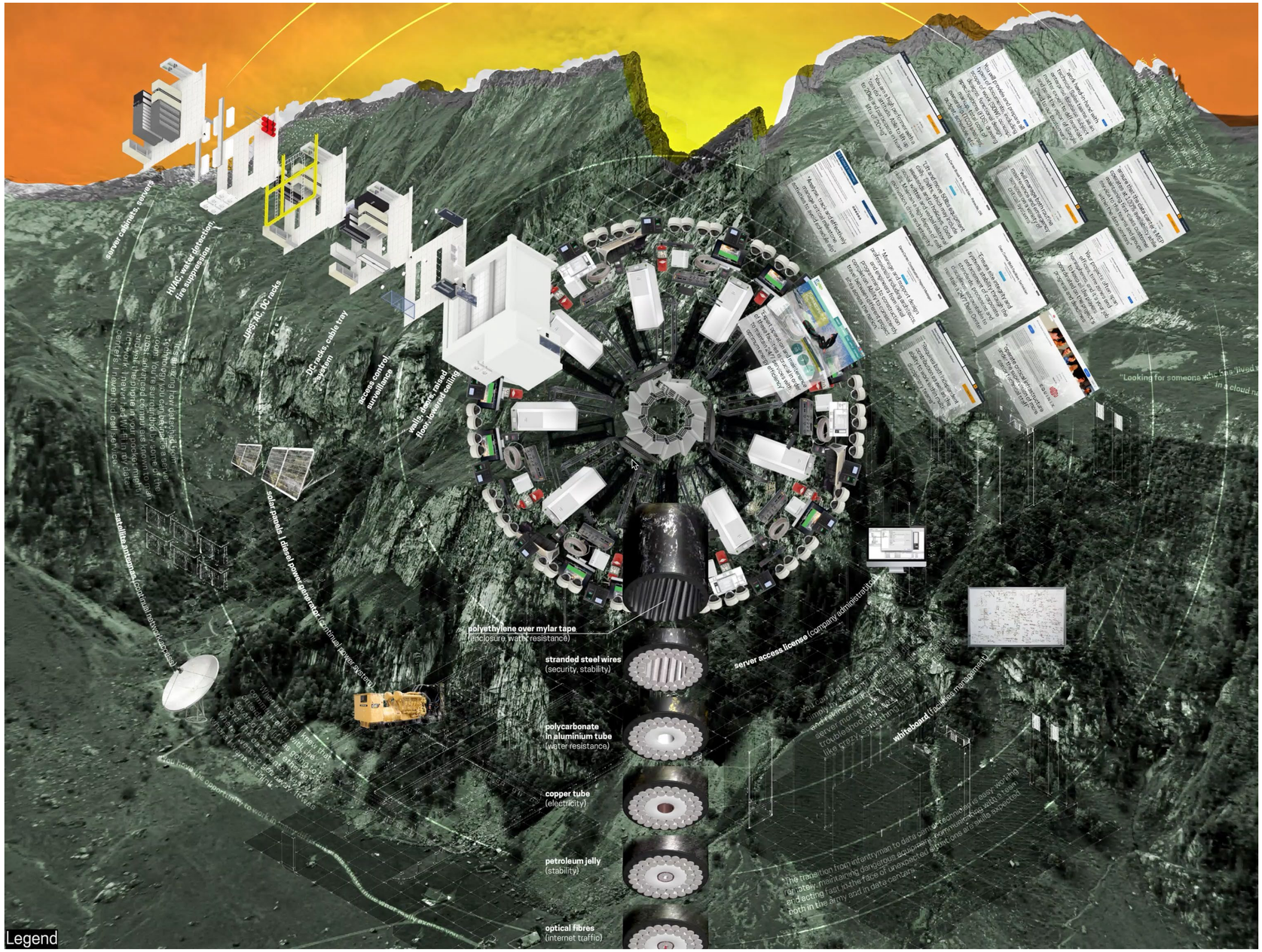
Radio Explorations: Data Observatories of Environmental Radio Transmissions

Radio Explorations project is concerned with ways to work with abstract datasets and machine learning training processes to tell stories about radio signals, to understand situated yet invisible transmissions.



