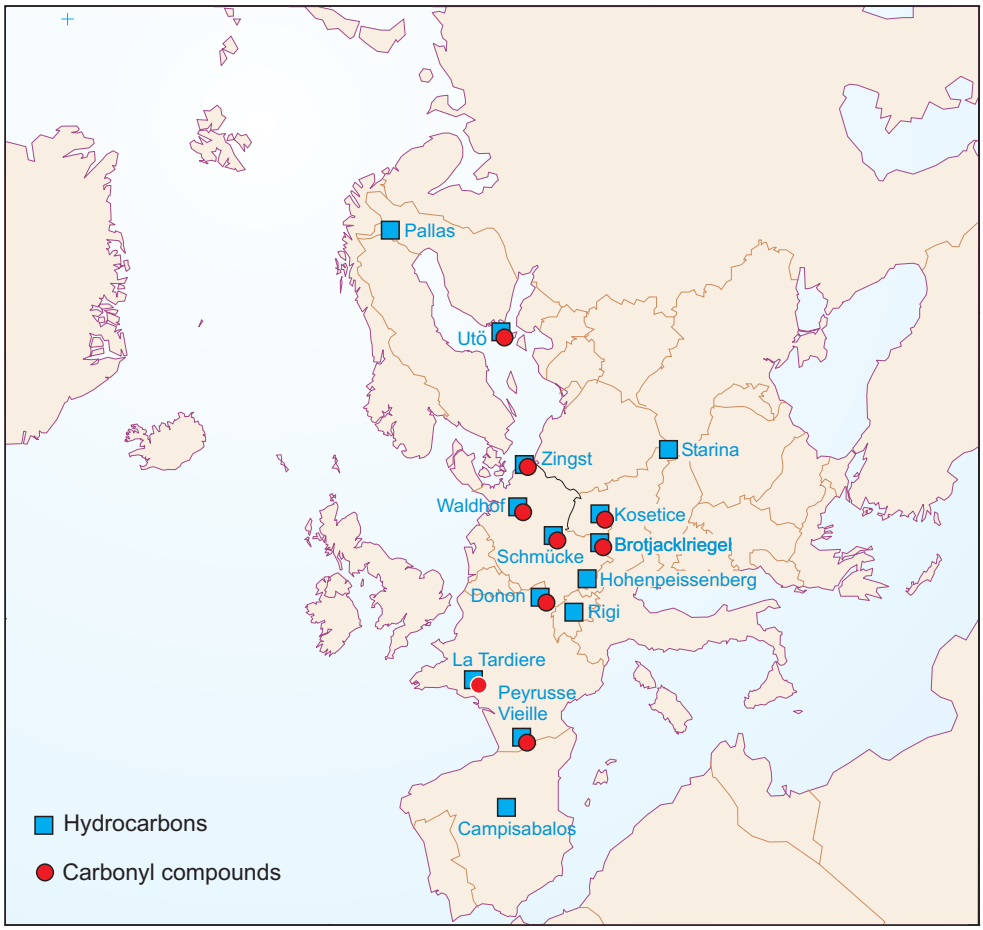
EMEP/CCC-Report 10/2005

EMEP Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe

VOC measurements 2003

Sverre Solberg



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Summary

This report presents measurements of VOC carried out during 2003 at EMEP monitoring sites. VOC measurements are reported for a total of 14 sites and 9 of these with carbonyls. All the VOC measurements are made by grab samples of light hydrocarbons in canisters and 8-h samples of carbonyls by DNPH adsorption tubes.

The carbonyl samples from Germany and France were analysed by the national laboratories. For the light hydrocarbons the national laboratories in the respective countries carried out their own chemical analyses. No parallel sampling of hydrocarbons or carbonyls were carried out in 2003.

Europe experienced extreme weather conditions in the summer half year of 2003 with several heat waves, the most pronounced in August. Overall the European summer was probably the warmest since year 1500. The measured concentration of the VOCs, however, don't indicate anomalous concentration in either direction. Isoprene is an exception to this and showed about twice as high concentrations in summer than compared to previous years at Donon in France whilst not at any of the other sites. This is an indication of increased biogenic emissions caused by the elevated temperature and enhanced solar radiation reaching the surface during the heat waves.

The long-term changes in the winter medians of hydrocarbons indicate a marked decline from 1993 to 2000 and a levelling off or even increase after that. The reduction is particularly evident for benzene, butane and isobutane and somewhat less for ethene and acetylene. To what extent these effects are explained by changes in European, anthropogenic emissions or by changes in meteorological conditions are not possible to quantify without long-term detailed transport model calculations.

For the summer medians in carbonyls the trends are less clear, presumably reflecting that inter-annual variations in photo-oxidation are controlling these species.

VOC measurements 2003

1. Introduction

The Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes was adopted in November 1991. It entered into force on 29 September 1997. Three options for emission reduction targets are specified by the Protocol:

(i) 30% reduction in emissions of VOC by 1999 using a year between 1984 and 1990 as a basis;
(ii) The same reduction as for (i) within a Tropospheric Ozone Management Area (TOMA) and ensuring that by 1999 total national emissions do not exceed 1988 levels;
(iii) Finally, where emissions in 1988 did not exceed certain specified levels, Parties may opt for a stabilization at that level of emission by 1999.

In 1999 the Gothenburg protocol to Abate Acidification, Eutrophication and Ground-level Ozone was adopted by the Executive Body of UN-ECE, and on the 17th May 2005 the Protocol entered into force. The Protocol sets emission ceilings for 2010 for four pollutants: sulphur, NO_x, VOCs and ammonia. These ceilings were negotiated on the basis of scientific assessments of pollution effects and abatement options. Parties whose emissions have a more severe environmental or health impact and whose emissions are relatively cheap to reduce will have to make the biggest cuts. According to the Protocol, Europe's sulphur emissions should be cut by at least 63%, its NO_x emissions by 41%, its VOC emissions by 40% and its ammonia emissions by 17% compared to 1990. The Protocol also sets tight limit values for specific emission sources (e.g. combustion plant, electricity production, dry cleaning, cars and lorries) and requires best available techniques to be used to keep emissions down. VOC emissions from such products as paints or aerosols will also have to be cut.

The EMEP VOC monitoring programme was initiated at the EMEP Workshop on Measurements of Hydrocarbons/VOC in Lindau, 1989 (EMEP/CCC, 1990). A three-fold objective of the measurement programme was defined at the workshop:

- Establishing the current ambient concentrations
- Compliance monitoring ("Do the emission control programme lead to a reduction of atmospheric concentrations?")
- Support to the transboundary oxidant modelling (prognostic and diagnostic)

The Workshop recommended that as a first step it would be sufficient with VOC monitoring at 10-15 rural sampling sites and taking two samples per week at each station centred at 12 noon GMT. Collection in stainless steel canisters and analyses by high resolution gas chromatography was recommended for the detection of light hydrocarbons, whereas impregnated adsorbent tubes sampling combined with high performance liquid chromatography (HPLC) was

recommended for the detection of carbonyls. A list of required and desirable compounds was defined and is shown in Table 1.

Certain additional remarks at the Workshop were underlined in the proceedings report (EMEP/CCC, 1990). The need for more information on VOC concentrations close to the emission sources for modelling purposes was raised. Harmonisation with national urban measurement programmes was recommended as well as the assembling of VOC emission inventories. Furthermore, the importance of concurrent measurements of oxides of nitrogen was strongly emphasised.

At the Lindau Workshop it was also recommended that during the starting period the analyses of the VOC samples should be made by the CCC and that other laboratories should be included later on.

Table 1: List of volatile organic compounds that are "required" or "desirable" to measure within the EMEP programme as defined at the EMEP Workshop in Lindau, 1989 (EMEP/CCC, 1990).

	required	**desirable**
Alkanes	ethane	hexane
	propane	branched hexanes
	i-butane	heptane
	n-butane	branched heptanes
	i-pentane	octane
	n-pentane	
Alkenes	ethene	butenes
	propene	pentenes
	isoprene	
Alkynes	acetylene	
Aromatics	benzene	styrene
	toluene	propylbenzenes
	o-xylene	ethyltoluenes
	m,p-xylene	
	ethylbenzene	
	trimethylbenzenes	
Aldehydes	formaldehyde	propionaldehyde
	acetaldehyde	
Ketones	acetone	methylethylketone
		methylvinylketone

The measurements of VOC within EMEP started with the collection of grab samples of light hydrocarbons in the middle of 1992, whereas measurements of carbonyls started in 1993. In the beginning five stations were included in the monitoring programme, Rucava (LV10), Košetice (CZ03), Waldhof (Langenbrügge) (DE02), Tänikon (CH32) and Donon (FR08). Since then the number and selection of VOC measurement sites have changed several times.

The first laboratory intercomparison of light hydrocarbons in EMEP was organised already in 1993 (Romero, 1995). The variation or relative deviation

among the laboratories was in a range ±25% from the median. The exercise showed that the majority of the participating laboratories had the required analytical technique to correctly analyse a wide range of NMHC within an accuracy of ±10–15%. Furthermore, the results showed no substantial differences whether the air samples were analysed immediately after collection or after a period up to 2 months (for C_2–C_5 hydrocarbons).

The measurements are reported annually, and officially made public by the Steering Body of EMEP. Previous results from the EMEP VOC programme have been presented in annual reports (e.g. Solberg, 2004). An EMEP expert meeting on VOC measurements was organised in Berlin, 1994 (EMEP/CCC, 1995), and an evaluation of the measurement programme was made in 1995 (Solberg et al., 1995). Highlights and findings from the EMEP VOC programme have also been presented in a number of scientific papers (Lindskog et al., 1995; Solberg et al., 1996; Hov et al., 1997; Solberg et al., 2001).

Lately, an initiative has been taken to increase the cooperation and exchange of VOC data between GAW (Global Atmospheric Watch) and EMEP. At the EMEP TFMM workshop in Oslo in November 2004, on the implementation of the EMEP monitoring strategy, a closer harmonisation between the VOC monitoring in EMEP and GAW was discussed. Minutes and conclusions from the workshop is given elsewhere (EMEP/CCC, 2005). Harmonisation of data quality objectives (DQOs) and using a common audit questionnaire was recommended, and it is also a wish to arrange common GAW/EMEP training course and to further increase the exchange of VOC monitoring data between EMEP, GAW and WDCGG (World Data Centre of Greenhouse Gases).

A revision and extension of the species recommended to measure was also discussed at the Oslo TFMM workshop. One starting point for such a revision is the VOC speciated emissions provided by UK's National Atmospheric Emissions Inventory (NAEI) as reported by Dore et al. (2004). Table 2, adopted from Dore et al. (2004), shows the photochemical ozone creation potential (POCP) for the top 50 VOCs (with respect to POCP) for the UK. The POCP identifies, on a relative basis, the ozone creation potential for each NMVOC compound through modelling studies. The creation potentials are then normalised by defining ethene as a creation potential of 1. Many of the components in Table 2 are not measured by the present EMEP VOC program due to limitations by the methods presently used, as e.g. alcohols, chlorinated compounds and long-chained alkanes. An extension to include these compounds in the monitoring program will require additional sampling devices as e.g. adsorption tubes.

Table 2: POCP Weighted NMVOC emissions (adopted from UK's NAEI emissions reported by Dore et al., 2004).

	POCP	code	Stationary Combustion	Production Processes	Extraction and Distrib_ Fossil Fuels	Solvent Use	Road Transport	Other Transport	Waste Treatment	TOTAL (Mass Emission)	TOTAL (POCP Weighted)	TOTAL (POCP Weighted %)
butane	35.2	a	4.37	4.52	70.21	19.61	13.30	0.47	0.02	112	40	7.2%
ethanol	39.9	a	1.39	53.56		40.27			0.27	95	38	6.9%
ethylene	100.0	a	3.29	5.65	0.03		14.22	3.55	1.07	28	28	5.0%
toluene	63.7	a	2.03	4.06	0.24	11.44	16.95	3.10	0.16	38	24	4.4%
m-xylene	110.8	a	0.75	2.14	0.09	10.90	5.04	0.70	0.07	20	22	3.9%
propylene	112.3	a	1.65	6.01	0.02	0.00	6.80	1.37	0.06	16	18	3.2%
pentane	39.5	a	2.66	2.00	28.93	0.41	8.64	0.29	0.02	43	17	3.1%
hexane	48.2	a	0.51	4.39	14.93	2.32	7.92	0.20	0.10	30	15	2.7%
1,2,4-trimethylbenzene	127.8	a	0.00	0.52	0.01	5.44	4.69	0.51		11	14	2.6%
2-methylbutane	40.5	a	3.48	1.08	11.11	0.04	17.74	0.77	0.01	34	14	2.5%
formaldehyde	51.9	a	9.05	0.38	0.21	0.03	6.26	1.50	3.40	21	11	2.0%
o-xylene	105.3	a	0.25	0.75	0.04	2.74	5.05	0.80	0.04	10	10	1.8%
heptane	49.4	a	0.77	0.30	15.07	1.26	1.61	0.09		19	9	1.7%
propane	17.6	a	3.22	2.26	36.90	3.81	1.18	0.38	5.11	53	9	1.7%
ethylbenzene	73.0	a	0.24	1.75	0.03	4.17	4.93	0.77	0.12	12	9	1.6%
p-xylene	101.0	a	0.19	0.92	0.02	2.92	3.90	0.54	0.06	9	9	1.6%
ethane	12.3	a	5.84	1.46	49.57	0.00	3.15	0.57	5.44	66	8	1.5%
octane	45.3	a	0.06	0.18	13.27	1.10	0.77	0.09		15	7	1.3%
2-methylpropane	30.7	a	1.01	0.24	13.24	0.89	5.96	0.22	0.01	22	7	1.2%
trichloroethene	32.5	a		0.87		18.97			0.06	20	6	1.2%
1,3,5-trimethylbenzene	138.1	a	0.00	0.19		1.82	1.85	0.24		4	6	1.0%
2-butene	113.9	a	0.60	0.14	0.81		2.67	0.21	0.02	4	5	0.9%
2-methylpropene	62.7	a	0.15	0.68	0.26		5.23	1.03	0.00	7	5	0.8%
2-butanone	37.3	a		0.68		11.38	0.24	0.02	0.01	12	5	0.8%
1,2,3-trimethylbenzene	126.7	a	0.00	0.18		1.84	1.07	0.15		3	4	0.7%
methanol	14.0	a		2.01	0.00	26.09			0.07	28	4	0.7%
2-pentene	111.9	a	0.34	0.01	1.41		1.57	0.04	0.00	3	4	0.7%
decane	38.4	a	0.03	0.84	0.03	7.38	0.92	0.47		10	4	0.7%
1,3-butadiene	85.1	a	0.00	0.29	0.01		2.74	0.61	0.01	4	3	0.6%
butyl acetate	26.9	a		0.19		11.19			0.02	11	3	0.6%
1-butanol	62.0	a		0.23		4.58			0.01	5	3	0.5%
methylethylbenzene	94.1	c		0.23		2.91				3	3	0.5%
benzene	21.8	a	3.88	1.41	0.84	0.00	5.06	1.44	0.89	14	3	0.5%
4-methyl-2-pentanone	49.0	a		0.65		5.07				6	3	0.5%
acetaldehyde	64.1	a	0.00	0.75			2.86	0.67		4	3	0.5%
ethyldimethylbenzene	132.0	c		0.11		1.98				2	3	0.5%
1-butene	107.9	a	0.34	0.62	0.23	0.00	1.21	0.12	0.01	3	3	0.5%
naphthalene	97.7	b	0.48	0.02		1.43		0.01		2	2	0.3%
nonane	41.4	a	0.05	0.52	0.08	4.44	0.21	0.11		5	2	0.4%
2-butoxyethanol	48.3	a		0.10		4.48				5	2	0.4%
dipentene	74.5	b		0.01		2.84				3	2	0.4%
1-propanol	56.1	a		0.06		3.29			0.04	3	2	0.3%
acetone	9.4	a	0.19	1.93		17.04	0.81	0.08	0.00	20	2	0.3%
2-methylpentane	42.0	a	0.03	0.99	2.17	1.09		0.01	0.05	4	2	0.3%
2-propanol	18.8	a	0.01	0.73		8.92			0.02	10	2	0.3%
ethyl acetate	20.9	a		1.31		6.98			0.02	8	2	0.3%
undecane	38.4	a	0.00	0.44		3.85		0.19		4	2	0.3%
1-pentene	97.7	a	0.14	0.06	0.29		0.93	0.04	0.00	1	1	0.3%
3-methylpentane	47.9	a	0.02	0.67	1.21	0.86			0.03	3	1	0.2%
1,2,3,5-tetramethylbenzene	136.0	b		0.06		0.84				1	1	0.2%
Total Top 50 (POCP)			**47**	**109**	**261**	**257**	**155**	**21**	**17**	**868**	**399**	**72.3%**
unspeciated	51.3	c	1.86	32.11	1.20	7.06	1.22	0.36	0.01	44	22	4.1%
other grouped species			0.72	23.31	9.51	6.69	34.54	32.53	1.13	108	68	12.3%
other VOC			1.50	29.87	1.80	106.06	19.80	4.44	1.78	165	62	11.3%
Total VOC			**51**	**194**	**274**	**376**	**211**	**59**	**20**	**1186**	**552**	**100%**

2. Status of the measurement programme in 2003

2.1 The station network

The location of the monitoring sites for VOC presented in this report is shown in Figure 1 and an overview of the measurement programme and the responsible laboratories in 2003 is given in Table 3. Totally 14 measurement sites reported VOC data to CCC in 2003, 9 of these with carbonyls.

Table 4 gives the number of valid (daily) samples of hydrocarbons and carbonyls (after inspection and removal of outliers). According to EMEP's recommendations, the samples should be taken twice a week, implying that 104 samples per year correspond to 100% data cover.

A 90% data completeness, i.e. 94 samples pr year, of daily values is given as data quality objective according to the EMEP manual (EMEP/CCC, 1996) and that is fulfilled at most of the VOC sites but not all. The data capture of the hydrocarbons was lower than 90% at Starina and at Peyrusse Vieille. The data capture of the carbonyls was particularly low at the three French sites, as it was around 50% for all these sites due to lack of an automatic sampler with a good quality of sampling.

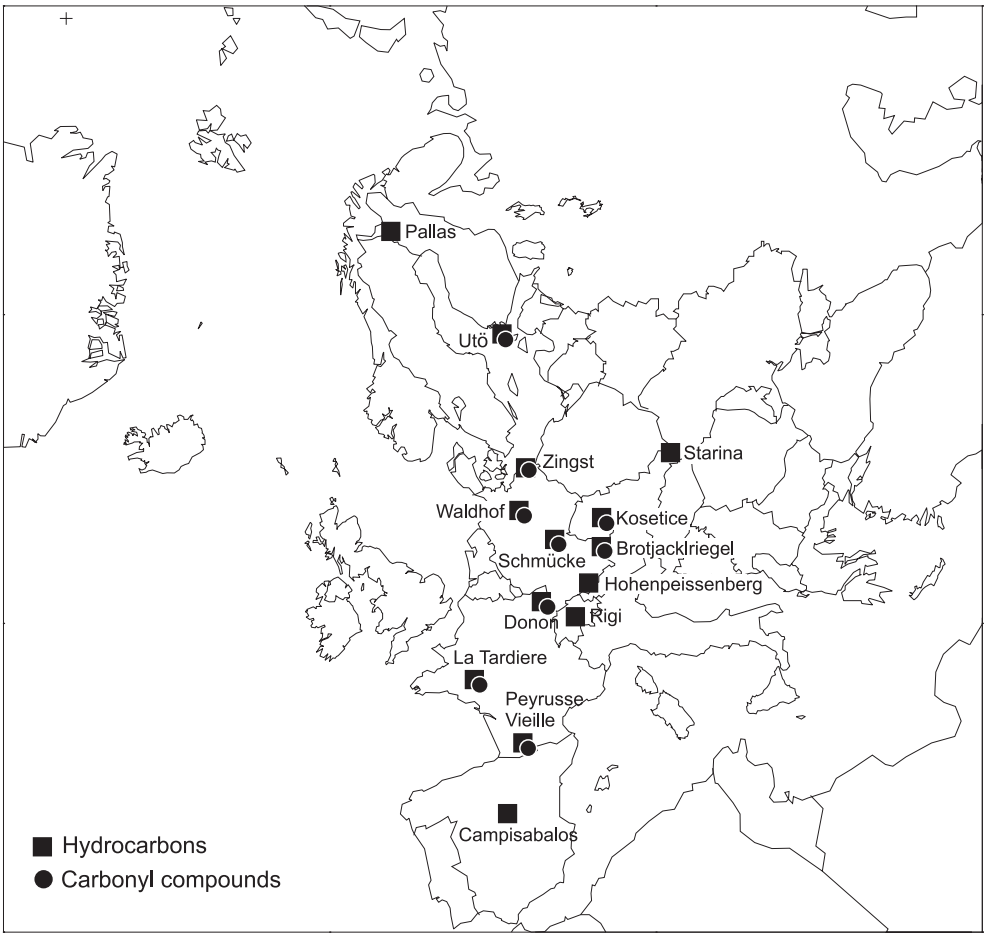

Figure 1: Monitoring sites for VOC in 2003.

Table 3: Status of the VOC monitoring programme in 2003. The columns give the station names, site code, and the sampling frequencies for hydrocarbons (HC) and carbonyl compounds (Carb). The laboratory responsible for the chemical analyses is also given.

Station	Code	HC[1)]	Lab.[2)]	Carb[1)]	Lab.[2)]	Comments
Pallas	FI96	Reg.	FMI	n.m.	-	
Utö	FI09	Reg.	FMI	Reg.	NILU	
Waldhof	DE02	Reg.	UBA	Reg.	UBA	
Schmücke	DE08	Reg.	UBA	Reg.	UBA	
Zingst	DE09	Reg.	UBA	Reg.	UBA	
Brotjacklriegel	DE05	Reg.	UBA	Reg.	UBA	
Hohenpeissenberg	DE43	Daily	DWD	n.m.	-	GAW station
Košetice	CZ03	Reg.	CHMI	Reg.	NILU	
Starina	SK06	Reg.	SHMI	n.m.	-	
Rigi	CH05	Cont.	EMPA	n.m.	-	
Donon	FR08	Reg.	EMD	Reg.	EMD	
Peyrusse Vieille	FR13	Reg.	EMD	Reg.	EMD	
La Tardiere	FR15	Reg.	EMD	Reg.	EMD	
Campisábalos	ES09	Reg.	MMA	Reg.	EMD	Monitoring of carbonyls started in May 2003. Data will be reported when the results from a parallel campaign is ready.

1) Reg. = regularly, Scat. = scattered, n.m. = not measured., cont. = Continuous
2) CHMI = Czech Hydrometeorological Institute
DWD = Deutscher Wetterdienst
EMD = Ecole des Mines de Douai (France)
EMPA = Swiss Federal Lab. for Materials Testing and Research
FMI = Finnish Meteorological Institute
MMA = Ministerio de Medio Ambiente (Spain)
NILU = Norwegian Institute for Air Research
SHMI = Hydrometeorological Institute in Slovakia
UBA = Umweltbundesamt (Germany)

Table 4: The number of samples of hydrocarbons (HC) and carbonyls (Carb) in 2003.

Station	Number of samples	
	HC	Carb
Pallas	94	-
Utö	98	97
Zingst	100	104
Waldhof	100	103
Schmücke	98	103
Brotjacklriegel	102	104
Hohenpeissenberg[1)]	329	-
Košetice	104	102
Starina	87	-
Rigi[1)]	287	-
Donon	101	47
Peyrusse Vieille	86	45
La Tardiere	101	47
Campisábalos	97	-

[1)] Refer to days with monitoring data

2.2 Analytical procedures and quality control

The procedures for sampling and chemical analyses were similar in 2003 as in previous years, and are not discussed in this report. A detailed description of the procedures used by NILU is given in the EMEP manual (EMEP/CCC, 1996). The technical procedures for the sampling and analysis of hydrocarbons by FMI at the two Finnish stations, as well as a site description and data interpretation, are given by Laurila and Hakola (1996). A presentation of the sampling and analyses performed by the laboratories at EMD (France), EMPA (Switzerland), CHMI (Czech Republic), MMA (Spain), SHMI (Slovakia) and UBA (Germany) has been given in previous annual reports and by Solberg et al. (1996) and is not repeated here. The instrumentation and methods applied by DWD at Hohenpeissenberg have been successfully tested in two international intercomparison experiments (NOMHICE, AMOHA) and have been documented by Plass-Dülmer et al. (2002) and were presented in the last annual report (Solberg, 2004).

For the EMEP VOC measurements in general, the quality control of the VOC measurements includes QA procedures at all stages from sampling to chemical analyses and integration. The QA procedures are described in the EMEP manual (EMEP/CCC, 1996) and are the laboratories' responsibility to follow up. In addition, data received from the individual laboratories are inspected before classified as valid or invalid by the EMEP/CCC.

A few notes about the measurements are given in the following. The concentrations of 3-buten-2-one, 2-methylpropenal, 2-butanone and butanal have for many years been difficult to interpret. No systematic and explainable pattern has been found and inter-laboratory comparisons between EMD, UBA and NILU have indicated analytical problems. Laboratory studies at CCC indicate that unsaturated carbonyl compounds are not chemical stable in the prepared sample solution. Furthermore, LC/MS studies indicate possibilities of chromatographic interference in the C_4 carbonyl compound range. Thus, a revision of the monitoring procedures for carbonyls is needed.

2.3 Revised parallel data of carbonyl compounds at Waldhof

The results of previous parallel sampling of carbonyls at Waldhof have been reported by Solberg et al. (2002) and Solberg (2003). However, since then UBA's data have been revised as the blank values were not subtracted previously. Figure 2 shows the revised results of the parallel time series of methanal, ethanal and propanone (formaldehyde, acetaldehyde and acetone) at Waldhof from NILU's and UBA's laboratories for all parallel data during 1999-2001. A statistical summary of the parallel analysis is given in Table 5. The statistical parameters include the medians of the data from NILU and UBA and the median differences as well as the modified median absolute difference estimator, M.MAD, as described in the EMEP manual (EMEP/CCC, 1996) and the coefficient of variation, CoV, defined as CoV=(M.MAD)/(NILU's median). The analyses from the laboratory at NILU were regarded the reference in these calculations.

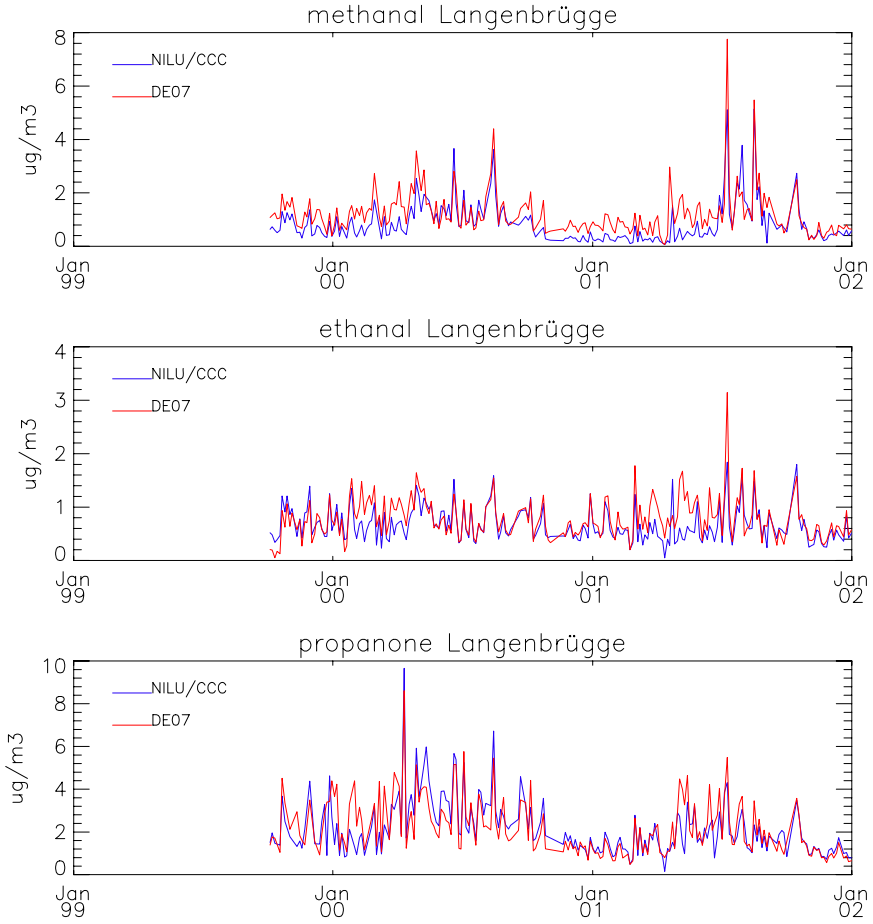

Figure 2: Revised results of parallel sampling and analyses of carbonyl compounds at Waldhof by NILU (blue line) and UBA (red line) during 1999-2001.

