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ARTICLE

Climate Modelling, the Data-Image and the Possible in Forest Ecologies: How an Art/Science Collaboration Engages with Ecoliteracy

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Abstract
Climate scenarios are produced through modelling, scientists draw on previously collected data and directions retrieved from governmental reports. In this article, an environmental data scientist and an artist-researcher reflect on their long-term art/science collaboration. They examine how certain models operate in forest ecologies. The concept of the "possible" by French philosopher Henri Bergson (1859–1941) accompanies them in questioning the idea of a future that would be already predetermined or resolved. This is to offer alternative views of the climate emergency, notwithstanding its unprecedented importance and scale. Climate modelling remains open to change, as does the experience of various types of imagery in art. With the notion of the "data-image", the authors delve into a local/micro incursion about tree carbon quantification visualisation techniques. This is discussed through an immersive outdoor art installation, according to experiential learning in place-based and arts-based interdisciplinary collaboration with digital media. The process of questioning how these images are produced and disseminated are ways to support visual literacy as it moves towards ecoliteracy. A thematic overview of responses by publics who experienced the art installations is included, to highlight the role of creativity and imagination with art in environmental education.

Keywords: art/science collaboration; data-image; ecoliteracy; possible; tree carbon quantification visualisation techniques

Outline

Critical forest studies (CFS) is an emerging interdisciplinary field examining forest ecosystems as situated and politicised sites of pluricultural expressions, socioeconomic struggles and socioecological transformations. To contribute to this new field, the present discussion is based on the long-term interdisciplinary approach. It was developed over six years and brought artists-researchers together with forest ecologists and data scientists. The endeavour was founded on collaboration. The focus was on artistic visualisations of forest imagery and sensor data about the effects of climate change. This led to the conceptualisation, production and dissemination of four place-based media art installations. In accordance with experiential learning and ecoliteracy (Murti et al., 2025), this art/science process is concerned with trees and forests, to create dialogues between research fields and with publics.

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For this article, we authors-collaborators will navigate between different spatial scales, to discuss scientific modelling and visualisations in lay terms about visual literacy, as it moves into ecoliteracy. As Levy (2024, p. 2) states, "science often neglects the spatial and visual presence of the solution. Art is able to make the solution legible and interesting to others". One can contend that "solutions" mentioned by Levy are not always readily accessible. However, creating artistic, experiential and meaningful explorations about trees and forests in a context of climate change is crucial. To do this, we authors examine how images operate when they traverse from the scientific field into place-based outdoor media art installations. Levy (2024) concurs, art contributes new visual forms to vital contemporary issues.

We start with data and images of trees and forests within a global ecosystem. We include those also rooted in more local dynamics, at the scale of a country such as Canada, or from a regional perspective such as Quebec and the Laurentians region. This text begins with an analysis of graphs from the larger field of climate modelling. It then engages in a discussion about visualisations of carbon modelling techniques in forestry data science. They cover measurements about diameter at breast height (DBH) and above-ground biomass (AGB). These can be generated with drone photography and computer vision, practices also prevalent in contemporary art. These techniques were explored in an outdoor installation presented in 2024. This immersive artwork is one of a series of four distinct art/science collaborations produced by MÉDIANE, the Canada Research Chair in Arts, Ecotechnologies of Practice and Climate Change (mediane.uqam.ca, 2020–2025). A Canada Research Chair refers to a federal governmental funding programme awarded to a researcher in a full-time professorship that is aligned with the academic institution's own strategic research plan and priorities. A key component of a research chair is the inclusion of students in research processes about issues and challenges that concern collectivities. It favours experiential learning and hands-on inquiry beyond the classroom, whereby visual literacy contributes to the development of ecoliteracy. Social and environmental relations are cultivated. At the end of the article, a summary of themes emerging from publics' responses to the artworks points to a compelling and emerging platform for creativity in times of climate change, in reciprocity with forest ecologies. To move-with, think-with and act-with images is to ask questions about how they operate and how they can enhance holistic learning.

Global scale

To give a larger context to our project and understand its scientific premises, it is relevant to emphasise that in ecology, and particularly in forest ecology, physical phenomena are studied at different spatial scales.

On a global scale, forests predominantly act as carbon sinks, that is, they absorb more carbon dioxide (CO_2) than they release (Pan et al., 2024). This absorption of CO_2 occurs primarily through photosynthesis. CO_2 is assimilated to produce biomass (trunks, roots, leaves, etc.) and accumulates in the soil through dead organic matter (Natural Resources Canada & Canadian Forest Service, 2024). Therefore, it is essential to quantify forest biomass in order to assess to what extent forests act as carbon sinks, or sources, and to estimate the impact of climate change on this carbon cycle. Recent studies conducted by Natural Resources Canada have shown that since 1990 Canada's managed forests have shifted towards carbon sources (Natural Resources Canada & Canadian Forest Service, 2024). This trend has become more pronounced recently due to increased wildfires (MacCarthy et al., 2024).

From a broader perspective, studies such as those conducted by the Intergovernmental Panel on Climate Change enable researchers to anticipate the impacts of climate change on forests. Referring to a global/macro scale, the IPCC released AR6, its sixth assessment report (IPCC, 2023). Throughout its 186 pages, numerous graphs illustrate projections obtained using different models. They are aggregated under the name of the *Coupled Model Intercomparison Project* (CMIP, currently in its sixth phase). These models are based on scenarios and pathways about

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future greenhouse gas (GHG) emissions. *Representative Concentration Pathways* (RCPs) use different values of radiative forcing; broadly speaking, the difference between the energy that enters the Earth's atmosphere and the amount that leaves it. These present more or less optimistic scenarios, as linked to projected increases in temperature. The latest report introduced new types of scenarios that include socioeconomic variables (*Shared Socioeconomic Pathways*, SSPs). The addition of these parameters allows the models to better reflect current realities. Another notable difference in AR6 is the introduction of confidence levels associated with the projections. A low to a very high level of confidence is linked to rising temperatures.

One such graph can be consulted here: *Figure SPM.4. A Subset of assessed climate outcomes and associated global and regional climate risks* (IPCC, 2023, p. 17). Its visual density speaks to emotion and analysis. On the left, upward slopes show the effects of warming driving impacts. On the right, a warm-to-hot colour spectrum of yellow corresponding to alert, orange to warning, red to danger, purple to catastrophe, conveys a continuous ramping up of climate risks, a painful bruising. Dots and dashes punctuate the gradients, signalling confidence levels and uncertainty ranges in the design. The graph brings forth information, expressed through lines and colours. Increasing risks are indicated, while scientific doubt remains in identifying precise thresholds. A comparison between projections put forth in AR5 (2014) and AR6 (2022) is also presented. A change in confidence levels is prominent. It can be explained partially by a shorter horizon and less uncertainty regarding the increase in average temperatures by year 2100.

