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Institute for Climate and Atmospheric Science

SCHOOL OF EARTH AND ENVIRONMENT environment.leeds.ac.uk/institute-climate-atmospheric-science

Director's Update

Welcome to the April 2019 edition of the ICAS Newsletter. Our newsletters summarise recent news and events from the Institute but, as always, there is far more going on than we have space to report. ICAS is fortunate to have a huge array of exceptional staff and students who are active on so many fronts. On that note it is particularly pleasing to record in this issue the MBE awarded to Stephen Mobbs in the New Years Honours (This is our first Newsletter of 2019!)

Stephen was the head of department when many of the current staff joined and he has had a huge impact on the growth of atmospheric and climate science in Leeds. Indeed, it was under Stephen's stewardship that ICAS was created within the old School of the Environment around 15 years ago. So, on behalf of ICAS: Thank you Stephen and congratulations.

Photo credit: Ian Brooks– Abisko, northern Sweden

INSIDE THIS ISSUE

FUNDING NEWS

RELAMPAGO field campaign

Ben Pickering has been awarded £1,200 by the RMetS Legacies Award and the NCAS Visiting Scientist Programme to take part in the US-led RELAMPAGO field campaign in Argentina. Ben was in Argentina from the 22nd November to the 16th December 2018, a gruelling 56-hour journey each way on trains, flights and an overnight bus through Argentina to reach Cordoba.

The team outside their DoW vehicle.

The campaign observed convection, upscale growth and initiation triggered by the Andes and the Sierra de Córdoba, using the Centre for Severe Weather Research's DoW (Doppler on Wheels) and Mobile Mesonet vehicles.

EXHALE project funding

Steve Arnold and Dominick Spracklen have been successful in gaining funding for the EXHALE project (EXploiting new understanding of Heterogeneous production of reactive species from AIRPRO: Links to haze and human health Effects).

The £334k project is funded by NERC and the Newton Fund, and is led by Prof. Dwayne Heard in the School of Chemistry. The project will investigate interactions between reactive chemical species and aerosol surfaces within Chinese pollution haze.

The project is a collaboration between the Schools of Chemistry and Earth & Environment at the University of Leeds, and Chinese partners from Peking University, Nanjing University and Shanghai Jiao Tong University.

CONGRATULATIONS

PhD Student Successes

Congratulations to **Chris Kelly** on receiving an **AGU Outstanding Student Presentation Award** for his poster at the Fall Meeting in December 2018. According to the AGU information, this put Chris' poster into the top 5% of presentations by student participants.

PhD student Chris Kelly, who won an AGU Outstanding Student Presentation Award

Luke Conibear, Ben Silver and Thomas Slater have all won a School **Postgraduate Researcher Publications prize** for 2018/19. A celebration event during which each of the prize-winners will present a 15 minute talk about their publication will take place on May 1st.

New Years Honour for Stephen Mobbs

Professor Stephen Mobbs has been awarded an MBE for services to Atmospheric Sciences.

Having gained a BSc in Physics and a PhD in Applied Mathematics at Leeds, Professor Mobbs joined the University's Environment Centre in 1995, which later evolved into the School of the Environment. As head of school in the late 1990s/early 2000s Stephen was key in driving the expansion of atmospheric science in Leeds and the creation of ICAS. Following the merger with Earth Sciences in 2003, Stephen became Head of the newly formed School of Earth and Environment (SEE).

In 2005, Stephen became Director of the National Centre for Atmospheric Science (NCAS), whose headquarters have been based on the Leeds campus since this date.

NCAS is a world-leading research centre dedicated to the advancement of atmospheric science, funded by the Natural Environment Research Council (NERC). It carries out research in air pollution, high-impact weather and long-term global changes in atmospheric composition and climate, providing state-of-the-art technologies for observing and modelling the atmosphere.

Through his inspirational leadership, Stephen has been a major player in elevating UK atmospheric science to become an internationally respected academic community.

