



# Polar Geosonif-i

*a python-based comprehensive web tool for geo-data sonification in polar regions*

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# Introduction | What is “sonification”?

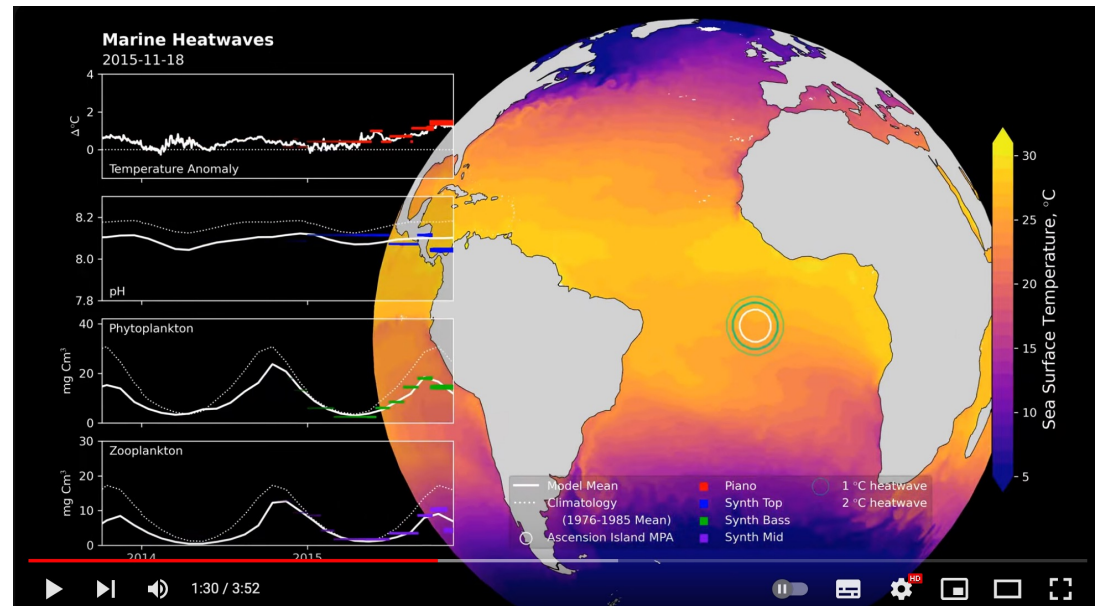


Non-verbal sound representing data



Cardiac Trigger Monitor  
(PD from Wikipedia)

Sonification in geoscience



**Marine Heat Waves - a sonification of ocean model data  
- original music by Lee de Mora**

<https://youtu.be/zUPc3CmMpiY?feature=shared>

Ref) de Mora, L. et al. : 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.

# Introduction | My last work: “Polar Energy Budget”



CSV export

MIDI export

Sheet Music

Performance



A strings-quartet piece from polar climate data  
(Nagai, 2023; EGU)

CellPress  
OPEN ACCESS

iScience

**Backstory**  
String Quartet No. 1 “Polar Energy Budget” – Music composition using Earth observation data of polar regions

Hiroto Nagai<sup>1,\*</sup>

**SUMMARY**  
In recent years, advancements in digital processing have facilitated the transformation of data into sound, a process referred to as *sonification*. To raise awareness and understanding of climate change, various sonification endeavors utilizing Earth science data have surfaced; nevertheless, the outcomes frequently deviate from conventional music compositions. This backstory aims to examine the possibilities and limitations of sonification by composing music based on Earth observation data with intentional and staged intervention of arrangements by a composer, presenting the music composition results and presenting the feedback and discussions raised by the audience.

(Nagai, 2024; *iScience* in press)

