

## ***Interactive comment on “Earth System Music: the methodology and reach of music generated from the United Kingdom Earth System Model” by Lee de Mora et al.***

### **Anonymous Referee #2**

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Comments on: “Earth System Music: the methodology and reach of music generated from the United Kingdom Earth System Model by Mora et al.

This manuscript describes six music pieces that have been produced to make climate data accessible to non-experts. The aims are (1) to generate music pieces using climate model data, (2) to use music to illustrate standard practices in Earth System modelling to non-experts, and (3) to quantify the dissemination of music pieces. The method employed here (i.e., data sonification or turning data into music) is a powerful approach and have been successfully used by others for presenting complex datasets to engage/inspire those outside the expert community. The method is particularly well-

C1

suitable for working with climate data. The authors have done a thorough job of explaining each music video. However, there are several sections that need improvements (particularly the method and evaluation). Therefore, I see two major changes:

1. Of the above three goals (also stated in the manuscript), goal 1 was clearly achieved. However, it is not clear how this manuscript addresses goal 2. As for goal 3, there was no systematic, robust documentation of the authors’ dissemination strategy, the audience demographics, learning, etc. Therefore, a more quantitative (and systematic) assessment of the video usage is needed. The authors state some strategies for doing this (in discussion and conclusion, e.g., performing to a live audience and surveying the audience to measure impact). I think such strategies are great and should be implemented. It is difficult to indicate if a science communication product is helpful (and if so in what way) without any systematic assessment. Therefore, I highly encourage the authors to consider evaluating their videos, and adding the analysis of their findings to the manuscript.

2. The method section (lines 106-192) is difficult to follow for non-musicians. This section explains how the music was produced but fails to explain how it relates to climate data. I think giving some examples may increase its readability. For example, when you state “the lowest value in the dataset is presented by the lowest note...” (line 120), it may be helpful to give an example of the lowest value in the dataset (e.g., coldest recorded temperature). The same goes for the highest value in the dataset (line 121). Line 119 also says “each model dataset is linked to a series of notes”, so does this mean each note is a data point? Again, translating this into climate data would be helpful. Similar suggestions for Fig 2 (see below) and lines 169-172. Also, many of the comments shown in the next few pages are related to this issue.

Figure 2- It would be very helpful if you can connect what you show in the piano keyboard to climate data. See figure 1 of George et al. (2017, American Meteorological Society) for example. Again what does each note represent? What does each pitch represent? A bit hard to follow as a non-musician.

C2

Below, my comments are shown line by line:

Line 23 (Introduction)-The authors introduce the topic well, and the references they list are relevant and helpful. Since this study combines sonification with imagery, it would also be helpful to know if this approach has been taken before, and if so, how does this study contribute (or build on) previous work?

Line 56 points out the potential for biased-interpretation of data using sonification. However, the authors do not return to this issue later to discuss it. Was this a concern during this study and how was it addressed?

Figure 1. Though flow charts are generally produced in this way, I suggest to add a few images (one per section) to draw in the readers. The sections are: datasets (top), music (middle) and videos (bottom).

Line 224. When you state “The Earth System Allegro is a relatively fast-paced piece in C Major”, can you describe what C Major sounds like for non-musicians? Also the rest of the sentence starting with “. . .showing some important metrics of the happy to keep. . .” does not make grammatical sense. Please revise.

Line 226. Could you explain how this video demonstrates the principles of sonification using the data series?

Line 232. I think there may be a typo here. Could it be “year 2030/2040” as oppose to year 2100?

Line 235. Consider deleting this sentence as it is repetitive.

Line 240. Consider deleting the sentence starting with “Effectively, . . .” It is redundant.

Line 248. Change “there’s” to “there is”, and “doesn’t” to “does not” in line 292. And reflect this change throughout the manuscript.

Line 250. Again “a very common 4 chord song: C Major, G Major, A Minor, and F Major” does not mean anything to a non-musician. Please clarify this by giving an

C3

example for each or give a word to describe what they sound like.

