Earth Syst. Dynam. Discuss.,
https://doi.org/10.5194/esd-2016-58-AC2, 2017

Earth System
Dynamics
Discussions

Interactive comment on "Future supply and demand of net primary production in the Sahel" *by* Florian Sallaba et al.

Florian Sallaba et al.

jonathan.seaquist@nateko.lu.se

Received and published: 29 June 2017

We thank Dr. Pugh for providing constructive and insightful comments on our manuscript. Below, we provide a point-by-point response to each comment. Note that we have already made minor changes in our manuscript suggested by Dr. Pugh, and submit a marked up manuscript to show these. We also indicate changes made in our responses.

Thomas Pugh: I presume the LPJ-GUESS simulations used to calibrate the BME model were potential natural vegetation (would help if this was explicitly stated)? In which case I wonder how effectively NPP of natural ecosystems can be used as a proxy for NPP of agricultural ones. NPP is not independent of plant type, and the distinction between natural vegetation, which may well be woody, and cereal and pasture vegetation may be particularly relevant in the Sahel, where the deeper roots of trees may have access to water resources that herbaceous plants cannot use. Can the authors demonstrate that such effects are not large, both in the LPJ-GUESS model and also based on any observations in the Sahel or analogous ecosystems?

Authors' Response: The LPJ-GUESS (C-N) simulations used to calibrate BME were based on potential natural vegetation and we have already made this change in the manuscript. In order to test how effectively the NPP of natural ecosystems can be can be used as a proxy for the NPP of agricultural ones we ran LPJ-GUESS managed land (C-N version) for the period 1970 to 2010 and compared this to LPJ-GUESS (C-N, and used to develop BME), for the greater Sahel region defined in our manuscript (note that for comparison purposes, we also provide runs of LPJ-GUESS (C-only), BME and MOD-17). The results (see Figure 1) of this experiment show that mean NPP derived from LPJ-GUESS ml over the region underestimates mean NPP derived from LPJ-GUESS by 2.4% (0.02 kg dry-weight m-2 yr-1), though both models show similar levels of interannual variability and trend (see Figure 1). The implication of this experiment is that there is a demonstrable reduction in NPP when land management is taken into consideration, but the effect is relatively minor. The one caveat is that modelled crop yield in LPJ-GUESS (C-N) produces estimates of potential yield for various crops, rather than actual yield, therefore representing an upper limit to actual yield. Lindeskog et al. (2013) show that LPJ-GUESS managed land (C-version) overestimates actual yield derived from FAO country-level crop statistics. Smith et al. (2014a) also report that natural systems are more productive than agricultural systems in sub-Saharan Africa. We conclude that our results are likely in the upper range for NPP in the Sahel, and that our analysis across the scenarios regarding the advent of supply shortfalls is optimistic. We will be willing to add this point to the discussion in a revised version of our manuscript.

Thomas Pugh: Whilst the BME model is evaluated against LPJ-GUESS, any evaluation of the extent to which LPJ-GUESS can accurately represent actual NPP in the Sahel region is lacking. The references given (pg. 4 l. 14) did not address this ecosystem and also used a version of the model lacking carbon-nitrogen interactions, which leads to quite different vegetation simulations for the Sahel (Smith et al., 2014). Evaluation of the model response for the Sahel is necessary to give credence to the comparisons of supply and demand, which strongly depend on simulated absolute values for NPP. Whilst there is no gold-standard NPP (or GPP) dataset to compare against, comparison against NPP from the ESMs used to assess uncertainty, along with comparison of GPP against the alternative approaches of Jung et al. (2011) and Zhao et al. (2005) could go a long way towards increasing confidence. Alternatively (or additionally), FAO yield statistics could be used to evaluate the "yields" calculated here. Although none of these sources of comparison are likely to be low in uncertainty in the Sahel region, as it stands we have no idea how well LPJ-GUESS performs in this region - and current DGVMs cover a wide range of possibilities at regional scales (Sitch et al., 2015).

