The manuscript aims to test the intermediate fire productivity hypothesis based on analyses of charcoal particles, total organic matter, d13C, CaCO3 and clay mineralogy on sediments from two periods of the early Jurassic. Charcoal particles are used as a proxy of fire.

Based on my expertise (paleofire, paleoecology), I will discuss only the fire issue.

Two categories of charcoal measurements have been carried out, "macrocharcoal" based on sieving approach, and microcharcoal based on palynological slides. Technically, this reminds the methodological study by Carcaillet et al. (2001), but on different type of sediments and geological period.

I strongly recommend completing such study with SEM images of these "charcoal" extracted from these Jurassic sediments. This would be of great interest for people specialist of plant anatomy to prove that the measured charcoal was, indeed, burned plant material and not coal or any other type of artefacts. Nobody is protected from lab error. Indeed, I personally had a bad experience with one of my assistants that measured coal particles in lake sediments within a catchment area with coal. My assistant produced nice sedimentary "charcoal" series; fortunately, a second assistant worked in parallel on these sediments on other proxies and indicated me that he never observed charcoal in these sediments, but he found abundant coal fragments. After cross-verification, the second assistant was right. In such old material, I absolutely need images (and why not cross-verification with another lab, abroad, with no conflict of interest), to verify and validate the charcoal report.

A great deal of attention was given to the correct identification of charcoal in this study. We have studied the charcoal particles in the Mochras borehole for nearly 10 years now, with multiple experts looking at it. Our first article studying the charcoal preserved in Jurassic sediments of this borehole (Baker et al., 2017, *Nature Communications*) already clearly shows that the charcoal particles quantified in this study are not coal or coalified plant material.

Furthermore, part of the charcoal data in the present study were already previously published (Hollaar et al., 2021, *Communications, Earth & Environment;* Hollaar et al., 2023, *Climate of the Past*), as clearly outlined in the present manuscript. Importantly, the 2021 publication already included SEM images of the charcoal particles in the studied borehole.

In all the above papers, charcoal particles are identified as opaque and black, angular, reflective of light, with lustrous shine, no brown edges, elongated, and splinter during breakage, often showing anatomical structure of the plant preserved (criteria from Scott, 2000 and Scott & Damblon, 2010). Coalified material lacks these characters and can be easily (with a trained eye) distinguished from charcoal.

The wildFIRE lab, led by Prof. C.M. Belcher and where this work was carried out, is an internationally recognized lab specialized in deep time palaeo-fire records. The first author was trained in this lab and has now over 6-years experience in pre-Quaternary (Mesozoic) fire studies including charcoal recognition.

To accommodate the reviewers' suggestions, the revised manuscript will include charcoal recognition characteristics in a table in the SI. It will also include additional SEM images from charcoal particles that were studied here for complete transparency and verification.

Identification characteristics	**Charcoal**	**Non-charcoalified**
Colour	Opaque, black, silver	Brown, orange edges
Shine	Reflective, lustrous	Dull
Structure	Original anatomy preserved, cellular structure visible	No apparent structure
Shape	Elongated, sharp edges	Rounded, paper thin
Fracture	Brittle, splintery fragmentation	Conchoidal, total disintegration, orange appearance

If charcoal identification is validated with an independent lab, this study of sedimentary charcoal during the Jurassic, would be a great finding showing that fire is a global process since millions of years, maybe since the settlements of plant fuel on terrestrial habitats as already evidenced by Glasspool and co-workers (2004).

The present study does not aim to, or cannot show that fire has been a global process for millions of years; primarily because the present study considers only one site.

Furthermore, there is a huge body of literature and data that shows the presence of charcoal through Earth's history, ever since the first arrival of land plants (a few recent papers include Jasper et al., 2021; Baker, 2022; Glasspool & Gastaldo, 2022). The aim of this study is to test the applicability of the intermediate productivity gradient hypothesis to understand climate-vegetation-fire relations in the Mesozoic world.