He led the development of the Facility for Airborne Atmospheric Measurement (FAAM) research aircraft, providing a national platform for experimental atmospheric research and UK emergency capability. Following the 2010 Eyjafjallajokull volcanic eruption in Iceland, Professor Mobbs deployed the FAAM aircraft, demonstrating dust concentrations to be far smaller than feared, leading to the early reopening of UK airspace to civilian flights.

Of his latest accolade, Stephen said: "I am delighted to be awarded an MBE, which recognises my work on behalf of NCAS and NERC.

“I have been fortunate to have the support of a tremendous team of staff in NCAS; collectively we have established NCAS as an internationally recognised research organisation in atmospheric science."

Stephen is also a Fellow of the Royal Meteorological Society. Read more about his research and achievements.

Professor Stephen Mobbs, who was awarded an MBE in the New Year Honours.

ADVISING THE UK GOVERNMENT ON CLIMATE CHANGE

Professor Piers Forster has been appointed to the Committee on Climate Change and will help to shape environmental legislation and policy. Piers, Director of the Priestley International Centre for Climate and Professor of Physical Climate Change in ICAS, takes up the post of climate scientist on the Committee for a five-year term. He replaces founding Committee member, Sir Brian Hoskins, who recently stood down after 10 years of service.

Professor Piers Forster

The Climate Change Act 2008 made the UK the first country to establish a long-term legally binding framework to cut carbon emissions. The Committee on Climate Change was established under this act as an independent body of experts to advise the UK Government on emissions targets and report to Parliament on progress made in reducing greenhouse gas emissions and preparing for climate change.

Commenting on Professor Forster's appointment, Lord Deben, Chairman of the Committee on Climate Change, said: “I am absolutely delighted to welcome Piers Forster to the Committee. His exceptional experience in climate research and analysis – including at the very highest levels of the IPCC – will be extremely valuable, particularly as we prepare to deliver a major report to Government on the UK’s long-term climate change targets."

Piers said: “I am thrilled to be taking up this post on the 10th anniversary of the UK’s Climate Change Act. The Act and the Committee have done a great job in helping the UK establish itself as a world leader in reducing emissions. However, the challenging ‘teenage years’ are just around the corner and the Committee has some important work to do on long-term targets and evidence-based solutions that, if we get it right, will help the transition to a zero-carbon UK. Although climate change is a global problem, many of its solutions need to be implemented at a local level, and I am keen to learn best practice from the cities, rural communities and businesses of the UK. I can’t wait to roll up my sleeves and get started.”

Piers has played a significant role authoring Intergovernmental Panel on Climate Change (IPCC) reports, and currently has a coordinating lead author role for the IPCC sixth assessment report. As well as his research career, he established the forest protection and research charity, the United Bank of Carbon and has a number of roles advising industry, including membership of the Rolls Royce Environment Advisory Board.

AVOIDING FOSSIL-FUEL “LOCK-IN” COULD HELP LIMIT GLOBAL TEMPERATURE RISE

New research suggests there is a 64% chance of limiting the increase in global average temperatures to 1.5°C above pre-industrial levels if fossil fuel infrastructure is immediately phased out.

An international team of scientists led by the University of Leeds has used a new climate model to determine what would happen to global temperatures if the phase-out process for carbon-intensive infrastructure had begun at the end of 2018.

In the study's scenario, fossil fuel power plants, cars, aircraft, ships, and industrial infrastructure are replaced with zero carbon alternatives at the end of their design lifetime – the point where large-scale refurbishments or maintenance would be required. The team found that if the process of replacing these systems with zero carbon alternatives – or not replacing them at all – began from the end of 2018 and their subsequent CO_2 emissions decreased at close to a linear rate as a result, the chance of keeping global temperature rise to below 1.5°C is 64%.

