

Supplementary Information

Regulation of N₂O emissions from acid organic soil drained for agriculture: Effects of land use and season

Taghizadeh-Toosi, Arezoo¹, Elsgaard, Lars¹, Clough, Tim², Labouriau, Rodrigo³ & Petersen, Søren Ole¹

¹ Department of Agroecology, Aarhus University, Tjele, 8830, Denmark

² Faculty of Agriculture and Life Sciences, Lincoln University, Christchurch, New Zealand

³ Applied Statistics Laboratory, Department of Mathematics, Aarhus University, Aarhus, Denmark

Correspondence to: Arezoo Taghizadeh-Toosi (Arezoo.Taghizadeh-Toosi@agro.au.dk)

Table S1. Mineral N ($\mu\text{g g}^{-1}$ dry wt. soil) at 0-25 and 25-50 cm depth at *RGI* with rotational grass. Fertilisation occurred on 16 April.

Date	DOY	Unfertilised		Fertilised		25-50 cm			
		0-25 cm	25-50 cm	0-25 cm	25-50 cm	NH ₄ ⁺ -N	NO ₃ ⁻ -N	NH ₄ ⁺ -N	NO ₃ ⁻ -N
3/4/2015	62	9.03 (1.00)	8.80 (1.73)	11.34 (1.68)	4.15 (0.55)	5.41 (0.70)	7.05 (0.72)	13.79 (0.04)	5.10 (1.32)
3/17/2015	75	10.9 (0.85)	11.77 (1.19)	9.68 (0.50)	7.17 (2.17)	1.36 (0.15)	8.77(0.69)	5.05 (0.69)	7.67 (0.19)
3/24/2015	82	7.13 (0.20)	4.80 (0.33)	11.60 (0.88)	5.52 (0.87)	3.73 (0.52)	4.05 (0.52)	11.07 (0.34)	6.07 (0.63)
4/9/2015	98	0.13 (0.00)	3.07 (0.07)	1.51 (0.27)	2.85 (0.36)	0.12 (0.00)	4.33 (0.43)	2.38 (0.10)	3.72 (0.10)
4/14/2015	103	4.09 (0.37)	3.84 (0.00)	7.11 (0.65)	2.83 (0.08)	3.84 (0.48)	3.18 (0.30)	14.98 (0.47)	2.17 (0.47)
4/22/2015	111	0.70 (0.19)	25.94 (0.57)	6.44 (1.18)	2.91 (0.14)	133.2 (11.9)	120.0 (5.17)	81.91 (3.81)	72.9 (6.18)
4/29/2015	118	4.26 (0.14)	2.21 (0.07)	4.52 (0.07)	2.11 (0.13)	21.06 (1.43)	17.2 (0.66)	39.64 (7.41)	34.20 (8.11)
5/6/2015	125	5.54 (0.56)	1.40 (0.19)	8.38 (1.09)	0.15 (0.15)	7.81 (1.49)	2.55 (0.44)	15.15 (0.27)	1.29 (0.08)
