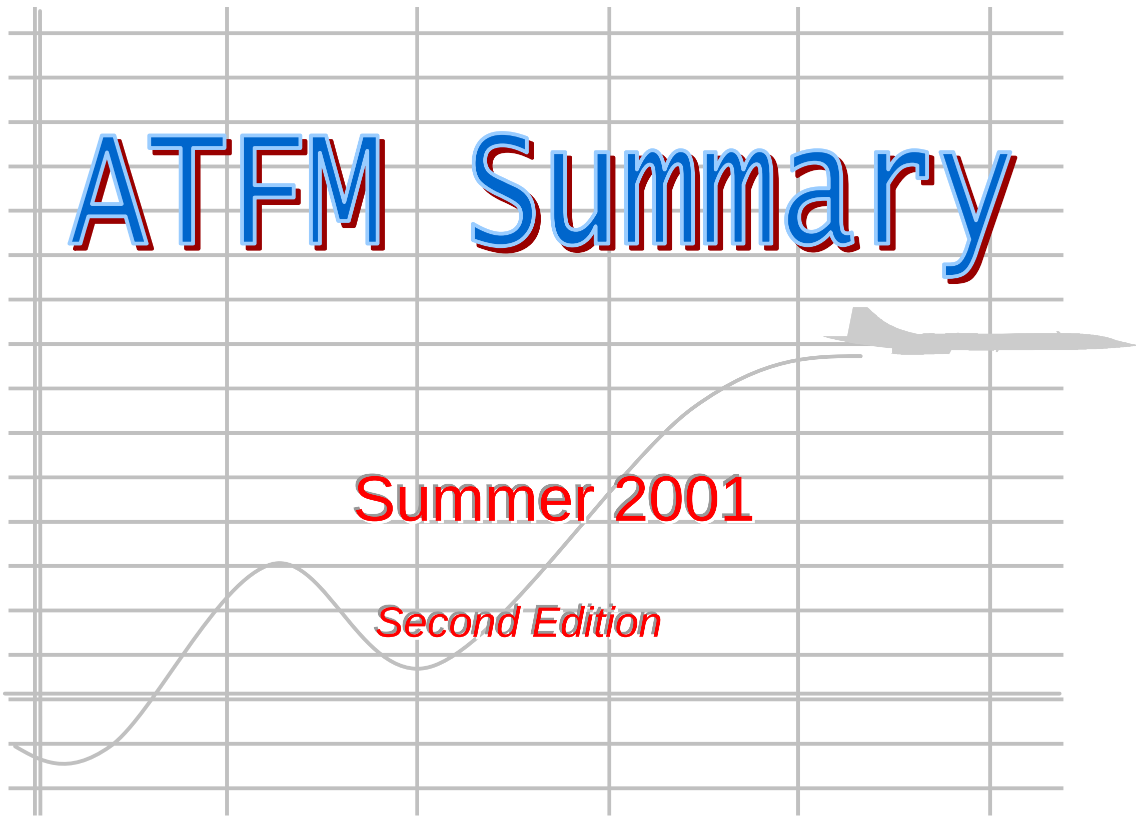
EUROPEAN ORGANISATION
FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

Central Flow Management Unit

ATFM Summary



Summer 2001

Second Edition

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Abbreviations

ACC	**Area Control Centre**
ATC	**Air Traffic Control**
ATFM	**Air Traffic Flow Management**
ATM	**Air Traffic Management**
ATS	**Air Traffic Service**
ATSP	**Air Traffic Service Providers**
CFMU	**Central Flow Management Unit**
ECAC	**European Civil Aviation Conference**
FMD	**Flow Management Division**
FMP	**Flow Management Position**
ICAO	**International Civil Aviation Organization**
IFPS	**Initial Flight Plan Processing System**
TACT	**CFMU Tactical ATFM system**
THC	**Traffic Handling Capability**
TMA	**Terminal Manoeuvering Area (= Terminal Control Area)**

1 Introduction

A target for Summer 2001 was set by the Provisional Council: "the average delay per flight during the summer season would not exceed **3.5** minutes (the level of delay in 1997) while handling a **5.3%** traffic increase in ECAC". Based on the assumption of a 5.3% traffic increase and the timely implementation of the capacity increases planned by the ANSPs for Summer 2001, an average delay of **4.9** minutes per flight has been estimated (FAP model).

At the end of the summer period (defined as the period between May and October), we observe that the traffic increase is only **0.2%** (instead of the assumed 5.3%), while the average delay per flight is **3.9** minutes (instead of the 3.5 minutes target but better than the expected 4.9 minutes). The average En-Route delay per flight is **3.1** minutes.

The "Summer 2001 Report" presents an overall view of the ATFM data (only between May and October) over the last 6 years. The aim is to identify the major trends at the ECAC level. In this report, all ATFM delays are included, i.e. integrating both En-Route and Airport delays.

A more detailed presentation, at the ACC level, is given in the "ATFM Seasonal Summary per ACC (May-Oct 2001)". The report is the conclusion of the monthly reporting made by the CFMU to the Directors of ATC Operations during the summer. It displays the monthly evolution of the traffic and the En-Route ATFM delays for the 20 most congested ACCs during Summer 2001.

2 Overall ATFM indicators

2.1 Traffic and ATFM Delays

2.1.1 Yearly Traffic evolution

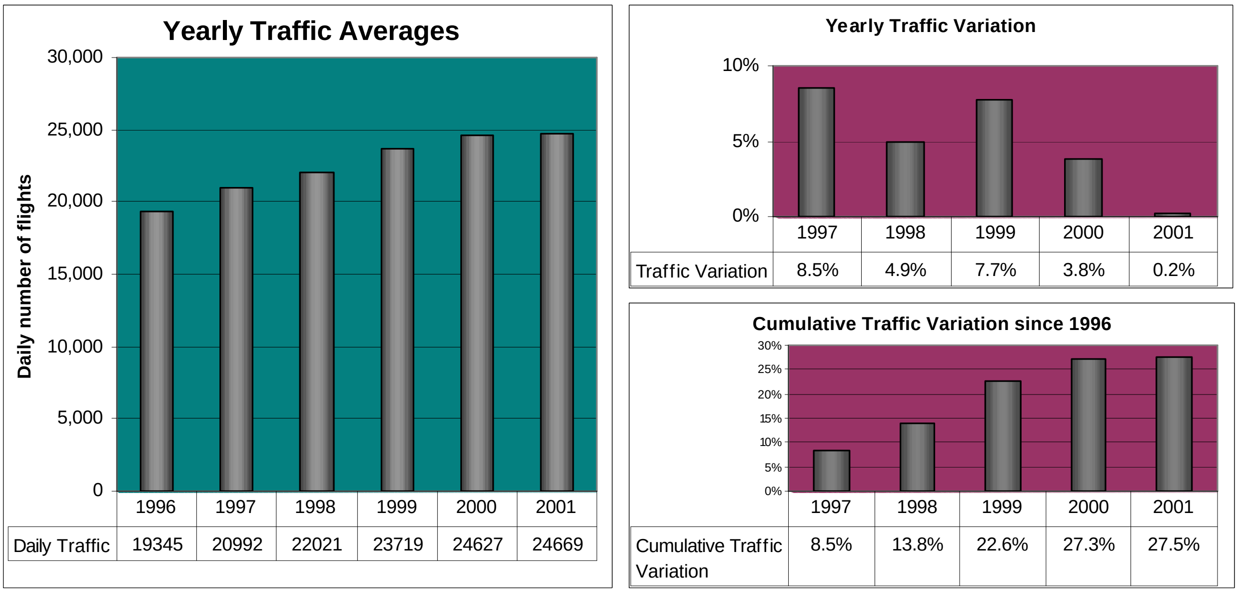


Figure 1

The continuous increase of the traffic[1] between 1996 and 2001 is shown on Figure 1. During 1996, the daily number of flights in the CFMU area used to stay around 19.300 flights. Six years later it reaches almost 25.000 flights, which means that European ATC absorbed a traffic increase of 27.5% in 6 years.

The charts also show that the increase rate is not constant: it has slowed down during the last 3 years. There is no significant traffic increase between 2000 and 2001: until August, a small increase of 1 % was observed; after the 11th September events, the traffic decreased. The number of flights is therefore equivalent during the two summer periods.

[1] *The **daily traffic** is the average number of flights entering daily in the CFMU area during the period. Only the flights for which a flight plan is received by the CFMU can be taken to compute the CFMU traffic.*

2.1.2 Highest Daily Traffic

Table 1 displays the 10 days in 2001 with the highest traffic demand in the ECAC area. Peak days are essentially concentrated at the beginning and the end of the Summer period, and all of them occur on Fridays and Thursdays. Usually most of the peak days are observed in September. This observation is still valid in 2001, despite the 11th September events: the two last Fridays of September are in the Top 10 traffic days.

Peak Days in 2001	Traffic (flights)
Fri 31/08/01	**27,872**
Fri 29/06/01	**27,870**
Fri 01/06/01	**27,651**
Fri 07/09/01	**27,636**
Fri 21/09/01	**27,619**
Fri 28/09/01	**27,484**
Fri 08/06/01	**27,341**
Thu 30/08/01	**27,326**
Thu 28/06/01	**27,235**
Fri 13/07/01	**27,144**

Table 1

Peak Days in 2000	Traffic (flights)
Fri 08/09/00	27,895
Fri 15/09/00	27,731
Fri 16/06/00	27,677
Thu 14/09/00	27,583
Fri 01/09/00	27,558
Fri 29/09/00	27,455
Fri 09/06/00	27,431
Fri 30/06/00	27,412
Thu 07/09/00	27,318
Thu 31/08/00	27,293

Table 2

The evolution of the Top 10 Daily Traffic[2] and the Top 10 Traffic ratios[3] over the last 6 years are displayed in Figure 2. The Top 10 Daily Traffic evolution is very similar to the Daily Traffic evolution (see Figure 1). During the 6 years, the Top 10 Traffic ratio remained almost constant, decreasing slightly from 16% to 12% above the average Daily Traffic.

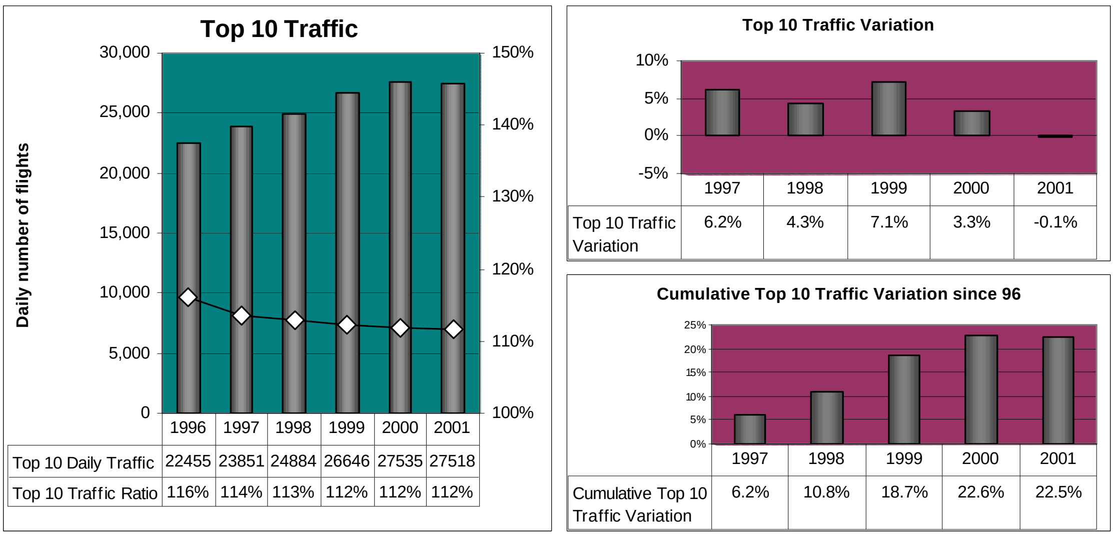


Figure 2

[2] *The Top 10 Daily Traffic is computed as the average of the 10 peak days traffic.*
[3] *the Top 10 Traffic ratio is computed as the ratio between the Top 10 Daily Traffic and the Daily Traffic of the corresponding year.*

2.1.3 Yearly ATFM Delay evolution

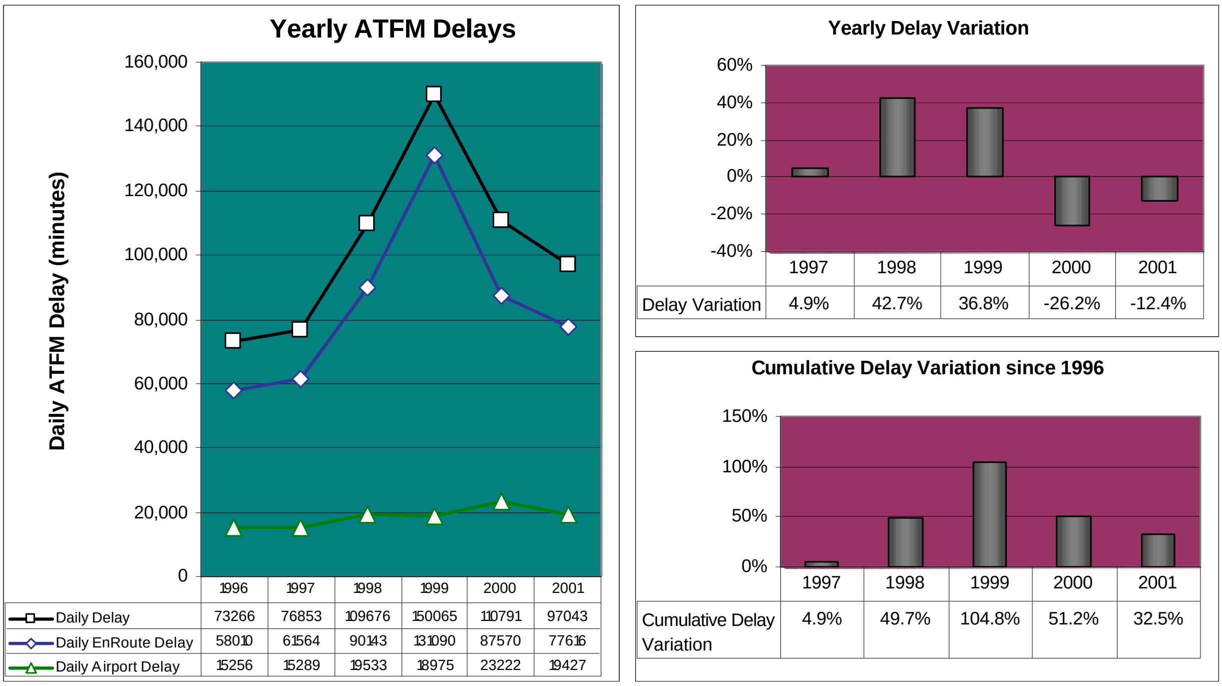


Figure 3

Figure 3 displays the daily ATFM Delay[4] over six years, as well as the portion attributed to the En-Route and Airport (*see 2.5 below*). Summer 2001 delays are below the delays observed during the previous three years, including 1998. The Airport delays stayed rather constant during the last 4 years.

2.1.4 Highest Daily Delays

Table 3 displays the 10 days in 2001 with the highest ATFM Delays. Peak days are essentially concentrated in the beginning of the Summer period (June and July), during the week-ends (Saturdays or Fridays).

The events with the highest impact during these special days are Staffing issues, weather, and an industrial action of bus drivers in the Balaeric Islands.

While peak traffic days are observed mainly at the end of the Summer, peak delays days occur in June and July: only 1 peak traffic day is among the peak delays days.

[4] *Unless specified otherwise, the delays presented in this document correspond to ATFM delays, i.e. delays consecutive to ATFM regulations. "ATFM delay" is defined as the duration between the last Take-Off time requested by the aircraft operator and the Take-Off slot given by the CFMU.*

Peak Days in 2001	Delays (minutes)	Special events
Sat 14/07/01	**203,946**	Partially (40%) due to Staffing issues
Sat 30/06/01	**194,900**	Ind Action (Bus Drivers - Balaerics)
Sun 01/07/01	**184,426**	Ind Action (Bus Drivers - Balaerics)
Sat 04/08/01	**179,780**	Partially (30%) due to Staffing issues
Fri 18/05/01	**172,589**	
Fri 29/06/01	**172,168**	Ind Action (Bus Drivers - Balaerics)
Sat 16/06/01	**172,089**	Partially (20%) due to weather
Wed 27/06/01	**169,677**	Partially (50%) due to weather
Fri 06/07/01	**165,293**	Industrial action (Italian ACC's)
Wed 11/07/01	**163,358**	Weather in Amsterdam and Heathrow

Table 3

Peak Days in 2000	Delays (minutes)
Sat 17/06/00	312,110
Fri 07/07/00	247,557
Mon 26/06/00	217,025
Fri 28/07/00	200,862
Fri 01/09/00	190,723
Fri 09/06/00	187,936
Mon 03/07/00	187,545
Fri16/06/00	185,030
Sat 29/07/00	183,607
Mon 05/06/00	178,834

Table 4

The evolution of the Top 10 Daily Delays[5] and the Top 10 Delay ratio[6] over the last 6 years are displayed in Figure 4. The high ratio in 1998 is mainly due to staff shortage problems during Whit Sunday in Spain (800,000 minutes of delay during one week-end). The low ratio in 1999 on the other hand is due to the numerous congested days following Kosovo war and ARN-V3 (*40 days with more than 200,000 minutes of delay in 1999*). 2001 is a year similar to 2000, i.e. no days with events impacting severely on the delays.

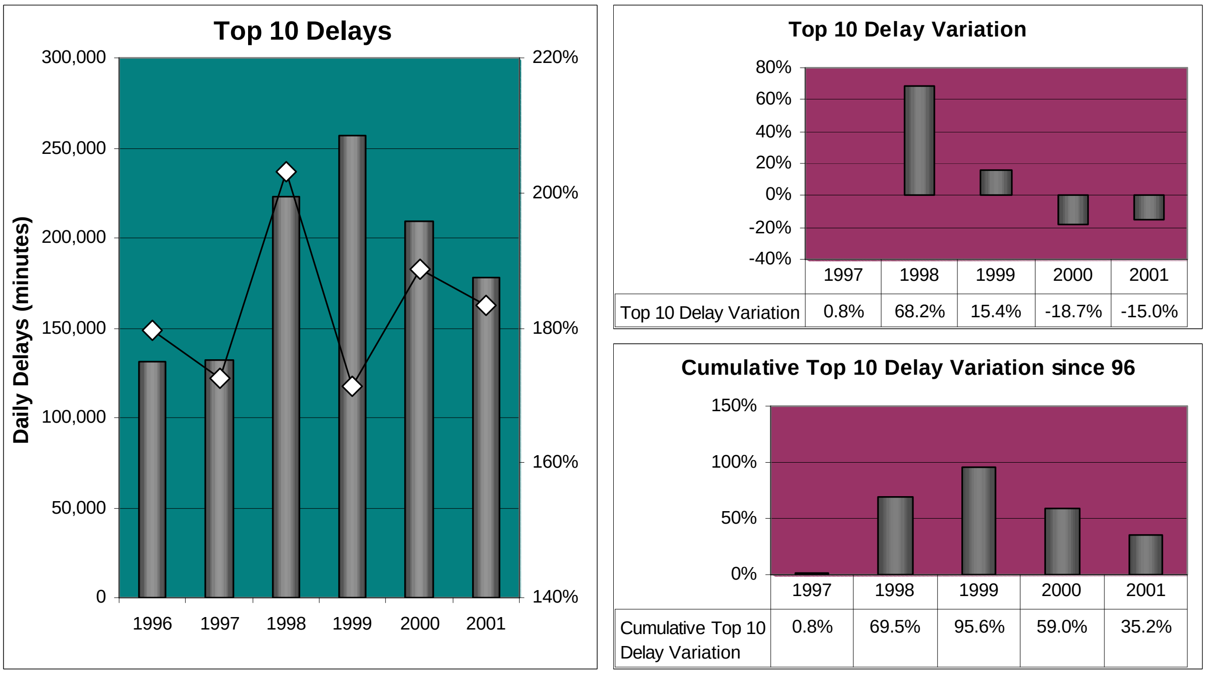
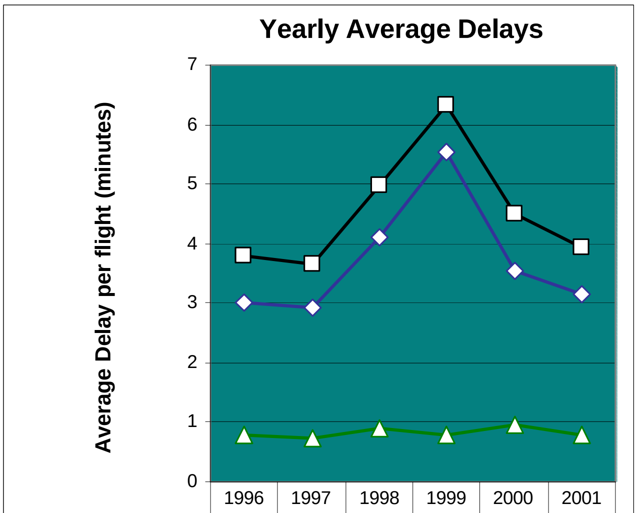


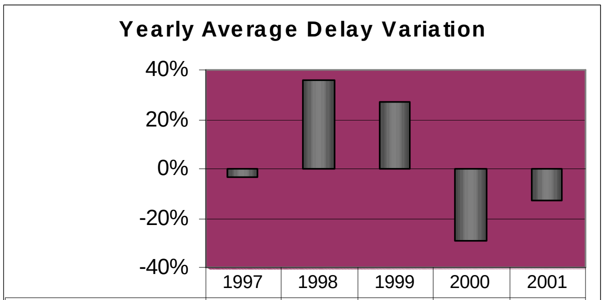
Figure 4

[5] *The Top 10 Daily Delay is computed as the average of the 10 peak days delays.*
[6] *the Top 10 Delay ratio is the ratio between the Top 10 Daily Delay and the Daily Delay of the corresponding year.*

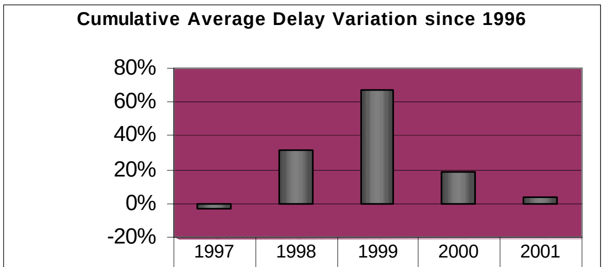
2.1.5 Average Delay per flight evolution



	1996	1997	1998	1999	2000	2001
Average Delay per Flight	3.8	3.7	5.0	6.3	4.5	3.9
Average EnRoute Delay per Flight	3.0	2.9	4.1	5.5	3.6	3.1
Average Airport Delay per Flight	0.8	0.7	0.9	0.8	0.9	0.8



	1997	1998	1999	2000	2001
Average Delay Variation	-3.3%	36.0%	27.0%	-28.9%	-12.6%



	1997	1998	1999	2000	2001
Cumulative Average Delay Variation	-3.3%	31.5%	67.1%	18.8%	3.9%

Figure 5

The evolution of the average delay per flight[7] is displayed in the Figure 5. The delay variations shown in Figure 3 are compensated by the traffic increases, showing that the Summer 2001 values are coming back close to the 96-97 values.

2.1.6 Evolution Summary

Two different observations show how the ATC capacity increased in the ECAC area:

- between 2000 and 2001, the same level of traffic is observed, but the delays decreased by 13%.
- between 1996 and 2001, the average delay per flight is almost the same, but the traffic increased by 27%.

ATFM delays are significantly higher during the Summer period. Another way to highlight the improvement is to note that the average delay per flight during Summer 2001 (3.9 minutes) is equivalent to the average delay per flight during the whole year 2000 (3.8 minutes).

[7] *The **average delay per flight** is the total ATFM delay divided by the total traffic for the considered period.*

2.2 ATFM delays and other delays

The ATFM delay is the departure delay assigned by the CFMU and defined as the duration between the last Take-Off time requested for the flight and the Take-Off slot given by the CFMU. However, ATFM is not the only cause of the delays corresponding to passenger perception: some airport delays, or delays which are attributable to operations of the aircraft operators are not taken into account in the ATFM delays. The "Overall Delay" is computed, as the duration between the first Departure Time requested for a flight and the Actual Departure Time.[8]

The diagram in Figure 6 shows the proportion of the ATFM delay on the overall delay. A portion of the "Other Delays" displayed in the diagrams might be attributed indirectly to the ATFM through the Reactionary Delays[9]. Nevertheless, all delay values displayed in this report correspond only to the ATFM delays.

The contribution of the ATFM delays to the overall delay remains around 27% during the last 4 years, with an exception for 1999, due to the Kosovo operations.

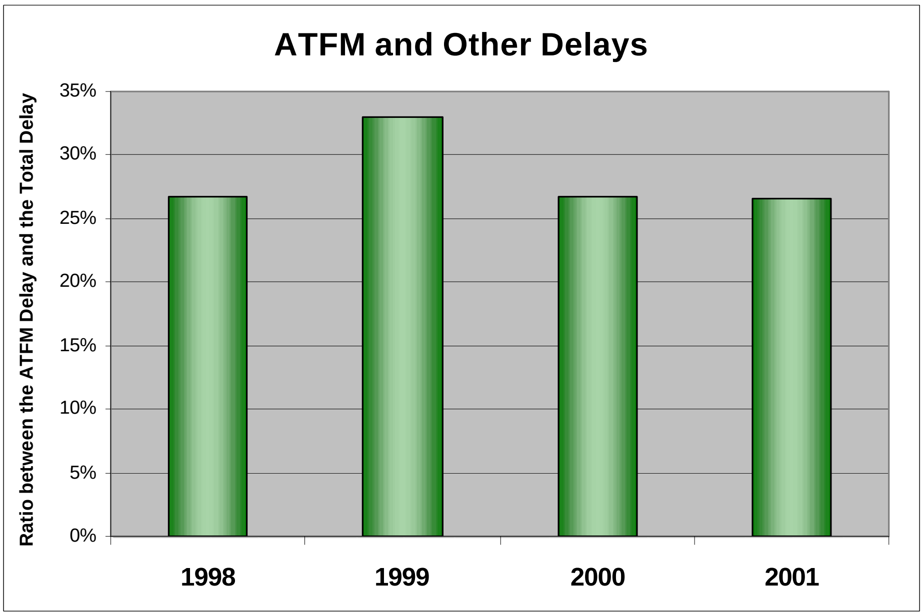


Figure 6

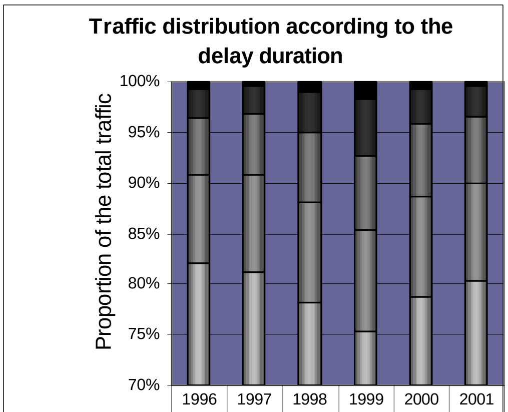
[8] *The evaluation of the overall delay is only done for flights with an ATC activation message for the departure of the flight.*
[9] *Reactionary delays correspond to delays imposed to a connecting flight awaiting the arrival of another one which is itself delayed.*

2.3 Distribution of the delay durations

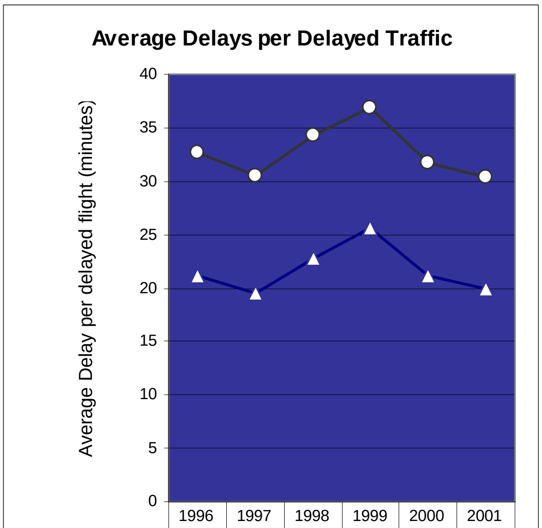
In the first chart of Figure 7, the flights delayed by ATFM regulations are grouped according to the duration of their delay. Five groups are displayed with their respective proportion.

During the Summer 2001 period, less than 20% of the flights are delayed, which is similar to the 1997 delayed traffic distribution. The traffic with a delay higher than 60 minutes corresponds to 0.5% in 2001 (*0.7% in 2001 and 1.4% in 1999*). It is important to mention though that, with a daily traffic of 24,669 flights, about 123 flights are delayed by more than one hour every day.

The second chart compares the average delay per delayed flight[10] and the average delay per highly delayed flight[11], where only flights with a delay higher than 15 minutes are considered.



	1996	1997	1998	1999	2000	2001
Delayed Traffic (more 60 min)	0.7%	0.5%	1.0%	1.7%	0.7%	0.5%
Delayed Traffic (31 to 60 min)	2.9%	2.8%	4.0%	5.6%	3.6%	3.0%
Delayed Traffic (16 to 30 min)	5.5%	5.9%	6.9%	7.4%	7.2%	6.6%
Delayed Traffic (less 15 min)	8.7%	9.6%	10.0%	9.9%	9.8%	9.6%
Undelayed Traffic	82.1%	81.3%	78.1%	75.4%	78.8%	80.3%



	1996	1997	1998	1999	2000	2001
All delayed Traffic	21	20	23	26	21	20
Delayed Traffic (>15 min)	33	30	34	37	32	30

Figure 7

[10] *The **average delay per delayed flight** is the total ATFM delay devided by the total number of delayed flights.*
[11] *The **average delay per highly delayed flight** is the sum of all delays higher than 15 minutes devided by the number of flights delayed by more than 15 minutes.*

2.4 Reasons of the ATFM regulations

The ATFM controller, when creating a regulation, introduces the reason, which made this regulation necessary. The amount of delay associated with each of these causes is displayed in the following figures.