Study lead author **Dr Chris Smith**, from ICAS, said: "All fossil fuel infrastructure, such as coal power plants, carries a climate change commitment. A new coal plant will emit carbon dioxide for roughly 40 years across its lifecycle which in turn affects global warming. Investments into carbon-intensive infrastructure and their development and maintenance lock us in to the associated carbon emissions and make the transition to lower-carbon alternatives more difficult. Our research found that the current amount of fossil fuel infrastructure in the global economy does not yet commit us to exceeding the 1.5°C temperature rise limit put forward by the Paris Agreement. We may have missed starting the phase out by the end of 2018, but we are still within the margin of achieving the scenario the model put forward.

"Every year we delay in phasing out this infrastructure makes the fossil fuel 'lock-in' harder to get out of and the possibility of keeping global temperature rise below 1.5°C less likely. In an article written for The Conversation, Chris explains the details of the research findings and the necessity of phasing out fossil fuel infrastructure immediately.

The study, published in Nature Communications, focused on energy generation, transport and industrial sectors, which have the best data available for the CO_2 emissions for their historical lifetimes and produce 85% of global emissions. The study produced a scenario that reduces CO_2 emissions to net zero over 40 years. By contrast, the recent special report by the Intergovernmental Panel on Climate Change (IPCC) highlighted a requirement for CO_2 emissions to be reduced to net zero over the next 35 years. The authors explained that window of five years to get to net zero can be attributed to different modelling approaches with some of the difference is accounted for by the timing of emissions phase out. The authors also acknowledged that their results rely on no large-scale climate tipping points being breached in the coming decades, such as large amounts of carbon dioxide that would be released from extensive permafrost melting.

'Current fossil fuel infrastructure does not yet commit us to 1.5 °C warming' was published in Nature Communications 15 January 2018 (DOI: 10.1038/s41467-018-07999-w)

https://environment.leeds.ac.uk/see/news/article/418/avoiding-fossil-fuel-lock-in-could-help-limit-global-temperature-rise

UK CHIPS AN INCH SHORTER AFTER SUMMER HEATWAVE: INCREASE IN EXTREME WEATHER DUE TO CLIMATE CHANGE IS DAMAGING FRUIT AND VEGETABLE GROWING

The spell of baking summer weather left potatoes substantially smaller than usual. Photograph: Lex van Lieshout/EPA-EFE.

The British chip has been left an inch shorter by the 2018 heatwave, according to a report on the risks to UK fruit and vegetable growing from climate change. The spell of baking summer weather was made 30 times more likely by global warming and left spuds substantially smaller than usual. Yields of carrots and onions were also sharply down.

Recent years have seen winter deluges cause flooding, severe late frosts and dry summers, all of which make the precarious job of growing fruit and vegetables even harder. Climate change is already making extreme weather more likely and, with projections indicating severe water stress in key parts of England, some growers fear for their future.

The report, Recipe for Disaster, was produced by The Climate Coalition, which brings together 130 organisations including WWF, the National Trust, the Women's Institute and Christian Aid, and represents more than 15 million UK members. The report calls for urgent reductions of carbon emissions and food waste by, for example, eating more wonky veg.

The summer of 2018 was the joint hottest on record, with some places not seeing any rain for 58 days. The lack of water resulted in the fourth lowest potato harvest in the last 60 years.

"Yields were down 20-25%," said Richard Thompson, a potato grower in Staffordshire. "We also had quality issues with a lot of misshapen and small potatoes. Cedric Porter, editor of World Potato Markets, said consumers were seeing smaller chips as a result of last year's drought and extreme heat: "They were 3 cm shorter on average in the UK. Smaller potatoes means smaller chips."

More than 80% of the potatoes eaten in the UK are homegrown, but climate change could make three-quarters of land used unsuitable by 2050, the report found. "It should be unthinkable to us that the humble spud could become a delicacy," said Gareth Redmond-King, at WWF. "But the unthinkable becomes reality if climate change isn't tackled."

ICAS scientists **Kate Sambrook and Prof Piers Forster** contributed climate analysis to the report. They found that high temperature extremes in summer and intense winter downpours have become more common in recent decades, with 2013-2014 the wettest winter on record for the UK. Extreme weather will worsen further in future as the world gets hotter, they said.

