Heathland ecosystems, human impacts and time: A long term heathland trial investigating ecosystem changes that occur after exposure to climate change, elevated N deposition and traditional vegetation management practices
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Appendix 1

Details of the \( \text{P}_G \) Measurements

The gross photosynthetic rate provided a measure of plant activity for the three heathland ages (Chapter 3) and for the Control and Drought treatments (Chapter 4). The gross photosynthetic rate (\( \text{P}_G \)) was calculated as the Net Ecosystem Exchange (NEE) rate of CO\(_2\) flux minus the Ecosystem Respiration (ER) rate of CO\(_2\) flux (\( \mu \text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1} \)). The \( \text{P}_G \) has a negative sign. A loess smoother curve was applied to the photosynthesis data to obtain daily estimates of plant activity.

The CO\(_2\) fluxes of the vegetation were measured with a LI-6400 infrared gas analyzer (LI-COR, Lincoln, NE, USA) attached to a 288 L ultra-violet light transparent Perspex chamber (60cm x 60cm x 80cm) using the method described by Larsen et al. (2007). The chamber was installed with a fan, a soil temperature probe (LI-6400-09 temperature probe) and a PAR sensor (LI-COR quantum sensor). Three permanent sampling locations were selected in each vegetation age. A metal base frame (60 cm x 60 cm) was permanently installed using small, narrow sandbags to provide a seal between the frame and the soil surface and was fixed with metal pins. Measurement of CO\(_2\) fluxes commenced immediately prior to the Perspex chamber being placed on the frame so as to capture the point at which the chamber was sealed and NEE occurred entirely within the chamber. The LICOR measurement program ran for 180 seconds however, the results obtained while the chamber fitting were later discarded so that only data obtained from the sealed chamber (approximately 150 seconds) were utilized for calculation of NEE rates. After the NEE measurements, the chamber was vented and measurements of the ER rate were obtained by covering the chamber with a fitted blackout-cloth, in which the outer layer was white and the inner lining was black, to minimize any heating effect within the darkened chamber.

In most cases, NEE decreased from the first to the third minute of measurement, indicating an effect of the chamber by the decreasing CO\(_2\) concentration as photosynthesis progressed. Thus a linear regression did not provide a good fit for all measurements. To overcome this problem, the HMR procedure was used (Pedersen et al. 2010). This procedure was developed for soil-atmosphere trace-gas flux estimation with static chambers and tests the fit of both log-linear and linear regression models to the NEE or ER data at each measurement. If linear regression provided the best fit, the flux value was determined by the slope of the regression line. If non-linear regression gave the best fit, the flux was determined by the slope at \( t=0 \) sec. The HMR procedure is implemented in an R-package (Pedersen 2011) and this was used in our study.

References


Pedersen, AR (2011) HMR: Flux estimation with static chamber data, R package version 0.3.1.