Biospheric Emissions in Europe. Estimates and Impacts

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Emission estimates

	Year	Iso	MT	OVOC	Total
Lubkert & Schöpp	1989				7.5
Simpson et al.	1995	3–4		6	
Guenther et al. (GEIA)	1995				
Simpson et al.	1999	4.6	3.9	5	13.5
Steinbrecher et al.	2008	4	12		20.0
Karl et al.(GEIA)	ACPD	10.3			
Karl et al.(G97)	ACPD	3.2	12		20.0

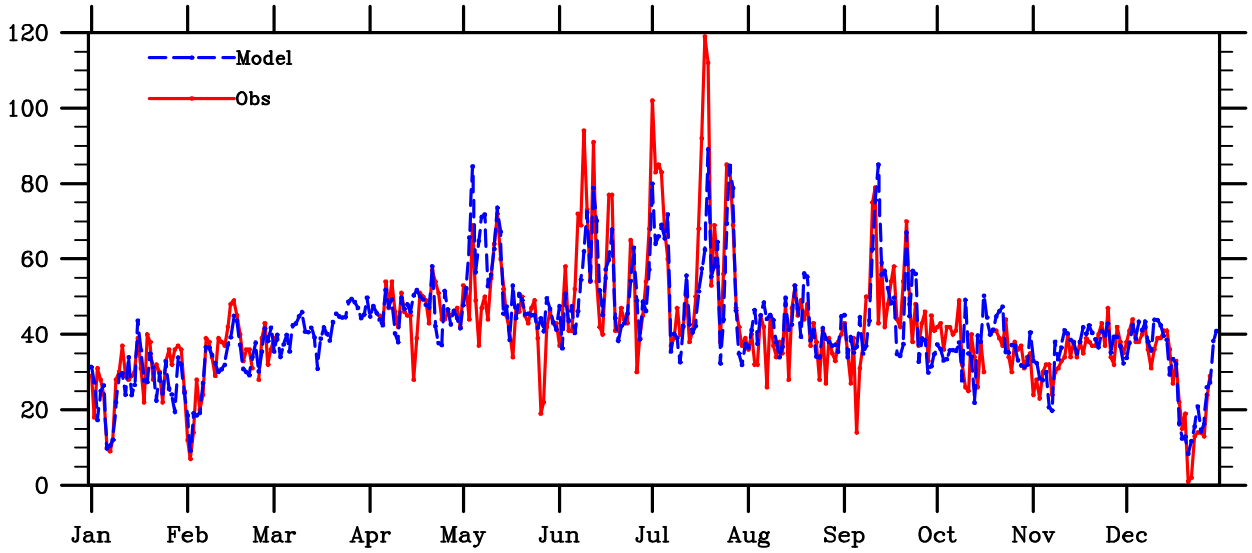
Units : Gg/yr (Table adapted from Karl et al.)

GEIA-based estimates likely too high, U.S. Emissions

Otherwise robust, or ‘illusion’ ?! (Arneth et al., 2006)

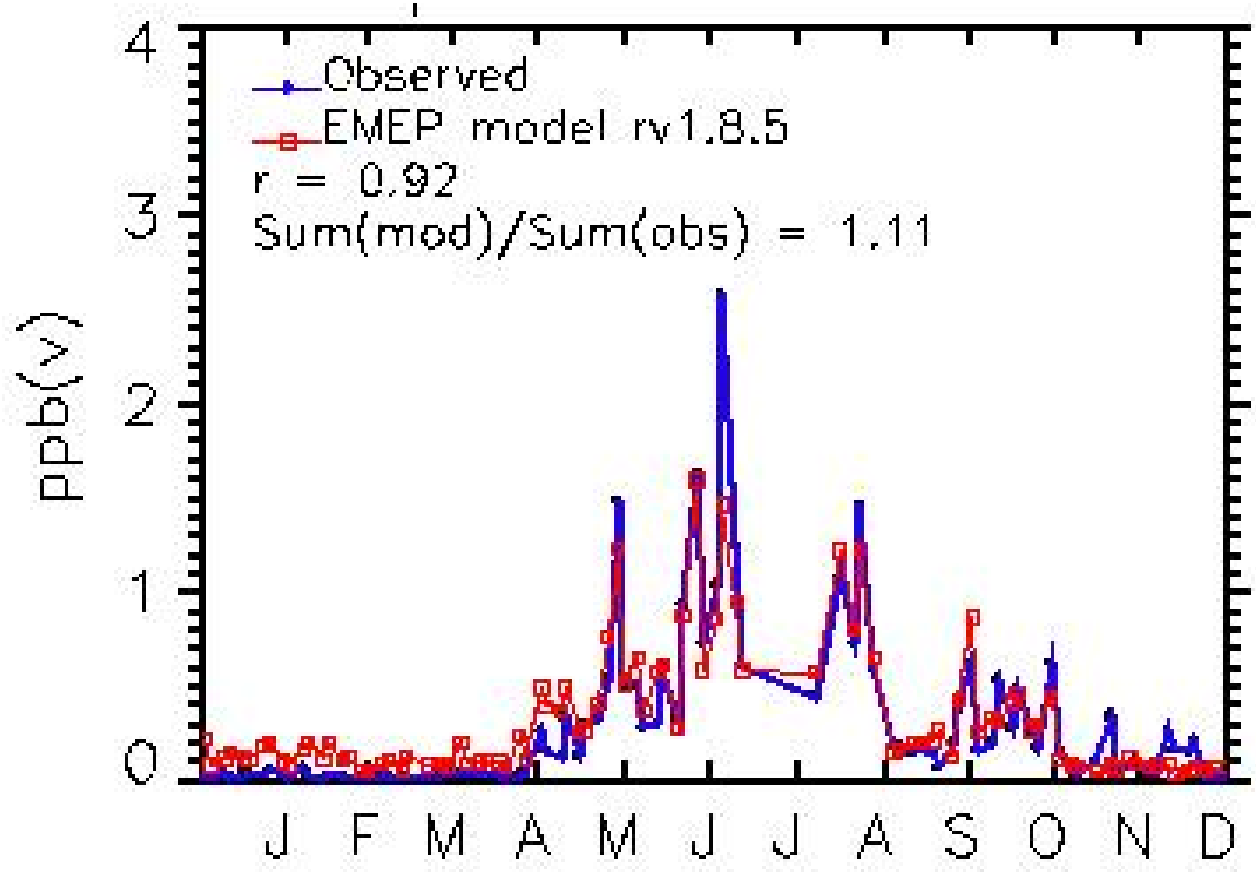
EMEP modelling?

An O_3example:



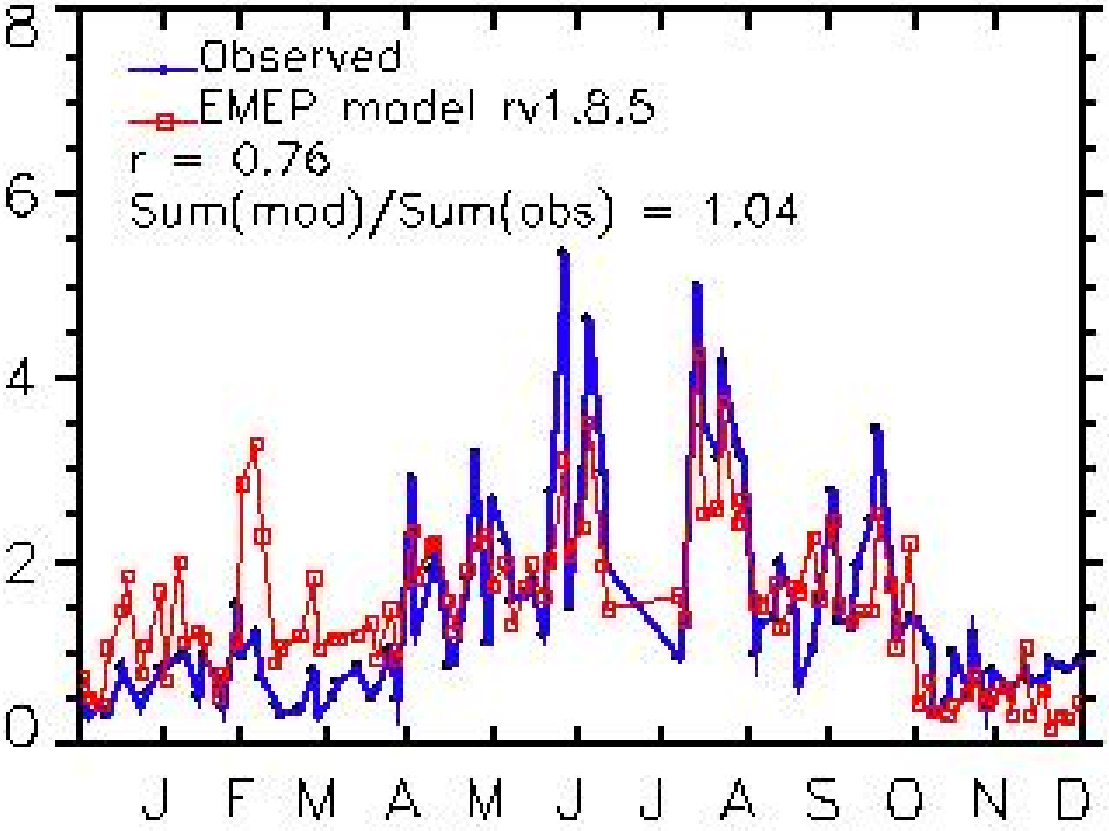
Isoprene

EMEP model verus observations:



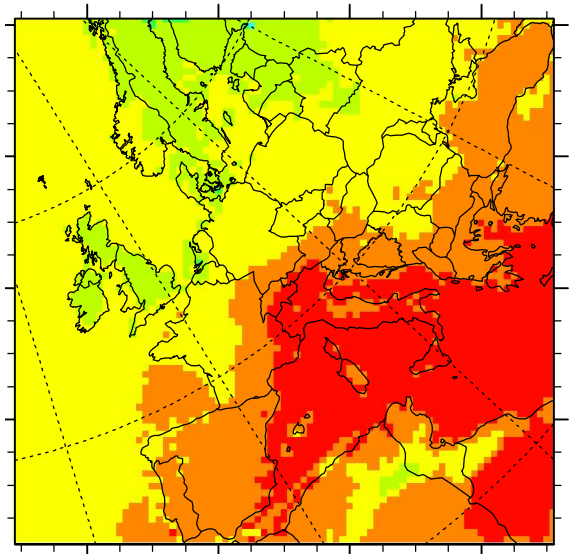
HCHO Cont. Field Comp:

(Nice result for product too:)
Donon, France:

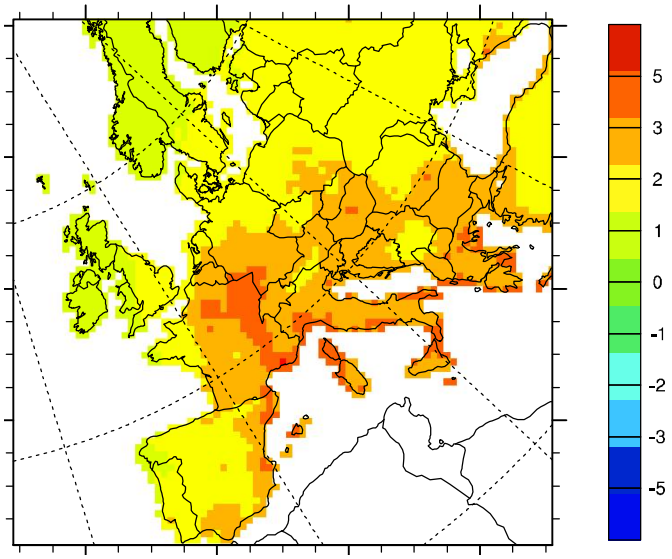


Does BVOC Matter?

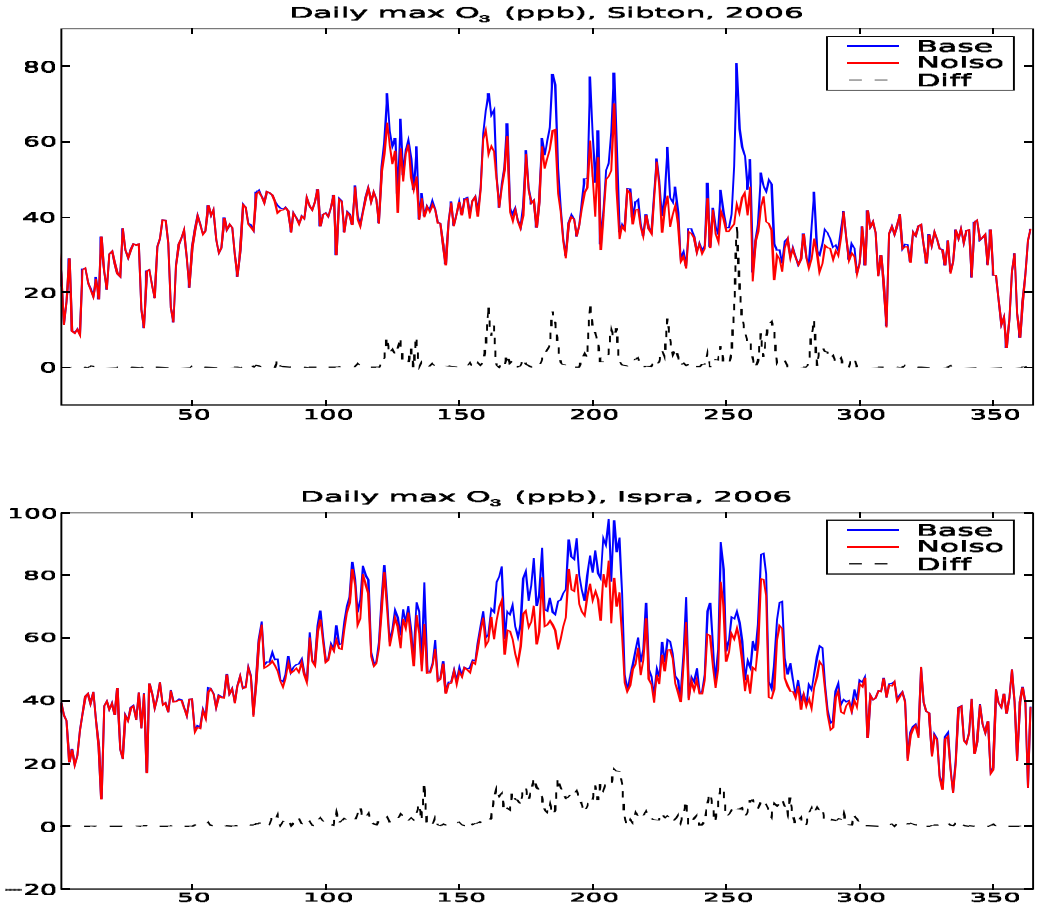
DMax-O_3, Base:



ΔDMax-O_3, No-isoprene:

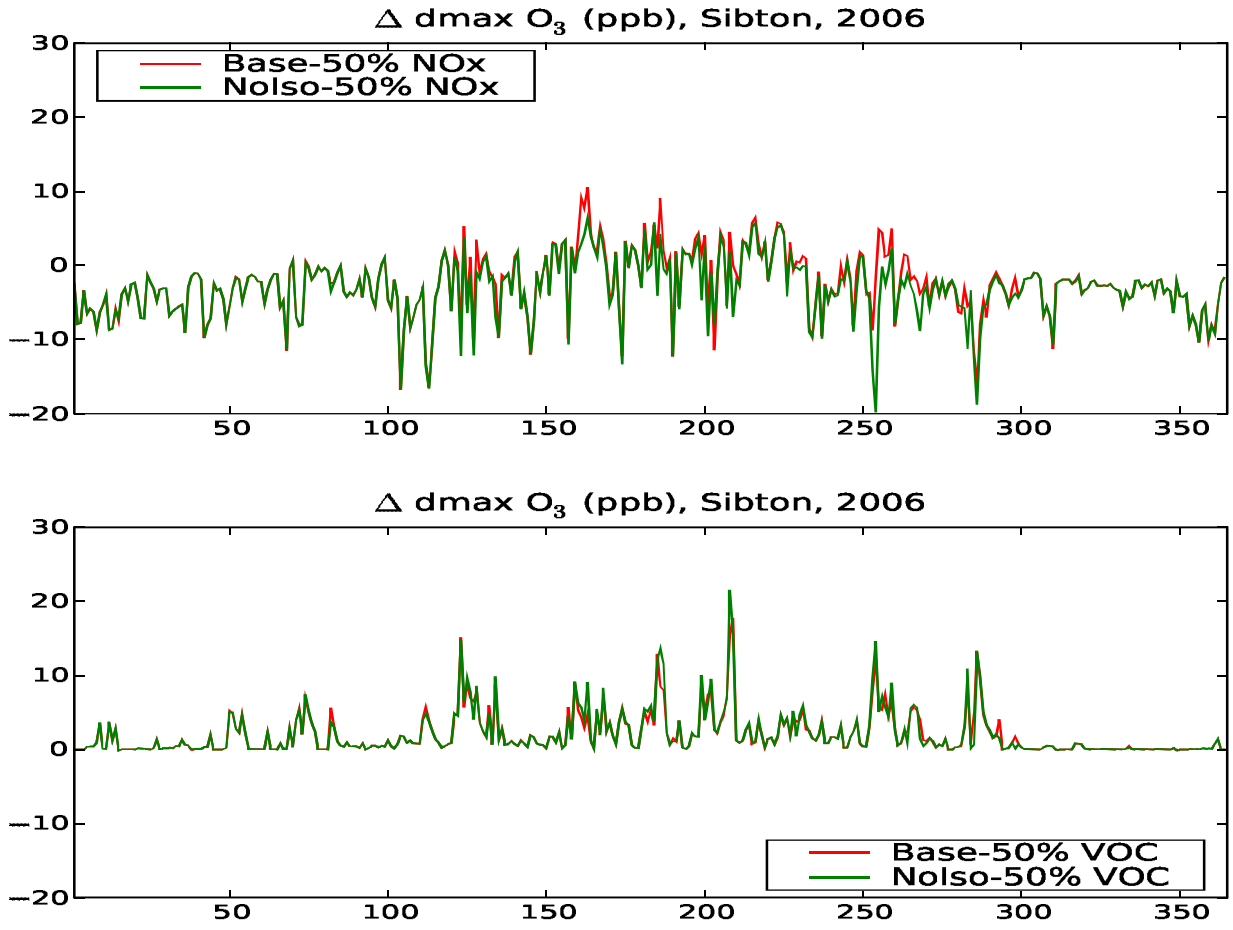


Does isoprene matter?



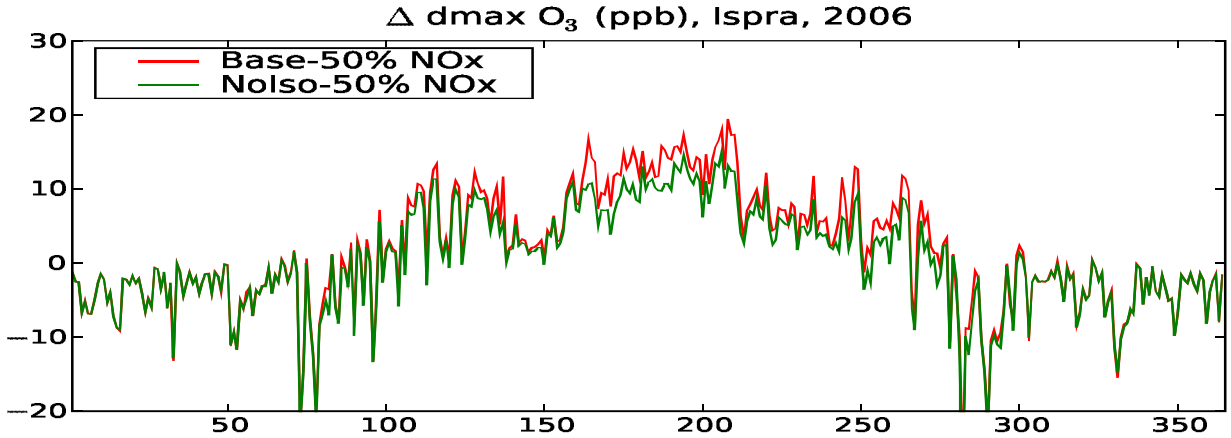
Emission Control?

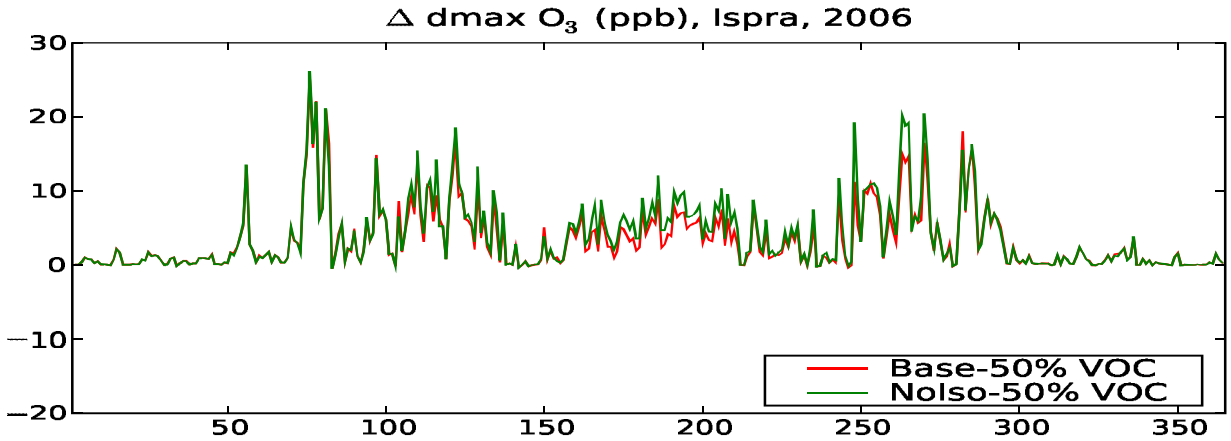
In the UK:



Emission Control?

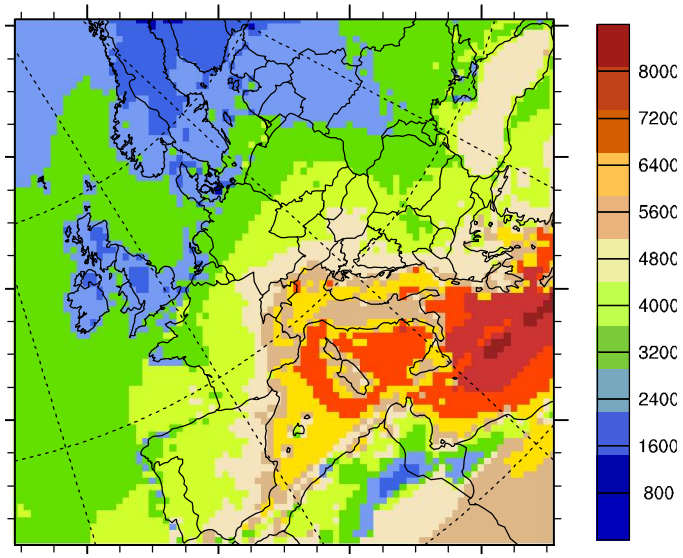
Italy:



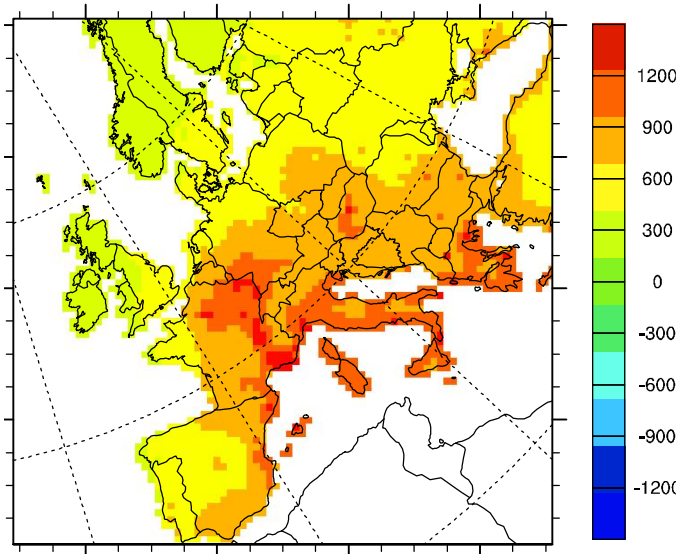


Does BVOC Matter?

SOMO35,
Base:



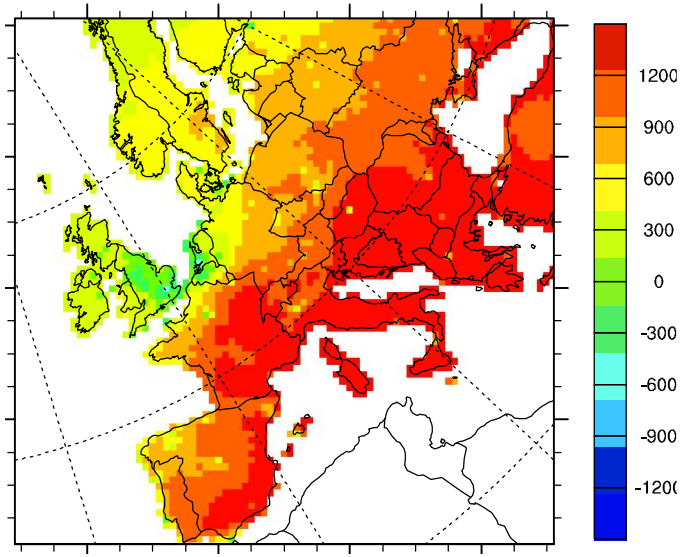
ΔSOMO35,
No-isoprene:



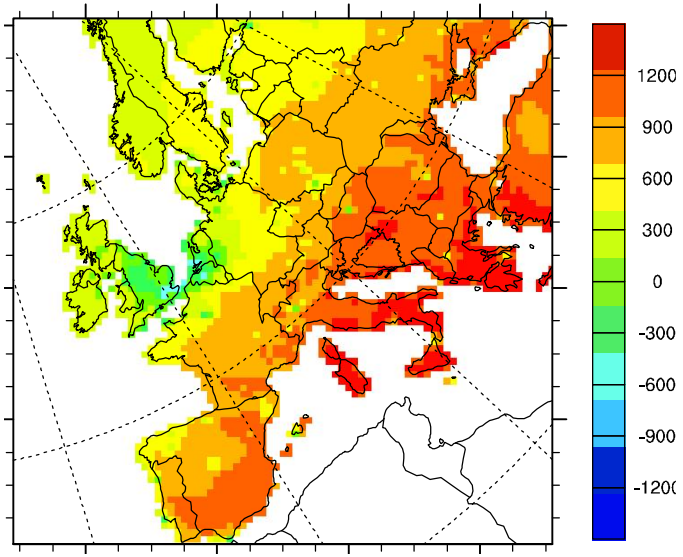
Does BVOC Matter?

Effects of Emissions Control (1): 50% NOx control

ΔSOMO35,
From Base:



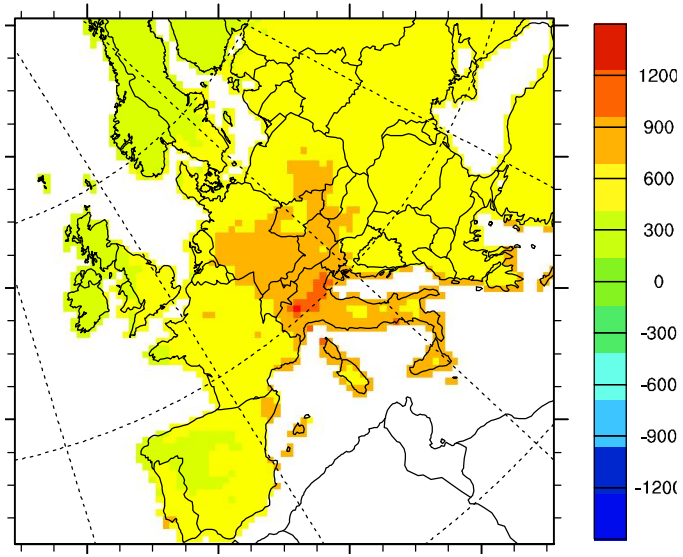
ΔSOMO35,
From No-Iso:



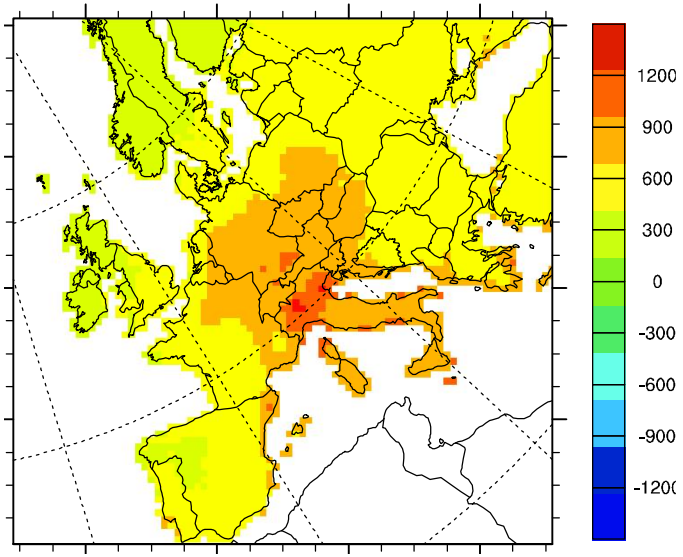
Does BVOC Matter?

Effects of Emissions Control (2): 50% VOC control

ΔSOMO35,
From Base:



ΔSOMO35,
From No-Iso:



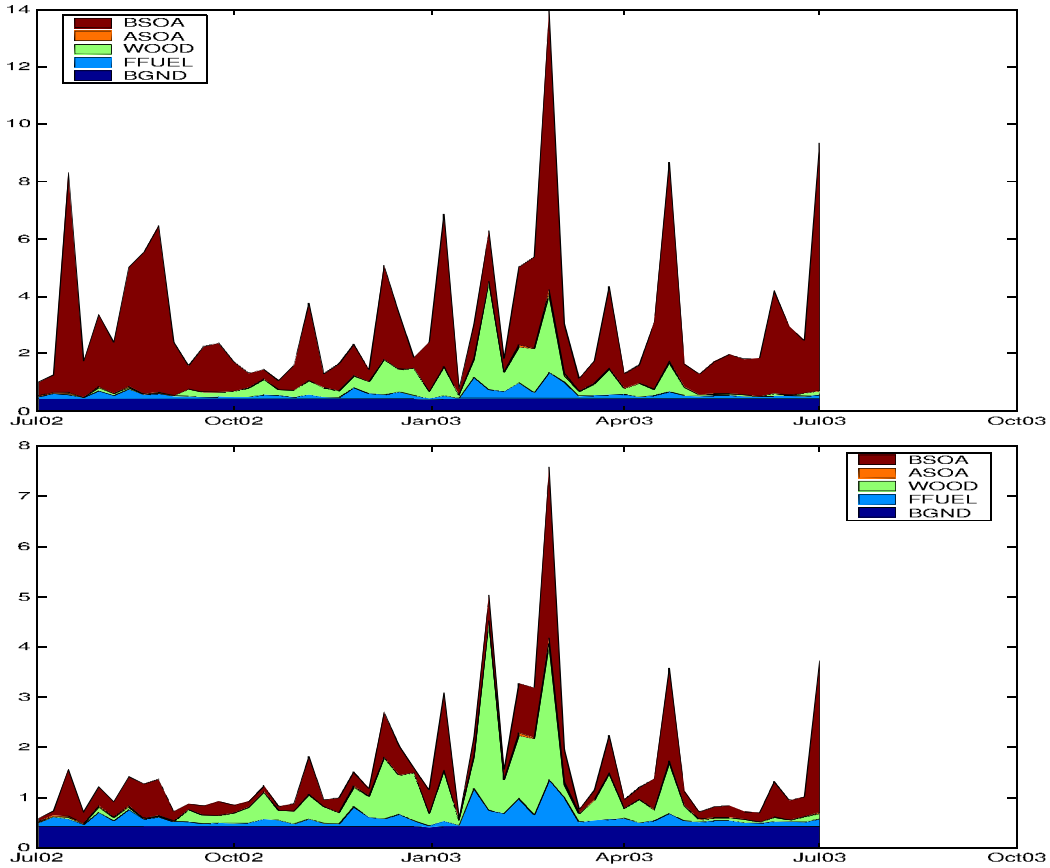
BVOC and Organic Aerosol

OC: Subject=Horrendous?! 1000s of compounds, mainly unknown.

Formation mechanisms complex and unkown!

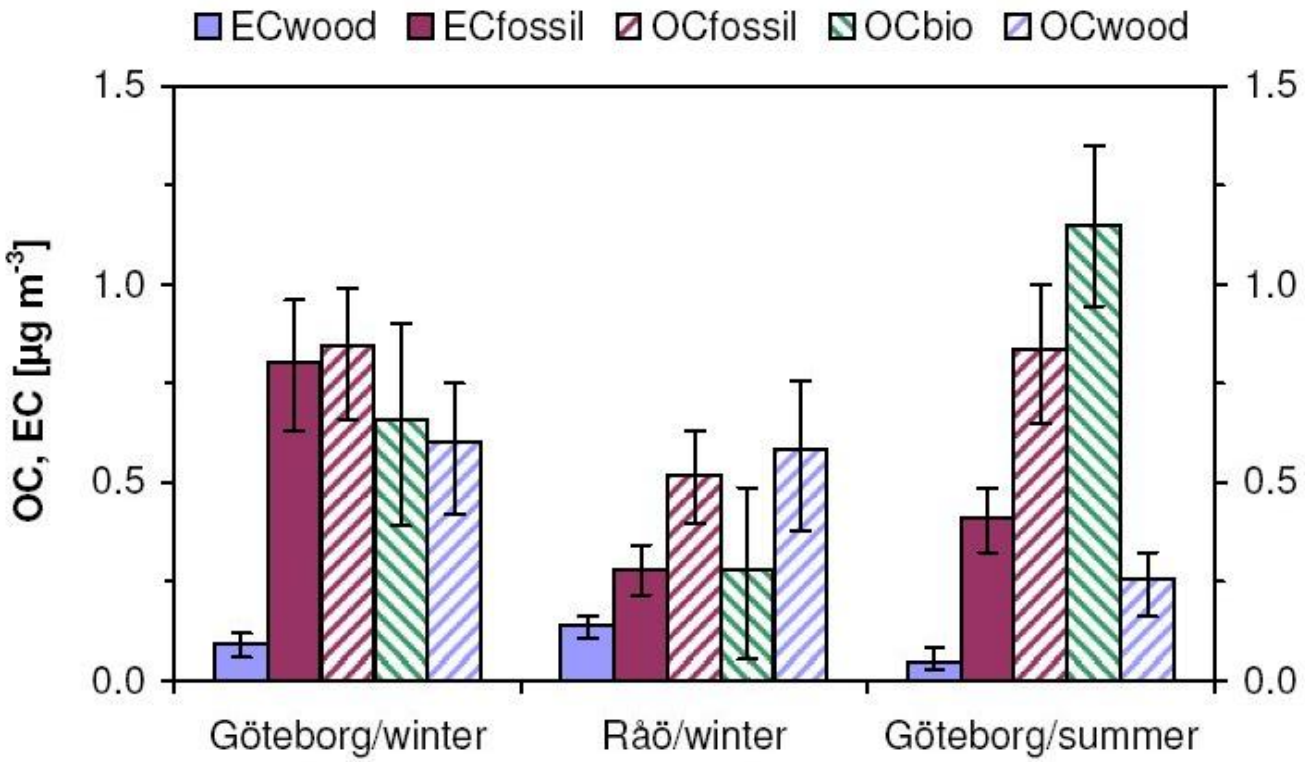
Modelled OC: Aspvreten, SE

Results very sensitive to vapour pressure:



(EMEP model Kam2X (top) and Kam2 (bottom), Simpson et al., JGR, 2007)

Measured OC: Göteborg, SE



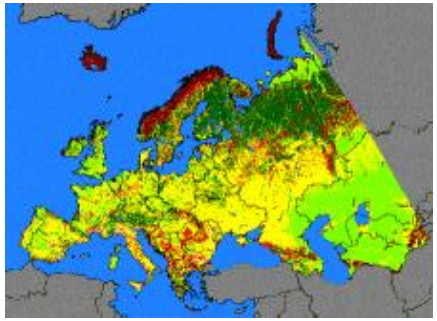
(Szidat et al., ACP, 2009)

Wintertime Bio?

Uncertainties

1. LAI (leaf area index)
2. Phenology (seasonal effects)
3. Forest density, height
4. Temperature
5. Soil moisture
6. Emission factors
7. Canopy effects (Environ, chem?)

The easy bit: pretty colour maps:



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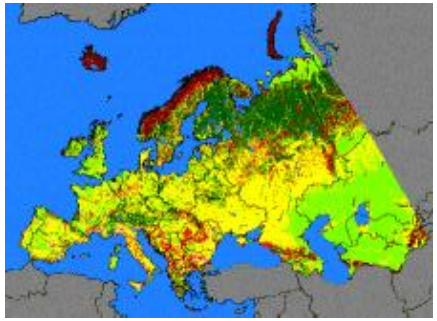


Problem: we have very poor data on (1), (2), (3), (5), (6) and (7)!

