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AMDAR STATUS AT SEPTEMBER 2003

(*Submitted by Mr J. J. Stickland, Representative of AMDAR and CAeM)*

Summary and purpose of document

This document summarises major AMDAR activities coordinated by the AMDAR Panel over the past 12 months as well as planned new systems and targeted programmes.

Action proposed

The meeting is invited to take into account information presented in this document when discussing issues related to a discussion on how to best integrate CIMO into AMDAR.

AMDAR STATUS AT SEPTEMBER 2003

1. Introduction

1.1 The work of the AMDAR Panel over the past 12 months has continued to consolidate AMDAR as a cost effective observing system for upper air observations. Significant achievements have been made in the 4 high priority projects and new development projects were commenced. The Panel welcomed Chile as a new member to the 2002 annual meeting and now welcomes Argentina to the October meeting. Chile has commenced developing a pilot AMDAR programme and Argentina has taken the first steps to assess the feasibility of developing a programme. Moderate progress has also been made in the Middle East. Of significance is the commencement of a targeted observations programme in the ASECNA group of countries in Central and Eastern Africa in collaboration with the E-AMDAR regional programme. There was a modest increase in the daily number of AMDAR observations exchanged on the GTS despite difficulties being experienced by 2 national programmes. Progress has been achieved in configuring smaller regional (Bombardier Dash 8) aircraft but a major problem has been identified that serves as a substantial caution that hopes to implement AMDAR on many smaller aircraft, will not necessarily be straightforward. A number of administrative changes have taken place with responsibility for project management of E-AMDAR passing from the UK to Sweden and the relocation of the AMDAR Panel Technical Coordinator from UK to Australia. The US has appointed a new national AMDAR Focal Point who is achieving very good results in rebuilding the US programme. Work with the various WMO OPAGs, Expert Teams, ICAO and other government and intergovernmental agencies, continued as did extensive collaboration with the aviation industry.

1.2 Of special interest to the Panel has been the recognition by various WMO bodies including the Fourth Session of ET-ODRRGOS (Jan 2002), the Second Session of ICT/IOS (Oct. 2002), and more recently Fourteenth Congress (May 2003), the Fifty-Fifth Session of Executive Council (May 2003) and the 2 technical commissions CBS and CAeM, that AMDAR is an important component of the Global Observing System and that it should be more fully integrated into the WWW Programme. Plans are being developed to implement changes that will ensure ongoing support for AMDAR activities, their sustainability in the future and the desirability of funding these activities. Initial steps will be taken at a meeting of the CBS Management Group in October 2003 to address Congress and EC directives on the AMDAR Programme. A discussion paper for the meeting has been prepared jointly by the President of CAeM and the Chairman of the AMDAR Panel in which a number of possible mechanisms are proposed to more fully integrate AMDAR activities into the WWW Programme.

2. Major Projects

2.1 The AMDAR Reference Manual was published by WMO as WMO 958 in English only, after a delay of several months. This completes a substantial effort by a number of people within the Panel and the WMO Secretariat and provides a wide range of information.

2.2 Following some unexpected delays, testing of new onboard software developed using the AAA Ver.2 specification was completed on KLM aircraft and initial trials on BA aircraft are due to commence soon. Continuing assessment of the improved DEVG turbulence algorithm selected by E-AMDAR, is ongoing.

2.3 The Panel has continued its valuable collaboration with the Airlines Electronic Engineering Committee (AEEC) through the Data Link Systems Sub-committee. A number of minor modifications, mostly of an editorial-presentation nature, have been made to the new ARINC 620 Ver. 4 onboard software specification. It is expected to be formally approved by the end of 2003, a year later than originally planned. The delay was caused by substantial new work in other unrelated parts of the ARINC 620 document. ARINC 620 Ver. 4 is based on the upgraded E-AMDAR AAA Ver.2 specification and effectively becomes a new international standard.

2.4 The AMDAR Panel has commenced another project that proposes to convert the new broadly based ARINC 620 specification into a universal onboard software package that will be licensed by WMO to all major avionics hardware providers. It is proposed that the avionics companies will adapt the package to suit many different types of aircraft ranging from the largest long haul models to small regional aircraft. The project replaces several smaller projects that were targeted at a small number of specific types of aircraft. It is expected to take several years to implement.

