ISSN 2262–9754

GEO

THE QUARTERLY NEWSLETTER OF
THE EUROPEAN GEOSCIENCES UNION

ISSUE 1, MARCH 2012

HOW TO NAVIGATE THROUGH THIS NEWSLETTER

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

Use the Navigation Bar on the right to move between sections

Click on the links marked in blue and underline to direct you to a webpage or to compose an e-mail

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

EDITORIAL

Welcome to GeoQ!

Formerly known as the EGGS, the quarterly newsletter of the European Geosciences Union is entering a new phase. While keeping much of the informative material of the previous newsletter, GeoQ brings a few changes.

Not only is the name different, but so is the look. This new version comes in the form of a completely redesigned interactive PDF file. The user can navigate through GeoQ by clicking on the articles listed in the table of contents, or on the side tabs, visible from page 6 onwards.

The new version also features new sections. From these, I would highlight EGU Voice, which brings personalised news about EGU activities, and offers division presidents a chance to inform GeoQ readers about the workings of their respective divisions.

Issue 1 of GeoQ also provides readers with their quarterly intake of EGU and external news, information about new books, conferences and other events. There is also a Journal Watch section, which features particularly interesting articles recently published in EGU journals and highlighted by their editors. And much more!

The publication of this first issue was made possible by the work of all at the EGU office, particularly Edvard Glücksman, the 2012 EGU Science Communications Fellow. Jennifer Holden, the 2011 Fellow, also deserves acknowledgement for her excellent outreach work at the office, and for coming up with the name GeoQ.

The assistance of those elsewhere was also invaluable. Kostas Kourtidis, Chief Editor of the previous EGU newsletter, actively collaborated with us to make the transition process go as smoothly as possible. The EGU is most thankful to him for his excellent work in the EGGS, which resulted in the publication of 37 unique issues of the Union's newsletter in almost a decade.

Prior to joining EGU in September 2011, Bárbara worked as a science writer at the European Southern Observatory in Garching near Munich, and as a technical editor for London-based Form & Content Media. She completed a PhD in astrophysics from the University of Cambridge in 2010.

As we enter this new phase of EGU communications, we would like to hear from you about it. Feel free to drop me an e-mail with any comments, questions, or suggestions you might have about the new EGU newsletter.

Happy reading!

Bárbara Ferreira
Chief Editor of GeoQ & EGU Media and Communications Officer

GeoQ available online at www.egu.eu/geoq | Previous editions of the EGU newsletter the eggs E.G.U. NEWSLETTER at www.the-eggs.org

CHIEF EDITOR: Bárbara T. Ferreira – EGU Executive Office, Luisenstr. 37, 80333 Munich, Germany | Phone: +49-6189-2180-6703 | geoq@egu.eu
CONTRIBUTORS: Edvard Glücksman, Wayne Deeker, David Bressan, Oksana Tarasova, Denis-Didier Rousseau, G. Hilmar Gudmundsson, Michael Kühn, EGU Committee on Education, Clare Green
DESIGN: André Roquette

COVER PHOTO: Paradise Bay in the Antarctic Peninsula, by Sierra Pope (University of Ottawa, Canada), distributed by EGU under a Creative Commons licence via www.imaggeo.net

LETTER FROM THE PRESIDENCY

Dear EGU members, dear friends and colleagues,

You are reading the first issue of EGU's new quarterly newsletter, GeoQ. At the same time, we are saying goodbye to our long-standing form of communication, the EGGS newsletter. As times change, especially in the world of electronic communication, we have had quite a vivid discussion of the future format of our newsletter for some time now. Meanwhile, major changes have occurred at EGU and its organisatory partners.

With the establishment of the Executive Office at Munich, and its manning with a highly capable and motivated staff, the time has come to act on the results of our deliberations. In particular, as you have no doubt noticed, the EGU has acquired the skills and talent of a first-rate scientist and science journalist, Bárbara Ferreira, to serve as the first full-time media officer of the Union. What you see here is largely her achievement. In the short space of a few months she has brought this initiative to completion with the issue you are perusing. I strongly encourage you to do so – to peruse it. I am certain there is something in it for most of you … and if not … tell us!

With a powerful platform of publications, meetings, awards, outreach and a large, stable and growing membership, the EGU has matured to a remarkable state. The office as well as the Union officers and functions are there to help you to achieve your professional goals. As always, you are invited to make your voice heard – also in this new format. See you in Vienna at the General Assembly!

Don Dingwell
EGU President

Tuija Pulkkinen
EGU Vice-president

GEOQ ISSUE 1
MARCH 2012

Arsenic levels lowered by adsorption onto soil sediment in the Bengal Basin

Study challenges existing ideas about arsenic in deep groundwater supplies

Naturally occurring arsenic contaminates water supplies in Bangladesh and other parts of Asia, leading to what the World Health Organization (WHO) describes as the "largest mass poisoning in history". A recent study reported in *Nature Geoscience* examined the dynamics of arsenic in soil, showing that adsorption of the element onto sediment particles reduces its presence in tapped water drawn from deep underground. This finding is important because it challenges existing beliefs about how arsenic enters water supplies and, therefore, has the potential to change water management procedures and drastically improve the supply of potable water to millions of people.

A challenge to current beliefs

The study, conducted by an international team of scientists from Columbia University, Queens College, the University of Delaware, Barnard College, and the University of Dhaka, is unique because it uses data obtained both from in situ field experiments at the Bengal Basin and from high throughput computer models to illustrate that arsenic adsorption onto deeper sediments significantly impedes arsenic migration from soil to groundwater. This contradicts the widely held belief that the element enters deep-water wells when they are replenished by arsenic-rich water from shallower sediments, drawn deeper in downwards seepage and replacing water removed for irrigation and large-scale domestic use. Rather, the authors argue, the quality of construction of individual wells and isolated, naturally occurring, groundwater arsenic, may be responsible for higher readings in some deep-water sources.

This research follows in the wake of alarmingly high arsenic readings in deep groundwater wells across Bangladesh, exceeding the WHO's drinking water guideline value (10µg/l) and threatening both private and large-scale public water supply systems. Deep-water, taken from at least 150m underground, is routinely drawn from more than 100,000 wells across Bangladesh and Western Bengal to avoid reliance on shallower aquifer systems that are widely contaminated with arsenic and microbial pathogens. In South and Southeast Asia, shallow water sources may contain arsenic concentrations in excess of 200µg/l and the resulting health problems have ravaged local populations.

Long-term exposure to soluble arsenic salts through contaminated drinking water or the products of arsenic-rich irrigation waters (rice, livestock, burning cattle dung for fuel) leads to a gradual poisoning of the body, including the development of pigment patches, scaly skin, swollen limbs and joints, tumorous growths, and ultimately, fatal bouts of cancer.

Multifaceted experimental design

In the *in situ* portion of the experiment, arsenic levels were measured after uncontaminated groundwater was extracted and enriched with approximately 200µg/l of two arsenic species (III and V) and conservative tracer bromide, before being injected back into a nearby well of the same depth. Measurements over nine days showed that arsenic levels of species III and V dropped to 31% and 14% of their initial levels, respectively, during the 48 hours following inoculation. Meanwhile, concentrations of bromide remained near the level of injection during the first two days, suggesting arsenic was being removed from the groundwater by adsorption onto aquifer sands. Similar results were achieved in sand and groundwater removed from the same aquifer and characterised in the laboratory setting.

These data provided background information for hydrological computer model simulations charting groundwater flow and transport throughout the entire Bengal Basin. As in the field study, the models suggest that adsorption significantly slows the spread and subsequently reduces the presence of arsenic in publicly accessible water systems under several present and future scenarios.

Simple solutions to a global problem

Lead author Kathleen Radloff and her colleagues suggest that, by showing that increased contamination of deep groundwater is unlikely to be triggered by water withdrawal for small-scale domestic use, their findings may have direct implications on local policy and behaviour. However, the authors urge caution, pointing out that their study only considers the large-scale use of hand-pumps and does not cover recently introduced water supplies that are piped to burgeoning human communities. Moreover, they are careful to point out that most of the Bengal Basin remains highly vulnerable to downward migration of high-arsenic groundwater in the event of large-scale withdrawal of deeper waters, despite the effects of adsorption to the sediment, and therefore they discourage the use of deep groundwater for irrigation. Rather, they suggest, farmers should find alternative methods of irrigation or consider growing less water-intensive crops.

Arsenic contamination of groundwater is a global phenomenon and this study captures the imagination of researchers worldwide. "This research carries a far-reaching public health significance, not just for the people of Bangladesh but for those affected globally from arsenic exposure, including Americans," explains William Suk of the US National Institute of Environmental Health Services, which funded the study. According to the US Geological Survey, up to 43

million Americans depend on unregulated private wells and roughly a quarter of these having at least one contaminant exceeding levels considered safe by the Environmental Protection Agency.

Radloff herself is optimistic about the implications of her team's findings but remains careful not to overstate the meaning of what is largely a pilot study. "It is important to verify how adsorption changes across the Delta. We have specifically made very conservative assumptions in our modelling since it is likely that the different parts of the basin, with different sediment, will also have different responses," she explained to *Chemistry World*.

Dipankar Chakraborti of Jadaupur University, a globally renowned scholar in the field of arsenic contamination, reiterates Radloff's point. "This paper shows that deep aquifer sediment will adsorb arsenic resulting in safe water, but will this procedure work the same all over the Bengal Delta? Consideration must be given to differences in Bengal Delta sub-surface geology."

Nevertheless, with around a quarter of Bangladeshi and West Bengali wells contaminated with arsenic at above-WHO limits, this study's implications are a prime example of scientific discovery challenging existing knowledge, with the potential to directly improve the quality of human life with relatively simple planning and behavioural solutions.

Edvard Glücksman, EGU Science Communications Fellow

Reference

Radloff, K. A. et al. (2011): Arsenic migration to deep groundwater in Bangladesh influenced by adsorption and water demand, *Nature Geosci.* 4, 793–798

More tsunamis for Aceh

New research shows the 2004 tsunami was the first in a new cycle of clustered earthquakes – Aceh is still in danger

Indonesia has everything seismologists could wish for, particularly the island of Sumatra in the western part of the country. Researchers have long wanted to study this region, but political unrest in Aceh, the northern tip of Sumatra, made that difficult and risky. Thus, the 2004 tsunami came as a surprise: nothing was previously known of tsunami recurrence patterns for that spot and no historical records existed.

The country, though, is rich with seismic history. Centuries of colonial records established Indonesia's proneness to frequent large earthquakes. No wonder: it is part of the Sunda megathrust, where the Indo–Australian plate subducts under the Sunda plate, and is one of the most tectonically active regions on Earth.

Megathrusts produce the most powerful of all earthquakes. The oblique alignment of their plates gives vastly greater surface area than plates contacting only along their edges. This means more friction, more strain, and much more energy finally released.

The Sunda megathrust runs 6,000km from near northern Australia, along the southern coasts of the islands of Java and Sumatra, and northward through the Andaman Sea into Myanmar. Being so long, it is broken into several segments, each with distinct earthquake recurrence patterns. Recent historical and paleoseismic studies of the Mentawai segment, adjacent to the site of the 2004 epicentre, indicate strong clustering: several large earthquakes occur in a relatively short time, followed by relatively longer calm periods.

After 2004, an urgent need arose to establish the earthquake history for that location too. The tsunami also changed the political situation in Aceh – the current Governor came to power because the tsunami allowed him to escape from political detention – meaning that the province opened to international researchers. So began an international study, spearheaded by Dr. Aron Meltzner, now of the Earth Observatory of Singapore.

Conventional paleoseismic methods, such as trenching combined with carbon dating, are notoriously inaccurate. With these techniques, it is normally difficult to differentiate a clustered group of earthquakes from regular periodic patterns. Coral reefs, on the other hand, offer a way of distinguishing between clustering and regular seismic patterns, at least in tropical waters where such marine life thrives.

Fortunately, the southern Sumatran islands are one of few places on Earth where corals grow over a locked megathrust fault segment. Corals there directly respond to, and record, relative sea-level changes caused by strain accumulation and earthquake release: virtually a seismic logbook which Dr. Meltzner and colleagues could access. Even better, Simeulue Island, off southern Aceh, straddles the boundary between the 2004 segment and the adjacent, historically active, segment of the megathrust. This site is, therefore, one of very few where it might be possible to distinguish close but unrelated earthquakes originating from neighbouring fault segments.

Earthquakes generally lift coral microatolls partly out of the water, killing the corals. Obtaining the date of coral death, via uranium-series radiometric dating, closely approximates the earthquake date. Living corals preferentially absorb uranium-234 from seawater; measuring accumulation of decay-product thorium-230 indicates time since death. Meltzner's study employed intense sampling, sufficient to obtain date-errors of only two to three years. The study team also surveyed the microatolls, giving precise 3D uplift and lateral movement vectors. The date and vector information,

combined with coral's annual growth rings, can be used to accurately reconstruct and date land movements resulting from previous earthquakes and subsequent subsidence.

The 2004 megathrust segment, like its neighbour the Mentawai segment, revealed a rough earthquake clustering pattern. A trio of earthquakes seems to have occurred there for over 50 years starting in mid-1390. Uplift data shows the middle one, which occurred around 1430, was smaller and less well resolved, though the final earthquake of that series, in about 1450, was probably larger than the 2004 event. The corals also suggest a fourth historical earthquake around 950, although the date-error for this event is some five times larger than for the trio of earthquakes. The simplest conclusion, according to Dr. Meltzner, is that the 2004 segment had no activity from 1450 to 2004, and that 2004 marked the beginning of a new cycle. The 10th century earthquake was probably the tail of a previous cycle.

