

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

1999-IV

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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 353 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.

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.

AMDAR reports received at KNMI have been monitored by the Quality Evaluation Centre 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 UK Meteorological Office (UKMO) would be the Responsible Member for the E-AMDAR Programme. The Programme Manager is Mr Bruce Truscott. 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 October 1st, 1999, 00:00 UTC to December 31st, 1999, 24:00 UTC (1999-Q4).

2) Operational AMDAR units

Data from 149 AMDAR units were received at KNMI HQ in De Bilt during the stated period. For a list of reporting aircrafts and their identifiers, see table 1.

3) List of outstanding issues

- a) From a number of aircraft the 'Phase of flight indicator' $i_p i_p i_p$ sometimes presents '///', whereas all other groups gives appropriate values. However for this indicator only the values LVR, LVW, ASC, DES or UNS are allowed in the code and not '///'. Although it is stated that '///' should be the alternative for 'UNS' (unstable) in the AAA software, these reports are token apart and are not evaluated.
- b) From 1st November, AMDAR bulletins are transmitted from Lufthansa aircraft in the BUFR AMDAR format. Since KNMI has no facilities to convert such bulletins on a real time basis for further evaluation, these bulletins are kept outside the evaluation process. KNMI is planning to implement an operational BUFR AMDAR decoding software package capable for future BUFR AMDAR data QEv routines.

- c) Sometimes two reports are generated within the same minute (during ASC or DES). As a consequence these reports contain the same timestamp given by the group GGgg in section 2 of FM42-IX AMDAR and therefore one of both reports will be regarded as a copy of the other report and consequently discarded for evaluation. In the first quarter of 2000 the evaluation software is improved and only those reports are discarded if reported observation time, latitude, longitude and altitude are identical.
- d) Due to the fact that within the group GGgg only hours and minutes are presented and not the date, confusion will arise when in a bulletin reports are presented from the previous day (e.g. combinations of GG=00 H UTC and GG=23 H UTC). In such cases meteorological message switches will reject the reports with GG=23 when the bulletin is received before 23 H and marked "incorrect time". In May 2000 an AMDAR code change will become effective where the GGgg group is extended with the day number to become YYGGgg.
- e) It is found that regularly a number of bulletins is disseminated twice on GTS. Although such "twins" are identified automatically and the second identical one is filtered out at many sites, it is good practice to prevent this situation. Specific investigations should be carried to identify the sources of this phenomenon.
- f) Occasionally code errors are identified in the reports resulting in rejection of the report. Although it is thought that most of these errors are due to communication faults it is worthwhile to investigate this issue in a more detailed manner.

4) Monitoring results

a) Data Availability

AMDAR reports are received via the different collecting centres with ground based receiving stations and consequently through GTS. Excluding Lufthansa data (BUFR encoded) the total number of reports received daily was on average 15421. An overview for all aircraft involved is presented in table 2.

b) Data coverage

Aircraft carrying the AMDAR units fly prominently within Europe. A typical map of aircraft reports for the period 5 to 9 December is attached to this report as annex 1 (EU AMDAR aircraft only). Note that the HIRLAM window in which observed data is evaluated is shown as well.

c) Data Timeliness

The delay between observation and reception at the GTS nodes should be small. During the period, 97% of all reports was received within one hour of observation time and 99% within 2 hours from observation. These figures compare favourably with similar statistics for the ASDAR aircraft.

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 with the higher frequency applying to the lower part of the atmosphere.

This reporting frequency is checked for each aircraft by taking samples every day (if available). Statistics are compiled by calculating the average time between reports during level flight at

cruising heights. For the ascent and descent phases the average pressure difference is calculated from the first 10 reports on ascent and the first 10 reports below 3500 feet (approximately 890 hPa) on descent. These pressure differences for ascent and descent are obtained from the reported height differences and by using the ICAO standard atmosphere (1 hPa equals approximately 29 feet in the layer from 1000-900 hPa). 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. It is recommended to investigate in more detail this issue as an impact study.

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. FM-42 coded AMDAR data passing through the KNMI MSS is used for statistical analysis. Heavily corrupted reports and reports without any positional information are kept outside further evaluation. Note that AMDAR reports received in the BUFR format are not evaluated as well, since no automatic conversion process is available at KNMI.

Differences between observations and model-forecast fields from the HIRLAM 31 level global forecast model are used for analysing the quality of AMDAR reports. Differences between 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 the reports from each 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 and 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 E-AMDAR operators (procedure to be effective after approval by E-AMDAR project manager). Although all FM42 encoded AMDAR data (with the exception of the rejected reports) are evaluated, the daily reports were found more practical when presenting 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: $|T_A(O)-T_A(B)| \geq \mathbf{0,5\text{ }^\circ\text{C (0,5 K)}}$
- Wind speed: $|f(O)-f(B)| \geq \mathbf{2,0\text{ m/s (4 Knots)}}$
- Wind direction: $|d(O)-d(B)| \geq \mathbf{20\text{ Degrees}}$

No criterion is stated concerning standard deviations.

f) Results (tables)

In the tables 4 to 6 attached to this report **all** 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) or with $i_p i_p = '///'$.

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. (To be inserted in table 3). 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.

Not appropriate (first report)

7) Summary

1. Timeliness and data quality: Timeliness is comparable to ASDAR data. The number of anomalies is very low with respect to the total number of reports (96% within 45 min).
2. The number of aircraft reporting AMDAR was 149.
3. Since reports are generated automatically, in general data is error free at the reception site.
4. Temperature anomalies were established for the aircraft EU 0063, EU 0101 and EU 0363; significant wind speed or wind direction anomalies were not found.

8) Special case study

During Christmas a severe storm struck the middle part of Europe and by surprise. Since it will be of interest to investigate any impact of AMDAR reports on short term and high resolution NWP models, the list of AMDAR reports is evaluated to identify those AMDAR reports with observations prior to the storm (25 December 1999, observations before 12 UTC). An overview over these AMDAR reports is presented as a map in annex 2

Table 1**List of operational AMDAR units (inclusive aircraft activated for the EUCOS SOP)**

Identifier	Identifier	Identifier	Identifier	Identifier
EU0002	EU0197	EU0745	EU3321	EU6845
EU0003	EU0201	EU0807	EU3654	EU6893
EU0005	EU0204	EU0826	EU3684	EU6923
EU0008	EU0209	EU0934	EU3689	EU6994
EU0021	EU0221	EU0947	EU3908	EU7082
EU0022	EU0234	EU0961	EU4001	EU7156
EU0024	EU0245	EU0985	EU4002	EU7285
EU0032	EU0249	EU1001	EU4003	EU7367
EU0034	EU0254	EU1002	EU4021	EU7398
EU0041	EU0263	EU1222	EU4278	EU7413
EU0043	EU0274	EU1456	EU4333	EU7521
EU0045	EU0281	EU1495	EU4387	EU7621
EU0047	EU0285	EU1532	EU4409	EU7634
EU0049	EU0291	EU1567	EU4426	EU7865
EU0050	EU0299	EU1593	EU4444	EU7866
EU0051	EU0300	EU1673	EU4519	EU8264
EU0052	EU0312	EU1688	EU4529	EU8342
EU0054	EU0321	EU1692	EU4587	EU8431
EU0055	EU0324	EU1698	EU4589	EU8478
EU0059	EU0332	EU1789	EU4656	EU8598
EU0061	EU0341	EU1809	EU4756	EU8605
EU0063	EU0347	EU2321	EU4792	EU8632
EU0072	EU0354	EU2378	EU4838	EU8789
EU0077	EU0357	EU2389	EU4896	EU8956
EU0078	EU0363	EU2397	EU4956	EU9012
EU0081	EU0367	EU2399	EU5098	EU9023
EU0082	EU0372	EU2547	EU5167	EU9678
EU0088	EU0385	EU2578	EU5175	EU9834
EU0099	EU0393	EU2590	EU5182	
EU0101	EU0405	EU2618	EU5191	
EU0106	EU0432	EU2630	EU5218	
EU0109	EU0452	EU2634	EU5245	
EU0121	EU0475	EU2689	EU5349	
EU0123	EU0482	EU2743	EU5590	
EU0124	EU0498	EU2845	EU5591	
EU0134	EU0568	EU2890	EU4593	
EU0143	EU0574	EU2896	EU5673	
EU0154	EU0592	EU2912	EU6287	
EU0158	EU0632	EU2978	EU6321	
EU0167	EU0646	EU2984	EU6386	
EU0175	EU0689	EU3056	EU6524	
EU0176	EU0720	EU3257	EU6723	
EU0185	EU0734	EU3268	EU6821	

