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Supplement of

Trends and drivers of ozone human health and vegetation impact metrics from UK EMEP supersite measurements (1990–2013)

C. S. Malley et al.

Correspondence to: C. S. Malley (c.malley@sms.ed.ac.uk)

This supplementary information contains 12 datasheets, summarising the statistics outlined in Section 2 for the derivation of chemical climates relating to the impact of O_3 exposure on human health and on four vegetation types at Harwell (1990-2013) and Auchencorth (2007-2013).

Tables S1 and S2: the chemical climates for the O_3 exposure associated with impact on human health (characterised using the SOMO10 and SOMO35 metrics) for Harwell and Auchencorth respectively.
Tables S3 and S4: the chemical climates for the impact of O_3 on potato (characterised using the POD_Y metric) at Harwell and Auchencorth respectively.
Tables S5 and S6: the chemical climates for the impact of O_3 on wheat (characterised using the POD_Y metric) at Harwell and Auchencorth respectively.
Tables S7 and S8: the chemical climates for the impact of O_3 on crops (characterised using the AOT40 metric) at Harwell and Auchencorth respectively.
Tables S9 and S10: the chemical climates for the impact of O_3 on beech (characterised using the POD_Y metric) at Harwell and Auchencorth respectively.
Tables S11 and S12: the chemical climates for the impact of O_3 on Scots pine (characterised using the POD_Y metric) at Harwell and Auchencorth respectively.

Table S1: Chemical climate datasheet summarising the O_3 exposure associated with human health impact at Harwell.

Impact

Acute ozone human health impact

Respiratory effects: Increased mortality, decreased lung function, coughing, throat irritation, shortness of breath, inflammation of airways, increased asthma attacks (REVIHAAP, 2013).

Metric

REVIHAAP (2013) recommends:

1. Assessment of the O_3 health impact using all year coefficients based on daily maximum 8-hour average O_3 concentrations.
2. A linear concentration-response relationship for short term exposure
3. 2 thresholds: 10 ppb and 35 ppb

Hence health impact evaluated using annual SOMO10 and SOMO35 metrics (sum of max daily 8h means above 10ppb and 35ppb).

Years	SOMO10 (ppb)	SOMO35 (ppb)
1990-1993	8058	1661
1994-1997	8249	1676
1998-2001	8322	1134
2002-2005	9094	1657
2006-2009	7738	985
2010-2013	8512	1088

Spatial domain

Harwell
EMEP level 2 Supersite,
lat: 51.571078
long: -1.32528

Representivity

S and SE UK
(Malley et al., 2014a)
AURN classification:
Rural Background

Temporal Domain

O_3 data: 1990-2013
NO_x data: 1996-2013

State

No. of exceedance days/year

	SOMO10	SOMO35
1990-1993	312	138
1994-1997	323	147
1998-2001	347	143
2002-2005	346	185
2006-2009	337	129
2010-2013	358	148

Ozone Variation (ppb)

	Mean	3rd Quartile	Max
1990-1993	25.0	33.3	111.8
1994-1997	24.6	33.3	107.3
1998-2001	25.8	33.3	89.3
2002-2005	27.3	35.8	88.8
2006-2009	25.2	32.8	85.0
2010-2013	26.7	33.5	77.9

Seasonal contribution to no. of exceedance days

	Spring		Summer		Autumn		Winter	
	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35
1990-1993	29%	46%	29%	36%	25%	9%	17%	9%
1994-1997	27%	41%	27%	39%	24%	9%	22%	12%
1998-2001	24%	42%	26%	34%	26%	10%	24%	14%
2002-2005	27%	40%	27%	31%	23%	13%	24%	16%
2006-2009	22%	46%	27%	30%	27%	9%	24%	15%
2010-2013	25%	50%	26%	28%	25%	8%	24%	14%

	Spring		Summer		Autumn		Winter	
	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35
1990-1993	34.1%	38.3%	35.8%	52.4%	17.7%	7.9%	12.4%	1.4%
1994-1997	30.6%	31.0%	36.8%	63.4%	16.6%	3.1%	16.1%	2.5%
1998-2001	29.0%	41.2%	30.9%	47.0%	20.6%	7.0%	19.4%	4.8%
2002-2005	31.6%	43.0%	30.6%	40.1%	19.2%	9.6%	18.6%	7.3%
2006-2009	28.7%	46.9%	30.8%	43.3%	21.1%	4.0%	19.5%	5.8%
2010-2013	32.7%	56.5%	28.0%	32.1%	19.5%	6.3%	19.9%	5.0%

Mean diurnal variation: SOMO10/35 exceedance (non-exceedance) days (ppb)

	O_3		NO		NO_2	
	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35
1990-1993	27.6 (6.9)	36.8 (19.3)	-	-	-	-
1994-1997	26.8 (8.1)	34.0 (19.1)	8.9 (55.2)	5.4 (19.1)	14.5 (18.4)	12.1 (16.8)
1998-2001	22.8 (8.3)	27.7 (18.9)	6.3 (43.8)	4.6 (9.1)	11.9 (16.0)	10.2 (13.2)
2002-2005	24.2 (9.3)	27.5 (19.6)	5.6 (42.0)	3.5 (10.3)	10.8 (15.4)	9.5 (12.5)
2006-2009	20.8 (8.6)	24.8 (17.9)	4.4 (38.6)	2.8 (6.9)	9.2 (17.5)	7.6 (10.4)
2010-2013	19.9 (9.8)	23.7 (17.0)	4.0 (27.1)	2.5 (5.7)	9.2 (15.0)	7.3 (10.6)

Contribution to SOMO10/35 from different daily max 8h concentrations

Concentration	90-93		94-97		98-01		02-05		06-09		10-13	
range (ppb)	10	35	10	35	10	35	10	35	10	35	10	35
10-20 ppb	2%	-	2%	-	2%	-	1%	-	3%	-	2%	-
20-30 ppb	15%	-	15%	-	18%	-	12%	-	23%	-	18%	-
30-35 ppb	20%	-	18%	-	24%	-	19%	-	21%	-	24%	-
35-40 ppb	18%	7%	21%	9%	21%	14%	23%	14%	22%	15%	21%	14%
40-50 ppb	21%	29%	19%	25%	23%	44%	29%	46%	22%	46%	26%	52%
50-60 ppb	8%	17%	10%	22%	7%	21%	8%	21%	4%	21%	7%	24%
60-70 ppb	6%	16%	4%	12%	4%	14%	3%	10%	3%	11%	1%	6%
>70 ppb	10%	32%	10%	32%	2%	8%	4%	10%	2%	7%	1%	4%

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	SOMO10	SOMO35
1990-1993	10.8 (2.8)	12.6 (8.7)
1994-1997	10.3 (3.4)	12.3 (8.0)
1998-2001	10.4 (3.4)	12.0 (9.1)
2002-2005	10.8 (3.9)	12.0 (8.8)
2006-2009	10.7 (1.3)	11.9 (9.6)
2010-2013	10.0 (4.0)	11.3 (9.0)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

SOMO10	Northerly	Easterly	Southerly	Westerly
1990-1993	25% (25%)	20% (64%)	28% (9%)	27% (2%)
1994-1997	23% (19%)	17% (69%)	21% (8%)	40% (3%)
1998-2001	19% (21%)	19% (65%)	26% (6%)	35% (9%)
2002-2005	24% (20%)	19% (58%)	21% (20%)	36% (3%)
2006-2009	21% (23%)	18% (71%)	23% (3%)	38% (3%)
2010-2013	21% (2%)	19% (66%)	19% (32%)	40% (1%)

SOMO35	Northerly	Easterly	Southerly	Westerly
1990-1993	22% (26%)	28% (20%)	27% (28%)	22% (26%)
1994-1997	27% (19%)	15% (24%)	19% (20%)	39% (37%)
1998-2001	19% (20%)	19% (21%)	28% (25%)	35% (35%)
2002-2005	23% (25%)	19% (20%)	21% (22%)	37% (33%)
2006-2009	19% (23%)	22% (18%)	20% (23%)	39% (35%)
2010-2013	24% (19%)	19% (20%)	19% (20%)	38% (41%)

Emissions: Av. hourly emissions along 96 hour back trajectory path arriving on POD_y exceedance (non-exceedance) days (Mg)

	SOMO10	SOMO35
1990-1993	57 (138)	67 (61)
1994-1997	49 (116)	52 (55)
1998-2001	38 (100)	39 (39)
2002-2005	35 (91)	35 (39)
2006-2009	27 (92)	27 (30)
2010-2013	23 (72)	24 (24)

Table S2: Chemical climate datasheet summarising the O_3 exposure associated with human health impact at Auchencorth.

Impact

Acute ozone human health impact

Respiratory effects: Increased mortality, decreased lung function, coughing, throat irritation, shortness of breath, inflammation of airways, increased asthma attacks (REVIHAAP, 2013).

Metric

REVIHAAP (2013) recommends:
1. Assessment of the O_3 health impact using all year coefficients based on daily maximum 8-hour average O_3 concentrations.
2. A linear concentration-response relationship for short term exposure
3. 2 thresholds: 10 ppb and 35 ppb

Hence health impact evaluated using annual SOMO10 and SOMO35 metrics (sum of max daily 8h means above 10ppb and 35ppb).