Table 5: Revised results from parallel sampling and analyses of carbonyl compounds at DE02, Waldhof during 1999-2001. The columns give the median of all samples as analysed by NILU and UBA, respectively, as well as the median difference, the modified median absolute difference estimator (M.MAD), the coefficient of variation (CoV) and the linear correlation coefficient (r). Unit: $\mu g\ m^{-3}$.

	median NILU	median UBA	median difference	M.MAD	CoV	r
methanal	0.630	1.010	0.390	0.329	0.522	0.829
ethanal	0.570	0.705	0.073	0.176	0.310	0.751
propanone	1.795	1.752	-0.115	0.523	0.292	0.812

M.MAD expresses the spread of the data and equals the standard deviation if the population has a normal distribution. CoV expresses the relative spread of the data, and, similar to the M.MAD, approaches the relative standard deviation for a normal distributed population. Both parameters are non-parametric statistics that make them particularly useful for trace gas measurements that normally show a non-normal distribution in the data.

The revised data show a generally better agreement between the two time series than before. The most pronounced change is for ethanal (acetaldehyde) for which the subtraction of the blank values has significantly reduced the values and differences with NILU's data.

3. VOC concentrations in 2003

3.1 General

Monthly mean and median concentrations of the individual hydrocarbons and carbonyls for 2003 are tabulated in Appendix A. The monthly statistics were not calculated for sample numbers less than 4. Time series of all compounds during 2003 are given in Appendix B. For the continuous monitor data from CH05 Rigi the average of two 2-hourly values around noon were used in the calculations whilst the day-time and night-time data from Hohenpeissenberg were used. Based on previous experience there is not much difference in the anthropogenic HC concentrations at noon and at midnight at Hohenpeissenberg (pers. comm., Christian Plass-Dülmer). For isoprene, however, the difference is large.

A comparison of the seasonal mean and percentile concentrations of hydrocarbons in winter (Jan., Feb., Nov., Dec.) and carbonyls in summer (May, June, July, Aug.) measured at the different stations is given in Figure 3 and Figure 4. This shows that the hydrocarbon concentrations at SK06, Starina, and, to a less extent CZ03, Košetice, were high for many of the hydrocarbons. Furthermore, a number of very high concentrations of isobutane and butane in January 2003 are the reason for the high values at FR08, Donon. At the Finnish sites there were problems with the blank values for butane, thus most of these data had to be deleted.

The hydrocarbon concentrations at ES09, Campisábalos, were substantially lower than at the other sites, particularly for the most lightweight components. In winter ethane, propane and many other hydrocarbons are chemically stable and the results from previous years have indicated well-mixed concentrations of these species in Europe during winter. The monitoring results from Campisábalos are thus surprisingly low and parallel sampling and analyses with other laboratories have been recommended. In November 2004 representatives from NILU/CCC visited Campisábalos and the Spanish laboratory and made parallel samples. The result of this exercise and the Spanish carbonyl data will be reported when the evaluation is finished.

The summer seasonal means and percentiles for four selected carbonyls, formaldehyde, acetaldehyde, acetone and butanone, are given in Figure 4. This shows particularly low concentrations at DE05, Brotjacklriegel, probably reflecting the altitude of the monitoring site (approx. 1000 m asl.) and at Utö, located further north than the other sites. The formaldehyde (methanal) concentrations were highest at Donon, while acetaldehyde (ethanal) were highest at Košetice. A likely explanation for this is biogenic formation of formaldehyde from the degradation of isoprene at Donon as the isoprene concentrations at Donon are substantially higher than at the other sites. Acetaldehyde, on the other hand is to a larger extent a primary or secondary product of anthropogenic emissions.

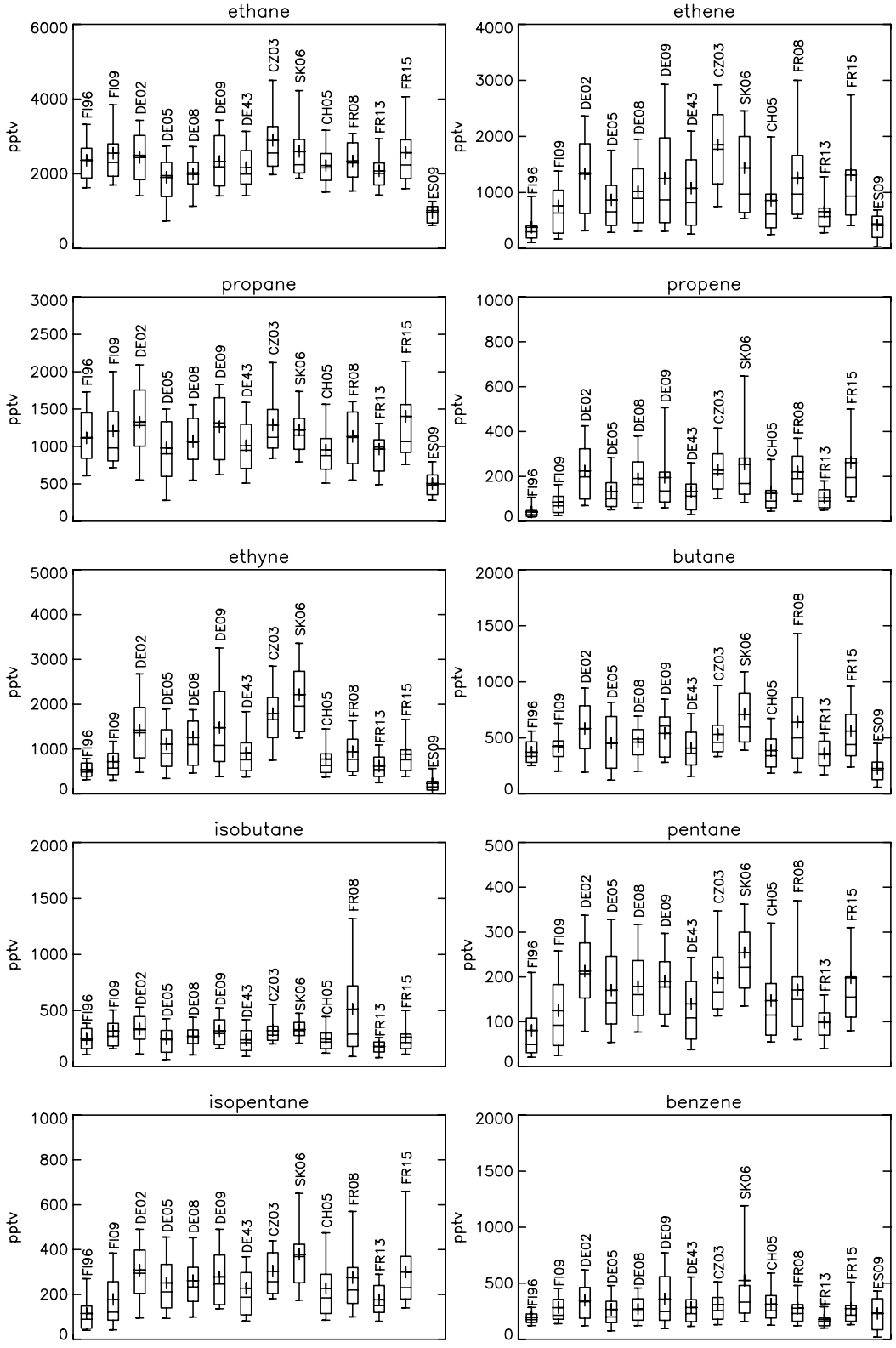

Figure 3: Box- and whisker-diagrams for hydrocarbons during winter 2003 (Jan., Feb., Nov., Dec.). The markers indicate the 10-, 25-, 50-, 75- and 90-percentiles. Mean values are indicated by a cross.

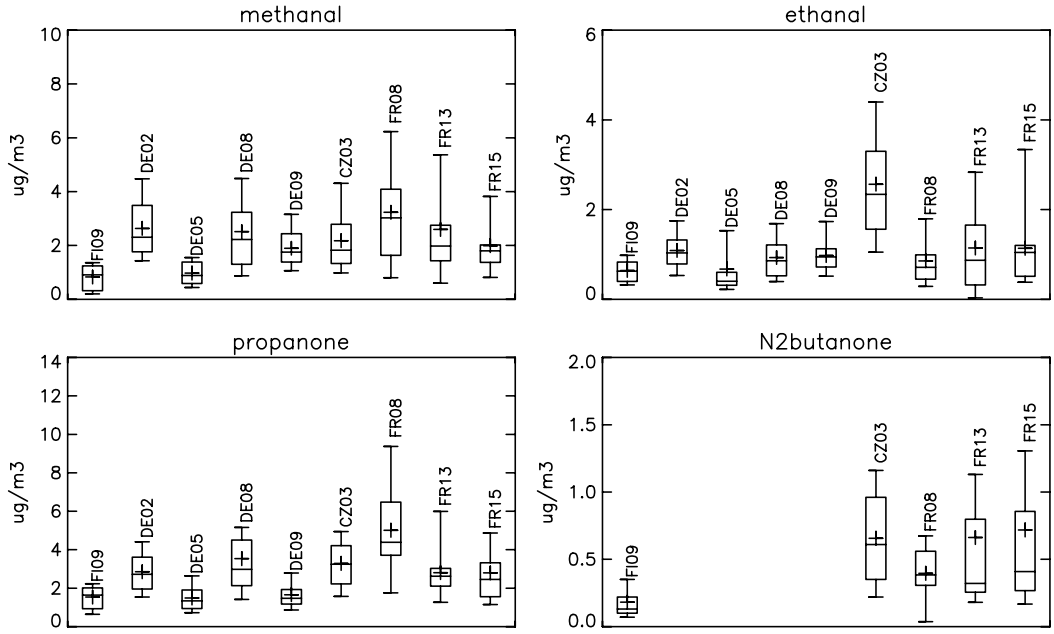

Figure 4: Box- and whisker-diagrams for carbonyls during summer 2003 (May, June, July, August). The markers indicate the 10-, 25-, 50-, 75- and 90-percentiles. Mean values are indicated by a cross.

The weather conditions were extreme in Europe in the summer half year of 2003 and the continent experienced several heat waves, most pronounced in August. The meteorological conditions have been extensively described in other studies (e.g. Fink et al., 2004). Luterbacher et al. (2004) concluded that the summer of 2003 was very likely warmer than any other summer back to 1500. Over Europe, persistent anticyclonic anomalies, warm temperatures and a series of intense heat waves characterised the summer (Schär et al., 2004; Stott et al., 2004).

As argued by Solberg et al. (2005) the anomalous weather conditions likely lead to a number of side effects, as e.g. increased biogenic emissions due to the elevated temperature and increased sunshine during the heat waves. As shown by Figure 5 the summer concentrations of isoprene at Donon were clearly elevated in summer 2003 compared to previous years indicating increased emissions. There was no corresponding increase in the other anthropogenic VOCs. For the German and Czech sites there was not a similar enhancement in summer isoprene in 2003 compared to previous years. This is surprising as the heat waves affected large regions of central Europe. One possible reason could be if the other VOC sites to a less extent reflects the biogenic emissions. Donon is located inside a forest and normally shows considerably higher isoprene concentrations than the other sites (e.g. Solberg, 2004). If the other sites are located further away from the area of biogenic emission than Donon the isoprene concentrations measured at these sites will to a larger degree reflect the photochemical breakdown and to a less degree the emissions. However, many other factors could also contribute, as e.g. changes in vertical exchange and in OH concentration. Thus, without more detailed analyses we can't really conclude why a marked isoprene increase was seen at Donon and not at the other sites during the extreme summer 2003.

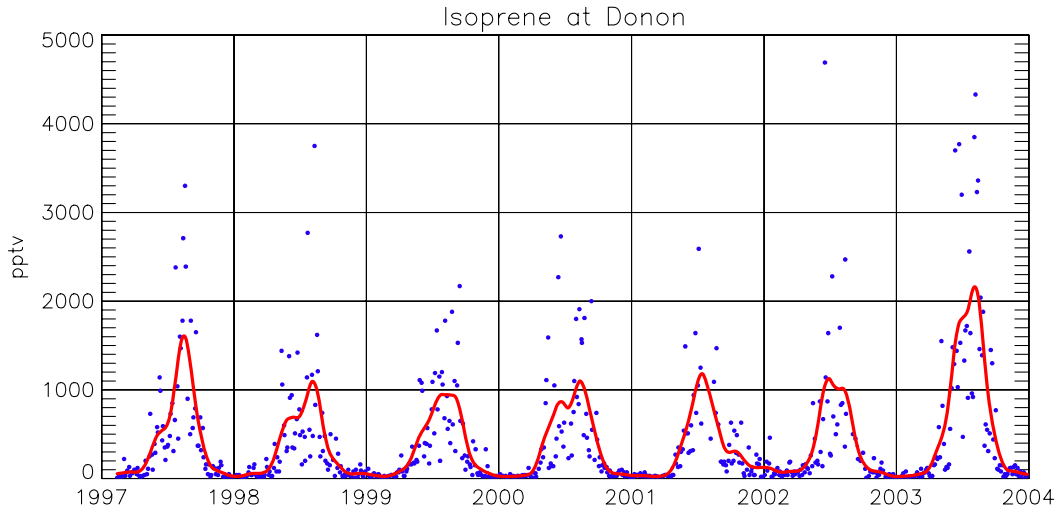

Figure 5: Isoprene measurements at Donon during 1997-2003. Individual samples (twice a week) are shown as blue marks and the corresponding smoothed running average as a red curve (adopted from Solberg et al., 2005).

3.2 Regional distribution of VOC

Figure 6–Figure 15 shows maps with the stations' median concentrations of 10 light hydrocarbons for the winter months January, February, November and December in 2003 taken together. These medians are based on the average of the two 2-hourly values around noon at Rigi and on both the day-time and night-time values at Hohenpeissenberg.

Although the number of sites obviously is too low to give a clear picture of the regional background distribution of hydrocarbons in Europe, some characteristics are indicated by these results. Similar figures for three carbonyls for the summer months May-August 2003 are given in Figure 16–Figure 18.

As noted in previous reports, the measurements indicate that hydrocarbons become fairly well mixed in Europe in winter. Components indicative of natural gas emissions, ethane and propane, were higher in north and east, whereas e.g. ethene, propene and acetylene were higher in central and eastern parts of the continent. n- and i-butane that stems from a number of different emissions sources also show high concentrations to the north.

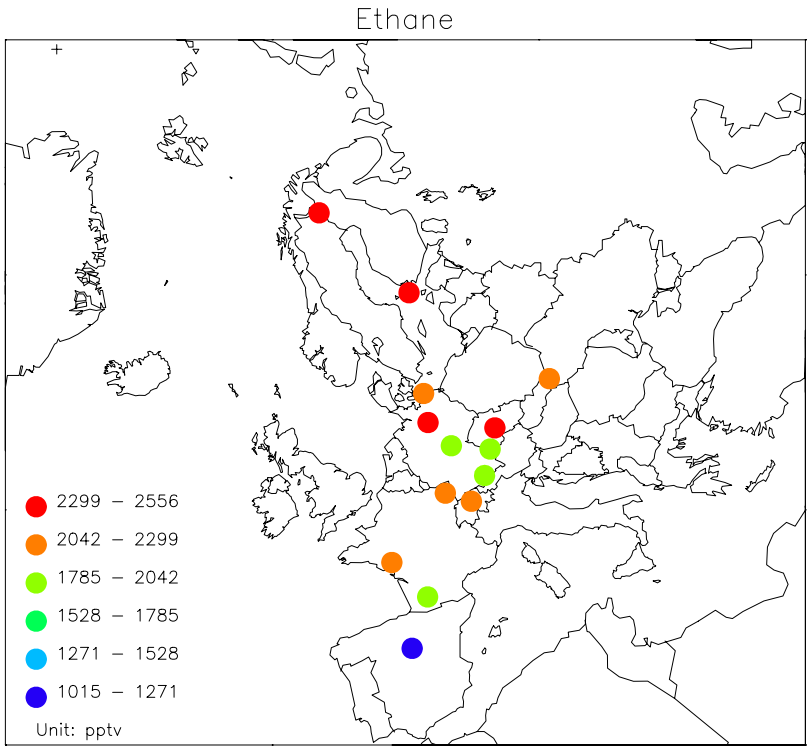

Figure 6: Median concentration of ethane at EMEP sites in the winter months November, December, January and February 2003 taken together.

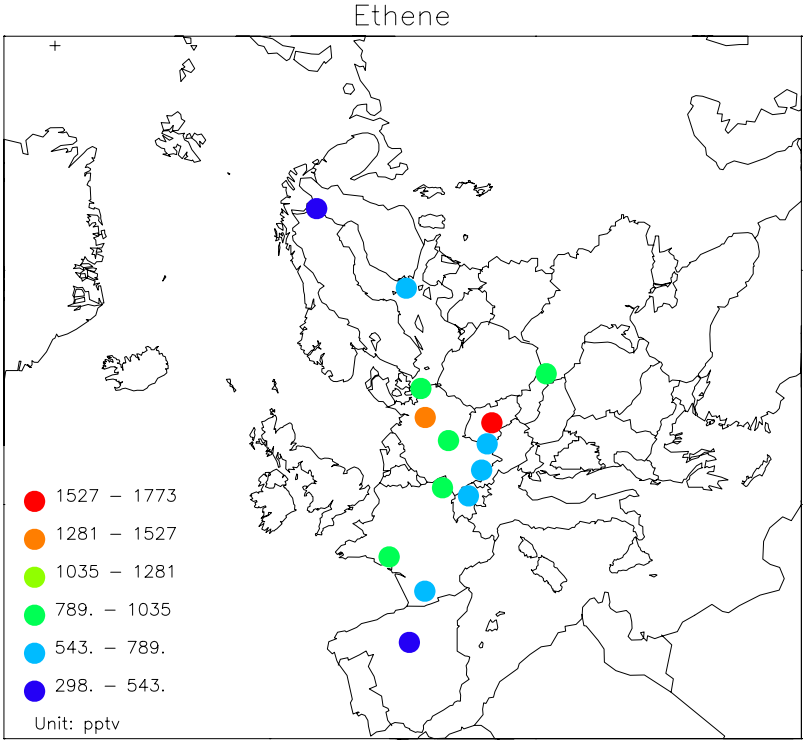

Figure 7: Median concentration of ethene at EMEP sites in the winter months November, December, January and February 2003 taken together.

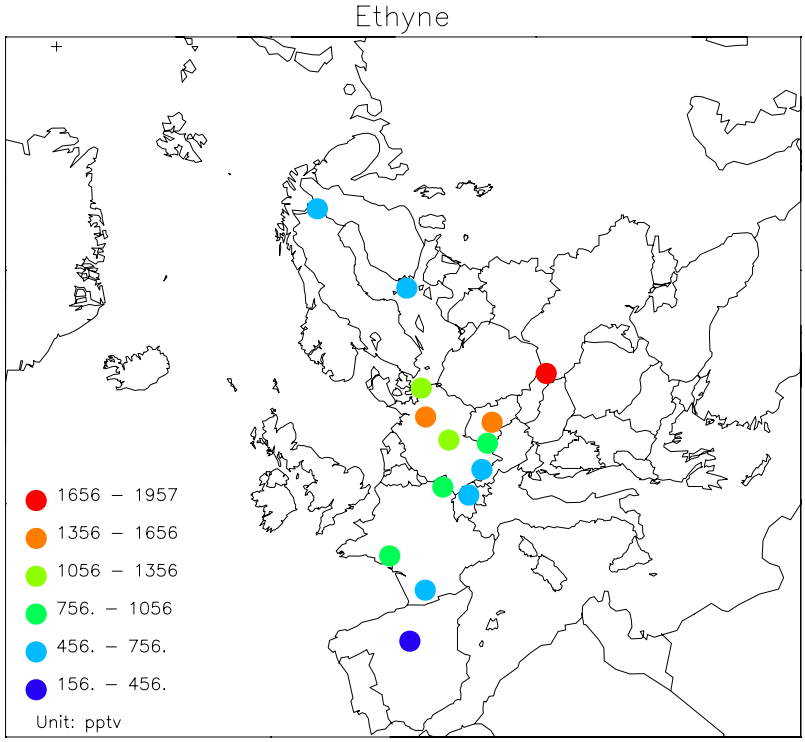

Figure 8: Median concentration of acetylene at EMEP sites in the winter months November, December, January and February 2003 taken together.

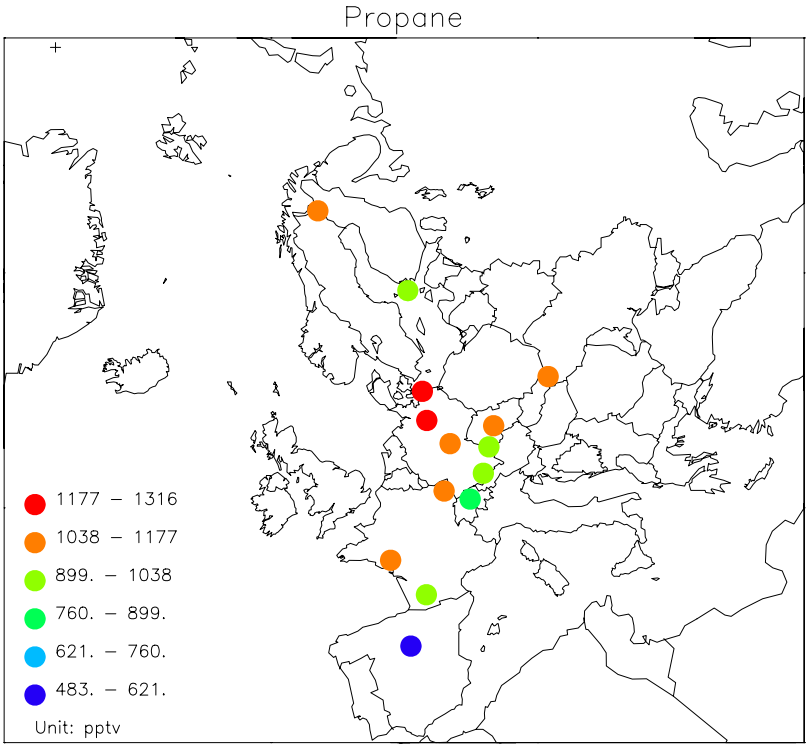

Figure 9: Median concentration of propane at EMEP sites in the winter months November, December, January and February 2003 taken together.

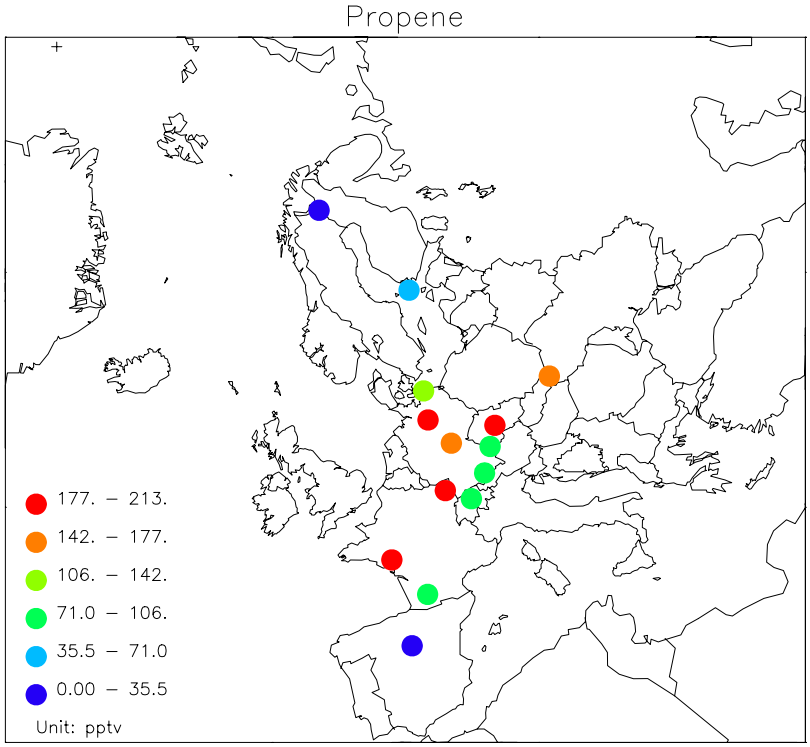

Figure 10: Median concentration of propene at EMEP sites in the winter months November, December, January and February 2003 taken together.

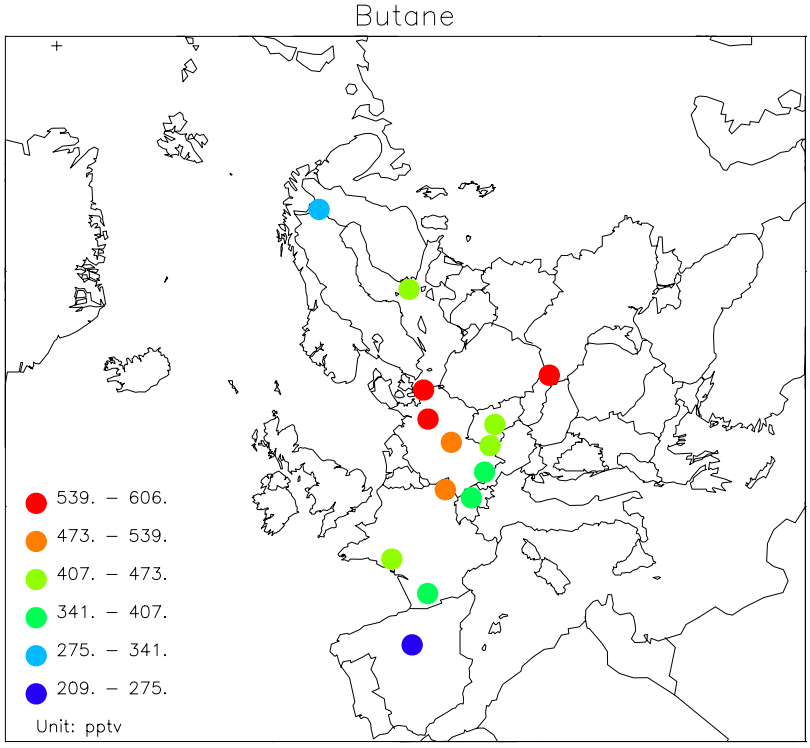

Figure 11: Median concentration of n-butane at EMEP sites in the winter months November, December, January and February 2003 taken together.

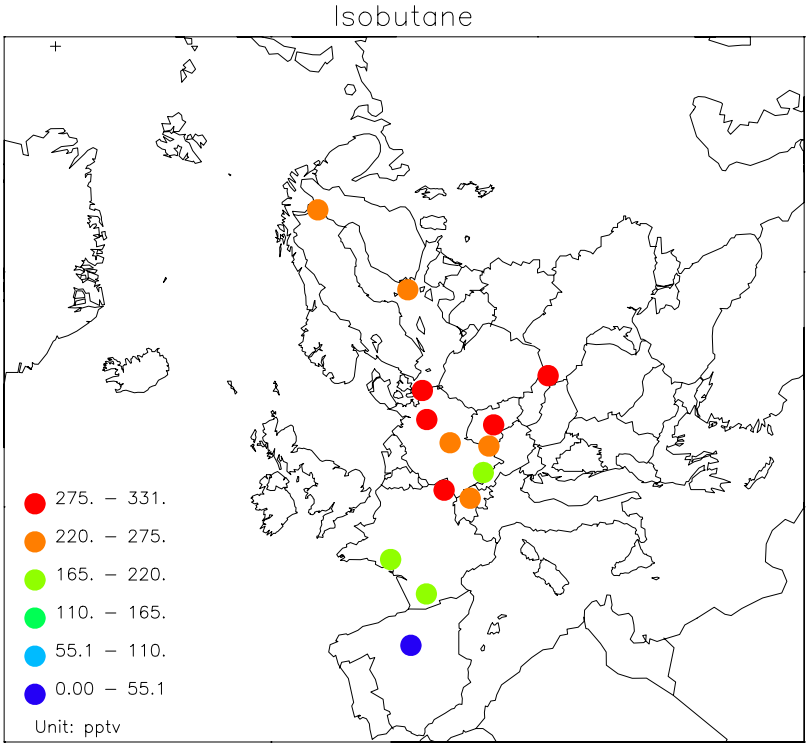

Figure 12: Median concentration of i-butane at EMEP sites in the winter months November, December, January and February 2003 taken together.

