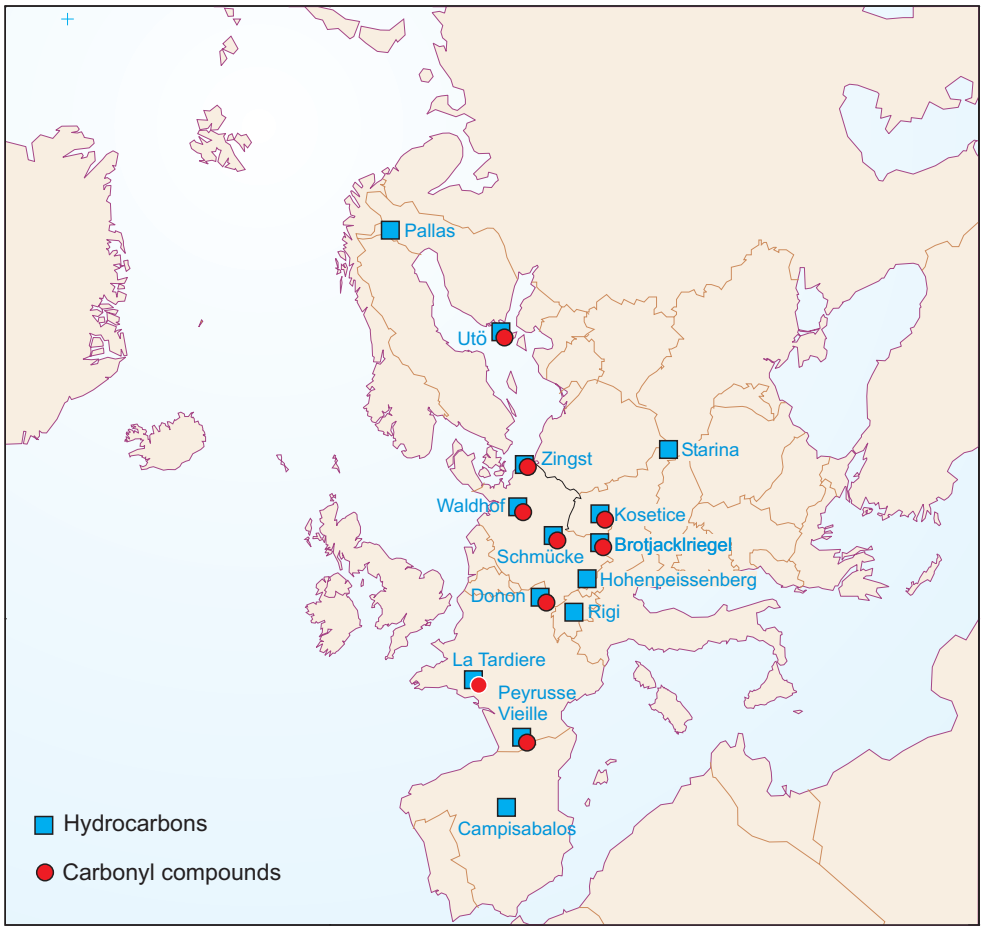
EMEP/CCC-Report 8/2004

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

VOC measurements 2002

Sverre Solberg



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Summary

This report presents measurements of VOC carried out during 2002 at EMEP monitoring sites. VOC measurements are reported for a total of 14 sites and 9 of these with carbonyls. A new French station, FR13 La Tardiere, is included in the EMEP VOC network with hydrocarbon and carbonyl sampling. Furthermore, hydrocarbon measurements from the GAW station Hohenpeissenberg have also been included, provided by Deutscher Wetterdienst in Germany. With exception of these and the Swiss data, all the VOC measurements are made by grab samples of light hydrocarbons in canisters and 8-h samples of carbonyls by DNPH adsorption tubes.

The carbonyl samples from Germany and France were analysed by the national laboratories. For the light hydrocarbons the national laboratories in the respective countries carried out their own chemical analyses. No parallel sampling of hydrocarbons or carbonyls were carried out in 2002.

Particularly high concentrations of many VOCs were observed in December 2002, corresponding with a persistent blocking high-pressure system located in Russia and E-Europe in that month. In August elevated concentrations of ethane were observed at several sites in the eastern part of the continent and the trajectories indicate transport from E-NE.

The long-term changes in the winter medians of hydrocarbons indicate a marked decline from 1992 to 2000 and a levelling off or even increase after that. The reduction is particularly evident for benzene, butane and isobutane and somewhat less for ethene and acetylene. To what extent these effects are explained by changes in European, anthropogenic emissions or by changes in meteorological conditions are not possible to quantify without long-term detailed transport model calculations.

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

VOC measurements 2002

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 so-called Gothenburg protocol, the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, was adopted by the Executive Body of UN-ECE. 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. Once the Protocol is fully implemented, Europe's sulphur emissions should be cut by at least 63%, its NO_x emissions by 41%, its VOC emissions by 40% and its ammonia emissions by 17% compared to 1990. The Protocol also sets tight limit values for specific emission sources (e.g. combustion plant, electricity production, dry cleaning, cars and lorries) and requires best available techniques to be used to keep emissions down. VOC emissions from such products as paints or aerosols will also have to be cut.

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

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

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

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

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

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

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

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

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

The first laboratory intercomparison of light hydrocarbons in EMEP was organised already in 1993 (Romero, 1995). The variation or relative deviation among the laboratories was in a range ±25% from the median. The exercise

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

The measurements are reported annually, and officially made public by the Steering Body of EMEP. Previous results from the EMEP VOC programme have been presented in annual reports (e.g. Solberg et al., 2002). 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).

2. Status of the measurement programme in 2002

2.1 Status of station network

The location of the monitoring sites for VOC presented in this report is shown in Figure 1. An overview of the EMEP VOC measurement programme and the accompanying measurements presented in this report are given in Table 2. As indicated by Table 2, data for 14 measurement sites for VOC have been reported to CCC and 9 of these with carbonyls.

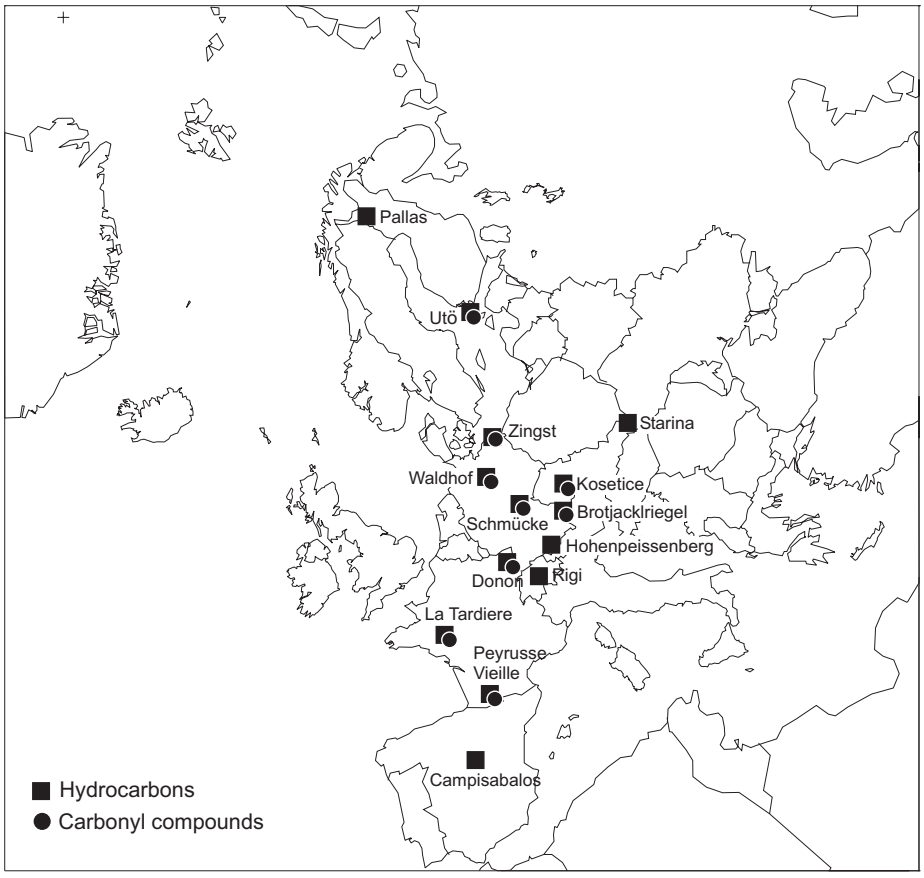


Figure 1: Monitoring sites for VOC in 2002.

VOC has been monitored at the GAW (Global Atmospheric Watch) station at Hohenpeissenberg in south Germany since 1998 but not previously reported in the EMEP VOC reports. As part of the agreement of cooperation between EMEP and GAW as well as by a wish from individuals at Deutscher Wetterdienst and EMEP these data are reported here for the first time.

Furthermore, VOC monitoring including both hydrocarbons and carbonyls has been initiated at FR15, La Tardiere, in the west part of France in 2002 and are reported here.

Due to technical problems at the analysing laboratory, no carbonyl data are presented for Utö or Košetice for 2002 in this report. These data will, however, become available from the EMEP web page at a later stage.

Table 2: Status of the VOC monitoring programme in 2002. 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. Additional laboratories taking part in parallel measurements are indicated in parenthesis.

Station	Code	HC[1)]	Lab.[2)]	Carb[1)]	Lab.[2)]	Comments
Pallas	FI96	Reg.	FMI	n.m.	-	
Utö	FI09	Reg.	FMI	(Reg.)	NILU	Technical problems with carbonyl analyses in the lab
Waldhof	DE02	Reg.	UBA	Reg.	UBA	
Schmücke	DE08	Reg.	UBA	Reg.	UBA	
Zingst	DE09	Reg.	UBA	Reg.	UBA	
Brotjacklriegel	DE05	Reg.	UBA	Reg.	UBA	
Hohenpeissenberg	DE43	Daily	DWD			New contributor to the EMEP VOC program
Košetice	CZ03	Reg.	CHMI	(Reg.)	NILU	Technical problems with carbonyl analyses in the lab
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	New EMEP VOC site
Campisábalos	ES09	Reg.	MMA	n.m.	-	

1) Reg. = regularly, Scat. = scattered, n.m. = not measured., cont. = Continuous
2) CHMI = Czech Hydrometeorological Institute
DWD = Deutsche 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 3 gives the number of valid (daily) samples of hydrocarbons and carbonyls (after inspection and removal of outliers). According to EMEP's

recommendations, the samples should be taken twice a week, implying that 104 samples per year correspond to 100% data cover.

A 90% data completeness, i.e. 94 samples pr year, of daily values is given as data quality objective according to the EMEP manual (EMEP/CCC, 1996) and that is fulfilled at most of the VOC sites. The data capture was particularly low at Starina and, due to station renovation, also at Peyrusse Vieille.

Table 3: The number of samples of hydrocarbons (HC) and carbonyls (Carb) in 2002.

Station	Number of samples	
	HC	Carb
Pallas	96	-
Utö	89	-
Zingst	101	104
Waldhof	104	104
Schmücke	104	104
Brotjacklriegel	104	104
Hohenpeissenberg	337	-
Košetice	103	-
Starina	80	-
Rigi [1)]	314	-
Donon	91	75
Peyrusse Vieille	79	28
La Tardiere	104	28
Campisábalos	97	-

[1)] Refer to days with monitoring data

2.2 Analytical procedures and quality control

The procedures for sampling and chemical analyses were similar in 2002 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.

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

A few notes about the measurements are given in the following. The concentrations of 3-buten-2-one, 2-methylpropenal, 2-butanone and butanal have

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

2.2.1 Instrumentation and technical procedures at Hohenpeissenberg

The VOC monitoring at Hohenpeissenberg by Deutscher Wetterdienst are carried out by a custom-built sampling and gas flow system with samples split from a permanently flushed glass manifold. The system consist of the following components:

- A Nafion dryer (Permapure) used until Jan 31st 2002, thereafter replaced by a moisture trap at 233 K
- Cryo-adsorption on glass beads (87 K adsorption, 503 K desorption)
- Separation on Al2O3/KCl PLOT column (Varian Chrompack, 50 m x 0.53 mm i.d.) temperature programmed from 313 K to 473 K
- Materials in contact with sample are silcosteel (Restek), stainless steel (at 443 K) and valve sealing (Valcon E rotor material in Valco GC valves by VICI, 443 K).

Calibration gas runs are performed every 2 weeks with a 30-component mixture produced and certified by NPL (National Physics Laboratory, UK). Calibration factors are based on one carbon response factor by FID for all pure C-H hydrocarbons, except for ethyne (acetylene) which is directly calibrated using NPL certified standard. Zero, reference, and calibration gas runs are performed every 2 weeks. Detection limit is between 1 and 10 ppt, depending on the individual hydrocarbon. The sampling interval is 15 min with typically one sample per day between 10 and 15 (CET).

The hydrocarbons are identified by retention time. 28 individual hydrocarbons corresponding to the recommended VOC calibration mixture (WMO GAW report No. 111) are listed. Accuracy values comprise the 2 sigma errors of calibration, reproducibility of the measurements, and peak integration errors due to peak overlap and baseline noise. No averaging is applied for daily data.

The applied instrumentation and methods has been successfully tested in two international intercomparison experiments (NOMHICE, AMOHA) and have been documented by Plass-Duelmer et al. (2002).

3. VOC concentrations in 2002

3.1 General

Monthly mean and median concentrations of the individual hydrocarbons and carbonyls for 2002 are tabulated in Appendix A. The monthly statistics were not calculated if the number of samples were below four. Time series of all compounds during 2002 are given in Appendix B. Note that daily average concentrations are shown for the continuous monitor data from CH05 Rigi and that both the day-time and night-time data from Hohenpeissenberg were used in the calculations. As discussed in Chapter 3.2 this may introduce a bias in the comparison.

When comparing the monitoring for 2002 with previous years of VOC data, several episodes with particularly high concentrations were observed in December 2002. This is seen at many sites at the European continent from Zingst in NE Germany to Donon in SE France and was likely caused by the large-scale meteorological situation. A persistent high-pressure system was located over Russia for an extended time period in this month, and the western part of this blocking anticyclone was extending into E- and Central Europe during several periods as indicated by Figure 2.

This weather system was associated with low surface temperatures (Figure 2), and several meteorological stations in E-Europe recorded monthly mean temperatures well below the average. The December mean temperature in Moscow was 6° below the standard normal and also in Warsaw and Prague the monthly mean surface temperature was several degrees below the average.

The elevated VOC concentrations observed during this period agrees with a polluted, continental air mass (weak SE winds) trapped and accumulating during several days in a thermally stable boundary layer. This is a common meteorological situation for observing peak concentrations during winter in Europe.

Another period with higher concentrations than normal was August 2002 when elevated concentrations of particularly ethane were observed at several stations in the east; Utö, Zingst, Košetice and Starina. The reason that this was most pronounced for ethane could be the shorter chemical lifetime of VOC in summer. Another explanation, however, could be that particular emissions source types could be responsible, and a major source for ethane is natural gas. The trajectories for 26th August 2002, when peak concentrations of ethane relative to the average were observed, indicate a fairly slow transport from E-NE to the mentioned stations (Figure 3).

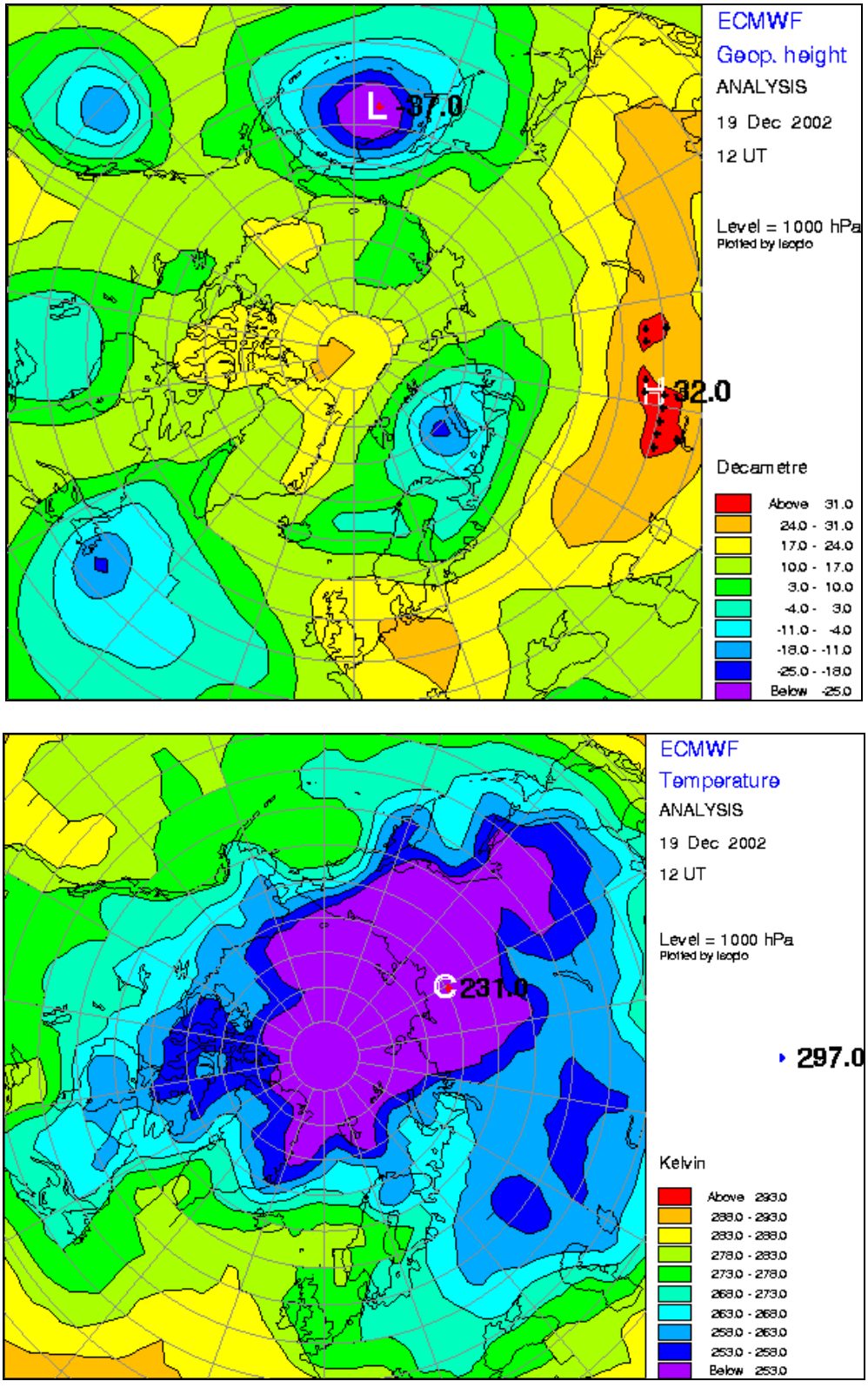


Figure 2: The geopotential height (upper panel) and the temperature (lower panel) at the 1000 hPa surface on 19th December 2002 (based on data from ECMWF).

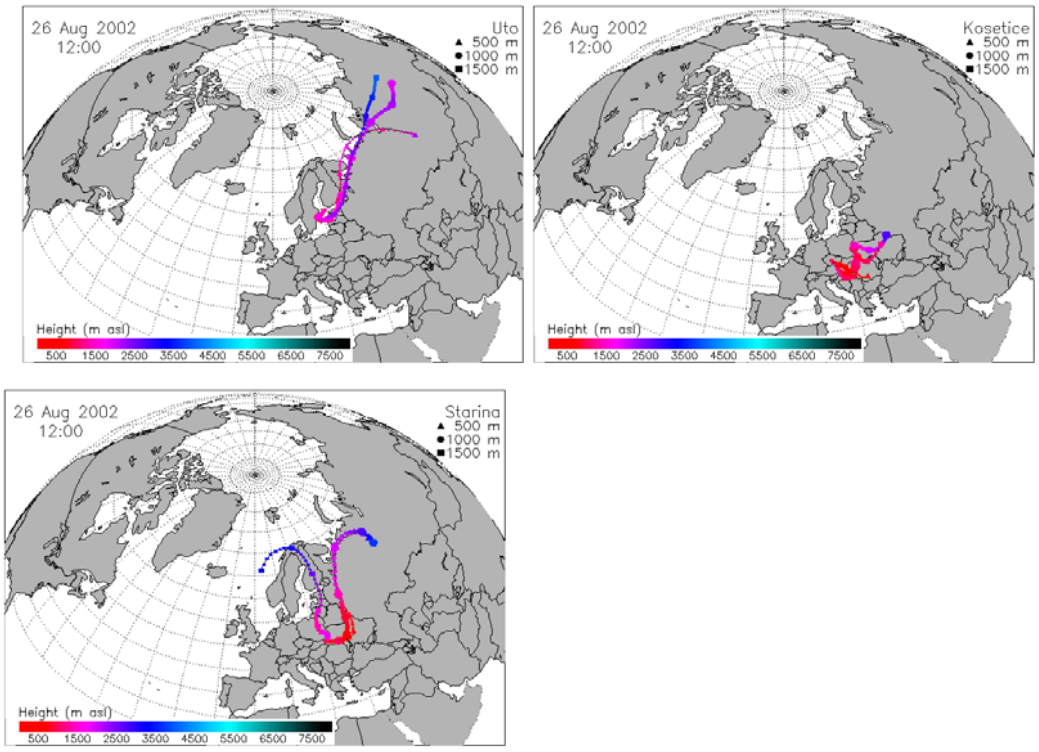


Figure 3: Air-mass back trajectories calculated with the FLEXTRA model based on meteorological data from ECMWF. The trajectories are 7 days long and arrive on 26th August 2002 when peak concentrations of ethane were observed.

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 4 and Figure 5. This shows that the hydrocarbon concentrations at CZ03, Košetice, were particularly high for many of the measured components. The fact that also the low percentiles at Košetice were significantly higher than at the other sites indicate that the monitoring site is located in an area with generally higher emissions and background concentrations than the other sites.

Also the data from SK06, Starina, are high for many of the hydrocarbons. However, as this regards particularly the high percentiles, it indicates a number of highly polluted episodes and a low background level.

As for 2001 the hydrocarbon concentrations at ES09, Campisábalos, were substantially lower than at the other sites, particularly for the most light-weight components. In winter ethane and propane are chemically stable and the results from previous years have indicated well-mixed concentrations of these species in Europe during winter. On this background the results from Campisábalos are surprisingly low and parallel sampling and analyses with other laboratories are recommended.

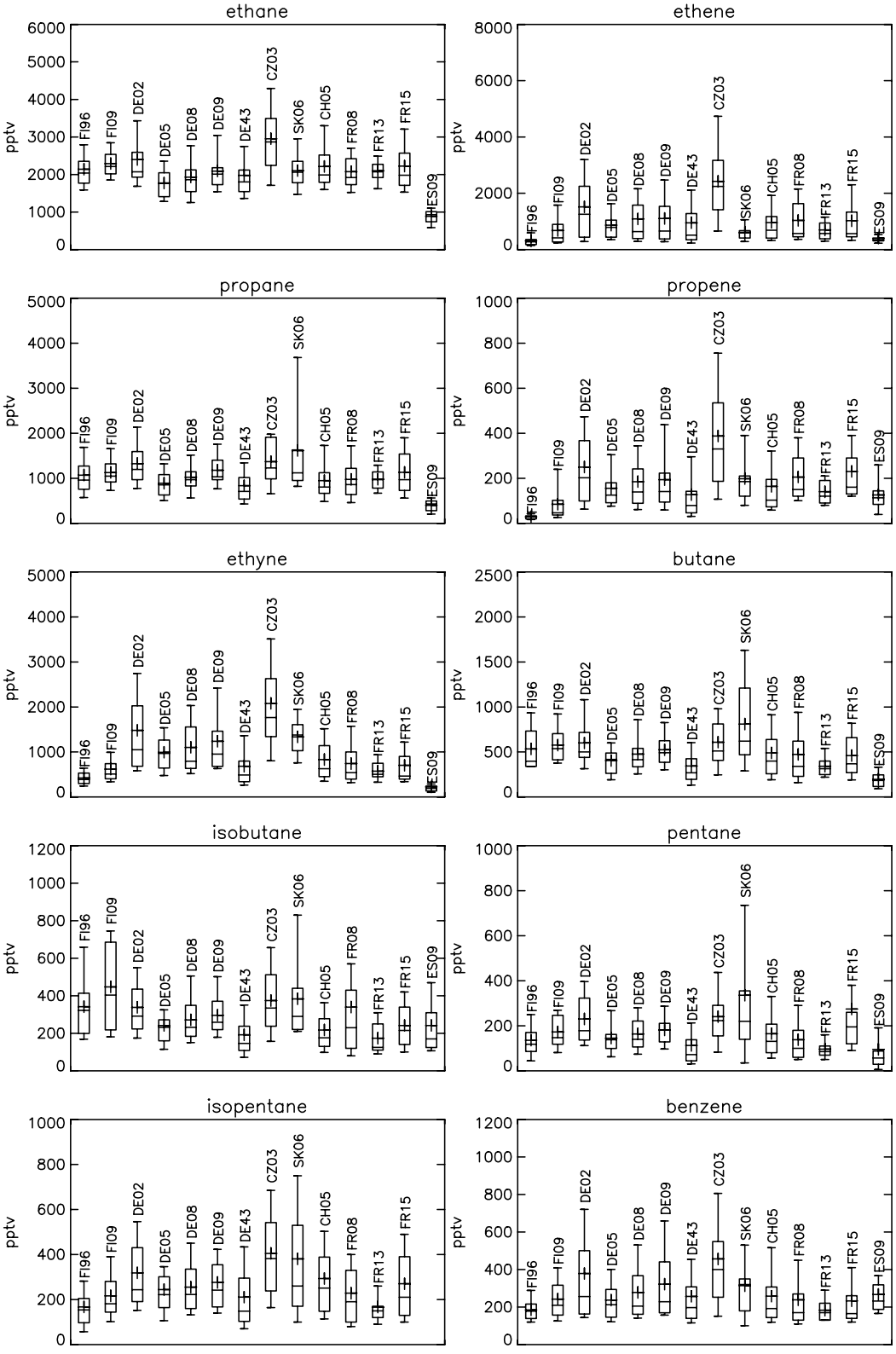


Figure 4: Box- and whisker-diagrams for hydrocarbons during winter 2002 (Jan., Feb., Nov., Dec.). The markers indicate the 10-, 25-, 50-, 75- and 90-percentiles. Mean values are indicated by a cross.

