Dear Dr. Christopher Cleal,

We would like to thank you for reviewing our manuscript. We value the comments and will make amends in the upcoming version of the article. The suggestions are highly appreciated and a revised version addressing the comments will enhance the understanding of the readers and put to rest any confusion concerning the study.

Here we have addressed the comments and concerns:

Comment 1: *This paper is an attempt to develop a local dynamic vegetation model to show that lycopsids may have had a significant impact on weathering rates and atmospheric* CO_2 *during Silurian times. I cannot comment on the validity of the model itself, as this is outside my area of competence; I assume that someone more familiar with such models will also be looking at this manuscript. The following comments are mainly restricted to the general context (mainly palaeobotanical) of the results.*

Throughout: "Lycophytes" implies a plant division (or phylum), which is debatable and open to confusion. Better to call these plants lycopsids (i.e., class Lycopsida), which I think few would dispute.

Response: In the article, we aim at representing a broad class of vascular plants, hence 'Lycophytes' has been used to represent the phylum Lycophyta. The limited availability of observable data on physiological characteristics mandates us to use data from the broader range of the plant phylum for laying the boundary condition of the model. Using 'Lycopsids' will put to rest some confusion, and help in being more specific. We will include it wherever we can in the revised version. Besides, we need to include 'Lycopodiosida' and 'Lycophytina' as well if we want to replace 'lycophytes' with 'lycopsids' since Zosterophyllopsida and Protolepidododendrales also thrived in the period of our concern. LYCOm inherits few boundary conditions from them and hence accommodates such species as well.

Comment 2: *Lycopsids never really evolved into woody plants as such. The late Palaeozoic arborescent lycopsids had some secondary wood in their trunk, but the majority of its thickness consisted of periderm. The term woody plants is usually used for those gymnosperms and angiosperms whose trunks and stems consisted almost entirely of secondary wood.*

Response: In the revised version we will refrain from using 'Woody'. In this context, we will state instead: 'Lycopodiales (club mosses) represent a distinct lineage of vascular plants with a long evolutionary history including numerous extant and extinct species which started as tiny herbaceous plants and later went onto growing into forests with tree-like structure.'

Comment 3: *Why is Thomas & Watson (1976) being recorded here? This is a record of a large lycopsid trunk found in much younger strata, in the late Bashkirian. If you are talking about the earliest lycopsids, surely reference to late Silurian Baragwanathia would be more relevant.*

Response: Citing Silurian Baragwanathia is apt here and will be included in the revised version in place of Thomas & Watson (1976).

Comment 4 & 5: *Neither Rubinstein et al. (2010) nor Steemans et al. (2009) are reporting lycopsids from the Ordovician. They are reporting cryptospore-bearing Eoembryophyta. The lycopsids probably had their origins in the eoembryophytes, but there is no way you* *could really call these eoembryophytes lycopsids. The earliest lycopsid remains (and lycophyte remains, namely the Zosterophyllopsida) remain late Silurian in age.*

It is here that Thomas & Watson (1976) should be mentioned as documenting these arborescent lycopsids, rather than the Gensel & Berry paper.

Response: The earliest Lycopsid remains from the Silurian will be used for accurate emphasis as follows:

'This ancient group of vascular plants (Qiu et al., 2006; Wickett et al., 2014) dates back to the Silurian (Garratt et al., 1984), and later evolved tree stature in the Mid-Devonian (Stein et al., 2012) before surpassing a height of 50 meters during the Carboniferous period (Thomas and Watson, 1976; Taylor et al., 2009)'.

Comment 6: *I might be mis-interpreting this, but why is it thought that transpiration during the Silurian was into saturated air?*

Response: The purpose of the statement was not to imply that Silurian air was always saturated but to point out that our way of simulating stomatal conductance is suitable for a broad range of environmental conditions, including saturated air.

