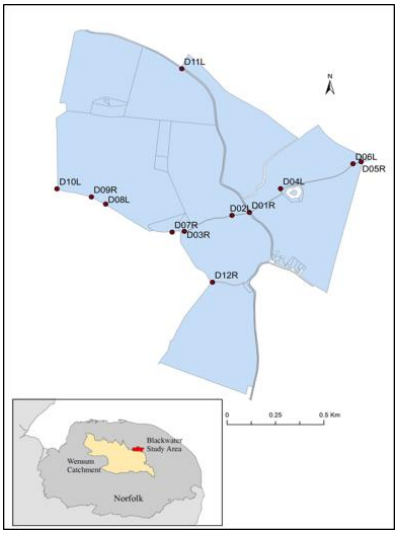
Monitoring dissolved nitrous oxide concentrations in field drains from arable lands

Aim: To monitor dissolved nitrous oxide concentrations in field drainage and assess the effect of temporal and spatial variations on this gas.

Description: Nitrous oxide N_2O is a potent greenhouse gas that persists in the atmosphere and has 298 times more global warming potential than CO_2. Emissions of N_2O arise both directly from fertilized soils and indirectly from drainage streams, groundwater, rivers and estuaries. N_2O is highly soluble in water, thus a significant amount of N_2O may be discharged with drain water and degassed to the atmosphere subsequently.

Methods: Sampling continued from mid-March until end of August 2013 from 12 field drains on a weekly basis. Samples for dissolved N_2O analysis were collected at drain outlet pipes in 20 ml glass syringes with a three-way stopcock attached to each syringe by a Luer-Lock fitting. N_2O was analysed by gas chromatography with an electron capture detector (GC-ECD).



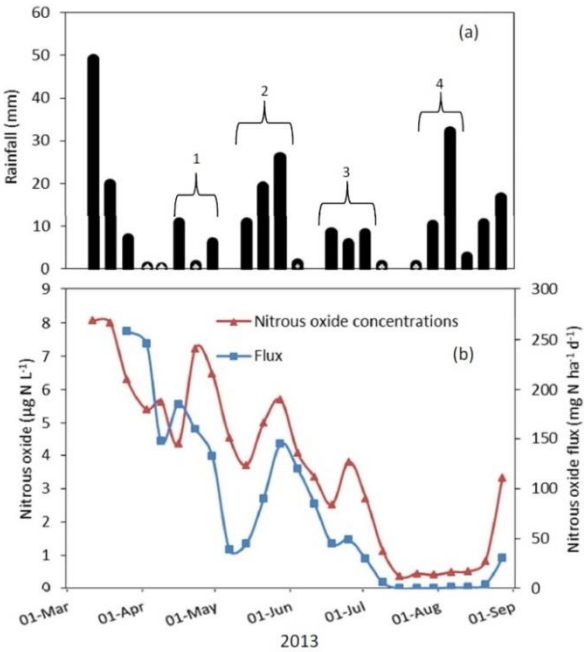
Study area and locations of drains

Table 1. Summary of data. Values are average concentrations (except for range of N_2O). Value in brackets is the number of samples analysed. Drain water samples collected from mid-March to end of August 2013

Site	N_2O (µg N L^{-1})	Range of N_2O (µg N L^{-1})	NO_3^- (mg N L^{-1})	NH_4^+ (µg N L^{-1})	NO_2^- (µg N L^{-1})
Drain1(13)	3	0.4-7	6.5	5	1
Drain2(21)	1	0.4-3	1.3	6	2
Drain3(5)	3	1-4	6.5	15	8
Drain4(14)	12	2-19	3.6	5	2
Drain5(14)	3	1-4	9.5	5	4
Drain6(10)	7	2-18	7.5	10	15
Drain7(5)	8	1-16	7.1	5	1
Drain8(3)	2	2-3	5.6	2	2
Drain9(8)	4	1-8	12.1	4	1
Drain10(6)	19	13-22	11.2	6	12
Drain11(2)	7	4-9	7.8	1.5	1
Drain12(4)	3	3-4	3.0	24	23

Key results:

- There is a great variation in N_2O concentration in field drains from 0.4 µg N L^{-1}, just above atmosphere-water equilibrium level, to18 µg N L^{-1}, up to 50 times greater than atmospheric–water equilibrium values.
- Mean of N_2O concentrations decreased continuously, by 1 order of magnitude, during the time of sampling from 8 µg N L^{-1} in winter to 0.8 µg N L^{-1} in summer.
- Three main rain events 1 to 3 occurred in spring and early summer created three associated peaks in dissolved N_2O concentrations. However, rainfall might not cause an increase in N_2O concentration when it happens in mid-summer (late July).



(a) Temporal variation of weekly rainfall (b) Mean N_2O concentration and flux

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