



Process-based forward modelling of European tree-ring width chronologies using models of the Vaganov-Shashkin family

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Among the great variety of proxy data conveying climate information, tree-ring records outstand for its large spatial coverage and its stable and relatively high temporal resolution, constituting then one of the main sources of paleoclimate information, specially for the last millennium. Tree rings are expected to carry a strong climatic signal as its formation is greatly influenced by climate conditions. However, the extraction of this climate information is still an open question due to several practical and mathematical stumbling blocks, notably (i) the multivariate and non-linear character of tree response to climate forcing and (ii) the influence of additional non-climatic factors on tree growth, including soil characteristics, tree biological processes, insect and disease outbreaks, forest dynamics and human intervention.

Nowadays, the most widely used process-based model of tree-ring growth is the so-called VS (Vaganov-Shashkin) model, which uses a simple mathematical representation of the principle of limiting factors to calculate the daily growth rate in terms of growth responses to insolation, temperature and soil water balance. This growth rate is subsequently used to drive a cambium model which simulates the cellular processes of ring formation: division and maturation. VS model has successfully simulated tree-ring width chronologies coming from very different climate regimes, however in practice its great number of parameters (>40) and its high data requirements (daily climate data) limit to an important extent its applicability. Due to this fact, a simplified version called VS-Lite - lacking cambial representation, with just 12 parameters and requiring only monthly data - has been recently proposed. Despite its much lower level of complexity as compared to full VS model, VS-Lite is still able to capture to a great extent the climate-tree growth relationship and furthermore has allowed for systematic calibration schemes.

We investigate the relationship between climate and a set of European tree-ring width chronologies by way of VS and VS-Lite models, with the purpose of comparing their performances. The skill of these two approaches is evaluated with reference to the quality and type of climate data used as input and the standardization methods used to generate the chronologies.