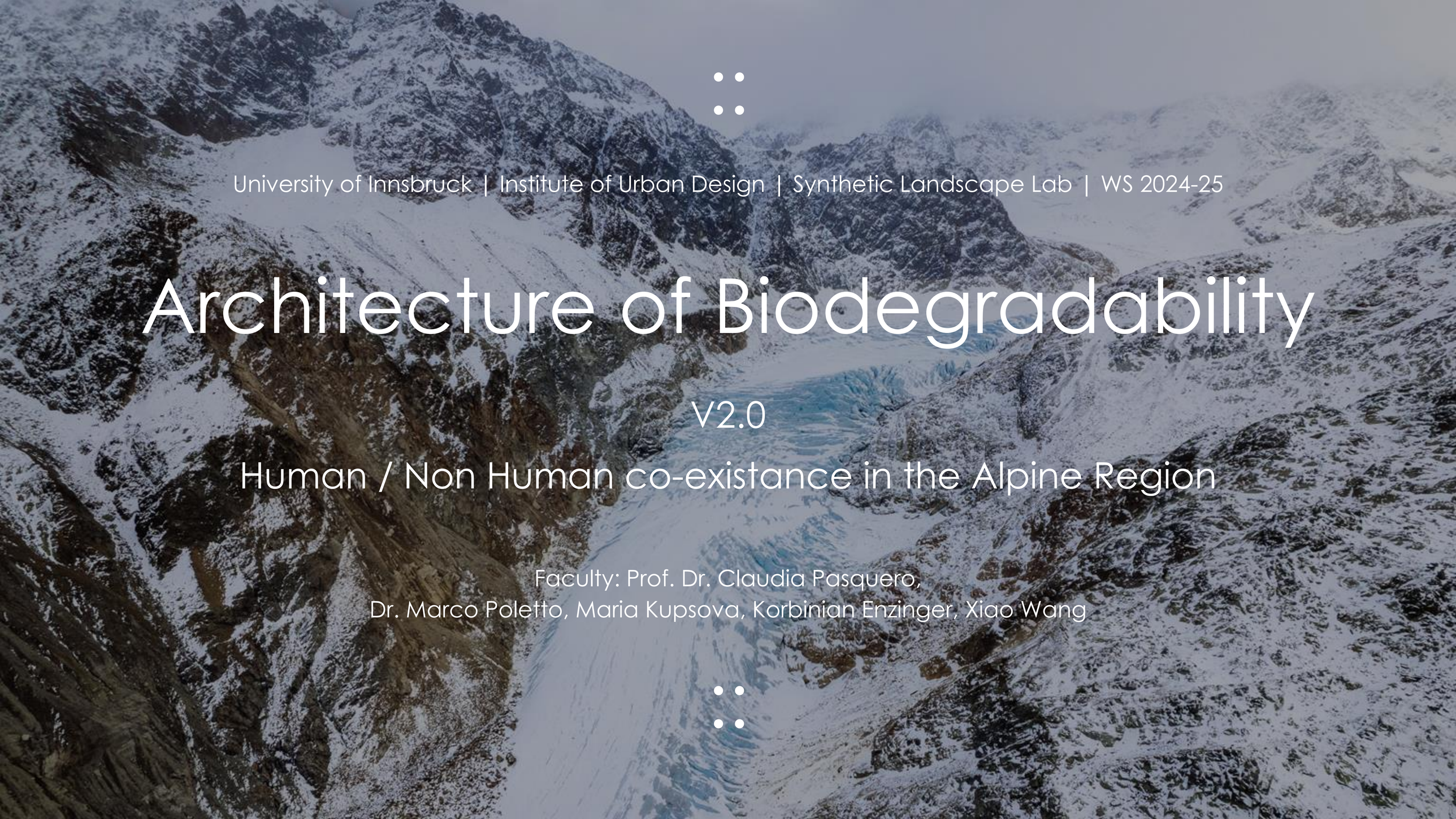


University of Innsbruck | Institute of Urban Design | Synthetic Landscape Lab | WS 2024-25

Architecture of Biodegradability

V2.0

Human / Non Human co-existance in the Alpine Region

Faculty: Prof. Dr. Claudia Pasquero,
Dr. Marco Poletto, Maria Kupsova, Korbinian Enzinger, Xiao Wang

What is bio-digital Architecture?

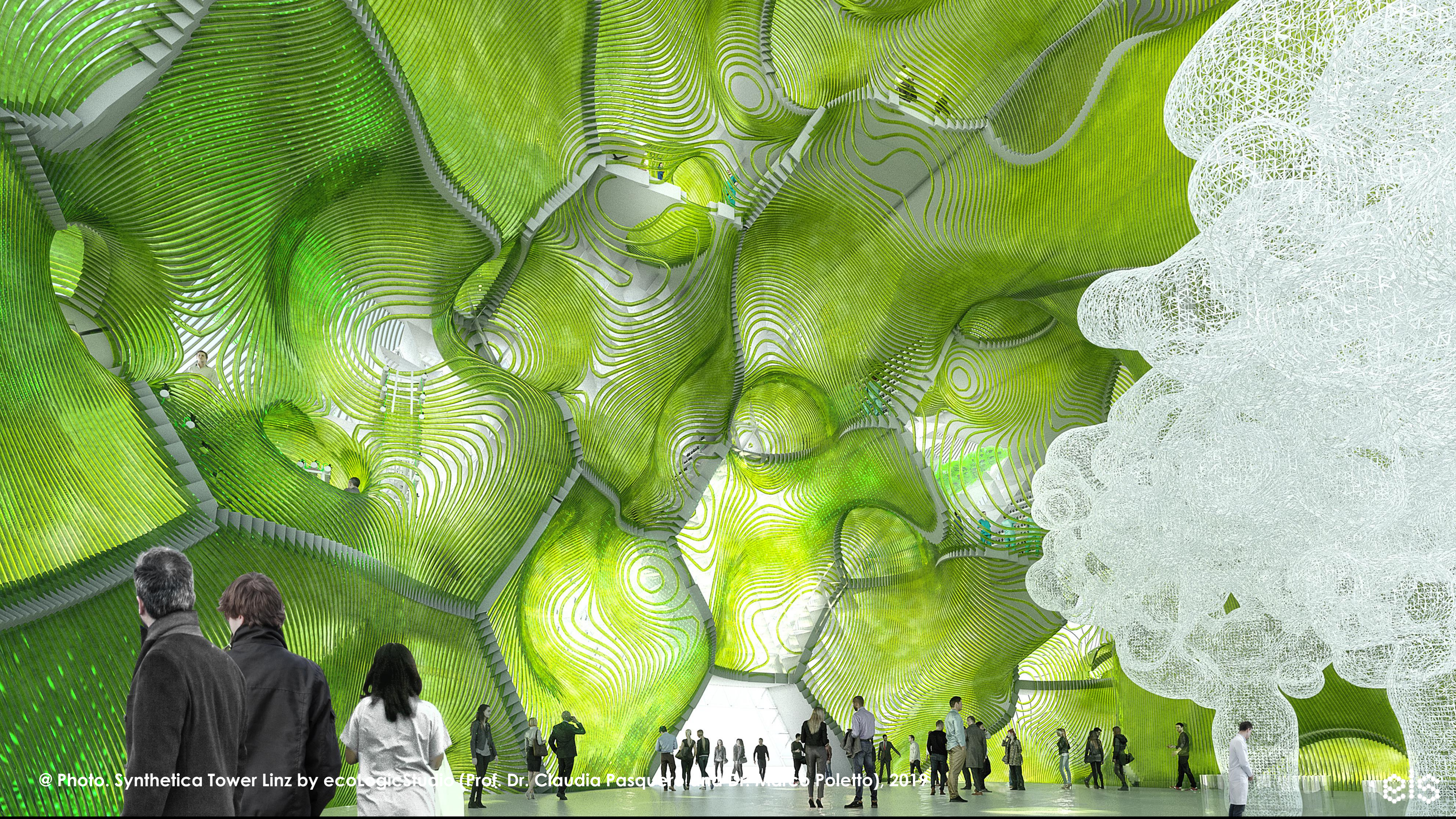
Bio-digital architecture pioneers the convergence of digital cultures and ecologic thinking. In bio-digital architecture the natural landscape and its living organisms become generative forces in shaping the future of architecture.

The Synthetic Landscape Lab is part of an international community of knowledge and practice pioneering the field of bio-digital architecture. This includes London-based EcoLogicStudio, led by Prof. Claudia Pasquero and Dr. Marco Poletto, and the Urban Morphogenesis Lab at the Bartlett School of Architecture.

At the Synthetic Landscape Lab you are joining a collaborative practice that integrates academic research and a project-based approach, and together we are pushing the boundaries of design innovation, proposing new scenarios for sustainable, biodegradable, metabolically circular architectures.

Bio-digital architecture that is receptive to microbial life

@ H.O.R.T.U.S XL Astaxanthin.g by ecoLogicStudio (Prof. Dr. Claudia Pasquero and Dr. Marco Poletto), 2019



© Photo. Synthetica Tower Linz by ecoLogicStudio (Prof. Dr. Claudia Pasquero and Dr. Marco Poletto), 2019

@ Air Bubble | air-purifying eco-machine by ecoLogicStudio (Prof. Dr. Claudia Pasquero and Dr. Marco Poletto), 2021

Urban laboratory for converting air pollution into products

@ Otrivin AIRlab by ecoLogicStudio (Prof. Dr. Claudia Pasquero and Dr. Marco Poletto), 2022

Biopolymer for 3D-printing
@ Otrivin AIRlab by ecoLogicStudio (Prof. Dr. Claudia Pasquero and Dr. Marco Poletto), 2022

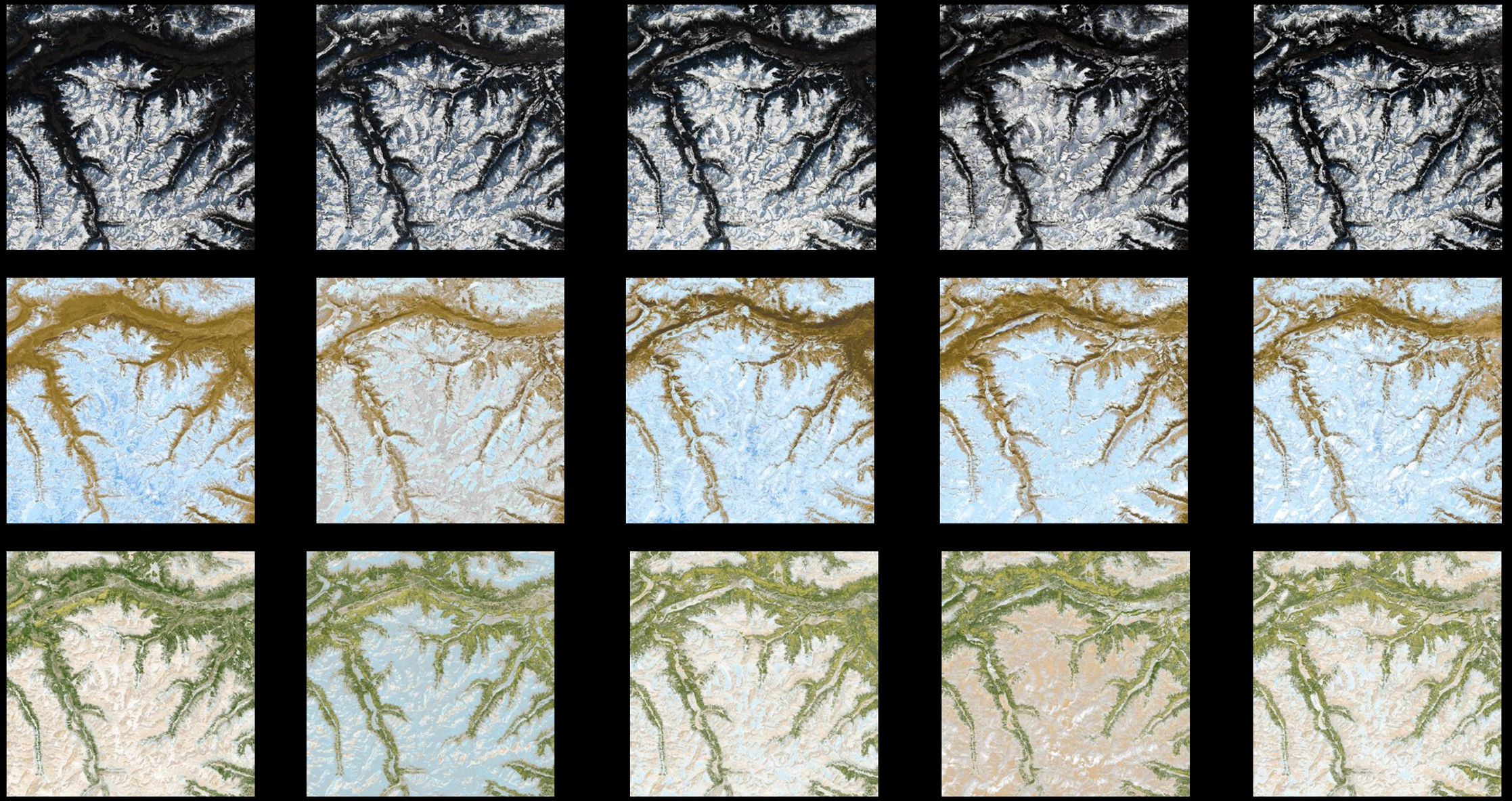
The Alpine region as a bio-digital territory for architecture innovation

At the Synthetic Landscape Lab we have observed over recent years how the Alpine region has become a poignant reflection of the effects of global climate change.

