CHANGES TO THE BIOGENIC EMISSIONS INVENTORY SYSTEM VERSION 3 (BEIS3)

Donna Schwede, George Pouliot, Tom Pierce

Atmospheric Sciences Modeling Division

Air Resources Laboratory, NOAA

In partnership with the National Exposure Research Laboratory, USEPA

BEIS3 Emissions Model

$$Emission = [\varepsilon][\gamma_P \gamma_T][\rho]$$

= Standardized emission factor

(30☜C; PAR 1000 ☞mol m^{-2} s^{-1})

☎$_P$ = Light adjustment factor

☎$_T$ = Temperature adjustment factor

👎 = Foliar density

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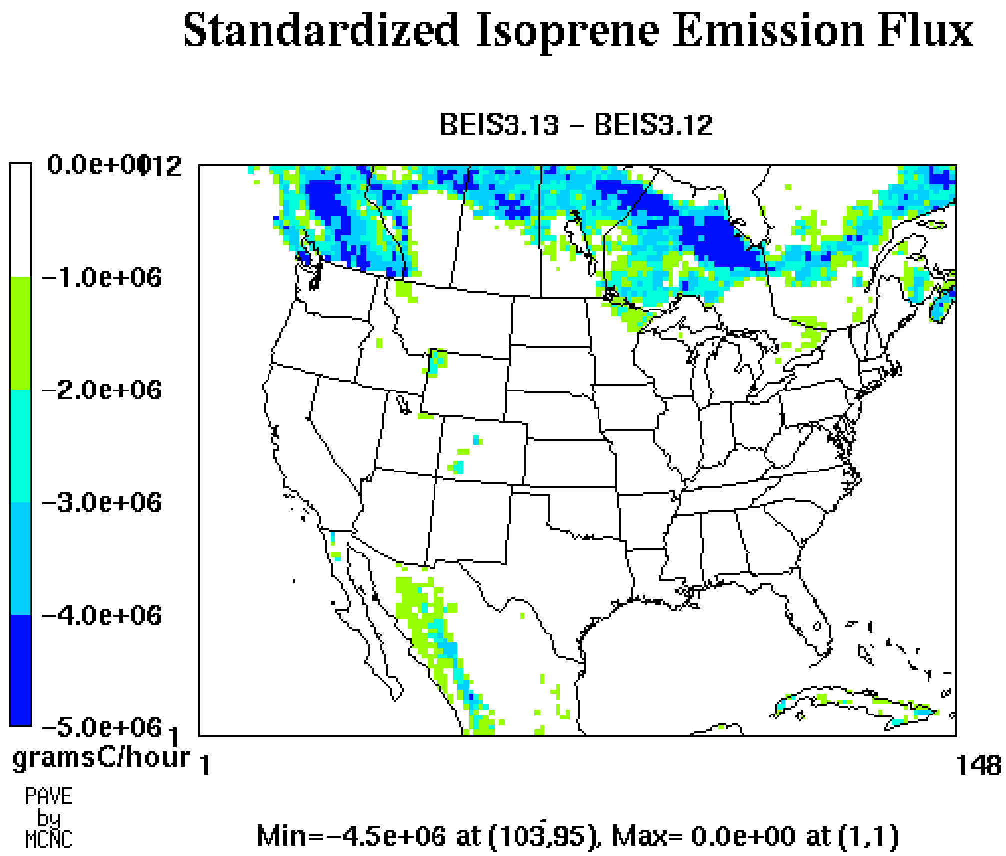
Standardized Emission Factors - Isoprene

	BEIS3.12 (g C km^{-2} h^{-1})	BEIS3.13 (g C km^{-2} h^{-1})	Net Change
Spruce	10,500	5,250	-50%
USGS Coniferous	11,383	7,918	-19%
USGS Deciduous	8,232	6,707	-30%

* Based on Isebrand et al (1999), Pattey et al (1999), and Westberg et al (2000).