Authors' Response: Firstly, thank-you very much for highlighting these validation issues. We compare total yearly means of NPP from LPJ-GUESS (N-C) to NPP derived from the MOD-17 processing stream for the period 2000 to 2006 for the greater Sahel region as defined in our manuscript. Our results show that MOD-17 derived NPP underestimates modelled NPP from LPJ-GUESS N-C by 43% (0.37 kg dry-weight m-2 yr-1) (Figure 1). Despite this, the R2-value between the two series is 0.8 suggesting similarity in both interannual variability and trend. Ardö (2015) also reports that that average annual MOD-17 NPP underestimates LPJ-GUESS (C version) for Africa for 2000-2010 and attributes this to the fact that autotrophic respiration is considerably higher for MOD17 compared to LPJ-GUESS, due to large temperature sensitivity in the MOD17 algorithm, differences in the biome-specific parameterizations in MOD-17 as well as specification of plant functional types in LPJ-GUESS.

We also gauged LPJ-GUESS (N-C) and BME performance for estimating NPP with NPP field-measurements from Michaletz et al. (2016) and Luyssaert et al. (2009) at the

biome level (see Sallaba et al., 2015) for the Major Biome Classification of Reich and Eswaran (2002) including the biomes found in the Sahel (Desert Temperate, Tropical Semi-arid and Tropical Humid). Note that since only two observations were available for our study area (see Figure 2) this evaluation demonstrates the ability of both LPJ-GUESS and BME to replicate NPP for Sahel biomes but found elsewhere in the world.

Before we combined the Michaletz et al. (2016) and Luyssaert et al. (2009) datasets, we removed sites with no records of combined above- and below-ground NPP measurements. After we merged the data, we checked the final assembly of NPP measurements for duplicates and removed them. The final dataset consists of 1561 samples (i.e. 1247 samples from Michaletz et al. (2016) and 314 samples from Luyssaert et al. (2009)) representing total NPP measurements across the terrestrial biosphere (sample sizes are 18, 6, and 12 for Sahel biomes of Desert Temperate, Tropical Semi-arid and Tropical Humid, respectively) from 1959-2006. Both LPJ-GUESS (N-C) and BME were driven with CRU TS 3.21 climate data (Harris et al. 2014, Trenberth et al. 2014) that has global coverage across the time period. We calculated mean values of the NPP field-measurements and the modelled NPP estimates located in the respective biomes, following Smith et al. (2014b). We aggregated to the biome-level to account for the difference in scale between in situ NPP measurements and modelled grid cell NPP estimates (being grid cell averages).

Finally, we determined the overall model performance, biome-by-biome, with the coefficient of determination (R2 value) and the root mean square error (RMSE). Additionally, we investigated model agreement with performance ratios (hereafter referred to as 'Q') by dividing mean biome NPP estimates (for both models) with mean biome NPP observations. Model overestimation in comparison to in situ NPP measurements is indicated by Q > 1 and underestimation by Q < 1. Good model performance is classified with a Q range between 0.9-1.1 assuming an error of ± 10% following Sallaba et al. (2015). However, we further defined an acceptable model performance error range of ±20% (i.e. Q = 0.8-1.25) given the limitations of using LPJ-GUESS (C-N) standard modelling protocol, PNV and CRU climate observations, and especially the simplicity of BME.

LPJ-GUESS (N-C) performs reasonably well in simulating NPP at the overall biome level (R2 = 0.71 and RMSE = 0.16) but the model performance varies notably across the biomes (see Figure 3 and Table 1). In general, LPJ-GUESS (N-C) yields acceptable model agreement in seven (with good performance in four biomes) out of thirteen biomes. At the same time, the model underestimates NPP in three biomes while it overestimates NPP in two biomes as shown in Figure 3.

For Greater Sahel biomes: LPJ-GUESS (N-C) exhibits good skill in simulating NPP in the Tropical humid (Q = 0.96, see Table 1) where it also captures satisfactorily the variability of the NPP measurements. LPJ-GUESS (N-C) underestimates NPP for the tropical semi-arid biome (Q = 0.75) showing reduced NPP variation compared to the observations. Performance is reduced for Desert temperate (Q =0.56).

BME performance is acceptable at the overall biome level (R2 = 0.57 and RMSE = 0.26) but varies substantially for individual biomes (see Figure 4). Overall, BME model agreement is reasonable in four biomes (with good performance in two biomes). At the same time, BME overestimates NPP in two biomes while it underestimates plant growth in six biomes. The variability in in- situ NPP measurements cannot be captured by BME in the majority of biomes except in the tropical humid and tundra permafrost biomes (see vertical and horizontal lines connected to the diamonds in Figure 4).

For Greater Sahel biomes: BME yields acceptable agreement in estimating NPP in the tropical semi-arid and tropical humid biomes (Q = 0.84, 0.81 respectively) but accuracy drops more water limited biomes of desert temperate (Q = 0.28).