We have filmed the striking phenomenon of retreating glaciers and we have mapped their microbiome, revealing human’s historical impact on it.

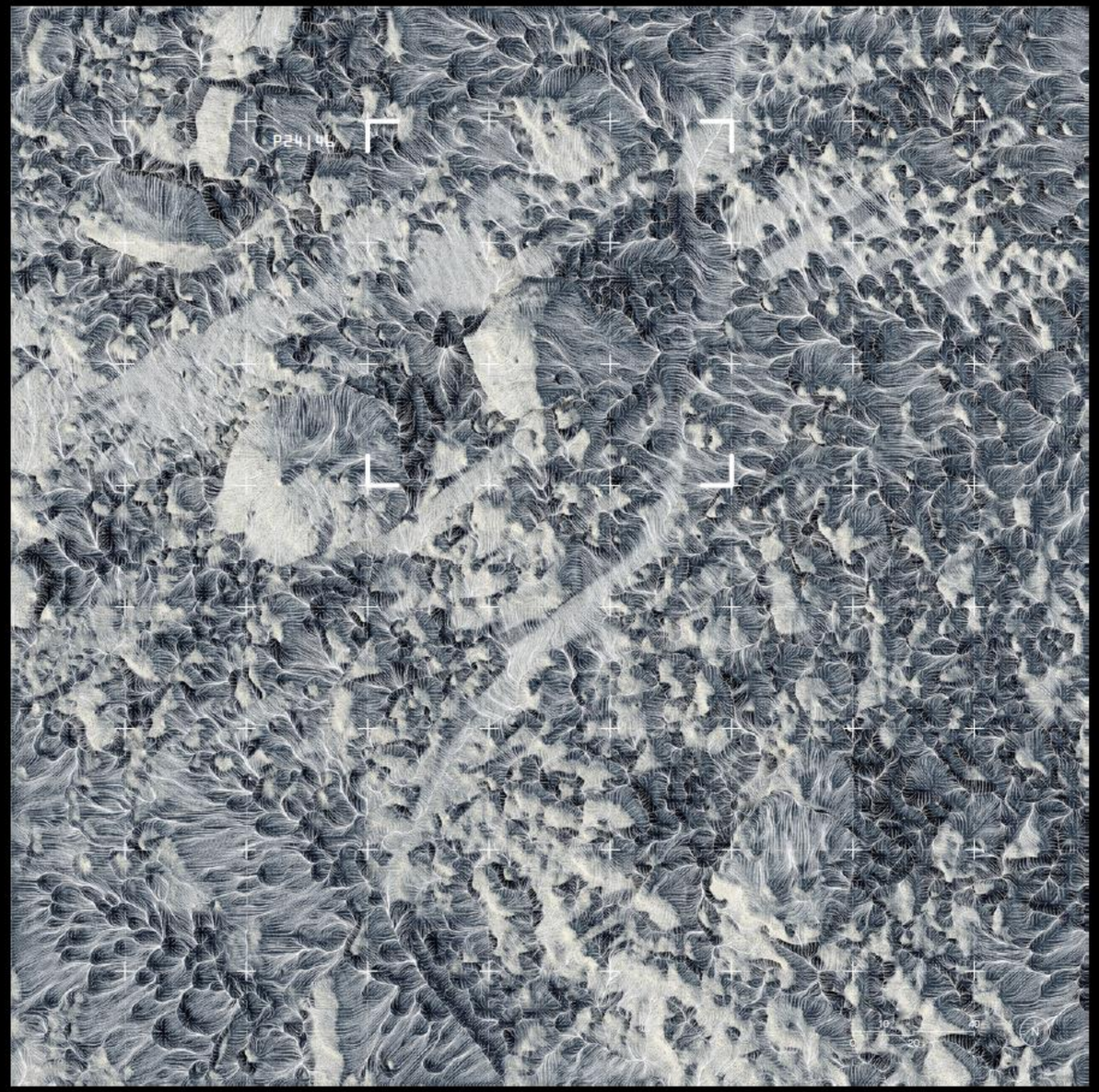
Mapping of Retreating Snow Area

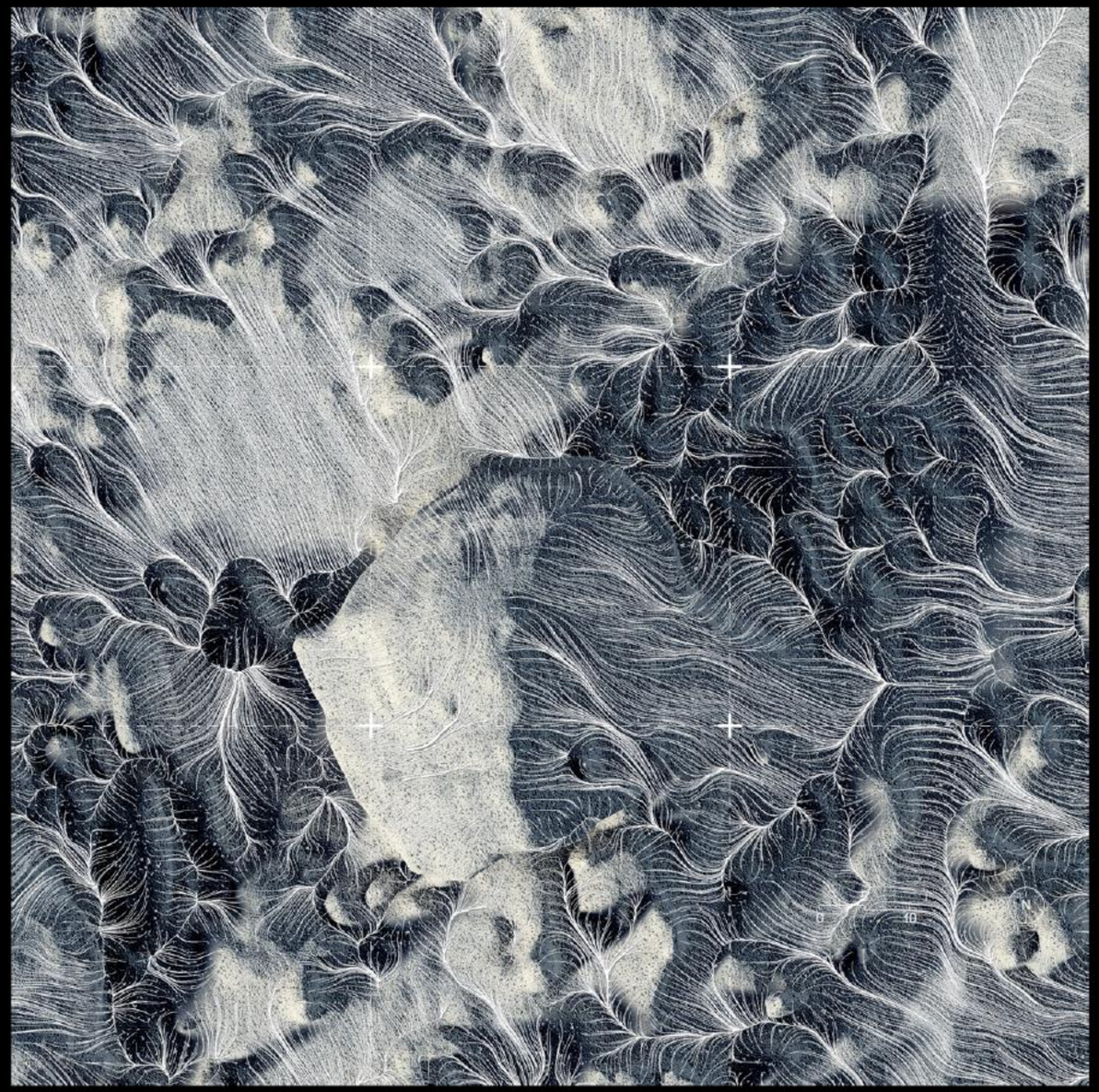
February 2023 | February 2022 | February 2021 | February 2020 | February 2019



