Southern New Mexico Ozone Modeling Study

Task 11: Emission Sensitivity Modeling

Ramboll-Environ (RE)
University of North Carolina (UNC-IE)

August 11, 2016

WESTAR

Western Regional Air Partnership

RAMBOLL ENVIRON

UNC INSTITUTE FOR THE ENVIRONMENT

SNMOS Background and Objectives

- The southern Doña Ana County region has the highest ozone levels of any area in New Mexico
  - The southern Doña Ana County area is within 95% of the federal standard for ozone
  - The New Mexico Air Quality Control Act requires the New Mexico Environment Department to develop a plan for reducing ozone levels in areas that are within 95% of the ozone standard
- The first step towards developing the plan is to understand the causes of high ozone in Doña Ana County
- SNMOS objectives:
  - Study the factors contributing to high ozone in Doña Ana County
  - Investigate future emissions scenarios that will produce attainment of the ozone standard

Overview of Approach

- SNMOS builds off of the Western Air Quality Study (WAQS)
  - WAQS 2011 modeling platform: WRF/SMOKE/CAMx
  - Adjustments to the meteorology and modeling domains to optimize for southern New Mexico
- Modeling 2011 New Mexico ozone season: May 1 – August 31
- Modeling Plan
  - Prepare base year emission inventories
  - Run WRF/SMOKE/CAMx for 2011 base year
    - Evaluate 2011 base year model against observations, refine model if needed
  - Prepare future year emission inventories for 2025
  - Run SMOKE/CAMx for future year
    - Modeled Attainment Test
    - Emissions sensitivity/control runs
    - Source apportionment to diagnose causes of high ozone in Doña Ana County
  - Reporting

SNMOS Tasks

- **Completed**
  - **Task 1**: 2011 WRF 36/12/4 km with 4 km focus on Dona Ana/El Paso/Juarez and Work Plan (11/30/15)
  - **Task 2**: 2011 update Permian Basin O&G (11/30/15)
  - **Task 3**: 2011 update of Juarez and nearby Mexico EI, 2020 Mexico emissions update (11/30/15)
  - **Task 4**: SMOKE current 2011 NEI for 4 km domain (2/29/16)
  - **Task 5**: Gridded 2011 biogenic, fires, wind-blown dust, lightning emissions for 4 km domain (2/29/16)
  - **Task 6**: Develop 2011 4 km CAMx database and perform base case (2/29/16)
  - **Task 7**: 2011 MPE and sensitivity modeling for Dona Ana County (4/30/16)
  - **Task 8**: SMOKE current FY US EI and FY Mexico emissions update (4/30/16)
  - **Task 9**: FY 12/4-km CAMx simulation (5/31/16)
  - **Task 10**: FY ozone projections (MATS) (5/31/16)
- **This Deliverable Period (8/15/2016)**
  - **Task 11**: 2025 emissions sensitivity/controls
- **Pending**
  - **Task 12:** 2025 4-km source apportionment run (9/15/16)
  - **Task 13**: Air Quality Technical Support Document (AQTSD)

Task 11: Objectives and Deliverables

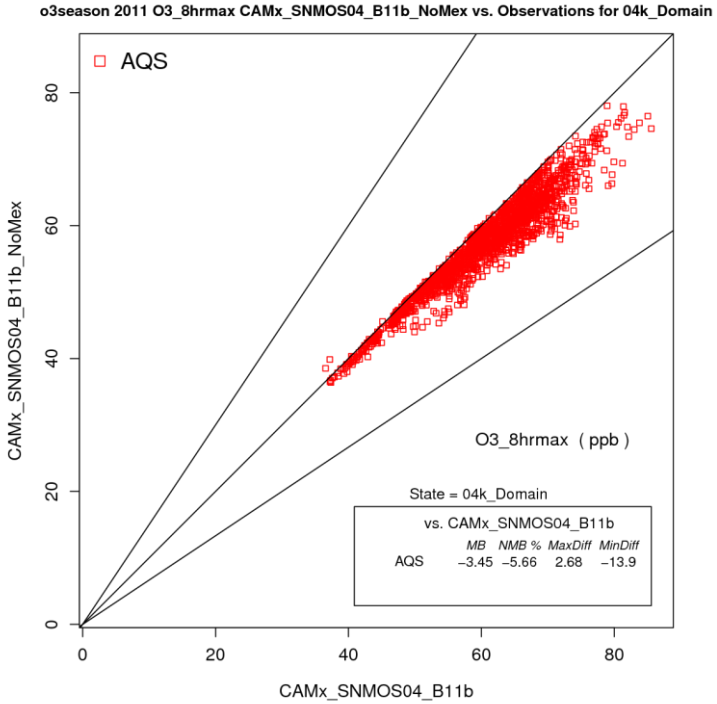
- Objective
  - Carry out SNMOS emissions sensitivity CAMx modeling (**Completed 7/1/2016**)
- Deliverables
  - PowerPoint presentation on future year air quality modeling (**Completed 8/11/2016**)
- Tasks
  - Run CAMx 12/4 km emissions sensitivity cases to evaluate the impacts of emissions reductions on attainment of the ozone NAAQS.
    - Zero Out Mexico emissions in 2011
    - Double U.S. onroad mobile (MOVES) emissions in 2025.
  - Use MATS to estimate changes to design values and RRFs for the emissions sensitivity simulations.
  - Prepare PowerPoint

CAMx Air Quality Modeling

- CAMx configured as in SNMOS Base11b
  - See SNMOS Task 7 MPE report
- CAMx run for April–August, 2025 (2011 dates)
- Base Emissions
  - Primarily from EPA NEI2011 v6.2 modeling platform 2025 projection
  - 2020 WAQS oil and gas projections
  - Biogenic, lightning, fires, and sea salt constant at 2011 levels
  - SNMOS Task 3 deliverable for Mexico future year EI details
  - SNMOS Task 8 deliverable for US future year EI details
- Sensitivity Simulations
  - Zero out all 2011 anthropogenic emissions in Mexico and compare to SNMOS Base11b
  - Double all 2025 onroad mobile (MOVES) U.S. emissions and compare to SNMOS Base11b and Base25a_11b.

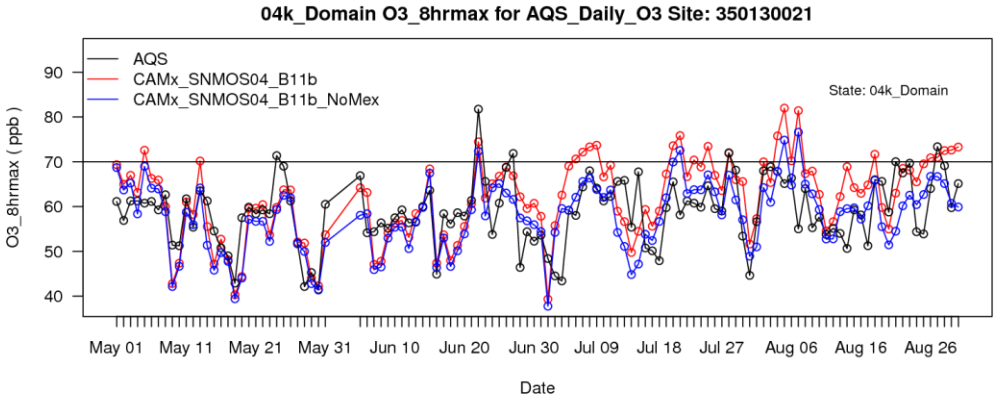
SNMOS 4-km Domain 2011 Results

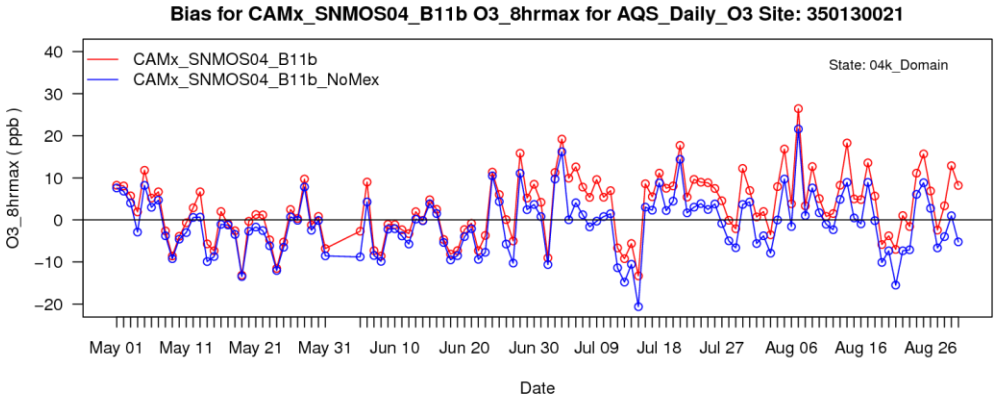
Zero Out Mexico (NoMex): Performance Summary



