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Savanna carbon turnover: quantifying source and sink dynamics from frequent and infrequent disturbance events in north Australian savannas

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Approximately 12% of the world's savanna biome is found in north Australia. Given it's size, understanding process that determine carbon, water and energy exchange with the atmosphere is essential. Ecosystem carbon dynamics is driven by climatic drivers and disturbance regimes. Savanna ecosystems of north Australia experience a unique combination of climatic extremes and are in a state of near constant disturbance from either fire events (events 1 in 3 years), storms and cyclones (1 in 50 years) or from mega-cyclones (1 in 500 years). As a result, these savannas are likely to be a spatial and temporal mosaic of carbon sources and sinks. At a patch scale, post-cyclonic recovery results in a carbon sink in the vicinity of 2-3 t C ha-1 y-1, with this sink persistent for 40 or more years. However, this carbon accumulation can be rapidly lost via large fire events or more significantly, extreme cyclonic events which are associated with large greenhouse gas emissions . We quantify the carbon loss associated with frequent, but low intensity fire events as well as losses from a mega-cyclone event that affected 7000 km2 of savanna across north Australia which released 38.8 Mt CO_2-e, equivalent to $\sim$10 of Australia's accountable greenhouse gas emissions. The impacts of climate variability on these processes needs to be understood, especially given the increasing interest for using savanna environments for enhanced carbon sinks in emissions offset schemes.