ICAS Newsletter

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Institute for Climate and Atmospheric Science
SCHOOL OF EARTH AND ENVIRONMENT

CELEBRATING OUR WOMEN OF ACHIEVEMENT 2016

To mark International Women's Day on Tuesday 8 March 2016, the University has awarded members of staff or students the title 'Woman of Achievement 2016' including ICAS's Dr Anja Schmidt.

Anja Schmidt is one of a new group of Academic Fellows in ICAS appointed over the last three years. Anja studies the atmospheric impacts of volcanic eruptions by combining her background in geology with her expertise in global modelling. Anja's award is based on her recognition as an expert by the UK government, her external recognition through prizes, and her dedication to the public's understanding of science. Anja has already built up a notable collection of early career publications, often exploiting her ability to stimulate fruitful interdisciplinary collaborations,

The University is committed to supporting all staff to deliver their best and works hard to support the career development of women in all fields. Its Women of Achievement awards recognise staff and students who have achieved an external recognition for their work.

Photo: The Niger River during the Monsoon. Credit: Guylaine Canut

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INSIDE THIS ISSUE

PROJECT NEWS

IMPROVING RAINFALL AND FLOODING PREDICTIONS

The University of Leeds is a partner in a new research project to improve our understanding of rainfall and flood predictions in Scotland.

Scientists from the ICAS will work alongside the Scottish Environment Protection Agency (SEPA), the National Centre for Atmospheric Science (NCAS), Scottish Water and the Met Office.

The Radar Applications in Northern Scotland (RAINS) project involves the deployment of NCAS' Mobile X-band Radar to Kinloss, Scotland, from January to July 2016, to observe clouds and measure rainfall. The observations from the NCAS radar will be used alongside the existing Met Office radar network to study precipitation and flooding.

This will be the first in-depth study of clouds, precipitation and how they link to flooding in Scotland. The NCAS radar is capable of measuring clouds and precipitation in remote locations and is the only one of its kind in the United Kingdom.
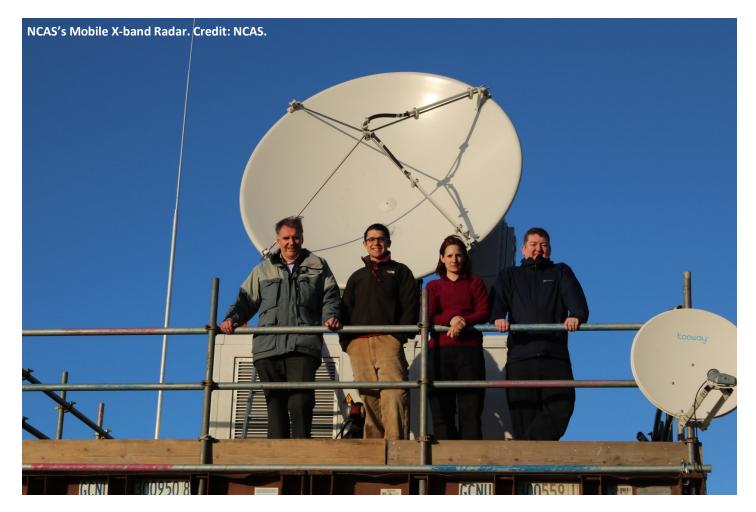
Dr Lindsay Bennett from NCAS and ICAS, who operates the radar, said: "By deploying this radar in this location, we can provide high resolution observations of the precipitation in the Inverness and the Moray Firth area. Using this data we aim to improve the understanding of rainfall and the predictions of floods in Scotland."
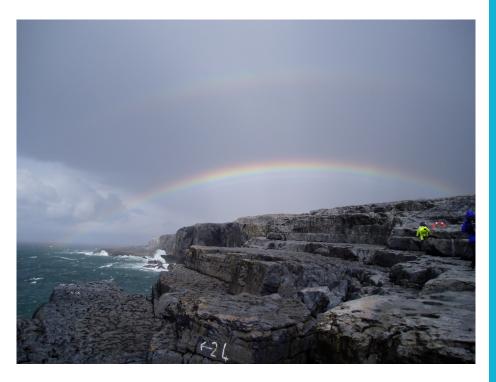
Co-ordinating the effort between partners will allow the cutting-edge meteorological research and data from the radar to be translated into real improvements of flood forecasts and defences. The Met Office is a partner organisation with SEPA in the Scottish Flood Forecasting Service, which brings together meteorological and hydrological expertise in providing flood forecasting and warning services.

