

We have three funded studentship available. The studentships are jointly with the James Hutton Institute in Dundee. Applications are in first instance send to the JHI.

Application deadline: 15 February 2012.

Studentships are awarded on a competitive basis.

Studentship 1: Soil Structure Dynamics and the Role of Carbon (contact: W. Otten: w.otten@abertay.ac.uk)

Overview/Background

The change in soil pore structure over time underpins a vast array of environmental processes, including root growth, water transport and the functional capacity of soil microorganisms. One certainty, shown in hundreds of observational studies, is that soil carbon has a massive influence on the formation and stabilisation of soil pore structure. There is considerable knowledge of the biogeochemical interaction between different forms of carbon and soil minerals, but the translation of this understanding to shifts in physical behavior has only been attempted in a handful of studies. Recent separate advances by SIMBIOS in visualizing soil pore structure dynamics in 3D with X-ray tomography and assessing its impact on a range of biophysical processes, and by the JHI on the impact of carbon compounds on soil micromechanics, offer the potential to advance understanding considerably. This underpinning research is useful for understanding many soil processes, including carbon sequestration by physical protection in soil, rhizosphere dynamics, benefits of carbon amendments and shifts in flood risk over time.

Aim/Scope

By using advanced techniques in X-ray Tomography, soil micromechanics and biogeochemistry the project will unravel underlying processes that drive the dynamic nature of soil structure and its interaction with carbon.

Objectives

1. To provide high quality training in soil biophysics using state-of-the-art approaches developed by a multidisciplinary team of supervisors.
2. To unravel underlying physical mechanisms that drive soil structure formation from micromechanical properties.
3. To quantify the impact of carbon properties on soil aggregation, cracking and dispersion to describe the genesis of soil pore structure.
4. To visualize the dynamics of soil structure formation using high resolution X-ray CT and relate observed structural changes to the alteration of soil physical properties from carbon.

Funding Notes:

The studentship is funded under the JHI/University Joint PhD programme and will be undertaken in conjunction with the University of Abertay. Prof.W Otten will be the principal university supervisor on this project. Candidates are urged strongly to apply as soon as possible so as to stand the best chance of success. A more detailed plan of the studentship is available to suitable candidates upon application. Funding is available for European applications, but Worldwide applicants who possess suitable self-funding are also invited to apply.

<http://www.findaphd.com/search/ProjectDetails.aspx?PJID=11833&LID=1374>

Studentship 2: Factors Controlling Root Growth in Heterogeneous Substrates: Physical Structures and Root Behaviour. (contact: w.otten@abertay.ac.uk)

Overview/Background

A recent survey of agricultural fields in Scotland suggested that the surface layers of soils are compacted enough to cause over 50% inhibition in root elongation in 57% of the field tested. Soils varied significantly in their pores size distribution and data suggested that where roots were able to elongate this was linked to the volume of pores of a specific diameter. Comparisons of different barley varieties have also suggested that they vary in their ability to elongate in soils of increasing density and this may be linked to the gravitropic response as indicated by the early spreading angle of roots. However other root traits such as border cells and mucilage which aid soil root contact may also be of importance. Unfortunately, the acquisition of quantitative information on such root traits in situ has been constrained by destructive observation methods. One notable consequence of such limitations is a broad lack of understanding of the functions of many of these traits. In particular, it is still unknown if and why some of these traits favour growth in mechanically constrained soils. Methods such as μ CT are being developed to visualize and analyse soil pore structure and potentially root growth. We aim to combine the imaging of roots growing in intact soil samples using μ CT and a new insitu optical imaging system using a “triphasic artificial medium” (3D imaging utilizing both confocal laser scanning microscopy and optical projection tomograph) to gain a better understanding of root exploratory behaviour.

Aim/Scope

The object of this study is to establish the relationship between root tip traits and the elongation rate of individual root tips in complex media particularly in relation to pore geometry and root gravitropic response. This project will make use of μ CT of soil grown plants to gain a greater understanding of the relationship between the specific gravitropic response and other root tips traits and the roots ability to explore the pores structure of soil. Further the triphasic system will be used to test specific hypotheses generated as this system allows manipulation of pores space, water content, osmotic potential and nutrient availability.

Objectives/Possible outcomes

The project will establish which root tip traits at a cellular level may assist roots to explore soil pore structure. The output will be a better understanding of the relationship between soil structure and root traits which will have applications for crop breeders. In addition, the data will improve models of root growth in heterogeneous media and contribute to making better predictions of root uptake efficiency.

Funding Notes:

The studentship is funded under the JHI/University Joint PhD programme and will be undertaken in conjunction with the University of Abertay. Prof W Otten will be the principal university supervisor on this project. Candidates are urged strongly to apply as soon as possible so as to stand the best chance of success. Funding is available for European applications, but Worldwide applicants who possess suitable self-funding are also invited to apply.

<http://www.findaphd.com/search/ProjectDetails.aspx?PJID=20181&LID=1374>

Studentship 3: Developing and testing geovisualization approaches for understanding multiple benefits from Scottish agricultural systems (contact: r.falconer@abertay.ac.uk)

Overview/Background:

Geovisualization is increasingly used to support land based decision making, in particular to understand the views of stakeholders and the public in relation to prospective changes driven by biophysical and social pressures (e.g. impacts of adaptation to climate change, landscape preferences, etc)¹. Complex land use decisions from the field to national scale require balancing of demands for the production of larger quantities of food and energy with regulatory and cultural services that landscapes provide for society. To advance how virtual decision environments (VDE) can improve decision making in complex agricultural environments there is a need to understand the decision-making process, and then to support it ². In rural land use systems there is a requirement to convey complex information, from point to catchment scales, to stakeholders which include farmers/land managers, conservation bodies, regulatory staff and policy makers. The data can be overlaid on the geographical context (via DEM) in a manner that not only looks recognizable but is based on our knowledge and ability to model the processes and structures that support key ecosystem functions. The bidirectional linking of robust models with high quality visualizations is possible through the use of computer games technology ³⁻⁴, resulting in visually accessible imagery which is based on underlying patterns and processes ⁵. This provides opportunities for people to learn and communicate about complex issues whilst supporting decision making ⁴. At the same time recognizing the importance of different publics and how they interact with visual and non-visual components of landscapes in a myriad of ways ⁶. To integrate our understanding, and communicate it when addressing several competing or complimentary functions from the field to national scale, there is an opportunity to exploit developments in management science. The analytic network process (ANP) is a widely used method for multi-criteria decision making since there is no assumption of independence between criteria ⁷. ANP has been integrated with computer games technology geovisualizations to summarize sustainability issues in the build environment ^{3,8}.

Aim and hypotheses:

The aim of this research studentship is to develop and test an interdisciplinary VDE using computer games technology to enable stakeholders to learn and manage agricultural land for multiple benefits and tradeoffs associated with production, regulatory and aesthetic ecosystem services in Scotland. The theoretical basis will draw on that of information processing in relation to understanding landscapes ⁹, and semiotics in relation to visual communications ¹⁰. H1) Land manager understanding of multiple benefits and functions of land use is improved by the use of visual tools for communications. H2) Land manager decision-making between future land use options at field to small catchment scale is enhanced through improved access to information via virtual environments. H3) Virtual environments can support the linking of farm to national scale planning of multiple benefits and trade-offs from ecosystem services. The testing of these hypotheses will consider issues of consistency in approaches to trade-offs between benefits and audience groups, and individual and group environments.

Funding Notes:

The studentship is funded under the JHI/University Joint PhD programme and will be undertaken in conjunction with the University of Abertay. University funding is guaranteed for this PhD. Dr R Falconer will be the principal university supervisor (working closely with Dr David Blackwood) http://simbios.abertay.ac.uk/SIMBIOS_Team/Ruth_Falconer.php Candidates are urged strongly to apply as soon as possible so as to stand the best chance of success. An application form and further information (a more detailed plan of the studentship) available from CJA (Kit) Macleod kit.macleod@hutton.ac.uk. Funding is available for European applications, but non-European applicants who possess suitable self-funding are also encouraged to apply.