

IOP | Institute of Physics

Environmental Physics Group

Newsletter May 2019

Welcome to the May 2019 newsletter from the Environmental Physics Group. In this edition we set out our proposed programme for 2019, introduce our committee members, invite you to contribute to our activities over the coming 12 months and summarise our activities for last year, 2018.

1 PROGRAMME FOR 2019

Every year IOP funds each of its groups to hold events, talks, conferences and prizes. We are now planning our programme in detail. Last year's events on the theme of "Physics of the Built Environment" were scheduled late in the year to coincide with the move of IOP to the new building in King's Cross London, which is now completed. As a result we still have some events planned on that theme, and these are listed below.

For this year, 2019, we have chosen "**Oceans**" as our theme. Early developments of the 2019 EPG Programme are also given below and we welcome involvement from members on suggested additional events, venues, and speakers.

Please note these dates for your diary.

1. **Green Infrastructure** – two evening lectures discussing current research aimed at understanding what role different green infrastructure plays on local and micro-scale environmental conditions in a built environment context. **Tuesday 21 May 2019**, 18:00 – 20:00 at IOP building King's Cross. More details at the IOP events website:
<https://events.iop.org/physics-green-infrastructure>
2. **City Pollution** – an event organised by the Combustion Group, co-sponsored by the Environmental Physics Group and the Tribology Group, together with the Aerosol Society. **Wednesday 5 June 2019**, IOP building King's Cross. More details on the IOP conferences website at:
<https://www.iopconferences.org/iop/frontend/reg/thome.csp?pageID=854115&eventID=1369>
3. **Instrumentation for Combustion and Environmental Sensing** – an event organised by the Instrument Science and Technology Group, co-sponsored by the Environmental Physics Group and the Combustion Physics Group. **Tuesday 25 June 2019**, 09:30 – 16:15, University of Manchester. More details on the IOP conferences website:
<https://www.iopconferences.org/iop/frontend/reg/thome.csp?pageID=858227&eventID=1375>
4. **Indoor Air Quality**. A joint one-day event with the Environmental Chemistry Group of the Royal Society of Chemistry. **Tuesday 17 September 2019**, 10:00 – 18:00 at IOP building King's Cross. More details on the IOP events website soon.
5. **Oceans** – the Environmental Physics Group annual event. **Wednesday 23 October 2019**, 14:00 – 17:30 at IOP building Kings Cross. More details on the IOP events website soon.

As the details for each event are finalised we will send out an email to all members with a specific link to the IOP events website. We are conscious that many of these events are being held in London, so if members of the group have suggestions for events at other locations they would be very welcome. Please contact Hugh Deighton, EPG chair on env@physics.org

Essay Competition 2019

The annual Institute of Physics Environmental Physics Group essay competition is now open. Entries can cover any aspect of environmental physics, but we particularly encourage essays aligning with this year's focus on "Oceans". The competition is open to all (IOP members or non-members, individuals or groups) with prizes in two categories; entrants in secondary education; and entrants studying for, or with, a degree. Entries should be accompanied by 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://www.iop.org/activity/groups/subject/env/prize/page_40693.html

Closing date: 30 September 2019

Other events for 2019

Although we already have a theme for 2019 we always welcome suggestions from members of EPG for events which would be of interest to all members, not necessarily related to the year's theme. If you have an idea for a talk or for a seminar within the overall subject of Environmental Physics (see <http://env.iop.org> for a statement of purpose for EPG) then the committee would be very pleased to hear from you and to help you organise the event. Contact details for the committee are given in the next section.

Physics World Environment and Energy Newsletter

IOP Physics World publish weekly newsletters on various topics, one of which is Environment and Energy. The newsletter is available at:

<https://physicsworld.com/c/environment-energy/>

but you can also sign up in your Physics World account to have the newsletter emailed to you weekly. The newsletter is edited by Liz Kalaugher, who is one of the EPG committee members (see below).

2 EPG COMMITTEE

As with all IOP groups the Environmental Physics Group committee has three officers (chair, secretary and treasurer) along with a number of ordinary members, some of whom are co-opted because of their other affiliations or specialist skills. There is a list below of the current committee members and their roles. We can be contacted either through the general IOP Groups email address (groups@iop.org) or through our dedicated physics.org address (env@physics.org). We welcome enquiries from our members and we encourage all members to participate in the activities of the group.

