Assessing biomass and wood-productivity under Climate Change at national scale : the new forestry component of MOSAICC

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Introduction to MOSAICC

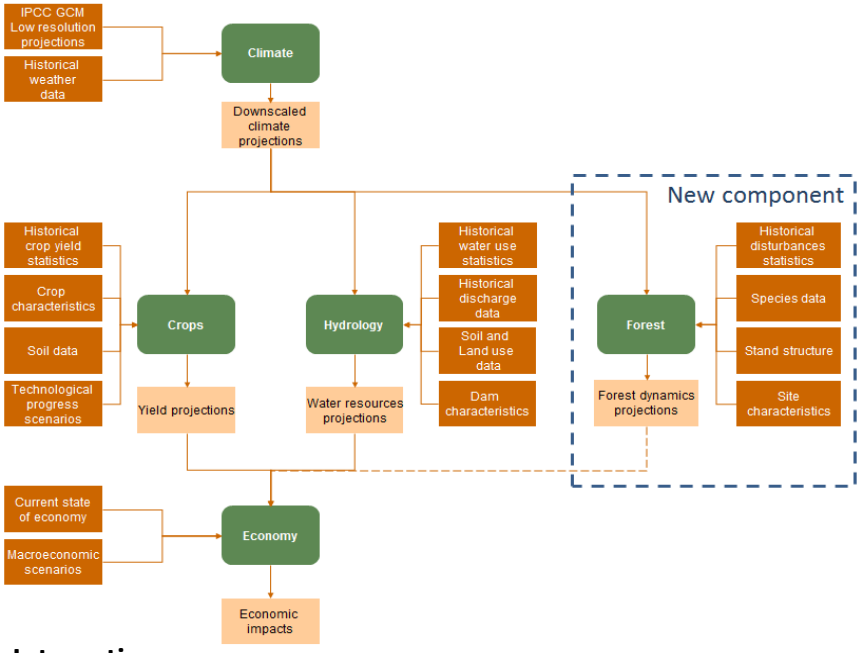
Information on potential impacts of Climate Change is key in the elaboration of national adaptation plans and policies. Given the large uncertainties about the future of the climate and the response of human systems, model simulations offer interesting possibilities to test scenarios, explore potential impacts and understand how different processes interact with each other.

In the framework of the joint EU-FAO programme on improving global governance for hunger reduction, FAO has developed an integrated system to carry out Climate Change impact assessments at national level. This server-based system called MOSAICC (Modelling System for Agricultural Impacts of Climate Change) has been built in association with various scientific institutions in Europe (universities, research centers) and combines climate data downscaling, hydrological, crop yield and economic models.

Forestry component

Climate Change poses a great challenge to agricultural but also to forest production systems, potentially threatening those who particularly depend on local food and wood production for their livelihood.

A new Forestry component of MOSAICC (fig.) is being developed in accordance with the interests at national and regional level concerning the impacts of Climate Change on biomass and wood productivity.



Integration

Models and utilities are integrated within a software architecture based on a data typology. About 60 data types have been defined to manage the data exchange between the system and the users and to link the data with the models. A set of web interfaces has been developed to manage data, simulations and user accounts. The system is installed on a server.

Objectives

MOSAICC Forestry component is a capacity development tool for assessing Climate Change impacts on forest at national level by national experts (ministries, universities, research institutions) using own data in a perspective of decision support

MOSAICC is designed for specialized institutions and delivered with training program on the system administration and the utilization of the models.

Discussion

The integration of models and utilities has several advantages such as:

Remote access through web interfaces opens opportunities for participatory approach. Users do not need to install any software on their own computer since the system is accessed through usual web browsers.

The time spent on carrying out experiments is reduced thanks to easy data exchange, low computing time and automatic data formatting and unit conversion

Data can be tracked down the flow. Experiments replication and comparison is easy.

Once installed, the system requires maintenance but no licensing cost.

The utilization of the system however requires particular attention on the study design (consistent use of the different models, in accordance with their own characteristics) as well as on the calibration, the validation and the error propagation.

Fig.: Overview of the system with the 5 disciplines, the inputs (dark orange boxes) and the generated data (light orange boxes)

FAO Modelling System for Agricultural Impacts of Climate Change

Model

The forest model that will be integrated in MOSAICC is called LANDIS-II and is a forest landscape simulation model. It simulates how ecological processes including succession, seed dispersal, disturbances, and climate change affect a forested landscape over time. The LANDIS-II model is linked with the new PnET-II Succession Extension, a process-based model. It uses direct cause-and-effect relationships to link forest dynamics with fundamental drivers such as climate drivers (temperature, precipitation and CO2 concentration) and can produce robust predictions under novel conditions. Low resolution climate data from the statistical downscaling portal of MOSAICC serves as primary input for the whole model structure.

