Response：

We thank the reviewer for providing further comments on our manuscript. The reviewer reiterated his/her concerns about the method we used to develop the land surface parameters for CLM and further emphasized his/her view on the importance of using vegetation fraction data to develop land surface parameters. While we agree with the reviewer on the importance of vegetation fraction in defining land surface parameters, we do not think that there is an accepted or "correct" way to derive PFT parameters. The issue stems from limitations in global datasets available to derive different land surface parameters. Thus far, global vegetation fraction information is available from three sources: (1) 1km Continuous Fields Tree Cover Product for 1992-1993; (2) MODIS 500m Vegetation Continuous Field (VCF) Collection 3 for 2001, which contains continuous tree, herbaceous and bare soil coverage information, but the herbaceous and bare soil coverage data have never been evaluated or validated; (3) MODIS VCF Collection 5 for 2005, which only contains fractional tree cover data. Among the three datasets, only MODIS VCF Collection 3 provides overall vegetation (tree + herbaceous) and non-vegetated fraction.

In developing our method, we had considered combining the bare ground percentage from the MODIS VCF Collection 3 product with MODIS land cover data to produce the PFT composition. However, we decided against this because the MODIS VCF data has not been validated. For example, the CLM4 bare ground coverage derived from the MODIS VCF Collection 3 bare soil percentage is much higher than that estimated by Poulter et al. (2011), Bonan et al. (2002), and Jung et al. (2007). In contrast, the bare ground coverage we derived using our method is much closer to the above studies and the NLCD bare ground fraction over the U.S. (Figure 4 of the manuscript). Therefore, it is very likely that the MODIS VCF product generally overestimates bare ground percentage, although it may well be superior in some regions dominated by less homogeneous landscape such as the shrub land in Australia, as pointed out by the reviewer. Using bare ground fraction can introduce uncertainty not only through uncertainty of the bare ground data itself, but the MODIS LAI, which represents the averaged LAI over a pixel, must be modified to eliminate the influence of bare ground to be consistent with the PFT derived with vegetation fraction data. This would further introduce uncertainty because assumptions are needed to estimate PFT LAI from the averaged LAI over a pixel. The combined use of MODIS VCF data and other land cover data that correspond to conditions for different years (e.g.,

AVHRR Continuous Fields Tree Cover Project data in 1992-1993) adds further uncertainty and hinders the development of land cover time series consistent with the satellite records (Bontemps et al. 2012). Lastly, validating the resulting PFT LAI globally will present significant challenges for assessing the validity of the approach.

In contrast, the method we adopted derives PFT and LAI from MODIS data defined over each pixel, with the added advantage of using land cover and LAI from the same year for consistency. Because erroneous LAI information can have important negative effects as LAI is used in many calculations in CLM, preserving the consistency between PFT and LAI is an important consideration in our development effort. This partly steered our preference towards using MODIS land cover data to derive PFT parameters for CLM. We are not alone in using such an approach. Indeed land cover products have been extensively used to develop PFT parameters in a way similar to our method. For example, Bonan et al. (2002) used the AVHRR 1km IGBP DISCover land cover data set to determine non-tree-covered PFT composition, and the bare ground composition was derived using exactly the same approach as our method:

"The non-tree-covered portion of the 1-km pixel was determined from the IGBP DISCover data. In this data set, bare ground originates from nonvegetated land (''barren or sparsely vegetated'' land cover) and may not be present even in semiarid regions with sparse, yet homogeneous land cover. Because we lacked consistent information on nonvegetated cover, we assumed that non-tree covered land in forests, savannas, and grasslands was covered by grasses, in shrub lands by shrubs, in croplands by crops. Other IGBP cover types were treated as bare ground." (Bonan et al. 2002)."

Besides Bonan et al. (2002), Jung et al. (2007) also calculated fractional PFTs for carbon cycle model directly based on GLC 2000, MODIS land cover or 1km SYNMAP (Jung et al. 2006) land cover product, and Poulter et al. (2011) utilized land cover products to calculate PFT compositions for earth system models.

Although methods similar to ours have been widely used, our approach also has obvious limitations. In our previous response, we noted the underlying assumption of our method in that each 500m pixel in the MODIS land cover product was exclusively covered by one land cover type. We considered this assumption to be valid in most areas since a 500mx500m grid may be

small enough to be covered by homogeneous landscape. However, we also recognized that this assumption will cause distortion in less homogeneous landscape such as shrub land, as the reviewer pointed out, which explains the big differences in shrub and bare ground coverage between the new and CLM4 dataset.

In summary, we understand the reviewer's viewpoint on the use of vegetation fraction but we did not adopt our approach without scientific basis and careful considerations. We believe the divergence of our viewpoints mainly stems from the fact that global datasets available for deriving land surface parameters have limitations so there are both advantages and disadvantages in the methods used to derive the CLM4 and our new dataset depending on the assumptions used and what uncertainty one considers more acceptable. Discussions of the assumptions used and the pros and cons of each method as well as limitations in the resulting datasets are important to provide guidance on the use of the datasets. We intend to include such discussions in the revised manuscript and point out the shortcoming of our dataset particularly in less homogeneous landscape such as the shrub land in Australia.

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