

Author reply to Referee comments from **Nigel Roulet** from 8 July 2019  
(<https://doi.org/10.5194/bg-2019-156-RC2>) on:

## Cushion bogs are stronger carbon dioxide net sinks than moss-dominated bogs as revealed by eddy covariance measurements on Tierra del Fuego, Argentina

by David Holl et al.

Reviewer comments (RC)

Author comments (AC)

Mentioned line numbers refer to the originally submitted manuscript

Manuscript changes (MC)

This is a very nice comparative analysis of the NEE, GPP, and ER of a southern hemisphere Sphagnum dominated bog and a cushion plant dominated bog. The authors clearly show that the cushion plant system has a greater NEE and they convincingly show it is due to greater light use efficiency. They deduce this from eddy covariance measurements in the two systems. The authors provide the details in their methods and data processing – it all seems very sound.

The authors' data suggest there is something different in the photosynthetic efficiency of the cushion plants relative to Sphagnum. More correctly, they show the PAR saturation of Sphagnum occurs at a lower level of PAR. How Sphagnum photosynthesizes is still a bit of a mystery. Are there any physiological and biochemical explanations why the cushion plants are adapted for higher light levels? Has anybody done A/Ci curves for the cushion plants? These questions are at the root of the differences. Not suggesting the authors should know the answers but discussion along these lines would be useful. The manuscript is very clean. Only editorial comments is Mer Bleue should have an 'e' at the end.

- I corrected the misspelling of Mer Bleue.
- To our knowledge, A/Ci data has so far not been published for *Astelia pumila* or *Donatia fascicularis*. Our group did actually attempt to estimate *in situ* leaf-scale photosynthesis of *Astelia pumila* using a Licor 6400 infrared gas analyzer, with which the determination of A/Ci curves would be possible in principle. However, fitting one of the rigid, relatively small and close to the ground growing leaves into the instrument measurement chamber while gaining signals consistently above the instrument noise level proved to be too challenging for the moment. We will need to adapt the methodology.
- I added a discussion about possible explanations for the effective light use of cushion plants to the end of the first paragraph of section 4.6.

Reasons for the highly effective PAR use of *A. pumila* have been investigated by Fritz (2012) who found up to six times more leaf nitrogen per area compared to *S. magellanicum* capitula. Furthermore, Fritz (2012) found a high density of chloroplasts in cross sections of *A. pumila* leaves sampled at the Moat cushion bog on Tierra del Fuego. This notion is substantiated by our own (unpublished) data of chlorophyll content per gram dry weight, which was elevated by factors of up to ten in *A. pumila* leaves compared to *S. magellanicum* capitula. As a key competitive strategy of cushion plants for efficient nutrient recycling (Fritz, 2012) is the development of a dense and large root system, which contributes up to 90 % to their total biomass, the respiration cost that the plant imposes on itself by the maintenance of a large belowground part is high. The comparably high ecosystem respiration fluxes we determined in this study also point in this direction.