Montpellier, January 11th 2024

Dear editors and reviewers,

We appreciate your valuable feedback and have carefully considered all the comments. In particular, we have addressed the suggestion to include spatial analyses in an Appendix, as they were secondary to the focus of this manuscript and simplified our message.

We hope you find these modifications satisfactory. Looking forward to hearing back from you.

All the best,
Isis Poinas, on behalf of all co-authors

Below, the original comments from reviewers are in black, while our responses are in blue.

Dear Isis Poinas

Many thanks for sending the revised version of your manuscript to PCI Ecology. Two reviewers (Dr. Ignasi Bartomeus and Dr. Claelia Sirami) and I read carefully this new version. We all agree that you made a great work to incorporate our comments or provided arguments about the suggestions you disagreed. Dr. Sirami still has some minor comments on your work, but both reviewers are very positive about your contribution. I still have a major point to discuss with you and some other suggestions to improve your manuscript.

Your work is impressive because of the dataset you analyzed to answer key questions related with the influence of climate change and agricultural practices on the taxonomic and functional diversity of spontaneous vegetation in agricultural systems. Your main question is related to temporal changes on such predictors and their influence on spontaneous vegetation. As you recognize the spatial correlation of your samples, you also present a complementary analysis that show how considering such spatiality may influence your key question (that is still on climate variables and agricultural practices and their temporal variation). I have no doubts about the timing and relevance of such work and I want to recommend it, but there is still a key issue of your study design (or the way you chose to communicate it) that I think that need to be addressed.

Now you provided answers to different questions that we made on your first version and that the manuscript has been improved, during my second (and deep) read I realized that what you presented as a “spatial model” (Figure 4) is more related to controlling spatial autocorrelation among samples -given your questions on climate change and agricultural practices- rather than a specific question related to spatiality itself. For the different comments that the reviewers and I made related to your analyses, you provided the reasons underpinning each analysis and I understand that there is no way to consider all spatiotemporal dependencies on your data in just one analysis (the ideal analysis to answer your original question). I am ok with that. However, now I feel that presenting your “average” analysis as a spatial one is not correct. What makes me think about this point is that your introduction clearly describes temporal changes in both climate and agricultural practices, but “the spatial problem/question” is not really introduced;

readers may have no idea about how spatiality may affect variability in climate or agricultural practices. In fact, you do not have hypotheses related to spatiality and your Table 1 describes expected temporal patterns and hypothesis. Moreover, considering that you have a clear pattern related to temporal changes, I think that collapsing information to an average just to understand how controlling spatial autocorrelation changes the statistical effects of climate variables and agricultural practices and showing that as a spatial analysis as important as the temporal one basically adds confusion to your work. For me, your main question is related to temporal trends in climate variables and agricultural practices patterns and on their effects on spontaneous vegetation; then, you realized that you need to control for spatial autocorrelation to understand such changes in a more robust way. This is very different from having a spatial analysis itself, with an introduction and associated hypotheses. Based on this reasoning, I will suggest you simplify your results, focus on the temporal analysis (for which you have a clear background) and mention your results considering spatiality as a secondary, complementary analysis, and not as a one as central as the temporal analysis. This implies changing the way you describe some results and some of your figures, and clearly stating that your focus is on temporal changes that in turn may be affected by spatiality. In this vein, it is important to mention that you do not have temporal patterns in agricultural practices; thus, you are analyzing the effect of the intensity of agricultural practices by considering spatio-temporal samples. In the case of climate variables, their variation follows a temporal pattern, i.e. the value of climate variables can be associated to temporal changes. In the following, I will exemplify across your manuscript how considering spatiality as important as temporality may confound readers and suggest changes that I feel may improve the manuscript.

We fully agree with this comment, as exclusive spatial inquiries and hypotheses linked to this dataset have previously been addressed in a paper that is now published (*Poinas, I., Fried, G., Henckel, L., & Meynard, C. N. (2023). Agricultural drivers of field margin plant communities are scale-dependent. Basic and Applied Ecology, 72, 55-63.*). Furthermore, many outcomes emphasized in the spatial models are also observed in the temporal models. For instance, communities respond similarly to an increase in the intensity of field margin management, regardless of whether this latter is temporal or spatial. We therefore eliminated the spatial results from the main text to focus on the temporal trends, which greatly helped simplifying our methods and the paper in general. However, these spatial models are quite interesting as a complement to temporal analyses, warranting their inclusion in an Appendix.

