Frontline EXPRESS
Canadian Forest Service, Great Lakes Forestry Centre

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Seedwhere: a Computer Tool for Tree Planting and Ecological Restoration

Drawing by:
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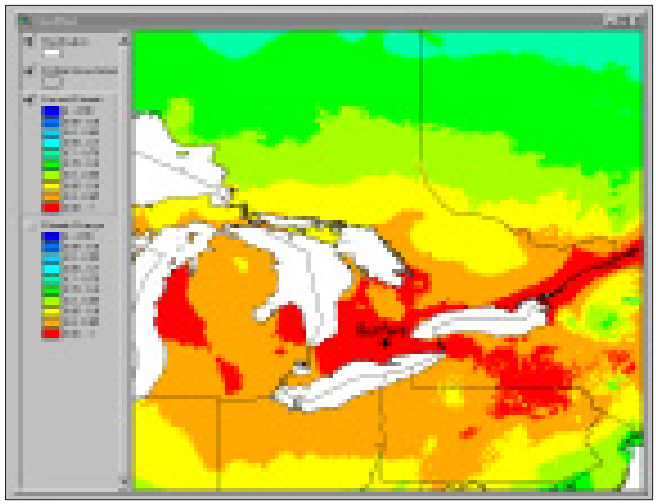
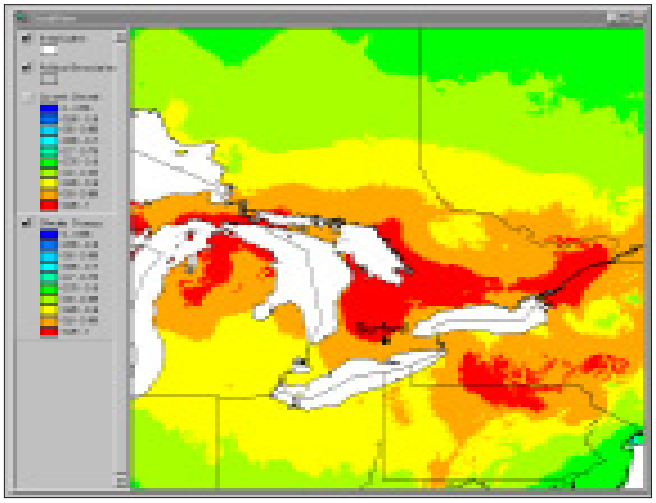
INTRODUCTION

It is generally recognized that plants are genetically adapted to the prevailing climate. Planting stock is often moved across environmental gradients with little knowledge of the ecological risks. For long-lived species (e.g., forest trees) this introduces risks of increased mortality, lowered potential growth rates, and increased susceptibility to insects and diseases. Thus mistakes in seed transfer in forest regeneration programs can be costly. *Seedwhere* is a Geographic Information System (GIS) tool designed to assist in making nursery stock and seed transfer decisions for forest regeneration activities over environmental gradients. Given a suitable database, *Seedwhere* maps out the similarity of a chosen location to the rest of the region of interest. The location could be a potential seed collection or planting area.



The similarity of climate of the Great Lakes area to the climate for Burford, Ontario (using a selection of 1961-1990 climate grids).

The program is based on the underlying premise that populations of plant species can become genetically differentiated through adaptations to local environmental conditions, of which climate is a major component. Forest regeneration can therefore be at risk if the environmental conditions where seed is used are dissimilar from the conditions at the point of its origin. Biologically sound forestry practices suggest that tree species should be planted in conditions suited to their genetically inherited environmental responses. This means trying to match species gene complexes to their optimum soil and climatic conditions.



Above, the climate from Burford (1961-1990) is being indexed according to similarity to an estimation of the Great Lakes climate conditions from 2010 to 2039.

METHODOLOGY

Seedwhere provides a quantitative approach to the task of ensuring seed and planting stock are only used at locations that are similar. Currently, *Seedwhere* uses bioclimatic parameters. They are defined using time periods that relate to the seasonal cycle of trees in temperate and boreal ecosystems. The climatic similarity is calculated using the Gower metric. This metric summarizes the differences between sets of values at two points as an index between 0 and 1, where 0 is most dissimilar and 1 is exactly the same. Thus, when the climate at a location is compared to the gridded estimates of climate, the similarity is calculated and mapped.

THE PROGRAM

Seedwhere is generic in the sense that it can be applied in any region where the necessary spatial database has been developed. In our application, the calculation of mathematical climate surfaces and grids were based on interpolation of long-term climatic means at a network of stations using the method of Hutchinson (Hutchinson 1995). The gridded climatic data can be entered into GIS and combined with other environmental, cartographic, or land-use data. The program is currently implemented as an ArcView application (ESRI©). Users must have the Spatial Analyst component of ArcView. In the future we hope to have the program implemented as an internet application.

MANAGEMENT IMPLICATIONS

Seedwhere is no panacea but it does provide a quick and quantitative approach to comparing a large number of climatic attributes across a large region. It can be used in the absence of taxa-specific biological response data to assist decision makers and resource managers make more informed decisions about where to collect seed and how far it can be moved. In principle, the program could also make use of other types of continuous environmental data that can be generated into a regular grid format. The result would be a map indicating those landscapes that have relatively similar conditions.

SOURCES OF RELEVANT INFORMATION

Hutchinson, M.F. 1995. Interpolating mean rainfall using thin plate smoothing splines. Int. J. GIS, 9:385-403.

McKenney, D.W.; Mackey, B.G.; and Dennis Joyce, D. 1998. Seedwhere: a Computer Tool to Support Seed Transfer and Ecological Restoration Decisions. Environmental Modelling & Software 14: 589-595.

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