Daily Max 8-hr O3, all NM 4-km AQS Monitors: May-August 2011

NoMex vs Base11b





Desert View AQS Monitor

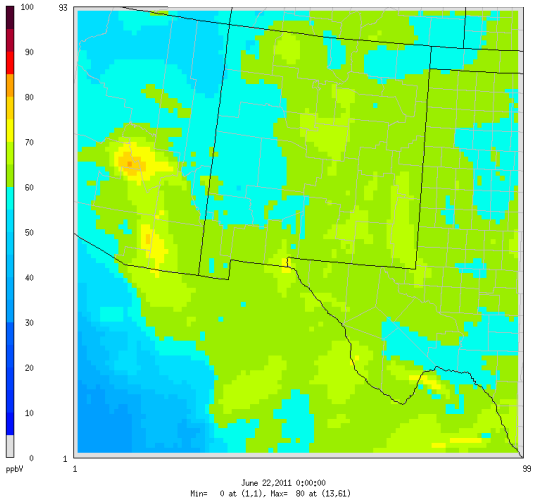
Daily Max 8-hr O3: Obs, Base11b, NoMex

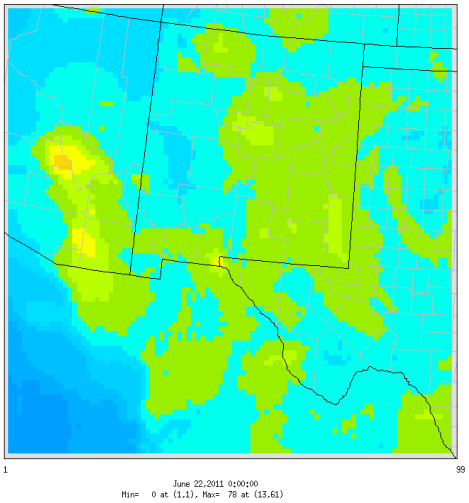
SNMOS 12-km Domain 2011 Results

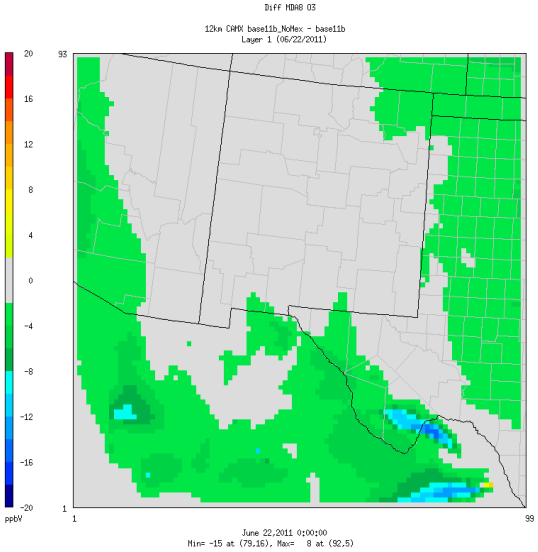
NoMex: June 22 Spatial Plots

Base11b | NoMex

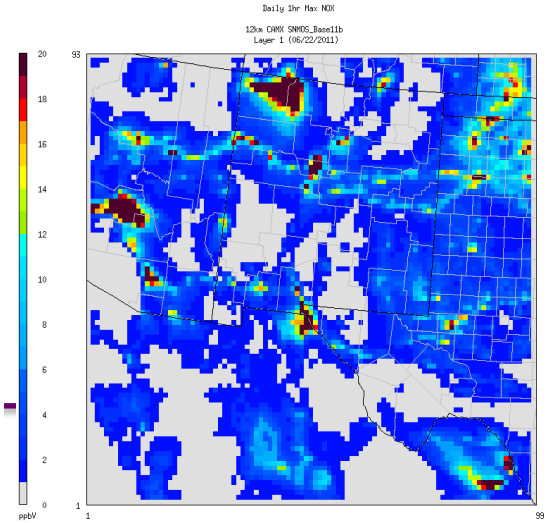
Daily Max 8-hr O3

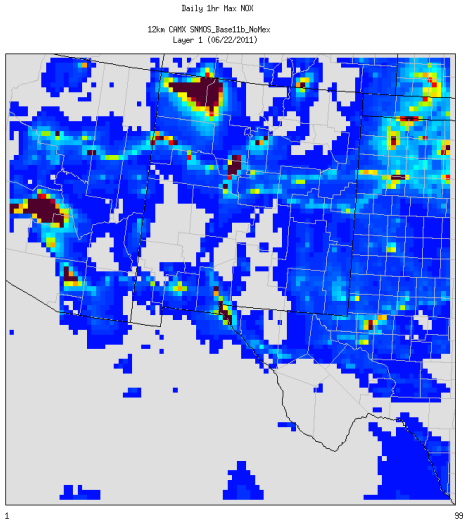


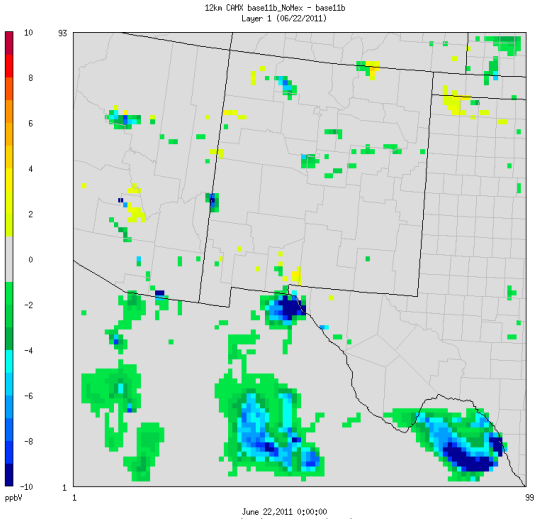




Daily Max NOx







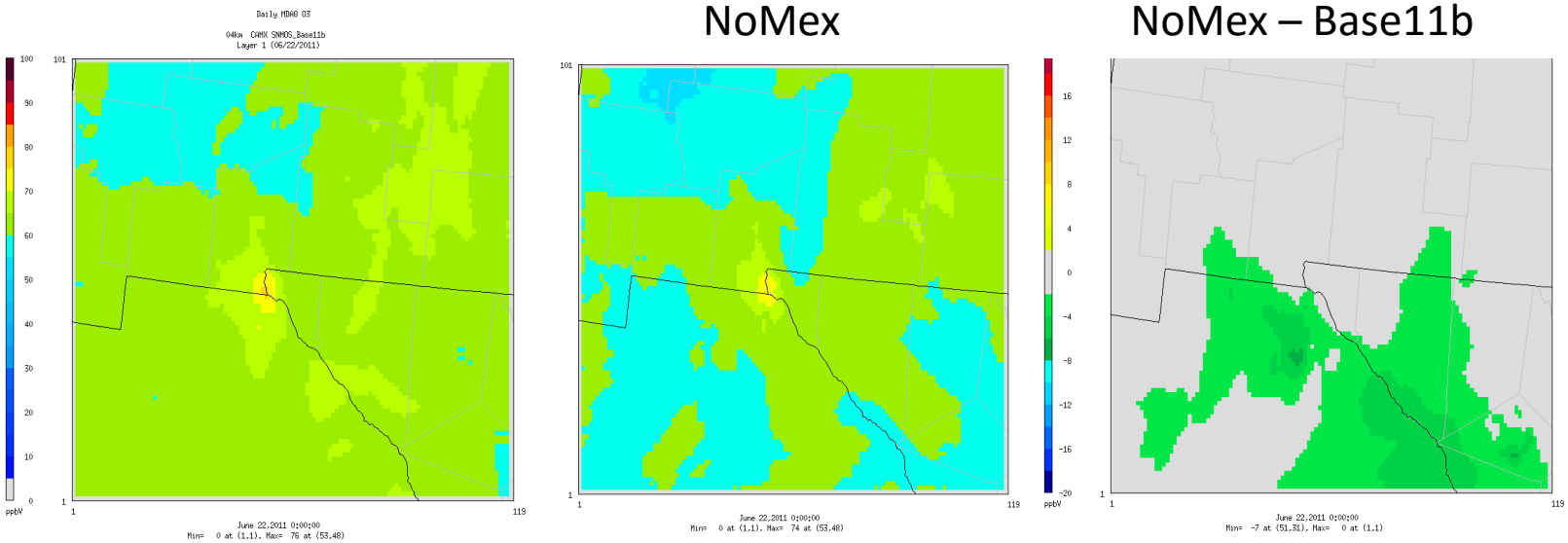
SNMOS 4-km Domain 2011 Results

NoMex: June 22 Spatial Plots

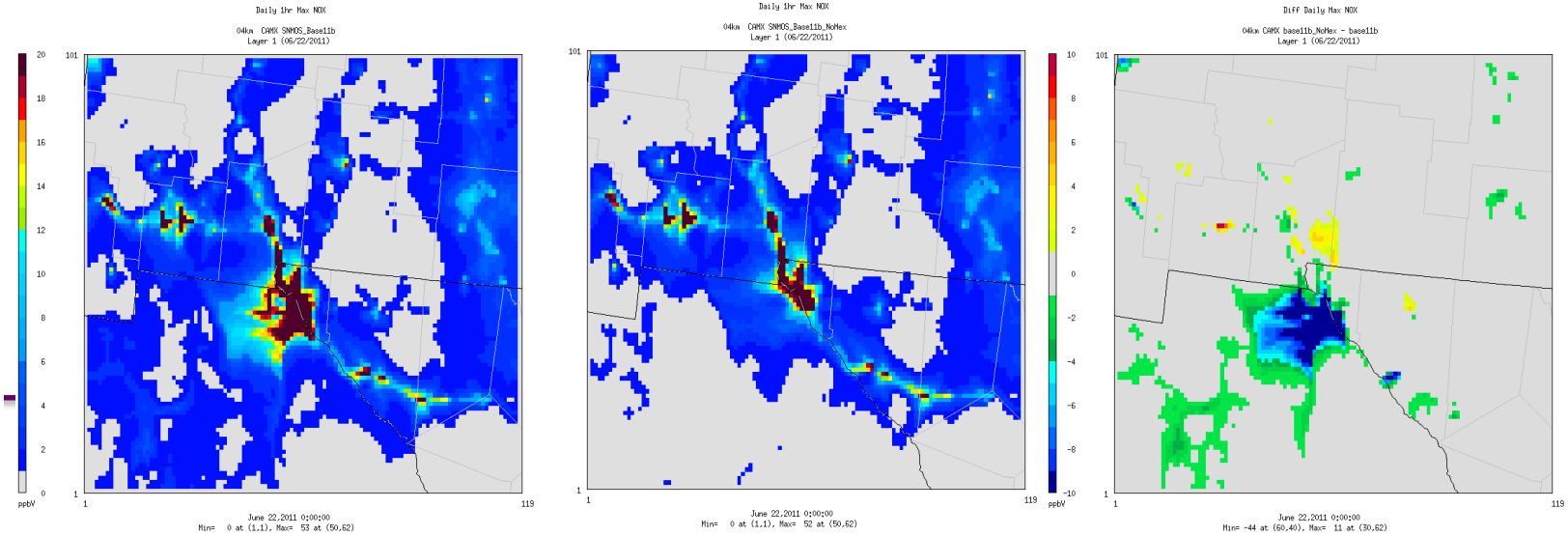
NoMex

NoMex – Base11b

Daily Max 8-hr O3



Daily Max NOx

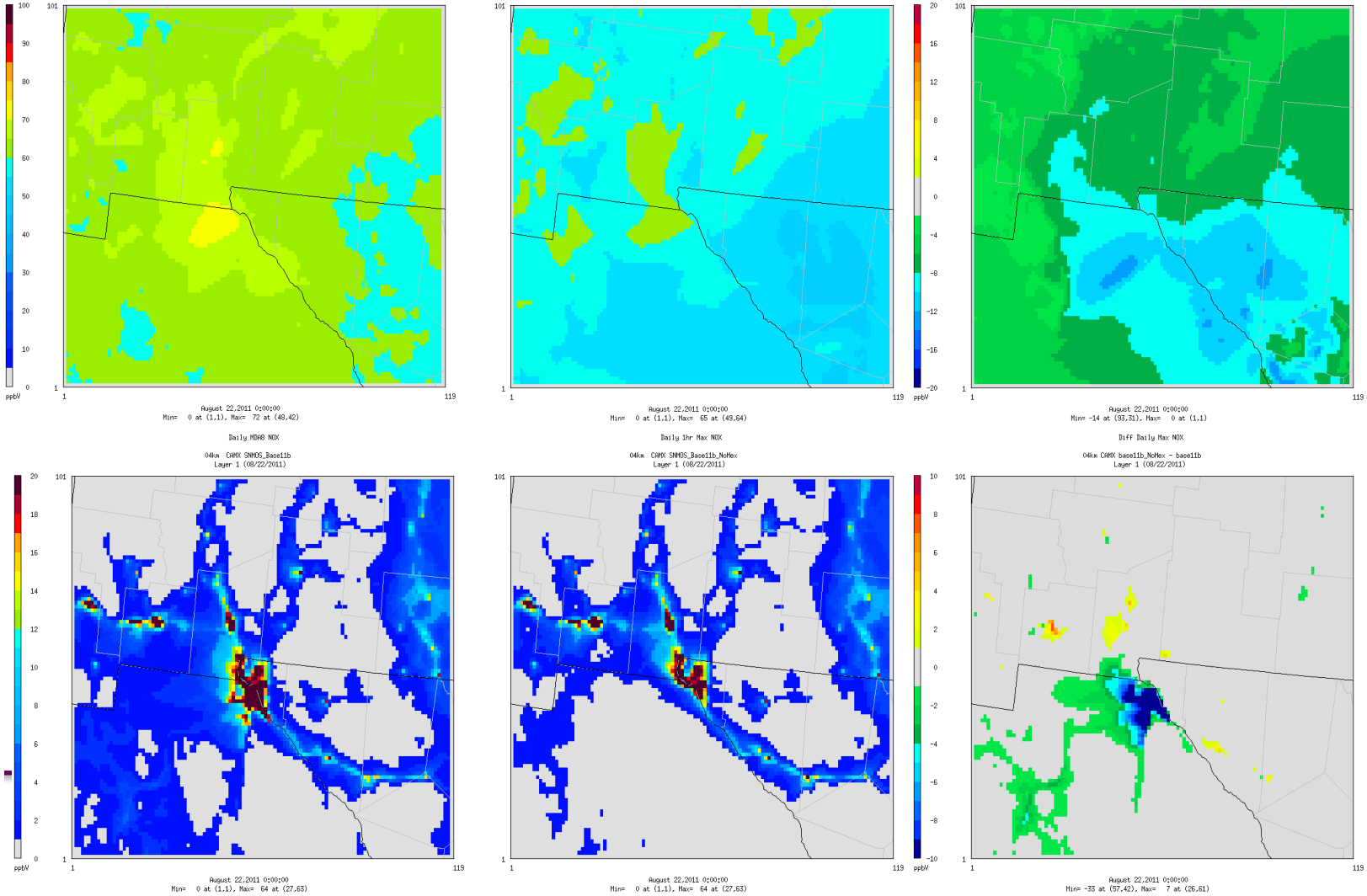


SNMOS 4-km Domain 2011 Results

NoMex: August 22 Spatial Plots

Base11b | NoMex | NoMex – Base11b

Daily Max 8-hr O3

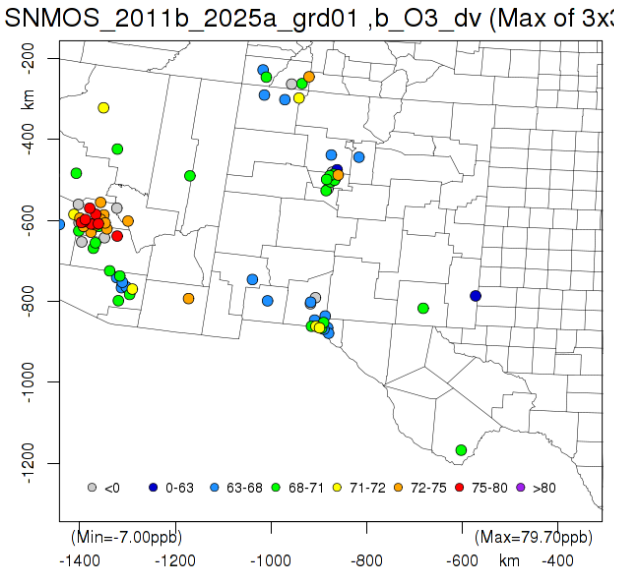


Daily Max NOx

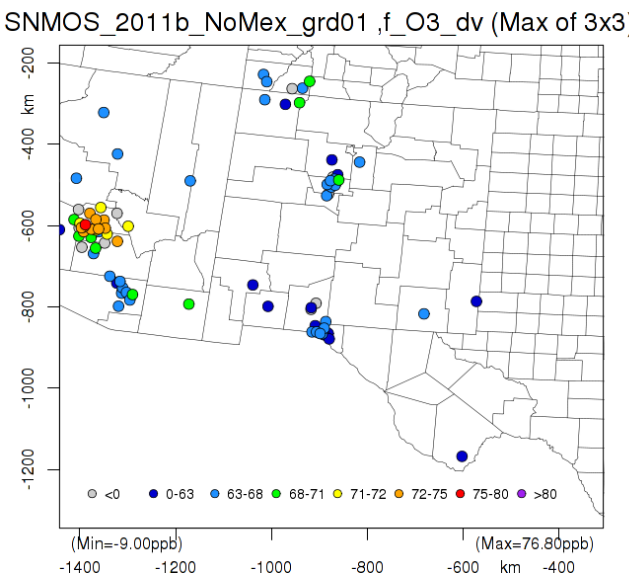
SNMOS 12-km Domain 2011 Results

NoMex: MATS

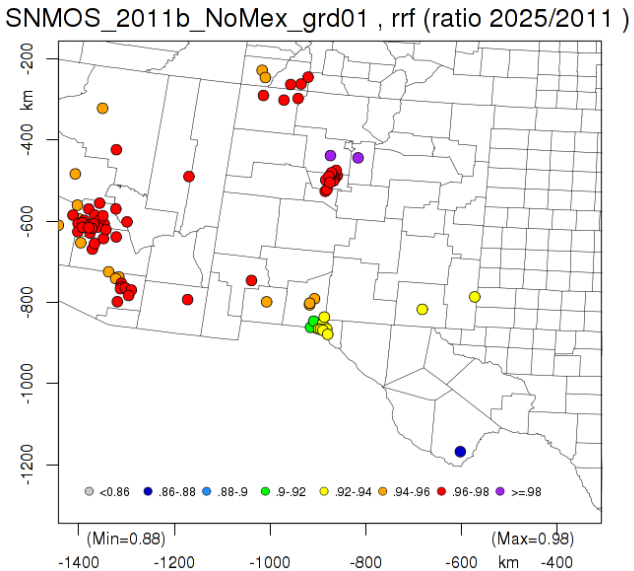
DVC (2011)



DV NoMex (2011)



Ratio (NoMex/2011)



Exceeds Oct 2015 ozone NAAQS ≥ 71.0 ppb

SNMOS 12-km Domain 2011 Results

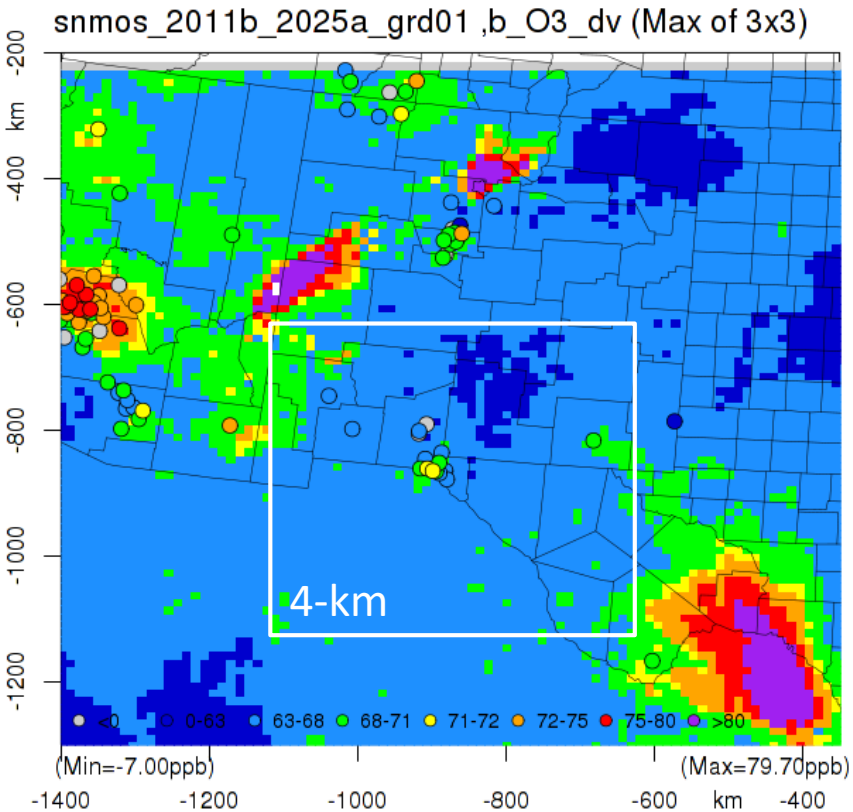
NoMex: MATS New Mexico Counties

Site ID	DVC	DV NoMex	Diff DV	NoMex/2011	County	Site Name
350010023	68	65.8	-2.2	0.9689	Bernalillo	4700A SAN MATEO NE (2ZM)
350010024	69.3	67.1	-2.2	0.9689	Bernalillo	6000 ANDERSON AVENUE SE
350010027	70	67.9	-2.1	0.9706	Bernalillo	5100 MONTANO BLVD NW
