Supporting Information for Publication

Methane emissions reductions from alternate wetting and drying of rice fields detected using the eddy covariance method

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Supplemental information

Table S1: Agronomic calendar of farm activities on each site (both are 700 m West to East, 350 m North to South); each field was planted with RiceTec Hybrid 745. Applications are given in units kg ha^{-1}; DAP is diammonium phosphate.

Field treatment and name	Plant date, DOY	Herbicide Trade name (chemical, rate)	Insecticide (rate)	Fungicide (rate)	Fertilizer type (rate)	First permanent flood initiated
North field, DF	April 8, 2015 (98)	April 9: Command (clomazone, 0.98) April 9: Roundup (glyphosate, 2.35) May 2: Command (clomazone, 0.70) May 2: Riceshot (propanil, 2.35) May 2: Clearpath (imazethapyr, 0.56) May 13: Riceshot (propanil, 4.69) May 13: Newpath (imazethapyr, 0.28)	July 6: Lambda cyhalothrin (0.27) July 21; Lambda cyhalothrin (0.27)	July 6: Propiconazole (0.42)	May 1: DAP (112) May 14: Urea (112) May 30: Urea (101) June 3: Urea (101)	May 16
South field, AWD	April 7, 2015 (97)	April 9: Command (clomazone, 0.98) April 9: Roundup (glyphosate, 2.35) May 2: Command (clomazone, 0.70) May 2: Riceshot (propanil, 2.35) May 2: Clearpath (imazethapyr, 0.56) May 14: Riceshot (propanil, 4.69) May 14: Newpath (imazethapyr, 0.28)	July 6: Lambda cyhalothrin (0.27), July 21; Lambda cyhalothrin (0.27)	July 6: Propiconazole (0.42)	May 1: DAP (112) May 14: Urea (112) May 30: Urea (101) June 3: Urea (101)	May 16
North field, AWD	April 23, 2016 (114)	April 23: Command (clomazone, 1.05) April 23: Powermax (glyphosate, 1.54) May 20: Command (clomazone, 0.56) May 20: Riceshot (propanil, 7.04) May 20: Newpath (imazethapyr, 0.28) June 6: Riceshot (propanil, 4.69) June 6: Newpath (imazethapyr, 0.28) July 16: Bolero (thiobencarb, 0.07)	July 25: Lambda cyhalothrin (0.27) Aug. 9: Lambda cyhalothrin (0.27)	July 25: Propiconazole (0.42)	May 21: DAP (101) June 14: Urea (224) June 22: Urea (112)	June 14
South field, AWD	April 23, 2016 (114)	April 23: Command (clomazone, 1.05) April 23: Powermax (glyphosate, 1.54) May 20: Command (clomazone, 0.56) May 20: Riceshot (propanil, 7.04) May 20: Newpath (imazethapyr, 0.28) June 8: Riceshot (propanil, 4.69) June 8: Newpath (imazethapyr, 0.28) July 16: Bolero (thiobencarb, 0.07)	July 21; Lambda cyhalothrin (0.27) Aug. 9: Lambda cyhalothrin (0.27)	July 21: Propiconazole (0.42)	May 21: DAP (101) June 14: Urea (224) June 22: Urea (112)	June 16
North field, DF	Apr 10, 2017 (100)	April 10: Powermax (glyphosate, 1.68) April 10: Command (clomazone, 0.89) April 19: Command (clomazone, 0.56) April 19: Riceshot (propanil, 2.35) April 19: Newpath (imazethapyr, 0.28) May 8: Command (clomazone, 0.42) May 8: Riceshot (propanil, 2.35) May 8: Newpath (imazethapyr, 0.28)	July 11: Lambda cyhalothrin (0.27)	July 11: Propiconazole (0.42)	May 10: DAP (112) May 16: Urea (112) May 23: Urea (112) June 2: Urea (112)	May 18
South field, DF	Apr 9, 2017 (99)	April 9: Powermax (glyphosate, 1.68) April 9: Command (clomazone, 0.89) April 19: Command (clomazone, 0.56) April 19: Riceshot (propanil, 2.35) April 19: Newpath (imazethapyr, 0.28) May 8: Command (clomazone, 0.42) May 8: Riceshot (propanil, 2.35) May 8: Newpath (imazethapyr, 0.28)	July 11: Lambda cyhalothrin (0.27)	July 11: Propiconazole (0.42)	May 10: DAP (112) May 16: Urea (112) May 23: Urea (112) June 2: Urea (112)	April 30

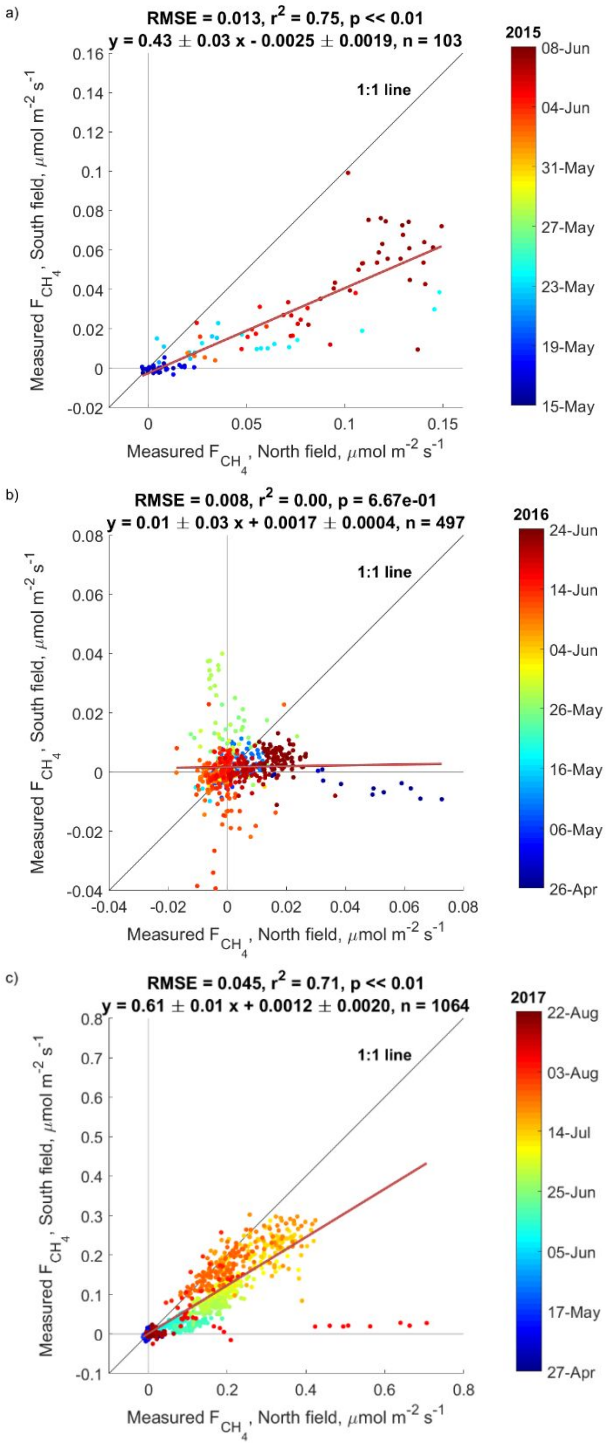

Figure S1: Comparison of turbulent CH_4 fluxes (F_{CH4}) between two fields during the identical-treatment phase in 2015, 2016, and 2017 (note change in axis limis between graphs)

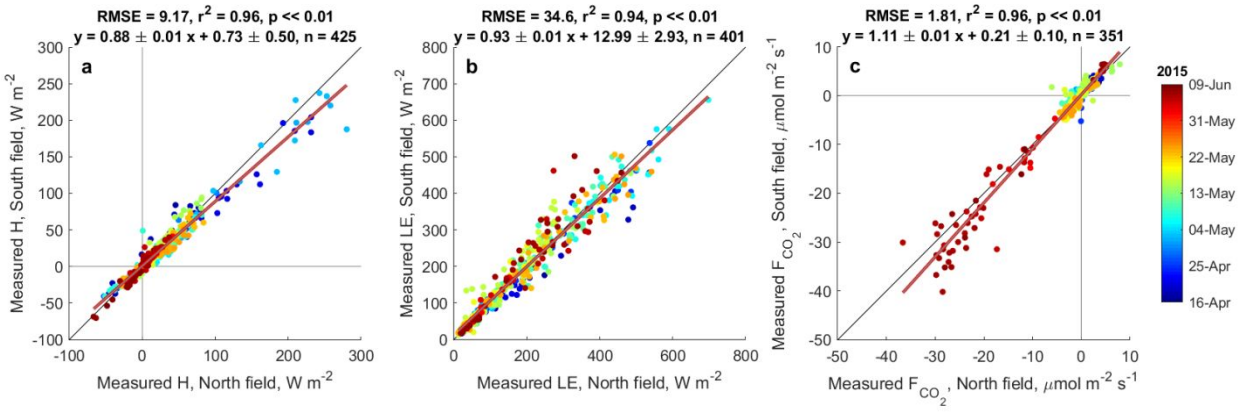

Figure S2: Comparison of turbulent fluxes between two fields during the identical-treatment phase in 2015: (a) Sensible heat *H* (b) latent energy *LE*, and (c) CO_2 exchange (F_{CO2}).

Table S2: Soil characteristics, taken by aggregating push probe samples at two depth intervals in each field; OM is organic matter determined by loss on ignition. All terms are significantly different (P < 0.05) between the different fields at the same depth interval except for %N at 10-20 cm on 23-Mar-2017. Methods are described in the main text

Sample date	Depth interval	Field	n	OM, %	C, %	N, %	EC, µmhos cm^{-1}	Na, mg kg^{-1}
7-Apr-15	0-10 cm	North	6	4.4 ± 0.4	Not analyzed		420 ± 41	159 ± 23
		South	5	2.9 ± 0.1			188 ± 27	66 ± 7
	10-20 cm	North	6	2.7 ± 0.4			578 ± 232	230 ± 50
		South	5	1.5 ± 0.4			165 ± 19	79 ± 10
17-Oct-16	0-10 cm	North	30	3.9 ± 0.6	1.41 ± 0.40	0.10 ± 0.03	537 ± 78	167 ± 23
		South	21	2.7 ± 0.3	1.05 ± 0.25	0.08 ± 0.02	323 ± 56	86 ± 16
	10-20 cm	North	30	2.8 ± 0.5	0.66 ± 0.34	0.05 ± 0.02	466 ± 117	196 ± 51
		South	21	1.8 ± 0.7	0.39 ± 0.23	0.04 ± 0.02	236 ± 70	91 ± 27
23-Mar-17	0-10 cm	North	21	4.2 ± 0.5	1.63 ± 0.41	0.13 ± 0.03	534 ± 120	234 ± 36
		South	21	3.0 ± 0.4	1.26 ± 0.30	0.10 ± 0.02	359 ± 64	105 ± 24
	10-20 cm	North	21	2.9 ± 0.4	0.68 ± 0.35	0.06 ± 0.02	692 ± 132	295 ± 55
		South	21	2.0 ± 0.4	0.48 ± 0.27	0.06 ± 0.02	376 ± 71	125 ± 34

Yield measurements

The yield estimates (Table S3) are made from a harvest monitoring device on the harvesting combine that had good coverage of the field in 2015 and 2017 (example in Figure S3) but poor coverage in 2016 (Figure S4). The combine's measurement points (in black in the images) are interpolated into a grid that is used to generate a mean value for each field in 2015. A subarea that had good measurement coverage in 2016 is selected (in pink) in all years, for each field. Assuming that measurements in this subarea are linearly scaled to the field-wide yield, we generate a ratio of the full-field mean to the sub-area mean yield. The average of this ratio in 2015 and 2017 is applied in 2016 from its sub-area mean yield to

generate a full area mean. In all years there are not significant yield differences between the fields. The sub-area in the northern field averaged 95.4% of the field-averaged yield, and the southern field's sub-area averaged 104.1% of the field-averaged yield.

Table S3: Yield in t ha^{-1} for the two study fields in 2015 and 2016, standard error estimates on the 2015 ratio and 2016 calculated mean are determined through the propagation of error assuming there is no correlation in error structure between the subarea error and the full area error, and using the standard deviation of points interpolated from the harvest monitoring combine.

Field	Year	Whole-field mean, t ha^{-1}	Subarea mean, t ha^{-1}	Ratio of full/subarea yield		Mean ratio full/subarea yield to apply in 2016	2016 subarea mean, t ha^{-1}	2016 calculated whole-field mean
North	2015	9.27 ± 0.90	9.42 ± 0.73	98.4 ± 12.2%		95.4 ± 16.7%	11.53 ± 2.10	11.00 ± 2.78
	2017	9.80 ± 1.00	10.61 ± 0.73	92.3 ± 11.4%				
South	2015	9.67 ± 1.11	8.85 ± 0.59	109.3 ± 14.5%		104.1 ± 18.5%	10.56 ± 1.65	10.99 ± 2.61
	2017	10.58 ± 1.07	10.70 ± 0.67	98.9 ± 11.7%				

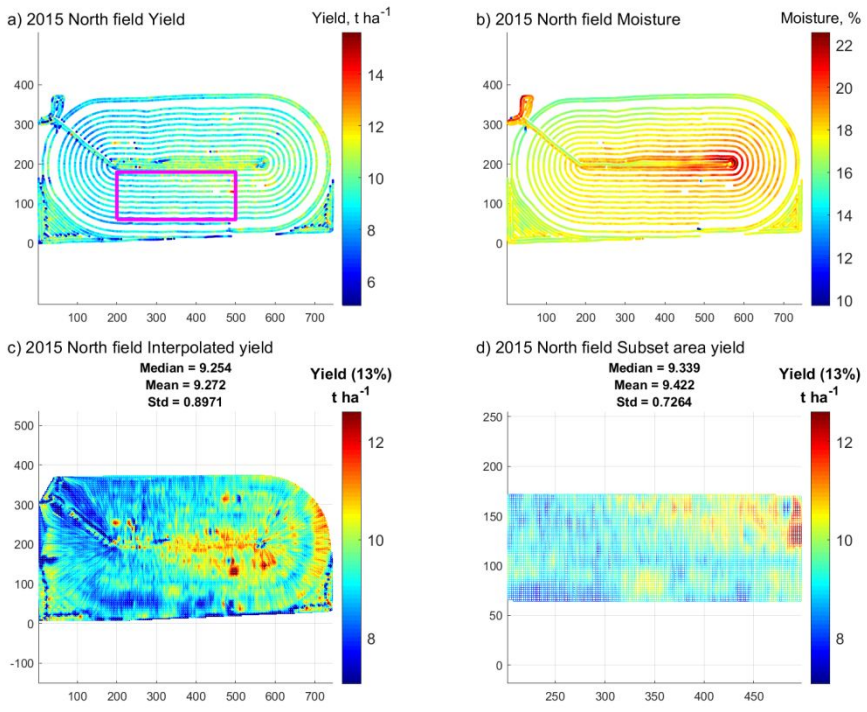

Figure S3: Harvest map of dry yield for the North field in 2015: (a) Yield points taken approximately 2 m apart, measured during harvest via automated and GPS-enabled yield monitor. (b) Moisture points; (c) Interpolated yield across the whole field; (d) Yield of area subset from pink rectangle of plot (a).

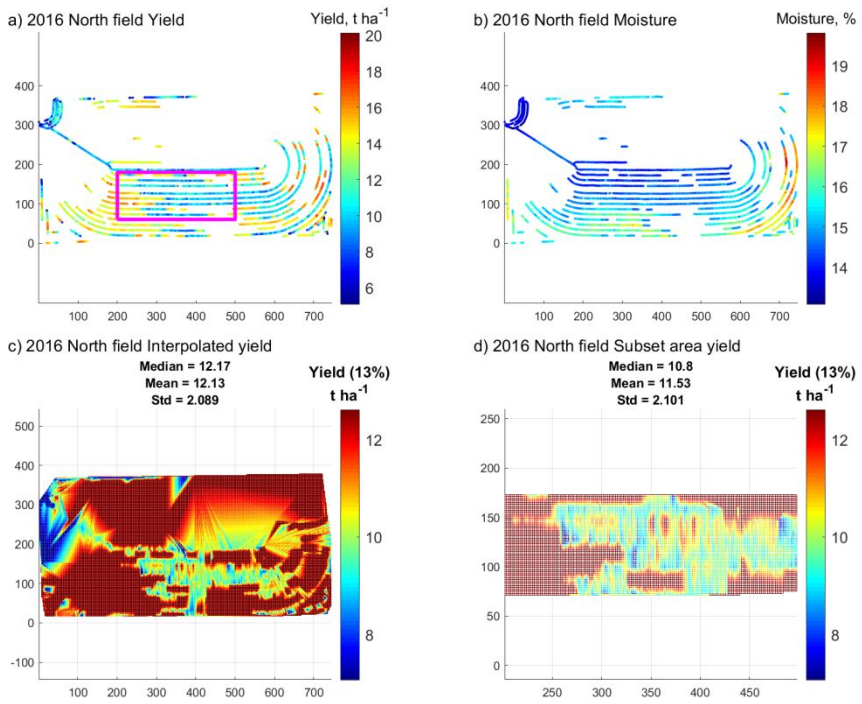

Figure S4: Harvest yield map and measurements (2016): (a) the yield maps are interpolated from points, but because of technical difficulties the full field was not captured. This error is corrected by focusing on the pink rectangle area, which we assume scales to the whole-field harvest in a similar manner in each year. (b) harvest moisture map; (c) interpolated whole field yield; (d) subset area yield.