Supplement of

Net ozone production and its relationship to NO_x and VOCs in the marine boundary layer around the Arabian Peninsula

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Day to day calculation of the correction factor to scale the fractional noontime integral to a diurnal value. An average \pm standard deviation of (46.1 \pm 2.8) % of the diurnal integral within \pm 2h around noontime was estimated.



Figure S1: Calculation of the fractional noontime integral (\pm 2h around noon) with regard to the particular diurnal integral. Dashed line represents the campaign average of (46.1 \pm 2.8) %. The errors bars are represented by the relative uncertainty (6 %) of the campaign average.



20 Figure S2: Timeline of NO, NO₂ (both CLD), O₃ and *j*(NO₂) data during the first leg. See Table ST1 for additional information on the ship cruise.



Figure S3: Timeline of NO, NO₂ (both CLD), O₃ and $j(NO_2)$ data during the second leg. See Table ST1 for additional information on the ship cruise.



Figure S4: Ship cruises with color-scaled OH mixing ratios a) during the first and b) the second leg and color-scaled HO₂ mixing ratios c) during the first and d) the second leg. Note that both OH and HO₂ has been filtered for own stack contamination.



30 Figure S5: Scatterplot of simulated and measured regional NO_x median in ppb_y. 1:1 line added for orientation. The errors bars are represented by the 25-75-percentile variation.



Figure S6: Scatterplot of simulated and measured regional O₃ median in ppb_v. 1:1 line added for orientation. The errors bars are represented by the 25-75-percentile variation.



Figure S7: Scatterplot of simulated and measured regional RO_2 median in ppt_v . 1:1 line added for orientation. The errors bars are represented by the 25-75-percentile variation.



Figure S8: Scatterplot of simulated and measured regional NOPR median in $ppb_v day^{-1}$. 1:1 line added for orientation. The errors 40 bars are represented by the 25-75-percentile variation.

Table ST1: Overview of the time spent in the particular regions during AQABA. Red color indicates periods with KI at anchor that are not included in the data analysis. Data measured during bunkering at Fujairah City (August 06th, 07:00-15:00 UTC) were also not included in the analysis.

Date	Region	Date	Region	
03.07.2017	Northern Red Sea	02.08.2017	Kuwait port	
04.07.2017	Northern Red Sea	03.08.2017	Kuwait port/Arabian Gulf	
05.07.2017	Northern Red Sea	04.08.2017	Arabian Gulf	
06.07.2017	Northern Red Sea	05.08.2017	Arabian Gulf/Oman Gulf	
07.07.2017	Northern Red Sea	06.08.2017	Oman Gulf	
08.07.2017	Northern Red Sea	07.08.2017	Oman Gulf/Arabian Sea	
09.07.2017	Southern Red Sea	08.08.2017	Arabian Sea	
10.07.2017	Southern Red Sea	09.08.2017	Arabian Sea	
11.07.2017	Southern Red Sea/Jeddah port	10.08.2017	Arabian Sea	
12.07.2017	Jeddah port	11.08.2017	Arabian Sea	
13.07.2017	Jeddah port/Southern Red Sea	12.08.2017	Arabian Sea	
14.07.2017	Southern Red Sea	13.08.2017	Arabian Sea	
15.07.2017	Southern Red Sea	14.08.2017	Arabian Sea	
16.07.2017	Southern Red Sea	15.08.2017	Arabian Sea	
17.07.2017	Djibouti port	16.08.2017	Arabian Sea	
18.07.2017	Arabian Sea	17.08.2017	Southern Red Sea	
19.07.2017	Arabian Sea	18.08.2017	Southern Red Sea	
20.07.2017	Arabian Sea	19.08.2017	Southern Red Sea	
21.07.2017	Arabian Sea	20.08.2017	Southern Red Sea	
22.07.2017	Arabian Sea	21.08.2017	Northern Red Sea	
23.07.2017	Arabian Sea	22.08.2017	Northern Red Sea	
24.07.2017	Arabian Sea/Oman Gulf	23.08.2017	Northern Red Sea	
25.07.2017	Oman Gulf	24.08.2017	Northern Red Sea	
26.07.2017	Oman Gulf	25.08.2017	Mediterranean	
27.07.2017	Oman Gulf/Arabian Gulf	26.08.2017	Mediterranean	
28.07.2017	Arabian Gulf	27.08.2017	Mediterranean	
29.07.2017	Arabian Gulf	28.08.2017	Mediterranean	
30.07.2017	Arabian Gulf	29.08.2017	Mediterranean	
31.07.2017	Arabian Gulf/Kuwait port	30.08.2017	Mediterranean	
01.08.2017	Kuwait port	31.08.2017	Mediterranean	

NO _x (upper),	Mediterranea	Northern Red	Southern Red			
O ₃ (lower)	n	Sea	Sea	Arabian Sea	Oman Gulf	Arabian Gulf
data points	1767	1694	1755	2656	1056	1539
average	1.24	4.69	1.62	0.95	4.16	3.65
stdev	3.34	7.9	3.7	3.15	4.33	9.24
1 st quantile	0.12	0.68	0.18	0.10	1.03	0.52
median	0.25	1.76	0.46	0.19	2.74	1.26
3 rd quantile	0.96	5.68	1.6	0.54	5.92	3.47
data points	2010	2717	2307	4130	1249	1809
average	61.56	63.39	50.35	21.53	34.04	73.99
stdev	8.25	18.45	12.96	6.8	11.27	35.68
1 st quantile	57.05	53.51	40.68	17.45	26.66	53.08
median	61.54	64.16	46.93	22.52	31.5	62.5
3 rd quantile	66.48	75.51	60.28	26.19	38.03	90.42

Table ST2: Overview of measured NO_x (upper table) and measured O_3 (lower table) spatial volume mixing ratio average, standard deviation, 1^{st} quantile, median, 3^{rd} quantile (all in ppb_v) and number of considered data points.

