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Biogeosciences Discussions

Interactive comment on "Temperature and moisture effects on greenhouse gas emissions from deep active-layer boreal soils" *by* Ben Bond-Lamberty et al.

Anonymous Referee #2

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This paper studies carbon (C) release in the form of CO2 and CH4 from deep-active layer boreal soils using 30 soil cores in interior Alaska. After 100 days of incubation at two different temperatures and different moisture conditions, the authors find that incubation temperature, core water content and soil nitrogen strongly influenced CO2 release. This is a useful dataset that adds to the growing body of literature on C release from permafrost once thawed. There is a good amount of publications that deal with warmer temperatures in the Arctic and changing soil moisture condition but not many have simulated drought conditions. A probably unfortunate overlap in publication date with this paper is a recent meta-analysis published by Schädel et al. 2016, which showed that C release doubles when incubation temperature increases by 10°C

and that C release under aerobic conditions is three times higher than under anaerobic conditions. It seems like this paper was published as a discussion paper before Schädel et al. 2016 was published and hence a discussion of the meta-analysis was not possible but should be addressed in the revisions. The importance of the results would be more obvious if the discussion also contained an upscaling or circumpolar aspect of drought in the Arctic. It would be useful to have some discussion about the area that is expected to be most affected by drought. This is important as changes in temperature will affect most of the Arctic, whereas drought effects or dry soils will occur more locally.

Minor comments:

1) Throughout the manuscript, I have noticed that important papers from the permafrost literature are missing. This applies to C stocks in the permafrost area, Tarnocai et al. 2009 is a good paper but there are more recent and more accurate estimates of permafrost C stocks described in Hugelius et al. 2014 and Schuur et al. 2015 that should be cited. When it comes to the permafrost C feedback, Schuur et al. 2015 is currently the best and most up to date review. In addition, Koven et al. 2015 is a good one too. The discussion on incubation literature should include papers like Lavoie et al. 2011, Dutta et al. 2006, and Schädel et al. 2014.

2) L. 31: Permafrost thaws and does not melt

3) A better explanation is needed why deep-active layer soils are different to active layer or permafrost soils, I couldn't find a strong argument for why they would behave differently. Also, deep-active layer soils are those that are the most impacted by inter annual variability in thaw depth and so they might switch between active layer in one year to permafrost in another, that's worth some discussion as well.

4) The statistics in this paper are generally good and I would like to compliment the authors on making the entire data set and analysis available online. I would still suggest that the manuscript would profit from some additional details on collinearity of the

tested variables as well as model outputs such as AIC.

5) Add a table with soil properties such as bulk density, %C etc.

6) Why not include C/N as a variable in the statistical analysis? Schädel et al. 2014 showed that C/N is a good predictor of C release and can be used as a scaling factor. It would be interesting to see if C release from short-term incubations show the same result

7) In the discussion, it would be good to also include the warming potential of CO2 and CH4 especially when making assumptions about the permafrost C feedback, it is briefly mentioned in line 348 but a more in depth discussion would be good

8) the conclusions might be a bit strong given the data and previous results published

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