Table 2**Quantity and Timeliness of AMDAR Reports**

Summary	
Number of days in this period	92
Number of aircraft reporting AMDAR	149
Total number of observations during the period	1419108 (15421 per day)
Average daily number of aircraft reporting AMDAR	54 (59 %)
Percentage of data available within 60 minutes is	97 %
Percentage of data available within 120 minutes is	99 %
Average reports per day, per aircraft is	103

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
Actual/possible	Ratio of Number of days aircraft reported/ maximum possible days in %
Average reports/day	Average number of reports per day from each aircraft
0 – 45	percentage of total reports received within 45 minutes of observation time
0 – 60	percentage of total reports received within 60 minutes of observation time
0 – 120	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	13163	90	97.8%	146	96.8%	97.0%	97.2%
EU0003	1943	43	46.7%	45	91.0%	91.9%	100.0%
EU0005	8536	81	88.0%	105	99.7%	99.7%	99.8%
EU0008	1748	49	53.3%	35	85.8%	87.9%	99.0%
EU0021	7025	61	66.3%	115	99.6%	99.6%	100.0%
EU0022	16006	81	88.0%	197	99.8%	99.9%	99.9%
EU0024	5620	47	51.1%	119	99.1%	99.3%	99.5%
EU0045	3742	64	69.6%	58	95.4%	97.8%	99.3%
EU0049	5351	88	95.7%	60	97.6%	97.6%	97.6%
EU0051	9291	77	83.7%	120	99.7%	99.8%	99.9%
EU0054	10933	90	97.8%	121	100.0%	100.0%	100.0%
EU0055	12541	87	94.6%	144	98.2%	98.2%	98.2%
EU0063	4996	25	27.2%	199	99.0%	99.0%	99.4%
EU0072	11397	90	97.8%	126	99.7%	99.7%	99.7%
EU0077	10174	48	52.2%	212	99.3%	99.5%	99.6%
EU0081	17113	90	97.8%	190	99.7%	99.8%	99.9%
EU0082	9979	68	73.9%	146	98.6%	98.6%	98.6%
EU0088	17603	87	94.6%	202	99.5%	99.6%	99.7%
EU0101	5921	48	52.2%	123	99.4%	99.4%	99.4%
EU0109	17379	90	97.8%	193	99.5%	99.5%	99.7%
EU0121	5319	46	50.0%	115	99.8%	99.9%	100.0%

AIRCRAFT	Total No of Reports	Days of Reports	Actual/ possible	Average reports/day	0-45 min	0-60 min	0-120 min
EU0123	4211	48	52.2%	87	83.1%	83.9%	99.0%
EU0124	12840	87	94.6%	147	97.4%	97.4%	97.9%
EU0134	6226	47	51.1%	132	99.4%	99.7%	100.0%
EU0143	9301	46	50.0%	202	98.9%	99.2%	99.5%
EU0175	4963	47	51.1%	105	99.4%	99.4%	99.4%
EU0201	5685	31	33.7%	183	98.4%	98.4%	98.8%
EU0204	4499	52	56.5%	86	99.1%	99.6%	100.0%
EU0221	5368	45	48.9%	119	99.8%	99.8%	99.8%
EU0234	5664	47	51.1%	120	99.1%	99.1%	100.0%
EU0245	8378	74	80.4%	113	99.4%	99.6%	99.6%
EU0249	8527	45	48.9%	189	99.7%	99.7%	99.7%
EU0254	8321	85	92.4%	97	99.8%	99.9%	100.0%
EU0263	6293	63	68.5%	99	100.0%	100.0%	100.0%
EU0274	9577	48	52.2%	199	99.9%	99.9%	99.9%
EU0285	4647	40	43.5%	116	99.8%	100.0%	100.0%
EU0291	2781	30	32.6%	92	99.6%	99.6%	100.0%
EU0299	12655	85	92.4%	148	97.9%	98.0%	98.0%
EU0300	5228	47	51.1%	111	99.5%	99.5%	99.5%
EU0312	5441	47	51.1%	115	99.5%	99.8%	100.0%
EU0324	10081	87	94.6%	115	99.4%	99.4%	99.6%
EU0332	6557	68	73.9%	96	99.8%	100.0%	100.0%
EU0341	5389	47	51.1%	114	100.0%	100.0%	100.0%
EU0354	4802	41	44.6%	117	100.0%	100.0%	100.0%
EU0357	5225	47	51.1%	111	99.0%	99.0%	99.6%
EU0363	3791	32	34.8%	118	100.0%	100.0%	100.0%
EU0367	10856	76	82.6%	142	98.0%	98.0%	98.1%
EU0372	718	14	15.2%	51	100.0%	100.0%	100.0%
EU0385	941	12	13.0%	78	100.0%	100.0%	100.0%
EU0393	5409	44	47.8%	123	99.5%	99.5%	99.5%
EU0405	5125	46	50.0%	111	99.4%	99.6%	100.0%
EU0432	13556	88	95.7%	154	97.9%	98.5%	98.7%
EU0475	10532	87	94.6%	121	99.7%	99.7%	99.9%
EU0482	8752	83	90.2%	105	100.0%	100.0%	100.0%
EU0568	11108	79	85.9%	140	98.1%	98.3%	98.4%
EU0574	4355	46	50.0%	94	99.8%	99.8%	100.0%
EU0592	6126	47	51.1%	130	99.8%	100.0%	100.0%
EU0646	6855	35	38.0%	195	99.6%	99.6%	99.6%
EU0720	8975	46	50.0%	195	99.1%	99.3%	99.4%
EU0745	5554	45	48.9%	123	99.5%	99.5%	99.5%
EU0807	10599	83	90.2%	127	99.4%	99.6%	99.7%
EU0826	9871	68	73.9%	145	98.4%	98.4%	98.7%
EU0934	5878	49	53.3%	120	95.8%	98.5%	99.6%
EU0947	7998	71	77.2%	112	90.1%	92.1%	99.4%
EU0961	7746	69	75.0%	112	92.0%	93.5%	99.2%
EU0985	9442	63	68.5%	149	90.8%	93.0%	99.4%
EU1001	12924	90	97.8%	143	97.6%	97.8%	98.4%
EU1002	8432	58	63.0%	145	94.8%	97.1%	99.5%
EU1222	11329	80	87.0%	141	91.4%	93.3%	99.5%
EU1456	13330	88	95.7%	151	98.1%	98.6%	98.8%