Warmer winters encourage early flowering of fruit such as apples and wine grapes, but they can then be wiped out by late frosts. Mild winters also mean pests such as the cabbage moth can thrive and could allow the pea beetle to cross the channel from France.

Lee Abbey, head of horticulture at the National Farmers Union, said: "A lot of growers will have come out of [2018] with sore heads and not much income. Farmers and growers are used to dealing with fluctuations in the weather but if we have two or three extreme years in a row it has the potential to put growers out of business." Carrots yields were down 25% and onions down 40%.

https://www.theguardian.com/environment/2019/feb/05/uk-chips-an-inch-shorter-after-summer-heatwave-report

DRAMATIC RAINFALL CHANGES FOR AGRICULTURE CAN BE AVOIDED THROUGH CLIMATE ACTION

A new study suggests climate change will significantly alter rainfall patterns for key agricultural regions, but the worst effects could be mitigated by reducing greenhouse gas emissions.

Greenhouse gas emissions, many of which are produced by burning fossil fuels such as coal and oil, become trapped in the atmosphere. This causes a greenhouse effect which warms the atmosphere and can have a significant impact on weather patterns and the amount of rainfall globally. The 2015 Paris Agreement set the reduction of greenhouse emissions as a critical step in achieving the goal of limiting the increase in global average temperatures to 1.5 – 2°C above pre-industrial levels.

An international team of scientists, including **Professor Andy Challinor** from ICAS, used 20 different climate models to examine how rainfall could be affected by climate change around the world.

The team combined the models with greenhouse gas emission scenarios to predict the extent of the areas affected and how quickly the precipitation changes would become detectable or the "new normal" for crop growing regions. The timeline for this discernible change to rainfall is what scientists refer to as "time of emergence."

How climate change will brew a bad-tasting, expensive cup of coffee.

Their study, published in the journal *Proceedings of the National Academy of Sciences,* warns that up to 14% of land dedicated to wheat, maize, rice and soybean could have less rainfall, while up to 31% may see increases in rainfall. However, in a low-emission scenario the percentages are 3% and 1%, respectively.

Study co-author Professor Challinor, who is based in the Priestley International Centre for Climate, said: "Changes in rainfall patterns have been challenging to predict in the past, making it difficult to offer advice on how growing conditions may change. This is the first study to overlay predicted time of emergence on croplands and growing seasons.

"Wheat, maize, rice and soybean represent roughly 40% of global caloric intake and our findings show that by limiting greenhouse gas emissions we can help preserve the rainfall patterns vital for their growth.

"While low-emissions scenarios still showed some effect on rainfall patterns in certain regions, the higher the amount of greenhouse gas emissions, the higher the percentage of land affected by drier conditions in key crop growing areas, such as South Western Australia and Southern Africa.

"The greenhouse gas mitigation measures needed to achieve climate targets, such as the one set by the Paris Agreement, will go a long way to helping us reduce the risk of future droughts or flood conditions and possibly avoid a global food crisis."

Under a high emission scenario, France, Australia and Turkey – three of the world's top 15 wheat producers – would see 26%, 28% and 88%, respectively, of their wheat growing land affected by reduced rainfall. In France and Turkey this is reduced to zero under the lowest emission scenario, and in Australia it reduces to 4%.

Argentina and, Brazil are the three biggest producers of soybean. With a high emission scenario 70% and 9% of Argentinian and Brazilian soybean area, respectively, would be affected by reductions in rainfall. In both cases this reduces to zero under a low emissions scenario.

STORY CONTINUED FROM PAGE 7...

China and India are the world's two biggest rice producers globally and are among the countries predicted to have wetter conditions for all four crops included in the study, even in a scenario with low levels of emissions. However, curtailing greenhouse gas emissions from high to low levels reduces the area affected from 11% down to 6% for China, and 80 per cent to 17% for India.