Indeed, using a model to generate values involves a certain level of uncertainty. Therefore, many uncertainties related to the models and tested scenarios imply a low confidence level. Added to this are uncertainties due to the variability of climate and governmental (in)actions. The way projections are now shown allow for greater transparency about scientific methods but may add a degree of difficulty for non-scientific publics to understand. Scientific climate modelling uses visual techniques that are not necessarily understood through everyday experience. This is because of the quantity of data analysed and the condensed graphical presentation. Thus, it requires targeted learning approaches, as meaning can be difficult for anyone outside the specific scientific field (Lowe, 2000). Levy (2024) confirms that visual understandings enable paramount issues to be brought to the foreground for public sense-making. Furthermore, Holloway (2012) adds that despite youth spending less time outdoors, visual literacy with technologies such as photography can help foster closer connections to the environment. For Ahn (2020, p. 69), knowledge production supports the "emergence of digital technologies as increasingly multimodal". This becomes especially pertinent when the learning experience occurs outdoors, through a greater combination of approaches, working on site *and* with digital technologies, as is the case with MÉDIANE.

In our art/science collaboration, these approaches also broach uncertainty and doubt. They become occasions to reflect on projections in scientific models with the concept of the "possible" by French philosopher Henri Bergson (1859–1941). His philosophy rejects values considered immutable in favour of those that are in motion and evolving (Encyclopaedia Britannica, 2025). "It is the real which makes itself possible, and not the possible which becomes real" (Ansell Pearson & Mullarkey, 2002, p. 232). Models require continued critical questioning and engagement in and for lifelong learning. "Experiential learning can foster a deeper sense of caring and encourage students to think of innovative solutions to environmental problems" (Hussain & Huang, 2022, as quoted in Murti et al., 2025, p. 2). Engaging with art can kindle joy and wonder in life processes, which enriches environmental education (van Boeckel, 2009).

Process at situated scales

The process is to engage in dialogues between research fields and with publics about trees, forests and climate change. The process is integral to the long-term *research-creation* of this university research chair. It is based on an interdisciplinary collaboration, at the conjunction of the arts and natural sciences. Research-creation is "an approach to research that combines creative and

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academic research practices, and supports the development of knowledge and innovation through artistic expression, scholarly investigation, and experimentation" (SSHRC, 2025). MÉDIANE, the Canada Research Chair in Arts, Ecotechnologies of Practice and Climate Change (2020–2025) bridges together artist-researchers, students, forest ecologists, and data scientists from the University of Quebec at Montreal (UQAM) and TÉLUQ University. The process enabled the teams, over a six-year period, to work with sensor-based and image-based forest data. They became moving-image visualisations in outdoor art installations which included sound, as developed through the guidance of the artistic research unit Ælab, co-founded by artist-professor Gisèle Trudel and sound artist Stéphane Claude in 1996 (aelab.com). Trudel leads the MÉDIANE research chair.

The artworks are not however science communication. They are art, thus open to multiple interpretations and experiences. What is at stake is critical thinking for artists-researchers and forest scientists, along with publics, to engage with ecoliteracy in land-based and art-based experimentations. Visual literacy is ensured, as photography, moving-image and sensor data are expressed artistically, enabling awareness of environmental issues (Holloway, 2012) through the art/science collaboration. This contributes to developing stewardship about current issues in forest practices of biological science, data science and environmental education. Climate change is addressed through a creative angle, calling forth the strength of imagination (Papavasileiou et al., 2020). This holistic view, where publics engage with trees and forests drives a shift from environmental literacy towards ecoliteracy (McBride et al., 2013).

The research chair's teams have co-generated four large-scale immersive artworks, each with its own distinct configuration and theme presented in outdoor public spaces over the last four years (2021–2024). An overview of each artwork is described below. Forest data was collected at the Station de biologie des Laurentides of the University of Montreal located in Saint-Hippolyte, Quebec. This academic biodiversity reserve prohibits activities such as mining or logging. Data also comes from a scientific group which studies a former maple grove donated to a land conservation collective in Lanaudière. It is located in Sainte-Émélie-de-l'Énergie, unceded Anishinaabeg (Algonquin) and Haudenosaunee territories (Mohawk and Iroquois, Six Nations). Three installations occurred in Montreal on Indigenous unceded lands known as Tiohtiá:ke to the Haudenosaunee and Mooniyang to the Anishinaabeg. One was held at Saint-Edmond-de-Grantham, on the unceded territory of the W8banaki Nation, near Drummondville, in the same province. Each site carried its own dynamics of living ecosystems and sensor technologies. Each location became connected to a new urban site and different publics through the art/science collaboration.

Overview of the art installations

In 2021, the art installation entitled *bois eau métal* (in English: *wood water metal*) focused on ecophysiology, the study of an organism's physiological behaviour within its environment. It was presented in three open scaffolding pavilions located in the Arboretum of Espace pour la vie | Montreal Botanical Garden within the conifer section, some of the planet's oldest plant species. In 2022, the installation *orée des bois* (*on the edge of woods*) shifted its focus to phenology, the study of seasonal cycles, with a yellow birch tree and its surrounding environment. This piece was housed within an arched, roofed scaffolding passageway at the science campus of the University of Quebec at Montreal, under a majestic Elm tree and adjacent to downtown urban community gardens. In 2023, the installation *devenir-hêtre* (*beech-becoming*) took the form of two semi-circles in an extruded open cube, in a rural forest by the small winding river named David. Positioned beneath the outdoor mezzanine of the Fondation Grantham for Art and the Environment, the focus was on the American beech tree's resilience to short-term droughts.

The artwork of 2024 (discussed in more detail in this article) is entitled *c-six. canopée captation classification cellule cycle carbone (c-six. canopy collection classification cell cycle carbon).* It was

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situated beneath a family of Eastern Cottonwoods. These trees live near a municipal art complex called Quai5160 – Maison de la culture de Verdun, and the St Lawrence River, known as Kaniatarowanenneh ("big waterway") to the Mohawk Nation, of profound indigenous significance for over 9,000 years (Bonaparte, n.d.). The artwork was designed as a large circle with openings and passageways and sought to visualise the carbon cycle of trees (for information about all installations and activities by MÉDIANE, mediane.uqam.ca).

Each installation posed challenges in artistically expressing sensor data through ephemeral architectures in specific sites. Each combined the sensing of trees with instruments that render their signals into human perceptions. The iterative and entangled processes linked art visualisation and forest ecology through moving-images. Ellison et al. (2018) discuss the importance of these types of art/science collaborations, specifically when they are concerned with public outreach. Our project emphasises ecoliteracy beyond conventional 2D graphs, bringing them into on-site participation with movement, emotion, colour and lines (Papavasileiou et al., 2020). Shared experiences of problem-solving with the numerical data were expressed visually and physically. As a layered expression, scientific modelling techniques were expanded upon, to make forest research perceptible across disciplines. Collectivities, those of trees, machines, students, researchers and publics, were engaged through sensorial, site-based experiential learning.