5/13/2015	132	0.00 (0.00)	3.37 (0.25)	0.00 (0.00)	1.91 (0.28)	0.57 (0.57)	4.75 (0.37)	4.36 (2.03)	3.43 (0.08)
5/20/2015	139	5.03 (0.31)	1.39 (0.25)	5.09 (0.39)	0.44 (0.26)	3.23 (0.49)	2.49 (0.36)	10.33 (0.47)	1.18 (0.16)
5/27/2015	146	3.98 (0.11)	1.99 (0.29)	4.78 (0.35)	1.00 (0.07)	4.97 (0.12)	3.36 (0.12)	9.72 (0.75)	1.55 (0.25)
6/4/2015	154	4.23 (0.06)	1.63 (0.18)	5.30 (0.08)	1.16 (0.22)	4.05 (0.30)	2.43 (0.00)	8.97 (0.09)	1.65 (0.00)
6/11/2015	161	3.64 (0.17)	1.90 (0.17)	6.10 (1.34)	1.03 (0.07)	4.22 (0.06)	3.69 (0.06)	10.31 (0.10)	1.75 (0.00)
6/16/2015	166	1.72 (0.28)	4.12 (0.01)	5.10 (0.42)	2.66 (0.07)	5.93 (0.11)	9.51 (0.45)	8.63 (0.75)	5.16 (0.17)
9/3/2015	245	5.72 (0.20)	2.12 (0.24)	9.14 (0.52)	2.50 (0.67)	6.72 (0.24)	4.04 (0.10)	6.32 (0.16)	0.95 (0.00)
9/9/2015	251	9.15 (0.65)	2.44 (0.52)	11.58 (0.24)	1.20 (0.00)	10.48 (0.18)	3.52 (0.51)	15.23 (0.00)	1.79 (0.09)
9/16/2015	258	7.11 (0.31)	2.51 (0.08)	9.57 (0.00)	2.69 (0.00)	6.52 (0.04)	6.23 (0.18)	14.08 (0.05)	7.92 (4.77)
9/23/2015	265	7.06 (0.31)	4.45 (0.91)	6.99 (0.13)	2.46 (0.44)	9.07 (0.22)	7.55 (3.06)	14.39 (0.56)	2.20 (0.30)
9/29/2015	271	5.40 (0.10)	1.74 (0.14)	10.38 (0.00)	3.92 (1.71)	6.02 (0.16)	5.18 (0.02)	11.69 (0.42)	4.50 (0.25)
10/7/2015	279	37.4 (19.0)	4.06 (2.02)	18.97 (2.97)	1.55 (0.08)	8.52 (0.87)	7.58 (4.20)	13.21 (0.04)	2.63 (0.10)
10/21/2015	293	8.25 (0.20)	2.42 (0.07)	8.94 (0.17)	1.50 (0.00)	11.43 (0.14)	5.34 (0.07)	16.15 (1.00)	4.34 (0.00)
10/28/2015	300	38.2 (2.01)	2.43 (0.13)	53.24 (0.06)	1.07 (0.08)	14.64 (3.66)	6.10 (0.04)	16.44 (0.95)	3.83 (0.05)
11/4/2015	307	8.15 (0.28)	2.66 (0.07)	5.34 (0.67)	1.17 (0.17)	8.89 (0.03)	3.98(0.29)	14.50 (0.79)	2.94 (0.20)
11/10/2015	313	8.99 (0.08)	3.77 (0.12)	10.32 (0.07)	1.91 (0.08)	10.32 (0.16)	11.30 (0.08)	10.77 (1.94)	6.35 (0.35)

