

1 Supplementary Material

2 Table 1S Agricultural field management practices to facilitate the DNDC model

Crop	Date (year-month-day)	Management ^a
Wheat	2005-10-15	Fertilization (135 and 60 kg N ha ⁻¹ as urea for treatments CT and IT, respectively, surface broadcast), tillage (20 cm) after fertilization, and wheat sowing
	2006-3-18	Fertilization (85 and 120 kg N ha ⁻¹ as urea for treatments CT and IT, respectively, soil covering 0-5 cm after band application)
Maize	2006-6-28	Fertilization (60 N ha ⁻¹ as urea for IT treatment, soil covering 0-5 cm after hole application near plants)
	2006-7-19	Fertilization (210 and 120 kg N ha ⁻¹ as urea for treatments CT and IT, respectively, soil covering 0-5 cm after hole application near plants)
Wheat	2006-10-15	Fertilization (135 and 60 kg N ha ⁻¹ as urea for treatments CT and IT, respectively, surface broadcast), tillage (20 cm) after fertilization, and wheat sowing
	2007-3-18	Fertilization (85 and 120 kg N ha ⁻¹ as urea for treatments CT and IT, respectively, soil covering 0-5cm after band application)
Maize	2007-6-28	Fertilization (60 N ha ⁻¹ as urea for IT treatment, soil covering 0-5 cm after hole application near plants)
	2007-7-19	Fertilization (210 and 120 kg N ha ⁻¹ as urea for treatments CT and IT, respectively, soil covering 0-5 cm after hole application near plants)
Wheat	2007-10-29	Straw incorporation, tillage (20 cm), wheat sowing
	2007-12-21	Irrigation (flooding, 145.6 mm for CT treatment)
	2007-12-22	Irrigation (sprinkler, 81.5 mm for IT treatment)
	2008-3-18	Fertilization (85 and 120 kg N ha ⁻¹ as urea for treatments CT and IT, respectively, soil covering 0-5cm after band application)
	2008-3-21	Irrigation (flooding, 118.0 mm for CT treatment)
	2008-3-22	Irrigation (sprinkler, 62.6 mm for IT treatment)
	2008-6-2	Wheat harvest
Maize	2008-6-5	Straw incorporation
	2008-6-6	Tillage (20 cm) and maize sowing
	2008-6-8	Irrigation (sprinkler,100.5mm)
	2008-7-19	Fertilization (210 and 120 kg N ha ⁻¹ as urea for treatments CT and IT, soil covering 0-5 cm after hole application near plants)
	2008-8-10	Irrigation (sprinkler, 27.8 and 28.6 mm for treatment CT and

		IT, respectively)
	2008-10-8	Maize harvest
Wheat	2008-10-14	Straw incorporation for WS treatment
	2008-10-15	Fertilization (10.5 kg N ha ⁻¹ in urea and 49.5 kg N ha ⁻¹ in diammonium phosphate, surface broadcast), tillage (20 cm) after fertilization, and wheat sowing
	2008-12-18	Irrigation (sprinkler, 58.2 mm)
	2009-3-6	Fertilization (120 kg N ha ⁻¹ as urea, soil covering 0-5cm after band application)
	2009-3-15	Irrigation (sprinkler, 89.4 mm)
	2009-4-19	Irrigation (sprinkler, 93.6 mm)
	2009-6-4	Wheat harvest
Maize	2009-6-5	Straw incorporation for WS treatment
	2009-6-6	Tillage (20 cm) and maize sowing
	2009-6-10	Irrigation (sprinkler, 41.9 mm)
	2009-7-11	Fertilization (210 kg N ha ⁻¹ as urea, soil covering 0-5 cm after hole application near plants)
	2009-7-17	Irrigation (sprinkler, 65.0 mm)
	2009-8-14	Irrigation (sprinkler, 21.3mm)
	2009-10-14	Maize harvest
Wheat	2009-10-17	Straw incorporation
	2009-10-21	Fertilization (20, 40, 60, 100, 150, 60, 60 and 60 kg N ha ⁻¹ as urea for treatments N135, N270, N430, N650, N850, U, DCD and DMPP, respectively, surface broadcast), tillage (20 cm) after fertilization, and wheat sowing
	2010-1-9	Irrigation (sprinkler, 89.4 mm)
	2010-3-18	Fertilization (40, 80, 120, 200, 250, 120, 120 and 120 kg N ha ⁻¹ as urea for treatments N135, N270, N430, N650, N850, U, DCD and DMPP, respectively, soil covering 0-5 cm after band application)
	2010-3-23 ^b	Irrigation (sprinkler, 86.7 mm)
	2010-5-4 ^c	Irrigation (sprinkler, 77.6 mm)
	2010-6-15	Wheat harvest
Maize	2010-6-16	Straw incorporation
	2010-6-17	Tillage (20 cm) and maize sowing
	2010-6-18 ^d	Irrigation (sprinkler, 60.5 mm)
	2010-7-13	Fertilization (75, 150, 250, 350, 450, 250, 250 and 250 kg N ha ⁻¹ as urea for treatments N135, N270, N430, N650, N850, U, DCD and DMPP, respectively, soil covering 0-5 cm after band application)
	2010-8-7 ^e	Irrigation (sprinkler, 93.5 mm)
	2010-10-14	Maize harvest

- 1 ^a Only the fertilizer application rate and approximate time were recorded from
2 October 2005 to October 2007, while other management practices such as sowing,

- 1 irrigation and harvest were not available, so we simply used the management
- 2 practices from October 2007 to October 2008 to substitute for them.
- 3 ^b 2010-3-23 (19:00) ~ 2010-3-24 (14:00)
- 4 ^c 2010-5-4 (07:00) ~ 2010-5-5 (19:00)
- 5 ^d 2010-6-18 (23:00) ~ 2010-6-19 (10:00)
- 6 ^e 2010-8-7 (08:00) ~ 2010-8-9 (14:00)

1 Table 2S Observed and simulated grain yields (GY) for wheat season (WS) and maize
 2 season (MS) and annual emissions of N₂O, NO and CH₄.

Treatment	Observed					Simulated				
	GY ^a		Annual emissions ^b			GY ^a		Annual emissions ^b		
	WS	MS	N ₂ O	NO	CH ₄	WS	MS	N ₂ O	NO	CH ₄
CT ^c	2.55 (0.13)	2.30 (0.09)				2.30	2.26			
IT ^c	2.44 (0.06)	2.62 (0.06)				2.27	2.42			
CT ^d	1.94 (0.05)	3.52 (0.16)				2.05	3.24			
IT ^d	1.92 (0.08)	3.77 (0.07)				2.08	3.24			
CT ^e	2.48 (0.11)	3.37 (0.16)				2.41	3.05			
IT ^e	2.47 (0.10)	3.69 (0.35)				2.51	2.97			
WS	2.40 (0.14)	3.17 (0.18)	4.45 (0.69)	2.49 (0.45)		2.56	3.04	3.88	2.42	
NS	2.19 (0.07)	3.21 (0.23)	3.46 (0.44)	2.40 (0.40)		2.58	3.04	2.85	2.42	
U	2.67 (0.04)	3.03 (0.20)	4.49 (0.21)	2.27 (0.37)		2.55	3.25	4.37	1.90	
DCD	2.56 (0.03)	3.01 (0.39)	2.93 (0.06)	0.86 (0.15)		2.57	3.25	3.03	0.93	
DMPP	2.84 (0.26)	3.22 (0.19)	2.78 (0.16)	0.82 (0.12)		2.55	3.25	2.67	0.88	
N135	2.51 (0.16)	2.61 (0.40)	2.09 (0.20)	0.91 (0.14)	-1.59 (0.04)	2.46	3.05	2.74	1.18	-1.84
N270	2.56 (0.13)	3.02 (0.36)	2.59 (0.33)	1.21 (0.08)	-1.56 (0.04)	2.55	3.25	3.50	1.37	-1.84
N430	2.71 (0.18)	3.11 (0.44)	3.51 (0.26)	1.75 (0.06)	-1.51 (0.09)	2.56	3.25	4.41	1.92	-1.83
N650	3.07 (0.32)	3.43 (0.50)	5.12 (0.78)	2.23 (0.17)	-1.69 (0.10)	2.56	3.25	5.83	2.80	-1.84
N850	2.74 (0.20)	3.70 (0.36)	5.57 (0.68)	2.64 (0.35)	-1.79 (0.07)	2.56	3.25	6.95	3.18	-1.84

3 ^a Mg C ha⁻¹ yr⁻¹; ^b kg C or N ha⁻¹ yr⁻¹; ^c 2005-2006 rotation; ^d 2006-2007 rotation; ^e
 4 2007-2008 rotation. Treatment code definitions are found in Table 1 and in the text.