Although a visual approach of forest data was central to the art/science process, the integration of sound and the choice of outdoor locations contributed to fully embodied sensory encounters. This brings visual literacy into a larger ecology, when place-based and arts-based environmental education respond to each other. "Art is not an added quality" for science, it is a crucial "point of departure" for renewed connection to the environment (van Boeckel, 2009, p. 2). Thanks to the art/science collaboration, images traverse from the scientific field into outdoor media art installations. A key distinction in our case lies in the transformation of sensor data into moving-image animations using generative software. This is an infrequent approach for scientists, advocating for the value of collaboration with artists (Clark et al., 2020; Levy, 2024). Within this research-creation framework, data and visualisations are grounded in scientifically validated methods developed through dialogue. They generate new experiences for publics who rarely engage directly with scientists or in outdoor art installations. Peoples are curious about art/science practices that address the effects of climate change on trees and forests. Arts-based environmental approaches "stimulate transformative shifts" for students and publics to think about other climate futures (Hannigan et al., 2025). The MÉDIANE research chair purposefully presented the four installations in public spaces where breath is shared with trees and in local summer weather conditions, rather than in museums or galleries (Levy, 2024, p. 2). Being out-of-doors provided a tangible, immediate grounding for each installation, connecting with trees and forests which are both actants and witnesses to climate change challenges.

Models and uncertainties in environmental ecology and education

Regarding various climate challenges, we authors move here into a global projection about the implementation of mitigation or adaptation strategies, with the five scenarios of the *Shared Socioeconomic Pathways* (SSPs, 1–5) (Figure 1). This figure blends a narrative of analytical clarity in vertical and horizontal axes, and quadrant mapping. The colour palette steers emotional associations: cooler zones feel safer, risky zones feel hotter. Tunneling through the four paths, the center green "middle of the road" suggests stability, yet resilience is low. This pathway follows current developments, based on a 2°C increase in temperature, considered the most likely. The different scenarios (SSPs, 1–5) bring different levels of optimism.

Policymakers and specialists study these scenarios, which are imbued with a range of uncertainties because of highly complex modelling. Philosopher of science Vincent Bontems (2011) recalls that it is pertinent to remember that modelling is an image, which "is closely tied to

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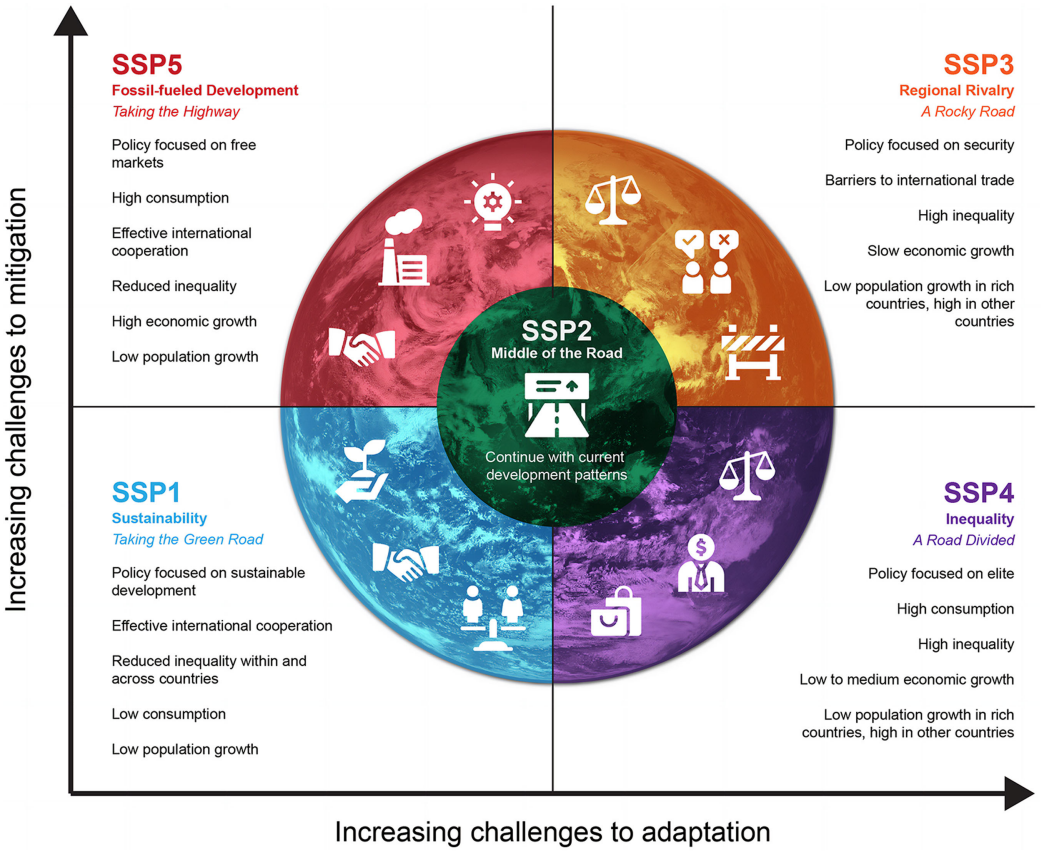


Figure 1. The five shared socioeconomic pathways and the associated challenges to mitigation and adaptation. (2025). Copyright-free. Used with permission by ClimateData.ca.

its production context and the modifications it undergoes as it circulates within the scientific field. The image accompanies the progress of research in all its phases". Modelling is therefore not a static image; it remains open to change and to the evolution of critical analysis, informed by past and present events.

IPPC graphs require a specific type of forward thinking, usually introduced at university level education (Wiek et al., 2011). This anticipatory competence is supported by methods such as forecasting or scenario construction. Developed by experts, the challenge is to bring this skill into the dimension of ecoliteracy. In this way, knowledge and cognitive skills are extended with another dimension, an affective one. Peoples can experience these models in a comprehensive holistic way. One of the most effective approaches to building ecoliteracy is experiential learning (Murti et al., 2025).

The data-image and the possible

We authors now introduce the notion of "data-image", which can be considered as a vector for experiential learning. In our art/science approach, models are brought into question by engaging scientific methods with art. Looking back to the five SSPs scenarios (Figure 1), the quadrant figures are not *possibles*. This might seem counterintuitive. This is because the "possible", as conceived by Bergson, lies *after* the present moment, not before it. The philosopher maintains that

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the present moment always remains immanent and emerging. If obstacles have not hindered an event, it is often believed that its possibility already existed in the past, as if it had always been favourable to occur (Ansell Pearson & Mullarkey, 2002, p. 230). Bergson reiterates, this is how the illusion happens. Thus, caution is required when thinking about models. Models can only become *possible* when they are proven empirically. Depending on the degrees of uncertainty associated with the five SSPs scenarios, data will necessarily change in time. Data is not fixed. Bergson's thought helps to consider the qualities and variable nuances of any temporal situation: lived experience is the very force of change.

Scientific models thus retain an indeterminate character, because knowledge and experience also change in time. They rely on the sampling frequency of measured data, and their performance is determined on a specific horizon of time: it can be the year 2030, 2050, or 2100 (as in IPCC). Usually, the broader the temporal horizon, the greater the uncertainties associated with the results they produce. The SSPs models will generate other data that will need to be interpreted, while considering the inherent doubts of the scientific process, known uncertainties and defined confidence levels. Art/science collaborations concerned with these implications of these approaches can provide guidance.

