Drying and rewetting cycles substantially increase soil CO_2 release, study shows

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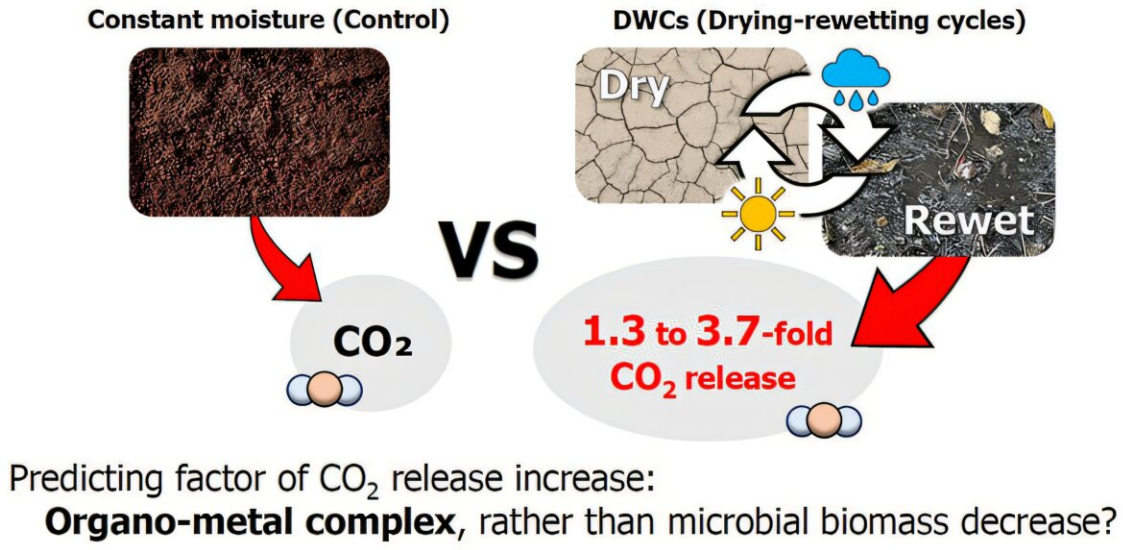

CO_2 release increase under repeated drying-rewetting cycles (DWCs). Credit: Suzuki, Nagano et al., 2025 SOIL

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 researchers from Kyushu University and the Japan Atomic Energy Agency conducted incubation experiments on forest and pastureland soils at 10 locations across Japan.

The research is published in the journal *SOIL*.

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 was 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 points 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.

More information: Yuri Suzuki et al, Comprehensive increase in CO2 release by drying–rewetting cycles among Japanese forests and pastureland soils and exploring predictors of increasing magnitude, *SOIL* (2025). DOI: 10.5194/soil-11-35-2025

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