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Responses of CO_2 and CH_4 fluxes in early stage managed re-alignment saltmarshes to tidal inundation and climatic conditions

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Saltmarsh restoration projects convert historic saltmarshes, reclaimed for agricultural land, back to functional saltmarshes, a process known as managed re-alignment. However, knowledge of carbon cycling at managed re-alignment sites is limited, speculation exists as to the magnitude of $CO_2$and CH_4 fluxes and whether managed re-alignment sites are net carbon sinks.

A closed chamber method was used to collect data on $CO_2$and CH_4 fluxes at a newly created managed re-alignment site in Hesketh, North-West England, and a naturally establishing saltmarsh in Southport, North-West England.

Site net ecosystem respiration for the managed re-alignment site ranged from 0.020 $gCO_2\ m^{-2}\ h^{-1}$ to 0.279 $gCO_2\ m^{-2}\ h^{-1}$ and had a slight positive correlation with soil temperature (r^2= 0.385 n=32). Data from a nearby natural saltmarsh demonstrated NER (Net Ecosystem Respiration) values between 0.119 $gCO_2\ m^{-2}\ h^{-1}$ and 0.826 $gCO_2\ m^{-2}\ h^{-1}$ and had a stronger positive correlation between NER and soil temperature (r^2= 0.488 n=17) than the managed re-alignment site. Initial data reveals that early stage managed re-alignment site carbon NEE (Net Ecosystem Exchange) is sensitive to tidal inundation. NEE CO_2fluxes reached their highest values on the managed re-alignment saltmarsh (0.238 $gCO_2\ m^{-2}\ h^{-1}$) after an inundation following a dry period (584 hours). Conversely CH_4fluxes for the managed re-alignment site were at their lowest values (-2.285E-5 $gCH_4\ m^{-2}\ h^{-1}$) during the same tidal inundation period. Following a similar drying period (559 hours) the natural saltmarsh continued to sink CO_2(-0.195 $gCO_2\ m^{-2}\ h^{-1}$), but converted from a CH_4 source (max value of 0.784E-5 $gCH_4\ m^{-2}\ h^{-1}$) to a sink (max value -4.023E-5 $gCH_4\ m^{-2}\ h^{-1}$) following inundation. The managed re-alignment site continued as a NEE CO_2 source until a second drying period occurred (157 hours) following a series of low tides returning it to a sink (-0.009 $gCO_2\ m^{-2}\ h^{-1}$). The natural site continued as a net ecosystem exchange CO_2 sink until vegetation die back occurred in late October returning it to a source of both CO_2 (0.103 $gCO_2\ m^{-2}\ h^{-1}$) and CH_4 (0.779E-5 $gCH_4\ m^{-2}\ h^{-1}$).