350010029	68.7	66.7	-2	0.9712	Bernalillo	201 PROSPERITY SW
350010032	70	67.8	-2.2	0.9691	Bernalillo	
350011012	72	69.6	-2.4	0.9675	Bernalillo	1.4 MILES WSW INTERSECTION TRAMWAY
350011013	68.7	66.6	-2.1	0.9701	Bernalillo	9819A SECOND STREET NW
350130008	64.7	59.4	-5.3	0.9187	Dona Ana	LA UNION
350130017	66.7	61.1	-5.6	0.9171	Dona Ana	SUNLAND PARK
350130019	-7	-9			Dona Ana	LAS CRUCES WELL STATION #41;HOLMAN ROAD
350130020	67.7	63.1	-4.6	0.9324	Dona Ana	CHAPARRAL
350130021	71	65.1	-5.9	0.9171	Dona Ana	DESERT VIEW
350130022	70.3	64.5	-5.8	0.9175	Dona Ana	SANTA TERESA
350130023	64.3	60.5	-3.8	0.9416	Dona Ana	750 N.SOLANO DRIVE
350131012	-7	-9			Dona Ana	HOLIDAY INN
350151005	70.3	65.2	-5.1	0.9279	Eddy	HOLLAND ST;SE OF WATER TANK;CARLSBAD;NM
350171003	65	62.7	-2.3	0.9651	Grant	CHINO BLVD NR HURLEY PARK; HURLEY;NM
350250008	62.7	58.7	-4	0.9363	Lea	2320 N. JEFFERSON ST; HOBBS; NEW MEXICO
350290003	63	59.5	-3.5	0.9453	Luna	310 AIRPORT ROAD; DEMING; NM 88030
350431001	61.7	59.8	-1.9	0.9694	Sandoval	HIGHWAY DEPT. YARD NEAR BERNALILLO
350439004	63	61.9	-1.1	0.9833	Sandoval	040 TRADING POST ROAD
350450009	65.3	62.9	-2.4	0.9641	San Juan	162 HWAY 544; BLOOMFIELD NM 87413
350450018	71	68.3	-2.7	0.9629	San Juan	423 HWAY 539; BLANCO NM 87412
350451005	66	63.5	-2.5	0.9629	San Juan	USBR SHIPROCK SUBSTATION (FARMINGTON)
350490021	64.3	63.1	-1.2	0.9814	Santa Fe	2001 Aviation Drive, Santa Fe
350610008	68.5	66.4	-2.1	0.9708	Valencia	1000 W. MAIN ST; LOS LUNAS; NM 87031

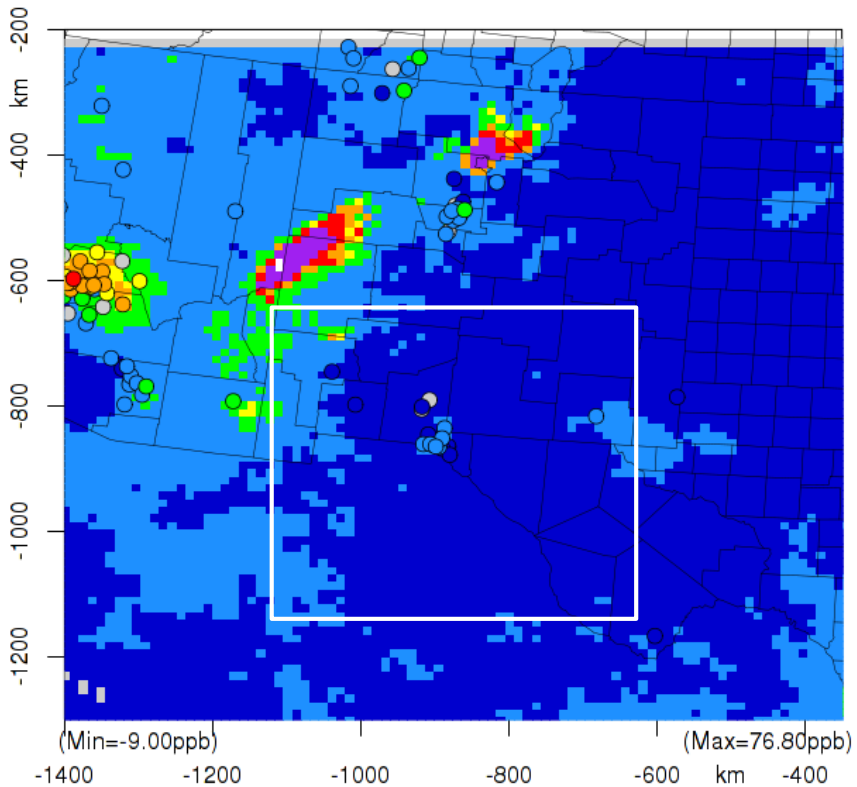
SNMOS 12-km Domain 2011 Results

NoMex: Unmonitored Area Analysis (UAA)

