

# going with the flow

## exploring ecotechnologies in practice

Acer saccharum, cameras, Christoforos Pappas, computers, Daniel Kneeshaw, data loggers, dendrometers, electricity, heat, humidity, Gisèle Trudel, Manon Huberland, maple grove, Marie-Eve Morissette, médiane, microphones, Québec, rain, Sainte-Émélie-de-l'Énergie, sap flow sensors, SmartForests Canada, software, soil, sugar bush, sun, time, touch designer, water, wind & 60 frames per second - March 23, 2023

• climate • living matter • sensors • trees • engineering • data visualization • fluids • ecology • immersive • exploration

Trees, scientists, artists, and their instruments sense how water flows. Trees take risks during the growing season by boosting transpiration (sap flow) or they hold back. Veins expanding, contracting. Water is pulled upwards from the soil to the air, passing by tree stems. But if drought occurs, trees could die.

Scientists and trees are both sensing in tandem with environmental conditions. Because of its regular fluctuations, the process can be compared to the pulse of a heart. During daytime, trees transpire, resulting in stem water movement. This decreases from the outer to the inner sapwood, and because of dehydration, stem shrinkage ensues. During the night, the stem swells due to rehydration and water recharge. Pulling, funneling, decreasing, expanding. The pulsing relays these functions in relation with light and atmospheric humidity.

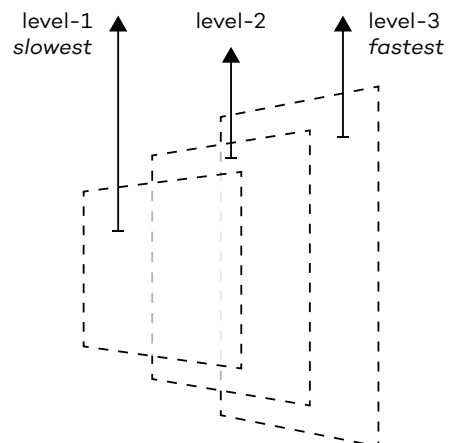
Scientists monitor the tree stem with heated needles, and encircle the tree trunks with straps and machines. A dendrometer quantifies the changes in the stem's size

