Future CO_2 – Future bioaerosol concentrations?

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Rationale CO_2 is rising and this profoundly changes plant, fungi and microbe growth. The student will measure the effect of enriched CO_2 ($enCO_2$) upon the production rate of bioaerosols, including pollen and fungal spores, within a mature oak woodland. These measurements are required to understand the response of bioaerosols to a high CO_2 future. Increases in bioaerosol concentrations will likely have wide impact, for example on human health via increased allergenicity and plant health via the spread of pathogens e.g. acute oak decline.

Background Bioaerosol concentrations have been monitored in many locations worldwide over the last century and the production rate has been increasing for many species including pollen and fungal spores, however, this does not necessarily imply enCO2 is the main driver since other potential drivers have also changed (e.g. temperature). Explicit studies of bioaerosol production under $enCO_2$ are rare, and performed under highly idealized conditions in growth chambers, but those that do exist indicate significant increases in production rate. For example, Ziska and Caulfield showed that ragweed pollen production is much enhanced (~250%) under $enCO_2$ (600 ppm) compared to current conditions. Klironomos et al observed that concentrations of fungal spores increased four-fold under a doubling of atmospheric CO_2.

Plan of Work This student will generate robust data, under real woodland conditions, on the atmospheric concentration of bioaerosols under both present and $enCO_2$ conditions. The new multi-million pound Birmingham Institute for Forestry Research (BIFoR) Free Air Carbon dioxide Enrichment (FACE) experiment will be exploited as the field site. The experiment is comprised of six 30 m wide FACE rings which are as tall as the mature trees in this oak woodland. Three rings contain $enCO_2$ (550 ppm) and three are non-enriched (400 ppm) but contain the same scientific infrastructure. The experimental design minimizes perturbations to the natural conditions and hence the effect of $enCO_2$ can be isolated. The enrichment will begin in Spring 2016. This study is the first of its kind and will not only be of great interest for the 2016 summer season; it will continue to be of immense use as the FACE experiment progresses.

Bioaerosol concentration in the woodland will be measured using online fluorescence monitoring. This technique distinguishes different bioaerosol classes via their fluorescence wavelength and intensity profiles. In addition traditional microscopy techniques will be used to unambiguously determine bioaerosol speciation.

Training The student will be in the enviable position of joining the internationally important FACE experiment. Multiple researchers, visiting scholars and technicians will be on site throughout the duration of the project investigating the effect of $enCO_2$ on all aspects of the woodland. Full training in the aerosol field measurement instruments, data analysis and presentation will be provided with day-to-day help and guidance available from the BIFoR team.

Student Selection Process – The bursary will be advertised within the University of Birmingham in the following departments: Chemistry, Physics, Mathematics, Engineering, Geography, Earth and Environmental Sciences. Applicants will be asked to provide a CV and a half page rationale for their selection. From the applicants, Dr Pope and other members of the BIFoR team will choose the successful candidate from assessment of both their academic track record and their enthusiasm for the project. It is noted that this methodology has previously been highly successful in attracting top class undergraduate students for previous NERC summer bursaries.

Ziska and Caulfield. (2000) Functional Plant Biology, 27 (10), 893-898.
Klironomos et al. (1997) *Can. J. Botany*, 75, 1670-1673.