**Biogeosciences
Discussions**

Interactive comment on "Sensitivity of North Patagonian temperate rainforests to changes in rainfall regimes: a process-based, dynamic forest model" *by* A. G. Gutiérrez et al.

Anonymous Referee #1

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General comments:

This manuscript describes a modeling study of forest water fluxes and biomass changes under different rainfall regimes. The model was developed based on FORMIND with a new extension of forest hydrological cycle added. They run the model for both a young and an old-growth stands of temperate rainforest under current and future climate scenarios and compared the modeling results with measurements of water fluxes in the young stand under current climate condition. They found that drier climate in the region would reduce evaportranspiration and soil moisture, but have stronger effects on the old-growth forest than the young forest. They concluded that model is a

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Interactive Discussion

Discussion Paper

suitable tool for analyses of the impacts of multiple drivers of global change on forest processes.

This study provided valuable information of temperate rainforest responses to future rainfall changes and may be helpful for forest management. The results of decreasing ET and soil moisture under future drier climatic conditions in the region seem to be reasonable. The manuscript was well organized and well written. But I have a few concerns of the manuscript in the current form. 1. There is a lack of further explanations of the results, particularly the different response patterns between two forest stands. The authors suggest that soil moisture limitation for biomass production in OG was the main reason. But similar soil moisture changes were found in these two forests (P6311, L15), how could different influences be produced? Were the same model parameters used for YS and OG? The authors may need to check other variables, such as LAI, Ad and provide mechanisms for the changes. 2. Estimation of transpiration using the WUE concept. Since T or ET is directly influenced by WUE, whether WUE change or not seasonally or under drought conditions could significantly influence the model results. I would suggest the authors to test how varying WUE vs constant WUE or a change in WUE under drought condition would influence model outputs of ET and biomass. I'm also not quite clear how the soil moisture influence on biomass production was applied in the model. Was the influence applied to the photosynthesis and respiration sub-models? The authors may need to clarify these and some other minor issues raised below.

Specific comments: Title:Change Sensitivity to Responses?

Abstract: Forest sensitivity is a word too general and not well defined here. I suggest the authors either define it clearly or use an alternative word, such as responses.

L21-25. These two sentences have similar meanings. I suggest merge into one sentence.

Introduction: L5. Move citations (Botkin et al. ...) to the end of the sentence.

L27. A key reference of Gutierrez and Huth (2012) was cited, but the paper is still in press and can't be accessed. I can't find it in the supplemental documents.

Materials and methods: P6298, L6: in annual time steps. Did the revised model use the same time step, or change to the daily step?

P6299, L5. Lateral water flow: This region has more than 2000 mm rainfall a year and lateral water flow could be significant during the rain seasons.

L17: Eqa. (8) uses the WUE concept to calculate the T. This is a simple way to estimate T, but how are WUE and Ad estimated? If Ad is described in the FORMIND model, please add one sentence or references for Ad calculation. Which WUE values were used? Did the WUE vary with time, particularly, under different climatic conditions?

P6302, Eqn.(12) The authors described soil moisture impact on tree biomass production. How was tree biomass production calculated? Was the production calculated as the sum of leaf photosynthesis? Was this soil moisture limitation applied to Ad (photosynthesis) or respiration?

P6306, L4-11. I'm not quite sure about the time step in the model. WUE usually varies with time of year and with treatments (irrigation, CO2 etc). A constant WUE may influence the model results on transpiration estimation in the current and future conditions.

L18: Results of weather generator were tested elsewhere. Please describe briefly the results of the test. Did the model produce the similar outputs using the measured weather data and the generated weather data?

P6307,L28: a total of 36 climatic scenarios. I'm not quite sure how the 36 scenarios were generated. Were 6 levels of each of the two rain event parameter selected? Please clarify.

Results: P6309, L9-12 (Evapotranspiration was . . .): Comparisons between YS and OG were not model verification, but model outputs. L22: ET is usually used for evapo-

transpiration.

Discussion:

P6312, L15-25: WUE. Since T or ET is directly influenced by WUE, whether WUE change or not under drought could significantly influence the model results. I would suggest the authors to test how a varying WUE vs constant WUE or a change in WUE under drought would influence model outputs of ET and soil moisture.

L26-L3, P6313. Temperature effects. Temperature is another factor that directly influences water cycling greatly, not just on forest growth. As temperature is not included in this study, the authors need to be careful in terms of inference it draw on forest responses to future drought climate.

P6313, L15-L3, P6314: Not much useful information is provided in this paragraph. I suggest delete this paragraph.

Tables:

Table 1: change "(a) literature, (b) calibrated with field data, . . ." to "* a: literature, b: calibrated with field data, . . .", and move to the bottom of the table. Add "*" to the Method*. Table 2. What's the total amount of rainfall for different scenarios? Table 4. Soil moisture, Only SD and % change reported?

Figures: Fig. 3. Add linear regression models to panel a, Fig. 5. Simulated and measured are not the same thing, how can they be compared to each other? 2008 or 2007?

Technical corrections:

P6294, L9. change "confronted" to "compared"?

P6296, L6: add the before largest?

L26, add an before old-growth.

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P6299, L7: soil depth z (cm): cm should be mm, otherwise, a scale 10 should be added to Equ. (1).

P6302, L14: soil water content s: s was used for soil saturation before, please change to m or w.

P6303, L1: move "theda(fc) is the soil field capacity" after Equ. (13).

P6306, L24: i.e. 2008. It seems that soil moisture was measured in 2007 (1/2007-1/2008), not 2008.

P6307, L10: contrasted?

P6312, L2: focused on

L7: "order along"?

L14: reword "but first is".

Interactive comment on Biogeosciences Discuss., 9, 6293, 2012.