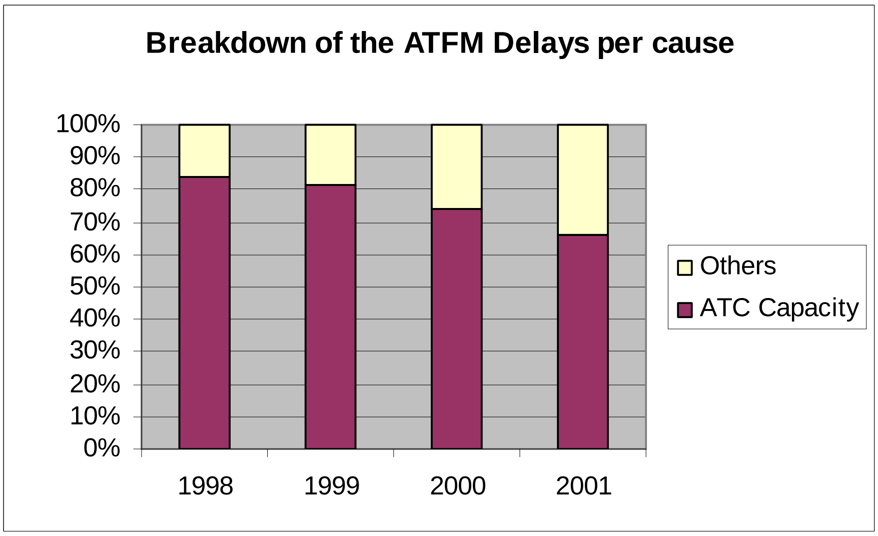


Figure 8

Figure 8 shows that the contribution of ATC capacity remains the main cause of ATFM delays but is continuously decreasing. Staffing issues[12] (En-Route) increased significantly in 2001 (see Figure 9), as well as the Aerodrome Capacity. The ATC capacity (Airport) is continuously decreasing since 1998.

The decrease of the contribution of En-Route ATC capacity in the ATFM delays is mainly observed in the 2 most congested FMPs, London (from 67% to 57%) and in Maastricht (from 98% to 86%). (*See annex).*

In both FMPs' delays, the contribution of En-Route ATC Staffing increased instead. In the other FMPs, the ATC capacity maintained the same contribution (*Zurich, Geneve*), or even increased (*Madrid, Reims, Bordeaux, Karlsruhe*,…).

The increase of the Aerodrome capacity contribution is mainly due to Athinai FMP.

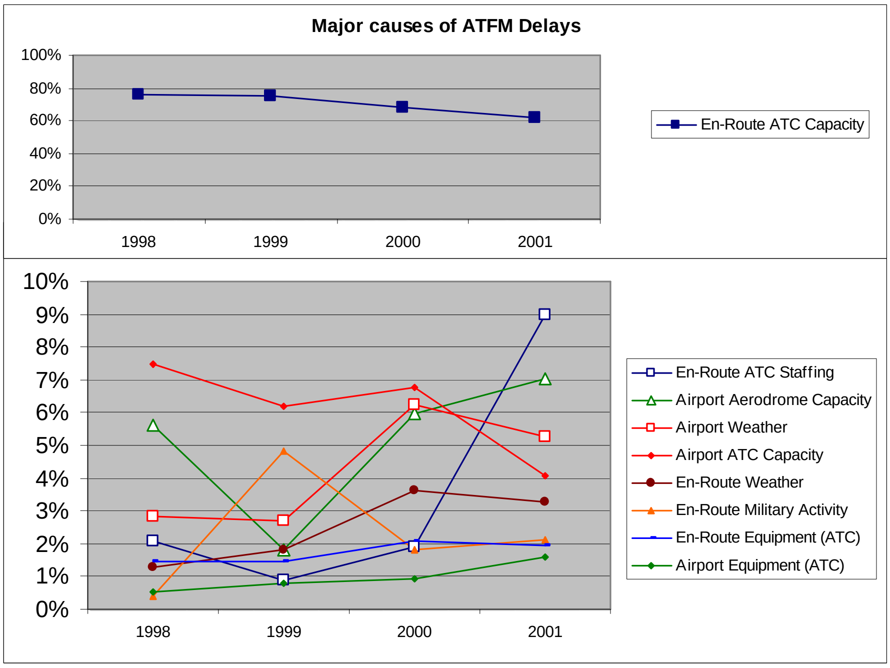
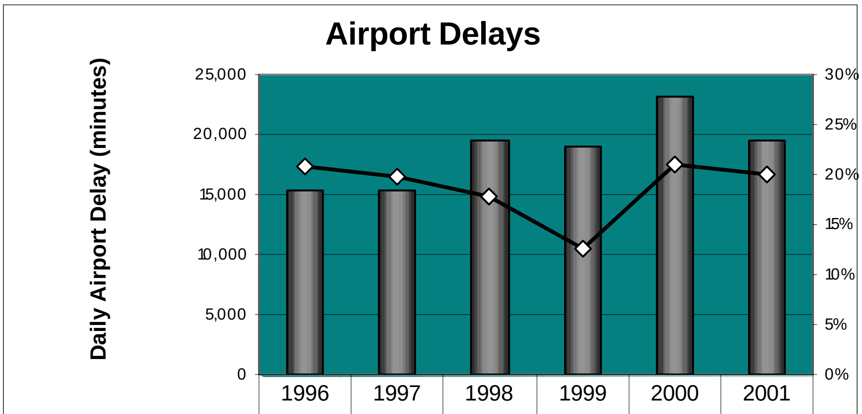


Figure 9

[12] *staffing issues corresponds only to accidental events in these diagrams, not to a systematic lack of staff which some ATSPs have to face and which is included here in the ATC capacity reason.*

2.5 En-Route and Airport delays

ATFM delays are caused by regulations protecting either Airports[13] or En-Route sectors. Figure 10 shows that the proportion between the Airport delay and the total delay remains between 18% and 21% during the last 6 summers (exception again in 1999 due to the dramatic En-Route delay increase following the Kosovo war).



	1996	1997	1998	1999	2000	2001
Daily Airport Delay	15256	15289	19533	18975	23222	19427
Proportion Airport Delay	21%	20%	18%	13%	21%	20%

Figure 10

[13] *A regulation is considered as associated to an airport when its Reference Location is an aerodrome or a set of aerodromes.*

2.6 Weekly Evolution of the ATFM indicators

Figure 11 shows the weekly evolution of the CFMU traffic between 1999 and 2001. The traffic shown is the average daily traffic for each week. The picture is of consistent growth year on year following the pattern set in previous years (some exceptions correspond to the unmatching of events such as Easter[14] or Whit Sunday[15]). Significant traffic increases at the end of the holiday period (starting early September, between the weeks 34 and 36) are observed during the 3 years.

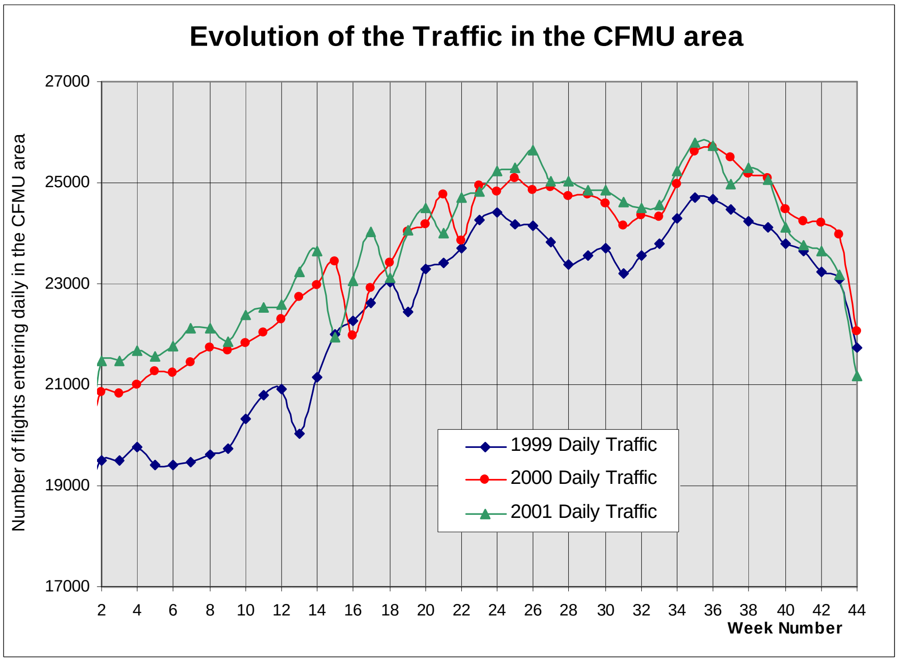


Figure 11

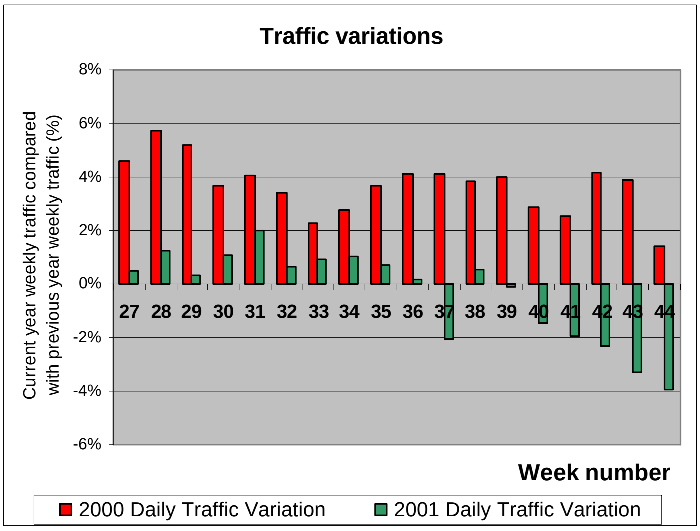


Figure 12

[14] *Easter = week 15 in 2001, week 16 in 2000 and week 13 in 1999.*
[15] *Whit Sunday = week 21 in 2001, week 22 in 2000, and week 19 in 1999.*

Traffic values are slightly higher during the whole period in Summer 2001. During week 37, with the tragic events of the 11th September, the traffic drops momentarily by 2% then resumes the previous year values during 2 weeks. In October 2001, a significant traffic decrease is observed, reaching –4% during week 44 which corresponds to the start of the winter period.

Figure 13 below shows the average delay per flight recorded by the CFMU.

During the first part of the period, the 2001 delays usually stay below the 2000 values. Peaks above the 2000 delays are associated to special events such as an industrial action by French Air Traffic Controllers (week 2001-12), or the implementation of the EAM04 route re-organisation in Germany (starting week 2001-16).

After Mid-June (week 23), the delays stay below the 2000 values, even in case of significant events such as the industrial action by bus drivers in Palma (week 2001-26).

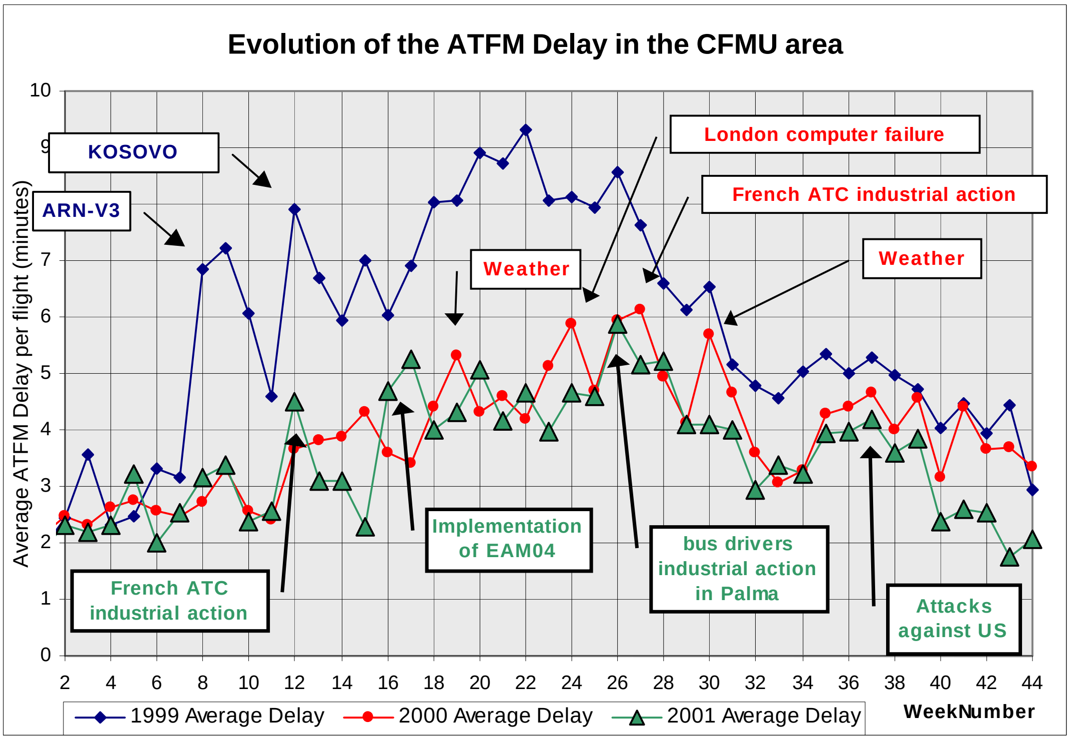


Figure 13

3 ATFM indicators per FMP

3.1 Delay Distribution

The regulations protecting ATC units in a specific Flow Management Position (FMP) area (including ATC sectors, TMAs, Airports) are grouped and the corresponding delays are combined.

Figure 14 displays the distribution of the delays for Summer 2001, according to the FMP areas. Only 15 FMPs, corresponding to the areas with the highest delays, are explicitly displayed. The other 50 FMPs are regrouped under the label "others".

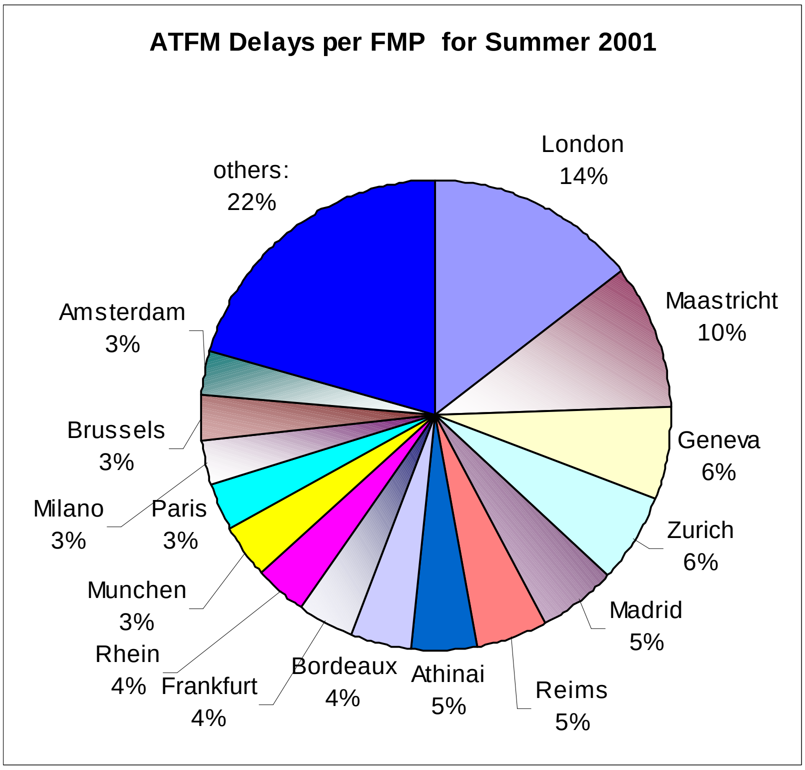


Figure 14

Three FMPs were in the list of the Top 15 FMPs for the Summer 2000 period, but do not show up anymore in 2001: Padova, Marseille and Barcelona. On the other hand, three FMPs appear this year: Bordeaux, Munchen and Brussels.

3.2 Traffic and Average Delay per flight

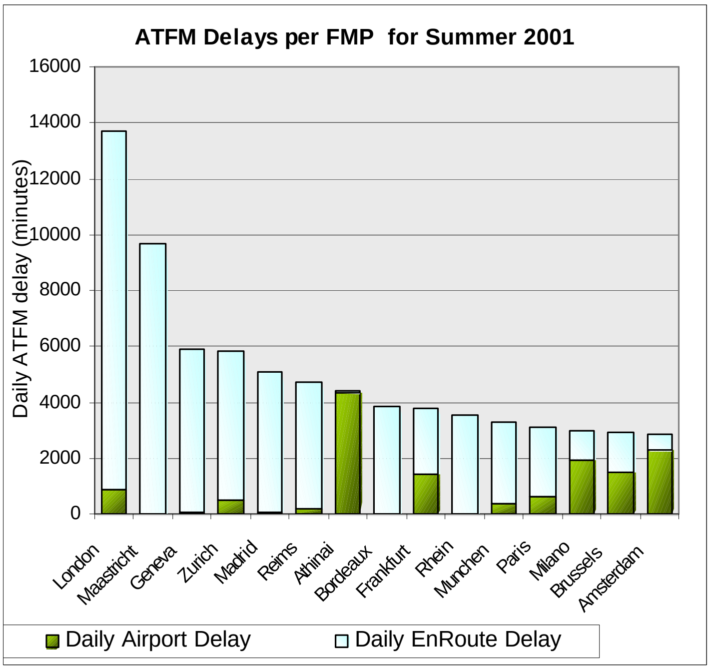


Figure 15

The daily ATFM delay of the 15 most congested FMP areas during the period are shown in Figure 15. The delay is significantly higher in London, followed by Maastricht, and then by Geneva and Zurich. Delay values are slowly decreasing for the following 11 FMPs, from 5.000 to 3.000 minutes of delay per day.

The contribution of the Airport delays is significant in Athinai (98%), Amsterdam (80%), Milano (64%) and Brussels (52%).

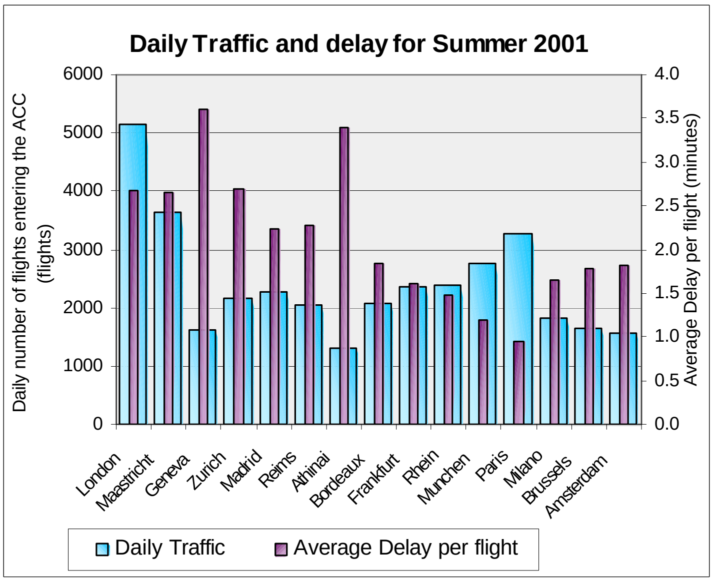


Figure 16

The delays are associated with the corresponding traffic in Figure 16. The resulting average delay per flight (i.e. the total ATFM delay divided by the number of flights entering in the FMP area) is also displayed.

London has the highest total delay, but with more than 5,000 flights per day, its average delay per flight is below 2.7 minutes. Maastricht and Zurich have similar values. An average delay higher than 3 minutes is observed in only two FMPs, namely Geneva (*3.6 min*) and Athinai (*3.4 min*).

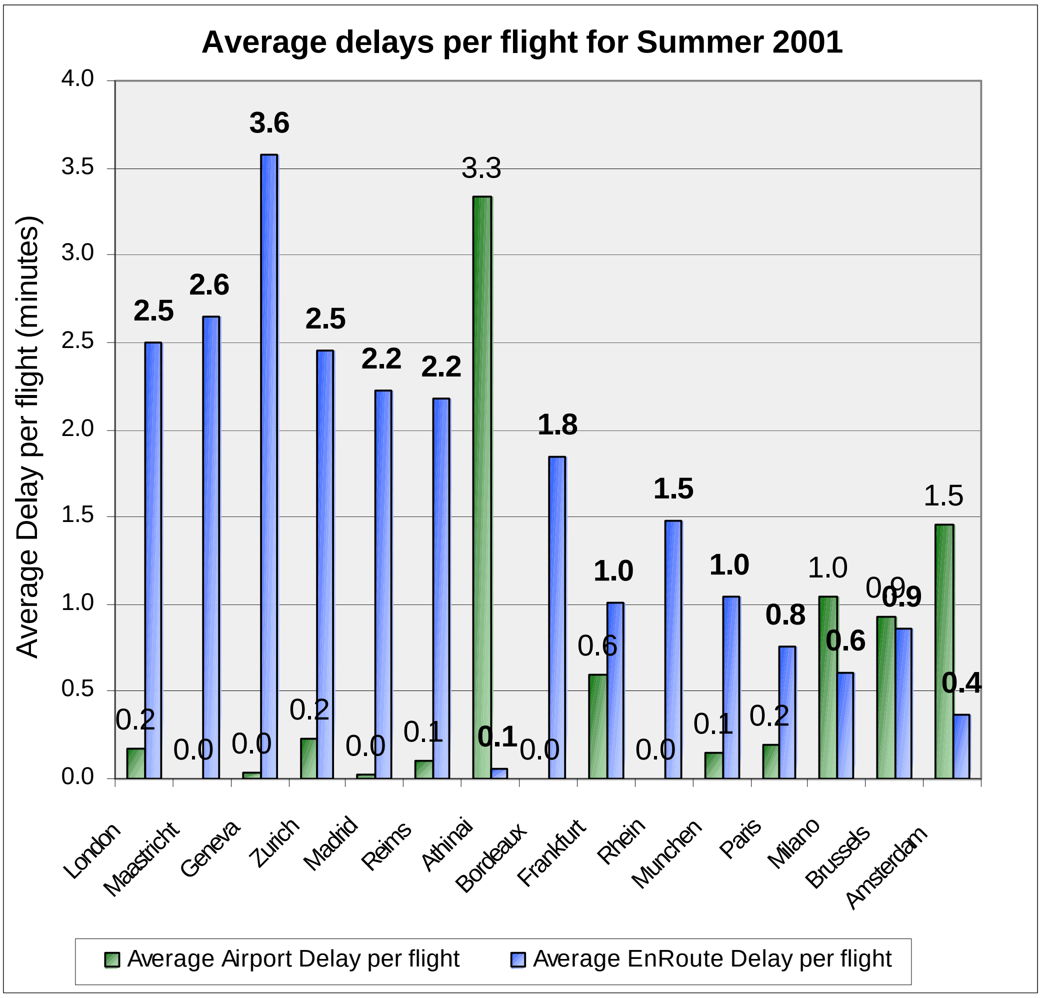


Figure 17

The contribution of En-Route and Airport regulations is shown in Figure 17. The average En-Route delay per flight displayed here corresponds to the average delays presented in the "ATFM Seasonal Summary per ACC[16] " reports.

The graph shows that Athinai and Amsterdam are mainly affected by Airport delays, that a combination of Airport and En-Route regulations are delaying Frankfurt , Milano and Brussels and that the other FMPs are delayed by En-Route regulations.

[16] *The ATFM Seasonal Summary per ACC is a CFMU report developed in support to the Directors of ATS Operations meetings.*

3.3 Delay and traffic variations per FMP

The evolution of the capacity in the FMP area can be represented by displaying the traffic variation (ΔT) and the delay variation (ΔD) between 2 successive years. A position below the (*DD = 5 x DT*) line[17] indicates that the capability of the relevant centre to cope with the demand improved. Figure 18 represents the traffic and delay variations of the 15 most congested FMPs between 2000 and 2001.

Figure 18 shows that several FMPs increased their capacity because their corresponding point is located below the reference line. The most significant improvement is observed in Madrid with 30% delay reduction and 3.5% traffic increase. Paris, Reims, Athinai and Zurich FMPs increased also their capacity. Inversely, deteriorations are observed in Brussels, Munchen, Maastricht and Bordeaux. With a delay variation of 204%, Brussels is not represented on the diagram; while doubling the ATFM delay, the traffic passing through this FMP area decreased by 2%. For the other centers, the relationship between the traffic and the delay variations show that the two summer periods have been equivalent. Despite the implementation of the EAM04 route re-organisation. no deteriation is observed in several German FMPs.

Although not included in the delaying FMPs during Summer 2001 and therefore not displayed, the improvements of Padova, Marseille and Barcelona need to be mentioned: the top score is for Padova with a traffic increase of 8% and a delay reduction of 85%; a very good score can be attributed also to Marseille with a delay reduction of 65% while absorbing almost the same traffic; the traffic and delay variations for Barcelona are very similar to the good results of Madrid and allow this FMP to be removed from the Top list.

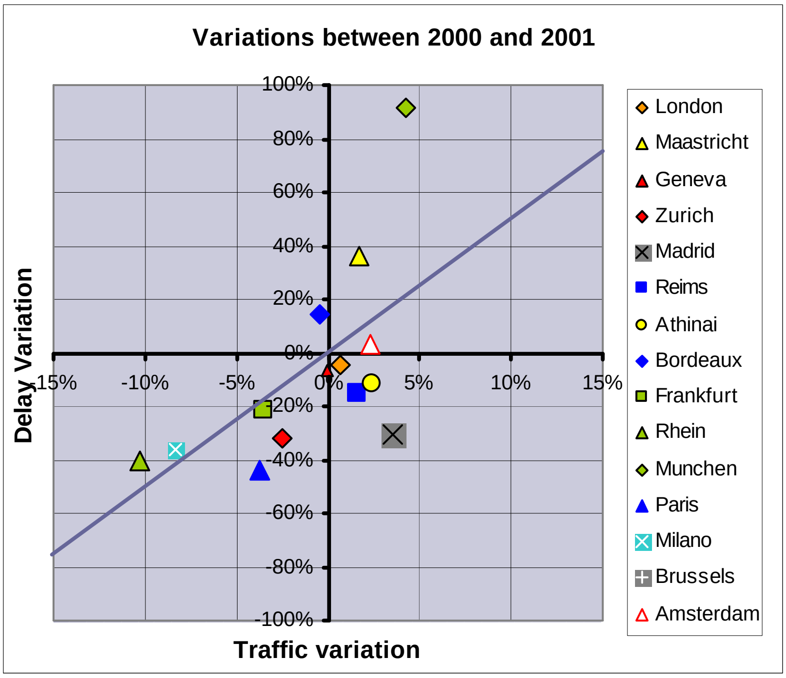


Figure 18

[17] *For 2000, the correlation between the daily Traffic and the Regular Delays can be represented by a power function of a factor 5: at constant capacity, a variation of 1% of the traffic is associated to a variation of 5% of the delay. In a diagram showing the Traffic and Delay Variations, this corresponds to a straight line passing by the origin and with a slope of 5.*

3.4 Geographical representations

The following maps display the average ATFM delay per flight and the traffic variation between 2000 and 2001 in the FMP areas.

The map displaying the average ATFM delay per flight in Figure 19 allows us to immediately spot the most congested areas: Geneva in the central region and Athinai in the South-East. Two years ago, 9 FMPs belonged to the group of most congested areas. This number dropped to 4 in 2000.

One of the reasons for this reduction is found in Figure 20: many areas had to absorb less traffic during Summer 2001 than last year. An overall decrease is observed in the Scandinavian countries and in the Southern part of the central region. The traffic increased significantly in a group of FMPs in the central part of Europe (Berlin, Warszawa, Praha and Bratislava), and to a minor extent in some of the Balkan countries. The important traffic increase in Brindisi is due to a transfer of sectors from Roma during the period.

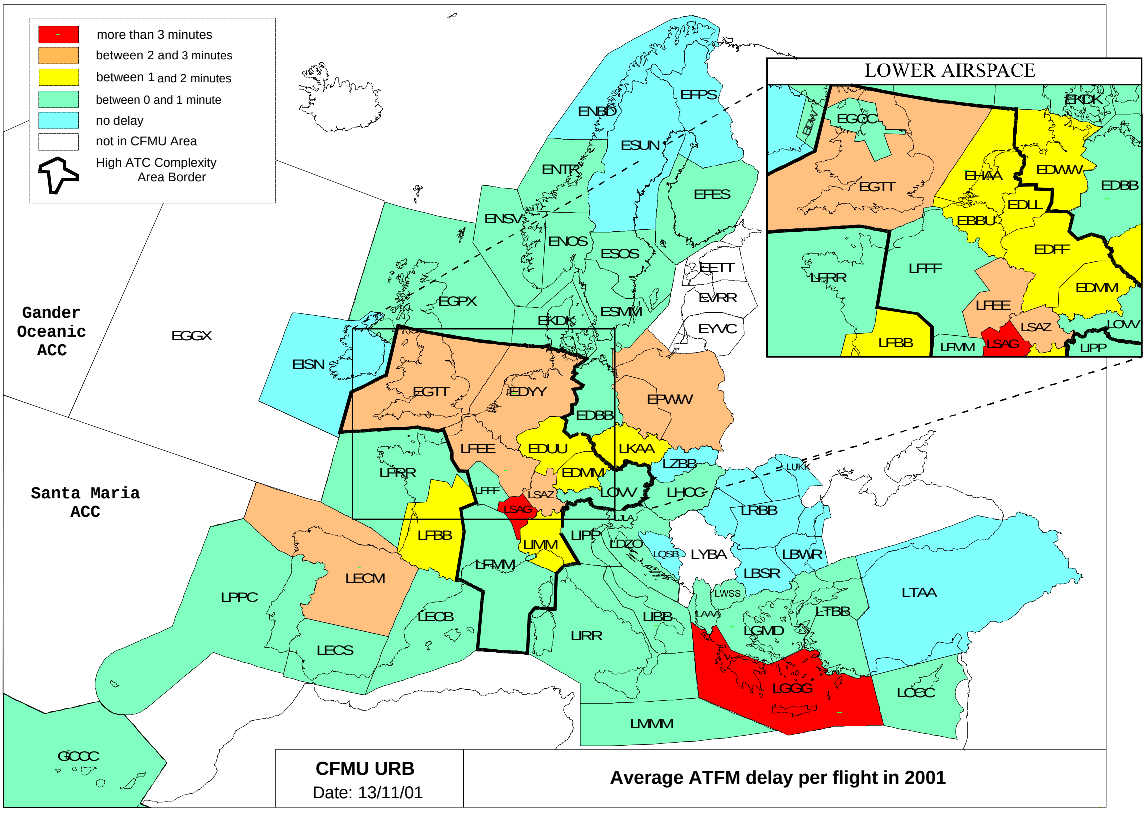


Figure 19

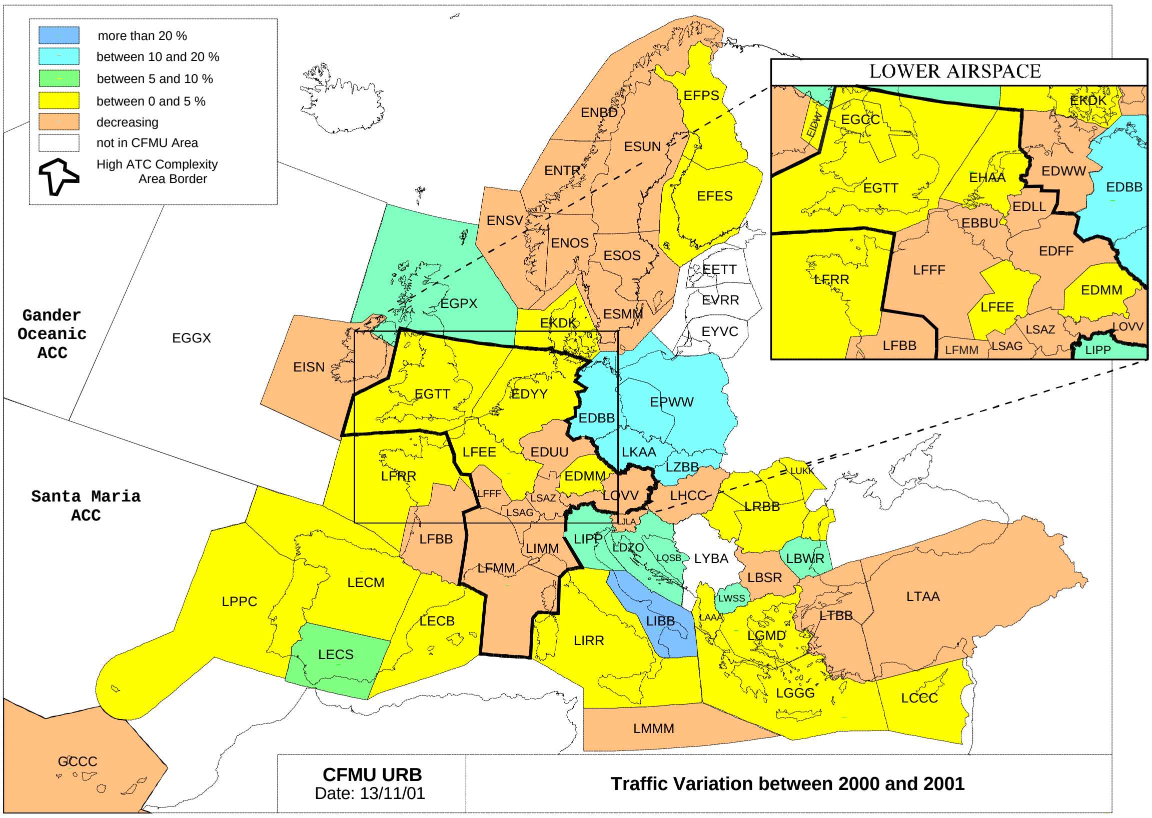


Figure 20

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4 ATFM indicators per ACC

4.1 En-Route Delay Distribution

The performance of an ACC can be monitored by considering only the En-Route delays of the corresponding FMP. The “ATFM Summary per ACC” reports have been especially developed to monitor the evolution of the En-Route delay and traffic associated to the most congested ACCs and to assess to which extent the performance targets are met. The following graphs are a synthesis of the ATFM Summary for the Summer 2001 period.

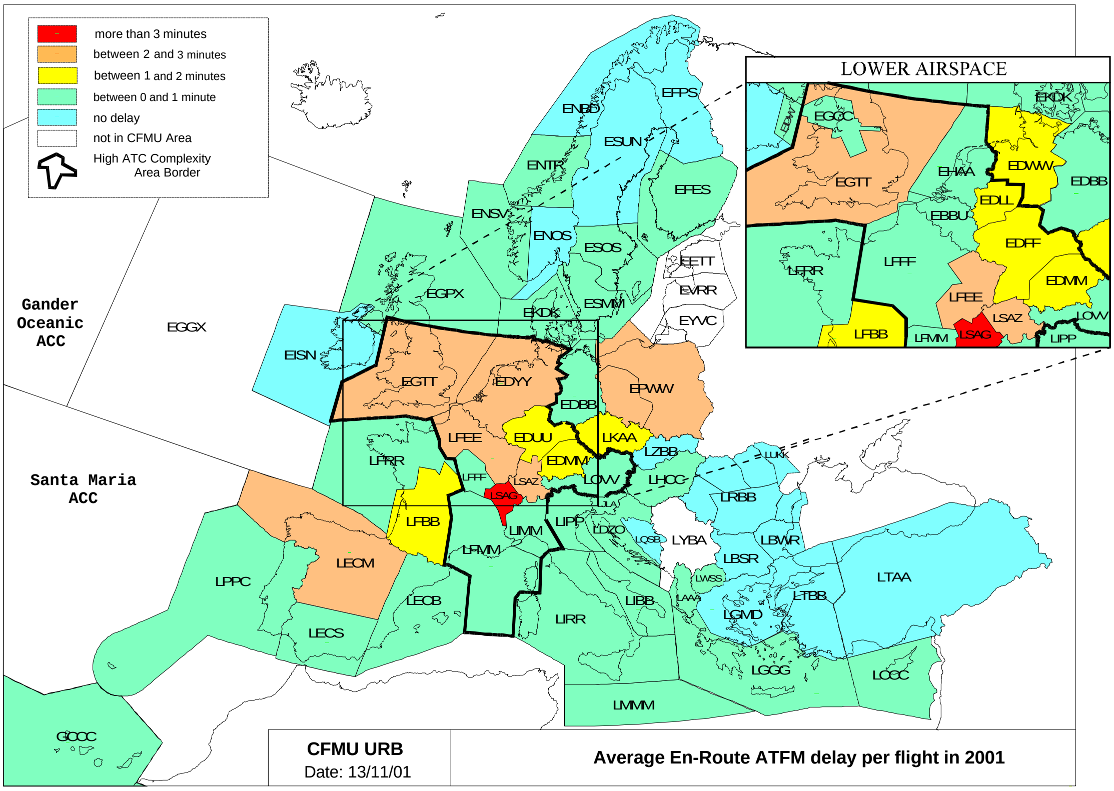


Figure 21

The most congested ACCs are quickly spotted on the map displaying the average En-Route ATFM delay per flight in Figure 21: Geneva is the only ACC with more than 3 minutes of En-Route delay per flight. There are 6 ACCs with more than 2 minutes: Maastricht, London, Zurich, Madrid, Reims and Warszawa. The delays associated to all other ACCs are lower than 2 minutes.

4.2 Actual Delays compared with targets

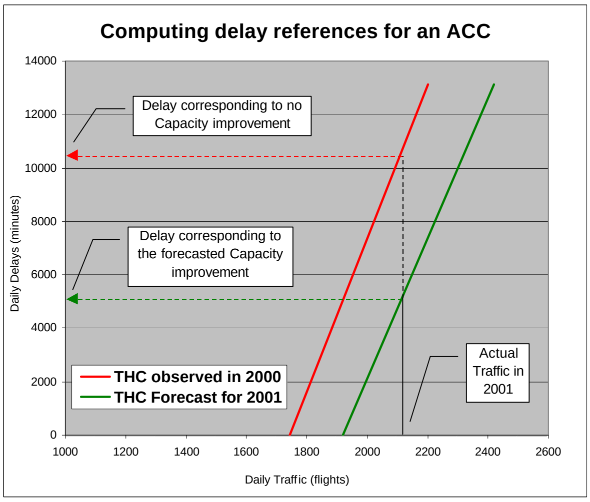


Figure 22

A difficulty to assess the actual delays and to compare them with the previous year's results is coming from the impact of the traffic on the performance. A solution is to use the **T**raffic **H**andling **C**apability[18] (**THC**) representing the behaviour of the ACC in 2000, as well as the Forecasted THC[19] which includes the capacity targets for 2001. The actual traffic observed in 2001 is then used with the two THCs, to determine what would have been the delays with the same capacity as in 2000, and with the capacity forecasted for 2001 (see Figure 22).

The En-Route ATFM delays of the 20 most congested ACC are compared with these two delay references, namely the delays "with forecasted capacity increase" and the delays "equivalent to the 2000 capacity" in Table 5 and in Figure 23 below:

Acc Name	Capacity Target	With forecasted capacity increase	Equivalent to 2000 Capacity	Actual EnRoute delay
Geneva	7%	3.0	3.7	3.6
Maastricht	5%	1.6	2.0	2.6
London	4%	2.0	2.5	2.5
Zurich	7%	2.1	2.8	2.5
Madrid	8%	2.5	3.3	2.2
Reims	6%	2.3	2.6	2.2
Warszawa	21%	0.7	1.4	2.1
Bordeaux	6%	1.1	1.4	1.8
Rhein	7%	1.3	1.7	1.5
Bremen	4%	0.0	0.0	1.4
Praha	7%	0.7	0.9	1.1
Dusseldorf	7%	0.2	0.4	1.1
Munchen	4%	0.4	0.4	1.0
Frankfurt	3%	0.5	0.7	1.0
Marseille	7%	1.4	1.9	0.9
Brussels	3%	0.2	0.2	0.9
Paris	4%	0.9	1.0	0.8
Milano	3%	1.0	1.2	0.6
Brest	5%	0.3	0.6	0.6
Barcelona	8%	0.9	1.0	0.6

Table 5

[18] *The relationship between the traffic entering an ACC airspace and the En-Route delay due to regulations protecting the ACC during the year can be represented by a linear correlation. This correlation provides a representation of the capability of the ACC to handle the traffic crossing its airspace during a specific year. This **T**raffic **H**andling **C**apability is also referred as the **THC.***

[19] *Starting from the correlation of 2000, it is possible to represent the relationship between the Traffic and the Delay for 2001 corresponding to a THC increase: at constant delay, the traffic increase equals the THC increase.*

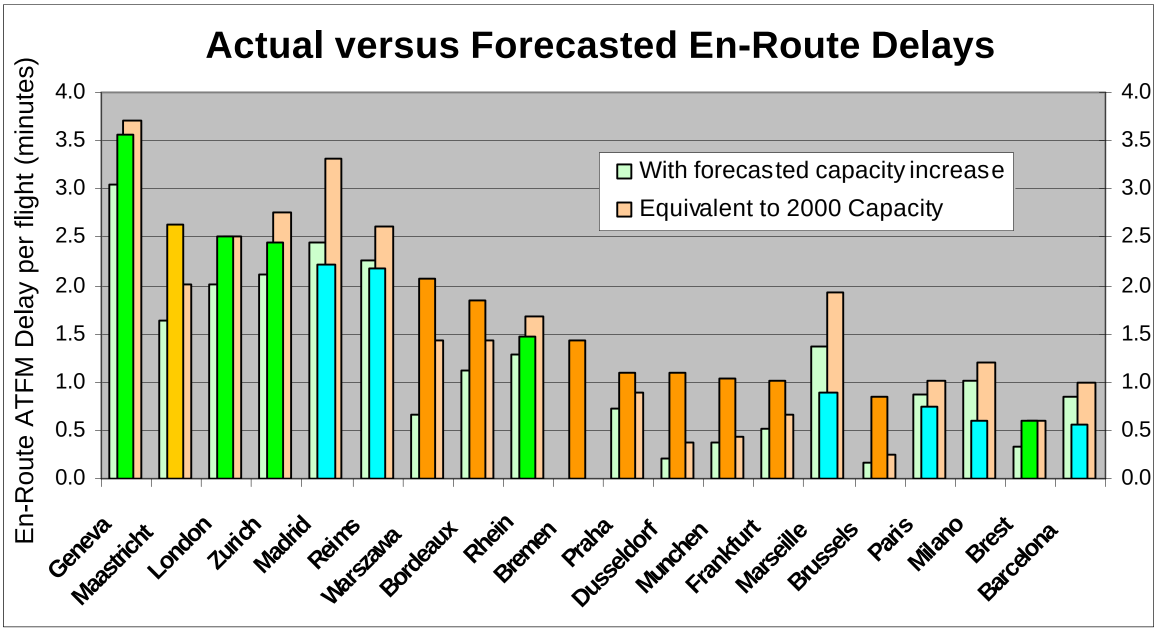


Figure 23

A color code is used showing when the 2001 delays are better than the forecasted improvement (*blue*), between the two delay references (*green*) or below the 2000 value (*amber*). Figure 23 confirms the good performance of the Spanish centers, some French centers (Reims, Marseille and Paris) and Milano. The Swiss centers, London, Rhein and Brest did not reach their targets but improved or maintained their 2000 performance. The delays in Maastricht, Brussels, Praha, Warszawa and the German ACCs correspond to a deterioration but is explained for the latter by the implementation of the EAM04 program.

4.3 Traffic variations

The delay references computed above are taking the actual traffic into account. It is nevertheless interesting to observe the traffic increases between 2000 and 2001: two centers, Warszawa and Praha, had to absorb a dramatic traffic increase explaining the delays observed in these ACCs. In the other ACCs, except Madrid and Munchen, the traffic decreased or remained constant.

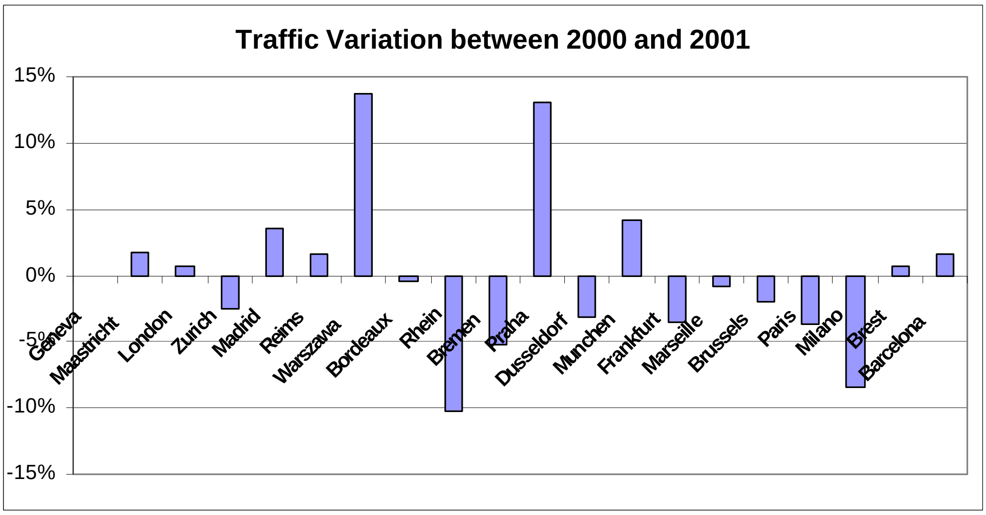


Figure 24

5 Week-End Operations

Significant differences in traffic and delays are observed between week-ends (Saturday and Sunday) and week days, as shown in Table 6 and Table 7: the average daily traffic during the week-end is only 83 % of the traffic during the week and the delay is 7% higher. These numbers show that the capability of ATC to handle week-end traffic is lower than during the week. Compared with the week, the week-end delays corresponds to a traffic 18% higher than the observed one[20]. This 18% is a measure of the ATC capacity reduction.

Average Traffic	Average Traffic (Week-End)	Average Traffic (Weekdays)	Ratio Week-End and Week Traffic
(flights)	(flights)	(flights)	(%)
24,669	21,542	25,901	83%

Table 6

Average Delays	Average Delays (Week-End)	Average Delays (Weekdays)	Ratio Average Delay[21]	Ratio Total Delay[22]
(minutes)	(minutes)	(minutes)	(%)	(%)
3.9	4.7	3.7	129%	107%

Table 7

The week-end deterioration is observed in Madrid, Marseille and Warszawa (in Marseille, delays are almost exclusively caused during the week-end).

In London, Bordeaux, Brest, Barcelona and Munchen, the delay increase is significant especially on Saturdays. In Brussels, the deterioration is visible on Sundays.

[20] *An estimation of the capacity reduction can be computed according to the observed elasticity factor of 5 between traffic and delay variations: a 7% delay increase should correspond, under a constant capacity, to a traffic increase of about 1.4%. The figures in Table 6 and Table 7 show that the week-end traffic is 17% lower instead. Hence a total capacity reduction of 18.4%.*

[21] *The* ***Ratio Average Delay*** *is the ratio between the week-end and week-days average delays.*

[22] *The* ***Ratio Total Delay*** *is the ratio between the week-end and week-days total delays.*

6 Special events during Summer 2001

Some special events had an impact on the ATFM delays at ECAC level during the Summer 2001 period (see 2.6 above), namely the implementation of EAM04 in the beginning of the period and an industrial action by bus drivers in Palma in June.

