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Conservation

Comparison of the CAMx performance of 2016 based modeling platforms at 12 km and 4 km resolution

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Modeling Setup for 2016 v1

- Model: CAMx v7.10
  - CB6r5 chemical mechanism (CB6r5_CF2E)
  - No bidirectional ammonia flux
- 2016 v1 (fi) emissions inventory, developed through collaborative effort between states and EPA
  - ERTAC EGU
  - BEIS v3.61 biogenic emissions, BELD v4.1 landuse
- Modeling years: 2016 (base) and 2023 (future)
- Modeling period: April to October
- 2016 Meteorology from WRF v3.8 (from EPA), wrfcamx v4.8.1
- Boundary conditions from our 36US3 CMAQ v5.3.1 model runs with 2016 v1 (fh) emissions for 2016 and 2023
- Two modeling domains at 12 km and 4 km resolution

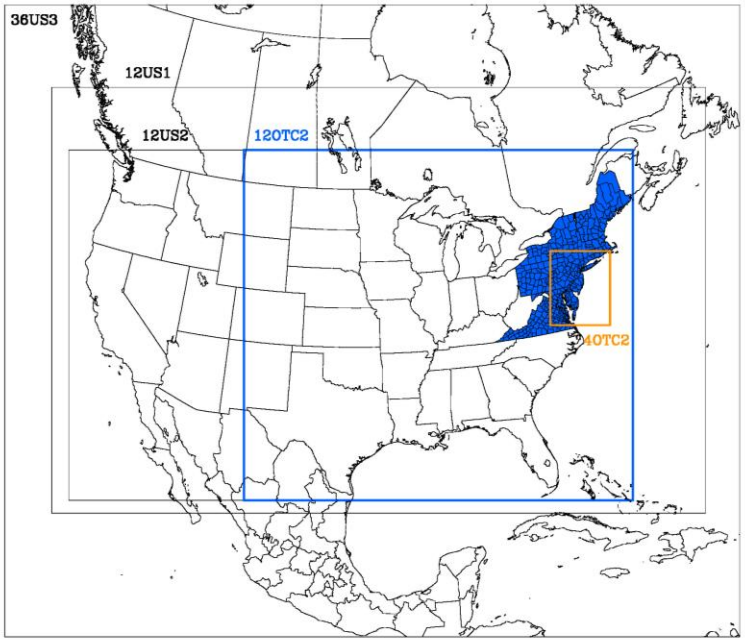
Modeling Platforms, 12 km vs. 4 km

OTC 12 km resolution

12OTC2

One-way nesting
12 km run:
(273 x 246 x 35)

boundary conditions from 36US3 CMAQ v5.3.1 model runs with 2016 v1 (fh) emissions



OTC 4 km resolution

4OTC2

Two-way nesting
4 km run:
(126 x 156 x 35)

To provide boundary conditions from the 12 km domain

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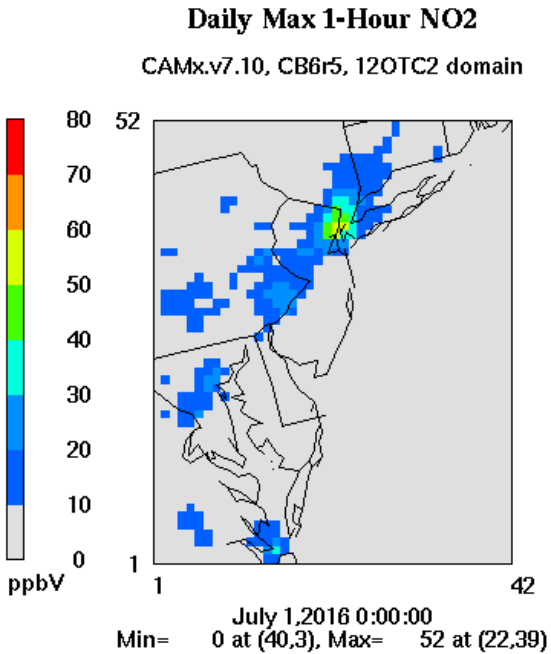
Model Performance Comparison

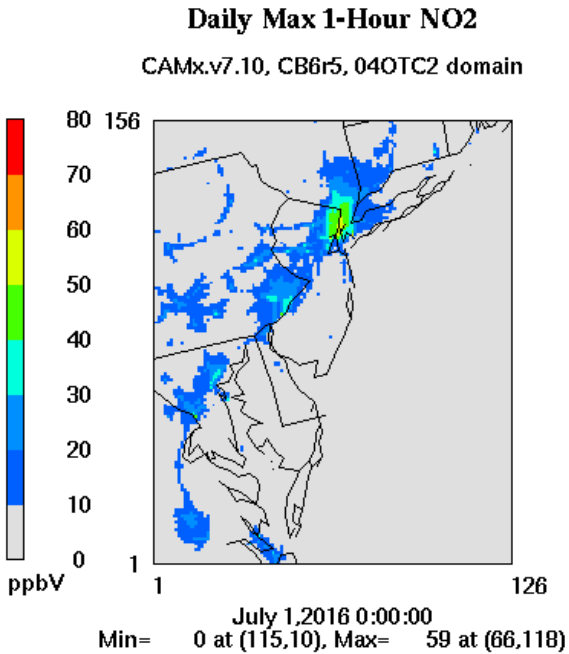
12 km vs. 4 km

Daily max 1-hour NO_2 spatial patterns in CAMx (July)

OTC 12 km



OTC 4 km



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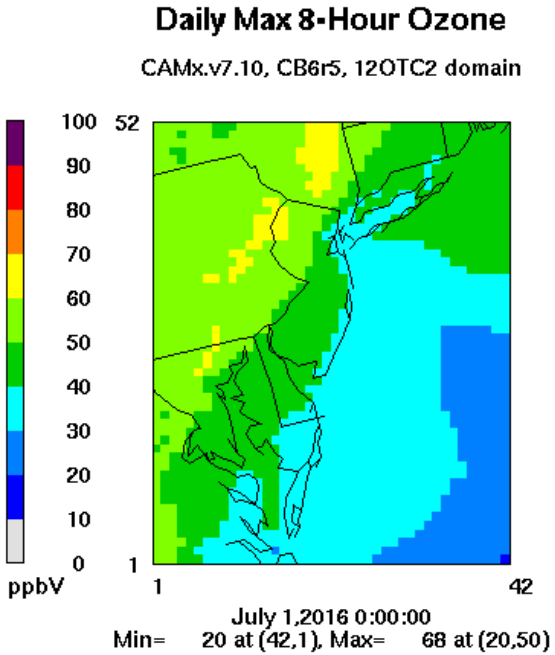
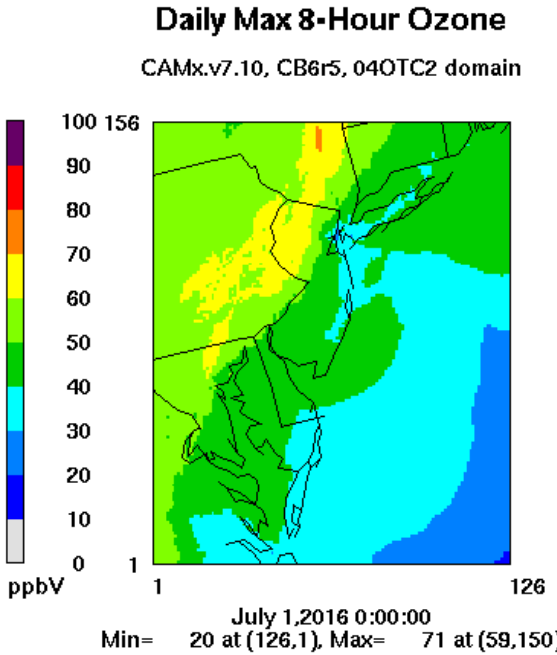
MDA8 O_3 spatial patterns in CAMx (July)

