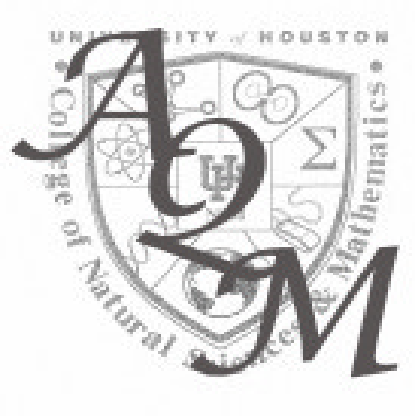
Comparison of Emissions Processing Systems and Emissions Inventories used for Houston-Galveston Air Quality Studies



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Contents

- **Comparison of three emissions inventories available for Houston-Galveston Air Quality Studies**

  : National EI - NET96, NEI99 from U.S. EPA
  State EI - Texas EI from TCEQ

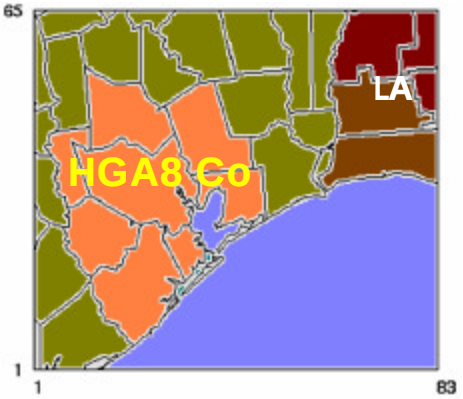
- **Comparison of two emission processing systems based on Texas EI preparation steps**

  : SMOKE & EPS2

Emissions Processing

1 Emission domain

- TCEQ's HGBPA_4 km domain
- Covering Southeastern Texas, Southwestern Louisiana, and the Gulf of Mexico



2 Emissions Inventories compared

- TCEQ: o2n2 emissions scenario (EPS2), GloBEIS3.
- NET96: U.S. EPA (SMOKE), BEIS2 with BCUSE.
- NEI99: Final version2 (SMOKE), BEIS3 with BGUSE.

Overall Emissions

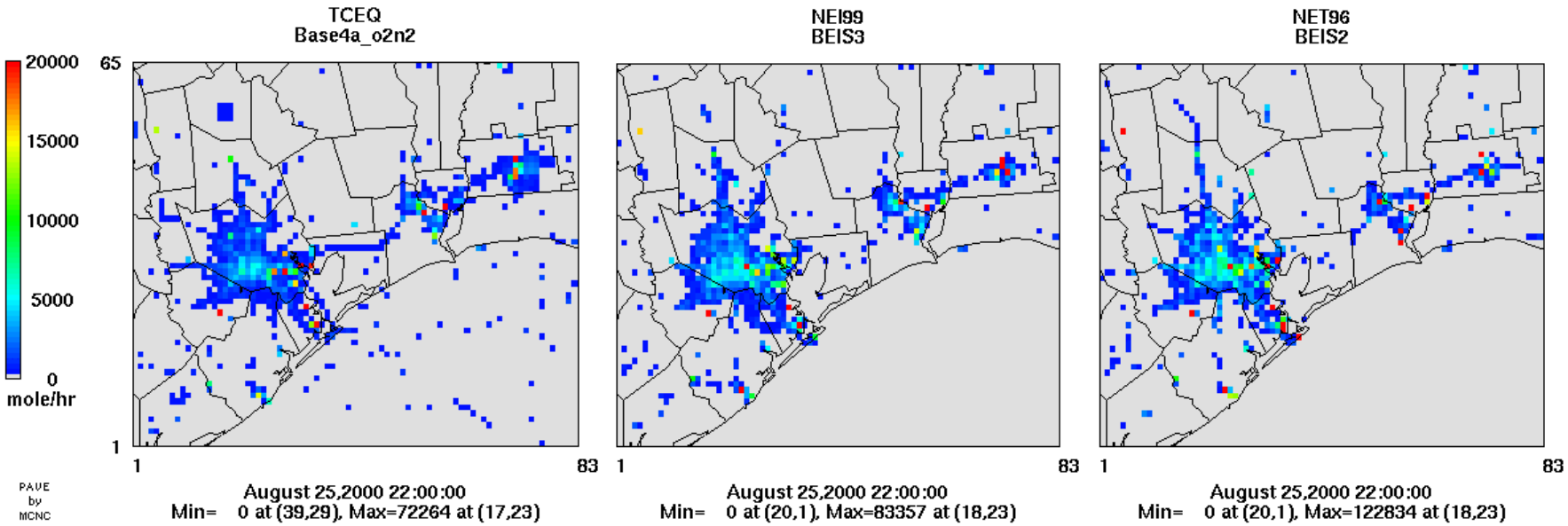
Source type	NOx (tons/day)		VOC (tons/day)	
	NEI99 [1]	TCEQ [2]	NEI99	TCEQ
On-road mobile	353	246	255	156
Area/Nonroad mobile	192	193	227	241
Point	521	490	152	327 (178) [3]
8-County total anthropogenic emissions	1066	929	633	724 (575)

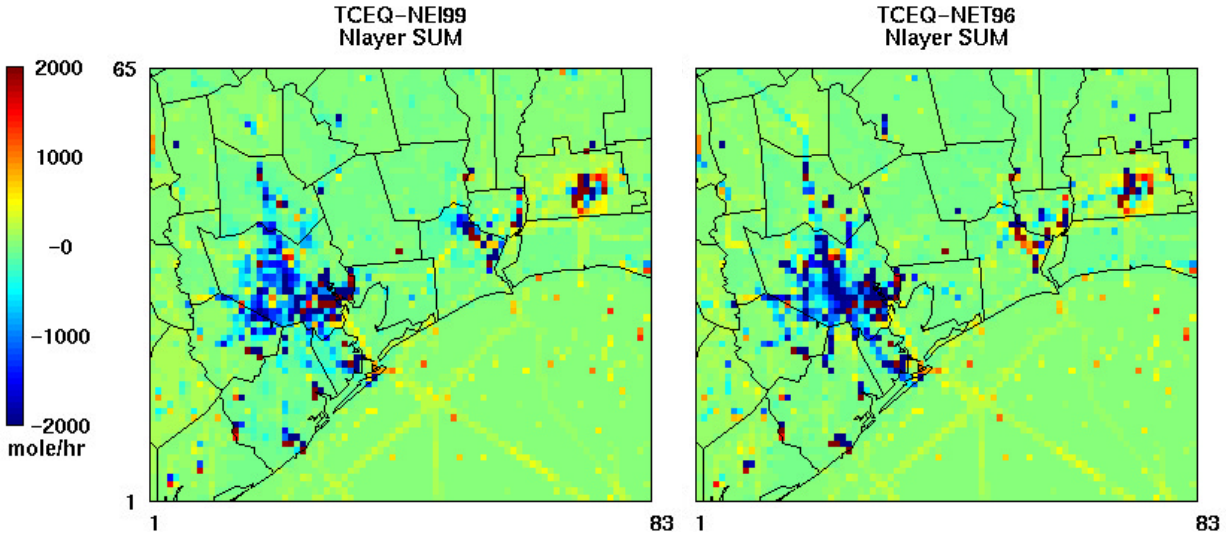
Data sources: [1] National – Calculated based on U.S. EPA NEI 1999 final version 2 EI

[2] State – TCEQ documents (available at ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/ TAD/ Modeling/HGAQSE/Modeling/Doc/TSD_PHASE1/attachment3-emissions_inventory.pdf)

[3] Parenthesis presents regular case emissions.

NO emissions

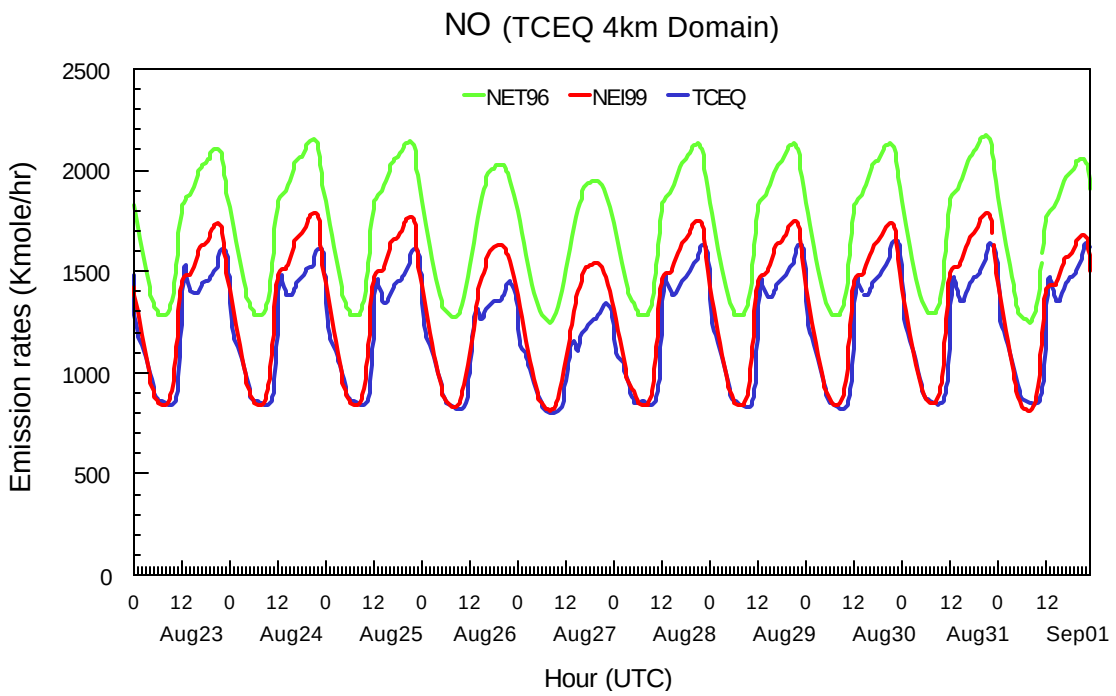


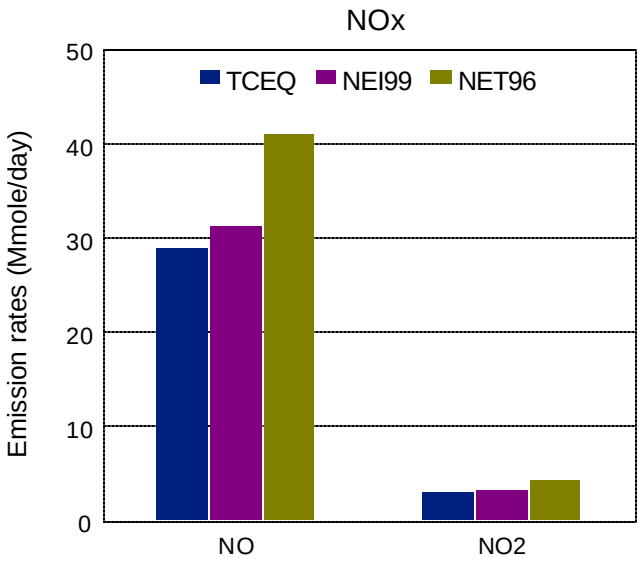


Texas EI shows offshore emissions.

Compared to Texas EI, NEI99 and NET96 show higher NO emissions in downtown Houston due to differences in mobile emissions.