Years	SOMO10 (ppb)	SOMO35 (ppb)
2007	8762	816
2008	9111	1379
2009	8137	750
2010	8517	680
2011	8456	676
2012	8312	673
2013	8820	799

Spatial domain

Auchencorth
EMEP level 2 Supersite,
lat: 55.792160
long: -3.242900

Representivity

Central/northern UK (Malley et al., 2014a)
AURN classification: Rural Background

Temporal Domain

O_3 statistics: 2007-2013
NO_x statistics: 2007-2013
(data from proxy site Bush)

State

No. of exceedance days/year

	SOMO10	SOMO35
2007	363	166
2008	361	160
2009	360	125
2010	365	129
2011	365	131
2012	366	123
2013	364	144

Ozone Variation (ppb)

	Mean	3rd Quartile	Max
2007	29.1	35.0	59.0
2008	30.1	36.0	71.0
2009	27.8	34.0	64.0
2010	28.1	34.0	70.0
2011	28.2	33.0	71.0
2012	28.2	33.0	56.0
2013	29.8	34.5	54.5

Seasonal contribution to no. of exceedance days

	Spring		Summer		Autumn		Winter	
	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35
2007	25%	52%	25%	16%	25%	11%	24%	21%
2008	24%	53%	25%	24%	25%	3%	25%	20%
2009	25%	64%	26%	14%	25%	7%	25%	15%
2010	25%	59%	25%	17%	25%	14%	25%	10%
2011	25%	55%	25%	17%	25%	11%	25%	18%
2012	25%	63%	25%	24%	25%	4%	25%	9%
2013	25%	56%	25%	17%	25%	7%	24%	20%

	Spring		Summer		Autumn		Winter	
	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35
2007	33%	72%	24%	16%	21%	3%	22%	9%
2008	35%	74%	24%	16%	19%	1%	22%	9%
2009	34%	75%	24%	17%	19%	2%	23%	6%
2010	31%	63%	24%	19%	23%	9%	22%	9%
2011	32%	66%	23%	16%	22%	10%	24%	9%
2012	33%	78%	24%	15%	22%	4%	21%	3%
2013	33%	77%	23%	11%	21%	2%	24%	11%

Mean diurnal variation: SOMO10/35 exceedance (non-exceedance) days (ppb)

	O_3		NO		NO_2	
	SOMO10	SOMO35	SOMO10	SOMO35	SOMO10	SOMO35
2007	15.7 (10.0)	17.0 (14.7)	3.8 (33.6)	3.6 (4.2)	9.0 (12.8)	8.8 (9.1)
2008	16.1 (-)	18.4 (14.3)	3.4 (-)	1.9 (4.7)	8.7 (-)	7.3 (9.9)
2009	14.9 (16)	17.6 (13.6)	3.2 (12.8)	2.1 (3.9)	7.9 (11.7)	7.6 (8.1)
2010	16.3 (-)	18.8 (15.0)	4.3 (-)	2.3 (5.4)	9.5 (-)	7.6 (10.5)
2011	15.4 (-)	18.3 (13.8)	2.6 (-)	1.9 (3.1)	6.9 (-)	5.9 (7.4)
2012	14.5 (-)	17.3 (13.1)	2.4 (-)	1.3 (2.8)	7.4 (-)	5.8 (7.9)
2013	13.8 (-)	15.2 (12.9)	2.4 (-)	1.6 (2.9)	7.6 (-)	6.8 (8.1)

Contribution to SOMO10/35 from different daily max 8h concentrations

Concentration range (ppb)	2007		2008		2009		2010		2011		2012		2013	
	10	35	10	35	10	35	10	35	10	35	10	35	10	35
10-20 ppb	0%	-	0%	-	1%	-	0%	-	0%	-	1%	-	0%	-
20-30 ppb	19%	-	20%	-	28%	-	21%	-	23%	-	26%	-	16%	-
30-35 ppb	24%	-	20%		23%	-	33%	-	30%	-	28%		33%	-
35-40 ppb	32%	27%	15%	8%	18%	15%	25%	30%	26%	27%	21%	21%	23%	21%
40-50 ppb	21%	58%	32%	56%	27%	72%	19%	60%	17%	55%	22%	67%	25%	71%
50-60 ppb	3%	15%	9%	25%	3%	13%	1%	6%	2%	10%	2%	12%	2%	8%
60-70 ppb	0%	0%	3%	11%	0%	0%	1%	4%	1%	8%	0%	0%	0%	0%

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	SOMO10	SOMO35
2007	9.6 (-1.9)	9.1 (9.9)
2008	9.0 (-)	9.4 (8.7)
2009	9.3 (11.8)	8.5 (9.7)
2010	8.1 (-)	9.2 (7.5)
2011	9.6 (-)	9.6 (9.6)
2012	8.6 (-)	9.1 (8.4)
2013	9.0 (-)	8.2 (9.6)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

SOMO10	Northerly	Easterly	Southerly	Westerly
2007	25% (0%)	17% (100%)	12% (0%)	46% (0%)
2008	20% (-)	20% (-)	9% (-)	52% (-)
2009	19% (6%)	22% (0%)	25% (50%)	34% (44%)
2010	22% (-)	24% (-)	34% (-)	21% (-)
2011	19% (-)	13% (-)	43% (-)	26% (-)
2012	20% (-)	18% (-)	28% (-)	34% (-)
2013	20% (-)	23% (-)	29% (-)	28% (-)

SOMO35	Northerly	Easterly	Southerly	Westerly
2007	24% (26%)	19% (16%)	11% (12%)	46% (46%)
2008	18% (21%)	28% (13%)	9% (9%)	45% (56%)
2009	16% (21%)	32% (16%)	23% (25%)	28% (37%)
2010	23% (21%)	23% (24%)	34% (33%)	19% (21%)
2011	15% (21%)	16% (11%)	40% (44%)	30% (24%)
2012	25% (17%)	29% (13%)	17% (33%)	28% (37%)
2013	19% (20%)	30% (19%)	29% (29%)	22% (32%)

Emissions: Av. hourly emissions along 96 hour back trajectory path arriving on POD_Y exceedance (non-exceedance) days (Mg)

	SOMO10	SOMO35
2007	15 (87)	12 (17)
2008	16 (-)	14 (17)
2009	14 (17)	14 (14)
2010	13 (-)	12 (14)
2011	15 (-)	14 (15)
2012	12 (-)	12 (13)
2013	10 (-)	9 (11)

Table S3: Chemical climate datasheet summarising the impact of O_3 on potato at Harwell.

Impact

Ozone impact on POTATO

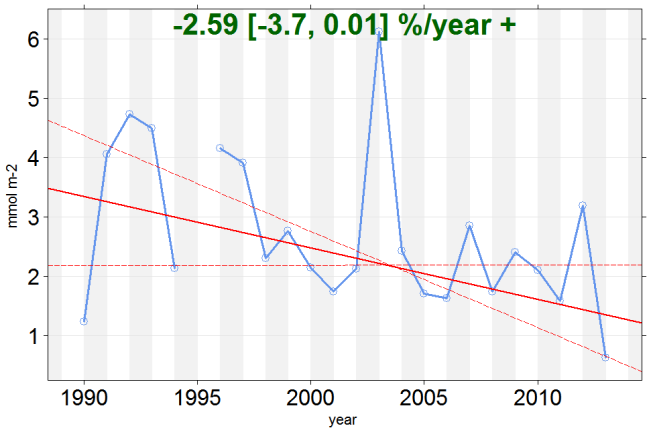
Critical levels for O_3 impact on potato based on reduction in tuber size (LRTAP Convention, 2010).

Metric

Phytotoxic O_3 Dose above a flux threshold of Y nmol m^{-2} s^{-1} (POD_Y) calculates accumulated stomatal flux of O_3 into the plant across growing season (1130°C days after plant emergence (26th May)). Critical level POD_6 = 2 corresponds to 5% tuber reduction.

Annual PODy 1990-2013

Theil Sen trend estimate is not statistically signiciant (p = 0.05)



Average annual PODy and % yield reduction

Averaged period	POD_Y (mmol m^{-2})	Yield reduction
1990-1993	3.62 ± 1.62	4.7%
1994-1997	2.87 ± 1.38	3.7%
1998-2001	2.24 ± 1.35	2.9%
2002-2005	3.09 ± 2.04	4.0%
2006-2009	2.15 ± 0.58	2.8%
2010-2013	1.88 ± 1.07	2.4%

Spatial domain

Harwell
EMEP level 2 Supersite,
lat: 51.571078
long: -1.32528

Representivity

S and SE UK
(Malley et al., 2014a)
AURN classification:
Rural Background

Temporal Domain

O_3 data: 1990-2013
NO_x data: 1996-2013

State

Annual and monthly no. of POD_Y exceedance days

	annual	5	6	7
1990-1993	27	2	16	8
1994-1997	25	2	19	3
1998-2001	26	3	19	5
2002-2005	23	3	19	1
2006-2009	27	2	19	6
2010-2013	25	2	20	3

Monthly % contribution to POD_Y

	5	6	7
1990-1993	20%	57%	24%
1994-1997	6%	89%	5%
1998-2001	10%	87%	3%
2002-2005	12%	87%	1%
2006-2009	6%	90%	4%
2010-2013	9%	86%	5%

Mean diurnal O_3 variation: POD_Y exceedance (non-exceedance) days (ppb)

	5	6	7
1990-1993	46.5 (35.7)	39.2 (24.0)	39.2 (25.2)
1994-1997	36.9 (30.8)	37.0 (23.0)	63.6 (39.2)
1998-2001	39.3 (27.0)	32.9 (19.9)	31.7 (27.7)
2002-2005	38.8 (23.3)	29.4 (20.5)	26.4 (28.0)
2006-2009	32.0 (25.8)	30.8 (23.3)	28.8 (24.4)
2010-2013	20.3 (22.6)	22.7 (19.2)	40.2 (21.9)

Mean diurnal NO variation: POD_Y exceedance (non-exceedance) days (ppb)

	5	6	7
1990-1993	-	-	-
1994-1997	8.5 (6.0)	4.8 (3.1)	- (3.4)
1998-2001	4.5 (5.7)	5.6 (3.8)	8.0 (3.9)
2002-2005	3.7 (2.6)	2.2 (1.5)	1.4 (2.7)
2006-2009	4.4 (3.9)	3.5 (4.5)	1.9 (2.5)
2010-2013	0.9 (2.2)	2.1 (2.0)	2.2 (1.7)

Mean diurnal NO_2 variation: POD_Y exceedance (non-exceedance) days (ppb)

	5	6	7
1990-1993	-	-	-
1994-1997	12.7 (11.3)	12.7 (8.6)	- (7.9)
1998-2001	9.5 (12.1)	11.7 (8.1)	11.7 (8.6)
2002-2005	11.1 (7.7)	7.6 (6.9)	5.6 (7.2)
2006-2009	10.9 (8.9)	8.1 (8.2)	3.8 (6.5)
2010-2013	4.4 (6.4)	6.5 (6.0)	11.5 (4.9)

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	5	6	7
1990-1993	15.0 (11.7)	15.5 (13.0)	17.3 (16.3)
1994-1997	13.8 (10.2)	15.3 (13.0)	17.9 (17.3)
1998-2001	14.1 (12.1)	15.3 (13.5)	16.2 (16.7)
2002-2005	14.9 (11.4)	16.2 (14.3)	15.4 (16.7)
2006-2009	14.7 (12.5)	16.0 (14.8)	17.5 (16.9)
2010-2013	15.4 (11.2)	14.9 (13.8)	18.0 (16.8)

Av. Global radiation on exceedance (non-exceedance) days (W m^{-2})

	5	6	7
1990-1993	233 (182)	226 (121)	121 (262)
1994-1997	365 (241)	330 (201)	201 (250)
1998-2001	271 (185)	239 (151)	151 (216)
2002-2005	264 (186)	243 (152)	152 (275)
2006-2009	249 (187)	244 (180)	180 (196)
2010-2013	310 (233)	259 (191)	191 (311)

Emissions: Av. hourly emissions along 96 hour back trajectory path arriving on POD_Y exceedance (non-exceedance) days (Mg)

	5	6	7
1990-1993	79 (68)	107 (62)	52 (49)
1994-1997	55 (61)	52 (35)	67 (47)
1998-2001	66 (39)	47 (35)	46 (41)
2002-2005	43 (28)	34 (30)	39 (28)
2006-2009	42 (31)	45 (34)	23 (24)
2010-2013	16 (23)	19 (21)	55 (18)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

	Northerly	Easterly	Southerly	Westerly
1990-1993	22% (28%)	35% (15%)	21% (27%)	22% (29%)
1994-1997	38% (27%)	6% (13%)	20% (17%)	35% (43%)
1998-2001	21% (20%)	17% (16%)	27% (27%)	35% (36%)
2002-2005	23% (26%)	11% (16%)	21% (18%)	45% (40%)
2006-2009	26% (24%)	25% (14%)	18% (25%)	30% (38%)
2010-2013	25% (24%)	14% (6%)	21% (19%)	40% (51%)

Table S4: Chemical climate datasheet summarising the impact of O_3 on potato at Auchencorth.