OTC 12 km



OTC 4 km



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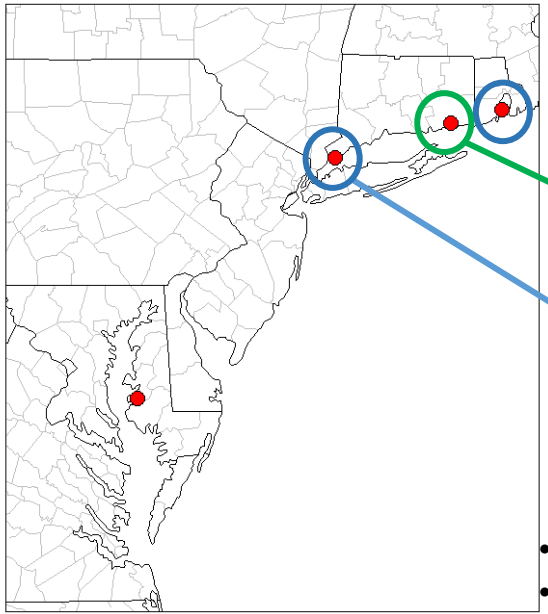
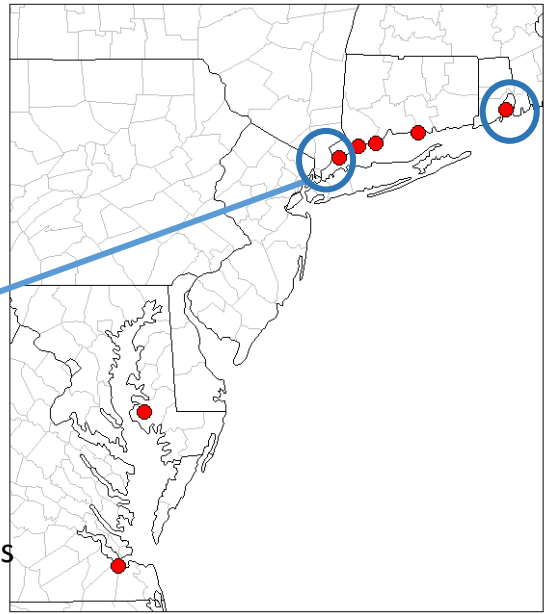
Sites defined as water cell

OTC 12 km



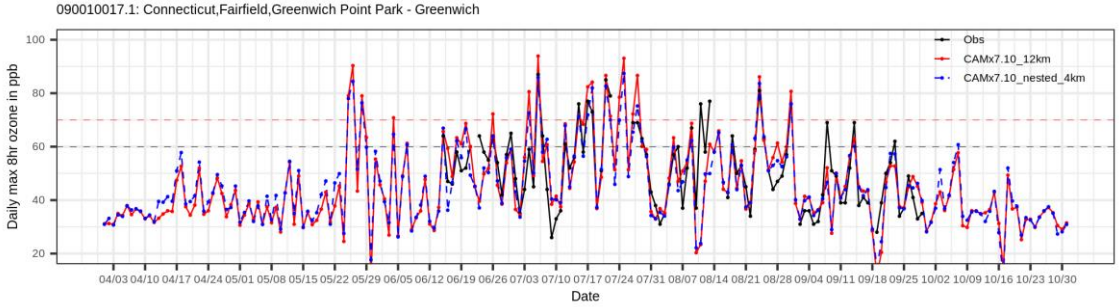
OTC 4 km

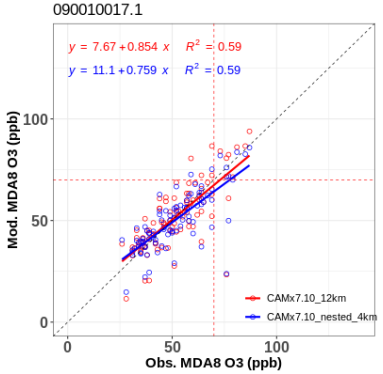


- 12 km resolution: 4 sites
- 4 km resolution: 7 sites
- Common sites for both resolutions: 2 sites

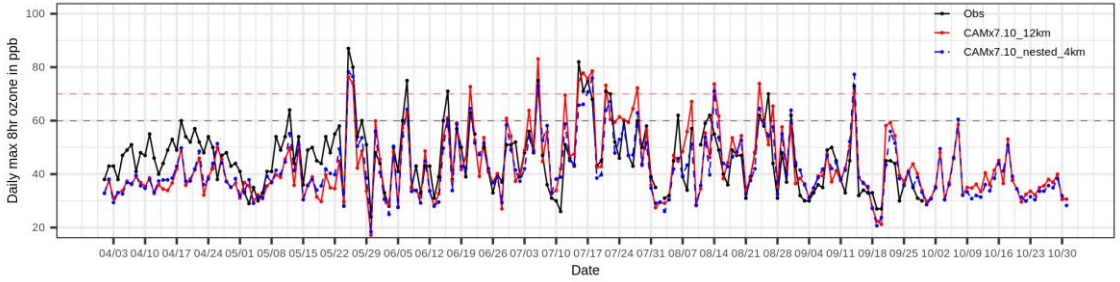
Observed vs. modeled MDA8 O_3 at selected sites

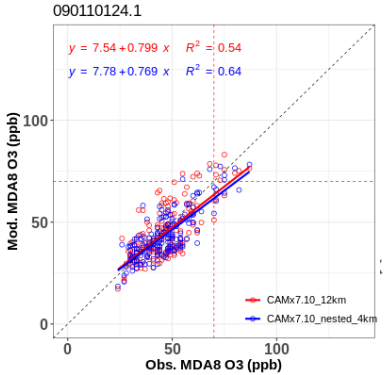
Greenwich, CT (090010017) water(12km), water(4km)





Groton, CT (090110124) water(12km), land(4km)





