

Quarterly reports of the E-AMDAR Quality Evaluation Centre on AMDAR data

2002-II

Report number 11 7 January, 2003

Period: 1 APRIL 2002 – 30 JUNE 2002

KNMI
Wilhelminalaan 10
NL-3732 GK De Bilt
The Netherlands

[BLANK]

Quarterly reports of the E-AMDAR Quality Evaluation Centre on AMDAR data

2002-II

Report number 11 07 January 2003

Period: 1 APRIL 2002 – 30 JUNE 2002

KNMI
Wilhelminalaan 10
NL-3732 GK De Bilt
The Netherlands

Contents

1)	Introduction	3
2)	Operational AMDAR units.....	3
3)	List of outstanding issues.....	3
4)	Monitoring results	4
	a) Data Availability.....	4
	b) Data coverage.....	4
	c) Data Timeliness.....	4
	d) Frequency of reporting AMDAR observations	5
	e) Data quality evaluation.....	5
	f) Results (tables).....	8
5)	Outstanding identified anomalies.	8
6)	Solutions and actions taken from the previous period.....	8
7)	Summary.....	9
8)	Special case studies.....	9
	a) Frequency distribution of the mean O–B differences	9
	b) Trends in the daily amount of observations	9
	c) Trends in the mean O–B differences.....	9
	d) The daily cycle and observation times.....	9
	e) Standard deviations of the OBS–MOD differences.	9

Tables

Table 1, List of operational AMDAR units	10	
Table 2, Quantity and Timeliness of AMDAR Reports	11	
Table 3, Description and number of errors.....	19	
Tables 4 to 6, Evaluation results	23	
	a) Table 4, <i>Temperature (°C)</i>	24
	b) Table 5, <i>Wind Speed (m/s)</i>	31
	c) Table 6, <i>Wind direction (deg)</i>	38

Annexes

Annex I. EU Amdar Observations from 28 – 30 May 2002.	45
Annex II. Frequency distribution of mean temperature, mean wind speed and wind direction differences.	47
Annex III. Trend in the daily amount of observations.	49
Annex IV. Trends in the mean O–B differences.	51
Annex V. The daily cycle and observation times.	53
Annex VI. Special case study: Standard deviations of the OBS–MOD differences.....	55

Report produced by the E-AMDAR Quality Evaluation Centre (KNMI, De Bilt, the Netherlands).
 This document is intended for internal circulation within the framework of the Eumetnet
 AMDAR Programme (E-AMDAR)

© Property rights: No part of this publication may be reproduced without the prior written
 permission of the Responsible Member for the Eumetnet Amdar Programme.

Identified manager for the production of this report:

Dr Jitze P. van der Meulen, KNMI
 Tel.: +31 30 2206432
 E-mail: meulenvd@knmi.nl

The appointed Technical Co-ordinator E-AMDAR Programme:

Stewart W Taylor
 Met Office
 +44 (0) 1344 855533
 E-mail: stewart.taylor@metoffice.com

Recipients of the report are the Participating National Meteorological Centres:

LIST OF E-AMDAR OPERATORS – Contact Details.

NAME/ADDRESS	AIRLINE	E-MAIL	TELEPHONE	FAX
Mr Hansjoerg BRUST Deutscher Wetterdienst Referat TI 22 Frankfurter Str. 135 63067 OFFENBACH AM MAIN GERMANY	Lufthansa	hansjoerg.brust@dwd.de	(+49) (0)69 8062 2286	(+49) (0)69 8062 5210
Mr F GROOTERS KNMI Observations & Modelling Department P.O.Box 201 NL-3730 AE DE BILT NETHERLANDS	KLM	Grooters@knmi.nl	(+31) (0)30 2206 691	(+31) (0)30 2210 407
Mr T HOVBERG SMHI SE-601 76 Norrköping SWEDEN	SAS	ture.hovberg@smhi.se	(+46) (0)11 495 8237	(+46) (0)11 495 8001
Jean-Louis GAUMET Meteo-France SETIM BP 202 78195 TRAPPES CEDEX FRANCE	Air France	jean-louis.gaumet@meteo.fr	(+33) (0)130 136470	(+33) (0)130 136468
Paul ARTHUR Met Office, Beaufort Park, Easthampstead, Wokingham Berkshire RG40 3DN ENGLAND	BA	paul.arthur@metoffice.com	(+44) (0)1344 855896	(+44) (0)1344 855897

1) Introduction

AMDAR offers the potential for a large increase in upper air wind and temperature data, observed for use as input for models. To improve the usefulness of these data, quality evaluation is essential in combination with appropriate impact studies. Today the E-AMDAR fleet will number approximately 528 assigned aircraft, 80% of which will fly predominantly European routes and the remainder long haul. All E-AMDAR data for evaluation will be made available on the GTS with in near real time performances. ***It should be noted that not all identified aircraft are fully operational at present*** (operational on July, 1st, 2002: 273).

The purpose of this report is to provide statistical information on the quality, quantity and availability of aircraft reports made available from all Participating Members. The information will be used for further impact studies and feed back to the E-AMDAR operators to improve the quality of the E-AMDAR observing system.

The Quality Evaluation Centre has monitored AMDAR reports received at KNMI since September 17th 1999. The aim of the monitoring process is to detect and identify any incorrectness or anomalies of the data or transmission within 24 hours and to instigate fault correction procedures. Such a process is vital for maintaining data quality and credibility at the required level. The monitoring of the observations covers data availability, receipt delays, reporting frequency and checks on the consistency and quality of the meteorological data.

The EUMETNET Council agreed in September 1998 that the Met Office would be the Responsible Member for the E-AMDAR Programme. The Programme Manager Mr Paul Arthur. The appointed Technical Co-ordinator, Mr Stewart Taylor, will ensure that any faults identified are investigated and rectified in a timely manner. All irregularities on E-AMDAR data will be reported to the Programme Manager.

Observations period: The coverage of the data used for the statistical analysis for AMDAR reporting aircraft is the period April 1st, 2002, 00:00 UTC to June 30st, 2002, 24:00 UTC (2002Q2).

2) Operational AMDAR units

Data from the 280 activated E-AMDAR units producing **FM 42-IX** or **BUFR AMDAR** code were received and analysed at KNMI HQ in De Bilt during the stated period. From 21 activated aircraft no data was received. Notice that a number of aircraft only report during the ascending and descending phases. For a list of reporting aircraft and their identifiers, see [table 1](#). In this table aircraft are indicated, which were activated or deactivated during this period.

3) List of outstanding issues

Code errors

In previous quarterly reports a number of issues concerning errors in the FM 42-IX AMDAR code bulletins were presented. During this quarter, both the standard error check routine and regular random checks did not find erroneous bulletins which is very remarkable with respect to many other WMO bulletins, disseminated through the GTS. Many of the previous coding errors have been corrected due to new quality checking routines implemented within the E-AMDAR Data Acquisition System (E-ADAS). This is the central processing system for AMDAR data before insertion to the GTS. More information on E-ADAS can be obtained from the E-AMDAR Technical Co-ordinator. Although the issue of code errors seems to be diminished to a highly acceptable minimum, the code checking of the received bulletins will be continued.

4) Monitoring results

a) Data Availability

AMDAR reports are received via the different collecting centres with ground based receiving stations and consequently through GTS. Some aircraft fly "long haul" routes and where no ground station coverage available, send AMDAR data via satellite communications systems. An overview for all aircraft involved is presented in [table 2](#). At the end of this table also a list of aircraft is presented for which more than one percent of the observations took more than two hours to arrive at the QEvC.

The total number of observations evaluated during the period is 1959516. The ten aircraft, which produced the highest number of observations, evaluated at QEvC, are presented in the following table:

no.	aircraft	amount
1	EU9245	17702
2	EU4607	16818
3	EU9234	16020
4	EU5167	15485
5	EU9158	15355
6	EU5529	14916
7	EU4582	14870
8	EU4573	14739
9	EU5478	14385
10	EU2389	14348

Special issues

- Although de-activated, observations were reported by the following 7 aircraft: EU0003, EU0034, EU0204, EU1495, EU2912, EU5182 and EU6723.

More details on availability issues are presented in [table 3](#).

b) Data coverage

Aircraft carrying the AMDAR units fly prominently within Europe. To get a brief impression of the EU AMDAR coverage of Europe and the Atlantic two figures are presented in [Annex I](#).

c) Data Timeliness

The delay between observation and reception at the GTS nodes should be small. During the period, 96.9% of all reports were received within one hour of observation time and 98.5% within 2 hours from observation. Overall, the data timeliness is very good. This is demonstrated by figure 1 below, where from the cumulative frequency distribution it follows that 50% of all recorded observations is received within 14 minutes. After distinguishing FM42 and BUFR encoded data it was found however that some sets of BUFR encode data are received within 30 minutes intervals causing an increase of the overall delay (typically median value for BUFR: 23 min, for FM42: 8 min.).

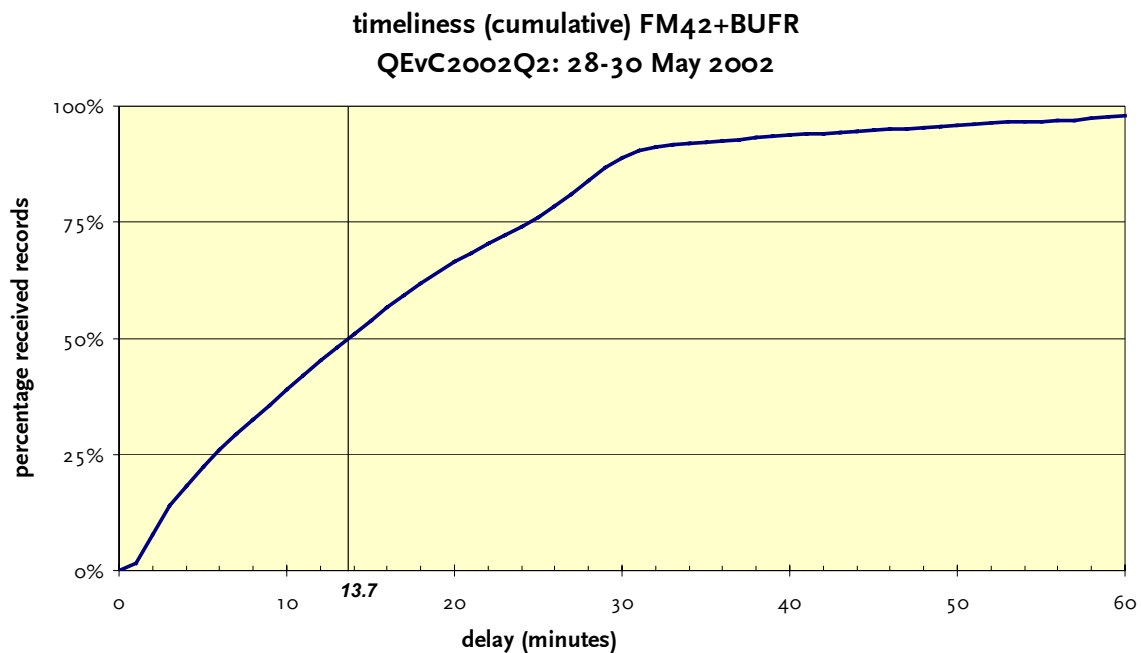


Fig. 1. Cumulative frequency distribution for all FM42 and BUFR encoded EU-Amdar observations during the period 28-30 May 2002 as a function of the interval between observation and time of reception. (Median value: 13,7 minutes; for FM42: 8,0 min, for BUFR: 22,7 min).

d) Frequency of reporting AMDAR observations

During level flight at cruising height the reporting frequency of AMDAR reports is expected to be one report per 7 minutes or 10 minutes depending on the Aircraft software. During the ascent or descent phase reports should be generated more frequently (*i.e.* every 50 hPa) with the higher frequency applying to the lower part of the atmosphere (*i.e.* every 10 hPa). It was found that the BUFR encoded AMDAR bulletins contain observations repeatedly done within one minute when in ascending or descending phase. As a consequence the reporting frequency of BUFR AMDARS is extremely high during that phase. Most of the aircraft operate within Europe and within relatively short travel distance. As a consequence data obtained from E-AMDAR reports at cruising heights is significant less than e.g. for data from ASDAR units during Atlantic flights.

e) Data quality evaluation

Every day quality control procedures are performed. By comparing the meteorological and positional information supplied by the AMDAR units with a reference background, suspect reports are selected and presented. FM42-IX and BUFR encoded AMDAR bulletins passing through the KNMI MSS are analysed for statistical evaluation purposes. Incorrectly encoded reports are stored apart and kept outside further evaluation.

The differences between observations and model-forecast fields from the HIRLAM-3 1-level-global-forecast-model are used for analysing the quality of AMDAR reports. These differences between the values from the observation and the model background (indicated by "O-B") are calculated for the levels from 950 to 400 hPa (ascent/descent levels) and for 350 to 150 hPa (cruise levels). Average values and standard deviations of the calculated differences for temperature, wind speed and wind direction are derived for all reports from any AMDAR unit separately and by taking into account time and place/position. For the evaluation process the

most actual output from the HIRLAM model is used as reference. Note that this model has a 3 hours update interval. Consequently quality evaluation is performed every 3 hours. From this evaluation process AMDAR units are selected as an entry for identifying as a suspect report in case of overriding the stated criteria. As a result from this evaluation process a daily report is generated for direct transmission by e-mail to the E-AMDAR technical co-ordinator and all E-AMDAR operators. With the exception of rejected reports and of observations outside the HIRLAM area, **all** data is evaluated¹ [see footnote]. However, for practical reasons, the daily reports present **only** those aircraft with identifiers starting with 'EU' (E-AMDAR) or ending on 'Z' (ASDAR).

Criteria

The critical (absolute) margins used for selecting entries are:

- Air Temperature: $|T_A(O)-T_A(B)| \geq 0,5 \text{ }^\circ\text{C} (0,5 \text{ K})$
- Wind speed: $|f(O)-f(B)| \geq 2,0 \text{ m/s} (4 \text{ Knots})$
- Wind direction: $|d(O)-d(B)| \geq 20 \text{ }^\circ (\text{Degrees})$

No criterion is stated concerning standard deviations. Possible usefulness of standard deviation as a measure for quality evaluation is discussed as a special case study in [Annex VI](#).

The Obs-Background mean temperature differences vary between -0.7°C and $+1.4^\circ\text{C}$ (50% within -0.3 and $+0.3^\circ\text{C}$). Aircraft with a mean difference, typically significant larger than expected are: EU0316, **EU2673**, EU3421, EU3702, EU4593, EU5777, EU6544, EU7285, EU8520, EU8742 (frequent faults are in **bold**). Aircraft exceeding the wind speed tolerances *frequently* were EU0177, EU0432, EU0476, EU0558, EU0711, EU0802, EU0921, EU2673, EU6743 and EU7119. Nevertheless the *mean* differences did not exceed the wind speed tolerances for any aircraft (except for EU2673 due to software tests). Aircraft with a *mean* difference in wind direction, larger than expected are: EU0054, EU0807, EU2673, EU2912, EU2984, EU3684, EU3702, EU4426, EU4853, EU5182, EU6264, EU6281, EU6444, EU6524. Aircraft exceeding the wind directions tolerances *frequently* were EU0002, EU0021, EU0022, EU0041, EU0043, and EU0049. In [Annex II](#), three figures are shown, presenting the frequency distribution of the mean O-B temperature differences, wind speed differences and wind direction differences as found for the set of aircraft.

For a number of observations extreme temperature differences were observed:

AIRCRAFT	Day	Time (UTC)	Latitude	Longitude	Altitude (m)	Temperature [observed] ($^\circ\text{C}$)	Temperature [background] ($^\circ\text{C}$)	Temperature difference ($^\circ\text{C}$)
EU8742	2002.04.24	12.05	55.56	34.68	10710	308.3	217.9	90.4
EU2673	2002.06.27	19.29	52.21	1.61	60	227.7	288.2	-60.5
EU5891	2002.05.12	14.29	46.37	11.02	10980	273.5	215.4	58.1
EU1337	2002.04.23	22.41	50.06	8.57	120	328.8	285.5	43.3
EU2610	2002.06.23	09.23	50.03	8.56	80	332.7	297.1	35.6
EU9145	2002.06.18	18.35	55.40	8.40	12190	237.7	214.5	23.2

Aircraft with occasionally extreme temperature differences ($> 15 \text{ K}$) are: EU0311, EU0810, EU1337, EU2327, EU2610, EU2673, EU5891, EU7001 and EU8742.

¹ Aircraft outside the HIRLAM area are evaluated by the E-AMDAR Technical Co-ordinator using other data sources.

Remarkable wind speed differences were observed for:

AIRCRAFT	Day	Time (UTC)	Latitude	Longitude	Altitude (m)	Wind speed [observed] (m/s)	Wind speed [background] (m/s)	Wind speed difference (m/s)
EU0711	2002.04.20	05.48	50.03	8.51	80	51.4	2.1	49.3
EU7119	2002.04.01	13.34	39.52	-2.93	10660	2.6	43.1	-40.5
EU6743	2002.04.09	08.49	40.96	28.82	10650	5.1	41.2	-36.1
EU0558	2002.06.21	15.39	52.50	9.71	8190	2.1	36.8	-34.7
EU6743	2002.04.09	08.39	40.96	28.82	10650	7.2	41.2	-34.0
EU2673	2002.06.27	19.30	52.23	1.80	60	36.0	3.7	32.3
EU0802	2002.06.14	10.46	52.88	15.99	10050	18.5	47.1	-28.6
EU0476	2002.05.04	06.00	49.92	6.77	9130	58.6	31.5	27.1
EU0921	2002.04.12	13.54	47.46	17.35	9220	42.7	16.6	26.1
EU0558	2002.06.21	15.29	52.50	9.71	11000	11.3	37.1	-25.8
EU0432	2002.06.04	10.52	38.40	-5.07	7680	44.2	19.7	24.5

Aircraft with occasionally *extreme* wind speed differences (> 20 m/s) are: EU0177, EU0432, EU0476, EU0558, EU0711, EU0802, EU0921, EU2673, EU6743 and EU7119.

Occasionally wind direction differences of 90° or more are observed, even up to 180°, e.g.:

AIRCRAFT	Day	Time (UTC)	Latitude	Longitude	Altitude (m)	Wind direction [observed] (°)	Wind direction [background] (°)	Wind direction difference (°)
EU0002	2002.05.29	18.58	43.69	1.19	1430	126	306	180
EU0021	2002.05.11	06.39	51.89	0.19	4200	7	186	179
EU0022	2002.04.21	09.37	51.31	-0.02	2980	87	269	178
EU0032	2002.04.21	13.06	52.20	4.64	420	37	215	178
EU0041	2002.05.06	16.54	48.41	11.82	1590	319	141	178
EU0043	2002.06.25	06.16	48.70	9.20	580	220	37	177
EU0049	2002.06.10	14.17	33.39	-7.30	1180	215	41	174
EU0047	2002.05.20	04.47	40.17	32.95	1950	209	18	169
EU0059	2002.06.30	06.41	48.40	11.77	1220	300	131	169

Aircraft with frequent extreme wind direction differences are EU0002, EU0022, EU0021, EU0041, EU0043, EU0049, EU0047. An impression of the distribution of the individual wind direction differences is given in figure 2, where a frequency distribution is presented of $\langle |\Delta DD| \rangle$ (=AVG(ABS(DD_OBS - DD_MOD))):

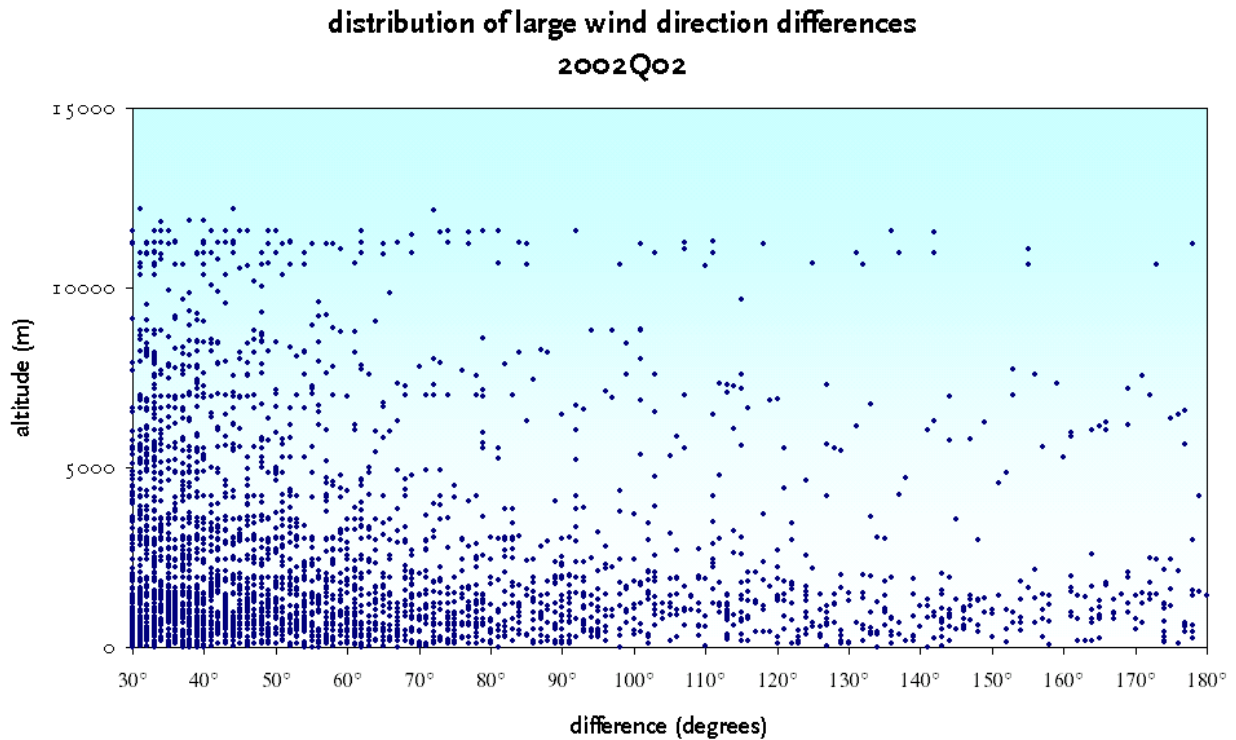


Fig. 2. Distribution for the individual O-B obs wind direction differences, $\langle |\Delta DD| \rangle$ as a function of altitude. Note that for most of the observations it holds that $\langle |\Delta DD| \rangle < 30^\circ$, so this figure presents only a **very small subset** of the total amount of received data: i.e. **0,2 %**.

f) Results (tables)

In the tables 4 to 6 attached to this report all (EU-)AMDAR units are presented together with the observed total of average differences and standard deviations. All these tables are divided in two lists, one for the DES/ASC phase and the other for the cruise level phase. No statistics are presented for the UNS phase (unstable).

5) Outstanding identified anomalies.

The identified anomalies are to be considered by the Responsible Members. Reports from published detailed investigations on these issues will be summarised in the following quarterly report. Typical problems/faults (apart from routine maintenance) are presented in table 3 (information provided by the appointed Technical Co-ordinator of the E-AMDAR Programme).

6) Solutions and actions taken from the previous period.

Errors or problems, traditionally mentioned in paragraph 3 are found to be accidentally and of minor importance only. Relevant issues are solved by direct contact between the appointed Technical Co-ordinator of the E-AMDAR Programme and the E-AMDAR operator(s).

7) Summary.

Timeliness and data quality: Timeliness is comparable to ASDAR data or better. The number of anomalies is very low with respect to the total number of reports (94.8% within 45 min).

1. The number of aircraft reporting (EU-)AMDAR was 280. The number of evaluated observations was 1959516.
2. Since reports are generated automatically, in general data is error free at the reception site.
3. Significant temperature, wind speed or wind direction anomalies were not found, except for the issues stated under par. 4.e. Overall, anomalies of $\pm 0,3^{\circ}\text{C}$, $0,0 - 0,6\text{m/s}$, $\pm 9^{\circ}$ (for LVR/LVW) and $\pm 17^{\circ}$ (for ASC/DES) are typical (see [Annexes II](#), [III](#) and [VI](#)). These values are based on a 50% cumulative level score, i.e. 50% of all data are within these ranges.

8) Special case studies

a) Frequency distribution of the mean O–B differences

In [Annex II](#) of this report three figures are presented to indicate the frequency distribution of the mean O-B differences for temperature, wind speed and wind direction for the set of observing aircraft (N=280). In these figures distinction is made between observations in flight level (LVR/LVW) and observations during ascent or descent (ASC/DES). Note that only the absolute values of wind direction are analysed. Obviously differences (averaged over this quarter) vary within ranges of approx. $-0,7$ to $+1,5^{\circ}\text{C}$, $-0,2$ to $+0,8$ m/s and $\pm 12^{\circ}$ (for LVR/LVW) to $\pm 21^{\circ}$ (for ASC/DES) (to be considered as the *uncertainty* of observation).

b) Trends in the daily amount of observations

From April 1st to June 30st the amount of observations is registered on a daily base. In [Annex III](#) of this report the trend of this daily amount is presented. Obviously number of received data is stable during this period. In this annex also an overall overview is presented for the reporting behaviour of the individual aircraft.

c) Trends in the mean O–B differences.

In [Annex IV](#) of this report the results of a case study on the trends in the mean O–B differences are presented for the individual aircraft.

d) The daily cycle and observation times.

In [Annex V](#) of this report four figures are presented, which gives a clear impression of AMDAR/ASDAR/AIREP data availability during a 24h cycle. In these figures (source: ECMWF) positional information is presented for the four main intervals of a day. Typically, very little AMDAR data are available around 00:00 UTC.

e) Standard deviations of the OBS–MOD differences.

