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RReShar: a functional –structural forest model to simulate tree regeneration according to resources

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In many parts of the world, forests are facing rapid climate and practice changes, so that their evolution and composition will be difficult to predict. Yet forest managers and owners obviously need this knowledge to adapt their silviculture and if necessary replace some species by better adapted ones. Indeed their current choice will influence economic and ecological results for the next century, at least. Forests are complex ecosystems made up of several strata that interact with each other mainly according to resource availability, namely light (that also controls microclimate), water and nutrients. Indeed modelling forest dynamic is a key tool to assist the management of complex uneven-aged forest stands.

RReShar (Regeneration and Resource Sharing) is a functional - structural model aiming at modelling forest dynamic, and particularly the regeneration stage, according to resource availability. It is implemented under the simulation platform named Capsis (<http://capsis.cirad.fr>) helping to run and compare different scenarii of forest stand dynamic and evolution.

In RReShar stand structure is explicitly described, including all the strata of the forest ecosystem, i.e. adult trees, suppressed trees, saplings and seedlings growing in the understorey (regeneration) and herbaceous/shrubby vegetation. This detailed description of stand structure allows to take into account biotic and abiotic processes of interaction (competition / facilitation) between the different components. Growth and mortality functions are based on the interactions with light and water in this model version. The simulated scene is a 1 ha plot divided into square cells of a chosen size (a few meters). Adult trees are explicitly spatialised on the plot, whereas understorey vegetation and small trees are considered as a multi-species layer whose characteristics vary at the cell level. Vegetation is described by its height and cover. Tree regeneration, i.e. seedlings and saplings, are initialised as cohorts characterized by a diameter and height distribution. The overstorey and understorey growth time step is annual, whereas within this annual loop, the light interception by the different strata and water cycle (interception, evapotranspiration and soil water content) processes are daily simulated.

Currently, RReShar is calibrated with data coming from uneven-aged mixed *Quercus petraea* – *Pinus sylvestris* stands with an understorey colonised by *Calluna vulgaris*, *Pteridium aquilinum* and *Molinia caerulea* in temperate conditions. Forest dynamic (regeneration, growth and mortality) is compared according to different scenarii of stand structure and climates on the short and mid terms.