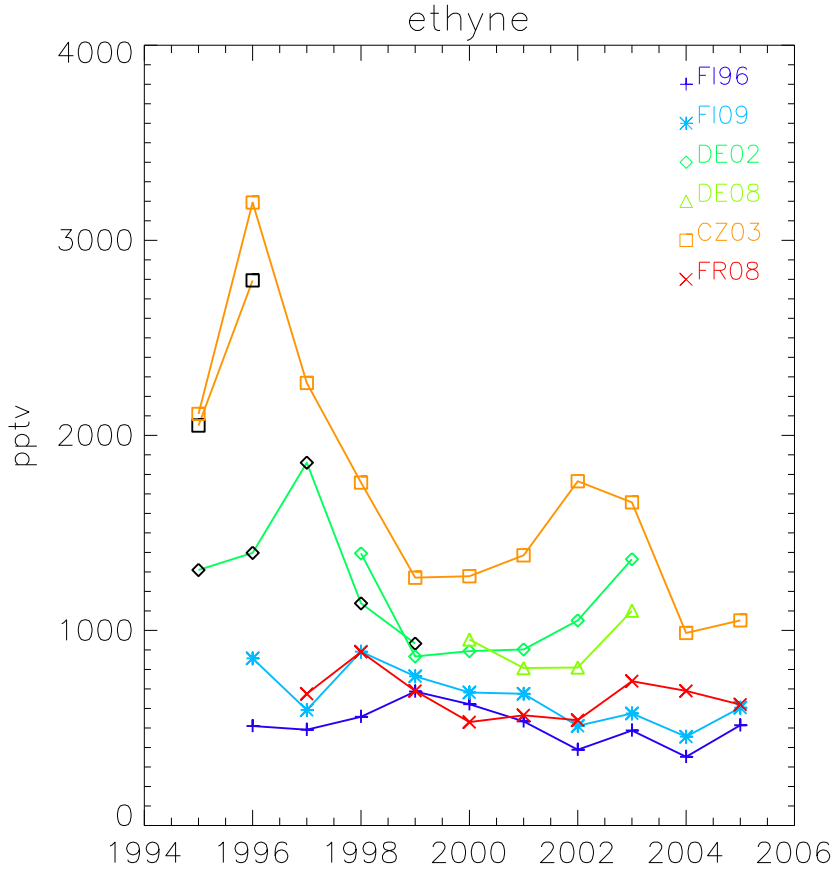
EMEP/CCC-Report 7/2007

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

VOC measurements 2005

Sverre Solberg



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Summary

This report presents measurements of VOC carried out during 2005 at EMEP monitoring sites. VOC measurements are reported for a total of 16 sites, 14 of these with light hydrocarbons and 7 of these with carbonyls. All the VOC measurements are made by grab samples of light hydrocarbons in canisters and by 8-hours samples of carbonyls by DNPH adsorption tubes.

There was a few changes in the German monitoring network in 2005. The VOC measurements were ended at Brotjacklriegel, whereas such monitoring was started at the two EMEP sites Neuglobsow and Schauinsland. Furthermore, carbonyl measurements were re-established at the Norwegian site Birkenes. Due to technical problems no hydrocarbon data is given for the Spanish site Campisábalos and no carbonyl data for the German sites.

Fairly uniform mean concentration levels of alkanes were seen in winter, indicating that these compounds become well mixed in the dark season without effective chemical loss mechanisms, although the data from the Slovak station Starina was an exception and showed elevated concentrations of many compounds. Larger regional differences were seen for the alkenes consistent with the fact these compounds undergo chemical oxidation also in winter through the reaction with ozone.

The number of sites with carbonyl measurements are less and the regional pattern is more mixed than for the hydrocarbons. The highest summer median concentrations for acetone were found at Birkenes, and for acetaldehyde and 2-butanone at Utö in S-Finland with lower concentration levels to the south. The reason for these somewhat surprising results is not clear.

The trend in hydrocarbon concentrations based on the 11 years winter median values for the period 1995-2005 show a mixed picture. For toluene the data do show a strong decline in the concentrations through the whole period whereas for other compounds there are signs of concentrations levelling off or even increasing during the last few years. Modelling studies are needed to separate the effect of changes in emissions from those of changing meteorology from year to year.

A preliminary comparison of the ethene measurements at Hohenpeissenberg with results from the EMEP model shows encouraging results for the winter months giving confidence to the model and the measurements. For other periods of the year the agreement is poorer reflecting problems when comparing measurements and regional model calculations for mountain sites.

VOC measurements 2005

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 (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).

In the EU FP5 project AMOHA (Accurate Measurements of Hydrocarbons in the Atmosphere) a large number of laboratories in Europe participated in parallel sampling and analyses of hydrocarbons in ambient air (Slemr et al., 2002). A major part of the project was to organize four annual intercomparisons starting in 1997 and ending in 2000. The results showed that except for a few laboratories the agreement was within ±25% of the median for the lighter alkanes. For some aromats and unsaturated hydrocarbons as well as the C_6-C_7 alkanes a large spread in the values were seen, indicating measurement difficulties with these compounds. The spread in the results were, however, much less for laboratories using a NPL standard for calibration (Aas et al., 2001). Thus, it may be concluded that a large part of the differences seen among the laboratories reflected the use of different calibration gases. When using the same NPL standard the results from this intercomparison were very satisfactory.

The EMEP VOC 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, 2006). 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.

In 2006 a WMO/GAW workshop on global measurements of VOCs (WMO, 2007) proposed a list of species to be measured based on current and future possibilities and needs of GAW. The proposed species are: Ethane, propane, acetylene, isoprene, formaldehyde, terpenes, acetonitrile, methanol, ethanol, acetone, DMS, benzene, toluene, iso- and n-butane, iso- and n-pentane. Most of these compounds are already part of the EMEP VOC programme with some exceptions. The alcohols (methanol and ethanol) are likely to become more important in the future due to increased use of biofuels in vehicles. Furthermore, terpenes are important as precursors for secondary organic aerosols. These compounds would be of interest to include in the EMEP monitoring as well, but require other sampling methods and instrumentations than presently used for the hydrocarbons and carbonyls.

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 2005

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 2005 is given in Table 3. Totally 16 measurement sites reported VOC data to CCC in 2005, 7 of these with carbonyls and 14 with light hydrocarbons. Due to technical problems with the instrumentation the carbonyl samples from the German EMEP sites could not be analysed. Furthermore, the hydrocarbon data from ES09, Campisábalos, were classified as invalid by the data originator.

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). The data capture was lower than this for several sites in 2005. Carbonyls are only measured once per week in France. In addition the number of hydrocarbon samples was slightly below the data quality objective at a few of the other sites.

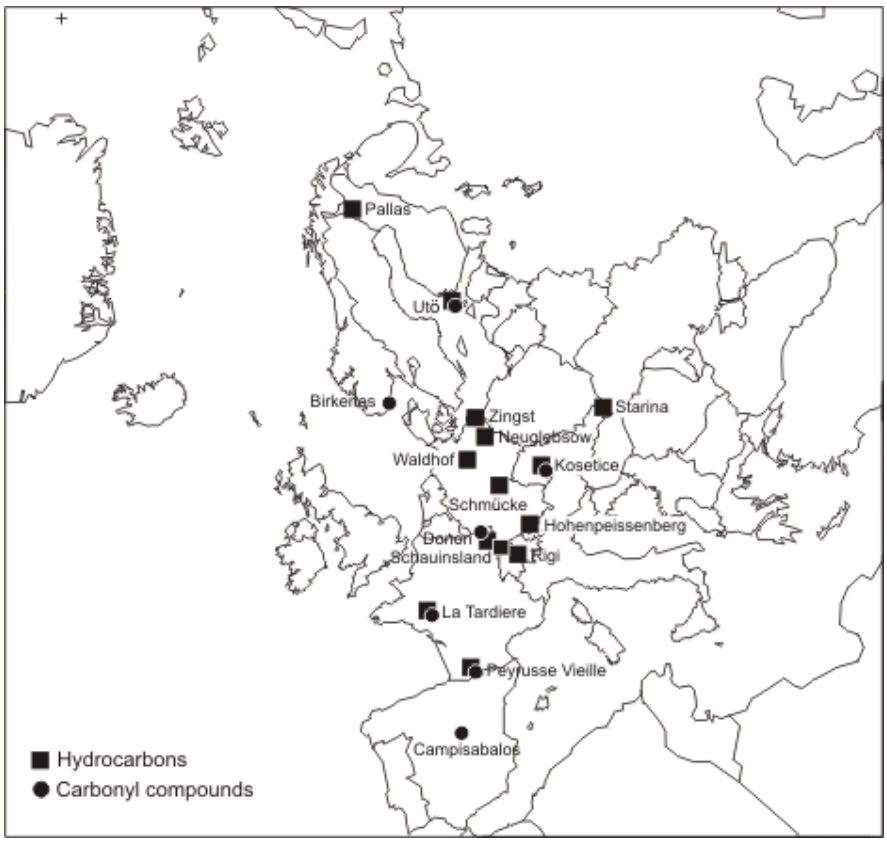

Figure 1: Monitoring sites for VOC in 2005.

Table 3: Status of the VOC monitoring programme in 2005. 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
Birkenes	NO01	n.m.	-	Reg.	NILU	
Pallas	FI96	Reg.	FMI	n.m.	-	
Utö	FI09	Reg.	FMI	Reg.	NILU	
Waldhof	DE02	Reg.	-	(Reg.)	UBA	Carbonyls not reported due to technical problems
Schauinsland	DE03	Reg.	UBA			New VOC site
Neuglobsow	DE07	Reg.	UBA			New VOC site
Schmücke	DE08	Reg.	-	(Reg.)	UBA	Carbonyls not reported due to technical problems
Zingst	DE09	Reg.	-	(Reg.)	UBA	Carbonyls not reported due to technical problems
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.	MMA	Hydrocarbons invalidated by MMA due to sampling problems

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 valid samples of hydrocarbons (HC) and carbonyls (Carb) in 2005.

Station	Number of samples	
	HC	Carb
Birkenes	-	101
Pallas	96	-
Utö	98	102
Waldhof	103	-
Schauinsland	91	-
Neuglobsow	102	-
Schmücke	96	-
Zingst	101	-
Hohenpeissenberg[1)]	342	-
Košetice	103	101
Starina	93	-
Rigi[1)]	226	-
Donon	91	50
Peyrusse Vieille	59	50
La Tardiere	95	52
Campisábalos	-	100

[1)] Refer to days with monitoring data

2.2 Analytical procedures and quality control

The procedures for sampling and chemical analyses were similar in 2005 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).

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.

3. VOC concentrations in 2005

3.1 General

Monthly mean and median concentrations of the individual hydrocarbons and carbonyls for 2005 are tabulated in Appendix A. The monthly statistics were not calculated for sample numbers less than 4. Time series of all compounds during 2005 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 sample taken around noon at Hohenpeissenberg were used (samples from noon and midnight were reported). 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 the difference is substantial as this is a reactive biogenic compound, emitted during daytime, with low concentrations during night.

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 2 and Figure 3.

Considering that the sites span a wide area from south to the most northern part of Europe, the hydrocarbon winter mean levels are fairly uniform for the alkanes. The measurement data from Starina, SK06, are, however, an exception and show particularly high concentration levels for many compounds compared to the other sites. Furthermore, generally high values of isopentane at Peyrusse Vieille, FR13, and high peak levels of benzene at Neuglobsow, DE07, could be mentioned. Larger regional differences are seen for the alkenes, partly explained by the chemical reaction with O_3, making these compounds less stable in winter, even in absence of an effective OH oxidation at that time of year.

The summer seasonal means and percentiles for four selected carbonyls, formaldehyde, acetaldehyde, acetone and butanone, are given in Figure 3. This shows a very mixed picture with no north-south gradients. This is somewhat surprising as previous years' of data have indicated increasing concentration levels in the south. The reason this is not seen from the 2005 data may be very high levels at Utö, FI09, in 2005, particularly for acetaldehyde (ethanal) and 2-butanone. For acetone, however, the highest seasonal mean concentration is seen at Birkenes with decreasing concentrations to the south. The reasons for these unexpected results should be investigated further.

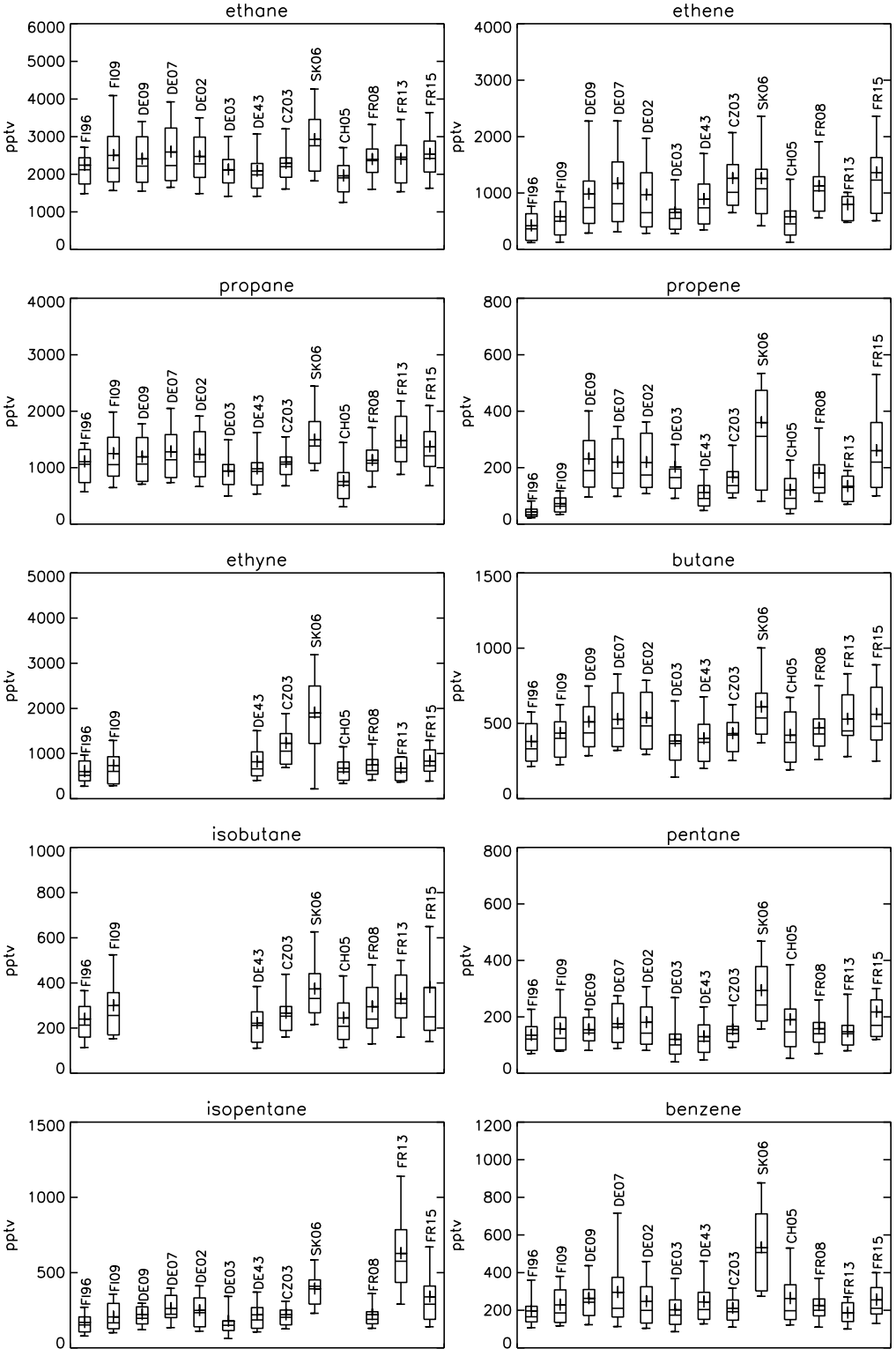

Figure 2: Box- and whisker-diagrams for hydrocarbons during winter 2005 (Jan., Feb., Nov., Dec.). The markers indicate the 10-, 25-, 50-, 75- and 90-percentiles. Mean values are indicated by a cross.

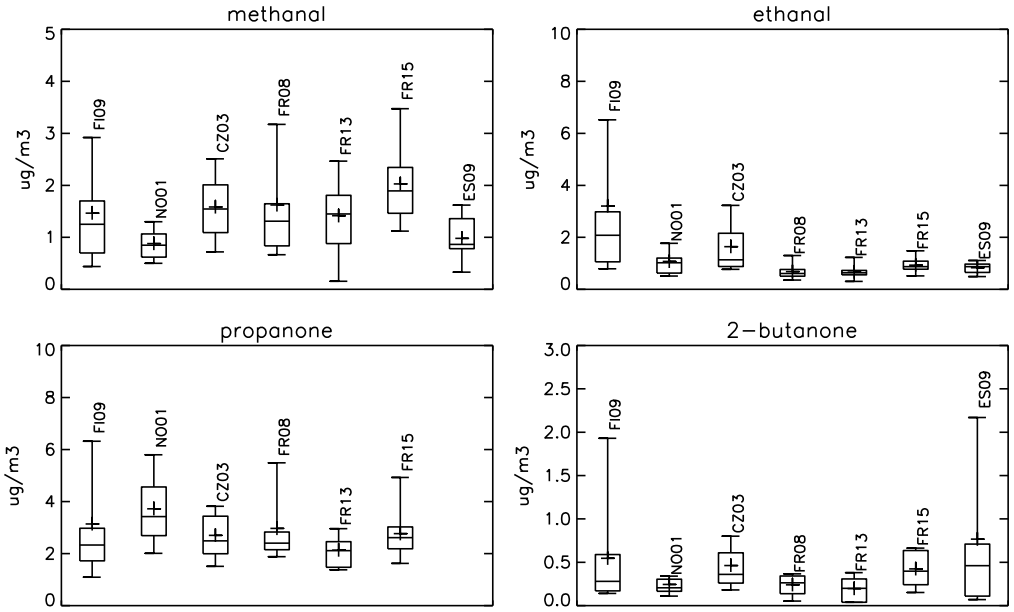

Figure 3: Box- and whisker-diagrams for carbonyls during summer 2005 (May, June, July, August). The markers indicate the 10-, 25-, 50-, 75- and 90-percentiles. Mean values are indicated by a cross.

3.2 Regional distribution of VOC

Figure 4–Figure 13 shows maps with the stations' median concentrations of 10 light hydrocarbons for the winter months January, February, November and December in 2005 taken together. These medians are based on the average of the two 2-hourly values around noon at Rigi and on the day-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 2005 are given in Figure 14–Figure 16.

As noted in previous reports, the measurements indicate that hydrocarbons become fairly well mixed in Europe in winter. Components with a long chemical lifetime in winter, such as ethane, propane and acetylene show less geographical variations except for the results from Starina, SK06, which show generally higher levels. Next, the three mountain sites Hohenpeissenberg (985 m asl), Schauinsland (1205 m asl) and Rigi (1031 m asl) show systematically lower concentrations than the other sites for all the species shown here. The results for the three carbonyls (Figure 14–Figure 16) shows high summer median concentrations of acetaldehyde at Utö and of acetone at Birkenes as mentioned above.

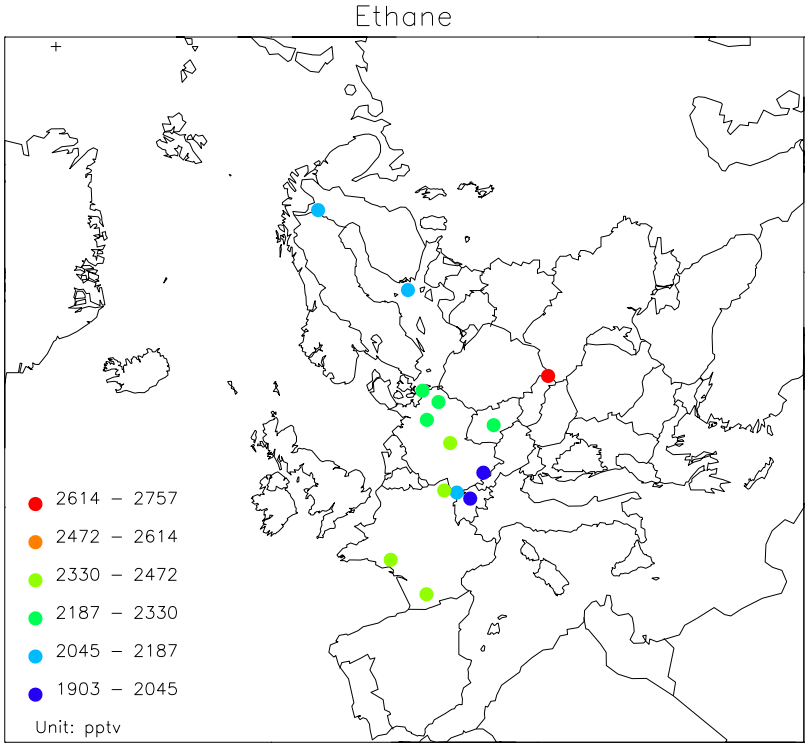

Figure 4: Median concentration of ethane at EMEP sites in the winter months November, December, January and February 2005 taken together.

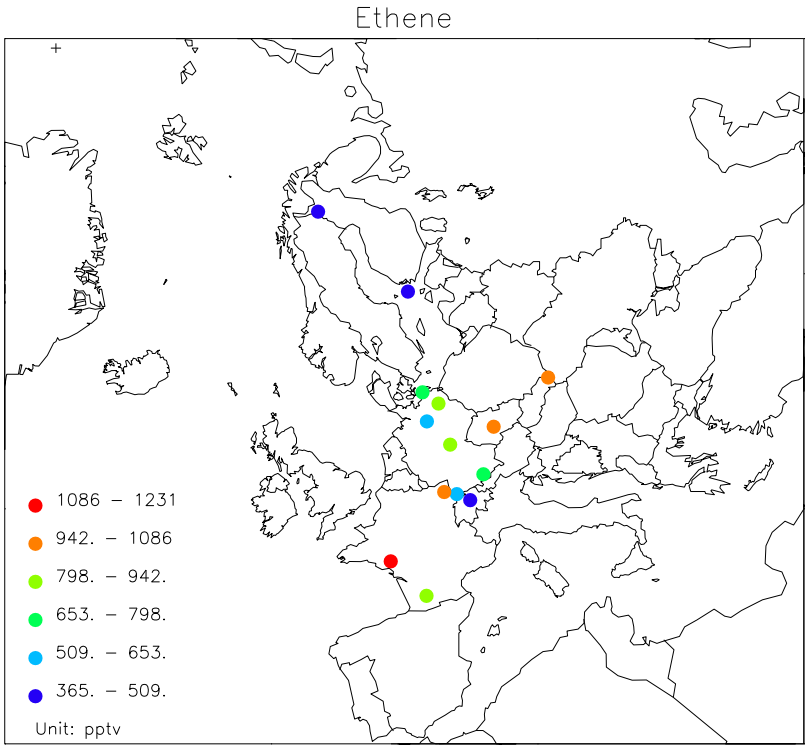

Figure 5: Median concentration of ethene at EMEP sites in the winter months November, December, January and February 2005 taken together.

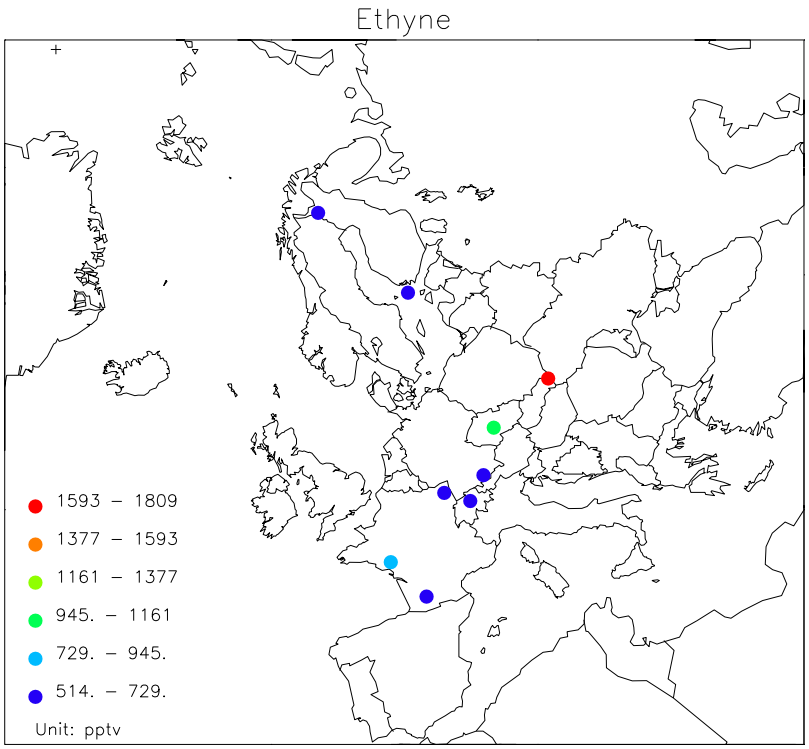

Figure 6: Median concentration of acetylene at EMEP sites in the winter months November, December, January and February 2005 taken together.

