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Wood ant nests as hot spots of carbon dioxide production and cold spots of methane oxidation in temperate forests

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Wood ant nests are known as hot spots of carbon dioxide (CO_2) production and are also thought to affect methane (CH4) flux. Stable high temperatures are maintained in ant nests even in cold environments. Here we focused on quantification of CO_2 and CH4 flux in wood ant nests, contribution of ants and microbes to CO_2 production, properties of nest material that affect CO_2 production and the role of ants and microbes in the maintenance of nest temperature. The research was conducted in temperate and boreal forests inhabited by wood ants (Formica s. str.). Gas fluxes were measured either by an infrared gas analyser or a static chamber technique. Ants and nest materials were also incubated in a laboratory. Material properties potentially influencing CO_2 flux, such as moisture, nutrient content or temperature were determined.
According to the results, CH4 oxidation was lower in wood ant nests than in the surrounding forest soil suggesting that some characteristics of ant nests hinder CH4 oxidation or promote CH4 production. These characteristics were mainly available carbon and nitrogen contents. Wood ant nests clearly are hot spots of CO_2 production in temperate forests originating mainly from ant and also from microbial metabolism. Most important properties positively affecting CO_2 production were found to be moisture, nutrient content and temperature. Nest temperature is maintained by ant and microbial metabolism; nests from colder environments produce more metabolic heat to maintain similar temperature as nests from warmer environments. In conclusion, as the abundance of wood ant nests in some forests can be very high, ant nests may largely increase heterogeneity in greenhouse gas fluxes in forest ecosystems.