The first problem is less the quantification method than the use of data. Indeed, to reconstruct fire history, whatever the fire intervals/frequency or the fire severity, a solid chronology is absolutely needed to transform charcoal concentration in terms of accumulation rate (or influx). Same charcoal concentration can result different charcoal influx according to differences in sedimentation time inferred from measured chronology, and vice versa, different charcoal concentration can correspond to the same charcoal influx.

The present study is applied to a much longer time series than suggested in the above comment (approximately 1 Myr for the Late Pliensbachian Event). Obtaining annual-resolution data in deep time marine records is not possible, and it is also not necessary given the objectives of our study (charcoal influx cm^{-2} yr^{-1}). The presented/utilized age model is based on precession cycles (~20 kyr) at its most resolved level. Sedimentation rate is accounted for when assessing charcoal abundance in Quaternary sediments (often lake deposition), by expressing the charcoal accumulation rate (charcoal influx) as the number of fragments per unit area per unit time (Marlon et al., 2016). A similar charcoal influx measure has been proposed for older periods, where the charcoal influx is based on the mass per unit area per unit time (Herring, 1985). However, reporting the charcoal flux can impose uncertainty based on an incorrect age-depth model and potential core stretching (Daniau et al., 2019); these possible biasing factors are more likely to occur in deep time geological records.

More common practice is to take potential changes in sedimentation rate and terrestrial run-off into the marine environment into account in deep time charcoal studies. This is either done by counting the total terrestrial organic fraction and comparing this to the charcoal record (Belcher et al., 2005) or to terrestrial sediment influx determined through elemental proxies (Daniau et al., 2013; Hollaar et al., 2021). In this study we compare changes in palynofacies (total terrestrial organic particles) with the charcoal record to indicate any concomitant major changes in terrestrial runoff or preservation, of which there is no evidence. For the LPE interval in the studied borehole we normalized the charcoal record to total terrestrial elemental influx (already published in Hollaar et al., 2021, 2023). Importantly, normalizing the charcoal record to the terrestrial elemental influx does not influence the pattern observed in the charcoal record (SI Fig. 4 and SI Fig. 4 respectively of Hollaar et al., 2021, 2023).

Second, in international high-profile paleo-fire paper, no one uses today charcoal series without decomposing the time series to detect charcoal peaks to determine the fire intervals and thus the fire frequency, and to eventually assess changes in fire severity thanks to magnitude of charcoal peaks (see for instance Higuera 2006 or Blarquez et al. 2013 or also Higuera 2009).

This statement is incorrect as it only relates to studies on Quaternary records. For studies of older materials, such as recorded in Mesozoic marine sedimentary archives, this is simply not possible. One charcoal/sediment sample represents 2,000 years, on average, which in fact represents a remarkably high data resolution for pre-Quaternary charcoal records.

As also per the answer above, none of the recent studies of geological deep-time charcoal in international journals even attempt to determine the fire return interval/fire frequency because such data-resolution is impossible to obtain in deep time geological archives, except under very, very rare and exceptional circumstances. Some recent and relevant papers outlining and exemplifying charcoal and palaeo botanical data resolution in deep time geological archives are: Götz & Uhl, 2022 *Annales Societatis Geologorum Poloniae*, Vajda et al., 2020 *Earth and Planetary Science Letters*, Baker et al., 2019 *GSA Bulletin,* Pole et al., 2018 *Palaeobiodiversity and Palaeoenvironments,* Baker et al., 2017 *Nature Communications*, Tanner & Lucas, 2016 *PPP*, Petersen & Lindstrom, 2012 *Plos One*, Uhl & Montenari, 2011 *Geological Journal*, Glasspool & Scott, 2010 *Nature Geoscience*, Belcher et al., 2010 *Nature Geoscience*, Marynowski & Simoneit, 2009 *Palaios*, Collinson et al., 2007 *Journal of the Geological Society* (and many more).

We note that the reviewer uses the term 'fire severity' differently from what is now commonly accepted; we here refer to Keeley (2009), where fire severity describes the loss of carbon from an ecosystem.

Additionally, this study does not contain any statistics. It is not acceptable to read such a manuscript whose interpretation is completely intuitive.