Vapor pressure deficit (VPD) is the most common regulator of stomatal conductance in dynamic global vegetation models for calculating photosynthesis. The use of VPD, however, fails to capture the fact that a plant's stomata may also react to water loss due to transpiration into saturated air, which is warmed up by radiation and thus may take up water while staying close to saturation during this process. Furthermore, the role of soil moisture for transpiration under dry conditions is addressed by our approach.

Comment 7: *I don't think these Silurian lycopsids had much in the way of underground roots.*

Response: The idea of the article is to represent lycopsids in the model and is not restricted to one period in history but a general representation of the potential climate impacts of these evolving plants. We try to explore and capture the consequence of root evolution and scale their impacts throughout history starting from Silurian. With a model like LYCOm a foundation can be laid for further research to scale such interactions with better precision.

The presence of complex root systems has been reported in the Devonian by Matsunaga and Tomescu, 2016 and the article by Hao et al., 2010 confirms evidence of rootlike structure in the Zosterophyllum plants during the Lower Devonian which are precursors of lycopsids. These plants coexisted with lycopsids around the period of our interest which is specifically a transition between the Late Silurian and Early Devonian when the initiation of diversification of vascular plants began. Even though the early lycopsids featured shallow roots, this was a change from the pre-existing non-vascular vegetation with regard to carbon input into soil. Furthermore, infiltration of the topsoil by roots was a significant phenomenon as it altered the water cycle and the structure of the soil. We will refer to the Early Devonian period as the time when lycopsids with roots first appered from here on.

Comment 8: *Bryophytes were not the immediate precursors of the lycopsids â these were the Zosterophyllopsids (a sister group to the lycopsids) and the various eotracheophytic / eoembryophytic "rhyniophytoid" groups. Lichens are of course fungi (albeit with algal symbionts) and it is difficult to see how they would have contributed significantly to early Palaeozoic levels of photosynthesis. Moreover, most lichens favour hardground-type* *substrates, whereas the model seems to be dealing with plants on soft substrates, and so it is difficult to see the relevance of comparing the effect of lichens against that of lycopsids.*

Response: Porada *et al*., 2016 suggested Lichen and Bryophyte Net Primary Productivity of 14.4 Gigatons per year globally during the Ordovician and influenced the weathering. Besides, their productivity is significant for the ecosystem Net Primary Productivity especially in the Tundra and the Boreal forest where they boast of a net carbon uptake of 1.9-297 g C m^{-2} yr^{-1} (Uchida et al., 2006; Bond-Lamberty et al., 2004) . Porada *et al*., 2016 suggested an influence of lichens and bryophytes on weathering rates during the Ordovician. The model LYCOm described in this article is suggestive of a greater weathering potential by Lycopsids. Neither bryophytes nor lichens are an immediate precursor to lycopsids, it is just to put in perspective the importance of Lycopsids and uncover their potentials. Since lichens and bryophytes existed before the Lycopsids, the change in weathering potential emphasizes the impacts of lycopsids and their corresponding effects on the biogeochemical cycle.

Comment 9: *The evidence does seem to suggest that lycopsids had the potential to increase local levels of photosynthesis and maybe substrate stability. But aerial cover of lycopsids during the Silurian is likely to have been very limited – probably mainly restricted to areas of wet substrates. With such a limited aerial spread, what global impact are they likely to have had in Silurian times on atmospheric composition? On the other hand, it has been suggested that the early eotracheophytes were already influencing atmospheric CO 2 and weathering rates by the Ordovician (e.g., Servais et al. 2019. Palaeogeography, Palaeoclimatology, Palaeoecology, 534: 109280) so it is maybe to be expected that the much larger lycopsids could have been having a larger effect in the late Silurian.*

Response: As rightly pointed out, the evidence does suggest that lycopsids had the potential to increase local levels of photosynthesis and modulated water recycling. We want to emphasize the fact that our model is not restricted to any particular period of history, we want to explore the extent of the influence of these plants on the climate of the past. We aim to capture the effects of Lycopsids when they were restricted spatially as well as for the period when they thrived abundantly.

We look forward to hearing from you in due time regarding our submission and to respond to any further questions and comments you may have.

Yours Sincerely,
Suman Halder

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