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PRESS RELEASE (2025/03/21)

Drying and rewetting cycles substantially increased soil CO_2 release

The amount of carbon dioxide (CO_2) released by microbial decomposition of soil organic carbon on a global scale is approximately five times greater than the amount of anthropogenic CO_2 emissions. Thus, it is essential to clarify the impact of climate change on soil CO_2 release dynamics.

A collaborative research group consisting of Dr. Hirohiko Nagano and Ms. Yuri Suzuki of Niigata University with Professor Syuntaro Hiradate from Kyushu University's Facutly of Agriculture, and the Japan Atomic Energy Agency conducted incubation experiments on forest and pastureland soils at 10 locations across Japan. The research group revealed that the amount of CO_2 released from soil increases significantly due to repeated drying and rewetting cycles (DWCs) expected to be caused by changes in precipitation patterns due to global warming.

Here, the CO_2 release under DWCs were 1.3- to 3.7-fold greater than under continuous constant moisture conditions. They also observed a significant decrease in microbial biomass under DWCs, suggesting that the newly supplied organic carbon resulting from the destruction of microbial cells by repeated DWCs contributed to the increase in CO_2 release. In addition, it was found that the increased rate of CO_2 release due to repeated DWCs was greater in soils with a higher abundance of reactive metal-organic matter complex. This suggests that the reactive metal-organic matter complex, considered important as a stable accumulation mechanism for soil organic carbon, may become more readily available to microorganisms through repeated DWCs. Thus, organic carbon that has previously avoided decomposition may become a new source of CO_2 release under DWCs.

Dr. Nagano pointed out that extreme weather phenomena are becoming more evident due to global warming. Furthermore, he says that the results of this research will lead to a detailed elucidation of the impact of extreme weather phenomena on soil CO_2 emissions, contributing to improving the accuracy of prediction models for the future of the global environment. In the future, they plan to conduct impact assessments and mechanism verification in outdoor environments in addition to further detailed research of mechanisms for the DWCs-induced increase in CO_2 releases among various soils all over the world.

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For more information about this research, see "Comprehensive increase in CO2 release by drying-rewetting cycles among Japanese forests and pastureland soils and exploring predictors of increasing magnitude" Yuri Suzuki, Syuntaro Hiradate, Jun Koarashi, Mariko Atarashi-Andoh, Takumi Yomogida, Yuki Kanda, and Hirohiko Nagano, *SOIL*, https://doi.org/10.5194/soil-11-35-2025

About Kyushu University
Founded in 1911, Kyushu University is one of Japan's leading research-oriented institutes of higher education, consistently ranking as one of the top ten Japanese universities in the Times Higher Education World University Rankings and the QS World Rankings. The university is

one of the seven national universities in Japan, located in Fukuoka, on the island of Kyushu—the most southwestern of Japan's four main islands with a population and land size slightly larger than Belgium. Kyushu U's multiple campuses—home to around 19,000 students and 8000 faculty and staff—are located around Fukuoka City, a coastal metropolis that is frequently ranked among the world's most livable cities and historically known as Japan's gateway to Asia. Through its VISION 2030, Kyushu U will "drive social change with integrative knowledge." By fusing the spectrum of knowledge, from the humanities and arts to engineering and medical sciences, Kyushu U will strengthen its research in the key areas of decarbonization, medicine and health, and environment and food, to tackle society's most pressing issues.

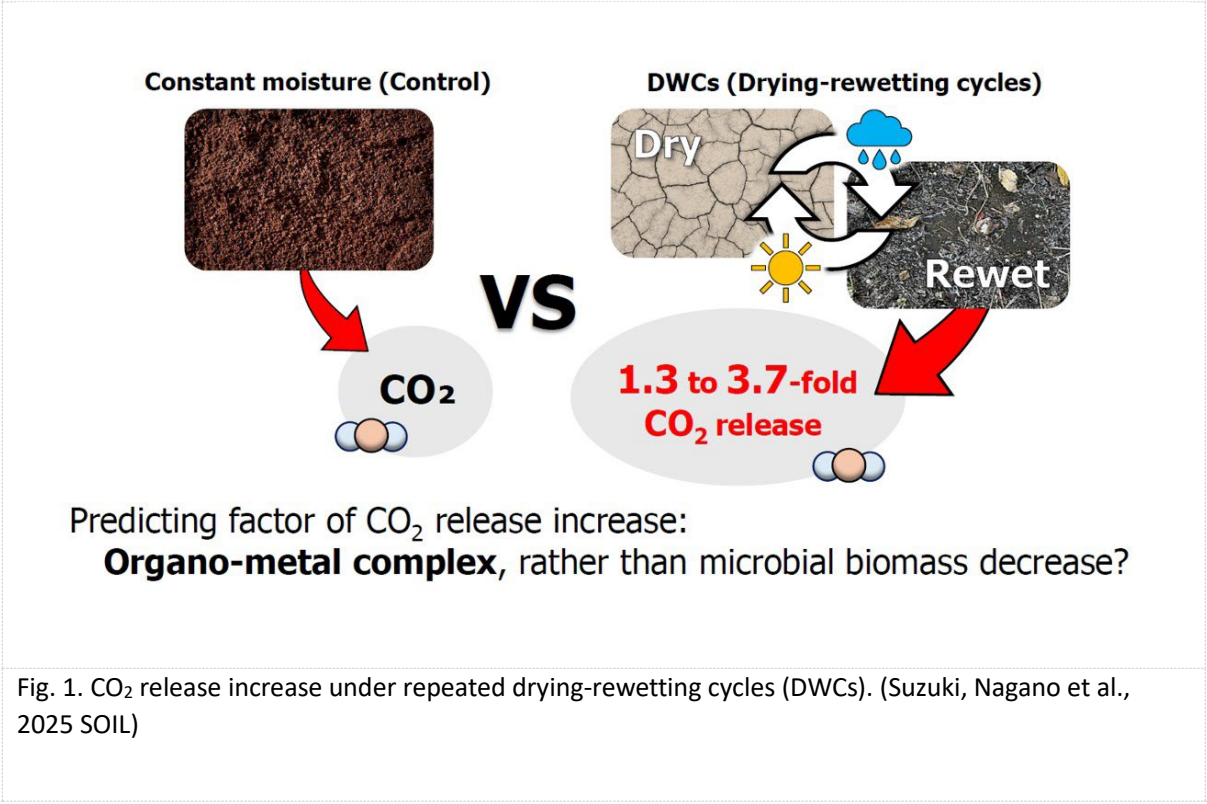

Fig. 1. CO_2 release increase under repeated drying-rewetting cycles (DWCs). (Suzuki, Nagano et al., 2025 SOIL)

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