Michael Cranston, SEPA's Forecasting and Warning Manager, said: "The winter of 2015/16 has already seen devastating floods across several parts of the country and Scotland has been reminded just how horrendous the effects and impacts of flooding can be for people. SEPA is committed to reducing the risk caused by floods by improving our ability to predict flooding, which is why we have funded this new research project.

"Innovation like this increases our knowledge, which leads to better forecasting, which ultimately helps our partners and those at direct risk to prepare and reduce the impacts of flooding on their lives."

Dr Aileen McLeod MSP, Minister for Environment, Climate Change and

NCAS's Mobile X-band Radar. Credit: NCAS.

Land Reform, said: "Recent flood events have shown the importance of flood warning in supporting informed and effective responses. This initiative will help enhance SEPA's flood forecasting capacity and delivery of the recently published flood risk management strategies."

In addition to the rainfall data that NCAS will provide to SEPA, scientists from NCAS and the University of Leeds will be analysing a range of other information that the radar produces. These more sophisticated observations will be used to better understand how much rainfall comes from certain types of clouds during the winter and spring.

Double Rainbow, County Clare, Ireland. Credit: Dave Bond.

PROJECT NEWS

CONVECTIVE CLOUD MODELLING FEASIBILITY STUDY

A bid by David Dritschel (PI, University of St. Andrews), Doug Parker (SEE), Alan Blyth (SEE, NCAS) and Steven Boeing (SEE) for a feasibility study has recently been granted.

This is a 6 month project (£ 21600 funding), where a new method to model the dynamics of convective clouds will be developed.

The method is based on small-scale vortices, which will be used to represent the flow. The project is part of the EPSRC Maths Foresees network.

PROJECT NEWS

NEW £20 MILLION RESEARCH PROGRAMME TO DEEPEN UNDERSTANDING OF AFRICA'S CHANGING CLIMATE

A UK government-funded initiative will put £20 million behind research to better understand Africa's changing climate and the use of climate change information in decision-making across the continent.

HyCristal workshop discussion

Future Climate for Africa (FCFA) supports five major research projects to develop better climate information for Africa and to test how the new information could be used in decision-making. Dr John Marsham from the University of Leeds is leading the HyCRISTAL project, which addresses East Africa, while fellow researchers from the University's School of Earth and Environment are taking key roles in the projects addressing West Africa (AMMA2050), southern Africa (UMFULA) and modelling African climate (IMPALA).

HyCRISTAL is a four-year project to develop an understand-ing of climate change and its impacts in East Africa and to work with the region's decision makers to provide a future that is more resilient to climate change. The HyCRISTAL Team and twenty-nine partners from six countries attended the Workshop, which was opened by the Hon. Flavia Munaaba Nabugere, the Acting Minister for Water and Environment in the Cabinet of the Government of the Republic of Uganda, and closed by the Rt. Hon. Dr. Ruhakana Rugunda, the Prime Minister of the Republic of Uganda. Both delegates stressed the importance of the work for East Africa and their support for the project.

HyCRISTAL is part of the Future Climate for Africa (FCFA) Programme (*http://www.futureclimateafrica.org*), funded by the UK Department for International Development (DfID) and the UK Natural Environment Research Council (NERC). FCFA aims to develop both climate science for Africa and its use for decision making on a 5-40 year timescale. HyCRISTAL, which is supported by GEWEX, will work with the Lake Victo-ria Basin-Hydroclimate to Nowcasting Early Warning Systems Consortium, which consists of three com-ponents: the World Climate Research Programme (WCRP)/ GEWEX Regional Hydroclimatology Project, Hydrolo-gy of the Lake Victoria Basin Study; the WMO Severe Weather Nowcasting Demonstration Project; and the East African Community Nowcasting Early Warning Systems Project, which addresses weather and safety on Lake Victoria.

