

Víctor Mazón Gardoqui and Jussi Parikka

Vortex: Artistic and Curatorial Practices for Wind

Vortex: Actions for a Moving Body (2023) is an installation about sound and wind. These two invisible entangled forces are restaged in a museum setting while they remain proxies of the landscape they were extracted from. The wind that is recreated is a small-scale reminder of the impact of wind turbines, in this case on the landscape in the North coast of Spain. However, the soundscapes are simulated as large waves that envelop the listener and the space into an acoustic atmosphere: the acoustics enlarges the space and the experiential dimensions of locations. Indoors and outdoors temporarily change place in this auditory cultural technique. The minimalist visual design of the sound installation (Fig.1 and 2) brings to forth this dynamic of hidden but audible, infrastructurally invisible force.

Fig. 1 and 2. Details of the two infrasound amplification systems (custom made propeller subwoofers) installed and illuminated in the room. Credit LABORAL Art and Industrial Creation Centre. 2023.

This envelope is also part of the core questions of the artistic research project that led into the commissioned installation at Laboral, in Gijón: Can we sense energy landscapes as soundscapes? Can experimental ecoacoustics help to understand the transformation of landscapes?

Vortex sits as part of landscape-specific investigations by artist Víctor Mazón Gardoqui, which look into the domestication and commodification of wind for energy. It thus investigates the infrastructures of green transition that pertain to large parts of Europe and beyond. Sierra de Carondio in Asturias, in the north coast of Spain, has become one of the sites for such energy harvesting. The site has long been characterized by archaeological excavations and stories: Neolithic and megalithic settlements from 4000 to 2000 B.C have been found in the area, and the preserved elements and sites are represented in the tumuli, petroglyphs, mounds, and bowls.

In general, the tumuli, funerary monuments (Fig. 3), are as the first example of monumental architecture (Antona, Lo Schiavo, Perra 2011) as they stand as monuments of landscape modification as well as the social order of these incipient sedentary and horticultural societies (Romero 2004). This place houses a later historical road that runs from the Sierra de Carondio to Muriellos, an ancient path that runs alongside several of the mounds, and overlapped with later traces with the vestiges of the gold extraction and navigation routes of the Roman Camp of Moyapán (Costa-García, J. & Fonte, J. 2017).

Figure 3. Dolmen Filandoira or Entrerrios (burial) in Sierra de Caróndio, Asturias, Spain. 2023. Víctor Mazón Gardoqui.

Figure 4. Digital terrain model (DTM) from PNOA LiDAR data (2012), taken during the wind farm construction. Excavation directed by Luis Blanco Vazquez. Original source: Costa-García & Fonte 2017.

The area has been a point of interest and mapped by archeologists since the early 2000s. Digital terrain models (fig. 4) were created also during the construction of a wind farm in the area of these large burial grounds. The excavation of archaeological hot spots were met with another vertical dimension, namely the upward rising wind turbines that in their own way, connected to another ancient element: the wind. Stephen Graham's point about the multidimensionality of mapping becomes particularly useful in making sense of this epistemology of verticality that helps to connect different temporal layers of heritage and natural formations beyond the solid ground: "We live in a world that can no longer be read as a two-dimensional map, but must be understood as a series of vertical layers that go from the satellites that surround our planet to the tunnels that are in the deepest part of the earth." (Graham 2016: 210). The area was later inhabited by short distance -25 km- transhumanceⁱ activities and nowadays is populated by several endangered flora and fauna. For example the Asturian Mountain cattle is officially classified as a Native Breed in Danger of Extinction. (Fig. 3).

Figure 5. Asturian Mountain cattle (Bos taurus) at the location of the windpark and location of the prior Digital terrain model (DTM) from PNOA LiDAR data. 2023. Víctor Mazón Gardoqui.

The location represents a cluster of historical vestiges of ancient populations with the desire to use passage and extraction of materials, food and minerals; now though, the mountain range has become a built environment with new monumental architecture. Those structures shift the relation to histories of the place while also creating a particular zone of sensing with an interest in how air moves (fig 4) and the sort of acoustic signatures that were later used in the artistic installation too.

Figure 6. Detail of the wind and atmospheric sensors at the top of the wind turbine. 2023. Víctor Mazón Gardoqui

At the back of this horizontal and vertical historically rich landscape, the artistic project took as its focus the winds that travel through the mountain range. From the built environment to the dynamics of fluids that define the atmospheric above-the-surface cultural heritage of invisible kind, the aim of *Vortex* was to investigate the transformation brought about by wind turbines. The domestication of wind was addressed through a study, amplification and recordings of

differences in pressure for the creation of an installation that makes use of sound (acoustic pressure) as its sculptural material.

Disturbances in the local pressure deviation from the ambient from geogenic and anthropic sources were used to build an environment of atmospheres (non-cochlear) and sounds (cochlear) to create an amplified discourse in the exhibition space through changes in pressure and induced turbulence. Already the fieldwork at the wind turbine sites, enhanced by interviews and dialogues with the *Energias de Portugal* engineers who build and maintain the structures and allowed to visit the energy harvesting infrastructures, included the theme of exteriors and interiors: the rare glimpse at the interior of wind turbines (fig 5) was linked to the wind-driven analysis of the landscape.

Figure 7. Detail inside the wind turbines. Víctor Mazón Gardoqui. 2023.

Diagrams of electric plans of the wind farm ecosystem (fig 6) become a different kind of a map than the geographical one – both abstractions of different kinds, both relating to the landscape in their own way as operational images (Parikka 2023).

Figure 8. Detail of the electric plans of the wind farm infrastructure at Sierra de Carondio which helped to identify and record each acoustic signature. Víctor Mazón Gardoqui 2023

II

Vortex responded to the commission brief set by the Climate Engines / Motores del Clima exhibition (2023-2024) curators Daphne Dragona and Jussi Parikka. The commission was also part of the Weather Reports: Wind as Media, Model, Experience project (AHRC and DFG) where the link between material infrastructures of wind, media instrumentation, and cultural experience was a central part of methodological investigations. Hence, also in *Vortex* a multiscalarity of wind connected landscape transformations with experience and aesthetics of air and wind. Mazon's earlier fieldwork experience and critical making methods helped to formulate the focus on the Carondio mountain range as an ecosystem where geogenic and anthropogenic sound sources cohabitate. This soundscape was then channeled into an installation piece that had to function in the restricted space of the museum (a high ceiling type of a "hangar" space).

A listening into vertical and horizontal dialogues from the sensing of the atmosphere and energetic movement of wind and fluid dynamics was also turned inwards, to be about the wind turbine itself: each spectral acoustic signature of every individual wind engine was detected and captured with a series of self-designed and built sensors and microphones used in geology and developed by the artist at the LABoral FabLab through rapid prototyping and open-source software (Fig. 7).

Figure 9. Details of the production of 3D designs, prototypes and final parts in the LABoral FabLAB. Víctor Mazón Gardoqui. 2023

Each sensor works on a specific frequency range from infrasound to high frequency. At the low-end, specific geophones were installed underground to create an array of sonic sensors that allow acoustic recordings of the velocity vector of the vibrations (micro-vibrations) through the ground in relation to the impact of the wind -mass of acoustic pressure in motion- affecting these macrostructures and where the geogenic layer -natural- or anthropic -human- converge in the mountains. In the pole of the wind turbines a high impedance, phantom powered and balanced lead zirconate titanate sensors were attached with neodymium magnets to amplify its resonance frequencies as the electric charge obtained is proportional to the applied mechanical stress -and the mechanical stress is linear connected to the force introduced-. Inside the nacelle of the wind turbine, which houses the mechanical components needed to convert the rotation of the turbine blades into energy, first order ambisonic microphones were installed to have a 3D sound source in the interior. There, the transformation of the kinetic energy of a moving fluid takes place, in other words, where the mechanical turns into electrical energy (fig 8).

Figure 10 and figure 11 Details of the data acquisition in different parts of each wind turbine. Víctor Mazón Gardoqui 2023.

Different landscapes emerge based on which end of the spectrum the instrumentation allows to listen in to. One can think of these as speculative archaeological instruments that tap into the earlier strata from megalithic or Roman settlements, or the more recent wind farms. Naturally, one could consider the atmosphere as the material, physical, and even anthropological constant that has stayed the same: the pressure and winds are archaic fossils in motion. But to radically historicize wind is a useful speculative method too: what if due to the melting of the ice at the poles of the Earth, air currents and winds will change which means that recording these airs and winds now will remain as a time capsule? (See Beck 2014; Chakrabarty 2018).

For the installation, the recordings included three elements: firstly, the so-called natural winds of the Sierra de Carondio, secondly, the turbulence generated by the windmills, and thirdly, the new fluid flows -sounds and electromagnetic emissions- that these wind turbines create when interacting with the environment. This layered procedure of recordings was done in order to obtain an acoustic and energy signature from the valley, i.e. the cumulative change in the landscape after the introduction of the turbines. Three overlapping temporal and spatial scales of wind become such proxies for the work that also resonated with other recent artistic methods that had pitched the idea of wind farms as musical instruments (Højlund and Riis 2020).

The sound installation brings these three sound layers and scales into the exhibition space. Technically, this involves bringing into the room through a custom infrasound amplification

system, made of two propeller subwoofers constructed by the artist in the FabLAB. Each unit rotates at a speed of 1200 rpm, generating a current of wind and their blades, with the same mechanism of helicopters oscillate back and forth through the speaker coil at the speed of the reproduced sound

(Park, Garcés, Thigpen, 2009). The wind becomes the carrier and the sound is embedded in the wind. It is a process similar to frequency modulation of radio broadcasting, where the carrier is the broadcast frequency and the content goes within that broadcast wave (Fig. 8). The system of 10 transducers are arranged in a 9 + 1 central circumference, on a 20:1 scale (20 times smaller) with the arrangement or size of the wind turbine blades. The multichannel composition uses custom-made algorithms that move the sound according to the data and recordings obtained in the Carondio mountain range (Fig. 9).

Figure 12. Design of work assembly for room, modeling and lighting. Víctor Mazón Gardoqui. 2023

Figure 13. Screenshot from the Digital Audio Workstation, Ambisonic plugins from the The Institute of Electronic Music and Acoustics from Gratz and a custom tool to recreate the turbulence. Víctor Mazón Gardoqui. 2023

From the curatorial perspective, such a complex assemblage of field recordings, software, critical making, and soundscapes were an interesting spatial challenge. The already mentioned minimalist nature of the actual installed “artefact” became a combination of conceptual and sonic sculptures that imply the complex background infrastructure while it remained invisible behind the backwall. Such a spatio-temporal deplating and replacing with the help of sound waves was a central element in teasing out the methodology of the artistic research itself.

III

The broader stakes of the method relate to listening-based research and the role ecoacoustics can play in aesthetic and epistemic mapping of multiscale planetary changes. Fundamentally, this concerns method: observational methods are still mostly related to the different visual techniques, even if also underpinned by invisual operational images too (Parikka 2023) where other spectrum of radiation beyond the visible is epistemically central.

The ecoacousticⁱⁱ mechanism is a tool used to monitor and research into animal behavior and environmental sounds to suggest new, non-invasive, non-toxic control interventions and detection strategies (Erbe & Thomas. 2022); by the use of modern techniques as machine listening, sound pattern recognition, sound to image and computer vision through rapid

prototyping for development and customization of open design hardware and software community tools, scientists, engineers and artists can address particular conservation and environmental monitoring challenges and achieve a significant impact by confronting the right problems and using the right tools and technologies (Wang 2010). Through this path we can explore creative approaches to co-creating aesthetic strategies and public awareness of real-world conservation challenges based on the theoretical and practical challenges proposed under the scientific bioacoustic and ecoacoustic researchⁱⁱⁱ and different outcomes that can be expected from an artist's perspective of an ecological and critical use of sound as material (Farina and Li 2022).

Through the proliferation of ecoacoustics and locative audio we are able to interrelate the interior and exterior, an axis capable of detecting, amplifying and studying a wide range of oscillations of natural and human-made origin, beyond our perceptible spectrum by our senses. The rendered matrix that can be obtained, presents specific spatial coordinates using sound as a material capable of sculpting the perceptual space and blending a social and bodily personal sense of a space. Through microphone arrays, custom algorithms, machine listening and self-design systems which combines multiple sensors and antennas, a translation of different wavelengths can be obtained, distant from those perceived by our senses, mechanical and electromagnetic oscillations of nature -tectonics, phreatic water, cosmic rays, natural radio, etc.- in conversation to those anthropogenic sounds -GPS, GSM, WIFI, BT, Radar, etc.- as indicators of the abrupt transition in which we are immersed at the exact moment of the reading.

Combining such experimental methods in a curatorial setting adds a further layer of interesting possibilities: how to curate ecoacoustics in settings such as the Climate Engines exhibition, and how to develop curatorial strategies for the broader invisible spectrum of operational sensing that is increasingly important for the current aesthetic epistemology of climate change?

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References

Naso, Alessandro. 2011. "Tumuli e sepolture monumentali nella protostoria europea." *Atti del convegno internazionale (Celano, 21-24 settembre 2000)*, 237-258

Beck, John. "The call of the Anthropocene." *Cultural Politics* 10, no. 3 (2014): 404-414.

- Chakrabarty, Dipesh. 2018. "Anthropocene Time" *History and Theory*, Vol. 57, No. 1 (MARCH 2018): 5-32.
- Costa García, José Manuel, and João Fonte. 2017. "Scope and limitations of airborne LiDAR technology for the detection and analysis of Roman military sites in Northwest Iberia, in: V. Mayoral Herrera, C. Parcero-Oubiña & P. Fábrega-Álvarez (Eds.), *Archaeology and Geomatics. Harvesting the benefits of 10 years of training in the Iberian Peninsula (2006-2015)*. Leiden: Sidestone Press, 55-71
- Pistrick, Eckehard, and Cyril Isnart. "Landscapes, soundscapes, mindscapes: introduction." *Etnográfica. Revista do Centro em Rede de Investigação em Antropologia* 17, no. 3 (2013): 503-513
- Erbe, Christine, and Jeanette A. Thomas. 2022. *Exploring animal behavior through sound: Volume 1: Methods*. Cham: Springer, 27-33.
- Farina, Almo, and Peng Li. 2022. *Methods in ecoacoustics: the acoustic complexity indices*. Vol. 1. Cham: Springer Nature.
- Farina, Almo & Gage, S. H. (Eds.). 2017. *Ecoacoustics: The ecological role of sounds*. John Wiley & Sons: 16-17.
- González Álvarez, David. 2010, "El Parque Eólico Sierra de Carondio: Una oportunidad perdida para el conocimiento de la Prehistoria reciente cantábrica.", 75-88
- Højlund, Marie, and Morten Riis. "Transductive Wind Music: Sharing the Danish Landscape with Wind Turbines." *Leonardo Music Journal* 30 (2020): 90-94.
- Parikka, Jussi. *Operational Images: From the visual to the invisual*. University of Minnesota Press, 2023.
- Park, Joseph, Milton Garcés, and Bruce Thigpen. "The rotary subwoofer: A controllable infrasound source." *The Journal of the Acoustical Society of America* 125, no. 4 (2009): 2006-2012.
- Menéndez Blanco, Andrés, David González Álvarez, Valentín Álvarez Martínez, and Jesús Ignacio Jiménez Chaparro. 2014. "Campamentos romanos de campaña en el Occidente de Asturias." *Excavaciones Arqueológicas en Asturias 2007-2012. En el centenario del descubrimiento de la caverna de La Peña de Candamo*, 245-251.
- Muñoz, Iván, and Francisca Zalaquett. 2011. "El paisaje en la distribución de los túmulos funerarios del valle de Azapa, durante el periodo formativo, norte de Chile." *Revista de Geografía Norte Grande* 50, 23-43
- Wang, Wenwu, ed. 2010. *Machine audition: principles, algorithms and systems: principles, algorithms and systems*. IGI global.

Bios

Víctor Mazón Gardoqui (M.Sc.) is a PhD candidate in the University of the Basque Country, researcher, senior educator and professional working with open hardware and experimental circuit design, researches and coordinates seminars and educational formats in the domain of perception, device-studies and experimental sensory applications. His artistic work exposes the unheard and unseen, addressing the inaccessible and experiencing vulnerability and awareness on the viewer. The work materializes in three main fields: actions or site-specific performances through experimental processes, exhibitions as consequences of previous actions and collaborative works through seminars to form a communal dialogue.

Jussi Parikka is professor in Digital Aesthetics and Culture at Aarhus University as well as (visiting) professor at University of Southampton (Winchester School of Art). He also works as curator, including the recent *Motores del Clima / Climate Engines* exhibition (with Daphne Dragona), 2023-2024. His most recent books include *Operational Images* (2023) and *Living Surfaces: Images, Plants, and Environments of Media* (2024, co-authored with Abelardo Gil-Fournier).

ⁱ Transhumance (From the Latin *trans*, from the other part, and *humus*, earth). Cattle saying: Pass with the ranchers from the winter pastures to the summer pastures, and vice versa.

ⁱⁱ The consideration of environmental sounds for ecological investigations opens up a field of research that is defined with the term ecoacoustics.

ⁱⁱⁱ Scientific study of the recording and analysis of animal communication and related behavior, ontogeny, taxonomy and systematics.