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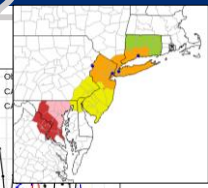
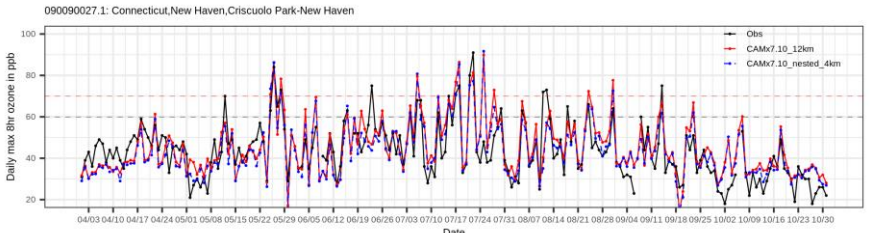
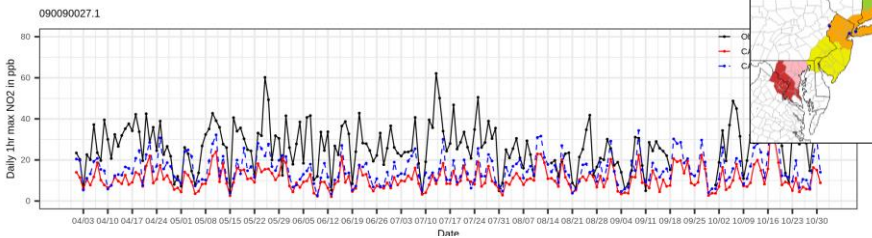
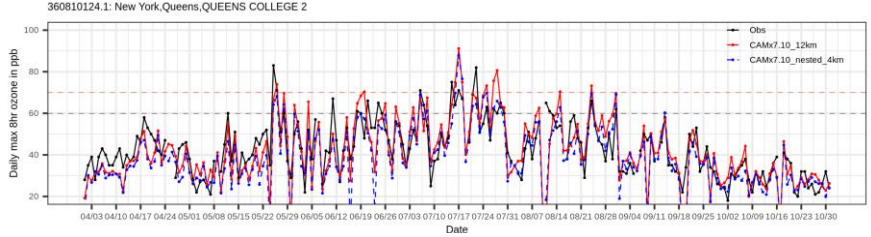
MDA8 O_3

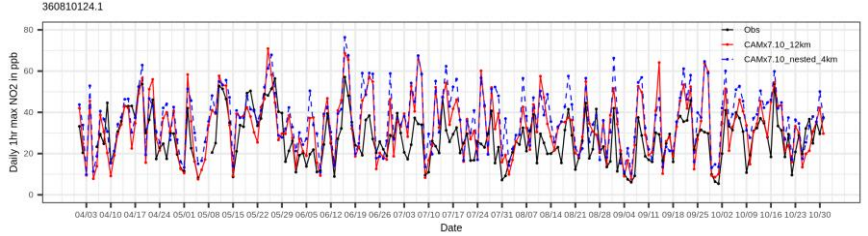
Daily max 1-hour NO_2

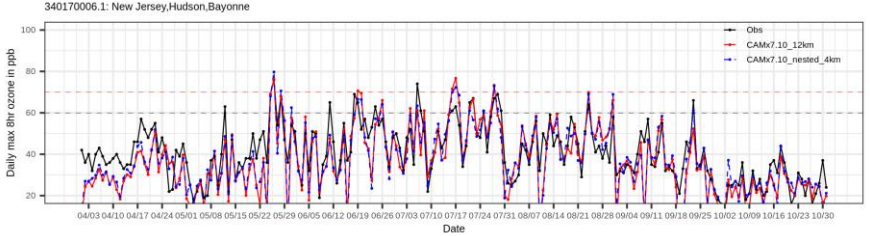


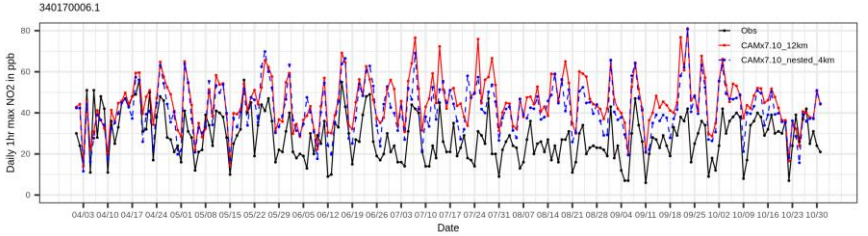


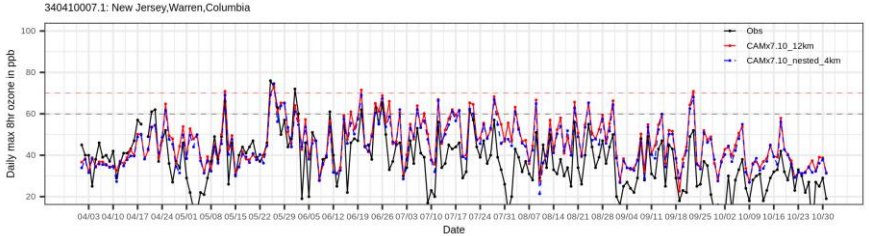


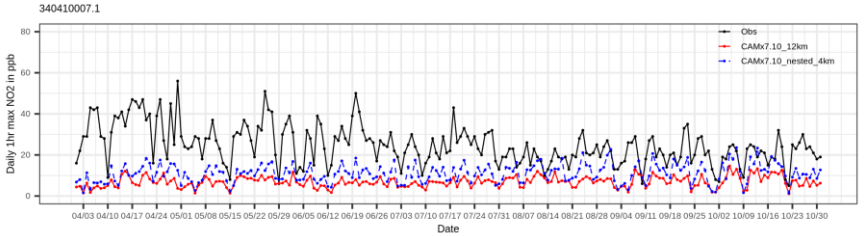






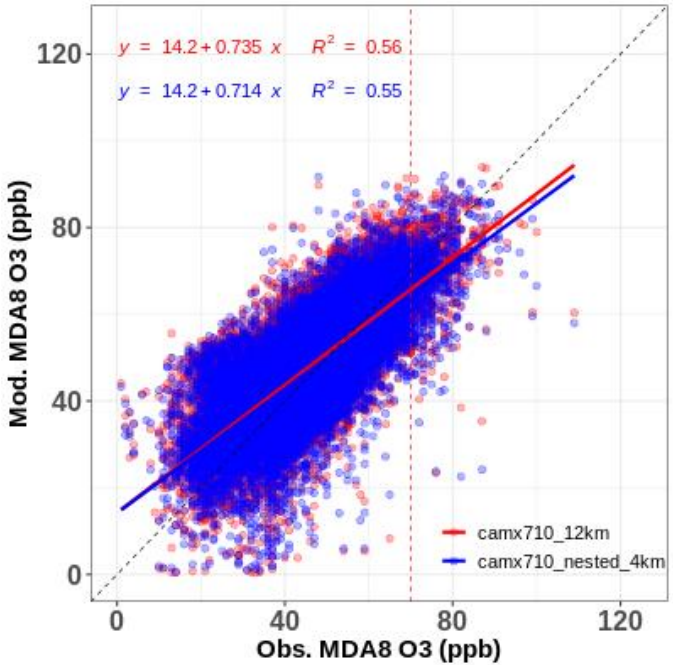




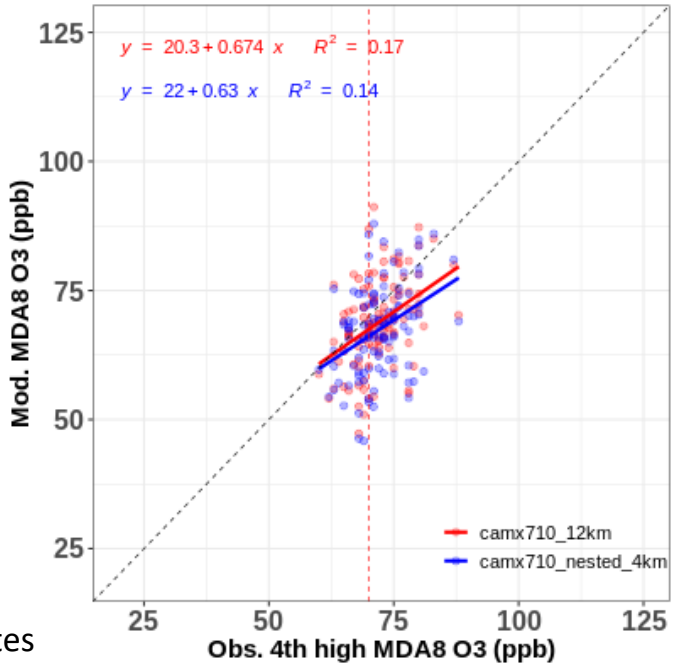


Observed vs. Modeled MDA8 O_3 comparison at sites in the 4 km domain, 12 km vs. 4 km

