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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Impact of revegetation of the Loess Plateau of China on the regional growing season water balance" *by* Jun Ge et al.

Anonymous Referee #2

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Review comments for the manuscript "Impact of revegetation of the Loess Plateau of China on the regional growing season water balance" by Jun Ge, Andrew J. Pitman, Weidong Guo, Beilei Zan, Congbin Fu.

General

The paper investigated the impact of revegetation on the hydrology of the Loess Plateau. The introduction needs to be further clarified. For example, the authors stated that "the response of rainfall to large-scale revegetation is rarely investigated". As far as I known, there are studies (e.g., Ma et al., 2013; Chen et al., 2016; Yosef et al., 2018) that have investigated it. Furthermore, the authors mentioned in the discussion section that "Our results are broadly consistent with both field (Jia et al., 2017; Jian et al., 2015; Jin et al., 2011) and satellite (Feng et al., 2017; Li et al., 2016; Xiao, 2014)

observations". Therefore, the new findings in this work need to be further highlighted. The applied land cover change in 2015 relative to 2001 was not consistent with the expected fact. Explanations were missing in several places in the manuscript which kind of focused more on the phenomenon. Detailed comments are given below.

Specific Concerns/Comments

1) Line 55: The authors stated that "the response of rainfall to large-scale revegetation is rarely investigated". As far as I known, there are studies that have investigated it.

Ma, D., M. Notaro, Z. Liu, G. Chen, and Y. Liu. Simulated impacts of afforestation in East China monsoon region as modulated by ocean variability, Climate Dynamics, 41(9-10), 2439-2450, 2013, doi: 10.1007/s00382-012-1592-9

Chen, L., Z. Ma, R. Mahmood, T. Zhao, Z. Li, and Y. Li. Recent land cover changes and sensitivity of the model simulations to various land cover datasets for China, Meteorology and Atmospheric Physics, 129(4), 395-408, 2016, doi:10.1007/s00703-016-0478-5

Yosef, G., R. Walko, R. Avisar, F. Tatarinov, E. Rotenberg, and D. Yakir. Large-scale semi-arid afforestation can enhance precipitation and carbon sequestration potential. Scientific Reports, 8(1), 996, 2018. doi:10.1038/s41598-018-19265-6

Wang, Y. L, Feng, J. M, Gao, H. Numerical simulation of the impact of land cover change on regional climate in China. Theoretical & Applied Climatology, 2014, 115(1-2):141-152

Chen, H. S et al. Numerical Simulation of the Impact of Land Use/Land Cover Change over China on Regional Climates during the Last 20 Years. Chinese Journal of Atmospheric Sciences, 2015

Xu, L., G. Yang, Y. Feng, Y. Du, and X. Han. A study on microclimate impacts of artifical vegetation on the Loess Plateau, Research of Soil and Water Conservation, 17(4), 170-179, 2010

Ma, Y. Climatic and agricultral effect of converting farmland into forest or grass land in ShanGanNing region in China, Chinese Academy of Meterological Sciences and Nanjing University of Information Science & Technology, 2011

2) Lines 69–70: "Thus, the impact of revegetation on the hydrology of the Loess Plateau remains unclear due to the uncertainty in the rainfall response." The conclusion is kind of arbitrary because there are multiple factors, for example, whether the applied land use change data can reflect the reality, and whether a continuous change in the vegetation boundary condition is considered in the modeling. To my knowledge, the existing modeling studies are mainly about sensitivity experiments which cannot exactly reveal what happened in the real world. This manuscript was also a sensitivity experiment. On the other hand, the change in soil moisture under the GFGP was associated with the investigated soil layer depths. The soil moisture above 1 m on the Loess Plateau was mainly controlled by precipitation.

3) As shown in Fig. 2g, the croplands mainly increased from 2015 to 2001, which is contrary to the expected fact. The applied land cover change data cannot reflect the reality well. Consequently, readers may wonder how much the simulation can represent the fact.

4) Lines 70–71: "Moreover, as far as we know, there has been no study investigating how the regional hydrology would be affected if further revegetation was undertaken." The current effects of land use/cover change still need to be further identified. Readers may want to know to what extent can we trust the conclusion of the study with further revegetation?

5) Lines 107–109: "The MCD12Q1 data were reprojected to Geographic Grid data with a resolution of 30 second (approximately 0.9 km) by the MODIS Reprojection Tool to make them suitable for WRF." Why didn't you resample the MCD12Q1 data into 10 km that is exactly the same to the domain 2?

6) Lines 155–156: "We note land cover change here, rather than revegetation or af-

forestation, for two reasons. First, actual land cover changes since the launch of the GFGP are highly spatially heterogeneous." However, the authors mentioned "revegetation" throughout the manuscript including the title and abstract. If the applied land cover change cannot represent the fact, the simulated conclusions cannot provide too much guidance for the implement of GFGP.

7) The significant changes (grey) in rainfall were not located in the main area of vegetation changing under the "Grain for Green Program" in Fig. 11l. What is the reason?

8) Lines 161–168: The used VEGFRA, LAI and α changes also incorporated other factors including improved agricultural management, climate variability, rising atmospheric CO2 concentration and nitrogen deposition. This may interfere the isolation of vegetation change effect. Please clarify.

9) As shown in Fig. 5c, the latent heat flux (ET) increased significantly almost across the Loess Plateau. However, the LAI and land cover almost didn't change in the region except the ELP and SLP (i.e., the region near the internally draining area). Moreover, the extent of changes in the green vegetation fraction was much larger than that of LAI (LC2015-LC2001). Please clarify the reasons. Additionally, what induced the changes in albedo in the region near the internally draining area? Furthermore, the LAI changed in the ELP and SLP regions, but there was almost no change in albedo. What is the reason? The Lines 248-250 need to be further explained.

10) The rainfall change mainly occurred in the region above the ELP (Fig. 7a), which was not consistent with the mainly occurring area of GFGP. What is the reason? Moreover, the convective rainfall increased and non-convective rainfall decreased for LC2015-LC2001 in Fig. 7. Please clarify the reason.

11) Lines 260–262: "Moreover, the increased rainfall in northeast Loess Plateau occurring in LC2015-LC2001 dissipate when further revegetation is implemented suggesting that this change is largely associated with internal model variability." However, the initial conditions were the same between LC2015-LC2001 and LCfutr-LC2001 with the only

differences in land cover and the biogeophysical parameters.

12) Suggest the authors to add one more figure of spatial P-ET changes which is highly correlated with runoff and soul moisture above 1 m.

13) The rainfall responses were obviously different in different years in Figure 10 under the same vegetation change. Please give some explanation. The Figure 12 was used to demonstrate the impact of model internal variability, but one important factor for the phenomenon may be the large variability in rainfall.

14) Lines 365–371: Generally, if a continuous simulation is conducted, much time will be taken. This may be why the simulation periods were usually not too long in a certain number of studies. If long time spans are considered, continuous simulations usually cannot be realized like this study (only including the growing season). On the other hand, the effects of land cover change are likely associated with the backgrounds of circulation, which suggests that the effects could be different for different research time periods. Tobella et al. (2014) reported that tree planting had both negative and positive effects on water resources in drylands and the net effect was the result of a balance between them. Similarly, this manuscript found that there existed both positive and negative effects of vegetation change on rainfall, and the effects were not small as stated in Line 267 and Fig. 6b. The authors concluded that the results show no impact on rainfall in most places of this manuscript. It seems that the expression is inappropriate because the negative and positive effects likely canceled each other out from 1996 to 2015.

15) Lines 307–316: It was first stated that “the RAIN increase in 2001 with an initial date of 1st May is likely associated with internal variability rather than land cover change.” Then, it was concluded “the multiyear averaged RAIN change over northeast Loess Plateau for LC2015-LC2001 (Fig. 7a) cannot be robustly linked with land cover change.” If the rainfall response was not associated with the land cover change, does it mean all the results in the manuscript were not linked with the vegetation change?

16) The authors mentioned that their simulations were at high resolution of 10 km many times in the manuscript. However, I don’t think a 10 km resolution is high nowadays.

17) Suggest the authors to give the study periods (1996-2015 or just 2001) in the figure captions.

18) Typo mistakes:

Line 20: Results suggests that...

Line 122: “As we only focus the growing season” should be “focus on the growing season”.

Line 308: “cf. Fig. 7a and 10f”

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