The earthquake cycle that finished in 1450 resulted in a cumulative fault slip of the 2004 segment of 20–25 metres. Yet, in 2004 the fault only slipped ten metres. Similarly, the total coral uplift of that period was also double that of 2004. These results indicate the 2004 fault segment should still hold considerable unreleased strain. The study authors concluded that in this area, after centuries of quiet, one large tsunami will be followed by others within decades, and then the site will quieten again. That means more tsunamis soon.

Huge tsunamis such as that of 2004, affecting the whole Indian Ocean, are unlikely in the region for several more centuries. However, the next rupture of the 2004 fault segment will almost certainly occur within decades, and probably within 200–400 kilometres of the 2004 epicentre. For Aceh, that means local effects similar to 2004. This suggests urgent preparation and mitigation priorities for the Aceh government.

Future studies will push back the dates to determine the 2004 segment's cycles beyond 1000 years. Ongoing research will also establish patterns for other megathrust segments and compare them as a whole, including how segments interact and the reasons large earthquakes do not cross the segment boundaries.

Wayne Deeker, freelance science writer

References

Meltzner, A. J. et al. (2009): Earthquake clusters and persistent segmentation near the boundary of the 2004 and 2005 Sunda megathrust ruptures, *Eos Trans. AGU* 90(52), Fall Meet. Suppl., Abstract T11D–07

Meltzner, A. J. et al. (2010): Coral evidence for earthquake recurrence and an A.D. 1390–1455 cluster at the south end of the 2004 Aceh–Andaman rupture, *J. Geophys. Res.* 115, B10402

What we know about catastrophic rockslides in the Alps

New and old dating methods are helping scientists understand what triggers large landslides

Very large rockslides, with a volume of more than one million cubic metres, are rare but can have disastrous effects on human settlements. A famous example of one of these 'catastrophic rockslides' happened in 1963, when a large volume of rocks fell into the artificial lake of Vajont, Italy causing a flood wave that destroyed several villages and killed 2,000 people.

To prevent similar disasters, it is important to understand the factors that can cause such large landslides. Early explanations involved only earthquakes, but since the mid-19th century, climate change has also been considered an important factor that can increase the occurrence of catastrophic rockslides.

According to this hypothesis, temperature oscillations increase the weathering rate of rock surfaces, causing the rock to become strongly cracked and fissured. During periods of more humid climate, water infiltrates the rocks trough these fissures. The water acts like a lubricant and causes huge blocks to slip off – a rockslide occurs.

To test this hypothesis, it is necessary to compare the occurrence of rockslides with past climatic variations. In the Alps, written records of rainfall or temperature span about 250 years, a period where only a few large landslides occurred, like in 1806 when a rockslide destroyed the Swiss village of Goldau and killed some 500 people. To improve this limited database, geologists reconstructed the climate of the last 10,000 years and dated as many fossil rockslides as possible.

The climate in the Alps can be reconstructed with various methods: the chemical composition and fossil content of sediments deposited in alpine lakes can be used to estimate the amount of rainfall during the period when these sediments formed. Fluctuations of glaciers, inferred from the preserved moraines, are used to reconstruct the oscillations of temperature in the same time period.

Until about 50 years ago, radiocarbon dating was the only applicable method to date fossil rockslides. One of the first catastrophic landslides investigated with this method was the rockslide of Köfels in Tyrol, Austria, where a piece of wood buried by the rocks was dated to more than 9,800 years. However, such findings are rare

A large boulder of dolostone at the Tschirgant rockslide in the Tyrol region. Note the smaller pebbles at the basis of the boulder, which are hold together by the cement that formed after the rockslide occurred. (Credit: David Bressan)

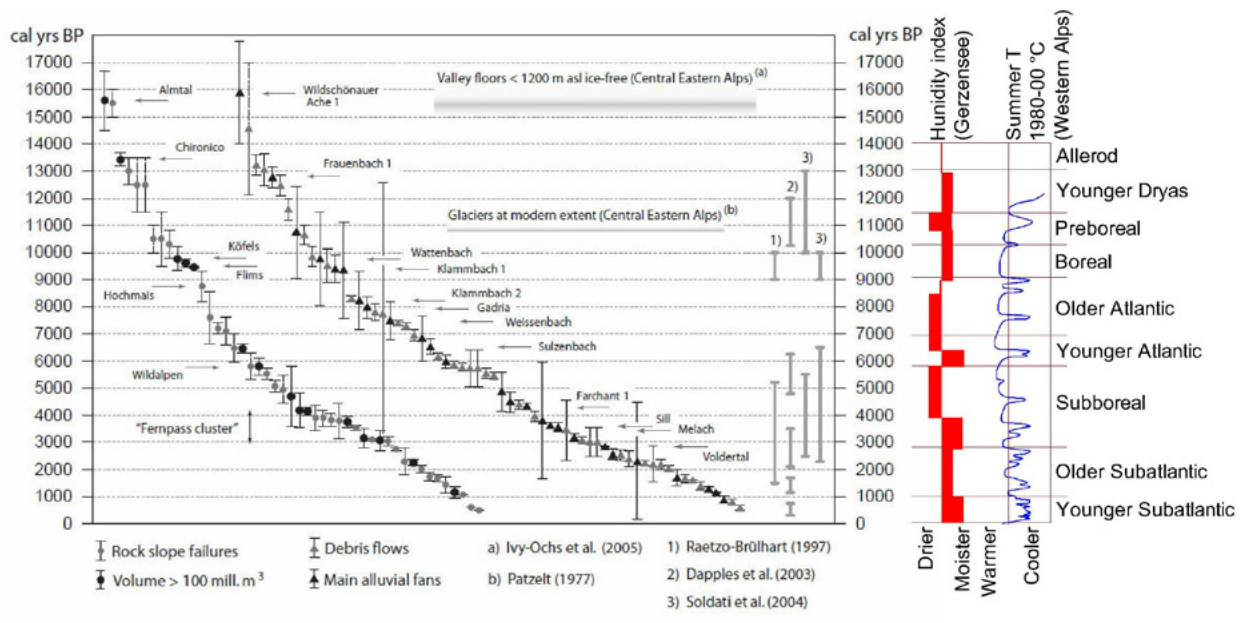
and the age of many fossil rockslides could not be measured until recently.

A new dating method, developed in the past few years by Marc Ostermann and colleagues at the University of Innsbruck in Austria, has significantly increased the number of datable deposits of old rockslides. Many landslides in the Alps occurred in regions characterised by carbonate rocks, like limestone or dolostone. Both these minerals, composed of calcium and magnesium, and with traces of uranium, are soluble in water. When a rockslide occurs, the superficial debris is rapidly dissolved by rainfall. The saturated water then percolates to the underground where it deposits a part of the dissolved elements, forming a new generation of minerals inside the cavities of the rockslide debris. This new formed 'cement' has almost the same age as the rockslide event.

The radioactive uranium incorporated into the cement slowly decays into thorium. By measuring the concentration of these two elements, it is possible to calculate the age of formation of the cement and therefore the age of the rockslide, as shown by the Innsbruck researchers.

With this method, the scientists dated various catastrophic rockslides of unknown age situated in the Austrian region of Tyrol, like the rockslide at the mountain pass of Fernpass or at the Tschirgant Mountain. Both fossil rockslides were dated to an age interval between 4,000 and 3,000 years.

In 2008, Prager and collaborators reviewed the available ages of these and other large fossil landslides and debris flows in the Central Alps. They found indications of a clustering of rockslides during the Subboreal – a period between 4,200 and 3,000 years ago. From the studied sediments deposited in the Swiss lake of Gerzen, and from the reconstructed fluctuations of the alpine glaciers, it is also known that the Subboreal was a period characterised by a humid climate, and with strong oscillations in temperature. However, Prager and his team note that the available data is still limited, and that



Temporal distribution of fossil landslides in the Tyrol and its surrounding areas compared to climatic variations (humidity and temperature). Note the cluster of events around 4,000 years ago (modified by David Bressan after Prager et al. 2008).

there are significant regional variations in the occurrence of landslides, possibly related to local variations in rainfall or temperature.

With a steadily growing database, using old and new dating methods, it will become clearer how rockslides are triggered by these environmental factors and how the occurrence of catastrophic events is controlled by climate change.

David Bressan, freelance geologist based in Italy

References

Ostermann et al. (2007): Aragonite and calcite cementation in 'boulder-controlled' meteoric environments on the Fern Pass rockslide (Austria): implications for radiometric age dating of catastrophic mass movements, *Facies* 53(2):189–208

Prager et al. (2008): Age distribution of fossil landslides in the Tyrol (Austria) and its surrounding areas, *Nat. Hazards Earth Syst. Sci.* 8, 377–407

Sanders et al. (2010): Meteoric lithification of catastrophic rockslide deposits: Diagenesis and significance. *Sedimentary Geology* 223, 150-161

Interview with Dr. Andy Smith, glaciologist who collaborated with BBC's Frozen Planet team

The British Antarctic Survey scientist talks about his research and the experience of working with a film crew

"Frozen Planet takes you on the ultimate polar expedition. This landmark series brings to the screen the frozen wildernesses of the Arctic and Antarctic as you have never seen them before, and may never see them again..." (BBC)

First of all, could you introduce yourself and talk a bit about your research work?

I have been working on the glaciers and ice sheets of Antarctica and the Arctic for over 28 years. I work as a glaciologist, using geophysical methods to study the ice and what lies beneath it. Changes in the ice sheets could have a significant impact on global sea level so we want to understand how the ice flow is controlled, what causes changes, and even what could mitigate change. We are currently working on Pine Island Glacier, part of the West Antarctic Ice Sheet. It is remote and difficult to get to, but it is the part of the ice sheet showing more change than anywhere else, so the logistical effort required to work there is well worth it. We hope to be in the field for nearly 3 months, living in tents and travelling by skidoo and sledge.

Where, when, and why did you team up with the Frozen Planet team?

The Frozen Planet team were at Rothera Station, our main station just off the west coast of the Antarctic Peninsula, in early 2010. This coincided with my return from a project on another large glacier, Rutford Ice Stream, where we were using seismic and radar surveys to study the material beneath the ice stream and, in particular, the subglacial hydrology. We had arranged in advance that our time at Rothera would overlap so we could work together. They were working with many people at Rothera and filming a whole range of the activities there. For their time with me, we specifically wanted to fly to Wilkins Ice Shelf and, if possible, land on one of the huge icebergs that have calved off it. Not long before, Wilkins Ice Shelf had suffered a major collapse in which a large proportion of the ice shelf very rapidly disintegrated into hundreds of pieces, some of which were easily big enough to land a plane on. When we flew over the ridge and first saw all the icebergs where the ice shelf had been, it really was an amazing sight. And then flying down and between the icebergs was some of the most exciting flying I've experienced. We also spent some time discussing and filming some of the geophysical methods we use, especially those where we use explosives as the energy source, to look beneath the ice.

How would you describe your experience accompanying the BBC crew and, in particular, the series-presenter David Attenborough?

The best way to describe my experience was immensely enjoyable and very stimulating, but David Attenborough himself was not part of the crew I worked with. Being able to work with them was a memorable experience. They combined being very professional and thorough, with at the same time being able to make me feel relaxed and comfortable. I'm sure this helped them to get the best out of people, which I think comes over well in the programmes. Being with them was hard work, but it was great fun too and I was impressed at how much they managed to fit into a relatively short visit. One thing everyone had to get used to was plans changing almost on a minute-by-minute basis, but I was expecting this and it clearly is the best way for them to fit so much in and to get the best footage possible.

What was a typical day like during that trip?

Busy! Early starts with a hurried breakfast normally followed by either hurriedly getting all the filming equipment to the aircraft if we were flying, or else an early morning drive to a snowfield a few

kilometres away if we were doing 'ground work' that day. I would often go ahead to prepare the scientific equipment or, if we were using them, the explosives charges, before the crew arrived. The best way to describe the day once the crew arrived is 'full-on'. But there was a lot of variety – trying new ideas, taking new opportunities, and just staying very focused on getting all the right footage. Evenings back at the station were the time for checking the day's work and planning for the next one. I remember long conversations about my work and its relevance, about the things we would – and perhaps wouldn't – be able to film, about the different options for the next day and what things would affect decisions and dictate the plan; they were very thorough about getting a complete understanding of things. Then of course, the day's plan could easily change at a moment's notice if the lighting improved or whales were seen unexpectedly. It was a sign of how thorough the crew's preparation was that they were able to do this when conditions required it.

University of California scientists benefited from teaming up with the Frozen Planet team on a field trip since they couldn't afford the specially equipped boat the BBC team had access to. Did the collaboration help your research in a similar way?

The field project I was working on at the time was in a different location and couldn't really benefit from the crew in this way. However, I think it is excellent that other teams could gain in this way and improve the research being done thanks to the BBC. Where both sides can benefit, it can only be a good thing for everyone.

Do you think the programme, in particular the episode you feature in (number 7), shows a good balance between portraying good and correct science with the need to get interesting shots?

I have yet to see the full programme but what I have seen across the series so far has shown a good balance. I think the photography has been absolutely stunning; at the same time, as an environmental research scientist, I've been perfectly happy with the science that has been portrayed.