HyCristal Team

PROJECT NEWS

East Africa has one of the world's fastest growing populations, and is experiencing rapid urbanization. Environmental prob-lems include land degradation, pollution, over fishing and declining water resources, resulting in changing livelihoods. Climate change adds to these problems by increasing the vul-nerability of the poorest. The impact of climate change on water resources, such as rainfall, lakes, rivers and groundwater, will be critical in East Africa, but projections of the future water cycle are highly uncertain. Climate projections show a warming trend in East Africa, but changes in rainfall are un-certain. The East African long rains have been observed to be decreasing in some areas, but Coupled Model Intercom-parison Project (CMIP) models tend to predict an increase, although with some disagreement on the size and substantial disagreement on magnitude.

HyCRISTAL will work with users to characterize model pro-jections for decision-relevant metrics of climate change in East Africa on a 5-40 year time-scale and will address the roles of aerosols, lake hydrology, urbanization and land-use in re-gional climate change. HyCRISTAL will also develop our un-derstanding of the reliability of projections for East Africa by determining the mechanisms that drive the changes in model projections, evaluating models and understanding recent dec-adal climate variability. The representation of convection is a key source of error in simulations of African climate . HyCRISTAL will use new convection-permit-ting simulations from the Met Office-led Improving Model Processes for African Climate (IMPALA) FCFA Project to bet-ter understand the implications for projections. HyCRISTAL will address the impacts of climate change for two key settings in East Africa: rapidly growing urban cen-tres and their water supply and sanitation systems, and rural communities reliant on agriculture and fisheries. This requires underpinning work on climate impacts on lakes and lake eco-systems, groundwater and agriculture, as well as understand-ing vulnerabilities, decision-making governance structures and institutional influence. This work will

Rt. Hon. Dr. Ruhakana Rugunda, the Prime Minister of the Republic of Uganda gives closing address at HyCRISTAL workshop

feed into two key pilot studies using climate information for decision making for the 5-40 year time-scale in these two key contexts, and potentially additional smaller pilots as the project develops.

The HyCRISTAL consortium consists of the University of Leeds (*http://www.wateratleeds.org*); the African Centre for Technology Studies; the British Geological Survey; the Centre for Ecology and Hydrology (UK); Evidence for Development; Jomo Kenyatta University; Loughborough University; the Met Office (UK); the

National Centre for Atmospheric Sci-ence (UK); the National Fisheries Resources Research Institute (Uganda); North Carolina State University; Practical Action; Stony Brook University; the Tanzanian Meteorological Agency; the Ugandan National Meteorological Authority; the Ugandan Ministry of Water Resources; the University of Connecticut; Makerere University; Maseno University; Walker Institute; and the University of Reading (Africa Climate Exchange).

PARTNERSHIPS NEWS

KARLSRUHE INSTITUTE OF TECHNOLOGY (KIT)

Since introduction of the ICAS-KIT academic partnership in June's ICAS newsletter several exchange visits and seminars have taken place:

(1) KIT PhD student Konrad Deetz (DACCIWA) visited John Marsham in Aug 2015 to work on aerosol modelling in the West African monsoon region.

(2) Michael Kunz gave a seminar on hail prediction in Leeds in October 2015.

(3) KIT PhD student Marlon Maranan (DACCIWA) visited John Marsham in December 2015 to work on rainfall climatologies and processes in the West African monsoon.

(4) Romy Ulrich visited last November for 2 weeks. She is working on modelling convective clouds as well as developing new parameterisations for heterogeneous ice nucleation. She also came to the Aerosol Society Annual Science meeting in Birmingham which organised by Ben Murray.

(5) Cathyn Birch gave a seminar at KIT in January 2016, initiating new collaborations on East Africa.

(6) Joint ETN proposal led by Heini Wernli (ETH) with Andy Ross (Leeds) and Peter Knippertz (KIT) submitted in January 2016 .

(7) Paul Field and Phil Rosenberg will visit KIT in April/May 2016 to work on cloud-aerosol interactions in West Africa (DACCIWA).

(8) Joseph Njeri will visit Cathryn Birch (ICAS) to work on extreme rainfall/storms on weather timescales in East Africa (Summer 2016).