All data



4th highest obs. MDA8 O_3



Total: 113 sites

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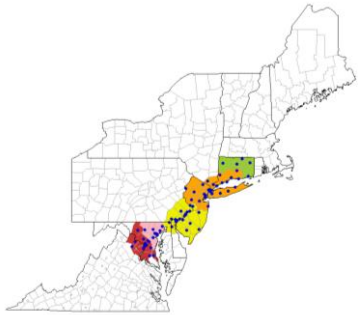
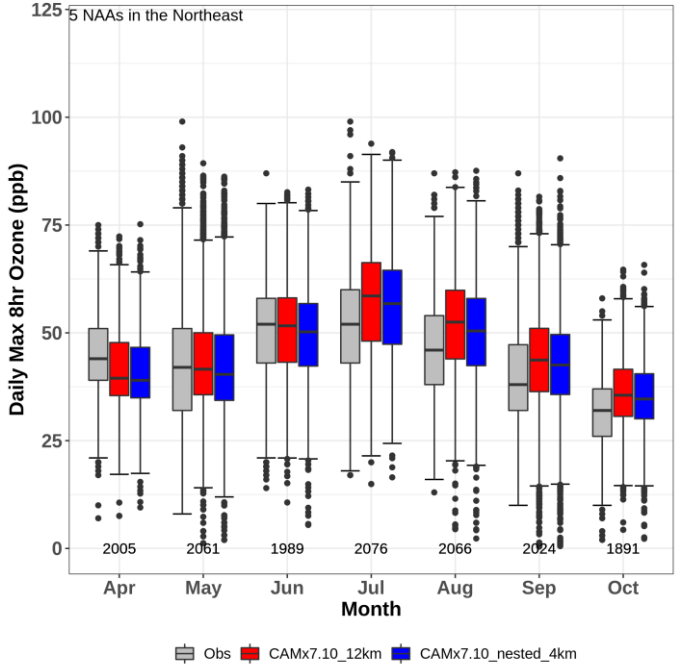
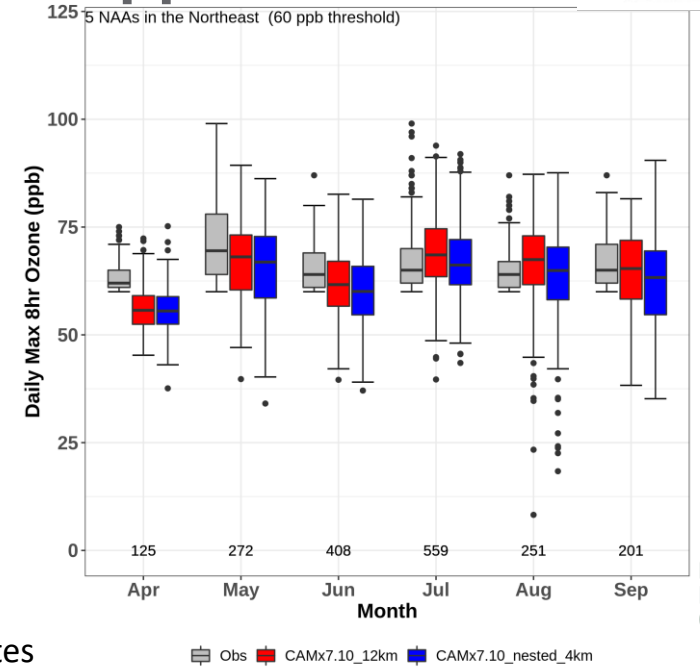
Monthly distributions of MDA8 O_3 in the 5 NAAs in the Northeast, 12 km vs. 4 km



All data



60 ppb threshold



Total: 71 sites

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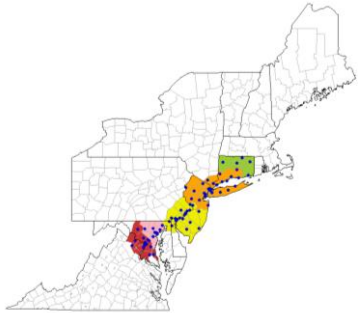
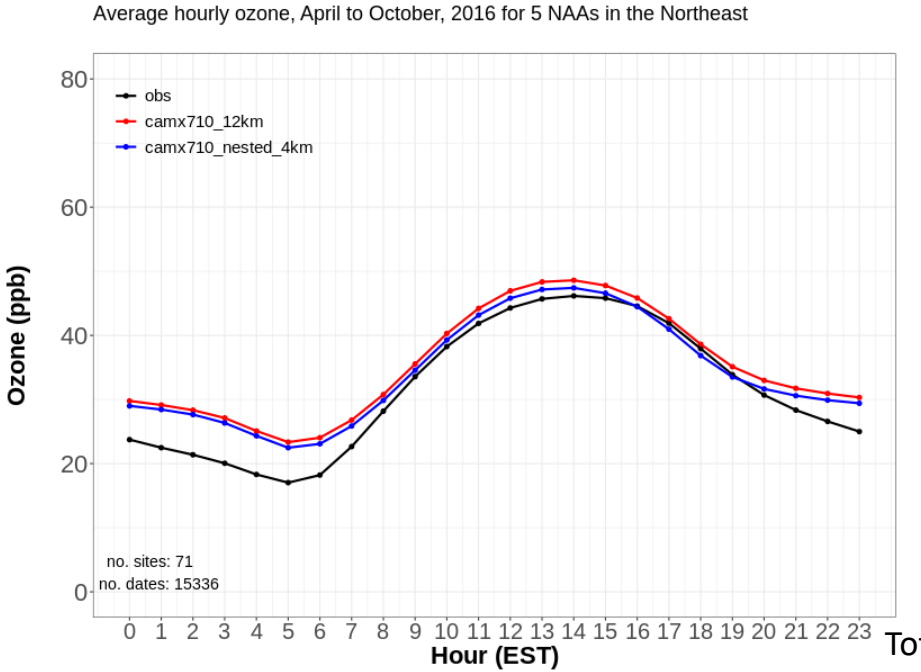
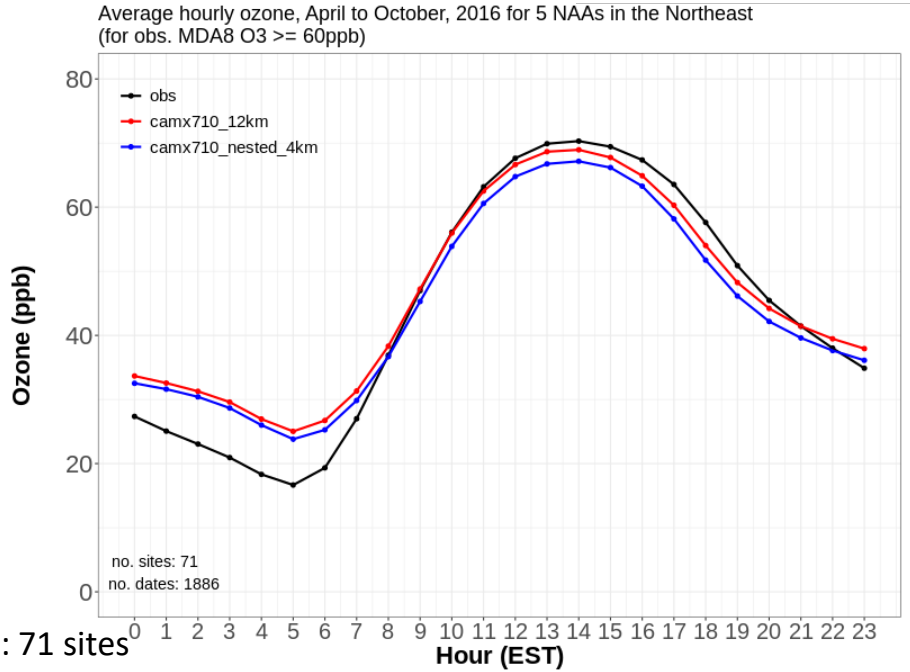
Average hourly O_3 from April to October for the 5 NAAs in the Northeast , 12 km vs. 4 km