@ Eco Ski, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

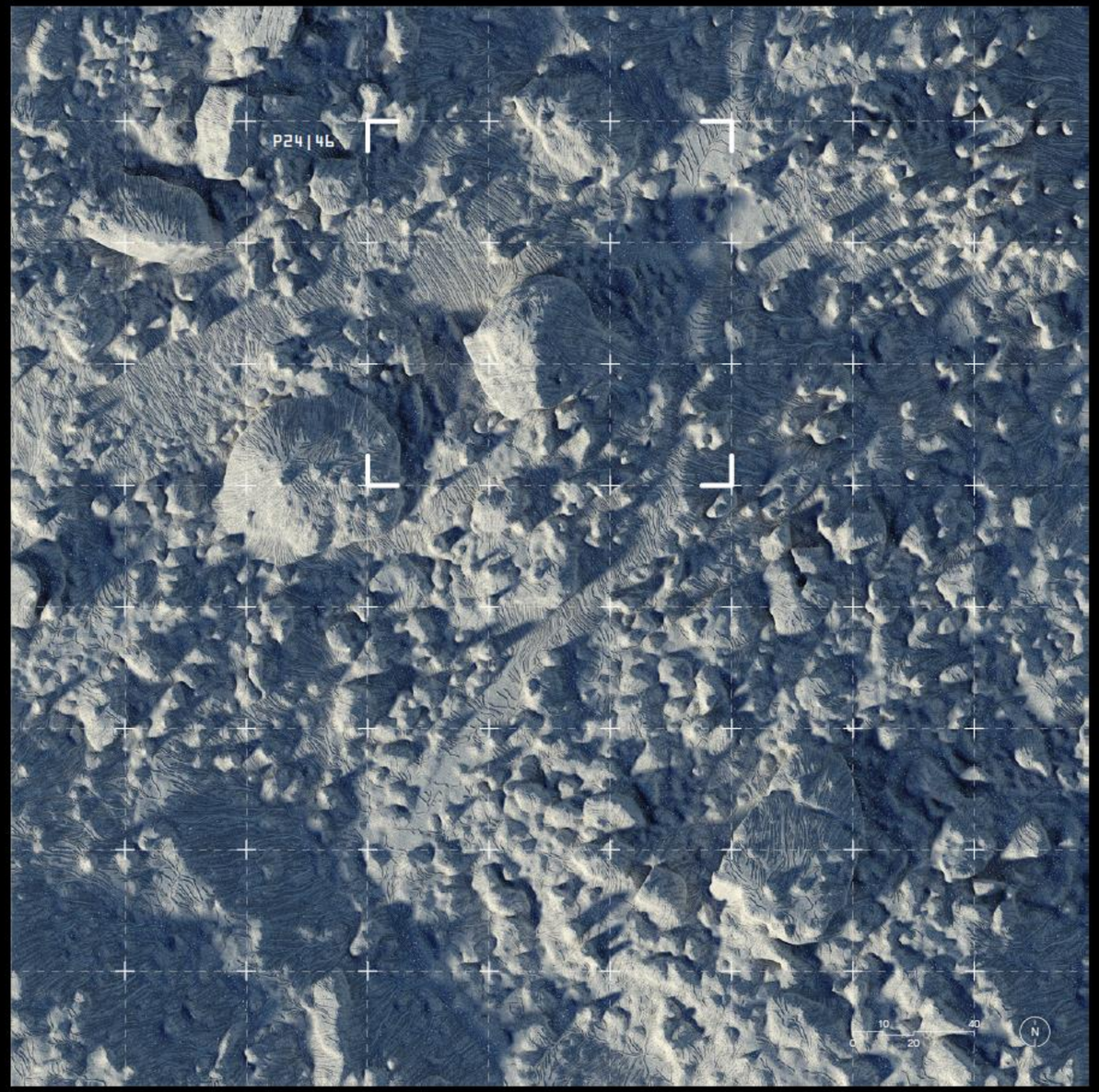
Landscape Shaped by Water Flowline

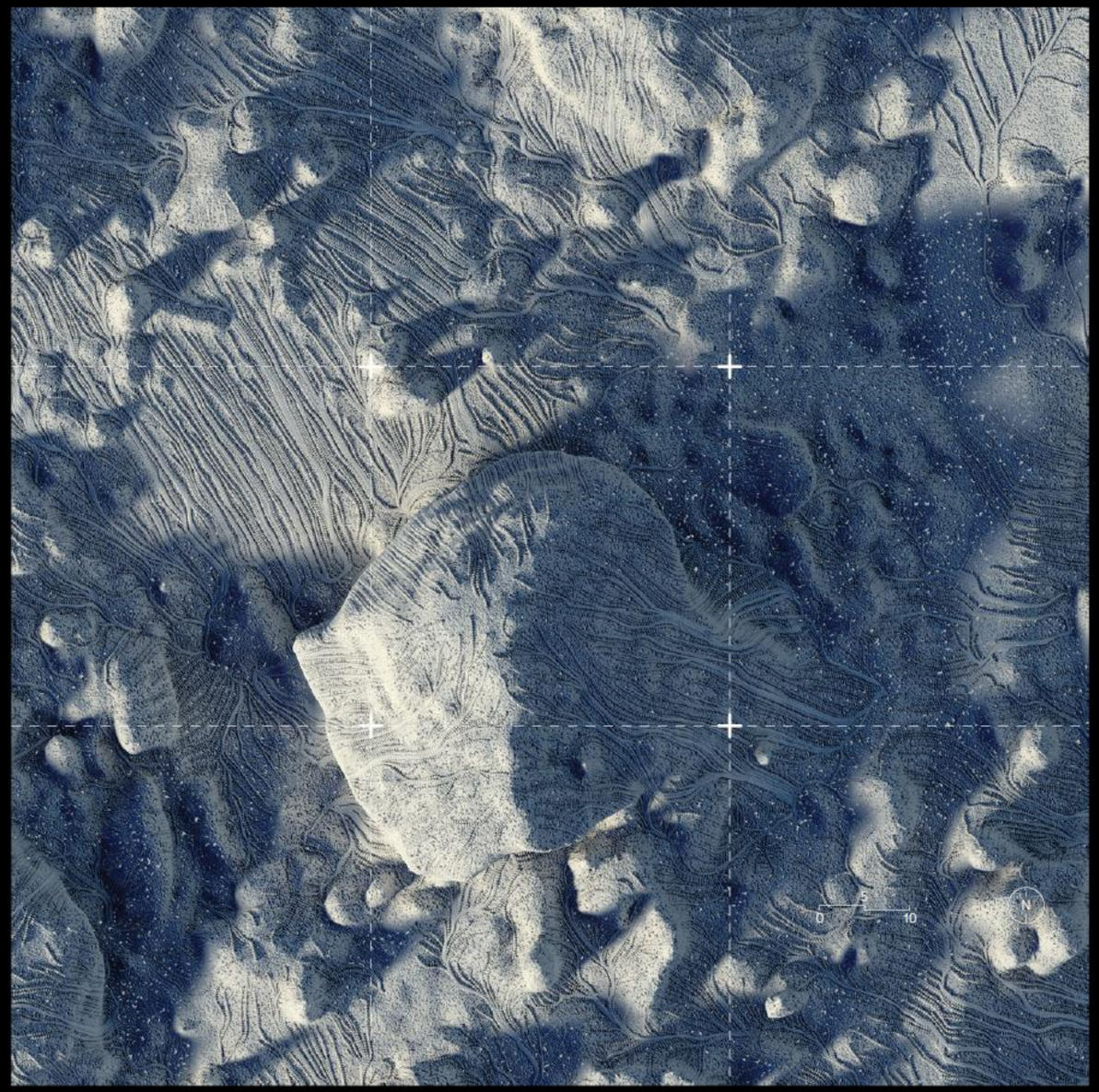




@ Drone Ecologies, Diploma Project from Synthetic Landscape Lab, 2019.

Landscape Shaped by Water Flowline



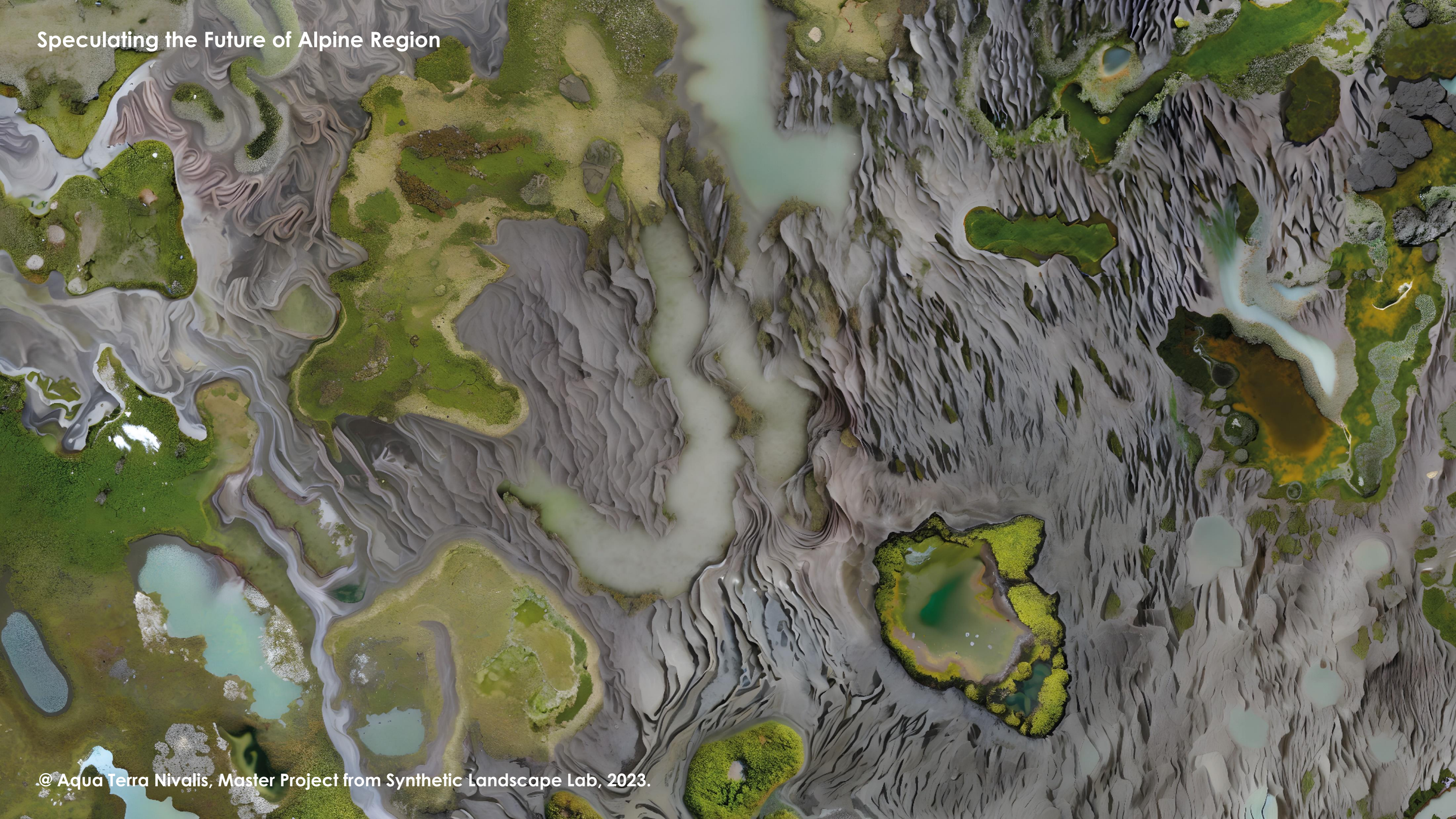


P24 | 46

@ Drone Ecologies, Diploma Project from Synthetic Landscape Lab, 2019.

Glaciers' dissolution is not only symbolic of drastic global changes taking place but it is also releasing a unique diversity of ancient contaminants and it is fuelling an intense and entirely new metabolic activity.

Bio-organic growth manifests itself in the unique coloration of the snow, as well as in the unexpected qualities of the bacteria colonies proliferating within the melting crystals.


Speculating the Future of Alpine Region
@ Aqua Terra Nivalis, Master Project from Synthetic Landscape Lab, 2023.

Speculating the Future of Alpine Region
@ Aqua Terra Nivalis, Master Project from Synthetic Landscape Lab, 2023.

Speculating the Future of Alpine Region
@ Aqua Terra Nivalis, Master Project from Synthetic Landscape Lab, 2023.

The circular metabolism of the architecture of bio-degradability

The aim of the studio is to recognize the opportunities offered by these accelerated manifestations of alpine life to design architectural habitats able to support the continued human and non-human inhabitation of these landscapes.

Bio-degradable Prototype
@ Workshop at Obergurgl, Synthetic Landscape Lab, 2023

The aim of the studio is to recognize the opportunities offered by these accelerated manifestations of alpine life to design architectural habitats able to support the continued human and non-human inhabitation of these landscapes.

@ Workshop at Obergurgl, Synthetic Landscape Lab, 2023

These metabolically circular architectures shall be biologically receptive and materially fully biodegradable.

Taking advantage of the possibilities offered by 3D printing technologies and bio-printing craftsmanship the architecture of bio-degradability will be capable of growing into landscapes of “bio-degradability” thus establishing a productive symbiosis with the alpine territory.

Landart Project: Landscape of Bio-degradability
@ Workshop at Obergurgl, Synthetic Landscape Lab, 2023

The new typologies of the architecture of bio-degradability.

The pioneering architectures of bio-degradability will influence the future evolution of the Alpine region and its industries, proposing new building typologies, social and economic activities: building heritage conservation, renewable energy production, sustainable farming and eco-tourism.

Mycelium infused fabric structure and building heritage conservation

@ Airvista, Master Project from Synthetic Landscape Lab, 2024

Mycelium infused fabric structure and building heritage conservation

@ Airvista, Master Project from Synthetic Landscape Lab, 2024

To achieve this goal the studio will engage the notion of architectures of bio-degradability at multiple levels:

As a design philosophy, in the context of advanced landscape architecture.
As a collection of material processes affecting human, animal, mineral, microbiological and digital systems and ecosystems.
As an emerging bio-economy of carbon re-metabolization, carbon capturing, carbon trading and carbon offsetting, capable of supporting future and continues life in the region.