In your view, how important are programmes like Frozen Planet in raising public awareness of what's happening in polar regions?

They are very important. As my research is funded by the UK Government it is very important to show UK taxpayers how their money is being spent and why study of the Antarctic affects them. Being so far away, the public often wonders why there is such a big science effort at the polar regions – but they are vast and play an important role in our understanding of how the Earth works. My work on Pine Island Glacier, for instance, is important for scientists to be able to access how this glacier (the size of England) in Western Antarctica is contributing to sea level rise.

Email interview conducted by Bárbara T. Ferreira, Chief Editor of GeoQ

Dr. Andy Smith (centre) with polar guide Ian Hey (left), and fellow glaciologist Gabby Chevalier (right). Credit: British Antarctic Survey

Division reports

News brought to you by presidents of four of EGU's divisions

In each edition of GeoQ, we ask four to six division presidents to contribute a report updating members with news from their division. Issue 1 gives voice to Oksana Tarasova of Atmospheric Sciences, Denis-Didier Rousseau of Climate: Past, Present and Future, G. Hilmar Gudmundsson of Cryospheric Sciences, and Michael Kühn of Energy, Resources and the Environment.

Atmospheric Sciences

The Atmospheric Sciences (AS) Division is one of the largest EGU divisions. The research areas covered by it extend from the large-scale dynamical processes in the atmosphere (like cyclones and global atmospheric circulation) to the small scale of the condensation nuclei and chemical reaction kinetics studied in laboratory. This report highlights some of the key areas of research for Europe in atmospheric sciences.

Many research activities in Europe, in particular in the area of environment, are supported via financial tools provided by the European Commission. Research infrastructures play an increasingly important role in the atmospheric sciences, and serve to attract the best researchers from around the world and to build bridges between national and research communities and scientific disciplines. Several atmospheric research initiatives are included in the ESFRI (European Strategy Forum on Research Infrastructures) roadmap, including the ones on polar research and atmospheric composition observations from the ground and from on board the civil aircraft. These research infrastructures, together with a number of big research projects, address the current priorities in atmosphere-composition research in Europe.

The state and changes of the polar areas are currently the subject of intense scientific debate and investigations. Two research infrastructures studying these regions are included in the ESFRI roadmap, namely, AURORA BOREALIS (research icebreaker in the Arctic) and SIOS (establishing Arctic Earth Observing System in and around Svalbard). These infrastructures are currently in preparatory phase.

In the area of climate forcing agents, long-lived greenhouse gases (GHG) and aerosols remain the focus of atmospheric research as these are recognised as climate-active substances. Research infrastructures in this area are also present in the ESFRI roadmap. Examples include the Integrated Carbon Observation System (ICOS) for quantifying and understanding the greenhouse balance of the European continent and of adjacent regions. ICOS has already substantially contributed to the harmonisation of GHG observations in Europe.

Finally, in the chemical weather research area, an European programme to highlight is MACC (Monitoring Atmospheric Composition and Climate). This is the current preoperational atmospheric service of the European GMES (Global Monitoring for Environment and Security) programme. MACC combines state-of-the-art atmospheric modelling with Earth observation data to provide information services covering European Air Quality, Global Atmospheric Composition, Climate, and UV and Solar Energy.

Oksana Tarasova
AS Division President

Climate: Past, Present & Future

The Climate Division (CL) restructured its programme by adding a new sub-programme, as required during the 2011 business meeting, covering past, present and future aspects of one topic. It is not, however, intended to have more sub-programmes as this would introduce more noise and confusion to the potential authors interested in climate studies. On the contrary, CL intends to increase its number of co-organised sessions, which is more attractive than simply co-listing sessions, and opens its programme to a wider audience.

Proposing new sessions also contributed to changing the programme, important in maintaining the Climate group as one of EGU's leading divisions. In doing so, CL has been very successful in increasing the number of abstracts submitted, a marked progression compare to its competitors from the Atmospheric Sciences and Hydrological Sciences, which continue to lead the Union.

The use of poster presentations using CL template, introduced at the 2011 General Assembly, will be encouraged in order to show the interest the Division and its conveners are placing on poster sessions and presentations. Therefore, the programme of 2012 should be once again very popular, and the attendance to CL sessions a great success, even if this year the Division is not organising Union sessions like in previous years (the idea of its master-class being now followed and used by other divisions).

The medal lectures will celebrate two very important scientists, but also two generations: Michael Mann for the Hans Oeschger medal and Wolfgang Berger for the Milutin Milankovic medal. The CL candidate for the Arne Richter Young scientist, Didier Roche, was not successful in being elected at the Union level. Nevertheless, CL was once more proactive in initiating the nomination of Michael Ghil to the Wegener medal in association with two other divisions, Nonlinear Processes in Geophysics and Ocean Sciences.

During the inter-General Assembly year, the Division's organisation has been improved with the addition of two new officers: Martin Wild, for present climate, and Jules Hargreaves, for future climate, complementing Jan-Berend Stuut who is covering past climate. With these additions, the three main themes of the Division are being monitored. Last but not the least, the CL journal, Climate of the Past, is doing well even with a decrease in its impact factor, remaining among the top ten of its category. The chief editorship evolved with the addition of Carlo Barbante, alongside new editors, in order to cover new fields brought by the authors.

Denis-Didier Rousseau
CL Division President

Cryospheric Sciences

The Cryospheric Sciences Division (CR) looks back at a very busy and successful year. The Division journal The Cryosphere got listed for the first time in ISI (Institute for Scientific Information) with an impact factor of 3.64. For a journal that was only launched about three years ago, to achieve such an high impact factor in such a short time is great news indeed. The journal has now firmly established itself as the leading journal in its field, and as one of the highest impact-factor journals available in the Earth sciences.

The number of submissions to sessions lead by CR to the EGU General Assembly increased by about 20% between 2010 and 2011, and this trend seems set to continue this year. The EGU Assembly is now one of the most, if not the most, important annual meeting in the cryospheric sciences.

The Division established the Louis Agassiz medal in 2005. The medal is reserved for individuals in recognition of their outstanding scientific contribution to the study of the cryosphere on Earth or elsewhere in the Solar System. This year's recipient of the medal is Ian Joughin at the Polar Science Center, Applied Physics Laboratory, University of Washington, US for outstanding contributions to the study of the dynamics and mass balance of polar ice sheets using differential SAR (synthetic aperture radar) interferometry and other techniques that he has helped to pioneer. The young scientist award is given to Gaël Durand at the Laboratoire de Glaciologie et de Géophysique de l'Environnement, Grenoble, France for his contributions to the understanding of polar ice dynamics from the micro- to the macro-scale.

As a division president, I would like to thank all those who have worked so hard on behalf of EGU and the Division of Cryospheric Sciences to make this possible.

G. Hilmar Gudmundsson
CR Division President

Energy, Resources and the Environment

The Energy, Resources & the Environment (ERE) Division is concerned with one of humankind's greatest challenges: providing sustainably harvested, reliable, and adequate supplies of affordable energy and other resources. Overcoming this challenge is essential to ensure the world's economic prosperity, environmental quality, and political stability. The need for answers to these interconnected challenges of energy, resources and the environment is what drives our work. The ERE Division has been progressing steadily in recent years, even in the face of growing challenges, being now very well established. This highlights the extreme importance of the topics we cover.

As with other EGU divisions, ERE's cycle of planning and organising culminates with the General Assembly. With Vienna in sight in April, and the deadline for abstract submission having passed, our main activities of the last months were to motivate the community to contribute to the programme. Our basis has been the skeleton programme we provided with the aim to ensure that all relevant subjects within the ambit of the ERE Division are well represented. The increase of the number of proposed sessions can be taken as indicator that the number of contributions and participants within ERE at the annual EGU meeting will grow again in 2012.

Steps in the near future are consolidation of the Division and engagement of young scientists – the next generation – to solve future problems in energy, resources and the environment.

Michael Kühn
ERE Division President

New EGU Science Communications Fellow

Edvard Glücksman will be working on GeoQ and assisting Bárbara Ferreira in developing media-related and science information communications

Edvard, a Swedish citizen, recently completed his doctorate (DPhil) at the University of Oxford, where his molecular biology project explored the diversity and ecology of Apusozoa. He also takes an active interest in science policy and communication and spent three months at the UK Parliamentary Office of Science & Technology in London, where he researched and wrote a parliamentary briefing on biodiversity offsetting, market-based conservation strategies.

Having also recently served as a Trans-Atlantic Junior Fellow at the Colorado-based El Pomar Foundation, Edvard maintains a keen interest in large-scale transatlantic policy issues. Further, he has recently been chosen to participate in the Emerging Leaders in Environment and Energy Policy network, a project hosted by the Atlantic Council of the United States.

Edvard's studies include an MSc degree from the University of Oxford as well as undergraduate degrees in Environmental Biology (BSc) from the University of St Andrews and Sociology/Psychology (BA) from McGill University.

If you have any questions for Edvard, he can be reached by phone at +49-(0)89-2180-6717 or by email at glucksman@egu.eu.

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

EGU in social media and new website icons

The EGU is proud to announce a new addition to its website: a set of social media icons and a group of links to some of the Union's outreach products. The new icons are visible below the website's menu on the left-hand side of the page.

The social-media icons link to the various profiles of the Union on social media networks such as Twitter, Facebook, Google+, LinkedIn, and YouTube. Users less familiar with these networking websites, can read more about them by clicking on 'What is this?'. Those who already have social media accounts are invited to follow EGU for Union's updates, information and geosciences-related news.

Website users can also access other communication and outreach products of the Union more easily, by clicking on the large icons below the social media links.

Two of these large icons give access to products that were already advertised through the Union's website. These are 'Imaggeo', which links to EGU's open-access geosciences image repository, and 'EGU TV', which gives access to General Assembly webstreaming and GIFT videos.

Finally, the website also features new links to GeoQ, and to the archive of the EGGS newsletter. 'GeoLog' links to the official blog of the Union, which recently saw changes in content and design. The blog regularly provides information about the Union and its activities, particularly its General Assembly, posts about recent research in the geosciences, and weekly highlights of Imaggeo pictures.

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

International Innovation interviews two EGU Division Presidents

The magazine, a scientific dissemination resource in Europe, recently talked to Michael Kühn and Stefano Tinti

Interview with Michael Kühn

Boldly trying to push science for solutions to solve the energy problems of tomorrow, Michael Kühn, is studying new approaches where renewables play a vital role.

What were some of the motivating factors underpinning the establishment of the Division on Energy, Resources & the Environment?

The European Geosciences Union (EGU) brings together geoscientists from all over Europe and the rest of the world, covering all disciplines of Earth, planetary and space sciences. This level of geoscientific interdisciplinary approach is needed if we are to successfully tackle the challenges of the future.

One challenge for humankind, for example, is to provide adequate and reliable supplies of affordable energy and other resources, obtained in environmentally sustainable ways, which will be essential for economic prosperity, environmental quality and political stability around the world. The Division on Energy, Resources & the Environment (ERE) works towards being a leading forum for these kinds of topics and also serves to inform the European Commission on such matters. It is driven by the need for answers to the interwoven challenges of energy, resources and the environment.

As the President of the Division, what does your role involve?

The scientific activities of the EGU are organised through the divisions, encompassing all studies of the Earth and its environment. The management and administration of each division are the collective responsibility of the respective President and officers. The major task and responsibility is to provide a sub-programme for the General Assembly of the EGU. I also take an active part in the EGU publications, by personally contributing to the EGU journals and book series and by serving as a referee to increase the standard of these publications. In addition, I contribute to our newsletter and support the outreach and educational activities of the EGU. The focal point for all division presidents is to bring together scientists and foster discussion between them, especially during the annual General Assembly.

Could you take us through some of the Division's and your day-to-day activities?

The activities of the Division need to be seen less on a day-to-day basis, and more from year-to-year. We have a cycle of planning and organising that climaxes with the General Assembly every year. However, to provide greater insight, I ensure that all relevant subjects within the ambit of the ERE are well represented.

With so many divisions at the European Geosciences Union, to what extent do you interact with the other departments? How does the Union maintain unity and harmony across such a broad range, all with their own individual requirements?

The Union is supposed to pursue scientific objectives exclusively. Through our divisions we promote cooperation and discussion in Europe among scientists concerned with studies of the Earth and its environment, as well as planetary and space sciences. We primarily use scientific assemblies, specifically our own annual General Assembly, as well as the promotion to the previously mentioned publications in order to achieve our objectives. It is the structure of the EGU which ensures optimal work. The Council, within which division presidents are members, is the highest decision making body in EGU, and is our platform for extensive discussion and cooperation across, and between, the divisions. Further support comes from seven Union-wide committees that report to the Council. However, the major focus for all of us is our annual General Assembly, which is the largest geoscientific meeting and discussion forum in Europe. Last year, we had more than 10,000 participants.

What types of energy does the Division's remit cover? As we move forward, what role are renewables going to have?

The planned programme for this year's General Assembly demands that the ERE cover wind and solar energy, in addition to geo-energy, geothermal energy and biomass. Furthermore, we will also study the topic of geological CO_2 storage, which is closely related to the use of fossil fuels.

In my view, renewables are going to have, or need to have, an outstanding role in the future. However, we scientists only provide the scientific basis to enable policy makers and the public to lead future directions. Unfortunately at the moment there are a lot of discussions going on which are not at all based on the required knowledge of natural science and engineering. I personally advocate that every idea and opportunity should be studied and tested. This is why we incorporate emerging topics into the ERE along the line.

