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Listen to the ocean

Earth System Music: the creation and reach of music generated from UKESM1

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@LeedeMora https://www.youtube.com/c/LeedeMora

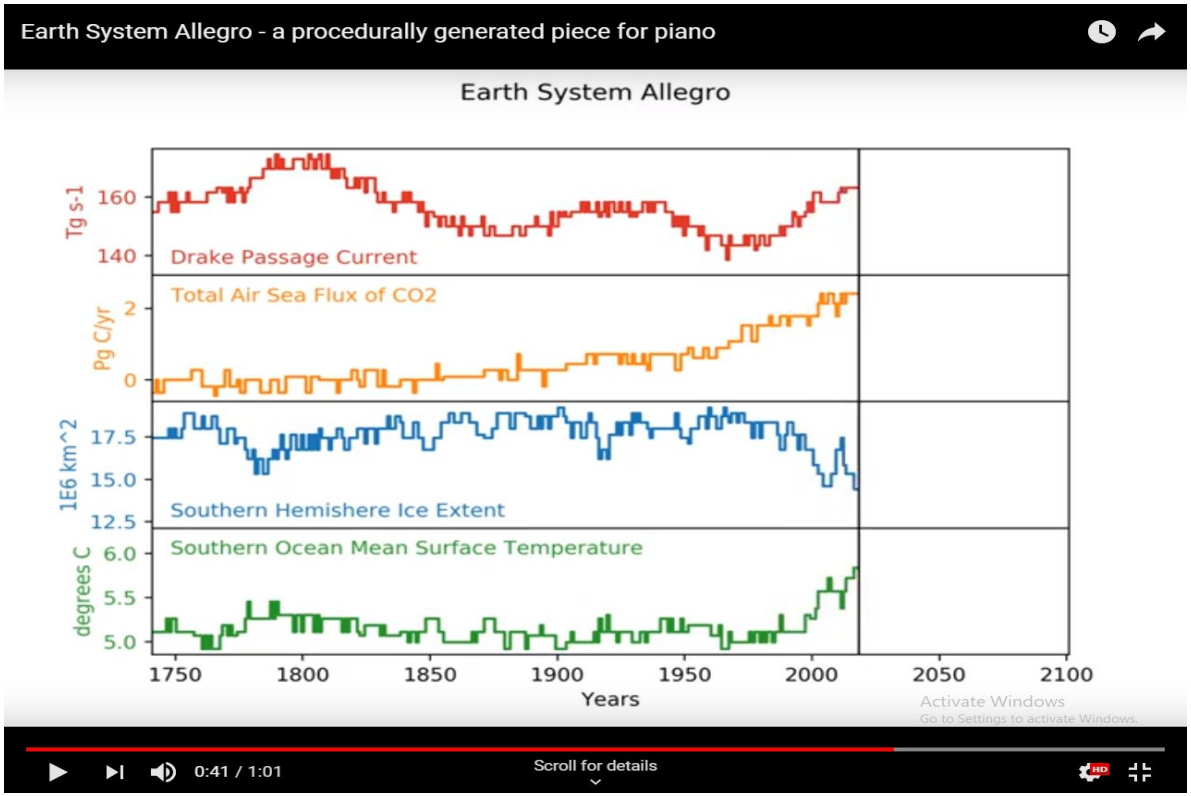
Earth System Music - pilot study

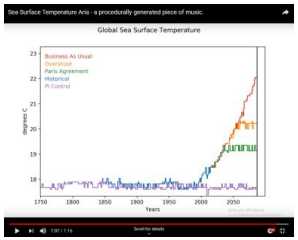
Sonification: The use of non-speech audio to convey information.

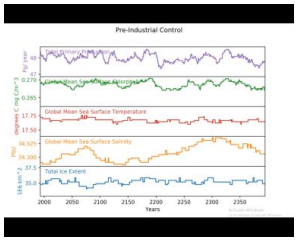
UKESM1 ocean time series data used to generate seven musical pieces and videos.

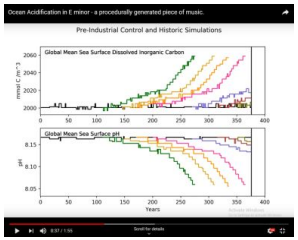
Diverse behaviors of modelling, scientific and musical contexts:

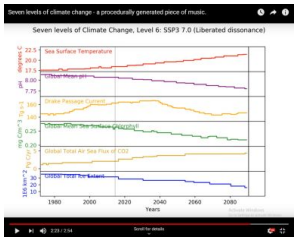
- UKESM Spin up, Pre-industrial control, Historical, future scenarios
- Circulation, Marine carbon cycle, sea ice extent Sea surface temperature, Ocean Acidification.
- Allegro, Vivaci, “4 chord song”, *12-bar blues*, Minor aria, Lizzo’s *juice*, Pachelbel’s *Canon*

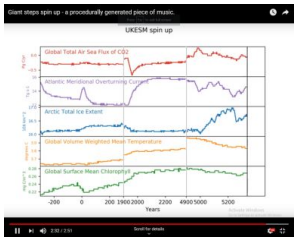


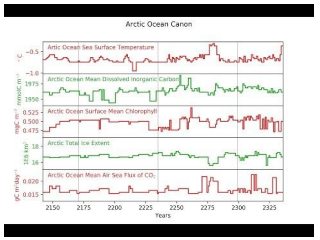












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Methodology

Model Data and Pre-processing

UKESM1
Model data in NetCDF format

BGC-val
Python based model evaluation toolkit

Time series shelves
BGC-val processed output data

UKESM

BGC-val

Legend

File
Box with thick border

Process
Arrow with no border

Earth System Music Processor

Load settings
Includes data selection criteria and artistic choices.

Earth system music processor settings
Python dictionary containing all required settings, artistic choices and paths to data.

Load shelve data
Access UKESM1 data as time series

Apply smoothing window
Removes some of the temporal variability

Convert data to MIDI pitch
Uses data range provided

Enforce scale or chord
Uses artistic choice

Set MIDI velocities
Adjust note loudness

Remove duplicate notes

Extend final note

Process MIDI and model data into images

Output notes as MIDI

Post Processing

Final Video
Audio and video in mpeg format

Ffmpeg video processor
Combines images and audio to produce video

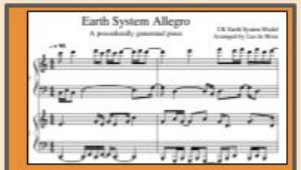
Video frame images
png format

MP3 audio
Performance by piano synth

Timidity++ Piano player
Piano synthesizer

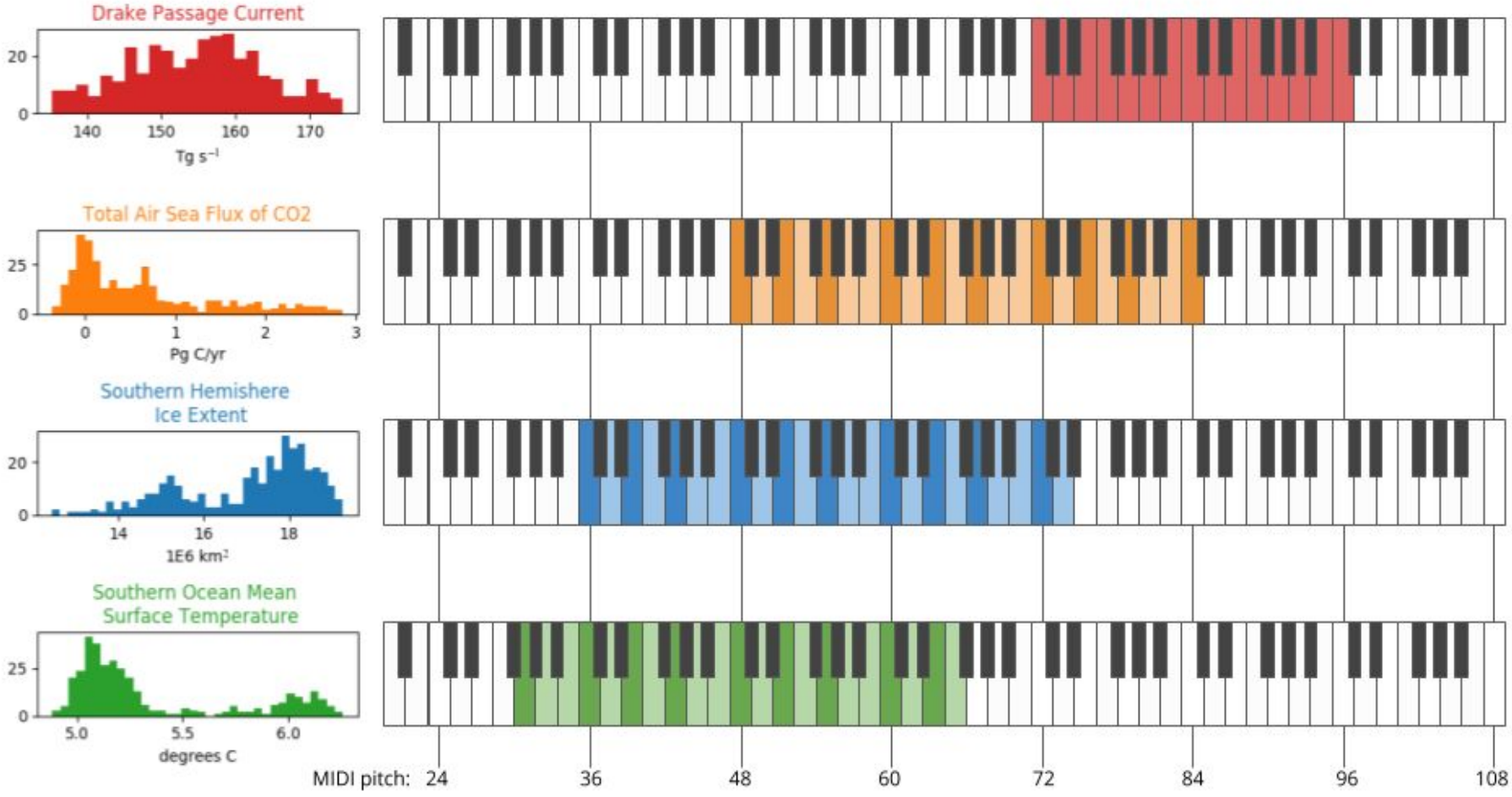
Musical Instrument Digital Interface
(MIDI) file

Musescore
Loads MIDI as sheet music.



Sheet music
pdf format

Musical range and artistic decisions



- The choice of datasets used to determine pitch and velocity
- The pitch and velocity ranges
- Width of the smoothing window
- Tempo & the number of notes per beat
- Key and chord progressions
- The choice of instruments
- Title
- Style
- Mastering

These choices allow the composer to attempt to define the emotional context of the piece. ie:

SSP1 1.9: optimistic & free

SSP5 8.5: uneasy & foreboding

Quantifying the reach

Videos posted on YouTube, shared via author's personal & professional social media.

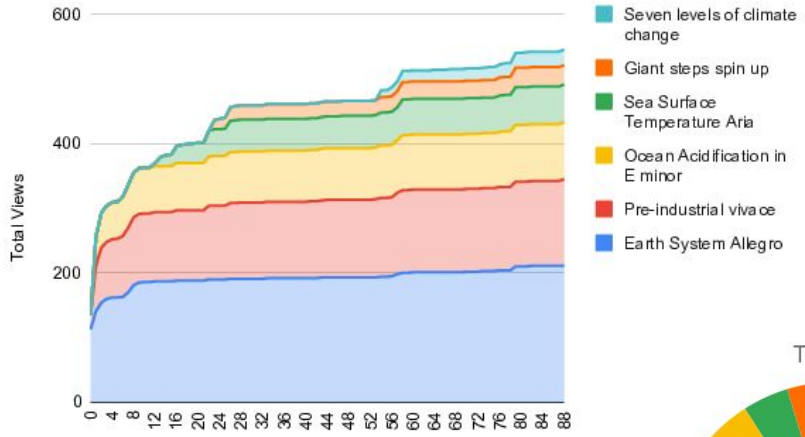
View count & demographics tracked using YouTube Studio.

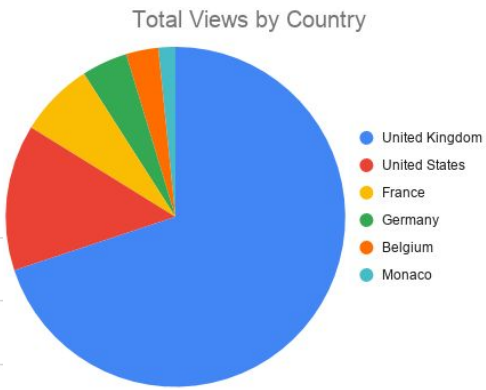
Comments from audience also tracked.

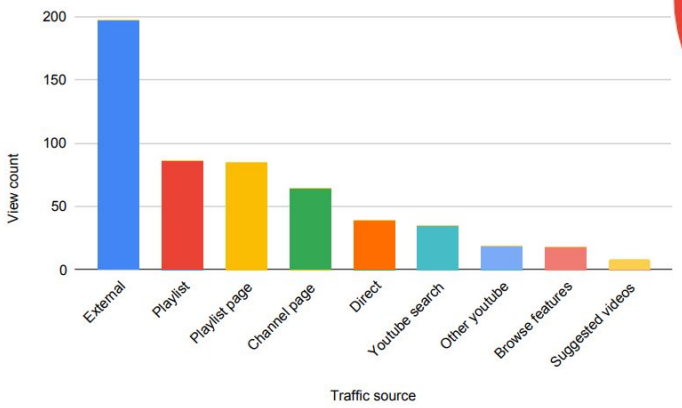
First 90 days: 525 views, 247 unique viewers, 465 minutes watch time.

Overall:
1463 views, 22 hours watch time, many positive comments.

Possible Extensions: Live performance; additional instruments, musical styles, models, domains; ESMValTool instead of BGC-val; include obserservations, create a viewer survey; add in-video explanations.







More details in Geoscientific Communications manuscript **GC-2019-28**: https://www.geosci-commun-discuss.net/gc-2019-28

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