

STARTS Residency Public Report

By the Code of Soil: Kasia Molga + Scanner x GROW Observatory

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This paper discusses jointly the outputs and outcomes of the Vertigo STARTS residency and GROW Observatory art commission delivered by Kasia Molga, Robin Rimbaud (Scanner) and the GROW Observatory. Hemment, tech partner of the residency, was the project lead in the GROW Observatory, and is also a curator and artist in his own right. The residency and commission were produced by FutureEverything, a project partner in GROW, who facilitated relationships between the artists and the project consortium. The report describes the methodology, and process, used by the artists to develop their ideas into the final artworks, including points of collaboration and co-creation with the project. The report assesses how the artists' practice has been impacted by the residency and interaction with the project. It considers the position of this collaboration within the framework of art-science interactions. It concludes with an overview of where residency outcomes will be presented both by the artists and the project

Index terms - Citizens' Observatories, citizen science, data, Internet of Things, satellites, soil

I. INTRODUCTION

GROW is unique among the H2020 projects participating in the STARTS programme, as it already featured art as a part of its methodology and work plan. GROW allocated budget and staff time to the creation of an artwork drawing on knowledge and data within the project. GROW wanted to work with artists to add a new dimension to the project. As a number of the leaders of the project are from an arts and design background, the team understands that art can change the way we see the world and help bring curiosity and imagination to a project like GROW.

In addition to this art commission, the GROW team proposed and were awarded a residency by the VERTIGO project. The same methodology and framework used in the commission was applied to the design of the residency. For the GROW residency and data art commission, a set of criteria were developed, and artists were invited to respond to them.

The ambition was to illuminate and reframe the idea of a citizens' observatory, and to stimulate innovation in the project. For the purposes of this report, the artworks are addressed as a total - with no distinction made between the artwork commissioned by GROW and the outcome of the residency. The residency took place from November 2017, and finished in March 2019

II. ARTWORK

Artist - My initial residency title was "Ode from the Dirt". However, when meeting scientists in GROW Observatory I noted concerns in using the word "dirt" in reference to soil. "Dirt" in scientific language can mean dead unwanted matter. In the course of researching and conceptualising, a new title emerged, together with three artworks (the final, a concept for future creation) under the umbrella title "By the Code of Soil".

By the Code of Soil: is a networked, data-driven artwork that appears on participating computers when the ESA Sentinel-1A satellite passes by the computer's location. It displays an artistic representation of soil moisture, temperature and light data from a cluster of GROW sensors in closest proximity to the viewer. The installation version includes an audiovisual portrait of the soilscape in the

GROW Place – so that individual growers can access an overview of their soil’s conditions in one picture and short sound file.

In GROW, Molga and Rimbaud are working with soil data as their material. The artists developed code and algorithms that translated dynamic data from soil sensors, combined with static data on soil texture and season, into different graphical shapes and electronic sounds, creating a new “language” of tangible forms. Starting from visual noise, various visual configurations then emerge – frequencies, shapes, speed of motion and sizes. Audio files are written in such a way that they can respond and reflect the values of various data parameters, so that they create an abstract representation of soil condition when clustered together by incoming data, in a way that creates periodic portraits of each of the GROW Places. The artwork portrays a system of interconnected and interdependent processes which in total can describe the condition of the land.

By the Code of Soil: (de)Compositions: considers the already existing bio-marker which indicates fertility and other conditions of soil - Earthworms, alongside man-made technology - IoT sensors, as agents monitoring the work of these pre-existing living technology. Earthworms are biosensors of soil health as well as bio-mechanisms crucial for soil fertility. While contemporary farming / observatory practices can be preoccupied with digital technology to gather and transmit signals about the state of the land, these digital means rarely offer a whole picture about the reasons for this state. The myriad of processes happening in the soil and the presence (or absence) of living “non-human others” animating some of these processes are missing from the experience and conversation. In this way the data tells only a very small part of the story leaving recipients / observers / viewers still very much disconnected from the source of data. (de)Compositions bridges the source (input) and the data (output) through inviting viewers to take part in a multi-sensory experience observing how the artwork changes through time - its form, sound and even smell.

In a specially constructed container - a monolith - there are different types of soil, moist and fertile and also depleted and dry. Tiger earthworms, which occupy the "topsoil" layer, work tirelessly to mix all types of soil - reviving and fertilising while at the same time recycling the remains of organic matter. Moisture sensors placed across soil in the container(s) are continuously monitoring the soil conditions and their transition (thanks to the work of the earthworms) whilst bespoke piezo sensors surveil for activity and number of worms. These sensors influence the sound surrounding the container, distributed spatially across at least 4 speakers and slowly changes in time and space. The artwork is a durational piece - with the condition of the soil sonically and visually changing over the time of the exhibition. The Earthworms are the main actors / artists transforming the structure of soil and the soundscape.