The summer seasonal means and percentiles for four selected carbonyls, formaldehyde, acetaldehyde, acetone and butanone, are given in Figure 5. This shows particularly low concentrations at DE05, Brotjacklriegel, probably reflecting the altitude of the monitoring site (approx. 1000 m asl.). The formaldehyde (methanal) concentrations were highest at Donon, while acetaldehyde (ethanal) were highest at Zingst, Waldhof and Schmücke. A likely explanation for this is biogenic formation of formaldehyde from the degradation of isoprene at Donon as the isoprene concentrations at Donon are substantially higher than at the other sites. Acetaldehyde, on the other hand is to a larger extent a primary or secondary product of anthropogenic emissions.

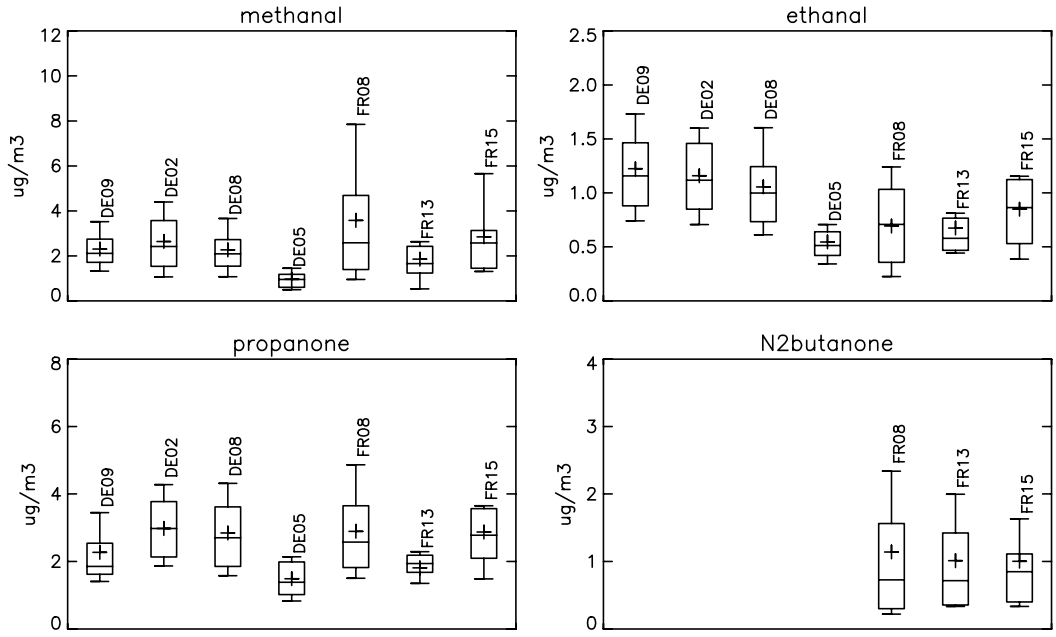


Figure 5: Box- and whisker-diagrams for carbonyls during summer 2002 (May, June, July, August). The markers indicate the 10-, 25-, 50-, 75- and 90-percentiles. Mean values are indicated by a cross.

3.2 Diurnal cycle in measured hydrocarbons

While the standard EMEP measurements of light hydrocarbons are grab samples collected around noon, the VOC monitoring at Rigi is continuous and at Hohenpeissenberg include one day-time and one night-time measurement. The monthly and seasonal statistics (means, medians etc) in this report are based on all data and may thus introduce a bias between the monitor data (Rigi and Hohenpeissenberg) vs. the manually collected grab samples. The annual average diurnal cycles of a number of the hydrocarbons at Rigi are shown in Figure 6. This shows that except for the sum of butenes all compounds follow a diurnal cycle with higher concentrations during day and lower during night.

One likely explanation for this is the diurnal mountain wind system causing upslope winds and a deeper mixed layer during daytime, carrying polluted air masses from the boundary layer to the mountain site. At night downslope (katabatic) winds due to stronger cooling of the mountain air and a more stable and shallow boundary layer will give less transport of polluted air masses into the

site. Additionally, stronger emissions during day could enhance the measured diurnal cycle. Inspection of the diurnal cycles in the measured hydrocarbons during 3-months mid-summer and mid-winter seasons, separately, did indeed reveal a stronger diurnal cycle in summer than winter, supporting the influence of the changing mountain wind effect. However, as a distinct diurnal cycle peaking at daytime was also found in mid-winter (when the diurnal cycle in the boundary layer height is less), the influence of closer emission sources is also of importance for this site.

The dominant source of isoprene is biogenic emissions from plants and deciduous trees and is only taking place during daytime. The particularly strong diurnal cycle of isoprene seen in Figure 6 reflects this. The reason for the opposite cycle of butenes is probably the short photochemical lifetime of these compounds (through OH), causing a chemical decay during daytime.

Based on the compounds shown in Figure 6 the daytime concentrations at Rigi are of the order of 10-20% higher than the daily mean concentrations when based on measurements through the whole year.

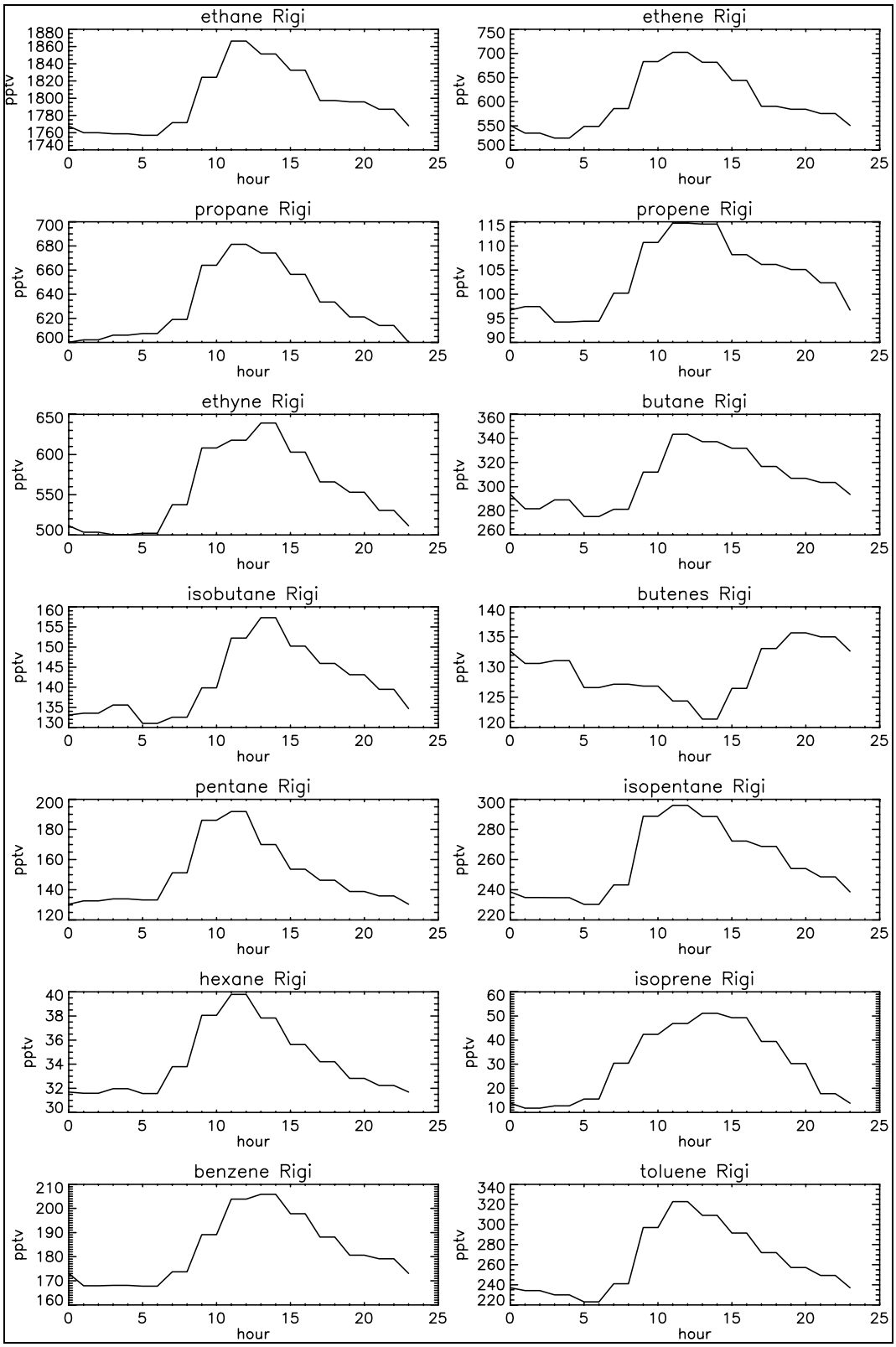


Figure 6: Annual average diurnal cycle of hydrocarbons measured at Rigi in 2002.

3.3 Regional distribution of VOC

Figure 7–Figure 16 shows maps with the stations' median concentrations of 10 light hydrocarbons for the winter months January, February, November and December in 2002 taken together. Note that these medians are based on monitoring data through the whole day at Rigi and on both the day-time and night-time values at Hohenpeissenberg. As shown above, this may introduce a slight bias compared to the grab samples which are collected at noon.

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 2002 are given in Figure 17–Figure 19.

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

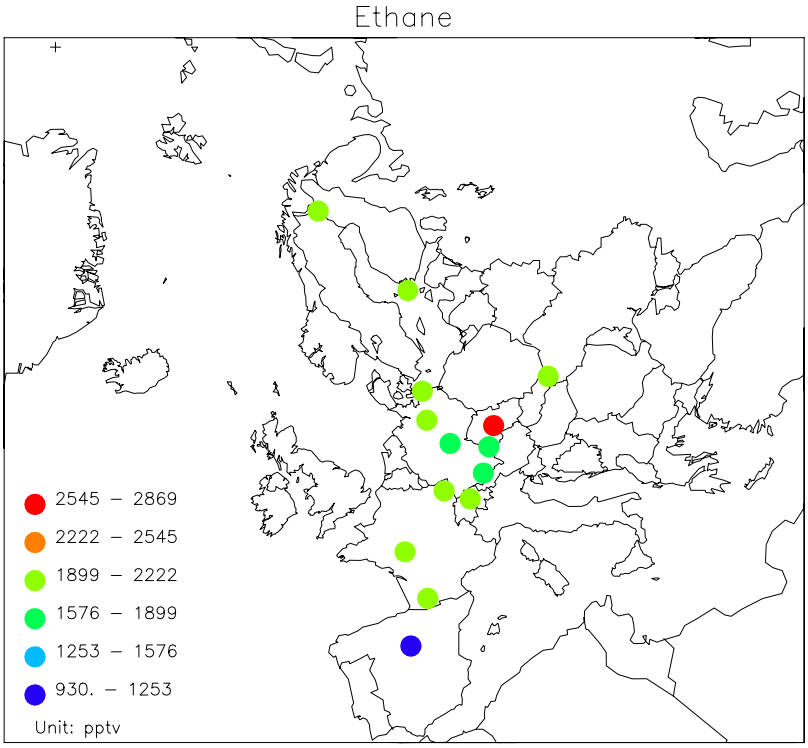


Figure 7: Median concentration of ethane at EMEP sites in the winter months November, December, January and February 2002 taken together.

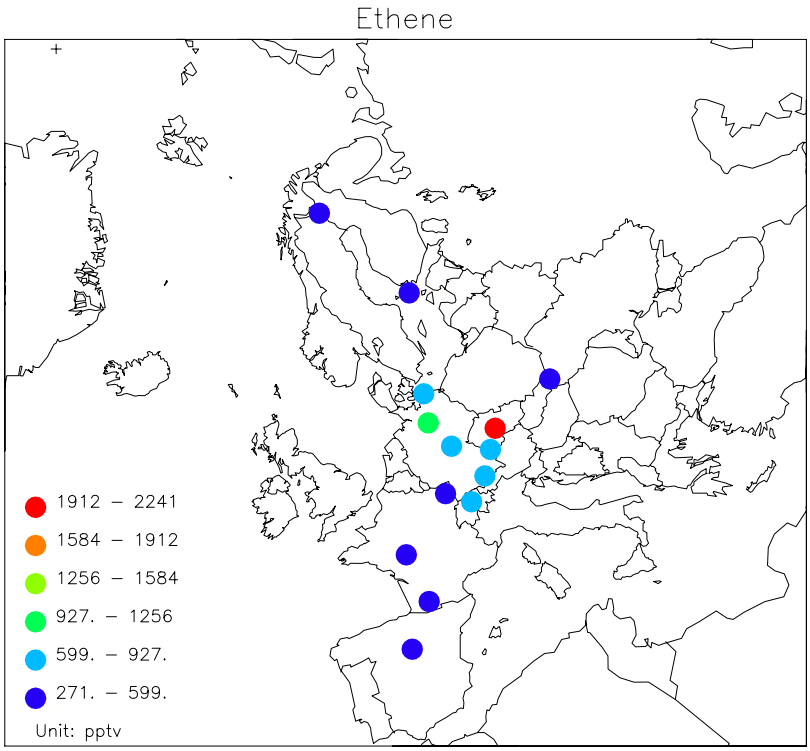


Figure 8: Median concentration of ethene at EMEP sites in the winter months November, December, January and February 2002 taken together.

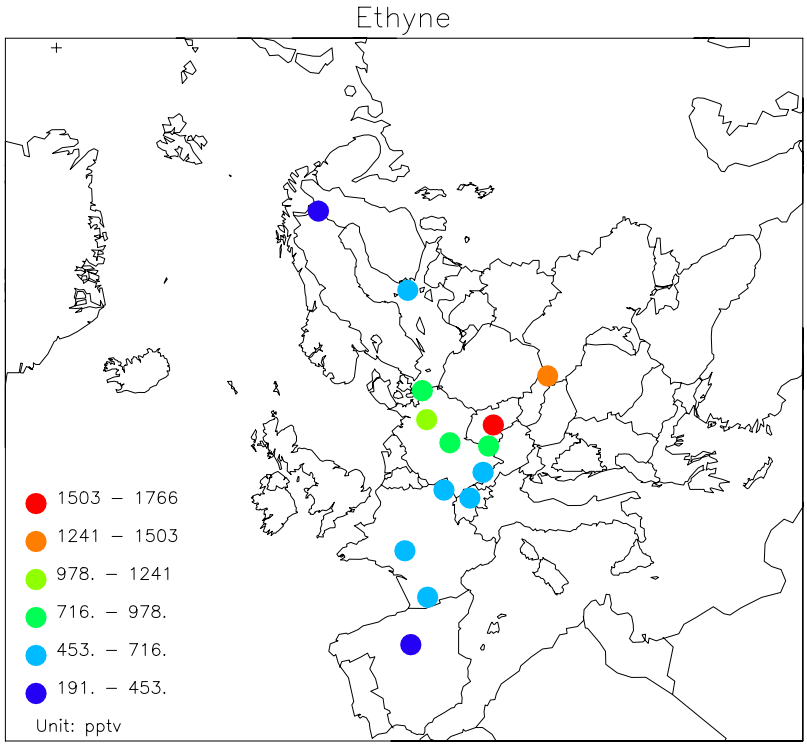


Figure 9: Median concentration of acetylene at EMEP sites in the winter months November, December, January and February 2002 taken together.

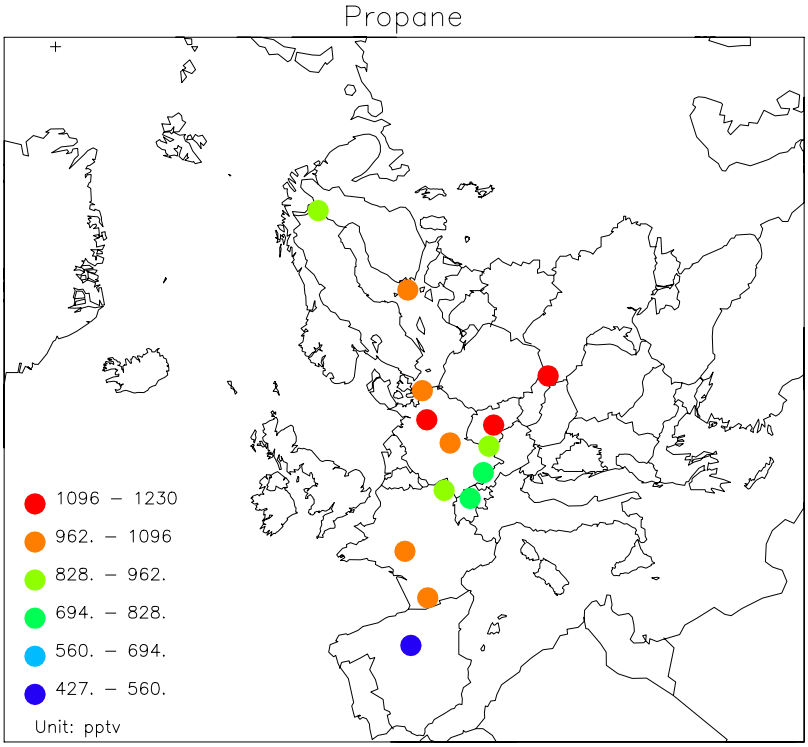


Figure 10: Median concentration of propane at EMEP sites in the winter months November, December, January and February 2002 taken together.

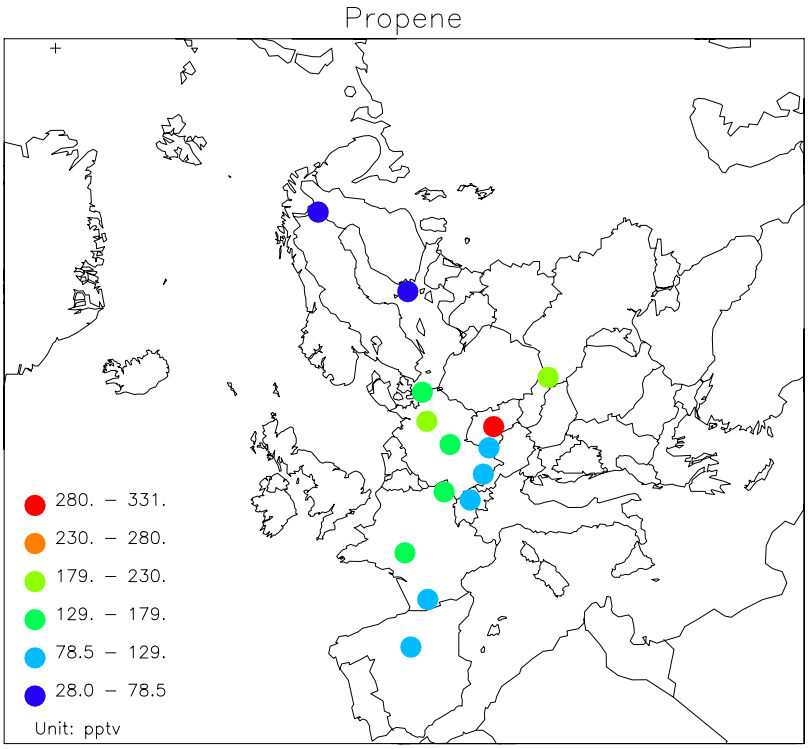


Figure 11: Median concentration of propene at EMEP sites in the winter months November, December, January and February 2002 taken together.

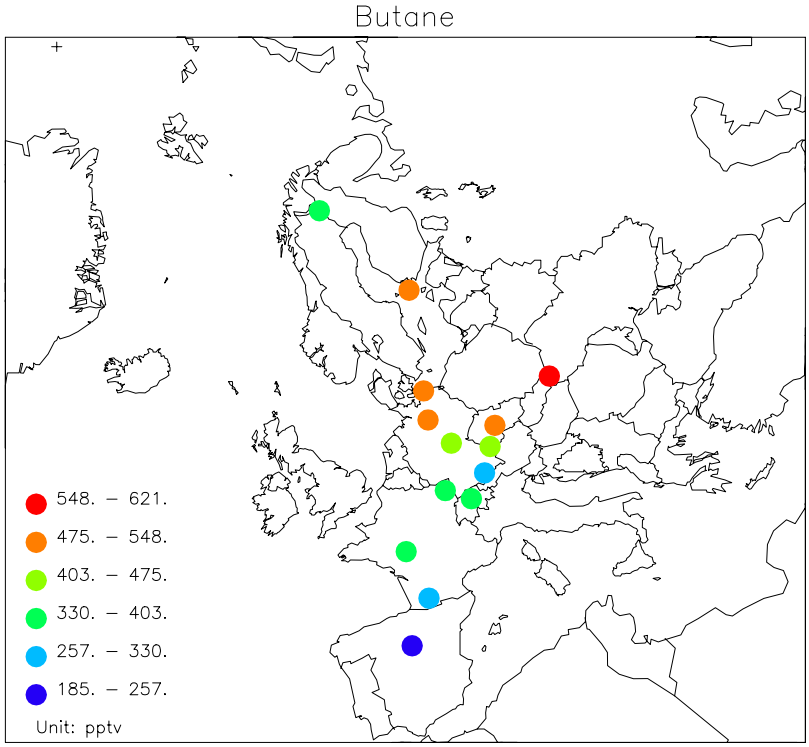


Figure 12: Median concentration of n-butane at EMEP sites in the winter months November, December, January and February 2002 taken together.

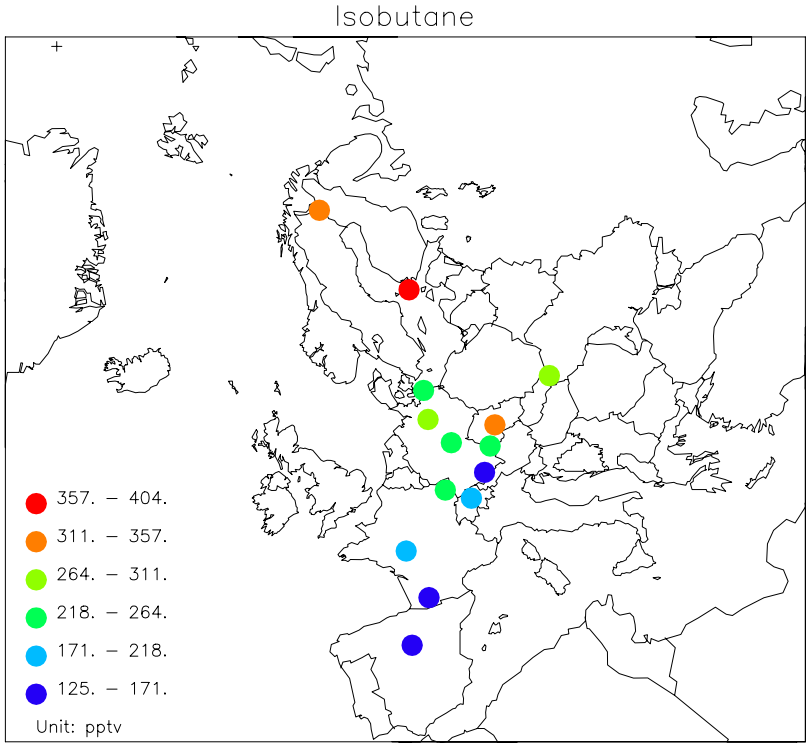


Figure 13: Median concentration of i-butane at EMEP sites in the winter months November, December, January and February 2002 taken together.

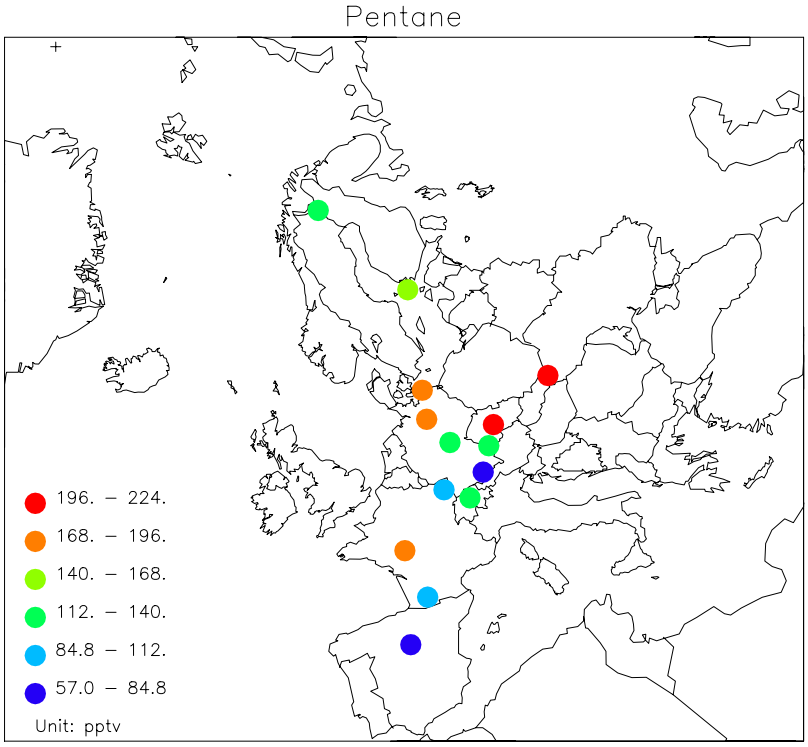


Figure 14: Median concentration of n-pentane at EMEP sites in the winter months November, December, January and February 2002 taken together.

