Collaboration Between the Forestry and Space Industry for Taking Up Global Environmental Challenges

NeXT Forest — innovative collaborative project between Sumitomo Forestry and IHI for tropical forest and peatland management

Tropical forests play an essential role in achieving carbon neutrality and conserving biodiversity. Sumitomo Forestry Co., Ltd. and the IHI Group has launched a project to conserve and properly manage tropical forests, and even forecast how such forests become in the future. The project takes advantages of advanced forest management and water management techniques of Sumitomo Forestry and sophisticated sensing and data analysis technologies of the IHI Group.

Forests owned by Sumitomo Forestry (Photo provided by Sumitomo Forestry Co., Ltd.)

Introduction

To achieve carbon neutrality, in addition to reducing carbon dioxide emissions, it is necessary to preserve and enhance its absorption capacity. Since forests can absorb and fix carbon dioxide (or internally store it as carbon), they play an essential role toward achieving carbon neutrality. In recent years, the function they have in conserving biodiversity has also been drawing attention.

Current situation and issues of forests as natural capital

Due to a lack of actual measurement data for comparison and verification, it has become a challenge to improve the estimate accuracy of fixed carbon dioxide in forests. As such, the value of carbon credit corresponding to the amount of fixed carbon dioxide is not being properly evaluated currently. Forests significantly contribute against climate

Peat fire (Photo provided by Sumitomo Forestry Co., Ltd.; the site is not Sumitomo Forestry's business site)

change. And the proper management of forests contributes to the conservation of biodiversity, the water cycle on a global scale, and even the development of local communities. It is a great challenge for the future to appropriately evaluate these forests as natural capital and properly manage them.

Current situation and issues of tropical peatland

Like the forests that we have been talking about, the soil that nurtures forests is also an essential natural capital. A kind of soil known as tropical peatland is distributed in parts of Indonesia, the Congo Basin, and the Amazon as massive carbon storage. Tropical peatland is mostly composed of water, with the remaining part being organic matter from the remains of trees and other plants piled up without decaying. The area is estimated to be more than 820 000 km^2 around the globe, storing around 89 billion tons of carbon (about 10 times the global carbon emissions in 2017).

In tropical peatland, improper land management causes the groundwater level to drop and dry peat burns extremely easily. Haze pollution and carbon emissions to the atmosphere caused by peat fire are now large global issues. It is said that the peat fire that occurred in Indonesia in 2015 led to a loss of area of approximately 46 000 km^2 in total, emitting 890 million tons of carbon dioxide (which corresponds to 2.5% of the global carbon dioxide emitted that year). Therefore, water-level management is of extreme importance in tropical peatland.

NeXT Forest project

NeXT Forest (Negative emission eXpert Technologies for Forest) refers to a cooperative project between Sumitomo Forestry Co., Ltd. and IHI for a forest management consulting business and sustainable business development that maximizes the value of natural capital.

The major strength of Sumitomo Forestry is its forest management techniques cultivated through worldwide experience, management techniques for tropical peatland in Indonesia, and aboveground measurement data of the peatland accumulated for over 10 years.

The strength of the IHI Group, on the other hand, is its sensing and data analysis technologies cultivated over many years of space development as well as weather observation and forecasting.

By combining the strengths of both companies, we are looking to create a high-quality carbon credit. In this process, not only will we be adding to the value of carbon absorption as a climate change countermeasure, but also to the value of the natural capital, including biodiversity, water cycle conservation, and contribution to local communities.

