Reviewer 1

The authors responded well to the reviewer comments, and I think the paper is essentially suitable for publication. I noticed the following minor corrections on re-reading the paper:

103: I would not call this "measurement errors"

Following the suggestion we replaced the definition with "incompleteness of the accounted fluxes"

104-105: "which cannot be assessed" — an overstatement, considering that there is an entire TransCom project that has been devoted to doing exactly that

We agree with the comment of the reviewer and have changed the sentence accordingly in addition to adding the following reference to TransCom.

Baker, D. F. et al. TransCom 3 inversion intercomparison: Impact of transport model errors on the interannual variability of regional CO_2 fluxes, 1988-2003. Global Biogeochem. Cycles 20, 1988–2003 (2006).

128: good to give a citation for the R package

A citation was added.

334: ; —> ,

The change was made.

340: "barely correlated" — please also give a numerical value

R^2 and p values were added.

346: were —> where

The typo was corrected.

Reviewer 2

Marcolla and co-authors have done a nice job revising the manuscript. In particular, I appreciate the efforts that went into interpreting the results in section 3 of the revised text.

Broad comments
Sorry to keep harping on this, but if IAV is the SD of NEE calculated using a sliding, 12-month window (line 130) doesn't this effectively remove potential trends in the results? This isn't a field I work in, but results in Fig 5 showing that the 'residuals' explain nearly all of the variance in NEE seems like a completely expected result of how the analysis was done. Perhaps this assumption on my part is misconstrued, but I'd recommend removing this figure from the text, as it does little to inform broader message of the manuscript. More, the regions where trends (line 238) seem more important in the Jena product seem particularly void of observational constraints (Fig 1c).

We confirm that the results presented in Fig. 5 are not an artifact produced by the moving window. To support this statement we have reproduced the same figure using the yearly values (jan-dec) of NEE (see figure below) and the results are almost identical to those produced with the moving window approach. This latter method is typically used in the literature to avoid any subjective choice in the definition of the "year", which is particularly relevant in the tropics and in the southern hemisphere, where a jan-dec windows clearly does not match the annual cycle of ecosystems.
Given that the moving-window method does not generate any artifact, we prefer to maintain the original version of Fig. 5. In addition, this figure is bringing interesting information about the possible underestimation of the trend driven IAV in MTE. In general the figure highlights the limited importance of the trend in the IAV, showing that in the last 30 years climate variability more than climate change has dominated the yearly fluctuation of the terrestrial carbon budget.
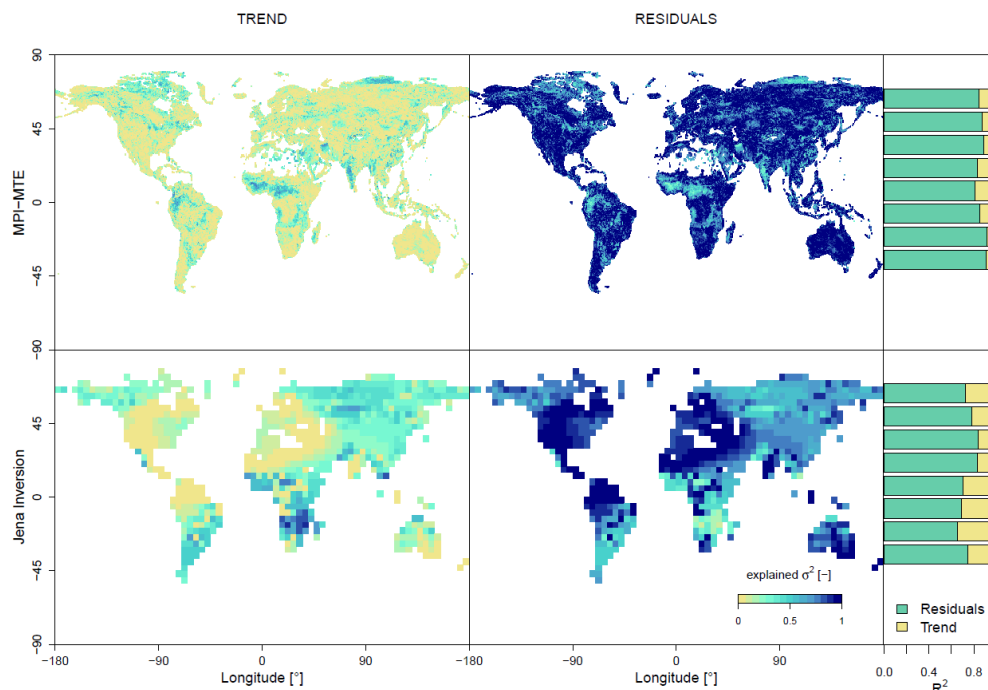