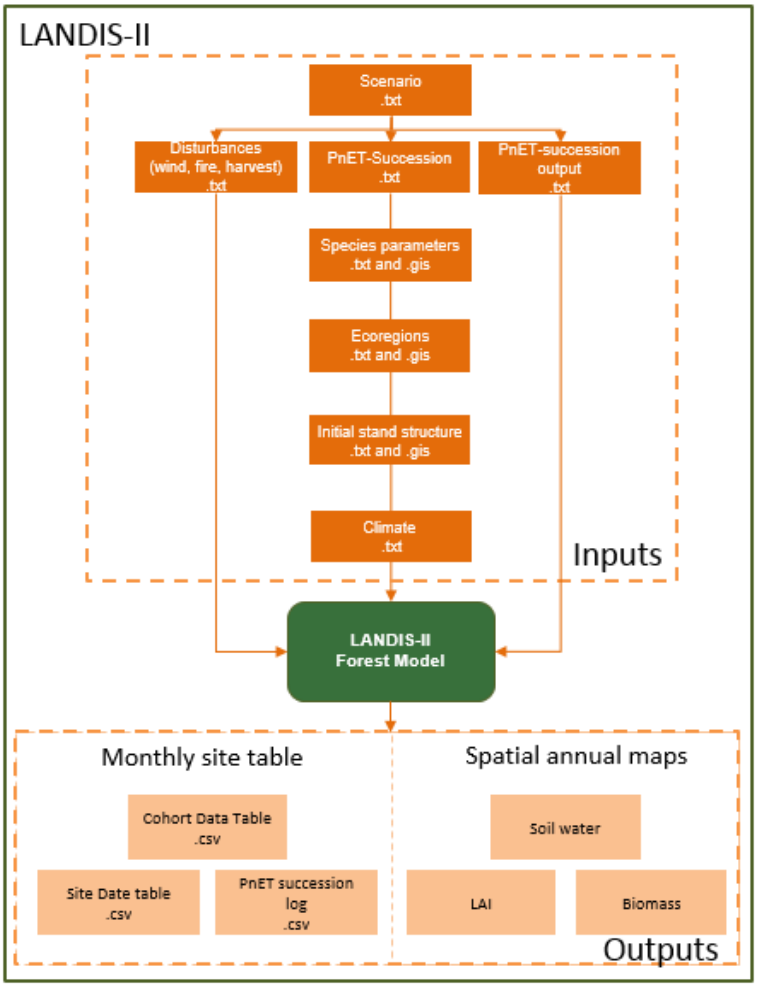


Fig.: Overview of the LANDIS-II forest model, the inputs (dark orange boxes) and the generated data (light orange boxes)

Inputs

The inputs needed in this model are:

•**Climate data**: Temperature, PAR, Precipitation and CO2 concentration by month.

•**Species parameters data**: Among others: Species Name; Longevity; Sexual maturity; Shade tolerance; Fire tolerance; Seeding distance; Resprouting age; Foliar characteristics (Nitrogen content, turnover, photosynthesis …); Wilting point; Water use efficiency; Root-stem ratio; Roots turnover.

•**Ecoregions data**: a map of the different ecoregions of the area studied created from the layers of soils, precipitation and temperature.

•**Initial communities' data**: List of species present in the study area grouped into cohorts (by span age).

Outputs

The outputs are of two types:

•**Spatial annual output (maps)**: Set of maps by species of the evolution in time of biomass, LAI, Litter, soil water…

•**Monthly output (tables)**:

- Cohort Data - Among others: Cohort net photosynthesis, Cohort mean WUE, Biomass of the cohort foliage/root/wood pool.
- Site Data - Among others: Monthly transpiration, Net photosynthesis for all species combined, Total aboveground woody/root/foliage biomass of all species.

The users will have the possibility to add disturbances as fire and wind, or even harvest (in the case harvested forests) to the model, based on historical data.

Uses and Application

This new component will be a useful tool to :
-Assess wood productivity and its influence on economy.
-Assess biomass in forest regarding the UNREDD Programme and the voluntary carbon market.
-Asses the impacts of disturbances as fire or wind on wood production and on economy.
-Decision support tool for policy makers in accordance with Climate Change previsions.

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