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

VOC measurements 2007

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Summary

This report presents measurements of VOC carried out during 2007 at EMEP monitoring sites. VOC measurements are reported for a total of 15 sites, and 4 of these with carbonyls. Except for two sites with continuous monitoring of hydrocarbons (Rigi and Hohenpeissenberg) 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.

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 winter median concentration of the hydrocarbons, used as a proxy for the European emission source strength, was fairly low in 2007 for many of the components measured. Some compounds, like toluene and butane, show a long-term development indicating a general reduction in the concentration level, whereas for other compounds there is no clear picture. Robust trend calculations of the VOCs are difficult due to the poor sampling frequency (normally 2 samples per week) and the strong influence of meteorology. Modelling studies are needed to separate the effect of changes in emissions from those of changing meteorology from year to year.

VOC measurements 2007

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, 2007). 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; Borbon et al., 2004; Hakola et al., 2006).

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 2007

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 2007 is given in Table 3. Totally 15 measurement sites reported VOC data to CCC in 2007. Carbonyls were only sampled at 4 sites and only in France and Spain. Previously the lab at NILU/EMEP-CCC has analysed carbonyls sampled at Utö in Finland and Košetice in Czech Republic, but this service is now ended. Furthermore, the hydrocarbon data reported from Campisábalos in Spain need further inspection in order to be considered valid.

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 at least 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 many sites in 2007. Carbonyls are only measured once per week in France giving a data capture of the order of 50%. Only Pallas, Košetice and La Tardière had a sufficient data capture of hydrocarbons, i.e. 94 samples or more, in addition to the sites with daily/continuous monitoring, Hohenpeissenberg and Rigi. Only Campisábalos in Spain had a data completeness fulfilling the criteria of 90% for carbonyls.

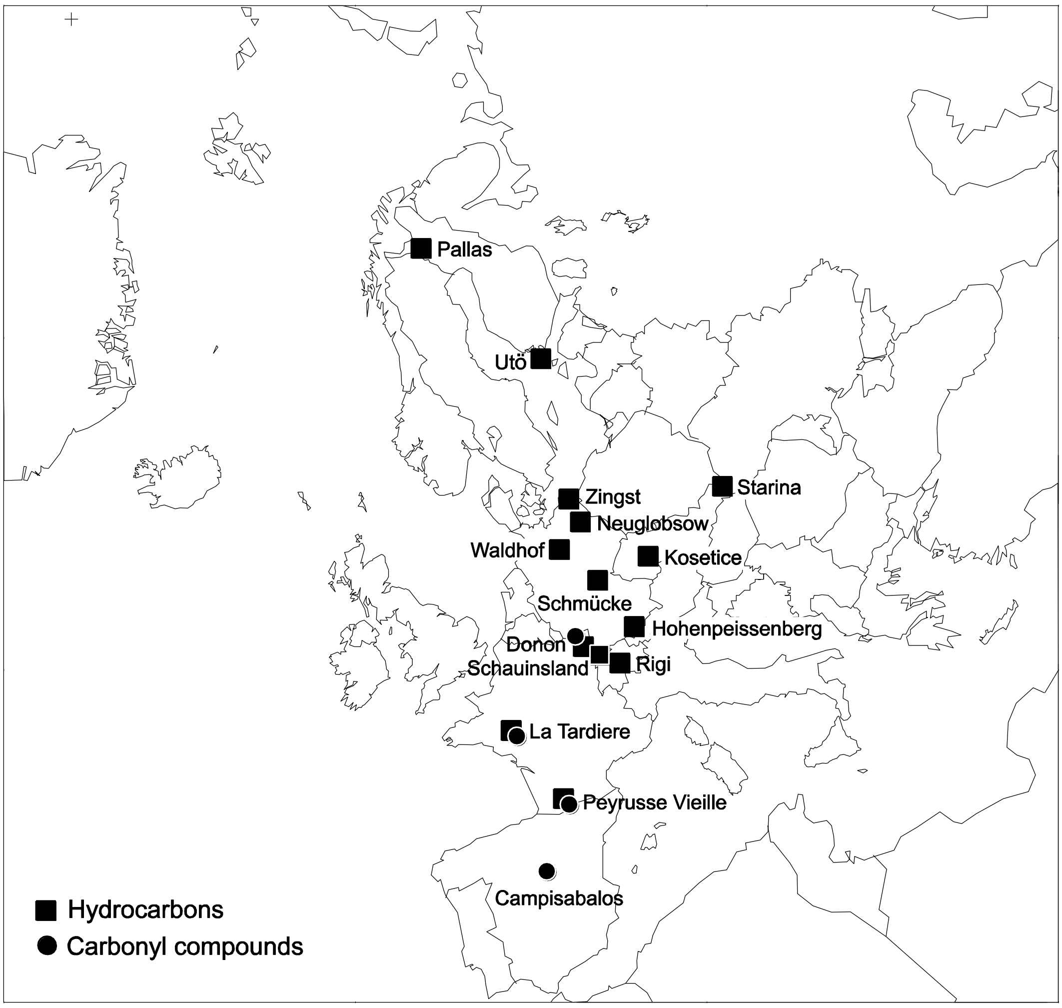

Figure 1: Monitoring sites for VOC in 2007.

Table 3: Status of the VOC monitoring programme in 2007. The columns give the station names, site code, and the sampling frequencies for hydrocarbons (HC) and carbonyl compounds (Carb). The laboratory responsible for the chemical analyses is also given.

Station	Code	HC[1)]	Lab.[2)]	Carb[1)]	Lab.[2)]	Comments
Pallas	FI96	Reg.	FMI	n.m.	-	
Utö	FI09	Reg.	FMI	n.m.	-	Carbonyl sampling ended
Waldhof	DE02	Reg.	UBA	n.m.	-	
Schauinsland	DE03	Reg.	UBA	n.m.	-	
Neuglobsow	DE07	Reg.	UBA	n.m.	-	
Schmücke	DE08	Reg.	UBA	n.m.	-	
Zingst	DE09	Reg.	UBA	n.m.	-	
Hohenpeissenberg	DE43	Daily	DWD	n.m.	-	GAW station
Košetice	CZ03	Reg.	CHMI	n.m.	-	Carbonyl sampling ended
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 Tardière	FR15	Reg.	EMD	Reg.	EMD	
Campisábalos	ES09	(Reg.)	MMA	Reg.	MMA	Hydrocarbons reported but considered preliminary

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)
SHMI = Hydrometeorological Institute in Slovakia
UBA = Umweltbundesamt (Germany)

Table 4: The number of valid samples of hydrocarbons (HC) and carbonyls (Carb) in 2007.

Station	Number of samples HC[2)]	Carb[3)]
Pallas	95	-
Utö	70	-
Waldhof	84	-
Schauinsland	74	-
Neuglobsow	85	-
Schmücke	90	-
Zingst	83	-
Hohenpeissenberg[1)]	346	-
Košetice	104	-
Starina	91	-
Rigi[1)]	272	-
Donon	92	49
Peyrusse Vieille	76	49
La Tardière	95	50
Campisábalos	0	103

[1)] Refers to days with monitoring data
[2)] Refers to ethane (may differ for other HCs)
[3)] Refers to formaldehyde (may differ for other carbonyls)

2.2 Analytical procedures and quality control

The procedures for sampling and chemical analyses were similar in 2007 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. As noted in the last year's report, a new GC and new analytical methods were introduced by UBA for the German sites in 2006 leading to certain systematic changes. In general, the new method was more sensitive to C_7 and higher VOCs. The instrumentation and methods applied by DWD at Hohenpeissenberg have been successfully tested in two international inter-comparison 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 these carbonyls is needed.

3. VOC concentrations in 2007

3.1 General

Monthly mean and median concentrations of the individual hydrocarbons and carbonyls for 2007 are tabulated in Appendix A. The monthly statistics were not calculated for sample numbers less than 4. Time series of all compounds during 2007 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. The stations are arranged from north to south. Considering that the sites span a wide area from southern Europe to the most northern part of the continent, the hydrocarbon winter mean levels are fairly uniform for the alkanes but some systematic differences are seen. Highest concentrations of ethane and propane are seen at Starina (SK06), indicating a higher influence from natural gas there. Particularly high peak values are seen for butane and isobutane at Donon (FR08). Low concentration levels are seen at the two Finnish sites, Pallas (FI96) and Utö (FI09), and at the two German mountain sites, Schauinsland (DE43, 1205 m asl) and Hohenpeissenberg (DE03, 985 m asl) as well as at Rigi (CH05, 1031 m asl).

For the alkenes, ethene and propene, the differences among the sites are larger reflecting an efficient chemical loss in the atmosphere also during winter through the reaction with O_3. The ratio between the peak values (90 percentiles) and the mean are generally largest for propene of all the compounds. Particularly high concentrations of ethene, propene and acetylene (ethyne) are seen at Košetice (CZ03) indicating a stronger influence of road traffic emissions at that site.

The amount of carbonyl data for 2007 is too low to allow any statements about geographical or latitudinal patterns. Furthermore, at the French sites the sampling frequency is once per week, making the seasonal statistics more uncertain. We note, however, that the concentration levels differ substantially between the Spanish site Campisábalos on one side and the three French sites on the other. Formaldehyde levels were significantly lower at Campisábalos than the other sites and vice versa for acetaldehyde.

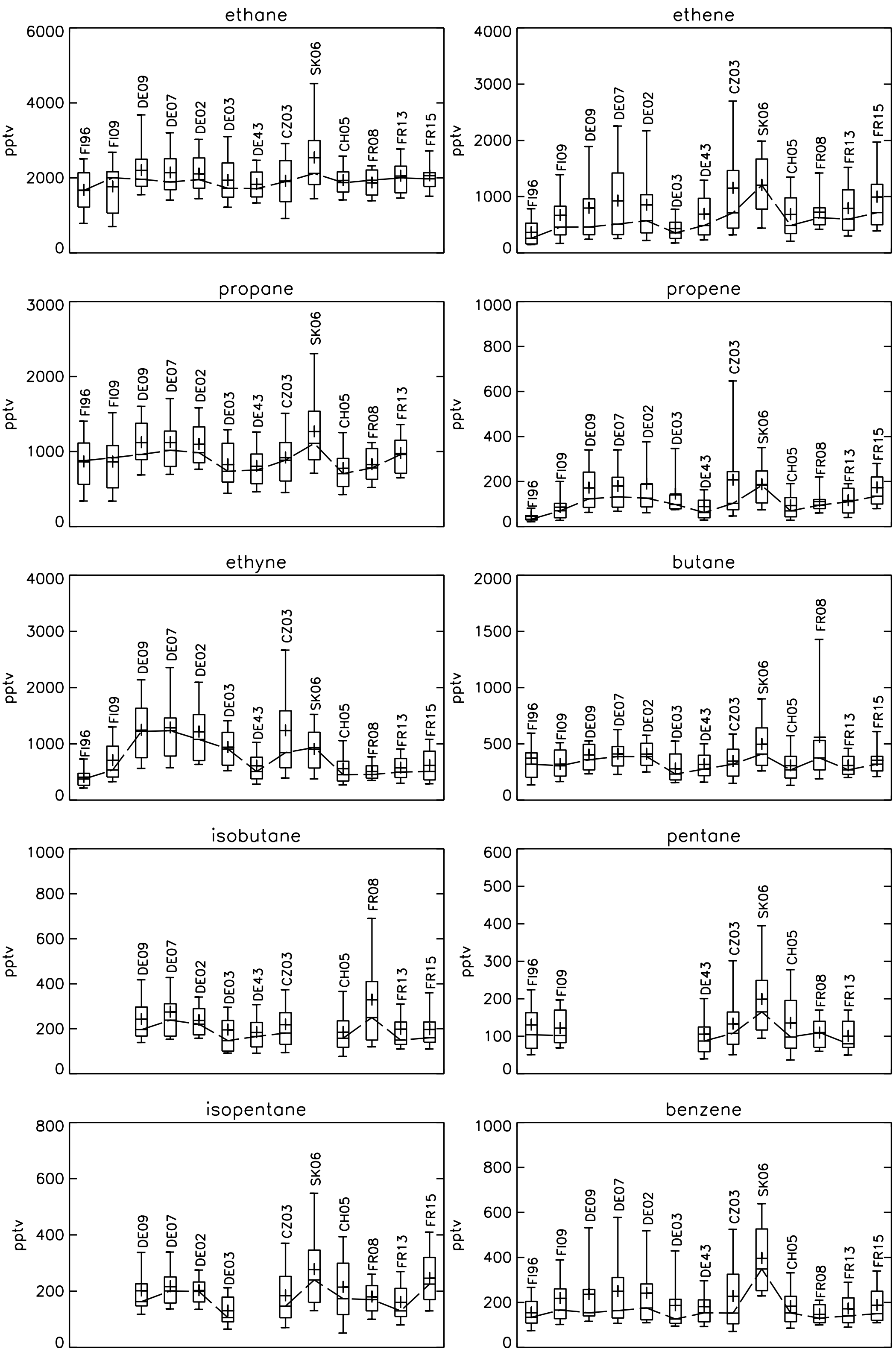

Figure 2: Box- and whisker-diagrams for hydrocarbons during winter 2007 (Jan., Feb., Nov., Dec.). The markers indicate the 10-, 25-, 50-, 75- and 90-percentiles. Mean values are indicated by a cross. The dashed line connects the median values for clarity.

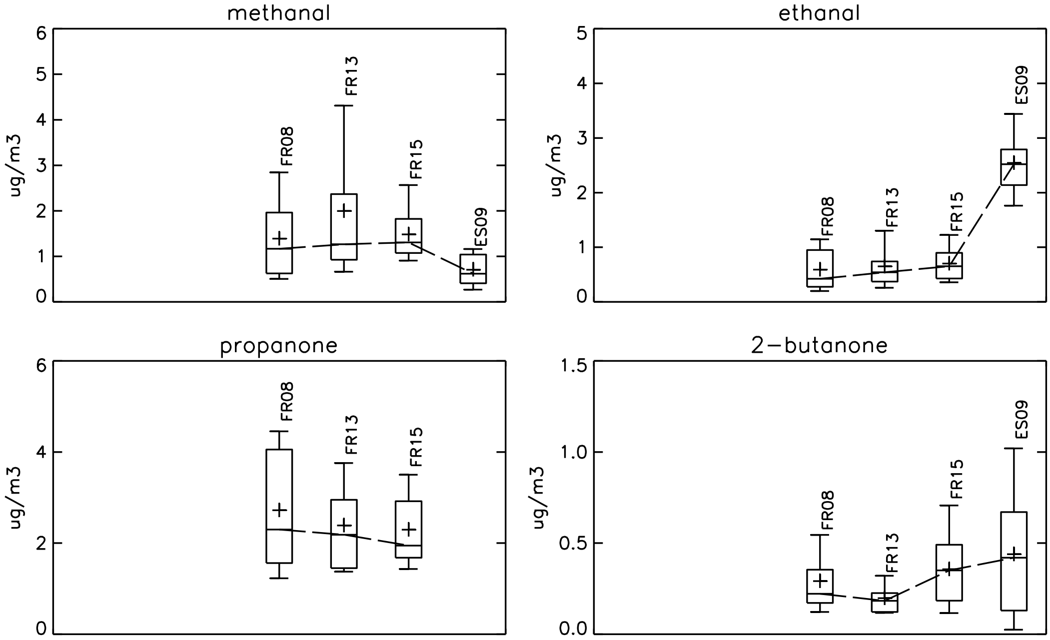

Figure 3: Box- and whisker-diagrams for carbonyls during summer 2007 (May, June, July, August). The markers indicate the 10-, 25-, 50-, 75- and 90-percentiles. Mean values are indicated by a cross.

3.2 Regional distribution of VOC

Figure 4–Figure 13 show maps with the stations' median concentrations of 10 light hydrocarbons for the winter months January, February, November and December in 2007 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 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 2007 are given in Figure 14–Figure 16.

The measurements indicate that hydrocarbons become fairly well mixed in Europe in winter. Components with a long chemical lifetime in winter, such as ethane and propane, show less geographical variations.

Certain characteristics are seen in the 2007 though. A north to south gradient in median concentration level is seen for many components indicating the distance to the main emission areas. For several components an area with maximum winter median concentration levels are found in central Europe (central/Eastern Germany) in addition to Starina (East Slovakia).

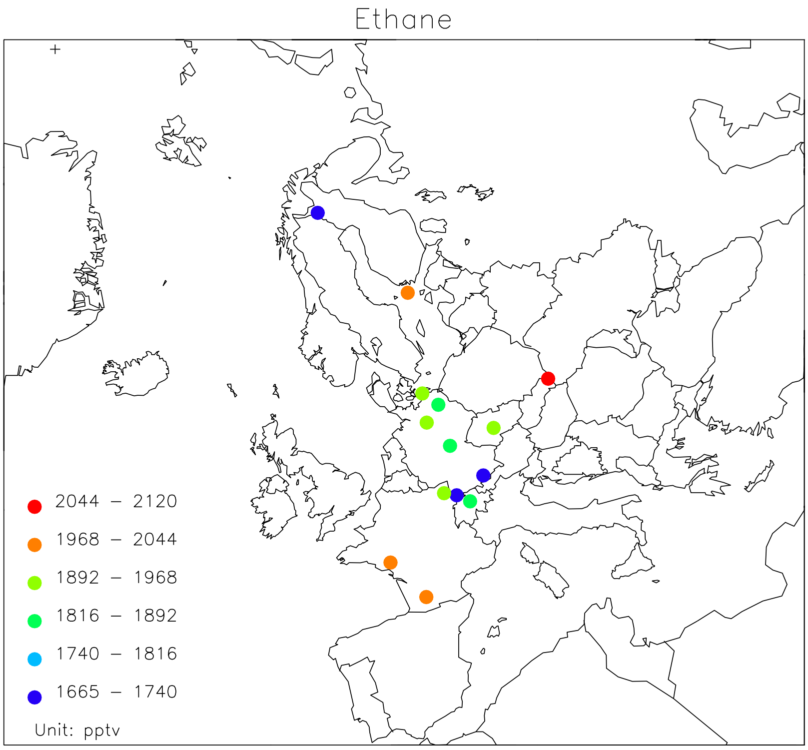

Figure 4: Median concentration of ethane at EMEP sites in the winter months November, December, January and February 2007 taken together.

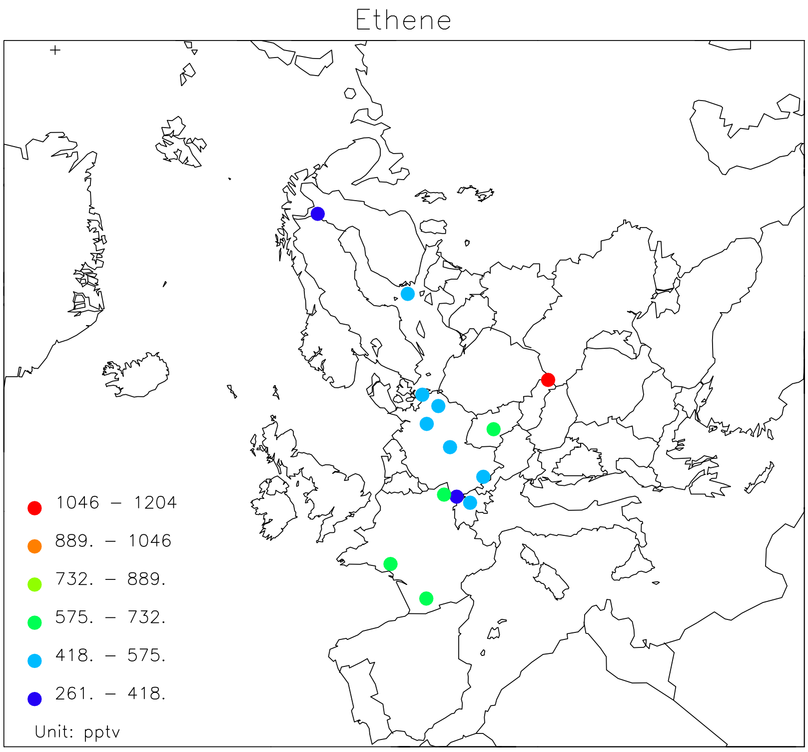

Figure 5: Median concentration of ethene at EMEP sites in the winter months November, December, January and February 2007 taken together.

