A web-based application to simulate alternatives for sustainable forest management: SIMANFOR

F. Bravo1, 2*, F. Rodriguez3, C. Ordoñez1, 2
1 Sustainable Forest Management Research Institute University of Valladolid-INIA, Avda de Madrid 44, 3004 Palencia, Spain
2 Departamento de Producción Vegetal y Recursos Forestales, Universidad de Valladolid (Campus de Palencia), Spain
3 Centro de Servicios y Promoción Forestal y de su Industria de Castilla y León (CESEFOR), Polígono Industrial “Las Casas”, Calle C, Parcela 4. 42005 Soria, Soria, Spain

Abstract

Growth and yield models at different scales are useful tools for forest stakeholders. Adequate simulation of forest stand conditions after different silvicultural scenarios allows stakeholders to adopt appropriate actions to maintain forest integrity while forest products and services are obtained to benefit society as a whole. SIMANFOR is a platform to simulate sustainable forest management alternatives, integrating different modules to manage forest inventories, simulate and project stand conditions and maintain systems security and integrity. SIMANFOR output is compatible with an Office environment (Microsoft or Open), allowing users to exchange data and files between SIMANFOR and their own software. New developments are being planned under a web 2.0 environment to take advantage of user input to improve SIMANFOR in the future.

Key words: simulation; forestry; models; growth; yield.

Introduction

During the last decade, different forest growth and yield models have been developed. Models currently abound for diverse forest ecosystem types around the world. These models are usually implemented on software that allows end-users to simulate different management alternatives. Among the most used, PROGNOSIS (Wykoff et al., 1982), ORGANON (Hester et al., 1989; Hann et al., 1995), FVS (Dixon, 2002), CAPSIS (Coligny et al., 2004), TREEGROSS (Nagel, 2005) and SExi-FS (Harja et al., 2006) should be stressed because of their relevance at the international level. However, there are no systems based on the use of the web and the web 2.0 concept. Using this concept will help to create a user community to cooperate in using and developing simulations models. Models implemented on a software platform can be used for different objectives such as (1)
SIMANFOR: web-based application to simulate forest management

SIMANFOR access

SIMANFOR can be used world-wide from any computer with an Internet connection by visiting the web page www.simanfor.org, where the user (Fig. 2) can log into the simulator. The system is hosted in a server located at the “Escuela Técnica Superior de Ingenierías Agrarias”, University of Valladolid (Palencia, Spain). A valid user name and password is required to log into SIMANFOR. The access page provides information on conditions of use and how to request user permission.

User types

Different user types can log into SIMANFOR (foresters, researchers, students, etc.) with the following roles: administrator, modeler and user. Administrators manage the system and provide privileges to the other user types. Modelers can upload and develop models, while users can simulate forest management scenarios by projecting growth and yield models previously implemented in the system. Model use, as well as the system itself, is freely available to the whole community. Modelers are responsible for model accuracy and proper performance and must provide adequate documentation to understand and use the models.

Users can upload, modify and download data sets and develop forest management scenarios, which can be stored and retrieved to improve future system performance by repeating past searches or scenarios already tested. Users are responsible for the adequacy and accuracy of their management scenarios.

Starting with SIMANFOR

Once the user has logged into SIMANFOR, a welcome page appears (Fig. 3). This page allows users, depending on their privileges, to access the different system functionalities: inventory management, model uploads, scenario generation and user management.

Help system

SIMANFOR includes a help system (Fig. 3) with a user manual and a manual designed specifically for modelers that insert a template to facilitate model programming. Additionally, support can be re-
quested by e-mail (simanfor@pvs.uva.es) while a blog (www.simanfor.es/blog) provides solutions to the users’ main problems.

**Forest Inventories in SIMANFOR**

Forest inventories can be uploaded for personal use, but public data (such as National Forest Inventories) can be uploaded as well. When these inventories are uploaded by an administrator, they become accessible to all users. A data template is included in SIMANFOR to facilitate data exchange and system use. Once the inventory is uploaded to SIMANFOR, users can select a data subset by choosing data according to different criteria (species, location, stand conditions, etc.).

**Implementing models in SIMANFOR**

A specific module to program growth and yield models is included in SIMANFOR. To facilitate model
SIMANFOR: web-based application to simulate forest management

programming by users, a program template is included. The programming language for including models in the system is C#. Currently, two individual tree distance-independent model for **Pinus pinaster** Ait. (Lizarralde et al., 2010a) and for **Pinus sylvestris** L. (Lizarralde et al., 2010b) are included in the system. Each model in SIMANFOR must be adequately documented by the modelers, including information on (1) model name, (2) model description including species and target area, (3) model type including target stand type, data range, model validation and model structure, (4) recommended application, (5) credits (authorship and citation) and (6) contact details.