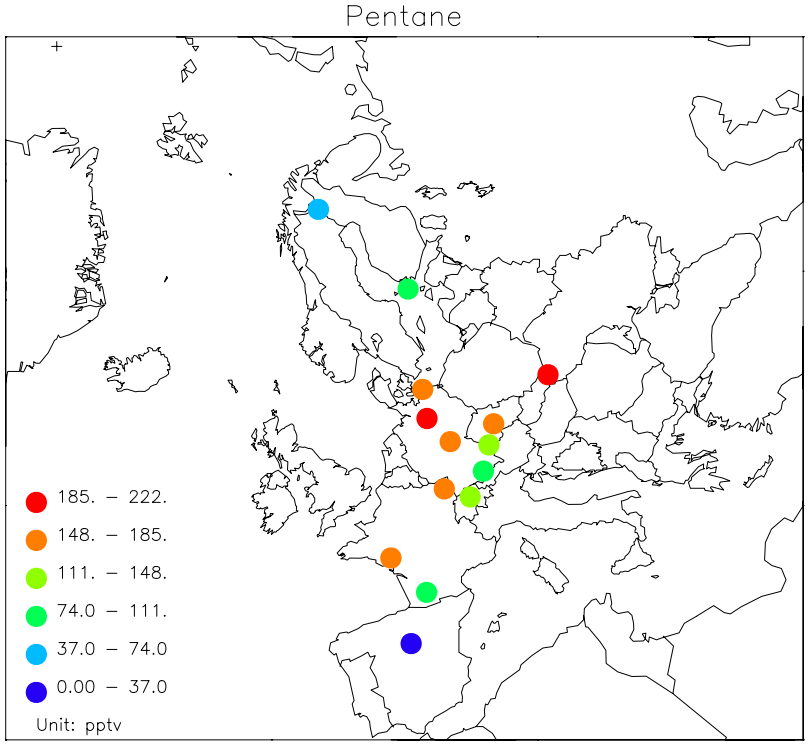

Figure 13: Median concentration of n-pentane at EMEP sites in the winter months November, December, January and February 2003 taken together.

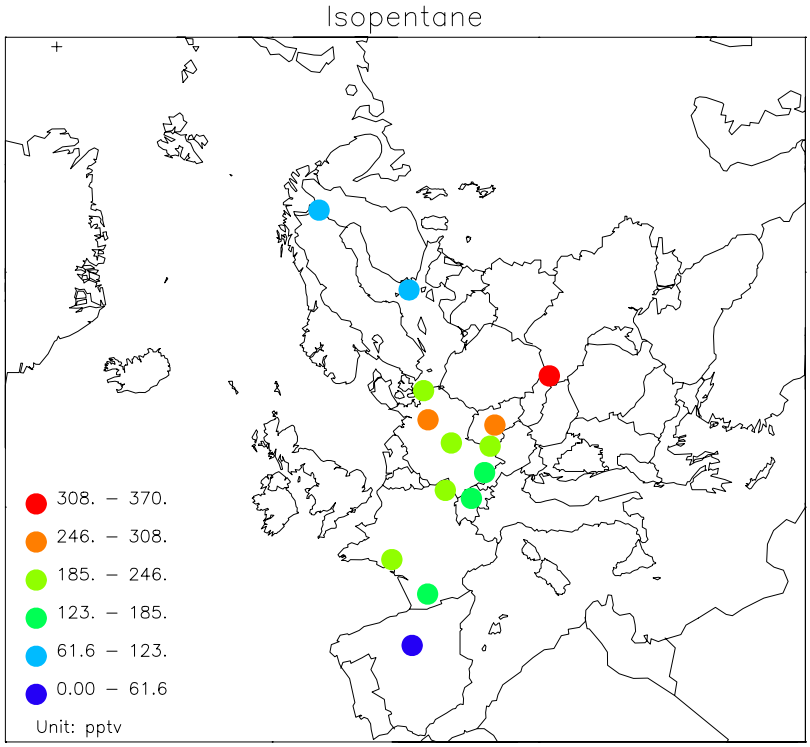

Figure 14: Median concentration of i-pentane at EMEP sites in the winter months November, December, January and February 2003 taken together.

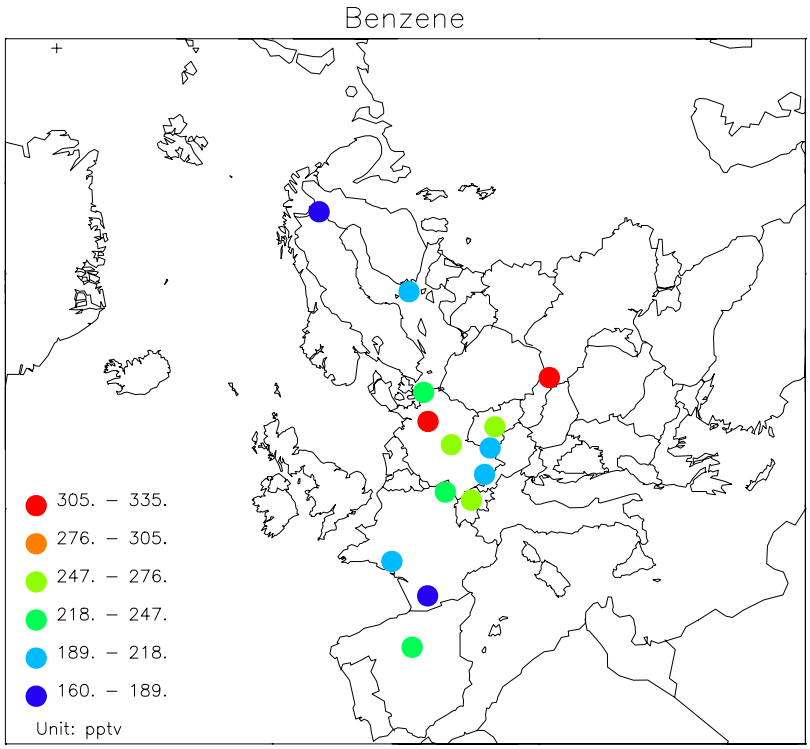

Figure 15: Median concentration of benzene at EMEP sites in the winter months November, December, January and February 2003 taken together.

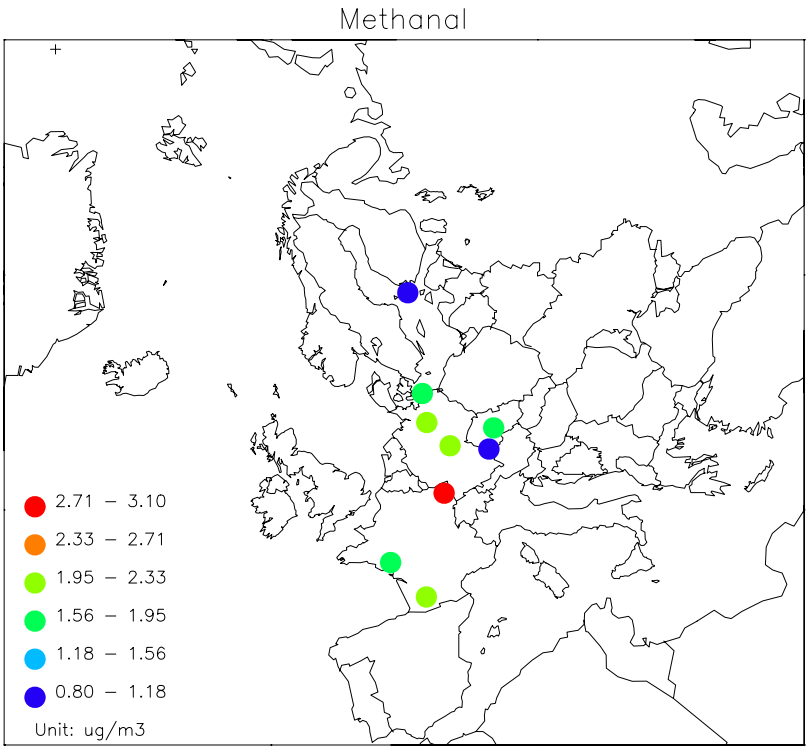

Figure 16: Median concentration of formaldehyde at EMEP sites in the summer months May, June, July and August 2003 taken together.

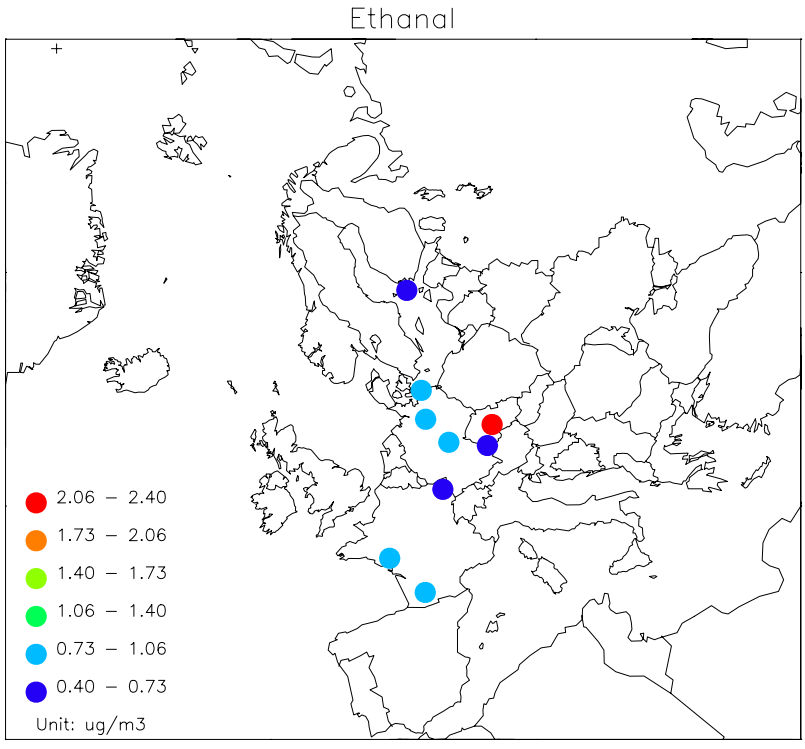

Figure 17: Median concentration of acetaldehyde at EMEP sites in the summer months May, June, July and August 2003 taken together.

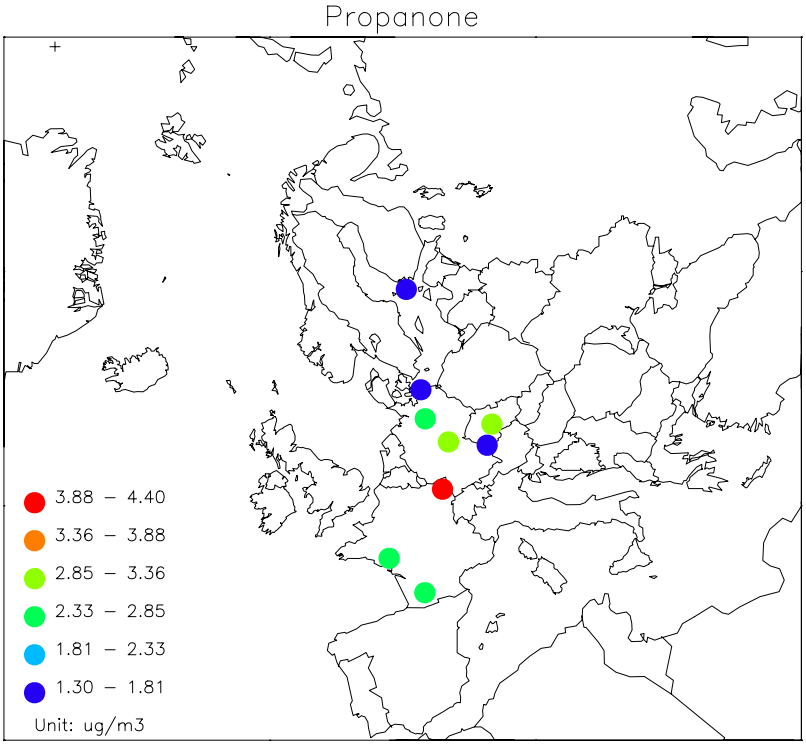

Figure 18: Median concentration of acetone at EMEP sites in the summer months May, June, July and August 2003 taken together.

4. Long-term trends in VOC

The long-term trend in the measured VOC from 1993 is indicated in Figure 19 and Figure 20 showing the seasonal medians at Waldhof (DE02), Košetice (CZ03), Donon (FR08) and Peyrusse Vieille (FR13) of selected hydrocarbons (winter) and carbonyls (summer), respectively.

In addition to the emission source strength, these long-term trends or variations will be largely controlled by inter-annual changes in weather conditions and atmospheric stability. Furthermore, the changes in chemical analysing laboratory may also have a significant impact on the median concentrations and this is marked in the Figures. Note that the parallel sampling and analyses has not necessarily been carried out during the whole season. Thus, large differences between two laboratories for the same year may give a false impression of the laboratory differences.

A marked decline in the winter medians of several hydrocarbons is indicated by Figure 19. To separate the sole effect of changes in European VOC emissions on the observed concentrations trends in Figure 19 and Figure 20 requires a number of detailed model calculations. Furthermore, due to the large scatter in data values from year to year, a linear trend is of little value to assign.

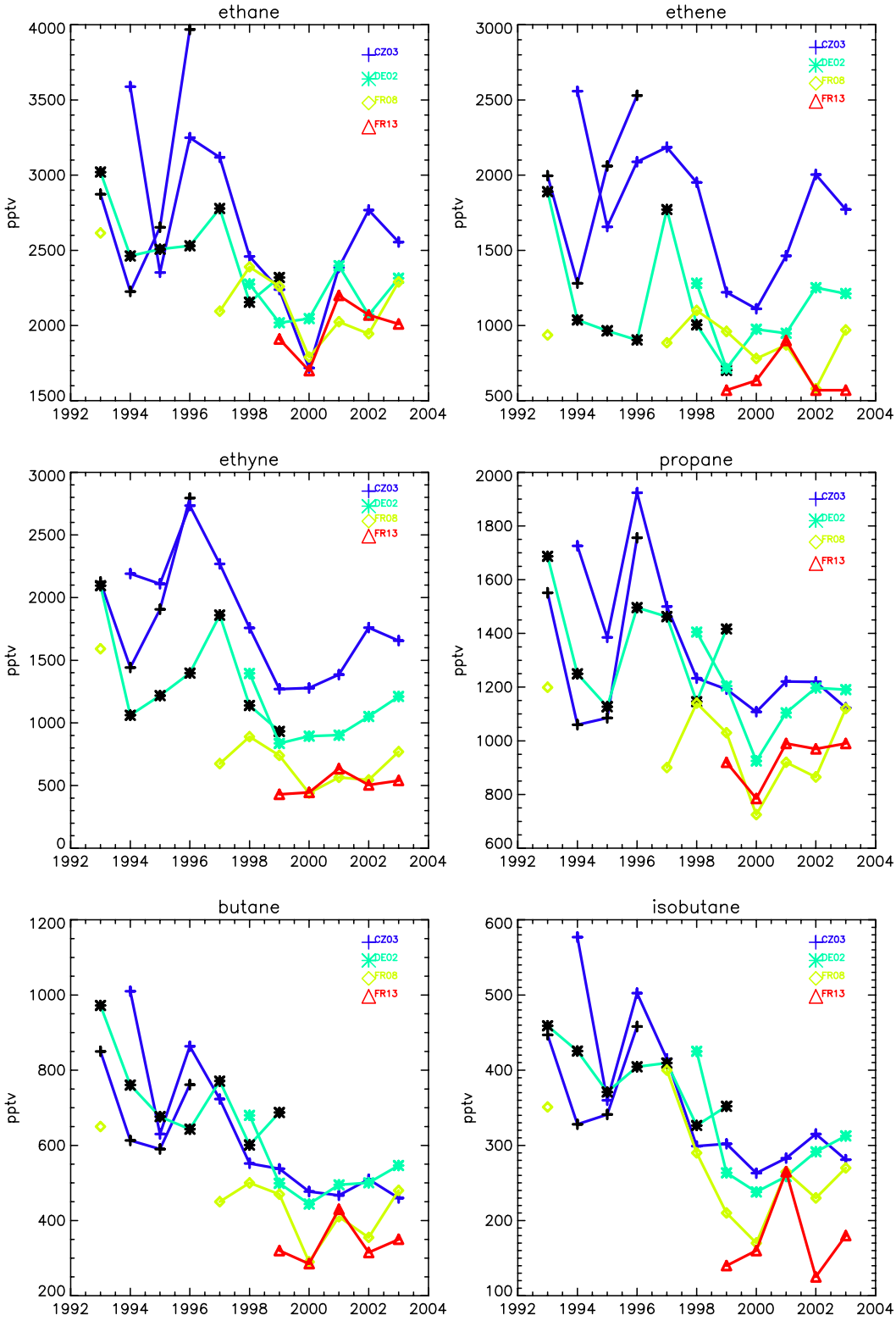

Figure 19: Annual winter (Jan., Feb., Nov., Dec.) median concentrations of hydrocarbons at Košetice (CZ03), Waldhof (DE02), Donon (FR08) and Peyrusse Vieille (FR13). Black symbols mark analyses from NILU's lab., coloured symbols mark the national lab.

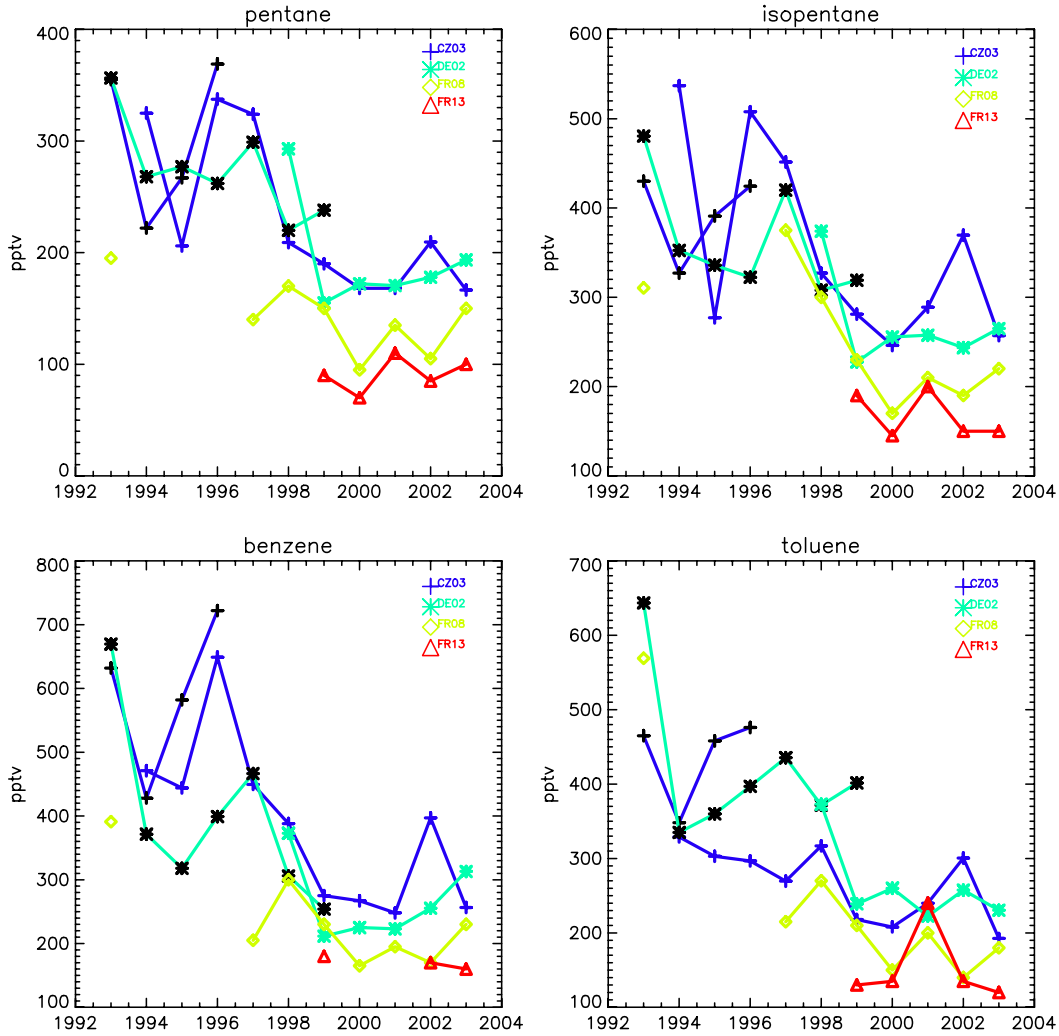

Figure 19, cont.

Particularly strong reductions are indicated for benzene, butane and isobutane and somewhat less for ethane and ethyne (acetylene). The hydrocarbon data suggest that the median concentrations dropped markedly until 2000 and that the trends then have levelled off or even increased after that. To what extent this is explained by meteorological variability or by an actual increase in European VOC emissions after 2000 is not possible to answer without transport model calculations.

For the summer median concentrations of carbonyls (formaldehyde, acetaldehyde, acetone and butanone) the trends are less clear, probably because these compounds are determined by secondary photochemical formation in summer, and thus even more controlled by the inter-annual meteorological conditions than the primary hydrocarbons.

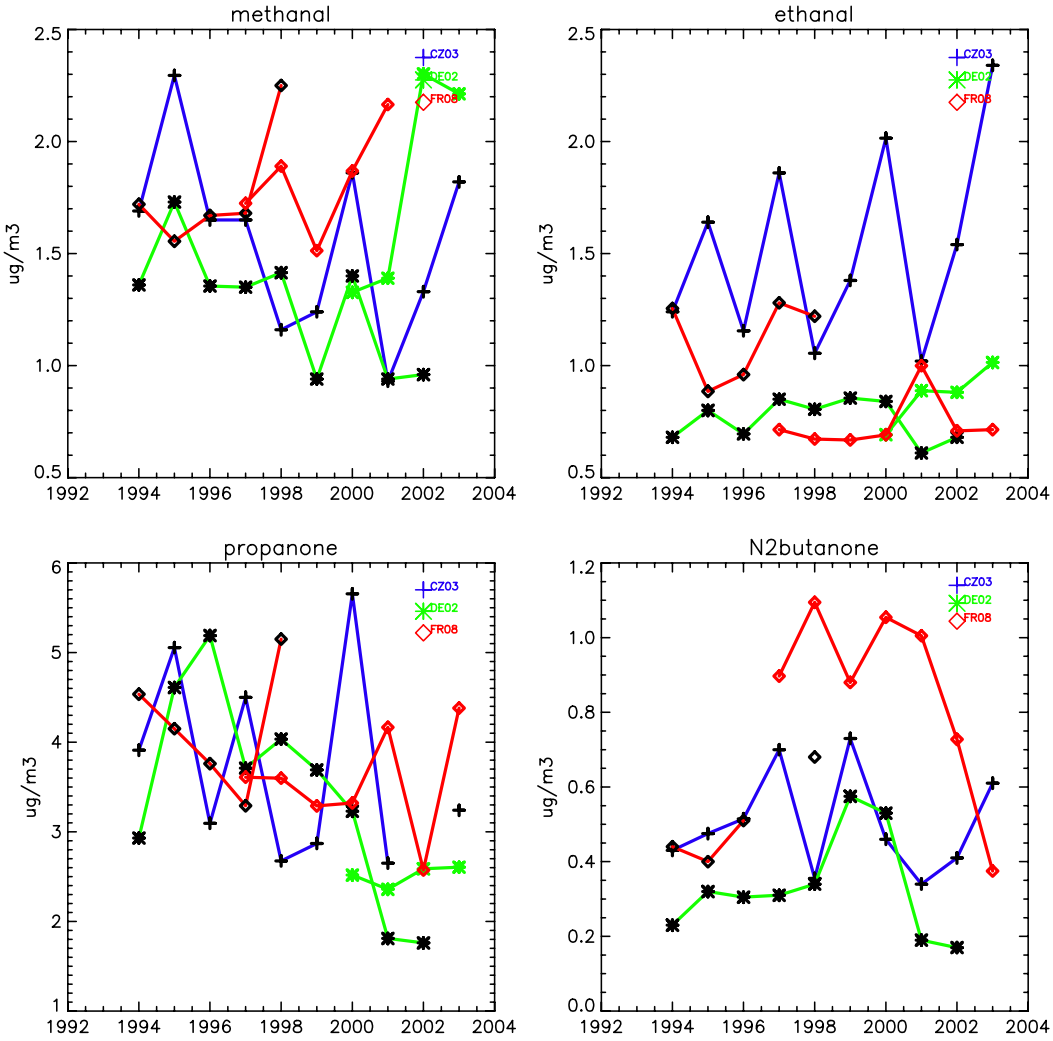

Figure 20: Annual summer (May, June, July, Aug.) median concentrations of carbonyls at Košetice (CZ03), Waldhof (DE02) and Donon (FR08). Black symbols mark analyses from NILU's lab., coloured symbols mark the national lab.