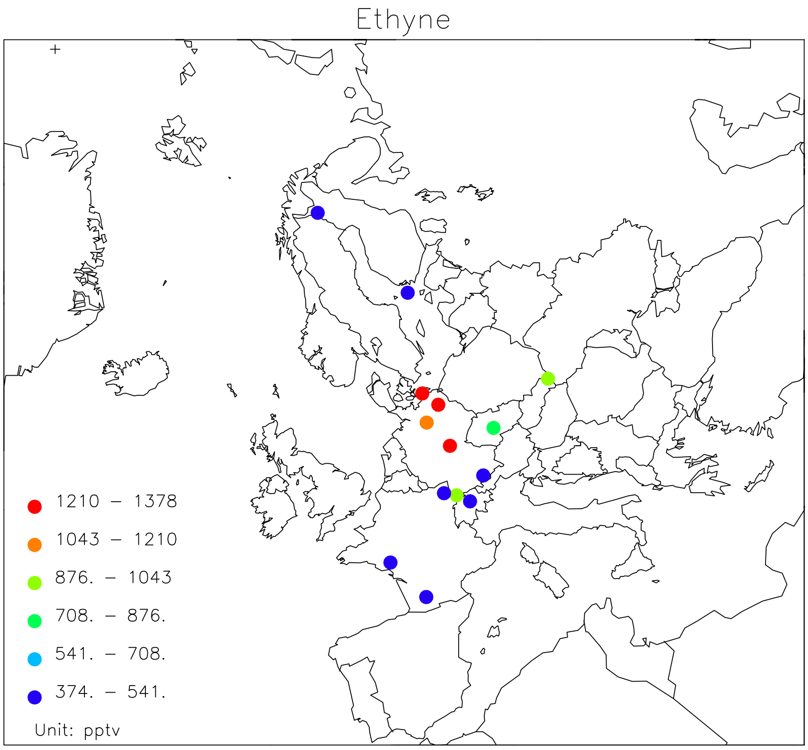

Figure 6: Median concentration of acetylene at EMEP sites in the winter months November, December, January and February 2007 taken together.

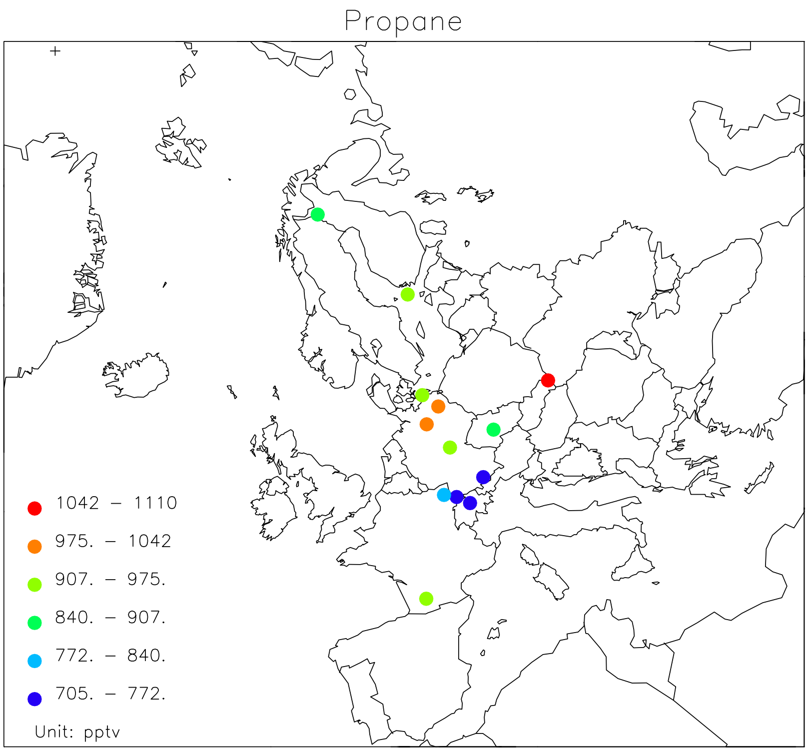

Figure 7: Median concentration of propane at EMEP sites in the winter months November, December, January and February 2007 taken together.

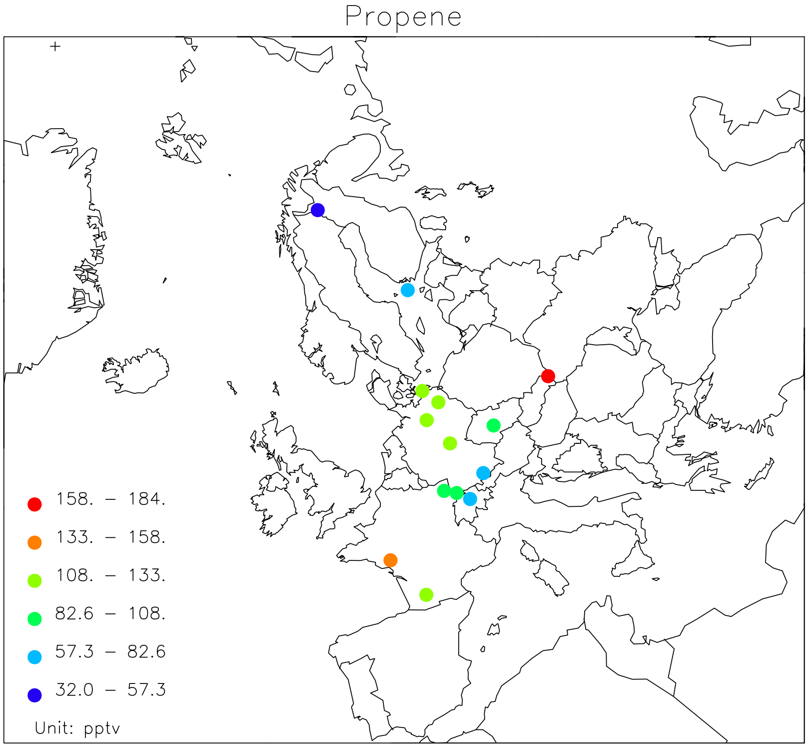

Figure 8: Median concentration of propene at EMEP sites in the winter months November, December, January and February 2007 taken together.

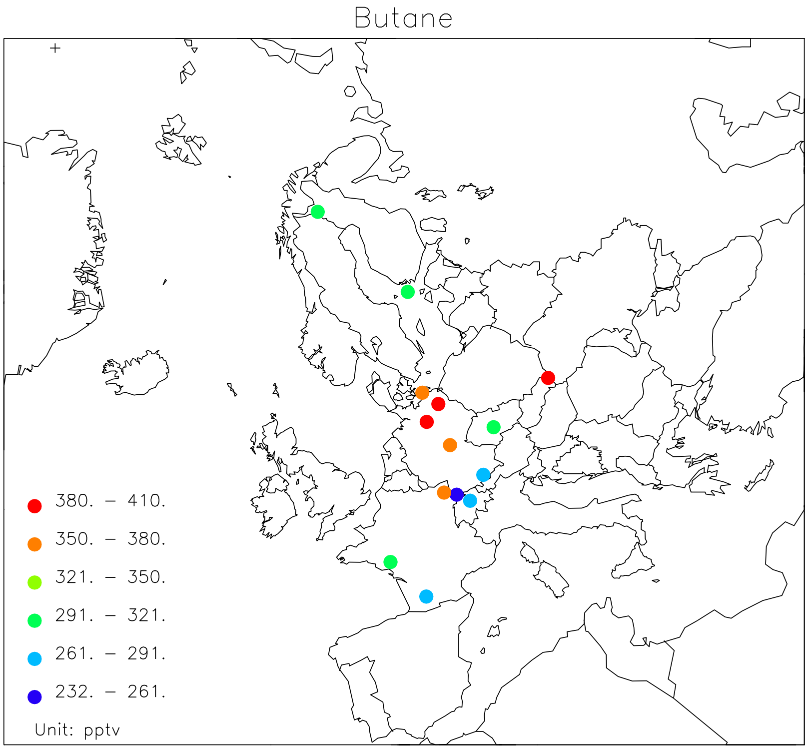

Figure 9: Median concentration of n-butane at EMEP sites in the winter months November, December, January and February 2007 taken together.

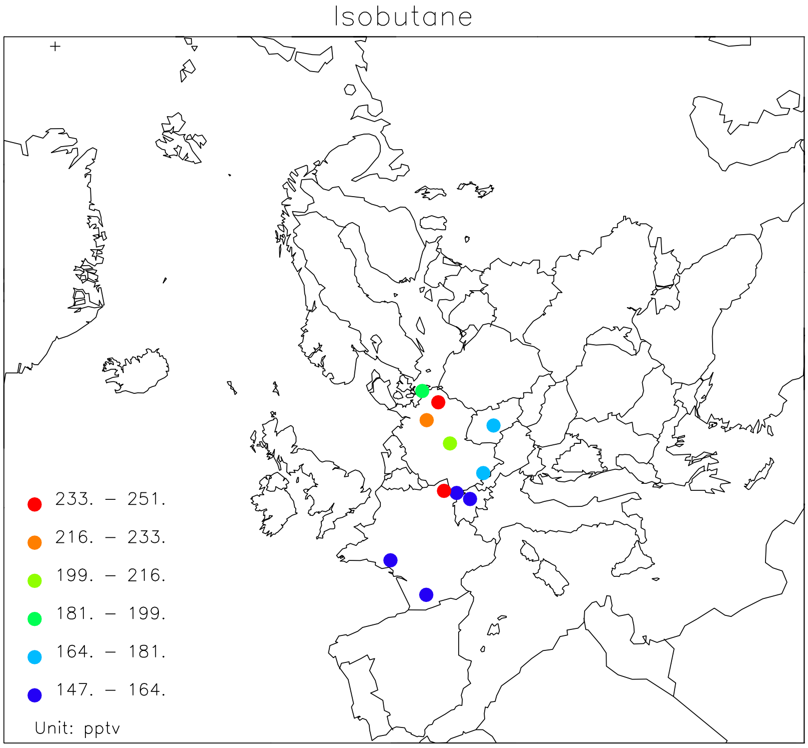

Figure 10: Median concentration of i-butane at EMEP sites in the winter months November, December, January and February 2007 taken together.

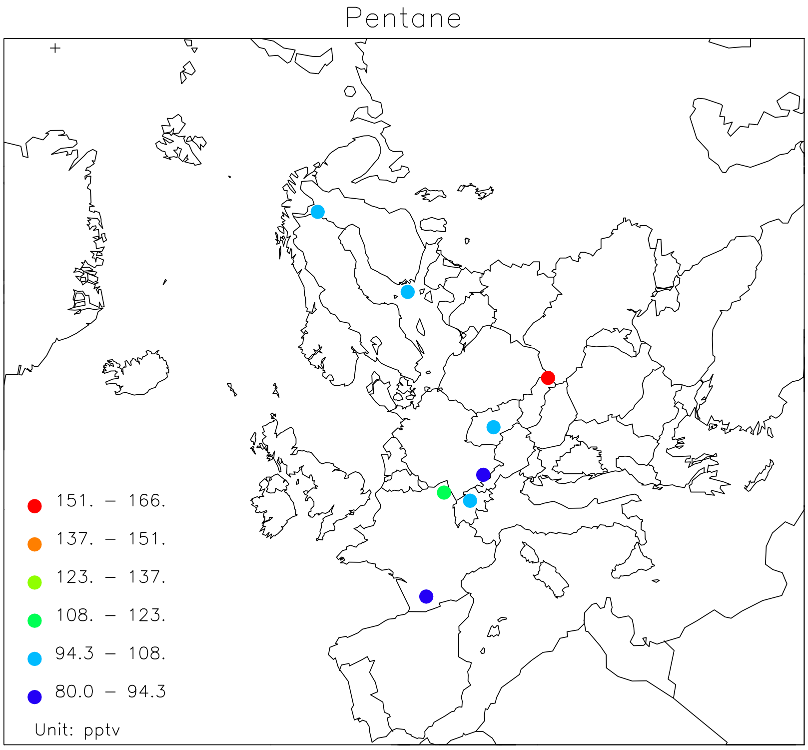

Figure 11: Median concentration of n-pentane at EMEP sites in the winter months November, December, January and February 2007 taken together.

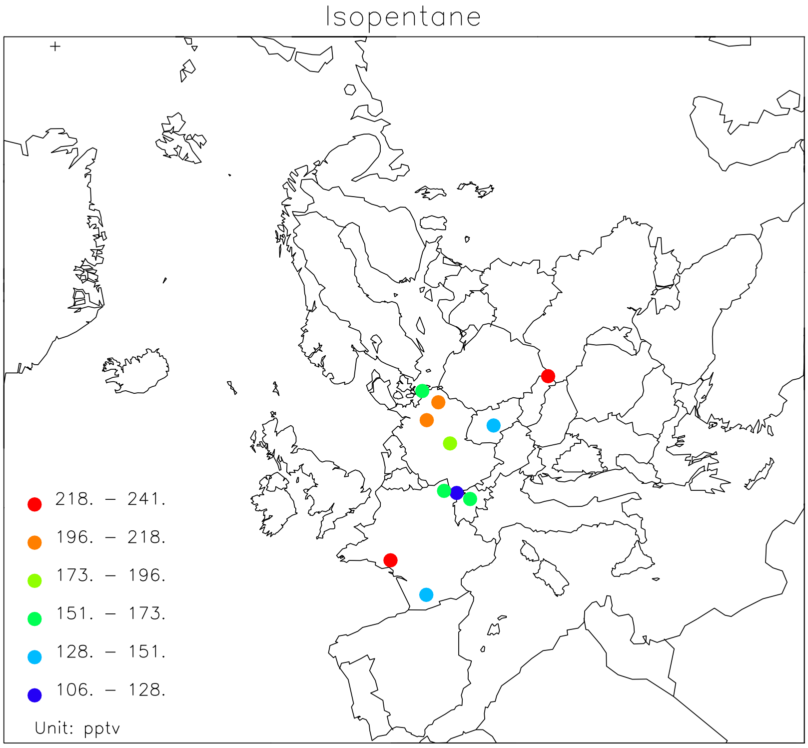

Figure 12: Median concentration of i-pentane at EMEP sites in the winter months November, December, January and February 2007 taken together.

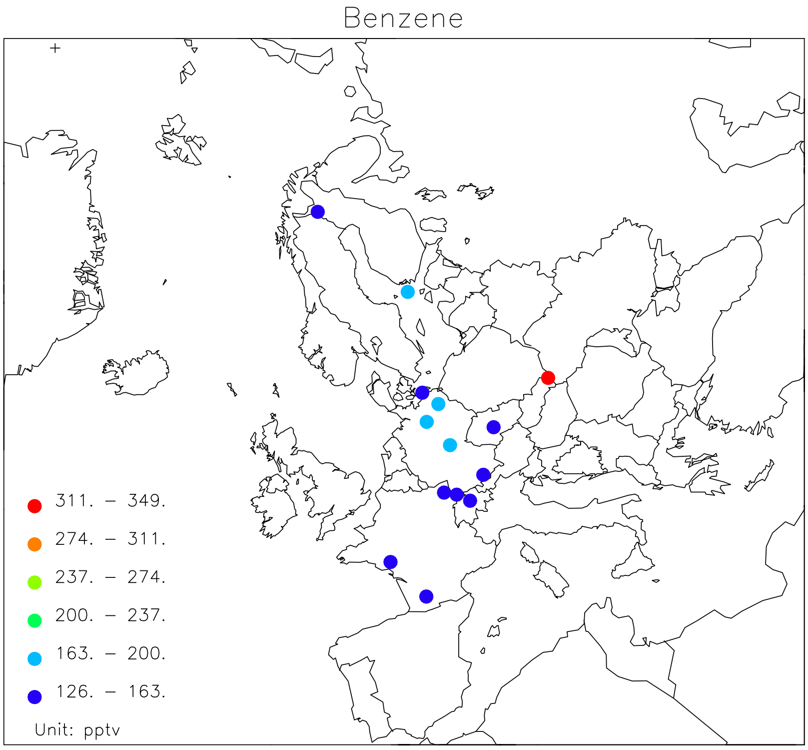

Figure 13: Median concentration of benzene at EMEP sites in the winter months November, December, January and February 2007 taken together.

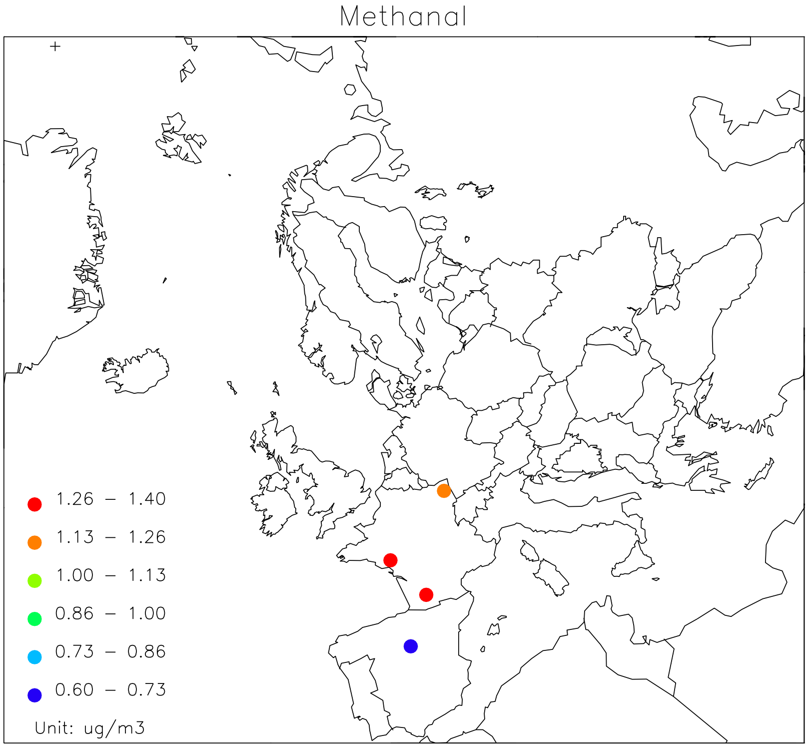

Figure 14: Median concentration of formaldehyde at EMEP sites in the summer months May, June, July and August 2007 taken together.

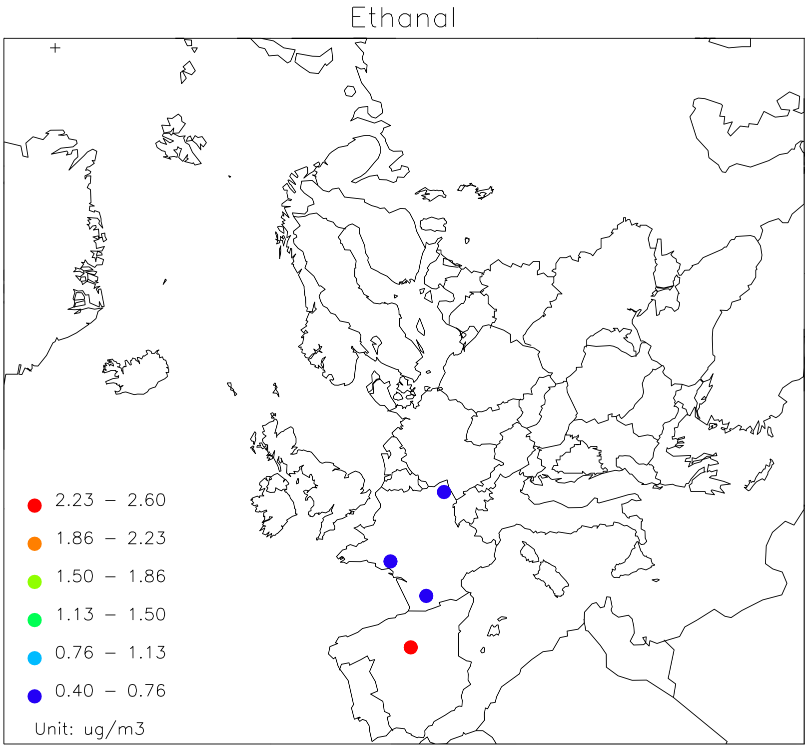

Figure 15: Median concentration of acetaldehyde at EMEP sites in the summer months May, June, July and August 2007 taken together.

