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All Division 4 (Forest Assessment, Modelling and Management) Meeting

181 - Cross-boundary modelling in a changing world

Room "Colmar" (Novotel Freiburg)

IUFRO17-2493 **Modelling canopy variables related to wildfire hazard with field data, LiDAR and other remote sensors**

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Abstract: Accurate knowledge of fuel characteristics is critical in forest fire management, as fuel constitutes a primary component of fire risk. Wildfire planning is inherently spatial, requiring calculation, display and analysis of fire behaviour across large landscapes. Therefore, accurate fuel mapping is required for using fire simulation systems, which are essential for establishing fuel treatment priorities and evaluating the effectiveness of fuel management actions. One of the current main objectives of fuel management programs is the mitigation of crown fire hazard, because these fires are usually intense and spread quickly, which makes them difficult and dangerous to suppress.
Crown fire initiation and spread are widely recognized to be determined by canopy fuel complex variables such as canopy bulk density and canopy base height. Direct measurement of these variables is impractical at landscape level, and they are usually estimated indirectly by relating them to other traditional forest stand variables.
Remote sensing techniques (RS) have the capacity to obtain spatially explicit data over large areas in a timely and economic fashion. Specially, Airborne Laser Scanning (ALS) has proven to be a useful source of auxiliary data for describing the canopy fuel stratum, because it directly measures the three-dimensional structure of forest vegetation, while satellite imagery adds important quantitative information to predict forest variables at stand level.
Different approaches used to model the main canopy variables related to crown fire hazard from field data, ALS and satellite data are presented in this study. The main advantage of modelling using RS variables is that these variables and metrics are available for all population elements, and model-based inference could be used to predict the population value and its variance or to derive spatial-explicit maps of canopy variables distribution, thus enabling a more realistic and accurate prediction of crown fire potential.

canopy variables, pine stands, crown fires

Room "Colmar" (Novotel Freiburg)

IUFRO17-2936 **Mixed-effect models for nonlinear natural processes**

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Abstract: Linear models are suitable for such y-x relationships where g(y) can be expressed as a linear function of h(x); g and h are linear or nonlinear transformations. Nonlinear models allow also relationships that are nonlinear with respect to regression coefficients. The use of nonlinear transformations g(y) and h(x) in the linear model make it very flexible. Therefore, nonlinear models are not necessarily needed to model the nonlinearity of y-x relationship. However, they can be used to fit parsimonious models based on the theory of the underlying process. They allow model parameterization in terms of the parameters of interest and analyzing the effects of treatments and covariates on them. Random effects are often needed to take into account the grouped structure caused by the experimental setup and repeated measurements.

I will demonstrate the use of nonlinear mixed-effects models in two recent papers. The first paper models the effect of thinning on the annual tree growth using a sigmoidal logistic curve, which parameterizes the tree-level thinning effect using two parameters: (1) the reaction time needed to recover from the competition and (2) the full thinning effect in terms of annual growth after the recovery period. Model fitting in a Scots Pine thinning experiment showed that the reaction time is affected by the social position of the tree in the forest, whereas the full thinning effect is affected by the thinning intensity. The second paper models the response of Sphagnum moss on the available light using a hyperbolic light saturation curve, which is parameterized using three parameters: (1) respiration, (2) maximum photosynthesis, and (3) the linear response at low light level. The nonlinear mixed-effect model allowed us to analyze the effects of various factors such as water table, temperature, treatments and leaf area index simultaneously on all these parameters.

Nonlinear, mixed-effects, thinning, photosynthesis