Mapping Functional-Structural Models to Fields of Neighborhood

U. Grüters, H. Schmidt & U. Berger

Dresden University of Technology (TU Dresden), Institute of Forest Growth and Computer Sciences, Postfach 1117, D-01735 Tharandt, Germany. E-mail: Uwe.Grueters@forst.tu-dresden.de

Abstract

Morphological plasticity of mangroves is unrivaled within the plant kingdom. After forest degradation due to changes in hydrology, mangrove trees recolonising such areas often tend to exhibit a shrub-like architecture. Subsequent tree generations, however, may shift back to tree architecture thereby re-establishing the functionality of a forest.
Due to its complex nature this morphological plasticity as well as the consequences for forest regeneration are best studied using simulation models. However, since current mangrove models are not taking into account morphological plasticity, we propose here a functional-structural modelling (FSM) approach, which has proven successful at incorporating structural detail on other species.
We have adopted major routines from the Universal Individual-Based Model (UIBM), which was originally developed for constructing plant species from trait databases. Due to a lack of a traitbase for mangroves, we chose the species with the best trait information available, i.e. *Rhizophora apiculata*, as template species.
The developed FSM simulates the annual growth of a pair of *Rhizophora apiculata* trees at competitive distance. The aboveground structure is simulated using phytomers comprised of an internode, foliage and a set of meristems. At the whole organ level carbon partitioning is driven by allometric relationships, whereas at lower level partitioning is dependent on apical dominance and branching order. Incorporated functions include: photosynthesis, respiration and organ ageing/death.
Due to the level of physiological processes described by the model, FSM is computationally expensive and not well suited for simulation of larger numbers of trees. FSM results for varying tree distances are therefore used to parameterize the field of neighborhood underlying the well-known KiWi mangrove forest model. In the context of this modelling effort, but also because of the ongoing interest in the FON approach in general, we have made the KiWi model open-source (kiwi.sourceforge.net).
Mapping FSM to FON allows us to scale up effects of morphological plasticity to the forest stand. Once a mangrove traitbase is available FSM-FON mapping can develop into a general approach for modelling multi-species mangrove forests.

Keywords
morphological plasticity, functional-structural model, FON, KiWi