

# Birmingham Institute of Forest Research (BIFoR)

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*Annual Report*

2016





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## Introduction

On 6 November 2013, in response to a visionary gift from the JABBS Foundation, the University of Birmingham launched the Birmingham Institute of Forest Research (BIFoR). The vision for BIFoR is to provide fundamental science, social science and cultural research of direct relevance to forested landscape anywhere in the world.

During 2016, BIFoR has focused on the establishment of a Free-Air Carbon Enrichment (FACE) Facility in an English woodland (see images right). BIFoR FACE will study how forests will respond to future increases in atmospheric carbon dioxide (CO<sub>2</sub>). Extra CO<sub>2</sub> — equivalent to concentrations expected around 2050 — will be delivered to undisturbed patches of woodland. Many aspects of the growth of vegetation and the interactions with surrounding ecosystems will then be measured until at least 2026.

One of only two forest-FACE facilities operating across the world, a major challenge has been to build the facility without damaging the delicate natural ecosystem. For that reason, no concrete foundations have been used and major elements of the infrastructure were put in place by [helicopter](#)<sup>1</sup> in January 2016. Six completely open cylindrical rings, 30m wide and as high as the tree canopy, are served by gas-handling facilities, which store 100 tonnes of liquid CO<sub>2</sub> and vaporise and deliver up to 15 tonnes per day to 3 of the 6 rings. Tests in 2016 verified that the system keeps CO<sub>2</sub> within 0.33% (less than 2 parts per million) of the target in the experimental treatment patches.

The team of academic staff working with BIFoR is growing steadily. We are delighted to announce that in March 2017, Professor Michael Tausz will join the School of Biosciences as Chair in Forest Ecosystems and a Director of BIFoR.



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<sup>1</sup> Hyperlinks are available in the PDF version of this report. Our website is [www.birmingham.ac.uk/bifor](http://www.birmingham.ac.uk/bifor)

Vision and Aims

World leading and interdisciplinary research\*



\*a full list of publications is given in Appendix 2

## Who's who in BIFoR Natural Science



Dr Rebecca Bartlett



Dr Phil Blaen

The Director of BIFoR is Professor Rob MacKenzie and the Director for Education within BIFoR is Dr Jerry Pritchard. In 2017, Professor Michael Tausz will be joining the School of Biosciences as Chair in Forest Ecosystem Sciences, academic lead for BIFoR FACE, and a BIFoR Director. We will also welcome Dr Sabine Tausz-Posch a Lecturer in Plant Sciences and expert in the nutritional quality of seeds.



Prof Ben Brown



Dr Rosemary Dyson

In 2016 we welcomed Dr Tom Pugh, a forest biogeochemistry modeller with interests currently focused on drought effects and tree mortality and Dr Sami Ullah, an expert in greenhouse gas emissions from soils. In addition, two Birmingham Fellows with BIFoR related interests were recruited, Dr Iain Johnston and Dr Eloïse Marais. We are developing strong links with the University of Birmingham Centre of Computational Biology through the appointment of Professor James Bentley (Ben) Brown, a world-leading authority on the impact of genes beyond the organism.



Dr Iain Johnston



Dr Scott Hayward

Five PhD students started their research specifically at BIFoR FACE in 2016 (see more details on page 16). They are expertly supported by a team of academic staff from across Biosciences and Geography Earth and Environmental Sciences, including Dr Rebecca Bartlett, Dr Rosemary Dyson (Mathematics), Dr Iain Hartley (University of Exeter), Dr Scott Hayward, Dr Iain Johnston, Prof Stefan Krause, Dr Francis Pope, Dr Jeremy Pritchard, Prof Jon Sadler and Dr Zongbo Shi.



Prof Stefan Krause



Prof. Rob MacKenzie



Dr Eloïse Marais



Dr Francis Pope



Dr Jeremy Pritchard



Dr Tom Pugh



Prof. Jon Sadler



Dr Zongbo Shi



Dr Rick Thomas



Dr Sami Ullah

## Who's Who in BIFoR Cultural and Social Science



Faye Claridge



Dr Emma Ferranti



Dr Louise Hardwick



Jennifer Kirby



Jenny Shepherd



Dr Frank Uekötter

Humanity has always, and will always, need to understand forests as much more than "sticks of carbon". Higher education establishments help to shape societal values through all aspects of their educational and outreach provision, by providing ambassadors able to make the case for wooded landscapes to all interested sectors of society. Research at the University of Birmingham investigates how to value our landscape and how to enable public participation in environmental decision-making. Social science and cultural studies like these are vital aspects of re-shaping our view of, and valuing of, forests. By inspiring students with all these different kinds of research, and by making a significant investment into novel forest research facilities, BIFoR aims to generate results of immediate and significant relevance to the problem of one-world living and to help us conceive of our planet in new ways. We have a growing team of BIFoR champions in this area. Highlights of 2016 include:

- [Faye Claridge](http://www.fayeclaridge.co.uk) became Artist in residence at University of Birmingham in 2016 and immediately sought out a connection with BIFoR. She is exploring ways of bringing BIFoR FACE into the heart of the University of Birmingham campus [www.fayeclaridge.co.uk](http://www.fayeclaridge.co.uk).
- Emma Ferranti is a NERC Knowledge Exchange Fellow working on a range of infrastructure/climate projects. She is now chair of the Trees and Design Action Group, West Midlands.
- Vilane Goncalves Sales has recently started her PhD focussed on deforestation in Brazil, she is based within the Birmingham Business School.
- Louise Hardwick was recently awarded funding through EU Climate-KIC to develop her research in Ecocriticism and Ecoliteracy. She undertook a placement at the Small Woods Association where she scoped potential future projects.
- Jennifer Kirby's PhD study is focussed on building a low cost high resolution leaf fall monitor. This monitor takes near infra-red hemispherical images of a tree canopy throughout an autumn period. From the images the percentage of leaf fall can be calculated. This research aims to find a plausible and cheap solution to monitoring leaf fall around the UK rail network and hence improve current leaf fall prediction services. Jennifer has worked with the [Sylva Foundation](http://www.sylva.org.uk) during the initial research for this project. Through their help, volunteers around the UK monitored leaf fall on a weekly basis.
- Prof. David Maddison, hosted a seminar by Prof. Nick Hanley, University of St Andrews, entitled the "Economics of Invasive Species".
- Anne Parouty an artist working with University of Birmingham, has been taking oak leaf samples from the BIFoR FACE Facility and has been using the cyanotype process of printing to record a very different way of keeping images of our first and valuable leaf samples.
- Jenny Shepherd is working with University Estates on the health and well-being effects of the University's "[Green Heart](http://www.greenheart.ac.uk)" development.
- Dr Frank Uekötter spoke on the legacy of sustainable forestry to a forestry Think Tank chaired by MP Rory Stewart. BIFoR also jointly hosted Dr Tait Keller from Rhodes College, Memphis, USA. As part of his stay Dr Keller spoke on "Frontiers of Trouble: The Environmental Legacies of the First World War".

