Study suggests non-uniform climate warming affects terrestrial carbon cycle, ecosystems and future predictions

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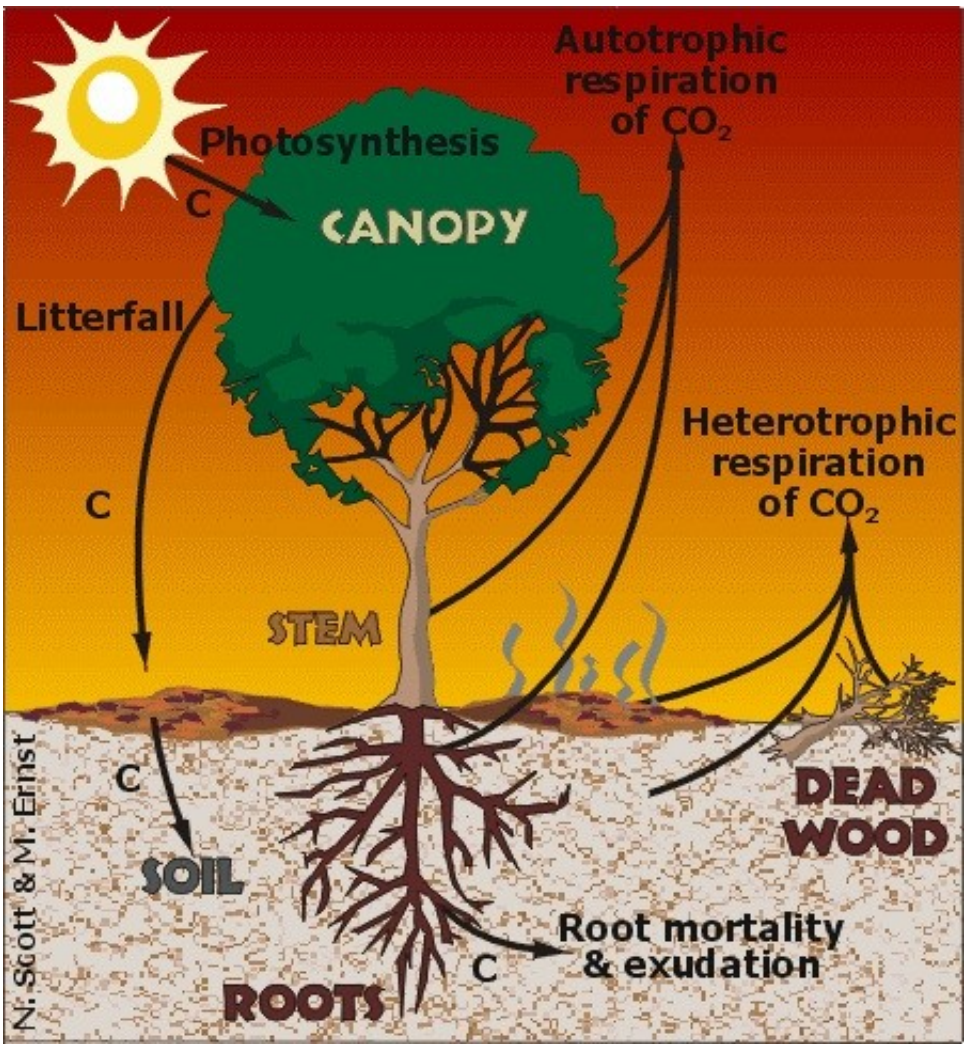

A recent University of Oklahoma study of five decades of satellite data, model simulations and in situ observations suggests the impact of seasonal diurnal or daily warming varies between global regions affecting many ecosystem functions and services, such as food production, carbon sequestration and climate regulation. The effects of non-uniform climate warming on terrestrial ecosystems is a key challenge in carbon cycle research and for those making future predictions.

Jianyang Xia, a research associate in the OU College of Arts and Sciences, says the impact of non-uniform warming is just one aspect of climate change. Shifts in precipitation and disturbances, such as wildfires, increases in the frequency of extreme temperature events, large year-to-year shifts in temperature and shifts in regional climate zones can be expected as the climate warms. A complete understanding of the consequences of climate change for carbon cycling on land requires insight into the impact of all these changes on the ecosystem.

As this study suggests, the rate of climate warming varies by season and region, and between day and night. A synthesis of air temperature data from across the world reveals a greater rate of warming in winter than in summer in northern and high latitudes, but the inverse is true in some tropical regions.

Also, the data show a decline in the daily temperature range over 51 percent of the globe and an increase over only 13 percent, because night-time temperatures in most locations have risen faster than daytime temperatures.

From the data analyzed, a number of trends emerged in non-uniform climate warming for ecosystem carbon cycling. Spring warming will enhance ecosystem carbon uptake at high latitudes and diminish the magnitude of seasonal temperature change in these regions. Summer and

autumn warming are more likely to reduce ecosystem carbon uptake in tropical ecosystems and amplify the magnitude of seasonal temperature change.

The contrasting impacts of day- and night-time warming on plant carbon gain and loss are apparent in many regions. Day warming increases carbon uptake in most areas of tundra and boreal forests but decreases it in most grasslands and deserts. Night warming enhances carbon uptake in arid ecosystems, such as grassland desert but has negative impacts in other regions.

Most of the existing temperature-manipulation experiments relied on continuous and uniform warming, so further research is needed to predict the effects of non-uniform climate warming on terrestrial carbon cycling.

A paper on this study was accepted for early online publication on February 23, 2014, by *Nature Geoscience*.

Provided by University of Oklahoma

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