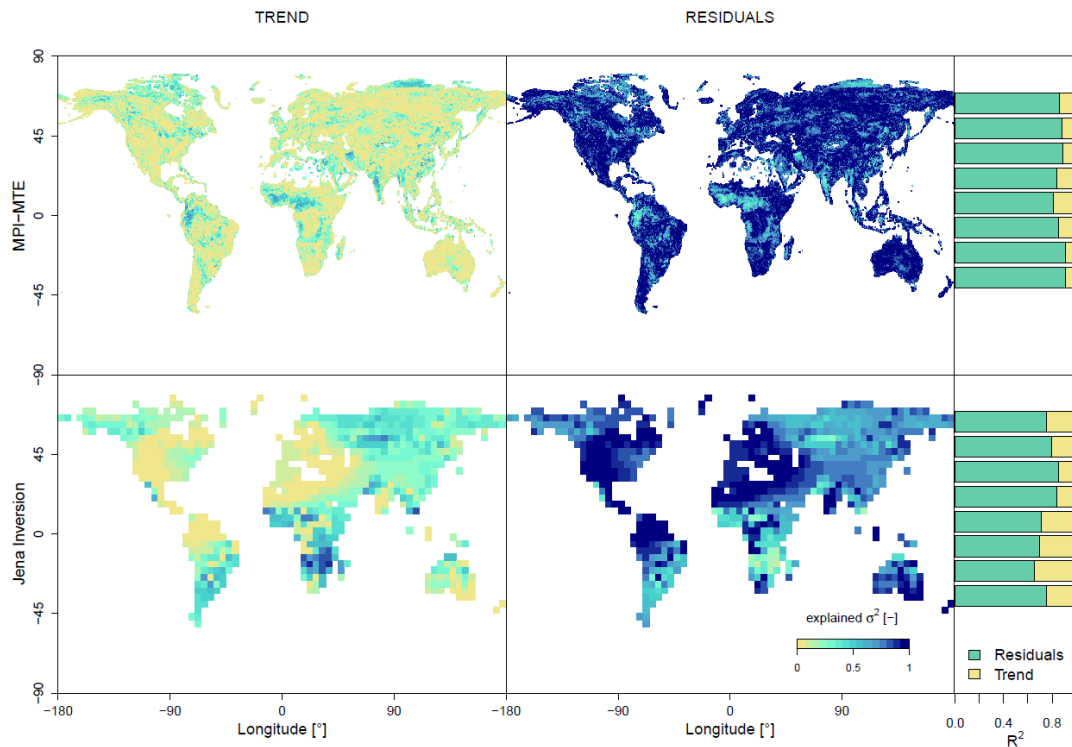Figure 5 data analysis performed without the moving window

Figure 5 as reported in the manuscript with the moving window

Minor comments & Technical corrections

Again, standard deviation and IAV are used interchangeably throughout the manuscript, since they mean the same thing please just use one term and stick with it throughout the manuscript.
Following the suggestion of the reviewer the term "standard deviation" was replaced by IAV throughout the manuscript when appropriate.

Line 17. I might reorganize this sentence for clarity: "Results show that the global average of IAV, quantified as the standard deviation of annual NEE, at FLUXNET sites is ~120 g C m-2 y-1 and peaks in arid ecosystems. This variability is almost six times larger than…"
Following the reviewer suggestion, the sentence was reorganized.

