The Laboratory of Tree-Ring Research

presents a talk by

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Forests, climate, and tree rings: forecasting the future state of complex systems

Wednesday, September 29, 2021 - 12:00pm to 1:00pm
Room: Zoom Only

At this stage in the Anthropocene, answering questions about the future state of ecological systems has become critical – the future growth of trees exposed to changing climate, tree species' future geographic distributions, and the future role of forests in the global carbon cycle – yet ecological systems are complex. Summarizing four lines of research, I will illustrate how the use of tree-ring and forest inventory data can help address questions about and improve prediction of forest and climate system dynamics. The first research line focuses on the fundamental global change problem of extrapolation. Based on range-wide analyses of tree-ring data for Douglas-fir (Pseudotsuga menziesii) and common piñon (Pinus edulis), we have concluded that space-for-time substitution cannot be used to predict near-term future tree growth, which will be governed by fast processes (plasticity), not slow ones (evolution, migration). The second research line concerns what limits tree species' geographic distributions. We used demographic models parameterized from forest inventory data to test two classic hypotheses for species' distributions. From these demographic analyses, we propose species' distributions are climate-driven, but characterized by complex dynamics involving feedbacks and cross-scale interactions, implying that static, climate-only models are inadequate to predict the loss of species with climate change. In a third line of research, we are using a Bayesian state space model for ecological forecasting of tree growth, to better quantify the forest-climate feedback. I'll explain what "ecological forecasting" means, by demonstrating three of its practices aimed at improving model skill: data fusion (of tree-ring and forest inventory data), the use of incoming data to confront model predictions, and forecast uncertainty quantification. Fourth, I'll describe the incorporation of tree-ring data into an empirical forestry model, the Forest Vegetation Simulator – creating a much-needed, climate-sensitive version of a management tool that is used across the U. S., which also forms the basis for a number of forest carbon calculators. Throughout, I will emphasize insights gained, and future directions for research.

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