**Scenario simulation in SIMANFOR**

By using the models included in the system and the inventories uploaded to SIMANFOR, users can simulate different silvicultural scenarios. Each model projection or silvicultural prescription (including no intervention) generates a node. For each node, SIMANFOR provides information on stand conditions at the appropriate level (tree, size class or stand). Users can redesign their silvicultural prescriptions by starting a new simulation from a specific node obtained in a previously-simulated scenario.

**SIMANFOR conditions of use**

SIMANFOR use is free, but users must accept some conditions established by the system administrators. The main conditions are: (1) SIMANFOR developers reserve for themselves the right to actualize the system and to translate to other languages; (2) SIMANFOR use is open to the forestry community (foresters, scientists, students, etc.) and can be used for research, teaching and developing new silvicultural scenarios; (3) SIMANFOR use must be acknowledged by the proper citation (a credit link is included in the system to facilitate this) and (4) users must guarantee the reliability of the results provided by SIMANFOR.

Conditions of use are developed to maintain system functionality and SIMANFOR use as a service to the forestry community. Feedback is welcomed to develop a web 2.0 environment.

**Conclusions and further development**

This paper presents SIMANFOR, which is freely available from www.simanfor.org. SIMANFOR is under permanent development and three new features will be included in the near future: (1) new models programmed, (2) improvement of the user-friendly interface and (3) translation to other languages, starting with English and followed by Portuguese and French. SIMANFOR is open to incorporating models from different ecosystems around the world and is supported by a server that can be scaled up to respond to future demands.

**Acknowledgments**

SIMANFOR has been funded by the Spanish Ministries of “Medio Ambiente, Rural y Marino” and of “Ciencia y Tecnología” and the European FEDER funds through the projects TRT2006-00045-C02, SELVIRED Network AGL2008-0374-E/FOR, PSS-310000-2008-3 and -5 and PSS-310000-2009-3 and -5) and the University of Valladolid. SIMANFOR also benefited from the collaboration of different modelers and end users (a complete list is provided in www.simanfor.org). Medianet Software (www.medianet.es) has been programming responsible since the SIMANFOR project starts.

**References**

Coligny F De, Ancelin P, Cornu G, Courbaud B, Dreyfus P, Goreaud F, Gourlet-Fleury S, Meredieu C, Orazio C, Saint-André L. 2004. Capsis: Computer-Aided Projection for Strategies In Silviculture: Open architecture for a shared forest-modelling platform. In Proceedings of the IUFRO Working Party S5.01-04 conference (September 2002), Harrison, British Columbia, Canada, pp. 371-380.

Dixon GE comp. 2002. Essential FVS: A User’s Guide to the Forest Vegetation Simulator. Internal Rep. Fort Collins, CO: U. S. Department of Agriculture, Forest Service, Forest Management Service Center. 193 pp.

Hann DW, Hester AS, Olsen CL. 1995. ORGANON user’s manual: Edition 5.0. Department of Forest Resources, Oregon State University, Corvallis, Oregon. 127 pp.

Harja D, Vincent G, Joshi L. 2006. SExI-FS — a tree growth simulation model to explore mixed stand designs and their production potential. 2nd International Conference on Sustainable Sloping Lands and Watershed Management 2006. Luang Prabang, Lao PDR 12-15 December 2006.
Hester AS, Hann DW, Larsen DR. 1989. ORGANON: South-west Oregon growth and yield model user manual, Version 2.0. Oregon State. University, Forest Research Laboratory, Corvallis, Oregon. 59 pp.

Lizarralde I, Ordóñez AC, Bravo-Oviedo A, Bravo F. 2010a. IBERO\textsuperscript{PT}: Modelo de dinámica de rodales de \textit{Pinus pinea} L. en el sistema ibérico meridional (available online at www.simanfor.org).

Lizarralde I, Ordóñez AC, Bravo-Oviedo A, Bravo F. 2010b. IBERO\textsuperscript{PS}: Modelo de dinámica de rodales de \textit{Pinus sylvestris} L. en el Sistema Central y el Sistema Ibérico en Castilla y León (available online at www.simanfor.org).

Nagel J. 2005. TreeGrOSS eine Java basierte Softwarekomponente zur Waldwachstumsmodellierung für Forschung. Lehre und Praxis. Deutscher Verband Forstlicher Forschungsanstalten — Sektion Forstliche Biometrie und Informatik, 15. Tagung Freiburg 9-10. Oktober 2003, 33-37.

Wykoff WR, Crookston NL, Stage AR. 1982. User’s guide to the stand prognosis model. USDA For. Serv., GTR-INT-133. 112 pp.