NOx emissions



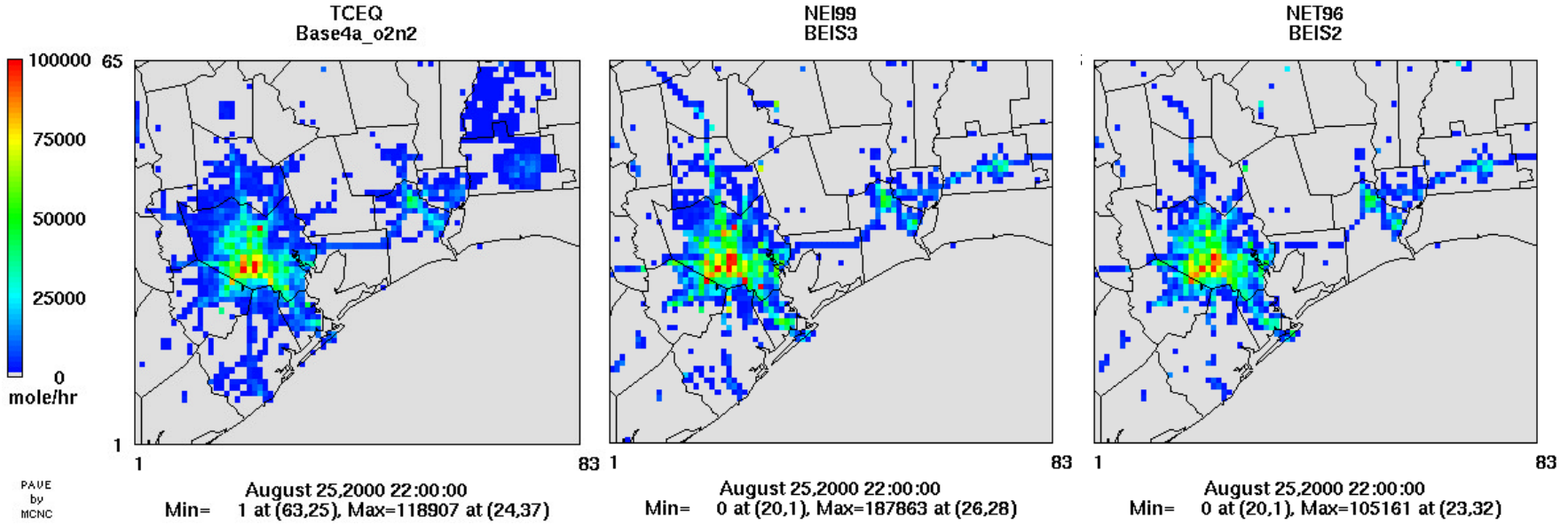


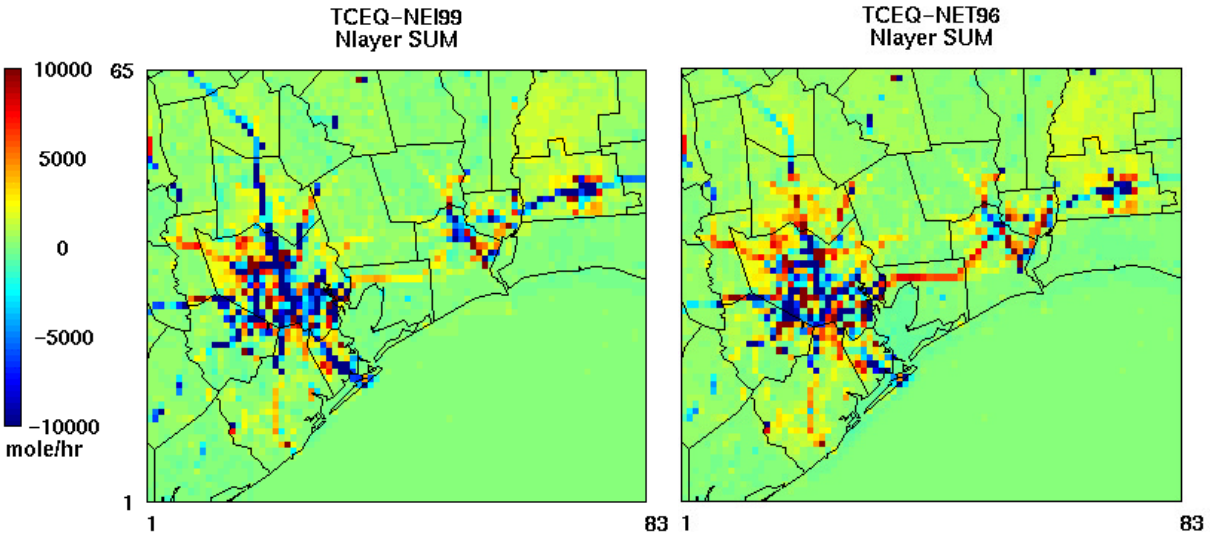
Compared to NET96, NOx emissions in NEI99 has decreased by ~25%.

NEI99 shows higher NO emission in daytime, which is related to diurnal variation pattern of mobile emissions.

Recognizing the offshore emissions not available from NEI99, the difference will increase up to ~20% in/around downtown Houston.

CO emissions

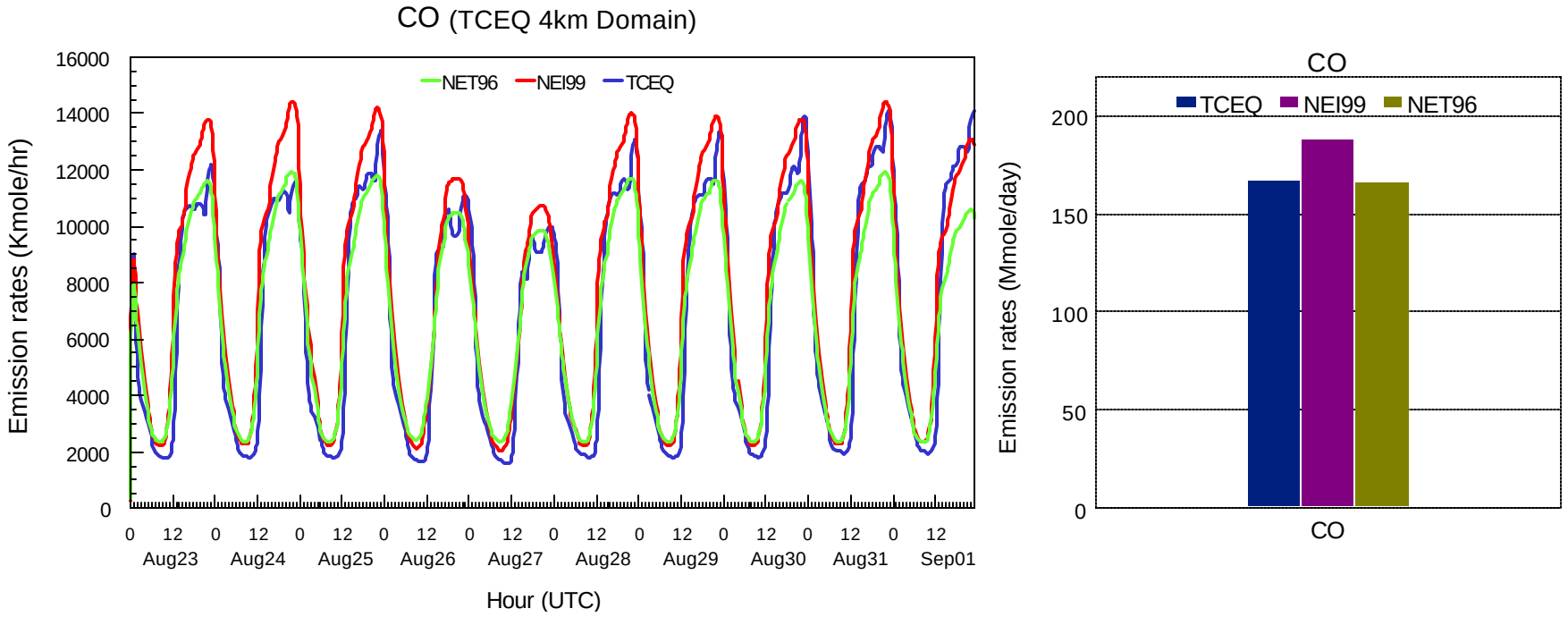




While NEI99 & NET96 show higher emissions along the urban primary roads, Texas EI presents relatively higher emissions on urban areas.

Compared to NET96, CO emissions in NEI99 has increased. (Mobile and nonroad emissions)

