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Sediment CO_2 efflux from cleared and intact temperate mangrove and tidal flat habitat

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Temperate mangroves in Southern Australia and New Zealand have been increasing in extent over the past 50 years, whereas tropical mangroves have declined by 30-50% over a similar time frame to support development of aquaculture, land development and timber production. Tropical mangroves are understood to be an important carbon sink and carbon emissions following clearance are estimated to be significant; comparable or greater than clearance of many terrestrial forest systems. As temperate mangrove clearance is proposed and has already occurred at some locations, it is important to determine potential carbon emissions from temperate mangroves, as well as exploring the factors which may influence emission rates. Here, we investigated the impact of temperate mangrove clearance on CO_2 efflux from the sediment to the atmosphere along with a range of other biotic and abiotic factors.

Higher CO_2 efflux rates were observed within cleared (1.34 ± 0.46 μmol m^2 s^{-1}) and intact mangrove (2.31 ± 0.72 μmol m^2 s^{-1}) than in tidal flat sites (-0.23 ± 0.27 μmol m^2 s^{-1}). Numerous site characteristics (sediment carbon, nitrogen, and chlorophyll α concentration, grainsize, mangrove height, macrofaunal abundance, and sediment temperature and moisture) were related to sediment CO_2 efflux. CO_2 efflux from intact and cleared temperate mangrove was found to be comparable to rates observed in the tropics. Disturbance of the surface biofilm resulted in elevated CO_2 efflux across all habitats, suggesting the important role of surface biofilm communities in mediating CO_2 efflux. Our results suggest that carbon stored within temperate mangrove sediment is released over a period of years to decades after mangrove clearance, in rates comparable to clearance of tropical mangrove.