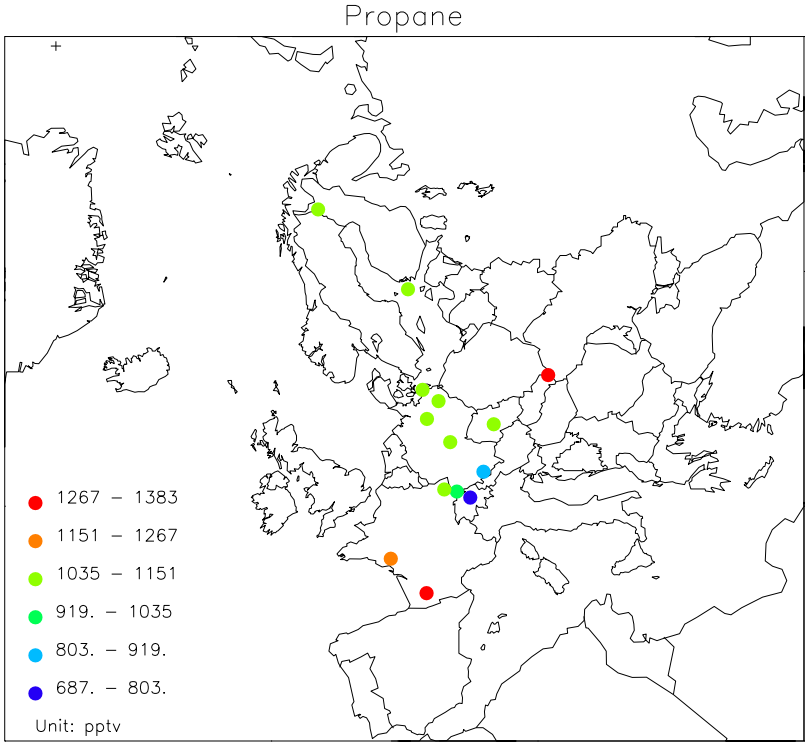

Figure 7: Median concentration of propane at EMEP sites in the winter months November, December, January and February 2005 taken together.

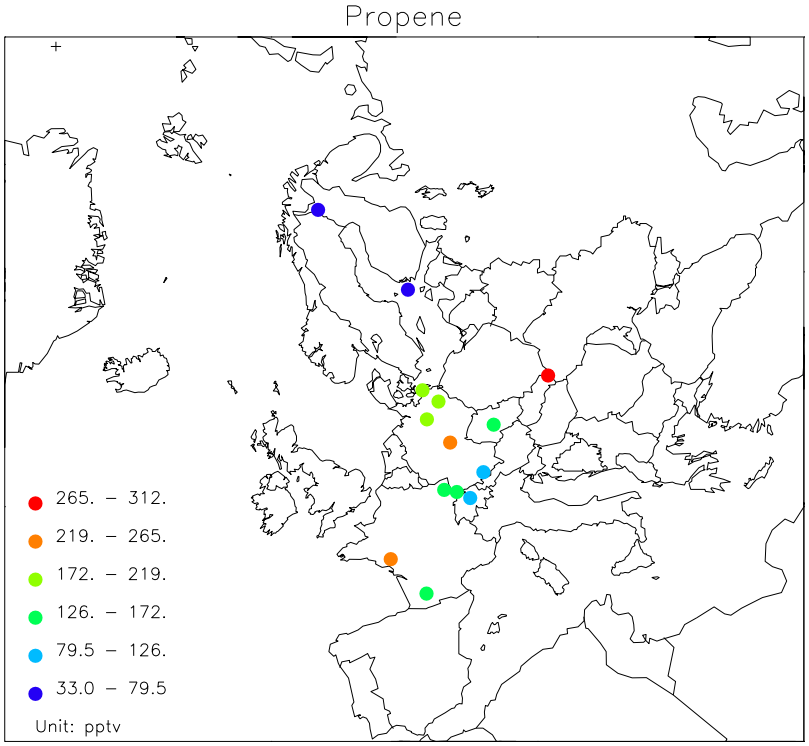

Figure 8: Median concentration of propene at EMEP sites in the winter months November, December, January and February 2005 taken together.

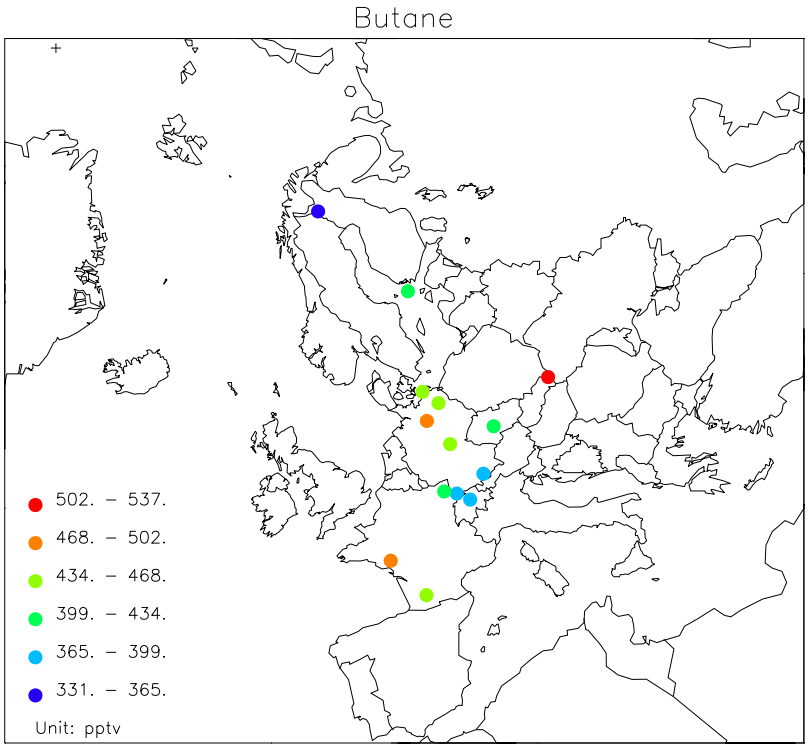

Figure 9: Median concentration of n-butane at EMEP sites in the winter months November, December, January and February 2005 taken together.

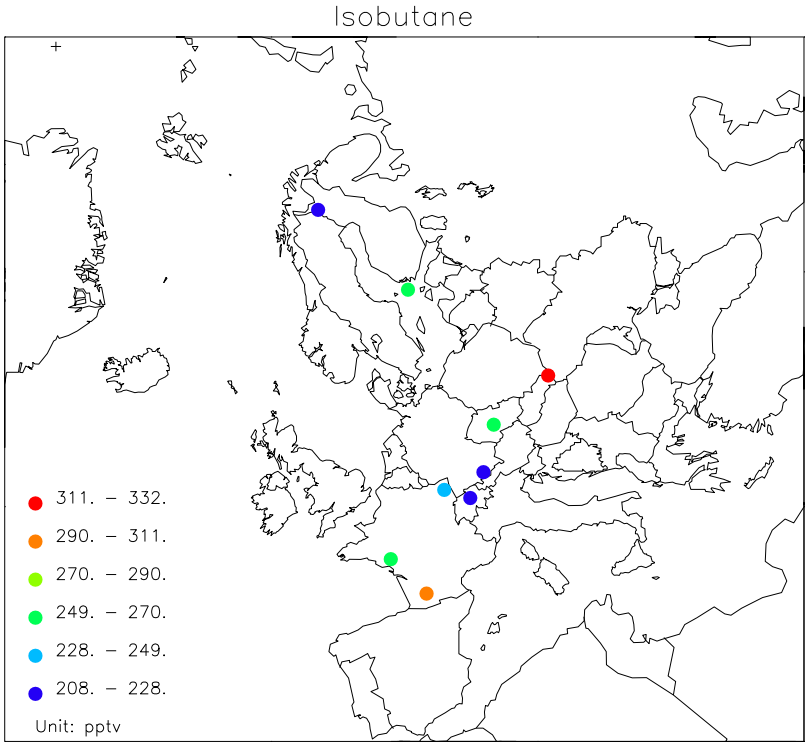

Figure 10: Median concentration of i-butane at EMEP sites in the winter months November, December, January and February 2005 taken together.

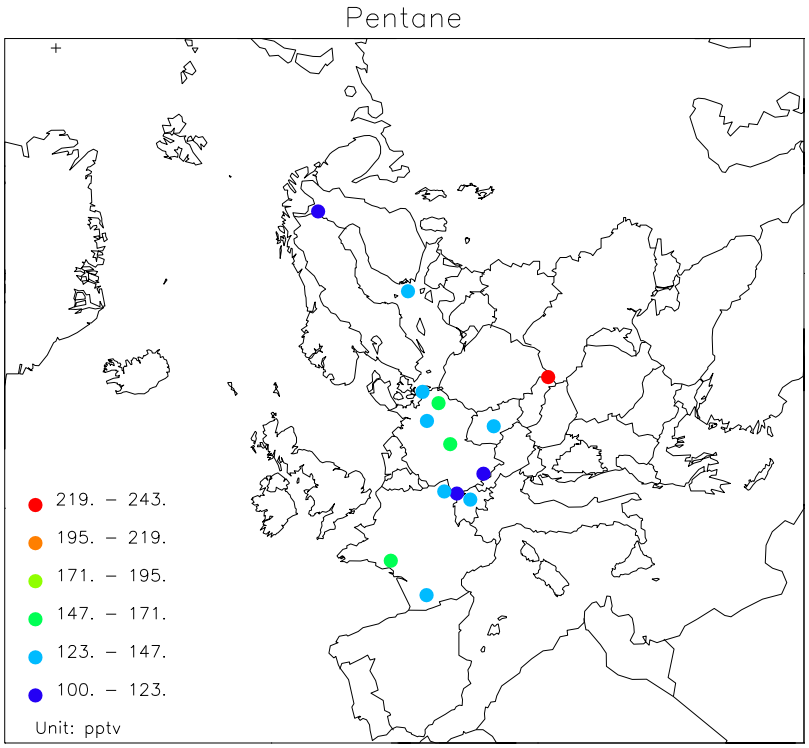

Figure 11: Median concentration of n-pentane at EMEP sites in the winter months November, December, January and February 2005 taken together.

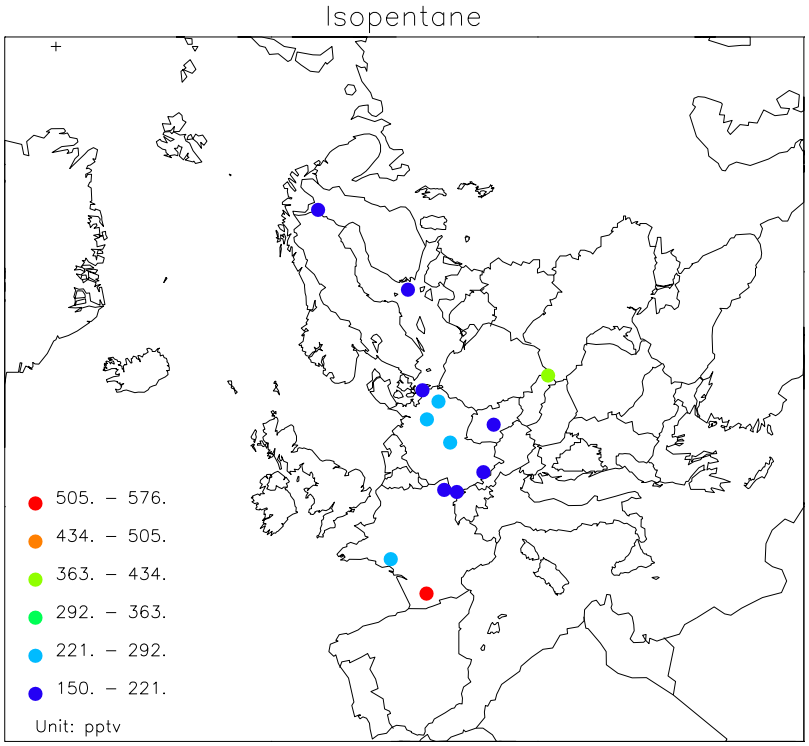

Figure 12: Median concentration of i-pentane at EMEP sites in the winter months November, December, January and February 2005 taken together.

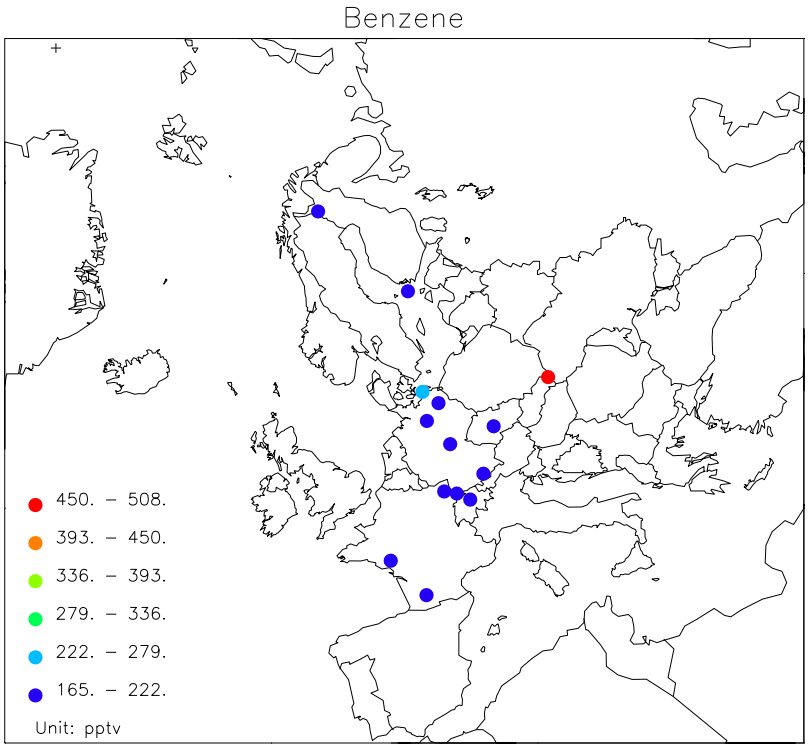

Figure 13: Median concentration of benzene at EMEP sites in the winter months November, December, January and February 2005 taken together.

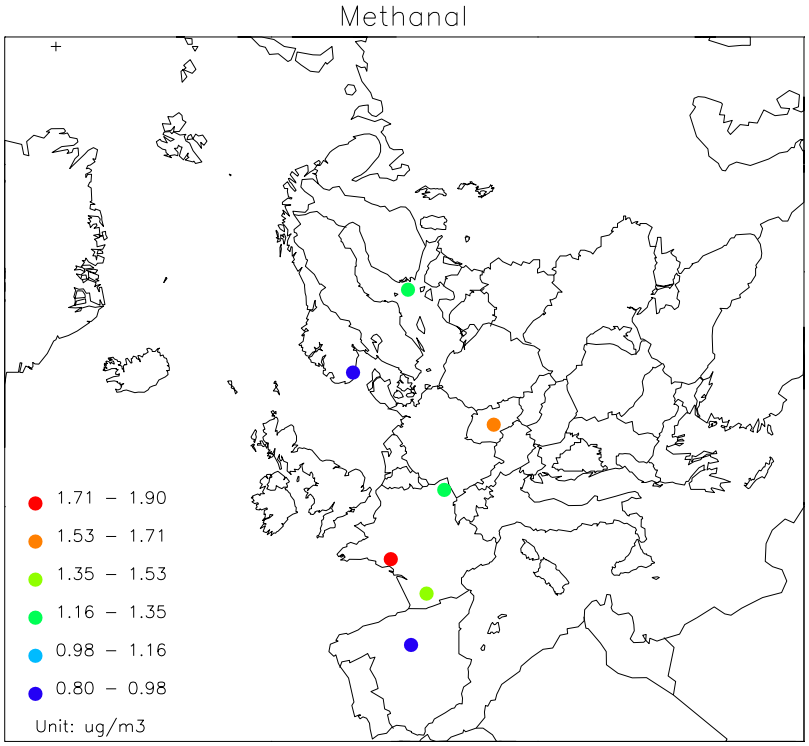

Figure 14: Median concentration of formaldehyde at EMEP sites in the summer months May, June, July and August 2005 taken together.

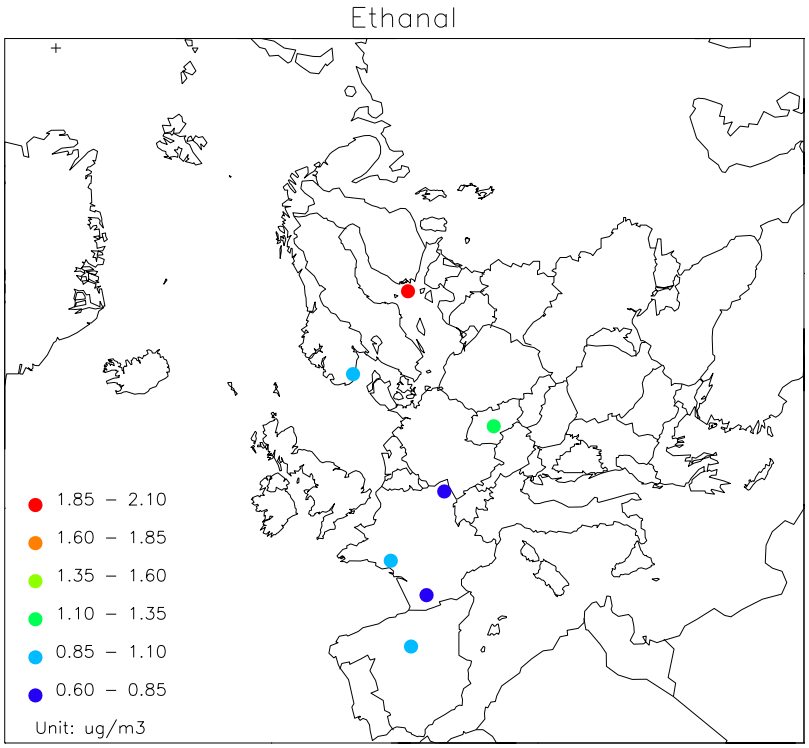

Figure 15: Median concentration of acetaldehyde at EMEP sites in the summer months May, June, July and August 2005 taken together.

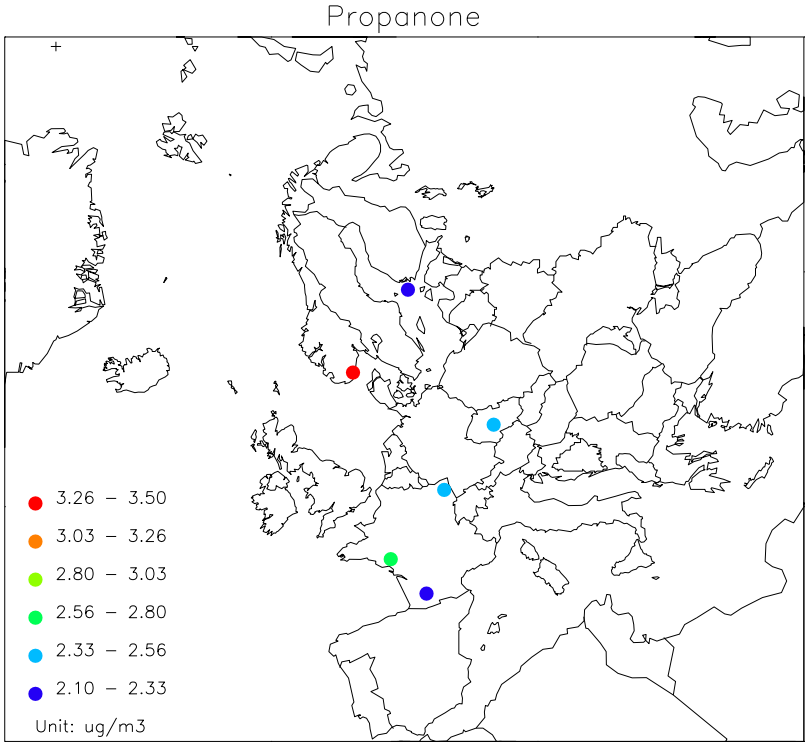

Figure 16: Median concentration of acetone at EMEP sites in the summer months May, June, July and August 2005 taken together.

4. Long-term trends in VOC

The 11 year's trend in the measured VOC from 1995 is indicated in Figure 17 showing the winter medians at Pallas (FI96), Utö (FI09), Waldhof (DE02), Schmücke (DE08), Košetice (CZ03) and Donon (FR08) of selected hydrocarbons.

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.

The 11 year's trend, or variations, in the winter medians clearly varies for the various hydrocarbons as indicated by Figure 17 and no overall picture is seen. For some compounds, like toluene, the results do indicate a long-term reduction in the winter median concentration level, whereas for other compounds, there are signs of a concentration levelling off or even increasing during the last few years. However, to separate the sole effect of changes in European VOC emissions on the observed concentrations trends in Figure 17 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.

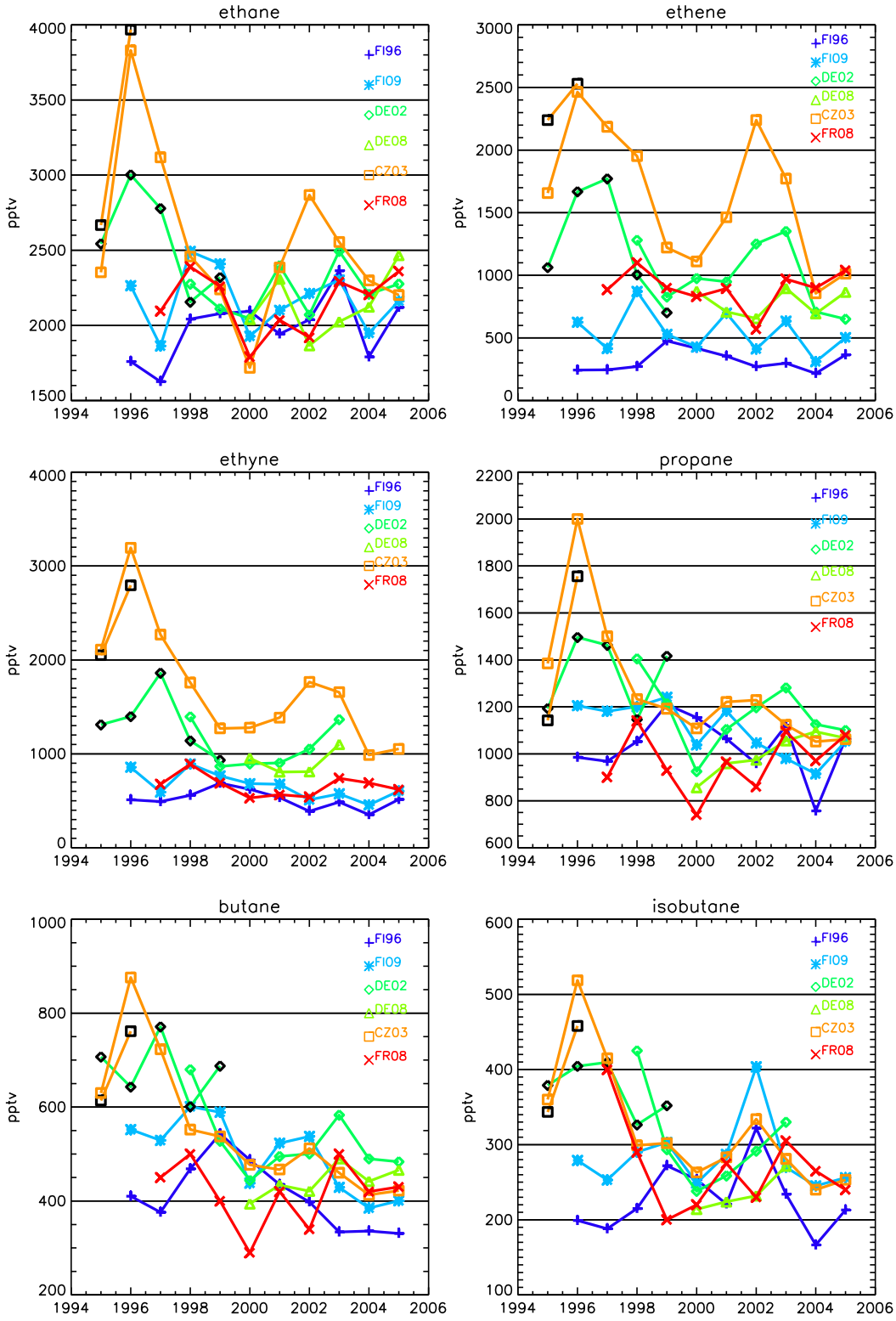

Figure 17: Annual winter (Jan., Feb., Nov., Dec.) median concentrations of hydrocarbons at Pallas (FI96), Utö (FI09), Waldhof (DE02), Schmücke (DE08), Košetice (CZ03) and Donon (FR08). Black symbols mark analyses from NILU's lab., coloured symbols mark the national lab.

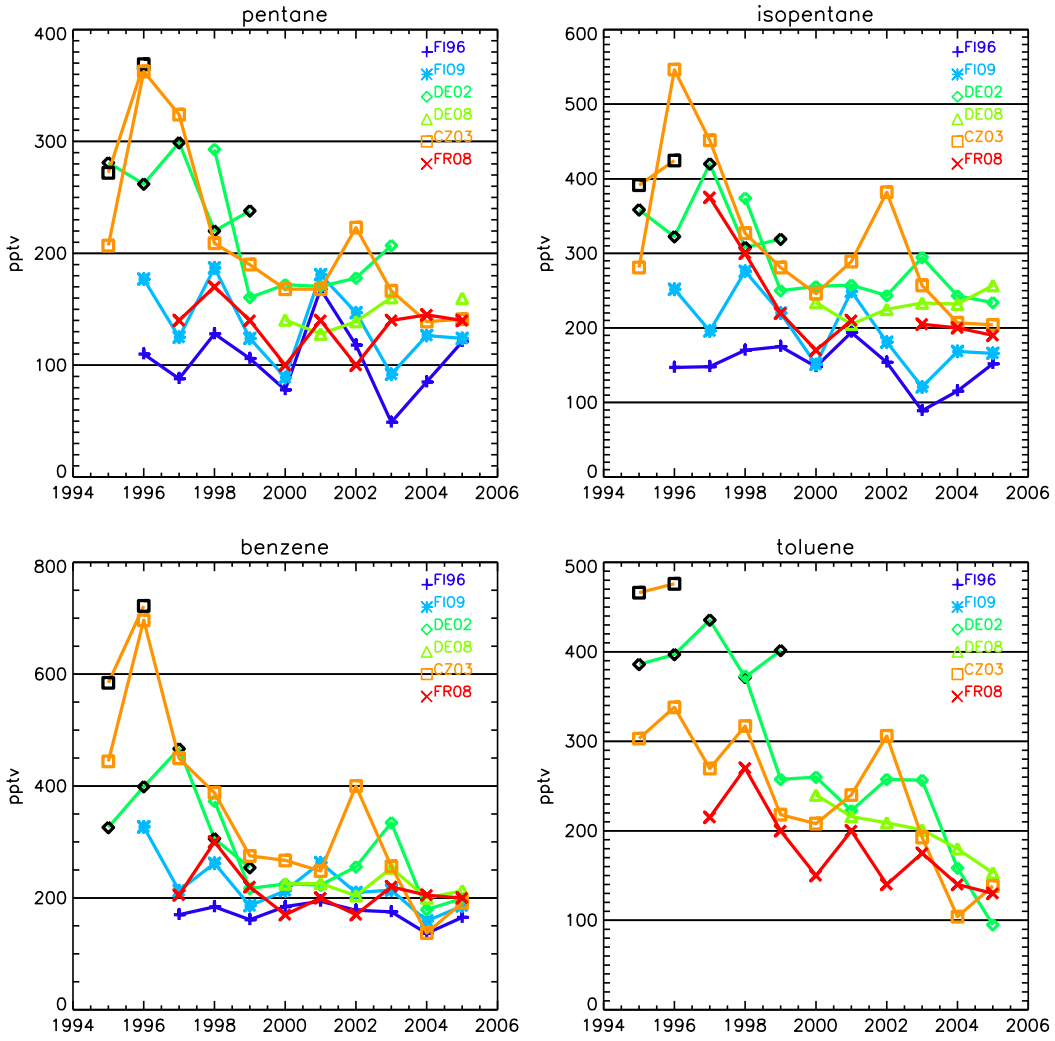

Figure 17, cont.

5. Comparison with results from the EMEP model

The VOC monitoring data are not directly comparable with the results from the EMEP model as the model uses a lumped chemical mechanism with a limited number of VOCs representing the sum of a group of real, individual species. To model each individual species, one would need to include emissions and oxidation (normally by OH, O_3 and NO_3) of each species in the model. This is a task to be done. As a preliminary result we below show the model-measurement comparison for ethene. The lumped species ethene in the model represents the sum of ethene and various methyl-butenes, and ethene is by far the largest component of this group. So ethene in the model is close to representing the true ethene. Besides, ethene is a main component in traffic related emissions.

The results for ethene at Hohenpeissenberg in January and December 2005 are shown in Figure 18 as an example. Hohenpeissenberg was chosen as the site has daily VOC sampling, and the winter months were chosen as the diurnal cycle in concentrations due to local circulation is the least. As this exercise is regarded a preliminary example no further statistical evaluation of the results are included.

However, the time series plots indicate a fairly good agreement between modelled and measured values. Note that the model gives hourly values whereas the measurement data only has two values per day (noon and midnight). Many of the peaks and dips in the measured time series are reproduced by the model although the model during periods calculate higher concentrations than observed. These results are encouraging and suggest that a more detailed modelling study of individual VOCs should be carried out.

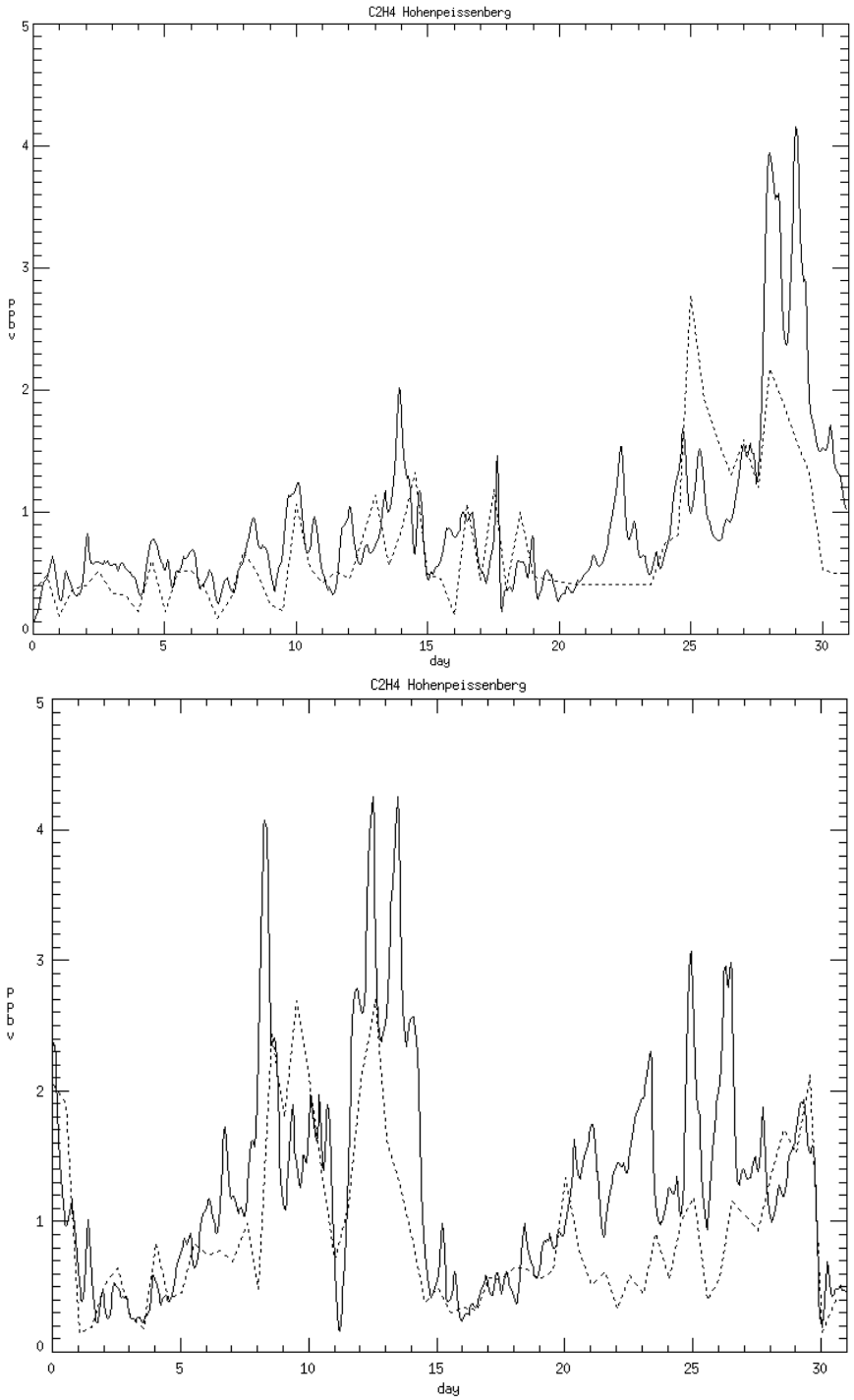

Figure 18: Measured (dotted line) and modelled (full line) of ethene at Hohenpeissenberg, in January (top) and December (bottom) 2005.

It should be mentioned, however, that the agreement was significantly poorer for other periods like e.g. the summer months. A model-measurement comparison for a mountain site like Hohenpeissenberg is not trivial due to significant vertical gradients in concentration. This will be much more evident in summer compared to winter due to the stronger vertical mixing in the warm season. Unfortunately both the two sites with daily/continuous VOC monitoring are located at mountain tops (Rigi and Hohenpeissenberg).

6. Acknowledgement

We would like to thank all people involved in the sampling and handling of hydrocarbon canisters and DNPH tubes. We are very grateful for the VOC measurement data provided by Patrice Coddeville (EMD), Christian Dye (NILU), Hannele Hakola (FMI), Radek Pokorny (CHMI), Marta Mitosinkova (SHMI), Alberto Gonzalez Ortiz (MMA), Karin Uhse (UBA), Christian Plass-Dülmer (DWD) and Stefan Reimann (EMPA). Thanks to David Simpson for discussions and assistance regarding the EMEP model.

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Appendix A

Monthly mean and median concentrations of hydrocarbons and carbonyls in 2005

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	2348	2825	2177	1939	1484	957	719	687	974	1193	1748	1950
	2423	2269	2110	2013	1489	937	718	702	858	1077	1607	1943
Utö	2673	3300	2325	2021	1478	916	697	708	818	1364	1806	2159
	2349	3006	2151	2025	1564	922	697	699	809	1097	1799	2158
Zingst	2165	3052	2253	1992	1416	1012	871	823	1083	1852	1944	2494
	1979	3123	2056	1959	1442	947	895	802	1057	1677	1710	2297
Neuglobsow	2174	3330	2153	1897	1391	1003	811	874	1003	1707	2378	2535
	2132	3551	2186	1932	1445	1067	782	789	979	1578	1740	2501
Waldhof	2273	3191	2302	1886	1398	1068	828	1005	1060	1808	2074	2381
	2240	3051	2349	1941	1406	1112	809	852	1061	1535	1664	2347
Schmücke	2335	2730	2205	1850	1366	1059	902	956	1019	1475	2250	2263
	2404	2772	2198	1764	1386	1112	871	904	972	1329	2559	2024
Schauinsland	2030	2562	1874	1884	1480	1092	873	914	919	1261	1883	1946
	2170	2353	1754	1898	1395	1061	781	860	860	1163	2075	1801
Hohenpeissenberg	2000	2749	2145	2004	1343	982	742	841	887	1343	1651	2009
	1997	2288	2083	1991	1305	1013	767	804	881	1279	1632	2028
Starina	2965	3401	2508	2525	1579	966	1141	1130	1582	1759	2299	3074
	2752	3257	2312	2432	1552	865	1203	1179	1206	1519	1887	3117
Košetice	2309	2861	2496	1955	1313	941	760	846	1029	1937	2022	2005
	2312	2440	2239	1984	1320	951	750	804	968	2157	1804	2165
Rigi	1698	1928	2501	2066	1628	1287	-	1189	1352	1624	1870	2962
	1596	1920	2205	2040	1541	1304	-	1172	1329	1549	1827	2869
La Tardière	2377	2854	2244	2013	1561	877	640	758	893	1359	2130	2711
	2505	2625	2120	1980	1550	780	680	710	880	1310	2075	2420
Donon	2329	2945	2349	2138	1596	1014	852	1032	974	1650	2119	2199
	2170	2670	2400	2010	1840	1030	850	830	955	1470	2205	2210
Peyrusse Vieille	-	2745	2170	1946	1768	810	660	853	942	1400	2054	-
	-	2720	2170	1930	1640	740	720	885	920	1470	1770	-

ETHENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	548	423	138	76	53	77	85	102	105	189	347	331
	442	172	109	69	39	68	91	95	88	104	231	359
Utö	675	644	348	181	152	144	193	114	112	410	441	558
	560	778	213	168	131	74	129	112	98	180	342	563
Zingst	807	1214	636	394	275	176	272	336	376	865	1006	929
	684	1080	519	382	232	175	218	324	394	850	643	809
Neuglobsow	723	1455	613	348	290	280	235	225	304	771	1497	1055
	524	1362	527	330	269	220	212	174	270	796	1241	937
Waldhof	702	1315	684	362	259	288	219	312	312	735	961	934
	611	966	648	346	224	223	200	227	276	620	678	1040
Schmücke	1023	942	668	332	184	246	211	247	289	428	1650	901
	864	684	651	187	155	218	181	231	297	344	1633	757
Schauinsland	482	738	463	436	376	214	299	345	268	449	704	708
	501	652	425	467	284	206	322	348	281	477	503	519
Hohenpeissenberg	747	963	660	462	265	173	134	214	267	583	788	934
	513	1002	540	417	194	121	133	152	241	533	597	701
Starina	1139	1052	458	520	244	139	322	310	294	425	920	2035
	1083	1156	401	444	232	117	300	227	315	362	667	1820
Košetice	1239	1176	870	390	181	141	149	259	268	699	1500	1146
	835	1088	579	396	139	122	139	157	235	357	987	1122
Rigi	524	446	553	374	237	180	230	379	371	665	556	847
	366	352	387	327	192	164	230	310	316	530	432	777
La Tardière	1147	961	660	354	254	217	129	288	312	589	1471	1764
	1100	845	410	310	210	220	130	225	270	540	1280	1290
Donon	976	1110	916	523	426	286	450	658	381	772	1298	1134
	850	1140	800	475	340	280	320	590	380	660	1170	985
Peyrusse Vieille	-	795	415	310	333	181	189	260	274	403	822	-
	-	780	420	310	305	160	170	255	220	410	800	-

PROPANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	1238	1445	887	569	306	123	105	143	246	411	755	923
	1320	1026	868	654	260	115	75	138	165	354	647	879
Utö	1410	1707	919	626	364	104	148	130	217	508	858	969
	1249	1572	836	686	277	95	129	112	183	372	806	967
Zingst	1067	1467	1053	646	347	238	267	255	415	818	975	1263
	950	1480	848	615	303	196	252	256	399	919	717	1095
Neuglobsow	1046	1556	939	586	312	194	255	278	389	788	1257	1295
	1051	1532	891	612	270	175	244	259	387	757	861	1274
Waldhof	1071	1498	983	637	306	260	250	398	424	777	1177	1217
	1096	1461	1035	593	287	210	273	320	375	699	836	1177
Schmücke	1175	1336	905	579	378	331	214	412	458	648	1195	1118
	1159	1291	905	571	374	384	208	381	413	573	1284	992
Schauinsland	894	1199	684	538	488	219	214	299	311	446	789	835
	978	1046	610	573	324	183	201	261	253	419	918	765
Hohenpeissenberg	927	1316	850	631	260	196	172	287	334	572	734	949
	922	1103	765	616	213	177	162	266	296	549	741	950
Starina	1468	1793	1195	936	518	333	464	493	866	831	1164	1571
	1481	1488	1109	886	512	333	413	452	659	797	1097	1447
Košetice	1132	1355	978	623	283	188	184	263	365	763	908	1002
	1173	1159	920	623	295	172	170	222	345	756	798	1056
Rigi	813	758	744	605	334	266	-	286	162	487	557	1141
	709	713	662	611	299	248	-	274	145	445	525	1074
La Tardière	1280	1468	837	519	348	207	134	208	312	539	1154	1534
	1400	1395	710	525	320	210	80	180	260	500	1000	1210
Donon	1117	1420	944	611	420	267	190	449	358	789	950	1040
	1010	1265	830	520	390	250	210	235	325	640	1010	1030
Peyrusse Vieille	-	-	1002	666	638	304	325	443	692	856	1276	-
	-	-	1125	540	760	240	210	390	680	840	1180	-

PROPENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	45	36	25	22	25	29	30	52	51	57	53	34
	35	26	23	24	22	29	31	48	40	55	50	33
Utö	77	57	38	41	36	64	42	35	36	88	77	79
	68	57	31	41	29	36	41	35	34	70	66	70
Zingst	206	194	212	129	158	103	109	121	114	171	244	279
	161	178	184	132	105	86	106	118	110	153	222	274
Neuglobsow	150	189	181	115	125	104	101	100	97	171	299	253
	139	156	145	113	127	96	102	83	93	182	261	295
Waldhof	160	248	191	113	123	119	100	90	101	148	267	213
	144	175	208	113	119	133	104	77	104	150	181	186
Schmücke	244	325	155	107	110	99	136	117	100	124	538	255
	177	131	155	90	114	91	144	117	97	128	369	235
Schauinsland	136	154	259	143	135	90	164	108	101	162	325	225
	140	141	150	148	128	82	201	107	97	167	175	194
Hohenpeissenberg	96	116	84	79	20	20	22	25	30	66	96	117
	81	115	66	73	17	18	20	19	23	55	81	88
Starina	257	207	80	111	76	86	107	145	-	68	607	312
	213	216	78	110	58	74	88	76	-	61	461	311
Košetice	195	131	94	52	25	23	25	38	36	65	200	139
	168	122	58	49	23	23	23	29	35	35	157	110
Rigi	82	83	70	75	64	34	-	91	99	153	142	163
	71	66	61	65	52	25	-	81	77	128	112	147
La Tardière	217	173	109	79	50	58	47	77	84	137	304	329
	185	140	90	70	40	60	50	70	70	120	225	260
Donon	180	163	137	106	72	68	146	113	71	129	193	189
	110	125	150	80	40	70	80	70	60	110	160	175
Peyrusse Vieille	-	123	60	49	65	46	70	55	84	83	132	-
	-	125	60	50	55	40	60	55	50	70	170	-

ETHYNE (ACETYLENE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	756	792	539	372	176	74	67	115	136	213	369	432
	836	637	525	371	188	53	63	71	87	137	295	437
Utö	998	1034	769	436	259	98	226	90	121	327	365	465
	796	1101	570	414	228	92	275	92	88	174	314	495
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	739	1161	808	556	264	168	147	218	290	537	650	746
	562	905	677	559	237	163	142	198	242	511	569	630
Starina	2495	2343	1495	1267	630	323	512	408	2084	932	400	2574
	2279	2458	1383	1273	654	317	363	359	1943	828	239	2256
Košetice	1159	1577	1438	770	333	226	207	276	433	958	1275	943
	839	1268	1099	806	292	207	217	198	358	754	1018	905
Rigi	777	687	780	575	353	257	-	446	509	731	545	684
	609	642	627	559	312	244	-	433	487	647	476	645
La Tardière	778	854	562	373	304	139	90	109	168	367	726	940
	790	815	480	355	250	130	70	90	160	350	660	760
Donon	709	943	778	530	344	186	321	183	274	557	679	668
	590	825	630	525	330	180	180	150	235	500	545	615
Peyrusse Vieille	-	903	487	379	275	237	88	175	222	331	544	-
	-	815	435	330	250	110	75	140	220	360	490	-

BUTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	448	414	216	124	65	33	24	33	66	146	291	350
	490	280	207	134	52	30	21	38	35	130	244	334
Utö	493	516	244	159	98	31	54	35	80	208	341	378
	428	506	202	167	70	30	33	34	71	138	310	371
Zingst	441	614	600	237	183	101	120	141	180	327	402	584
	399	590	424	225	176	98	103	136	174	330	341	471
Neuglobsow	439	629	472	243	158	78	132	134	170	338	547	504
	449	653	440	223	95	82	122	112	153	324	412	498
Waldhof	463	634	403	290	128	119	163	200	162	349	562	505
	459	686	433	229	131	103	126	142	122	338	368	529
Schmücke	552	535	375	258	241	132	149	156	148	228	556	468
	532	524	368	216	132	142	138	138	139	237	592	414
Schauinsland	353	500	361	244	216	118	127	194	150	211	373	303
	391	404	295	250	175	82	117	188	128	213	387	273
Hohenpeissenberg	358	519	324	209	91	90	80	120	130	236	322	385
	348	468	276	202	84	83	72	114	119	222	308	360
Starina	621	729	419	335	190	143	219	201	371	200	443	654
	624	562	384	312	176	138	176	185	284	172	476	556
Košetice	442	517	327	195	89	69	73	106	151	303	369	405
	456	439	291	186	76	59	72	89	156	274	302	443
Rigi	354	334	336	255	199	161	-	284	266	378	415	633
	311	291	305	244	182	153	-	264	252	315	382	624
La Tardière	552	578	299	171	132	97	68	97	123	232	501	604
	555	545	220	155	110	100	50	80	110	230	390	480
Donon	451	576	477	208	180	133	86	514	181	481	388	465
	400	500	360	170	120	120	90	110	215	440	400	415
Peyrusse Vieille	-	-	372	217	248	110	125	182	238	300	484	-
	-	-	400	170	260	60	75	165	240	280	430	-

ISOBUTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	278	287	149	90	37	18	19	26	46	99	171	211
	296	202	143	91	32	16	13	23	33	78	137	206
Utö	386	358	163	96	56	16	50	24	54	133	204	232
	289	348	136	109	36	15	30	18	56	90	180	232
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	202	288	183	120	51	49	46	75	78	153	183	214
	186	261	166	117	45	46	43	67	70	144	176	193
Starina	385	432	245	203	117	92	141	129	211	258	281	428
	374	340	225	192	116	85	115	130	150	246	268	331
Košetice	259	310	208	127	60	42	49	73	81	190	233	264
	274	266	173	120	55	38	46	84	76	181	181	257
Rigi	219	203	197	154	107	63	-	182	168	224	244	361
	181	183	181	150	97	60	-	172	161	205	224	353
La Tardière	315	628	186	75	57	57	25	48	57	214	259	313
	280	290	190	65	50	50	15	40	40	110	185	270
Donon	244	371	390	121	104	90	57	106	106	434	251	319
	210	335	220	110	60	70	50	75	115	370	245	230
Peyrusse Vieille	-	-	267	110	128	67	79	107	172	206	300	-
	-	-	255	60	130	40	35	90	160	200	270	-

BUTENES

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Starina	90	69	48	43	37	49	55	55	64	57	56	73
	58	70	41	42	38	40	52	38	64	48	57	70
Košetice	135	117	110	70	36	33	31	28	28	33	65	65
	83	83	55	59	35	35	31	26	26	22	63	61
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardière	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

BUT_1_ENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	12	11	10	12	13	12	12	14	5	8	5	4
	12	10	11	12	13	12	13	13	4	9	4	4
Utö	16	15	13	15	14	19	15	12	4	11	11	10
	13	15	12	13	13	12	15	13	4	13	11	10
Zingst	33	34	38	32	32	33	28	34	25	31	39	33
	31	30	34	31	29	30	26	34	24	31	38	31
Neuglobsow	29	27	28	28	39	30	26	28	29	31	44	37
	25	25	25	29	33	28	27	23	24	33	42	39
Waldhof	28	31	26	28	38	32	30	32	22	25	38	37
	26	23	28	26	32	30	27	29	24	25	36	39
Schmücke	38	31	24	28	44	35	27	29	23	23	51	38
	38	22	19	24	45	34	25	29	23	23	51	34
Schauinsland	22	30	32	37	43	32	33	30	21	25	34	32
	19	32	27	37	35	30	30	32	23	26	27	29
Hohenpeissenberg	17	21	16	12	6	7	6	8	8	14	19	22
	14	19	12	10	6	6	6	7	6	13	15	17
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardière	40	36	29	20	19	22	21	29	33	37	53	57
	35	30	30	20	20	20	20	30	30	30	40	50
Donon	37	39	27	33	30	30	41	40	43	34	39	34
	30	30	20	20	20	30	30	30	35	30	35	30
Peyrusse Vieille	-	24	14	21	18	16	19	18	18	17	32	-
	-	30	15	20	20	10	10	20	20	20	30	-

TRANS_2_BUTENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	7	8	8	8	5	8	8	11	6	12	11	15
	5	8	8	7	5	10	7	9	5	12	10	17
Utö	7	7	8	11	10	8	10	12	5	10	13	15
	5	5	10	12	11	5	10	12	5	12	15	15
Zingst	8	12	19	15	15	8	9	9	5	5	7	3
	8	12	16	14	12	7	9	7	4	4	7	3
Neuglobsow	5	6	16	15	16	7	7	6	6	5	6	4
	5	5	13	15	11	7	7	7	5	5	4	4
Waldhof	6	7	10	14	14	5	9	5	4	3	7	7
	6	6	9	14	12	5	6	5	4	3	6	6
Schmücke	8	9	13	16	23	8	8	9	4	5	9	6
	9	11	12	17	11	8	7	8	4	4	8	6
Schauinsland	6	11	14	15	16	5	9	8	5	5	6	4
	5	10	12	15	15	5	9	7	5	5	4	4
Hohenpeissenberg	8	-	-	-	-	-	-	-	-	-	-	-
	7	-	-	-	-	-	-	-	-	-	-	-
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardière	11	6	6	6	5	5	5	5	6	8	19	12
	8	5	5	5	5	5	5	5	5	5	8	10
Donon	10	18	7	9	14	9	6	9	29	12	7	6
	5	5	5	5	5	5	5	5	8	5	5	5
Peyrusse Vieille	-	6	6	5	5	5	5	5	5	5	7	-
	-	5	5	5	5	5	5	5	5	5	5	-

CIS_2_BUTENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	5	5	4	4	4	4	4	4	4	4	4	4
	4	4	4	4	4	4	4	4	4	4	4	4
Utö	4	4	4	4	6	5	6	4	4	4	4	4
	4	4	4	4	4	4	4	4	4	4	4	4
Zingst	6	6	14	12	13	7	6	11	5	6	8	5
	6	6	10	12	11	6	6	9	6	6	7	5
Neuglobsow	5	5	10	12	13	7	7	7	7	5	8	5
	5	4	9	13	11	8	8	6	7	5	6	5
Waldhof	6	7	9	12	12	6	10	9	5	5	11	6
	6	6	9	11	9	5	8	8	4	4	10	7
Schmücke	8	8	10	13	17	10	9	12	5	6	10	7
	8	8	10	14	9	9	8	9	5	5	8	6
Schauinsland	4	8	11	13	12	6	8	12	4	5	8	7
	4	7	10	12	12	6	8	7	5	5	6	7
Hohenpeissenberg	6	10	7	5	3	3	3	4	4	6	6	7
	6	10	6	5	3	3	3	4	3	5	5	5
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardière	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

PENTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	163	144	64	34	19	15	18	20	22	47	108	118
	162	96	64	36	15	13	18	16	17	39	78	109
Utö	190	200	79	49	39	12	29	17	40	67	111	120
	147	198	58	52	31	12	25	14	39	47	87	105
Zingst	147	191	153	80	82	58	50	101	87	124	129	153
	130	197	135	76	75	42	50	80	79	125	135	120
Neuglobsow	154	212	135	84	72	43	64	54	74	117	187	153
	149	221	135	70	45	35	68	49	65	115	149	132
Waldhof	155	200	169	94	63	59	71	82	72	125	223	150
	133	204	112	91	58	46	64	73	56	117	129	139
Schmücke	182	192	130	102	128	91	102	106	92	93	216	135
	172	172	124	86	84	84	97	110	89	101	203	126
Schauinsland	122	163	97	88	97	60	68	90	72	88	114	82
	111	118	101	88	71	42	62	81	71	92	101	76
Hohenpeissenberg	106	159	91	77	53	52	43	64	67	130	130	122
	97	153	88	62	36	52	35	58	58	113	112	109
Starina	375	311	177	170	121	140	268	208	245	199	205	282
	327	255	171	149	120	123	229	164	130	167	217	232
Košetice	145	165	103	82	45	37	38	53	66	127	162	149
	146	139	78	70	41	31	34	41	65	116	112	153
Rigi	119	111	126	132	157	136	179	205	203	313	235	226
	100	94	97	110	124	100	161	171	162	235	176	206
La Tardière	180	318	220	114	116	131	120	97	119	124	173	192
	180	270	130	85	110	90	110	100	90	120	145	170
Donon	152	171	126	69	66	49	46	83	76	191	165	143
	130	155	100	55	50	50	50	50	70	170	130	155
Peyrusse Vieille	-	-	80	61	96	47	45	63	80	253	150	-
	-	-	110	50	70	30	30	65	70	100	130	-

ISOPENTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	208	185	90	78	29	20	22	30	37	72	124	153
	206	125	87	64	26	19	24	26	22	55	93	141
Utö	244	257	141	75	60	23	62	33	66	99	147	164
	227	296	89	68	52	21	50	27	62	83	140	163
Zingst	212	251	246	127	106	87	110	160	162	200	199	225
	183	269	185	124	95	63	86	112	139	262	161	210
Neuglobsow	227	283	236	139	114	86	111	91	114	201	309	234
	205	280	224	110	79	72	111	88	95	178	274	224
Waldhof	204	281	192	138	77	96	123	116	110	212	299	221
	164	267	187	113	76	89	91	98	79	211	231	241
Schmücke	269	280	196	147	193	116	141	145	134	143	350	199
	246	257	219	129	130	116	134	138	122	138	293	176
Schauinsland	171	227	205	166	164	114	139	183	142	163	190	125
	152	170	185	184	134	63	126	165	127	179	159	111
Hohenpeissenberg	172	252	184	149	105	109	104	147	163	256	225	210
	158	231	168	141	90	107	97	139	144	245	182	192
Starina	452	457	543	458	487	640	739	160	311	209	257	398
	439	441	571	441	458	668	712	94	166	175	232	396
Košetice	223	243	161	118	79	63	74	94	111	179	208	209
	224	211	133	104	75	58	73	71	105	153	143	224
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardière	365	350	240	134	142	126	73	106	112	197	298	347
	285	285	190	125	120	120	70	100	100	170	255	290
Donon	223	248	219	123	138	110	89	150	163	298	221	193
	190	225	150	100	100	100	80	110	165	300	205	190
Peyrusse Vieille	-	-	426	239	386	266	243	257	474	440	522	-
	-	-	280	100	180	110	65	225	430	420	570	-

HEXANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	58	52	21	12	7	6	6	7	10	14	30	38
	56	36	20	13	8	7	8	5	3	11	22	37
Utö	66	69	26	14	11	6	15	8	9	18	34	48
	43	65	22	14	10	5	11	8	10	11	37	50
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	35	46	25	17	10	11	10	14	14	26	29	33
	32	45	22	13	9	10	9	13	13	23	25	29
Starina	137	141	72	100	24	114	76	99	129	109	114	145
	151	122	34	66	21	126	70	127	95	66	81	94
Košetice	38	50	34	20	11	7	9	15	19	40	40	37
	37	53	21	17	9	9	9	14	17	37	30	37
Rigi	36	32	33	36	35	23	-	35	31	36	42	64
	31	26	27	31	29	18	-	32	27	32	40	60
La Tardière	65	70	40	24	26	27	24	32	32	34	55	71
	65	60	40	25	20	30	20	20	30	40	40	70
Donon	58	68	50	33	30	26	23	63	48	64	59	56
	50	60	50	30	20	20	20	50	50	70	45	55
Peyrusse Vieille	-	85	36	33	63	23	23	38	43	66	50	-
	-	60	40	30	50	20	20	40	40	60	40	-

ISOPRENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	10	16	6	11	9	48	75	41	8	9	10	9
	9	9	4	11	4	39	68	44	4	4	9	4
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	4	3	5	12	39	63	54	28	26	15	7	5
	2	3	3	9	20	25	20	14	13	12	5	4
Starina	10	11	6	13	19	331	479	405	157	52	27	23
	5	6	5	6	11	287	386	378	73	42	24	20
Košetice	22	6	12	7	58	41	117	44	66	12	7	6
	4	4	5	4	14	40	49	40	36	7	7	7
Rigi	15	14	21	19	263	228	-	105	102	68	11	17
	10	10	15	14	124	86	-	90	80	62	8	14
La Tardière	12	9	6	11	139	524	489	309	214	72	20	11
	10	8	5	10	70	290	395	360	180	70	25	10
Donon	24	21	62	78	740	1124	1233	838	828	264	89	27
	20	5	70	55	150	780	660	745	480	230	55	20
Peyrusse Vieille	-	21	62	56	498	2150	1335	818	486	251	64	-
	-	20	60	10	295	1310	910	870	380	220	30	-

BENZENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	244	234	161	129	86	51	62	36	61	80	141	149
	217	160	152	129	89	47	48	33	45	59	110	153
Utö	264	307	239	150	101	57	52	43	55	131	149	183
	256	305	193	139	90	46	57	37	44	66	128	170
Zingst	194	335	203	116	84	51	63	79	100	222	292	240
	179	332	186	119	75	43	59	81	94	194	263	211
Neuglobsow	187	467	215	117	74	52	57	72	98	201	291	249
	164	382	197	99	73	47	49	65	91	222	226	207
Waldhof	208	368	238	137	84	46	61	96	101	201	199	221
	163	214	237	127	79	37	66	80	102	210	150	225
Schmücke	224	289	247	129	75	73	74	107	120	155	319	213
	200	301	245	121	80	80	74	92	100	169	308	187
Schauinsland	176	274	169	144	99	61	60	90	100	116	185	170
	157	224	142	141	88	52	50	88	80	105	190	134
Hohenpeissenberg	215	351	255	182	83	61	51	79	101	155	196	222
	167	295	217	174	75	57	49	74	86	148	169	192
Starina	514	567	343	312	150	131	182	163	487	274	406	670
	538	551	274	337	142	96	134	138	313	311	421	596
Košetice	226	245	244	126	48	34	37	45	66	134	197	176
	188	223	184	118	44	38	33	44	66	97	160	154
Rigi	260	202	270	271	132	109	-	177	169	232	224	392
	194	192	212	262	121	105	-	176	162	213	194	374
La Tardière	248	259	167	105	73	54	40	47	60	116	223	283
	255	245	140	100	60	50	35	40	60	100	195	230
Donon	211	285	210	133	84	60	77	100	83	153	204	203
	170	240	180	140	70	60	70	75	75	130	195	190
Peyrusse Vieille	-	218	135	90	77	41	35	38	56	87	154	-
	-	220	120	80	65	40	30	35	50	100	140	-

TOLUENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	156	130	431	63	78	74	116	86	97	155	153	160
	158	104	408	60	77	62	112	103	90	159	137	169
Neuglobsow	116	183	358	89	71	115	200	102	71	165	285	171
	93	178	287	42	72	62	108	91	82	175	220	159
Waldhof	163	-	78	78	62	70	121	106	90	184	209	157
	102	-	66	87	68	52	95	100	76	171	169	81
Schmücke	200	137	132	90	89	87	75	132	125	114	262	155
	157	142	91	87	94	93	76	140	101	115	256	153
Schauinsland	185	105	162	108	181	108	109	122	115	110	176	96
	154	111	111	143	136	107	100	152	114	110	125	73
Hohenpeissenberg	145	196	168	114	67	68	67	84	102	171	171	167
	117	168	134	97	59	62	61	77	91	152	142	150
Starina	114	97	79	151	13	105	68	73	156	116	68	71
	36	40	20	85	10	29	14	13	89	39	21	31
Košetice	168	157	88	63	32	29	32	37	43	104	121	113
	141	158	65	55	32	27	27	24	37	88	93	128
Rigi	154	153	217	193	224	188	-	376	206	315	327	351
	131	110	167	174	199	164	-	351	174	235	227	313
La Tardière	263	246	172	109	111	116	60	57	113	200	310	343
	215	220	140	90	80	100	65	50	80	160	250	340
Donon	158	166	174	76	100	76	69	103	110	202	151	148
	120	140	130	70	70	60	50	70	105	190	140	120
Peyrusse Vieille	-	193	165	71	90	41	45	60	80	100	152	-
	-	145	105	60	80	30	45	65	90	110	150	-

ETHYLBENZENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	24	34	27	18	11	10	11	13	16	28	28	28
	19	35	21	15	9	10	10	11	14	24	24	23
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	24	27	13	10	8	5	6	9	10	19	24	21
	23	22	10	9	9	5	5	7	9	14	17	21
Rigi	30	22	34	30	33	23	-	29	34	44	76	57
	27	17	27	27	28	19	-	27	31	41	64	49
La Tardière	43	39	36	28	22	23	14	13	24	40	50	51
	40	40	30	20	20	20	10	10	20	30	40	50
Donon	27	30	27	11	15	12	12	18	27	35	25	26
	20	25	20	10	10	5	10	10	30	40	25	20
Peyrusse Vieille	-	45	18	9	16	9	11	8	13	17	24	-
	-	25	20	5	15	5	8	10	10	20	30	-

m+p-XYLENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	49	66	18	31	24	42	79	-	90	-	36	-
	37	51	15	25	10	26	53	-	60	-	21	-
Neuglobsow	-	-	32	47	-	26	29	-	83	-	-	-
	-	-	26	48	-	30	24	-	86	-	-	-
Waldhof	-	35	-	48	21	21	22	-	54	-	51	57
	-	36	-	63	17	16	20	-	17	-	52	48
Schmücke	-	52	50	-	-	-	46	-	33	61	-	21
	-	34	47	-	-	-	42	-	18	66	-	14
Schauinsland	-	61	-	33	17	-	62	-	-	55	-	-
	-	62	-	19	16	-	53	-	-	47	-	-
Hohenpeissenberg	54	70	56	37	19	21	19	26	31	65	67	68
	45	63	42	27	17	15	15	21	23	56	55	54
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	56	68	20	18	17	9	15	22	24	40	47	48
	63	61	17	16	12	9	13	16	19	23	34	49
Rigi	53	43	65	59	69	40	-	67	69	106	194	167
	50	29	50	51	58	29	-	64	62	81	145	137
La Tardière	127	96	101	86	63	77	49	46	64	111	155	133
	105	85	90	65	50	80	50	50	60	100	120	140
Donon	61	54	53	33	30	29	47	39	39	73	68	63
	50	50	40	30	20	20	40	30	40	70	55	50
Peyrusse Vieille	-	-	43	23	40	21	21	28	38	34	58	-
	-	-	30	20	30	20	25	25	40	30	50	-

o-XYLENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	24	13	-	-	15	-	-	-	-	-	-
	-	19	12	-	-	13	-	-	-	-	-	-
Neuglobsow	-	-	14	12	-	12	9	-	-	-	-	-
	-	-	13	11	-	13	6	-	-	-	-	-
Waldhof	-	14	-	19	-	-	-	-	-	-	-	-
	-	12	-	18	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	25	-	-	-	-	20	-	-	-	-	-
	-	22	-	-	-	-	15	-	-	-	-	-
Hohenpeissenberg	21	28	23	15	9	10	11	12	13	26	27	26
	17	27	16	11	8	8	9	10	11	22	23	22
Starina	552	371	244	388	147	407	440	341	613	241	270	429
	424	404	163	270	139	300	377	200	391	189	233	362
Kosetice	-	-	-	-	-	-	-	-	-	-	-	26
	-	-	-	-	-	-	-	-	-	-	-	24
Rigi	23	18	29	26	31	22	-	37	45	57	118	93
	20	13	23	22	28	19	-	33	39	47	103	71
La Tardière	-	-	-	-	-	-	-	-	-	-	50	47
	-	-	-	-	-	-	-	-	-	-	30	50
Donon	-	-	-	-	-	-	-	-	-	-	30	23
	-	-	-	-	-	-	-	-	-	-	30	20
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	19	-
	-	-	-	-	-	-	-	-	-	-	20	-

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
Birkenes	0.298	0.403	0.730	0.737	0.608	0.903	1.280	0.766	0.618	0.544	0.280	0.238
	0.270	0.390	0.535	0.675	0.590	0.890	1.090	0.720	0.540	0.570	0.245	0.180
Utö	0.585	1.338	1.230	1.827	1.917	0.775	1.416	1.788	1.186	0.788	0.412	0.257
	0.650	1.350	1.110	1.565	1.380	0.490	1.360	1.450	1.245	0.590	0.330	0.230
Košetice	0.697	0.930	1.426	1.491	1.455	1.625	1.812	1.371	1.475	1.422	0.938	0.721
	0.580	0.800	1.300	1.480	1.090	1.540	1.655	1.450	1.320	1.560	0.965	0.720
La Tardière	0.884	0.944	1.330	0.896	1.286	1.974	2.251	2.497	1.656	1.279	0.993	0.943
	0.916	0.926	1.070	0.930	1.401	2.131	2.207	2.216	1.775	1.164	0.995	0.974
Donon	1.961	2.666	1.094	0.823	1.352	-	1.743	1.218	1.412	1.209	-	0.681
	1.129	2.146	0.822	0.695	1.473	-	1.483	1.256	1.577	1.159	-	0.577
Peyrusse Vieille	0.842	1.060	1.095	1.103	1.365	1.550	1.426	1.329	1.186	1.201	0.829	0.961
	0.800	1.034	1.320	1.132	1.228	1.185	1.588	1.379	1.269	1.062	0.724	1.031
Campisábalos	0.377	0.273	0.590	0.540	0.885	1.195	1.043	0.927	0.364	0.593	0.398	0.437
	0.330	0.255	0.585	0.500	0.820	1.190	0.865	0.830	0.340	0.520	0.400	0.360

ETHANAL (ACETALDEHYDE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.372	0.453	1.463	1.331	0.581	1.041	1.855	0.916	0.691	0.922	0.432	0.356
	0.275	0.435	0.920	1.020	0.540	1.010	1.690	1.040	0.660	0.690	0.400	0.310
Utö	0.785	1.522	1.685	2.922	4.874	1.380	2.090	4.627	2.532	0.653	0.500	0.411
	0.590	1.340	1.640	2.040	2.320	1.060	2.070	2.420	2.430	0.610	0.500	0.415
Košetice	0.915	1.356	1.415	1.577	1.797	1.062	1.926	1.528	1.824	1.353	1.035	0.803
	0.830	1.110	1.210	1.475	1.320	1.060	1.245	1.210	1.490	1.450	1.035	0.790
La Tardière	0.774	0.787	1.165	0.532	0.775	1.071	0.861	0.972	0.894	1.096	0.834	0.809
	0.797	0.855	1.070	0.524	0.794	1.088	0.780	0.859	0.959	1.248	0.834	0.799
Donon	-	1.004	0.655	0.486	0.673	-	0.589	0.677	0.687	0.911	-	0.729
	-	0.906	0.568	0.437	0.649	-	0.449	0.610	0.727	0.935	-	0.726
Peyrusse Vieille	0.758	0.892	0.875	0.583	0.638	0.799	0.629	0.579	0.557	0.789	0.591	0.845
	0.610	0.884	0.937	0.634	0.633	0.680	0.494	0.528	0.590	0.753	0.521	0.981
Campisábalos	0.283	0.311	0.498	0.670	0.726	0.681	0.956	0.941	0.711	1.438	1.202	1.004
	0.230	0.260	0.445	0.680	0.750	0.660	0.960	0.940	0.640	1.310	1.130	1.040

PROPANONE (ACETONE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	1.327	1.593	2.903	4.247	2.895	3.756	5.001	3.415	2.743	2.387	0.891	0.824
	1.325	1.525	2.935	4.560	2.960	3.970	5.460	3.430	2.655	2.170	0.895	0.830
Utö	2.077	2.728	3.615	3.963	4.856	1.701	2.680	3.336	2.570	1.021	0.611	0.621
	2.130	2.855	2.910	3.360	2.970	1.720	2.160	2.390	2.490	1.030	0.615	0.600
Košetice	1.833	2.568	3.322	3.540	3.024	2.745	2.677	2.357	2.890	2.807	1.720	1.150
	1.740	2.230	3.585	3.720	3.430	2.690	2.750	2.170	2.860	3.000	1.635	1.140
La Tardière	1.220	1.383	2.163	2.108	2.484	2.712	2.989	2.864	3.130	2.229	1.766	1.226
	1.259	1.246	1.769	2.109	2.896	2.700	2.702	2.385	3.111	2.446	1.603	1.244
Donon	0.858	1.673	1.663	1.680	2.481	-	2.784	3.053	3.273	2.962	-	0.878
	0.859	1.685	1.177	1.648	2.334	-	1.965	2.687	3.222	2.604	-	0.883
Peyrusse Vieille	1.099	1.366	2.064	1.795	2.497	1.941	2.287	1.720	2.173	1.693	1.689	1.414
	0.970	1.285	1.944	1.912	2.322	1.966	1.950	1.503	1.957	1.626	1.670	1.521
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

PROPANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.013	0.062	0.266	0.103	0.052	0.116	0.196	0.081	0.068	0.131	0.048	0.033
	0.010	0.065	0.110	0.090	0.050	0.110	0.160	0.070	0.070	0.070	0.050	0.010
Utö	0.068	0.213	0.186	0.586	1.341	0.203	0.290	1.522	0.617	0.090	0.081	0.042
	0.070	0.165	0.180	0.360	0.380	0.130	0.220	0.630	0.645	0.100	0.080	0.050
Košetice	0.125	0.166	0.200	0.155	0.242	0.175	0.318	0.263	0.283	0.218	0.127	0.124
	0.110	0.155	0.150	0.140	0.160	0.160	0.205	0.230	0.240	0.210	0.140	0.130
La Tardière	0.111	0.118	0.173	0.106	0.155	0.213	0.099	0.103	0.095	0.126	0.129	0.156
	0.122	0.114	0.173	0.106	0.151	0.220	0.092	0.094	0.099	0.123	0.140	0.155
Donon	0.096	0.157	0.102	0.095	0.107	-	0.039	0.046	0.060	0.096	-	0.123
	0.110	0.132	0.095	0.083	0.087	-	0.016	0.016	0.065	0.105	-	0.118
Peyrusse Vieille	0.117	0.138	0.140	0.090	0.096	0.094	0.049	0.049	0.038	0.078	0.124	0.152
	0.096	0.133	0.133	0.091	0.089	0.056	0.035	0.030	0.034	0.077	0.102	0.176
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

2-PROPENAL (ACROLEIN)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.010	0.010	0.011	0.010	0.010	0.010	-	0.010	0.010	0.011	0.010	0.010
	0.010	0.010	0.010	0.010	0.010	0.010	-	0.010	0.010	0.010	0.010	0.010
Utö	0.010	0.010	0.015	0.010	0.030	0.014	0.010	0.010	0.032	0.014	0.010	0.010
	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Košetice	0.020	0.021	0.022	0.015	0.021	0.012	0.010	-	0.010	0.036	0.031	0.041
	0.010	0.010	0.010	0.010	0.020	0.010	0.010	-	0.010	0.030	0.015	0.040
La Tardière	0.016	0.016	0.015	0.019	0.016	0.015	0.016	0.016	0.015	0.016	0.015	0.017
	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.015
Donon	0.022	0.016	0.016	0.015	0.016	-	0.015	0.015	0.016	0.016	-	0.016
	0.018	0.016	0.016	0.016	0.016	-	0.016	0.015	0.016	0.016	-	0.016
Peyrusse Vieille	0.016	0.015	0.016	0.016	0.016	0.023	0.017	0.016	0.015	0.015	0.016	0.015
	0.016	0.016	0.016	0.016	0.016	0.017	0.017	0.016	0.015	0.015	0.015	0.016
Campisábalos	0.025	0.044	0.172	0.285	0.190	0.115	0.247	0.254	0.070	0.361	0.328	0.232
	0.025	0.025	0.170	0.270	0.180	0.130	0.245	0.270	0.070	0.370	0.310	0.230

2-BUTANONE (METHYLETHYLKETONE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.095	0.422	0.461	0.274	0.211	0.365	0.245	0.146	0.235	0.513	0.112	0.123
	0.115	0.340	0.370	0.325	0.200	0.270	0.240	0.130	0.180	0.470	0.077	0.130
Utö	0.337	0.805	0.714	0.595	1.227	0.261	0.212	0.470	0.393	0.226	0.161	0.120
	0.420	0.805	0.750	0.520	0.780	0.270	0.150	0.265	0.385	0.280	0.155	0.135
Košetice	0.207	0.705	0.780	0.491	0.560	0.502	0.420	0.370	0.747	1.014	0.466	0.297
	0.220	0.620	0.710	0.515	0.350	0.280	0.355	0.400	0.590	1.030	0.450	0.290
La Tardière	0.390	0.483	0.700	0.372	0.510	0.492	0.417	0.289	0.696	0.561	0.450	0.384
	0.434	0.524	0.470	0.375	0.562	0.465	0.439	0.261	0.682	0.589	0.508	0.380
Donon	0.348	0.562	0.326	0.295	0.311	-	0.133	0.273	0.277	0.615	-	0.250
	0.343	0.654	0.267	0.286	0.298	-	0.072	0.301	0.231	0.580	-	0.253
Peyrusse Vieille	0.295	0.403	0.418	0.285	0.277	0.231	-	-	-	-	0.367	0.362
	0.281	0.387	0.436	0.269	0.281	0.254	-	-	-	-	0.350	0.393
Campisábalos	0.025	0.052	1.191	2.041	0.707	0.115	0.887	1.274	0.306	1.180	0.050	1.722
	0.025	0.025	1.460	2.215	0.260	0.100	0.635	0.630	0.320	0.220	0.025	2.170

3-BUTEN-2-ONE (METHYLVINYLKETONE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.082	0.025	0.025	0.025	0.025
	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Utö	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Košetice	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
La Tardière	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

2-METHYLPROPENAL (METHACROLEIN)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.025	0.025	0.036	0.036	0.025	0.025	0.054	0.029	0.025	0.025	0.025	0.025
	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Utö	0.025	0.025	0.025	0.025	0.025	0.028	0.025	0.025	0.030	0.025	0.025	0.025
	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Košetice	0.025	0.025	0.025	0.025	0.027	0.025	0.028	0.026	0.025	0.025	0.025	0.023
	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
La Tardière	0.015	0.012	0.027	0.011	0.016	0.076	0.137	0.121	0.087	0.036	0.020	0.019
	0.012	0.012	0.030	0.012	0.012	0.086	0.127	0.091	0.090	0.039	0.012	0.015
Donon	0.016	0.016	0.024	0.018	0.093	-	0.222	0.204	0.184	0.045	-	0.014
	0.013	0.012	0.012	0.012	0.090	-	0.215	0.233	0.140	0.033	-	0.012
Peyrusse Vieille	0.012	0.015	0.012	0.012	0.152	0.452	0.464	-	0.167	0.084	0.043	0.011
	0.012	0.012	0.012	0.012	0.072	0.240	0.233	-	0.162	0.083	0.037	0.012
Campisábalos	-	2.832	0.140	0.303	0.420	0.302	0.525	0.551	0.845	0.513	0.581	0.307
	-	2.930	0.025	0.335	0.400	0.320	0.420	0.680	0.830	0.490	0.560	0.370

BENZENECARBALDEHYDE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.030	0.030	0.045	0.030	0.030	0.030	0.041	0.030	0.041	0.030	0.030	0.030
	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
Utö	0.030	0.030	0.060	0.030	0.038	0.043	0.044	0.030	0.036	0.041	0.030	0.030
	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
Košetice	0.044	0.061	0.030	0.040	0.036	0.030	0.030	0.033	0.030	0.040	0.038	0.047
	0.030	0.040	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
La Tardière	0.052	0.051	0.087	0.070	0.086	0.104	0.106	0.079	0.074	0.072	0.062	0.073
	0.055	0.048	0.116	0.075	0.081	0.099	0.095	0.044	0.064	0.073	0.057	0.068
Donon	0.025	0.045	0.021	0.025	0.038	-	0.060	0.043	0.059	0.047	-	0.024
	0.018	0.048	0.016	0.016	0.041	-	0.064	0.037	0.060	0.052	-	0.017
Peyrusse Vieille	0.021	0.039	0.026	0.029	0.046	0.035	0.043	0.020	0.020	0.027	0.025	0.028
	0.016	0.043	0.016	0.025	0.049	0.040	0.026	0.017	0.016	0.025	0.016	0.027
Campisábalos	0.170	0.222	0.313	0.321	0.257	0.311	0.130	0.278	0.034	0.173	0.070	0.091
	0.160	0.215	0.290	0.290	0.230	0.320	0.145	0.025	0.030	0.050	0.025	0.040

PENTANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.020	0.020	0.126	0.067	0.025	0.060	0.126	0.065	0.020	0.057	0.032	0.020
	0.020	0.020	0.020	0.040	0.020	0.060	0.070	0.060	0.020	0.020	0.020	0.020
Utö	0.041	0.063	0.065	0.218	0.632	0.098	0.180	0.601	0.327	0.020	0.020	0.020
	0.020	0.020	0.020	0.020	0.300	0.020	0.150	0.275	0.375	0.020	0.020	0.020
Košetice	0.055	0.028	0.050	0.065	0.090	0.041	0.100	0.114	0.090	0.035	0.020	0.025
	0.050	0.020	0.020	0.065	0.050	0.040	0.050	0.100	0.060	0.020	0.020	0.020
La Tardière	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Campisábalos	0.025	0.034	0.083	0.128	0.127	0.060	0.498	0.444	0.327	0.196	0.228	0.188
	0.025	0.025	0.085	0.135	0.080	0.040	0.520	0.420	0.310	0.190	0.190	0.170

ETHANEDIAL (GLYOXAL)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.015	0.041	0.063	0.142	0.033	0.032	0.047	0.029	0.019	0.030	0.016	0.015
	0.015	0.035	0.055	0.150	0.030	0.030	0.040	0.030	0.015	0.015	0.015	0.015
Utö	0.064	0.067	0.145	0.115	0.156	0.071	0.105	0.044	0.055	0.038	0.023	0.020
	0.070	0.047	0.160	0.135	0.160	0.060	0.090	0.025	0.060	0.015	0.017	0.015
Košetice	0.082	0.176	0.122	0.070	0.117	0.077	0.112	0.067	0.066	0.107	0.080	0.042
	0.040	0.120	0.100	0.075	0.090	0.080	0.090	0.070	0.060	0.050	0.075	0.040
La Tardière	0.020	0.016	0.028	0.011	0.029	0.043	0.084	0.082	0.036	0.050	0.014	0.020
	0.020	0.012	0.031	0.012	0.033	0.045	0.094	0.072	0.033	0.055	0.012	0.022
Donon	0.020	-	0.020	0.014	0.040	-	0.026	0.027	0.036	0.054	-	0.012
	0.013	-	0.012	0.012	0.037	-	0.031	0.032	0.032	0.047	-	0.012
Peyrusse Vieille	0.015	0.035	0.021	0.023	0.032	0.029	0.045	0.043	0.029	0.040	0.012	0.035
	0.012	0.036	0.012	0.021	0.026	0.032	0.036	0.040	0.030	0.039	0.011	0.032
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

HEXANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.015	0.025	0.141	0.191	0.045	0.087	0.121	0.040	0.045	0.045	0.018	0.018
	0.015	0.022	0.075	0.080	0.050	0.090	0.090	0.030	0.015	0.015	0.015	0.015
Utö	0.075	0.068	0.170	0.301	0.906	0.171	0.287	0.642	0.486	0.036	0.038	0.016
	0.100	0.057	0.170	0.185	0.340	0.070	0.130	0.340	0.470	0.015	0.032	0.015
Košetice	0.070	0.113	0.093	0.080	0.100	0.087	0.107	0.109	0.120	0.067	0.030	0.045
	0.090	0.060	0.065	0.090	0.100	0.090	0.110	0.090	0.120	0.070	0.015	0.050
La Tardière	0.028	0.031	0.038	0.055	0.080	0.103	0.091	0.081	0.055	0.060	0.094	0.027
	0.027	0.027	0.040	0.057	0.079	0.106	0.091	0.080	0.055	0.068	0.057	0.030
Donon	0.037	0.039	0.024	0.038	0.232	-	0.061	0.057	0.061	0.064	-	0.019
	0.042	0.039	0.017	0.041	0.089	-	0.068	0.043	0.056	0.052	-	0.016
Peyrusse Vieille	0.039	0.029	0.049	0.078	0.075	0.096	0.073	0.071	0.044	0.055	0.041	0.029
	0.033	0.029	0.055	0.052	0.074	0.075	0.068	0.068	0.044	0.040	0.045	0.028
Campisábalos	0.117	0.172	0.170	0.225	0.245	0.160	0.192	0.176	0.131	0.248	0.184	0.207
	0.140	0.155	0.170	0.225	0.220	0.160	0.190	0.180	0.130	0.300	0.190	0.220

2-OXOPROPANAL (METHYLGLYOXAL)

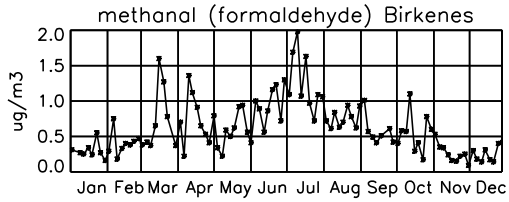
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Birkenes	0.020	0.026	0.106	0.271	0.044	0.037	0.142	0.032	0.020	0.052	0.023	0.020
	0.020	0.020	0.055	0.290	0.020	0.020	0.155	0.030	0.020	0.030	0.020	0.020
Utö	0.082	0.033	0.165	0.128	0.152	0.147	0.282	0.225	0.091	0.056	0.017	0.025
	0.080	0.020	0.130	0.155	0.150	0.170	0.170	0.125	0.090	0.050	0.020	0.020
Košetice	0.133	0.163	0.087	0.138	0.215	0.078	0.138	0.057	0.147	0.090	0.042	0.027
	0.070	0.085	0.035	0.120	0.090	0.080	0.075	0.030	0.090	0.080	0.020	0.020
La Tardière	0.016	0.030	0.079	0.015	0.034	0.072	0.140	0.120	0.024	0.042	0.020	0.029
	0.016	0.027	0.107	0.016	0.033	0.078	0.112	0.110	0.016	0.032	0.016	0.029
Donon	0.024	0.051	0.026	0.015	0.039	-	0.128	0.065	0.044	0.037	-	0.016
	0.018	0.043	0.016	0.016	0.018	-	0.104	0.054	0.037	0.035	-	0.016
Peyrusse Vieille	0.026	0.015	0.030	0.016	0.041	0.051	0.114	0.090	0.015	0.029	0.016	0.020
	0.016	0.016	0.016	0.016	0.016	0.051	0.072	0.087	0.015	0.025	0.015	0.016
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

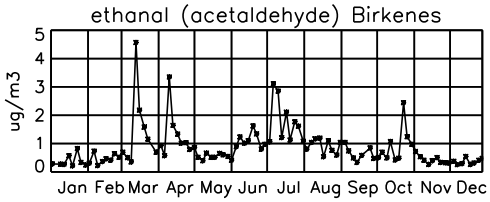
Appendix B

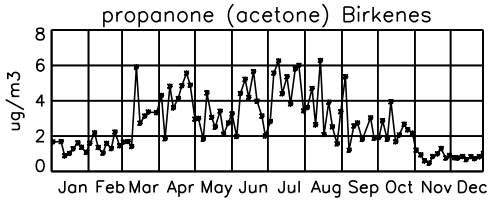
Time series of VOC measured in 2005

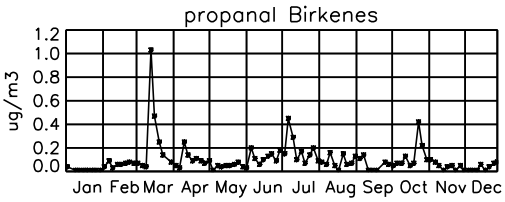
Explanations and synonyms to component names

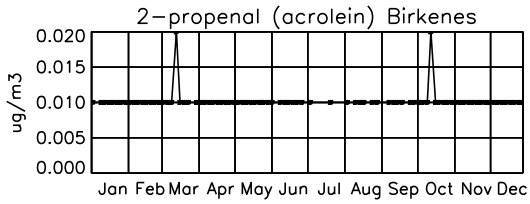
ethyne:	acetylene
butane:	n-butane
isobutane:	i-butane
pentane:	n-pentane
isopentane:	i-pentane
hexane:	n-hexane
methanal:	formaldehyde
ethanal:	acetaldehyde
propanone:	acetone
N2propenal:	2-propenal (acrolein)
N2butanone:	2-butanone (methyl ethyl ketone)
N3buten2one:	3-buten-2-one (methyl vinyl ketone)
N2methylpropenal:	2-methyl propenal (methacrolein)
benzenecarbaldehyde:	benzaldehyde
ethanedial:	glyoxal
N2oxoproanal:	2-oxopropanal (methyl glyoxal)

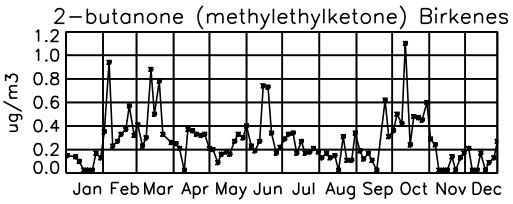

methanal (formaldehyde) Birkenes
ug/m3
0.0
0.5
1.0
1.5
2.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

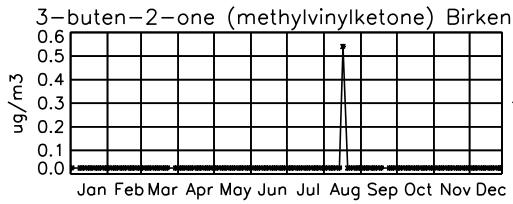

ethanal (acetaldehyde) Birkenes
ug/m3
0
1
2
3
4
5
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


propanone (acetone) Birkenes
ug/m3
0
2
4
6
8
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


propanal Birkenes
ug/m3
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


2−propenal (acrolein) Birkenes
ug/m3
0.000
0.005
0.010
0.015
0.020
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


2−butanone (methylethylketone) Birkenes
ug/m3
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


3−buten−2−one (methylvinylketone) Birkenes
ug/m3
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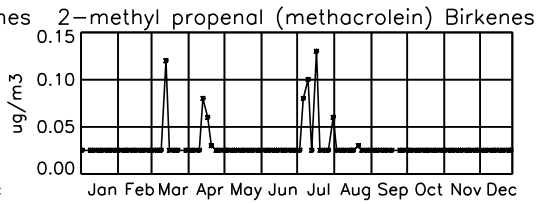
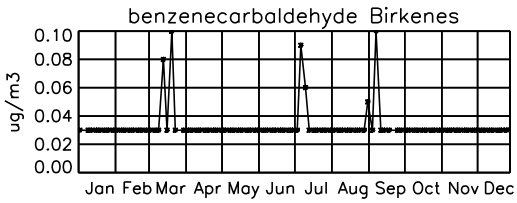
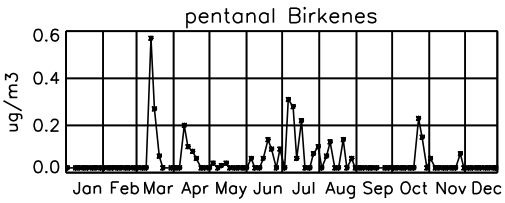
0.2
0.3
0.4
0.5
0.6
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


2−methyl propenal (methacrolein) Birkenes
ug/m3
0.00
0.05
0.10
0.15
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


benzenecarbaldehyde Birkenes
ug/m3
0.00
0.02
0.04
0.06
0.08
0.10
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


pentanal Birkenes
ug/m3
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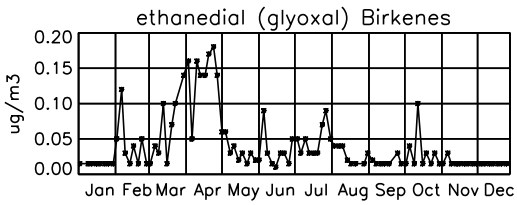
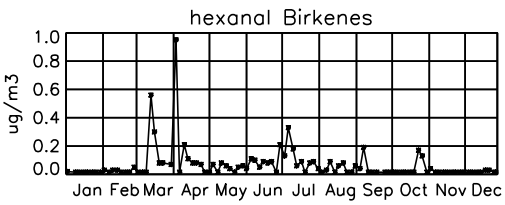
0.2
0.4
0.6
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethanedial (glyoxal) Birkenes
ug/m3
0.00
0.05
0.10
0.15
0.20
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


hexanal Birkenes
ug/m3
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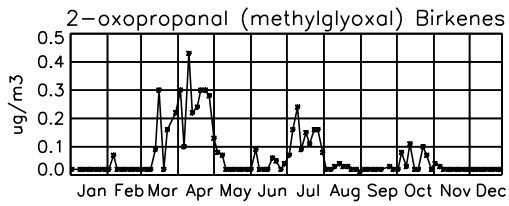
0.4
0.6
0.8
1.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


2−oxopropanal (methylglyoxal) Birkenes
ug/m3
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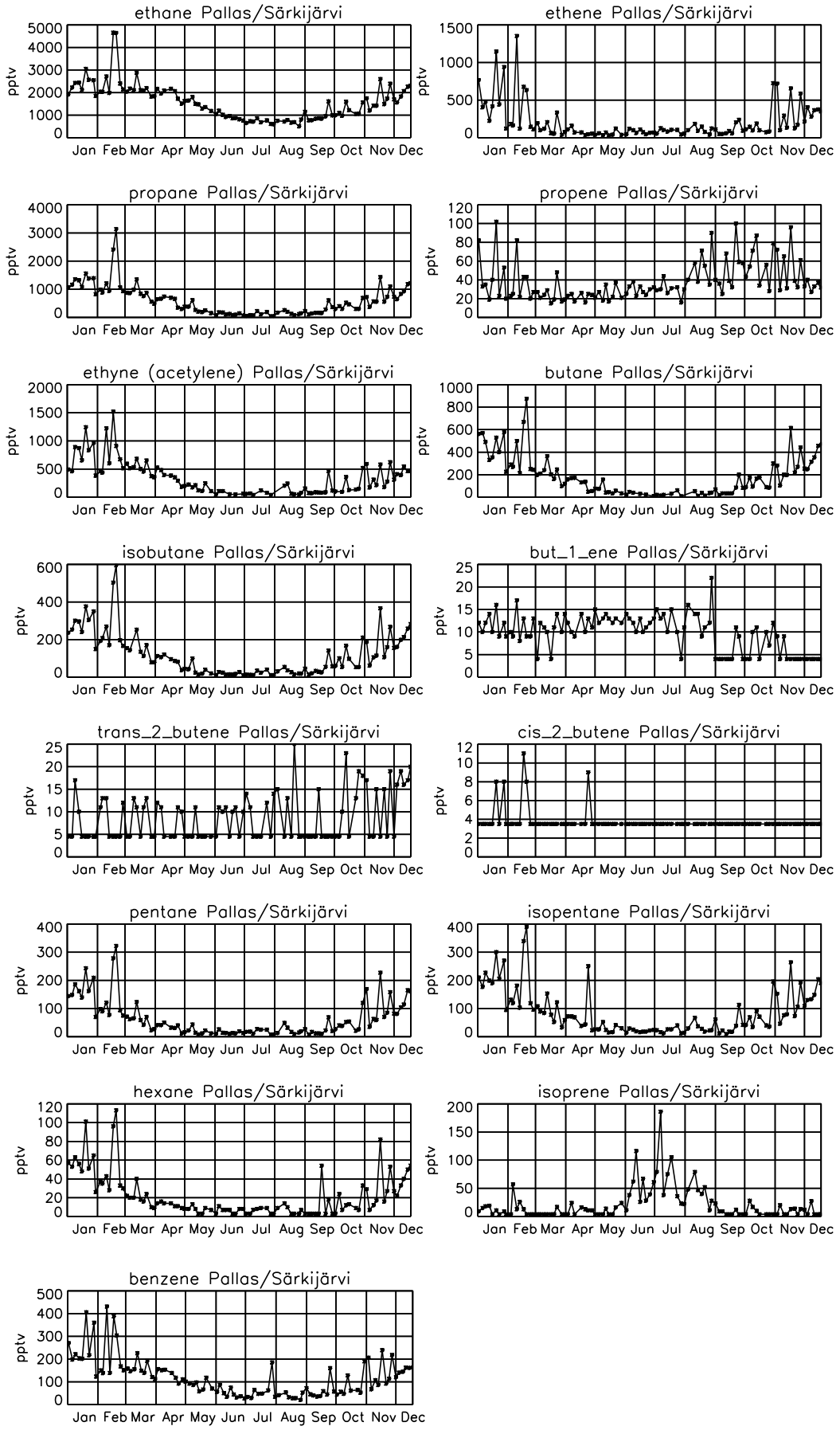
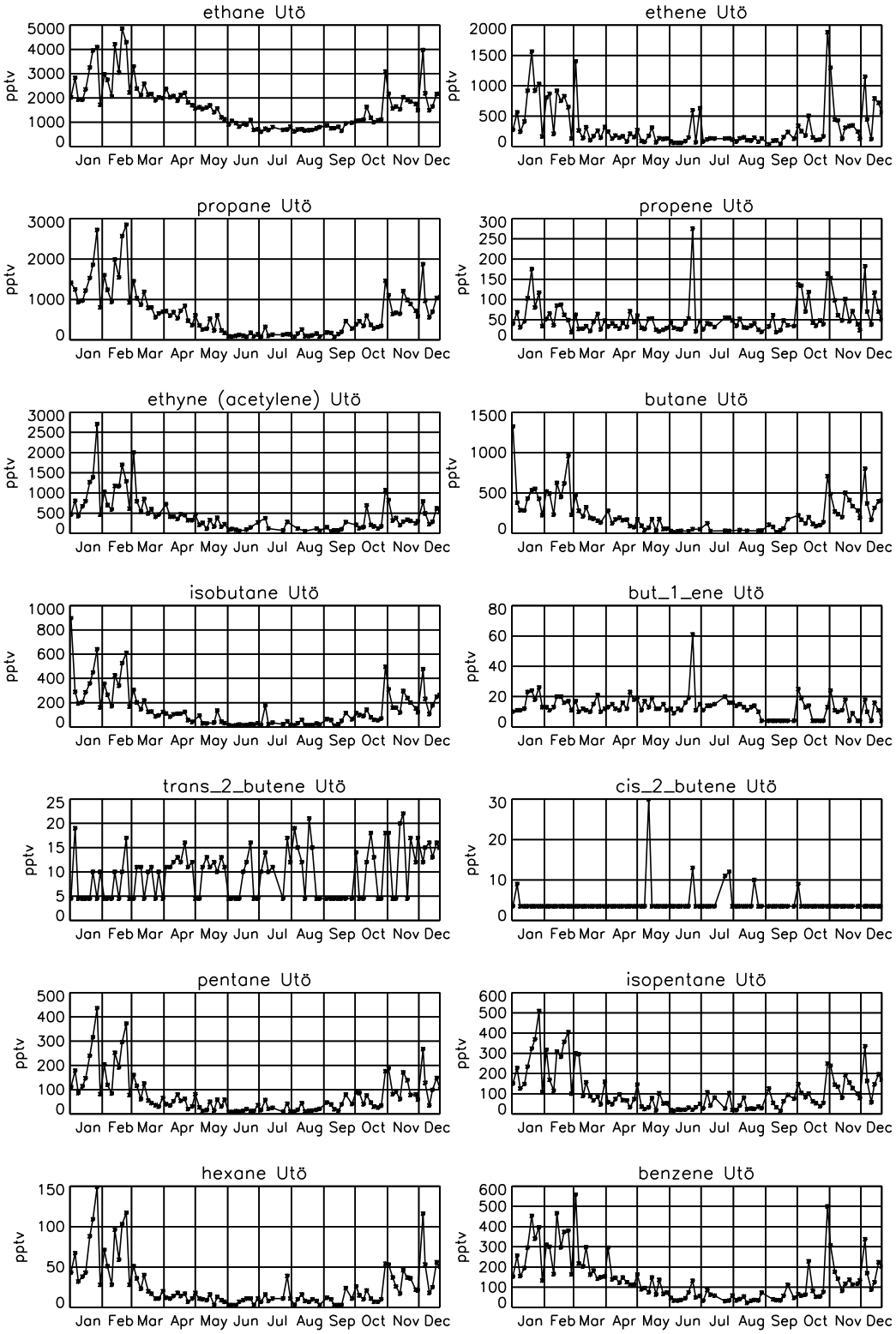
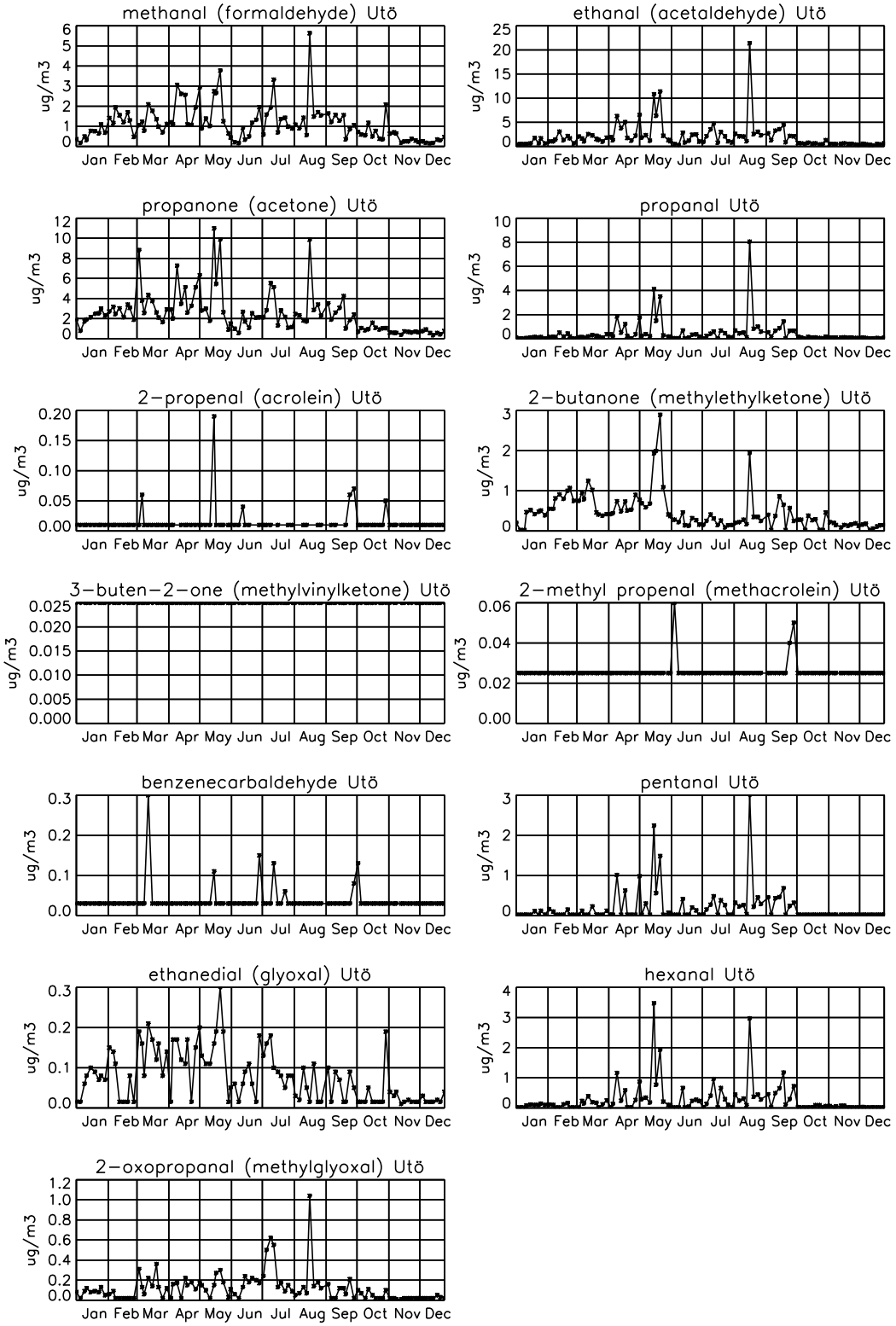
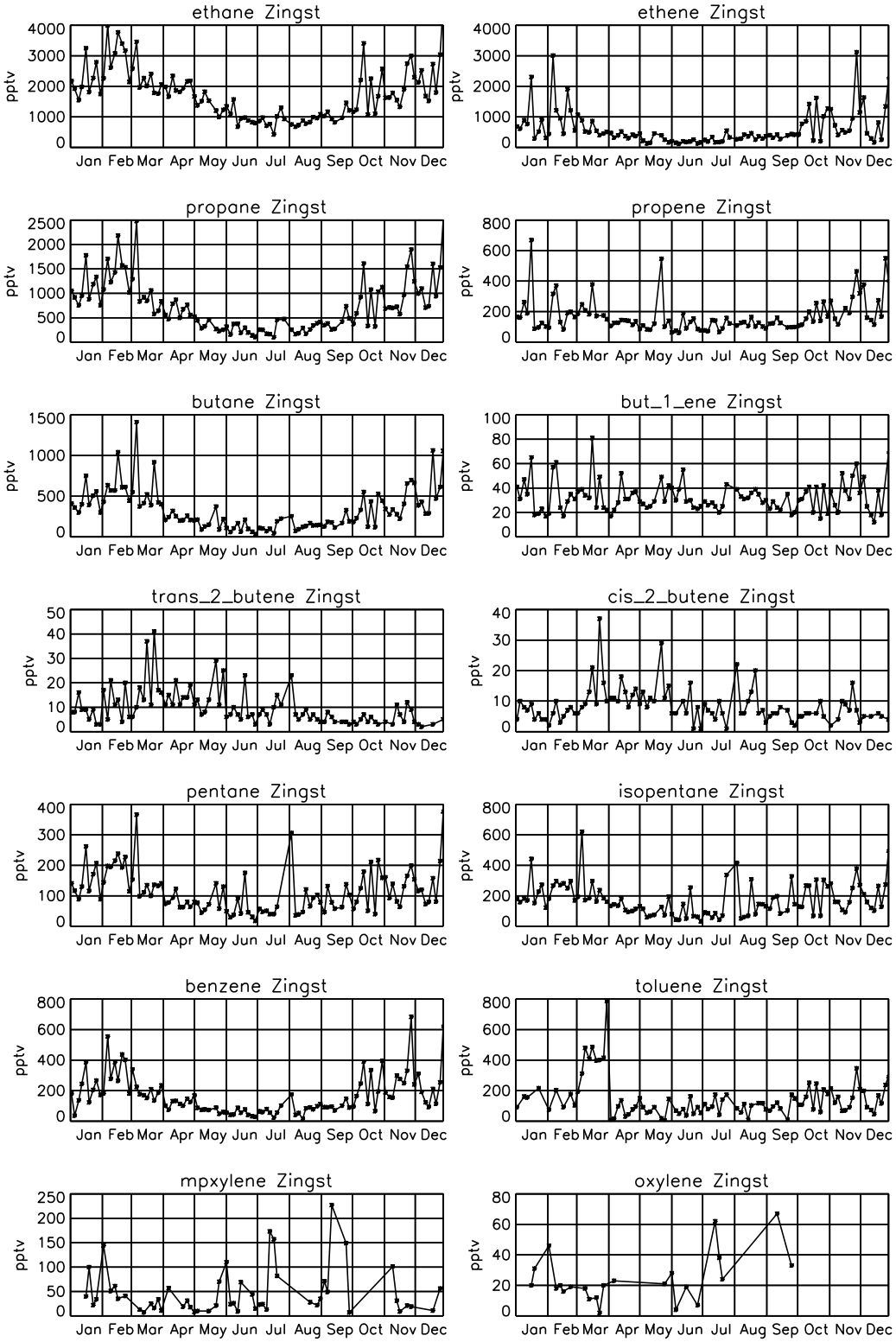
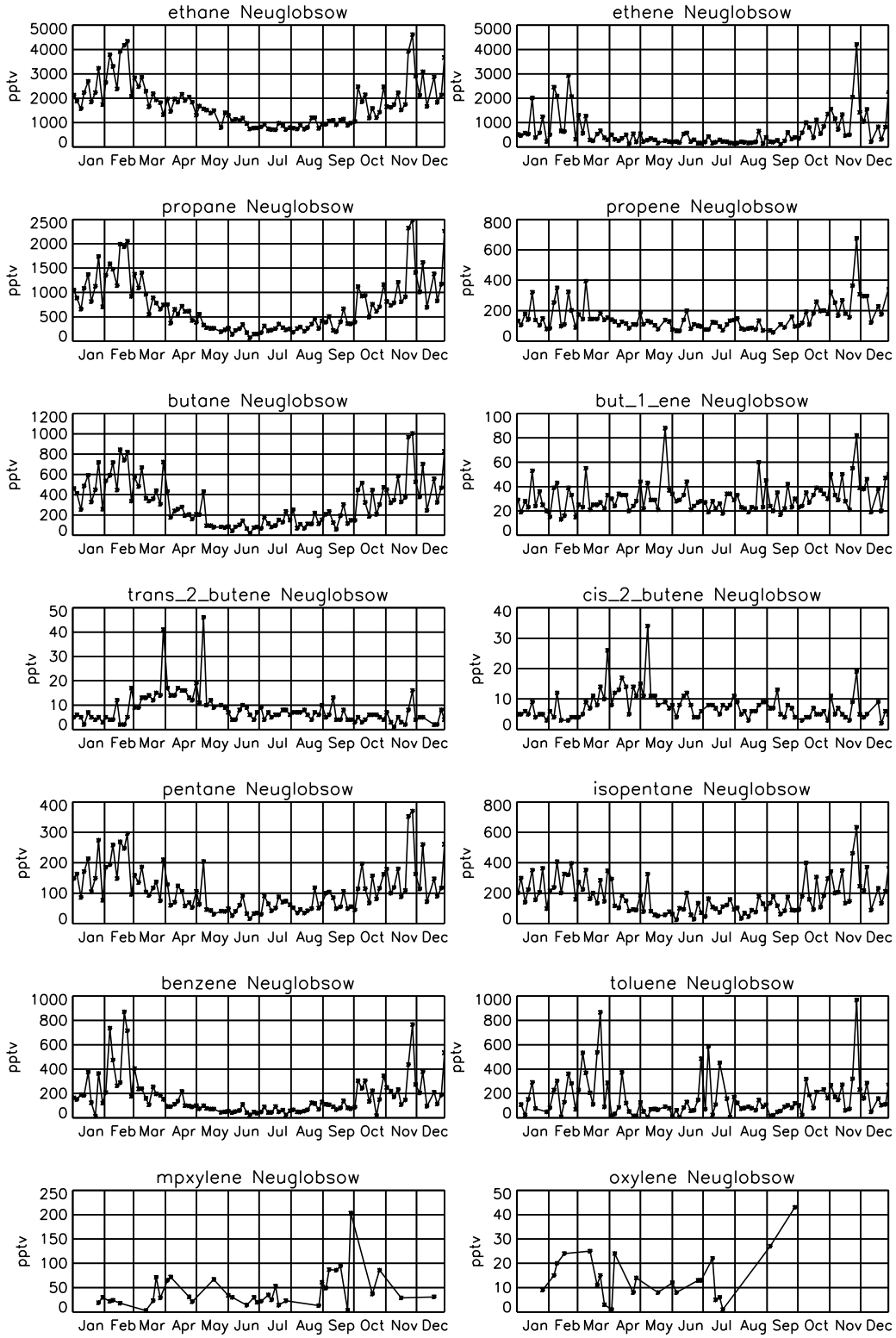
0.1
0.2
0.3
0.4
0.5
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

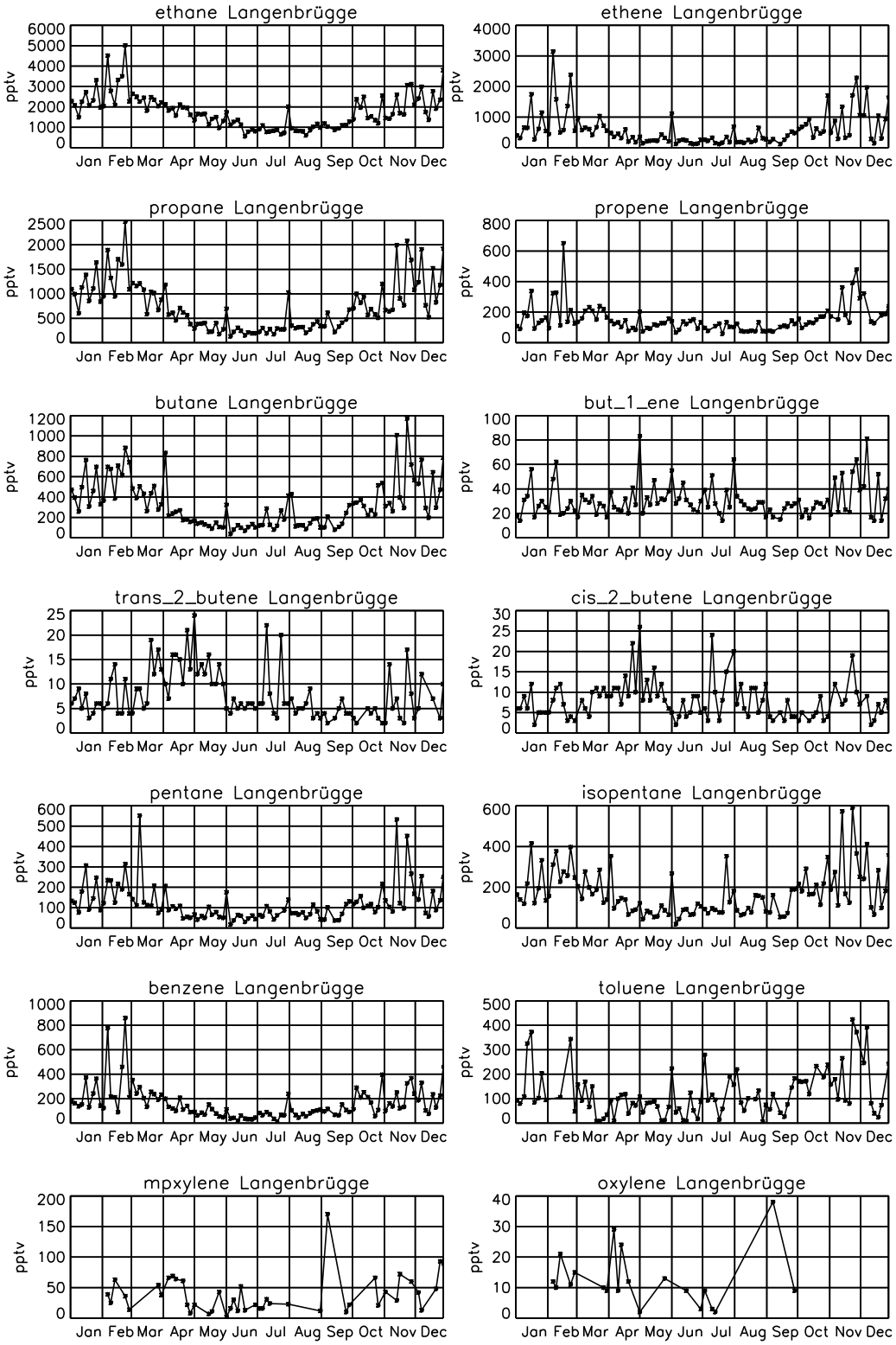

ethane Pallas/Särkijärvi
ethene Pallas/Särkijärvi
propane Pallas/Särkijärvi
propene Pallas/Särkijärvi
ethyne (acetylene) Pallas/Särkijärvi
butane Pallas/Särkijärvi
isobutane Pallas/Särkijärvi
but_1_ene Pallas/Särkijärvi
trans_2_butene Pallas/Särkijärvi
cis_2_butene Pallas/Särkijärvi
pentane Pallas/Särkijärvi
isopentane Pallas/Särkijärvi
hexane Pallas/Särkijärvi
isoprene Pallas/Särkijärvi
benzene Pallas/Särkijärvi
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Utö
ethene Utö
propane Utö
propene Utö
ethyne (acetylene) Utö
butane Utö
isobutane Utö
but_1_ene Utö
trans_2_butene Utö
cis_2_butene Utö
pentane Utö
isopentane Utö
hexane Utö
benzene Utö
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


methanal (formaldehyde) Utö
ethanal (acetaldehyde) Utö
propanone (acetone) Utö
propanal Utö
2−propenal (acrolein) Utö
2−butanone (methylethylketone) Utö
3−buten−2−one (methylvinylketone) Utö
2−methyl propenal (methacrolein) Utö
benzenecarbaldehyde Utö
pentanal Utö
ethanedial (glyoxal) Utö
hexanal Utö
2−oxopropanal (methylglyoxal) Utö
ug/m3
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Zingst
ethene Zingst
propane Zingst
propene Zingst
butane Zingst
but_1_ene Zingst
trans_2_butene Zingst
cis_2_butene Zingst
pentane Zingst
isopentane Zingst
benzene Zingst
toluene Zingst
mpxylene Zingst
oxylene Zingst
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Neuglobsow
ethene Neuglobsow
propane Neuglobsow
propene Neuglobsow
butane Neuglobsow
but_1_ene Neuglobsow
trans_2_butene Neuglobsow
cis_2_butene Neuglobsow
pentane Neuglobsow
isopentane Neuglobsow
benzene Neuglobsow
toluene Neuglobsow
mpxylene Neuglobsow
oxylene Neuglobsow
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Langenbrügge
ethene Langenbrügge
propane Langenbrügge
propene Langenbrügge
butane Langenbrügge
but_1_ene Langenbrügge
trans_2_butene Langenbrügge
cis_2_butene Langenbrügge
pentane Langenbrügge
isopentane Langenbrügge
benzene Langenbrügge
toluene Langenbrügge
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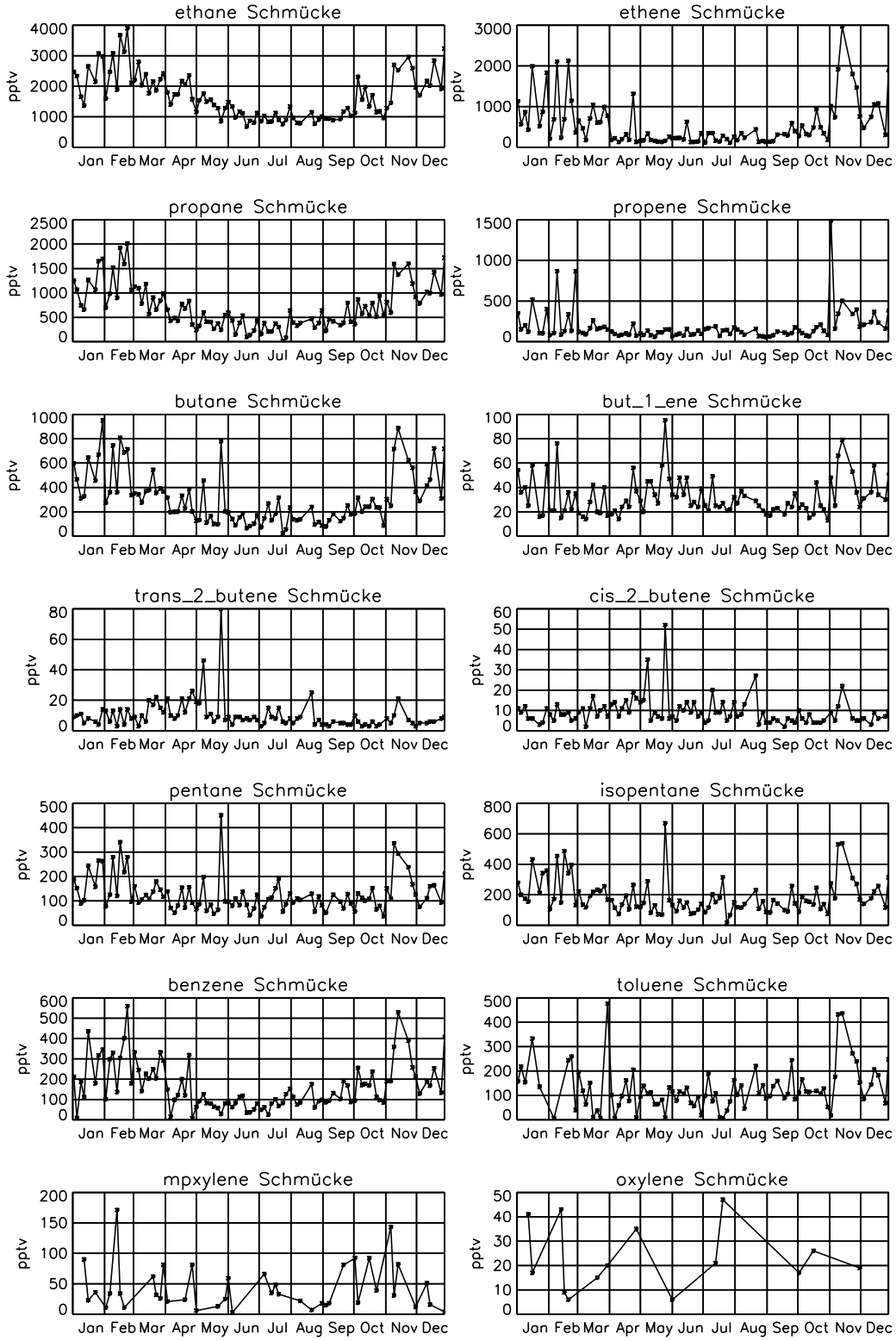
oxylene Langenbrügge
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Schmücke
ethene Schmücke
propane Schmücke
propene Schmücke
butane Schmücke
but_1_ene Schmücke
trans_2_butene Schmücke
cis_2_butene Schmücke
pentane Schmücke
isopentane Schmücke
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toluene Schmücke
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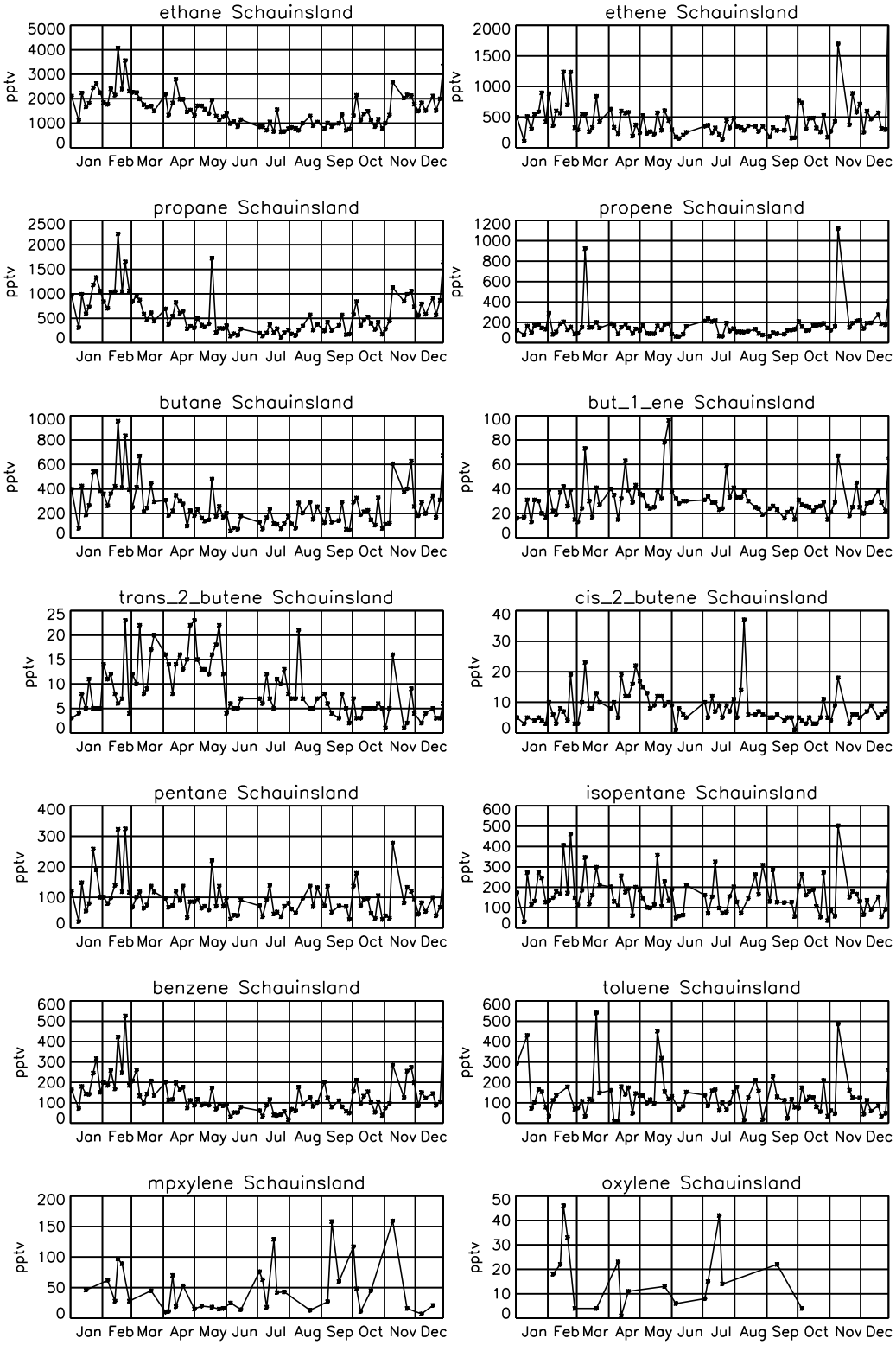
oxylene Schmücke
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Schauinsland
ethene Schauinsland
propane Schauinsland
propene Schauinsland
butane Schauinsland
but_1_ene Schauinsland
trans_2_butene Schauinsland
cis_2_butene Schauinsland
pentane Schauinsland
isopentane Schauinsland
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toluene Schauinsland
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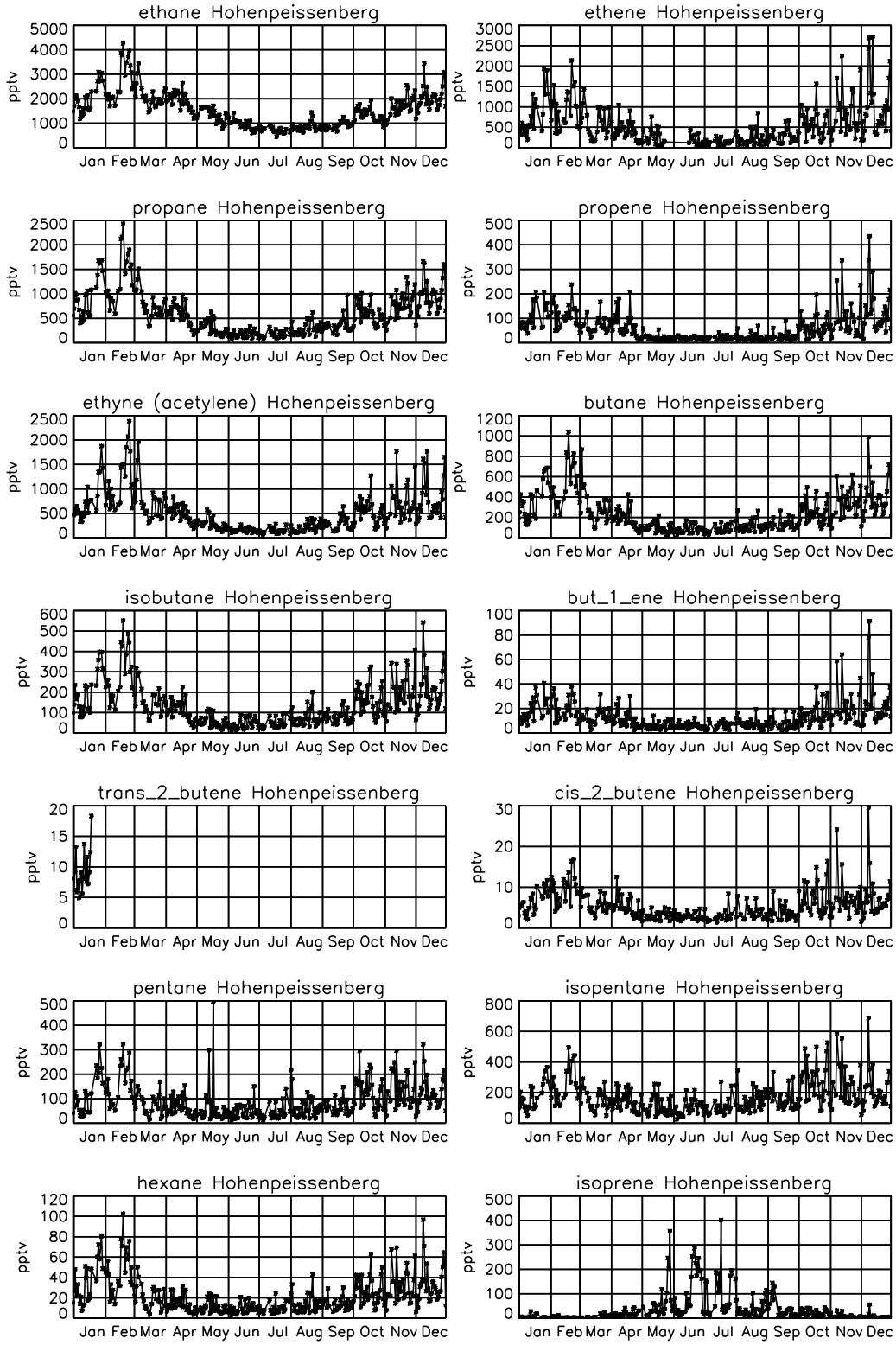
oxylene Schauinsland
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Hohenpeissenberg
ethene Hohenpeissenberg
propane Hohenpeissenberg
propene Hohenpeissenberg
ethyne (acetylene) Hohenpeissenberg
butane Hohenpeissenberg
isobutane Hohenpeissenberg
but_1_ene Hohenpeissenberg
trans_2_butene Hohenpeissenberg
cis_2_butene Hohenpeissenberg
pentane Hohenpeissenberg
isopentane Hohenpeissenberg
hexane Hohenpeissenberg
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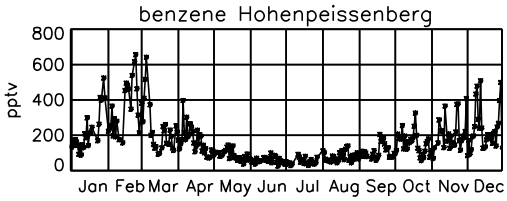
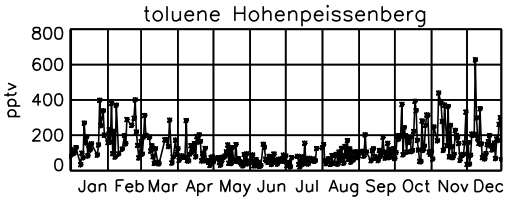
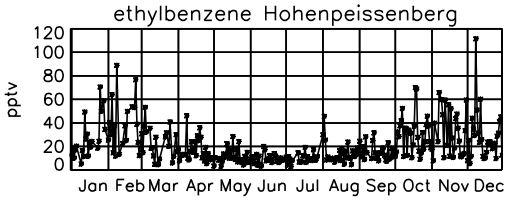
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


benzene Hohenpeissenberg
pptv
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


toluene Hohenpeissenberg
pptv
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethylbenzene Hohenpeissenberg
pptv
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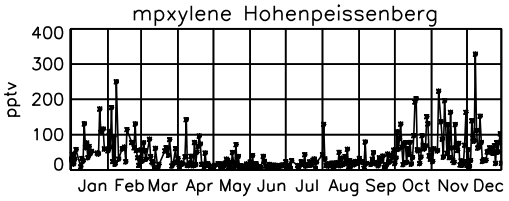
100
80
60
40
20
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


mpxylene Hohenpeissenberg
pptv
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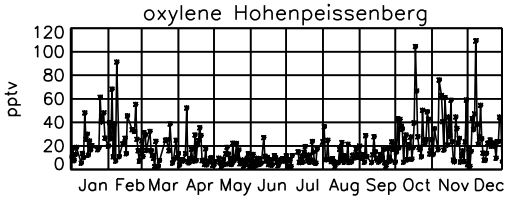
300
200
100
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


oxylene Hohenpeissenberg
pptv
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100
80
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40
20
0
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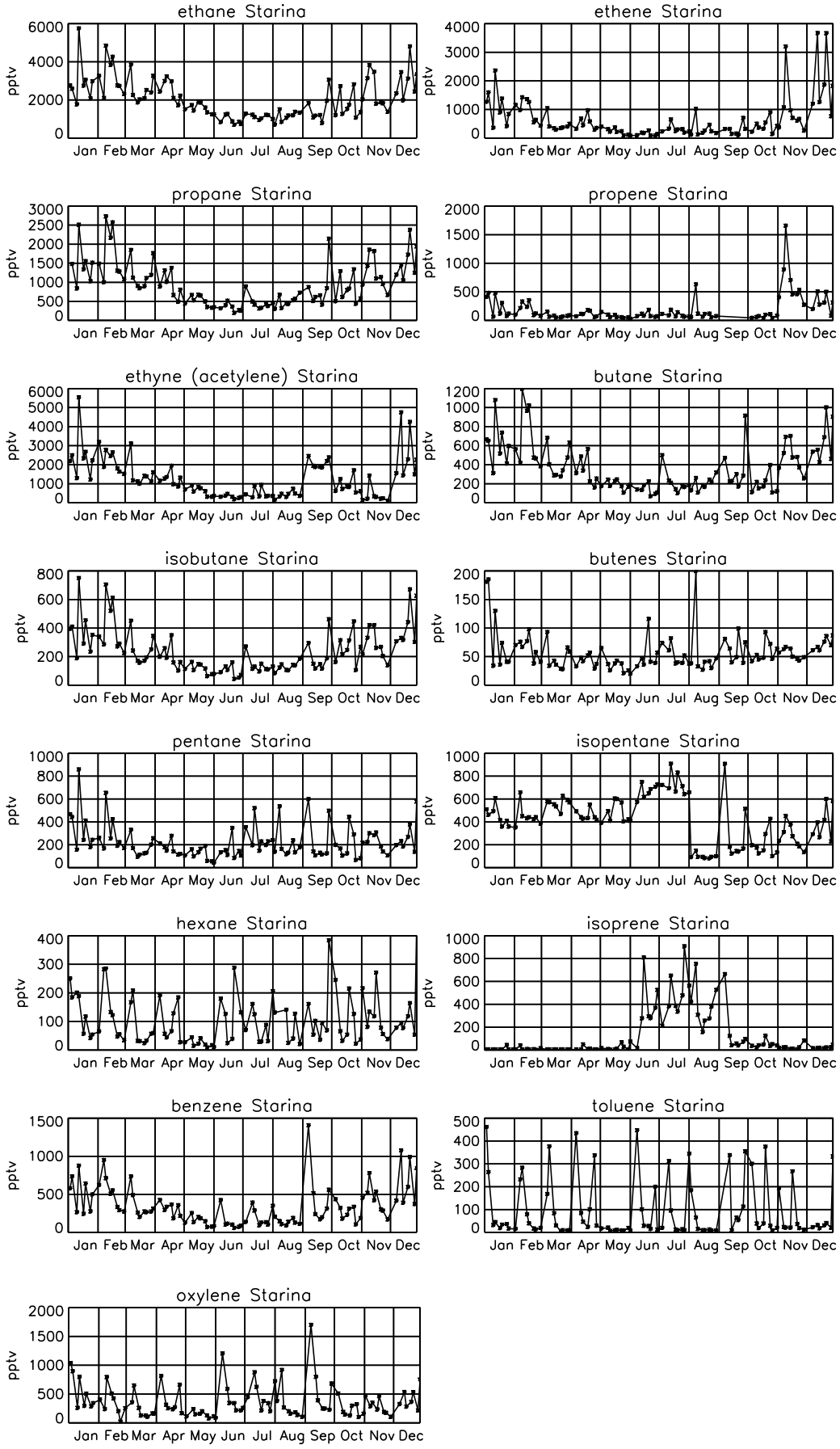
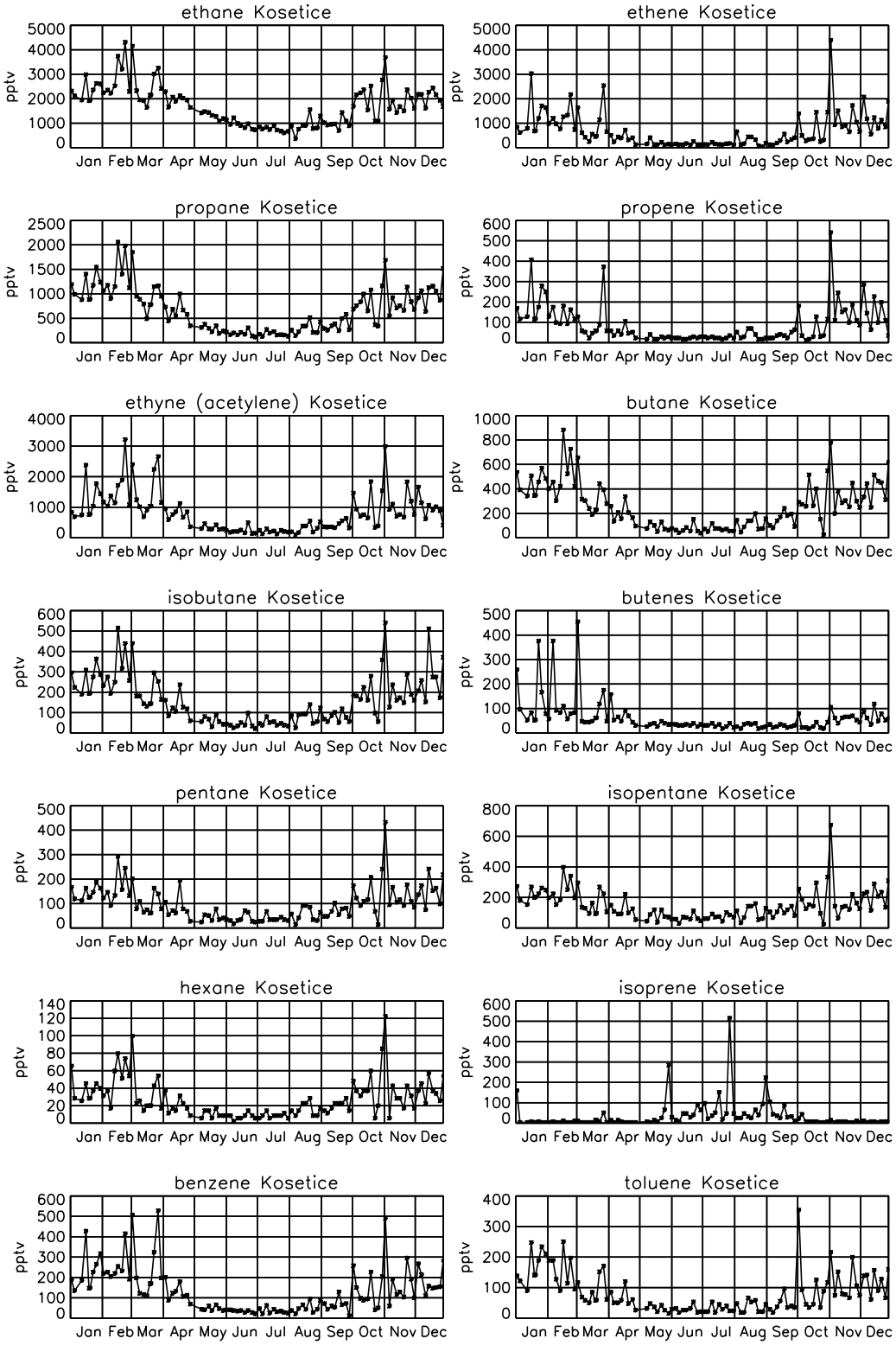
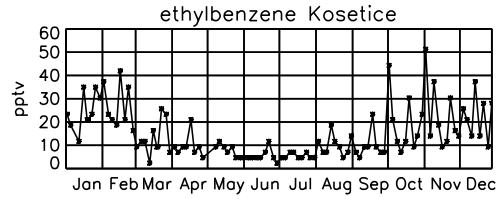

ethane Starina
ethene Starina
propane Starina
propene Starina
ethyne (acetylene) Starina
butane Starina
isobutane Starina
butenes Starina
pentane Starina
isopentane Starina
hexane Starina
isoprene Starina
benzene Starina
toluene Starina
oxylene Starina
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Kosetice
ethene Kosetice
propane Kosetice
propene Kosetice
ethyne (acetylene) Kosetice
butane Kosetice
isobutane Kosetice
butenes Kosetice
pentane Kosetice
isopentane Kosetice
hexane Kosetice
isoprene Kosetice
benzene Kosetice
toluene Kosetice
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethylbenzene Kosetice
pptv
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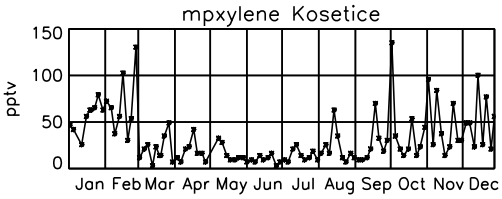
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


mpxylene Kosetice
pptv
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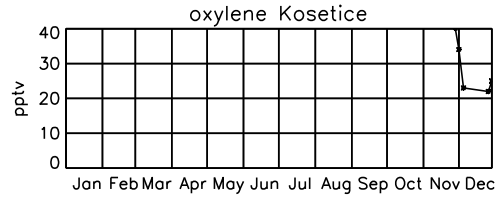
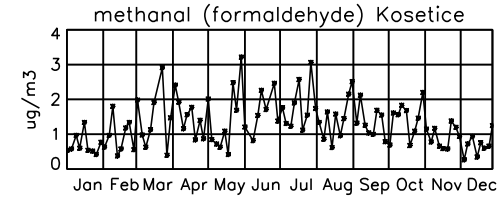
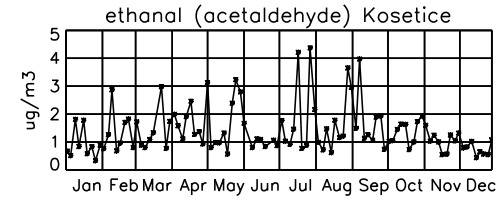
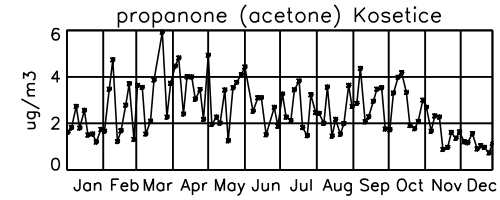
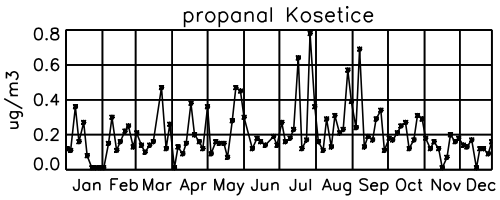
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


oxylene Kosetice
pptv
0 10 20 30 40
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


methanal (formaldehyde) Kosetice
ug/m3
0 1 2 3 4
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethanal (acetaldehyde) Kosetice
ug/m3
0 1 2 3 4 5
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


propanone (acetone) Kosetice
ug/m3
0 2 4 6
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


propanal Kosetice
ug/m3
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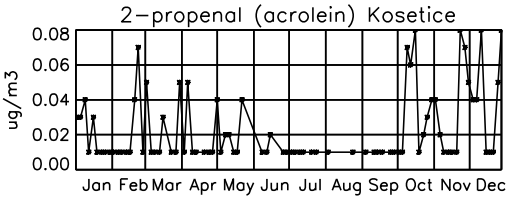
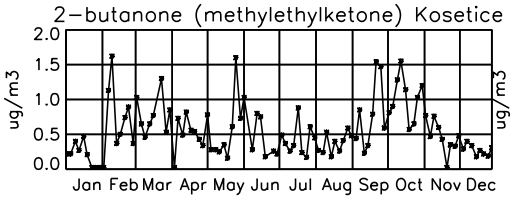
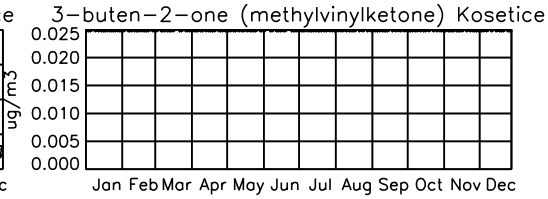
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


2−propenal (acrolein) Kosetice
ug/m3
0.00 0.02 0.04 0.06 0.08
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


2−butanone (methylethylketone) Kosetice
ug/m3
0.0 0.5 1.0 1.5 2.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


3−buten−2−one (methylvinylketone) Kosetice
ug/m3
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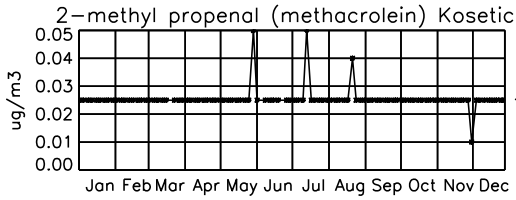
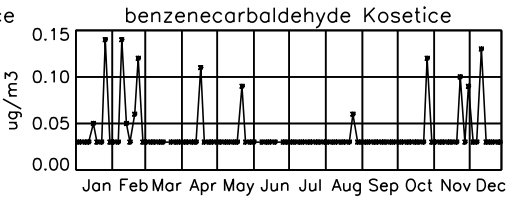
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


2−methyl propenal (methacrolein) Kosetice
ug/m3
0.00 0.01 0.02 0.03 0.04 0.05
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


benzenecarbaldehyde Kosetice
ug/m3
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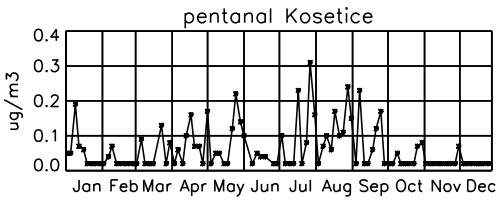
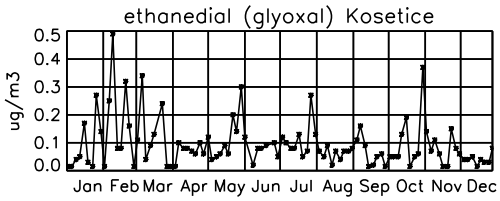
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


pentanal Kosetice
ug/m3
0.0 0.1 0.2 0.3 0.4
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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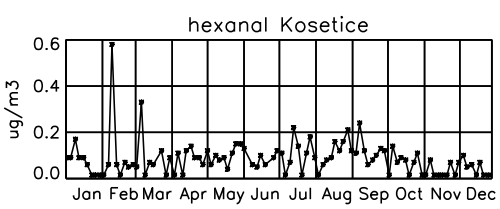
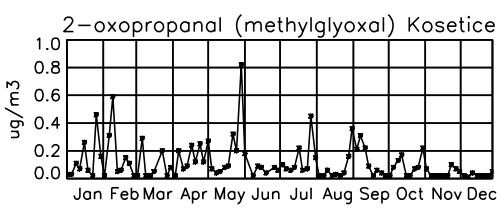
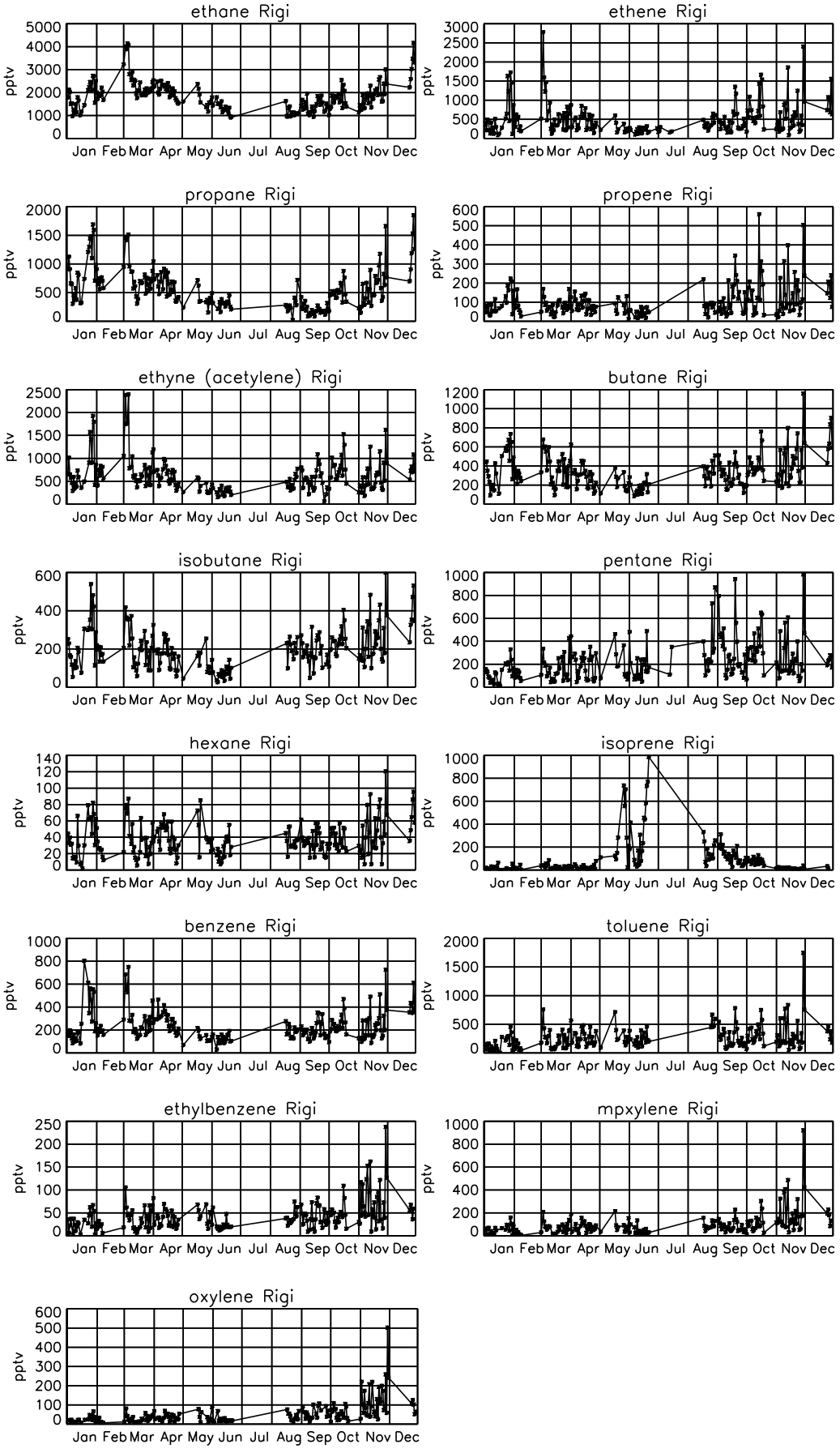
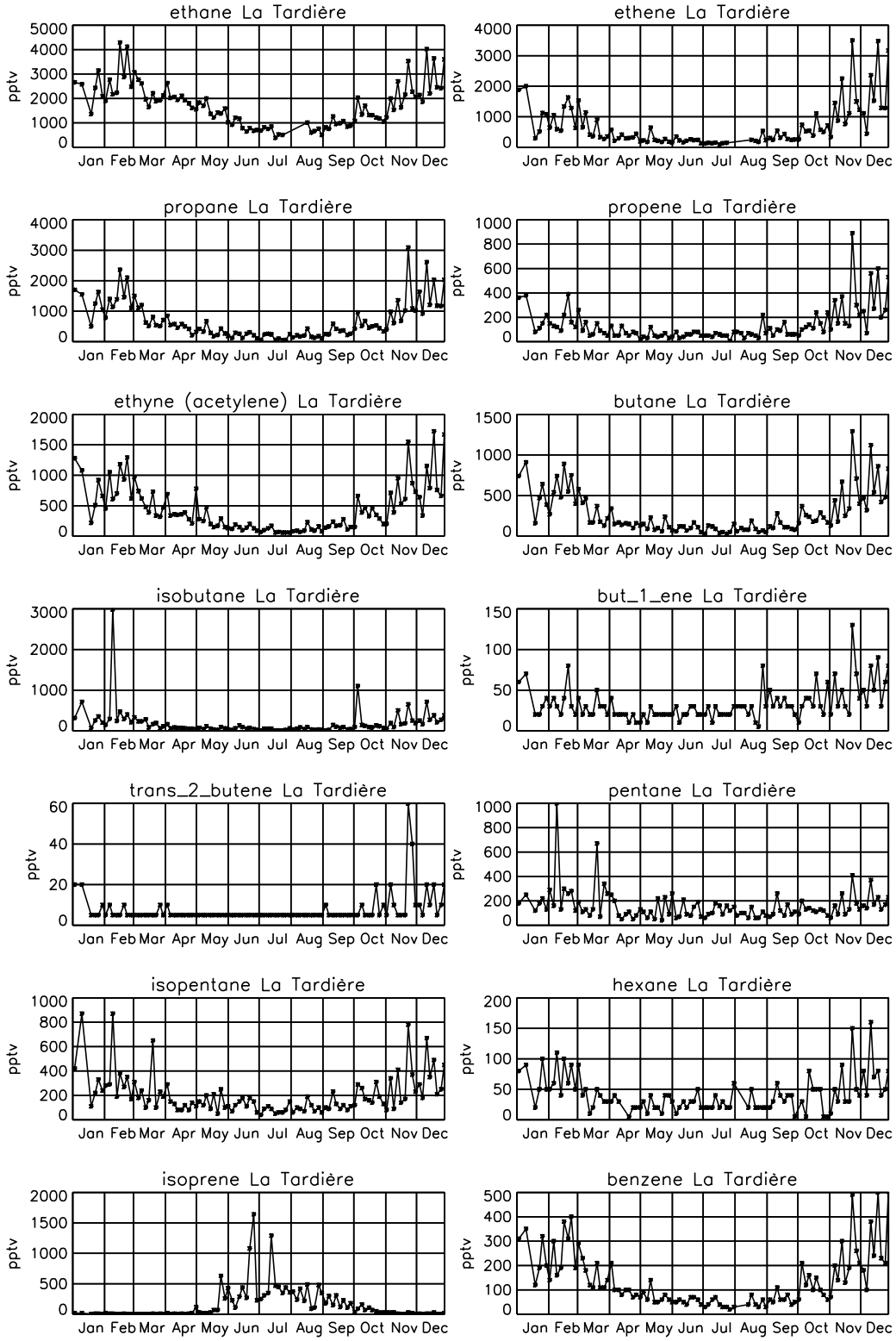
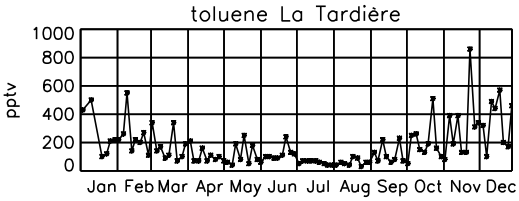
ug/m3
0.0 0.1 0.2 0.3 0.4 0.5
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

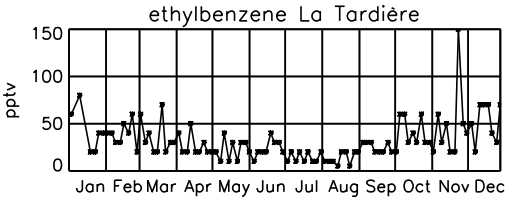

hexanal Kosetice
ug/m3
0.0 0.2 0.4 0.6
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

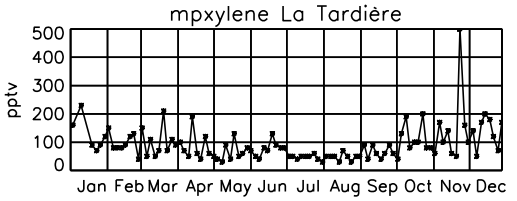

2−oxopropanal (methylglyoxal) Kosetice
ug/m3
0.0 0.2 0.4 0.6 0.8 1.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

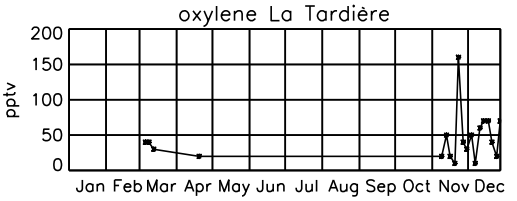

ethane Rigi
ethene Rigi
propane Rigi
propene Rigi
ethyne (acetylene) Rigi
butane Rigi
isobutane Rigi
pentane Rigi
hexane Rigi
isoprene Rigi
benzene Rigi
toluene Rigi
ethylbenzene Rigi
mpxylene Rigi
oxylene Rigi
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

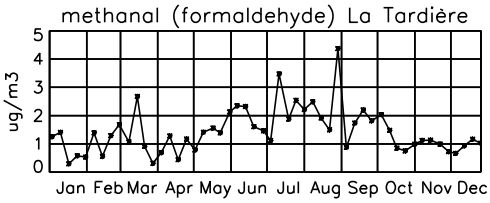

ethane La Tardière
ethene La Tardière
propane La Tardière
propene La Tardière
ethyne (acetylene) La Tardière
butane La Tardière
isobutane La Tardière
but_1_ene La Tardière
trans_2_butene La Tardière
pentane La Tardière
isopentane La Tardière
hexane La Tardière
isoprene La Tardière
benzene La Tardière
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

