



EGUsphere, referee comment RC1  
<https://doi.org/10.5194/egusphere-2022-1356-RC1>, 2023  
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## **Comment on egusphere-2022-1356**

Anonymous Referee #1

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Referee comment on "GC Insights: Communicating the Causes of Climate Change – Immersive Sonification for the Piano" by Charles Jahren Conrad, EGU Sphere, <https://doi.org/10.5194/egusphere-2022-1356-RC1>, 2023

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### **General comments:**

Thanks for your contribution. A common pitfall of this kind of musification is that the music winds up sounding similar. Basically, if CO<sub>2</sub> or temperature is rising constantly and you link it to pitch, all the resulting music will sound roughly similar. However, by only linking one hand to the data while allowing the other to perform original music, you're doing something unique and you've managed to side-step that pitfall - so congratulations!

I hadn't encountered the GC-Insights type or submission before, so I realise that some of my comments may not be addressed within the format this kind of article. For instance, the manuscript doesn't strictly follow a scientific article template, ie it has no results or discussion sections. I'll defer to the editor to confirm whether they are required for GC Insight publications.

I'd like to see some comments on previous work on sonification of climate change data in your introduction. Typically, references don't contribute to the total word count, so you should be able to add as many as you'd like. Here are some starting points:

- Borromeo, L., Round, K., and Perera, J.: Climate Symphony, available at: <https://www.disobedientfilms.com/climate-symphony> 2016.
- Crawford, D.: Planetary Bands, Warming World string quartet, Video published by Ensia magazine, available at: <https://vimeo.com/127083533>, 2013
- the Climate Music Project (<https://climatemusic.org/> )
- de Mora, L., Sellar, A. A., Yool, A., Palmieri, J., Smith, R. S., Kuhlbrodt, T., Parker, R. J., Walton, J., Blackford, J. C., and Jones, C. G.: Earth system music: music generated from the United Kingdom Earth System Model (UKESM1), *Geosci. Commun.*, 3, 263–278, <https://doi.org/10.5194/gc-3-263-2020>, 2020.

It would be good for you to use these to highlight how your work is novel and different from previous approaches.

The audio file:

- There are no clear breaks between the five movements. Perhaps a fermata and a bar of rest between them might help separate each movement?
- The syncopation of the first movement makes it harder for me to perceive time passing. I think perhaps you could decouple the rhythm of the left and right hands such that the left hand is closely linked to CO<sub>2</sub>, but the right hand anchors the time signature. (This is an artistic choice so I leave it up to you whether this improves or deteriorates the piece.)
- I'm not a huge fan of the sound of this instrument - it sounds very dry and digital. Perhaps a different virtual instrument might produce a better sound - or alternatively you may be able to use some reverb and Eq? If a huge budget were available, then you may be able to find a local recording studio with some expensive microphones and a grand piano you could use to record your performance. Or maybe a pianist on a service like Fiverr could perform and record it for you?

I don't think that dropbox is the best place to keep a permanent record of this piece. The first place would be to append it to this article as a supplementary file. A scientific data repository might also be appropriate, something like zenodo or BODC, plus this would provide a DOI. As a backup, youtube or soundcloud or might also work for hosting, however it's not guaranteed that any of these companies will exist in ten years (including Dropbox).

I'd like a section on how the recording was created as well. Did you program the MIDI and pass it to a virtual instrument or did you record a live performance? What instrument, microphone and interface (if any) were used? What VST have you used to generate the audio? Did you use a DAW, if you which one? Were any post-processed effects added? reverb, compression, delay etc. Was any mastering applied?

The main criticism that I have of this draft is that the author does make quite a few unsupported statements in the abstract, introduction and conclusions. I've made some suggestions here, but I'd recommend a careful re-reading, to ensure that what is written is accurate, and not hyperbolic.

A second criticism is that there's only one image permitted in Insight articles, so you really

need the figure to shine. You could have one pane about the sonification method, one pane about the recording method, one about the data derivation. At the moment, this figure is not very clear and it would really be worth putting in the effort to make it great.

On the whole, I'm happy with this as an Insight article, and I enjoyed the music.

### **Specific Comments:**

#### **Abstract:**

L11: remove (parts per million)

L12: remove (scale notes)

L12-:L15: This entire sentence should be replaced with a brief but explicit characterisation of your method. Something like "CO2 measurements from Mauna Loa were linked to musical pitch to drive the sonification, but additional musical parts were creatively composed to balance the piece, add nuance, emphasis, and emotion to the piece." (This is the part of your work that really stands out to me: it's not 100% data driven, and the musical freedom that you allowed yourself makes it stand out. It's worth emphasising this in the abstract! )

L15: Because -> As

L16: I'm not sure this is true: "it provides a level of immersion beyond a visual or auditory understanding". However, I do agree that it certainly adds a sense of urgency and gloom to the data.

