Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2017-172-RC1, 2017

Biogeosciences
Discussions

Interactive comment on "Explaining CO_2 fluctuations observed in snowpacks" *by* Laura Graham and David Risk

F. A. Rains (Referee)

farains@hotmail.com

Received and published: 25 July 2017

General Comments

First of all, I would like to say this was a very well put together study. Having performed wintertime respiration measurements myself, I know that it is not an easy task, kudos. Also, the system design seems robust, and accurate. Please take the below questions/comments with an open mind. Does the rate of flux affect the total quantity of CO2 released to the atmosphere? A bit of a rhetorical question, however this seems pertinent. Its clear that total C released is obviously a significant metric, but perhaps you could expand on how/why the rate of release is significant.

You mention a trend of thinning snowpack in North America over the last number of

decades. Also mentioned is the insulating effect that a deeper snowpack plays in allowing microbes to exist/or allowing for microbial respiration. It would follow logically then that assuming no change in air temperature, a thinning snowpack would decrease microbial, wintertime respiration by allowing the soil to reach sub 0 Celsius, or whatever that lower threshold may be. This may be slightly off topic but it seems related and pertinent. This could perhaps be addressed by mentioning other long term meteorological trends in North American winters, such as average air temperature, etc. . .

Content Comments

Section 1, lines 28-29. An example of "underestimating" winter contribution to atmospheric C would be supportive of your statement. It seems that assumptions are being made that current models assume that the wintertime contribution is nil. In fact some models may over estimate this variable. Again, an example of a widely used, modern model that excludes or under represents wintertime production of CO2 would be illustrative.

Section 2.3 Model Development. Line 30. How did you calculate snow pack porosity, and tortuosity? Was snow pack density measured at different intervals or assumed homogeneous for the different "steps"? Also, Fick's 1st Law of Diffusion is adequate for explaining flux in a 1-dimensional, relatively homogeneous medium. However we know that a snowpack stratigraphy is highly variable in space and time. Furthermore, assuming the non-static/non-homogeneous nature of wind and how it affects the snowpack in a very localized manor, could lateral flux occur with the snow pack. Also, elaboration on the role of dense wind slabs, sun crusts, and other ice crusts/lenses within the snowpack would be enlightening. In addition, it seems plausible that Fick's 2nd Law of Diffusion could potentially be useful.

Conclusion. Why is total "accounting" via eddy covariance lacking in this regard? At the outset it would appear that eddy covariance can tell you not only the rate of flux, but the net production of CO2 for a given footprint (accounting?), while eliminating margin

for error i.e. snowpack variability. What other sources of CO2 would be accounted for in addition to soil respiration that would not allow you assume all measured net wintertime CO2 was in fact from the soil? An few more sentences explaining your statements/reasoning that in-situ CO2 probes are superior would be enlightening.

Technical comments

Line numbering appears off, continues from abstract through first portion of introduction, and then switches back mid way. No other technical or grammatical errors were noted.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2017-172, 2017.