All data

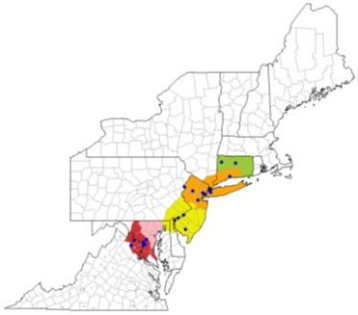


60 ppb threshold

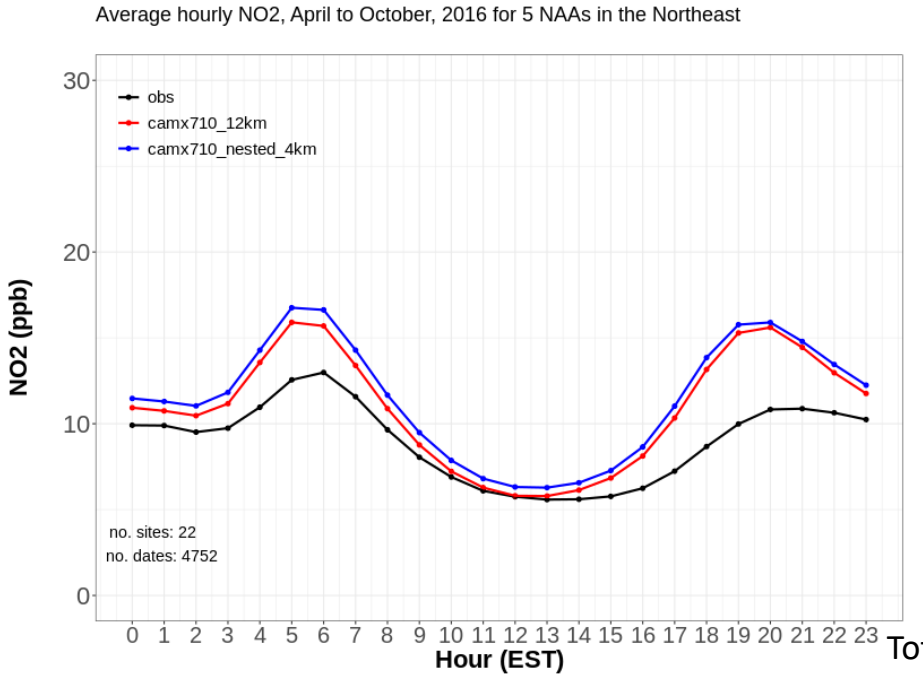


Total: 71 sites

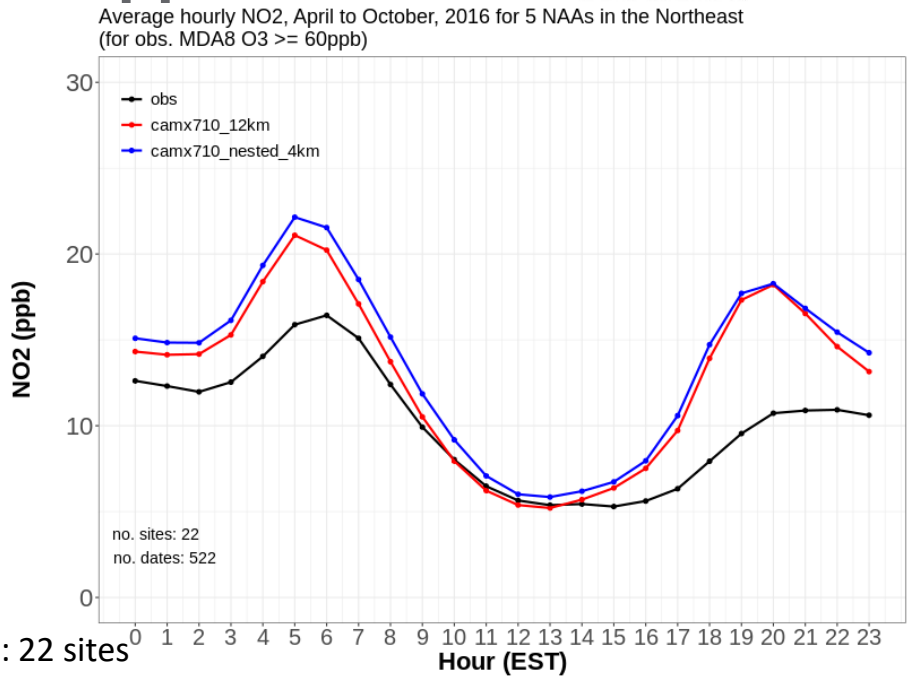
Average hourly NO_2 where obs. O_3 available from April to October for the 5 NAAs in the Northeast 12 km vs. 4 km



