Are Pesticides Important in the Atmosphere?

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Pesticides in the Environment

- 2 million tonnes of pesticides are used globally per year.¹
- Potential to be volatilised in to the atmosphere.
- Previously been observed to be transported large distances as far as the Arctic.²
- Fundamental properties and behaviours are not well understood.
- A range of mass spectrometry techniques will be used to probe their properties and behaviour once in the atmosphere.

Manchester Aerosol Chamber

- Experiments allow observations of transformation products (SOA) when exposed to OH.
- 18 m² bag made of fluorinated ethylene propylene (FEP).³
- Temperature and humidity controlled.
- Contains 2 arc lamps to initiate OH radical formation.
- Sampling lines are attached to several instruments including:
  - Chemical Ionisation Mass Spectrometer (CIMS)
  - Aerosol Mass Spectrometer (AMS)
  - Scanning Mobility Particle Sizer (SMPS)
  - NOx and O₃ sensors.
- Pesticide is introduced into the chamber through nebulisation.

Chamber Observations

A) Nebulising starts
- Pesticide is introduced into the chamber.
- Increase in MCPA concentration in both the particle and gas phases.

B) Nebulising stops
- MCPA concentration drops due partitioning to gas phase.
- Significant wall loss suggest wall loss rates need to be determined.⁴

C) Lights on
- 1/3 concentration of OH of a typical Manchester sunny June day.
- Fragmentation to form a major first generation product C₈H₇ClO₃.

D) Stronger UV lights on
- 2x concentration of OH of a typical Manchester sunny June day.
- Nucleation event seen on SMPS data.
- Oxidation of C₈H₇ClO₃ to form highly oxidised molecules.
- SOA formation observed.

Vapour Pressure Measurements

- Initial vapour pressure pesticide measurements using a well characterised technique - Knudsen Effusion Mass Spectrometry (KEMS).
- Previous literature values of pesticides often come with large uncertainties and discrepancies, between sources - often lead to confidential reports.⁴
- Vapour pressure is often measured at high temperature leading to extrapolation for ambient results - KEMS avoids this.
- The differences in Vapour pressure will have large effects on predictions of a pesticides behaviour in the atmosphere.

Future Work

- Calculate corrections for particles lost to the walls.
- Determination of OH reactivity constant and photolysis rates.
- Proposal of mechanism.
- Assessment of toxicity of proposed products.
- Comparison of vapour pressure measurements from other techniques: KEMS and Filter Inlet for Gases and Aerosol (FIGAERO) – CIMS.