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Soil temperature and soil moisture induced spatio-temporal variability of soil respiration in winter wheat

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Soil respiration is the major transfer of CO_2 from the soil to the atmosphere and is characterized by a high spatio-temporal variability depending, among others, on variations in soil temperature and soil moisture. We simultaneously measured soil respiration, soil temperature (3 cm depth) and soil moisture (0-5 cm depth) in winter wheat from April to September 2008 at a 50x50 m plot at a site near Jülich, Germany. The average soil respiration rate over the whole sampling period was 3.8 $\pm$1.5 μmol m^{-2} s^{-1}. Spatial variations of soil respiration, represented by the coefficient of variation (CV), were in average more than 5 times higher than the spatial variations of soil temperature and soil moisture, respectively. Concerning soil respiration, considerably higher spatial variations were observed during the growth period of winter wheat. Semivariogram analysis revealed a strong spatial autocorrelation of soil temperature, whereas a moderate spatial autocorrelation of soil respiration and soil moisture was detected. However, the range of spatial autocorrelation was nearly similar for all three variables, on average 20 m. For the given temporal and spatial scale, a large proportion in temporal changing of the spatial structure of soil respiration could be explained by the spatial distribution of soil moisture.