

Interactive comment on “Tropical climate and vegetation changes during Heinrich Event 1: comparing climate model output to pollen-based vegetation reconstructions with emphasis on the region around the tropical Atlantic Ocean” by D. Handiani et al.

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Handiani, Paul and Dupont’s manuscript examine the global vegetation response to changes in climate boundary conditions (Pre-industrial interglacial versus Last Glacial Maximum) and AMOC (Atlantic Meridional Overturning Circulation) intensity during Heinrich event (HE) 1, ~15 to 18 ka BP, with emphasis on tropical regions. For this analysis, they use the UVic Earth System-Climate Model (ESCM) which includes the

TRIFFID dynamic global vegetation model. The authors simulate four scenarios, Pre-industrial (PI_CNTRL), Last Glacial Maximum (LGM), freshwater perturbation during PI and freshwater perturbation during the LGM simulating HE 1. The methodology, results, discussion and conclusions are clearly written. They show that the model over represents C3 grasslands in southern Europe and forest in tropical and sub-tropical South America during the PI_CNTRL and LGM experiments, respectively. Despite that and in agreement with observations, the southern limit of the Northern Africa desert is simulated to move southward during HE1. The SST (Sea Surface Temperature) distribution confirms the bipolar seesaw pattern during this episode as the result of a slowdown/collapse of the AMOC. In my opinion one of the most important contributions of this paper is that it demonstrates the physical consistency of observed vegetation changes in the equatorial region as the result of freshwater input under LGM boundary conditions (HE1). Also this manuscript highlights the discrepancies between model outputs and observations due to limitations in the number of PFTs in climate-vegetation coupled models and the lack of precision in pollen-derived biomes. These mismatches encourage further studies on this topic.

This work warrants publication in The Climate of the Past and I suggest only minor but necessary revisions:

The title is too long. I suggest “Tropical climate and vegetation changes during Heinrich Event 1: a model-data comparison”.

The Abstract is not informative enough and needs to be rewritten:

a) the interest of the paper is not highlighted. Why are the authors particularly interested in the tropical regions? I think that this derives from the lack of focus of the introductory section of this manuscript (see below);

b) the final paragraph should be modified. What do the authors mean by “paleodata” in line 19? I suppose they refer to simulated mega-biomes;

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c) the sentence “The mega-biomes from the HE1 simulation with glacial...were in agreement with paleovegetation data from land and ocean proxies...”. I suggest adding “ocean conditions” after mega-biomes; and

d) the authors present the similarities and discrepancies between simulated and re-constructed mega-biomes but the contribution of this work in comparison with previous studies is not clearly presented.

I am a non-native English speaker but I feel that the Introduction is not fluent, including a number of repetitions. For instance, the idea that we still need to understand how the HE1 affects tropical vegetation is presented three times in this section. Additionally, the entire paragraph about previous studies lacks of clarity. I do not understand how a southward shift in tree line at around 40°N would produce a decrease in CO₂, in the present form I do not know even if this sentence is necessary as the authors do not discuss CO₂ changes during HE1 in the manuscript.

Minor modifications

Page 1975: line 8 – During Heinrich events, there is also the disintegration of the Fennoscandian ice sheet (e.g. Grousset et al., *Geology* 28: 123-126, 2000)

Page 1975: line 21 – The authors should also cite here Hessler et al., 2010.

Page 1977: line 8 – Add “in” between changes and vegetation

Page 1983: line 9 – Replace "moist" by "dry"

Page 1986: lines 26 – 28 – I do not see in BIOME 6000 map (Fig. 6), in contrast with the authors statement, that desert biomes and warm-temperate forest occupied Northern and Central Africa, respectively during the LGM.

Page 1990: line 15 – Replace "a" by "any"

Page 1994: line 13 – The authors state that changes in AMOC during HE1 “drove a subsequent response in the vegetation distribution, especially around the sub-tropical

Interactive
Comment

North Atlantic (Fig. 10)”. In contrast with this statement, Fig. 10 indicates significant changes around the tropical North Atlantic, tropical South Western America and Southwestern Asia.

Page 1995: line 6 – Why Holocene biome reconstructions are introduced here? There is no one figure in the manuscript showing Holocene data, only modern and LGM reconstructions.

Page 1995: line 26 – The authors should replace changing climate with freshwater input. Not all kinds of climate changes lead to “an increase in non-forested and desert PFT coverage in Northern tropical Africa, and a change from warm-temperate to tropical forests in Southwestern Africa”.

Figure 11 and Table 4: There is a mistake between the figure and the table. Sites 14 and 15 are represented by red crosses in Table 4 indicating the discrepancy between model and data while they are represented by blue crosses in Figure 11.

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