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Greenhouse gas budget from a rice paddy field in the Albufera of Valencia, Spain.

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Rice paddy fields are large sources of anthropogenic methane (CH4) and therefore many studies have assessed CH4 fluxes from rice paddy fields, mainly in Asia where most of the rice cultivation takes place. However, rice is also cultivated in the Mediterranean, where climatic and management conditions greatly differ. In the Albufera of Valencia, the largest freshwater lagoon in Spain, rice paddy fields have the particularity of being flooded not only while the rice grows, but also after the harvest during the winter. These flooding conditions might result in emissions which are very specific of this ecosystem, and cannot be extrapolated from other studies. We studied CH4 fluxes in a rice paddy field in the Albufera of Valencia at different stages of rice cultivation using the eddy covariance technique and static chambers. We additionally measured carbon dioxide (CO_2), water fluxes and nitrous oxide (N2O) fluxes with eddy covariance and chamber methods respectively, in order to obtain a full greenhouse gas (GHG) budget. Our study also aimed at providing a mechanistic understanding of GHG emissions at different stages of rice cultivation, and therefore we also used the Enhanced and Normalized Vegetation Indexes (EVI and NDVI, respectively), derived from remote sensing images. The general ecosystem functioning encompasses three different phases. The first one, over the autumn and the winter, a biological dormancy period causes low CO_2 emissions (ca. 1-5 μmol m-2 s-1), which coincides with the EVI and NDVI. The intermittent flooding taking place during this period is expected to cause CH4 emissions. Then, during the spring months (March-May), larger CO_2 respiratory emissions take place during the daytime (> 5 μmol m-2 s-1) due to an increase in air temperature, which turn to neutral at the end of spring due to the start of photosynthesis by the rice. The third phase corresponds to the vegetation growth, when the net CO_2 uptake increases gradually up to maximum CO_2 sequestration rates of ca. 40 μmol m-2 s-1. During this period, the higher air temperature together with the flooding allows for the development of rice plants, resulting in the highest EVI and NDVI values (0.59 and 0.85, respectively) and nighttime maximum CO_2 emissions (5-10 μmol m-2 s-1). These conditions also favor the production of CH4, which make the rice paddy field a CH4 source. The ecosystem behaved as a N2O sink during most of the study period. Positive N2O emissions were only observed at the beginning of the vegetation growth phase, which seems to be related to fertilizer application.