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Interactive comment on "Observationally based analysis of land–atmosphere coupling" *by* F. Catalano et al.

Anonymous Referee #1

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The paper "Observationally based analysis of land–atmosphere coupling" used the CM method to investigate the coupling relationships between soil moisture and precipitation, as well as other variables. It has some merits and presents interesting results, especially those linking EOF signals to external forcings such as ESNO and volcanic events.

The scientific question proposed regarding to land-atmosphere coupling is worth investigating, but the key content discussed in the paper is the coupling of soil moisture and precipitation, which is far form enough to cover this topic.

The authors did a lot of analysis, but unfortunately the paper is not well organized. Important information on method section is incomplete and makes it difficult to understand the following analysis and results. Overall, the presentation is not satisfactory

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and sometimes confusing. It lacks logic and as a reader I get lost in the too much descriptive details without a clear focus. Many key concepts like "variance" haven't been clearly defined. And language and wording is another issue that has to be significantly improved for clarity and accuracy. Although a number of Tables/figures are provided, but many of them are not very useful, they feel less informative and even hard to understand. The authors need to carefully decide how to best present their results.

It seems soil moisture does not paly a strong role as the authors claimed, because the variance of precipitation explained by soil moisture is less than 20%. Therefore, the influences of volcanic AOD as well as ENSO on PRE are relatively weak signals in general. More importantly, correlation does not necessarily mean causality or feedback, the author cited a lot of reference to explain their results, but there isn't enough information to evaluate if their proposed explanations are plausible and credible. And these discussions are mixed together with results, distracting the flow of the paper. A separate and refined discussion could be much better than current layout.

Datasets are not independent and are correlated/coupled to each other. For example, both ET and LAI are based on AVHRR. Perhaps due to this reason, precipitation forced by soil moisture is nearly equivalent to other (ET and LAI). And there are many coupling left unaccounted, e.g., soil moisture is forced by ET.

Therefore, significant efforts have to be made by the authors to address those issues relating to presentation, organization and readability of the paper before publication.

Minor comments:

P1940 L2-3 Does the word "variance" here mean spatial or temporal variance? Need to specify.

L6: what does "memory" means here? I don't get it.

P1941 L11 Please explain "soil moisture memory". L22 "improvement" of what? P1942

L9 what does "land variability" indicate here? L13-L20 what is advantage of CM method compared to other methods? P1943 L4 It is strange for me to see the claim that those datasets are "state-of-art". For example, there are many alternative precipitation, ET and LAI datasets and it is hard to say one is better than the other without rigorous comparison. The data used here are far from "state-of-art". As far as I know, GLEAM ET and GLASS LAI are also high quality products. L20 Please briefly explain the gap filling procedure used. L22 The use of model information weakens the previous claim that these observation data are independent of models. Table 1. Better to add Ref for each dataset shown in the table; and spell out ET, LAI, GPCP etc. or explain them in notes. P1944 The authors at least need to describe the mathematical theory of CM (Eq. 1 and 2) and explain how it works to decompose a field into forced and free components. L18 what is CCA scaling? Since Eq 3 and 4 are listed in method, the authors must explain their meanings. What are $\hat{Z}$ and $\hat{S}$? And I don't understand why Eq 3 and 4 are needed here? P1945 L1-3. How to understand significance level for each element in A and B? L6-8 Why not to follow the common practice to define four seasons as JJA, SON, DJF and MAM? The incompatible definition for season would make this study incomparable with most other studies. L10-20. It seems this paragraph describes the gap filling method? L23 EOF is an important part for the analysis but has never been explained previously in the method section. P1946 L3 Again, what is "variance" here? Is it temporal or spatial variance? L1-L14. It seems all these variables are coupled with each other in multiple ways, e.g., ET and LAI, LAI and SM, and ET and SM are correlated/interconnected but not analyzed here. According to Table 2, LAI and ET have similar role on PRE compared to SM. Despite PRE, LAI and ET are also important drivers for SM and may also accounts for a fraction of variance of SM. P1947 L1-3 how to define transitional regions, are there any quantitative criteria for that? Table 3 uses Rainfall but in the text that is PRE. The use of term must be consistent throughout the paper to avoid possible confusion. And NINO3 in the table should be explained. L6 In table 2, SM only accounts for 17% variance of PRE, why EOF shows 48% of total variance in table 3? L12 All data used including AOD should be described in

method section. I am confused by Table 3 and Table 4 that show different variance explained by PCs. P1950 L18-24 and Table 5: How to understand "PRE forced by SM and ET(LAI)". Do they mean PRE forced by SM is further decomposed into two parts - forced by ET and free? The corresponding text is not clear enough to correctly get the meaning. My understanding is that in this case, 17% x 20% = 3.4%, does it suggest only 3.4% PRE variance is explained by ET? ET and LAI are closely related especially in vegetated areas as the calculation of ET may have used LAI. This can be seen in the similar distribution of identified hotspots. P1951 The analysis in the second paragraph is very difficult to follow! And I don't quite understand the explanations that linking ET to AOD. . .

The direction of triangles in Figure 7 is almost indistinguishable without zooming.

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Interactive comment on Earth Syst. Dynam. Discuss., 6, 1939, 2015.

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