## BIFoR FACE

A unique experimental test of environmental resilience — the BIFoR Free-Air Carbon Dioxide Enrichment (FACE) facility

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BIFoR FACE is in the vanguard of a global initiative to investigate the effects of climate change on real, mature, complicated forest ecosystems<sup>2</sup>. The establishment of a global network of FACE experiments in different climatic zones will allow our global network of research scientists to test the generality of results derived from BIFoR FACE.

How can this woodland best be managed for carbon storage under climate change, and what general lessons can be learnt from BIFoR FACE and the global network of second-generation forest FACE experiments?

Do other macro- or micro-nutrients limit the uptake of carbon in this ecosystem now, or are they likely to in the future?

A BIFoR FACE array. Each mast reaches above the canopy. The masts form a circle around an area of about 30m in diameter.



3 treatment arrays – elevated CO<sub>2</sub>  
3 control arrays – ambient air  
3 further control arrays - no infrastructure rings

What aspects of biodiversity and ecosystem structure-and-function alter under elevated CO<sub>2</sub> and how do these alterations feed back onto carbon stocks and flows?

Which carbon stocks and flows change under elevated CO<sub>2</sub> in a mature temperate deciduous woodland ecosystem?

Norby, R. J., M. G. De Kauwe, T. F. Domingues, R. A. Duursma, D. S. Ellsworth, D. S. Goll, D. M. Lapola, K. A. Luus, A. R. MacKenzie, B. E. Medlyn, R. Pavlick, A Rammig, B Smith, R Thomas, K Thonicke, A. P. Walker, Xiaojuan Yang, and Sönke Zaehle, Model-data synthesis for the next generation of forest FACE experiments, *New Phytologist*, 2015, DOI: 10.1111/nph.13593.

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## Building BIFoR FACE

Throughout early 2016 the major elements of the BIFoR FACE Facility at Mill Haft, Staffordshire were put in place. Access to the site has been formed including installation of incoming services and the formation of a tarmac access road and parking facilities. The welfare units provide workspace for four members of staff working full-time (Fig 1): left to right, Peter Miles (Field Engineer); Anna Gardner (Research Technician); Nick Harper (Senior Engineer); Dr Kris Hart (Operations Manager). They are supported back on campus by Dan Holmes (Estates Lead) and Deanne Brettle (Project Administrator).

The three large CO<sub>2</sub> storage tanks are in place and have been filled with liquid CO<sub>2</sub> (Fig 2). A large wooden sign marks the entrance to BIFoR FACE and three display boards at key way-points are in position to provide passers-by with information.

A new forest track runs through the forest (Fig 4). The CO<sub>2</sub> pipework and services in the forest are in place. Approximately one thousand metres of pipework carries CO<sub>2</sub> throughout the woodland (Fig 5 and 6). The FACE array masts and 40m high Central Flux Tower were put in position by helicopter (Fig 8). Video footage of this spectacular feat can be found on our [website](#). Figure 10 shows an aerial view of the facility.

The contractors appointed, Shaylor Group, maintained outstandingly high standards throughout the build. At the Construction 2016 awards, in relation to the BIFoR FACE Facility build, Shaylor Group were 'Highly Commended' in the 'Project of the Year' category. A key member of the team was shortlisted for Construction Manager of the Year award.

Successful commissioning of the FACE Facility took place throughout 2016. We will start to elevate the level of CO<sub>2</sub> in the three treatment arrays operationally in spring 2017.

