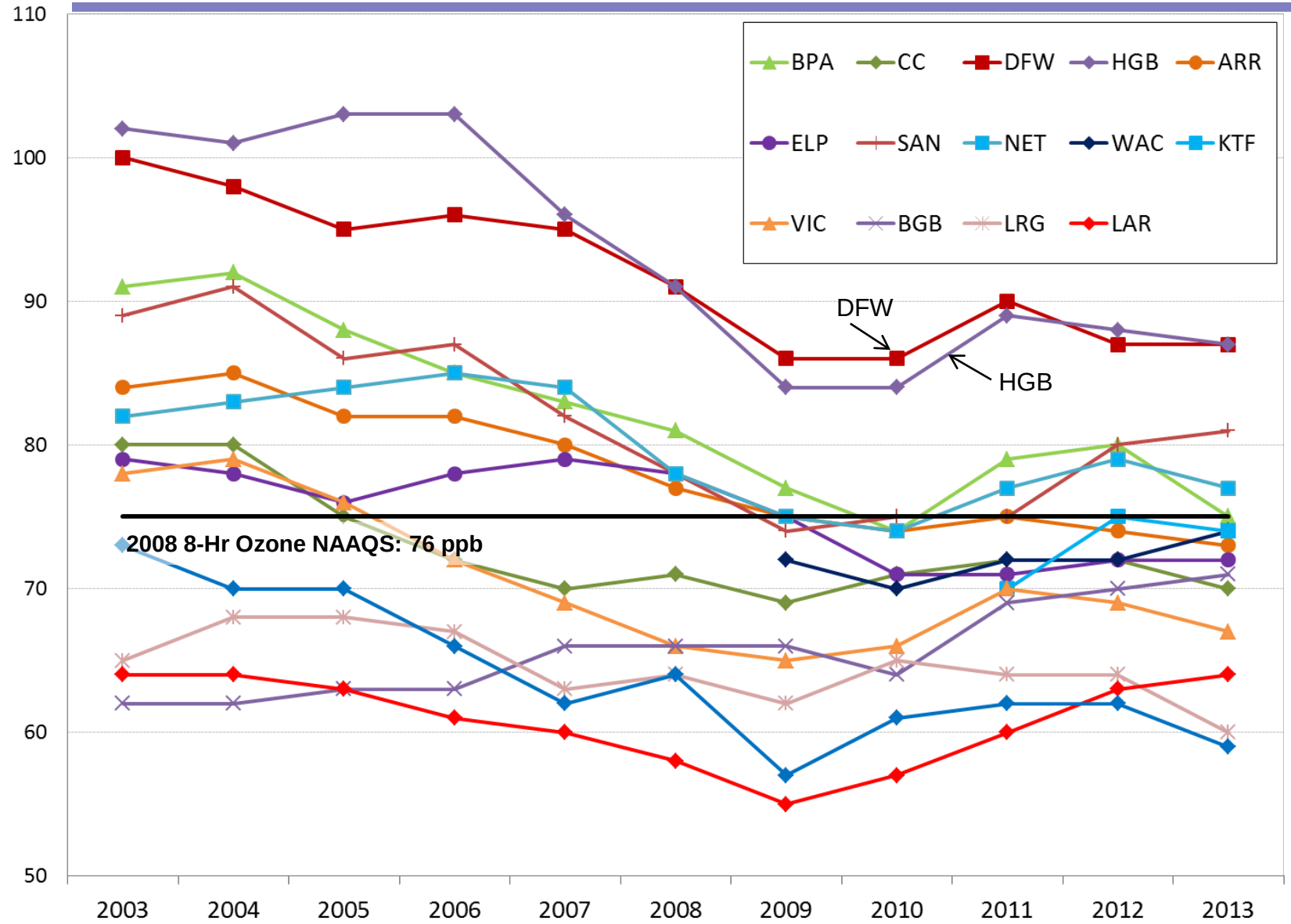
TCEQ Photochemical Modeling Update

Doug Boyer
Air Modeling & Data Analysis
Air Quality Division

Southeast Texas Photochemical Modeling Technical Committee Meeting
Houston-Galveston Area Council Offices