Radio Explorations

Savić, S., Bruder, J., Ganesh, M. Cloud Cosmogram http://cloudcosmogram.space

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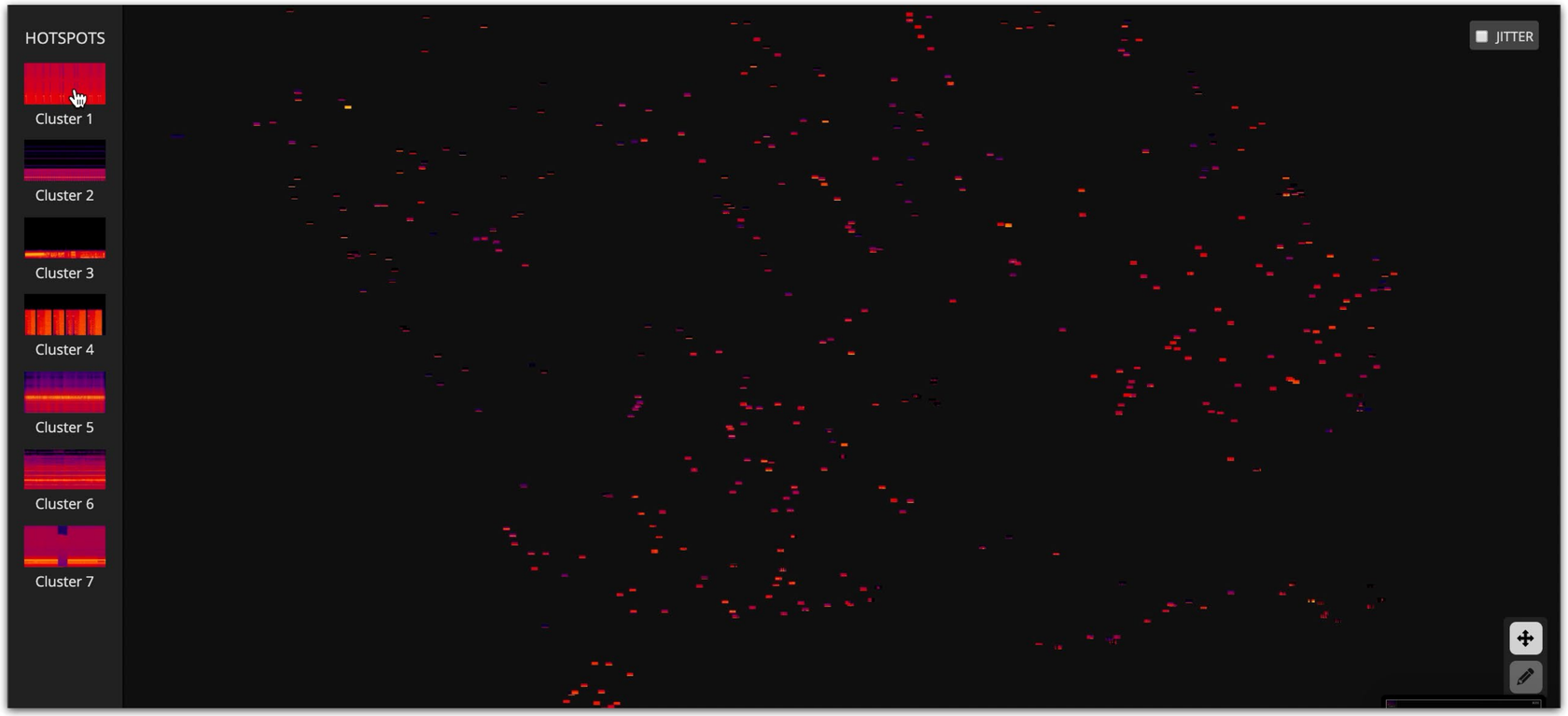
One of the premisses of this project is to question the way we order things. Haunted by Cartesian thought, we rely on the habit of dualism and hyper-separations to know the world. Nature and culture, body and mind, information and noise. Furthermore, we attempt to fix layers of operation, responsibility and communication, to organise things into coherent sub-domains. This ordering of what we know and experience, informs how we understand and interact with the world, or attempt to design it.



Radio Explorations

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A data-driven approach promises to treat the world with computational objectivity. Taken at face value, it rationalizes the world in ways inaccessible to humans. This can absolve us from agency and responsibility in deciding what matters and how. I propose to invert these concerns and explore how data can be organized. I look at recordings of environmental radio transmissions as digital artefacts. I ask how this can provide avenues for working with other kinds of environmental data?

Radio Explorations

“Radio was heard before it was invented” D. Kahn, *Earth Sound, Earth Signal,* 2013

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Radio is an interesting phenomenon to challenge the dualisms and hyper-separations previously mentioned. It is a natural phenomenon, but it can be artificially generated, engineered and used in human communication. Radio is one way the city leaks into nature.

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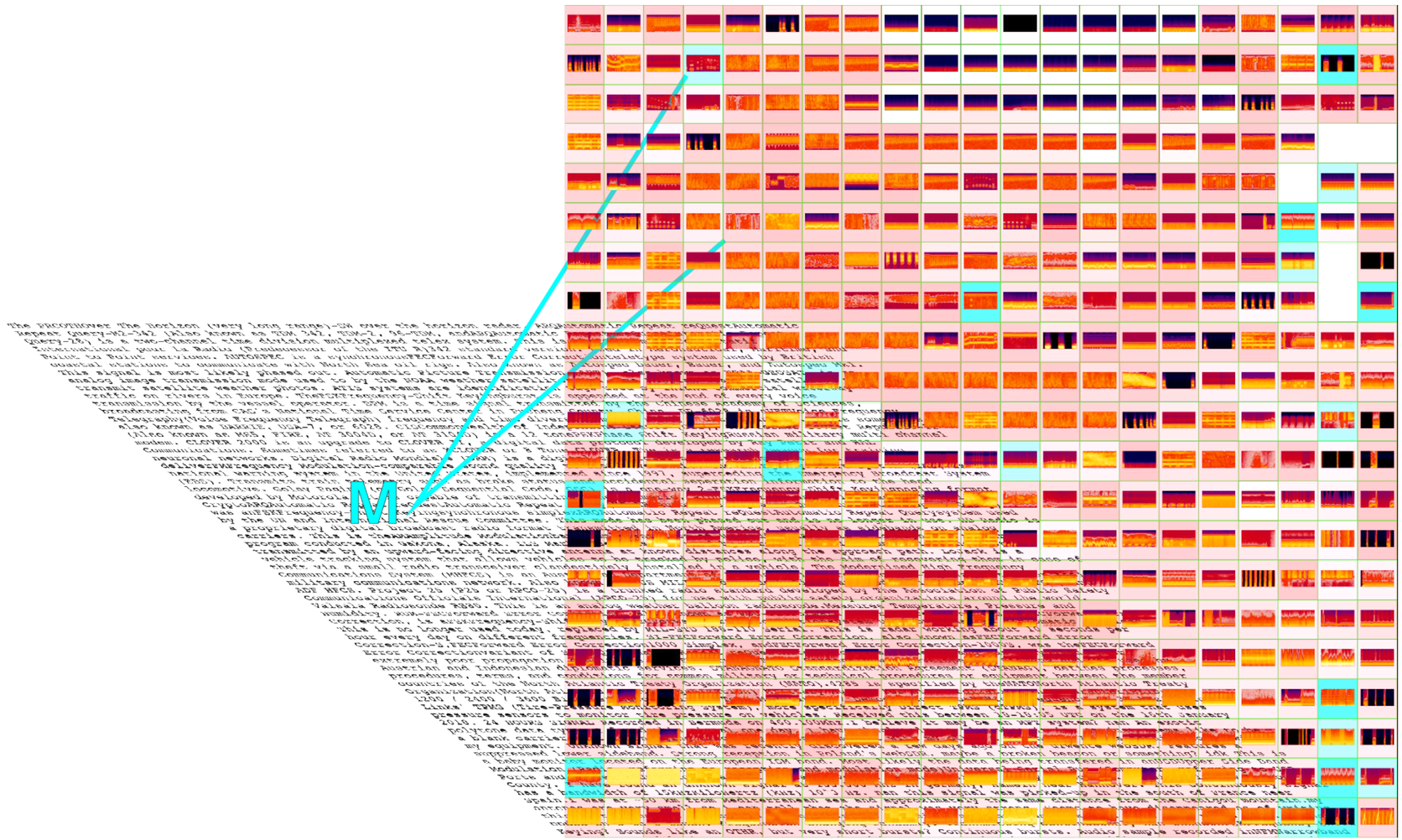
The Signal Identification Guide (SIGID) wiki is an organized collection of information about radio signals, held among a community of radio amateurs and enthusiasts. There are currently 424 known or identified and 318 non-identified signal pages on the website. Known signals are divided up in categories based on different listeners community interests, such as the military, amateur radio, trunked signals or satellite reception. Each signal is characterized by its different properties, a short description and includes a recording sample with the spectrogram. Any radio signal that can be received and recorded can be included in the database.



