

Thursday 5th March 2009 7:15 for 7:45

Lecture Theatre, Department of Plant Sciences,  
Downing Site, Cambridge

## Mapping the spatial change of soil phosphorus in the northern Everglades

**Ben Marchant**  
Rothamsted Research

**Abstract:** In recent decades the Florida Everglades have been impacted by runoff from neighbouring agricultural areas. Nutrients – particularly phosphorus – within this runoff have caused a change to the predominant plant communities. Indigenous vegetation communities have been replaced by bulrushes. These bulrushes grow rapidly in the nutrient rich soil and block the sunlight required by the indigenous wildlife. Thus the biodiversity of the Everglades has been reduced. Attempts have been made to restore the Everglades ecosystem. The Everglades have been divided into a number of water conservation areas which are bounded by canals. Since the mid-1990s agricultural runoff has been diverted or treated. Thus the inputs of phosphorus have been decreased. Soil surveys have been conducted to determine whether this strategy has been effective at decreasing the amount of phosphorus available for plants. This talk is concerned with the analysis of soil surveys conducted in 1991 and 2003. Geostatistical methods are employed to map the change in the concentration of phosphorus in the soil between these dates. Conventional geostatistical methods assume that the variable of interest is second order stationary across the study region. However this assumption is not valid because the variation of soil phosphorus is larger adjacent to the bounding canals than in the interior of the conservation areas. Therefore a novel and more general geostatistical model is devised which permits different behaviour adjacent to the boundary than in the interior. This model is expressed as a linear mixed model, the parameters of which are fitted by residual maximum likelihood. One of these parameters describes the extent of the boundary region. The effectiveness of this model is confirmed via cross-validation and likelihood ratio tests. The resulting map of change shows that a front of soil phosphorus advanced from the boundary region into the interior of the conservation areas between 1991 and 2003. This front is not evident when conventional models are used because these models are dominated by the variation in the boundary region. Further soil surveys are being conducted to determine whether this front continued to advance after 2003 when the restoration efforts were fully implemented. Based upon the novel geostatistical model the sites at which soil phosphorus is to be measured have been optimized using an algorithm known as spatial simulated annealing. The first phase of this optimized survey was conducted in December 2008.

**Speaker:** Ben Marchant is a senior post-doctoral scientist at Rothamsted Research, Harpenden, UK. His current research is concerned with the development and application of geostatistical methods for the analysis of spatial soil data. He trained as a mathematical modeller and received his D. Phil. from the University of Oxford in 2000 having developed a model describing the invasion of malignant tumours. From Oxford he moved to Silsoe Research Institute before joining Rothamsted Research in 2004. He has developed methods for analyzing non-stationary, contaminated and coregionalized data and for the optimization of spatial surveys. Dr Marchant has applied these methods to a diverse range of problems such as the spatial monitoring of soil phosphorus in the Florida Everglades and the identification of sites contaminated with heavy metals around Swansea.

**Directions:** The Department of Plant Sciences is located on the Downing site situated between Downing Street and Tennis Court Road (see map below). Go through the second door you come to in the building immediately on your left as you enter from Tennis Court Road. Once inside the building follow the arrows. Refreshments will be served in the first floor kitchen. It is not possible to park on the Downing site in the evening. The nearest car park is at Lion Yard. Arrivals after 7:45pm can gain admittance by contacting the secretary on 07761769436.

**Provisional Next Meetings:**

2nd April – Phil Dawid (Statistical Laboratory) on ‘Statistics and the Law’ .

7th May – Jenni Barclay (UEA).

**Supper:** Some members eat regularly in the University Centre before each meeting at 5-45pm. Feel free to join them.

**Subscriptions:** of 1 pound are now due for attending the 2008-2009 session.

**Secretary:** Peter Watson, MRC Cognition and Brain Sciences Unit, 15 Chaucer Road, Cambridge CB2 7EF;  
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