

The impact of emissions and climate change on the future U.S. ozone

Introduction

- Climate change itself will worsen the ozone pollution
- Emissions of ozone precursors have declined in the U.S. for the past decades

The objective of this study:

- Showing how the climate penalty will affect the future ozone levels
- What is the combined effect of climate change and reducing anthropogenic emissions on future ozone levels

Methods

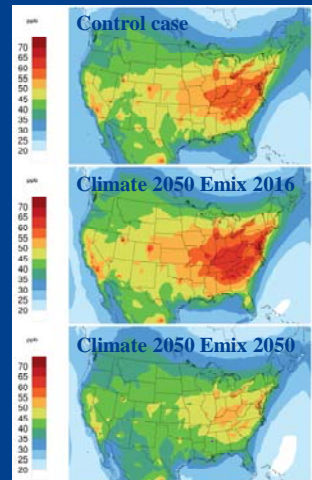
- Control case :2015-2017
- Future cases: 2049-2051
- CAMxV6.5 air quality model
- WRF v4.0
- CESM 1.0 (Downscaled to use in 2016 and 2050 WRF runs)
- 2016 GEOS-Chem (IC/BC for CAMx)
- EPA 2016 NEI (beta version)
- 299*459 horizontal grids (12km resolution) covers Continental U.S.
- 34 vertical grids
- RCP 8.5 Scenario



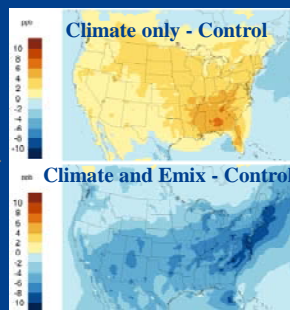
CAMx Modeling domain and 9 U.S. climate regions

Study cases

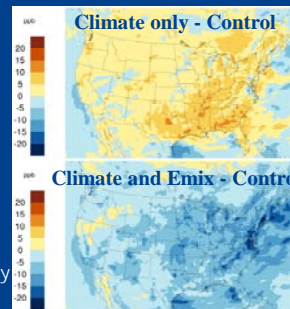
- Control case: Climate 2016 - Emission 2016
- Future case A: Climate 2050 – Emission 2016 (climate change only)
- Future case B: Climate 2050 – Emission 2050 (climate and emission change)



CAMx maximum 8h ozone average concentrations for three summers

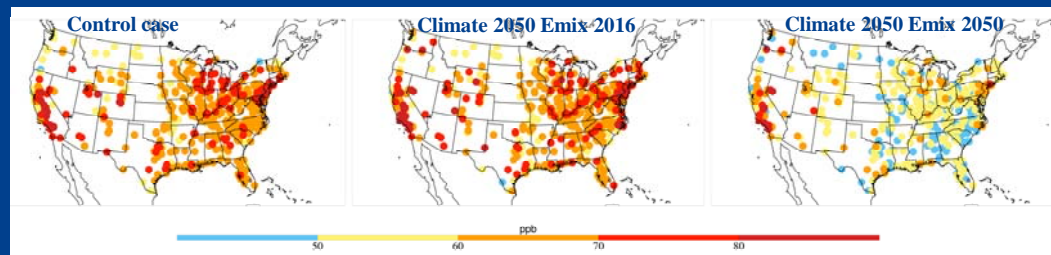
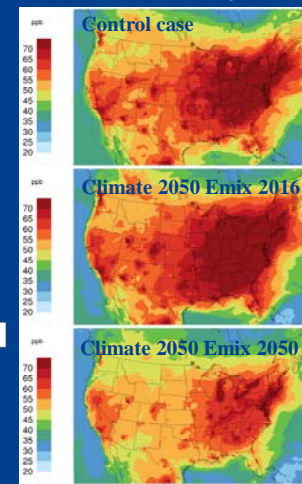


Difference plot of the maximum 8h ozone average concentrations for three summers

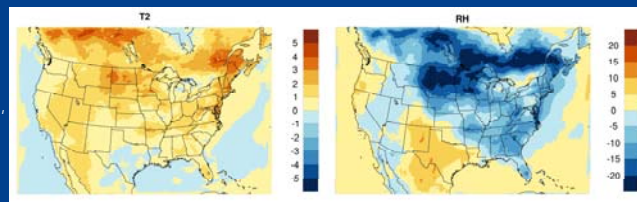


Difference plot of the 3-year average of the fourth highest daily maximum 8h concentration

CAMx 3-year average of the fourth highest daily maximum 8h concentration in each year



Observational 3-year average of the fourth highest daily maximum 8h concentration in each year



Temperature at 2m average difference, 2050 - 2016

Relative Humidity average difference, 2050 - 2016

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Key points:

- About 18% increase in the number of stations exceeding the 2015 NAAQS when no emission reduction happens from 2016 to 2050
- More than 95% of stations will be below the 2015 NAAQS in the U.S. with emission reductions proposed by RCP8.5
- With the 2015 NAAQS for ozone 95% of the problem will be solved but with a more stringent NAAQS for ozone (e.g. 60 ppb) in 2050 there would be still 81 stations (17% of total) exceeding the standard even with RCP 8.5 proposed emission reductions
- In this case, more emission reduction is needed (probably RCP 4.5 proposed emission reductions) to put all the states in attainment for the new standard
- Future work will probably answer this question

Table shows the # of stations with their design value above 70 ppb and 60 ppb in each climate region in the U.S.

Region	# of station with ozone above 70 ppb			# of station with ozone above 60 ppb		
	Control case	Climate 2050 emix 2016	Climate 2050 emix 2050	Control case	Climate 2050 emix 2016	Climate 2050 emix 2050
North East	34	46	1	65	68	21
South East	4	4	0	85	77	1
South	9	9	0	50	45	6
Central	21	21	0	97	97	4
East North Central	12	13	0	36	39	10
West North Central	0	2	0	5	11	1
West	19	21	12	32	34	26
South West	12	13	1	22	21	9
North West	1	2	1	3	3	3
Total	112	131	15	395	395	81

Acknowledgments

We thank the Division of Air Quality (DAQ) of Delaware Department of Natural Resources and Environmental Control (DNREC) for funding this project, specially Dr. Ali Mirzakhalli, the former director of DAQ for his kind support.