Art/Science collaboration

Guinibert (2020) explains "learning visual literacy is a community and collaborative activity" (p. 179), thus contributing to environmental education. The artistic processes of MÉDIANE's research-creation are named "knowledge co-construction sites". It refers to the elaboration of concept, production and presentation of each yearly art installation of the research chair, and also points to the importance of the tube scaffolding to temporarily invest the installations in each site. Each project could integrate up to thirty peoples, predominantly students from undergraduate and graduate programmes, often student members of Hexagram, the interuniversity research-creation strategic cluster in art, culture and technology (hexagram.ca). The teams were also composed of scientific advisors, professional artists and consultants from the private sector. A main objective of a research chair is to bring students to think- and act-with real-world issues in interdisciplinary teams, outside of the conventional classroom. Students from visual and media arts, design, computation and humanities held different positions, to learn and collaborate on all aspects of the research-creation.

The art installations are conceived as speculative 3D computer drawings by PhD student Kévin Pinvidic in collaboration with Gisèle Trudel that materialised in physical space. They are composed of scaffolding tubes and structures through a special long-term collaboration with consultant Nicolas Paulette at a local rental company (EchafaudsPlus). There is also the housing and addition of various types of audiovisual and electronic equipment, which are considered both theoretical and material. This refers to each piece of equipment containing and extending a vast array of knowledges in its assemblage. The physical and mental scaffolding of shared experiential learning is created intensively, through site-based integrations (Rone, 2010). Knowledges were gained through the mixing of on site sensor and image-based forest research and the creation of the art installations in four different sites. This learning-by-doing is complementary to more formal educational modes. Interdisciplinary group dynamics made new links between contemporary media art, forest science, and public engagement. In this way, the research chair cultivates students and publics experiences that are co-shaped by situated experimentations and understandings, hence the aspect of knowledge co-construction in and of each site. Over the full six-year period, the annual installations and their specificities were built out from each other, as experiential learnings and knowledges were gained. Levy (2024, p. 2) adds, "Art can play an essential role in bringing the problem to the foreground. By bringing the issues to the senses of the viewers, people can gain a new comprehension of the issues at hand". The focus was placed on the

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issues faced by trees in climate change and their responses. This became a way to learn about tree sensing in the climate crisis, to offer alternative views to publics.

It is pertinent to note that forest ecologists often use temporary scaffolding to place sensors and take measurements in their fieldwork. The ephemeral architectures of the art installations are also conceived as the situated platform to collect publics' comments with a semi-structured interview comprising seven questions. Question no. 7 reads as follows: "*What does the experience of the artwork inspire you to do creatively about climate change?*" (Ethics certification: no. 4528_e_2020, *UQAM – CIEREH, Comité institutionnel d'éthique de la recherche avec des êtres humains*). A thematic overview of their responses is integrated in this article, further on.

The annual installations are events, open air "relational zones," comprising a wide range of activities with invited guests (performances, workshops, presentations, discussions). These participatory platforms are occasions for experiential learning to freely circulate. In addition, there is *Mobile Station*, conceived by Stéphane Claude and assembled by master's student Antoine Caron on a bicycle trailer and equipped with various instruments and equipment. It is moved by cyclists to offer nomadic, spontaneous outdoor activities, grounded in collaborative and convivial physical effort. The research chair teams have also produced publications, presentations, and communications. This has contributed to the development of the concept "ecotechnologies of practice" (Trudel, 2024a, 2024b). This concept evolved through what happens when creative experimental techniques meet in the ecological relational milieu that co-processually re-invents practices: those of trees, sites, instruments, and peoples, as they combine, extend, and differentiate.

A serendipitous encounter led the co-authors to the art/science collaboration discussed in this article. Blandine Courcot happened to be passing through the research chair's installation *orée des bois* (2022), presented at UQAM's science campus in the summer. She graciously agreed to participate in the semi-structured interview which serves to gather and analyse impressions of the installation. Gisèle Trudel was nearby when one of the student assistants conducted the interview. Trudel immediately noticed Courcot's openness to dialogue and a shared interest in philosophy. We exchanged emails. Then, in the Fall, Nicolas Bélanger, forest ecologist, professor, director of the DOT-Lab (TÉLUQ University) and research member of Smartforests Canada, suggested her name, to act as environmental data specialist for MÉDIANE. Trudel was simply astounded and delighted about the prospect of reconnecting with her and working together. A meeting in December 2022 immediately confirmed our interest to collaborate on the production of the chair's annual installation for 2023. It is based on Courcot's master's degree research subject about the tolerance of short periods of drought by American Beech trees in the Laurentians region in Canada (Courcot, 2023; Courcot et al., 2025). The research trio formed with Courcot and Marc-André Cossette, artist and doctoral candidate who was responsible for producing the visualisations from sensor data, took the two editions in 2023 and 2024 of chair's installation to new heights.

Ahn (2020), Holloway (2012), Levy (2024), van Boeckel (2009) share similar views: it is relevant to sustain collaborative, arts-based, place-based and out-of-doors learning processes. In our case, students and researchers, all access and create experiences and meanings with forest data, tree and environmental sensors, softwares, computers and photography. In accordance with the research chair's pedagogical, social and environmental mission, its student members contributed to interdisciplinary collaborative learning about trees and climate change in the production of the annual immersive installations. With enhanced motivation and connection through the various collaborative situations, students and researchers built new art/science and public perspectives about climate change. By humbly focussing on another being, the tree living its life, marvels and survival strategies are sustained. The thematic public responses to the artworks later on point to the role of creativity.

For the fourth and final art installation entitled *c-six* (2024), the interdisciplinary collaboration is concerned with visualising tree carbon quantification techniques. It provides a solid basis for augmenting visual literacy which consists in questioning how this imagery operates, as a leading

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Figure 2. Ælab and MÉDIANE. (2024). *c-six* [Immersive outdoor media installation]. Quai5160 – Maison de la culture de Verdun (Quebec, Canada). Photo: Richard-Max Tremblay. With permission by MÉDIANE.

component of ecoliteracy. We co-authors address this with the concept of the "possible", a discussion based on Bergson's thought (Ansell Pearson & Mullarkey, 2002) (Figures 2–14).

