

# ***Interactive comment on “Empirical and model-based estimates of spatial and temporal variations in net primary productivity in semi-arid grasslands of Northern China” by Shengwei Zhang et al.***

## **Anonymous Referee #2**

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The paper entitled “Empirical and model-based estimates of spatial and temporal variations in net primary productivity in semi-arid grasslands of Northern China” by S. Zhang et al. presents an analysis on the impact of both temperature and precipitation on grassland NPP estimations obtained using a light-use efficiency model. The topic (climate control on NPP), although interesting, is far from the HESS scope and is probably more suitable for the sister EGU journal Biogeosciences. The paper is methodologically obscure as both the modelling approach and datasets applied in the study are poorly documented, which strongly hinders the reproducibility of the study. Furthermore, I have major concerns on the type of model chosen for estimating NPP, the data

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quality, and the (too simplistic) analysis presented in the study about the climate-driven controls on NPP.

Major concerns:

1. Model type: The authors applied the CASA model, a light-use efficiency model, to simulate the inter-annual dynamics of semi-arid grassland NPP. Vegetation production in drylands is limited mainly by water availability. Any attempt to model the dynamics of vegetation production in semi-arid landscapes must consider, at least, the dynamics of soil moisture availability.

2. Model details: The authors apparently fed the CASA model using MODIS NDVI data for estimating NPP. The model is described in the study in just two equations: an equation for APAR (that is proportional to FPAR and solar radiation) and another equation linking NPP with APAR. No details are described on how FPAR and solar radiation have been calculated. Furthermore, it is not clear how the authors have applied the NDVI data to feed the model. In fact, the variable NDVI is not included in the equations.

3. Use of NDVI data: In arid and semi-arid landscapes, where vegetation cover is sparse and generally low, NDVI data is strongly affected by the soil background properties. Bearing in mind that the study covers a very broad area of approx. 200,000 Km<sup>2</sup> where soil characteristics can change dramatically between locations, the use of NDVI data is undesirable. The use of either EVI or MSAVI is probably far more appropriate for this application.

4. Verification of NPP estimates: The authors indicate that “monitoring data from 46 monitoring stations within the Xilingol League collected in July 2011 (g C m<sup>-2</sup> year<sup>-1</sup>) were compared with simulated NPP for 2011”. However, the field-based NPP data is not described in any way in the paper. How was NPP measured in the field? What size were the plots? Were the NPP estimations obtained by a single harvest in July 2011? Please, note that a single harvest of aboveground biomass does not represent

accurately NPP in perennial grasslands (the type of vegetation analyzed in the paper). Biomass harvests must be taken both at the beginning and at the peak of the growing season to obtain a valid NPP estimate.

5. Climate data: Meteorological data for both the NPP estimations and the analysis of the NPP-climate relations was obtained by simple kriging interpolation from nine meteorological stations. Nine stations for an area of 193,000 km<sup>2</sup> is probably too little information to sustain an accurate estimation of spatially-distributed climate/meteorological variables for the full area. Furthermore, I expect that, in an area as big as 193,000 km<sup>2</sup>, topographical variations (e.g. local differences in elevation) can have a very important role in local climate and meteorology. Did the authors check for the influence of elevation and other topographical variables on the meteorological records of the stations? The use of kriging with varying local means, kriging with external drift and co-kriging can improve considerably the spatial interpolation of meteorological variables where local elevations (and other topographical factors) have a relevant role.

6. Livestock stocking density data: The authors indicate the source for the livestock data (a paper by Yang, 2015), but should also detail how this data was generated, since the source is in Chinese. Furthermore, the data is expressed in animal units (e.g. in Fig. A2) and should be expressed in density units (i.e. animals km<sup>-2</sup>).

7. Data analysis: The authors apply simple correlations to analyze the impact of temperature and rainfall on NPP. This type of analysis is too simplistic and does not provide any novel information to that already published on this topic.

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