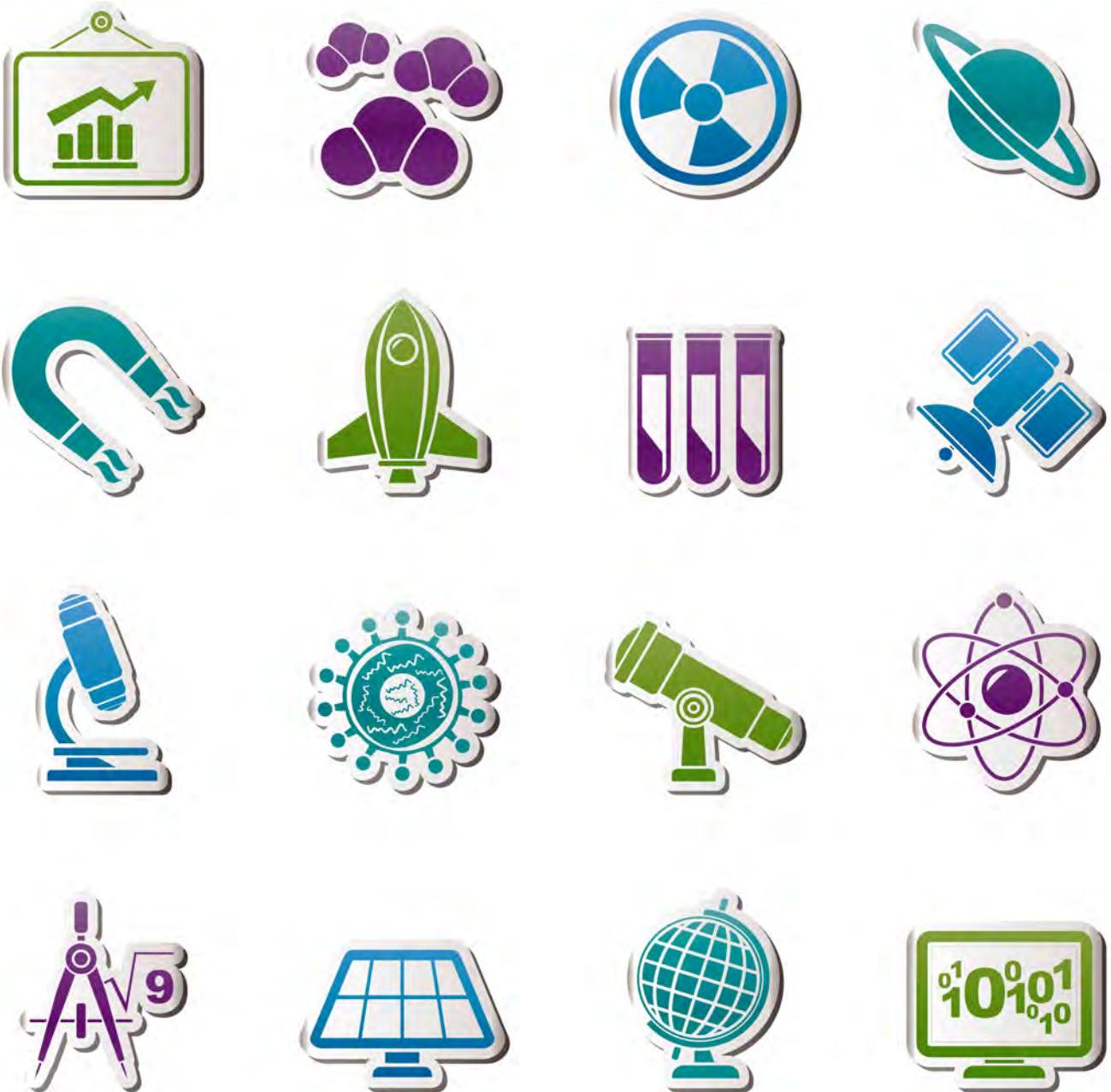


**Intergovernmental Panel on Climate Change release
Working Group II and III reports**

What next for international climate change negotiations?



**Review of UK scientist's contribution to IPCC Working Group I report
Highlights from Prof Jim Skea's IPCC Working Group III lecture**

Message from the Chair



This has yet again been an incredibly busy year, with over a dozen events completed, two changes to the committee and another successful physics essay competition, all with a reduction to our annual budget.

To top this, the IOP is moving its headquarters and is currently redeveloping a building that will shortly become the IOP's home for the foreseeable future.

I would first of all like to thank **Dr Simon Buckle** who is stepping down from the committee and **Dr Sally Brown** who is stepping aside from her duty as Secretary of the group. Their hard work and dedication has been invaluable. We do have a new secretary, **Dr Paul Green**, who was voted in at the Environmental Physics Day. The other significant change is in how we are communicating to our members. We have entered the digital age and now have Twitter and LinkedIn accounts which we will be using to advertise news, events and meetings (see over). This will be in addition to our long standing newsletter that will still be sent to our members by email and post.

In light of the changing budgets, and in order to maintain the number and quality of the meetings, lectures and events that we host, we are experimenting with how we run and organise events. You may notice that there may be a nominal fee for some events, while others may require us to pair back on food or drinks, but please be assured that we are trying to maintain the number of events without reducing the quality. We do however really appreciate your opinion, so please let us know how you feel about these changes.

I feel very privileged to be chair of the most vibrant group in the IOP, the fact that we have a very active and varied program is due to the hard work of our committee members who serve the EPG tirelessly. I would like to thank the committee and all of our members for their dedication and support.

Dr Hugh Mortimer (@HughMortimer)

Committee news

Social media

The Environmental Physics Group is now on LinkedIn and Twitter. Connect for all the latest news, reports and updates. Our LinkedIn page allows you to connect and network with colleagues working across the environmental physics sector, while our Twitter feed allows you to review and comment on any events you attend. We will include highlights of the feedback received here.



Search for IOP Environmental Physics Group [\[link\]](#)



Search for @IoPEPG [\[link\]](#)

We value your participation and we encourage you to put your thoughts and event ideas to the group, to get involved in discussions as well as sharing relevant articles and links.

Newsletter stories and images

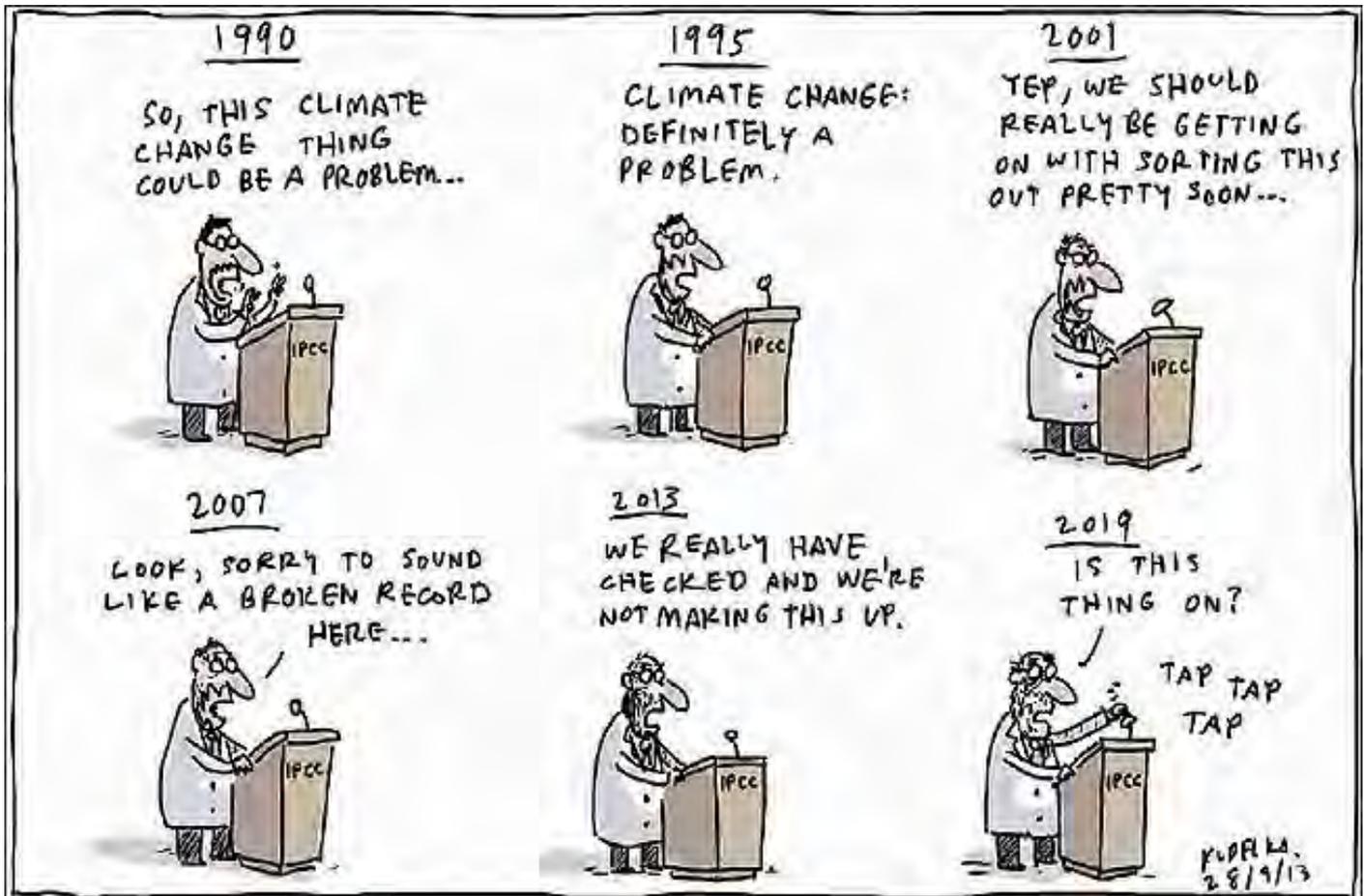
We are seeking your stock photos, images and graphics related to environmental physics, to use in our newsletter and online. If you have access to such an image library we would like to hear from you. Please contact the newsletter editor.

If you have any news, events, or notices you would like to see in the newsletter please let us know. An archive of past newsletters is available [\[here\]](#).



2013-2014 IOP EPG Committee

What next for climate change policy?



The Intergovernmental Panel on Climate Change (IPCC) has now released all three of the reports that comprise its Fifth Assessment Report (AR5). The report from Working Group (WG) I, released in late 2013, tackled the physical changes in the global climate, while the second from WGII addressed climate impacts and adaptation, and the third from WGIII looked at climate change mitigation, published in early 2014. A final synthesis report will be released in October 2014.

While the language may appear inaccessible to some, the Technical Summaries and Summaries for Policymakers are actually quite straightforward to read. For anyone following the development of the IPCC reports, the latest update adds more evidence to support what we already know about climate change and points to a bleaker future without action to address the problem.

Generally there is some friction between those preparing the reports, in their capacity as expert

contributors, reviewers and lead authors, and those who write the high level summaries. AR5 is no different, with WG lead authors focusing on the Technical Summary of each report at various speaking events since the launches. The content of the chapters and Technical Summary is not line-by-line reviewed by Governments, however they do nominate reviewers who participate in the overall process. The Summary for Policymakers is line-by-line reviewed by Governments and this leads to some curious differences in focus and language between the two summaries for each report.

Prof David Stern was an author of chapter 5 in WGIII, which dealt with historical trends in emissions. He has speculated as to why countries may not have wanted to include some of the graphs in the summary for policymakers. For example, one graph highlights regional growth in total greenhouse gas (GHG) emissions over the last 40 years, mainly from developing States. Another graph shows that developed States are now responsible

What next for climate change policy?

for less than half of total historical GHG emissions, while a third graph reveals that the GHG to produce goods in developing States destined for developed States outweigh the emissions created by rich countries to make goods for export elsewhere.

It is not difficult to understand why developed States want to focus on their stabilising or reducing domestic GHG emissions and avoid too much attention on their offshored emissions. The States where these goods are produced equally want to avoid the spotlight of rapidly rising GHG rates. As a result, how we make sense of the science, adaptation and mitigation options is crucially important.

The IPCC stagger the release of the reports to allow sufficient time for people to digest their contents. Inevitably the launch events get widespread media coverage and a few days of comment, debate and analysis before the news cycle turns to the next political football. A report by the largest scientific collaboration in history, dealing with global planetary inter-generational challenges then gets relegated behind a story of a football manager's sacking. When some of those responsible for informing, educating and engaging the public allow implicit comparisons to be made between stories of this nature, is it any surprise that policymakers don't feel the need, or support, to engage on climate change mitigation policy more earnestly?

The WGI report notes that globally averaged combined land and ocean temperature data shows a warming of 0.85 °C since 1880. Meanwhile, atmospheric concentrations of CO₂ continue to rise and the yearly average will soon pass 400 ppm. Twenty four years after the IPCC's first report, and the creation of the UN Framework Convention on Climate Change (UNFCCC), we are no closer to reaching international agreement on climate policy. The UNFCCC's Conference of the Parties (COP) meets annually to review measures taken by States and progress made. States have agreed to commit to a maximum temperature rise of 2°C above pre-industrial levels, but there is no agreement on how this should be specifically achieved.

Ahead of COP20 in Lima later this year, the UN Secretary General is hosting a special climate summit in September. Perhaps in response to acrimonious COP meetings in recent years, the UN Secretary General has changed tack and together with leaders of other international UN and other organisations, he has been engaging with civil society, business and other groups to try and create a space for renewed action from policymakers. Leaders from these groups will be joined by Heads of State & Government at the summit in New York to attempt to raise ambitions, catalyse greater action and support policymakers. This is especially important as it is expected that negotiators will use COP20 to begin to firm up language for a new climate change global agreement, including binding GHG emissions targets, to be subsequently finalised at COP21 in Paris, in 2015, taking effect from 2020.

Another unresolved high-profile policy challenge is to deal with aviation GHG emissions within the International Civil Aviation Organization (ICAO). This debate has been particularly fraught and not helped by aeropolitics. However, it is expected that an agreement will be finalised in 2016, also coming into effect from 2020.

This timeline may also compliment parallel discussion on a successor to the UN Millennium Development Goals, i.e. the post-2015 Development Agenda. The original goals refer to poverty, health, education, sustainability and development actions. It will be interesting to see if and how these are linked to climate and sustainability policy.

The IPCC reports have become clearer and more definitive over time. Notwithstanding a vocal minority who are ideologically opposed to climate science and mitigation policies, a broad based coalition has been building momentum for action and to inform the public on the risks we face. Will our political leaders be able to make the necessary decisions, in the face of short term considerations and vested interests in the next 18 months?

Dr Jarlath Molloy (@jmolloy5)

Climate change 2013: The physical science basis



Institute of Physics, London, 5 February 2014

The physical science basis for climate change is presented in Working Group I (WGI) of the IPCC Fifth Assessment Report (AR5). Following the publication of the WGI report in late 2013, the Environmental Physics Group, along with the Royal Meteorological Society (and supported by the Met Office and National Centre for Atmospheric Science (NCAS)), held an event to discuss its findings and mark the significant contribution of the UK science community to the evidence basis for the AR5 report. As all presentations and talks are available online, this report will highlight some of the key points from the event.

A large number of UK scientists had various roles in the WGI report, including Coordinating Lead Authors, Lead Authors, Contributing Authors and Review Editors for all but one chapter, in addition to others who held central roles in the Coupled Model Intercomparison Project (Phase 5) (CMIP5) that supports the AR5 report. CMIP5 involves coordinated climate model experiments using multiple climate models to assess the general ability of models to predict climate on decadal and longer timescales as well as mechanisms leading to model

differences in 1) climate system feedbacks, and 2) model response due to forcing (e.g from increased GHG levels). With such a strong contribution from the UK science community each of the 13 main chapters were presented at the meeting by contributing/lead authors, out of a total of 259 authors from 39 countries.

The event kicked-off with a short introductory presentation from **Prof Gabi Hergel** who reviewed three key headline messages from the Summary for Policy Makers and how they related to the chapters of the WGI report:

1. Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased (Chapters 2-5).

2. Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of the climate system (Chapters 6-10).

Climate change 2013: The physical science basis

3. Continued emissions of greenhouse gases (GHG) will cause further warming and changes in all components of the climate system.

Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions (Chapters 11-14).

Warming is Unequivocal

The first morning session themed "Observations" covered chapters 2 to 5, with **Dr Tim Osborn** (University of East Anglia) presenting on Atmosphere and Surface (2) and Paleoclimate (5) observations. **Prof Simon Josey** (National Oceanography Centre) and **Prof Jonathan Bamber** (University of Bristol) presented on observations of the Oceans and Cryosphere. Using figure 1a from the summary for policy makers, it was shown how the last three decades have been successively warmer than any decade since 1850, based on globally averaged land and ocean surface temperature. Looking at the annual values rather than decadal means shows the underlying variance and comparing different timescales shows variation in the warming trend. So over the past 60 years (since 1951) the mean warming rate is 0.12 [with a range 0.08 to 0.14] °C/decade, whilst over the past 15 years the mean warming rate is 0.05 [with a range -0.05 to +0.15] °C/decade.

The 'pause' in warming associated with the past 15 years is considered to be influenced by a reduced trend in radiative forcing (volcanic eruptions and downward phase of 11-year solar cycle) and a cooling contribution from internal variability in the climate system. However, whilst there has been a clear slowdown in surface temperature warming, the climate system as a whole has continued to warm, with greater heating of the upper and deep ocean. A further ~75 to ~200 ZJ of energy has entered the climate system in the past 15 years.

The spatial distribution of the underlying datasets used (HadCRUT4, MLOST, GISS) in observing the trend in surface temperature change from 1901 to

2012 were presented. The research challenges of improving spatial and temporal coverage of the datasets, and understanding biases (caused by infilling missing data) were identified. It was noted that greater transparency in developing these datasets is also needed going forward to aid communication of the science.

For Paleoclimate records (going as far back as 2,000 BP), 14 reconstructions from 12 studies using either tree-ring and/or a combination of other proxy data have shown good agreement in the timing of relatively warm and cold periods, though there is clear difference in the size of change.

Human Influence is Clear

One of the key developments of the CMIP5 modelling is the inclusion of the carbon cycle. **Dr Chris Jones** (6) showed how the model can simulate land and ocean carbon fluxes, by either specifying emissions or concentration of CO₂ to then diagnose the other. Representing it as emissions driven is considered more like the real world, calculating the change in CO₂ concentration by taking away the natural CO₂ uptake (land and ocean) from anthropogenic emissions. However, controlling the CO₂ concentration in the model enables evaluation of the emissions so allowing a particular future scenario to be followed. Whilst seen as a key development it was noted that the large uncertainty in emissions scenarios hinders the usefulness for pathway assessment.

The key model uncertainties of processes were summarised as there being a fine balance between large, competing effects (more CO₂ means more carbon uptake, but warmer climate generally reduces uptake); the timescales and sensitivity of processes varies across timescales that mean extrapolation of feedback metrics is not possible; whilst soil and biomass stores of CO₂ can model regional influences effectively, they don't do well at global influences; and missing processes (permafrost, nutrient cycles, wetland, and ocean acidification).

Climate change 2013: The physical science basis

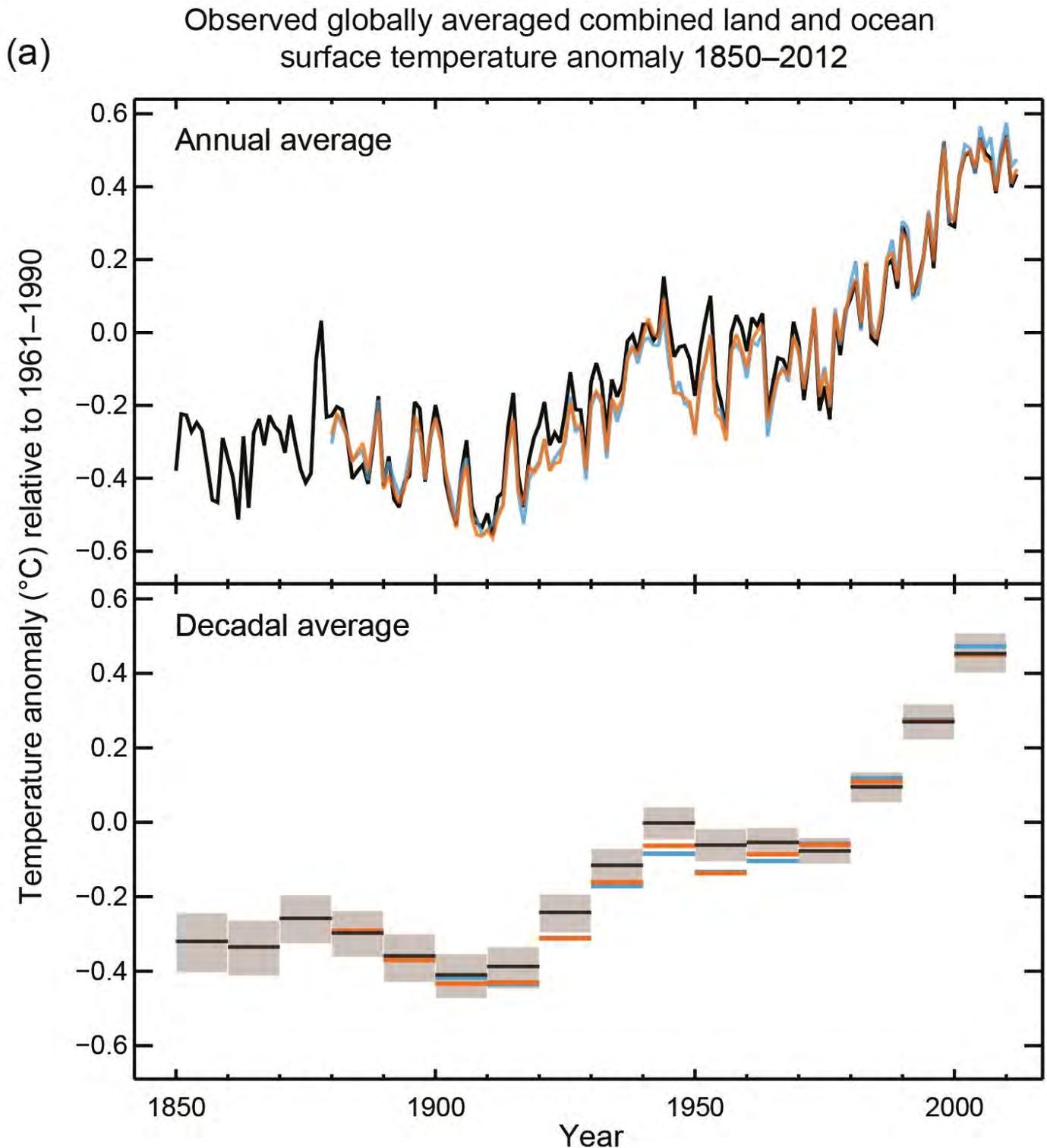


Figure SPM.1a: Observed global mean combined land and ocean surface temperature anomalies, from 1850 to 2012 from three data sets. Top panel: annual mean values. Bottom panel: decadal mean values including the estimate of uncertainty for one dataset (black). Anomalies are relative to the mean of 1961–1990.

Climate change 2013: The physical science basis

Further uncertainty in our understanding of climate change comes from cloud feedbacks and aerosol radiative forcing. Whilst still representing the two biggest uncertainties, **Prof Piers Forster** (8) showed that there has been improvement in our understanding of clouds as a result of new satellite sensors and a better understanding of climate-relevant aerosol processes. This improved data and knowledge has shown that (robust) cloud feedbacks are likely having a positive (amplifying) effect on global warming.

The anthropogenic component of Effective (all atmospheric temperatures allowed to adjust rather than just stratospheric temperatures) Radiative Forcing (net change in energy balance of the Earth system) is a result of well-mixed GHGs (WMGHGs), chemically reactive gases and aerosols, and land surface change. The radiative forcing from increased concentrations of WMGHG has increased by 8% since 2005, with very high confidence that industrial-era natural forcing is only a small fraction of the anthropogenic forcing except for brief periods following large volcanic eruptions. The combination of all anthropogenic radiative forcings equates to 2.3 (mean in the range 1.1 to 3.3)Wm⁻². The different forcings mean that there is a geographical distribution in Effective Radiative Forcing levels, but as yet no link is found with the distribution in surface temperature changes.

Consequence of Continued Emissions

Understanding the consequence of continued emissions of GHGs is dependent on climate modelling capability and so an evaluation of models was presented by **Catherine Senior**, **Prof Peter Cox**, and **Prof Eric Guilyardi** (9). The increased complexity and resolution of climate models since CMIP3 has led to incremental improvements in the correlation between the modelled and observed annual mean global patterns (though not uniform improvement across all models). The simulation of cloud proves challenging with significant associated errors leading to uncertainties in cloud feedbacks that contribute to the spread in climate

change projections.

New to AR5 is a chapter on near-term climate change projections. This was introduced as recognition of the importance to policy making and raised the question: to what extent is climate predictable, in theory and in practice? On these shorter time-scales the natural internal variability of the climate system is most significant, with low sensitivity to changes in GHG concentrations and only some sensitivity to short lived forcings, particularly on regional scales. Many regional research challenges were identified for near term modelling at regional scales, ranging from understanding the changes in atmosphere and ocean circulation to better understanding of high impact weather events.

Final Note

The day proved a great success, attracting a diverse audience from across the UK and Europe that led to a healthy and constructive discussion session in the final afternoon session. We are particularly grateful that so many were able to join us for the event despite the transport challenges on the day.

All the presentations were recorded (slides & audio) and are available here: [<http://www.rmets.org/events/climate-change-2013-physical-science-basis-working-group-1-contribution-fifth-assessment>]

Reference: IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp., available at [<https://www.ipcc.ch/report/ar5/wg1>]

Dr Stefan Thor Smith

Centre for Ecology & Hydrology site visit

Wallingford, 10 April 2014

The Centre for Ecology & Hydrology (CEH) is the UK's Centre of Excellence for integrated research in terrestrial and freshwater ecosystems and their interaction with the atmosphere. As part of the Natural Environment Research Council, they provide National Capability based on innovative, independent and interdisciplinary science and long-term environmental monitoring, forming an integral part of NERC's vision and strategy. Working in partnership with the research community, policy-makers, industry and society, they deliver world-class solutions to the most complex environmental challenges facing humankind.

The day started with some talks from staff at CEH Wallingford, highlighting some of the work lead by scientists at that site. **Dr Chris Huntingford** reviewed some of the work on climate change, highlighting: the work CEH does to quantify the carbon cycle, uncertainties in climate sensitivity, complexities of studying fluid dynamic systems, tipping points, what do GCMs actually tell us and how can we use historical data to validate them, and finally the difficult line that has to be trod between advocating action and remaining impartial in the highly emotive area of politics and commercial interests.

Dr Jonathon Evans described a new flagship NERC Project - COSMOS a network of 30 stations to monitor soil moisture on a large scale across the country. The novel instrumentation is based on sensors that measure the natural amount of fast neutrons generated by cosmic rays. These neutrons are slowed by water and so can be used to estimate soil moisture content, although the relationship is non-linear and requires specific site characteristics. It will provide vital information on the country-wide hydrological cycle, assisting in flood/drought prediction, agronomy, climate and land/atmosphere exchange modelling, weather, etc.

Dr James Hannaford discussed the work CEH does in hydrology: providing a hydrological outlook for the UK, modelling floods and droughts, maintain



The riverbed flow simulation facility

the National River Flow Archive, studying impacts including socioeconomic factors, highlighting the key role CEH plays in helping predict and manage flooding. This is an area of particular local interest as Wallingford is close to the Thames and has been subjected to extensive flooding in recent years.

The morning session was followed by lunch in the site cafe, then a tour of the site where we saw the custom designed facilities for processing ecological samples, from bulky dirty bags of soil through to chemical analysis in clean rooms and laboratories. We also saw some of the growing facilities used for ecological experiments and an artificial river bed facility for examining river flow dynamics.

In the afternoon **Dr William Ball** from Imperial College London, presented the impact the sun has on our weather, explaining the different ways solar

Centre for Ecology & Hydrology site visit

activity is monitored as there is no perfect instrument or model. The sun's natural 11 year cycle impacts on our weather through changes in the incident power and wavelengths but contributes at most 10% to annual temperature changes, and is typically only 2-3%.

Dr Darren Ghent from the University of Leicester followed by giving a very interesting overview of the difficulties involved in measuring land-surface temperatures from space. Sea-surface temperatures are a good indicator of global & regional climate and are relatively straight forward to retrieve due to extensive area and relative homogeneity of the oceans' surface. However land surfaces are more complex due to inhomogeneity and the influence of so many factors.

Philip Harwood from CGI described the ESA e-Surge project which is utilising real-time data to predict the potentially catastrophic occurrence of coastal flooding caused by sea-surges. Storm surges can be extremely destructive. 44% of global human population are located within 150 km of the coast and eight of the ten largest cities in the world

are located on the coast. In northern Europe many coastal areas are just above or even below the mean sea level and are particularly vulnerable to the persistent threat and impact of storm surges. e-Surge is collating data from satellites, tidal gauges, weather forecasts and ocean models and helping people make the best use of it to predict storm surges in their region. The final talk of the day was given by **Dr Mhairi Coyle** from CEH-Edinburgh, titled "From Earth to Atmosphere & Back" and described the work done at other CEH sites studying the land/atmosphere exchange of trace-gases and aerosols. Going through history of the UK as the "dirty man of Europe", exporting sulphur dioxide to the continent where it caused severe damage to ecosystems and architecture, to a world leader in emission controls and understanding of the ecological impacts of many pollutants.

Overall it was a very interesting day, attended by ~45 people, with a wide range of talks covering global to local issues and highlighted the varied role physics plays in studying and understanding our natural environment.

Dr Mhairi Coyle (@VCO3)



Climate, Environment & Press

Royal Astronomical Society, London, 27 March 2014

The aim of “The Climate, the Environment and the Press” event was to bring together environmental scientists, journalists and science communicators to discuss the ways in which climate science can be communicated more effectively in the press. Over 45 people attended the main lecture theatre at the Royal Astronomical Society, to listen to talks by **Richard Black** (former BBC science correspondent), **Professor Averil MacDonald** (Chair in Science Communication at the University of Reading), **Dr Matt Watson** (senior lecturer at Bristol University), **Mike Bishop** and **Joe Winters** (press officers for the IOP) and **Asher Minns** (knowledge transfer of climate change specialist at the Tyndall Centre). The talks complemented each other in the advice, stories and the message that they conveyed.

Impressively, **Averil MacDonald** gave her talk unaided by powerpoint and described the importance of “*knowing your audience*”. She described how the “*public*” in public engagement is actually made from many different publics that the message of your news or science article should reflect this.

Richard Black outlined a journalist’s perspective on climate stories in the press. Richard spoke about what motivates the press and how this is often in conflict with our expectation of the media.

Matt Watson spoke about his work on a controversial environmental science project SPICE, which drew a large amount of media attention. His account of his experience of working the press and the ethical side of science was very enlightening.

The event concluded with a panel discussion where the audience had the chance to ask questions from the experts and gain insights into how the science and media communities could work more effectively together.

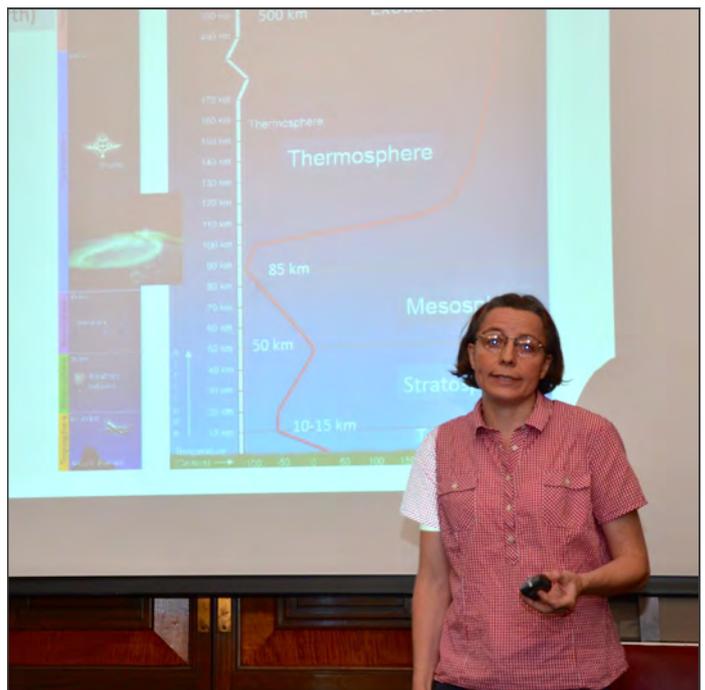
Dr Hugh Mortimer (@HughMortimer)

Environmental Physics Day

“The role of physics in understanding atmospheres”

Royal Institute of British Architects, London, 21 May 2014

Amongst the splendid surroundings of the Royal Institute of British Architecture, the Environmental Physics Group held its annual event on 21 May. We were treated to some excellent talks on the topic of “Atmospheres” before the winners of the Essay Competition were announced. In keeping with general public interest in climate change the committee chose the theme of atmospheres to be topical but still very much within the overall remit of the group.

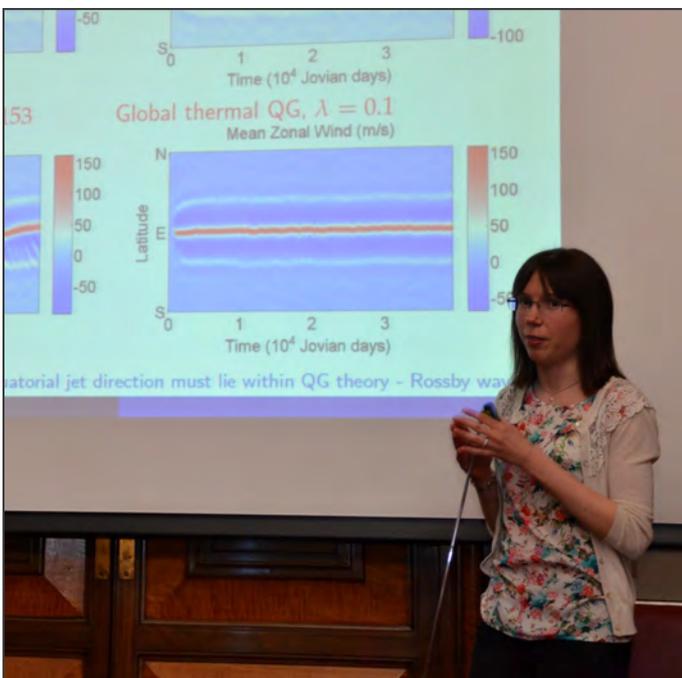


The first talk, by **Dr Marina Galand** of Imperial College, took us on a tour of some of the bodies in the solar system which have atmospheres, ranging from CO₂ on Venus and Mars to N₂ on Titan (and Earth, of course). A comparison of the drivers of thermal structure in the various atmospheres was followed by an explanation of what the Huygens probe has taught us more specifically about Saturn’s moon Titan. This very cold moon has a “Methanological Cycle” in which methane and ethane take the place of water on Earth and the

Environmental Physics Day

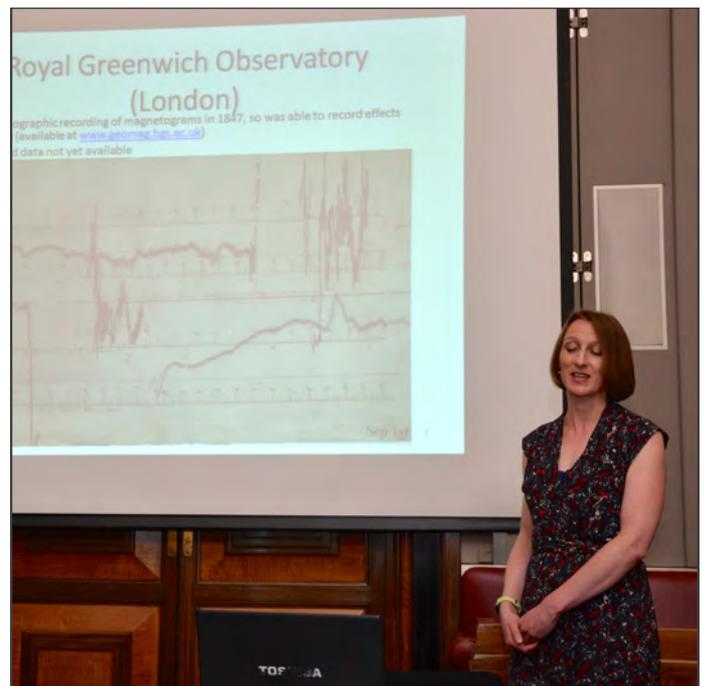
intense cold has had a slowing effect on the evolution and meteorological cycles of the atmosphere. Titan also has the most complex ionosphere in the Solar System which resembles the pre-biotic period on Earth.

Dr Emma Warneford from Oxford University then continued far out in the Solar system to tell us about her PhD research, which has developed models for super-rotating equatorial jets within the atmosphere of Jupiter to try to account for the zonal jets (banding) observed there and on Neptune. Previous thermal shallow water models achieved some success but had deficiencies such as predicting the wrong direction for the rotation of the equatorial jet. Various modifications have now improved these models, and a further extension to a quasi-geostrophic form have demonstrated closer theoretical predictions to observed data such as the correct direction of rotation.



Bringing us back to Earth and back in time to 1859 **Dr Karen Aplin**, also from Oxford University, told us about the largest solar storm in the history of quantitative measurements. The coronal flare associated with the event was seen by Richard Carrington with his unaided eyes from his home in Surrey. “*Space Weather*” is now recognised as an

important hazard, and the Carrington event was one of the most extreme solar storms ever recorded. The storm caused widespread aurorae, even in the tropics, and major disturbances to the telegraph network operating at that time.

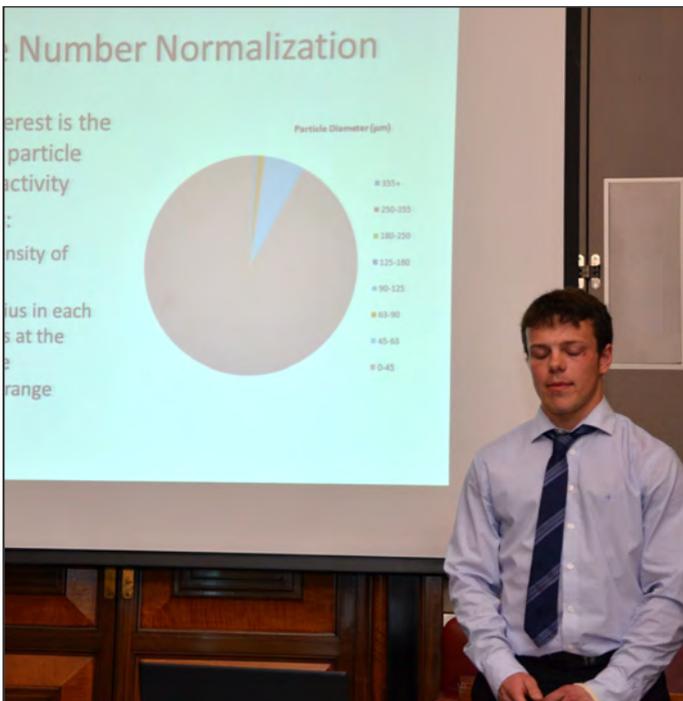


Contemporary measurements of atmospheric electricity, including those from Greenwich and Melbourne in Australia and also from data collected by Lord Kelvin in Scotland have been collated and synthesised since the event. Atmospheric electricity data from that period is unexplored and so offers a potentially new source of quantitative information.

Michael Humphries, a student of Dr Aplin at Oxford, then explained the effect of natural radioactivity in volcanic ash, the significance of which was brought home by the 2010 eruption of Eyjafjallajökull in Iceland. Ash seen over Scotland exhibited significant electric charge which might have originated from a number of causes, including from radioactive decay.

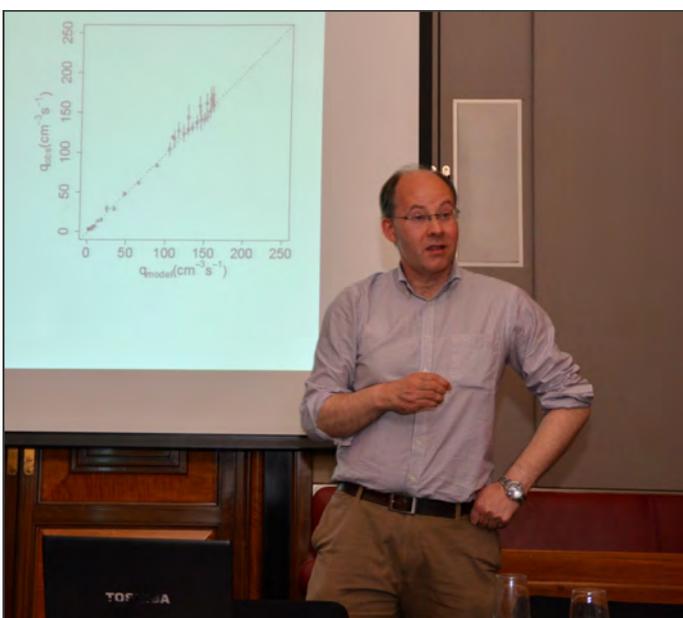
Gamma and Alpha spectroscopy performed on samples collected at the time of the event showed radioactive charging was significant only for larger particles, which were not seen as far away from the event as Scotland. The charging is therefore

Environmental Physics Day



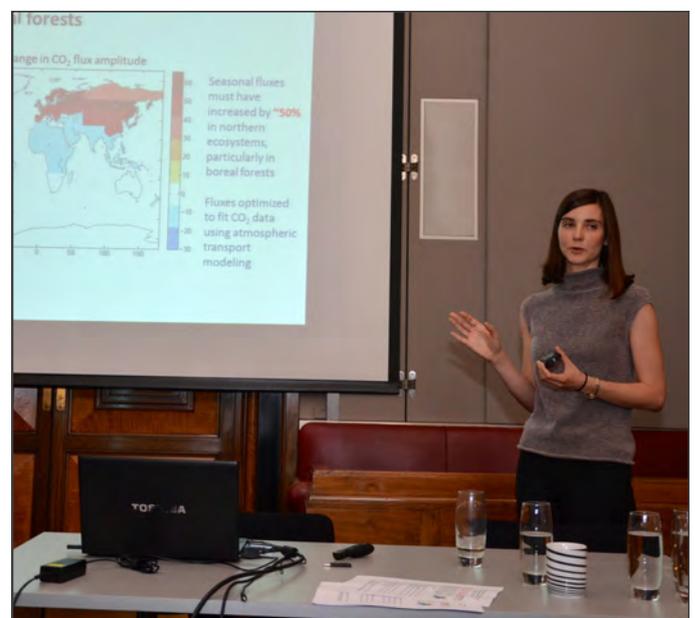
thought to be more probably associated with triboelectrification (through friction), which occurs in the actual plume emitted from the volcano.

Continuing with the topic of space weather, **Professor Giles Harrison** from Reading University described how weather balloons are being used to gather data on events which can have a major impact on our communications systems. Space weather and Earth weather are related and in particular events outside the atmosphere such as cos-



mic rays and the solar wind stream can create pathways in the atmosphere for lightning strikes.

Modern radiosondes carried on weather balloons have sufficient payload and battery power to allow compact ionisation sensors to be carried for space weather and radioactivity monitoring applications. The combination of earth weather and space weather measurements is well suited to investigating the effects of energetic particles in the lower atmosphere, and Professor Harrison explained how weather balloons using a sensor package called PANDORA developed at Reading have allowed the investigation of the geomagnetic latitude effect as well as varying neutron counts at different layers of the atmosphere. One event on 11 April 2013, when surface electric potential was varying at the time of a radiosonde ascent, showed that enhanced counting rates were observed within the upper troposphere (identified from temperature data) when surface atmospheric electricity properties also showed transient changes.



Dr Heather Graven from Imperial College London then talked about the increasing trend in the amplitude of the seasonal cycle of atmospheric CO₂, explaining how seasonal CO₂ cycles naturally follow its uptake and release by the terrestrial biosphere. However, observations from ground-based time

Environmental Physics Day

series and from scientific profiling flights over the period from the late 1950s up to 2011 have shown that there has been a clear 55% increase in the CO₂ seasonal change amplitude at latitudes above 45° N. This pattern relates to a large increase in seasonal carbon exchange in northern ecosystems, particularly in boreal forests. Current models used by the IPCC underestimate the change in CO₂ amplitude at 6 km altitude north of 45°N. This is not yet explained but could involve changing forest composition, changing forest age from disturbance and land-use soil dynamics.



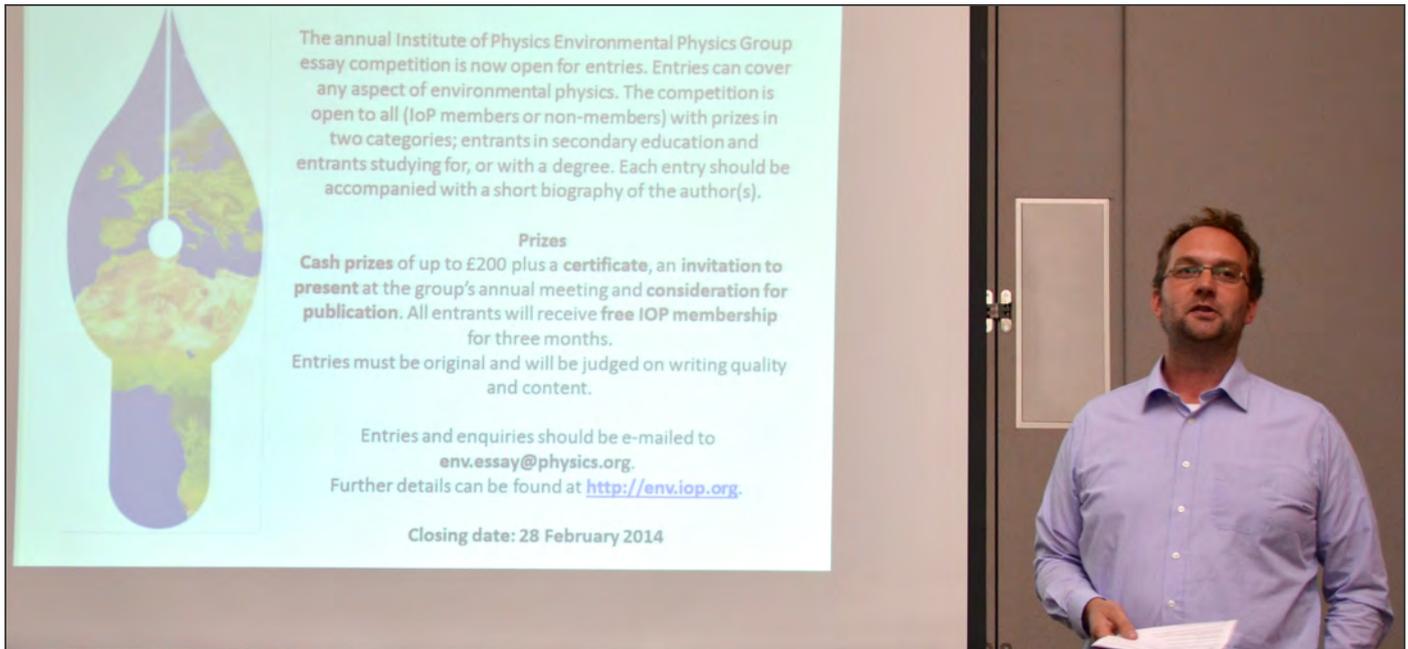
The final talk, by **Dr Paul Williams** of Reading University, described how and why flights are likely to get bumpier through climate change. Aviation turbulence is a serious problem for aircraft and in the US alone causes 40 fatalities, hundreds of injuries and millions of dollars of damage annually. In particular, clear air turbulence (CAT), is difficult to detect and avoid, and computer simulations at the height resolution required to predict it are infeasible. Models for the causes of CAT take account of height stratification, which has a stabilising effect, as well as wind shear, which has a destabilising effect.

A phenomenon called Kelvin-Helmholtz instability occurs if the ratio of these two effects drops below a threshold value, causing the observed turbulence. The tropopause, the boundary between the troposphere and the stratosphere and above which most commercial aircraft fly, varies in height between the equator and the poles and CO₂ in the atmosphere cools the stratosphere but warms the troposphere. Satellite observations show that the lower stratosphere has cooled by around 1 degree over the past few decades. CAT is linked to upper-level jet streams, which are projected to be strengthened by anthropogenic climate change, and this is borne out by the increases in a number of CAT diagnostics by 40-90% over the period 1958-2001 in the North Atlantic, USA, and European sectors. The overall prediction is therefore that transatlantic flights are indeed likely to become bumpier by the middle of the century.



Dr Hugh Deighton

Annual EPG essay competition



The annual Institute of Physics Environmental Physics Group essay competition is now open for entries. Entries can cover any aspect of environmental physics. The competition is open to all (IoP members or non-members) with prizes in two categories; entrants in secondary education and entrants studying for, or with a degree. Each entry should be accompanied with a short biography of the author(s).

Prizes
Cash prizes of up to £200 plus a certificate, an invitation to present at the group's annual meeting and consideration for publication. All entrants will receive free IOP membership for three months.
 Entries must be original and will be judged on writing quality and content.

Entries and enquiries should be e-mailed to env.essay@physics.org.
 Further details can be found at <http://env.iop.org>.

Closing date: 28 February 2014

Royal Institute of British Architects, London, 21 May 2014

The annual essay competition results were announced at the Environmental Physics Day event. Entries can cover any aspect of environmental physics. The competition is open to all (IOP members or non-members) with prizes in two categories; entrants in secondary education and entrants studying for, or with a degree.

The overall winner was **Rachel White** from Imperial College London for her essay entitled "*A changing climate – should Britain worry now?*". Rachel was unable to attend in person and so explained her essay via a video, in which she predicted that although Britain might actually see some benefits from rising atmospheric temperatures, nevertheless the economic impact of increasing rainfall and sea levels would be substantial and this, combined with the risk to food security, was cause for Britain to be concerned about the changing climate.

The first runner-up was **Toby Bryce-Smith** from Leys school in Cambridge, and his essay was about "*Britain's current nuclear crisis*". Toby argued in his video presentation that although nuclear energy was the best way for Britain to generate its future energy needs, the Government should look to

cheap, reliable and small pressurised water reactors, as used in submarines, rather than the single massive 3.2 GW reactor as planned at Hinkley Point C. This will offer economic benefits to British industry as well as improving delivery through mass production techniques.



The joint runner-up was **Anne Gill** (above), who attended in person to read her essay entitled "*What is global warming and what are the dangers associated with it?*".

Dr Hugh Deighton

IPCC Working Group III lecture



Institute of Physics, London, 21 May 2014

After an afternoon of 'atmosphere' themed presentations, we concluded Environmental Physics Day, with an evening lecture by **Prof Jim Skea** of Imperial College. Run jointly with the IOP London and South East branch and attended by around 50 people, Jim's talk focused on the Intergovernmental Panel on Climate Change's recent report on climate mitigation.

The report – which focused on ways to reduce greenhouse gas emissions and the wider implications of this - consisted of 16 chapters drafted by 235 authors. Jim discussed the methodologies and complexities of the IPCC process, including reviewing tens of thousands of comments from scientists and working through the night to produce the final draft. An exhausting night for many scientists and government officials!

The report notes that greenhouse gas emissions have grown over past decades despite efforts and mitigation policies designed to reduce emissions: cumulative CO₂ emissions have doubled since the 1970s, and energy supply and industry are respon-

sible for around three quarters of all emissions. So what causes the increase? Is it more people or are we using more energy? Findings indicate that whilst we are becoming more energy efficient, economic and population growth tend to be the main drivers for the release in fossil fuels. In high income countries, energy, industry and transport tend to release to greatest amount of emissions, whilst in lower income countries there is a shift towards agricultural, forestry and land use practices.

Whilst we are aware that there is more carbon CO₂, what can be done about it and when? One clear message was that the earlier that we reduce our emissions the better it will be for our environmental, and the more cost-effective it will be for us in the long-term. But decarbonising our lifestyles and economies is challenging – how many governments would be prepared to reduce GDP growth to accommodate new energy supplies? As difficult decisions lie ahead, this is the case where the sum could really more than the parts.

Dr Sally Brown

EPG Annual General Meeting

*Royal Institute of British Architects, London,
21 May 2014*

Honorary Secretary's report 2014

The AGM was attended by 24 group members and a few other attendees from Environmental Physics Day. The minutes of the 2013 AGM were read and approved. Reports from the Chair and Treasurer were presented.

The elected committee and co-opted members met four times during 2013-14 (September – 7 attendees, December – 7 attendees, March – 10 attendees and May – 12 attendees). The meeting in March took place via teleconferencing. Although there were a few hitches, it generally went well. The group may do this more in the future to keep costs down, but still recognise the value meeting face-to-face. It was felt that this was particularly important for us as we are such a diverse group. Prior to the AGM, the committee comprised three officers, eight ordinary members and three co-opted members. Group membership is still healthy at 641 – a slight increase from last year.

Dr Sally Brown stepped down as Secretary, with the position being taken by **Dr Paul Green**. **Dr Jarlath Molloy** and **Dr Chris Lavers** were successfully re-elected. **Dr Simon Buckle** stepped down, having reached the end of his elected 3 year term. Special thanks should go to Simon for his enthusiasm in helping to organise events, and suggestions for speakers, which of course, are always welcomed! Simon has kindly agreed to continue to support the EPG, but will no longer take a formal role.

The AGM were made aware of the change in the Constitution. Group members may be elected for up to 12 years in succession, serving up to four as an officer in any one go. **Dr Mhari Coyle** agreed to continue as EPG Treasurer into a fourth year. Thus the position of Treasurer will be vacant in 2015.

As part of AOB, potential meetings were discussed, such as pollution or aerosols. There was also en-



couragement from the members to have greater links with other societies, such as the Aerosol Society or RSC. The Group Chair, **Dr Hugh Mortimer** welcomed the suggestions and encouraged members to nominate topics and help organise events.

This is your group – we welcome suggestions and help in organising events. Environmental physics education was also raised, continuing the good work and enthusiasm of **Dr Peter Hughes** who was part of the education sub-committee for many years. Again, the EPG would like to develop this further, working with the IOP to better promote education at A level and University level education.

Finally, thank you for all committee members, group members and those outside of the group who have helped and supported the group over my last two years as Secretary. The interactions between different multi-disciplinary topics within the environmental field is always a delight to see, and I have enjoyed working with each one of you. I now handing over to **Dr Paul Green**, who I am sure will bring fresh idea and enthusiasm to the post.

This is my final report as Honorary Secretary.

Dr Sally Brown

EPG Annual General Meeting

**Royal Institute of British Architects, London,
21 May 2014**

Chair's report 2014

Thanks to all who contributed to the programme of events in 2013/14, including speakers, organisers and those who supported with their attendance.

The 9th EPG essay competition was launched in the autumn of 2013. We continue to get very high quality entries, particularly from secondary school children. We which really challenges our judges to select the winners. I would like to thank all those who entered their work and to the judges, with particular thanks to **Dr Peter Hodgson**, who started this competition and to **Dr Paul Green** who has now taken over managing the competition. We are delighted that some of our winners are attending Members' Day and presenting their work.

In other news, the IOP have consulted with the group on many issues, and we have endeavoured to respond to these requests for information. The IOP has bought and is redeveloping a site in Kings Cross London which will act as our new headquarters. We are providing input as to the design and layout which will be our new home into the future.

I would like to express my sincere thanks to all of the committee for their hard work during the past year. All of the events we have held are due to their hard work and commitment. I would also like to thank you, the members, for attending our events. Finally I would like to express my sincere thanks **Dr Sally Brown** (Secretary) and **Dr Mhairi Coyle** (Treasurer) who made my role as chair an easier task.

Dr Hugh Mortimer (@HughMortimer)

Date	Title	Type	Location	Jointly organised with
21/05/2013	Members' Day	½ day	RIBA London	
21/05/2013	AGM	30 mins	RIBA London	
21/05/2013	Evening lecture	Evening	RIBA London	IOP London & South East Branch
16/10/2013	Photonex13 - The space applications	1 day	Ricoh Arena, Coventry	
23/10/2013	The science behind our cultural heritage	Evening	IOP London	IOP London & SE Group and RSC Env. Chemistry Group
30/10/2013	The role of remote sensing in assessing environmental impact	½ day	Grantham Institute, Imperial College	Royal Meteorological Society
14/11/2013	Charged aerosols	1 day	IOP London	Aerosol Society and the IOP Electrostatics group
04/12/2013	The teaching of environmental physics	1 day	IOP London	IOP Higher Ed. Group and Higher Ed. Academy
09/01/2014	The Earth's climate past, present and future	1 day	IOP London	IOP Retired Members Group
15/01/2014	Aviation and turbulence in the free atmosphere	1 day	Imperial College London	Royal Meteorological Society
05/02/2014	Climate change 2013: The physical science basis	1 day	IOP London	Royal Meteorological Society
27/03/2014	The Climate, the Environment and the Press	1 day	RAS, London	IOP Physics Communicators Group
10/04/2014	The environment: Centre for Ecology & Hydrology site visit	1 day	CEH, Wallingford	IOP Retired Members Group

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Environmental Physics Group Committee

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EPG on LinkedIn: <http://www.linkedin.com/groups/loP-Environmental-Physics-Group-7424238>

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Didcot



Secretary
Dr Paul Green
Teddington



Treasurer
Dr Mhairi Coyle
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