Another major comment is that your abstract still needs more work to be clear. As stated by Dr. Sirami, you use different words and expressions to talk about each variable and that may confound readers. Moreover, I think that there are some results that I highlighted in my first review that need to be clarified or written in a different way as they remain unclear.

We have edited our abstract to address this concern. Hopefully, it is now much clearer.

Hope you find that our comments and suggestions will improve your manuscript.

Finally, apologies for the time we took to review this new version.

Best wishes

Julia

Specific comments

ABSTRACT

Lines 23-25. You state "Here we used a standardized yearly 23 monitoring effort of agricultural field margin flora at the national scale to assess the spatial-temporal response of diversity and functional traits to climatic and agricultural variations". As I explained before, you do not assess a given hypothesis related with spatiality, you control for spatial patterns to assess how mean climate and agricultural practices values modulate species diversity. Following my suggestion, you should focus your abstract on temporal changes and state your spatial analysis in a separated sentence. That will clarify your abstract. Moreover, I think that you need to clarify what do you mean by climatic and agricultural variations here and use the same words or expressions to refer to these factors in order to clarify your abstract.

Throughout all the manuscript, we removed all references to spatial analyses (moved to Appendix I). Climatic and agricultural variations are defined in the following sentence: temperature and soil moisture for climate; herbicides, fertilization and margin management for agricultural practices. We homogenized the different expressions:

"Here we used a standardized yearly monitoring effort of agricultural field margin flora at the national scale to assess the temporal response of diversity and functional traits to variations in climate and intensity of agricultural practices."

Lines 25-29. You state "We examined temporal trends in climate (temperature, soil moisture), intensity of agricultural practices (herbicides, fertilization, margin management), plant species richness, and community-weighted means and variances of traits expected to vary both with climate and practices (e.g., seed mass, specific leaf area), across 555 sites in France between 2013 and 2021." This is, again, related to a temporal analysis. You do not mention details on your "spatial analysis" (which should be briefly explained) nor a hypothesis related to spatiality.

We removed spatial analyses.

Line 31: Functional changes... temporal? spatial? mainly explained by temporal variation in climate variables instead of climate change? Why you do not introduce results on plant species richness, and community-weighted means and variances of traits, before going directly to an interpretation of results according to Grime's strategies? For me, introducing some variables in methods and then mentioning results related to something that you have not mentioned before may totally confound readers. The same for the next sentence, you go directly to ruderal species, without any mention on species richness/diversity.

As depicted in Fig. 5, species richness exhibited minimal temporal variability, and its temporal fluctuations were not explained by any of the climatic and agricultural factors included in our models. Here, we focused on shifts in strategies rather than traits, given their capacity to aggregate a set of traits, allowing us to be more synthetic. The mentioned strategies (conservative, ruderal/acquisitive) are not derived from Grime's CSR triangle (Fig. 7) but from the models on the CWM. Specifically, the PCA on CWM (Fig. 4) distinguished different strategies along the main axes. To mitigate potential confusion for the reader, we have added the most relevant functional traits:

"During the same period, functional changes in plant communities were significant, showing an increase of thermophilic species (including Mediterranean species) with a conservative resource acquisition strategy (high stature, late and short flowering) mainly explained by climate change."

Lines 33-34. "The impact of agricultural practices was more limited". What do you mean with "was more limited"? In which sense? I also suggest you write "The impact of temporal changes in the intensity of agricultural practices", as this is the focus of your work. Maybe you can add just one sentence summarizing what is the effect of considering spatiality in the effect of mean values of climate and agricultural practices, also stating clearly that you analyse mean values of response variables.

The impact of agricultural practices was more limited, meaning that fewer agricultural factors were involved in community changes. We have made this clearer:

"The reduction in field margin management intensity resulted in a vegetation shift towards a more conservative strategy. In contrast, there was no impact from the slight temporal changes of practices conducted within the field (herbicides, fertilization)."

Line 34: Please, add "the intensity" of field margin management and fertilization.

Done

"The reduction in field margin management intensity resulted in a vegetation shift towards a more conservative strategy."

Lines 33-35. "The impact of agricultural practices was more limited and mainly exerted through field margin management and fertilization that shifted vegetation towards species with a ruderal syndrome." This sentence is confusing as before you stated "whereas the intensity of agricultural practices did not show clear temporal trends over the past decade". Maybe it is not clear because of the use of different words/expressions to talk about the same variables.