Current committee members:

- Chair: Dr Hugh Deighton
- Secretary: Ms Eleanor Barber
- Honorary Treasurer: Dr Paul Green
- Ordinary Members: Dr Stefán Smith, Ms Holly Marshall, Dr Tim Lee, Dr Natalie Harvey, Mr Owen Stevens, Ms Ally Williams and Ms Natasha Wright.
- Co-opted members: Dr Liz Kalaugher, Dr Matt Wright and Mr Gui Wright.

(Further details for the group and its committee can be seen at <http://env.iop.org>)

3 EVENTS HELD IN 2018

Annual EPG day: Physics of the Built Environment – 10 October 2018

We held our annual event on our chosen theme for 2018, Physics of the Built Environment. The day was one of the last events to be hosted at the IoP's headquarters in Portland Place. Invited speakers gave talks on a range of interesting topics including the impact of building design on energy use, measuring the thermal performance of homes and modelling airflows in outdoor urban environments. It was a fascinating insight into the role physics can play in helping to identify and resolve issues surrounding energy use and sustainability in the built environment. The full list of talks is given below and further information can be found on the [Environmental Physics Group website](#).

- Welcome and Introduction – Professor Paul Hardaker, CEO Institute of Physics
- Are Buildings Evil? - Professor David Coley, University of Bath, UK
- The challenge of overheating in modern UK housing - Dr Andrew Wright, De Montfort University, UK
- Designing for indoor environmental quality in a warming climate - Dr Anna Mavrogianni, University College London, UK
- Measuring the Thermal Performance of Homes – a Data-Driven Revolution - Dr David Allinson and Mr Matt Li, Loughborough University, UK
- Energy Performance of Photo-Voltaic façade systems - Dr Mehdi Shahrestani, University of Reading, UK
- Moisture in buildings and the unintended consequences of energy - Ms Valentina Marincioni, University College London, UK
- Building physics and statistical inference to inform policy and practice - Dr Cliff Elwell, University College London, UK
- Quick, robust characterisation of the thermal properties of building elements: a Bayesian approach and its applications - Dr Virginia Gori, University College London, UK
- Outdoor airflows, urban ventilation and city breathability - Dr Xiaoming Cai, University of Birmingham, UK
- Physics of natural ventilation of buildings and connections to urban airflows - Professor Paul Linden, University of Cambridge, UK.

Physics of Thunderstorms –talk given by Professor Paul Hardaker CEO of the IOP and formerly at the MET office. Held at Exeter University – 9 May 2018

Report by Chris Lavers, IOP member, former EPG committee member and talk organiser.

Thunderstorms are ever-present across the globe and for centuries have had a strong cultural influence. Our knowledge about thunderstorms has been largely driven though by our need to protect ourselves from their impact on local communities and infrastructure. This talk explored what we know and don't know about the physics of thunderstorms and how this has helped us understand how and where they occur, both on the earth and on other planets, the important role they play in balancing earth's energy budget, how to mitigate the weather hazards they create and how this knowledge can help make predictions and give warnings. The impact of thunderstorms on health is still poorly understood, and yet significant in light of the June 1994 asthma thunderstorm event in the South East. The sudden influx of those with respiratory problems in A and E units in hospitals across the South East, made staff initially think they were under some form of chemical attack. It subsequently appeared the storm acted like a giant Hoover, with all available pollen coming together, with charging making it much more 'sticky', especially for particles smaller than 10 microns size.

This was probably the most entertaining talk I have attended over 3 decades, perfectly staged with the threat of a thunderstorm in the balmy afternoon! Paul introduced the many differences between atmospheric and weather patterns, ocean currents, global circulation and how thunderstorms balance energy out. Northern hemisphere storms (having more land) are quite different to those over the Southern Ocean (it has much more ocean). Weather helps redistribute the energy: evaporation providing 25% and convection 5%, both important contributions. Paul showed some useful vertical radar scans of height against range which illustrated the bottom 1km of boundary air which results in turbulent mixing (bad for aircraft) and thermal (convective) colour turbulence boundary layer slides.

Paul showed a Tephigram, one of 4 thermodynamic diagrams commonly used in weather analysis and forecasting to describe the relationship between temperature and entropy, first developed by Napier Shaw in 1915. A typical storm contains 5×10^8 kg water vapour and 1015 Joules. The audience was then asked to listen to some audio clips and participate in describing the sounds, as well as illustrative points made from classical paintings such as John Constable's Seascape.

Reference was made to the Chilbolton 3 GHz radar in monitoring dangerous multi-cells. Weather prediction and aviators want advance notice of wind shear, with flow formation resulting in the classic need for a sick bag in flight! Wind shear results in rapid changes in winds over a short horizontal distance which can cause a rapid change in lift, and thus the altitude of the aircraft. Paul looked at other consequences such as flooding, notably Lynmouth, Martinstown, and Boscastle, and the issues of regenerating storms which providing huge volumes deluging a small area.

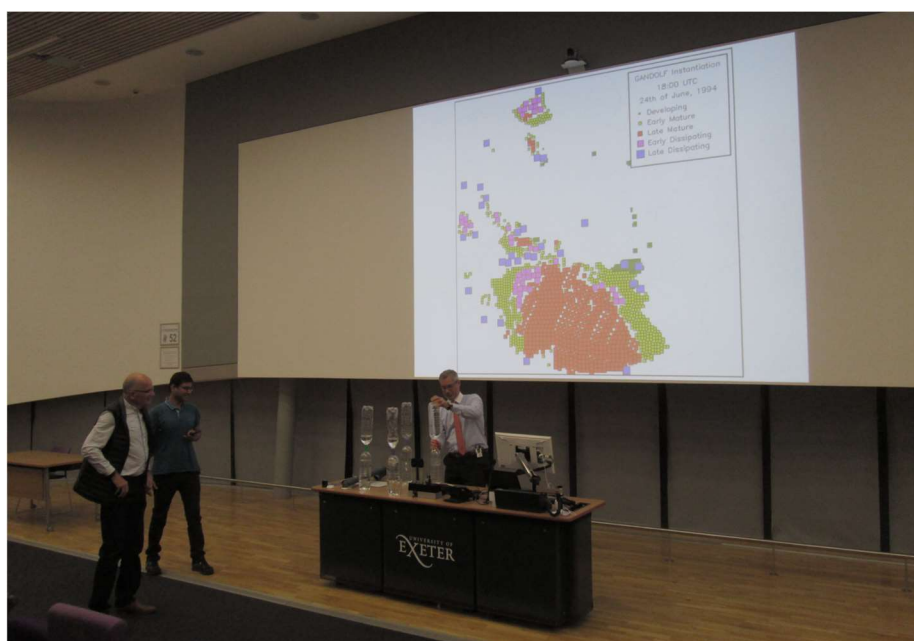
Monsoon multi-cells can provide 6cm rain daily which has large agricultural implications. Large hail can also result with soft cross-sections (looking like tree rings) however, 'golf ball' dense hail can also arise, big enough to cause considerable damage.

Lightning climatology is especially interesting, and intimately linked to the charging of water droplets. Paul covered some aspects of Forked lightning, considered as electrical charge tries to find the best connection with 'leaders' going up, and lightning coming down, with channels meeting above ground spectacularly! The process of charge generation is still something of a mystery, is it due partly to cosmic rays, or other charge particles? How does the charge break down, and why is the process triggered in the first place?

There then followed an 'extra-terrestrial' consideration of lightning on Galileo (Jupiter) and Cassini (Saturn), moons, looking at methane/ammonia convection circulations over days rather than terrestrial hours.

Gust fronts of airports pick up dust/insects and generate significant downbursts and microbursts (e.g. Denver). Wind shear warning in these cases in the early afternoon is important. Paul introduced the topic of Tornadoes, and how they generate supercells. He had his 'Blue Peter moment' demonstrating how as you equalise pressure between two plastic bottles you can generate a rotating 'tornado' vortex. He then proceeded to get the whole crowd engaged with multi-tornado demonstrations across the auditorium. He followed with some physics principles, and showing how a Hook radar echo develops inside storms, helping to identify where you are on the cell cycle.

A good Question and Answer session followed, some quite technical, others less so, but everyone was engaged with the discussion that followed, especially in answer to questions about ball lightning. Paul was an excellent speaker providing one of the most informative, and dare I say, down to earth talk, only giving more technical physics contributions where it helped to further the understanding.



4 OTHER NOTICES

IOP have asked groups to remind members that travel bursaries are available to help with costs associated with attending conferences. These are called the Research Student Conference Fund and the Early Career Researchers Fund and details can be found at:

http://www.iop.org/about/grants/travel-bursaries/page_69141.html

The committee look forward to meeting as many of the group's members as possible in the coming year and we cordially invite members to contact us with suggestions for events. As planning is completed for each event we will announce details via emails to members.

With best wishes

Hugh Deighton