Effect of Isoprene Emission Factor Change

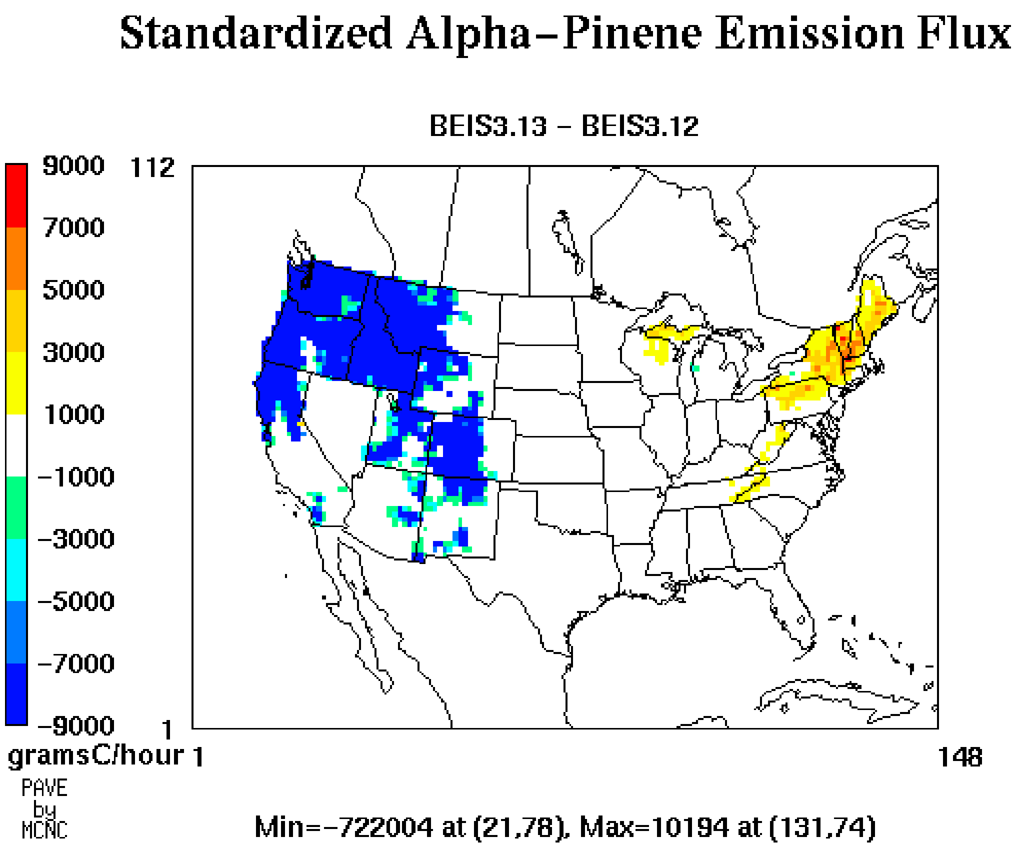


Standardized Emission Factors - Monoterpene

	BEIS3.12 (g C km^{-2} h^{-1})	BEIS3.13 (g C km^{-2} h^{-1})	Net Change
Douglas Fir	1064	585	-72%
Hemlock	126	665	+541%

* Based on Pressley et al (2004).

