comparing elevated-frequency versus protected plots are attributable both to C and N accumulation during fire protection, and to C and N loss during increased burning.

In conclusion, our results reveal the sensitivity of surface soils to fire and the substantial effects that changes in soil pools have on long-term ecosystem C exchange. The large empirical and conservative model-based estimates of soil C changes suggest that present estimates of fire-driven C losses[7], which primarily consider losses from plant biomass pools, may substantially underestimate the effects of long-term trends in fire frequencies in savanna grasslands and broadleaf forests in particular. Our findings suggest that future alterations in fire regimes in savanna grasslands and broadleaf forests may shift ecosystem C storage by changing soil C levels and changing the N limitation of plant growth, altering the carbon-sink capacity of these fire-prone ecosystems.

Data Availability The datasets generated and analysed during this study are available from the corresponding author on request and in the corresponding papers cited in Supplementary Information.

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