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Hydrology and Earth System Sciences Discussions

Interactive comment on "A global analysis of the impact of drought on net primary productivity" *by* T. Chen et al.

Anonymous Referee #2

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The objective of this article is of high relevance due to the significant role of terrestrial ecosystems in the C cycle and the effect of water availability, especially droughts, on C sequestration. Besides, it is suitable to attempt to compare it with Zhao & Running (2010), however I missed on your article to highlight the controversy of their results. The estimated global reduction of NPP in the last decade found by Zhao (2010) is a current controversy, specially while other papers do not show a reduction in global NPP, such as modelled by Piao (2009). How much decline of NPP (you mention in page 6,line25) did you estimate for your study period? Furthermore, your calculations of NPP anomalies differ from the ones in Zhao & Running (2010). For example, global NPP anomaly in 2005 is -0.5 PgC, while in the case of Zhao & Running (2010) is about -2. This difference can be due to calculation method for NPP?

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Interactive Discussion

Discussion Paper

Following, I add my comments:

Page 7 line 7: “the interannual pattern was robust and the calculated correlation coefficients between NPP and SPEI range between 0.50 and 0.54 ($p < 0.1$) for all SPEI times scales (Table 2).” and Page 9, line 12-14: “We found a statistically significant relation between global NPP and the drought index SPEI, just like Zhao and Running (2010) who studied this for a shorter time frame.”

Why did you choose SPEI instead of PDSI, which was used by Zhao & Running (2010)? Did you try to calculate correlations between NPP anomalies and other drought indices that might give higher correlations at the global scale? Is it possible that correlations with SPI and NPP anomalies are higher?

Page 7, lines 18-19:

You mention NPP in Southern Hemisphere appeared to be more sensitive to variability in droughts. Did you calculate these correlations? Zhao & Running (2010) reported that: “. . .there is a significant correlation ($r=0.87$, $p < 0.001$) between NPP and PDSI in the SH, though only a weak correlation ($r = 0.39$, $p < 0.27$) in the NH.”

Page 7, lines 25-28, & table 2:

You mention that correlations for DFEA changes with SPEI time scales, from -0.58 (1-SPEI) to -0.09 (6-SPEI). In contrast, DFNA (also a cold humid climate, but in North America) does not show these differences between correlations. Do you know why?

Page 9, lines 14-18:

What do you want to say with “by the dominance of areas where more soil moisture leads to increased NPP”? You mean soil moisture-driven NPP? Arid regions?

Page 9, las paragraph (line 21-27):

Why do you refer here to ENSO in this paragraph?

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Page 9, line 26: “We have shown how the tropical landmass SPEI shows a clear relation with NPP (Fig. 4d–f), suggesting the mechanism is indeed related to droughts”

Did you find a clear relation in the whole tropics? If I understood well you just find significant correlations in the equatorial humid regions, isn't it? And, Which mechanism do you refer to? The one related to NPP variability to ENSO? How can you conclude that from your analysis?

Page 9, Line 27 & page 10 lines 1-3:

The paragraph needs to be re-written, It is difficult to understand.

Third Paragraph page 10 (lines8-17):

What do you mean about arid regions suffer more from strong water deficits? Aren't those ecosystems more adapted to water deficit?

Vicente-Serrano (2013) also points out this issue: “It is noteworthy that the highest influence of drought on vegetation identified in arid areas does not imply necessarily that plant communities from those areas are more vulnerable to drought than those dominant in humid biomes. . .In arid and semiarid regions, drought impacts usually result in decreased vegetation activity and plant growth, but rarely cause plant mortality or long-term damage. . .In general, drought vulnerability is much larger in humid biomes than in arid ones, although we found a lower response to drought in the former. This might be explained by the more complex relationship between drought and vegetation activity and plant growth in humid areas because they are characterized by water surplus. . .in humid areas, long-lasting or recurrent droughts may also be too intense to allow for a fast vegetation recovery, and this could help explain some recent plant mortality episodes in humid forests around the world after severe drought events”

Page 10, Lines 15-17:

How do we see from your analysis that: “most of seasonally dry regions also show positive relations between NPP and SPEI, particularly if the dry season occurs within

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the growing season"?

Page 11, Lines 1-2: "In contrast, we are not able to detect an intense NPP decline in Amazon rainforest during 2005"

How do we see that from your results? Where are your calculations for the Amazon region?

Page 11, Lines 12-14:

You do not comment on your paper about the role of evaporative demand (potential evapotranspiration), which is calculated by SPEI. Could you add something about it on the paper? For example, Zhao & Running (2010) discussed that: "Despite increased precipitation over large parts of the SH, the warming trend induced a much higher evaporative demand, leading to a drying trend. As a result, NPP decreased because of warming-associated drying trends."

Page 11, Line 23: "Our study demonstrates that at annual time scale NPP variance is led by the change in drought."

What do you mean by change in drought?

Would you suggest, as Zhao & Running (2010) that the NPP decline is related to droughts?

Suggestion: could be possible to improve the representation of the different climatic zones in all tables and graphs to look at them easier?

References:

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Vicente-Serrano, S. M., Gouveia, C., Camarero, J. J., Begueria, S., Trigo, R., Lopez-Moreno, J. I., Azorin-Molina, C., Pasho, E., Lorenzo-Lacruz, J., Revuelto, J., Moran-Tejeda, E., and Sanchez-Lorenzo, A.: Response of vegetation to drought time-scales across global land biomes, P. Natl. Acad. Sci. USA, 110, 52–57, doi:10.1073/pnas.1207068110, 2013.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 2429, 2013.