Impact

Ozone impact on POTATO

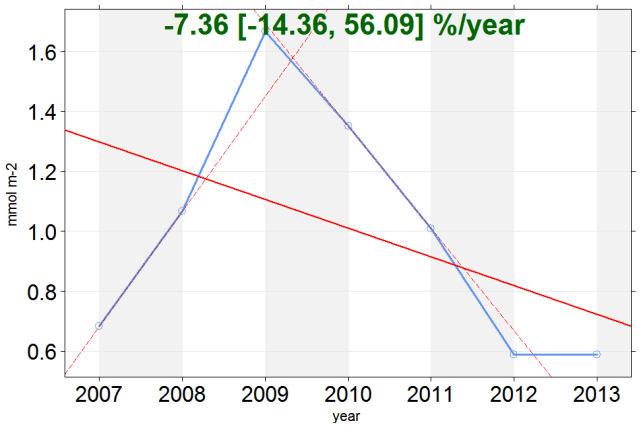
Critical levels for O_3 impact on potato based on reduction in tuber size (LRTAP Convention, 2010).

Metric

Phytotoxic O_3 Dose above a flux threshold of Y nmol m^{-2} s^{-1} (POD_y) calculates accumulated stomatal flux of O_3 into the plant across growing season (1130°C days after plant emergence (26th May)). Critical level POD_6 = 2 corresponds to 5% tuber reduction.

Annual PODy 2007-2013.

Theil Sen trend estimate is not statistically significant (p = 0.05)



Average annual PODy and % yield reduction for quartile groups

Year	POD_y (mmol m^{-2})	Yield reduction
2007	0.7	0.8%
2008	1.1	1.4%
2009	1.7	2.2%
2010	1.4	1.7%
2011	1.0	1.3%
2012	0.6	0.8%
2013	0.6	0.8%

Spatial domain

Auchencorth
EMEP level 2 Supersite,
lat: 55.792160
long: -3.242900

Temporal Domain

O_3 statistics: 2007-2013
NO_x statistics: 2007-2013
(data from proxy site Bush)

Representivity

Central/northern UK
(Malley et al., 2014a)
AURN classification:
Rural Background

State

Annual and monthly no. of POD_y exceedance days

	Annual	5	6	7
2007	24	0	11	13
2008	36	2	22	12
2009	23	3	13	7
2010	20	0	17	3
2011	23	0	9	14
2012	18	3	11	4
2013	17	2	14	1

Monthly % contribution to POD_y

	5	6	7
2007	-	80%	20%
2008	27%	53%	20%
2009	20%	39%	42%
2010	-	100%	-
2011	-	30%	70%
2012	50%	47%	3%
2013	2%	96%	2%

Mean diurnal O_3 variation: POD_y exceedance (non-exceedance) days (ppb)

	5	6	7
2007	- (18.0)	27.1 (15.9)	17.1 (16.1)
2008	44.5 (22.4)	17.4 (21.3)	23.3 (16.1)
2009	24.7 (15.5)	19.3 (12.8)	23.7 (12.7)
2010	- (20.0)	22.4 (16.5)	19.0 (13.6)
2011	- (16.0)	20.2 (15.9)	22.1 (15.9)
2012	24.0 (18.7)	18.9 (15.4)	20.5 (13.9)
2013	23.8 (16.6)	21.3 (16.0)	17.0 (18.9)

Mean diurnal NO variation: POD_y exceedance (non-exceedance) days (ppb)

	5	6	7
2007	- (3.2)	6.6 (5.0)	2.8 (3.5)
2008	0.8 (3.3)	1.1 (2.0)	3.1 (2.5)
2009	1.3 (0.6)	3.5 (1.2)	- (0.6)
2010	- (2.6)	2.0 (2.1)	1.3 (1.4)
2011	- (1.5)	1.3 (2.1)	1.9 (2.4)
2012	1.6 (2.8)	1.5 (1.1)	6.4 (0.9)
2013	1.6 (1.4)	2.0 (1.7)	0.8 (1.5)

Mean diurnal NO_2 variation: POD_y exceedance (non-exceedance) days (ppb)

	5	6	7
2007	- (8.3)	14.9 (11.1)	5.6 (5.0)
2008	8.2 (11.0)	4.9 (7.2)	7.7 (5.8)
2009	7.6 (3.8)	9.0 (5.7)	- (3.7)
2010	- (7.8)	6.4 (7.1)	3.2 (3.8)
2011	- (3.8)	4.0 (5.5)	5.4 (6.3)
2012	5.3 (8.4)	4.9 (5.2)	10.2 (3.8)
2013	5.6 (6.5)	6.3 (4.9)	1.6 (5.9)

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	5	6	7
2007	- (10.2)	14.7 (11.6)	14.6 (13.5)
2008	15.3 (11.2)	13.3 (11.5)	15.4 (14.7)
2009	15.6 (10.3)	14.6 (11.8)	17.0 (14.5)
2010	- (10.2)	15.2 (13.8)	16.4 (14.9)
2011	- (10.9)	13.8 (11.7)	14.6 (14.0)
2012	14.8 (8.7)	13.5 (11.1)	15.5 (13.2)
2013	13.6 (9.9)	13.8 (12.6)	17.3 (16.7)

Av. Global radiation on exceedance (non-exceedance) days (W m^{-2})

	5	6	7
2007	- (195)	171 (138)	217 (174)
2008	287 (185)	223 (147)	206 (144)
2009	295 (208)	230 (206)	221 (171)
2010	- (277)	350 (220)	366 (219)
2011	- (307)	306 (173)	363 (258)
2012	499 (269)	313 (217)	248 (234)
2013	360 (274)	370 (289)	487 (327)

Emissions: Av. hourly emissions along 96 hour back trajectory path arriving on POD_y exceedance (non-exceedance) days (Mg)

	5	6	7
2007	- (10)	30 (14)	13 (10)
2008	36 (19)	11 (13)	21 (16)
2009	16 (7)	14 (7)	17 (13)
2010	- (8)	14 (12)	7 (8)
2011	- (13)	11 (12)	16 (10)
2012	8 (11)	12 (15)	23 (7)
2013	6 (9)	12 (8)	5 (11)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

	Northerly	Easterly	Southerly	Westerly
2007	24% (33%)	30% (16%)	24% (5%)	22% (46%)
2008	21% (19%)	14% (20%)	10% (14%)	55% (47%)
2009	15% (21%)	52% (13%)	24% (26%)	10% (40%)
2010	21% (19%)	9% (15%)	56% (40%)	14% (26%)
2011	47% (33%)	5% (4%)	34% (34%)	13% (28%)
2012	29% (28%)	23% (11%)	38% (32%)	10% (28%)
2013	25% (19%)	8% (7%)	36% (34%)	31% (40%)

Table S5: Chemical climate datasheet summarising the impact of O_3 on wheat at Harwell.

Impact

Ozone impact on WHEAT

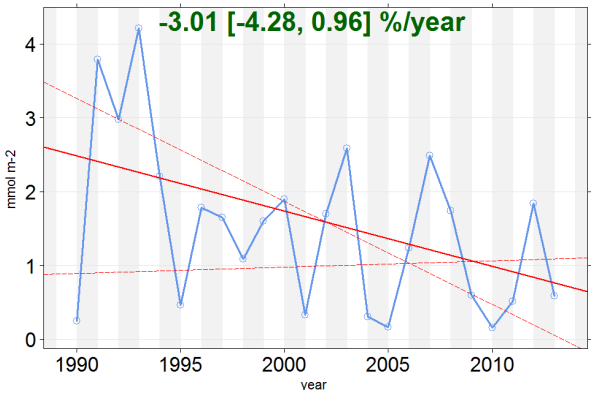
Critical levels for O_3 impact on wheat based on reduction in grain yield (LRTAP Convention, 2010).

Metric

Phytotoxic O_3 Dose above a flux threshold of Y nmol m^{-2} s^{-1} (POD_y) calculates accumulated stomatal flux of O_3 into the plant across growing season (200°C before anthesis - 700 °C after anthesis)). Critical level POD_6 = 1 corresponds to 5% yield reduction.

