A new reconstruction algorithm of the cell production kinetics for conifer species

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Tree-rings are important to reconstruct past environmental conditions. To describe and to understand development of tree-ring formation and predict the wood characteristics, a process-based modeling of wood formation have great potentials.

Seasonal dynamics of tree growth can be explained by tree-ring growth, individual features of tree and external climatic conditions. The main anatomical characteristics of tree ring structure, e.g. the number of cells, the radial cell size and cell walls thickness are closely related to the kinetic characteristics of seasonal tree-ring formation, especially with the kinetics of cell production. Due to specificity of these processes and complexity of labor-intensive experimental methods (reference) mathematical modeling can be considered as an one possible approach, which requires to develop adequate mathematical methods and corresponded software components.

In modern times the most process-based models simulate biomass production only with no possibility to determine the processes of cell production by cambium and differentiation cambial derivatives. A new block of the Vaganov-Shashkin model was proposed to estimate a cell production in tree rings and transfer it into time scale based on the simulated integral growth rates of the model. Here the VS-modeling is extremely important step because the simulated daily tree-ring growth rate is a basis to evaluate intra-seasonal variation of cambial production. The comparative analysis of the growth rates with one of the main tree-ring anatomical characteristics of conifers – radial cells size was carried out to provide a new procedure of timing cambium cell production during the season.

Based on the previous research experience when the seasonal tree-growth dynamics were analyzed by direct (cutting, etc.) and indirect methods, the new proposed method is free from any complexity and limitations accompanying previous methods.