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Using the detailed 3D structure of a forest stand for upscaling purposes of transpiration from leaf to tree.

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The reliability of plant upscaling methods strongly depends on a precise calculation of radiation uptake which in turn depends on the three dimensional distribution of the plant biomass. A 3D upscaling method for transpiration (LUP) based on a fine description of plant structure is proposed. The vegetative elements distribution of a *Quercus ilex* L. tree was acquired with a ground based LiDAR system. The volume containing the tree was subdivided into voxels of 10 cm in side and a leaf surface was assigned to each voxel based on the presence of laser hits and *in situ* data. The preprocessed LiDAR data was imported into a ray tracing program to simulate the light environment through the crown. Absorption of photosynthetic active radiation (PAR) was calculated for each voxel during 15 days on a half hour time step. Absorbed PAR was used as input for a Jarvis-type conductance model in order to calculate the transpiration per voxel by inverting the Penman-Monteith equation. Daily mean intercepted radiation was used to scale gs_{max}. hence avoiding the classification of leaves in shaded and sunlit. Total transpiration was obtained by integrating transpiration of all voxels and validated by comparison with direct measurements of sap flow. The method yielded an R^2 of 0.90 without the need to parameterize coefficients with the direct measurements. The approach reproduces the exponential extinction of light through the canopy, the vertical LAI profile of the tree and it provides the possibility to observe the contribution of any voxel inside the crown to total transpiration. It is shown how the most shaded parts of the canopy (interception of 0% to 20% of the total daily radiation) con-

tribute the most to total transpiration because of the wider surface of this class. The method highlights that the light environment is horizontally heterogeneous also in closed stands. The choice to describe the 3D light environment with small voxels (0.1 m^3) allowed to counterbalance the effect of a simplified ray tracing algorithm. The combination of structural LiDAR data with eco-physiological measurements proved to be a valid tool for upscaling. However some steps in the procedure could be optimized, leaving space for further improvements.