In [Annex VI](#) an analyses is presented on the possible usefulness of determined standard deviations of OBS-MOD differences as given in the tables 4-6. Based on a general overview of σ data and on an analyses of σ -values from five randomly chosen aircraft it turns out that those σ values are within a narrow range for all aircraft. To demonstrate the usefulness of σ , further investigation will be necessary to be able to discriminate between the uncertainty of the *in-situ* aircraft observations and the uncertainty of the reference background, provided by the HIRLAM model.

Table 1, List of operational AMDAR units

(A: activated, D: deactivated during this quarter)

Identifrier	Identifrier	Identifrier	Identifrier	Identifrier	Identifrier	Identifrier
EU0002	EU0281	EU0961	EU2559	EU3986 A D	EU5372	EU7654
EU0021	EU0299	EU0985	EU2590	EU4002	EU5429	EU7724
EU0022	EU0301	EU1001	EU2595	EU4021	EU5435	EU7865
EU0032	EU0303	EU1002	EU2610	EU4278	EU5441	EU7888
EU0041	EU0307	EU1234	EU2618	EU4333	EU5478	EU7894
EU0043	EU0310 A	EU1282	EU2630	EU4426 D	EU5529	EU8264
EU0045	EU0311	EU1301	EU2673 A	EU4444	EU5587	EU8431
EU0047	EU0313	EU1312	EU2751	EU4463	EU5591	EU8478
EU0049	EU0316	EU1334	EU2773	EU4491	EU5593	EU8520
EU0051	EU0319	EU1337	EU2832 A D	EU4519	EU5612	EU8598
EU0052	EU0321	EU1411	EU2845	EU4527	EU5613	EU8605
EU0054	EU0359	EU1446	EU2898 A D	EU4529	EU5777	EU8632
EU0055	EU0367	EU1456	EU2978	EU4532	EU5802	EU8733
EU0059	EU0373	EU1498	EU2984	EU4573	EU5821	EU8736
EU0060	EU0394	EU1532	EU3000	EU4582	EU5891	EU8742
EU0061	EU0413	EU1547	EU3030 A D	EU4587	EU6264	EU8787
EU0072	EU0432	EU1567	EU3181	EU4589	EU6281	EU8789
EU0073	EU0442	EU1593	EU3257	EU4591	EU6287	EU8891
EU0078	EU0453 A	EU1698	EU3268	EU4593	EU6321	EU8943
EU0081	EU0456	EU1790	EU3270	EU4607	EU6349	EU8969
EU0082	EU0457	EU1863	EU3321	EU4699	EU6444	EU9013
EU0086	EU0458	EU1929	EU3358	EU4721	EU6524	EU9023
EU0088	EU0476	EU2017	EU3420 A D	EU4756	EU6527	EU9145
EU0106	EU0511	EU2043	EU3421	EU4792	EU6544	EU9158
EU0109	EU0558	EU2055	EU3469	EU4838	EU6556	EU9234
EU0110 A	EU0568	EU2130	EU3533	EU4853	EU6743	EU9245
EU0120	EU0575 A	EU2165	EU3544	EU4865	EU6821	EU9356
EU0123	EU0583	EU2189	EU3598	EU4896	EU6890	EU9378
EU0124	EU0601	EU2200 A	EU3599	EU4950	EU6893	EU9544
EU0154	EU0676	EU2201	EU3621	EU4956	EU6923	EU9589
EU0158	EU0711	EU2247	EU3654	EU5098	EU7001	EU9622
EU0167	EU0723	EU2301	EU3684	EU5134	EU7082	EU9678
EU0177	EU0802	EU2327	EU3702 A	EU5167	EU7119	EU9680
EU0185	EU0807	EU2350 A D	EU3714	EU5175	EU7218	EU9692
EU0202 A	EU0810	EU2356	EU3725	EU5191	EU7285	EU9723
EU0203	EU0826	EU2389	EU3755	EU5245	EU7521	EU9729
EU0230 A	EU0875	EU2401	EU3854 A	EU5331	EU7629	EU9734
EU0234	EU0921	EU2430	EU3874	EU5349	EU7634	EU9743
EU0251	EU0934	EU2530	EU3908	EU5351	EU7635	EU9883
EU0263	EU0947	EU2547	EU3972	EU5360	EU7643	EU9967

[280]

Table 2, Quantity and Timeliness of AMDAR Reports

Summary	
Number of days in this period	91
Number of aircraft reporting AMDAR	266
Number of E-AMDAR activated aircraft	280
Total number of observations evaluated during the period	1959516
Average daily number of aircraft reporting AMDAR	194 (69% of activated aircraft)
Percentage of data available within 60 minutes is	96.9%
Percentage of data available within 120 minutes is	98.5%
Average reports per day, per reporting aircraft is	111

Legend	
AIRCRAFT	Aircraft identifier
Total No of Reports	Number of reports received by E-AMDAR Quality Centre, exclusive of erroneous data.
Days of Reports	Number of days reports were received from aircraft by QEvC
Actual/possible	Ratio of Number of days aircraft reported/ maximum possible days in %
Average reports/day	Average number of reports per day of report from each aircraft
0 – 45 min	percentage of total reports received within 45 minutes of observation time
0 – 60 min	percentage of total reports received within 60 minutes of observation time
0 – 120 min	percentage of total reports received within 120 minutes of observation time

AIRCRAFT	Total No of Reports	Days of Reports	Actual/possible	Average reports/day	0–45 min	0–60 min	0–120 min
EU0002	10148	82	90%	124	99.6%	99.6%	99.6%
EU0003	42	1	1%	42	100.0%	100.0%	100.0%
EU0021	9095	90	99%	101	99.8%	99.9%	100.0%
EU0022	11582	80	88%	145	99.5%	99.7%	100.0%
EU0032	3038	59	65%	51	95.9%	96.2%	98.2%
EU0034	2205	38	42%	58	99.0%	99.3%	100.0%
EU0041	9235	81	89%	114	90.8%	94.3%	96.9%
EU0043	9205	91	100%	101	88.8%	94.5%	98.4%
EU0045	4313	36	40%	120	98.0%	98.0%	98.6%
EU0047	9115	86	95%	106	85.0%	90.3%	96.5%
EU0049	8615	84	92%	103	100.0%	100.0%	100.0%
EU0051	6116	67	74%	91	99.1%	99.5%	100.0%
EU0052	9751	84	92%	116	90.5%	93.4%	97.0%
EU0054	3991	46	51%	87	99.8%	99.8%	100.0%
EU0055	4955	47	52%	105	98.6%	98.6%	98.6%

AIRCRAFT	Total No of Reports	Days of Reports	Actual/ possible	Average reports/ day	0–45 min	0–60 min	0–120 min
EU0059	10534	88	97%	120	90.3%	93.6%	96.3%
EU0060	339	4	4%	85	100.0%	100.0%	100.0%
EU0061	10086	88	97%	115	91.1%	94.8%	97.3%
EU0072	10615	89	98%	119	100.0%	100.0%	100.0%
EU0073	12429	90	99%	138	79.9%	91.0%	96.3%
EU0081	9591	73	80%	131	99.2%	99.5%	99.8%
EU0082	7495	60	66%	125	100.0%	100.0%	100.0%
EU0086	10936	87	96%	126	76.2%	87.1%	95.1%
EU0088	12645	83	91%	152	99.6%	99.8%	100.0%
EU0106	10473	86	95%	122	90.8%	94.8%	97.0%
EU0109	14215	90	99%	158	99.6%	99.7%	99.9%
EU0110	2188	13	14%	168	100.0%	100.0%	100.0%
EU0120	12337	90	99%	137	80.4%	91.4%	96.5%
EU0123	5890	44	48%	134	99.7%	100.0%	100.0%
EU0124	9023	79	87%	114	100.0%	100.0%	100.0%
EU0158	6124	53	58%	116	90.4%	94.2%	95.6%
EU0167	9788	90	99%	109	90.0%	94.7%	96.8%
EU0177	11884	89	98%	134	79.1%	89.3%	94.5%
EU0185	8576	70	77%	123	87.2%	92.1%	97.5%
EU0202	2227	13	14%	171	99.7%	100.0%	100.0%
EU0203	8950	71	78%	126	76.1%	86.7%	93.8%
EU0204	7087	49	54%	145	100.0%	100.0%	100.0%
EU0230	1975	13	14%	152	100.0%	100.0%	100.0%
EU0234	9701	83	91%	117	99.1%	99.1%	99.1%
EU0251	10575	87	96%	122	92.4%	95.4%	97.9%
EU0263	10456	74	81%	141	99.1%	99.1%	99.2%
EU0281	753	26	29%	29	100.0%	100.0%	100.0%
EU0299	10090	87	96%	116	100.0%	100.0%	100.0%
EU0301	10608	87	96%	122	86.2%	90.4%	96.6%
EU0303	6346	60	66%	106	90.6%	95.3%	97.9%
EU0307	11458	89	98%	129	91.4%	94.8%	97.2%
EU0310	1977	12	13%	165	100.0%	100.0%	100.0%
EU0311	7361	71	78%	104	84.8%	90.9%	94.8%
EU0313	8063	79	87%	102	89.2%	93.3%	95.3%
EU0316	7119	67	74%	106	87.8%	93.8%	96.4%
EU0319	8921	84	92%	106	88.0%	93.5%	98.1%
EU0359	7823	70	77%	112	90.4%	94.9%	97.8%
EU0367	9269	78	86%	119	99.5%	99.5%	99.5%
EU0373	11232	87	96%	129	91.3%	95.2%	98.1%
EU0394	10049	84	92%	120	90.7%	94.6%	97.1%
EU0413	10270	84	92%	122	90.4%	93.1%	95.9%
EU0432	10957	84	92%	130	100.0%	100.0%	100.0%
EU0442	9489	86	95%	110	89.9%	94.0%	97.4%

AIRCRAFT	Total No of Reports	Days of Reports	Actual/ possible	Average reports/ day	0–45 min	0–60 min	0–120 min
EU0453	2100	13	14%	162	100.0%	100.0%	100.0%
EU0457	2258	59	65%	38	100.0%	100.0%	100.0%
EU0476	7763	89	98%	87	88.5%	93.4%	96.4%
EU0511	10084	89	98%	113	91.8%	95.0%	97.6%
EU0558	6569	59	65%	111	88.5%	92.2%	94.5%
EU0568	5118	51	56%	100	100.0%	100.0%	100.0%
EU0575	1843	12	13%	154	99.7%	100.0%	100.0%
EU0583	9401	83	91%	113	89.2%	93.4%	95.8%
EU0601	10580	90	99%	118	91.3%	95.0%	97.3%
EU0676	9629	84	92%	115	90.1%	93.4%	96.2%
EU0711	8138	86	95%	95	88.3%	94.6%	97.8%
EU0723	8848	89	98%	99	91.9%	95.2%	97.8%
EU0802	9442	88	97%	107	89.5%	93.9%	96.4%
EU0807	4390	50	55%	88	99.5%	99.8%	100.0%
EU0810	7265	64	70%	114	89.3%	94.1%	95.8%
EU0826	7967	73	80%	109	98.9%	99.4%	99.4%
EU0875	8502	85	93%	100	90.5%	94.2%	97.2%
EU0921	9848	86	95%	115	88.6%	93.6%	96.6%
EU0934	10024	61	67%	164	99.0%	99.0%	99.3%
EU0947	10062	72	79%	140	99.5%	99.6%	99.7%
EU0961	9102	68	75%	134	99.3%	99.3%	99.4%
EU0985	11414	75	82%	152	98.6%	98.6%	98.9%
EU1001	6236	53	58%	118	98.8%	98.8%	99.4%
EU1002	10987	71	78%	155	99.1%	99.2%	99.6%
EU1234	10525	88	97%	120	89.9%	94.1%	96.8%
EU1282	3833	62	68%	62	97.5%	97.5%	98.0%
EU1301	2607	62	68%	42	99.6%	100.0%	100.0%
EU1334	8217	61	67%	135	98.7%	98.7%	99.2%
EU1337	8965	86	95%	104	88.4%	93.4%	96.1%
EU1411	831	30	33%	28	100.0%	100.0%	100.0%
EU1456	6690	67	74%	100	100.0%	100.0%	100.0%
EU1495	161	2	2%	81	100.0%	100.0%	100.0%
EU1498	10186	88	97%	116	89.6%	93.7%	97.6%
EU1532	9067	81	89%	112	100.0%	100.0%	100.0%
EU1547	9862	82	90%	120	92.0%	95.0%	98.1%
EU1567	9398	81	89%	116	99.5%	100.0%	100.0%
EU1593	6070	41	45%	148	98.6%	98.7%	99.4%
EU1698	9664	85	93%	114	99.1%	99.1%	99.1%
EU1790	5935	64	70%	93	98.9%	98.9%	99.3%
EU1863	10521	88	97%	120	91.9%	95.0%	97.7%
EU1929	2123	57	63%	37	100.0%	100.0%	100.0%
EU2017	10869	88	97%	124	90.4%	94.3%	97.1%
EU2043	1935	62	68%	31	100.0%	100.0%	100.0%

AIRCRAFT	Total No of Reports	Days of Reports	Actual/ possible	Average reports/ day	0–45 min	0–60 min	0–120 min
EU2055	11636	90	99%	129	89.1%	92.7%	96.7%
EU2130	10059	85	93%	118	91.4%	94.5%	97.1%
EU2165	10673	89	98%	120	87.3%	92.0%	96.2%
EU2189	8389	80	88%	105	88.2%	93.6%	96.9%
EU2200	1343	9	10%	149	100.0%	100.0%	100.0%
EU2201	9632	81	89%	119	89.9%	93.4%	96.3%
EU2247	10174	87	96%	117	90.5%	95.0%	98.6%
EU2301	7133	65	71%	110	89.7%	94.0%	98.3%
EU2327	11220	87	96%	129	74.7%	86.3%	94.1%
EU2356	7898	83	91%	95	68.6%	87.5%	96.1%
EU2389	14348	82	90%	175	99.6%	99.7%	100.0%
EU2401	8147	89	98%	92	90.6%	94.6%	97.4%
EU2430	8270	88	97%	94	90.3%	94.9%	97.6%
EU2530	8753	88	97%	99	86.7%	91.3%	96.1%
EU2547	5010	42	46%	119	99.4%	99.4%	99.4%
EU2559	9257	79	87%	117	92.8%	95.9%	98.2%
EU2590	8486	66	73%	129	98.8%	98.9%	99.5%
EU2595	7967	84	92%	95	91.5%	94.4%	97.1%
EU2610	2597	24	26%	108	78.0%	88.3%	94.7%
EU2618	7674	57	63%	135	99.6%	99.6%	99.7%
EU2630	4076	60	66%	68	100.0%	100.0%	100.0%
EU2673	149	2	2%	75	99.3%	100.0%	100.0%
EU2751	4281	76	84%	56	98.1%	98.3%	98.9%
EU2773	3839	61	67%	63	99.4%	99.4%	99.6%
EU2845	14101	87	96%	162	99.8%	99.9%	100.0%
EU2912	709	4	4%	177	100.0%	100.0%	100.0%
EU2978	5718	51	56%	112	100.0%	100.0%	100.0%
EU2984	4359	49	54%	89	97.8%	97.8%	98.3%
EU3000	10686	86	95%	124	89.5%	93.3%	97.6%
EU3181	5176	81	89%	64	98.0%	98.0%	98.7%
EU3257	9505	83	91%	115	90.5%	93.9%	98.3%
EU3268	6354	65	71%	98	98.1%	98.1%	99.0%
EU3270	8613	78	86%	110	99.5%	99.5%	100.0%
EU3321	3575	50	55%	72	97.7%	97.7%	98.8%
EU3358	8621	85	93%	101	98.5%	99.1%	99.1%
EU3421	7030	64	70%	110	87.2%	92.5%	97.0%
EU3469	8368	86	95%	97	98.8%	98.8%	99.4%
EU3533	10153	86	95%	118	100.0%	100.0%	100.0%
EU3544	2762	30	33%	92	89.3%	92.0%	94.2%
EU3598	6248	62	68%	101	90.4%	94.9%	98.0%
EU3599	6406	65	71%	99	89.5%	94.2%	97.0%
EU3621	2986	34	37%	88	100.0%	100.0%	100.0%
EU3654	7034	71	78%	99	98.8%	98.8%	99.2%

AIRCRAFT	Total No of Reports	Days of Reports	Actual/ possible	Average reports/ day	0–45 min	0–60 min	0–120 min
EU3684	4537	62	68%	73	100.0%	100.0%	100.0%
EU3702	476	5	5%	95	100.0%	100.0%	100.0%
EU3714	9836	81	89%	121	100.0%	100.0%	100.0%
EU3725	4800	72	79%	67	99.3%	99.7%	99.7%
EU3755	8063	82	90%	98	100.0%	100.0%	100.0%
EU3874	3044	54	59%	56	96.7%	97.1%	98.8%
EU3908	14125	74	81%	191	99.4%	99.6%	99.7%
EU3972	7479	80	88%	93	99.4%	99.4%	99.4%
EU4002	5076	63	69%	81	99.0%	99.3%	100.0%
EU4021	8742	85	93%	103	99.0%	99.0%	99.0%
EU4278	4989	54	59%	92	99.1%	99.1%	99.1%
EU4333	9377	61	67%	154	99.6%	99.6%	99.7%
EU4426	2624	36	40%	73	99.2%	99.2%	100.0%
EU4444	7302	80	88%	91	98.4%	98.4%	98.9%
EU4463	8637	78	86%	111	99.6%	100.0%	100.0%
EU4491	9559	85	93%	112	100.0%	100.0%	100.0%
EU4519	7367	79	87%	93	99.5%	99.6%	99.6%
EU4527	8811	86	95%	102	90.5%	94.1%	96.3%
EU4529	12194	78	86%	156	99.8%	99.8%	100.0%
EU4532	9153	90	99%	102	89.6%	94.7%	97.7%
EU4573	14739	71	78%	208	99.1%	99.2%	99.9%
EU4582	14870	75	82%	198	99.0%	99.1%	99.7%
EU4587	1768	43	47%	41	98.9%	100.0%	100.0%
EU4591	7650	68	75%	113	99.3%	99.7%	100.0%
EU4593	6831	62	68%	110	92.4%	96.6%	99.7%
EU4607	16818	76	84%	221	99.4%	99.6%	99.9%
EU4699	6356	75	82%	85	100.0%	100.0%	100.0%
EU4721	4212	58	64%	73	98.4%	98.7%	99.6%
EU4792	5189	68	75%	76	100.0%	100.0%	100.0%
EU4838	8888	80	88%	111	99.6%	99.6%	99.6%
EU4853	6631	73	80%	91	98.4%	98.4%	98.8%
EU4865	2565	23	25%	112	100.0%	100.0%	100.0%
EU4896	44	2	2%	22	100.0%	100.0%	100.0%
EU4950	3779	48	53%	79	99.4%	99.4%	99.4%
EU5098	9333	79	87%	118	99.1%	99.5%	99.5%
EU5134	7733	77	85%	100	99.4%	99.4%	99.4%
EU5167	15485	89	98%	174	99.8%	100.0%	100.0%
EU5175	467	13	14%	36	98.0%	100.0%	100.0%
EU5182	79	2	2%	40	100.0%	100.0%	100.0%
EU5331	7451	69	76%	108	86.5%	91.3%	95.6%
EU5349	7415	77	85%	96	98.4%	98.4%	99.5%
EU5351	9427	88	97%	107	88.0%	93.3%	97.0%
EU5372	4248	50	55%	85	100.0%	100.0%	100.0%

AIRCRAFT	Total No of Reports	Days of Reports	Actual/ possible	Average reports/ day	0–45 min	0–60 min	0–120 min
EU5429	3075	25	27%	123	100.0%	100.0%	100.0%
EU5435	9016	80	88%	113	88.4%	92.5%	95.7%
EU5441	4642	63	69%	74	99.8%	99.8%	100.0%
EU5478	14385	74	81%	194	99.0%	99.1%	99.7%
EU5529	14916	76	84%	196	99.1%	99.4%	99.8%
EU5587	8989	86	95%	105	88.7%	93.1%	96.0%
EU5591	5559	71	78%	78	99.8%	100.0%	100.0%
EU5593	213	4	4%	53	100.0%	100.0%	100.0%
EU5612	7022	71	78%	99	99.6%	99.6%	99.9%
EU5613	9356	88	97%	106	89.3%	93.6%	96.3%
EU5777	156	3	3%	52	100.0%	100.0%	100.0%
EU5802	2708	27	30%	100	100.0%	100.0%	100.0%
EU5821	4223	43	47%	98	98.9%	99.2%	99.4%
EU5891	9101	81	89%	112	89.1%	92.5%	95.6%
EU6264	14050	74	81%	190	99.4%	99.4%	99.4%
EU6281	7402	76	84%	97	99.2%	99.2%	99.5%
EU6287	8251	78	86%	106	99.0%	99.0%	99.0%
EU6349	5618	71	78%	79	99.3%	99.4%	99.5%
EU6444	5077	66	73%	77	99.5%	99.6%	100.0%
EU6524	6433	82	90%	78	99.8%	100.0%	100.0%
EU6527	5188	59	65%	88	97.6%	97.8%	99.2%
EU6544	8722	87	96%	100	84.1%	90.6%	96.7%
EU6556	8749	87	96%	101	89.3%	92.7%	95.6%
EU6723	3681	35	38%	105	100.0%	100.0%	100.0%
EU6743	10408	90	99%	116	89.7%	94.4%	96.8%
EU6821	986	22	24%	45	96.5%	96.5%	96.5%
EU6890	3554	53	58%	67	100.0%	100.0%	100.0%
EU6893	8334	80	88%	104	99.4%	100.0%	100.0%
EU6923	5446	51	56%	107	100.0%	100.0%	100.0%
EU7001	7662	66	73%	116	88.7%	93.7%	95.9%
EU7082	9118	78	86%	117	98.9%	98.9%	98.9%
EU7119	2943	30	33%	98	88.3%	95.8%	99.1%
EU7218	3647	56	62%	65	100.0%	100.0%	100.0%
EU7285	632	7	8%	90	100.0%	100.0%	100.0%
EU7521	7437	73	80%	102	100.0%	100.0%	100.0%
EU7629	5954	65	71%	92	98.8%	98.8%	99.6%
EU7634	8397	86	95%	98	99.4%	99.4%	99.4%
EU7635	8205	77	85%	107	90.2%	94.6%	96.6%
EU7643	4049	61	67%	66	99.0%	99.4%	100.0%
EU7654	2906	37	41%	79	99.1%	99.1%	100.0%
EU7724	3631	56	62%	65	97.9%	98.3%	100.0%
EU7865	7955	70	77%	114	98.9%	98.9%	99.5%
EU7888	6287	64	70%	98	98.3%	98.4%	98.6%

AIRCRAFT	Total No of Reports	Days of Reports	Actual/ possible	Average reports/ day	0–45 min	0–60 min	0–120 min
EU7894	2517	30	33%	84	88.3%	92.2%	94.4%
EU8264	8062	71	78%	114	99.4%	99.4%	99.4%
EU8431	8985	84	92%	107	99.5%	99.5%	99.5%
EU8478	8302	82	90%	101	99.7%	99.7%	99.7%
EU8520	3194	49	54%	65	98.7%	99.3%	100.0%
EU8598	6484	61	67%	106	100.0%	100.0%	100.0%
EU8605	4398	49	54%	90	98.2%	98.2%	98.2%
EU8632	8624	82	90%	105	99.4%	99.4%	100.0%
EU8733	9804	88	97%	111	89.8%	94.4%	97.8%
EU8736	6864	78	86%	88	98.8%	98.8%	99.4%
EU8742	7687	67	74%	115	89.7%	92.9%	96.9%
EU8787	9589	86	95%	112	91.2%	95.6%	97.8%
EU8789	7454	67	74%	111	99.0%	99.0%	99.5%
EU8891	4513	56	62%	81	100.0%	100.0%	100.0%
EU8943	8860	80	88%	111	99.5%	99.5%	99.5%
EU8969	5186	66	73%	79	99.4%	99.5%	100.0%
EU9013	9554	89	98%	107	88.4%	93.0%	96.8%
EU9023	9149	86	95%	106	98.5%	99.0%	99.0%
EU9145	4287	54	59%	79	99.7%	99.7%	100.0%
EU9158	15355	77	85%	199	99.0%	99.0%	99.3%
EU9234	16020	73	80%	219	99.0%	99.2%	99.6%
EU9245	17702	77	85%	230	98.7%	98.8%	99.4%
EU9356	8673	72	79%	120	100.0%	100.0%	100.0%
EU9378	7781	18	20%	432	96.3%	96.9%	97.5%
EU9544	6455	66	73%	98	100.0%	100.0%	100.0%
EU9589	9407	86	95%	109	99.5%	99.5%	99.5%
EU9622	4820	65	71%	74	99.6%	99.7%	100.0%
EU9678	5971	53	58%	113	100.0%	100.0%	100.0%
EU9680	6465	63	69%	103	99.0%	99.0%	99.1%
EU9692	2055	28	31%	73	100.0%	100.0%	100.0%
EU9723	9658	85	93%	114	88.8%	93.2%	96.7%
EU9729	5621	65	71%	86	99.5%	99.5%	100.0%
EU9734	9506	87	96%	109	99.6%	99.6%	99.6%
EU9743	6706	73	80%	92	97.9%	98.2%	98.9%
EU9883	8765	80	88%	110	89.3%	93.3%	96.4%
EU9967	9017	80	88%	113	99.6%	100.0%	100.0%

[266]

- *Timeliness: From 19 aircraft more than 4% of the received data had on average a delay after observation for more than two hours. A number of these aircraft fly long haul routes and either “store” data until reaching a Ground Receiving Station or use Satcom – which would account for some delay.*

Identifier	Identifier	Identifier	Identifier
EU0086	EU0313	EU2327	EU5891
EU0158	EU0413	EU2610	EU6556
EU0177	EU0558	EU3544	EU7001
EU0203	EU0583	EU5331	EU7894
EU0311	EU0810	EU5435	

- *No data was received from the following 21 aircraft (*: not reporting due to budgetary constraints; ¢: Software testing - data not being transmitted; \$: testing software. Errors found and switched off.)*

Identifier	Identifier	Identifier	Identifier
EU0078 ¢	EU1446	EU3854	EU5245 *
EU0154	EU2350 \$	EU3986 \$	EU5360 ¢
EU0321 ¢	EU2832 \$	EU4589 *	EU6321 *
EU0456	EU2898 \$	EU4756 *	
EU0458	EU3030 \$	EU4956 *	
EU1312	EU3420 \$	EU5191 *	

Table 3, Description and number of errors

Aircraft with parameter anomalies:

Aircraft deactivated due to temperature anomalies

- EU0203: Disabled 10th April. Sensor changed 25th April reactivated 30th April monitoring will continue during May.
- EU7119: Disabled 25th April – temp error >4.0deg. Sensor changed and enabled again 25th June.