Artwork experience: the visitor enters a very dark space. Straight red LED light lines from the container(s) together with sound guide the way. When the visitor approaches one side of the container, a motion sensor detects her presence and a light illuminates the relevant part of the container - so the visitor can see the amazing work of earthworms. The sound of the artwork is spatial and transmitted from at least 4 speakers positioned around the installation. There is soil scattered on the ground and the scent of soil in the air.

By the Code of Soil: Earth Fertility Test: Concept sketches based on the two works above - to use Machine Learning to analyse data from the movement of earthworms in soil together with data from other sensors (such as moisture). Earthworms are indicators of soil conditions; however, it is often difficult to assess their presence, as they are underground. There are methods of bringing earthworms to the surface – but it is a lengthy process and can cause them stress.

Based on experiments conducted to record the sound of earthworms as well as detecting their number and level of activity using specially adjusted piezzo sensors, the artists discovered an affordable and relatively simple way to gather data about the activity under the surface of the soil. An obstacle is the differentiation of activity of worms and other underground species from the noise above the ground. This is where Machine Learning provides some good insight.

The “Earth Fertility Test” will be a wearable tool containing a number of small devices able to gather the required information – which when uploaded, and through the use of software, compares the gathered data with that from GROW’s database. “Earth Fertility Test” is not a straightforward method of assessing whether soil is fertile or not, as this also depends on the plants and species, it will indicate the level of past human interventions and possibly advise on how to either maintain the condition of the soil or make it more fertile.

For GROW, the goal of the residency was to develop a collaborative relationship with an artist to bring artistic curiosity and enquiry around the project themes, science, technology and data, and translate concepts and data into experiences or tangible form. The ambition was to offer imaginative ways to engage the public in envisioning the future of soils, growing, satellites, sensing and citizen science. The residency and its artistic outcomes helped to explore the meaning and relevance of scientific information for citizens, and contributed to devising novel forms of engagement and participation in the science, data and activities.

III. METHODOLOGY

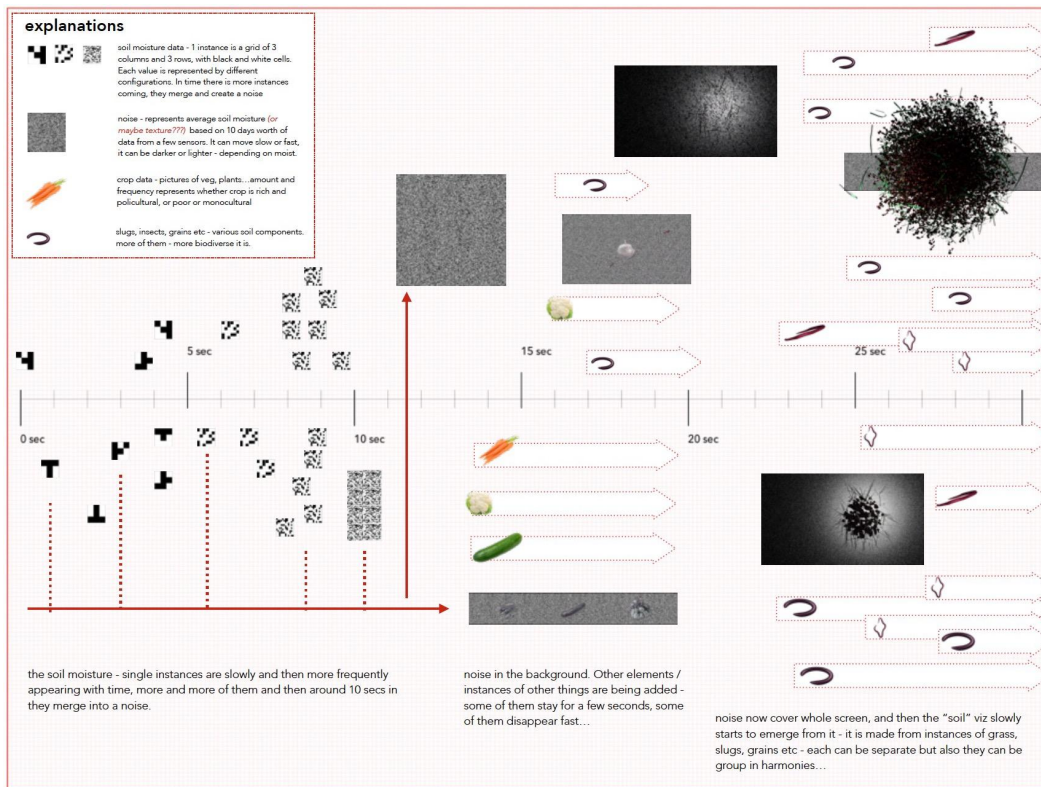
Artist: rather than molding my process to a strict methodology, I am guided by intuition, opportunity and necessity before making final decisions on what to construct. However, considering that I work with a team of people there are certain steps required to assure results.