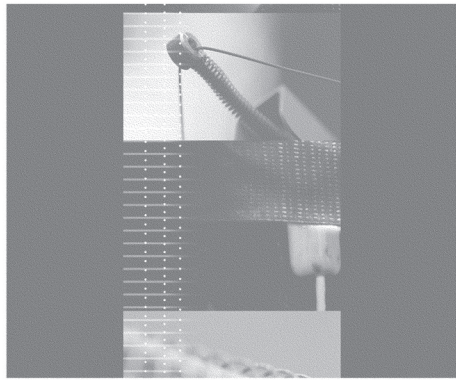
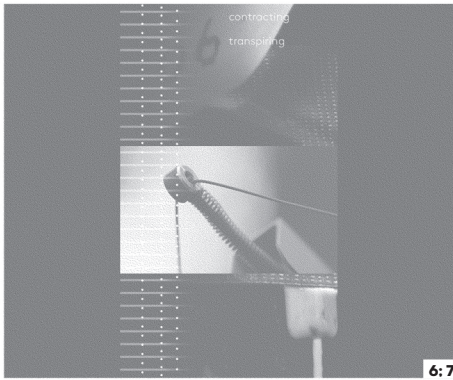
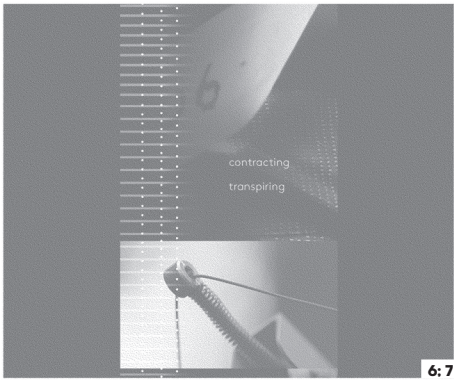
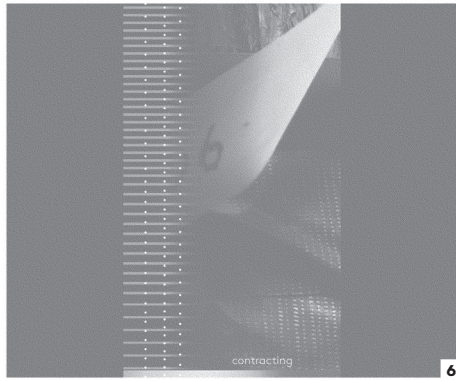
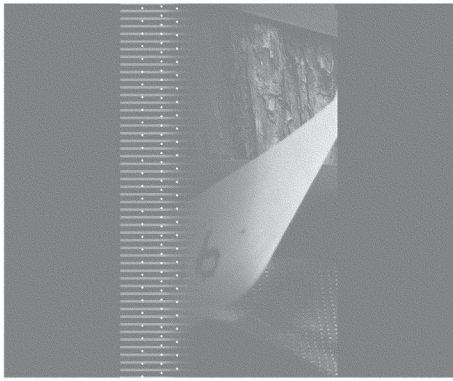
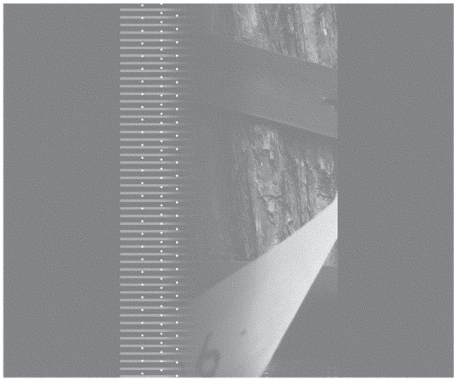
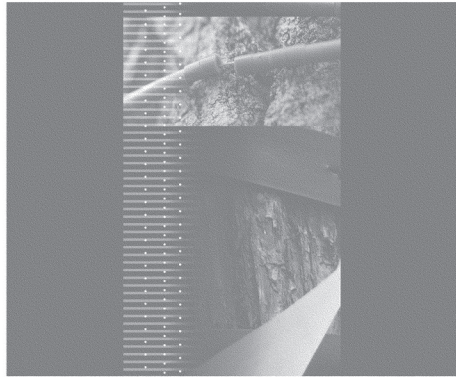
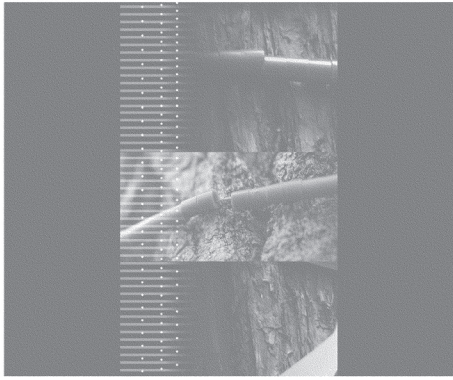
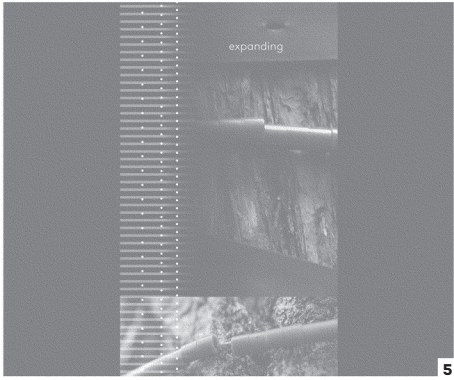
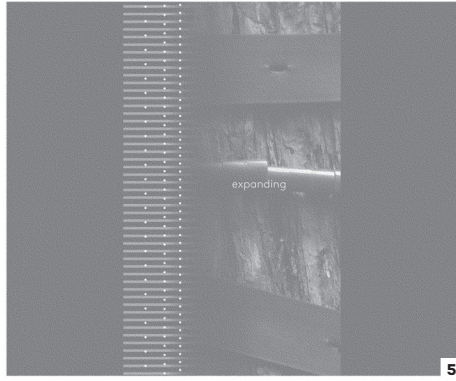
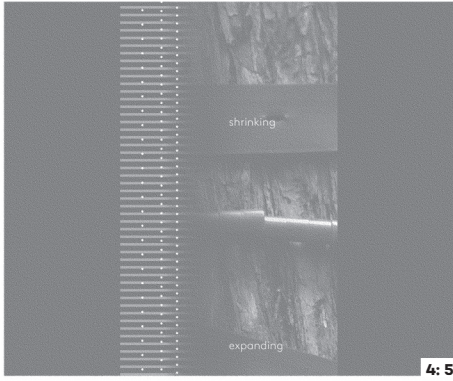
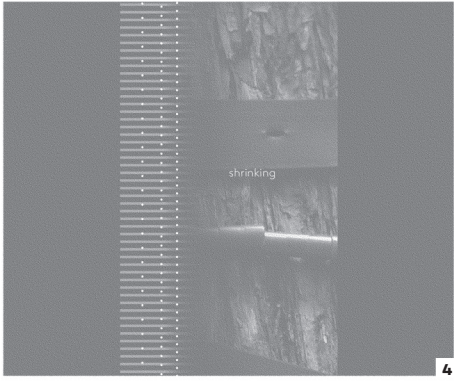
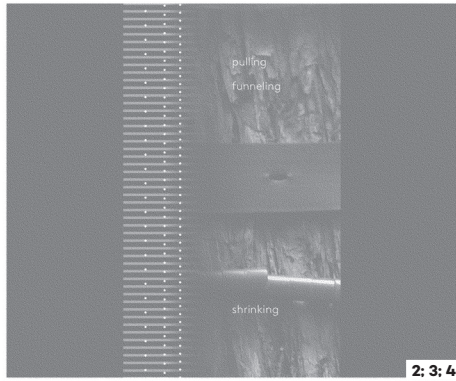
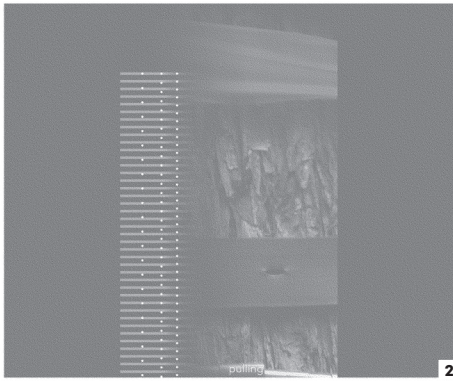
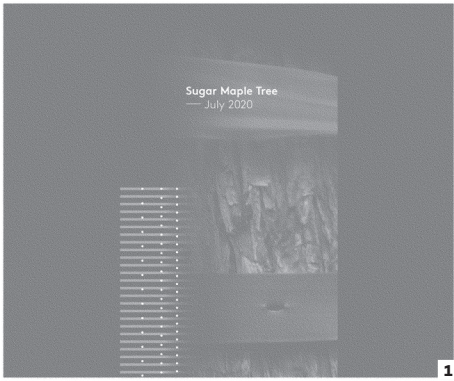
due to swelling, shrinkage, and growth, rendering it in microns. On July 3, 2020, for a mature sugar maple tree, its diameter was 355000.13 micrometers at 3:00 pm and 355062.47 micrometers at midnight. On the same day and for the same tree, a sap flow sensor combined with a data logger and algorithms reported the transpiration in centimeters per hour: 1.05 cm/h at 5:00 am and 14.89 cm/h at 2:00 pm. The sampling concurs, the tree is constantly changing. The tree's experience is shared with humans. Building together, from experience, the knowledge *about* and *in* changing climates, opening up to multiplicities, embracing ecotechnologies in practice: the tree's own, the instrumentation and the milieu of co-occurrence. Visualizations weave relations of this meeting between quantitative and qualitative sensing, an interoperability with computers. Is this data fidelity? Here, sap flow becomes a series of dots, densifying, the tree water deficit is inferred by the changing dimensions of the intervals between lines, pointing to local changes and changes in the tree. Still. Flowing. On.

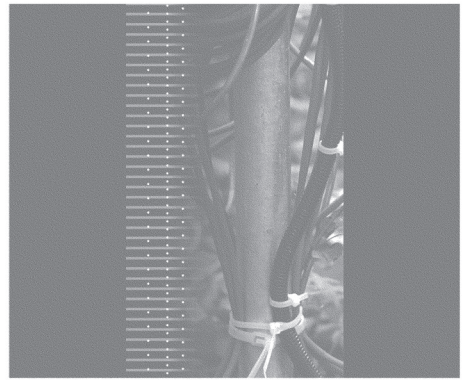
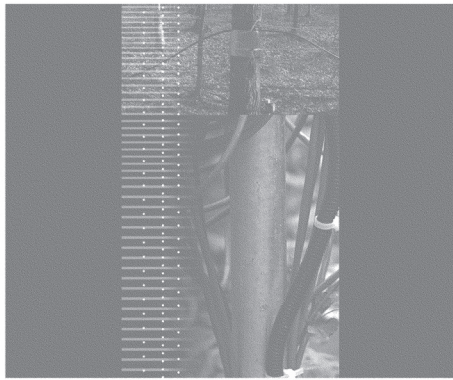
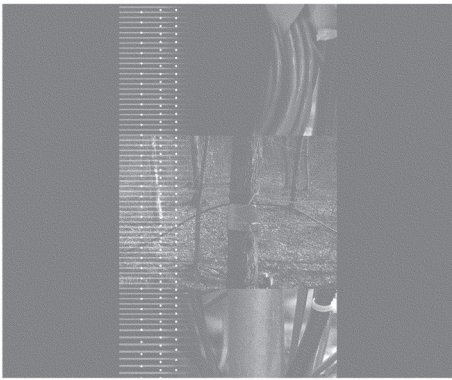
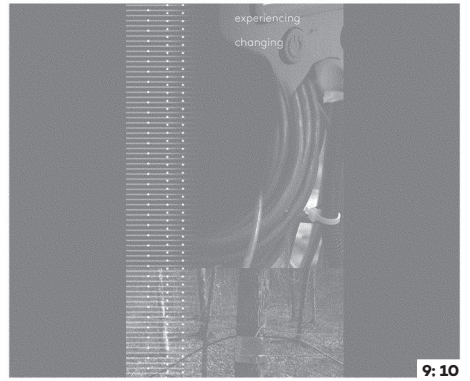
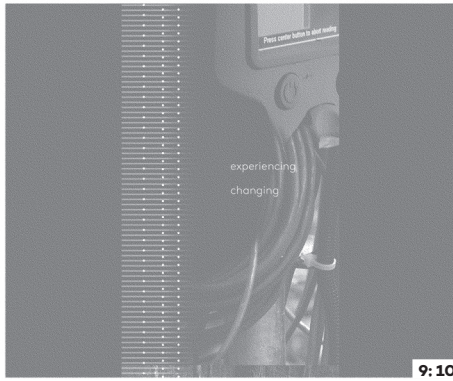
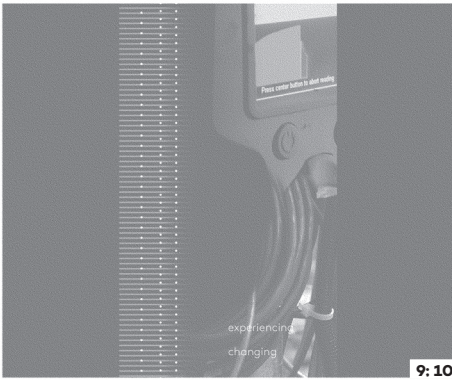
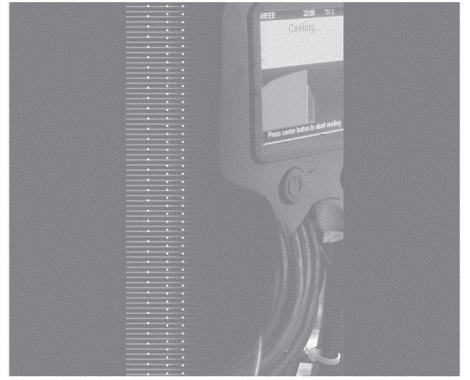