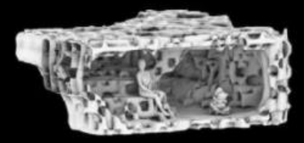
Micro algae integrated system and renewable energy production

@ Harnessing Algae´s Potential, Bachalor Thesis Project from Synthetic Landscape Lab, 2024

Synthetic crystalisation and eco-tourism
@ Eco Ski, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

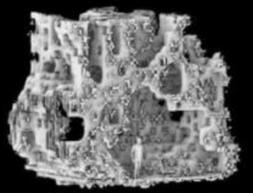
Advanced Landscape Architecture

@ GAN.OS.101, Master Thesis Project from Urban Morphogenesis Lab, UCL, 2021



10 X 12 X 4 Housing

20 X 24 X 8 Housing



26 X 24 X 10 Medical attention Space

20 X 24 X 8 Community Gathering

@ GAN.OS.101, Master Thesis Project from Urban Morphogenesis Lab, UCL, 2021

Design method and bio-digital workflow

Our creative process involves a tran-scalar approach and the most advanced design application of Artificial Intelligence, 3d scanning, biotechnology, satellite monitoring, robotic 3D printing and bio-polymer craftsmanship.

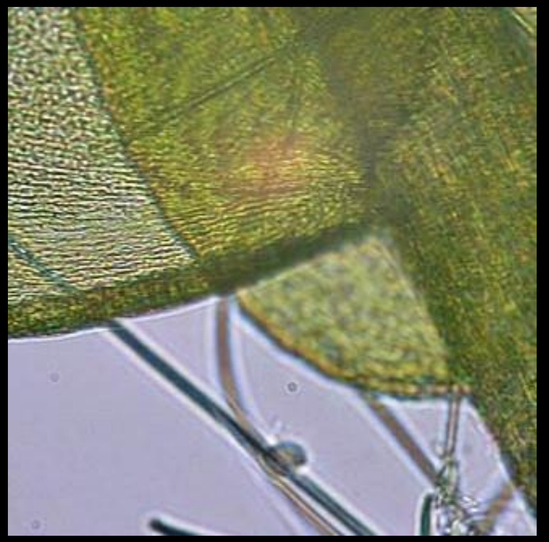
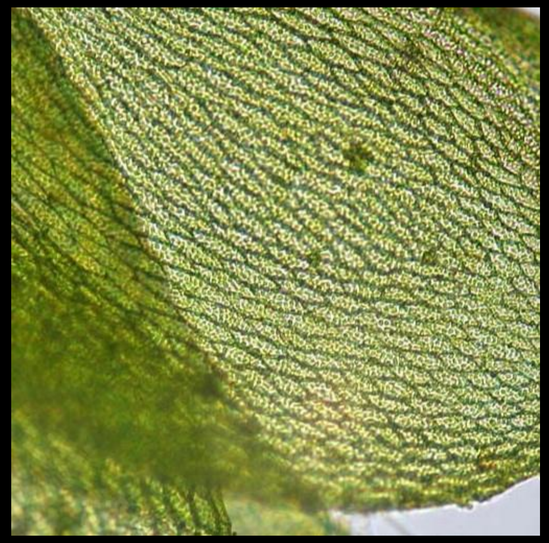
MICROSCOPIC SCALE

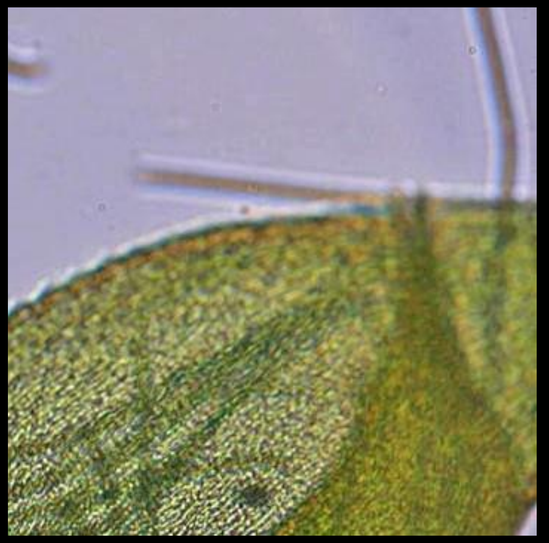
Microbiome and Bio-technics

Sample Collection, Moss

@ Green Ground, Bachalor Thesis Project from Synthetic Landscape Lab, 2024

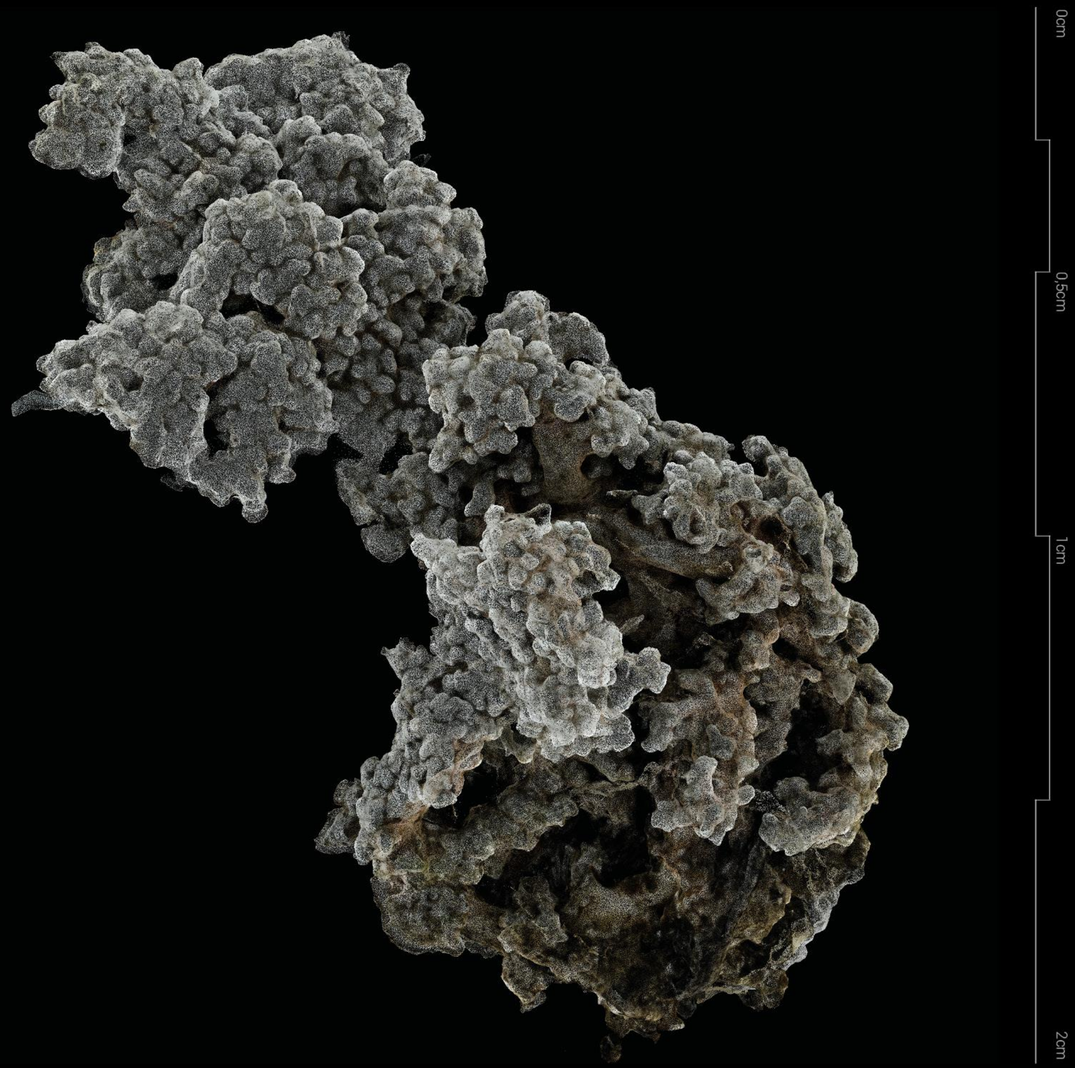
Microscopic Observation, Moss



Microbial Cultivation, Mycelium

3D Scanning, Lichen

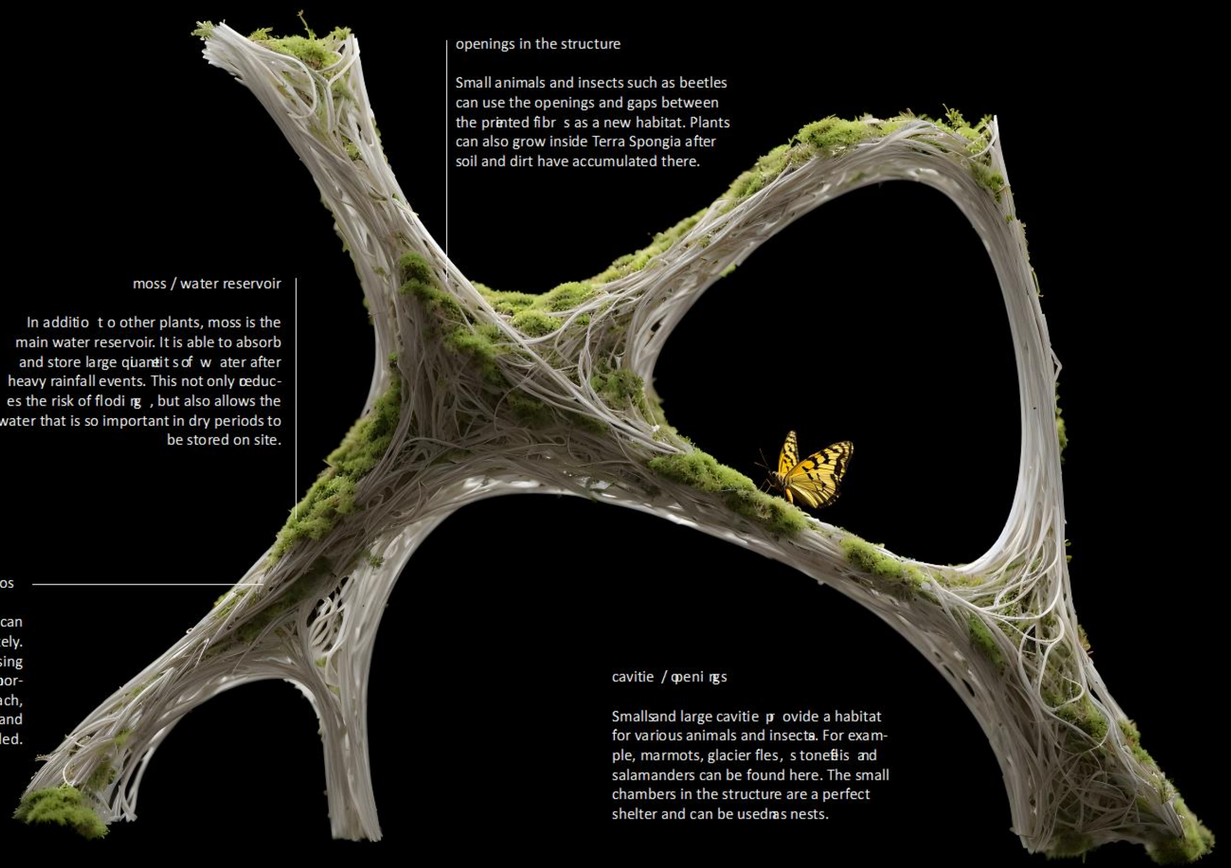


@ EcoGenesis, Master Project from Synthetic Landscape Lab, 2024

MESO SCALE

Architectures of Biodegradability

Computational Modeling



openings in the structure

Small animals and insects such as beetles can use the openings and gaps between the printed fibers as a new habitat. Plants can also grow inside Terra Spongia after soil and dirt have accumulated there.

moss / water reservoir

In addition to other plants, moss is the main water reservoir. It is able to absorb and store large quantities of water after heavy rainfall events. This not only reduces the risk of flooding, but also allows the water that is so important in dry periods to be stored on site.

