

Data sonification

Music, Sound, and the Environment

October 3, 2023

"The current environmental crisis is due at least in part to a lack of effective science communication. Traditional methods of disseminating findings are important for continued progress but can be inaccessible to the public and rarely communicate the important emotional and cultural dimensions of environmental issues.

There has been significant communications research into these issues—findings have suggested that communication techniques that can create a narrative, engage emotion, make the abstract more understandable, and use value frames to connect to an audience and encourage empathy will be most effective in encouraging behavioral change. The arts are capable of communicating in this fashion; sounding art in particular has a long history of engaging with politicized and emotional issues in ways that can ultimately provoke large-scale shifts in social convention. The arts and sciences each provide important responses to environmental problems. When used together, however, they have serious potential to create change.

Bailey Hilgren

"THE MUSIC OF SCIENCE: ENVIRONMENTALIST DATA SONIFICATIONS, INTERDISCIPLINARY ART, AND THE NARRATIVE OF CLIMATE CHANGE."
MM thesis, FSU, 2019.



Data sonification

- Data sonification:
- the translation of data into sound, or the translation, representation, or conveyance of information through non-speech sound
- can combine climate science and ecological art into **a potentially powerful form of environmental activism.**
- sometimes will also see other terms: audification, sonification, auditory display, auralization, and acoustic display
- interdisciplinary, usually involving collaborations between scientists, artists, programmers, and others.
- really coalesces in the 1990s and afterwards



Data sonification

The sonifiers in each project come from a wide range of disciplinary backgrounds, including performance, programming, neuroscience, visual arts, multimedia/sound arts, climate science, and more traditional composition.

- How?
- sonifiers assign musical characteristics to variables of a dataset;
- there's a spectrum here, from “direct or pure” sonifications to those that use data sonification as a compositional technique (which include subjective aesthetic decisions)



Data sonification

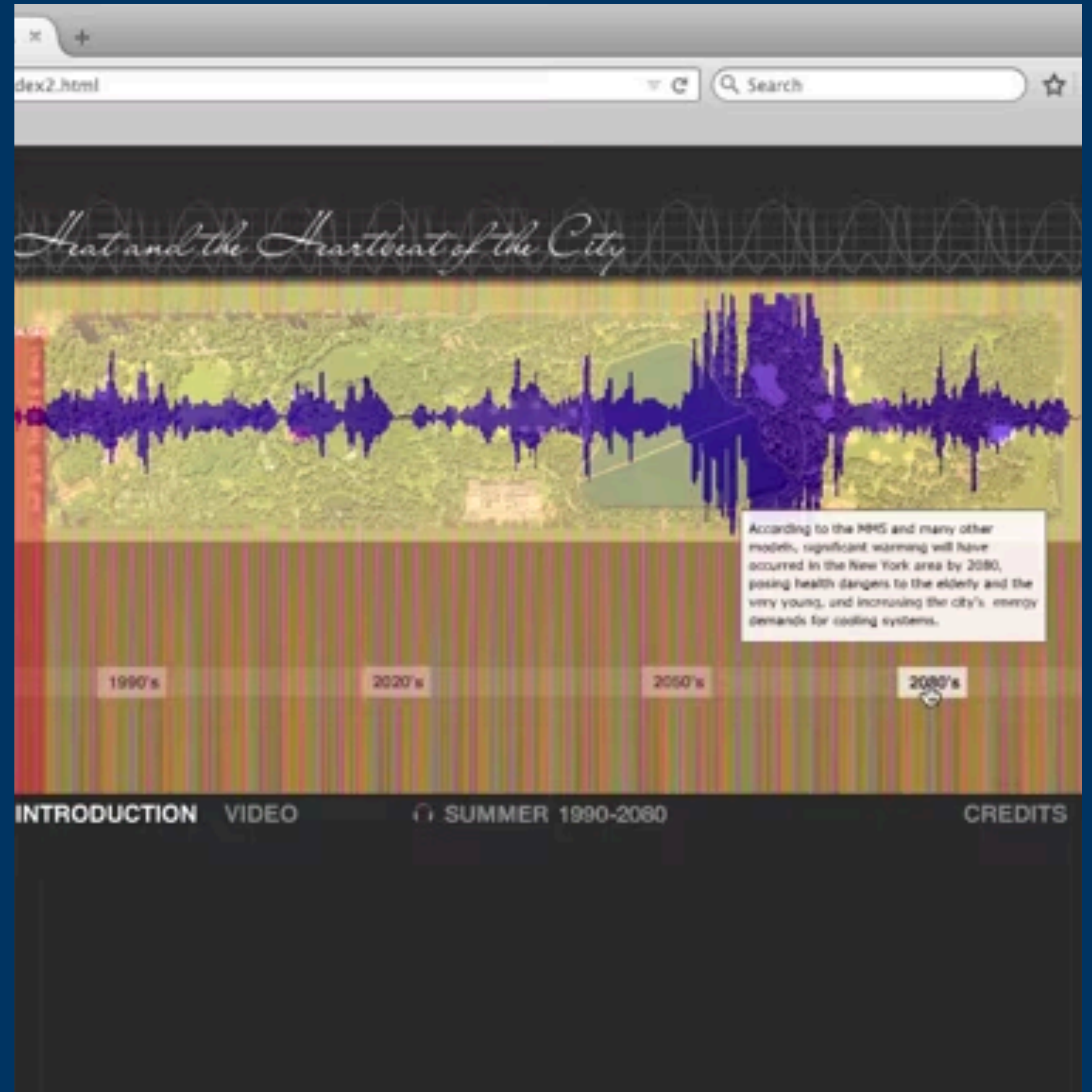
- Why?
 - Sonifications continually resist classification as either an art or science...there is a tension over whether data sonifications are exploratory scientific tools or artistic products.
 - this broader attitude that the arts and sciences are conflicting or opposed....in fact the tool's greatest strength when used for the purposes of environmental activism.
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- Sonifications appeal to emotions and logic and require creativity and evidence, powerful persuasive combinations in the face of environmental issues.
 - They require scientists to consider the aesthetics behind the art, and composers to understand the science behind the data; in forcing us to acknowledge the importance of the other disciplinary perspective, they help us to question some of our disciplinary boundaries and effectively serve as a model for the interdisciplinary collaboration that is increasingly necessary as we navigate our changing world.