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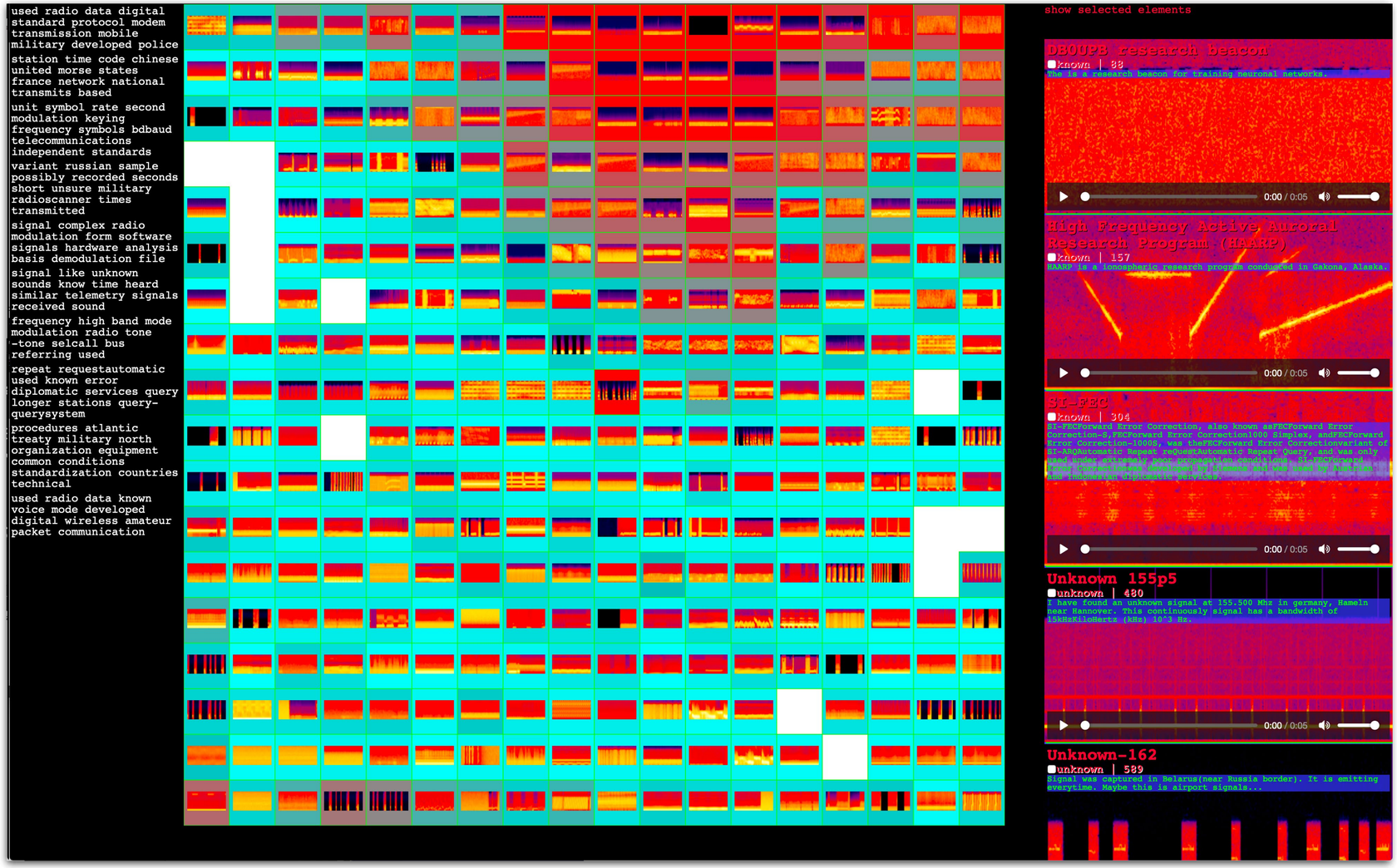
I organize concrete manifestations of radio, collected by radio enthusiasts around the world, in a grid space using the unsupervised machine learning algorithm, self-organising map. Interestingly, the data itself - audio samples of radio signal transmissions - means nothing to us as humans. It is hard to say what, if anything, the clustering means then. I take this as an additional degree of freedom - and responsibility - to articulate precisely and specifically what I am looking for.