Consistent (>75%) warm temperature biases were noted on the following aircraft

April 2002:

- 1 to 2°C EU0316, EU3421, EU4593, EU5435, EU6544, EU8742
- >2°C EU0008 - Operator will inform when sensor replaced.
EU9378 - Operator will inform when sensor replaced.

May 2002:

- 1 to 2°C EU0073, EU0203, EU0316, EU3321, EU3421, EU4593, EU5435, EU6544, EU8742
- >2°C Nil this period.

June 2002:

- 1 to 2°C EU0073, EU0177, EU0316, EU3421, EU5435, EU6544, EU6821, EU8742
- >2°C Nil this period.

Frequent (40 - 74%) warm temperature biases were noted on the following aircraft

April 2002:

- 1 to 2°C EU0073, EU0088, EU0177, EU5331, EU6566, EU6743, EU9723
- >2°C EU7285 – error started 29th April – monitoring to continue during May.

May 2002:

- 1 to 2°C EU0086, EU0088, EU0167, EU0177, EU0568, EU1456, EU5331, EU6743, EU9723
- >2°C EU7285 – aircraft disabled 2nd May.

June 2002:

- 1 to 2°C EU0041, EU0086, EU0167, EU0203, EU0281, EU3598, EU3874, EU4593, EU5331, EU6566, EU6743, EU9723
- >2°C Nil this period.

Occasionally (30-39%) warm temperature biases were noted on the following aircraft

April 2002:

- 1 to 2°C EU0032, EU0041, EU0167, EU0281, EU0558, EU1281, EU2043, EU8773, EU9883
- >2°C Nil this period.

May 2002:

- 1 to 2°C EU0041, EU2301, EU4587, EU5587, EU5891, EU6556, EU7894, EU9883
- >2°C Nil this period.

June 2002:

- 1 to 2°C EU0359, EU0568, EU0947
- >2°C Nil this period.

No reports received although expected:

- EU0022: no reports Jun 22 – 30th

-
- EU0032: no reports Jun 2 – 6th, Jun 11 – 30th
 - EU0045: no reports May 1 – 22nd
 - EU0051: no reports Jun 1 – 11th
 - EU0054: no reports May 22 – Jun 30th extended maintenance
 - EU0060: no reports Apr 2 – Jun 27th extended maintenance
 - EU0078: no reports Apr 1 – Jun 30th
 - EU0081: no reports May 7 – 22nd
 - EU0082: no reports Jun 7 – 30th
 - EU0123: no reports May 11 – Jun 6th
 - EU0158: no reports Apr 24 – May 28th
 - EU0203: no reports Apr 10 – 29th
 - EU0204: no reports May 1 – 6th
 - EU0263: no reports Apr 14 – 23rd
 - EU0281: no reports May 4 – Jun 9th, Jun 13: 30th
 - EU0303: no reports Jun 6 – 30th
 - EU0313: no reports Apr 22 – 27th
 - EU0367: no reports Jun 16 – 24th
 - EU0394: no reports May 10 – 16th
 - EU0457: no reports May 1 – 9th
 - EU0568: no reports May 13 – Jun 12th
 - EU0583: no reports Jun 24 – 28th
 - EU0807: no reports May 20 – Jun 10th, Jun 12 – 26th
 - EU0826: no reports Apr 1 – 10th
 - EU0934: no reports Jun 5 – 22nd
 - EU0947: no reports May 24 – 31st
 - EU1001: no reports May 24 – Jun 25th
 - EU1282: no reports Jun 11 – 30th
 - EU1301: no reports Jun 3 – 11th
 - EU1312: no reports Apr 1 – Jun 30th, extended maintenance.
 - EU1411: no reports May 8 – Jun 30th, extended maintenance
 - EU1495: no reports Jun 1 – 25th
 - EU1567: no reports Apr 15 – 20th
 - EU1593: no reports May 1 – 14th
 - EU1929: no reports May 2 – 13th, Jun 20 – 30th
 - EU2043: no reports May 12 – 23rd, Jun 16 – 20th
 - EU2189: no reports May 11 – 16th
 - EU2389: no reports Jun 20 – 24th
 - EU2547: no reports May 9 – Jun 5th, Jun 20 – 27th
 - EU2559: no reports May 11 – 17th
 - EU2590: no reports May 13 – 20th
 - EU2610: no reports Apr 1 – May 31st
 - EU2618: no reports May 6 – 12th
 - EU2630: no reports Jun 2 – 9th
 - EU2673: no reports Jun 1 – 26th
 - EU2773: no reports Jun 7 – 30th
 - EU2978*: no reports May 3 – Jun 6th
 - EU2984: no reports Jun 8 – 16th
 - EU3270*: no reports May 19 – 25th
 - EU3321: no reports May 7 – 12th
 - EU3421: no reports Apr 22 – May 17th
-

-
- EU3544: no reports Apr 1 – 7th, Apr 11 – May 31st
 - EU3598: no reports Jun 3 – 30th
 - EU3599: no reports Apr 7 – 22nd
 - EU3621*: no reports May 2 – 9th, Jun 14 – 27th
 - EU3654: no reports Apr 15 – 21st
 - EU3684: no reports May 15 – 20th
 - EU3725: no reports May 2 – 10th
 - EU3874: no reports Jun 6 – 30th
 - EU3908: no reports Jun 8 – 12th
 - EU4278*: no reports Apr 1 – 30th
 - EU4333: no reports May 1 – 6th
 - EU4463*: no reports Jun 1 – 7th
 - EU4529: no reports May 24 – 31st
 - EU4587: no reports Apr 1 – May 6th
 - EU4593: no reports May 19 – Jun 16th
 - EU4865: no reports May 1 – Jun 30th
 - EU4950: no reports Apr 11 – 17th
 - EU5134*: no reports May 10 – 17th
 - EU5331: no reports May 11 – 16th, Jun 16 – 30th
 - EU5349*: no reports Apr 1 – 8th
 - EU5372*: no reports Jun 26 – 30th
 - EU5429*: no reports Apr 1 – May 31st
 - EU5441: no reports Jun 7 – 11th
 - EU5591: no reports May 10 – 15th
 - EU5777: no reports Apr 1 – 7th, Apr 12 – Jun 30th
 - EU5802: no reports May 16 – Jun 30th
 - EU5821: no reports May 18 – 28th, Jun 4 – 30th
 - EU5891: no reports May 11 – 16th
 - EU6287*: no reports Apr 4 – 12th
 - EU6890: no reports Apr 1 – 7th
 - EU6893*: no reports Apr 1 – 16th
 - EU6923*: no reports May 2 – 13th, Jun 8 – 12th
 - EU7082*: no reports Jun 21 – 30th
 - EU7218: no reports Jun 6 – 10th
 - EU7285*: no reports Apr 1 – 26th, May 4 – Jun 30th
 - EU7521*: no reports Apr 13 – 22nd
 - EU7635: no reports May 9 – 18th
 - EU7654: no reports Apr 16 – May 23rd
 - EU7724: no reports Apr 1 – 7th, Jun 6: 10th
 - EU7865*: no reports Apr 23 – 30th
 - EU7888: no reports Jun 24 – 30th
 - EU7894: no reports May 1 – 26th
 - EU8264*: no reports Jun 26 – 30th
 - EU8520: no reports May 16 – 21st
 - EU8598*: no reports May 24 – 31st
 - EU8605*: no reports Apr 25 – 30th
 - EU8789*: no reports May 14 – 24th
 - EU8891*: no reports Apr 3 – 9th, May 20 – 25th
 - EU9145: no reports May 17 – 22nd
 - EU9356*: no reports May 2 – 16th
-

- EU9378*: no reports May 14 – Jun 30th
- EU9622: no reports May 16 – 21st
- EU9678*: no reports Apr 5 – 30th
- EU9692: no reports Apr 11 – 30th, Jun 6 – 12th
- EU9883: no reports May 11 – 16th

* All aircraft marked with * are using an optimisation system which only transmits data from airports designated by the E-AMDAR Programme: this is the main reason for periods of non-reporting.

Specific problems:

- The following aircraft have been sold (awaiting details of actual sale dates from operator): EU0008, EU1222 and EU1495
- Air Traffic Control problems 10th April – aircraft grounded in the UK for a short period early morning. Data totals reduced slightly.
- Industrial action by French Air Traffic 19th June – reduced data from Air France aircraft.
- QEv daily report production problems 18-19th June. During this period QC of data was carried out using other available resources.
- EU2043: clock error 16-19th June reset by operator.
- No reports from the following aircraft during this period owing to the operator temporarily grounding the aircraft whilst reviewing airline requirements:
 - EU0154, EU0456, EU0458, EU1446.
- Data formatting problems with the following aircraft from 25th April to:
 - EU0185, EU0311, EU0359, EU8742: problem fixed 14th May
 - EU0316, EU0810, EU2301: problem fixed 17th May
 - EU7001: problem fixed 15th May
 - EU0558: problem fixed 26th May.

Ground stations issues and other problems:

- Uplinking problems at SAS 1–4th April. Reduced data totals from B737 fleets.
- Application problems at SAS 17 – 21st May. Data restarted 09:58.
- Telex software problems at SAS 7 – 10th June. Data restarted 09:44.

Activated and deactivated aircraft:

- EU5182: aircraft testing 3 – 4th April
- EU2912: aircraft testing 16 – 19th April
- EU4426: deactivated 17th May. Compressed data format causing problems with other software applications.
- EU6723: activated 17th May. Replacement for EU4426 (with compressed data format).
- EU3702: activated by operator 26th June.
- The following aircraft were activated 18th June:
 - EU0110, EU0202, EU0230, EU0310, EU0453, EU0575, EU2200

(problems/faults reported here are apart from routine maintenance (less than 5 days). Information provided by the appointed Technical Co-ordinator of the E-AMDAR Programme; more details to be inserted in the following Quarterly reports)

Tables 4 to 6, Evaluation results

Presented values: Observation *minus* Reference (Model values), O–B.

All statistics are evaluated separately for two datasets:

- 1) Data from Ascent/Decent ($i_p i_p i_p = \text{ASC or DES}$)
- 2) Cruise level, level flight at cruising height ($i_p i_p i_p = \text{LVR or LVW}$)

Notes:

- Data with $i_p i_p i_p = \text{UNS}$ is not evaluated.
- AMDAR aircraft produce much more reports during Ascent/Decent than during Cruise level.
- O–B values larger than the stated criterion are presented in **bold**.
- Temperatures are in °C, wind speed in m/s and wind direction in degrees.
- The total number of reported observations in the table 4 to 6 differs from the total number in table 2. The main reason is that within table two data are presented from observations world wide, whereas in the tables 4 to 6 data are presented which were evaluated with using the HIRLAM model as reference. Since this model is a limited area model, only those data were evaluated which were observed within the HIRLAM area (roughly Europe, Northern Africa and the North Atlantic, see Annex 1 - Figure 3) and within the three hours time-window around main and intermediate hours (eight times a day). Other reasons for this difference are incorrect encoding, cases with identical reports (only one is used) or in case of incomplete bulletins.
- Notice that a number of aircraft only report in ascent/descent phase.
- For wind direction (tabel 6) the column "Observed" is not filled to avoid confusion. For the column with the mean differences (*i.e.* Obs-backgrnd, Mean), these values are calculated based on $\langle |\Delta DD| \rangle (= \text{AVG}(\text{ABS}(DD_OBS - DD_MOD)))$ resulting in non-negative values.

Legends

Number of Reports	Actual number of reports used for calculation of values
Observed Mean	Average value of the parameter for relevant phase in units of °C (for temperature), m/s (wind speed) or degrees (wind direction)
Observed SD	Standard Deviation of observed parameter
Obs–Backgrnd Mean	Average value of calculated differences (observed parameter minus model output value)
Obs–Backgrnd SD	Standard Deviation of calculated differences (observed parameter minus model output value)

a) Table 4, Temperature (°C)

2002-II TA	Temperature Cruise level in °C					Temperature Ascent & Descent in °C					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
	EU0002						9034	-17.3	18.1	-0.2	1.0
	EU0003	9	-42.8	16.6	-0.3	1.2	24	0.4	12.0	-0.9	1.6
	EU0021	1261	-46.4	14.3	-0.2	1.2	5734	-3.1	10.9	-0.3	1.1
	EU0022	2527	-52.0	10.9	0.0	1.2	6863	2.6	12.3	-0.5	1.4
	EU0032	676	-46.5	12.5	-0.1	1.8	1818	7.6	8.5	-0.1	1.3
	EU0034	691	-45.0	10.3	0.0	1.0	1156	7.2	8.4	-0.2	0.9
	EU0041	1329	-45.0	15.1	1.2	1.3	7906	-9.2	21.8	0.5	1.2
	EU0043	1714	-46.4	15.3	0.9	1.3	7491	-8.2	20.8	0.2	1.2
	EU0045	2708	-47.1	7.9	-0.2	1.7	1058	4.2	12.9	-0.2	1.1
	EU0047	1453	-46.1	14.7	0.7	1.2	7662	-8.3	21.7	0.2	1.2
	EU0049						7396	-18.4	19.9	-0.2	1.1
	EU0051	1717	-52.2	8.5	-0.3	1.3	3428	3.3	13.2	-0.6	1.4
	EU0052	1466	-44.7	15.9	-0.5	1.2	8285	-8.2	20.9	-0.5	1.2
	EU0054	1149	-53.5	8.3	-0.4	1.4	2186	2.8	13.1	-0.4	1.4
	EU0055						4371	-13.8	17.7	0.1	1.0
	EU0059	1521	-44.1	16.0	0.0	1.0	9013	-7.7	20.3	-0.1	1.2
	EU0060	183	-45.1	8.1	-0.5	1.3	122	7.7	11.1	-0.3	1.2
	EU0061	1486	-44.7	17.2	-0.2	1.1	8600	-8.1	20.8	-0.4	1.1
	EU0072	1039	-45.3	15.8	0.0	1.1	7287	2.9	11.8	-0.5	1.2
	EU0073	5565	-50.2	8.0	0.9	1.5	6864	2.5	21.1	0.3	1.6
	EU0081	1856	-49.7	11.6	0.3	1.2	5870	3.5	12.4	-0.1	1.3
	EU0082						6583	-18.7	18.4	0.3	1.0
	EU0086	5285	-43.8	23.1	0.8	1.8	5651	3.1	20.8	0.2	1.4
	EU0088	2118	-49.5	12.1	1.3	1.8	8014	4.4	12.1	0.4	1.3
	EU0106	1270	-42.7	18.1	-0.2	1.1	9203	-8.1	20.5	-0.3	1.1
	EU0109	3438	-51.5	10.3	0.2	1.4	8162	3.9	12.4	-0.1	1.3
	EU0110	1524	-48.5	6.4	0.0	1.7	664	5.1	9.2	-0.2	0.9
	EU0120	5400	-50.6	8.0	0.2	1.5	6937	2.8	20.0	0.0	1.5
	EU0123	3266	-49.6	7.4	0.1	1.5	1905	-4.0	12.3	-0.1	1.4
	EU0124						8033	-17.0	18.0	0.6	1.0
	EU0158	981	-43.8	14.4	0.8	1.0	5143	-6.3	20.8	0.5	1.2
	EU0167	1642	-44.2	14.3	1.1	1.2	8146	-7.2	20.4	0.5	1.2
	EU0177	5219	-50.4	8.2	0.9	1.5	6665	2.5	21.1	0.3	1.4
	EU0185	1544	-46.2	12.6	0.5	1.1	7032	-5.4	20.0	0.3	1.2
	EU0202	1539	-47.0	7.9	-0.1	1.7	688	6.5	9.8	-0.3	1.1
	EU0203	4398	-49.9	8.5	1.0	1.6	4552	3.5	20.3	0.4	1.6
	EU0204	1035	-48.9	12.5	0.7	1.2	4481	6.4	11.7	-0.2	1.4
	EU0230	1339	-45.2	8.2	0.4	1.8	636	8.0	10.6	0.0	0.8
	EU0234						8593	-17.5	18.3	-0.1	1.0
	EU0251	1473	-44.7	16.5	-0.3	1.1	9102	-8.4	20.7	-0.4	1.1
	EU0263	4548	-48.1	9.1	0.4	1.5	4290	7.1	12.7	0.0	1.2

2002-II TA	Temperature Cruise level in °C					Temperature Ascent & Descent in °C					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU0281	106	-40.7	13.7	0.3	1.1	467	6.3	7.5	0.6	1.4	
EU0299						8949	-16.7	19.5	-0.2	1.1	
EU0301	1848	-46.9	14.4	0.6	1.1	8760	-8.0	21.3	0.4	1.1	
EU0303	818	-44.9	16.9	-0.3	1.1	5528	-9.4	20.5	-0.4	1.2	
EU0307	1517	-44.8	17.6	-0.4	1.1	9941	-6.8	20.1	-0.4	1.1	
EU0310	1367	-47.8	7.7	0.0	1.8	610	6.7	10.0	-0.2	1.0	
EU0311	1473	-45.4	12.2	0.5	1.1	5888	-5.7	20.2	0.2	1.5	
EU0313	1267	-42.5	14.7	0.7	1.1	6796	-6.4	20.1	0.4	1.2	
EU0316	1231	-45.1	14.2	1.5	1.3	5888	-8.9	22.1	0.7	1.1	
EU0319	1544	-46.9	15.8	0.2	1.2	7377	-7.9	21.1	0.1	1.2	
EU0359	1226	-43.7	13.6	0.9	1.2	6597	-6.2	19.7	0.4	1.1	
EU0367						8255	-18.3	18.0	-0.2	1.0	
EU0373	1531	-44.7	16.2	-0.2	1.1	9701	-8.2	20.7	-0.2	1.1	
EU0394	1736	-45.5	15.6	0.0	1.2	8313	-7.7	20.2	-0.2	1.2	
EU0413	1506	-44.8	16.7	-0.5	1.1	8764	-7.1	20.3	-0.5	1.1	
EU0432						9696	-16.8	19.6	-0.2	1.0	
EU0442	1505	-45.7	14.5	0.4	1.1	7984	-7.4	20.5	0.0	1.2	
EU0453	1368	-45.2	7.6	0.1	1.6	732	7.5	10.3	-0.3	0.8	
EU0457	1771	-51.7	7.1	0.2	1.7	365	16.0	10.9	0.1	1.9	
EU0476	1474	-41.1	20.5	-0.1	1.1	6289	-10.2	23.6	0.0	1.3	
EU0511	1280	-42.5	18.8	-0.3	1.1	8804	-8.4	20.2	-0.4	1.2	
EU0558	982	-43.8	17.4	0.6	1.3	5587	-6.0	20.0	0.3	1.5	
EU0568						4556	-18.9	19.0	0.6	0.9	
EU0575	1244	-44.0	9.9	-0.1	1.5	599	9.0	10.2	-0.2	1.2	
EU0583	1461	-44.0	17.7	0.2	1.1	7940	-8.0	20.2	-0.1	1.2	
EU0601	1632	-44.5	16.1	0.0	1.2	8948	-7.9	20.8	-0.2	1.2	
EU0676	1447	-44.6	17.3	-0.5	1.2	8182	-6.8	19.7	-0.3	1.1	
EU0711	1386	-44.1	15.7	0.1	1.1	6752	-11.2	23.5	0.1	1.3	
EU0723	922	-26.3	28.5	0.8	2.4	7926	-11.2	22.3	0.1	1.2	
EU0802	1723	-45.7	13.8	0.6	1.3	7719	-5.7	20.0	0.2	1.3	
EU0807	703	-48.8	10.2	-0.2	1.0	2762	-0.6	12.3	-0.6	1.3	
EU0810	990	-43.6	15.8	0.1	1.2	6275	-7.0	20.1	-0.3	1.2	
EU0826						7049	-17.5	18.5	0.0	1.0	
EU0875	1460	-44.0	15.2	0.7	1.0	7042	-6.4	20.1	0.4	1.2	
EU0921	1504	-45.0	14.7	0.5	1.1	8344	-7.7	20.8	-0.1	1.2	
EU0934	6374	-48.9	8.2	-0.2	1.6	2395	-1.1	12.3	0.0	1.3	
EU0947	6367	-48.7	8.3	0.1	1.7	2489	-0.1	12.8	0.0	1.2	
EU0961	5277	-49.4	8.0	0.0	1.5	2709	-1.3	12.1	0.0	1.3	
EU0985	7611	-49.7	7.2	-0.3	1.7	2797	-0.3	12.5	-0.3	1.0	
EU1001						5454	-18.5	18.6	-0.2	1.1	
EU1002	7229	-49.8	7.3	-0.1	1.6	2723	0.0	12.4	-0.2	1.1	
EU1234	1495	-43.7	17.6	-0.4	1.1	9030	-7.8	20.4	-0.4	1.1	
EU1282	3252	-48.5	7.4	0.1	1.5	446	5.3	11.5			

2002-II TA	Temperature Cruise level in °C					Temperature Ascent & Descent in °C					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU1301	1334	-46.3	8.8	0.0	1.3	1067	4.8	10.8			
EU1334	4874	-51.5	7.7	0.5	1.8	2629	7.4	12.8	-0.1	1.2	
EU1337	1060	-36.2	23.3	0.3	1.3	7905	-11.0	22.8	0.4	1.6	
EU1411	742	-51.2	8.5	0.1	1.8	60	13.0	12.4			
EU1456						5912	-19.0	18.9	0.6	1.0	
EU1495	98	-49.7	13.1	0.2	1.2	38	1.9	13.7	-0.1	1.0	
EU1498	1548	-44.7	15.8	-0.3	1.1	8638	-8.3	20.8	-0.3	1.2	
EU1532						8035	-16.7	18.4	-0.4	1.0	
EU1547	1211	-42.9	17.3	0.0	1.0	8651	-8.4	20.3	-0.2	1.1	
EU1567						8413	-17.0	19.6	-0.1	1.2	
EU1593	3894	-47.9	7.4	-0.2	1.7	1501	4.3	12.7	-0.1	1.0	
EU1698						8661	-17.8	18.0	0.1	1.0	
EU1790	604	-49.4	10.2	-0.2	1.1	5331	-8.3	17.5	-0.4	1.2	
EU1863	1511	-44.1	17.0	-0.3	1.3	9010	-7.7	20.3	-0.4	1.2	
EU1929	2040	-49.7	6.5	0.2	1.5	40	3.4	18.4			
EU2017	1668	-44.4	14.8	0.0	1.2	9201	-8.1	20.8	-0.3	1.1	
EU2043	1697	-47.4	7.2	0.4	1.7	172	10.6	10.0			
EU2055	1621	-45.6	17.3	-0.4	1.2	10015	-7.2	20.5	-0.3	1.1	
EU2130	1330	-42.9	17.4	0.3	1.2	8729	-7.4	20.7	-0.1	1.1	
EU2165	1606	-44.9	16.4	0.1	1.1	9067	-7.0	19.8	-0.2	1.2	
EU2189	1457	-43.6	14.3	0.8	1.2	6932	-6.9	20.4	0.3	1.2	
EU2200	929	-47.2	8.7	0.2	2.1	414	7.9	9.5	-0.1	1.2	
EU2201	1326	-43.7	17.1	-0.3	1.1	8306	-7.7	20.8	-0.3	1.2	
EU2247	1479	-43.5	16.0	0.1	1.2	8695	-8.4	20.7	-0.2	1.1	
EU2301	1175	-46.2	14.8	1.1	1.5	5958	-8.2	21.2	0.3	1.2	
EU2327	5461	-50.0	8.3	0.5	1.5	5759	4.5	21.1	0.2	1.7	
EU2356	6043	-49.2	7.9	0.0	1.5	1855	0.8	21.0	0.0	1.2	
EU2389	1521	-44.8	14.0	-0.4	1.2	9807	1.9	11.5	-0.7	1.3	
EU2401	1181	-44.5	18.5	0.0	1.2	6966	-11.1	23.6	0.3	1.2	
EU2430	1009	-43.3	19.0	0.1	1.2	7261	-10.9	23.0	0.2	1.2	
EU2530	1273	-46.5	17.5	-0.1	1.3	7480	-11.0	24.2	0.1	1.2	
EU2547	2953	-49.1	8.7	0.1	1.5	1380	-1.6	11.8	0.1	1.3	
EU2559	1282	-45.6	13.0	1.2	1.3	7975	-10.3	22.6	0.3	1.2	
EU2590	600	-46.0	8.0	0.8	1.3	7886	-5.9	16.7	-0.1	1.2	
EU2595	1029	-43.7	20.7	-0.3	1.3	6938	-11.3	23.5	0.0	1.3	
EU2610	1013	-47.5	12.4	-0.5	1.5	1584	-1.6	24.7	0.3	3.2	
EU2618	641	-47.0	8.8	0.5	1.4	7033	-7.7	16.5	-0.2	1.1	
EU2630	534	-49.9	10.2	0.5	1.4	3542	-7.0	18.0	-0.3	1.2	
EU2673	15	-13.5	24.6	-16.3	16.2	134	-10.6	22.9	-14.2	18.6	
EU2751	3783	-48.2	7.6	-0.3	1.5	358	8.4	10.6			
EU2773	3210	-51.7	6.8	-0.1	1.6	518	4.2	11.8			
EU2845	1209	-41.6	15.3	-0.1	1.1	9632	2.5	11.5	-0.7	1.3	
EU2912	89	-47.2	13.4	-0.3	1.0	468	-2.2	12.2	-0.2	1.2	