Overall, BME mimics the behavior of LPJ-GUESS (N-C) , shown by a good model agreement of R2 = 0.71 and moderate RMSE = 0.12 kg C m-2 yr-1 between the average biome NPP estimates of BME and LPJ-GUESS (N-C). BME yields on average less NPP in the majority of biomes compared to the observations. In sum, a comparison with MOD-17 shows that LPJ-GUESS N-C (and BME) overestimates total mean annual

NPP in the greater Sahel region (2000-2006) while a validation involving ground measurements for the same biomes found in the Sahel (but observations mostly from other locations) show that LPJ-GUESS (N-C) and BME underestimate NPP. Differences are due to a combination of spatial aggregation/sampling issues (e.g. low sample sizes for biomes typically found in the Sahel, that CRU data do not necessarily represent site-level climate, and the uncertain assessment below-ground and short-lived above-ground plant matter at the site level) as well differing assumptions between the MOD-17 processing stream and LPJ-GUESS (N-C) (particularly respiration). We conclude that LPJ-GUESS (N-C) and BME replicate ground observations of NPP at similar orders of magnitude at the biome level. This underscores the fact that LPG-GUESS (N-C) and BME should be restricted to biome-level applications (or coarser) while applications on the grid cell level should be limited to explorations of patterns and trends, which is the reason why, in our manuscript, we emphasize an aggregated level.

We would be happy to include, in the appendix of a new version of our manuscript, a complete description of this validation exercise.

Thomas Pugh: On the theme of evaluation. I'm not clear from the manuscript if PLUM land-use simulations are normalised in some way to the dataset of Hurtt et al. (2011) in 2000, or if they represent a purely "PLUM version" of the Sahel land-use in 2000. The former would raise the question of how much the model drifts from the observed towards its preferred state at the start of the simulations. The latter suggests the need for a comparison of the PLUM initial state with current observation-based estimates (such as Hurtt et al., 2011). I realise there are significant difficulties in modelling actual land-use, but surely the size of any discrepancies and the resulting implications should be discussed?

Authors' Response: The Hurtt et al. (2011) data for the year 2000 is used as basis, and we will make sure to clarify this in the updated manuscript. In the table below the scaling factors for the year 2000 are shown, these numbers will be added to the Appendix, possibly to Table C1. The scaling factors are the per country ratios Hurtt:PLUM.

Thomas Pugh: pg. 2 l. 31. Why does a 31% population increase lead to a 100% increase in NPP requirement? What information is missing here?

Authors' Response: The line from our original manuscript is reproduced here:"Abdi et al. (2014) also showed that 19% of the NPP supply in the Sahel was able to satisfy demand for the year 2000 but this increased to 41% in 2010 due to a 31% increase in the population." Abdi et al. (2014) point out that NPP demand increased at an annual rate of 2.2% between 2000 and 2010 while the supply was near constant. So, in relative terms, the doubling in NPP demand is simply because there is less NPP supply to service the increase in population. We have already clarified this in our manuscript.

Thomas Pugh: pg. 6 l. 16. I'm confused about the cropland cover, I thought it was taken from PLUM? How is Hurtt being used here?

Authors' Response: Please refer the previous response.

Thomas Pugh: pg. 6 l. 23. Surely the total amount of NPP for human appropriation must be the sum of NPPcereal_demand and NPPgrazing_demand, not just NPPcereal_demand alone? As parts of both cereal and grazing demand contribute to animal raising, the current definition is inconsistent. Was it meant to be something like "total amount of annual NPP for human appropriation via cropland"?

Authors' Response: We have already changed this sentence to read "total amount of annual NPP for human appropriation via cropland." Indeed, we explicitly distinguish between the demand of cereal and pasture products. Cereal demand is given in Equation 1 of the manuscript, while grazing demand is given in Equation 9 (not Equation 8 as stated in the first version, Appendix A3 – we have changed this too). Cereal-based and grazing-based supply-demand balances are then computed separately. They are then summed according to Table 1 of the manuscript in order to determine final balances of supply and demand of NPP.

Thomas Pugh: The SSP-RCP scenario likelihoods seem rather important. Rather than referring the reader to another paper, maybe you could include them in this analysis? For instance along the right y-axis of Fig. 3b?