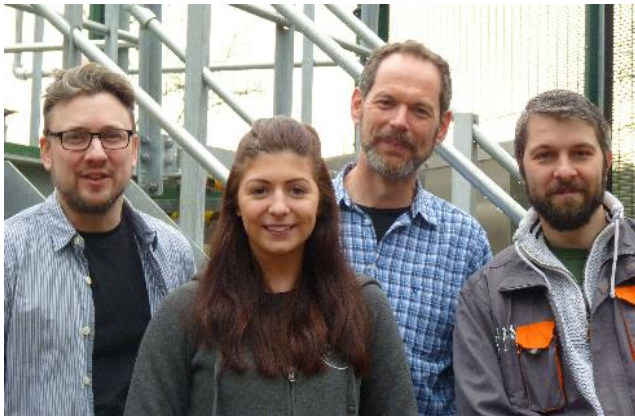


Figure 1 BIFoR Technical Team



Figure 2 Access road, CO<sub>2</sub> tankers and welfare units



Figure 3 Entrance to BIFoR FACE Facility





Figure 4 Upgraded forest track



Figure 5 Some of the 1000m of pipework running through the forest



Figure 6 Tower snuggled into canopy





Figure 7 The FACE control sheds



Figure 9 Inside the FACE control sheds



Figure 8 Installing the large flux tower using a helicopter

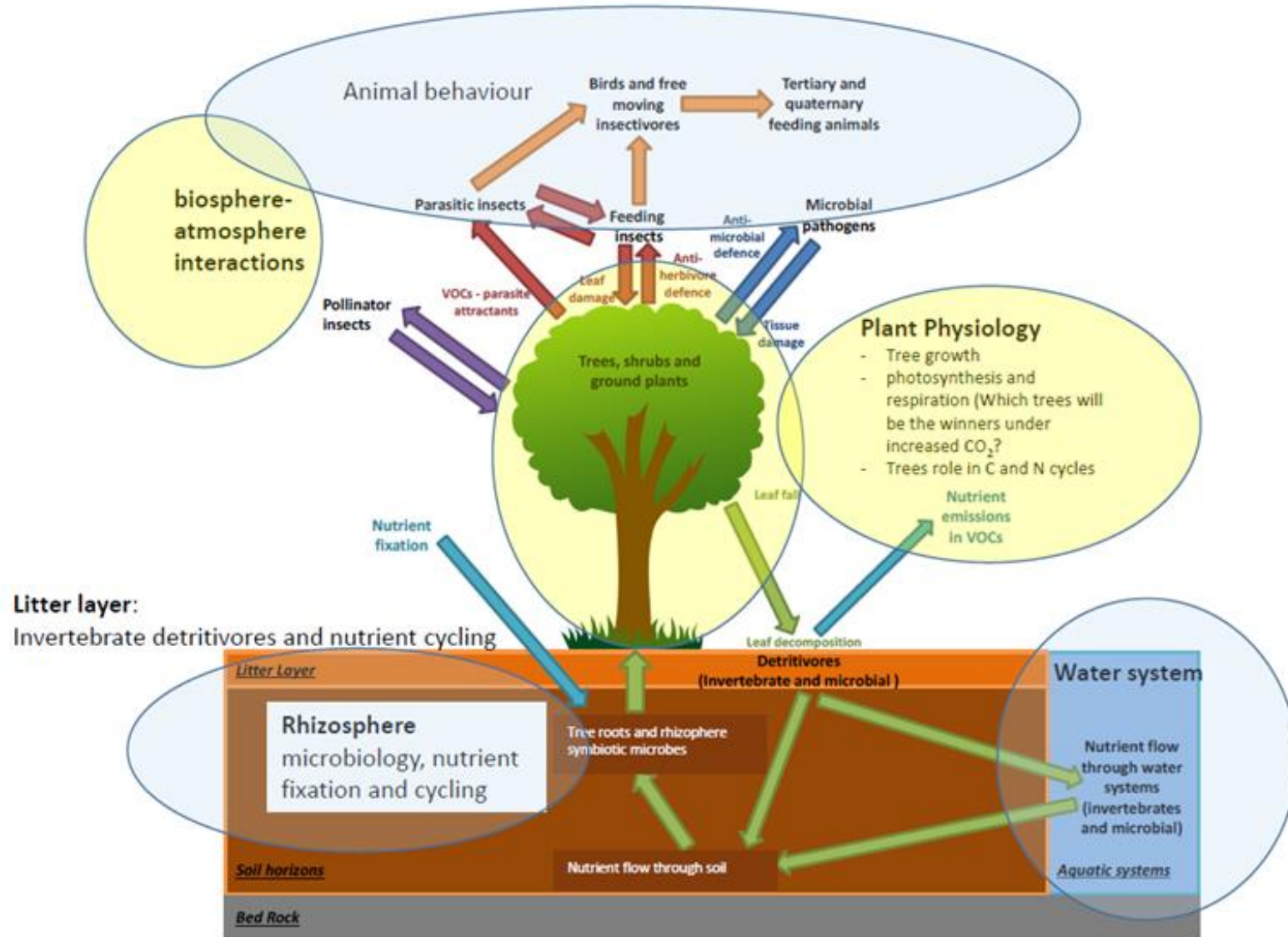




Figure 10 View from above of the BIFoR FACE Facility



## Scientific Activity at BIFoR FACE





### Scientific Activity at BIFoR FACE

2016 has been a year of intense baseline monitoring at BIFoR FACE. Our team of research fellows have been assisted by colleagues from UK research institutes and undergraduate student volunteers from University of Birmingham. Agreements are in place with Earthwatch Institute and with Harper Adams for additional volunteering.

Current measurements at BIFoR-FACE include: climate; exchange of CO<sub>2</sub>, momentum, energy and water vapour between the woodland canopy and the air; soil, ground, and stream water quantity and quality; leaf-level gas exchange and photosynthetic efficiency; volatile metabolites that are released into the air; leaf-litter production; woody debris production and loss; partitioned soil respiration (i.e., the production of CO<sub>2</sub> by roots, fungi and decomposer invertebrates); real-time stem width 'dendrometry'; leaf area index and canopy greenness index; and fine root growth; 80 soil samples, analysed for nutrients, soil texture and pH, show Mill Haft is a low nutrient forest, similar to other mature temperate forests in the UK and elsewhere. Habitat classification shows that Mill Haft is representative of similar oak woodlands. Mill Haft developed in a way typical of UK oak woodland: carbon isotopes in tree rings correlate closely with summer [Central England Temperature](#) and oxygen isotopes correlate with [England and Wales Precipitation](#). Dr Francis Pope, Dr Neil Loader (Swansea), and Dr Rick Thomas are leading the preparation of the first science papers reporting these results.



Phenology camera live  
<http://ow.ly/XQ3WY>



## Research collaborators at BIFoR FACE

Throughout 2017 we have continued to work closely with national and international research collaborators, including:

### The Met Office

Dr Vicky Chapman is coordinating research on the impacts of climate change of resilience of the railway system, including benefits and threats associated with the railway's linear forest.

Dr Deborah Hemming has continued work on leaf composition started during her stay at BIFoR as a Distinguished Fellow in 2015. This work also includes contributions from **University of Exeter** colleagues Dr Anna Harper, Dr Lina Mercado and Professor Stephen Sitch.

### Forest Research

Dr Eric Casella is providing 3D laser scanning of the BIFoR FACE woodland, from which changes in canopy structure as a result of elevated CO<sub>2</sub> can be determined.

Dr Sandra Denman's tree health team have visited BIFoR FACE and provided advice on surveillance for pests and diseases.

Dr James Morrison and colleagues are helping us scale-up our flux measurements by comparing with their data from Alice Holt, Farnham, Surrey.

### The University of Lancaster

Dr Peter Wynn is working with BIFoR and Dr Neil Loader (Swansea) to measure trace amounts of sulphur in BIFoR FACE tree rings. The amount of sulphur trapped in each ring indicates the level of pollution reaching the site.

### The Open University

Dr Kadmiel Maseyk is working with BIFoR on remote sensing of leaf physiology.

### Swansea University

Dr Neil Loader has provided the environmental history of BIFoR FACE through dendrochronology analysis of tree rings.

Prof Natasha Kljun is working with Dr Rick Thomas to interpret measurements of CO<sub>2</sub>, water vapour, temperature, and wind taken on the BIFoR FACE tall tower.

### Amazon FACE

Dr Rich Norby, Dr David Lapola, Dr Iain Hartley, all members of the Amazon FACE Advisory Group, have contributed significantly to the design of BIFoR FACE science. Two doctoral researchers from BIFoR attended the summer school on Amazonia and climate change in September 2016.

### Western Sydney University – Hawkesbury Institute for the Environment - EucFACE

Prof David Ellsworth and Dr Kristine Crous visited in summer 2015 and have continued to provide steer to make BIFoR FACE and EucFACE coordinate measurements for maximum scientific returns.



## Doctoral level study

### Soil Respiration and Biogeochemistry at BIFoR-FACE, Angeliki Kourmouli

This project will measure rates of soil respiration at the BIFoR FACE woodland, and identify the contributions of roots, mycorrhizal fungi and free-living microorganisms; thus, the project will help determine whether trees increase carbon allocation below ground under elevated CO<sub>2</sub>.

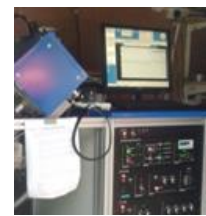
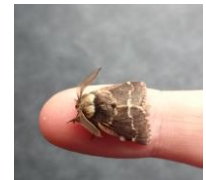
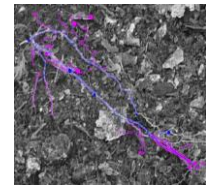
Partitioning of “new” and “old” carbon in soil respiration and dissolved organic carbon (DOC) to determine how forest soil DOC and carbon storage is changing under elevated CO<sub>2</sub>.

### Quantitative modelling of root growth and carbon allocation: bridging theory and experiment, Clare Ziegler

Roots bridge plants and soils, two central players in the carbon cycle, and constitute a vital and poorly understood aspect of carbon processing in ecosystems across the globe. Clare will use cutting-edge statistical and simulation tools to analyse lab and ecosystem observations of root structure, to elucidate the micro- and mesoscopic physical role of elevated carbon budgets.