2002-II TA	Temperature Cruise level in °C					Temperature Ascent & Descent in °C					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU2978						5081	-18.3	22.4	-0.3	1.1	
EU2984	490	-49.8	7.1	0.1	1.2	3869	-7.4	18.1	-0.5	1.1	
EU3000	1346	-42.6	18.1	-0.4	1.1	9340	-7.5	20.4	-0.4	1.2	
EU3181	4402	-48.5	6.9	0.0	1.6	574	4.7	11.0			
EU3257	1235	-44.5	16.9	-0.4	1.1	8270	-8.0	19.7	-0.4	1.2	
EU3268	669	-51.1	7.5	0.0	1.2	5685	-7.5	18.4	-0.3	1.2	
EU3270						7697	-18.1	20.9	0.3	1.1	
EU3321	335	-45.6	11.0	0.7	2.0	3240	-5.1	17.3	0.3	1.4	
EU3358						7597	-20.0	23.0	-0.3	1.1	
EU3421	1130	-44.3	13.8	1.5	1.1	5900	-7.5	20.8	0.8	1.2	
EU3469						7310	-16.0	19.5	-0.3	1.0	
EU3533						8791	-18.2	19.8	0.2	1.1	
EU3544	370	-34.1	24.0	0.0	2.3	2392	-9.5	24.3	0.3	1.5	
EU3598	771	-41.5	20.3	0.1	1.2	5477	-12.9	22.8	0.2	1.2	
EU3599	824	-39.8	20.8	-0.1	1.2	5582	-9.2	23.0	0.1	1.2	
EU3621						2629	-22.2	20.3	-0.4	1.0	
EU3654	642	-44.6	10.4	0.7	1.3	6390	-6.2	17.1	-0.3	1.3	
EU3684	687	-48.6	10.3	0.9	1.4	3850	-6.4	18.3	-0.1	1.1	
EU3702	39	-14.4	17.3	3.0	3.1	396	0.7	9.3	0.9	2.3	
EU3714						8767	-17.3	18.8	0.0	1.0	
EU3725	4105	-49.2	7.5	0.1	1.5	537	8.2	11.4			
EU3755						7020	-22.5	22.3	-0.3	1.1	
EU3874	2452	-49.2	7.7	0.2	1.5	452	9.2	9.8			
EU3908	595	-45.3	9.7	0.7	1.3	13530	-6.6	16.3	-0.2	1.1	
EU3972						6589	-20.1	22.7	-0.2	1.2	
EU4002	823	-47.5	10.4	0.3	1.2	4253	-6.8	18.0	-0.3	1.1	
EU4021						7589	-20.5	23.0	-0.3	1.2	
EU4278						4283	-15.1	18.7	-0.4	1.1	
EU4333	688	-47.3	9.4	0.7	1.2	8689	-6.2	16.4	-0.1	1.1	
EU4426	563	-50.0	9.4	-0.2	1.1	1596	-1.3	12.2	-0.5	1.3	
EU4444	569	-48.3	8.5	0.1	1.1	6731	-6.0	16.9	-0.4	1.2	
EU4463						7609	-16.3	19.8	0.0	1.0	
EU4491						8435	-15.3	19.2	-0.3	1.0	
EU4519	626	-46.4	9.6	0.6	1.2	6739	-6.4	16.9	-0.1	1.2	
EU4527	954	-31.4	27.1	0.6	2.4	7857	-11.5	23.0	0.2	1.2	
EU4529	1069	-43.4	15.4	0.0	1.1	8349	2.6	11.5	-0.6	1.3	
EU4532	1151	-31.4	27.3	0.3	1.2	8002	-10.5	22.7	0.2	1.2	
EU4573	713	-45.9	8.8	0.7	1.5	14026	-7.1	16.5	-0.2	1.2	
EU4582	678	-45.9	8.6	1.2	1.3	14192	-6.6	16.4	0.3	1.2	
EU4587	405	-42.2	13.0	0.7	1.2	1023	0.3	11.5	-0.1	1.1	
EU4591	526	-47.4	9.2	0.5	1.1	7124	-8.0	17.0	-0.2	1.2	
EU4593	1167	-46.3	14.5	1.8	1.3	5664	-9.7	22.0	0.9	1.1	
EU4607	852	-41.4	9.3	0.5	1.2	15966	-6.3	16.1	-0.1	1.1	

2002-II TA	Temperature Cruise level in °C					Temperature Ascent & Descent in °C					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU4699	625	-49.2	9.7	-0.1	1.2	5731	-8.8	17.8	-0.3	1.3	
EU4721	699	-48.2	11.1	0.5	1.1	3513	-6.2	18.1	-0.3	1.2	
EU4792	716	-49.9	11.2	0.2	1.4	4473	-6.4	17.4	-0.4	1.2	
EU4838						7999	-20.0	20.9	-0.3	1.0	
EU4853	637	-46.0	10.0	0.1	1.1	5989	-5.8	16.8	-0.4	1.3	
EU4865	201	-53.7	5.5	0.3	1.1	2364	-11.5	15.9	0.0	1.3	
EU4896						32	10.7	5.5	0.0	0.5	
EU4950	523	-47.6	12.1	1.0	1.4	3256	-4.8	17.1	0.1	1.2	
EU5098						8331	-18.9	20.6	-0.3	1.1	
EU5134						6866	-18.7	23.0	-0.4	1.1	
EU5167	1537	-44.7	13.8	-0.3	1.2	10602	2.6	11.7	-0.5	1.3	
EU5175	78	-41.5	16.8	0.0	0.9	279	12.5	7.6	0.0	0.9	
EU5182	6	-40.9	17.5	1.0	0.7	56	-2.8	11.0	-0.5	1.6	
EU5331	1385	-47.4	14.1	1.1	1.3	6066	-10.1	21.7	0.6	1.2	
EU5349						6580	-17.6	21.0	0.2	1.1	
EU5351	1669	-45.1	13.4	0.6	1.1	7758	-6.5	19.9	0.2	1.2	
EU5372						3723	-17.8	19.6	-0.2	1.1	
EU5429						2728	-2.4	14.4			
EU5435	1417	-43.4	14.3	1.3	1.2	7599	-5.5	19.7	0.8	1.3	
EU5441	609	-48.4	9.1	1.3	1.3	4033	-6.3	17.6	-0.1	1.1	
EU5478	720	-44.5	12.2	0.1	1.2	13665	-7.8	16.1	-0.5	1.2	
EU5529	612	-47.6	8.4	0.8	1.3	14304	-7.1	16.3	-0.2	1.2	
EU5587	1541	-44.4	14.3	0.9	1.2	7448	-5.3	19.8	0.4	1.2	
EU5591	1023	-46.3	10.3	-0.1	1.1	3528	2.7	12.8	-0.6	1.5	
EU5593	91	-43.9	11.6	0.2	1.2	101	15.4	8.6	0.0	1.1	
EU5612	698	-47.9	9.4	-0.4	1.1	6323	-8.7	17.5	-0.4	1.2	
EU5613	1495	-44.1	14.0	0.8	1.0	7861	-6.3	20.5	0.3	1.2	
EU5777	20	-56.0	3.3	1.5	1.7	136	-11.2	15.5	0.1	0.9	
EU5802	245	-53.0	6.8	-0.1	1.1	2463	-9.8	17.1	-0.1	1.2	
EU5821	389	-50.1	11.0	0.5	1.1	3834	-9.9	16.6	0.0	1.4	
EU5891	1333	-44.1	14.9	0.8	1.9	7768	-5.6	20.2	0.5	1.2	
EU6264	799	-41.8	10.0	-0.2	1.1	13251	-6.2	16.2	-0.4	1.1	
EU6281	513	-46.7	7.8	0.7	1.1	6887	-6.8	16.8	-0.3	1.3	
EU6287						7431	-18.2	23.6	-0.3	1.1	
EU6349	797	-48.7	11.2	1.3	1.4	4821	-5.7	18.1	0.2	1.1	
EU6444	704	-49.9	10.9	-0.4	1.3	4373	-6.0	17.8	-0.6	1.3	
EU6524	1191	-46.9	10.6	0.4	1.1	4024	2.1	13.2	-0.2	1.3	
EU6527	615	-47.8	10.0	0.8	1.4	4573	-6.1	17.0	-0.1	1.2	
EU6544	1867	-46.7	14.4	1.6	1.4	6855	-7.5	21.4	0.8	1.2	
EU6556	1323	-46.3	14.7	0.7	1.1	7426	-9.2	22.0	0.6	1.2	
EU6723	548	-43.3	10.0	0.5	1.2	2364	3.6	12.2	-0.6	1.5	
EU6743	1708	-44.7	13.6	1.4	1.3	8700	-5.7	20.2	0.7	1.3	
EU6821	281	-45.0	12.0	0.0	1.2	481	10.4	9.5	0.1	1.1	

2002-II TA	Temperature Cruise level in °C					Temperature Ascent & Descent in °C					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU6890	566	-48.2	11.3	0.6	1.3	2988	-5.9	17.1	-0.3	1.2	
EU6893						7193	-17.7	20.0	-0.1	1.0	
EU6923						4880	-14.8	21.3	-0.4	1.2	
EU7001	1274	-44.0	14.0	0.7	1.0	6388	-6.6	20.5	0.5	1.2	
EU7082						8012	-23.4	22.7	0.0	1.0	
EU7119	618	-34.2	28.6	0.8	2.0	2325	-14.6	22.5	0.1	1.2	
EU7218	461	-48.7	7.7	0.3	1.2	3186	-7.5	17.4	-0.4	1.2	
EU7285						566	-25.0	18.9	2.6	2.0	
EU7521						6601	-18.3	24.0	-0.1	1.1	
EU7629	1004	-48.7	12.1	0.9	1.3	4944	-5.2	17.3	0.2	1.4	
EU7634						7361	-21.0	22.8	0.2	1.1	
EU7635	1139	-39.9	22.6	0.0	1.2	7066	-10.9	23.3	0.0	1.2	
EU7643	739	-48.2	11.6	-0.2	1.2	3310	-6.0	18.4	-0.8	1.4	
EU7654	376	-49.7	8.5	-0.1	1.3	2530	-6.0	17.8	-0.4	1.2	
EU7724	549	-49.1	10.8	0.4	1.3	3082	-6.8	17.8	-0.3	1.2	
EU7865						6956	-16.9	20.1	-0.3	1.0	
EU7888	532	-46.9	9.0	0.5	1.3	5754	-6.5	16.7	-0.1	1.3	
EU7894	553	-42.6	13.9	0.4	1.2	1964	-6.5	24.6	0.2	1.2	
EU8264						7158	-16.7	22.0	-0.1	1.0	
EU8431						8157	-18.9	20.6	-0.2	1.1	
EU8478						7434	-19.8	23.4	-0.1	1.1	
EU8520	392	-47.1	9.9	1.5	1.5	2802	-5.9	17.3	0.0	1.2	
EU8598						5715	-15.8	21.9	-0.1	1.1	
EU8605						3819	-19.4	21.6	-0.5	1.1	
EU8632						7655	-18.9	22.4	-0.3	1.2	
EU8733	1622	-46.1	15.3	0.8	1.2	8182	-8.5	20.8	0.3	1.1	
EU8736						6169	-21.5	23.2	-0.3	1.0	
EU8742	1046	-44.7	15.4	1.6	3.0	6641	-9.0	21.7	0.9	1.2	
EU8787	1854	-46.0	13.5	0.6	1.1	7735	-5.2	20.0	0.4	1.2	
EU8789						6588	-16.8	20.8	-0.3	1.1	
EU8891						3990	-21.2	22.3	-0.3	1.1	
EU8943						7873	-16.9	18.1	-0.2	1.0	
EU8969	818	-49.2	11.1	0.4	1.3	4368	-6.9	18.2	-0.5	1.2	
EU9013	1748	-45.3	14.0	0.3	1.1	7806	-6.7	20.3	0.2	1.1	
EU9023						8197	-20.0	23.0	-0.2	1.1	
EU9145	596	-47.6	9.8	1.4	1.9	3691	-6.0	17.4	-0.3	1.4	
EU9158	705	-48.0	7.4	0.2	1.3	14650	-6.8	16.5	-0.3	1.2	
EU9234	753	-41.9	7.5	-0.1	1.1	15267	-7.1	16.2	-0.5	1.1	
EU9245	685	-40.7	8.2	0.2	1.0	17017	-7.0	16.1	-0.4	1.1	
EU9356						7663	-15.7	19.2	-0.3	1.1	
EU9378						6855	-19.9	19.5	-0.2	1.1	
EU9544	517	-51.7	8.0	-0.4	1.1	5938	-8.6	17.6	-0.3	1.3	
EU9589						8380	-19.4	23.0	-0.6	1.1	

2002-II TA	Temperature Cruise level in °C					Temperature Ascent & Descent in °C					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU9622	471	-50.6	8.3	0.2	1.2	4349	-9.1	17.5	-0.2	1.3	
EU9678						5101	-13.8	19.2	-0.1	1.1	
EU9680	749	-52.1	7.2	-0.3	1.3	5716	-7.3	18.3	-0.3	1.2	
EU9692						1818	-20.7	24.4	-0.3	1.2	
EU9723	1505	-43.8	15.5	1.0	1.0	8153	-6.1	20.5	0.6	1.1	
EU9729	723	-50.3	9.5	-0.3	1.2	4898	-7.5	18.3	-0.5	1.1	
EU9734						8399	-17.7	22.6	-0.4	1.1	
EU9743	483	-50.2	7.1	-0.1	1.0	6223	-8.2	17.4	-0.4	1.2	
EU9883	1462	-43.5	15.1	0.7	1.1	7303	-6.8	20.4	0.5	1.2	
EU9967						8038	-19.5	22.8	-0.3	1.1	

[266]

b) Table 5, Wind Speed (m/s)

2002-II FF	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
	EU0002						9034	13.5	8.7	0.3	2.7
	EU0003	9	16.5	7.3	1.0	1.9	24	7.6	2.8	0.6	1.4
	EU0021	1261	20.6	11.2	0.1	2.6	5734	11.6	7.7	0.3	2.1
	EU0022	2527	18.4	11.0	0.1	2.4	6863	9.1	6.1	0.6	2.2
	EU0032	676	24.8	13.1	0.2	3.2	1818	8.8	5.5	0.3	2.2
	EU0034	691	19.4	13.7	0.1	2.8	1156	8.9	6.1	0.3	2.1
	EU0041	1329	18.2	12.0	0.3	2.4	7906	11.7	9.4	0.2	2.2
	EU0043	1714	19.2	12.1	0.3	2.6	7491	11.3	8.8	0.3	2.2
	EU0045	2708	23.4	14.4	0.1	2.6	1058	10.4	6.4	0.1	1.9
	EU0047	1453	17.8	10.4	0.1	2.5	7662	10.9	8.8	0.2	2.2
	EU0049						7396	13.6	9.2	0.4	2.4
	EU0051	1717	20.6	11.5	0.1	2.5	3428	8.2	5.7	0.5	2.2
	EU0052	1466	18.1	11.7	0.4	2.9	8285	11.0	8.7	0.3	2.5
	EU0054	1149	22.6	13.8	0.1	2.6	2186	8.4	6.8	0.5	2.3
	EU0055						4371	12.6	8.8	-0.1	2.4
	EU0059	1521	19.6	11.8	0.4	2.6	9013	11.3	8.8	0.3	2.4
	EU0060	183	20.5	12.0	0.2	2.1	122	8.3	3.9	0.5	1.5
	EU0061	1486	19.5	11.5	0.4	2.6	8600	11.0	8.8	0.2	2.4
	EU0072	1039	19.0	11.0	0.2	2.3	7287	9.5	6.7	0.6	2.1
	EU0073	5565	23.5	14.6	0.2	2.3	6864	10.7	8.9	0.2	2.0
	EU0081	1856	18.8	10.6	0.1	2.4	5870	9.3	6.7	0.6	2.0
	EU0082						6583	14.1	9.8	0.4	2.8
	EU0086	5285	21.8	15.6	0.1	2.3	5651	10.1	8.4	0.2	2.0
	EU0088	2118	19.6	11.7	0.3	2.5	8014	9.0	6.4	0.6	2.1
	EU0106	1270	17.9	11.3	0.2	2.5	9203	10.7	8.6	0.3	2.3
	EU0109	3438	18.8	10.6	0.1	2.7	8162	9.0	6.3	0.6	2.1
	EU0110	1524	19.0	12.2	0.2	2.3	664	9.8	5.3	0.2	1.7
	EU0120	5400	23.9	15.0	0.2	2.4	6937	10.8	9.2	0.3	2.1
	EU0123	3266	21.8	14.6	0.0	2.2	1905	9.9	6.7	0.3	2.2
	EU0124						8033	13.0	8.3	0.4	2.7
	EU0158	981	18.5	12.2	0.2	2.3	5143	10.2	7.5	0.3	2.3
	EU0167	1642	19.5	12.5	0.2	2.5	8146	10.8	8.9	0.3	2.2
	EU0177	5219	23.4	14.6	0.1	2.3	6665	10.8	8.9	0.3	2.2
	EU0185	1544	20.6	12.3	0.3	2.6	7032	10.6	8.6	0.2	2.1
	EU0202	1539	21.2	12.8	0.1	2.4	688	10.2	5.4	0.3	1.8
	EU0203	4398	24.6	14.5	0.1	2.4	4552	10.5	8.4	0.3	2.1
	EU0204	1035	23.2	14.2	0.2	2.7	4481	8.8	6.3	0.6	2.1
	EU0230	1339	17.2	11.0	0.1	2.1	636	9.2	4.7	0.3	1.9
	EU0234						8593	12.7	8.2	0.1	2.6
	EU0251	1473	19.4	11.4	0.3	2.6	9102	11.6	9.2	0.1	2.2
	EU0263	4548	25.4	15.5	0.2	2.7	4290	9.2	7.2	0.3	2.1

2002-II FF	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU0281	106	14.8	16.1	0.2	2.1	467	9.7	5.3	0.9	2.2	
EU0299						8949	14.3	10.5	0.2	2.7	
EU0301	1848	18.0	11.8	0.2	2.3	8760	10.5	8.8	0.2	2.3	
EU0303	818	18.4	11.2	0.4	2.7	5528	10.6	8.2	0.1	2.3	
EU0307	1517	20.0	12.3	0.2	2.5	9941	10.5	8.2	0.1	2.3	
EU0310	1367	19.8	12.0	0.2	2.5	610	9.5	5.0	0.3	1.7	
EU0311	1473	20.0	11.4	0.1	2.7	5888	10.0	8.1	0.2	2.2	
EU0313	1267	19.7	11.8	0.3	2.4	6796	10.2	8.0	0.1	2.2	
EU0316	1231	19.0	11.1	0.2	2.6	5888	10.6	8.4	0.1	2.2	
EU0319	1544	17.5	10.9	0.2	2.3	7377	10.6	8.7	0.1	2.2	
EU0359	1226	21.1	11.6	0.3	2.7	6597	10.3	8.8	0.1	2.1	
EU0367						8255	14.0	8.7	0.2	2.6	
EU0373	1531	19.4	11.4	0.3	2.8	9701	11.4	8.7	0.2	2.4	
EU0394	1736	20.5	11.9	0.3	2.8	8313	11.5	9.5	0.2	2.5	
EU0413	1506	19.5	12.1	0.4	2.7	8764	10.6	8.9	0.3	2.3	
EU0432						9696	14.0	9.7	0.1	2.9	
EU0442	1505	20.2	11.2	0.3	2.7	7984	11.0	8.8	0.3	2.4	
EU0453	1368	20.7	13.4	0.1	2.5	732	9.4	5.0	0.1	1.9	
EU0457	1771	19.7	13.0	0.0	2.2	365	9.9	3.4	0.2	2.7	
EU0476	1474	17.5	11.9	0.2	2.8	6289	13.2	10.0	0.8	2.7	
EU0511	1280	18.9	12.2	0.4	2.5	8804	11.3	8.9	0.2	2.4	
EU0558	982	18.8	11.3	0.1	3.3	5587	10.3	8.1	0.1	2.9	
EU0568						4556	14.4	8.9	0.3	2.5	
EU0575	1244	20.3	13.0	0.2	2.4	599	8.9	4.7	0.0	2.2	
EU0583	1461	19.7	11.6	0.3	2.6	7940	10.8	8.6	0.2	2.3	
EU0601	1632	20.6	12.0	0.3	2.6	8948	11.3	8.9	0.2	2.3	
EU0676	1447	20.5	12.1	0.3	2.7	8182	11.1	9.0	0.2	2.3	
EU0711	1386	17.7	10.7	0.3	4.2	6752	11.3	8.0	0.8	3.5	
EU0723	922	14.4	11.9	0.2	2.4	7926	13.1	10.2	0.6	2.5	
EU0802	1723	19.5	11.9	0.1	3.2	7719	10.0	8.2	0.1	2.4	
EU0807	703	20.1	12.3	0.3	2.6	2762	8.7	6.9	0.5	2.2	
EU0810	990	19.2	11.7	0.3	2.7	6275	10.5	8.3	0.4	2.4	
EU0826						7049	13.7	9.7	0.2	2.7	
EU0875	1460	18.0	10.9	0.2	2.6	7042	10.5	7.8	0.4	2.2	
EU0921	1504	19.7	11.3	0.4	2.8	8344	11.1	8.9	0.4	2.6	
EU0934	6374	22.9	14.1	0.1	2.4	2395	10.4	7.6	0.0	1.9	
EU0947	6367	23.6	15.2	0.1	2.5	2489	10.2	7.4	0.1	2.0	
EU0961	5277	23.2	15.0	0.1	2.2	2709	10.0	7.3	0.1	2.1	
EU0985	7611	23.0	14.4	0.1	2.4	2797	10.2	7.2	0.1	2.0	
EU1001						5454	13.5	9.7	0.3	2.7	
EU1002	7229	22.0	14.3	0.1	2.4	2723	9.8	6.9	0.2	1.9	
EU1234	1495	20.2	12.1	0.3	2.7	9030	10.9	8.4	0.1	2.5	
EU1282	3252	19.5	13.7	0.1	2.2	446	7.2	5.5			

2002-II FF	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU1301	1334	21.3	15.7	0.0	1.8	1067	7.4	5.8			
EU1334	4874	27.6	16.3	0.1	2.5	2629	9.0	6.2	0.3	2.0	
EU1337	1060	16.4	11.8	0.1	2.5	7905	12.4	9.5	0.6	2.4	
EU1411	742	24.8	14.5	0.1	2.3	60	6.1	2.4			
EU1456						5912	12.0	8.9	0.3	2.4	
EU1495	98	14.4	7.9	-0.2	1.9	38	6.8	4.2	0.2	1.8	
EU1498	1548	19.7	11.7	0.3	2.5	8638	11.6	8.8	0.2	2.5	
EU1532						8035	13.1	8.2	0.4	2.5	
EU1547	1211	18.0	11.3	0.2	2.6	8651	11.3	8.9	0.2	2.3	
EU1567						8413	13.7	9.5	0.2	2.7	
EU1593	3894	20.8	14.5	0.2	2.6	1501	9.1	6.2	0.0	1.9	
EU1698						8661	13.9	8.8	0.3	2.6	
EU1790	604	15.6	10.9	0.1	2.2	5331	8.8	6.7	0.4	2.1	
EU1863	1511	18.5	12.0	0.3	3.1	9010	11.5	9.0	0.3	2.6	
EU1929	2040	19.1	13.6	0.1	2.1	40	13.0	10.3			
EU2017	1668	17.4	10.4	0.3	2.6	9201	10.8	8.1	0.3	2.3	
EU2043	1697	20.9	14.7	0.0	2.2	172	7.1	5.6			
EU2055	1621	19.1	11.3	0.3	2.5	10015	11.2	9.2	0.1	2.3	
EU2130	1330	19.3	11.8	0.4	2.8	8729	11.2	9.3	0.3	2.5	
EU2165	1606	19.0	11.8	0.4	2.6	9067	10.8	8.5	0.3	2.3	
EU2189	1457	19.9	12.2	0.5	3.2	6932	10.4	8.5	0.2	2.4	
EU2200	929	18.0	11.1	0.0	2.3	414	9.7	5.2	0.5	2.2	
EU2201	1326	19.0	11.3	0.3	3.0	8306	11.1	8.6	0.2	2.4	
EU2247	1479	19.5	11.6	0.4	2.8	8695	11.4	8.8	0.3	2.4	
EU2301	1175	17.7	11.0	0.2	2.5	5958	11.2	9.3	0.1	2.2	
EU2327	5461	24.4	15.4	0.1	2.5	5759	10.6	8.4	0.4	2.4	
EU2356	6043	23.2	15.5	0.1	2.5	1855	9.2	7.7	0.0	2.2	
EU2389	1521	20.2	11.1	0.2	2.7	9807	9.2	6.3	0.6	2.2	
EU2401	1181	18.7	11.3	0.2	2.5	6966	13.1	9.8	0.6	2.4	
EU2430	1009	19.9	12.0	0.1	2.8	7261	13.5	10.2	0.7	2.5	
EU2530	1273	18.2	10.8	0.2	2.5	7480	11.5	9.7	0.8	2.3	
EU2547	2953	24.2	15.6	0.2	2.4	1380	11.3	7.9	0.2	1.9	
EU2559	1282	18.0	10.5	0.3	2.5	7975	10.7	9.2	0.2	2.2	
EU2590	600	16.7	10.4	-0.1	2.4	7886	10.4	8.2	0.1	2.5	
EU2595	1029	18.9	11.5	0.3	3.1	6938	12.2	9.3	0.7	2.5	
EU2610	1013	21.2	11.7	0.3	2.8	1584	11.8	9.6	0.2	2.8	
EU2618	641	15.9	11.1	-0.3	3.0	7033	8.8	7.1	0.2	2.2	
EU2630	534	20.6	12.0	0.2	2.3	3542	10.1	8.2	0.3	2.3	
EU2673	15	21.2	16.7	9.6	12.6	134	19.3	12.1	7.6	9.9	
EU2751	3783	18.7	12.9	0.1	2.4	358	7.3	5.1			
EU2773	3210	20.5	13.9	0.0	2.2	518	8.0	6.9			
EU2845	1209	21.7	11.8	0.3	2.7	9632	9.4	6.6	0.6	2.2	
EU2912	89	14.2	9.1	0.3	2.2	468	5.9	3.3	0.6	2.0	

