Investigating Ground-Level Ozone Pollution in Semi-Arid and Arid Regions of Arizona Using WRF-Chem Modeling

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Table S1. Ozone design values for the Phoenix-Mesa metropolitan area for the last two decades. Note: there were two concurred exceptional events in the 2017 design value (20 June 2015 and 7 July 2017). Without that the 2017 design value is 75 ppb.

Design Value years	Design Value (ppm)	NAAQS Value (ppm)	NAAQS Year
2020-2022	0.081	0.070	2015
2019-2021	0.080	0.070	2015
2018-2020	0.079	0.070	2015
2017-2019	0.077	0.070	2015
2016-2018	0.077	0.070	2015
2015-2017	0.076	0.070	2015
2014-2016	0.077	0.075	2008
2013-2015	0.076	0.075	2008
2012-2014	0.078	0.075	2008
2011-2013	0.081	0.075	2008
2010-2012	0.081	0.075	2008
2009-2011	0.077	0.075	2008
2008-2010	0.077	0.080	1997
2007-2009	0.076	0.080	1997
2006-2008	0.081	0.080	1997
2005-2007	0.083	0.080	1997
2004-2006	0.083	0.080	1997
2003-2005	0.084	0.080	1997

Table S2. Evaluation of MDA8 O₃ over Phoenix, Tucson, and Yuma for individual years for WRF-Chem simulations. The datasets for evaluation include AQS observations, CMAQ reanalysis (2017-2018), and ADEQ forecasts (2019-2021).

	Phoenix					Tucson					Yuma				
Year	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
AQS	67.9	66.6	64.1	62.0	67.8	60.1	54.9	54.8	54.6	57.2	54.3	53.8	56.1	48.2	52.1
WRF Chem	66.8	62.6	58.9	59.2	62.6	60.2	55.3	52.8	54.3	56.8	60.5	61.8	58.5	57.8	57.7
CMAQ /ADEQ	58.4	57.5	67.7	65.1	68.5	53.7	51.1	55.6	55.6	57.1	64.1	64.7	53.8	50.8	50.4
R (W)	0.81	0.69	0.61	0.56	0.62	0.79	0.70	0.68	0.68	0.26	0.85	0.50	0.72	0.40	0.83
R (C/A)	0.87	0.66	0.44	0.66	0.19	0.71	0.78	0.55	0.77	0.22	0.44	0.30	0.82	0.31	0.71