**Thank you for your suggestions for publication, Michael and conveners!!**

# Issue and Purpose |



## Difficulties for non-scientist



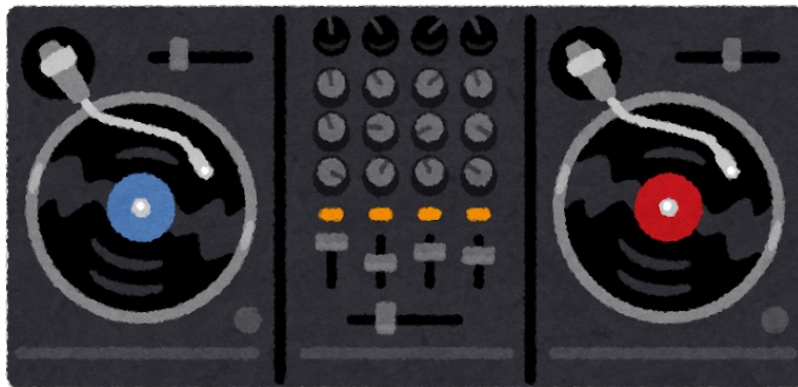
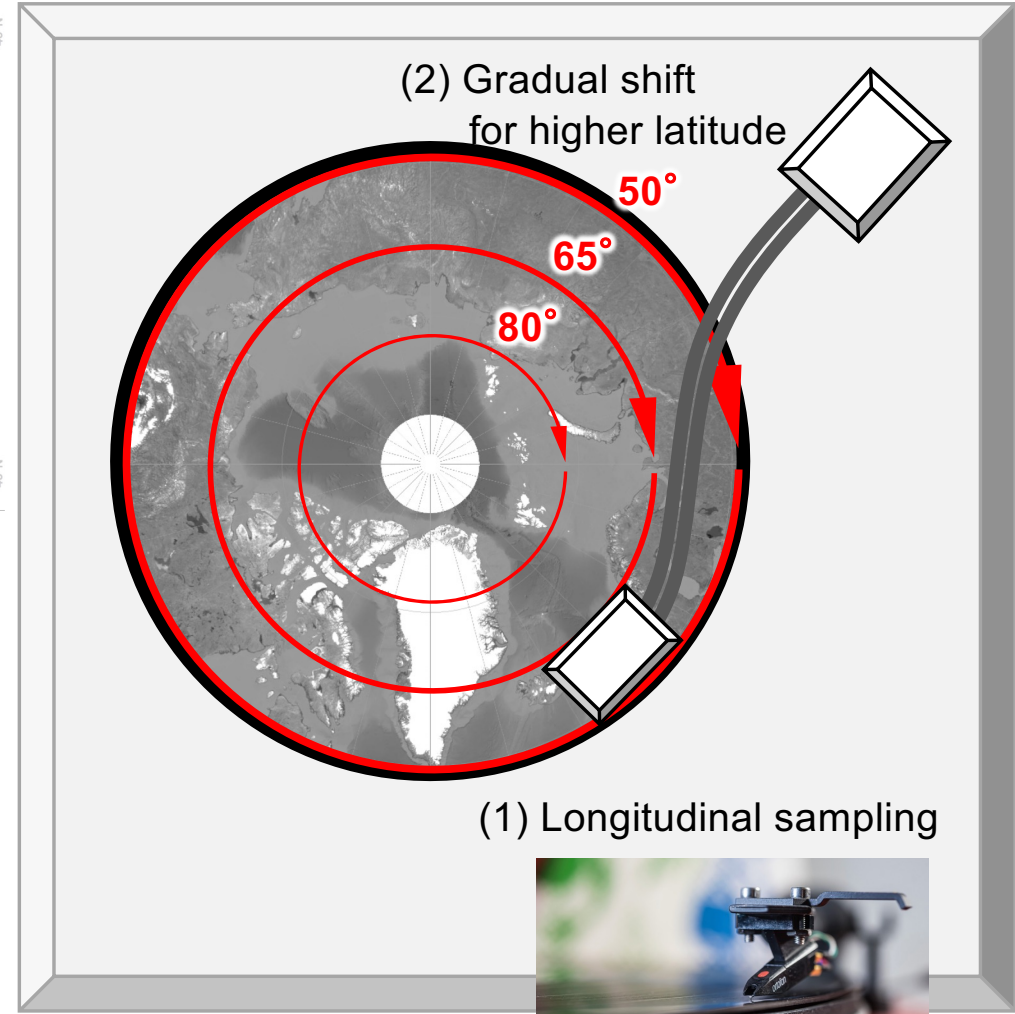
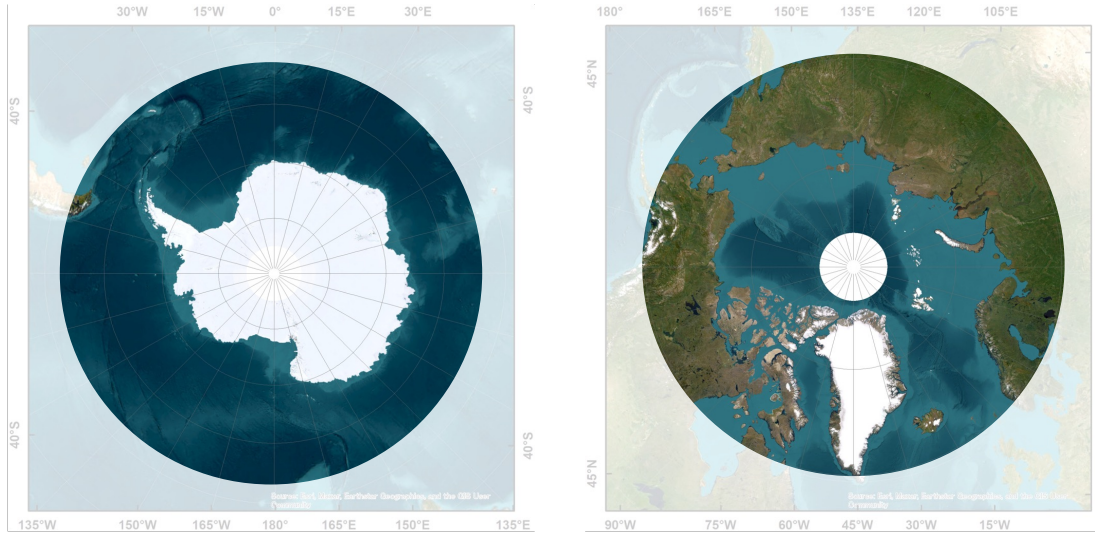
**= BARRIER HERE =**