Annual PODy 1990-2013

Theil Sen trend estimate is not statistically signiciant (p = 0.05)



Average annual PODy and % yield reduction

Averaged period	POD_y (mmol m^{-2})	Yield reduction
1990-1993	2.81 ± 1.78	10.7%
1994-1997	1.53 ±0.74	5.8%
1998-2001	1.23 ±0.60	4.7%
2002-2005	1.19 ± 1.16	4.5%
2006-2009	1.52 ± 0.80	5.8%
2010-2013	0.77 ±0.74	2.9%

Spatial domain

Harwell
EMEP level 2 Supersite,
lat: 51.571078
long: -1.32528

Representivity

S and SE UK
(Malley et al., 2014a)
AURN classification:
Rural Background

Temporal Domain

O_3 data: 1990-2013
NO_x data: 1996-2013

State

Annual and monthly no. of POD_y exceedance days

	Annual	6	7
1990-1993	24	14	10
1994-1997	18	13	5
1998-2001	20	14	7
2002-2005	15	11	4
2006-2009	22	14	8
2010-2013	19	15	4

Monthly % contribution to POD_y

	6	7
1990-1993	74%	26%
1994-1997	83%	17%
1998-2001	90%	10%
2002-2005	92%	8%
2006-2009	90%	10%
2010-2013	97%	3%

Mean diurnal O_3 variation: POD_y exceedance (non-exceedance) days (ppb)

	6	7
1990-1993	40.5 (27.3)	38.2 (26.5)
1994-1997	35.6 (27.0)	58.9 (26.7)
1998-2001	31.9 (24.7)	29.5 (26.6)
2002-2005	29.2 (26.2)	35.0 (26.7)
2006-2009	27.0 (30.0)	29.9 (24.0)
2010-2013	20.9 (20.8)	27.4 (22.7)

Mean diurnal NO variation: POD_y exceedance (non-exceedance) days (ppb)

	6	7
1990-1993	-	-
1994-1997	5.1 (3.6)	2.8 (3.1)
1998-2001	5.6 (4.7)	5.4 (3.7)
2002-2005	1.4 (2.0)	3.5 (2.5)
2006-2009	3.9 (4.2)	2.1 (2.5)
2010-2013	1.7 (2.3)	2.9 (1.7)

Mean diurnal NO_2 variation: POD_y exceedance (non-exceedance) days (ppb)

	6	7
1990-1993	-	-
1994-1997	12.1 (10.4)	6.1 (7.1)
1998-2001	11.1 (9.8)	10.1 (8.3)
2002-2005	7.2 (7.7)	7.8 (6.9)
2006-2009	7.8 (9.0)	4.9 (6.3)
2010-2013	5.1 (7.7)	6.2 (5.5)

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	6	7
1990-1993	15.4 (13.5)	17.4 (16.4)
1994-1997	15.1 (13.6)	17.9 (17.2)
1998-2001	15.2 (14.0)	16.4 (16.6)
2002-2005	16.5 (15.1)	16.3 (16.7)
2006-2009	15.7 (15.4)	17.5 (16.8)
2010-2013	14.2 (14.4)	16.4 (17.0)

Av. Global radiation on exceedance (non-exceedance) days (W m^{-2})

	6	7
1990-1993	228 (147)	251 (158)
1994-1997	324 (238)	224 (252)
1998-2001	236 (177)	214 (199)
2002-2005	236 (187)	222 (180)
2006-2009	233 (213)	190 (199)
2010-2013	247 (222)	279 (258)

Emissions: Av. hourly emissions along 96 hour back trajectory path arriving on POD_y exceedance (non-exceedance) days (Mg)

	6	7
1990-1993	122 (59)	52 (53)
1994-1997	53 (39)	76 (43)
1998-2001	49 (38)	43 (40)
2002-2005	34 (35)	35 (26)
2006-2009	40 (41)	28 (23)
2010-2013	17 (21)	16 (20)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

	Northerly	Easterly	Southerly	Westerly
1990-1993	28% (27%)	33% (25%)	21% (23%)	19% (25%)
1994-1997	37% (30%)	3% (16%)	15% (21%)	45% (33%)
1998-2001	23% (23%)	13% (24%)	28% (23%)	35% (29%)
2002-2005	18% (29%)	15% (13%)	30% (14%)	37% (44%)
2006-2009	33% (18%)	11% (27%)	23% (21%)	22% (16%)
2010-2013	27% (27%)	13% (16%)	33% (33%)	38% (41%)

Table S6: Chemical climate datasheet summarising the impact of O_3 on wheat at Auchencorth.

Impact

Ozone impact on WHEAT

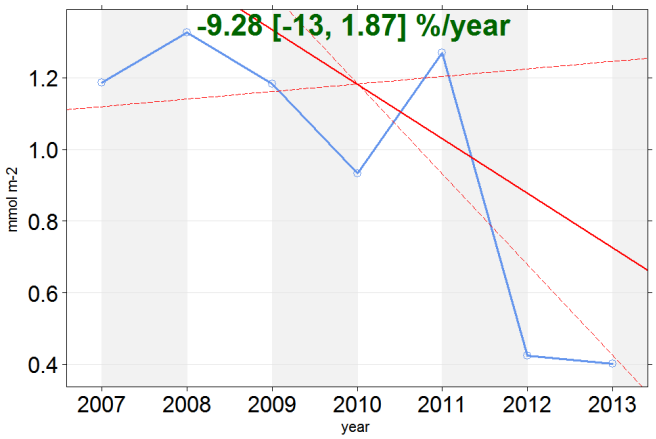
Critical levels for O_3 impact on wheat based on reduction in grain yield (LRTAP Convention, 2010).

Metric

Phytotoxic O_3 Dose above a flux threshold of Y nmol m^{-2} s^{-1} (POD_y) calculates accumulated stomatal flux of O_3 into the plant across growing season (200°C before anthesis - 700 °C after anthesis)). Critical level POD_6 = 1 corresponds to 5% yield reduction.

Annual PODy 2007-2013

Theil Sen trend estimate is not statistically signiciant (p = 0.05)



Average annual PODy and % yield reduction

Year	POD_y (mmol m^{-2})	Yield reduction
2007	1.2	4.5%
2008	1.3	5.0%
2009	1.2	4.5%
2010	0.9	3.6%
2011	1.3	4.8%
2012	0.4	1.6%
2013	0.4	1.5%

Spatial domain

Auchencorth
EMEP level 2 Supersite,
lat: 55.792160
long: -3.242900

Representivity

Central/northern UK
(Malley et al., 2014a)
AURN classification:
Rural Background

Temporal Domain

O_3 statistics: 2007-2013
NO_x statistics: 2007-2013
(data from proxy site Bush)

State

Annual and monthly no. of POD_y exceedance days

	Annual	6	7
2007	33	11	22
2008	40	23	17
2009	29	14	15
2010	22	15	7
2011	31	10	21
2012	22	15	7
2013	13	12	1

Monthly % contribution to POD_y

	6	7
2007	61%	39%
2008	64%	36%
2009	42%	58%
2010	90%	10%
2011	20%	80%
2012	80%	20%
2013	99%	1%

Mean diurnal O_3 variation: POD_y exceedance (non-exceedance) days (ppb)

	6	7
2007	27.0 (16.0)	16.9 (15.6)
2008	17.0 (23.0)	20.4 (17.0)
2009	18.2 (13.3)	17.5 (13.0)
2010	19.1 (21.2)	17.3 (13.3)
2011	17.5 (17.1)	20.8 (14.2)
2012	18.3 (15.1)	17.6 (13.9)
2013	20.8 (16.9)	17.0 (18.9)

Mean diurnal NO variation: POD_y exceedance (non-exceedance) days (ppb)

	6	7
2007	8.1 (4.2)	3.2 (2.8)
2008	1.1 (2.1)	2.5 (3.0)
2009	1.3 (2.3)	0.3 (0.8)
2010	1.9 (2.3)	0.9 (1.5)
2011	1.2 (2.2)	2.1 (2.3)
2012	1.4 (1.0)	3.8 (1.1)
2013	1.7 (1.9)	0.8 (1.5)

Mean diurnal NO_2 variation: POD_y exceedance (non-exceedance) days (ppb)

	6	7
2007	14.5 (11.4)	5.3 (5.3)
2008	5.0 (7.0)	7.0 (5.9)
2009	6.2 (7.0)	2.2 (5.1)
2010	5.5 (8.0)	2.4 (4.2)
2011	3.9 (5.6)	5.7 (6.2)
2012	4.7 (5.5)	6.5 (4.1)
2013	6.2 (5.1)	1.6 (5.9)

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	6	7
2007	14.3 (11.8)	14.3 (13.2)
2008	13.2 (11.7)	15.4 (14.6)
2009	13.6 (12.4)	15.9 (14.3)
2010	15.4 (13.8)	16.2 (14.6)
2011	12.9 (12.1)	14.5 (13.6)
2012	13.0 (11.0)	15.2 (13.0)
2013	13.8 (12.8)	17.3 (16.7)

Av. Global radiation on exceedance (non-exceedance) days (W m^{-2})

	6	7
2007	179 (134)	209 (148)
2008	219 (147)	187 (144)
2009	217 (214)	211 (155)
2010	332 (261)	270 (223)
2011	271 (184)	355 (200)
2012	320 (184)	253 (230)
2013	354 (309)	487 (327)

Emissions: Av. hourly emissions along 96 hour back trajectory path arriving on POD_y exceedance (non-exceedance) days (Mg)

	6	7
2007	23 (18)	12 (10)
2008	10 (15)	21 (15)
2009	13 (7)	12 (15)
2010	11 (16)	6 (8)
2011	11 (12)	15 (9)
2012	13 (15)	15 (8)
2013	13 (8)	5 (11)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

	Northerly	Easterly	Southerly	Westerly
2007	35% (25%)	23% (31%)	17% (7%)	25% (36%)
2008	25% (20%)	12% (39%)	10% (15%)	53% (26%)
2009	33% (13%)	33% (26%)	20% (25%)	14% (37%)
2010	19% (22%)	2% (14%)	55% (37%)	25% (27%)
2011	56% (25%)	4% (18%)	27% (32%)	14% (25%)
2012	38% (41%)	17% (24%)	34% (16%)	11% (20%)
2013	11% (25%)	23% (10%)	40% (32%)	26% (34%)

Table S7: Chemical climate datasheet summarising the impact of O_3 on crops at Harwell using the AOT40 metric.

Impact

Ozone impact on crops

Impact of O_3 crops and wild plants are summarised in (Royal Society, 2008), and include decreased crop yields, nutritional quality, tree growth and photosynthesis rates.

Metric: AOT40

Accumulated annual exposure of hourly O_3 concentrations over a threshold of 40 ppb. Gothenburg Protocol 1999 sets long term critical value for the protection of crops at 3000 ppb.h for the sum of daylight hourly concentrations between May and July (typical growing season).