MB (W)	-1.09	-3.94	-5.21	-2.76	-5.16	0.14	0.37	-1.98	-0.35	-0.40	6.16	7.95	2.32	9.62	5.62
MB (C/A)	-9.5	-9.1	3.1	1.2	0.0	-6.4	-3.8	0.7	-1.1	-0.5	9.8	10.9	-2.7	2.8	0.6
ME (W)	6.3	6.6	7.0	6.6	8.1	4.7	4.7	4.3	4.8	7.0	9.1	11.8	5.5	10.1	6.8
ME (C/A)	9.9	10.1	5.1	4.2	9.9	7.4	5.1	3.9	4.0	6.0	13.8	14.2	4.1	6.8	6.8
RMSE (W)	7.6	8.5	8.3	8.3	10.4	5.7	5.9	4.9	6.2	9.0	11.9	15.5	6.6	13.2	9.5
RMSE (C/A)	11.1	12.7	7.4	5.4	12.6	8.8	6.6	4.9	4.9	6.9	16.6	17.5	5.5	8.0	8.3
NMB (W, 100%)	-1.6	-5.9	-8.1	-4.5	-7.6	0.2	0.7	-3.6	-0.6	-0.7	11.3	14.8	4.1	20.0	10.8
NMB (C/A, 100%)	-14.0	-13.6	4.8	1.9	-0.1	-10.7	-6.9	1.3	-2.0	-0.8	18.0	20.2	-4.9	5.8	1.1
NME (W, 100%)	9.2	10.0	10.8	10.7	12.0	7.8	8.6	7.8	8.7	12.3	16.8	22.0	9.8	21.0	13.0
NME (C/A, 100%)	14.6	15.2	8.0	6.7	14.6	12.3	9.3	7.2	7.3	10.6	25.3	26.3	7.3	14.2	13.0
MNB (W, 100%)	-2.0	-6.0	-7.7	-4.3	-7.0	0.3	1.0	-3.2	0.2	0.0	11.6	18.5	5.0	21.3	12.3
MNB (C/A, 100%)	-14.5	-13.9	5.9	2.1	1.8	-10.5	-7.1	2.1	-1.5	0.1	25.8	25.9	-4.4	7.8	4.1
MNE (W, 100%)	9.4	10.0	11.0	10.6	11.4	7.8	8.7	8.0	8.7	12.5	16.9	24.6	10.1	22.1	14.2
MNE (C/A, 100%)	14.9	15.3	8.9	6.6	13.7	12.2	9.4	7.6	6.9	10.7	31.0	30.5	7.0	14.9	14.1
FB (W, 100%)	-2.7	-6.9	-8.6	-5.3	-8.0	-0.2	0.4	-3.6	-0.4	-1.3	9.5	14.2	4.3	17.9	10.5
FB (C/A, 100%)	-16.1	-16.1	5.0	1.8	0.4	-11.7	-7.9	1.6	-1.8	-0.7	19.3	19.7	-4.8	6.4	2.6
FE (W, 100%)	9.6	10.7	11.7	11.3	12.2	7.7	8.8	8.1	8.7	12.7	15.3	21.0	9.7	18.8	12.4
FE (C/A, 100%)	16.5	17.5	8.1	6.4	13.9	13.2	10.2	7.3	7.0	10.7	24.9	24.6	7.3	14.1	13.4
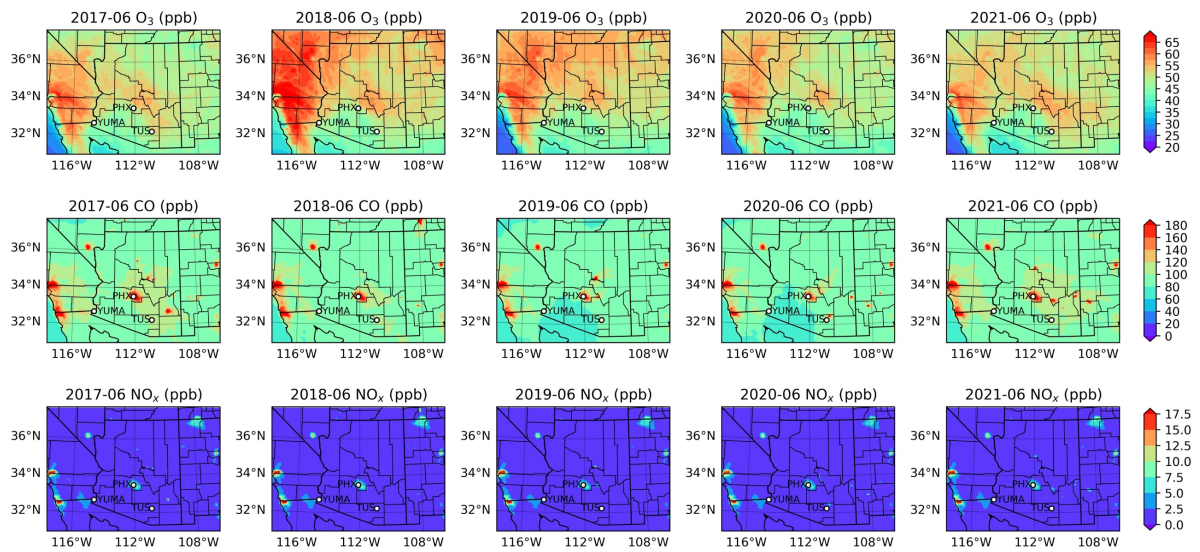
Figure S1. June monthly mean O₃, CO, and NOₓ from WRF-Chem simulations for 2017 to 2021.
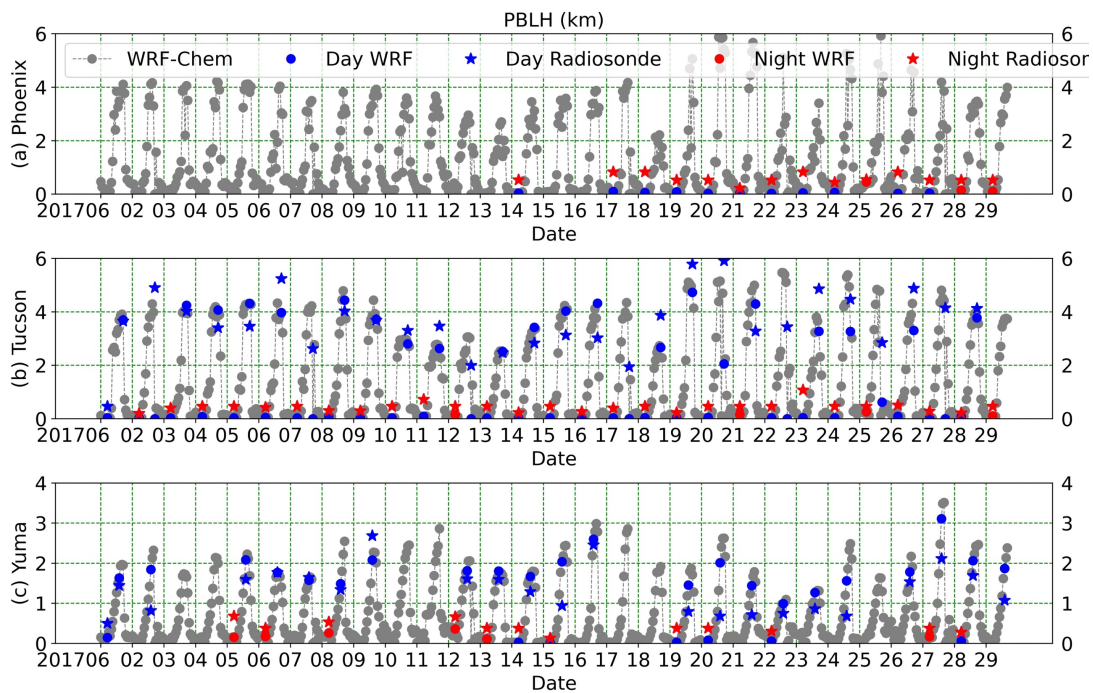
Figure S2. Radiosonde observed and WRF-Chem simulated PBLH in June 2017.
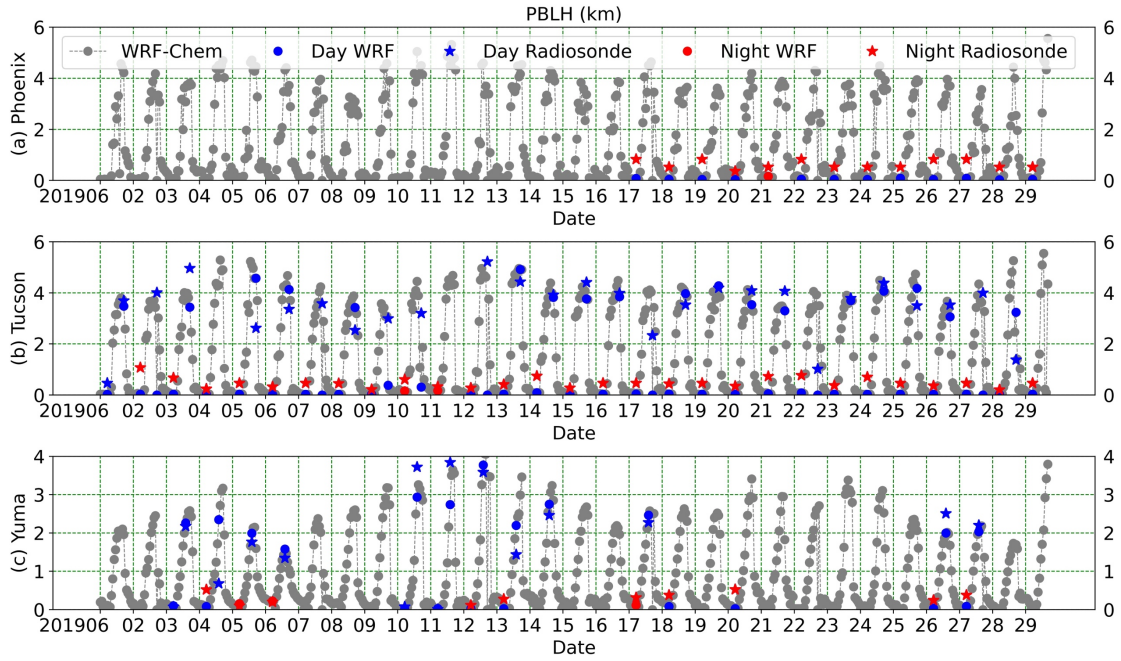
Figure S3. Radiosonde observed and WRF-Chem simulated PBLH in June 2019.
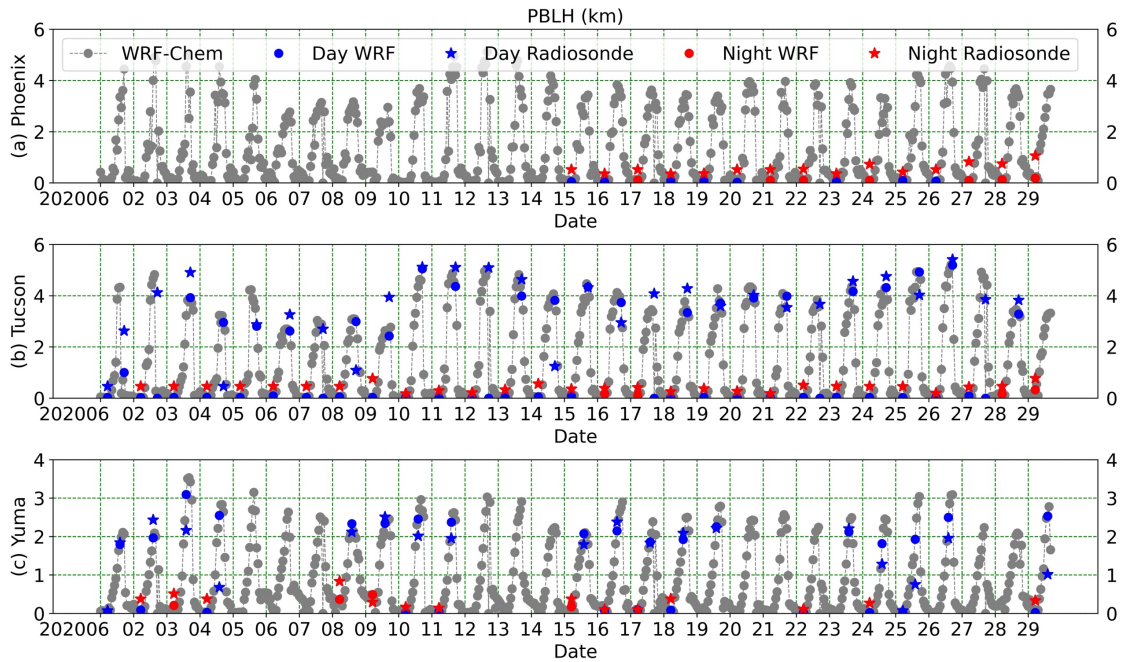
Figure S4. Radiosonde observed and WRF-Chem simulated PBLH in June 2020.
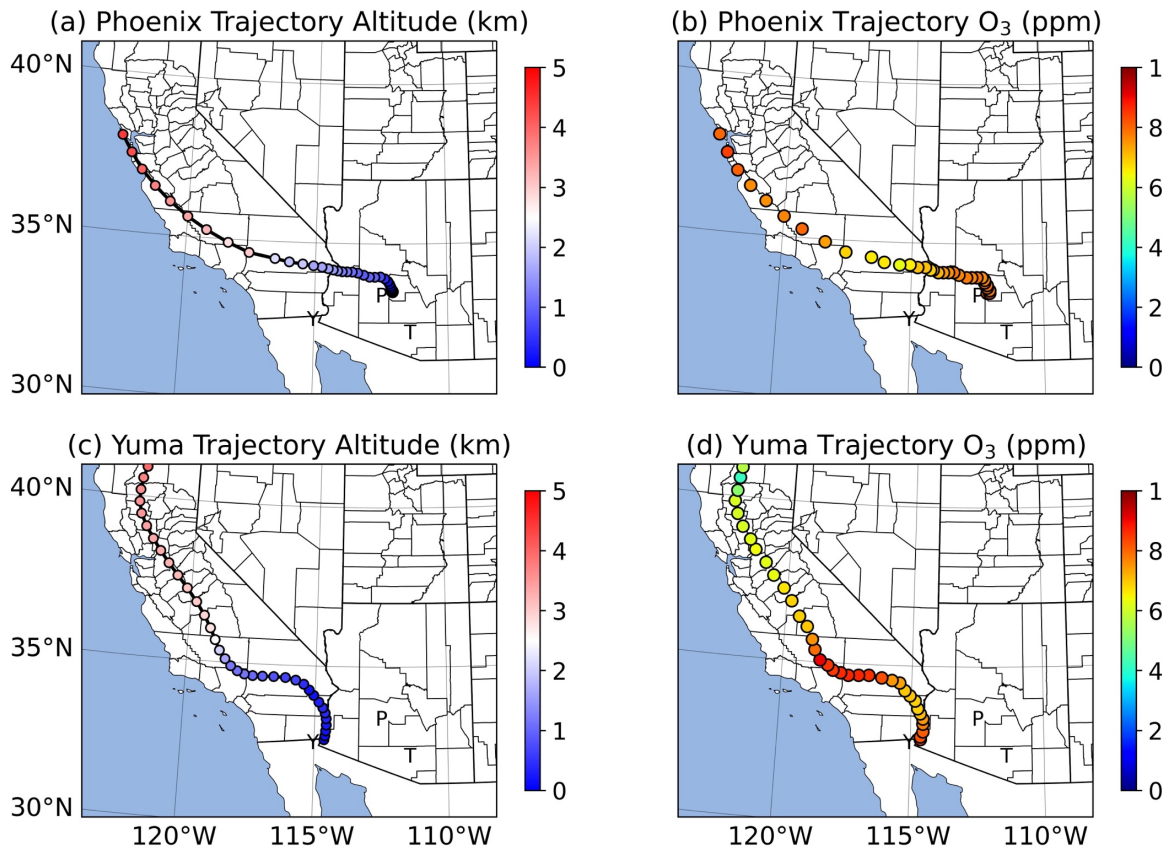
Figure S5. HYSPLIT back trajectories for the observed O₃ exceedance event on 13 June 2017 in both (a) Phoenix and (c) Yuma, and the corresponding O₃ concentrations along the trajectories.