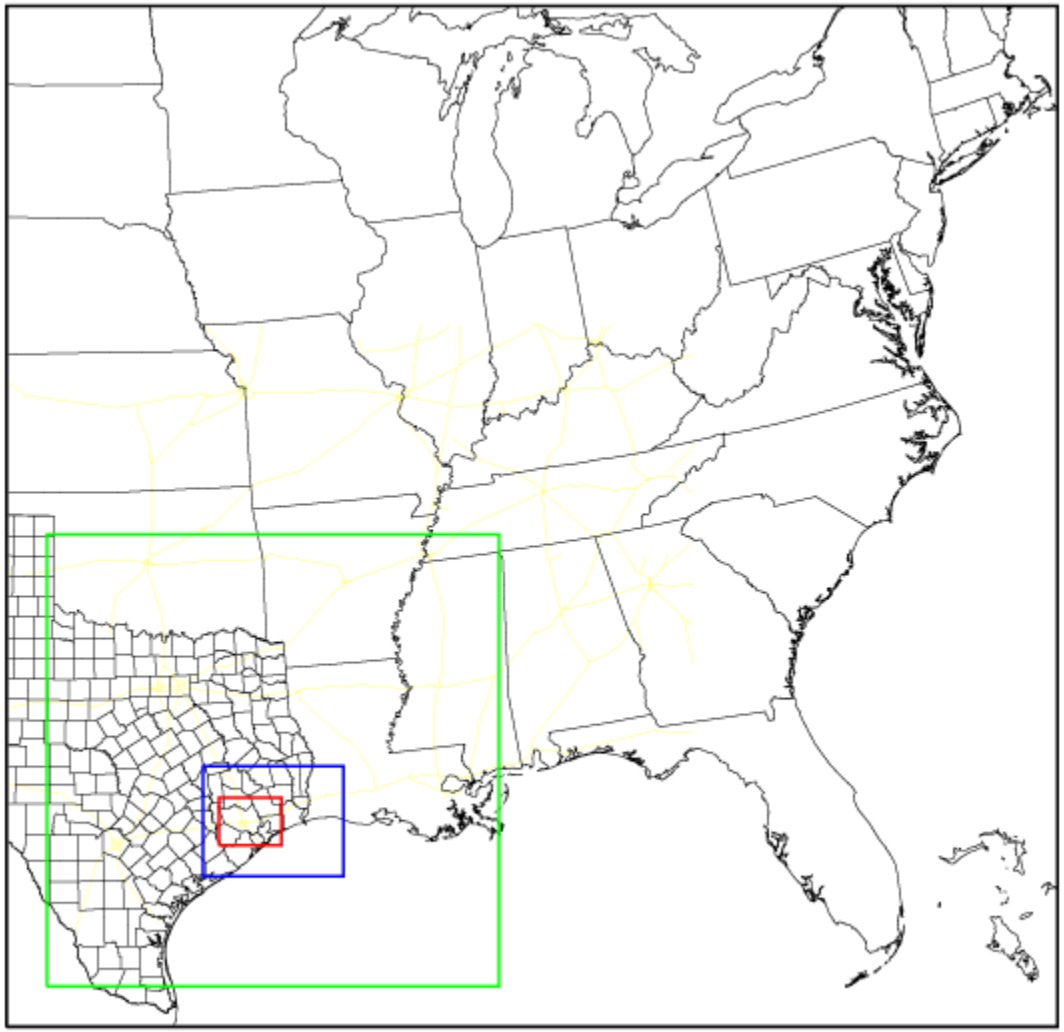
February 27, 2014

Texas Design Values by Area 2003-2013*

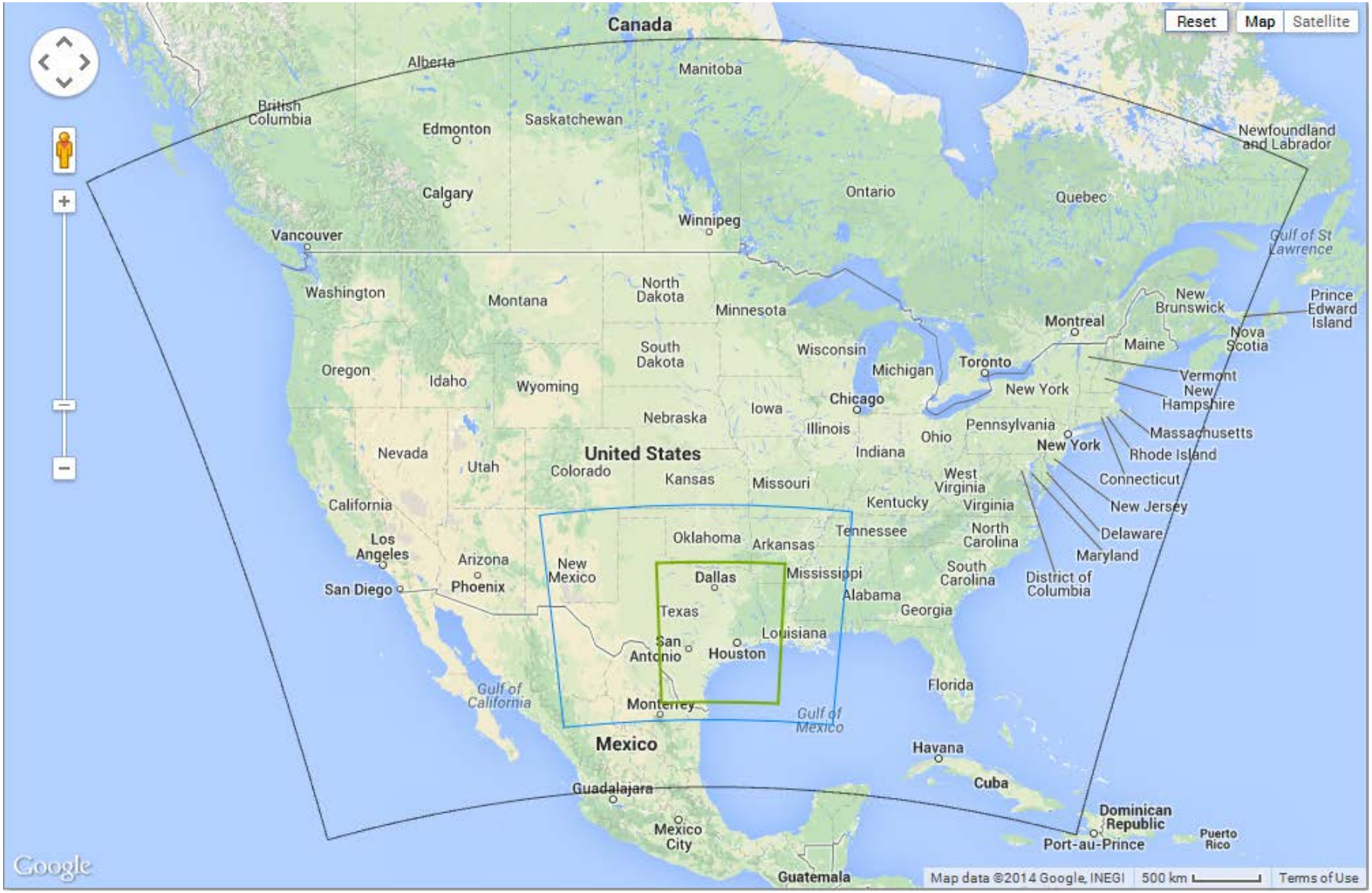


*2013 data is current as of 11/12/2013 and is subject to change.

Previous SIP Modeling Domains



Texas RPO Modeling Domains



Modeling Setup

HGB MVEB Update SIP (4/2013) vs Current TCEQ Modeling

CAMx Photochemical Model

- v4.53 → v6.00a
- CB05 → CB6 (additional explicit species and isoprene chem.)
- New inline photolysis rate adjustments
- MPI (CAMx 5+) – huge speed-up in run-time
- New dry deposition scheme w/ 26 landuse categories
- Improved Plume-In-Grid dynamics (vertical allocation of emissions)

Meteorological Model

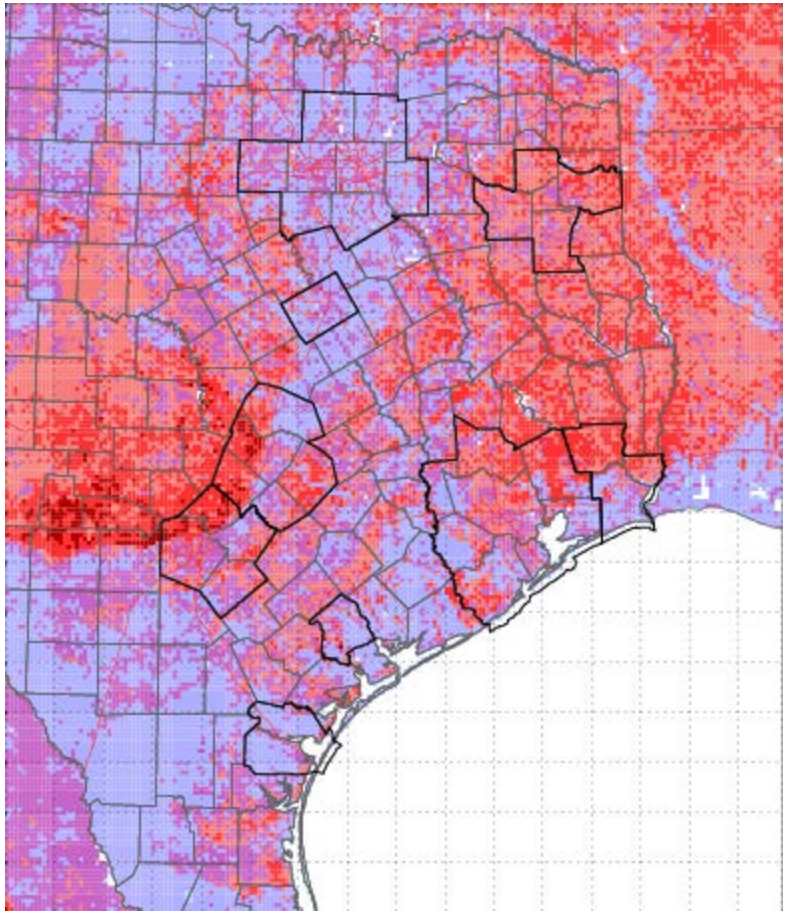
- MM5 v3.7.3 → WRF v3.2
- Met-to-CAMx interface significantly improved
  - Speed-up, vertical mixing, convective cloud

Biogenic Emission Model

- GloBEIS3 → MEGAN v2.10
- MODIS Satellite-based Leaf Area Index (LAI)

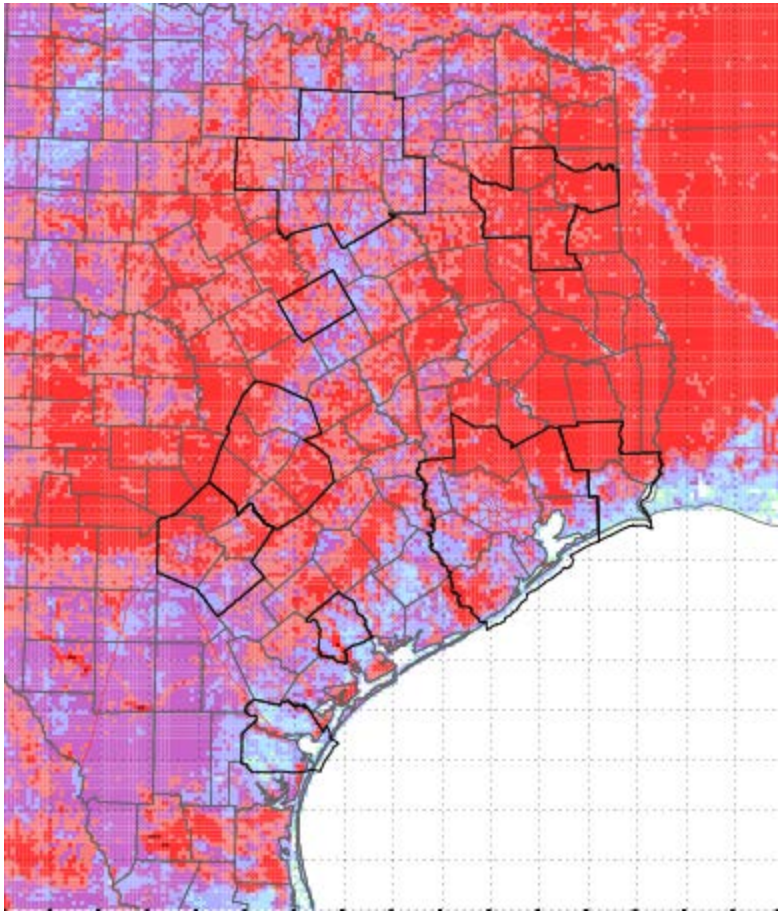
MEGAN 2.10 vs GloBEIS3 Biogenic VOC Emissions
June 12th Episode Day

MEGAN 2.10



HGB:1579 tons/day

GloBEIS3



HGB: 2117 tons/day

Modeling Setup

HGB MVEB Update SIP (4/2013) vs Current TCEQ Modeling

Point Sources

- Texas: latest 2006 State of Texas Air Reporting System (STARS)
- Non-Texas: 2002 NEI/CENRAP → 2008 NEI

Area/Non-road

- 2002 NEI & 2005 TexAER → 2008/2011 NEI/TexAER
- Shipping and Locomotives link-based

Oil and Gas

- Old: NEI/TexAER factors
- Now: Detailed county-based production and drilling from TX calculator and Railroad Commission of Texas

2006 HGB Area Anthropogenic Emissions Summary by Source Category

2006 Summer Weekday Emissions (tons per day)	**From 2013 MVEB SIP**		**Current TCEQ Modeling**	
	NO_X	**VOC**	**NO_X**	**VOC**
On-Road	270.00	104.74	270.28	105.07
Non-Road	78.85	75.97	75.40	55.86
Area	36.35	528.99	25.69	261.36
Off-Road	73.55	6.05	28.08	2.99
Oil and Gas - Production	In Area	In Area	2.85	102.15
Oil and Gas - Drill Rigs	In Non-Road	In Non-road	2.44	0.17
Point Sources	170.82	222.33	204.69	209.46
Total	**629.57**	**938.08**	**609.43**	**737.07**

Note: Current TCEQ modeling emissions are preliminary

2018 DFW & HGB Area Anthropogenic Emissions Summary by Source Category

2018 Summer Weekday Emissions (tons per day)	**DFW**		**HGB**	
	NO_X	**VOC**	**NO_X**	**VOC**
On-Road	113.21	55.61	103.39	50.71
Non-Road	39.87	32.77	31.09	27.63
Area (w/o Oil and Gas)	30.76	284.94	27.19	269.38
Off-Road	30.67	4.46	23.30	2.62
Oil and Gas - Production	12.21	43.68	2.13	67.86
Oil and Gas - Drill Rigs	5.83	0.01	0.40	0.00
Point Sources	57.57	47.09	174.73	151.36
Total	**290.12**	**468.56**	**362.23**	**569.56**

Note: Current TCEQ modeling emissions are preliminary

Tier 3 and 10 ppm Gasoline Sulfur Standards for Light-Duty On-Road Vehicles

- Current proposal by EPA (http://www.epa.gov/otaq/tier3.htm) is to require:
  - more stringent Tier 3 standards for light-duty vehicles phasing in between the 2017-2025 model years; and
  - 10 parts per million (ppm) gasoline sulfur instead of the current 30 ppm level.

- Overall on-road fleet benefits accrue from both:
  - introduction of tighter standards with the 2017 model year; and
  - lower sulfur levels increasing catalytic converter effectiveness, which reduces emissions from in-use vehicles.

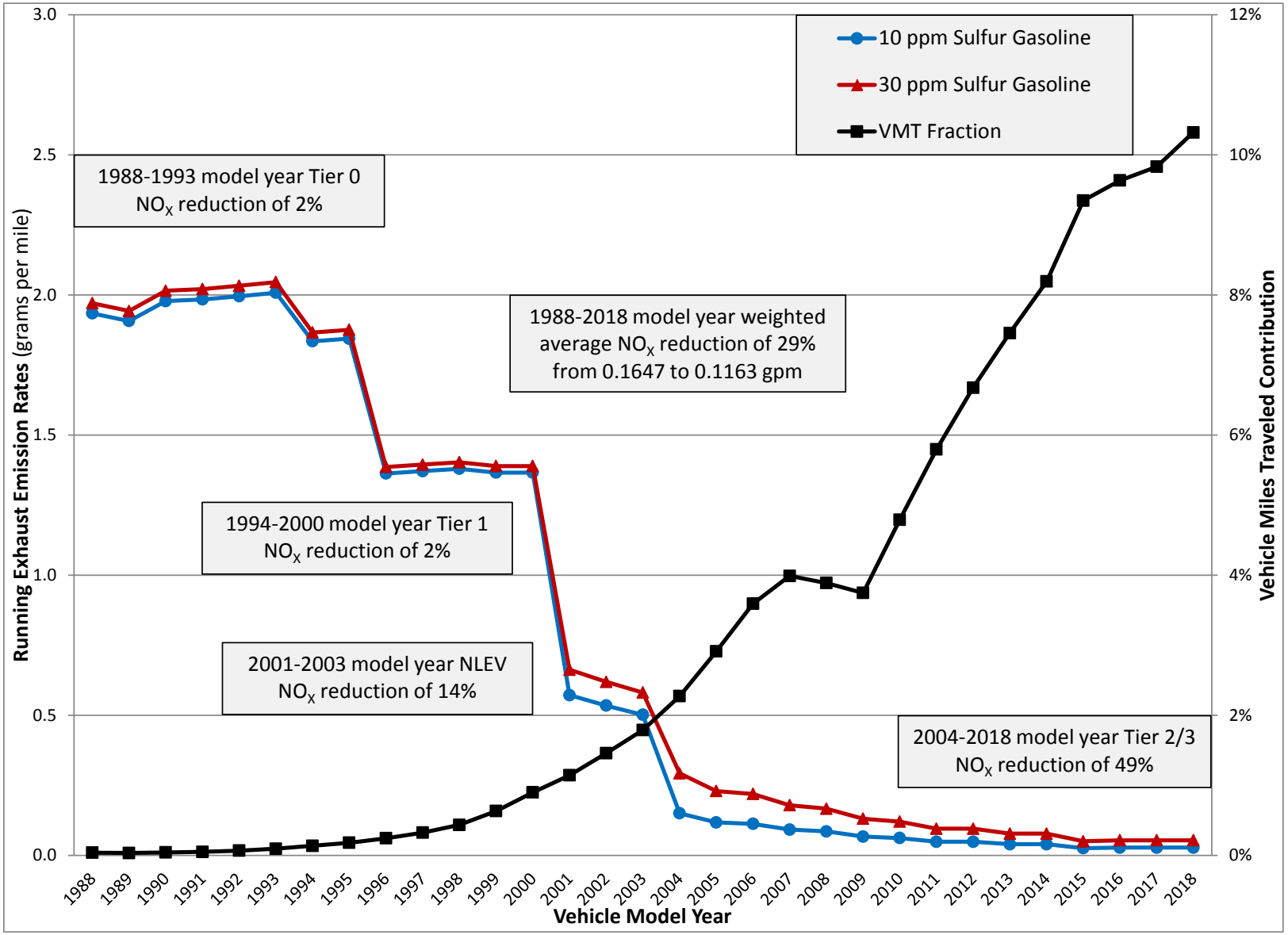
- Excerpt from page 12 of EPA's Tier 3 air quality modeling technical support document (http://www.epa.gov/otaq/documents/tier3/454r13006.pdf):
  - **"The maximum projected decrease in an eight-hour ozone design value in 2017 is 1.09 ppb in Tarrant County, Texas…"**

- Estimating Tier 3 on-road emission benefits for the 2018 attainment year:
  - the current MOVES2010b model does not include Tier 3 benefits;
  - MOVES2013 will include them and is scheduled for release after Tier 3 rule finalization;
  - TCEQ obtained the MOVEST3NPRM database available from EPA as part of the Tier 3 proposed rulemaking;
  - TCEQ ran 2018 gasoline scenarios for the current 30 ppm and the proposed 10 ppm levels; and
  - TCEQ applied ratios of the results by vehicle type, pollutant, and emission process (e.g., running exhaust versus start exhaust) to the 2018 on-road inventories based on 30 ppm.

Preliminary 2018 DFW Future Design Values for 10 and 30 ppm Sulfur Gasoline Scenarios

DFW Area Monitor and CAMS Code	2018 Future Design Values (ppb)		
	Current 30 ppm Sulfur Gasoline	Proposed 10 ppm Sulfur Gasoline	10 ppm Sulfur Gasoline Reduction
Denton Airport South - C56	77.09	76.29	0.80
Eagle Mountain Lake - C75	76.38	75.64	0.74
Grapevine Fairway - C70	76.12	75.38	0.74
Keller - C17	75.31	74.55	0.76
Fort Worth Northwest - C13	74.07	73.37	0.70
Frisco - C31	73.33	72.59	0.74
Dallas North #2 - C63	71.82	71.18	0.64
Parker County - C76	71.75	71.12	0.63
Dallas Executive Airport - C402	71.41	70.82	0.59
Cleburne Airport - C77	70.91	70.36	0.55
Arlington Municipal Airport - C61	69.92	69.32	0.60
Dallas Hinton Street - C401	68.85	68.24	0.61
Granbury - C73	68.56	68.06	0.50
Midlothian Tower - C94	68.09	67.60	0.49
Pilot Point - C1032	66.91	66.22	0.69
Rockwall Heath - C69	65.82	65.33	0.49
Greenville - C1006	63.40	62.98	0.42
Midlothian OFW - C52	63.38	62.93	0.45
Kaufman - C71	63.10	62.71	0.39

Gasoline Passenger Car Running Exhaust NO_X Emission Rates in 2018 for 10 and 30 ppm Sulfur Gasoline



Source: 2018 Dallas County default runs of MOVES2010b by model year with the T3NPRM database. Refer to *Updates to MOVES for the Tier 3 NPRM Analysis*, U.S. EPA Office of Transportation and Air Quality, March 2013.

Estimated 10 ppm Sulfur Gasoline Reductions to 2018 Summer Weekday On-Road Emissions

Geographic Area	2018 Summer Weekday On-Road Emissions (tpd) Use of Current 30 ppm Sulfur Gasoline for In-Use Fleet						
	NO	NO_2	HONO	NO_X	VOC	CO	SO_2
Ten-County DFW	95.80	16.51	0.91	113.21	63.61	670.82	1.04
Eight-County HGB	87.01	15.50	0.83	103.34	57.88	656.24	1.55
236 Attainment Counties	344.32	58.84	3.25	406.41	181.18	1,925.78	3.03
Texas Total (254 Counties)	527.13	90.85	4.98	622.96	302.66	3,252.84	5.62
Non-Texas U.S. (2,856 Counties)	7,173.34	1,194.80	67.49	8,435.63	4,159.52	46,377.90	65.53
Southern Canada (10 Provinces)	406.42	66.50	3.81	476.73	483.56	8,201.72	18.31
Northern Mexico (562 Municipios)	91.77	15.73	0.87	108.37	196.27	833.96	2.90
Grand Total	8,198.65	1,367.89	77.15	9,643.69	5,142.02	58,666.41	92.36

Geographic Area	2018 Summer Weekday On-Road Emission Reductions (tpd) Use of Proposed 10 ppm Sulfur Gasoline for In-Use Fleet						
	NO	NO_2	HONO	NO_X	VOC	CO	SO_2
Ten-County DFW	8.46	1.43	0.08	9.98	2.39	13.25	0.54
Eight-County HGB	7.79	1.35	0.07	9.21	2.25	12.66	0.87
236 Attainment Counties	22.89	3.86	0.22	26.97	5.52	27.74	1.41
Texas Total (254 Counties)	39.14	6.65	0.37	46.16	10.16	53.65	2.83
Non-Texas U.S. (2,856 Counties)	588.39	104.59	5.59	698.57	126.58	873.91	34.96
Southern Canada (10 Provinces)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Northern Mexico (562 Municipios)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grand Total	627.54	111.24	5.96	744.73	136.74	927.56	37.79

EPA's Estimated Ozone Reduction Benefits in 2017 from Tier 3/10 ppm Sulfur Rule Proposal

Metropolitan Area	Texas County	2017 Future Design Value		Ozone Reduction
		Without Tier 3	With Tier 3	
Austin	Travis	67.77	67.06	0.71
Beaumont-Port Arthur	Jefferson	75.14	74.86	0.28
	Orange	68.09	67.80	0.29
Dallas-Fort Worth	Collin	75.35	74.46	0.89
	Dallas	76.92	76.02	0.90
	Denton	75.80	74.73	1.07
	Ellis	67.53	66.67	0.86
	Hood	65.82	64.80	1.02
	Hunt	66.40	65.94	0.46
	Johnson	68.73	67.85	0.88
	Kaufman	63.93	63.48	0.45
	Parker	69.66	68.65	1.01
	Rockwall	67.66	67.12	0.54
	Tarrant	**77.34**	**76.25**	**1.09**
El Paso	El Paso	68.37	67.95	0.42
Houston-Galveston-Brazoria	**Brazoria**	**83.33**	**82.80**	**0.53**
	Galveston	**75.38**	**75.12**	**0.26**
	Harris	**90.22**	**89.68**	**0.54**
	Montgomery	**73.00**	**72.41**	**0.59**
Northeast Texas	Gregg	74.18	73.88	0.30
	Harrison	66.93	66.51	0.42
	Smith	69.81	69.44	0.37
San Antonio	Bexar	72.36	71.76	0.60

Source: *U.S. EPA Air Quality Modeling Technical Support Document: Proposed Tier 3 Emission Standards, Appendix B*

Comparing DFW Area Ozone Modeling from EPA for 2017 and TCEQ for 2018

EPA Modeling – 2005 Base Case, 2017 Future Year, 12 km Resolution

Scenario Description	2017 Future Year Ozone Design Values (ppb)	
	Minimum – Kaufman	Maximum - Tarrant
With 30 ppm Sulfur Gasoline	63.93	77.34
With 10 ppm Sulfur Gasoline	63.48	76.25
Net Ozone Reduction	0.45	1.09

TCEQ Modeling – 2006 Base Case, 2018 Future Year, 4 km Resolution

Scenario Description	2018 Future Year Ozone Design Values (ppb)	
	Minimum – Kaufman	Maximum – Denton Airport
With 30 ppm Sulfur Gasoline	63.10	77.09
With 10 ppm Sulfur Gasoline	62.71	76.29
Net Ozone Reduction	0.39	0.80

Current Ozone Modeling Plans and Known Future Changes

- Emission estimate updates:
  - 2018 (and maybe 2006) on-road emissions after MOVES2013 is released by EPA, which is scheduled to occur in 2014. Currently relying on emission estimates from MOVES2010a and MOVES2010b.
  - 2018 point source emission projections based on 2013 acid rain database (ARD) for electric generating utilities (EGUs) and 2012 State of Texas Air Reporting System (STARS) database for non-EGUs (NEGUs). Currently using 2012 ARD and 2011 STARS.
  - 2018 oil and gas emissions based on recently received 2012 production data from the Railroad Commission of Texas. Currently projecting from 2011 production data.
  - If version 2 of the 2011 National Emissions Inventory (NEI) is released by EPA, update 2018 future projections for non-Texas areas. Version 1 of the 2011 NEI was recently released and is currently being used.

- Chemical mechanism:
  - Implement any CB6 improvements that result in improved base case performance.
  - Currently using the "revision 2" option for CB6 in CAMx to estimate ozone.
  - 2006 base case CAMx runs showed that both the initial version of CB6 and "revision 1" caused significant over estimation of ozone.
  - CB05 was an improvement over its predecessor (CBIV), but still had under estimation problems.

- Meteorological modeling:
  - Implement any WRF improvements that result in improved base case performance.
  - Currently using WRF 3.2 output.
  - The recently released WRF 3.5 has been run for the 2006 episodes and the output is currently undergoing quality assurance review.

Modeling Web Sites

- SET PMTC: Presentations and past meeting information
  http://www.tceq.state.tx.us/airquality/airmod/committee/pmtc_set.html
- Interactive Air Quality Modeling Results (New)
  http://www.tceq.texas.gov/airquality/airmod/data/results
- Proposed HGB and DFW EI SIP Revision for the 2008 Eight-Hour Ozone Standard (12/11/2013)
  http://www.tceq.texas.gov/airquality/sip/hgb/hgb-latest-ozone
- Current Eight-Hour Ozone SIP Modeling Details
  http://www.tceq.texas.gov/airquality/airmod/rider8/rider8Modeling
- Current Modeling File FTP Site
  ftp://amdaftp.tceq.texas.gov/pub/TX/

Questions?

Doug Boyer – HGB Modeling Project Manager
doug.boyer@tceq.texas.gov
512 239-1523

The Air Modeling & Data Analysis Section contributed to these results.

Contact: amda@tceq.texas.gov