Statistics do form an important component of this study, we strongly object to the suggestion that interpretations are merely intuitive. Extensive visual comparison of trends, Pearson correlation, box plots, and bandpass filtering form the building blocks of our interpretations and conclusions. We understand that that it is always possible to explore statistical space more extensively and will consider this for the revised manuscript.

For example, a Wilcoxon test is a prerequisite for analysing the boxplots in Figure 4. Such a boxplot could be complemented by a kernel density which could be useful for detecting data distribution patterns. It is astonishing that this text is so intuitive (cf. L 270 or LL 301-304).

As per the above, we disagree on the suggestion that interpretations are merely intuitive.

L270: "*… to the LPE interval, however, the absolute minimum and maximum are similar*." Part of figure description Fig. 4. The exact values (mean, min, max are given in the text).

L301-304: "*However, the mean abundance of macrocharcoal and microcharcoal is higher during the SPB (mean of 787 and $2x10^5$ respectively) compared to the LPE (mean of 376 and $1.1x10^5$ respectively) in the Mochras borehole, suggesting that the shore proximity did not impact overall charcoal abundance.*" This text gives the statistical mean.

For clarification, in a revised manuscript we will add in a statistical data table of the micro- and macro-charcoal in the SI.

As per the reviewers suggestion, we will include the results of the Wilcoxon test and add this in the revised manuscript (macrocharcoal LPE and SPB H0 rejected at significance level p=0.006^{-10} and microcharcoal LPE and SPB H0 rejected at significance level p=0.005^{-9}; and will thus support the conclusions drawn from the boxplots.

Also, LL 304-307 mentions comparisons of means, even though no statistics have been carried out and the data are not illustrated.
The statistical values will be included also in a supplementary data table.

Generally, the authors speculate on the interactions between bio- and geo-proxies, sometimes indicating correlations (r-values) associated with p-values, when a simple principal component analysis (PCA) would have been very efficient if carried out as a preliminary analysis. to make a solid descriptive statistic of the environmental data (all proxies) to clearly distinguish those that exhibit the same behaviour (correlated or anti-correlated) from those that have no links. With such a PCA, the authors would have interpreted their data based on a good methodology allowing a rational sedimentological interpretation (e.g., Clark-Wolf et al. 2023). Such a basic strategy should avoid "visual comparison" of data (L. 212) and speculation (the entire manuscript). I am not sure r (linear correlation coefficient) is appropriate. I would have used the coefficient of determination (r2) (LL261-264).

For the aim of this study a Pearson correlation is effective: to indicate no correlation between terrestrial organic matter content and charcoal. We performed a PCA analysis previously for the LPE interval (published in Hollaar et al., 2023, *Climate of the Past*, Fig. 5). However, following the reviewers suggestion we will explore further PCA analysis for the SPB and LPE intervals in the revised manuscript here. Importantly, the previous analysis confirms the trends we discuss in the current manuscript based on the Pearson correlation. As the PCA in Hollaar et al. (2023) does not yet include macrocharcoal and does include elemental proxies that are not a part of the current manuscript, it will indeed be valuable to re-do the PCA also for the LPE interval and include the proxies presented in this study.

LL 81-83: I partly disagree with the assertion that "high fire activity in ecosystems (…) is strongly driven by grass biomes". Archibald et al. 2018 is cited. This a very good paper, but many papers demonstrated that it is not grass component of the ecosystem that drive high biomass burning or fire risk but an intermediate tree-cover (Archibald et al. 2009; Frejaville et al. 2016; Aleman et al. 2017), which increases the ETP, then dryness, and finally the development of grass cover in the understorey. Grass cover is a secondary process, but the main process is the intermediate tree-cover, which can be sustained by wildfires resulting a feedback-loop.

In L81-83 we explain that the observation of the intermediate-productivity gradient is based on a world in which grass ecosystem burning (>80% of all burned area) dominates.

L81-83: "However, the observation of high fire activity in ecosystems that are of intermediate aridity and productivity is strongly driven by grass biomes (Archibald et al., 2018)."

The sentence will be recast in a revised manuscript: "The observation of high fire activity in ecosystems that are of intermediate aridity and productivity is strongly driven by grass biomes (Archibald et al., 2018)."

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