On reflection, the STARTS residency has been quite difficult - starting with a requirement in the application process for a fairly detailed description of outputs (arguably, residencies should be about open-ended research and experimentation in the creation of a new body of work) and the demand for “innovation” without providing space in the application to describe experimentation (integral to any innovation). So, the first challenge was to resist being bounded by the initially proposed concept. Another challenge is the scale of the GROW Observatory - not one institution in a specific location, but 18 organisations, 9 GROW places and hundreds of growers with thousands of sensors.

My first few months were about understanding the project structure, layers of objectives and the application of expertise from a variety of fields to make these objectives happen. While awaiting the first batch of data, I immersed myself in fortnightly project calls, had regular online meetings with scientists, and played with the platform developed for transmission of GROW data (becoming an alpha user of the platform). I also wrote software which plotted data from the IoT platform - so that I, scientists and growers could quickly gain an overview of parameters from sensors used in GROW. In the meantime, Robin Rimbaud and I had regular meetings to relay my findings and trigger new ideas of what we might want to create.

When the first batch of data became available and growers became more active after winter, the next step occurred. This phase was about immersing myself in fieldwork - spending time with growers, observing their work, how they used technology provided by GROW and listening to their ideas and concerns relating to land, farming practices and the future of food. Through this I was revisiting the initially proposed concepts; readjusting, refreshing and restructuring the focus of the work - trying to find what is important, above all, to a consortium as large as a Europe-wide Citizen Observatory in such large contexts as the future of food, climate and environmental transition and our relation to nature.

A few months in, I knew I needed to make more than one work to encapsulate everything - one digital, drawing on the IoT as used within GROW, and a second physical work concerned with “living soil”. Starting with the digital element, I explored the best tool to respond to incoming data in a visual and sonic way and allow for an accessible platform. I experimented with programming environments and visual manifestation concepts, eventually settling on a solution which would enable the audio/visual manifestation to occur on personal computer screens. While probing sensor data that GROW could deliver and various implications of the IoT and open data in farming practices and land management, I wrote a short speculative fiction which became the basis for *By the Code of Soil*. To develop a piece of software with a particular manifestation I had to use methods from my previous experience as a UX designer, and invited a couple of software engineers to collaborate developing the architecture and its behaviour. I worked closely with Robin to ensure his sound files were appropriate for the software without losing the quality.



I created "data notes" (like musical notes) across the timeline of the artwork to help understand how the parts could come together to make a surprising a/v event, different every time and particular to each geolocation.

The last part in this stage was being able to analyse data from the Sentinel satellites and use their real time position to influence the behaviour of the artwork.

The second work was inspired by an early visit to the James Hutton Institute - GROW partners and soil scientists, and the idea that the physicality of soil is non-existent in the digital realm, and in the IoT. My methodology here was to experience the work of farmers, examining their relationship with their soil; understanding the difference between organic and non-organic farming and the importance of new ways of farming. GROW's idea of "living soil" resonated with Robin and I, and we decided to create a work to provide a multisensory experience. I was also pondering emerging concepts of living technologies - those embedded in nature which can be utilised for the benefit of all life on Earth - and started considering the common, but extremely important earthworm as a living sensor and mechanism behind the soil condition and creation.

We created a set-up with various types of soil and earthworms and spent time observing them, recording with highly sensitive microphones, considering how to detect their activity and presence. With this work, we wanted to highlight another aspect of citizen observatories, and another form of the IoT - the presence of living organisms and information we can gather about soil from them. By the Code of Soil: (de)Composition is a durational spatial-sound multisensory installation where viewers are invited to observe the work of earthworms and listen to changes from the soil as it undergoes transformation from dead to fertile. While this particular work is mostly about poetry and the beauty of soils, it has been an extremely important step to the third part - which is innovation.

While trying to assess the volume and activity of worms we ran into issues with too much sound information from the soil; the data signal was dirty. With experimentation, and some simple adjustments, we managed to recognise which signal was the worms alone. If, in the future, we want to use piezo sensors to detect worms (and by extension appraise the condition of soil) we can use an algorithm to differentiate their signal from other noises. This opens up opportunity for experimentation with Machine Learning and possibly new sensors gathering better information about the condition of the land. This led to a third possible artwork - By the Code of Soil: Earth Fertility Test.