Line 20. It's unclear what the "two data-driven global products" are referring to (I'm assuming this is MPI and Jena)? If so maybe this sentence can be reorganized, "Most of the temporal variability observed in the last three decades of the MPI-MTE and Jena Inversion products is due to yearly anomalies, whereas the temporal trends explain only about 15% and 20% of the variability, respectively.
The sentence was replaced with the one suggested by the reviewer.

Why is tropics often capitalized?
We changed into lowercase.

Line 92, can a reference be supplied for this statement, or is all in the 2011 Jung paper?
Yes, it all refers to Jung et al, 2011.

I can see investigating the lag correlations of climate drivers and NEE variability is perhaps outside the scope of the paper, but still feel the topic still should be mentioned, as ground observations clearly demonstrate a temporal mismatch between the timing of weather anomalies and their ultimate influence on different components of the C cycle (e.g. Doughty et al. 2015). The lack of potential lags is mentioned for the MTE product (line 95, but not the present study)

We agree with the referee that lag effects can influence the temporal dependence of the terrestrial carbon budget on the climate drivers. On the other hand the present study focuses mostly on the role of GPP/TER and/or CUP/CRP in determining the inter-annual variability in NEE, hence both the dependent and independent variable involved in the analyses are lagged compared to climate.
The issue has a larger importance when mentioning the missing representation of time lags in the MPI-MTE, since climate drivers are used to predict the fluxes at global scale and hence ignoring the presence of lags can indeed affect the flux estimations, as stressed by the referee.
We have added a sentence in the section 3.2 to address this point and we have added the reference suggested by the referee.

Line 136, maybe it's explained elsewhere, but how were IAV[NEE] normalized?
Since it was firstly explained in the results section we added a sentence on the normalization of IAV at the line indicated by the reviewer.

Line 161 "resumed" is a funny word choice here. Maybe replace with 'shown'
We replaced "resumed" with "shown".

Line 204. What is shown in the right panels? The text says "it's the ratio of the mean IAV and GPP (right column)" while the caption claims "IAV[NEE] (CV[NEE], right panels). Please be clear and consistent with language throughout the text.
Both in the text and in figure 2 caption we refer to normalized IAV. In the figure caption we introduced the symbol CV_{NEE} to explain the axis label.

Line 239. Please provide references to support this claim.
The following reference was added:
Forkel, M. et al. Enhanced seasonal CO_2 exchange caused by amplified plant productivity in northern ecosystems. Science (80). 351, 696–699 (2016).

Lines 250 to 265. The eruption of undefined pft abbreviations in this paragraph make the text nearly unintelligible.
We explained the acronyms to make the sentence clearer.

Please refer to particular panels in the figure captions.

Fig 1 Would marking the observations used in the MTE product be useful (as in panels A & B)? Also, the figure caption should call out the different scale bars used for FLUXNET and gridded results.
Most of the observations used in the MTE products are actually plotted in panel (a), superimpose the points in panel b would completely cover the map colors especially in Europe. A sentence was added to the caption which highlights the different scales used.

Fig. 2. Please clarify in the caption what color bar is being used for MPI IAV. I'm assuming it's the same as the Jena panels below, but it's not really clear.

Following the reviewer suggestion it was specified in the caption.

Fig. 3. I don't see any black dots on the figure, I'm assuming MPI is in grey?
Corrected.

Fig. 4. It's confusing to have the dot colors switch between data products in Figs 3 & 4. Can these display items use a common color scheme (e.g. fluxnet = red, Jena = green). Selecting colors appropriate for color blind readers would also be nice.
Colors were made consistent in Fig 3 and 4, and turned into colors suitable for color blind readers.

Fig 8 referring to panels in the caption would be helpful. Also, avoiding abbreviations in the caption will help reader understanding.
References to the figure panels were added to the figure caption.

Figure 9 is still unclear. Is this the grid cell correlation between IAV[NEE] and (a) MPI GPP-TER (b) MIP CUP – CRP and (c) Jena CUP – CRP? Again, the caption is not clear.
Analytical expressions of the plotted variables were added to the figure caption to improve readability.

References:
Doughty, C. E., et al. (2015), Drought impact on forest carbon dynamics and fluxes in Amazonia, Nature, 519(7541), 78-82, doi:10.1038/nature14213.