Authors' Response: Table 3 shows the scenario likelihoods, and is the same as Table 4 found in Engström et al. (2016). We would be happy to include them in a new version of the manuscript. Note that these likelihoods refer to the most consistent SSP-RCP combinations (e.g. it is more likely that the sustainability assumptions for SSP1 would yield greenhouse gas concentrations in line with RCP4.5/6 rather than RCP2.6/8.5).

Thomas Pugh: pg. 7 l. 29-33. This text reads as if it was originally located before the first paragraph of 2.1.3, and some of the text would seem to be more logically located there, where this likelihood matrix is first mentioned.

Authors' Response: We have already moved this information to the suggested location in our manuscript.

Thomas Pugh: pg. 9 l. 11. I would say that the shortfalls in SSP5-RCP6.0 and SSP5-RCP8.5 are pretty sustained. They just don't run to the end of the century. Consider rephrasing? More generally, regarding the discussion of "shortfalls", it seems strange that you only consider shortfalls to occur when the 95% confidence limits do not overlap (and demand is higher of course). To my mind this lack of overlap of the confidence limits suggests very high likelihood of shortfalls, but the best guess result shows shortfalls occurring for a larger number of scenarios. For instance, on pg. 11, l. 26 it is stated that "statistically significant shortages never develop" in the context of SSP1, but that doesn't seem quite right. Assuming non-skewed distributions of uncertainty (big assumption, I know), then when the best estimate of demand exceeds the best estimate of supply there is a more than even chance of shortages occurring, but it's not possible to say with high certainty that a shortage will occur until the 95% limits no longer overlap. Consider rephrasing also?

Authors' Response: These items have been rephrased, here we produce a suggestion for a rewritten portion of the results that, if acceptable, we would be happy to include a revised manuscript:

“Per capita demand exceeds supply in the early 2040s for SSP2-RCP6.0 after which a very high likelihood for shortfalls begin in 2070 (see black dots in Fig. 3a showing non-overlapping 95% confidence limits). By 2050, per capita demand almost doubles while per capita supply drops by almost 30% for the same scenario. Across the scenarios, differences in the timing of the start of persistent supply shortfalls with high certainty (see black dots in Fig. 3b) are observed. Three of these high likelihood shortfalls begin at 2050 or before (SSP5 scenarios – see black dots in Fig. 3b) while an additional six display shortfalls with high certainty by the end of the 21st century (black dots in Fig. 3a, b). Out of these nine, two scenarios never achieve a sustained run of shortfalls (SSP2-RCP6.0, SPP2-RCP8.5).). In total, there is better than an even chance for shortfalls before 2050 for 9 scenarios (exceptions are SSP1-RCP2.6, SSP1-RCP6.0, and all SSP4 scenarios).

Variations in the timing of onset and end of supply shortfalls are generally greater between the SSPs than between the RCPs (Fig. 3b). For SSP2 and SSP3 scenarios, onsets of high likelihood supply shortfall range from the early 2050s to the mid-2070s (even chance from late 2030s to early 2050s). The SSP5 family shows the largest deficits of high likelihood shortfalls beginning in the 2040s-2050s (even chance from the early 2030s), and after several decades of deepening begin to diminish in the 2080s. Shortfalls with high certainty never emerge for SSP1 (even chance from the early 2050s) while the SSP4 scenarios show sustained but diminishing surplus throughout.”

Thomas Pugh: pg. 9 l. 22. Reference to Table 3 here?

Authors’ Response: We have already referred Table 3 at this location in our manuscript.

Thomas Pugh: pg. 12 l. 3. Regarding, "so strong efforts should be made to reduce these gaps", this is too simplistic. Efforts to close yield gaps have other environmental

and socio-economic consequences which are not addressed here, meaning that this statement cannot be supported by the presented evidence. I suggest to remove this recommendation. Going beyond this however, can you say anything about the potential additional yield by closing yield gaps in this region, and whether such efforts could alleviate the shortages simulated? Maybe PLUM can provide the necessary data?

Authors’ Response: We will remove this recommendation in a revised manuscript. And thank you very much for suggesting this experiment, which we have now conducted. We find that closing production gaps in the greater Sahel for the year 2050 (the mid-century point of reference given in our manuscript), for the scenario SSP2-6.0, would result in a change in mean per capita NPP balance from -107 kg DW yr-1 (see Table 3 in the manuscript) to 9 kg DW yr-1 – though the balance for many countries will still be negative, but reduced in magnitude. We conclude that closing yield gaps in the region could indeed alleviate the simulated shortages by mid-century. We would be happy to briefly treat this aspect in the discussion of a revised manuscript.

