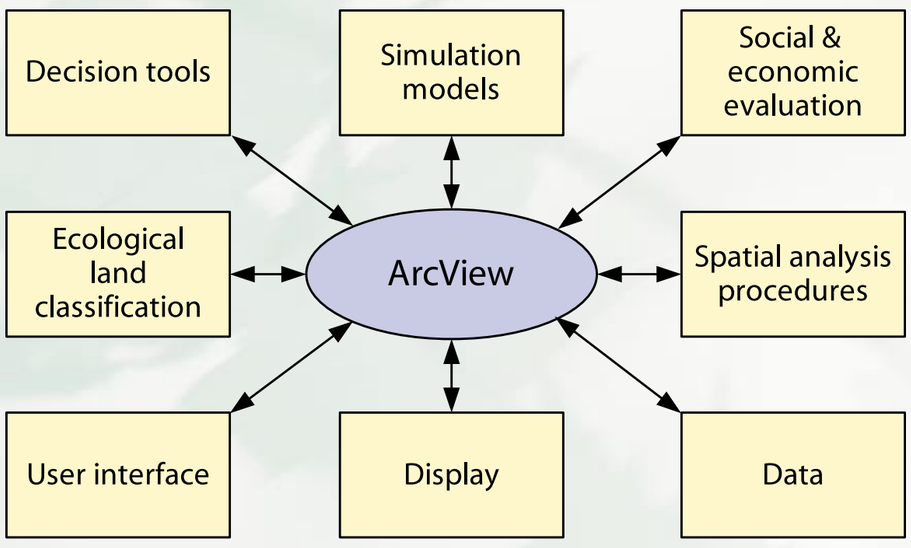
A Dynamic Decision Support System for Adaptive Management

Introduction

Forest resource management is an application of combined natural science (such as timber supply prediction), social science (such as social and environmental considerations), and economics (such as cost-benefit analysis-based decision-making). Adaptive management (AM) is one of the approaches that could be applied to forest management practice; it emphasizes the ever changing properties of ecosystem dynamics and acknowledges and accommodates uncertainties. Decision support systems (DSS) for implementing AM will require the assessment of current and future forest conditions; thus a conceptual dynamic decision support system (DDSS) was proposed. The objective of our study was to develop a DDSS for implementing the AM in forest resource management practice.



Conceptual framework of DDSS

Methods

The key component of this DDSS is the inclusion of simulation models that will enable forest managers to make decisions based on not only current forest conditions but also possible future forest conditions. This sets this DDSS apart from other existing DSS.

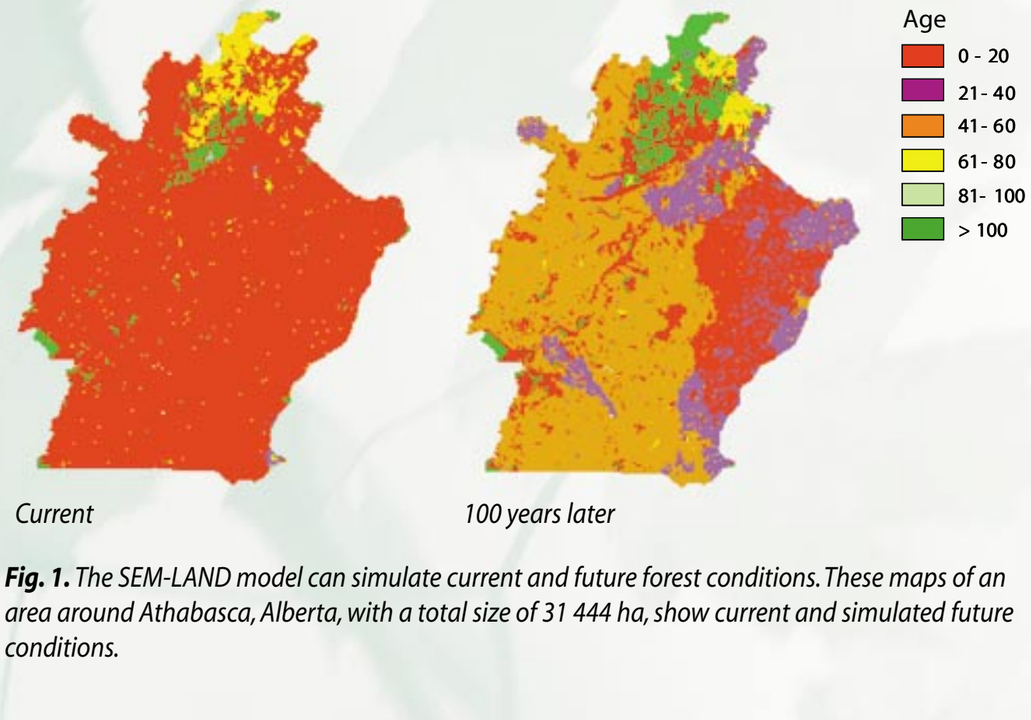
The spatial analysis procedures supply a linkage to the FRAGSTATS software package to calculate various matrices at both landscape and stand scales. The ecological land classification makes a map layer available to characterize landscape structure. Together with decision tools, the simulation models and social and economic evaluation provide essential evaluations to assist in decision making in forest management.

All the components are linked through geographic information system software, ArcView, which enables the user to change the parameters and variables.

Results

A spatially explicit model for landscape dynamics (SEM-LAND) was developed to provide assessment of current and future forest conditions. The SEM-LAND model simulates current forest inventory into future inventory according to available quantitative relationships of interactions among forest growth, fire disturbance process, landscape topography, and climate variables across time and space. The model can also simulate fire suppression processes and evaluate their impact on forest landscape. Figure 2 shows the current and simulated future forest conditions for an area in northern Alberta.

The user interface controls the model parameter values and locations of input and output data. It can also modify the input climate scenarios and fire ignition sources (Figures 2 and 3).



Current *100 years later*

Fig. 1. *The SEM-LAND model can simulate current and future forest conditions. These maps of an area around Athabasca, Alberta, with a total size of 31 444 ha, show current and simulated future conditions.*

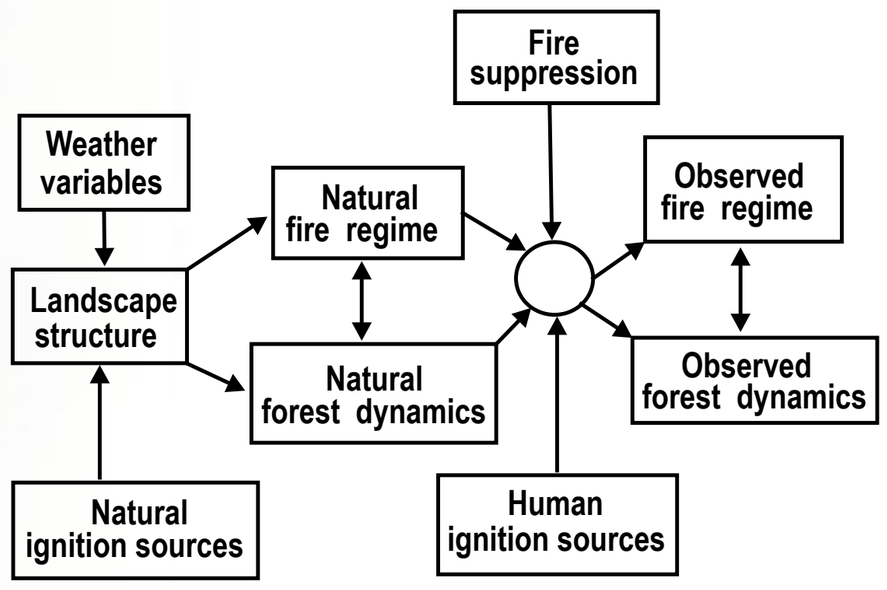


Fig. 2. *Conceptual framework of SEMI-LAND simulation.*

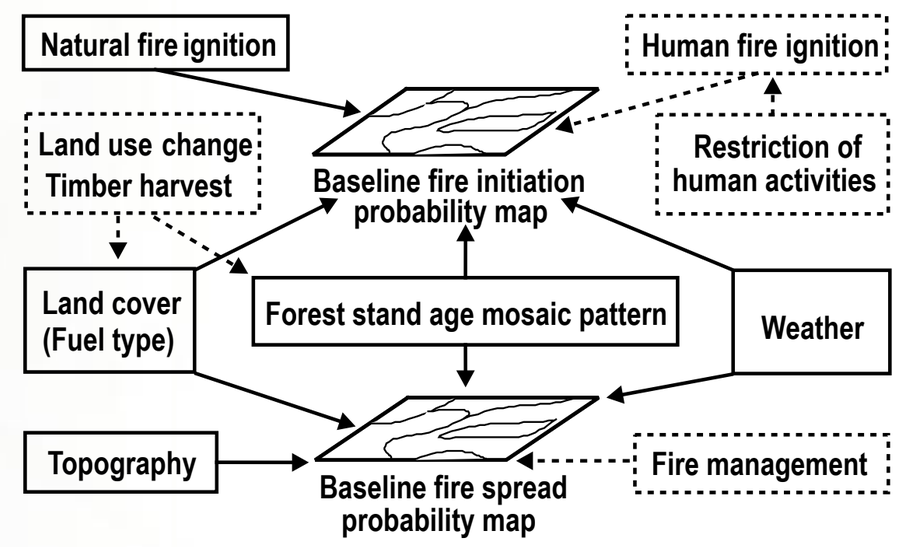


Fig. 3. *Fire process simulated in SEMI-LAND.*

Discussion

Our study suggests the SEM-LAND model was able to simulate forest landscape dynamics subject to fire disturbance regimes with and without fire suppression actions. The proposed DDSS conceptual framework is feasible for use and implementation for action as an AM tool.

Adaptive management specialists will benefit from knowing how forest landscape conditions could be changed over time and space and what are the effects of various management options. The capabilities of SEM-LAND in predicting landscape dynamics under different environmental scenarios will determine the effectiveness of DDSS. This capability has been tested and documented in a number of case studies published in scientific journals.

The on-going incorporation of social and economic evaluation will make the DDSS complete and ready to use in AM practices.

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