### Plant volatile compounds under elevated CO<sub>2</sub>, Anthony (Tony) Hyacinth

Plants react to stress (drought, heat, pests and diseases, and changes in atmospheric composition) by changing the priority of metabolic pathways down which they channel the carbon they fix in photosynthesis. Some pathways produce chemicals which can be detected in the air and in crushed leaves. This project uses state-of-the-art mass spectrometry to detect changes in volatile plant chemicals over time and in response to elevated CO<sub>2</sub>.



### Insects as key drivers of change in woodland systems under climate change, Liam Crowley

This project will seek to elucidate the effects of elevated CO<sub>2</sub> (eCO<sub>2</sub>) on insect communities and the associated impacts these have on their role as ecosystems drivers; including the impact on above- and belowground processes involved in carbon cycling. This will be achieved by addressing the impact of eCO<sub>2</sub> on four core areas.

- Leaf nutrition (C:N ratio)
- Insect diversity, abundance and phenology
- The contributions of herbivorous species to nutrient dynamics
- Synchronicity of woodland plant-pollinator interactions.

### Tree-Soil-Water relations under elevated CO<sub>2</sub>, Susan Quick

This project will investigate the role the water cycle (export/import and storage) plays in carbon transport, in a small temperate oak-hazel woodland.

Is the canopy and understorey development, natural decay and regeneration in a mature oak/ hazel woodland influenced by climate variability, especially eCO<sub>2</sub>, temperature and precipitation?

Considerations include: use of water by the dominant/subdominant tree species; understanding of canopy water holding and water flux at the leaf/ twig level; the influence of understorey (herb and shrub layers); woodland species diversity.



## Outputs

The principal modes of delivery for BIFoR are:

### DATA

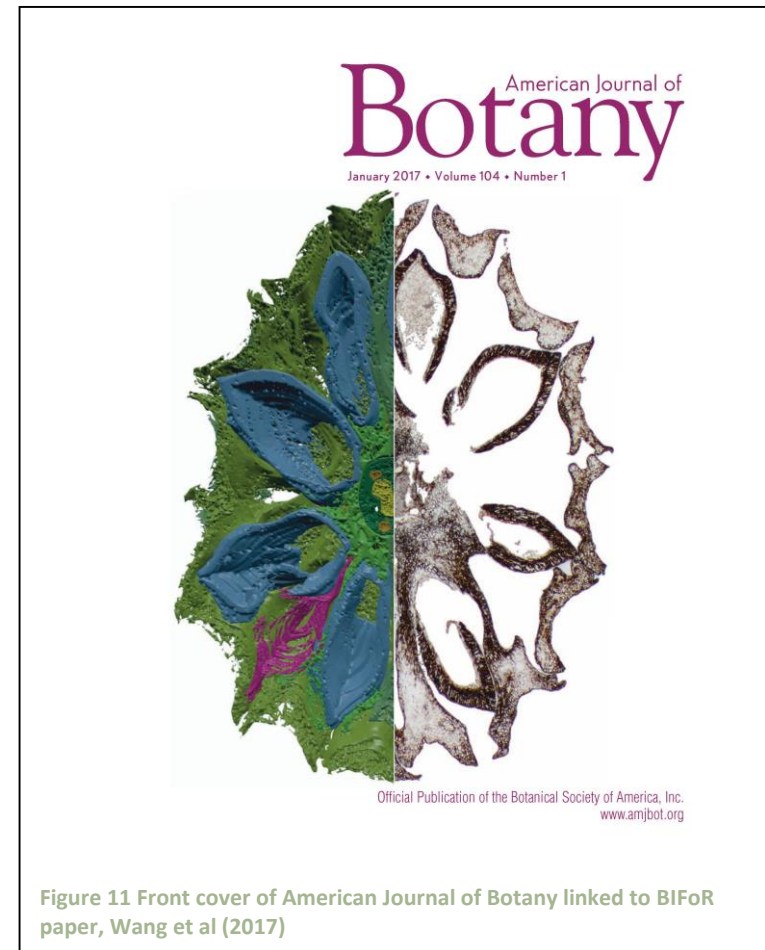
from long-term experiments on the effects of elevated carbon dioxide levels on woodland ecophysiology, shared via a protocol based on the principles of open data.

### CO-DESIGN

of research with stakeholders – engaged at the start and throughout; robust evidence of the value of forests not just as factors in economic wealth but as part of an ecosystem service: clean water, clean and temperate air, pollination vectors and habitats as well as their role in social wellbeing;

Research that can be translated into  
**MANAGEMENT PRACTICE** relevant to plantation forestry, tree-based horticulture and botanical collections

High-impact Journal and policy **PAPERS** which are likely to form the basis of governmental practice and implementation through our stakeholders and collaborations.



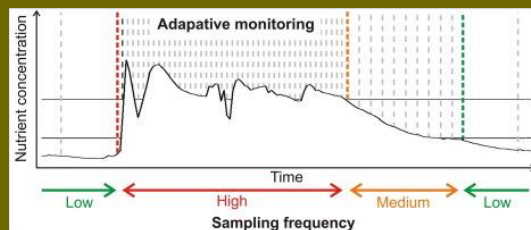
The number of BIFoR related papers continues to grow, some are highlighted on the following page. A full list of papers can be found in Appendix 2.

## Example BIFoR Papers

**BIFoR Paper 15:** Blaen, P., Khamis, K, Lloyd, CEM, Bradley, C, Hannah, DM & Krause, S (2016). Real-time monitoring of nutrients and dissolved organic matter in rivers: adaptive monitoring strategies, technological challenges and future directions *Science of The Total Environment*, 569-570, 647-660. doi:10.1016/j.scitotenv.2016.06.116

Excessive riverine nutrient concentrations threaten aquatic ecosystem structure and functioning and can pose substantial risks to human health. Robust monitoring strategies are therefore required to generate reliable estimates of river nutrient loads and to improve understanding of the catchment processes that drive nutrient fluxes. In this paper, we review the principles underlying in-situ nutrient monitoring and highlight the advantages, opportunities, and challenges associated with high-resolution sampling programs. We then suggest how adaptive monitoring strategies, comprising several different temporal sample frequencies, controlled by one or more 'trigger variables' (e.g. river stage, turbidity, or nutrient concentration), can advance our understanding simultaneously overcoming many of the practical and economic challenges encountered in typical in-situ river nutrient monitoring applications. We present examples of short-term variability in river nutrient dynamics, driven by complex catchment behaviour, which support our case for the development of monitoring systems that can adapt in real-time to rapid changes in environmental conditions. Finally, we suggest future research directions based on emerging technologies in this field.

