

Transport And Dispersion of Pollutants in the Environment

An increase in computer power has enabled high resolution (1km) meteorological models to be run routinely. These models are capable of resolving mesoscale weather processes such as convection. Combined with the recently developed capability of these models to transport chemical tracers, a means of producing more accurate air quality forecasts is anticipated. These air quality forecasts are essential so that those most at risk can be warned of pollution episodes. This project will investigate the ability of these meteorological chemistry transport models to accurately represent the distribution of pollution as a result of transport by mesoscale processes.

The aims of this PhD project are:

- (i) To evaluate the performance of transport and mixing schemes in meteorological chemical transport models.
- (ii) To quantify vertical mixing in the lower atmosphere.

This will be achieved by simulating the transport of radon for case studies using the state-of-the-art UK Met Office Air Quality forecast model (AQUM). The model will be run at a range of horizontal and vertical resolutions to both explicitly resolve and parameterise convective transport processes. The distribution of modelled radon will be compared with observations of radon from a unique dataset of high-resolution vertical profiles. These vertical radon measurements provide valuable quantitative information regarding mixing and exchange processes in the atmospheric boundary layer under a range of conditions

Radon is present in most rock and soil types from which it is emitted with a fairly consistent flux density. It is particularly useful for tracing air transport in the atmospheric boundary layer as, over land, radon sources can be assumed to be approximately constant over the diurnal cycle, and horizontally uniform on local scales. As radon is inert and poorly soluble in water it is not susceptible to wet or dry atmospheric removal processes. Radon's only significant atmospheric sink is radioactive decay. It has a half-life of 3.82 days which is well suited for boundary layer studies, as it is long compared with typical turbulent time scales (1h) but short enough to constrain radon concentrations in the free troposphere to be typically two orders of magnitude lower than average boundary layer values. The result is large concentration variations through the lower troposphere that are principally related to vertical mixing processes (Williams et al. 2011).

The PhD student will carry out a range of modelling experiments and handle observational data and will acquire cross-disciplinary expertise in mesoscale meteorology and aspects of atmospheric chemistry. In addition the student will be encouraged to develop transferable skills in data analysis and presentation.

Williams, A. G., Zahorowski, W., Chambers, S., Griffiths, A., Hacker, J. M., Element, A. And Werczynski, S. (2011). The Vertical Distribution of Radon in Clear and Cloudy Daytime Terrestrial Boundary, *J. Atmos. Sci.*, 68, 155-174.