DVC (2011)



DV NoMex (2011)



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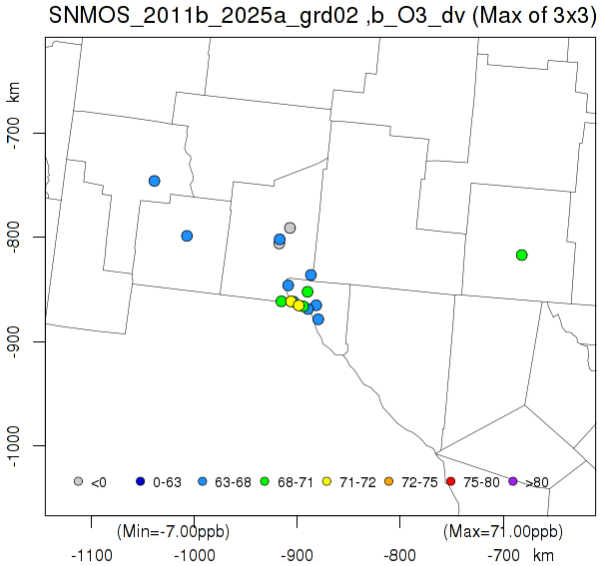
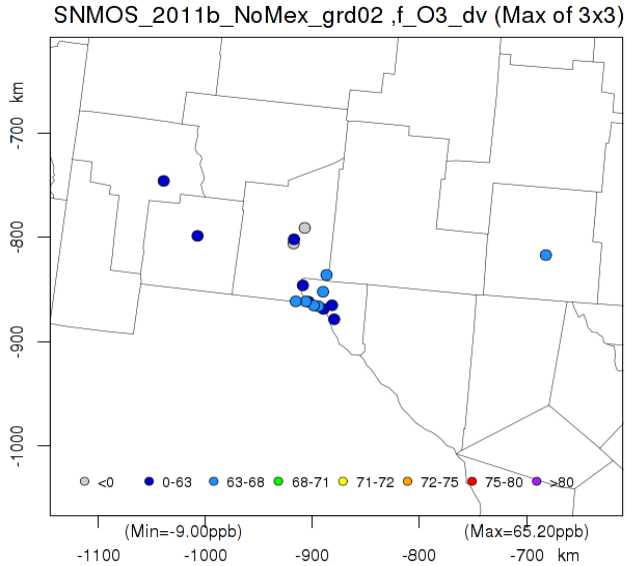
SNMOS 4-km Domain 2011 Results

NoMex: MATS

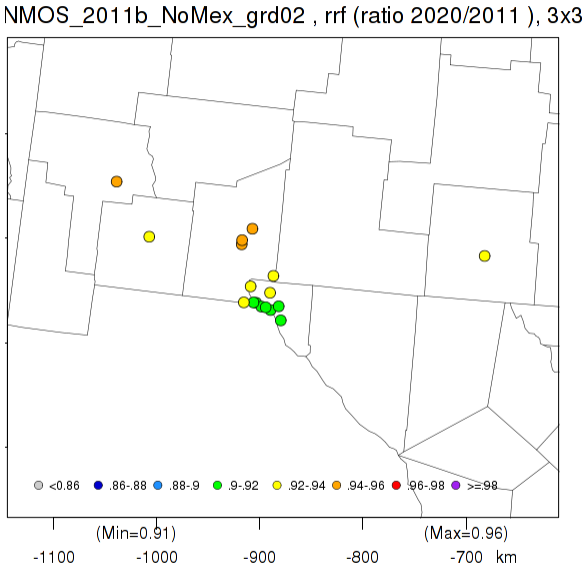
DVC (2011)



DV NoMex (2011)



Ratio (NoMex/2011)



SNMOS 4-km Domain 2011 Results

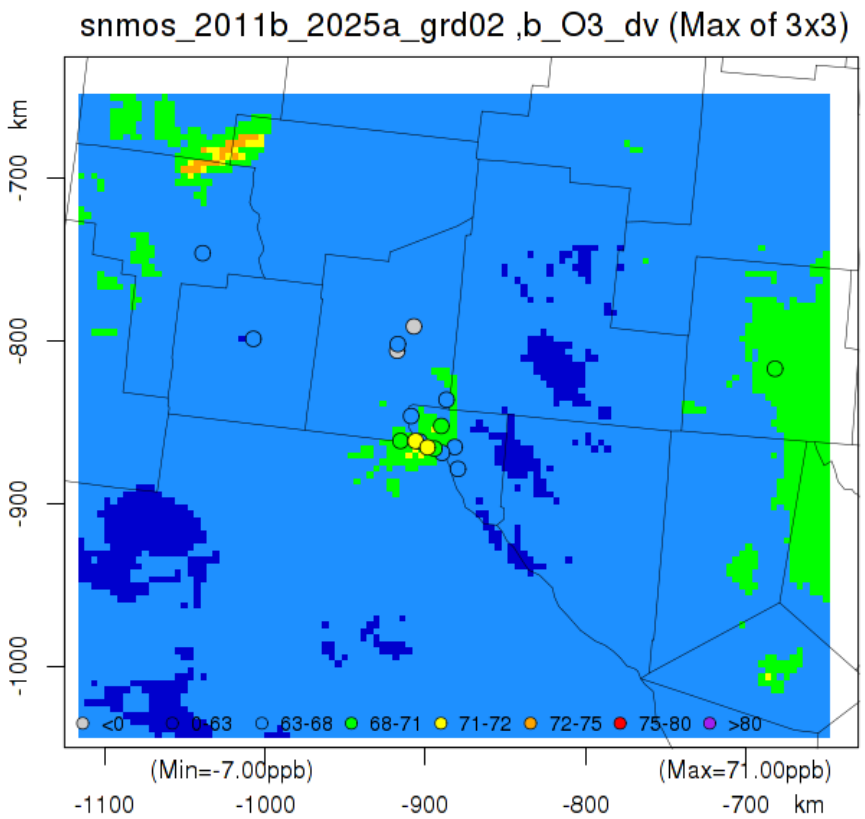
NoMex: MATS

Site ID	DVC	DV NoMex	Diff DV	NoMex/2011	County	Site Name
350130008	64.7	59.6	-5.1	0.9219	Dona Ana	LA UNION
350130017	66.7	60.4	-6.3	0.9064	Dona Ana	SUNLAND PARK
350130019	-7	-9			Dona Ana	LAS CRUCES WELL STATION #41;HOLMAN ROAD
350130020	67.7	63.3	-4.4	0.9356	Dona Ana	CHAPARRAL
350130021	71	64.8	-6.2	0.9132	Dona Ana	DESERT VIEW
350130022	70.3	65.2	-5.1	0.9285	Dona Ana	SANTA TERESA
350130023	64.3	60.6	-3.7	0.9438	Dona Ana	750 N.SOLANO DRIVE
350131012	-7	-9			Dona Ana	HOLIDAY INN
350151005	70.3	65.2	-5.1	0.9281	Eddy	HOLLAND ST;SE OF WATER TANK;CARLSBAD;NM
350171003	65	62.2	-2.8	0.9584	Grant	CHINO BLVD NR HURLEY PARK;HURLEY;NM
350290003	63	59.2	-3.8	0.9397	Luna	310 AIRPORT ROAD; DEMING; NM 88030
481410029	65	59.5	-5.5	0.9162	El Paso	10834 IVANHOE; IVANHOE FIRE STATION
481410037	71	64.5	-6.5	0.9089	El Paso	RIM RD. NEAR HAWTHORNE NEXT TO UT POLICE
481410044	69	63.1	-5.9	0.9151	El Paso	800 S. SAN MARCIAL STREET
481410055	66.3	60.4	-5.9	0.912	El Paso	650 R.E. THOMASON LOOP
481410057	66	60.7	-5.3	0.9198	El Paso	201 S. NEVAREZ RD.
481410058	69.3	64.4	-4.9	0.9295	El Paso	5050 A YVETTE DRIVE

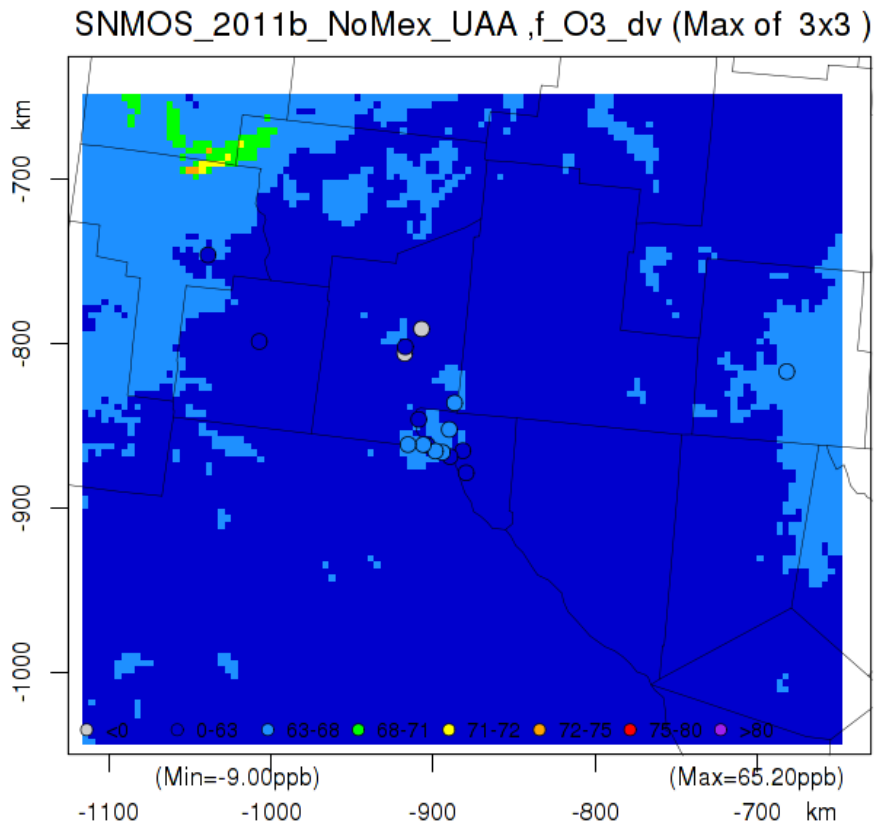
SNMOS 4-km Domain 2011 Results

NoMex: Unmonitored Area Analysis

DVC (2011)



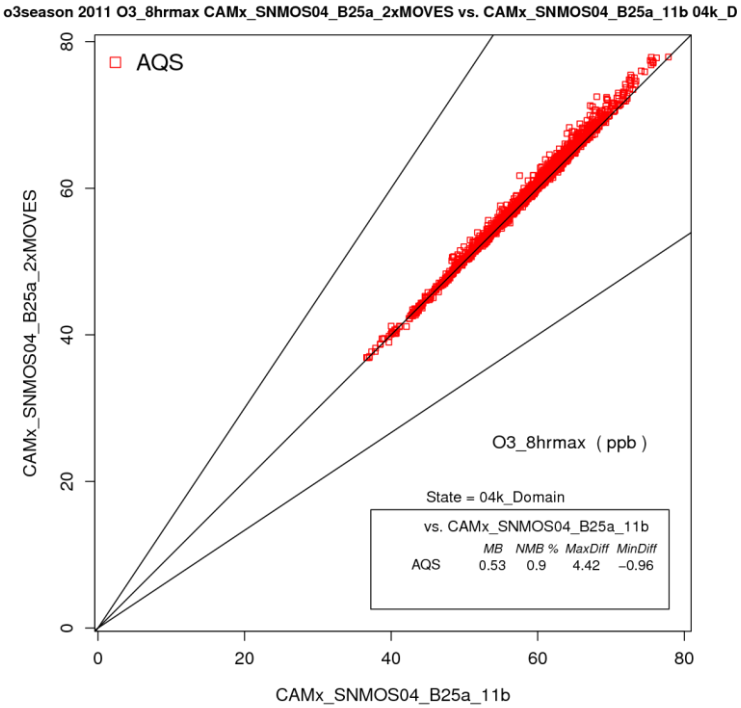
DV NoMex (2011)



Exceeds Oct 2015 ozone NAAQS ≥ 71.0 ppb

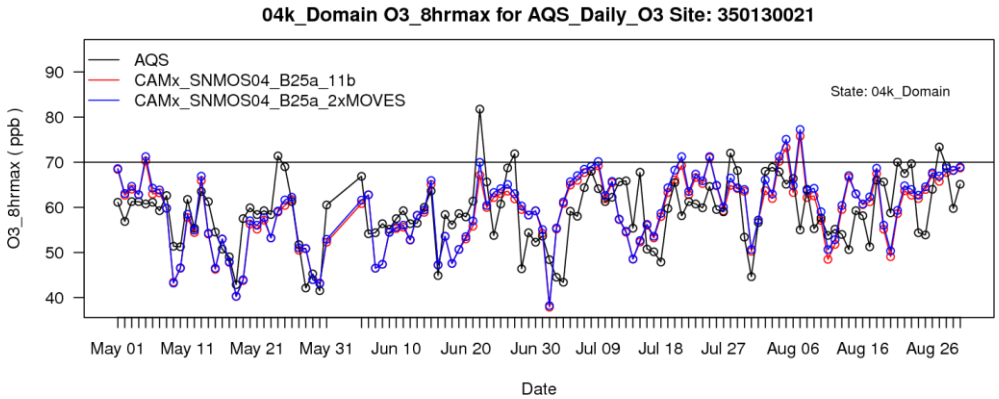
SNMOS 4-km Domain 2025 Results

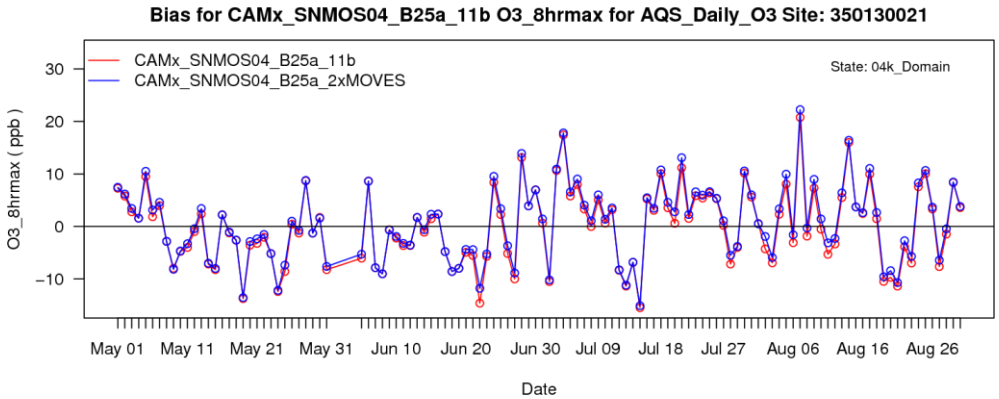
Double 2025 U.S. Onroad Emissions (2xUSOR): Performance Summary



Daily Max 8-hr O3, all NM 4-km AQS Monitors: May-August 2011

2xUSOR vs Base25a_11b





Desert View AQS Monitor

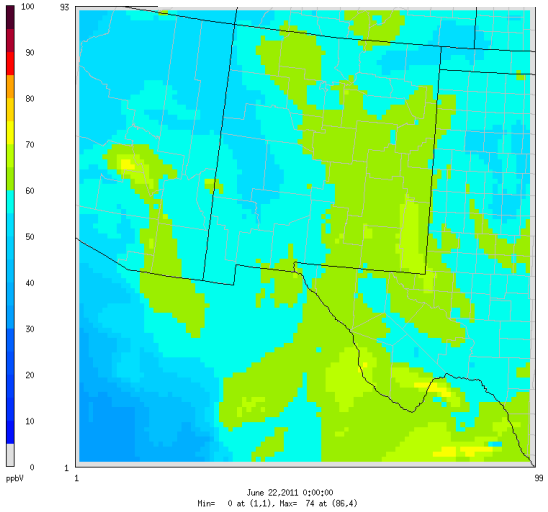
Daily Max 8-hr O3: Obs, Base25a_11b, 2xUSOR

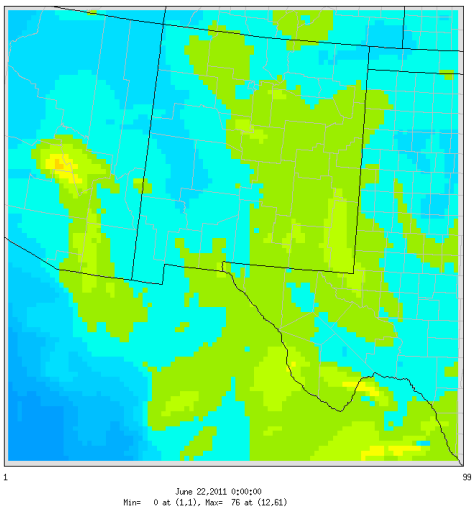
SNMOS 12-km Domain 2025 Results

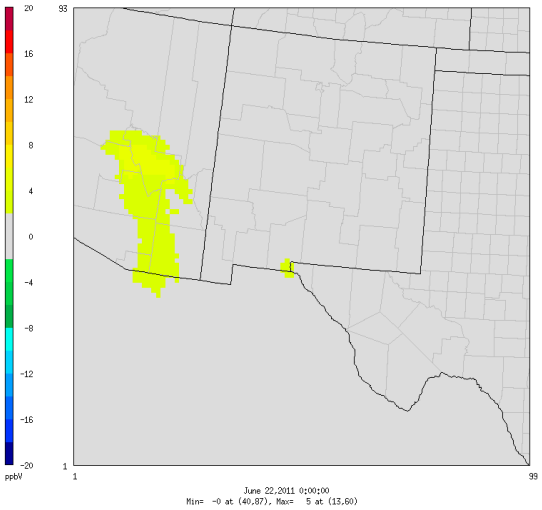
2xUSOR: June 22 Spatial Plots

Base25a_11b | 2xUSOR | 2xUSOR – Base25a_11b

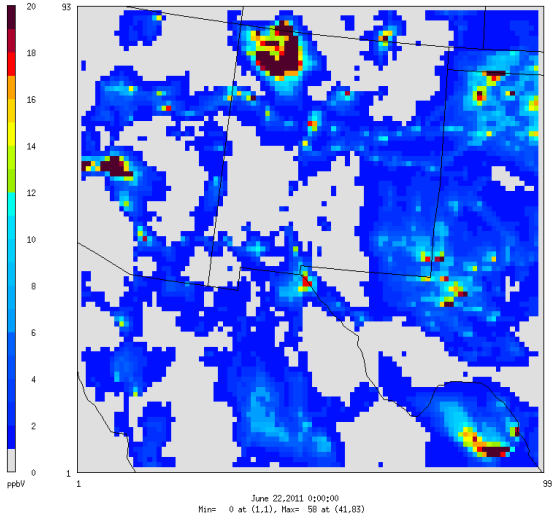
Daily Max 8-hr O3

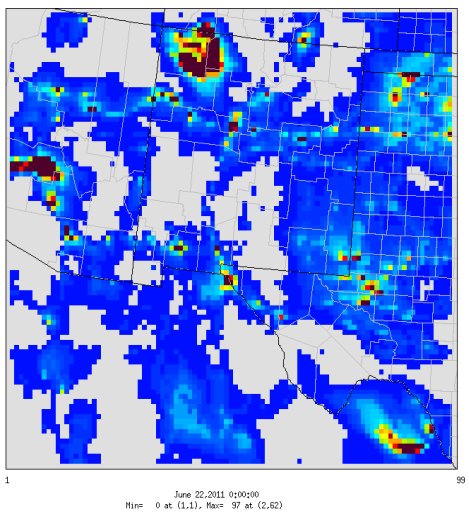


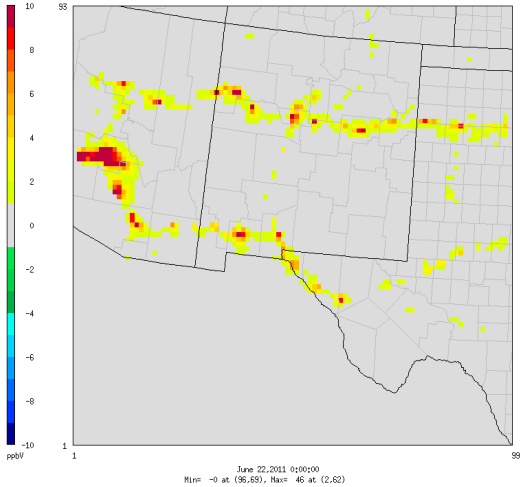




Daily Max NOx



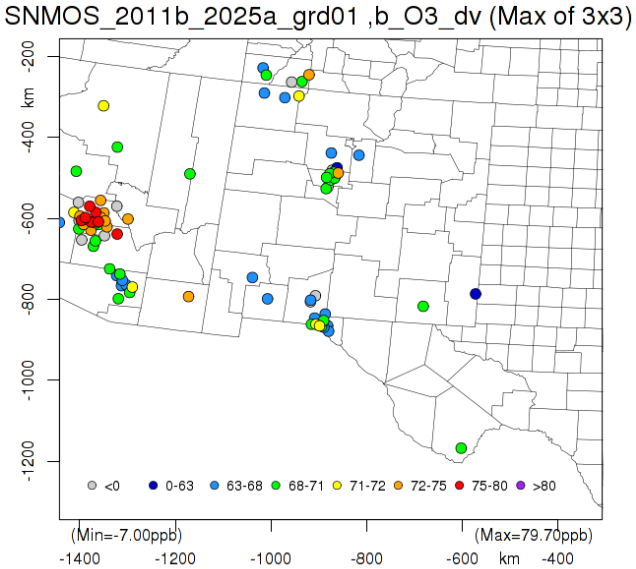




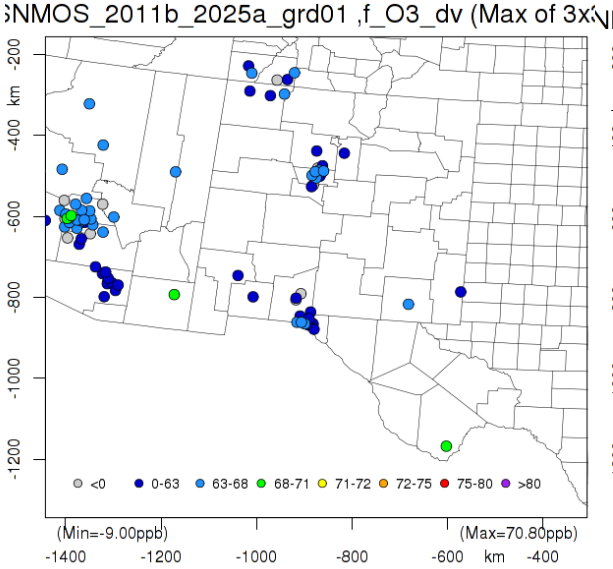
SNMOS 12-km Domain 2025 Results

2xUSOR: MATS

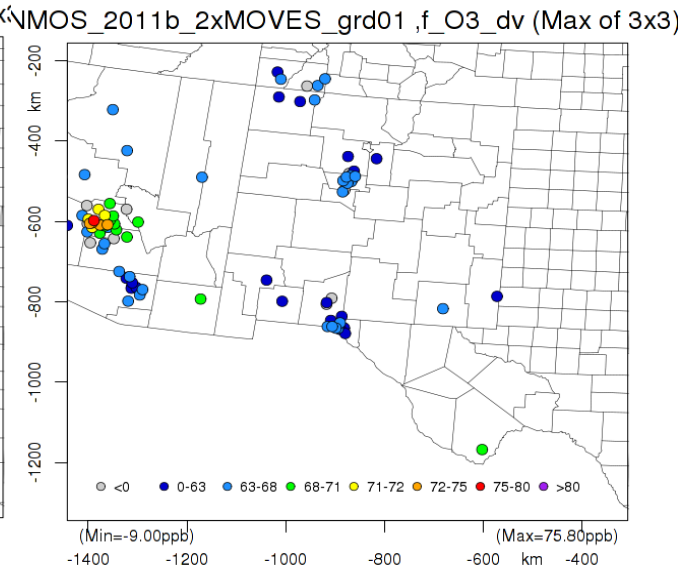
DVC (2011)



DVF (2025)



DV (2xUSOR 2025)

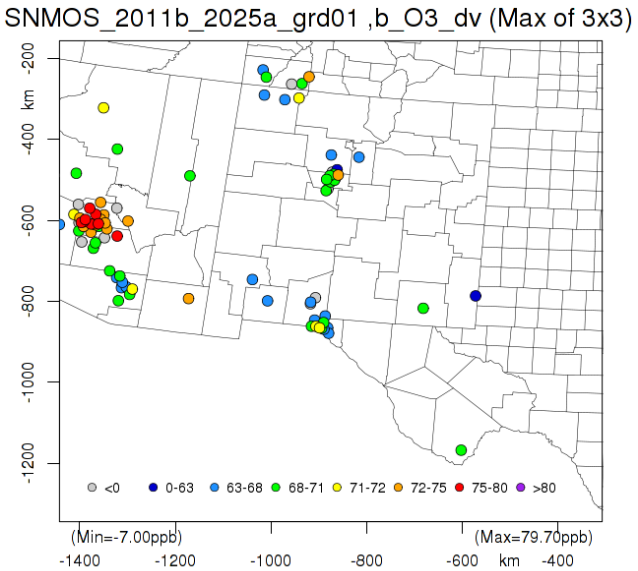


Exceeds Oct 2015 ozone NAAQS ≥ 71.0 ppb

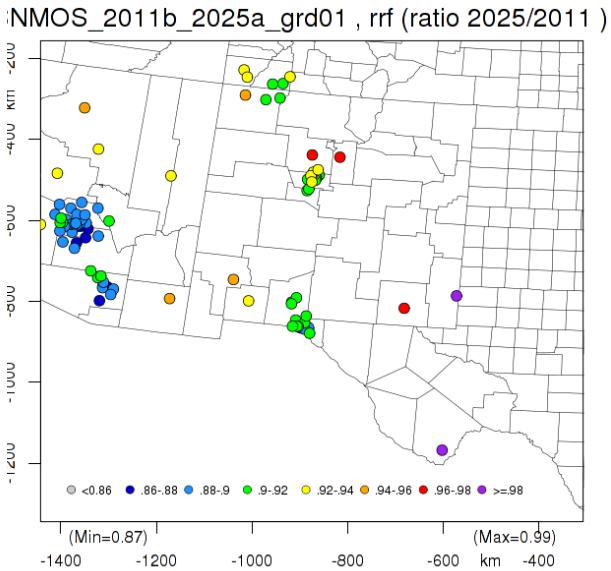
SNMOS 12-km Domain 2025 Results

2xUSOR: MATS

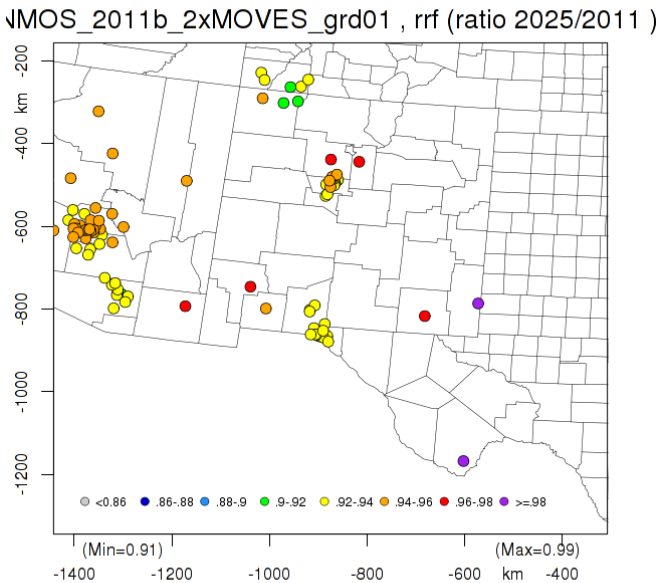
DVC (2011)



RRF (2025/2011)



RRF (2xUSOR/2011)



Exceeds Oct 2015 ozone NAAQS ≥ 71.0 ppb

SNMOS 12-km Domain 2025 Results

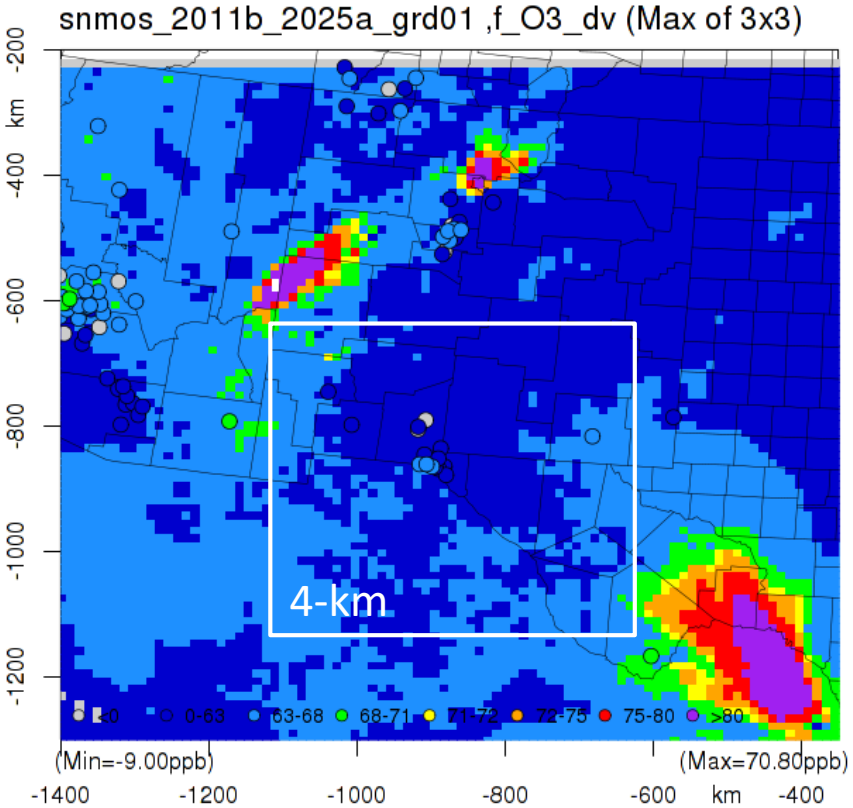
2xUSOR: MATS New Mexico Counties

Site ID	DVC	DV 2025	DV 2xUSOR	Diff DV	RRF 2025	RRF 2xUSOR	County	Site Name
350010023	68	61.6	63.5	1.9	0.9068	0.9346	Bernalillo	4700A SAN MATEO NE (2ZM)
350010024	69.3	62.8	64.7	1.9	0.9068	0.9346	Bernalillo	6000 ANDERSON AVENUE SE
350010027	70	64.6	66.3	1.7	0.9242	0.9479	Bernalillo	5100 MONTANO BLVD NW
350010029	68.7	63.4	64.9	1.5	0.9242	0.9459	Bernalillo	201 PROSPERITY SW
350010032	70	63.5	65.5	2	0.9079	0.9365	Bernalillo	
350011012	72	64.8	67	2.2	0.9002	0.9307	Bernalillo	1.4 MILES WSW INTERSECTION TRAMWAY
350011013	68.7	63.2	64.8	1.6	0.921	0.9446	Bernalillo	9819A SECOND STREET NW
350130008	64.7	58.3	59.8	1.5	0.9017	0.9249	Dona Ana	LA UNION
350130017	66.7	60.3	61.8	1.5	0.9049	0.928	Dona Ana	SUNLAND PARK
350130019	-7	-9	-9				Dona Ana	LAS CRUCES WELL STATION #41;HOLMAN ROAD
350130020	67.7	61.6	62.9	1.3	0.9106	0.9297	Dona Ana	CHAPARRAL
350130021	71	64.2	65.8	1.6	0.9049	0.928	Dona Ana	DESERT VIEW
350130022	70.3	63.8	65.2	1.4	0.9078	0.9287	Dona Ana	SANTA TERESA
350130023	64.3	58.6	59.9	1.3	0.9114	0.9322	Dona Ana	750 N.SOLANO DRIVE
350131012	-7	-9	-9				Dona Ana	HOLIDAY INN
350151005	70.3	67.7	67.9	0.2	0.9639	0.9666	Eddy	HOLLAND ST;SE OF WATER TANK;CARLSBAD;NM
350171003	65	62.3	62.7	0.4	0.9586	0.9657	Grant	CHINO BLVD NR HURLEY PARK; HURLEY;NM
350250008	62.7	61.6	61.9	0.3	0.9839	0.9874	Lea	2320 N. JEFFERSON ST; HOBBS; NEW MEXICO
350290003	63	58.8	59.5	0.7	0.9343	0.946	Luna	310 AIRPORT ROAD; DEMING; NM 88030
350431001	61.7	57.1	58.3	1.2	0.9261	0.9458	Sandoval	HIGHWAY DEPT. YARD NEAR BERNALILLO
350439004	63	60.8	61.3	0.5	0.9655	0.9735	Sandoval	040 TRADING POST ROAD
350450009	65.3	59.4	59.9	0.5	0.9101	0.9181	San Juan	162 HWAY 544; BLOOMFIELD NM 87413
350450018	71	64.4	64.9	0.5	0.9075	0.9143	San Juan	423 HWAY 539; BLANCO NM 87412
350451005	66	62.2	62.6	0.4	0.9432	0.9489	San Juan	USBR SHIPROCK SUBSTATION (FARMINGTON)
350490021	64.3	62.4	62.8	0.4	0.9709	0.9771	Santa Fe	2001 Aviation Drive, Santa Fe
350610008	68.5	62.7	64.1	1.4	0.9161	0.9369	Valencia	1000 W. MAIN ST; LOS LUNAS; NM 87031

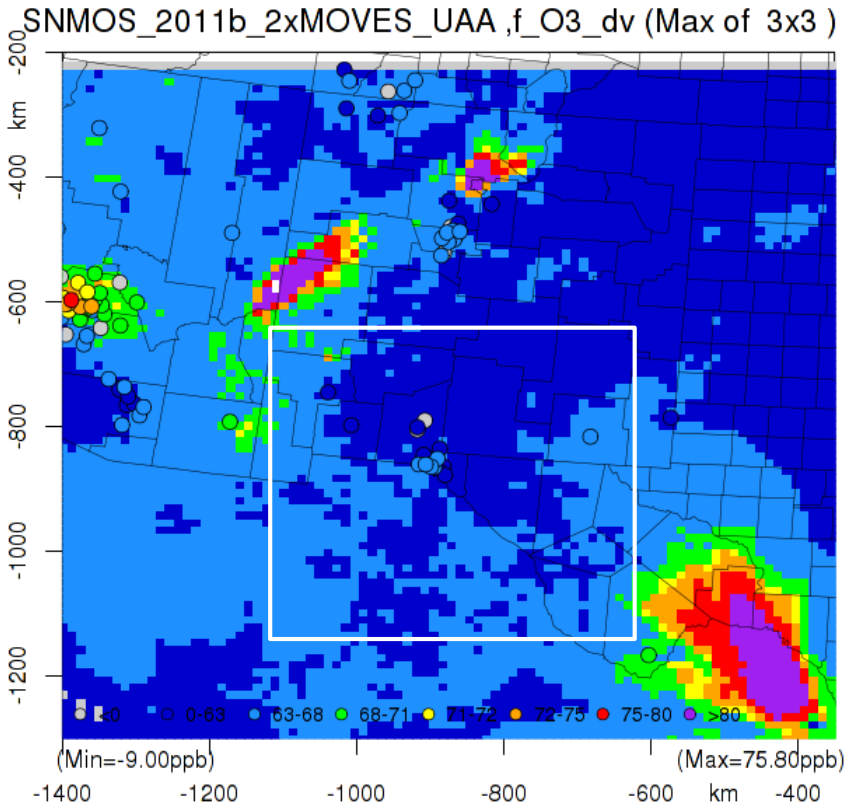
SNMOS 12-km Domain 2025 Results

2xUSOR: Unmonitored Area Analysis

DVF (2025)



DV 2xUSOR (2025)

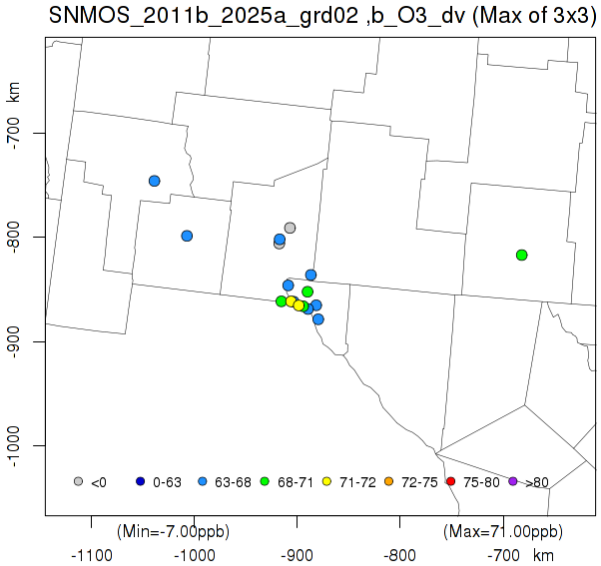


Exceeds Oct 2015 ozone NAAQS ≥ 71.0 ppb

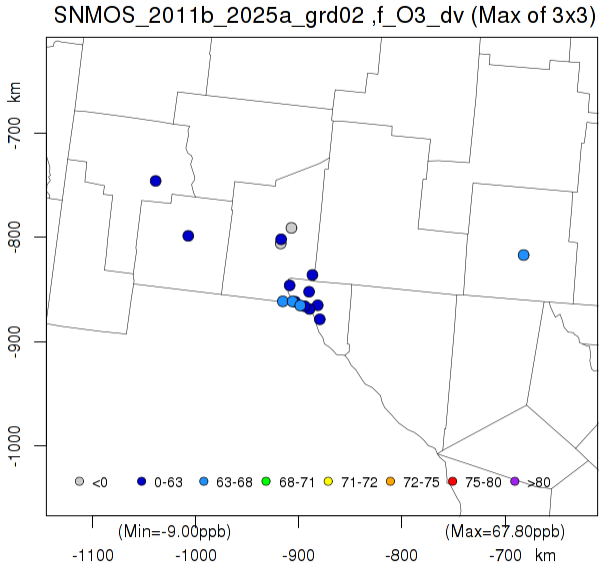
SNMOS 4-km Domain 2025 Results

2xUSOR: MATS

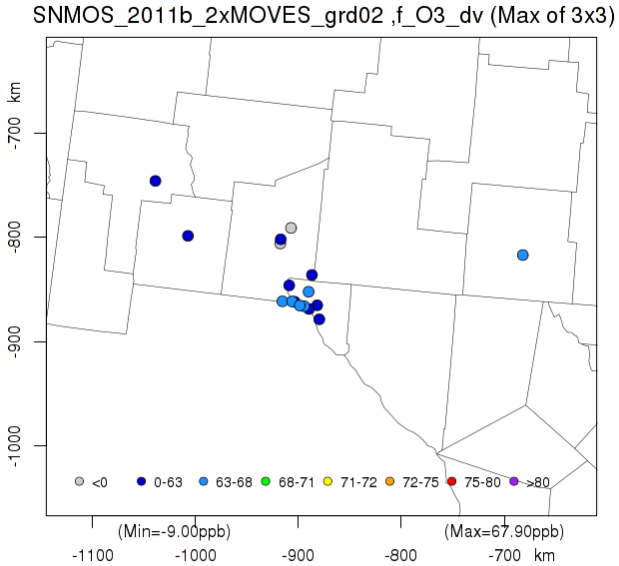
DVC (2011)



DVF (2025)



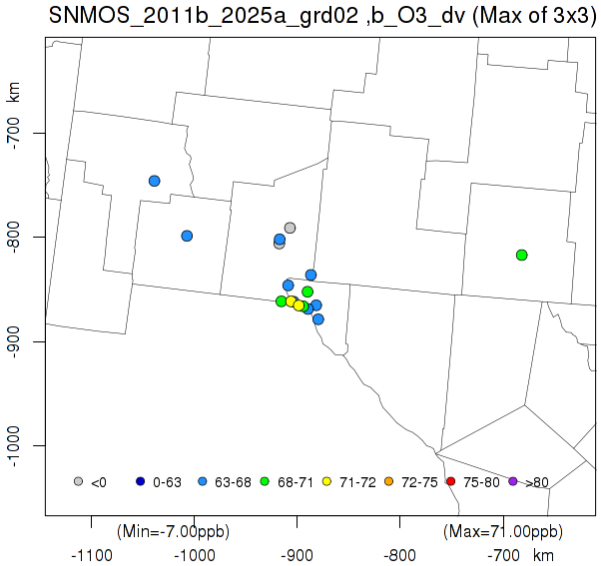
DV (2xUSOR)



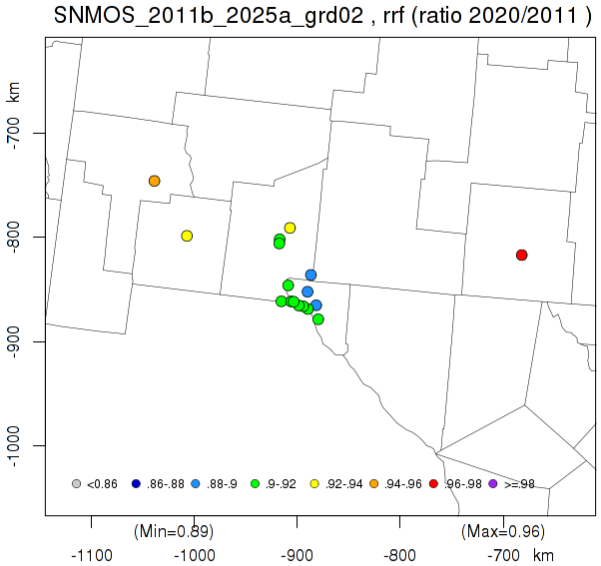
SNMOS 4-km Domain 2025 Results

2xUSOR: MATS

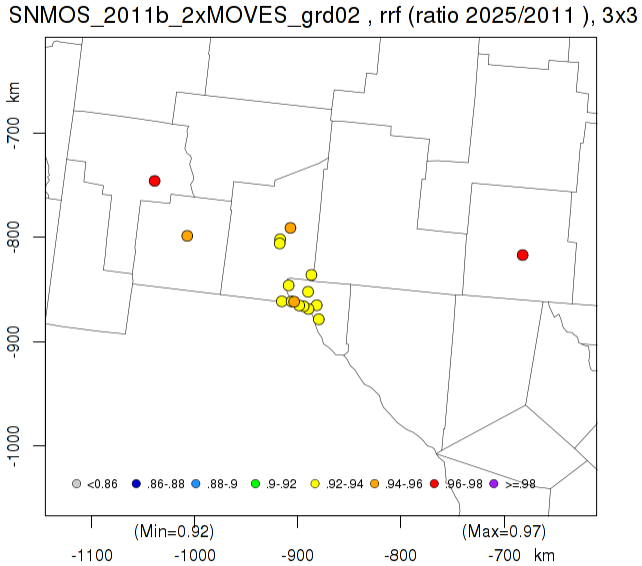
DVC (2011)



RRF (2025/2011)



RRF (2xUSOR/2025)