AIRCRAFT	Total No of Reports	Days of Reports	Actual/ possible	Average reports/ day	0-45 min	0-60 min	0-120 min
EU1495	10445	76	82.6%	137	92.6%	94.2%	99.6%
EU1532	12107	82	89.1%	147	99.1%	99.1%	99.1%
EU1567	12855	84	91.3%	153	98.6%	98.6%	98.6%
EU1593	9916	63	68.5%	157	90.8%	92.3%	99.6%
EU1673	8860	48	52.2%	184	99.7%	99.7%	99.8%
EU1688	11524	90	97.8%	128	99.7%	99.7%	99.7%
EU1692	11336	88	95.7%	128	99.5%	99.7%	99.7%
EU1698	15149	90	97.8%	168	97.2%	97.2%	97.5%
EU2378	8879	24	26.1%	370	99.4%	99.7%	100.0%
EU2389	16918	85	92.4%	199	99.7%	99.8%	99.9%
EU2399	6680	37	40.2%	180	99.7%	99.9%	100.0%
EU2547	6694	60	65.2%	111	90.3%	92.1%	99.5%
EU2578	9139	47	51.1%	194	99.5%	99.5%	99.5%
EU2590	54574	84	91.3%	649	91.0%	93.0%	99.0%
EU2618	56686	87	94.6%	651	90.1%	92.6%	99.1%
EU2630	26169	52	56.5%	503	87.7%	89.4%	99.4%
EU2634	7418	40	43.5%	185	99.7%	99.9%	100.0%
EU2689	8570	45	48.9%	190	99.3%	99.4%	99.6%
EU2845	8945	79	85.9%	113	99.9%	99.9%	100.0%
EU2890	14515	39	42.4%	372	98.7%	98.7%	98.7%
EU2896	8223	46	50.0%	178	99.5%	99.5%	99.5%
EU2912	8584	48	52.2%	178	100.0%	100.0%	100.0%
EU2978	9638	46	50.0%	209	96.7%	97.1%	97.5%
EU2984	26365	51	55.4%	517	88.3%	90.6%	99.5%
EU3056	15568	44	47.8%	353	97.5%	97.5%	97.9%
EU3268	27611	50	54.3%	552	90.8%	92.9%	99.3%
EU3321	24036	48	52.2%	500	88.9%	90.6%	99.4%
EU3654	35499	53	57.6%	669	88.2%	89.7%	99.1%
EU3684	7594	15	16.3%	506	94.8%	97.7%	99.9%
EU3689	6282	45	48.9%	139	92.8%	92.8%	93.5%
EU3908	5902	11	12.0%	536	95.0%	97.0%	99.4%
EU4002	7124	13	14.1%	548	95.9%	97.8%	99.6%
EU4003	6972	46	50.0%	151	92.6%	93.2%	93.7%
EU4021	8408	45	48.9%	186	98.2%	99.3%	99.3%
EU4278	4750	32	34.8%	148	92.1%	93.1%	95.1%
EU4333	19883	36	39.1%	550	91.7%	96.2%	98.4%
EU4387	6949	46	50.0%	151	96.6%	96.6%	96.6%
EU4409	6432	44	47.8%	146	92.3%	92.9%	93.9%
EU4426	3947	31	33.7%	127	99.5%	99.7%	100.0%
EU4444	6290	13	14.1%	483	98.1%	99.0%	100.0%
EU4519	6240	14	15.2%	445	95.2%	98.5%	100.0%
EU4529	11181	87	94.6%	128	99.6%	99.6%	99.7%
EU4587	10190	81	88.0%	125	99.6%	99.7%	99.9%
EU4656	6963	45	48.9%	154	96.0%	96.6%	96.6%
EU4756	625	13	14.1%	48	99.5%	99.5%	100.0%
EU4838	9795	20	21.7%	489	97.6%	97.6%	97.6%
EU4956	15	1	1.1%	15	100.0%	100.0%	100.0%
EU5098	9208	45	48.9%	204	95.6%	96.0%	96.3%
EU5167	6067	46	50.0%	131	99.3%	99.3%	99.5%

AIRCRAFT	Total No of Reports	Days of Reports	Actual/ possible	Average reports/ day	0-45 min	0-60 min	0-120 min
EU5175	239	10	10.9%	23	100.0%	100.0%	100.0%
EU5182	9340	46	50.0%	203	99.3%	99.4%	99.5%
EU5191	371	13	14.1%	28	85.7%	85.7%	85.7%
EU5218	16922	87	94.6%	194	99.6%	99.6%	99.8%
EU5245	386	17	18.5%	22	88.3%	90.9%	94.8%
EU5349	8489	43	46.7%	197	94.7%	94.7%	95.3%
EU5590	6479	46	50.0%	140	96.0%	96.0%	96.9%
EU5591	10848	86	93.5%	126	99.8%	100.0%	100.0%
EU5673	8008	46	50.0%	174	100.0%	100.0%	100.0%
EU6287	6455	44	47.8%	146	94.9%	94.9%	96.3%
EU6524	10303	80	87.0%	128	99.9%	100.0%	100.0%
EU6723	9735	81	88.0%	120	99.9%	99.9%	99.9%
EU6821	364	13	14.1%	28	100.0%	100.0%	100.0%
EU6893	7527	42	45.7%	179	94.4%	95.1%	95.1%
EU6923	8601	46	50.0%	187	93.4%	93.4%	95.1%
EU7082	8745	45	48.9%	194	92.4%	93.9%	94.5%
EU7285	7046	46	50.0%	153	94.7%	95.8%	95.8%
EU7521	11160	45	48.9%	248	98.9%	99.3%	99.7%
EU7634	14301	41	44.6%	348	97.9%	97.9%	98.2%
EU7865	7744	40	43.5%	193	95.8%	95.8%	95.8%
EU7866	11460	87	94.6%	131	99.6%	99.6%	99.7%
EU8264	10075	41	44.6%	245	99.7%	99.7%	99.7%
EU8431	8104	46	50.0%	176	94.3%	94.3%	95.6%
EU8478	5185	44	47.8%	117	98.2%	98.2%	98.2%
EU8598	8368	46	50.0%	181	95.0%	95.6%	95.6%
EU8605	12415	34	37.0%	365	97.1%	97.1%	97.1%
EU8632	7503	46	50.0%	163	94.9%	94.9%	95.4%
EU8789	7538	45	48.9%	167	96.4%	96.4%	96.4%
EU9023	6530	44	47.8%	148	97.6%	97.6%	98.3%
EU9678	6506	43	46.7%	151	94.5%	94.5%	95.9%

Table 3

Description and number of errors

Aircrafts deactivated due to temperature anomalies:

- EO0204 (deactivated on 27SEP99, air temperature mean error > 4°C, reconfigured on 03NOV99)
- EU0363 (deactivated on 03NOV99, air temperature mean error > 3°C).

No reports received although expected:

- EU0063 (no reports until 22OCT99)
- EU0347

Specific problems:

- Problems with some AMDAR data reporting latitude positions in error. Problem was resolved by NMS/airlines involved on and around 05OCT99

Ground stations issues and other problems:

- Data being received from 12 Lufthansa aircraft activated on or around 01/11/99. Due to the problems processing BUFR coded messages at QEv Centre, this data was routed to EGRR. (Data also routed to ECMWF from 22NOV99)
- First opportunity to switch off AMDAR equipment: EU0063 (deactivated 07DEC99)
- SAS computer system failure: Starting on 30OCT99 and resolved on 01NOV99.
- The reports from EU4444 and EU4519 were being “listed” under SKXXXX header. (Problem resolved 17DEC99).
- Reports from the following aircraft have not been “listed”: EU2590, EU2618, EU4333, EU4444 and EU4519 (To be investigated)
- Lufthansa Ground Data Processing System failure from 07DEC99 to 09DEC99 and from 12DEC99 until 13DEC99.

(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 $i_p i_p i_p = \text{UNS}$ or $///$ 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 map 1). Other reasons for this difference are data rejection by the observations database caused by local misinterpretation (until mid October) and by wrong encoding of $i_p i_p i_p$, cases with more than one report from the same aircraft within one minute (only one is used) or in case of incomplete bulletins.

