

Global Pyrogenic Carbon Production During Recent Decades Has Created the Potential for a Large, Long-Term Sink of Atmospheric CO₂

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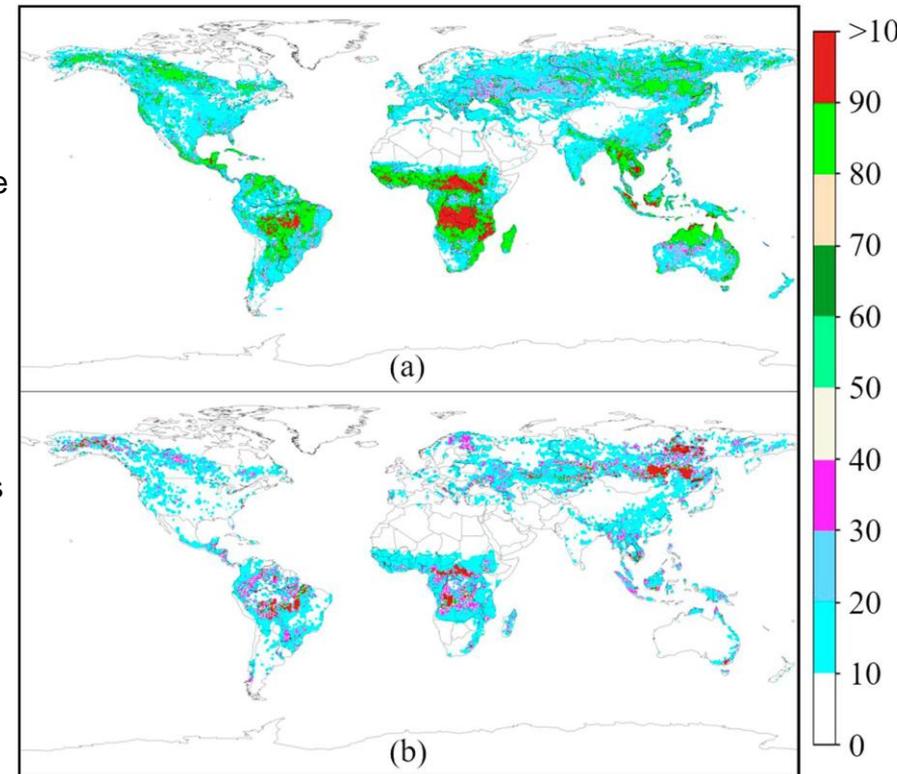
Background: Fires play an important role in the terrestrial biosphere carbon cycle, not only through direct carbon release but also contributing to potential long-term storage as pyrogenic carbon (PyC). PyC is formed through fires, and is more stable in soil and sediment than original biomass. At the global scale, contributions of fires to both atmospheric CO₂ emissions and PyC accumulation are potentially large but difficult to estimate.

Methods: This analysis looked at existing simulation results from two different modeling approaches (Global Fire Emissions Database version 4 [GFED4s] and Terrestrial Ecosystem Model version 6 [TEM6]) that used global area burned data to provide recent, retrospective estimates of CO₂ emissions from vegetation combustion, together with published, biome- and continental-scale conversion ratios that relate CO₂ emissions to PyC production (PyC/CO₂) in combustion.

Results:

- GFED4s estimated 2,041 Tg C/year between 2000 and 2016.
- TEM6 estimated 643 Tg C/year from 2000 to 2010.
- Global PyC production estimates from fires were 153.4 ± 18.7 (GFED4s) and 49.5 ± 4.9 Tg C/year (TEM6).
- African tropical savanna fires produced the largest amount of CO₂ emissions and PyC among global biomes.
- The most significant interannual variations in CO₂ emissions and PyC production were found in tropical forests.

Significance: This new approach represents an improved estimate of global PyC emissions from fires. The magnitude of PyC produced by fires each year represented a potentially significant long-term sink of atmospheric CO₂.



The mean of grid-weighted average annual CO₂ (g C·m²·year⁻¹) released from fires resulting from (a) GFED4s in the period of 2000–2016, and (b) TEM6 in the period of 2000–2010. GFED4s = Global Fire Emissions Database version 4; TEM6 = Terrestrial Ecosystem Model version 6.