

Interactive comment on “The effects of clouds and aerosols on net ecosystem CO₂ exchange over semi-arid Loess Plateau of Northwest China” by X. Jing et al.

Anonymous Referee #2

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General comments: This study contributes to science with an analysis of impacts of aerosols and clouds on grasslands net ecosystem exchange (NEE) of a semi-arid grassland in the Loess Plateau in north west China. The study uses a unique data set of NEE, meteorology, AOD's and solar and solar diffuse radiation measurements. It adds to the limited knowledge on the response of grasslands NEE, photosynthesis and ecosystem respiration to clouds and aerosols.

This is a well written article, with a well described methodology and results. The paper includes a good analysis of carbon fluxes under various cloudy conditions. However, the analysis on impacts of aerosols on carbon fluxes misses on the temperature effects.

C5511

It seems that the diffuse radiation effect (which is low) on photosynthesis is counteracted by the temperature effect on ecosystem respiration, but this is not really shown and discussed.

Specific comments: On the same topic, Figure 11 could be modified to show, how in clear sky days (under aerosol loaded conditions) NEE, photosynthesis and ecosystem respiration vary with AOD, diffuse fraction, and temperature. Figure 11 has i) a considerable amount of scatter in the data, ii) very few points at low CI which seem to be driving the slope of those regression lines, and for this reason, those lines should not be there, especially the one with AOD higher than 0.5.

There seem to be two messages: 1) The diffuse radiation effect due to aerosols on photosynthetic C uptake of these grasslands, (how much is this?) and 2) the counteracting effect of ecosystem respiration due to temperature (how much is it?).

The authors mention through the text, that diffuse radiation photosynthetic enhancement is not as large as in croplands and forests, due to the lower light saturation points of forest and croplands. The respective light saturated values of forest and croplands should be stated in the text to put more context into such statements. The authors could also include values of light saturation points from other or similar grassland ecosystems.

On the temperature effect on photosynthesis, some of the following issues could be included in the discussion, if there was information on it. Are there any other studies showing the same response to temperature? Is the temperature response of photosynthesis found in this study also found in other or similar grasslands under similar environmental conditions? Are there any gas exchange measurements confirming the observed photosynthetic response to temperature?

Cloudiness data: It would be very good to see the relationship of global radiation and cloudiness derived for this study with the method from Long et al. This could be placed in the main text or in an appendix.

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Technical comments:

Page 2 (abstract) Line 11, 'light saturation levels in 'the' canopy are lower, with a value of about '. Lower than which values?. Page 2 (abstract), Line 12, define CI (first time that it is mentioned). Page 2, Line 14, clearness index is mentioned, please define.

Page 2, Lines 14-15. 'Under other sky conditions the CO₂ uptake decreases with the cloudiness but the light use efficiency is enhanced, due to increase the fraction of diffuse PAR'. Rephrase, 'Under other sky conditions, CO₂ uptake decreases with cloudiness, but light use efficiency is enhanced, due to increased diffuse fraction of PAR'.

Page 3, Lines 11-12 'Under cloudy and aerosol conditions', under aerosol conditions reads very strange, it could be reworded to read better.

Page 3, Line 14,-15 for the North America 'n' forests.

Page 5, lines 1-2, are these grasses C3 or C4?.

Page 9, equation 5a, please define τ_{A_m} (Greek letter m).

Page 11, lines 18-24, Very long sentence, it could be cut into two sentences. Hard to follow what the authors mean in lines 22-24.

Page 13, end of Line 21, replace diffusion with diffuse.

Page 16, line 26. There are at least 9 points with diffuse fraction higher than 0.6.

Page 17, lines 1 and 2. 'under a high aerosol loading condition, CI can still be large, corresponding to a high solar radiation (about 1000 W m⁻²)'. Where is this shown?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 13337, 2010.