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Interactive comment on "Remote sensing of annual terrestrial gross primary productivity from MODIS: an assessment using the FLUXNET La Thuile dataset" *by* M. Verma et al.

Anonymous Referee #2

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Overall comments: This paper uses a large and comprehensive flux tower dataset (i.e. LaThuile) to evaluate the ability of ten commonly-used remote sensing (RS) proxies and models representing spatial and temporal anomalies of annual GPP across multiple biomes and years. This paper is likely to have broad interest and significant value to the carbon cycle community, and overall the paper is well written. However, there are several areas that could use improvement and would add significant value to this work. First, the current paper only gives a general evaluation of the performance of the different RS proxies or models, while a more in-depth analysis would strengthen the value of this paper. For example, the authors should explore which factors provide the major control governing spatial/temporal anomalies within/across the different biomes,

and why the RS models fail to represent inter-annual variability in forests. A more in-depth analysis of causal mechanisms would advance the authors objective to "improve understanding of the processes and factors that control geographic and interannual variation in annual GPP". Overall, this paper is suitable for publication but would be greatly strengthened by the following moderate revisions.

Major comments: 1) The discussion is too general, and a more in-depth discussion would make this paper more interesting. For example, why do most remote sensing proxies and models fail to represent spatial and inter-annual variations of GPP for DBF areas? Could this be due to uncertainty in the remote sensing data or model representation of spring phenology during the early growing season? It would be more interesting if the authors could explain why the different RS proxies/models perform differently for biome types (e.g. MOD17 and VPRM model for GRS in Fig. 9). This would provide the reader with more specific information on what processes might be missing in a certain model. Also, most models/proxies do not do well in representing inter-annual variability in forests. It would be useful if the authors could provide a more detailed explanation of the reasons for this behavior.

2) Page 11641, Paragraph 4: there may be some inconsistency in this paragraph. The previous discussion on the "Proxy+Met" model indicated that the spatial variation in annual terrestrial GPP over large areas might reflect an equilibrium response to climate. But then the authors state that "the influence of environmental variables on GPP becomes progressively weaker as the temporal scale increases". I would think a lack of understanding of how leaf level processes scale to daily and longer time scales might largely explain why the LUE model fails to account for the spatial variability of annual GPP for certain biome types. This might also apply to the results on modeled inter-annual anomalies. Also, the declaration that "the LUE-based remote sensing approaches need to incorporate processes occurring at sub-diurnal time scales" does not seem to be supported by the results, as this paper focuses on annual time scales.

3) Page 11643, Paragraph 2: "the interannual anomalies in mean growing season

greenness (EVI, NDVI) and annual GPP were highly correlated in EBF": this seems odd to me. Vegetation indices (especially NDVI) tend to saturate in dense vegetation such as EBF, and their seasonal cycle is likely partially obscured by cloud/aerosol effects. Besides, the failure of remote sensing models for EBF is mostly likely due to a lack of understanding of the processes controlling seasonality or inter-annual variability of EBF photosynthesis (not just due to increased model complexity). Further explanation is needed here.

Minor comments: 1) Page 11629, Line 17: "variability GPP" should be "variability in GPP". 2) Page 11631, Line 25: "charactering" should be "characterizing". 3) Page 11634, Line 19: the most recent (Collection 5) MOD17 product (Zhao & Running, Science, 2010) uses 11-biome specific parameters. Line 26-27, "Following the same procedure that is used by the operational MOD17 algorithm. . .": it would be better to include the reference (Zhao et al. RSE, 2005). 4) Page 11637, Line 10, "jackknifed": what does this mean? 5) The number of figures could be reduced. For example, Figs 4, 6, 8 and 10 could be removed and summarized in the text. Most of the critical information can be found in Figs 3, 5, 7, and 9. 6) Fig. 1: It would be useful to distinguish different biomes to give readers a better idea of the spatial representation of flux towers for different biomes. 7) Fig. 2: What does the red line/cross represent? 8) Give the definition of RMSE and MBE in Fig. 5.

Interactive comment on Biogeosciences Discuss., 10, 11627, 2013.