Averaging period	AOT40 (ppb.h)
1990-1993	6533
1994-1997	6463
1998-2001	3483
2002-2005	3688
2006-2009	3433
2010-2013	2623

Spatial domain

Harwell
EMEP level 2 Supersite,
lat: 51.571078
long: -1.32528

Representivity

S and SE UK
(Malley et al., 2014a)
AURN classification:
Rural Background

Temporal Domain

O_3 data: 1990-2013
NO_x data: 1996-2013)

State

Monthly contribution to AOT40

	May	June	July
1990-1993	32%	31%	37%
1994-1997	28%	27%	45%
1998-2001	38%	36%	26%
2002-2005	39%	31%	30%
2006-2009	38%	36%	26%
2010-2013	44%	21%	35%

Monthly average diurnal O_3 cycle (ppb)

	May	June	July
1990-1993	26.8	22.9	23.8
1994-1997	22.5	22.5	30.4
1998-2001	17.3	18.2	20.8
2002-2005	15.5	19.5	21.3
2006-2009	16.5	20.6	20.3
2010-2013	15.7	14.7	18.8

Monthly average diurnal NO cycle (ppb)

	May	June	July
1990-1993	-	-	-
1994-1997	3.4	2.3	2.7
1998-2001	2.9	2.4	1.8
2002-2005	1.7	0.9	1.6
2006-2009	1.9	1.8	1.5
2010-2013	1.6	1.1	1.4

Monthly average diurnal NO_2 cycle (ppb)

	May	June	July
1990-1993	-	-	-
1994-1997	4.1	5.0	4.4
1998-2001	5.2	4.4	3.8
2002-2005	3.2	2.9	2.5
2006-2009	2.6	2.7	2.2
2010-2013	2.8	2.5	2.3

Drivers

Meteorology: Monthly average temperature (°C)

	May	June	July
1990-1993	12.2	14.4	16.7
1994-1997	10.6	14.4	17.4
1998-2001	12.5	14.6	16.5
2002-2005	11.8	15.6	16.7
2006-2009	12.6	15.4	17.2
2010-2013	11.5	14.5	17.1

Air Mass origin: Percentage of trajectories from 4 geographical groupings during growing season (May-July)

	Northerly	Easterly	Southerly	Westerly
1990-1993	27%	27%	14%	32%
1994-1997	32%	13%	20%	35%
1998-2001	23%	23%	24%	30%
2002-2005	29%	11%	15%	45%
2006-2009	21%	25%	17%	38%
2010-2013	28%	15%	17%	40%

Emissions: Average hourly emissions along 96 hour back trajectory path during each month of growing season (Mg)

	May	June	July
1990-1993	70.6	78.3	53.8
1994-1997	61.6	46.5	49.6
1998-2001	41.9	42.3	40.8
2002-2005	29.6	32.7	28.3
2006-2009	30.1	39.1	22.0
2010-2013	22.6	19.7	21.4

Annual crop AOT40 1990-2013

Theil Sen trend estimate is statistically signiciant (p = 0.001)

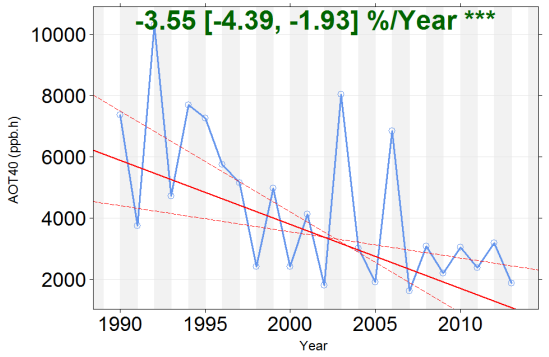


Table S8: Chemical climate datasheet summarising the impact of O_3 on crops at Auchencorth using the AOT40 metric.

Impact

Ozone impact on crops

Impact of O_3 crops and wild plants are summarised in (Royal Society, 2008), and include decreased crop yields, nutritional quality, tree growth and photosynthesis rates.

Metric: AOT40

Accumulated annual exposure of hourly O_3 concentrations over a threshold of 40 ppb. Gothenburg Protocol 1999 sets long term critical value for the protection of crops at 3000 ppb.h for the sum of daylight hourly concentrations between May and July (typical growing season).

Years	AOT40 (ppb.h)
2007	896
2008	4555
2009	1332
2010	963
2011	925
2012	1085
2013	694

Spatial domain

Auchencorth
EMEP level 2 Supersite,
lat: 55.792160
long: -3.242900

Representivity

Central/northern UK (Malley et al., 2014a)
AURN classification: Rural Background

Temporal Domain

O_3 statistics: 2007-2013
NO_x statistics: 2007-2013
(data from proxy site Bush)

State

Monthly contribution to AOT40

	May	June	July
2007	42%	57%	1%
2008	82%	11%	7%
2009	57%	23%	20%
2010	39%	61%	0%
2011	61%	10%	30%
2012	96%	3%	1%
2013	73%	13%	14%

Monthly average diurnal O_3 cycle (ppb)

	May	June	July
2007	8.4	7.4	10.2
2008	14.0	12.0	11.3
2009	10.1	11.4	10.8
2010	12.7	13.8	7.0
2011	8.7	10.6	13.7
2012	11.4	8.4	8.0
2013	7.0	11.2	11.9

Monthly average diurnal NO cycle (ppb)

	May	June	July
2007	1.9	3.5	1.7
2008	1.5	0.5	1.4
2009	0.3	1.1	0.3
2010	1.6	1.1	0.8
2011	0.8	1.3	1.5
2012	2.0	0.8	1.1
2013	0.7	1.2	1.0

Monthly average diurnal NO_2 cycle (ppb)

	May	June	July
2007	3.3	3.5	2.1
2008	4.3	1.2	2.3
2009	1.5	2.9	1.4
2010	2.6	2.0	1.5
2011	0.9	1.6	1.9
2012	3.8	1.6	1.6
2013	2.2	1.8	2.0

Drivers

Meteorology: Monthly average temperature (°C)

	May	June	July
2007	10.2	12.7	14.0
2008	11.4	12.9	15.0
2009	11.0	13.1	15.3
2010	10.2	14.5	15.0
2011	10.9	12.5	14.3
2012	9.3	12.0	13.5
2013	10.1	13.2	16.8

Air Mass origin: Percentage of trajectories from 4 geographical groupings during growing season (May-July)

	Northerly	Easterly	Southerly	Westerly
2007	27%	32%	11%	30%
2008	22%	32%	12%	34%
2009	19%	31%	20%	30%
2010	20%	14%	43%	24%
2011	34%	11%	32%	23%
2012	40%	24%	17%	19%
2013	24%	13%	31%	32%

Emissions: Av. hourly emissions along 96 hour back trajectory path arriving on POD_y exceedance (non-exceedance) days (Mg)

	May	June	July
2007	9.7	19.9	11.2
2008	20.4	11.6	18.1
2009	7.8	10.1	13.5
2010	8.0	13.5	7.6
2011	13.4	11.7	13.1
2012	10.4	13.9	9.3
2013	8.4	9.9	10.5

Annual crop
AOT40
1990-2013

Theil Sen trend estimate is not statistically signiciant (p = 0.05)

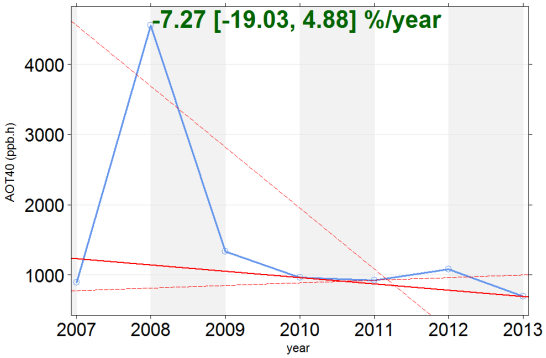


Table S9: Chemical climate datasheet summarising the impact of O_3 on beech at Harwell.

Impact

Ozone impact on BEECH

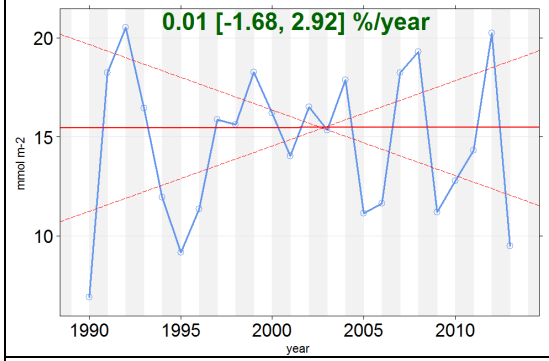
Critical levels for O_3 impact on beech based on reduction in whole tree biomass (LRTAP Convention, 2010).

Metric

Phytotoxic O_3 Dose above a flux threshold of Y nmol m^{-2} s^{-1} (POD_Y) calculates accumulated stomatal flux of O_3 into the plant across growing season (19th April-20th October)). Critical level POD_1 = 4 corresponds to 4% biomass reduction.

Annual PODy 1990-2013

Theil Sen trend estimate is not statistically signiciant (p =0.05)



Average annual PODy and % yield reduction for quartile groups

Averaged period	POD_Y (mmol m^{-2})	Biomass reduction
1990-1993	15.5 ± 6.0	17.1%
1994-1997	12.0 ±2.8	13.3%
1998-2001	16.0 ±3.3	17.6%
2002-2005	15.2 ±2.9	16.7%
2006-2009	15.1 ±4.3	16.6%
2010-2013	14.2 ±4.5	15.6%

Spatial domain

Harwell
EMEP level 2 Supersite,
lat: 51.571078
long: -1.325283

Representivity

S and SE UK
(Malley et al., 2014a)
AURN classification:
Rural Background

Temporal Domain

O_3 data: 1990-2013
NO_x data: 1996-2013

State

No. of POD_Y exceedance days & monthly contribution

	Annual	4	5	6	7	8	9
90-93	154	8	29	29	27	26	25
94-97	148	8	27	28	29	24	20
98-01	170	8	30	30	30	30	30
02-05	166	10	31	30	31	30	29
06-09	165	8	29	29	30	30	29
10-13	162	8	31	29	29	29	28

Monthly % contribution to POD_Y

	4	5	6	7	8	9
90-93	3%	33%	23%	16%	16%	7%
94-97	3%	35%	34%	12%	7%	8%
98-01	3%	27%	28%	15%	14%	11%
02-05	3%	34%	30%	13%	11%	9%
06-09	3%	29%	29%	15%	13%	9%
10-13	3%	33%	25%	12%	12%	14%

Mean diurnal O_3 variation: POD_Y exceedance (non-exceedance) (ppb)

	4	5	6	7	8	9
90-93	31.5 (24.0)	36.7 (14.9)	33.7 (21.5)	33.6 (8.8)	36.4 (13.1)	31.5 (10.8)
94-97	28.6 (27.9)	32.2 (2.5)	32.4 (-)	40.6 (22.0)	42.5 (17.7)	24.1 (14.8)
98-01	28.5 (21.9)	28.1 (-)	27.9 (-)	28.1 (-)	30.0 (13.5)	24.5 (6.0)
02-05	26.7 (29.5)	25.2 (-)	26.8 (-)	28.2 (17.0)	32.5 (15.8)	28.9 (13.3)
06-09	24.6 (24.5)	26.2 (-)	28.4 (-)	24.8 (11.0)	20.5 (19.0)	21.0 (5)
10-13	22.6 (18.5)	22.8 (-)	21.4 (-)	24.1 (16.9)	21.6 (15.6)	19 (13)

Mean diurnal NO variation: POD_Y exceedance (non-exceedance) (ppb)

	4	5	6	7	8	9
90-93	-	-	-	-	-	-
94-97	2.1 (8.9)	6.2 (-)	4.1 (-)	3.4 (-)	-	3.4 (3.6)
98-01	4.2 (3.6)	5.7 (-)	5.0 (-)	4.1 (-)	4.8 (6.2)	5.5 (-)
02-05	3.1 (4.1)	2.8 (-)	1.8 (-)	2.6 (6.4)	3.9 (6.4)	6.0 (3.5)
06-09	2.7 (2.9)	4.0 (-)	3.8 (-)	2.5 (0)	2.2 (1.2)	4.4 (1.8)
10-13	2.7 (1.8)	2.1 (-)	2.0 (-)	1.8 (1.3)	1.9 (2.5)	3.9 (1.2)

Mean diurnal NO_2 variation: POD_Y exceedance (non-exceedance) (ppb)

	4	5	6	7	8	9
90-93	-	-	-	-	-	-
94-97	9.7 (18.4)	11.6 (-)	11.2 (-)	7.9 (-)	-	10.6 (7.4)
98-01	10.0 (10.3)	11.9 (-)	10.2 (-)	8.8 (-)	11.1 (11.7)	10.5 (-)
02-05	11.0 (12.7)	8.2 (-)	7.3 (-)	7.0 (9.0)	13.2 (11.8)	11.8 (9.7)
06-09	9.0 (8.2)	9.0 (-)	8.1 (-)	6.1 (2.1)	4.6 (9.0)	9.0 (6.6)
10-13	7.5 (6.5)	6.3 (-)	6.3 (-)	5.4 (5.0)	6.5 (7.8)	7.8 (5.6)

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	4	5	6	7	8	9
90-93	9.8 (7.9)	11.9 (11.2)	14.5 (12.9)	17.0 (15.3)	16.8 (15.6)	13.5 (11.3)
94-97	10.4 (7.3)	10.7 (5.4)	14.5 (-)	17.4 (17.9)	18.0 (18.0)	12.1 (14.3)
98-01	9.9 (6.5)	12.4 (-)	14.6 (-)	16.7 (-)	16.5 (14.3)	14.6 (11.8)
02-05	10.9 (8.2)	11.8 (-)	15.6 (-)	16.7 (14.1)	17.4 (17.6)	14.5 (14.5)
06-09	10.6 (8.2)	12.7 (-)	15.6 (-)	17.2 (16.4)	16.2 (17.6)	14.3 (14.5)
10-13	10.6 (8.4)	11.5 (-)	14.6 (-)	16.9 (18.9)	16.3 (16.4)	13.9 (13.1)

Av. Global radiation on exceedance (non-exceedance) days (W m^{-2})

	4	5	6	7	8	9
90-93	150 (138)	194 (9)	198 (11)	209 (39)	185 (83)	130 (24)
94-97	221 (192)	257 (-)	278 (-)	269 (159)	247 (180)	151 (82)
98-01	170 (112)	194 (-)	206 (-)	206 (-)	182 (35)	119 (9)
02-05	161 (154)	193 (-)	211 (-)	190 (57)	177 (155)	135 (36)
06-09	173 (148)	190 (-)	224 (-)	211 (147)	164 (177)	131 (24)
10-13	166 (141)	242 (-)	239 (-)	269 (221)	251 (135)	146 (60)

Emissions: Average hourly NO_x emissions along 96 hour back trajectory path arriving on POD_Y exceedance (non-exceedance) days (Mg)

	4	5	6	7	8	9
90-93	74 (55)	68 (106)	81 (69)	55 (33)	58 (35)	68 (66)
94-97	49 (61)	60 (65)	47 (-)	49 (19)	59 (36)	38 (54)
98-01	38 (45)	41 (-)	42 (-)	43 (-)	40 (28)	43 (21)
02-05	47 (45)	30 (-)	33 (-)	28 (39)	38 (33)	40 (25)
06-09	31 (30)	32 (-)	40 (-)	22 (6)	19 (22)	29 (15)
10-13	28 (27)	23 (-)	19 (-)	22 (8)	17 (9)	19 (25)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

	Northerly	Easterly	Southerly	Westerly
90-93	28% (29%)	23% (18%)	25% (27%)	24% (27%)
94-97	29% (23%)	15% (22%)	20% (21%)	36% (34%)
98-01	19% (20%)	20% (17%)	27% (35%)	33% (28%)
02-05	27% (19%)	16% (42%)	18% (20%)	39% (19%)
06-09	21% (28%)	20% (15%)	22% (22%)	37% (35%)
10-13	20% (15%)	15% (16%)	19% (20%)	43% (41%)

Table S10: Chemical climate datasheet summarising the impact of O_3 on beech at Auchencorth.

Impact

Ozone impact on BEECH

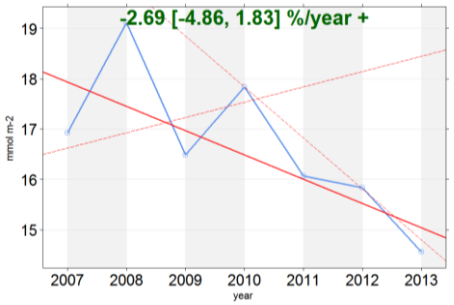
Critical levels for O_3 impact on beech based on reduction in whole tree biomass (LRTAP Convention, 2010).

Metric

Phytotoxic O_3 Dose above a flux threshold of Y nmol m^{-2} s^{-1} (POD_y) calculates accumulated stomatal flux of O_3 into the plant across growing season (26th April-10th October)). Critical level POD_1 = 4 corresponds to 4% biomass reduction.

Annual PODy 2007-2013.

Theil Sen trend estimate is not statistically signiciant (p = 0.05)



Average annual PODy and % yield reduction for quartile groups

Averaged period	POD_y (mmol m^{-2})	Biomass reduction
2007	16.9	18.6%
2008	19.1	21.0%
2009	16.5	18.1%
2010	17.8	19.6%
2011	16.1	17.7%
2012	15.8	17.4%
2013	14.6	16.0%

Spatial domain

Auchencorth
EMEP level 2 Supersite,
lat: 55.792160
long: -3.242900

Representivity

Central/northern UK (Malley et al., 2014a)
AURN classification: Rural Background

Temporal Domain
O_3 statistics:
2007-2013
NO_x statistics:
2007-2013
(data from proxy site Bush)

State

Annual and monthly no. of POD_y exceedance days

	Annual	5	6	7	8	9
2007	159	31	30	31	31	30
2008	157	31	30	31	31	30
2009	156	29	30	31	31	29
2010	160	31	30	31	31	30
2011	155	31	28	31	31	30
2012	155	31	30	29	31	30
2013	155	31	30	31	31	29

Monthly % contribution to POD_y

	5	6	7	8	9
2007	21%	23%	23%	19%	14%
2008	30%	25%	21%	15%	9%
2009	25%	25%	22%	18%	10%
2010	21%	27%	19%	19%	15%
2011	25%	21%	26%	14%	14%
2012	25%	23%	18%	21%	13%
2013	25%	28%	15%	22%	10%

Mean diurnal O_3 variation: POD_y exceedance (non-exceedance) (ppb)

	5	6	7	8	9
2007	18.0 (-)	20.0 (-)	16.5 (-)	16.8 (-)	13.4 (-)
2008	23.8 (-)	18.4 (-)	18.9 (-)	15.7 (-)	16.0 (-)
2009	16.4 (-)	15.5 (-)	15.2 (-)	13.3 (-)	13.1 (5)
2010	20.0 (-)	20.1 (-)	14.2 (-)	15.6 (-)	16.8 (-)
2011	16.0 (-)	17.5 (8)	18.7 (-)	14.4 (-)	14.2 (-)
2012	19.2 (-)	16.7 (-)	15.1 (4)	17.3 (-)	12.8 (-)
2013	17.1 (-)	18.5 (-)	18.8 (-)	14.3 (-)	14.1 (17.0)

Mean diurnal NO variation: POD_y exceedance (non-exceedance) (ppb)

	5	6	7	8	9
2007	3.2 (-)	5.6 (-)	3.1 (-)	3.3 (-)	2.0 (-)
2008	3.1 (-)	1.3 (-)	2.7 (-)	1.5 (-)	2.6 (-)
2009	0.7 (-)	2.0 (-)	0.6 (-)	1.5 (-)	1.6 (7.2)
2010	2.6 (-)	2.1 (-)	1.4 (-)	2.4 (-)	3.0 (-)
2011	1.5 (-)	1.6 (8.8)	2.2 (-)	2.6 (-)	1.6 (-)
2012	2.6 (-)	1.2 (-)	1.9 (0)	1.1 (-)	1.4 (-)
2013	1.4 (-)	1.8 (-)	1.5 (-)	2.8 (-)	2.6 (27.2)

Mean diurnal NO_2 variation: POD_y exceedance (non-exceedance) (ppb)

	5	6	7	8	9
2007	8.3 (-)	12.5 (-)	5.3 (-)	6.1 (-)	5.7 (-)
2008	10.8 (-)	5.5 (-)	6.5 (-)	5.8 (-)	7.7 (-)
2009	4.2 (-)	6.7 (-)	3.7 (-)	3.3 (-)	5.3 (8.5)
2010	7.8 (-)	6.6 (-)	3.8 (-)	6.3 (-)	7.6 (-)
2011	3.8 (-)	4.4 (22.9)	5.9 (-)	5.7 (-)	3.8 (-)
2012	7.9 (-)	5.1 (-)	5.0 (0.5)	4.4 (-)	4.1 (-)
2013	6.5 (-)	5.5 (-)	5.7 (-)	5.9 (-)	6.6 (17.6)

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	5	6	7	8	9
2007	10.2 (-)	12.7 (-)	14.0 (-)	14.1 (-)	12.6 (-)
2008	11.4 (-)	12.8 (-)	15.0 (-)	14.9 (-)	12.4 (-)
2009	10.9 (-)	13.0 (-)	15.1 (-)	15.5 (-)	13.3 (10.4)
2010	10.2 (-)	14.7 (-)	15.0 (-)	14.0 (-)	12.9 (-)
2011	10.9 (-)	12.3 (13.4)	14.2 (-)	13.7 (-)	13.5 (-)
2012	9.3 (-)	12.0 (-)	13.6 (11.0)	14.8 (-)	11.8 (-)
2013	10.1 (-)	13.2 (-)	16.8 (-)	15.3 (-)	12.5 (13.6)

Av. Global radiation on exceedance (non-exceedance) days (W m^{-2})

	5	6	7	8	9
2007	195 (-)	150 (-)	192 (-)	208 (-)	117 (-)
2008	192 (-)	202 (-)	168 (-)	122 (-)	94 (-)
2009	217 (-)	216 (-)	182 (-)	231 (-)	154 (116)
2010	277 (-)	299 (-)	234 (-)	215 (-)	156 (-)
2011	307 (-)	223 (-)	305 (-)	190 (-)	183 (-)
2012	291 (-)	252 (-)	230 (388)	232 (-)	178 (-)
2013	280 (-)	327 (-)	333 (-)	232 (-)	106 (27)

