A simple model for predicting the global distribution of the N_2 fixing host genus *Alnus Mill.*: impact of climate change on the global distribution in 2100

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7 1 Response to Anonymous Referee #1

⁸ The author proposed a simplified empirical approach for estimating spatial pattern in N2-fixing and the approach is based on characteristics of alder group activity. To understand global nitrogen cycle and the interaction with carbon cycle and climate change, a role of N2 fixing plants is important and the paper focusing point is interesting. However, the paper might be not worthy of publishing to the journal, Biogeoscience. I think the paper needs two major improvements.

¹⁵ Referee #1

¹⁷ First, a validity of the method is suspect.

18 Reply

Unfortunately, there is no available dataset about the distribution of alder 19 species on global scale except GBIF dataset which can be used for a valida-20 tion of the ADM. I used the available records of GBIF dataset to validate the 21 results of ADM methods. For the validation, the countries with more then 22 1000 records about the Alnus distribution which have ca. 93% of the total data 23 records were used. There were just two countries (i.e. USA and Russia) which 24 25 have over 1000 data records on low density according to the number of grid elements. Because of the low density, this two countries were not used in the 26 validation. 27

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Referee #1 The three equations are too simple comparing with other processes in general global nitrogen cycle model, and I doubt spatial versatility of these equations, especially for global scale.

32 Reply

To generate the climate field for the locations in which the alder species occur natively, I used climate data of 308 locations. In this locations all member of genus *Alnus Mill.* on species level (34 species) which published in the study from Chen & Li (2004) are represented. Since the climate field envelope all 34 alder species, I assumed that the climate field is representable for all alder species on global level. A table with the name of 34 species which were recorded ³⁹ in the 308 locations was added to the manuscript.

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41 Referee #1

In Fig. 4, the author can't determine the validity of the method, because of too
few evaluation points and just Europe. Moreover, the equations are also too
simple for separating in into factors (Clim, Veg, Soil).

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46 Reply

For the validation of the methods, not only data records from European countries were used but also data records from Mexico and Japan. The 13 countries include ca. the 93% of the total data records in 49 countries with alder data records which are represented in the GBIF database. And the differences between the r^2 and d of the four used methods for the predicting of potential distribution areas of alder are quite visible (see Fig. 4).

54 Referee #1

Second, a purpose of the model application is not clear. I understood general importance of alder, but i never find scientific knowledge provided from the author results. It means originality of the paper. I can't understand why the author estimated the model improvement using the alder distribution?

59 60 **Reply**

Numerous biogeochemical, biome models use empirical or statistical methods to 61 predict the nitrogen fixation by N₂ fixing plants. However, none of them consid-62 ers the N_2 fixation by the all species of genus Alnus Mill. since there is limited 63 information about the distribution of alder species on global scale. It makes 64 difficult the implementation of the N₂ fixation process in biogeochemical, biome 65 models to investigate the interactions between the carbon and nitrogen biogeo-66 chemical cycles. In this paper, a new methodology for predicting of potential 67 distribution of alder species on global scale is presented. The new methodology 68 of ADM gives the scientist the possibility to understand the climatological and 69 ecological requirements of alder species to distribute in natural areas and the 70 opportunity to implement a simple method to predict the potential distribution 71 locations of the alder species on each resolution. This text is also going to be 72 added in the section 6 of the paper. 73

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75 Referee #1

⁷⁶ For example, why the author used IPCC AR4 scenario?, why the author used ⁷⁷ several outputs of GCMs?

78 **D** - ---

79 Reply

By using the new methodology of ADM, the spatial and temporal change of alder 80 distribution can be investigated with required generated climate variables. In 81 this paper, the temporal and spatial change of alder distribution was modeled 82 by using the climate variables from five different GCMs and its four IPCC AR4 83 SRES scenarios. The using of climate variables from five different GCMs should 84 give an overview of the sensitivity of the methodology according to climate mod-85 els. Also, the using of the climate variables of four IPCC AR4 SRES scenarios 86 gives the scientist the information about the climate changed effect on the alder 87 distribution on global scale. This Informations are going to be added to the 88

⁸⁹ text in section 6.

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91 Referee #1

⁹² what the author can know by using results from simplified approach?

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94 Reply

Simplified approaches allowed the modeler to understand the basic requirements of the species (e.g. Alnus spp.) for distribution in their native areas. The results of this study shows that the distribution of alder is simply dependent on two climate parameters (Tann and Pann), vegetation units and soil types. For the determination of the vegetation units, Schmithuesen (1975) considered the plant-plant interaction as well as competition, which make the ADM considering this two important natural phenomena.

The author needs to accumulate these discussions. Present paper is not scientific paper, similar to just report. The difference is originality. I hope the author will have more time for re-think and re-discuss.