

# CLIMADAPT

## The use of Ecological Site Classification in adapting forests and their management to climate change

### PROJECT TEAM

Duncan Ray, Forest Research, UK\*  
 Georgios Xenakis, Forest Research, UK  
 Dr Kevin Black, FERS Ltd  
 Andrew Mason, eenviron-IT, UK  
 Prof. Maarten Nieuwenhuis, University College Dublin  
 Armand Tenet, University College Dublin  
 Dr Brian Tobin, University College Dublin

\* Email: [duncan.ray@forestry.gsi.gov.uk](mailto:duncan.ray@forestry.gsi.gov.uk)

### BACKGROUND

The project was initiated to guide forest species selection in Ireland. Climate change will impact on species selection and CLIMADAPT will provide guidance on suitability for climate scenario projections.

### OBJECTIVES

- Design a forest classification system for tree species selection and yield potential in Ireland, based on the interpretation of six biophysical factors.
- Develop a knowledge base of climate change adaptation strategies, including species choice and silvicultural modifications from an interpretation of the likelihood of abiotic and biotic impacts resulting from climate change.
- Validate knowledge-based yield models for Sitka spruce and other species if data availability permits.
- Develop a web-based combined stand-scale and spatial-scale decision support tool.

### PROGRESS

*Data preparation:* Spatial data representing the six biophysical variables have been completed for Ireland. In addition, spatial AT and MD values, based on future climate change projections for the IPCC A2 and B1 emissions scenarios, have been calculated for Ireland. These data will form the basis of assessing tree species suitability, and will provide an initial assessment of likely climate impacts and adaptation strategies for particular species-site type climate impact combinations.

*Model specification:* Knowledge-based suitability models have been described for 21 tree species. Models have used information from a Delphi expert group meeting in Dublin, in 2007, and from the results of an expert group discussion of tree species suitability for Great Britain in

2001. The models describe the suitability of a species in relation to each of the six biophysical variables. Suitability is defined by the most limiting factor for a particular site type.

*Validation:* Further validation of the knowledge-based yield predictions for Sitka spruce using Bayesian and Monte Carlo methods has revealed an additional model suitable for predicting the yield of Sitka spruce. Validation has been difficult due to the unknown impacts associated with fertilisation of many of the sites used for training and validating the model. The model is being written up for publication.

*Web-application:* The core model of web application has been completed and tested. This uses Java script and AJAX (asynchronous Java and xml) technologies, and links to Google™ maps and satellite imagery. The spatial data analysis module has now been completed, The large number of spatial files used by the application are currently being compiled and made ready for deployment.

*User interface:* The user interface has been completed and is ready for testing. The spatial module of the interface allows the user to visualise site factors that limit tree species suitability and growth. Figure 1 shows the soil fertility layer superimposed on a Google™ map backdrop. The interface also allows users to visualize climatic factors for the baseline period 1961-1990, and for future climate change projections for two IPCC emissions scenarios. The suitability and yield predicted under those conditions is also shown spatially by the CLIMADAPT tool.

*PhD study:* A pilot study (part of a PhD at UCD) to assess moisture stress in several tree species across a west-east transect through Ireland and the UK, has provided very interesting results. Multivariate statistical analyses showed that the density of individual tree rings increased with the warmth index - accumulated temperature (Figure 2), and the magnitude of radial growth was reduced in summers with a higher moisture deficit (Figure 2).

*Next steps:* Cores from Sitka spruce, Douglas fir and Scots pine will be taken from sample trees in permanent sample plots in Ireland, Wales and southern England. The choice of sites forms an increasing moisture deficit gradient from west to east, but with similar climatic warmth and soil conditions. This will allow us to test if the moisture deficit limits tree growth at sites, and how the effect varies between species that have a different moisture stress tolerance.

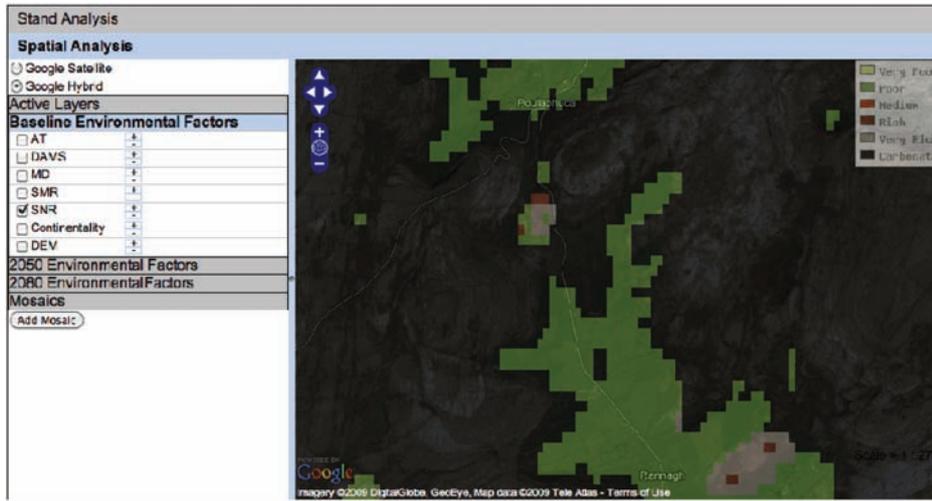


Figure 1: Visualisation of soil fertility rating of a potential afforestation site derived from the national soil map for Ireland, superimposed on a Google hybrid backdrop (composite of satellite imagery and mapping).

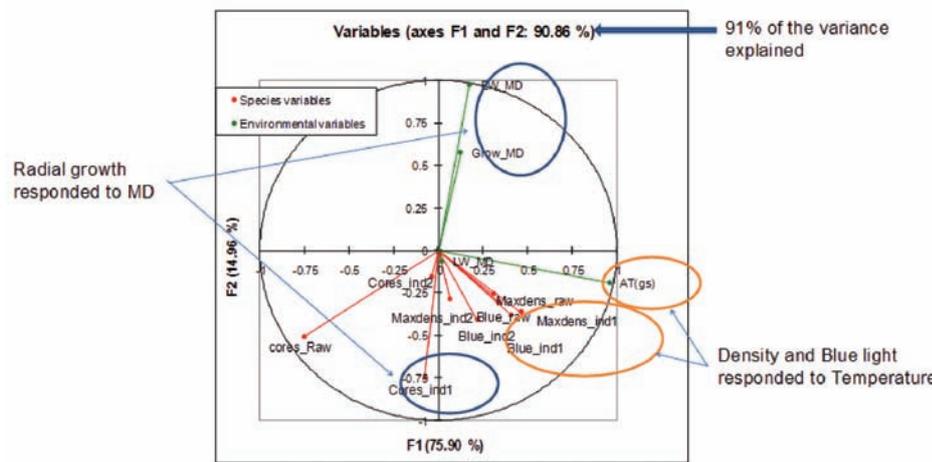


Figure 2: Canonical correlation analysis (CCA) was used to identify the major gradients of species-environment variation across the plots. Radial growth was inversely correlated to moisture deficit, whereas wood density was directly correlated with accumulated temperature.

It is hoped that the study will show whether an improved moisture stress resistance in terms of growth impacts can be useful in choosing better suited species for climate change adaptation on forest sites of increasing drought risk.

**ACTIVITIES PLANNED**

- Test the application with the user group in Ireland.
- Hold workshops in Ireland to demonstrate the CLIMADAPT web application.

**OUTPUTS**

*Papers*

Ray, D., Xenakis, G., Semmler, T. and Black, K. 2008. *The impact of climate change on forests in Ireland and some options for adaptation*. In: E. Hendrick and K.G. Black (Eds), *Forests, Carbon and Climate Change - Local and International Perspectives*. COFORD, Dublin.

Ray, D., Xenakis, G., Tene, A. and Black, K. (accepted). *Developing a site classification system to assess the impact of climate change on species selection in Ireland*. *Journal of Irish Forestry*.

Black, K, Xenakis, G, and Ray, D. (in preparation) *Climate Change Impacts and Adaptive Strategies*. *Journal of Irish Forestry*.

Xenakis, G., Black, K., and Ray, D. (in preparation) *Bayesian calibration of yield class predictions for CLIMADAPT*. *Forestry*.

*Presentations*

- Site Classification Conference, Tullamore, Ireland, June 2008.
- International Conference on climate change, Nancy, France (Poster).
- Dendro-ecology conference, Birmensdorf, Switzerland (Poster).
- Association of Tree-Ring Research (ATR) Annual Meeting, Slovenia.
- EuroDendro2009 Annual Meeting, Mallorca (Poster).
- Expected Climate change impact for Environment and Silviculture (ECHOES), Thessaloniki.