Emissions: Average hourly NO_x emissions along 96 hour back trajectory path arriving on POD_y exceedance (non-exceedance) days (Mg)

	5	6	7	8	9
2007	10 (-)	20 (-)	11 (-)	8 (-)	6 (-)
2008	20 (-)	12 (-)	18 (-)	16 (-)	23 (-)
2009	8 (-)	10 (-)	13 (-)	7 (-)	7 (18)
2010	8 (-)	13 (-)	8 (-)	6 (-)	14 (-)
2011	13 (-)	12 (9)	13 (-)	17 (-)	13 (-)
2012	10 (-)	14 (-)	9 (9)	15 (-)	5 (-)
2013	8 (-)	10 (-)	10 (-)	10 (-)	7 (36)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

	Northerly	Easterly	Southerly	Westerly
2007	28% (43%)	23% (3%)	7% (13%)	42% (42%)
2008	18% (38%)	27% (2%)	12% (0%)	42% (60%)
2009	20% (19%)	20% (10%)	23% (40%)	38% (31%)
2010	21% (0%)	14% (31%)	41% (67%)	23% (2%)
2011	30% (19%)	11% (0%)	35% (46%)	24% (35%)
2012	28% (58%)	17% (7%)	27% (0%)	27% (36%)
2013	21% (32%)	13% (13%)	31% (31%)	34% (25%)

Table S11: Chemical climate datasheet summarising the impact of O_3 on Scots pine at Harwell.

Impact

Ozone impact on PINE

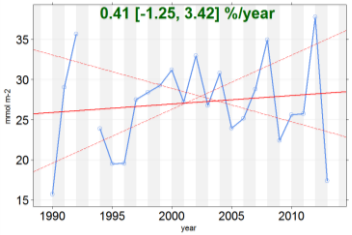
Critical levels for coniferous trees based on whole tree biomass reductions. Scots pine representative tree for 'atlantic central Europe' (LRTAP Convention, 2010).

Metric

Phytotoxic O_3 Dose above a flux threshold of Y nmol m^{-2} s^{-1} (POD_y) calculates accumulated stomatal flux of O_3 into the plant across growing season (year round when daily mean temperature >0 °C).

Annual PODy 1990-2013

Theil Sen trend estimate is not statistically signiciant (p = 0.05)



Average annual PODy and % yield reduction for quartile groups

Averaged period	POD_y (mmol m^{-2})	Biomass reduction
1990-1993	27.1 ±8.3	Response function not available for Scots pine.
1994-1997	22.6 ±3.8	
1998-2001	29.0 ±4.9	
2002-2005	28.6 ±4.0	
2006-2009	27.8 ±5.4	
2010-2013	26.6 ±8.4	

Spatial domain

Harwell
EMEP level 2 Supersite,
lat: 51.571078
long: -1.325283

Representivity

S and SE UK (Malley et al., 2014a)
AURN classification: Rural Background

Temporal Domain

O_3 data: 1990-2013
NO_x data: 1996-2013

State

Annual and monthly no. of POD_y exceedance days

	Annual	3	4	5	6	7	8	9
90-93	291	31	28	29	30	28	27	25
94-97	294	28	30	27	28	29	24	20
98-01	325	29	22	30	30	30	30	30
02-05	324	30	30	31	30	31	31	29
06-09	316	23	23	29	29	30	30	30
10-13	316	28	24	31	29	28	30	29

Monthly % contribution to POD_y

	3	4	5	6	7	8	9
90-93	11%	17%	20%	14%	12%	10%	4%
94-97	10%	20%	23%	19%	6%	4%	5%
98-01	8%	11%	20%	18%	9%	8%	7%
02-05	11%	18%	24%	16%	7%	7%	3%
06-09	8%	13%	20%	17%	10%	9%	6%
10-13	9%	14%	21%	14%	7%	8%	6%

Mean diurnal O_3 variation: POD_y exceedance (non-exceedance) (ppb)

	3	4	5	6	7	8	9
90-93	23.7 (30.0)	26.6 (7.3)	38.7 (9.2)	30.6 (16.0)	36.8 (12.8)	38.8 (24.0)	32.5 (12.4)
94-97	22.4 (18.0)	28.1 (23.0)	32.2 (2.5)	32.4 (-)	40.4 (25.3)	42.0 (17.7)	24.1 (14.8)
98-01	21.2 (20.4)	26.6 (4.0)	28.1 (-)	27.9 (-)	28.1 (-)	30.0 (13.5)	24.5 (6.0)
02-05	25.4 (17.3)	28.5 (-)	25.2 (-)	26.8 (-)	28.2 (17.0)	32.4 (19.0)	28.8 (13.5)
06-09	18.6 (9.5)	24.3 (4.0)	26.2 (-)	28.4 (-)	24.8 (11.0)	20.4 (21.0)	20.7 (11.0)
10-13	21.9 (10.5)	20.4 (-)	22.8 (-)	21.4 (-)	24.2 (16.4)	21.2 (34.6)	19.3 (10.6)

Mean diurnal NO variation: POD_y exceedance (non-exceedance) (ppb)

	3	4	5	6	7	8	9
90-93	-	-	-	-	-	-	-
94-97	12.2 (17.4)	6.6 (28.0)	6.2 (-)	4.1 (-)	3.4 (-)	-	3.4 (3.6)
98-01	8.2 (20.9)	3.9 (0)	5.7 (-)	5.0 (-)	4.1 (-)	4.8 (6.2)	5.5 (-)
02-05	9.6 (20.3)	4.0 (-)	2.8 (-)	1.8 (-)	2.6 (6.4)	4.0 (2.0)	5.9 (4.8)
06-09	2.7 (2.2)	2.9 (0)	4.0 (-)	3.8 (-)	2.5 (0)	2.1 (1.4)	4.3 (1.6)
10-13	6.7 (10.2)	2.1 (-)	2.1 (-)	2.0 (-)	1.8 (1.0)	1.9 (0.5)	3.8 (0)

Mean diurnal NO_2 variation: POD_y exceedance (non-exceedance) (ppb)

	3	4	5	6	7	8	9
90-93	-	-	-	-	-	-	-
94-97	17.0 (18.0)	15.7 (28.7)	11.6 (-)	11.2 (-)	7.9 (-)	-	10.6 (7.4)
98-01	13.8 (22.3)	10.4 (2.1)	11.9 (-)	10.2 (-)	8.8 (-)	11.1 (11.7)	10.5 (-)
02-05	15.0 (17.2)	12.0 (-)	8.2 (-)	7.3 (-)	7.0 (9.0)	9.4 (6.6)	11.8 (8.6)
06-09	7.6 (5.9)	9.2 (0)	9.0 (-)	8.1 (-)	6.1 (2.1)	6.2 (5.3)	8.9 (10.6)
10-13	12.7 (10.7)	6.9 (-)	6.3 (-)	6.3 (-)	5.4 (4.4)	5.6 (3.9)	7.8 (2.1)

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	3	4	5	6	7	8	9
90-93	7.9 (5.7)	8.2 (5.8)	12.0 (12.2)	14.0 (14.6)	17.2 (17.0)	17.6 (17.4)	13.9 (12.8)
94-97	6.3 (4.3)	8.2 (4.7)	10.7 (5.4)	14.5 (-)	17.4 (17.3)	18.0 (17.9)	12.1 (14.3)
98-01	7.0 (5.7)	8.5 (-0.8)	12.4 (-)	14.6 (-)	16.7 (-)	16.5 (14.3)	14.6 (11.8)
02-05	6.9 (6.2)	9.1 (-)	11.8 (-)	15.6 (-)	16.7 (14.1)	17.4 (21.0)	14.5 (14.3)
06-09	6.1 (4.1)	9.6 (8.1)	12.7 (-)	15.6 (-)	17.2 (16.4)	16.2 (18.7)	14.4 (14.7)
10-13	5.6 (3.3)	9.1 (8.3)	11.5 (-)	14.6 (-)	16.9 (18.8)	16.3 (20.3)	13.9 (13.6)

Av. Global radiation on exceedance (non-exceedance) days (W m^{-2})

	3	4	5	6	7	8	9
90-93	92 (36)	149 (0)	196 (1)	182 (0)	210 (58)	184 (166)	135 (26)
94-97	131 (40)	202 (58)	257 (2)	278 (-)	268 (261)	247 (180)	151 (82)
98-01	92 (35)	156 (0)	194 (-)	206 (-)	206 (-)	182 (35)	119 (9)
02-05	98 (28)	156 (-)	193 (-)	211 (-)	190 (57)	177 (126)	134 (41)
06-09	108 (5)	160 (0)	190 (-)	224 (-)	211 (147)	163 (206)	129 (51)
10-13	139 (51)	163 (-)	242 (-)	239 (-)	271 (239)	246 (304)	144 (71)

Emissions: Average hourly NO_x emissions along 96 hour back trajectory path arriving on POD_y exceedance (non-exceedance) days (Mg)

	3	4	5	6	7	8	9
90-93	51 (61)	60 (55)	74 (89)	72 (76)	64 (40)	62 (30)	67 (40)
94-97	54 (89)	56 (108)	60 (65)	47 (-)	49 (24)	59 (36)	38 (54)
98-01	42 (68)	40 (21)	41 (-)	42 (-)	43 (-)	40 (28)	43 (21)
02-05	47 (88)	45 (-)	30 (-)	33 (-)	28 (39)	38 (11)	40 (24)
06-09	19 (13)	28 (109)	32 (-)	40 (-)	22 (6)	19 (21)	29 (15)
10-13	33 (41)	25 (-)	23 (-)	19 (-)	22 (13)	17 (15)	19 (29)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

	Northerly	Easterly	Southerly	Westerly
90-93	29% (15%)	18% (33%)	26% (21%)	27% (22%)
94-97	23% (22%)	15% (44%)	21% (13%)	41% (21%)
98-01	18% (27%)	18% (38%)	27% (16%)	36% (18%)
02-05	24% (28%)	18% (42%)	21% (18%)	38% (12%)
06-09	22% (25%)	17% (35%)	23% (19%)	38% (21%)
10-13	22% (18%)	15% (52%)	20% (16%)	43% (14%)

Table S12: Chemical climate datasheet summarising the impact of O_3 on Scots pine at Auchencorth.

Impact

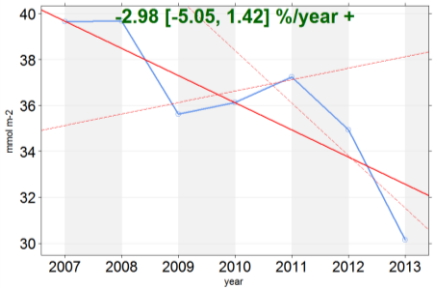
Ozone impact on PINE

Critical levels for coniferous trees based on whole tree biomass reductions. Scots pine representative coniferous tree for 'atlantic central Europe' (LRTAP Convention, 2010).

Metric

Phytotoxic O_3 Dose above a flux threshold of Y nmol m^{-2} s^{-1} (POD_Y) calculates accumulated stomatal flux of O_3 into the plant across growing season (year round when daily mean temperature >0 °C).

Annual PODy 2007-2013. Theil Sen trend estimate is not statistically signiciant (p = 0.05)



Average annual PODy and % yield reduction for quartile groups

Year	POD_Y (mmol m^{-2})	Biomass reduction
2007	39.7	Response function not available for Scots pine.
2008	39.7	
2009	35.6	
2010	36.1	
2011	37.2	
2012	34.9	
2013	30.1	

Spatial domain

Auchencorth
EMEP level 2 Supersite,
lat: 55.792160
long: -3.242900

Representivity

Central/northern UK (Malley et al., 2014a)
AURN classification: Rural Background

Temporal Domain

O_3 statistics: 2007-2013
NO_x statistics: 2007-2013
(data from proxy site Bush)

State

Annual and monthly no. of POD_Y exceedance days

	Annual	3	4	5	6	7	8	9	10
2007	351	31	30	31	30	31	31	30	31
2008	330	25	30	31	30	31	31	30	30
2009	322	28	30	29	30	31	31	30	31
2010	317	31	30	31	30	31	31	30	31
2011	346	31	30	31	28	31	31	30	31
2012	345	31	30	31	30	29	31	30	31
2013	343	24	30	31	30	31	31	30	31

Monthly % contribution to POD_Y

	3	4	5	6	7	8	9	10
2007	7%	15%	15%	14%	14%	11%	9%	7%
2008	6%	12%	22%	17%	14%	10%	8%	5%
2009	8%	16%	17%	16%	14%	11%	8%	5%
2010	7%	15%	16%	17%	12%	12%	11%	6%
2011	7%	15%	18%	18%	15%	9%	10%	6%
2012	10%	11%	18%	18%	12%	13%	10%	5%
2013	4%	15%	20%	20%	7%	12%	8%	7%

Mean diurnal O_3 variation: POD_Y exceedance (non-exceedance) (ppb)

	3	4	5	6	7	8	9	10
2007	14.6 (-)	18.9 (-)	18.0 (-)	20.0 (-)	16.5 (-)	16.8 (-)	13.4 (-)	16.3 (-)
2008	15.9 (-)	19.3 (-)	23.8 (-)	18.4 (-)	18.9 (-)	15.7 (-)	16.0 (-)	11.8 (-)
2009	13.6 (-)	20.8 (-)	16.4 (-)	15.5 (-)	15.2 (-)	13.3 (-)	12.9 (-)	14.4 (-)
2010	18.6 (-)	18.8 (-)	20.0 (-)	20.1 (-)	14.2 (-)	15.6 (-)	16.8 (-)	13.5 (-)
2011	17.2 (-)	20.8 (-)	16.0 (-)	17.5 (8)	18.7 (-)	14.4 (-)	14.2 (-)	13.0 (-)
2012	16.2 (-)	14.9 (-)	19.2 (-)	16.7 (-)	15.1 (4)	17.3 (-)	12.8 (-)	16.5 (-)
2013	13.4 (8.6)	14.9 (-)	17.1 (-)	18.5 (-)	18.8 (-)	14.3 (-)	14.2 (-)	11.6 (-)

Mean diurnal NO variation: POD_Y exceedance (non-exceedance) (ppb)

	3	4	5	6	7	8	9	10
2007	3.2 (-)	5.3 (-)	3.2 (-)	5.6 (-)	3.1 (-)	3.3 (-)	2.0 (-)	5.1 (-)
2008	1.2 (-)	2.7 (-)	3.1 (-)	1.3 (-)	2.7 (-)	1.5 (-)	2.6 (-)	1.5 (-)
2009	2.1 (-)	3.2 (-)	0.7 (-)	2.0 (-)	0.6 (-)	1.5 (-)	1.8 (-)	4.7 (-)
2010	3.8 (-)	2.9 (-)	2.6 (-)	2.1 (-)	1.4 (-)	2.4 (-)	3.0 (-)	1.8 (-)
2011	3.4 (-)	2.9 (-)	1.5 (-)	1.6 (8.8)	2.2 (-)	2.6 (-)	1.6 (-)	1.3 (-)
2012	- (-)	0.9 (-)	2.6 (-)	1.2 (-)	1.9 (-)	1.1 (-)	1.4 (-)	4.3 (-)
2013	3.1 (1.3)	1.3 (-)	1.4 (-)	1.5 (-)	1.5 (-)	2.8 (-)	3.5 (-)	2.6 (-)

Mean diurnal NO_2 variation: POD_Y exceedance (non-exceedance) (ppb)

	3	4	5	6	7	8	9	10
2007	9.0 (-)	8.3 (-)	8.3 (-)	12.5 (-)	5.3 (-)	6.1 (-)	5.7 (-)	10.5 (-)
2008	6.0 (-)	9.7 (-)	10.8 (-)	5.5 (-)	6.5 (-)	5.8 (-)	7.7 (-)	7.0 (-)
2009	5.4 (-)	9.6 (-)	4.2 (-)	6.7 (-)	3.7 (-)	3.3 (-)	5.4 (-)	9.7 (-)
2010	11.3 (-)	8.4 (-)	7.8 (-)	6.6 (-)	3.8 (-)	6.3 (-)	7.6 (-)	6.8 (-)
2011	8.3 (-)	6.9 (-)	3.8 (-)	4.4 (22.8)	5.9 (-)	5.7 (-)	3.8 (-)	6.0 (-)
2012	- (-)	7.4 (-)	7.9 (-)	5.1 (-)	5.0 (0.5)	4.5 (-)	4.1 (-)	11.1 (-)
2013	11.4 (5.5)	7.2 (-)	6.5 (-)	5.5 (-)	5.7 (-)	5.9 (-)	7.0 (-)	8.2 (-)

Drivers

Meteorology: Av. Temp on exceedance (non-exceedance) days (°C)

	3	4	5	6	7	8	9	10
2007	6.3 (-)	10.1 (-)	10.2 (-)	12.7 (-)	14.0 (-)	14.1 (-)	12.6 (-)	10.6 (-)
2008	4.9 (-)	7.1 (-)	11.4 (-)	12.8 (-)	15.0 (-)	14.9 (-)	12.4 (-)	8.8 (-)
2009	6.5 (-)	9.1 (-)	10.9 (-)	13.0 (-)	15.1 (-)	15.5 (-)	13.2 (-)	10.7 (-)
2010	5.3 (-)	8.4 (-)	10.2 (-)	14.7 (-)	15.0 (-)	14.0 (-)	12.9 (-)	9.8 (-)
2011	6.1 (-)	10.3 (-)	10.9 (-)	12.3 (-)	14.2 (-)	13.7 (-)	13.5 (-)	11.2 (-)
2012	8.2 (-)	6.4 (-)	9.3 (-)	12.0 (-)	13.6 (11.0)	14.8 (-)	11.8 (-)	7.4 (-)
2013	2.7 (1.2)	6.6 (-)	10.1 (-)	13.2 (-)	16.8 (-)	15.3 (-)	12.6 (-)	11.2 (-)

Av. Global radiation on exceedance (non-exceedance) days (W m^{-2})

	3	4	5	6	7	8	9	10
2007	115 (-)	171 (-)	195 (-)	150 (-)	192 (-)	208 (-)	117 (-)	69 (-)
2008	97 (-)	139 (-)	192 (-)	202 (-)	168 (-)	122 (-)	94 (-)	65 (-)
2009	106 (-)	138 (-)	217 (-)	216 (-)	182 (-)	231 (-)	153 (-)	61 (-)
2010	89 (-)	212 (-)	277 (-)	299 (-)	234 (-)	215 (-)	156 (-)	79 (-)
2011	140 (-)	258 (-)	307 (-)	223 (-)	305 (-)	190 (-)	183 (-)	83 (-)
2012	158 (-)	194 (-)	291 (-)	252 (-)	230 (388)	232 (-)	178 (-)	96 (-)
2013	130 (42)	253 (-)	280 (-)	326 (-)	333 (-)	232 (-)	104 (-)	76 (-)

Emissions: Average hourly NO_x emissions along 96 hour back trajectory path arriving on POD_Y exceedance (non-exceedance) days (Mg)

	3	4	5	6	7	8	9	10
2007	9.6 (-)	15.3 (-)	9.7 (-)	19.9 (-)	11.2 (-)	7.8 (-)	5.7 (-)	29.9 (-)
2008	8.2 (-)	13.6 (-)	20.4 (-)	11.6 (-)	18.1 (-)	15.7 (-)	23.0 (-)	7.7 (-)
2009	9.2 (-)	23.9 (-)	8.1 (-)	10.1 (-)	13.5 (-)	7.2 (-)	7.0 (-)	25.1 (-)
2010	17.5 (-)	13.6 (-)	8.0 (-)	13.5 (-)	7.6 (-)	6.2 (-)	13.7 (-)	11.1 (-)
2011	17.8 (-)	12.8 (-)	13.4 (-)	11.9 (-)	13.1 (-)	17.5 (-)	13.5 (-)	18.7 (-)
2012	18.4 (-)	11.7 (-)	10.4 (-)	13.9 (-)	9.4 (8.7)	14.5 (-)	5.5 (-)	12.2 (-)
2013	14.0 (-)	7.0 (-)	8.4 (-)	9.9 (-)	10.5 (-)	10.2 (-)	7.6 (-)	12.8 (-)

Air Mass origin: Percentage of trajectories from 4 geographical groupings on exceedance (non-exceedance) days

	Northerly	Easterly	Southerly	Westerly
2007	25% (13%)	16% (58%)	12% (8%)	47% (21%)
2008	19% (22%)	19% (23%)	8% (14%)	53% (42%)
2009	19% (23%)	20% (36%)	25% (21%)	37% (19%)
2010	22% (24%)	19% (59%)	37% (7%)	22% (11%)
2011	18% (24%)	13% (10%)	43% (35%)	26% (31%)
2012	19% (26%)	16% (53%)	29% (9%)	35% (12%)
2013	20% (12%)	20% (74%)	30% (10%)	30% (5%)