Stream physics and chemistry live at <http://ow.ly/XQ3L2>



## BIFoR paper numbers 17,19, and 20:

**Dr Tom Pugh** contributed in 2016 to three studies published in **Nature Climate Change** and led another published in **Nature Communications**. All papers make use of the state-of-the-art land surface modelling Tom brings with him from Karlsruhe Institute of Technology. Three of the papers deal with the question of how global agriculture will be affected by climate change. They show that multiple independent approaches show consistency in projections of the effect of climate on crop yields, with negative effects being found over much of current cropland. However, there was also indication that crop growth potential may increase in regions which currently contribute little to global production, and that elevated atmospheric CO<sub>2</sub> concentration could lead to large reductions in crop water requirements in arid regions. The papers highlights the requirement for more field work and for consistent modelling across crop and hydrological communities. The final paper describes observations that suggest that leaf area has been increasing globally over the last three decades, amounting to a "greening of the planet". This effect was overwhelmingly attributed to the effects of elevated CO<sub>2</sub> concentration by an ensemble of state-of-the-art models. Whether such a "greening" effect translates into increased carbon storage in the biosphere remains an open question to be tackled by the combination of BIFoR FACE and modelling studies.

- Pugh et al. (2016) Climate analogues suggest limited potential for intensification of production on current croplands under climate change.(for full reference see appendix 2)
- Zhu et al. (2016) Greening of the Earth and its drivers.(for full reference see appendix 2)
- Deryng, D., et al (2016) Regional disparities in the beneficial effects of rising CO<sub>2</sub> concentrations on crop water productivity. (for full reference see appendix 2)

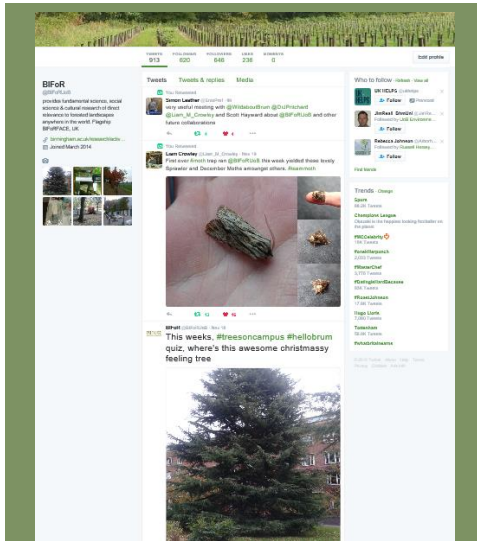


Figure 12 Our Twitter site - over 700 followers and growing

## Strategic Stakeholder Engagement Public Engagement with Research

BIFoR has a public website (<http://www.birmingham.ac.uk/bifor>) a Twitter account: @BIFoRUoB and a recently created Instagram account. Our Social Media presence is growing with thanks to our PhD students and our growing number of volunteers.

There are two [videos](#) available to view on our website that explain in less than four minutes the importance of the BIFoR FACE Facility and video footage of the Facility under construction.

The construction of the FACE arrays was covered by BBC One Midlands news. This news item was viewed by over 17,000 people online. We produce two newsletters a year — ‘Bud Burst’ and ‘Last Leaf Fall’ — The newsletters are circulated to over 600 people and are also available online. In 2017 we will design a more easily readable emailable edition

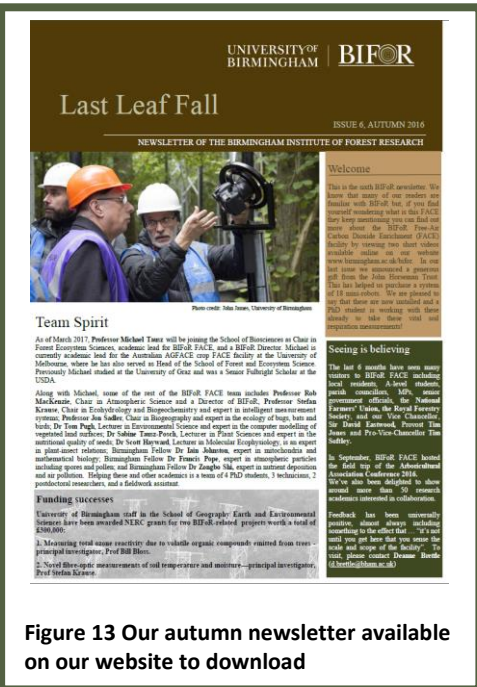


Figure 13 Our autumn newsletter available on our website to download

Dr Simon Dixon from School of Geography Earth and Environmental Sciences was lead author of a [study](#) that was able to show that targeted tree planning and restoration could reduce flood risk by slowing down the flow of water, and the larger the area included in the work and the older the forests became, the more reductions in flood peak height would be achieved. This study has had great coverage in UK Media. To read Simon’s blog visit <https://therivermanagementblog.wordpress.com/>



Dr Simon Dixon

In 2016 we have held three open evenings at the BIFoR FACE Facility for local residents to come and find out more. These were fully booked (circa 45 people) and feedback was very positive with many people signing up to pledge their time to the project.

## External Stakeholder Engagement

There has been significant engagement with key stakeholders throughout 2016. We have worked very hard at ensuring we link up to other Higher Education Institutes (HEIs). Here is a flavour of the relationships we are building with Businesses, Government Organisations and Non-governmental Organisations (NGOs):

### Earthwatch Institute

We have been working closely with Earthwatch through 2016. Earthwatch staff and undergraduate student volunteers installed 198 dendrometer bands on trees within the 9 FACE experimental arrays. During 2017 Earthwatch will look to get their corporate partners to send staff out to take regular follow up measurements.

### Forestry Commission and Forest Research

Senior members of the Forestry Commission have visited through 2016: Sir Harry Studholme (Chairman), Mary Barkham (Commissioner), and Roger Coppock (Head of Corporate and Forestry Support). Peter Freer-Smith continues his support through the BIFoR Advisory Group. Rob MacKenzie advises the Forestry Commission through its West Midlands Forestry and Woodlands Advisory Committee (FWAC) and the FWACs Urban Network.

### Harper Adams University

We have an agreement with colleagues at Harper Adams to co-supervise Masters Projects utilising the FACE facility at Mill Haft. There are multiple Masters Programs at Harper Adams of relevance. Prof. Myra Nimmo (Pro-Vice Chancellor and Head of College of Life and Environmental Sciences) met with the Deputy Vice Chancellor and senior members of staff of Harper Adams in October 2016

### Heart of England Forest

Senior members of Heart of England Forest and University of Birmingham have met to look at how we can work together. Through 2017 we will work to provide Heart of England with advice and expertise.

They have also expressed an interest in replicating some of our cutting-edge research on their sites.

### The Small Woods Association

In 2016 University of Birmingham's Louise Hardwick undertook a placement at The Small Woods Association, where she scoped potential future projects between Small Woods and BIFoR. During her placement, Louise developed training and presentation materials to support the centre. Louise learned about 'the story of wood', from the local heritage of coracles to wood's fascinating role in the construction of the Ironbridge, Shropshire.