Agreed. We have changed the first sentence which was too vague:

"We found clear temporal climatic trends (temperature increased while soil moisture decreased), whereas trends in agricultural practices were weak over the past decade, with only slight decreases in herbicides and margin management intensity."

Lines 35-36. “Responses to climate change differed according to crop type (vineyards versus annual crops), region (Mediterranean versus continental)”. These analyses were not introduced before and thus it may confound readers. I suggest you briefly introduce them before or here, and then reveal your results.

As the summary is already very long (>350 words), we propose to delete this sentence. These analyses on subsets of data are secondary to our main analysis encompassing all sites and species. Furthermore, the following sentence (“Our findings suggest that species adapted to climate change (including Mediterranean and conservative species) have temporally increased in proportion.”) does not only result directly from these regional analyses and also describes a result already obtained at a national scale.

Lines 37-38. “Our findings suggest that species adapted to climate change (including Mediterranean and conservative species) have [add “temporally”] increased in proportion.”

Done

Lines 40-42. We put these results into the conceptual framework of Grime’s CSR triangle and revealed a [add temporal] decline of competitive and ruderal species in favor of stress-tolerant species better adapted to climate change.

Done

Lines 43-44. Why more diverse communities if CC is favoring a given strategy?

This conclusion arises from the functional trade-offs highlighted in this study. Given that species best adapted to climate change are also more sensitive to intensive agricultural practices, we assume that an agricultural intensification would lead to a collapse in diversity (no species adapted to both climate change and agricultural practices). Conversely, reducing agricultural disturbance levels would create an opportunity for climate change to favor the selection of adapted (stress-tolerant) species.

As agricultural plant communities predominantly exhibit a ruderal syndrome (see *MacLaren, C., Storkey, J., Menegat, A., Metcalfe, H., & Dehnen-Schmutz, K. (2020). An ecological future for weed science to sustain crop production and the environment. A review. Agronomy for Sustainable Development, 40, 1-29.),* the selection of stress-tolerant species would likely increase functional diversity within these assemblages.

To make it clearer, we have modified it as follows:

“Choosing less intensive management can broaden the functional spectrum of agricultural plant communities, by maintaining the ability of stress-tolerant species selected by climate change to colonize habitats largely dominated by ruderals.”

General comment: It is not clear for me which results are associated to the analyses that controls

for spatiality. As the abstract should work independently from the text, I strongly suggest you work hard to make it more transparent and associated with your full set of results, even if you cannot mention all results.

The abstract was modified in this direction.

INTRODUCTION

Lines 62-65. Spatiality is introduced in the first paragraph in the last sentence but it isn't clear what do you mean wit “spatiality”. Maybe regions where pesticide use has decreased? If you really think you have a spatial analysis, I strongly suggest you introduce spatiality in this section and review spatial changes as you did for temporal changes.

As we removed spatiality, we also removed this sentence.

Line 68. "these changes"-> are you referring to temporal change in biodiversity? That will be "this change" (draw by climate or agricultural practices changes). Spatial changes are not contextualized in your first paragraph. Maybe you can explicit what changes you are you referring here.

Yes, we clarified it:

“Temporal changes in plant communities cannot be discerned solely by taxonomic diversity due to the differing traits affected by resource availability and disturbance levels (Garnier and Navas, 2012); therefore, a functional dimension provides an additional perspective to accurately understand these changes.”

Lines 84-85. You state “To understand the complex interactions between climate change and agricultural practices, it is thus essential to examine the temporal dimension of functional inter-specific trait variations”. However, agricultural practices do not show a temporal trend. Then, what you are evaluating is the effect of the intensity in agricultural practices (either, spatially or temporally sampled). Is that correct? This will be different from having a temporal trend in agricultural intensification. This point is definitely unclear for me. I think that trying to simplify your work and messages you confounded your factors. Climate variables have temporal samples that show a temporal trend, so your climatic gradient is temporal. But your gradient of agricultural practices it is not. Then, should temporality be considered in the same way as for climate? Are temporal changes in agricultural practices or the intensity of agricultural practices across different years what is being evaluated? This is a major point of your manuscript and you need to make a strong effort to make it clear. Maybe that is why you do not use the word temporal in your Table 1?