“While data sonification is still far from the mainstream scientific process, music could be a lynch pin for taking climate research out of the pages of academic journals and into our lives. And it may serve as a reminder that we’re all composers and our choices will define what the next movement sounds like.”

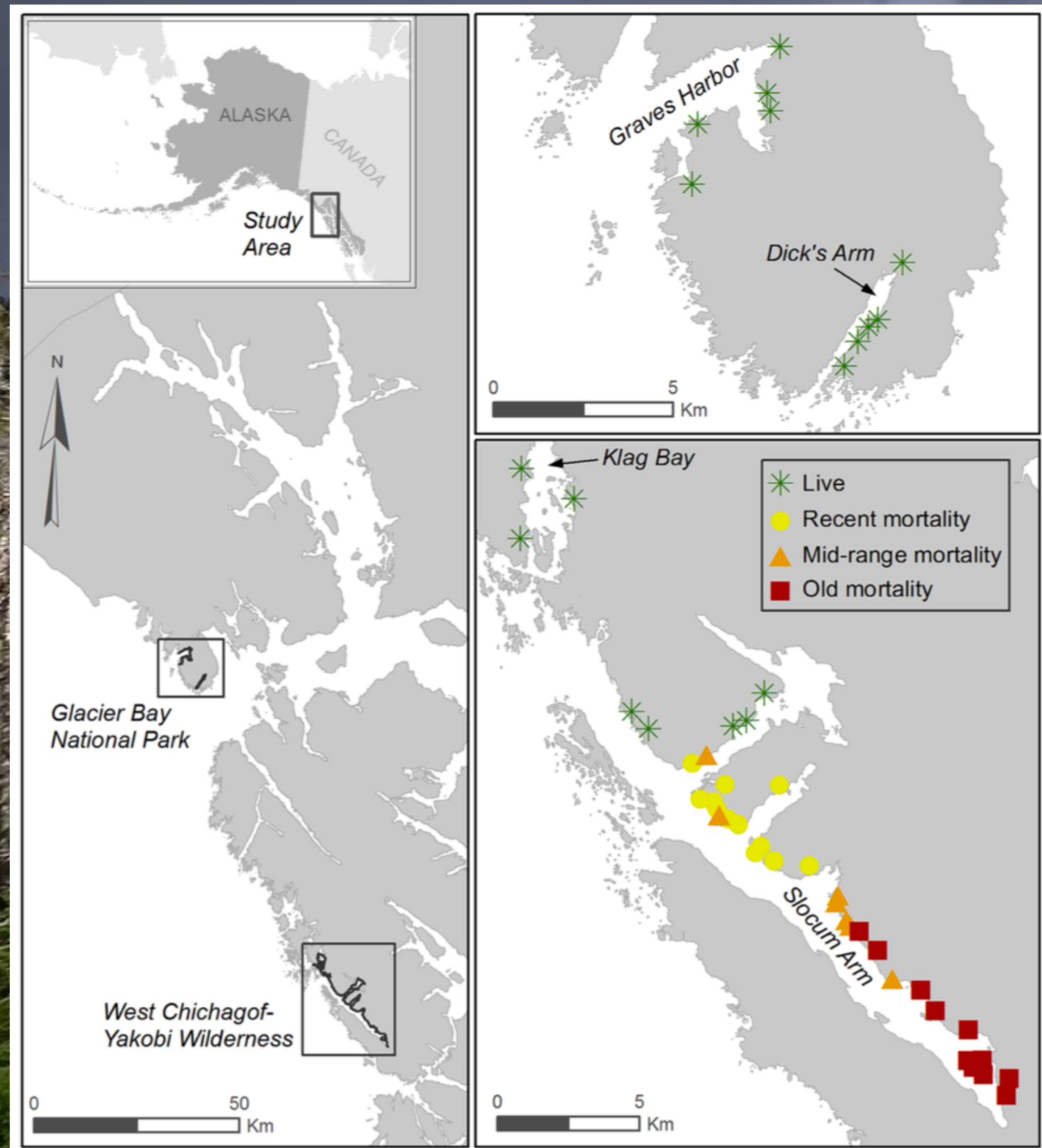
– Brian Kahn, Climate Central

Potential Case Studies

1. Lauren Oakes and Nik Sawe's 2016 sonification of climate change impacts on Alaskan forests
2. Andrea Polli's 2004 online sonification project *Heat and the Heartbeat of the City*
3. 2012 telematic multimedia opera *Auksalaq* by Matthew Burtner and Scott Deal.



Potential Case Studies



- Lauren Oakes and Nik Sawe's 2016 sonification of climate change impacts on Alaskan forests
- Stanford interdisciplinary scientist Lauren Oakes, data from her doctoral work described population dynamics in a forest affected by climate change (investigated the specific responses of Alaskan yellow-cedar trees to human environmental change).
- Oakes and her team collected field data by conducting plant surveys within fifty land plots along the outer coast of southeast Alaska moving from north to south
- Within the circular survey plots, they recorded metrics including tree height, health of crown, trunk diameter, species, whether trees were alive, and if not, the time passed since death.

Figure 1. Oakes' study area and yellow-cedar death with change in latitude.⁵²

Potential Case Studies

- Oakes and Sawe’s data sonification process was collaborative throughout. Sawe was familiar with sonification techniques from his time working with CCRMA and led the coding side of the project.
- Sawe created the sonification from Oakes’ data in the software environment R, which he knew well as a common platform for data analysis.