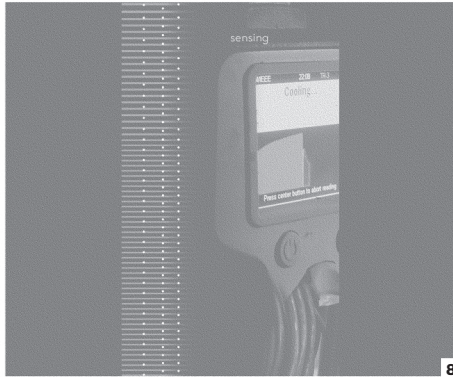
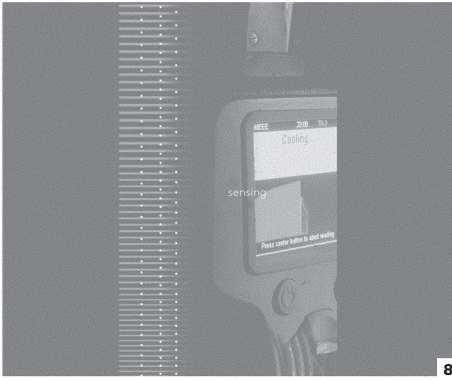
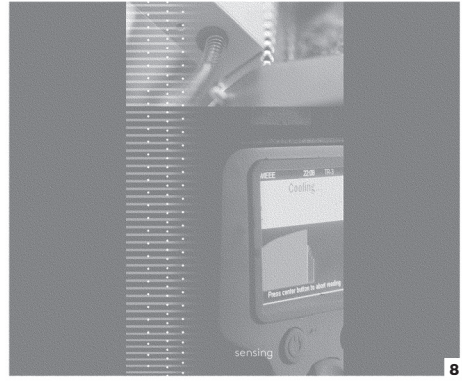
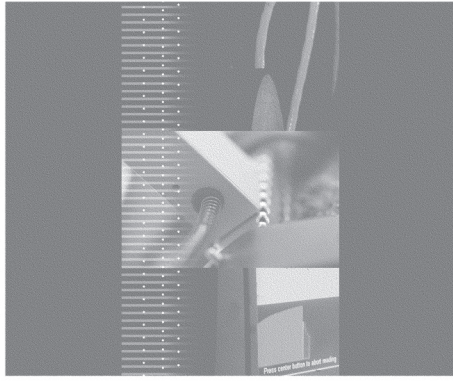
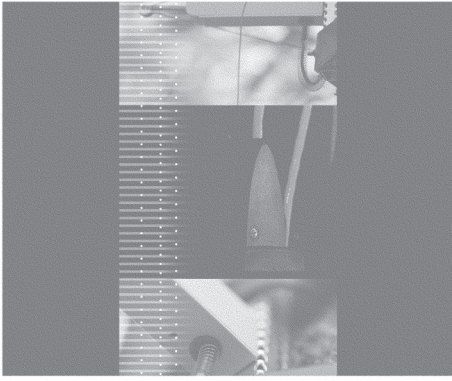
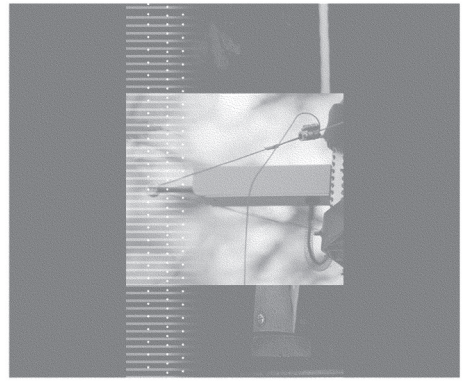