2002-II FF	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU2978						5081	14.8	10.3	0.4	2.5	
EU2984	490	18.0	12.7	0.0	2.5	3869	8.3	7.0	0.3	2.0	
EU3000	1346	19.1	11.5	0.1	2.4	9340	10.1	7.9	0.1	2.3	
EU3181	4402	19.1	13.3	0.1	2.3	574	9.2	6.6			
EU3257	1235	17.8	11.2	0.3	2.7	8270	11.3	9.3	0.3	2.4	
EU3268	669	15.0	11.9	0.1	2.3	5685	8.7	6.4	0.3	2.1	
EU3270						7697	13.0	8.6	0.1	2.8	
EU3321	335	21.8	10.7	-0.1	2.7	3240	9.9	7.6	0.3	2.2	
EU3358						7597	13.9	9.7	0.4	2.5	
EU3421	1130	18.8	12.0	0.3	2.3	5900	10.7	8.7	0.2	2.2	
EU3469						7310	13.4	9.8	0.5	2.6	
EU3533						8791	14.7	10.8	0.4	2.4	
EU3544	370	18.9	14.8	-0.1	2.5	2392	17.1	12.3	0.6	2.6	
EU3598	771	17.4	11.4	0.3	2.6	5477	11.8	8.6	0.6	2.4	
EU3599	824	18.3	11.7	0.2	2.6	5582	12.6	9.4	0.6	2.7	
EU3621						2629	14.6	10.6	0.4	2.6	
EU3654	642	17.3	11.1	0.0	2.9	6390	10.1	7.4	0.4	2.4	
EU3684	687	15.4	10.4	0.2	2.5	3850	9.2	7.2	0.3	2.2	
EU3702	39	10.0	4.9	0.6	3.6	396	8.3	3.9	0.5	3.0	
EU3714						8767	14.3	9.5	0.2	2.7	
EU3725	4105	19.7	13.8	0.1	2.2	537	7.7	5.4			
EU3755						7020	15.0	10.9	0.5	2.7	
EU3874	2452	20.3	13.9	0.0	2.2	452	7.4	5.1			
EU3908	595	17.0	11.5	0.2	2.2	13530	9.5	7.3	0.2	2.4	
EU3972						6589	14.7	10.6	0.3	2.5	
EU4002	823	17.2	10.4	0.2	2.4	4253	10.0	8.1	0.3	2.3	
EU4021						7589	14.3	10.6	0.4	2.3	
EU4278						4283	14.3	10.8	0.4	2.6	
EU4333	688	16.1	11.4	0.2	2.3	8689	9.6	7.3	0.1	2.3	
EU4426	563	18.9	11.4	0.1	2.3	1596	8.0	6.0	0.4	2.2	
EU4444	569	16.3	11.2	0.3	2.5	6731	9.4	6.8	0.4	2.3	
EU4463						7609	13.3	8.6	0.6	2.5	
EU4491						8435	13.6	9.3	0.4	2.5	
EU4519	626	15.5	11.1	0.1	2.2	6739	9.2	6.7	0.4	2.3	
EU4527	954	17.0	12.4	0.1	2.6	7857	13.5	10.6	0.8	2.6	
EU4529	1069	21.8	12.0	0.2	2.5	8349	9.5	6.7	0.5	2.2	
EU4532	1151	16.0	12.6	0.2	2.7	8002	12.6	9.5	0.5	2.4	
EU4573	713	15.8	10.8	0.2	2.2	14026	9.0	6.9	0.1	2.2	
EU4582	678	17.2	13.1	0.3	2.4	14192	9.7	7.6	0.2	2.2	
EU4587	405	23.4	11.6	0.2	2.8	1023	11.6	6.4	0.3	2.2	
EU4591	526	16.4	10.7	0.0	2.3	7124	9.4	7.2	0.2	2.2	
EU4593	1167	17.6	10.6	0.1	2.3	5664	10.9	9.7	0.1	2.3	
EU4607	852	16.2	12.3	-0.2	2.6	15966	8.8	7.1	0.2	2.2	

2002-II FF	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU4699	625	16.1	9.6	0.0	2.4	5731	9.6	6.9	0.4	2.1	
EU4721	699	16.5	12.0	0.0	2.2	3513	9.4	6.9	0.3	2.3	
EU4792	716	17.0	10.8	0.2	2.5	4473	10.8	7.6	0.3	2.4	
EU4838						7999	14.2	9.6	0.4	2.7	
EU4853	637	14.0	8.8	0.3	2.2	5989	9.0	6.5	0.5	2.3	
EU4865	201	19.0	11.2	0.2	2.0	2364	11.2	8.0	0.3	2.2	
EU4896						32	8.5	2.5	0.9	1.3	
EU4950	523	19.5	10.6	0.1	2.7	3256	10.8	8.6	0.3	2.1	
EU5098						8331	13.9	9.0	0.3	2.7	
EU5134						6866	15.0	10.0	0.3	2.6	
EU5167	1537	23.9	13.8	0.3	2.9	10602	8.9	6.5	0.4	2.2	
EU5175	78	12.2	5.9	0.0	0.6	279	6.8	4.1	0.2	1.8	
EU5182	6	28.0	10.2	-1.5	1.2	56	12.1	9.5	0.4	2.2	
EU5331	1385	18.1	10.8	0.3	2.3	6066	11.4	9.2	0.1	2.2	
EU5349						6580	13.9	9.5	0.1	2.5	
EU5351	1669	19.1	11.7	0.2	2.5	7758	9.9	8.0	0.2	2.1	
EU5372						3723	13.0	8.8	0.4	2.4	
EU5429						2728	6.8	3.5			
EU5435	1417	18.8	10.5	0.3	2.6	7599	10.4	8.2	0.3	2.3	
EU5441	609	19.0	13.1	-0.1	2.3	4033	9.4	8.0	0.1	2.2	
EU5478	720	16.8	11.2	-0.1	2.4	13665	9.5	7.9	0.2	2.3	
EU5529	612	16.3	11.0	0.1	2.3	14304	9.6	7.5	0.2	2.3	
EU5587	1541	19.7	11.8	0.3	3.0	7448	11.1	8.5	0.3	2.3	
EU5591	1023	24.1	13.0	0.2	3.1	3528	9.5	7.1	0.5	2.5	
EU5593	91	13.2	8.4	0.0	1.8	101	6.0	3.8	-0.2	2.2	
EU5612	698	15.7	11.2	-0.2	2.1	6323	9.4	7.4	0.3	2.1	
EU5613	1495	20.2	12.0	0.3	2.5	7861	10.3	8.2	0.2	2.1	
EU5777	20	15.4	11.4	0.4	2.1	136	14.2	7.8	0.4	2.1	
EU5802	245	17.8	10.2	0.2	1.9	2463	9.9	7.0	0.5	2.2	
EU5821	389	15.4	8.8	0.5	2.3	3834	9.9	7.3	0.2	2.1	
EU5891	1333	18.7	10.9	0.2	2.5	7768	10.5	8.4	0.1	2.2	
EU6264	799	16.2	11.2	0.5	2.8	13251	8.9	7.3	0.3	2.5	
EU6281	513	16.6	11.6	0.0	2.4	6887	8.9	6.9	0.4	2.3	
EU6287						7431	14.8	10.7	0.2	2.4	
EU6349	797	16.3	8.8	0.3	2.5	4821	10.3	7.4	0.2	2.3	
EU6444	704	16.1	11.3	-0.1	2.4	4373	9.2	7.2	0.4	2.5	
EU6524	1191	21.6	12.4	0.3	3.0	4024	9.4	6.9	0.6	2.6	
EU6527	615	19.5	10.3	0.1	2.4	4573	10.1	7.7	0.1	2.3	
EU6544	1867	18.2	11.6	0.3	2.4	6855	11.0	8.6	0.1	2.2	
EU6556	1323	17.6	10.8	0.3	2.4	7426	11.4	8.8	0.2	2.1	
EU6723	548	27.4	11.7	0.3	3.3	2364	10.8	6.2	0.7	2.4	
EU6743	1708	20.4	11.4	-0.3	3.8	8700	11.0	8.8	0.1	2.8	
EU6821	281	23.2	16.1	-0.1	3.1	481	7.0	4.5	0.4	1.8	

2002-II FF	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU6890	566	15.1	9.7	0.1	2.3	2988	9.6	7.4	0.3	2.3	
EU6893						7193	14.0	10.0	0.2	2.3	
EU6923						4880	14.5	9.7	0.5	2.4	
EU7001	1274	18.7	11.3	0.2	2.5	6388	10.6	7.5	0.2	2.2	
EU7082						8012	13.9	9.8	0.5	2.3	
EU7119	618	17.2	13.1	0.1	3.8	2325	11.4	8.1	0.4	2.4	
EU7218	461	17.3	10.0	0.2	2.2	3186	9.6	7.6	0.3	2.4	
EU7285						566	26.6	12.5	0.4	2.8	
EU7521						6601	14.3	10.2	0.3	2.7	
EU7629	1004	17.3	9.1	0.0	2.3	4944	10.1	7.9	0.4	2.4	
EU7634						7361	14.2	9.7	0.3	2.4	
EU7635	1139	17.6	11.3	0.1	2.8	7066	12.7	9.4	0.8	2.7	
EU7643	739	16.9	9.4	-0.1	2.6	3310	9.9	7.3	0.3	2.4	
EU7654	376	20.9	11.6	-0.2	2.3	2530	10.8	8.2	0.3	2.3	
EU7724	549	16.4	11.0	0.0	2.4	3082	10.0	7.9	0.4	2.3	
EU7865						6956	12.8	9.4	0.3	2.4	
EU7888	532	15.9	11.4	0.2	2.1	5754	9.4	7.3	0.5	2.2	
EU7894	553	22.1	11.7	0.2	2.8	1964	14.2	9.9	0.7	2.5	
EU8264						7158	14.0	9.8	0.5	2.6	
EU8431						8157	14.4	10.2	0.3	2.7	
EU8478						7434	15.6	11.6	0.4	2.6	
EU8520	392	19.2	9.8	0.1	2.5	2802	10.2	7.3	0.2	2.4	
EU8598						5715	13.9	9.5	0.4	2.7	
EU8605						3819	15.3	11.2	0.4	2.6	
EU8632						7655	13.7	9.8	0.2	2.5	
EU8733	1622	18.7	10.5	0.2	2.5	8182	11.2	9.3	0.2	2.4	
EU8736						6169	14.5	9.6	0.3	2.5	
EU8742	1046	19.5	12.0	0.3	2.6	6641	11.5	9.3	0.1	2.2	
EU8787	1854	20.1	11.7	0.3	2.7	7735	9.8	7.8	0.1	2.2	
EU8789						6588	12.9	9.2	0.4	2.6	
EU8891						3990	14.6	10.9	0.4	2.3	
EU8943						7873	13.0	8.7	0.3	2.4	
EU8969	818	16.9	11.0	0.0	2.5	4368	10.1	7.3	0.4	2.2	
EU9013	1748	19.9	11.0	0.2	2.4	7806	10.4	8.2	0.3	2.1	
EU9023						8197	15.5	10.8	0.5	2.7	
EU9145	596	16.3	12.8	0.0	2.4	3691	11.5	8.7	0.3	2.3	
EU9158	705	18.1	12.7	0.0	2.4	14650	9.8	7.7	0.2	2.3	
EU9234	753	15.7	10.1	0.1	2.7	15267	8.8	6.8	0.2	2.2	
EU9245	685	16.5	11.4	0.2	2.5	17017	8.8	6.9	0.1	2.2	
EU9356						7663	14.0	9.4	0.5	2.5	
EU9378						6855	15.4	10.6	0.1	2.5	
EU9544	517	17.5	11.1	0.3	2.1	5938	8.8	7.0	0.2	2.1	
EU9589						8380	14.1	9.7	0.6	2.5	

2002-II FF	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU9622	471	15.6	9.4	0.2	2.2	4349	9.5	7.0	0.4	2.2	
EU9678						5101	14.0	9.6	0.4	2.6	
EU9680	749	18.4	11.8	0.0	2.5	5716	9.1	7.2	0.3	2.0	
EU9692						1818	14.3	9.9	0.5	2.6	
EU9723	1505	18.0	11.1	0.3	2.5	8153	10.1	8.3	0.2	2.2	
EU9729	723	16.4	11.3	0.0	2.4	4898	9.0	7.3	0.4	2.2	
EU9734						8399	14.5	10.2	0.6	2.5	
EU9743	483	16.7	11.8	0.2	2.3	6223	9.4	7.4	0.2	2.2	
EU9883	1462	18.9	10.8	0.2	2.8	7303	10.8	8.8	0.2	2.2	
EU9967						8038	13.2	10.2	0.3	2.9	

[266]

c) Table 6, Wind direction (deg)

2002-II DD	Wind Direction Cruise level in degrees					Wind Direction Ascent & Descent in degrees					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
	EU0002						9034			14	21
	EU0003	9		6	5	24			11	11	
	EU0021	1261		8	14	5734			13	20	
	EU0022	2527		9	16	6863			16	22	
	EU0032	676		1	5	1818			5	17	
	EU0034	691		2	11	1156			5	11	
	EU0041	1329		9	13	7906			15	23	
	EU0043	1714		8	13	7491			16	24	
	EU0045	2708		6	13	1058			8	18	
	EU0047	1453		8	13	7662			17	24	
	EU0049					7396			14	22	
	EU0051	1717		7	11	3428			20	27	
	EU0052	1466		11	16	8285			19	26	
	EU0054	1149		8	13	2186			25	36	
	EU0055					4371			15	23	
	EU0059	1521		9	14	9013			18	25	
	EU0060	183		4	13	122			6	8	
	EU0061	1486		9	15	8600			17	23	
	EU0072	1039		9	17	7287			15	22	
	EU0073	5565		6	13	6864			8	18	
	EU0081	1856		8	10	5870			16	23	
	EU0082					6583			15	21	
	EU0086	5285		6	13	5651			9	22	
	EU0088	2118		9	15	8014			17	25	
	EU0106	1270		10	15	9203			18	27	
	EU0109	3438		9	14	8162			17	24	
	EU0110	1524		5	12	664			4	16	
	EU0120	5400		5	13	6937			8	18	
	EU0123	3266		6	12	1905			14	24	
	EU0124					8033			16	23	
	EU0158	981		8	12	5143			17	24	
	EU0167	1642		9	16	8146			16	22	
	EU0177	5219		5	11	6665			8	19	
	EU0185	1544		9	14	7032			17	24	
	EU0202	1539		4	10	688			3	7	
	EU0203	4398		5	10	4552			8	19	
	EU0204	1035		7	11	4481			18	25	
	EU0230	1339		5	12	636			3	7	
	EU0234					8593			16	22	
	EU0251	1473		9	13	9102			17	25	
	EU0263	4548		5	9	4290			8	22	

2002-II DD	Wind Direction Cruise level in degrees					Wind Direction Ascent & Descent in degrees					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU0281	106			2	15	467			10	15	
EU0299						8949			16	25	
EU0301	1848			8	13	8760			18	25	
EU0303	818			10	16	5528			17	25	
EU0307	1517			8	15	9941			18	25	
EU0310	1367			3	7	610			3	9	
EU0311	1473			8	13	5888			16	22	
EU0313	1267			9	14	6796			18	25	
EU0316	1231			9	14	5888			16	24	
EU0319	1544			9	14	7377			18	27	
EU0359	1226			7	11	6597			16	23	
EU0367						8255			15	22	
EU0373	1531			9	15	9701			17	25	
EU0394	1736			9	13	8313			19	26	
EU0413	1506			9	15	8764			19	28	
EU0432						9696			14	21	
EU0442	1505			8	12	7984			18	25	
EU0453	1368			4	11	732			3	13	
EU0457	1771			5	13	365			6	56	
EU0476	1474			11	19	6289			16	24	
EU0511	1280			10	18	8804			17	24	
EU0558	982			11	19	5587			20	28	
EU0568						4556			12	16	
EU0575	1244			3	12	599			4	9	
EU0583	1461			9	16	7940			18	26	
EU0601	1632			8	13	8948			16	23	
EU0676	1447			8	13	8182			16	23	
EU0711	1386			10	16	6752			17	25	
EU0723	922			17	30	7926			15	23	
EU0802	1723			9	16	7719			18	26	
EU0807	703			10	17	2762			22	30	
EU0810	990			9	13	6275			18	26	
EU0826						7049			15	22	
EU0875	1460			10	15	7042			17	25	
EU0921	1504			9	15	8344			19	27	
EU0934	6374			6	11	2395			9	24	
EU0947	6367			6	13	2489			10	23	
EU0961	5277			6	13	2709			13	25	
EU0985	7611			5	11	2797			7	18	
EU1001						5454			15	22	
EU1002	7229			5	11	2723			8	20	
EU1234	1495			9	14	9030			17	25	
EU1282	3252			5	11	446					

2002-II DD	Wind Direction Cruise level in degrees					Wind Direction Ascent & Descent in degrees					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU1301	1334			1	4	1067					
EU1334	4874			4	9	2629			8	20	
EU1337	1060			13	24	7905			15	23	
EU1411	742			4	14	60					
EU1456						5912			17	22	
EU1495	98			8	23	38			7	6	
EU1498	1548			9	16	8638			17	24	
EU1532						8035			14	20	
EU1547	1211			10	14	8651			17	24	
EU1567						8413			15	23	
EU1593	3894			8	16	1501			10	24	
EU1698						8661			13	19	
EU1790	604			9	11	5331			19	26	
EU1863	1511			11	18	9010			20	29	
EU1929	2040			7	15	40					
EU2017	1668			10	14	9201			17	24	
EU2043	1697			5	11	172					
EU2055	1621			8	13	10015			17	25	
EU2130	1330			10	16	8729			18	26	
EU2165	1606			9	15	9067			17	24	
EU2189	1457			10	14	6932			19	27	
EU2200	929			4	12	414			4	7	
EU2201	1326			10	17	8306			18	25	
EU2247	1479			9	12	8695			18	27	
EU2301	1175			9	15	5958			16	24	
EU2327	5461			5	12	5759			9	21	
EU2356	6043			5	13	1855			9	26	
EU2389	1521			8	14	9807			17	24	
EU2401	1181			9	14	6966			15	21	
EU2430	1009			9	15	7261			15	21	
EU2530	1273			9	16	7480			18	26	
EU2547	2953			6	11	1380			9	21	
EU2559	1282			9	16	7975			19	28	
EU2590	600			10	16	7886			18	27	
EU2595	1029			9	13	6938			17	25	
EU2610	1013			8	18	1584			11	29	
EU2618	641			11	19	7033			19	29	
EU2630	534			8	12	3542			20	28	
EU2673	15			20	16	134			9	11	
EU2751	3783			5	13	358					
EU2773	3210			6	13	518					
EU2845	1209			7	10	9632			17	25	
EU2912	89			12	15	468			22	28	

2002-II DD	Wind Direction Cruise level in degrees					Wind Direction Ascent & Descent in degrees					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU2978						5081				15	24
EU2984	490			7	11	3869				21	29
EU3000	1346			9	13	9340				18	24
EU3181	4402			5	12	574					
EU3257	1235			10	15	8270				18	25
EU3268	669			9	15	5685				19	26
EU3270						7697				17	24
EU3321	335			6	6	3240				18	27
EU3358						7597				14	22
EU3421	1130			9	17	5900				16	23
EU3469						7310				16	24
EU3533						8791				13	21
EU3544	370			16	29	2392				11	19
EU3598	771			11	20	5477				15	22
EU3599	824			11	18	5582				15	21
EU3621						2629				14	21
EU3654	642			9	15	6390				19	26
EU3684	687			10	14	3850				21	29
EU3702	39			21	35	396				23	29
EU3714						8767				14	22
EU3725	4105			5	13	537					
EU3755						7020				14	22
EU3874	2452			4	9	452					
EU3908	595			10	15	13530				18	27
EU3972						6589				13	20
EU4002	823			9	12	4253				18	26
EU4021						7589				14	23
EU4278						4283				13	18
EU4333	688			13	20	8689				19	27
EU4426	563			8	14	1596				22	31
EU4444	569			10	14	6731				19	24
EU4463						7609				14	21
EU4491						8435				15	23
EU4519	626			9	15	6739				20	27
EU4527	954			15	27	7857				14	21
EU4529	1069			7	12	8349				16	22
EU4532	1151			9	16	8002				14	21
EU4573	713			10	13	14026				19	28
EU4582	678			10	16	14192				17	26
EU4587	405			6	7	1023				12	17
EU4591	526			9	13	7124				17	25
EU4593	1167			8	11	5664				17	27
EU4607	852			14	21	15966				19	27

2002-II DD	Wind Direction Cruise level in degrees					Wind Direction Ascent & Descent in degrees					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU4699	625			9	14	5731			17	25	
EU4721	699			11	19	3513			19	27	
EU4792	716			9	13	4473			16	23	
EU4838						7999			14	22	
EU4853	637			10	18	5989			21	29	
EU4865	201			9	15	2364			14	20	
EU4896						32			11	7	
EU4950	523			7	7	3256			20	30	
EU5098						8331			14	22	
EU5134						6866			13	20	
EU5167	1537			7	10	10602			18	25	
EU5175	78			1	12	279			12	23	
EU5182	6			2	1	56			22	31	
EU5331	1385			8	12	6066			16	25	
EU5349						6580			15	25	
EU5351	1669			9	15	7758			18	26	
EU5372						3723			14	21	
EU5429						2728					
EU5435	1417			8	12	7599			17	23	
EU5441	609			9	12	4033			20	28	
EU5478	720			11	21	13665			19	27	
EU5529	612			9	15	14304			17	26	
EU5587	1541			8	12	7448			18	27	
EU5591	1023			8	11	3528			20	29	
EU5593	91			3	7	101			9	14	
EU5612	698			9	14	6323			19	27	
EU5613	1495			8	14	7861			17	25	
EU5777	20			8	11	136			10	18	
EU5802	245			7	10	2463			17	24	
EU5821	389			8	9	3834			16	23	
EU5891	1333			9	15	7768			17	25	
EU6264	799			11	16	13251			22	30	
EU6281	513			10	16	6887			21	29	
EU6287						7431			12	18	
EU6349	797			9	12	4821			17	26	
EU6444	704			12	21	4373			22	31	
EU6524	1191			10	14	4024			24	33	
EU6527	615			6	6	4573			17	24	
EU6544	1867			9	14	6855			18	27	
EU6556	1323			9	14	7426			17	26	
EU6723	548			6	8	2364			15	20	
EU6743	1708			8	13	8700			17	25	
EU6821	281			2	11	481			9	15	

2002-II DD	Wind Direction Cruise level in degrees					Wind Direction Ascent & Descent in degrees					
	AIRCRAFT	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU6890	566			10	16	2988			20	28	
EU6893						7193			14	23	
EU6923						4880			13	22	
EU7001	1274			8	13	6388			16	23	
EU7082						8012			12	19	
EU7119	618			16	28	2325			17	26	
EU7218	461			8	10	3186			19	28	
EU7285						566			7	12	
EU7521						6601			14	21	
EU7629	1004			9	14	4944			20	28	
EU7634						7361			13	20	
EU7635	1139			10	19	7066			15	23	
EU7643	739			9	11	3310			20	28	
EU7654	376			6	6	2530			19	28	
EU7724	549			10	13	3082			17	24	
EU7865						6956			15	22	
EU7888	532			10	15	5754			19	26	
EU7894	553			9	16	1964			13	18	
EU8264						7158			15	24	
EU8431						8157			15	24	
EU8478						7434			14	22	
EU8520	392			7	8	2802			19	27	
EU8598						5715			16	24	
EU8605						3819			14	22	
EU8632						7655			15	23	
EU8733	1622			7	10	8182			17	25	
EU8736						6169			13	21	
EU8742	1046			8	11	6641			16	24	
EU8787	1854			8	13	7735			19	27	
EU8789						6588			16	23	
EU8891						3990			12	18	
EU8943						7873			15	22	
EU8969	818			10	15	4368			17	24	
EU9013	1748			8	12	7806			17	26	
EU9023						8197			14	22	
EU9145	596			9	10	3691			17	25	
EU9158	705			10	18	14650			19	28	
EU9234	753			12	19	15267			19	27	
EU9245	685			11	19	17017			19	28	
EU9356						7663			13	20	
EU9378						6855			12	17	
EU9544	517			8	13	5938			18	26	
EU9589						8380			14	23	

AIRCRAFT	Wind Direction Cruise level in degrees					Wind Direction Ascent & Descent in degrees				
	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU9622	471			9	11	4349			18	26
EU9678						5101			15	23
EU9680	749			8	13	5716			19	27
EU9692						1818			16	27
EU9723	1505			9	14	8153			19	27
EU9729	723			10	16	4898			20	27
EU9734						8399			15	23
EU9743	483			9	13	6223			17	25
EU9883	1462			9	14	7303			16	23
EU9967						8038			16	24

[266]

Annex I. EU Amdar Observations from 28 – 30 May 2002.

In order to have a brief impression of the distribution of the locations of observations, two maps are presented. In fig. 3 Europe is presented with all EU Amdar observations for the period 28 – 30 May 2002. Note that most data is acquired during ascending or descending (ASC/DES: 84%, LVR/LVW: 16%). In figure 4 (next page), data from and around the Atlantic is displayed. AMDAR data is evaluated using HIRLAM numerical model data as background. This background reference is restricted by a limited area, as shown in fig. 4. An impression of the global coverage of E-AMDAR observations is given by fig 5. In this figure also ASDAR and other AMDAR observations are presented (Australia and New Zealand).

