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Interactive comment on "The contribution of land-use change versus climate variability to the 1940s CO_2 plateau: Former Soviet Union as a test case" *by* Ana Bastos et al.

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Dear Authors,

here are additional comments from a reviewer. The reviewer is very critical to the quality and depth of your data collection and the modelling.

Sincerely yours, Yakov Kuzyakov

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Dear all,

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Discussion paper

Thanks for your heavy elaboration and clarification of the certain parts in the manuscript. This helped me a lot to understand your paper.

Let me shortly go over your major answers and point out the remaining critical aspects of your analysis and data you used, which I suggest improving and clarifying if you plan resubmit your paper to Biogesciences or to elsewhere. I have been noticed, your manuscript got already rejected for right now, but I still feel my second comments could help improving the manuscript.

1. You state, you are using state-of-the-art models and dataset to evaluate contribution of abandonment during WWII into CO2 plateau. I am more on the applied side of DVGM and other methods to estimate SOC dynamic due to LULCC, and this reflects, why I am so picky about utilized LULCC datasets. But let me add five cents on global DVGM and utilized datasets, such as HYDE 3.1. for LULCC modeling and carbon dynamic. Few words about HYDE. As you correctly stated in your manuscript, HYDE 3.1 FAOSAT data (cropland area) at the national level is implemented at country level. Cropland area does not track fodder crops, which is relevant for FSU. Thus, it does not match up data from Lyuri et al.,they used sown areas, which include fodder crops. It would be best to use here consistently the same source of information, such as stats from GOSKOMSTAT/ ROSSTAT, other official sources of FSU statistics on sown data. So, even if it is used widely for global studies (HYDE 3.1, K11), it does not necessarily mean the data is correct particularly for the regional studies, such as parts or entire FSU. For this reason, there were several studies, which tracked recently SOC due to LULCC for different parts of FSU, and then utilized, when it is possible, the official statistics at province level across different parts of FSU (Vuichard et al. 2008 http://doi.wiley.com/10.1029/2008GB003212, Kuemmerle et al. 2015 http://doi.wiley.com/10.1111/gcb.12897, Schierhorn et al. 2013 http://dx.doi.org/10.1002/2013GB004654).

Regarding, your modeling efforts, I did not find any contrasts with regional studies, which utilized DVGMs for your study area. Unfortunately, often validation of the outputs

of DVGMs is neglected produced numbers on SOC sequestration or release may vary quite a lot. As reviewer #1 also pointed out, you did not present and did not elaborate enough on validation of your model for such large region as FSU.

2. Now let me reflect on very important dataset you used to reconstruct cropland decline during WWII across FSU, namely reconstruction of sown area statistics. Thanks for clarification that you utilized Nove, Linz, Sapir, Davies for cross-reference and Maddison. I personally feel, you can delete this references and unnecessary text for few reasons. With the exception of few people, very few could easily access the stats from these books (I managed to download only work of Linz and just preordered the book of Nove). You could provide some permanent links to few key pages with data and key references to this data from Nove et al. I do not think, in this case, Nove publishing house would object. More importantly though, the sources of statistics, Nove and you utilized maybe the same, but not necessarily absolutely correct. There is no reason to argue that sown statistics from Goskomstat is better compared to FAOSTAT, so I would downplay spending so much time on data from other questionable sources (here I am asking why not then to use entirely stats on Gross Regional product and population from Soviet stats consistently?). But let me now shortly write down why statistics you utilized on abandoned land (declined crops) in your study requires additional elaboration or modification.

I managed to find and download the book you used. I am providing the link. https://drive.google.com/drive/folders/0Bzi0kSKsuOdgeFUzSFhraGFabWM?usp=sharing

You utilized the following statistics Goskomstat SSSR.

" These numbers were collected from: National economy of the USSR in the World War II (1941-1945). (Statistical Digest), Chapter 13: Agriculture (pp. 83-92). Goskomstat USSR, Information and Publishing Center, Moscow, 235 pp., 1990. (Narodnoe xozyajstvo SSSR v Velikoj Otechestvennoj vojne 1941-1945 gg. (Statisticheskij sbornik)., Goskomstat SSSR., Glava 13: Selskoe xozyajstvo (str. 83-92), Informacionno-

Izdatelskij Centr, Moskva, 235 s., 1990), (in Russian). Even though there is a gap of two years in 1941 and 1942, it is evident that the decrease in cropland area was not all located in the occupied territory."

If to look at the publication, this is minor, you provided wrong set of pages, this is surely minor (pp. 83-103). The most important though, the years for which there has been reported sown area statistics for the occupied area, namely 1940, 1943, 1944, 1945. By 1943 (and here we do not know if it was assessed for January 1st or by December 1943) there has been reported 23.1 Mha. However, by this time only a fraction of occupied area has been freed from Nazis. This means, Soviets could report only for those lands, which were able to control. I fully agree, a portion of abandoned lands on liberated territories could be abandoned (we also do not when abandonment actually started in 1941 or 1942). So only by 1945 the largest territory of FSU (including the Baltics) has been freed and here we confidentially by taking a difference between 1941 and 1945 to be on conservative safe side. Here we have then 19 Mha. It is much less than 64 Mha, but you can ensure avoiding issues with a lack of information for uncontrolled territories. Also a large portion of abandoned lands was actually abandoned for a year or two. This was also a reason, why I suggested to spatially differentiate and account in your models, where and when abandonment occurred. But I did not find any such spatial adjustment for your regional study.

I became further intrigued how Soviets could collect stats on occupied territories and decided to look at the definitions (p.4 National economy of the USSR in the World War II (1941-1945).). Here in Predislovie in Russian it says: ÂńĐš ŇĄĐśĐ¿ÑĂĐ¡ĐÿĐžĐţ Đ£ÑĂĐÿĐšĐţĐťĐţĐ¡ÑŃ ĐťĐřĐ¡Đ¡ÑŃĐţ ĐůĐř 1940 Đÿ 1943-1945 ĐşĐş. Đ£Đ¿ ÑĂĐřĐźĐ¿Đ¡ĐřĐij, Đ£Đ¿ĐťĐšĐţÑĂĐşÑĹĐÿĐijÑĄŇŔ Đ¿ĐžĐžÑČĐ£ĐřÑĘĐÿĐÿ. Đ§ÑĂĐÿ Ñ■ÑĆĐ¿Đij ĐůĐř ĐžĐřĐűĐťÑŃĐź ĐÿĐů ĐšĐ¿ĐţĐ¡Đ¡ÑŃÑĚ ĐžĐţÑĆ (1943-1945 ĐşĐş.) Đ£ÑĂĐÿĐšĐţĐťĐţĐ¡ÑŃ ĐťĐřĐ¡Đ¡ÑŃĐţ Đ£Đ¿ Đ¿ĐśĐžĐřÑĄÑĆÑŔĐij Đÿ ÑĂĐřĐźĐ¿Đ¡ĐřĐij, ĐžĐ¿ÑĆĐ¿ÑĂÑŃĐţ Đš ÑĆĐţĐžÑČÑĽĐţĐij ĐÿĐžĐÿ Đ£ÑĂĐţĐťÑŃĐťÑČÑĽĐÿÑĚ ĐşĐ¿ĐťĐřÑĚ ĐśÑŃĐžĐÿ

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Đ¿ÑĄĐšĐ¿ĐśĐ¿ĐűĐťĐţĐ¡ÑŃ Đ¿ÑĆ Đ¿ĐžĐžÑČĐ£ĐřÑĘĐÿĐÿ. ĐŮĐř 1940 ĐşĐ¿Đť Đš Ń■ÑĆĐÿÑĚ ÑĆĐřĐśĐżĐÿÑĘĐřÑĚ ĐśÑŃĐżĐÿ Đ£ÑĂĐÿĐšĐţĐťĐţĐ¡ÑŃ ĐťĐ¿ĐšĐ¿ĐţĐ¡Đ¡ÑŃĐţ ĐťĐřĐ¡Đ¡ÑŃĐţ Đ£Đ¿ ÑĆĐţÑĂÑĂĐÿÑĆĐ¿ÑĂĐÿĐÿ Đ¡Đř ĐijĐ¿ĐijĐţĐ¡ÑĆ ĐţĐţ ĐijĐřĐžÑĄĐÿĐijĐřĐžÑŃĐ¡Đ¿Đź Đ¿ĐžĐžÑČĐ£ĐřÑĘĐÿĐÿ Đš 1941- 1942 ĐşĐş.)Âż. I am translating this. ÂńIn the compendium there have been provided numbers for 1940 and 1943-1945 for the areas(can be also interpreted-districts or rayons), which suffered from the occupation. At the same time, for each of the war years (1943-1945) there have been provided the numbers for oblasts and areas (can be also interpreted-districts or rayons), which in the current and preceeding years were liberated from the occupation. For 1940 in tables there have been provided prior the war data for the territory of the maximum occupation in 1941- 1942Âż. This confirms my assumption that stats you used is representative for freed territory by 1943 but not for entire occupied area, however, we do not know exactly if this was reported by jan 1, 1943 or December 31, 1943.

Again, to regionally fine tune your study, I recommend to account for the spatial location of the occupation and a fraction of the potentially occupied area. You may consider to reconstruct land use at province (oblast) level (this stats is available), and then make plausible projections on abandonment for occupied provinces for eahc specific year. Solely relying on country level data complemented with global data, is not sufficient to disentangle regional spatially differentied processes.

Here are two examples of the maps on the advancement and retreat of Nazis

http://press.princeton.edu/chapters/haywood/s5_9519.pdf

https://en.wikipedia.org/wiki/Eastern_Front_(World_War_II)#/media/File:Eastern_Front_1943-08_to_1944-12.png

3. 13 Mha of cropland expansion for USA it is a large number as for any country too, including FSU. Taking into account large uncertainties with abandonment during WWII and more realistic 19Mha, this number has to be taken into account. I would

still heavily elaborate and contrast with other contributions to CO2 emissions, since AFOLU represents roughly 21 from total anthropogenic emissions of CO2. Reviewer 1, correctly pointed out, the importance to account for fires, burning, heavy extraction or forests by Nazis on occupied areas (e.g., Smolensk region). You take a hard task –to deal with large uncertainties with the numbers/ data you use and modeling approach, and you need to account for factors, which may balance out CO2 sink, in order to trust your numbers.

4. As you pointed out, and I reread your modeling approach, it would be best to avoid wording such as immediate forest regrowth, afforestation, rather establishment of seeds, shrubs regrowth. If you will spatially differentiate occupied lands, where occupation occurred, you will notice, a large portion of lands experienced SOC loss (thanks of for your figure). Even it has been occupied a large portion of temperate and northern regions, contribute probably not that much regarding cropland extent, compared to forest-steppe and southern regions (thanks for explanatory figure on spatially differentiated C pools and sinks).

Additional remarks.

L.15 p6. Howe sensitive your model to this threshold 0.85. how important this number compared to many other assumptions?

Table A1. Is it based on field data? How do these numbers vary across the study area? Some additional information on these numbers would be helpful.

Figure 1. I would just stick to your major storyline and will retain only FSU-Ref and FSE-New. Too much unnecessary details, with most likely, repeatable and questionable data.

To sum up, the storyline on wars and catastrophes and any socio-economic and environment shocks regarding land use and C dynamic is interesting and hot. However, the data you used (primarily data) and some assumptions right now downplay the va-

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lidity of your story and claims. This certainly makes for right now feeling contribution of land abandonment to explain the plateau is dubious. However, surely, any large scale abandonment represents a certain C sink, but how other factors may counterbalance such sink, have to be accounted as well. Nevertheless, I pointed the options to improve the manuscript to address raised issues well and to make your findings stronger and more trustful.

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