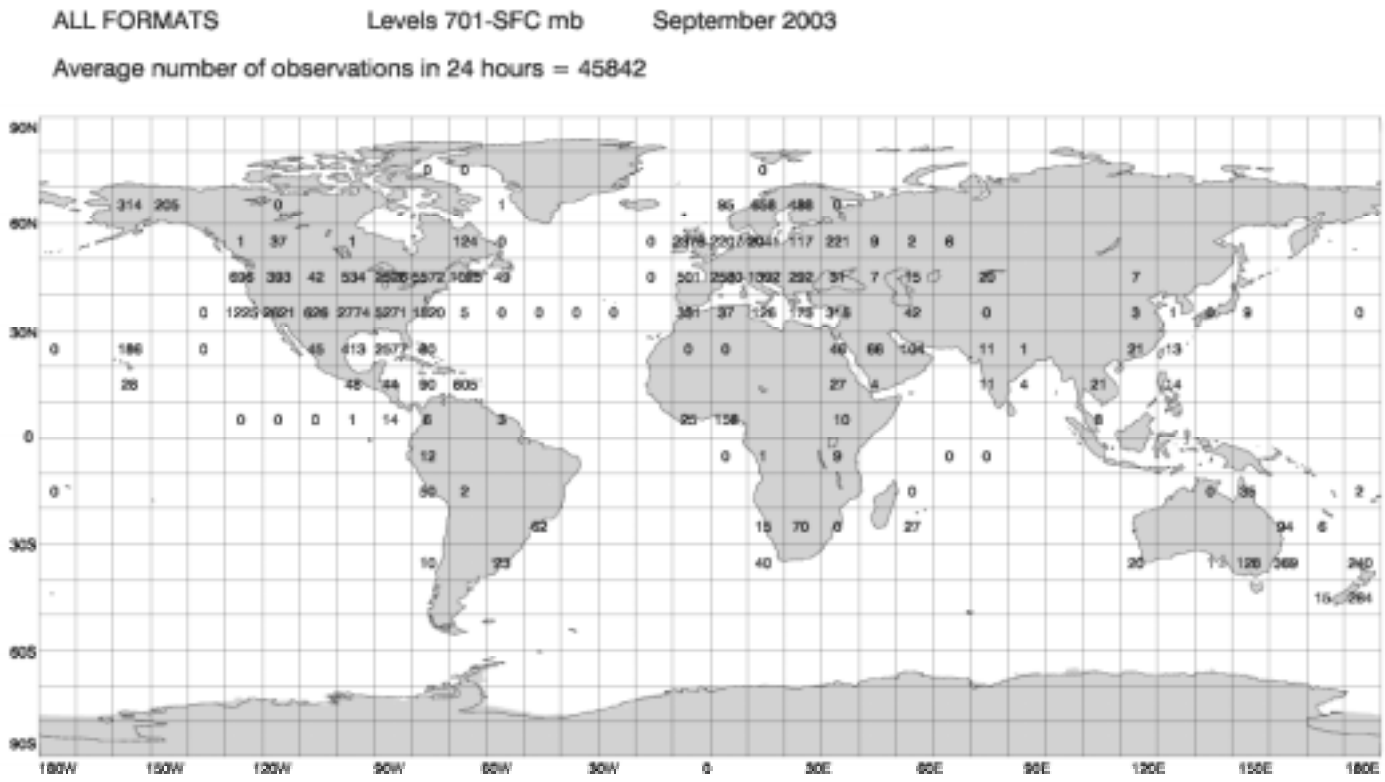
2.5 Proposed changes to the AMDAR BUFR code were accepted by CBS in 2002 and recommended for operational use in November 2003 subject to satisfactory testing by 2 WMO Members. A testing programme will be conducted in August 2003 between DWD, KNMI and Canada. New regional bulletins of FM42 AMDAR reports in text format have also been approved and are being implemented operationally by most originating AMDAR centres. These bulletins will make it easier for countries with basic GTS message processing capability to handle data that is relevant to their specific area of interest.

2.6 The AMDAR Panel’s plan to develop its own web site has moved a step closer through acceptance of Hong Kong China’s offer to develop the site in collaboration with the Panel and WMO. Initial planning of site content has commenced.