AMDAR COVERAGE 28 – 30 MAY 2002

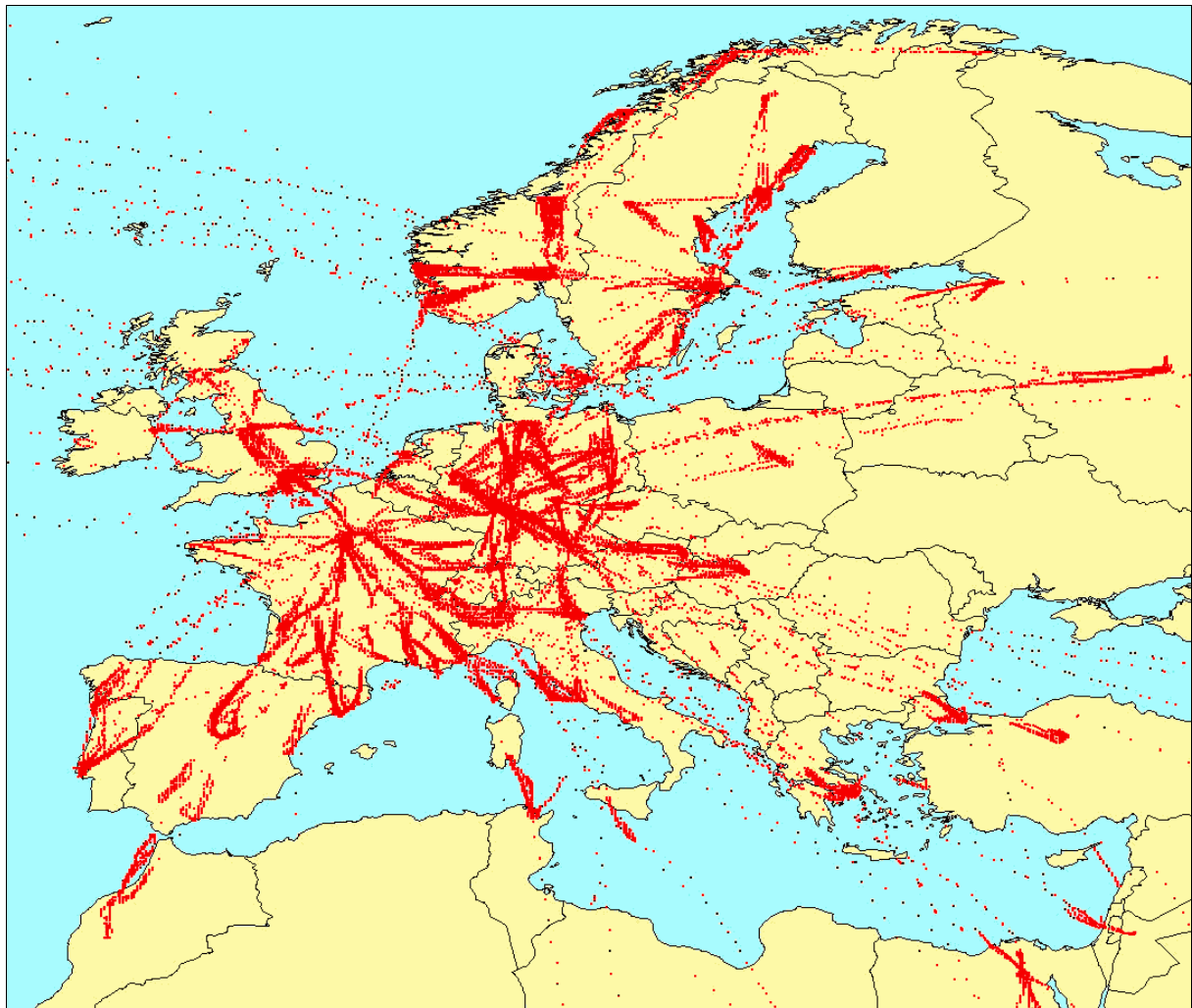


Fig. 3. All EU AMDAR observation locations, for the period 28 – 30 May 2002 and zoomed in over Europe.

AMDAR coverage 28 – 30 May 2002

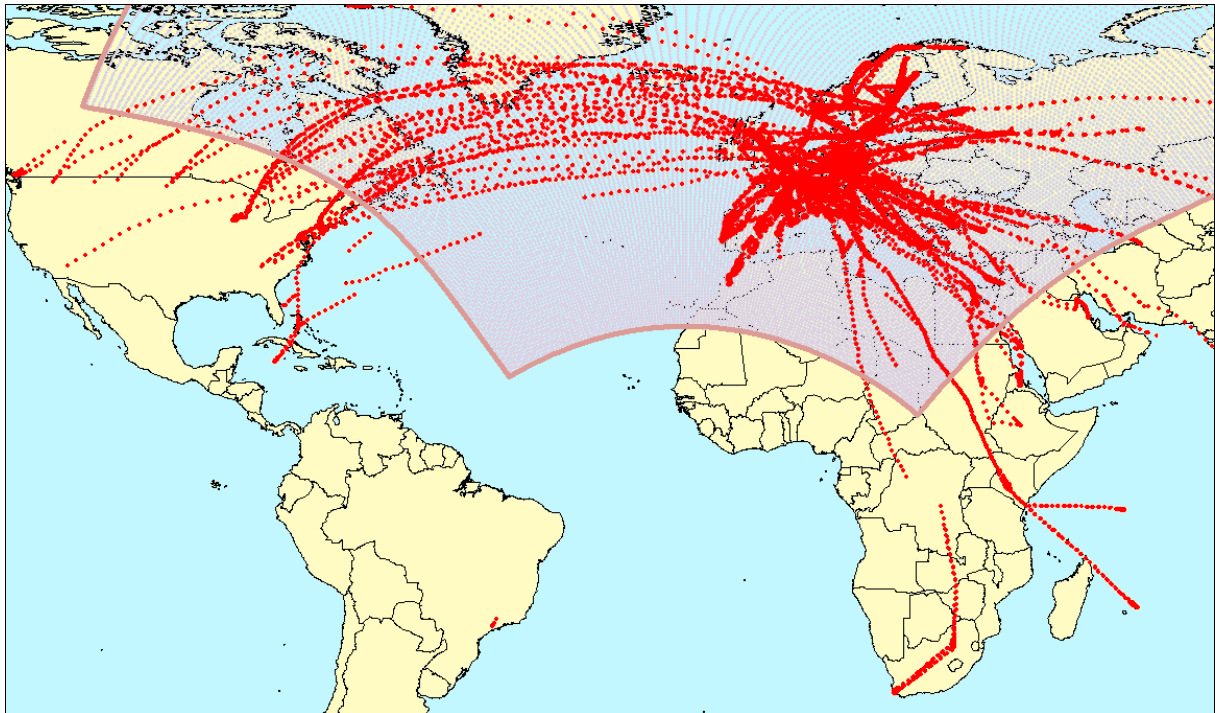


Fig. 4. All EU-AMDAR observations locations for 28 – 30 May 2002. In this figure the Hirlam area used for the evaluation purposes is indicated (■)¹ [see footnote]

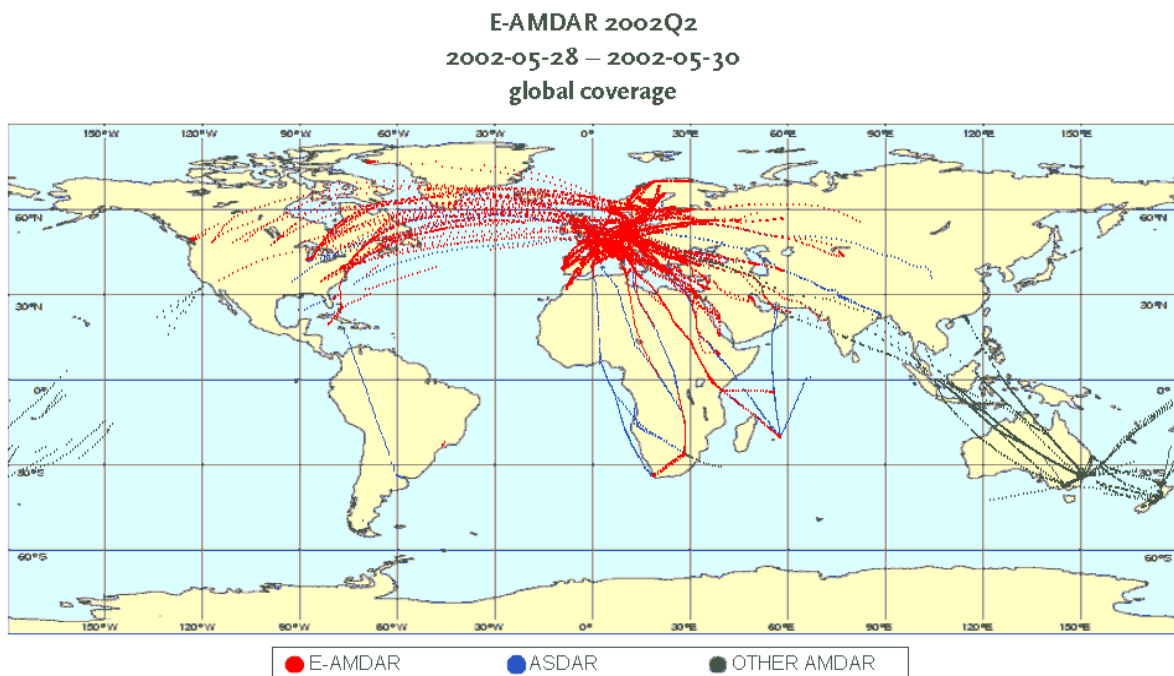


Fig. 5. Global coverage of E-AMDAR (•), ASDAR (•) and other AMDAR (•) observations. Period: 28 – 30 May 2002.

¹ Aircraft outside the HIRLAM area are evaluated by the E-AMDAR Technical Co-ordinator using other data sources.

Annex II. Frequency distribution of mean temperature, mean wind speed and wind direction differences.

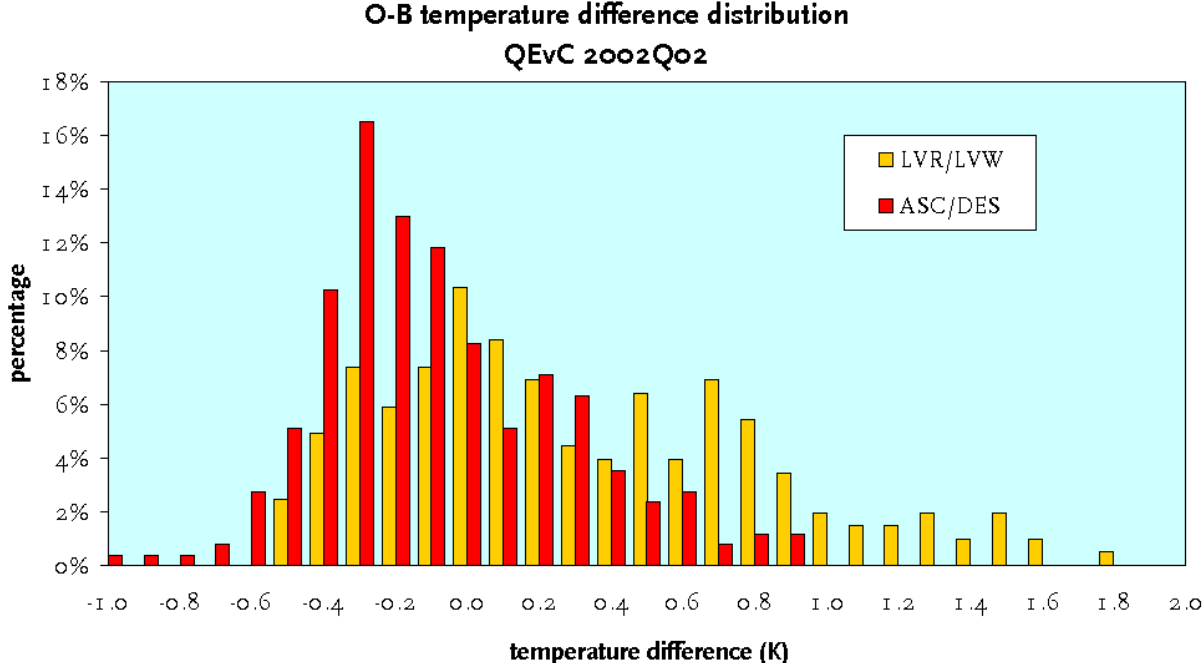


Fig. 6. Frequency distribution of the mean temperature difference (OBS–Background) for the number of aircraft reporting AMDAR reports (N=280). Distinction is made between the Flight Level (LVR/LVW) and the Ascending or Descending phase (ASC/DES). Clearly, there is only a slight difference between the distributions of both phases.

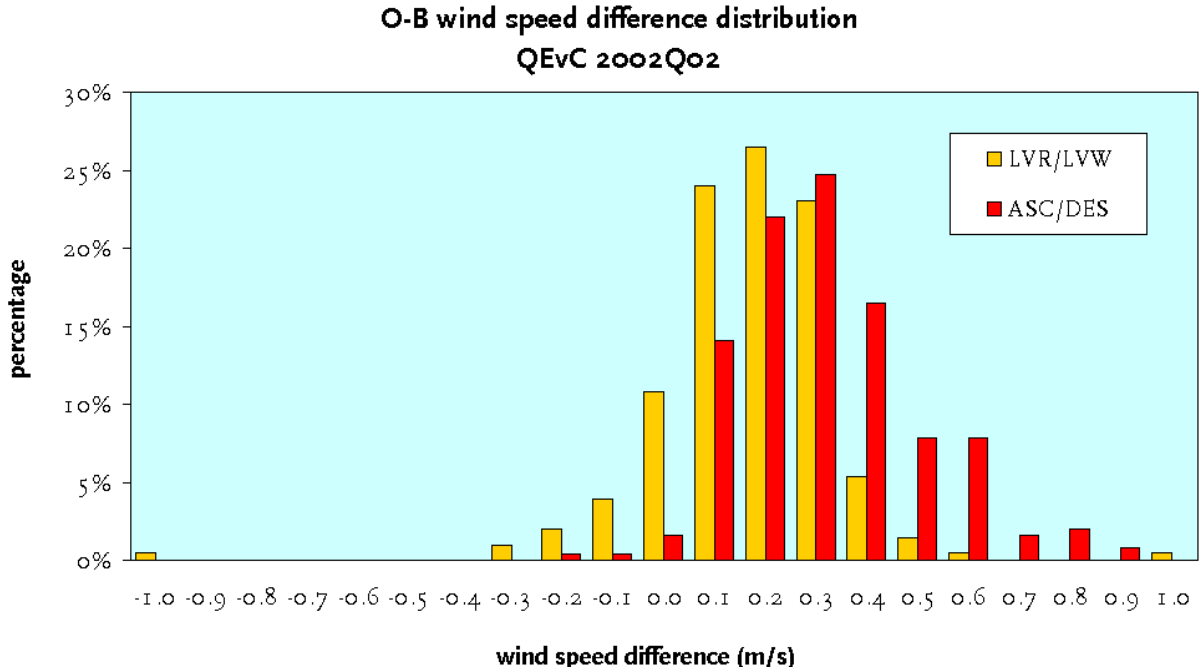


Fig. 7. Frequency distribution of the mean wind speed difference (OBS–Background) for the number of aircraft reporting AMDAR reports (N=280). Distinction is made between the Flight Level (LVR/LVW) and the Ascending or Descending phase (ASC/DES). Clearly, there is no significant difference between the distributions of both phases.

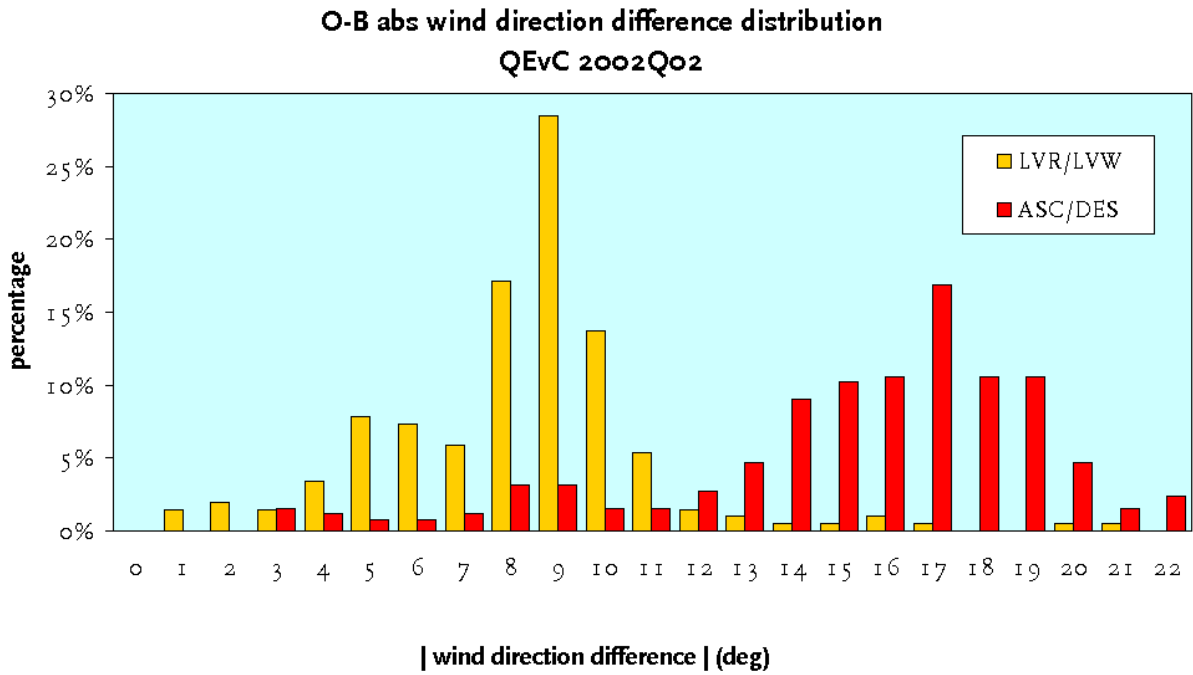


Fig. 8. Frequency distribution of the mean of the absolute wind direction difference ($|OBS - Background|$) for the number of aircraft reporting AMDAR reports ($N=280$). Distinction is made between the Flight Level (LVR/LVW) and the Ascending or Descending phase (ASC/DES). Clearly, in this case there is a significant difference between the distributions of both phases.

Annex III. Trend in the daily amount of observations.

The number of observations, received every day can be presented as a function of time (see fig. 8). Such a figure will demonstrate the trend in this daily amount. The figure shows a stable pattern in which the reduced amounts of observations during weekends can be recognised easily.

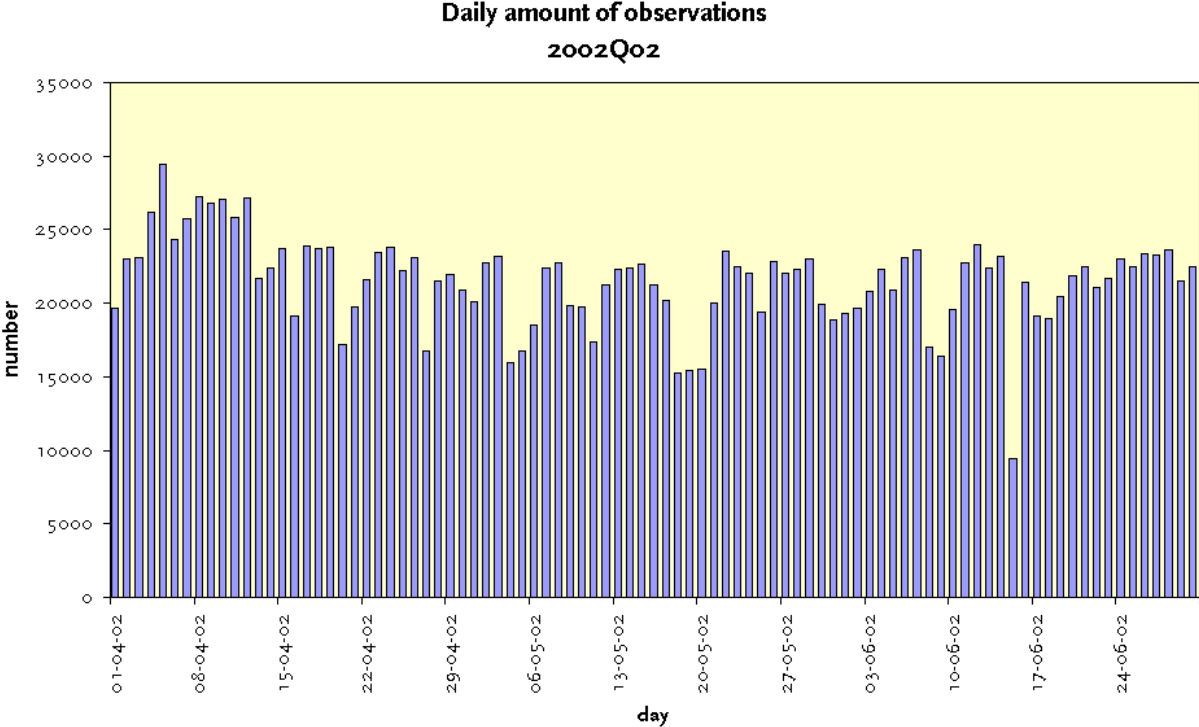
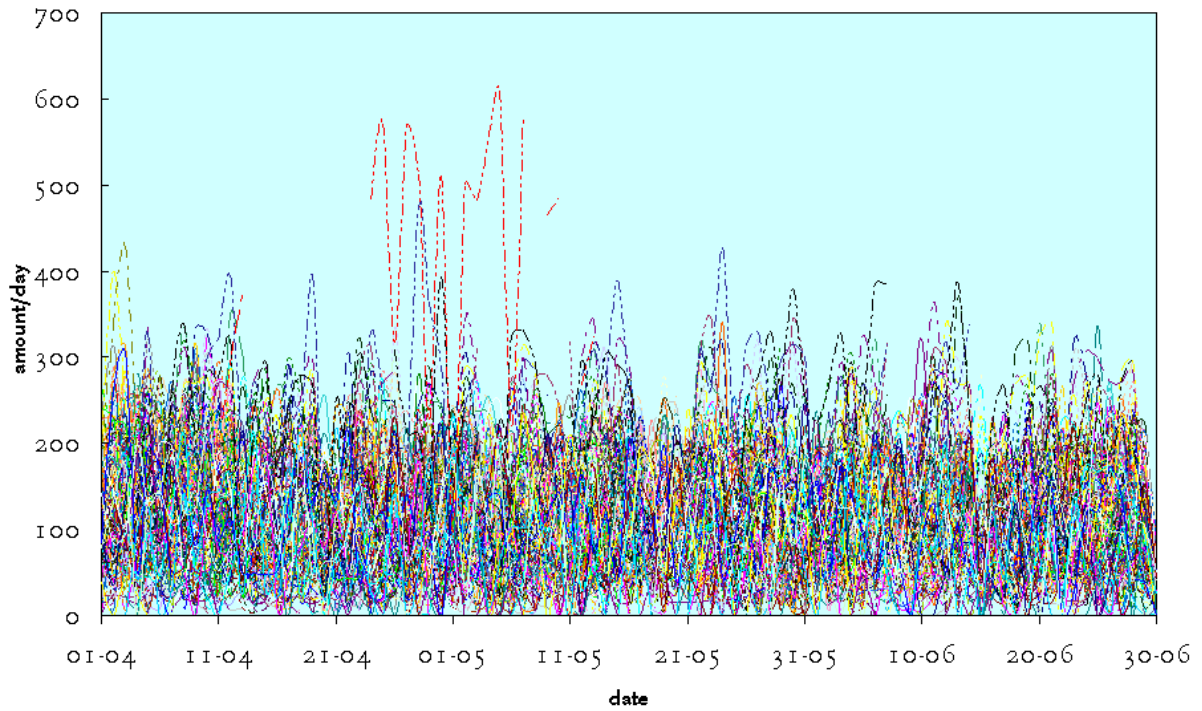


Fig. 9. The daily amount of EU-Amdar observation, evaluated at De Bilt. (The dip at June 1st is caused by a computer system interruption at the QEvC).