In terms of Europe's resources, do we have sufficient stocks to continue utilising energy at our current rate for another 100 years? Is the situation as dire as the media portrays?

We certainly have enough energy resources for the next 100 years. However, we need to define and decide on a sustainable way, which takes into account the Earth's climate, the environment and the welfare of the world's population. Mankind has tried this with so called

'silver-bullets' a couple of times. In my opinion I don't think this will work. What we need are diverse solutions which are location-specific – both in terms of available georesources, as well as being culturally-compatible. The danger is that without a working climate policy, a massive re-investment in the coal sector appears rational, because only a minor fraction of worldwide coal resources have been fully exploited to date. Furthermore, the latter option would trigger a new dimension of dependence from Europe on energy imports.

In what way does the work of the ERE assist energy policy makers and to what effect?

The EGU runs a substantial outreach programme, which is supported by the different divisions, as well as our own. In general terms, the outreach programme and committee promotes geosciences. This includes engaging people, institutions, organisations – or other scientific unions – to make policy and decision makers aware of social problems related to geoscience. However, it is difficult to quantify the effect, because it isn't measurable.

What benefits to researchers does the ERE offer? How closely do you work with researchers?

We are working side by side with researchers – we are all researchers ourselves! This work is at the heart of the EGU, which is a research-driven Union. The ERE is an interdisciplinary division, and offers the specific benefit of combining knowledge from different areas of basic research.

Like the EGU, the ERE was founded in 2002. Within this framework, we are devoted to the promotion of geosciences and cooperation between scientists. We offer scientists our annual General Assembly and additional workshops, scientific meetings, topical conferences, short courses and summer schools. Importantly, we encourage the participation of young scientists in the affairs of the Union.

Would you like to highlight some recent achievements facilitated by the ERE?

Even in the face of growing challenges, the Division has showed a constant growth in recent years and is now very well established. This demonstrates that the topics we cover are of utmost importance.

What plans for the future do you have for the Division, and to what extent is innovation at the centre of your strategy?

Thus far I have helped the ERE to become an established division within the EGU, specifically focusing on the integration of geoscientific knowledge available within the entire Union. The increase of the number of sessions, the number of contributions and the number of participants at the annual EGU meeting will grow further within the coming years.

For the period of 2011–2013, for which I am again President, I will put my labour into the consolidation of ERE. My aim is to grow the Division into a notable group of experts, advising the council and the general community to solve the problems of tomorrow with regard to the unsolved questions of energy, resources and the environment.

Is there any other aspect of the Division that you would like to comment on?

We need young and motivated scientists and engineers to engage with our work and to spread scientific knowledge. This is not only an issue for the Division but relates to the entire EGU. Ultimately, our goal is always the pursuit of scientific excellence.

www.egu.eu/inside-egu/divisions-and-present-officers/division-energy-resources-and-the-environment/home.html

Mud boiling in geothermal hot springs, Hveragerdi, Iceland. In 2009, roughly 84% of primary energy use in the country came from renewable sources; of these, 66% was from geothermal. (Image distributed by EGU under a Creative Commons licence via www.imaggeo.net. Credit: Ragnar Sigurdsson/ Arctic-Images.com)

Interview with Stefano Tinti

Stefano Tinti, President of EGU Natural Hazards Division, details their important work and the Division's role in helping to protect Europe from the effects of natural disasters that occur in the region.

Could you begin by offering an insight into your background and professional areas of expertise?

I am Professor of Geophysics at University of Bologna, Italy, and my background is in seismology and in tsunami science. My first research papers dealt with the propagation of long ocean waves, such as tsunamis, and their interaction with harbours. Then I expanded to tsunamigenic earthquake sources, numerical modelling of tsunamis, inversion techniques, and tsunami early warning.

Furthermore, are you actively engaged in research yourself, and if so, what are you studying?

I am involved in research on tsunamis. This has been my main field of research in recent years, with my main focus on numerical modelling, tsunami hazard and risk assessment for the European coasts, and on local and regional early warning systems.

How would you explain the mission of your Division and what specific issues it addresses?

In principle, the mission of the Division of Natural Hazards is the same as all other divisions of EGU: to provide a forum at European level to all experts in the field, to exchange ideas, to discuss methods and results, to present theories and observations, and to focus on knowledge gaps.

However, there is a specific feature that makes the Division unique. Natural Hazards are 'natural' phenomena that become a 'hazard' because they impact on society and/or on the environment. Therefore, one essential element of this Division is interest in the societal aspects of natural processes, which means that the actors here are not only researchers covering basic and applied science, but also all those subjects involved in civil protection activities, including management of critical emergencies and hazard mitigation.

Why are we concerned about natural hazards? If they are naturally occurring, what can we do to counter their impact? Would you talk us through some of the Division methods and approaches?

There are two time scales when we apply countermeasures, in the short term and in the long term. Long term mainly implies prevention, which is devising and implementing policies and strategies to reduce the impact of natural catastrophes. This involves a strong cooperation between scientists and policy makers, and investing in resources now to gain an advantage in the future.

The short term concerns the time where the natural process is ongoing, or just ended, requiring real time monitoring, forecast, warning, rescue, humanitarian assistance.

Regarding the second part of the question, I can tell you that an EGU division has no specific methods or approaches. It is not an operational body or a research institution. It is a forum offered to all scientists involved in research in geosciences who have special sensitivity to those natural processes that can have impact on the society, and that like to discuss these topics openly.

All scientists active in the Division share the belief that science is a means to help our societies to develop 'correctly' in the physical environment. This belief inspires the selection of the problems to study, the objectives of the research, as well as the way the results are communicated.

To what extent does your Division and its work leverage effort and activity to support researchers?

Our Division is part of the EGU and works at a European level. The annual General Assembly (GA) of the EGU is the most important event in Geosciences in Europe, involving more than 10,000 participants not only from Europe, but from around the world.

Traditionally, Natural Hazards is one of the largest divisions of EGU, and is, in turn, structured into many subdivisions, and organising tens of symposia. Nowadays the event is considered a classical appointment for researchers. Moreover, EGU provides support for other symposia and conferences during the year on specific topics. One example is the Plinius Conference series, a thematic series of meetings on storms in the Mediterranean that reached the 13th edition in 2011, and which falls within the frame of the Natural Hazards Division.

Furthermore, EGU has established a number of awards for young scientists who have shown themselves to be outstanding in their field of research.

It is important to understand that atmospheric hazards can trigger geologic hazards, and geologic hazards can trigger other hazards. Could you offer an example of this? Is this something that is increasing as the lines blur between what are 'natural' and what are a 'human-induced' hazards?

The processes that lead to hazards are quite complex and are strongly interrelated, which has the subsequent implication that they have to be studied with a multidisciplinary approach. The chain of interdependency is very interesting and also very common, therefore it is not difficult to provide examples. Think of intense rain associated with storms that can cause diffuse landslides, river flooding, and violent sea waves. The storm is the primary hazard, then landslides, floods and storm waves are the secondary hazards. But floods can also be generated by the obstruction of a river by a landslide, and therefore can be a hazard of third level.

Another example is a submarine earthquake that can provoke a tsunami, or which can induce a submarine landslide, in turn causing a tsunami. A further example can be a large volcanic explosion that, in addition to local damage, can be hazardous for air navigation up to hundreds of kilometres away from the volcano.

As for the aspect of contiguity between natural and human-induced hazards, I can state that, in a sense, it is connatural to the concept of natural hazard itself. As I said before, a natural process is not a hazard per se; it is only a hazard as a consequence of the potential impact on the society. Building houses on the slope of a volcano is a bad example of land management that increases the consequences of a possible eruption, much as building industrial plants in areas that are exposed to natural hazards is not a clever idea.

Everybody has in mind the impact of the 11 March 2011 tsunami on the nuclear power plant of Fukushima on the coast of Japan. The tsunami was disastrous, killing more than 20,000 people (if we include even missing persons in the count), but the impact was amplified by the nuclear accident in the plant that was not protected adequately from tsunami waves.

Does the Division cover the full gamut of natural hazards? Are there new and emerging natural hazards coming into play as a result of climate change and human activity?

In principle yes, but in practice not all of them are represented in the way we wish. The main hazards covered are hydro-meteorological hazards, volcanic hazards, landslides, earthquakes, tsunamis and other ocean and coastal hazards, snow avalanches, and forest fires.

We reserve a subdivision to cover all other hazards, mainly biological and environmental. In the GA of 2012 we will, for example, touch

on the problem of hazard related to sinkholes – a special kind of geologic hazard that is usually not so widely discussed, but which deserves attention. However, I would like to extend the interest to other fields like desertification, droughts, lightening, etc. that are not satisfactorily covered.

I would not say that there are new natural hazards; I would say that there are more territories and more people exposed to hazards, and therefore it becomes ever more important to find countermeasures to natural hazards and to get to a new culture of societal development. As for climate change, this is the specific focus of an EGU Division called Climate: Past, Present and Future, which is concerned with climate variability and consequences, for instance, sea-level rise, which has the potential to increase the vulnerability of low-land coasts, and the observed increase in the frequency of high-energy atmosphere storms, which poses serious problems for many places that are unprepared to cope with them.

Natural hazards, such as landslides, often cause damage to human property and loss of lives. The picture shows a house damaged by a mud flow in the Buzau County, Romania. (Image distributed by EGU under a Creative Commons licence via www.imaggeo.net. Credit: Raluca-Mihaela Maftei)

Further to this, are there particular fields of research that you expect to gain prominence in the field of natural hazards in the future?

On one hand, modern society has proven to be very vulnerable to natural hazards, especially at the level of structures and infrastructures. On the other, modern society is increasingly based on the fast transmission of huge quantities of data and information.

My feeling is that one of the priorities that future research and technology should address is the development of more sophisticated systems of real-time monitoring and forecasting. As we move towards integrated and complex global systems of monitoring of the Earth: the ocean, the atmosphere, the land, we should also move towards integrated systems of forecast and warning.

Weather forecasting is already an operational routine, and river flooding forecasts are also implemented in several countries, but we should aim at improving the prediction quality and at extending the forecasting to many other fields, such as forest fires, landslides, and tsunamis – though each of these has its own specificity.

Where prediction is impossible at the today's level of experience, such as for earthquakes, the goal is to progress in the development of warning systems – which are currently capable of detecting a quake within a few seconds, and launch an automatic alert before the arrival of the S waves in the target place – and of techniques for the almost real-time determination of earthquake parameters.

In light of the recent forest fires in Australia, and the flooding in Bangladesh, natural hazards are taking many lives. If they are exacerbated by reduced resource-availability and people living in high-risk areas, such as on flood plains, how can this be tackled when our global population is growing?

This is a serious problem. Your examples are not taken from Europe, but we can add more examples also from Europe of the impact of natural phenomena that is worsened by bad practices. In a sense, there is always a problem of lack of resources behind any major disaster, in both poor and developed countries.

The gap is more cultural than technological. To reinforce buildings in such a way to make them resistant to earthquakes may require a huge amount of money. This is certainly the case in Italy, my country, where most of the territory is classed as seismic and where most of the old houses would be severely damaged or destroyed by a strong earthquake. Yet, private and public investments for prevention are hard to find, since there is always some other goal that gains priority. History teaches us that serious action is only taken after disasters have occurred, even with recent events. It seems that, though it is proven that prevent actions are more efficient and less costly, the general practice has, too often, been to act only in the post-disaster phase.

Finally, besides the direct impacts of natural hazards, such as a flood destroying a house, there are usually many indirect impacts, such as the spread of disease for weeks after the initial destruction. These indirect impacts can threaten more lives and add years to the recovery time from a disaster. Is this an area which the Division also considers, and in what capacity?

There is a subdivision of NH called Natural Hazards and Society. It is mainly here that these aspects, including the evaluation of the total cost of a disaster and resilience, are handled. Furthermore, it is here that geoscientists have to work hand-in-hand with all the other actors. This is a specific feature of our Division within EGU.

http://www.egu.eu/inside-egu/divisions-andpresent-officers/division-natural-hazards/home.html

Fukushima at increased earthquake risk

EGU press release highlights research published in *Solid Earth*

Seismic risk at the Fukushima nuclear plant increased after the magnitude 9 earthquake that hit Japan last March, scientists report. The new study, which uses data from over 6,000 earthquakes, shows the 11 March tremor caused a seismic fault close to the nuclear plant to reactivate. The results are now published in Solid Earth, *an open-access journal of the European Geosciences Union (EGU).*

The research suggests authorities should strengthen the security of the Fukushima Daiichi nuclear power plant to withstand large earthquakes that are likely to directly disturb the region. The power plant witnessed one of the worst nuclear disasters in history after it was damaged by the 11 March 2011 magnitude 9 earthquake and tsunami. But this tremor occurred about 160km from the site, and a much closer one could occur in the future at Fukushima.

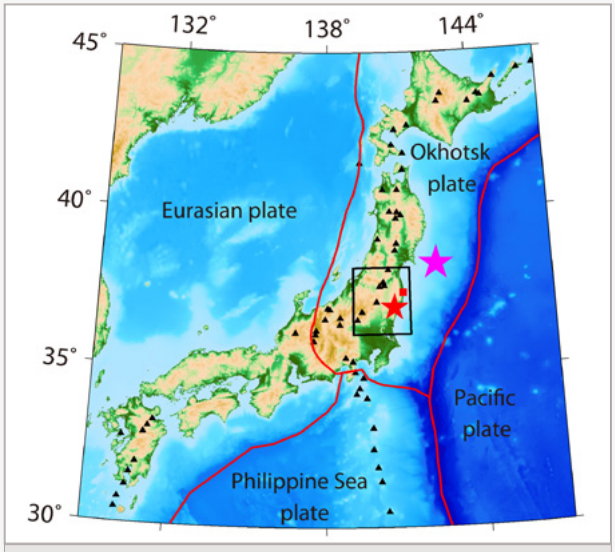
"There are a few active faults in the nuclear power plant area, and our results show the existence of similar structural anomalies under both the Iwaki and the Fukushima Daiichi areas. Given that a large earthquake occurred in Iwaki not long ago, we think it is possible for a similarly strong earthquake to happen in Fukushima," says team-leader Dapeng Zhao, geophysics professor at Japan's Tohoku University.

The 11 April 2011 magnitude 7 Iwaki earthquake was the strongest aftershock of the 11 March earthquake with an inland epicentre. It occurred 60km southwest of the Fukushima nuclear power plant, or 200km from the 11 March epicentre.

The research now published in EGU's *Solid Earth* shows that the Iwaki earthquake was triggered by fluids moving upwards from the subducting Pacific plate to the crust. The Pacific plate is moving beneath northeast Japan, which increases the temperature and pressure of the minerals in it. This leads to the removal of water from minerals, generating fluids that are less dense than the surrounding rock. These fluids move up to the upper crust and may alter seismic faults.

"Ascending fluids can reduce the friction of part of an active fault and so trigger it to cause a large earthquake. This, together with the stress variations caused by the 11 March event, is what set off the Iwaki tremor," says Ping Tong, lead author of the paper.

The number of earthquakes in Iwaki increased greatly after the March earthquake. The movements in the Earth's crust induced by the event caused variations in the seismic pressure or stress of nearby faults. Around Iwaki, Japan's seismic network recorded over 24,000 tremors from 11 March 2011 to 27 October 2011, up from under 1,300 detected quakes in the nine years before, the scientists report.



Map of Japan's islands indicating the area of study (black box). The purple star marks the epicentre of the 11 March earthquake and the red star the Iwaki epicentre. Fukushima Daiichi is highlighted by a red square. Black triangles indicate active volcanoes. (Credit: Ping Tong, Dapeng Zhao, and Dinghui Yang)

The 6,000 of these earthquakes selected for the study were recorded by 132 seismographic stations in Japan from June 2002 to October 2011. The researchers analysed these data to take pictures of the Earth's interior, using a technique called seismic tomography.

"The method is a powerful tool to map out structural anomalies, such as ascending fluids, in the Earth's crust and upper mantle using seismic waves. It can be compared to a CT or CAT scan, which relies on X-rays to detect tumours or fractures inside the human body," explains Zhao.

While the scientists can't predict when an earthquake in Fukushima Daiichi will occur, they state that the ascending fluids observed in the area indicate that such an event is likely to occur in the near future. They warn that more attention should be paid to the site's ability to withstand strong earthquakes, and reduce the risk of another nuclear disaster.

The scientists also note that the results may be useful for reviewing seismic safety in other nuclear facilities in Japan, such as nearby Fukushima Daini, Onagawa to the north of Fukushima, and Tōkai to the south.

Reference

Tong, P. et al. (2012): Tomography of the 2011 Iwaki earthquake (M 7.0) and Fukushima nuclear power plant area, *Solid Earth,* 3, 43–51, 2012

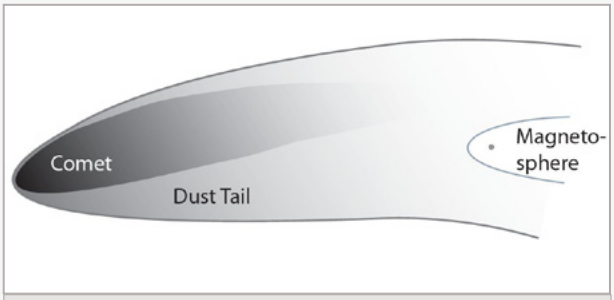
GEOQ JOURNAL WATCH

Magnetopause displacements: the possible role of dust

Article published in *Annales Geophysicae*

Abstract

Large compressions of the magnetopause are proposed to occasionally result from temporary encounters of the magnetosphere with dust streams in interplanetary space. Such streams may have their origin in cometary dust tails or asteroids which cross the inner heliosphere or in meteoroids in Earth's vicinity. Dust ejected from such objects when embedding the magnetosphere for their limited transition time should cause substantial global deformations of the magnetopause/magnetosphere due to the very large dust grain mass and momentum which compensates for the low dust density when contributing to the upstream pressure variation.



Schematic of the magnetosphere embedded into a wide cometary dust tail. (Credit: Treumann and Baumjohann)

Reference

Treumann, R. A. and Baumjohann, W. (2011): Magnetopause displacements: the possible role of dust, *Ann. Geophys.*, 29, 2219–2223

Glacial CO_2 cycle as a succession of key physical and biogeochemical processes

Article published in *Climate of the Past*

Abstract

During glacial-interglacial cycles, atmospheric CO_2 concentration varied by about 100ppmv in amplitude. While testing mechanisms that have led to the low glacial CO_2 level could be done in equilibrium model experiments, an ultimate goal is to explain CO_2 changes in transient simulations through the complete glacial-interglacial cycle. The computationally efficient Earth System model of intermediate complexity CLIMBER–2 is used to simulate global biogeochemistry over the last glacial cycle (126kyr). The physical core of the model (atmosphere, ocean, land and ice sheets) is driven by orbital changes and reconstructed radiative forcing from greenhouses gases, ice, and aeolian dust. The carbon cycle model is able to reproduce the main features of the CO_2 changes: a 50ppmv CO_2 drop during glacial inception, a minimum concentration at the last glacial maximum 80ppmv lower than the Holocene value, and an abrupt 60ppmv CO_2 rise during the deglaciation. The model deep ocean $\delta^{13}C$ also resembles reconstructions from deep-sea cores. The main drivers of atmospheric CO_2 evolve in time: changes in sea surface temperatures and in the volume of bottom water of southern origin control atmospheric CO_2 during the glacial inception and deglaciation; changes in carbonate chemistry and marine biology are dominant during the first and second parts of the glacial cycle, respectively. These feedback mechanisms could also significantly impact the ultimate climate response to the anthropogenic perturbation.

Reference

Brovkin, V. et al. (2012): Glacial CO_2 cycle as a succession of key physical and biogeochemical processes, *Clim. Past*, 8, 251–264

Engineering team completes ambitious Antarctic expedition in the 'deep-field'

A team of four British Antarctic Survey (BAS) engineers has returned to the UK after completing a gruelling journey to one of the most remote and hostile locations on the planet to put in place equipment and supplies for an ambitious project later this year. Enduring temperatures of minus 35°C the Subglacial Lake Ellsworth 'Advance Party' has successfully paved the way to explore an ancient lake buried beneath 3km of Antarctic ice. A powerful 'tractor-train' towed nearly 70 tonnes of equipment across Antarctica's ice over deep snow and steep mountain passes. This December a science and engineering team will make the 16,000km journey from the UK to collect water and sediments from the buried lake.

Lake Ellsworth will be the first Antarctic subglacial lake to be measured and sampled directly through the design and manufacture of space-industry standard 'clean technology'. Scientists have been planning for more than 15 years to access the lake, which is one of more than 400 known subglacial lakes in Antarctica, in the quest to yield new knowledge about the evolution of life on Earth and other planets. Lake-bed sediments could also provide vital clues about the Earth's past climate. Through a bore hole, drilled using high-pressure hot water, the team will lower a titanium probe to measure and sample the water, followed by a corer to extract sediment from the lake.

The Advance Party team paved the way for this mission by transporting the drilling equipment more than 250km through the Ellsworth Mountain range, over deep-snow terrain and crevasses to the Lake Ellsworth drilling site. The final leg of this journey was the most challenging and required powerful tractors to tow heavy containers of equipment on sledges and skis, forming a 'tractor-train'. The soft, deep snow and concrete-hard 'sastrugi' snow forms caused the Advance Party's progress to slow, but after three days they safely reached the Lake Ellsworth drilling site.

The Ellsworth Mountains. (Credit: British Antarctic Survey)

The tractor train passing through the Ellsworth Mountains. (Credit: British Antarctic Survey)

Andy Tait, Advance Party Member and Hot Water Drill Designer / Engineer from BAS says,

"Lake Ellsworth is extremely remote, cold and hostile – ambient temperatures dropped to -35°C and with wind chill they dropped further still making living and working on site a physical challenge. We deliberately located the equipment over a kilometre (1.7km) from the drill site to protect it during the harsh Antarctic winter. We will move it to its final position and set up the rig ready for drilling in December.

"Severe winds and the extreme environmental conditions of the area made it vital that we spent a number of days winterising the equipment. Windblown snow will partially bury the equipment and this area of Antarctica is so vast that it would be difficult to find it again without the GPS locators we fitted at the corners of the site. Going back to live there for three months in November will certainly be an experience!"

Chris Hill, Advance Party Member and Lake Ellsworth Programme Manager from BAS says,

"This is a major milestone for the programme and we are delighted that our complex logistical operations were a success this season. Working within the short Antarctic summer season adds pressure to our time on the continent, which is why we had to plan two stages of the programme. The drilling season is nearly upon us, and we still have a long way to go before we can access Lake Ellsworth, but the success of the Advance Party this season certainly puts us in a good position for November."

The Lake Ellsworth Programme Principal Investigator, Professor Martin Siegert from the University of Edinburgh says,

"The completion of this stage of the mission is a welcome one – we are now one step closer to finding out if new and unique forms of

microbial life could have evolved in this environment. The samples we hope to capture from Lake Ellsworth will be hugely valuable to the scientific community. This year we will complete and test both the water sampling probe and the sediment corer. Extracted sediment samples could give us an important insight in to the ancient history of the West Antarctic Ice Sheet, including past collapse, which would have implications for future sea level rise."

Reference

The Lake Ellsworth consortium has published a paper describing how the sampling of Lake Ellsworth can be undertaken with minimal environmental impact – Reviews of Geophysics: Clean access, measurement, and sampling of Ellsworth Subglacial Lake: A method for exploring deep Antarctic subglacial lake environments.

Release issued by British Antarctic Survey Press Office on behalf of the Subglacial Lake Ellsworth consortium

Warmer climate, warmer European mountains

The decade from 2000 to 2009 was the warmest since the initiation of worldwide climate measurements, and while localised studies have shown evidence of changes in mountain plant communities that reflect this warming trend, no study has yet taken a continental-scale view of the situation – until now.

With the publication of "Continent-wide response of mountain vegetation to climate change," as an Advance Online Publication (AOP) in *Nature Climate Change* on 8 January 2012, researchers from 13 countries report clear and statistically significant evidence of a continent-wide warming effect on mountain plant communities.

These results are "clearly significant," says Ottar Michelsen, a researcher at the Norwegian University of Science and Technology (NTNU) and one of the article's co-authors. "You can find studies that have shown an effect locally, and where researchers try to say something more globally, but in this case, when you have so many mountains in so many regions and can show an effect, that's a big thing."

60 sites, 17 mountain areas

The article describes the results of a comprehensive effort to measure plant community changes in the mountains over the whole of Europe, with nearly a decade of time between the sampling efforts.

Researchers looked at 60 summit sites and 867 vegetation samples from 17 mountain areas across Europe in 2001 and then revisited the mountain sample sites in 2008. In Norway, a team of researchers including Michelsen and former NTNU researcher Bård Pedersen, now at the Norwegian Institute for Nature Research, studied mountain plots in the Dovre region in central Norway.

By comparing the vegetation found in the sample plots in 2001 and 2008, the researchers were able to see a clear shift in the species in the plots towards species that preferred warmer temperatures.

More specifically, the researchers assigned what they called an altitudinal rank to all 764 plant species included in the study. The rank reflects the temperature at which each species has its optimum performance. And because altitude and temperature are directly correlated in each mountain area (the higher your altitude in the mountains, in general, the colder it will be) the location on the mountain where a plant is found reflects its response to the actual temperature at that location.

Ranking the plant mix?

By summing the altitudinal ranks for the species in the plots, the researchers then used a mathematical formula to give each plot a "thermic vegetation indicator". The indicator was calculated for each plot for 2001 and 2008, and the change in the indicator over the seven years between sample periods showed researchers whether the mix of plants in each plot had stayed the same or shifted on average to plant types that preferred either colder or warmer temperatures.

They then combined the data for the 17 mountain areas for the two time periods to get a continental-scale view of what kind of larger changes, if any, might be underway.

"The transformation of plant communities on a continental scale within less than a decade can be considered a rapid ecosystem response to ongoing climate warming," the researchers wrote. "Although the signal is not statistically significant for single mountain regions, it is clearly significant when data throughout Europe are pooled."

The finding is significant both because the shift in plant communities could be clearly detected over time, but also because it suggests that plants adapted to colder temperatures that are now found in alpine plant communities will be subject to more competition, which "may lead to declines or even local disappearance of alpine plant species," the researchers note. "In fact, declines of extreme high-altitude species at their lower range margins have recently been observed in the Alps."

While the *Nature Climate Change* paper reports on European results, the overall effort is a part of a worldwide monitoring programme being coordinated out of the University of Vienna, Austria that extends over more than 90 mountain sites on five continents. The monitoring programme is called GLORIA, or the Global

Observation Research Initiative in Alpine Environments. University of Vienna researchers and GLORIA coordinators Michael Gottfried and Harald Pauli are the paper's lead authors.

Release published by the Norwegian University of Science and Technology

Unprecedented, man-made trends in ocean's acidity

Nearly one-third of CO_2 emissions due to human activities enters the world's oceans. By reacting with seawater, CO_2 increases the water's acidity, which may significantly reduce the calcification rate of such marine organisms as corals and molluscs. The extent to which human activities have raised the surface level of acidity, however, has been difficult to detect on regional scales because it varies naturally from one season and one year to the next, and between regions, and direct observations go back only 30 years.

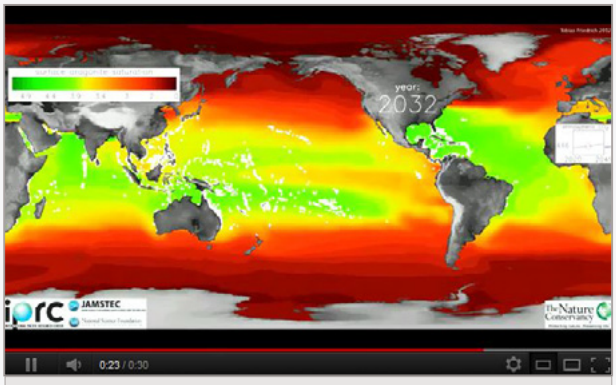
Combining computer modelling with observations, an international team of scientists concluded that anthropogenic CO_2 emissions over the last 100 to 200 years have already raised ocean acidity far beyond the range of natural variations. The study is published in the January 22 online issue of *Nature Climate Change*.

The team of climate modellers, marine conservationists, ocean chemists, biologists and ecologists, led by Tobias Friedrich and Axel Timmermann at the International Pacific Research Center, University of Hawaii at Manoa, came to their conclusions by using Earth system models that simulate climate and ocean conditions 21,000 years back in time, to the Last Glacial Maximum, and forward in time to the end of the 21st century. They studied in their models changes in the saturation level of aragonite (a form of calcium carbonate) typically used to measure of ocean acidification. As acidity of seawater rises, the saturation level of aragonite drops. Their models captured well the current observed seasonal and annual variations in this quantity in several key coral reef regions.

Today's levels of aragonite saturation in these locations have already dropped five times below the preindustrial range of natural variability. For example, if the yearly cycle in aragonite saturation varied between 4.7 and 4.8, it varies now between 4.2 and 4.3, which – based on another recent study – may translate into a decrease in overall calcification rates of corals and other aragonite shell-forming organisms by 15%. Given the continued human use of fossil fuels, the saturation levels will drop further, potentially reducing calcification rates of some marine organisms by more than 40% of their preindustrial values within the next 90 years.

"Any significant drop below the minimum level of aragonite to which the organisms have been exposed to for thousands of years and have successfully adapted will very likely stress them and their associated ecosystems," says lead author Postdoctoral Fellow Tobias Friedrich.

"In some regions, the man-made rate of change in ocean acidity since the Industrial Revolution is hundred times greater than the natural rate of change between the Last Glacial Maximum and



The animation shows how aragonite saturation at the ocean's surface is projected to decrease towards the end of the 21st century as man-made carbon dioxide accumulation in the atmosphere continues to rise.

preindustrial times," emphasises Friedrich. "When Earth started to warm 17,000 years ago, terminating the last glacial period, atmospheric CO_2 levels rose from 190 parts per million (ppm) to 280ppm over 6,000 years. Marine ecosystems had ample time to adjust. Now, for a similar rise in CO2 concentration to the present level of 392ppm, the adjustment time is reduced to only 100–200 years."

On a global scale, coral reefs are currently found in places where open-ocean aragonite saturation reaches levels of 3.5 or higher. Such conditions exist today in about 50% of the ocean – mostly in the tropics. By end of the 21st century this fraction is projected to be less than 5%. The Hawaiian Islands, which sit just on the northern edge of the tropics, will be one of the first to feel the impact.

The study suggests that some regions, such as the eastern tropical Pacific, will be less stressed than others because greater underlying natural variability of seawater acidity helps to buffer anthropogenic changes. The aragonite saturation in the Caribbean and the western Equatorial Pacific, both biodiversity hotspots, shows very little natural variability, making these regions particularly vulnerable to human-induced ocean acidification.

"Our results suggest that severe reductions are likely to occur in coral reef diversity, structural complexity and resilience by the middle of this century," says co-author Professor Axel Timmermann."

Release published by the University of Hawaii

Researchers discover particle which could 'cool the planet'

Scientists have shown that a new molecule in the Earth's atmosphere has the potential to play a significant role in off-setting global warming by cooling the planet

In a breakthrough paper published in *Science*, researchers from the University of Manchester, the University of Bristol and Sandia National Laboratories report the potentially revolutionary effects of Criegee biradicals.

These invisible chemical intermediates are powerful oxidisers of pollutants such as nitrogen dioxide and sulphur dioxide, produced by combustion, and can naturally clean up the atmosphere.

Although these chemical intermediates were hypothesised in the 1950s, it is only now that they have been detected. Scientists now believe that, with further research, these species could play a major role in off-setting climate change.

The detection of the Criegee biradical and measurement of how fast it reacts was made possible by a unique apparatus, designed by Sandia researchers, that uses light from a third-generation synchrotron facility, at the Lawrence Berkeley National Laboratory's Advanced Light Source.

The intense, tunable light from the synchrotron allowed researchers to discern the formation and removal of different isomeric species – molecules that contain the same atoms but arranged in different combinations.

The researchers found that the Criegee biradicals react more rapidly than first thought and will accelerate the formation of sulphate and nitrate in the atmosphere. These compounds will lead to aerosol formation and ultimately to cloud formation with the potential to cool the planet.

The formation of Criegee biradicals was first postulated by Rudolf Criegee in the 1950s. However, despite their importance, it has not been possible to directly study these important species in the laboratory.

In the last 100 years, Earth's average surface temperature increased by about 0.8°C with about two thirds of the increase occurring over just the last three decades.

Most countries have agreed that drastic cuts in greenhouse gas emissions are required, and that future global warming should be limited to below 2.0°C (3.6°F).

Dr. Carl Percival, Reader in Atmospheric Chemistry at the University of Manchester and one of the authors of the paper, believes there could be significant research possibilities arising from the discovery of the Criegee biradicals.

He said: "Criegee radicals have been impossible to measure until this work carried out at the Advanced Light Source. We have been able to quantify how fast Criegee radicals react for the first time.

"Our results will have a significant impact on our understanding of the oxidising capacity of the atmosphere and have wide ranging implications for pollution and climate change.

"The main source of these Criegee biradicals does not depend on sunlight and so these processes take place throughout the day and night."

Professor Dudley Shallcross, Professor in Atmospheric Chemistry at the University of Bristol, added: "A significant ingredient required for the production of these Criegee biradicals comes from chemicals released quite naturally by plants, so natural ecosystems could be playing a significant role in off-setting warming."

Release published by the University of Manchester

Acidification provides the thrust

How diamond-bearing kimberlites reach the surface

Kimberlites are magmatic rocks that form deep in the Earth's interior and are brought to the surface by volcanic eruptions. On their turbulent journey upwards magmas assimilate other types of minerals, collectively referred to as xenoliths (Greek for "foreign rocks"). The xenoliths found in kimberlite include diamonds, and the vast majority of the diamonds mined in the world today is found in kimberlite ores. Exactly how kimberlites acquire the necessary buoyancy for their long ascent through the Earth's crust has, however, been something of a mystery. An international research team led by Professor Donald Dingwell, Director of the Department of Geo- and Environmental Sciences at LMU, has now demonstrated that assimilated rocks picked up along the way are responsible for the providing the required impetus. The primordial magma is basic, but the incorporation of silicate minerals encountered during its ascent makes the

melt more acidic. This leads to the release of carbon dioxide in the form of bubbles, which reduce the density of the melt, essentially causing it to foam. The net result is an increase in the buoyancy of the magma, which facilitates its continued ascent. “Because our results enhance our understanding of the genesis of kimberlite, they will be useful in the search for new diamond-bearing ores and will facilitate the evaluation of existing sources,” says Dingwell. (*Nature* 18 January 2012)

Most known kimberlites formed in the period between 70 and 150 million years ago, but some are over 1200 million years old. Generally speaking, kimberlites are found only in cratons, the oldest surviving areas of continental crust, which form the nuclei of continental landmasses and have remained virtually unchanged since their formation eons ago.

Kimberlitic magmas form about 150km below the Earth’s surface, i.e. at much greater depths than any other volcanic rocks. The temperatures and pressures at such depths are so high that carbon can crystallise in the form of diamonds. When kimberlitic magmas are forced through long chimneys of volcanic origin called pipes, like the water in a hose when the nozzle is narrowed, their velocity markedly increases and the emplaced diamonds are transported upwards as if they were in an elevator. This is why kimberlite pipes are the sites of most of the world’s diamond mines. But diamonds are not the only passengers. Kimberlites also carry many other types of rock with them on their long journey into the light.

In spite of this “extra load”, kimberlite magmas travel fast, and emerge onto the Earth’s surface in explosive eruptions. “It is generally assumed that volatile gases such as carbon dioxide and water vapour play an essential role in providing the necessary buoyancy to power the rapid rise of kimberlite magmas,” says Dingwell, “but it was not clear how these gases form in the magma.” With the help of laboratory experiments carried out at appropriately high temperatures, Dingwell’s team was able to show that the assimilated xenoliths play an important role in the process. The primordial magma deep in the Earth’s interior is referred to as basic because it mainly consists of carbonate-bearing components, which may also contain a high proportion of water. When the rising magma comes into contact with silicate-rich rocks, they are effectively dissolved in the molten phase, which acidifies the melt. As more silicates are incorporated, the saturation level of carbon dioxide dissolved in the melt progressively increases as carbon dioxide solubility decreases. When the melt becomes saturated, the excess carbon dioxide forms bubbles. “The result is a continuous foaming of the magma, which may reduce its viscosity and certainly imparts the buoyancy necessary to power its very vehement eruption onto the Earth’s surface,” as Dingwell explains. The faster the magma rises, the more silicates are entrained in the flow, and the greater the concentration of dissolved silicates – until finally the amounts of carbon dioxide and water vapour released thrust the hot melt upward with great force, like a rocket. The new findings also explain why kimberlites are found only in ancient continental nuclei. Only here is the crust sufficiently rich in silica-rich minerals to drive their ascent and, moreover, cratonic crust is exceptionally thick. This means that the journey to the surface is correspondingly longer, and the rising magma has plenty of opportunity to come into contact with silicate-rich minerals.

The project was funded by a European Research Council (ERC) Advanced Investigator Grant (EVOKES) and further supported by an LMUexcellent Research Professorship awarded to Donald Dingwell. (göd/PH)

Release published by LMU, the University of Munich

News from the EGU Committee on Education

2012 is set to be a year full of exciting educational activities

GIFT Distinguished Lectures

In late January, Anny Cazenave, from LEGOS (Laboratoire d'Etudes en Géophysique et Océanographie Spatiale) in Toulouse, France, gave the first GIFT Distinguished Lecture. She talked on the occasion of the XII Meeting of Earth and Environmental Sciences High School Teachers hosted by the Museum CosmoCaixa, in Barcelona, Spain. The meeting, attended by around 170 teachers, was organised by the Institute of Educational Sciences and the Faculty of Geology of the University of Barcelona, in cooperation with ESA.

Two other GIFT Distinguished Lectures are already planned for 2012. Mathias Harzhauser, from Vienna's Museum of Natural History, will address teachers from AEPECT, the Spanish organisation for Earth sciences teaching, in Huelva, Spain, in July 2012. Yvon Le Maho, from the Hubert Curien Multidisciplinary Institute (IPHC) in Strasbourg, France, will give a lecture in Poland in September 2012, on the occasion of the XIII Polish Forum of Science Teachers.

For more information about the GIFT Distinguished Lectures, a new programme inaugurated by the Committee on Education in 2012, please check information on the EGU website. After an initial call for proposals, applications can now be submitted at any time; the Committee will examine them every six months in spring and autumn.

Anny Cazenave giving the first GIFT Distinguished Lecture.

2012 GIFT Workshop coming soon!

This year's Workshop, to take place at the EGU General Assembly in April, covers one of the most important environmental challenges of our epoch: 'Water!' Selected top scientists will address 81 teachers from 19 different countries participating in the symposium, while the teachers themselves will present their own activities to their colleagues, either during the workshop or during the EOS2 Educational session 'Sciences in Tomorrow's Classroom'.

A few excursions are also planned, such as a visit to the International Atomic Energy Agency Isotope Hydrology Laboratory, which will follow a talk by the laboratory's manager. At the end of the Workshop, the plan is to visit Vienna's water treatment plant, the most modern in Europe. And of course, the GIFT Workshop will be inaugurated by a visit to Vienna's Museum of Natural Sciences, followed by a small ice-breaker reception at the Museum itself!

Teachers at Sea

The next session of Teachers at Sea, a 3-week oceanographic cruise on board the R/V Marion–Dufresne of the French Polar Institute (IPEV), will start from Singapore at the end of the General Assembly week. Five or six teachers from France, Italy, Malaysia, and Spain will take part in the cruise. They will be involved in the scientific research on board at every stage, working with the scientists in retrieving the secrets of deep ocean circulation and evolution of the Asian Monsoon during the last climatic cycles. Teachers might be able to bring home sediments collected during the cruise (depending on the success of operating equipment on board), and will be able to explain to their pupils how these sediments can be used to unravel the Earth's mysteries. Training will be provided on board to meet this goal.

In addition, the teachers will be in contact with hundreds of educators and pupils worldwide, via the daily reports (in English) that they will write together, which will be assembled in a blog. Their own classrooms will also be able to follow their teacher's scientific adventures on a daily basis, as teachers plan on writing targeted blog posts to their students, in their native languages.

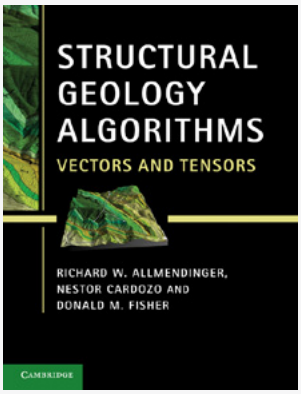
The teachers on board the cruise will surely absorb the enthusiasm of the scientists. The educational goal of Teachers at Sea is to see this enthusiasm transmitted to the students in the different schools, as their teachers bring 'live' science into the classrooms.

Hélder Pereira, a Portuguese teacher who took part in a Teachers at Sea cruise a few years ago, said: "I truly think that this experience on board the R/V Marion–Dufresne changed and improved my teaching strategies, allowing me to take 'real science' into the classroom. I would like to acknowledge the EGU and the IPEV that have funded the 'Teachers at Sea' educational programme (...). I can only hope that other fellow teachers will have the opportunity to participate and enjoy the great experiences this programme provides".

EGU Committee on Education

GEOQ BOOKS

Structural Geology Algorithms: Vectors and Tensors



By Richard W. Allmendinger, Nestor Cardozo, and Donald M. Fisher

CAMBRIDGE UNIVERSITY PRESS

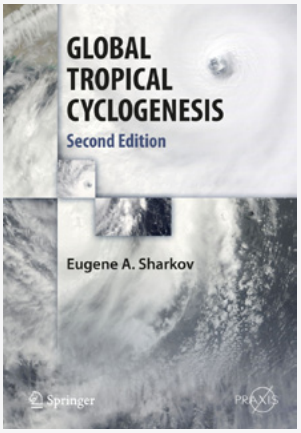
302 pages | Paperback
1st edition | December 2011
ISBN 978-1-10-740138-9

Price: £30.00 (~€37.00)

Publisher's summary

State-of-the-art analysis of geological structures has become increasingly quantitative but traditionally, graphical methods are used in teaching. This innovative lab book provides a unified methodology for problem-solving in structural geology using linear algebra and computation. Assuming only limited mathematical training, the book begins with classic orientation problems and progresses to more fundamental topics of stress, strain and error propagation. It introduces linear algebra methods as the foundation for understanding vectors and tensors, and demonstrates the application of geometry and kinematics in geoscience without requiring students to take a supplementary mathematics course. All algorithms are illustrated with a suite of online MATLAB functions, allowing users to modify the code to solve their own structural problems. Containing 20 worked examples and over 60 exercises, this is the ideal lab book for advanced undergraduates or beginning graduate students. It will also provide professional structural geologists with a valuable reference and refresher for calculations.

Global Tropical Cyclogenesis



By Eugene A. Sharkov

SPRINGER

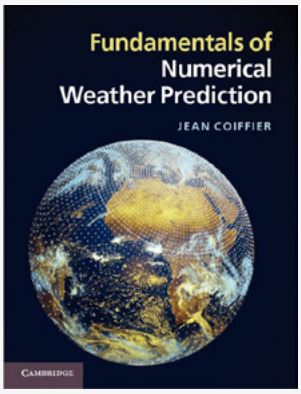
604 pages | Hardcover
2nd edition | December 2011
ISBN 978-3-642-13295-7

Price: €139.05

Publisher's summary

This book presents the first physical findings of an investigation into the spatio-temporal characteristics of the global tropical cyclogenesis. Since Global Tropical Cyclogenesis was first published in 2001, many important scientific results have been obtained using methods and techniques developed by the author, including: the detection of the global tropical cyclogenesis as a main element of poleward heat transport in the terrestrial atmosphere; the evolution tropical activity in equatorial precipitable water fields; and scales of interactions between solar activity and global tropical cyclogenesis. These are all explained, together with the new scientific knowledge gained from the study of spatial-temporal properties of the global tropical cyclogenesis which affects satellite oceanography, atmosphere physics, ocean engineering, air-sea interaction and ocean remote sensing. Professor Sharkov gives findings from the Russian scientific airplane-based remote sensing expeditions to the Far East over the Pacific and the several scientific marine expeditions to the tropics as part of major research projects of the Russian Academy of Sciences. A principal feature of the book is the integrated description of spatial-temporal and structure properties of atmosphere catastrophes. Emphasis is placed on the physical aspects of breaking processes necessary to judge the possibilities and limitations of remote sensing methods in monitoring and mitigating natural hazards. The author includes numerous practice applications and illustrations taken from air-borne, ship-borne and laboratory up-to-date experiments. New chapters cover the possible impact of solar activity and effects of tropical cyclones on the upper atmosphere, time series and cumulative functions of global tropical cyclogenesis over 25 years, ionosphere and tropical cyclones activity, instability genesis in compress and saturated moist air atmosphere and complex satellite and in-situ 'Scenario-TC' and 'Global-RT' databases. A new Appendix gives quantitative data on spatio-temporal features of global and regional tropical cyclogenesis from 1983 to 2008.

Fundamentals of Numerical Weather Prediction



By Jean Coiffier

CAMBRIDGE UNIVERSITY PRESS

368 pages | Hardback
1st edition | December 2011
ISBN 978-1-10-700103-9

Price: £45.00 (~€55.00)

Publisher's summary

Numerical models have become essential tools in environmental science, particularly in weather forecasting and climate prediction. This book provides a comprehensive overview of the techniques used in these fields, with emphasis on the design of the most recent numerical models of the atmosphere. It presents a short history of numerical weather prediction and its evolution, before describing the various model equations and how to solve them numerically. It outlines the main elements of a meteorological forecast suite, and the theory is illustrated throughout with practical examples of operational models and parameterisations of physical processes. This book is founded on the author's many years of experience, as a scientist at Météo-France and teaching university-level courses. It is a practical and accessible textbook for graduate courses and a handy resource for researchers and professionals in atmospheric physics, meteorology and climatology, as well as the related disciplines of fluid dynamics, hydrology and oceanography.

Environmental Hazards and Disasters: Contexts, Perspectives and Management

By Bimal K. Paul

WILEY-BLACKWELL

334 pages | Softcover
1st edition | November 2011
ISBN 0-470-66001-5

Price: €48.90

Publisher's summary

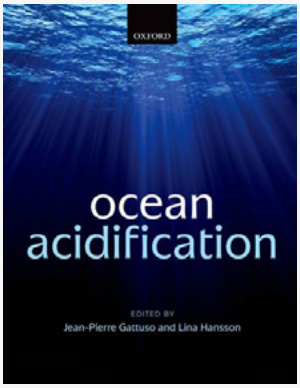
Environmental Hazards and Disasters: Contexts, Perspectives and Management focuses on manifested threats to humans and their welfare as a result of natural disasters. The book uses an integrative approach to address sociocultural, political and physical components of the disaster process. Human and social vulnerability as well as risk to environmental hazards are explored within the comprehensive context of diverse natural hazards and disasters.

In addition to scientific explanations of disastrous occurrences, people and governments of hazard-prone countries often have their own interpretations for why natural disasters occur. In such interpretations they often either blame others, in order to conceal their inability to protect themselves, or they blame themselves, attributing the events to either real or imagined misdeeds. The book contains a chapter devoted to the neglected topic of such reactions and explanations. Includes chapters on key topics such as the application of GIS in hazard studies; resiliency; disasters and poverty; climate change and sustainability and development.

This book is designed as a primary text for an interdisciplinary course on hazards for upper-level undergraduate and Graduate students. Although not targeted for an introductory hazards course, students in such a course may find it very useful as well. Additionally, emergency managers, planners, and both public and private organisations involved in disaster response, and mitigation could benefit from this book along with hazard researchers. It not only includes traditional and popular hazard topics (e.g., disaster cycles, disaster relief, and risk and vulnerability), it also includes neglected topics, such as the positive impacts of disasters, disaster myths and different accounts of disasters, and disasters and gender. The book is for advanced undergraduates or beginning graduate students. It will also provide professional structural geologists with a valuable reference and refresher for calculations.

Ocean Acidification

A review of the new book edited by Gattuso and Hansson



Edited by Jean-Pierre Gattuso and Lina Hansson

OXFORD UNIVERSITY PRESS

352 pages | Paperback
1st edition | September 2011
ISBN 978-0-19-959109-1

Price: £37.50 (~€46.00)

Ocean acidification refers to the decrease in the pH of the ocean, caused primarily by the uptake of atmospheric CO_2. As industrialisation continues to increase CO_2 concentrations, the surface ocean is responding by taking up more of the gas. The ability to store significant quantities of anthropogenic CO_2 helps to slow the rate and extent of climate-change impacts, but with other consequences, especially for the ocean. CO_2 reacts with water and results in several chemical changes which lead to a reduction in surface-ocean pH and carbonate ion concentrations. This reaction between CO_2 and seawater is raising concerns for the biological, ecological, and biogeochemical health of the world's oceans. For example, increasing amounts of CO_2 within seawater can make life more difficult for marine organisms that live in shells made of calcium carbonate ($CaCO_3$), such as clams, oysters and mussels, and for coral reefs, which are built of $CaCO_3$. Therefore, ocean acidification has implications for a large number of scientific and socioeconomic subdisciplines. Since the rate of increase of atmospheric CO_2 emission is likely to be on the rise, it is important to improve the understanding of the impacts of ocean acidification, with the aim of educating the public and evaluating possible actions for reducing these impacts.

Research addressing the effects of elevated CO_2 on marine organisms and ecosystems has only recently emerged as a key research priority for marine science, and has begun to gain prominence in political agendas. With a considerable increase in the number of papers on ocean acidification over the last decade, it is an appropriate time to publish the first authoritative book on this interdisciplinary subject. Ocean Acidification provides a synthesis of knowledge on the topic, including research within the European Project on Ocean Acidification (EPOCA). The contributors provide an appraisal of recent understanding of the chemical, biological, biogeochemical, and societal implications of ocean acidification, with a focus on its impact on marine organisms and ecosystems. Also evaluated are the uncertainties, hazards, and thresholds related to ocean acidification at molecular, cellular, organismal, local, and global scales. The text identifies current gaps in the literature, and provides recommendations for future research and international coordination. The main focus of the book is on the component of pH reduction caused by human activity.

The text is edited by two EPOCA contributors: Jean-Pierre Gattuso, research professor at the Laboratoire d'Océanographie de Villefranche, and Lina Hansson, project manager of EPOCA. They succeed in producing a synthesis of current understanding of ocean acidification by bringing together contributions from an esteemed list of authors, including coordinators of key national and international projects on ocean acidification.

This text touches upon all areas related to the history and recent research on ocean acidification and its consequences, and identifies the most pressing questions. It is structured in four parts: chemistry (chapters 2 and 3), biology and ecology (chapters 4-10), biogeochemistry (chapters 11 and 12), and social consequences of ocean acidification (chapters 13 and 14). Books comprised of a collection of research articles can often be disjointed and fail to provided sufficient background material. Here, however, the editors have avoided this by providing an introduction that describes the topic in a broad context, provides a history of ocean acidification research, and outlines potential social and political implications. Ocean Acidification ends with a summary chapter (chapter 15) which reviews key information provided by the proceeding chapters, identifies what is known and unknown about the subject, identifies the ecosystems most at risk, and discusses prospects and recommendations for future research. The well-written chapters are coherently arranged, but can also be read largely independently of the rest of the book.

It is clear from the text that there is substantial evidence that seawater chemistry is changing due to rising atmospheric CO_2 concentrations, and that human activities are the root cause. A challenge in spreading the word about the possible impacts of ocean acidification is that the science can appear complex and confusing. This book helps to partly resolve this problem by providing information and answers to several of the common questions that are now being asked about ocean acidification. The content of the text is appropriate for graduate level students and professional researchers in oceanography and marine biology. It also contains information useful to those in the general marine science community who are interested in the significant impacts of ocean acidification, particularly those who work with the ecosystems which are identified as being most susceptible to ocean acidification: polar seas, the deep sea, and coral reefs. It is the unwritten rule of a book reviewer to complain about something and so I mention that, as someone with limited knowledge of chemistry, I did find some of the chemistry components hard to follow, and would recommend that a good understanding of chemistry is required to fully benefit from reading this book, especially the first few chapters.

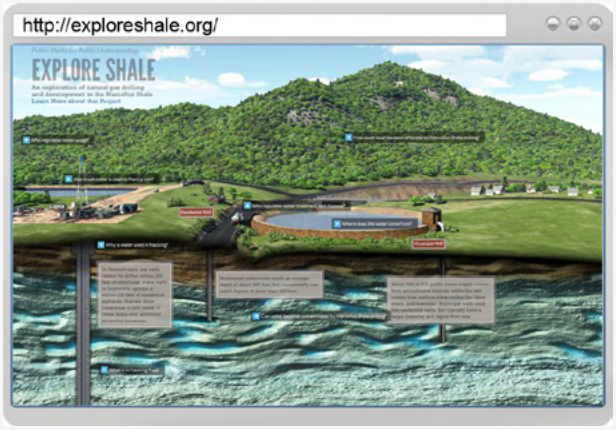
It is difficult to predict what the future of the oceans in high CO_2 conditions will be, and there is a lot of research still to be done on the topic. Overall, Ocean Acidification provides an excellent summary of the current key knowledge of ocean acidification and will prove to be a very good reference for current researchers of the subject, and a must for those in the science community who have a keen interest in finding out more about this fascinating and important subject.

Clare Green, postdoctoral researcher in climate modelling and oceanography at the School of Ocean Sciences, Bangor University

Featured website: Explore Shale

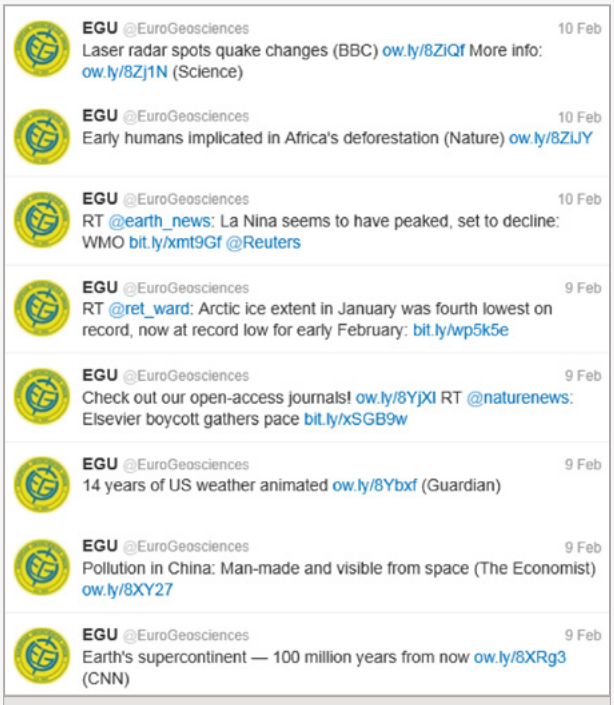
An exploration of natural gas drilling and development in the Marcellus Shale

Explore Shale is a beautifully created site explaining the science surrounding the Marcellus Shale, a geologic formation of shale rock buried under parts of Pennsylvania, New York, and West Virginia, USA. Although its visual layout is what immediately grabs the eye and makes it unique, the site's content, provided by expert sources from several universities and research institutions, is concise and clear, providing a balanced account of the processes involved in the extraction of shale gas. For visitors who are keen to skip the visuals, the site also includes a glossary and text-only section at the bottom of the diagram. The project is funded by the Colcom Foundation, a Pennsylvania-based environmental charity.



Social media: Who's following EGU?

To demonstrate the global reach of our social media network, in this section we feature some of our most prominent followers



Sample EGU Twitter feed from 9–10 February 2012.

In this issue of GeoQ, we highlight four followers of the official account of EGU on Twitter, @EuroGeosciences. Do follow us if you would like to receive official information and updates about the Union, as well as a daily intake of interesting geoscience news from trusted sources. Your Twitter profile may even be featured in future editions of the EGU newsletter!

@NASA_ICE: NASA's Cryospheric Sciences Program, responsible for the satellites that monitor and observe Earth's cryosphere.

@Geo_Dev: Geology for Global Development is an organisation aiming to raise the profile of international development in the geosciences community.

@AGI_Updates: The American Geosciences Institute is a non-profit federation of over 50 geoscientific and professional associations, based in Virginia, USA.

@ECORD_Outreach: The European Consortium for Ocean Research Drilling is a European-Canadian management structure for scientific ocean drilling within IODP, the Integrated Ocean Drilling Program.

EGU General Assembly 2012

22–27 April 2012, Vienna, Austria

The 2012 General Assembly of the European Geosciences Union (EGU) will bring together geoscientists from all over the world into one meeting covering all disciplines of the Earth, planetary and space sciences. Especially for young scientists, it is the aim of the EGU to provide a forum where they can present their work and discuss their ideas with experts in all fields of geosciences. Online registration is open until 22 March 2012.

Website: http://egu2012.eu
Contact: egu2012@copernicus.org

4th WCRP International Conference on Reanalyses

7–11 May 2012, Maryland, USA

The 4th World Climate Research Programme (WCRP) International Conference on Reanalyses (ICR4) provides an opportunity for the global community to review and discuss the major observations and modelling research associated with reanalyses, including the current uncertainties, such as consistency of the time series, and the complexity of Earth system.

Characterising the uncertainty and quality of reanalyses is a task that reaches far beyond the international community of developing institutions, and into the interdisciplinary research community, especially those using the reanalyses products in their research and applications.

Website: http://icr4.org/index.html
Contact: Michel Rixen, mrixen@wmo.int

Japan Geoscience Union Meeting 2012

20–25 May 2012, Makuhari Messe, 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 sciences, and biogeosciences. All presentations of International sessions are in English.

Website: http://www.jpgu.org/meeting_e/index.htm
Contact: N/A

GAC–MAC Joint Annual Meeting 2012 – Geoscience at the Edge

27–29 May 2012, St John's, Canada

The Geological Association of Canada (GAC) and the Mineralogical Association of Canada (MAC) are returning to North America's oldest city, St. John's, Newfoundland and Labrador, in 2012 for their Joint Annual Meeting – Geoscience at the Edge. The venue is situated on the edge of the North Atlantic craton and the technical programme promises an array of topics on cutting-edge geoscience. The meeting will feature over forty symposia, special and general sessions, short courses and field trips. The Local Organizing Committee for GAC–MAC 2012 proudly invites you to attend this exciting conference, to experience the rich culture, stunning natural beauty and dynamic nightlife that the City of Legends boasts.

Website: http://stjohns2012.ca/
Contact: Alana Hinchey, alanahinchey@gov.nl.ca

IBiS 2012: Isotopes in Biogenic Silica

28–30 May 2012, Hamburg, Germany

The upcoming IBiS meeting will strengthen the discussion and collaboration between the (B)Si-isotope community, silica cycle community and the modeller community (local scale to global scale, including Earth System Models). A programme and exact timings of the event will be posted on the IBiS–2012 website in the New Year, along with information concerning transport options and directions for getting to the venue.

Website: http://ibis.zmaw.de/IBIS-HAMBURG-2012.6875.0.html
Contact: Jens Hartmann, jens.hartmann@zmaw.de

Les Houches Summer School on Advanced Data Assimilation for Geosciences

28 May–15 June 2012, Les Houches, France

This 3-week summer school will be strongly focused on methodology. However, it will not ignore the applications' side since applications motivate and specify the kind of methodology is needed. The school will not be an introduction to data assimilation, but an advanced school, attended by students and young scientists with previous experience in data assimilation. A book of proceedings will be published, which will contain contributions from all speakers. The school is co-sponsored by EGU.

Website: http://houches2012.gforge.inria.fr/
Contact: Marc Bocquet, bocquet@cerea.enpc.fr

11th International Symposium on Landslides

2–8 June 2012, Banff, Alberta, Canada

The Canadian Geotechnical Society, the Association of Environmental and Engineering Geologists and the Joint Technical Committee on Landslides (JTC–1) invite you to the 11th International Symposium on Landslides (ISL) and the 2nd North American Symposium on Landslides at the Banff Springs Hotel in Banff, Alberta, Canada from June 2 to 8, 2012. The theme of the symposium will be Landslides and Engineered Slopes: Protecting Society through Improved Understanding.

Website: http://www.isl-nasl2012.ca/
Contact: Corey Froese, chair@isl-nasl2012.ca

2nd International Landscape Archaeology Conference

6–9 June 2012, Berlin, Germany

Standing in the tradition of the 1st Landscape Archaeology Conference held in Amsterdam in 2010, LAC2012 will provide a platform for archaeologists, geographers and researchers from neighbouring disciplines to present and discuss results in the broad field of geo- and landscape archaeology. The 2nd International Landscape Archaeology Conference, co-sponsored by EGU, will take place at the Science & Conference Center of Freie Universität Berlin.

Website: http://www.geo.fu-berlin.de/geog/fachrichtungen/physgeog/lac2012/
Contact: lac2012@geo.fu-berlin.de

7th International Conference Interfaces Against Pollution (IAP2012)

11–14 June 2012, Nancy, France

As a general objective, IAP conferences seek to provide a forum for researchers working in the interdisciplinary field of Environmental Science. The main focus is brought on the importance of Colloids and Interfaces in natural environments both from fundamental and applied perspectives. This includes topics of societal concerns like environmental protection, remediation of polluted sites, optimisation of mineral resources or the impacts of nanotechnology residues on the environment.

Website: http://www.iap2012.fr/
Contact: http://www.iap2012.fr/spip.php?rubrique18

9th International Planetary Probe and Short Course

16–22 June 2012, Toulouse, France

The 9th International Planetary Probe Workshop (IPPW–9) will be hosted by ISAE (Institut Supérieur de l'Aéronautique et de l'Espace) on its campus. The goal of the workshop is to bring together scientists, technologists, engineers, mission designers, and policy makers interested in the technological challenges and scientific opportunities in the exploration of Solar System using atmospheric entry and descent probes. The 9th workshop will build on the success of the previous workshops to promote international cooperation in probe missions to Solar System bodies.

In addition to the five-day workshop, a two day short course is normally held on a related topic during the preceding weekend. The topic selected for IPPW-9 is 'Probe Science Instrumentation Technologies' (June 16–17, 2012).

Website: http://www.planetaryprobe.eu/IPPW9/
Contact: contact@ippw9.cborg.net

7th International Conference on Geographical Analysis, Urban Modeling, Spatial Statistics

18–20 June 2012, Salvador de Bahia, Brazil

In past decades, the main problem in geographical analysis was the lack of spatial data availability. Nowadays the wide diffusion of electronic devices containing geo-referenced information generates a great production of spatial data. However, the increase of geographical data availability has not been fully coupled by an increase of knowledge to support spatial decisions. Spatial modelling, analytical techniques and geographical analyses are therefore required in order to analyse data and to facilitate the decision process at all levels, with a clear identification of the geographical information needed and reference scale to adopt. Old geographical issues can find an answer thanks to new methods and instruments, while new issues are developing, challenging the researchers for new solutions. This workshop aims at contributing to the development of new techniques and methods to improve the process of knowledge acquisition.

Website: http://www.unibas.it/utenti/murgante/geog_an_mod_12/index.html
Contact: N/A

26th International Laser Radar Conference

25–29 June, 2012, Porto Heli, Peloponnesus, Greece

For this year's edition of ILRC, organisers are developing a programme that will make use of invited talks and conference themes to describe current and future needs for atmospheric, Earth and ocean measurements. Present emerging technologies and platforms that promise to increase the impact and application of laser remote sensing will also have a place at ILRC. The conference will also discuss the deployment of lidars, as part of multi-dimensional, multi-sensor observation networks and show examples and ideas on the analysis and assimilation into models of multi-parameter, geographically extensive data sets. Additionally, specific issues such as the lidar applications in climate change, as well as historical building restorations and lidar educational activities will be encouraged.

Website: http://ilrc26-2012.gr/mdlcms/index.php
Contact: Prof. Dr. Alex Papayannis, apdlidar@central.ntua.gr

4th International Congress of ECSSS (Eurosoil 2012)

2–6 July 2012, Fiera Del Levante, Bari, Italy

The general theme of EUROSOIL 2012 'Soil Science for the benefit of mankind and environment' aims to encompass several aspects and to offer ample opportunity to explore many issues of current soil sciences. The main objective of the scientific programme and structure of the Congress is to provide an interactive forum of exchange of ideas by bringing together and establishing durable and strict relationships among older and younger soil scientists and researchers, technical and professional operators, industry and administrative representatives, policy makers and regulators operating in the field of soil sciences.

Website: http://www.eurosoil2012.eu/
Contact: info@eurosoil2012.eu

21st Electromagnetic (EM) Induction Workshop

25–31 July 2012, Darwin, Australia

The 21st Electromagnetic Induction Workshop is the premier event for researchers around the world to exchange latest developments in the field of geophysical-electromagnetism. The Workshop is important for both the international research community and for the many sectors of industry and government that use EM methods for mineral, petroleum and geothermal energy exploration, groundwater and environmental resource evaluation, geohazards monitoring and many other applications.

Website: http://www.21emiw.com/
Contact: Graham Heinson, Graham.Heinson@adelaide.edu.au

16th International Conference on Clouds and Precipitation

28 July–3 August 2012, Leipzig, Germany

The conference is organised every 4 years by the International Commission on Clouds and Precipitation (http://www.iccp-iamas.org), which is part of the International Association of Meteorology and Atmospheric Sciences (IAMAS, http://www.iamas.org). The goal of the conference is to provide a venue for the presentation of scientific research in the area of clouds and precipitation and to encourage the exchange of ideas within the international community.

Website: http://iccp2012.tropos.de/
Contact: Zev Levin, zevlev@post.tau.ac.il

EGU at work. The author, Cian O'Luanaigh, is Web Editor at CERN and a freelance cartoonist. For cartoon commissions, contact him at cianoluanaigh@gmail.com.