3. Global Data Coverage

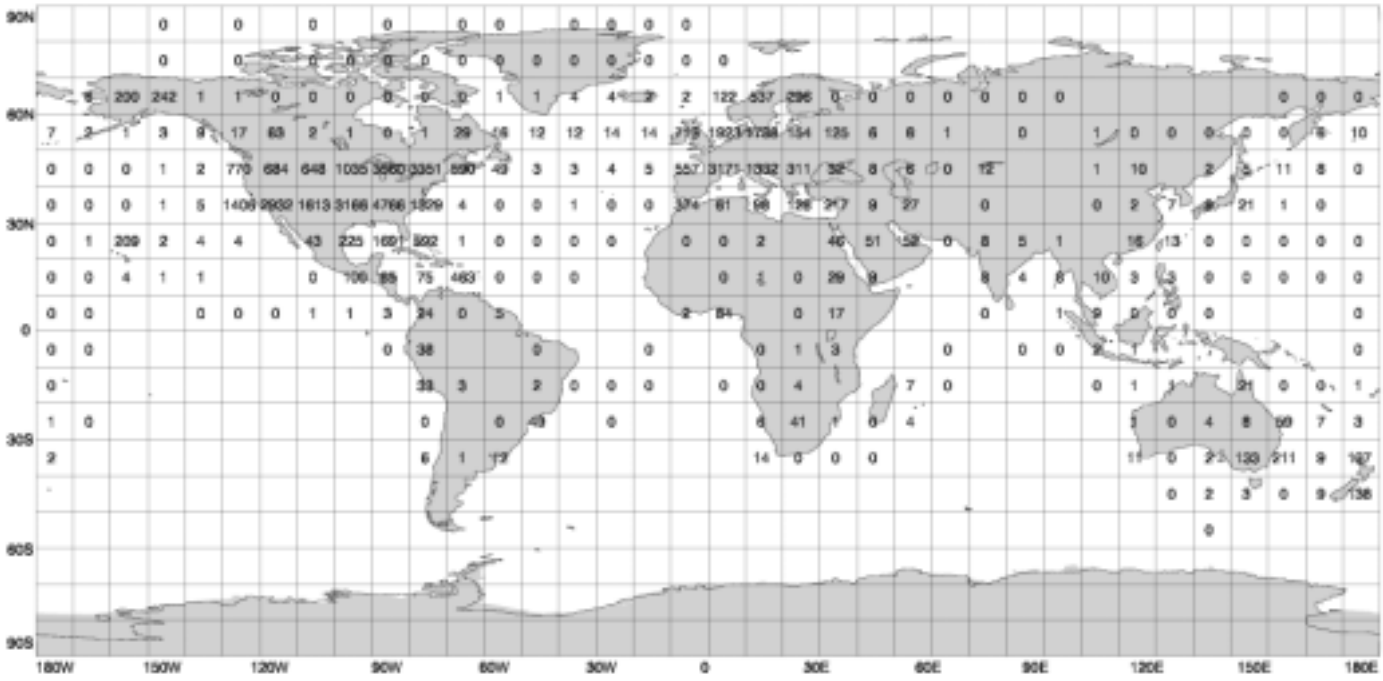
3.1 Global coverage of AMDAR data is depicted in the 3 figures below for different altitude zones (surface - 701 hPa, 700 – 301 hPa and 300 – 100 hPa). The difference between regions where AMDAR profiles are obtained on a regular basis and those where only high altitude cruise level data are obtained from long haul flights, are clearly identified. Profile data are most prolific over North America, Western Europe and to a lesser degree, in eastern Australia and New Zealand. Some profiles are also available over parts of Africa, South America, Eastern Europe and Asia. The majority of cruise level data, ie. above 300 hPa are available over these same areas and the North Atlantic and to a much lesser extent over Africa, the Middle East, Eastern Europe, Siberia, parts of Asia, the Pacific, Indian and central Atlantic Oceans. The AMDAR Panel is working to help fill the large gaps in profile data over Africa, Eastern Europe, the Russian Federation and Siberia, the Middle East, arctic regions of Canada, South America, Asia and the island countries in the Pacific and Indian oceans. This is being achieved through a series of new development programs by countries in these regions and the use of targeted data provided by existing mature programs.

AMDAR Data Coverage – Sept. 2003
(Courtesy Canadian CMC)



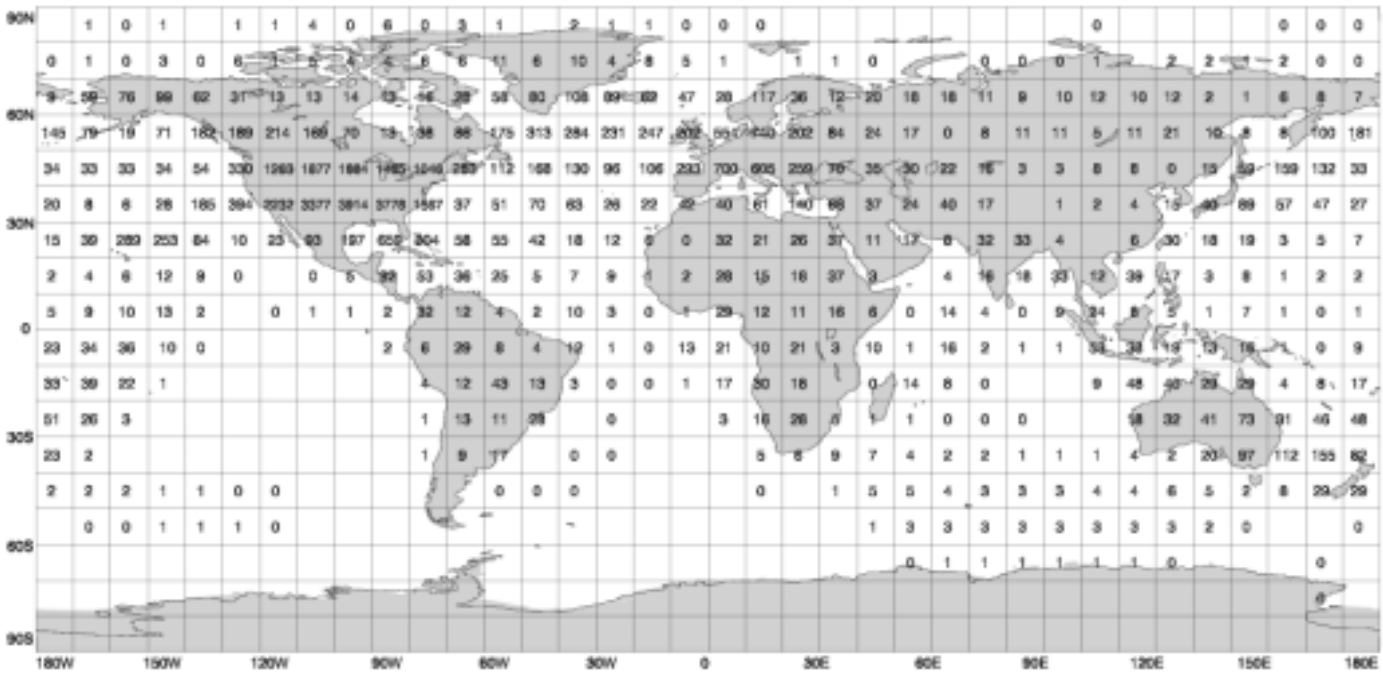
ALL FORMATS Levels 301-700 mb September 2003

Average number of observations in 24 hours = 43612



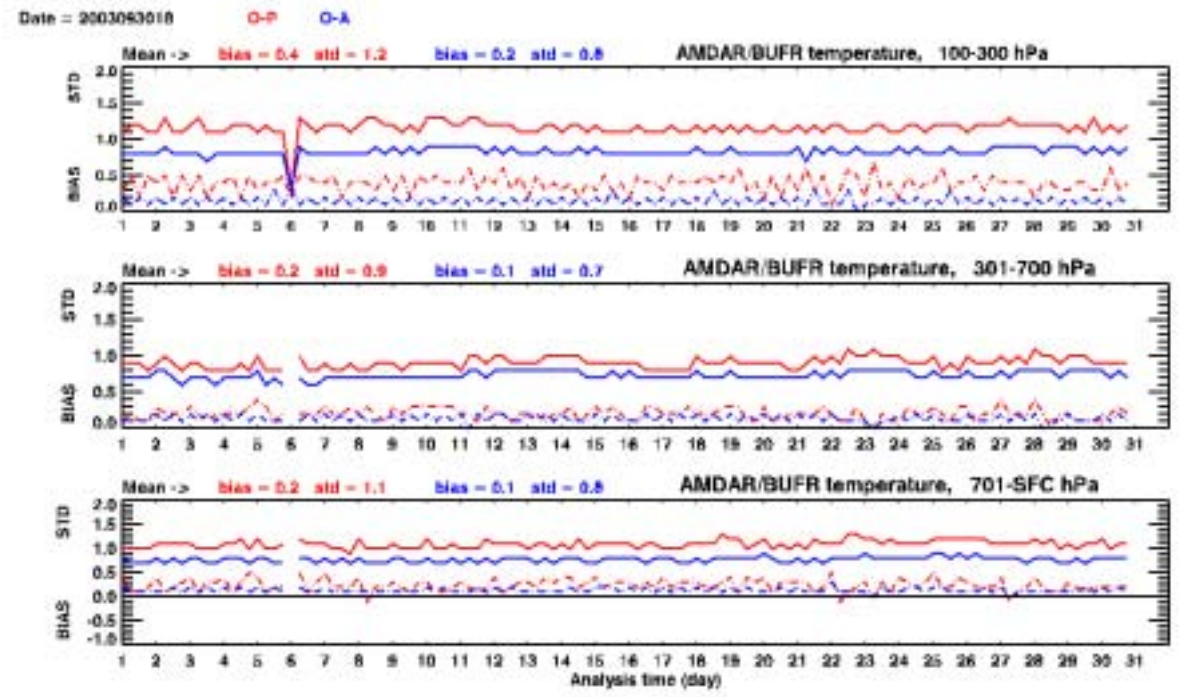
ALL FORMATS Levels 100-300 mb September 2003