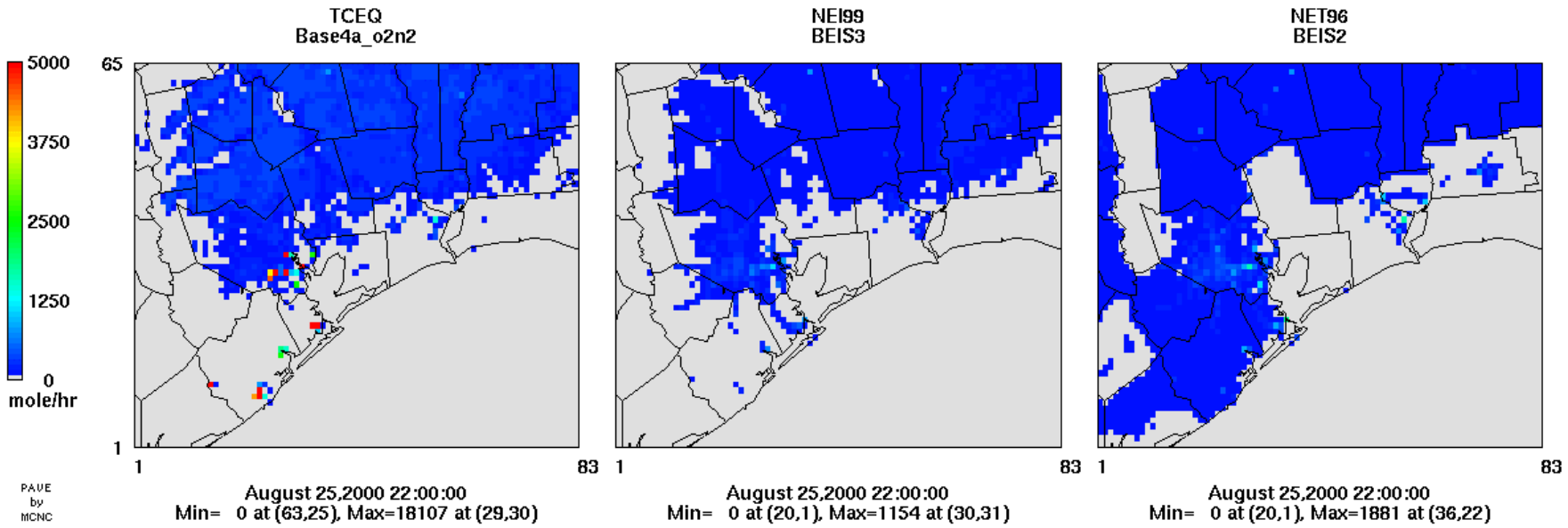
CO emissions

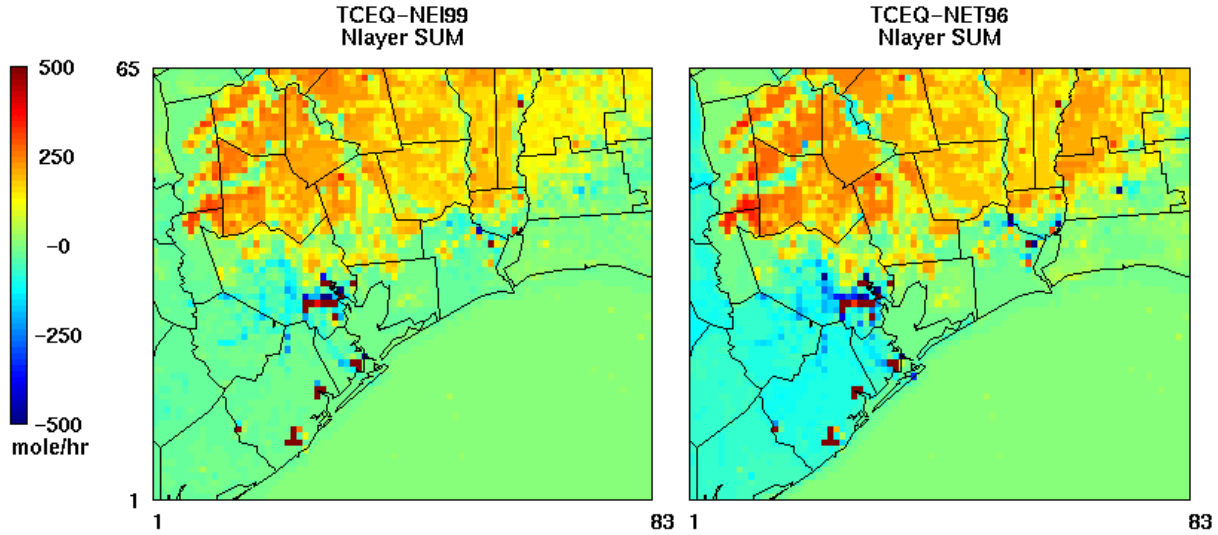


NEI99 shows higher CO emissions than Texas EI and NET96, especially in daytime.

The first half of simulation days: NET96 and Texas EI are comparable;
The second half : NEI99 and Texas EI are close to each other.

VOC emissions - OLE





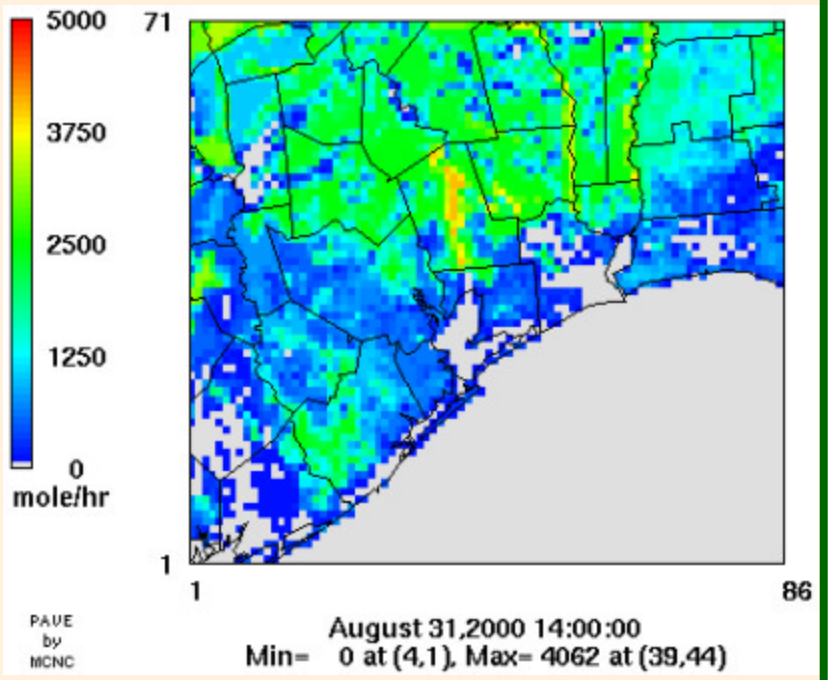
High emissions spots in Texas EI present point source emissions, especially around ship channel area (o2n2 case—selective increase of OLE emissions).

GloBEIS3 estimations show higher OLE emissions than BEIS2/BEIS3 in forest area.

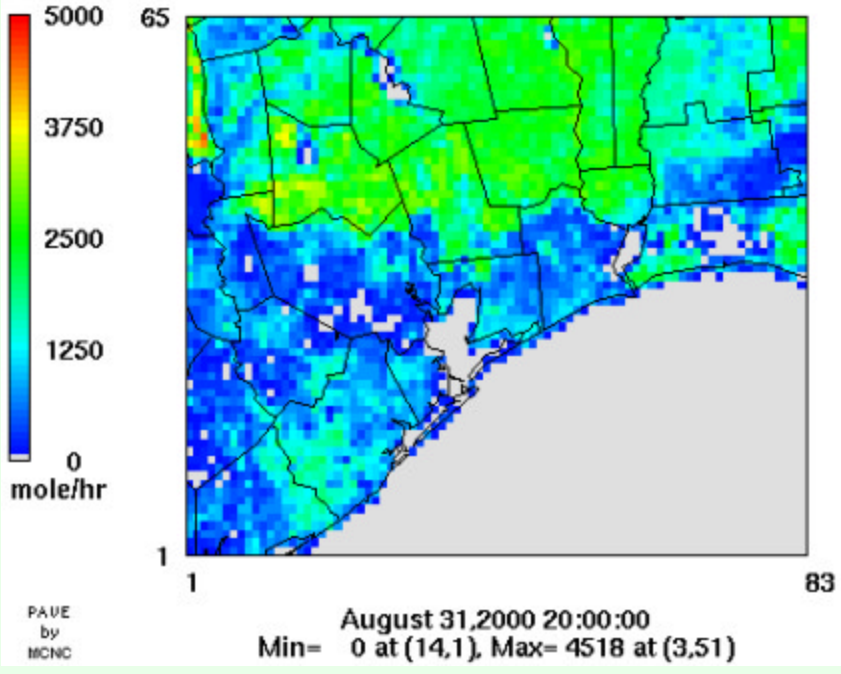
BEIS2 in NET96 based on county-based land use land cover.

Biogenic emissions - ISOP

GLOBEIS3 (TCEQ)



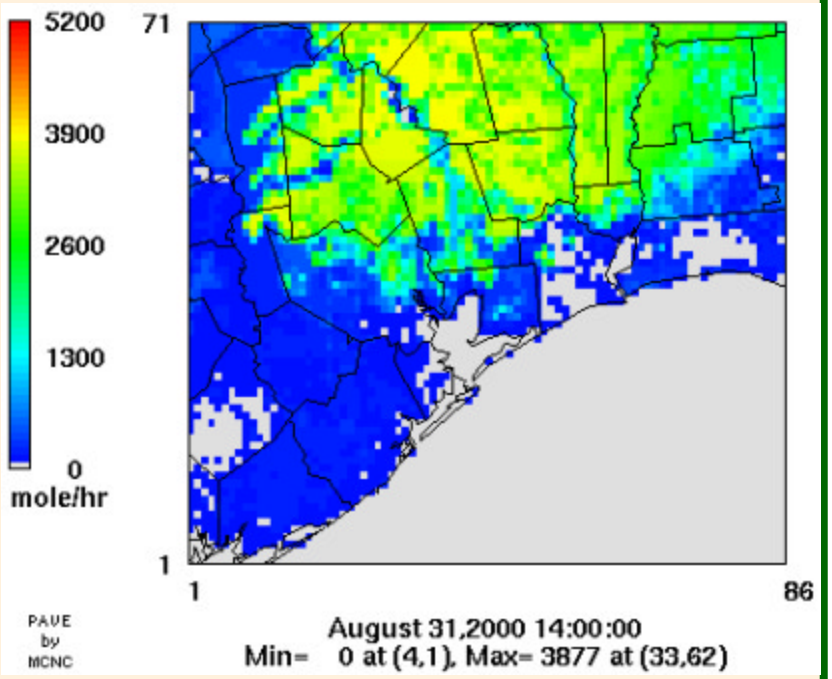
BEIS3 - BGUSE



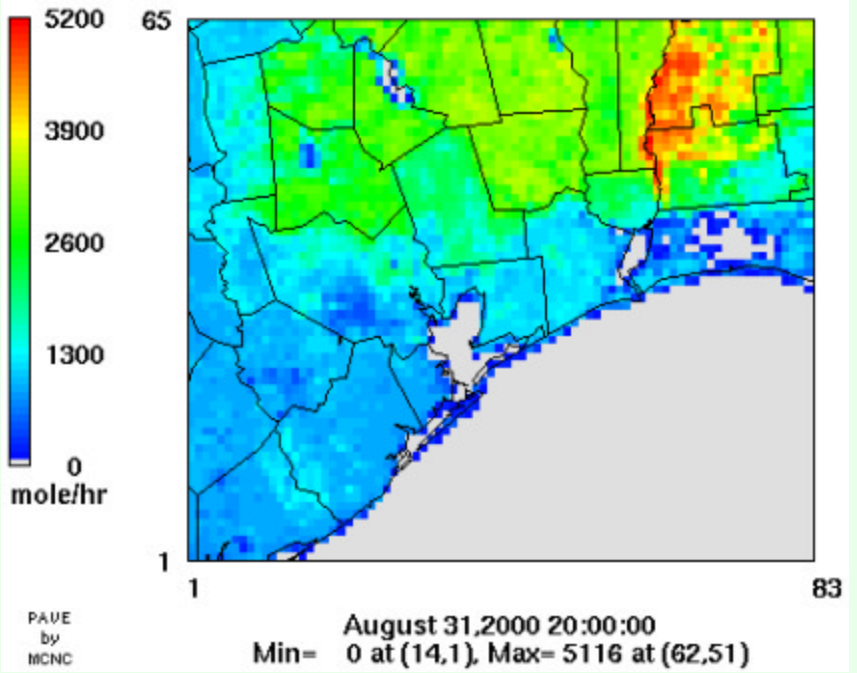
Biogenic 4km, GLOBEIS3 & BEIS3, TexAQS 2000

Biogenic emissions – PAR

GLOBEIS3 (TCEQ)



BEIS3 - BGUSE



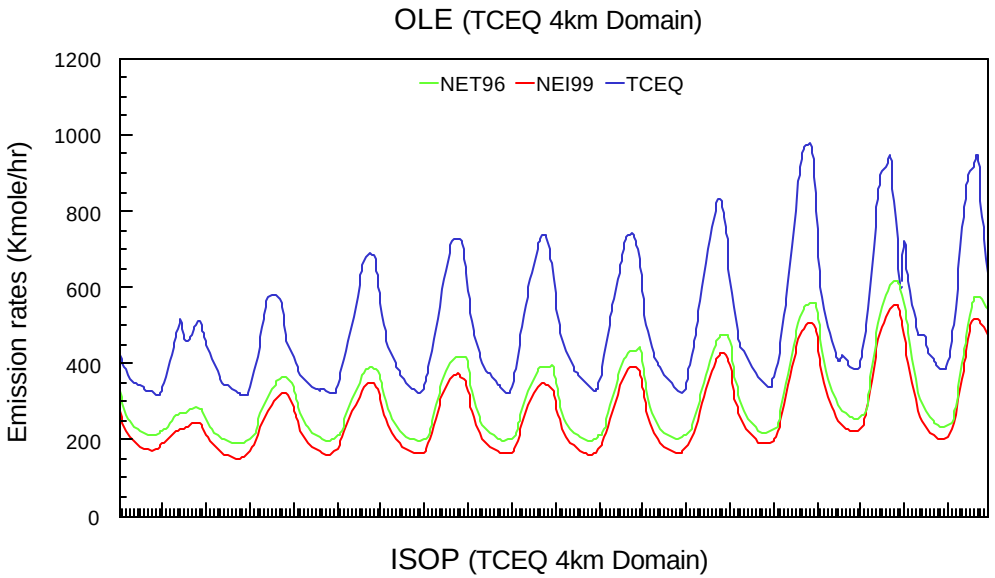
Biogenic 4km, GLOBEIS3 & BEIS3, TexAQS 2000