Other organisations we continue to work with to develop research and educational opportunities are: Arboricultural Association, Centre for Ecology and Hydrology (CEH), Crown Estates, Grown in Britain, Foundation Conservation Carpathia (FCC), Institute of Chartered Foresters (ICF), Italian National Research Council, National Trust, Natura, Natural England, Open University, Royal Forestry Society, Swiss Federal Institute for Forest, Snow and Landscape Research, Sylva Foundation, Trees for Cities, USDA Forest Research and Woodland Trust.

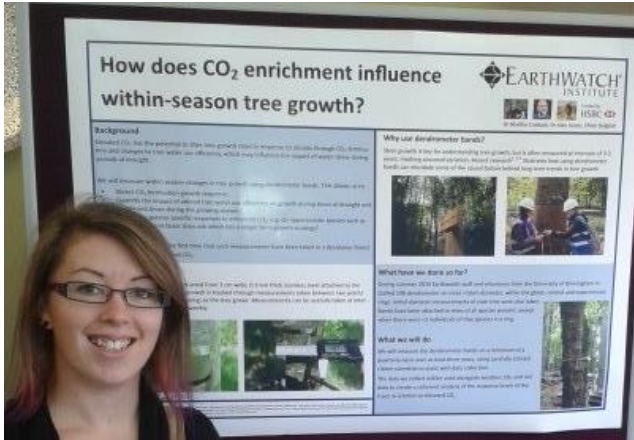


# BIFoR National Community Meeting



Professor Michael Tausz (BIFoR), Professor Arthur Gessler (Swiss Federal Institute for Forest), Professor Thorsten Grams (Technische Universität München), and Dr Gabriele Guidolotti (Italian National Research Council) were distinguished guests at a workshop to introduce BIFoR FACE to the UK researcher community. Made possible by the Institute of Advanced Studies, 25 specially invited colleagues from outside BIFoR joined 17 BIFoRists to plan grant applications and discuss early science results, ranging from hysteresis in nutrient inputs to Mill Haft stream to early model results from the Joint UK Land Environment Simulator (JULES) model applied to

Mill Haft. Attendees debated the mechanism for applying to carry out research at BIFoR FACE, and agreed a common process and cost structure. We will host a second National Community workshop on 14 September 2017.



## Internal Stakeholder Engagement

Throughout 2016 we have continued to build the Institute's network within the University of Birmingham. BIFoR news has been included in every College of Life and Environmental Sciences (LES) newsletter and we contribute news regularly to the newsletters of the Schools of Biosciences and Geography Earth and Environmental Sciences. Additionally, we have Interdisciplinary Fellows and BIFoR Champions in the Colleges of Art and Law, Social Sciences and Engineering and Physical Sciences who help connect us into their colleges. We are working with the University Secondary School towards a site visit for staff and students in 2017.

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### Vice-Chancellor Visit

Hosted by Professor Jo Bradwell (Norbury Estate and the JABBS Foundation) and BIFoR, University of Birmingham Vice-Chancellor Professor Sir David Eastwood was joined on a visit to the BIFoR FACE Facility last month, by Professor Tim Jones (Provost and Vice-Principal), Professor Tim Softley (Pro-Vice-Chancellor for Research and Knowledge Transfer), Professor Myra Nimmo (Pro-Vice-Chancellor and Head of College for LES) and Professor Chris Bunce (Head of the School of Biosciences).



BIFoR researchers and PhD students were on hand to share information about their research, and the Operations and Estates Team explained the enormous engineering feat that had been achieved in the building and implementation of this facility.

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### BIFoR Seminar and Celebration

In January, over 40 university colleagues joined us to celebrate the installation of the BIFoR FACE arrays. We also shared details about the initial baseline measurements taking place and encouraged internal members of staff to visit and engage.

BIFoR Face was one of the key project featured in the [University of Birmingham Annual Meeting](#).

BIFoR has also been featured in [Old Joe](#) magazine for alumni.



## Funding

In addition to our £15 million founding gift, we have secured £0.5 million directly into BIFoR FACE and £1.6 million into BIFoR research more broadly.

### The JABBS Foundation

We continue to work closely with the JABBS Foundation who in November 2013 provided a £15 million gift to the University of Birmingham to initiate BIFoR.



### The John Horseman Trust

Alumnus John Horseman and his wife Moyra have very generously donated a fourth gift to the project, bringing their total donation to £260,000.



### Research Councils UK

NERC NE/P003486/1: DiHPS - A Distributed Heat Pulse Sensor Network for the quantification of subsurface heat and water fluxes. 2016-2018, **£170,000**

### Research Councils UK

NERC NE/P003524/1: Total Ozone Reactivity: A new measurement of volatile organic compounds in the atmosphere. 2016-2017. **£157,000**

### Arts and Humanities Research Council

Investigation into how non-human life – that is to say nature – has also been subject to systems of dominance and regulation, **£168,000**

**EU Horizon 2020-MSCA-RISE-2016:** HiFreq - Smart high-frequency environmental sensor networks for quantifying nonlinear hydrological process dynamics across spatial scales, **2,335,500 EUR, ~800,000 EUR UoB**

**NERC Biomolecular Analysis Facility (NBAF)** - Speciation of fungi in ground and in air under current and future CO<sub>2</sub> conditions, **£6,000**

**CENTA** PhD student carrying out joint BIFoR / Krycklan fieldwork – linked to 4 “Connectivity” studentships in Uppsala, Umea, Zurich + 2 BIFoR PhD students.

**NERC Isotope Facility:** The relative contribution of *in situ* carbon dioxide production to total carbon dioxide in streambed sediments. 2016-2017, **£8,736**

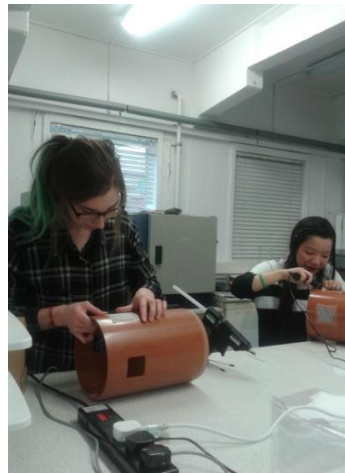


## Going Forward

The capability and reputation of BIFoR is growing quickly, internally and externally, nationally and internationally. We have a dedicated and passionate team working directly for BIFoR, and are supported by many BIFoR Champions across the University.