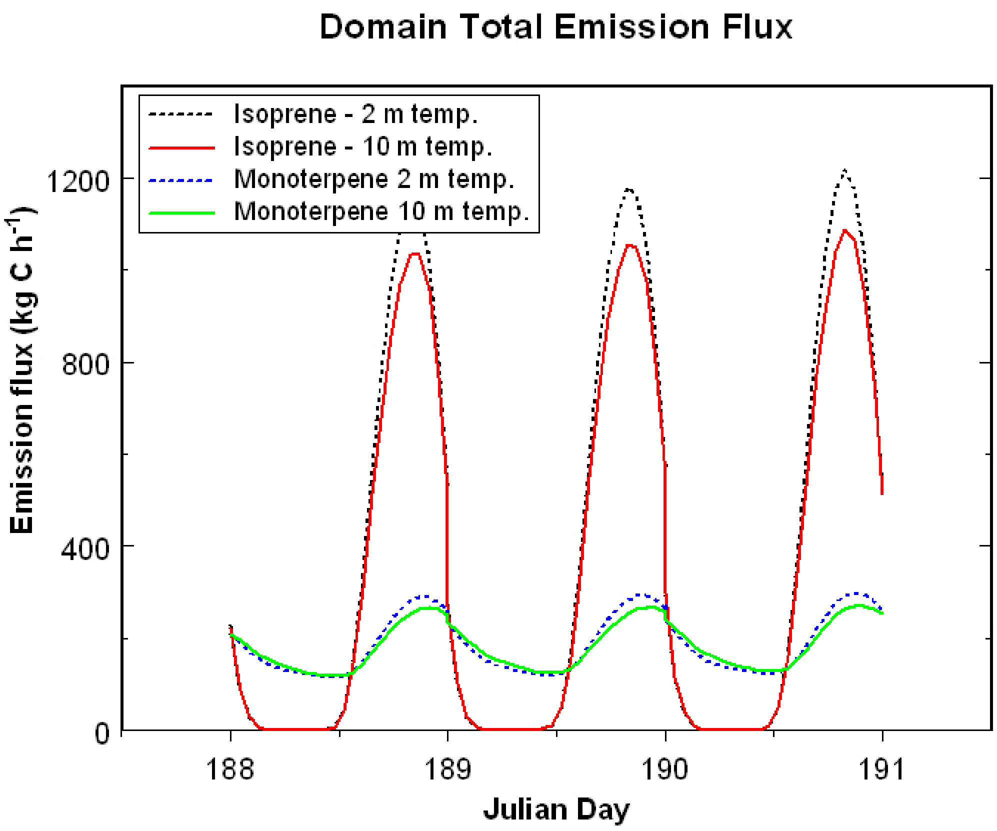
Effect on Monoterpene Emission Factor Change



Effect of Temperature

- Ambient temperature used as a surrogate for leaf temperature
- MCIP version 3 provides both 2m and 10m temperatures
- Choice of temperature height currently an input to BEIS3.13
- Different heights may be appropriate for different areas and biogenic emissions processes