Data science modeling in production of the immersive art installation c-six

We are now addressing the local/micro level of our most recent collaboration about data science modelling in production of the art installation entitled *c-six* (Figures 2, 3, 7, 10, 12, 14). The exhibition and its accompanying series of activities were presented in 2024, behind the arts building Quai5160 – Maison de la culture de Verdun (Quebec, Canada). It focussed on drone imagery, computer vision, 3D modelling, and particle animation of trees within the carbon cycle. The work is produced by Ælab, the artistic research unit co-founded by Gisèle Trudel and sound artist Stéphane Claude, and the teams of MÉDIANE, the Canada Research Chair in Arts, Ecolotechnologies of Practice and Climate Change, housed at the University of Quebec at Montreal (aelab.com; mediane.uqam.ca). The chair's research-creation explores "smartforest" scientific sensor data about forests from two scientific research groups, Smartforests Canada (led by professor and forest ecologist Daniel Kneeshaw, UQAM) and DOT-Lab (led by professor and forest ecologist Nicolas Bélanger, TÉLUQ University). To foster critical engagement and epistemic justice around this particular research method and practice, an Atlas can be consulted online. As part of the Smart Forests research project led by Dr Jennifer Gabrys, it provides crucial perspectives on a dynamic research website and archive about digital technologies that are co-shaping forests. The website focuses on sociopolitical implications for collaboration, reflection, and the cultivation of diverse systems of knowledges, rather than promoting strictly machinic solutions (Smart Forests Atlas, n.d.).

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Figure 3. Ælab and MÉDIANE. (2024). *c-six* [Immersive outdoor media installation]. Quai5160 – Maison de la culture de Verdun (Quebec, Canada). Photo: Richard-max Tremblay. With permission by MÉDIANE.



Figure 4. FiCEL parcel no 13. Sainte-Émélie-de-l'Énergie, Quebec, Canada. Drone image by Daniel Namur. With permission by DOT-Lab.

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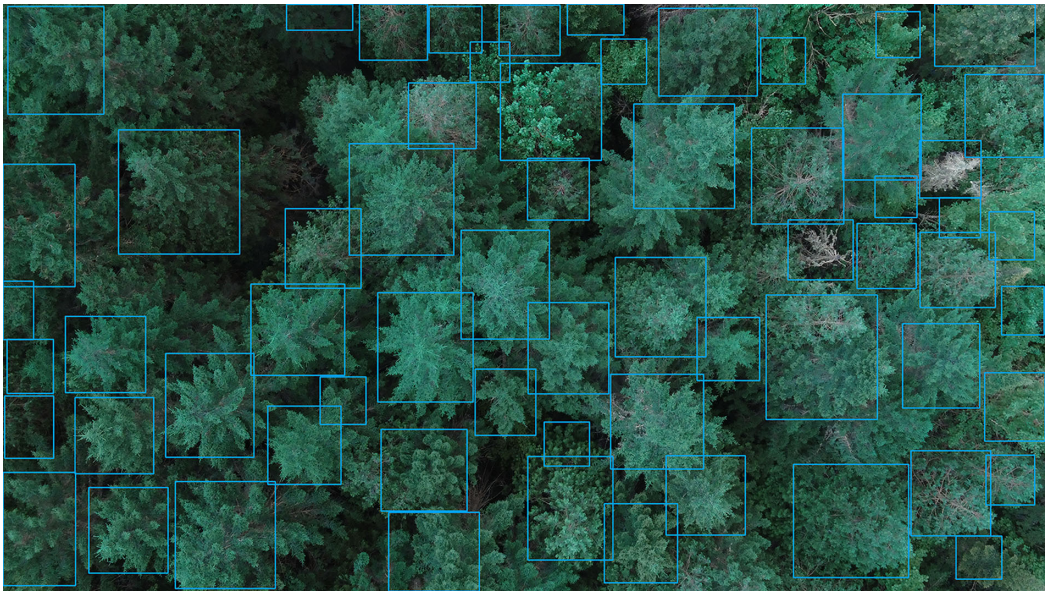


Figure 5. Drone image (Figure 4) as trained in the DeepForest algorithm (Weinstein et al., 2020), by Blandine Courcot. The blue square-shaped outlines indicate the automatic recognition of a tree canopy using DeepForest. With permission by DOT-Lab.

As mentioned before, our co-author's art/science collaboration is grounded in photographs and numerical data from forests in the region of Quebec. The connection between the experience of trees, forests and sensor data were drawn in this project from research plots in Sainte-Émélie-de-l'Énergie, unceded Anishinaabeg and Haudenosaunee lands. The imagery fuels our shared reflection on the carbon cycle, a key factor in climate change. Indeed, forests contribute to this cycle by storing and releasing carbon through "a dynamic process of growth, decay, disturbance, and renewal" (Natural Resources Canada & Canadian Forest Service, 2024).

With the risks and adaptation conditions associated with climate change and CFS, we both ask, alongside Bergson: how does the *possible* operate in relation to the data-image? How do imaging techniques in a forest science and contemporary art collaboration enhance visual literacy that leads to ecoliteracy?

Trees, the carbon cycle and imaging techniques

The IPPC graph shows how central, yet complex, scientific ecological models are. They help to understand phenomena when field data is not always available or are difficult to measure. It is a challenge also faced in forest ecology, particularly in carbon quantification. This concern initiated the co-author's art/science discussion about the role of models.

At a global scale, as previously mentioned, quantifying forest biomass allows for evaluating the role of forests as carbon sinks or sources. At a local scale, this quantification can help, for example, to promote and value mature forests that can still capture carbon. This involves fieldwork based on scientifically tested protocols. From data collected on trees, an allometric approach, which links the tree's diameter (known as diameter at breast height, or DBH) and its height, allows the determination of the AGB in a specific forest plot.

However, this method comes with complex logistics in hard-to-reach areas as well as high demands on materials and humans. By relying on drone imagery, these conditions might be overcome to automatically determine DBH and height of each tree represented in the image.

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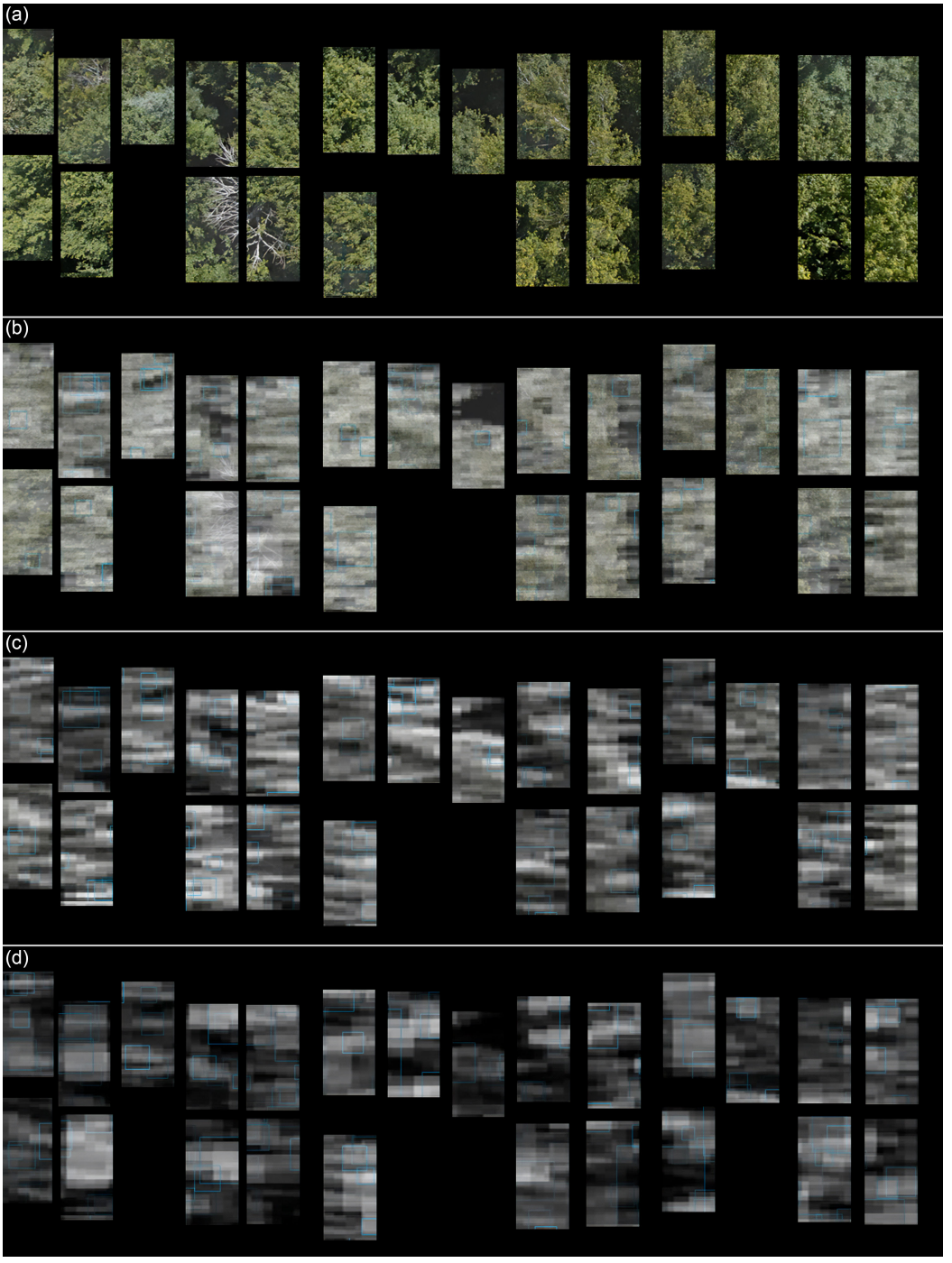


Figure 6. (a)–(d) Ælab and MÉDIANE. (2024). *c-six* [Composition_A. Screen renders in TouchDesigner software. A sequence showing drone imagery as it becomes recognised as the tree canopy with computer vision]. Visual programmer: Marc-André Cossette. With permission by MÉDIANE.

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Figure 7. Ælab and MÉDIANE. (2024). *c-six* [Immersive outdoor media installation, Composition_A, as experienced in the installation]. Quai5160 – Maison de la culture de Verdun (Quebec, Canada). Photo: Denis McCready. With permission by MÉDIANE.

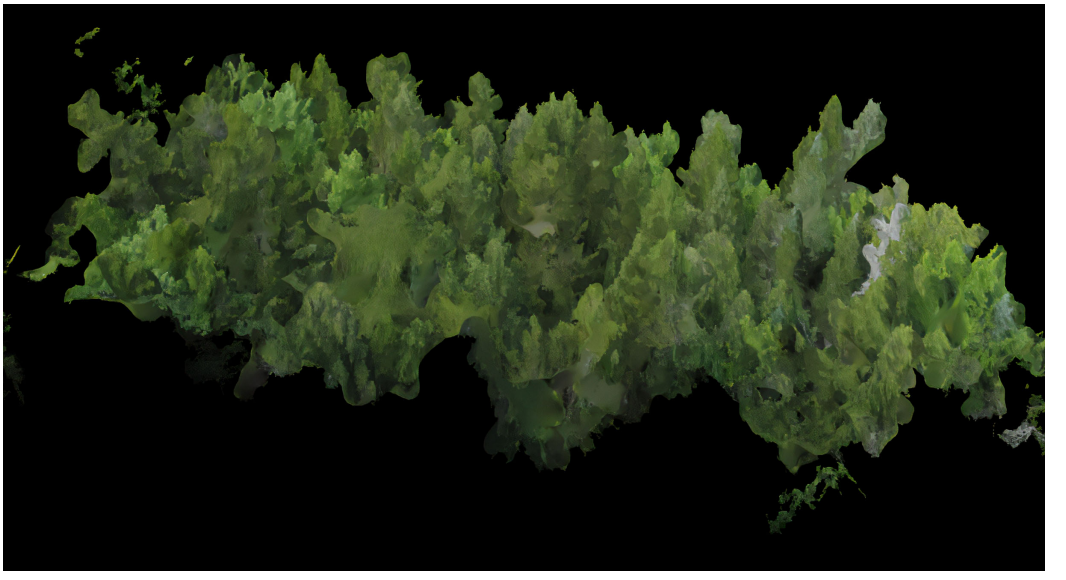


Figure 8. 3D model by Blandine Courcot, Pix4D software. Obtained by drone images, as in Figure 4. With permission by DOT-Lab.

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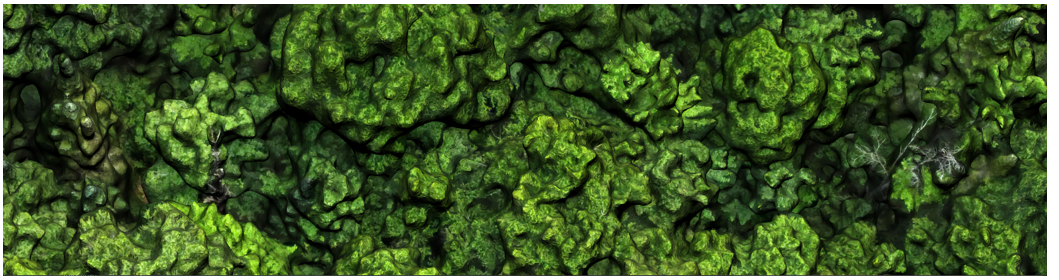


Figure 9. Ælab and MÉDIANE. (2024). *c-six* [Composition_B. Screen render in TouchDesigner software]. Visual programmer: Marc-André Cossette. With permission by MÉDIANE.



Figure 10. Ælab and MÉDIANE. (2024). *c-six* [Immersive outdoor media installation. Composition_B, as experienced in the installation]. Quai5160 – Maison de la culture de Verdun (Quebec, Canada). Photo: Richard-Max Tremblay. With permission by MÉDIANE.

Using these two parameters obtained solely from a photograph – and applying an allometric equation – AGB could be calculated.

Courcot studied the feasibility of such a model, in collaboration with The Lanaudiere Conservation Social Trust (FiCEL), dedicated to the preservation of natural habitats and especially mature forests. This model's open and speculative nature sparked the basis for the art/science conceptualisation of the 2024 edition of the art installation *c-six*.

