

We thank Dr. Victor Brovkin for his comments. In this reply we address the suggestions for revisions of the manuscript point by point.

### **general comments**

*The manuscript “Data-based modelling and environmental sensitivity of vegetation in China” by Wang et al. is a well-written paper focused on a new empirical model of equilibrium relationship between vegetation cover and climate in China. This new approach (called “process-oriented niche specification” model) accounts for changes in atmospheric CO<sub>2</sub> concentration through changes in water use efficiency. This is a novel aspect in comparison with the classic biogeography models. While the new approach cannot fully substitute process-based vegetation models, it can serve as a first check of vegetation changes in climates with CO<sub>2</sub> levels considerably different from present-day CO<sub>2</sub> concentration. I have several comments listed below, which are rather easy to deal with in a course of a minor revision.*

- 1. My major comment is that the equations of the new model are not well described. The model equations are missing and this is not acceptable, especially for introducing the new approach. The regression coefficients are given in the Table 3, but they are useless if the units for the predictors are not provided.*

The units for the predictors are provided now in Table 2. The table already contains all the necessary information to construct the model equations. For example, the predicted probability (P) of temperate woodland and dry grassland is given by:

$$\ln [P/(1 - P)] = -20.334 + 14.252 \times \alpha - 11.166 \times \alpha^2 + 0.185 \times \text{mGDD}_5 + (5.672 \times 10^{-3}) \times \text{GDD}_0 - (0.782 \times 10^{-6}) \times \text{GDD}_0^2$$

Considering the number of vegetation types (16) and the number of predictor terms (potentially 7), it might not guarantee a concise presentation by providing all model equations directly in the text.

Therefore, we think that Table 2 is a good way to present the model equations. However, to make this point more obvious, we give one worked example in the caption to Table 2.

2. *My other concern is about presentation of model results on Fig. 5. The maps on this figure illustrate a response of vegetation to climate changes. To follow the discussion of regional vegetation changes, the readers have to compare two maps point-by-point, which is not straightforward for small-size maps of many colors. It would be easier to follow the discussion if the areas of changes in vegetation are clearly marked. For example, one could present a difference between the given map and the reference map (e.g. present-day distribution) by showing areas of changes in black/gray color. If a direction of changes is important to show, e.g. a transition from grassland to woody type or vice versa, different gray shading could be used. I suggest presenting these black-and-white difference maps for potential vegetation in addition to the color maps already provided.*

Indeed, the way we presented maps was not straightforward for comparing the changes of vegetation distribution. Therefore, we have now replaced the original Fig. 5 with a new figure just showing the areas where vegetation *changed* in the projected scenarios. Now it should be much easier to follow the discussion.

3. *Discussion of regional vegetation changes, especially in the sensitivity sections 3.2- 3.3, is hard to follow for readers not familiar with the geography of China. While the Tibetan Plateau is easy to recognize, the others regions mentioned (Hainan Island, North China Plain, Loess Plateau, Xinjiang province, Yungui Plateau, Sichuan Basin, Heilongjiang Province, Zangnan area) are not easy to identify on vegetation maps. It would make sense to add (e.g. as a supplementary material) a geographical map of China where all regions and provinces mentioned in the text are clearly indicated.*

An elevation map of China has been added as Supplementary material. This map also shows all of the regions and provinces mentioned in the text.

4. *In the section 4.4, limitation of equilibrium models should be clearly indicated. For example, this approach does not tell when exactly the changes in vegetation will happen. The readers should be warned that predicted vegetation response is not instantaneous. It could be achieved*

*only decades or centuries after the new climate state is established. Besides, processes leading to vegetation succession, such as fire disturbances, are not explicitly simulated. This is another strong limitation of the given method.*

As the reviewer suggested, some words have been added to the revised manuscript in section 4.4 to indicate these well-established limitations of equilibrium models.

### **Specific comments**

*P.55, l.19-29, p.56, l.1-4 – provide units for all variables discussed here. Remind the reader how the “alpha” index is calculated.*

The units are now provided for all variables, and the calculation for the “alpha” index has been mentioned in the text.

*P.55, l. 21: mGDDx variable is called “mean growing degree days”, while its meaning is a mean temperature of days above  $x$  °C and units are degrees, and not degree days. This is confusing. Following the logic of naming of the mPARx variable, the mGDDx variable should be called mTx. If the authors do not want to change the variable names, the meaning of mGDDx should be clearly explained in the text to avoid confusion.*

To avoid confusion, GDDx and mGDDx and the difference between them are now explicitly defined in the text. We prefer not to change these names, however, because they have been used in a number of other papers.

*Equations, p. 59, l.21, p. 60, l.3: provide units for variables and numbers for the equations. Provide all model equations (see my major comment above).*

The units for variables and the equation numbers have been provided now. All model equations can easily be derived from Table 2, as we indicated in our response above.

*P. 61, l. 4-7: “The shape of this diagram indicates the fundamental tradeoff between high annual productivity (associated with climates that are both warm and wet) and tolerance of dry or cold conditions, both of which are*

*incompatible with high productivity." What are both of? Productivity and tolerance? Or dry and cold conditions? Re-write the sentence to avoid confusion.*

This sentence has been rewritten to make its meaning clear.