published in Climate of the Past.

Crucially, they also found that an ice core extending that far into the past should be between 2.4 and 3-km long, shorter than the 800,000-year-old core drilled in the previous expedition.

The next step is to survey the identified drill sites to measure the ice thickness and temperature at the bottom of the ice sheet before selecting a final drill location.

BACK TO CONTENTS

"A deep drilling project in Antarctica could commence within the next 3–5 years," Fischer states. "This time would also be needed to plan the drilling logistically and create the funding for such an exciting large-scale international research project, which would cost around 50 million euros."

This press release was originally published on the EGU website

References

Fischer, H. et al.: Where to find 1.5 million yr old ice for the IPICS 'Oldest-Ice' ice core, Clim. Past, 9, 2489–2505, 2013

Liefferinge, B. and Pattyn, F.: Using ice-flow models to evaluate potential sites of million year-old ice in Antarctica, Clim. Past., 9, 2335–2345, 2013

Terrestrial ecosystems at risk of major shifts as temperatures increase

EGU press release on research published in Earth System Dynamics

Over 80% of the world's ice-free land is at risk of profound ecosystem transformation by 2100, a new study reveals. "Essentially, we would be leaving the world as we know it," says Sebastian Ostberg of the Potsdam Institute for Climate Impact Research, Germany. Ostberg and collaborators studied the critical impacts of climate change on landscapes and have now published their results in Earth System Dynamics, an open access journal of the European Geosciences Union (EGU).

The researchers state in the article that "nearly no area of the world is free" from the risk of climate change transforming landscapes substantially, unless mitigation limits warming to around 2 degrees Celsius above preindustrial levels.

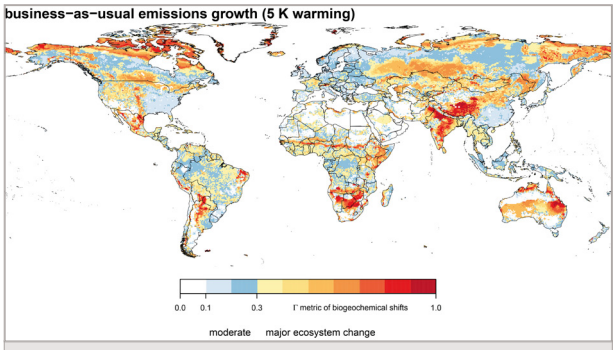
Ecosystem changes could include boreal forests being transformed into temperate savannas, trees growing in the freezing Arctic tundra or even a dieback of some of the world's rainforests. Such profound transformations of land ecosystems have the potential to affect food and water security, and hence impact human well-being just like sea level rise and direct damage from extreme weather events.

The new Earth System Dynamics study indicates that up to 86% of the remaining natural land ecosystems worldwide could be at risk of major change in a business-as-usual scenario (see note). This assumes that the global mean temperature will be 4 to 5 degrees warmer at the end of this century than in pre-industrial times – given many countries' reluctance to commit to binding emissions cuts, such warming is not out of the question by 2100.

"The research shows there is a large difference in the risk of major ecosystem change depending on whether humankind continues with business as usual or if we opt for effective climate change mitigation," Ostberg points out.

But even if the warming is limited to 2 degrees, some 20% of land ecosystems – particularly those at high altitudes and high latitudes – are at risk of moderate or major transformation, the team reveals.

The researchers studied over 150 climate scenarios, looking at ecosystem changes in nearly 20 different climate models for various degrees of global warming. "Our study is the most comprehensive and internally consistent analysis of the risk of major ecosystem change from climate change at the global scale," says Wolfgang Lucht, also an author of the study and co-chair of the research domain Earth System Analysis at the Potsdam Institute for Climate Impact Research.



Simulated ecosystem change by 2100, if the global mean temperature increase is of five degrees Celsius above preindustrial levels. The parameter Γ measures how far apart a future ecosystem under climate change would be from the present state. Blue colours (lower Γ) depict areas of moderate change, yellow to red areas (higher Γ) show major change. The map shows the median value of Γ across all climate models, meaning at least half of the models agree on major change in the yellow to red areas. (Credit: Ostberg et al., 2013)

Few previous studies have looked into the global impact of raising temperatures on ecosystems because of how complex and interlinked these systems are. "Comprehensive theories and computer models of such complex systems and their dynamics up to the global scale do not exist."

To get around this problem, the team measured simultaneous changes in the biogeochemistry of terrestrial vegetation and the relative abundance of different vegetation species. "Any significant change in the underlying biogeochemistry presents an ecological adaptation challenge, fundamentally destabilising our natural systems," explains Ostberg.

The researchers defined a parameter to measure how far apart a future ecosystem under climate change would be from the present state. The parameter encompasses changes in variables such as the vegetation structure (from trees to grass, for example), the

carbon stored in the soils and vegetation, and freshwater availability. “Our indicator of ecosystem change is able to measure the combined effect of changes in many ecosystem processes, instead of looking only at a single process,” says Ostberg.

He hopes the new results can help inform the ongoing negotiations on climate mitigation targets, “as well as planning adaptation to unavoidable change.”

This press release was originally published on the EGU website

Note

Even though 86% of land ecosystems are at risk if global temperature increases by 5 degrees Celsius by 2100, it is unlikely all these areas will be affected. This would mean that the worst case scenario from each climate model comes true.

Reference

Ostberg, S. et al.: Critical impacts of global warming on land ecosystems, Earth Syst. Dynam., 4, 347–357, 2013

Tiny plankton could have big impact on climate

EGU press release on research published in Biogeosciences

As the climate changes and oceans’ acidity increases, tiny plankton seem set to succeed. An international team of marine scientists has found that the smallest plankton groups thrive under elevated carbon dioxide (CO_2) levels. This could cause an imbalance in the food web as well as decrease ocean CO_2 uptake, an important regulator of global climate. The results of the study, conducted off the coast of Svalbard, Norway, in 2010, are now compiled in a special issue published in Biogeosciences, a journal of the European Geosciences Union (EGU).

“If the tiny plankton blooms, it consumes the nutrients that are normally also available to larger plankton species,” explains Ulf Riebesell, a professor of biological oceanography at the GEOMAR Helmholtz Centre for Ocean Research Kiel in Germany and head of the experimental team. This could mean the larger plankton run short of food.

Researchers check the ‘mesocosms’, eight-metre long floatation frames carrying plastic bags with a capacity of 50 cubic metres, deployed for a five-week long field study on ocean acidification conducted in the Kongsfjord off the Arctic archipelago of Svalbard. (Credit: Ulf Riebesell/GEOMAR)

Large plankton play an important role in carbon export to the deep ocean, but in a system dominated by the so-called pico- and nanoplankton, less carbon is transported out of surface waters. “This may cause the oceans to absorb less CO_2 in the future,” says Riebesell.

The potential imbalance in the plankton food web may have an even bigger climate impact. Large plankton are also important producers of a climate-cooling gas called dimethyl sulphide, which stimulates cloud-formation over the oceans. Less dimethyl sulphide means more sunlight reaches the Earth’s surface, adding to the greenhouse effect. “These important services of the ocean may thus be significantly affected by acidification.”

Ecosystems in the Arctic are some of the most vulnerable to acidification because the cold temperatures there mean that the ocean absorbs more carbon dioxide. “Acidification is faster there than in temperate or tropical regions,” explains the coordinator of the European Project on Ocean Acidification (EPOCA), Jean-Pierre Gattuso of the Laboratory of Oceanography of Villefranche-sur-Mer of the French National Centre for Scientific Research (CNRS).

The increasing acidity is known to affect some calcifying organisms in the Arctic, including certain sea snails, mussels and other molluscs. But scientists did not know until now how ocean acidification alters both the base of the marine food web and carbon transport in the ocean.

The five-week long field study conducted in the Kongsfjord off the Arctic archipelago of Svalbard, under the EPOCA framework, intended to close this knowledge gap. For the experiment, the scientists deployed nine large ‘mesocosms’, eight-metre long floatation frames carrying plastic bags with a capacity of 50 cubic metres. These water enclosures, developed at GEOMAR, allow researchers to study plankton communities in their natural environment under controlled conditions, rather than in a beaker in the lab. Few studies have looked at whole communities before.

The scientists gradually added CO_2 to the mesocom water so that it reached acidity levels expected in 20, 40, 60, 80 and 100 years, with two bags left as controls. They also added nutrients to simulate a natural plankton bloom, as reported in the Biogeosciences special issue.

The team found that, where CO_2 was elevated, pico- and, to a lesser extent, nanoplankton grew, drawing down nutrients so there were less available to larger plankton. “The different responses we observed made it clear that the communities’ sensitivity to

acidification depends strongly on whether or not nutrients are available," Riebesell summarises.

"Time and [time] again the tiniest plankton benefits from the surplus CO_2, they produce more biomass and more organic carbon, and dimethyl sulphide production and carbon export are decreasing," he concludes.

This press release was originally published on the EGU website

Note

With 35 participants from 13 European institutions, the GEOMAR-coordinated mesocosm experiment was the largest project of EPOCA, a large EU-funded research initiative on ocean acidification that ran from 2008 to 2012. It was supported by the French–German Arctic Research Base.

Reference

Eds. U. Riebesell et al.: Arctic ocean acidification: pelagic ecosystem and biogeochemical responses during a mesocosm study, Biogeosciences, special issue 120, 2013

How pigeons may smell their way home

EGU press release on research published in Biogeosciences

Homing pigeons, like other birds, are extraordinary navigators, but how they manage to find their way back to their lofts is still debated. To navigate, birds require a 'map' (to tell them home is south, for example) and a 'compass' (to tell them where south is), with the sun and the Earth's magnetic field being the preferred compass systems. A new paper provides evidence that the information pigeons use as a map is in fact available in the atmosphere: odours and winds allow them to find their way home. The results are now published in Biogeosciences, an open access journal of the European Geosciences Union (EGU).

