Southern New Mexico Ozone Modeling Study

Summary of Results: Tasks 1-3

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

November 30, 2015

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 – September 30
- 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, year TBD
  - 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

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

Outline of Today's Presentation

Task 1-3 Deliverables

1. Modeling work plan and PowerPoint presentation of Weather Research Forecast (WRF) Meteorological Modeling Application/Evaluation Report
2. PowerPoint presentation on Permian Basin oil and gas 2011 and future year emission update (Technical memorandum provides additional detail)
3. PowerPoint presentation on Mexico emissions to be used in 2011 base and future year modeling

Task 1: Weather Research Forecast (WRF) Meteorology Modeling

SNMOS 2011 WRF Sensitivity Results and Recommendations

Lead: University of North Carolina

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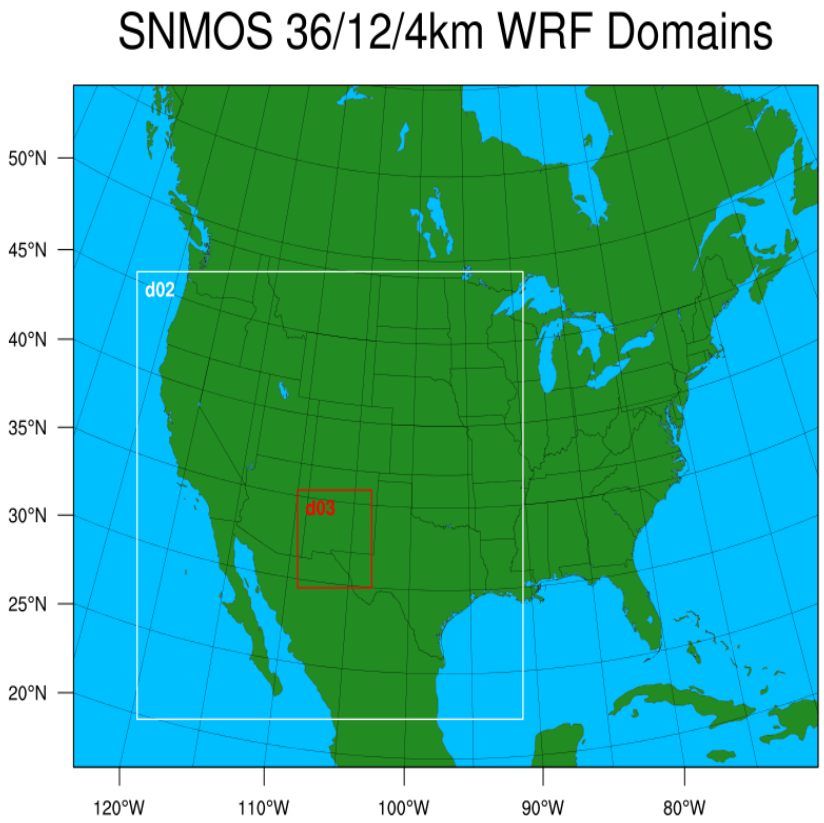
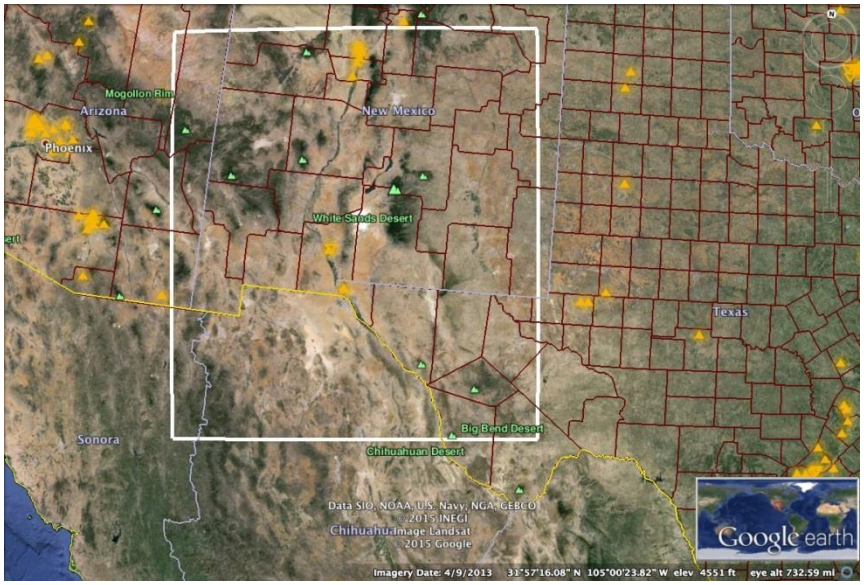
Task 1 Objectives and Deliverables

- Objective
  - Simulate and evaluate WRF meteorology for modeling 2011 summer season ozone in Doña Ana County, New Mexico
- Deliverables
  - Prepare a work plan for the WRF modeling and other aspects of study. (**Completed 10/28/2015**)
  - Power Point Presentation of WRF Results/Recommendations (**Completed 11/30/2015**)
- Tasks
  - Coordinate with WRF modelers in New Mexico to find the best model configuration for simulating ozone in Doña Ana County. (**Completed 11/30/2015**)
  - Use the current version of WRF to simulate summer ozone season (mid-April- August) meteorology for the year 2011 (**Completed 11/1/2015**)
  - Modeling domains: 36-km CONUS, 12-km Western U.S., and 4-km Doña Ana/El Paso/Juarez (**Completed 10/28/2015**)
  - Convert WRF output to CAMx inputs using WRFCAMx for 12-km New Mexico/West Texas/Northern Mexico and the 4-km Doña Ana/El Paso/Juarez domains (**Completed 11/30/2015**)
  - Prepare documentation and model performance information for Task 13. (**Completed 11/30/2015**)

WRF Modeling Domains





WRF Sensitivities

WRFv3.7.1 (latest WRF release)

1. ***WRF_NAM_Kfmods*** – NAM ICBCs and the modified Kain-Fritsch cumulus scheme.
2. ***WRF_NAM_MSKF*** - Same as Configuration 1 with the multi-scale (grid-aware) Kain-Fritsch (MSKF) cumulus scheme.
3. ***WRF_ERA_MSKF*** - Same as Configuration 2 but using the ECMWF ERA-Interim Reanalysis as the ICBC fields.
4. ***WRF_ERA_MSKF_AN*** - Same as Configuration 3 but based on prior experiences from the San Juan Hg study. Analysis nudging was not applied in domain 2 in the San Juan Hg study. This configuration will turn off analysis nudging for domain 2.

WRF Model Evaluation

- Evaluation focused on 4-km domain statistics (other domains available)
  - May-August 2011 Average statistics of bias and error for temperature, mixing ratio, wind speed and direction. (Simplified into a table)
- Evaluation during periods with high ozone and active monsoon (Table stats., precipitation, and windrose)
  - 06/02/2011 thru 06/06/2011
  - 06/20/2011 thru 06/24/2011
  - 07/25/2011 thru 07/29/2011
  - 08/02/2011 thru 08/05/2011
  - 08/19/2011 thru 08/22/2011

12-km Domain Average Statistics

May-Aug 2011 Period Average

	Temperature (deg K)		Mixing Ratio (g/kg)		Wind Speed (m/s)		Wind Direction (degrees)	
	Bias	Error	Bias	Error	Bias	RMSE	Bias	Error
Benchmark: Simple	≤ ±0.5	≤ 2.0	≤ ±0.5	≤ 1.0	≤ ±0.5	≤ 2.0	≤ ±5	≤ 40
Benchmark: Complex	≤ ±1.0	≤ 3.0	≤ ±1.0	≤ 2.0	≤ ±1.0	≤ 3.0	≤ ±10	≤ 80
NAM KFmods	0.07	1.85	-0.44	1.35	-0.53	1.64	2.15	**29.6**
NAM MSKF	0.11	1.84	-0.40	1.36	-0.53	**1.63**	**2.14**	**29.6**
ERA MSKF	**-0.06**	**1.82**	0.18	**1.32**	-0.61	1.67	3.19	30.6
ERA MSKF no AN	0.39	2.08	**-0.13**	1.42	**-0.01**	1.96	4.44	38.2

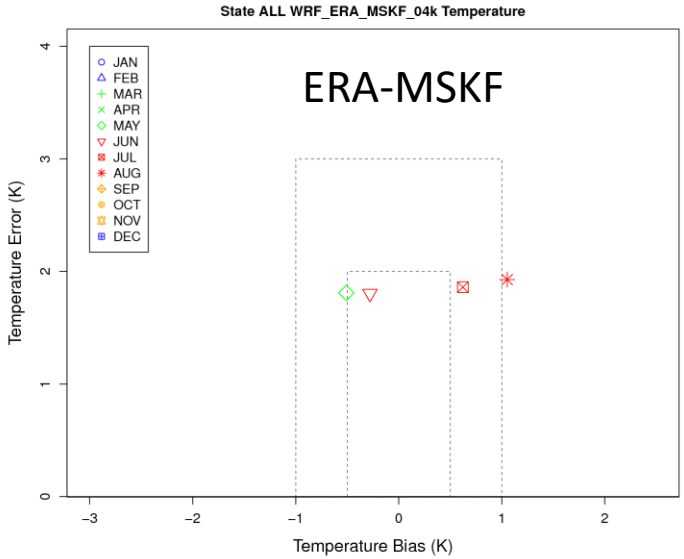
4-km Domain Average Statistics

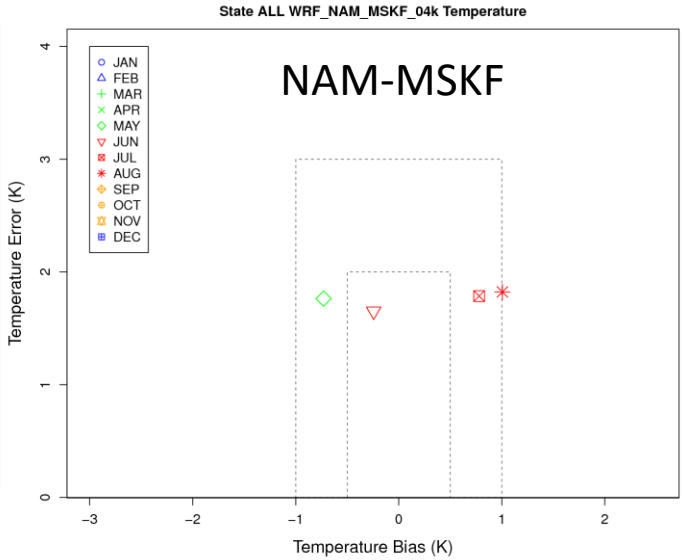
May-Aug 2011 Period Average

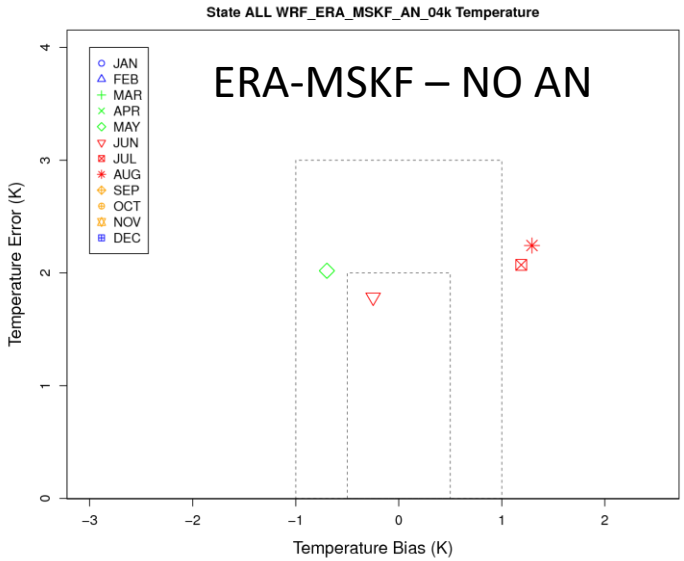
	Temperature (deg K)		Mixing Ratio (g/kg)		Wind Speed (m/s)		Wind Direction (degrees)	
	Bias	Error	Bias	Error	Bias	RMSE	Bias	Error
Benchmark: Simple	≤ ±0.5	≤ 2.0	≤ ±0.5	≤ 1.0	≤ ±0.5	≤ 2.0	≤ ±5	≤ 40
Benchmark: Complex	≤ ±1.0	≤ 3.0	≤ ±1.0	≤ 2.0	≤ ±1.0	≤ 3.0	≤ ±10	≤ 80
NAM KFmods	**0.21**	**1.77**	-0.53	1.05	**-0.30**	2.12	5.46	43.6
NAM MSKF	0.22	**1.77**	-0.46	**1.03**	-0.34	2.12	5.02	43.9
ERA MSKF	0.24	1.87	**0.14**	1.12	-0.43	**2.08**	**3.95**	**42.8**
ERA MSKF no AN	0.40	2.05	-0.39	1.18	-0.34	2.28	4.73	49.1

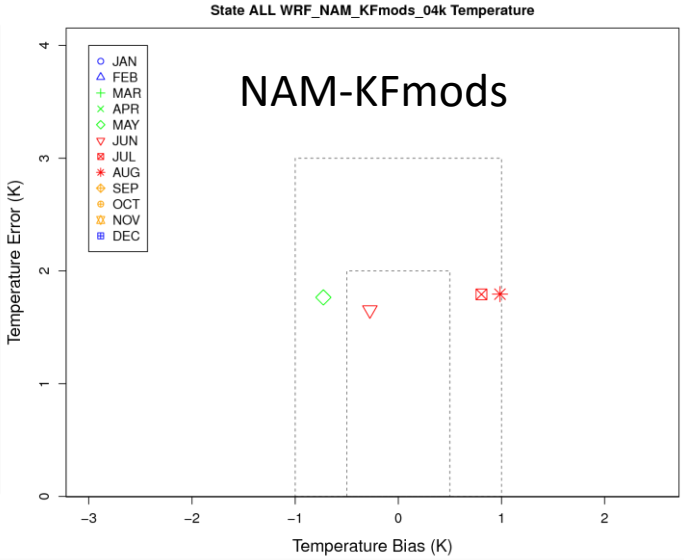
NAM – **warm bias** / dry MR bias / **underestimates wind speed**
ERA – warm bias / **wet MR bias** / underestimates wind speed
MSKF – warm bias / *sensitive to ICBC* / underestimates wind speed; *precipitation*

Temperature



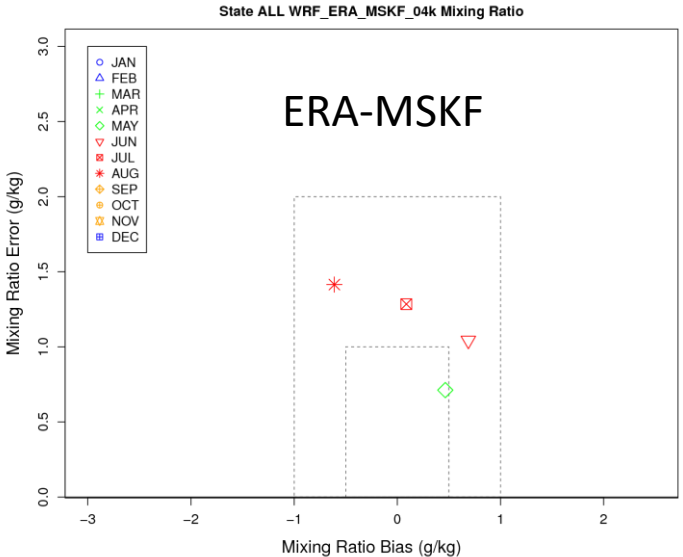


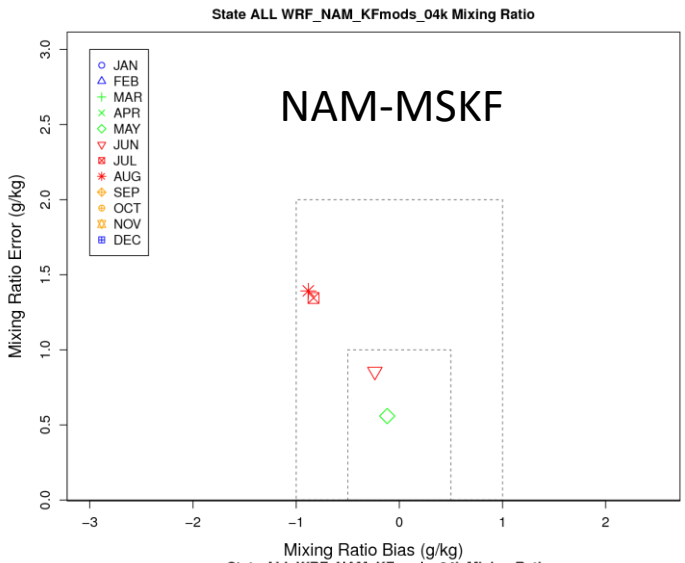


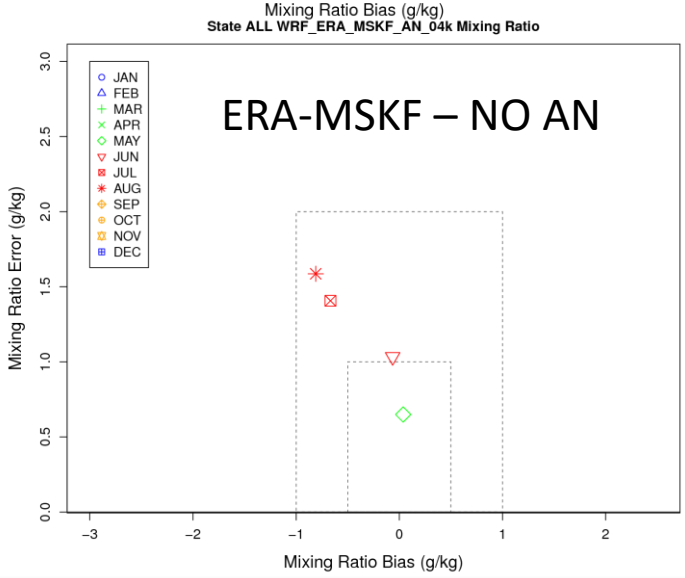


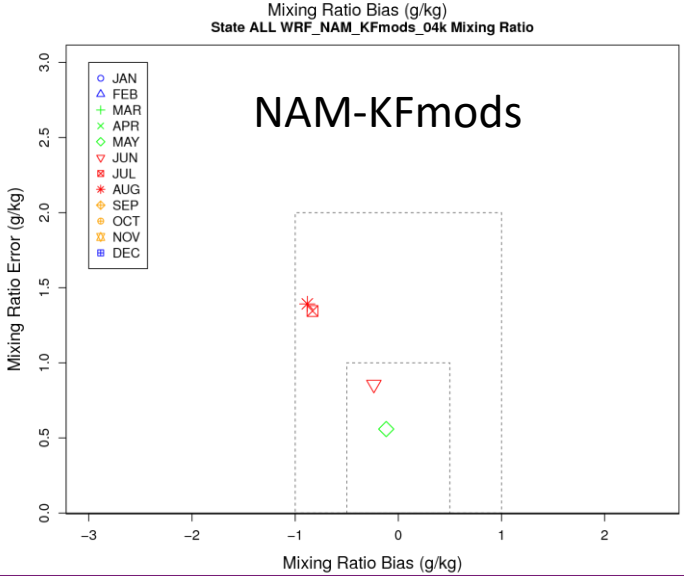
Overall warm bias but **cool bias in late spring that is consistent between runs**

Mixing Ratio







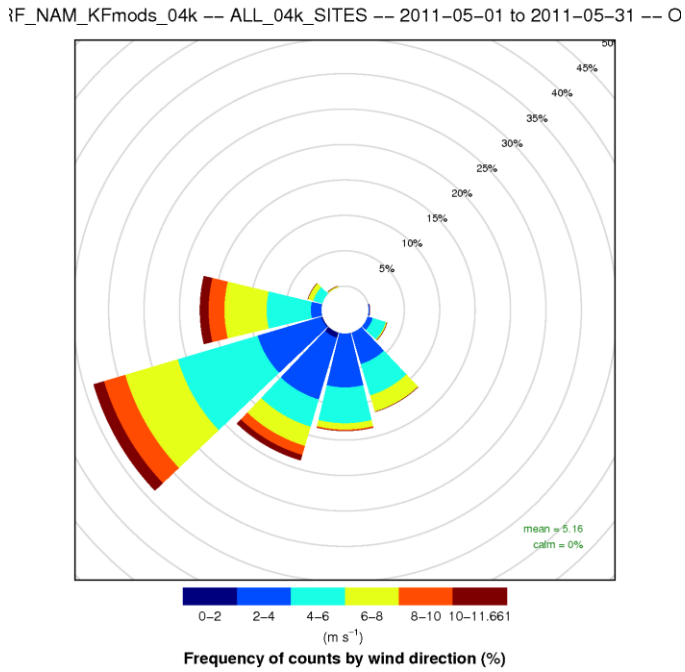


Overall errors are consistent with **error growing from late spring to summer**

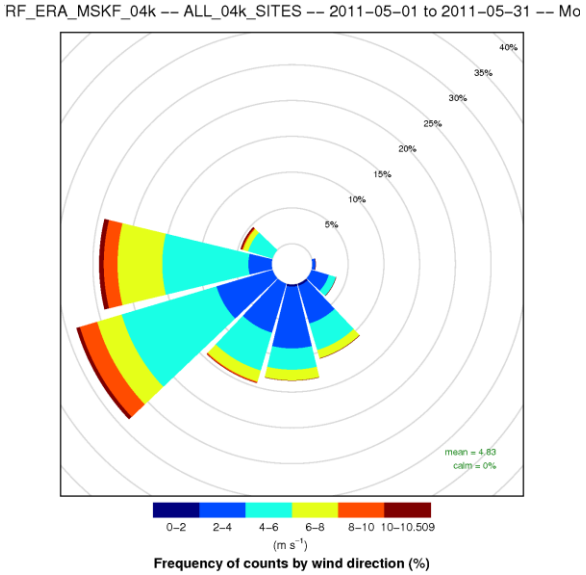
Winds

May 2011
All Sites within 4-km

OBS



ERA-MSKF



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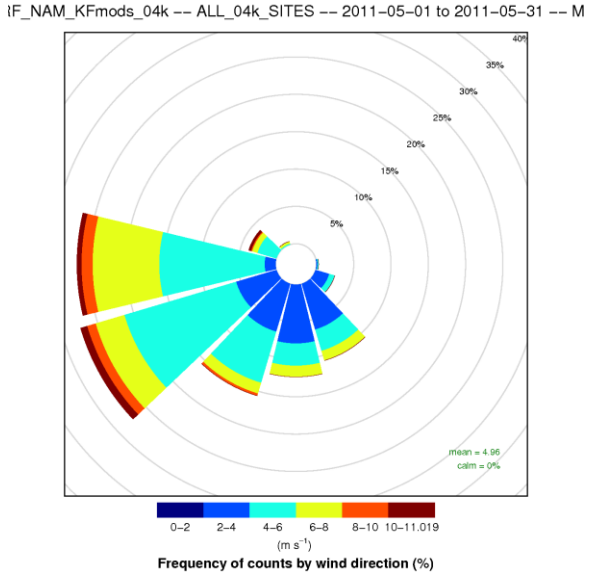