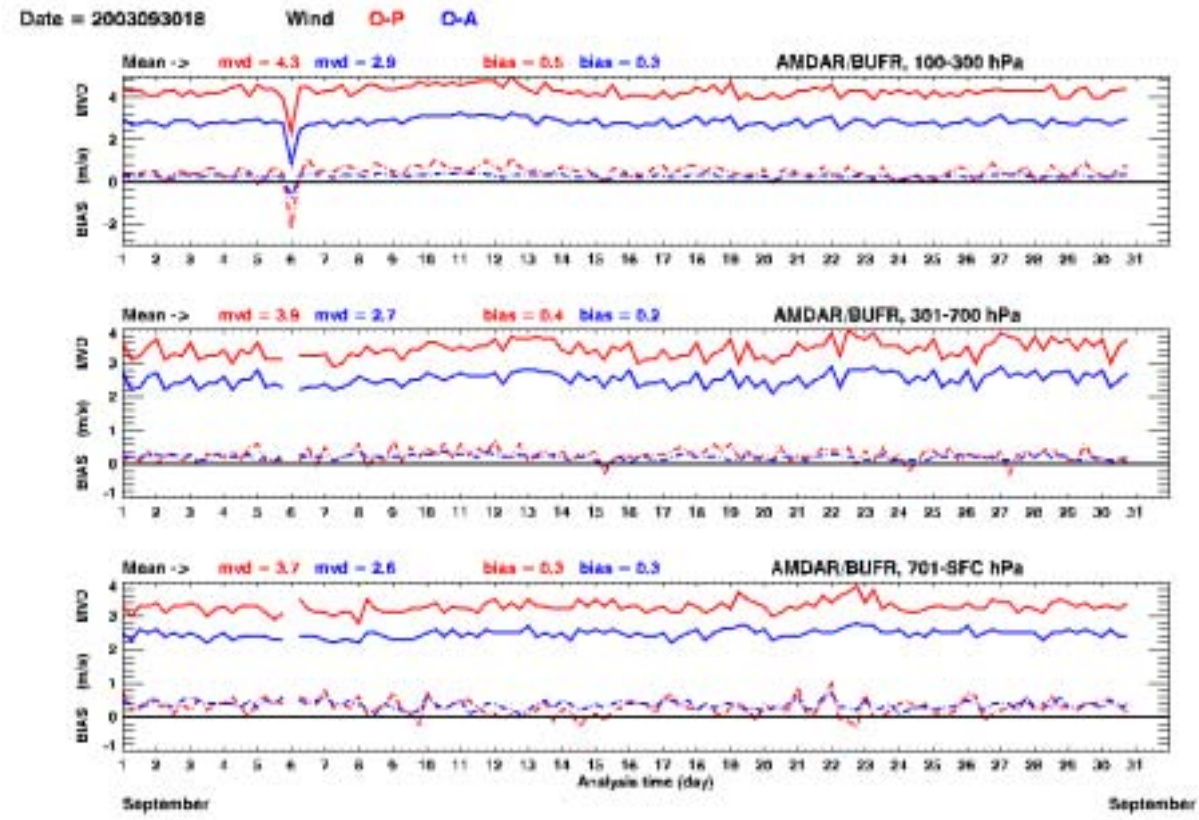
Average number of observations in 24 hours = 39273



