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Net ecosystem CO2 exchange of sub-Arctic heath and lichen communities across a forest to mire transition

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Landscape level measurements of net ecosystem CO_2 exchange (NEE) in Arctic tundra show that seasonal and annual values of NEE vary considerably due to site-specific factors and interannual variation of climatic drivers. The taiga-tundra ecotone in northern Fennoscandia is representative of these complex sub-Arctic landscapes, a mosaic of mountain birch woodland and palsa mires associated to waterlogged areas. In the margins of these mires, the growth of cryogenic peat hummocks introduces yet another factor inducing fine-scale vegetation heterogeneity, creating a variety of habitats which differ in snow cover during the winter and substrate moisture during the growing season. Using an *in-situ* automated chamber system, we measured hourly NEE in four vegetation types from June to September of the year 2008 in Petsikko, near the Kevo Subarctic Research Institute, in Finnish Lapland. The system was installed within the hummocky area, sampling: (1) *Empetrum hermaphroditum* -dominated hummock tops adjacent to wet areas in the mire-wetland transition, (2) *E.hermaphroditum*-dominated hummock tops by the sparse birch area, (3) Dry hollows covered by *Calluna vulgaris* and (4) eroded hummock tops, partially covered by lichen. These lichen-covered hummocks behaved as a CO_2 source for most of the study period. Within the tundra shrub communities, variation in NEE was explained by differences in vegetation structure rather than by vegetation type. NEE fluxes modeled using seasonally variable light response curves showed that maximum values of light-saturated photosynthesis and the respiration parameter were highly and positively correlated with patch-scale NDVI. The seasonal variation of the respiration parameter was also related to air temperature and peat moisture content. Finally, different methods for decomposition of NEE into Gross Primary Productivity (GPP) and Ecosystem Respiration (R_{eco}), combining night-time NEE fluxes and semiempirical NEE modelling (photosynthetic irradiance-response and temperature-sensitive respiration model, PIRT), were compared against actual measurements of R_{eco}using dark chambers.