Experiments over the past 40 years have shown that homing pigeons get disoriented when their sense of smell is impaired or when they don't have access to natural winds at their home site. But many researchers were not convinced that wind-borne odours could provide the map pigeons need to navigate. Now, Hans Wallraff of the Max Planck Institute for Ornithology in Seewiesen, Germany, has shown that the atmosphere does contain the necessary information to help pigeons find their way home.

In previous research, Wallraff collected air samples at over 90 sites within a 200 km radius around a former pigeon loft near Würzburg in southern Germany. The samples revealed that the ratios among certain 'volatile organic compounds' (chemicals that can be a source of scents and odours) in the atmosphere increase or decrease along specific directions. "For instance, the percentage of compound A in the sum A+B or A+B+C+D increases the farther one moves from north to south," Wallraff explains.

These changes in compound ratios translate into changes in perceived smell. But a pigeon that has never left its loft does not know in what directions what changes occur – unless it has been exposed to winds at its home site.

At home, a bird is thought to associate certain smells with particular wind directions. "If the percentage of compound A increases with southerly winds, a pigeon living in a loft in Würzburg learns this wind-correlated increase. If released at a site some 100 km south of home, the bird smells that the ratio of compound A is above what it is on average at its loft and flies north," Wallraff explains. To use an analogy, a person in Munich could smell an Alpine breeze when there is wind blowing from the south. When displaced closer to the mountains, they would detect a strong Alpine scent and remember that, at home, that smell is associated with southerly winds: the person would know that, roughly, they needed to travel north to find home.

But this explanation of how pigeons might use wind-borne odours to find their loft was just a hypothesis: Wallraff still needed to prove that the atmosphere does indeed contain the basis of the map system pigeons need to navigate. In the new Biogeosciences paper, he develops a model showing that 'virtual pigeons' with only knowledge of winds and odours at home, can find their way back to their lofts by using real atmospheric data.

"My virtual pigeons served as tools to select those volatile compounds whose spatial distributions, combined with variations dependent on wind direction, were most suitable for homeward navigation," explains Wallraff.

The model uses an iterative approach to imitate animal evolution by introducing random mutations in the virtual pigeons, making them most sensitive to those volatile compounds that are most effective for navigation. By selecting the best mutations in the course of thousands of generations, the model creates virtual pigeons capable of finding their bearings as well as real pigeons, showing that even inexperienced birds could use atmospheric information for navigation. The findings present a missing piece in the puzzle of homing pigeon navigation, confirming that winds and odours can indeed work as a map system.

"Work with real pigeons was the beginning of the story. In this research, I wanted to find out whether and in what way the chemical atmosphere fulfils the demands for avian navigation. Eventually, to identify the chemical compounds birds actually use for home-finding, we will need real birds again. But this is far in the future."

This press release was originally published on the EGU website

Reference

Wallraff, H. G.: Ratios among atmospheric trace gases together with winds imply exploitable information for bird navigation: a model elucidating experimental results, Biogeosciences, 10, 6929–6943, 2013

Using digital SLRs to measure the height of Northern Lights

EGU press release on research published in Annales Geophysicae

Scientific research doesn't often start from outreach projects. Yet, Ryuho Kataoka from the National Institute of Polar Research in Tokyo, Japan, came up with an idea for a new method to measure the height of aurora borealis after working on a 3D movie for a planetarium. Kataoka and collaborators used two digital single-lens reflex (SLR) cameras set 8 km apart to capture 3D images of Northern Lights and determine the altitude where electrons in the atmosphere emit the light that produces aurora. The results are now published in Annales Geophysicae, a journal of the European Geosciences Union (EGU).

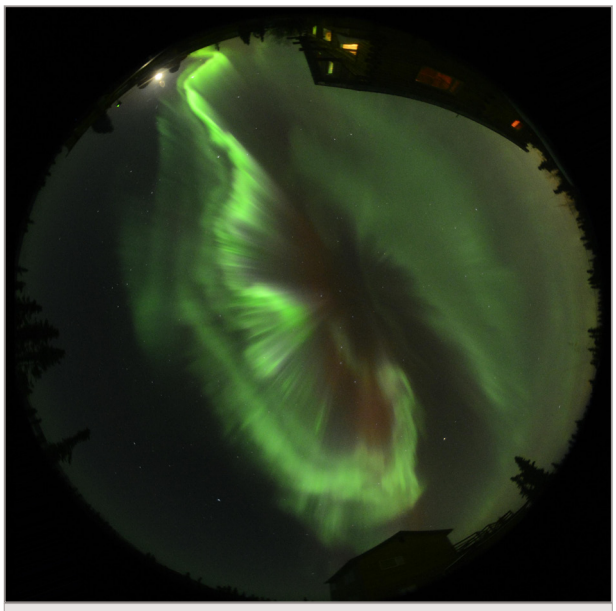
"We had initial success when we projected the digital SLR images at a planetarium and showed that the aurora could be seen in 3D. It was very beautiful, and I became confident that it should be possible to calculate the emission altitude using these images," recalls Kataoka, who also works at the Graduate University for Advanced Studies (Sokendai) in Hayama, Japan. He teamed up with other Japanese researchers and an American scientist to do just that.

The separation distance between the human eyes is what allows us to see in 3D. When we look at an object, the images captured by the left and right eyes are slightly different from each other and when combined they give the brain the perception of depth. But because the distance between our eyes – about 5 cm – is small, this only works for objects that are not very far away.

Since aurora extend between about 90 and 400 km in altitude, a much larger separation distance is needed to see them in 3D. The researchers used two cameras, mimicking the left and right eyes, separated by 8 km across the Chatanika area in Alaska. Their two digital SLRs, equipped with fisheye lenses and GPS units, captured two simultaneous all-sky images that the researchers combined to create a 3D photograph of the aurora and measure the emission altitude.

"Using the parallax of the left-eye and the right-eye images, we can calculate the distance to the aurora using a [triangulation] method that is similar to the way the human brain comprehends the distance to an object," explains Kataoka. Parallax is the difference in the apparent position of an object when observed at different angles.

Scientists have obtained altitude maps of aurora before. They are useful because they provide information about the energy of the electrons that produce the lights. But this is the first time the emission height of Northern Lights has been measured using images captured with digital SLR cameras. As the authors explain in the new Annales Geophysicae paper, the altitude maps obtained in this way are consistent with previous observations.



The authors used two digital SLRs (single-lens reflex cameras), equipped with fisheye lenses and GPS units, to capture two simultaneous all-sky images of aurora in Alaska, USA, one of which is shown here. The subtle differences between the two pictures allow researchers to measure the altitude where electrons in the atmosphere emit the light that produces aurora. You can see the two images, and a 3D side-by-side video of aurora, on the EGU website. (Credit: Kataoka et al., 2013)

The technique is low cost and allows researchers to measure the altitude of small-scale features in the aurora. Further, it opens up the door for citizen scientists to get involved with auroral research.

"Commercially available GPS units for digital SLR cameras have become popular and relatively inexpensive, and it is easy and very useful for photographers to record the accurate time and position in photographic files. I am thinking of developing a website with a submission system to collect many interesting photographs from night-sky photographers over the world via the internet," says Kataoka.

The researchers believe this may lead to new scientific findings, while working to engage the public in auroral research. After all, it was the beauty of 3D imaging of auroras that inspired Kataoka to develop a new tool for scientific research in the first place.

This press release was originally published on the EGU website

Reference

Kataoka, R. et al.: Stereoscopic determination of all-sky altitude map of aurora using two ground-based Nikon DSLR cameras, Ann. Geophys., 31, 1543–1548, 2013

Atmospheric Chemistry and Physics (ACP)

Heterogeneous formation of polar stratospheric clouds – part 2: nucleation of ice on synoptic scales

This paper provides compelling evidence for the importance of heterogeneous nucleation, likely on solid particles of meteoritic origin, and of small-scale temperature fluctuations, for the formation of ice particles in the Arctic stratosphere.

Reference

Engel, I. et al.: Heterogeneous formation of polar stratospheric clouds – Part 2: Nucleation of ice on synoptic scales, Atmos. Chem. Phys., 13, 10769–10785, 2013

Filamentary structure in chemical tracer distributions near the subtropical jet following a wave breaking event

This paper presents a set of observations and analyses of trace gas cross sections at mid-latitudes in the upper troposphere/lower stratosphere.

Reference

Ungermann, J. et al.: Filamentary structure in chemical tracer distributions near the subtropical jet following a wave breaking event, Atmos. Chem. Phys., 13, 10517–10534, 2013

Cloud-resolving simulations of mercury scavenging and deposition in thunderstorms

This study examines dynamical and microphysical features of convective clouds that affect mercury wet scavenging and concentrations in rainfall.

Reference

Nair, U. S. et al.: Cloud-resolving simulations of mercury scavenging and deposition in thunderstorms, Atmos. Chem. Phys., 13, 10143–10157, 2013

Naphthalene SOA: redox activity and naphthoquinone gas–particle partitioning

In this study, the authors examined chamber secondary organic aerosol (SOA) from low-NO_x photooxidation of naphthalene by hydroxyl radical with respect to its redox cycling behaviour using the dithiothreitol assay.

Reference

McWhinney, R. D., Zhou, S., and Abbatt, J. P. D.: Naphthalene SOA: redox activity and naphthoquinone gas–particle partitioning, Atmos. Chem. Phys., 13, 9731–9744, 2013

Black carbon in the Arctic: the underestimated role of gas flaring and residential combustion emissions

Chemistry transport models and climate chemistry models struggle to reproduce the Arctic Haze phenomenon, and this has recently prompted changes in aerosol removal schemes to remedy the modelling problems. In this paper, the authors show that shortcomings in current emission data sets are at least as important.

Reference

Stohl, A. et al.: Black carbon in the Arctic: the underestimated role of gas flaring and residential combustion emissions, Atmos. Chem. Phys., 13, 8833–8855, 2013

The magnitude and causes of uncertainty in global model simulations of cloud condensation nuclei

In this article the authors perform a variance-based analysis of a global 3D aerosol microphysics model to quantify the magnitude and leading causes of parametric uncertainty in model-estimated present-day concentrations of cloud condensation nuclei.

Reference

Lee, L. A. et al.: The magnitude and causes of uncertainty in global model simulations of cloud condensation nuclei, Atmos. Chem. Phys., 13, 8879–8914, 2013

Global CO_2 fluxes estimated from GOSAT retrievals of total column CO_2

This paper presents one of the first estimates of the global distribution of CO_2 surface fluxes using total column CO_2 measurements retrieved by the SRON-KIT (Netherlands Institute for Space Research and Karlsruhe Institute for Technology) RemoTeC algorithm from the Greenhouse gases Observing SATellite (GOSAT).

Reference

Basu, S. et al.: Global CO_2 fluxes estimated from GOSAT retrievals of total column CO_2, Atmos. Chem. Phys., 13, 8695–8717, 2013

Gravitational separation in the stratosphere – a new indicator of atmospheric circulation

The O_2/N_2 ratio observed in the middle stratosphere, corrected for gravitational separation, showed the same mean air age as estimated from the CO_2 mole fraction. Therefore, gravitational separation can be used as a new indicator of changes in atmospheric circulation in the stratosphere, the authors concluded in this study.

Reference

Ishidoya, S. et al.: Gravitational separation in the stratosphere – a new indicator of atmospheric circulation, Atmos. Chem. Phys., 13, 8787–8796, 2013

Quantitative evaluation of emission controls on primary and secondary organic aerosol sources during Beijing 2008 Olympics

To assess the primary and secondary sources of fine organic aerosols after the aggressive implementation of air pollution controls during the 2008 Beijing Olympic Games, researchers measured 12-h $PM_{2.5}$ values at an urban site at Peking University and an upwind rural site at Yufa. The results are reported in this paper.

Reference

Guo, S. et al.: Quantitative evaluation of emission controls on primary and secondary organic aerosol sources during Beijing 2008 Olympics, Atmos. Chem. Phys., 13, 8303–8314, 2013

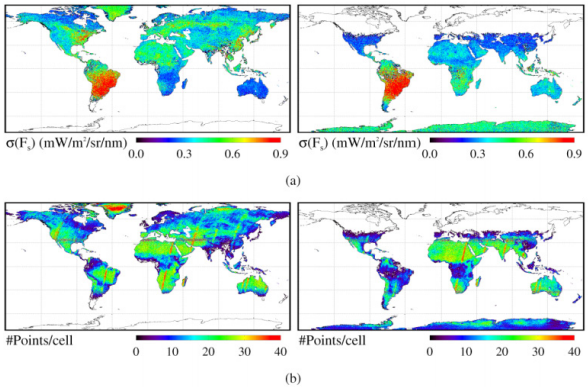
Atmospheric Measurement Techniques (AMT)

Global monitoring of terrestrial chlorophyll fluorescence from moderate-spectral-resolution near-infrared satellite measurements: methodology, simulations, and application to GOME-2

In this paper, the authors describe a new methodology to retrieve global far-red fluorescence information. They use hyperspectral data with a simplified radiative transfer model to disentangle the spectral signatures of three basic components: atmospheric absorption, surface reflectance and fluorescence radiance.

Reference

Joiner, J. et al.: Global monitoring of terrestrial chlorophyll fluorescence from moderate-spectral-resolution near-infrared satellite measurements: methodology, simulations, and application to GOME-2, Atmos. Meas. Tech., 6, 2803–2823, 2013



Global maps of GOME-2 fluorescence radiance retrieval statistical parameters in a 0.5° grid cell for July (left column) and December (right column) 2009. Each column shows the standard deviation (top) and the number of points per grid cell (bottom). (Image and caption from Joiner et al., 2013)

Biogeosciences (BG)

A novel salinity proxy based on Na incorporation into foraminiferal calcite

This study investigates the impact of salinity on foraminiferal Na/Ca values by laser ablation ICP-MS (inductively coupled plasma mass spectrometry) analyses of specimens of the benthic foraminifer *Ammonia tepida* cultured at a range of salinities (30.0–38.6).

Reference

Wit, J. C. et al.: A novel salinity proxy based on Na incorporation into foraminiferal calcite, Biogeosciences, 10, 6375–6387, 2013

Carbonate mineral saturation states in the East China Sea: present conditions and future scenarios

To assess the impact of rising atmospheric CO_2 and eutrophication on the carbonate chemistry of East China Sea shelf waters, the authors calculated the saturation states for two important biologically relevant carbonate minerals throughout the water column.

Reference

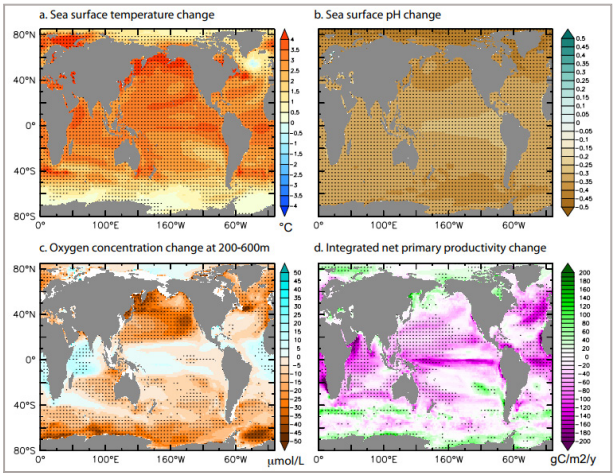
Chou, W.-C. et al.: Carbonate mineral saturation states in the East China Sea: present conditions and future scenarios, Biogeosciences, 10, 6453–6467, 2013

Multiple stressors of ocean ecosystems in the 21st century: projections with CMIP5 models

Ocean ecosystems are increasingly stressed by human-induced changes of their physical, chemical and biological environment. In this paper, the authors use the most recent simulations performed in the framework of the Coupled Model Intercomparison Project (CMIP) 5 to assess how stressors such as warming, acidification deoxygenation and changes in primary productivity by marine phytoplankton may evolve over the course of the 21st century.

Reference

Bopp, L. et al.: Multiple stressors of ocean ecosystems in the 21st century: projections with CMIP5 models, Biogeosciences, 10, 6225–6245, 2013



Change in stressor intensity in 2090–2099 relative to 1990–1999 under RCP8.5. (Credit: Bopp et al., 2013)

Nitrous oxide (N_2O) production in axenic *Chlorella vulgaris* microalgae cultures: evidence, putative pathways, and potential environmental impacts

Using antibiotic assays and genomic analysis, this study demonstrates nitrous oxide (N_2O) is generated from axenic *Chlorella vulgaris cultures*. In batch assays, this production is magnified under conditions favouring intracellular nitrite accumulation, but repressed when nitrate reductase activity is inhibited.

Reference

Guieysse, B. et al.: Nitrous oxide (N_2O) production in axenic *Chlorella vulgaris* microalgae cultures: evidence, putative pathways, and potential environmental impacts, Biogeosciences, 10, 6737–6746, 2013

Remote sensing of LAI, chlorophyll and leaf nitrogen pools of crop- and grasslands in five European landscapes

Leaf nitrogen and leaf surface area influence the exchange of gases between terrestrial ecosystems and the atmosphere, and play a significant role in the global cycles of carbon, nitrogen and water. This study used field-based and satellite remote-sensing-based methods to assess leaf nitrogen pools in five diverse European agricultural landscapes located in Denmark, Scotland, Poland, the Netherlands and Italy.

Reference

Boegh, E. et al.: Remote sensing of LAI, chlorophyll and leaf nitrogen pools of crop- and grasslands in five European landscapes, Biogeosciences, 10, 6279–6307, 2013

Climate of the Past (CP)

Peak glacial ^{14}C ventilation ages suggest major draw-down of carbon into the abyssal ocean

Here the authors present a new, though still fragmentary, ocean-wide $\Delta^{14}C$ data set showing that during the Last Glacial Maximum and Heinrich Stadial 1 the maximum ^{14}C age difference between ocean deep waters and the atmosphere exceeded the modern values by up to 1500 ^{14}C yr, in the extreme reaching 5100 ^{14}C yr.

Reference

Sarnthein, M., Schneider, B. and Grootes, P. M.: Peak glacial ^{14}C ventilation ages suggest major draw-down of carbon into the abyssal ocean, Clim. Past, 9, 2595–2614, 2013

North–south palaeohydrological contrasts in the central Mediterranean during the Holocene: tentative synthesis and working hypotheses

Using a multi-proxy approach and a strategy combining lacustrine and marine records along a north–south transect, data collected in the central Mediterranean as part of a collaborative project have led to reconstruction of high-resolution and well-dated palaeohydrological records and assessment of their spatial and temporal coherency.

Reference

Magny, M. et al.: North–south palaeohydrological contrasts in the central Mediterranean during the Holocene: tentative synthesis and working hypotheses, Clim. Past, 9, 2043–2071, 2013

Earth System Dynamics (ESD)

The impact of nitrogen and phosphorous limitation on the estimated terrestrial carbon balance and warming of land use change over the last 156 yr

The authors examine the impact of land use and land cover change over 1850–2005 using an Earth system model that incorporates nitrogen and phosphorous limitation on the terrestrial carbon cycle.

Reference

Zhang, Q. et al.: The impact of nitrogen and phosphorous limitation on the estimated terrestrial carbon balance and warming of land use change over the last 156 yr, Earth Syst. Dynam., 4, 333–345, 2013

Climate response to imposed solar radiation reductions in high latitudes

Model simulations in which the authors reduced solar insolation over high latitudes not only cooled those regions, but also drew energy from lower latitudes, exerting a cooling influence over much of the hemisphere in which the reduction was imposed.

Reference

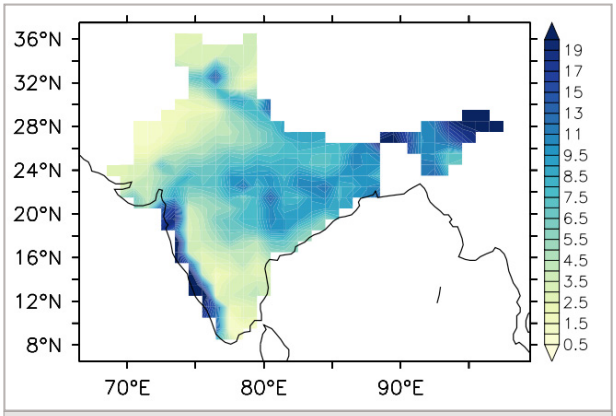
MacCracken, M. C. et al.: Climate response to imposed solar radiation reductions in high latitudes, Earth Syst. Dynam., 4, 301–315, 2013

Consistent increase in Indian monsoon rainfall and its variability across CMIP5 models

In this study, the Indian summer monsoon rainfall is evaluated in 20 CMIP5 models for the period 1850 to 2100.

Reference

Menon, A. et al.: Consistent increase in Indian monsoon rainfall and its variability across CMIP-5 models, Earth Syst. Dynam., 4, 287–300, 2013



June–September rainfall climatology (mm/day) during the period 1970–2000. (Credit: Menon et al., 2013)

Hydrology and Earth System Sciences (HESS)

Inverse streamflow routing

Routing is a runoff-to-streamflow process, and the streamflow in rivers is the response to runoff integrated in both time and space. In this article, the authors develop a methodology to invert the routing process, i.e., to derive the spatially distributed runoff from streamflow (e.g., measured at gauge stations) by inverting an arbitrary linear routing model using fixed interval smoothing.

Reference

Pan, M. and Wood, E. F.: Inverse streamflow routing, Hydrol. Earth Syst. Sci., 17, 4577–4588, 2013

A thermodynamic approach to link self-organisation, preferential flow and rainfall–runoff behaviour

This study investigates whether a thermodynamically optimal hillslope structure can, if present, serve as a first guess for uncalibrated predictions of rainfall–runoff.

Reference

Zehe, E. et al.: A thermodynamic approach to link self-organisation, preferential flow and rainfall–runoff behaviour, Hydrol. Earth Syst. Sci., 17, 4297–4322, 2013

The Cryosphere (TC)

Antarctic ice-mass balance 2003 to 2012

This paper presents regional-scale mass balances for 25 drainage basins of the Antarctic Ice Sheet from satellite observations of the Gravity and Climate Experiment (GRACE) for the period January 2003 to September 2012.

Reference

Sasgen, I. et al.: Antarctic ice-mass balance 2003 to 2012: regional reanalysis of GRACE satellite gravimetry measurements with improved estimate of glacial-isostatic adjustment based on GPS uplift rates, The Cryosphere, 7, 1499–1512, 2013

ARTICLES
EGU VOICE
EGU NEWS
PRESS RELEASES
JOURNAL WATCH
EXTERNAL NEWS
EDUCATION
YOUNG SCIENTISTS
BOOKS
EVENTS

BACK TO CONTENTS

Building a world you like, with a climate you like

Report on the European Commission's communication campaign to promote climate action and a low-carbon economy.

The latest report on climate science from the UN's Intergovernmental Panel on Climate Change, issued in September 2013, concludes that global warming is unequivocal and almost certainly man-made. The result of contributions by some 2,000 climate scientists around the world, the report shows that much more ambitious action is needed to cut the world's greenhouse gas emissions to prevent climate change reaching dangerous levels in the coming decades.

Daily media reports about record CO_2 emissions, record ice melts, record droughts and record rainfall are making people frustrated and concerned about climate change. And yet – despite the growing awareness – not enough people around the world are taking action themselves. They think it doesn't matter, but it does.

By 2020 we could reduce CO_2 emissions by an amount equivalent to the combined annual emissions of Ireland, France, Finland, Belgium and Portugal if all Europeans changed their habits in areas such as eating, shopping, transport and heating. To tap into this huge potential, the European Commissioner for Climate Action, Connie Hedegaard, has launched the public awareness campaign 'A world you like. With a climate you like'.

Changing the narrative about climate change

'A world you like' is a European Union-wide campaign that seeks to change the narrative about climate change – not least by highlighting success stories from all EU member states. Focusing on five areas – travel and transport, production and innovation, building and living, shopping and eating, and re-use and recycling – the campaign shows that climate action is not only necessary but also feasible and affordable. It promotes practical, innovative and cost-efficient solutions to climate change. But it is about more than one-way communication: 'A world you like' provides a platform for dialogue on climate solutions and best practices applied by citizens, businesses and public authorities across Europe.

Stakeholder engagement

The campaign engages with many different stakeholders through a large variety of online and offline channels: an interactive website, social media, electronic media, and press and campaign events in several European member states. Since its launch in October 2012, the campaign has reached millions of Europeans and has gained over 70,000 followers on social media. It also attracted the support of high-level politicians and celebrities, including UN Secretary-General Ban Ki-moon and award-winning actor Colin Firth.

EU Commissioner for Climate Action Connie Hedegaard

"We have a choice: we can *act* on our knowledge about climate change. Or we can sit idly by and watch as things get worse. Both options come with a price tag. So why not create a world we like, with a climate we like – while we still have time?"

To further increase its reach, the campaign works together with a variety of partners. More than 250 public authorities, NGOs, universities and businesses from across Europe are official partners. They help to spread the campaign's message and support its social media activities. Some partners, such as the Confederation of Danish Industry, have included the campaign in their own events.

The World You Like Challenge

A key part of the campaign is the World You Like Challenge. This low-carbon contest encouraged creative minds from across the EU to put their innovative climate solutions to the test. Of more than 300 projects submitted, 269 were accepted and entered into the Challenge for the public to vote on over the summer. Over 230,000 votes were cast and the top-ranked projects were presented to distinguished juries to select the winners.

The overall winner was the Sown Biodiverse Pastures project from Portugal, which involves some 1,000 farmers and covers 50,000 hectares of land. The project won for its innovative solution in reducing CO_2 emissions, soil erosion and the risk of wildfires while increasing the productivity of pasture. In this project, each farmer is provided with a specific mixture of up to 20 different seeds adapted to the soil and climate conditions.

Commissioner Connie Hedegaard announced Sown Biodiverse Pastures' success at an award ceremony organised by campaign partner Sustainia, the sustainability organisation led by Arnold Schwarzenegger, on 7 November in Copenhagen. The project's prize was a European media package to promote the winning solution across Europe.

The two runners-up were also honoured:

- Airport Carbon Accreditation: This European project, based in Brussels, is a voluntary programme covering 75 European airports which aim to improve their energy efficiency and lower their CO_2 emissions. The programme was launched by the European airport trade body Airports Council International Europe in 2009.
- Low Energy Houses for Everyone: This project by the Polish company Dworek Polski builds traditional Polish houses that are both affordable and low in energy consumption.

The European winner of the World You Like Challenge competition for the best solutions to climate change. Professor Tiago Domingos (pictured) is the CEO of Terraprima and Project Manager of its Sown Biodiverse Pastures project. The Sown Biodiverse Pastures project not only won the European Challenge, but also the Challenge in Portugal.

In addition to the overall prize, the Challenge also rewarded one climate solution in each of the campaign's five target countries – Bulgaria, Lithuania, Italy, Poland and Portugal. Juries were set up in each country to choose the winner, which received a billboard campaign in its capital city.

The winner in Portugal was Sown Biodiverse Pastures, while Low Energy Houses for Everyone won in Poland. The Bulgarian winner is a community composting initiative that increases citizens' environmental awareness. Lithuania's winner contributes to reducing waste by turning items that would otherwise have been thrown away into attractive jewellery and accessories. In Italy the jury crowned a low-energy and low-emissions housing project which makes climate-friendly living affordable for all.

The number and quality of entries in the Challenge has reinforced the positive message of the campaign by highlighting how many innovative solutions are out there already. As Connie Hedegaard said when announcing the overall winner, "it's time to scale up these climate solutions to build a world we like, with a climate we like."

a world you like
with a climate you like

The Directorate-General for Climate Action, European Commission

Background information

The World You Like campaign and the World You Like Challenge are run by the European Commission's Directorate-General for Climate Action
It follows the Commission's 'Roadmap for moving to a competitive low-carbon economy in 2050' of March 2011, which sets out pathways for achieving the EU's objective of an 80-95% reduction in greenhouse gas emissions by 2050.

In the medium-term, by 2020, the EU aims to reduce greenhouse gas emissions by 20%, improve energy efficiency by 20% and boost the share of renewables in the energy mix to 20%. Currently, EU emissions are more than 18% below 1990 levels.

The Directorate-General for Climate Action was established in February 2010. Apart from raising awareness of climate change, DG CLIMA leads international climate negotiations, promotes low carbon and adaptation technologies and develops and implements the EU Emissions Trading System, as well as international and domestic climate action policies and strategies.

Further information

World You Like campaign and Challenge:
http://world-you-like.europa.eu/en/ (as of January 2014: http://ec.europa.eu/clima/aworldyoulike)
https://www.facebook.com/EUClimateAction
https://twitter.com/EUClimateAction #worldulike
Directorate-General for Climate Action, European Commission:
http://ec.europa.eu/clima/

Climatica: a new initiative for climate science outreach

A team of researchers writes about their climate science and public interaction initiative: climatica.org.uk.

Over the past few decades, public interest in climate science has intensified greatly. The concepts of 'climate change' and 'global warming' extend far into the public sector, and now play a significant role in local and global politics, policies and daily activities. It is therefore vital that the information received by the public is both accurate and accessibly presented. However, achieving high quality science-public interaction is not always straightforward. Here we present a new outlook on science-public interaction, through the recently launched web-based initiative Climatica.

The current state of science communication

Scientists belong to a global network of knowledge exchange, where data are disseminated via peer reviewed publications and conference proceedings, for example. However, this successful transfer of information does not always translate into effective

communication with wider public audiences. This is, in large part, due to the highly specialist skills required to convey complex scientific ideas in an accessible manner. At present, public understanding of climate science is often superficial, and factual inaccuracies give rise to misunderstandings between academic and public spheres. The need to more effectively engage public audiences with scientific understanding of environmental issues is therefore more pressing than ever before.

The role of Climatica

A great number of climate scientists already engage very effectively with public audiences, through Earth science documentaries, weblogs and popular science publications, for example. The internet is an ideal platform through which scientists can disseminate their ideas with full content control. There are currently a number of climate science websites, but many of these are not written by authoritative sources, often contain technical language and can be difficult to navigate. Climatica is a new climate science website launched by three climate and Earth scientists from the United Kingdom and New Zealand. We aim to bridge the gap between scientists and the wider public by publishing two levels of articles: basic background information which aims to dispel uncertainties and lay foundations for understanding climate sciences, and short articles written by experts about their research field. In contrast to academic texts, our material is written with little scientific vocabulary or jargon, allowing the public to clearly understand the information provided. We deliver scientific understanding directly to wider audiences, in an easily accessible format.

Project development and plans for the future

Our initial ideas for the website came from a discussion meeting at the UK Quaternary Research Association. It was attended by academics and media specialists, and highlighted the need to develop a more effective public-academic discourse. The development and launch of the website was made possible through the kind support of The Geological Society of London and the Quaternary Research Association. Since August 2013, Climatica has already published over 15 articles written by leading researchers, and we have a further 10 exciting articles ready for publication by 2014.

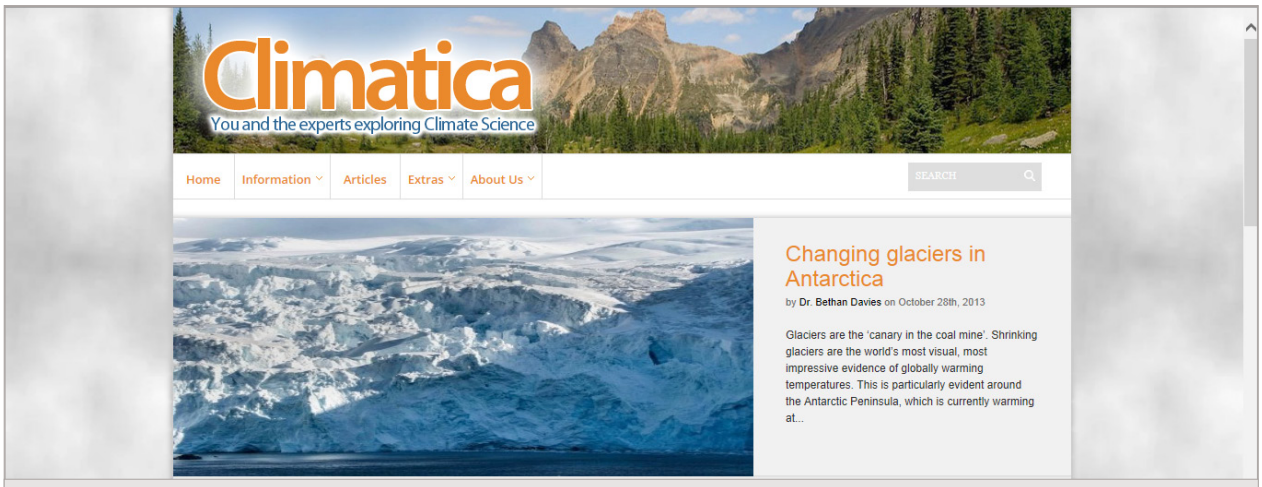
Since our launch, we have received very positive feedback from scientists and members of the public alike. The increasing interest in Climatica has raised the profile of climate science and science communication, and has led to a series of high profile opportunities. We were recently invited to contribute an article to The Guardian focusing on some of the difficulties encountered in science communication.

We are now also part of the World Bank's Connect4Climate coalition. This is a global community of partners with research, policy, and social interests in climate change. Our collaboration with C4C has considerably enhanced our outreach potential. The continued effectiveness of Climatica relies heavily on the contribution of articles from early career researchers and academics. Developing a sustained, two-way dialogue between scientists and the public is vitally important for the future of science communication – we need your input!

The Climatica website is only a small part of this dialogue. As well as communicating through websites like Climatica, the scientific community needs to equip its scientists with the skills to communicate independently with wider audiences. To do this, we have teamed up with the EGU communications team to host a new science communication workshop at the EGU 2014 General Assembly (session EOS22/SC10). With contributions from media experts and academics, this session will tackle the issues faced by scientists when trying to communicate with wider audiences. Participants will gain practical experience of the writing and oral skills needed to prepare their work for public and media consumption. The workshop is open to all delegates at the General Assembly, and we would like to extend our invitation to you all. Please check the Climatica and EGU websites or Twitter feeds (@Climatica & @EuroGeosciences) before the conference for more information on the workshop schedule.

For further information on Climatica, or if you would like to contribute an article or blog post please contact us at climaticauk@gmail.com.

Kathryn Adamson, Tim Lane and Selwyn Jones
The Climatica team



Screenshot of the Climatica website: http://www.climatica.org.uk

Sending GIFT to Africa

A new collaboration between the EGU, UNESCO and ESA

For the past ten years, the EGU's Geosciences Information For Teachers (GIFT) workshops – spreading first hand scientific research to teachers of primary and secondary school – have been hugely successful in shortening the time that research takes to disseminate from scientist to textbook to teacher and offering usable practical activities for the classroom. GIFT workshops are usually held at the EGU General Assembly in Vienna, adding to the experience of the teachers by immersing them in a world of geoscientific research and discussion. In recent years, workshops have also been held in association with Alexander von Humboldt conferences in Mexico, Malaysia and Peru and are now on the way to Africa.

UNESCO's Earth Science Education Initiative in Africa was set up to support the development of the next generation of Earth scientists in Africa. The initiative aims to provide the necessary tools, networks and perspectives to apply sound science to solving the challenges of sustainable development and in turn gathering opportunities from them. Challenges and opportunities range from evolution in mineral extraction techniques to environmental management including mitigation of climate change, prevention of natural hazards, and ensuring access to clean drinking water.

Institutions collaborating in the organisation of UNESCO-EGU-ESA teacher workshops in Africa.

Education is key to forging the next generation of 'Earth stewards' and give Earth sciences a status that reflects the importance that this discipline plays in the everyday life of African people. One of the initial actions of the initiative was a focus on Earth science education at primary and secondary level in schools. To achieve this, it was recognised that first providing teachers with the necessary information, conveyed in an engaging way by scientists was essential for inspiring and educating future generations.

Bringing together the expertise of the EGU with UNESCO's Earth Science Education Initiative in Africa, the EGU are proud to announce a new series of annual GIFT workshops to be held around the African continent over the next four years. As international events, the workshops will be held in four different regions of Africa, starting with Southern Africa. They will cover various topics of societal relevance such as climate change, groundwater, geohazards, mineral resources and environmental sustainability. The UNESCO-EGU-ESA African GIFT workshops will take place over the course of three days with 40 teachers from across the region and 8–10 speakers, half of whom will be non-African experts. Applications to participate in the first UNESCO-EGU-ESA African GIFT workshop should be sent to sa-loc@egu.eu. See the EGU website for more information and details on how to apply.

At the EGU, the Committee on Education will be responsible for developing the programme with the help of the new EGU Educational Fellow. Programme specialists from the Division of Ecological and Earth Sciences at UNESCO headquarters, Paris and UNESCO African field offices will be jointly organising the workshops. For the

Africa is a continent with beautiful and rich geoscientific landscapes, from snow covered glaciers near the summit of Mount Kilimanjaro in Tanzania (left) to stunning valleys such as the Suguta in the Great Rift Valley in Kenya (right). (Credit: left: Dalia Kirschbaum; right: Annett Junginger, distributed by EGU via imaggeo.egu.eu under a Creative Commons licence)

first UNESCO-EGU-ESA GIFT workshop, to be held from 26–28 February 2014 in Port Elizabeth, South Africa, the European Space Agency and the Africa Earth Observatory Network will be offering support and expertise and the Nelson Mandela Metropolitan University will be hosting the workshop. The Local Organizing Committee also includes experts from the University of Free State, the University of Namibia, the University of Witswaterstrand and the International Geoscience Educators Organization of the International Union of Geological Sciences. To reflect on one of the most pressing societal issues and the release of the 5th Assessment Report of the IPCC, the first workshop will be on Climate Change and Human Adaptation.

With preparations already underway for this first African workshop, all those involved are looking forward to a successful event that will become a sustainable part of teacher education in Africa.

Carlo Laj, Sarah Gaines and Jane Robb
Chair of the EGU Committee on Education, Assistant Program Specialist at UNESCO and EGU Educational Fellow, respectively

Taking part in GIFT

A report by teacher Abigail Morton

"After reviewing the numerous applications, your application has been selected to receive the travel award, stipend, and registration for this meeting. Congratulations!"

I had to read it several times before it sank in. A few weeks earlier, I had been sifting through e-mails at work. I scanned through the newsletter from NESTA (the National Earth Sciences Teachers Association in the USA) and something caught my eye just as I went to delete it: the EGU was having its annual General Assembly in Vienna, and one person would be chosen to attend the Geoscience Information For Teachers (GIFT) workshop portion of the conference, paid for by the William Goree Award. In the interest of full disclosure, I spent nine of my formative years in Europe, and have longed to return since I left in 1991. I had to throw my hat in the ring; this felt too good to be true.

In fact, I was in disbelief up until my actual arrival in Vienna. The conference began with a meet-and-greet at the Natural History Museum. I was thrilled to finally meet programme directors Carlo Laj, chairman of the EGU Committee on Education, and Stephen Macko, with whom I'd been corresponding for months. I quickly lost my group when I couldn't tear myself away from the astonishing rock and mineral specimens in the museum's geology rooms. I found the group just in time for a special tour of the museum's roof, which provided stunning views of beautiful Vienna. While chatting with the other teachers in the GIFT programme, I was fortunate to meet with three Einstein Fellows, the "other Americans" in the programme. I was fascinated to learn about their fellowship, which brings educators from around the country to Washington DC to improve national science education policies through the lens of their classroom experience. Each attendee was thrilled to receive a beautiful Dierke Atlas, which has since provided me hours of reading entertainment. (I'm sure I'm not the only one with a map fetish.)

While talking to Carlo, I got a better understanding of the award that allowed me to attend. The award, sponsored in memory of William C. Goree, is designed to give teachers opportunities to expand and broaden their scientific background, which they can then bring back to the classroom. Goree was the co-founder of 2G Enterprises with

Abigail Morton participated in this year's EGU GIFT workshop in Vienna.

Bill Goodman and he had designed and produced superconducting rock magnetometers. Professional accomplishments aside, it was touching to hear so many kind words about Bill Goree, who passed away in 2007. Hearing about what a great person he was made me feel all the more honored to have received the award in his name.

We started bright and early the next morning at the conference centre. Having already attended several NESTA conferences in the US, I don't know why I was so surprised at the sheer size of the conference. There were several thousand attendees. I had spotted countless EGU name tags on the train through the city, and even a few in our tiny hotel across town. I was buzzing with energy and ready to take it all in.

Over the next three days, I was a sponge. The overarching topic of the GIFT workshop was Natural Hazards. The presenters covered every possible angle: types of hazards, from tsunamis to solar disturbances, and the science behind them; the human impact, which dictates the difference between hazards and disasters; what is avoidable, especially given the uncertainty of nature; and our responsibilities as science educators to disseminate this

information. We even heard from the insurance industry on the economic consequences of these global events. Jean-Luc Berenguer and François Tilquin ran a workshop where we designed and built models of buildings that could withstand tectonic motion. Although the setup was too elaborate for me to recreate exactly in my classroom, it did inspire me to create a similar (if simpler) activity for my own students.

Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research spoke about the increase of extreme weather events due to climate change. In his lecture, he showed the graphs of warming trends that we've all seen; what set his apart was that he then adjusted the graphs for other interferences such as El Niño and solar activity, and the results were still clearly trending in the same direction. I was reminded of his talk and its relevance when Vienna itself and regions further north were flooded just one month later. Later, while researching for current events lessons in meteorology, I realised Stefan was the go-to scientist for the media – his name was everywhere. Had I not had a flight to catch directly after the programme's end, I could have attended the optional tour of Flood Protection in Vienna that would have made the following month's events even better understood.

On the second day of the workshop, we were treated to a visit from a genuine celebrity in the geology world: Franco Barberi. Everyone in the room was familiar with his connection to the unfortunate L'Aquila earthquake in 2009, as evidenced by the reverent silence and camera-flashes of the audience. Barberi discussed the risk assessment of Mt. Vesuvius. It was fascinating to realise the number of unpredictable variables that factor in to volcanic eruption hazards, such as wind direction, that can make the difference between life and death. Hearing him speak in person only served to verify my convictions that he is an outstanding scientist whose October 2012 conviction was shocking and wrong.

I took copious notes through every lecture, and have since referenced my dog-eared notebook several times to find website addresses, analogies and case studies. I have many new landslide video clips to use in lectures, thanks to Bruce Malamud. I will be comparing ocean studies to space exploration, as Norma Crosby taught me. I will use the story of the Nice Airport expansion to illustrate the potential devastation of submarine landslides, as Angelo Camerlenghi did. And I will definitely have my students produce their own silent short films to teach Earth science concepts!

The poster session was a feast of new ideas. I wanted to stay by my poster to explain it, as I had hands-on material to accompany it; I also wanted to absorb and record as much as I could from other participants' posters. I took an in-between approach, scribbling notes and snapping pictures as often as I could manage. A group of teachers from Poland showed their students' extensive travels doing independent expeditions to places like the Sahara Desert and the Himalayas. Talking to them motivated me to look into creating a geology field trip to Iceland with my own students. Teachers from Italy and Japan were able to take their students to sites of very recent tectonic events. The evening was a priceless opportunity to network with my fellow teachers, and served as a nice visual "shopping trip" for new ideas. I only regret that it didn't last longer.

Looking through my journal of the trip, the word "inspired" stands out several times. In the US over the past decade or so, there has been a small, yet unfortunate movement of both science denial and demonisation of teachers. It was refreshing and, yes, inspiring just to be in the company of thousands of science professionals and consider myself a peer. I felt honored to hear top scientists in their field share their research with us. It motivated me to seek new conferences, and even present my own workshops. The aptly-acronymed GIFT has helped me grow a new limb, professionally; now it's up to me to discover new ways to use it.

Abigail Morton

Teacher at Woburn Memorial High School and participant in the 2013 GIFT workshop at the EGU General Assembly

More information

If you would like to get involved in GIFT, please check the EGU website for more information: http://www.egu.eu/outreach/gift/

The William Goree Award is a travel grant sponsored jointly by the 2G Enterprise company in the US and EDUGEA, a non-profit educational association in France. Selection of the awardee is made via NESTA.

Representing young scientists at EGU 2014

Sam Illingworth is the new young scientists (YS) representative for the EGU Programme Committee, the body that coordinates the General Assembly programme. He is a postdoctoral research assistant at the University of Manchester working on the retrieval of trace and greenhouse gases from airborne measurements.

At the EGU 2013 General Assembly, I attended a YS discussion forum where one of the key issues raised was the importance of having a YS representative for each of the divisions within EGU. Inspired by this call to arms, I promptly went to the Atmospheric Sciences (AS) Division meeting and suggested that we needed a YS representative. The president of the division, Oksana Tarasova, thought this was a marvellous idea and asked me if I was volunteering for the cause. I then gave a rather impromptu speech (I think I may have alluded to a past life in which I trained to be a TV presenter) explaining why I was a suitable candidate, following which I was swiftly voted in as the YS representative for the AS division!

Shortly after EGU 2013, there was another call for volunteers to put themselves forward to become the YS representative for the EGU General Assembly, and so once more I decided to throw my hat into the ring. Fast forward a couple of months and I found myself being invited to Munich to sit in on the Programme Committee meeting, in which many of the decisions regarding EGU 2014 were to be discussed and deliberated.

It is fair to say that it is a reasonably swift trajectory of fortuitousness and candidness that has gotten me this far, and that I am even more fortunate to be taking over from Jennifer Holden, who has done such a wonderful job in developing a definitive and articulate voice for young scientists at EGU. I am also extremely grateful to EGU's Communication Officer Sara Mynott (the YS contact person working year-round at the EGU Executive Office), who has been a constant source of help and inspiration.

But what is it that I actually do as the YS representative for EGU General Assembly? Well, it is my job to make sure that the young scientists (defined as people 35 years or younger, and within 7 years of their highest degree qualification) are well represented, and that they are made to feel like the integral part of the conference, which they already are: did you know that at EGU 2013 over a third of the participants were classified as young scientists?

One of the issues to come out of the EGU 2014 Programme Committee meeting was that the division presidents would love to see more young scientists propose sessions and to act as conveners at EGU 2015. The bottom-up nature of EGU, combined with the high esteem with which our young scientists are held, means that they should not feel inhibited by their relative inexperience, and remember over a third of the Assembly are in the same boat!

I will be the YS representative for the EGU General Assembly until the 2015 meeting, at which point a YS representative from one of the other divisions will take my place for a 2-year term. But before any of that can happen I must issue my own call to arms: many of the EGU divisions are still without a YS representative, and so we need people to volunteer themselves to the presidents of their divisions. By 2015 I would love to see every division with their own young scientist representative, as well as a larger percentage of YS-convened sessions.

Feel free to reach me via email (samuel.illingworth@manchester.ac.uk) or Twitter (@samillingworth) with any ideas you might have for YS activities or events at the forthcoming General Assembly. You can also contact Sara Mynott at mynott@egu.eu and on Twitter at @SaraMynott or @EuroGeosciences.

Sam Illingworth
University of Manchester & EGU Programme Committee

Snacking on climate

Early career climate scientists improve their communication skills through a new international and interactive initiative

Good communication skills are rapidly becoming a pre-requisite for any scientist beginning his or her research career. Writing, presenting, interacting and collaborating are crucial for making contacts, developing research proposals, applying for fellowships and communicating one's work. This is particularly true in a publicised field such as climate change research, where inter-disciplinarity reigns, and the ability to convey ideas to wide-ranging audiences is crucial.

But gaining these precious skills is not always straightforward for young scientists. Writing and publishing online can be daunting, so can interacting with researchers outside of one's field.

Born in January 2013 at the University of Bergen, Norway, ClimateSnack brings together postdoctoral and PhD scientists across climate change disciplines, and helps them improve the way they communicate their work in a friendly, interactive environment. In July, Imperial College London became the second institution to join what has now become a global network of hungry climate snackers. To find out more about this international, multi-disciplinary community of promising climate scientists, I chatted to three members of the London group.

BACK TO CONTENTS

"ClimateSnack is essentially designed to help early career researchers develop their writing skills and their communication skills in general," says Dr Will Ball, a postdoctoral researcher in the department of Physics and the founder of the ClimateSnack group at Imperial College London.

"At each institute that we have set up a ClimateSnack group, we physically bring together people in different areas of climate research. They will write thousand-word blogs about their work, keeping it very simple. In fact you want to keep it at the level that any other climate scientist in a different area of climate research would be able to understand. So as a solar physicist, I should be able to communicate my work to somebody working on, say, atmospheric dust."

These blog pieces are the climate 'snacks' that eventually get published online. "Then we have a centralised hub that all the institutes publish through, which is the website," Will continues. "Through that, people will be able to interact, get to know each other and give feedback on the actual writing. So they get better at writing, and also learn about the science that's going on around them. That's the concept."

Sian Williams, a PhD student in atmospheric physics looking at dust plumes and land-atmosphere interactions, runs the day-to-day climate snacking affairs in London: "We have a meeting once a month where people from different departments across Imperial College come together."

"Every time, we have a few snacks. I try to encourage people to write them and then send them out to anyone who is coming to the meeting in advance, so that people get a chance to read what has been written and give feedback."

Writing a snack can be a daunting but rewarding experience. Each author reads out his or her piece and the floor is then open to discussion. "People who have come together from different institutions say what they like about the articles [and] how they think they can be improved. Normally when you write something, be it for a journal or a website, you never really get that direct feedback, so I think it's a really great opportunity," Sian continues.

Dr Rachel White, a postdoctoral researcher in regional climate modelling, has recently published her very first snack, writing about the difficulties of simulating global rainfall patterns: "I actually found that it was easier to write than I thought it would be."

But putting pen to paper is just the first step. "Trying to check that you have really written what you wanted to write, and that people are going to understand what you meant, is the really interesting process," Rachel adds. "That's where the ClimateSnack meetings come in. Different people will have got different things from your article. You have to be quite careful so that everybody understands what you meant. That is a really interesting concept to learn and try and get you head around."

Will is now an experienced snacker. "Publishing online was nerve-racking, but I developed a better sense of confidence in what I'm doing and in my writing."

Happy snackers: Rachel White, Will Ball and Sian Williams. (Credit: M. Ferrat)

These meetings are not just useful for improving one's writing, but also for placing early career researchers in a safe, productive environment where they can hone their discussion and personal engagement skills.

"It's not just writing. At these meetings you have to communicate, debate, argue, discuss, and you get better at that. And it's in a safe environment. That's where you build the confidence and then start moving out," Will explains.

"Important, imaginative work comes out of collaborating with people who aren't in your field," Rachel adds. "Being able to discuss your research and describe it clearly to someone who is in a different field is incredibly important, at conferences, over the internet, everywhere."

For Will, these communication skills are valuable even within one's own field. "How many abstracts, how many summary papers have you read that are difficult to understand, even in your own field? [ClimateSnack] makes you more aware of the phrases and the words you use. I've noticed that in the way I write. I'm just a little bit more aware of what might confuse somebody."

ClimateSnack has grown at an incredible pace since January. "We are setting up at many other institutes in the UK, and have interest from several others in Europe and in the United States," Will tells me. "So it's going to expand very quickly in the next coming months."

The success and uniqueness of ClimateSnack lies, I think, in its open and constructive environment, and in the opportunities it creates for early career researchers to forge international collaborations with other climate scientists.

Concluding our interview, Sian adds: "There are opportunities for climate snackers to go on residential courses across Europe, which is really exciting because it's not only building skills but again building collaborations with different people. And I think the main exciting thing is more people from different universities getting involved."

ClimateSnack is supported by the Grantham Institute for Climate Change, Uni Climate, ResClim and the Bjerknes Centre for Climate Research. You can have a bite of the latest tasty snacks on the ClimateSnack.com website. If you are interested in joining the community or setting up a group at your institute, you can also get in touch with the ClimateSnack organisers. Happy snacking!

Marion Ferrat

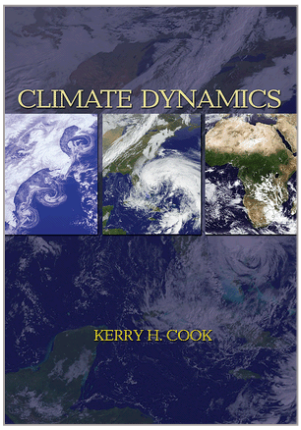
Climate scientist and science communication student at Imperial College London & EGU blogger

ARTICLES
EGU VOICE
EGU NEWS
PRESS RELEASES
JOURNAL WATCH
EXTERNAL NEWS
EDUCATION
YOUNG SCIENTISTS
BOOKS
EVENTS

BACK TO CONTENTS

Climate Dynamics

A book review



By Kerry H. Cook

PRINCETON UNIVERSITY PRESS

216 pages | Hardback
1st edition | July 2013
ISBN 978-0-69-112530-5

Price: $65 / £44.95 (~€49)

Limiting climate change and mitigating its adverse effects is certainly one of the major challenges of today and for decades to come. It will also require cooperation across many disciplines from humanities to engineering and the natural sciences. As a consequence, it is of great importance that a wide array of audiences is equipped with a basic knowledge of the climate system's fundamental processes and feedbacks. Not only will this promote a better understanding of the Earth system, but will also lead to more informed discussions about climate science and its implications for society and policy decisions.

Climate Dynamics, by Kerry H. Cook, is a short, accessible introductory textbook aimed at undergraduate students. It does not assume prior knowledge in Earth or atmospheric sciences and is thus intended for a broader audience of future engineers, scientists and policymakers. The book has a quantitative approach, which introduces the fundamental equations of the climate system and develops, for instance, a series of simple concept models for the illustration of the greenhouse effect. It is therefore recommended that readers have a basic understanding of calculus and physics. However, pages are never overloaded with equations.

This concise textbook is based on Cook's 20 plus years of experience teaching courses in climate dynamics at Cornell University and the University of Texas at Austin. While the book itself appears to be based on lecture notes, this is not necessarily a disadvantage, considering the author's expertise and the number of students the material was likely tested on. The text is precise and well written and the high-quality grayscale illustrations support the concepts and introduce students to the commonly found visualisations of the field. However, sometimes figures are accompanied by bullet-point style explanations rather than comprehensive text. The chapters are often relatively short and introduce key concepts in a clear manner, though a few more words would probably help novice climate students to make the most of their reading.

Climate Dynamics is divided into three parts: chapters 1–3 provide a description of the mean climate state and its variability on all timescales from seasonal variation to solar and orbital forcings. At the same time the reader is given an introduction to basic climate variables, their observation and typical presentation. Chapters 4–6 introduce the climate system's fundamental processes, such as radiation, thermodynamics and heat fluxes as well as the forces that make up atmospheric dynamics. The following chapters 7–9 show the reader how these processes lead to global atmospheric and oceanic circulations as main pathways for balancing the global energy budget. The final chapters 10–12 address climate change through changing atmospheric composition and atmospheric feedbacks and give a very brief introduction to climate modelling, but do not discuss the magnitude or impacts of climate change.

Climate Dynamics really shines when it devotes time and space to certain key processes such as the greenhouse effect. Over several pages a sequence of quantitative and increasingly realistic models of the atmosphere with radiation-absorbing layers are introduced, which greatly help the reader understand the principal cause and mechanism of current climate change. The same is to be said for the description of climate variability and its different timescales, a topic rarely understood in public discussion. However, due to the shortness of the text and its concise style, the book may not satisfy the curious reader who would like to get a deeper understanding of the climate system. For example, it misses a chance to point the reader to additional readings.

Overall, the book is an excellent basis for outlining an undergraduate climate dynamics course that can be taught in one term. It introduces and describes all processes and parts of the climate system that are necessary for its understanding.

Tobias Gerken
PhD student, Micrometeorology Department, University of Bayreuth, Germany (from January: Postdoctoral Researcher, Meteorology Department Pennsylvania State University, USA)

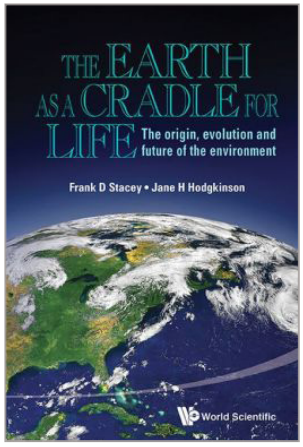
More information

A supplementary Solutions Manual, restricted to professors using the text in their courses, is available for this book: http://press.princeton.edu/titles/10041.html.

BACK TO CONTENTS

The Earth as a Cradle for Life: The Origin, Evolution and Future of the Environment

A book review



By Frank D. Stacey and Jane H. Hodgkinson

WORLD SCIENTIFIC

308 pages | Hardcover
1st edition | July 2013
ISBN 978-981-4508-32-2

Price: £46 (~€55)

The subject matter of this book will be very familiar – perhaps depressingly so – to most readers. It documents the intricate and, at times, highly fortuitous series of events that lead to making the Earth into a cradle for life, as the authors describe it. It then documents the effect that man has had in interfering with this finely balanced and inconceivably complex system, and its catastrophic outcomes: namely, a rapid and most likely irreversible warming of the Earth's atmosphere, ocean acidification and rapid ecosystem destruction.

There are many books that cover this precise subject, yet this volume can still be considered highly original. Much of this relates to the tone of the text. The authors adopt a far more conversational language than that found in other similar books, closer in style to Kant than to a textbook. Indeed, from the opening preface to the conclusions at the end, the book reads more like a grand thesis, with arguments built up point by point, with evidence and explanations given to support each statement. This is not to say that the grand conclusions are particularly unusual: though an Edmund Halley quote in the preface alludes to a "new and so bold a supposition", the authors' interpretations of the evidence are broadly similar to those of the recent report by the Intergovernamental Panel on Climate Change. The sense of seeking to convince the reader, however, lends the book a clear, decisive and ultimately highly readable tone.

The grand theme at the centre of the book is that man can be viewed as a product of his environment, and consequently, as the Earth has grown, we have evolved in tandem with it. It is laid out chronologically, with the genesis of the Earth as a planet in the first part, Earth processes and cycles in the second part, and human influences in the final section. Each part has five major chapters, and the book concludes with some thoughts by the authors, a concise summary and a subject index.

The Earth as a Cradle for Life benefits from being highly subdivided, with each section being only two or three paragraphs long. This compartmentalised style makes the book very easy to skim through and quickly understand the basics of its particular subject. It is even possible to understand the rationale by reading the subject headings. It also affords the book an incredibly large breadth of subject matter for such a short volume. The downside to this style, however, is that some subjects are not dealt with in as much depth as perhaps is necessary, and others are just mentioned in passing. In fact, there are some important topics whose absence almost seems like something of an oversight. In particular, I was surprised at the lack of a section about ocean circulation, which underpins the climate and governs the cycling of nutrients.

The book is punctuated with frequent and well-chosen figures. Though the diagrams themselves are well designed, the quality is surprisingly poor. Often the scale is unnecessarily stretched, or too small, but in general, the resolution is so poor that the text can be difficult to read. This makes them often difficult to interpret and certainly unsuitable for reproduction.

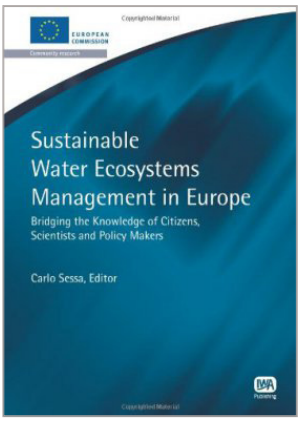
There will be few readers who are not at least moderately familiar with many of the concepts covered in this book, yet this volume offers a fresh take on the science, and contains material which is certain to be new to many. This book straddles the line between a textbook and a general-interest volume quite comfortably, making it suitable for anyone with a basic understanding of science that wants to place modern climate change in the context of the Earth's history.

Oliver Knevitt
PhD student, University of Leicester, UK

BACK TO CONTENTS

Sustainable Water Ecosystems Management in Europe: Bridging the Knowledge of Citizens, Scientists and Policy Makers

A book review



Edited by Carlo Sessa

IWA PUBLISHING

148 pages | Paperback
1st edition | August 2012
ISBN 978-178-0401-14-0

Price: €114.75 (IWA members price: €86.06)

Coastal areas provide a multitude of services: they house wildlife, offer recreation opportunities for humans and have economic value for the fishery sector. Furthermore, they accommodate a high share of people living in the European Union (EU): about 200 million individuals, or 44% of the population of EU member states with a sea border. The high number of people living in these areas puts pressure on the coastal ecosystems, which are prone to pollution, overexploitation and degradation. The EU wants to halt the deterioration of these ecosystems and has drawn up a policy framework to regulate the quality of coastal waters with sustainable management. To find a broad support for the regulations, the European AWARE Project was set up to realise sustainable management of water ecosystems by connecting research, people and policymakers in Europe.

Sustainable Water Ecosystems Management in Europe: Bridging the Knowledge of Citizens, Scientists and Policy Makers, edited by AWARE Project Coordinator Carlo Sessa, illustrates how the different stakeholders can be engaged in the sustainable management of water ecosystems. The book's title mentions the bridge between scientists, policymakers and citizens, but the emphasis throughout the volume is clearly on engaging the public. Readers will learn little about the coastal areas or their deterioration; rather, the book focuses on reporting on the AWARE project and providing a guide for bringing scientists, policymakers and the public together for ecosystem management. The key concept of the book is "integrated adaptive ecosystem management" – a complex notion that is translated into practical guidelines and illustrated by clear case studies throughout the paperback's 10 short chapters.

The book takes off with a foreword by Carlo Sessa and researcher Francesca Somma that highlights the relevance of the topic that is dealt with in the chapters that follow: public engagement in the research-policy cascade. They advocate real engagement, rather than idle talk. People should get easily accessible information to make an informed decision on their involvement. Only then, can they really agree to produce valuable ideas for the management of ecosystems.

Different chapters in the first part of the book deal with the AWARE project, its rationale, concepts and foundations. Together with a presentation of the institutional and policy framework for coastal waters at the EU level, this is rather dry but necessary basic information. More lively and hands-on are the chapters on the experience of the panel of 30 citizens who participated in case studies of the AWARE project (in Gulf of Riga in Latvia and Estonia, in the Southern North Sea in Belgium and France, and in Sacca di Goro in Italy). These chapters report very specifically on how citizens actively participated in decision-making processes for coastal area management. For readers who were unsatisfied with the given scientific information on coastal areas up to here, the case-study chapters provide facts and figures on nutrient cycling, river flow, geographical and chemical details of the coastal areas. Continuing with the philosophy of involving citizens in water ecosystems management, the book features the participants' own conclusions of the project in the form of the AWARE Citizens' Declaration in the appendix.

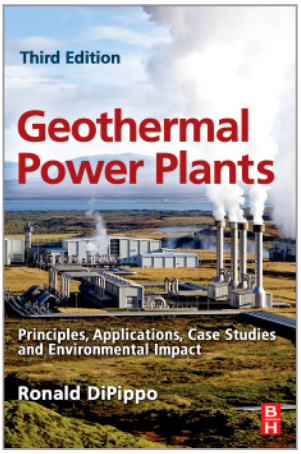
The book concludes with a practical guide for 'knowledge brokerage', the processes that contribute to improving the science-citizen-policy interface. The last chapter contains concrete tips to bridge people, scientists and policymakers in the water sector and beyond, so that the experiences gained in the field of water ecosystems can be translated to other projects.

This book is not an easy-to-read volume with visually attractive illustrations that you want to have on your bookshelf. But it is a practical guide if you are aiming at closing the gap that exists between scientists, policymakers and the broad public.

Eline Vanuytrecht
Post-doctoral researcher at the Department of Earth & Environmental Sciences, KU Leuven (Belgium) and freelance science writer

Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact

A book review



By Ronald DiPippo

BUTTERWORTH-HEINEMANN (ELSEVIER)

624 pages | Hardcover
3rd edition | May 2012
ISBN 978-008-0982-06-9

Price: €92.95

Geothermal Power Plants is a highly detailed book that seeks to provide an explanation to both the underlying principles and the technical challenges of power generation from geothermal resources. Although it states it is intended for students, researchers, engineers and designers, it is heavily weighted towards the energy industry and practical applications, and does require significant background knowledge, particularly of the geophysical concepts involved in reservoir geology, and classical mechanics.

The book has been written by Ronald DiPippo, Chancellor Professor Emeritus of Mechanical Engineering at the University of Massachusetts and geothermal expert. His research into thermodynamics of high-temperature and pressure gases, his work as a geothermal consultant in nine different countries and his experience in mechanical engineering in both the public and private sectors make him the ideal author for a book of this nature.

The first chapter aims to familiarise the reader with the geology of geothermal zones, and it does this very well. The pace of the author's writing in this first part of the book is steady, making this chapter a pleasure to read. The links between fracking and geothermal energy, and between different types of geothermal energy and their environmental impact, are concisely discussed and are later expanded on in the final chapter.

In chapter two, the author explains the viability of any particular site as a geothermal resource and illustrates the various factors site viability is dependedn on by using bullet-pointed lists. This information could prove very useful to potential investors in the industry who desire to know the complexity behind a project's viability and the procedures that apply to the exploratory stage.

However, the knowledge level jumps dramatically once geochemical and geophysical techniques enter the picture, and again in chapter four, where reservoir geology is discussed. To aid understanding, the author provides extensive references and the appendices contain more information.

If you are unfamiliar with the general layout and operation of a power plant, chapter three provides a decent, easily readable description, but the book becomes quite a heavy onslaught of information from chapter five onwards. Given time, due to the amount of detail the book possesses, there is much information to be obtained here, however the task of doing so can be quite daunting. Once you start to see the structure of the book it becomes easier to digest, but this only became apparent to me on the second read-through.

Chapters 5–10 form Part Two of the volume, which details the different types of geothermal power plant possible. Chapter 11 onward forms Part Three, which is composed of case studies from various geothermal power plants across the world. I found that supplementing the power plant types with real examples to be very useful, and also enlightening, as there were many I did not know of (such as Turkey, which has three of the most highly efficient units in the world, and Russia's Kamchatka peninsula).

In all, this is a valuable book that could benefit from either becoming more accessible to the intended audience or from changing its focus to a purely engineering audience. I can see this book being very useful indeed for those actively working in the geothermal energy sector.

Holly Ferrie
Geosciences student, Department of Environment, Earth and Ecosystems, Open University, UK

This section advertises conferences, summer schools and workshops submitted to the EGU online meetings calendar. Meetings co-sponsored by the Union are highlighted with an EGU logo.

Towards a more Accurate Quantification of Human–Environment Interactions in the Past

03–07 February 2014, Leuven, Belgium

Since the introduction of agriculture, humans have profoundly impacted natural environments through land cover change. However, the extent to which humans have impacted the environment at regional to global scales prior to the modern era is still under debate. The aim of this workshop is to provide a forum where scientists from both environmental sciences and humanities can meet and share their data and ideas on how to quantify past human-environment interactions.

Website: http://ees.kuleuven.be/pages/index.html

The Changing Arctic and Subarctic Environment: Proxy- and Model Based Reconstructions

04–06 February 2014, Bordeaux, France

A research and training programme on marine biotic indicators of recent climate changes in the high latitudes of the North Atlantic. The meeting will deal with the following themes: developing paleoceanographic proxies: qualitative versus quantitative reconstructions; interglacial paleoceanography from the northern North Atlantic and Arctic Ocean; ocean-continent linkages during interglacial periods and the past 2000 years.

Website: http://caseitn.epoc.u-bordeaux1.fr/

German Geophysical Society, 74th Annual Meeting

10–13 March 2014, Karlsruhe, Germany

The annual meetings of the DGG (German Geophysical Society) attract seniors and students from all fields of geophysical research and application. Apart from talks, posters and discussions there is a lot of room for scientific and social exchange. The meeting's exhibition also offers a wide spectra of exhibitors from academia and industry.

Website: http://www.dgg-2014.de/

9th EGU Alexander von Humboldt International Conference on High Impact Natural Hazards Related to the Euro–Mediterranean Region

24–28 March 2014, Istanbul, Turkey

The aim of this conference is to open a forum on natural hazard events that are characterised by high impact and large destructive potential, particularly related to the Euro–Mediterranean Region including Turkey (e.g., Marmara Region).

Website: http://www.avh9.net/

AOGS 11th Annual Meeting

28 July – 01 August 2014, Sapporo, Japan

The Asia Oceania Geosciences Society (AOGS) annual conference and exhibition is the society's major activity. It aims to promote geosciences and its application for the benefit of humanity not only to the Asia Oceania region, but also all over the world.

Website: http://www.asiaoceania.org/aogs2014
Abstracts deadline: 11 February 2014