Effect of Temperature

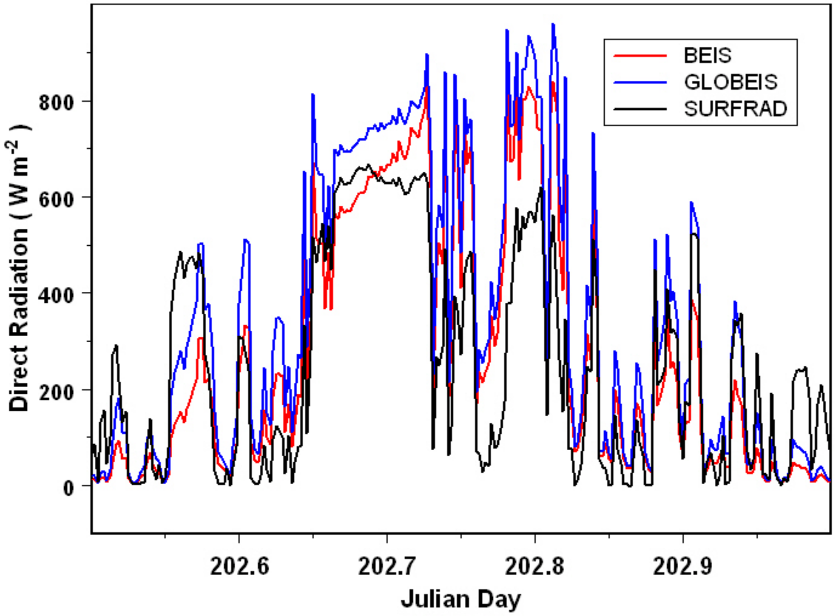


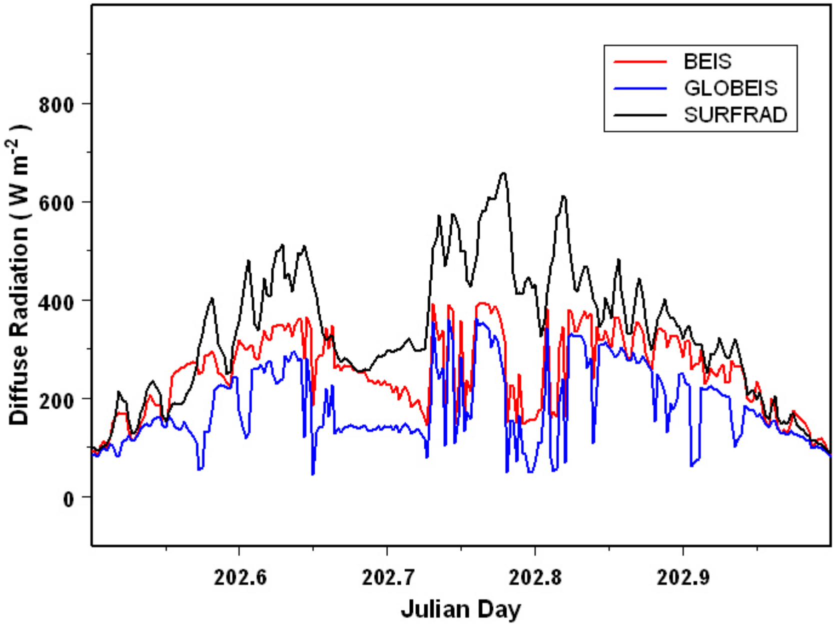
Effects of Radiation – Radiation Model

- Bug fix (clnew.for)
- Empirical parameterization used to separate radiation into components (direct, diffuse, PAR, IR)
  - BEIS - Weis and Norman (1985)
  - GLOBEIS – Spitters et al (1986) w/ mods

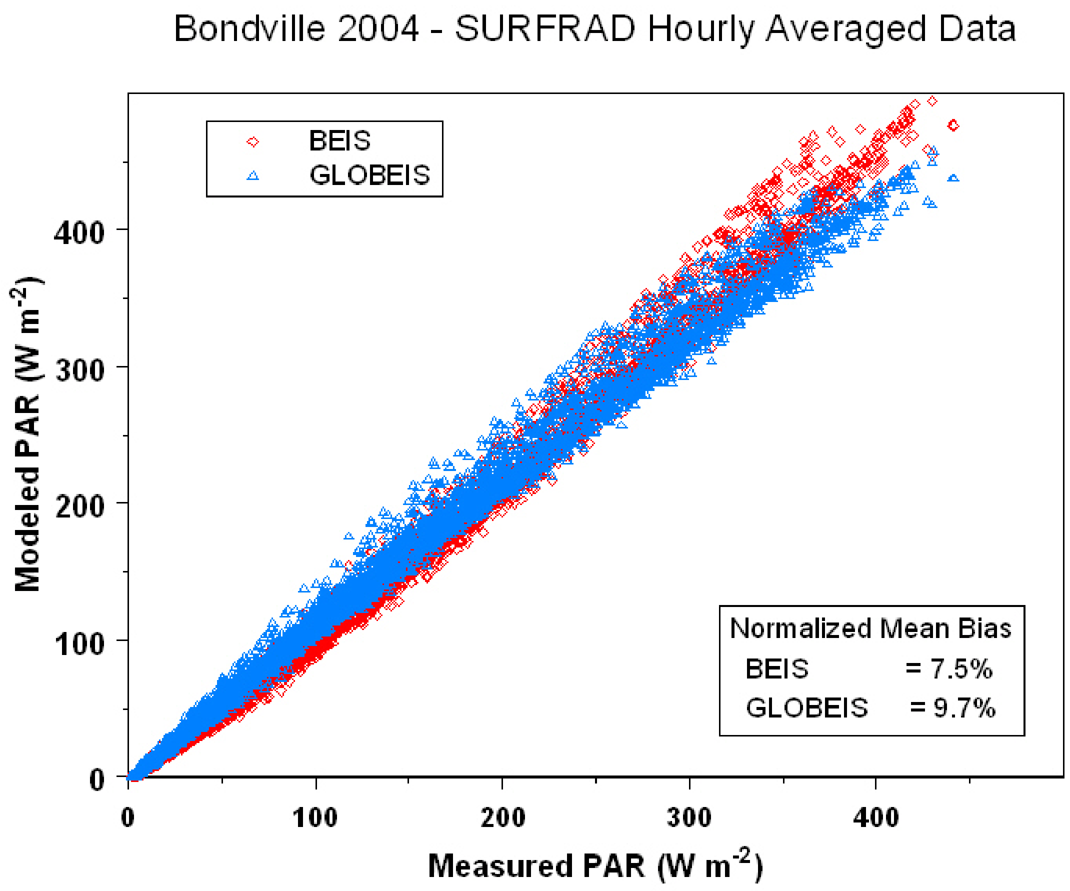
Comparison of Direct and Diffuse Radiation

Bondville 2004 SURFRAD 3-Minute Data





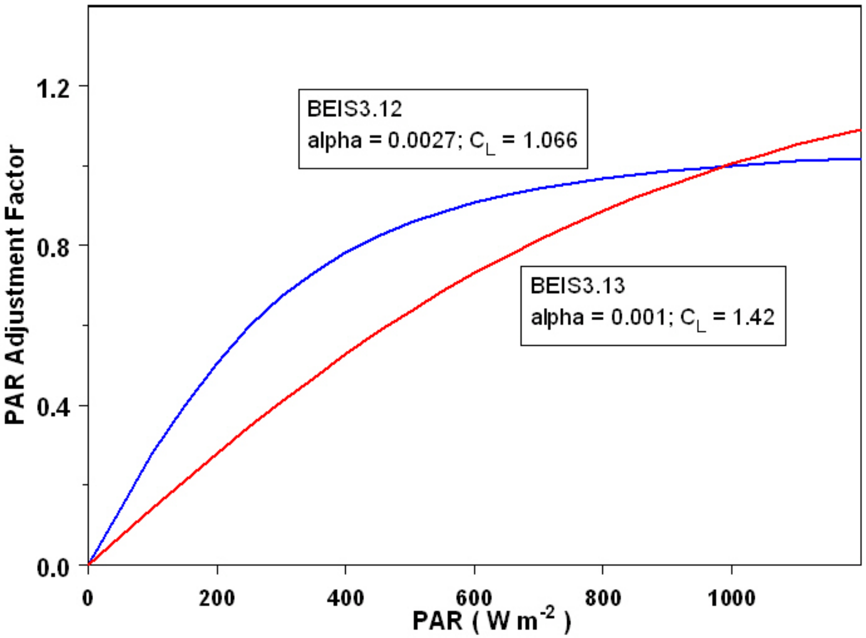
Comparison of PAR Values



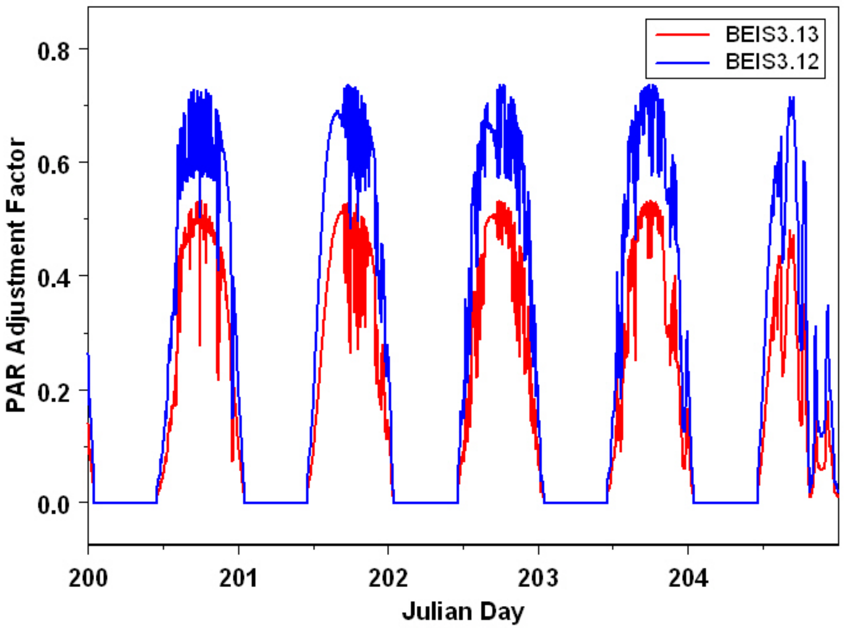
Effects of Radiation – Adjustment Factor

$$\gamma_P = \frac{\alpha C_L Q}{(1+\alpha^2 Q^2)^{0.5}}$$

- Guenther et al (1993)
  - α = 0.0027; C_L = 1.066
- Guenther et al (1999)
  - α = 0.001 + 0.0085*LAI
  - C_L = 1.42*exp(-0.3*LAI)
  - LAI = cumulative LAI
  - BEIS assumes
    LAI = 0 = Top of canopy



Comparison of the light (PAR) adjustment factor calculated by the Guenther et al (1993) and Guenther et al (1999) equations as implemented in BEIS3.

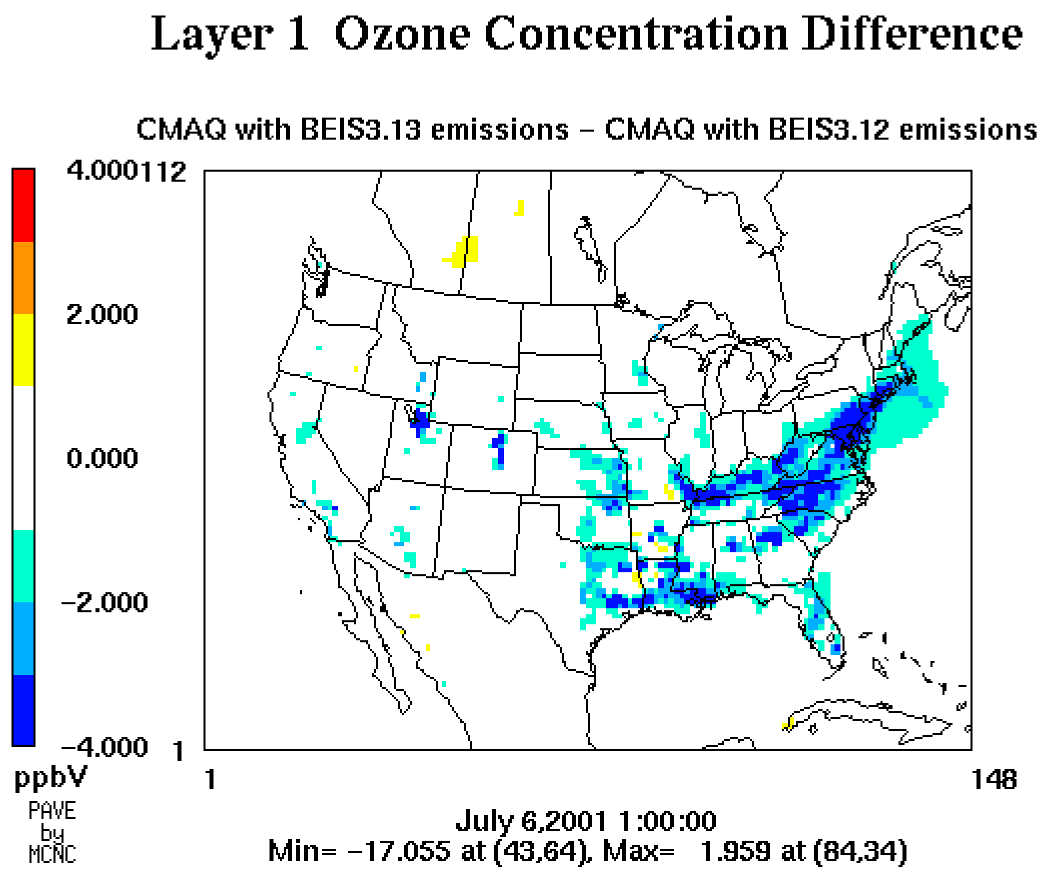


Diurnal variation of PAR adjustment factor using data from the Bondville, IL SURFRAD station for July 2004.

