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GEOQ

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THE EUROPEAN GEOSCIENCES UNION

ISSUE 9, MARCH 2014

THE FACE OF THE EARTH

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THE FACE OF THE EARTH – PROCESS AND FORM

EGU President Günter Blöschl and EGU Programme Committee Chair Gert-Jan Reichart introduce this year's themed General Assembly.

For the first time in 2014, the EGU General Assembly will have a theme: The Face of the Earth – Process and Form.

Why a theme?

The theme intends to enhance coherence between disciplines and provide conference participants with a stronger community feeling. It also reflects the fact that the most thrilling research questions are becoming more interdisciplinary, and we hope it will facilitate the exchange of ideas across EGU disciplines. Why not dip your toes into something different at this year's Assembly? Take this opportunity to take a peek at sessions outside your area of research and get an idea of what other disciplines within the geosciences are all about!

In addition to making the General Assembly even more attractive to participants, we also hope the theme will make the conference more visible to the wider public: a theme allows us to better communicate what the conference is about to those less familiar with it. We are also enhancing the visibility of the EGU and the geosciences to school children – the future of science – by encouraging educational visits to the conference centre.

What does the theme refer to?

Our planet exhibits intricate shapes and patterns. We are interested in the processes and forms spanning our planet, from the core of the Earth to interplanetary space, at various space and time scales. Patterns are formed by processes in the dynamic Earth system, and they change with time: they continuously create, modify and destroy specific forms while, at the same time, individual forms and larger patterns constrain how processes operate. Process, form and the complex inter-relationships between them are basic to the understanding of the origin and development of the Earth and space.

Like a human face, the Earth's processes and forms present a wide variety of features. The theme intends to celebrate the diversity of geoscience processes and the great variety of associated forms
It spans all spheres of the geosciences: from the shapes of crystals and minerals to those drawn by aurora in the sky, to mountain formation and swirling waves, patterns of motion in the Earth's atmosphere, and foraminiferal tests, to mention just a few.

This diversity is reflected in the five subtopics: Rocks of the Earth (how tectonics shape the Earth's surface, for example), Waters of the Earth (including the interplay of oceanic flow patterns and the atmosphere), Life of the Earth (such as the role of microbes on shaping geo-biosphere patterns at a range of scales), the Atmosphere of the Earth (how aerosols affect the climate patterns, for example) and Space and the Earth (including the comparison of patterns on the surface of other planets with those on Earth).

What will be different this year?

General Assembly participants will notice a few changes around the conference centre. There will be a display of different 'spheres', highlighting the face of the Earth diversity and representing each of the subtopics, and a few other surprises. With regards to sessions, there will be Keynote Lectures on Rocks, Waters, Life, Atmosphere and Space on each of the five days of the conference, and a Union Symposium on The Face of the Earth. All changes and theme-specific activities will be advertised through a flyer distributed to conference participants.

The theme does not constrain the topics being presented at the Assembly. Rather, we hope it will add to the conference experience. We look forward to welcoming you in Vienna!

Günter Blöschl and Gert-Jan Reichart
EGU President and EGU 2014 Programme Committee Chair, respectively

EDITORIAL

Following from this year's idea of having a themed General Assembly, this issue of the EGU newsletter is dedicated to The Face of the Earth. If you have not yet read the letter from the EGU 2014 Programme Committee Chair Gert-Jan Reichart and the EGU President Günter Blöschl on the previous page, make sure you do to find out all about this theme and what will be different at this year's General Assembly.

In this issue of GeoQ, inspired by the five sub-topics at the Assembly, we publish five articles about exciting research focusing on Waters of the Earth, Life of the Earth, Atmosphere of the Earth, Rocks of the Earth and Space and the Earth. Sara Mynott writes about how the seas stimulate rainfall, Laura Soul covers evolution, extinction and the fossil record, and Michelle Cain briefs us about the face of the atmosphere. Moving on to the Rocks of the Earth, Becky Summers' article deals with research on how cold climate affects mountain erosion, while Jane Robb's piece on Space and the Earth provides a glimpse of Mars' early history.

The Young Scientists and Education sections also focus on this year's General Assembly. The former provides information about activities for young scientists, from workshops and lunchtime sessions to short courses (and even a video competition), at the meeting. The Education section naturally focuses on the Geosciences Information For Teachers (GIFT) workshop, which takes place during the first few days of the General Assembly. This year's GIFT is on a very timely topic, Our Changing Planet, and it will explore some of the recent complex changes of the Earth's environment, focusing on climate in particular.

And make sure not to miss the other sections of the newsletter either! As always, keep up-to-date with activities from the EGU and its divisions in EGU News and EGU Voice, and read about the latest research published in EGU journals in the Press Releases and Journal Watch sections. External News features an engaging article about EuroGeoSurveys, the association of the European Geological Surveys, and its policy work.

For the first time, a few printed copies of GeoQ will be distributed at the General Assembly. If you had not yet heard of the EGU quarterly newsletter and are picking up one of these copies, I hope you enjoy reading this issue of GeoQ and continue to read our magazine and information service in the future! Each new edition of GeoQ is distributed for free to EGU members in the form of an interactive PDF file (hence all the links), and is made available from the EGU website every three months.

Happy reading!

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: Eve Arnold, Friedrich Barnikel, Günter Blöschl, Thomas Blunier, Michelle Cain, Francesca Cifelli, Kasra Hosseini, Christopher Juhlin, Carlo Laj, Bruno Merz, Sara Mynott, Gert-Jan Reichart, Jane Robb, Laura Soul, Becky Summers, Oksana Tarasova, and the 2013 Modern Geo-Ecosystems class at VU University Amsterdam
DESIGN: André Roquette

COVER PHOTO: The Face of the Earth, detail from logo available on the EGU 2014 General Assembly website

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How the seas stimulate rainfall

Waters of the Earth

The ocean and the atmosphere have a long-lasting relationship. At the global scale, winds give the water its momentum and affect its buoyancy. The waters of the Earth are constantly trading heat and moisture with the atmosphere, and these exchanges have a big impact on where and when rainfall occurs around the world. Recent investigations have revealed just how big this impact is.

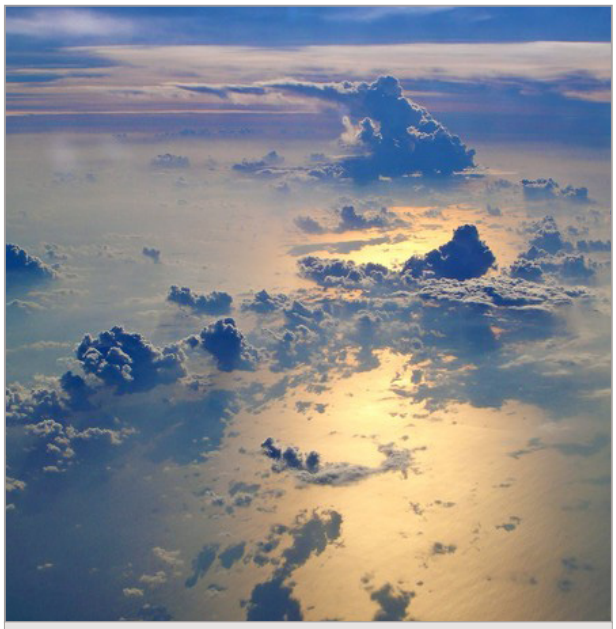
Snatching heat from the Southern Hemisphere

North and south of the equator, the same basic circulation systems are shifting air around the planet, but there are huge differences in tropical weather and climate either side of this line. To the north, it is much wetter and many countries are affected by heavy rains, particularly when the monsoon comes into season. In the past, this difference in rainfall between the Northern and Southern Hemispheres has been attributed to the amount of land vs. the amount of water either side of the equator, but there are other forces at work.

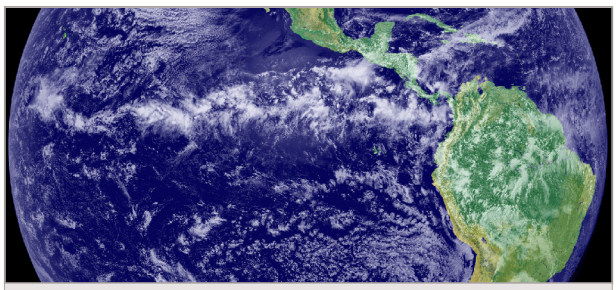
The region where the mass of rainfall forms is the Inter-Tropical Convergence Zone (ITCZ), and its position shifts with the seasons. The ITCZ snakes across the Northern Hemisphere between May and July, forming the hemisphere's wet season. The rain band shifts to the south for the southern wet season from November to February, but throughout the year there's still more rain in the north. Why?

Within the oceans, heat is redistributed via the thermohaline conveyor belt. In the Atlantic, for example, warm surface water flows north, cools, sinks and returns south at depth. This cold, deep water upwells in the Southern Ocean and warms as it flows towards the equator, where the process begins again. A recent study, led by Dargan Frierson, from the University of Washington, has revealed that this circulation system is responsible for shifting the ITCZ further north.

Frierson found that the flux of energy from the ocean to the atmosphere in the north is far higher than its southern equivalent at almost every latitude beyond 20°. The water cycle is more vigorous when there's more energy in the system, so more heat means more rainfall. But because the Southern Hemisphere receives slightly more radiation from the Sun over the course of a year than its northern counterpart, this couldn't explain why there was more heat being exchanged in the north. There had to be some mechanism taking the heat from the south and setting it free in the Northern Hemisphere – ocean circulation. Using a model of a world without continents, Frierson found that small gradients in surface heat flux from the ocean were enough to cause the ITCZ to be displaced northward, dispelling the idea that geography was the cause of the rain band's position.



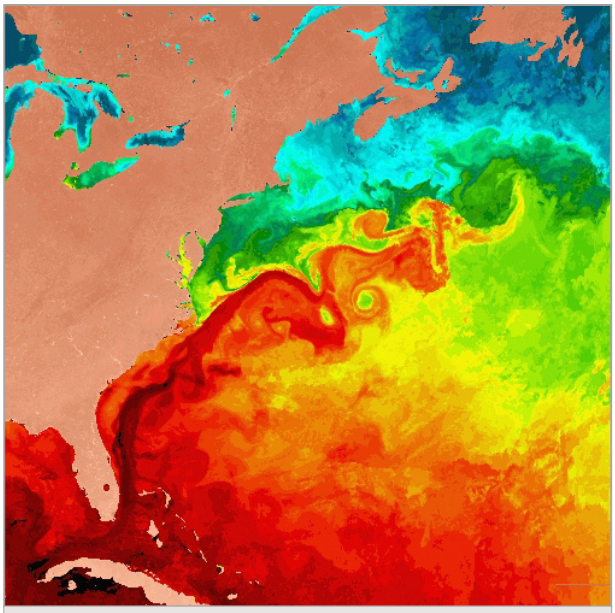
The amount of moisture the atmosphere picks up over the ocean is strongly influenced by sea surface temperature. Generally, the warmer it is, the more moisture the air picks up from the ocean. This leads to greater cloud cover and an increase in rainfall. (Credit: Jorge Magalhães, distributed via imaggeo.egu.eu)



The Inter-Tropical Convergence Zone (ITCZ) is the region where trade winds from the Northern and Southern Hemispheres converge and create a low pressure area characterised by high rainfall. The location of the ITCZ varies over the course of a year and with extreme weather events, but generally lies just north of the equator. (Credit: NASA Earth Observatory/GOES Project Science Office)

The eddy effect

While it is well-known how the oceans and atmosphere interact at the global scale, what happens at the mesoscale has remained more of a mystery – especially just outside the tropics. Circular currents spanning some 10–100 kilometres in diameter are found all over the ocean. These circling masses are known as mesoscale eddies, and have an effect on the Earth's winds, clouds and rainfall.



Eddies bud off large ocean currents, like the Gulf Stream, bringing packages of cold water into warmer regions and pockets of warmer water into colder regions. These 10–100 km across masses of water have a big impact on local wind and rainfall patterns. The colour is indicative of relative water temperature. (Credit: National Science Foundation/NOAA)

An eddy can be a package of warm water in an otherwise cold ocean, or a pocket of cold in the warm, and they affect the atmosphere differently, depending on their temperature.

The effect of an eddy on atmospheric circulation has, until now, been rather overlooked, as they were initially thought to be too small to have a significant impact. A group of Swiss scientists set out to solve the mystery of how eddies effect the atmosphere by looking at some 600,000 eddies in the Southern Ocean. Using satellite data, they tracked both eddies and the properties of the surrounding atmosphere, taking into account temperature, cloud cover, wind and rainfall. They found the warmer eddies in the Southern Ocean were typically 0.5°C warmer than their surroundings and the cold ones were 0.5°C colder than the water beyond. Throughout the Southern Ocean, these temperature anomalies correspond to changes in cloud cover and water content, as well as the frequency and probability of rainfall. The reason? They alter the flux of heat between the ocean and the atmosphere.

In the atmosphere, low pressure systems are the ones that generate rainfall. As these systems pass cold-core eddies, which have less heat to release, the cloud cover drops, moisture declines and rainfall reduces by 2-6%. The converse is true for warm-core eddies, which stimulate rainfall in their local vicinity.

As well as providing the fuel for rain-filled clouds, the oceans shape where rain forms and falls around the planet. The heat energy heist undertaken by the Northern Hemisphere as it harvests energy from the south drives the differences in rainfall either side of the equator. And an eddy in the ocean is all that's needed to create a small, but significant, change in the amount of rainfall close to the water mass. Combined, these studies highlight just how wonderfully connected the waters of the Earth are.

Sara Mynott
EGU Communications Officer

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Evolution, extinction and the fossil record

Life of the Earth

Recent research suggests that the Earth is entering a biodiversity crisis and we may be on the brink of our planet's sixth mass extinction. Under these circumstances, an understanding of macroevolutionary patterns in diversification and extinction will be vital to guide conservation strategies. In a recent analysis, Barnosky and colleagues from the University of California showed current extinction rates are highly elevated when compared to background rates in the geological past. If extinctions continue at this pace, we could be seeing an event that qualifies as the Earth's sixth mass extinction (defined by a loss of at least 75% of species) in as little as 300 years from now. Fortunately, the team also discovered that it may not be too late to slow down extinction rates and avoid a catastrophic event. So far we have only lost a few percent of species, and we may be able to reduce extinction rates by targeting conservation where it is most needed, or will be most effective.

Uncertainty remains in these estimates, though. To get a clear picture of which conservation approaches could avoid a mass extinction, it is important to address this uncertainty. A huge amount of information is available on present day extinction patterns and risk factors, but this is only a snapshot of the 3.5 billion years that life has existed on Earth. To map out and truly understand macroevolutionary processes that could help us today, we have to use data from fossils, and the researchers emphasise that integration of palaeontological and present day data will be crucial. Previously, the differences between these types of data have often made it difficult

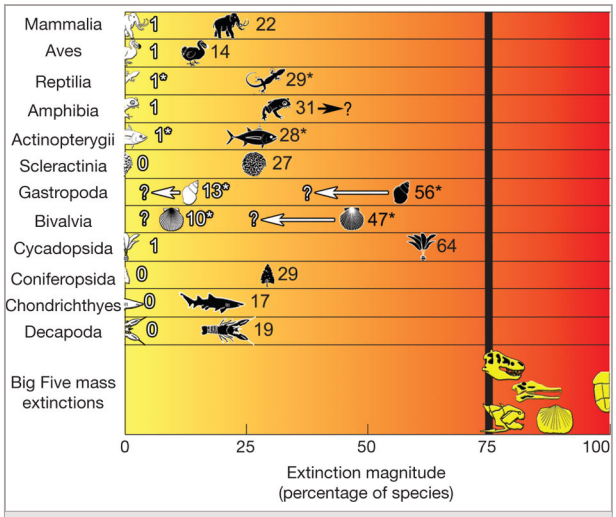
to use both of them in combination. However, advances in methods used to analyse the fossil record, and an increase in data available from ongoing collection efforts, have led to interesting insights into the interrelated factors that have shaped the diversity of life on Earth as we see it today.