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) Tabel 4, *Temperature (°C)*

1999-IV AIR- CRAFT	Temperature Cruise level in °C					Temperature Ascent & Descent in °C				
	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU0002	0					3930	-16.3	15.6	-0.2	1.2
EU0003	584	-52.4	9.6	-0.2	1.4	875	-5.8	11.1	0.1	1.1
EU0005	2505	-52.8	9.0	-0.3	1.7	3662	-4.7	11.9	-0.2	1.7
EU0008	289	-49.3	11.4	0.0	1.3	810	-8.3	11.6	0.2	1.3
EU0021	1304	-52.1	10.2	-0.3	1.3	3426	-4.9	11.9	0.1	1.4
EU0022	2201	-50.9	11.6	-0.1	1.9	8361	-1.5	11.3	-0.1	1.3
EU0024	1053	-51.8	10.2	-0.5	1.3	2146	-0.9	11.7	-0.6	1.4
EU0045	899	-52.6	7.5	-0.4	1.4	1119	-8.1	11.7	-0.2	1.1
EU0049	0					1732	-15.6	16.4	-0.3	1.3
EU0051	1952	-50.7	10.7	-0.3	1.8	5009	-4.1	11.4	-0.3	1.4
EU0054	1594	-47.2	14.2	-0.4	1.3	6026	-3.0	11.9	-0.3	1.4
EU0055	0					3214	-15.6	15.6	-0.1	1.3
EU0063	604	-44.8	12.9	0.9	2.4	2923	2.2	10.8	0.9	1.4
EU0072	2210	-49.5	10.7	0.2	1.4	5514	-3.4	11.8	0.2	1.6
EU0077	963	-46.4	13.4	0.5	2.0	4765	1.3	10.6	0.4	1.3
EU0081	2931	-51.8	11.0	0.4	1.7	8655	-0.7	11.1	0.2	1.4
EU0082	0					1851	-14.5	15.6	0.1	1.2
EU0088	2157	-49.7	12.1	0.2	1.3	9407	-1.4	11.3	0.2	1.4
EU0101	1186	-48.1	10.0	2.6	1.5	2328	1.0	11.6	1.3	1.6
EU0109	2885	-51.6	11.7	-0.1	1.6	8848	-1.8	11.1	-0.1	1.4
EU0121	917	-49.9	10.3	-0.6	1.2	2193	-1.0	11.9	-0.6	1.4
EU0123	1810	-49.7	8.4	-0.2	1.7	1012	-5.9	10.9	0.0	1.5
EU0124	0					4506	-16.9	16.2	0.0	1.3
EU0134	604	-40.9	14.9	0.9	1.1	2972	-0.2	11.8	0.2	1.4
EU0143	1172	-48.9	12.8	0.6	2.0	4374	1.5	10.5	0.5	1.3
EU0175	1410	-52.4	8.3	0.5	1.3	1430	1.1	12.2	0.1	1.5
EU0201	719	-51.5	11.9	-0.5	1.4	1755	2.9	11.1	-0.1	1.3
EU0204	1512	-53.9	8.2	0.3	1.5	2282	-3.1	12.2	0.1	1.7
EU0221	1243	-51.2	8.6	0.5	1.3	2005	0.9	12.7	-0.1	1.4
EU0234	0					1822	-2.3	17.8	0.0	1.5
EU0245	2240	-53.7	8.8	-0.1	1.3	3473	-1.4	12.5	-0.1	1.6
EU0249	1153	-50.9	11.5	0.4	1.2	3339	2.3	11.0	0.3	1.4
EU0254	4031	-51.7	7.4	0.1	1.7	1604	-1.2	11.2	0.1	1.5
EU0263	3441	-52.4	7.6	-0.3	1.6	1389	0.0	12.7	-0.1	1.3
EU0274	1609	-51.9	10.9	-0.3	1.3	3682	2.0	10.9	0.1	1.3
EU0285	1120	-53.2	8.7	-0.4	1.3	1660	0.5	12.4	-0.2	1.4
EU0291	767	-48.0	6.1	-0.5	1.6	413	2.4	10.9	0.2	1.2
EU0299	0					3567	-15.3	15.3	-0.1	1.3
EU0300	1361	-52.3	7.3	0.0	1.2	1674	1.0	12.7	0.0	1.6
EU0312	1210	-51.3	8.4	0.5	1.3	2039	1.3	12.2	0.3	1.4
EU0324	2806	-53.5	8.5	-0.4	1.3	4421	-1.7	12.4	-0.3	1.6
EU0332	3093	-53.2	7.2	-0.4	1.6	1555	-0.8	11.2	0.0	1.7
EU0341	1286	-52.5	8.6	-0.1	1.3	2067	1.6	12.5	0.0	1.6
EU0354	1138	-52.9	7.7	-0.4	1.3	1716	0.1	12.3	-0.3	1.3
EU0357	1372	-53.5	7.6	-0.4	1.2	1667	0.7	11.7	-0.5	1.6
EU0363	642	-46.4	8.7	4.4	1.5	1154	5.5	12.4	2.7	1.7
EU0367	0					2484	-16.3	15.6	0.0	1.2
EU0372	270	-50.4	5.8	0.9	1.7	22	-12.2	5.8	0.4	0.8
EU0385	649	-54.6	5.7	-1.0	1.3	179	-3.7	10.7	0.0	1.3