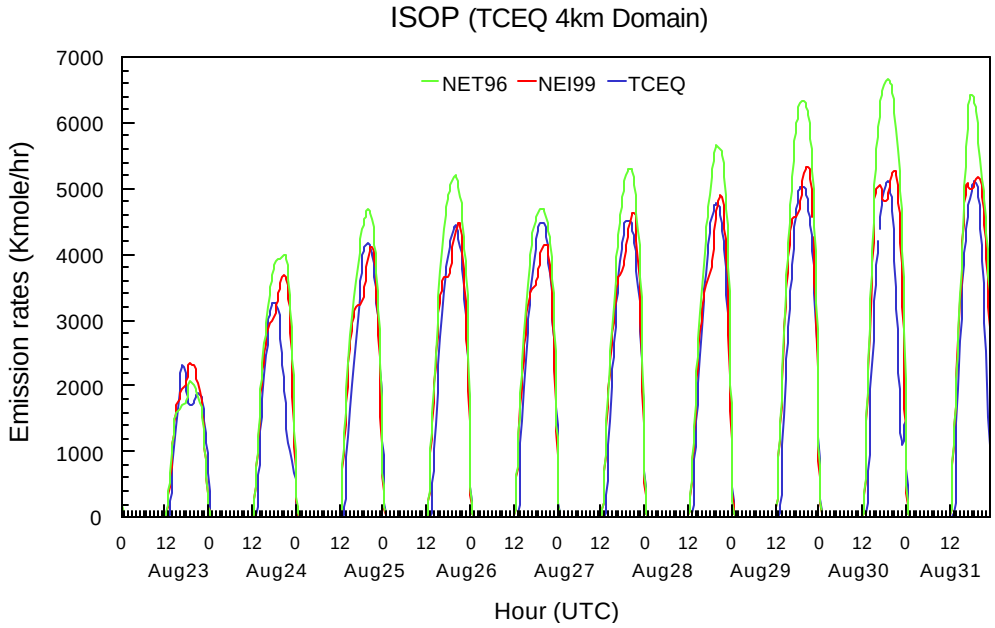
Input differences:

TCEQ GLOBEIS uses obs. Surface temperature, GOES satellite estimated PAR

UH SMOKE uses temperature and PAR provided by MM5

VOC emissions – OLE & ISOP

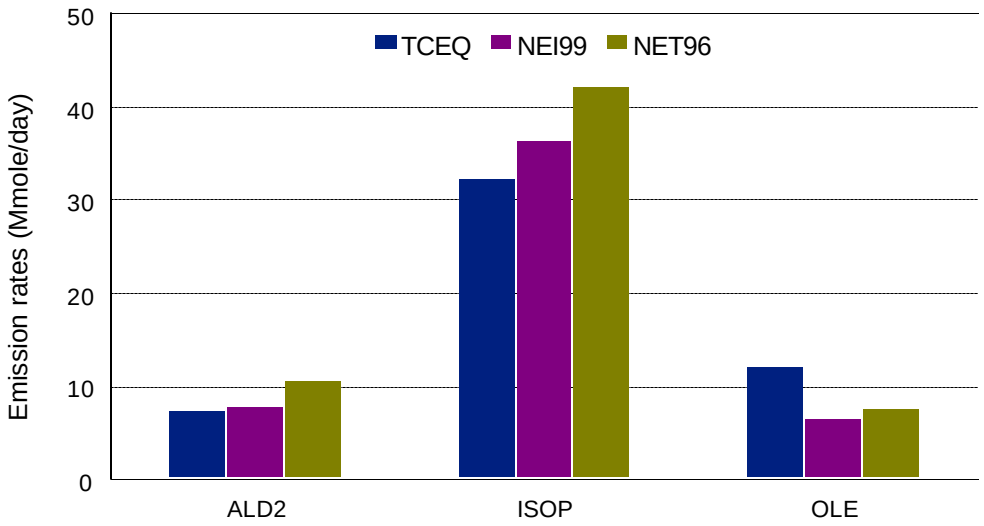


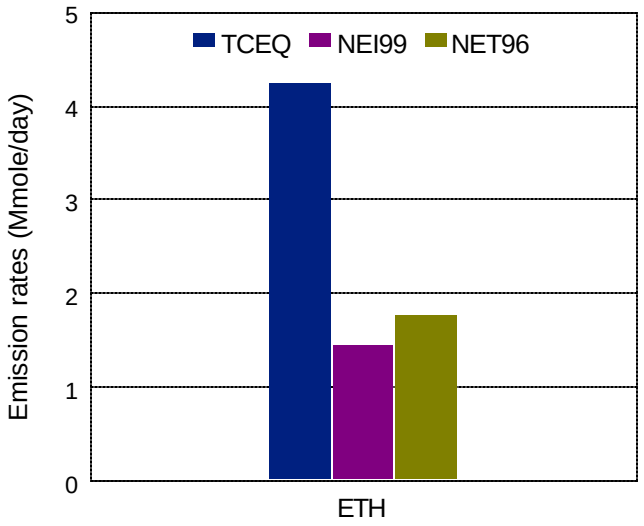


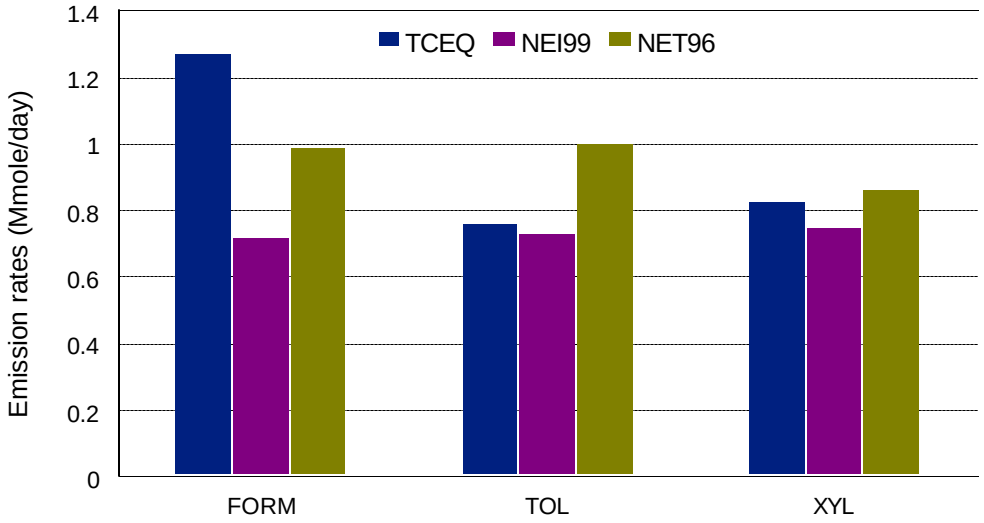
Texas EI shows twice higher OLE emissions due to mainly the selectively increased VOC emissions for point sources.

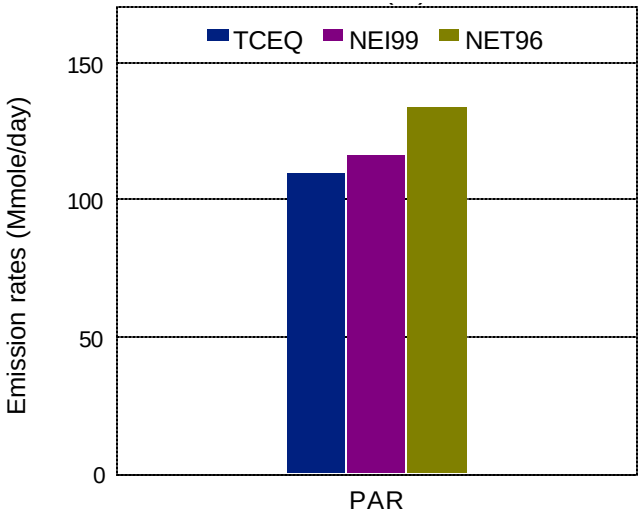
Compared to BEIS2 emissions with BCUSE (NET96), GloBEIS3 (TCEQ) and BEIS3 with BGUSE (NEI99) show similar ISOP emissions.

VOC emissions









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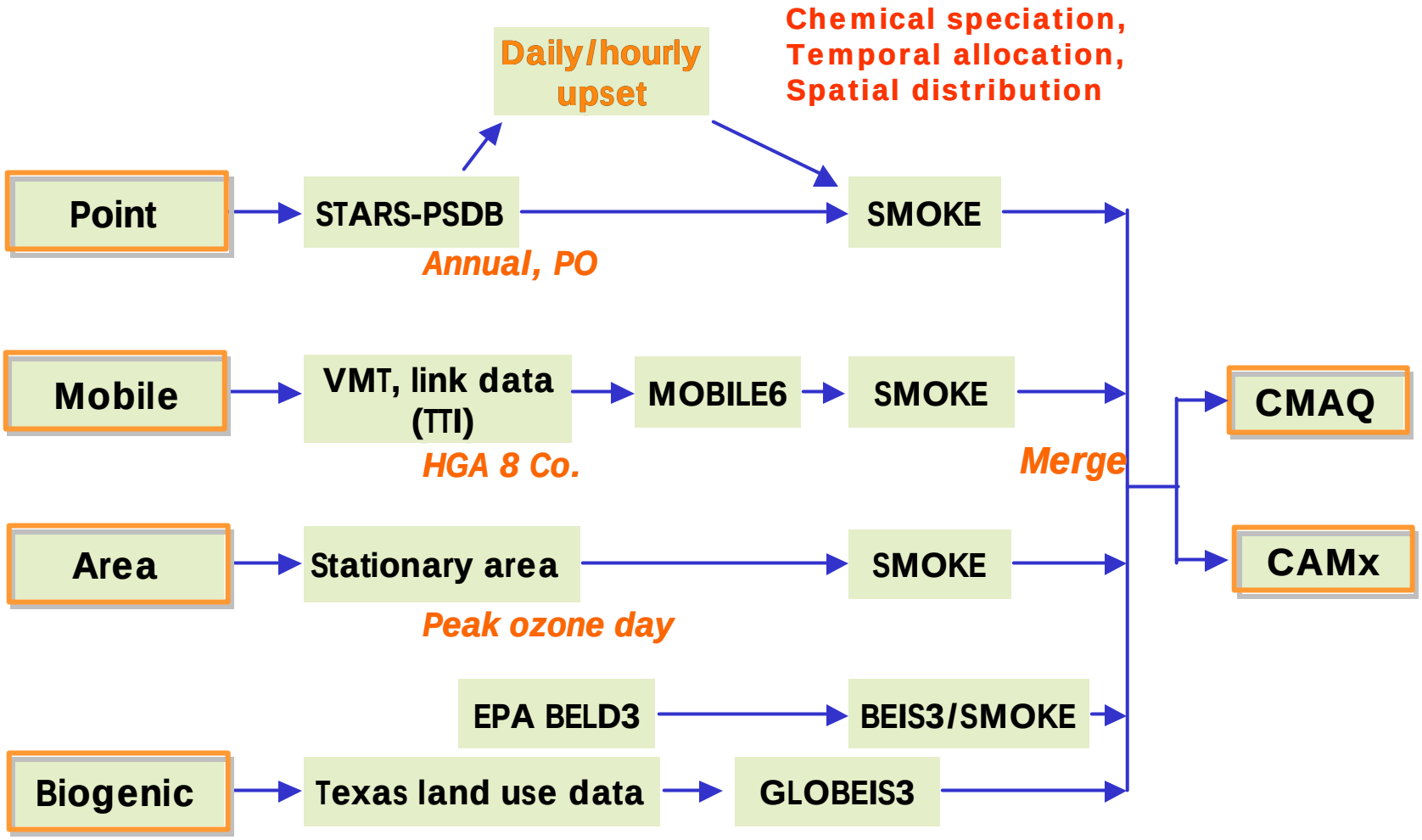
Texas Emissions Inventory

