

## Oceanic fluxes of very short-lived (VSL) halocarbons and their subsequent atmospheric chemistry and transport

Paul Palmer

E: paul.palmer@ed.ac.uk

W: www.geos.ed.ac.uk/research/eochem

**Project summary** VSL oceanic bromocarbons such as bromoform ( $\text{CHBr}_3$ ) and dibromomethane ( $\text{CH}_2\text{Br}_2$ ) are the major sources of bromine to the upper troposphere and make an important contribution to the burden of lower stratospheric bromine, which contributes to ozone destruction. Reactive iodine appears to be the major contributor to halogen-related ozone loss in the tropical marine boundary layer, in part through amplification of bromine-only cycles. There are major uncertainties in the global distributions of VSL halocarbons (VSLH), exacerbated by large spatial variability in their sea-air fluxes. Models assume a variety of scenarios for oceanic VSLH emissions, which require better validation by global oceanic and atmospheric measurements. The transport and transformation of VSLH between the surface and the stratosphere is also not well understood. In addition to the uncertainties in the transport of trace gases in convection discussed above, the removal of the source gases (through photolysis and reaction with OH and Cl radicals) and of their inorganic oxidation products (e.g.  $\text{Br}_y$ , removed via scavenging by clouds and aerosol) during ascent into and through the tropical transition layer (TTL) are highly uncertain. The tropical warm pool (TWP) is potentially an important source of VSL bromocarbons to the TTL, as well as being a region with strong convection.

The student will be part of a national research project that includes model and measurement scientists. The main focus of the project will be an aircraft campaign over the TWP that is to be part of a larger, coordinated international effort, including other aircraft and the NASA Globalhawk unmanned airborne vehicle. The principal outcome of this studentship is to develop a better quantitative understanding of oceanic fluxes of VLSH, and their subsequent transport and oxidant chemistry in the atmosphere. In particular, the student will address some of the following fundamental research questions:

- 1) *What drives observed variability in ocean fluxes of VSLH?*
- 2a) *How large is the ocean source of atmospheric VSLHs?*
  - b) *What is the role of VSLH in determining tropospheric oxidant chemistry?*
- 3a) *What is the distribution and uncertainty of net ocean fluxes of VSLHs inferred from dedicated UK research aircraft measurements and surface data?*
  - b) *What is the vertical ascent rate of VSLHs in the TWP?*

**Techniques** The studentship will include the interpretation of trace gas, aerosol, and ocean surface measurements from aircraft and satellite instruments using computer models that describe the ocean-surface and atmospheric chemistry and transport. This project offers the candidate an excellent opportunity to work within a strong UK team of researchers to help make atmospheric measurements, and use these data to test current understanding of the chemistry-climate system.

**Training** includes: (1) computer modelling for simulating ocean-surface processes and atmospheric chemistry; (2) data analysis to help interpret measurements; and (3) Bayesian source estimation modelling related to melding the model and data.

**Existing facilities** The computing resources, model codes and satellite data, necessary to successfully complete the project, will be available within the School or publicly accessible data archives. The aircraft data will be available via the science team.

**Summary statement** The student will quantify the role of very short-lived halocarbons on regional and global atmospheric composition by interpreting new aircraft and satellite measurements using a computer model of atmospheric chemistry and transport.