3D printing / connections

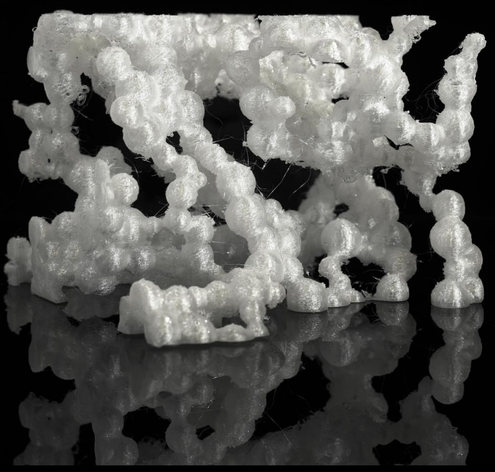
Individual strands of the structure can be printed and delivered separately. They then joined together on site using a connector system. To simplify transport to areas that are difficult to reach, modules can also be prepared and then installed.

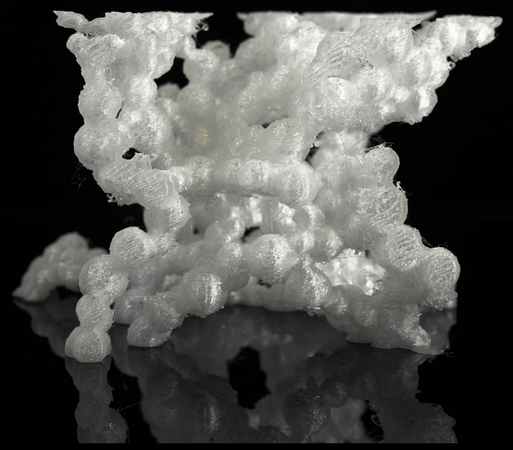
cavities / openings

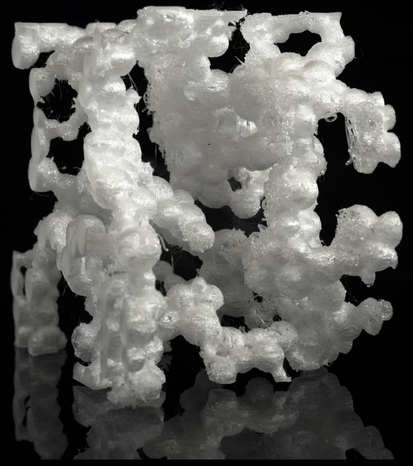
Small and large cavities provide a habitat for various animals and insects. For example, marmots, glacier flies, stonefllies and salamanders can be found here. The small chambers in the structure are a perfect shelter and can be used as nests.

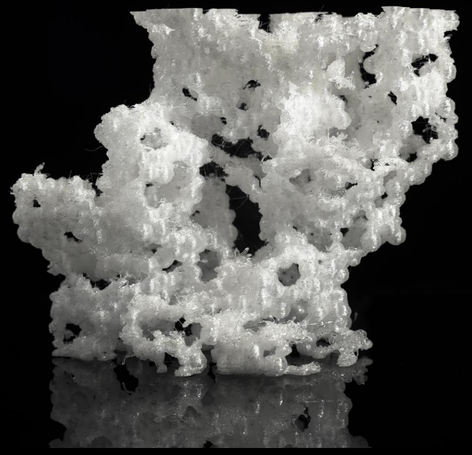
@ Terra Spongia, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

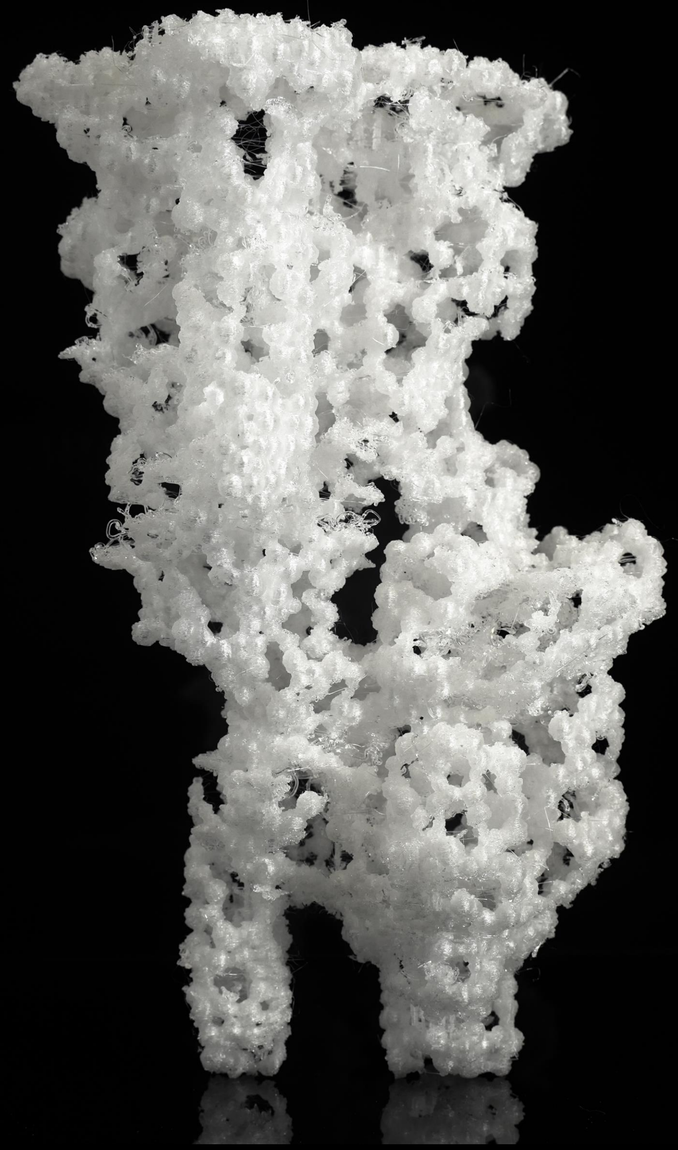
Robotic 3D Printing









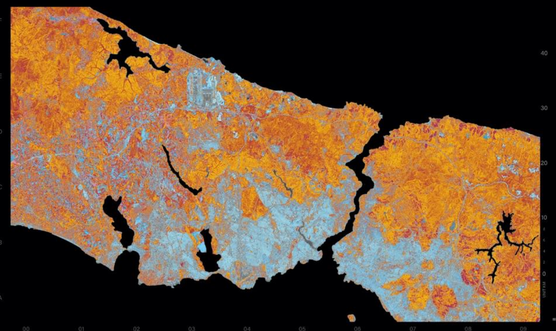


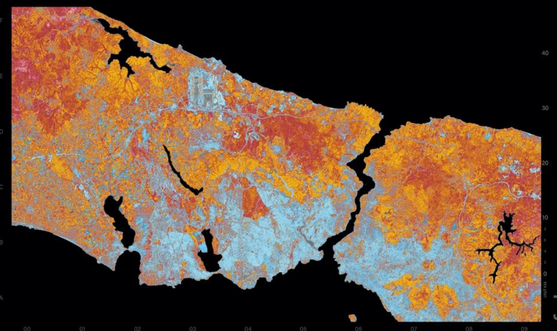
@ Prototyping Course, Synthetic Landscape Lab, 2024

