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Biogeosciences Discussions

Interactive comment on "Impacts of increasing water and nitrogen availability on ecosystem CO_2 fluxes in a temperate steppe of Northern China" *by* L. Yan et al.

Anonymous Referee #1

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The manuscript reports results from an experiment conducted over two growing seasons in Inner Mongolia, China to examine the influences of increased precipitation (15 mm every 14 days) and nitrogen (28g N / m2/yr divided equally into bimontly additions) on both primary production and whole ecosystem CO2 exchange partitioned into components of gross ecosystem production (GEP) and respiration (R). The methods used a tenting approach for measuring net gas exchange, which has become well established for whole ecosystem research. The results found an overall decrease in net ecosystem exchange (where negative is defined as storage in the ecosystem) due to a relatively larger increase in GEP over R. The GEP data were supported by measures of net primary production, both above and below ground. They found a reduced effect

of watering during and an increased effect of nitrogen in the wetter year.

I was not convinced the findings advanced our understanding nor did the authors make a strong case for new learning. The discussion begins by describing how the results primarily corroborate many recent findings by this group and others examining water additions independently and interactively with nitrogen addition. Grasslands in Inner Mongolia were previously shown by this group to be strongly affected by water and nitrogen (Yan et al. 2009 Global Change Biology). Documenting the growing season increases following N and water additions does not advance the science. The most interesting finding was the contrasting effect of growing season precipitation on the sensitivity to watering and nitrogen. I would expect this as during the dry year the system would be in severe moisture stress and during the wet year sufficient water would be present to allow full utilization of the nitrogen. However, these differences were not sufficiently quantified or described to understand why.

Much of the continuing interest in understanding net carbon balance with altered water and nitrogen addition has moved to examining effects at individual event scales, more broadly across regimes of precipitation, and antecedent effects at multiple scales. The watering manipulation treatment, a regular watering schedule makes examining changes associated with either the event or regime scale difficult. How the effects at the individual scale influenced the gas exchange measurements is unknown, but as previously shown by this group the effect could be high. The limitation of only 2 years of data prevents any examination of possible effects of the prior growing season.

Extrapolating these findings to predicting future carbon sequestration with likely climate changes (as in the discussion section labeled as such) is not supported by the experimental design. The watering treatment neither simulated a possible future climate nor tested predictions derived from likely climate scenarios.

Specific Comments – How much did the nitrogen treatment increase deposition above background levels?

I think many of the statistical analyses should use a repeated measures ANOVA.

Figure 3: Why doesn't this figure break out the different treatments as in Figure 4? For the relationships, statistical tests should be conducted to determine if the slopes are different.

Table 4, Figure 4, Figure 5 – I'm not sure how to interpret Q10 across the growing season other than as a proxy for seasonality. These results were not directly referenced in the discussion.

Figure 4 and 5 have as a caption – "temporal dependence" but focus either moisture or temperature. It would be useful to see pattern of soil moisture and temperature as for flux measurements in Figure 2.

Pg 11 Paragraph starting at ln 16: While the effect of water addition is visually much greater in 2007 than 2006 a quantification of this effect would be useful.

Pg 11 ln 20: I don't follow the relevance of the Potts et al. 2006 New Phytologist paper, which looked at sensitivity to specific wetting events rather than whole season patterns.

Interactive comment on Biogeosciences Discuss., 7, 5829, 2010.