4. Data Quality

4.1 AMDAR data have proven to be reliable with quality comparable to radiosonde data. Many years of direct intercomparisons against radiosondes and NWP analysis and forecast fields show that temperature bias is typically better than 0.3 degree C. in the low to mid troposphere and less than 0.5 degree C. in the upper troposphere. Standard deviations are of the order of 1 deg. C. Likewise wind data show biases of less than 3 m/s and wind vector differences of 4 m/s or better. These statistics include both aircraft sensor and model error. The figures below show statistics for September 2003 of observation minus first guess (O-P) and observation minus analysis (O-A) for wind and temperature observations assimilated by the Canadian Meteorological Centre operational analysis program.





5. Existing Systems

5.1 The number of daily observations exchanged on the GTS has increased from around 140,000 in 2002 to about 150,000 in mid 2003. This is despite a reduction in the number of observations from E-AMDAR due to improvements to the very effective data optimisation system. A small reduction also resulted from a further decrease in the number of operational ASDAR aircraft.

5.2 Australia's attempts to rebuild its domestic AMDAR programme following the demise of Ansett Airlines have been slowed by a variety of technical and business reasons. New Zealand has increased the number of equipped aircraft but carefully controls the number reporting because of budget constraints.

5.3 Although E-AMDAR has continued to expand its aircraft fleet equipped with AMDAR from approximately 300 aircraft a year ago to about 500 aircraft in mid 2003, the number of daily reports has declined from about 25,000 to 23,000 per day as mentioned above. This has resulted in a much better controlled programme governed by the competing components of budget constraints and the need to provide more data. It is now technically feasible to fine-tune the programme on a daily basis. The various participating airlines have undergone substantial changes to their operational fleets following the down turn in the aviation industry. New components have been added to the data acquisition system including a financial package that allows for micro-management of costs for each individual airline, and the ability to inhibit selected measured elements from being reported in the data message on the GTS. Selection is based on data quality information. It was mentioned earlier that E-AMDAR has changed the EUCOS member responsible for management in line with normal EUCOS procedures requiring the rotation of major tasks amongst members. Improvements have also been made to the various targeting systems within the E-AMDAR programme making it easier to control data from aircraft involved in specific targeted programmes.

5.4 The US has begun a major overhaul of its MDCRS/ACARS programme under the guidance of a new national Focal Point. Changes to the funding base have been implemented following the very serious financial positions of the larger participating airlines. Plans are being prepared to develop the programme along similar lines to E-AMDAR. This has required the unprecedented cooperation and collaboration of the airlines and various government agencies. The number of observations continues to increase slowly despite financial constraints. Additional data are being produced as part of evaluation trials that are not exchanged on the GTS because of concerns with data quality. These trials consist of ongoing turbulence reporting and a new project to establish the benefit of icing reports.

5.5 South Africa has faced a number of operational difficulties during the year that have resulted in extensive periods with no reports. However, most of them have been resolved and the possibility still exists for a substantial increase in the number of reporting aircraft, subject to the usual budgetary constraints.

5.6 The operational ASDAR programme has also undergone a further change with the closure of the maintenance support infrastructure provided by the UK Met Office and a repair/maintenance contractor. No further repairs are possible. KLM has been contracted to undertake a small unit replacement programme as needed but this does not include the critical data processing unit. Changes have also been made to the data quality monitoring system with the Met Office closing the ASDAR Centre in March 2003. The offer by KNMI to take over part of the monitoring service is appreciated.

5.7 The number of reporting ASDAR aircraft has continued to decline with the failure of the Lufthansa unit and a number of aircraft parked on the ground due to the decline in passengers. One Saudia aircraft recommenced reporting but this lasted for only a few

months. It is unlikely that either of the 2 aircraft will report again. Aerolineas has also put on long term hold one of its 2 reporting aircraft. It is unlikely that it will report again. Air Mauritius has had difficulties keeping its 2 units operational. At the time of writing, only 3 aircraft are reporting on a reasonably regular basis. Despite earlier advice by SAA that it would decommission its 2 units, one has continued for more than a year longer than suggested and continues to report on an irregular basis. Data quality problems in temperature observations remain on several aircraft.

5.8 The ICAO Automatic Dependant Surveillance (ADS) system showed a small increase in reported data following the installation of corrected software by some airlines. A number of important operational matters are being considered by ICAO that will help clarify the need for air traffic control authorities to obtain and pay for data. The need for and establishment of a global data quality monitoring system is being considered.