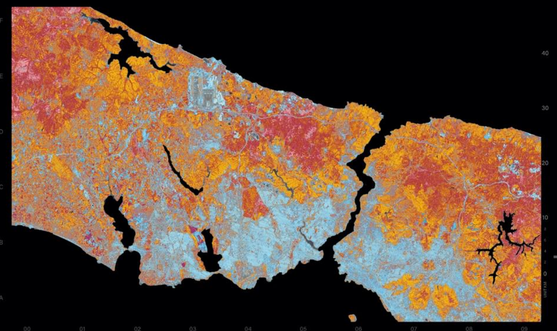
MACROSCOPIC SCALE

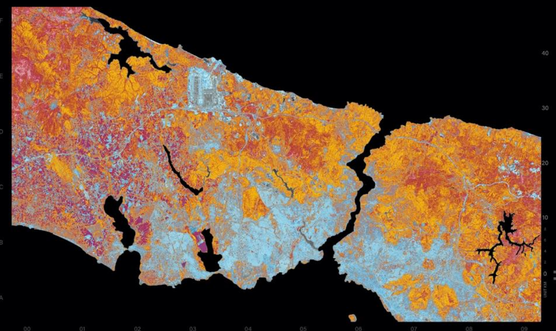
Landscapes of Biodegradability

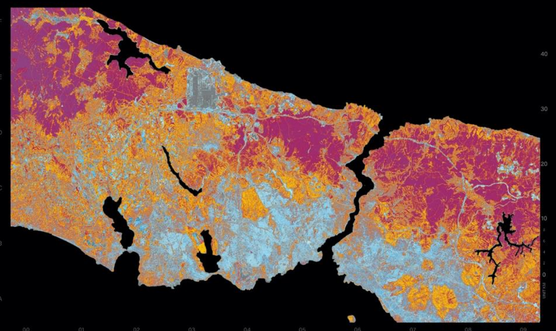
Satellite Analysis

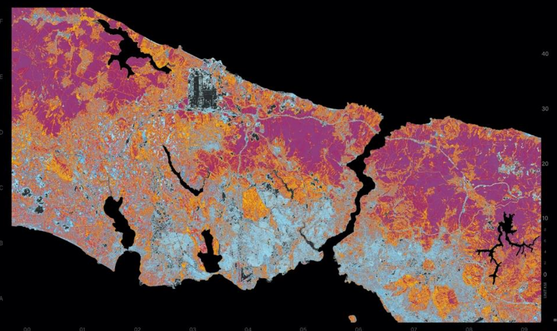


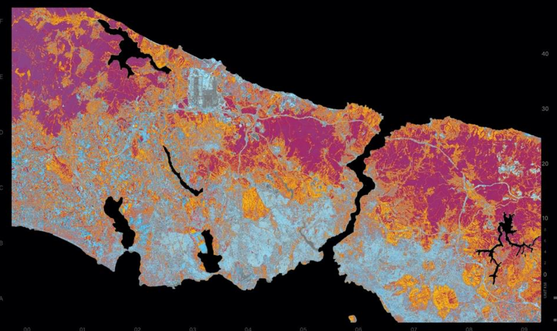


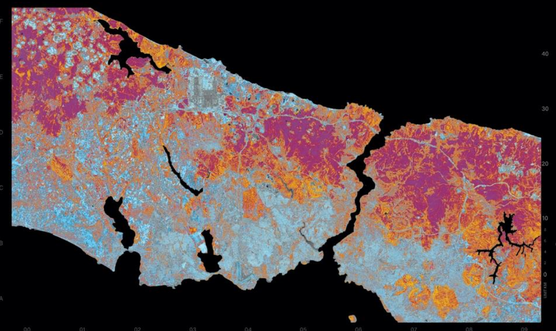


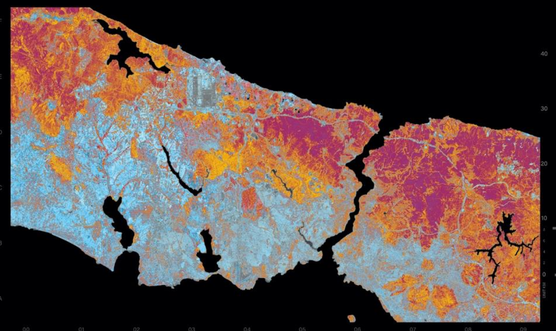


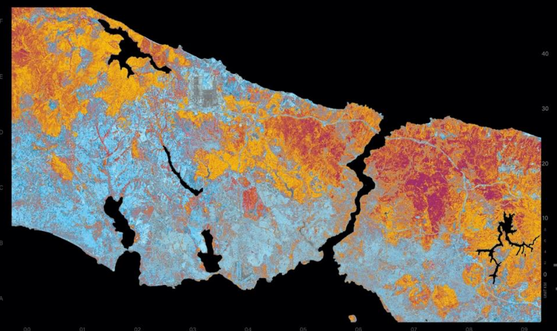


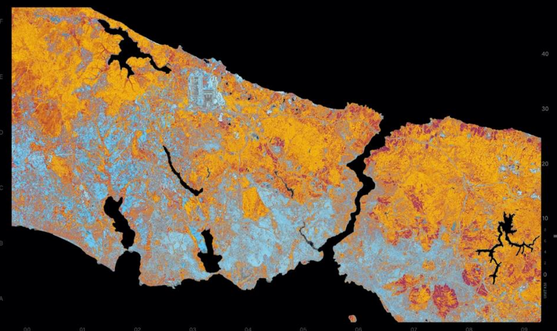


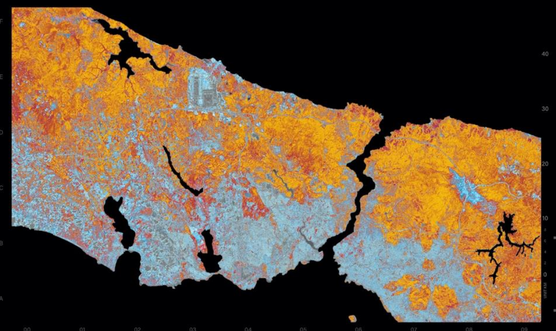




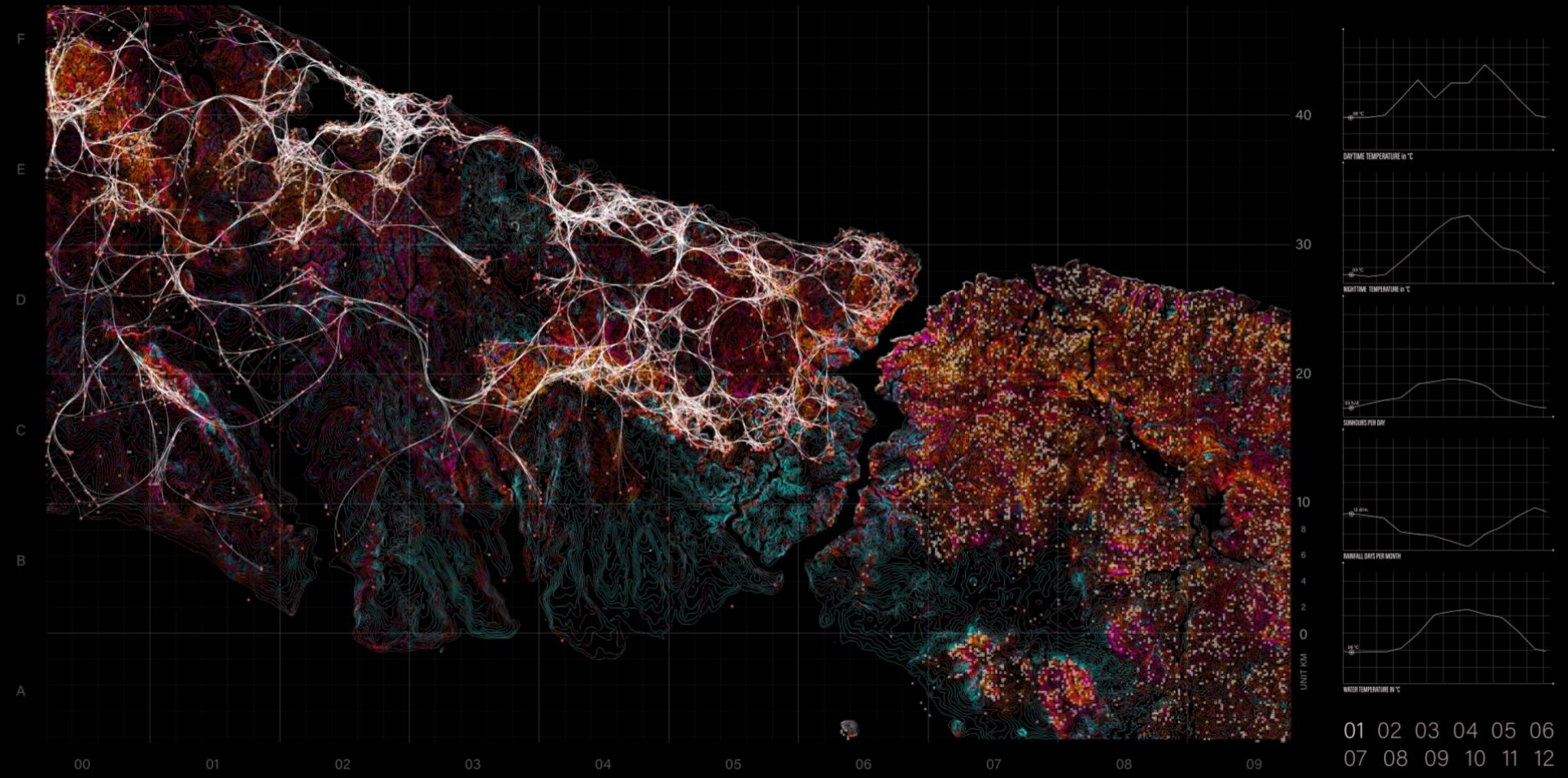






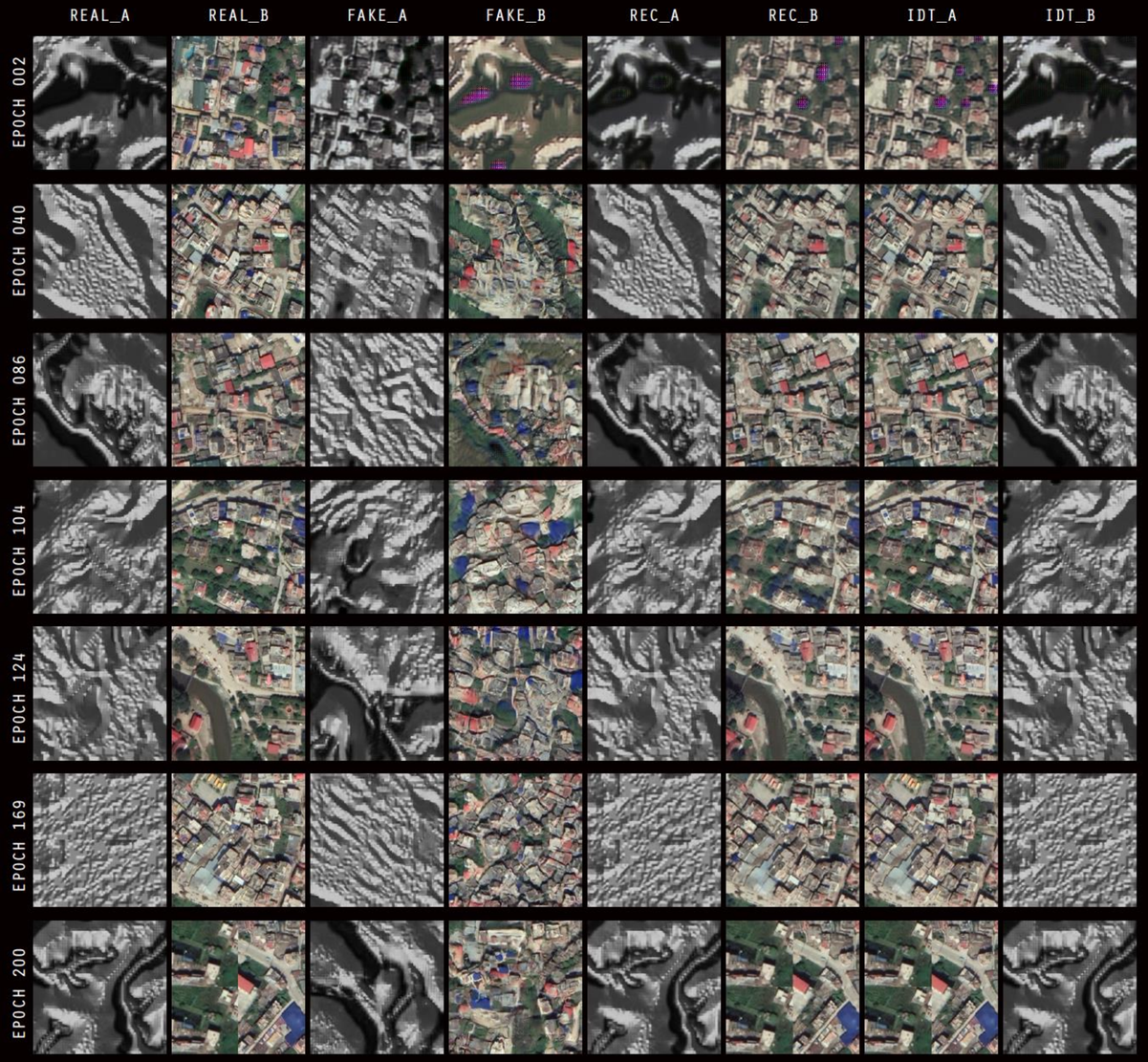


Satellite Mornitoring



@ The Buffalo, Bachalor Thesis Project from Synthetic Landscape Lab, 2022

Cycle GAN



TRAINING URBAN NETWORK

@ The Buffalo, Bachalor Thesis Project from Synthetic Landscape Lab, 2022

STUDIO model and collaborative design approach.

We run the studio-based learning model,
supporting cross-fertilization and multidisciplinary exchange.

@ Workshop at Obergurgl, Synthetic Landscape Lab, 2023

Biotechnology and design.

We will explore the generative intelligence of living organisms as analogue models for architecture and design, integrating it into the architectural design process.

Bio-computation of
Bees
@ The Organism of Bees, Diploma Project from Synthetic Landscape Lab, 2019

Prototyping and generative proxy-models

Each team will research on a specific application of bio-degradable polymers to test and prototype bio-composites, bio-receptive and living architectural components.

Material Study

Study 1:

Materials used:

- Wood Cuttings 80 ml
- Dirt 60 ml
- Aga Aga
- Leaves
- Bark

Stability Rating: 3/10

Crumbles easily/ too fragile

Study 2:

Materials used:

- Wood Cuttings 80 ml
- Dirt
- Aga Aga
- Leaves
- Bark
- Water

Stability Rating: 1/10

Doesn't properly dry

Study 3:

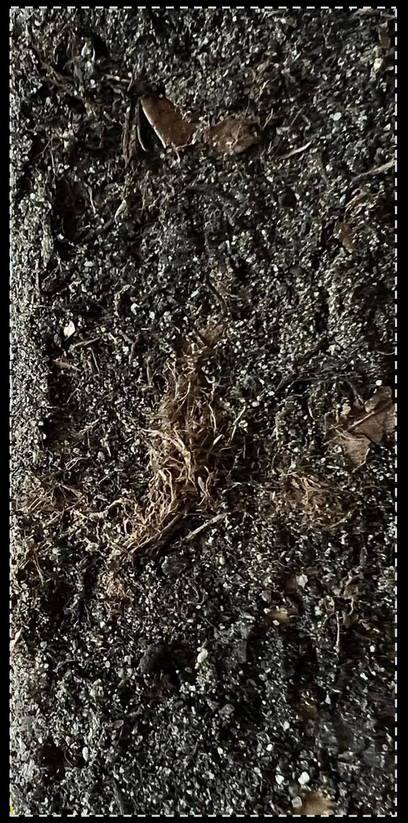
Materials used:

- Wood Cuttings 80 ml
- Dirt
- Aga Aga
- Leaves
- Bark
- Water

Stability Rating: 5/10

Flaky/ too fragile

☆Study 4:



Materials used:

- Wood Cuttings 80 ml
- Dirt
- Aga Aga
- Leaves
- Sand
- Water
- Coffee grounds

Stability Rating: 9/10

Study 5:

Materials used:

- Wood Cuttings 80 ml
- Dirt
- Aga Aga
- Leaves
- Sand
- Water
- Coffee grounds

Stability Rating: 6/10

@ Green Ground, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

Bio-polymer Printing

Aga Aga

Water

Bark

Sawdust

Soil

Coffee Grounds

Sand

Leaves

Wet Mixture

@ Green Ground, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

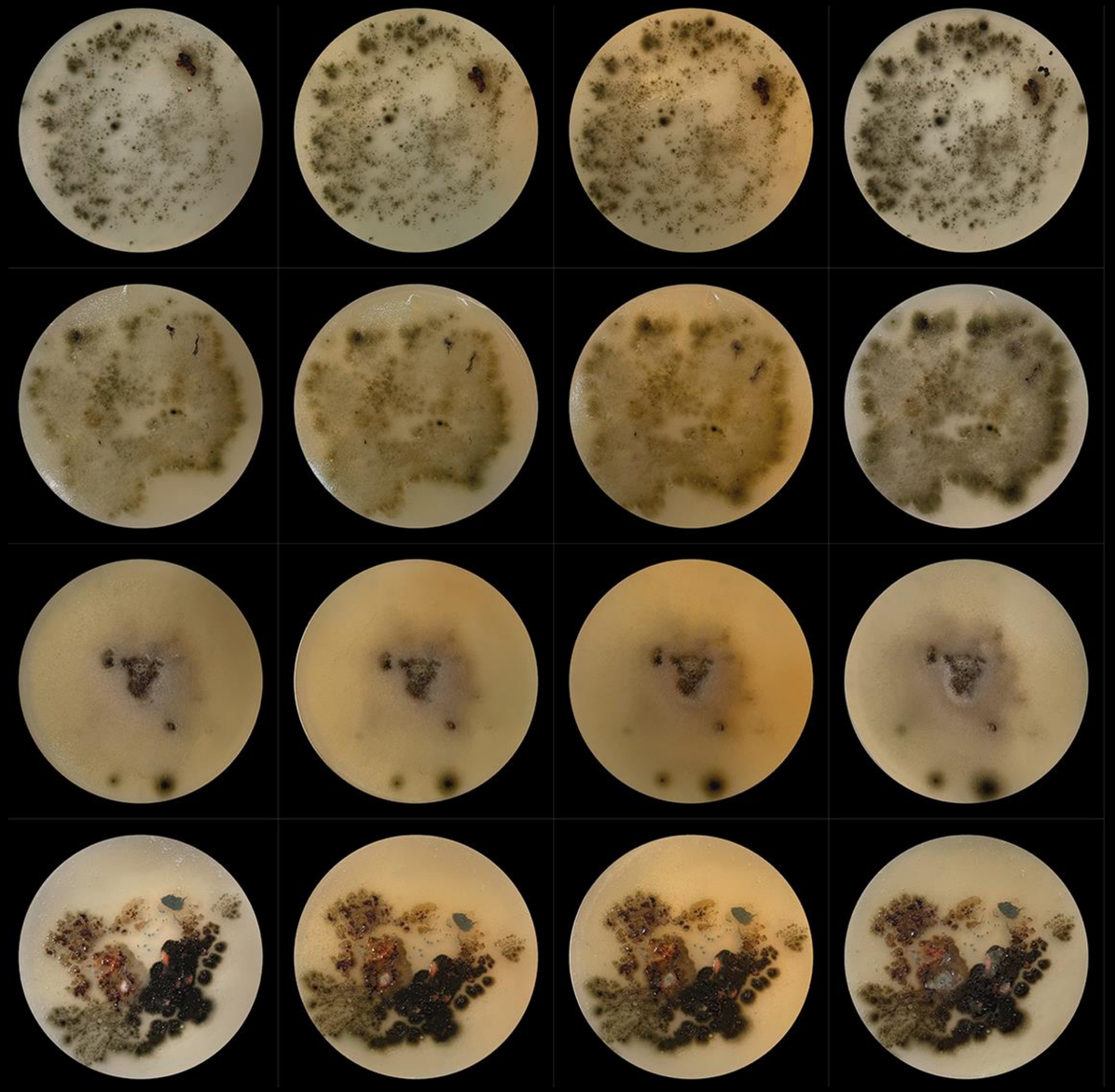
Prototyping

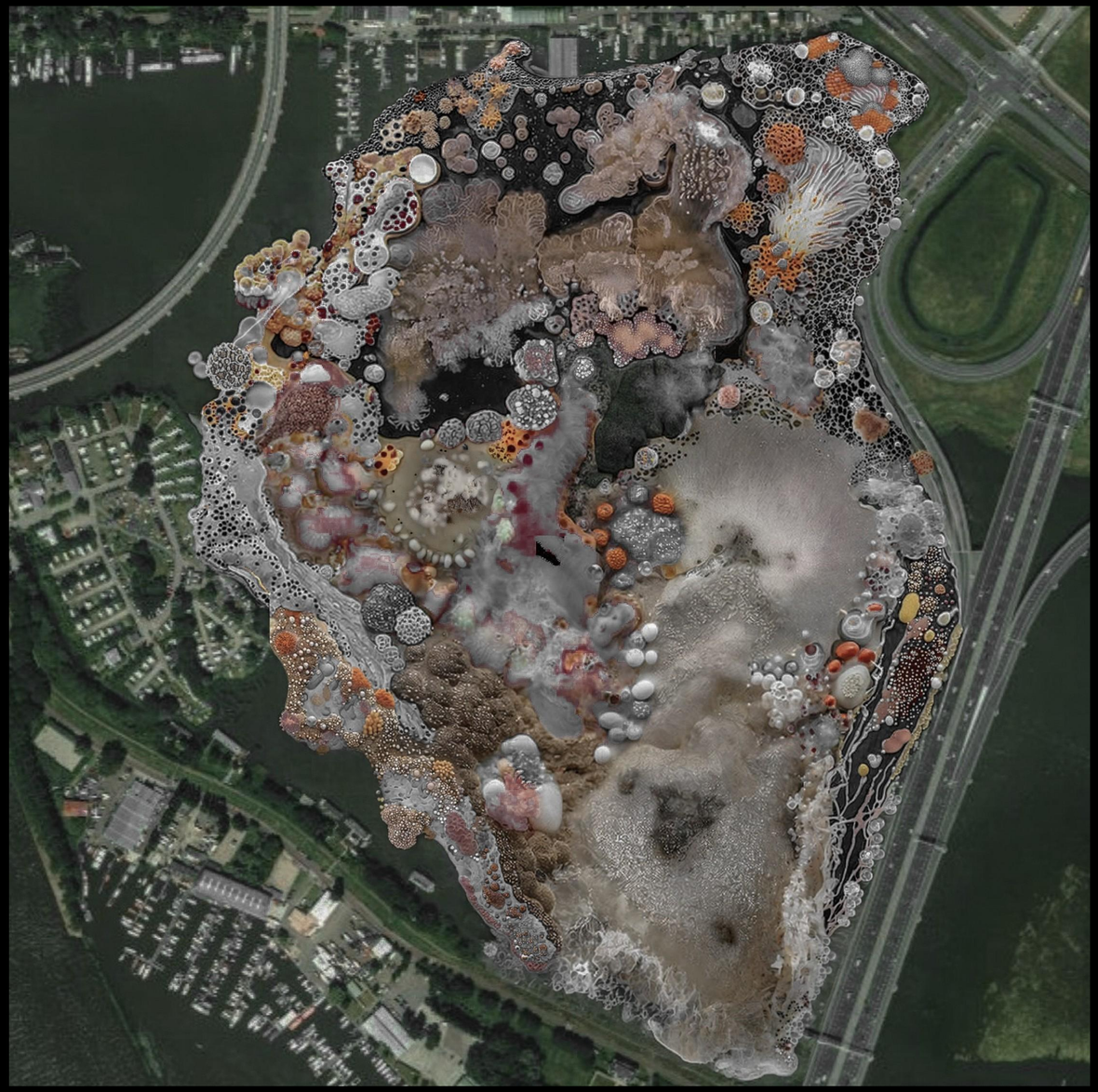
@ Green Ground, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

Generative Artificial Intelligence in design.

Students learn and test new AI design workflows for generative machine learning, speculative architectural imaging and 2D image to 3D prototyping conversion.

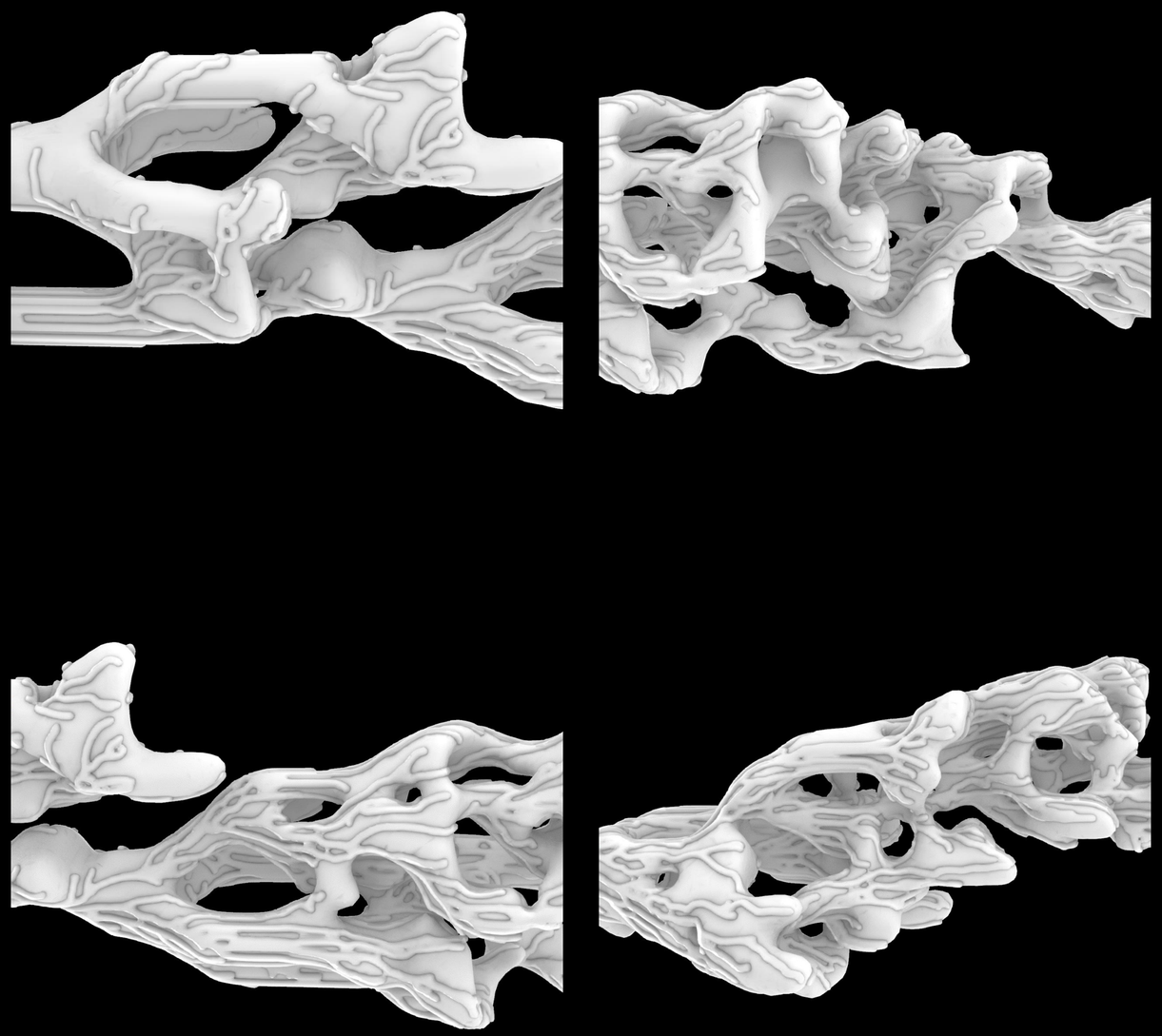
Biological Experiment as Input for AI Landscape Integration