Moreover, the trend in the daily amount of observations from each aircraft can be evaluated. In fig. 10. such a trend is clearly demonstrated. Overall the daily amounts are found to be very stable during this period. Note the very high production of EU9378 during a relatively short period (see also par. 4.a)

Trends in the daily amount of observation



EU0002	EU0003	EU0021	EU0022	EU0032	EU0034	EU0041	EU0043
EU0045	EU0047	EU0049	EU0051	EU0052	EU0054	EU0055	EU0059
EU0060	EU0061	EU0072	EU0073	EU0081	EU0082	EU0086	EU0088
EU0106	EU0109	EU0110	EU0120	EU0123	EU0124	EU0158	EU0167
EU0177	EU0185	EU0202	EU0203	EU0204	EU0230	EU0234	EU0251
EU0263	EU0281	EU0299	EU0301	EU0303	EU0307	EU0310	EU0311
EU0313	EU0316	EU0319	EU0359	EU0367	EU0373	EU0394	EU0413
EU0432	EU0442	EU0453	EU0457	EU0476	EU0511	EU0558	EU0568
EU0575	EU0583	EU0601	EU0676	EU0711	EU0723	EU0802	EU0807
EU0810	EU0826	EU0875	EU0921	EU0934	EU0947	EU0961	EU0985
EU1001	EU1002	EU1234	EU1282	EU1301	EU1334	EU1337	EU1411
EU1456	EU1495	EU1498	EU1532	EU1547	EU1567	EU1593	EU1698
EU1790	EU1863	EU1929	EU2017	EU2043	EU2055	EU2130	EU2165
EU2189	EU2200	EU2201	EU2247	EU2301	EU2327	EU2356	EU2389
EU2401	EU2430	EU2530	EU2547	EU2559	EU2590	EU2595	EU2610
EU2618	EU2630	EU2673	EU2751	EU2773	EU2845	EU2912	EU2978
EU2984	EU3000	EU3181	EU3257	EU3268	EU3270	EU3321	EU3358
EU3421	EU3469	EU3533	EU3544	EU3598	EU3599	EU3621	EU3654
EU3684	EU3702	EU3714	EU3725	EU3755	EU3874	EU3908	EU3972
EU4002	EU4021	EU4278	EU4333	EU4426	EU4444	EU4463	EU4491
EU4519	EU4527	EU4529	EU4532	EU4573	EU4582	EU4587	EU4591
EU4593	EU4607	EU4699	EU4721	EU4792	EU4838	EU4853	EU4865
EU4896	EU4950	EU5098	EU5134	EU5167	EU5175	EU5182	EU5331
EU5349	EU5351	EU5372	EU5429	EU5435	EU5441	EU5478	EU5529
EU5587	EU5591	EU5593	EU5612	EU5613	EU5777	EU5802	EU5821
EU5891	EU6264	EU6281	EU6287	EU6349	EU6444	EU6524	EU6527
EU6544	EU6556	EU6723	EU6743	EU6821	EU6890	EU6893	EU6923
EU7001	EU7082	EU7119	EU7218	EU7285	EU7521	EU7629	EU7634
EU7635	EU7643	EU7654	EU7724	EU7865	EU7888	EU7894	EU8264
EU8431	EU8478	EU8520	EU8598	EU8605	EU8632	EU8733	EU8736
EU8742	EU8787	EU8789	EU8891	EU8943	EU8969	EU9013	EU9023
EU9145	EU9158	EU9234	EU9245	EU9356	EU9378	EU9544	
EU9589	EU9622	EU9678	EU9680	EU9692	EU9723	EU9729	EU9734
EU9743	EU9883	EU9967					

Fig. 10. Daily amount of observations, evaluated by QEvC. Clearly the daily amount is stable during this period

Annex IV. Trends in the mean O–B differences.

In fig 11, an overview is presented of the mean O–B air temperature differences ΔTA for each aircraft apart. This figure shows some typical outliers, but in general the overall differences show a random behaviour, which is stable during the period.

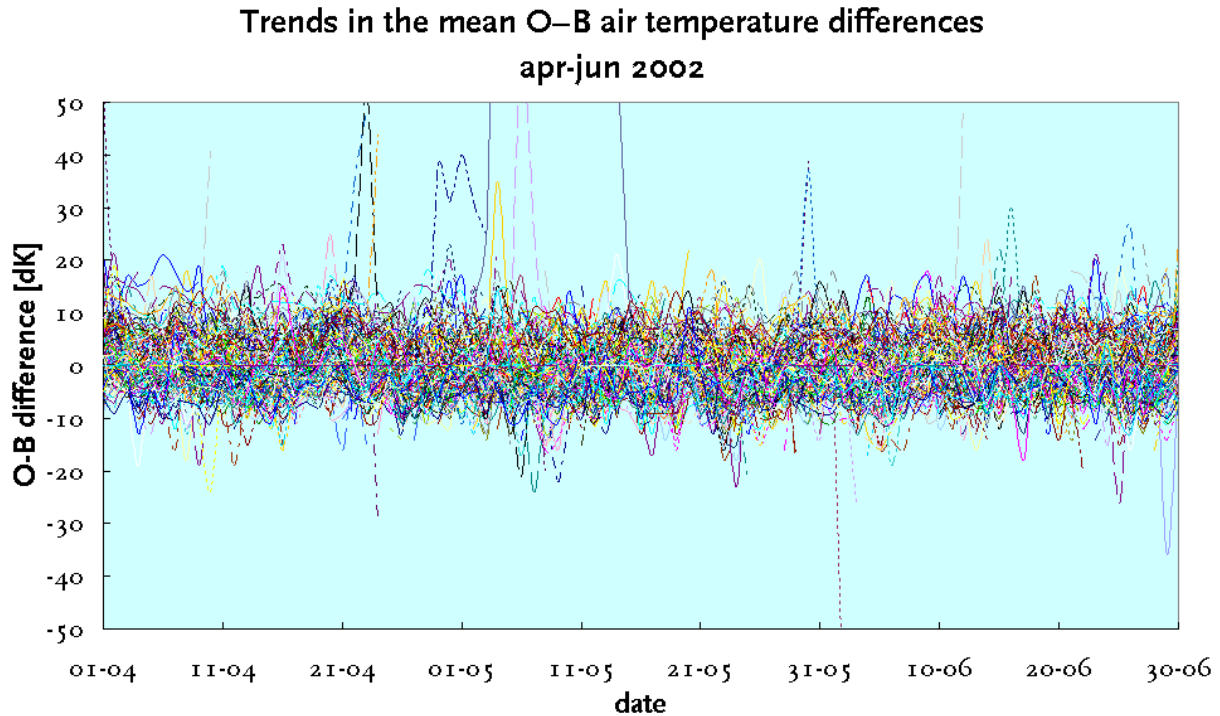


Fig. 11. Trends in the mean O–B air temperature differences (note: temperature-scale is in **deci-Kelvin**, /0.1 K). In general the differences demonstrate a rather random behaviour, as expected. Notice the typical outliers.

In fig. 12, a similar overview is presented for the wind speed differences ΔFF :

Trends in the mean O–B wind speed differences apr-jun 2002

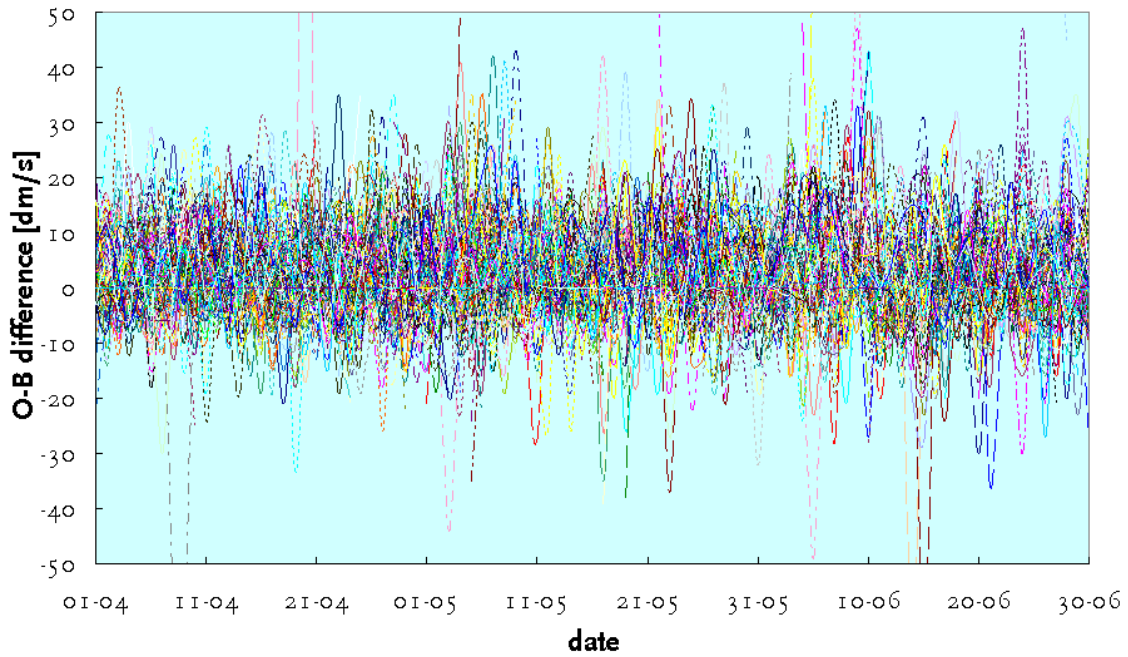


Fig. 12. Trends in the mean O–B wind speed differences (note: velocity-scale is in **deci**-metres per second, $\text{dm}\cdot\text{s}^{-1}$). In general the differences demonstrate a rather random behaviour, as expected.

In fig. 13, a similar overview is presented for the wind direction differences (based on absolute values, i.e. $|\Delta DD|$):

Trends in the mean O–B wind direction differences apr-jun 2002

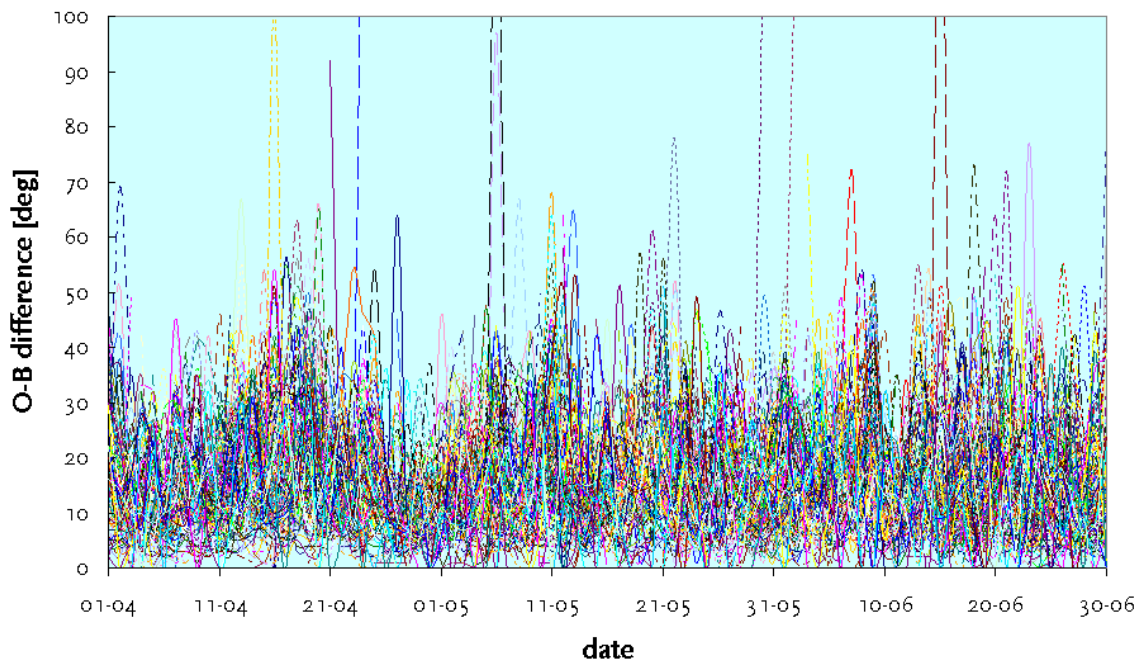


Fig. 13. Trends in the mean O–B wind direction differences. Like with the previous figures, in general the differences demonstrate a rather random behaviour.

Annex V. The daily cycle and observation times.

In the figures 13 to 16 the 'aircraft data coverage' is presented for the period 13 April 2002 18:00 – 14 April 2002 12:00 UTC (for observations from aircraft: AIREP [•], AMDAR [•] and ACARS [•]). The figures give an impression of the availability of aircraft observations for use in the ECMWF models runs at 00, 06, 12 and 18 UTC.

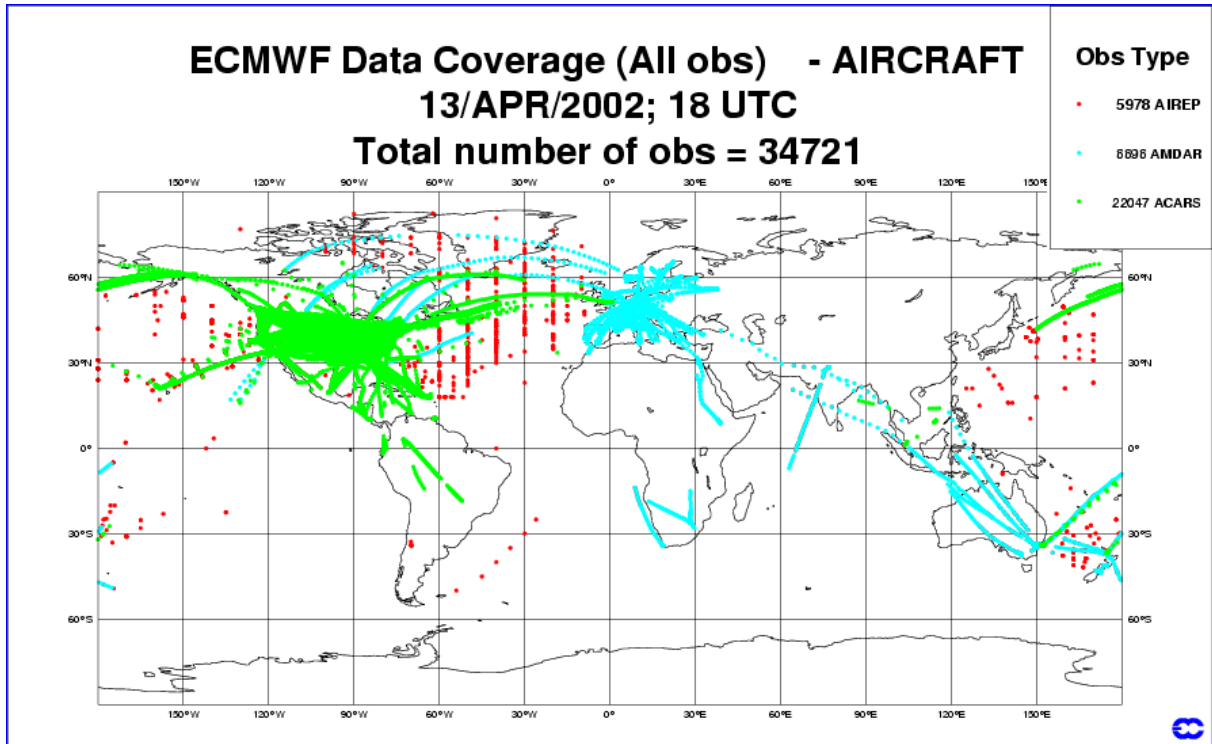


Fig. 14.

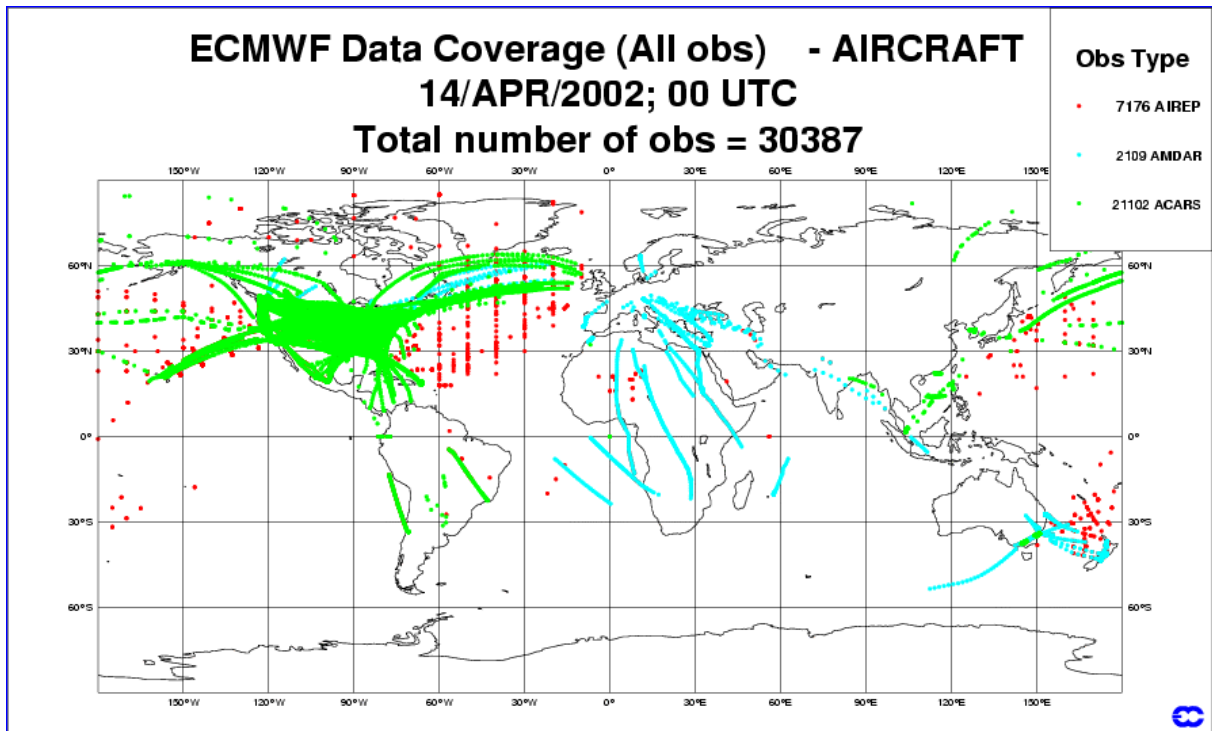


Fig. 15.

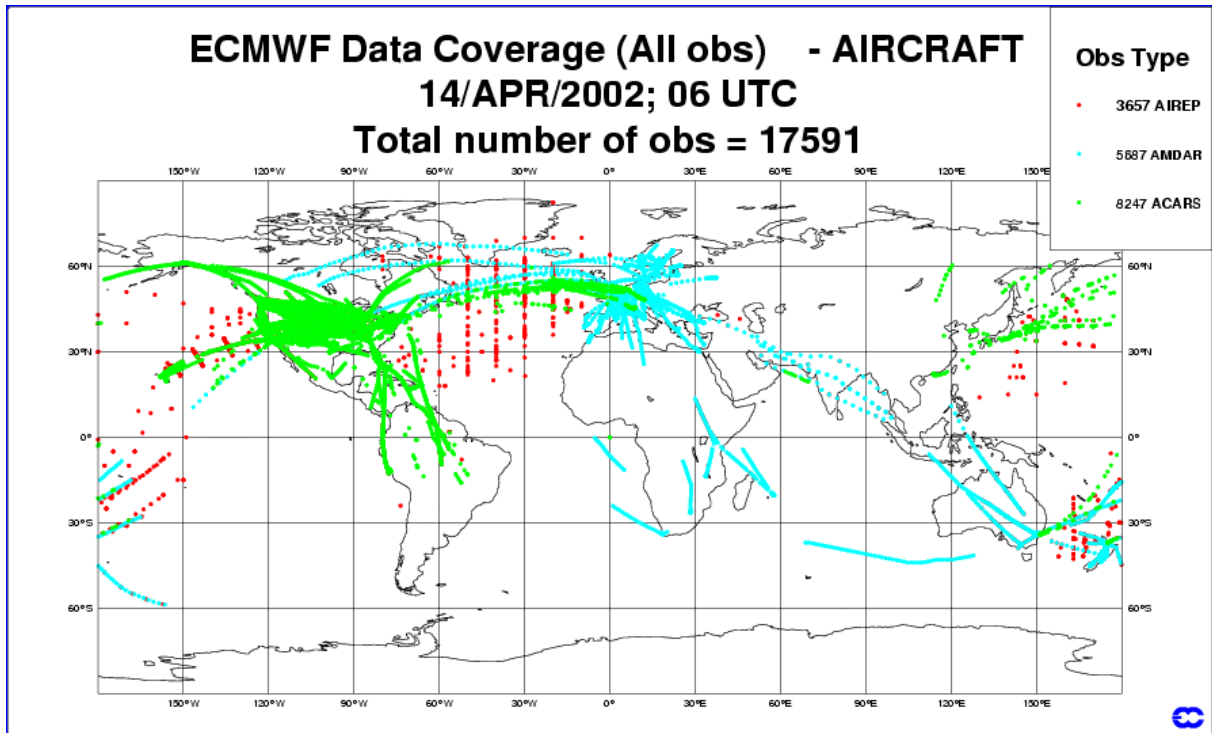


Fig. 16.

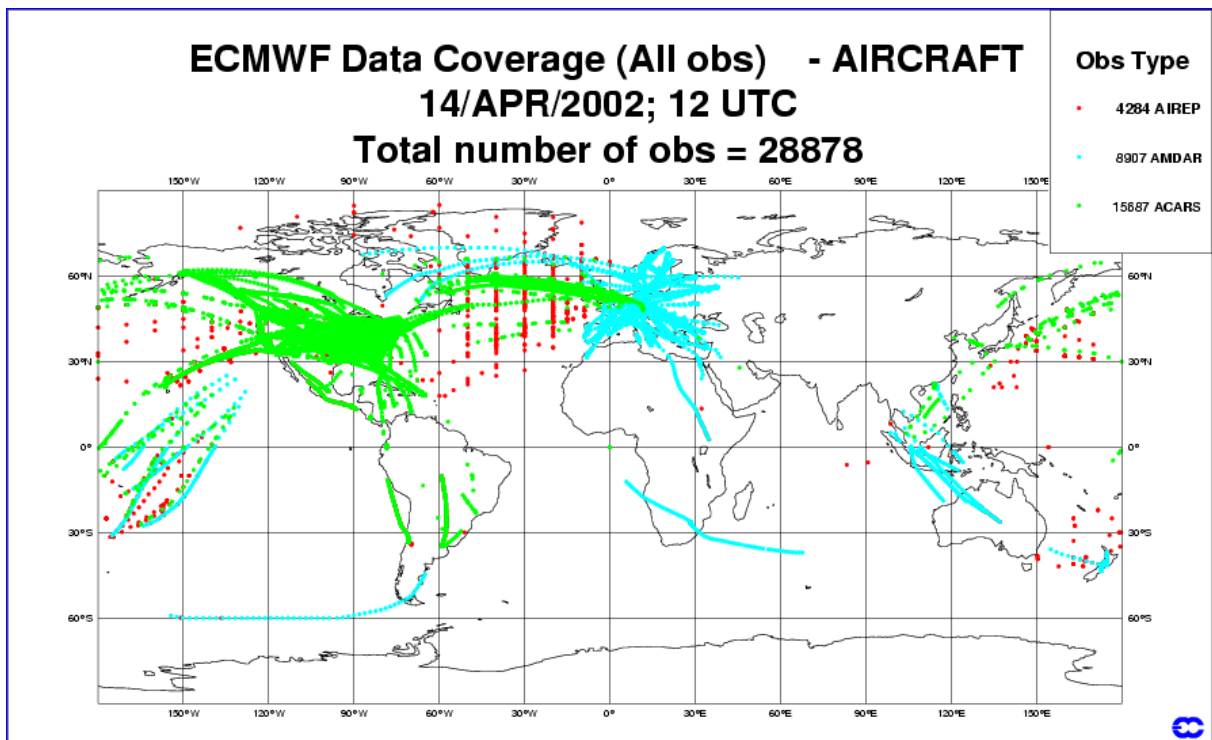


Fig. 17.

Obviously the European region is well covered with AMDAR data for the 06, 12, 18 UTC runs, but rather limited for 00 UTC. Note that the long haul intercontinental flights give a global coverage, independent of time (LVR only at approx. 11 km altitude, see doc. QEvC-2001QII, Annex V).

Annex VI. Special case study: Standard deviations of the OBS–MOD differences.

In par. 4.e (Data quality evaluation) criteria are stated for the maximum deviations of the observed variables. These margins are used for further considering the data as presented in the tables 4 to 6. However, only the mean differences are considered and not the fluctuations around these values. Well considered, if mean differences are taken as measure to evaluate observational data, then only the systematic error is analysed, traditionally indicated as *off-set*. Although such error is indicative for the quality of the measurement, it is not for the accuracy of an observation, measured randomly. In practice, error analysis of measurements focuses on two types of errors: 1) the systematic error and 2) the random error. The first type can be removed after appropriate calibrations. The second one cannot be removed and should be indicated within the notation of the value as measured (traditionally presented as $x = a \pm b$). How to calculate and to express such errors are presented in the *Guide to the Expression of Uncertainty in Measurement* (published in the name of BIPM, IEC, IFDD, ISO, IUPAC, IUPAP and OIML, available from ISO, Geneva, Switzerland). In other words, those two types of errors can be labelled as 'static' (for the systematic error) and as 'dynamic' (for the random error). In the tables 4 to 6 two columns are presented for the determined differences OBS–MOD (or OBS–background): 'Mean' and 'SD'. The values for mean are the 'static' component of those differences, to be presented as $\langle \Delta(x) \rangle$, where x stands for an OBS-MOD differences (e.g. $\Delta(TA) = TA[\text{observed}] - TA[\text{background}]$; TA is air temperature). The 'dynamic' component is represented by SD, which stands for the standard deviation of $\Delta(x)$, to be presented as $\sigma(\Delta(x))$. Assuming that the random errors will behave according to a 'normal' distribution around $\langle \Delta(x) \rangle$, 98% of all observed data will be within the range $\langle \Delta(x) \rangle \pm 2 \cdot \sigma$ (see the above *Guide*). This value of $2 \cdot \sigma$ is defined as the *uncertainty of measurement* (or traditionally 'accuracy'). It expresses the uncertainty of a single, randomly chosen measurement.

Although such uncertainty is relevant when evaluating observations, no criterion is stated concerning standard deviations (see par. 4.e). Defining such criterion however is rather hazardous when comparing a parameter with a second one (a reference or background) having a relatively limited uncertainty as well (model data should not be regarded as true reference values, since the traceability to objective observations is rather complex). Obviously the determined uncertainty has only significance if the uncertainty of the reference parameter is much smaller than the uncertainty of the parameter in question. Since in this case the reference parameter is obtained from model calculations and by taking into account that these calculation are based on similar *in-situ* observations, great care should be taken when drawing any conclusion from standard deviation analysis. Nevertheless the results obtained by such a study can be helpful to improve the quality of observations and experiences can be useful for the evaluation of specific cases to understand erroneous results.

Distribution of SD-data.

