

Interactive comment on “Testing gridded land precipitation data and precipitation and runoff reanalyses (1982–2010) between 45 S and 45 N with Normalized Difference Vegetation Index data” by S. O. Los

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- Note: Reviewers’ comments in plain text; *author’s response in italics.*

General Comments: The paper provides an interesting insight into the performance of rainfall and runoff products from both observed and reanalyses. The approach is novel and offers an independent verification of rainfall products using NDVI data. A proxy to NDVI was calculated from the rainfall and runoff called the derived Net Primary Productivity (NPP). The consideration of runoff had little overall effect on the relation between NDVI and NPP. Areas over Africa in particular were found to have a relatively poor relation between NDVI and NPP. Also for high altitudes, the assumption that water is a limiting factor to vegetation growth breaks down so a poorer performance is expected here. The authors found a variable performance of products. CRU and TRMM data performed better than the GPCP data and MERRA, NCEP and ERA reanalyses. The authors suggest that their results indicate a need for further improvement of reanalysis rainfall and runoff series in particular.

Specific Comments: The authors have considered both temporal and spatial correlations for NPP and NDVI for each rainfall product. Performance over Africa in particular is found to be relatively poor, with reanalysis products in particular unable to represent the 1984 drought. The separate consideration of temporal and spatial correlations is interesting and provides a useful insight. Correlations were calculated on an annual basis which also helps to understand what conditions are associated with poor representation of rainfall. The authors do not consider limiting factors to vegetation growth other than water (e.g. solar radiation, temperature, groundwater storage) and acknowledge that in some regions this may increase the error in NPP. A further analysis of correlations between altitude (e.g. from SRTM) and NPP error for example would be interesting and could form a useful extension.

- *Response: It is planned to extend the NPP model to incorporate a range of other effects and to improve its temporal resolution. The author believes that an extension of the NPP model falls outside the scope of the current paper and prefers at this stage not to incorporate the effects mentioned by the reviewer.*

In addition to meteorological reasons for the variable temporal correlations between NPP and NDVI for the various products, it would also be interesting to note changes to algorithms within the products. The temporal correlation of TRMM is not shown but given that the product has changed significantly since its inception it would be interesting to hear a comment on whether we can see changes in correlation attributed to the launch of new versions etc.

- *Response: The spatial distribution of temporal correlations for the TRMM data was not shown since these data do not extend back to 1982. Instead, a comparison was made between TRMM (NPP vs NDVI) correlations and CRU (NPP vs NDVI) correlations for 1998-2010 (Fig. 6.f). Text was added to the caption of Fig. 6.f comparing the averages of the TRMM and CRU correlations indicating a small but significantly higher average correlation for the TRMM data.*
 - *Text in the caption of Fig. 6.f was changed to: Density scatter plot of correlations for the CRU and TRMM (version 3B43) data for the period of 1998 and 2010 (all (significant and not significant) correlations included; grey line is 1:1 line). The mean correlation for TRMM 3B43 data ($r = 0.188$) was significantly higher ($p = 0.0033$) than for CRU data ($r = 0.181$). The mean temporal correlation for TRMM 3A12 data ($r=0.115$) between 40 S and 40N was significantly lower (Note: agreement between TRMM 3A12 and 3B43 was higher over oceans — not shown).”.*
- *If desired, figures showing the spatial distribution of temporal correlations for 1998-2010 can be incorporated for all precipitation fields analysed, although the author believes this would add little information.*

- *A second version of TRMM data (3A12) was evaluated but result of this analysis were not included in the first submission since this product was not as realistic as the 3B43 data. (similarly, the best performing version of the NCEP precipitation was included and other versions left out). Some information on the 3A12 data is now included in the paper , i.e. the mean temporal correlation is reported in caption Fig 6.f with the result of a t test; see revised text above.*
- *It is agreed that it would be interesting to evaluate multiple versions of the TRMM data but the author did not choose to do this to preserve balance. The purpose of the paper is to introduce a technique and illustrate on a range of frequently used data sets how this technique would work. The author would be happy to carry out an analysis of multiple TRMM products as a separate activity. A brief comment on the difference between version 3A12 and 3B43 is included in the caption of Fig. 6.*

The authors note that their approach could be used to test other aspects of the water balance. This paper therefore represents a novel first step towards an improved quantification of the global water cycle. Ensuring there is an independent verification (NDVI) is useful as it moves away from the need for ground-based observations, which are frequently difficult to obtain. Over the global scale this therefore represents an interesting and useful study.

