

Monday, 26 August 2024

Dear editorial board,

We are resubmitting our manuscript, which originally had the manuscript number **egusphere-2024-1653**: *Earth Science for all? The economic barrier to Geoscience conferences*.

Please find attached a revised version of the manuscript. The changes are highlighted in red. We thank both reviewers and the editor for their valuable feedback on this manuscript. Below, we address their comments point by point.

R#1 comments

1) **L35**: *I recommend being more precise. Is this motivation only for ethnic minorities? Or also participants from LMIC, Global South, etc - who may not be ethnic minorities per se.*

Changed accordingly. Added “**citizens from developing nations**” (line 35).

2) **L35**: *I recommend adding additional references here and throughout introduction to strengthen the scientific basis for these important points.*

There are not many publications on the topic. We added another reference: **Talavera-Soza (2023)** (line 36).

3) **L49**: *I recommend providing more motivation for why EGU? For example, why is attendance at an EGU conference important for a water research from say Chile? How is a conference that is based in and by name focused on Europe important for researchers globally? As I note, I also agree that it is, but I do think that it needs motivation here about why assessing EGU is important and indicative of trends in the field.*

We added, “**We selected EGU because it integrates all geosciences subjects and ranks among the biggest international conferences in the world with participants from over 110 countries.**” (lines 53-55 of the revised manuscript).

Additionally, this is the only major conference with publicly available demographics. Multiple times we have contacted the Diversity and Inclusion Advisory Committee of the American Geophysical Union (AGU) to obtain data from the AGU Fall Meeting (USA) but never heard back from them.

4) **L82:** *I recommend noting that these are not shown on Figure 1b.*

We incremented the text to make it more clear “(they are between 10^{-8} to 10^{-13} , below the minimum value for the y-axis in Fig. 1b)” (lines 90-91).

5) **Fig. 1a:** *These differences in the virtual meetings look like they could help with increasing participation of under-represented perhaps? As correlation with population means things are more equal and lower correlation with GNI also means things are more equal.*

Yes, that is what the data shows. We state that in the text: second paragraph of topic 5.

6) **Fig. 1a (legend):** *I recommend fixing this style issue with the -5.*

We fixed it (line 133).

7) **Fig. 2a (legend):** *Is this the linear regression developed by the points in the figure? Or some theoretical relationship?*

This is a best-fit linear regression. We’ve changed it accordingly and added “best-fit” to the figure legend (line 138).

8) **L131:** *I recommend rewording to be more precise. The analysis of this data highlights this. And also that it is controlled by GNI more than the others investigated. I recommend adding that here because, as noted above, not all possible factors are investigated.*

We have added “Based on the variables investigated here, our results indicate” to the beginning of the paragraph (line 141).

9) **L145:** *What is the equation here? In the text it says 2b is a linear regression and not a power-law.*

It is a power-law regression. We fixed the legend of figure 2b (line 138).

10) **L151, Fig. 3:** *I see the equation very small in the figure. I recommend putting it in methods as well. I can't tell what the equation is as is distance in the denominator? But it is divided and has -1, so perhaps then is in the numerator?*

For this map, we hypothesize that the number of attendees should be proportional to a country's population and inversely proportional to their distance to the conference center. That is why the distance is raised to -1. We increased the size of the equation in Figure 3 (line 175).

11) *I would also carefully define "underrepresented" and "overrepresented". The latter in particular can have a negative connotation if not articulated clearly what it means in this analysis.*

We have changed Fig. 3 and removed the overrepresented term. Now, it only includes an “**underrepresented**” trend (line 175).

12) *Also, I think somewhere in this discussion the assumption that the sizes of the communities of geoscientists should come up. The population is used as a proxy with the assumption that the rate of geoscientists per capita is the same. But that we know is not true, so just because some place has more people, it doesn't mean that there are the same number of scientists who would like to go to EGU. I think also this should include a discussion on the assumption that all communities want to go to EGU and feel part of EGU enough to travel there. I am not asking for more analysis, but am recommending some additional discussion on such assumptions.*

We included this in the methods: “**Given the lack of precise demographic data on the number of geoscientists per country, we use population as a proxy assuming the rate of geoscientists per capita is the same.**” (lines 68-70).

13) **Fig. 3:** *I recommend improving the resolution of the figure. To me it seems the line with Zimbabwe is pointing to Mozambique, but I think it is just because the line gets lots in the dark red of Moz. I recommend updating this figure to use a colourblind friendly colour scale.*

We have updated both the color scheme and the resolution (line 175). Hope it is better now.

14) **L168:** *This is a very firm statement when the analysis has only been about GNI in general. I recommend this statement is tempered some based on the findings. Yes, the analysis does show strong correlations with GNI - but that doesn't yet show that money is the ultimate control. I do think the explanation here is very helpful and needed, so I am not questioning that.*

We changed the statement “Ultimately, attendance in the in-person EGU assembly **is largely controlled by income**”. (line 178).

15) **L170:** *This is interesting and puts the cost in local context. Where are the monthly wages from? Also, is this the minimum for the full population or for academics? I recommend the authors consider also putting this into context of academia and the geoscience community. For example, how does this compare to bursaries for students? I understand using minimum wage, but if it is for the entire economy, the it is a little removed from academia. So perhaps this could be augmented with examples from the geoscience community.*

We made the comparison of the registration fees in comparison to the salaries of full professors in the cited countries, e.g. “**or half the monthly wage of a full professor (World Salaries, 2024)**.” (lines 182, 184, 186).

16) **L204:** *I recommend expanding how this would assist? If it is still within the EU then costs will be quite similar, and visas will also be quite similar issues (and travel distance isn't that different for those under-represented countries even though distance isn't a major driver)*

We expanded our thought: “**Besides changing the distance to other countries outside of Europe, costs of accommodation and meals vary significantly across European countries (ranging from approximately €36 to €136 per day; Price of Travel, 2024)**.” (lines 236-238).

17) **L204:** *I recommend changing the order of these as to me this last one is one of the most important and impactful changes that could happen of those listed. Also, I recommend the authors expand to discuss what other factors should be considered as EGU works to make the conference more accessible. Issues with researchers not receiving visas were discussed a lot this year and could be an example of further analyses that EGU should do when looking for a solution.*

We changed the order of that paragraph as well as expanded our thoughts (lines 230-240).

18) **L219-226:** *I recommend that the authors consider moving this to the introduction as this helps to also provide background and context for this work.*

L227-235: *I recommend the authors also think if this part should be in the intro. I understand it is saying that the issues are not only conferences, but a more structural issue. But to me, that provides the background against which the study is using the EGU conference attendance as a proxy to analyse inequities. In the discussion here, I think these key points may be lost as they are more a list of issues not directly from the results of this study.*

We prefer to keep the introduction short (given this is a letter, not a full research article).

19) **L232 (citation list):** *An opinion piece in ACP also explored this and could be of interest. <https://acp.copernicus.org/articles/24/5757/2024/>*

We added the citation to line 260.

R#2 comments

1) **L10** – *It was initially unclear how scientific meetings “perpetuate unconscious biases”, although this then becomes clear later in the Introduction, i.e., L32-33.*

We modified the sentence to “**reflect** unconscious biases” (line 11).

2) **L18** – *Is this essentially repeating the immediately preceding clause?*

We removed the extra sentence (line 18).

3) **L22-23** – “...extending to barriers...” sounds a little odd to me. I would rephrase the last part of this sentence, after the comma, to read, “...given they can also help remove barriers to inclusivity in other areas of our community”.

We modified it: “Our actions must go beyond the EGU General Assembly and other geoscience conferences, **as these actions can also help dismantle barriers to inclusivity in other areas of our community.**” (lines 23-24).