1999-IV AIR-CRAFT	Temperature Cruise level in °C					Temperature Ascent & Descent in °C				
	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU0393	1462	-53.5	7.9	-0.2	1.2	1587	0.7	12.4	-0.3	1.4
EU0405	1348	-52.8	7.5	0.4	1.3	1571	0.1	12.4	-0.1	1.3
EU0432	0					4595	-17.8	16.3	-0.2	1.2
EU0475	2991	-53.1	8.5	0.2	1.5	4501	-1.8	12.3	-0.1	1.6
EU0482	4110	-52.3	7.2	-0.3	1.7	1750	-1.9	12.4	-0.2	1.5
EU0568	0					3865	-15.4	15.7	0.2	1.2
EU0574	1027	-52.5	8.7	-0.2	1.2	1225	-1.2	11.9	-0.3	1.3
EU0592	1410	-51.2	8.0	1.0	1.3	2195	2.0	12.1	0.1	1.5
EU0646	900	-47.5	10.9	0.2	1.2	2179	2.1	11.4	0.1	1.3
EU0720	1143	-47.0	12.0	0.2	1.1	3637	1.6	10.9	0.1	1.3
EU0745	1167	-49.1	9.8	-0.6	1.1	2113	-1.8	11.6	-0.5	1.3
EU0807	2861	-50.3	9.2	0.4	1.2	4242	-4.1	12.2	0.0	1.5
EU0826	0					2223	-15.3	15.6	0.1	1.7
EU0934	2186	-52.6	8.7	-0.4	1.5	826	-7.8	12.0	-0.1	1.2
EU0947	3450	-51.5	8.4	-0.6	1.5	1295	-7.2	11.7	-0.2	1.3
EU0961	3636	-51.3	8.8	-0.1	1.5	1345	-6.6	11.3	0.1	1.1
EU0985	3904	-52.3	8.4	-0.4	1.7	1469	-5.9	11.7	-0.1	1.1
EU1001	0					4455	-16.8	15.9	-0.2	1.2
EU1002	4082	-52.9	7.8	-0.4	1.6	1606	-7.0	11.3	0.0	1.2
EU1222	4771	-51.9	8.8	-0.4	1.6	1874	-4.9	11.4	-0.1	1.3
EU1456	0					4596	-17.3	15.8	-0.4	1.2
EU1495	4548	-51.3	8.9	-0.5	1.6	1890	-6.5	11.5	-0.1	1.5
EU1532	0					4125	-16.3	15.7	-0.3	1.2
EU1567	0					3682	-10.3	18.6	-0.1	1.5
EU1593	4521	-51.9	7.8	-0.3	1.7	1868	-4.2	11.4	-0.1	1.1
EU1673	1162	-47.4	11.5	-0.4	1.4	3468	1.5	10.8	-0.3	1.4
EU1688	2985	-50.8	9.3	-0.4	1.3	4817	-4.3	12.1	-0.1	1.4
EU1692	2901	-50.8	9.1	-0.1	1.3	4911	-5.2	12.3	-0.2	1.4
EU1698	0					4212	-16.0	15.8	0.0	1.2
EU2389	2840	-50.0	11.1	-0.5	1.3	7750	-3.0	11.4	-0.3	1.4
EU2399	718	-47.5	10.5	0.4	1.2	2076	2.2	10.9	0.1	1.3
EU2547	2772	-50.6	8.0	0.0	1.5	1089	-5.3	10.8	0.0	1.3
EU2578	1282	-48.1	10.9	-0.3	1.2	3570	1.4	10.9	-0.1	1.2
EU2634	932	-47.7	11.1	-0.1	1.2	2985	0.5	10.6	-0.1	1.4
EU2689	1202	-48.3	10.7	-0.4	1.1	3387	1.3	11.0	-0.2	1.3
EU2845	2047	-50.8	8.7	-0.3	1.3	3633	-2.8	12.3	-0.3	1.4
EU2896	1112	-49.1	11.5	-0.4	1.1	3018	1.4	10.4	-0.1	1.3
EU2912	1193	-47.1	11.5	-0.2	1.2	3501	1.9	10.8	-0.1	1.3
EU4426	793	-49.6	9.1	-0.3	1.1	1256	-1.9	11.4	-0.4	1.5
EU4529	2707	-50.3	9.2	-0.3	1.3	4619	-4.6	12.1	-0.3	1.4
EU4587	2600	-51.3	9.1	-0.2	1.2	4089	-4.0	12.0	-0.3	1.5
EU4756	61	-44.2	6.1			176	9.8	10.3	0.3	0.9
EU4956	0					9	-1.1	7.5	0.3	0.6
EU5167	1341	-49.6	9.0	-0.2	1.2	2169	-1.5	11.9	-0.2	1.3
EU5175	18	-42.5	17.5			98	4.7	10.8	0.6	1.4
EU5182	1115	-47.4	12.1	-0.1	1.1	3727	1.5	10.9	-0.1	1.3
EU5191	35	-47.0	5.4	-0.1	1.0	128	7.9	9.7	0.5	1.1
EU5218	2753	-48.0	11.5	0.1	1.2	7796	-1.9	11.2	-0.1	1.4
EU5245	32	-46.7	5.5			120	2.2	7.5	0.4	1.4
EU5591	2665	-50.4	9.9	-0.4	1.3	4675	-4.9	11.9	-0.3	1.6
EU5673	1046	-47.5	11.8	-0.4	1.1	3250	1.4	10.6	0.0	1.3
EU6524	2539	-49.4	10.0	0.4	1.8	4293	-2.2	12.1	0.1	1.9

1999-IV AIR-CRAFT	Temperature Cruise level in °C					Temperature Ascent & Descent in °C				
	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU6723	2271	-50.4	9.8	-0.4	1.2	3816	-3.9	12.5	-0.2	1.3
EU6821	16	-45.2	7.0			109	0.5	6.7	0.2	1.1
EU7866	2623	-49.8	9.3	0.0	1.2	4956	-3.7	12.0	-0.2	1.4

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

1999-IV FF AIRCRAFT	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s				
	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU0002	0					3930	17.9	12.3	0.1	2.6
EU0003	584	26.3	15.1	0.4	3.0	875	12.8	7.4	-0.4	2.1
EU0005	2505	25.8	14.0	0.0	2.8	3662	11.7	8.2	-0.1	2.5
EU0008	289	23.7	13.3	0.4	3.4	810	10.2	5.5	-0.3	2.1
EU0021	1304	31.6	15.6	0.2	3.2	3426	12.8	8.6	-0.1	2.4
EU0022	2201	27.7	15.3	0.1	3.1	8361	12.1	8.0	-0.2	2.2
EU0024	1053	22.1	12.6	0.1	3.1	2146	9.8	7.1	-0.1	2.3
EU0045	899	23.7	14.0	-0.1	2.9	1119	13.4	7.9	-0.1	2.2
EU0049	0					1732	19.0	13.4	-0.2	2.5
EU0051	1952	29.9	16.4	0.1	3.2	5009	11.9	8.5	-0.1	2.3
EU0054	1594	30.4	16.8	0.1	3.3	6026	12.8	8.5	-0.2	2.4
EU0055	0					3214	18.4	13.0	-0.2	3.3
EU0063	604	27.5	14.8	0.1	3.8	2923	12.7	7.7	-0.1	2.6
EU0072	2210	28.1	14.6	0.2	3.2	5514	13.4	9.3	-0.1	2.6
EU0077	963	21.5	12.9	0.1	2.9	4765	10.9	6.7	-0.2	2.3
EU0081	2931	27.0	14.7	0.2	3.1	8655	12.4	8.0	-0.1	2.3
EU0082	0					1851	16.7	10.6	-0.5	2.3
EU0088	2157	26.8	15.5	0.0	3.0	9407	12.4	8.1	-0.1	2.2
EU0101	1186	21.5	13.7	0.7	3.2	2328	9.4	6.3	0.0	2.1
EU0109	2885	27.5	15.5	0.1	2.9	8848	12.0	8.0	-0.2	2.3
EU0121	917	22.7	13.7	0.3	3.2	2193	9.2	6.4	-0.1	2.2
EU0123	1810	30.6	16.4	0.1	3.1	1012	13.1	8.6	-0.3	2.2
EU0124	0					4506	18.9	13.0	-0.1	2.6
EU0134	604	21.3	11.7	0.3	3.0	2972	10.8	6.4	-0.3	2.3
EU0143	1172	21.7	11.3	0.1	2.8	4374	9.9	6.2	0.0	2.1
EU0175	1410	23.8	12.3	0.4	3.4	1430	9.9	7.5	0.2	2.2
EU0201	719	22.3	11.9	0.5	3.5	1755	9.6	5.8	0.2	2.3
EU0204	1512	28.4	14.9	0.1	3.2	2282	10.3	8.3	0.1	2.6
EU0221	1243	24.2	13.4	0.6	3.6	2005	10.2	7.1	0.5	2.8
EU0234	0					1822	13.6	16.6	0.0	2.8
EU0245	2240	25.3	13.7	0.2	2.9	3473	10.1	8.1	0.1	2.2
EU0249	1153	21.0	12.3	0.6	3.0	3339	10.1	6.3	0.1	2.2
EU0254	4031	33.9	17.1	0.1	3.6	1604	13.9	9.4	0.0	2.8

1999-IV FF AIRCRAFT	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s				
	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU0263	3441	31.8	17.4	0.0	4.0	1389	13.5	9.5	-0.2	2.5
EU0274	1609	23.3	13.6	0.5	3.2	3682	10.0	6.6	0.2	2.8
EU0285	1120	24.0	13.7	0.5	3.3	1660	10.1	6.5	0.5	2.4
EU0291	767	35.3	21.5	0.0	2.6	413	9.9	4.7	0.0	2.2
EU0299	0					3567	17.7	11.9	-0.3	2.5
EU0300	1361	23.7	13.3	0.2	3.1	1674	10.0	6.8	0.4	2.3
EU0312	1210	22.1	11.7	0.2	3.0	2039	9.7	6.5	0.2	2.4
EU0324	2806	27.4	14.2	0.3	2.9	4421	10.6	8.1	0.0	2.4
EU0332	3093	32.5	16.3	0.2	3.1	1555	13.3	8.6	-0.2	2.5
EU0341	1286	22.8	12.7	0.5	3.2	2067	9.8	7.2	0.5	2.6
EU0354	1138	21.9	11.6	0.2	2.8	1716	9.3	6.3	0.1	2.2
EU0357	1372	23.6	12.9	0.5	3.4	1667	10.2	6.9	0.7	2.7
EU0363	642	25.0	15.2	0.9	4.0	1154	10.4	7.5	0.0	2.8
EU0367	0					2484	18.9	13.5	0.0	2.5
EU0372	270	29.9	13.8	0.3	2.7	22	22.9	8.2	1.8	1.8
EU0385	649	24.0	14.1	0.1	2.6	179	10.4	6.3	0.1	2.3
EU0393	1462	21.9	12.2	0.4	3.2	1587	9.7	7.0	0.1	2.4
EU0405	1348	21.1	12.6	0.3	2.9	1571	10.3	6.9	0.2	2.3
EU0432	0					4595	19.3	13.2	-0.4	2.9
EU0475	2991	27.6	15.4	0.1	3.2	4501	10.4	8.2	0.2	2.3
EU0482	4110	32.4	17.1	0.1	2.8	1750	14.3	9.2	-0.2	2.7
EU0568	0					3865	18.0	12.5	-0.1	2.5
EU0574	1027	22.0	12.2	0.4	3.0	1225	10.0	6.9	0.5	2.4
EU0592	1410	22.0	13.1	0.2	3.1	2195	9.1	6.9	0.2	2.4
EU0646	900	26.9	15.5	0.5	3.1	2179	10.1	6.6	-0.1	2.3
EU0720	1143	23.3	13.6	0.4	3.2	3637	10.4	6.6	-0.3	2.5
EU0745	1167	23.3	13.2	0.4	3.1	2113	10.8	7.5	0.1	2.3
EU0807	2861	27.3	14.6	0.2	3.2	4242	11.6	8.6	-0.1	2.5
EU0826	0					2223	18.8	12.9	-0.2	3.4
EU0934	2186	25.3	14.5	0.1	2.4	826	11.8	7.8	0.1	1.8
EU0947	3450	25.0	14.2	0.1	2.6	1295	13.0	8.4	-0.1	2.1
EU0961	3636	27.4	14.5	0.1	2.7	1345	13.9	9.0	-0.3	2.1
EU0985	3904	27.5	16.0	0.1	2.7	1469	13.7	8.4	-0.1	2.1
EU1001	0					4455	19.4	13.4	-0.2	2.7
EU1002	4082	27.1	15.6	0.0	2.7	1606	13.5	7.9	-0.2	2.3
EU1222	4771	28.0	16.1	0.1	2.8	1874	14.0	8.0	-0.1	2.2
EU1456	0					4596	18.5	12.5	-0.1	2.6
EU1495	4548	28.5	16.3	0.1	2.8	1890	14.0	7.8	-0.1	2.3
EU1532	0					4125	19.7	13.4	-0.3	2.5
EU1567	0					3682	17.1	14.5	-0.1	2.6
EU1593	4521	28.9	16.0	0.0	2.8	1868	13.5	7.6	-0.1	2.1
EU1673	1162	21.2	12.3	0.4	3.3	3468	10.1	6.8	-0.3	2.6
EU1688	2985	29.3	17.0	0.3	3.1	4817	12.1	8.4	0.0	2.5
EU1692	2901	27.8	16.1	0.4	3.5	4911	11.8	8.4	0.0	2.5
EU1698	0					4212	19.0	13.1	-0.3	2.6
EU2389	2840	29.2	16.1	0.2	3.2	7750	12.5	8.4	-0.3	2.6
EU2399	718	23.8	14.6	0.1	3.4	2076	10.7	6.9	-0.5	2.7
EU2547	2772	27.4	15.7	0.1	2.5	1089	12.5	7.5	-0.1	1.9
EU2578	1282	22.8	13.5	0.3	3.1	3570	10.0	6.5	-0.2	2.3
EU2634	932	24.4	14.4	0.6	3.3	2985	10.3	6.5	-0.3	2.5
EU2689	1202	23.7	13.7	0.4	3.0	3387	10.3	6.6	-0.2	2.4
EU2845	2047	27.1	15.9	0.3	3.2	3633	11.7	8.5	0.1	2.5
EU2896	1112	22.8	13.4	0.5	3.0	3018	10.1	6.2	-0.4	2.4

1999-IV FF AIRCRAFT	Wind Speed Cruise level in m/s					Wind Speed Ascent & Descent in m/s				
	Number of Reports	Observed		Obs-backgrnd		Number of Reports	Observed		Obs-backgrnd	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
EU2912	1193	22.7	13.2	0.3	3.3	3501	9.9	6.4	-0.2	2.5
EU4426	793	22.6	11.3	0.2	2.9	1256	11.1	7.3	-0.1	2.4
EU4529	2707	30.0	16.3	0.2	3.5	4619	12.7	9.7	-0.1	2.8
EU4587	2600	26.9	15.7	0.3	3.4	4089	12.1	8.8	0.1	2.5
EU4756	61	11.6	7.9			176	8.4	4.4	-0.4	2.8
EU4956	0					9	13.8	3.6	-1.2	2.3
EU5167	1341	23.8	14.0	0.3	3.1	2169	10.9	7.0	0.1	2.4
EU5175	18	8.5	4.4			98	9.3	6.4	-0.8	2.0
EU5182	1115	22.3	13.0	0.2	3.1	3727	9.8	6.5	-0.4	2.5
EU5191	35	18.5	13.0	0.2	0.8	128	10.2	7.2	-1.2	2.3
EU5218	2753	27.9	15.8	0.1	3.1	7796	11.7	8.1	-0.3	2.5
EU5245	32	17.6	6.4			120	12.6	6.9	-0.8	2.3
EU5591	2665	28.0	15.1	0.2	3.3	4675	12.5	9.2	0.0	2.9
EU5673	1046	22.0	13.7	0.3	2.7	3250	10.1	6.4	-0.3	2.3
EU6524	2539	27.3	15.3	0.2	3.2	4293	12.2	9.1	0.0	2.5
EU6723	2271	28.5	16.4	0.4	3.2	3816	11.6	8.7	-0.1	2.4
EU6821	16	15.5	6.4			109	9.9	6.1	-1.3	1.6
EU7866	2623	27.8	15.4	0.3	3.4	4956	12.1	9.0	0.0	2.6

c) Tabel 6, *Wind direction (deg)*

1999-IV DD 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
EU0002	0					3930			10.0	18.0
EU0003	584			8.0	16.0	875			11.0	14.0
EU0005	2505			7.0	10.0	3662			13.0	23.0
EU0008	289			7.0	13.0	810			13.0	17.0
EU0021	1304			5.0	8.0	3426			12.0	20.0
EU0022	2201			6.0	8.0	8361			11.0	19.0
EU0024	1053			8.0	13.0	2146			15.0	25.0
EU0045	899			7.0	11.0	1119			10.0	16.0
EU0049	0					1732			9.0	17.0
EU0051	1952			7.0	11.0	5009			12.0	19.0
EU0054	1594			6.0	9.0	6026			13.0	19.0
EU0055	0					3214			11.0	20.0
EU0063	604			8.0	11.0	2923			12.0	17.0
EU0072	2210			6.0	9.0	5514			12.0	20.0
EU0077	963			10.0	15.0	4765			12.0	16.0
EU0081	2931			7.0	11.0	8655			11.0	18.0
EU0082	0					1851			9.0	16.0
EU0088	2157			7.0	9.0	9407			11.0	18.0

