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Influence of plant productivity over variability of soil respiration: a multi-scale approach

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To investigate the role of plant photosynthetic activity on the variations in soil respiration (SR), SR data obtained from manual sampling and automatic soil respiration chambers placed on eddy flux towers sites were used. Plant photosynthetic activity was represented as Gross Primary Production (GPP), calculated from the half hourly continuous measurements of Net Ecosystem Exchange (NEE). The role of plant photosynthetic activity over the variation in SR was investigated at different time-scales: data averaged hourly, daily and weekly were used to study the photosynthetic effect on SR dial variations (Hourly data), 15 days variations (Daily averages), monthly variations (daily and weekly averages) and seasonal variations (weekly data). Our results confirm the important role of plant photosynthetic activity on the variations of SR at each of the mentioned time-scales. The effect of photosynthetic activity on SR was high on hourly time-scale (dial variations of SR). At half of the studied ecosystems GPP was the best single predictor of dial variations of SR. However at most of the studied sites the combination of soil temperature and GPP was the best predictor of dial variations in SR. The effect of aboveground productivity over dial variations of SR lagged on the range of 5 to 15 hours, depending on the ecosystem. At daily to monthly time scale variations of SR were in general better explained with the combination of temperature and moisture variations. However, 'jumps' in average weekly SR during the growing season yielded anomaly high values of Q10, in some cases above 1000, which probably reflects synoptic changes in photosynthates translocation from plant activity. Finally, although seasonal changes of SR were in general very well explained by temperature and soil moisture, seasonality of SR was better correlated to seasonality of GPP than to seasonality of soil temperature and/or soil moisture. Therefore the magnitude of the seasonal variation in SR was in general controlled by the seasonality of substrate supply by plants (via photosynthates translocation and/or litter) to soil. Although soil temperature and soil moisture exert a strong influence over the variation in SR, our results indicates that substrate supply by plant activity could exert a more important than previously expected role in the variability of soil respiration.

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