

Professor Rob MacKenzie PhD FRSC

Director, Birmingham Institute of Forest Research
Professor of Atmospheric Science

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About



(</university/colleges/les/research-gallery/rob-mackenzie.aspx>) Rob MacKenzie is an atmospheric scientist with a particular interest in how plants affect air composition. Watch a video of him describing one aspect of his research in 60 seconds by clicking on the play icon above.

As a result of a £15M grant, the University of Birmingham has set up the Birmingham Institute of Forest Research (BIFoR), of which Rob is delighted to be inaugural Director. BIFoR will focus on two linked challenges: the impact of climate and environmental change on woodlands; and the resilience of trees to pests and diseases (so Rob is learning Biology and Ecology!).

Rob is developing a broader understanding of urban systems and their resilience, particularly urban green infrastructure, as discussed in an [informal essay](http://savinghumans.org/2013/07/10/cities-are-for-life-not-just-for-people/) (<http://savinghumans.org/2013/07/10/cities-are-for-life-not-just-for-people/>) featured on the Institute of Advanced Studies' Saving Humans website.

Qualifications

- BSc (Hons) Environmental Chemistry, Edinburgh, 1986
- PhD "Small System Modelling of the Atmospheric Boundary Layer", Essex, 1989

Biography

During his PhD, Rob MacKenzie studied the atmospheric photochemistry of the mid-latitude boundary layer, including carrying out the first modelling study of the effect of biogenic volatile organic compounds (bVOCs) on ozone production downwind of a European city (MacKenzie et al., Atmos. Environ., 1991). This fascination with bVOCs and photochemistry returned when he took up a Lectureship (subsequently Senior Lectureship and Readership) at Lancaster University. He was deeply involved in the [OP3 project \(http://www.es.lancs.ac.uk/op3/\)](http://www.es.lancs.ac.uk/op3/) to study the atmospheric composition over the tropical rainforest of Borneo, and the impact of land-use change on atmospheric chemistry (MacKenzie et al., Proc. Roy. Soc. B, 2011). The team were able to show for the first time the prodigious capacity for ozone production if bVOC-laden air from oil palm plantations picks up nitrogen oxides (either through mixing or by changes to agricultural practice) ([Hewitt et al., PNAS, 2009 \(http://www.pnas.org/content/106/44/18447.full.pdf+html\)](http://www.pnas.org/content/106/44/18447.full.pdf+html)).

Before joining Lancaster, Rob spent 10 years in the [Centre for Atmospheric Science of the University of Cambridge \(http://www.atm.ch.cam.ac.uk/\)](http://www.atm.ch.cam.ac.uk/) as its Scientific Coordinator. During that time, Rob worked on issues related to the depletion of stratospheric ozone, particularly the behaviour of polar stratospheric clouds (reviewed in Lowe and MacKenzie, J. Atmos. Solar-Terrest. Phys., 2008). He also became deeply involved in the use of high-altitude aircraft for atmospheric science, and was a core team member of most of the scientific deployments of the Geophysica aircraft (see, e.g., Stefanutti et al., 2004; [Cairo et al., 2010 \(http://www.atmos-chem-phys.net/10/2237/2010/acp-10-2237-2010.pdf\)](http://www.atmos-chem-phys.net/10/2237/2010/acp-10-2237-2010.pdf)). Latterly, the focus of research in the atmospheric composition affecting the ozone layer has focused to processes at the tropical tropopause. Rob's work has included modeling studies of processes controlling the water budget at the tropical tropopause ([Ren et al., ACP, 2007 \(http://www.atmos-chem-phys.net/7/5401/2007/acp-7-5401-2007.pdf\)](http://www.atmos-chem-phys.net/7/5401/2007/acp-7-5401-2007.pdf)) and multi-aircraft campaigns to characterize transport and chemistry in the tropical tropopause region ([Vaughan et al., BAMS, 2008 \(http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-89-5-647\)](http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-89-5-647)).

In August 2011, Rob accepted a Chair in Atmospheric Science at the [School of Geography, Earth & Environmental Sciences \(/schools/gees/index.aspx\)](/schools/gees/index.aspx) at the University of Birmingham. Here he continued his research into issues at the interface of air quality, global atmospheric chemistry, and climate, using models and field deployments, including the use of unmanned aircraft such as the NASA Global Hawk.