Table S2. Mineral N ($\mu\text{g g}^{-1}$ dry wt. soil) at 0-25 and 25-50 cm depth at site *ARI* with potato. Fertilisation took place on 21 May.

Date		Unfertilised				Fertilised			
		0-25 cm		25-50 cm		0-25 cm		25-50 cm	
Date (m/d/y)	DOY	NH ₄ ⁺ -N	NO ₃ ⁻ -N	NH ₄ ⁺ -N	NO ₃ ⁻ -N	NH ₄ ⁺ -N	NO ₃ ⁻ -N	NH ₄ ⁺ -N	NO ₃ ⁻ -N
3/4/2015	62	2.14 (0.30)	15.36 (1.62)	14.07 (4.53)	22.08 (2.60)	1.53 (0.51)	18.27 (1.34)	4.69 (0.63)	14.48 (0.72)
3/17/2015	75	1.29 (0.44)	26.53 (0.61)	1.77 (0.11)	25.37 (2.03)	0.83 (0.24)	25.12 (0.96)	0.92 (0.25)	19.38 (1.30)
3/24/2015	82	0.99 (0.07)	22.63 (0.21)	3.61 (0.98)	24.11 (1.51)	1.19 (0.13)	17.06 (0.25)	4.21 (0.07)	19.46 (2.67)
4/9/2015	98	0.00 (0.00)	21.92 (0.39)	0.92 (0.06)	32.70 (1.30)	0.00 (0.00)	36.27 (0.06)	1.23 (0.15)	15.67 (0.55)
4/14/2015	103	2.25 (0.40)	28.37 (1.28)	3.09 (0.33)	24.62 (0.72)	2.85 (0.35)	30.98 (0.78)	5.93 (0.89)	26.96 (1.06)
4/22/2015	111	1.20 (0.19)	26.86 (2.00)	5.21 (0.08)	42.56 (1.34)	5.86 (0.05)	4.35 (0.27)	3.32 (0.51)	17.84 (0.71)
5/13/2015	132	178.99 (4.75)	117.2 (3.4)	105.9 (61.9)	85.87 (13.99)	72.73 (5.20)	91.87 (1.31)	39.29 (3.40)	64.94 (0.60)
5/20/2015	139	26.45 (2.90)	77.07 (8.48)	13.55 (0.07)	50.36 (0.07)	56.87 (12.09)	64.33(0.62)	13.74 (0.16)	18.86 (0.66)
5/27/2015	146	10.42 (0.57)	125.9 (7.3)	3.56 (0.19)	36.87 (1.41)	384.4 (67.0)	193.0 (16.0)	141.51(27.8)	54.03 (7.93)
6/4/2015	154	3.17 (0.23)	85.39 (10.87)	2.48 (0.33)	47.25 (5.24)	222.57 (0.79)	191.5 (0.3)	58.11 (1.21)	23.84 (2.57)
6/11/2015	161	2.53 (1.09)	93.66 (3.65)	4.13 (0.28)	73.75 (0.84)	121.1 (66.0)	172.6 (77.6)	80.16(39.48)	123.7 (50.6)
6/16/2015	166	1.32 (0.07)	102.5 (0.8)	0.71 (0.06)	59.94 (1.64)	70.80 (4.96)	298.13 (3.21)	30.73 (1.72)	71.88 (5.08)
9/3/2015	245	9.61 (0.02)	91.16 (3.80)	10.59 (1.10)	40.01 (0.24)	18.04 (0.91)	147.47 (0.66)	8.95 (0.18)	42.70 (2.02)
9/9/2015	251	6.77 (0.14)	58.66 (0.07)	11.85 (0.91)	32.46 (2.86)	14.34 (0.31)	118.22 (2.45)	14.83 (0.39)	80.70 (3.08)
9/16/2015	258	8.05 (0.19)	57.17 (1.63)	7.06 (0.41)	35.79 (0.55)	4.26 (0.06)	68.85 (2.76)	7.86 (0.27)	33.85 (2.09)
9/23/2015	265	22.26 (0.22)	21.72 (0.01)	13.49 (1.23)	15.82 (1.08)	4.30 (0.22)	34.62 (1.04)	8.78 (0.33)	16.85 (0.03)
9/29/2015	271	17.43 (0.33)	14.71 (1.40)	11.41 (0.50)	7.65 (0.15)	13.65 (0.23)	15.12 (0.37)	6.30 (0.03)	6.87 (1.19)
10/7/2015	279	38.54 (1.08)	13.38 (0.60)	27.78 (1.38)	22.13 (0.84)	13.81 (0.28)	23.81 (0.51)	5.95 (1.00)	16.17 (0.35)
10/21/2015	293	26.35 (0.50)	19.95 (0.51)	19.27 (0.01)	18.68 (0.58)	19.38 (0.86)	15.77 (0.05)	9.51 (0.05)	8.68 (0.38)
10/28/2015	300	25.63 (3.12)	17.76 (0.10)	15.22 (0.30)	16.44 (3.33)	236.35 (5.46)	1.68 (0.27)	28.59 (5.41)	4.54 (0.07)
11/4/2015	307	23.07 (0.74)	23.03 (0.68)	15.23 (0.25)	32.70 (2.30)	13.77 (0.10)	14.34 (0.38)	10.61 (0.03)	11.60 (1.74)
11/10/2015	313	16.20 (2.60)	21.73 (0.73)	16.59 (0.38)	23.77 (0.27)	22.58 (2.08)	23.24 (0.37)	12.85 (2.10)	11.74 (0.43)

Table S3. Mineral N ($\mu\text{g g}^{-1}$ dry wt. soil) at 0-25 and 25-50 cm depth at site *RG2* with rotational grass. Fertilisation with acidified slurry occurred on 5 May, and again on 2 July.

Date	DOY	Unfertilised				Fertilised			
		0-25 cm		25-50 cm		0-25 cm		25-50 cm	
		$\text{NH}_4^+\text{-N}$	$\text{NO}_3^-\text{-N}$	$\text{NH}_4^+\text{-N}$	$\text{NO}_3^-\text{-N}$	$\text{NH}_4^+\text{-N}$	$\text{NO}_3^-\text{-N}$	$\text{NH}_4^+\text{-N}$	$\text{NO}_3^-\text{-N}$
3/5/2015	63	6.28 (0.16)	4.41 (0.13)	4.93 (0.18)	1.76 (0.05)	15.46 (0.95)	3.65 (0.30)	9.99 (0.34)	3.76 (2.77)
3/18/2015	76	2.66 (0.19)	7.08 (2.59)	1.53 (0.03)	1.38 (0.15)	14.78 (0.79)	4.64 (0.12)	10.42 (0.31)	3.90 (2.56)
3/25/2015	83	4.18 (0.26)	4.81 (0.15)	3.27 (0.28)	2.00 (0.38)	7.71 (0.17)	10.80 (1.68)	5.73 (0.72)	3.30 (0.38)
4/8/2015	97	0.24 (0.24)	22.69 (0.70)	2.56 (0.00)	7.33 (0.85)	NA	NA	NA	NA
4/16/2015	105	2.81 (0.08)	3.99 (0.04)	3.29 (0.61)	1.45 (0.10)	NA	NA	NA	NA
4/21/2015	110	0.98 (0.08)	6.86 (0.16)	1.76 (0.34)	1.76 (0.06)	NA	NA	NA	NA
4/28/2015	117	2.55 (0.11)	7.43 (0.19)	8.45 (0.34)	5.00 (0.08)	NA	NA	NA	NA
5/5/2015	124	3.79 (0.88)	4.83 (0.42)	3.74 (0.28)	1.96 (0.00)	NA	NA	NA	NA
5/12/2015	131	2.76 (0.00)	5.47 (0.96)	0.74 (0.74)	3.76 (0.78)	4.55 (0.00)	16.66 (1.09)	14.02 (0.15)	9.40 (0.88)
5/19/2015	138	1.22 (0.24)	3.96 (1.31)	3.38 (0.55)	2.49 (0.10)	5.29 (1.13)	8.27 (0.49)	9.45 (0.50)	2.49 (0.21)
6/3/2015	153	5.86 (0.73)	12.99 (0.52)	50.5 (35.47)	5.73 (0.85)	22.54 (1.72)	34.52 (3.69)	16.34 (2.03)	16.46 (0.71)
6/10/2015	160	1.57 (0.24)	8.96 (0.61)	2.61 (0.09)	2.37 (0.03)	14.30 (1.56)	43.18 (0.62)	11.42 (1.25)	7.23 (0.20)
6/18/2015	168	3.11 (0.31)	3.51 (0.08)	1.93 (0.00)	0.83 (0.07)	12.35 (0.27)	46.95 (2.82)	9.01 (0.31)	10.37 (0.49)
9/17/2015	259	4.27 (0.16)	8.42 (0.51)	5.48 (0.21)	3.11 (0.59)	13.67 (1.13)	2.54 (1.16)	9.23 (0.28)	3.57 (0.51)
9/22/2015	264	1.76 (0.06)	17.13 (0.01)	5.65 (0.01)	7.21 (0.10)	4.65 (0.20)	16.38 (0.25)	5.61 (0.35)	7.05 (0.72)
9/29/2015	271	6.76 (0.30)	9.52 (0.14)	5.10 (0.05)	4.24 (0.09)	7.64 (0.41)	9.63 (0.32)	10.83 (0.33)	8.08 (0.07)
10/6/2015	278	1.75 (0.08)	10.41 (0.08)	3.75 (0.24)	4.91 (0.24)	6.75 (1.31)	11.96 (0.13)	10.25 (1.12)	5.48 (1.90)
10/20/2015	292	1.99 (0.04)	9.70 (0.13)	4.40 (0.21)	5.16 (1.31)	9.95 (0.09)	10.02 (1.44)	8.75 (0.44)	3.82 (0.91)
10/27/2015	299	2.23 (0.46)	13.75 (1.10)	5.67 (0.48)	4.39 (0.13)	4.48 (0.93)	13.05 (0.04)	8.51 (0.34)	4.18 (0.41)
11/3/2015	306	2.57 (0.64)	9.57 (0.37)	4.66 (0.18)	3.52 (0.58)	7.87 (1.00)	10.31 (0.84)	8.63 (0.28)	3.20 (0.11)