All data



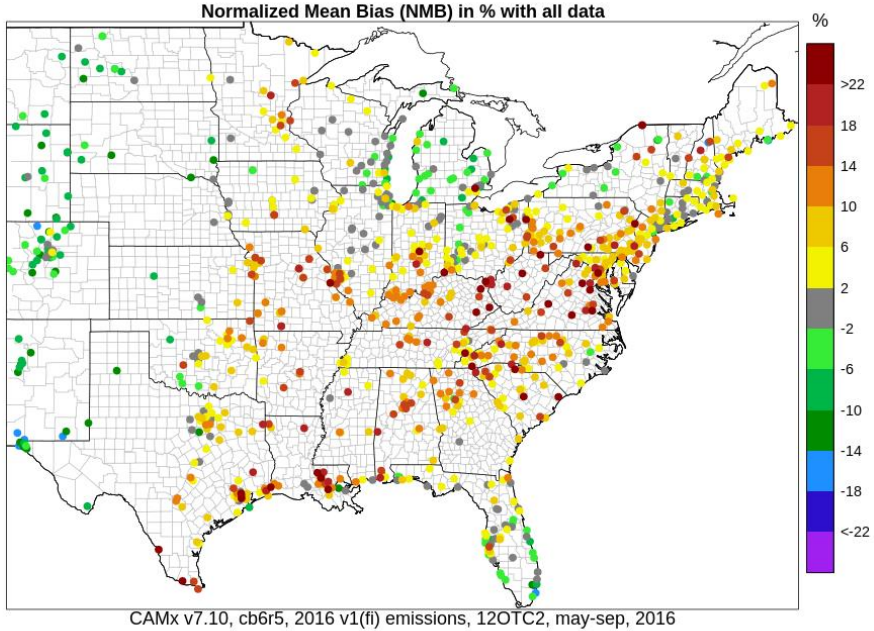
60 ppb threshold



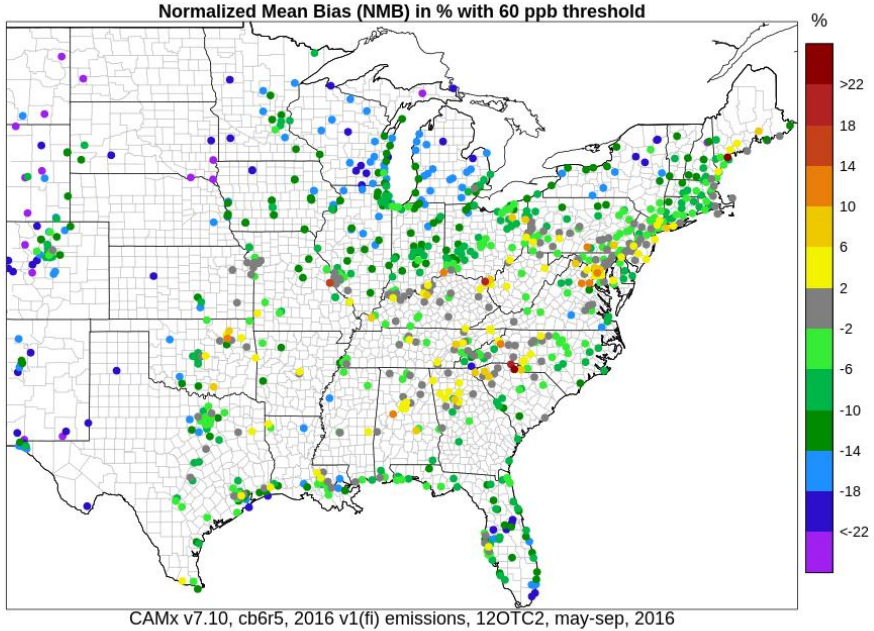
Total: 22 sites

Normalized Mean Bias (NMB, %) of MDA8 O_3 May to September, 2016, 12OTC2 domain

All data

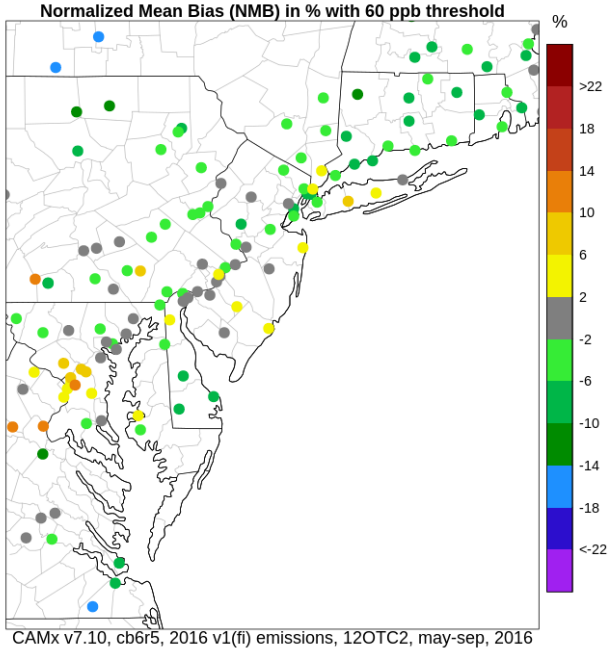


60 ppb threshold



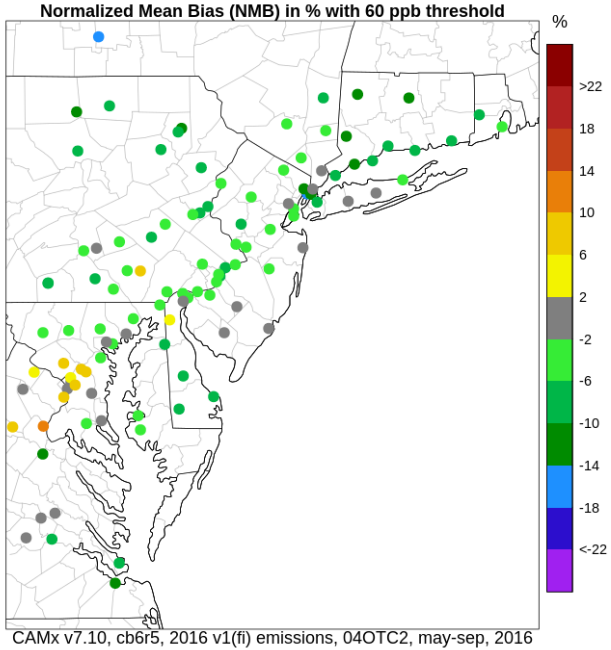
Normalized Mean Bias (NMB, %) of MDA8 O_3 (obs. >=60 ppb), May to September, 2016

OTC 12 km



CAMx v7.10, cb6r5, 2016 v1(fi) emissions, 12OTC2, may-sep, 2016

OTC 4 km



CAMx v7.10, cb6r5, 2016 v1(fi) emissions, 04OTC2, may-sep, 2016

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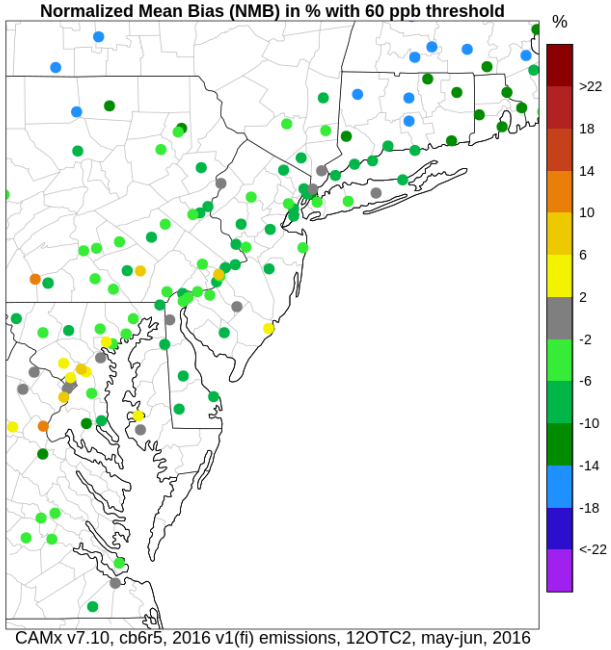
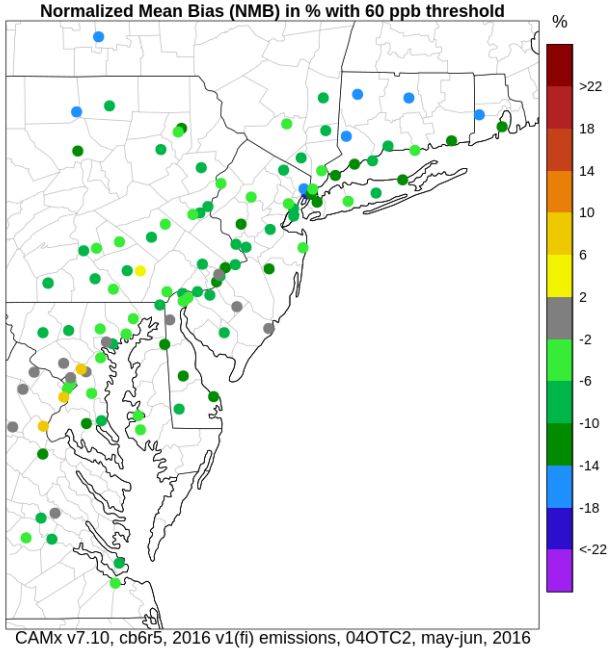
Normalized Mean Bias (NMB, %) of MDA8 O_3 (obs. >=60 ppb), May to June, 2016