In November 2013, Rob was appointed inaugural Director of the Birmingham Institute of Forest Research.

Teaching

Rob currently does no class-based teaching but does supervise PhD and MSc projects.

Postgraduate supervision

Other opportunities for graduate study in Professor MacKenzie's group can be found at [www.FindaPhD.com \(http://www.findaphd.com\)](http://www.findaphd.com) – search: provider = University of Birmingham and keywords = mackenzie.

Rob MacKenzie has graduated 7 PhD students and has 3 finishing at Lancaster. He is currently lead supervisor of 1 PhD student at Birmingham and co-supervisor of 2 students.

New studentship opportunities are available periodically through the [Central England NERC Training Alliance \(CENTA\)](http://www.birmingham.ac.uk/generic/centa/index.aspx) (<http://www.birmingham.ac.uk/generic/centa/index.aspx>).

Research

Rob's group develops atmospheric chemistry models. The group continues to develop the CiTtyCAT atmospheric chemistry model and have applied it to remote and polluted environments. The group provides the modelling support to the NERC CLAIRE-UK project, which is measuring atmospheric composition in remote Amazonia.

The group is interested in developing tools for urban planners and regulators. One such tool is the Urban Tree Air Quality Score (Donovan et al., ES&T, 2005). The group is currently working with a wide range of other researchers to study the interdisciplinary problems associated with urban regeneration. The project – **Urban Futures** (<https://connect.innovateuk.org/web/urban-futures>) - uses scenario/futures analysis to establish the robustness of measures put in place today in the name of sustainability. The project also includes detailed disciplinary work on urban air quality.

The latest urban atmospheric chemistry project that Rob is working on – the European Research Council FASTER project, led by Prof Roy Harrison – will involve adding the MADVEC aerosol composition model to a large-eddy simulation model.

Rob's research on the ozone layer is continuing with the CAST project - see the **NERC press release** (<http://www.nerc.ac.uk/press/releases/2013/02-airborne.asp>), or the **BBC news story** (http://www.bbc.co.uk/blogs/davidgregory/2013/02/climate_change_the_ozone_layer_2.html) / **BBC video feature** (<http://www.youtube.com/watch?v=wnNGXWz7a0>) (but do please note the correction regarding the ownership and history of the UK BAe146 Atmospheric Research Aircraft).

- **Listen to Rob's podcast 'Greening up our cities: tackling air pollution with plants' (MP3 - 13.3MB)** ([/Audio/news/Prof-Rob-MacKenzie-podcast.mp3](#)) or read the **podcast transcript** ([/accessibility/transcripts/Prof-Rob-MacKenzie.aspx](#)).
- Read Rob's article for The Conversation titled **'Fixing air pollution is like walking: easy until the ground starts moving'** (<http://theconversation.com/fixing-air-pollution-is-like-walking-easy-until-the-ground-starts-moving-16179>), in which he discusses the continuing problem of air pollution in our cities.
- Read Rob's article for The Conversation entitled **'Not just weapons of war'** (<http://theconversation.com/not-just-weapons-of-war-drones-hold-much-potential-for-civilians-18933>), in which he discusses civilian uses of "drone" technology.

Other activities

Rob MacKenzie has served the scientific community in a variety of ways, including:

- Member of the NERC Pool of Chairs (2010 - 2013).
- Member, Birmingham City Council Smart City Commission (2012-2013)
- Associate editor for **Atmospheric Chemistry and Physics** (<http://www.atmospheric-chemistry-and-physics.net/home.html>) and has acted as editor for 5 special sections of the journal.
- Reviewer for the European Commission (2006 -2008), including acting as project evaluator for the AMMA-EU Framework VI project
- Executive Committee member of the **SCOUT-O3 integrated project** (http://www.ozone-sec.ch.cam.ac.uk/scout_o3/) (2004 - 2009)
- Member of the Scientific Advisory Committee of the European Economic Interest Grouping that ran the scientific programme of the *Geophysica* research aircraft (2000 - 2006)
- Secretary to the Atmospheric Chemistry Specialist Group of the Royal Meteorological Society (1994 – 1998)
- External examiner, University of Leeds MRes "Physics of the Earth and Environment" (2003 - 2007)

