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Assessing nitrous oxide emissions from managed aquifer recharge basins undergoing wet-dry cycling column simulations

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Over pumping and climate change induced droughts have exhausted California's natural groundwater supply. To mitigate this issue, managed aquifer recharge (MAR) basins on agricultural fields have been implemented as an artificial method for groundwater restoration. In these basins, untreated stormwater runoff which can contain high concentrations of nitrate is collected during rain events as the source for groundwater infiltration. Carbon-based materials (wood mulch) are tilled into the surface sediments of MAR basins to act as a source of electron donors to stimulate microbial denitrification within the flooded basins during infiltration. However, prior to N_2 production, Microbial denitrification can release nitrous oxide (N_2O) as an intermediate, a potent greenhouse gas. Currently, it is unknown how MAR basins contribute to N_2O emissions, and how emission dynamics change due to redox fluctuations as the basin floods and drains. To close this gap, soil cores containing inert sand, clay, and wood mulch were used to replicate the natural basin profile. Soil cores were set up to undergo a wetting-drying cycle lasting for 49 days. Treatments included one control and two treatments: a continuously saturated control, one flood event, and two flood events to examine the effects of repeat wetting cycles. We hypothesize that the highest fluxes of N_2O release will occur when the soils are first wet up prior to saturation. A smaller flux of N_2O is expected after soils are flooded a second time due to starting with more saturated conditions where more pores are already filled. N_2O flux in the control is expected to be the lowest, where oxygen levels will remain suppressed and highly reducing conditions will favor denitrification all the way to N_2. The findings of this study can be used to better understand the dynamics of soil greenhouse gases in MAR systems and their contribution to GHG emissions.