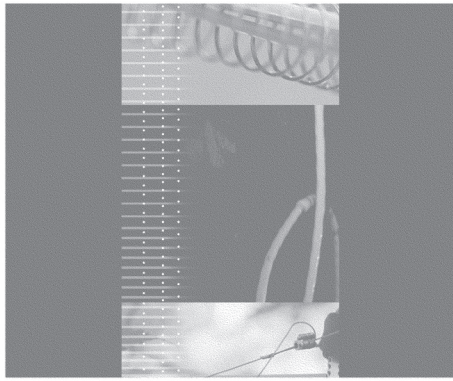
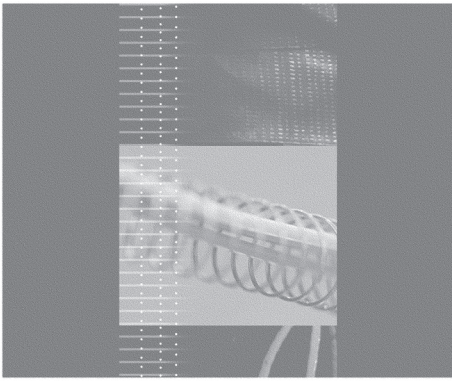
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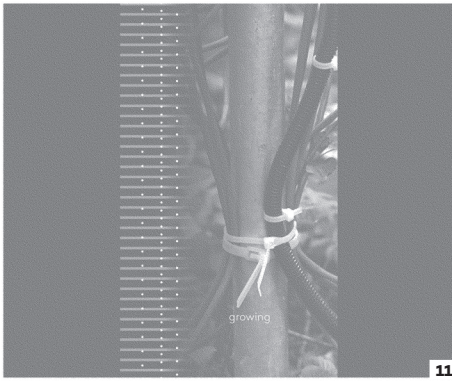
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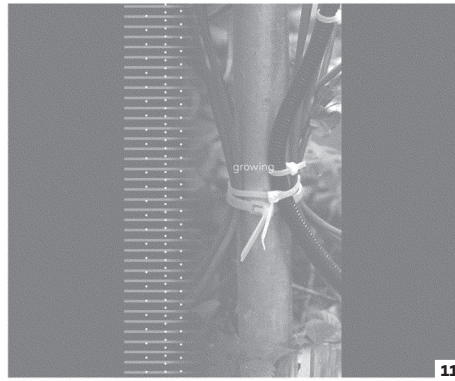