Publications

Most recent publications

See a full list of publications (PDF 58KB) ([/Documents/college-les/gees/staff/mackenzie-publications.pdf](#))

- Barnes, M.J., T. K. Brade, A. R. MacKenzie, J. D. Whyatt, D. J. Carruthers, J. Stocker, X. Cai, and C. N. Hewitt, Spatially-varying surface roughness and ground-level air quality in an operational dispersion model, *Environ. Pollut.*, 185, 44-51, DOI: 10.1016/j.envpol.2013.09.039
- Horseman, A. M., T. Richardson, A. T. Boardman, W. Tych, R. Timmis and A. R. MacKenzie (2013). "Calibrated digital images of Campbell–Stokes recorder card archives for direct solar irradiance studies." *Atmos. Meas. Tech.* 6(5): 1371-1379 DOI: 10.5194/amt-6-1371-2013
This paper has been included in the archive of articles relating to the Baseline Surface Radiation Network at http://www.bsrn.awi.de/en/other/publications/reviewed_scientific_papers_referring_to_bsrn/ (http://www.bsrn.awi.de/en/other/publications/reviewed_scientific_papers_referring_to_bsrn/)
- Pugh, T. A. M., **A. R. MacKenzie**, J. D. Whyatt, and C. N. Hewitt (2012). "The effectiveness of green infrastructure for improvement of air quality in urban street canyons." *Environmental Science & Technology*, 46 (14), 7692-7699. DOI: 10.1021/es300826w.
This paper formed the basis of a report on BBC Radio 4's Costing the Earth programme, broadcast Wednesday 14 September 2011 and was the subject of extensive media coverage in July 2012 (e.g. <http://www.bbc.co.uk/news/science-environment-18873391>) (<http://www.bbc.co.uk/news/science-environment-18873391>)
- Boyko, C. T., M. R. Gaterell, A. R. G. Barber, J. Brown, J. R. Bryson, D. Butler, S. Caputo, M. Caserio, R. Coles, R. Cooper, G. Davies, R. Farmani, J. Hale, A. C. Hales, C. N. Hewitt, D. V. L. Hunt, L. Jankovic, I. Jefferson, J. M. Leach, D. R. Lombardi, **A. R. MacKenzie**, F. A. Memon, T. A. M. Pugh, J. P. Sadler, C. Weingaertner, J. D. Whyatt, & C. D. F. Rogers, Benchmarking sustainability in cities: The role of indicators and future scenarios, *Global Environmental Change*, doi:10.1016/j.gloenvcha.2011.10.004, 2011.
- Hewitt, CN, K Ashworth, A. Boynard, A. Guenther, B Langford, **AR MacKenzie**, PK Misztal, E Nemitz, SM Owen, M Possell, TAM Pugh, AC Ryan and O Wild, **Ground-level ozone influenced by circadian control of isoprene emissions** (<http://news.sciencemag.org/sciencenow/2011/09/tick-tock-modeling-emissions-fro.html?ref=hp>). *Nature Geoscience*, doi:10.1038/ngeo1271, 2011.
This paper was given a front-page strap-line and was the subject of a News & Views item in Nature Geoscience. The paper received extensive press coverage, including in Science.
- Ryan, A. C., S. Watkins, **A. R. MacKenzie**, and R. Timmis, Using World War II contrails to study aviation effects on climate, *Int. J. Clim.*, DOI: 10.1002/joc.2392, 2011.
*This paper was the subject of a press release that generated a great deal of interest, with articles in several newspapers, the Fox News web site, Scientific American and the Natural History Magazine. See the **World War II contrails press release** ([/news/latest/2011/06/05July11WorldWarTwoBombingRaidsOfferNewInsightintotheEffectsofAviationonClimate.aspx](#)).*
This paper was in the top 5 research stories from University of Birmingham in the media in 2011.
- MacKenzie, A.R., B. Langford, T.A.M. Pugh, N. Robinson, P. K. Misztal, D. E. Heard, J. D. Lee, A. C. Lewis, C. E. Jones, J. R. Hopkins, G. Phillips, P. S. Monks,

A. Karunaharan, K. E. Hornsby, V. Nicolas-Perea, H. Coe, L.K. Whalley, P. M. Edwards, M. J. Evans, D. Stone, T. Ingham R. Commene, K. L. Furneaux, J. McQuaid, E. Nemitz, Yap Kok Seng, D. Fowler, J. A. Pyle, and C.N. Hewitt, The atmospheric chemistry of trace gases and particulate matter emitted by different land uses in Borneo, Phil. Trans. Roy. Soc. Lond. B, 366, 3177-3195, doi:10.1098/rstb.2011.0053, 2011.

