Remote Sensing for Continuous Cover Forestry.

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The conversion of British even-aged conifer plantations to Continuous Cover Forestry (a sustainable form of forest management that creates more heterogeneous stands) requires the redefinition of forest structure to include an evaluation of the spatial distribution of parameters, such as species, height and density. This study aims to quantify horizontal aspects of forest structure to allow comparison of different forest stands and the detection of changes over time.

Through the use of remotely sensed data (in particular, high spatial resolution optical satellite and airborne systems), spatial structure could be monitored over a wider area and at a more frequent time scale than with ground surveys alone. Horizontal spatial structure is usually described by the spatial arrangement of individual trees, but this information can be costly and time consuming to gather by field work and difficult to extract from remote sensing data. This study therefore takes an alternative approach of attempting to describe structure based on the distribution of canopy cover and canopy openings within a stand. This method has the advantage that such factors also play a role in predicting understorey light levels that can influence regeneration.

A number of key questions will be explored:

- Can canopy cover and the spatial distribution of canopy openings be accurately determined from optical remotely sensed data?
- Does the use of hyperspectral data allow better discrimination of canopy openings and understorey vegetation types and allow the identification of areas of natural regeneration?
- Can the distribution of canopy openings be used to derive a useful index of spatial forest structure that can describe the range of structures resulting from transformation of plantation forest stands to CCF management?
- When combined with vertical forest structure parameters, can the distribution of canopy gaps be used to predict understorey light levels (which may be a limiting factor in the occurrence of natural regeneration) as measured in the field?

In order to address these questions, an existing radiative transfer model is being used to simulate imagery based on field measurements for Welsh spruce forest. The accuracy of these simulations will be assessed by comparison to real AISA Eagle and Hawk hyperspectral data. Image simulation allows the influence of view and illumination angle effects and spectral and spatial resolution to be investigated as well as consideration of a greater range of forest structures (that may result from CCF in the future) than will be available in real imagery.

Techniques to identify canopy openings will then be applied to real optical imagery to assess the accuracy of the methods in comparison with field data on canopy density and gap distribution and gap delineations based on LiDAR data. High spatial resolution hyperspectral Eagle and Hawk data has been acquired (by NERC ARSF) for areas of Clocaenog and Glasfynydd forests in Wales where detailed ground information is being collected. Satellite imagery (QuickBird) and CASI airborne data has also been acquired for an area of the Queen Elizabeth II Forest Park in Western Scotland.