Alpine climate change: how does advanced snowmelt impact alpine greenhouse gas fluxes?

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Introduction: A dramatic signal of climate change in alpine regions is reduced snow cover. In the European Alps the amount and duration of snow cover has decreased in recent years, and is expected to decline significantly, on average, by the end of this century. Reductions in snow cover alter the frequency of soil frost events and the dynamics of freeze-thaw cycles. Evidence is accumulating that this could impact a range of ecosystem properties, including plant growth, the diversity of soil microbial communities, and rates of nutrient cycling, with implications for net biogenic greenhouse gas emissions. However, the scale of these impacts and their potential to feedback to climate change are poorly understood.

Goals of the studentship: The student will test the hypothesis that snowmelt timing is a major determinant of greenhouse gas emissions (CO_2, CH_4 and N_2O) from alpine ecosystems, and that reduced snow cover increases soil emissions to the atmosphere, thereby creating a feedback to climate change. The student will also explore the mechanisms involved, focusing on impacts of snowmelt timing on the activity of the microorganisms responsible for greenhouse gas emissions from soil. The project will involve the use of a combination of field manipulation experiments and landscape scale studies, combined with the use of a range of techniques for measuring microbial community activity and greenhouse gas emissions from soil. Research will be done on high alpine grassland ecosystems in the UNESCO Biosphere Park Gurgler Kamm in the Austrian Alps, close to the University of Innsbruck Alpine Research Station, Obergurgl.

Training: A multi-disciplinary team of scientist, with expertise in soil, plant and microbial ecology, and the measurement of greenhouse gas emissions will supervise the project. The student will be trained in state of the art methods for measurement of soil microbial and ecosystem properties, in assessing greenhouse gas emissions using a range of state-of-the-art in situ and remote sensing methods, and in statistical methods and numerical models for assessing data. The student will have access to world class facilities in the Soil and Ecosystem Ecology Laboratory in the Faculty of Life Sciences and the School of Earth, Atmospheric and Environmental Sciences at the University of Manchester.

References: Bardgett et al. (2005) *TREE* 20, 634-641; Bokhorst et al. (2013) *Soil Biol Biochem* 62, 157-164;Groffman et al. (2001) *Biogeochem 56*, 135-150; IPCC (2013); Kim et al. (2012) *Biogeosciences*; Kreyling (2010) *Ecology 91*, 1939-1948; Matzner & Borken (2008) *European Journal of Soil Science 59,* 274–284; Scherrer et al. (2013) *Int J Climat* 33, 3162-3173; Schimel et al. (2007) *Ecology 88*, 1386-1394; Shakhova, et al., (2010) Science, 327 (5970), 1246-1250.