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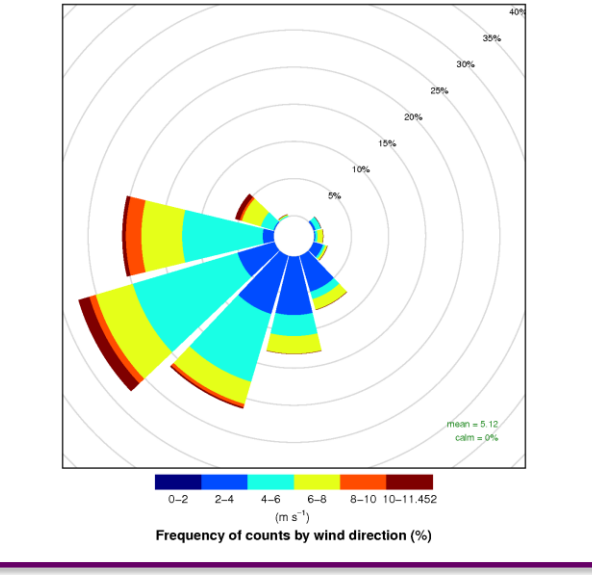

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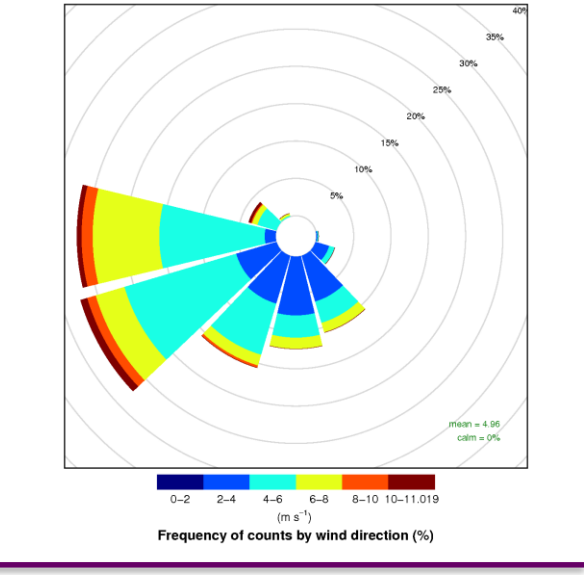
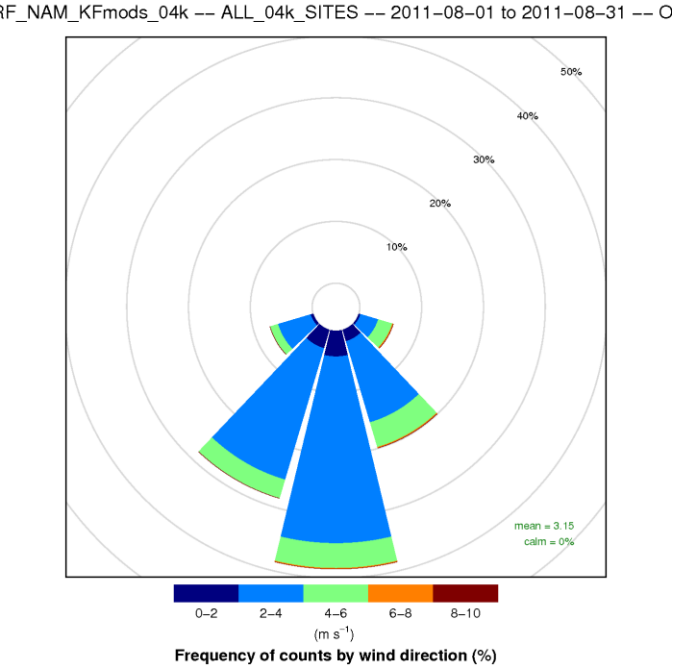


Winds

August 2011
All Sites within 4-km

OBS



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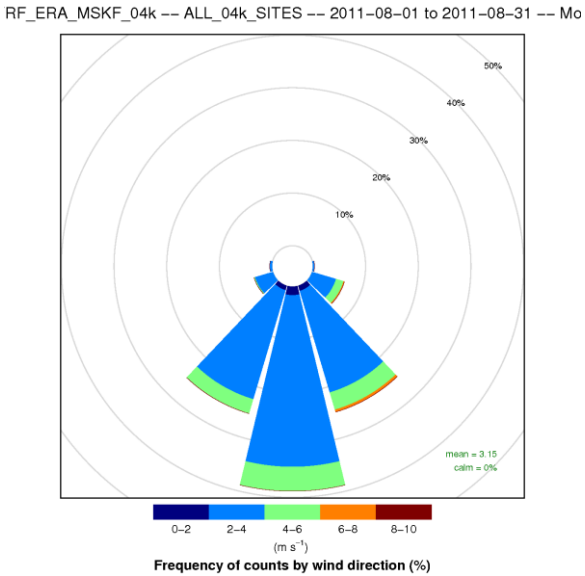

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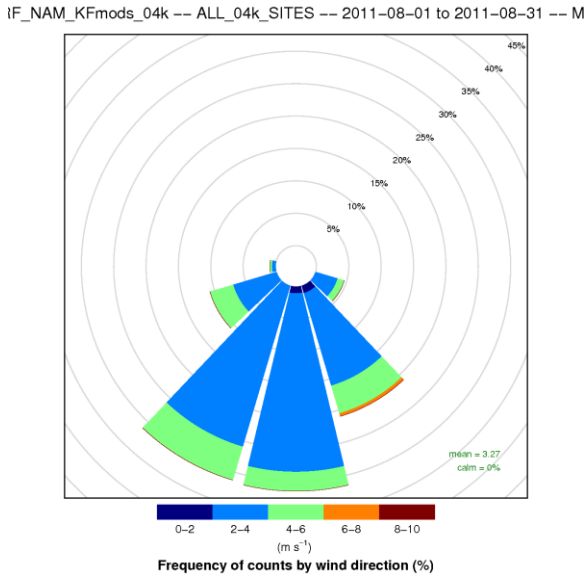

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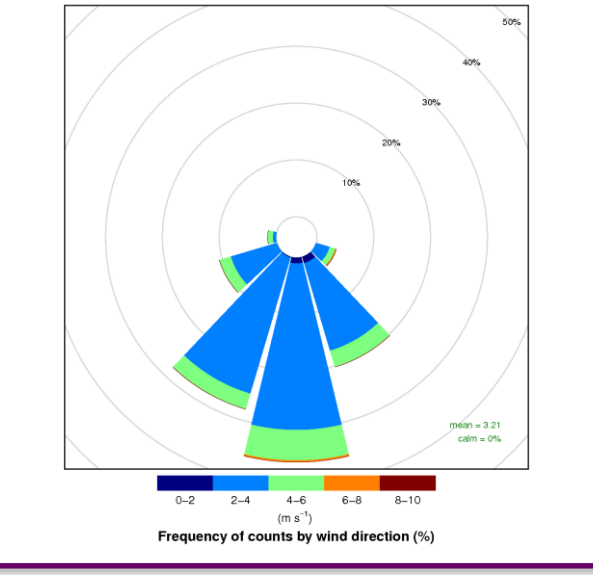

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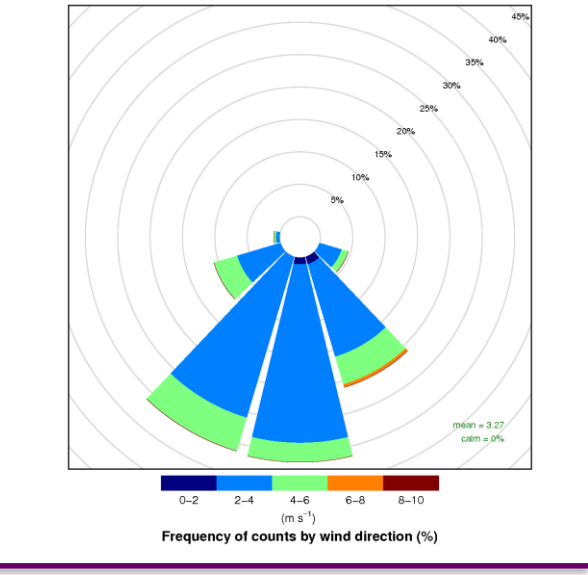
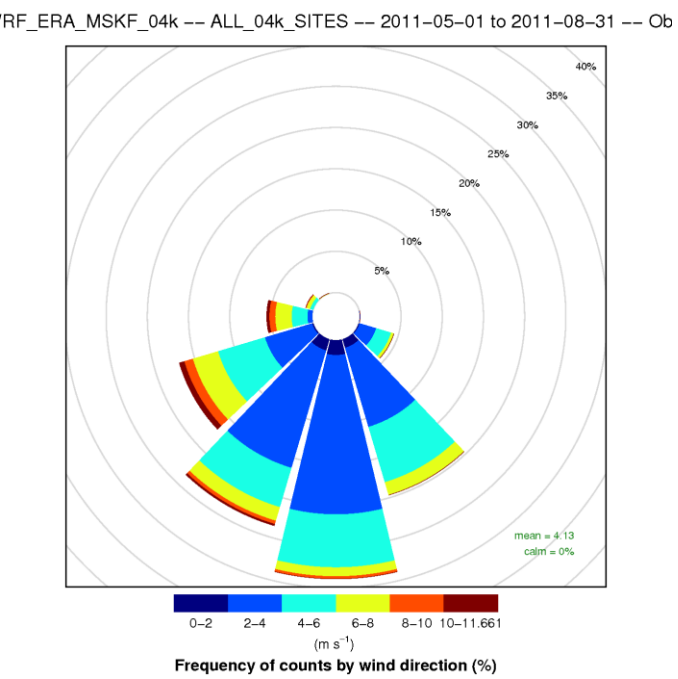


Winds

May - August 2011
All Sites within 4-km

OBS



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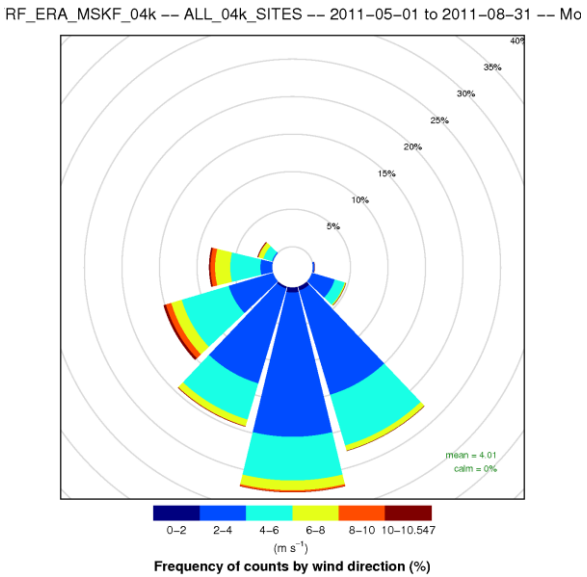

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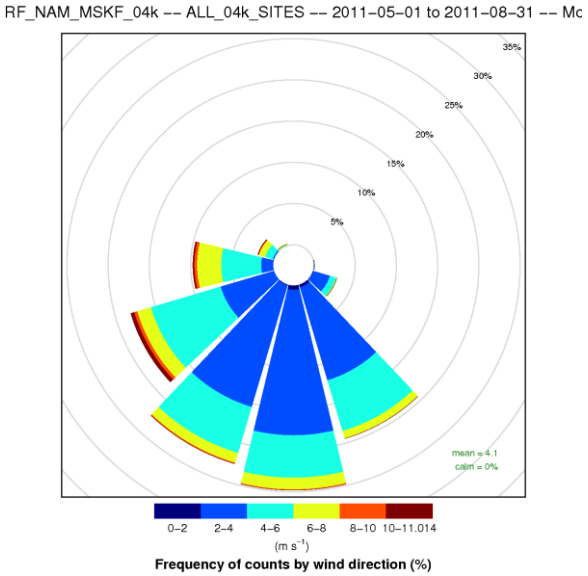

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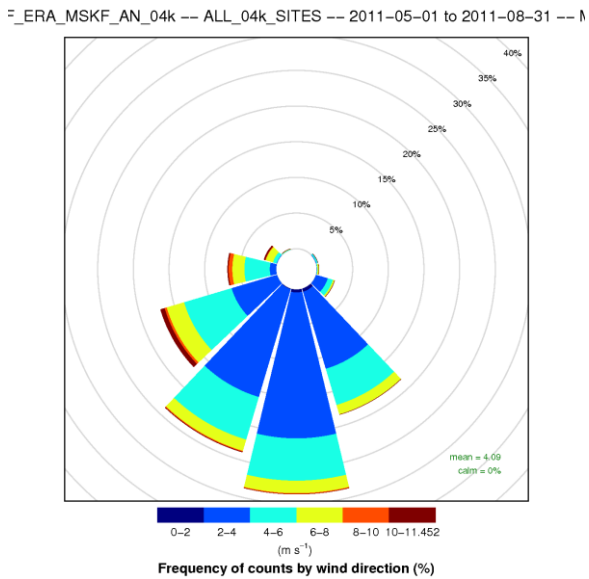

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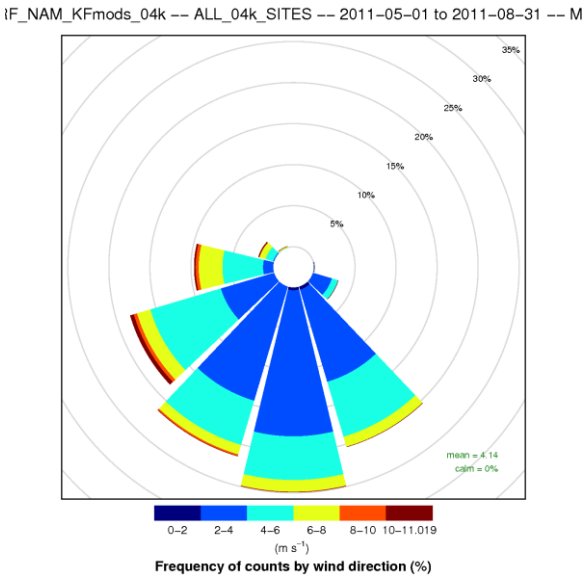


Las Cruces, NM (KLRU) 4-km Statistics

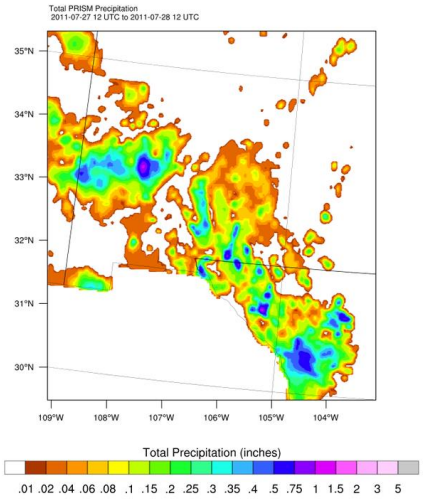
07/25/2011 thru 07/29/2011

	Temperature (deg K)		Mixing Ratio (g/kg)		Wind Speed (m/s)		Wind Direction (degrees)	
	Bias	Error	Bias	Error	Bias	Error	Bias	Error
Benchmark: Simple	≤ ±0.5	≤ 2.0	≤ ±0.5	≤ 1.0	≤ ±0.5	≤ 2.0	≤ ±5	≤ 40
Benchmark: Complex	≤ ±1.0	≤ 3.0	≤ ±1.0	≤ 2.0	≤ ±1.0	≤ 3.0	≤ ±10	≤ 80
NAM KFmods	**1.50**	**1.96**	-0.53	1.36	0.41	1.52	-3.40	15.6
NAM MSKF	1.80	2.03	-0.53	1.40	0.59	1.58	-1.80	15.6
ERA MSKF	2.30	2.51	**-0.47**	**1.23**	**0.13**	1.56	**-1.10**	15.6
ERA MSKF no AN	3.30	3.37	-1.30	1.63	0.30	**1.47**	-1.30	18.1

Precipitation

July 28th Ozone Episode

PRISM - OBS



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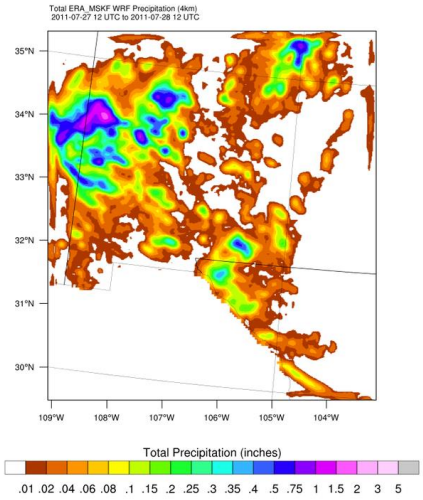

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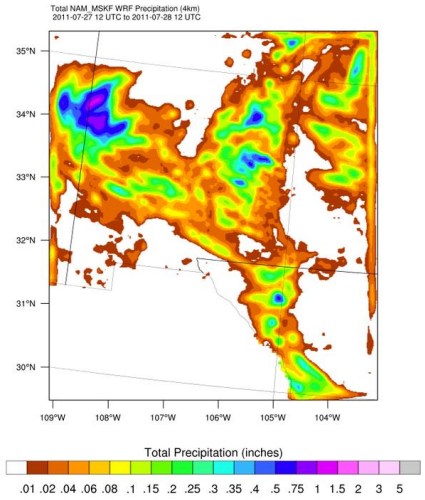

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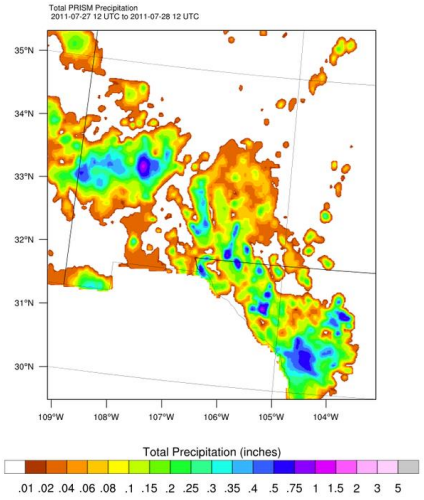

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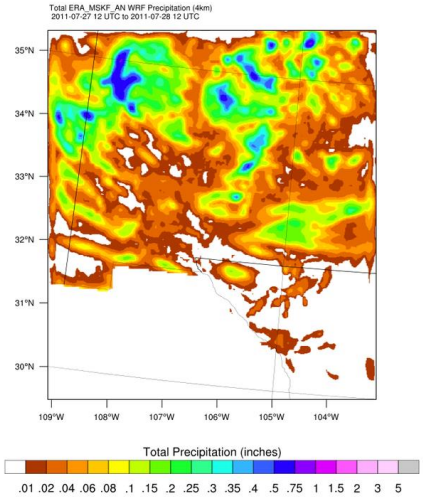

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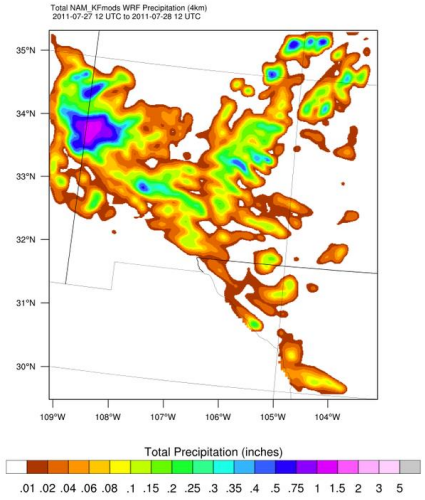
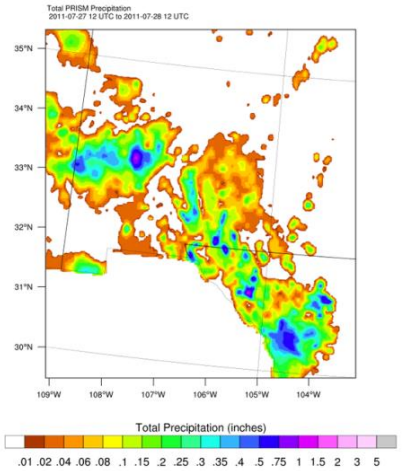


Precipitation

July 28th – No WRF Mask

PRISM - OBS



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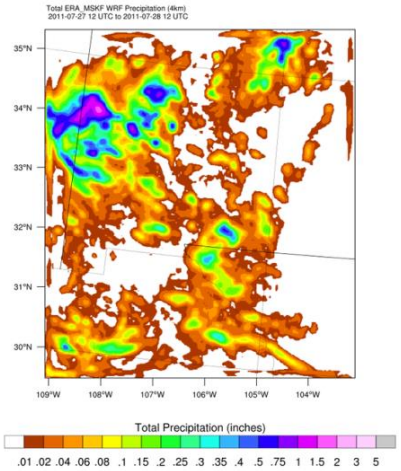

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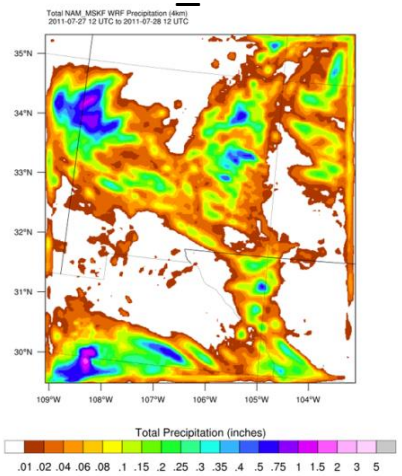

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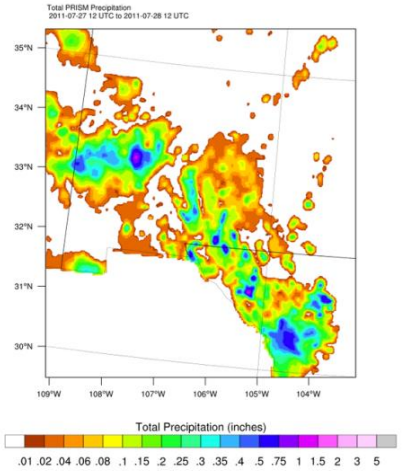

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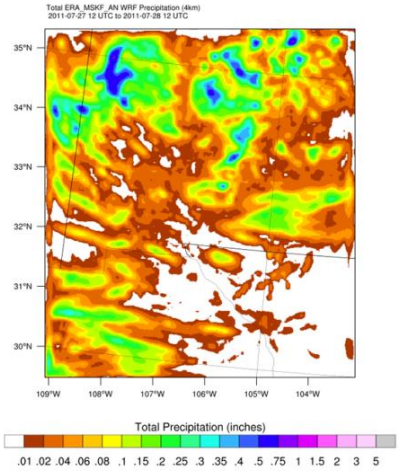
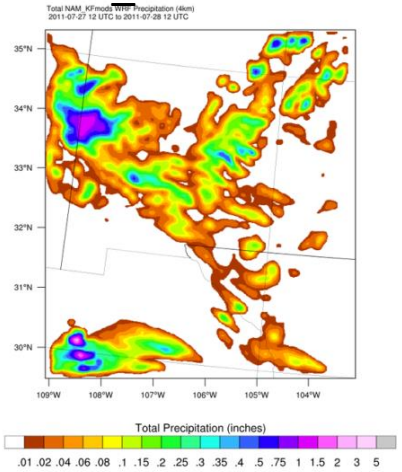