The greenhouse gas mitigation measures needed to achieve climate targets, will go a long way to helping us reduce the risk of future droughts or flood conditions and possibly avoid a global food crisis.

The study warns that without significant reductions in greenhouse gas emission, patterns of increased precipitation in high latitudes, including areas in North America and Europe could emerge as early as the 2020s and in some areas may have already altered due to climate change.

Patterns of decreased precipitation in areas such as the Mediterranean, western Mexico, Chile, South Africa and Australia could emerge by the 2050s.

How will wheat be affected by climate change?

https://environment.leeds.ac.uk/see/news/article/431/dramatic-rainfall-changes-for-agriculture-can-be-avoided-through-climate-action

IMPACT OF AIR POLLUTION ON CLIMATE, HUMANS AND THE ENVIRONMENT AS WELL AS THE ROLE OF THE WEST AFRICAN SUMMER MONSOON: GERMAN-AFRICAN CONSORTIUM PRESENTS POLICY BRIEF

Explosive population growth, urbanisation and a growing economy - the air over West Africa is exposed to a lot of stress. However, so far there is hardly meaningful information on the effects on health, weather and climate. The Karlsruhe Institute of Technology (KIT) coordinated the European-African consortium "DACCIWA", which has collected new data to investigate the causes and effects of air pollution. The study also examined the interaction of air composition and summer monsoon. The research team published their results in a policy brief.

The World Health Organization (WHO) estimates that each year, around seven million people die from the effects of polluted air. "In West African cities, the concentrations of small particles often cross the borders of the WHO," says Professor Peter Knippertz of the Institute of Meteorology and Climate Research of KIT (IMK). On the one hand, the particles have their origin in human actions: charcoal fires, waste combustion in cities or savanna fires emit fine particles into the air. On the other hand, there are particles of natural origin: "Winds from the north carry sand from the Sahara to the western parts of the region," says Knippertz.

The climate researcher coordinated the DACCIWA project (Dynamics-aerosol-chemistry-cloud interactions in West Africa), which examined the entire chain of natural as well as human-made emissions for the first time, from formation and distribution to the effects.

PARTNERSHIP UPDATE: KIT

For closing the project, the consortium published a policy brief that presents the most important results, campaigns and outlooks and provides concrete recommendations for action.

Traffic, waste combustion and dust from the Sahara pollute the air over African cities – with significant health implications (photo: Sébastien Chastanet).

Collecting comprehensive data was the biggest challenge. "There was no adequate air quality monitoring system in South West Africa," says Knippertz. "Previous computer models could not reliably map the complex atmospheric dynamics and chemistry in West Africa." Therefore, scientists had to gather up-to-date data on the composition of the atmosphere, clouds and air, as well as information on health risks and diseases. The results show that air pollution has already reached a health-damaging level: During the dry season, the concentration of fine particles in the atmosphere is highest, as desert dust from the Sahara and smoke from fires in savannah are mixed in the air in addition to the fine dust that originates in cities.

During the summer monsoon season, particulate matter from Central Africa, which can be transported thousands of kilometres by the prevailing south wind, appear additionally to local emissions. "In our field surveys, we were able to detect 20 to 40% of the particles already above the ocean," says Knippertz. Due to the high humidity during the monsoon, the particles can absorb more water. This tarnishes the atmosphere significantly so that less sunlight reaches the ground. "This influences air circulation, cloud formation and precipitation probability," explains Knippertz. "In the long run, this could affect food production, water and electricity."

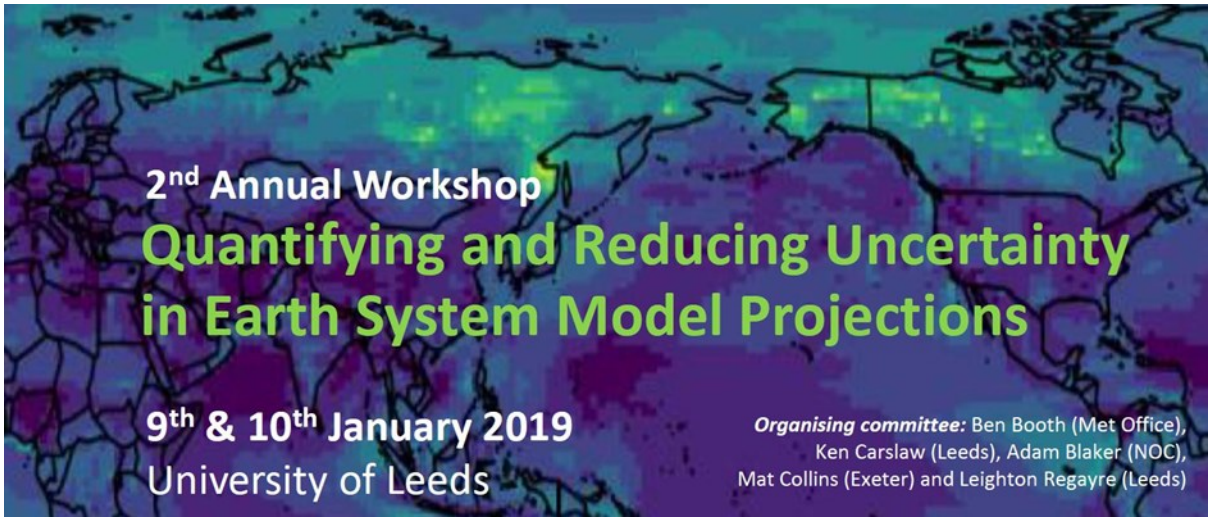
Computer simulations by the DACCIWA project team indicate that temperatures in West Africa are expected to increase by one to three degrees Celsius by 2050, depending on geographic location. In addition, the increased particle concentration in Southwest African cities can entail significant risks to the public health and increase respiratory, cardiovascular and skin diseases: "For the first time, we have shown that the number of hospital visits due to these health problems is closely related to the concentration of particulate matter in the air," says Knippertz. "Especially during the rainy season, the number of known cases of illness increased, which may suggest that humidity amplifies the effects of air pollution on humans."

With the new data and analyses, scientists can provide more accurate climate, weather and health forecasts, not only for West Africa, but also for regions further away: "For example, we know that the West African monsoon can affect European weather and is an important factor for Atlantic hurricanes," explains Knippertz. DACCIWA thus lays the foundations for more precise climate, weather and air quality models, which enable a more sustainable development policy.

More about the KIT Climate and Environment Center: http://www.klima-umwelt.kit.edu/english

WORKSHOP REPORT

QUANTIFYING AND REDUCING UNCERTAINTY IN EARTH SYSTEM MODEL PROJECTIONS



In early January **Dr Leighton Regayre and Professor Ken Carslaw** hosted the 2nd annual Workshop on Quantifying and Reducing Uncertainty in Earth System Model Projections. This workshop brought together Earth system modellers and measurement experts, with statisticians and climate projection end users. The first workshop focused on the potential to account for uncertainties and observations in the physical ocean, ocean biogeochemistry, land surface, carbon cycle and atmospheric chemistry components of Earth System Models (ESMs). This community provides the necessary breadth of expertise to explore how models and observations can be used to quantify and reduce climate projection uncertainty in support of global decision-making in the public and private sectors.

This year's workshop retained the focus on uncertainty quantification in ESMs, experimental design (such as perturbed parameter ensembles) as well as the use of observations to constrain multi-decadal model uncertainty. The workshop also addressed two key themes:

- Using multi-model comparisons to inform perturbed parameter ensemble analyses by identifying model structural errors and emergent constraints
- The transfer of uncertainty information between model variants at different resolutions and/or time scales

The workshop was enthusiastically attended and brought together an emerging community of researchers who are putting the reduction of uncertainty in near-term climate projections at the heart of their research agenda. Around one in four workshop participants travelled from abroad to take part, including five of the invited speakers.

The workshop focussed on discussion rather than presentations. Lively, productive debates were encouraged using provocative questions such as "Emergent constraints on a single climate variable/metric are likely to be overly confident" and "It is pointless to explore uncertainties in component models if their sensitivity is different in coupled models". Workshop participants rose to the challenge and discussed these topics with vigour.

Workshop feedback included comments such as: “This workshop was the highlight of my research career so far”. More importantly, the workshop has stimulated an appetite for closer collaboration on uncertainty reduction in ESM projections. Our community are actively seeking ways to design coordinated experiments that bring together techniques for analysing single model and multi-model uncertainties.

A perspective piece that summarises workshop outcomes is in production and planning for next year’s workshop is underway. Anyone interested in strategies for quantifying and reducing uncertainty in ESM projections should get in touch with Leighton and/or Ken.

UPDATE FROM CEMAC

CEMAC has had a busy start to 2019, which has included a rebrand to become the "**Centre for Environmental Modelling and Computation**.” This new name reflects a broader engagement with research and teaching across the whole of the School of Earth and Environment (SEE). CEMAC is already in discussion with researchers from the Institute for Geophysics and Tectonics (IGT) and the Sustainability Research Institute (SRI), exploring opportunities to support their research computing, including a potential major project with the NERC Centre for Observation and Modelling of Earthquakes, Volcanoes and Tectonics (**COMET**), which is based in Leeds.

CEMAC also welcomes **Richard Rigby** back to Leeds. He has joined the CEMAC software development scientists team as of April 2019.

Richard will take on a largely responsive role within CEMAC, working with SEE staff to support research computing and research-based learning involving computation and modelling, across the School.

EGU 2019

An impressive number of ICAS staff and students attended the recent European Geophysical Union (EGU) General Assembly in Vienna (April 7-12, 2019). Our attendees included Jess Baker, Steve Boeing, Luca Cantarello, Wuhu Feng, Declan Finney, Alan Haywood, Yajuan Li, Graham Mann, Amanda Maycock, Richard Pope, Alex Rap, Chris Wilson, Tom Wood and Despina Zoura, who were among the 16,273 scientists at this huge gathering.

ICAS researchers gave a range of oral, PICO and poster presentations. A particular highlight for us was Amanda Maycock receiving her Arne Richter Award for Outstanding Early Career Scientists.

Amanda receiving her Arne Richter Award for Outstanding Early Career Scientists from EGU president Alberto Montanari

FEATURED PERSON: LUKE CONIBEAR

What is your role in ICAS?

I've just started a 4-year postdoc position studying the health impacts of air pollution from deforestation fires.

What do you like the most about ICAS?

The friendly working atmosphere, the breadth of expertise, and the focus on important science.

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

I came from an engineering background, though I was inspired by the use of data in global development in efforts such as Gapminder and Our World in Data (I'd recommend watching the short TED talk from Hans Rosling on The Magic Washing Machine). This led me to transition to a PhD on air quality and I was immediately hooked by the potential real-world impacts to pressing problems.

What scientific achievement are you most proud of?

I was pleased that my work on the large contribution of residential biomass use to poor air quality in India was cited by an important study from the India Collaborators of the Global Burden of Disease, and at a World Health Organisation meeting on air pollution. Solid fuel burning in homes is an important source of poor air quality that is often overlooked and causes substantial, avoidable, and costly health impacts.

What does a typical working day involve for you?

There's always lots of emails and reading new papers. Then a mixture of model simulations, health calculations, meetings, writing papers, and (unfortunately) fixing coding errors.

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

I love the big picture aspects of my work on air quality, thinking of practical solutions that can have multiple benefits.

What's the most challenging aspect of your job?

Finding the time to fit everything into a day.

How do you decompress outside work?

I value living close to the Peak District and I find being outside always helps.

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

I'm a keen climber and I try to go often (daily if I could).