Category	Sub-types	Details
Area & nonroad	• Texas area • Texas nonroad • Louisiana all emissions • Off-shore • Elevated ship emissions	Peak ozone day data, AIRS AMS/AFS file format (Texas: 2000; LA & offshore: 1999; ship: 1997)
Point	• Texas EGU & NEGU • Louisiana EGU & NEGU • Off-shore • Texas upset	Peak ozone day and hourly emissions data, AFS format (1999)
Mobile	• MOBILE6 output for HGA 8 counties	Link-based (2000), TTI
Biogenic	• GloBEIS3 vs. BEIS3	Texas Landuse vs. BELD3

Prepared in EPS2-ready formats

Texas EI linked to SMOKE



Cross-reference and profile files

- **SMOKE based on EPA's cross-reference and profile files for during temporal/spatial allocations and chemical speciation.**

  Exceptions:

  Used surrogates for on-/offshore area Emissions.

  Created temporal profiles for supplementary hourly and upset point emissions based on daily and hourly variation patterns.

- **EPS2 used cross-reference and profile files provided by TCEQ.**

Chemical Speciation

1 Split factors

- Applied to VOC species.
- SMOKE assigns SCC-related profile codes by U.S. EPA.
- EPS2 uses SCC and FIPS code to assign profile codes by TCEQ.
- EPS2 also uses special profile for adjusted emissions.

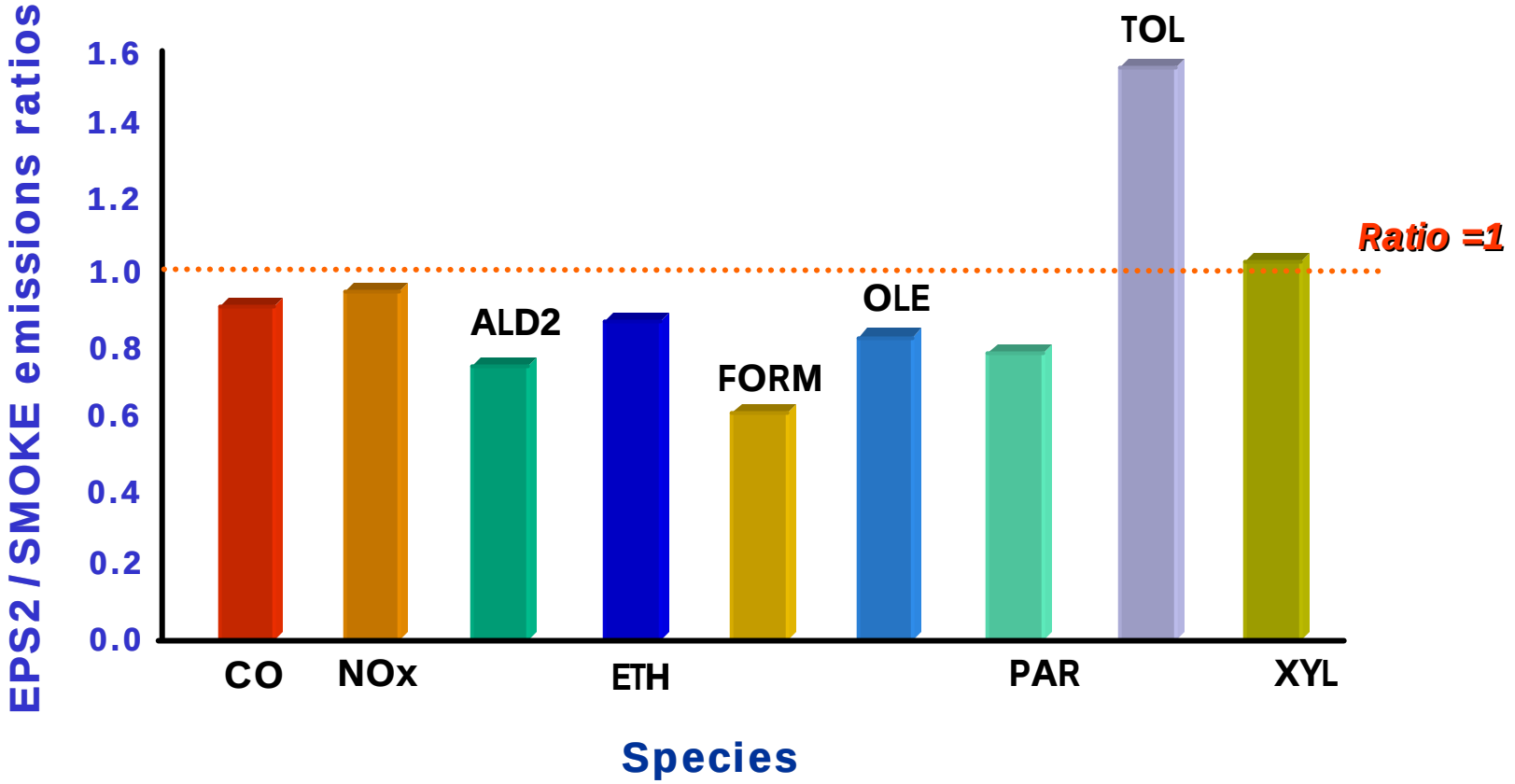
2 Example of speciation profile for SCC 30119701 (FIPS 48000)

Chemical Manufacturing, Ethylene: General

	OLE	PAR	TOL	XYL	FORM	ALD2	ETH	MEOH	ETOH	ISOP	NR
EPS2	8.04E-03	1.57E-02	1.69E-04	3.64E-05	1.07E-05	2.37E-04	1.55E-02	1.09E-04	0.00E+00	1.61E-05	-
SMOKE	-	2.95E-02	5.54E-05	-	-	-	-	-	-	-	3.72E-02