Here, the intensity of farming practices exhibits a temporal trend, although it is very weak compared to the more pronounced climatic trends. Furthermore, it is crucial to distinguish between monotonic temporal trends, which are relatively weak in the case of agricultural practices, and inter-annual temporal variations which do not follow a clear trend but are

assumed to also have an impact on communities. Our models take both aspects into account. And finally, we state that temporal trends in agricultural practices are weak when referring to the average national trends. But the absence of an average decrease in fertilization in France does not imply uniformity across all sites. Some sites may have become more extensive in fertilization, while others have become more intensive. Our models are able to discern these nuanced effects, which may not be apparent when data are aggregated at a national scale.

The expression "interaction between climate change and agricultural practices" refers to the interactive effect of climate change and temporal shifts in the intensity of agricultural practices.

In the last paragraph, we made it explicit that we were looking at temporal variations but that we also considered temporal trends, which is why we expected more impact from climate than from practices:

"In this study, we aimed at deciphering how **inter-annual temporal variations and temporal trends in climate** (temperature, soil moisture) **and agricultural practices** (frequency of herbicide use, margin management and nitrogen dose in fertilizers) in France structure species richness, trait composition and ecological strategies of field margin plant communities."

"We hypothesized that plant traits sensitive to temperature and soil moisture will co-vary with **temporal warming trends** while agricultural practices **would have a comparatively weaker temporal influence** on plant communities, as we did not expect **clear temporal trends in these practices."**

In Table 1, the temporal aspect was not mentioned, as the table also applied to spatial variations. We have corrected this.

Lines 93-94. "These temporal variations in functional traits reveal patterns that cannot be assessed solely with a space-for-time approach". This sentence is really confusing. What do you mean by a space-for-time approach, as this is not clear in your work?

The expression "space-for-time approach" refers to the use of spatial variations as a proxy for temporal changes. In other words, it involves studying environmental effects on communities at different sites and assuming that variations observed across these sites can represent community changes over time. We clarified it: "These temporal variations in functional traits reveal patterns that cannot be assessed solely with space-for-time substitution."

Lines 95-97. "In this study, we aimed at deciphering how spatio-temporal variations of climate (temperature, soil moisture) and agricultural practices (frequency of herbicide use, margin management and nitrogen dose in fertilizers)." This sentence is confusing, because you do not really have a hypothesis for spatial changes, you control spatiality in order to evaluate how variations in climate and agricultural practices modulate vegetation changes. Moreover, as I stated before, agricultural practices in fact do not show a temporal trend, so I suppose that temporality here is just a way to recognize that you have different values of agricultural practices because you studied different years. Hope you can see the difference between the two forms of analysis and argument.

We have removed the spatial analysis. For temporal analysis we choose to keep the term "temporal variations" as it synthesizes what you said: that temporality is just a way to recognize that we have different values of agricultural practices because we studied different years. But to enhance clarity, we used the term "inter-annual temporal variations" and added the temporal trends:

"In this study, we aimed at deciphering how inter-annual temporal variations and temporal trends in climate (temperature, soil moisture) and agricultural practices (frequency of herbicide use, margin management and nitrogen dose in fertilizers) in France structure species richness, trait composition and ecological strategies of field margin plant communities."

Lines 101-103. "Our study stands as one of the first to investigate the temporal trends in agricultural practices and climate, and explore the spatial and temporal drivers of species richness and functional traits at such extensive scales." Here again, I see very problematic the way you present your study.

"our study stands as one of the first to investigate the temporal trends in agricultural practices and climate, and explore the response of species richness and functional traits to these trends at such extensive scales."

Lines 104-106. "while agricultural practices would have a greater spatial than temporal influence on plant communities, as we did not expect clear temporal trends in these practices." There is no such spatial effect, there is an effect that emerges because you controlled by spatial autocorrelation. If you consider that there is such spatial effect, which factor will explain it? Your question will be "how species richness, functional diversity and strategies change with the intensity of agricultural practices (evaluated across different regions and years)? Hope you can see the difference between the two alternatives.

Certainly, the term "spatial effect" is inaccurate in this context as we referred to spatialized factors like the intensity of practices. This issue has been resolved in the current version, as spatial analyses have been removed from the main text.

METHODS

Table 1.
(1) I suggest you edit your table 1 according to my previous comments. As it is, the headers may confound readers. For example, the word "factor" in the first column, even if you put response variables in different colors. Maybe you can add something like "Factors/response variables". On the other hand, the fact that readers will find temporal hypotheses -not mentioned as temporal yet- for climate and agricultural practices in the column "hypothesis of response to the agricultural/climate gradient ", i.e. the gradient responding to the gradient itself. This sounds rare for me.

