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Simulating the Holocene re-colonization of Europe by tree species using dynamic vegetation models

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At the beginning of the Holocene (10.000 BP) started a progressive re-colonization of Europe by temperate tree species from a limited number of glacial refugia. To reconstruct the speed, seemingly species-specific, and the routes of the postglacial spread of European tree species, fossil records collected from various localities in Europe are invaluable. However, the relative roles of climatic fluctuations, dispersal capacities of individual species, and inter-specific competition in controlling the re-colonization rates remain controversial. We investigate these different aspects with two dynamic vegetation models (DVM), LPJ-GUESS and CARAIB. Transient runs of both models were performed over the Holocene, using HadCM3 GCM-reconstructed climate. Large-scale species migration at 0.5°x0.5° is represented in these models using migration rates derived from a small-scale cellular automaton, CATS. Individual tree species migration rates were pre-calculated with CATS every 1000 years over each grid cell used by the DVMs in the climatic conditions reconstructed by the GCM. In the DVMs, these migration speeds were influenced by the response to competition from other species, expressed as a function of net primary production ratios. The DVMs were used to study the migration of one species, from its 10.000 BP refugia, within a landscape defined by a set of other species for which no dispersal limitations are assumed. Here, we illustrate the results obtained for wind-dispersed tree species and compare them to their past distributions reconstructed from pollen and macrofossil data.