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Environmental and plant control on ecosystem respiration in a beech forest in Central Italy

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The net amount of carbon that is absorbed by or emitted from a forest ecosystem (NEE) is the result of the difference between gross primary production (GPP) and total ecosystem respiration (TER). Most of the variability on NEE among different ecosystems has been attributed to the variability of the TER rates. With the objective of analysing the response of TER to environmental "drivers", we compared the seasonal dynamics of NEE with the major components of TER: soil (R_S), stem (R_W) and leaf (R_L) CO_2 effluxes. The NEE was measured by the eddy-covariance technique, whereas the TER components by dynamic chambers.

Over the one year study period the temporal variability of TER was mostly explained by changes in R_S(63%), according to the variation in soil temperature and soil water content. R_w rates of the dominant trees were systematically higher than rates of the co-dominant ones, except for the measurements carried out after leaf fall: autumn and winter. The temporal variation of R_w was strongly related to air temperature, showing an exponential increase of CO_2 emission with increasing temperature. The temperature sensitivity (Q_{10}) of R_w was not significantly different between the two categories of trees (dominant and co-dominant), while the basal respiration rate was higher in the dominant trees.

Under common temperature R_L expressed on a leaf area basis differed significantly between the upper and the lower part of the canopy. Among all the leaf parameters analysed, total non-structural carbohydrates (TNC) were found to be a good predictor of leaf respiration, explaining 76% of the daily variability of $R_{L.}$

A comparison of different approaches to scale-up the measured component of TER was also done. Our results show the relative importance of the environmental factors on TER variability, demonstrating a relative increase in plant respiration when water was limiting soil processes.