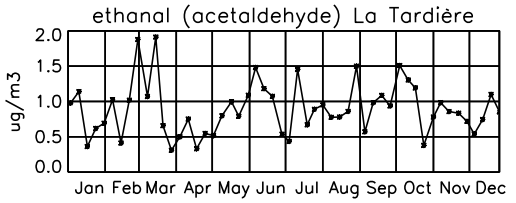

toluene La Tardière
pptv
1000
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

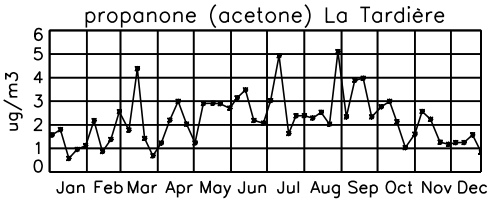

ethylbenzene La Tardière
pptv
150
100
50
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

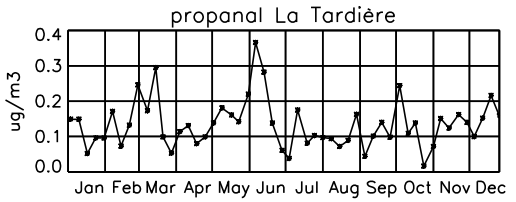

mpxylene La Tardière
pptv
500
400
300
200
100
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

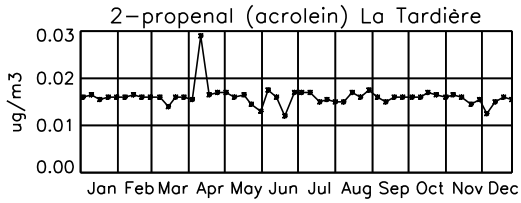

oxylene La Tardière
pptv
200
150
100
50
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

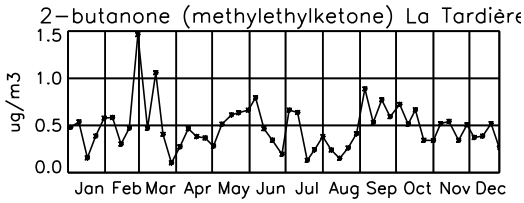

methanal (formaldehyde) La Tardière
ug/m3
5
4
3
2
1
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

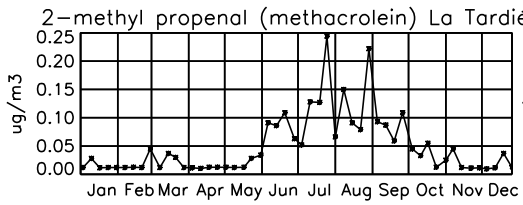

ethanal (acetaldehyde) La Tardière
ug/m3
2.0
1.5
1.0
0.5
0.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

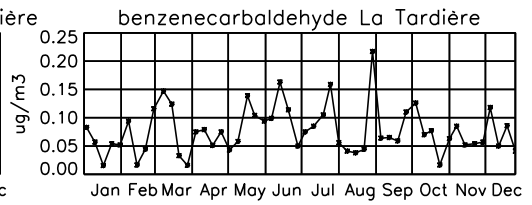

propanone (acetone) La Tardière
ug/m3
6
5
4
3
2
1
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

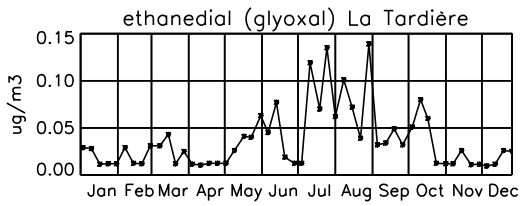

propanal La Tardière
ug/m3
0.4
0.3
0.2
0.1
0.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

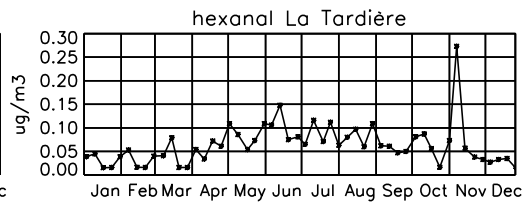

2−propenal (acrolein) La Tardière
ug/m3
0.03
0.02
0.01
0.00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

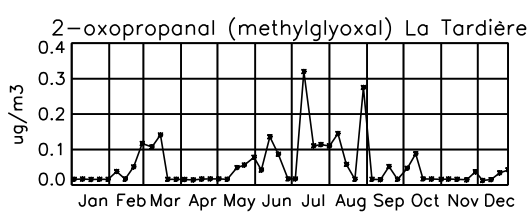

2−butanone (methylethylketone) La Tardière
ug/m3
1.5
1.0
0.5
0.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

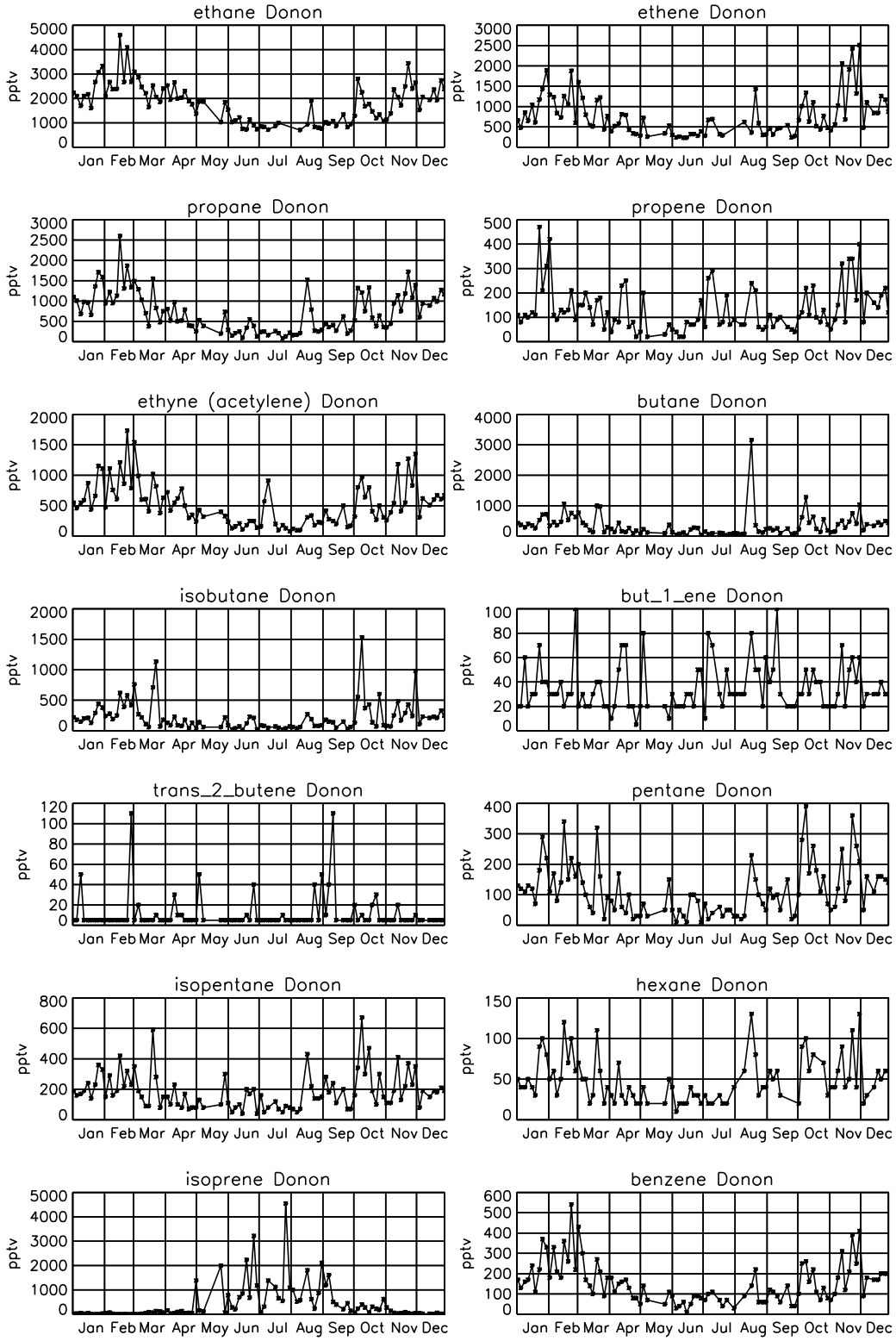

2−methyl propenal (methacrolein) La Tardière
ug/m3
0.25
0.20
0.15
0.10
0.05
0.00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

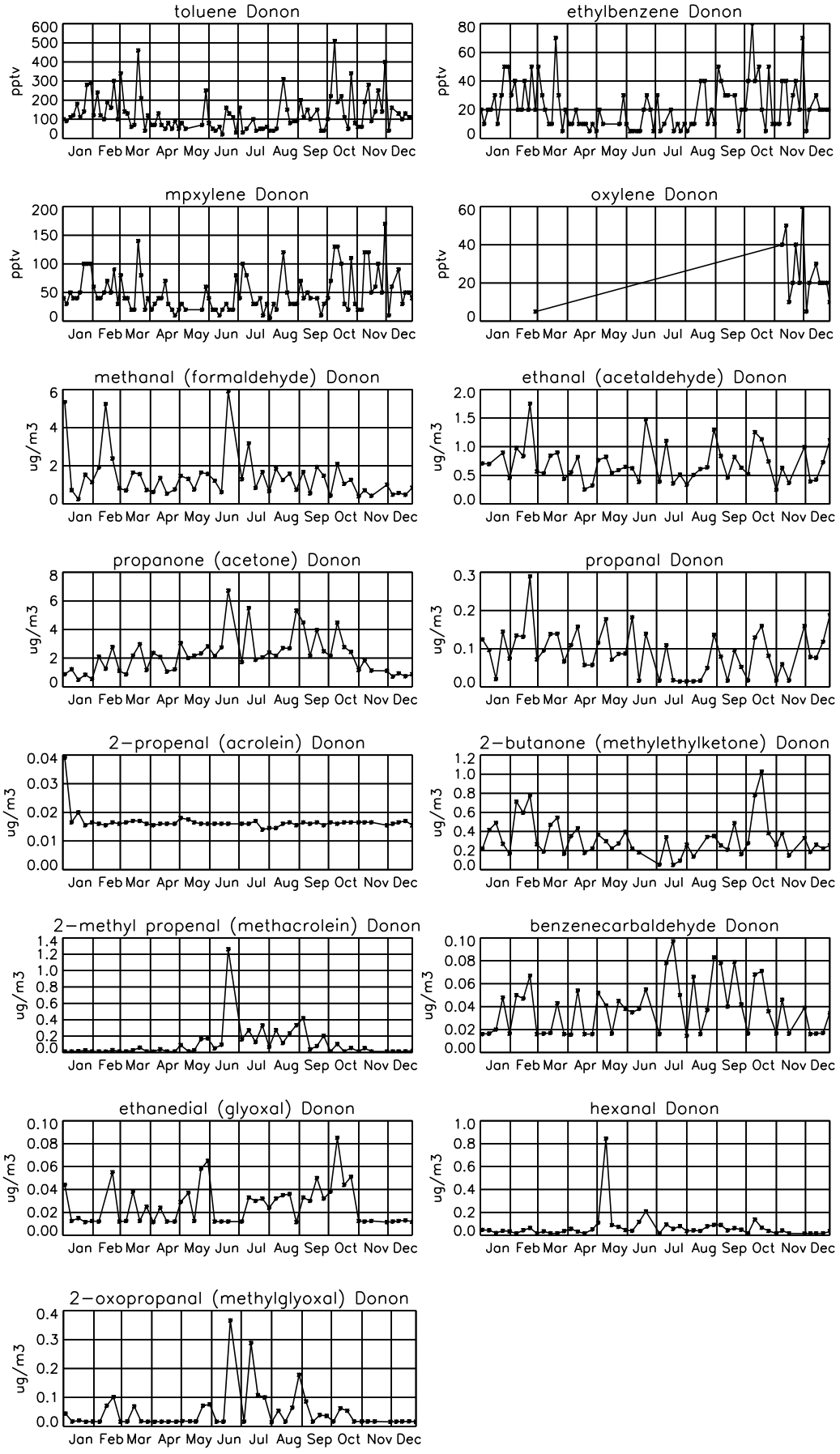

benzenecarbaldehyde La Tardière
ug/m3
0.25
0.20
0.15
0.10
0.05
0.00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

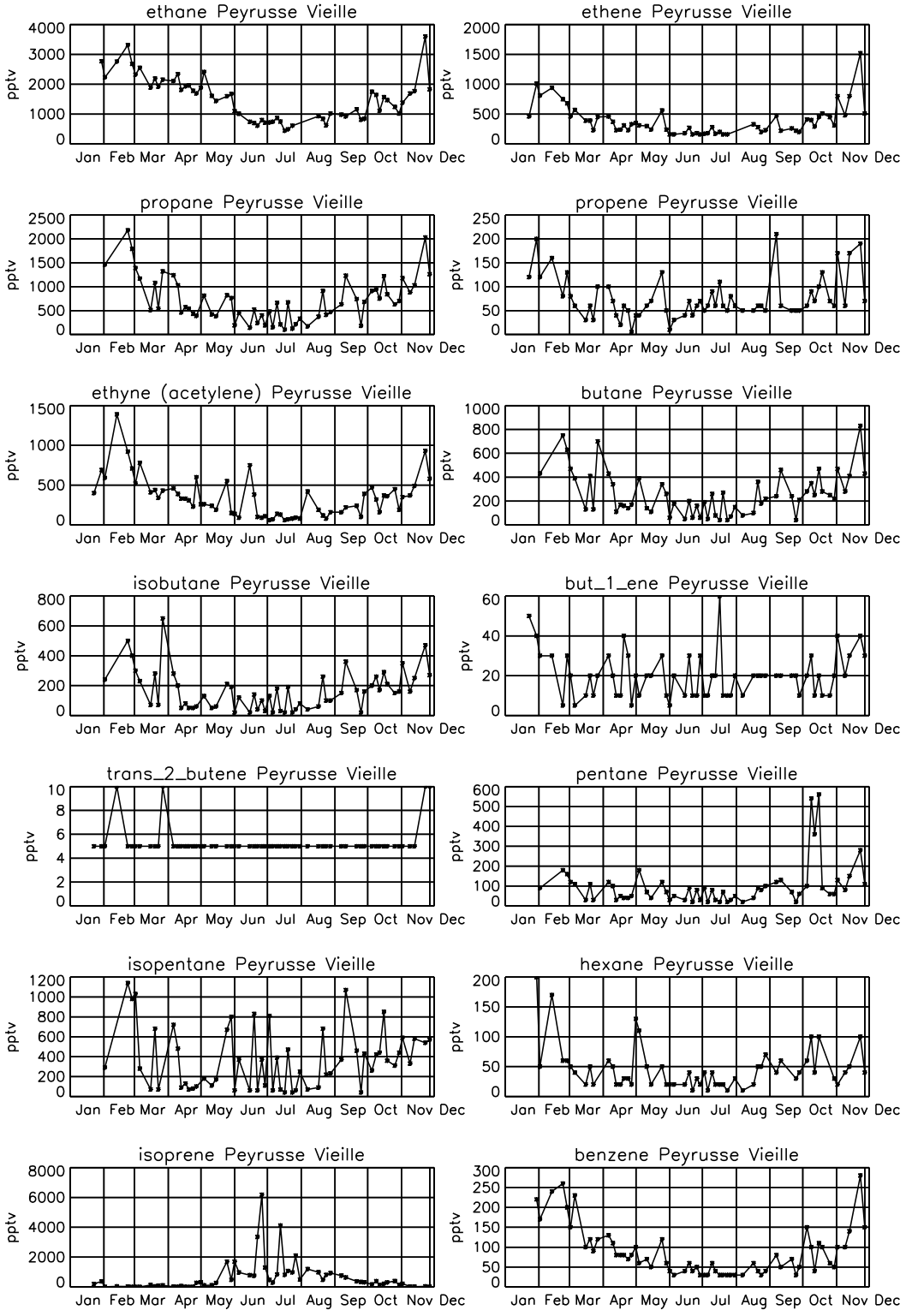

ethanedial (glyoxal) La Tardière
ug/m3
0.15
0.10
0.05
0.00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

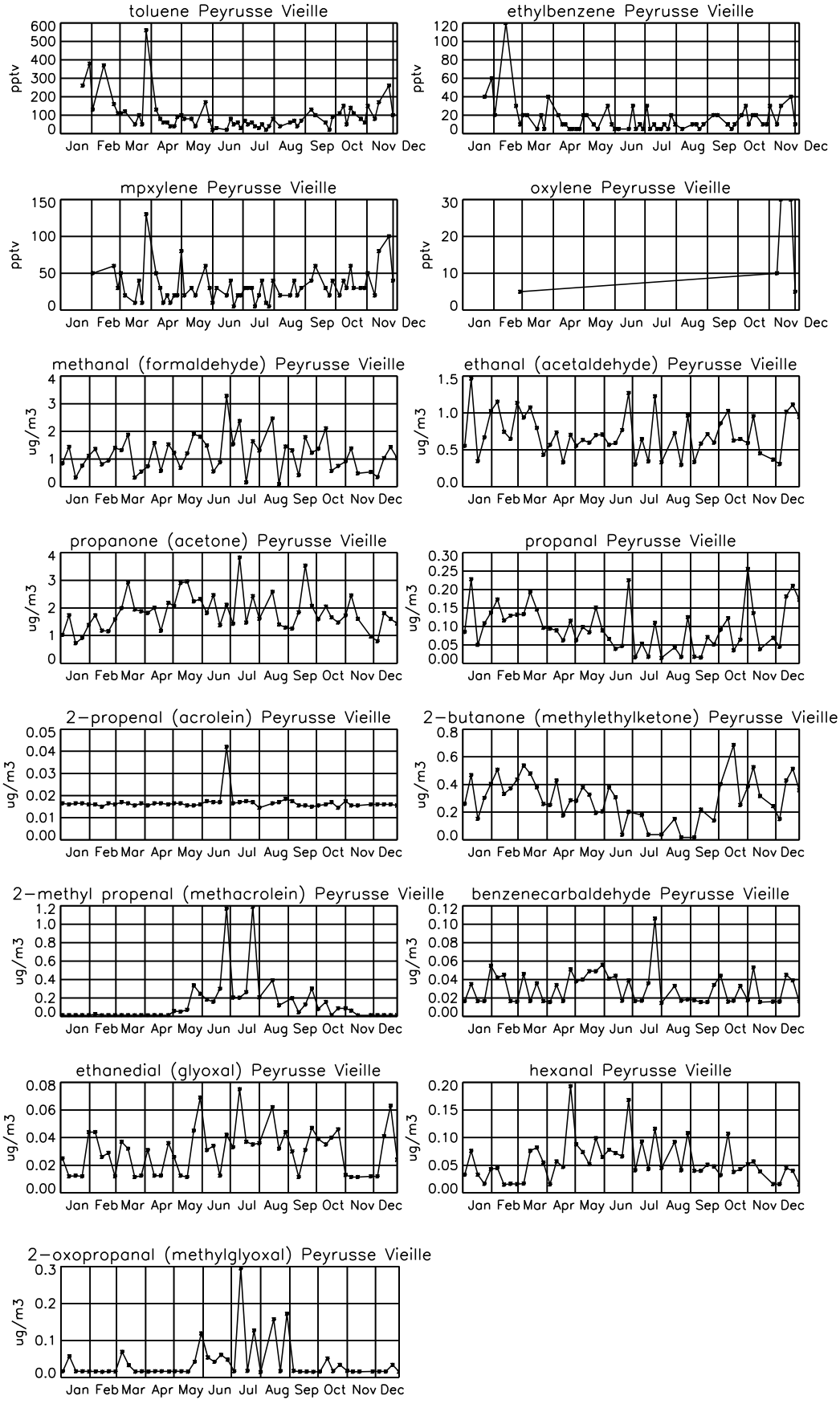

hexanal La Tardière
ug/m3
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

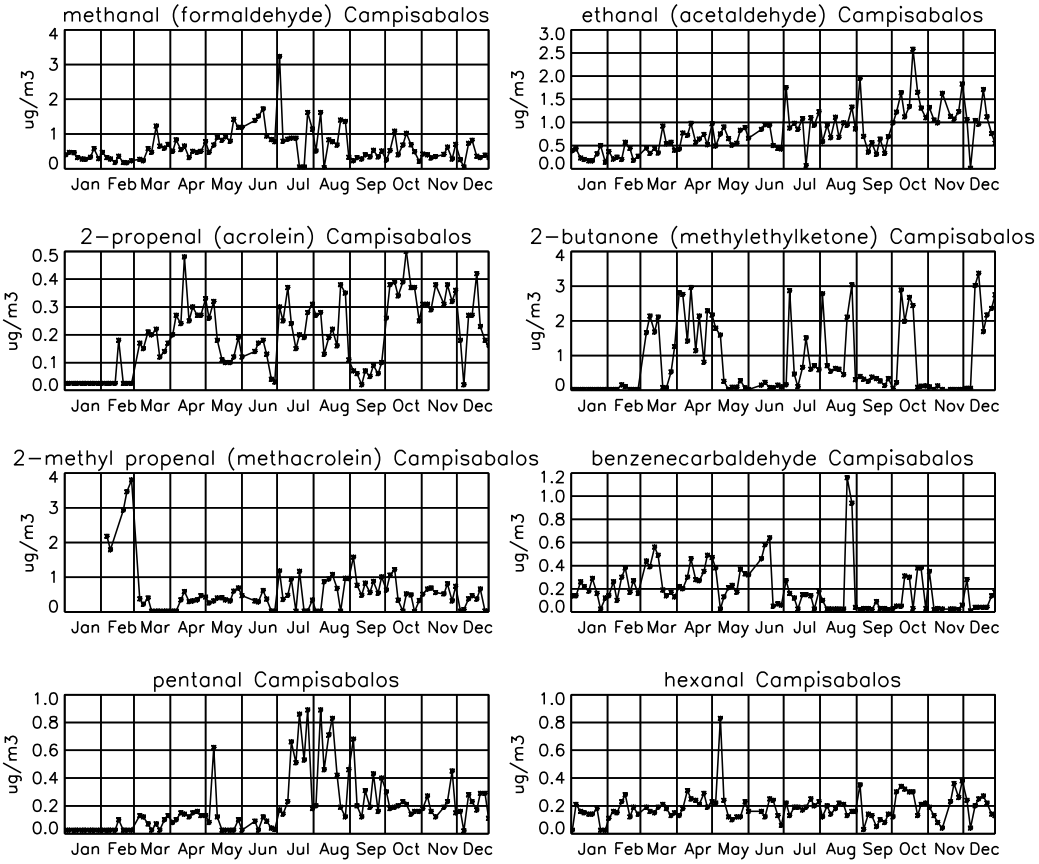

2−oxopropanal (methylglyoxal) La Tardière
ug/m3
0.4
0.3
0.2
0.1
0.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Donon
ethene Donon
propane Donon
propene Donon
ethyne (acetylene) Donon
butane Donon
isobutane Donon
but_1_ene Donon
trans_2_butene Donon
pentane Donon
isopentane Donon
hexane Donon
isoprene Donon
benzene Donon
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


toluene Donon
pptv
ethylbenzene Donon
pptv
mpxylene Donon
pptv
oxylene Donon
pptv
methanal (formaldehyde) Donon
ug/m3
ethanal (acetaldehyde) Donon
ug/m3
propanone (acetone) Donon
ug/m3
propanal Donon
ug/m3
2−propenal (acrolein) Donon
ug/m3
2−butanone (methylethylketone) Donon
ug/m3
2−methyl propenal (methacrolein) Donon
ug/m3
benzenecarbaldehyde Donon
ug/m3
ethanedial (glyoxal) Donon
ug/m3
hexanal Donon
ug/m3
2−oxopropanal (methylglyoxal) Donon
ug/m3
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Peyrusse Vieille
ethene Peyrusse Vieille
propane Peyrusse Vieille
propene Peyrusse Vieille
ethyne (acetylene) Peyrusse Vieille
butane Peyrusse Vieille
isobutane Peyrusse Vieille
but_1_ene Peyrusse Vieille
trans_2_butene Peyrusse Vieille
pentane Peyrusse Vieille
isopentane Peyrusse Vieille
hexane Peyrusse Vieille
isoprene Peyrusse Vieille
benzene Peyrusse Vieille
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


toluene Peyrusse Vieille
pptv
ethylbenzene Peyrusse Vieille
pptv
mpxylene Peyrusse Vieille
pptv
oxylene Peyrusse Vieille
pptv
methanal (formaldehyde) Peyrusse Vieille
ug/m3
ethanal (acetaldehyde) Peyrusse Vieille
ug/m3
propanone (acetone) Peyrusse Vieille
ug/m3
propanal Peyrusse Vieille
ug/m3
2−propenal (acrolein) Peyrusse Vieille
ug/m3
2−butanone (methylethylketone) Peyrusse Vieille
ug/m3
2−methyl propenal (methacrolein) Peyrusse Vieille
ug/m3
benzenecarbaldehyde Peyrusse Vieille
ug/m3
ethanedial (glyoxal) Peyrusse Vieille
ug/m3
hexanal Peyrusse Vieille
ug/m3
2−oxopropanal (methylglyoxal) Peyrusse Vieille
ug/m3
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


methanal (formaldehyde) Campisabalos
ethanal (acetaldehyde) Campisabalos
2−propenal (acrolein) Campisabalos
2−butanone (methylethylketone) Campisabalos
2−methyl propenal (methacrolein) Campisabalos
benzenecarbaldehyde Campisabalos
pentanal Campisabalos
hexanal Campisabalos
ug/m3
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec