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Impacts of meteoric smoke in the stratosphere and upper troposphere

Supervisors: Professor John Plane (School of Chemistry) and Dr Ben Murray (School of Earth and Environment)

The amount of cosmic dust entering the earth's atmosphere is highly uncertain: estimates range from about 10 to 270 tonnes per day globally. Most of the dust particles enter the atmosphere at very high speeds (12 - 72 km s⁻¹), causing the particles to undergo meteoric ablation. The resulting vapours of iron, magnesium and silicon become oxidised and then condense over several days to form nanometre-size particles termed *meteoric smoke*.

The purpose of this project is to investigate the impacts of smoke particles in the middle atmosphere. These impacts include reaction in the mesosphere and upper stratosphere with acidic gases such as sulphuric, nitric and hydrochloric acid. The smoke may also act as condensation nuclei for sulphuric acid droplets in the middle stratosphere. A major focus of the project will be the role of meteor smoke in crystallising sulphuric acid and nitric acid droplets in the lower stratosphere and upper troposphere (i.e. enhancing the freezing of polar stratospheric clouds), and determining the resulting effect on stratospheric O₃. Laboratory experiments using an optical microscope with Raman spectroscopy will be used to study droplets containing meteoric smoke analogues (made using the "lab-on-the-chip" microfluidics technique) under stratospheric conditions.

The results from these experiments will then be incorporated into a chemistry-climate model of the whole atmosphere. Comparison with observations of the meteoritic material in sulphuric acid droplets will be used to constrain the cosmic dust flux. This model will be used to simulate changes to O₃ as the stratosphere cools through the 21st Century, and also to explore how meteoric smoke may interfere with a proposed geo-engineering climate solution which involves pumping sulphur dioxide into the stratosphere.

The studentship will involve: experimental work using Raman microscopy and the microfluidics technique to generate nanoparticles; and atmospheric modelling using a microphysical mass advection model coupled to a leading chemistry-climate model. An appropriate background would be a first degree in chemistry, physics or atmospheric science.

The student will join a large research team studying the evolution of cosmic dust from the outer solar system to the earth's surface. The team consists of 4 senior staff members, 5 post-docs and 2 PhD students at Leeds, as well as 10 remote members in the US and Germany.

Enquires to Prof. John Plane (j.m.c.plane@leeds.ac.uk).

Webpage <http://www.chem.leeds.ac.uk/JMCP/>

Eligibility: open to applicants from throughout the EU.

Start date: 1 October 2012 (flexible)

Duration: 4 years