5. Acknowledgement

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Appendix A

Monthly mean and median concentrations of hydrocarbons and carbonyls in 2003

Monthly mean and median concentrations (first and second line, respectively) of hydrocarbons (pptv)

ETHANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	2837	2492	2629	2536	1706	1285	936	977	1059	1321	1661	2092
	2623	2288	2505	2473	1666	1261	941	981	1055	1349	1651	1886
Utö	3057	2769	2859	2635	1570	1394	1137	1125	1441	1523	1901	2451
	2801	2570	2521	2587	1594	1385	1095	1051	1422	1463	1919	2063
Zingst	2498	2743	2513	2110	1404	1231	1028	957	1109	1158	2135	1749
	2596	2879	2218	2171	1451	1221	993	917	1161	1160	1785	1773
Waldhof	2537	2702	2505	1877	1384	1170	1082	997	1278	1467	1864	2736
	2797	2567	2339	1840	1398	1132	1099	986	1212	1387	1838	2583
Schmücke	2224	2173	2077	1909	1433	1049	954	1048	1175	1457	1860	1742
	2229	2046	2028	1930	1444	1066	982	987	1197	1440	1792	1952
Brotjacklriegel	2241	2377	2155	1963	1178	1051	916	928	1050	1199	1440	1554
	2224	2083	2047	1994	1238	1057	900	868	1110	1185	1289	1820
Hohenpeissenberg	2451	2648	2435	2251	1490	1085	990	937	1196	1446	1868	1866
	2273	2583	2383	2300	1544	1077	979	910	1196	1486	1828	1774
Starina	3247	2999	3383	2298	1669	1185	1168	714	1581	1706	2107	2009
	2922	2853	3322	2255	1584	1238	1014	740	1525	1427	2057	2021
Košetice	2800	3759	2703	2428	1452	1101	944	940	1258	1665	2347	2689
	2685	3353	2554	2452	1535	1099	924	944	1323	1354	2365	2390
Rigi	2287	2641	2607	2186	1724	1415	1268	1342	1509	1813	1925	2108
	2220	2565	2510	2160	1660	1390	1260	1320	1490	1800	1850	2040
La Tardiere	2759	2595	2674	2128	1461	1117	935	974	1172	1677	1975	2863
	2310	2580	2785	2140	1435	1120	880	950	1160	1570	1810	2160
Donon	2543	2762	2488	2368	1542	1122	989	1121	1599	1619	1864	2280
	2480	2750	2380	2265	1580	1080	890	1065	1340	1550	1765	2220
Peyrusse Vieille	2184	2833	2121	2070	1509	1160	918	846	1176	1303	1721	1937
	2210	2615	2250	2110	1515	1160	920	825	1120	1260	1730	1950
Campisábalos	1036	1223	1014	1046	765	636	547	631	586	747	760	856
	1064	1174	969	1034	772	549	429	560	570	740	685	875

ETHENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	359	430	204	116	60	62	92	116	104	127	357	359
	335	172	71	66	59	59	96	141	94	110	320	260
Utö	589	726	297	282	170	179	283	152	287	354	854	878
	429	859	174	257	147	178	259	155	250	248	853	372
Zingst	1190	1234	671	277	226	205	285	189	224	357	1515	1063
	843	1299	447	263	176	194	238	161	201	236	902	678
Waldhof	1127	1298	793	225	265	265	212	183	312	571	1334	1733
	1249	1334	526	194	279	254	194	191	243	338	1299	1783
Schmücke	1174	1023	453	340	217	170	160	140	243	616	1052	839
	1186	781	430	192	212	176	169	144	178	611	1080	426
Brotjacklriegel	1337	714	608	314	248	258	229	243	313	538	840	555
	1260	569	570	287	203	248	230	202	248	440	528	534
Hohenpeissenberg	1252	1149	570	430	257	185	185	180	295	659	1031	790
	810	929	477	354	195	161	131	135	270	533	853	574
Starina	1963	994	1939	2183	265	217	276	219	329	1027	2002	808
	1257	850	1491	2142	283	244	228	125	385	614	1954	562
Košetice	1847	1909	945	424	195	172	231	159	265	803	1850	1796
	1680	1874	694	345	184	143	169	144	212	317	1816	1771
Rigi	753	1099	681	446	460	325	281	242	407	791	829	806
	660	835	560	350	340	300	245	220	350	555	670	570
La Tardiere	1694	965	781	308	210	239	201	325	373	902	1108	1416
	1010	685	645	280	210	250	220	295	370	780	880	1030
Donon	1204	1422	539	451	301	279	256	339	424	916	974	1491
	970	1295	490	305	280	300	240	295	350	870	735	1070
Peyrusse Vieille	590	1020	286	246	166	184	158	230	276	393	553	634
	520	905	300	225	135	210	105	230	260	385	430	570
Campisábalos	457	549	470	433	293	431	465	548	499	507	312	351
	348	525	344	419	290	397	391	440	445	540	250	400

PROPANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	1415	1119	1077	941	348	114	158	217	204	435	635	1059
	1358	935	1033	1001	339	104	108	203	151	440	609	906
Utö	1552	1231	1163	947	345	281	268	208	458	521	824	1176
	1475	980	1054	976	284	228	242	207	469	469	798	942
Zingst	1456	1444	1165	869	721	326	348	210	386	420	1114	904
	1565	1542	1010	914	569	315	308	224	381	379	1007	813
Waldhof	1442	1447	1157	877	438	319	294	303	518	665	1032	1398
	1578	1397	1105	847	441	308	264	277	498	525	1008	1284
Schmücke	1345	1097	932	789	486	396	312	352	463	667	930	902
	1471	1026	920	907	453	273	306	318	449	652	828	1009
Brotjacklriegel	1298	1247	914	701	370	282	212	284	367	462	658	704
	1333	1183	884	688	380	238	201	243	365	405	532	757
Hohenpeissenberg	1176	1164	920	738	350	273	249	285	439	591	833	836
	1036	1208	852	739	316	254	213	261	437	597	792	761
Starina	1178	1574	1932	1107	591	409	393	255	617	1015	1090	1069
	1220	1557	1909	1234	601	405	317	259	700	874	1050	1105
Košetice	1289	1631	1037	835	348	235	230	241	420	663	1016	1210
	1168	1398	1003	883	348	213	193	257	417	484	1022	1072
Rigi	1025	1195	942	672	443	291	270	393	507	747	787	899
	1010	1150	910	630	360	270	250	350	510	730	730	830
La Tardiere	1866	1214	998	709	308	239	206	349	368	740	971	1489
	1350	1235	975	645	260	240	175	260	390	710	940	1000
Donon	1263	1408	872	799	350	264	206	370	591	743	779	1133
	1120	1315	830	815	350	250	180	310	370	840	665	1085
Peyrusse Vieille	1010	1320	677	638	323	329	249	256	394	488	756	930
	1090	1190	750	620	275	290	250	245	360	480	660	990
Campisábalos	536	642	399	532	362	298	238	285	431	371	351	485
	547	638	325	375	192	249	199	220	160	330	330	505

PROPENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	37	52	23	31	29	34	41	55	48	38	35	39
	29	25	18	31	29	31	40	49	41	36	42	27
Utö	64	55	36	87	47	73	60	72	93	80	106	113
	45	46	31	61	45	69	62	70	79	71	97	39
Zingst	204	122	89	66	74	60	80	56	60	90	268	195
	148	106	91	69	73	59	73	50	57	80	149	125
Waldhof	224	145	103	48	77	63	55	55	74	121	234	334
	164	155	78	39	68	65	52	53	66	97	268	277
Schmücke	247	169	71	50	58	50	44	36	60	148	216	135
	262	111	57	42	56	50	44	33	48	128	164	63
Brotjacklriegel	215	85	90	66	82	71	66	54	75	110	133	92
	202	75	83	66	66	70	61	49	53	82	88	87
Hohenpeissenberg	146	102	61	49	35	33	30	30	38	82	148	109
	121	121	55	43	28	31	27	29	33	67	105	72
Starina	402	126	124	308	84	91	88	48	118	192	232	218
	374	134	133	170	90	76	101	42	150	189	179	127
Košetice	231	167	128	85	28	34	70	27	51	113	264	251
	247	148	62	26	28	29	41	27	34	39	220	251
Rigi	122	117	82	67	62	44	41	38	73	113	129	156
	100	90	70	60	60	40	30	30	50	90	90	100
La Tardiere	349	164	144	68	53	70	64	78	98	178	204	313
	260	135	85	60	50	70	60	70	90	150	175	200
Donon	273	185	89	74	51	60	47	69	80	137	146	261
	230	190	80	65	50	60	50	70	60	130	115	195
Peyrusse Vieille	127	128	31	36	33	37	45	54	59	53	76	99
	120	95	40	35	40	40	35	60	60	55	60	90
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

ETHYNE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	641	619	576	455	196	118	75	114	124	193	383	453
	663	466	468	393	184	123	65	93	119	169	324	397
Utö	613	918	661	611	222	174	154	103	242	291	662	700
	630	1030	502	573	212	159	166	101	208	235	630	456
Zingst	1442	1961	1370	745	287	220	253	195	341	432	1465	895
	1106	1931	1061	718	263	211	254	192	357	328	883	664
Waldhof	1171	1919	1377	779	303	240	196	226	388	628	1211	1419
	1155	1925	987	831	301	234	187	204	396	419	1033	1444
Schmücke	1153	1999	929	730	401	245	208	262	370	630	1165	847
	1094	1575	858	651	372	220	203	248	340	655	855	668
Brotjacklriegel	1522	1402	1140	781	350	300	224	303	391	601	831	679
	1423	1015	1106	788	353	288	226	298	377	490	529	652
Hohenpeissenberg	975	1114	682	513	266	201	157	184	310	535	838	742
	691	848	638	498	251	192	150	189	308	510	755	585
Starina	-	1944	3790	2987	570	397	502	408	808	1908	2739	1574
	1923	1846	3620	2930	614	466	457	269	681	1489	2674	1389
Košetice	1801	2480	1284	842	402	271	237	265	405	857	1363	1548
	1577	2367	1060	854	404	260	249	252	337	452	1446	1642
Rigi	872	998	676	654	603	415	403	276	479	880	687	701
	805	880	620	530	510	380	310	260	420	765	630	600
La Tardiere	1124	936	793	469	231	177	149	286	294	591	669	801
	850	870	770	465	215	180	165	210	270	500	550	710
Donon	978	1278	629	533	328	262	166	255	326	648	666	919
	830	1040	600	500	270	190	150	225	240	600	455	765
Peyrusse Vieille	611	1045	557	484	233	186	158	185	281	367	443	569
	600	955	650	415	210	180	135	155	220	270	260	530
Campisábalos	191	280	269	181	152	241	251	239	193	103	229	232
	164	278	177	178	158	311	199	110	180	5	95	105

n-BUTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	372	372
	-	-	-	-	-	-	-	-	-	-	353	315
Utö	-	-	-	-	-	-	-	-	-	-	431	417
	-	-	-	-	-	-	-	-	-	-	448	358
Zingst	652	553	430	285	246	113	174	74	142	178	486	418
	672	605	389	284	116	117	166	62	143	201	428	347
Waldhof	620	555	440	261	118	123	112	130	219	270	517	661
	639	552	456	267	117	114	102	105	187	267	494	657
Schmücke	593	465	318	243	159	106	106	138	162	267	424	376
	574	414	298	292	134	99	108	130	155	249	420	424
Brotjacklriegel	661	488	328	209	113	114	104	122	157	227	308	344
	726	472	358	187	118	101	104	91	129	206	269	314
Hohenpeissenberg	479	435	313	213	106	105	86	102	147	216	356	331
	430	474	288	212	80	100	78	88	136	212	310	305
Starina	1097	630	1118	423	237	164	200	151	264	480	623	459
	1038	605	1099	415	244	195	169	141	315	426	512	463
Košetice	532	622	367	250	119	97	108	92	192	275	443	527
	463	511	371	260	116	85	86	87	187	165	435	441
Rigi	394	464	388	243	195	182	147	208	225	329	374	395
	380	460	370	210	140	170	130	160	210	300	330	350
La Tardiere	639	468	391	278	105	114	89	174	161	306	373	731
	570	465	340	255	80	90	85	120	160	290	345	460
Donon	696	688	359	298	126	137	92	190	283	362	478	720
	580	605	380	290	90	120	70	150	150	390	285	490
Peyrusse Vieille	367	465	221	189	83	109	111	91	114	153	269	379
	380	450	240	175	85	90	95	80	120	150	250	380
Campisábalos	313	255	191	200	136	183	122	185	99	257	121	215
	275	220	133	171	90	153	96	135	80	180	90	225

i-BUTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	288	237	180	148	41	19	23	36	35	83	146	273
	282	167	162	169	42	13	14	38	24	82	136	234
Utö	409	258	189	162	55	60	68	40	115	161	290	308
	321	190	165	164	44	46	46	38	101	113	267	258
Zingst	367	329	263	176	134	67	99	41	82	96	297	257
	355	357	248	171	74	66	90	37	79	79	259	215
Waldhof	351	330	265	159	71	68	68	70	131	151	293	378
	357	318	285	158	72	67	54	61	120	142	283	339
Schmücke	342	261	196	145	87	80	71	72	92	148	252	223
	328	251	181	165	77	56	54	65	95	132	240	248
Brotjacklriegel	365	277	212	127	80	64	74	79	92	110	173	170
	363	251	230	122	73	51	48	56	71	101	121	184
Hohenpeissenberg	266	268	184	127	62	60	52	62	92	138	216	192
	227	285	171	128	47	57	48	58	88	128	192	174
Starina	415	329	527	238	136	138	127	83	163	276	307	264
	415	341	549	235	134	119	106	88	173	261	310	276
Košetice	317	369	226	152	93	64	72	60	121	175	278	322
	301	298	218	160	80	53	48	58	108	98	269	277
Rigi	233	284	221	130	101	114	79	102	132	192	223	281
	240	280	210	120	80	120	70	90	130	170	190	250
La Tardiere	308	243	219	144	46	46	43	81	67	161	163	320
	250	240	180	130	40	30	30	50	70	150	160	220
Donon	551	530	219	171	68	69	47	138	161	240	364	610
	350	390	200	155	40	50	40	85	90	240	180	335
Peyrusse Vieille	184	238	121	105	109	47	63	44	56	80	130	184
	190	225	130	100	40	40	30	40	50	85	140	180
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

SUM OF BUTENES

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Starina	121	144	153	-	114	142	82	33	58	60	-	653
	125	146	165	-	114	117	68	30	57	62	-	628
Košetice	144	121	214	59	101	259	158	45	454	191	145	213
	130	107	113	66	26	70	93	38	75	45	123	171
Rigi	161	127	96	118	53	35	55	62	102	172	167	146
	145	140	90	110	50	30	50	60	100	150	140	120
La Tardiere	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

BUT-1-ENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	39	28	23	17	13	16	24	17	19	25	47	37
	29	27	23	16	15	17	17	17	16	26	34	26
Waldhof	45	32	24	12	21	18	15	16	17	26	45	52
	37	34	21	12	21	17	14	16	16	26	50	51
Schmücke	46	38	19	21	16	17	19	14	17	29	43	32
	50	29	19	13	16	19	15	14	15	25	35	26
Brotjacklriegel	45	24	25	21	21	19	19	18	19	27	30	23
	44	24	23	20	21	17	19	17	19	23	25	25
Hohenpeissenberg	26	20	14	9	8	8	8	8	7	13	26	21
	21	23	14	10	7	8	7	8	7	11	18	14
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	53	40	43	29	24	22	21	25	27	36	40	68
	40	40	35	30	20	20	20	20	30	40	35	40
Donon	266	45	38	23	16	20	19	24	17	23	24	43
	50	45	30	25	20	20	20	25	20	20	20	30
Peyrusse Vieille	17	25	17	20	16	17	16	18	12	11	7	23
	20	20	20	20	15	20	20	20	10	10	5	20
Campisábalos	75	87	83	75	51	83	78	76	80	103	56	55
	57	88	70	70	45	72	69	65	80	90	40	65

TRANS-2-BUTENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	6	7	6	7	5	6	8	4	4	5	6	10
	6	7	6	7	5	5	6	4	4	4	6	5
Waldhof	7	5	7	5	5	5	4	5	4	6	8	7
	7	5	8	5	4	5	4	5	4	5	5	6
Schmücke	9	15	5	6	9	5	4	4	5	6	11	5
	9	8	5	7	5	5	4	4	5	6	7	5
Brotjacklriegel	12	8	9	7	5	6	7	4	5	6	7	7
	11	8	9	6	5	5	7	4	5	5	6	7
Hohenpeissenberg	9	8	7	7	7	7	7	7	6	9	10	9
	9	8	7	7	7	7	7	7	5	7	6	6
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	18	14	12	9	6	11	10	9	8	7	8	19
	20	10	10	8	5	10	10	10	5	5	5	10
Donon	178	13	21	9	8	11	8	9	5	5	7	10
	40	10	10	8	5	10	10	8	5	5	5	5
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Campisábalos	23	24	20	22	14	20	19	16	18	38	14	16
	16	25	16	18	11	17	14	10	10	30	10	20

CIS-2-BUTENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	9	11	9	11	7	5	11	5	3	4	10	8
	7	10	7	11	5	6	8	4	3	5	10	5
Waldhof	8	9	11	6	6	6	5	5	6	6	11	8
	5	9	11	6	6	6	4	5	6	5	7	5
Schmücke	13	18	7	8	10	4	7	6	6	7	11	6
	14	14	5	9	7	3	5	5	5	7	9	5
Brotjacklriegel	16	9	14	8	6	5	7	6	6	6	9	6
	15	7	14	8	5	4	6	5	6	5	7	5
Hohenpeissenberg	5	6	7	7	5	5	4	4	3	5	9	7
	5	6	7	6	5	4	4	4	3	5	6	5
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	11	9	9	6	5	7	6	5	7	7	7	14
	5	10	8	5	5	5	5	5	5	5	5	10
Donon	122	13	18	8	6	9	7	6	6	5	7	10
	30	10	10	5	5	10	5	5	5	5	5	5
Peyrusse Vieille	5	5	5	5	5	5	9	5	5	5	5	5
	5	5	5	5	5	5	5	5	5	5	5	5
Campisábalos	186	136	148	165	99	178	137	199	61	241	140	190
	110	88	48	73	26	183	100	155	30	200	75	185

n-PENTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	38	36	19	12	22	21	18	25	25	52	102	172
	38	25	17	13	20	19	14	25	18	51	81	134
Utö	82	31	19	21	49	72	101	55	107	115	181	190
	60	25	17	18	41	57	71	55	81	112	175	137
Zingst	220	172	134	95	103	43	93	32	63	78	190	165
	216	178	114	84	42	43	101	33	58	65	146	131
Waldhof	204	184	144	81	50	63	60	71	119	115	221	260
	210	180	153	72	39	55	51	51	84	79	198	245
Schmücke	179	172	110	92	88	112	92	103	82	135	167	194
	179	153	103	87	72	106	77	60	92	124	155	228
Brotjacklriegel	217	155	155	98	77	68	95	87	97	91	196	115
	197	132	145	73	80	66	70	63	85	87	144	119
Hohenpeissenberg	129	140	81	69	47	47	51	51	72	91	154	114
	96	134	74	56	29	42	31	38	70	75	130	90
Starina	348	241	1260	485	136	128	145	58	129	207	244	180
	333	230	981	358	155	107	111	57	143	178	234	175
Košetice	188	212	104	82	61	49	58	46	90	125	195	198
	178	166	121	83	49	44	47	43	84	76	210	149
Rigi	136	182	150	114	118	100	114	111	177	177	164	135
	120	160	120	90	70	80	80	80	140	150	130	110
La Tardiere	200	159	149	205	141	178	113	156	119	141	134	288
	180	165	135	120	105	120	90	125	110	100	115	150
Donon	168	180	109	110	53	56	39	86	127	163	141	198
	130	170	100	100	30	50	30	55	80	180	80	165
Peyrusse Vieille	113	118	56	53	34	47	58	24	40	52	73	98
	100	115	60	50	30	40	40	20	40	50	60	100
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

i-PENTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	70	79	42	37	25	25	-	-	31	80	129	203
	71	48	40	38	26	26	-	70	24	74	104	195
Utö	121	63	39	114	60	371	359	-	244	241	252	255
	97	42	38	66	56	393	308	274	152	176	238	313
Zingst	329	250	200	186	156	92	167	72	105	113	295	222
	281	261	181	130	72	83	157	73	85	85	247	168
Waldhof	300	268	208	106	77	85	87	112	167	168	316	377
	300	256	210	95	85	85	82	84	106	125	292	358
Schmücke	287	283	154	129	180	107	96	115	126	199	276	208
	279	221	156	122	113	91	95	99	136	165	234	190
Brotjacklriegel	392	220	227	112	127	120	334	183	169	149	200	184
	357	208	218	99	105	112	153	134	134	163	138	188
Hohenpeissenberg	199	210	150	107	98	111	95	127	148	175	256	193
	171	206	139	104	64	104	86	110	153	140	215	172
Starina	447	394	1694	991	758	486	312	170	207	902	393	285
	390	361	1438	802	408	373	223	113	182	458	408	252
Košetice	300	307	187	111	125	104	129	97	197	189	310	297
	330	244	209	113	95	115	95	86	145	126	338	241
Rigi	226	305	259	216	207	197	189	227	267	269	258	210
	200	280	240	180	140	180	170	200	250	250	210	170
La Tardiere	296	229	214	160	78	108	79	163	236	251	268	393
	270	215	210	165	70	70	75	110	160	190	205	230
Donon	241	303	160	161	107	102	89	188	216	251	260	305
	190	265	150	150	120	100	70	120	130	230	155	220
Peyrusse Vieille	171	215	117	90	51	80	151	81	91	103	149	184
	150	210	130	75	45	70	60	75	90	115	120	180
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

n-HEXANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	65	45	38	15	6	4	4	9	17	18	25	50
	61	41	34	14	3	3	3	9	20	18	21	43
Utö	56	40	36	22	14	19	29	15	29	33	53	55
	58	40	33	18	12	15	25	15	24	25	46	40
Zingst	76	57	44	35	-	-	44	14	21	24	69	60
	76	52	38	31	98	18	35	15	20	23	80	51
Waldhof	78	62	44	23	15	18	17	21	28	35	66	95
	77	59	45	20	16	19	14	21	20	28	57	90
Schmücke	68	57	31	21	-	19	16	16	24	41	55	51
	75	40	27	20	16	21	15	15	23	37	48	59
Brotjacklriegel	79	48	40	21	-	22	39	29	34	32	43	40
	80	43	36	21	21	18	21	21	20	25	23	39
Hohenpeissenberg	52	52	32	21	17	16	15	17	19	26	45	38
	46	55	31	21	15	15	14	14	17	22	37	32
Starina	190	196	87	153	177	612	75	18	64	87	231	507
	131	164	86	146	84	102	41	18	63	64	202	449
Košetice	73	68	36	25	23	25	23	14	29	39	70	77
	69	50	39	24	24	18	13	10	20	20	66	51
Rigi	44	50	35	24	15	14	16	21	37	74	65	40
	40	50	30	20	10	10	10	20	30	70	60	30
La Tardiere	53	38	-	25	5	13	21	28	23	41	35	120
	50	35	20	25	5	10	15	25	20	30	30	50
Donon	45	33	28	29	15	8	26	39	48	43	48	69
	50	25	25	13	5	5	20	30	20	50	30	60
Peyrusse Vieille	36	-	-	14	33	14	83	16	18	23	33	43
	30	20	-	10	20	5	25	15	20	20	30	30
Campisábalos	1171	2348	516	1299	643	2212	2476	2664	1366	1216	1119	1392
	291	214	275	902	295	2205	2540	920	1225	380	420	280

ISOPRENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	4	4	4	4	23	25	77	54	10	33	4	6
	4	4	4	4	23	18	67	42	4	39	4	4
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	10	10	14	40	-	-	609	650	225	81	24	16
	9	9	11	34	26	222	467	617	285	41	19	13
Waldhof	13	11	6	6	10	70	71	84	44	64	72	19
	12	11	6	5	9	64	77	65	29	30	27	17
Schmücke	16	18	8	10	-	63	70	59	19	24	27	16
	16	12	7	10	9	47	58	45	20	26	26	15
Brotjacklriegel	24	14	21	33	-	383	510	715	129	262	63	21
	16	13	13	31	564	523	346	756	126	39	59	18
Hohenpeissenberg	7	5	6	14	40	81	50	74	23	8	9	7
	6	4	5	5	15	36	16	17	6	5	6	4
Starina	-	-	64	-	192	220	182	107	171	131	-	26
	-	224	50	23	123	202	147	110	48	71	-	26
Košetice	16	14	19	13	44	161	97	97	40	11	15	35
	16	11	9	9	24	94	62	92	35	7	10	8
Rigi	23	12	19	29	39	87	112	173	44	31	20	16
	20	10	10	20	20	50	55	90	20	20	20	10
La Tardiere	13	9	13	29	130	402	470	898	237	63	20	11
	5	8	10	20	70	340	320	600	190	40	15	5
Donon	24	32	66	179	452	2051	1353	2693	641	162	95	51
	10	20	60	155	240	1480	1330	2635	510	100	105	45
Peyrusse Vieille	8	13	49	121	468	1334	986	2048	757	317	45	7
	5	10	40	100	205	1190	880	1565	590	140	40	5
Campisábalos	183	16	64	22	94	113	187	135	45	34	43	36
	18	10	9	13	51	122	96	140	40	5	10	15

BENZENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	202	215	218	179	92	42	41	60	63	79	158	182
	192	197	178	164	78	41	38	64	61	72	135	164
Utö	257	314	244	214	115	80	65	37	114	152	276	288
	213	345	195	193	106	70	54	37	119	141	294	208
Zingst	359	470	326	177	72	56	81	61	110	109	344	225
	282	462	232	162	56	60	67	58	105	90	223	155
Waldhof	297	474	330	178	70	61	53	64	105	160	272	352
	322	469	237	176	69	61	51	52	111	107	241	349
Schmücke	287	368	207	170	88	62	57	74	95	175	230	212
	260	335	203	151	87	51	63	76	95	168	212	171
Brotjacklriegel	362	335	264	173	79	71	63	77	98	149	202	166
	323	246	256	168	89	65	59	73	92	124	142	167
Hohenpeissenberg	337	387	226	190	104	74	61	70	136	185	228	202
	242	281	216	193	100	71	59	69	133	168	205	176
Starina	1047	361	514	263	169	247	127	75	167	250	170	446
	941	362	464	273	155	123	111	76	157	210	207	338
Kosetice	321	481	298	159	50	47	41	53	78	140	204	239
	295	401	225	155	56	34	36	53	78	104	181	237
Rigi	295	397	226	175	126	88	73	116	215	394	362	216
	270	355	210	150	110	90	70	110	190	350	330	180
La Tardiere	347	294	248	174	88	73	54	99	93	178	204	247
	220	265	250	170	85	80	55	95	90	160	170	200
Donon	277	397	186	179	97	78	57	103	100	193	193	273
	230	385	180	160	100	80	50	85	100	190	140	220
Peyrusse Vieille	189	280	156	139	79	63	61	76	74	90	134	153
	180	240	160	140	65	70	50	70	70	90	120	150
Campisábalos	354	379	318	465	265	254	193	138	105	164	101	53
	301	362	286	265	244	185	164	115	80	140	100	40

TOLUENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	233	210	147	70	93	51	128	70	75	77	249	188
	184	245	137	66	56	47	88	78	76	59	158	129
Waldhof	257	237	178	70	55	102	143	98	125	171	295	332
	213	231	178	53	52	76	59	65	73	111	276	281
Schmücke	273	285	136	87	85	76	87	81	100	190	237	164
	289	197	132	76	75	65	85	72	104	150	191	110
Brotjacklriegel	553	181	173	75	125	87	226	94	103	125	153	144
	465	193	165	78	88	76	110	84	98	116	105	150
Hohenpeissenberg	234	228	141	96	90	81	69	78	130	167	249	153
	212	231	137	87	69	68	63	67	126	141	208	110
Starina	-	120	44	84	-	38	48	-	66	84	69	53
	71	62	29	87	18	11	24	4	47	86	19	24
Kosetice	237	278	199	85	75	102	86	43	92	119	236	158
	229	224	176	81	45	42	73	38	81	100	220	130
Rigi	330	342	243	211	210	153	194	210	371	408	365	249
	260	270	210	160	130	120	160	180	320	340	280	160
La Tardiere	466	310	340	226	153	168	134	211	376	559	589	399
	340	320	330	210	140	170	110	140	210	420	340	270
Donon	226	295	142	115	78	84	44	96	133	196	223	239
	180	240	130	90	80	80	40	60	80	190	130	185
Peyrusse Vieille	143	245	91	84	68	80	121	48	76	93	151	183
	120	230	100	80	75	70	40	50	60	95	100	160
Campisábalos	1013	770	632	539	828	829	654	921	581	768	655	490
	695	711	421	491	403	678	559	795	490	810	495	475

ETHYLBENZENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	37	40	25	17	16	12	11	11	17	24	40	24
	35	39	24	16	14	11	10	9	17	22	27	16
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Kosetice	44	44	28	14	18	12	18	12	19	24	44	37
	43	39	27	11	18	8	17	11	14	16	47	33
Rigi	52	58	35	32	-	-	-	-	-	102	114	76
	40	50	30	30	-	-	-	-	-	100	90	50
La Tardiere	66	51	70	34	25	30	21	28	58	62	78	62
	40	60	45	35	25	30	20	20	40	50	50	30
Donon	38	60	26	23	18	17	7	18	22	33	39	41
	30	50	20	20	20	20	5	10	10	30	20	30
Peyrusse Vieille	19	35	12	13	9	9	23	6	8	15	31	23
	20	35	10	15	8	5	5	5	10	20	10	20
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

m+p-XYLENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	69	46	29	68	17	13	52	31	28	39	124	51
	59	51	32	24	5	5	43	24	28	34	130	30
Waldhof	92	50	42	42	38	15	29	16	36	74	146	87
	60	53	50	34	5	5	29	19	35	44	81	99
Schmücke	116	113	40	79	5	20	43	44	53	93	105	58
	124	56	34	87	5	22	42	40	57	67	86	37
Brotjacklriegel	215	41	51	33	41	20	63	25	40	47	62	49
	187	30	42	25	5	18	41	22	28	45	48	47
Hohenpeissenberg	87	78	47	33	29	26	24	25	31	56	104	61
	70	79	40	29	19	22	20	21	27	43	58	35
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Kosetice	107	97	64	31	26	26	36	17	38	59	103	71
	104	93	56	26	22	17	27	17	27	34	109	69
Rigi	155	176	63	53	-	-	-	-	-	220	229	147
	130	130	50	45	-	-	-	-	-	230	180	85
La Tardiere	211	163	218	91	76	101	81	69	197	187	274	179
	160	185	95	70	65	90	60	55	130	150	140	100
Donon	109	130	54	45	48	37	17	30	38	73	96	100
	90	110	50	35	50	40	20	20	20	60	50	70
Peyrusse Vieille	54	70	21	24	31	33	58	16	21	27	83	54
	50	65	20	20	30	30	15	15	20	25	20	40
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

o-XYLENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	26	15	11	21	5	5	14	6	5	24	25	15
	14	16	10	5	5	5	6	5	5	21	26	5
Waldhof	30	24	16	11	5	5	5	5	5	20	40	34
	23	22	18	9	5	5	5	5	5	13	16	24
Schmücke	36	49	13	24	10	5	7	8	5	21	26	19
	33	28	10	20	5	5	5	5	5	5	25	5
Brotjacklriegel	65	18	15	15	14	5	19	5	5	27	25	17
	55	15	11	12	5	5	5	5	5	25	23	14
Hohenpeissenberg	32	32	19	13	13	15	12	15	14	22	39	24
	26	33	19	13	9	11	10	12	13	18	26	16
Starina	421	420	475	306	407	267	223	383	578	829	376	363
	346	376	400	275	291	220	235	182	437	406	402	323
Kosetice	39	34	27	11	15	17	23	8	13	18	37	31
	38	32	20	10	11	10	21	7	9	13	38	30
Rigi	25	58	31	24	-	-	-	-	-	111	103	63
	10	50	20	20	-	-	-	-	-	105	80	40
La Tardiere	83	65	83	34	26	36	20	18	63	42	81	73
	90	70	50	35	30	30	20	10	40	40	55	50
Donon	59	58	33	30	17	19	6	20	23	31	39	46
	50	50	30	20	20	20	5	15	10	30	30	40
Peyrusse Vieille	59	50	39	33	23	20	24	21	7	15	34	33
	50	50	40	25	25	20	10	15	5	10	10	30
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

Monthly mean and median concentrations (first and second line, respectively) of carbonyls ($\mu g\ m^{-3}$)

METHANAL (FORMALDEHYDE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.236	0.326	0.411	0.294	0.291	0.646	1.408	1.063	1.022	0.578	0.418	0.498
	0.255	0.285	0.180	0.230	0.230	0.630	1.270	1.135	0.940	0.280	0.390	0.345
Zingst	0.574	1.242	1.139	1.289	1.627	1.778	2.250	1.926	1.750	0.669	0.676	0.578
	0.496	0.862	0.951	1.314	1.251	1.664	2.436	1.978	1.212	0.571	0.548	0.400
Waldhof	0.562	1.508	1.417	1.575	1.812	2.612	2.866	3.316	2.402	1.026	0.711	0.640
	0.507	1.817	1.485	1.680	1.547	2.086	3.299	3.103	1.511	0.717	0.610	0.595
Schmücke	0.532	1.007	1.102	1.346	1.592	2.277	2.306	4.008	1.807	0.892	0.877	0.602
	0.486	1.108	1.180	1.411	1.097	2.154	2.212	3.706	1.176	0.914	0.911	0.506
Brotjacklriegel	0.434	0.622	0.688	0.581	0.856	1.210	0.972	0.838	0.436	0.317	0.222	0.342
	0.448	0.582	0.644	0.700	0.758	1.300	0.928	0.639	0.417	0.297	0.197	0.351
Košetice	0.872	1.381	1.310	0.836	1.347	1.760	2.010	3.560	1.880	0.926	0.927	0.917
	0.670	1.310	0.940	0.700	1.120	1.630	1.730	3.650	1.480	0.840	0.980	0.780
La Tardiere	-	-	1.540	1.779	1.098	1.938	1.458	3.607	2.143	0.962	0.941	1.024
	-	-	1.694	1.867	0.816	1.854	1.592	3.411	2.132	1.050	0.923	0.903
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	1.436	1.494	2.680	1.461	5.032	1.904	1.333	1.424	0.887
	-	-	-	1.432	1.701	1.960	1.249	4.400	1.890	1.204	0.966	0.800

ETHANAL (ACETALDEHYDE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.633	0.771	0.701	0.668	0.352	0.567	0.857	0.845	0.872	0.683	0.368	0.491
	0.650	0.640	0.450	0.470	0.330	0.520	0.835	0.810	0.910	0.420	0.345	0.455
Zingst	0.501	1.087	0.952	0.761	0.898	0.910	1.129	0.965	0.949	0.637	0.638	0.708
	0.414	0.779	0.769	0.812	0.816	0.946	1.202	0.954	0.791	0.522	0.597	0.576
Waldhof	0.637	1.234	1.077	0.886	0.845	1.098	1.037	1.410	1.182	0.707	0.635	0.760
	0.435	1.398	1.109	1.040	0.787	0.965	0.925	1.271	0.710	0.698	0.598	0.651
Schmücke	0.475	0.813	0.822	0.756	0.736	0.738	0.814	1.496	0.895	0.690	0.640	0.585
	0.353	0.953	0.877	0.835	0.624	0.759	0.858	1.412	0.744	0.692	0.688	0.458
Brotjacklriegel	0.388	0.457	0.520	0.333	0.371	0.420	0.439	1.565	1.286	0.991	0.390	0.372
	0.348	0.411	0.508	0.347	0.347	0.469	0.330	1.417	1.411	0.510	0.337	0.417
Košetice	1.085	1.926	1.277	1.277	1.867	2.556	2.544	3.211	2.055	0.945	1.105	1.153
	0.990	1.995	1.130	1.075	1.580	2.000	1.800	3.230	1.760	0.970	1.070	1.130
La Tardiere	-	-	1.437	0.644	0.590	1.014	0.671	2.386	1.681	0.762	0.648	0.758
	-	-	1.258	0.586	0.462	0.944	0.672	2.484	2.129	0.825	0.647	0.672
Donon	0.579	-	1.311	1.046	0.502	1.019	1.047	0.814	1.675	0.837	0.557	0.627
	0.505	-	1.277	0.992	0.483	0.967	0.714	0.536	1.593	1.021	0.531	0.510
Peyrusse Vieille	0.855	-	-	0.803	0.993	0.638	0.936	2.058	1.388	0.686	0.687	0.542
	0.834	-	-	0.815	0.298	0.467	0.869	2.060	1.717	0.646	0.538	0.605

PROPANONE (ACETONE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.753	1.188	2.282	1.792	0.952	1.666	1.423	2.150	1.723	1.892	0.783	1.005
	0.810	1.060	1.055	1.600	0.840	1.640	1.465	2.020	1.850	1.260	0.830	0.965
Zingst	0.605	1.180	1.528	1.733	1.667	1.412	1.698	1.866	1.916	0.912	0.699	0.731
	0.735	0.934	2.029	1.647	1.473	1.328	1.789	1.574	1.543	0.843	0.694	0.476
Waldhof	0.747	1.600	2.177	2.613	2.366	2.410	3.032	3.628	3.312	1.475	1.068	0.912
	0.645	1.591	1.893	2.720	1.837	2.129	2.595	3.461	2.024	1.300	1.017	0.867
Schmücke	0.712	1.347	1.924	2.504	2.384	2.716	3.434	5.759	3.418	1.372	1.331	0.877
	0.551	1.174	1.777	2.801	1.782	2.898	2.837	5.124	3.237	1.227	1.124	0.812
Brotjacklriegel	0.530	0.651	0.937	0.931	1.323	1.796	1.328	1.485	0.760	0.242	0.312	0.219
	0.542	0.586	0.955	0.983	1.297	1.527	1.302	1.317	0.804	0.214	0.312	0.148
Košetice	1.190	2.813	2.841	3.363	2.588	2.474	3.483	4.576	3.647	2.157	2.033	1.735
	1.175	2.865	3.060	4.145	2.300	2.220	3.980	4.550	3.300	2.120	2.040	1.660
La Tardiere	-	-	2.508	3.304	1.819	3.043	2.665	3.668	3.515	2.107	1.530	1.680
	-	-	2.687	3.221	1.532	3.251	2.451	3.257	3.398	1.788	1.557	1.625
Donon	-	-	3.142	3.763	2.946	5.691	4.729	6.735	3.951	2.400	1.399	1.161
	-	-	3.690	4.027	2.969	5.811	4.381	6.791	3.602	2.533	1.222	0.977
Peyrusse Vieille	1.436	-	-	3.087	-	2.890	2.840	3.120	2.547	2.159	2.162	3.812
	1.397	-	-	2.948	-	2.968	2.656	2.106	2.454	2.138	1.838	1.454

PROPANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.193	0.145	0.181	0.116	0.030	0.094	0.163	0.143	0.148	0.100	0.058	0.066
	0.160	0.105	0.110	0.080	0.020	0.100	0.150	0.145	0.165	0.060	0.060	0.060
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.178	0.322	0.205	0.196	0.245	0.430	0.460	0.537	0.402	0.190	0.180	0.183
	0.170	0.285	0.180	0.135	0.190	0.350	0.280	0.520	0.400	0.200	0.180	0.160
La Tardiere	-	-	0.173	0.134	0.851	3.089	0.076	0.298	0.172	0.113	0.114	0.127
	-	-	0.143	0.152	0.110	3.297	0.049	0.307	0.187	0.120	0.120	0.113
Donon	0.101	-	0.222	0.134	0.084	2.826	0.102	0.119	0.167	0.152	0.095	0.108
	0.107	-	0.170	0.117	0.080	2.215	0.073	0.130	0.146	0.183	0.095	0.094
Peyrusse Vieille	0.165	0.128	-	0.152	0.144	0.308	0.113	0.239	0.133	0.126	0.114	0.097
	0.144	0.156	-	0.151	0.114	0.125	0.108	0.237	0.140	0.132	0.080	0.093

2-PROPENAL (ACROLEIN)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.022	0.020	0.026	0.017	0.022	-	0.095	-	-	-	0.020	0.030
	0.020	0.020	0.020	0.015	0.020	-	0.050	-	-	-	0.020	0.030
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.068	0.028	0.026	0.013	0.017	0.020	0.036	0.058	0.084	-	0.062	0.056
	0.045	0.030	0.030	0.010	0.010	0.010	0.035	0.055	0.080	-	0.065	0.050
La Tardiere	0.045	0.040	0.035	0.015	0.015	-	0.016	0.015	0.023	0.015	0.015	0.017
	0.015	0.015	0.035	0.016	0.015	-	0.015	0.015	0.015	0.015	0.015	0.017
Donon	0.015	-	-	0.015	0.015	-	-	0.023	0.027	0.015	0.015	0.016
	0.015	-	-	0.015	0.015	-	-	0.023	0.015	0.015	0.015	0.017
Peyrusse Vieille	0.015	0.015	-	0.015	0.015	-	0.020	0.034	0.076	-	-	0.016
	0.015	0.015	-	0.015	0.015	-	0.017	0.030	0.016	-	-	0.017

2-BUTANONE (METHYL ETHYL KETONE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.281	0.506	0.271	0.231	0.082	0.158	0.346	0.151	0.325	0.205	0.156	0.248
	0.285	0.455	0.300	0.230	0.090	0.160	0.340	0.140	0.285	0.190	0.140	0.260
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.404	0.713	0.546	0.581	0.391	0.423	0.841	0.942	0.703	0.521	0.562	0.536
	0.360	0.655	0.540	0.720	0.330	0.370	0.700	1.020	0.580	0.510	0.570	0.520
La Tardiere	2.237	0.411	0.619	0.730	0.416	0.514	0.979	0.894	0.832	0.648	0.399	0.887
	1.258	0.298	0.575	0.711	0.338	0.490	0.254	0.984	0.640	0.461	0.400	0.799
Donon	0.162	-	0.365	0.847	0.180	0.542	0.350	0.510	0.452	0.390	0.292	0.306
	0.057	-	0.360	0.533	0.171	0.557	0.386	0.514	0.411	0.448	0.264	0.225
Peyrusse Vieille	2.206	0.116	-	0.460	0.510	0.405	1.205	0.525	0.323	0.325	0.280	0.431
	2.464	0.015	-	0.448	0.385	0.320	0.535	0.355	0.375	0.297	0.273	0.289

3-BUTEN-2-ONE (METHYL VINYL KETONE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.048	-	-	-	-	-	-	-	-	-	-	-
	0.025	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

2-METHYLPROPENAL (METHACROLEIN)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	0.046	-	-	-	-	-	-	-
	-	-	-	-	0.035	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.010	-	-	-	-	0.042	-	0.070	0.033	-	-	-
	0.010	-	-	-	-	0.020	-	0.065	0.035	-	-	-
La Tardiere	0.022	0.018	0.011	0.014	0.017	0.263	0.472	0.781	0.111	0.052	0.023	0.016
	0.011	0.017	0.011	0.012	0.011	0.191	0.262	0.562	0.120	0.043	0.019	0.013
Donon	0.020	-	0.050	0.085	0.175	0.965	0.895	0.893	0.263	0.040	0.029	0.012
	0.019	-	0.056	0.080	0.064	0.991	0.569	0.883	0.206	0.047	0.027	0.012
Peyrusse Vieille	0.011	0.011	-	0.024	0.092	0.794	0.495	1.445	0.325	0.057	0.041	0.015
	0.011	0.012	-	0.018	0.090	0.676	0.499	1.481	0.292	0.060	0.027	0.013

BENZENECARBALDEHYDE (BENZALDEHYDE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	0.065	0.052	-	-	-	0.086	-	-	-	0.035	-
	-	0.070	0.055	-	-	-	0.080	-	-	-	0.035	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.040	0.084	0.050	-	0.046	0.024	-	-	0.032	-	0.054	0.045
	0.030	0.100	0.050	-	0.020	0.020	-	-	0.030	-	0.050	0.050
La Tardiere	0.091	0.097	0.085	0.057	0.069	0.125	0.056	0.112	0.069	0.062	0.088	0.049
	0.073	0.091	0.090	0.063	0.064	0.132	0.063	0.095	0.066	0.050	0.087	0.057
Donon	0.027	-	0.056	0.057	0.044	0.063	0.045	0.062	0.212	0.037	0.015	0.028
	0.015	-	0.052	0.050	0.038	0.065	0.015	0.062	0.084	0.030	0.015	0.019
Peyrusse Vieille	0.034	0.015	-	0.058	0.043	0.046	0.051	0.084	0.028	0.029	0.026	0.021
	0.015	0.015	-	0.061	0.050	0.050	0.031	0.072	0.016	0.016	0.016	0.017

PENTANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.180	0.090	0.072	-	-	-	0.074	-	-	0.057	0.042	0.033
	0.190	0.080	0.040	-	-	-	0.080	-	-	0.030	0.040	0.030
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.045	0.115	0.068	0.080	0.068	0.194	0.215	0.241	0.142	-	0.085	0.067
	0.050	0.110	0.055	0.045	0.060	0.150	0.190	0.250	0.125	-	0.080	0.060
La Tardiere	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

ETHANEDIAL (GLYOXAL)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.045	0.112	0.163	0.051	-	0.057	0.077	-	0.037	0.040	0.021	0.036
	0.050	0.095	0.145	0.050	-	0.050	0.090	-	0.035	0.030	0.020	0.020
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.053	0.320	0.113	0.143	0.075	0.154	0.091	0.166	0.134	0.078	0.052	0.067
	0.030	0.290	0.100	0.140	0.020	0.120	0.030	0.160	0.090	0.070	0.055	0.065
La Tardiere	0.035	0.025	0.011	0.016	0.042	0.011	0.011	0.011	0.020	0.011	0.011	0.013
	0.011	0.011	0.011	0.012	0.026	0.011	0.011	0.012	0.017	0.011	0.011	0.013
Donon	0.011	-	0.071	0.033	0.045	0.041	0.045	0.262	0.024	0.011	0.011	0.012
	0.011	-	0.077	0.011	0.011	0.040	0.031	0.166	0.011	0.011	0.011	0.012
Peyrusse Vieille	0.011	0.011	-	0.011	0.028	0.010	0.014	0.011	0.033	0.012	0.012	0.012
	0.011	0.012	-	0.011	0.019	0.011	0.012	0.011	0.012	0.011	0.012	0.013

HEXANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.075	0.073	0.150	0.147	-	0.104	0.128	0.107	0.116	0.118	0.036	0.051
	0.070	0.075	0.065	0.060	-	0.130	0.130	0.105	0.130	0.030	0.035	0.050
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.071	0.131	0.063	0.090	0.128	0.180	0.172	0.273	0.164	0.100	0.082	0.088
	0.070	0.120	0.060	0.055	0.110	0.130	0.160	0.235	0.130	0.100	0.080	0.080
La Tardiere	0.067	0.029	0.052	0.091	0.058	0.070	0.065	0.145	0.069	0.029	0.019	0.017
	0.038	0.023	0.052	0.086	0.049	0.068	0.055	0.142	0.070	0.028	0.015	0.017
Donon	0.045	-	0.105	0.215	0.159	0.148	0.122	0.207	0.260	0.035	0.015	0.020
	0.041	-	0.085	0.197	0.121	0.152	0.092	0.207	0.078	0.033	0.015	0.018
Peyrusse Vieille	0.100	0.058	-	0.220	0.567	0.124	0.245	0.224	0.069	0.174	0.272	0.204
	0.076	0.062	-	0.178	0.334	0.091	0.195	0.218	0.077	0.065	0.032	0.067

2-OXOPROPANAL (METHYL GLYOXAL)

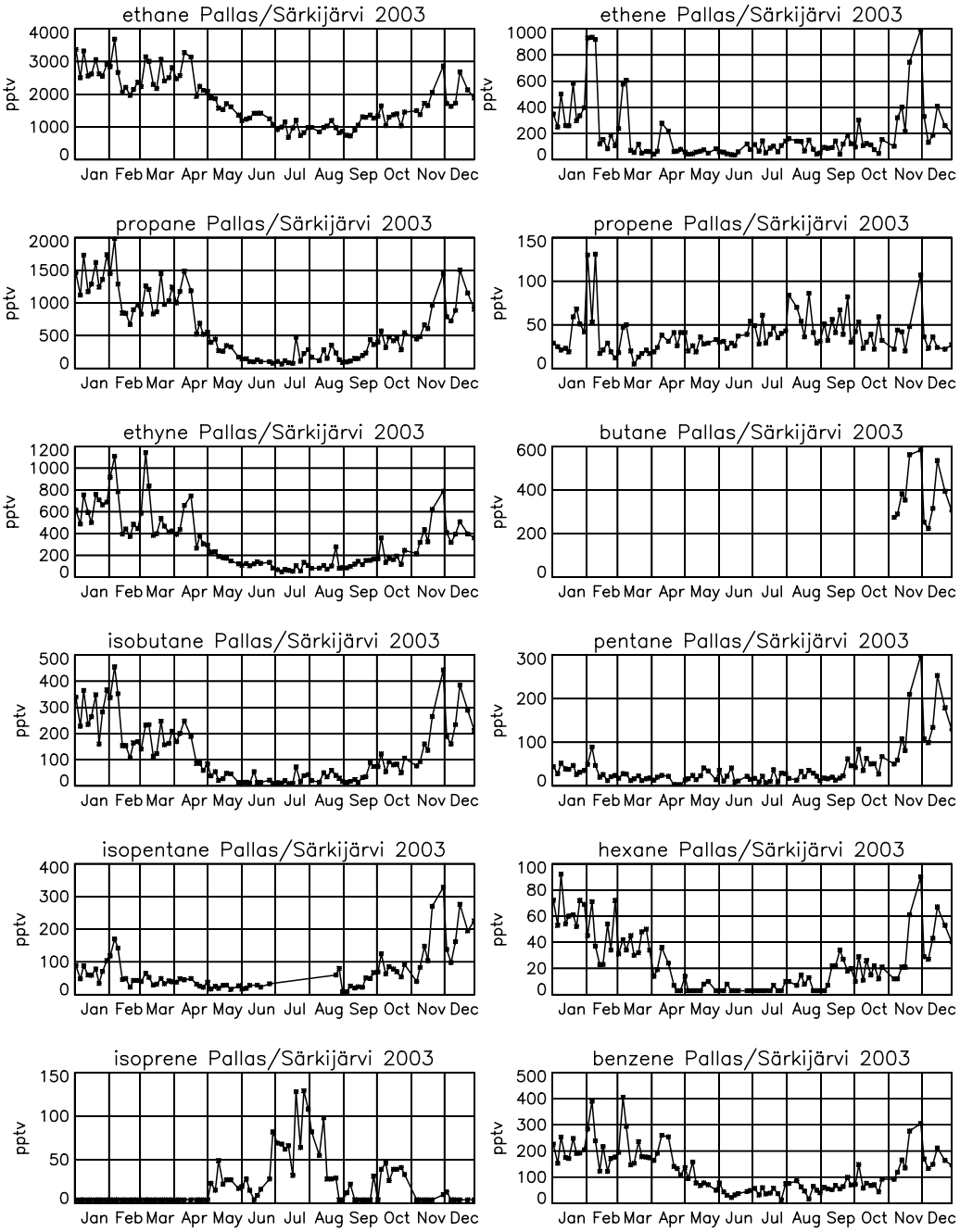
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	0.055	0.091	0.243	0.088	0.065	0.108	0.102	-	0.077	0.058	-	-
	0.050	0.095	0.100	0.100	0.050	0.090	0.085	-	0.085	0.050	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	0.046	0.230	0.100	0.168	0.117	0.316	0.190	0.352	0.198	0.097	0.022	0.050
	0.030	0.220	0.075	0.140	0.050	0.180	0.100	0.350	0.170	0.105	0.020	0.035
La Tardiere	0.081	0.074	0.077	0.033	0.038	0.042	0.064	0.313	0.070	0.026	-	0.017
	0.025	0.044	0.072	0.016	0.015	0.035	0.031	0.304	0.064	0.015	-	0.017
Donon	0.015	-	0.124	0.099	0.084	0.182	0.140	0.462	0.077	0.015	0.015	0.016
	0.015	-	0.121	0.081	0.068	0.146	0.107	0.363	0.081	0.015	0.015	0.017
Peyrusse Vieille	0.022	0.020	-	0.051	0.057	0.213	0.107	0.384	0.228	0.016	0.016	0.016
	0.015	0.016	-	0.055	0.015	0.198	0.074	0.229	0.054	0.015	0.016	0.017