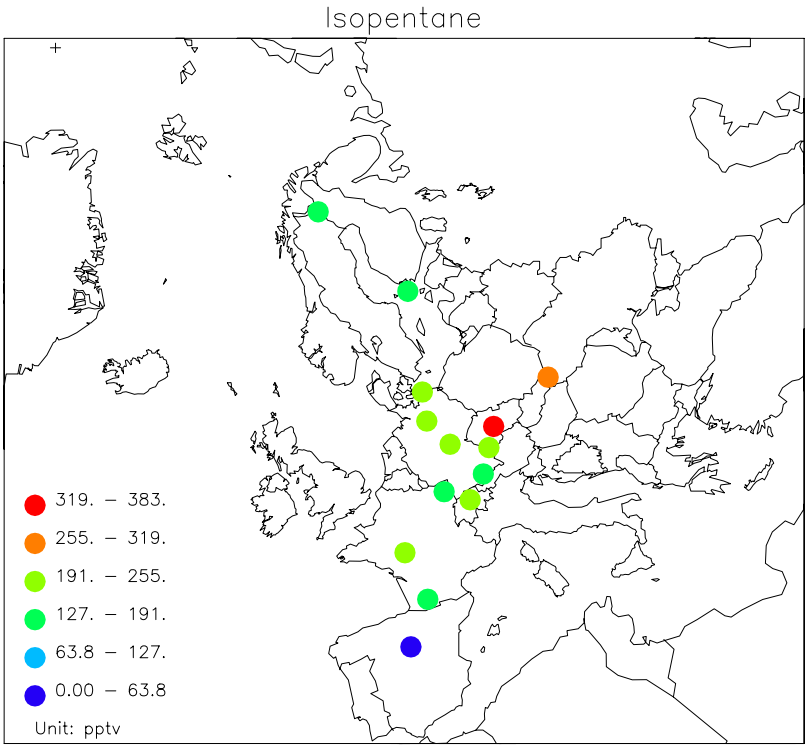


Figure 15: Median concentration of i-pentane at EMEP sites in the winter months November, December, January and February 2002 taken together.

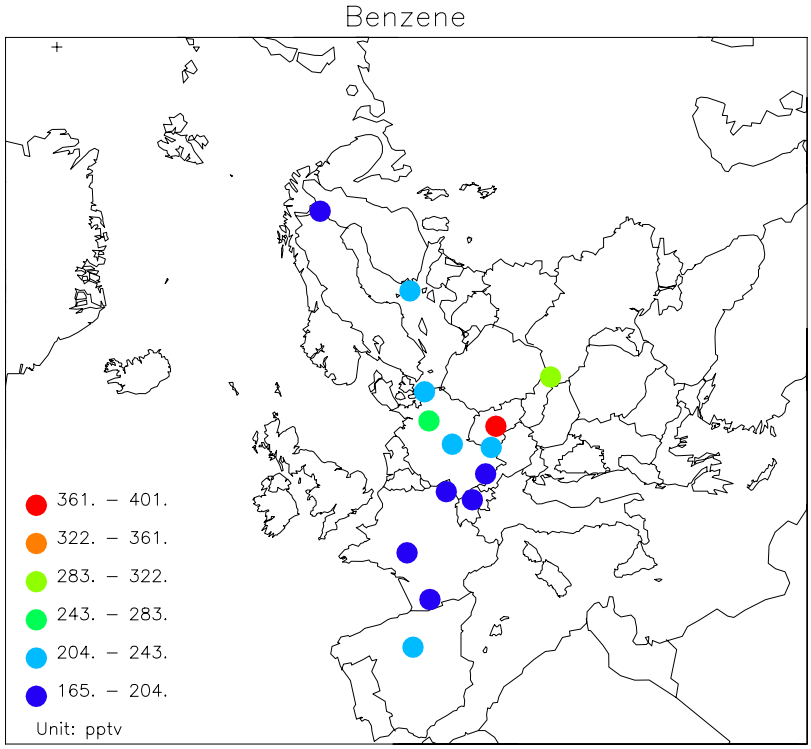


Figure 16: Median concentration of benzene at EMEP sites in the winter months November, December, January and February 2002 taken together.

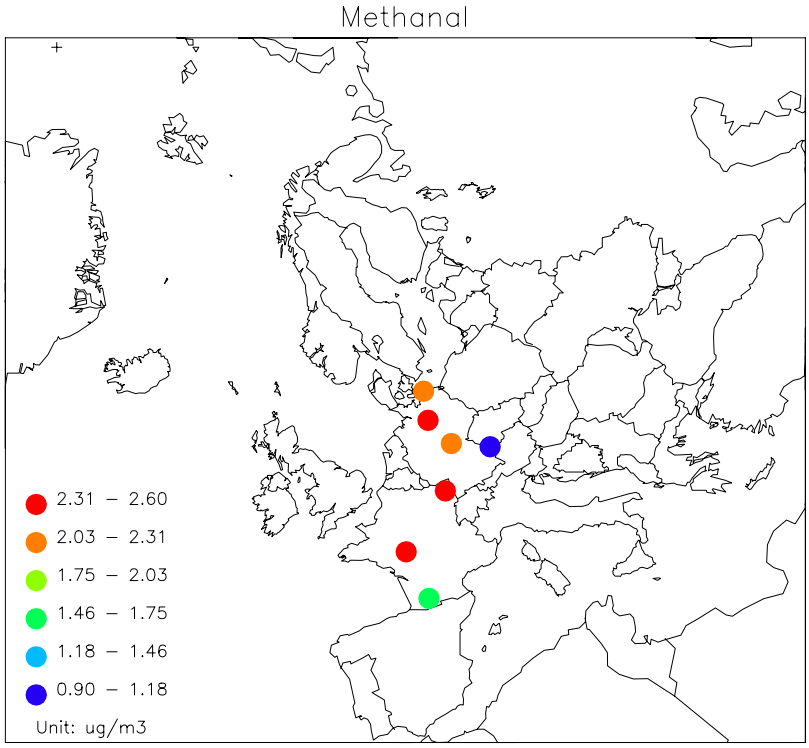


Figure 17: Median concentration of formaldehyde at EMEP sites in the summer months May, June, July and August 2002 taken together.

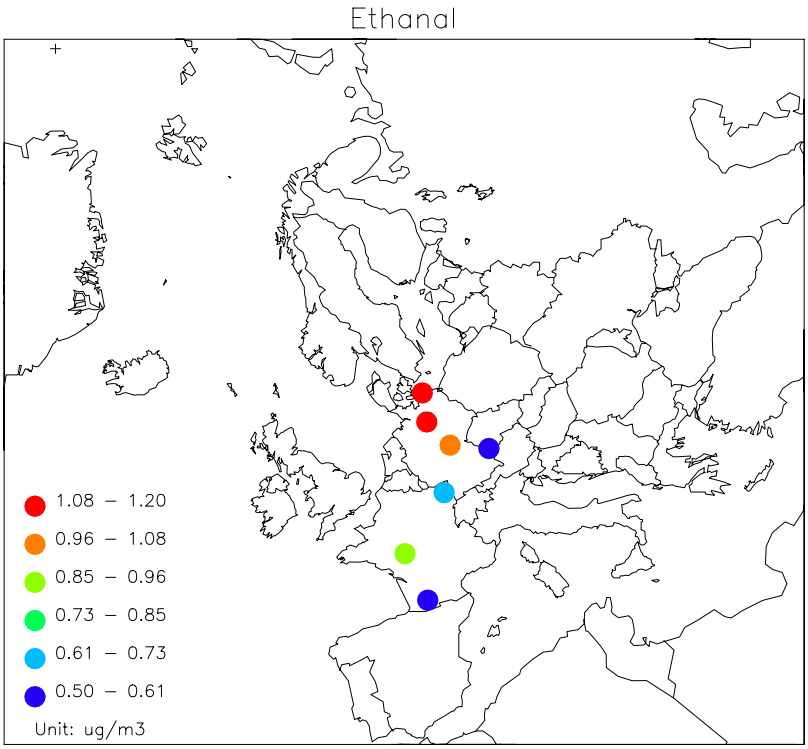


Figure 18: Median concentration of acetaldehyde at EMEP sites in the summer months May, June, July and August 2002 taken together.

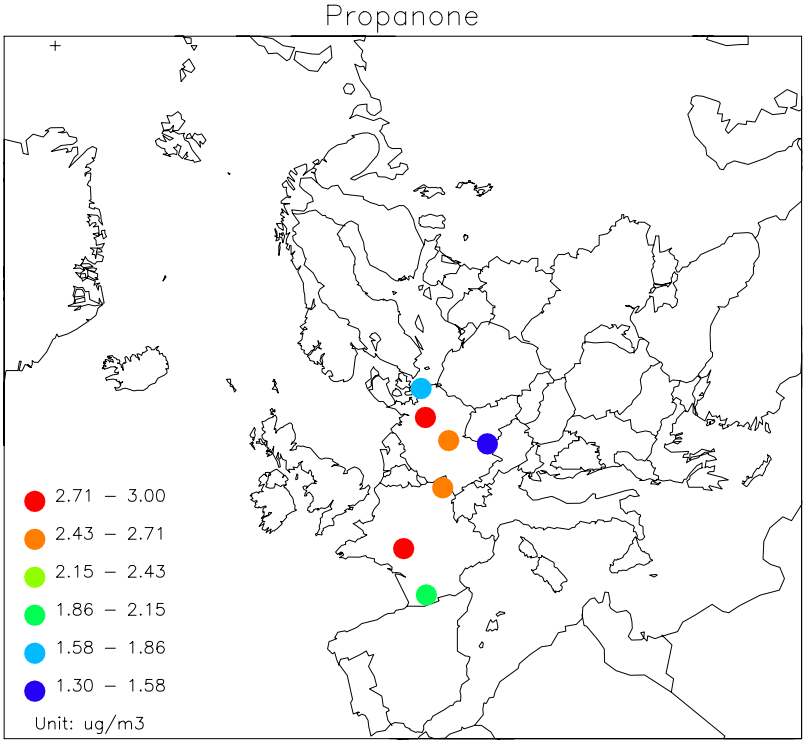


Figure 19: Median concentration of acetone at EMEP sites in the summer months May, June, July and August 2002 taken together.

4. Long-term trends in VOC

The long-term trend in the measured VOC from 1992 is indicated in Figure 20 and Figure 21 showing the seasonal medians at Waldhof (DE02), Košetice (CZ03) and Donon (FR08) of selected hydrocarbons (winter) and carbonyls (summer), respectively.

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

A marked decline in the winter medians of several hydrocarbons is indicated by Figure 20. To separate the sole effect of changes in European VOC emissions on the observed concentrations trends in Figure 20 and Figure 21 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.

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

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

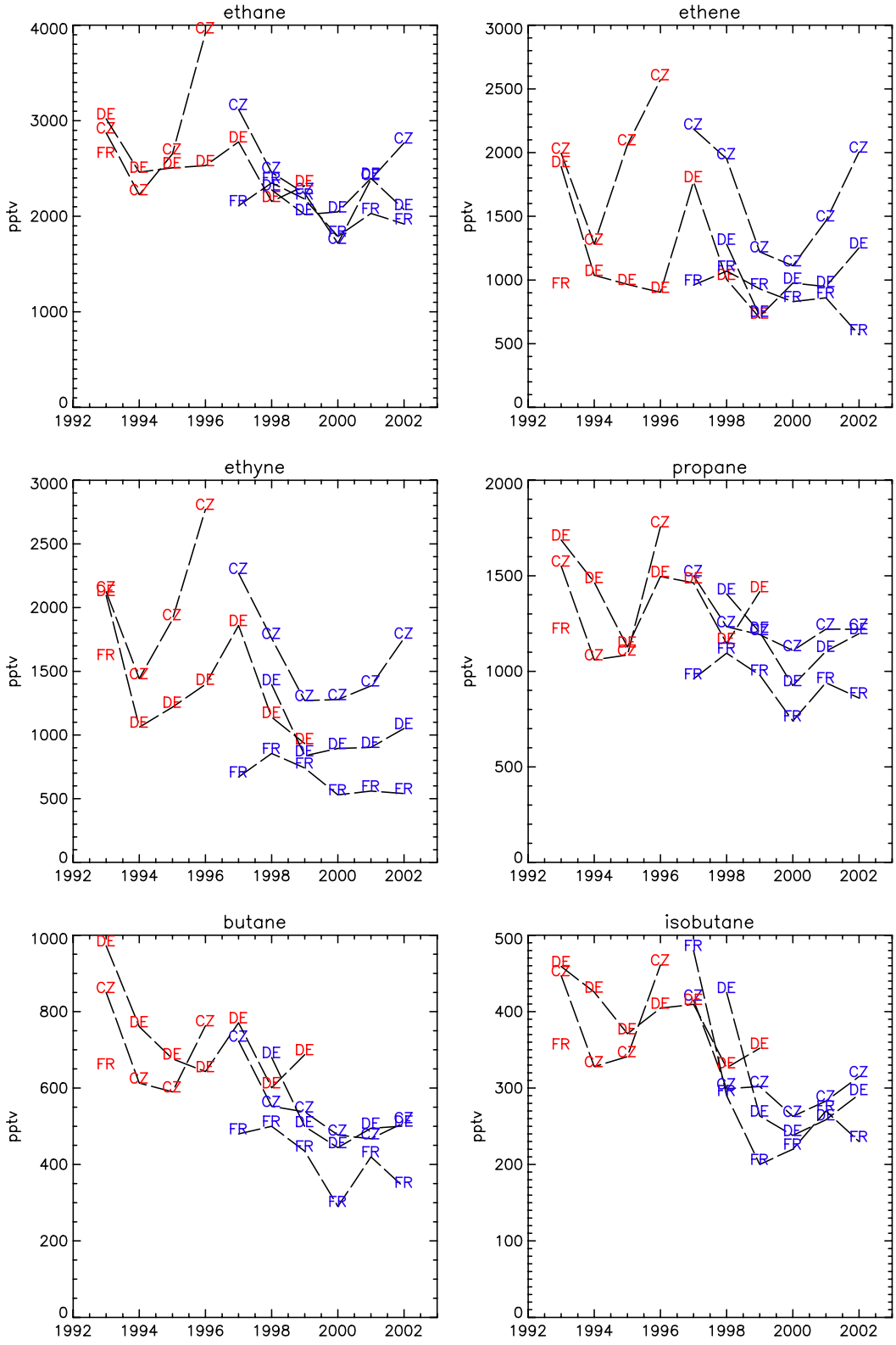


Figure 20: Annual winter (Jan., Feb., Nov., Dec.) median concentrations of hydrocarbons at Waldhof (DE), Košetice (CZ) and Donon (FR). Red letters mark NILU's lab., blue the national lab.

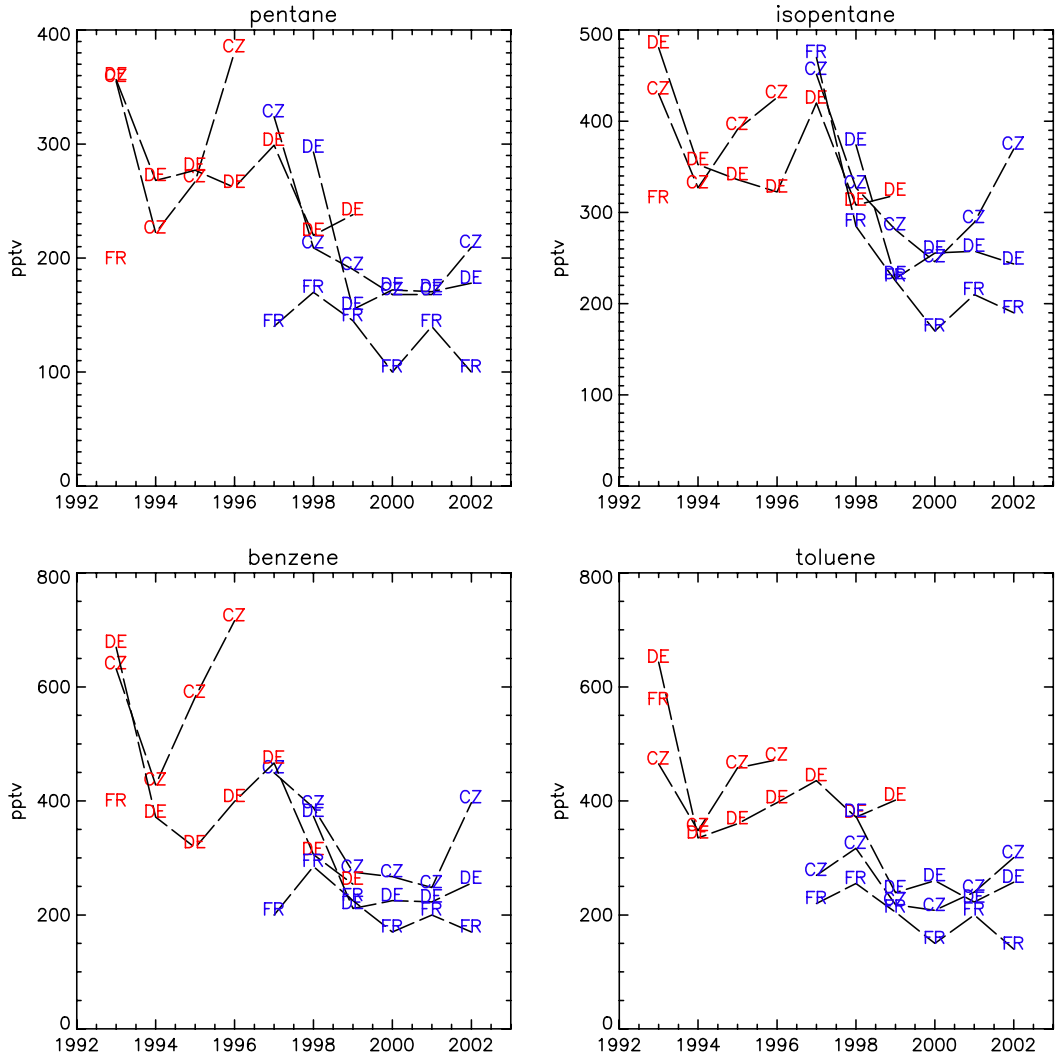


Figure 20 (contd.)

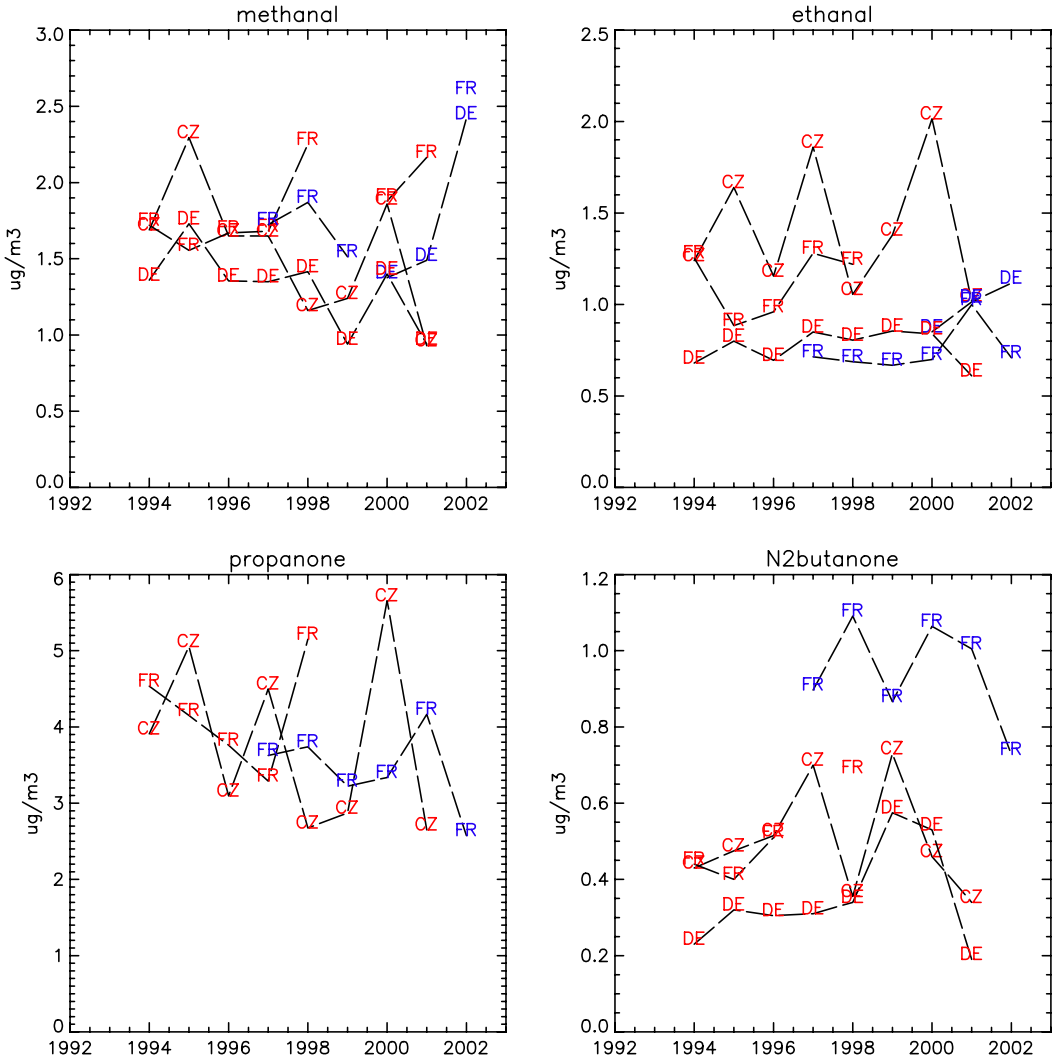


Figure 21: Annual summer (May, June, July, Aug.) median concentrations of carbonyls at Waldhof (DE), Košetice (CZ) and Donon (FR). Red letters mark NILU's lab., blue the national lab.

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), Jiri Honzak and Radek Pokorny (CHMI), Marta Mitosinkova (SHMI), Stefan Reimann (EMPA), Alberto Gonzalez Ortiz (MMA), Karin Uhse (UBA) and Christian Plass-Duelmer (DWD). ECWMF is acknowledged for the meteorological data shown and those used for the trajectory calculations. Andreas Stohl is acknowledged for providing the FLEXTRA trajectory model.

6. References

EMEP/CCC (1990) EMEP workshop on measurement of hydrocarbons/VOC. Lindau, Federal Republic of Germany. Lillestrøm, Norwegian Institute for Air Research (EMEP/CCC Report 3/90).

EMEP/CCC (1995) Expert meeting on EMEP VOC measurements. Berlin, Germany, 30 November–2 December 1994. Kjeller, Norwegian Institute for Air Research (EMEP/CCC Report 6/95).

EMEP/CCC (1996) Manual for sampling and chemical analyses. Kjeller, Norwegian Institute for Air Research (EMEP/CCC Report 1/95).

Hov, Ø, Sorteberg, A., Schmidbauer, N., Solberg, S., Stordal, F., Simpson, D., Lindskog, A., Areskoug, H., Oyola, P., Lättilä, H. and Heidam, N.Z. (1997) European VOC emission estimates evaluated by measurements and model calculations. *J. Atmos. Chem., 28*, 173-193.

Laurila, T. and Hakola, H. (1996) Seasonal cycle of C2-C5 hydrocarbons over the Baltic Sea and Northern Finland. *Atmos. Environ., 30*, 1597–1607.

Lindskog, A., Solberg, S., Roemer, M., Klemp, D., Sladkovic, R., Boudries, H., Dutot, A., Hakola, H., Schmitt, R. and Areskoug, H. (1995) The distribution of NMHC in Europe: results from the Eurotrac TOR project. *Water, Air, Soil Poll., 85*, 2027-2032.

Plass-Dülmer, C., Michl, K., Ruf, R. and Berresheim, H. (2002) C_2-C_8 hydrocarbon measurement and quality control procedures at the Global Atmosphere Watch Observatory Hohenpeissenberg. *J. Chromatogr., 953*, 175-197.

Romero, R. (1995) The first laboratory intercomparison of light hydrocarbons in EMEP. Stockholm University, Institute of Applied Environmental Research, Air Pollution Laboratory/Kjeller, Norwegian Institute for Air Research (EMEP/CCC Report 2/95).

Solberg, S., Dye, C., Schmidbauer, N., Herzog, A. and Gehrig, R. (1996) Carbonyls and nonmethane hydrocarbons at rural European sites from the Mediterranean to the Arctic. *J. Atmos. Chem., 25*, 33–66.

Solberg, S., Dye, C., Schmidbauer, N. and Simpson, D. (1995) Evaluation of the VOC measurement programme within EMEP. Kjeller, Norwegian Institute for Air Research (EMEP/CCC Report 5/95).

