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CO_2 emissions from coarse woody debris in forest stands of Southern Primorye, Russia

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Deadwood plays an important role in carbon cycling in forest ecosystems and is a well-researched topic in most regions of the world. We present first results from closed chamber measurements of CO_2 fluxes in the southern Sikhote-Alin region in the Russian Far East which is a comparatively under-investigated region.
Field work was carried out in the forest areas of Primorskaya State Agricultural Academy. The site has an area of 28,830.7 ha with altitudes in the range of 100-500 m above sea level. The average annual air temperature is 2.5 °C, average annual precipitation varies from 620 to 890 mm and relative air humidity 75-80%. The area is dominated by Mongolian oak (Quercus mongolica Fisch, ex. Ledeb.; 36.4%) and Korean pine (Pinus koraiensis Siebold & Zucc.; 23.7%).
CO_2 emission measurements were conducted on coarse woody debris (CWD) from 2015 to 2016 for five stages of decomposition. CWD from three species was chosen for each stage of decomposition: Mongolian oak, Korean pine and Japanese elm (Ulmus japonica (Rehder), Sarg.).
CO_2 emission intensity was determined by using the closed chamber method. The change in CO_2 concentration in a chamber was recorded using a portable gas analyzer utilizing an infrared sensor (AZ 7722, AZ Instrument Corp., TW). Additionally, the temperature of ambient air (Ta) and the temperature of the wood at a depth of 2, 5 and 10 cm (T2, T5, T10) was measured (Checktemp 1 thermometer, Hanna Instruments, AT) near the chamber. CWD humidity was determined using a moisture meter (HH2, Delta-T devices, UK).
While the degree of destruction is an important factor in the spatial variability of the intensity of CO_2 emissions, hardwood-deciduous oak and elm decompose on average two times more intensively than pine (4,92 and 5.03 vs. 2.92 C m-2 day-1, mainly due to differing C/N ratios affecting activity of Basidiomycota).
Temporal variability can be well described by an exponential function of the temperature of coarse woody debris as well as the ambient air and CWD temperature (range of R^2= 0.65-0.75, no differences in the degrees of influence of T2, T5, T10). Additionally, it was found that the contribution of CWD humidity to seasonal dynamics of CO_2 emission intensity does not exceed 10%.
The temperature sensitivity or van't Hoff coefficient (Q10) of the intensity of the specific CO_2-flux from the CWD surface for pine, elm and oak was 2.41, 1.89, 2.28, respectively. A similar indicator for Korean pine was measured for northeastern China in 2010 (2.74, 400 km south-west of the area under study; Wu et al. 2010) with comparable CO_2 fluxes for pine (2.64 g C m-2 day-1) and oak (6.23 g C m-2 day-1; Sun et al. 2007). In comparison, our results indicate that the oxidative conversion of CWD carbon in the forests the southern Russian Far East occurs at a lower rate which results in a comparatively longer carbon storage in CWD.