We thank reviewer 1 for the encouraging comments and good suggestions. We respond in detail to the reviewer's comments below (the reviewer's comments are numbered and our responses are given immediately below each comment).

***General Comments:***

***Overall, the paper is well written, clearly structured and methodologically sound. However, it does not become clear from the text how the uncertainties are calculated (Page 16358, Line 1 -7).***

Response: The following is added in the revised manuscript to describe how the uncertainties were calculated.

"Uncertainties are propagated in quadrature (Eq. 3). The assumption here is that the variables involved are uncorrelated and normally distributed.

$$\left(\frac{\sigma_{TP}}{TP}\right)^2 = \sum_{i=1}^{3}\left(\frac{\sigma_{x_i}}{x_i}\right)^2 \qquad \text{Eq. 3}$$

where TP is total P, σ is standard deviation and $x_1$, $x_2$, $x_3$ stand for PPDI, Hedley faction and soil strain respectively. "

***The manuscript may further benefit if the following two points would be addressed in more detail:***

***1. It is known that biological processes influence the soil P distribution for example by plant uptake, immobilization, biological and biochemical mineralization, biologically enhanced weathering etc. These processes are not accounted for in this study and a more detailed discussion on these processes and in what respect the results are affected by them may be beneficial.***

Response: This study tackles soil P estimates on the global scale using a data informed approach so we are not explicitly considering the biological processes such as plant uptake, immobilization, and mineralization (biological and biochemical). Processes-based models including these biological processes are needed in conjunction with our maps in order to improve the estimates of soil available P. We have revised the last paragraph in the discussion section to emphasize this point.

"Here we are not explicitly modeling various P processes in terrestrial ecosystems over geological time scales to provide initial conditions for global models, as it requires unrealistic computational time. We acknowledge that although our data-based approach can provide a reasonable initial condition for global biogeochemical models, they may not be accurate at local or regional scales due to lack of consideration of specific processes at those scales. For example, biological processes such as plant uptake, immobilization, biological and biochemical mineralization, biologically enhanced weathering etc., can influence soil P distribution. These processes are not explicitly accounted for in this study but are considered in most biogeochemical models that

include P cycle (Wang et al., 2010;Goll et al., 2012;Zhang et al., 2011). We recommend these maps provided here to be used in conjunction with process-based models as a reasonable starting point for describing soil P distribution and availability at regional and global scales and to improve our understanding of P dynamics in terrestrial ecosystems "

***2. The Hedley fractionation method does not provide fractions which would not directly translate to physiological fractions, for example labile P is not the same as plant available P (Cross & Schlesinger (1995), Yang & Post (2011)). However, in the few model studies labile P is treated as plant available (Wang et al. (2010), Zhang et al. (2011), Goll et al. (2012)). As this manuscript aims at the modeling community, a few sentences on the interpretation of the here used soil P classification used in this study from a mechanistic/physiological point of view would be helpful.***

Response: In Hedley fractionation method the amount of P that is liberated during extractions with anion exchange resin followed by 0.5 M $NaHCO_3$ is assumed to represent most readily available P, but these fractions may contain more or less P than is actually biologically available. Depending on the model structure and time step, labile inorganic P from Hedley fractionation method may or may not be treated as plant available P. For the previous model studies with daily time step (Wang et al., 2010;Goll et al., 2012) we think it is not unreasonable to treat labile P as available P. However if the model has a much shorter time step (hourly or less), it is not appropriate to treat labile inorganic P as available P.

We have added the following text in the revised manuscript to make this point clear.

"Labile inorganic P contains more or less P than is actually biologically available since in Hedley fractionation method it is defined through the sequential extraction procedure (extractions with exchange resin followed by 0.5 M $NaHCO_3$,each for 16 hours).From the modeling perspective, whether or not labile inorganic P can be treated as available P depends on the model structure and time step. It is reasonable to treat labile inorganic P as available P in models with daily time step (Wang et al., 2010;Goll et al., 2012). However if the model has a much shorter time step (hourly or less), it is not appropriate to treat labile inorganic P as available P. "

***Minor comments***

***Please change Durr to Dürr.***

Response: It is changed now

***Page 16350, Line 1: There are a few modeling studies which indicate a need to represent P for simulating the terrestrial C cycle, for example Zhang et al. (2011) (present day), Goll et al. (2012) (21st century). You may want to cite them.***

Response: These have been cited in the revised manuscript.

**Page 16354, Line 2 +5: The publication was published 2012, not 2011. Line 5 “et al.” is missing.**

Response: The reference has been corrected.

**Page 16354, Line 15. you may add that the term “volumetric soil strain” is discussed later in section 3.3.**

Response: It is added now.

**Page 16360, Line 13: you may add the estimate on soil organic P by Goll et al. (2012) (5.7 Pg)**

Response: It is added now

**Page 16360, Line 22: you may add the estimates on secondary P by Wang et al. (2010) (1.7Pg) and by Goll et al. (2012) (1.3Pg)**

Response: The estimates by Wang et al. (2010) (1.7Pg) and by Goll et al. (2012) (1.3Pg) have been added.

**Page 16376: Table 4.: Uncertainty estimates would be beneficial.**

Response: it is added now.

**Page 16378: Figure 3: The coloring can be improved as the concentrations differ strongly among the different soil P forms.**

Response: We have re-plotted all the maps so each map has its own color bar.


Goll, D., Brovkin, V., Parida, B., Reick, C., Kattge, J., Reich, P., van Bodegom, P., and Niinemets, U.: Nutrient limitation reduces land carbon uptake in simulations with a model of combined carbon, nitrogen and phosphorus cycling, Biogeosciences, 9, 3547-3569, 2012.

Wang, Y.-P., Law, R. M., and Pak, B.: A global model of carbon, nitrogen and phosphorus cycles for the terrestrial biosphere, Biogeosciences, 7, 2261-2282, 10.5194/bg-7-2261-2010, 2010.

Zhang, Q., Wang, Y., Pitman, A., and Dai, Y.: Limitations of nitrogen and phosphorous on the terrestrial carbon uptake in the 20th century, Geophysical Research Letters, 38, L22701, 2011.