

Interactive comment on “Delayed responses of an Arctic ecosystem to an extremely dry summer: impacts on net ecosystem exchange and vegetation functioning” by D. Zona et al.

Anonymous Referee #2

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General comments

The authors present an interesting data set on the land-atmosphere exchange of CO₂ from the Arctic tundra in Barrow, Alaska. The summer in 2007 was unusually warm and dry, but the CO₂ uptake was not lower than usual. On the contrary, during the normal summer of 2008, from a meteorological point of view, the CO₂ uptake was lowered. The authors suggest that the ecosystem had difficulties in readjusting to normal conditions after an extreme year.

In its present form, the paper is too speculative. The data and analyses do not satisfactorily back the conclusion that the ecosystem "momentarily lost its low-temperature

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acclimation". Alternative interpretations are possible; such as a high insolation in 2007 (table 1) that may have stimulated vascular plant activity (not discussed in the paper), while Sphagnum mosses suffered from desiccation. In 2008, during more normal conditions, Sphagnum activity were reduced. High GPP in 2007 was not reflected in the LAI measurements. This may indicate that vascular plants invested more than usual in root production to cope with decreasing groundwater tables in 2007. In 2008, the larger than usual belowground plant C pool resulted in higher rates of autotrophic respiration.

However, on the basis of data and analyses presented in the ms it is hard to evaluate both the authors' hypotheses and the alternative ones. Most of the analyses are conducted for 2006 and 2007. Information on GPP, Reco and NSE is not presented for 2008 and 2009. Light response curves are shown for all years but these suffer from having too long periods of data (see below) preventing meaningful interpretation. In addition, the flux partitioning method performed in this study is based on Reichstein et al. (2005), which requires dark periods for successful application. Due to the high latitude location of Barrow dark conditions should be absent for at least the first half of the measurement period in each year, leading to uncertain estimates of GPP and Reco.

Detailed comments:

Abstract

Authors discuss C uptake but this paper only deals with CO₂ exchange and not other important flows of C such as CH₄ exchange and C runoff. Suggest rephrasing "C" to "CO₂" throughout the manuscript.

Materials and methods

P19194: L13-22: Please include basic information on the EC system such as type of gas analyzer, anemometer and height of measurements.

P19195: L3-6: Flux partitioning was based on Reichstein et al., 2005. However, this

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method requires nighttime periods to be able to produce reliable estimates of Reco and hence GPP. The latitude of the site (71 deg N) is likely to have midnight sun throughout a large part of the study period (June-August) in each year. A more adequate method would be using light response curves to partition NEE, see Runkle et al. 2013 Biogeosciences 10, 1337-1349.

Reults

P19199, L5-6 and table 2: Authors state that GPP and Reco were significantly more positive in 2007 compared to 2006; however no post hoc tests on the difference have been performed

P19199, L17-20: This part belongs to discussions section

P19199, L20 (and other places): Desiccation is a more usual term used within the literature on Sphagnum compared with necrosis. Can the authors be sure that Sphagnum actually died during the dry period?

P19200, L5: Please indicate average (and st.dev.) of LAI for 2006 and 2007 (preferably for 2008 and 2009 as well).

P19200, L23-P19201, L2 and Fig. 6: The light response curves cover too long period including pre-leaf, peak season and post-leaf periods. Thus the information gained from Fig. 6 is scattered and limited due to seasonal evolution in vegetation greenness. It would be better to divide the measurement season into 10-20 day periods, such as the periods in Fig. 3, and to display four sets of light response curves.

Discussion

P19201, L19-P19202, L5: This text belongs to Introduction section.

P19202, L21-22: I am not convinced that the ecosystem momentarily lost its "low-temperature acclimation". Vegetation is generally adapted to its long-term environmental characteristics, cf Yuan et al., 2011, Biogeosciences 8, 1453-1463, and one

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extreme year would not be enough to change the acclimation.

Tables

Table 2., caption last sentence: Replace "dysplaied" with "displayed"

Interactive comment on Biogeosciences Discuss., 10, 19189, 2013.

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