Our key foci for 2017 will be;

- to nurture our newly recruited staff and PhD students
- to appoint an academic lead for research in plant-pathogen interactions or tree health
- to expand and deepen science at BIFoR FACE and submit early scientific deliverables
- to launch the facility, maximising coverage in popular and scientific media
- to work with partners to maximise the scientific opportunities during initial switch on
- to deepen our relationships with external stakeholders including, when appropriate, joint funding and help in-kind to BIFoR
- to expand educational visits to BIFoR FACE, deliver continuing professional development for teachers and encourage next generation of forest researchers





## Appendix 1: BIFoR Presence at Sectoral Conferences and Workshops

2017	The role of tree mortality and vegetation dynamics in global terrestrial carbon uptake.	Tom Pugh, University of Stirling, invited seminar. Jan 2017.	2016	Disturbance, mortality and turnover in global vegetation modelling	Tom Pugh, Oral presentation, JULES annual user meeting, Lancaster University, Jun 2016.
2017	Green Infrastructure & Air Pollution	Rob Mackenzie, invited talk and panel discussion, CIBSE workshop "Overcoming obstacles to high density resilient cities", 6th January, London's Living Room, City Hall, London	2016	Urban-allometry uncovers the scope and limits of nature-based solutions to urban air pollution	Rob MacKenzie, oral presentation, 19th European Forum on Urban Forestry, Ljubljana, 31 May- 3 June 2016
2016	Challenges to Green Infrastructure to tackle air quality	Rob MacKenzie, invited talk and panel discussion, London Sustainability Exchange & UCL Engineering Exchange joint meeting, 24 Nov 2016, London	2016	Experiments in Ecocriticism in the French Caribbean	Dr Louise Hardwick, Keynote paper at the international symposium 'Aesthetics of Crisis: Ecology, Disaster, Representation', University of Durham, May 2016
2016	Widespread vulnerability of current crops to climate change: A data-driven approach	Tom Pugh, University of Leeds, Invited seminar, Nov 2016.	2016	Multi-scale controls on spatial variability in river biogeochemical cycling	Phil Blaen, Society for Freshwater Science annual meeting oral presentation, Sacramento, May 2016
2016	The BIFoR case study of philanthropic giving	Rob MacKenzie, invited talk (with Matt Mangan), CASE Conference on Development for Academic leaders, London, 24 Nov 2016	2016	Widening Engagement and Diversity in Forestry and Forest Sciences	Emma Ferranti, invited speaker, Diversity in Forestry, Royal Forestry Society, May 2016
2016	Insects as key drivers of change in woodland systems under climate change.	Liam Crowley, Poster Presentation, Royal Entomological Society Climate Change special interest group meeting in November.	2016	Multi-scale controls on spatial variability in river biogeochemical cycling	Phil Blaen, European Geosciences Union, oral presentation, Vienna, April 2016
2016	Linking Function with Form: Hydrologic and geomorphic influences on reach-scale metabolism in a lowland forested stream	Phil Blaen, Forestry and Water workshop, invited speaker, Uppsala, Sweden, September 2016	2016	Do trees really help to clean the air in our towns and cities?	Rob MacKenzie, invited seminar, National Community Forestry partnership annual conference, BMI, Birmingham, 23 March 2016
2016	Is winter coming?: How climate warming disrupts the diapause response	Scott Hayward, XXV International Congress of Entomology (ICE), Orlando, Florida, USA, September 25-30 2016.	2016	Widespread vulnerability of current crops to climate change: A data-driven approach	Tom Pugh, ICROPM conference, Humboldt University Berlin, Mar 2016.
2016	Air Quality and Urban Form: the role of trees and the urban forest	Rob MacKenzie invited seminar, London Tree Officers Association, Camden Town Hall, 18 July 2016.	2016	Air Quality and Urban Form	Rob MacKenzie, invited seminar, Leicester University, 12 Feb 2016
2016	The BIFoR Free-Air Carbon Dioxide Enrichment Facility, Mill Haft	Rob MacKenzie and Francis Pope, invited seminar, The Met Office, Exeter, 7 June 2016	2016	The Sound of the Trees	Jenny Shepherd, invited speaker, Association of Science Education Conference, Jan 2016
2016	The Legacy of Sustainable Forestry	Frank Uekötter, oral presentation to Forestry Think Tank chaired by MP Rory Steward, DEFRA Nobel House, London. 28 June 2016	2016	Facing up to Climate Change	Jerry Pritchard, invited speaker Association of Science Education Conference, Jan 2016

## Appendix 2: BIFoR Publications

Those directly discussing the BIFoR FACE Facility are marked with an asterisk.

### 2014

Uekötter, F. (Ed.) (2014b). *Comparing Apples, Oranges, and Cotton. Environmental Perspectives on the Global Plantation*. Frankfurt: Campus.

Uekötter, F. (2014). *The Greenest Nation? A New History of German Environmentalism*. Boston: MIT Press.

Uekötter, F. (2014a). Ein Haus auf schwankendem Boden. Überlegungen zur Begriffsgeschichte der Nachhaltigkeit. *Aus Politik und Zeitgeschichte*, 64(31), 9-15.

Pettersson, F., Maddison, D., Acar, S., & Söderholm, P. (2014). Convergence of Carbon Dioxide Emissions: A Review of the Literature. *International Review of Environmental and Resource Economics*, 7(2), 141-178. doi:10.1561/101.00000059

Wyche, K. P., Ryan, A. C., Hewitt, C. N., Alfarra, M. R., McFiggans, G., Carr, T., . . . MacKenzie, A. R. (2014). Emissions of biogenic volatile organic compounds and subsequent photochemical production of secondary organic aerosol in mesocosm studies of temperate and tropical plant species. *Atmos. Chem. Phys.*, 14(23), 12781-12801. doi:10.5194/acp-14-12781-2014

### 2015

Hale, J., Pugh, TAM, Sadler, JP, Boyko, CT, Brown, J, Caputo, S, Caserio, M, Coles, R, Farmani, R, Hales, C, Horsey, R, Hunt, DVL, Leach, JM, Rogers, CDF & MacKenzie, R (2015). Delivering a multi-functional and resilient urban forest. *Sustainability*, 7(4), pp. 4600-4624. doi:DOI: 10.3390/su7044600

Levine, J. G., MacKenzie, A. R., Squire, O. J., Archibald, A. T., Griffiths, P. T., Abraham, N. L., . . . Nemitz, E. (2015). Isoprene chemistry in pristine and polluted Amazon environments: Eulerian and Lagrangian model frameworks and the strong bearing they have on our understanding of surface ozone and predictions of rainforest exposure to this priority pollutant. *Atmos. Chem. Phys. Discuss.*, 2015, 24251-24310. doi:10.5194/acpd-15-24251-2015

\*MacKenzie, A. R. (2015). Launching an Institute of Forest Research in the 21st Century. In V. Kishor (Ed.), *Forestry for the Curious: Why Study Forestry? (A Decision-Making Guide to Choosing a Major, Research & Scholarships, and Career Development)*. Australia: The Curious Publishing House.

Pateman, R. M., Thomas, C. D., Hayward, S. A. L. Hill, J. K. . (2015). Macro- And Micro-Climatic Interactions Can Drive Variation in Species' Habitat Association. *Global Change Biology*, 22(2), 556-566. doi:10.1111/gcb.13056

Spencer, A. R. T., Mapes, G., Bateman, RM., Hilton, J. Rothwell, G.W. (2015). Middle Jurassic evidence for the origin of Cupressaceae: a paleobotanical context for the roles of regulatory genetics and development in the evolution of conifer seed cones. *American Journal of Botany*, 102(6), 942-961. doi:10.3732/ajb.1500121

Uekötter, F. (2015). Recollections of Rubber. In D. Geppert & F. L. Müller (Eds.), *Imperial Sites of Memory. Commemorating Colonial Rule in the Nineteenth and Twentieth Centuries* (pp. 243-265). Manchester: Manchester University Press.