DESCRIPTIONS



Radio Explorations

https://radioexplorations.ch/study-1/visualize_radio/

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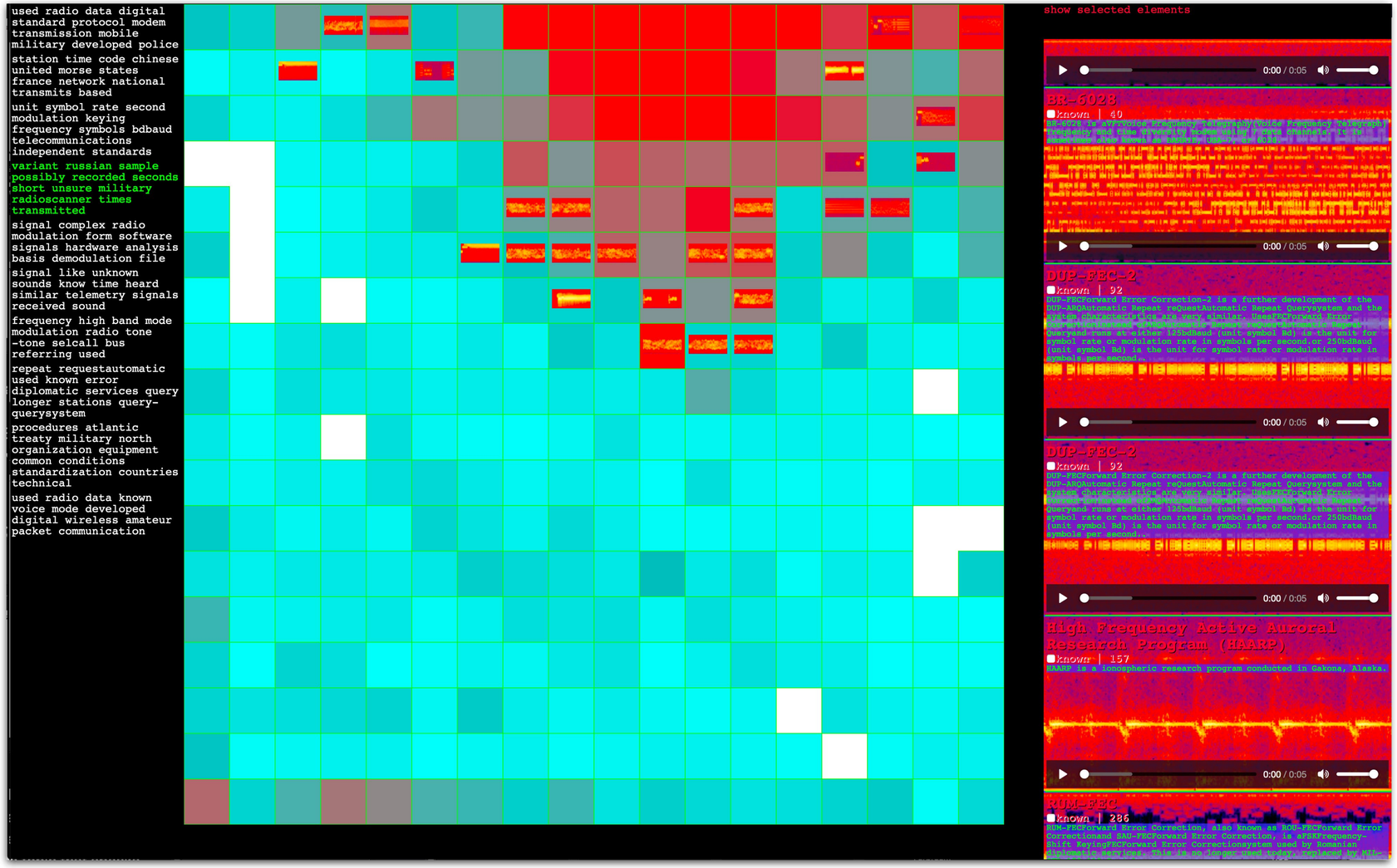
How do I know where to start? Let’s take any signal and look at it. For example: High frequency active auroral research programme. It looks like a photograph of neon lamps in space. But this is a spectrogram. It is a Time-frequency representation of sound. The description says it belongs to a research programme studying the properties and behavior of the Earth’s ionosphere. This is quite a good find for our topic today. Reading about ionospherics elsewhere, I learned that some climate research uses data on lightnings to measure the degree of climate change. They found, already in 1999, a significant correlation between the increase in temperature and in lightning activity in the northern hemisphere of our planet.

DESCRIPTIONS



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This is a story that can emerge from descriptions of radio signal transmissions. This is why I built the first data observatory around text. I extracted ‘topics’ from all descriptions of all signals in the archive. Now, let’s say that I am interested in the relationship of radio and military. Is there something new and specific we can learn from this setup? I highlight one topic that speaks about military and some related keywords. Interestingly, the signal we just looked at, is found in one of the cells at the bottom of this area. It is a rhythmical sample that has a similar rhythm and spectral power to DUP-FEC-2. I notice the FEC in the names of other signals. Apparently, FEC stands for “Forward error correction” - an error control method used in situations where retransmissions are impossible. What this cell tells us about military: it is tightly connected with diplomacy and intelligence; impossibility of retransmission is characteristic of military communication.

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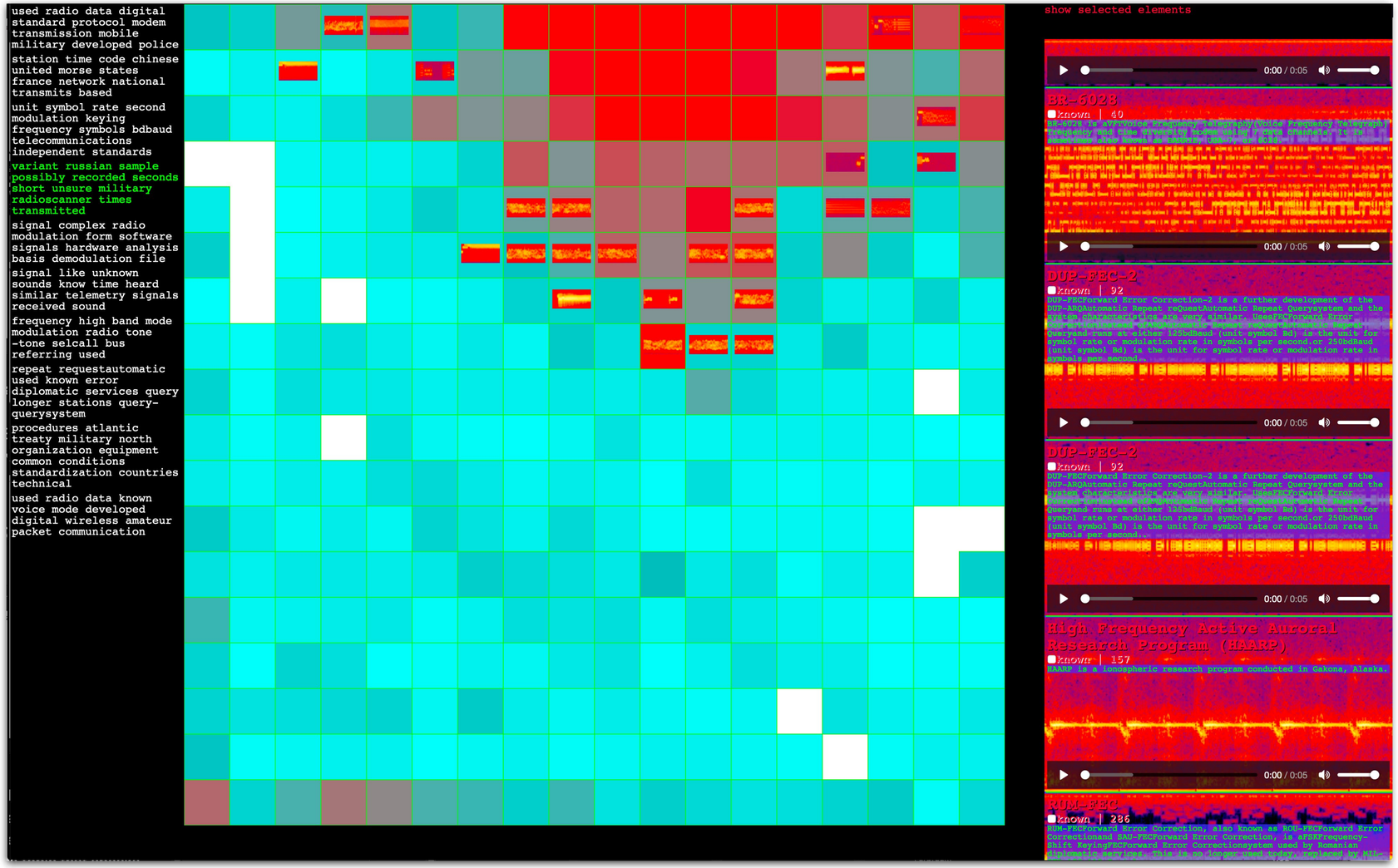

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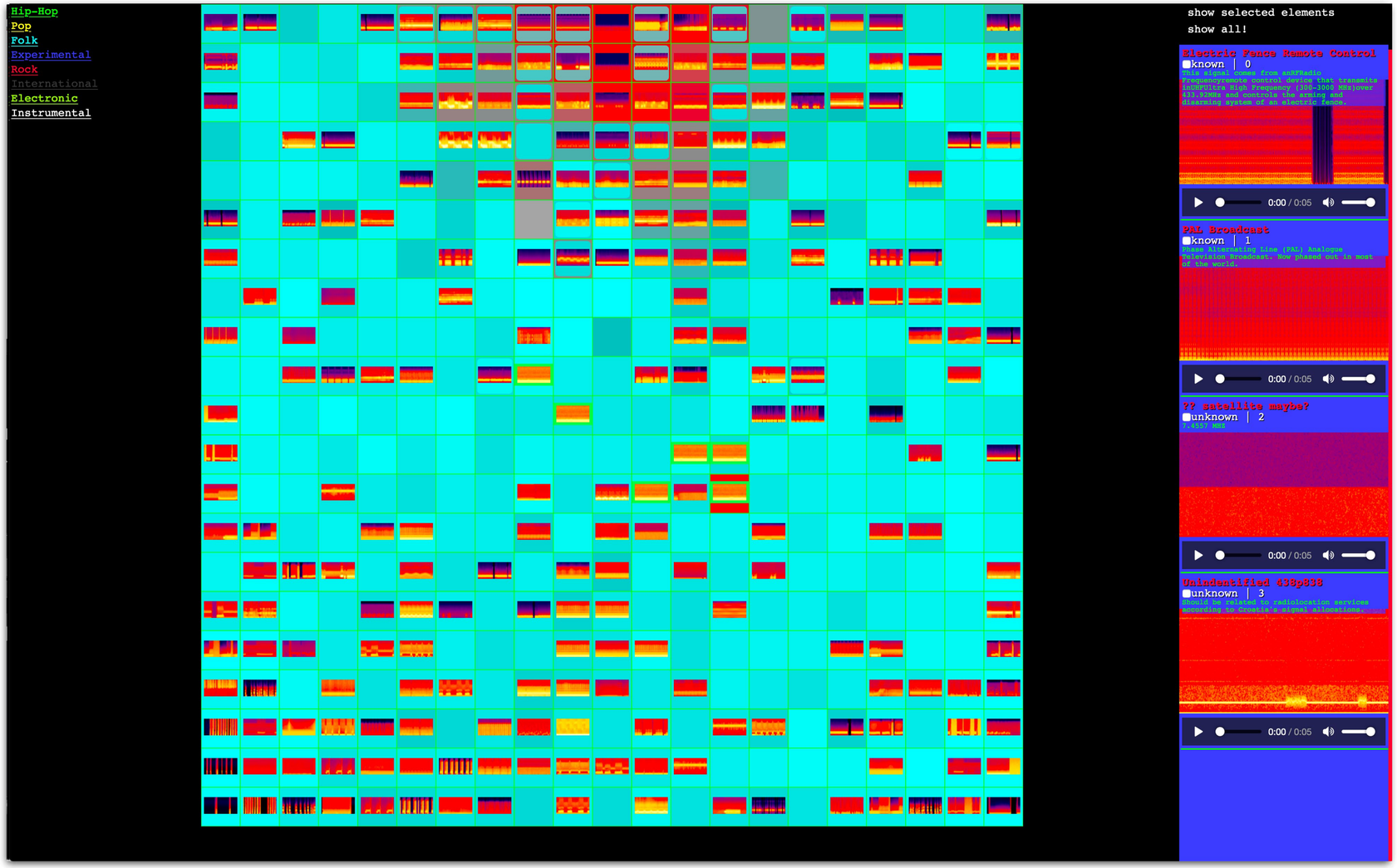
What do these relationships say about governance, democracy and planning more generally? Military clearly cares about information control, and people seek access to these secret transmissions. As the existence of the SIGID wiki itself asserts, there is always a pushback from the citizens to KNOW about this communication, not only in terms of content (journalism) but also in terms of the infrastructure it operates on. The channels, the protocols. There is an interest in technology. My work contributes to specific insights: we start to pay attention to the way protocols, modulations, application and histories intersect in these explorations of radio signals.

PROJECTIONS



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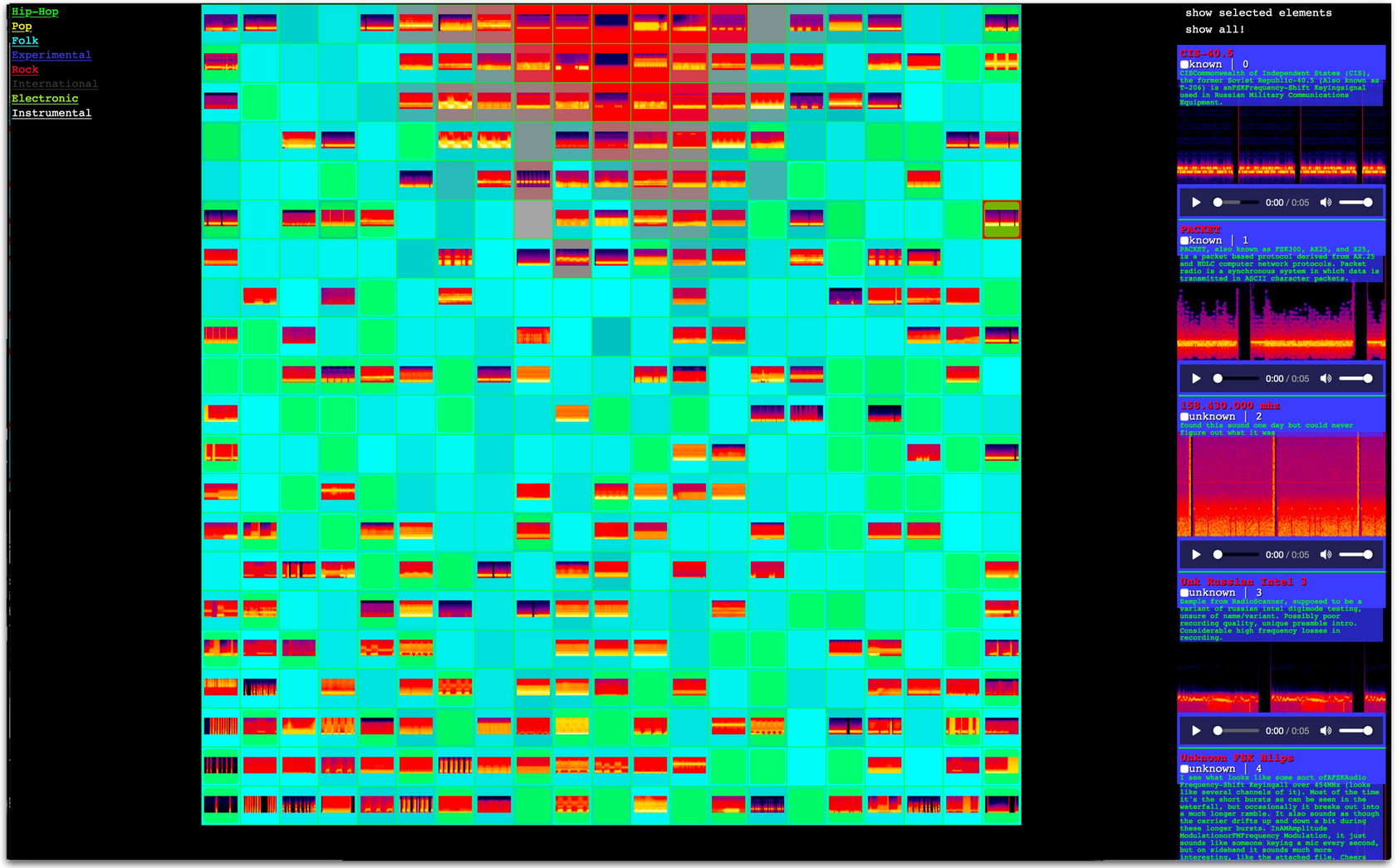
The second data observatory organizes radio signals through musical genres. It does not compare them to the genres, but projects radio signals onto a SOM that organises songs from the Free Music Archive (FMA) dataset for music analysis. Signals ‘land’ in those cells that correspond to them. Some cells do not attract any radio signals. Folk genre, as represented in this dataset, appears to have a lot in common with radio signals. Now, it is also relevant how radio is placed next to each other.
I tried to use this system to identify unknown signals, together with the administrator of the SIGID website. We identified some interesting groupings of unknown signals.

PROJECTIONS



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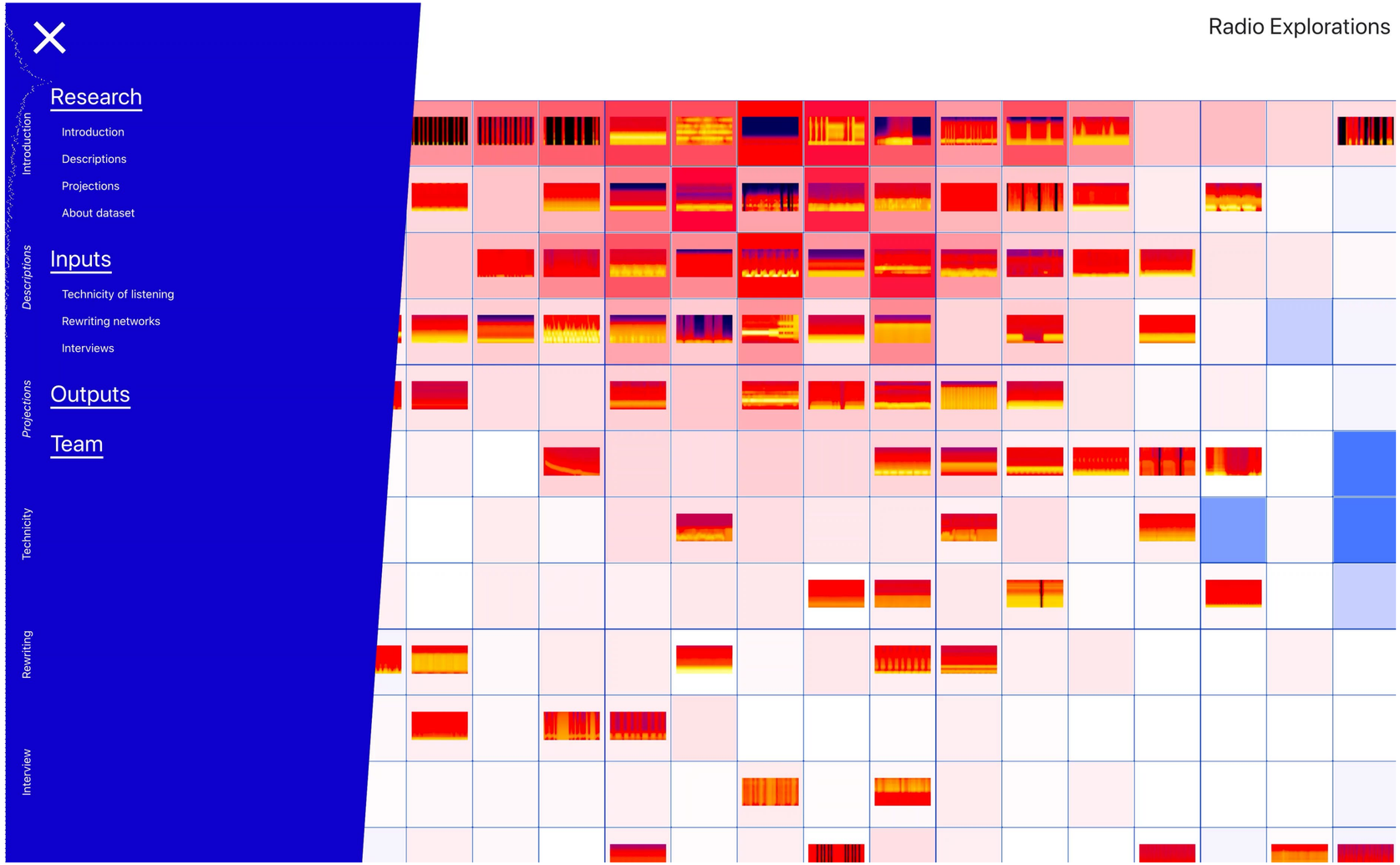
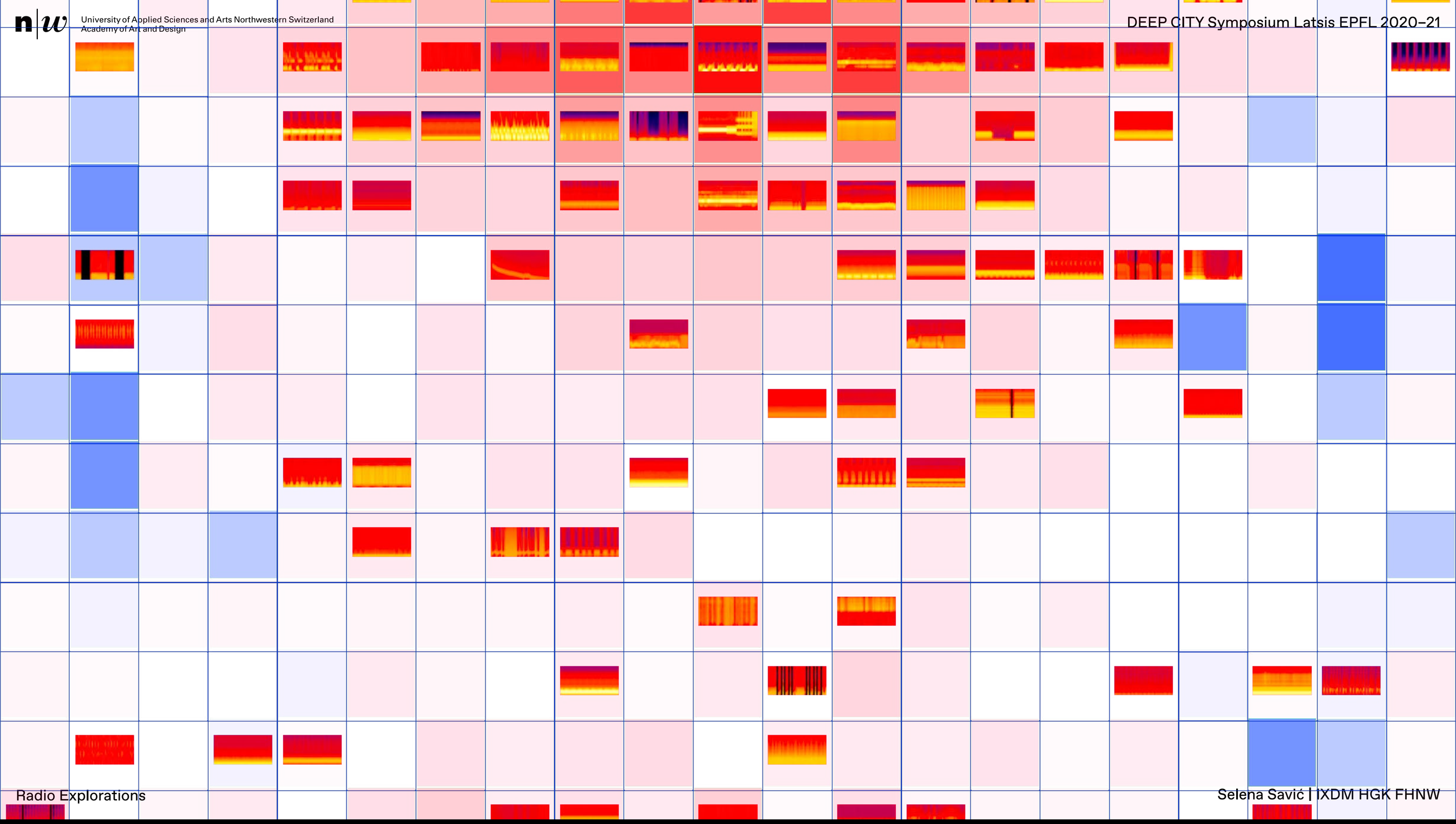
The imperfectness of data comes to focus. In terms of information content, these are like recordings of a pop song in a club. We found out that a lot of the ‘similarity’ between songs and radio signals comes in as an artefact of recording, listening itself, the fact that these are transmissions in the environment, modulated by the spatial conditions, and equipment operation. This points to the importance of not taking the results of algorithmic processes on data as ‘truth about the world’. We have to be aware that a lot of data we use to monitor, plan and predict the use of space - is possibly very noisy, or is speaking of a different phenomenon altogether. Good examples of misleading proxies can be found in Cathy O’Neil’s book Weapons of Math Descruction, but this is not the point I want to make. Working with data in an open-ended manner exposes the ‘noisiness’ of data in the environment. This contingent information is something we can work with, if we are able to expose it.



To wrap up, I would like to point out two important things about this research: radio cannot be known through engineering knowledge alone or indeed any single perspective. Without pertaining to be comprehensive, I gathered many perspectives on radio - through interviews and research meetings with experts in signal engineering, music classification, architecture's overlap with information technology, data-driven architectural and urban design, artistic interventions in infrastructure. This interdisciplinarity informs, powers the intentionality I exercise vis a vis the alien, meaningless radio signal data. It is a difficult but rewarding research practice that exposes all sorts of assumptions and biases that normally remain undeclared.



The second point I would like make concerns digital literacy. How can I get to work with digital tools like an instrument - to both measure and perform? The idea is to see coding on a level which is not about problem solving, but about articulating: it is about techniques of organizing information to tell a story, rather than showing the objectivity of the world. This project demonstrates a way to work with machine learning, through combining and bringing things together, rather than cutting apart.