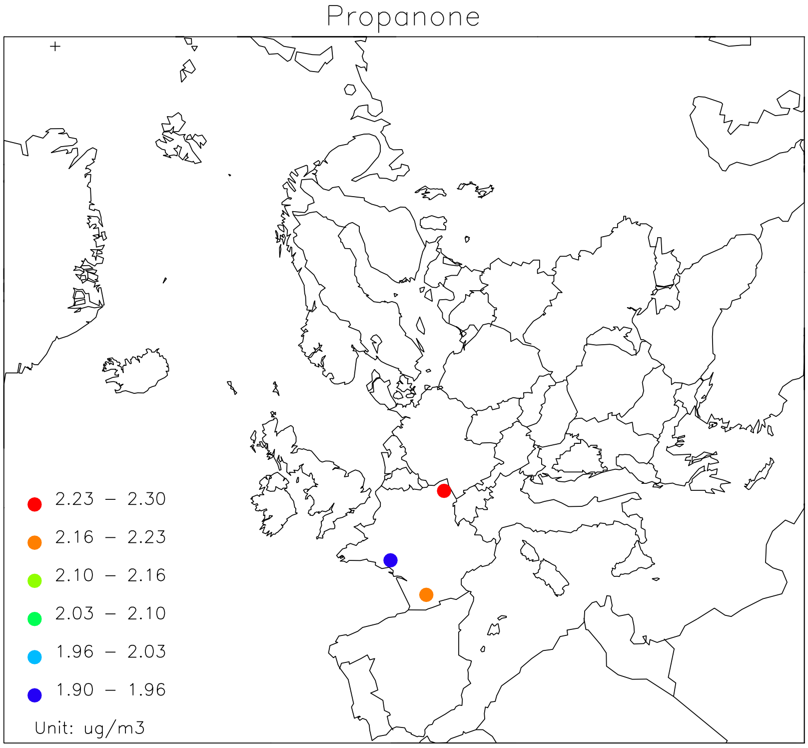

Figure 16: Median concentration of acetone at EMEP sites in the summer months May, June, July and August 2007 taken together.

4. Long-term trends in VOC

The 13 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 13 year's trend, or variations, in the winter medians 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.

In general the median concentration levels shown in Figure 17 indicates fairly low values in 2007 compared to previous years. For ethene, butane and toluene the time series indicate that the reduction in median levels seen previously continued in 2007.

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.

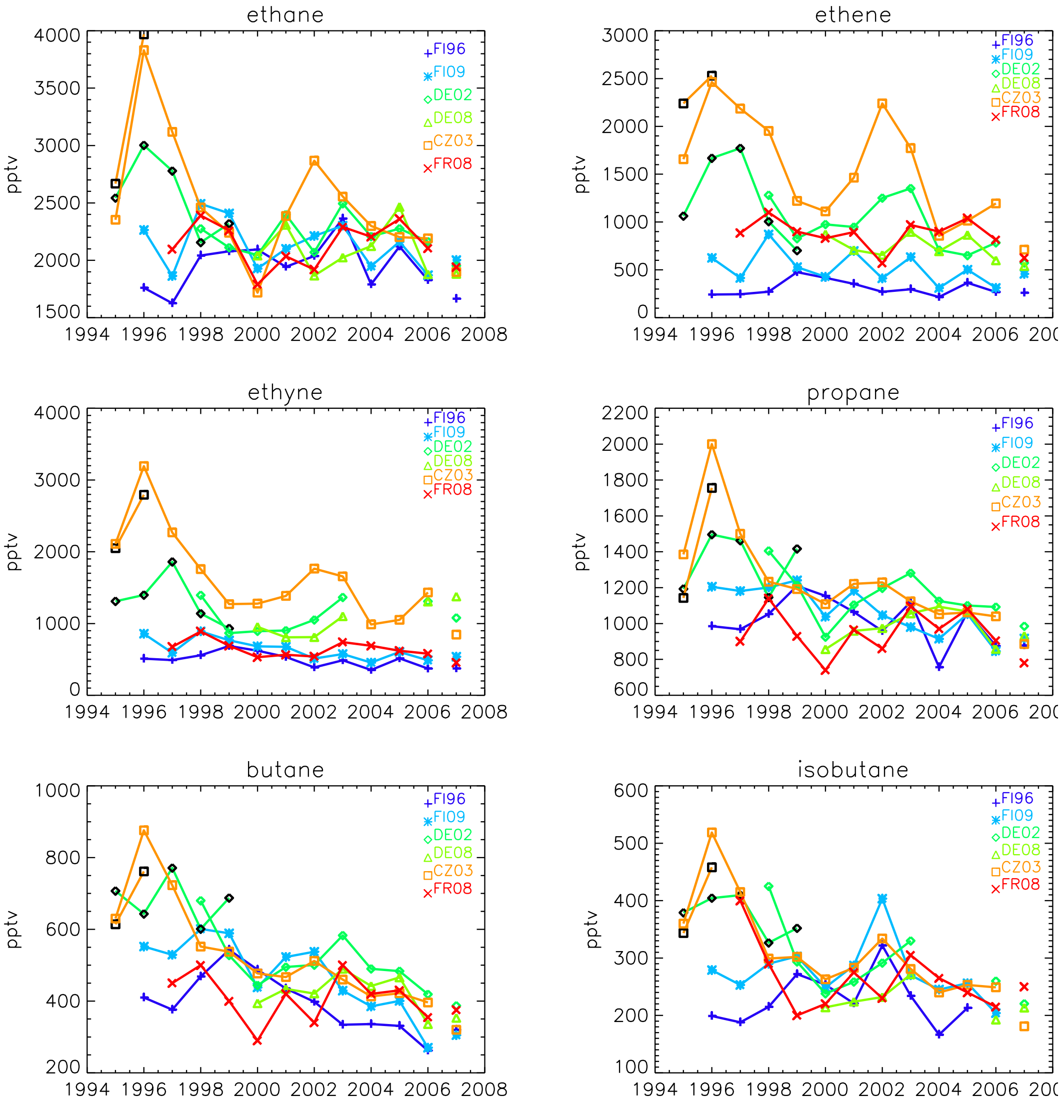

Figure 17: Annual winter (Jan., Feb., Nov., Dec.) median concentrations of hydrocarbons at Košetice (CZ03), Waldhof (DE02), Donon (FR08), Peyrusse Vieille (FR13), Utö (FI09) and Pallas (FI96). Black symbols mark analyses from NILU's lab., coloured symbols mark the national lab.

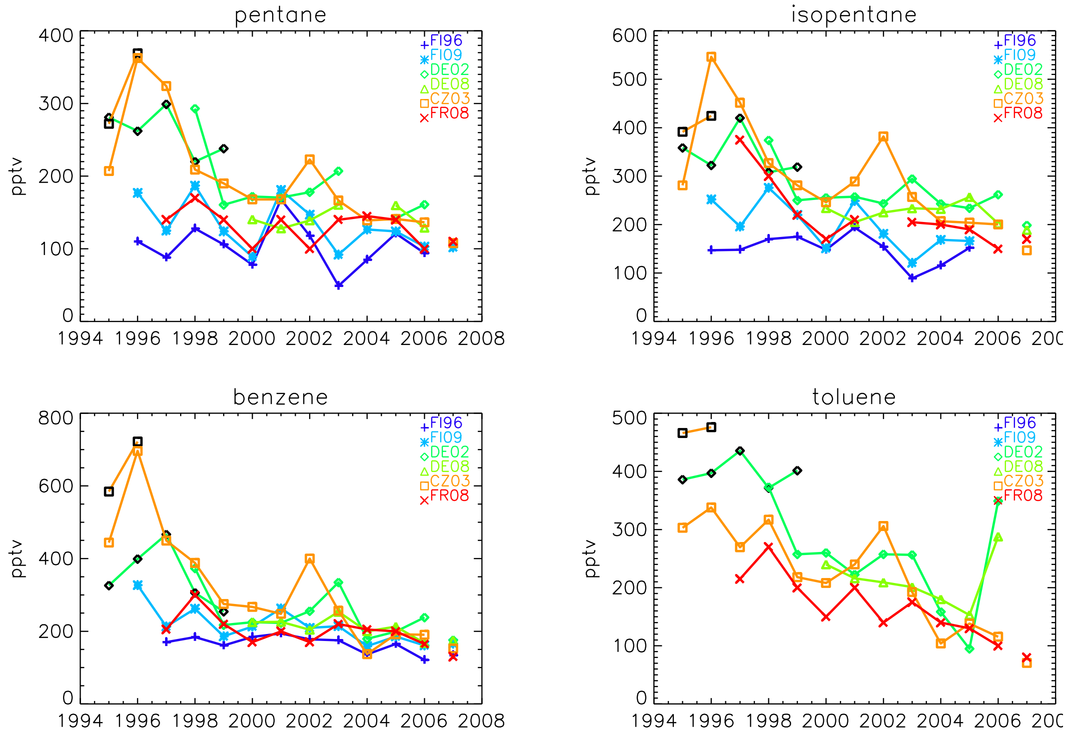

Figure 17, cont.

5. 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), Hannele Hakola (FMI), Radek Pokorny (CHMI), Marta Mitosinkova (SHMI), Alberto Gonzalez Ortiz (MMA), Karin Uhse (UBA), Christian Plass-Dülmer (DWD) and Stefan Reimann (EMPA).

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Appendix A

Monthly mean and median concentrations of hydrocarbons and carbonyls in 2007

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	-	2399	2074	1775	1559	1006	669	536	620	1092	1352	1395
	-	2432	2011	1760	1658	1034	659	537	596	961	1314	1456
Utö	-	2463	2410	-	-	943	673	659	709	1197	892	1384
	-	2142	2398	-	-	939	626	588	694	965	878	1059
Zingst	1948	2495	2596	1718	-	1030	696	876	922	1818	2117	2302
	1943	2214	2404	1643	-	1054	683	811	860	1399	1907	1932
Neuglobsow	1843	2841	2328	1746	-	1099	741	713	1060	1354	1958	1974
	1822	2808	2292	1542	-	1049	724	706	1048	1213	1724	1789
Waldhof	1991	2649	2094	1842	-	1221	767	739	830	1741	1813	1982
	1958	2754	2188	1730	-	1119	746	694	791	1332	1573	1757
Schmücke	1812	2446	2198	1761	-	1028	748	704	1065	1635	1682	2024
	1870	2409	2194	1617	-	952	715	642	1037	1319	1710	1849
Schauinsland	1841	1994	2752	1742	-	960	816	745	932	1702	2235	1595
	1661	1887	2805	1745	-	880	755	735	936	1639	1910	1540
Hohenpeissenberg	1804	2062	2271	1744	1272	1005	716	775	874	1364	1628	1790
	1696	2102	2287	1663	1243	949	737	725	840	1249	1526	1657
Starina	2583	3162	2165	1755	1495	1080	958	1043	1185	1773	2091	2413
	2453	2977	2030	1759	1500	1039	963	1012	1103	1383	1889	2065
Košetice	1430	2390	2383	1879	1293	1117	740	844	1126	1941	1995	1892
	1169	2159	2235	1840	1366	1137	733	803	954	1403	1627	1898
Rigi	1775	2058	2263	1771	1681	1076	873	938	1106	1834	1993	1998
	1676	2043	2240	1704	1681	1034	875	892	1110	1754	1966	1883
La Tardière	1924	2203	2284	1830	1251	918	603	759	831	1418	1840	2306
	1790	2125	2065	1880	1280	815	630	730	770	1375	1840	2315
Donon	2010	2155	2366	1760	1220	979	701	790	973	1432	1486	1918
	2065	2170	2435	1805	1210	965	695	720	925	1230	1405	1880
Peyrusse Vieille	1983	2136	2261	1879	1235	870	625	751	900	1254	1759	2306
	1690	2010	2205	1780	1260	830	650	740	855	1160	1595	2305

ETHENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	317	169	55	39	51	63	59	61	159	306	506
	-	248	153	57	36	40	58	52	53	127	165	292
Utö	-	536	577	-	-	122	102	127	108	317	799	794
	-	439	338	-	-	112	83	103	118	172	321	396
Zingst	499	857	457	262	-	187	148	215	213	525	852	1054
	420	608	493	256	-	191	125	208	178	375	404	378
Neuglobsow	407	1363	394	204	-	219	167	211	320	591	1044	940
	437	963	454	201	-	214	143	206	276	354	540	673
Waldhof	454	1091	400	251	-	246	194	185	222	531	921	929
	416	953	343	257	-	250	192	173	208	400	655	760
Schmücke	423	820	447	245	-	175	155	135	336	681	753	976
	398	818	450	173	-	177	149	124	293	606	666	635
Schauinsland	388	423	850	311	-	178	170	196	289	517	465	457
	324	376	786	344	-	168	152	235	274	465	455	257
Hohenpeissenberg	552	618	490	375	198	174	142	226	278	680	757	674
	392	521	459	325	152	132	108	180	270	509	516	418
Starina	1339	1220	565	307	252	184	429	371	320	623	990	1240
	1530	1137	420	263	174	198	186	339	302	505	870	1267
Košetice	523	1368	772	244	139	216	162	161	466	885	1131	1609
	433	779	867	171	132	163	165	163	264	681	699	1403
Rigi	505	611	480	297	237	148	140	254	308	960	967	625
	398	458	391	233	206	137	132	213	273	798	925	382
La Tardière	669	913	644	457	350	275	205	260	239	783	1073	1349
	570	775	570	470	350	270	200	235	260	640	910	1475
Donon	760	792	641	465	359	296	224	285	470	706	605	785
	705	755	710	435	320	275	180	245	300	520	570	600
Peyrusse Vieille	801	635	431	374	378	326	148	197	290	451	609	1123
	680	450	370	400	360	220	125	200	220	320	540	1250

PROPANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	1235	809	479	320	116	90	87	141	403	696	734
	-	1234	794	474	332	103	94	83	135	360	562	689
Utö	-	1180	1004	-	-	125	125	184	232	477	451	708
	-	1066	867	-	-	104	119	169	220	388	343	592
Zingst	1019	1248	1102	543	-	286	177	373	388	770	1022	1234
	956	1006	986	533	-	294	137	363	330	679	1042	1018
Neuglobsow	925	1454	974	574	-	426	257	378	544	661	1099	1037
	884	1323	1028	519	-	484	269	369	504	565	925	951
Waldhof	998	1305	905	562	-	461	252	296	328	832	1066	1021
	958	1329	941	465	-	439	239	283	322	602	898	900
Schmücke	896	1227	868	556	-	372	282	331	515	850	869	1044
	900	1184	921	492	-	317	263	300	593	705	896	911
Schauinsland	824	860	1261	556	-	245	220	258	362	708	846	766
	614	773	1296	552	-	223	220	224	344	667	880	669
Hohenpeissenberg	777	852	849	539	281	237	177	282	315	611	730	813
	694	897	812	512	260	219	144	249	289	584	648	675
Starina	1252	1617	953	604	517	354	325	462	471	817	922	1313
	1140	1573	900	626	515	335	339	467	470	580	791	1152
Košetice	628	1055	875	487	275	289	175	244	395	570	948	1050
	477	971	838	425	286	242	168	226	324	540	654	1039
Rigi	694	728	765	480	363	217	187	318	385	758	883	771
	598	681	740	427	364	189	170	287	349	655	839	706
La Tardière	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	903	913	893	538	262	218	199	283	378	631	630	935
	890	900	820	520	220	195	170	240	315	540	605	885
Peyrusse Vieille	910	974	860	556	296	279	138	258	338	510	850	1154
	770	965	845	510	280	195	105	210	335	430	765	1185

PROPENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	33	34	15	15	22	23	21	18	36	45	56
	-	30	31	15	16	19	22	17	17	36	37	42
Utö	-	57	62	-	-	40	39	36	23	39	98	96
	-	52	43	-	-	38	39	34	26	38	88	70
Zingst	141	136	133	74	-	54	66	71	68	150	187	233
	115	125	133	64	-	50	61	75	66	93	147	111
Neuglobsow	118	210	82	51	-	59	70	87	97	147	212	183
	123	154	63	46	-	57	63	83	81	83	124	142
Waldhof	120	172	85	59	-	63	64	78	66	191	271	184
	118	174	79	61	-	64	63	71	63	96	140	146
Schmücke	114	151	81	45	-	51	59	56	93	109	145	194
	110	142	79	41	-	45	55	53	98	111	130	138
Schauinsland	112	108	160	66	-	57	71	72	87	110	214	126
	106	96	150	63	-	46	70	63	75	107	116	82
Hohenpeissenberg	79	82	51	35	19	19	17	26	37	77	95	85
	57	63	47	19	16	13	15	19	34	55	69	55
Starina	205	186	91	48	52	52	133	126	69	101	130	218
	207	189	70	53	43	54	58	82	67	78	128	197
Košetice	77	238	96	32	25	37	31	25	67	166	160	356
	63	102	89	23	22	42	28	26	46	145	124	354
Rigi	66	66	61	42	40	26	29	51	58	147	138	95
	48	48	52	34	36	23	26	44	53	125	112	72
La Tardière	123	149	153	81	289	90	83	93	66	150	213	206
	100	115	90	80	110	90	80	90	70	165	160	225
Donon	118	115	91	65	67	59	51	58	155	108	90	130
	105	85	90	60	70	55	50	50	60	60	90	100
Peyrusse Vieille	131	75	59	68	81	68	69	58	74	87	88	170
	120	55	50	70	65	60	60	60	45	80	75	175

ETHYNE (ACETYLENE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	338	449	336	214	97	67	61	120	213	374	500
	-	368	425	364	220	97	64	60	98	175	313	376
Utö	-	850	907	-	-	130	96	134	130	369	655	663
	-	726	779	-	-	132	110	89	124	283	364	414
Zingst	1408	1538	1382	836	-	451	410	508	496	762	1012	998
	1438	1517	1423	752	-	443	403	490	462	767	656	791
Neuglobsow	1260	1802	1190	755	-	445	411	448	537	732	1166	944
	1337	1611	1143	748	-	410	405	436	486	662	773	785
Waldhof	1299	1761	1235	958	-	476	442	486	494	704	917	923
	1356	1537	1227	961	-	487	453	486	468	588	761	704
Schmücke	1513	1478	1367	942	-	433	467	493	615	1001	1023	1035
	1576	1502	1393	905	-	442	482	480	589	915	909	905
Schauinsland	1284	1151	-	1040	-	439	430	475	508	863	683	675
	1281	1145	-	1011	-	458	441	460	529	903	641	616
Hohenpeissenberg	536	662	662	462	237	184	128	188	218	580	571	574
	445	629	653	407	218	156	112	188	210	483	432	444
Starina	837	1032	566	432	269	172	258	308	285	525	731	1026
	855	964	570	425	235	171	179	228	272	448	726	1152
Košetice	620	1248	1067	603	303	286	189	261	464	681	1162	1913
	507	1064	1085	524	319	281	204	234	326	686	654	1816
Rigi	442	710	632	421	297	190	153	220	258	701	681	514
	373	629	557	379	296	188	139	198	235	595	616	379
La Tardière	450	688	583	397	183	126	88	119	133	418	584	783
	390	575	480	360	170	95	70	110	130	335	450	815
Donon	524	590	563	421	277	146	110	134	211	519	424	523
	490	575	510	390	190	145	90	140	190	470	390	400
Peyrusse Vieille	591	629	520	412	165	114	66	123	135	320	466	610
	500	585	450	410	165	95	45	80	135	180	380	535

BUTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	586	295	97	61	65	25	24	175	132	288	317
	-	420	257	97	46	63	23	17	34	120	203	284
Utö	-	393	288	-	-	45	43	52	78	160	224	282
	-	347	239	-	-	49	30	49	70	128	165	213
Zingst	381	410	389	159	-	97	65	136	156	367	328	493
	358	410	348	146	-	105	41	122	110	286	325	386
Neuglobsow	361	585	298	163	-	143	85	156	237	264	318	387
	348	558	293	179	-	147	92	120	185	200	305	376
Waldhof	373	491	304	167	-	162	107	128	141	338	383	389
	335	497	303	159	-	178	120	112	123	255	366	365
Schmücke	326	470	302	181	-	98	112	107	192	324	305	429
	347	461	329	188	-	92	92	90	195	287	330	366
Schauinsland	287	281	-	238	-	100	108	101	161	265	316	223
	221	240	-	249	-	71	119	93	140	282	250	221
Hohenpeissenberg	300	323	288	170	92	85	67	113	137	259	296	299
	257	317	281	161	79	76	61	87	129	231	258	255
Starina	493	627	327	216	186	149	151	239	179	343	362	524
	441	648	310	189	181	121	152	205	173	241	272	431
Košetice	233	397	279	126	88	106	73	87	155	279	347	414
	208	370	249	109	89	87	79	77	124	227	230	366
Rigi	277	303	307	231	150	93	96	156	177	319	366	272
	236	271	269	210	145	91	90	142	167	275	346	239
La Tardière	334	368	339	207	152	98	60	115	130	309	314	408
	310	320	310	170	120	80	55	105	100	265	300	390
Donon	354	445	305	209	99	129	83	115	159	262	403	1455
	330	375	245	210	80	70	60	100	140	220	295	1445
Peyrusse Vieille	299	298	253	149	79	55	43	76	101	151	275	359
	240	275	245	150	65	50	30	60	95	110	230	335

ISOBUTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	218	269	226	92	-	67	43	82	96	178	201	286
	199	233	192	95	-	57	32	81	68	135	200	193
Neuglobsow	214	335	201	139	-	150	101	83	194	207	289	268
	191	349	197	95	-	137	92	65	142	148	199	241
Waldhof	216	282	200	94	-	107	73	74	85	212	219	233
	202	269	178	88	-	119	69	66	83	155	203	190
Schmücke	205	291	172	101	-	64	61	64	125	196	207	261
	202	300	190	97	-	64	53	52	123	166	210	249
Schauinsland	168	168	334	169	-	63	77	65	104	172	263	176
	158	148	295	171	-	55	79	52	96	175	152	127
Hohenpeissenberg	169	191	177	116	64	67	46	77	83	177	179	170
	141	185	163	111	56	56	41	63	78	142	155	138
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	134	252	180	85	61	73	50	63	108	205	224	267
	120	228	156	77	62	66	50	57	81	163	142	226
Rigi	159	190	184	141	89	56	55	97	105	214	228	165
	135	175	154	129	87	49	50	89	98	172	211	132
La Tardière	192	215	335	214	77	105	36	68	74	279	170	214
	150	165	195	120	70	70	35	55	90	155	160	185
Donon	218	257	290	164	88	88	74	84	98	207	269	778
	185	210	145	155	40	45	30	70	85	180	260	725
Peyrusse Vieille	163	174	160	111	49	35	21	42	55	107	181	271
	130	150	140	90	40	40	15	20	50	80	135	210

BUTENES

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Starina	68	71	65	73	56	65	65	71	58	65	65	76
	68	71	60	60	54	65	62	64	58	61	67	74
Košetice	39	82	47	31	41	41	28	27	44	107	60	125
	25	58	50	28	38	39	27	28	37	64	67	86
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardière	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

BUT_1_ENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	12	9	3	3	7	6	6	6	9	11	13
	-	9	10	3	3	7	6	6	6	10	9	14
Utö	-	10	11	-	-	12	11	10	5	10	24	16
	-	10	8	-	-	10	11	10	6	10	22	14
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	16	16	11	9	6	6	5	6	8	16	18	16
	13	14	11	7	6	5	5	5	7	12	14	12
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardière	32	38	31	26	34	36	33	30	26	35	40	46
	30	30	30	20	30	35	30	25	30	40	40	50
Donon	29	28	25	20	24	21	20	20	21	23	23	-
	30	20	25	20	20	20	20	20	20	20	20	-
Peyrusse Vieille	26	16	17	16	26	20	22	18	26	20	19	40
	30	15	15	20	25	15	20	20	20	20	20	40

TRANS_2_BUTENE

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

PENTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	181	117	25	20	18	14	11	28	48	111	122
	-	105	69	27	13	21	11	9	14	44	68	90
Utö	-	143	101	-	-	28	25	29	34	79	107	101
	-	137	86	-	-	28	14	20	33	68	86	96
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	94	100	110	89	49	50	42	66	84	148	123	93
	82	94	83	73	41	43	32	54	71	122	92	73
Starina	199	284	140	95	81	72	79	94	83	150	135	190
	192	294	140	84	66	58	85	94	73	115	110	149
Košetice	78	141	99	43	50	73	41	39	84	123	155	158
	67	127	76	37	51	50	39	39	77	106	93	136
Rigi	109	129	140	173	109	63	73	113	134	190	189	110
	83	104	97	139	80	49	58	95	111	152	165	84
La Tardière	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	110	95	125	81	43	45	50	66	86	143	109	-
	95	100	65	80	30	45	50	60	65	110	95	-
Peyrusse Vieille	90	85	76	49	51	26	24	40	49	63	105	120
	80	80	70	50	25	20	25	30	40	40	80	115

ISOPENTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	186	200	213	80	-	85	64	96	123	207	171	253
	160	172	190	72	-	84	58	89	102	174	163	191
Neuglobsow	197	273	173	123	-	154	92	129	213	180	179	217
	178	259	173	92	-	118	77	98	177	128	150	201
Waldhof	185	217	152	89	-	123	94	110	119	258	201	207
	178	217	152	90	-	125	89	100	82	200	180	206
Schmücke	183	260	188	124	-	134	106	113	172	229	199	235
	182	271	191	128	-	114	104	97	159	214	180	192
Schauinsland	148	135	314	224	-	104	127	120	147	220	140	89
	125	131	287	238	-	67	109	128	131	175	115	102
Hohenpeissenberg	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Starina	298	347	211	240	152	174	230	385	135	245	212	262
	309	327	230	131	119	112	247	183	134	207	171	237
Košetice	104	208	138	68	81	104	71	81	131	168	191	235
	105	177	124	65	78	80	76	78	103	145	142	216
Rigi	172	224	211	268	171	139	171	244	257	313	306	175
	143	185	167	240	153	118	158	225	234	263	291	139
La Tardière	221	228	219	194	189	146	155	173	189	401	259	280
	220	210	160	170	130	160	125	130	210	305	240	275
Donon	165	167	149	128	82	74	93	105	134	189	148	295
	140	170	105	125	70	60	70	100	110	170	120	260
Peyrusse Vieille	150	143	128	104	95	56	46	70	89	114	159	189
	130	130	120	90	55	65	40	60	70	100	130	175

HEXANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	59	33	5	5	5	4	3	6	10	35	36
	-	51	22	6	3	3	3	3	3	9	20	28
Utö	-	49	29	-	-	9	7	7	8	18	35	39
	-	43	24	-	-	8	3	3	9	16	28	36
Zingst	84	79	82	32	-	47	35	36	48	56	96	165
	75	71	65	28	-	36	28	36	37	46	83	89
Neuglobsow	77	100	66	35	-	41	36	41	62	59	70	75
	73	102	62	35	-	41	38	39	59	40	55	59
Waldhof	80	82	61	35	-	84	41	39	37	91	72	64
	78	85	59	35	-	50	40	33	36	55	63	56
Schmücke	83	108	112	42	-	63	75	40	105	77	173	148
	75	102	75	42	-	55	62	36	105	66	168	108
Schauinsland	66	68	165	68	-	27	42	38	52	52	56	78
	57	58	166	60	-	27	44	35	43	51	61	51
Hohenpeissenberg	26	24	20	17	10	11	9	16	19	30	30	26
	22	21	18	15	8	9	8	12	17	27	24	21
Starina	86	108	53	36	35	25	29	45	28	53	54	86
	74	108	50	38	33	24	33	36	30	39	45	58
Košetice	23	39	70	147	378	226	50	20	36	31	40	39
	17	35	32	161	148	213	48	20	14	22	43	28
Rigi	31	33	32	34	24	15	16	23	31	45	45	31
	26	29	26	31	22	14	14	21	27	40	42	26
La Tardière	37	40	37	46	52	60	33	33	39	59	48	40
	30	35	40	40	40	30	30	30	30	45	50	30
Donon	43	47	59	34	31	34	31	45	48	48	63	183
	40	45	45	30	30	20	25	40	30	40	45	180
Peyrusse Vieille	31	31	27	26	15	19	23	24	29	41	50	45
	30	25	30	20	15	20	20	20	30	30	45	45

ISOPRENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	9	7	7	4	13	12	9	8	4	4	9
	-	9	8	4	4	13	4	4	7	4	4	4
Utö	-	4	4	-	-	21	9	10	8	5	4	4
	-	4	4	-	-	19	4	10	7	4	4	4
Zingst	7	7	12	23	-	213	302	269	64	45	13	22
	6	6	5	12	-	108	256	296	69	25	12	22
Neuglobsow	5	10	7	16	-	518	194	503	62	27	15	11
	5	8	5	18	-	390	138	455	44	16	10	11
Waldhof	5	6	5	11	-	68	65	72	35	17	8	7
	4	6	4	11	-	75	58	48	36	16	8	6
Schmücke	4	6	5	27	-	46	51	33	17	10	8	8
	4	5	5	19	-	46	31	32	14	9	7	6
Schauinsland	4	5	16	62	-	98	163	96	49	31	11	11
	3	5	17	58	-	121	134	41	39	29	10	6
Hohenpeissenberg	3	5	4	37	58	56	77	45	14	13	6	4
	3	3	3	17	18	21	16	23	9	10	4	3
Starina	17	17	20	194	168	268	714	303	82	34	17	16
	14	19	20	11	57	231	538	248	60	33	16	16
Košetice	9	33	20	47	62	148	109	163	56	14	21	18
	4	8	7	48	57	113	79	134	11	10	10	17
Rigi	12	15	12	82	42	91	103	102	38	19	16	8
	11	12	10	52	27	46	44	53	18	13	14	7
La Tardière	7	7	26	48	127	231	211	223	134	49	9	8
	5	5	5	20	100	215	180	220	130	35	5	8
Donon	36	48	37	253	401	956	981	718	299	248	43	16
	15	25	35	130	410	915	740	595	260	130	35	15
Peyrusse Vieille	6	5	11	58	194	788	753	828	536	280	11	6
	5	5	5	40	140	470	555	690	585	200	10	5

BENZENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	194	202	88	53	151	69	137	35	43	126	162
	-	199	163	88	58	16	17	18	28	41	92	131
Utö	-	231	226	-	-	29	16	54	39	84	219	234
	-	226	178	-	-	28	14	36	38	84	128	185
Zingst	148	301	219	122	-	113	50	86	75	169	273	234
	145	240	234	120	-	70	51	88	68	157	197	135
Neuglobsow	142	373	181	117	-	83	40	65	90	164	274	221
	140	292	170	108	-	81	40	63	75	135	155	165
Waldhof	148	342	191	133	-	165	78	80	89	200	280	196
	139	291	178	121	-	178	60	67	110	202	231	150
Schmücke	153	261	180	120	-	71	48	76	121	214	223	260
	151	266	172	103	-	58	53	70	112	178	196	188
Schauinsland	135	177	256	133	-	86	88	73	99	205	280	131
	120	187	261	142	-	68	69	74	105	195	184	106
Hohenpeissenberg	158	189	183	123	64	51	36	59	69	168	177	173
	131	181	177	108	58	42	32	51	64	132	141	132
Starina	450	455	265	203	152	93	111	127	132	239	280	401
	487	411	230	193	129	92	108	117	128	197	273	381
Košetice	103	228	193	82	51	62	37	57	107	209	225	354
	90	180	197	65	50	72	37	58	78	160	164	282
Rigi	149	192	181	118	87	50	53	86	104	243	232	175
	129	164	163	104	86	48	49	82	98	211	208	134
La Tardière	142	176	169	114	60	65	44	60	59	153	188	249
	120	150	135	110	70	60	40	60	60	125	150	250
Donon	150	163	158	104	48	40	43	58	81	160	133	140
	140	170	170	95	40	35	35	60	65	130	125	110
Peyrusse Vieille	166	164	140	93	41	31	20	40	46	100	146	211
	130	140	130	100	40	25	20	40	45	60	125	220

TOLUENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	116	145	109	87	62	68	58	83	99	176	149	113
	94	140	99	77	52	58	48	61	92	151	118	88
Starina	26	30	22	22	24	16	30	18	10	12	16	51
	28	29	20	22	22	15	17	16	10	10	15	58
Košetice	47	112	55	26	22	31	37	31	75	118	110	190
	37	98	56	25	21	27	32	29	56	102	107	162
Rigi	129	199	175	193	137	112	114	192	209	314	282	139
	103	152	126	169	112	95	97	159	182	258	249	81
La Tardière	167	190	153	113	141	138	171	100	117	265	250	213
	90	170	125	110	90	130	90	90	120	210	150	230
Donon	93	178	83	68	50	43	56	63	98	122	96	120
	80	140	70	60	40	35	45	60	60	100	80	90
Peyrusse Vieille	119	110	79	72	43	34	39	48	58	86	136	154
	110	100	70	60	40	30	30	30	55	60	115	145

ETHYLBENZENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Neuglobsow	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schauinsland	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	20	25	20	16	10	11	9	14	18	29	25	20
	15	23	18	15	9	9	8	9	16	26	20	13
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	8	21	13	7	7	7	7	7	14	25	22	32
	9	19	14	7	7	8	6	7	12	23	16	27
Rigi	22	27	28	28	23	26	17	25	30	48	42	21
	17	22	22	23	20	23	15	23	25	39	34	14
La Tardière	38	120	58	41	40	60	60	48	39	64	52	51
	30	60	55	40	40	50	30	50	40	50	60	55
Donon	18	-	18	19	14	21	29	21	31	29	20	38
	20	-	15	20	10	10	25	20	25	20	20	25
Peyrusse Vieille	27	239	21	47	25	16	31	25	21	27	30	30
	20	30	20	30	15	15	20	20	20	20	30	30

m+p-XYLENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	39	39	35	22	-	15	17	15	28	63	62	69
	35	41	30	19	-	16	17	13	14	37	44	38
Neuglobsow	42	90	30	12	-	23	18	21	52	52	88	67
	37	73	24	12	-	19	16	22	54	39	50	70
Waldhof	41	60	32	20	-	34	39	22	27	78	82	77
	34	58	25	19	-	28	19	14	20	36	71	76
Schmücke	42	77	43	20	-	29	50	26	42	59	77	84
	41	72	45	16	-	23	40	22	37	60	63	60
Schauinsland	45	30	107	50	-	25	31	21	48	50	111	53
	36	26	102	40	-	25	26	15	35	48	63	50
Hohenpeissenberg	48	54	41	34	20	25	18	30	42	68	66	52
	34	44	36	23	18	18	14	19	40	55	51	33
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	21	43	24	17	22	19	17	18	31	69	44	75
	19	40	23	15	21	17	16	19	22	36	38	56
Rigi	52	54	54	54	44	48	30	54	83	134	121	59
	37	35	44	40	35	43	23	44	59	112	87	36
La Tardière	128	391	185	117	134	250	260	161	123	189	161	145
	90	175	115	120	140	195	115	160	130	160	170	160
Donon	55	-	51	48	30	36	79	58	88	70	48	100
	60	-	55	45	30	30	80	40	60	50	55	60
Peyrusse Vieille	74	1095	58	219	96	51	111	71	54	63	63	69
	70	85	45	110	40	40	50	70	45	40	50	75

o-XYLENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	18	16	17	10	-	7	7	8	12	24	25	28
	17	15	14	9	-	7	7	6	7	16	20	17
Neuglobsow	15	36	17	12	-	18	9	14	24	23	35	29
	16	34	15	9	-	17	8	12	24	20	23	31
Waldhof	17	25	16	13	-	19	11	13	13	34	31	27
	13	25	13	12	-	18	11	9	13	16	27	24
Schmücke	18	32	20	14	-	15	15	11	17	26	27	35
	17	31	20	15	-	14	12	10	17	26	23	22
Schauinsland	20	12	50	24	-	11	13	9	16	20	41	21
	15	12	51	22	-	12	13	8	12	20	26	16
Hohenpeissenberg	17	20	16	15	10	10	8	13	16	26	24	20
	13	18	15	13	9	8	7	10	15	22	20	16
Starina	292	284	205	185	178	267	304	306	222	287	286	356
	316	260	170	174	154	280	320	280	213	318	254	297
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	21	23	24	25	21	25	15	21	28	48	46	26
	17	17	21	20	18	22	13	18	22	38	38	17
La Tardière	28	106	61	29	29	88	85	39	29	49	53	43
	10	40	45	30	20	40	20	35	30	35	40	50
Donon	13	-	18	17	7	8	18	15	32	21	19	33
	10	-	20	15	5	5	20	8	20	10	20	20
Peyrusse Vieille	19	503	17	62	34	13	24	16	13	15	24	24
	20	15	10	20	8	8	10	10	10	10	20	30

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

METHANAL (FORMALDEHYDE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.905	1.357	2.548	2.246	1.113	1.809	1.351	1.783	1.169	1.453	-	1.236
	0.956	1.364	1.613	2.237	1.151	1.771	1.231	1.764	1.126	1.570	-	0.944
Donon	0.595	0.749	1.363	3.478	1.325	1.937	1.136	1.238	0.570	1.178	-	-
	0.721	0.708	1.435	2.521	0.860	2.135	0.714	1.265	0.491	1.100	-	-
Peyrusse Vieille	0.890	-	1.241	1.112	2.529	1.755	1.599	2.069	1.499	1.221	1.414	0.817
	0.915	-	1.105	1.163	1.413	1.025	1.316	1.965	1.396	0.919	1.403	0.800
Campisábalos	0.297	0.263	0.177	0.490	0.573	0.875	0.755	0.648	0.675	0.530	0.270	0.236
	0.280	0.250	0.160	0.460	0.540	0.670	0.780	0.610	0.675	0.490	0.230	0.220

ETHANAL (ACETALDEHYDE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.625	0.902	1.069	1.572	0.521	0.981	0.575	0.808	0.551	1.120	-	1.128
	0.722	0.913	0.979	1.539	0.473	1.071	0.428	0.721	0.519	1.165	-	0.955
Donon	0.425	0.484	0.882	1.088	0.683	0.728	0.420	0.550	0.304	0.704	-	-
	0.534	0.431	0.820	1.087	0.324	0.808	0.270	0.487	0.229	0.736	-	-
Peyrusse Vieille	0.594	-	0.722	0.832	0.618	0.812	0.490	0.720	0.521	0.851	1.049	0.603
	0.534	-	0.704	0.797	0.498	0.834	0.506	0.513	0.435	0.780	0.874	0.573
Campisábalos	1.707	1.741	1.842	2.377	2.305	2.907	2.028	2.972	2.608	2.232	1.233	1.125
	1.860	1.750	1.780	2.270	2.300	2.670	2.330	2.740	2.610	2.230	1.140	1.130

PROPANONE (ACETONE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	1.129	1.898	2.482	4.384	2.021	2.578	2.182	2.492	2.027	2.803	-	1.855
	0.954	1.862	2.454	4.180	1.633	2.490	1.750	2.209	1.989	2.303	-	1.518
Donon	0.895	1.199	2.518	4.314	2.570	3.248	2.447	2.720	1.252	2.775	-	-
	1.093	0.875	2.381	4.368	1.561	3.564	1.749	2.669	1.158	2.445	-	-
Peyrusse Vieille	1.307	-	2.022	3.355	1.717	2.190	2.427	3.366	2.713	2.611	2.175	1.302
	1.259	-	2.096	3.373	1.563	2.131	2.220	2.981	2.519	2.520	1.983	1.206
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

PROPANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.090	0.138	0.191	0.220	0.064	0.117	0.099	0.135	0.106	0.164	-	0.173
	0.088	0.139	0.151	0.213	0.081	0.117	0.101	0.120	0.104	0.178	-	0.157
Donon	0.081	0.084	0.139	0.173	0.085	0.059	0.054	0.076	0.042	0.099	-	-
	0.093	0.094	0.129	0.151	0.051	0.061	0.041	0.059	0.041	0.107	-	-
Peyrusse Vieille	0.092	-	0.139	0.113	0.091	0.074	0.079	0.102	0.083	0.123	0.156	0.105
	0.094	-	0.137	0.101	0.070	0.071	0.080	0.089	0.070	0.101	0.126	0.095
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

2-PROPENAL (ACROLEIN)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.015	0.015	0.020	0.016	0.016	0.015	0.015	0.015	0.015	0.015	-	0.017
	0.015	0.015	0.016	0.016	0.016	0.015	0.015	0.015	0.016	0.015	-	0.016
Donon	0.015	0.015	0.016	0.024	0.016	0.016	0.015	0.016	0.016	0.015	-	-
	0.015	0.016	0.016	0.016	0.016	0.016	0.016	0.015	0.016	0.016	-	-
Peyrusse Vieille	0.015	-	0.017	0.016	0.017	0.016	0.017	0.016	0.016	0.018	0.015	0.015
	0.015	-	0.017	0.016	0.017	0.016	0.017	0.016	0.016	0.018	0.015	0.015
Campisábalos	0.028	0.033	0.027	0.025	0.025	0.025	0.025	0.044	0.025	0.025	0.025	0.025
	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.050	0.025	0.025	0.025	0.025

2-BUTANONE (METHYLETHYLKETONE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.391	0.626	0.577	0.812	0.331	0.430	0.283	0.403	0.341	0.536	-	0.576
	0.271	0.454	0.573	0.821	0.420	0.382	0.184	0.350	0.344	0.478	-	0.514
Donon	0.295	0.328	0.501	0.826	0.368	0.324	0.197	-	0.116	0.450	-	-
	0.278	0.233	0.458	0.605	0.222	0.347	0.172	-	0.116	0.422	-	-
Peyrusse Vieille	0.298	-	0.499	0.520	0.212	-	-	-	0.303	0.373	0.410	0.303
	0.283	-	0.542	0.545	0.167	-	-	-	0.210	0.446	0.368	0.283
Campisábalos	0.766	0.519	0.966	0.713	0.424	0.571	0.699	0.075	0.753	1.423	0.943	0.978
	0.760	0.540	1.070	0.880	0.460	0.525	0.670	0.070	0.655	1.470	0.930	0.940

