RESEARCH NEWS

Reducing greenhouse gas emissions

Digital Transformation and AI to Help Threatened Peatlands

In the VALPEATS project, Fraunhofer researchers are working with project partners to develop a monitoring platform to collect information and evaluate the condition of peatlands. Peatlands are drying out due to conversion to agricultural land and climate change, releasing huge quantities of CO_2 into the atmosphere in the process. The project involves an interdisciplinary team of specialists in the field along with a network of sensors, drones, and AI tools. VALPEATS is laying the groundwork for protecting peatlands and planning rewetting measures.

At three percent, peatlands cover a very small amount of the earth's surface, but they store about twice as much carbon as the entire biomass of all the world's forests. This is 1.3 billion metric tons in Germany alone, according to the Peatland Atlas published by Bund für Umwelt und Naturschutz Deutschland (German Federation for the Environment and Nature Conservation), the Heinrich Böll Foundation and partners. However, peatlands can only perform this storage function as long as they are intact. Draining peatlands for agriculture or forestry leads to oxygen infiltration, causing the peat to decompose. When that happens, the peat can no longer bind carbon, and instead it releases vast quantities of carbon dioxide, a greenhouse gas, into the atmosphere.

In the VALPEATS (Valuation Of Peatland Ecosystem Services) project, researchers from the Fraunhofer Institute for Computer Graphics Research IGD are working with the University of Greifswald and the Greifswald Mire Centre (GMC) to build a monitoring platform to collect information on the condition of the complex peatland ecosystems. The measurement data are analyzed using AI tools, which offers an innovative way to gauge the condition of peatlands by incorporating a wealth of information. The goal is to use this approach to evaluate greenhouse gas emissions in peatlands and gather information on peatland-specific biodiversity in the future.

As the first step, sensors in various locations measure the water level and weather data. "Previously, these data were largely collected and analyzed manually. Our multi-sensor approach is a much more efficient way to collect information on the peatland properties, and we can perform analyses almost in real time," explains Daniel Pönisch, who is responsible for the project. The measurements are then associated with geographic map data and meteorological values. This information is already enough to draw detailed conclusions about the peatland's condition.

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Drones and artificial intelligence

To gather further data from the surface, records are made of the different plants and their distribution over the area. In the process, expert botanists identify the plants directly in the field, using an app developed by the Fraunhofer team that makes it easier to enter the information. Drones also fly over the peatland in a grid pattern, using RGB and multispectral cameras to scan the vegetation. AI tools are then used to compare the drone images with the information provided by the botanists, yielding a detailed picture of the vegetation and types of plants present.

This botanical information is added to the data gleaned from the sensors, geographic maps and meteorological values, and everything is analyzed together as a whole. "We generate an image with a lattice structure, where every pixel brings together information from a variety of sources. This creates a multidimensional representation of the condition of the peatland across its entire area," explains product manager Milan Bergheim, a bioeconomy expert at Fraunhofer IGD. Finally, this is used as a basis for drawing highly detailed conclusions about the peatland's condition and planning rewetting measures.

To be able to make targeted use of all of this information in practice, the Fraunhofer researchers are developing a platform that incorporates all the different kinds of data. "Ultimately, looking at all the available information together makes it possible for us to put a value to how the ecosystem is performing. Those values are brought together, analyzed and displayed in a single platform," Pönisch says.

Data platform for planning firms

To make their work with the University of Greifswald as efficient as possible, the Fraunhofer researchers have opened an office in Greifswald specifically for this project. VALPEATS is especially valuable to planning firms, which are hired by municipalities and other entities to perform services. They receive a standardized, scalable data platform they can use to plan and monitor peatland maintenance or rewetting activities. Rewetting is achieved through measures such as rerouting streams or rivers or blocking specific drainage ditches, raising the water table.
Adjustments in the collection and analysis of data could also allow agricultural businesses operating in the field of paludiculture — managing peatlands through activities such as producing biomass from wet meadows, reeds or peat moss — to use the vegetation information as well. This makes it possible to determine which types of plants are present in the bales of material harvested. And that, in turn, facilitates further processing and customer-specific marketing.

Environmental certificate for the finance industry

VALPEATS is also opening up new opportunities for trading in environmental securities. The goal is to make it possible for designated peatlands or agricultural businesses operating in the field of paludiculture to obtain certification according to environmental standards based on the data from the monitoring platform. This will mobilize private-sector funds for rewetting purposes.

A pilot project in which the researchers can test their technology in real-world practice is already in progress. The Rosenhäger Wiese project in Glasin, in the state of Mecklenburg-Vorpommern, is rewetting a 5.4-hectare area and restoring the former peatland there. All of these initiatives serve a single aim, says Pönisch: "We need to raise public awareness of the need to protect and restore our precious peatlands. Our monitoring platform and AI tools can serve as the technological basis for this."

Fig. 1 Peatlands cover only three percent of the surface of the earth, but they store about twice as much carbon as the entire biomass of all of the world's forests.

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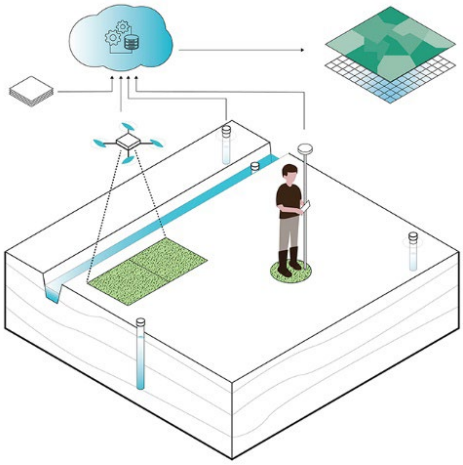

Fig. 2 VALPEATS links data spaces to evaluate the various roles this ecosystem plays: Sensors capture information on the soil and water, while drones photograph and survey the surface. The end product is a representation of vegetation distribution, water levels and greenhouse gas emissions over the entire peatland area.

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Fig. 3 The VALPEATS data platform displays the properties and measurement values for each section of a tract of peatland in a planned analysis. Time series can also be displayed.

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