IHI's technology and initiative 1: Groundwater level management system

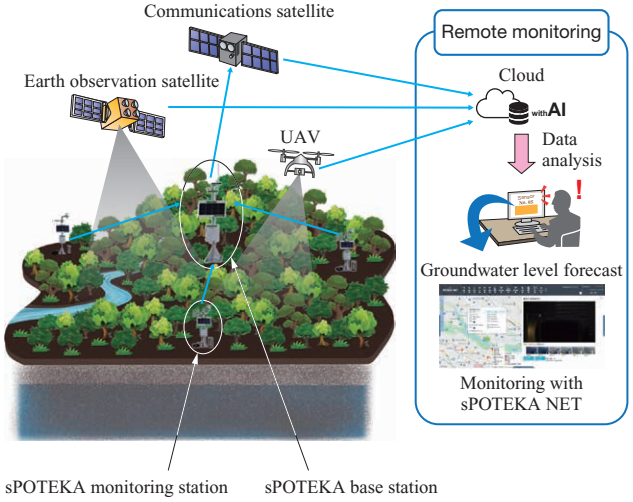
Sumitomo Forestry has undertaken a tree-planting program in the tropical peatland of Indonesia. They have the management skills to stabilize the groundwater level throughout the year and prevent peat fire, but they acquired them by trial and error on site. It is not easy for less experienced workers to stably maintain the appropriate groundwater level (within a limited range at several centimeters below the surface of the ground) as it heavily relies on the intuition and experience of skilled workers.

IHI decided to cooperate with Sumitomo Forestry to engage in the development of a groundwater level management system based on the current management techniques so that even less experienced workers will be able to conduct proper forest management.

(1) Sensing technology

In order to properly perform forest management in an extensive tropical peatland, sensing technology to accurately measure the weather conditions and groundwater level is indispensable.

For this reason, Sumitomo Forestry and the IHI Group have been jointly developing "sPOTEKA," a sensing



Groundwater level forecast system

solution for tropical peatland management. This development is based on POTEKA®, a high-density weather observation system developed by an IHI Group company, Meisei Electric Co., Ltd. POTEKA is a system for gathering weather data including temperature, atmospheric pressure, rainfall, and so on. As of September 2022, about 1 200 units have been delivered to local governments, private companies and universities. As an extension of the POTEKA system, sPOTEKA is equipped with a groundwater level sensor, which is essential for tropical peatland management. In addition, it also features the satellite communications function to communicate with the cloud so that it can be used in places where mobile communications services hardly be available. Specifically, in terms of configuration, the system includes two types of measurement devices: the base station and the monitoring station. They are connected wirelessly with the local network and the base station communicates with the cloud through satellite communications. Thanks to data management on the cloud, if the groundwater level is below the control value, for instance, sPOTEKA automatically sends an alert and provides information that is beneficial for the management such as fire risk. Moreover, the capability of remote detection of abnormalities in devices makes it possible to perform maintenance at appropriate times and helps achieve high operating rate of the system in the severe environment of the tropics.

We have constructed a groundwater level management system for stably maintaining the groundwater level throughout a year by combining data obtained by sPOTEKA, other weather information and artificial satellite data, and Sumitomo Forestry's aboveground measurement data.

(a) Base station (b) Monitoring station

Appearance of a full-size model of sPOTEKA

(2) Data analysis technology

For proper management of the groundwater level in tropical peatland, it is important to measure the current groundwater level and to forecast future behavior.

Accordingly, IHI is working on the development of a data analysis method to forecast the groundwater level based on data obtained using the sensing technology. Specifically, IHI aims to continuously forecast the distribution of groundwater spatially and temporally by combining a physical method to solve groundwater behavior (hydraulic model) and a statistical method using machine learning (machine learning model). This development, is conducted in collaboration with the University of Tokyo. So far, the analysis has been conducted based on altitude data, soil data obtained by boring measurement, and infrastructure data such as waterway locations provided by Sumitomo Forestry, as well as time series data including groundwater levels and rainfalls measured by observation equipment installed in the management zone. Currently, we are making improvements to the accuracy of groundwater level estimation by the hydraulic model and constructing the machine learning model.

IHI's technology and initiative 2: Estimation of the amount of fixed CO_2

Understanding forest information, including forest tree height, trunk diameter (diameter at breast height (DBH)) and tree species, is important in monitoring changes occurring in the forest. Since such forest information also helps us estimate the amount of fixed carbon dioxide in the forest, it is useful in appropriately evaluating the value of forests as natural capital as well. However, it is not realistic to manually collect forest information in an area so vast as tropical peatland.