CO-CREATION PROCESS

During the residency, I had the pleasure of many meetings and conversations with a number of scientists. Introductions were facilitated by FutureEverything (residency producer), along with follow up notes and requests, all documented. As part of the initiation meeting in Dundee, a long and informative meeting was held with scientists from James Hutton Institute and my questions and interests were met with enthusiasm. I also met people behind the technology and IoT platform who were extremely helpful in my creation of data visualization software.

In January 2018, I was invited to the Consortium meeting in Barcelona where I met many scientists, technologists and some growers. This was extremely important as I could explain my position as an artist and gained trust from scientists to help me test "my

hypothesis”. I observed workshops and had an insight into how scientists from various fields come together to discuss problems and look for solutions. In general, my ideas and questions were met with enthusiasm and it became easier for me to engage in later conversations by skype or email. I gained access to data, often obscure from public knowledge, with explanations. Additionally, I felt trusted enough for scientists to share their concerns regarding dissemination of research. Everyone I spoke with was very keen to help me to convey the idea in the best possible way.

The residency also took me to Greece where I not only engaged with project partner and scientist Dr. Pavlos Georgiadis but also experienced a GROW place first hand. I was invited to three farms, to immerse myself in their work, and witnessed the difficulties of shifting “old” farming practices to “new” - organic and sustainable practices. My knowledge certainly expanded around the strong connections between political, economical, social, educational and environmental fields. This was helped by one to one discussions but also by observing interactions between GROW farmers with other farmers. During the whole residency, my emails and requests to scientists were answered, if not immediately then within a good amount of time, and I felt incredibly supported.

IV. IMPACT

A. *Research Impact*

As a citizens' observatory GROW is a community platform to address urgent environmental challenges through citizen contributed data. GROW is one of four citizens' observatories funded by the EC, and is the first attempt to deliver one at a continental scale. A large element of this is engagement across communities. One outcome of the residency which is being explored is the creation of individual “data portraits”; whereby individual or small groups of growers can receive a personalised data portraits.

To portray the concept of citizens' observatories, in its enormity, By the Code of Soil brings the infrastructure of Earth observation and telecommunication into the foreground through its use of the transit of the Sentinel 1A satellite as a trigger for the audio-visual manifestation. By the Code of Soil is a durational work, which aligns with the need to create a data set over a long period of time within GROW. The duration of the GROW dataset is vital for the satellite scientists, who need temporal consistency – data created and quality controlled over long periods of time – in order to validate observations from space. By introducing art to the EC's Climate Action programme, and participating in EC VERTIGO, GROW powerfully illustrates the STARTS mission for art to catalyse the conversion of Science & Technology knowledge into products, services, and processes.

B. *Artistic Impact*

Artists were always within the realm of so-called innovation, with the ability to connect seemingly separate things, fields, practices, facts and thus create new opportunities, narratives or trends. Artists have also always been at the forefront of the new course of thoughts - using their creativity to help to disseminate new ideas and paradigms further.

V. ART-SCIENCE INTER-RELATIONSHIPS

The collaboration between the artists and project has been predominantly on the basis of ideas and concepts. Unlike other H2020 projects participating in VERTIGO STARTS residencies, GROW is not developing a specific technology but is innovating across a number of areas. A key element of GROW is the development of a flexible framework for Citizen Observatories with seven stages: (scoping, community building, discovery, sensing, awareness, innovation and advocacy). The artworks can contribute to the discovery and innovation stages, sparking interest in the possibilities of data interpretation

VI. FUTURE DIRECTION AND ACTIONS

For the artworks, there are a number of activities underway to explore further presentation opportunities. A participatory workshop was delivered at Somerset House, London in April 2019, as part of their Earth Day programme. Through connections made through STARTS, there is a potential exhibition of (de)COMPOSITIONS at the Futur.e.s Festival, Paris in June 2019. Touring packs have been assembled and approaches considered to a range of global new media arts festivals.

Submissions have been made for the STARTS prize with The GROW Observatory exhibit concept showcasing the combination of art, science and technology driving innovation in citizens' observatories and Earth observation. The exhibit concept includes the

networked, data-driven artwork, products and services developed in the project, and the tools and methods for innovation in a citizens' observatory (CO) at a continental scale.

VII. CONCLUSION

A. Concluding Remarks

The experience of participating in the ST+ARTS residency programme has been beneficial, though sometimes challenging.