Statistical modeling of current and potential future habitat, then simulation of potential colonization within that habitat, for tree species in the Eastern US.

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We use a regression tree ensemble method to assess current species-environment relationships as well as model potential suitable habitat under a variety of global climate change scenarios. We find that this variety of tools – regression tree analysis, bagging, random forest – each have their value in our analysis. As such, regression tree analysis creates a single regression tree that can be used to map where a species, within its range, is controlled by certain variables; bagging with ~30 trees can provide statistics on the constancy and reliability of the model; and random forest tends to provide the best prediction. We are using these methods on 135 of the most common trees of the eastern United States. We are using 38 variables of climate, soil characteristics, elevation, and landform to create models from 100,000+ Forest Inventory and Analysis plots which are used to map current habitat (as importance values) for each species at a 20 x 20 km scale. We then change the 7 climate variables according to two recent and tested climate GCM models under low and high emission scenarios to estimate suitable habitat for the year ca. 2100. We also evaluate 'hot spots' of importance for the species and assess the potential changes of these zones under climate change. We are doing similar habitat work for common bird species in the eastern United States. Within the defined suitable habitat estimated for ca. 2100, we then simulate migration of selected tree species through that suitable habitat. This cell-based model depends on abundance of the species within its range, habitat availability in the unoccupied, but suitable habitat, and distance propagules must travel between cells. In general, we find that generally 5% or less of the newly available habitat (mostly north of current range) has at least a 20% chance of getting colonized within 100 years, so that there is a serious lag of migration in the absence of humans physically aiding migration. We find that this modeling approach to empirically derive relationships and then map potential habitat changes is appropriate as long as the majority of the species range is included and sufficient organism and environmental data are available to populate the model. The migration modeling can then follow in a more stochastic manner. Together, we envision what might happen under climate change.

Keywords: regression tree, random forest, climate change, eastern United States, tree species distribution, migration