With the research chair's team of scientists and students, scientific ways of presenting the data-image about carbon quantification were analysed, and how the production of these types of images changes when collaborating with artists. We collaborators-authors were inspired to engage with the philosophical stance of Bergson's "possible", exploring how images remain open to the present and future of lived experience, and through the adoption of a critical questioning about their

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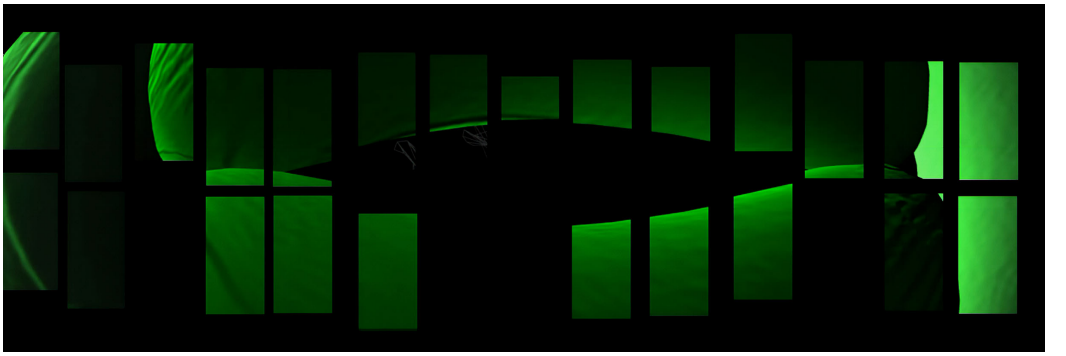


Figure 11. Ælab and MÉDIANE. (2024). *c-six* [Composition_C. Screen render in TouchDesigner software]. Visual programmer: Marc-André Cossette. With permission by MÉDIANE.



Figure 12. Ælab and MÉDIANE. (2024). *c-six* [Immersive outdoor media installation. Composition_C, as experienced in the installation]. Quai5160 – Maison de la culture de Verdun (Quebec, Canada). Photo: Denis McCready. With permission by MÉDIANE.

production and presentation. Bergson's concept also helps to reflect on anticipatory thinking skills (Wiek et al., 2011). Our intention here is to create connections with holistic ecoliteracy in its affective dimensions.

The previous discussion about Figure 1 shows that a key factor lies in the continuous flow of variations that persist at every moment. Bergson expounds the possible as: "the combined effect of reality once it has appeared *and* of a condition which throws it back in time" (italics ours, Ansell Pearson & Mullarkey, 2002, p. 230). With drone photography, 3D models, computer vision, this previously collected imagery contribute to the emergence of new moving-image and generative

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compositions in public space. The *c-six* installation became one such *possible*, extending the scientific data-image in time and in the particular location of the outdoor exhibition. Scientific modelling combined with art creates a new manifold of experiences about the past, present and future of imaging carbon quantification and how trees contribute to the larger context of climate change. The data-image carries forward the action of life, unpredictable and in continuous emergence, bridged in manifold art installations and with publics.

c-six. canopy collection classification cell cycle carbon

The *c-six* outdoor immersive art installation contains four sets of algorithmic compositions to reinforce continuity and difference with previously collected images. Past moments are set into constantly renewing motion, with different machines and software. The compositions are distributed across LED video screens (Figure 14) on temporary scaffolding structures, along with immersive multichannel sound and the physical and environmental conditions of the site itself along with winds, temperatures, biodiversity, water patterns, and more. The spatial arrangement of the LED video screens proposes a physical and mental connection between the physical fragments, between the data-image, the immediacy of the site and layered timeframes. The compositions are variations in the computer code produced with TouchDesigner generative software (derivative.ca). In collaboration with PhD candidate and visual programmer Marc-André Cossette, each one expresses a specific quality of the data-image, with movement and in the changing outdoor environment.

Two of the compositions integrate field images processed by the DOT-Lab team at TÉLUQ University. Composition_A presents transitions from drone imagery to the recognition of the tree canopy through computer vision (Figure 6a–d). The sequence initially shows the canopy that progressively displays larger pixels, similar to a digital zoom-in or close-up. This is how an algorithm such as DeepForest "sees" and interprets the canopy. The blue rectangles are translating the visual texture and the computational detection process, bridging forest complexity and computer vision.

Composition_B brings movement to 3D models generated from the drone images using Pix4D software, which transforms them into topographic terrains, in the aim of calculating AGB based on tree height (Figure 8). These datasets acquire a new kinetic dimension in the art installation (Figures 9 and 10), as the 3D camera moves through the terrains composed of crests and cavities that feel at once strange and familiar.

The three previous figures share the same visual sources: green textures of vegetation from the forest research site, yet each instantiation carries different qualities. The 3D model of the drone images of the forest becomes animated, the software's camera enables movement through the forest site in unforeseen ways. Finally, the spaces between the LED screens become filled with continuity and rhythm of the site.

Two other compositions are visualisations of tree carbon processes, but without field data. Composition_C presents a 3D model of the opening and closing action of stomata, a miniature orifice resembling a tiny mouth. It regulates the tree's daily activity by absorbing carbon dioxide or releasing water (H_2O) and oxygen (O). This microscopic organ, active by thousands beneath each tree leaf, can reach a monumental and ominous scale (Figure 11) within the art installation (Figure 12).

In Composition_D, a generative particle animation presents the continuously-evolving dance of photosynthesis in flows of colours – sun (yellow), water (blue), soil (brown), photosynthesis (green), and air (white). Although a tree is not visible, the animation evokes the cyclical internal and environmental processes joining in the middle (Figures 13 and 14).

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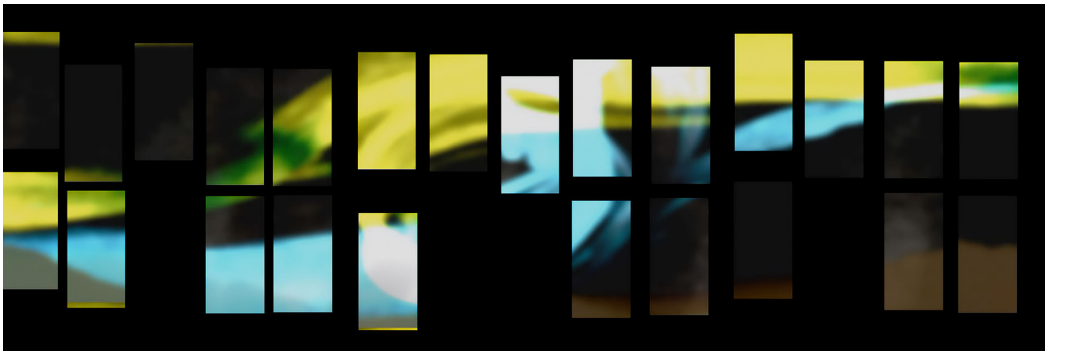


Figure 13. Ælab and MÉDIANE. (2024). *c-six* [Composition_D. Screen render in TouchDesigner software]. Visual programmer: Marc-André Cossette. With permission by MÉDIANE.



Figure 14. Ælab and MÉDIANE. (2024). *c-six* [Immersive outdoor media installation]. Quai5160 – Maison de la culture de Verdun (Quebec, Canada). Photo: Richard-Max Tremblay. With permission by MÉDIANE.