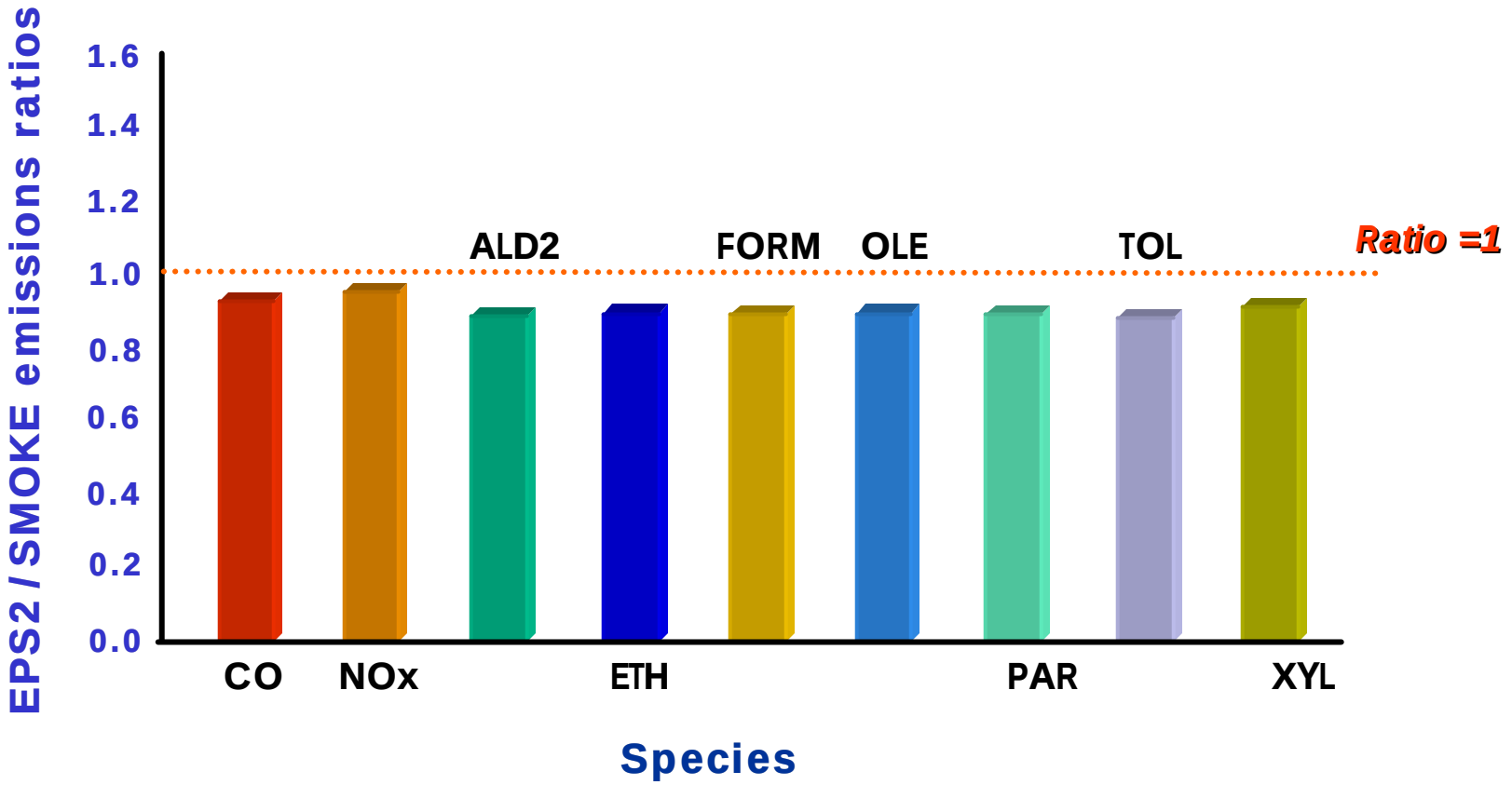
Example of Chemical Speciation

Area emissions



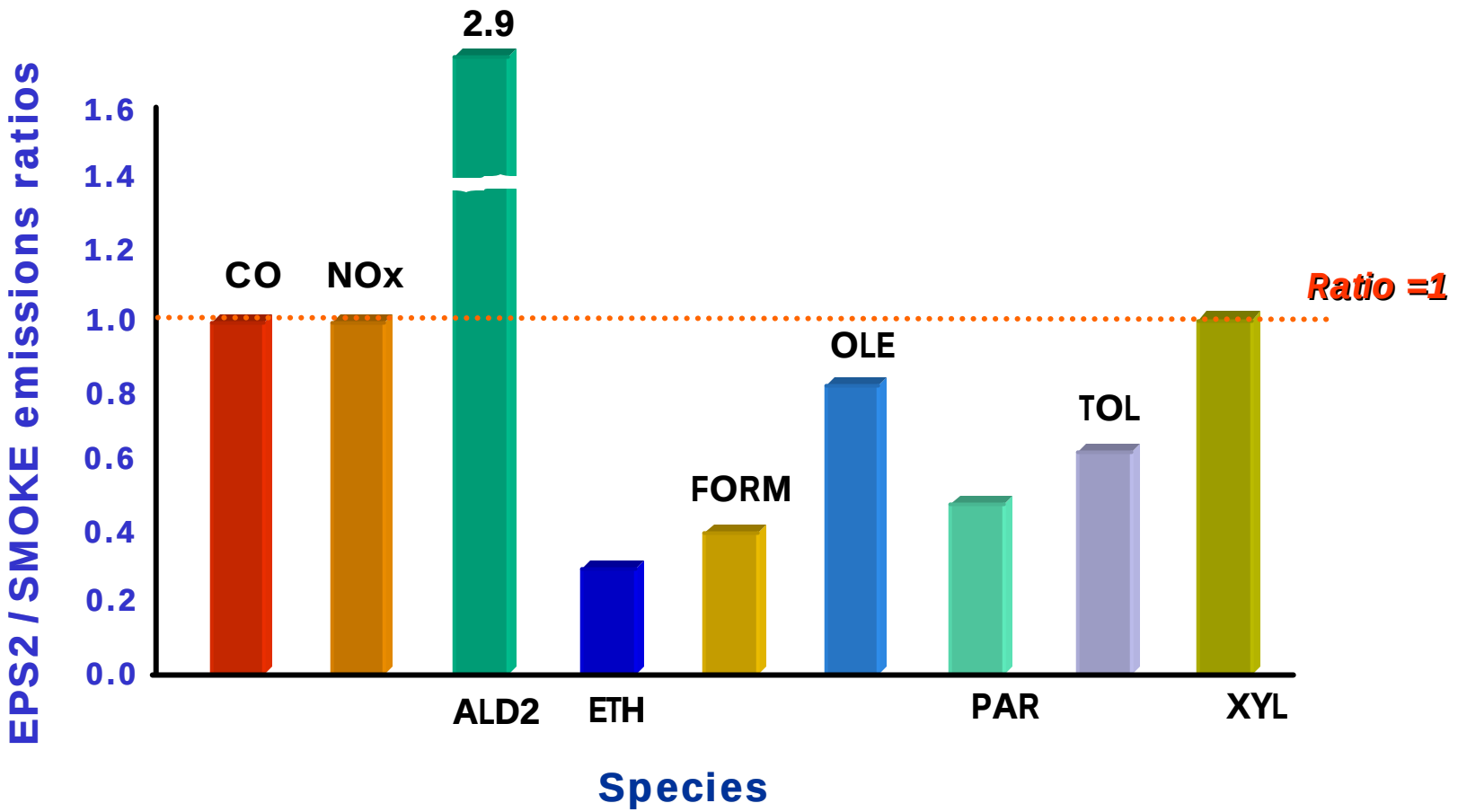
Example of Chemical Speciation

Nonroad mobile emissions



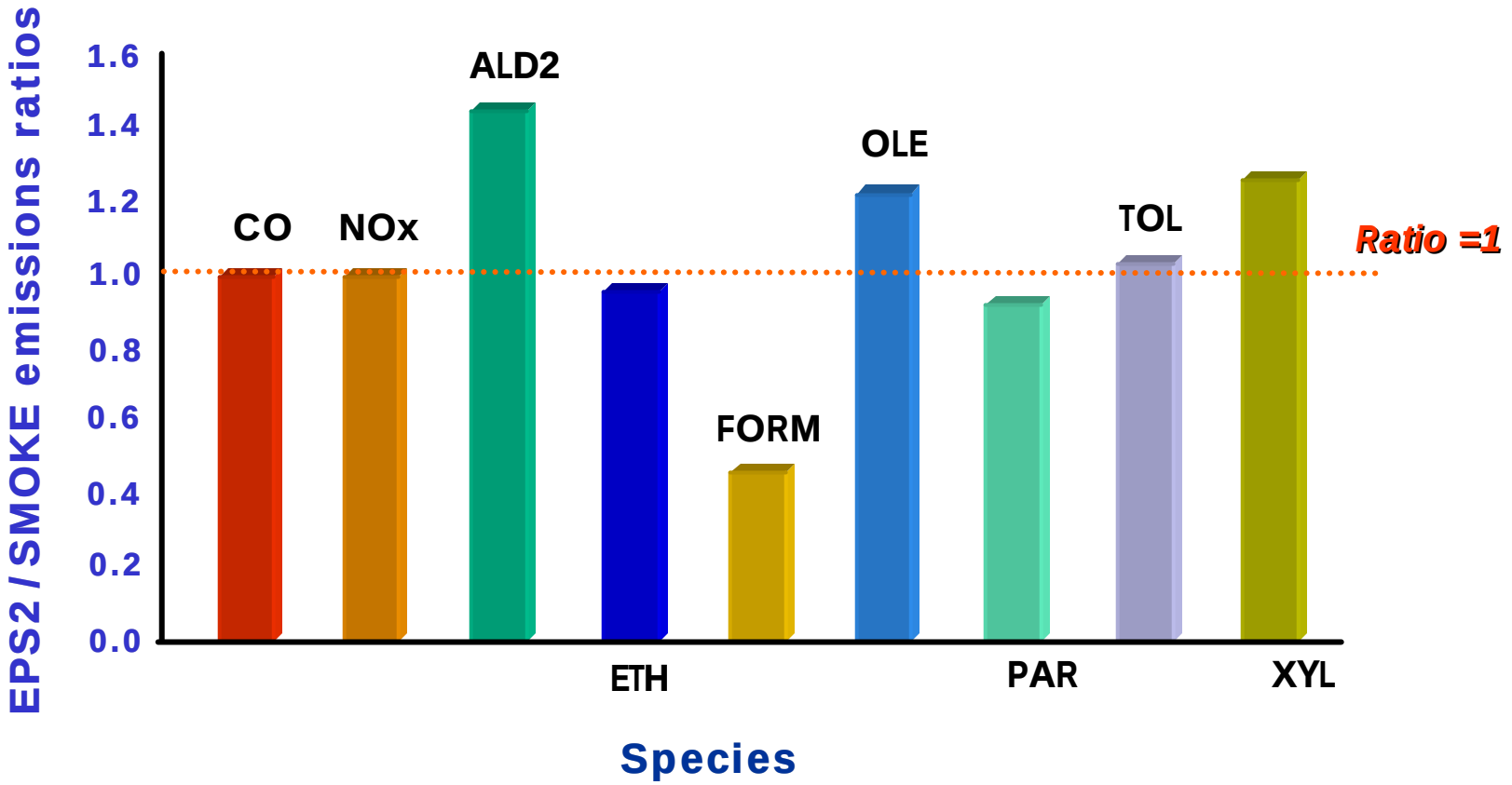
Example of Chemical Speciation

EGU point emissions



Example of Chemical Speciation

NEGU point emissions

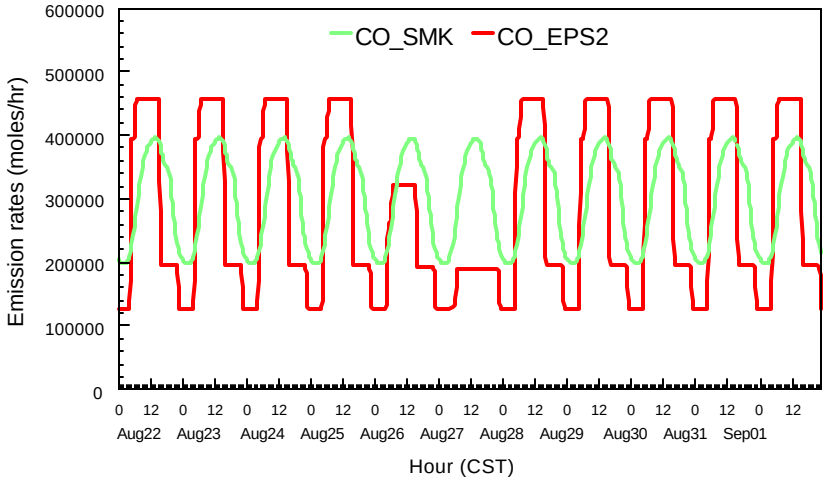


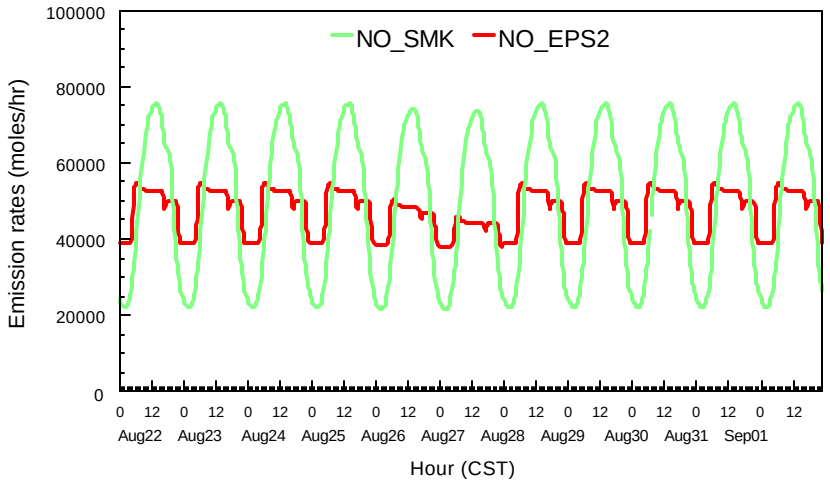
Temporal Allocation

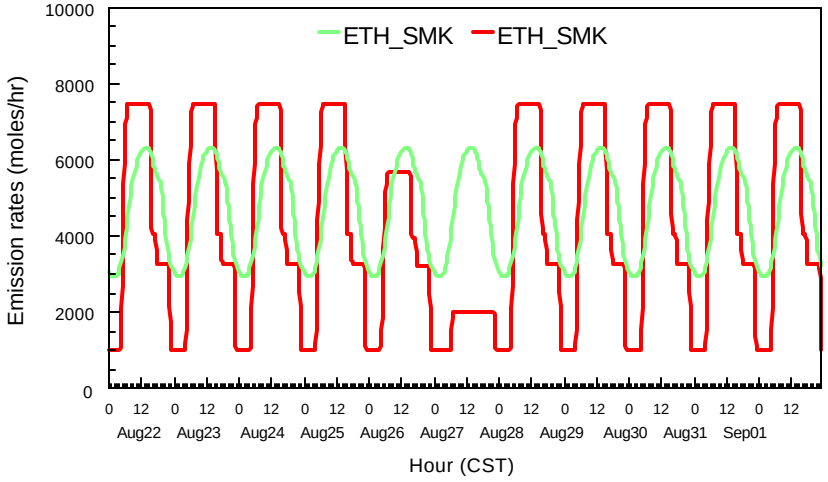
1. **Peak ozone day and annual average emissions**
   - Need to be allocated with monthly, weekly, and weekday/weekend profiles.
   - SMOKE uses nationwide profiles.
   - EPS2 based on Texas-specified profiles.
   - Area and regular point emissions
2. **Hourly and upset emissions**
   - Supplementary and special point emissions.
   - Source- and hour-specific profiles are prepared for SMOKE.