SNMOS 4-km Domain 2025 Results

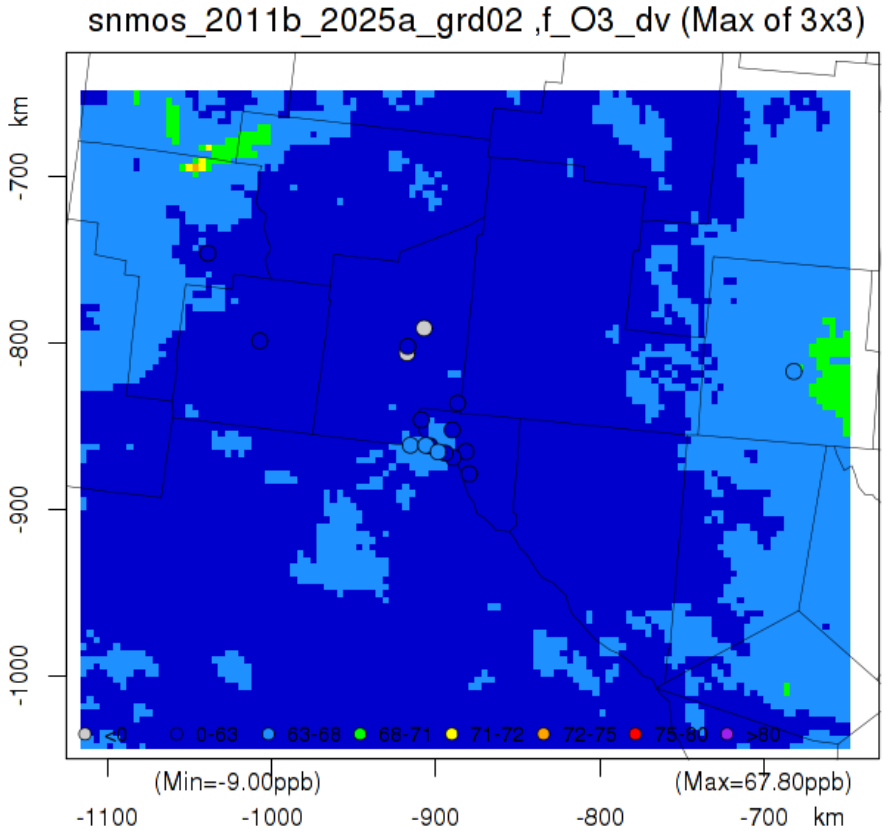
2xUSOR: MATS 4-km Domain Counties

Site ID	DVC	DV 2025	DV 2xUSOR	Diff DV	RRF 2025	RRF 2xUSOR	County	Site Name
350130008	64.7	58.3	59.9	1.6	0.9026	0.9271	Dona Ana	LA UNION
350130017	66.7	61.3	62.7	1.4	0.9195	0.9403	Dona Ana	SUNLAND PARK
350130019	-7	-9	-9				Dona Ana	LAS CRUCES WELL STATION #41;HOLMAN ROAD
350130020	67.7	60.8	62.3	1.5	0.8985	0.921	Dona Ana	CHAPARRAL
350130021	71	65.1	66.6	1.5	0.9183	0.9388	Dona Ana	DESERT VIEW
350130022	70.3	63.8	65.3	1.5	0.9086	0.9297	Dona Ana	SANTA TERESA
350130023	64.3	58.7	60	1.3	0.9136	0.9341	Dona Ana	750 N.SOLANO DRIVE
350131012	-7	-9	-9				Dona Ana	HOLIDAY INN
350151005	70.3	67.8	67.9	0.1	0.9646	0.9672	Eddy	HOLLAND ST;SE OF WATER TANK;CARLSBAD;NM
350171003	65	62	62.4	0.4	0.955	0.9615	Grant	CHINO BLVD NR HURLEY PARK;HURLEY;NM
350290003	63	58.6	59.3	0.7	0.9311	0.9424	Luna	310 AIRPORT ROAD; DEMING; NM 88030
481410029	65	58.4	60.2	1.8	0.8996	0.9274	El Paso	10834 IVANHOE; IVANHOE FIRE STATION
481410037	71	65.2	66.7	1.5	0.9186	0.9396	El Paso	RIM RD. NEAR HAWTHORNE NEXT TO UT POLICE
481410044	69	62.7	64.4	1.7	0.9098	0.9343	El Paso	800 S. SAN MARCIAL STREET
481410055	66.3	60.1	61.7	1.6	0.9069	0.9313	El Paso	650 R.E. THOMASON LOOP
481410057	66	59.8	61.4	1.6	0.9071	0.931	El Paso	201 S. NEVAREZ RD.
481410058	69.3	61.7	63.8	2.1	0.8917	0.921	El Paso	5050 A YVETTE DRIVE

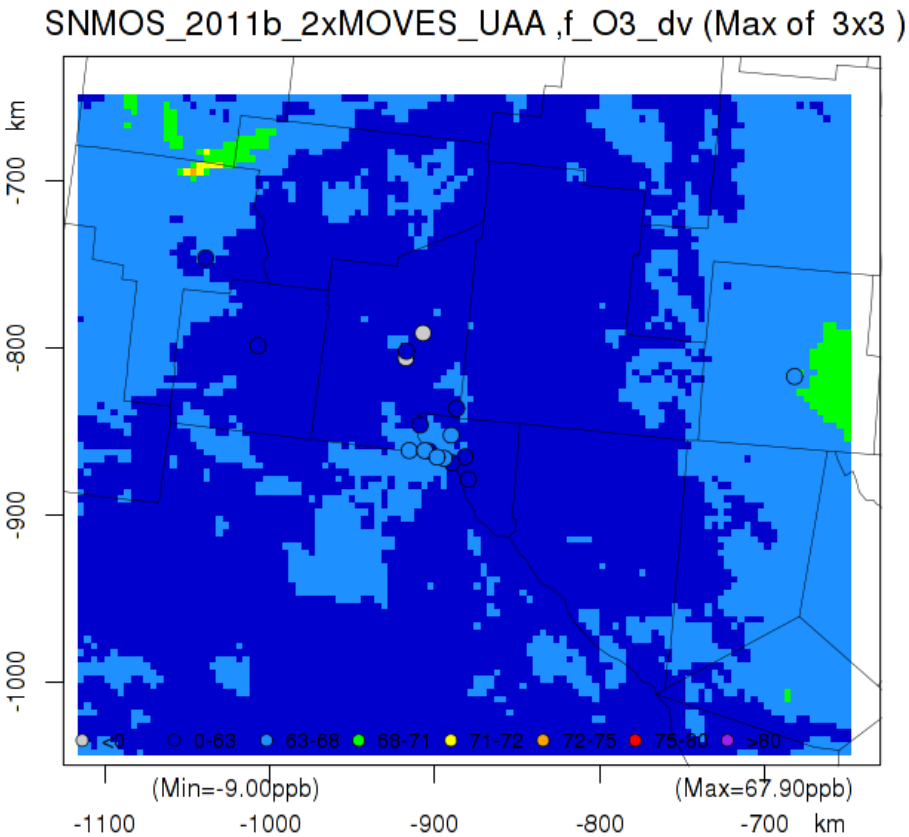
SNMOS MATS 4-km Domain 2025 Results

2xUSOR: Unmonitored Area Analysis

DVF (2025)



DV 2xMOVES (2025)



Exceeds Oct 2015 ozone NAAQS ≥ 71.0 ppb

SNMOS MATS 4-km Domain

Sensitivity Results

Zero 2011 Mexico Anthropogenic Emissions Summary

Site ID	DVC (2011)	DV No Mex (2011)	DV Diff	Site Name
350130008	64.7	59.6	-5.1	LA UNION
350130017	66.7	60.4	-6.3	SUNLAND PARK
350130020	67.7	63.3	-4.4	CHAPARRAL
350130021	71	64.8	-6.2	DESERT VIEW
350130022	70.3	65.2	-5.1	SANTA TERESA
350130023	64.3	60.6	-3.7	750 N.SOLANO DRIVE

Double 2025 U.S. Onroad Mobile Emissions Summary

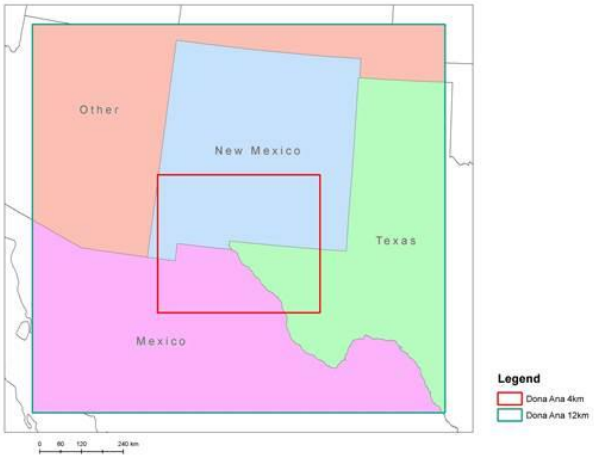
Site ID	DVC (2011)	DVF (2025)	DV 2xUSOR (2025)	DV Diff	RRF (2025)	RRF 2xUSOR (2025)	RRF % Change	Site Name
350130008	64.7	58.3	66.0	1.6	0.9026	0.9271	+2.71%	LA UNION
350130017	66.7	61.3	67.7	1.4	0.9195	0.9403	+2.26%	SUNLAND PARK
350130020	67.7	60.8	68.7	1.5	0.8985	0.9210	+2.50%	CHAPARRAL
350130021	71	65.1	71.9	1.5	0.9183	0.9388	+2.23%	DESERT VIEW
350130022	70.3	63.8	71.2	1.5	0.9086	0.9297	+2.32%	SANTA TERESA
350130023	64.3	58.7	65.2	1.3	0.9136	0.9341	+2.24%	750 N.SOLANO DRIVE

Task 11 Summary

- Removing the Mexico anthropogenic emissions in 2011 reduces the 4-km domain design values across the Dona Ana County monitors by an average of 5.1 ppb (range: -3.7 to -6.3 ppb).
- Doubling the U.S. onroad mobile emissions in 2025 increases the 4-km domain design values across the Dona Ana County monitors by average of 1.5 ppb (range: +1.3 to +1.6 ppb). The 2025 RRFs increase by an average of 2.4% (range: +2.23% to +2.71%).
- Additional plots (scatter, timeseries, tile) available at: https://drive.google.com/open?id=0B2kjxCwKICxUWkhxd1RlcUQ5anc

Task 12: Source Apportionment

- 2011 and 2025 CAMx 12/4 km ozone source apportionment Simulation:
  - Source Regions (4):
    - New Mexico
    - Texas
    - Mexico
    - Arizona+
  - Initial Concentrations
  - Boundary Conditions
  - Source Categories (8):
    - Natural (Biogenic + LNOx)
    - On-Road Mobile
    - Non-Road Mobile
    - Oil and Gas
    - EGU Point
    - Non-EGU Point
    - Fires (WF, RX, Ag)
    - Remainder Anthropogenic



- Results in 34 total Source Groups (34 = 4 x 8 + 2)
  - Contribution of Mexico to 2011 and 2025 ozone
  - 2025 ozone DV projections without presence of fires
  - Changes in ozone between 2011 to 2025 by region and source type
  - Ranking of sources that contribute to 2025 ozone levels

Task 12: Source Apportionment

- Completion Date: Sep 15, 2016
- Current (Aug 11, 2016) Status:
  - 2011 and 2025 Ozone Source Apportionment simulations are completed
  - Currently conducting post-processing:
    - 2011 and 2025 ozone Design Value contributions
    - 2011 and 2025 MDA8 ozone contributions for each day at monitoring sites
    - Deliverables: PPT and Interactive Excel spreadsheet
      - Possible Web-Based Visualization Tool on IWDW

Next Steps

Tasks to be Completed by September 15, 2016

- **Task 1**: 2011 WRF 36/12/4 km with 4 km focus on Dona Ana/El Paso/Juarez and Work Plan (Completed)
- **Task 2**: 2011 update Permian Basin O&G (Completed)
- **Task 3**: 2011 update of Juarez and nearby Mexico EI, 2020 Mexico emissions update (Completed)
- **Task 4**: SMOKE current 2011 NEI for 4 km domain (2/29/16)
- **Task 5**: Gridded 2011 biogenic, fires, wind-blown dust, lightning emissions for 4 km domain (2/29/16)
- **Task 6**: Develop 2011 4 km CAMx database and perform base case (2/29/16)
- **Task 7**: 2011 MPE and sensitivity modeling for Dona Ana County (4/30/16)
- **Task 8**: SMOKE current FY US EI and FY Mexico emissions update (4/30/16)
- **Task 9**: FY 4 km CAMx simulation (5/31/16)
- **Task 10**: FY ozone projections (MATS) (5/31/16)
- **Task 11**: FY emissions sensitivity/controls (8/11/16)
- **Task 12**: FY 4 km source apportionment run (9/15/16)
- **Task 13**: Air Quality Technical Support Document (11/18/16)