Appendix B

Time series of VOC measured in 2003

Explanations and synonyms to component names

ethyne:	acetylene
butane:	n-butane
isobutane:	i-butane
pentane:	n-pentane
isopentane:	i-pentane
hexane:	n-hexane
methanal:	formaldehyde
ethanal:	acetaldehyde
propanone:	acetone
N2propenal:	2-propenal (acrolein)
N2butanone:	2-butanone (methyl ethyl ketone)
N3buten2one:	3-buten-2-one (methyl vinyl ketone)
N2methylpropenal:	2-methyl propenal (methacrolein)
benzenecarbaldehyde:	benzaldehyde
ethanedial:	glyoxal
N2oxoproanal:	2-oxopropanal (methyl glyoxal)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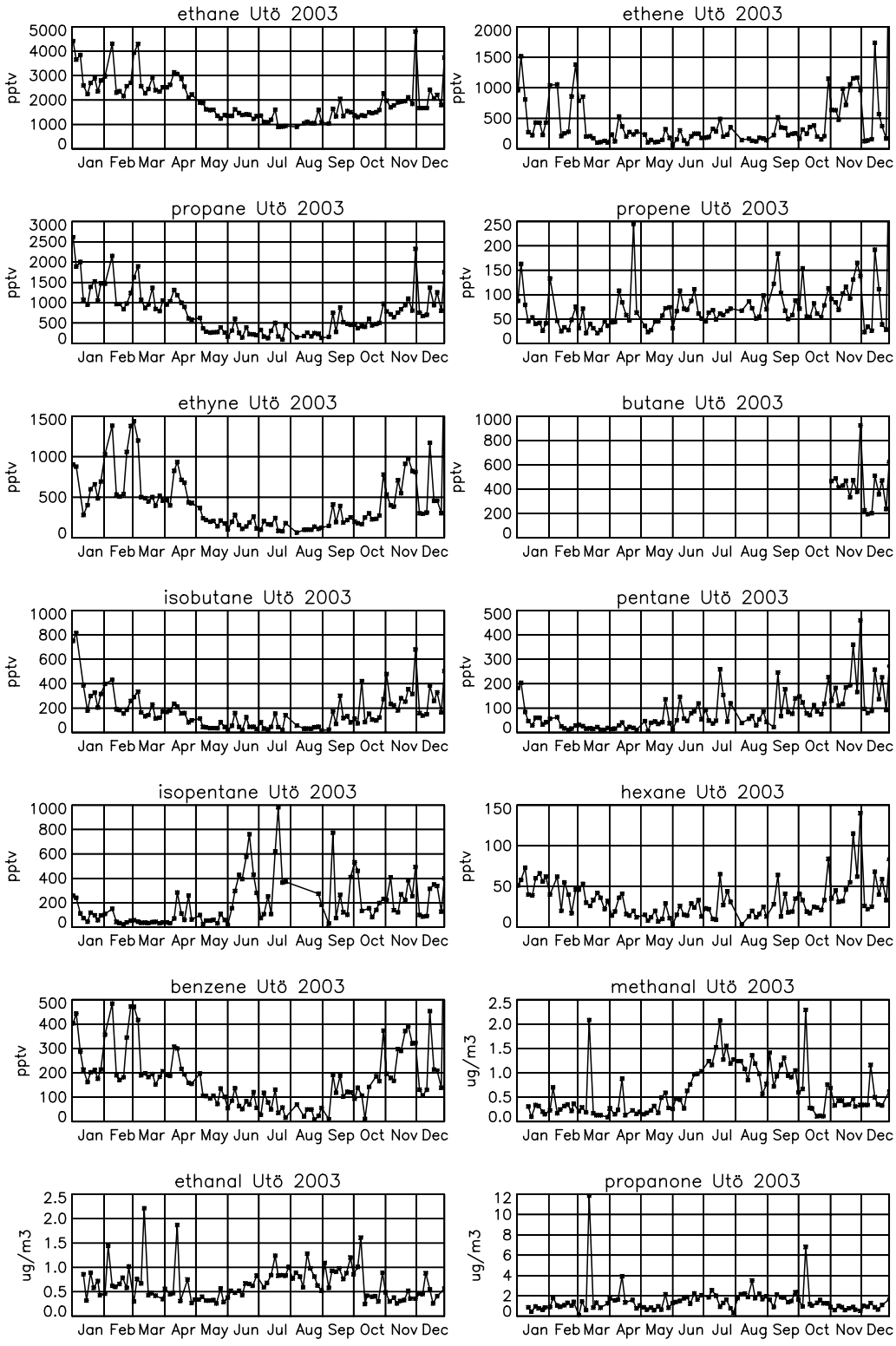
ethene Pallas/Särkijärvi 2003
propane Pallas/Särkijärvi 2003
propene Pallas/Särkijärvi 2003
ethyne Pallas/Särkijärvi 2003
butane Pallas/Särkijärvi 2003
isobutane Pallas/Särkijärvi 2003
pentane Pallas/Särkijärvi 2003
isopentane Pallas/Särkijärvi 2003
hexane Pallas/Särkijärvi 2003
isoprene Pallas/Särkijärvi 2003
benzene Pallas/Särkijärvi 2003
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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pptv
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propane Utö 2003
pptv
0 500 1000 1500 2000 2500 3000
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
propene Utö 2003
pptv
0 50 100 150 200 250
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
ethyne Utö 2003
pptv
0 500 1000 1500
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
butane Utö 2003
pptv
0 200 400 600 800 1000
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
isobutane Utö 2003
pptv
0 200 400 600 800 1000
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
pentane Utö 2003
pptv
0 100 200 300 400 500
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
isopentane Utö 2003
pptv
0 200 400 600 800 1000
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
hexane Utö 2003
pptv
0 50 100 150
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
benzene Utö 2003
pptv
0 100 200 300 400 500
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
methanal Utö 2003
ug/m3
0.0 0.5 1.0 1.5 2.0 2.5
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
ethanal Utö 2003
ug/m3
0.0 0.5 1.0 1.5 2.0 2.5
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ug/m3
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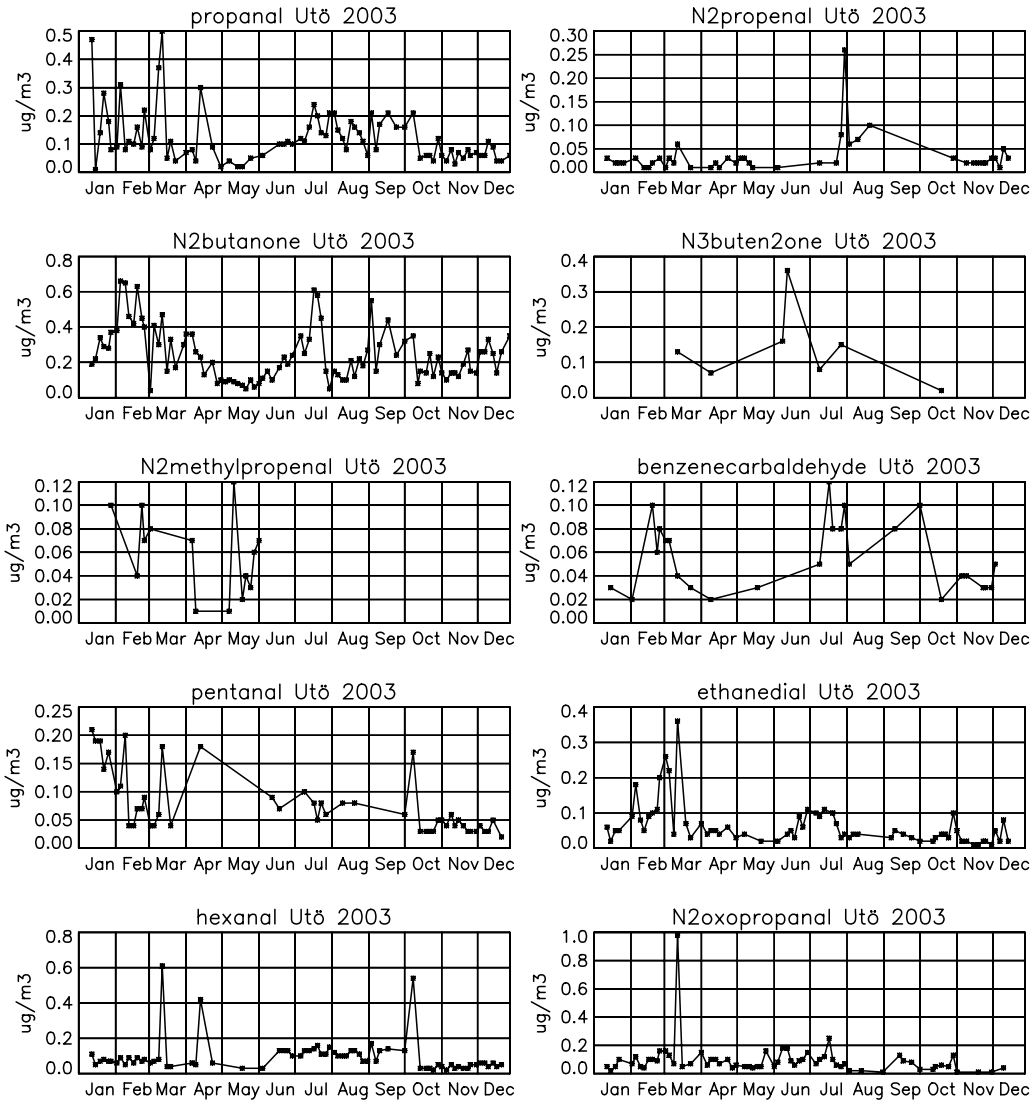
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ug/m3
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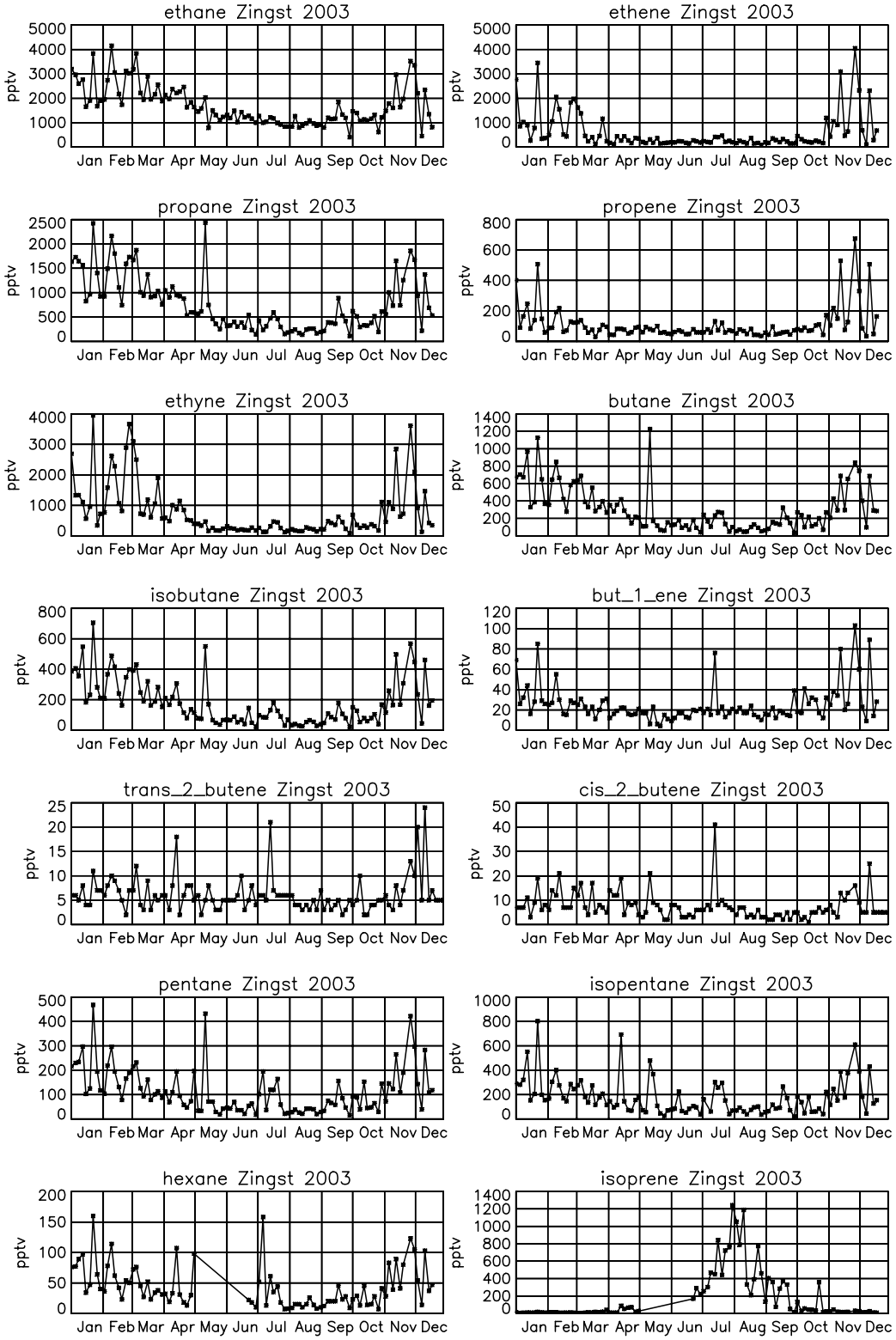
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ethyne Zingst 2003
butane Zingst 2003
isobutane Zingst 2003
but_1_ene Zingst 2003
trans_2_butene Zingst 2003
cis_2_butene Zingst 2003
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isopentane Zingst 2003
hexane Zingst 2003
isoprene Zingst 2003
pptv
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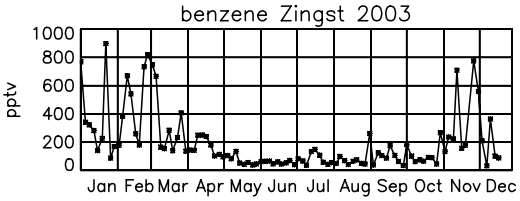
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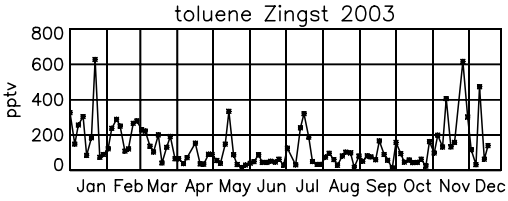
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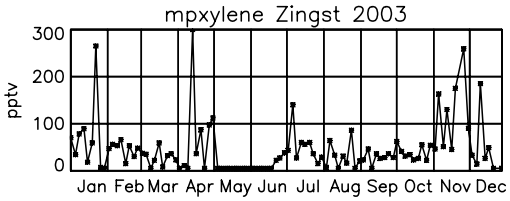
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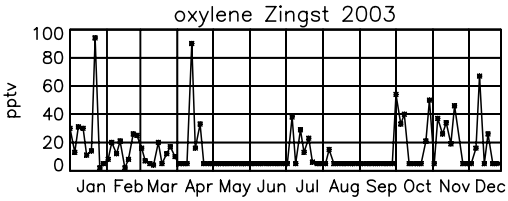
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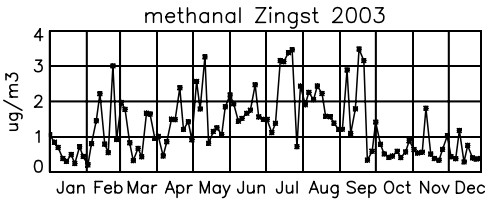
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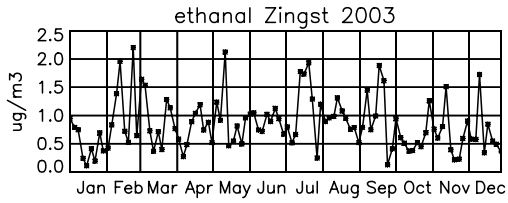
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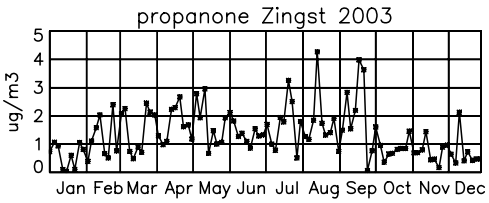
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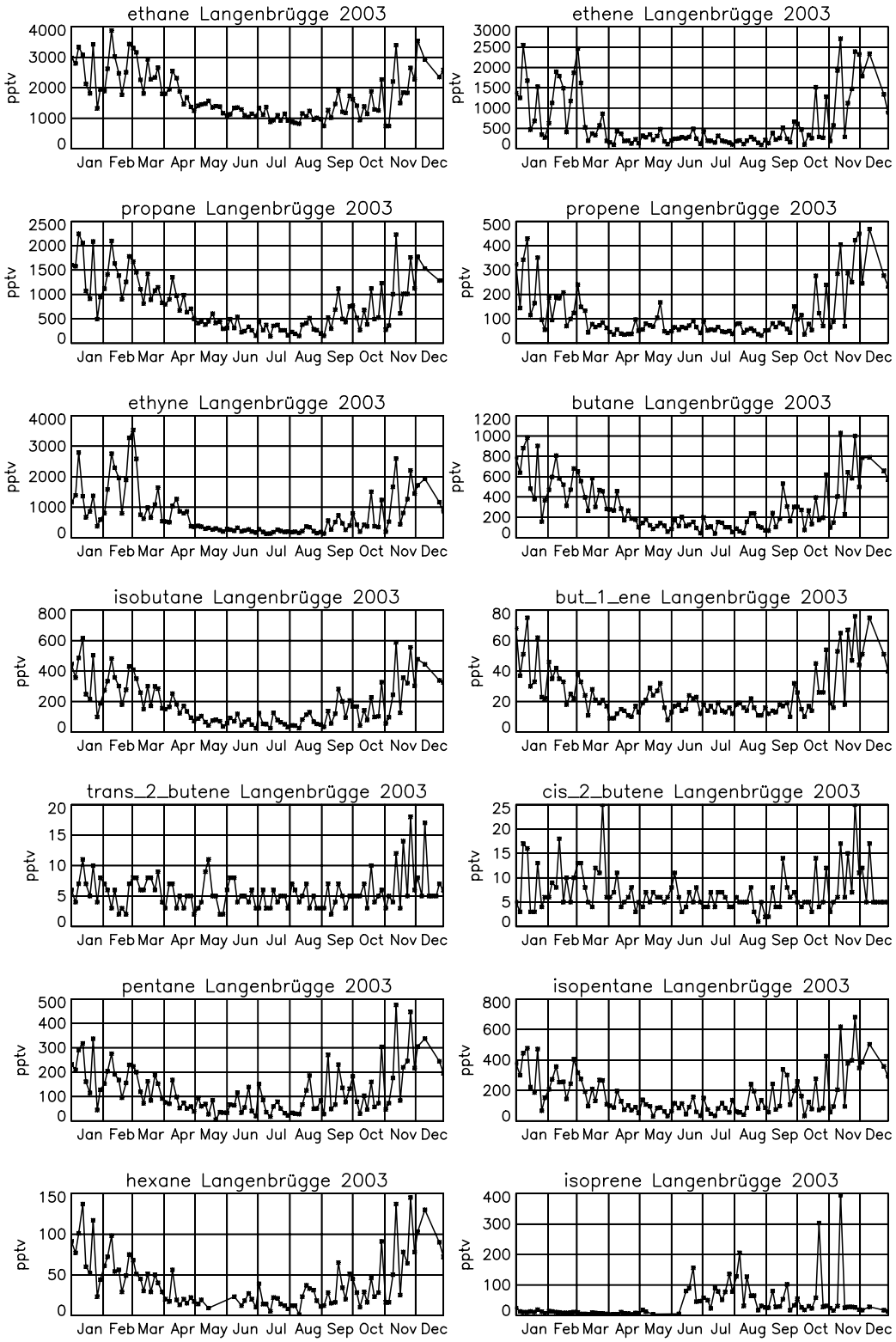
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isobutane Langenbrügge 2003
but_1_ene Langenbrügge 2003
trans_2_butene Langenbrügge 2003
cis_2_butene Langenbrügge 2003
pentane Langenbrügge 2003
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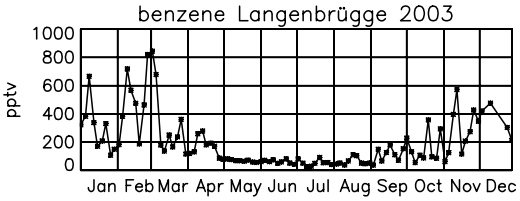
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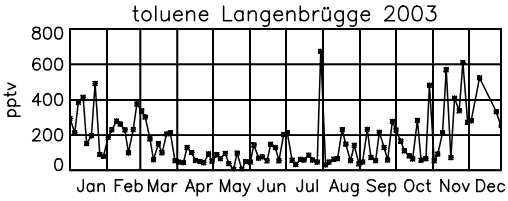
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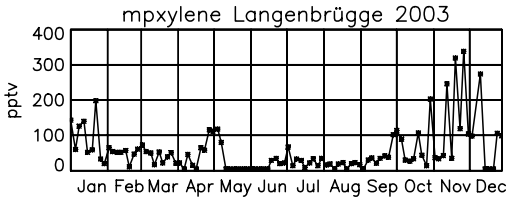
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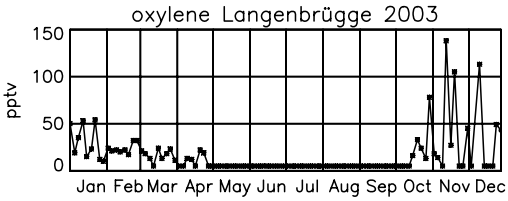
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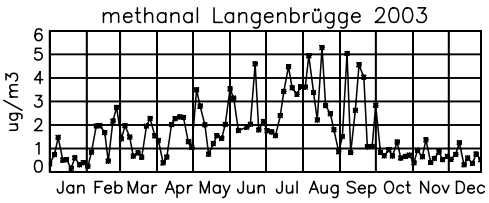
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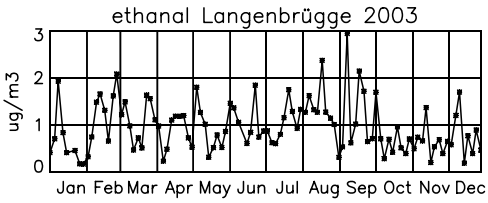
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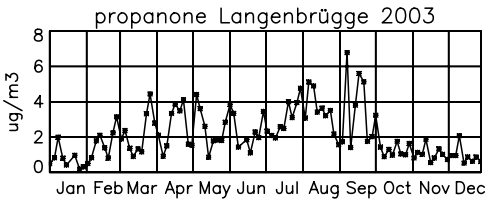
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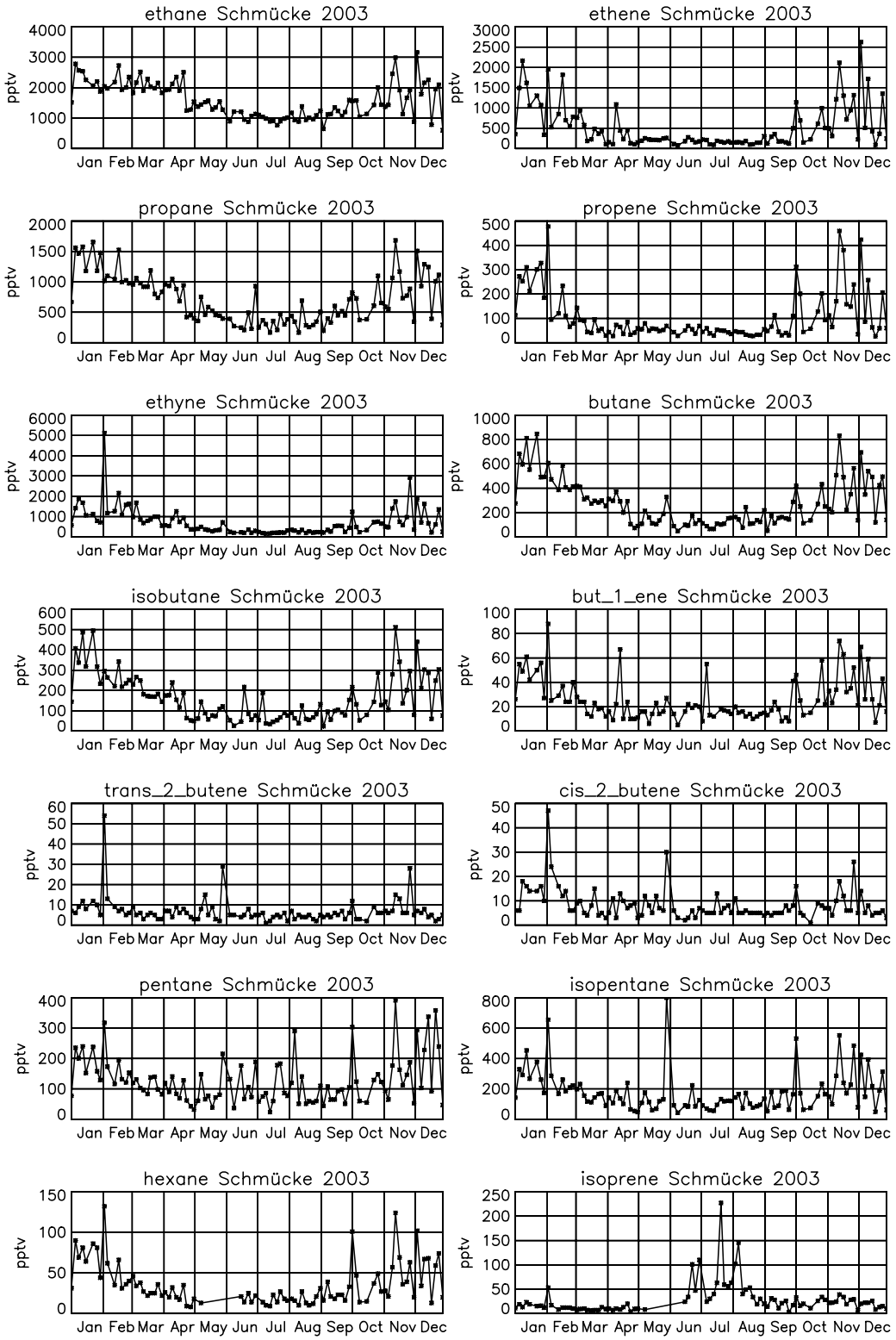
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but_1_ene Schmücke 2003
trans_2_butene Schmücke 2003
cis_2_butene Schmücke 2003
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isopentane Schmücke 2003
hexane Schmücke 2003
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pptv
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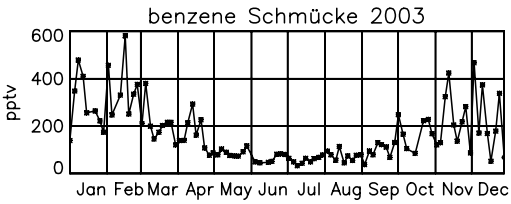
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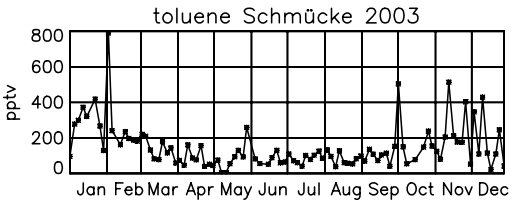
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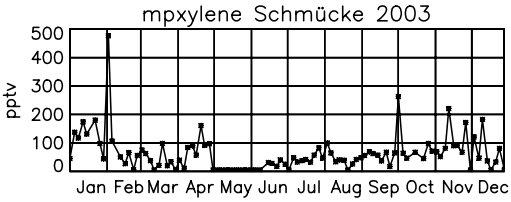
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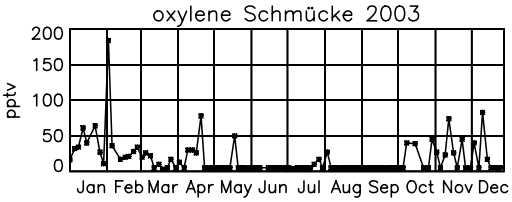
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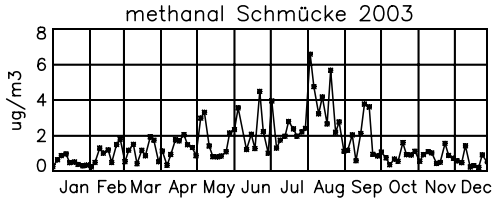
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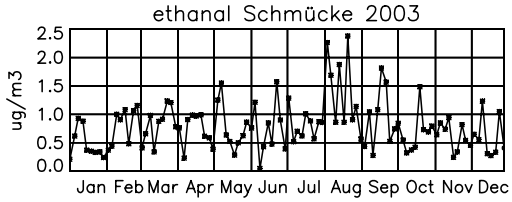
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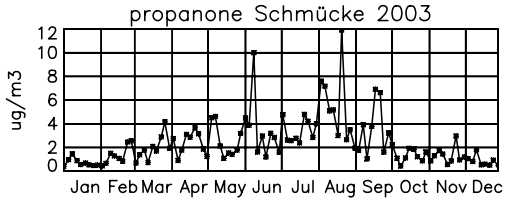
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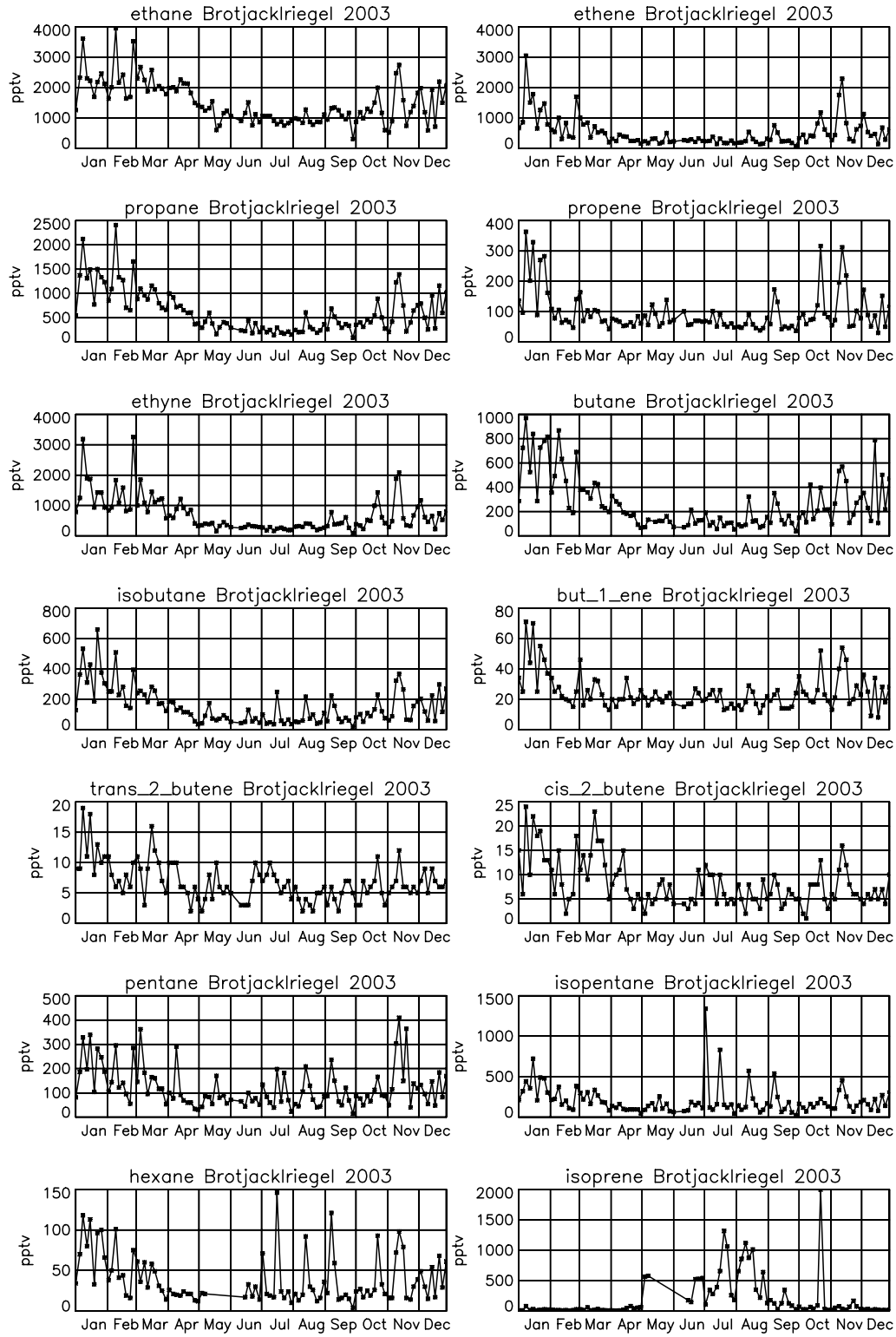
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isobutane Brotjacklriegel 2003
but_1_ene Brotjacklriegel 2003
trans_2_butene Brotjacklriegel 2003
cis_2_butene Brotjacklriegel 2003
pentane Brotjacklriegel 2003
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pptv
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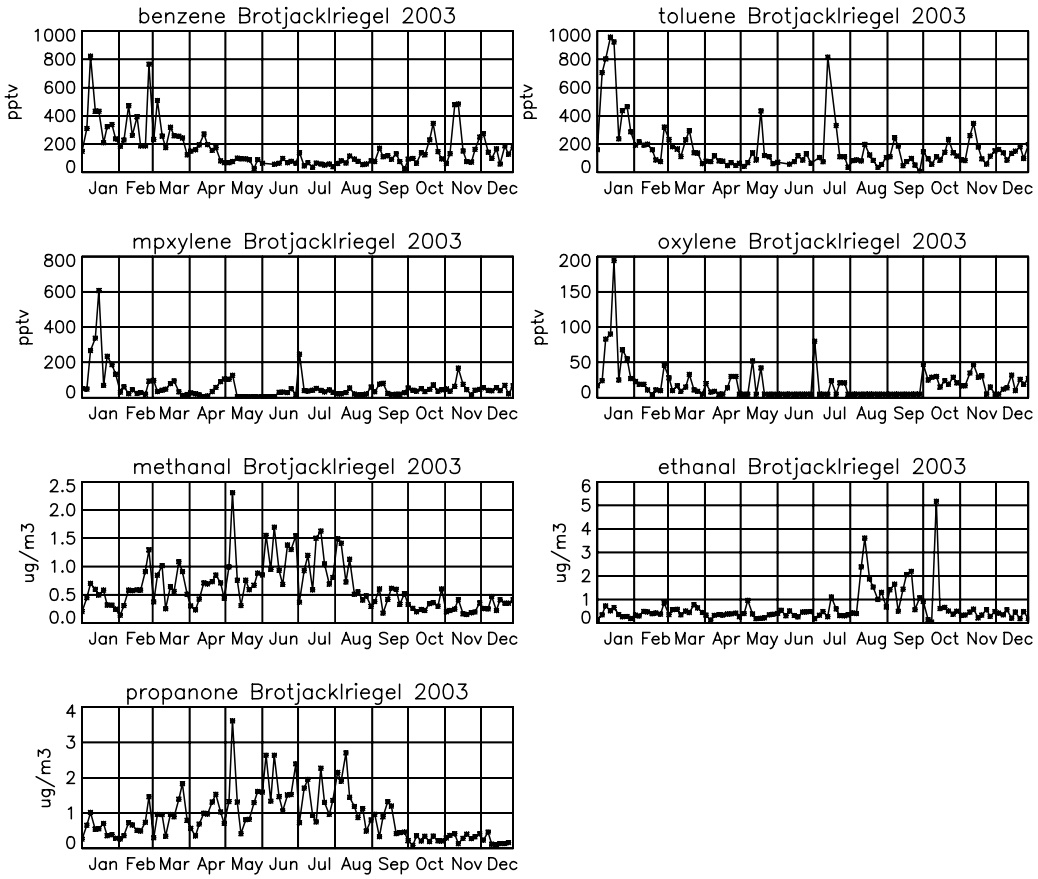
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pptv
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mpxylene Brotjacklriegel 2003
pptv
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oxylene Brotjacklriegel 2003
pptv
200
150
100
50
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
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ug/m3
2.5
2.0
1.5
1.0
0.5
0.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
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ug/m3
6
5
4
3
2
1
0
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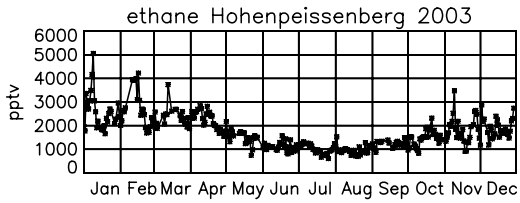
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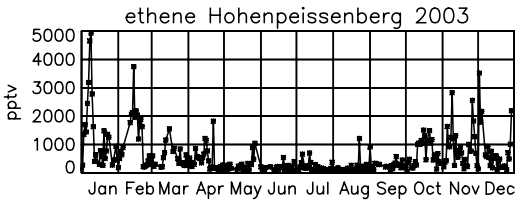
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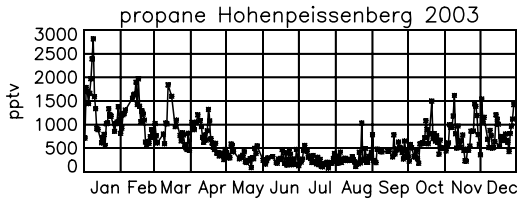
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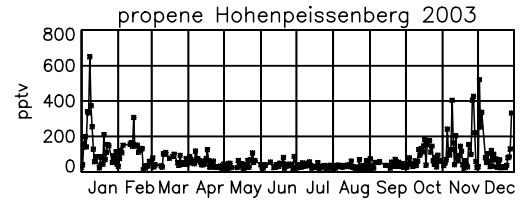
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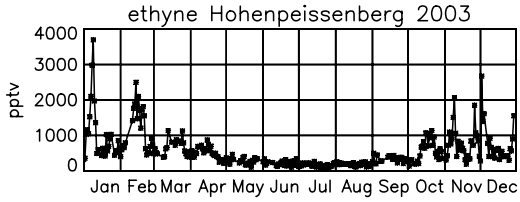
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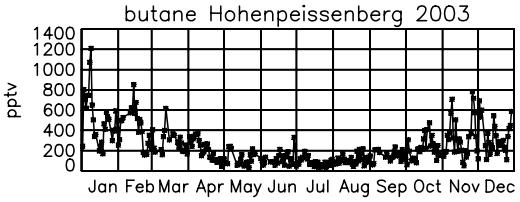
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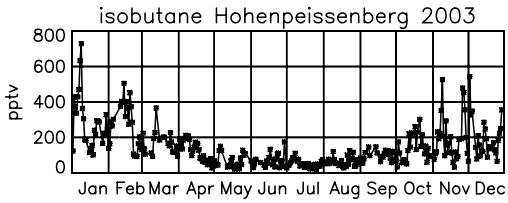
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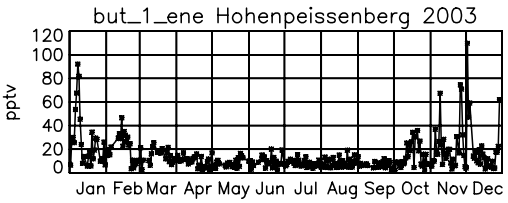
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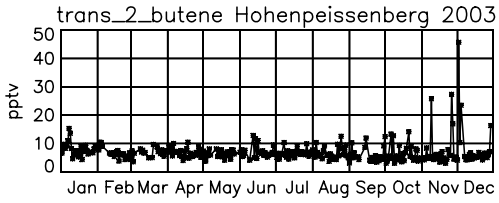
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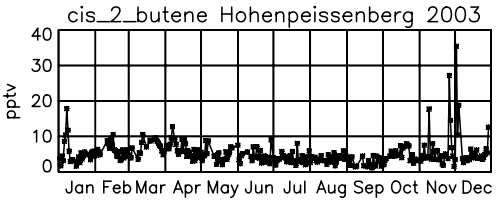
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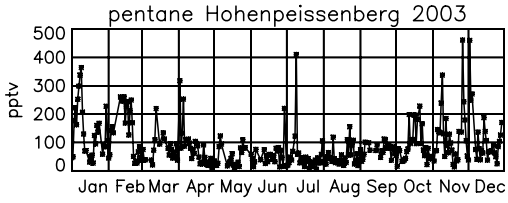
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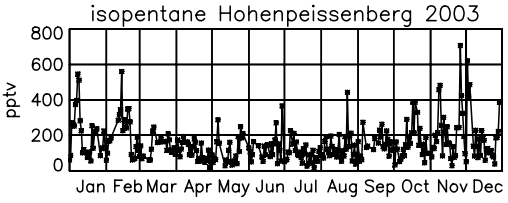
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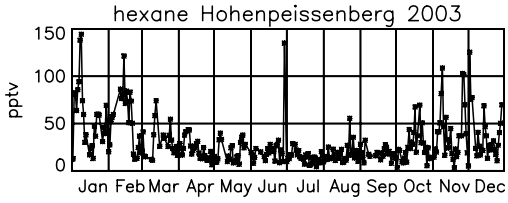
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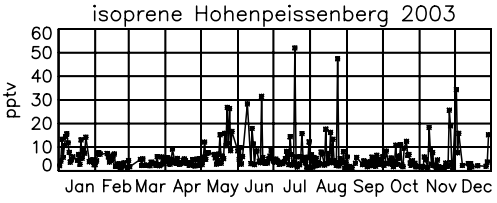
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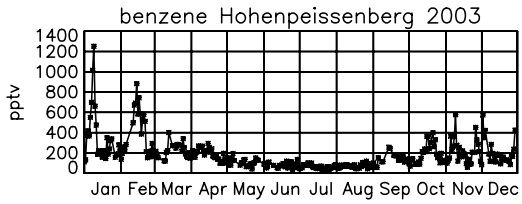
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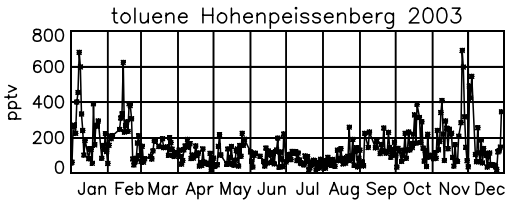
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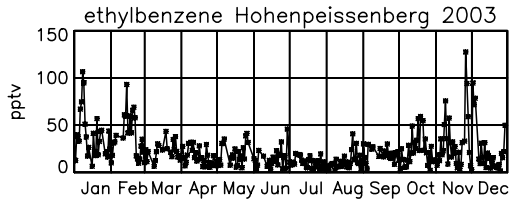
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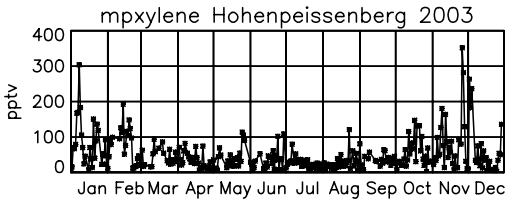
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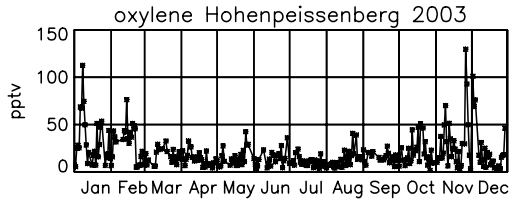
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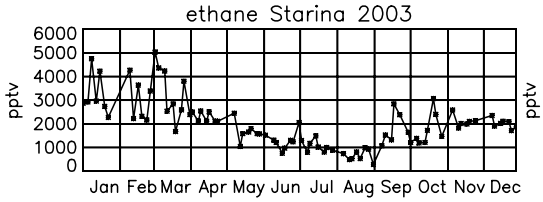
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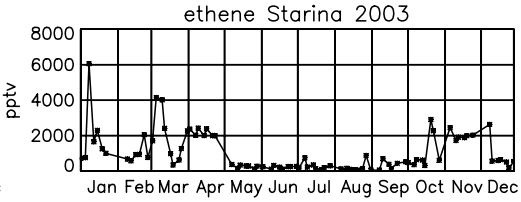
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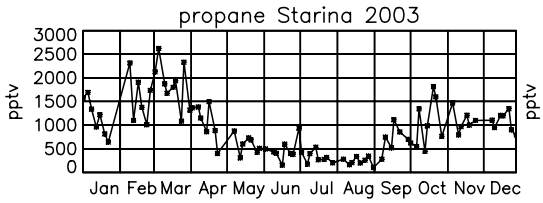
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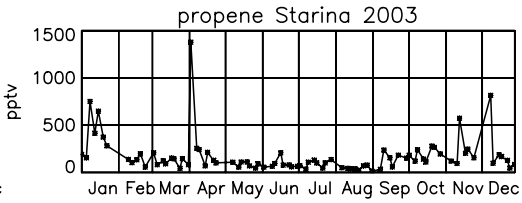
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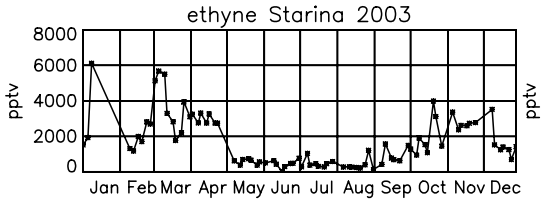
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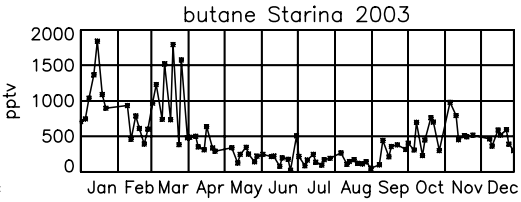
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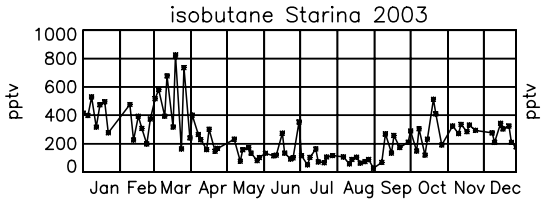
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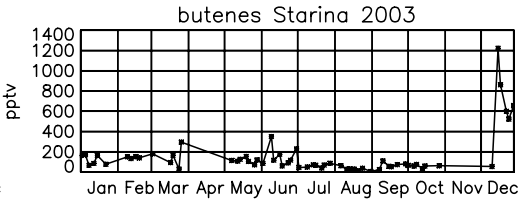
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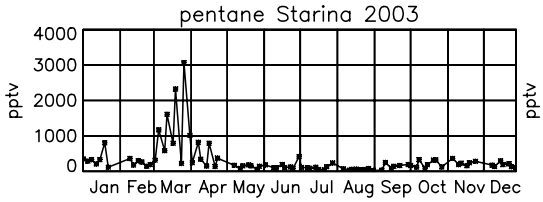
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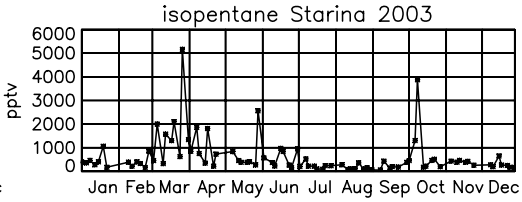
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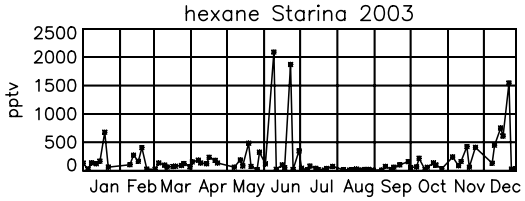
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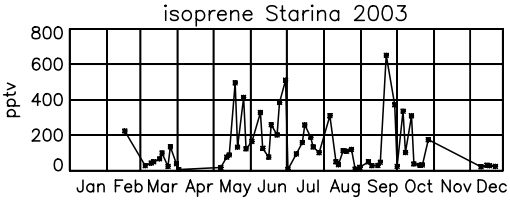
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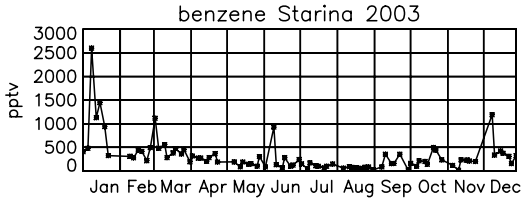
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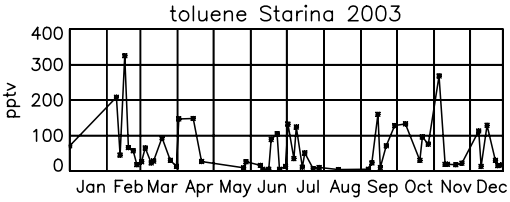
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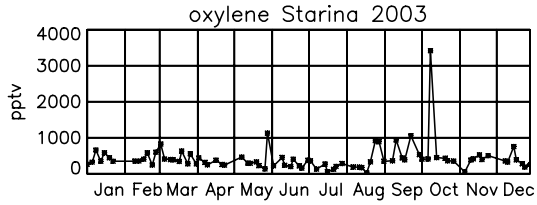
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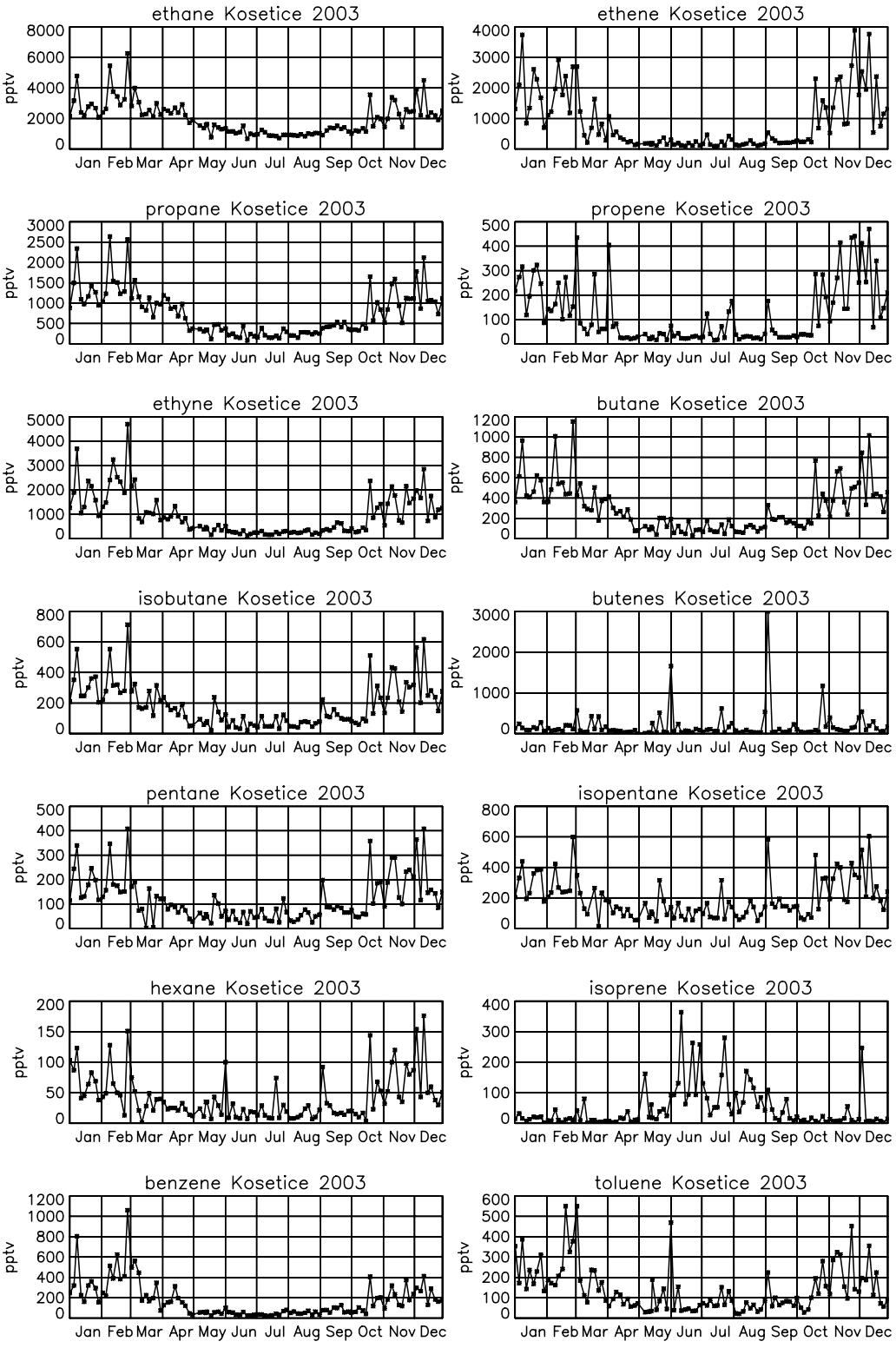
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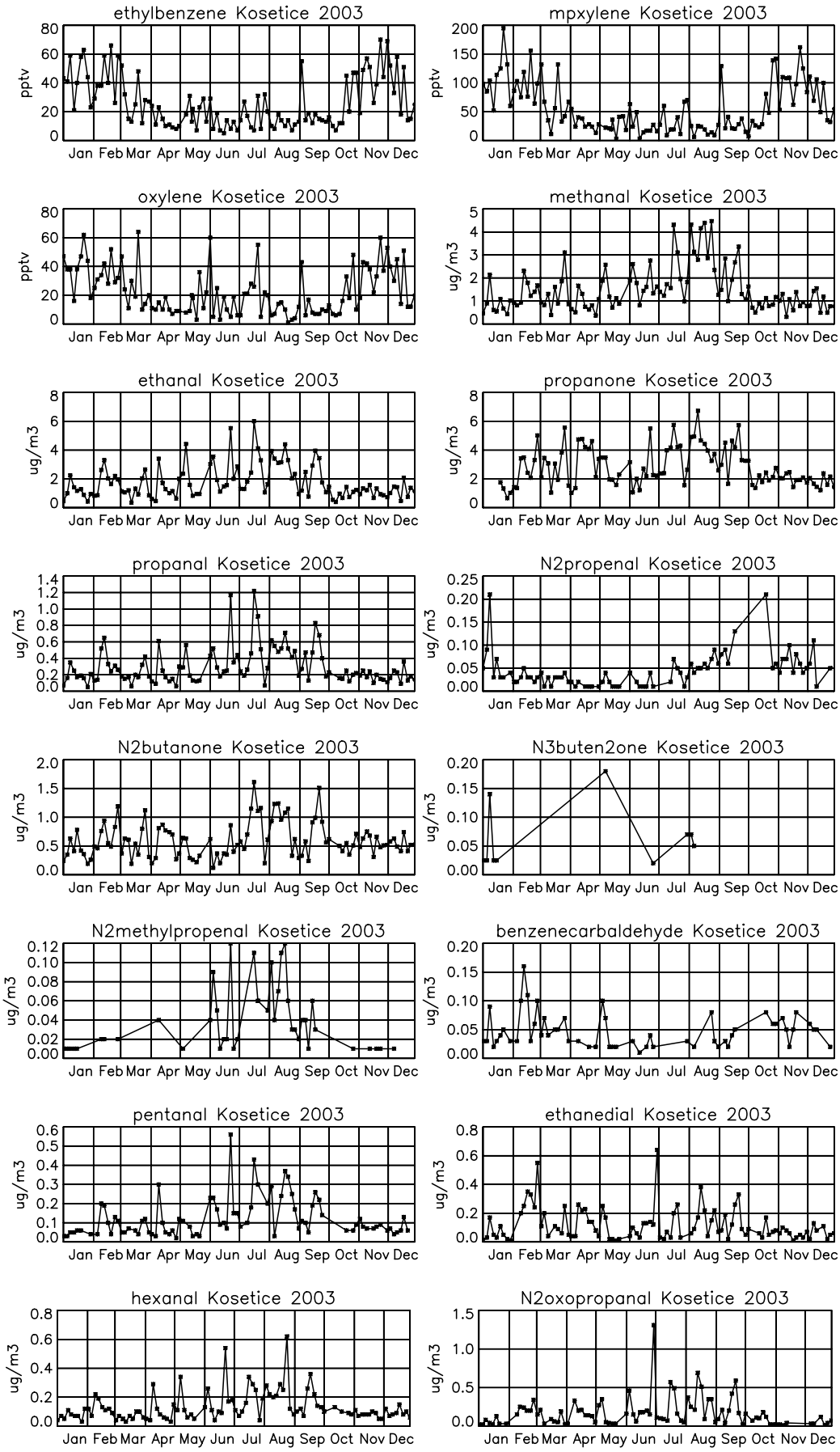
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ug/m3
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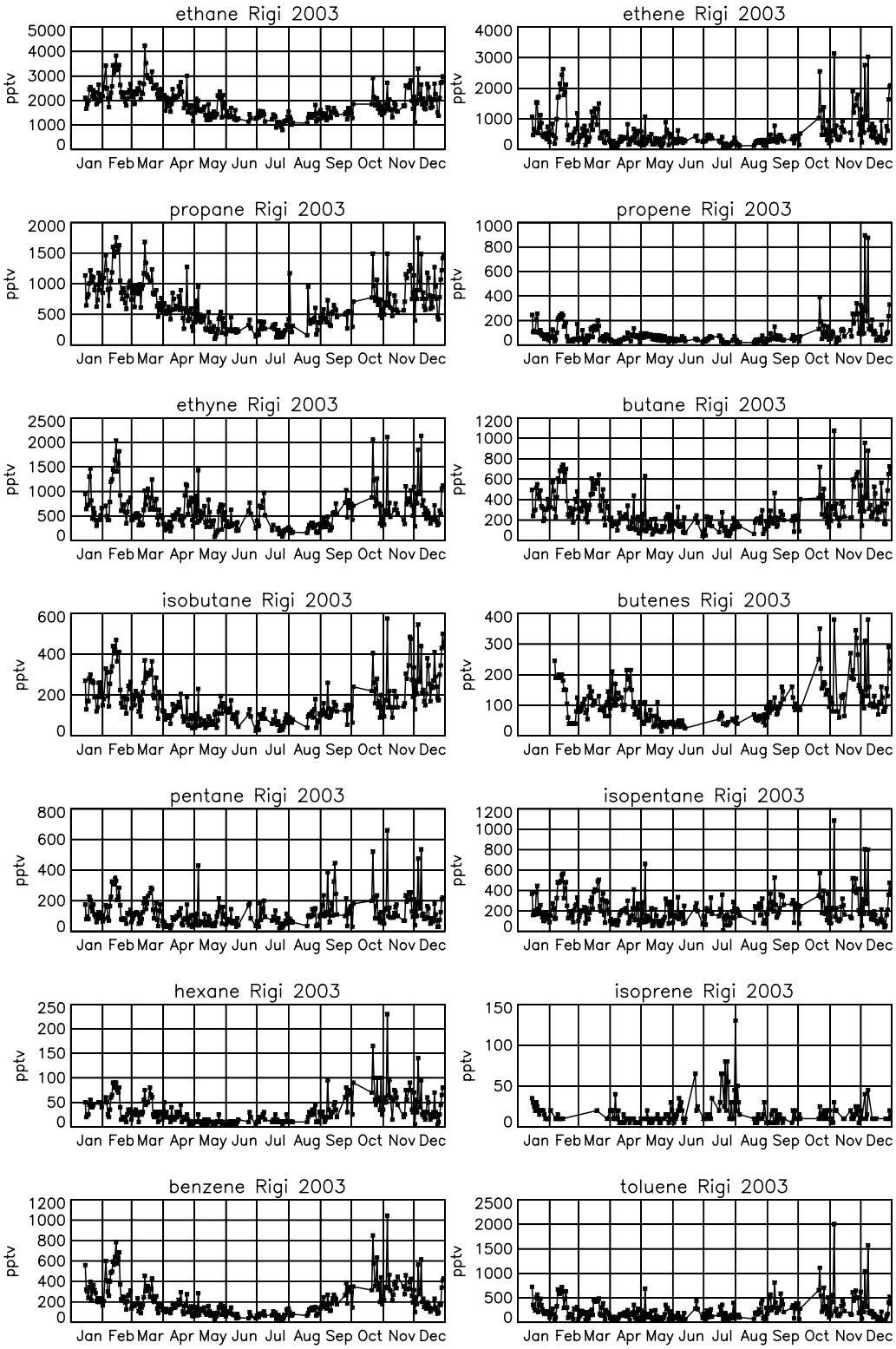
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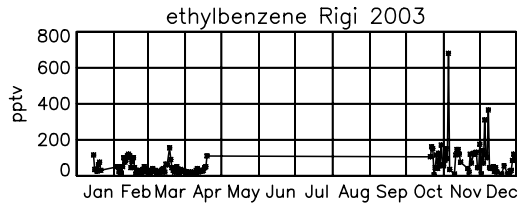
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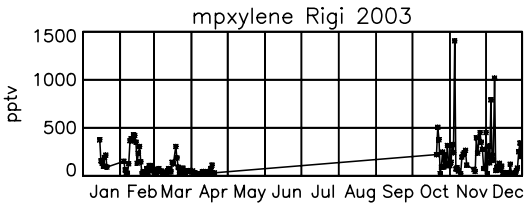
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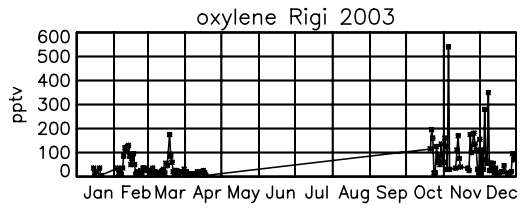
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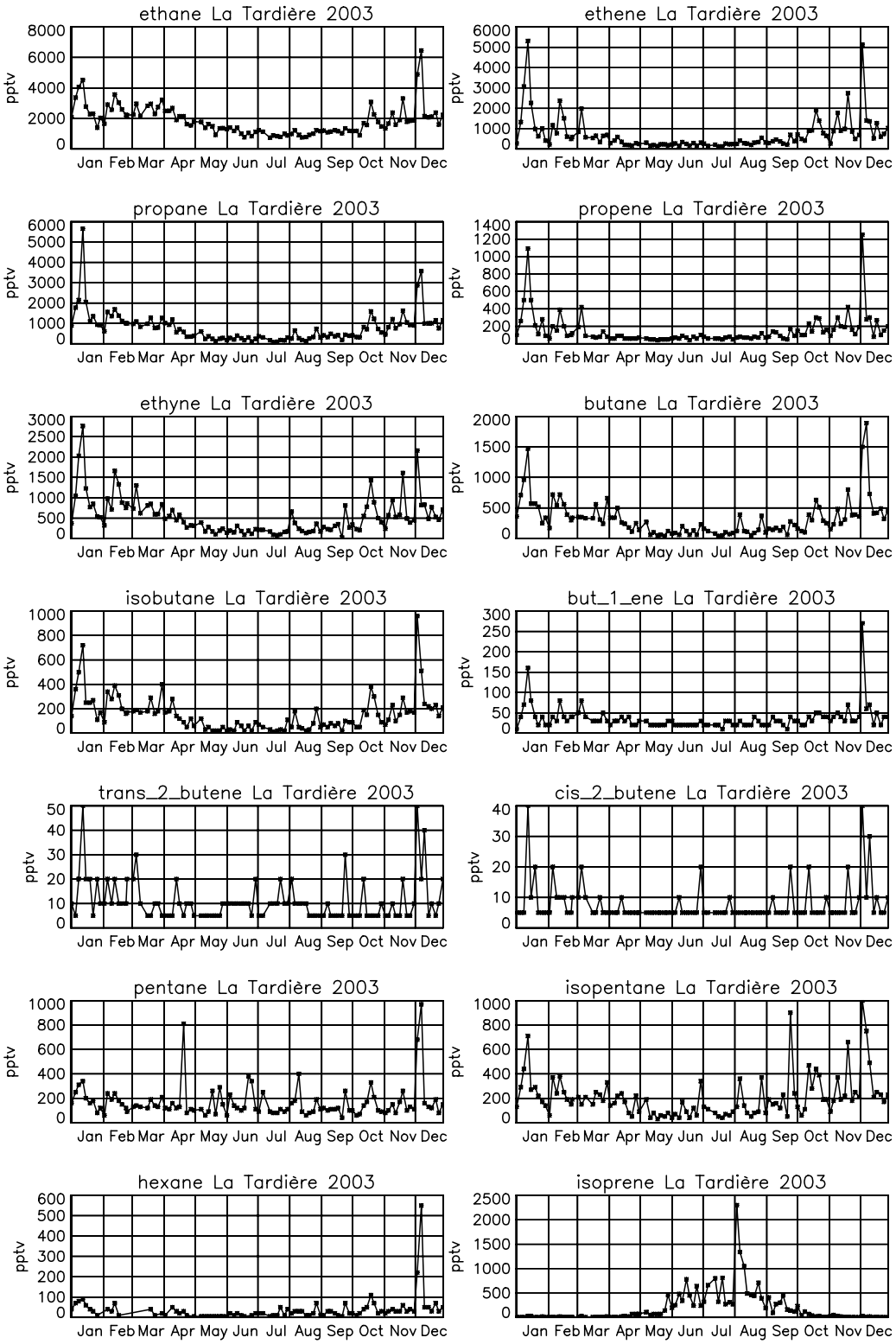
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but_1_ene La Tardière 2003
trans_2_butene La Tardière 2003
cis_2_butene La Tardière 2003
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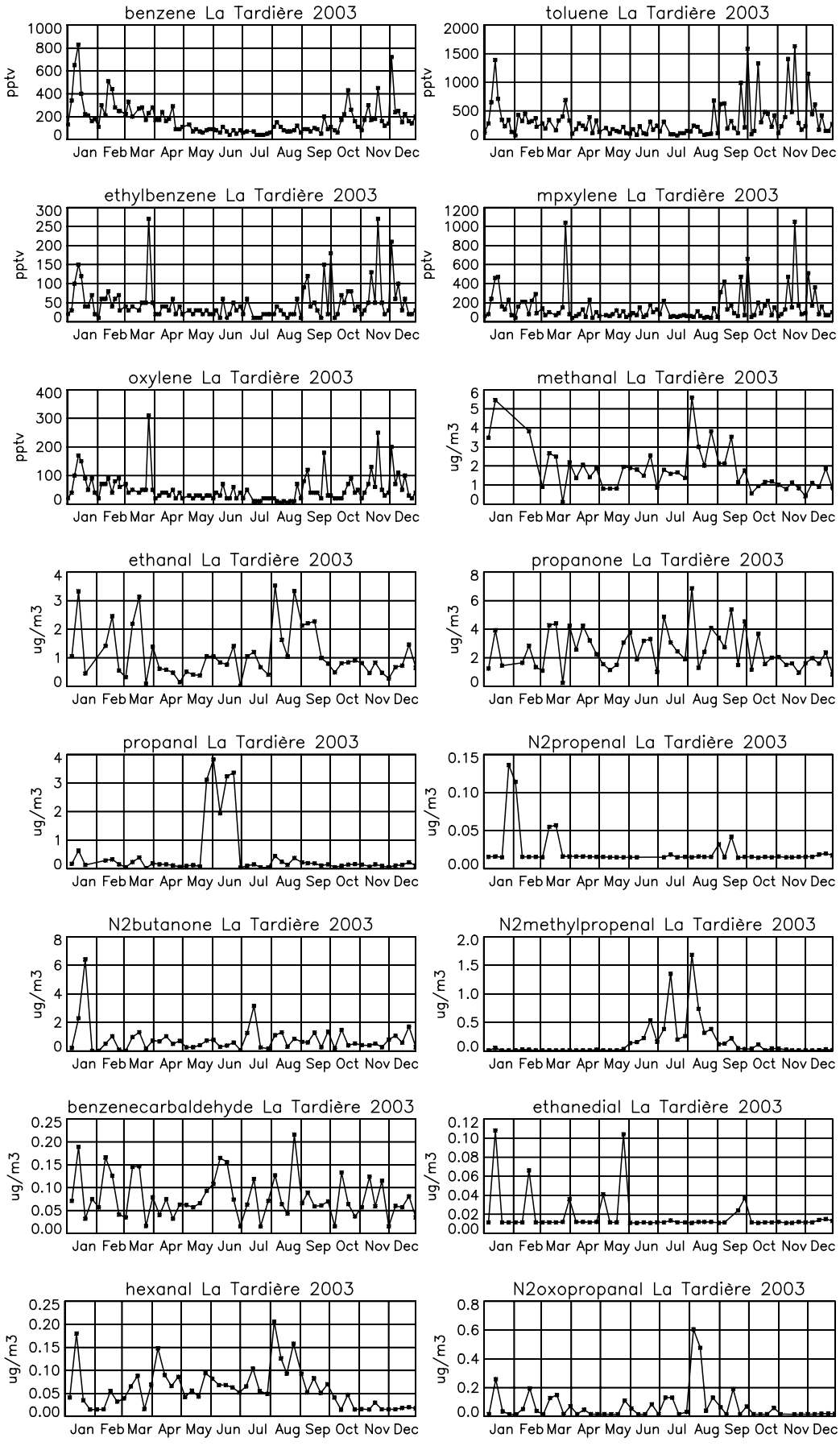
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mpxylene La Tardière 2003
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oxylene La Tardière 2003
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N2methylpropenal La Tardière 2003
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benzenecarbaldehyde La Tardière 2003
ug/m3
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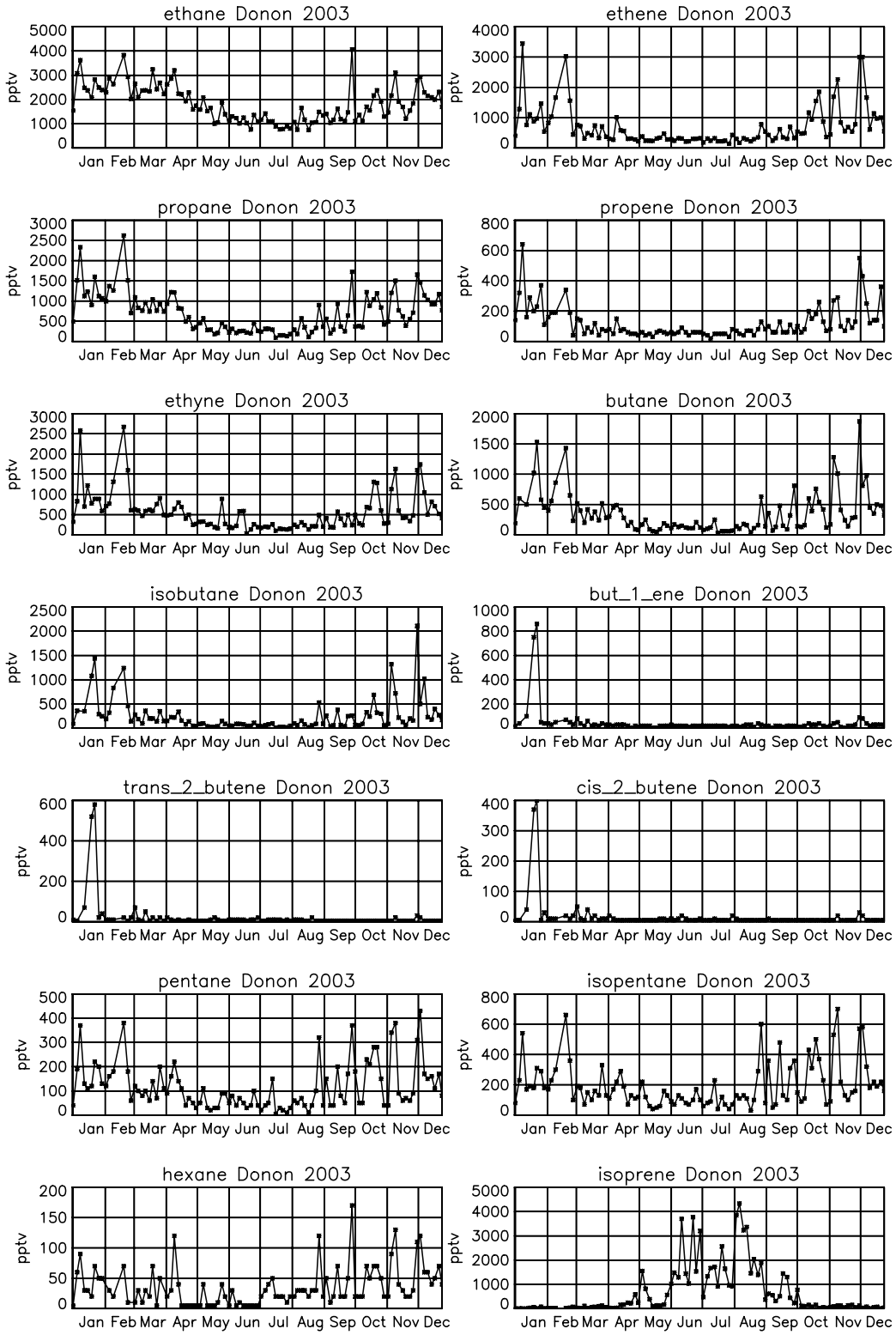
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but_1_ene Donon 2003
trans_2_butene Donon 2003
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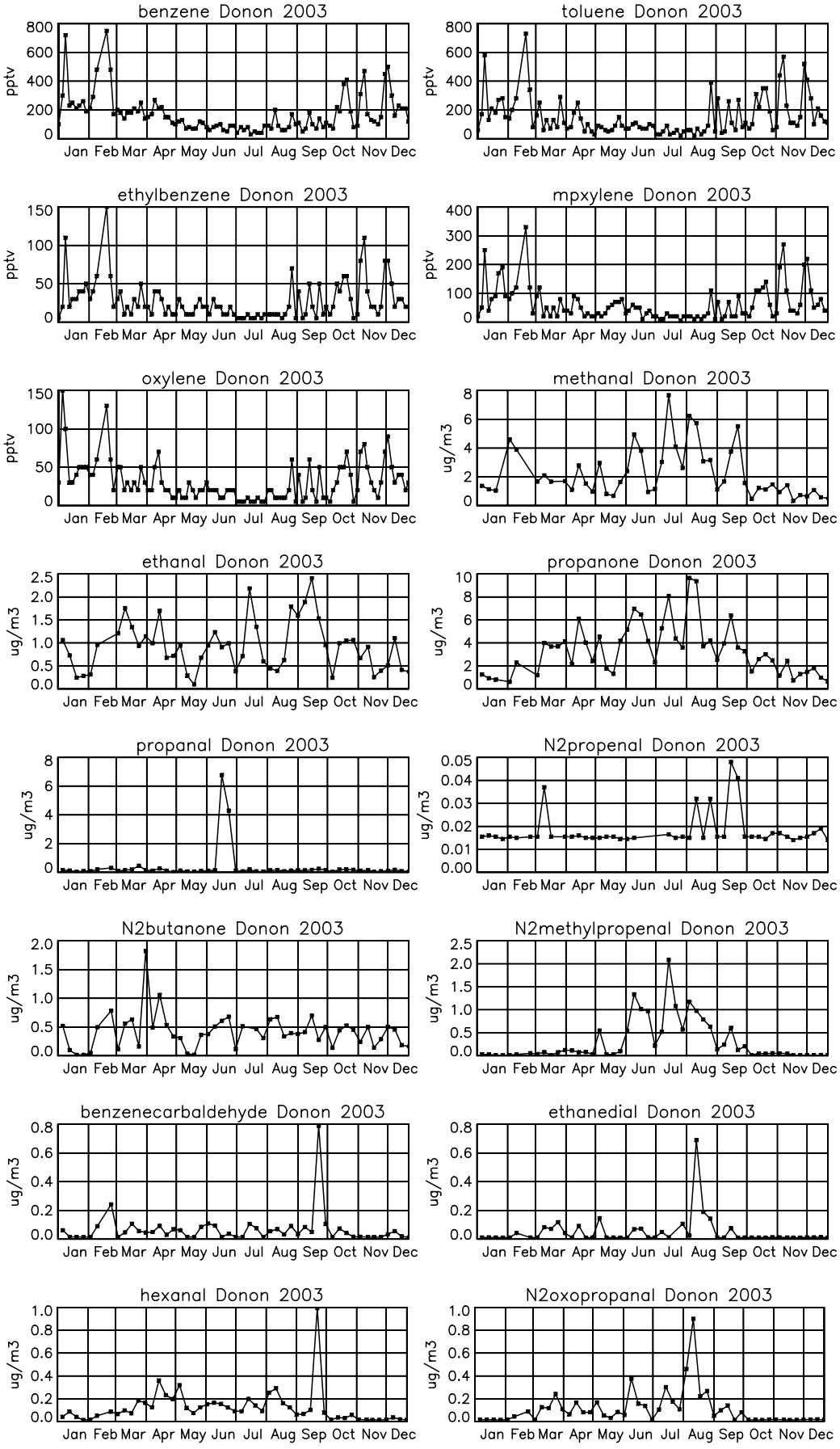
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mpxylene Donon 2003
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ug/m3
0 2 4 6 8 10
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
propanal Donon 2003
ug/m3
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N2propenal Donon 2003
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Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
N2butanone Donon 2003
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N2methylpropenal Donon 2003
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0.0 0.5 1.0 1.5 2.0 2.5
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benzenecarbaldehyde Donon 2003
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0.0 0.2 0.4 0.6 0.8
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ethanedial Donon 2003
ug/m3
0.0 0.2 0.4 0.6 0.8
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
hexanal Donon 2003
ug/m3
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Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
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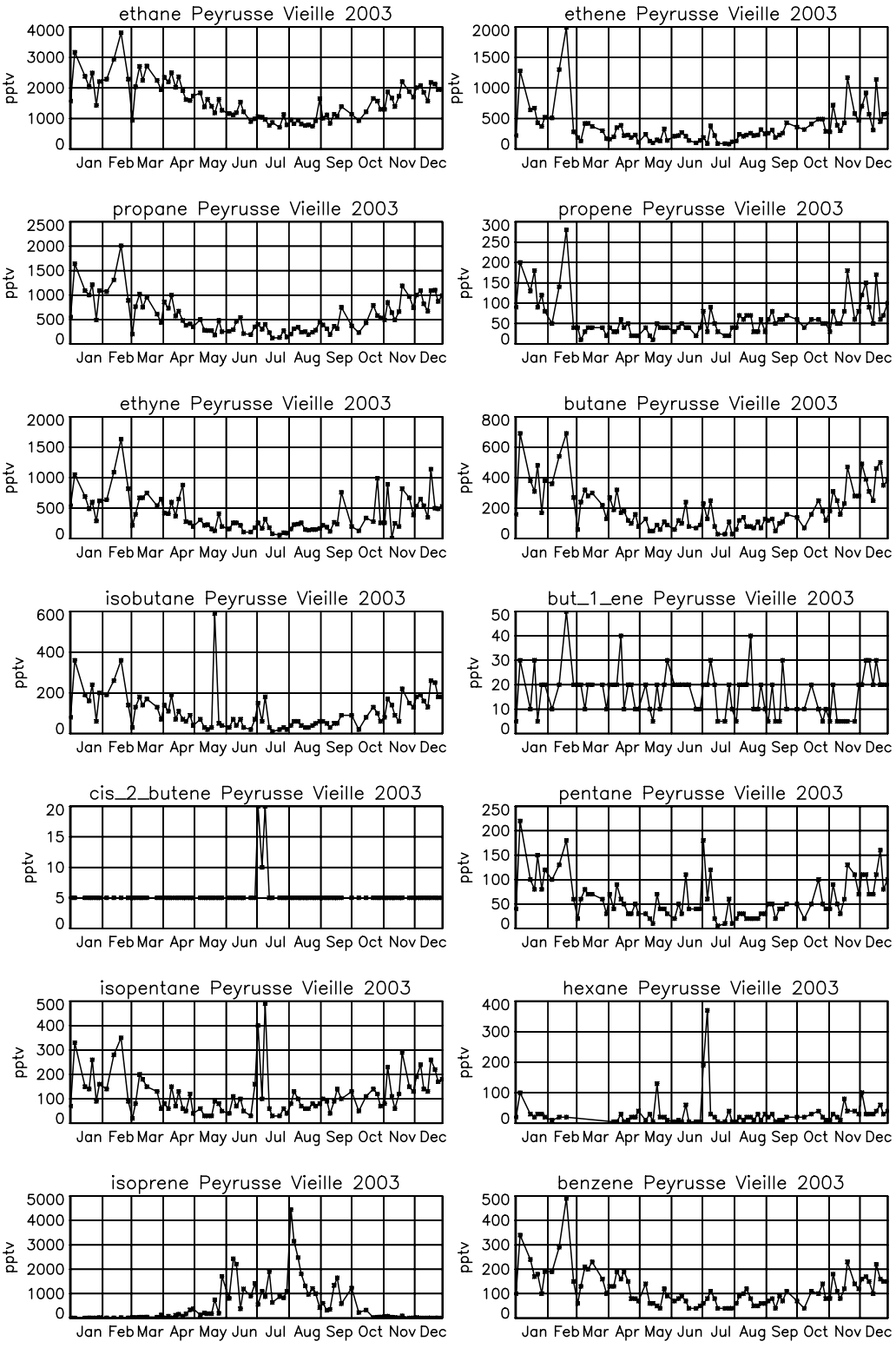
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isobutane Peyrusse Vieille 2003
but_1_ene Peyrusse Vieille 2003
cis_2_butene Peyrusse Vieille 2003
pentane Peyrusse Vieille 2003
isopentane Peyrusse Vieille 2003
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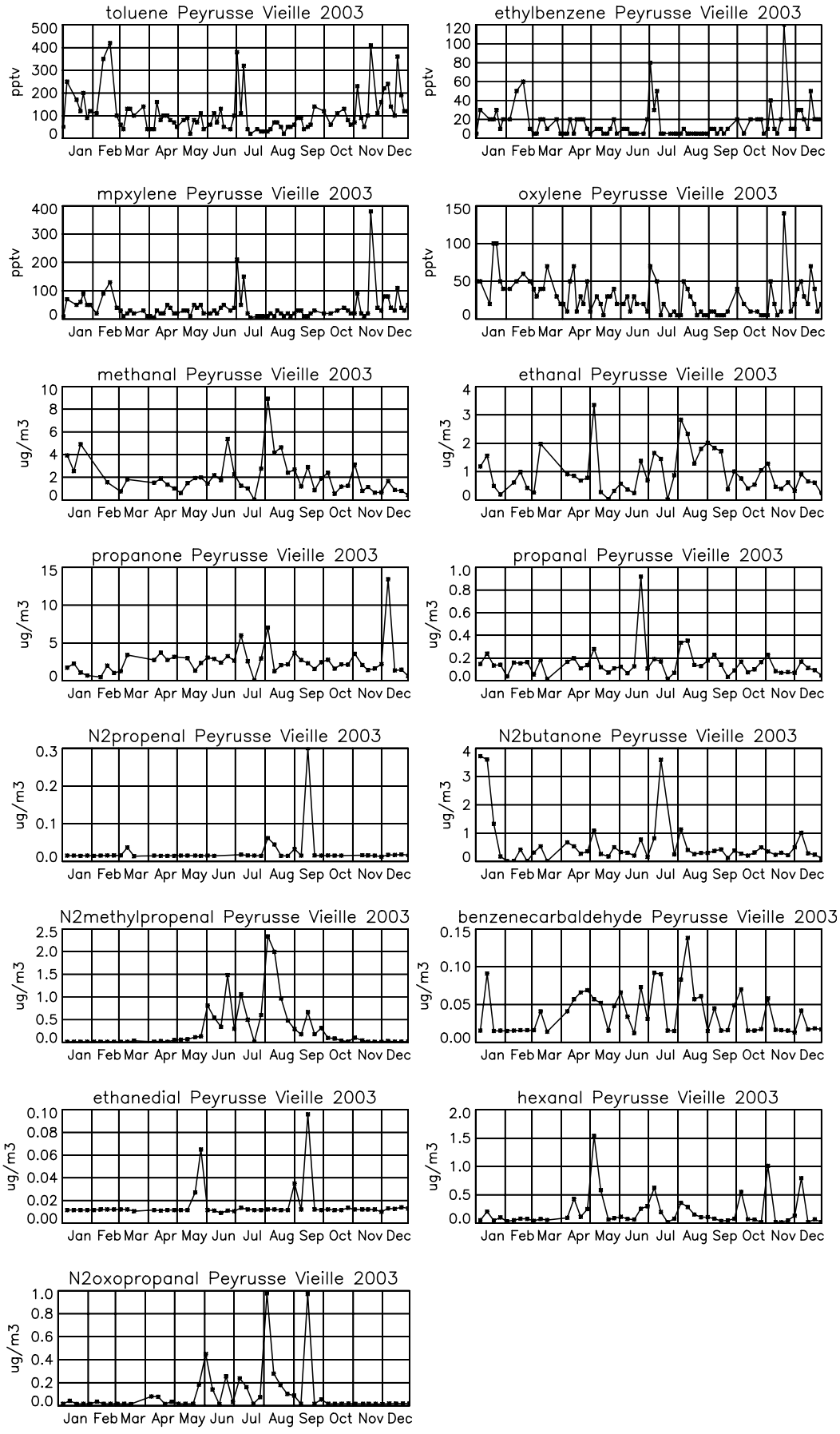
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pptv
methanal Peyrusse Vieille 2003
ug/m3
ethanal Peyrusse Vieille 2003
ug/m3
propanone Peyrusse Vieille 2003
ug/m3
propanal Peyrusse Vieille 2003
ug/m3
N2propenal Peyrusse Vieille 2003
ug/m3
N2butanone Peyrusse Vieille 2003
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N2methylpropenal Peyrusse Vieille 2003
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benzenecarbaldehyde Peyrusse Vieille 2003
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ethanedial Peyrusse Vieille 2003
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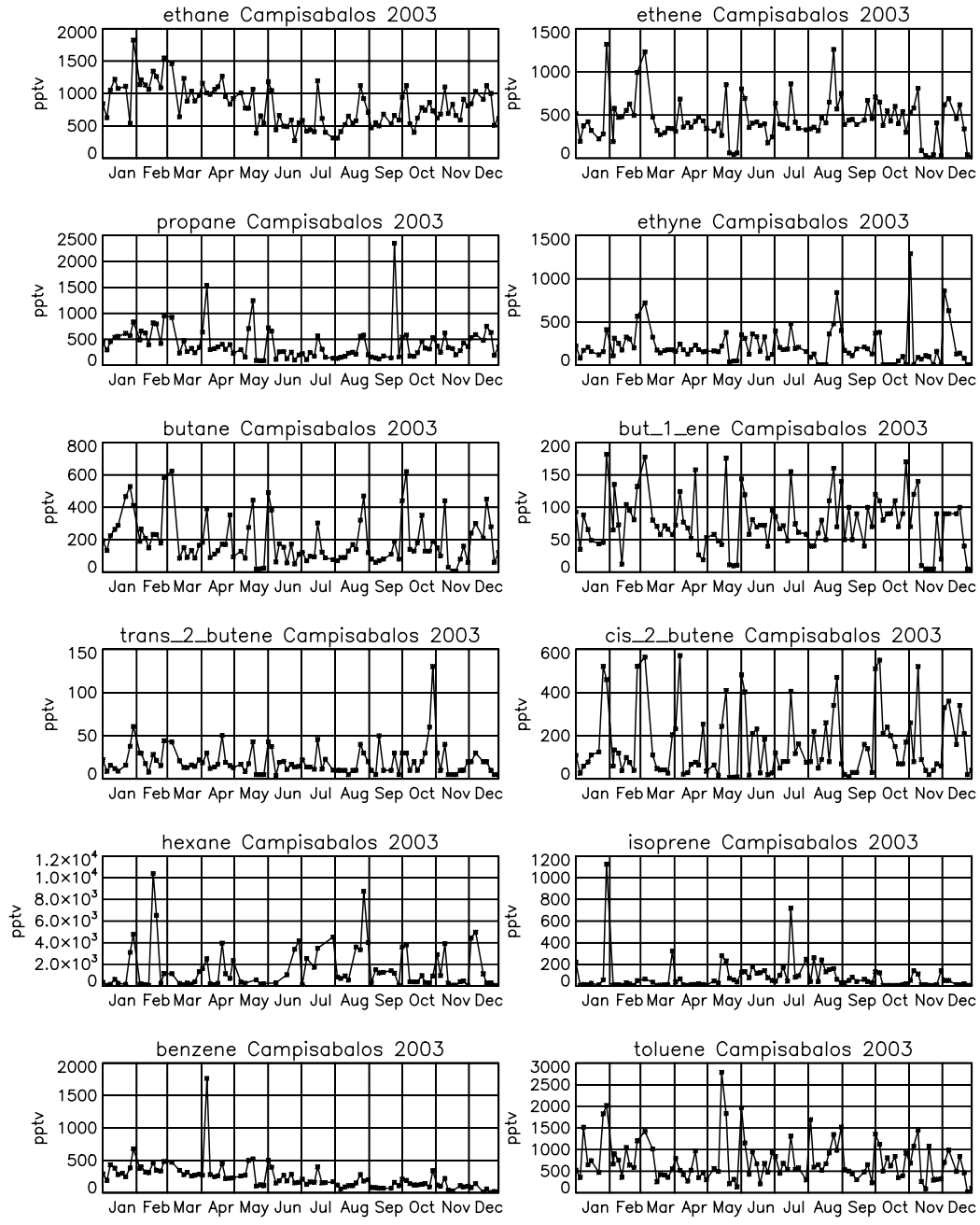
ethane Campisabalos 2003
ethene Campisabalos 2003
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trans_2_butene Campisabalos 2003
cis_2_butene Campisabalos 2003
hexane Campisabalos 2003
isoprene Campisabalos 2003
benzene Campisabalos 2003
toluene Campisabalos 2003
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec