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South American fires and their impacts on ecosystems increase with continued emissions

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Unprecedented fire events in recent years are leading to a demand for improved understanding of how climate change is already affecting fires, and how this could change in the future. Increased fire activity in South America is one of the most concerning of all the recent events, given the potential impacts on local health and the global climate from loss of large carbon stores under future environmental change. However, due to the complexity of interactions and feedbacks, and lack of complete representation of fire biogeochemistry in many climate models, there is currently low agreement on whether climate change will cause fires to become more or less frequent in the future, and what impact this will have on ecosystems. Here we use the latest climate simulations from the UK Earth System Model UKESM1 to understand feedbacks in fire, dynamic vegetation, and terrestrial carbon stores using the fire-enabled land surface model JULES-INFERNO, taking into account future scenarios of change in emissions and land use. Based on evaluation of the modelling framework performance for the present day, we address the specific policy-relevant question: how much fire-induced carbon loss will there be over South America at different global warming levels in the future? We find that burned area and fire emissions are projected to increase in the future due to hotter and drier conditions, which leads to large reductions in carbon storage especially when combined with increasing land-use conversion. The model simulates a 38% loss of carbon at 4°C under the highest emission scenario, which could be reduced to 8% if temperature rise is limited to 1.5°C. Our results provide a critical assessment of ecosystem resilience under future climate change, and could inform the way fire and land-use is managed in the future to reduce the most deleterious impacts of climate change.