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# Water management reduces greenhouse gas emissions in a Mediterranean rice paddy field

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Rice paddy fields are one of the biggest anthropogenic sources of methane (CH4), the second most important greenhouse gas (GHG) after carbon dioxide ($CO_2$). Therefore most studies on greenhouse gases (GHG) in these agricultural systems focus on the evaluation of CH4 production. However, there are other GHGs such as $CO_2$ and nitrous oxide (N2O) also exchanged within the atmosphere. Since each of the GHGs has its own radiative forcing effect, the total GHG budget of rice cultivation and its global warming potential (GWP) must be assessed. For this purpose a field experiment was carried out in a Mediterranean rice paddy field in the Po Valley (Italy), the largest rice producing region in Europe. Ecosystem $CO_2$ and CH4 fluxes were assessed using the eddy covariance technique, while soil respiration and soil CH4 and N2O fluxes were measured with closed chambers for two complete years. Combining all GHGs measured, the rice paddy field acted as a sink of -368 and -828 g $CO_2$ eq m-2 year-1 in the first and second years respectively. Both years, it was a $CO_2$ sink and a CH4 source, while the N2O contribution to the GWP was relatively small. Differences in the GHG budget between the two years of measurements were mainly caused by the greater CH4 emissions in the first year (37.4 g CH4 m-2 compared to 21.03 g CH4 m-2 in the second year), probably as a consequence of the drainage of the water table in the middle of the growing season during the second year, which resulted in lower CH4 emissions without significant increases of N2O and $CO_2$ fluxes. However, midseason drainage also resulted in small decreases of yield, indicating that GHG budget studies from agricultural systems should consider carbon exports through the harvest. The balance between net GWP and carbon yield indicated a loss of carbon equivalents from the system, which was more than 30-fold higher in the first year. Our results therefore suggest that an adequate management of the water table has the potential to be an effective GHG mitigation strategy to increase the carbon sequestration capacity of rice paddy fields and confirm that GHG budgets should be assessed in combination with yield in order to develop and evaluate mitigation strategies.