Net ecosystem CO_2 exchange of sub-Arctic heath and lichen communities across a forest to mire transition

Rafael Poyatos [1,2],(r.poyatos@creaf.uab.es), Andreas Heinemeyer[3,4], Phil Ineson [3,4], Brian Huntley [1], Robert Baxter [1]

[1] School of Biological and Biomedical Sciences, Durham University, UK [2] Centre for Ecological Research and Forestry Applications, Barcelona, Spain
[3] Stockholm Environment Institute, University of York, UK; [4] Department of Biology, University of York, UK

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Background & Methods

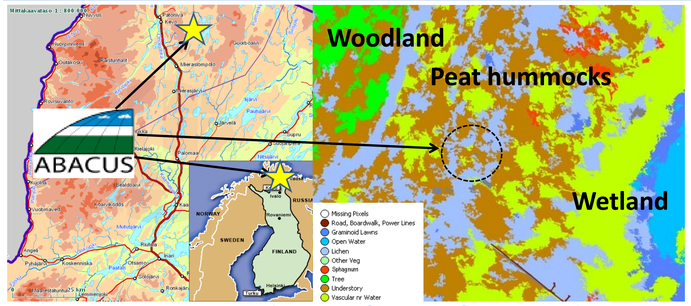
- Vegetation of **subarctic mires in tundra-taiga ecotones** is highly heterogeneous due to moisture gradients and microtopography.
- How do **seasonal controls on NEE fluxes** vary across different heath and lichen communities in these areas?
- Does NDVI explain **growing season NEE,** gross primary productivity **(GPP)** and ecosystem respiration **(R_{eco})** fluxes across vegetation types?

- **Automated closed chamber system.** LI-8100 IRGA and multiplexer, Dept. Of Biology, University of York

$$NEE = R_0 e^{\beta T} - \frac{P_{max} PAR}{k + PAR}$$

- Seasonallly variable **NEE model** using radiation and temperature.
- The model is employed for **gap-filling** NEE time series and **partitioning NEE into GPP and R_{eco}.**

Study site: Kevo, Finnish Lapland



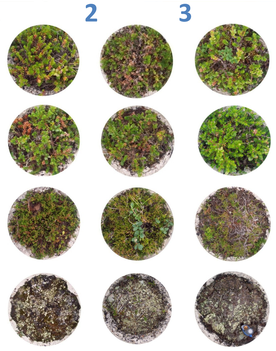
Land classification ABACUS WP5 (Tim Hill et al.)