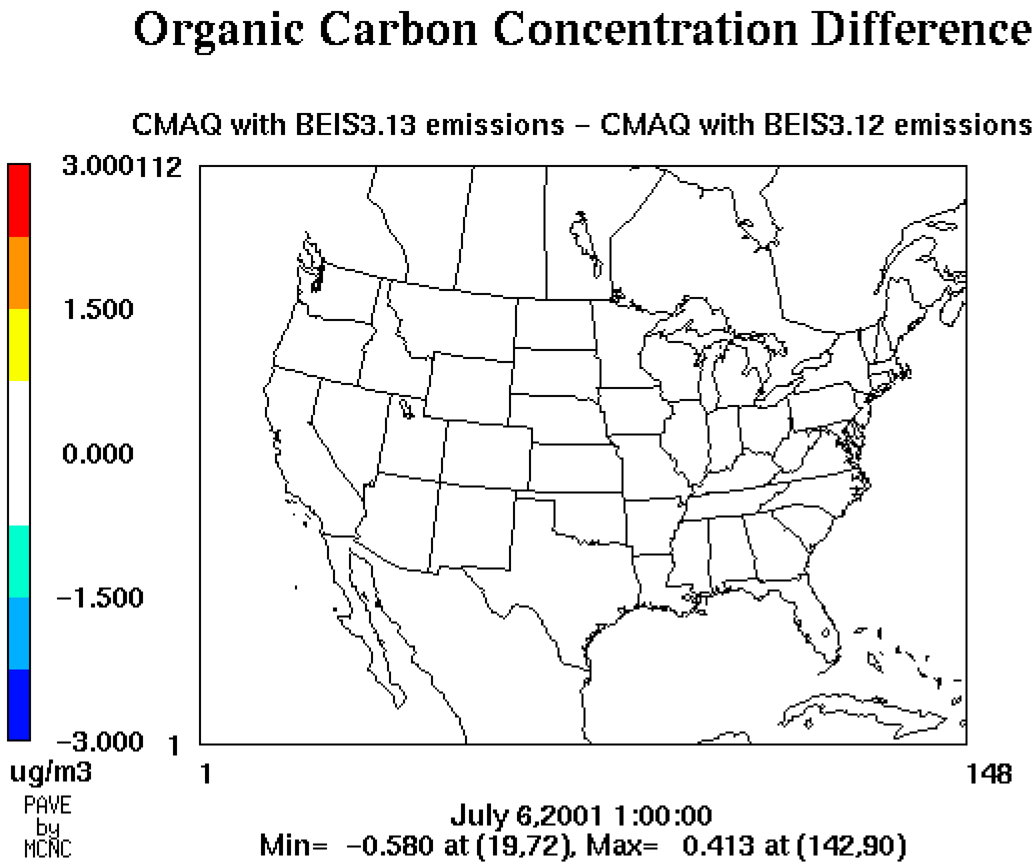
CMAQ Model Results

- CMAQ v4.5 (pre-release build)
- CB4 chemical mechanism
- July 2001; RPO North American Domain; 36 km grid size
- 2 m temperature from MCIP for BEIS3.13

Effect on Ozone Concentration



Effect on Organic Carbon



CMAQ Performance Statistics

IMPROVE and AIRS Data – July 2001

		BEIS3.12	BEIS3.13
8 hr O_3	RMSE (ppmV)	0.013	0.013
	NMB (%)	16.71	14.20
	NME (%)	37.78	36.97
PM2.5	RMSE (ug/m^3)	5.42	5.34
	NMB (%)	-35.70	-37.65
	NME (%)	47.80	46.89
Organic carbon	RMSE (ug/m^3)	1.25	1.07
	NMB (%)	10.35	0.38
	NME (%)	72.65	63.51

Summary

- A few standardized emission factors for isoprene and monoterpene have been changed in BEIS3.13
- The coefficients in the equation used to calculate the light adjustment factor have been changed
- When compared to emissions from BEIS3.12, domain total isoprene emissions for July 2001 from BEIS3.13 are about 35% lower and monoterpene emissions are about 2% lower
- Using BEIS3.13 produced a notable improvement in CMAQ's model performance for organic carbon

Future Work

- The Biogenic Emissions Landuse Database (BELD) will be upgraded to BELD3.2 using more recent agriculture data
- New temporal corrections for isoprene:
  - Introduce a “green-up” period in spring (to transition from winter to summer factors for deciduous trees)
  - Introduce a senescence period in autumn (to transition from summer to winter factors for deciduous trees)
  - Incorporate a correction function that considers 8-hour average temperature and 4-hour average PAR (all tree species)

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Disclaimer

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