OTC 12 km



CAMx v7.10, cb6r5, 2016 v1(fi) emissions, 12OTC2, may-jun, 2016

OTC 4 km



CAMx v7.10, cb6r5, 2016 v1(fi) emissions, 04OTC2, may-jun, 2016

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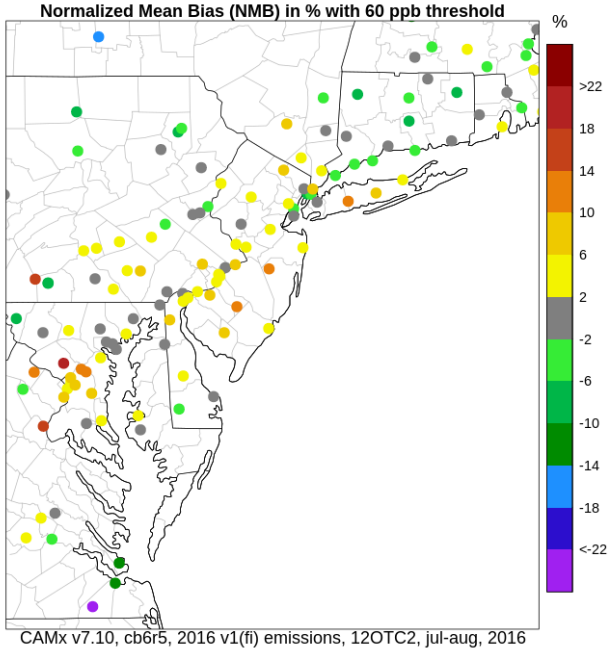
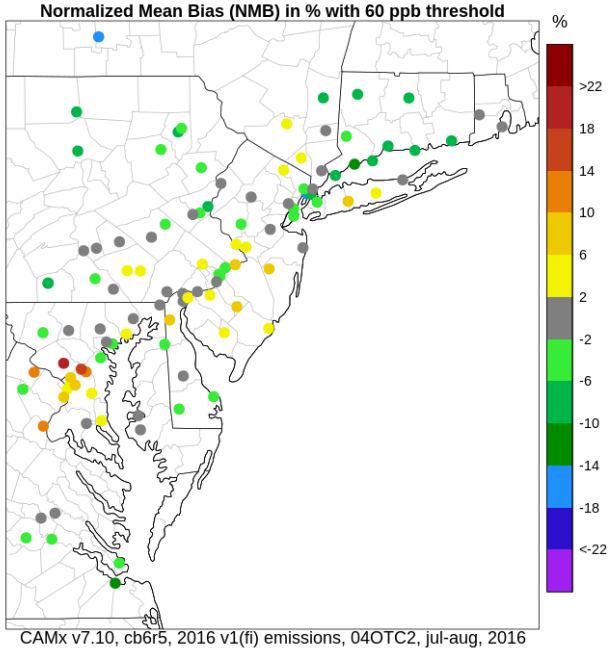
Normalized Mean Bias (NMB, %) of MDA8 O_3 (obs. >=60 ppb), July to August, 2016

OTC 12 km



CAMx v7.10, cb6r5, 2016 v1(fi) emissions, 12OTC2, jul-aug, 2016

OTC 4 km



CAMx v7.10, cb6r5, 2016 v1(fi) emissions, 04OTC2, jul-aug, 2016

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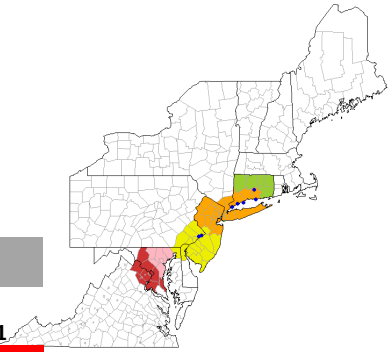
2023 Projected O_3 Design Values Comparison

12 km vs. 4 km

Preliminary 2023 Projected O_3 design values 12 km vs. 4 km



				12OTC2 domain				04OTC2 domain			
Site ID	State	County	2014-2018 DVB	3x3	3x3 no water 1	3x3 no water 2	1x1	3x3	3x3 no water 1	3x3 no water 2	1x1
090019003	Connecticut	Fairfield	82.7	78.6	76.1	76.1	76.2	77.9	77.8	77.6	78.8
090013007	Connecticut	Fairfield	82	76	75.4	75.4	75.3	77.1	77.1	76.1	78.5
090099002	Connecticut	New Haven	79.7	72	72.5	72.5	72.3	73.7	73.6	73.2	74
090010017	Connecticut	Fairfield	79.3	73.9	74.8	73.8	76.1	75.2	75.5	75.2	75.8
420170012	Pennsylvania	Bucks	79.3	70.9	70.9	70.9	71.9	72.4	72.4	72.4	72.3
090079007	Connecticut	Middlesex	78.7	70.6	70.6	70.6	70.8	70.9	70.9	70.9	70.9
421010024	Pennsylvania	Philadelphia	77.7	70	70	70	70.8	70.9	70.9	70.9	71.9

3x3: EPA's method

3x3 no water1: EPA's alternative method

3x3 no water2: further modified 3x3 no water1 method by excluding the water cell if the monitor is in a water cell

1x1: use the grid cell where the monitor is located

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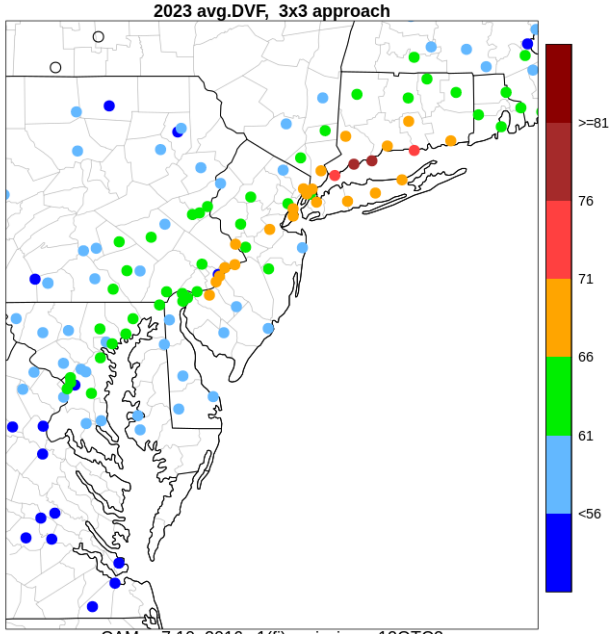
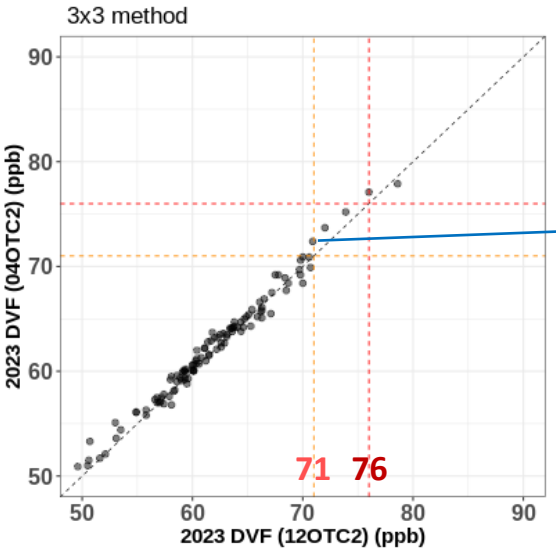
Preliminary 2023 Projected O_3 design values 3 x 3 method

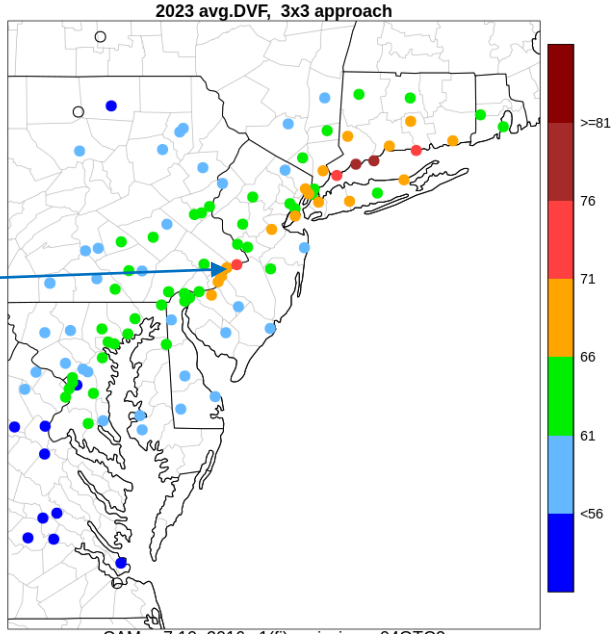
OTC 12 km



CAMx v7.10, 2016 v1(fi) emissions, 12OTC2



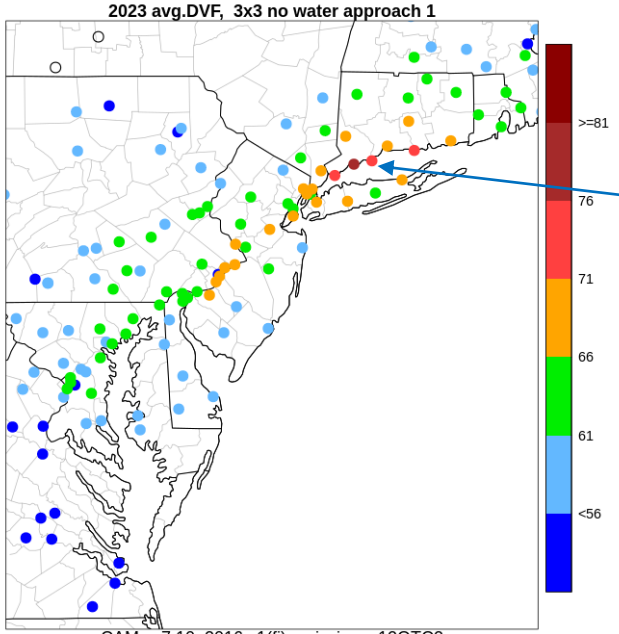
OTC 4 km



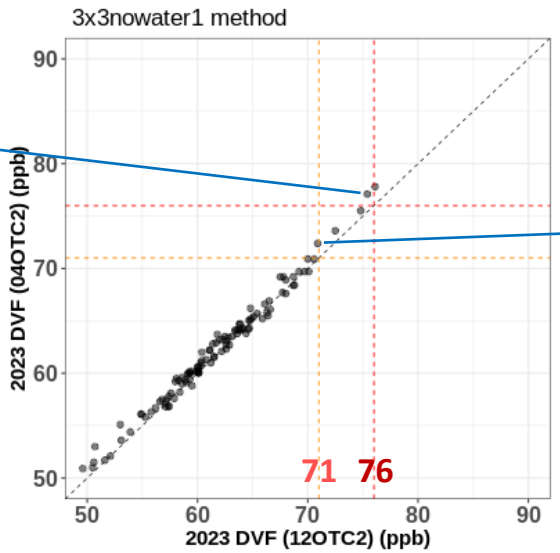
CAMx v7.10, 2016 v1(fi) emissions, 04OTC2

Preliminary 2023 Projected O_3 design values 3 x 3 no water method

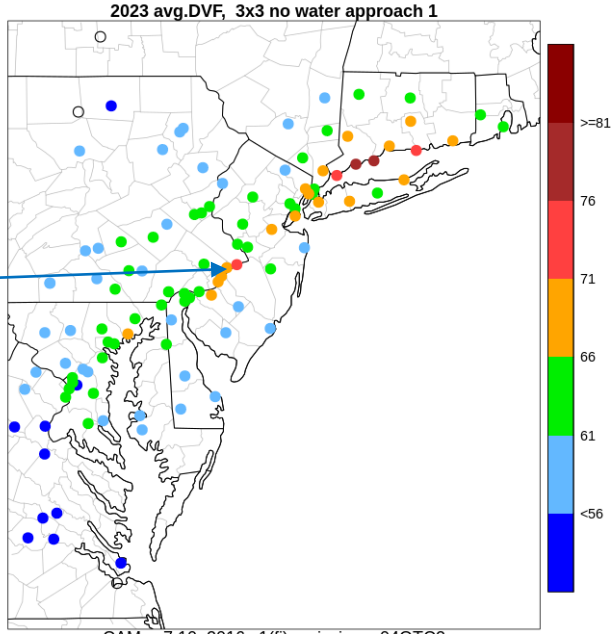
OTC 12 km



CAMx v7.10, 2016 v1(fi) emissions, 12OTC2



OTC 4 km



CAMx v7.10, 2016 v1(fi) emissions, 04OTC2

Conclusions

- Model performance for O_3 and NO_2 in the finer (04OTC2) grid domain was compared between the two platforms: 1) one-way 12 km resolution domain and 2) two-way 4 km resolution domain modeling.
- On average, CAMx at 4 km resolution predicted higher NO_2 and lower O_3 than at 12 km resolution in the five NAAs in the Northeast.
- CAMx modeling at coastal areas in NYC NAA was not impacted by water cell dramatically, compared to CMAQ modeling.
- On average, both platforms tend to underpredict O_3 in the CT coastal area on high O_3 days (negative NMB).
- DVFs slightly increased with the 04OTC2 platform, compared to the 12OTC2 platform.

Thank You

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