(2) Please, make clear which hypothesis are temporal here. As I mentioned before, from your introduction I understand that you have a hypothesis for climate, which is temporal, and two

different hypotheses for agricultural practices (temporal and about their intensity). Is that correct?

(3) Your legend will also need to be modified accordingly.

Done for the headers. We added the mention of the temporal aspect in hypotheses and clarified the legend:

"Table 1. List of explanatory factors (blue), functional traits (green) and response variables (red) with their abbreviations, units and calculation. We have illustrated by arrows the expected link of each factor and trait to the agricultural resource (fertilization) and disturbance gradient (herbicides and margin management), and to the climatic gradient (drought and increasing temperature). We also used arrows to illustrate the expected direction of variation of these gradients within a year (i.e. climatic and agricultural changes according to the date of observation). Horizontal arrows indicate contradictory findings in the literature (see Appendix C for the references)."

This temporal aspect was not mentioned before, as we assumed that communities would respond similarly to the gradients, whether they were spatial or temporal.

Lines 179-181. Can you give a more detailed explanation of these data-entry? How did you collapse information for site? (across all observations?).

Floristic data were first aggregated before calculating functional index. We removed this part on spatial analysis.

Lines 207-220. As I explained before, you do not have a spatial analyses per se. That's why in fact you do not have a spatial framework in your introduction or even a hypothesis linked to the spatial variation of your factors or variables (something that you have for the temporal analyses). You have an analysis in which you control for spatial correlation in order to make your samples more or less independent accordingly to their spatial distribution in the territory you are analyzing. It is important to note that in fact, you have a design to evaluate how mean species richness and mean trait variation of a given site (averaged across years) change with climate variables and agricultural practices (also collapsed across years by using averaged values). I strongly recommend you keeping the temporal analysis, as the spatial analyses seems secondary to me (collapsing values across years while you have an explicit analysis of temporal changes does not makes sense for me; but I understand that is the best analysis that you can introduce to better approach your results). I think that will simplify your article and make your contribution more valuable, since you have temporal trends in climate variables, which also seem to have the most important effect.

Agreed. We moved these analyses in an Appendix and we have made it clear that it is not a spatial analysis per se (see **Appendix I**).

Lines 222-223. You do not have a spatial analysis, see my previous comment.

We removed this sentence.

Fig.2. I strongly recommend you rethink this figure and your proposal (see my previous comment and general proposition). Just keep the temporal analysis as the main one and show how diversity patterns related to climate variables and agricultural practices change when space is considered (recognizing the limitations of this spatial analyses, which I think merits a paragraph in the discussion section).

Done

RESULTS

Line 250. Why you do not present a spatial analysis of vegetation as the one you present for the temporal analyses? I think that this is in line with my argument that you want to control for spatial correlation but you do not have the same interest/background/hypothesis as with temporal changes in climate i.e., higher temperatures and lower soil moisture. In case of having those hypotheses, I would like to see them separated in your Table 1 too.

We removed spatial analyses.

Lines 288-313. Here you confound a spatial analysis with an analysis based on the subgroups of species that you mentioned in your introduction. It does not seem to me that this is a spatial analysis per se, you are focusing on two regions that you already identified as different regions (in your introduction) and with the PCA you look for sites described as continental or Mediterranean being more similar. In fact, in your methods section you do not mention these analyses as spatial analyses (which will include lines 299-313). In fact, at lines 197-199 you said: We performed a normed PCA on the CWM of traits (by site for spatial analyses, by observation for temporal analyses) to classify each community based on its average trait combination or ecological strategy, which is reflected by its position on the first two axes. I suggest that you revise carefully all parts of your manuscript referring to a "spatial analysis".

We removed spatial analyses.

Line 299. In line with my previous comments, models evaluating factors and considering the spatial autocorrelation among samples are different from models that explicitly have an hypothesis about space. Again, for me you are controlling spatial autocorrelation to evaluate the effect of the factors you are interested in. PCA analysis and spatial analyses are different and provide different (and complementary) information, as far as I understand. PCAs allowed you to talk about Grime strategies, which is different from what the analyses mentioned as "spatial analyses" in the methods section show. I suggest you to show these results in a separated subsection in the Results section.

We removed spatial analyses.

Lines 327-331. Please, provide this results in a separated section, or explain clearly in the methods the relationship between your PCA analyses and the temporal analysis.

Done (separated section).

Line 333. In what part of the methods you mention this analysis with the "stress-tolerance" axis?

The stress-tolerance and ruderal axes are from the PCA analysis.

"Climatic factors were the predominant drivers of changes in community trait composition, with high R^2 for the temperature requirement ($R^2 = 0.33$) and stress-tolerance axis (see previous section, $R^2 = 0.27$, Fig. 5)."

DISCUSSION

GENERAL: I agree with Dr. Sirami's comment about starting with a general summary of your results.

Done. We also added a summary figure.

"Our study is one of the first to provide empirical evidence that climate change is already resulting in detectable functional changes in plant communities over a relatively short time interval of 10 years (see also Martin et al., 2019) (Fig. 6). Climate change tended to favor the stress-tolerance strategy at the expense of ruderality. These contrasting strategies highlight the functional trade-offs that prevent field margin plants from simultaneously adapting to climate change and intensive agricultural practices. Interestingly, reducing the frequency of margin management mimicked the impact of climate change on community trait composition, although the trend was less pronounced. Practices applied in the adjacent agricultural fields, including herbicide use and fertilization, had almost no effect on changes in community trait composition."

Fig. 6. Maybe adding your factors here will make the figure clearer; for instance, Climate change (increasing T, decreasing soil humidity), Resources (fertilization practices?), Disturbance (Mowing, herbicide use?). That will link more directly your figure to your specific results.

Done

Line 382. It does not seem to me that you have an analysis to say that climate drives the spatial variation of vegetation; instead, once you have controlled by spatial autocorrelation, you found a given relationship between climatic factors and species composition. In fact, you do not present a section related to the spatial variation of the factors or vegetation as you do with the temporal part.

We removed spatial analyses.

Line 383. Is a temporal shift, isn´t?

Yes. “Our analyses revealed a temporal shift towards more stress-tolerant and less ruderal communities, primarily driven by climate”

Lines 386-389. This is a temporal increase, not a spatial one, as you have collapsed information on many years. As explained before, your spatial analysis is controlling for spatial autocorrelation in order to make your mean values of everything more comparable.

Exactly. We removed spatial analyses, hence avoiding any confusion.

Review by Ignasi Bartomeus, 28 Sep 2023 14:44

Thank you for your detailed response. I read this new version, and the message is much clearer, I especially like the use of effect sizes to describe the magnitude of changes. The dataset is impressive but complex, and while some observed patterns are still challenging to interpret, the main messages are clearly stated and I have no further comments on the text.

Best,

Ignasi Bartomeus.

Review by Clelia Sirami, 31 Oct 2023 11:20

The authors have thoroughly addressed all comments, conducting additional analyses when needed, and providing important clarification on methods. I only have minor comments to improve readability because the analyses remain complex and sometimes difficult to follow. Overall, I suggest that the authors standardize terms throughout the whole ms, add a synthesis of the results at the beginning of the discussion section, and use more specific wording to avoid any confusion, in particular in the discussion. Below, I am providing detailed comments to illustrate these general suggestions.

Done. We have homogenized the terms throughout the whole manuscript.

Below is the beginning of the discussion. We also added a summary figure.

“Our study is one of the first to provide empirical evidence that climate change is already resulting in detectable functional changes in plant communities over a relatively short time interval of 10 years (see also Martin et al., 2019) (Fig. 6). Climate change tended to favor the stress-tolerance strategy at the expense of ruderality. These contrasting strategies highlight the functional trade-offs that prevent field margin plants from simultaneously adapting to climate change and intensive agricultural practices. Interestingly, reducing the frequency of margin

management mimicked the impact of climate change on community trait composition, although the trend was less pronounced. Practices applied in the adjacent agricultural fields, including herbicide use and fertilization, had almost no effect on changes in community trait composition."

L34 Replace "that with ", which"

We have changed the sentence in response to a previous comment.

"The reduction in field margin management intensity resulted in a vegetation shift towards a more conservative strategy."

L51 Replace "are observable" with "have been observed"

Done

L52 Add "temporal" before "trend"

This sentence has been removed.

L56 Replace "by taxonomic diversity" with "using taxonomic approaches"

Done

L58 Replace "dimension" with "approaches"

Done

L85 Replace "the temporal dimension of functional inter-specific trait variations" with "temporal changes in species trait distribution"

Done

L90 Since the authors use many traits and associated adjectives, it would be useful to specify the link between traits and adjectives the first time they are being used, e.g. more acquisitive species means species with a higher SLA.