Technical Comments: Merge sections 2.2.1, 2.2.2, 2.2.3 and 2.3.1, 2.3.2,2.3.3

- *replaced sub-subsections with paragraphs and removed numbers but retained titles*

Section 3 line 2- suggest the method bit is written in past tense, for agreement with Section 2

- *Some parts of section 3 could be written in the past tense, but others, e.g. “eta is the error” should probably be written in the present tense. The author would prefer to leave the text as is but is happy to take advise from the Editor.*

Suggest not to use sub-sub-sections;

- *replaced with paragraphs, removed numbers and retained titles*

suggest-

1. NPP derived precipitation; spatial comparison with NDVI

- *changed to: Spatial comparison of precipitation derived NPP with NDVI*

2. NPP derived precipitation; temporal comparison with NDVI or similar

- *changed to: Temporal comparison of precipitation derived NPP with NDVI*

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Anonymous Referee #2

General Comments The paper is sensibly-structured and clearly written. Objectives are established and then logically pursued. Figures are clearly labelled and provide useful information in support of the findings and arguments.

Specific Comments 2.2.1 (CRU Precipitation) There is no acknowledgement of the 'station count' files which are available alongside the data and which would allow data to be excluded where they are sourced from climatology rather than observation. Given that errors are being identified this might have been a good place to start. If not, then that should be explained.

- *Reply: added a paragraph to the discussion: “The decline in the number of stations available for the generation of global gridded data poses a problem for the spatial and temporal analysis in the present study. It is possible to analyse only those grid cells where a sufficiently large number of stations is available. However, this would lead to a decline over time in the number of grid cells incorporated in the analysis and would make both a comparison between years difficult as well as a comparison between observed fields and reanalysis fields. The advantage analysing the full data set is that it provides an estimate of the accuracy of entire data sets. A side analysis of the CRU data (not included in the present study) showed that the spatial correlation decreased when cells were left out based on the number of stations contributing to the gridded estimate; for example the spatial correlation between CRU NPP and FASIR NDVI for 1992 dropped from ($r = 0.893$) when all data were included to ($r = 0.838$) when cells were removed with fewer than 5 stations contributing to the gridded estimate.”*

2.2.2 (GPCP Precipitation) There is no acknowledgement of the extensive error estimates and related documentation for this dataset. As for the comment on 2.2.1, this might have been a useful contribution. Again, if not then that needs to be explained.

- *Added references Adler et al (2012) (bias errors in GPCP) and Dinku et al (2008) (bias in CRU over east Africa) to discussion and Adam and Lettenmaier (2003) (discussing undercatch corrections in global data incl. GPCP) to the caption of figure 8. Added the following paragraph to the Discussion: “The positive bias shown in the GPCP data, CRU data and TRMM data in West Africa and the Indian sub-continent (Figs. 4 and 5) could be caused either by a deficiency in the NPP model or by deficiencies in the data. An error analysis by Adler et al 2012 of the GPCP data based on a number of independent data sets indicates that GPCP precipitation is overestimated in these parts of the world similar to the present study (compare Fig. 4 with Fig. 7 in Adler et al 2012). A study by Dinku et al (2008) comparing global gridded data with data from a dense rain gauge network in East Africa found that CRU data overestimated precipitation in mountainous regions likely as a result of an over correction for altitude. The biases in West Africa and the Indian sub-continent were even larger in the reanalysis fields.”*

2.3.1 (NCEP/NCAR Reanalysis) This is ambiguous as to which version of the reanalysis products is used. Version 1 covers 1948-present (1949 is mentioned in the text), and version 2 covers 1979-present (this is the version described in the referenced paper, Kanamitsu et al., 2002). The 'Acknowledgements' section specifies v1, but then the Kanamitsu reference is wrong? <http://www.esrl.noaa.gov/psd/data/gridded/>

- *The version 1 data were used; the text was corrected as follows: the Kanamitsu reference was replaced by Kalnay et al 1996; 1949 was replaced by 1948.*

3 (Analysis) It could be instructive to make use of the error-related data and documentation for CRU TS and GPCP.

- *Added to discussion, see under previous comment re section 2.2.2*

4.1.3 (Temporal deviations in tropical N. Africa) In paragraph 2 & Fig. 8, why is GPCP excluded? A reason should be given.

- *The GPCP time series were added to Fig. 8 as well as a comment in the caption on the observed difference between GPCP and CRU.*

Technical Corrections 2.2.1 (CRU Precipitation) The dataset is called 'CRU TS 3.21'.

- *Corrected*

2.2.3 (TRMM) Delete 'mission' on first line.

- *Corrected*

Other changes:

Various minor changes were made throughout the paper to improve the clarity of the text.