Partitioning soil organic carbon for Australian croplands

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Abstract: Croplands cover ca. 3% of terrestrial ecosystem but account for 18% of anthropogenic carbon emission in Australia. Understanding carbon emission and sequestration in croplands is a necessary step towards carbon neutrality at industry and country scales. Here we combined models and ground-based observations to quantify the steady state soil organic carbon stock (SOC) of croplands in Australia. The steady state SOC is first modelled based on the carbon inputs and decomposition in a process-based model at 1,873 sites and extrapolated to all croplands at 1 km resolution with a neural network model. The SOC thus accounted for the impacts of climate, vegetation and management, but excluded any char and biochar. We then partitioned the climate- sensitive and resistant pools of SOC across Australia croplands. The results indicated a mean SOC of 11.6 t C ha-1 with high spatial variability, reflected by a standard deviation of 5.0 t C ha-1 and a coefficient of variation of 43%. On average, 36.1% of SOC is climate sensitive, while 61.3 % is climate resistant. The remining 2.6% of SOC is soil microbial biomass. We showed that the change of SOC in Australian croplands is likely jointly controlled by plant productivity, soil chemistry and existing SOC. This study provided quantification of SOC for Australian croplands and highlighted the potential as well as vulnerability of carbon sequestration of Australian croplands. The findings could facilitate future cropland policy making for maximising carbon sequestration.

Keywords: *soil organic carbon, cropland, process-based model, machine learning*

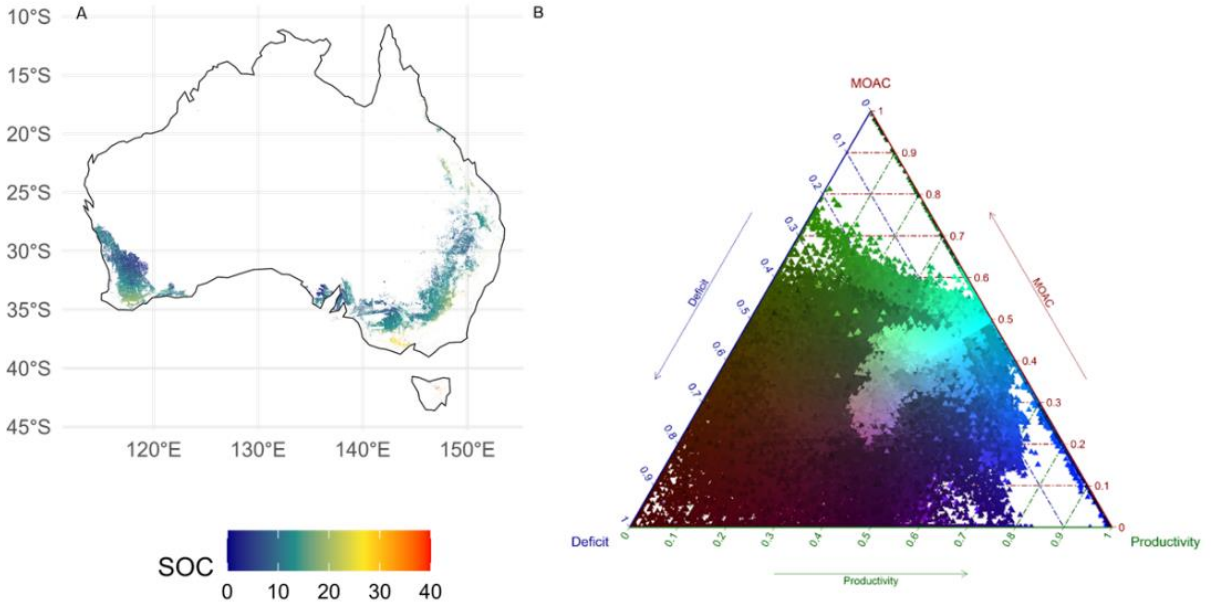

Fig 1. The steady state soil organic carbon (SOC) of Australia croplands (A) and the limiting factors (B). MOAC is the mineral associated organic carbon. The deficit is the difference between existing and potential MOAC. Extreme values accounting for <5% of the data are not shown. The unit of SOC is t C ha^{-1}.