Senior Research Associate: Atmospheric Chemistry Modelling of Ozone-Depleting Substances

FURTHER PARTICULARS

Ref: A2032

Overview

This is a 2.5 year senior postdoctoral research associate post at the Lancaster Environment Centre (LEC) at Lancaster University. The start date is ideally in October 2017 (or soon after by mutual agreement). The research will contribute to the NERC-funded SISLAC ('Sources and Impacts of Short-Lived Anthropogenic Chlorine') project. SISLAC is a joint project between Lancaster University and collaborators at the University of Leeds and University of East Anglia, and will involve engagement with a range of international partners (including NOAA in the USA). The underlying goal of SISLAC is to better understand and quantify the impact of chlorine-containing very short-lived substances on atmospheric composition (with a focus on ozone), now and in the future.

Science Background

Depletion of the stratospheric ozone layer is a persistent environmental issue. It is predominately caused by halogens (chlorine/bromine) released from long-lived anthropogenic compounds, such as chlorofluorocarbons (CFCs), whose production is now controlled by the UN Montreal Protocol. However, it is now increasingly recognised that very short-lived substances (VSLS) are also a major source of halogens in the stratosphere and contribute significantly to ozone loss. To date, most research has focused on naturally-emitted VSLS from the ocean, though there is mounting evidence that anthropogenic chlorinated VSLS (Cl-VSLS) are playing an increasingly important role (e.g. Leedham Elvidge et al., 2015). For example, the tropospheric concentration of dichloromethane (CH_2Cl_2), the most abundant Cl-VSLS, has increased by a factor of 2 or more since the early 2000s (Hossaini et al., 2015a, 2015b), and its continued growth threatens to delay ozone layer recovery by up to several decades (Hossaini et al., 2017). This would not only offset some of the benefits achieved by the Montreal Protocol but could also affect our future predictions of climate change, because ozone it an important climate gas.

Based on the above, the **key science objectives** are as follows:

1. Implement a treatment of Cl-VSLS into the UKCA chemistry-climate model.
2. Combine observations and model simulations to determine the present-day total chlorine budget from Cl-VSLS.
3. Quantify the stratospheric chlorine injection from Cl-VSLS and their products.
4. Develop future scenarios describing possible changes in emissions and the tropospheric abundance of Cl-VSLS.
5. Apply UKCA to examine the impact of Cl-VSLS on ozone layer recovery and impact on climate radiative forcing.
6. Investigate impact of Cl-VSLS on tropospheric composition.

References

Hossaini, R., et al: The increasing threat to stratospheric ozone from dichloromethane, *Nature Communications*, 15962, doi:10.1038/ncomms15962, 2017.

Hossaini, R., et al.: Efficiency of short-lived halogens at influencing climate through depletion of stratospheric ozone, *Nature Geoscience.*, 8, 186-190, doi:10.1038/ngeo2363, 2015a.

Hossaini, R., et al.: Growth in stratospheric chlorine from short-lived chemicals not controlled by the Montreal Protocol, *Geophys. Res. Lett*., doi:10.1002/2015GL063783, 2015b.

Leedham Elvidge, E. C., et al: Increasing concentrations of dichloromethane, CH_2Cl_2, inferred from CARIBIC air samples collected 1998–2012, *Atmos. Chem. Phys*., 15, 1939-1958, https://doi.org/10.5194/acp-15-1939-2015, 2015.

Lancaster Environment Centre

Lancaster Environment Centre (LEC) forms one of the largest and most prestigious groupings of environmental researchers in Europe, with over 200 staff who have research and teaching interests that span the Natural and Social Sciences. Our research community has international expertise in atmospheric science, earth science, ecology, geography, hydrology, marine science, plant science and sociology. It is the largest department in Lancaster University and is a key player in the strategic development of the University and the Faculty of Science and Technology. LEC currently admits about 240 undergraduate students and 100 postgraduate (MSc/PhD) students each year across a wide range of degree schemes. We have strong links with a wide range of national and international partners, including in Asia, Africa and the Americas, and we are home to one of the UK Government's top environmental research laboratories, run by the NERC Centre for Ecology and Hydrology (CEH). In collaboration with CEH and Rothamsted Research, we recently launched a new Graduate School for the Environment to create a world-leading and distinctive entity for postgraduate training, research and professional development. A distinctive feature of LEC is its Enterprise and Business Partnership unit which hosts around 20 small companies working with LEC researchers and which has links to a large number of other national and multi-national businesses and organisations. LEC offers a highly inclusive, stimulating and supportive environment for career development. We are committed to family-friendly and flexible working policies, and to the Athena SWAN Charter, which recognises and celebrates good employment practice undertaken to address gender equality in higher education and research.

Atmospheric Science is one of the major research themes in LEC, and the atmospheric science group has extensive involvement in national and international research, contributing to the success of a wide range of past and ongoing atmospheric measurement campaigns and international modelling studies. Atmospheric modelling experience ranges from process-based studies of the photochemistry of volatile organic compounds up to global scale modelling of future changes in atmospheric composition, air quality and climate. The atmospheric research group works closely with institutes around the UK and with a wide range of international partners through major international research and assessment projects (e.g., IPCC, CCMI, HTAP, ACCMIP) and through long-standing research collaborations. The group has access to good high-end computing facilities at Lancaster, with current provision of a well-maintained 3000-core cluster on site, supplementing the scientific computing facilities available within LEC and at a national level.

Lancaster University

Lancaster is a world-class university with an international reputation for excellence in teaching, scholarship and research. Lancaster is ranked in the UK Top 10 universities in all three of the major national league tables and is in the Top 1% of universities globally. Established in 1964, Lancaster currently has over 12,000 students and has seen £450 million invested in academic, student and sporting facilities, accommodation and teaching space over the last decade. The university has a beautiful parkland campus on the edge of the historic city of Lancaster, close to the spectacular scenery of the Lake District, Yorkshire Dales and Lancashire coast. Lancaster city centre is just 15 minutes away by bus, and the city was recently ranked one of the top 10 most vibrant cities in the UK thanks to its arts scene and student population. It is very well connected by road and rail with

Manchester (and its international airport) just over an hour away, while the train journey to London takes just two and a half hours.

Further information

Informal enquiries should be addressed to Dr Ryan Hossaini (r.hossaini@lancaster.ac.uk). Further details of activities in LEC can be found on our web site http://www.lancaster.ac.uk/lec/ and information about Lancaster University is available at http://www.lancaster.ac.uk/.