(9) Andreas Schlüter and Peter Vogel will visit Doug Parker (and others) in November/December to work on West Africa

(10) Ben Murray visited Ottmar Mohler at KIT for a week for proof of principle experiments for a new ice nucleating particle instrument.

(11) Ongoing web-sharing of seminars from both institutions.

 A partnership website should be up soon which will detail webcast seminars (in addition to the current email announcements of these) and other joint activities and projects. This will include a description of the research interests of the different members of research groups at each institution, to make it easier to identify where links could be made. The exchange visits so far have shown that they are a useful way for people at any point in their research career (PhD to Prof) to widen their research network.

Please contact John Marsham if you are interested in visiting KIT/hosting visits, or have other ideas for joint activities.

THE CENTRE FOR POLAR OBSERVATION AND MODELLING (CPOM)

As part of the Scientific Exploitation of Operational Missions (SEOM) programme element, the European Space Agency (ESA) announced the first advanced training course in Earth Observation of the Cryosphere, which will be hosted at the University of Leeds from 12 to 16 September 2016.

The course, developed and to be led by ICAS's Anna Hogg, aims to train the next generation of Earth Observation scientists to exploit data from ESA and other satellite missions for science and applications development. The training will include formal lectures by leading scientists as well as hands-on computing exercises exploiting real and simulated data. The course will provide advanced scientific knowledge on the theory and applications of cryosphere remote sensing, including:

- Theoretical fundamentals of space-borne optical, SAR, gravimeter and altimeter remote sensing;

- EO lectures on the Cryosphere, with a focus on: Sea Ice, Mountain Glaciers, Snow and the Polar Ice Sheets;

- Practicals using ESA toolboxes and commercial software for scientific exploitation of EO data;

- EO data processing and product demonstration for monitoring the cryosphere.

Post graduate, PhD students, post–doctoral research scientists and users from European countries and Canada interested in Cryosphere Remote Sensing and its applications are invited to apply to the 5 day course which will be held at the Centre for Polar Observation and Modelling (CPOM). Research scientists and students from all other countries are also welcome to apply and participate to the course subject to space availability.

Deadline for applications: **20 May 2016**

More info and an on-line application form are available at: http://seom.esa.int/cryotraining2016/
All enquiries should be sent to eotraining@esa.int

→ 1st ESA ADVANCED TRAINING COURSE ON REMOTE SENSING OF THE CRYOSPHERE

12–16 September 2016 | University of Leeds | Leeds, UK

ROLE OF VOLCANISM IN DINOSAUR EXTINCTION THEORY

The role volcanic activity played in mass extinction events in the Earth's early history is likely to have been much less severe than previously thought, according to a study led by Dr. Anja Schmidt.

Asteroid impacts and long-lasting volcanic eruptions called continental flood basalts – the two most commonly cited possible causes of mass extinction events – would have propelled gas and dust into the atmosphere and altered climate for years. But, until now, the impact of years of sulphur dioxide emissions from continental flood basalts was unknown.

In a study published in Nature Geoscience, researchers in ICAS have provided for the first time a quantitative estimate of the degree and nature of the effects that such eruptions had on the Earth's climate, vegetation and oceans.

Study lead author Dr Anja Schmidt said: "At the time when the dinosaurs reigned, numerous long-lasting eruptions took place over the course of about a million years. These eruptions, called continental flood basalts' were not like volcanic eruptions we often see today, with lava gushing from the ground like a curtain of fire."

"Each eruption is likely to have lasted years, even decades, and eruptions were separated by periods without volcanic activity. The lava produced by an eruption of average intensity would have filled 150 Olympic-size swimming pools per minute."

In the new study, the researchers used a sophisticated computer simulation of the spread of the gas and aerosol particles, which showed that the climatic impacts of flood basalts was less grim than scientists had previously suggested. They found that only if such flood basalts oozed for hundreds of years, without interruption, may the climatic impacts have had a severe effect on plants and animals.

The researchers used information on the duration and intensity of continental flood basalt eruptions, such as the Deccan Traps eruptions 65 million years ago, which covered one-third of what is now India, to estimate the climatic and environmental effects of the huge quantities of sulphur dioxide gas emitted by these eruptions.