- After Sawe created the basic sonification, he generated comma-separated values (CSV) files from the raw data. With assistance from CCRMA, he was able to generate MIDI files from the CSVs. About three seconds of reverberation were added to the MIDI output. A score of the full sonification has not yet been created, so the project has not yet been performed with live instruments.
- Oakes and Sawe decided to represent each of the study plots as one measure and each tree as a single note. The sonification was programmed to be about three minutes long to approximate the length of an average pop song. Listeners spend the same amount of time listening to each plot, meaning that plots with more trees are heard as measures with more notes. Each of the forty-eight plots lasts about 3.75 seconds.
- Dead trees remain standing in old growth forests for years, and act as important markers of which species have been lethally affected by temperature changes. Importantly, Oakes and Sawe included each dead tree as a silent space in the sonification. healthy forest plot has many notes sounding within one measure, and a plot more affected by temperature change has more dead trees and subsequently more moments of silence.
- Oakes and Sawe paired tree height and pitch, with higher-pitched notes representing taller trees.

Table 1. Tree variables mapped to musical elements.

Tree Variable	Musical Element
Trees in plot	Notes in measure
Tree mortality	Sounding of note
Tree height	Pitch
Trunk diameter	Dynamic
Tree species diversity	Texture

Table 2. Tree species mapped to instruments.

Tree Species	Instrument
Yellow-cedar	Piano
Western hemlock	Flute
Shore pine	Clarinet
Mountain hemlock	Violin
Sitka spruce	Cello

Groupwork

- With a partner, look up “data sonification” online
- You may need to add additional search terms (music, trees, fracking, whatever)
- Find an example of a data sonification project you find intriguing.
- On today’s forum, provide a link to the project, and explain in a paragraph or so what the project does