2-METHYLPROPENAL (METHACROLEIN)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.011	0.015	0.020	0.037	0.021	0.184	0.062	0.095	0.027	0.027	-	0.023
	0.012	0.011	0.012	0.012	0.024	0.070	0.055	0.090	0.032	0.024	-	0.020
Donon	0.011	0.011	0.021	0.110	0.121	0.192	0.107	0.115	0.026	0.066	-	-
	0.011	0.012	0.012	0.093	0.012	0.218	0.045	0.105	0.027	0.060	-	-
Peyrusse Vieille	0.011	-	0.012	0.033	0.078	0.384	0.165	0.359	0.082	0.085	0.015	0.011
	0.011	-	0.012	0.012	0.044	0.216	0.220	0.214	0.083	0.037	0.012	0.011
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

BENZENECARBALDEHYDE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.037	0.068	0.133	0.298	0.077	0.126	0.086	0.080	0.075	0.114	-	0.122
	0.044	0.064	0.080	0.118	0.066	0.131	0.080	0.078	0.069	0.082	-	0.111
Donon	0.025	0.023	0.036	0.056	0.044	0.058	0.031	0.034	0.016	0.041	-	-
	0.015	0.016	0.016	0.050	0.016	0.068	0.016	0.030	0.016	0.034	-	-
Peyrusse Vieille	0.030	-	0.031	0.054	0.037	0.053	0.026	0.034	0.033	0.031	0.047	0.030
	0.030	-	0.032	0.057	0.038	0.060	0.018	0.025	0.033	0.038	0.045	0.028
Campisábalos	0.180	0.125	0.215	0.337	0.206	0.245	0.826	0.168	0.798	0.581	0.121	0.058
	0.140	0.120	0.220	0.180	0.180	0.135	0.910	0.140	0.855	0.400	0.025	0.025

PENTANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Campisábalos	0.200	0.089	0.196	0.298	0.157	0.193	0.227	0.137	0.207	0.105	0.102	0.088
	0.200	0.085	0.210	0.330	0.130	0.185	0.210	0.130	0.210	0.120	0.100	0.090

ETHANEDIAL (GLYOXAL)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.025	0.022	-	0.029	0.012	0.011	0.022	0.030	0.015	0.028	-	0.016
	0.012	0.022	-	0.034	0.012	0.011	0.012	0.027	0.012	0.025	-	0.013
Donon	0.011	0.028	-	-	0.038	0.017	0.019	0.042	0.012	0.011	-	-
	0.011	0.012	-	-	0.012	0.012	0.012	0.027	0.012	0.012	-	-
Peyrusse Vieille	-	-	0.020	0.020	0.012	-	0.012	0.012	-	0.013	0.016	0.011
	-	-	0.013	0.012	0.012	-	0.013	0.012	-	0.013	0.012	0.011
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

HEXANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.015	0.032	0.072	0.117	0.038	0.054	0.051	0.058	0.040	0.117	-	0.037
	0.015	0.024	0.050	0.115	0.035	0.046	0.052	0.066	0.043	0.062	-	0.040
Donon	0.023	0.022	0.022	0.075	0.053	0.042	0.051	0.036	0.023	0.039	-	-
	0.015	0.016	0.016	0.069	0.016	0.041	0.038	0.038	0.016	0.032	-	-
Peyrusse Vieille	0.015	-	0.035	0.052	0.096	0.055	0.057	0.066	0.036	0.055	0.044	0.026
	0.015	-	0.040	0.051	0.041	0.054	0.054	0.060	0.036	0.051	0.031	0.023
Campisábalos	0.114	0.074	0.123	0.187	0.144	0.175	0.261	0.176	0.230	0.214	0.111	0.126
	0.110	0.080	0.120	0.210	0.190	0.160	0.280	0.160	0.225	0.200	0.100	0.130

2-OXOPROPANAL (METHYLGLYOXAL)

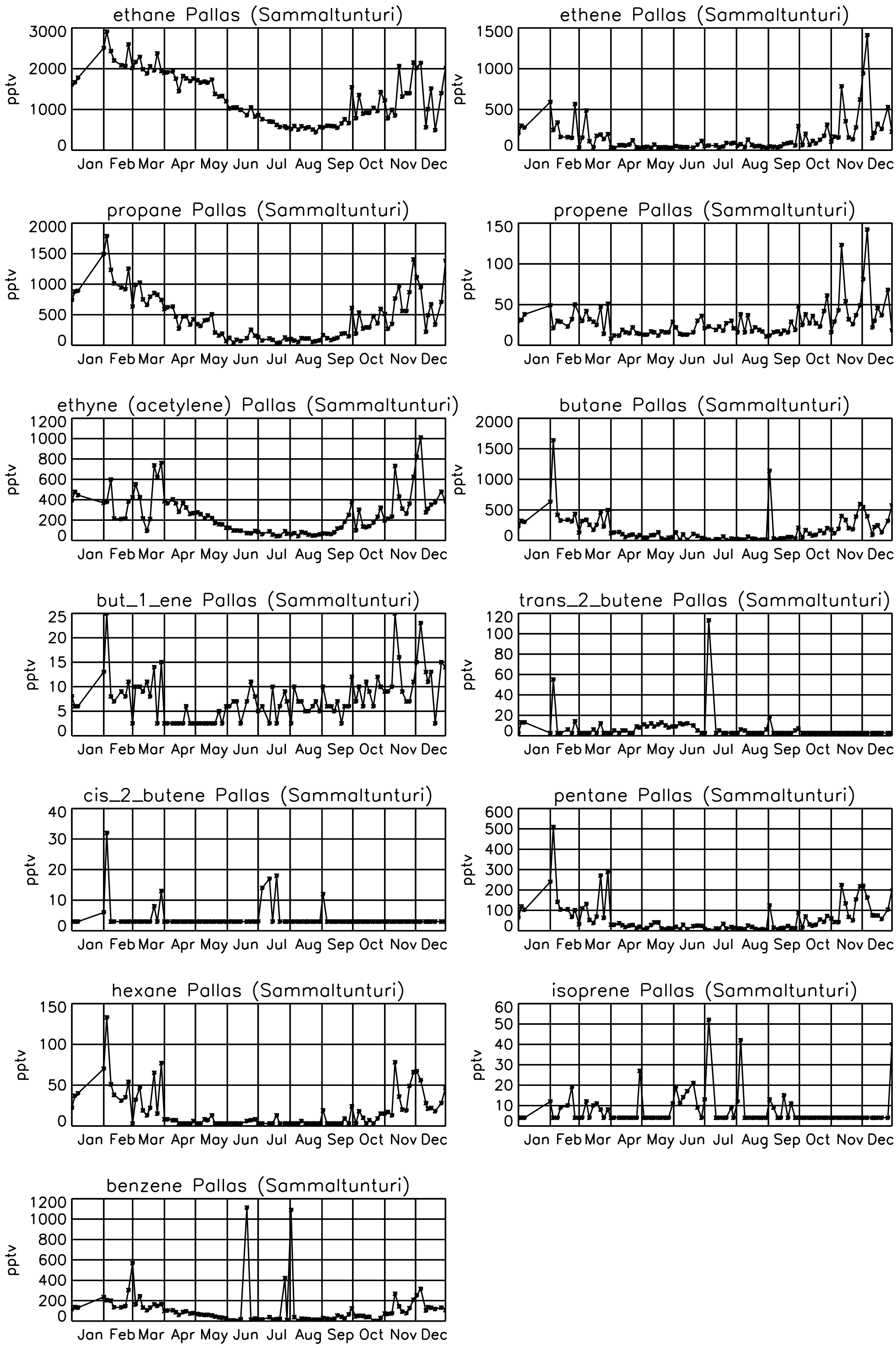
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
La Tardière	0.036	0.059	0.100	0.081	0.037	0.062	0.034	-	0.046	0.038	-	0.044
	0.016	0.055	0.067	0.089	0.038	0.052	0.028	-	0.050	0.042	-	0.047
Donon	0.028	0.033	-	0.253	0.081	0.069	0.030	0.073	0.016	0.034	-	-
	0.031	0.016	-	0.124	0.045	0.064	0.016	0.043	0.016	0.016	-	-
Peyrusse Vieille	0.020	-	0.044	0.048	0.098	0.144	0.044	0.092	0.048	0.029	0.028	0.021
	0.015	-	0.041	0.047	0.018	0.079	0.017	0.076	0.055	0.019	0.017	0.015
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B

Time series of VOC measured in 2007

Explanations and synonyms to component names

ethyne:	acetylene
butane:	n-butane
isobutane:	i-butane
pentane:	n-pentane
isopentane:	i-pentane
hexane:	n-hexane
methanal:	formaldehyde
ethanal:	acetaldehyde
propanone:	acetone
N2propenal:	2-propenal (acrolein)
N2butanone:	2-butanone (methyl ethyl ketone)
N3buten2one:	3-buten-2-one (methyl vinyl ketone)
N2methylpropenal:	2-methyl propenal (methacrolein)
benzenecarbaldehyde:	benzaldehyde
ethanedial:	glyoxal
N2oxoproanal:	2-oxopropanal (methyl glyoxal)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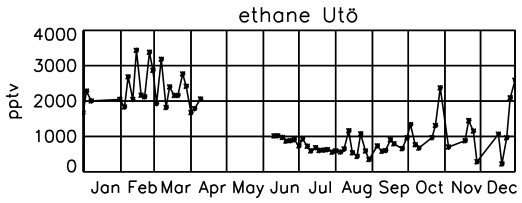
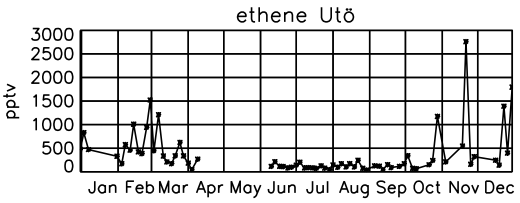
ethene Pallas (Sammaltunturi)
propane Pallas (Sammaltunturi)
propene Pallas (Sammaltunturi)
ethyne (acetylene) Pallas (Sammaltunturi)
butane Pallas (Sammaltunturi)
but_1_ene Pallas (Sammaltunturi)
trans_2_butene Pallas (Sammaltunturi)
cis_2_butene Pallas (Sammaltunturi)
pentane Pallas (Sammaltunturi)
hexane Pallas (Sammaltunturi)
isoprene Pallas (Sammaltunturi)
benzene Pallas (Sammaltunturi)
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Utö
4000
3000
2000
1000
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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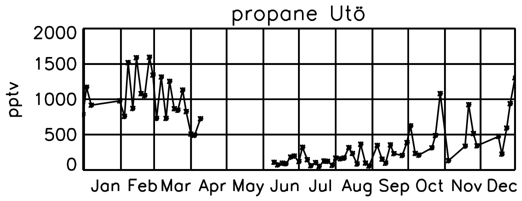
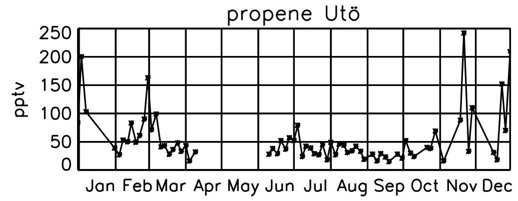
2500
2000
1500
1000
500
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


propane Utö
2000
1500
1000
500
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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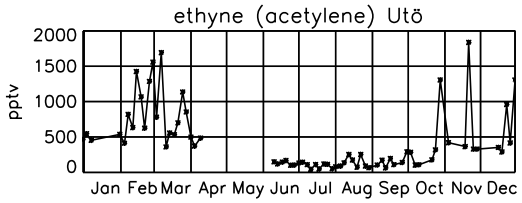
250
200
150
100
50
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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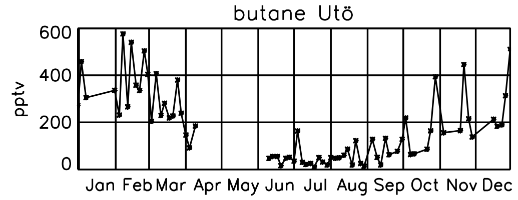
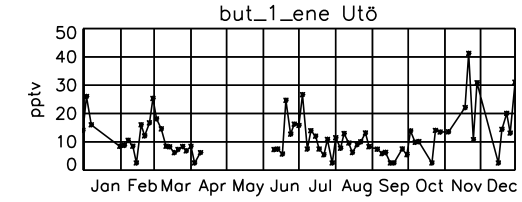
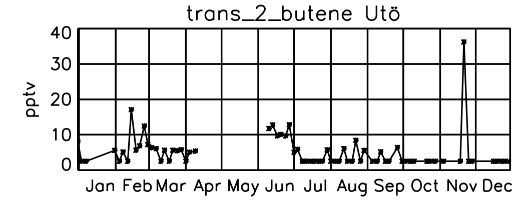
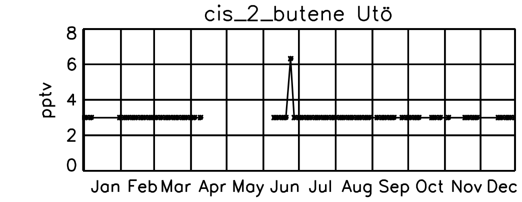
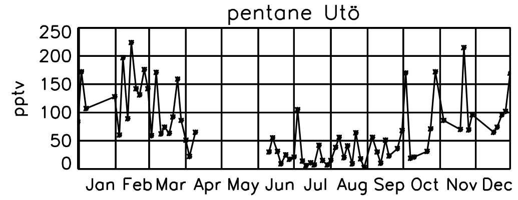
2000
1500
1000
500
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

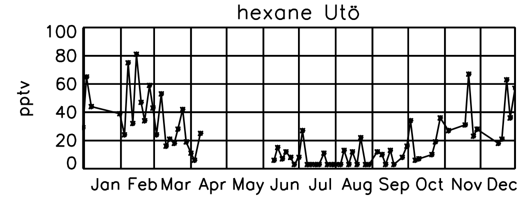

butane Utö
600
400
200
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


but_1_ene Utö
50
40
30
20
10
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


trans_2_butene Utö
40
30
20
10
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


cis_2_butene Utö
8
6
4
2
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


pentane Utö
250
200
150
100
50
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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100
80
60
40
20
0
pptv
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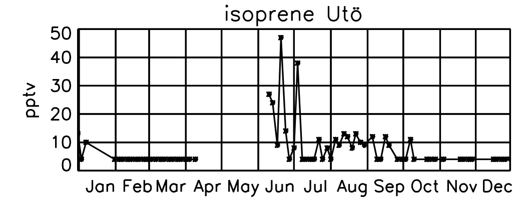
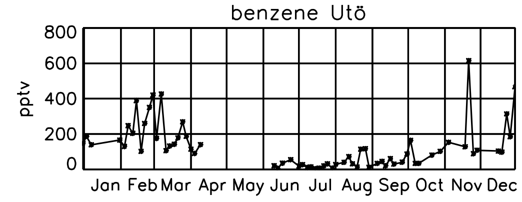
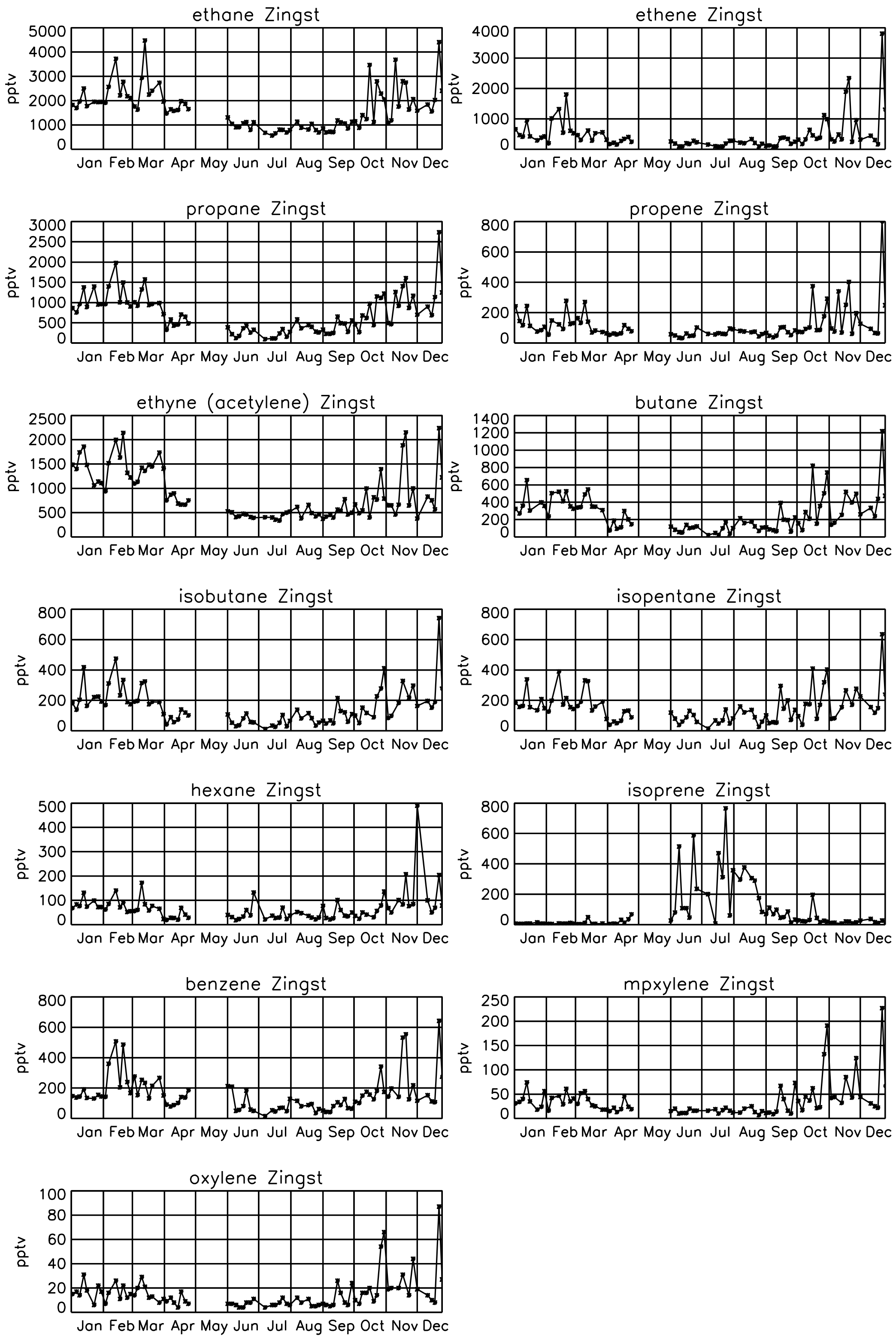

isoprene Utö
50
40
30
20
10
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


benzene Utö
800
600
400
200
0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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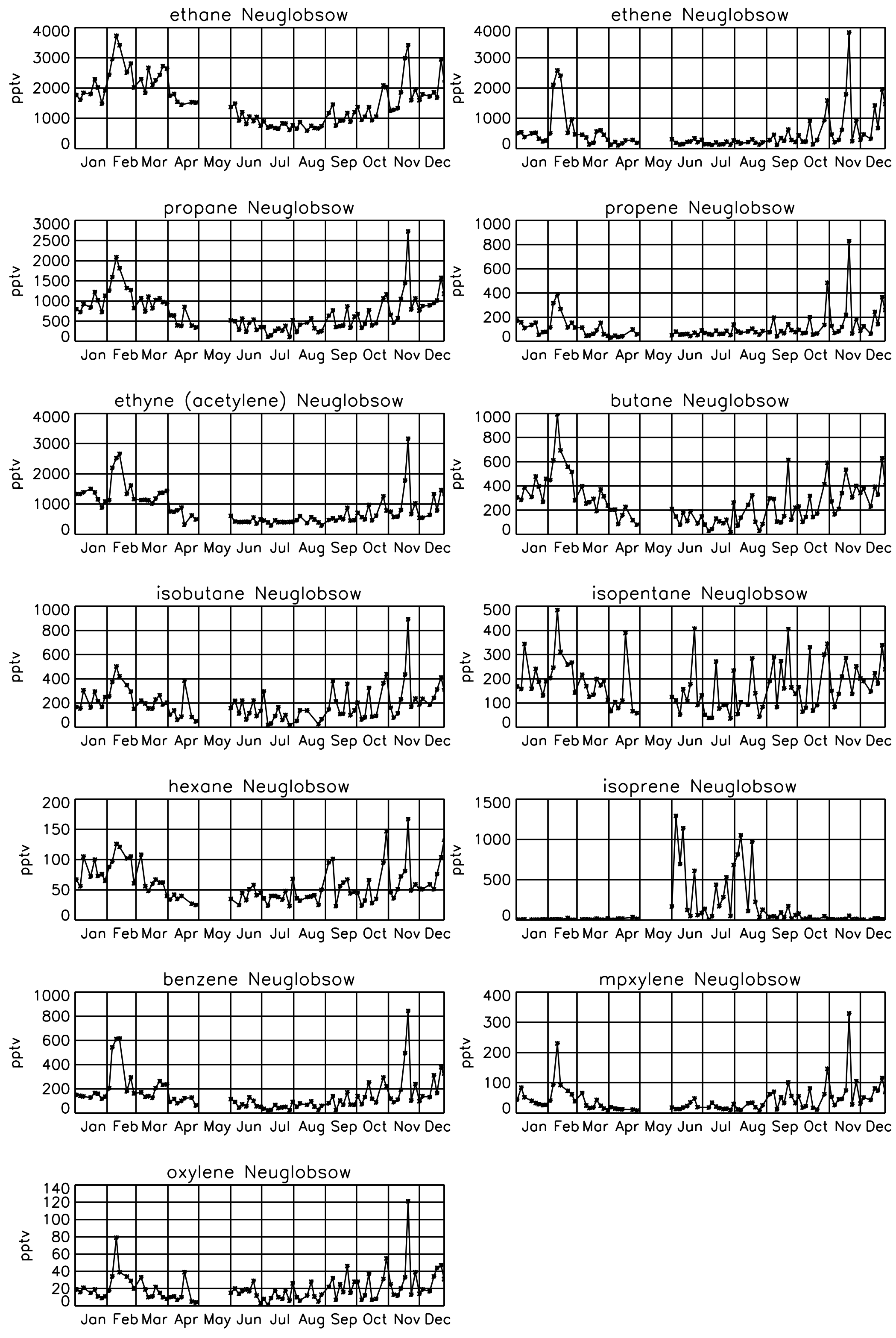
ethene Zingst
propane Zingst
propene Zingst
ethyne (acetylene) Zingst
butane Zingst
isobutane Zingst
isopentane Zingst
hexane Zingst
isoprene Zingst
benzene Zingst
mpxylene Zingst
oxylene Zingst
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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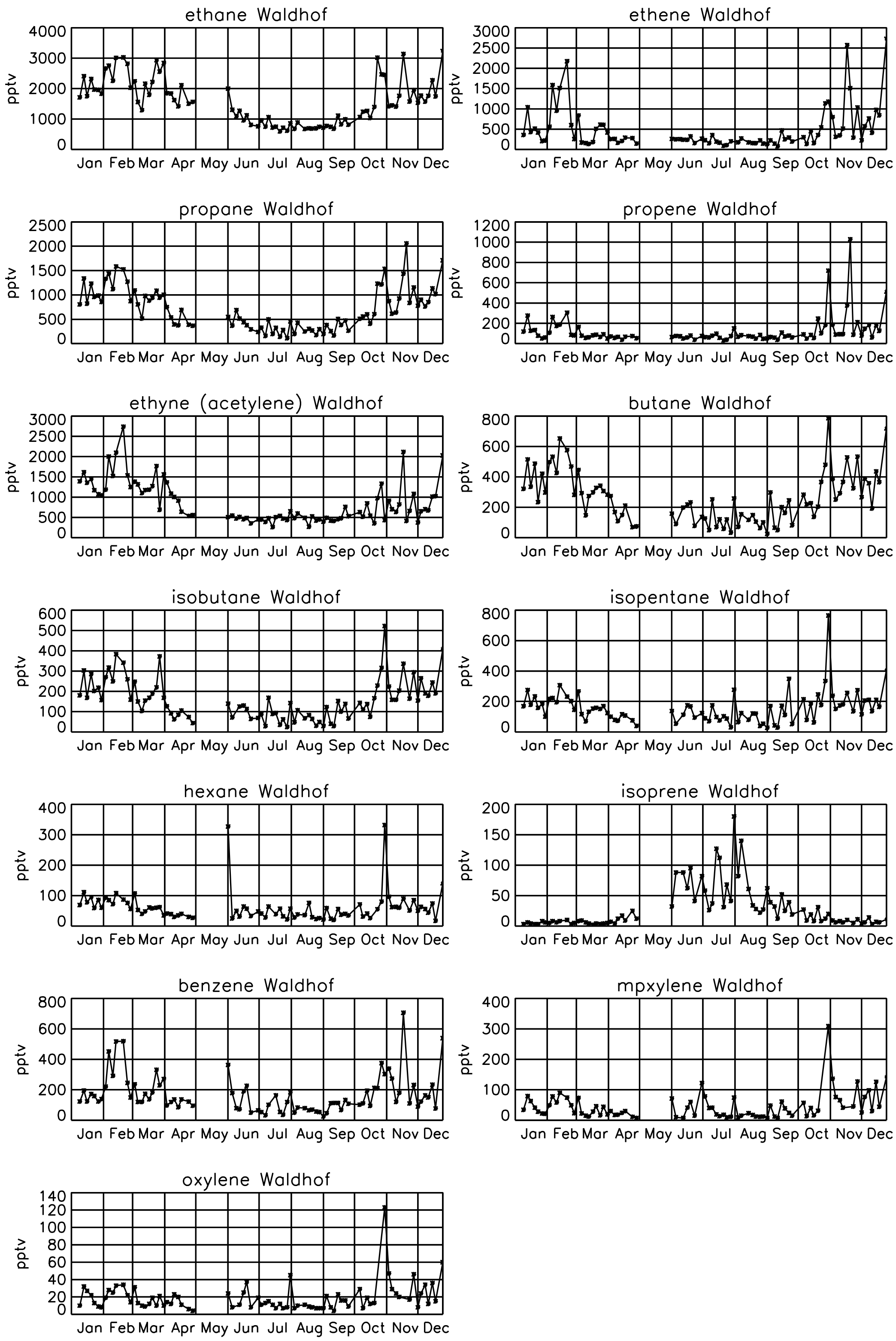
ethene Neuglobsow
propane Neuglobsow
propene Neuglobsow
ethyne (acetylene) Neuglobsow
butane Neuglobsow
isobutane Neuglobsow
isopentane Neuglobsow
hexane Neuglobsow
isoprene Neuglobsow
benzene Neuglobsow
mpxylene Neuglobsow
oxylene Neuglobsow
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


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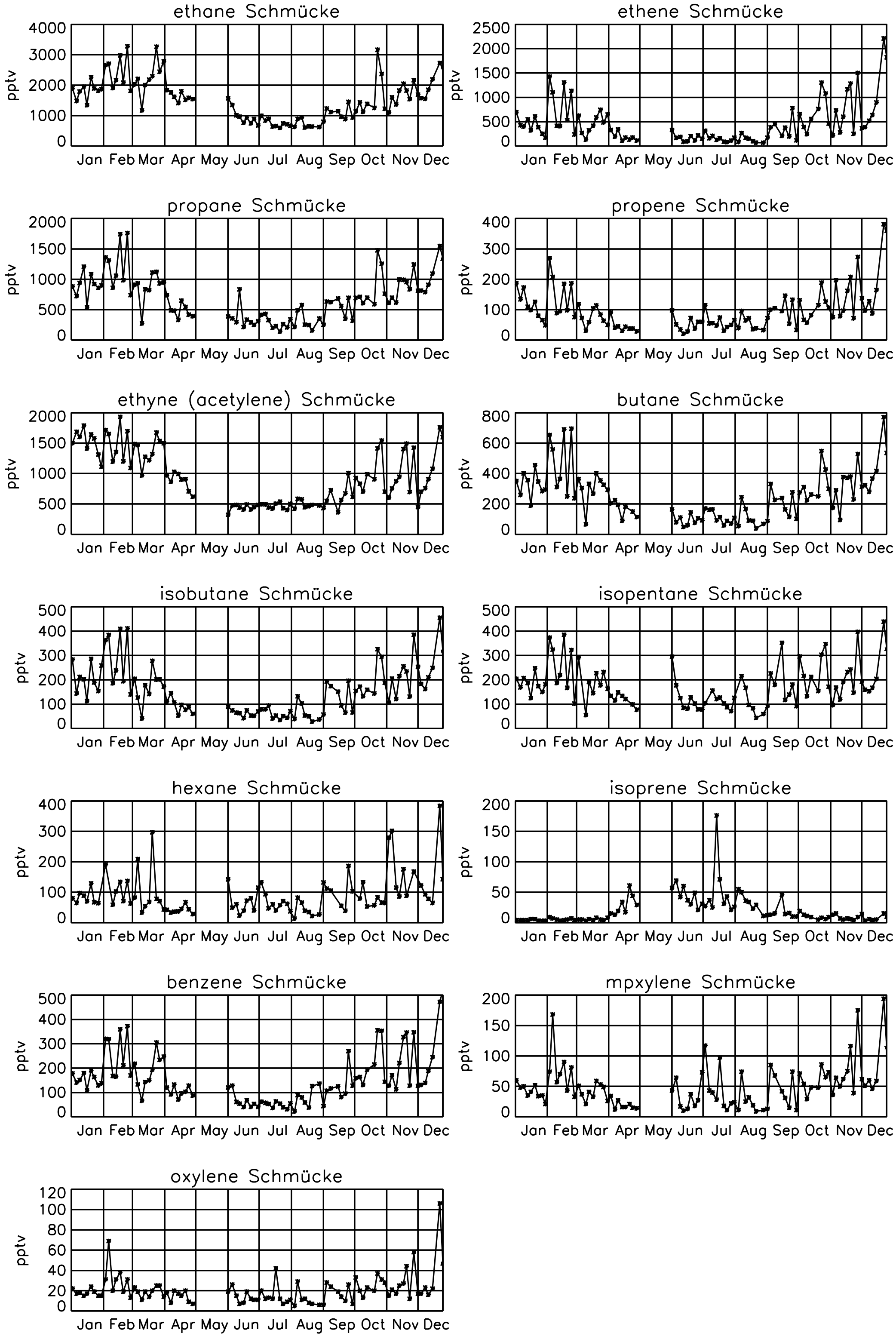
ethane Schmücke
ethene Schmücke
propane Schmücke
propene Schmücke
ethyne (acetylene) Schmücke
butane Schmücke
isobutane Schmücke
isopentane Schmücke
hexane Schmücke
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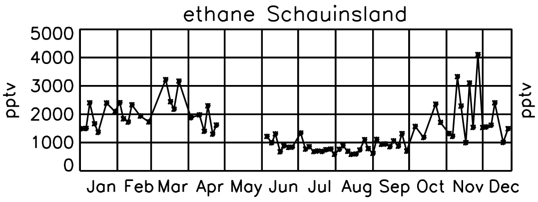
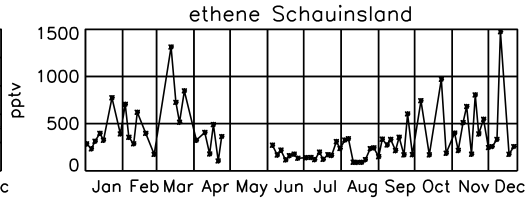
benzene Schmücke
mpxylene Schmücke
oxylene Schmücke
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Schauinsland
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethene Schauinsland
pptv
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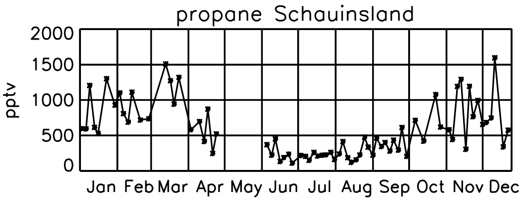
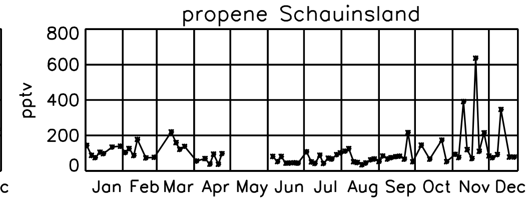

propane Schauinsland
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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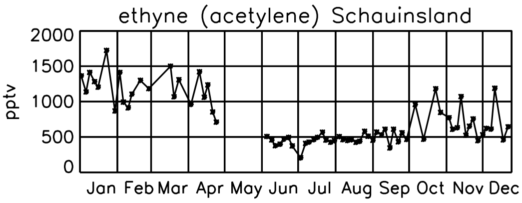
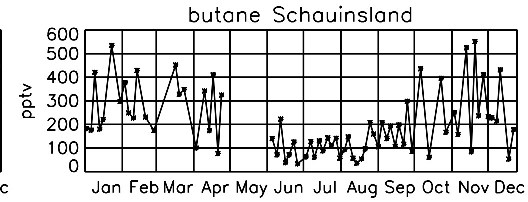
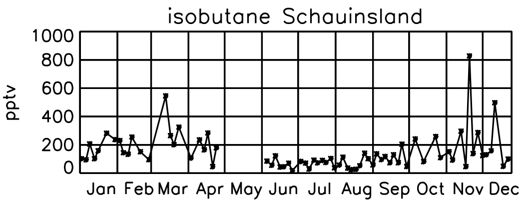
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethyne (acetylene) Schauinsland
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


butane Schauinsland
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


isobutane Schauinsland
pptv
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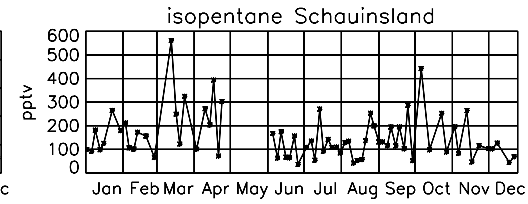
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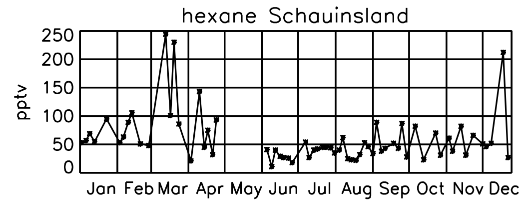
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pptv
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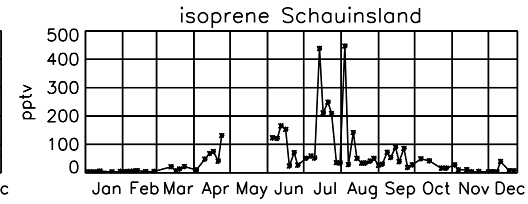
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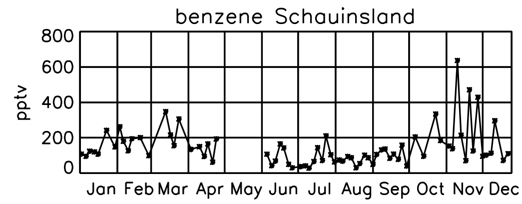
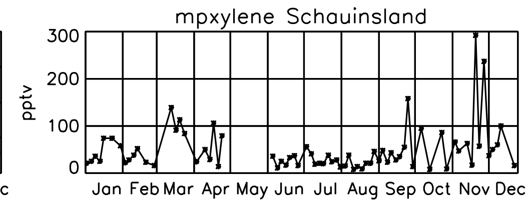

benzene Schauinsland
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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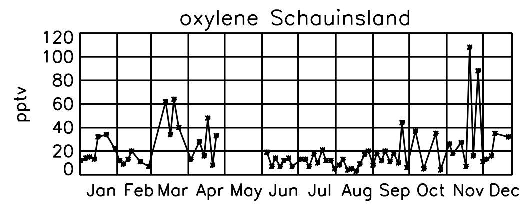
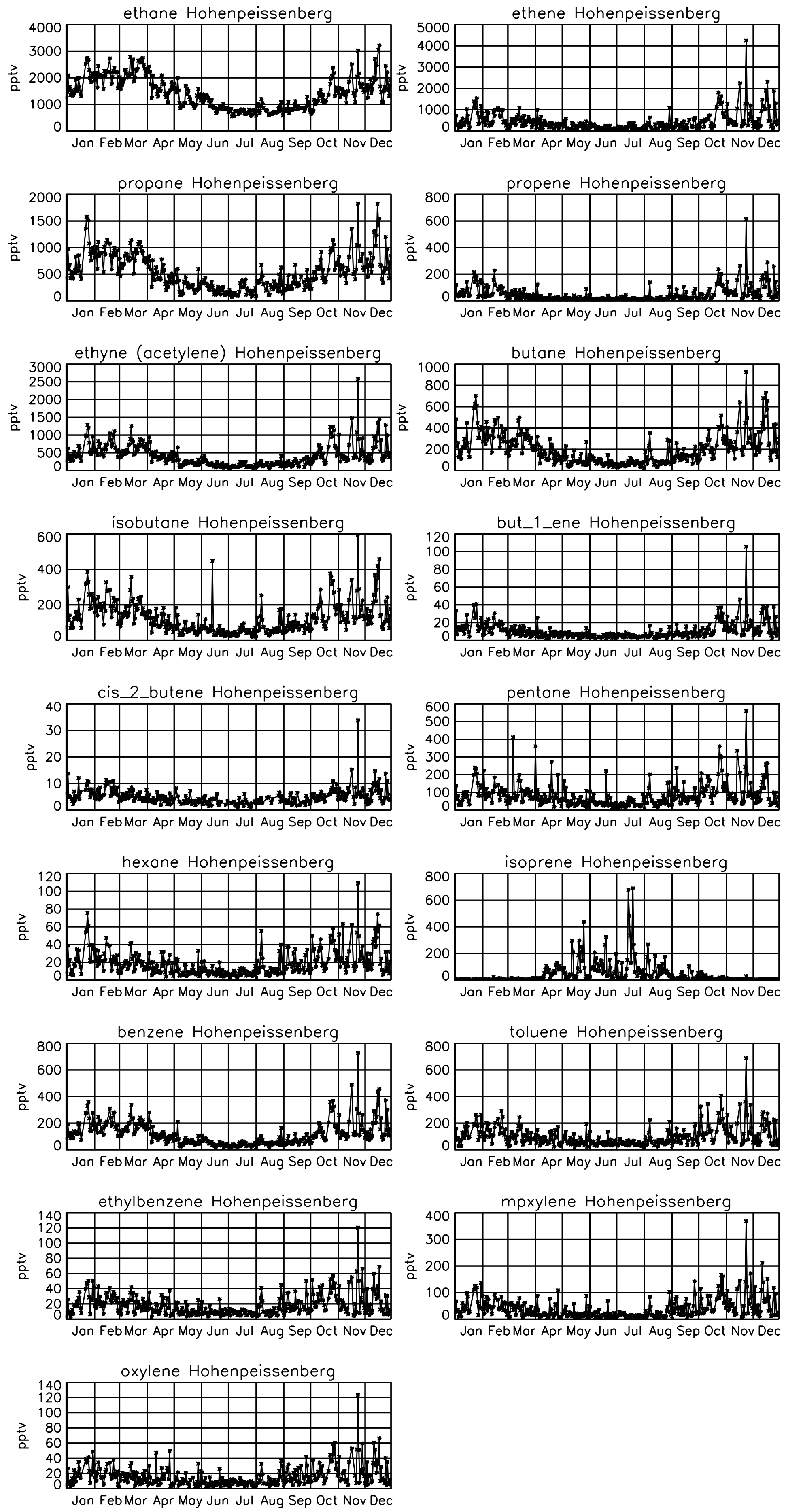