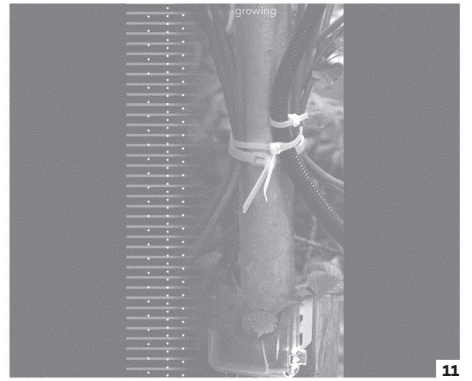




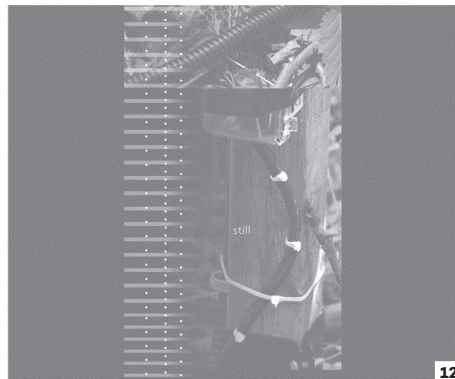
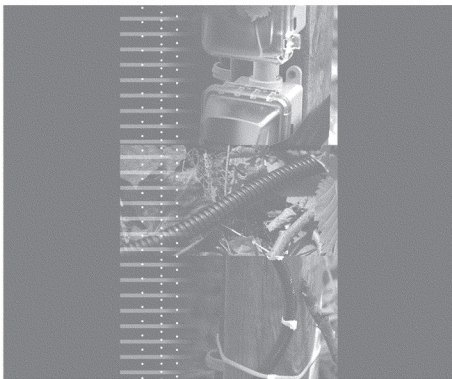
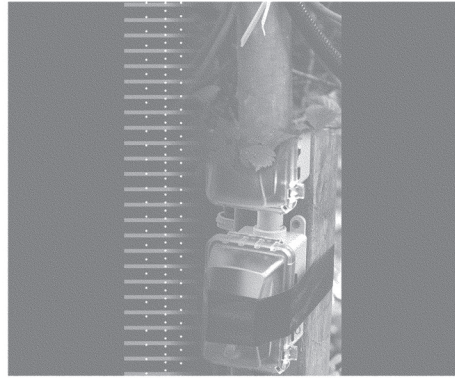
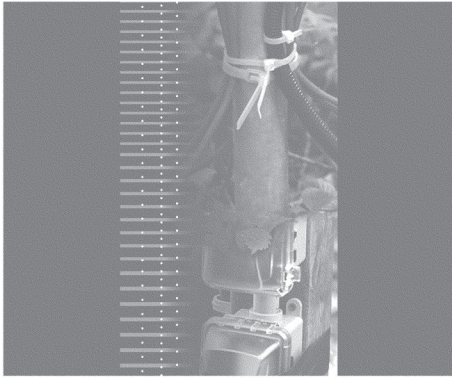
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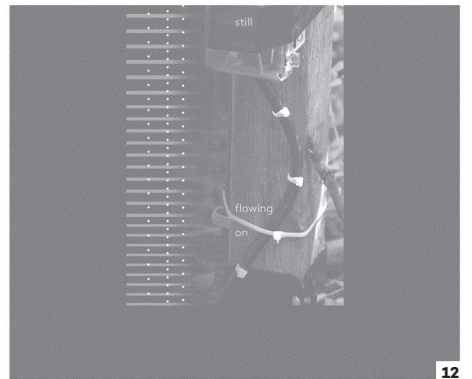
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**image captions**

- 1. Sugar Maple Tree - July 2020
- 2. pulling
- 3. funneling
- 4. shrinking
- 5. expanding
- 6. contracting
- 7. transpiring
- 8. sensing
- 9. experiencing
- 10. changing
- 11. growing
- 12. still flowing on

# credits

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## about the authors

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**Dan Kneeshaw** (PhD) is a forest ecologist interested in the effect of climate change on our forests. He and his team measure the response of trees to water stress, temperature, and pests. They are trying to determine which tree species and populations are resilient and which are vulnerable to climate change.

**Marie-Eve Morissette** has a master's degree in environmental design, a Specialized Graduate Diploma event design from UQÀM and is pursuing a master's digital design at NAD-UQAC. Her research focuses on the concept of interface encounters in installations that mobilize materiality, haptics, and sound. She works with the MÉDIANE research chair (UQÀM) and Mimesis (NAD-UQAC).

**Christoforos Pappas** (PhD), a civil engineer by training, has more than ten years of research experience in the geosciences, including academic appointments in Switzerland and Canada. His research addresses pressing questions regarding natural and urban landscapes, with cross-disciplinary engineering and science-based solutions that require accurate spatiotemporal characterization of the underlying phenomena.

**Gisèle Trudel** (PhD) is an artist and professor at the École des Arts Visuels et Médiatiques, Université du Québec à Montréal. With her Canada Research Chair, she collaborates with SmartForests Canada, to explore artistically in outdoor media installations how scientific research about climate change affects the boreal forest as a dialogue with publics.

<https://mediane.uqam.ca>

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