Understanding Atmospheric Transport and Volatility of the Gas and Particle Phases of Pesticides Using Oxidation Flow Reactor Experiments

Olivia M Jackson

University of Manchester, United Kingdom

Author list (excluding presenting author)

Aristiedis Voliotis, Emily Matthews, Stephen Robertson, David Johnson, Gordon. Mcfiggans, Hugh Coe

Abstract

Pesticides have been used on fields since the 1950s to promote crop yield by reducing crop losses due to diseases and/or pests. Where environmental exposure and risk assessment is very well developed for surface water, groundwater, and soil environments – and organisms and ecosystem services therein – there has been relatively much less attention on the fate and behaviour of pesticides in the atmospheric environment. Current reported physiochemical properties of pesticides e.g.: vapour pressure, often come with large uncertainties and discrepancies between sources (M.Leistra., 2011). Vapour pressure of low volatility compounds (like most atmospherically relevant species) are difficult to measure, historically being measured at high temperature leading to extrapolation for ambient results. To carry out calibration measurements of current use pesticides (CUPs) the FIGAERO-TOF-CIMS (Filter Inlet for Gases and AEROsols – Time of Flight – Chemical ionisation Mass Spectrometer), as described by F.D. Lopez-Hilfiker *et al.,* (2016) and A.Ylinsirnö et al., (2021) was used and compared to literature values and models commonly used in industry. Further experiments in the DEKATI Oxidation Flow Reactor (DOFR) have also been carried out with selected pesticides to monitor their degradation products when exposed OH and both the gas and particle phase constituents monitored using online FIGAERO-CIMS measurements. Experiments showed different behaviours of pesticides depending on their physiochemical properties. For example, Trifluralin was seen to form Secondary Organic Aerosol (SOA), this SOA was then monitored by collection of filters and run offline using FIGAERO-CIMS to monitor the change in volatility distribution throughout the experiment. Overall, this work along with the volatility work will allow predictions of the lifetime and fate of pesticides as well as gas and particle partitioning behaviour more confidently in the atmosphere

Early Career Scientist

YES, I am an early career scientist.

IGAC Activities

MAP-AQ: Monitoring, Analysis and Prediction of Air Quality