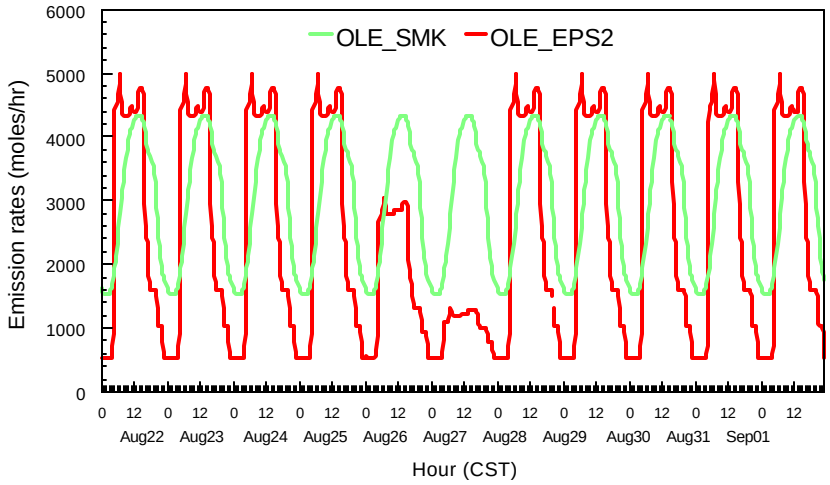
Example of Temporal Allocation

Area emissions



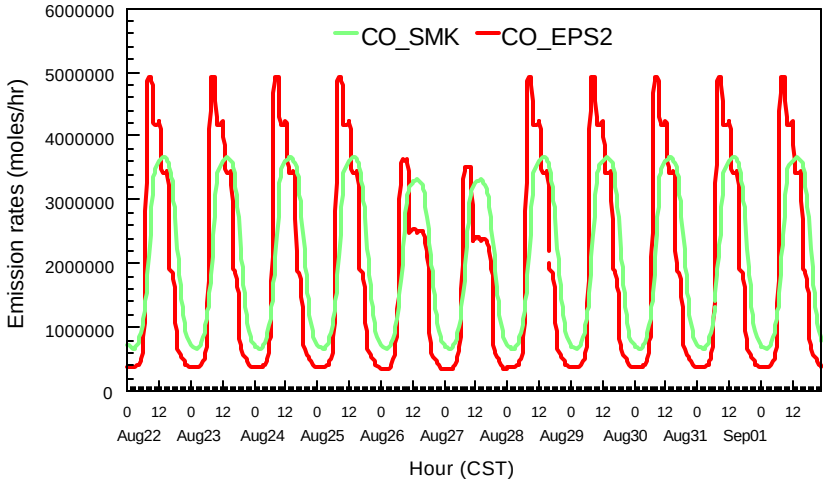


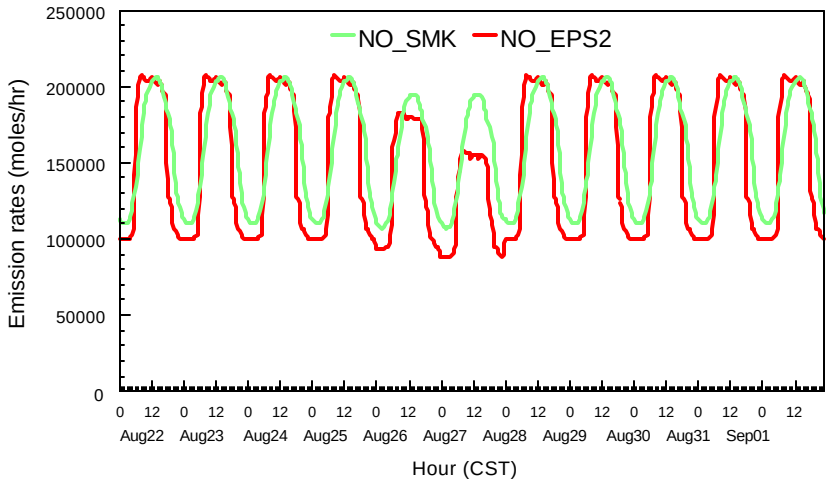


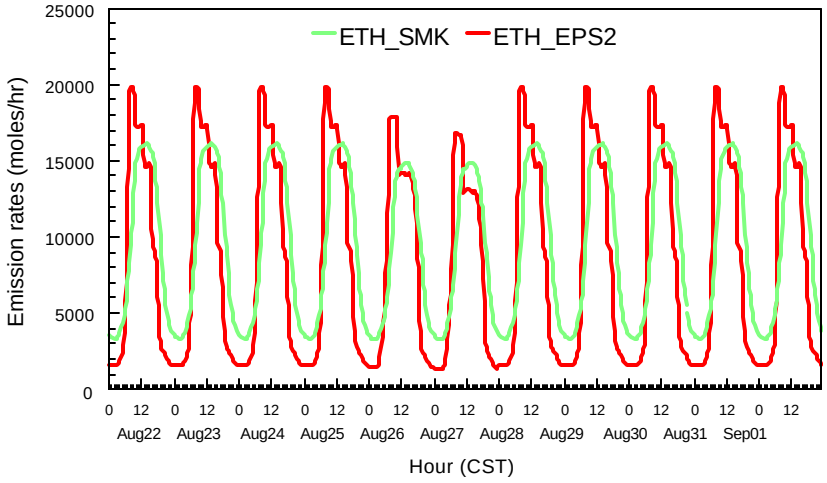


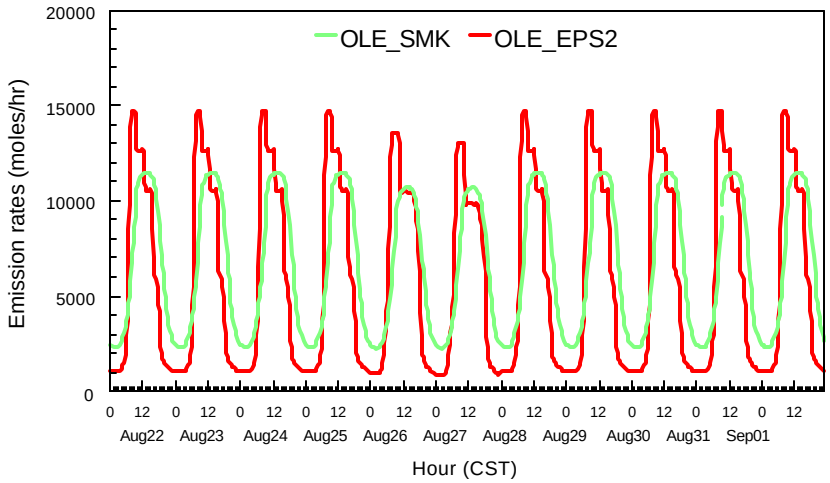
Example of Temporal Allocation

Nonroad mobile emissions



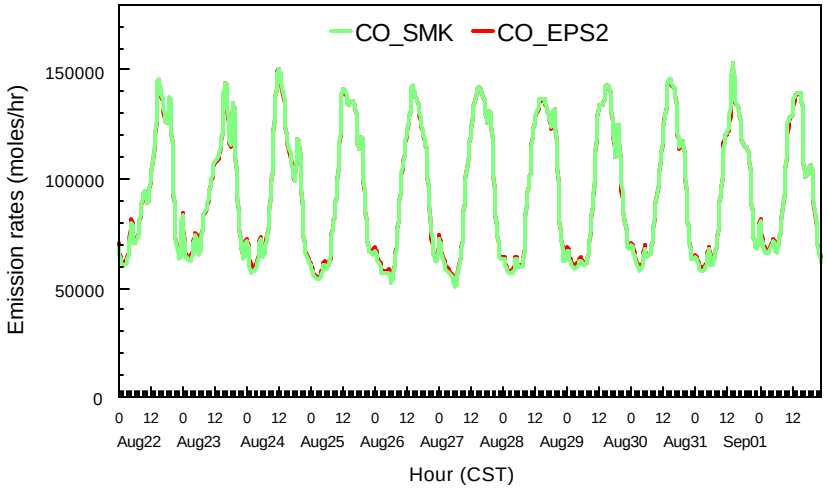


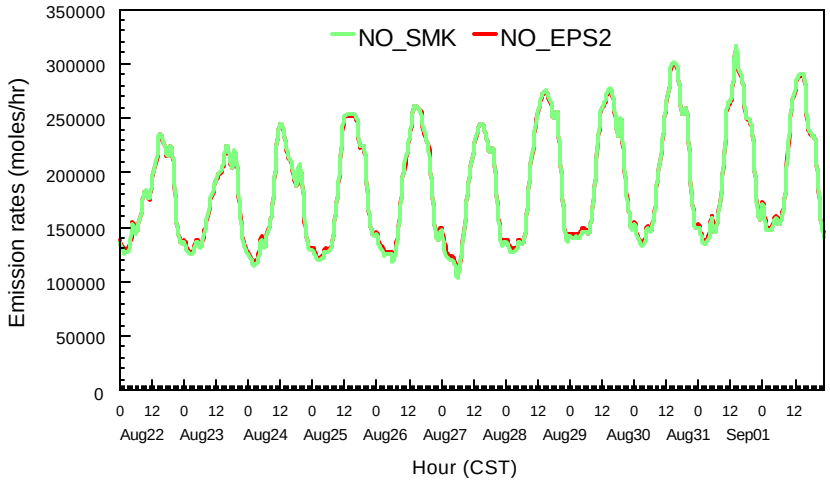


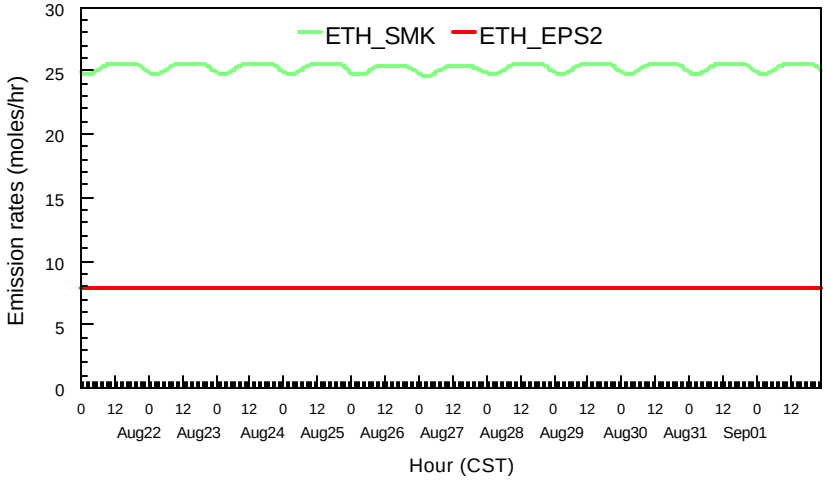


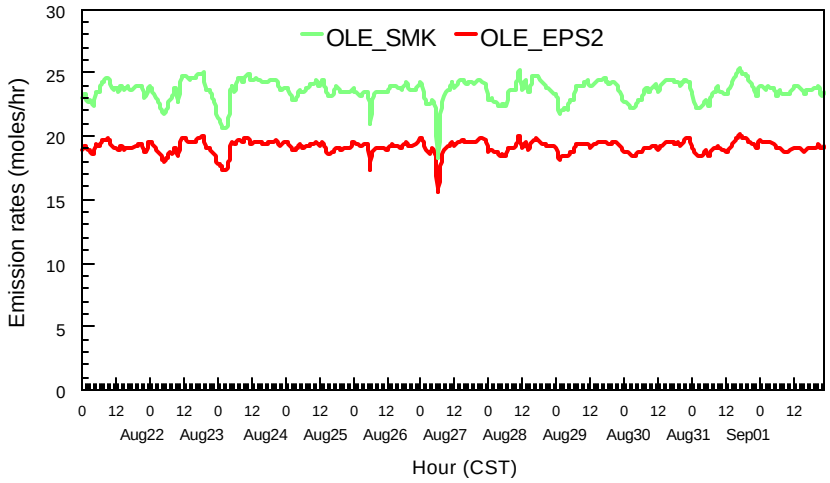
Example of Temporal Allocation

EGU point emissions



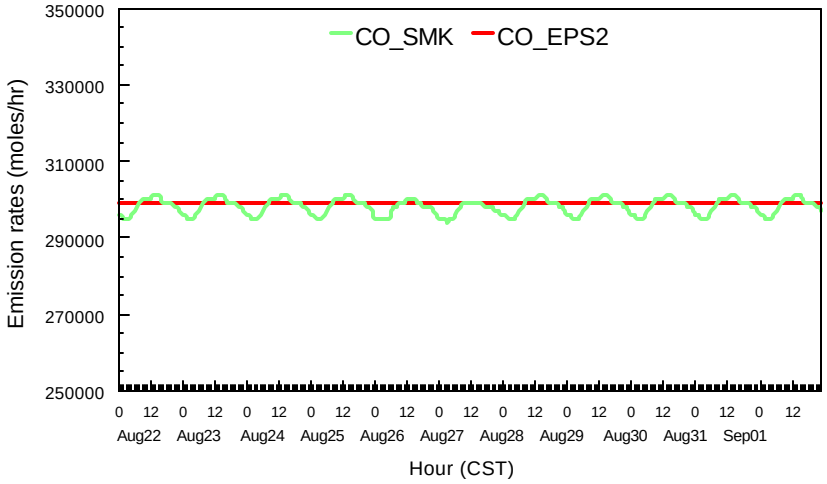


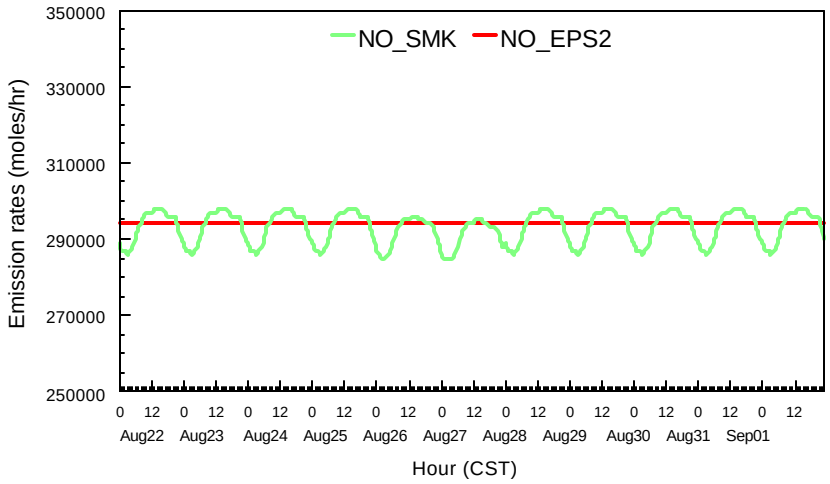


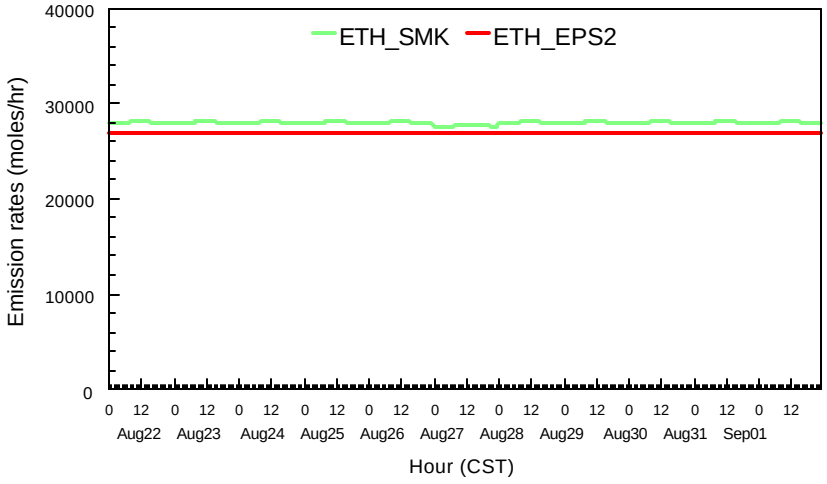


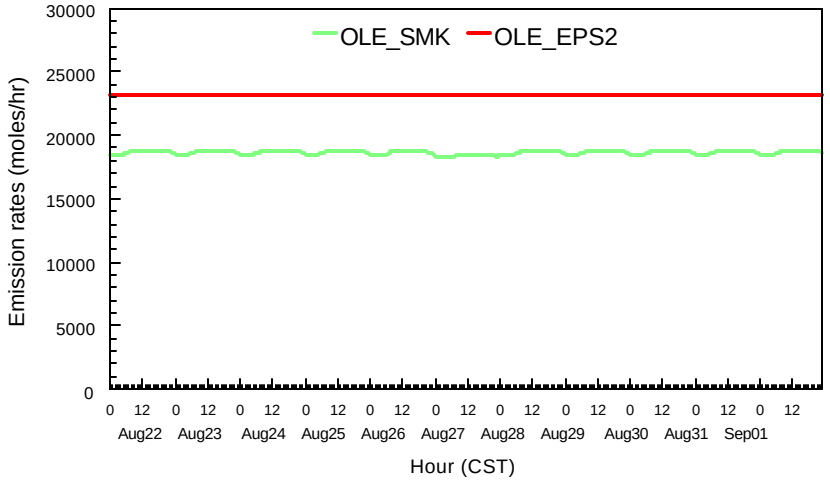
Example of Temporal Allocation

NEGU point emissions









Spatial Allocation

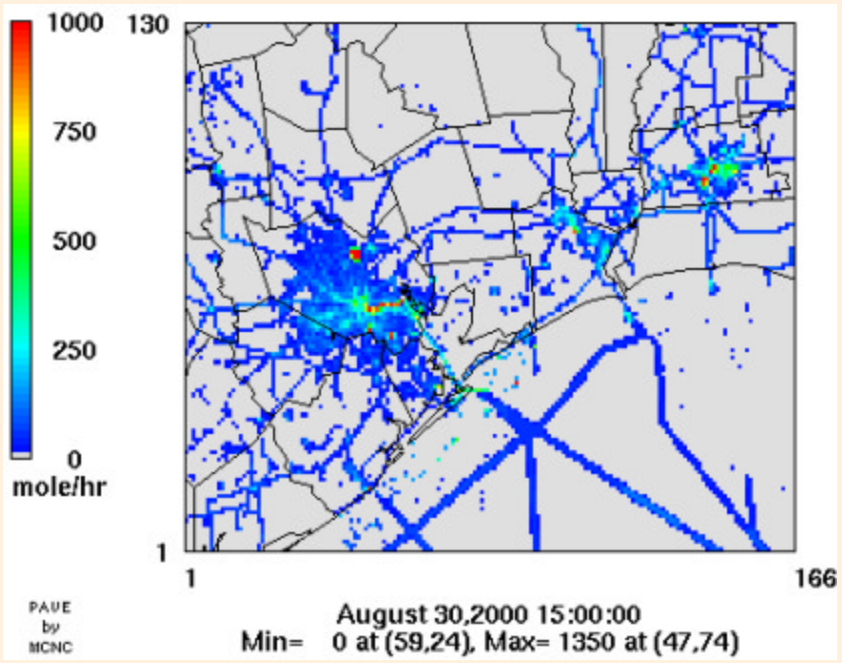
1 Surrogates data

- Determine spatial emission patterns.
- Area and non-road mobile emissions.
- Fine grid domain needs more detailed emission shape.
