Biogeosciences Discuss.,
doi:10.5194/bg-2016-117-AC2, 2016

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Permafrost thaw and release of inorganic nitrogen from polygonal tundra soils in eastern Siberia" *by* Fabian Beermann et al.

Fabian Beermann et al.

fabian.beermann@gmail.com

Received and published: 14 June 2016

Anonymous Referee 1 Received and published: 03 May 2016

This is an interesting study, which consists basically of two parts: an observational part examining the profiles are of organic and inorganic nitrogen in permafrost soils, and a modeling study that attempts to quantify the response of N to increased active layer thickness during warming.

The observational part of this study is a nice contribution with a clear result: that inorganic N pools are much higher in permafrost layers than in the active layer, implying that mineralization of nitrogen in permafrost layers and/or transport of mineral N from

Printer-friendly version

Discussion paper

the active layer to permafrost layers outpaces consumption of mineral nitrogen (particularly ammonium). It would be very interesting to explore whether this observation can be used to partition the seasonal cycle of nitrogen or the temperature sensitivity of various components of the N cycle in these soils better. In particular, the soils were sampled in August. I'd propose that there is merit, in future work, in trying to construct a seasonal cycle of this observation to ask whether ammonium builds up in seasonally frozen layers as it does in permafrost. Identifying an amplitude of the ammonium and nitrate seasonal cycles with depth may help to identify the timescales for nitrogen cycling, in order to better quantify the impact that this nitrogen may have upon release.

Thank you for your generally positive view on our manuscript and your helpful comment. As a result of your remarks, we added a short outlook to the conclusions section where we state that "Follow up studies should focus on the question whether the accumulation of inorganic nitrogen is a general characteristic of arctic permafrost soils. Furthermore, the analysis of the seasonal cycle of the contents of inorganic nitrogen in the active layer could give us more information about ammonium accumulations in the seasonally frozen layer and thus, also help to estimate the pace of the ammonium accumulation in the frozen ground." (Page 16, line 10-15)

That question forms the modeling part of the study, and here the results are ambiguous: the calculated N to be mobilized as a functin of active layer deepening are large in comparison to slow N cycle fluxes such as fixation, but small in comparison to fast N cycle fluxes such as gross mineralization or immobilization. Thus it is not clear what role this extra nitrogen at depth may play.

Given that the much more substantial store of permafrost-layer nitrogen is in the organic pools, which may mineralize more efficiently with warming, I would think that it is more useful to view the elevated profiles of frozen inorganic nitrogen as a diagnostic for the relative rates of nitrogen sources versus sinks in these layers, and how such

Printer-friendly version

Discussion paper

an observation may inform models of permafrost nitrogen cycling, rather than being a major lever in the ecosystem state on its own. It seems the authors agree with that, but I would encourage the authors to think more about how these profiles have been generated rather than just about how they may respond to warming.

We agree with you that it would be very interesting to have a look also on the frozen pools of organic nitrogen. Unfortunately, we only have data about the pool of total N and the pools of inorganic N but no data about different organic N pools. As the pools of total N is magnitudes higher than the pools of inorganic N, we cannot discuss sink vs. source dynamics with our data. However, we extended our discussion about the reason for the accumulation of ammonium in the frozen ground and try to explain the different contents of ammonium in the frozen ground at the three different sites (page 14, line 8-19)

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-117, 2016.

Printer-friendly version

Discussion paper