1999-IV DD 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
EU0101	1186			10.0	16.0	2328			13.0	23.0
EU0109	2885			6.0	9.0	8848			12.0	19.0
EU0121	917			9.0	13.0	2193			14.0	22.0
EU0123	1810			5.0	9.0	1012			9.0	18.0
EU0124	0					4506			9.0	16.0
EU0134	604			9.0	13.0	2972			12.0	17.0
EU0143	1172			8.0	11.0	4374			11.0	16.0
EU0175	1410			9.0	15.0	1430			15.0	25.0
EU0201	719			10.0	19.0	1755			16.0	23.0
EU0204	1512			7.0	11.0	2282			19.0	29.0
EU0221	1243			11.0	17.0	2005			17.0	25.0
EU0234	0					1822			16.0	33.0
EU0245	2240			7.0	10.0	3473			15.0	25.0
EU0249	1153			9.0	13.0	3339			14.0	23.0
EU0254	4031			5.0	10.0	1604			5.0	12.0
EU0263	3441			5.0	10.0	1389			5.0	13.0
EU0274	1609			10.0	15.0	3682			18.0	24.0
EU0285	1120			10.0	14.0	1660			17.0	28.0
EU0291	767			5.0	15.0	413			8.0	11.0
EU0299	0					3567			10.0	18.0
EU0300	1361			8.0	12.0	1674			13.0	21.0
EU0312	1210			8.0	14.0	2039			14.0	23.0
EU0324	2806			6.0	10.0	4421			16.0	27.0
EU0332	3093			5.0	11.0	1555			8.0	16.0
EU0341	1286			9.0	13.0	2067			18.0	30.0
EU0354	1138			9.0	15.0	1716			15.0	26.0
EU0357	1372			10.0	15.0	1667			18.0	27.0
EU0363	642			12.0	17.0	1154			19.0	28.0
EU0367	0					2484			10.0	17.0
EU0372	270			7.0	13.0	22			3.0	3.0
EU0385	649			7.0	11.0	179			12.0	14.0
EU0393	1462			9.0	13.0	1587			16.0	27.0
EU0405	1348			9.0	14.0	1571			13.0	19.0
EU0432	0					4595			9.0	15.0
EU0475	2991			7.0	11.0	4501			17.0	26.0
EU0482	4110			5.0	9.0	1750			6.0	17.0
EU0568	0					3865			9.0	16.0
EU0574	1027			9.0	15.0	1225			15.0	27.0
EU0592	1410			10.0	15.0	2195			18.0	29.0
EU0646	900			7.0	9.0	2179			16.0	24.0
EU0720	1143			9.0	15.0	3637			14.0	21.0
EU0745	1167			8.0	11.0	2113			17.0	28.0
EU0807	2861			7.0	10.0	4242			14.0	22.0
EU0826	0					2223			9.0	15.0
EU0934	2186			5.0	10.0	826			8.0	15.0
EU0947	3450			5.0	10.0	1295			10.0	16.0
EU0961	3636			5.0	11.0	1345			9.0	16.0
EU0985	3904			5.0	10.0	1469			6.0	15.0
EU1001	0					4455			9.0	15.0
EU1002	4082			5.0	10.0	1606			7.0	15.0
EU1222	4771			5.0	10.0	1874			5.0	14.0
EU1456	0					4596			9.0	16.0
EU1495	4548			5.0	11.0	1890			6.0	16.0

1999-IV DD 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
EU1532	0					4125			9.0	16.0
EU1567	0					3682			11.0	20.0
EU1593	4521			5.0	12.0	1868			7.0	17.0
EU1673	1162			9.0	13.0	3468			16.0	25.0
EU1688	2985			6.0	9.0	4817			12.0	20.0
EU1692	2901			7.0	11.0	4911			14.0	22.0
EU1698	0					4212			9.0	17.0
EU2389	2840			7.0	11.0	7750			13.0	21.0
EU2399	718			8.0	12.0	2076			14.0	21.0
EU2547	2772			5.0	11.0	1089			9.0	17.0
EU2578	1282			9.0	15.0	3570			15.0	23.0
EU2634	932			8.0	11.0	2985			16.0	23.0
EU2689	1202			8.0	11.0	3387			16.0	23.0
EU2845	2047			7.0	10.0	3633			14.0	23.0
EU2896	1112			9.0	13.0	3018			14.0	22.0
EU2912	1193			9.0	13.0	3501			15.0	21.0
EU4426	793			7.0	12.0	1256			13.0	20.0
EU4529	2707			6.0	9.0	4619			13.0	23.0
EU4587	2600			8.0	11.0	4089			15.0	25.0
EU4756	61					176			6.0	13.0
EU4956	0					9			3.0	2.0
EU5167	1341			9.0	14.0	2169			15.0	22.0
EU5175	18					98			10.0	19.0
EU5182	1115			8.0	11.0	3727			17.0	26.0
EU5191	35			1.0	3.0	128			10.0	17.0
EU5218	2753			7.0	12.0	7796			15.0	23.0
EU5245	32					120			15.0	24.0
EU5591	2665			7.0	11.0	4675			15.0	25.0
EU5673	1046			9.0	14.0	3250			14.0	20.0
EU6524	2539			7.0	11.0	4293			15.0	26.0
EU6723	2271			7.0	10.0	3816			14.0	24.0
EU6821	16					109			16.0	17.0
EU7866	2623			7.0	13.0	4956			15.0	24.0

Annex I. Amdar Observations 5 to 9 December 1999

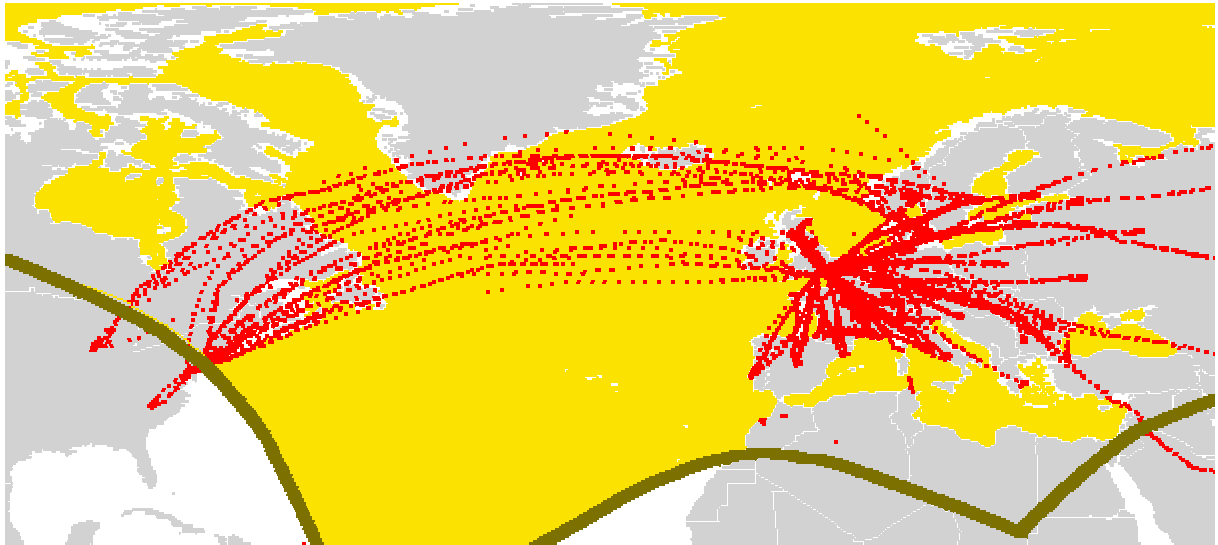


Fig. 1 In this map all EU AMDAR observation locations are presented, within the observation period 5 to 9 December 1999. In this figure also the HIRLAM area used for evaluation purposes is indicated.

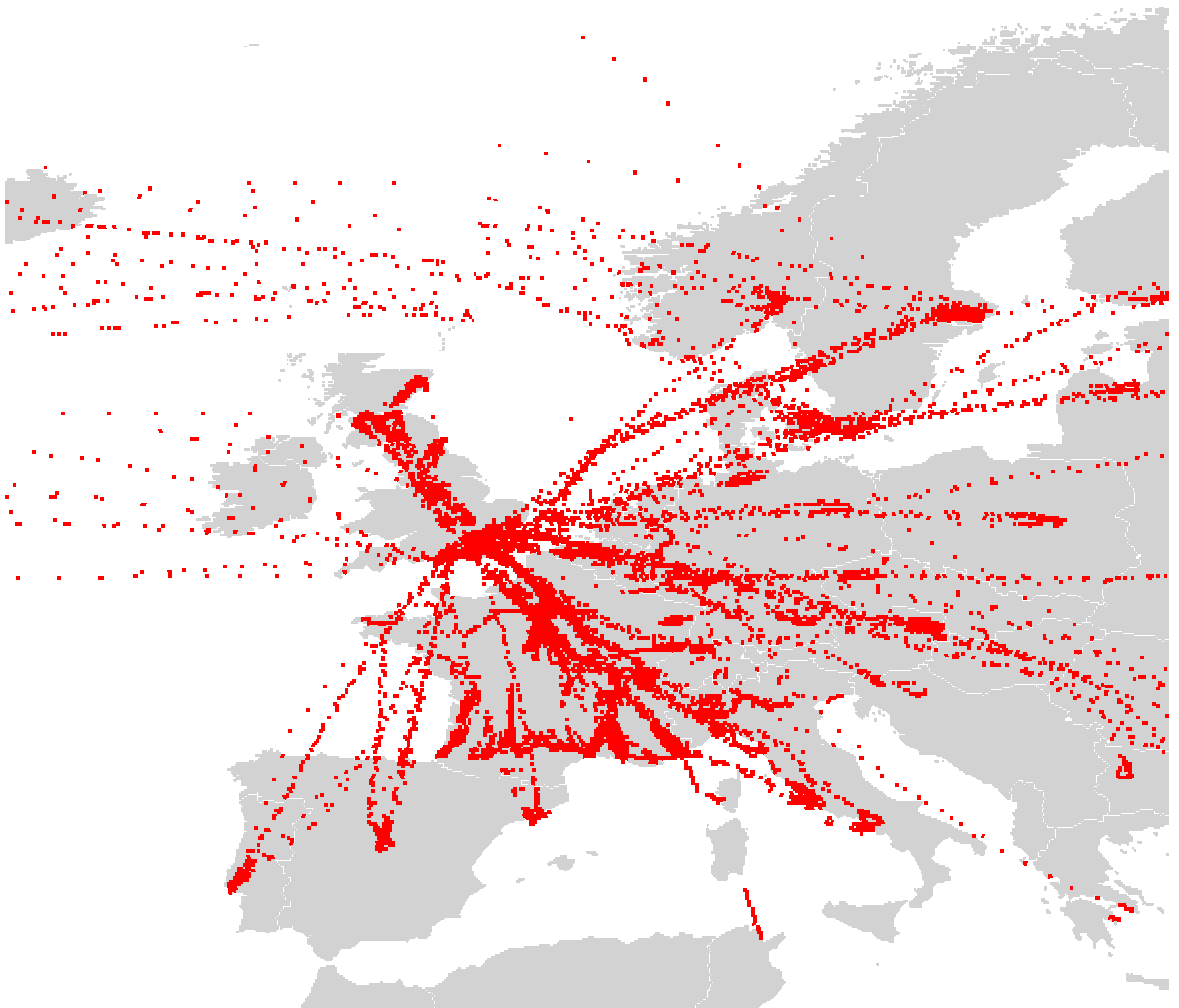
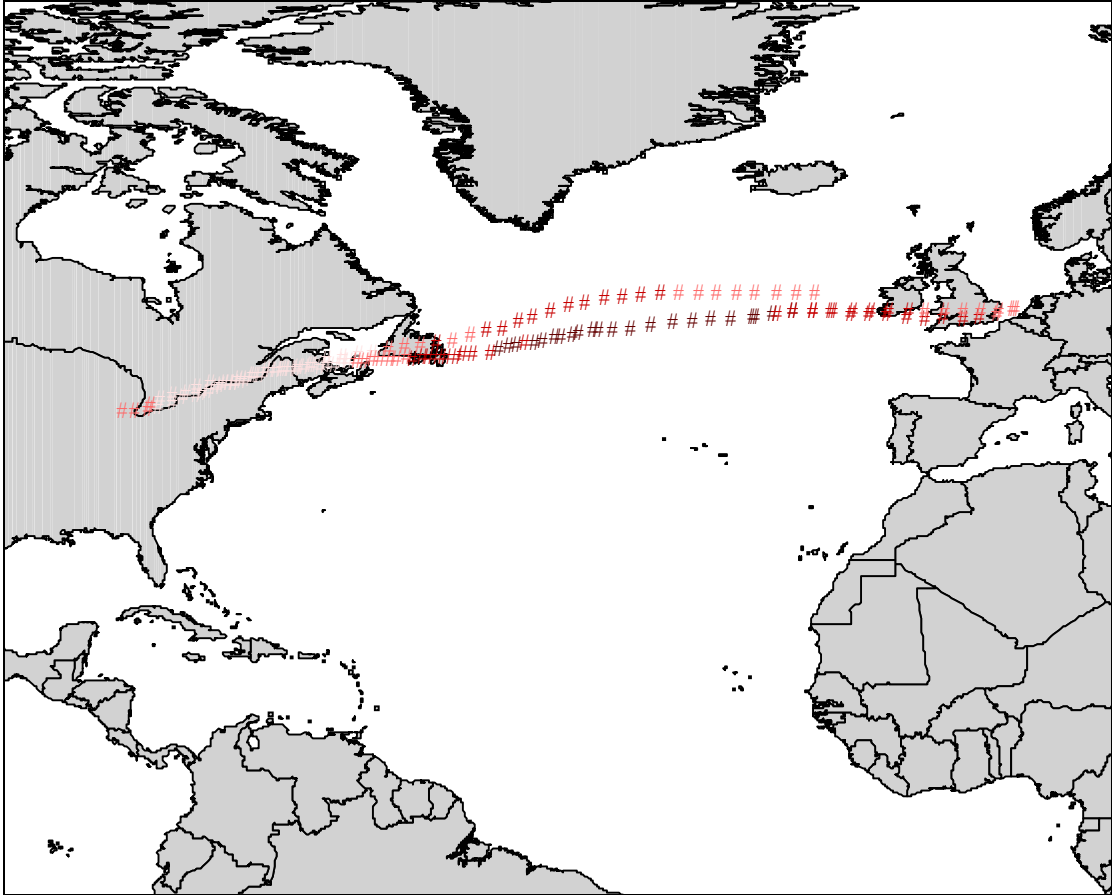


Fig. 2 The same figure, but zoomed in for Europe.

Annex II. Amdar observation on December 25, before the severe weather event in southern Europe

Severe Weather Christmas 1999

**Amdar Observations December 25, 1999
before 12.00 am GMT**



darker red represents higher wind speeds

Fig. 3 It was suggested that the severe weather during Christmas could be foreseen earlier if more observations from the Atlantic were available. In this figure the observations are presented from the area of interest which were made available from EU AMDAR. aircraft. The data can be used for further impact studies.