NA, not available; ND, not detected.

Table S4. Mineral N ($\mu\text{g g}^{-1}$ dry wt. soil) at 0-25 and 25-50 cm depth at site AR2 with potato. Fertilisation took place on 30 April.

Date	DOY	Unfertilised				Fertilised			
		0-25 cm		25-50 cm		0-25 cm		25-50 cm	
		NH ₄ ⁺ -N	NO ₃ ⁻ -N	NH ₄ ⁺ -N	NO ₃ ⁻ -N	NH ₄ ⁺ -N	NO ₃ ⁻ -N	NH ₄ ⁺ -N	NO ₃ ⁻ -N
3/5/2015	63	8.66 (0.26)	5.19 (0.55)	17.23 (0.71)	3.55 (0.12)	5.70 (0.19)	13.46 (0.44)	13.03 (0.07)	5.67 (0.52)
3/18/2015	76	8.06 (0.65)	10.71 (0.17)	20.19 (0.39)	9.80 (2.93)	2.89 (0.26)	14.79 (3.69)	6.82 (0.10)	6.07 (0.46)
3/25/2015	83	14.90 (0.96)	13.15 (3.24)	22.69 (1.08)	3.94 (0.79)	8.61 (0.61)	14.69 (0.52)	17.02 (1.15)	15.98 (0.34)
4/8/2015	97	2.04 (0.53)	10.96 (0.07)	0.00 (0.00)	1.23 (0.14)	1.66 (0.04)	6.18 (0.12)	8.66 (0.98)	8.12 (0.09)
4/16/2015	105	4.42 (0.14)	26.44 (1.33)	8.63 (0.97)	13.14 (0.08)	2.18 (0.22)	11.14 (0.22)	7.01 (0.55)	7.19 (0.27)
4/21/2015	110	2.80 (0.07)	34.72 (0.06)	NA	NA	0.33 (0.07)	23.35 (0.61)	6.37 (0.17)	16.45 (0.94)
4/28/2015	117	5.81 (0.60)	49.94 (0.66)	3.51 (0.30)	11.17 (0.33)	0.77 (0.00)	27.89 (0.36)	5.14 (0.09)	22.23 (0.10)
5/5/2015	124	7.72 (0.43)	44.80 (0.80)	15.67 (6.32)	34.73 (11.46)	181.8 (11.0)	22.20 (14.26)	22.19 (6.32)	23.55 (12.50)
5/12/2015	131	12.21 (6.42)	56.62 (0.50)	2.01 (0.52)	34.74 (0.27)	68.63 (13.65)	85.45 (0.13)	39.12 (27.30)	37.51 (0.38)
5/19/2015	138	8.24 (0.09)	44.97 (0.07)	6.77 (0.30)	28.66 (0.06)	15.93 (0.09)	103.2 (2.7)	12.81 (0.96)	32.21 (8.62)
5/26/2015	145	5.38 (0.01)	62.38 (3.74)	4.65 (0.42)	18.68 (1.02)	3.63 (0.07)	80.06 (4.96)	2.08 (0.30)	8.00 (0.19)
6/3/2015	153	5.61 (0.49)	36.58 (1.76)	5.57 (0.63)	20.56 (0.41)	1.86 (0.24)	64.15 (5.06)	3.24 (0.09)	26.73 (3.61)
6/10/2015	160	6.41 (0.34)	59.50 (1.88)	8.44 (0.47)	42.40 (1.99)	1.02 (0.15)	108.4 (0.5)	3.90 (1.02)	37.96 (1.75)
6/18/2015	168	4.49 (0.00)	64.76 (0.92)	9.07 (0.38)	37.85 (0.21)	2.05 (0.25)	62.36 (0.39)	2.35 (0.21)	21.46 (1.06)
9/2/2015	244	4.30 (0.29)	5.29 (0.35)	6.85 (0.83)	2.81 (0.21)	7.46 (0.33)	9.02 (0.32)	7.34 (1.23)	5.05 (0.07)
9/8/2015	250	6.71 (0.58)	4.64 (0.20)	5.36 (0.17)	2.38 (0.35)	9.76 (0.64)	10.48 (0.95)	5.04 (0.10)	2.91 (0.19)
9/17/2015	259	14.95 (0.09)	3.67 (0.35)	18.37 (2.43)	4.00 (0.11)	10.52 (0.84)	4.17 (0.21)	7.26 (0.46)	3.49 (0.77)
9/22/2015	264	9.81 (0.21)	9.95 (2.96)	6.57 (0.29)	3.16 (0.24)	8.37 (0.75)	11.28 (0.38)	8.93 (1.05)	6.01 (0.43)
10/6/2015	278	18.23 (0.62)	15.44 (0.18)	12.64 (0.08)	26.96 (2.29)	16.37 (0.13)	22.31 (0.02)	12.98 (0.02)	14.60 (0.07)
10/20/2015	292	22.31 (0.35)	16.82 (0.42)	21.03 (1.12)	10.58 (1.34)	20.57 (1.17)	18.69 (0.09)	12.44 (0.46)	18.11 (1.05)
10/27/2015	299	26.08 (1.49)	14.83 (1.36)	11.62 (0.31)	8.01 (0.05)	17.63 (1.80)	18.57 (0.43)	10.66 (1.20)	10.38 (1.49)
11/3/2015	306	25.34 (1.24)	12.27 (0.59)	18.66 (0.83)	10.62 (0.01)	19.61 (2.31)	16.92 (0.12)	9.89 (1.44)	15.10 (0.18)
11/10/2015	313	21.11 (0.38)	8.14 (0.12)	18.61 (2.80)	4.26 (0.20)	13.42 (1.88)	10.52 (0.41)	17.17 (3.84)	6.73 (0.03)

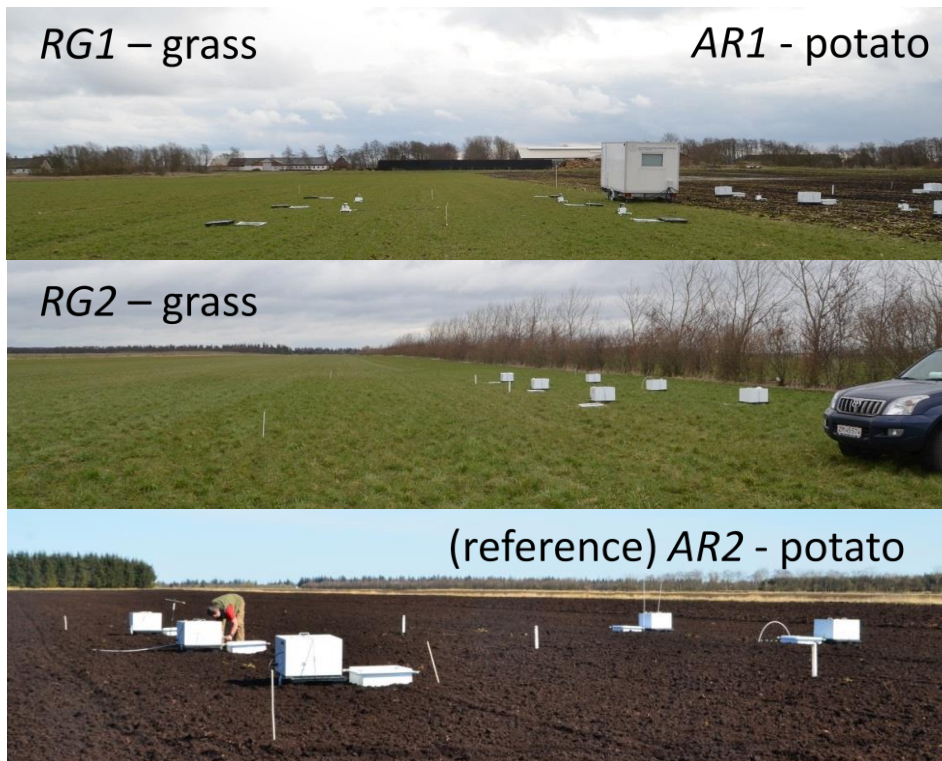


Figure S1. Distribution of field sites along a transect across remaining parts of Store Vildmose. Below impressions from each field site; *RG1* (grass) and *AR1* (potato) were aligned in two neighbouring fields.

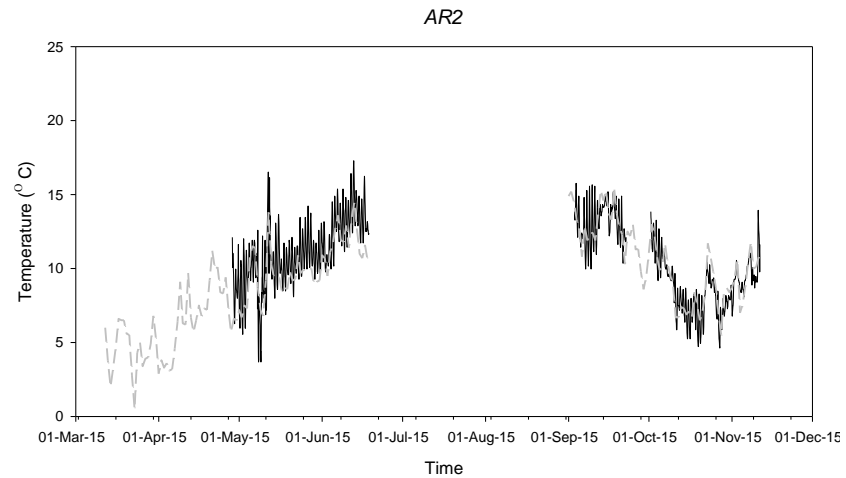
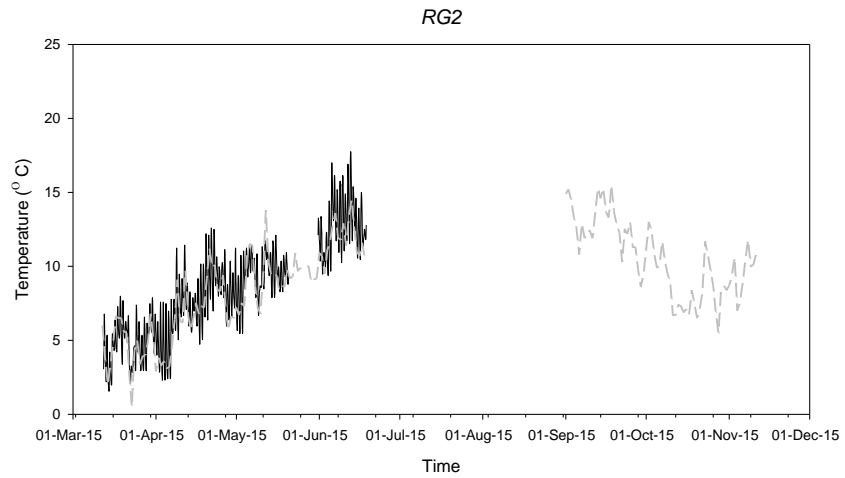
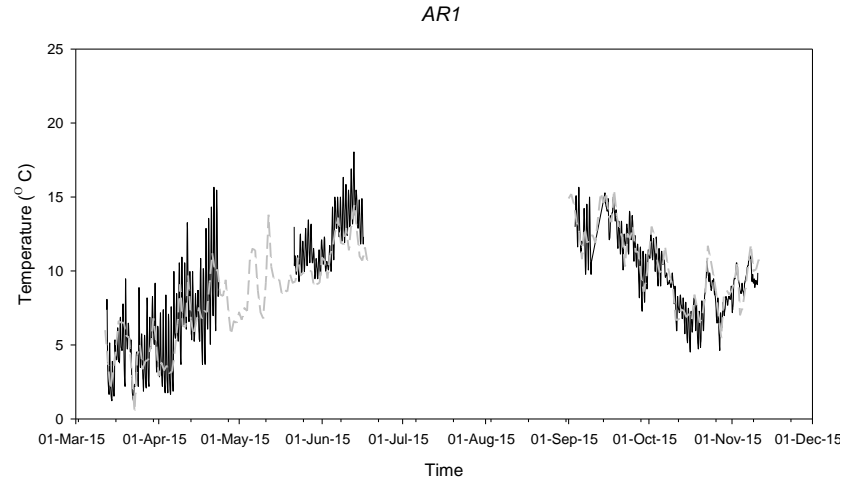
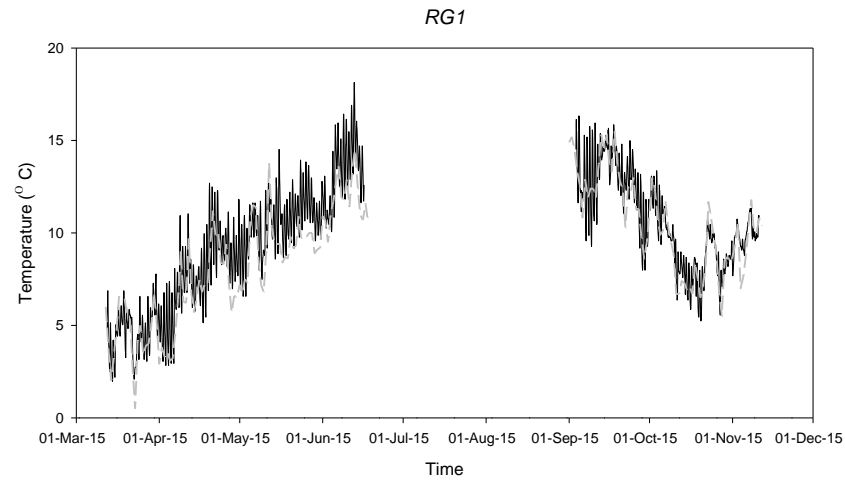


Figure S2. Hourly soil temperature at 10 cm depth over experimental period (Solid black line), and daily air temperature from the closest weather station (medium-dashed grey line).