## Make a web-based tool for general citizen/artists to spread inspiration



# Method | Concept of a EDM music: “Polar stereo-graphony”





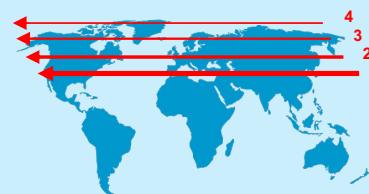
# Method | Google Earth Engine, Python, and Music editing

## Google Collaboratory (Python cloud platform)



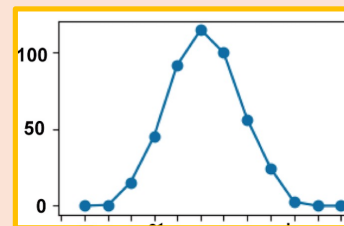
### Google Earth Engine / Python API

1. Select dataset and variables
2. Sampling along a longitude
3. Repeat in higher latitudes

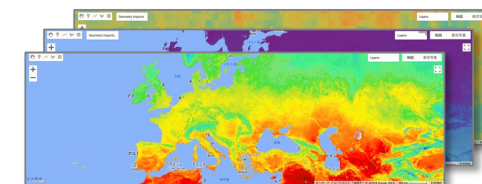


### Data processing with Python

1. Normalization of data values
2. Definition of music parameters (i.e. tone length, pitch range, scale)
3. Conversion to MIDI format



1. Chlorophyll density (SeaWiFS)
2. Topography (ArcticDEM & REMA)
3. Surface albedo (MODIS)
4. Aerosol density (Sentinel-5P)
5. Wind Velocity (N-S) (ERA5)