#### **Introduction:**

L20: If the goal of the project was to raise awareness of climate change, how do you do that? Have you tracked the number of listeners or shown where they came from? Were they already aware of climate change? To me, it looks like the goal was to generate and share a piece of music based on climate data.

L21: CO2 isn't an indicator of climate change - it's one of the main causes.

L23: Climate change is pretty well established at this stage. right?

L25: remove "mathematically"

L26: remove " that are playable on the Piano"

L27-L29: This is unsupported.

L29: remove "out"

L29: Is this really a new type of sonification? There is definitely a precedent of other people combining data and musical choices.

L30: I don't understand how statistics got involved here or what is meant by statistically accurate? These are specific terms that don't fit this context. I recommend changing this to: "combines climate data and creativity", and "musical piece that is data driven"

### **Sonification Use and Effect**

L34: " auditory display:" (replace , with :)

L35: remove " high index (" and following ")"

L47: remove "to those that are less able"

L48-50: unsupported statement.

L52: What do you mean type of instrument? I only hear a piano.

L52: Might be worth reading and references Flowers 2005 here. The key thing to note is that it's actually quite hard to get a lot of information out of sound, especially as with a single instrument you can't modify the tone, and it's challenging to perceive small fluctuations in amplitude. (Flowers, J. H.: Thirteen years of reflection on auditory graphing: promises, pitfalls and potential new directions, Proceedings of ICAD 05-Eleventh Meeting of the International Conference on Auditory Display, Limerick, Ireland, 6–9 July, 406–409, 2005, [http://sonify.psych.gatech.edu/ags2005/pdf/AGS05\\_Flowers.pdf](http://sonify.psych.gatech.edu/ags2005/pdf/AGS05_Flowers.pdf) )

**Figure 1:** This figure is not very clear to me. Did you use monthly or annual data? Why are movements 1 and 2 shown as straight lines, but movement four is segmented? Third movement uses monthly data? I think you would be better served by having five panes, one for each movement, and showing the Mauna Loa monthly data in black, and the values that you used to drive the modification as separate coloured lines.

L55: this isn't really the methodology, it shows which sections of the data were used by the sonification.

L56: you don't need the link to the dropbox file here.

### **Methodology: Numbers to Notes:**

L62: remove "basic":

L63: I've never heard of a " common musical backbone". Can you elaborate on what this means?

L72: We typically use "annual" instead of "yearly", but as this is the title of the movement, it's an artistic decision.

L72: For this and the other movements, please indicate at what timestamp they begin in the recorded piece.

L82: " and the value had to exceed the closest note value, promoting positive change": What does this mean - can you make it clearer, please?

L98: Decade -> Decadal

L109: Is there any reason why you fitted to recent data rather than using established CO2 projections (SSP5-8.5 or even RCP8.5 would both be appropriate. ) Ultimately, I suspect the difference is small, but you may reach a wider audience using these well established projections.

L124: uniquely playable -> unique and playable

L124: piano song -> piece for piano

L126: song -> piece

## **Ethical statement**

The ethical statement should be after the conclusions.

## **Conclusions:**

L129: "only available in English": I don't think that Mauna Loa data is in English! It's just Arabic numbers!

L130: This is a bit of a bold statement: "anyone in the world can understand, regardless of what language they speak". It's not clear to me that it's true. I'm not sure that this piece would make sense if you just heard the music. In order for it to mak sense, it needs to be explained in context that it is derived from climate data.

L128-130: To be honest, I think you can safely remove the first two sentences of this paragraph.

L132: "providing a unique musical and scientific experience." While this is indeed a unique experience, it's not what I would focus on here in the conclusions.

I'd like to see some suggestions on potential improvements. Ie, alternative datasets, audience survey, etc. See for instance de Mora et al, mentioned above.

### **Supplement:**

Table: Please add a caption or a description of the table.

Sheet music:

- Please add the tempo
- Please add the instrument (piano)
- You may want to add notation of when to hold and release the pedal.
- Please indicate where each of the five movements begins and ends. I'd recommend a double bar line at the end of each movement. as well as the title of the moment (ie Movement one: 40 years of yearly increase).
- This would also be a good opportunity to clarify where data came from directly in the music. Ie notes on the pdf stating "right hand plays annual mean CO2 from 1960-2015' or similar.