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Increased photosynthesis compensates for shorter growing season in subarctic tundra - seven years of snow accumulation manipulations

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This study was initiated to analyze the effect of snow cover on photosynthesis and plant growth in subarctic mires underlain by permafrost. Due to their narrow environmental window these raised bogs, often referred to as palsa mires, are highly sensitive to climatic changes. In Fennoscandia palsa mires are currently subjected to climate related thawing and shift in vegetational and hydrological patterns. Yet, we know little of how these subarctic permafrost mires react and feed back to such changes. By using snow fences to hinder snow drift the accumulation of snow was increased in six plots (10x20 m) in a snow manipulation experiment on a subarctic permafrost mire in northern Sweden. The thicker snow pack prolongs the duration of the snow cover in spring, causing a delay in the onset, as well as an overall shortening of the growing season. By measuring incoming and reflected photosynthetic active radiation (PAR) we wanted to address the question whether the increased snow thickness and associated delay of the growing season start affected the absorbed PAR and the accumulated gross primary production (GPP) over the season. The reflected PAR was measured at twelve plots where six of the plots experienced increased snow accumulation (treatment), and remaining six plots were untreated (control). Minikin QT sensors with integrated data loggers logged incoming and reflected PAR hourly throughout the growing seasons of 2011 and 2012. In July - September 2010 PAR measurements were coupled with flux chamber measurements to assess GPP and light use efficiency of the plots. The increased accumulation of snow prolonged the duration of the snow cover in spring, causing a delay in the onset, as well as an overall shortening of the growing season in the treated plots. The end of the growing season was not affected by the snow manipulation. The delay of the growing season start and hence overall shortening of the growing season in the treatment plots was 18 days in 2011 and 3 days in 2012 in relation to control plots. Results show higher PAR absorption together with almost 50% higher light use efficiency in treatment plots compared with control plots. Estimations of GPP suggest that the loss in early season photosynthesis due to the shortening of the growing season in the treatment plots is well compensated for by the increased absorption of PAR and higher light use efficiency throughout the whole growing seasons. This compensation is likely to be explained by increased soil moisture and nutrient availability together with a shift in vegetation composition associated with the accelerated permafrost thaw in the treatment plots. In our presentation implications and possible feedbacks of the increased absorbed PAR and estimated change in GPP will be discussed.