Their computer simulation showed that temperatures on Earth were indeed cooler as a result of the eruptions – by as much as 4.5 degrees Celsius – but that the temperature would return to normal within 50 years after an eruption ceased.

Dr Schmidt noted that the conclusions are based on the assumption that climate feedbacks were very similar to those today.

"Perhaps most intriguingly, we found that the effects of acid rain on vegetation were rather selective. Vegetation in some but not all parts of the world would have died off, whereas in other areas the effects would have been negligible," said Dr Schmidt.

The new findings will challenge the earth sciences community as a whole to re-examine the causes of mass extinctions and the role of volcanism. "We now need to better understand how long both the individual eruptions and the periods without volcanic activity lasted," concludes Dr Schmidt.

Read the paper at:

Schmidt A; Skeffington RA; Thordarson T; Self S; Forster PM; Rap A; Ridgwell A; Fowler D; Wilson M; Mann GW; Wignall PB; Carslaw KS (2016) Selective environmental stress from sulphur emitted by continental flood basalt eruptions, Nature Geoscience, 9, pp.77-82. doi: 10.1038/ngeo2588

Anja also features on the front page for winning the award for Woman of Achievement.

Caption: Anja in front of Fimmvörduháls flank eruption in March/April 2010, Iceland. Credit: Anja Schmidt
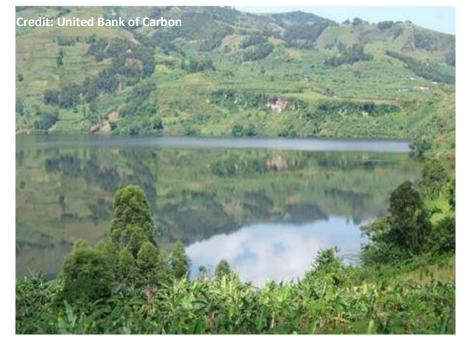
INCREASED DEFORESTATION AND THE AMAZON BASIN RAINFALL

Researchers report that continued deforestation of the Amazon rainforest could diminish rainfall levels in the Amazon River basin, which may impact the region's climate, ecosystems and economies. A new study, published today in *Geophysical Research Letters,* predicts that by the middle of the century annual rainfall in the Amazon could be less than the yearly amount of rain the region receives during drought years if deforestation rates revert back to pre-2004 levels.

Credit: United Bank of Carbon

Study lead author Dr Dominick Spracklen from ICAS, said: "Essentially, drought years could become the norm for the Amazon by 2050 if deforestation rates rebound. This significant drop in rainfall could affect ecosystems and wildlife throughout the entire Amazon basin, which covers roughly 40% of South America.

"Recent droughts in the Amazon in 2005 and 2010 showed that sustained reductions in rainfall could have massive consequences for Brazil's economy. Less rain could affect agriculture, which currently generates $15 billion a year for Brazil's economy, and hydropower, which generates 65% of Brazil's electricity."

Deforestation of the Brazilian Amazon started on a large scale in the 1970s. The opening of the Trans-Amazonian Highway in 1972 made the interior of the Amazon accessible for the first time, sparking a blast of forest clearing to create space for cattle ranching and agriculture. In Brazil, home to two-thirds of the Amazon rainforest, deforestation rates accelerated throughout the following decades until reaching a peak in 2004. That year, Brazil

cleared 2.7 million hectares (6.7 million acres) of forest – the equivalent of 7,400 hectares (18,300 acres) a day, according to Brazil's National Institute for Space Research (INPE). At that rate, researchers estimated nearly half of the original forest cover would be gone by 2050. After hearing these predictions, Brazil enacted laws to preserve the country's remaining rainforest. Deforestation began to decline in 2005, and by 2010, forest clearing rates had dropped to about 25% of 2004 levels, according to INPE. During the same time period, however, deforestation in other Amazonian countries increased, according to Spracklen. With a high global demand for increased beef and soy production, it's likely these countries will continue clearing forest and possible Brazil will relax its forest protection laws to meet those demands, according to Spracklen.