- Gormally, A., **A. R. MacKenzie**, and W. Tych, Extending Manley's Lancashire Plain Temperature Record: 1753 - 2007, Int. J. Clim., doi: 10.1002/joc.2404, 2011.
- Horseman, A.M., **A. R. MacKenzie**, and M. P. Chipperfield, **Tracers and traceability: implementing cirrus in a chemistry-transport model as an example of the application of quality assurance to legacy models (<http://www.geosci-model-dev.net/3/189/2010/gmd-3-189-2010.pdf>)**, Geosci. Model Dev., 3, 189-203, 2010
- Hewitt, C. N., Lee, J. D., **MacKenzie, A. R.**, Barkley, M. P., Carslaw, N., Carver, G. D., Chappell, N. A., Coe, H., Collier, C., Commane, R., Davies, F., Davison, B., DiCarlo, P., Di Marco, C. F., Dorsey, J. R., Edwards, P. M., Evans, M. J., Fowler, D., Furneaux, K. L., Gallagher, M., Guenther, A., Heard, D. E., Helfter, C., Hopkins, J., Ingham, T., Irwin, M., Jones, C., Karunaharan, A., Langford, B., Lewis, A. C., Lim, S. F., MacDonald, S. M., Mahajan, A. S., Malpass, S., McFiggans, G., Mills, G., Misztal, P., Moller, S., Monks, P. S., Nemitz, E., Nicolas-Perea, V., Oetjen, H., Oram, D. E., Palmer, P. I., Phillips, G. J., Pike, R., Plane, J. M. C., Pugh, T., Pyle, J. A., Reeves, C. E., Robinson, N. H., Stewart, D., Stone, D., Whalley, L. K., and Yin, X.: **Overview: oxidant and particle photochemical processes above a south-east Asian tropical rainforest (the OP3 project): introduction, rationale, location characteristics and tools (http://www.atmos-chem-phys.net/special_issue163.html)**, Atmos. Chem. Phys., 10, 169-199, 2010.
- Pugh, TAM, **AR MacKenzie**, CN Hewitt, B Langford, PM Edwards, KL Furneaux, DE Heard, JR Hopkins, CE Jones, A Karunaharan, J Lee, G Mills, P Misztal, S Moller, PS Monks, and LK Whalley, **Simulating atmospheric composition over a South-East Asian tropical rainforest: Performance of a chemistry box model (<http://www.atmos-chem-phys.net/10/279/2010/acp-10-279-2010.pdf>)**, Atmos. Chem. Phys., 10, 279-298, 2010.
- Lee, D. S., and **A. R. MacKenzie**, Trans-hemispheric effects of large volcanic eruptions as recorded by an early nineteenth century diary, Int. J. Clim., DOI: 10.1002/joc.2034, 2009.
- Hewitt, C.N., **A.R. MacKenzie**, P. Di Carlo, J.R. Dorsey, M. Evans, D. Fowler, M.W. Gallagher, C. Helfter, J. Hopkins, H. Jones, B. Langford, J.D. Lee, A.C. Lewis, S.F. Lim, C. di Marco, P. Misztal, S. Moller, P.S. Monks, E. Nemitz, D.E. Oram, S.M. Owen, G. Phillips, T. Pugh, J.A. Pyle, C.E. Reeves, J. Ryder, J. Siong, U. Skiba, D.J. Stewart, R. Thomas, **Nitrogen management is essential to prevent tropical oil palm plantations from causing ozone pollution (<http://www.pnas.org/content/106/44/18447.full.pdf+html>)**, Proc. Natl. Acad. Sci., 106, 18447-18451, 2009