Solberg, S., Dye, C., Schmidbauer, N., Wallasch, M. and Junek, R. (2002) VOC measurements 2000. Kjeller, Norwegian Institute for Air Research (EMEP/CCC Report 8/2002).

Solberg, S., Dye, C., Walker, S.-E. and Simpson, D. (2001) Long-term measurements and model calculations of formaldehyde at rural European monitoring sites. *Atmos. Environ., 35*, 195-207.

Appendix A

Monthly mean and median concentrations of hydrocarbons and carbonyls in 2002

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	2164	2641	2345	1920	1397	989	867	851	1111	1405	1846	2001
	2013	2483	2299	1886	1414	975	863	827	1131	1395	1767	2011
Utö	2580	2216	2222	2073	1488	1053	907	1112	1084	1533	2130	2338
	2816	2247	2214	1976	1522	1053	917	902	1108	1475	2120	2109
Zingst	1859	2090	2093	2185	1420	1118	925	1723	946	1623	1750	2565
	1738	2062	2064	2248	1386	1051	903	1855	918	1428	1768	2145
Waldhof	2160	2155	2167	2364	1499	1122	842	1439	1220	1730	2169	3054
	1968	1936	2019	2397	1463	1158	837	1550	1227	1581	2129	3001
Schmücke	1721	2172	2033	2152	1407	1157	915	1559	1301	1473	1509	2298
	1826	2029	2002	2062	1219	1149	911	1525	1104	1540	1492	2060
Brotjacklriegel	1746	1887	2064	1952	1335	1015	929	1206	1109	1373	1292	2123
	1752	1912	2100	2111	1235	952	896	1239	1011	1294	1286	2038
Hohenpeissenberg	1840	1904	2286	2335	1542	1004	949	887	1350	1661	1573	2444
	1808	1800	2263	2242	1425	1004	907	831	1239	1458	1561	2007
Starina	-	2101	2479	2230	1585	937	1483	2085	1408	1666	1876	2403
	1670	2130	2420	2440	1595	960	1580	1930	1250	1570	1870	2015
Košetice	2909	2284	2689	2496	1606	1180	1127	2090	1634	1831	2696	3789
	2925	2197	2661	2523	1524	1141	1116	1945	1475	1637	2519	3529
Rigi	2130	1841	2165	2134	1459	1214	1214	1008	1408	1783	1949	2923
	1952	1796	2191	2174	1364	1172	1230	978	1343	1680	1922	2655
La Tardiere	2388	2120	2268	2129	2007	1015	1138	1074	1270	1791	2023	2331
	2360	2165	2405	1950	1310	1055	970	940	1230	1650	1715	1900
Donon	2154	1883	2321	2244	1471	1018	1060	978	1270	1660	1741	2428
	1980	2080	2445	2110	1410	1065	1010	890	1235	1560	1730	2030
Peyrusse Vieille	2040	2168	2097	1990	1425	1091	1016	953	1203	1571	1800	2236
	2010	2130	2235	1910	1465	1095	960	880	1190	1550	1770	2140
Campisábalos	870	952	826	747	401	300	314	449	505	764	911	815
	914	1049	869	816	375	290	328	401	502	609	935	705

ETHENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	317	366	164	101	87	89	112	111	86	195	207	328
	326	314	173	97	72	78	103	102	93	182	201	262
Utö	1145	510	253	237	197	147	143	197	122	197	545	655
	1384	277	207	156	189	128	119	134	114	194	505	568
Zingst	894	438	372	372	251	197	272	315	157	588	1062	1909
	508	372	295	395	178	181	244	314	139	414	1159	1528
Waldhof	1034	492	462	665	248	227	219	270	296	782	1638	2798
	495	389	432	377	251	200	217	290	224	453	1596	2668
Schmücke	702	745	520	376	219	270	285	383	337	794	788	2036
	476	412	440	308	211	212	206	315	208	676	677	1835
Brotjacklriegel	891	527	513	373	214	220	200	376	340	565	655	1320
	849	534	475	389	202	223	187	350	235	548	647	1043
Hohenpeissenberg	797	656	677	585	327	198	230	232	428	734	617	1626
	527	445	575	440	231	156	200	211	406	406	434	818
Starina	-	536	558	439	245	200	303	308	230	345	658	645
	540	540	550	490	245	150	250	275	250	365	610	620
Košetice	2685	1162	777	550	340	302	212	285	479	1011	2406	3291
	3038	1268	640	501	277	159	147	227	449	985	2316	3048
Rigi	1076	551	702	525	313	256	310	208	286	659	768	1442
	513	435	600	430	240	236	286	184	263	414	567	1016
La Tardiere	1401	841	786	518	387	221	227	264	296	641	519	1252
	1290	825	690	390	320	205	200	200	260	540	450	500
Donon	1147	519	780	484	259	195	246	324	328	548	700	1633
	940	470	565	370	200	180	240	250	345	410	570	1270
Peyrusse Vieille	746	405	417	460	188	220	201	276	187	307	463	894
	560	330	410	360	170	230	200	220	190	280	500	810
Campisábalos	324	348	291	232	208	118	194	317	231	381	461	495
	339	358	309	197	201	65	194	324	179	249	426	326

PROPANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	1196	1415	974	555	252	131	153	166	240	476	831	898
	986	1167	919	538	245	131	144	161	244	407	742	889
Utö	1342	1026	896	607	344	268	204	265	263	537	1063	1150
	1449	1044	860	585	328	243	185	235	241	478	1037	1025
Zingst	1138	1139	872	814	412	247	349	485	240	751	884	1474
	1031	1050	825	717	384	215	336	513	221	638	915	1458
Waldhof	1244	1146	1050	887	442	258	251	450	455	833	1248	1632
	1076	984	819	945	428	239	268	480	423	631	1244	1593
Schmücke	921	1107	856	783	401	289	306	470	718	737	842	1213
	897	1005	804	725	379	259	306	453	395	667	896	1100
Brotjacklriegel	902	1052	832	677	336	233	262	345	340	534	531	1056
	879	1071	830	680	313	223	268	395	310	515	519	1043
Hohenpeissenberg	788	774	896	858	418	233	293	299	440	583	577	1104
	756	663	890	770	372	203	281	287	410	462	552	805
Starina	-	1174	1086	1011	508	346	628	612	512	1809	1233	2628
	980	1210	1150	1150	520	350	610	660	440	1855	990	2710
Košetice	1362	1117	1048	827	423	339	311	627	490	655	1133	1780
	1601	1150	1076	842	408	259	304	532	440	603	1090	1964
Rigi	896	726	841	696	365	345	339	194	278	616	764	1384
	774	671	874	665	308	332	334	174	247	526	719	1197
La Tardiere	1316	1099	1004	737	682	211	313	338	362	749	971	1119
	1290	1160	995	590	330	150	200	280	380	690	775	920
Donon	1098	846	954	913	321	226	229	268	383	559	664	1206
	880	915	980	780	290	245	270	230	420	505	640	880
Peyrusse Vieille	986	1045	772	618	315	269	243	274	296	469	705	1062
	970	1020	835	510	290	295	240	240	310	460	715	1070
Campisábalos	376	418	312	217	113	83	126	259	247	303	432	366
	398	475	294	212	74	75	101	213	165	201	433	280

PROPENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	28	31	21	26	31	36	48	42	26	30	24	32
	28	30	21	22	35	36	38	37	25	32	24	27
Utö	194	51	33	35	39	39	39	46	34	36	55	74
	240	38	33	31	33	37	35	49	31	35	48	52
Zingst	176	111	135	61	63	55	78	72	46	102	163	305
	106	96	72	60	52	52	76	65	42	76	171	226
Waldhof	187	146	147	77	54	59	69	65	60	153	266	390
	103	90	66	72	48	49	67	58	44	119	258	367
Schmücke	130	155	89	53	64	61	85	88	75	160	168	280
	120	82	81	50	60	56	58	75	68	141	157	226
Brotjacklriegel	157	87	70	58	44	61	54	82	77	89	135	233
	139	90	72	53	43	60	57	76	67	86	129	157
Hohenpeissenberg	106	86	76	58	44	36	35	33	65	104	74	227
	76	69	53	39	29	30	29	27	43	60	46	110
Starina	-	134	156	121	110	73	70	118	90	134	213	228
	160	130	115	110	115	70	70	100	90	135	180	205
Košetice	353	172	83	55	35	59	37	62	74	158	439	573
	394	169	82	40	35	30	31	52	57	135	330	506
Rigi	165	94	111	88	63	59	53	28	40	119	134	263
	78	77	92	73	53	55	49	23	34	67	92	183
La Tardiere	287	208	193	146	144	119	109	113	104	199	151	264
	290	205	165	130	130	115	100	110	100	150	150	160
Donon	199	124	161	99	102	91	131	158	95	156	179	306
	150	125	120	80	90	90	140	150	95	140	160	290
Peyrusse Vieille	140	108	145	138	95	100	100	101	86	106	108	169
	120	80	125	130	95	100	100	110	80	100	110	170
Campisábalos	146	104	79	55	19	12	7	-	169	220	-	-
	133	111	48	34	7	6	1	280	76	154	-	-

ETHYNE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	490	-	-	-	166	72	78	92	125	255	342	371
	469	493	-	-	114	71	73	84	134	209	300	387
Utö	866	-	-	-	-	162	111	164	147	257	484	526
	925	591	-	-	160	143	114	124	158	262	466	431
Zingst	1005	751	733	890	443	219	219	410	225	653	1073	2005
	861	663	643	897	325	218	164	441	192	632	1115	1616
Waldhof	1119	787	815	1030	350	203	185	361	362	741	1438	2491
	629	707	765	1136	321	182	177	393	291	473	1404	2678
Schmücke	887	1016	845	916	412	272	248	389	430	781	833	1637
	673	786	828	834	375	259	235	437	375	704	770	1831
Brotjacklriegel	1113	894	963	825	423	296	259	358	467	741	620	1294
	1131	848	912	889	421	337	265	370	403	595	599	1182
Hohenpeissenberg	589	550	643	604	290	179	186	202	274	466	442	1049
	478	463	612	559	239	163	170	184	259	329	371	646
Starina	-	1481	1551	1353	728	758	1103	750	634	1049	1284	1300
	1160	1520	1520	1450	730	770	1150	700	560	1010	1405	1220
Košetice	2315	1398	1145	1064	479	385	308	538	601	1023	1815	2653
	2185	1468	1031	1141	471	266	328	548	561	911	1614	2629
Rigi	805	478	619	564	298	265	318	206	275	638	700	1374
	547	406	585	521	280	257	309	202	272	450	577	1266
La Tardiere	824	561	665	482	219	149	204	154	221	487	428	958
	900	560	725	380	180	110	130	190	240	380	420	700
Donon	826	459	633	573	236	164	191	206	273	473	487	1109
	560	435	625	520	200	175	200	170	320	345	400	850
Peyrusse Vieille	538	468	457	356	370	161	131	123	170	357	410	720
	480	450	480	290	195	165	160	110	160	250	320	610
Campisábalos	188	214	160	195	179	103	224	629	532	796	380	153
	184	211	185	149	180	75	250	415	184	270	256	137

BUTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	497	-	-	-	-	-	-	-	-	-	-	-
	412	353	-	-	-	-	-	-	-	-	-	-
Utö	646	-	-	-	-	-	-	-	-	-	-	-
	699	447	-	-	-	-	-	-	-	-	-	-
Zingst	500	516	311	280	171	128	161	163	77	312	391	659
	429	476	285	246	151	104	133	162	66	263	381	635
Waldhof	554	498	408	310	162	108	122	160	175	349	625	717
	453	405	326	354	126	101	115	151	137	257	555	646
Schmücke	406	515	368	294	210	152	151	211	188	337	447	544
	408	433	344	277	162	140	147	216	153	307	360	443
Brotjacklriegel	411	440	294	248	113	113	141	142	141	227	240	515
	412	474	291	243	102	101	118	118	121	184	224	467
Hohenpeissenberg	295	307	332	266	147	100	107	109	160	251	249	493
	273	274	315	220	118	89	89	100	147	207	221	348
Starina	-	657	501	407	210	113	210	307	248	843	553	1220
	640	570	480	430	190	100	185	305	230	820	505	1425
Košetice	553	463	371	344	155	179	137	211	188	287	498	881
	555	452	356	257	166	106	122	261	174	261	451	890
Rigi	409	322	410	277	139	131	119	49	103	339	491	746
	279	266	391	254	125	111	122	39	71	259	420	636
La Tardiere	519	421	380	251	239	96	97	104	140	312	371	516
	520	430	350	180	100	65	80	70	130	230	325	520
Donon	456	333	414	289	110	106	91	144	218	258	363	703
	370	325	310	280	70	95	100	80	205	235	290	590
Peyrusse Vieille	300	385	227	166	85	90	87	86	94	147	218	401
	300	360	225	160	65	110	100	70	100	120	215	370
Campisábalos	166	166	132	188	57	57	74	112	111	192	277	195
	166	174	117	79	50	45	67	100	94	105	308	200

ISOBUTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	253	301	181	77	33	19	24	23	33	84	310	488
	199	236	162	71	31	15	22	20	36	68	325	446
Utö	343	218	158	92	62	54	41	39	52	109	493	667
	387	201	159	79	64	43	34	41	54	102	562	690
Zingst	279	267	173	164	101	69	91	94	47	180	219	398
	227	245	162	157	84	57	79	94	37	142	228	395
Waldhof	295	269	241	173	93	65	70	100	99	219	357	425
	237	216	183	197	74	59	72	94	67	147	348	388
Schmücke	225	286	214	169	110	77	88	114	104	234	250	324
	205	235	202	173	84	68	73	135	73	178	224	259
Brotjacklriegel	233	285	182	140	72	73	69	87	92	136	145	297
	229	262	163	149	68	74	68	69	67	107	153	237
Hohenpeissenberg	161	169	197	160	85	56	65	66	84	137	137	281
	147	149	183	133	70	48	57	66	80	102	118	184
Starina	-	256	328	236	125	69	119	180	130	411	324	584
	260	210	280	230	125	50	105	150	120	400	285	585
Košetice	330	288	225	165	98	114	74	120	115	163	327	532
	296	263	201	165	106	66	67	136	100	153	269	610
Rigi	211	166	210	150	70	64	81	33	48	145	182	307
	146	134	197	134	50	47	80	30	34	116	164	268
La Tardiere	292	251	244	176	131	49	51	69	67	142	178	239
	240	230	190	110	70	25	30	60	60	100	145	240
Donon	310	206	349	254	88	85	54	76	180	173	316	506
	250	180	225	270	50	60	50	40	130	125	150	470
Peyrusse Vieille	130	228	148	133	58	43	34	39	46	70	103	206
	100	215	130	120	50	45	40	30	50	60	105	190
Campisábalos	132	142	220	150	128	102	168	-	83	229	421	317
	119	142	202	125	126	45	195	433	54	1	430	270

BUTENES

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Starina	-	143	111	106	155	214	269	58	62	84	120	448
	110	130	105	100	150	220	280	60	70	70	90	145
Košetice	140	212	96	64	70	88	57	92	188	89	182	219
	145	75	56	43	54	54	49	62	70	92	128	152
Rigi	140	156	172	145	107	105	57	55	38	98	175	283
	114	137	156	139	106	94	54	51	32	98	162	277
La Tardiere	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Donon	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Peyrusse Vieille	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

BUT_1_ENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	5	3	3	3	6	7	10	10	7	4	8	8
	4	3	3	3	3	7	10	11	6	3	8	8
Utö	27	8	5	7	8	10	9	12	10	7	13	19
	38	7	5	7	8	10	10	13	9	7	13	21
Zingst	39	30	20	20	22	22	26	22	14	24	35	71
	27	26	19	18	21	20	25	19	14	22	33	66
Waldhof	45	33	26	23	19	19	20	19	18	27	54	80
	28	25	22	23	20	19	18	19	17	25	52	64
Schmücke	33	31	24	20	24	19	24	23	19	36	41	61
	28	24	22	21	21	19	21	23	18	30	37	52
Brotjacklriegel	39	28	21	20	16	24	19	21	21	27	34	56
	36	31	21	22	16	23	18	20	21	29	34	40
Hohenpeissenberg	18	16	17	13	8	6	7	7	10	18	16	42
	12	13	12	10	5	5	6	7	9	11	10	24
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	47	35	33	23	16	19	15	16	20	27	26	44
	50	35	30	20	20	20	20	20	20	20	30	30
Donon	24	11	19	7	8	5	13	17	6	19	26	46
	20	10	13	5	5	5	10	20	5	20	20	40
Peyrusse Vieille	29	20	20	26	13	13	41	21	13	16	15	27
	30	13	20	30	13	10	20	20	10	10	15	30
Campisábalos	80	66	73	58	43	27	47	59	45	80	189	111
	55	65	72	45	45	15	56	55	50	42	83	56

TRANS_2_BUTENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	3	3	3	3	3	5	3	4	3	3	3	3
	3	3	3	3	3	3	3	3	3	3	3	3
Utö	3	3	4	3	3	3	3	4	3	3	3	3
	3	3	3	3	3	3	3	3	3	3	3	3
Zingst	7	6	6	8	6	7	8	6	4	5	8	8
	6	7	5	7	6	6	7	5	4	4	8	7
Waldhof	10	6	6	7	5	4	7	5	4	5	9	8
	8	5	5	6	4	3	5	5	5	5	10	8
Schmücke	9	8	5	8	8	5	7	6	7	10	9	11
	9	6	5	7	7	5	6	5	6	7	9	8
Brotjacklriegel	7	6	6	7	5	11	5	5	6	9	9	12
	7	6	7	7	5	8	5	5	7	9	9	10
Hohenpeissenberg	9	7	9	7	7	7	7	7	7	7	8	12
	9	6	7	7	7	6	6	7	7	6	6	9
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	10	8	11	6	5	8	9	12	13	19	21	17
	10	5	5	5	5	5	10	10	10	20	20	20
Donon	6	6	6	5	5	5	8	20	8	18	17	30
	5	5	5	5	5	5	10	20	8	20	20	20
Peyrusse Vieille	5	5	5	5	5	5	11	16	9	14	15	11
	5	5	5	5	5	5	10	20	10	10	15	10
Campisábalos	19	11	21	31	11	5	19	14	14	38	45	90
	17	11	20	17	11	5	12	13	10	39	26	12

CIS_2_BUTENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	3	3	6	3	3	3	3	3	3	3	3	3
	3	3	3	3	3	3	3	3	3	3	3	3
Utö	3	3	3	3	3	3	3	3	3	3	3	3
	3	3	3	3	3	3	3	3	3	3	3	3
Zingst	9	7	7	8	8	7	8	10	5	5	11	11
	8	7	7	8	8	6	7	10	5	5	12	10
Waldhof	11	8	6	8	6	4	9	7	6	8	12	11
	8	5	6	7	6	4	9	5	5	7	12	12
Schmücke	10	8	7	10	11	6	9	9	5	12	11	13
	11	7	7	10	8	5	6	9	5	10	11	9
Brotjacklriegel	8	8	8	7	7	8	5	7	8	9	10	14
	6	7	9	8	6	6	5	6	7	8	9	14
Hohenpeissenberg	4	4	7	6	4	4	4	4	4	4	6	12
	4	4	7	6	4	4	3	4	4	4	5	8
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Rigi	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	9	8	10	5	5	5	5	5	5	7	8	11
	5	5	5	5	5	5	5	5	5	5	5	10
Donon	6	5	6	5	5	5	5	6	5	5	7	10
	5	5	5	5	5	5	5	5	5	5	5	10
Peyrusse Vieille	5	5	5	5	5	5	5	5	5	5	5	5
	5	5	5	5	5	5	5	5	5	5	5	5
Campisábalos	384	383	473	261	39	22	53	145	126	319	359	194
	386	375	271	114	12	15	18	49	42	280	266	57

PENTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	164	176	97	37	22	23	29	25	23	45	95	109
	126	138	82	27	17	24	28	26	26	32	91	101
Utö	205	125	84	54	57	47	30	40	30	60	163	213
	204	117	78	41	50	29	34	33	27	52	142	219
Zingst	174	157	92	91	67	73	70	67	37	118	148	237
	164	142	88	73	55	49	67	61	30	96	139	195
Waldhof	199	175	153	115	79	56	73	65	106	192	262	283
	144	145	106	140	56	45	58	62	58	103	281	236
Schmücke	135	155	102	98	70	87	166	188	118	217	173	194
	133	129	101	98	70	69	165	174	114	141	142	169
Brotjacklriegel	149	123	123	96	60	67	61	75	120	164	114	188
	140	134	116	87	52	70	57	77	79	104	120	161
Hohenpeissenberg	70	90	117	121	83	59	74	60	73	106	119	166
	55	72	102	85	56	46	55	52	69	69	60	85
Starina	-	142	195	167	113	164	166	137	124	344	301	593
	30	140	105	170	95	115	185	135	120	360	270	410
Košetice	193	165	125	99	78	103	65	91	106	135	228	366
	192	155	108	100	79	64	50	98	96	110	190	384
Rigi	149	107	166	149	99	137	130	133	142	188	172	223
	77	85	140	110	74	117	112	90	120	110	126	185
La Tardiere	383	320	200	233	287	205	269	161	176	218	209	183
	220	195	175	200	250	175	170	140	170	190	145	150
Donon	143	104	150	108	46	34	35	74	93	106	93	199
	100	110	100	70	30	30	30	20	90	75	80	120
Peyrusse Vieille	72	118	68	50	32	33	33	44	33	46	60	117
	80	110	65	40	25	40	30	20	30	40	55	90
Campisábalos	31	50	25	121	81	25	39	47	52	67	149	157
	7	39	15	27	30	15	26	30	27	33	98	56

ISOPENTANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	204	223	138	57	29	12	18	19	26	54	122	128
	173	184	131	41	23	10	17	14	25	40	115	108
Utö	347	181	122	84	76	62	53	43	47	64	190	192
	390	164	129	55	67	49	59	56	35	55	193	181
Zingst	270	219	139	136	141	279	119	110	103	163	235	364
	265	209	126	119	98	207	108	93	65	126	218	368
Waldhof	284	219	212	150	154	77	61	109	130	245	385	382
	219	179	175	197	101	74	55	97	84	176	374	362
Schmücke	222	245	178	154	145	132	139	173	156	288	240	310
	196	194	163	147	134	127	120	176	131	224	249	235
Brotjacklriegel	247	200	178	158	103	119	108	141	242	287	179	339
	221	194	136	125	102	113	101	142	205	266	180	301
Hohenpeissenberg	173	176	218	183	157	144	150	138	141	174	183	299
	140	153	186	153	127	127	128	133	140	138	130	186
Starina	-	224	353	202	235	379	361	233	206	504	348	603
	180	130	250	165	200	190	370	190	220	415	390	640
Košetice	348	288	195	159	144	182	116	153	168	218	392	576
	333	257	165	139	150	115	95	149	163	186	382	544
Rigi	288	203	297	222	171	242	243	237	233	309	279	391
	146	157	265	190	154	234	246	207	216	216	233	362
La Tardiere	304	224	228	168	162	116	100	118	109	248	213	328
	330	230	215	120	110	60	90	120	100	170	185	350
Donon	253	179	290	182	90	99	69	140	170	166	164	300
	210	195	260	180	60	105	50	60	150	110	130	260
Peyrusse Vieille	132	160	112	101	85	98	70	79	71	101	100	218
	120	145	110	60	70	110	70	70	70	90	100	160
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

HEXANE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	46	48	26	6	4	8	8	5	6	14	33	39
	40	32	23	3	3	3	7	3	7	9	30	32
Utö	67	35	21	14	16	12	10	12	9	12	52	57
	75	30	19	10	18	8	7	14	9	12	51	57
Zingst	62	75	28	37	22	31	25	-	14	38	47	87
	58	69	26	32	16	30	24	-	11	34	43	79
Waldhof	72	54	44	35	23	21	22	-	19	56	79	103
	54	49	34	39	21	16	26	11	19	37	72	81
Schmücke	48	56	32	31	22	24	23	-	31	52	45	67
	44	45	29	31	19	19	16	23	26	45	43	56
Brotjacklriegel	49	41	36	26	18	20	20	-	50	42	33	67
	43	43	35	24	15	16	18	4	26	48	33	56
Hohenpeissenberg	32	33	36	34	25	20	20	19	25	36	27	63
	26	29	32	28	19	17	17	19	24	23	22	31
Starina	-	78	80	110	385	84	74	135	52	105	119	126
	-	90	85	70	470	50	80	55	50	95	125	135
Košetice	72	77	46	36	29	30	22	33	42	54	101	166
	70	49	38	31	24	18	20	34	35	34	73	144
Rigi	39	29	38	33	21	26	27	18	23	46	43	66
	24	24	35	25	17	22	25	15	21	33	34	47
La Tardiere	36	32	19	16	26	9	17	11	10	32	33	21
	30	30	20	5	10	8	5	5	5	20	20	10
Donon	44	28	31	19	9	11	8	17	24	21	28	38
	30	25	20	20	5	8	10	5	20	15	20	20
Peyrusse Vieille	22	33	18	12	18	15	16	22	11	9	13	17
	20	30	15	10	13	15	10	10	10	10	10	20
Campisábalos	190	98	414	86	135	83	231	578	440	214	328	267
	59	69	128	42	57	80	134	705	426	123	373	153

ISOPRENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	4	4	4	4	11	24	65	37	16	4	4	4
	4	4	4	4	4	18	58	36	4	4	4	4
Utö	8	4	33	31	10	26	43	26	11	4	4	4
	4	4	4	4	4	20	28	17	11	4	4	4
Zingst	9	22	12	29	120	367	306	974	392	45	11	15
	8	16	8	21	74	299	201	935	426	20	11	12
Waldhof	13	9	9	9	16	57	65	116	50	18	16	18
	10	8	9	9	16	48	54	113	30	12	15	19
Schmücke	11	10	8	10	31	51	38	80	35	24	21	17
	12	10	9	8	30	41	28	79	40	16	15	14
Brotjacklriegel	15	15	20	28	106	386	324	396	148	40	34	18
	15	14	14	30	88	282	156	294	118	28	26	13
Hohenpeissenberg	6	5	7	10	29	63	58	51	20	9	8	9
	5	4	5	7	15	27	30	16	9	5	5	6
Starina	-	220	185	130	318	250	341	168	-	-	-	-
	-	110	150	35	310	195	210	170	-	-	-	-
Košetice	26	13	8	9	42	84	68	94	39	48	24	36
	11	10	5	7	36	50	63	91	28	8	17	16
Rigi	19	14	16	15	24	142	46	33	17	25	14	16
	15	12	14	12	17	65	34	19	12	21	11	11
La Tardiere	15	11	8	11	129	305	363	296	190	47	9	7
	10	8	5	5	50	205	270	270	150	40	5	5
Donon	122	60	91	91	268	1290	904	1048	343	113	77	24
	60	45	75	80	180	870	610	830	335	80	70	20
Peyrusse Vieille	5	9	64	101	310	1221	799	826	811	173	11	11
	5	5	60	20	85	450	840	800	980	150	10	5
Campisábalos	25	15	22	30	25	158	333	853	600	223	121	48
	10	9	18	19	19	125	137	241	119	65	29	14

BENZENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	184	191	163	104	64	39	88	100	87	129	161	202
	166	172	161	101	60	33	47	86	89	102	157	181
Utö	257	201	175	144	90	62	52	59	79	114	237	276
	304	162	171	120	89	54	54	63	79	111	249	246
Zingst	247	182	171	199	90	61	94	199	68	186	266	557
	218	169	150	214	73	71	82	198	61	149	225	476
Waldhof	269	194	188	247	89	49	77	140	125	215	349	679
	150	174	187	258	84	40	76	150	122	137	324	683
Schmücke	243	242	192	206	102	71	74	132	141	214	203	411
	184	185	188	194	101	70	72	142	99	209	187	445
Brotjacklriegel	263	203	222	185	96	73	74	114	123	187	151	317
	266	202	229	210	83	67	71	101	119	134	144	294
Hohenpeissenberg	239	227	240	227	119	95	98	99	151	204	159	367
	205	210	233	216	105	75	92	91	126	155	136	235
Starina	-	-	136	555	275	244	184	102	42	330	349	335
	170	200	35	300	280	230	220	95	40	350	320	320
Košetice	496	255	260	216	113	109	77	183	161	189	501	562
	477	245	225	221	99	112	78	178	153	163	320	455
Rigi	284	182	234	210	102	101	106	72	109	206	190	368
	178	148	227	185	91	99	110	66	97	166	161	297
La Tardiere	284	206	210	177	94	75	69	87	102	179	148	281
	260	210	200	160	90	80	80	70	100	180	135	150
Donon	269	158	219	197	90	68	84	78	120	163	153	346
	210	150	210	170	70	70	100	60	130	140	140	230
Peyrusse Vieille	172	168	160	166	77	57	97	81	77	110	120	224
	170	160	165	160	75	55	70	80	80	110	125	210
Campisábalos	197	226	366	321	219	215	233	372	271	331	342	316
	192	212	426	313	207	210	264	309	268	249	332	241

TOLUENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	263	167	181	100	95	156	82	91	61	118	229	441
	228	133	105	84	52	87	82	72	44	90	231	413
Waldhof	298	202	167	138	80	67	94	74	117	218	347	398
	154	150	136	155	72	51	71	84	80	159	346	355
Schmücke	236	234	157	136	131	109	112	126	143	294	250	303
	209	141	139	138	133	118	99	121	111	229	212	262
Brotjacklriegel	259	162	145	122	84	88	91	117	292	294	151	284
	225	160	123	105	81	90	95	108	217	312	165	250
Hohenpeissenberg	176	168	183	141	120	105	99	94	139	181	183	298
	121	151	140	119	93	89	80	85	111	140	128	208
Starina	-	347	111	349	425	313	448	338	245	268	284	133
	1720	165	60	240	425	240	450	310	190	165	240	50
Košetice	363	241	152	109	88	132	68	118	159	186	438	388
	352	204	134	95	93	83	62	131	137	167	343	295
Rigi	351	181	303	225	179	247	198	145	165	346	362	440
	115	140	256	177	138	205	177	120	148	220	242	283
La Tardiere	613	446	424	234	326	189	252	180	314	970	358	376
	510	240	455	240	170	145	240	190	170	560	340	260
Donon	242	119	179	140	66	69	73	104	133	143	151	294
	220	110	130	130	50	75	80	70	130	105	140	310
Peyrusse Vieille	114	103	90	91	57	100	73	97	57	101	105	202
	120	80	75	70	60	105	60	50	60	100	100	160
Campisábalos	603	959	865	458	370	377	482	879	398	891	758	403
	563	940	484	216	277	165	450	907	361	446	662	333

ETHYLBENZENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Hohenpeissenberg	27	26	29	22	19	15	15	13	19	24	27	46
	17	23	22	19	13	12	12	12	16	18	20	31
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	59	53	30	20	18	24	15	18	27	34	72	80
	71	40	29	22	17	14	12	17	24	32	62	66
Rigi	53	28	47	35	25	33	40	20	26	55	58	70
	20	22	37	27	18	29	30	16	22	33	38	45
La Tardiere	68	49	46	31	49	24	24	23	36	91	54	53
	50	30	35	30	30	20	20	20	30	80	45	40
Donon	50	24	37	26	12	12	12	17	26	28	30	53
	40	20	25	30	10	10	10	10	25	20	30	60
Peyrusse Vieille	16	14	10	15	7	14	9	14	6	15	14	35
	20	10	5	10	5	10	10	5	5	20	15	20
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

MPXYLENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	99	50	50	24	33	38	23	18	15	35	137	93
	85	49	40	22	21	38	24	17	16	31	78	101
Waldhof	116	74	54	34	26	-	25	-	25	62	134	110
	59	41	31	35	19	4	20	14	14	55	122	112
Schmücke	97	79	53	41	37	33	56	40	51	96	103	104
	90	52	57	36	35	27	61	42	33	83	86	71
Brotjacklriegel	87	45	39	30	19	29	30	21	40	58	54	88
	62	42	41	31	18	29	21	16	26	48	50	67
Hohenpeissenberg	65	58	64	43	40	29	29	23	42	58	70	123
	38	47	47	30	21	23	21	17	34	37	43	77
Starina	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	122	150	72	42	31	62	32	34	55	75	187	148
	110	121	62	38	29	27	21	33	42	69	146	121
Rigi	126	60	99	73	56	60	57	40	58	128	146	173
	34	48	74	47	38	48	42	29	43	64	86	82
La Tardiere	192	150	150	84	167	73	77	69	100	301	203	152
	150	95	85	80	70	65	70	70	70	200	170	120
Donon	108	56	81	38	17	19	21	34	50	60	76	144
	80	45	50	30	20	20	20	20	45	40	70	140
Peyrusse Vieille	34	25	21	21	18	25	21	37	13	33	30	76
	40	20	15	10	20	20	20	10	10	30	30	50
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

OXYLENE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Pallas	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	32	16	25	10	16	14	11	-	10	17	34	34
	24	12	18	10	13	13	11	11	9	16	19	37
Waldhof	36	23	22	13	11	-	16	-	15	25	46	43
	14	12	13	12	10	-	10	15	11	23	35	38
Schmücke	30	25	20	14	15	-	19	-	26	38	33	42
	27	19	22	12	14	8	19	31	23	25	31	34
Brotjacklriegel	33	15	13	11	7	-	8	19	18	23	16	28
	25	13	11	10	5	5	6	24	15	21	17	24
Hohenpeissenberg	32	24	29	22	22	19	15	17	19	25	27	47
	19	22	21	17	15	15	11	14	15	16	17	29
Starina	-	-	-	-	-	-	-	-	-	-	-	1152
	-	-	-	-	-	-	-	-	-	800	-	1075
Košetice	50	50	30	16	13	26	12	13	23	28	69	56
	42	39	25	18	11	10	8	12	21	27	50	49
Rigi	54	30	46	34	25	27	26	18	24	55	58	70
	16	23	35	24	18	22	22	14	20	31	35	37
La Tardiere	81	65	64	40	57	33	30	28	40	103	55	68
	70	55	40	30	30	30	30	30	30	80	50	50
Donon	49	25	36	22	9	14	14	16	24	38	37	62
	40	20	25	20	5	10	10	10	25	35	30	60
Peyrusse Vieille	24	20	20	24	18	27	24	30	27	31	28	50
	30	13	20	20	20	30	20	10	30	30	25	60
Campisábalos	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

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

METHANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	0.602	0.559	0.902	1.537	1.769	2.355	2.288	2.793	1.821	1.099	1.709	1.278
	0.598	0.511	0.81	1.526	1.764	1.977	2.297	2.594	1.636	0.839	1.127	1.01
Waldhof	0.756	0.695	1.055	1.909	2.252	2.773	2.028	3.517	2.515	1.368	0.883	1.152
	0.737	0.601	0.97	1.529	2.419	2.51	1.325	3.541	1.792	1.165	0.859	0.963
Schmücke	0.766	0.833	0.941	1.36	1.664	2.706	1.95	2.788	2.16	1.223	0.856	0.676
	0.823	0.586	0.82	1.415	1.714	2.473	1.578	2.686	2.159	0.981	0.895	0.566
Brotjacklriegel	0.452	0.467	0.632	0.627	0.928	1.016	0.859	1.033	0.803	0.478	0.5	0.427
	0.426	0.354	0.5	0.664	0.87	0.916	0.822	1.133	0.701	0.488	0.494	0.426
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	3.266	1.68	2.158	1.713	5.7	3.982
	-	-	5.151	-	-	4.114	2.965	1.376	2.186	2.074	0.902	3.118
Donon	0.994	0.703	1.312	2.019	4.076	4.03	3.519	1.751	1.785	1.562	-	4.982
	0.988	0.648	1.676	2.293	3.258	3.839	2.583	1.773	1.805	1.36	0.787	4.474
Peyrusse Vieille	-	-	-	-	-	-	2.165	1.116	2.139	1.609	-	2.239
	-	-	-	3.478	-	2.527	1.655	1.059	2.335	1.628	1.177	1.235

ETHANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	0.612	0.738	0.786	1.083	1.001	1.031	1.203	1.636	1.11	1.025	1.598	1.27
	0.575	0.613	0.695	0.944	0.887	1.049	1.298	1.65	1.043	0.969	1.217	0.853
Waldhof	0.686	0.722	0.822	1.266	1.116	1.107	0.864	1.54	1.322	1.106	0.828	1.356
	0.561	0.637	0.701	0.999	1.104	1.067	0.747	1.503	1.145	0.96	0.792	0.905
Schmücke	0.714	0.816	0.784	1.017	0.826	1.034	0.896	1.463	1.123	1.035	0.688	0.687
	0.614	0.609	0.739	0.984	0.896	0.983	0.85	1.419	0.979	0.889	0.614	0.639
Brotjacklriegel	0.419	0.415	0.517	0.477	0.487	0.636	0.447	0.621	0.592	0.423	0.484	0.394
	0.438	0.307	0.457	0.489	0.44	0.59	0.428	0.638	0.573	0.405	0.473	0.4
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	0.912	0.848	0.879	0.949	0.579	0.751
	-	-	0.261	-	-	0.689	0.92	0.864	0.774	1.025	0.551	0.76
Donon	0.655	0.368	0.728	1.252	0.515	0.902	0.721	0.682	0.849	0.862	-	0.528
	0.733	0.357	0.679	1.263	0.459	1.033	0.74	0.689	0.743	0.83	0.334	0.193
Peyrusse Vieille	-	-	-	-	-	-	0.632	0.563	0.915	0.802	-	0.46
	-	-	-	1.29	-	0.681	0.575	0.529	0.934	0.903	0.488	0.588

PROPANONE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	1.187	0.946	1.251	2.558	2.024	2.48	2.071	2.476	2.096	1.658	1.568	1.213
	1.007	0.939	1.263	2.454	1.731	2.382	1.772	1.853	1.941	1.676	1.18	1.044
Waldhof	1.262	1.07	1.643	2.899	2.689	3.328	2.421	3.512	3.357	2.102	1.451	1.361
	1.059	0.977	1.404	2.777	2.233	3.593	2.133	3.382	2.952	1.87	1.391	1.079
Schmücke	1.264	1.153	1.536	2.656	2.107	3.002	2.486	3.795	3.766	2.206	1.284	0.998
	1.177	0.949	1.224	2.908	1.965	3.035	2.222	3.618	3.001	1.765	1.196	0.966
Brotjacklriegel	1.486	0.735	1.019	1.077	1.189	1.661	1.256	1.866	1.507	0.721	0.698	0.604
	1.39	0.65	0.856	1.1	1.229	1.666	1.255	2.062	1.381	0.666	0.696	0.617
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	3.264	2.746	3.264	2.819	3.284	1.564
	-	-	0.697	-	-	2.148	3.165	2.618	3.106	3.293	3.243	1.414
Donon	1.482	1.023	2.146	3.967	2.429	3.336	3.385	2.425	3.05	2.723	-	0.849
	1.489	0.919	2.237	4.411	2.091	3.187	3.326	2.573	3.008	2.376	0.904	0.761
Peyrusse Vieille	-	-	-	-	-	-	1.895	2.04	3.273	2.706	-	1.564
	-	-	-	5.171	-	1.867	1.899	2.081	3.381	2.595	1.655	1.648

PROPANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	0.09	0.081	0.139	0.164	0.117	0.114
	-	-	0.017	-	-	0.063	0.072	0.091	0.142	0.187	0.108	0.112
Donon	0.211	0.18	0.146	0.222	0.075	0.037	0.023	0.016	0.06	0.135	-	0.1
	0.226	0.169	0.123	0.222	0.015	0.021	0.021	0.015	0.054	0.146	0.075	0.069
Peyrusse Vieille	-	-	-	-	-	-	0.03	0.025	0.183	0.148	-	0.081
	-	-	-	0.146	-	0.051	0.016	0.015	0.186	0.148	0.08	0.103

N2PROPENAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	0.038	-	0.015	-	0.015	0.058	0.074	0.015
	0.04	0.039	0.017	-	0.039	0.015	0.015	0.016	0.015	0.015	0.07	0.015
Donon	0.015	0.014	0.014	0.014	0.014	0.016	0.023	0.016	-	0.031	-	0.015
	0.015	0.014	0.014	0.014	0.014	0.015	0.021	0.015	0.015	0.015	0.015	0.015
Peyrusse Vieille	-	-	0.034	0.03	0.034	0.021	0.015	0.015	0.027	0.015	-	0.015
	0.042	0.035	0.035	0.034	0.035	0.016	0.016	0.015	0.024	0.015	0.056	0.015

N2BUTANONE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	1.463	0.625	0.735	0.506	1.791	0.301
	-	-	0.463	-	-	0.607	1.112	0.57	0.724	0.617	1.791	0.296
Donon	0.348	0.259	0.466	0.837	0.588	1.194	2.187	0.719	0.559	0.567	-	0.086
	0.298	0.243	0.482	0.916	0.471	1.504	1.951	0.696	0.518	0.561	0.015	0.015
Peyrusse Vieille	-	-	-	-	-	-	1.102	0.387	0.875	0.572	-	0.111
	-	-	-	0.922	-	1.382	1.344	0.401	0.931	0.653	0.16	0.065

N3BUTEN2ONE

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

N2METHYLPROPENAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	0.028	-	0.138	0.07	0.102	0.032	0.011	0.016
	0.029	-	0.07	0.028	0.029	0.031	0.099	0.067	0.101	0.041	0.011	0.011
Donon	0.013	0.011	0.035	0.039	0.131	0.352	0.473	0.282	0.139	0.099	-	0.028
	0.012	0.011	0.019	0.042	0.064	0.403	0.498	0.316	0.11	0.059	0.011	0.03
Peyrusse Vieille	-	-	-	-	-	0.348	0.214	0.131	0.335	0.137	-	0.011
	-	-	-	0.013	-	0.394	0.157	0.144	0.31	0.139	0.019	0.011

BENZENECARBALDEHYDE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	0.112	0.105	0.053	0.1	0.082	0.116
	-	-	0.035	-	-	0.069	0.118	0.081	0.055	0.11	0.083	0.048
Donon	0.047	0.023	0.039	0.06	0.066	0.071	0.04	0.038	0.079	0.07	-	0.035
	0.056	0.014	0.036	0.049	0.075	0.081	0.033	0.036	0.07	0.065	0.015	0.015
Peyrusse Vieille	-	-	-	-	-	-	0.05	0.184	0.059	0.046	-	0.025
	-	-	-	0.161	-	0.048	0.043	0.187	0.066	0.048	0.031	0.016

PENTANAL

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

ETHANEDIAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	0.024	0.016	0.011	0.024	0.011	0.011
	-	-	0.013	-	0.03	0.038	0.025	0.012	0.011	0.012	0.011	0.011
Donon	0.013	0.011	0.01	0.011	0.035	0.04	0.038	0.026	0.026	0.011	-	0.011
	0.012	0.011	0.01	0.011	0.034	0.026	0.023	0.027	0.023	0.011	0.011	0.011
Peyrusse Vieille	-	-	-	-	-	0.027	0.018	0.044	0.017	0.015	-	0.011
	0.026	0.026	0.025	0.032	0.026	0.02	0.012	0.031	0.012	0.011	0.011	0.011

HEXANAL

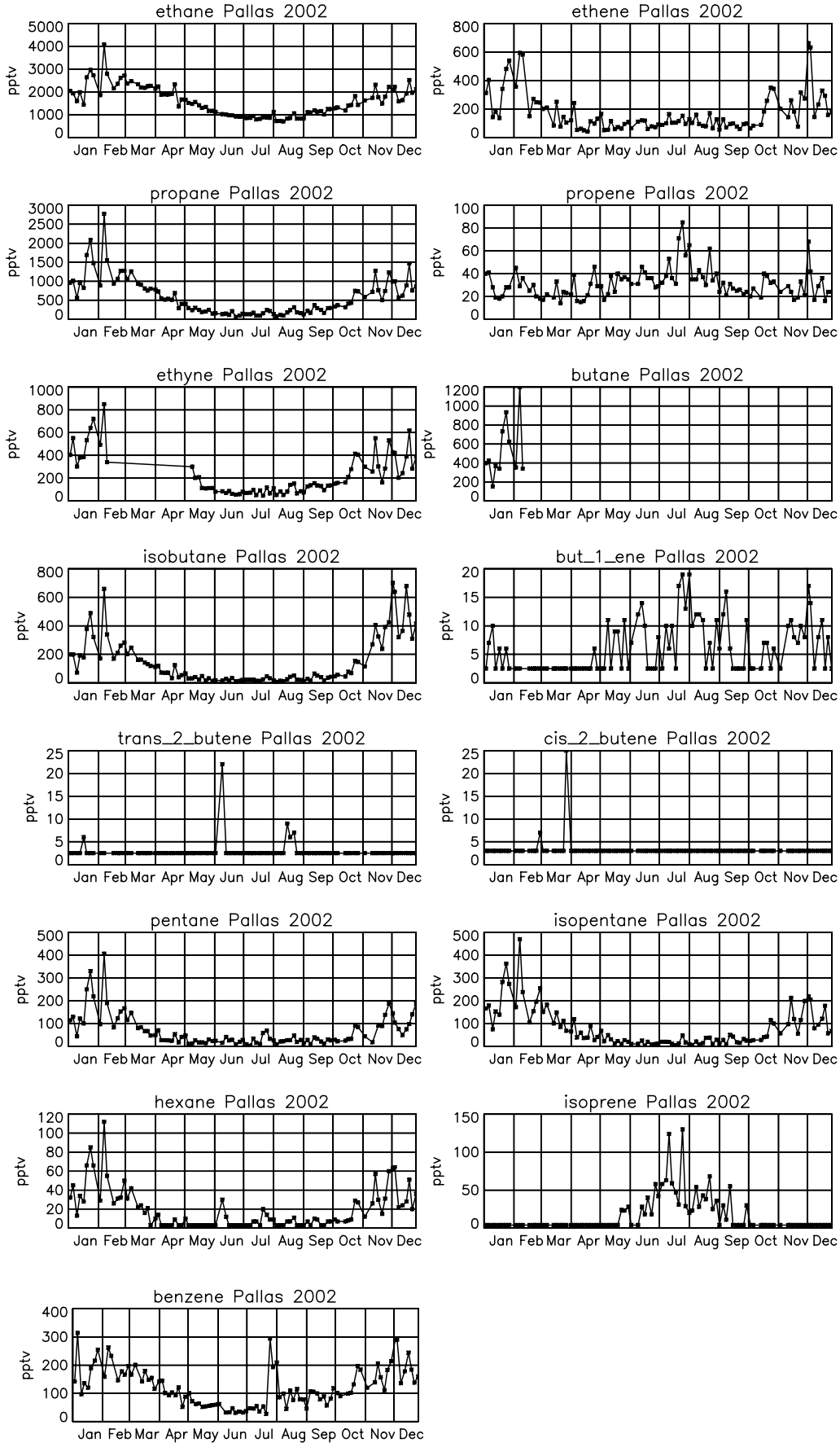
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	0.084	0.049	0.041	0.081	0.02	0.026
	-	-	0.045	-	-	0.103	0.059	0.049	0.045	0.084	0.015	0.024
Donon	0.047	0.023	0.031	0.046	0.068	0.081	0.066	0.064	0.076	0.039	-	0.045
	0.05	0.015	0.023	0.047	0.057	0.074	0.071	0.056	0.041	0.042	0.015	0.041
Peyrusse Vieille	-	-	-	-	-	-	0.119	0.25	0.371	0.161	-	0.106
	-	-	-	0.552	-	0.132	0.112	0.245	0.361	0.156	0.093	0.072

N2OXOPROPANAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Utö	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Zingst	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Waldhof	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Schmücke	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Brotjacklriegel	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
Košetice	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
La Tardiere	-	-	-	-	-	-	0.05	0.035	0.037	0.025	0.015	0.015
	-	-	0.017	-	-	0.094	0.057	0.026	0.032	0.015	0.015	0.015
Donon	0.015	0.014	0.014	0.014	0.048	0.134	0.123	0.097	0.015	0.022	0.023	0.015
	0.015	0.014	0.014	0.014	0.046	0.104	0.105	0.081	0.015	0.015	0.023	0.015
Peyrusse Vieille	-	-	-	-	-	-	0.06	0.057	0.067	0.018	-	0.015
	0.039	0.034	0.033	0.051	-	0.056	0.063	0.035	0.074	0.015	0.015	0.015

