Water availability determines carbon uptake under climate warming: study

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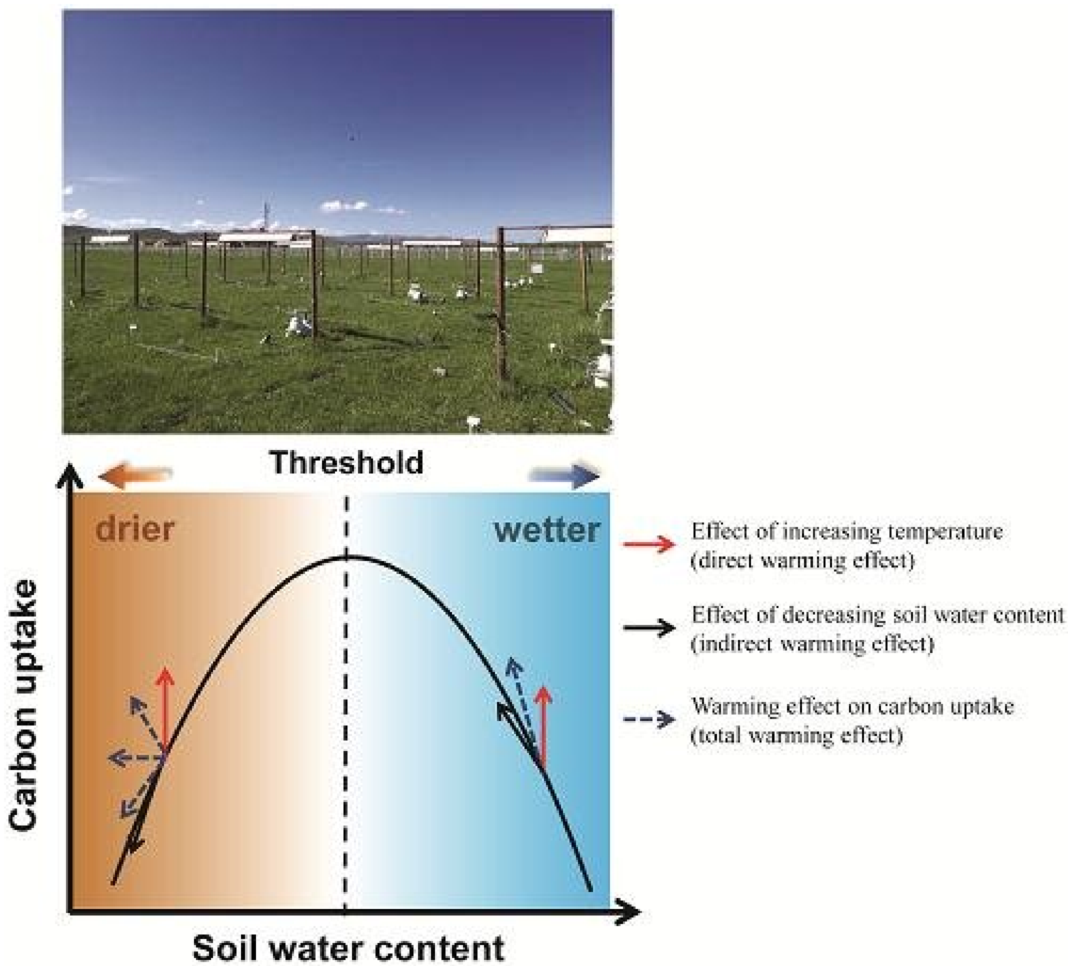

Credit: CAS

Increasing atmospheric CO_2 concentration is the leading cause of greenhouse effects and global warming. Notably, rapid climate warming can, in turn, either increase or decrease land carbon uptake, leading to negative or positive carbon cycle-climate change feedback, respectively.

Scientists previously did not understand what caused the direction of carbon-climate feedback, making it difficult to predict future climate warming.

Recently, however, a research group led by Dr. Niu Shuli from the Institute of Geographic Sciences and Natural Resources Research (IGSNRR) of the Chinese Academy of Sciences found that water availability in soil determines the direction of carbon-climate feedback. The group's findings were published in *Science Advances* on August 22, 2019.

The research team drew the conclusion primarily based on a field manipulation experiment in an alpine meadow on the Qinghai-Tibetan Plateau. They found that land carbon uptake increased when soil water content (SWC) was below its optimum but decreased above the optimum.

They revealed clear response surfaces showing how water availability determined the carbon cycle-climate warming feedback direction. Above optimum SWC, warming-induced decreases in SWC enhanced the direct warming effect of increasing soil temperature on land carbon uptake, leading to strong negative feedback.

However, below the optimum, warming-induced reduction in SWC dampened the direct warming effects on carbon uptake under moderately dry conditions and caused positive feedback under severe dry conditions.

"In addition, to test whether this water scaling pattern is generalizable across the ecosystem, we combined the site-level mechanism with a global synthesis. The results also show that warming stimulates net carbon uptake (negative feedback) under wet conditions but depresses it (positive feedback) under very dry conditions," said Prof. Niu.

The water scaling pattern revealed in this study provides compelling evidence that water regulates ecosystem feedback to climate warming at both temporal and spatial scales. It offers generalizable mechanisms that not only help explain varying magnitudes and directions of observed carbon-climate feedback but also improve model prediction of ecosystem carbon dynamics in response to climate warming.

More information: Quan Quan et al, Water scaling of ecosystem carbon cycle feedback to climate warming, *Science Advances* (2019). DOI: 10.1126/sciadv.aav1131

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