Microfluidic technology for atmospheric biological ice nucleating particle analysis

Polly Beth Foster
ee18pbf@leeds.ac.uk
School of Chemical and Process Engineering/School of Earth and Environment
University of Leeds, Woodhouse, Leeds LS2 9JT

Introduction

Ice nucleating particles (INP) are a rare subset of aerosol that initiate the formation of ice crystals from water vapour or supercooled water. Known INP sources include desert dust, sea spray, terrestrial biological aerosol, and anthropogenic aerosol. This project utilises novel developments in aerosol instrumentation to sample, analyse, and identify bioaerosol that acts as INP from agricultural sites in the UK.

The Importance of INP in the Climate System

• Mixed-phase clouds are a dynamic system made up of oil water vapour, ice crystals, and supercooled liquid water
• Mixed-phase clouds contribute to uncertainty in the magnitude of the cloud phase feedback
• Formation of ice impacts cloud lifetime, precipitation, and cloud radiative forcing [1]
• Increasing INP = positive climate feedback, amplified warming [1]
• Warming world = negative climate feedback, reduced warming [1]
• The contribution of bioaerosol, such as fungal spores, pollen, and lichen, to the atmospheric INP burden is less clear than the contribution from inorganic sources [1,2]

Identification

• Scanning electron microscopy (SEM)
• Fluorescence microscopy
• Culturing
• Polymerase Chain Reaction (PCR)

Placement with Rothamsted Research

• PCR to identify material in frozen droplets
• Collecting biological aerosol samples from various locations
• Establish relationship between wind and INP production in a wind tunnel

Future work

• Instrument development to analyse full range of concentrations and activation temperatures of atmospheric INP
• Bioaerosol sources, sinks, and distribution
• Autonomous micro total analysis system: collection to identification

References