The CFMU Flow Management Division recorded the following events listed below:

6.1 Technical Problems

The following technical problems have been reported to the FMD and have necessitated the implementation of ATFM measures of significant importance:

- Radar Failures:
  - Duesseldorf and Berlin 24 May,
  - Warszawa 25 July
  - Maastricht 20 October
  - Brest 27 October
- Computer Failures:
  - Zurich 29 May
  - Milano 8 July
  - Zurich 5 August
  - Tampere 10 September
- Communications:
  - Bordeaux 15/16 May
  - Maastricht 1 June
  - Bordeaux 5 July
  - Maastricht 2 August (blocked frequency)
  - Santiago TMA 23 August
- FDPS:
  - Maastricht 22 August
- Power Failure:
  - London 13 June

Brussels ACC suffered from Radar processing problems throughout the period which resulted in a severe impact on ATFM delays

6.2 Staff Shortage/Staff problems

The following incidents of staff shortage or staffing problems caused significant delays:

- London 5 May (combined with r/t problems)
- Geneva 18 May, 25 July, 3 August and 16 September
- Rhein UAC 22 May and 25 July
- Barcelona 4 August

- Madrid 14 July, 4 August, 16 August and 8 September
- Marseille 16 September
- Manchester 2 September

London, Frankfurt, Duesseldorf, Munchen and Bremen ACC's and Maastricht UAC suffered from staff shortages throughout the period.

6.3 Industrial Action

Industrial action was experienced at the following locations which required the imposition of ATFM measures resulting in significant delays:

- Palma ACC 29 June – 1 July (industrial action by bus drivers)
- Italian ACC's 6 July

6.4 TACT Failures

The TACT system had some minor outages with minimal impact on ATFM operations. The failures occurred on Saturday 2 June, Friday 8 June, Wednesday 22 August, and Friday 12 October

6.5 Communications Problems

SITA problems on 13 August necessitated the requirement to file all messages via AFTN network. No significant impact has been detected either.

7 Most penalising locations

During Summer 2001, the CFMU protected 831 different locations (en-route sectors, airports), applying between 100 and 200 ATFM regulations per day, but a small number of these locations represents already a large proportion of the total ATFM delay.

7.1 Most penalising EnRoute sectors

The number of En-Route sectors contributing to a portion of the total En-Route delay is shown in Figure 25.

25 sectors caused more than 40% of the En-Route delays; these sectors are listed in the Table 8, together with their delay in relation to the total En-Route delay.

67% of the En-Route delays of these congested sectors are associated to the protection of elementary sectors.

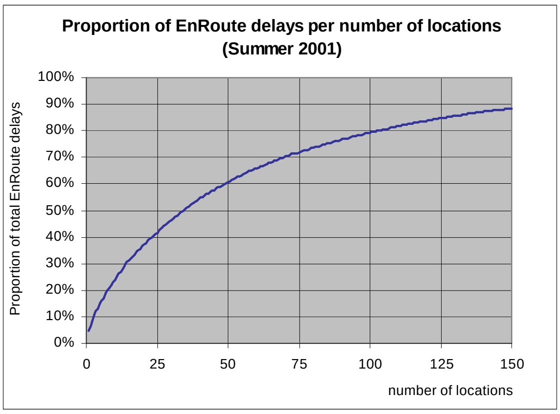


Figure 25

Reference Location	FMP	EnRoute Delay (minutes)	Collapsed or Elementary Sector	Upper or Lower Sector	Proportion EnRoute Delay	Cumulated Proportion EnRoute Delay
EBMAWSL	EDYYFMP	651727	Elementary	Upper	4.6%	4.6%
LSAZUP2	LSAZFMP	515751	Elementary	Upper	3.6%	8.2%
LSAGMS3	LSAGFMP	358039	Elementary	Upper	2.5%	10.7%
EBMALNL	EDYYFMP	337715	Elementary	Upper	2.4%	13.0%
EBMALUX	EDYYFMP	293128	Collapsed	Upper	2.1%	15.1%
EGTTS14	EGTTFMP	270327	Elementary	Lower	1.9%	17.0%
LSAZUP1	LSAZFMP	268421	Elementary	Upper	1.9%	18.9%
EDUUWUR	EDUUFMP	244933	Collapsed	Upper	1.7%	20.6%
LFEUE	LFEEFMP	240122	Collapsed	Upper	1.7%	22.3%
EGTT3C4	EGTTFMP	238473	Collapsed	Upper	1.7%	23.9%
EGTTS11	EGTTFMP	215349	Elementary	Upper	1.5%	25.4%
EBBULES	EBBUFMP	212044	Elementary	Lower	1.5%	26.9%
LFMNNR	LFMMAPP	198676	Elementary	Lower	1.4%	28.3%
EDUUFFM	EDUUFMP	196771	Collapsed	Upper	1.4%	29.7%
LSGMA45	LSAGFMP	187516	Collapsed	Upper	1.3%	31.0%
LECMZMR	LECMFMP	174634	Elementary	Both	1.2%	32.2%
MERUE	LFFFFMP	163981	Elementary	Both	1.1%	33.4%
LECMDGO	LECMFMP	161975	Elementary	Upper	1.1%	34.5%
LFEUY	LFEEFMP	157163	Elementary	Upper	1.1%	35.6%
EDLLCOL1	EDLLFMP	156529	Collapsed	Lower	1.1%	36.7%
EDWWO3R	EDWWFMP	149162	Collapsed	Lower	1.0%	37.8%
LSAGISE	LSAGFMP	148141	Collapsed	Lower	1.0%	38.8%
LFBUX2	LFBBFMP	142846	Elementary	Upper	1.0%	39.8%
LFEUHL	LFEEFMP	139222	Elementary	Upper	1.0%	40.8%
EDMMSR4	EDMMFMP	139021	Collapsed	Both	1.0%	41.7%

Table 8

The En-Route delays can also be distributed according to the levels of the protected sectors: in Summer 2001, **73%** of these delays were associated to Upper sectors (*above FL 245*), **19%** to Lower sectors, and the remaining **8%** to sectors extending from lower to upper levels.

7.2 Most penalising Airports

The number of airports contributing to a portion of the total Airport delay is shown in Figure 26. The slope is much steeper than in Figure 25.

25 airports caused 90% of the Airport delays; these airports are listed in the Table 9, together with their delay in relation to the total Airport delay.

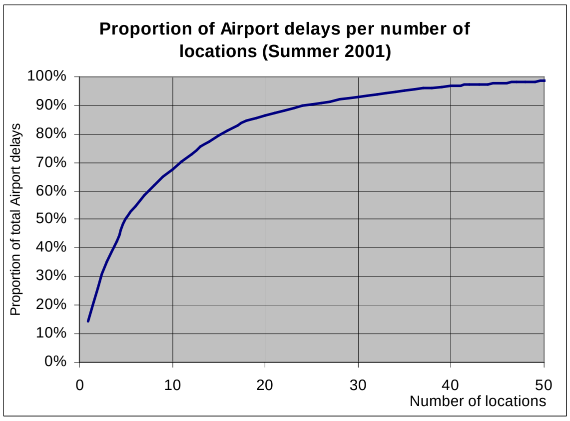


Figure 26

Airport Code	Airport Name	Airport Delay (minutes)	Proportion Airport Delay	Cumulated Proportion Airport Delay
LGAV	ATHINAI	512787	14.3%	14.3%
EHAM	AMSTERDAM/SCHIPHOL	418593	11.7%	26.1%
LIMC	MILANO/MALPENSA	330387	9.2%	35.3%
EDDF	FRANKFURT	259151	7.2%	42.5%
EBBRMB	BRUSSELS + MELSBROECK	279385	7.8%	50.4%
EGLL	LONDON/HEATHROW	146151	4.1%	54.5%
LGIR	NIKOS/KAZANTZAKIS	142058	4.0%	58.4%
LEBL	BARCELONA	125378	3.5%	61.9%
LIRQ	FIRENZE/PERETOLA	112414	3.1%	65.1%
LFPG	PARIS CH DE GAULLE	95944	2.7%	67.8%
EKCH	COPENHAGEN KASTRUP	94663	2.6%	70.4%
LSZH	ZURICH	93784	2.6%	73.0%
EPWA	WARSZAWA/OKECIE	84004	2.4%	75.4%
EDDM	MUENCHEN	72819	2.0%	77.4%
LOWW	WIEN SCHWECHAT	71564	2.0%	79.4%
LGRP	DIAGORAS	65301	1.8%	81.3%
LEPA	PALMA DE MALLORCA	61811	1.7%	83.0%
LIRF	ROME FIUMICINO	55728	1.6%	84.5%
LFSB	BALE/MULHOUSE	39392	1.1%	85.6%
LIPX	VERONA VILLAFRANCA	33536	0.9%	86.6%
LPFR	FARO	32938	0.9%	87.5%
LGTS	THESSALONIKI	29938	0.8%	88.3%
LIPSCTR1		26814	0.8%	89.1%
LGSR	SANTORINI	23805	0.7%	89.8%
ESSA	STOCKHOLM/ARLANDA	23116	0.6%	90.4%

Table 9

Annex 1: Reasons and Locations of the ATFM regulations

I.1 FMP affected by ATFM delay reasons

The ATFM delays can be broken down according to the reason of the regulations (see paragraph 2.4 above). Beside the "En-Route ATC Capacity", the main reasons are published in the next table.

Reason	2000 (minutes)	2001 (minutes)
En-Route ATC Capacity	13,740,920	10,969,092
En-Route ATC Staffing	386,759	1,598,398
Airport Aerodrome Capacity	1,214,788	1,250,705
Airport Weather	1,263,760	944,709
Airport ATC Capacity	1,372,816	725,848
En-Route Weather	739,577	580,883
En-Route Military Activity	365,854	380,577
En-Route Equipment (ATC)	423,060	341,613
Airport Equipment (ATC)	185,730	282,718
En-Route Other	107,109	196,837

The ATFM delays associated yearly to a special reason can be distributed in turn among the different affected FMPs, showing where a special reason has the most significant impact (*e.g. 37% of the 1,598,398 minutes associated to En-Route ATC Staffing in May-Oct 2001 occurred in London, 16% in Bremen, 14% in Frankfurt, …*).

This information is presented in the annex: **Reasons of the ATFM Regulations – FMP affected by ATFM Delay reasons.** Only the 5 most affected FMPs are displayed for each reason.

I.2 ATFM Delays per reason in the most congested FMP

The ATFM delays associated to an FMP can be broken down according to the special reasons, showing which are the most significant reasons causing the delays in each FMP (*e.g. 57% of the 2,512,775 minutes in LONDON during May-Oct 2001 were due to En-Route ATC Capacity, 24% due to En-Route ATC Staffing, 6% due to En-Route Weather, …).*

FMP	Delay in 2000 (minutes)	Delay in 2001 (minutes)
LONDON FMP	2,637,788	2,512,775
MAASTRICHT FMP	1,301,620	1,776,241
GENEVE FMP	1,154,718	1,079,903
ZURICH FMP	1,579,199	1,075,701
MADRID FMP	1,348,473	940,840
REIMS FMP	1,018,076	861,412
ATHINAI FMP	919,063	805,225
FRANKFURT FMP	892,233	700,394
BORDEAUX FMP	579,104	659,976
KARLSRUHE FMP	1,087,568	649,444

This information is presented in the annex: **Reasons of the ATFM Regulations – ATFM Delays per reason in the most congested FMP.** Only the 5 most affecting reasons are displayed.

EUROCONTROL

Reasons of the ATFM Regulations

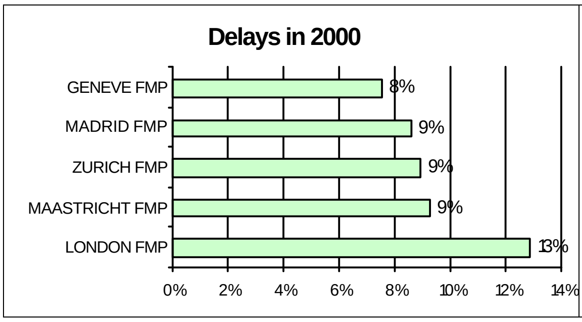
CFMU Statistics

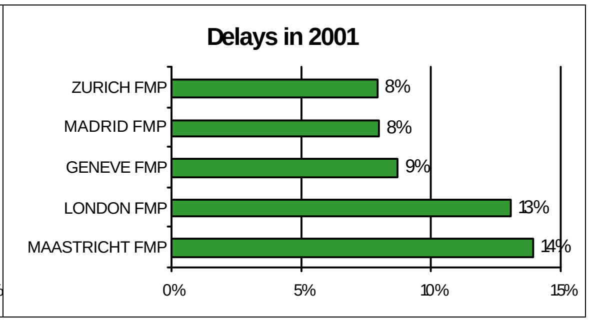
FMP affected by ATFM Delay reasons

Period between May And October

En-Route ATC Capacity

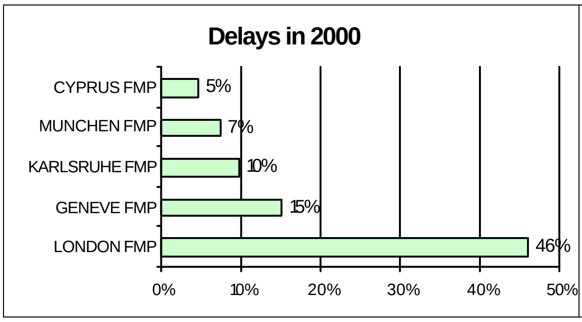
ATFM Delays in 2000: 13,740,920 **minutes and in 2001:** 10,969,092 **minutes**

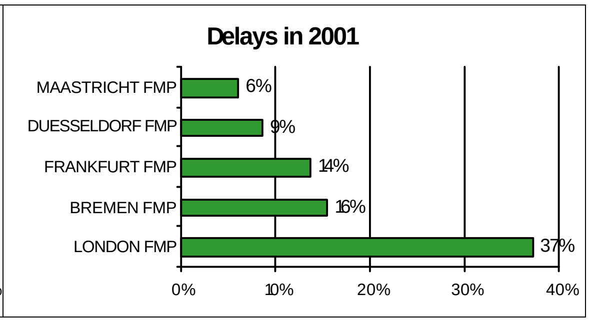




En-Route ATC Staffing

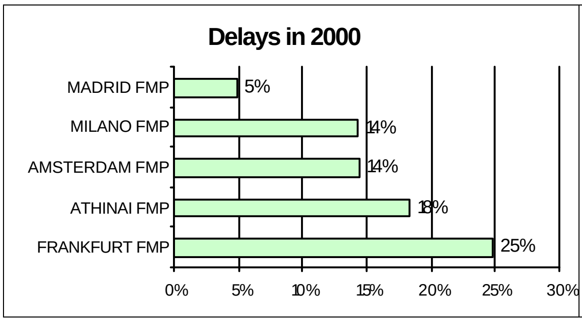
ATFM Delays in 2000: 386,759 **minutes and in 2001:** 1,598,398 **minutes**

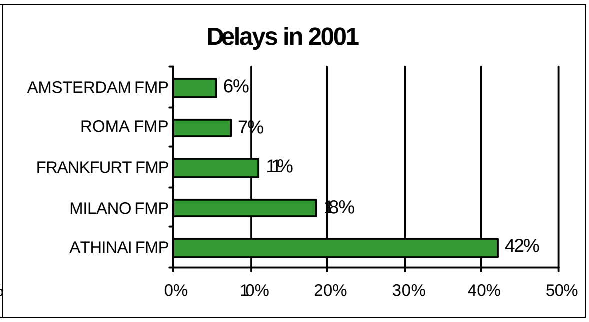




Airport Aerodrome Cap

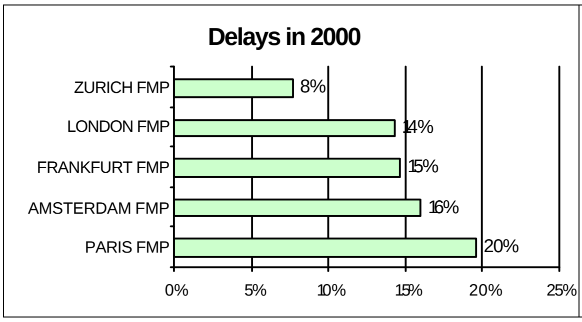
ATFM Delays in 2000: 1,214,788 **minutes and in 2001:** 1,250,705 **minutes**

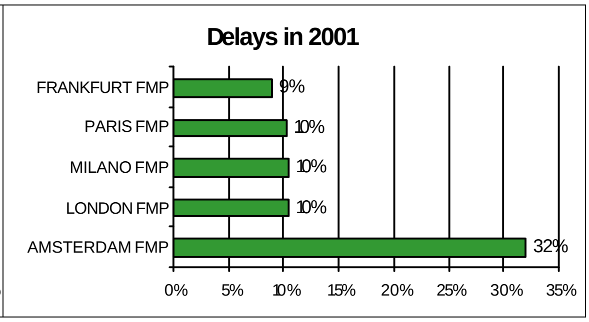




Airport Weather

ATFM Delays in 2000: 1,263,760 **minutes and in 2001:** 944,709 **minutes**





EUROCONTROL

Reasons of the ATFM Regulations

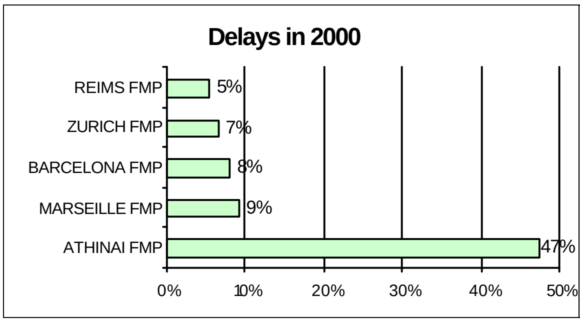
C F M U
Statistics

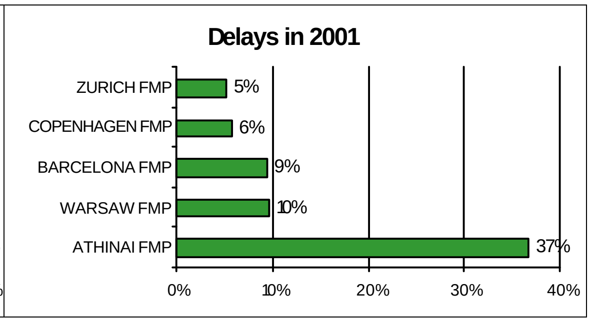
FMP affected by ATFM Delay reasons

Period between May And October

Airport ATC Capacity

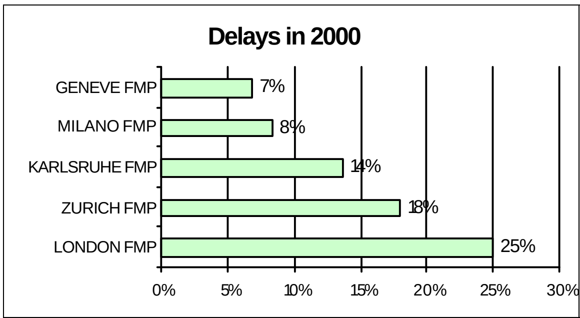
ATFM Delays in 2000: 1,372,816 minutes and in 2001: 725,848 minutes

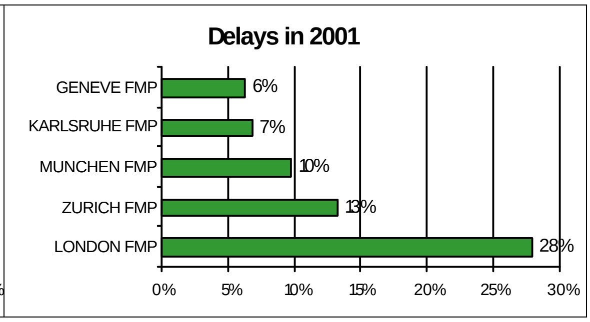




En-Route Weather

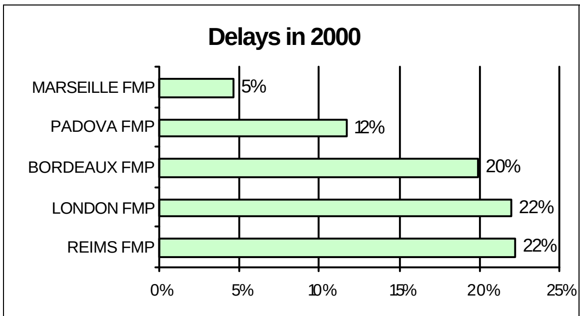
ATFM Delays in 2000: 739,577 minutes and in 2001: 580,883 minutes

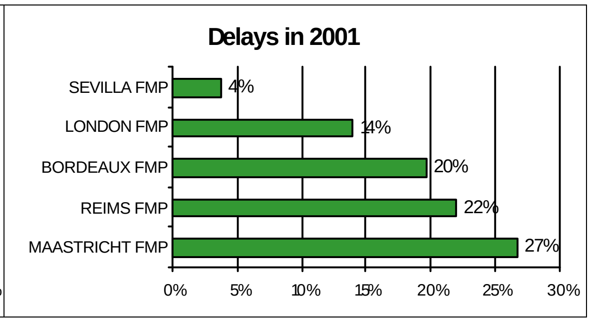




En-Route Military Activi

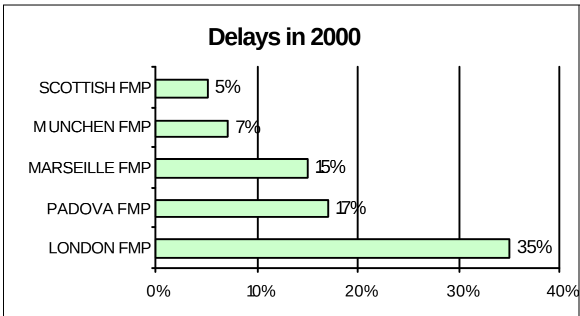
ATFM Delays in 2000: 365,854 minutes and in 2001: 380,577 minutes

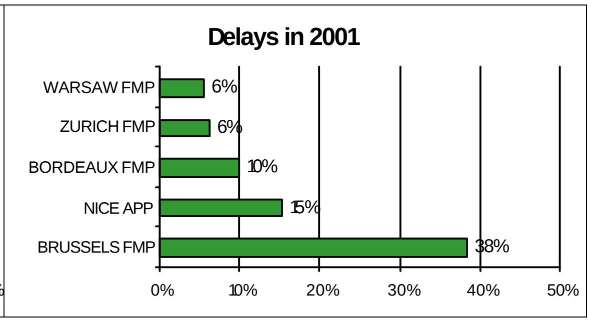




En-Route Equipment (A

ATFM Delays in 2000: 423,060 minutes and in 2001: 341,613 minutes





Reasons of the ATFM Regulations

EUROCONTROL

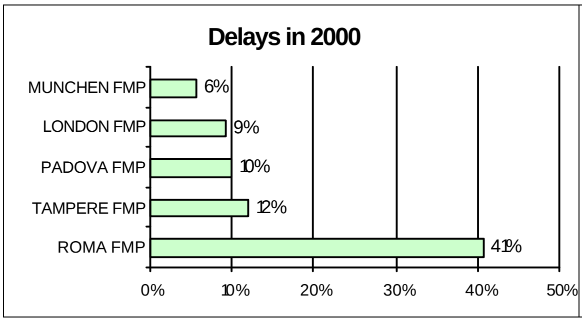
C F M U
Statistics

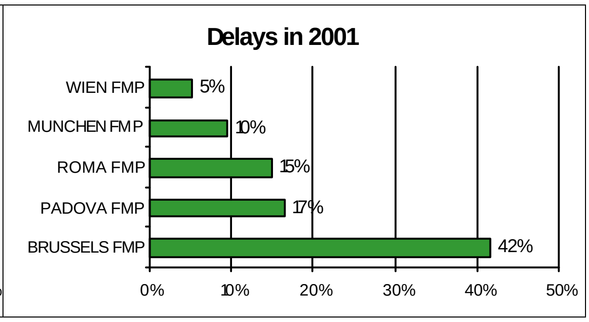
FMP affected by ATFM Delay reasons

Period between May And October

Airport Equipment (AT

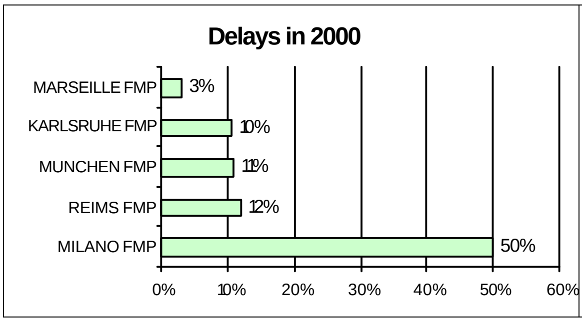
ATFM Delays in 2000: 185,730 **minutes and in 2001:** 282,718 **minutes**

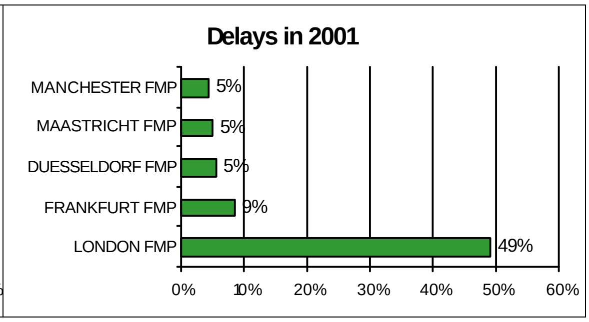




En-Route Other

ATFM Delays in 2000: 107,109 **minutes and in 2001:** 196,837 **minutes**





EUROCONTROL

C F M U Statistics

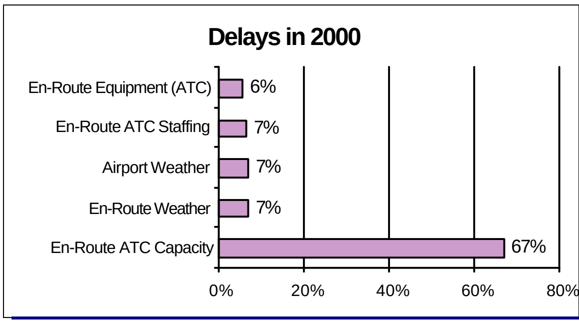
Reasons of the ATFM Regulations

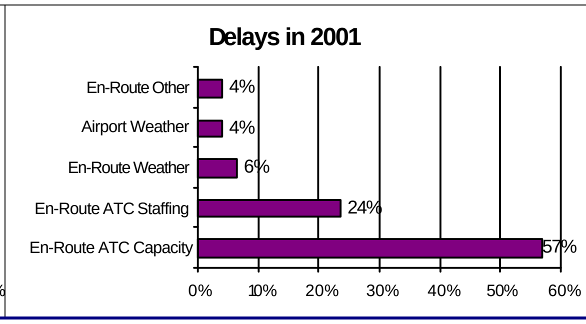
ATFM Delays per reason in the most congested FMP

Period between May And October

LONDON FMP

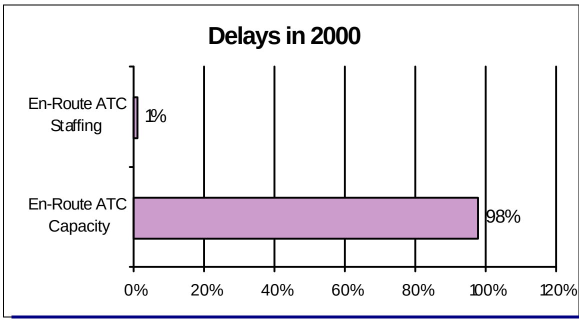
ATFM Delays in 2000: 2,637,788 and in 2001: 2,512,775

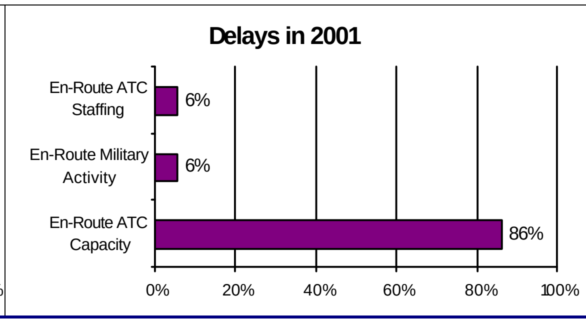




MAASTRICHT FMP

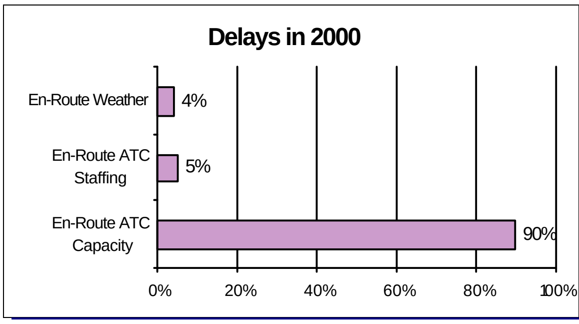
ATFM Delays in 2000: 1,301,620 and in 2001: 1,776,241

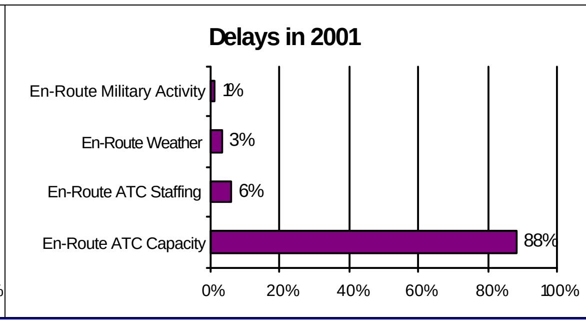




GENEVE FMP

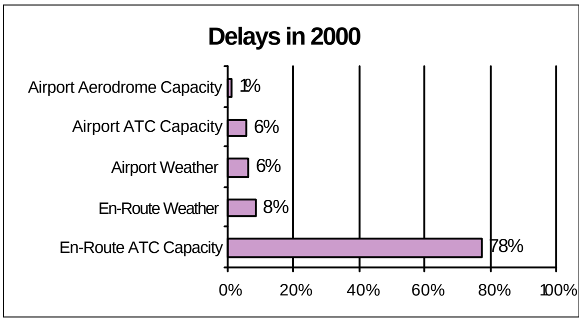
ATFM Delays in 2000: 1,154,718 and in 2001: 1,079,903

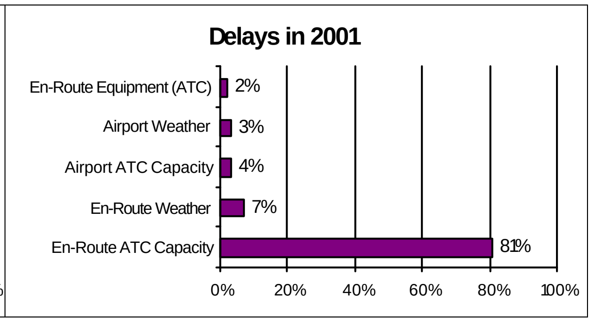




ZURICH FMP

ATFM Delays in 2000: 1,579,199 and in 2001: 1,075,701





EUROCONTROL

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Statistics

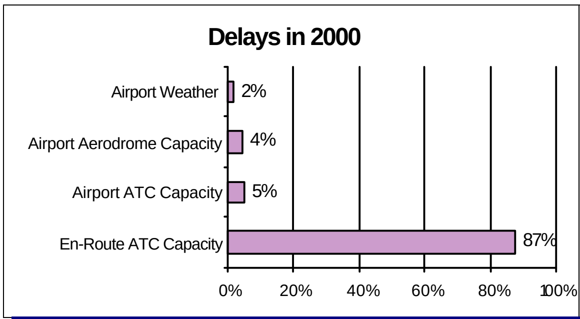
Reasons of the ATFM Regulations

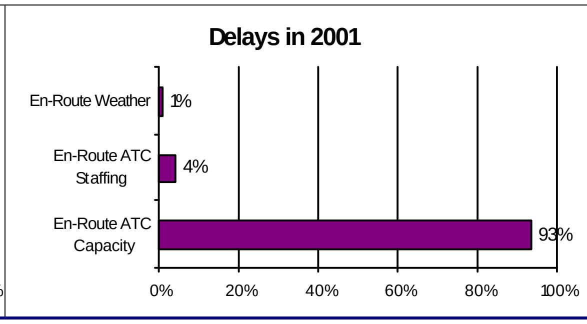
ATFM Delays per reason in the most congested FMP

Period between May And October

MADRID FMP

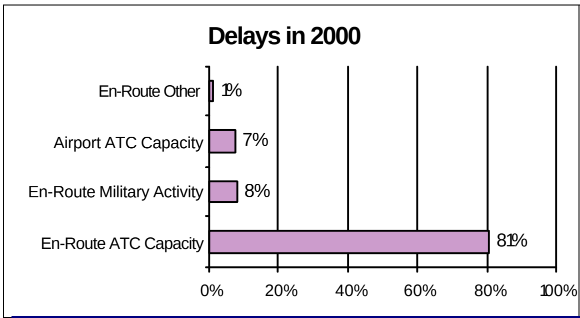
ATFM Delays in 2000: 1,348,473 and in 2001: 940,840

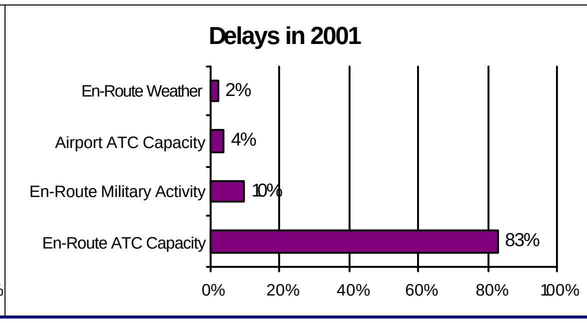




REIMS FMP

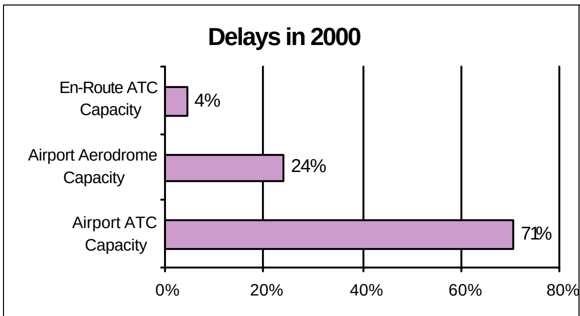
ATFM Delays in 2000: 1,018,076 and in 2001: 861,412

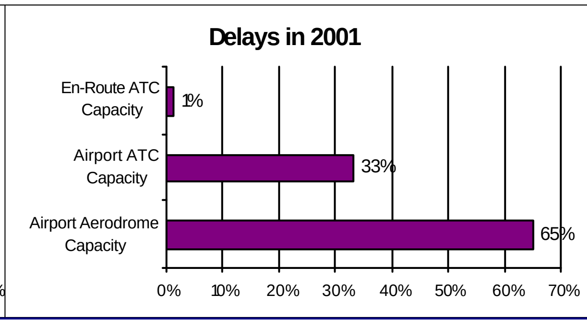




ATHINAI FMP

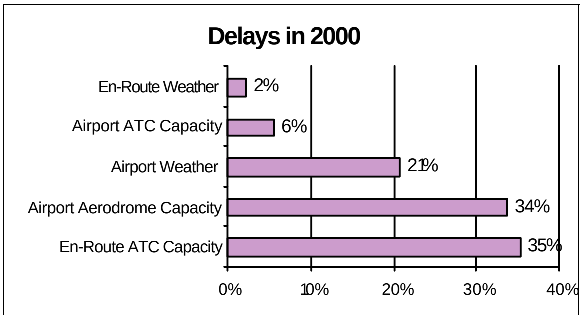
ATFM Delays in 2000: 919,063 and in 2001: 805,225

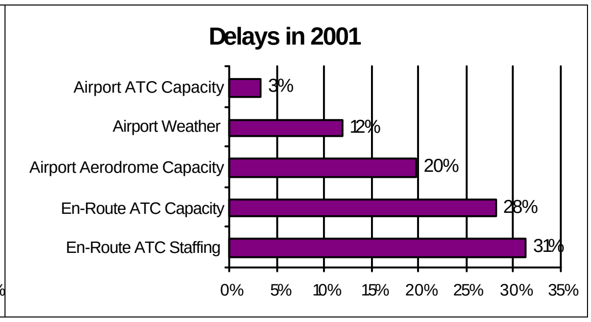




FRANKFURT FMP

ATFM Delays in 2000: 892,233 and in 2001: 700,394





EUROCONTROL

Reasons of the ATFM Regulations

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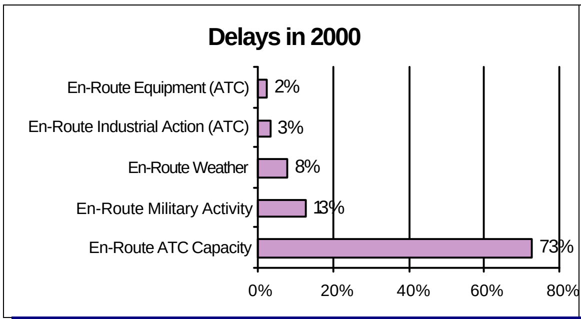
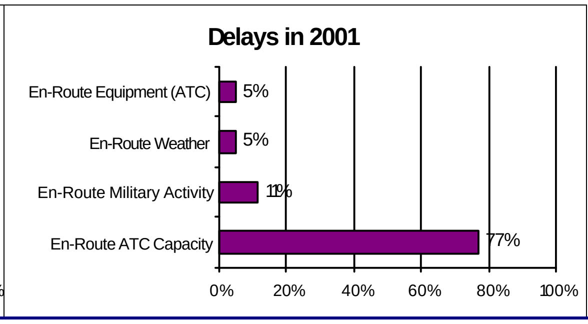
ATFM Delays per reason in the most congested FMP

Period between May And October

BORDEAUX FMP

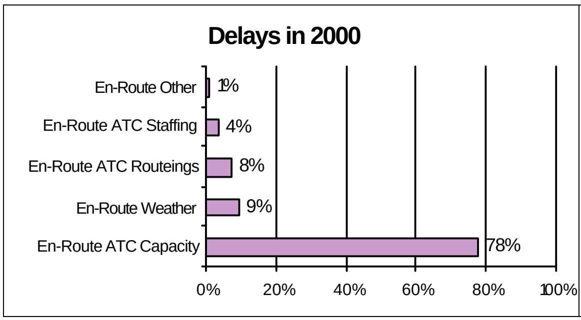
ATFM Delays in 2000: 579,104 and in 2001: 659,976

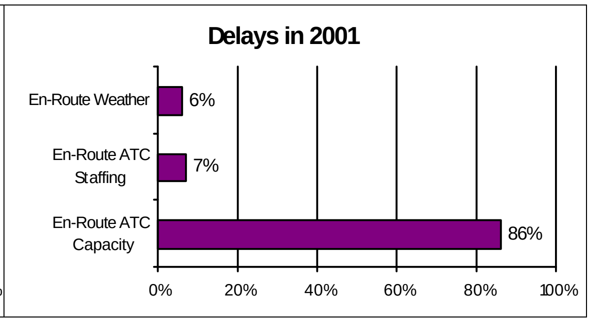




KARLSRUHE FMP

ATFM Delays in 2000: 1,087,568 and in 2001: 649,444





ATFM Summary – Summer 2001

ACC Code	ACC Name	Daily Traffic (flights)	Daily Delayed Traffic (flights)	Daily Delay (minutes)	Daily Airport Delay (minutes)	Daily EnRoute Delay (minutes)	Average Delay per flight (minutes)	Average Airport Delay per flight	Average EnRoute Delay per flight	Traffic Variation (from 2000)	Delay Variation (from 2000)	Traffic Variation (from 1999)	Delay Variation (from 1999)
EBBU	Brussels	1640	137	2920	1514	1406	1.8	0.9	0.9	-2%	204%	-1%	188%
EDBB	Berlin	1681	2	57	0	57	0.0	0.0	0.0	15%	-73%	18%	-76%
EDFF	Frankfurt	2366	195	3806	1408	2398	1.6	0.6	1.0	-4%	-22%	-1%	-9%
EDLL	Dusseldorf	1550	73	1750	61	1690	1.1	0.0	1.1	-3%	103%	0%	146%
EDMM	Munchen	2752	188	3273	396	2877	1.2	0.1	1.0	4%	92%	18%	866%
EDUU	Rhein	2379	199	3530	0	3530	1.5	0.0	1.5	-10%	-40%	1%	-33%
EDWW	Bremen	1083	71	1642	87	1555	1.5	0.1	1.4	-5%	316%	4%	879%
EDYY	Maastricht	3648	520	9654	0	9654	2.6	0.0	2.6	2%	36%	6%	42%
EFES	Tampere	521	2	52	8	44	0.1	0.0	0.1	0%	-60%	-2%	-80%
EFPS	Rovaniemi	80								3%	0%	0%	0%
EGCC	Manchester	1324	36	476	55	421	0.4	0.0	0.3	4%	252%	23%	218%
EGPX	Scottish	1535	26	367	2	365	0.2	0.0	0.2	6%	-16%	0%	304%
EGTT	London	5148	688	13728	885	12843	2.7	0.2	2.5	1%	-4%	5%	21%
EHAA	Amsterdam	1566	108	2841	2275	566	1.8	1.5	0.4	2%	3%	7%	224%
EIDW	Dublin	561	2	42	36	6	0.1	0.1	0.0	3%	-53%	10%	-49%
EISN	Shannon	875								0%		2%	
EKDK	Kobenhavn	1349	42	531	514	16	0.4	0.4	0.0	2%	376%	3%	240%
ENBD	Bodo	319								-1%		1%	
ENOS	Oslo	736	5	86	86	0	0.1	0.1	0.0	-3%	52%	-13%	-92%
ENSV	Stavanger	360	0	10	0	10	0.0	0.0	0.0	-4%	-84%	-18%	-95%
ENTR	Trondheim	278	0	2	0	2	0.0	0.0	0.0	-2%	0%	-5%	0%
EPWW	Warszawa	851	113	2214	457	1757	2.6	0.5	2.1	14%	176%	15%	32%
ESMM	Malmo	1266	0	3	0	3	0.0	0.0	0.0	-2%	230%	0%	-95%
ESOS	Stockholm	1092	5	129	126	3	0.1	0.1	0.0	0%	37%	0%	350%
ESUN	Sundsvall	221								-1%	0%	-10%	0%
GCCC	Canarias	666	6	110	55	54	0.2	0.1	0.1	0%	-14%	2%	-88%
LAAA	Tirana	307	8	242	0	242	0.8	0.0	0.8	0%	0%	0%	0%
LBSR	Sofia	632								-1%	0%	-26%	0%
LBWR	Varna	454								9%	0%	-4%	0%
LCCC	Nicosia	643	24	530	0	530	0.8	0.0	0.8	1%	34%	11%	-18%
LDZO	Zagreb	632	2	51	0	51	0.1	0.0	0.1	5%	-49%	197%	245%

ATFM Summary – Summer 2001

ACC Code	ACC Name	Daily Traffic (flights)	Daily Delayed Traffic (flights)	Daily Delay (minutes)	Daily Airport Delay (minutes)	Daily EnRoute Delay (minutes)	Average Delay per flight (minutes)	Average Airport Delay per flight	Average EnRoute Delay per flight	Traffic Variation (from 2000)	Delay Variation (from 2000)	Traffic Variation (from 1999)	Delay Variation (from 1999)
LECB	Barcelona	1815	97	1721	713	1008	0.9	0.4	0.6	2%	-38%	9%	-79%
LECM	Madrid	2280	287	5116	42	5074	2.2	0.0	2.2	4%	-30%	13%	-16%
LECP	Palma	871	6	525	525	0	0.6	0.6	0.0	-2%	38%	2%	7%
LECS	Sevilla	833	12	263	24	239	0.3	0.0	0.3	6%	-32%	10%	-59%
LFBB	Bordeaux	2080	174	3833	6	3828	1.8	0.0	1.8	0%	15%	4%	185%
LFEE	Reims	2051	253	4682	215	4467	2.3	0.1	2.2	2%	-15%	2%	-56%
LFFF	Paris	3277	145	3093	631	2462	0.9	0.2	0.8	-4%	-44%	0%	-56%
LFMM	Marseille	2713	99	2433	0	2433	0.9	0.0	0.9	-1%	-65%	0%	-83%
LFRR	Brest	2185	57	1255	13	1242	0.6	0.0	0.6	1%	1%	7%	94%
LGGG	Athinai	1303	165	4415	4346	69	3.4	3.3	0.1	2%	-12%	11%	-37%
LGMD	Makedonia	655	7	176	176	0	0.3	0.3	0.0	0%	-72%	22%	-83%
LHCC	Budapest	1348	1	11	11	0	0.0	0.0	0.0	-1%	-96%	0%	-99%
LIBB	Brindisi	866	23	489	31	458	0.6	0.0	0.5	26%	-2%	19%	-45%
LIMM	Milano	1820	142	3004	1908	1096	1.7	1.0	0.6	-8%	-36%	-15%	-62%
LIPP	Padova	1581	39	887	429	458	0.6	0.3	0.3	8%	-86%	9%	-93%
LIRR	Roma	2422	62	1485	1032	453	0.6	0.4	0.2	3%	12%	13%	-42%
LJLA	Ljubjana	482	0	7	0	7	0.0	0.0	0.0	0%	0%	114%	-66%
LKAA	Praha	1071	73	1183	0	1183	1.1	0.0	1.1	13%	95%	12%	-67%
LMMM	Malta	182	0	0	0	0	0.0	0.0	0.0	-1%	0%	5%	-99%
LOVV	Wien	1593	23	391	389	2	0.2	0.2	0.0	-7%	118%	18%	4%
LPPC	Lisboa	899	23	555	180	375	0.6	0.2	0.4	3%	-1%	5%	-56%
LQSB	Sarajevo	64								9%	0%	-13%	0%
LRBB	Bucuresti	967								2%	0%	-27%	
LSAG	Geneva	1628	301	5870	56	5814	3.6	0.0	3.6	0%	-6%	3%	-30%
LSAZ	Zurich	2175	346	5847	510	5337	2.7	0.2	2.5	-3%	-32%	3%	-60%
LTAA	Ankara	845								-1%	0%	-1%	0%
LTBB	Istanbul	1092	0	1	1	0	0.0	0.0	0.0	-2%	279%	1%	463%
LUKK	Chisinau	32								-20%	0%	-41%	0%
LWSS	Skopje	366	1	9	0	9	0.0	0.0	0.0	9%	-84%	343%	0%
LZBB	Bratislava	661								15%		-9%	

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