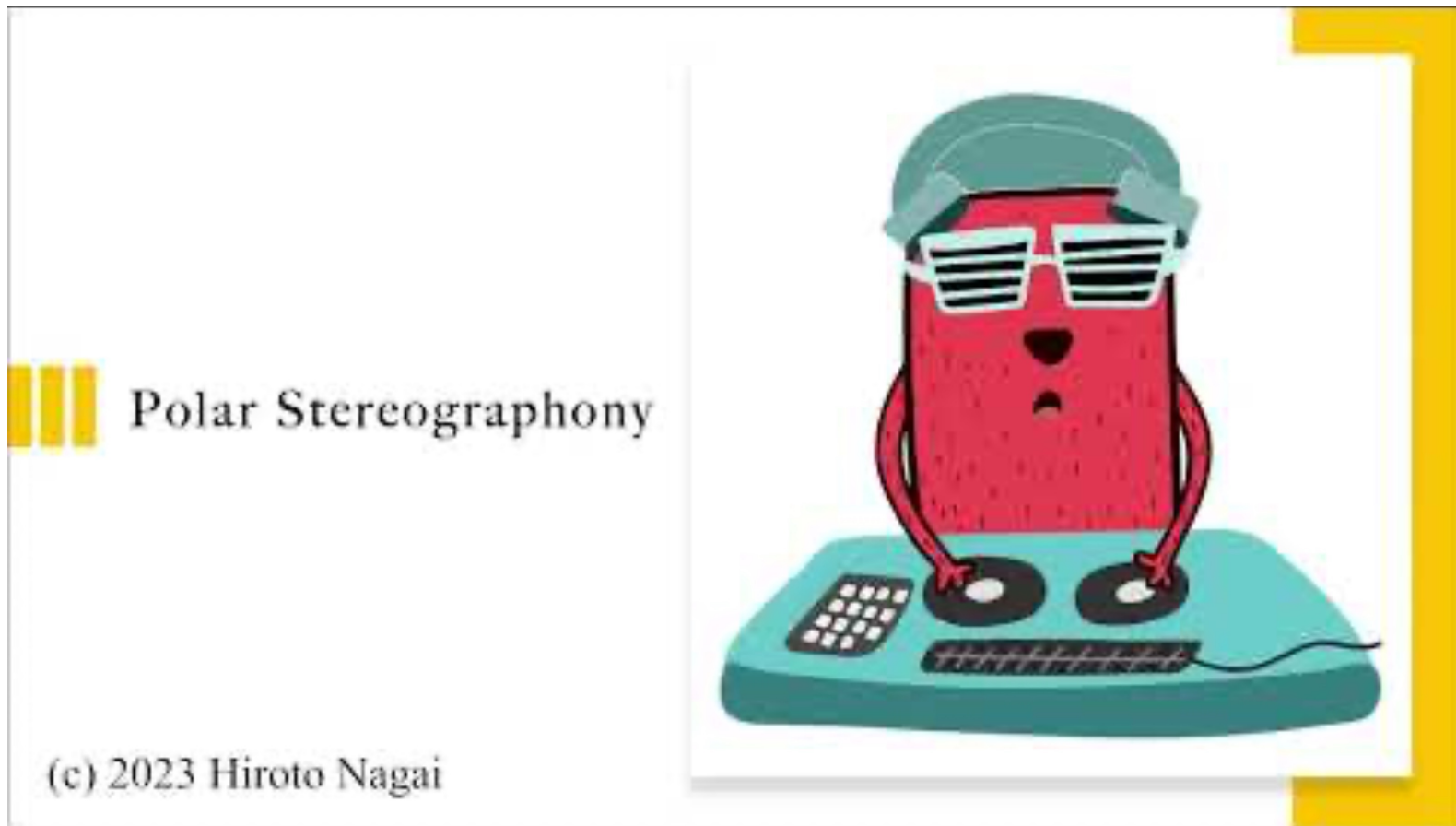


### LogicPro (Apple)

Free arrangement and mixing



## Result | Demo



[https://youtu.be/Atd9pqXct\\_E?feature=shared](https://youtu.be/Atd9pqXct_E?feature=shared)

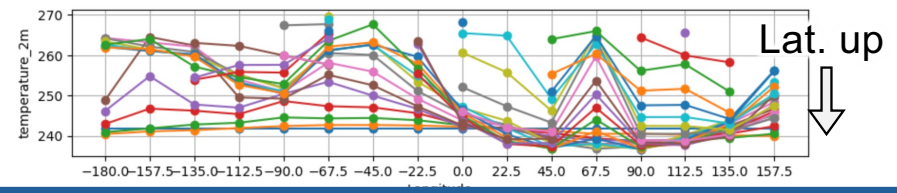
# Discussion | Impression, insights and perspectives



## 1. Easy to listen (and dance!)



- Similar but slightly shifting patterns by latitudinal shift



## 2. Easy to built as a music piece



- Select diatonic scale (Do-Re-Mi-Fa-Sol-La-Si-Do) with less muddy sound
- Semi-automatic drums background [Drummer] accompanying well

## 3. Excellence of creativity



- Huge amount of parameterization enables unlimited melody patterns
- Input data: Dataset, Variables, Date, Sampling steps on lat/lon
- Output music: Tone length, Pitch ranges, Scales, Sound, ...and numerous arrangements on DTM software!

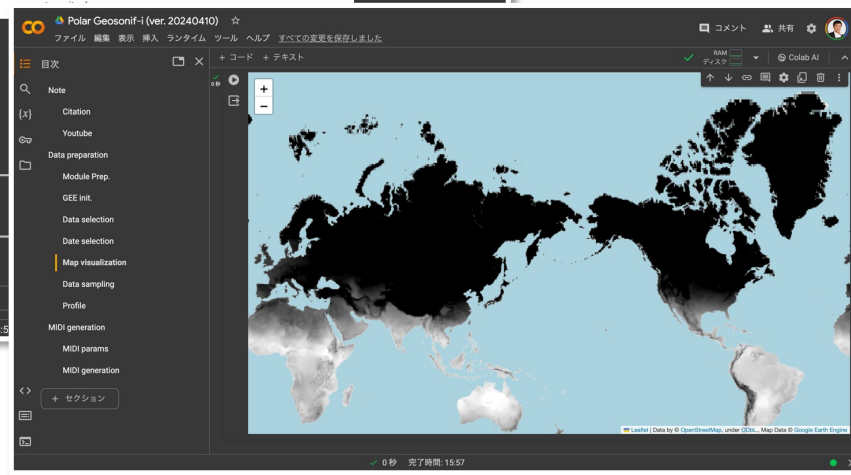
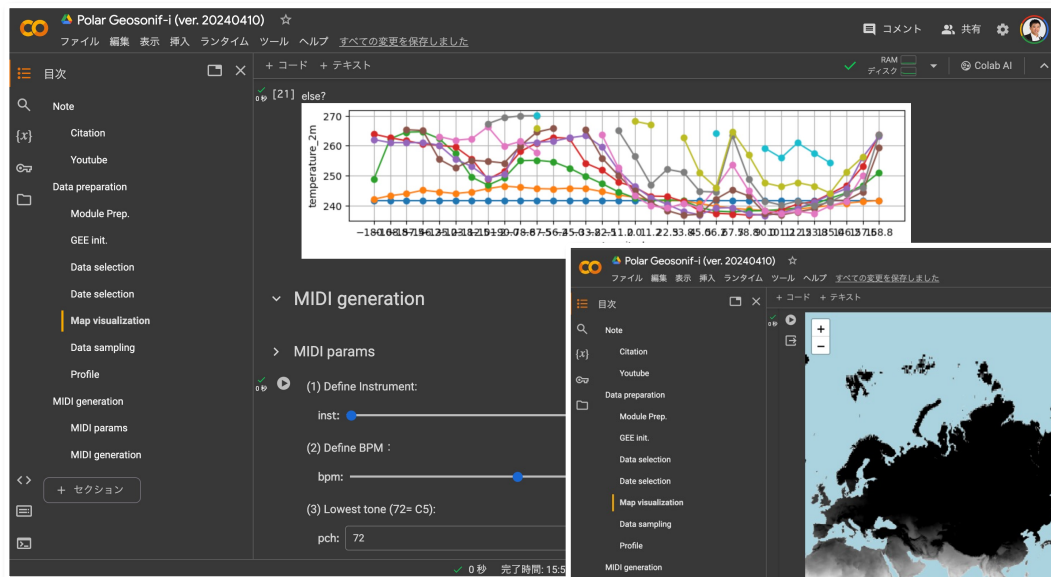


# Conclusion |

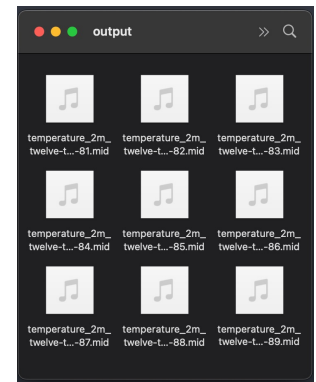


(\*Free accounts of Google, Colab, and GEE needed)

# An integrated web tool **“Polar Geosonif-i”** is now open!



<https://x.gd/MDMgo>



Let's turn the polar disks and play with geo-science data!