Lines 250-253. Draft a similar paragraph for section 3.1.1. This helps connect the music structure with what the dataset represents.

Line 256. Add a reference to Figure 3, pane 3, at the end of this sentence.

Lines 257-259. Add the name of scenarios (e.g., SSP5 8.5) to Figure 3, pane 3.

Line 270. Add reference to Figure 3, pane 4, after “E minor”.

Line 273. How are these 15 historical simulations are shown in the figure? Only 6 lines are shown. Have they been grouped?

Line 274. “This piece uses a repeating 12 bar blues structure in E minor”, what does this mean to a non-musician, and how is this connected to the dataset it is reflecting?

Line 285. What initial conditions are the authors referring to?

Line 286. When you state “. . .the results of our projections are due to changes. . .” what changes are the authors referring to?

Line 294. Please give an example of what it is meant by “inherent change” and “underlying drift”.

Line 295. The spin up ran for 5000 simulated years. Why 5000 years? How was this time selected? A reference is provided, but it would be useful to add a sentence explaining why.

Line 305. It may be useful to label these lines in Figure 3, pane 5 or describe them in the caption.

Line 311. Why was the musical progression slowed to one chord per four beats? What does it mean in terms of the climate dataset?

Line 335. Decapitalize “Global total ice” and insert a space between “extent” and “blue”.

C4

Line 336. Change “view” to “video” in “the percentage of the view that the average audience viewed”.

Line 366-369. Consider deleting this part starting from “Aside from the metrics...” These numbers are too small to be meaningful, and are not discussed.

Lines 370-378. Consider deleting the whole paragraph or move to discussion.

Figure 7. Consider removing it from the manuscript, but keep the text (lines 387 onward). The figure does not add much to the manuscript, especially when half of the data is unknown.

Lines 390-392. Consider deleting this or move to discussion.

Line 406. The study goals stated here differ from those stated in page 10. Please keep the goals consistent.

Line 411. The authors conclude that once the concept was demonstrated, there was reduced enthusiasm from the audience to return to it. How do they know that? Another possibility could be that the audience didn't feel the need to return to it, or it could also be that the videos sparked their interest further so that they ended up checking out similar videos outside the playlist. These are all possibilities, and there is no evidence for or against them. I suggest sticking to the facts, and only interpret the data when it is actually possible (which is not the case here).

Line 412. The last sentence may be true but it is irrelevant to this paragraph. Was the goal to grow a YouTube channel? Why do the authors mention this here?

Lines 420-426. The sea surface temperature aria is also the most visually simple animation when compared with the rest. The viewer is not required to keep track of multiple datasets and listen to the music at the same time. Could this be also why this piece has the highest audience retention?

Line 430. There is no documented evidence that the music pieces and animations

C5

improved the wider public's understanding of climate change modelling. The authors mention this in the next paragraph. So I suggest to delete the “perhaps, improve the wider public's understanding of climate change modelling”. One could hope for that, but this study was not designed to assess that, and certainly did not do that.

I suggest to move some of the content currently placed in the discussion section to two new sections: Limitations and Future Work. This means most of what is shown in page 19-20 can be reorganized to fit into one of these two sections. This might help the readers. Line 439. Here the authors suggest hosting live events to fully explain the methodology used by the modelling community. But is this something non-experts are interested in, or is this the aim of this study? I thought the idea was to use a unique communication method (sonification and imagery) to explain complex datasets to non-experts. If this method requires a live event for further explanation, then it does not fulfill what it was supposed to do: to engage non-experts.

Line 462. The authors state that it was hard to distinguish the different datasets in the music. One solution would be to insert a very short silence in music between different datasets. Just an idea.

Line 504. Insert a space between the word viral and the references.

Line 510. Insert a space between the word afternoons and the references.

Line 514. “they reached an audience of 251 unique viewers and a total view count of 553”

Table 1. Add unit of time for “duration”. Minutes?

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Interactive comment on Geosci. Commun. Discuss., <https://doi.org/10.5194/gc-2019-28>, 2020.

C6