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# Measuring subnivean soil respiration using Forced Diffusion chambers

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Subnivean soil respiration can be responsible for a dominant portion of an ecosystem's winter carbon budget which in turn provides a notable amount of the total annual budget. Despite this, challenges surrounding subnivean respiration measurements–disturbance of overlying snowpack, potential obstruction of automatic chambers, and uncertainties involved in the gradient method–leave the topic understudied. However, Forced Diffusion (FD) chambers use membranes to passively moderate and measure gas flux through the unit, resulting in a lack of externally moving parts and making them suitable for direct subnivean respiration measurements.

Here, we present laboratory flux-generator and in-situ field site results showing biases present in such measurements, caused by factors such as localised concentration gradients, preferential pathways, and disturbance of FD chamber calibration factors, and assess the performance of a "shield" attachment designed to mitigate these issues. Additionally, we present data showing respiration patterns measured prior to snowfall, in the presence of snowpack, and during snowmelt periods. This is supplemented with an examination of how flux measurements scale with snow-depth via artificially cleared and enhanced snowpack plots. Finally, we show how soil chambers can be be used to supplement eddy-covariance measurements and provide a deeper understanding of wintertime carbon dynamics.