Referee 2

Thank you for the substantial revision that was done; the flow was much smoother and I think the structure helped highlight the key results and novel directions. The major focus for the final revision should be on ensuring that the figures have complete information in the captions and legends.

I will note that it was time consuming to do the second review when there were no line numbers in the response to reviewers indicating where specific comments had been updated. I suggest in future revisions that the authors respond to each comment directly rather than "The response to reviewer X has been uploaded as an attachment."

Response: We are so happy that you are satisfied with our revision and grateful for the key suggestions you have given to improve this article. In the revised manuscript, we have addressed all the points raised by you. Please find the following sections and the main text. Also, thanks for the kind reminder that I will take care to respond directly to reviewers' comments in future revisions.

L 96. I don't see any drylands in the UK or Germany: https://www.fao.org/dryland-assessment/es/

Response: Thank you for pointing this out. For outlining drylands, we used Aridity Index data from Zomer et al. (2022). There is no dryland in the UK, but scarce areas of Germany belong to drylands. To simplify the expression, in the revised manuscript, we have revised this sentence to "Countries like China, the United States, Spain, Australia, and Israel, most of which have extensive dryland areas, have attempted to make breakthroughs on this issue (Fig. 1a)" (lines 59~61). The revised Figure 1(a) is also modified accordingly.

L255. Spell out RGB prior to using abbreviation – since this is for a general audience and not a remote sensing audience this will not necessarily be common knowledge.

Response: The full name of the RGB has been spelled out. (Line 109)

Fig 1. Caption needs substantial additional detail. A. what are the node sizes and distances? b. is this the origin of the author or the location of the study? c. What is an occurrence point? Is it just a publication originating from or highlighting that region? Or is it a dataset?

Response: A. Taken together with reviewer 3's suggestion, the original Figure 1(a) does not provide much valuable information on the topic of biocrust distribution, and the authors' research has been cited elsewhere in the review. In the revised manuscript, the original Figure 1(a) has been removed.

B. An additional description has been added "Numbers are the countries of the authors of published articles from 1990 to 2022…" (lines 68~69)

C. Occurrence point refers to the number of record items for which biocrust presence or absence or biocrust cover is noted. It is a dataset (unpublished) that we have continuously updated through field surveys and literature compilation. (lines 74~78)

Fig 4. A. Biocrust cover needs units, or word "proportion" in the caption. B. precipitation needs units.

Response: Done! Thanks!

Reference

Robert J. Zomer, Jianchu Xu, Antonio Trabucco. 2022. Version 3 of the Global Aridity Index and

Potential Evapotranspiration Database. **Scientific Data** 9:409.

Referee 3

The authors present a thorough review paper about the methods of measuring biocrust distribution, the factors that impact biocrust distribution, and the challenges in mapping biocrust distribution. Where the paper really shines, is the author's straight-forward descriptions of the modeling techniques and methods. This would be helpful to biocrust researchers in the future and is a nice starting point for distribution studies. Overall, I recommend this paper for publication with minor revisions.

Response: Thank you for your recognition and efforts in improving this paper. We hope that the review paper will provide a better understanding of the current state of biocrust distribution research, as well as give researchers specific suggestions on the next practical directions to take.

Reviewer Comments:

Overall, there are no major concerns. I know the author's worked very hard editing this draft and it shows. Well done to everyone involved. Below, I have a few line comments
to improve the clarity of the manuscript.

Line 21: "still needs to be" should be "remains limited"

Line 22: "stimulate" should be "simulate"

Line 29: "is supposed to" should be "will"

Response: Done! Thanks! (line 21, 22, 29)

Lines 60-63: This is true, but I don't see why it is necessary in the introduction for this paper. It does not provide any new information about biocrust distribution studies and the papers are cited elsewhere in the introduction.

Response: Thanks for the advice. As the work of these researchers has been referenced elsewhere in the text, we have removed the separate introductions to the authors in the revised manuscript.

Figure 1a: I think it is more suitable to show where biocrust distribution is measured (like 1b and 1c) rather than emphasizing the authors because unless the reader knows exactly where those authors do most of their work, it does not provide any new information.

Response: Thanks for the suggestion. The revised Figure 1 removed the original panel 1a.

Figure 1: 1a is very difficult to read since it is blury (though see above comment) and the font size of 1b and 1c is also too small. Perhaps you can modify the figures so the continent text size (1b) is larger and the font size of the graph in 1c is larger.

Response: The font size has been modified.

Line 104: "inverted" should be "invented?" I am unsure what the authors are saying here

Response: Done! (line 99)

Figure 2: make the font size a little bigger. This will fill the white space and make it easier to read.

Response: Done.

Line 258: “For a long time” is not necessary

Line 268: “The grassland is…” or “Grasslands are…”

Response: Done. (line 253, 263)