Thomas Pugh: pg. 12 l. 24. Where is the attribution of supply increases to additional rainfall and CO2 fertilisation shown in the results?

Authors’ Response: Fig 5 shows that for SSP2-RCP6, CO2 contributes far more to the increase in NPP compared to rainfall for the greater Sahel region. I order to produce the combined effect of CO2 and rainfall, we compared a simulation where both variables taken from the scenario were compared with a simulation where both were held constant from the year 2000 through to 2050. In order to isolate the CO2 (rainfall) effect, we compared a simulation where rainfall (CO2) was held constant with the simulation where both were held constant. We performed these simulations for RCP 6.0 for all GCMS. The mean of the scenarios are shown in Figure 5. We can add these findings to the results section of our manuscript.

Thomas Pugh: pg. 13 l. 7. The relative attribution of supply growth to climate/co2 and closure of yield gaps would be very informative, allowing the results to be interpreted more subtly. Your approach seems to be suitable to make this isolation.

Authors' Response: Fig 5 shows that for SSP2, the reduction in yield gap between 2000 and 2050 contributes slightly more to the increase in NPP than CO2 for RCP 6.0, and in turn much more than rainfall for the same climate scenario. We can update our manuscript to account for the yield gap effect.

Thomas Pugh: pg. 13 l. 12. I would take the opposite view. The extent to which models appropriately represent CO2 fertilisation is not clear, and the difference in NPP trends between models is very large (e.g. Friend et al., 2014; Körner, 2006; Pugh et al., 2016; Rosenzweig et al., 2014). Therefore, I think it is fair to say that we have no more confidence in the trends than we do in the absolute levels. Moreover, the reference here to Fig. A2 does nothing to support the point, as the point of comparison is an LPJ-GUESS simulation, not observations.

Authors' Response: Thanks very much for highlighting issues with the trends. Please see our response to Anonymous Review # 3 for a broader discussion of the trends (e.g. responses to comments #3 and #6). We suggest modifying our sentence in a revised version to:

“Uncertainty exists with respect to the total magnitude and trends of simulated NPP supply (given the lack of ground truth for the region, and that differences in NPP trends between models is very large (e.g. Friend et al., 2014; Körner et al., 2006; Pugh et al., 2016; Rosenzweig et al., 2014). Therefore, our emphasis is on the structural analysis of NPP supply and demand across a range of scenarios. This also serves to demonstrate the usefulness of our overall approach for this application.”

Thomas Pugh: pg. 13 l. 22. You could also briefly mention irrigation water availability projections here (Elliott et al., 2014).

Authors' Response: We suggest the following alteration a revised version of the manuscript

“However, Elliott et al. (2014) underscore that freshwater limitations in the dryer regions of the globe could limit agricultural production, and even lead to the reversion of irrigated farmland to rainfed farmland thereby negatively affecting food production. Conventional agricultural intensification can result in environmental degradation, vulnerability to pests, and depletion of aquifers (Ceccato et al., 2007; Foley et al., 2005).”

Thomas Pugh: pg. 1, l. 20. "surplus, while" pg. 1 l. 23. "diet" pg. 2 l. 13. "global food security is not ensured" pg. 2 l. 16. "world, where" pg. 2 l. 19. "own land, where", also full stop missing after "pastoralism" pg. 4 l 32. Should "estimates to the total area", read " estimates to sum over the total area"? I don't think you translated NPP to total area literally? pg. 5 l. 22. Replace "Furthermore" with "Therefore" pg. 5 l. 32. "choice, and the" pg. 6 l. 13, 14, 20. "Fig. 2" should be "Fig. 1"? Also there are several boxes in red in Fig. 1 so "box outlined in red" is of limited use, and the distinction between cereal and pasture products can't be seen in the picture. pg. 8 l. 4. "Hence, one" pg. 10 l. 2. Only two countries are listed. pg. 12 l. 26. "mobilization is one method local" pg. 12 l. 31. "increase" pg. 14 l. 2. I think this would read better as "the Sahel is likely to experience NPP shortages in most SSP scenarios due to" pg. 14 l. 7. Reference formatting. pg. 14 l. 25. "show" rather than "assume"? pg. 15 l. 2. "will outstrip supply during the 21st century". pg. 15 l.12. "unfolds, a relatively"

Authors Response: These have been fixed.

