Biogeosciences Discuss., 12, C306–C309, 2015
www.biogeosciences-discuss.net/12/C306/2015/

Biogeosciences
Discussions
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Interactive comment on "Assessing vegetation structure and ANPP dynamics in a grassland-shrubland Chihuahuan ecotone using NDVI-rainfall relationships" *by* M. Moreno-de las Heras et al.

Anonymous Referee #2

Received and published: 25 February 2015

General comments:

Vegetation structure and the associated dynamics in recent years is key to the understanding of terrestrial carbon cycle and prediction of future climate change. In an arid/semi-arid environment, it is particularly important, as land degradation is phenomenal and largely irreversible. In this paper, the authors used the latest satellite data derived from the MODIS sensor, as well as field-based measurements of climate and vegetation characteristics, and performed a theoretically correct, but empirically complex analysis over the study area in the Chihuahuan Desert in New Mexico, USA. It

clearly shows the linkage between the vegetation change and one major environmental driver in this region – precipitation. In my opinion, the paper is well written in the introduction part and the theoretical basis, with a complete set of references and a simplified but clear process-based model description. That means, the paper lays out the question quite well. However, the methodology and consequently the results have quite a few confusing points, and that limits my understanding of this paper.

Overall, I recommend reconsider the paper after major revisions. The authors need to make more efforts on clearly explain the methods, use simple and concise words, with the help of equations and diagrams. I am listing my major concerns below:

1. Concepts should be concise instead of wordy descriptions. For example, what are the reference NDVI-rainfall signatures (section 3.3)? Even after reading the entire paper, I was still confused by this concept. Is this the optimal RaL (in days) that maximizes Pearson's R (NDVI vs antecedent total rainfall for observations from 2000 to 2013)? I suppose it should be a simple variable and probably is 57 days for herbs and 145 days for shrubs as shown in Figure 3b. Why not use a simple term, such as ORaL (for optimal length of rainfall accumulation)? Or a symbol?

2. Figures and methods should be linked to explain the concepts better. Still in section 3.3, terms ARain_hv and ARain_S appear for the first time. But I did not understand what it was, until I saw it again in Figure 4. So are these in fact the green and red lines in Fig. 3b (for empirical results), and theoretically it should be the curves in Fig. 1b? Once the terminology is created, please use them consistently in the paper. Why not use them starting from Fig. 1?

3. One of the major flaws I found in this paper is the decomposition of NDVI (section 3.5). It is true that the signal can be partitioned into several contributions from pure pixels. However, I do not agree that the soil background contribution can be subtracted as a constant value. If the authors did not account for the contribution of soil underneath vegetation, the contribution of soil should be a linear function of vegetation cover. For

example, if a pure pixel of soil has an NDVI value of 0.12, then the contribution of soil for a pixel covered by 80% vegetation should be only 0.12*0.2 = 0.024.

Specific comments:

Abstract: “We use these relationships to (a) classify landscape types as a function of the spatial distribution of dominant vegetation, and to (b) decompose the NDVI signal into partial primary production components for herbaceous vegetation and shrubs across the study site.” I cannot understand this sentence. Overall, I think the authors need to put more results in the abstract rather than lots of introduction.

Page 58, Line 13: “a set of plausible parameters obtained from literature”. Why are these parameters not dependent on vegetation type? In particular W0 and k?

Page 59, Line 3: “These modelling results illustrate conceptually the distinct dependence of the relationship between plant biomass and antecedent precipitation on vegetation type”. This is the major contribution from the simplified model, and serves the purpose of this study pretty well. It would be even better to emphasize with one or two sentences describing the particular circumstances/assumptions where the “simplified” version can be applied.

Page 63, Line 15 and 19: “Exploratory data analysis. . .” and “Preliminary analysis”. Why not put these analyses as supplementary materials?

Page 63, Line 23: “In order to avoid confounding effects (i.e. the mixing of the dominant-shrub and non-dominant herbaceous responses to precipitation) on the identification of the local NDVI-rainfall signatures, correlations between NDVI and antecedent precipitation series (of different rainfall accumulation lengths) were determined independently for each annual cycle of vegetation growth (April–March).” Wordy, and no cause-and-effect relationship.

Page 64, Line 2: “The reference vegetation-type characteristic antecedent rainfall series (ARainhv and ARains for herbaceous vegetation and shrubs, respectively)”.

Please refer to figures here.

Page 64, Line 15: “Conversely, a low strength on the NDVI-rainfall relationship consistently obtained across the 2000–2013 cycles of vegetation growth for a specific vegetation-characteristic antecedent rainfall series will locally evidence a low activity of the analyzed vegetation type for the study period.” Not a necessary sentence, and hard to understand.

Page 64, starting from Line 20: This paragraph is hard to understand. I suppose that the authors have used PCA due to high dimensionality (28 variables). However, PCA analysis makes the study scene-dependent. How could it be applied to other regions, when the 1st dimension of PCA is not dominated by herbaceous/shrub fractions?

Page 67, Line 1: “Explorative comparisons revealed that this simple two-step procedure outperformed other more complex NDVI-decomposition methodologies”. When this is being said, better to provide evidence (e.g., results of comparisons).

Figure 5: When the core sites were used as reference pure pixels for herbs/shrubs, how can the NDVI series in panel A still show 2 components?

Interactive comment on Biogeosciences Discuss., 12, 51, 2015.