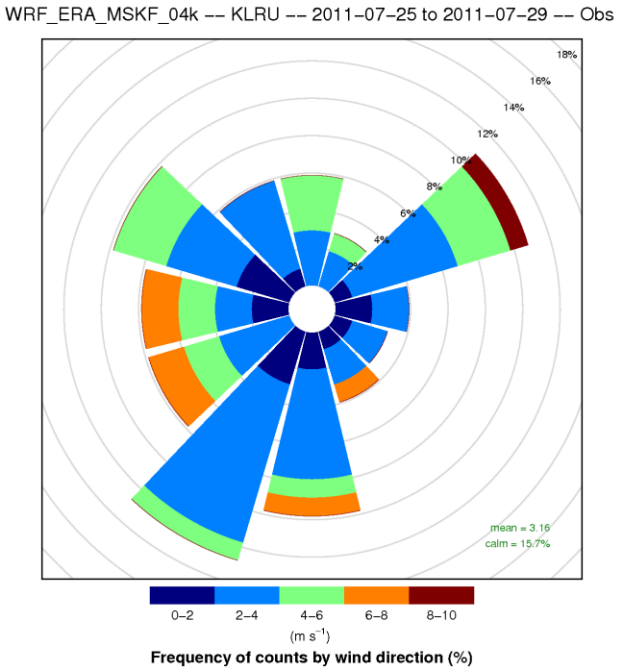
NAM_KFmods



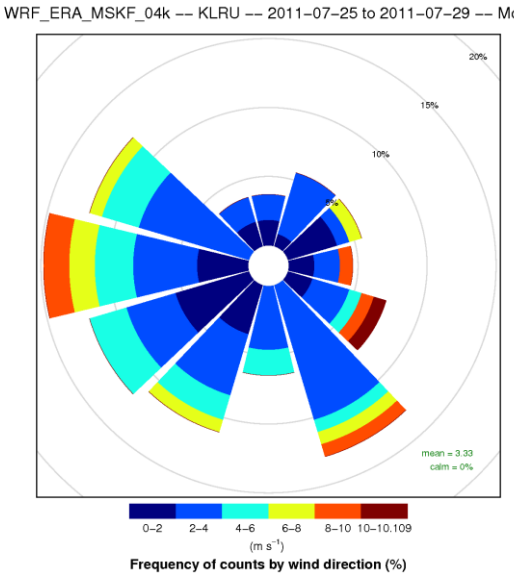
Winds

07/25/2011-07/29/2011
KLRU 4-km

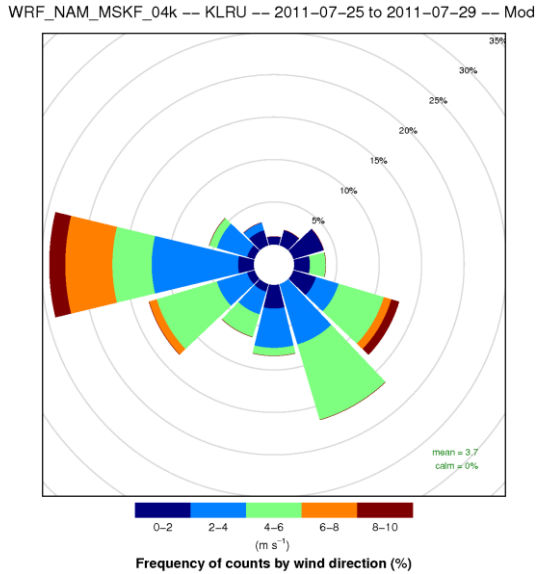
OBS



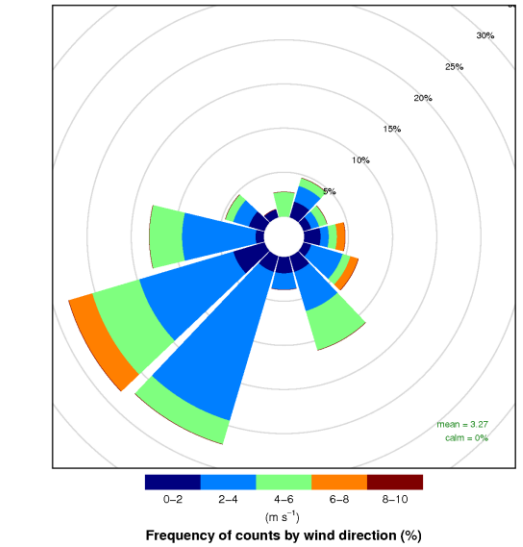
ERA-MSKF



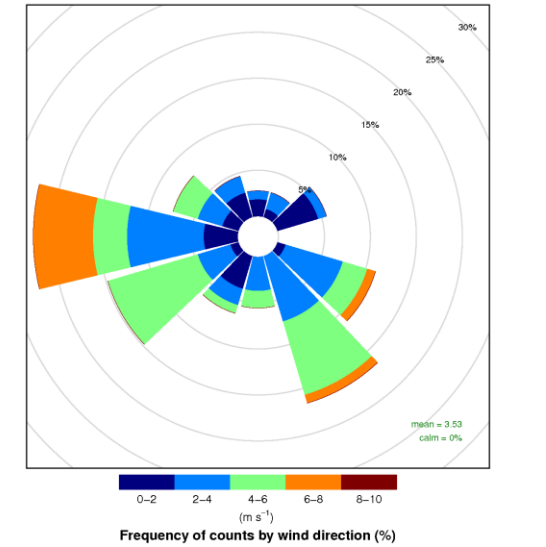
NAM-MSKF



ERA-MSKF – NO AN



NAM-KFmods



Las Cruces, NM (KLRU) 4-km Statistics

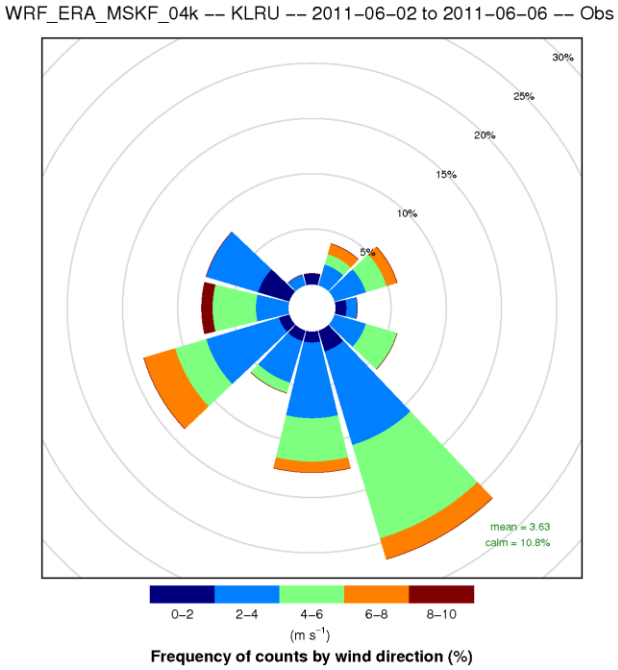
06/02/2011 thru 06/06/2011

	Temperature (deg K)		Mixing Ratio (g/kg)		Wind Speed (m/s)		Wind Direction (degrees)	
	Bias	Error	Bias	Error	Bias	Error	Bias	Error
Benchmark: Simple	≤ ±0.5	≤ 2.0	≤ ±0.5	≤ 1.0	≤ ±0.5	≤ 2.0	≤ ±5	≤ 40
Benchmark: Complex	≤ ±1.0	≤ 3.0	≤ ±1.0	≤ 2.0	≤ ±1.0	≤ 3.0	≤ ±10	≤ 80
NAM KFmods	0.59	**1.40**	-1.60	1.77	0.86	1.55	6.00	**16.5**
NAM MSKF	0.59	1.42	-1.60	1.78	0.60	1.67	7.40	17.4
ERA MSKF	1.30	1.96	**-0.16**	**1.06**	**0.55**	**1.52**	4.20	17.4
ERA MSKF no AN	**0.23**	1.80	-0.93	1.32	1.40	2.12	**-0.79**	18.0

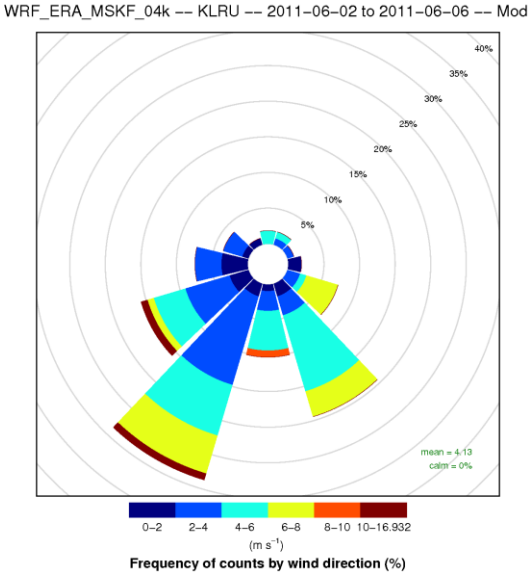
Winds

06/02/2011-06/06/2011
KLRU 4-km

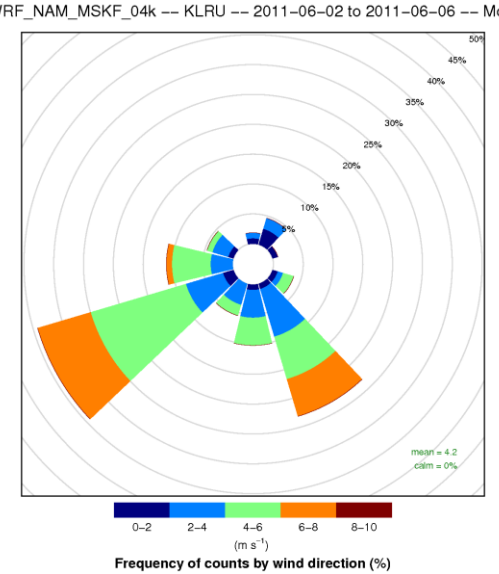
OBS



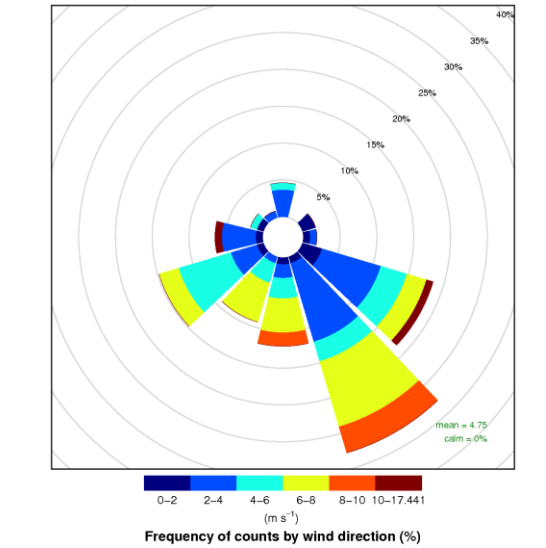
ERA-MSKF



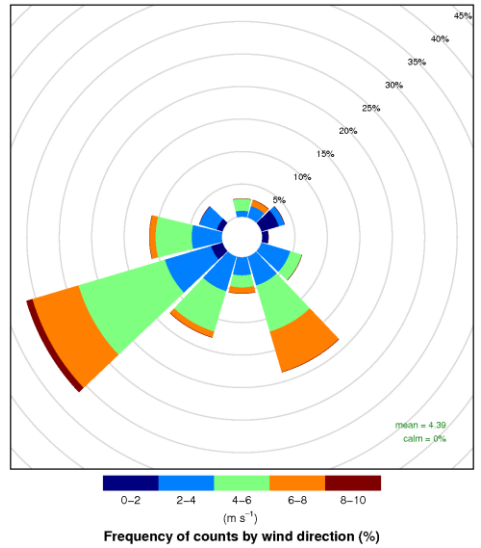
NAM-MSKF



ERA-MSKF – NO AN



NAM-KFmods



Las Cruces, NM (KLRU) 4-km Statistics

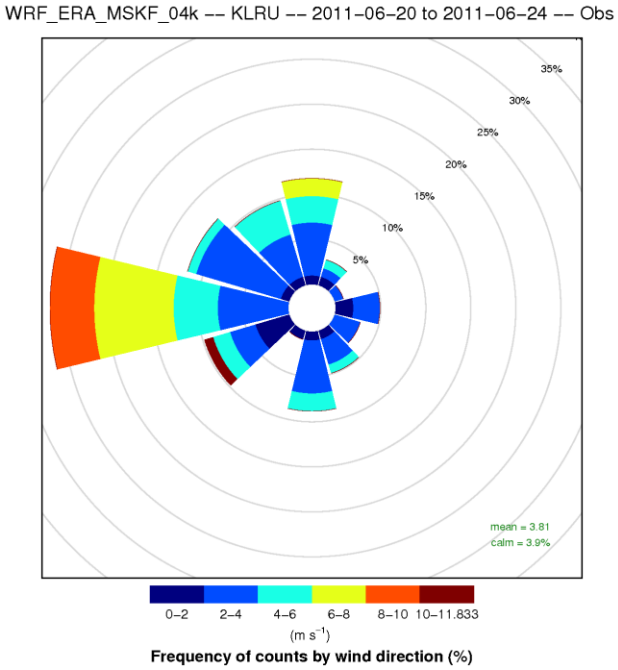
06/20/2011 thru 06/24/2011

	Temperature (deg K)		Mixing Ratio (g/kg)		Wind Speed (m/s)		Wind Direction (degrees)	
	Bias	Error	Bias	Error	Bias	Error	Bias	Error
Benchmark: Simple	≤ ±0.5	≤ 2.0	≤ ±0.5	≤ 1.0	≤ ±0.5	≤ 2.0	≤ ±5	≤ 40
Benchmark: Complex	≤ ±1.0	≤ 3.0	≤ ±1.0	≤ 2.0	≤ ±1.0	≤ 3.0	≤ ±10	≤ 80
NAM KFmods	-0.31	1.28	-0.41	0.52	0.55	1.50	3.40	11.6
NAM MSKF	-0.30	1.28	-0.39	**0.51**	0.56	1.50	3.30	**11.5**
ERA MSKF	**0.03**	1.37	0.38	0.52	0.27	**1.20**	**0.78**	12.4
ERA MSKF no AN	-0.33	**1.22**	**-0.01**	0.63	**-0.07**	1.28	-0.93	12.9

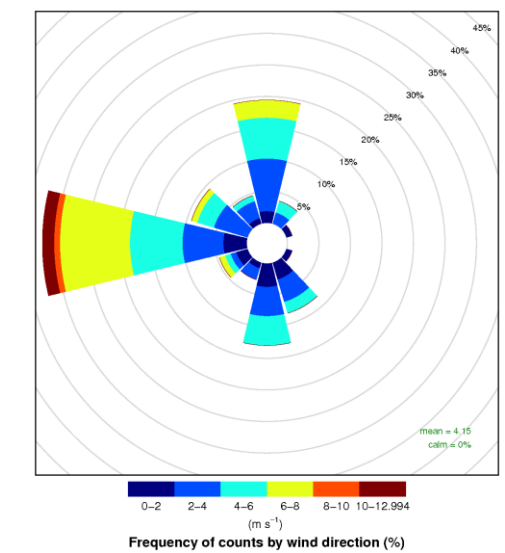
Winds

06/20/2011-06/24/2011
KLRU 4-km

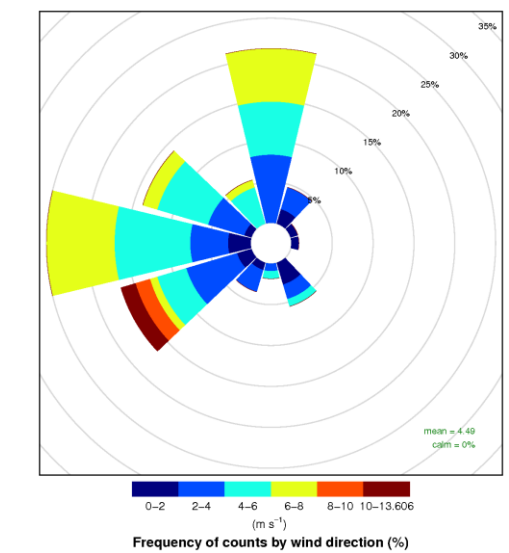
OBS



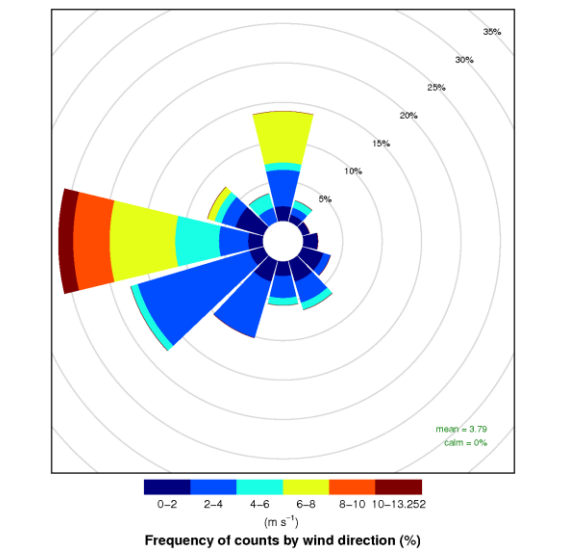
ERA-MSKF



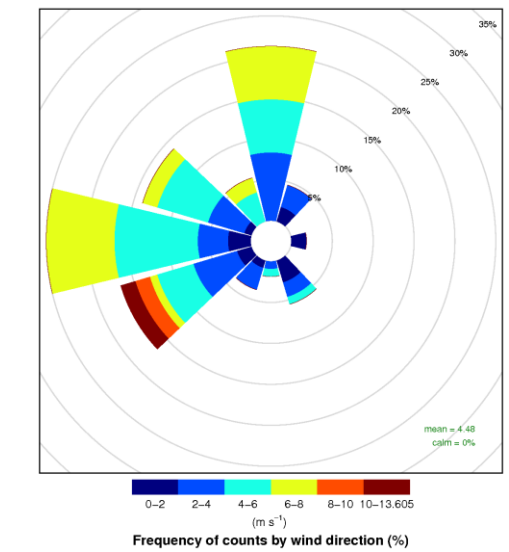
NAM-MSKF



ERA-MSKF – NO AN



NAM-KFmods



Las Cruces, NM (KLRU) 4-km Statistics

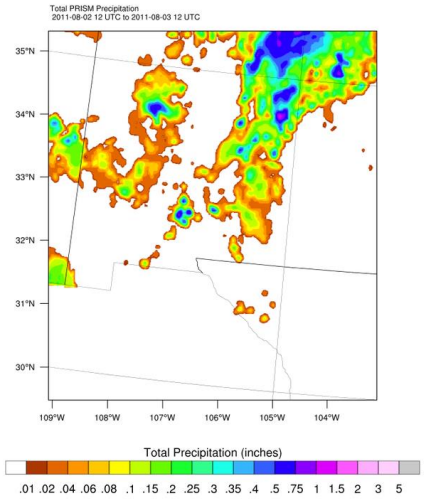
08/02/2011 thru 08/05/2011

	Temperature (deg K)		Mixing Ratio (g/kg)		Wind Speed (m/s)		Wind Direction (degrees)	
	Bias	Error	Bias	Error	Bias	Error	Bias	Error
Benchmark: Simple	≤ ±0.5	≤ 2.0	≤ ±0.5	≤ 1.0	≤ ±0.5	≤ 2.0	≤ ±5	≤ 40
Benchmark: Complex	≤ ±1.0	≤ 3.0	≤ ±1.0	≤ 2.0	≤ ±1.0	≤ 3.0	≤ ±10	≤ 80
NAM KFmods	1.80	1.92	-0.74	1.07	**0.00**	1.58	-2.90	19.8
NAM MSKF	**1.60**	**1.79**	**-0.70**	**0.99**	-0.39	1.63	-5.60	19.6
ERA MSKF	1.80	1.94	-0.87	1.16	-0.18	1.36	**1.90**	**18.7**
ERA MSKF no AN	1.90	1.96	-1.00	1.21	-0.38	**1.27**	-6.20	23.0

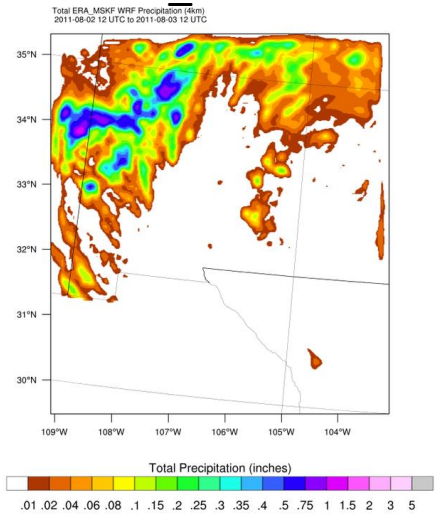
Precipitation

August 3rd Ozone Episode

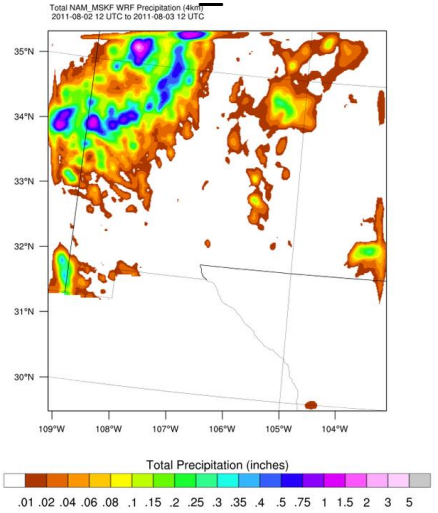
PRISM - OBS



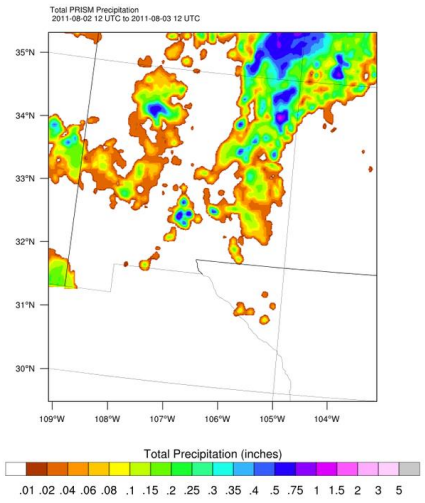
ERA_MSKF



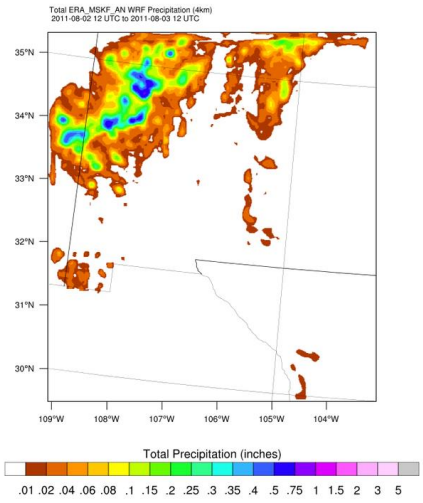
NAM_MSKF



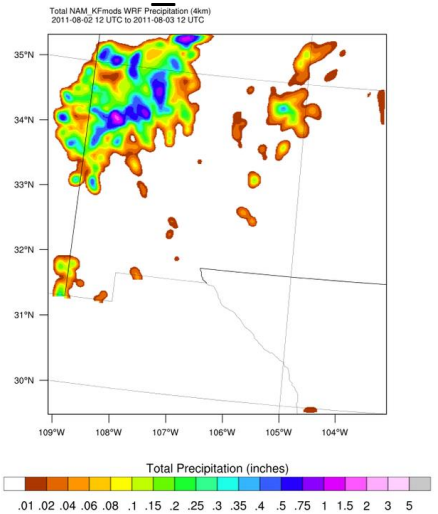
PRISM - OBS



ERA_MSKF – No AN



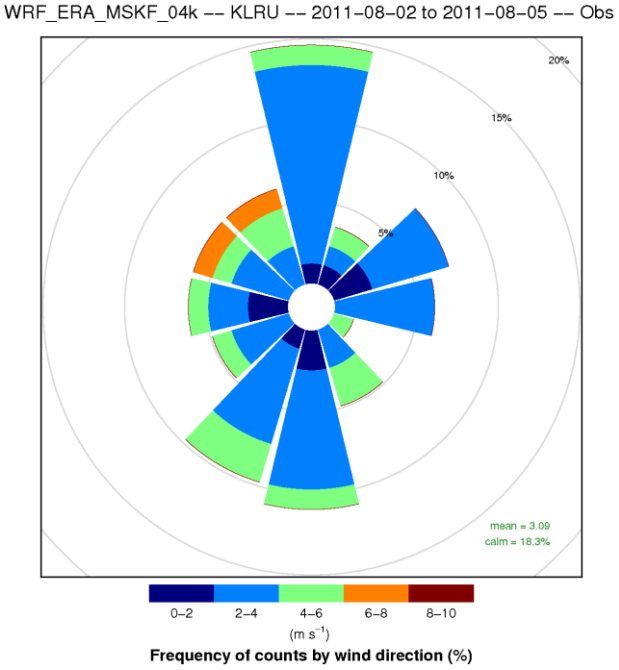
NAM_KFmods



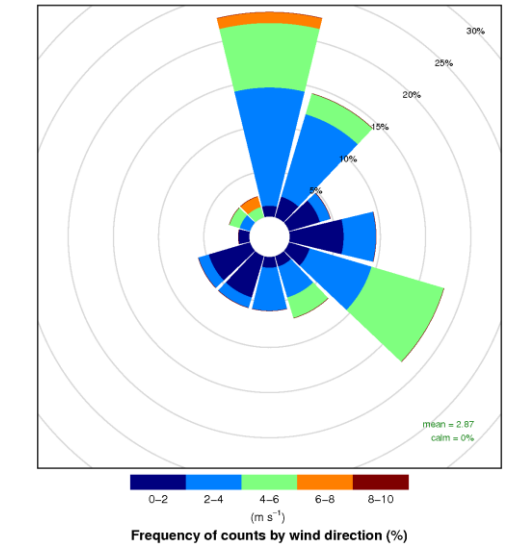
Winds

08/02/2011-08/05/2011
KLRU 4-km

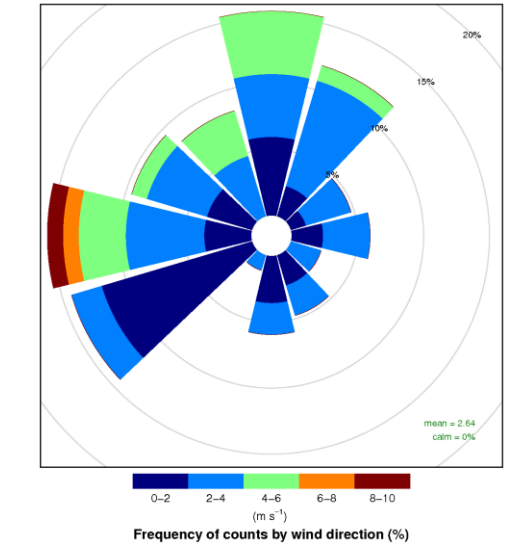
OBS



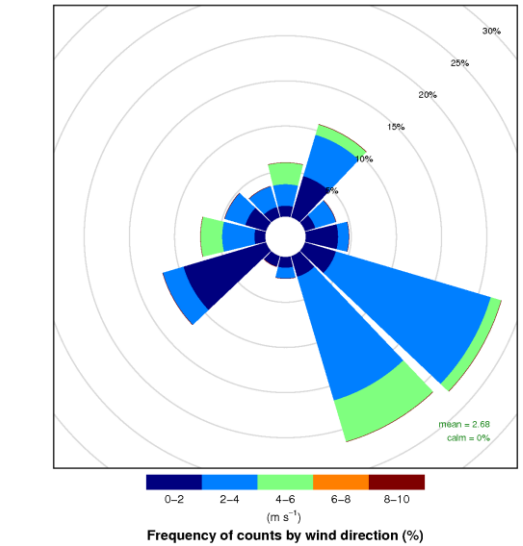
ERA-MSKF



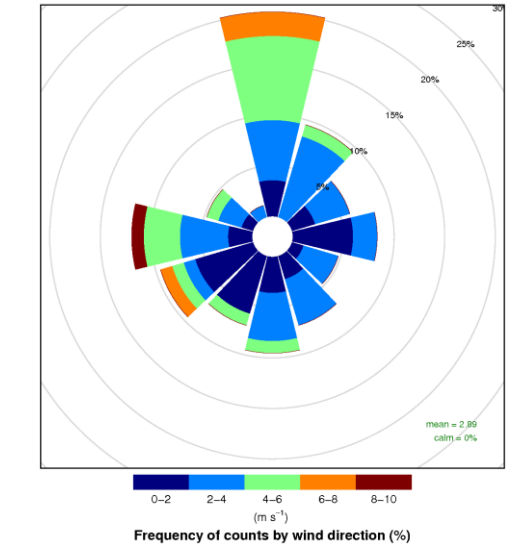
NAM-MSKF



ERA-MSKF – NO AN



NAM-KFmods



Las Cruces, NM (KLRU) 4-km Statistics

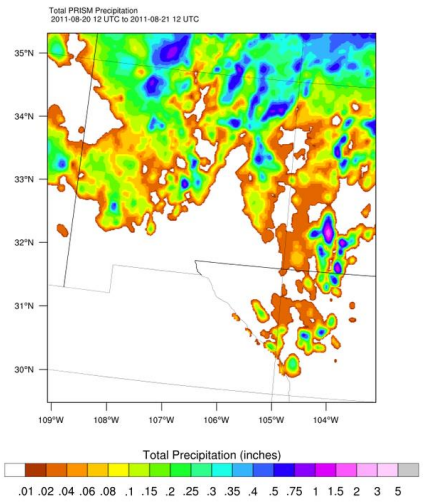
08/19/2011 thru 08/22/2011

	Temperature (deg K)		Mixing Ratio (g/kg)		Wind Speed (m/s)		Wind Direction (degrees)	
	Bias	Error	Bias	Error	Bias	Error	Bias	Error
Benchmark: Simple	≤ ±0.5	≤ 2.0	≤ ±0.5	≤ 1.0	≤ ±0.5	≤ 2.0	≤ ±5	≤ 40
Benchmark: Complex	≤ ±1.0	≤ 3.0	≤ ±1.0	≤ 2.0	≤ ±1.0	≤ 3.0	≤ ±10	≤ 80
NAM KFmods	1.20	**1.88**	-0.19	**1.02**	1.10	1.90	-3.10	9.15
NAM MSKF	**1.10**	1.99	**-0.10**	1.11	1.30	1.85	-1.10	**8.37**
ERA MSKF	2.20	2.38	-0.72	1.35	0.54	1.21	1.30	10.7
ERA MSKF no AN	3.60	4.04	-1.70	1.94	**-0.03**	**1.14**	**0.79**	13.8

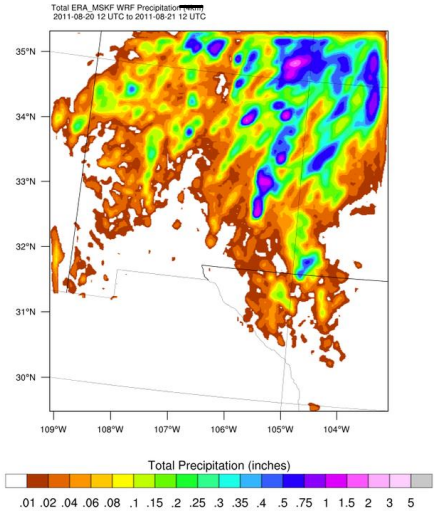
Precipitation

August 21st Ozone Episode

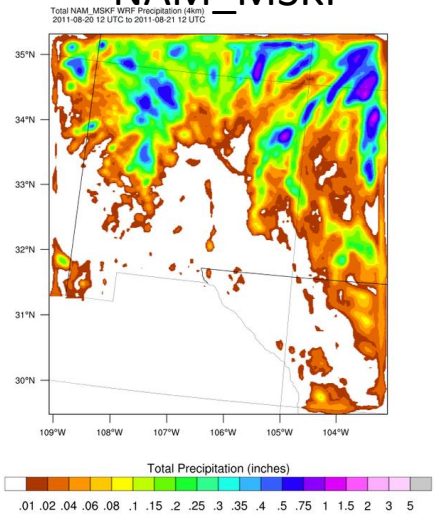
PRISM - OBS



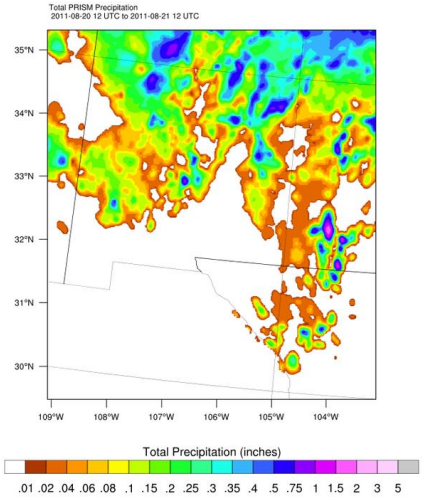
ERA_MSKF



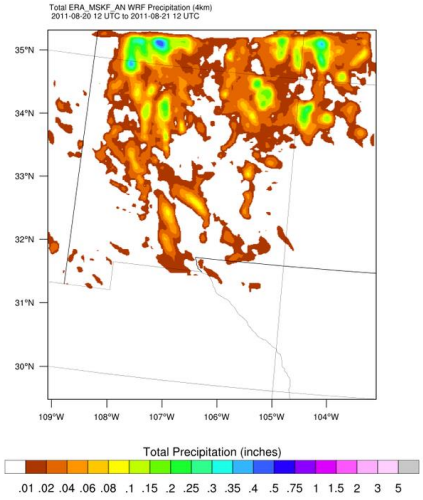
NAM_MSKF



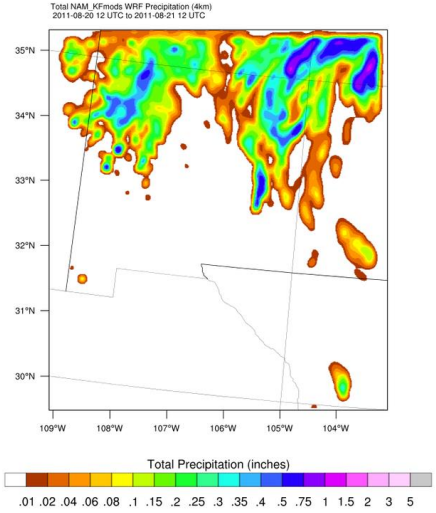
PRISM - OBS



ERA_MSKF – No AN



NAM_KFmods

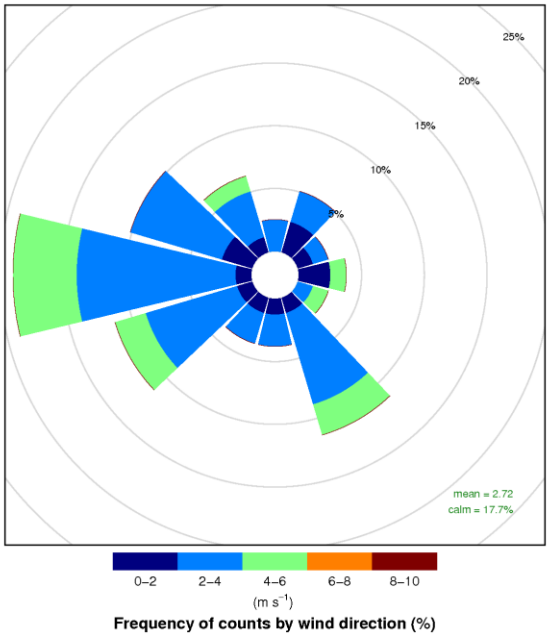


Winds

08/19/2011-08/22/2011
KLRU 4-km

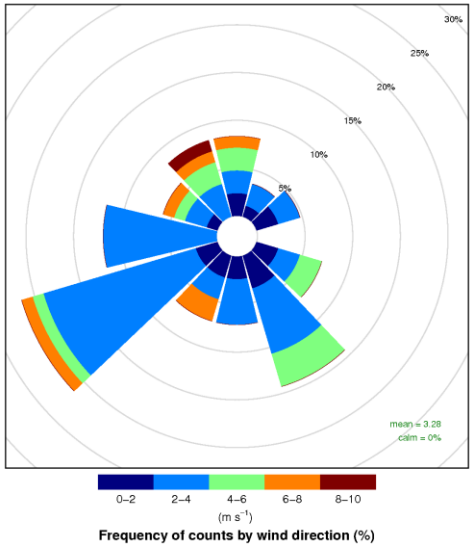
OBS

WRF_ERA_MSKF_04k -- KLRU -- 2011-08-19 to 2011-08-22 -- Obs



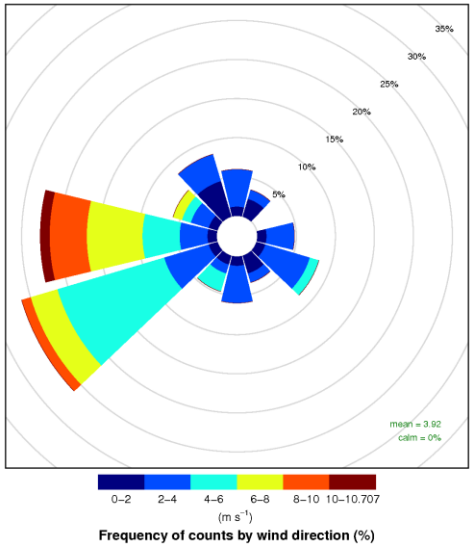
ERA-MSKF

WRF_ERA_MSKF_04k -- KLRU -- 2011-08-19 to 2011-08-22 -- Mod



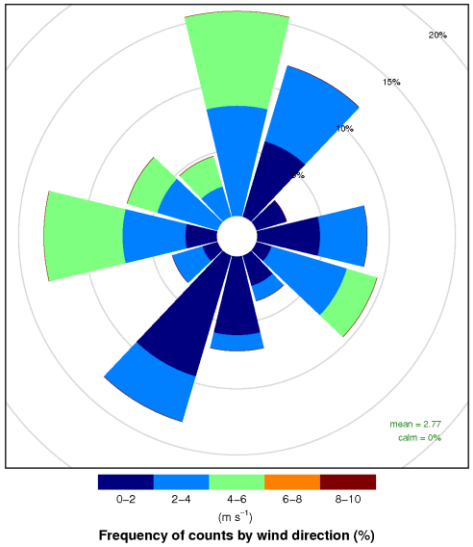
NAM-MSKF

WRF_NAM_MSKF_04k -- KLRU -- 2011-08-19 to 2011-08-22 -- Mod



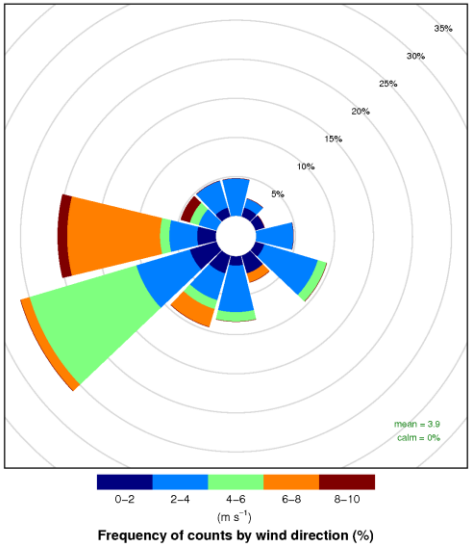
ERA-MSKF – NO AN

WRF_ERA_MSKF_AN_04k -- KLRU -- 2011-08-19 to 2011-08-22 -- Mod



NAM-KFmods

WRF_NAM_KFmods_04k -- KLRU -- 2011-08-19 to 2011-08-22 -- Mod



Task 1: WRF MPE Summary

- Analysis nudging is needed in the 12km domain
- ERA vs NAM
  - ERA is generally wetter than NAM, better mixing ratio performance but positively biased overall
  - NAM performs better with temperature
  - ERA performs better with winds
- MSKF vs KF-mods
  - KF-mods is drier overall
  - MSKF has lower bias and error in mixing ratio

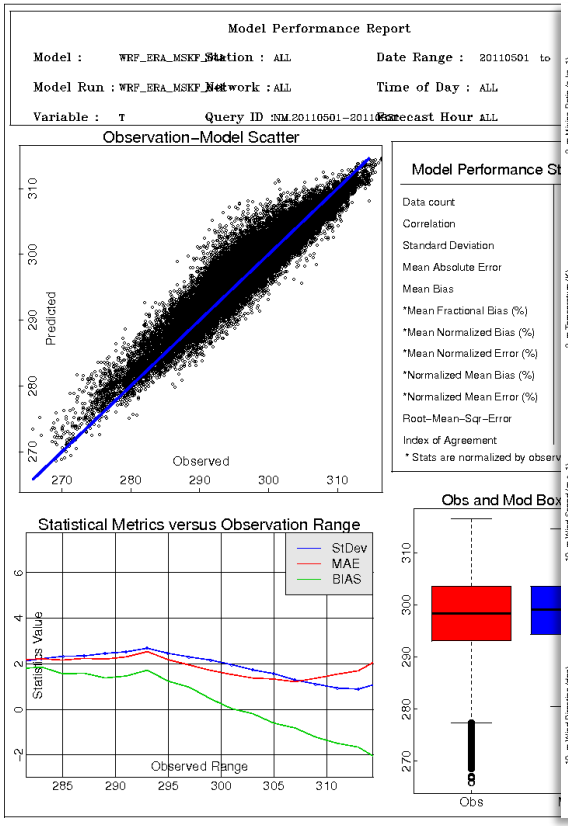
Task 1: SNMOS WRF Recommendations

- All WRF simulations able to simulate the predominant wind direction
- NAM-KFmods is too dry
  - select MSKF to improve dry bias
- ERA is wetter than NAM
- Recommend **NAM MSKF** because better to have a dry bias and improve temperature
  - Better to have a dry bias to allow more solar insolation for ozone production

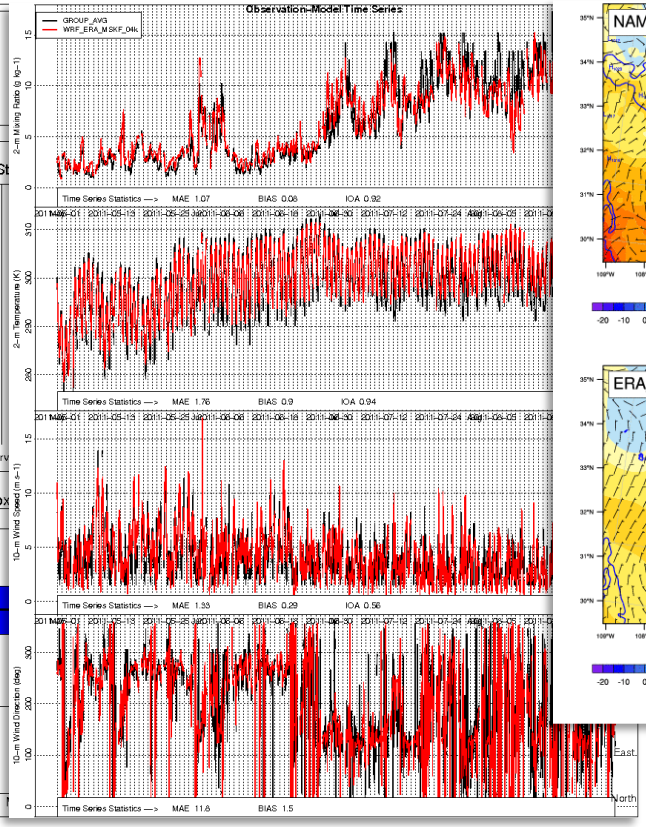
Additional SNMOS WRF MPE Plots

- http://ie.unc.edu/cempd/projects/data_viewer?project=SNMOS
- Results > View the results from a single simulation
- MET > WRF
- Plot Types
  - AMET: Soccer, Spatial Surface, Summary, Timeseries, Windrose
  - NCL: Temperature-Pressure-Winds 2-d Spatial
  - PRISM: Precipitation 2-d Spatial

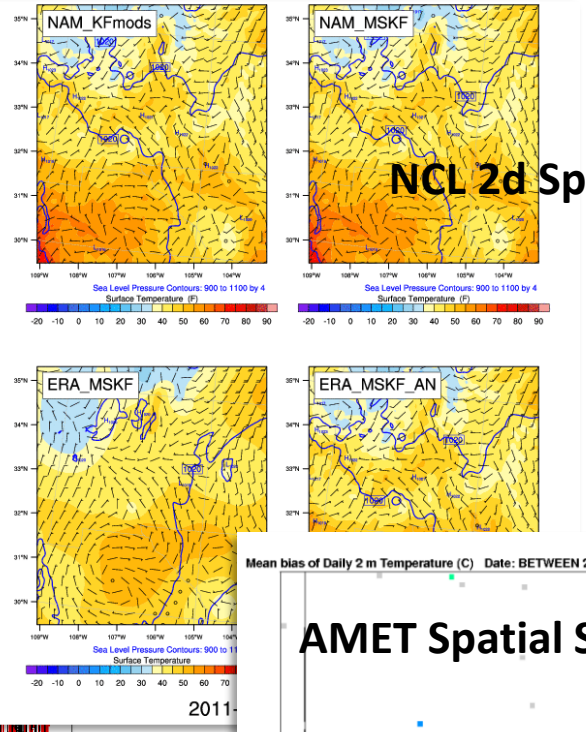
Additional SNMOS WRF MPE Plots



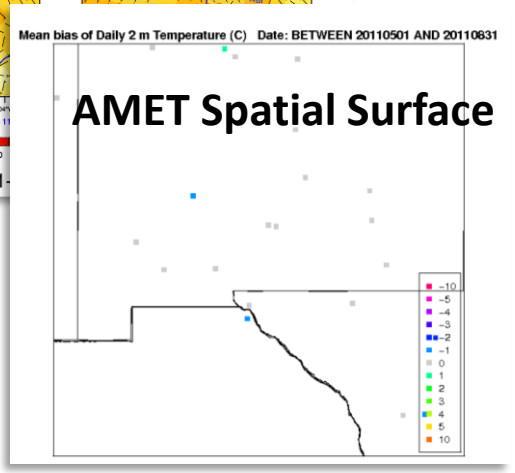
AMET Summary



AMET Timeseries



NCL 2d Spatial



AMET Spatial Surface

Task 2: Permian Basin Oil & Gas Inventory

Lead: Ramboll Environ

WESTAR

WESTERN REGIONAL AIR PARTNERSHIP

RAMBOLL ENVIRON

UNC INSTITUTE FOR THE ENVIRONMENT

Task 2 Objectives and Deliverables

- Objective
  - Review available Permian Basin oil and gas inventories and recommend 2011 and future year inventories for the SNMOS
- Deliverables
  - Power Point Presentation on Permian Basin oil and gas 2011 and future year emission update (**Completed 11/30/2015**)
  - Memo on available Permian Basin oil and gas 2011 and future year emissions data (**Completed 11/10/2015**)

Outline

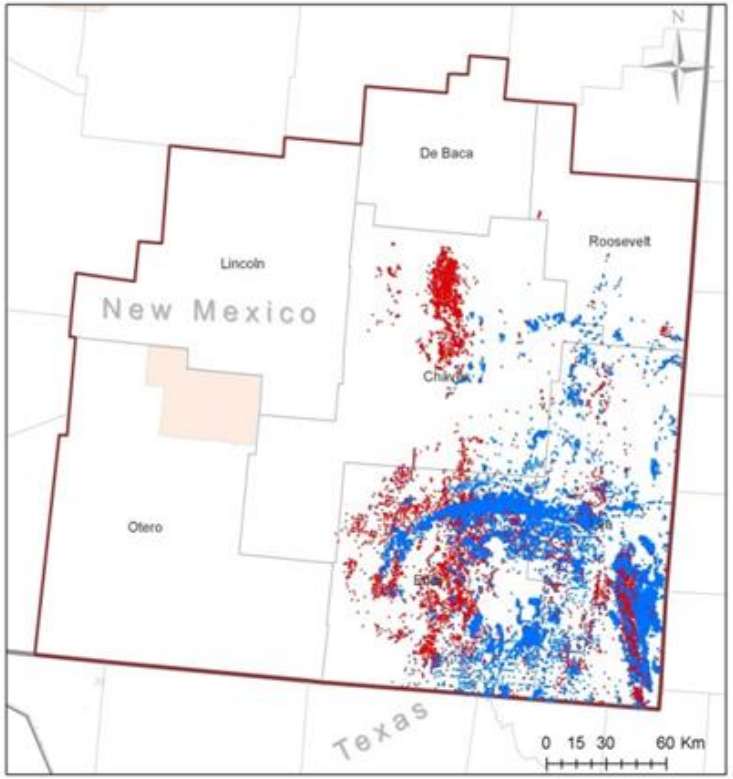
- Permian Basin emission inventory basis/ background
- 2011 emission inventory summary
- Permian Basin forecast emission inventory basis/background

Inventory Basis/Methods

- Basis: 2011NEIv2-based Platform (2011v6.2)
- 2011 base year emissions from 2011 NEI
  - Midstream (Point) sources: provided by state agencies
  - Well Site (Area) Sources:
    - New Mexico: estimated using EPA Oil and Gas Tool
    - Texas: provided by state agency
- 2017 and 2025 future year emissions forecasts
  - O&G Activity Growth: AEO 2014
  - Control: Pertinent rulemakings
- EPA O&G sector emissions only
  - Confirmed O&G point source emissions include all O&G NAICS codes

Permian Basin Well Locations (circa 2014)

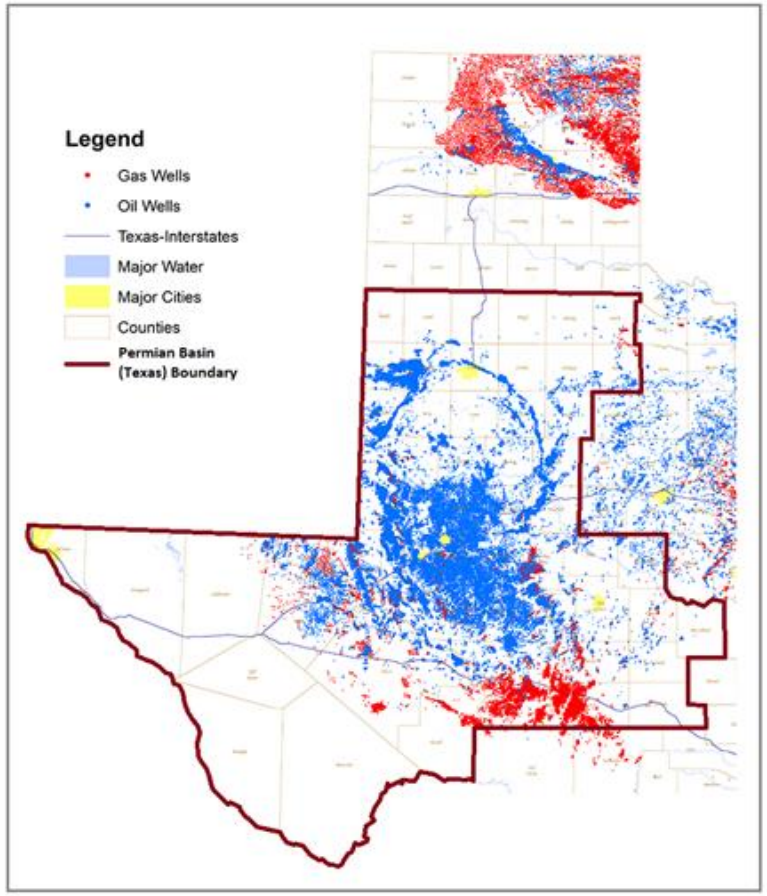
Permian Basin (New Mexico)



Legend

- Permian Basin (New Mexico) Boundary
- Tribal Lands
- Oil Wells
- Gas Wells

Permian Basin (Texas)



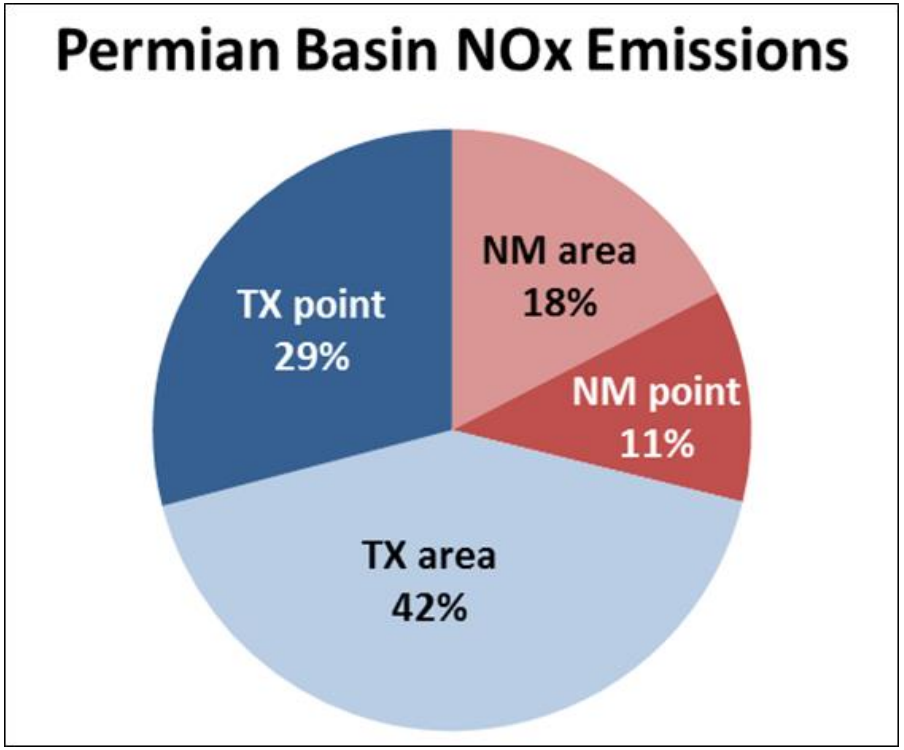
Source: Adapted from TCEQ Texas Oil and Gas Wells Map http://www.tceq.state.tx.us/assets/public/implementation/barnett_shale/bs_images/txOilGasWells.png

Source: IHS Enerdeq Production Data

Permian Basin 2011 NOx Emissions

2011 NOx Emissions

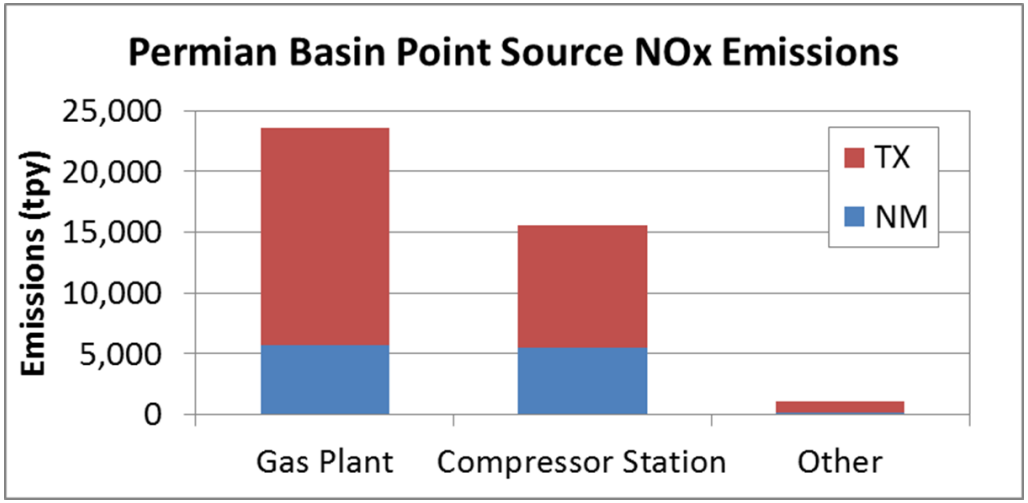
- Totals (99,577 tpy)
  - 60% area sources (40% point sources)
  - 71% Texas (29% New Mexico)



Permian Basin 2011 NOx Emissions

2011 NOx Emissions

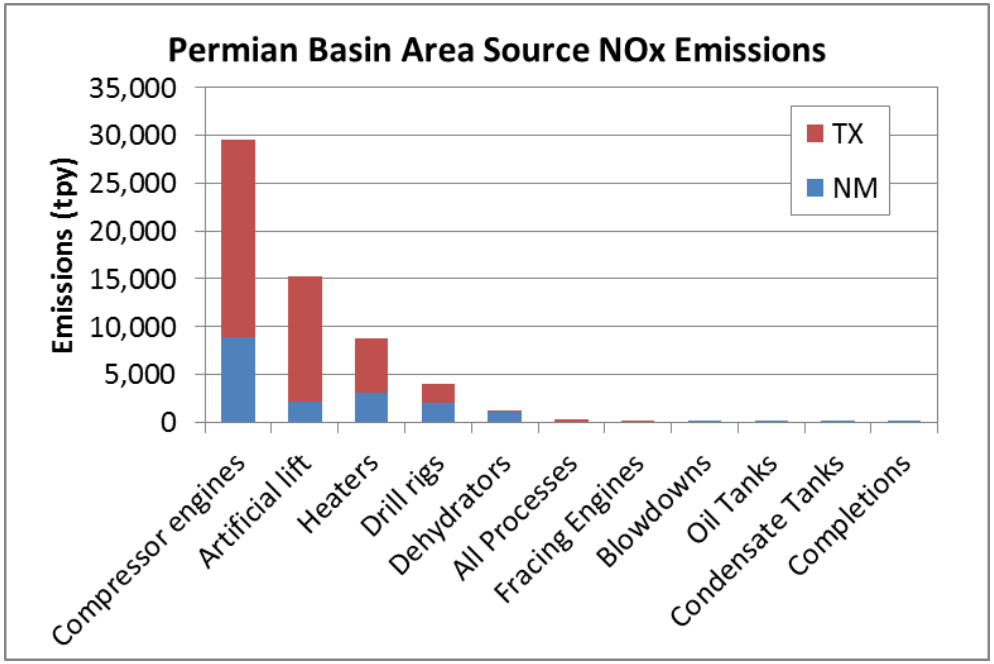
- Point Sources (40,302 tpy)
  - 59% Gas Plants
  - 39% Compressor Stations
  - 3% Other (tank batteries, etc.)



Permian Basin 2011 NOx Emissions

2011 NOx Emissions

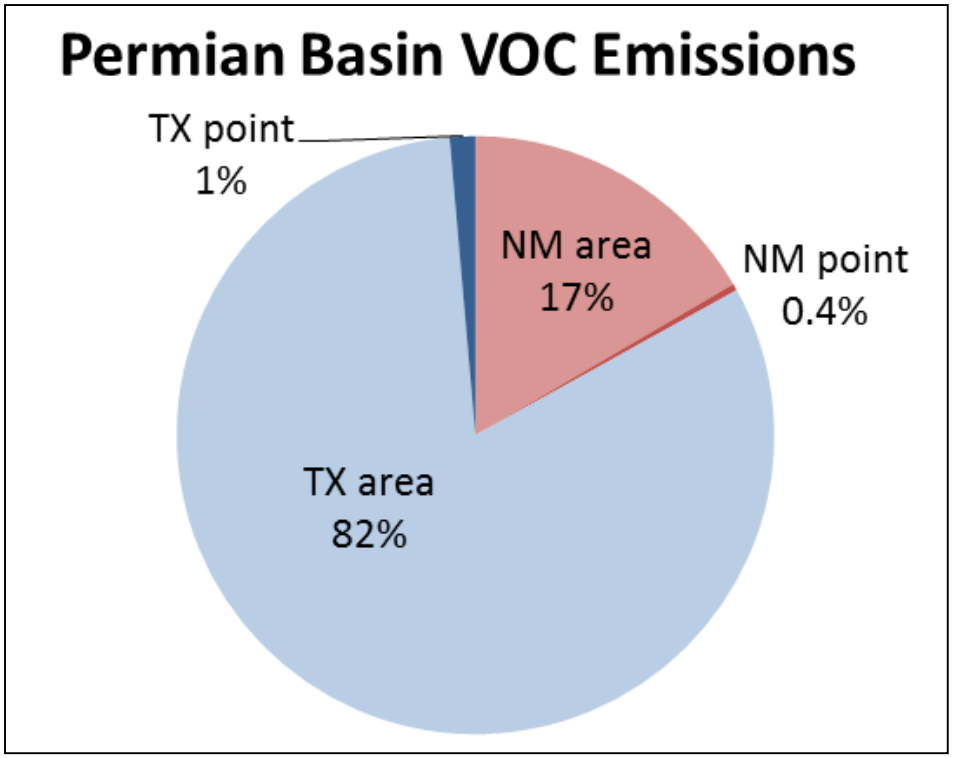
- Area Sources (59,275 tpy)
  - 50% Compressor Engines
  - 26% Artificial Lift
  - 15% Heaters
  - 7% Drill Rigs
  - <3% All other categories combined



Permian Basin 2011 VOC Emissions

2011 VOC Emissions

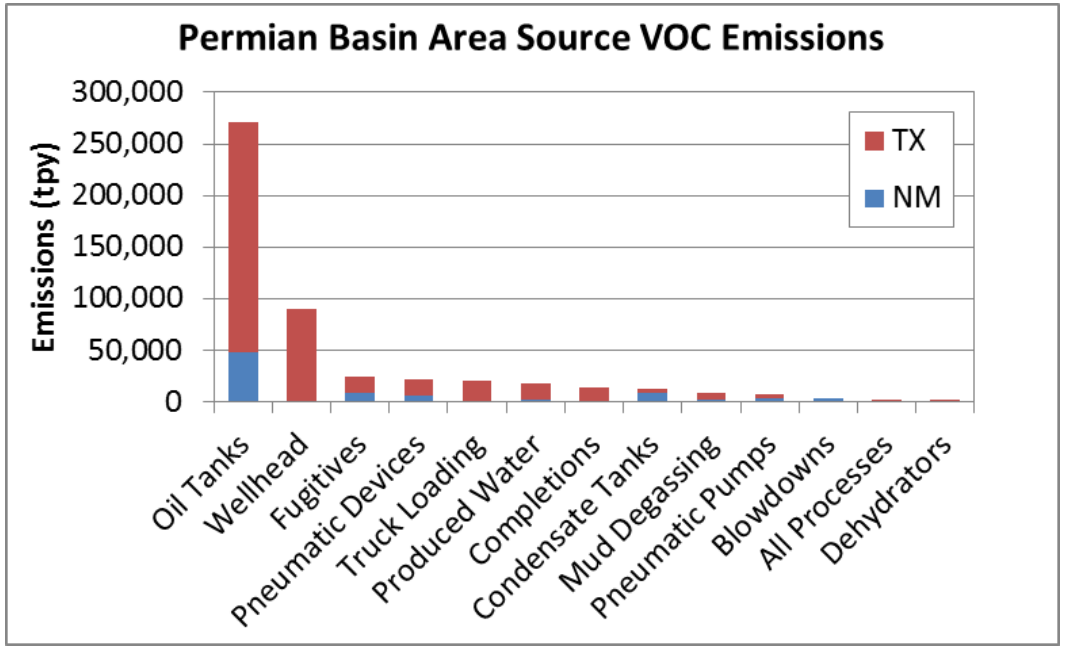
- Totals (507,813 tpy)
  - 99% area sources (1% point sources)
  - 83% Texas (17% New Mexico)
  - combined



Permian Basin 2011 VOC Emissions

2011 VOC Emissions

- Area Sources (498,889 tpy)
  - 55% Oil Tanks
  - 18% Wellhead Venting
  - 5% Fugitives
  - 4% Pneumatic Devices
  - 4% Truck Loading
  - 4% Produced Water
  - <11% All other categories combined



Permian Basin 2011 Inventory

Criteria Pollutant Emissions Summary

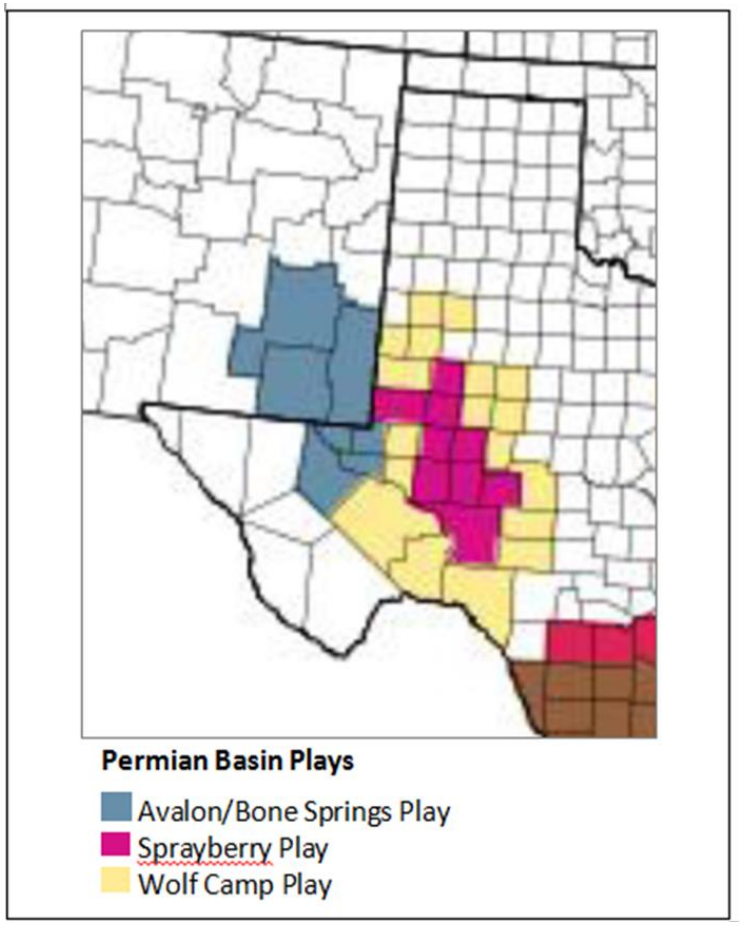
State	Type	2011 Permian Basin O&G Emissions (tpy)					
		NOX	VOC	CO	SO2	PM10	PM25
NM	area	17,354	84,140	20,694	190	518	516
	point	11,367	1,887	5,428	12,340	171	170
NM Total		***28,721***	***86,027***	***26,123***	***12,530***	***689***	***686***
TX	area	41,921	414,749	36,820	2,728	707	705
	point	28,935	7,036	16,699	5,136	935	920
TX Total		***70,856***	***421,786***	***53,519***	***7,864***	***1,642***	***1,626***
Grand Total		**99,577**	**507,813**	**79,642**	**20,395**	**2,331**	**2,312**

Permian Basin Forecast

Activity Growth

- O&G activity growth factors based on AEO 2014
- By O&G play growth factors (see figure)
- Southwest region growth factors outside of specified plays

Play / US Region	Oil Well Sources	Gas Well Sources	Oil and Gas Well Sources
Ratio 2017:2011			
Sprayberry Play	2.500	2.500	2.464
Wolfcamp Play	2.500	2.500	2.500
Avalon/Bone Springs Play	1.886	1.908	1.525
Southwest Region	1.004	1.350	0.972



Source: 2011v6.2 Modeling Platform TSD, excerpt from Figure 4-1

Permian Basin Forecast

Controls

- 2011NEIv2-based Platform O&G emission forecasts account for controls per the following regulations
  - New Source Performance Standards (NSPS) Subpart OOOO (area and point sources)
  - Reciprocating internal combustion engine (RICE) NSPS Subparts JJJJ and IIII and NESHAP Subpart ZZZZ (area and point sources)
  - Industrial/Commercial/Institutional Boilers and Process Heaters Maximum Achievable Control Technology (MACT) Rule (point sources)
  - Standards of Performance for Turbines 40 CFR Part 60 - Subpart KKKK (point sources)
  - Process Heaters NSPS (point sources)

Permian Basin Forecast Emissions

- Future year emissions will be summarized after the future year is determined

Task 3: Juarez and Mexico Border Inventory

Current and Future Years

Lead: University of North Carolina

WESTAR

Western Regional Air Partnership

RAMBOLL ENVIRON

UNC INSTITUTE FOR THE ENVIRONMENT

Task 3 Objectives and Deliverables

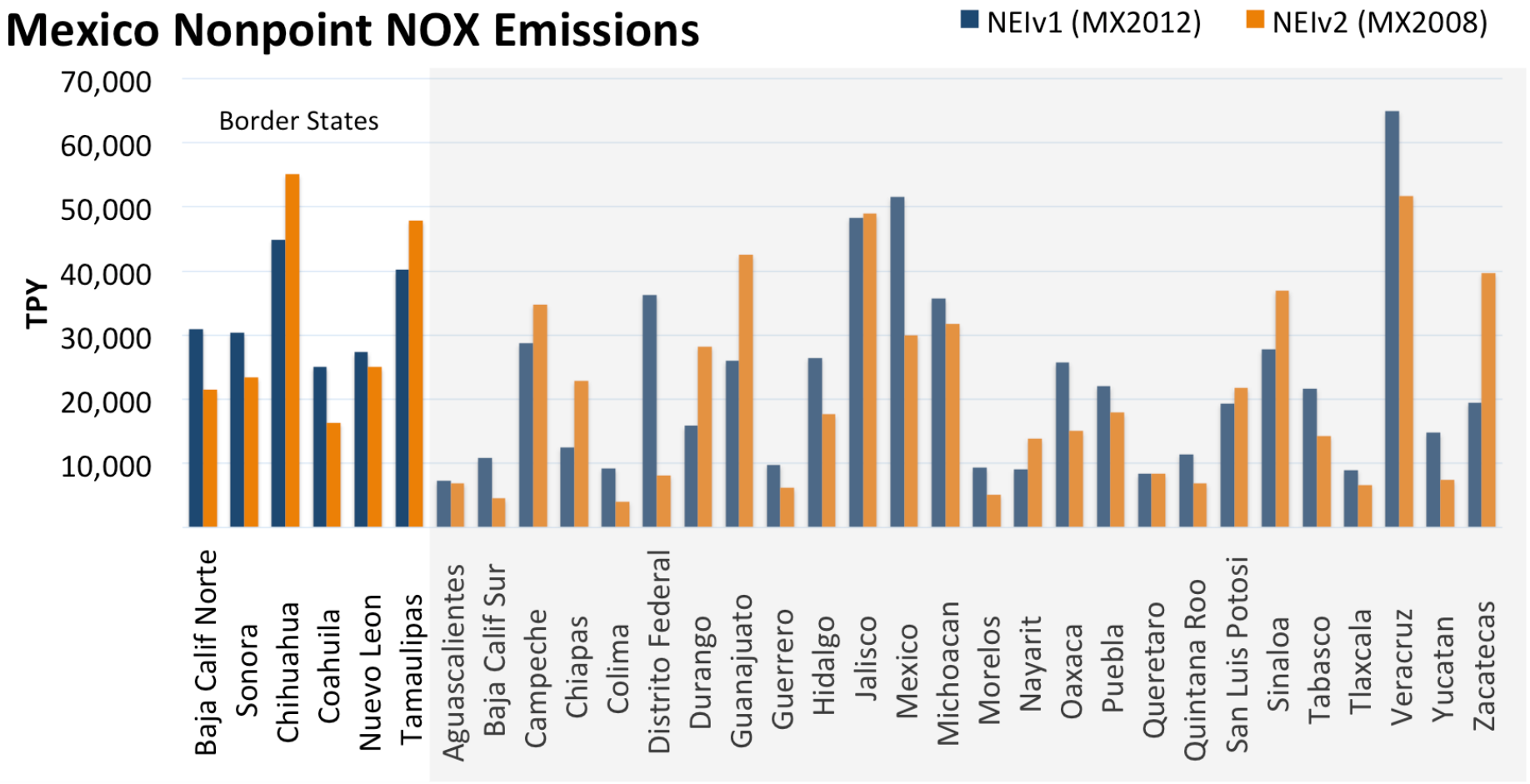
- Objectives
  - Review available inventories and emissions input data for Juarez and Mexico border states
  - Recommend 2011 and future year inventories for the SNMOS
- Deliverables
  - Power Point Presentation on Mexico emissions to be used in 2011 base and future year modeling (**Completed 11/30/2015**)
- Tasks
  - Coordinate with NMED, EPA, and others as needed to gather the best-available current and future year inventories for Northern Mexico. (**Completed 9/30/2015**)
  - Develop deficient inventory components, as needed
  - Collect and process ancillary emissions data (spatial surrogates, temporal profile, chemical speciation) (**Completed 11/1/2015**)

Base and Future Year Mexico Inventories

- US EPA 2011 Modeling Platforms
  - **NEI 2011v1**
    - 1999 Mexico NEI (INEM) projection to 2012
    - Documentation: EPA TSD; ERG Inventory Conference Paper
    - Projection years: 2018, 2025
  - **NEI 2011v2**
    - 2008 INEM inventory with corrections
    - Documentation: ERG report to EPA
    - Projection Years: 2018, 2025

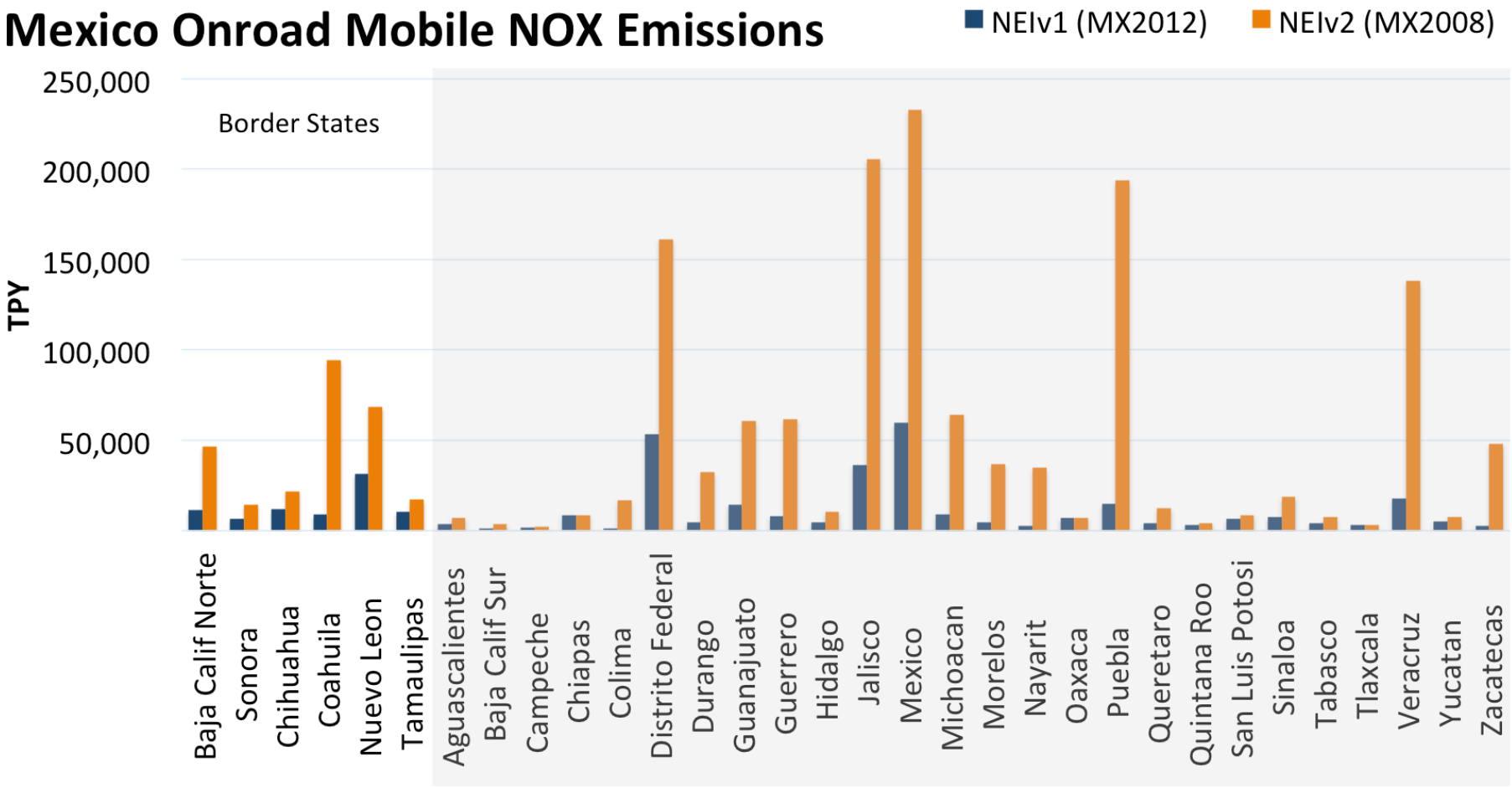
Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2



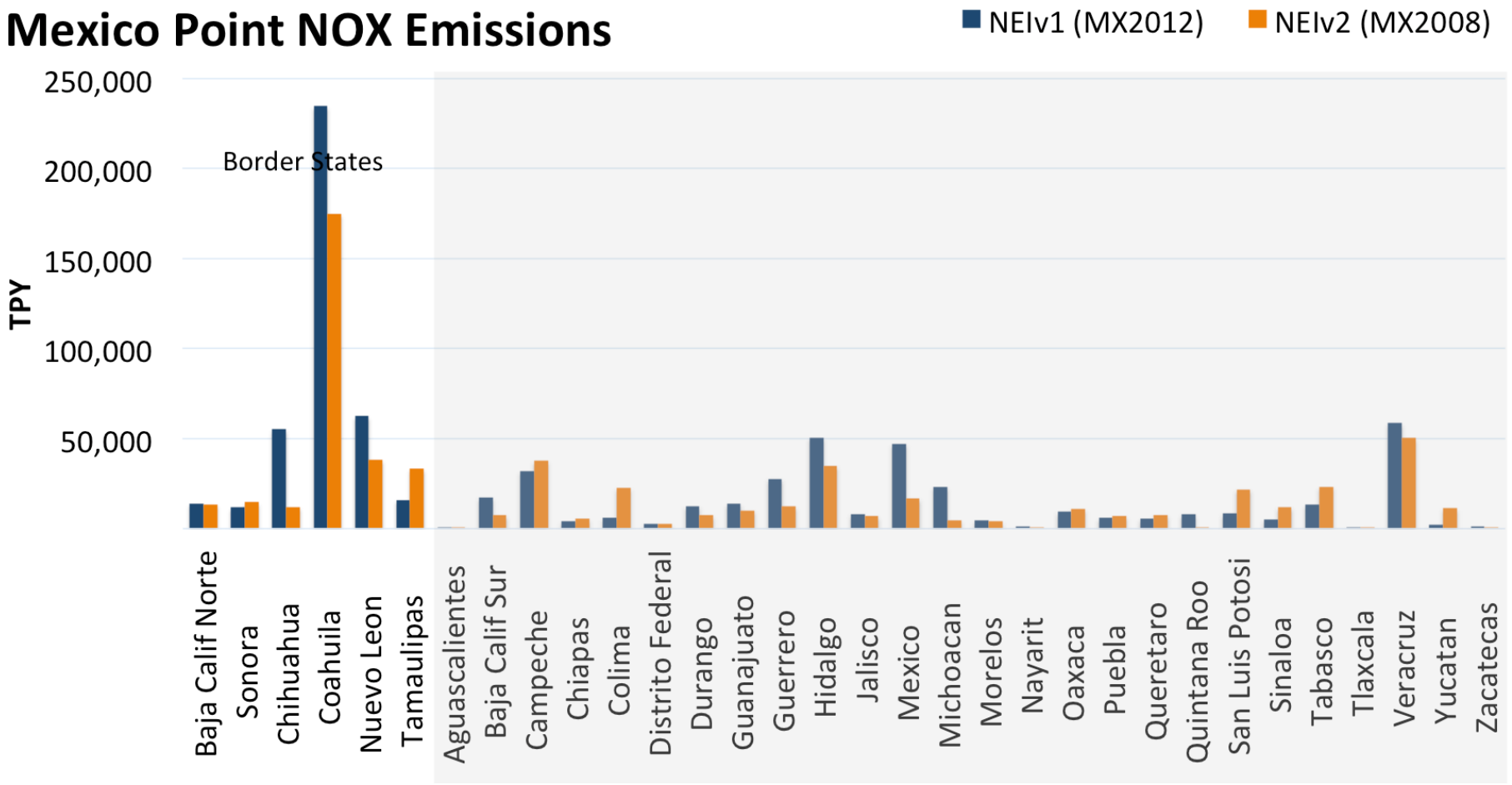
Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2



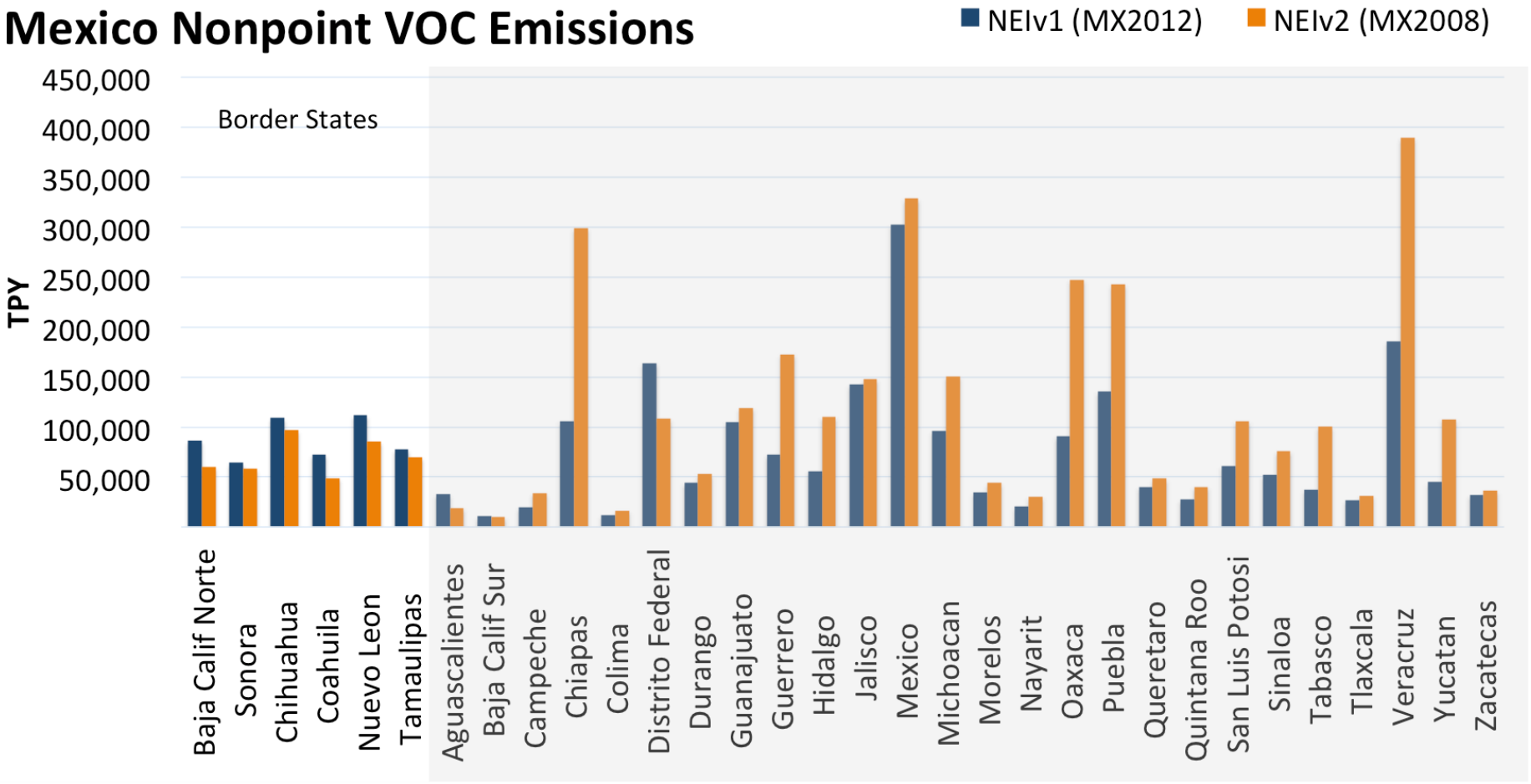
Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2



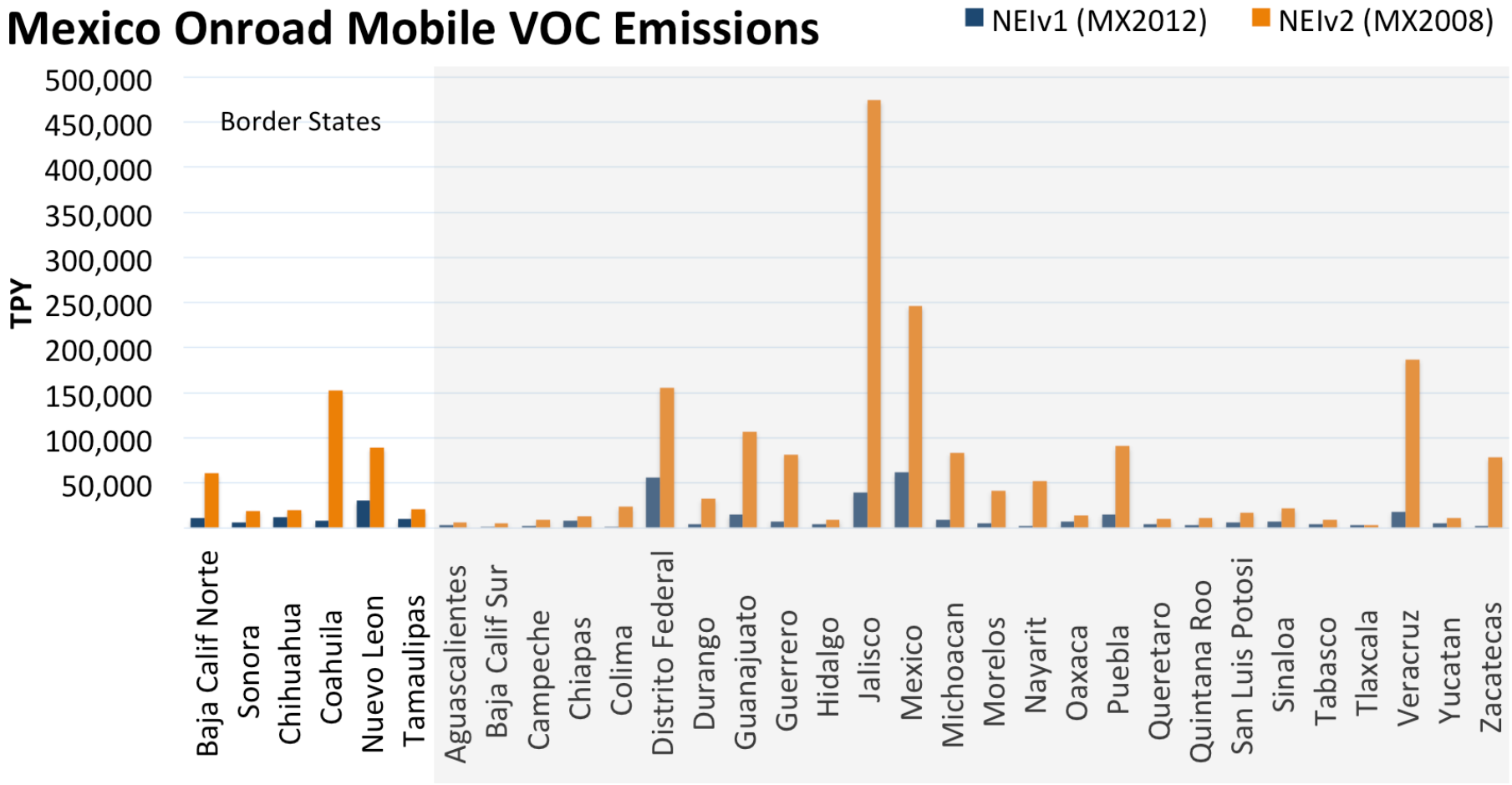
Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2



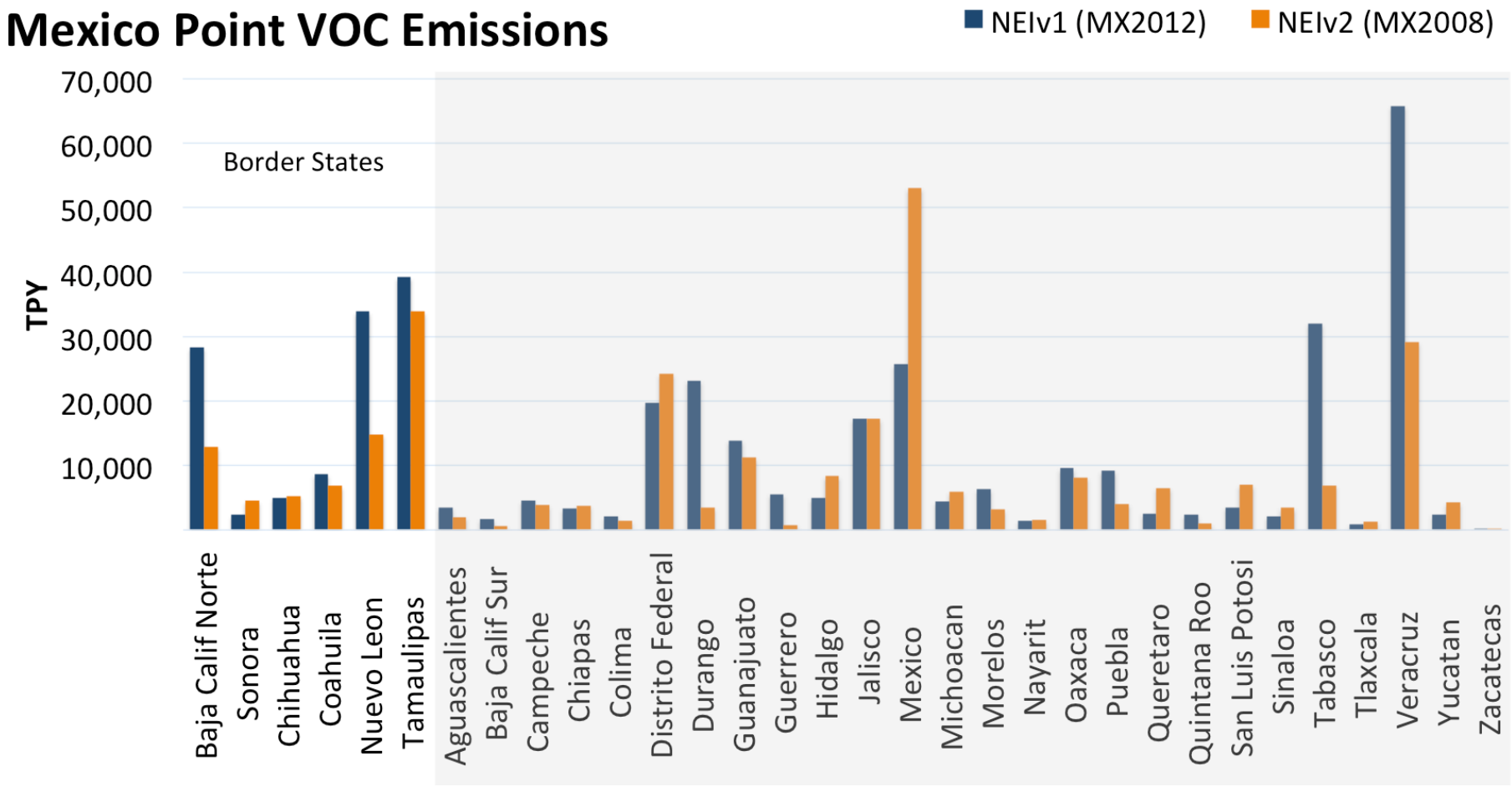
Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2



Base Year Mexico Inventories

Mexico 2011 Inventory Analysis: NEIv1 vs NEIv2

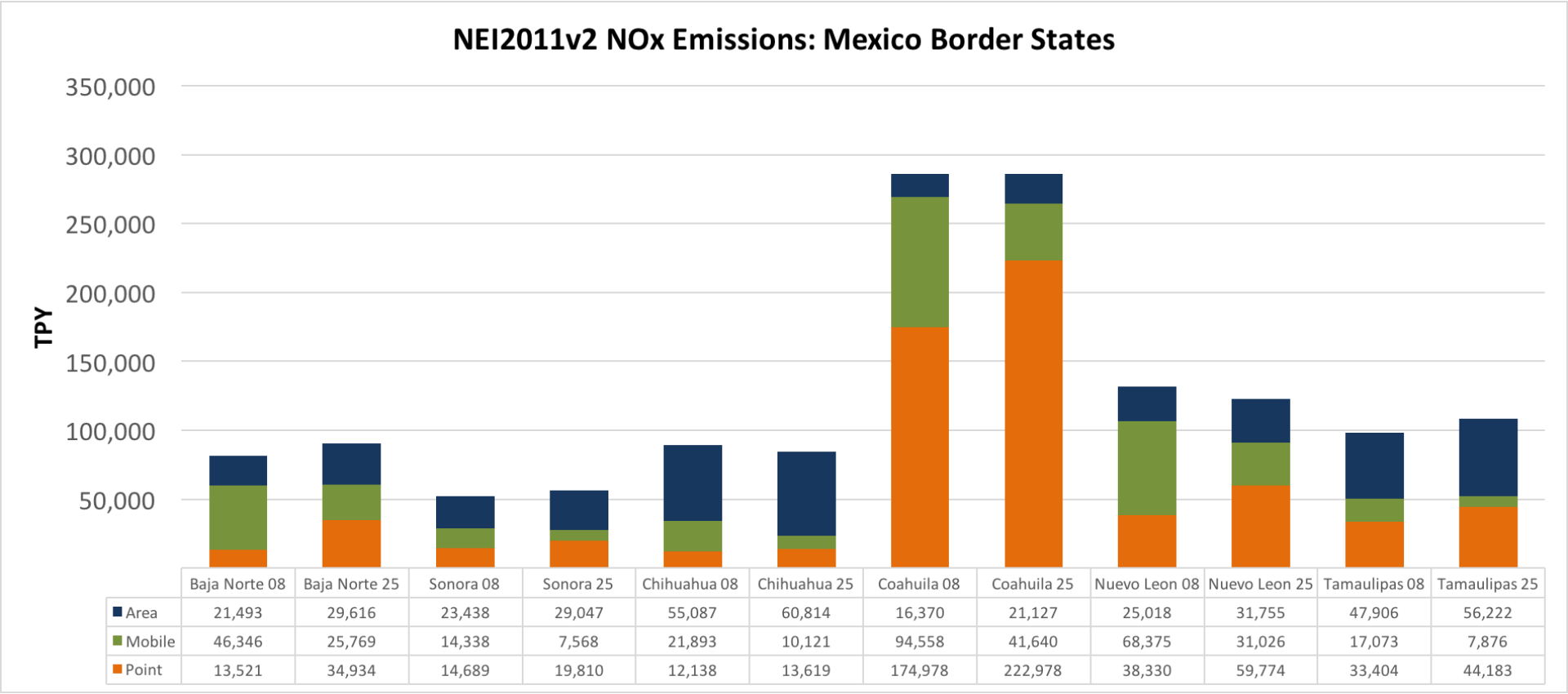


Base and Future Year Mexico Emissions

- On September 30 SNMOS conference call decision made in coordination with NMED to use NEI2011v2 Mexico inventories
- **NEI2011v2**: Mexico 2008, 2018, and 2025 inventories
  - Based on work by SEMARNAT published in early 2014 (Inventario Nacional de Emisiones de México)
  - Eastern Research Group (ERG) reviewed and improved the inventory for EPA in late 2014
  - Documentation: ERG Report
- Natural
  - Fires from WRAP PMDETAIL Phase II
  - Biogenics from MEGAN 2.10
  - Windblown Dust from WRAP WBD model

Base and Future Year Mexico Inventories

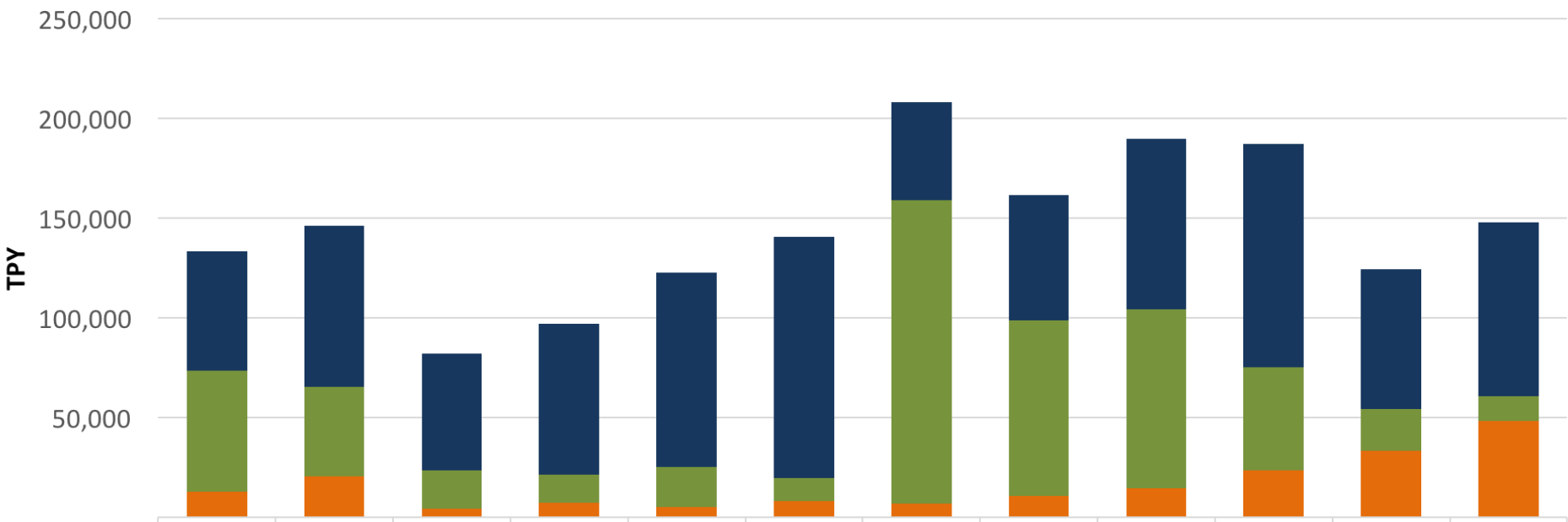
Mexico Inventory Analysis: 2008 vs 2025



	Baja Norte 08	Baja Norte 25	Sonora 08	Sonora 25	Chihuahua 08	Chihuahua 25	Coahuila 08	Coahuila 25	Nuevo Leon 08	Nuevo Leon 25	Tamaulipas 08	Tamaulipas 25
Area	21,493	29,616	23,438	29,047	55,087	60,814	16,370	21,127	25,018	31,755	47,906	56,222
Mobile	46,346	25,769	14,338	7,568	21,893	10,121	94,558	41,640	68,375	31,026	17,073	7,876
Point	13,521	34,934	14,689	19,810	12,138	13,619	174,978	222,978	38,330	59,774	33,404	44,183

Base and Future Year Mexico Inventories

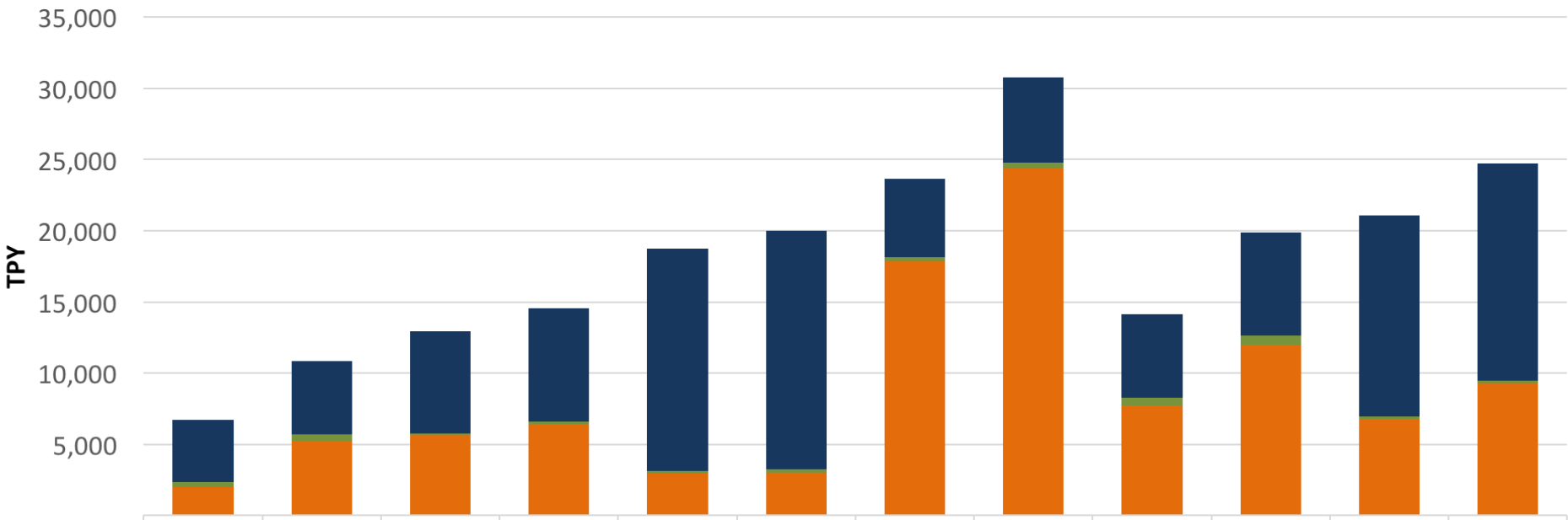
Mexico Inventory Analysis: 2008 vs 2025



	Baja Norte 08	Baja Norte 25	Sonora 08	Sonora 25	Chihuahua 08	Chihuahua 25	Coahuila 08	Coahuila 25	Nuevo Leon 08	Nuevo Leon 25	Tamaulipas 08	Tamaulipas 25
Area	60,078	81,036	58,422	75,485	97,197	120,858	49,052	62,857	85,480	112,230	70,068	87,327
Mobile	60,638	44,654	19,174	14,072	20,205	11,743	152,252	87,851	89,465	51,724	21,019	12,164
Point	12,886	20,655	4,511	7,470	5,223	8,253	6,833	10,936	14,872	23,453	33,404	48,594

Base and Future Year Mexico Inventories

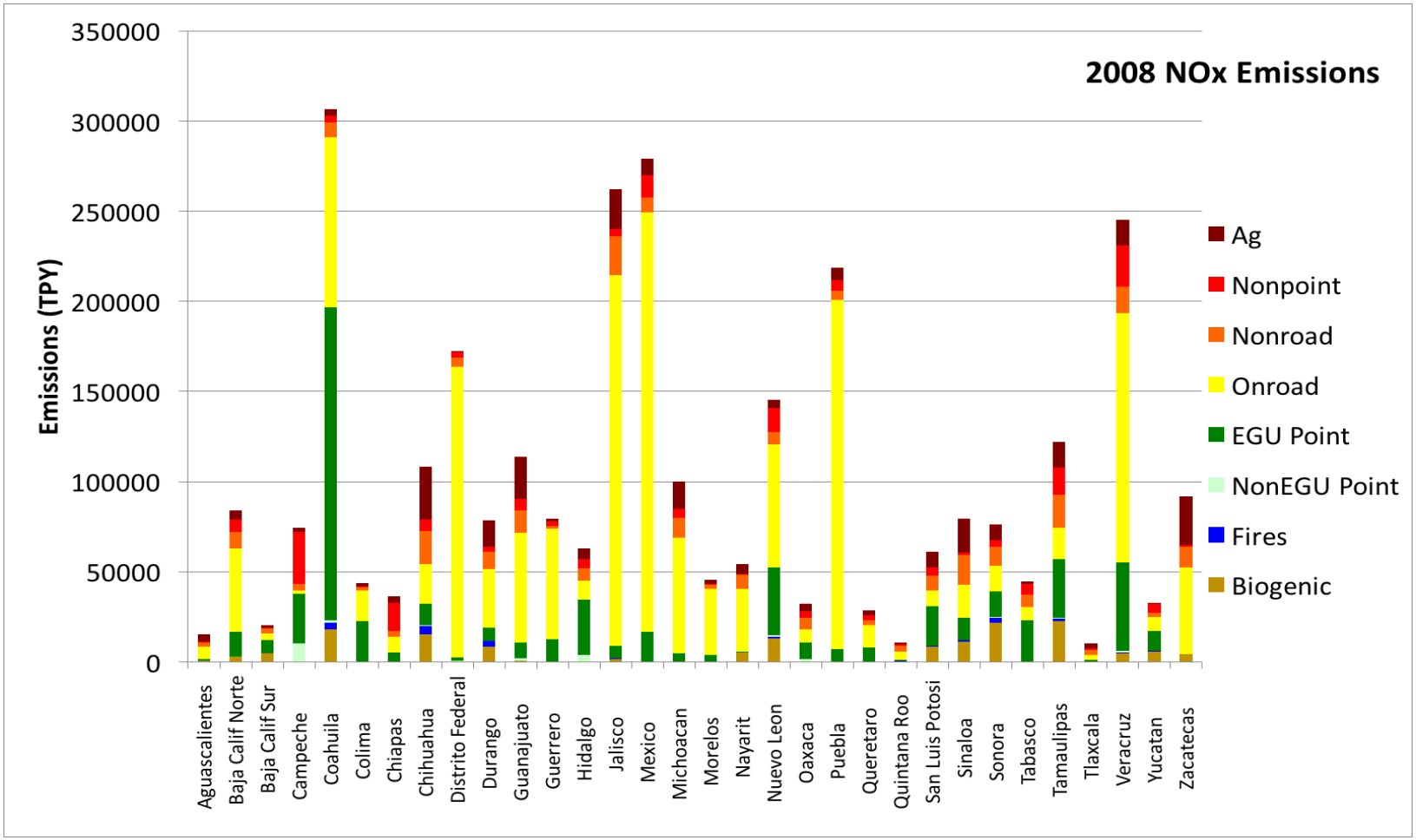
Mexico Inventory Analysis: 2008 vs 2025



	Baja Norte 08	Baja Norte 25	Sonora 08	Sonora 25	Chihuahua 08	Chihuahua 25	Coahuila 08	Coahuila 25	Nuevo Leon 08	Nuevo Leon 25	Tamaulipas 08	Tamaulipas 25
Area	4,370	5,141	7,156	7,976	15,590	16,752	5,518	5,941	5,877	7,264	14,136	15,250
Mobile	338	485	136	186	223	278	320	380	499	627	173	212
Point	2,025	5,235	5,636	6,408	2,925	2,988	17,822	24,425	7,756	12,000	6,785	9,276

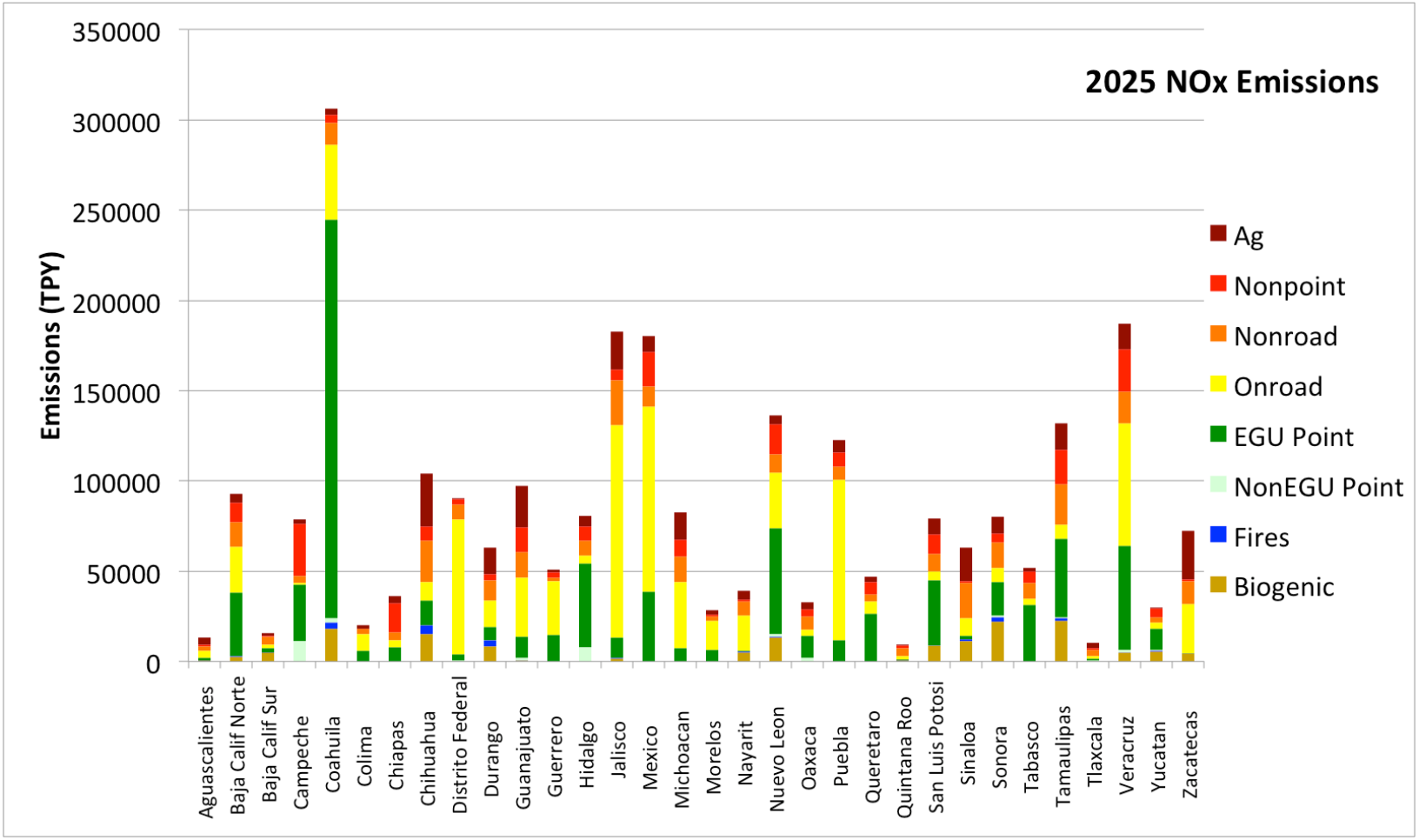
Base and Future Year Mexico Inventories

Mexico Inventory Analysis: NOx Emissions



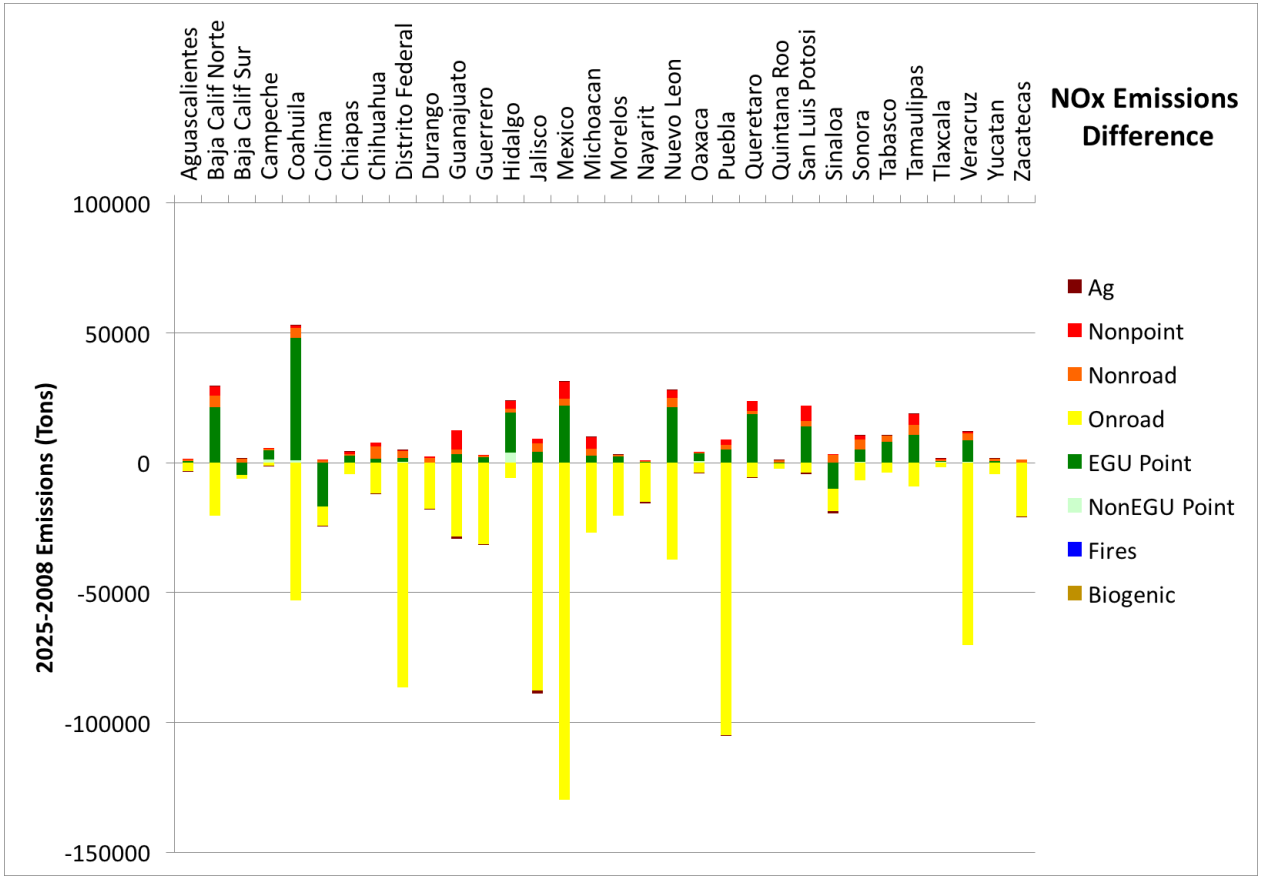
Base and Future Year Mexico Inventories

Mexico Inventory Analysis: NOx Emissions



Base and Future Year Mexico Inventories

Mexico Inventory Analysis: 2008 vs 2025 NOx

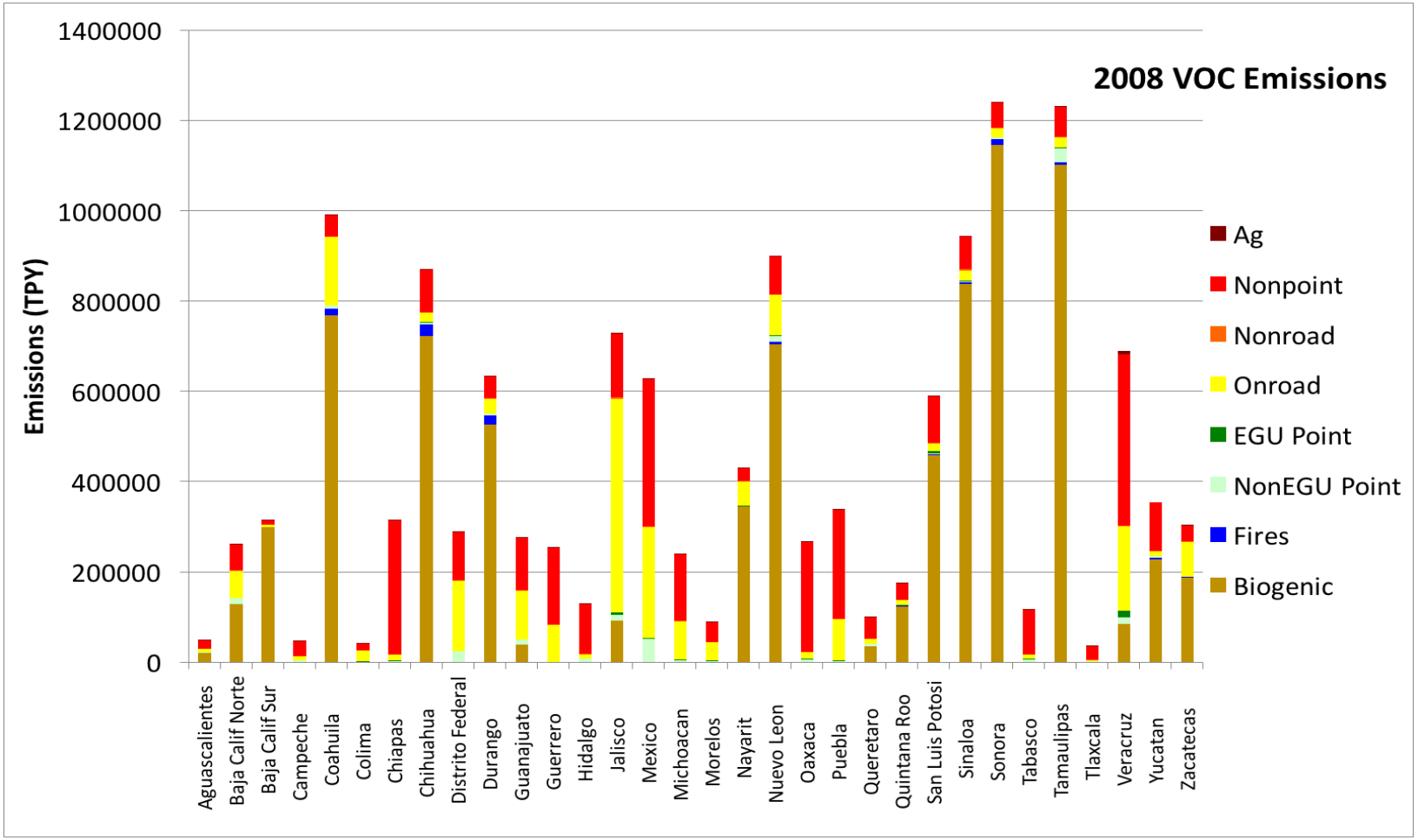


Trends Analysis

- Change from 2008 → 2025
- Border States
  - +11%: Baja N.
  - -0.1%: Coahuila
  - -4%: Chihuahua
  - -6%: Nuevo Leon
  - +8%: Tamaulipas
- Increases in Nonpoint, Nonroad, and EGU Point
- Decreases in Onroad NOx: 54% decrease from diesel vehicles, 50% decrease from gasoline vehicles

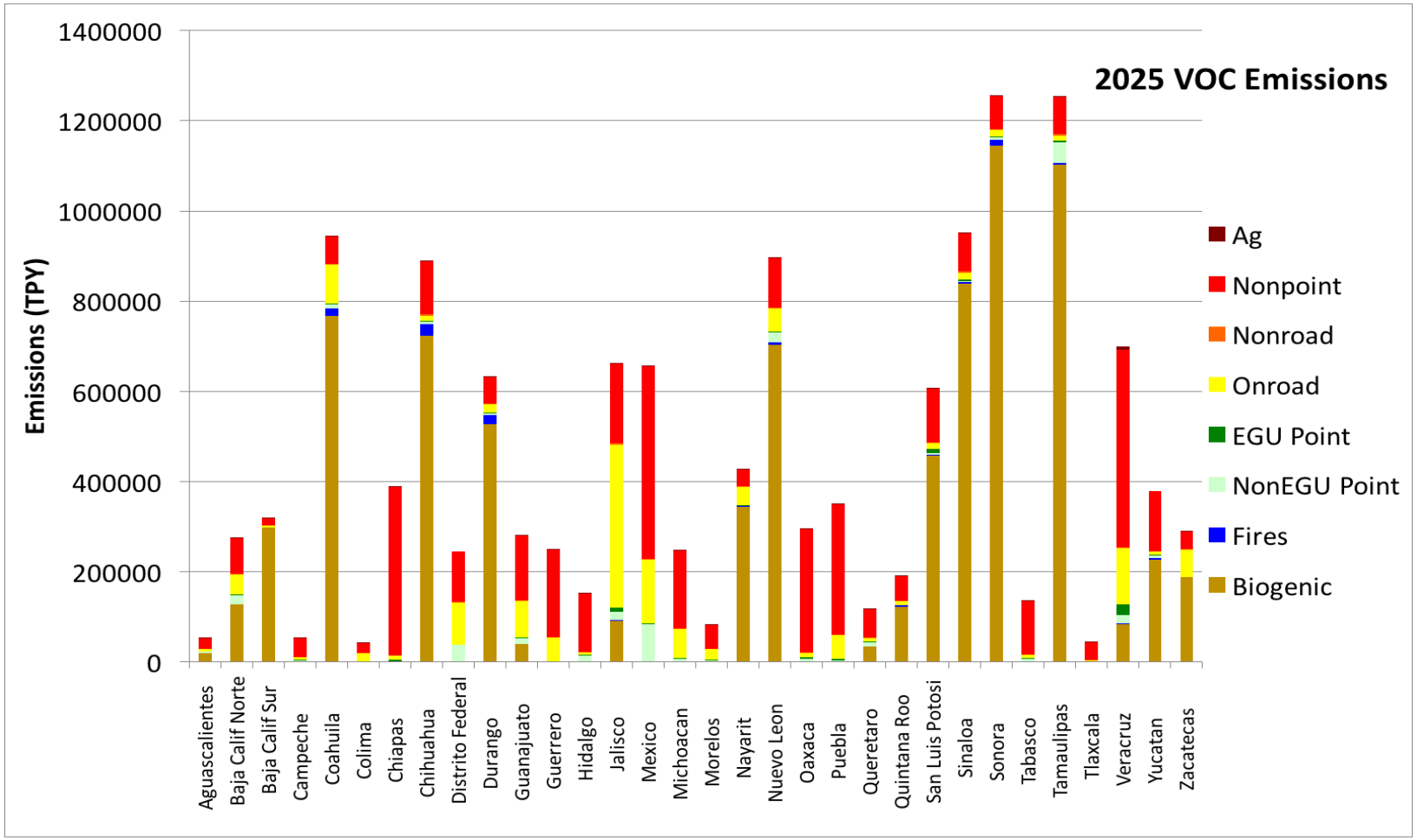
Base and Future Year Mexico Inventories

Mexico Inventory Analysis: VOC Emissions



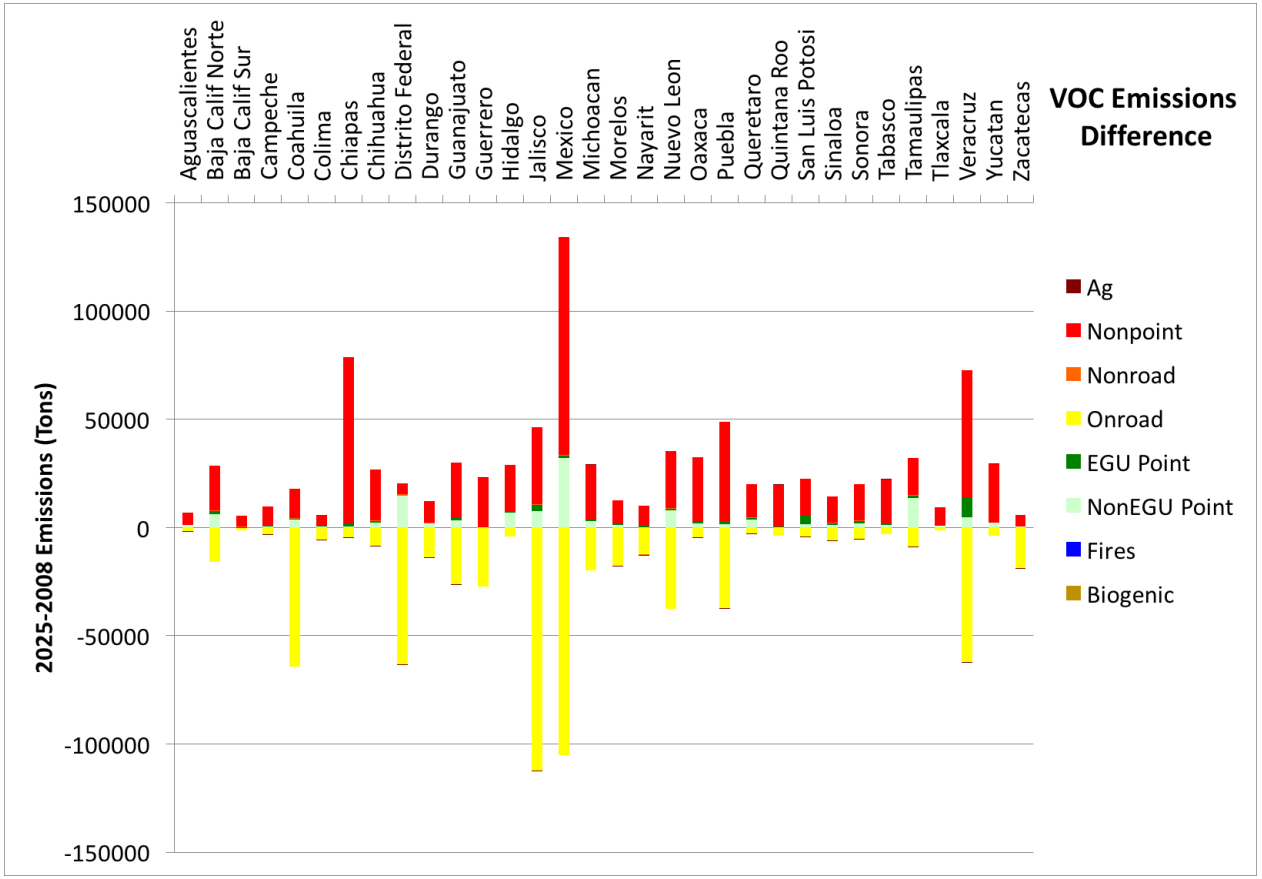
Base and Future Year Mexico Inventories

Mexico Inventory Analysis: VOC Emissions



Base and Future Year Mexico Inventories

Mexico Inventory Analysis: 2008 vs 2025 VOC

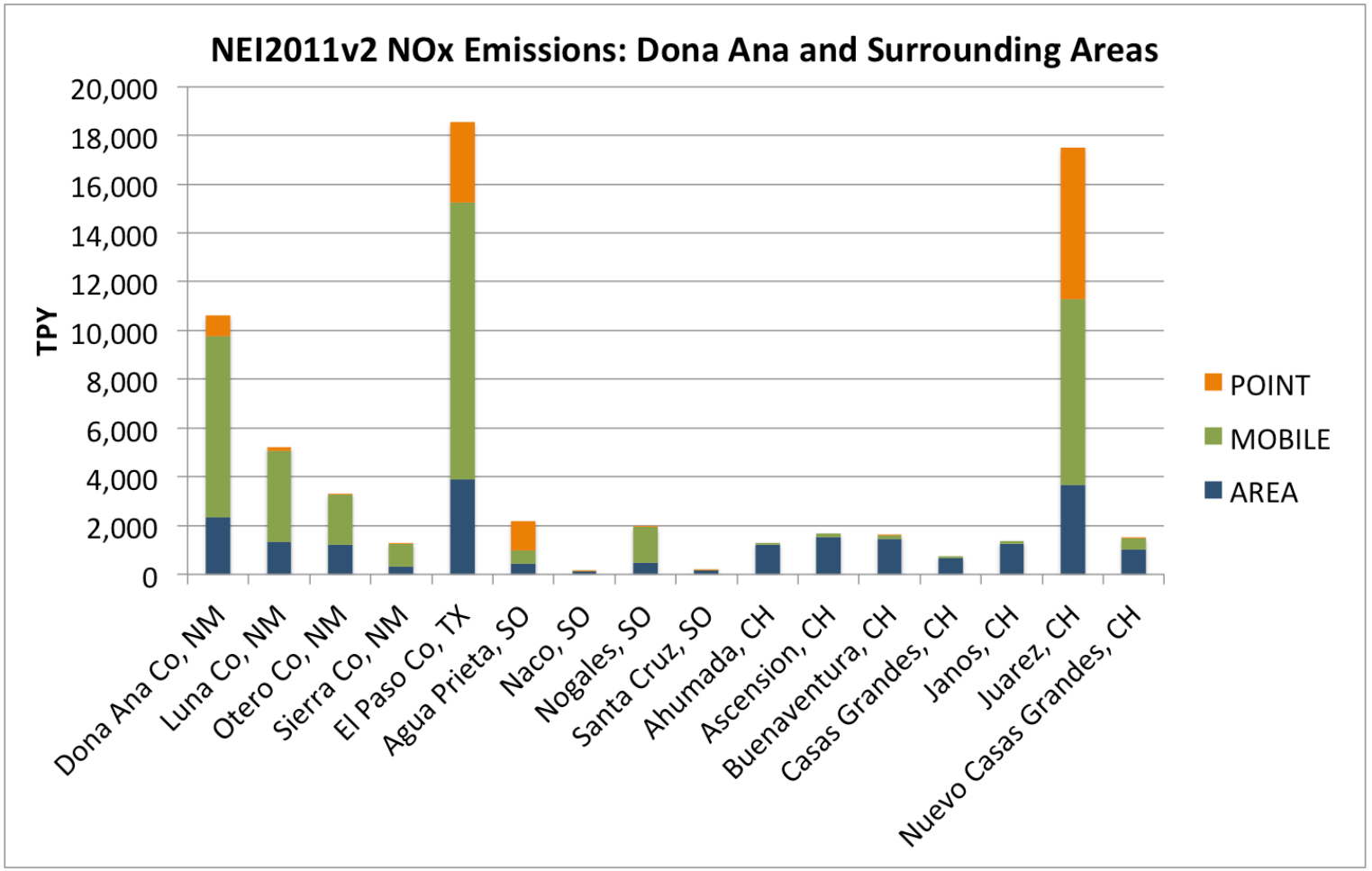


Trends Analysis

- Change from 2008 → 2025
- Border States
  - +5%: Baja N.
  - -5%: Coahuila
  - +2%: Chihuahua
  - -0.3%: Nuevo Leon
  - +2%: Tamaulipas
- Increases in Nonpoint, NonEGU, and EGU Point
- Decreases in Onroad

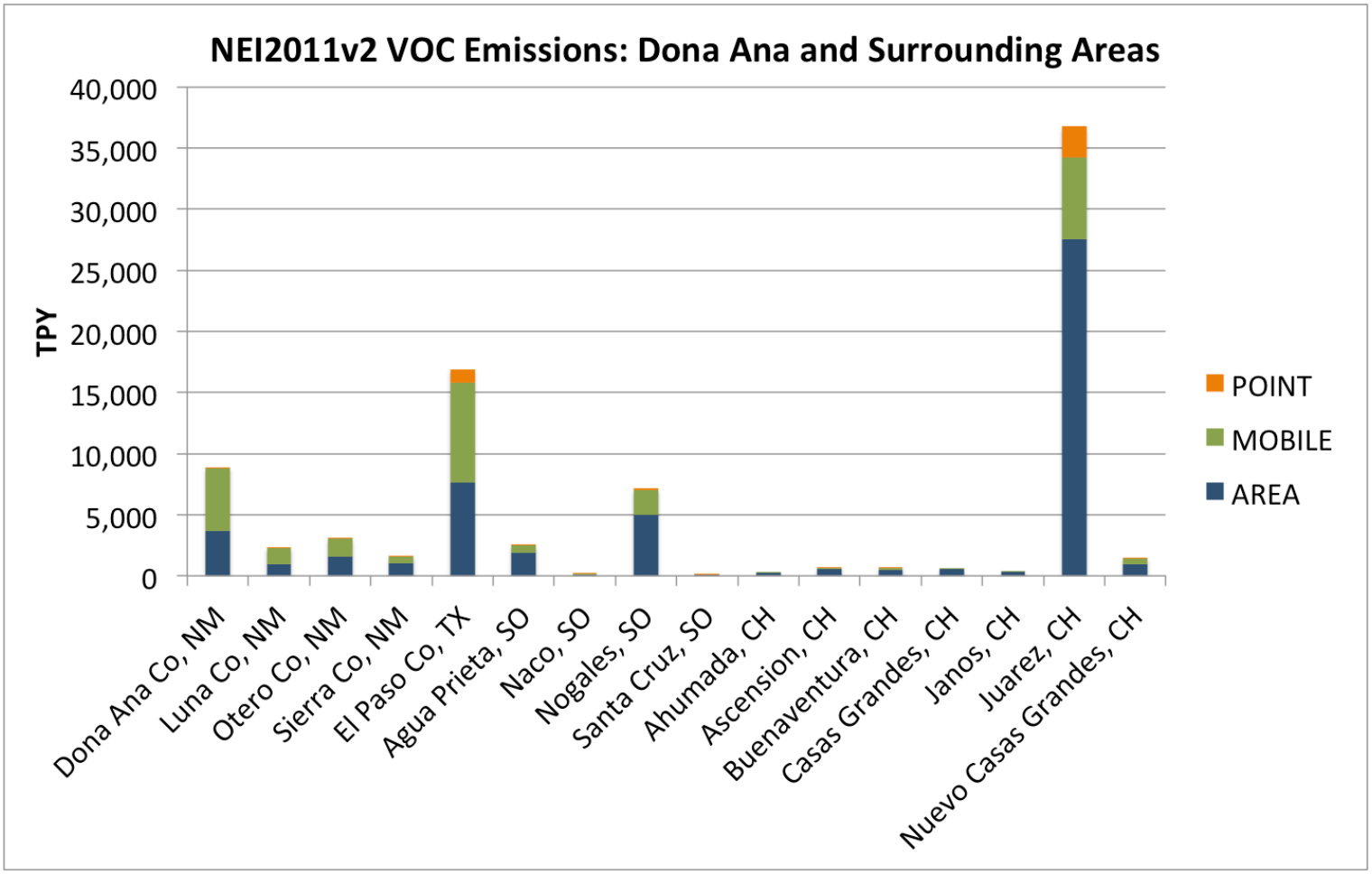
Base Year Mexico Inventories

Doña Ana and Surrounding Counties 2011 NOx EI



Base Year Mexico Inventories

Doña Ana and Surrounding Counties 2011 VOC EI

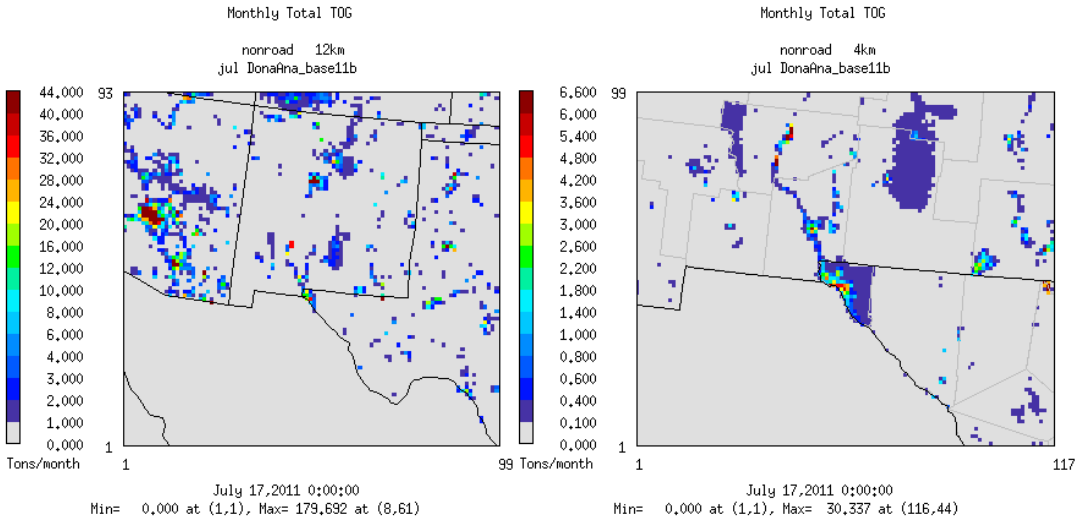


Task 3 Summary

- SNMOS will use 2008-based SEMARNAT/ERG inventory from the NEI2011v2 modeling platform
  - Future Year options include 2018 and 2025
  - Analyses in the above slides for 2025

Additional SNMOS Emissions Plots

- http://ie.unc.edu/cempd/projects/data_viewer?project=SNMOS
- Results > View the results from a single simulation
- EMIS > SMOKE > DonaAna_base11b
- Plot Types
  - 2d Tile Plots
  - Ex. 12-km and 4km July total US nonroad mobile total Organic Gas (TOG) emissions



Next Steps

Tasks to be Completed by February 29, 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 (8/15/16)
- **Task 12**: FY 4 km source apportionment run (9/15/16)
- **Task 13**: Air Quality Technical Support Document (11/18/16)