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# Modelling daily soil respiration in lowland oak forest during and after soil water saturation events

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Lowland forests of pedunculate oak (Quercus robur L.) in Croatia are acclimated to high soil water content and flooding during the cold part of the year (November – March). Changes in weather pattern and increasing frequency of extreme events, like high precipitation episodes or flooding events out of dormancy period, are becoming more likely. However, the response of these forest ecosystems to flooding during vegetation period is not well investigated. It is well known that soil respiration (SR) depends on soil water content. Nevertheless, some of the most popular daily time-step SR models, like the one of Reichstein et al (2003), do not take into account the effects of soil water saturation which leads to hypoxia in soil and decline of SR. Therefore, we propose a modification of the SR model of Reichstein et. al (2003) that takes into account the effects of high soil water content on SR.

In a 37 years old forest of pedunculate oak, located in Jastrebarsko forest (N45.619, E15.688), we measured soil $CO_2$ efflux, every four hours during years 2009 and 2010, using a closed dynamic system with 2-4 chambers. Measured effluxes were averaged to obtain a daily average $CO_2$ efflux. Measurements have shown that high soil water content (i.e. greater that field capacity) strongly decreases soil $CO_2$ efflux, while subsequent soil draining produces bursts in efflux, particularly in spring.

Assuming that the measured $CO_2$ efflux corresponds to the total SR, we parameterized the original Reichstein et al (2003) daily time-step SR model and models based on the original but with different modifications (added seasonality in LAI term, modification in soil water status term, addition of new pulse term due to soil draining) and their combinations. Performance of each model was assessed using standard statistical measures (R2, RMSE, Mean Absolute Error, Nash-Sutcliffe Efficiency).

Modification of soil water status term significantly improved daily SR estimate (RMSE 0.67) compared to original model (RMSE 0.82), particularly during flooding and post-flooding periods. Annual SR estimated with new model showed greater variability than the estimates with the original model which could be plausible if differences in meteorological conditions between relatively dry 2009 and very wet 2010 are taken into account. New SR models could find application in wet ecosystems or during flooding events. However, additional validation with an independent dataset would be useful.