In the first place the distribution of all SD data as presented in the tables 4 to 6 might give an impression on the mutual differences in quality between the set of EU-AMDR aircraft. In the figs. 18. to 19 such a frequency distribution is presented. These figures present $\sigma(\Delta(x))$ for $x = TA, FF$ and DD and may be compared to the figures in [Annex II](#), where the $\langle \Delta(x) \rangle$ ('systematic errors') are shown. Clearly the ranges for both air temperature (TA) and wind speed (FF) are very narrow. The range for wind direction (DD) is rather wide, which means that some aircraft demonstrate a very small $\sigma(|\Delta(DD)|)$, e.g. 5° , other aircraft have a typical large $\sigma(|\Delta(DD)|) \approx 30^\circ$.

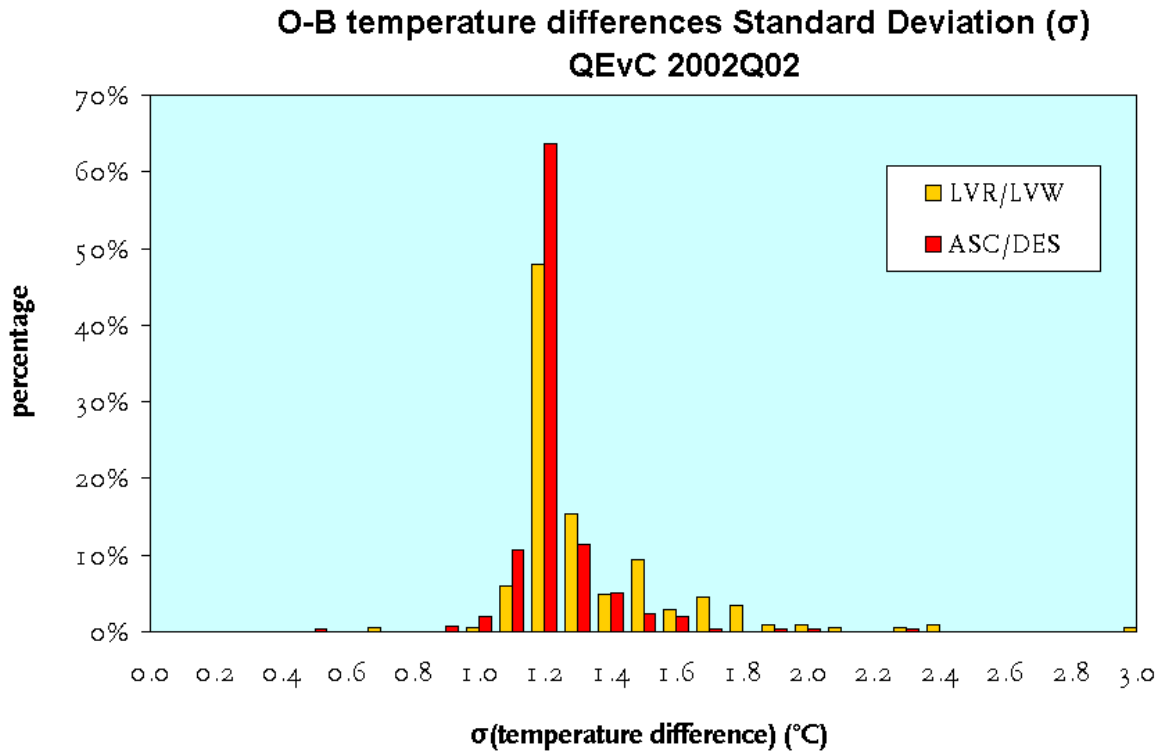


Fig. 18. Frequency distribution of the standard deviations of the temperature difference (OBS–Background) for the number of aircraft reporting AMDAR reports ($N=280$). Distinction is made between the Flight Level (LVR/LVW) and the Ascending or Descending phase (ASC/DES). Notice the narrow range, approx. $1.0 < \sigma(\Delta TA) < 1.8$ °C.

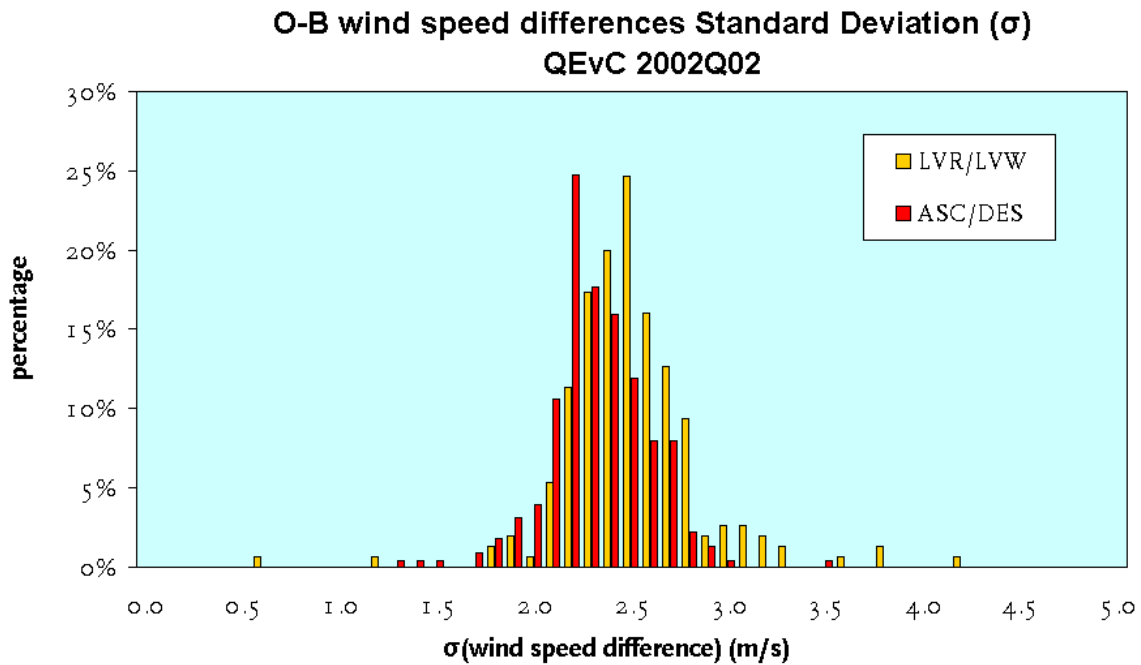


Fig. 19. Frequency distribution of the standard deviations of the wind speed difference (OBS–Background) for the number of aircraft reporting AMDAR reports ($N=280$). Distinction is made between the Flight Level (LVR/LVW) and the Ascending or Descending phase (ASC/DES). Notice the narrow range, approx. $1.7 < \sigma(\Delta FF) < 3.2$ m/s.

**O-B abs wind direction differences Standard Deviation (σ)
QEvC 2002Q02**

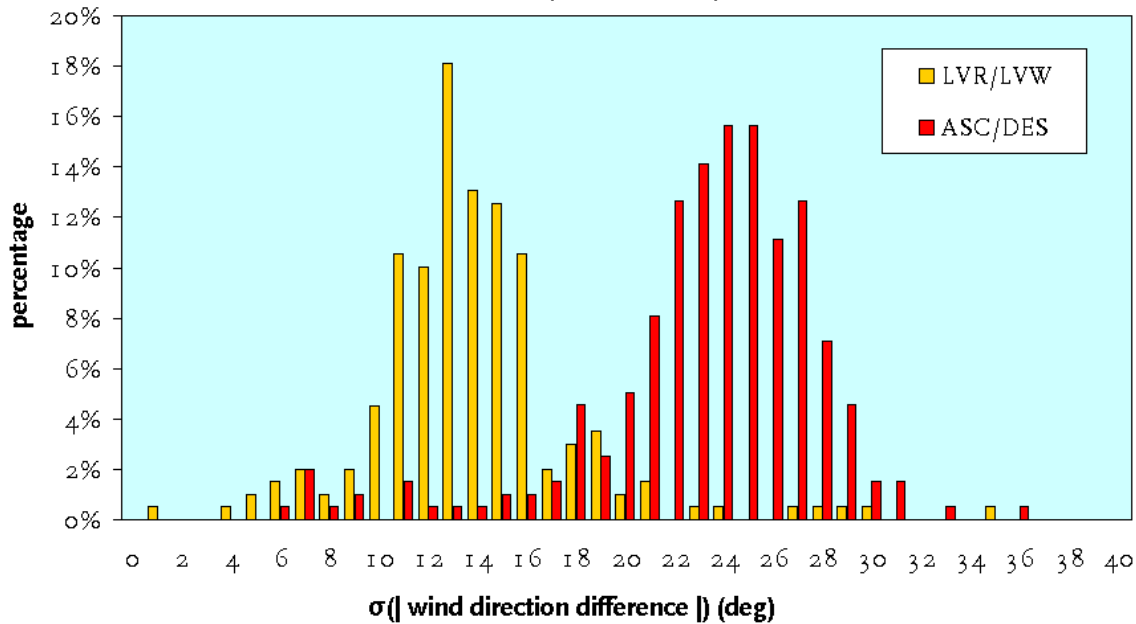


Fig. 20. Frequency distribution of the standard deviations of the absolute wind direction difference (OBS–Background) for the number of aircraft reporting AMDAR reports (N=280). Distinction is made between the Flight Level (LVR/LVW) and the Ascending or Descending phase (ASC/DES). As expected, after considering fig. 8. (Annex II), the range for $\sigma(|\Delta DD|)$ is rather wide, especially for ASC/DES.

From these figures and the figures in Annex II, and overall table can be determined valid for the set of EU-AMDAR aircraft for the period 2002Q2:

Variable	Systematic error		Standard deviation	
	range	median	range	median
Temperature /°C	(-0.6, +1.3)	-0.1	(1.0, 1.8)	1.2
Wind speed /ms ⁻¹	(-0.2, +0.7)	+0.2	(1.7, 3.2)	2.4
Wind direction [LVR] /°	(3, 13)	8	(4, 22)	14
Wind direction [ASC] /°	(4, 21)	16	(13, 31)	25

These figures are based on the evaluations results, presented in the tables 4 - 6, and give an overall view on $\langle \Delta(x) \rangle$ (the systematic error) and $\sigma(\Delta(x))$ (standard deviation, related to the random error) for the set of EU-AMDAR aircraft for the period 2002Q2.

To obtain a more precise impression of the relevance of $\sigma(\Delta(x))$, the standard deviation of the determined differences for each individual aircraft should be analysed. To obtain an overall impression, a small number of aircraft can be chosen for further analyses. For this purpose five aircraft were selected randomly, i.e. EU0263, EU0299, EU0301, EU0934 and EU6821. For these aircraft, the evaluation results from the tables 4 - 6 are summarised below:

EU0263	VARIABLE	LVR		ASC/DES	
		$\langle \Delta(x) \rangle$	$\sigma(\Delta(x))$	$\langle \Delta(x) \rangle$	$\sigma(\Delta(x))$
	air temperature /°C	0.4	1.5	0.0	1.2
	wind speed /ms ⁻¹	0.2	2.7	0.3	2.1
	wind direction /°	5.0	9.0	8.0	22.0

EU0299 <i>(only observations during ASC/DES)</i>	VARIABLE	LVR		ASC/DES	
		$\langle\Delta(x)\rangle$	$\sigma(\Delta(x))$	$\langle\Delta(x)\rangle$	$\sigma(\Delta(x))$
	air temperature /°C			-0.2	1.1
	wind speed /ms ⁻¹			0.2	2.7
	wind direction /°			16.0	25.0

EU0301	VARIABLE	LVR		ASC/DES	
		$\langle\Delta(x)\rangle$	$\sigma(\Delta(x))$	$\langle\Delta(x)\rangle$	$\sigma(\Delta(x))$
	air temperature /°C	0.6	1.1	0.4	1.1
	wind speed /ms ⁻¹	0.2	2.3	0.2	2.3
	wind direction /°	8.0	13.0	18.0	25.0

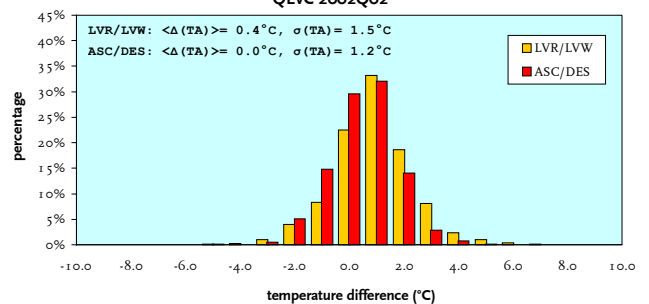
EU0934	VARIABLE	LVR		ASC/DES	
		$\langle\Delta(x)\rangle$	$\sigma(\Delta(x))$	$\langle\Delta(x)\rangle$	$\sigma(\Delta(x))$
	air temperature /°C	-0.2	1.6	0.0	1.3
	wind speed /ms ⁻¹	0.1	2.4	0.0	1.9
	wind direction /°	6.0	11.0	9.0	24.0

EU6821	VARIABLE	LVR		ASC/DES	
		$\langle\Delta(x)\rangle$	$\sigma(\Delta(x))$	$\langle\Delta(x)\rangle$	$\sigma(\Delta(x))$
	air temperature /°C	0.0	1.2	0.1	1.1
	wind speed /ms ⁻¹	-0.1	3.1	0.4	1.8
	wind direction /°	2.0	11.0	9.0	15.0

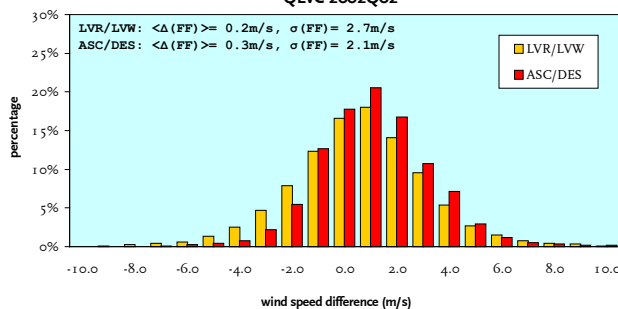
Frequency distributions of $\langle\Delta(x)\rangle$ for air temperature (AT), wind speed (FF) and wind direction (DD) for each of those five aircraft are presented below in Fig. 21. These figures demonstrate very clearly very similar results (the noise in the EU6821 is caused by the limited amount of observations). Although the median value differ (because any offset or $\langle\Delta(x)\rangle$ differ for each aircraft), the distribution function itself demonstrate significant similarity for all aircraft.

EU0263

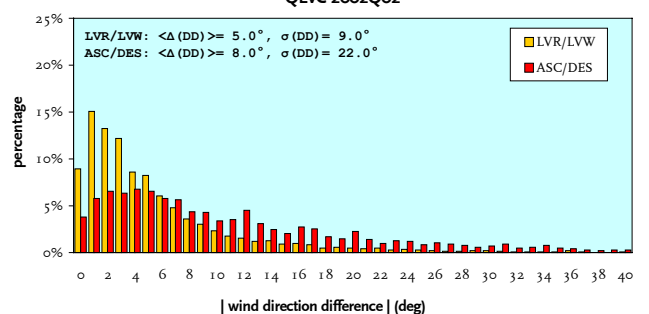
O-B temperature difference distribution for EU0263
QEvC 2002Q02



O-B wind speed difference distribution for EU0263
QEvC 2002Q02

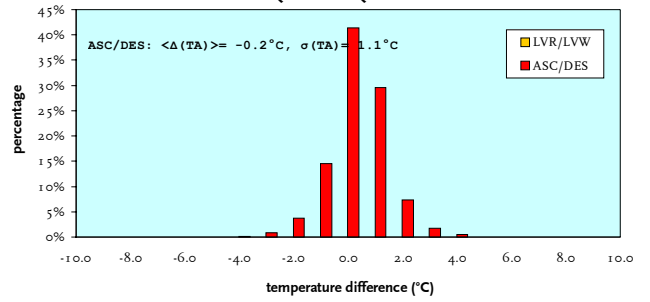


O-B abs wind direction difference distribution for EU0263
QEvC 2002Q02

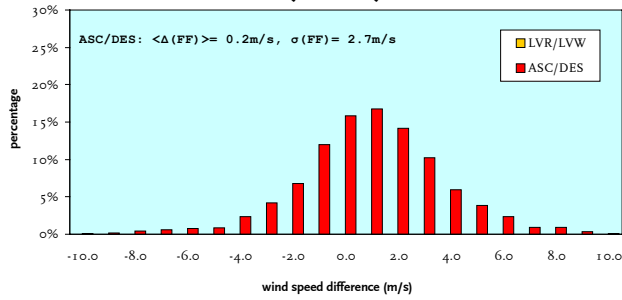


EU0299

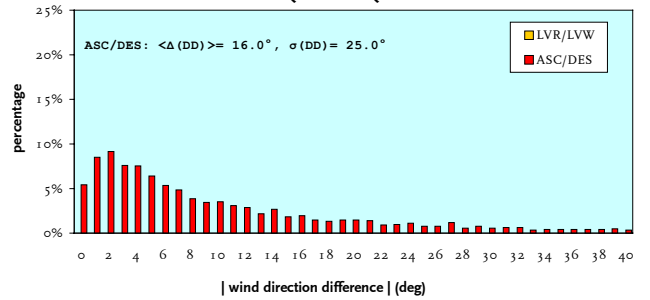
O-B temperature difference distribution for EU0299
QEvC 2002Q02



O-B wind speed difference distribution for EU0299
QEvC 2002Q02

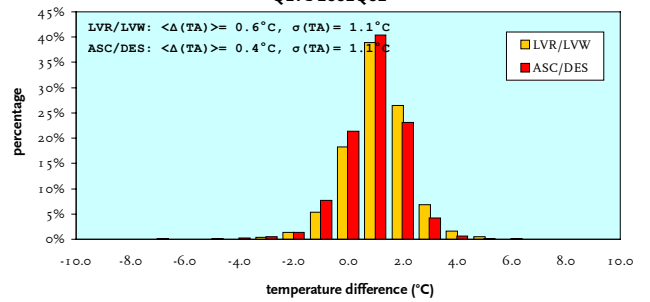


O-B abs wind direction difference distribution for EU0299
QEvC 2002Q02

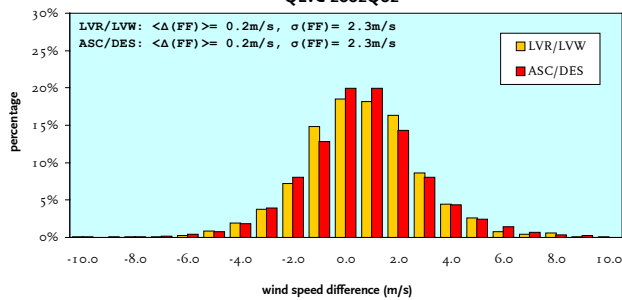


EU0301

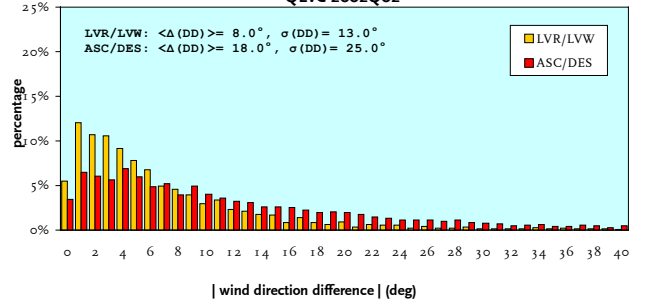
O-B temperature difference distribution for EU0301
QEvC 2002Q02



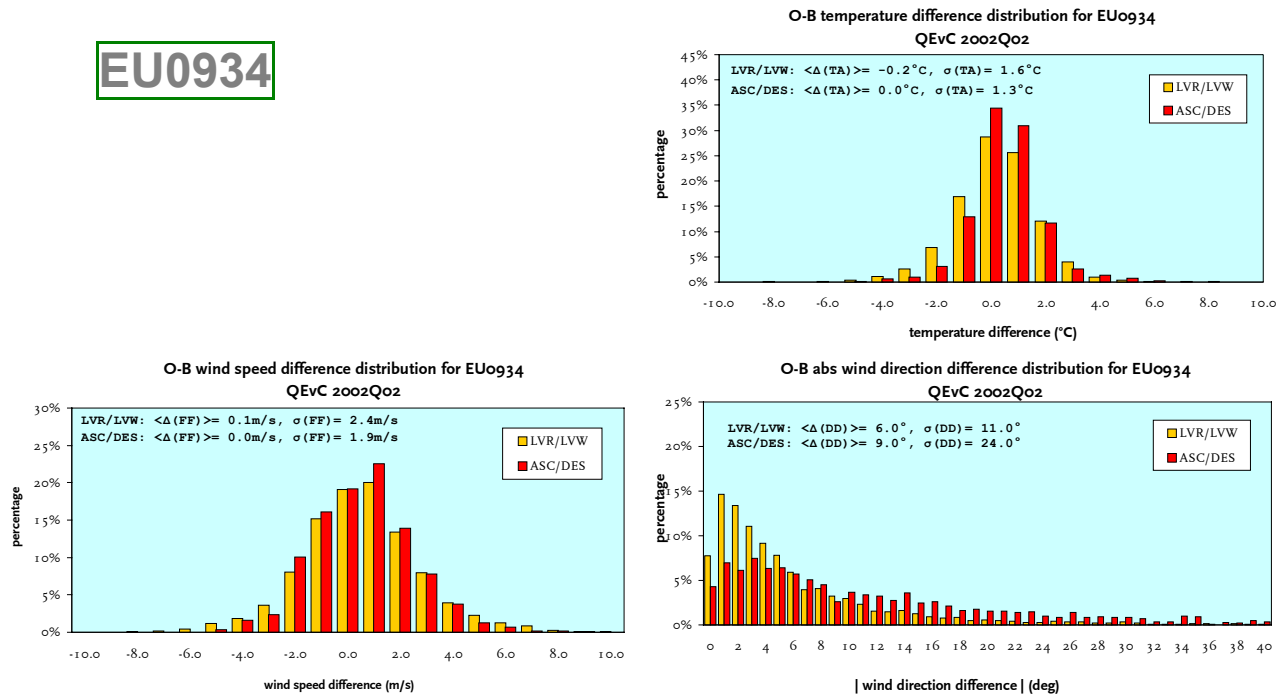
O-B wind speed difference distribution for EU0301
QEvC 2002Q02



O-B abs wind direction difference distribution for EU0301
QEvC 2002Q02



EU0934



EU6821

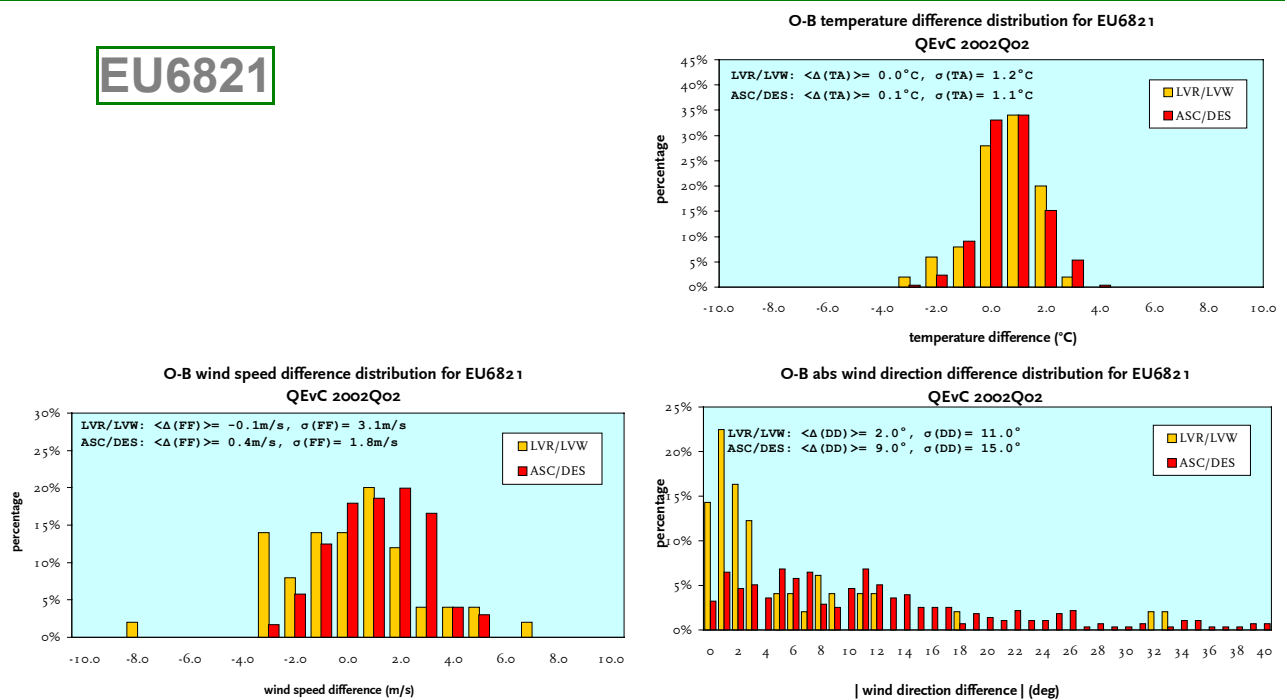


Fig. 2 1. a-e: Frequency distribution of $\langle \Delta(x) \rangle$ for 5 randomly chosen aircraft

As a result from this exercise we may conclude that evaluations of the standard deviation of the OBS–MOD differences, *i.e.* $\sigma(\Delta(x))$, result in similar data, to be aircraft independent. Typical values are found, namely: $\sigma(\Delta(AT)) \cong 1.6^\circ\text{C}$, $\sigma(\Delta(FF)) \cong 2.3\text{m/s}$, $\sigma(\Delta(FF-LVR)) \cong 13^\circ$ and $\sigma(\Delta(FF-LVR)) \cong 25^\circ$. It should be noted that these values are caused by uncertainties in **both** the *in-situ* measurement of the aircraft **and** the uncertainties in the HIRLAM model as well. Therefore statements on the usefulness of standard deviation calculations for quality evaluation purposes requires further and more *in-depth* investigations.