Mire hummocks HM
Empetrum hermaphroditum
Vaccinium vitis-idaea

Forest hummocks HF
E. hermaphroditum,
V.vitis-idaea

Heather hollows CV
Calluna vulgaris,
Vaccinium uliginosum

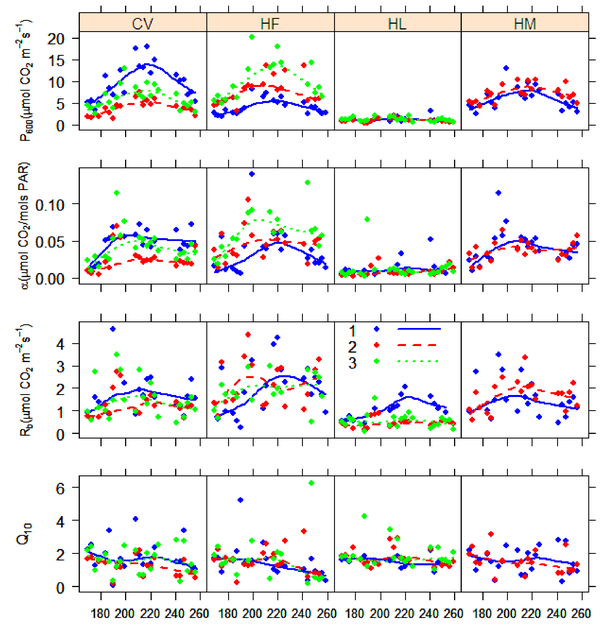
Lichen hummocks HL



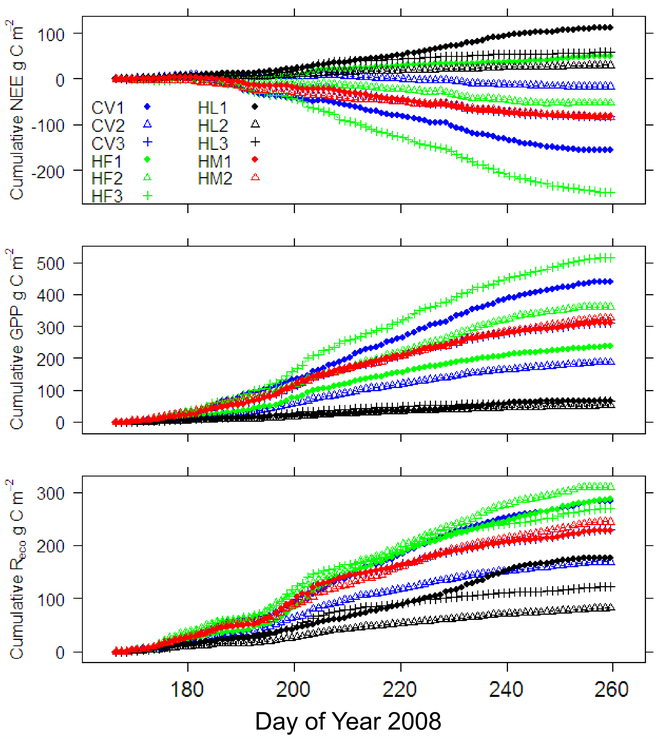
12 NEE chambers
4 veg types
3 replicates

Seasonality in NEE model parameters

- Gross photosynthesis at PAR = 600 µmols m^{-2} s^{-1}
- Quantum efficiency $\alpha = \frac{k}{P_{max}}$
- Basal respiration
- Respiration temperature sensitivity $Q_{10} = e^{10\beta}$

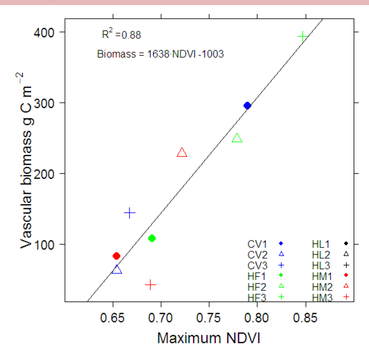


Structural controls on CO_2 fluxes

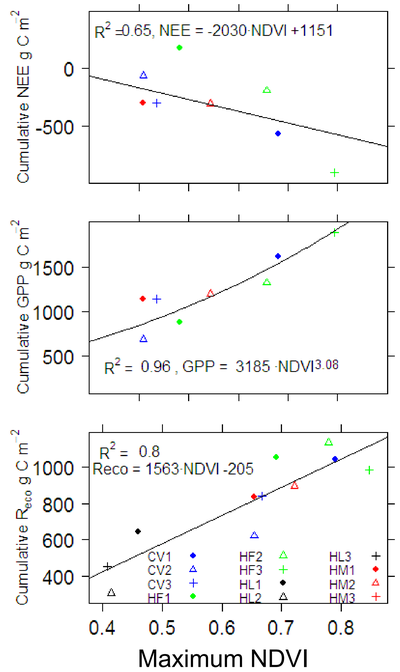


✓**Eroded hummock tops**, only covered by lichen, and **poorly vegetated hummocks** near the forest margin, were net C sources.

✓Within the vegetation types with vascular cover, **growing season fluxes were highly variable**.

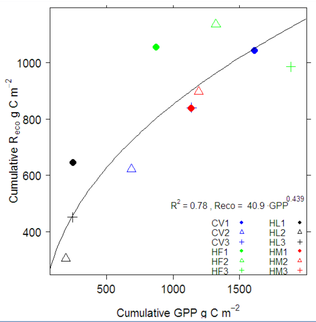


✓**Vascular green biomass** varied across plots, and **was well explained by maximum patch-scale NDVI**.



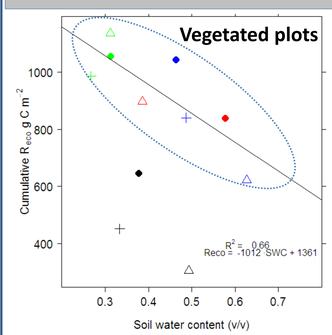
✓**NDVI also explained growing season NEE and its components.**

Relationship between GPP and R_{eco}



✓Unique **relationship between gross primary productivity and ecosystem respiration** across plots.

Soil moisture influence on R_{eco}



✓Apparent **decrease in ecosystem respiration with average soil water content** in plots with vascular plant cover.