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Please also note the supplement to this comment:
https://www.earth-syst-dynam-discuss.net/esd-2016-58/esd-2016-58-AC2-supplement.pdf

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Interactive comment on Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2016-58, 2016.

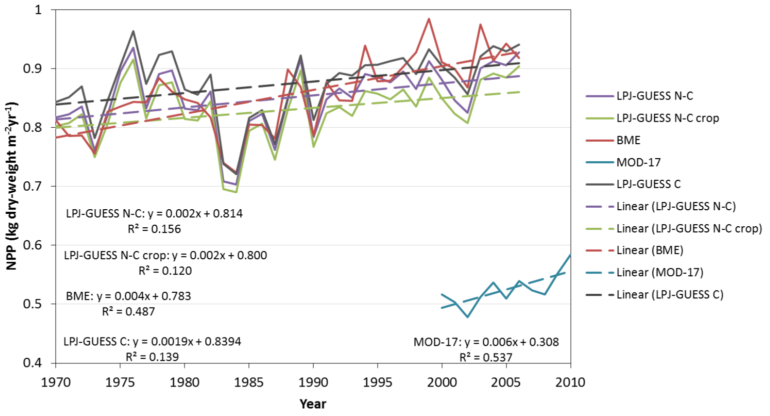


Fig. 1. Total mean annual NPP for the greater Sahel with runs of different versions of LPJ-GUESS, BME, as well as MOD-17.

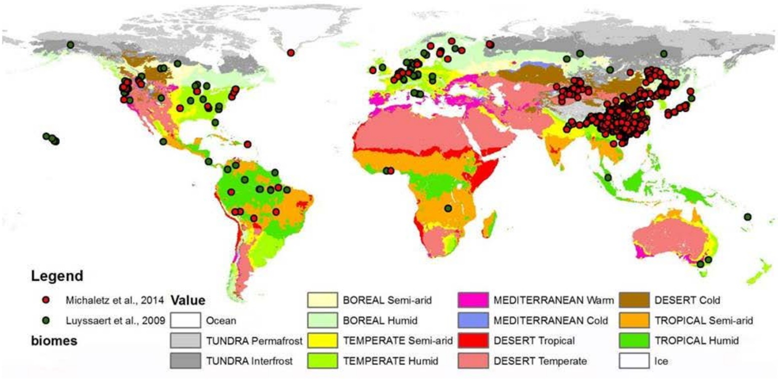


Fig. 2. Map of the Major Biome Classification based on Reich and Eswaran (2002). The red and green points are the locations of the NPP field-data from Michaletz et al. (2016) and Luyssaert et al. (2009)

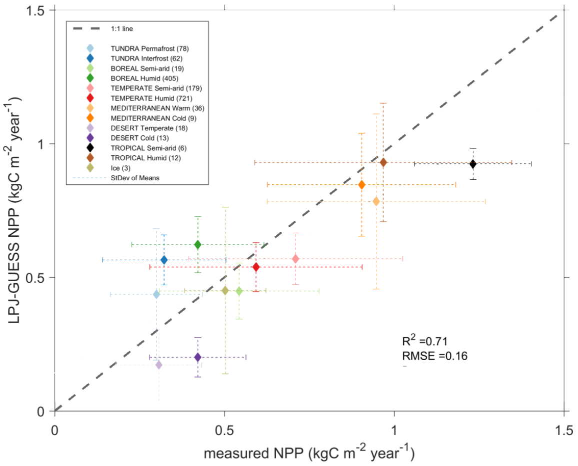


Fig. 3. Comparison of LPJ-GUESS (N-C) through NPP estimates and NPP field-measurements at the biome level using biome mean NPP values and their standard deviation. The different colours represent MBC

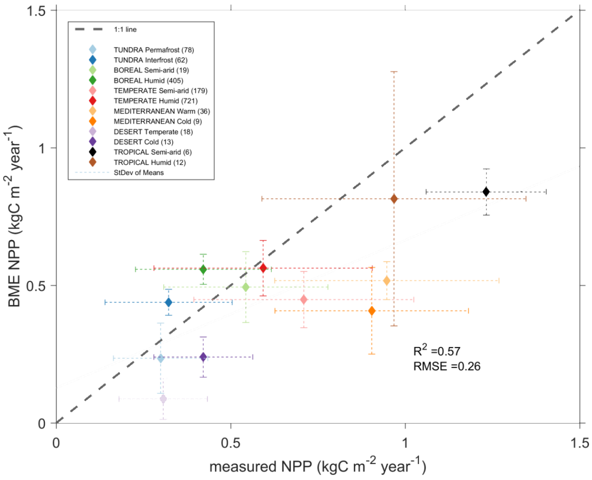


Fig. 4. Comparison of BME NPP estimates and NPP field-measurements on biome level using biome mean values as well as biome standard deviation of the means. The different colours represent MBC biomes

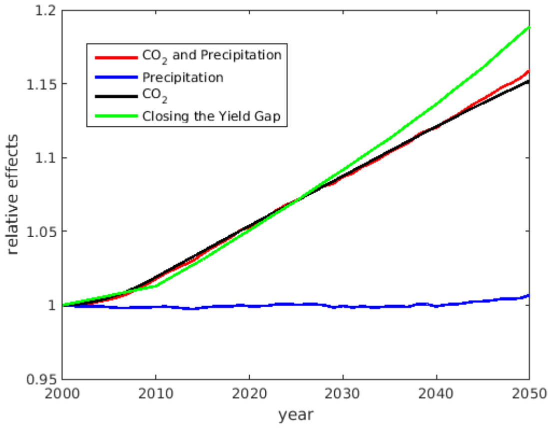


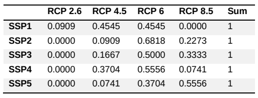
Fig. 5. The relative contributions of CO2, precipitation and yield gap closure to the increased NPP over the greater Sahel region. Results for CO2 and precipitation are from the RCP 6.0 and yield ga

Biome (sample size)	Field-data mean NPP [kg C m^{-2} yr^{-1}]	LPJ-GUESS mean NPP [kgC m^{-2} yr^{-1}]	LPJ-GUESS Q	BME mean NPP [kgC m^{-2} yr^{-1}]	BME Q
TUNDRA Permafrost (78)	0.30	0.44	1.46	0.24	0.79
TUNDRA Interfrost (62)	0.32	0.56	1.75	0.44	1.36
BOREAL Semi-arid (19)	0.54	0.45	0.83	0.49	0.91
BOREAL Humid (405)	0.42	0.62	1.48	0.56	1.32
TEMPERATE Semi-arid (179)	0.71	0.57	0.80	0.45	0.63
TEMPERATE Humid (729)	0.59	0.54	0.91	0.56	0.95
MEDITERRANEAN Warm (36)	0.95	0.78	0.83	0.52	0.55
MEDITERRANEAN Cold (9)	0.90	0.85	0.94	0.41	0.45
DESERT Temperate (18)	0.31	0.17	0.56	0.09	0.28
DESERT Cold (13)	0.42	0.20	0.48	0.24	0.57
TROPICAL Semi-arid (6)	1.23	0.92	0.75	0.84	0.68
TROPICAL Humid (12)	0.97	0.93	0.96	0.81	0.84
Ice (3)	0.50	0.45	0.90	-	-

Fig. 6. Table 1 Comparison between mean biome NPP field-measurements, LPJ-GUESS (N-C), BME NPP estimates; and their Q as model performance measure. Sahel biomes are underlined.

Country	Scaling factor
Benin	0.8898
Burkina Faso	0.8996
Cameroon	1.0436
Central African Rep	0
Chad	1.0047
Cote d'Ivoire	0.9751
Djibouti	0
Eritrea	1.1015
Ethiopia	0.9798
Gambia	1.5776
Ghana	1.0246
Guinea-Bissau	1.253
Guinea	1.7329
Liberia	0.906
Mali	0.9698
Mauritania	0.9726
Niger	1.0142
Nigeria	1.0363
Senegal	0.7394
Sierra Leone	0.9939
Sudan	0.9801
Togo	1.1044

Fig. 7. Table 2 Hurtt:PLUM scaling factors per country for year 2000



	RCP 2.6	RCP 4.5	RCP 6	RCP 8.5	Sum
SSP1	0.0909	0.4545	0.4545	0.0000	1
SSP2	0.0000	0.0909	0.6818	0.2273	1
SSP3	0.0000	0.1667	0.5000	0.3333	1
SSP4	0.0000	0.3704	0.5556	0.0741	1
SSP5	0.0000	0.0741	0.3704	0.5556	1

Fig. 8. Table 3: Scenario-matrix translated to quantitative probabilities