Thematic responses to Question no. 7

During each of the four art installations, students conducted a semi-directed interview comprising seven questions, to extend public experiences into qualitative discourse analysis. The responses collected from Question no. 7 ("*What does the experience of the artwork inspire you to do creatively about climate change?*") produce a collective sensibility in flux. Over the course of the four years, 154 participants (140 anonymous and 14 collaborators) have contributed responses. The number 140 includes two groups each of twenty peoples, a group of elders and a group of high school students, calculated as two participants, since they answered collectively. The process of analysing the responses is explored in two recent articles (T Paris & Trudel, 2025a;

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Trudel et al., 2025b; Trudel, 2025c, in press). Renowden et al. (2022) lend a convincing argument about art/science collaboration to foster stronger and deeper nature relations, which is in resonance with this article's ecoliteracy focus:

> To date, sustainability research has often focused exclusively on harnessing people's cognitive understanding, people's place in nature and the importance of nature in people's daily lives, rather than concomitantly exploring the personal, experiential, affective and emotional affinity people share with the natural world. (Connelly et al., 2016; Jacobson et al., 2007; Lumber et al., 2017, as quoted in Renowden et al., 2022, p. 520)

It follows to highlight the three principal themes – Community, Creativity, and Belonging – that have emerged in relation to Question no. 7 of the semi-directed interview. Each artwork was site-specific, students discussed with anonymous participants from diverse social and cultural backgrounds who contributed thoughtfully to the interview. Overall, the responses articulate a shared aspiration to re-establish meaningful relationships with nature. According to Murti et al. (2025, pp. 12–13), it can be confirmed that four approaches in environmental issues such as experiential learning, collaboration with local communities, project-based education and digital technologies are named in the responses, contributing to actions in everyday life. The responses are ecological, in the sense that they contribute to a dynamic relational field. They yield, through tension, creative gestures and actions that are co-shaped by socio-environmental conditions. Drawing inspiration from arboreal forms and ecological cycles, peoples are seeking to reconceptualise their roles within an era of extensive environmental transformation. The responses collectively indicate a growing orientation towards creativity as a central mode of environmental engagement and ecoliteracy. Artistic practices, spanning painting, sound recording, and interactive installation, are proposed as acts of caring, as ways to circulate knowledges, and as subtle forms of resistance to exploitation. Anchored in practices of slowness, attentiveness, and intergenerational dialogue, these creative expressions cultivate belonging, resilience, and hope, while emphasising the imperative to act collaboratively and imaginatively in a context of accelerating ecological change.

Bergson asserts that change is expressed in motion and evolution – of, in, and with images. Experimentation with change is integral to the production of the installation *c-six* and the previous three, as grounded in art/science collaboration and the publics' experience of the artworks. "If we put the possible back into its proper place, evolution becomes something quite different from the realisation of a programme: the gates of the future open wide; freedom is offered an unlimited field" (Ansell Pearson & Mullarkey, 2002, p. 231). This view coincides with hands-on and direct experience, real-world observation and participation in and with nature (Murti et al., 2025, p. 6), in defiance of predetermined applications and methods. Perpetually co-constructed and resolutely committed towards the present and future, nourished by the past, one can assert with Bergson that scientific models and their artistic compositions are data-images. They are heightened visual literacy components that lead to ecoliteracy through interdisciplinary collaboration about environmental concerns and in outdoor locations. The data-image in art/science and the responses to Question no. 7 of the semi-directed interview strive to carry forward creativity in continuous emergence.

Conclusion and moving onwards

Scientific models are based on complex calculations about climate data, they also sustain emotional qualities with the use of lines, dots and colours. Models are affected by time and acquiring new knowledges. The philosophical affordance in this article follows Bergson's concept of the *possible*. It focuses on the data-image in climate modelling, forest image and sensor visualsations in a research-creation by a university research chair's teams for a future not yet

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written. Visual literacy leading to ecoliteracy acknowledges the importance of art/science collaboration for CFS. Models continue to change when combined with generative image compositions of outdoor contemporary media art installations. Co-shaped by dialogues, scientific models and their expressive differences in art are crucial propositions about change. Experiential learning is achieved through critical inquiry, place-based and art-based explorations. Futures thinking and stewardship about climate issues are experienced through intensive, direct on-site learning with student involvement and public participation. According to degrees of uncertainty, risk, levels of confidence and foremost, collaboration and creativity, they render room to maneuver in the present and future of changing climates. Offering a holistic conception of environmental education through interdisciplinarity, ecoliteracy is about connecting expertise and sensibilities with the vital processes of trees, highlighting powerful forces in climate change, to actively create other *possibles*.

Acknowledgements. MÉDIANE conducts its research-creation in Montreal, known as Tiohtià:ke in Kanien'kéha, and Mooniyang in Anishinaabemowin. We gratefully acknowledge that these unceded lands hold a long and rich history of stewardship by Indigenous peoples for millennia through to the present day and for the future. The Research Chair thanks all of the students and professionals of its teams. It thanks professor and forest ecologist Nicolas Bélanger, director of the DOT-Lab at TÉLUQ University and co-investigator of Smartforests Canada, the research programme led by Daniel Kneeshaw, professor, forest ecologist and MÉDIANE's principal collaborator at the University of Quebec at Montreal. We wish to thank ClimateData.ca for providing the climate information and the graph used in this paper. ClimateData.ca was created through a collaboration between the Pacific Climate Impacts Consortium (PCIC), Ouranos Inc., the Prairie Climate Centre (PCC), Environment and Climate Change Canada (ECCC) Centre de Recherche Informatique de Montréal (CRIM) and Habitat7. Images are courtesy of MÉDIANE, the Canada Research Chair in Arts, Ecotechnologies of Practice and Climate Change (mediane.uqam.ca) which holds agreements with DOT-Lab, the visual programmer and both photographers for image publication.

Ethical statement. The *Comité institutionnel d'éthique de la recherche avec des êtres humains (CIEREH)* at Université du Québec à Montréal granted ethical certification approval no. 4528_e_2020, to conduct anonymous semi-directed interviews with publics during the art installations.

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Author Biographies

Blandine Courcot After her studies in fundamental physics and neurosciences, it was through her PhD research project at the École Centrale Paris that she discovered the benefits of a strong synergy between physicists, chemists and biologists. Passionate about learning and technologies, she was naturally interested in artificial intelligence and undertook a master's degree in data science within the DOT-Lab (Université TÉLUQ), at the junction of big data and forestry.

Gisèle Trudel is an artist and full professor. She teaches at École des arts visuels et médiatiques, Université du Québec à Montréal (UQAM) since 2003. Her artist name is Ælab, the research unit she co-founded with sound artist Stéphane Claude in 1996 (aelab.com). Their artistic approach is based in experimental documentary. She leads MÉDIANE, the Canada Research Chair in Arts, Ecotechnologies of Practice and Climate Change (2020–2025). She is a research member of Hexagram since 2005, and the first artist-professor integrated as associate researcher at UQAM's Centre for Forest Research.

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