"I think one of the big environmental success stories of the past decade has been the reduction in deforestation in the Amazon, within Brazil," Spracklen said. "But I think at the moment we're at a kind of cusp, where there's continued pressure within Brazil to relax some of the forest laws." Forests mediate the exchange of water, energy and gases between the Earth's surface and the atmosphere. As a result, clearing forests can affect local temperature, humidity and rainfall, but these effects can be difficult to quantify. Researchers use atmospheric models to simulate this

process in the Amazon. Many of these simulations show an association between forest cover and rainfall, but every model is different and makes different assumptions. In the new study, researchers analysed the results of 96 existing climate models to see if there was any consensus among them.

Study co-author Dr Luis Garcia-Carreras, also from the University of Leeds' School of Earth and Environment, said: "We wanted to make a comprehensive assessment using all of the information that was available until now to give us the best estimate of what the impact of deforestation would be on rainfall."

Performing a meta-analysis of the 96 models, the study found that if deforestation rates return to pre-2004 levels, annual rainfall in the Amazon will decrease 8% by 2050. Dr Garcia-Carreras concludes: "We found a very consistent picture that deforestation is going to drive a reduction in rainfall, and that was consistent virtually across all models and all studies that we analysed."

Read the paper at:

Spracklen DV; Garcia-Carreras L (2015) The impact of Amazonian deforestation on Amazon basin rainfall, Geophysical Research Letters, 42, pp.9546-9552. doi: 10.1002/2015GL066063.

FEATURED PERSON: GRAHAM MANN

What is your role in ICAS?

I am a Senior Global Aerosol Modelling Research Scientist funded via NCAS, and an affiliate member of ICAS. I see my role as being to carry out atmospheric science, which involves advising and discussing with researchers ideas and strategies to design model experiments to better understand the drivers of and effects from changes in atmospheric aerosol. My NCAS role means my interactions within ICAS and SEE are just one part of a range of activities with other organisations in the UK, and internationally.

What do you like the most about ICAS?

ICAS is at its best when it resists short-term thinking and recognises the unmeasureable value of researchers working in teams. Strategic forward-thinking, and working together in teams, is, I believe, one of the reasons why ICAS has been so successful. Another thing I like is that both ICAS and NCAS have given me the space and opportunity to spend a proportion of my time to read, learn and develop an expertise in a research area (upper troposphere and stratosphere composition) in which I am now able to propose and lead projects, of benefit to both organisations, as well as to me.

Why did you choose this career and how did you get here?

My Mum was a chemistry teacher in the comprehensive secondary school I attended and my Dad was a chemical engineer at UMIST. The trajectory of my career was more than likely influenced by a chimney which was continually polluting the valley town I grew up in. As part of her teaching my Mum set up collectors to measure the pH of rainwater and my Dad set up a video camera from our upstairs window to film the dispersion of the chimney plume. A local campaign group was seeking to pressure the company to fit "scrubbing" technology to remove the sulphur dioxide pollution at source. So atmospheric science and environmental monitoring have been part of my life from an early age.

What scientific achievement are you most proud of?

I'm most proud of the professional development I have made from my PhD through a series of postdoc positions to now being a senior research fellow. NCAS's ongoing strategic investment in aerosol modelling allowed me to make the transition from the anxiety associated with uncertain short-term postdoc positions to being able to commit to plan a career in atmospheric science.

What does a typical working day involve for you?

Generally rushing about trying to progress the range of research projects I'm involved with, spend quality time with my two kids and trying to defend some time to think about papers and plan ahead.

What's the most interesting aspect of your job right now?

We have planned a series of experiments seeking to better understand the climate effects form major volcanic eruptions, initially in the post-industrial period. This really feels like we are embarking on a voyage of discovery and it feels a genuine privilege to be part of a research grouping where I think we will be able to make an important contribution to better understand natural influences on past climate.

What's the most challenging aspect of your job?

Giving a short answer is something I continue to struggle with...

How do you decompress outside work?

Listening to and playing music are key stress-reducers for me. Or watching a good film with the kids.

What bit of information about you is likely to surprise your colleagues?

I have grade 8 piano and was the guitarist in a (short-lived) indie rock band in the mid-1990s, called Billy.

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