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Biogeosciences Discussions

Interactive comment on "Modeling the biogeochemical effects of rotation pattern and field management practices in a multi-crop (cotton, wheat, maize) rotation system: a case study in northern China" *by* Wei Zhang et al.

Anonymous Referee #1

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The manuscript entitled "Modeling the biogeochemical effects of rotation pattern and field management practices in a multi-crop (cotton, wheat, maize) rotation system: a case study in northern China" is within the scope of BG. To ensure reliability, models should be tested and improved as part of their development and application. The manuscript is important in that context (though it is poor- it lacks for a 6 years validation that includes a rotation of all three commodity crops as well as all management practices studied in question) but the novelty of this manuscript lies with the optimization of different rotation patterns (of three cultivars: cotton, wheat, maize) and management

practices which is very complex. Overall, the manuscript lacks of structure and the English language in the manuscript needs to be improved. The manuscripts need major revisions to be acceptable for the publication. In the current state should be rejected. For more details please see my comments below:

In the site simulation NEE and NO emission are predicted with lower accuracy by the model, then how this impacted the optimization of mitigation options?

The novelty of this manuscript lies with optimization of mitigation options at site level but authors exploited this inadequately in this manuscript. Elaborating and extending optimization analysis will add substantial knowledge and value to the manuscript. What about using i.e. Monte Carlo optimization technique to screen different set of possible agricultural management practices (a multiple optimization criteria that includes crop rotation in interaction with all studied management practices) which maximize yields while minimizing environmental effects.

Uncertainty quantification is a critical challenge in both validation and calibration. There is NO mention of model uncertainty in the manuscript. I suggest adding one section on model uncertainty and discussing uncertainties and how that might propagate to model outputs in this study. Authors should also focus on potential applications of optimization considering uncertainty. Otherwise these mitigation options have only academic interest and not much real-world value. Please, see the specific comments below.

Introduction: In general I would say that the introduction is too long and not enough focused on the task. There are plenty of paragraphs which must be shortened and better structured. This will improve the content and impact of the current manuscript. Please skip unnecessary things. i.e. frequent applications of pesticides and/or herbicides. My suggestion is to reduce the introduction section to max. 2 pages.

I will start with one example: Globally, fiber crops (i.e. cotton) and cereals such as wheat and maize have been playing a relevant role in humanity as they are a primary source for the textile and food industry. In China, while the cultivation of cotton only

covers between 2.0−3.9% of the annual crop harvest areas (cotton lint production of 5.3−7.6 million metric tons during 2007−2016), the cultivation of cereals is significantly large. Wheat and maize account for 39% and 26% of the harvest area and represent 129 and 220 million metric tons of grain in 2016, respectively (China Statistical Yearbook, 2017).

Northern China is not only the second most important area of cotton production but the largest region of the winter wheat−summer maize double-cropping system (i.e., both crops harvested within a year, hereinafter referred to as W-M) in the country (e.g., Cui et al., 2014). Crop rotations of cotton and the W-M have been commonly applied in this region (e.g., Liu et al., 2010, 2014) and are typically alternated every 3−5 years. During the last decades, cotton, wheat and maiz's yields have increased by means of intensified agricultural management practices such as: increased fertilizer inputs, advanced irrigation methods (Han, 2010). A recent study (Liu et al., 2019) indicated that the cotton cropping system in northern China persistently functioned as an intensive carbon or net greenhouse gas (GHG) source compared to the W-M because of strong carbon dioxide (CO2) emissions during the long non-growing periods. Add Reference.. revealed that the change in storage of soil organic carbon (âŰşSOC), net ecosystem GHG emission (NEGE) and other biogeochemical processes of the multiple-cropping systems in northern China likely are closely related to the rotation pattern of cotton and the W-M. Thus, one can hypothesize that identifying and adopting optimal rotation pattern of cotton and the W-M are beneficial for soil carbon sequestration and mitigation of GHG emissions in the region. . . .. . . Please see general comment of this section!

Material and Methods

General comment: Same as above, please shorten and restructure this section

Put sections 2.1 and 2.3 together (short and concise)

Lines 222-226 what do you want to say? It is not clear to me. Please keep in mind that you are not studying the environmental impacts of using pesticides.

Discussion

Please delete lines 526-527. I do not see that such statement helps to your work. Unfortunately – your model validation is poor as it evaluates only one site and does not include a rotation of all three commodity crops together. Remember that optimization studies rely on robust site validations. These validation studies should be done using several pilot areas with different geographical, climatic and soil conditions; different types of reference data (long term datasets) used for model calibration. I am not sure that you will get the same results if you apply your best rotation and management practices across different geographical, climatic and soil conditions. A regional simulation will help you to clarify this.

I would start with this: The scenario analysis relying on model simulations in this study showed that environmental contamination can be reduced while a) sustaining crop yields and b) increasing carbon sequestration in the soil. Reductions of environmental i.e. N losses are attributed to the better synchronization of crop N requirements and soil N availability. . .. .

Lines 531-532 Why do you discuss about pesticides when the DNDC model does not account for?. Please state that DNDC model assumes balanced nutrient supplies for any crops as well as optimum phytosanitary conditions. Hence negative effects of monoculture are not accounted for.

I suggest you to add an uncertainty section as requested before.

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