Done

"For instance, weeds with a ruderal strategy (low height and seed mass, long and early flowering, high SLA) are better adapted to agricultural disturbances, such as tillage, herbicides or management by mowing"

"Inter-annual variations in specific leaf area, leaf dry matter content and plant height are related to nitrogen supply (Borgy et al., 2017; Gaba et al., 2014), while increased precipitations push the foliar economic spectrum towards more acquisitive species (i.e. with higher SLA; Wheeler et al., 2023)."

L103 Use the same wording as above “species richness, trait composition and ecological strategies”

Done

L111 When possible, use the same wording throughout the ms, e.g. here “soil moisture” instead of “water resource”, to help readers.

Done

L170 Add “and ecological requirements”

Done

L215 Try to use the same wording, e.g. here you call CWV “divergence”

Done

For each response variable (species richness, CWM, CWV and CSR strategies) and explanatory factor (temperature, soil moisture, nitrogen dose, herbicides and margin management), we built a first model with the year as a linear fixed effect.

L262 Use the words “significant”, “strong”, “non-significant” or “weak” rather than “clear” and “uncertain”. The word “uncertain” may suggest that the statistical power is not sufficient or that confidence intervals are too large to conclude. It would be great if the authors can clarify this point.

“Overall, there was a clear warming and drying trend in climate, but agricultural trends were weaker.”

L265 Since this study only focuses on French data, delete “In France,”

Done

L280 Fig 3 would be easier to read if legends for y-axes are indicated along the axis rather than above

Done

L296 As suggested above, it would be useful to specify at least once the link between adjectives and traits (here conservative and acquisitive)

Done

“The second PCA axis (named thereafter ruderal axis) explained 19.5% of the variation and contrasted stress-tolerant/conservative communities adapted to low disturbance (low SLA, high stature, late and short flowering) with ruderal/acquisitive communities adapted to high disturbance (high SLA, short stature, early and long flowering).”

L332 Specify “temporal models” on what?

"Climatic factors were the predominant drivers of changes in community trait composition…"

L333 "Effect sizes" rather than "regressions"?

We are not specifically addressing effects sizes here, but rather the direction of the relationship/association between the two types of factors.

"Associations between each Ellenberg value and climatic factors opposed in a consistent way Mediterranean communities to nitrophilous continental ones along the stress-tolerance axis (Fig. 5)."

L339 and 342 Replace "community changes" with "community trait composition"

Here, we want to keep the idea of "changes" to ensure that the reader keep in mind the temporal dimension of our models. We replaced it by "changes in community trait composition"

"Margin management was the agricultural practice with the largest impact on changes in community trait composition, with an increase in its frequency associated with more ruderality"

L349 Explicit the meaning of CWM in the legend.

Done

L363 The way this sentence is constructed suggests that you ran a model on a data subset for "frequently managed margins of the MZ".

"When margins were more frequently managed in the MZ, Mediterranean species declined (decrease of temperature requirement and convergence towards higher values of continentality, Appendix H)."

L366 What does "seasonal effects" means? Date of observation?

Yes, we added it: "Annuals were more impacted by climatic variations and seasonal effects (observation date) than perennials, …"

L371-380 This whole section explains Grime's theory and belongs to the method section rather than the beginning of the discussion. I believe a summary of the results would be more useful at the beginning of the discussion section.

Agreed. We have moved this section on Grime's theory to Materials & methods.

L390 What is "functional variety"? Does it refer to "trait divergence"?

Yes, we have reworded: "Our results also indicated that sites increasingly warmer and drier allowed for coexistence of a wider functional set of species"

L394-396 It would be good to start the discussion with this kind of sentence on the main results.

Done

L403 Reword “dry and heat stress”

“On top of the fact that climatic trends observed in the MZ were weaker than in the CZ, Mediterranean species are already adapted to drought and heat stress, and might be more resilient to extinction risks (Thuiller et al., 2005).”

“Heat stress” is the more precise term to express the idea of stress caused by elevated temperatures (whereas “thermal stress” also encompasses stress due to cold or temperature variations).

L417 The authors suggest that “plant communities are also responding to past landscape diversification”. However, landscape simplification has been ongoing for more than 70 years in most agricultural landscapes in France (except in the Mediterranean region). Do they refer to a heritage effect from past landscape diversity rather than diversification?

By landscape diversification, we were referring to the changes in landscape composition and not in landscape structure. Since the 1950s, forests in France have increased by 35% (Le Roux et al., 2008), while arable lands have decreased by 10% (https://www.insee.fr/fr/statistiques/1288586?sommaire=1288637). This reduction in farmland has been achieved by intensifying farming practices, such as increased inputs and shorter crop rotations, resulting in higher yields. In other words, France has tended to adopt a land-sparing rather than a land-sharing strategy. While this choice has notably enhanced the composition of the landscape (by reallocating space previously occupied by agriculture), the same cannot be said for its structure as arable lands have been regrouped and hedgerows have been removed (which can be seen as landscape simplification). We have thus removed this hypothesis.

L419 The authors mentions “arable lands decrease” whereas it has increased in most agricultural landscapes in France.

See our previous comment. Arable lands represented 63% of the French area in 1950 vs 53% in 2013 (https://www.insee.fr/fr/statistiques/1288586?sommaire=1288637).

L423 The authors did not study “functional diversity”

“These phenological shifts coincided with a decrease in trait variance, leading to trait convergence within communities.”

L427 Farmers will certainly adapt to climate change so this sentence sounds a bit naïve.

Agreed.

“As species will not be able to advance their phenology indefinitely, this can ultimately result in species losses in the long-term. However, farmers are likely to adapt the temporality of their practices to climate change, mitigating some of these impacts.”

L429 Replace “diversity and species assembly” with “field margin plant communities”

Done

L435 Replace “can only have” with “are likely to have only”

Done

L437 I do not understand what "functionally similar subset of communities without herbicide application" means

We meant that herbicides could reduce the number of species without altering the trait composition (i.e. the community with herbicides would be nested within the community without herbicides). We have deleted this idea, as it appears unlikely given we have not observed any effect of herbicides on species richness.

L438 Add "some" in front of "traits"

Done

L444 Replace "this" with "fertilization"

"Fertilization had minimal influence on changes in community trait composition, but reduced species richness (Kleijn and Verbeek, 2000), an effect detected in the MZ and leading to the loss of some annual Mediterranean species (Poinas et al., 2023)."

L446-447 Delete "high nitrogen levels can favour" and ", which". Replace ", explaining that" with ", which explains why"

Done

L450 Specify which vegetation

"Nitrogen dose remained constant over time, which aligns with the weak change in global nitrophily levels in plant communities, suggesting that eutrophication may no longer be the primary driver of changes in arable vegetation (Alignier, 2018; Duchenne et al., 2021)."

L463 Change to "and implications for communities response to ongoing global changes"

Done

L467 Are trade-offs evident due to the scale of the size of the species pool considered?

Functional trade-offs are not necessarily better detected with a smaller species pool, but they differ according to pool size, as functional richness (range of trait values) depends on pool size. For instance, including species from the tree stratum in our species pool might have resulted in a primary axis of variation only driven by plant height, as observed in Diaz et al. (1998). The strong correlation between plant height and seed mass would have hindered the identification of the ruderality axis (axis 2 in our PCA).

L468 Change to "occur"

Done

L470 Specify "field-margin plant communities"

Done

L479 Replace “space” with “spatial analyses” and “identify” with “imagine”

Done

“However, the effects of practices were more perceptible with analyses focused on spatial effects”

L483 Replace “specialized to their habitat” with “habitat specialists”

Done

L485 Which “restricted areas”?

“However, a large part of these species are habitat specialists (e.g. Mediterranean species as found in Munoz et al. (2017); Fried, Chauvel, et al., 2009) and have a high affinity for calcareous soils, which will probably limit their expansion towards the CZ to restricted calcareous areas, such as the Paris Basin”

L491 Add “to understand the temporal dynamics of field margin plant communities” or something similar at the end of this sentence.

“This highlights the need to consider the conjunction of climate change and intensive agriculture when making future predictions.”

L497 The authors mention “at the national level” but they did not study field margin plant communities at that level.

We removed this mention.

L498 Change to “Our study suggests that species selected by…”

Done

L500 Specify which agricultural practices

Here, we wanted to convey a broader perspective beyond the specific practices considered or directly impacting in our study. The trade-offs between stress-tolerant and ruderal strategies carry implications extending beyond the practices addressed in this study. For example, ruderal species are not only selected by mowing, but also by tillage, herbicides, shorter crop rotations, etc....

L510 Replace “some perspectives” with “other important research questions”

Done