In their paper, Barnosky's team outline the key complications in merging fossil and recent data, the most apparent of which is timescale. Modern data goes back a few hundred years at the most, whereas fossil data are recorded on geological timescales, and the majority of past mass extinction events are estimated to have occurred over millions of years. The apparent rate of extinction varies with the time period over which it is measured, so this is a particularly important problem to solve.

Other difficulties include the sparsity of fossil data: estimated sampling rates are around 70% for the very best preserved fossil groups, but are generally more like 10% at the most. Out of the species that we have discovered, many are in fact only known from a single specimen (and sometimes a single tooth!). Some ancient groups had high preservation potential – such as marine gastropods and bivalves – but, unfortunately, these groups have received far less research attention in the present day than larger and more easily accessible groups like birds and mammals.

Fortunately there is some hope for improving the basis for comparison, in the form of phylogenies. A phylogeny is a hypothesis of the evolutionary relationships between species, represented as an evolutionary 'tree' with branches scaled either to the time the species lived for, or the amount of evolutionary change along a branch. In a 2008 review focussing on understanding patterns in extinction, Andy Purvis summarised the progress that has been made in uncovering rates of speciation and extinction using phylogeny as a framework. He also showed how extinction patterns relate to phylogenetic relationships between species (i.e. do close relatives go extinct at the same time?), in different scenarios. Phylogeny can be used to test whether factors like the geographic range of a species or a particular physical trait correlate with extinction proneness. This is often done in present day analyses, but less so for the geological past. He finished by calling for more work in improving methods to model combined data sets in a phylogenetic framework.

In a review published last year, Graham Slater and Luke Harmon summarise innovative new methods based upon phylogeny that are being employed to help tackle some of these data comparison and modelling problems. One such method can be used to stochastically scale evolutionary trees of fossil taxa to time, and will allow palaeobiologists to more accurately estimate the timescales of evolutionary change and extinction in the fossil record. This, in turn, will enable them to make valid comparisons with the rate of events in the present day. In addition, Slater and Harmon point to several new methods that will allow researchers to develop and analyse phylogenies that include similar numbers of extinct and living species, and to more accurately model phenotypic change using fossil and living data in tandem. Further data collection by conservation biologists on the modern day groups that have the most well researched fossil records will also improve results.



Extinction magnitudes in the geological past and the present day. Numbers next to each icon indicate the percentage of species extinct. White icons indicate species 'extinct' and 'extinct in the wild' over the past 500 years. Black icons add currently 'threatened' species to those already 'extinct' or 'extinct in the wild'. Yellow icons indicate the big five mass extinctions, with a black line at the 75% benchmark for comparison. (Reprinted by permission from Macmillan Publishers Ltd: Nature, Barnosky et al., 2011)

These new methods can be used to untangle the relative importance of factors such as body size, population size and ecological specialism, so that we can begin to identify the species most at risk of extinction, and those whose survival will be most effective for maintaining biodiversity. To move forward from these advances we must incorporate them into the effort to standardise different types of data, and into developing predictive models of how different risk factors interact.

A final and particularly interesting idea to come out of Barnosky's research is that of the 'perfect storm'. Past mass extinctions often seem to have occurred during synergies of unusual events. The Earth's current changing climate dynamics, in combination with new ecological stressors like habitat fragmentation, pollution, overfishing and invasive species, may represent such a synergy. The fossil record could act as an ideal natural laboratory to formulate, model and test this hypothesis. Although the Earth has recovered from catastrophic extinction events in the past, it has never before supported 7 billion humans, and modelling macroevolutionary patterns in order to help mitigate against escalating extinction threats may be key in determining our own future as a species.

Laura Soul
Postgraduate Student at the Department of Earth Sciences, University of Oxford

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How the Earth's atmosphere shows its face

Atmosphere of the Earth

Looking from outer space, the Earth's atmosphere appears as an encapsulating fluid that flows in patterns caused by the rotation of the planet and the heating from the Sun. Up close, however, the atmosphere shows its face in much more detail, helping researchers understand the complex interactions in the Earth system.

Temperature of the atmosphere

The temperature of the Earth is much like the temperature of a person: it is a symptom of everything else that is going on in that person's body. It may seem like a basic property of the atmosphere, but it is a product of many other aspects of the Earth system, including land and oceans.

Recently, there has been much discussion of the so-called 'temperature hiatus', the weakening of the trend in global mean surface air temperature since the late 1990s. Observations, such as those from the HadCRUT4 dataset, appear to show temperatures in the past decade rising more slowly than in the preceding two decades (see figure below).

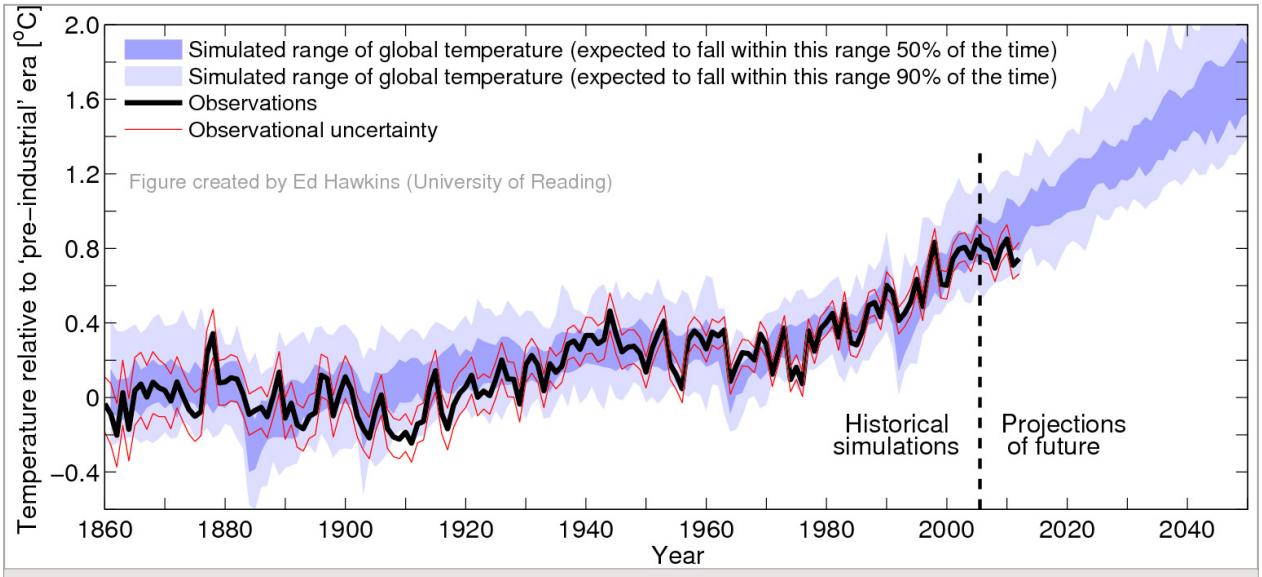
The HadCRUT4 dataset is a combination of ground-station and sea surface temperature measurements, which represent about 85% of Earth's surface. Recent analysis by Cowtan and Way has tested whether this data contains a bias due to incomplete coverage of the globe, and they conclude that it has led to an underestimate of recent global warming. The authors point out that satellite data, models and isolated weather station data show that regions not covered by the dataset, especially the Arctic, have warmed faster than other parts of the world. Accounting for this gives a trend two and a half times greater than that from HadCRUT4, for temperature since 1997.

So even establishing the magnitude of the temperature hiatus is an ongoing area of research. The range of different studies investigating the causes of it is indicative of just how many different factors affect the air temperature.

Work by Estrada, Perron and Martínez-López explores global temperature data sets and radiative forcing variables (greenhouse gases in the atmosphere, natural changes in composition and land use, and solar irradiance) using statistical techniques. Their method interrogates the data without the use of models, and the authors conclude that the temperature record and the radiative forcing (which describes whether the Earth system has a net warming or cooling) can be described by linear trends punctuated by breaks. In this picture, the hiatus is simply a period with a different trend following a break. But what caused this break to occur?

The results suggest that the predominant cause was an unintended consequence of the 1987 Montreal Protocol, the international treaty to stop the destruction of stratospheric ozone by chlorofluorocarbons (CFCs). CFCs are also greenhouse gases, so reducing them to protect the ozone layer also led to a relative cooling of the atmosphere. Pretis and Allen tested this finding in an energy balance model and found that global mean temperatures are 0.1°C cooler because of the Montreal Protocol.

Estrada and colleagues also attributed a cooling from the reduction in the methane growth rate in recent years. Methane is a potent but short-lived (about a decade) greenhouse gas, with major natural and anthropogenic sources. The amount of methane in the atmosphere had been growing in the latter half of the 20th century, until it levelled off in the period around 2000 to 2006. The cause of this stagnation is in itself an active research area, with changes



This graph of average global temperatures is generated using 42 different climate simulators, assuming 'medium' (Representative Concentration Pathway: RCP4.5) future emissions of greenhouse gases, and compares their projections to observations from the HadCRUT4 dataset. A common reference period of 1961–1990 is used, but the temperatures are presented relative to the 'pre-industrial' era. (Image and caption: Ed Hawkins, Climate Lab Book)

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The dome of the Jungfraujoch atmospheric observatory in Switzerland is seen in the distance in this photo. (Credit: Michelle Cain)

to agricultural practices, variability of wetlands, and changing fossil fuel emissions being likely factors.

Others have looked to the oceans to find a cause for the temperature hiatus. Modelling work by Kosaka and Xie shows that it can also be explained by recent La Niña events. La Niña events are characterised by cooler tropical Pacific sea surface temperatures and cooler surface air temperatures. By putting observed tropical Pacific sea surface temperatures in to an atmospheric model (which also contained the observed greenhouse gas concentrations), the authors were able to reproduce the hiatus.

This is not necessarily in contradiction to the Estrada study, as Kosaka and Xie do not specify what is causing the sea surface temperatures to be La Niña-like – the cause could be linked to greenhouse gas warming. A trend towards more La Niña-like conditions since 1950, coinciding with increases in global mean surface temperature, has been identified by L'Heureux et al..

These studies illustrate some of the complex interactions between atmospheric temperature, composition and climate. If temperature is the symptom, then we have seen that the make-up of the atmosphere is one of the many causes. To complicate things further, the symptom can also feed back into the cause. For example, wetland emissions of methane depend on temperature, so a warming Arctic may cause increased methane emissions and therefore even more warming.

Composition of the atmosphere

We are finding ever more sophisticated ways of measuring the atmosphere's composition: continuous ground-station measurements, sensors attached to weather balloons, aircraft- and ship-based instruments, drones, and satellites are all used to analyse the components of the atmosphere. This array of measurements at different scales is used in combination with models to paint the clearest picture of the atmosphere possible, within current understanding.

The MACC (Monitoring Atmospheric Composition and Climate) project has done just this, by assimilating satellite data into a global model of the atmosphere to produce an 8-year data set of atmospheric composition. The data for carbon monoxide, ozone, nitrogen dioxide and formaldehyde are evaluated against independent satellite, weather balloon, ground station and aircraft observations in Inness et al., which goes on to highlight where the discrepancies lie and also indicates the direction for future work. With so much varied data to consider, this kind of large modelling study is a good way of bringing together the current knowledge of atmospheric composition.

These are just a few facets of the atmosphere, with weather patterns, climate modes, aerosol, boundary layer flows, and interactions with the surface being some of the other parts of the atmospheric system that we take interest in studying in just as much depth. It is thanks to the multitude of ways of observing and describing this encapsulating fluid we have today, that we get the atmosphere to show its face.

Michelle Cain
Postdoctoral Research Associate, Department of Chemistry, University of Cambridge

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Shrinking mountains

Rocks of the Earth

A cool climate may be to blame for eroding some of the world's highest summits in the past.

The silent peaks of the Himalayan mountain range pierce the cloudy Asian sky. You could be fooled into thinking this is a peaceful place, but mountains are endless construction sites. Continental plates collide and force the Earth's crust upwards while, at the same time, erosion counteracts this process by slowly weathering the planet's surface. Rivers, glaciers and landslides scour through the bedrock and move sediment back down to lower ground.

What exactly the forces at play in mountain building and destruction are is controversial. Scientists on one side argue the main influence on high altitude erosion is tectonics, which is constantly heaving sediment to the surface. Others, such as Peter Molnar and Philip England, suggested that climate is a bigger factor in the long term, wearing away mountain peaks.

Now a new study by Frédéric Herman of the University of Lausanne, Switzerland, and collaborators shows for the first time that erosion rates can speed up when the global temperature drops. "This study gives a unique contribution to one of the most intriguing debates in Earth Sciences today," says Vivi Pedersen at the Department of Earth Science, University of Bergen, who was not involved in the study.

Swings and roundabouts

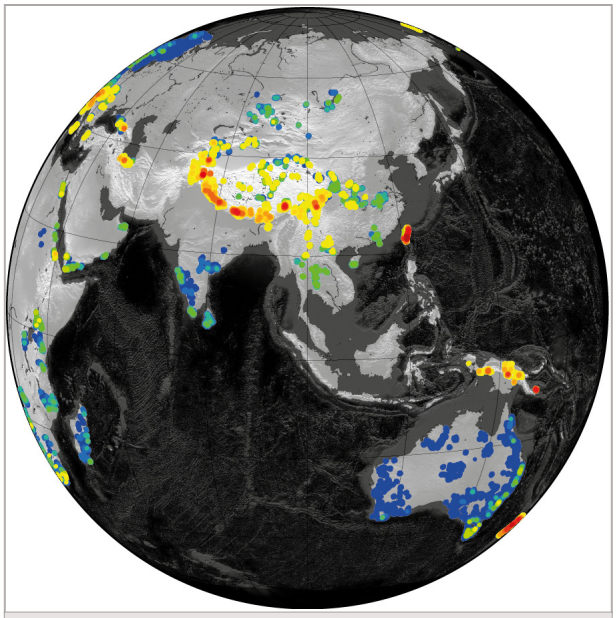
The Earth's climate naturally fluctuates between warm and cold periods. A strong cooling trend began six million years ago and, using sediment records, scientists observed a rapid increase in erosion rates around that time. In particular, since the onset of the Quaternary period some 2.5 million years ago, erosion increased dramatically by at least a factor of two.

But, until now, no-one was able to show why exactly that happened. Sudden changes have often been put down to capricious tectonic movements, but high rates of erosion followed a pattern that suggested something else. At latitudes between 30° and 50°, where glaciers and large ice sheets would have iced the continents, erosion increased significantly. This led scientists to consider the role of climate, and, particularly, the role of glaciers in mountain building and destruction.

Hot rocks

Herman and his team used the thermal ages of rocks – a technique known as thermochronology – to determine past changes in erosion rates. As rocks move away from the heat of the Earth's core, the minerals begin to cool and change. The scientists used the natural abundance of a mineral's radioactive isotope and its decay products to find how fast the rock moved towards the surface and, therefore, its age. The closure temperature – when the mineral has cooled enough to stop isotopes diffusing out of the rock – is used as the starting point. A cooling history can be found by dating two minerals (apatite and zircon) with different closure temperatures in the same rock. Age is then converted into erosion rates using a thermal model.

The glaciers of southern Tibet carve valleys in the Himalayan mountain range. (Credit: Amos Aikman)



Erosion rates between 2 Myr ago and 0 Myr ago, as determined by Herman et al. (2013). The colours represent varying degrees of erosion rate, from about 0.01 mm/yr (blue) to 7 mm/yr (red). Along mountain ranges such as Himalayas and the New Zealand Southern Alps the rates of erosion during this time period were up to four times higher than 6–4 Myr ago. (Credit: Frédéric Herman)

Map the world

The ages were then matched together in a global set. Global patterns of erosion emerged in separate plate-tectonic regions. "We found [that] erosion rates are sensitive to changes in climate even though tectonic activity always has some control," says Herman.

View of one of the peaks of the Southern Alps. (Credit: Frédéric Herman)

Eighteen thousand rock ages were used in the project – a huge job. "The course of one PhD usually identifies around 30 rock ages so we benefited from a large number of people's work," says Herman.

"A global signal requires a global cause, and the strong correlation found with global climate change shows that cooling is a very good candidate for the causing mechanism," says Pedersen. "This study gives persuasive evidence for a strong link between highly variable cold climates and erosion rate, especially linked to glacial and periglacial proceses."

Pointing to glaciers as a cause of the erosion makes sense: glaciers can scour relatively flat topography into a rugged, jigsaw-like landscape within several thousand years. The rock currently on the surface of the fjords in the New Zealand Southern Alps, for example, used to lie two kilometres deep just 2.5 million years ago – a rapid change in geological terms. However it's not just glaciers that can have an influence. These Southern orogens – belts of the Earth's mountainous crust – receive high amounts of rainfall, which can trigger landslides and add to the erosive action.

Missing years

But the climate versus tectonic debate does not stop here. Thermochronometry is based on the idea that a rock's age can be converted into an erosion rate. The rocks must have been moved a couple of kilometres through the Earth before a rock age can be taken, a process that only occurs in areas where there is enough tectonic activity, such as the Alps, Patagonia and Himalaya.

Philippe Steer, who used a different method, found erosion increased by a factor of 20 during the past five million years. Even with such a huge increase, the total erosion remains too small to be detected by the technique used by Herman and his colleagues, so this study was restricted to certain parts of the world only.

"We don't know every cycle and are only seeing one part of the signal. Therefore this study is just the tip of the iceberg," says Herman. "We are now developing techniques to isolate shorter timescales to, say, 100,000 years."

Becky Summers
Freelance Science Writer, London, UK

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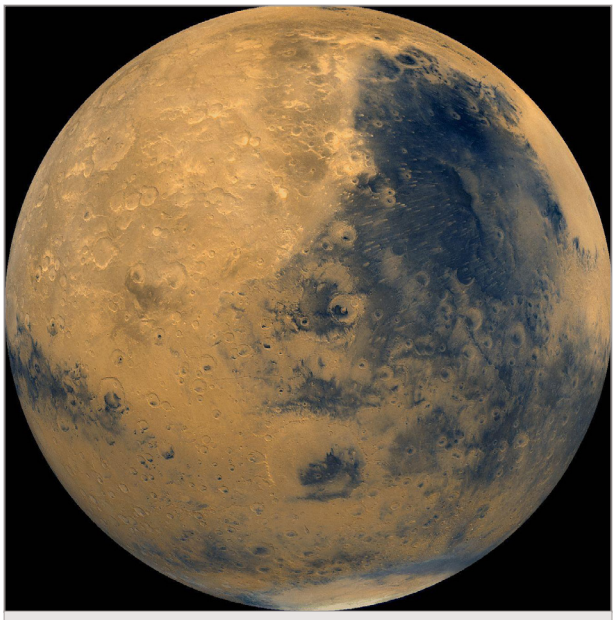
A glimpse of Mars' early history

Space and the Earth

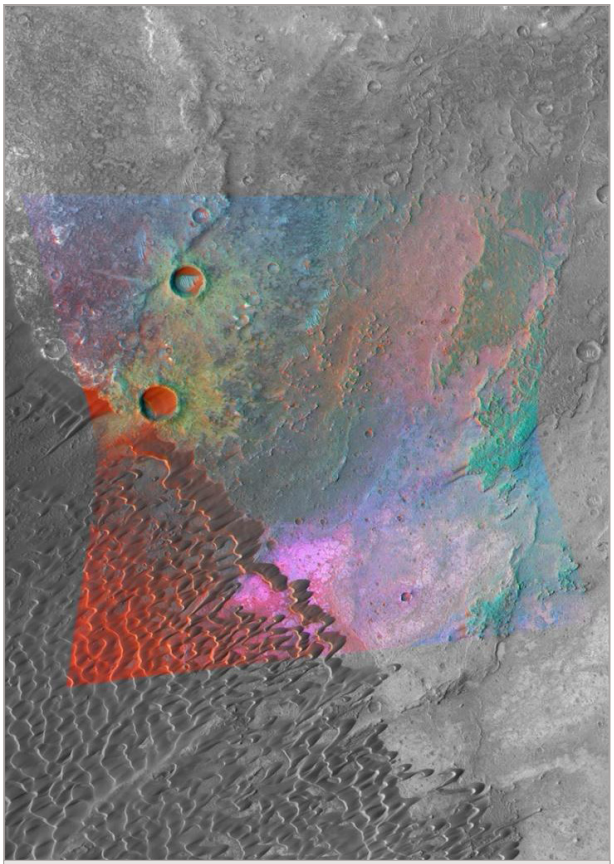
Finding increasing evidence of rocks previously thought to be non-existent on Mars sheds new light on the composition and early evolution of the planet.

Termed the Goldilocks Planet because of its ideal distance from the sun, which allows the planet to have liquid water on its surface, the Earth is also the perfect size to have maintained plate tectonics over the past 4,600 million years. Mars was likely too small to develop plate tectonics in its early years, cooling too quickly to maintain the hot core needed to power large-scale motions on the surface of the planet. Tectonics are the key to the variety of rocks we have on Earth: the tectonic system works as a giant conveyor belt that transports elements from deep within the planet up to the surface and back again. Mars, without the ability to maintain a tectonic cycle, was left with a largely basaltic composition. So, recent articles by Wray et al. (2013) and Carter and Poulet (2013) describing Martian rocks containing large amounts of iron-rich feldspar (a group of aluminium silicate minerals not commonly found in basaltic rocks) are unexpected and exciting.

In both studies, the researchers used data from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) on the Mars Reconnaissance Orbiter to identify the feldspars. Usually, feldspar is undetectable by CRISM, unless there are small amounts of metal such as iron within the mineral structure. CRISM detected very weak absorptions in the wavelength range typically associated with iron, but not strong enough to indicate the presence of iron-rich minerals like olivine and pyroxene common in basalt. Because of



Mars (Credit: NASA)



Mars surface as imaged by the Mars Reconnaissance Orbiter. Magenta coloured areas are high in feldspar. (Credit: NASA Jet Propulsion Laboratory)

the weak absorptions, both teams have associated the findings with extremely high levels of feldspar in the rocks, specifically iron-bearing plagioclase feldspar. Where the studies begin to differ, however, is on the identification of the host rock.

Carter and Poulet argue that the feldspar is indicative of a rock called anorthosite. The absorption spectra show an electronic transition band at 1.25 µm, which is characteristic of iron-bearing feldspar. The same band has also been detected when spectrally imaging the Earth and the Moon. The Moon has widespread occurrences of anorthosite, and the rock is also present on Earth, but in general, it is rare in the Solar System. Wray et al., although acknowledging the possibility of anorthosite on Mars, do not rule out the possibility that the presence of the feldspars could indicate rocks that contain quartz (pure silica), such as granite or dacite, or even selective hydrological weathering of other iron-rich rocks. In either case, these rocks have a significantly different (more silica rich) composition than other, typically basaltic rocks, such as those erupted by the Martian super-volcano Olympus Mons.

In the case that the feldspars do represent either anorthosite or granite, both studies are in agreement about the implications for altering our understanding of Mars' early evolution. Many silica-rich rocks on Earth, such as granite and dacite, are formed at subduction zones, or 'hotspots' (where super-hot magma from the mantle rises up below a plate and forms volcanoes, like Yellowstone) and some formed very early in the Earth's past, in the Archean, where the hot primordial Earth melted the plates at shallow depths. In all of these processes partial melting or fractional crystallisation is likely to occur, leading to the formation of silicate rocks. In fractional crystallisation of magma, minerals such as olivine and pyroxene crystallise first (forming basaltic rocks), leaving behind a silica-rich 'evolved' residue. Partial melting melts silica-rich rocks first, as these have low melting temperatures. Until now, these types of prolonged magmatic processes were not thought to have been present on Mars, but the presence of feldspar leaves open new avenues of investigation for planetary and space scientists.

In addition to needing slow magma crystallisation, the formation of granitic rocks requires the presence of water. Granitic rocks are also the core of many continents, their relative density to basalts being lighter. The possible presence of granitic rocks on Mars indicates that maybe it was not always so different from Earth: there was water present and even the possibility of a brief magnetic field.

As most of Mars is swept by winds and battered by meteorites, it is rare to get a glimpse of past processes in its early history. Currently, the quest for water on Mars tends to make the headlines, but maybe knowing more about the planet's geochemistry can help us answer this question and begin to ask some more: is Mars a 'failed' Earth and if so, what could this teach us about our own planet's future?

Jane Robb
EGU Educational Fellow

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Division reports

News brought to you from three EGU divisions

In each edition of GeoQ division presidents contribute reports updating EGU members with news from their divisions. Issue 9 gives voice to Oksana Tarasova (Atmospheric Sciences), Thomas Blunier (Climate: Past, Present & Future) and Chris Juhlin (Energy, Resources and the Environment).

AS Atmospheric Sciences

The Atmospheric Sciences (AS) Division is one of the largest EGU divisions. It has developed dynamically as reflected in the growing number of AS sessions at the General Assembly and interdisciplinary sessions. There are four subdivisions in AS, which cover a wide spectrum of scientific issues, from meteorological and boundary layer research, to atmospheric chemistry studies.

Improving weather forecasting has always been one of the important directions in meteorological research. There is a growing need in society for very short range weather forecasts (0–12 hours) to minimise the impact of weather hazards and improve risk prevention. Nowcasting has become an important scientific tool for weather-critical operations and the safety of human life and property. The accurate analysis and forecast of weather in both high time and space resolution for the early hours is opening new opportunities for safer and more efficient land and air transport. A special session will be held at the EGU General Assembly 2014 to highlight progress and recent developments in the area of nowcasting and its applications. The nowcasting tools will be further discussed at the follow-up European Nowcasting Conference, which will be held in Vienna, Austria, 29–30 April 2014 in the frame of EUMETNET (European Meteorological Network).

The advances in weather science, which will be presented at a number of exciting meteorological sessions at the forthcoming General Assembly, will be further discussed and brought to the attention of user communities at the first World Weather Open Science Conference (wwosc2014.org). This conference will take place from 16 to 21 August 2014 in Montreal, Canada.

As many areas of atmospheric research are inter-connected, research on weather is echoing at the longer time scales, and many activities now bridge the historic gap between weather and climate research. These research efforts are tightly connected to the studies on atmospheric chemical composition, as knowledge on many of the constituents is needed to improve the skill of weather forecasts and climate projections.

Atmospheric aerosols play an important role in the interaction between atmosphere dynamics and composition. This is reflected in the number of contributions to the session on aerosol chemistry and microphysics and several other sessions. The work of Urs Baltensperger, the winner of the AS Division Vilhelm Bjerknes Medal in 2014, also highlights important aspects of aerosol formation and its impacts on weather and climate. Research on aerosols is a broad field covering issues from aerosol formation, transformation, composition and properties to interactions with precipitation and other impacts. The role of aerosols in climate forcing is very diverse and uncertain as reflected both in recent IPCC Assessments and the summer 2013 paper on the role of black carbon in the climate system. Further discussion on the role of aerosols in climate will happen at the AS session Radiative effects of atmospheric aerosols. Another feature of aerosols in the Earth system is the delivery of the nutrients to the ocean. This important connection will be highlighted during the General Assembly session Atmospheric deposition to the ocean: impacts on marine biogeochemistry and climate.

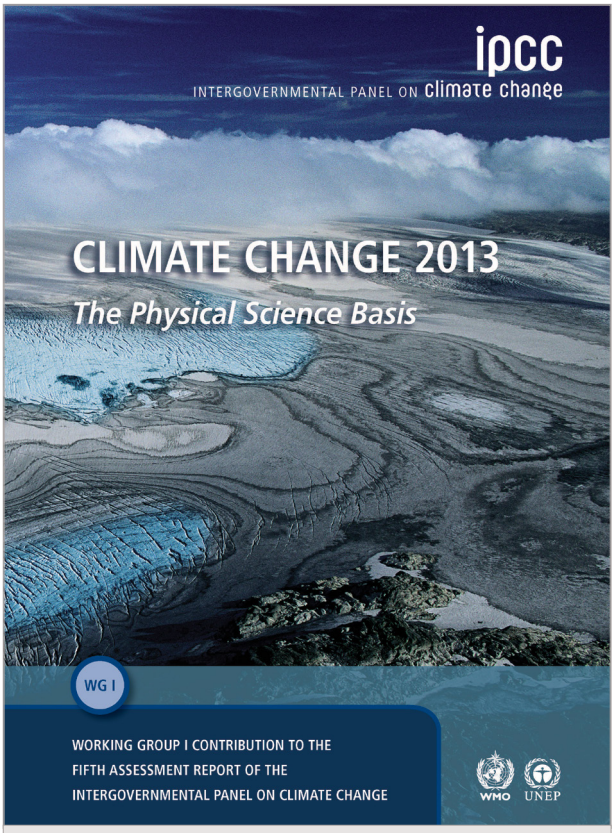
Oksana Tarasova
AS Division President

CL Climate: Past, Present & Future

Shortly before the EGU 2014 General Assembly all three scientific assessments of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) will ultimately have been released. Many members of the Climate Division (CL) contributed their science to the IPCC report and many have also invested time and effort into writing the report, some in key positions as chapter leaders. Overviews of the most relevant findings of all three working groups will be presented at a Union Symposium, an idea initiated by Thomas Stocker (a co-chair of Working Group I).

This year the CL programme features a special IPCC section for sessions related to the work of the IPCC Working Group I. The three sessions cover observed climate change, understanding climate change, and projecting climate change, and each of them will start with two invited IPCC keynote presentations. The rigid structuring of the IPCC process prevents the latest science being included in the IPCC report; therefore, the focus of the final talks in these sessions will be on recent findings relevant in the IPCC framework.

The IPCC is an assemblage of all the excellent science realised by the members of the CL Division, the details of which are presented in our regular session programme covering everything from measurement techniques and observations to projections and climate modelling. CL continues to be one of the strongest divisions at the EGU conference, and co-organises sessions with most other



The Working Group I contribution to the IPCC's Fifth Assessment Report (The Physical Science Basis) was published late last year. The contributions of Working Group II (Impacts, Adaptation and Vulnerability) and Working Group III (Mitigation of Climate Change) will be released in late March and mid April 2014, respectively.

divisions, which reflects the interdisciplinary nature of the Climate Division.

Major national and international programmes chose to have sessions and adjacent programme meetings at EGU. Two of these that I would like to mention are the EU Past4Future programme and the NERC (UK's Natural Environment Research Council) iGlass initiative, both aiming to project the future climate by looking at past climate variations.

This year's CL medalists are Sherilyn C. Fritz, for the Hans Oeschger Medal, and Maureen E. Raymo, for the Milan Milankovic Medal. Maureen Raymo is being honoured for her intellectual leadership in palaeoceanography, her impressive landmark publications in Cenozoic climate evolution, chronology, and astronomical climate forcing. Sherilyn Fritz receives the award in recognition of her outstanding contributions in reconstructing and understanding past periods of drought in North America and past hydrological changes in tropical and mid-latitude regions from lake sediments. She is also awarded for her thorough approach in using present-day limnological and landscape processes to interpret past hydrological shifts as well to decipher natural climate impact from human-induced landscape changes.

Our division journal, Climate of the Past, keeps growing with an increase of 34% of published pages in 2013 compared to 2012. In 2013, four new special issues have been initiated on:

- Western Pacific palaeoceanography – an ocean history perspective on climate variability at orbital to centennial scales;
- The changing Arctic and Subarctic environment: proxy- and model-based reconstructions of Holocene climate variability in the northern North Atlantic;
- Integrated analysis of interglacial climate dynamics; and
- International Partnerships in Ice Core Sciences (IPICS): 2012 First Open Science Conference

On the editorial side, Gerald Ganssen, co-founder and former co-editor in chief, stepped down from the editorial board and is now an honorary editor of the journal.

Thomas Blunier
CL Division President

ERE Energy, Resources and the Environment

The Energy, Resources and the Environment (ERE) Division has spent the last few months preparing the skeleton programme for the upcoming EGU General Assembly in Vienna with the aim of keeping the number of contributions at the same level as in recent years. After the abstract closure deadline, it was clear that we were only partly successful in this goal since there was a decrease by about 15% in the number of abstracts to those sessions in which ERE was in the lead. However, there are some research areas that are still quite active within the ERE Division and that had a large number of abstract submissions. These include energy meteorology, geothermal resources and CO_2 storage. There was also a significant number of contributions to ERE3 (Hydrothermal and Mineral Systems – Materials and Elements) sessions.

Whether ERE is satisfied with the number of contributions at the present level, or whether an effort should be made to increase the number, will be discussed at the ERE Division Meeting at the EGU General Assembly. Regardless of the outcome of that discussion, the ERE Division will make an effort to attract young scientists to the Assembly and to encourage more young researchers to organise sessions. ERE will have a new officer join the division at the General Assembly as a young scientist representative. This addition should make it easier to get more young scientists involved in the division and its activities. All scientists, young or old, are encouraged to be active within the ERE and we welcome you in the Division Meeting at the conference to hear your views.

Chris Juhlin
ERE Division President

Results of the EGU Autumn 2013 elections

The EGU election for the next EGU President/Vice-President and General Secretary closed on 1 December.

Hans Thybo was elected as the EGU President/Vice-President for the term 2014–2018. He will be inaugurated during the EGU Plenary Meeting on 28 April 2014 in Vienna, Austria. The elected candidate will serve as Vice-President (President-Elect) for the first year, then as the Union President for the next two years and finally as Vice-President (Past-President) for the fourth year, with the terms starting and ending at the General Assembly Plenary Meeting.

Mioara Mandea was re-elected as the EGU General Secretary for the term 2014–2016. She will also be inaugurated during the EGU Plenary Meeting in Vienna.

In total, we received 1272 ballot papers. The EGU is grateful to all those who used their voting right. Active participation in elections ensures continuation of the well-established bottom-up structure of our Union!

Hans Thybo and Mioara Mandea.

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

Communicate Your Science Video Competition

Want to communicate your research to a wider audience and try your hand at video production? Now's your chance! Young scientists pre-registered for the EGU 2014 General Assembly are invited to take part in the EGU's first ever Communicate Your Science Video Competition!

What we're looking for

The aim is to produce a video up-to-three-minutes long to share your research with the general public. Your video can include scenes of you out in the field and explaining an outcrop, or at the lab bench showing how to work out water chemistry; entries can also be cartoons, animations (including stop motion), or music videos – you name it! As long as you're explaining concepts in the Earth, planetary and space sciences in a language suitable for a general audience, you can be as creative as you like.

How to enter

Video files should be sent to Sara Mynott (mynott@egu.eu) by **Friday 21 March 2014**, together with proof of online pre-registration to EGU 2014. Videos must be submitted in one of the file formats supported by YouTube (.MOV, .MPEG4, .AVI, .WMV, .MPEGPS .FLV, 3GPP and WebM) and be no longer than 3 minutes. The aim is to be creative, concise, and to communicate geoscience effectively.

Selecting finalists

The judging panel will select up to 10 shortlisted videos which will be showcased on the EGU YouTube Channel for public voting in April 2014. In the run up to the General Assembly and during the conference, viewers can vote for their favourite film by clicking on the video's 'like' button. The winning video will be the one with the most likes by the end of the General Assembly.

What you can win

The winning entry will be announced during the conference and the winner will receive a free registration to the General Assembly in 2015.

What are you waiting for? Take the chance to showcase your research and spread great geoscientific facts with the world!

This information was originally published on the EGU website.

Welcome to a new Imaggeo!

The EGU's open access geoscience image repository has a new and improved home at imaggeo.egu.eu. We have redesigned the website to give the database a more modern, image-based layout and have implemented a fully responsive page design. This means the new website adapts to the visitor's screen size and looks good on any device (smartphones, tablets, laptops or desktops).

But it is not only the new design that makes Imaggeo look great. The database draws from all geoscientists and photographers who have submitted incredible images (and, more recently, short videos) to Imaggeo over the years. We encourage everyone to upload their own geoscience images to the website to make the database even richer.

As it was the case in the past, all Imaggeo material is copyrighted under a Creative Commons licence, meaning it is owned by the individual creators who originally uploaded it to the database. In the new website, users interested in submitting photographs or videos will be able to choose from a variety of attribution licences. Users can now also connect to Imaggeo through their social media accounts (Twitter, Facebook, Google Plus and LinkedIn).

Despite extensive testing, as with any newly launched website, the new Imaggeo is bound to have some bugs and glitches. If you find any problems, please report them to the EGU Webmaster and System Administrator Robert Barsch at webmaster@egu.eu.

Imaggeo Photo Competition

From 1 February until 23:59 on 1 March, pre-registered participants to the Assembly can submit photos and moving images to the annual Imaggeo Photo Competition. The finalist images will soon be selected by a panel of judges and will be exhibited at the EGU 2014 General Assembly. Each participant of the Assembly can then vote for up to three of their favourite exhibited photos using voting terminals set up next to the exhibition area. The public voting takes place from 8 am on Monday to midnight on Thursday. The votes are counted automatically and the three photographs with the highest number of votes are the winners. The winning photos are awarded during the lunch break on Friday.

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

The new Imaggeo website has a responsive design, which adapts to the visitor's screen size. (Credit: André Roquette)

More information

Imaggeo is the EGU's online open access geosciences image repository. All geoscientists (and others) can submit their photographs and videos to this repository and, since it is open access, these images can be used for free by scientists for their presentations or publications, by educators and the general public, and some images can even be used freely for commercial purposes.

All the material in this database is copyrighted under a Creative Commons Attribution licence, which means that Imaggeo content is owned by the individual creators and that they must always be credited when their content is used. People interested in submitting material to Imaggeo can also choose a more restrictive licence, such as Creative Commons Attribution NonCommercial ShareAlike licence.

The EGU would like to thank Konstantinos Kourtidis for coming up with the idea for Imaggeo and for designing and coordinating the database from 2007–2013. We also thank André Roquette for designing the new website and Robert Barsch for implementing it.

New EGU journal SOIL to be launched at the 2014 General Assembly

SOIL (www.soil-journal.net), the newest interactive and open access journal of the EGU, is dedicated to the publication and discussion of high-quality research in the field of soil system sciences. It will open for submissions in May 2014, following the journal's official launch at the EGU 2014 General Assembly.

SOIL is at the interface between the atmosphere, lithosphere, hydrosphere and biosphere. It publishes scientific research that contributes to understanding the soil system and its interaction with humans and the entire Earth system. The scope of the journal includes all topics that fall within the study of soil science as a

Journal SOIL cover detail

discipline, with emphasis on studies that integrate soil science with other sciences (such as hydrology, agronomy, socio-economics, health sciences and atmospheric sciences).

"We're really looking forward to launching SOIL because it will provide a unique platform for the publication of soil work within a broad and multi-disciplinary context. We are also particularly excited about EGU's two-stage open access and discussion process, which allows for a dynamic and interactive peer-review and publication process," says Managing Editor Johan Six. "We are grateful for the support provided by Copernicus Publications and the EGU Publications Committee."

With SOIL, the EGU now publishes a suite of 16 peer-reviewed open access journals through Copernicus Publications. Like the majority of these journals, SOIL is an interactive two-stage journal with public peer-review and interactive public discussion. The discussion and peer-review of submitted papers are handled in an open access discussion forum (SOIL Discussions, SOILD), while final papers, upon acceptance, will appear in SOIL.

The journal will be officially launched at the EGU General Assembly, taking place in Vienna, Austria from 27 April to 2 May 2014.

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

Earth System Dynamics indexed in the Science Citation Index Expanded

Thomson Reuters has announced that they will include the EGU-Copernicus journal Earth System Dynamics (ESD) in their Web of Science/ISI listings following the completion of their assessment of the quality, characteristics and flow of papers published in the journal since its launch in 2010. This is terrific news that highlights the tremendous work of the editorial board and, more importantly, the trust of the scientific community to submit excellent articles to ESD.

Thomson Reuters will include all issues of the journal in their databases and will announce ESD's first impact factor in June 2014. The journal's chief editors are grateful to all authors, referees, editors and Copernicus Publications for helping make the journal a success.

An earlier version of this article was published on the ESD website.

Nonlinear Processes in Geophysics becomes interactive

Nonlinear Processes in Geophysics (NPG), an EGU–Copernicus publication, is transitioning from an open access journal with a traditional review process into an interactive open access journal applying the public peer-review and interactive public discussion concept.

Since its launch in 1994, NPG followed the traditional single stage publication process. From 2014 on, all new submissions will undergo a two-stage publication process with the publication of an access-reviewed discussion paper (NPG Discussions) as the first stage and a final-revised journal article publication in NPG as the second stage. Only papers that successfully pass the open discussion involving publicly accessible reviewer comments will finally be published in NPG.

An earlier version of this article was published on the NPG website.

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GIFT teachers and EGU scientists: apply now to take part in I'm a Geoscientist, Get me out of here!

The EGU are funding a European-wide educational project to provide school students with the opportunity to meet and interact with real scientists.

Imagine a talent show where contestants get voted off depending on their skills in their area of choice. Then imagine that this talent show is populated by scientists with school students voting them off based on the scientist's ability to communicate their research well. This is the basis of the EGU's new educational initiative to launch in June 2014.

The EGU have entered into a collaboration with Gallomanor, a UK company that runs the events I'm a Scientist (Get me out of here) and I'm an Engineer (Get me out of here). The EGU are now funding a European-wide sister project called I'm a Geoscientist (Get me out of here) where we provide school students with the opportunity to meet and interact with real geoscientists!

The event takes the form of an online chat forum using an innovative online platform designed especially for this event. School students log on and post questions to the scientists taking part, ranging from questions about their research to their favourite music. The scientists then log on and answer those questions. Based on their answers, students get to vote out scientists until there is one left – the best scientific communicator – who wins €500 for a new public-engagement project of their choice.

The primary objective of the event is to change students' attitudes to the geosciences and make them feel it's something they can relate to and discuss in a rapidly changing world. Students have fun, but also get beyond stereotypes, learn about how science relates to real life, develop their thinking and discussion skills and make connections with real scientists. Giving students some real power (deciding where the prize money goes) also makes the event more real for them. The student who interacts the most with scientists and asks the most insightful questions will also win a €20 gift voucher.

Our launch event is taking place from the 16th to 27th June 2014. If you would like to apply as a teacher or a scientist see the details below – the **deadline for all applications is 17th March 2014**.

Teachers

To apply to take part in the event go to imageoscientist.eu/teachers and fill in the simple online form for teachers. Applications are open to all teachers who have taken part in a GIFT event (at any time). Successful teachers will be notified by the 24th March. You will need to use some class time before the event to prepare your students, but we have flexible lesson plans already prepared to help you keep the class time used to a minimum.

To take part you need to be able to devote at least 2 hours (it doesn't matter when, and the maximum you will need is 5 hours) for those two weeks to ready your students for interacting with the scientists and take part in some online discussion – and of course you will have to have reliable internet access. The entire event will be conducted in English, so you and your class will also need a basic understanding of and ability to write questions to scientists in English. Why not team up with your school's English department and use the event as a language learning exercise as well? If you choose to do this, make sure that the teacher who has been involved with GIFT in the past is the one who formally registers.

Scientists

For scientists, this is a unique opportunity to get involved with some public engagement from the comfort of your own home or lab computer, in your own time. You can build up your skills in talking about your research to varied audiences, tick the box for public engagement in your funding proposals, gain an understanding of how the public relate to research and, importantly, help inspire the next generation about the geosciences.

The potential of winning the €500 prize for further public engagement is also attractive. A public engagement activity could involve: buying equipment to allow a research oceanography vessel to communicate with school students during expeditions, funding an open day for communities living in a disaster area to find out about natural hazards research and get advice, giving the money to a school in Uganda to pay for science kits and a projector to watch science films on or buying a quadcopter to film inside the rim of a volcano and help school children understand their local natural environment.

To apply to take part in the event go to imageoscientist.eu/geoscientists and fill in the simple online form for scientists. Applications are open to all EGU members (if you are not a member you can register on the EGU website) from across Europe. Once applications close, we will ask the registered school classes to judge the scientist applications and chose the final 5 scientists who will get to take part in the final event. Successful scientists will be notified by the 7th April.

To take part you need to be able to devote around an hour a day (it doesn't matter when, but if you can devote more time that is always better) for those two weeks to answer the questions posed by the students – and of course you will have to have reliable internet access. The entire event will be conducted in English, so you will also need to be able to confidently understand and communicate in English.

If you have any other questions about the event email Jane Robb at robb@egu.eu or info@egu.eu.

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

Greenland's fastest glacier reaches record speeds

EGU press release on research published in The Cryosphere

Jakobshavn Isbræ (Jakobshavn Glacier) is moving ice from the Greenland ice sheet into the ocean at a speed that appears to be the fastest ever recorded. Researchers from the University of Washington and the German Space Agency (DLR) measured the dramatic speeds of the fast-flowing glacier in 2012 and 2013. The results are published in The Cryosphere, an open access journal of the European Geosciences Union (EGU).

"We are now seeing summer speeds more than 4 times what they were in the 1990s on a glacier which at that time was believed to be one of the fastest, if not the fastest, glacier in Greenland," says Ian Joughin, a researcher at the Polar Science Center, University of Washington and lead-author of the study.

In the summer of 2012 the glacier reached a record speed of more than 17 kilometres per year, or over 46 metres per day. These flow rates are unprecedented: they appear to be the fastest ever recorded for any glacier or ice stream in Greenland or Antarctica, the researchers say.

They note that summer speeds are temporary, with the glacier flowing more slowly over the winter months. But they add that even the annually averaged speedup over the past couple of years is nearly 3 times what it was in the 1990s.

This speedup of Jakobshavn Isbræ means that the glacier is adding more and more ice to the ocean, contributing to sea-level rise. "We know that from 2000 to 2010 this glacier alone increased sea level by about 1 mm. With the additional speed it likely will contribute a bit more than this over the next decade," explains Joughin.

Jakobshavn Isbræ, which is widely believed to be the glacier that produced the large iceberg that sank the Titanic in 1912, drains the Greenland ice sheet into a deep ocean fjord on the coast of the island. At its calving front, where the glacier effectively ends as it breaks off into icebergs, some of the ice melts while the rest is pushed out, floating into the ocean. Both of these processes contribute about the same amount to sea-level rise from Greenland.

As the Arctic region warms, Greenland glaciers such as Jakobshavn Isbræ have been thinning and calving icebergs further and further inland. This means that, even though the glacier is flowing towards the coast and carrying more ice into the ocean, its calving front is actually retreating. In 2012 and 2013, the front retreated more than a kilometre further inland than in previous summers, the scientists write in the new The Cryosphere study.

In the case of Jakobshavn Isbræ, the thinning and retreat coincides with an increase in speed. The calving front of the glacier is now located in a deeper area of the fjord, where the underlying rock bed is about 1300 metres below sea level, which the scientists say explains the record speeds it has achieved. "As the glacier's calving front retreats into deeper regions, it loses ice – the ice in front that is holding back the flow – causing it to speed up," Joughin clarifies.

Iceberg from Jakobshavn Isbræ (Credit: Ian Joughin, PSC/APL/UW)

Iceberg-choked Jakobshavn fjord (Credit: Ian Joughin, PSC/APL/UW)

The team used satellite data to measure the speed of the glacier as part of US National Science Foundation (NSF) and NASA studies. "We used computers to compare pairs of images acquired by the German Space Agency's (DLR) TerraSAR-X satellites. As the glacier moves we can track changes between images to produce maps of the ice flow velocity," says Joughin.

The researchers believe Jakobshavn Isbræ is in an unstable state, meaning it will continue to retreat further inland in the future. By the end of this century, its calving front could retreat as far back as the head of the fjord through which the glacier flows, about 50 km upstream from where it is today.

This press release was originally published on the EGU website

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Joughin, I. et al.: Brief Communication: Further summer speedup of Jakobshavn Isbræ, The Cryosphere, 8, 209–214, 2014

Ancient forests stabilised Earth's CO_2 and climate

EGU press release on research published in Biogeosciences

UK researchers have identified a biological mechanism that could explain how the Earth's atmospheric carbon dioxide and climate were stabilised over the past 24 million years. When CO_2 levels became too low for plants to grow properly, forests appear to have kept the climate in check by slowing down the removal of carbon dioxide from the atmosphere. The results are now published in Biogeosciences, an open access journal of the European Geosciences Union (EGU).

"As CO_2 concentrations in the atmosphere fall, the Earth loses its greenhouse effect, which can lead to glacial conditions," explains lead-author Joe Quirk from the University of Sheffield. "Over the last 24 million years, the geologic conditions were such that atmospheric CO_2 could have fallen to very low levels – but it did not drop below a minimum concentration of about 180 to 200 parts per million. Why?"

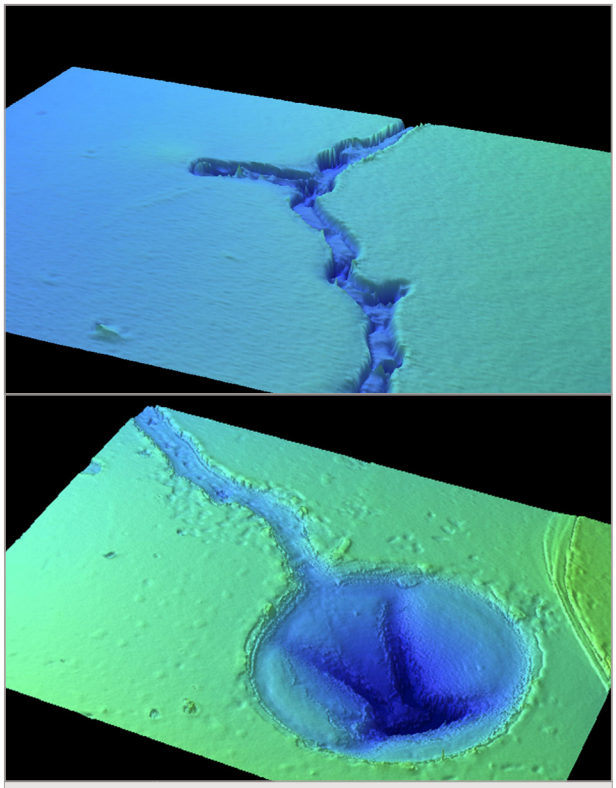
Before fossil fuels, natural processes kept atmospheric carbon dioxide in check. Volcanic eruptions, for example, release CO_2, while weathering on the continents removes it from the atmosphere over millions of years. Weathering is the breakdown of minerals within rocks and soils, many of which include silicates. Silicate minerals weather in contact with carbonic acid (rain and atmospheric CO_2) in a process that removes carbon dioxide from the atmosphere. Further, the products of these reactions are transported to the oceans in rivers where they ultimately form carbonate rocks like limestone that lock away carbon on the seafloor for millions of years, preventing it from forming carbon dioxide in the atmosphere.

Forests increase weathering rates because trees, and the fungi associated with their roots, break down rocks and minerals in the soil to get nutrients for growth. The Sheffield team found that when the CO_2 concentration was low – at about 200 parts per million (ppm) – trees and fungi were far less effective at breaking down silicate minerals, which could have reduced the rate of CO_2 removal from the atmosphere.

"We recreated past environmental conditions by growing trees at low, present-day and high levels of CO_2 in controlled-environment growth chambers," says Quirk. "We used high-resolution digital imaging techniques to map the surfaces of mineral grains and assess how they were broken down and weathered by the fungi associated with the roots of the trees."

As reported in Biogeosciences, the researchers found that low atmospheric CO_2 acts as a 'carbon starvation' brake. When the concentration of carbon dioxide falls from 1500 ppm to 200 ppm, weathering rates drop by a third, diminishing the capacity of forests to remove CO_2 from the atmosphere.

The weathering rates by trees and fungi drop because low CO_2 reduces plants' ability to perform photosynthesis, meaning less carbon-energy is supplied to the roots and their fungi. This, in turn, means there is less nutrient uptake from minerals in the soil, which slows down weathering rates over millions of years.



Mineral weathering by fungi (Credit: Joe Quirk)

"The last 24 million years saw significant mountain building in the Andes and Himalayas, which increased the amount of silicate rocks and minerals on the land that could be weathered over time. This increased weathering of silicate rocks in certain parts of the world is likely to have caused global CO_2 levels to fall," Quirk explains. But the concentration of CO_2 never fell below 180–200 ppm because trees and fungi broke down minerals at low rates at those concentrations of atmospheric carbon dioxide.

"It is important that we understand the processes that affect and regulate climates of the past and our study makes an important step forward in understanding how Earth's complex plant life has regulated and modified the climate we know on Earth today," concludes Quirk.

This press release was originally published on the EGU website.

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Quirk, J. et al.: Weathering by tree-root-associating fungi diminishes under simulated Cenozoic atmospheric CO_2 decline, Biogeosciences, 11, 321–331, 2014

Europe to suffer from more severe and persistent droughts

EGU press release on research published in Hydrology and Earth System Sciences

As Europe is battered by storms, new research reminds us of the other side of the coin. By the end of this century, droughts in Europe are expected to be more frequent and intense due to climate change and increased water use. These results, by researchers from the European Commission's Joint Research Centre (JRC) and the University of Kassel in Germany, are published in Hydrology and Earth System Sciences, an open access journal of the European Geosciences Union (EGU).

"Our research shows that many river basins, especially in southern parts of Europe, are likely to become more prone to periods of reduced water supply due to climate change," says Giovanni Forzieri, a researcher in climate risk management at the JRC and lead author of the study. "An increasing demand for water, following a growing population and intensive use of water for irrigation and industry, will result in even stronger reductions in river flow levels."

Drought is a major natural disaster that can have considerable impacts on society, the environment and the economy. In Europe alone, the cost of drought over the past three decades has amounted to over 100 billion euros. In this study, the researchers wanted to find out if and where in Europe increasing temperatures and intensive water consumption could make future droughts more severe and long-lasting.

To do this, they analysed climate and hydrological models under different scenarios. "Scenarios are narratives of possible evolutions – up to 2100 in this study – of our society that we use to quantify future greenhouse gas emissions and water consumption by different sectors," explains Luc Feyen, a hydrologist at JRC and co-author of the paper. "Climate and water-use models then translate the greenhouse gas concentrations and water requirement into future climate and water consumption projections."

The scientists then used these projected conditions to drive a hydrological model that mimics the distribution and flow of water on Earth. By running this model until 2100 for all river basins in Europe, they could evaluate how drought conditions may change in magnitude and severity over the 21st century.

The research shows that southern parts of Europe will be the most affected. Stream and river minimum flow levels may be lowered by up to 40% and periods of water deficiency may increase up to 80% due to climate change alone in the Iberian Peninsula, south of France, Italy and the Balkans.

Higher temperatures not only result in more water being evaporated from soils, trees and bodies of water, but will also lead to more frequent and prolonged dry spells, reducing water supply and worsening droughts. The emission scenario used in the study predicts that average global temperature will increase by up to 3.4°C by 2100, relative to the period 1961–1990. But the authors warn that the warming projected for Europe, particularly its southern regions, is even stronger. "Over the Iberian Peninsula, for example, summer mean temperature is projected to increase by up to 5°C by the end of this century," says Feyen.

In addition to climate warming, intensive water use will further aggravate drought conditions by 10–30% in southern Europe, as well as in the west and centre of the continent, and in some parts of the UK.

"The results of this study emphasise the urgency of sustainable water resource management that is able to adapt to these potential changes in the hydrological system to minimise the negative socio-economic and environmental impacts," Forzieri concludes.

This press release was originally published on the EGU website

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Forzieri, G. et al.: Ensemble projections of future streamflow droughts in Europe, Hydrol. Earth Syst. Sci., 18, 85–108, 2014

Dry river bed in a peat upland in Northern England (Credit: Catherine Moody, distributed via imaggeo.egu.eu)

Geoengineering approaches to reduce climate change unlikely to succeed

EGU press release on research published in Earth System Dynamics

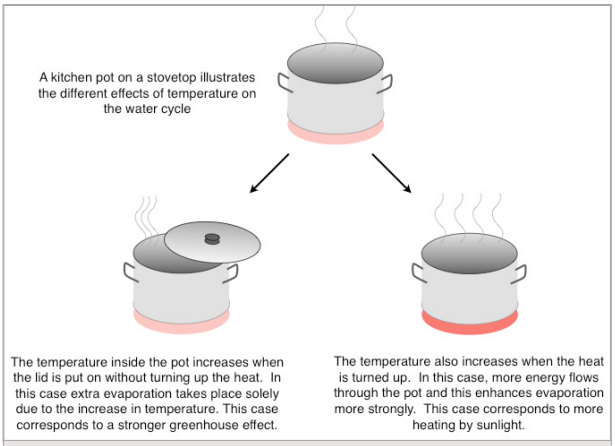
Reducing the amount of sunlight reaching the planet's surface by geoengineering may not undo climate change after all. Two German researchers used a simple energy balance analysis to explain how the Earth's water cycle responds differently to heating by sunlight than it does to warming due to a stronger atmospheric greenhouse effect. Further, they show that this difference implies that reflecting sunlight to reduce temperatures may have unwanted effects on the Earth's rainfall patterns. The results are now published in Earth System Dynamics, an open access journal of the European Geosciences Union (EGU).

Global warming alters the Earth's water cycle since more water evaporates to the air as temperatures increase. Increased evaporation can dry out some regions while, at the same time, result in more rain falling in other areas due to the excess moisture in the atmosphere. The more water evaporates per degree of warming, the stronger the influence of increasing temperature on the water cycle. But the new study shows the water cycle does not react the same way to different types of warming.

Axel Kleidon and Maik Renner of the Max Planck Institute for Biogeochemistry in Jena, Germany, used a simple energy balance model to determine how sensitive the water cycle is to an increase in surface temperature due to a stronger greenhouse effect and to an increase in solar radiation. They predicted the response of the water cycle for the two cases and found that, in the former, evaporation increases by 2% per degree of warming while in the latter this number reaches 3%. This prediction confirmed results of much more complex climate models.

"These different responses to surface heating are easy to explain," says Kleidon, who uses a pot on the kitchen stove as an analogy. "The temperature in the pot is increased by putting on a lid or by turning up the heat – but these two cases differ by how much energy flows through the pot," he says. A stronger greenhouse effect puts a thicker 'lid' over the Earth's surface but, if there is no additional sunlight (if we don't turn up the heat on the stove), extra evaporation takes place solely due to the increase in temperature. Turning up the heat by increasing solar radiation, on the other hand, enhances the energy flow through the Earth's surface because of the need to balance the greater energy input with stronger cooling fluxes from the surface. As a result, there is more evaporation and a stronger effect on the water cycle.

In the new Earth System Dynamics study the authors also show how these findings can have profound consequences for geoengineering. Many geoengineering approaches aim to reduce global warming by reducing the amount of sunlight reaching the Earth's surface (or, in the pot analogy, reduce the heat from the stove). But when Kleidon and Renner applied their results to such a geoengineering scenario, they found out that simultaneous changes in the water cycle and the atmosphere cannot be compensated for at the same time. Therefore, reflecting sunlight by geoengineering is unlikely to restore the planet's original climate.



A stronger greenhouse effect puts a thicker 'lid' over the Earth's surface but, if there is no additional sunlight (if we don't turn up the heat on the stove), extra evaporation takes place solely due to the increase in temperature. Turning up the heat by increasing solar radiation, on the other hand, enhances the energy flow through the Earth's surface because of the need to balance the greater energy input with stronger cooling fluxes from the surface. As a result, there is more evaporation and a stronger effect on the water cycle. (Credit: Max Planck Institute for Biogeochemistry)

"It's like putting a lid on the pot and turning down the heat at the same time," explains Kleidon. "While in the kitchen you can reduce your energy bill by doing so, in the Earth system this slows down the water cycle with wide-ranging potential consequences," he says.

Kleidon and Renner's insight comes from looking at the processes that heat and cool the Earth's surface and how they change when the surface warms. Evaporation from the surface plays a key role, but the researchers also took into account how the evaporated water is transported into the atmosphere. They combined simple energy balance considerations with a physical assumption for the way water vapour is transported, and separated the contributions of surface heating from solar radiation and from increased greenhouse gases in the atmosphere to obtain the two sensitivities. One of the referees for the paper commented: "it is a stunning result that such a simple analysis yields the same results as the climate models."

This press release, based on materials provided by the Max Planck Institute for Biogeochemistry, was originally published on the EGU website

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Using moving cars to measure rainfall

EGU press release on research published in Hydrology and Earth System Sciences

Drivers on a rainy day regulate the speed of their windshield wipers according to rain intensity: faster in heavy rain and slower in light rain. This simple observation has inspired researchers from the University of Hanover in Germany to come up with 'RainCars', an initiative that aims to use GPS-equipped moving cars as devices to measure rainfall. The most recent results of the project are now published in Hydrology and Earth System Sciences, an open access journal of the European Geosciences Union (EGU).

Rainfall can be very variable across different parts of a region such as Northern Germany. Conventional rain gauges are accurate, but are often distributed too sparsely to capture much of this variation. Having good information about precipitation is important for flood prediction and prevention, for example.

"If moving cars could be used to measure rainfall the network density could be improved dramatically," explains project-leader Uwe Haberlandt, who says the idea for RainCars emerged during a brainstorming session between geoinformatics researchers and hydrologists. With over 40 million cars in Germany alone, and with traffic increasing worldwide, the multi-disciplinary team might be onto a winner.

Now, with a lab equipped with a rain simulator, the researchers have been able to put their idea to the test. They placed cars with different wiper systems under the rain machine, which uses a sprinkler irrigation system with adjustable nozzles to simulate light to heavy rain, to find out exactly how wiper speed relates to rainfall intensity.

In one set of experiments, an individual in the car adjusted the wiper speed manually, depending on the windscreen visibility. "The experiments have shown that the front visibility is a good indicator for rainfall intensity," says Ehsan Rabiei, Haberlandt's collaborator and the paper's lead author. But the measurements could depend on the person adjusting the wiper speed so may not be very reliable.

In another set of experiments, the team used the rain machine to test optical sensors that are installed in many modern cars to automate wipers. The sensors use a system of infrared laser beams that detect when drops of rain accumulate on the surface of the device. Each sensor reading corresponds to a specific amount of water, with more frequent readings corresponding to more intense rainfall.

"The optical sensors measure the rain on the windshield in a more direct and continuous manner so, currently, they would be the better choice for rain sensors in cars," says Haberlandt.

The team could also test the effects of car movement on the measurements by placing the sensors on a rotating device, which simulates car speed, under the rain simulator. By knowing how the readings are affected by car speed, they can correct for this effect when using moving cars to measure rainfall.

A car tested under a rain simulator. An individual in the car adjusts the wiper speed manually depending on the windscreen visibility. The visibility is related to the intensity of the rain. This is set by the rain simulator, a machine that uses a sprinkler irrigation system with adjustable nozzles to simulate light to heavy rain. (Credit: www.ikg.uni-hannover.de, Daniel Fitzner)

But speed is not all that can alter the rain measurements, as Rabiei explains. "Our experiments so far were carried out in an ideal and controlled environment. In nature there are external effects like wind, spray from other cars or shielding trees that can affect the readings, and rainfall characteristics are different from the rain simulator."

However, Haberlandt clarifies, "the value of using moving cars to measure rainfall is not about a higher accuracy of rainfall measurements but about a much higher number of measurement points." In a Hydrology and Earth System Sciences study published in 2010, two of the team members showed that a high number of less accurate rain gauges gives more reliable rainfall readings than a low number of very accurate devices.

The researchers are already working on field experiments using cars to measure real rainfall in and around the city of Hanover. "There are some volunteers, a taxi company and a car company involved in the field experiments. We certainly would like to have some more people engaged."

This press release was originally published on the EGU website

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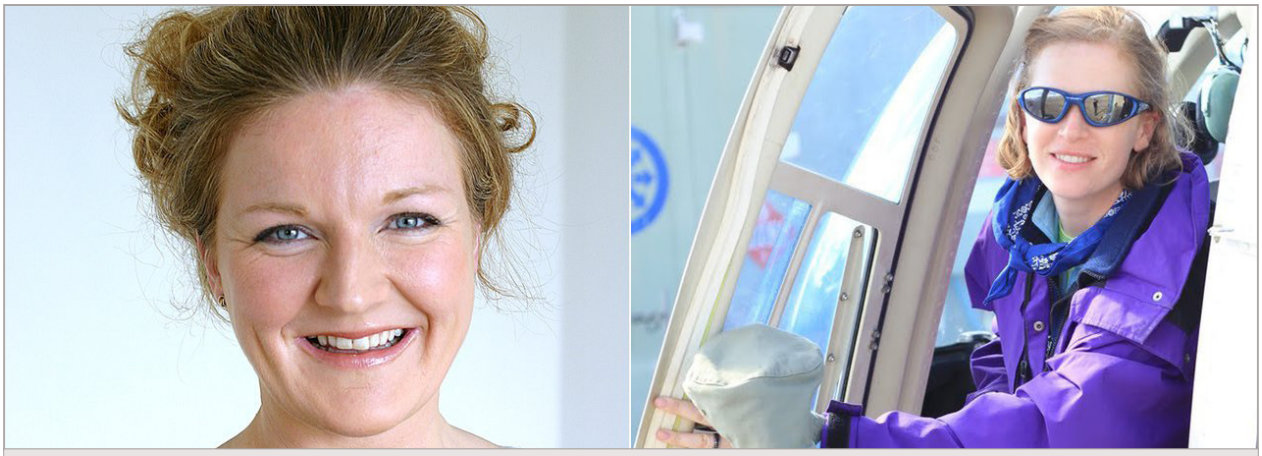
Sybille Hildebrandt and Chelsea Wald awarded EGU Science Journalism Fellowship



Sybille Hildebrandt and Chelsea Wald (Credit: right – Ben Shaw)

The European Geosciences Union (EGU) has named journalists Sybille Hildebrandt and Chelsea Wald as the winners of its 2014 Science Journalism Fellowship for projects on palaeontology, geochemistry and the origin of animal life, and on soil sciences and forensics, respectively. Hildebrandt will receive €3,500 to join a research team travelling to the Canadian Rockies, and Wald €1,500 to cover expenses related to a trip to Scotland.

Sybille Hildebrandt's proposal focuses on the recent discovery of a fossil mine near the Burgess Shale that has an abundance of early animal fossils that can provide important clues to solve the mystery of the origin of animal life. She will be accompanying a Danish team on a summer field trip to the mine where researchers will study the fossils and harvest geochemical samples.

Chelsea Wald proposes to report on a story that shows how soil science techniques can help in solving crimes. She will be travelling to Scotland where she will follow soil scientist Lorna Dawson of the James Hutton Institute in Aberdeen and colleagues as they test new methods at a mock crime scene.

Hildebrandt is a freelance journalist and press consultant based in Copenhagen, Denmark. She previously worked as a journalist for the Danish science website Videnskab.dk and as an editor at the popular science magazine Science Illustrated. Wald is a freelance science, health and environment writer based in Vienna, Austria. Her stories have appeared in Science, New Scientist, and Nautilus, among other renowned publications.

This press release was originally published on the EGU website

More information

The EGU Science Journalism Fellowship is an annual competition open to professional journalists wishing to report on ongoing research in the Earth, planetary and space sciences. The winning proposals receive up to €5K to cover expenses related to their projects. This support is intended to allow the fellows to follow geoscientists on location and to develop an in-depth understanding of their questions, approaches, findings and motivation.

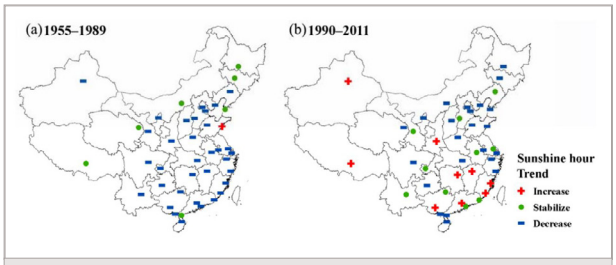
Annales Geophysicae (ANGEO)

China's dimming and brightening: evidence, causes and hydrological implications

In this paper, the authors synthesise reliable results and conclusively address recent advances and insufficiencies in studies on dimming and brightening in China.

Reference

Wang, Y. W. and Yang, Y. H.: China's dimming and brightening: evidence, causes and hydrological implications, Ann. Geophys., 32, 41–55, 2014



Spatial patterns of sunshine hour trends over 42 meteorological stations across China (Credit: Wang et al. 2013)

Atmospheric Chemistry and Physics (ACP)

Incidence of rough and irregular atmospheric ice particles from Small Ice Detector 3 measurements

Two-dimensional light-scattering patterns were obtained in situ for the first time using the Small Ice Detector 3 (SID-3) probe during several flights in a variety of mid-latitude mixed-phase and cirrus clouds. The patterns are analysed using several measures of pattern texture, selected to reveal the magnitude of particle roughness or complexity.

Reference

Ulanowski, Z. et al.: Incidence of rough and irregular atmospheric ice particles from Small Ice Detector 3 measurements, Atmos. Chem. Phys., 14, 1649–1662, 2014

Arctic stratospheric dehydration – Part 1: Unprecedented observation of vertical redistribution of water

This paper presents high-resolution measurements of water vapour, aerosols and clouds in the Arctic stratosphere in January and February 2010 carried out by in situ instrumentation on balloon sondes and high-altitude aircraft combined with satellite observations.

Reference

Khaykin, S. M. et al.: Arctic stratospheric dehydration – Part 1: Unprecedented observation of vertical redistribution of water, Atmos. Chem. Phys., 13, 11503–11517, 2013

Microphysical properties and high ice water content in continental and oceanic mesoscale convective systems and potential implications for commercial aircraft at flight altitude

Two complementary case studies are conducted to analyse convective system properties in the region where strong cloud-top lidar backscatter anomalies are observed as reported by Platt et al. (2011).

Reference

Gayet, J.-F. et al.: Microphysical properties and high ice water content in continental and oceanic mesoscale convective systems and potential implications for commercial aircraft at flight altitude, Atmos. Chem. Phys., 14, 899–912, 2014

Quantifying aerosol mixing state with entropy and diversity measures

This paper presents the first quantitative metric for aerosol population mixing state, defined as the distribution of per-particle chemical species composition.

Reference

Riemer, N. and West, M.: Quantifying aerosol mixing state with entropy and diversity measures, Atmos. Chem. Phys., 13, 11423–11439, 2013

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Biogeosciences (BG)

Regional variability of acidification in the Arctic: a sea of contrasts

In this study, the authors use an ocean-only general circulation model, with embedded biogeochemistry and a comprehensive description of the ocean carbon cycle, to study the response of pH and saturation states of calcite and aragonite to rising atmospheric pCO_2 and changing climate in the Arctic Ocean.

Reference

Popova, E. E. et al.: Regional variability of acidification in the Arctic: a sea of contrasts, Biogeosciences, 11, 293–308, 2014

Seasonal variations of sea–air CO2 fluxes in the largest tropical marginal sea (South China Sea) based on multiple-year underway measurements

Based on 14 field surveys conducted between 2003 and 2008, this paper shows that the seasonal pattern of sea surface partial pressure of CO_2 and sea–air CO_2 fluxes differed among four different physical–biogeochemical domains in the South China Sea proper.

Reference

Zhai, W.-D. et al.: Seasonal variations of sea–air CO2 fluxes in the largest tropical marginal sea (South China Sea) based on multiple-year underway measurements, Biogeosciences, 10, 7775–7791, 2013

Climate of the Past (CP)

Salinity changes in the Agulhas leakage area recorded by stable hydrogen isotopes of C^{37} alkenones during Termination I and II

Here the authors reconstructed sea surface salinity changes using alkenone δD, and palaeo-sea surface temperature using TEX^{H}_{86} and $U^{K'}_{37}$, from two sediment cores located in the Agulhas leakage area during Termination I and II.

Reference

Kasper, S. et al.: Salinity changes in the Agulhas leakage area recorded by stable hydrogen isotopes of C^{37} alkenones during Termination I and II, Clim. Past, 10, 251–260, 2014

Using palaeo-climate comparisons to constrain future projections in CMIP5

This paper presents a selection of methodologies for using the palaeo-climate model component of the Coupled Model Intercomparison Project (Phase 5) to attempt to constrain future climate projections using the same models.

Reference

Schmidt, G. A. et al: Using palaeo-climate comparisons to constrain future projections in CMIP5, Clim. Past, 10, 221–250, 2014

Geoscientific Instrumentation, Methods and Data Systems (GI)

Autonomous thermal camera system for monitoring the active lava lake at Erebus volcano, Antarctica

In December 2012, Mount Erebus Volcano Observatory installed a thermal infrared camera system to monitor the volcano's active lava lake. The new system is designed to be autonomous, and capable of capturing images of the lava lake continuously throughout the year.

Reference

Peters, N., Oppenheimer, C., and Kyle, P.: Autonomous thermal camera system for monitoring the active lava lake at Erebus volcano, Antarctica, Geosci. Instrum. Method. Data Syst., 3, 13–20, 2014

The surface temperatures of Earth: steps towards integrated understanding of variability and change

In June 2012, the EarthTemp Network brought together 55 researchers from five continents to improve the interaction between scientific communities who focus on surface temperature in particular domains, to exploit the strengths of different observing systems and to better meet the needs of different communities.

Reference

Merchant, C. J. et al.: The surface temperatures of Earth: steps towards integrated understanding of variability and change, Geosci. Instrum. Method. Data Syst., 2, 305–321, 2013

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Hydrology and Earth System Sciences (HESS)

Quantifying mesoscale soil moisture with the cosmic-ray rover

Existing techniques measure soil moisture either at a point or over a large area many kilometers across. The cosmic-ray rover, an instrument similar to the recently developed COSMOS probe, but bigger and mobile, bridges these two scales. This paper explores the challenges and opportunities for mapping soil moisture over large areas using the cosmic-ray rover.

Reference

Chrisman, B. and Zreda, M.: Quantifying mesoscale soil moisture with the cosmic-ray rover, Hydrol. Earth Syst. Sci., 17, 5097–5108, 2013

Statistical analysis to characterise transport of nutrients in groundwater near an abandoned feedlot

Surface water from a lagoon and groundwater samples from 17 wells within and near an abandoned feedlot in northwestern Minnesota, USA, were analysed for carbon, nutrients, and field parameters. This study shows the value of multivariate analyses in characterising variability in groundwater quality.

Reference

Gbolo, P. and Gerla, P.: Statistical analysis to characterise transport of nutrients in groundwater near an abandoned feedlot, Hydrol. Earth Syst. Sci., 17, 4897–4906, 2013

Nonlinear Processes in Geophysics (NPG)

Voyager 2 observation of the multifractal spectrum in the heliosphere and the heliosheath

This paper looks in detail at the multifractal scaling of the fluctuations in the strenght of the interplanetary magnetic field as measured onboard Voyager 2 in the entire heliosphere and even in the heliosheath. This study brings significant support to earlier claims suggesting that the solar wind termination shock is asymmetric.

Reference

Macek, W. M. and Wawrzaszek, A.: Voyager 2 observation of the multifractal spectrum in the heliosphere and the heliosheath, Nonlin. Processes Geophys., 20, 1061–1070, 2013

Ocean Science (OS)

Observed decline of the Atlantic meridional overturning circulation 2004–2012

The Atlantic meridional overturning circulation and its component parts are monitored by combining a transatlantic array of moored instruments with submarine-cable-based measurements of the Gulf Stream and satellite derived Ekman transport. The time series has recently been extended to October 2012 and the results show a downward trend in circulation since 2004.

Reference

Smeed, D. A. et al.: Observed decline of the Atlantic meridional overturning circulation 2004–2012, Ocean Sci., 10, 29–38, 2014.

Solid Earth (SE)

Palaeosols in the Transantarctic Mountains: indicators of environmental change

Palaeosols on unconsolidated deposits are emphasised in this study. Examples are given from the McMurdo Dry Valleys (78° S) and two outlet glaciers in the central and southern Transantarctic Mountains, including the Hatherton–Darwin Glacier region (80° S) and the Beardmore Glacier region (85°30' S).

Reference

Bockheim, J. G.: Palaeosols in the Transantarctic Mountains: indicators of environmental change, Solid Earth, 4, 451–459, 2013

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Geological surveys' capacity to address economic and social challenges

A piece introducing EuroGeoSurveys, the association of the European Geological Surveys, and its policy work. The organisation is collaborating with the EGU on a science policy workshop at the 2014 General Assembly (The Role of Geoscientists in Public Policy).

Every geoscientist knows that geological data, information, knowledge and expertise are key tools to respond to many of the key social and economic challenges facing the European and global communities in the 21st century. The European society, in particular, faces great challenges for which ecologically, economically and socially sound solutions and scientific advice are required. These challenges include geo-energy, raw materials, groundwater and geohazards.

The various National Geological Surveys are key players to respond to these major geoscientific challenges. They are the national entities responsible for policy support in all subsurface-related survey and management activities, including mitigation and exploration research, vulnerability and risk assessments, forecasts and statistics. As such, the Geological Surveys of Europe – united in EuroGeoSurveys (EGS) – jointly represent the critical mass of knowledge, research capacity and capability, data and facilities needed to fulfil that same role on a European level. As a not-for-profit international organisation based in Brussels, EGS has 31 member countries, also representing some regional surveys in Europe, and an overall workforce of several thousand experts.

EGS aims to play a role in stimulating economic growth, mitigating the effects of climate change, guaranteeing a sufficient supply of food and water, providing a healthy and clean living environment and in protecting EU's citizens against natural hazards. Its mission is "to provide public Earth science knowledge to support the EU's competitiveness, social well-being, environmental management and international commitments". To achieve this, EGS has drafted a vision document which adheres to three pillars. These include a joint research programme with significant impact at EU policy level, creating an information system for Europe, and a focus on building a common European Geological Data Infrastructure (EGDI). EGS' vision is also based on sharing knowledge, capacities and infrastructure to address capacity building through training and participation in multinational and multidisciplinary research, multinational exchange of researchers and of best practices, and sharing of laboratories, facilities and infrastructures. These three pillars are essential for establishing a common European geological knowledge base and providing a geological service for Europe that ultimately will guarantee a common single access point for EU bodies and other stakeholders.

EGS has the capacity to achieve its vision due to its flexible structure and the broad range of scientific fields it covers. The organisation coordinates a number of expert groups and temporary task forces that integrate information, knowledge and expertise deriving from the member countries in fields such as natural hazards, water, soils, energy, mineral resources, marine geology, spatial data, carbon capture and storage, geochemistry, Earth observation and international cooperation. These expert groups have contributed significantly to the definition of some fundamental legislative initiatives and policy provisions within the European Commission. These include the INSPIRE Directive, the Raw Materials Initiative, the Directive on the geological storage of CO_2, the Maritime Policy, the Soil Thematic Strategy, the Water Framework Directive, the Mining Waste Directive, the Resource Efficiency Policy and the Coastal Zone Policy. Moreover the participation of our member geological surveys in a substantial number (over 250 since 1998) of EU-funded Research and Development (R&D) and policy support projects has contributed to solving important societal challenges and promoting sustainable and competitive growth.

New geological knowledge has become essential as it can lead to the discovery and safe and sustainable exploitation of new energy, mineral and other resources. At the same time, knowledge and information on the dynamic geosphere are indispensable in helping European citizens cope with anthropogenic pressures, climate change and natural hazards. They are also key elements in protecting the European environment. The subsurface, including soils and groundwater, is increasingly used and therefore under pressure. Many human activities have positive effects, increasing safety, generating renewable energy or creating valuable habitats. Some others affect the Earth negatively. Essential parts of Europe are facing pollution, erosion, soil sealing and loss of fertility as a result of urbanisation, industrialisation and land-use change. These affect the availability and access to food, drinking water, clean air and other benefits from resources and processes that are supplied by ecosystems for Europe's citizens. Exposure to naturally occurring toxic substances like arsenic, mercury or radioactive materials (e.g. radon) or harmful minerals (e.g. asbestos) may also endanger human health. In short, geological knowledge and information are essential to allow us to make optimal use of the geosphere without compromising it for future generations. Operating according to their legal national mandate, the Geological Surveys of Europe are ideally positioned to operate at EU level through EuroGeoSurveys for the development of geological knowledge and the provision of official and reliable information.

Claudia Delfini, EGS Communication Manager, on behalf of EuroGeoSurveys

Our Changing Planet: a timely 'gift' for teachers!

In September 2013 the Intergovernmental Panel on Climate Change (IPCC) published the first part of its Fifth Assessment Report (AR5), The Physical Science Basis (IPCC Working Group I contribution). In a worldwide press conference, Working Group I Co-Chair Thomas Stocker announced that the IPCC has concluded that "warming in the climate system is unequivocal" and that "it is extremely likely that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in greenhouse gas concentrations and other anthropogenic forcing together." Model simulations of future climate change crucially depend upon the quantity of CO_2 in the atmosphere, with predictions for the increase in global average temperature varying between 1.5°C and 4.5°C depending on the different gas-emission scenarios. In conclusion, the AR5 affirms: "Limiting climate change will require substantial and sustained reductions in greenhouse gas emissions."

Given its major interest for humankind, there is no doubt that the IPCC report will be discussed worldwide. Therefore, it was clear to us that teachers would be eager to receive current and significant scientific information from eminent scholars, in order to answer the questions that will be asked by their students, as well as sharing their expertise as natural science pedagogues with their peers and scientists attending the EGU General Assembly.

There will be 85 science teachers from 18 different countries participating in the 3-day 2014 GIFT workshop focusing on Our Changing Planet. They will be very busy! First, a guided tour of the Vienna Museum of Natural History on Sunday afternoon will get their natural science juices flowing, and will give them a chance to meet their new colleagues! In the following days, the teachers will first hear speeches about climate-change science from some of the leaders of different chapters of the IPCC report, as well as other leading science experts that are attending the General Assembly. Thomas Stocker will present the IPCC AR5 report, summarising the science that supports the interpretations of the Earth's changing past and the modelling results based on this science. There will also be presentations about natural environmental archives, such as ice cores that capture chemistry in the atmosphere, sea level rise in the context of climate warming, ocean acidification, changes in agricultural outputs and other key climatic factors that are used to understand climate change over time.

Two interactive hands-on demonstrations of climate science activities that teachers can use back in their classrooms after the workshop are planned for the GIFT participants. Experienced science educators will propose two different presentations to the teachers: 'Some experiments on ocean acidification and the role of the ocean in the carbon cycle' and the 'Carbon cycle through the 5E model: game and experiment' (5E stands for Engage, Explore, Explain, Extend (or Elaborate), and Evaluate).

GIFT teachers take part in a GPS activity outside the Austria Center Vienna.

GIFT teachers presenting their work at the EGU General Assembly.

Sixty teachers and 13 EGU researchers have submitted abstracts to the EGU poster session EOS2: 'Science in tomorrow's classroom', which highlights geology, biology, chemistry and physics field studies, lab exercises and other activities, primarily for middle/high school and undergraduate university students. This poster session gives teachers the opportunity to share their best practices in natural science activities with others, and also make connections for future collaborations for students from different countries to work together.

Based on previous GIFT workshop outcomes, we expect the teachers to use their updated knowledge and new contacts to create science activities in the future. Examples of previous outcomes include published articles in science magazines about the contents of the GIFT workshop, teaching colleagues about the latest developments presented at GIFT, and creating new teaching units in book form or websites.

Eve Arnold, Friedrich Barnikel, Francesca Cifelli and Carlo Laj, on behalf of the EGU Committee on Education

Young Scientists at the Assembly

This year, there's a great line-up of sessions for young scientists at the General Assembly. Not only that, but there are opportunities to meet those that represent you in the Union, get to know other young scientists in your field, and make the most of both the scientific and social sides of the conference.

First up for young scientists is the icebreaker event on the Sunday before the meeting, while this is open to everyone attending the Assembly, there'll be meeting points especially for young scientists. So, if you're coming alone, or if it's your first time, you're sure to find a few like-minded fellows! At EGU 2014 we'll also be introducing a young scientists' lounge – somewhere that you can take a break, grab a coffee and gather your thoughts away from the buzz of the conference. The lounge is also a great place to catch up with colleagues you haven't seen in a while, or start up a conversation with someone new, and it provides a great meeting point to launch your evening's activities. There will be a pin board with our top picks for places to go in Vienna, so if you haven't been before, or just need a little inspiration, you can get a good idea of where to grab a drink, bite to eat, or catch a film in the evening.

It's not all about the social stuff though, there's a veritable feast of courses where you can fine-tune your skills and grab those all-important nuggets of information to help you forge a career in academia. From Union-wide sessions to workshops and short courses, there's a lot to choose from, including division-specific sessions to hone your hydrological skills and get the most out of geomorphological data. There are also a number of science communication courses including a workshop led by geoscience communicators, an opportunity to learn about outreach in schools, ways to communicate climate science, and suss out how to start a science film. And this is just a snapshot of what's on offer! You will be able to see all sessions of interest to young scientists, which also include two careers sessions, on the young scientists' website in March, when the General Assembly programme goes online.

Like last year, we'll be hosting a lunchtime session to let young scientists know how they can get involved in the Union and gather feedback to make what we're doing even better. Since the last General Assembly, young scientist representation in the Union has grown leaps and bounds, with several divisions appointing young scientist officers whose role is to feedback from the young scientist community and make sure we do our best to act on your suggestions. What better way to tell us what you want than over a lovely lunch where you can meet your representatives?

Keep your eye out for posters that are part of the Outstanding Student Poster competition and make sure you save a space for a few talks from outstanding young scientists. The winners of the Arne Richter and division awards will be giving talks throughout the week and are well worth a listen. Finally, if you'd like to try your hand at science communication and have the chance to attend next year's conference for free, why not enter the EGU's Communicate Your Science Video Competition? The aim is to make a short film to share your research with the general public. Shortlisted videos will be showcased at GeoCinema, the home of geoscience films at EGU 2014, and the winner will be announced at the end of the Assembly.

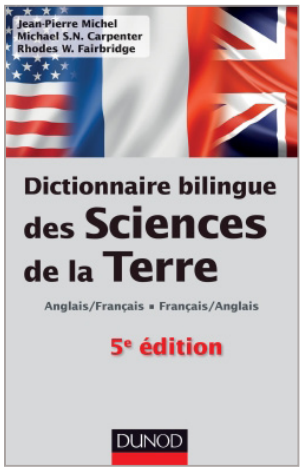
Young Scientists mingling during the EGU2013 opening reception.

If you have any questions about activities for young scientists at the General Assembly please contact me at mynott@egu.eu. I look forward to seeing you there!

Sara Mynott
EGU Communications Officer and Young Scientists contact person at the EGU office

Bilingual Dictionary of Earth Sciences

English–French, French–English



By Jean-Pierre Michel, Michael S. N. Carpenter and Rhodes W. Fairbridge

DUNOD

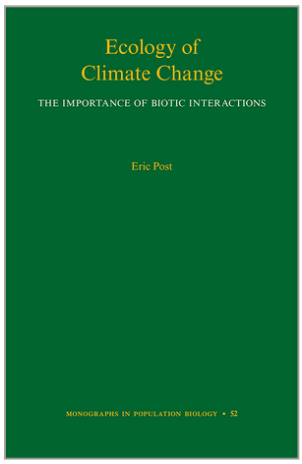
512 pages | Paperback
5th edition | 2013
ISBN 978-2-10059-2913

Price: €49

Publisher's summary

The 5th edition of the Dictionnaire Bilingue des Sciences de la Terre was launched last year. This fully revised and expanded new edition brings together scientific, technical and general terms that are most used in various fields of the Earth and space sciences. These include mining and petroleum geology, geophysics, geomorphology, climatology, oceanography, palaeontology and geochemistry. This bilingual dictionary is also enriched with new entries in hydrogeology, soil and other environmental sciences. Readers wishing to translate an article from English to French or vice-versa or write a scientific report will find many tips in the introduction of the book.

Ecology of Climate Change



By Eric Post

PRINCETON

408 pages | Hardback
1st edition | August 2013
ISBN 978-0-69114-8472

Price: £41.95 (~€51)

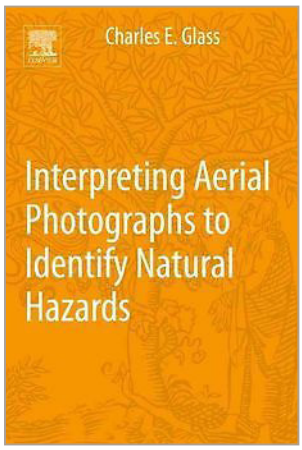
Publisher's summary

Rising temperatures are affecting organisms in all of Earth's biomes, but the complexity of ecological responses to climate change has hampered the development of a conceptually unified treatment of them. In a remarkably comprehensive synthesis, this book presents past, ongoing, and future ecological responses to climate change in the context of two simplifying hypotheses, facilitation and interference, arguing that biotic interactions may be the primary driver of ecological responses to climate change across all levels of biological organisation.

Eric Post's synthesis and analyses of ecological consequences of climate change extend from the Late Pleistocene to the present, and through the next century of projected warming. His investigation is grounded in classic themes of enduring interest in ecology, but developed around novel conceptual and mathematical models of observed and predicted dynamics. Using stability theory as a recurring theme, Post argues that the magnitude of climatic variability may be just as important as the magnitude and direction of change in determining whether populations, communities, and species persist. He urges a more refined consideration of species interactions, emphasising important distinctions between lateral and vertical interactions and their disparate roles in shaping responses of populations, communities, and ecosystems to climate change.

BACK TO CONTENTS

Interpreting Aerial Photographs to Identify Natural Hazards



By Charles E. Glass

ELSEVIER

184 pages | Paperback
1st edition | August 2013
ISBN 978-0-12-420018-0

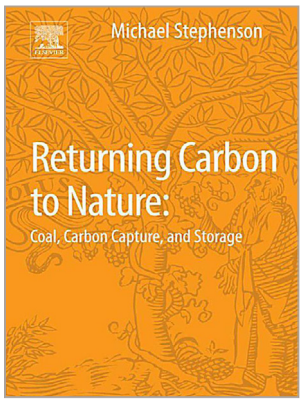
Price: €35.99

Publisher's summary

Authored by a world-renowned aerial photography and remote sensing expert, Geographic Aerial Photography: Identifying Earth-Surface Hazards Through Image Interpretation is the most practical and authoritative reference available for any professional or student looking for a reference on how to recognise, analyse, interpret and avoid – or successfully plan for – dangerous contingencies.

Whether they are related to natural terrain, geology, vegetation, hydrology or land use patterns, it's critical for you to be able to recognise dangerous conditions when and where they exist. Failure to adequately recognise and characterise geomorphic, geologic, and hydrologic dangers on the ground using aerial photography is one of the major factors contributing to due to natural hazards and disasters, damage to architectural structures, and often the subsequent loss of human life as a result. Aerial photographs provide one of the most prevalent, inexpensive and under-utilised tools to those with the knowledge and expertise to interpret them.

Returning Carbon to Nature: Coal, Carbon Capture, and Storage



By Michael Stephenson

ELSEVIER

150 pages | Paperback
1st edition | August 2013
ISBN 978-0-12-407671-6

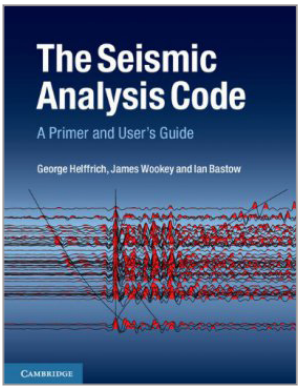
Price: €35.95

Publisher's summary

Carbon capture and storage is one of the main carbon emissions policy issues globally, yet you may know little about it if you're outside the academic community. As the global push to address the impact that carbon emissions has on global warming continues, awareness and knowledge of viable solutions must be communicated in layperson terms. Returning Carbon To Nature breaks across traditional barriers among history, geology, biology and climate change to address the topic from a multidisciplinary, Earth System Science approach. If you're a policymaker or someone who influences policy, this book will explain carbon capture and storage-a relatively new concept-in easy-to-understand terms. Clearly presented charts, tables and diagrams explain critical concepts, and a range of full-colour photographs will help you visualise the carbon capture and storage process and its principles.

The Seismic Analysis Code: A Primer and User's Guide

A book review



By George Helffrich, James Wookey and Ian Bastow

CAMBRIDGE UNIVERSITY PRESS

183 pages | Paperback
1st edition | September 2013
ISBN 978-1-10761-3195

Price: £30.00 (~€37)

Seismological data are one of the most prominent data-resources in many fields of geophysics. Various codes and libraries are available for seismic data analysis in order to extract information for different applications. The Seismic Analysis Code (SAC), originally developed in the 1980s, is one such code. It is a general purpose programme for basic operations on time series data and, due to its ease of use and suitability for data analysis, it is one of the most widely used analysis packages for regional and teleseismic data.

The Seismic Analysis Code: A Primer and User's Guide, by George Helffrich, James Wookey and Ian Bastow, is the first book that provides users with a complete guide to SAC. Its main target audiences are researchers and graduate students in seismology and geophysics. The book has a practical approach to a wide range of topics: from the essence of SAC processing, basic commands and macro language, to many advanced features, such as its file structure, integration of external processing steps into production-type data analysis schemes and advanced graphical aspects.

This book is based on the authors' decades of experience, both as core contributors to its development and as advanced users. The text is well-written with high-quality illustrations and example outputs of the SAC programme that support the concepts presented in the book. The chapters are short and thoughtfully divided into sub-sections which provide a categorised access to the content. Each section starts with a clear introduction to the key concepts followed by practical examples that represent the main functionalities of SAC.

The Seismic Analysis Code: A Primer and User's Guide is divided into eleven chapters. Chapters 1–3 provide an introduction to history of SAC development, different versions of this code, data formats and SAC processing philosophy. This helps readers familiarise themselves with SAC and the main concepts behind the data format, processing scheme and SAC commands. Chapter 4 introduces the basic commands. It explains the fundamental features of this code such as reading and writing data, plotting and cutting, picking, file header, trace preparation and resampling, rotation and frequency-domain operations and filtering, all of which are essential in routine processing of seismological data. While using the programme in interactive mode can be very helpful for many applications, SAC's powerful macro capabilities can capture repeated or commonly used commands and execute them with minimal user interaction. This plays an important role in today's seismic data processing and is explained in Chapter 5, which introduces the required elements for writing macros. The book goes one step further in Chapter 6 by describing how to access SAC data and its functionalities from external programs. Chapters 7–10 address more advanced examples of plotting and data processing (array data handling and spectral estimation), as well as three-dimensional data in SAC. Finally, in Chapter 11, SAC implementations for two standard applications, shear wave splitting and receiver function analysis are presented. Additionally, the authors provide a list of SAC commands in alphabetical order as well as SAC command descriptions sorted by a selected set of keywords at the rear of the book.

Perhaps the most impressive aspect of this book is its ability to guide new users through the steps of learning SAC basics in detail, by providing extensive example inputs and outputs, as well as catering for experienced users, by describing hidden features in SAC. However, due to the focus on practical usage of the code and the shortness of the text in introducing the theoretical concepts, it is more a tutorial guide for methods available in SAC rather than a reference book for theoretical aspects of data processing. This is indeed not a disadvantage since the aim of the book, as the book's title suggests, is to be a primer and user's guide for SAC.

All in all, the book is an excellent and complete guide to SAC for users with different levels of expertise. It covers diverse aspects of the Seismic Analysis Code in a concise and clear way and provides a practical description for both fundamental and more advanced features of SAC.

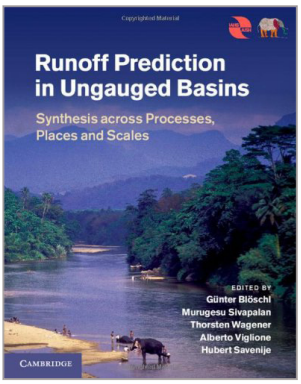
Kasra Hosseini
PhD student, Department of Earth and Environmental Sciences, LMU University of Munich, Germany

More information

All the examples can be downloaded from the publisher's website:
www.cambridge.org/helffrich

Runoff Prediction in Ungauged Basins: Synthesis across Processes, Places and Scales

A book review



Edited by Günter Blöschl, Murugesu Sivapalan, Thorsten Wagener, Alberto Viglione and Hubert Savenije

CAMBRIDGE UNIVERSITY PRESS

484 pages | Hardback
1st edition | April 2013
ISBN 978-1-107-02818-0

Price: £90.00 (~€110)

Floods, crop-threatening droughts, water shortages and water contamination are only some of the global problems that require information on the way water runs in drainage basins. Estimates of the space-time variability of runoff are needed for almost every location where people live, but in most catchments around the world runoff is not monitored. Unrecorded conditions in monitored catchments, such as anticipated changes in climate or land use, pose a similar challenge for hydrologists and water managers.

Runoff Prediction in Ungauged Basins: Synthesis across Processes, Places and Scales is a comprehensive book on runoff prediction. The term prediction stands for the estimation of runoff characteristics – such as the mean annual runoff or the probability of exceeding a certain flood runoff – for unmonitored locations and situations using climate data and catchment properties.

The book is an attempt to overcome the so-called fragmentation problem in hydrology. Hydrology lacks universal theories at the catchment scale, which is the scale of interest for most water problems. Process knowledge has been derived mainly from the point scale, but upscaling from this to the catchment scale is extremely difficult. Today, there is a huge variety of models and approaches for catchment runoff prediction, strongly differing in model concepts, structure and parameters, as well as input used. Many, if not most, runoff predictions follow a pragmatic strand, are not rigorously tested, and aim at local solutions, but do not foster the transfer of knowledge and understanding. As a response to this fragmentation, the International Association of Hydrological Sciences started the global community effort Predictions in Ungauged Basins (PUB) in 2003. Over the last decade, this initiative has successfully worked towards organising knowledge and developing transferable generalisations. This book is a central outcome of the PUB initiative, and attempts to put in order the current practice, experience and range of approaches in this field. It builds, among other things, on a comparative assessment of thousands of studies. The editors have managed to collect more than 130 authors in a coherent book, covering about 25000 catchments from all around the world.

The book is intended for hydrologists and Earth and environmental scientists with an interest in hydrology. The editors put much effort in laying out how runoff is interwoven with landscape characteristics and catchment history. The concept of co-evolution of landscape processes (i.e. reciprocal evolutionary change of soils, vegetation, and topography in response to climate dynamics, geological processes and human interventions) plays an important role. Thanks to such comprehensive and advanced perspectives, this book will also be a good starting point for early stage researchers. It contains a large number of very illustrative, high-quality figures, schematically depicting the functioning of catchments or exemplifying central statements. Many photographs of rivers and landscape features support the editors' concept of 'reading the landscape', with the aim to better understand the processes underlying spatio-temporal variability of runoff. Even though the volume is not a hydrology textbook, the concepts and many figures will be most valuable in university hydrology courses.

The book addresses the fragmentation of modelling approaches through comparative hydrology – comparing prediction methods and their success across regions, scales and processes. Investigating the differences and similarities between a large number of catchments around the world is used as vehicle to understand how catchments function and why and where prediction methods work. A key to diagnosing catchments are runoff signatures, such as annual runoff or low-flow indicators. The idea is that catchments can be seen as organisms that have reached their current state through co-evolution, and that runoff signatures are the result of the catchment functioning. Hence, the collection of runoff signatures may reveal some aspects of the state and internal dynamics of catchments.

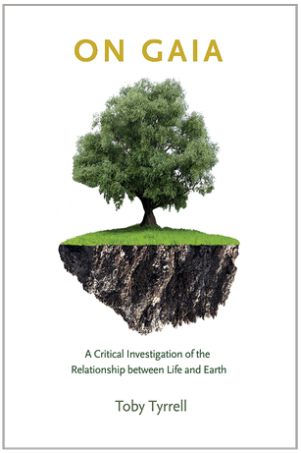
The book is organised around six runoff signatures, and each of the chapters 5 to 10 deals with one of these signatures. Chapter 2 introduces the synthesis framework, Chapter 3 discusses the important issue of data, and Chapter 4 gives the basic understanding of the essential catchment processes. The volume also features case studies collected from around the world and includes a summary of the findings and best-practice recommendations for prediction runoff in ungauged basins.

The editors convincingly demonstrate how the comparative hydrology approach helps bring order to the overwhelming variety of prediction methods. Given the large number of authors and the range of concepts and methods, it is amazing that the editors managed to compile such a coherent book. It is truly a unique synthesis of the available knowledge on runoff prediction, and a rich source for scientists and professionals working in ungauged catchments. Its broad perspective and the many attempts to reconcile diverging concepts will certainly stimulate the discussion in areas beyond runoff prediction.

Bruno Merz
Head of the Hydrology Section, Earth Surface Processes Department
GFZ German Research Centre for Geosciences

On Gaia: A Critical Investigation of the Relationship between Life and Earth

A book review



By Toby Tyrrell

PRINCETON

183 pages | Hardcover
1st edition | July 2013
ISBN 978-1-40084-7914

Price: £24.95 (~€31)

In the preface Tyrrell writes, "The book maintains a tight-beam focus on evaluating the Gaia hypothesis and includes only topics that contribute to a deeper understanding of its plausibility," a promise On Gaia keeps for most of its length.

In the following chapters Tyrrell first explains the concept of Gaia: "life is not solely a passenger on a fortuitously habitable planet, but instead is at the controls of the planetary environment." He then chooses bio-geological conditions to test the hypothesis. These range from modern evolutionary theory and techniques (selfish genes and recent experimental evidence on kin selection) to the icehouse Earth and evolutionary innovations. It becomes clear after a few chapters that the author does not subscribe to Gaia as an all-encompassing explanation for how our Earth system works, but instead gives us ample (and interesting) support for Stephen Schneider's co-evolutionary hypothesis. Earth and its biota have co-evolved, but this evolution does not ensure the sort of harmony implied by Gaia.

Still Tyrrell continues to put Gaia in the framework of empirical evidence and more recent modelling. Does Gaia hold in unstable climate conditions? In Tyrrell's estimation, the instability of the Earth's climate history is a strike against the theory – in the midst of rapid environmental changes and near extinctions it seems hard to find any evidence of a planet heading towards homeostasis.

Toby Tyrrell approaches the Gaia theory from many different points of view. Multiple subjects are handled in an objective and factual way. To understand the (sometimes complex) topics, the author gives relevant examples where he provides further explanation. Occasionally Tyrrell indulges in too many repetitions and examples, which lack depth in certain places. Other areas suffer from too much attention, for instance the section on chlorofluorocarbon's in the concluding chapter.

The use of colour figures would make the book more attractive and understandable, especially for the non-scientific public, as clear illustrations could make the difference in the understanding of the topic. For example, a figure explaining silicate weathering could help readers outside the geosciences have a better grasp on the process.

The book is timely because Tyrrell puts Gaia into the framework of Earth system sciences. The Gaia hypothesis has had forty years of empirical and theoretical scrutiny; On Gaia is a welcome check-up on the state of the theory and the evidence used to support or refute its claims.

On Gaia is a rewarding read for the knowledgeable reader. The book is an easy read and accessible to a broad audience. Unlike some science books intended for popular audiences, the book is sophisticated enough to keep the interest of graduate students. Tyrrell's tendency to repeat might have frustrated us a bit but it will probably help a more general audience better grasp sometimes complicated material. For the more scientific readers, the book offers a section with additional information on different subjects presented in a stimulating way.

Modern Geo-Ecosystems class, VU University Amsterdam, MSc Earth Sciences (September 2013)
The class used the book in their graduate course

More information

On Gaia Errata: In Chapter 4 the description of figure 4.9 talks about "the species richness of reptiles and trees (ectotherms)…", while there is no figure about the species richness of trees displayed in the figure itself.

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.

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: www.avh9.net

Wave Interaction – 2014

23–26 April 2014, Linz, Austria

Advances in the last 50 years have greatly improved our understanding of statistically described wave systems, but controlled experiments to study wave interactions and turbulence are relatively scarce. The aim of this workshop is to discuss regularly observable wave interaction phenomena that are not fully explained by the existing theories and develop new avenues for future research.

Website: www.dynamics-approx.jku.at/lena/Workshop2014/wt14.htm

Operational Techniques in Volcanic Hazard Assessment

24–25 April 2014, Vienna, Austria

The two-day workshop will include short lectures and demonstrations by experts in the volcanological application of Bayesian event trees, expert judgment methods, Bayesian belief networks and automated monitoring alerts. There will be an emphasis on the practical application of these techniques for operational hazard assessment.

Website: bet.bo.ingv.it/OTVHA2014

Japan Geoscience Union Meeting 2014

28 April – 02 May 2014, Yokohama, Japan

The annual meeting of the Japan Geoscience Union covers areas such as space and planetary sciences, atmospheric, ocean, and environmental sciences, human geosciences, solid Earth and biogeosciences. All presentations of international sessions are in English.

Website: www.jpgu.org/meeting_e

6th International Orogenic Lherzolite Conference

04–15 May 2014 , Marrakech, Morocco

The general objective of the International Orogenic Lherzolite Conferences is to assemble specialists on mantle processes to share new findings (often resulting from recent PhD theses) that are discussed in a group setting, both on key outcrops and in room sessions.

Website: lherzolite.gm.univ-montp2.fr

Summer School on Adaptation Policies and Practices in the Mediterranean Basin (MedAdapt)

19–23 May 2014, Venice, Italy

The International Center for Climate Governance and the Euro-Mediterranean Centre on Climate Change are pleased to announce the second edition of their Summer School for postgraduate students. The aim of this school is to offer an in-depth view of the impacts of climate change in the Mediterranean Basin and to pursue a thorough investigation of key adaptation policies and best practices, whether not yet implemented or already implemented across the region.

Website: www.iccgov.org/EventDetails.aspx?IDEvento=204&IDSM=62&IDM=99&Past=&Lan=en-US

2014 International Conference on Environment and Sustainability (ICES 2014)

24–25 May 2014, Hong Kong, China

ICES 2014 will be the most comprehensive conference focused on the various aspects of advances in environment and sustainability. It provides a chance for academic and industry professionals to discuss recent progress in the area of environment and sustainability. The goal of this conference is to bring together the researchers as well as practitioners to share ideas, problems and solutions relating to the multifaceted aspects of environment and sustainability.

Website: www.ices-conf.com

C-MORE Summer Programme

27 May – 28 June 2014, Honolulu, Hawaii, USA

The Center for Microbial Oceanography: Research and Education (C-MORE) in the School of Ocean and Earth Science and Technology (SOEST) at the University of Hawai'i at Mānoa is pleased to offer an international summer programme Microbial Oceanography: Genomes to Biomes. Sponsored by the Agouron Institute, the National Science Foundation (NSF), SOEST and C-MORE, the programme is offered to graduate students and post-docs, and will explore the dynamic and fundamental role marine microbes play.

Website: cmore.soest.hawaii.edu/summercourse/2014/index.htm

6th IAHS–EGU International Symposium on Integrated Water Resources Management

04–06 June 2014, Bologna, Italy

The conference aims to bring together experts from different countries and areas of expertise in a stimulating environment to present research ideas and results to bring hydrology into the future by reaching an improved connection with society. The conference will represent a key step in providing a first summary of the relevant research activity being carried out on the theme of hydrology and society and will be an opportunity to discuss the next editorial activities planned on the subject.

Website: iahs.info/bologna2014
Abstract deadline: 15 March 2014

20th World Congress of Soil Science

06–13 June 2014, Jeju, Korea

The field of soil science is mushrooming due to the growing interest in food security and safety as well as environmental quality. In addition, many emerging state-of-the-art technologies being developed by other fields will be available for us to adapt to soil science. Thus, we are in the presence of an explosion of information and knowledge in the many fields of soil science. The 20th WCSS will be an excellent opportunity to get on top of the changes in soil science and to envision new perspectives for basic and applied soil research.

Website: 20wcss.org

XX. International Conference on Computational Methods in Water Resources (CMWR 2014)

10–13 June 2014, Stuttgart, Germany

The conference will be a forum for the dissemination of the latest ideas in the development and application of advanced computational techniques to problems in water resources and related fields. Topics will include surface and subsurface hydrology, environmental hydrodynamics, ecohydrology, contaminant remediation, carbon sequestration, climate change, nuclear waste storage, fracking and geomechanics.

Website: www.cmwr14.de

76th EAGE Conference & Exhibition 2014

16–19 June 2014, Amsterdam, Netherlands

The upcoming event of the European Association of Geoscientists and Engineers features a six-day programme consisting of a large conference and a technical exhibition. The theme of the conference is Experience the Energy.

Website: www.eage.org/event

3rd Biennial Structural Geology and Tectonics Forum

16–18 June 2014, Golden, Colourado, USA

This forum will provide an informal and interactive venue for discussing important frontiers, new ideas, and current research in structural geology and tectonics. The forum will also provide opportunities to discuss effective teaching of structural geology and tectonics, including integrating research with teaching. The three-day forum will be bracketed by two optional days of workshops and field trips.

Website: serc.carleton.edu/NAGTWorkshops/structure/2014_Forum_index.html

48th ESLAB Symposium: New Insights into Volcanism across the Solar System

16–20 June 2014, Noordwijk, The Netherlands

This symposium aims to review the different mechanisms, sources and surface expressions of volcanism, both effusive and explosive. The symposium will focus on understanding the role and impact of volcanism in the early history of terrestrial planets (including Earth) with particular emphasis on moons and Mercury. This information will be brought together in order to improve our understanding of the formation and evolution of the Solar System.

Website: congrexprojects.com/2014-events/48-ESLAB/introduction

Latsis Symposium on Atmosphere and Climate Dynamics: From Clouds to Global Circulations

18–21 June 2014, Zurich, Switzerland

This four-day conference will bring together researchers from different subcommunities in the climate sciences to map out the most promising research avenues and answer the most pressing questions in climate dynamics. About half of the conference will be

devoted to invited talks and interactive discussion sessions, with the rest allocated to contributed talks and posters. This information will be brought together in order to improve our understanding of the formation and evolution of the Solar System.

Website: www.clidyn.ethz.ch/latsis2014
Abstract deadline: 21 March 2014

EUCOP4, 4th European Conference on Permafrost

18–21 June 2014, Évora, Portugal

The Portuguese Committee of the International Permafrost Association warmly invites you to bring permafrost science to Southern Portugal and enjoy scientific discussions in a great setting of culture and tradition in the city of Évora.

Website: www.eucop4.org

Biogeochemical Processes at Air–Soil–Water Interfaces and Environmental Protection

23–26 June 2014, Imola-Ravenna, Italy

The objective of this conference is to promote exchanges and discussion on the complex processes occurring at the air-soil-water interfaces in a perspective of environmental protection. Selected papers will be published on a Special Issue of the International Journal of Environmental Quality devoted to the 2014 ASWEP–ESSC (Air–Soil–Water Environmental Protection – European Society for Soil Conservation) Conference.

Website: aswep-essc.unibo.it

Sustainable Resource Development in the Himalaya

24–26 June 2014, Leh, India

The rich and varied resources of the Himalaya hold the promise of enormous opportunities for local communities and the nations to which they belong. Yet unless these resources are developed sustainably, they also have the potential to do great damage to people and environments. Geoscience holds the key to understanding these resources, and their effective and responsible development. Topics to be discussed include hazards, tourism, climate, sustainable resources, landscape evolution, and water.

Website: www.geolsoc.org.uk/himalaya14

What Ecology can Learn from Natural and Human-Induced Disturbances: a Cross-System View

07–18 July 2014, Barcelona, Spain

Ramon Margalef Summer Colloquia, a series of annual two-week summer encounters aimed at recent PhDs and advanced graduate students. Its main objective is to explore special topics of the Earth system, promoting the exchange of ideas between young and experienced researchers. The principal aim of this Colloquia is to enhance the exchange of ideas and to promote imaginative thinking by bringing together ecological knowledge from experts on terrestrial, limnetic and marine systems.

Website: www.acoio.org/margalef-summer-colloquia

BIOGEOMON 2014: 8th International Symposium on Ecosystem Behavior

13–17 July 2014, Bayreuth, Germany

The focus of BIOGEOMON is on the biogeochemistry of forest and natural ecosystems as influenced by anthropogenic and environmental factors. We invite empirical and modelling studies on fluxes and processes related to the turnover of major and trace elements at the ecosystem, watershed, landscape and global scale.

Website: www.bayceer.uni-bayreuth.de/biogeomon2014/
Abstract deadline: 04 April 2014