Uncertainties

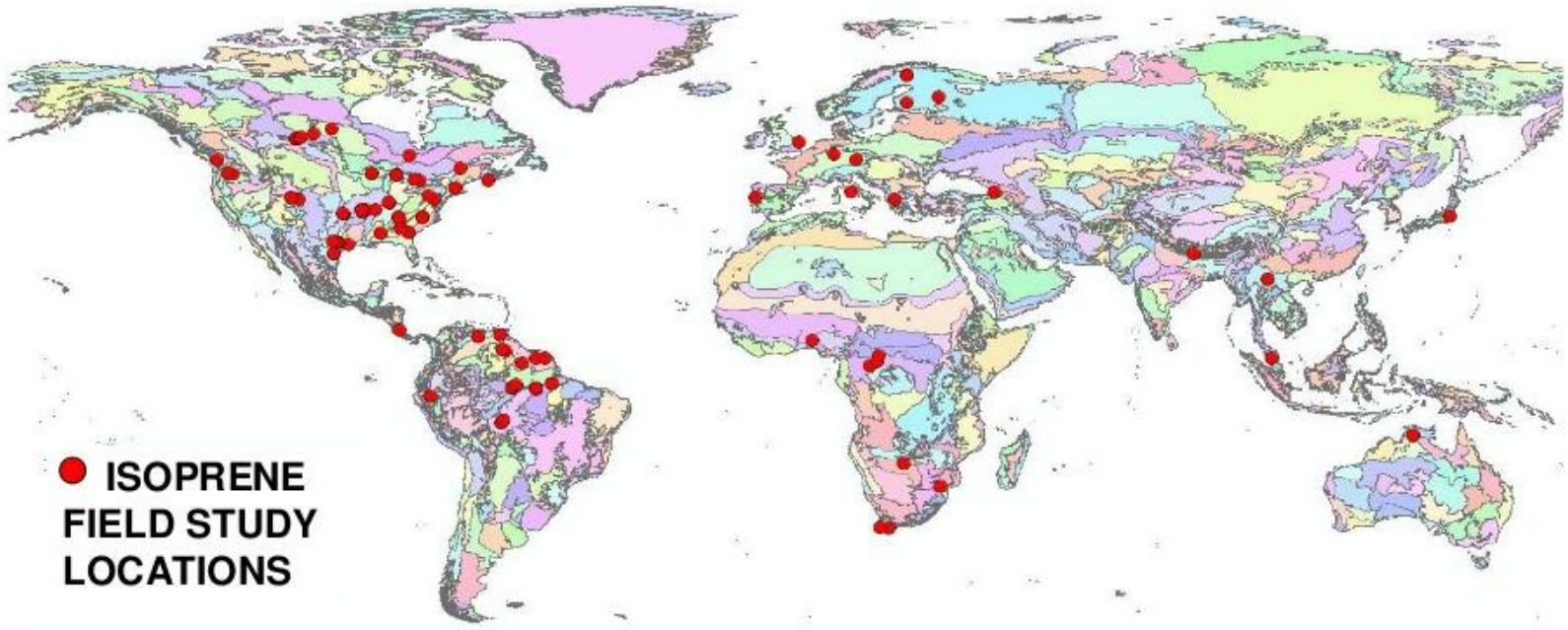
Emission Factors, monoterpenes:

	μg g^{-1}h^{-1}	Ref
Norway	3.0	Simpson et al., 1999
spruce	$\sim$1	Janson et al., Hakola et al., 2003
	4.0	Stewart et al., 2003
	3.52	Smiatek& Steinbrecher, 2006
Beech	0.0	Simpson et al., 1999, Guenther et al., 1995
	15.0	Smiatek& Steinbrecher, 2006

Further problems with seasonal variation (few winter measurements!), spatial variation, and methodological differences (e.g. EC versus gradient, enclosure).

Evaluation

Ideally with extensive flux measurements, but these are limited:



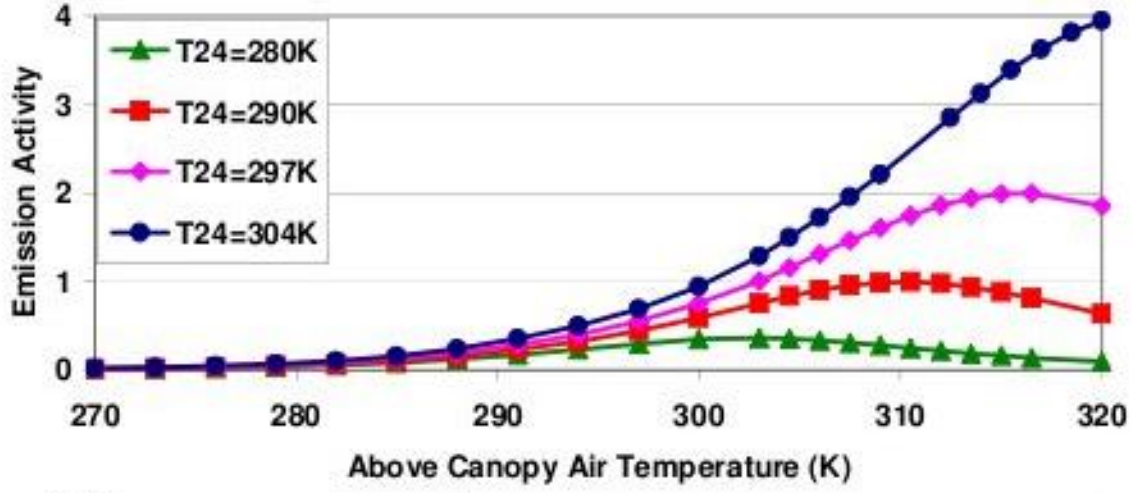
(From Guenther et al., 2006)

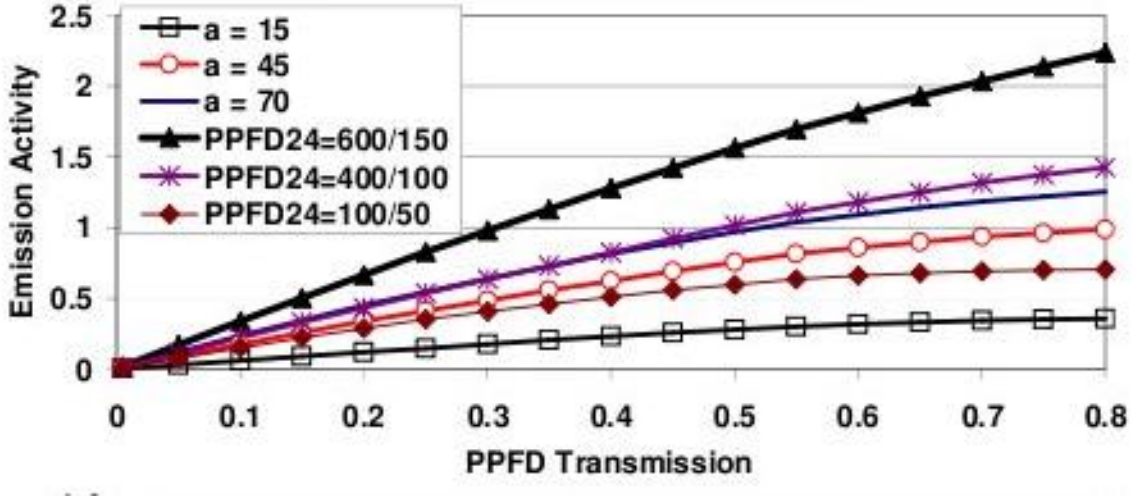
HCHO: proxy-comparison

- Palmer et al.....
- Difficulties with assumptions concerning HCHO/isoprene chemistry and retrievals

Complexities

History effects?
Guenther et al., 2006 (MEGAN) - Is this real?





Complexities

Missing VOC?

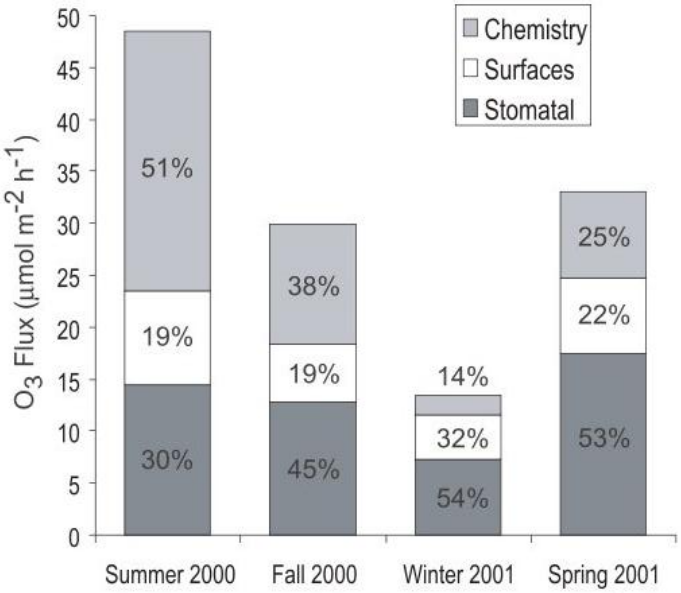


Figure 2. Seasonal contributions of daytime mean O_3 flux with percentages shown on bars.

Chemical loss ten times more than be accounted for! (Kurpius and Goldstein, 2003)
Is this typical?

(I doubt it, but ...)

Complexities

Speciation (e.g. from NATAIR) :

Table 3: Monoterpene split for tree species as percentiles of the total monoterp

Tree Species	α -Pin	β -Pin	d-Lim	α -Terp	γ -Terp	Cam	Δ ^{3}-Car	
Abies alba	26	8	30			28		
Abies borisii-regis	15	24	18		1	2		
Abies cephalonica	15	20	20	1	1	2		
Abies grandis	15	20	20	1	1	2		
Acer platanoides	46	15	3			2	4	
Acer sp.	20	42	17			2	1	
Arbutus unedo	23	9	8		6	4	5	
Betula pendula	19	7	7			3	5	
Betula pubescens	19	7	7			3	5	
Castanea sativa	21	16	14			5		
Cupressus sempervirens	26		10			4	8	
Eucalyptus sp.	12	5	10	9	1			
Fagus sylvatica	3	1	4					

Data-base *v*ery limited!

Conclusions

- BVOC *are* important for O_3, SOA
- Despite this, few BVOC flux data are available
- Isoprene inventories change little - too few new data! (Illusion-phase, see Arneth et al., ACP, 2008)
- Still little known about OVOC
- Measure!
- What happens in the future? Temperature increases BVOC? CO_2 reduces BVOC?

Finally

Tribute to Chris Veldt: data still relevent today!

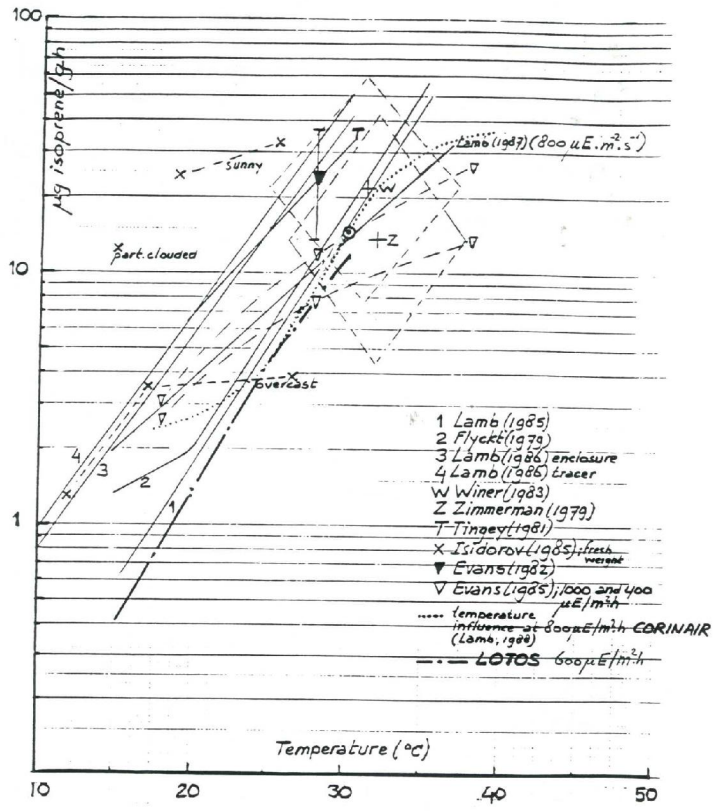


Fig. 1 Isoprene emissions from nigh isoprene emitters