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Interactive comment on "The sensitivity of microbial processes in Icelandic soils to increasing temperatures" *by* R. Guicharnaud et al.

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Comment on 'The sensitivity of microbial processes in Icelandic soils to increasing temperatures' (Guicharnaud et al., BGD 2009).

The potential positive feedback of soil organic matter to global warming in high latitude ecosystems is a matter of great debate because temperature is assumed to be among the important limiting factors for microbial activity, leading to the accumulation of organic materials in these soils. In their study on the sensitivity of microbial processes in Icelandic soils, Guicharnaud et al. use laboratory incubations to determine the temperature sensitivity of organic matter decomposition to temperature. Their data from a two-week laboratory incubation of eight soils at different temperatures stress the importance of microbial activity at subzero temperatures. Based on incubations

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run at different temperatures, the authors derive temperature sensitivities, expressed as the commonly used Q10 value, of the heterotrophic CO2 emission (Fig. 3). It may be noteworthy, however, that the incubation approach is possibly not appropriate for detecting temperature sensitivities because a second variable, namely substrate availability, affects the measured temperature response. Fig. 3 shows, that the cumulative CO2 release over two weeks of laboratory incubation at + 10 °C exceeds that at – 10 °C by a factor of up to ca. five. Though the maximum total CO2 release is only 0.1 percent of the SOC in the sample, the data suggest that at higher temperatures rapidly decomposable substrate may have become short at the end of the incubation. Consistently, the decline in microbial biomass for many soils (Fig. 2) at higher incubation temperatures after two weeks may be caused by the onset of substrate limitation. The role of substrate availability on apparent temperature sensitivities has been elaborated by Kirschbaum (2006) in some detail. He argues, that the observable CO2 efflux at any point in time is determined by the amount and quality of available substrate AND other conditions, such as temperature. In parallel incubations as applied by Guicharnaud et al., nominal constant Q10 values may induce apparent changes in Q10 just by a change in available substrate or, in other words, a change in substrate quality, over time even if the intrinsic Q10 does not change (Leifeld, 2003). If the pool of readily available substrate is limited, then incubation at lower temperatures will result in proportionally higher CO2 efflux rates at the end of the incubation relative to the experiment at higher temperatures, where more of the available substrate is already respired at any given point in time. As a consequence, the apparent Q10 drops. In the current study, DOC seems to be strongly related to the size of the readily available carbon pool. One approach to overcome such limitations has been proposed by Conant et al. (2008), who introduced the Q10-q value that computes Q10 from incubations at different temperatures for points in time having the same cumulative amount of CO2 respired. Though in the study by Guicharnaud et al. substrate depletion may be small, its confounding effect needs to be discussed in the context of Q10.

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