@ A°BiS, Master Project from Synthetic Landscape Lab, 2024

Digital Model as Input for AI Rendering

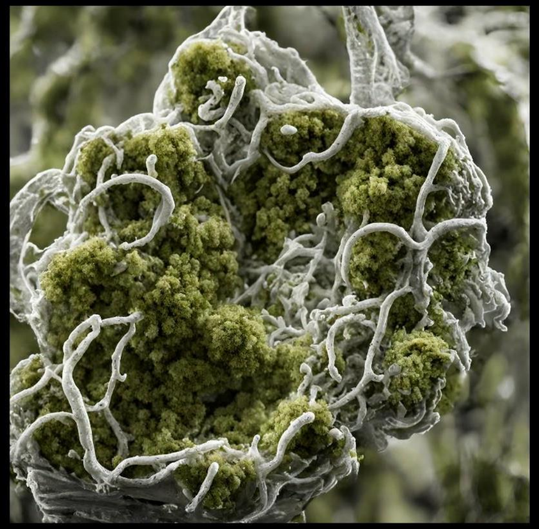


@ Green Ground, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

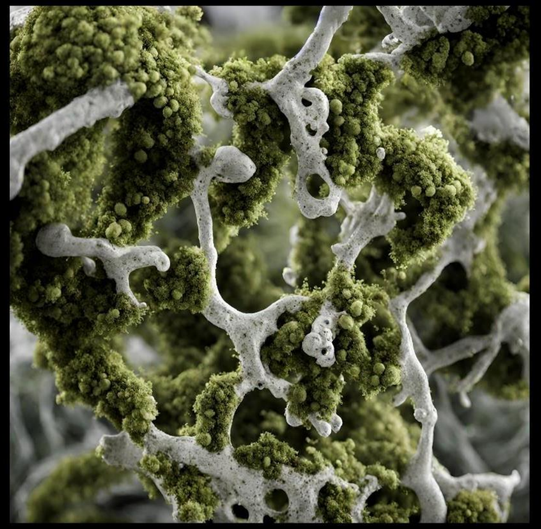
AI Speculative Architectural Imaging

@ Green Ground, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

AI Morphological Exploration



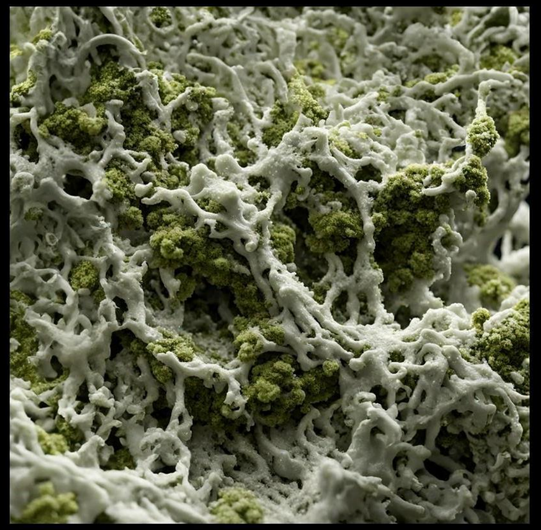
5 mm x 5 mm



5 mm x 5 mm

15 cm x 15 cm

15 cm x 15 cm

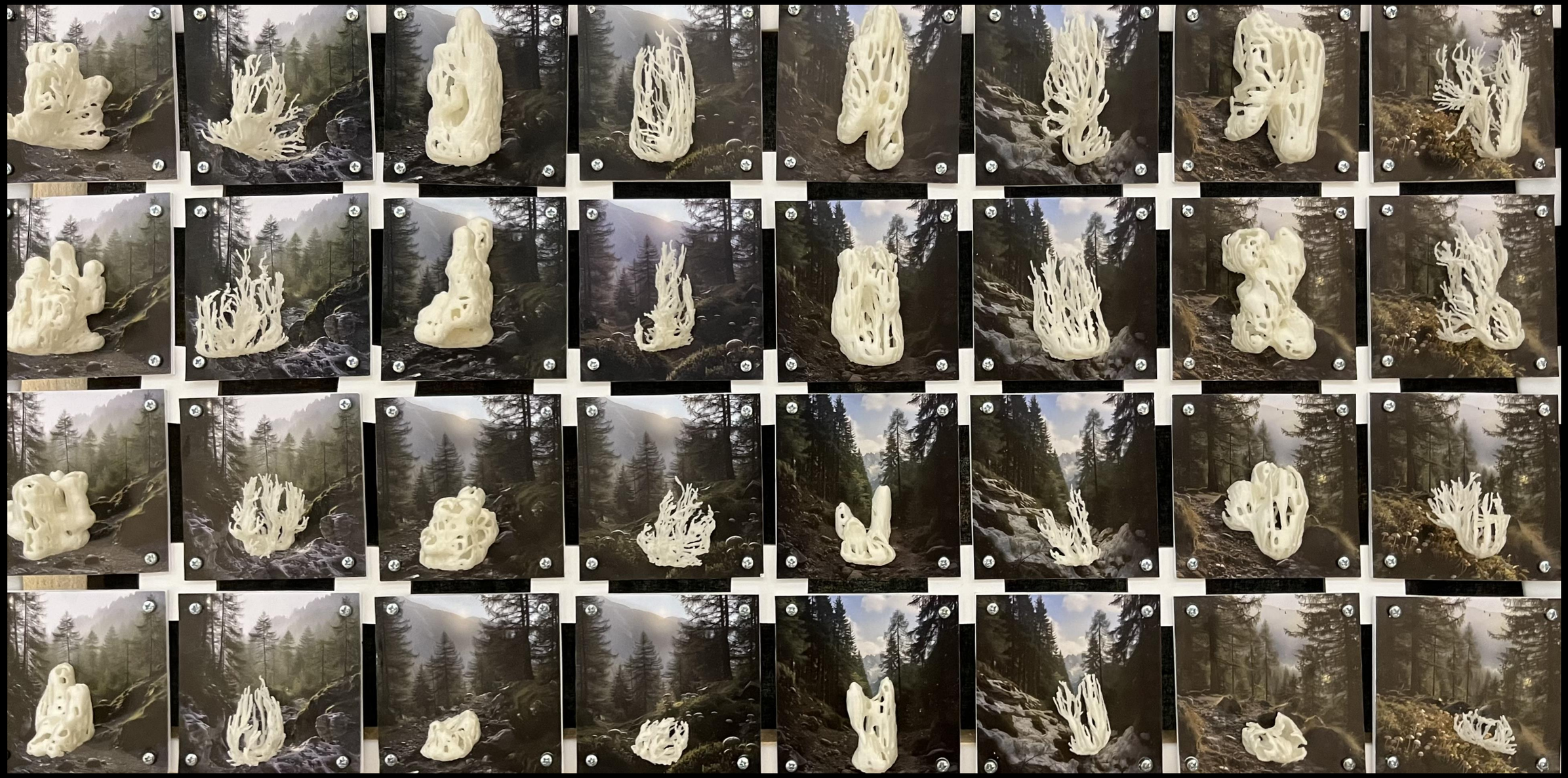


@ Terra Spongia, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

AI Simulation

@ Strands of Relationship, Bachelor Thesis Project from Synthetic Landscape Lab, 2024

3D Prototyping Conversion



@ Strands of Relationship, Bachelor Thesis Project from Synthetic Landscape Lab, 2024

3D Prototyping Conversion

@ Terra Spongia. Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

PROJECT OUTCOMES

Architecture of Bio-degradability

@ Strands of Relationship, Bachelor Thesis Project from Synthetic Landscape Lab, 2024

@ MycelialAlps, Bachelor Thesis Project from Synthetic Landscape Lab, 2024

@ A°BiS, Master Project from Synthetic Landscape Lab, 2024

@ MycoHabitat, Diploma Project from Synthetic Landscape Lab, 2024

@ Collective Space, Diploma Project from Synthetic Landscape Lab, 2024

@ Terra Spongia, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

@ Green Ground, Bachelor Thesis Project from Synthetic Landscape Lab, 2024.

Books and papers

Allen J., Me and the Biospheres: A Memoir by the Inventor of Biosphere 2. Synergetic Press, Santa Fe, NM 2007.

AMO Koolhaas, Rem. Countryside, a Report. 2020. Taschen.

Buckminster Fuller R., "Operating Manual for Spaceship Earth". First Published in 1968.

Branzi, Andrea. Weak and Diffuse Modernity: The World of Projects at the Beginning of the 21st Century. Skira Architecture Library.

Clark, Andy. Natural-Born Cyborgs: Minds, Technologies, and the Future of Human Intelligence. 2003. Oxford University Press.

Glanville R., (2003), SECOND ORDER CYBERNETICS, in Systems Science and Cybernetics,[Ed. Francisco Parra-Luna], in Encyclopedia of Life Support Systems (EOLSS), Developed under the Auspices of the UNESCO, Eolss Publishers, Oxford ,UK, [http://www.eolss.net] [Retrieved August 31, 2008]

Gobiet, A. et al. (2014) '21st century climate change in the European Alps—A Review', Science of The Total Environment, 493, pp. 1138–1151. doi:10.1016/j.scitotenv.2013.07.050.

Ian Goldin and Robert Muggah. "Terra Incognita: 100 Maps to Survive the Next 100 Years". 2020. Cornerstone Digital

Wang, Xiaowei. Blockchain Chicken Farm: And Other Stories of Tech in China's Countryside. 2020. FSGO / LOGIC.

Lamprecht, A. et al. 2018 'Climate change leads to accelerated transformation of high-elevation vegetation in the central alps', New Phytologist, 220(2), pp. 447–459. doi:10.1111/nph.15290.

Pasquero, C., and M. Poletto. 2019. "Beauty as Ecological Intelligence: Bio-digital Aesthetics as a Value System of PostAnthropocene Architecture." Architectural Design 89: 58–65. https://doi.org/10.1002/ad.2480.

Pasquero, C., & Poletto, M. 2023. Biodesign in the Age of Artificial Intelligence: Deep Green (1st ed.). Routledge. https://doi.org/10.4324/9781003168614

Suresh Neethirajan. 2020. "The role of sensors, big data and machine learning in modern animal farming". Sensing and Biosensing Research. https://doi.org/10.1016/j.sbsr.2020.100367

Suresh Neethirajan. 2021. "Digital Twins in livestock farming". Sensing and Biosensing Research. https://doi.org/10.3390/ani11041008

Articles

https://www.theguardian.com/environment/2021/sep/14/global-farm-subsidies-damage-people-planet-un-climate-crisis-nature-inequality?CMP=Share_AndroidApp_Other

https://www.theguardian.com/technology/gallery/2021/sep/13/snowflakes-to-slime-mould-nikon-small-world-photomicrography-2021-in-pictures?CMP=Share_AndroidApp_Other

https://www.theguardian.com/environment/2021/sep/13/cows-potty-trained-in-experiment-to-reduce-greenhouse-gas-emissions?CMP=Share_AndroidApp_Other

https://www.theguardian.com/environment/2021/sep/13/meat-greenhouses-gases-food-production-study?CMP=Share_AndroidApp_Other

https://www.theguardian.com/environment/2021/sep/07/20-meat-and-dairy-firms-emit-more-greenhouse-gas-than-germany-britain-or-france?CMP=Share_AndroidApp_Other

https://www.bbc.com/future/article/20230322-how-climate-change-is-melting-permafrost-in-the-alps

https://www.theguardian.com/environment/2001/jan/04/globalwarming.climatechange

Videos

“Future of Farming”
Video Link: https://www.youtube.com/watch?v=IXuQKoQCtOc

“How vertical farms could take over the world”
Video Link: https://www.youtube.com/watch?v=J4SaSfnHK3I

Lecture about “Countryside, the Future” by Rem Koolhaas
Video Link: https://www.youtube.com/watch?v=shVxB6wRHo0

“Rem Koolhaas – Countryside, the Future”. Guggenheim Museum.
Video Link: https://www.youtube.com/watch?v=eTbH5RWb66o