Therefore, at IHI, we have been developing a technology to gather forest information based on data obtained by remote measurement using artificial satellites and unmanned aerial vehicles (UAV). Sensing with artificial satellites, in particular, which allows an extensive range to be observed at once, is effective in forest management. Visible light and infrared light spectrum data from a forest is analyzed by AI to identify tree species. Then, by combining the result with tree height and trunk diameter data measured by using microwave radiometer and laser light, forest biomass (forest dry weight) and the amount of fixed carbon dioxide are estimated.

By combining IHI's sensing and data analysis technologies as described above and detailed aboveground measurement data being collected and accumulated by Sumitomo Forestry, we will evaluate the forest information and estimated amount of fixed carbon dioxide and improve their accuracy.

Global development: Exhibiting at COP26

To communicate this initiative for climate change to the world, Sumitomo Forestry and IHI jointly exhibited at the Japan Pavilion in the 26th United Nations Framework Convention on Climate Change Conference of Parties (COP26) held in Glasgow, U.K. from October 31 to November 13, 2021.

We introduced our efforts to globally implement the solution that combines the IHI Group's technologies using satellite data and state-of-the-art sensing technology for weather observation and forecasting with Sumitomo Forestry's tropical peatland management techniques. We were also excited to introduce the NeXT Forest project at the seminar hosted by The Ministry of Economy, Trade and Industry (METI) of Japan, "Utilization of satellite data and sustainable tropical peatlands management through Japan Industrial-Government-Academia Collaboration," and at the Peatland Pavilion hosted by the United Nations Environment Programme (UNEP).

While exhibiting a full-scale model of the sPOTEKA sensing solution for tropical peatland management at the Japan Pavilion and the Peatland Pavilion, we also displayed groundwater level, amount of rainfall, and other weather data obtained by a prototype system installed in Kalimantan in Indonesia to demonstrate its functionality.

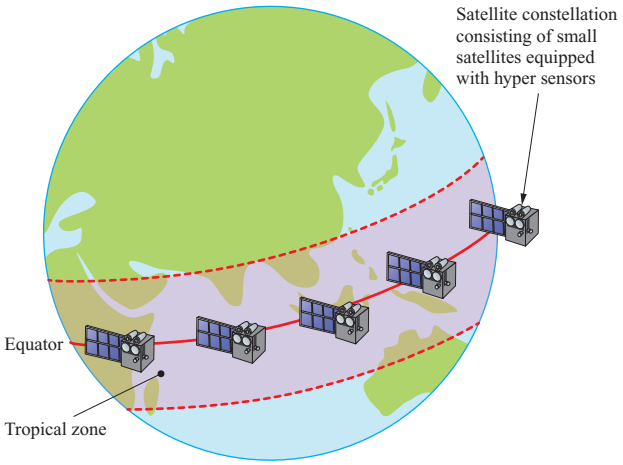
The COP26 summit, at which forest conservation has started to gain attention as a specific solution, was a good opportunity to introduce this initiative by Sumitomo Forestry and IHI. We received inquiries from participants from Africa at a later day, indicating the high level of interest in our technology. Going forward, we will continue to actively communicate the importance of this project to the world.

Conclusion

Conservation and proper management of tropical peatland play an essential role in solving social challenges, such as achieving carbon neutrality and conserving biodiversity. On the other hand, such proper management requires multiple state-of-the-art technologies, including that for groundwater level management, to spread as technologies that can easily be implemented at low cost.

With respect to the groundwater level management system, our future prospects are to develop a technology to produce even higher added value information from the data we obtain. As an example, we will provide a solution that will take forest management in tropical peatland to the next level of sophistication by realizing a function to calculate fire risks. As for the technology to estimate the amount of fixed carbon dioxide in forests, we will promote development in data analysis for evaluating forest information and use it to monitor forest fires and illegal logging. Moreover, we will launch multiple artificial satellites on the equator and construct a satellite constellation with the aim of creating a sensing system based on monitoring with a high time resolution that can be used for tropical peatland around the world.

The IHI Group will build a sustainable business for solving environmental challenges faced by the world through the NeXT Forest project in conjunction with Sumitomo Forestry.



Equator satellite constellation

sPOTEKA exhibited at COP26