4) **L39-41** – This is grammatically a little difficult to follow, so I suggest rephrasing to read, “Some of these problems, such as X, Y, and Z, are urgent, and failure to tackle them will have dramatic negative consequences.”.

We modified it: “**Some of these problems, such as natural resource depletion, disaster risk reduction, and climate change, are urgent, and failure to tackle them will have dramatic negative consequences**” (lines 40-42 of the revised manuscript).

5) **L62-66** – One of my major suggestions is to make it clearer why these three variables, i.e., what specific hypotheses were you testing? For example, following this list, you could say something like, “We chose distance to assess whether geography was the principal driver of attendance variability, where GNI...etc”. By doing this, I think it would strengthen the paper by making it clear that the variables were not picked arbitrarily.

We included an explanation as suggested “**We chose distance to assess whether geography was the principal driver of attendance variability and GNI to assess the impact of income on participation. Given the lack of precise demographic data on the number of geoscientists per country, we use population as a proxy assuming the rate of geoscientists per capita is the same**” (lines 66-70).

6) **L70** – Could you make it clear if this statement is an outcome of the study *or* something that is obvious, a priori. My view is that it must be the former, rather than the latter, but maybe clarify here what your viewpoint is.

The statement explains a methodological choice. We modified the sentence to make it clear “Because the selected metrics vary over several orders of magnitude, we calculate the Spearman's rank correlation coefficient (ρ) rather than a linear regression to examine their relative impact on EGU's conference participation” (lines 75-77).

7) **L72-74** – *I do not understand this sentence, i.e., did you study data from 2005 to 2024, as stated in L63, or did you only study the post-COVID data?*

We did study data from 2005 until 2024. However, in-person participation after covid was affected due to travel disruptions, and therefore we chose to use the 2019 data (last EGU edition before covid) as a representation of in-person participation.

8) **L82** - *Why is GNI not shown in Fig. 1b? And why are values $<10^{-5}$ not shown in Fig. 1b?*

P-values for the GNI correlation are not shown because they are below 10^{-5} . We added a sentence to make that clear “(p-values for the GNI correlation are between 10^{-8} to 10^{-13})” (line 131). We chose to limit the Y-axis to 10^{-5} because any value below that does not alter interpretations (confidence interval remains $> 99\%$) and to allow visualization of the 0.05 – 0.001 range for P-values (which marks the transition from a significant to an insignificant correlation).

9) **L83-84** – *Where is the stated claim illustrated in Fig. 1?*

We added a sentence to make it clear “(they are between 10^{-8} to 10^{-13} , below the minimum value for the y-axis in Fig. 1b)” (lines 90-91).

10) **L85-86** – *Do you mean that despite having relatively low GNI, the participation of these countries is higher than anticipated? If so, I would maybe state this more clearly.*

We added a sentence to make it more clear “In other words, these countries exhibit higher-than-expected participation based on their GNI values.” (lines 93-94).

11) **L86-90** – *I cannot see a decreasing trend in the red line in Fig. 1b. Can you please clarify where this is shown?*

We modified the text to make it clearer “While there has been a decreasing trend in the correlation between attendance and GNI since the inception of the EGU assembly (2005) until 2015” (lines 95-96).

12) **L90-91** – *Why do you think this is the case? Is it because participants from low-GNI countries can attend virtually at a lower cost? If so, I would state this more clearly.*

This is the results section and therefore we do not include interpretations. We address this issue in the second paragraph of topic 5.

13) **L91** – *Why is it ‘unsurprising’? Again, I would make it a little clearer why the observed relationships are strong (or otherwise).*

We removed the word unsurprisingly from line 99.

14) **L98-99** – *The distance to conference line/data, i.e., the blue data points, seemingly plot in the 99% rather than 95% field. Please check.*

We made the correction (line 107).

15) **L104** – *Again, why is this relationship “as expected”? As for comments 13 and 14, I would consider adding a sentence to explain why the observed relationship (or otherwise) might arise.*

We removed the “as expected” from line 112.

16) **L148** - *See comment 5, i.e., by stating “we would expect to see...” you are implying that you have some sort of hypothesis.*

We rephrased it to “Under an income-independent participation scenario, participation would depend on distance and population” (lines 158-159).

17) **L151-153** – *Could this be described as “over-representation”, given the opposite is “under-representation”?*

Following the recommendations of Reviewer #1, we chose not to use the term “over-representation”.

18) **L170-172** – *Could you perhaps use/cite some World Bank data to support this statement?*

We added a citation to support our statement “(World Salaries, 2024)” (lines 182, 185 and 187).

19) **L173-174** – *Another major(ish) comment is that the relationship between country-level GNI and the financial status of an EGU attendee is assumed, but not necessarily proven, i.e., a country may have a low-GNI, but an in-country senior scientist may be disproportionately wealthy, to a level comparable to, for example, a student scientist from a higher-GNI country. To be clear, I agree with the outcomes of your study and that, generally speaking, low-GNI countries are directly impacted by financial barriers; however, I think the paper might benefit from at least a brief discussion of some anomalies that may exist.*

We included the average salaries of full professors in the selected countries to tackle this issue “For instance, in our home country Brazil, registration costs can amount to nearly three times the monthly minimum wage, **or about half the monthly wage of a full professor (World Salaries, 2024)**. In African nations like Angola, Nigeria, and the Democratic Republic of Congo, fees can exceed ten times the monthly minimum wage, **or roughly twice to three times the monthly wage of a full professor (World Salaries, 2024)**. In contrast, in Canada, fees equate to roughly half of the monthly minimum wage, **or about one-tenth of the monthly wage of a full professor (World Salaries, 2024)**.” (lines 180-187).

20) **L185-187** – *The Geological Society of London has a new EDI committee: <https://www.geolsoc.org.uk/About/Diversity/EDIA-Committee>.*

We added that information “**The Geological Society of London has recently established a new Equity, Diversity, Inclusion and Accessibility Committee in 2024 (The Geological Society of London, 2024)**.” (lines 211-213).

21) **L191-193** – *Can you maybe rephrase this sentence, making it clearer what ‘p’ means?*

We modified the sentence “, which show record-breaking increased **ranked correlation** (ρ) for population” (line 218).

22) **L204-206** – *It is not clear to me how rotating the meeting *within Europe* would help people from low-GNI countries, unless those countries were within, for example, the more eastern or southern parts of Europe, etc. Please clarify how you think this would benefit global attendees.*

We included an explanation “**Besides changing the distance to other countries outside of Europe, costs of accommodation and meals vary significantly across European countries (ranging from approximately €36 to €136 per day; Price of Travel, 2024).**” (lines 236-238).

23) **L216** – *I would personally avoid the terms “developed” (and “under-developed”), given they are slightly disparaging.*

We removed the word “developed” from line 234.

Editor comments

1) *Narrow the title of the manuscript, as it primarily pertains to the EU/Europe.*

We changed the title to: “Earth Science for all? The economic barrier to **European** Geoscience conferences”

2) *Include a discussion on visa issues.*

We added a paragraph: **Another significant barrier to in-person attendance for researchers from developing countries, countries with less political stability, and nations facing geopolitical tensions, is the challenge of obtaining a visa to enter Austria. The process is often both costly and time-consuming, often requiring extensive paperwork, letters of support, and sometimes in-person appointments which may involve travel costs. Scientists from countries like Iran, Afghanistan,**

Yemen, and Bangladesh frequently face more stringent visa requirements and higher rejection rates compared to those from countries like Canada, Australia, or Japan (Passport Index, 2024). To address this issue, the EGU has implemented measures to support visa applications by providing detailed invitation letters (EGU, 2024). (lines 192-201).