Study finds future terrestrial ecosystem will produce more oxygen for the atmosphere

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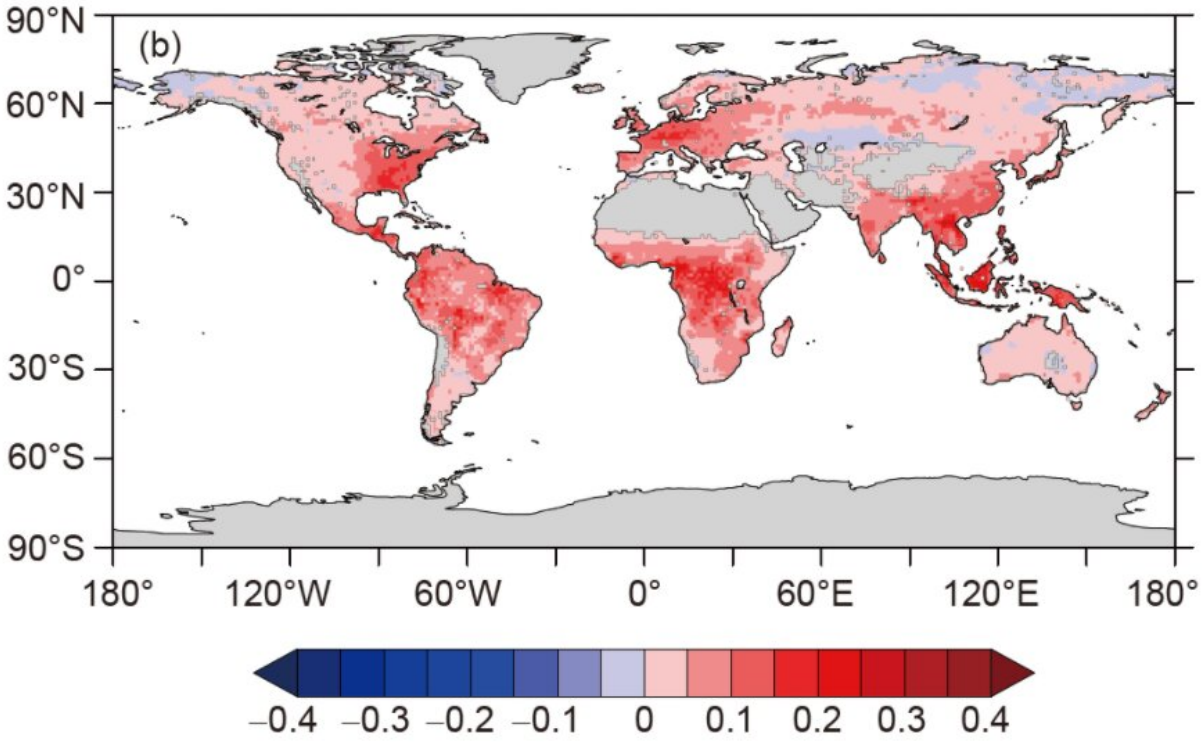


The main O_2 sources are located in the tropics, and the O_2 fluxes decrease as the latitudes decrease. Credit: Science China Press

In a study led by Dr. Lei Ding and Prof. Jianping Huang (College of Atmospheric Sciences, Lanzhou University), researchers found the future terrestrial ecosystem will produce more oxygen for atmosphere

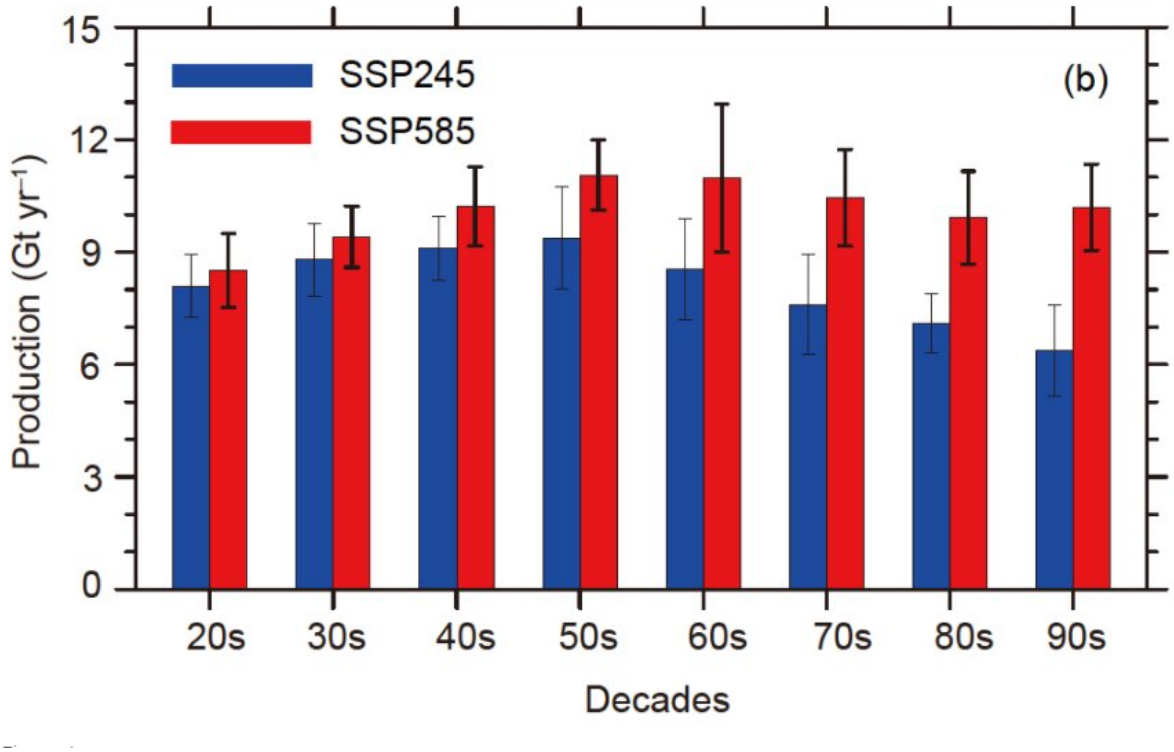
when exploring the variation of the modern oxygen cycle.

"Oxygen cycle is an essential biogeochemical cycle for all aerobic life on Earth. However, the modern oxygen cycle has experienced a drastic change compared with that in pre-industrial period," Huang says. This change is characterized by the decline in atmospheric oxygen (O_2) level, which continued for recent decades.

As a main component of oxygen cycle, the terrestrial ecosystem had attracted the researchers' attention. To determine the response of ecosystem O_2 production to climate change and anthropogenic activities, the research group developed a long-term global terrestrial ecosystem O_2 production database.

They found that, as the largest O_2 source on Earth, terrestrial ecosystem can produce more than 80% of the total O_2 production (7.10 Gt from land, 1.74 Gt from ocean). The main O_2 sources are located in the tropics, and the O_2 production decrease as the latitudes increase.

The team also found, in the future, the terrestrial ecosystem O_2 productions will experience a significant increase, which may slow down the decline of atmospheric O_2 level. "With the increase in net photosynthesis of vegetation, more O_2 will be emitted into atmosphere," Ding says.



The blue and red bars represent the annual terrestrial O_2 production per decade in the SSP245 and SSP585 scenarios, respectively. The black lines denote the standard errors of the bars. Credit: Science China Press

Long-term analysis reveals that anthropogenic activities and climate change are responsible for the variations in terrestrial O_2 sources, owing to land-use changes and competing effects between net photosynthesis and heterotrophic respiration. By 2100, more O_2 will be produced from the low and middle latitudes, while the high latitudes will serve as a larger oxygen sink due to extreme land-use type changes and drastic increases in soil respiration.

"The increase of terrestrial O_2 production will partly compensate for the loss of O_2 in the atmosphere. However, we must stress that this situation is still not optimistic, as the amount of O_2 consumed by fossil fuel

combustion is also increasing to unprecedented levels. If we rely entirely on ecosystem adaptation and recovery without reducing or limiting fuel combustion and other anthropogenic activities, the O_2 concentration will continue to decline," Huang says.

This study of O_2 production in terrestrial ecosystems complements the understanding of the modern oxygen cycle and helps provide better estimates for future variations in atmospheric O_2 level. Moreover, the integrated long-term global terrestrial ecosystem production database provides a new tool for assessing ecosystem health.

The research was published in *Science China Earth Sciences*.

More information: Lei Ding et al, Variations in terrestrial oxygen sources under climate change, *Science China Earth Sciences* (2022). DOI: 10.1007/s11430-021-9956-5

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