Uekötter, F. (2015). You Ain't Seen Nothing Yet. A Death-Defying Look at the Future of the Climate Debate. In H. Greschke & J. Tischler (Eds.), *Grounding Global Climate Change. Contributions from the Social and Cultural Sciences* (pp. 175-181): Dordrecht.

Wyche, K. P., Monks, P. S., Smallbone, K. L., Hamilton, J. F., Alfarra, M. R., Rickard, A. R., . . . MacKenzie, A. R. (2015). Mapping gas-phase organic reactivity and concomitant secondary organic aerosol formation: chemometric dimension reduction techniques for the deconvolution of complex atmospheric data sets. *Atmos. Chem. Phys.*, 15(14), 8077-8100. doi:10.5194/acp-15-8077-2015

## 2016

\*Blaen, P., Khamis, K, Lloyd, CEM, Bradley, C, Hannah, DM & Krause, S (2016). Real-time monitoring of nutrients and dissolved organic matter in rivers: adaptive monitoring strategies, technological challenges and future directions *Science of The Total Environment*, 569-570, 647-660. doi:10.1016/j.scitotenv.2016.06.116

Deryng, D., Elliott, J., Folberth, C., Muller, C., Pugh, T. A. M., Boote, K. J., . . . Rosenzweig, C. (2016). Regional disparities in the beneficial effects of rising CO<sub>2</sub> concentrations on crop water productivity. *Nature Clim. Change*, 6(8), 786-790. doi:10.1038/nclimate2995

Dixon, S. J. (2016). A dimensionless statistical analysis of logjam form and process. *Ecohydrology*, 9(6), 1117-1129. doi:10.1002/eco.1710

Dixon, S. J., Sear, D. A., Odoni, N. A., Sykes, T., and Lane, S. N. . (2016). The effects of river restoration on catchment scale flood risk and flood hydrology. *Earth Surfaces Processes and Landforms*, 41(7), 997-1008. doi:10.1002/esp.3919

Hamilton, R. L., Trimmer, M., Bradley, C., & Pinay, G. (2016). Deforestation for oil palm alters the fundamental balance of the soil N cycle. *Soil Biology and Biochemistry*, 95, 223-232. doi:http://dx.doi.org/10.1016/j.soilbio.2016.01.001

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\*Norby, R. J., De Kauwe, M. G., Domingues, T. F., Duursma, R. A., Ellsworth, D. S., Goll, D. S., . . . Zaehle, S. (2016). Model-data synthesis for the next generation of forest free-air CO<sub>2</sub> enrichment (FACE) experiments. *New Phytologist*, 209(1), 17-28. doi:10.1111/nph.13593

Porwollik, V., Müller, C., Elliot, J., Chryssanthacopoulos, J., Iizumi, T., Ray, D.K., Ruance, A.C., Arneth, A., Balkovic, J., Ciais, P., Deryng, D., Folberth, C., Izaurralde, R.C., Jones, C.D., Khabarov, N., Lawrence, P.J., Liu, W., Pugh, T.A.M., Reddy, A., Sakurai, G., Schmid, E., Wang, X., de Wit, A., Wu, X. (2016). Spatial and temporal uncertainty of crop yield aggregations. *European Journal of Agronomy*, In press. doi:10.1016/j.eja.2016.08.006, 2016

Pugh, T. A. M., Müller, C., Arneth, A., Haverd, V., & Smith, B. (2016). Key knowledge and data gaps in modelling the influence of CO<sub>2</sub> concentration on the terrestrial carbon sink. *Journal of Plant Physiology*, 203, 3-15. doi:http://dx.doi.org/10.1016/j.jplph.2016.05.001

Pugh, T. A. M., Müller, C., Elliott, J., Deryng, D., Folberth, C., Olin, S., . . . Arneth, A. (2016). Climate analogues suggest limited potential for intensification of production on current croplands under climate change. *Nature Communications*, 7, 12608. doi:10.1038/ncomms12608  
<http://www.nature.com/articles/ncomms12608#supplementary-information>

Treble, P. C., Fairchild, I. J., Baker, A., Meredith, K. T., Andersen, M. S., Salmon, S. U., . . . McGuire, E. (2016). Roles of forest bioproductivity, transpiration and fire in a nine-year record of cave dripwater chemistry from southwest Australia. *Geochimica et Cosmochimica Acta*, 184, 132-150. doi:http://dx.doi.org/10.1016/j.gca.2016.04.017

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\*Fayose, T., Mendecki, L., Ullah, S., & Radu, A. (2017). Single strip solid contact ion selective electrodes on a pencil-drawn electrode substrate. *Analytical Methods*. doi:10.1039/C6AY02860H

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Wang, S.-J., Bateman, R. M., Spencer, A. R. T., Wang, J., Shao, L., & Hilton, J. (2017). Anatomically preserved "strobili" and leaves from the Permian of China (Dorsalistachyaceae, fam. nov.) broaden knowledge of Noeggerathiales and constrain their possible taxonomic affinities. *American Journal of Botany*, 104(1), 127-149. doi:10.3732/ajb.1600371

Wilson, E. R., B. Ambrose-Oji and E. J. S. Ferranti. 2017. Widening engagement and diversity in forestry and forest science. Workshop Report. Royal Forestry Society, Banbury, Oxon. 19 pp.  
<http://www.birmingham.ac.uk/research/activity/bifor/research/ferranti-emma.aspx>

### Appendix 3: BIFoR material for public engagement

- Article about BIFoR FACE in **USA Chronicle** University's supplement to the US based Chronicle of Higher Education (roughly equivalent to the Times Higher Education produced in the UK).
- BIFoR showcased in UoB alumni publication [Old Joe](#).
- Article in the Royal Entomological Society, Forest Insect and their Allies Group [newsletter](#).
- Article about BIFoR FACE in the Arboricultural Association Magazine, this was linked to a field trip to the Facility

BIFoR related bloggers include:

- Dr Louise Hardwick (ecocriticism) <https://josephzobel.wordpress.com/ecocriticism-ecocritique/>
- Dr Simon Dixon (river management) <https://therivermanagementblog.wordpress.com/>



BIFoR FACE array model.



Tree coring during undergraduate Open Days



Display to show the CO<sub>2</sub> released during a 50 mile journey in an av. car needs 5kg of wood to store the equivalent amount of carbon.



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## Stay in touch

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\*not all sat nav devices have been updated to include this postcode. An alternative is head for Norbury Junction, ST20 0PN: BIFoR FACE is about 200 metres south of the canal junction.