Appendix B

Time series of VOC measured in 2002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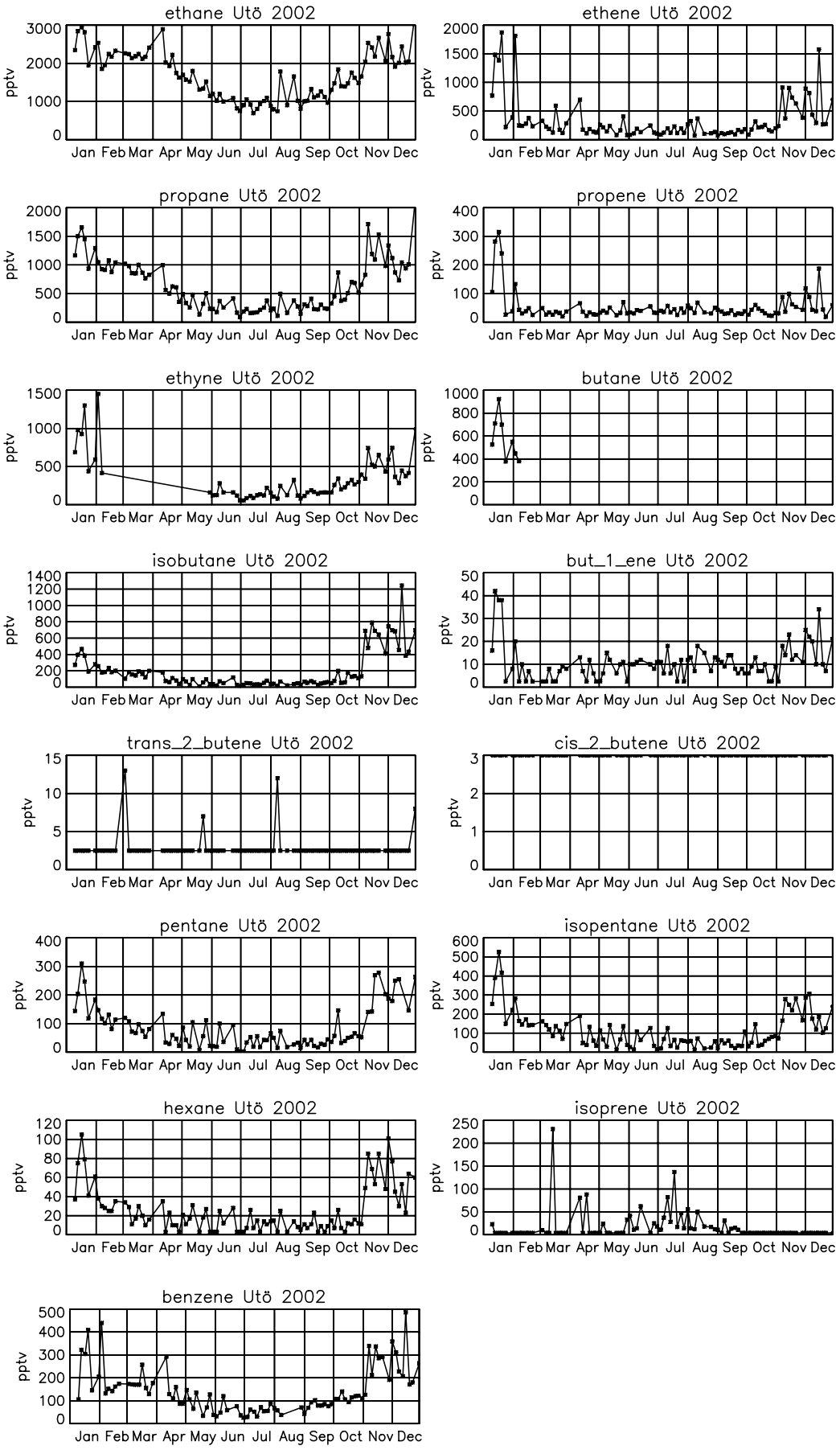
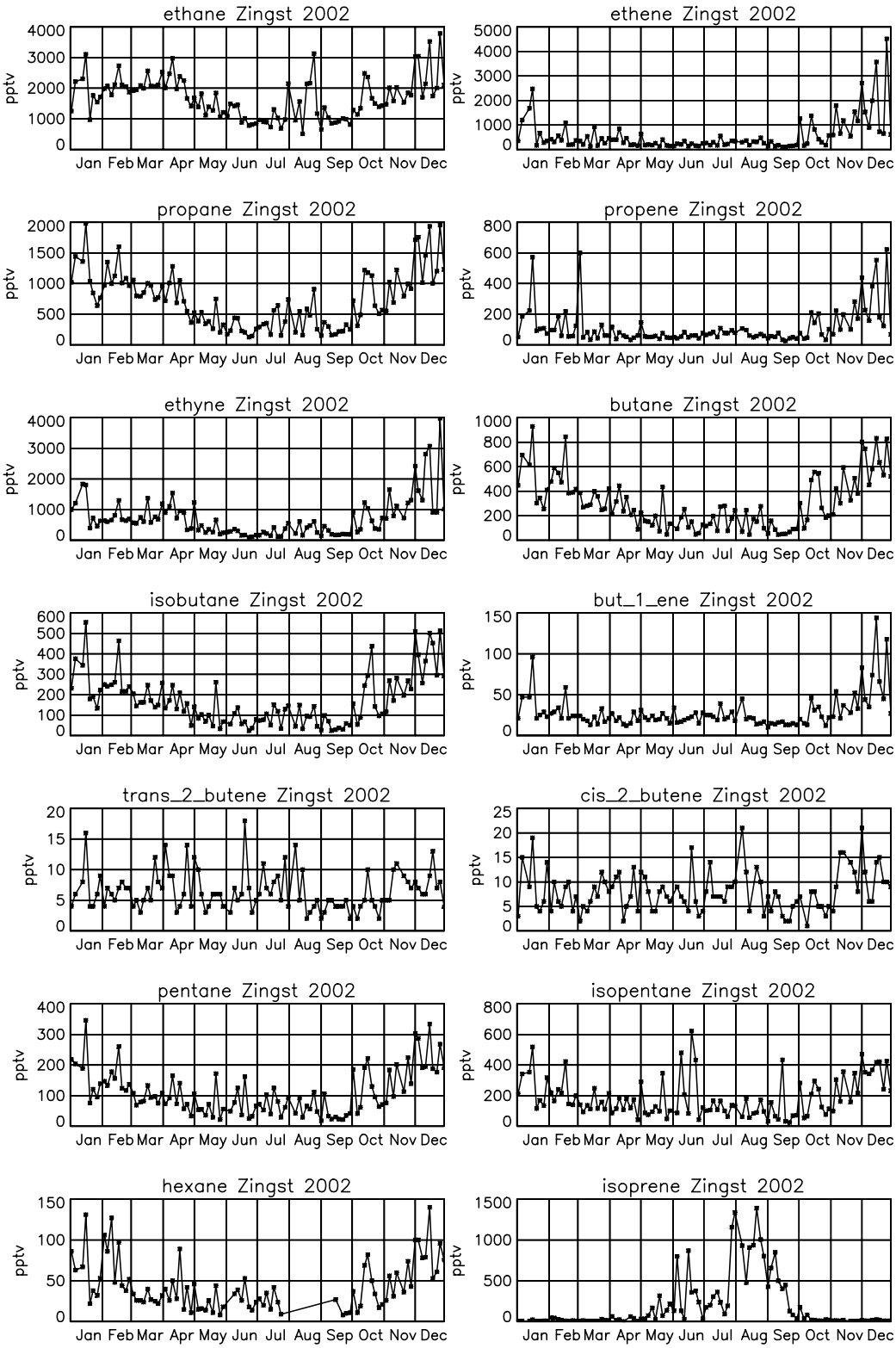
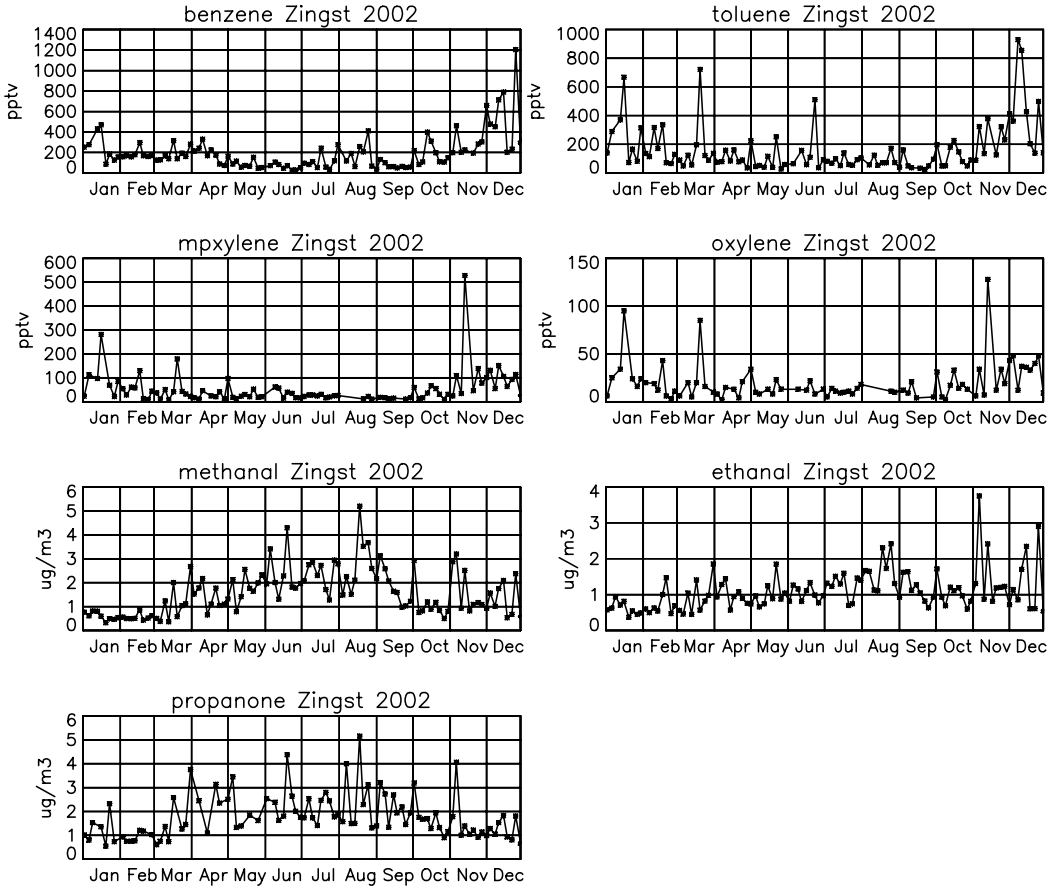
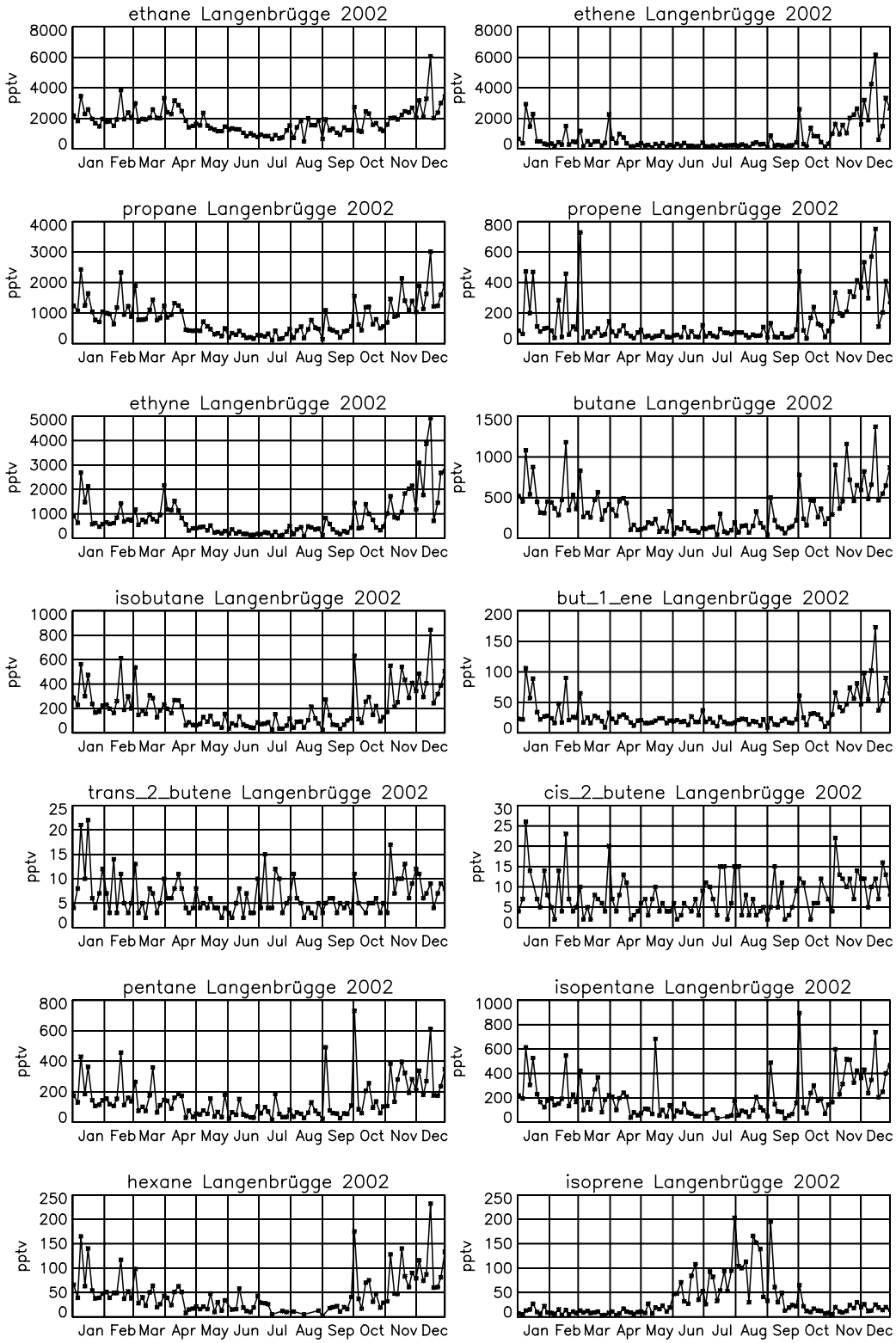
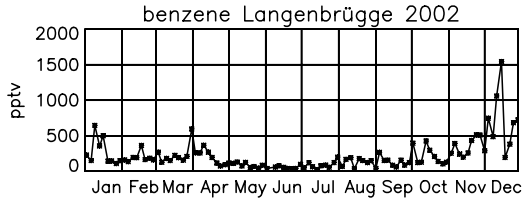
ethene Pallas 2002
propane Pallas 2002
propene Pallas 2002
ethyne Pallas 2002
butane Pallas 2002
isobutane Pallas 2002
but_1_ene Pallas 2002
trans_2_butene Pallas 2002
cis_2_butene Pallas 2002
pentane Pallas 2002
isopentane Pallas 2002
hexane Pallas 2002
isoprene Pallas 2002
benzene Pallas 2002
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

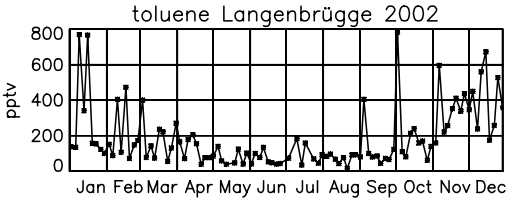

ethane Utö 2002
ethene Utö 2002
propane Utö 2002
propene Utö 2002
ethyne Utö 2002
butane Utö 2002
isobutane Utö 2002
but_1_ene Utö 2002
trans_2_butene Utö 2002
cis_2_butene Utö 2002
pentane Utö 2002
isopentane Utö 2002
hexane Utö 2002
isoprene Utö 2002
benzene Utö 2002
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

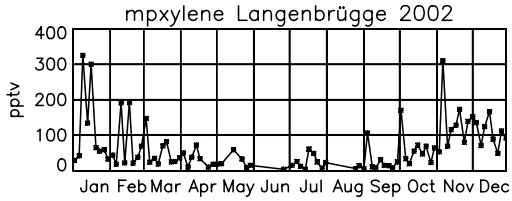

ethane Zingst 2002
ethene Zingst 2002
propane Zingst 2002
propene Zingst 2002
ethyne Zingst 2002
butane Zingst 2002
isobutane Zingst 2002
but_1_ene Zingst 2002
trans_2_butene Zingst 2002
cis_2_butene Zingst 2002
pentane Zingst 2002
isopentane Zingst 2002
hexane Zingst 2002
isoprene Zingst 2002
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

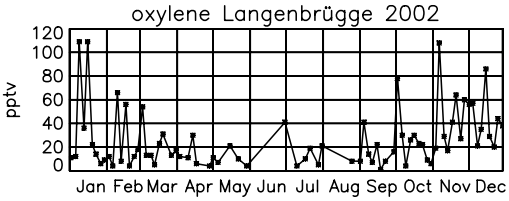

benzene Zingst 2002
pptv
0
200
400
600
800
1000
1200
1400
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
toluene Zingst 2002
pptv
0
200
400
600
800
1000
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
mpxylene Zingst 2002
pptv
0
100
200
300
400
500
600
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
oxylene Zingst 2002
pptv
0
50
100
150
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
methanal Zingst 2002
ug/m3
0
1
2
3
4
5
6
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
ethanal Zingst 2002
ug/m3
0
1
2
3
4
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
propanone Zingst 2002
ug/m3
0
1
2
3
4
5
6
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

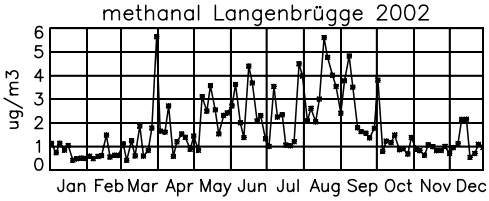

ethane Langenbrügge 2002
ethene Langenbrügge 2002
propane Langenbrügge 2002
propene Langenbrügge 2002
ethyne Langenbrügge 2002
butane Langenbrügge 2002
isobutane Langenbrügge 2002
but_1_ene Langenbrügge 2002
trans_2_butene Langenbrügge 2002
cis_2_butene Langenbrügge 2002
pentane Langenbrügge 2002
isopentane Langenbrügge 2002
hexane Langenbrügge 2002
isoprene Langenbrügge 2002
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

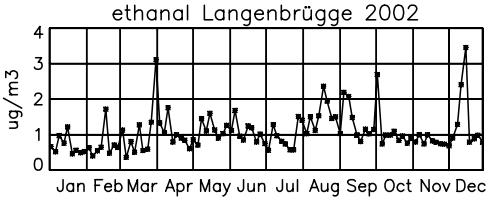

benzene Langenbrügge 2002
pptv
2000
1500
1000
500
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

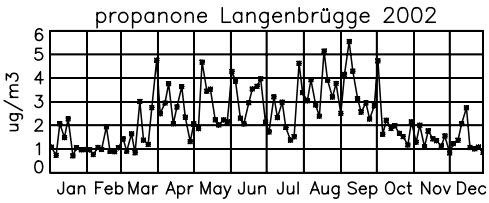

toluene Langenbrügge 2002
pptv
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

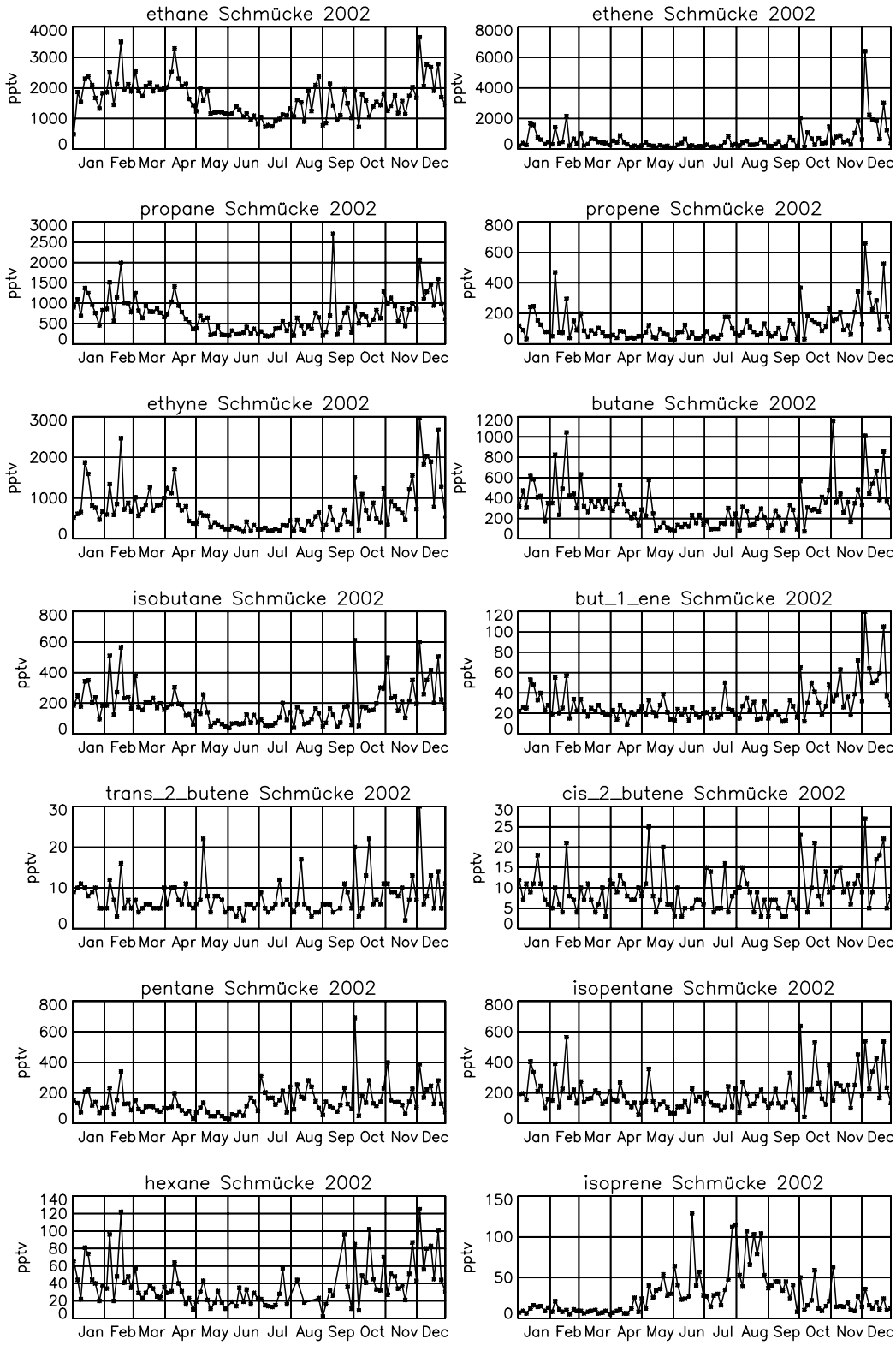

mpxylene Langenbrügge 2002
pptv
400
300
200
100
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

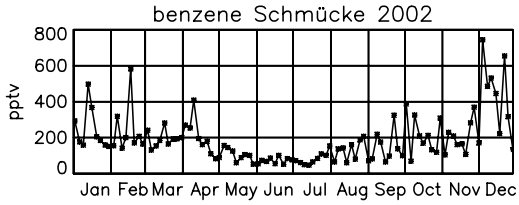

oxylene Langenbrügge 2002
pptv
120
100
80
60
40
20
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

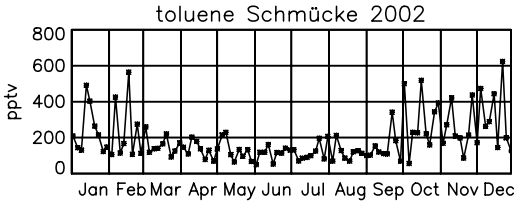

methanal Langenbrügge 2002
ug/m3
6
5
4
3
2
1
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

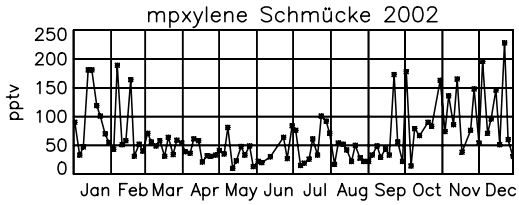

ethanal Langenbrügge 2002
ug/m3
4
3
2
1
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

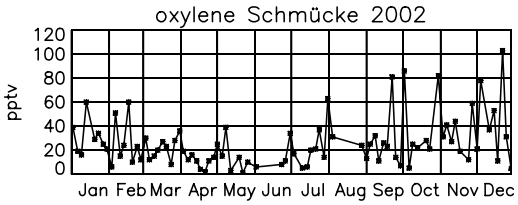

propanone Langenbrügge 2002
ug/m3
6
5
4
3
2
1
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

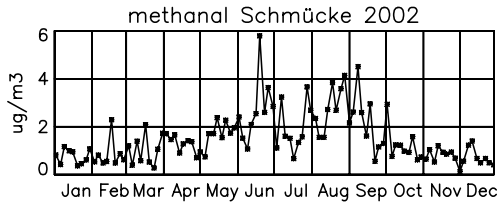

ethane Schmücke 2002
ethene Schmücke 2002
propane Schmücke 2002
propene Schmücke 2002
ethyne Schmücke 2002
butane Schmücke 2002
isobutane Schmücke 2002
but_1_ene Schmücke 2002
trans_2_butene Schmücke 2002
cis_2_butene Schmücke 2002
pentane Schmücke 2002
isopentane Schmücke 2002
hexane Schmücke 2002
isoprene Schmücke 2002
pptv
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


benzene Schmücke 2002
pptv
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


toluene Schmücke 2002
pptv
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


mpxylene Schmücke 2002
pptv
250
200
150
100
50
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


oxylene Schmücke 2002
pptv
120
100
80
60
40
20
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


methanal Schmücke 2002
ug/m3
6
4
2
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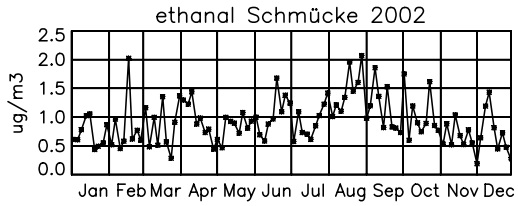
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec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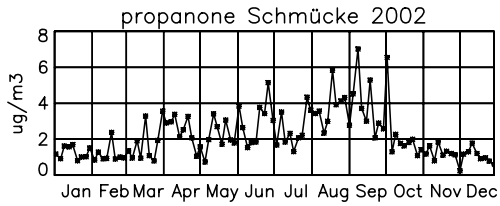
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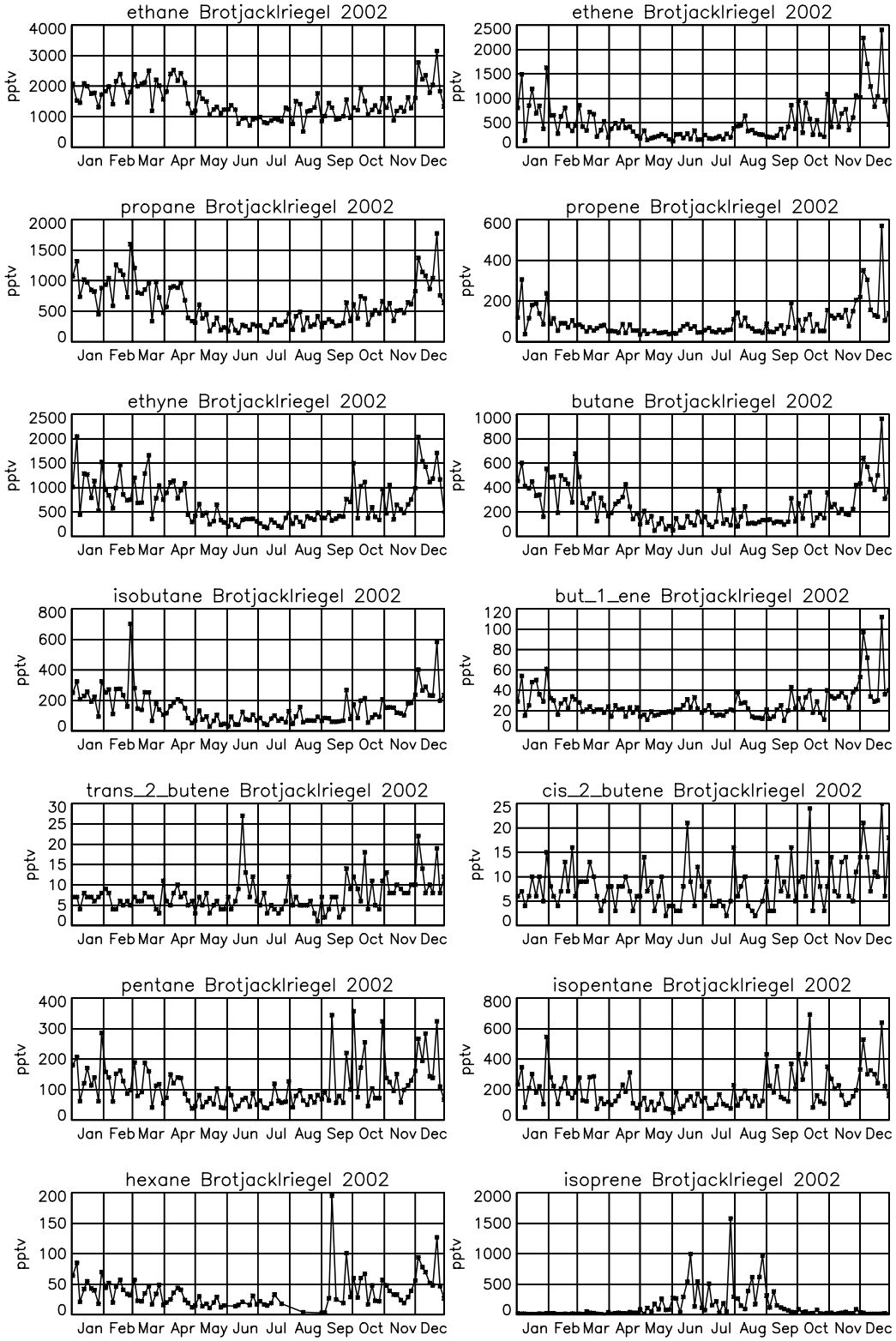
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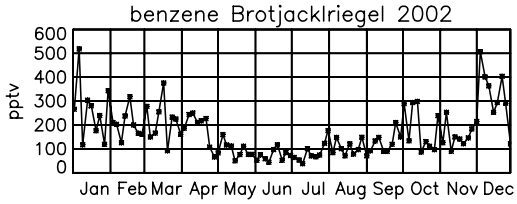
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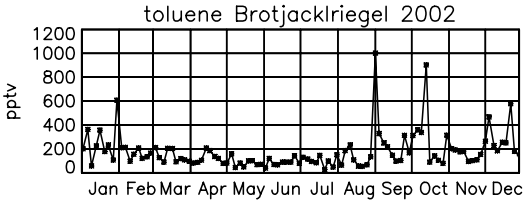
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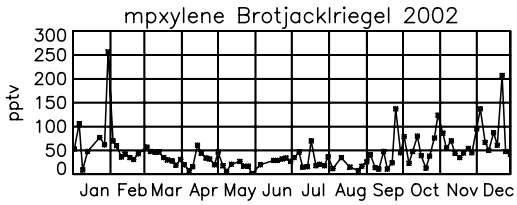
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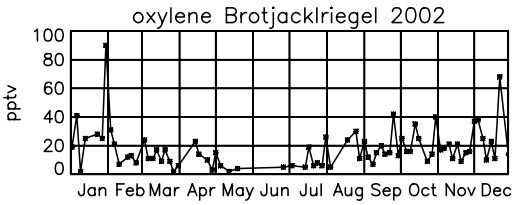
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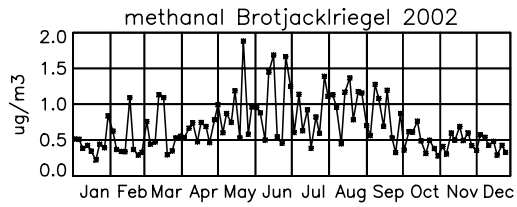
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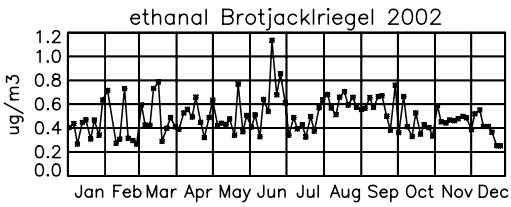
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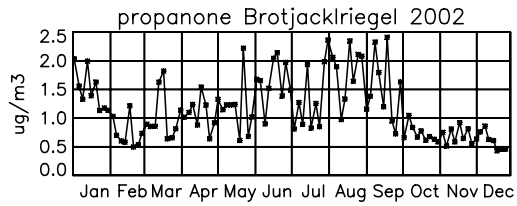
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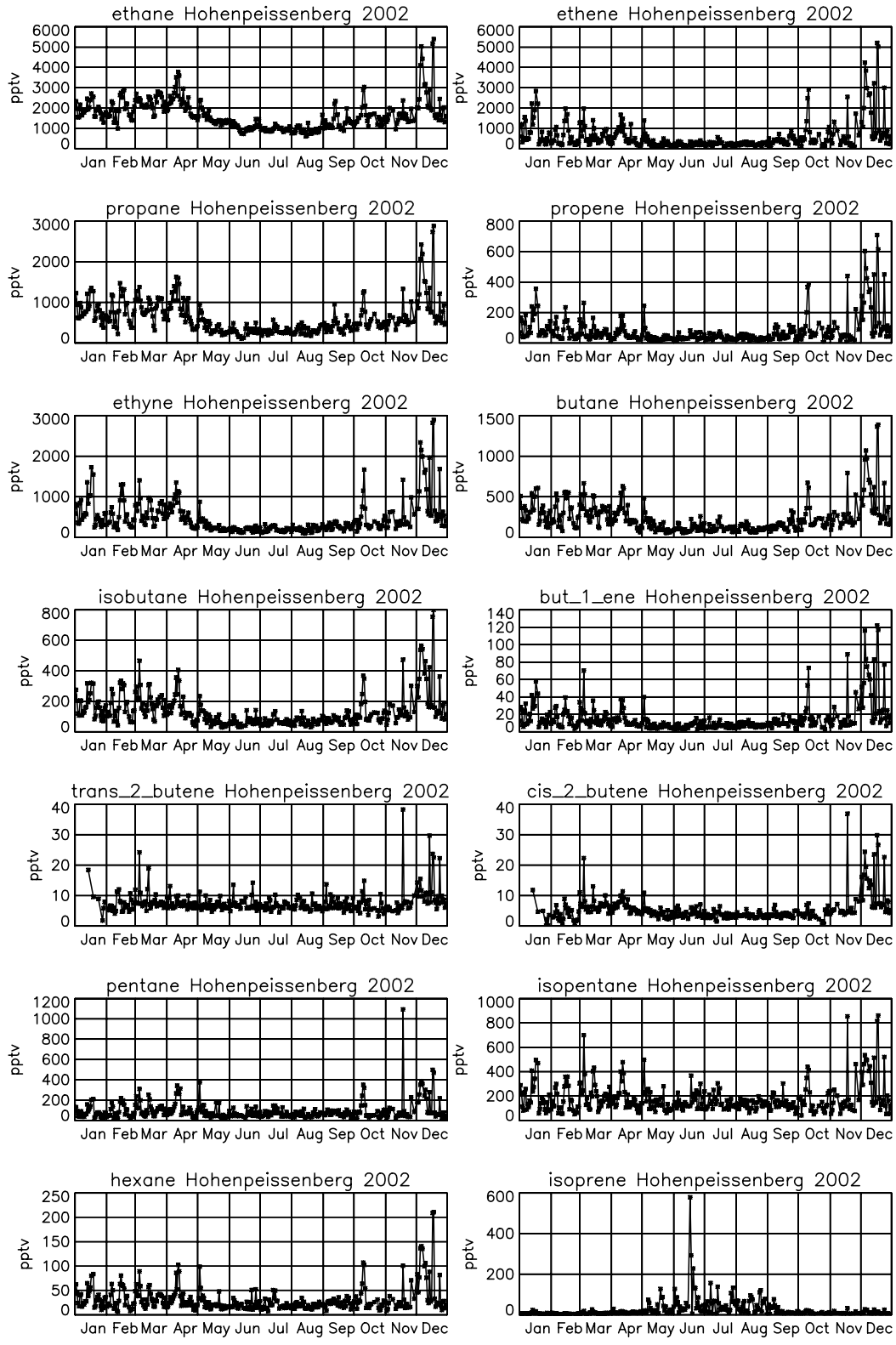
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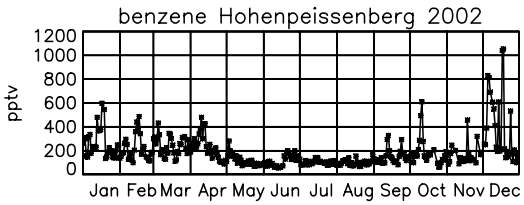
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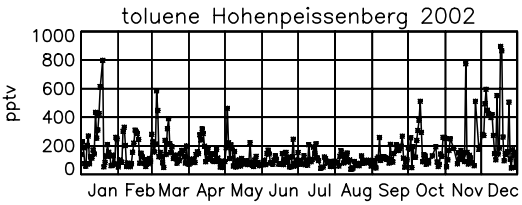
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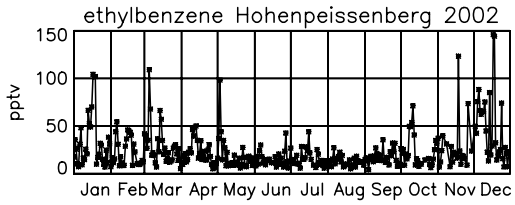
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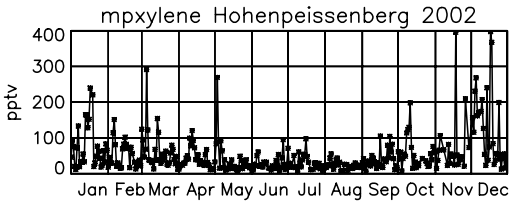
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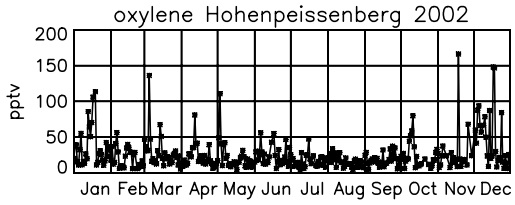
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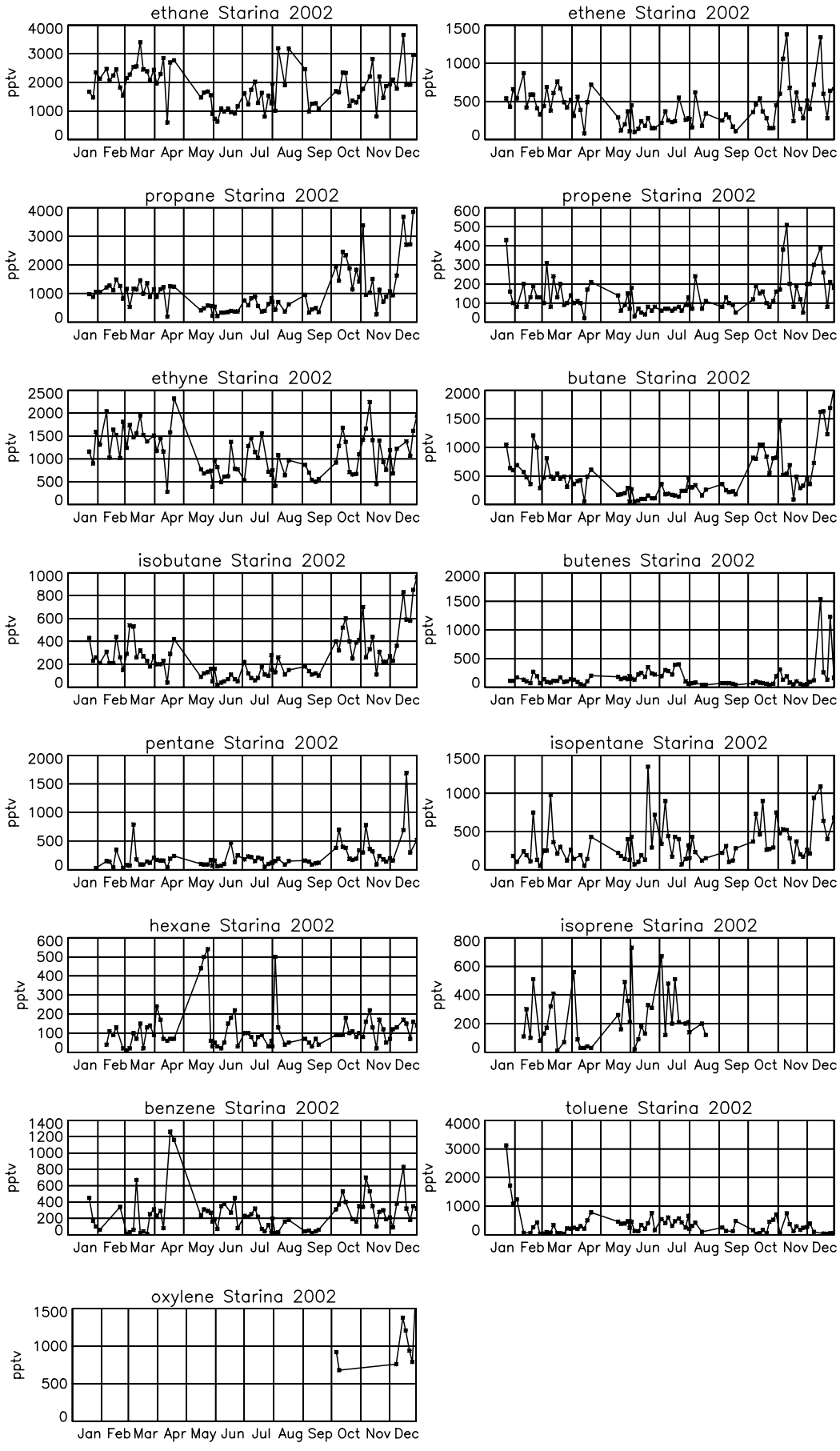
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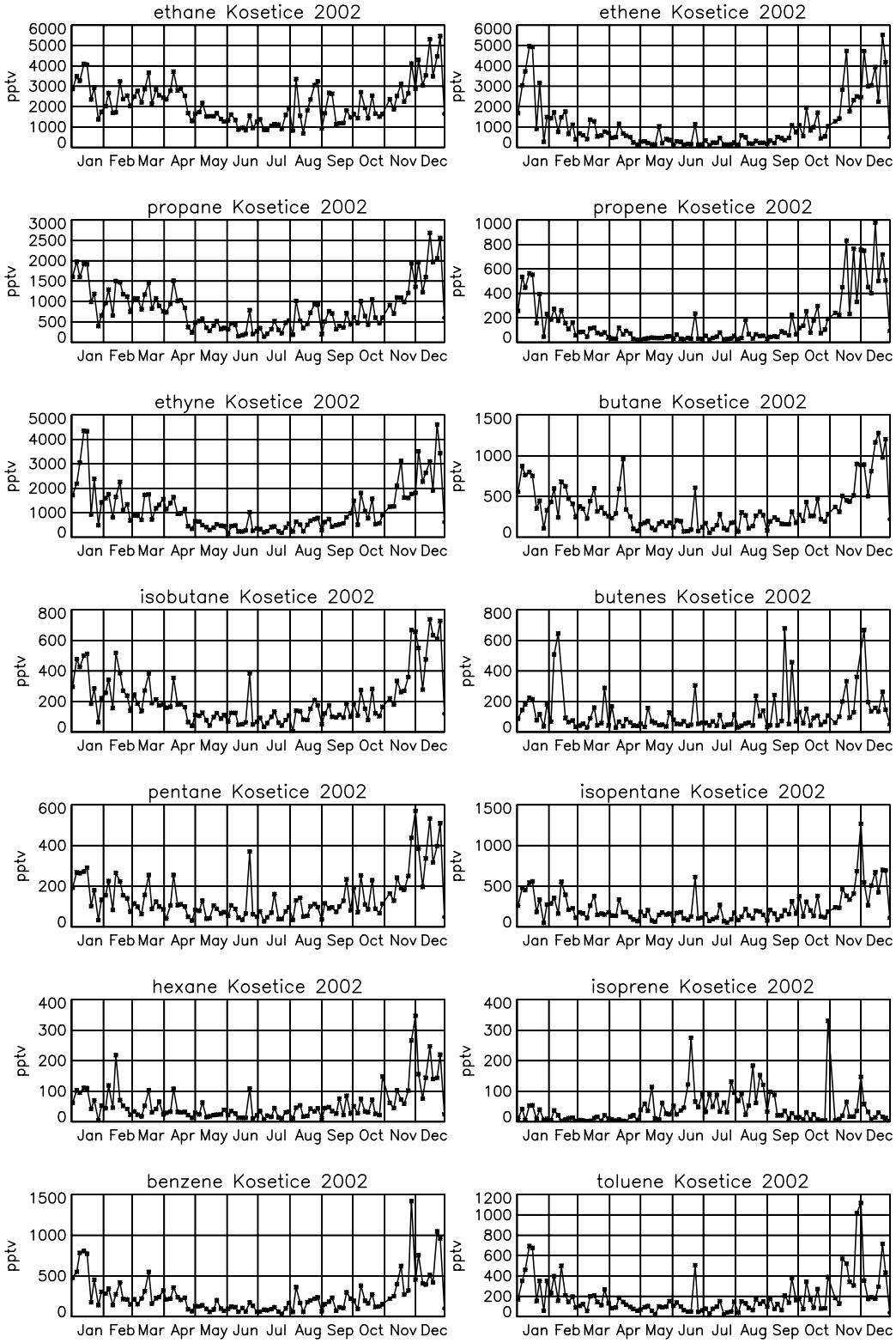
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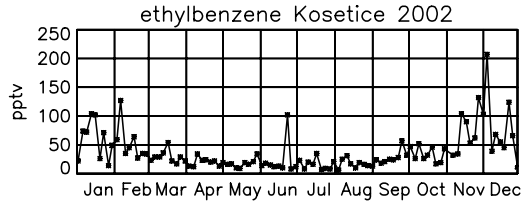
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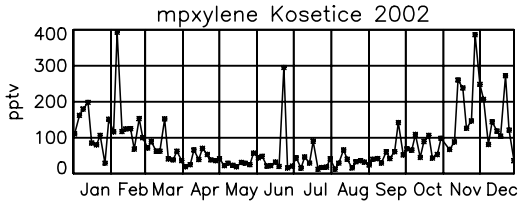
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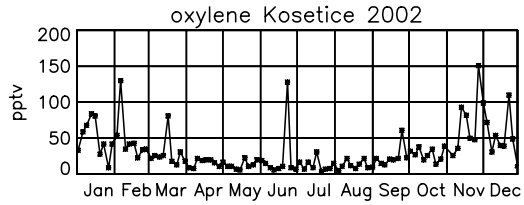
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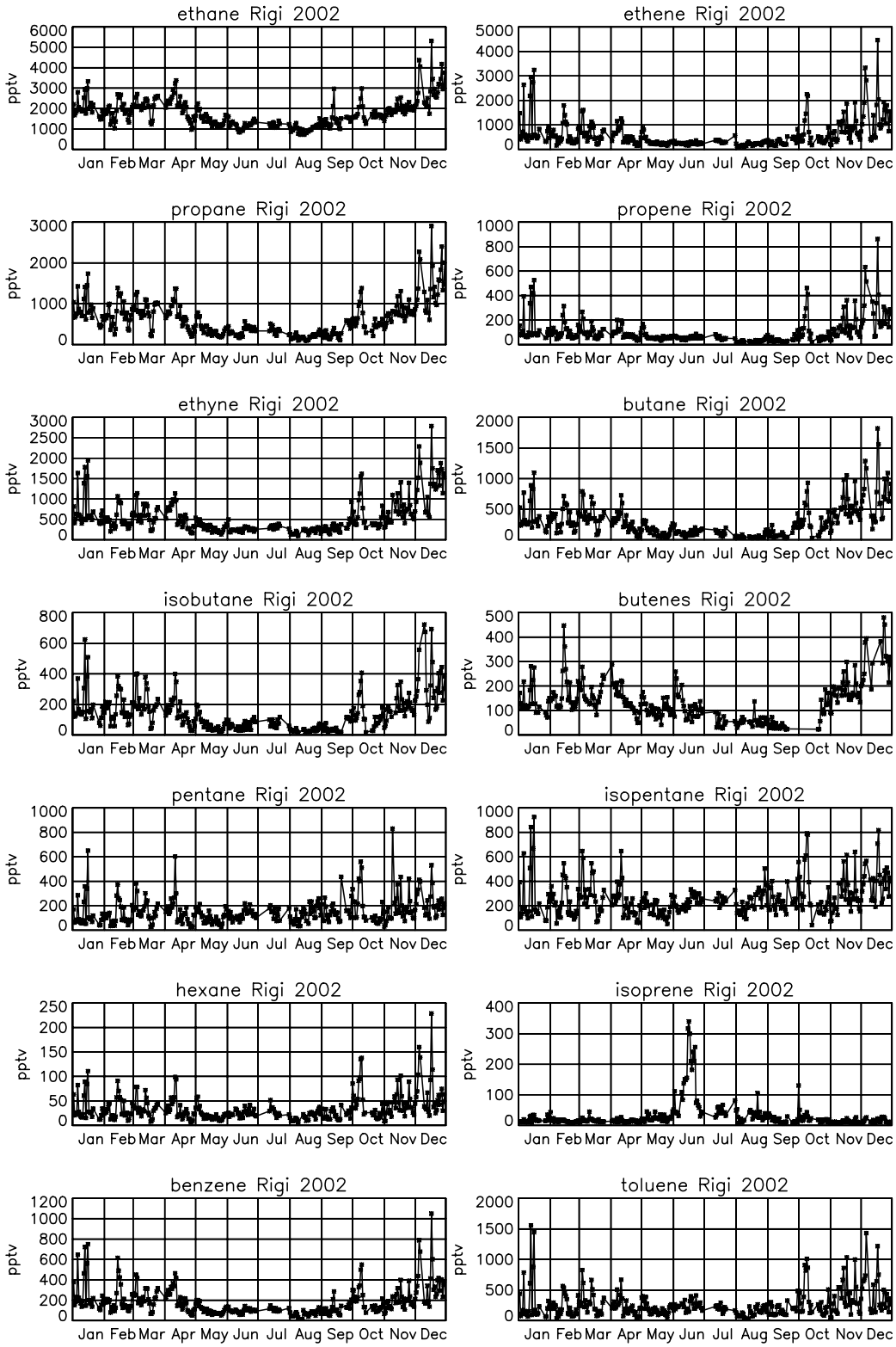
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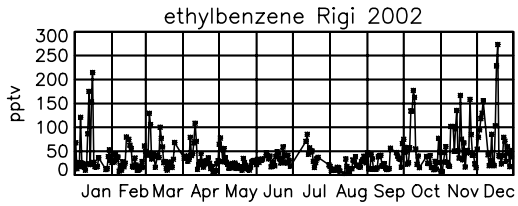
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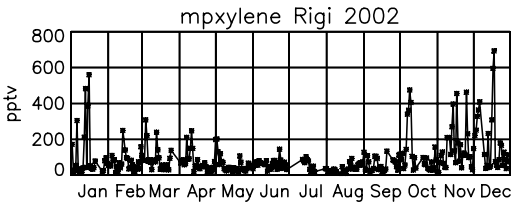
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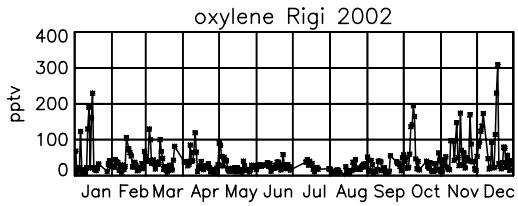
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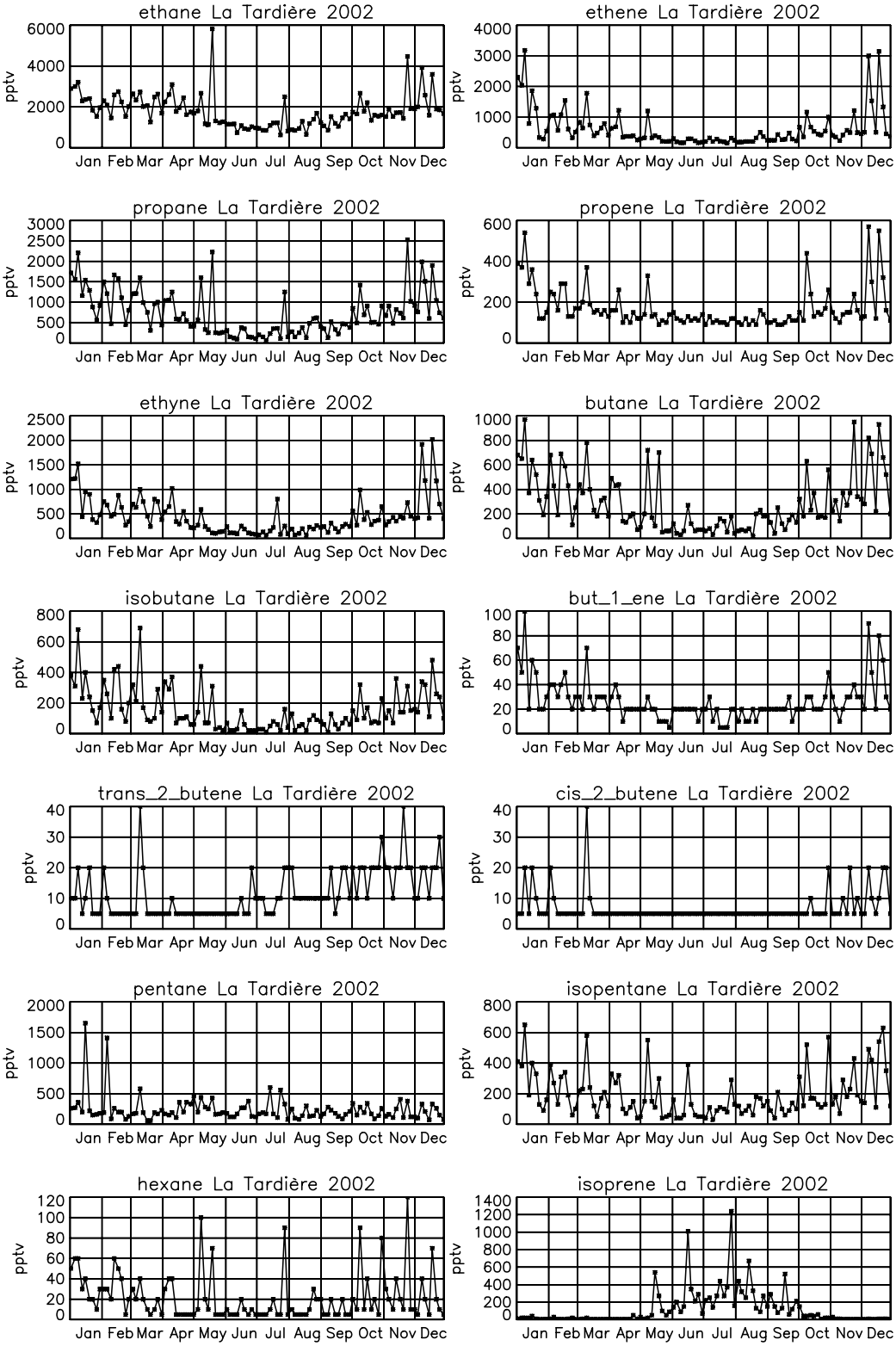
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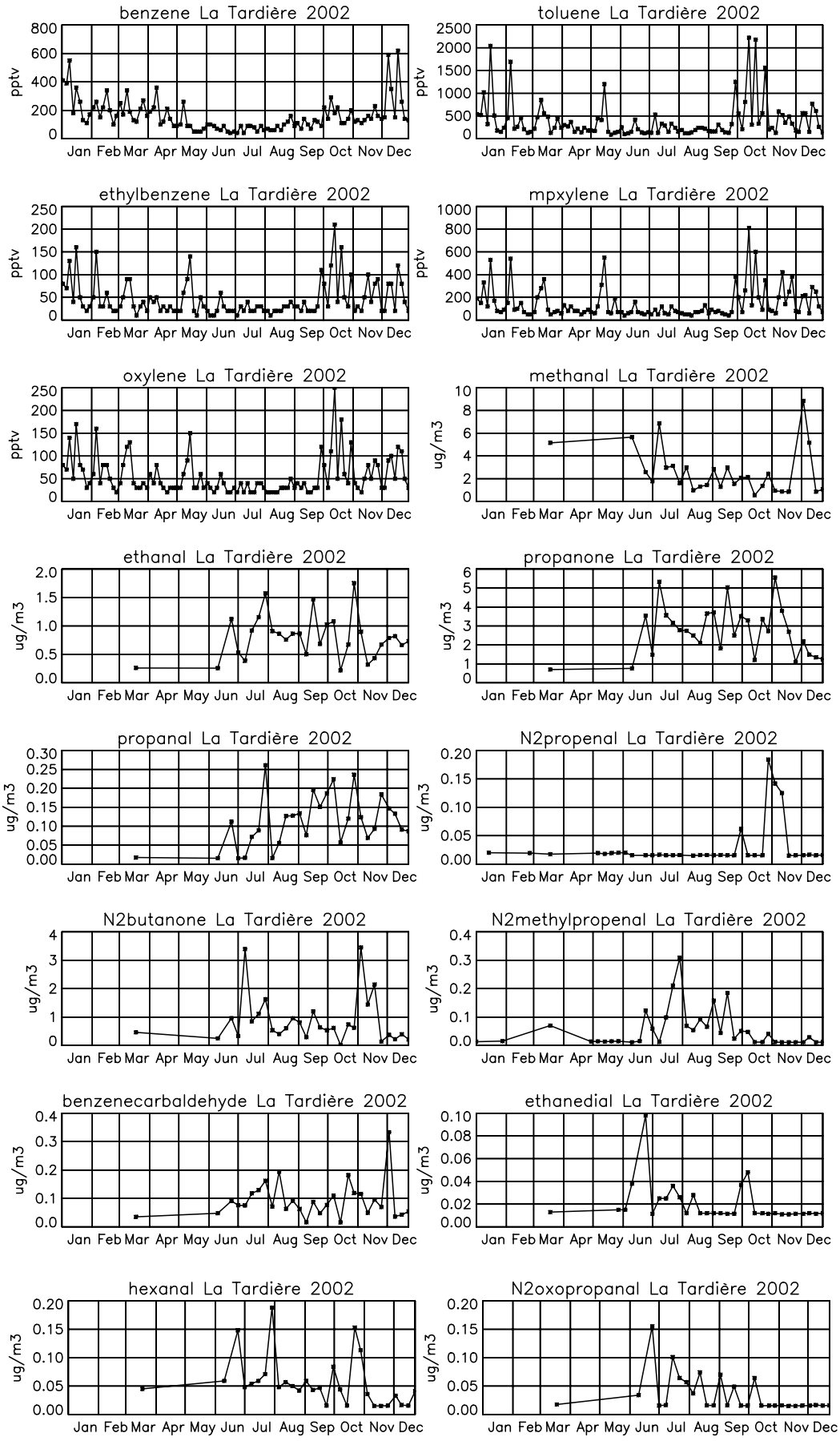
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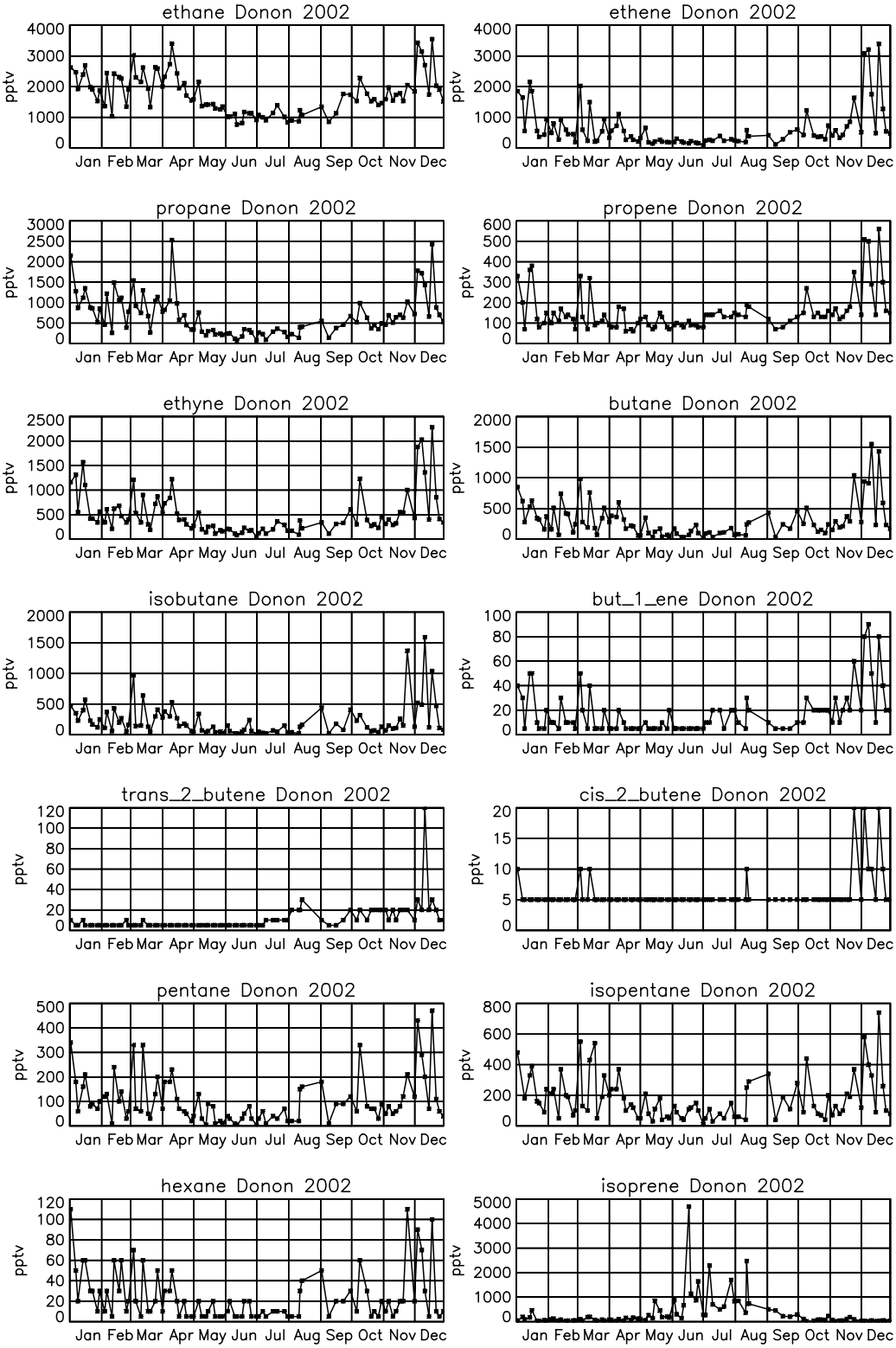
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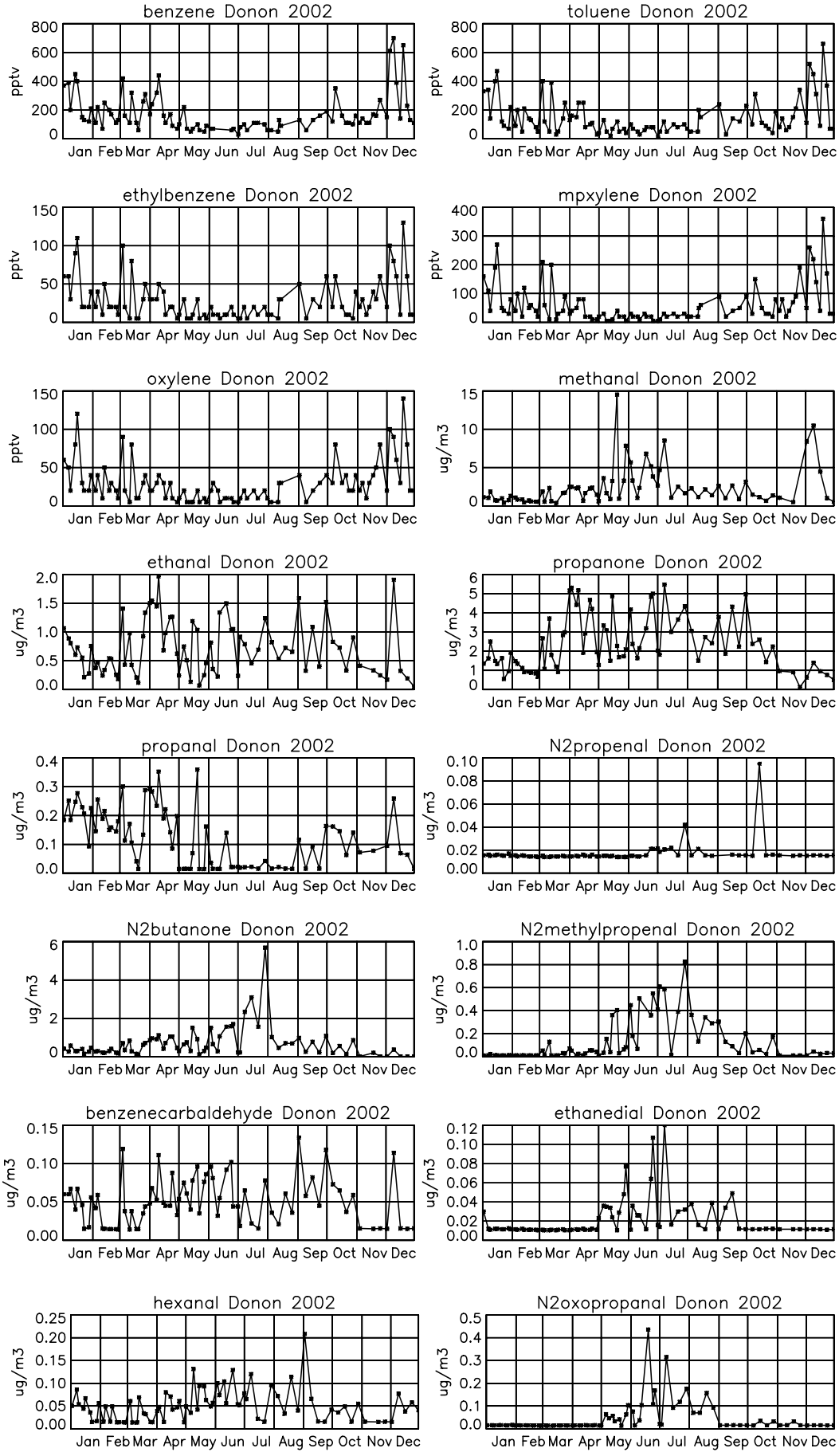
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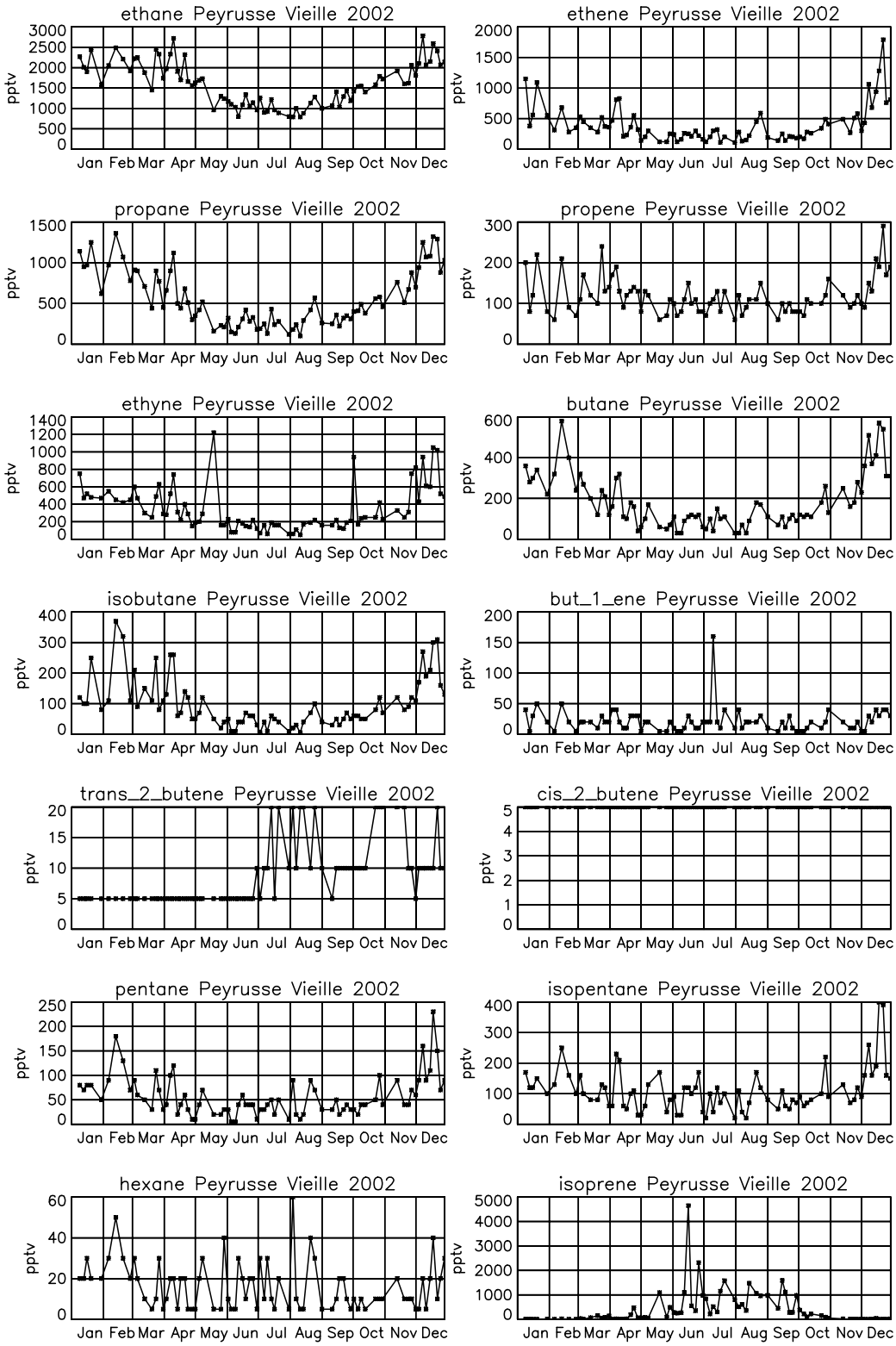
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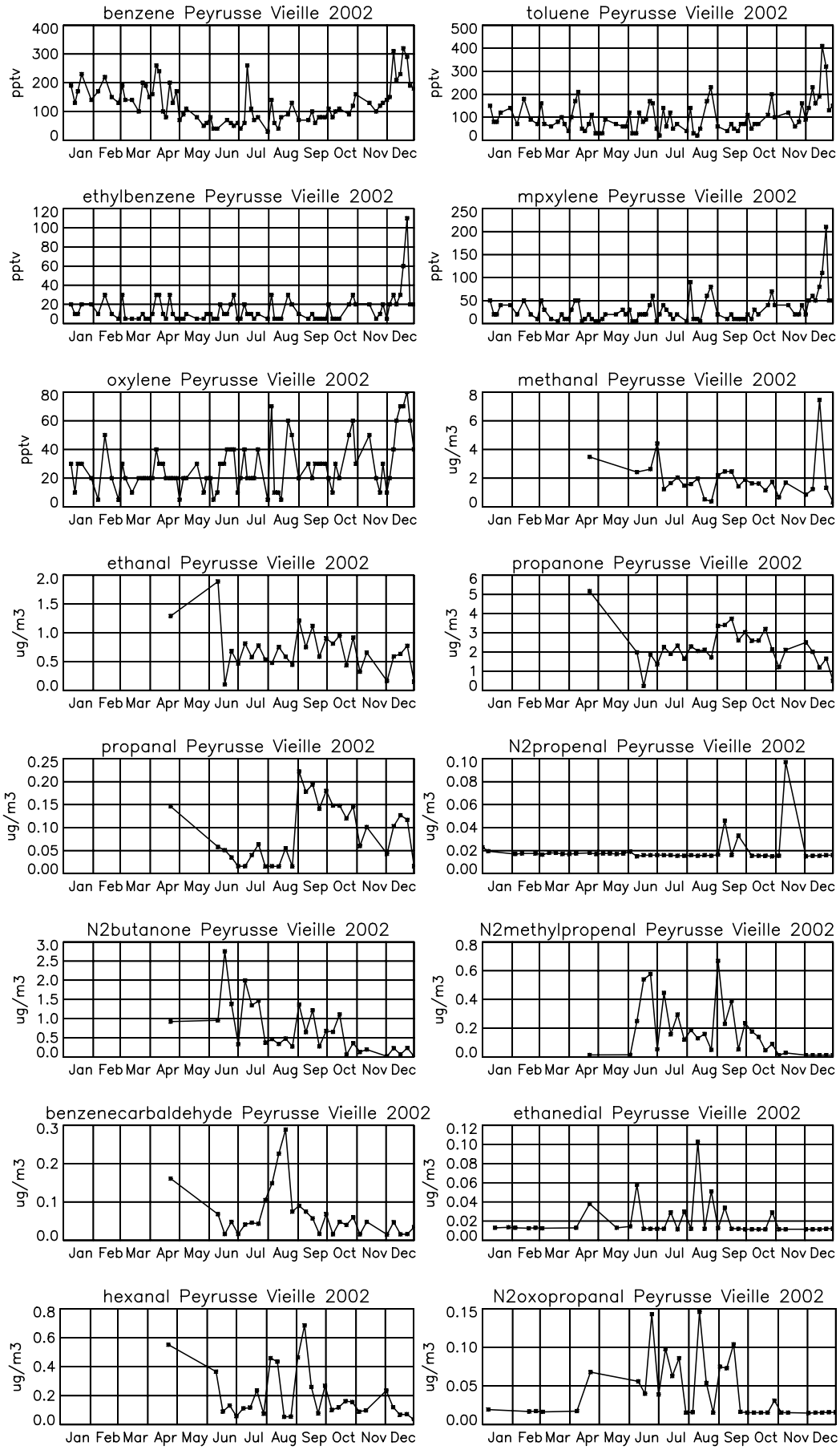
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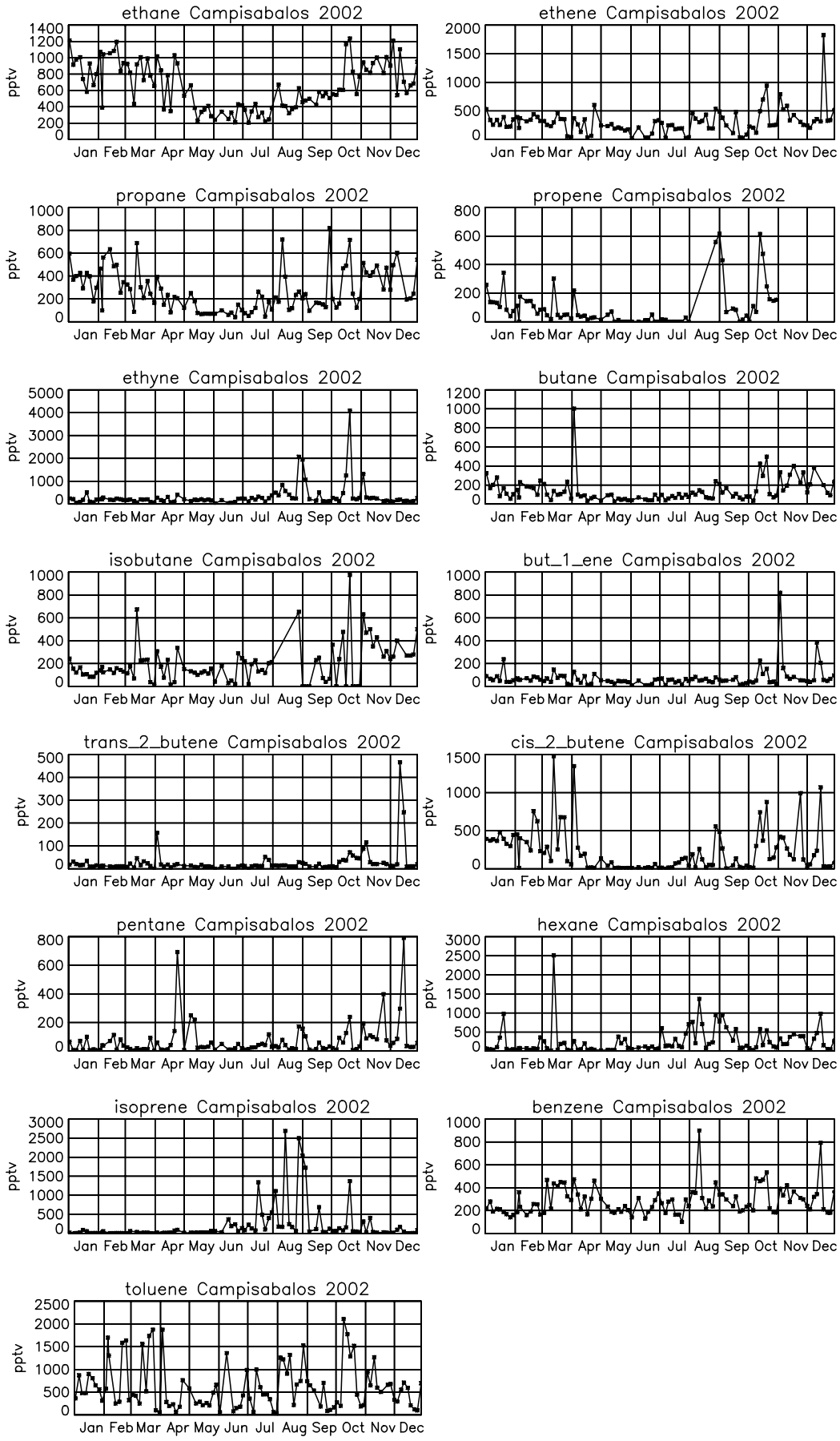
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