- U.S. EPA has two versions: US96 & US2003.
- TCEQ has also developed for Texas EI.
- SMOKE and EPS2 are using different surrogating data.
- U.S. EPA implementing new surrogating system

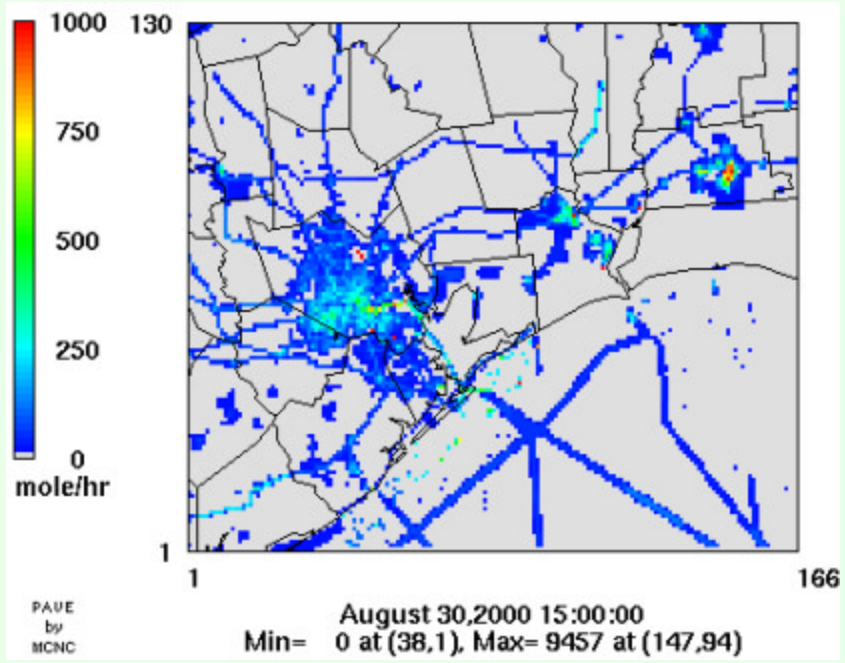
Example of Spatial Allocation

Area/Nonroad mobile emissions

EPS2



SMOKE



Inland emissions use different surrogates.

Conclusions

- Compared to NET96, NO emissions in NEI99 has decreased, but still higher than Texas EI.
- NEI99 shows higher CO emissions than both NET96 and Texas EI due to increase in mobile emissions.
- Texas EI presents different emission rate for each VOC species compared to national inventories, especially for point sources.
- Different land use and meteorological data cause different biogenic emission patterns in BEIS3 and GloBEIS3.

Things to be done

- Surrogates, chemical split factors and temporal profiles in SMOKE and EPS2 will be harmonized in the near future.
- BEIS3 will reprocessed with PAR, LULC and temperature data used in GloBEIS3.