

Forest fires and global atmospheric chemistry

Paul Palmer

E: paul.palmer@ed.ac.uk

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

Project summary The burning of boreal forests, of which approximately 5 to 20 million hectares burn annually (mainly in Russia and North America), removes vegetation, changes land-surface properties, and emits trace gases, aerosols, and smoke in prodigious quantities. Consequently, wildfires are amongst the most important global contributors to a number of key atmospheric species (e.g., CO₂, CH₄, CO, black carbon) and their long-range transport impact Earth's radiation budget and air pollution far from the source region.

We lead an international project to investigate the connection between the chemical and physical composition and distribution of plumes from boreal forest fires, chemistry within the outflow, and the resulting perturbation to atmospheric chemistry. The focal point of the project is a 3-week aircraft campaign over the North Atlantic during July 2011 (seasonal peak of Canadian forest fires), which involved additional measurements over mainland Canada and the Azores.

There is an enormous breadth of science that can be achieved using measurements from this project. A number of projects are available in these general areas: 1) modelling the magnitude, distribution, and vertical transport of emissions from fires; 2) estimating emissions of CO, CO₂ and CH₄ using aircraft and satellite data using Bayesian statistical methods; and 3) modelling the response of global atmospheric chemistry to emissions from forest fires. Prospective students are encouraged to contact the supervisor to discuss choice of projects.

Techniques The studentship will include the interpretation of trace gas, aerosol, and land surface measurements from aircraft and satellite instruments using computer models that describe the land-surface and atmospheric chemistry and transport. All models used for this project are already widely used within our group.

This project offers the candidate an excellent opportunity to work within a strong international team of researchers to test current understanding of the climate system. More broadly, the project is affiliated through the supervisor to the National Centre for Earth Observation (NCEO).

Training includes: (1) computer modelling for simulating land-surface processes and atmospheric chemistry; (2) remote sensing techniques and subsequent interpretation of retrieved quantities; and (3) Bayesian source estimation related to melding the model and data.

Existing facilities The computing resources, model codes and aircraft and satellite data, necessary to successfully complete the project, are available within the School or publicly accessible data archives.

Summary statement The student will quantify the role of forest fires on global atmospheric composition by interpreting new aircraft and satellite measurements using a computer model of atmospheric chemistry and transport.