

Proposed PhD Research Studentship



Seasonal fluxes of N₂O and CH₄ in treated forest soils

Supervisors

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Project Description

The UK Government is committed to increasing forest woodland cover to mitigate against climate and environmental change through carbon sequestration and wood-fuel supply, and to provide a wide range of other socio-economic benefits. However, N-deposition from air pollution continues to increase, and there is a need to utilise wood-ash after combustion of wood fuel. Wood-ash has potential applications as a fertiliser in forest systems as its Ca content raises soil pH and increases both microbial activity and the potential mineralisation of N, which may affect fluxes of N₂O and CH₄ (Pitman, 2006).

However, the interactions and impacts of these soil characteristics on forest soil fluxes of N₂O and CH₄ are neither particularly well understood nor quantified. This project seeks to address this, primarily through field manipulation studies in randomised forest soil plots with different applications of N-deposition and wood-ash. The field studies will be carried out throughout the year to account for full seasonal variations; interpretation of results will be supported by laboratory work and numerical simulations using the LandscapeDNDC model (Haas et al., 2013).

Field studies: Initially, soil fluxes of N₂O and CH₄ will be monitored in small field plots within an oak forest with different application rates and forms of N-deposition and wood-ash. Soil fluxes of N₂O and CH₄ will be measured by the closed-chamber technique with several discrete air samples collected over time for subsequent GC-ECD & GC-FID analyses. In addition, the use of soil flux chambers with closed-loop air circulation coupled to state-of-the-art laser-based instrumentation will be developed to allow comparisons with soil flux data measured by GC.

Laboratory work: Soil samples from field plots within other types of forests will then be incubated with different amendments to parameterise the influences of soil properties such as pH, C:N ratio, moisture, and temperature, on fluxes of N₂O and CH₄. Soil mineral N (NH₄⁺ and NO₃⁻) will be measured to indicate the extent of nitrification and denitrification processes. This laboratory work will help to interpret the field studies and better parameterise the numerical model simulations.

Numerical model simulations: The LandscapeDNDC model will be used to simulate biosphere-atmosphere-hydrosphere exchange processes using climatic and soil data recorded at the forest sites, and to extrapolate measured fluxes to the regional scale.

References

- Gundersen, P., et al., (2012). The response of methane and nitrous oxide fluxes to forest change in Europe. *Biogeosciences*, 9, 3999-4012.
- Pitman, R.M. (2006). Wood ash use in forestry: A review of the environmental impacts. *Forestry*, 79, 563-588.
- Haas, E., et al., (2013). LandscapeDNDC: A process model for simulation of biosphere-atmosphere-hydrosphere exchange processes at site and regional scale. *Landscape Ecology*, 28, 615-636.
- Cade, S. et al. (2013) LandscapeDNDC used to model nitrous oxide emissions from soils under an oak forest in southern England. EGU General Assembly, 7-12 April, 2013 in Vienna, Austria, id. EGU2013-7257, <http://adsabs.harvard.edu/abs/2013EGUGA..15.7257C>

Research Context & Benefits

This proposed PhD research studentship will build on the findings of a current PhD project which successfully combined seasonal studies of forest soil fluxes of N₂O, CH₄ and CO₂, and monitoring of forest soil fluxes of NO and NO₂, with the development and application of the LandscapeDNDC model in oak and Sitka spruce forests in the UK, and participation in an international inter-comparison of soil flux chambers for N₂O (Cade et al., 2013).

The proposed field studies will be carried out at Forest Research, while the laboratory work and numerical modelling will take place at RHUL, where the studentship will be based.

Successful completion of the proposed research project will benefit understanding of climate change and air pollution science, and the management of woodland/forest ecosystems. The mitigation of environmental impacts of N-deposition and utilisation of wood-ash from wood fuel combustion will benefit sustainable forestry.

Training & Career Opportunities

Training provided will be specific to the research work carried out:

- Determination of soil chamber fluxes of N₂O and CH₄ using GC and laser-based techniques
- Characterisation of soil properties using a range of analytical methods
- Numerical modelling of biosphere-atmosphere-hydrosphere exchange processes

Training will also be provided in laboratory- and field-based practical scientific research, quantitative analysis and interpretation of quality assured data, and in written and verbal dissemination of results to national and international science communities.

Individual research development programmes at RHUL offer a wide range of transferable skills to conduct and present research efficiently and effectively. They also provide broad knowledge of environmental geoscience, and help foster a multi-disciplinary approach to research that benefits career opportunities.

Potential degree-related career paths include national and international positions as a post-doctoral research scientist within universities and research institutes, an environmental consultant within the environmental sector, and a scientific officer at local and regulatory authorities such as Defra or the Environment Agency.

How to Apply

Please use the online application system to submit an application for this project. Applications will require 2 letters of reference, plus a cover letter and CV. (<http://www.rhul.ac.uk/studyhere/postgraduate/applying/home.aspx>) Applicants are also requested to send their cover letter and CV directly to all 3 supervisors of this project (e-mail: k.clemishaw@rhul.ac.uk, d.lowry@rhul.ac.uk and sirwan.yamulki@forestry.gsi.gov.uk)

Please submit completed applications by January 19th, 2015. Suitable candidates will be invited for interviews, which will take place in February/March 2015, with decisions made by March/April, 2015.

For queries, please contact the Postgraduate Programmes Co-ordinator (e-mail: pgadmin@es.rhul.ac.uk or tel: 01784-443581). Further information can also be found within the Department's web pages (<https://www.royalholloway.ac.uk/earthsciences/home.aspx>)