oxylene Schauinsland
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ethane Hohenpeissenberg
ethene Hohenpeissenberg
propane Hohenpeissenberg
propene Hohenpeissenberg
ethyne (acetylene) Hohenpeissenberg
butane Hohenpeissenberg
isobutane Hohenpeissenberg
but_1_ene Hohenpeissenberg
cis_2_butene Hohenpeissenberg
pentane Hohenpeissenberg
hexane Hohenpeissenberg
isoprene Hohenpeissenberg
benzene Hohenpeissenberg
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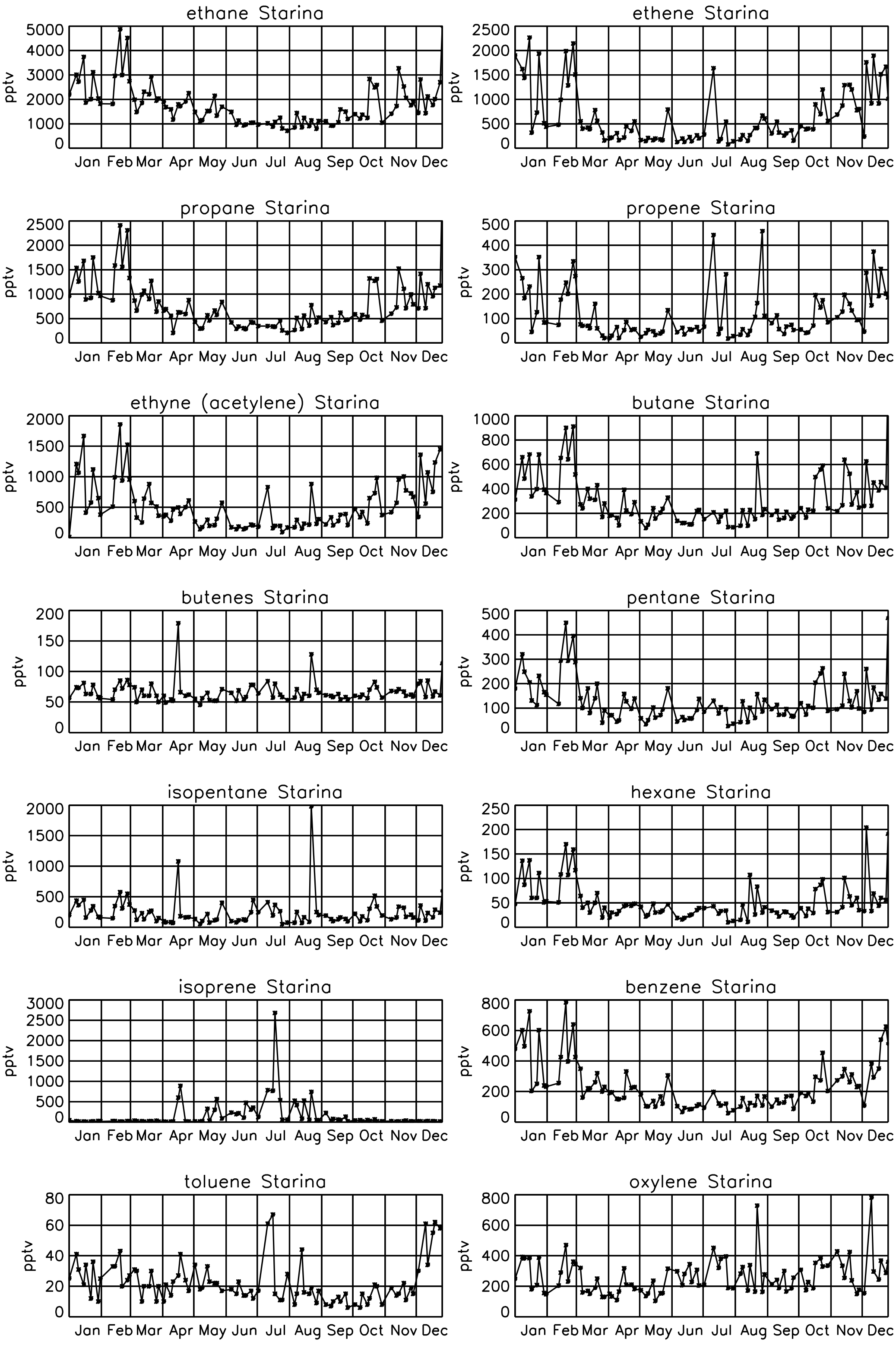
mpxylene Hohenpeissenberg
oxylene Hohenpeissenberg
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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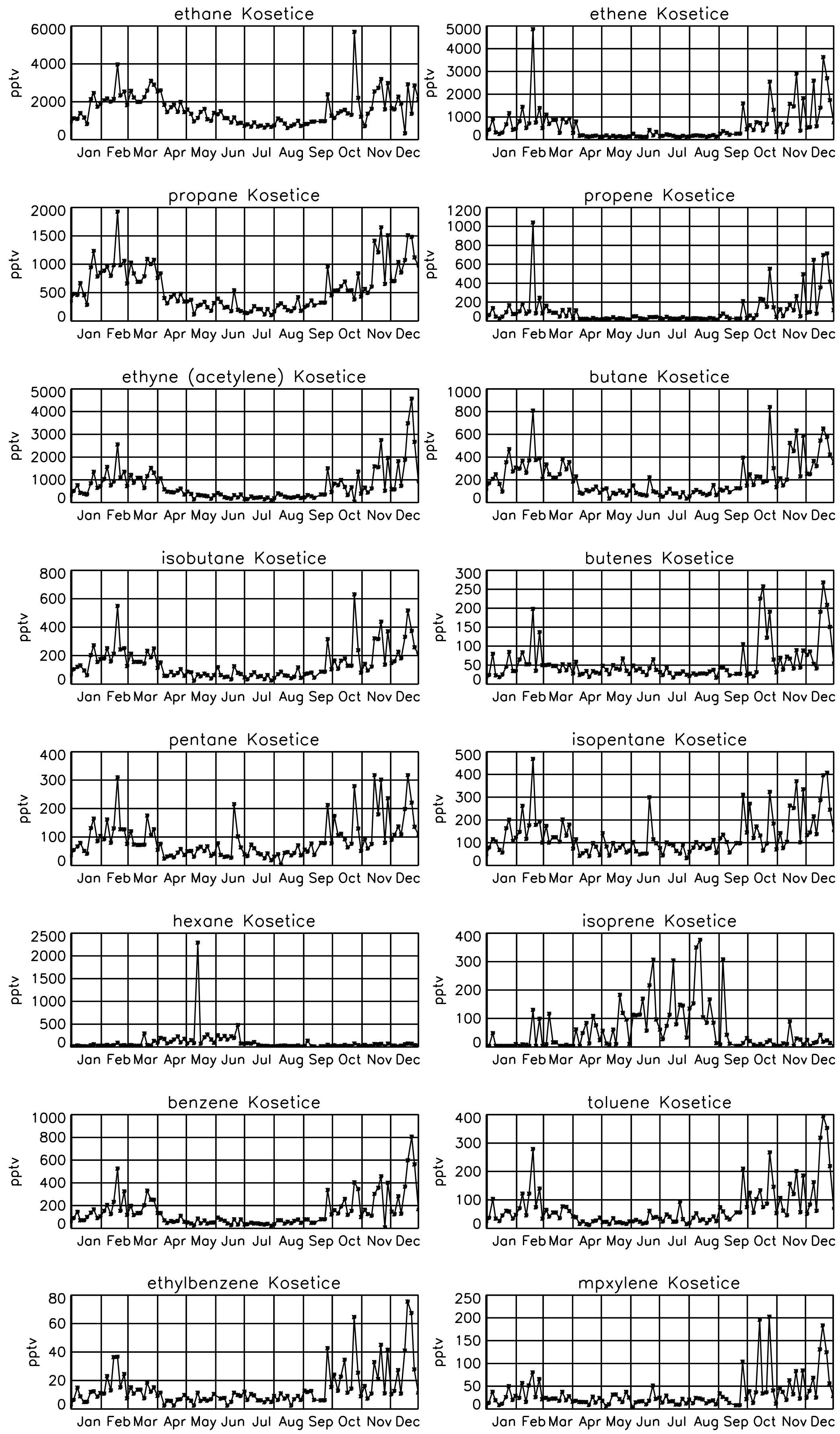
ethene Starina
propane Starina
propene Starina
ethyne (acetylene) Starina
butane Starina
butenes Starina
pentane Starina
isopentane Starina
hexane Starina
isoprene Starina
benzene Starina
toluene Starina
oxylene Starina
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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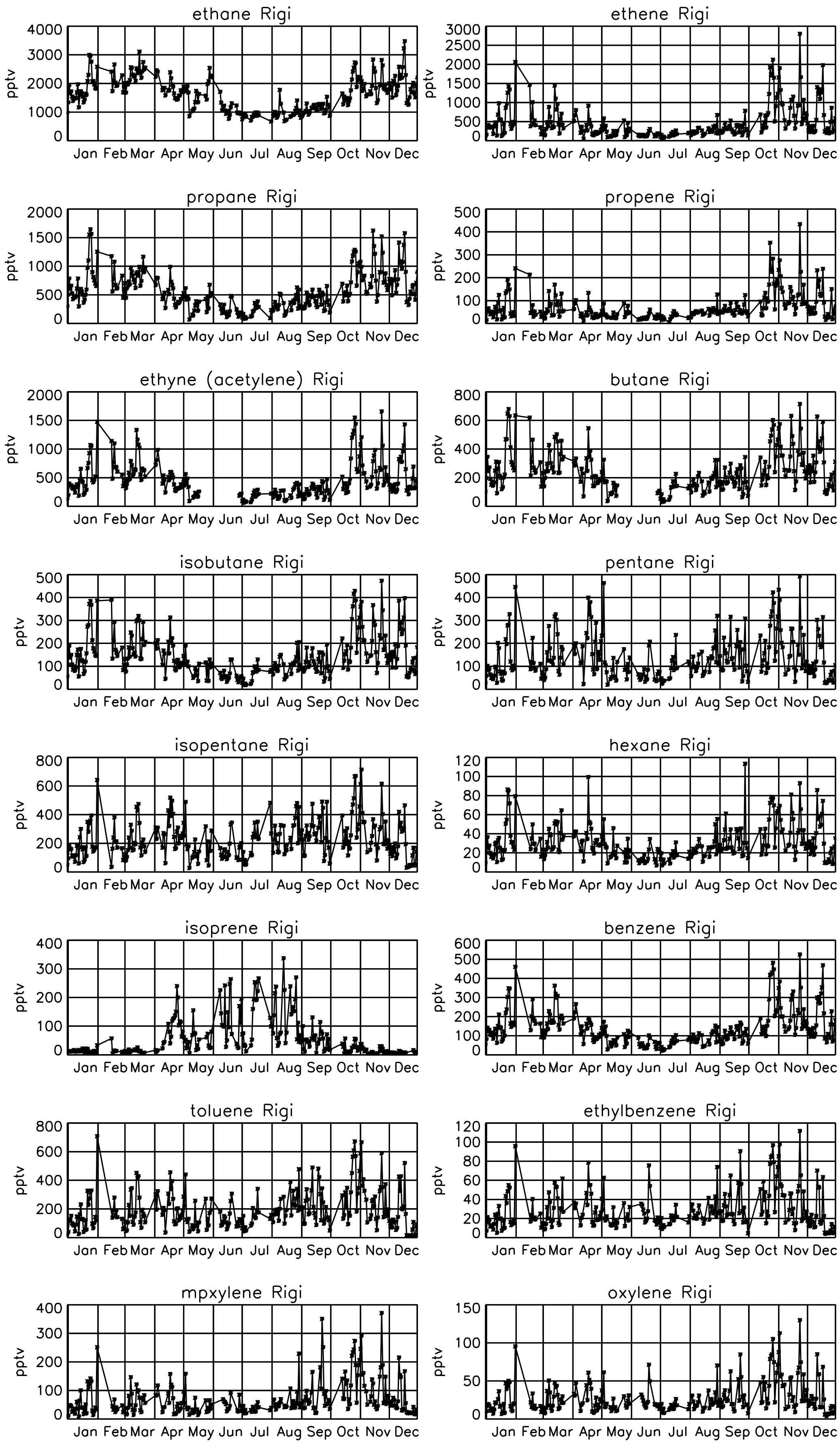
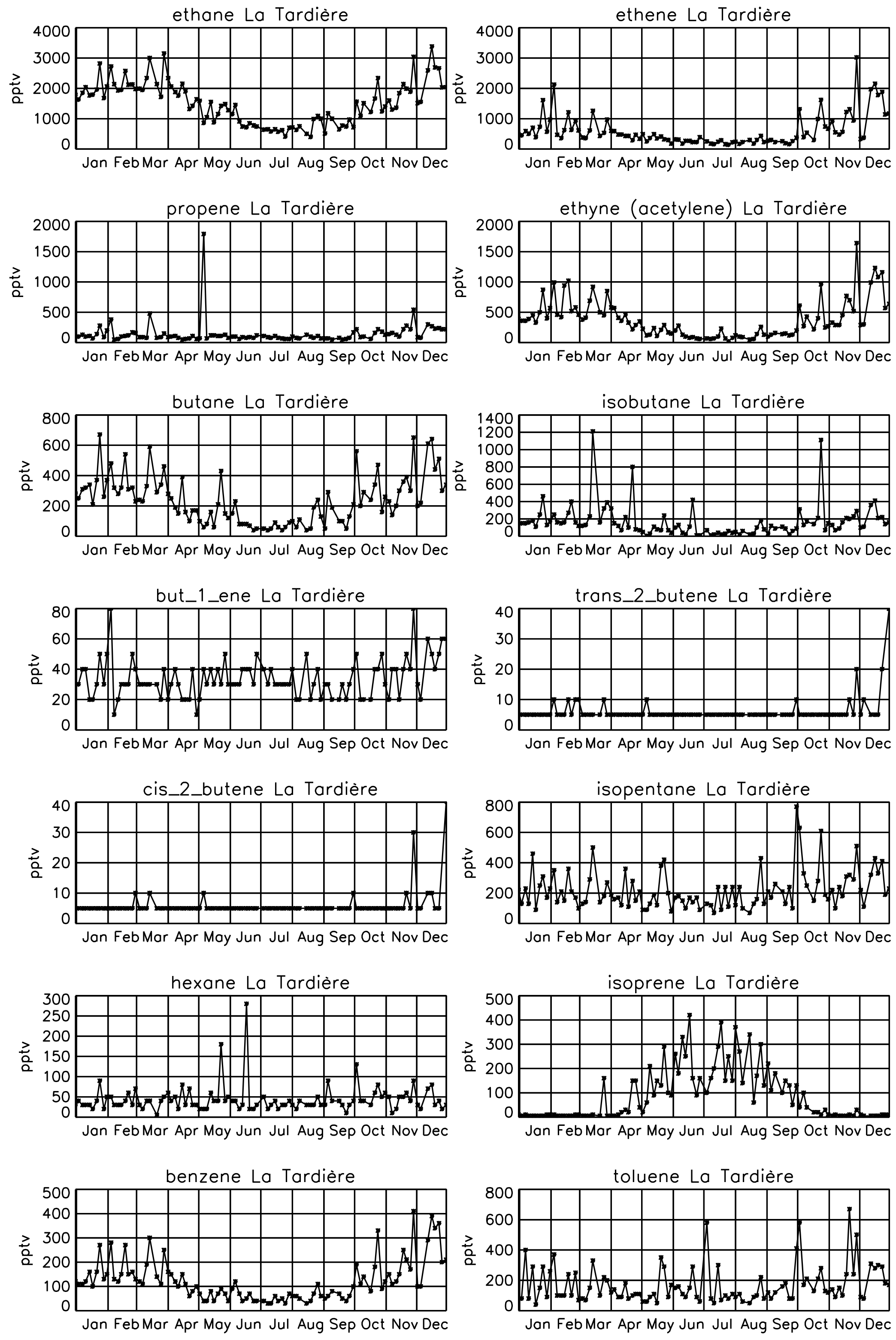
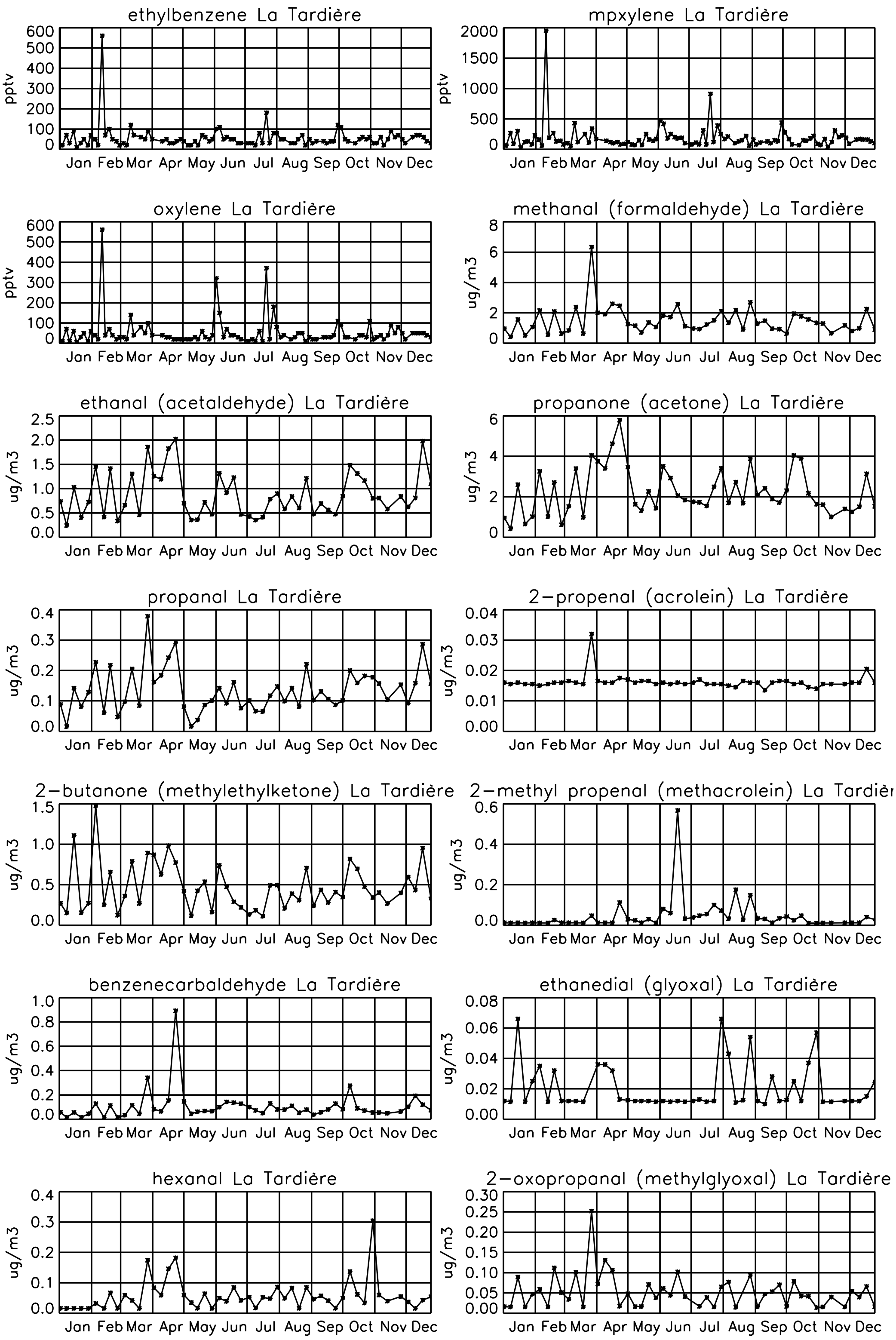
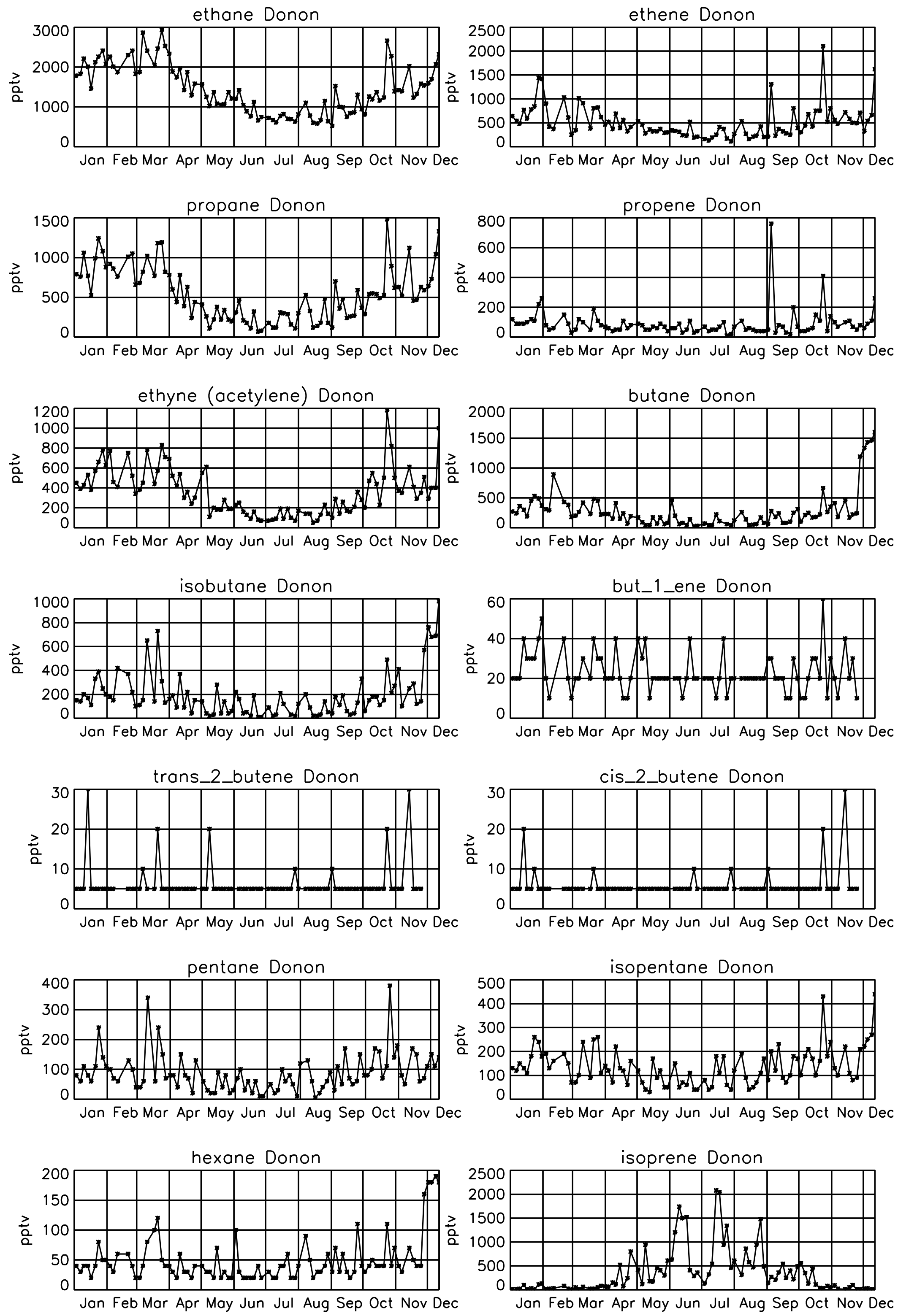
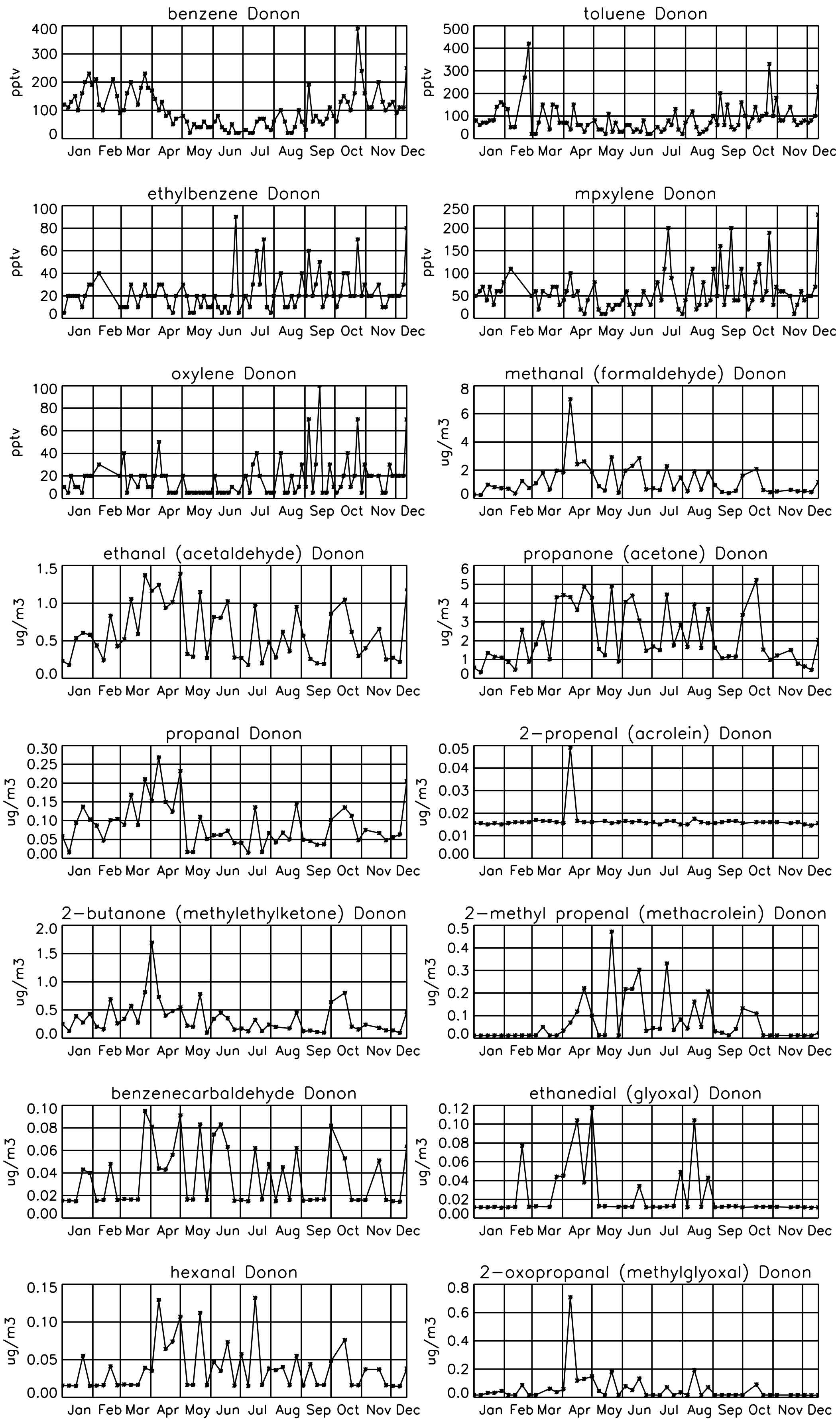
ethene Kosetice
propane Kosetice
propene Kosetice
ethyne (acetylene) Kosetice
butane Kosetice
isobutane Kosetice
butenes Kosetice
pentane Kosetice
isopentane Kosetice
hexane Kosetice
isoprene Kosetice
benzene Kosetice
toluene Kosetice
ethylbenzene Kosetice
mpxylene Kosetice
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

