

Beaufort Scale: A data soundscape for live improvisation representing the formation of storm structures

OLIVER BOWN, UNSW School of Art & Design, Australia

Additional Key Words and Phrases: Improvised Music, Sonification, Data Soundscapes, AI Music, Weather

1 Program Notes

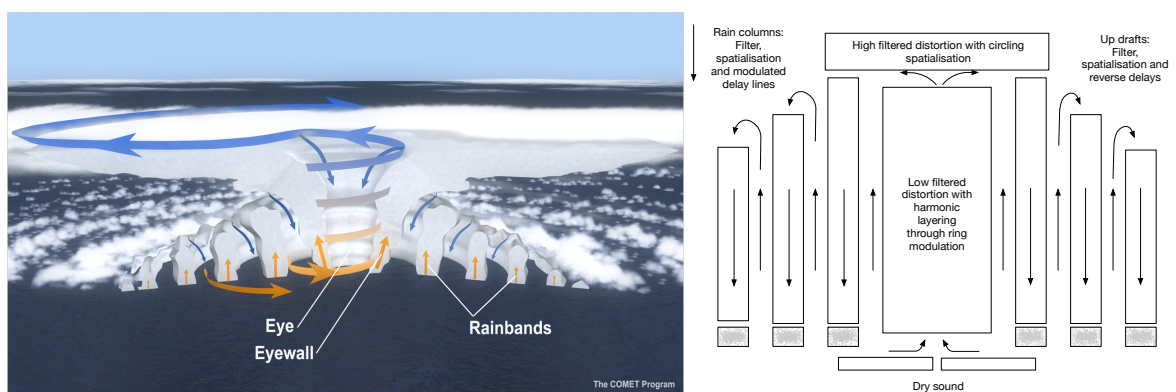


Fig. 1. Left: components of a storm (Image source <https://mynasadata.larc.nasa.gov/basic-page/hurricane-dynamics>). Right: abstract representation of storm structure with DSP mappings.

Beaufort Scale is a live improvised project for one or more performers organised around the wind. The improvisers perform storms from real historical storm data. A storm event is selected, and the data is used to drive a model of a storm structure, capturing the complex folded layers of circulating air flow that form in a full-blown hurricane. These in turn shape the parameters of an audio effects array that the performers play through. The result is a data-driven improvisational system where the performers should be thought of as playing "in the storm" rather than with it or over it, a sort of improvisational challenge involving an uncontrollable force external to the performers.

The storm data is also conveyed as a series of improvised performance cues taking the Beaufort Scale as aesthetic instructions ("Smoke rises vertically", "Wind felt on face", "Devastation"). These are infused with wider historical associations from the context of the storm. Poetically, the work also posits an *ambivalence of extremes* where perfectly still and perfectly chaotic may be seen as having qualities in common, not shared by their intermediate phases.

Beaufort Scale is realised through a system of agentic AI interactions in which an agent is used to create the DSP effect processor, a VST3 audio plugin, support the generation of storm reanalysis data, leading to a numeric and textual description of the storm's journey in terms of its various structural components, and then support the mapping of this storm data into instructions for the VST plugin. The plugin implements a series of grain delays operating on a ring buffer of incoming audio, then passing through a bandpass filter and distortion phase with multiple distortion options. This is a powerful parametric audio effect capable of spawning multiple sonic objects at once. It can also manage the delivery of performance cues to musicians. The plugin reads timeline data from a JSON file describing the evolution of grain streams and their parameters.

The performance at NIME 2026 will use data from storm Daria which ravaged British Isles in January 1990 before continuing through Scandinavia. The lead author was 12 years old and was told in no uncertain terms they were not to go out to do their paper round, as metal bin-lids flew across the street. Other storms were brewing in 1990. The Berlin Wall had fallen, the internet was about to give birth to the Web, and house music was in its heyday.

Author's Contact Information: Oliver Bown, UNSW School of Art & Design, Sydney, Australia.



This work is licensed under a Creative Commons Attribution 4.0 International License.

NIME '26, June 23–26, 2026, London, UK

© 2026 Copyright held by the owner/author(s).

2 Project Description

Beaufort Scale creates a multi-perspective immersion into the life of a storm through the form of an improvised music performance. It combines elements of free improvisation with sound art installation and sonification, although the term "data soundscape" is preferred. A large parallel audio effect array based on realtime granular processing is created to model a storm's structure as it evolves over time, constructed from real historical storm data (via re-modeling of the predicted storm structure). As the storm builds out at sea, it begins to form into familiar forms known to storm scientists. Tropical cyclones take the form of a set of complex, folded layers of airflows moving up and down, inwards and outwards, and around the storm's eye. Extratropical storms like Daria have long interfacing warm and cold fronts and a comma head. These are self-stabilising structures reinforced by the feedback of its own action.

Storms have long been a focus of sonification and sound art works, such as *Three Storms* by Andrew Lewis (2022), and *Sonification of Hurricane Sandy* by Mark Ballora (2017). This project does not identify itself as a direct sonification work, instead continuing the theme of semantic mapping and data soundscapes explored previously in work by the first author and colleagues (Ocampo et al., 2024). The soundscape is not derived directly from data but via a series of analysis stages that combine numeric computational and more impressionistic elements, for which an AI agent is used to combine analysis code with direct LLM analysis. In this way it attempts to situate itself somewhere between data sonification and more impressionistic forms of musical representation, such as storms featuring in classical era works. The project also differs from being a sonification work in that the result is not sound, but a DSP effect through which performers play.

An agentic AI system creates this effect array and maps data from raw weather data to storm analysis data to granular object. This is done in a series of staged interactive processes where the compositional work includes providing directions to how storm elements are mapped to grain objects. The result is a series of granular effect processing objects, with additional layers of ring modulation, filtering, distortion and harmonic mapping, corresponding to the components that make up a hurricane's structure, such as the cloud canopy, eye, eye wall, rain bands and the sea-level suction of moist air, connected and spatialised accordingly, so that the improvisers' sound is transformed into a dense, complex, but harmonically and rhythmically related mass.

This effects chain is both impressionistic of a hurricane in its sonic qualities, designed by hand via the agentic system, and directly driven from conceptual models of hurricane structure, which are in turn generated from real historical data in a process of reanalysis from the specific storm being represented.

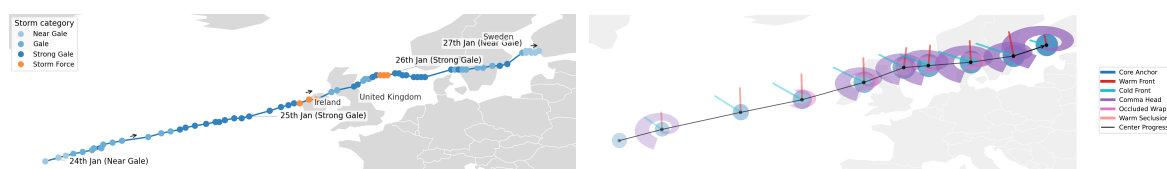


Fig. 2. Storm Daria developed in the Atlantic in January 1990, then crossed the British Isles and continued across Scandinavia. Historical reanalysis data is used to derive the storm path and intensity (left) and estimate feature extraction of structural elements (right).

Following a given framework provided as structured information, the system dynamically constructs and configures parameters of the signal chain according to the historical storm data and storm model. It also integrates additional textual and visual material which is primarily designed to act as a set of prompts to the performers. The textual material weaves in language from the Beaufort Scale describing the weather state, as well as wider historical, cultural, scientific and philosophical material. This material is primarily pre-prepared by the authors, with the LLM only being used to integrate it into the evolving storm model in order to create a dynamic performance experience for the performers.

On screen, an abstract impressionistic representation of the storm, also data driven, gives simple pointers to the audience about the storm's development and relation to the granular soundscape, along with the performer's textual cues.

A guiding principle of free improvisation is to be unconstrained by score or idiom. Thus the storm is never considered a score or a source of directions for the performers, but instead something that is happening, that the performers must contend with, literally out of control.

3 Technical Notes

The work will be performed from a Mac M3 MacBook using a PreSonus Studio 1810 audio interface. The interface will receive a mono or stereo mic (dynamic or condenser) or line input from the performing musician (venue to provide necessary microphones, stands and cable). The audio interface will output 2-8 channels depending on the available speaker configuration and can be output in stereo or a relevant spatial format.

