Interactive comment on "Sensitivity analysis of the GEMS soil organic carbon model to land cover land use classification uncertainties under different climate scenarios in Senegal" by Dieye, Roy, et al.

Response to Anonymous Referee #1

Our responses to the referee's Interactive Comments are below in red.

Dieye et al. studied the impact of the accuracy of land cover land use change information on simulated soil organic carbon in biogeochemical models. Tests were performed for three different climate change scenarios. I recommend publishing this paper in BG after addressing following issues:

1) There is a significant scale mismatch between climate and landcover data. How does this impact on the SOC estimates and the main findings of this study? Figure 3 for example reveals an unnatural chessboard pattern of the SOC map which blanks out variations caused by the landcover data.

Done:

We already note this scale mismatch issue (page 6608, lines 18-24): "*Figures 3 and 4 illustrate year 2000 GEMS SOC in the top 0–20 cm soil layer and the above ground NPP respectively. … Some spatial discontinuities are evident and are due to changes in certain GEMS input data, including the soil and climate data that are defined at coarser spatial resolutions than the 28.5m Landsat pixel dimensions.*"

We explain in Section 7.2.3 (page 6610, lines 2-11) "*The SOC varies between the 30 SOC soft decision tree classification estimates due to differences both in the LCLU classifications and to spatial differences in the GEMS model inputs. The 30 soft LCLU classifications are different because of differences in the training data sampling which causes differences in the LCLU class membership probabilities for each soft decision tree classification. In addition, the modeled SOC for a given class can vary significantly from one location to another as a function of the GEMS model inputs (soil, climate, land management etc). For this reason the sensitivity of the GEMS SOC model is dependent not only on the LCLU classification errors and the degree of generalization of the landscape into the LCLU classes, but also on where the classes occur relative to the other GEMS model inputs.*"

However, to address Referee #1's concern more clearly and to clarify that this issue impacts both the hard classification (alluded to by Referee #1), and the 30 soft classification results, **we request that the first paragraph of Section 7.2.3 (page 6610, lines 2-11) be revised to read**:

"The SOC derived from the hard classification (Figure 3) for a given LCLU class varies spatially due to spatial variation in the GEMS model inputs (soil, climate, land management etc). The SOC also varies between the 30 SOC soft decision tree classification estimates due to differences both in the LCLU classifications and to spatial differences in the GEMS model inputs. The 30 soft LCLU classifications are different because of differences in the training data

sampling which causes differences in the LCLU class membership probabilities for each soft decision tree classification. For these reasons the sensitivity of the GEMS SOC model is dependent not only on the LCLU classification errors and the degree of generalization of the landscape into the LCLU classes, but also on where the classes occur relative to the other GEMS model inputs."

Please note that the impact of this is quantified in Tables 4 and 5 which show for each LCLU class the minimum, mean and maximum SOC for the hard classification and for the mean of the 30 soft classifications.

2) I do not understand the climate scenarios set out in eq 1-4. What is the meaning of the additive constants. I understand a temperature change of 0.0133 deg per year. But why -26.6?

Done:

In this study, future climate scenarios were derived using the approach of Hulme et al. (2001) from projected future temperature and precipitation values for 2020, 2040 and 2060. We used these values to derive linear equations (recall that linear equations have the form y = a . x + b, where *a* is the slope and *b* the intercept) allowing prediction of the percent change in precipitation and the absolute change in temperature relative to 2000 for any given future year.

The intercepts in Equations 1-4 are necessary to ensure that the changes are zero valued in the start year 2000. For example, substitution of Year=2000 into Equation (1) provides a change of zero deg. C.

To make this very clear we request that (page 6598, lines 5-9) **be revised to read:**

"The additive constants in the above equations ensure that the LCCS and HCCS values are equal to the NCCS values in year 2000. In this way under the low climate change scenario by 2052 the temperature is 0.69ºC warmer with 13% less precipitation, and under the high climate change scenario by 2052 the temperature is 3.12ºC warmer with 28.6% less precipitation."

3) The dominant land cover of the study area is savanna and rainfed agriculture. Both exhibit a very high classification accuracy and low SOC. It can be expected that any statistic derived in this study is dominated by these two classes, restraining more interesting features. It would be interesting to separate the statistics for each class or at least to comment on it. The authors made a first attempt by stating that the area average show little variation between the scenarios but more significant changes are observed locally. But still the main findings are presented for the entire study area.

Not Done:

Respectfully we already have presented LCLU class specific results in Tables 4 and 5 and in Figure 6, and commented on them in detail, and we explicitly state in the last paragraph of the paper: *"The findings of this study indicate that the high local variability of SOC due to satellite*

classification errors should be taken into consideration, for example, using the method described here. This is particularly important as local-scale SOC variations imposed by satellite classification errors may obscure modeled temporal changes in SOC due to climate influences that may be highly land cover specific."

Respectfully, if we were to generate the results shown in Figures 7 and 8 for each of the 8 LCLU classes we would need 16 more plots which is beyond the journal page length limitations.