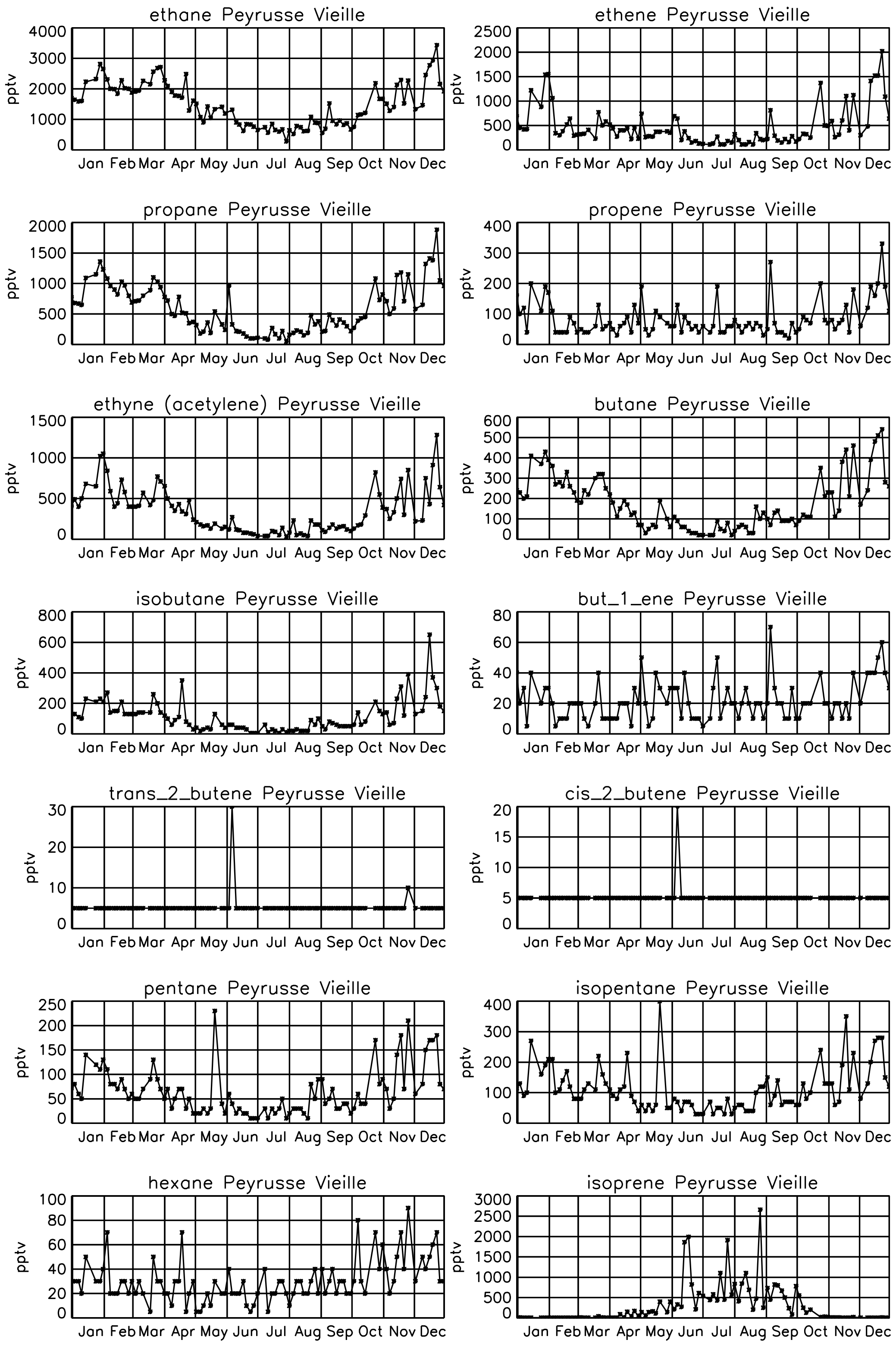

ethane Rigi
ethene Rigi
propane Rigi
propene Rigi
ethyne (acetylene) Rigi
butane Rigi
isobutane Rigi
pentane Rigi
isopentane Rigi
hexane Rigi
isoprene Rigi
benzene Rigi
toluene Rigi
ethylbenzene Rigi
mpxylene Rigi
oxylene Rigi
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

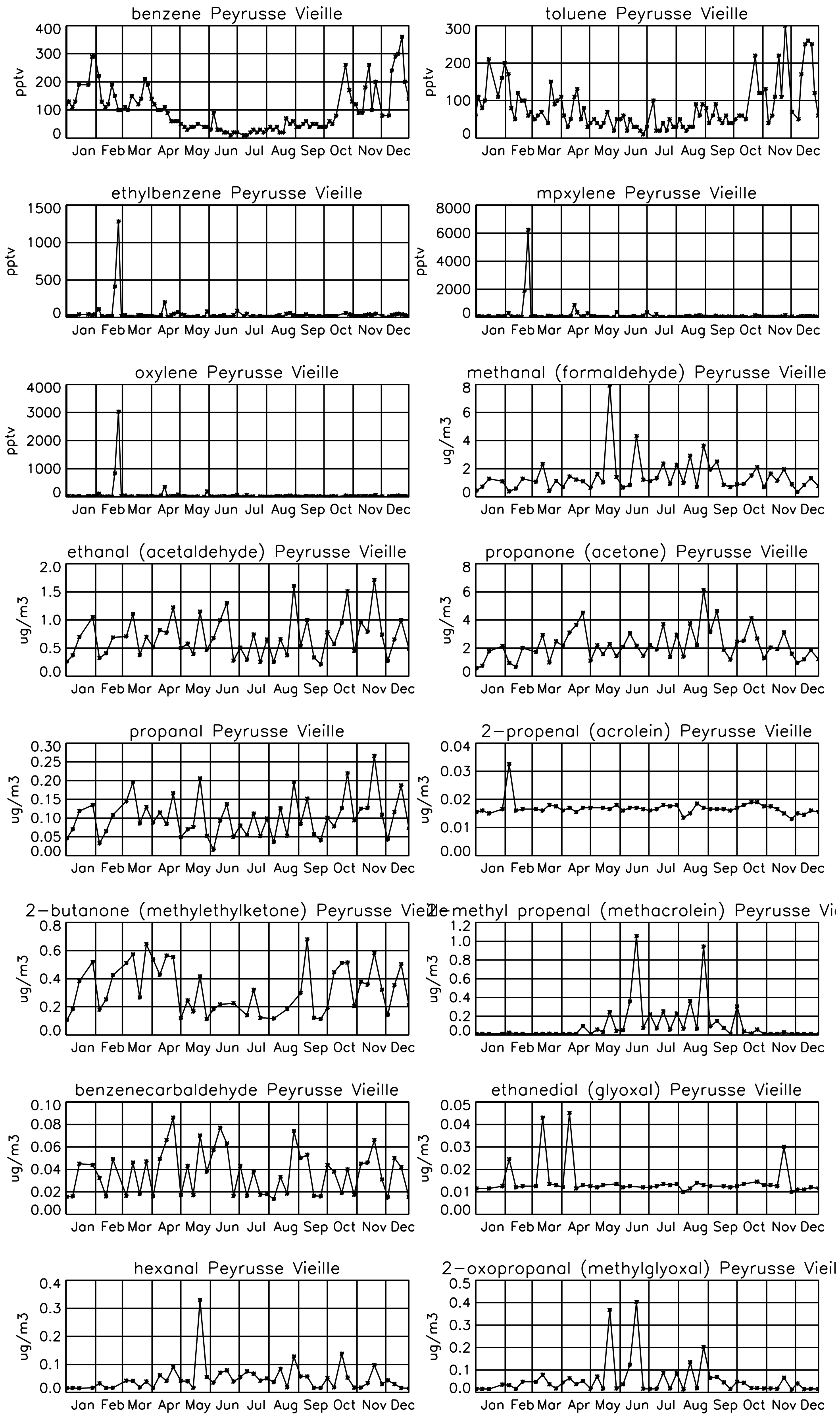

ethane La Tardière
ethene La Tardière
propene La Tardière
ethyne (acetylene) La Tardière
butane La Tardière
isobutane La Tardière
but_1_ene La Tardière
trans_2_butene La Tardière
cis_2_butene La Tardière
isopentane La Tardière
hexane La Tardière
isoprene La Tardière
benzene La Tardière
toluene La Tardière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

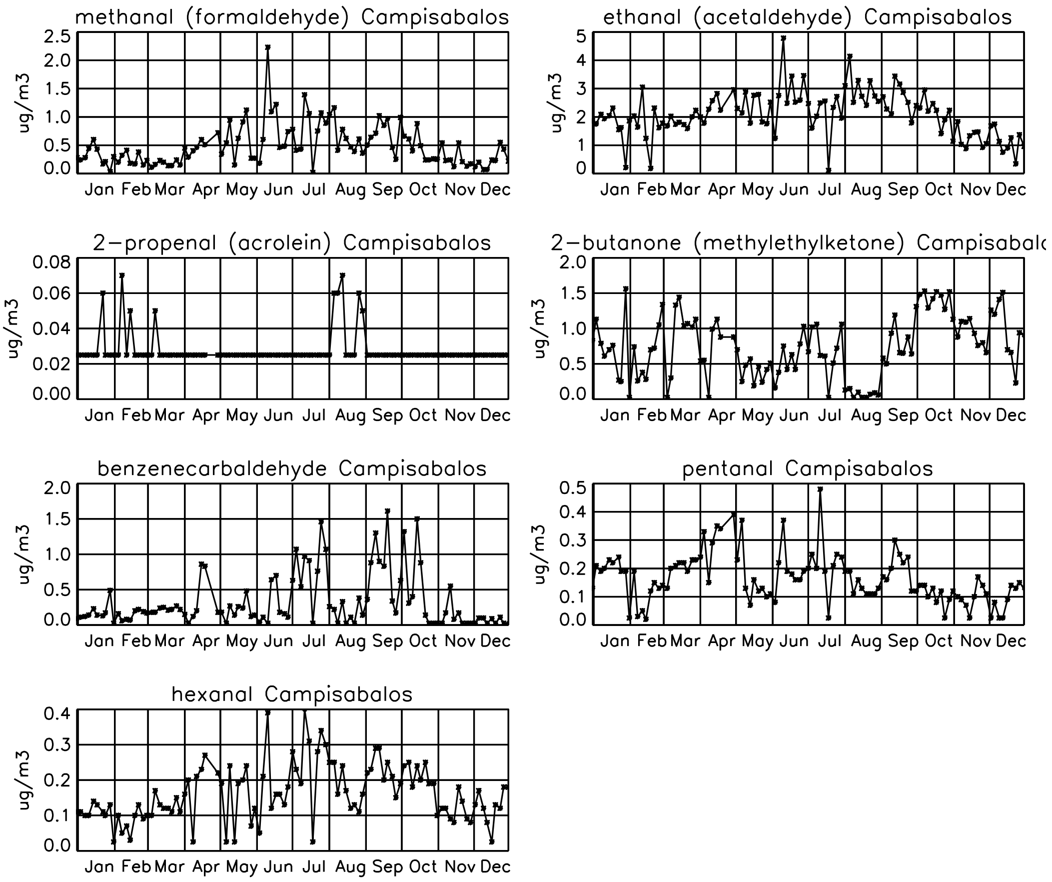

ethylbenzene La Tardière
pptv
600 500 400 300 200 100 0
mpxylene La Tardière
pptv
2000 1500 1000 500 0
oxylene La Tardière
pptv
600 500 400 300 200 100 0
methanal (formaldehyde) La Tardière
ug/m3
8 6 4 2 0
ethanal (acetaldehyde) La Tardière
ug/m3
2.5 2.0 1.5 1.0 0.5 0.0
propanone (acetone) La Tardière
ug/m3
6 4 2 0
propanal La Tardière
ug/m3
0.4 0.3 0.2 0.1 0.0
2−propenal (acrolein) La Tardière
ug/m3
0.04 0.03 0.02 0.01 0.00
2−butanone (methylethylketone) La Tardière
ug/m3
1.5 1.0 0.5 0.0
2−methyl propenal (methacrolein) La Tardièr
ug/m3
0.6 0.4 0.2 0.0
benzenecarbaldehyde La Tardière
ug/m3
1.0 0.8 0.6 0.4 0.2 0.0
ethanedial (glyoxal) La Tardière
ug/m3
0.08 0.06 0.04 0.02 0.00
hexanal La Tardière
ug/m3
0.4 0.3 0.2 0.1 0.0
2−oxopropanal (methylglyoxal) 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


ethane Donon
3000 2000 1000 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
ethene Donon
2500 2000 1500 1000 500 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
propane Donon
1500 1000 500 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
propene Donon
800 600 400 200 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
ethyne (acetylene) Donon
1200 1000 800 600 400 200 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
butane Donon
2000 1500 1000 500 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
isobutane Donon
1000 800 600 400 200 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
but_1_ene Donon
60 40 20 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
trans_2_butene Donon
30 20 10 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
cis_2_butene Donon
30 20 10 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
pentane Donon
400 300 200 100 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
isopentane Donon
500 400 300 200 100 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
hexane Donon
200 150 100 50 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
isoprene Donon
2500 2000 1500 1000 500 0
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


benzene Donon
toluene Donon
ethylbenzene Donon
mpxylene Donon
oxylene Donon
methanal (formaldehyde) Donon
ethanal (acetaldehyde) Donon
propanone (acetone) Donon
propanal Donon
2−propenal (acrolein) Donon
2−butanone (methylethylketone) Donon
2−methyl propenal (methacrolein) Donon
benzenecarbaldehyde Donon
ethanedial (glyoxal) Donon
hexanal Donon
2−oxopropanal (methylglyoxal) Donon
pptv
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
cis_2_butene Peyrusse Vieille
pentane Peyrusse Vieille
isopentane Peyrusse Vieille
hexane Peyrusse Vieille
isoprene Peyrusse Vieille
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


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


methanal (formaldehyde) Campisabalos
ug/m3
0.0 0.5 1.0 1.5 2.0 2.5
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
ethanal (acetaldehyde) Campisabalos
ug/m3
0 1 2 3 4 5
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2−propenal (acrolein) Campisabalos
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) Campisabal
ug/m3
0.0 0.5 1.0 1.5 2.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
benzenecarbaldehyde Campisabalos
ug/m3
0.0 0.5 1.0 1.5 2.0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
pentanal Campisabalos
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 Campisabalos
ug/m3
0.0 0.1 0.2 0.3 0.4
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec