Functional-structural plant modelling in crop production: adding a dimension

J. Vos
L.F.M. Marcelis
J.B. Evers

Abstract

The role acquired by modelling in plant sciences includes integration of knowledge, exploration of the behaviour of the plant system beyond the range of conditions covered experimentally and decision support. The purpose of the model determines its structure. Initially process-based models (PBM) were developed separately from structural (or: architectural or morphological) plant models (SPM). Combining PBMs and SPM into functional-structural plant models (FSPM) or virtual plants has become feasible. This adds a dimension to classical crop growth modelling. FSPM are particularly suited to analyse problems in which the spatial structure of the system is an essential factor contributing to the explanation of the behaviour of the system of study. Examples include intra-specific and interspecific competition phenomena, analyses of mechanisms of physiological response to environmental signals that affect allocation of carbon and nitrogen in the plant, and exploration of alternative, manipulated plant architectures on production of fruits or flowers. Good modelling practice involves different steps in model development. These steps are discussed and include the conceptual modelling, data collection, model implementation, model verification and evaluation, sensitivity analysis and scenario studies.
Functional-structural plant models (FSPMs) describe in quantitative terms the development over time of the three-dimensional (3D) structure of plants as governed by physiological processes and affected by environmental factors. FSPMs are particularly suited to analyse problems in which the spatial structure of the plant or its canopy is an essential factor to explain, e.g., plant competition (intra-plant, inter-plant, inter-species) and the effects of plant configuration and plant manipulation (e.g., pruning and harvesting) on yield and produce quality. Examples of application of FSPMs include wheat modelling in the context of remote sensing and the analysis of predator–prey insect interactions on glasshouse plants. Combining PBMs and SPM into functional-structural plant models (FSPM) or virtual and behaviour of the real world were tested, has expanded enormously. Forecast Uncertainties in Macroeconometric Modelling. May 10, 2000 - the UK and comments on the relationship between the fan charts published by the Bank of. www.macsur.eu CropM International Symposium and Workshop: Modelling climate change impacts on crop production for food security The international crop modelling community meets between 10-12 February 2014 at Oslo, Norway, to assess the state-of-the-art in crop modelling for climate change risk assessment, and develop a joint vision and research agenda for the future. Functional-structural plant models (FSPM), combine the representation of three-dimensional (3D) plant structure with selected physio. Plants react to their environment and to management interventions by adjusting physiological functions and structure. Functional-structural plant models (FSPM), combine the representation of three-dimensional (3D) plant structure with selected physiological functions. An FSPM consists of an architectural part (plant structure) and a process part (plant functioning). The first deals with (i) the types of organs that are initiated and the way these are connected (topology), (ii) co-ordination in organ expansion dynamics, and (iii) geometrical variables (e.g. leaf angles, leaf curvature).