50 Table ST3: Overview of simulated NO_x (upper table) and simulated O₃ (lower table) spatial volume mixing ratio average, standard deviation, 1st quantile, median, 3rd quantile (all in ppb_v) and number of considered data points.

NO_x (upper), O_3	Mediterranea	Northern Red	Southern Red			
(lower)	n	Sea	Sea	Arabian Sea	Oman Gulf	Arabian Gulf
data points	2012	2719	2310	4464	1253	1810
average	0.84	1.27	1.13	0.31	1.88	1.91
stdev	0.75	1.97	0.62	0.29	1.47	1.37
1 st quantile	0.33	0.43	0.67	0.14	0.82	1.17
median	0.43	0.76	0.97	0.18	1.59	1.61
3 rd quantile	1.27	1.08	1.51	0.39	2.05	2.16
data points	2012	2719	2310	4464	1253	1810
average	65.15	64.76	49.5	36.91	55	76.85
stdev	4.99	7.7	7.21	3.87	9.94	12.8
1 st quantile	61.35	60.34	43.47	34.12	48.37	65.88
median	65.53	64.6	49.33	36.54	55.01	76.39
3 rd quantile	69.33	68.25	54.58	38.85	61.42	86.22

Table ST4: Overview of noontime RO_2 spatial volume mixing ratio average, standard deviation, 1^{st} quantile, median, 3^{rd} quantile (all in ppt_v) estimated based on measured tracer data. Number of considered data points added in the first line.

RO ₂	Mediterranean	Northern Red	Southern Red	Arabian Sea	Oman Gulf	Arabian Gulf
		Sea	Sea			
data points	288	126	190	338	166	242
average	13	27	7	64	23	94
stdev	24	20	34	83	42	113
1 st quantile	1	15	-13	23	-8	11
median	16	28	15	33	22	73
3 rd quantile	26	44	27	54	49	176

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Table ST5: Overview of simulated noontime RO₂ spatial volume mixing ratio average, standard deviation, 1st quantile, median, 3rd quantile (all in ppt_v). Number of considered data points added in the first line.

RO ₂	Mediterranean	Northern Red	Southern Red	Arabian Sea	Oman Gulf	Arabian Gulf
		Sea	Sea			
data points	336	192	192	720	203	293
average	41	46	36	40	48	49
stdev	5	4	11	5	6	7
1 st quantile	36	43	25	38	44	44
median	41	46	38	41	50	49
3' [°] quantile	46	49	42	43	53	54

Table ST6: Overview of NOPR average, standard deviation, 1^{st} quantile, median, 3^{rd} quantile (all in ppb_v day⁻¹) estimated based on measured tracer data. Number of considered data points added in the first line.

		Northern	Southern			
NOPR	Mediterranean	Red Sea	Red Sea	Arabian Sea	Oman Gulf	Arabian Gulf
data points	176	114	89	188	84	111
average	-4	16	-5	-66	-105	-27
stdev	40	39	12	575	361	449
1 st quantile	-6	6	-9	1	-18	23
median	-2	16	-4	5	14	28
3 rd quantile	5	40	-1	11	21	65

Table ST7: Overview of NOPR average, standard deviation, 1^{st} quantile, median, 3^{rd} quantile (all in ppb_v day⁻¹) estimated based on simulated tracer data. Number of considered data points added in the first line.

		Northern	Southern			
NOPR	Mediterranean	Red Sea	Red Sea	Arabian Sea	Oman Gulf	Arabian Gulf
data points	336	192	192	720	203	293
average	11	16	12	5	30	38
stdev	8	12	6	6	11	10
1 st quantile	5	8	8	1	22	30
median	8	12	11	2	28	35
3 rd quantile	17	21	15	10	37	46

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Table ST8: Overview of measured HCHO/NO₂-ratio average, standard deviation, 1st quantile, median, 3rd quantile and number of considered data points.

	Mediterranea	Northern Red	Southern Red			
Ratio	n	Sea	Sea	Arabian Sea	Oman Gulf	Arabian Gulf
data points	203	79	48	252	108	122
average	5.4	1.5	8.5	11.1	2.7	9
stdev	4.7	0.7	6.5	8.9	2.1	6.4
1 st quantile	1.3	0.8	4.4	2.3	1	2.5
median	5	1.4	7.7	9.4	2.2	9.3
3 rd quantile	7.4	2.1	9.8	16.1	3.6	12.7

Table ST9: List of included peroxy radicals (with less than four carbon atoms) for the reaction with NO as recommended by Sander et al. (2019).

Species
HO ₂
CH ₃ O ₂
C ₂ H ₅ O2
C ₂ H ₅ CO ₃
CH ₃ CO ₃
C3DIALO2 (C ₃ H ₃ O ₄)
CH ₃ CHOHO ₂
CH ₃ COCH ₂ O ₂
CH ₃ COCO ₃
CHOCOCH ₂ O ₂
CO ₂ H ₃ CO ₃
HCOCH ₂ CO ₃
HCOCH ₂ O ₂
HCOCO ₃
HCOCOHCO ₃
HOC ₂ H ₄ CO ₃
HOCH ₂ CH ₂ O ₂
HOCH ₂ CO ₃
HOCH ₂ COCH ₂ O ₂
HOCH ₂ O ₂
CH ₃ CHO ₂ CH ₂ OH
IC3H7O2 (isopropylperoxy radical)
NC3H7O2 (propylperoxy radical)
NCCH ₂ O ₂
NO ₃ CH ₂ CO ₃
CH ₃ CHO ₂ CH ₂ ONO ₂