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

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1. Introduction

Rice paddy fields are one of the biggest anthropogenic sources of methane (CH_4), the second most important anthropogenic greenhouse gas (GHG) after carbon dioxide (CO_2). Therefore most studies on GHGs in these agricultural systems focus on the evaluation of CH_4 production. However, other GHGs such as CO_2 and nitrous oxide (N_2O) are 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.

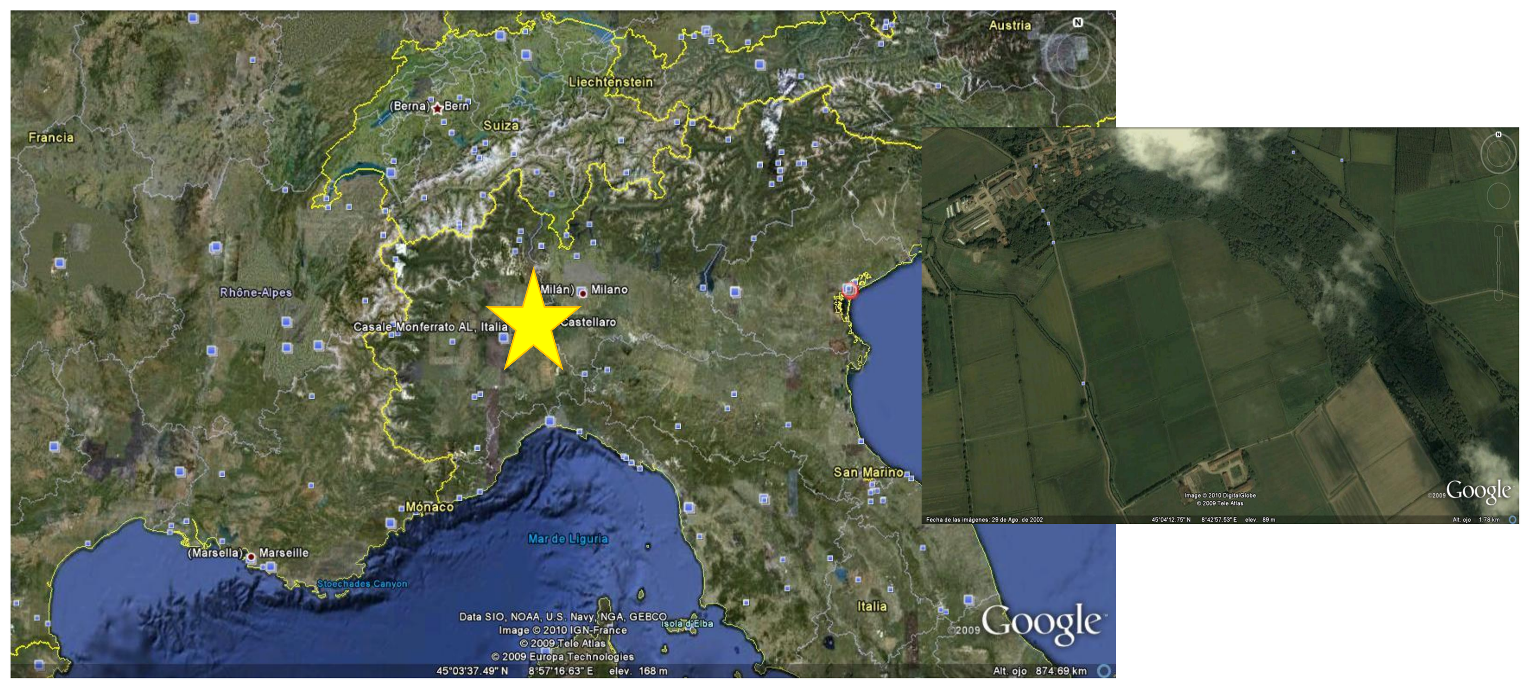
2. Objectives

1) To assess the full GHG budget of a Mediterranean rice paddy field and 2) to evaluate the effect of a mid-season drainage of the water table on GHG fluxes.

3. Methods

3.1. Study site:

Rice paddy field under Mediterranean climate in the Po Valley (Italy), the largest rice producing region in Europe.



3.2. Measurement techniques

Eddy covariance: ecosystem CO_2 and CH_4 fluxes

- Anemometer: Gill HS-100
- CO_2 and H_2O: Licor-6262
- CH_4: Los Gatos RMT-200

Closed chambers: soil CH_4 and N_2O fluxes

- Vented chambers
- Analysis by gas chromatography

Measurements carried out for 2 years with different management of the water table (Fig.1):

- 2009: standard management
- 2010: mid-season drainage

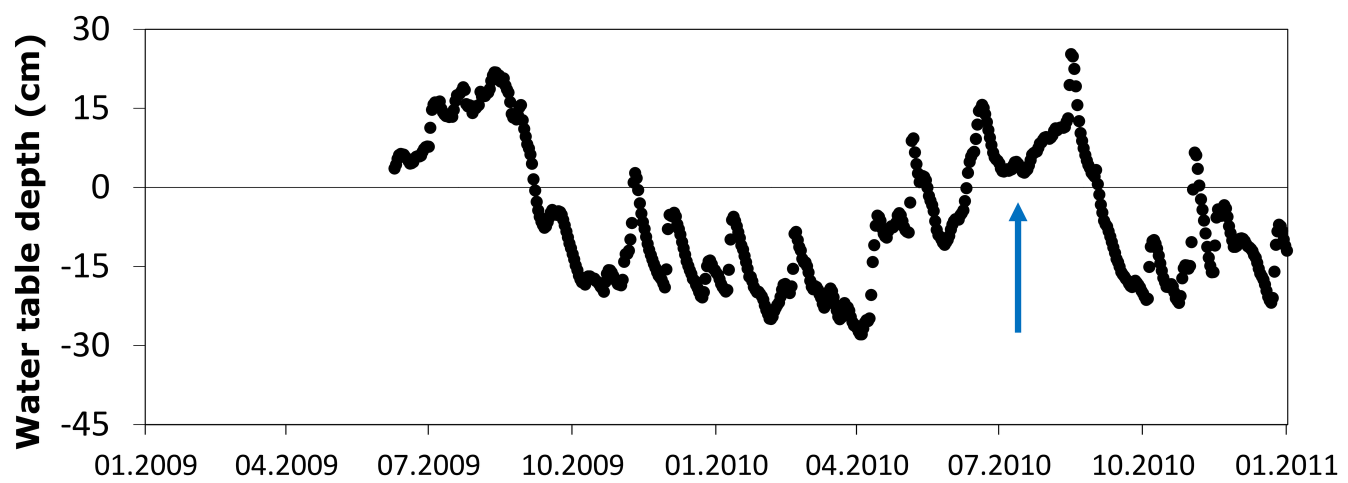


Fig. 1: Water table depth during the 2 years of measurements. Arrow indicates drainage in 2010.

4. Results and discussion

- Higher CH_4 emissions in 2009 (37.4 g CH_4 m^{-2} compared to 21.03 g CH_4 m^{-2} in 2010, Fig.2, Table 1).
- Lower CH_4 fluxes probably as a consequence of the mid-season drainage of the water table.

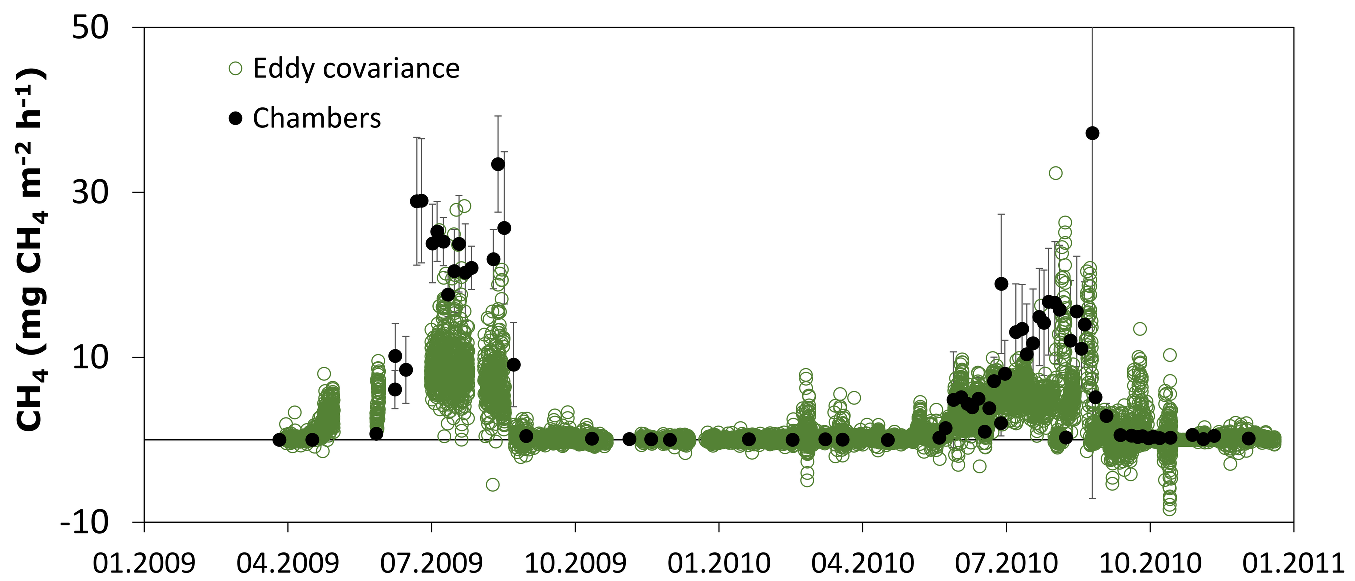


Fig. 2: Eddy covariance and chamber measurements of CH_4 fluxes.

- CH_4 fluxes were higher in 2009 and mainly when water table depth >10cm.
- Different responses of CH_4 fluxes to water table depth suggest different microbial communities.

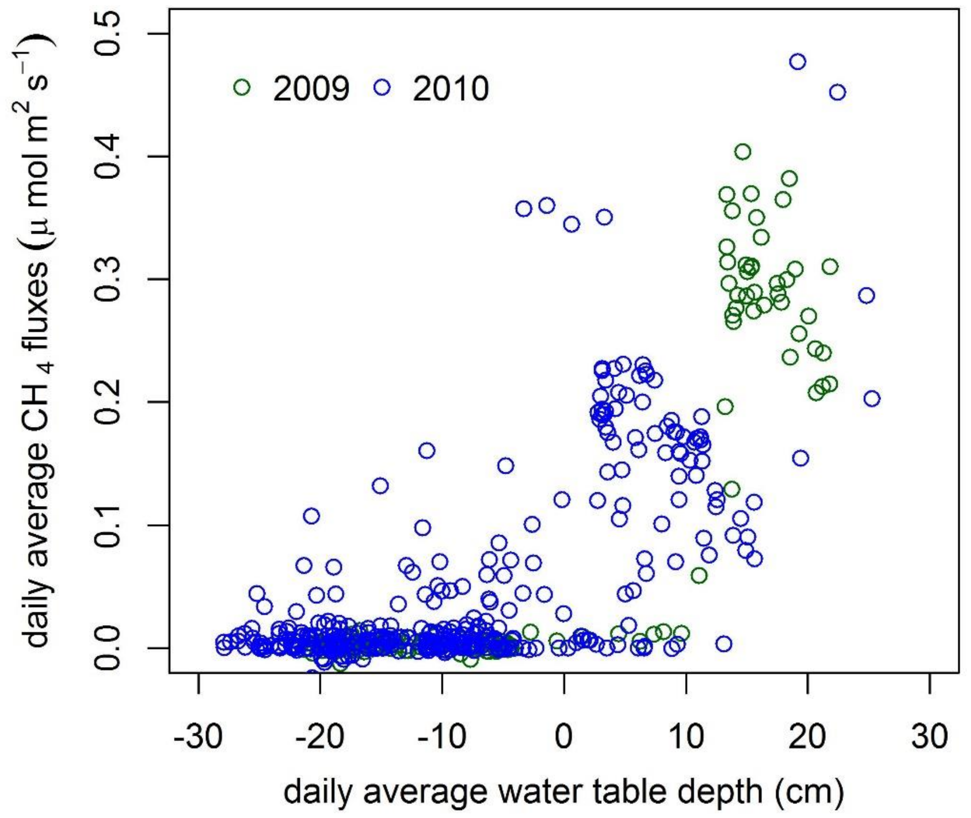


Fig. 3: Relationship between CH_4 fluxes and water table depth in 2009 (without management of the water table) and 2010 (decreasing the water table in the middle of the growing season)

- GHG budget dominated by CH_4 emissions.
- Rice paddy field was transformed from a GHG source to a nearly neutral system by managing the water table.

Table. 1: Contribution to GWP from all GHGs in the rice paddy field.

	Soil C				CH_4		N_2O		Total
	NEE	Biomass	Total C	Total C					
	g C m^{-2}			g CO_2-eq m^{-2}	g C m^{-2}	g CO_2-eq m^{-2}	g N m^{-2}	g CO_2-eq m^{-2}	g CO_2-eq m^{-2}
2009	-359	281	-78	-285	37.4	786	0.05	25	526
2010	-375	231	-144	-527	21.0	442	0.07	32	-54

5. Conclusions

- 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 paddies.
- GHG budgets should be assessed in combination with yield in order to develop and evaluate mitigation strategies.

Acknowledgements

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