PROJECT TITLE: Atmospheric measurements and modelling of halocarbons to support international climate agreements

DTP Research Theme(s): Changing Planet
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Project keywords: greenhouse gas, climate change, ozone depletion, CFCs

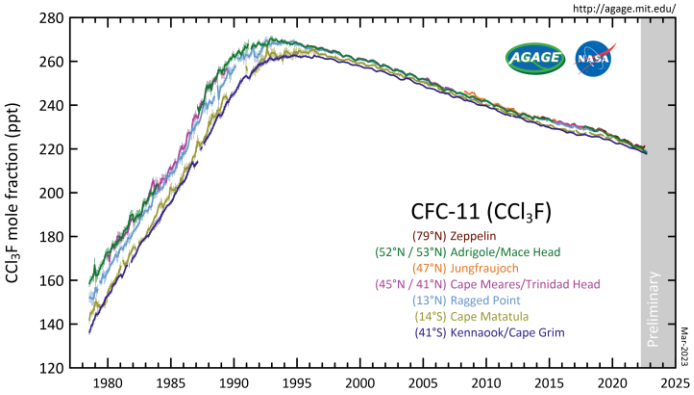

Figure 1. Atmospheric measurements of CFC-11 from AGAGE stations (measured under background, unpolluted conditions). Source: https://agage.mit.edu/data/agage-data.

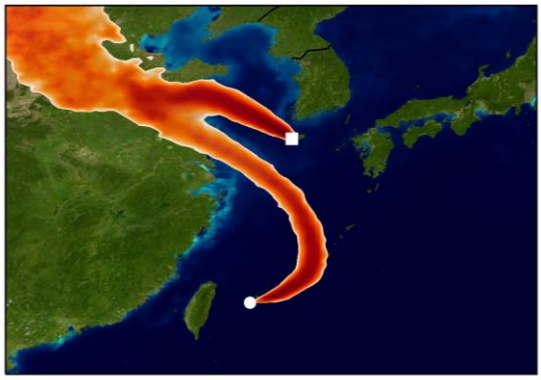

Figure 2. Met Office NAME model simulations of atmospheric transport.

Project Background

In a series of four papers published in *Nature* between 2018 and 2021 *[e.g., 1,2]*, our team used atmospheric data to present evidence of a major violation of the Montreal Protocol, the universally ratified treaty designed to protect the stratospheric ozone layer; emissions of the potent ozone depleting substance, CFC-11, had increased since 2012, despite the global ban in 2010. Intense media coverage followed, and enforcement activities were initiated in China, where a substantial fraction of the new emissions were found to originate. Subsequently, emissions dropped substantially, with a CO_2-equivalent magnitude equal to that of the whole of London. Here, we will determine whether similar contraventions of the Montreal Protocol and its amendments have occurred for a much wider range of gases than CFC-11. We will do this using new measurements historical air samples and new measurements of over 40 halocarbon species in eastern Asia. We will develop new global and regional modelling approaches to interpret this data, and quantify emissions changes responsible for the trends that are observed.

Project Aims and Methods

The Atmospheric Chemistry Research Group (ACRG) is a key member of the international Advanced Global Atmospheric Gases Experiment (AGAGE). AGAGE measures over 50 greenhouse gases and ozone depleting substances covered by the Montreal and Kyoto Protocols. To infer emissions from the AGAGE data (Figure 1), models of atmospheric chemistry and transport are required (e.g., Figure 2). These inferred emissions are reported to the UK government, and are vital to international decision making on climate.

In this project, you will:

a) make measurements of halocarbons using archived and newly collected air samples on the AGAGE Medusa pre-concentration and gas-chromatography mass-spectrometry system.

b) create new computationally efficient open-source modelling tools to infer global greenhouse gas emissions using observations from remote monitoring sites from AGAGE and other international networks, allowing us to understand how global emissions are changing.

c) develop a cloud-based system for the efficient and open sharing of data, model output and code, thus ensuring transparent and rapid access to results by interested parties.

Candidate requirements

This project is an excellent opportunity to use your scientific, mathematical, or computational skills to provide policy makers, scientists and the public with vital information on the emissions of greenhouse gases and ozone depleting substances. You should have a degree in physical or environmental sciences. Experience in chemistry is *not* required. A good foundation in environmental science is essential. Experience in scientific computing is desirable. We welcome and encourage student applications from under-represented groups. We value a diverse research environment.

Project partners

This project has been co-developed with the Met Office Hadley Centre. The Met Office supervisor will provide training on the NAME model and ensure close links to policy makers through the UK DECC network.

Training and international collaboration

In collaboration with the Met Office and our team of post-docs and postgrads, you will be trained in atmospheric measurements and modelling, Bayesian methods and high-performance computing. There will be the opportunity to work extensively with international AGAGE collaborators (e.g. MIT, Scripps Institution of Oceanography, CSIRO), with whom exchange visits can be arranged. You will have the opportunity to participate in AGAGE meetings and measurement site visits (e.g. to Mace Head, Ireland or Ragged Point, Barbados). With the Advanced Computing Research Centre, you will be trained in cloud computing techniques that have been developed through the ACRG-led OpenGHG project. You will have the opportunity to participate in meetings with scientists and policy makers at national and international conferences and meetings of ACRG-led projects such as DARE-UK or the UK DECC network.

Background reading and references

[1] Montzka, S. A. et al., *Nature*, 557(7705), 413–417, doi:10.1038/s41586-018-0106-2, 2018.

[2] Rigby, M. et al., *Nature*, 569(7757), 546–550, doi:10.1038/s41586-019-1193-4, 2019.

Useful links

http://www.bristol.ac.uk/chemistry/courses/postgraduate/

Bristol NERC GW4+ DTP Prospectus:
http://www.bristol.ac.uk/study/postgraduate/2024/sci/phd-great-western-four-doctoral-training-partnership-nerc/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/
Please note: If you wish to apply for more than one project please contact the Bristol NERC GW4+ DTP Administrator to find out the process for doing this**.**

The application deadline is Tuesday 9 January 2024 at 2359 GMT. Interviews will take place from 26 February to 8 March 2024.

For more information about the NERC GW4+ Doctoral Training Partnership please visit
https://www.nercgw4plus.ac.uk

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