6. Developing Programmes

6.1 The past year has seen significant progress being made by members in either developing and testing new programmes, or planning new programmes. Although no new systems have reached the stage of being able to exchange data on the GTS during that time, several are very close to doing so and it is only a matter of time before this will happen. Of special note are the 4 new national programmes currently under test in East Asia, and the progress being made by potential new programmes in the Middle East and South America. Also, the first large collaborative programme of targeted observations is under development in the data sparse areas of Central and West Africa through the leadership of ASECNA. The AMDAR Panel stands ready to assist these countries in converting these various national programmes into well-coordinated mutually supportive regional programmes.

Canada

6.2 The comprehensive Canadian programme that was about to go operational a year ago struck a major problem with the quality of temperature data that also impacted on wind data quality. The cause was traced to inappropriate sensor exposure on the Dash 8 100 aircraft. Later analysis showed this was also the cause of unusual aircraft in-flight performance resulting from the poor quality temperatures impacting on the flight management system. The participating airline (Air Canada Jazz) has undertaken to replace the sensors. (The same problem was discovered on later model SAS Dash 8 aircraft where the impact is likely to be reduced engine efficiency during take off. Data transmissions were terminated on these aircraft.) Data from new Canadian aircraft currently under test is expected in the next few months that should not be affected by this problem.

6.3 The result is disappointing to all concerned as it was the first attempt to establish AMDAR on smaller regional aircraft. There is clearly a warning to be noted from this exercise that the broad hope to extend AMDAR into extensive regions not served by the larger aircraft may not be as easy as was first thought.

6.4 Canada is also breaking new ground with the development of alternative, non-conventional ways of implementing AMDAR in remote data sparse areas of the country.

Japan

6.5 Japan has established a successful and substantial trial operational programme in collaboration with 2 national airlines, JAL and ANA. Data impact evaluation trials are being undertaken by JMA but data are not being exchanged on the GTS during the trial period in accordance with an agreement with the airlines.

Hong Kong China

6.6 Hong Kong China is beginning to see the benefits of its efforts over the past 2 years in pursuing the development of an AMDAR programme with its national airline Cathay Pacific. Data being produced as part of a trial phase are being evaluated for quality and impact. A second component is also being developed in collaboration with the Government Flying Services agency.

China

6.7 Advice has been received recently that China is developing a substantial AMDAR programme and is producing up to 10,000 observations daily. Data are being assessed and used operationally in a limited capacity and will be exchanged on the GTS in the near future. China has requested the assistance of the UK Met Office with conducting a user-training programme.

Republic of Korea

6.8 The Republic of Korea has made much progress in less than 12 months in developing its AMDAR programme in collaboration with Korean Air. It was expected that the first test data would be received during the third quarter of 2003. Noting that many aircraft are already configured with software, further rapid progress is anticipated over the next year including the exchange of data on the GTS.

Saudi Arabia

6.9 The Middle East programme continues to advance slowly although there are promising signs of new planned systems, described below. Saudi Arabia continues to evaluate data being transmitted from several Saudia MD90 aircraft that are being received by PMA. Data will be exchanged on the GTS once some minor encoding issues have been resolved and quality has been established. E-AMDAR has offered to conduct routine data quality monitoring and advise on follow up activities. The programme will then be extended to the entire MD90 fleet.

7. Planned New Systems

7.1 While many of the countries listed below were mentioned at the last AMDAR Panel meeting, some encouraging progress has been made. The past 12 months has seen a significant deterioration in airline profits and their ability to remain viable with the direct result that they are less prepared to participate in any non-essential activities such as developing AMDAR systems. This situation has slowed progress in some countries with developing new programmes, however, work has continued with planning of new national and regional AMDAR programmes.

7.2 The Russian Federation and Morocco continue to express interest in developing national programmes as they prepare basic infrastructure in their respective meteorological services. E-AMDAR provides en-route data and a limited number of profiles in cities of both countries as part of its normal programme. Of special interest are the expressions of interest and activities being undertaken in South America and the Middle East. Chile continues with the development of a pilot programme and regular contact is being maintained by the airline Lan Chile. The meteorological agency of Argentina together with the national airline Aerolineas Argentinas are exploring possibilities of developing a national programme. Brazil has also taken the first steps with discussions between relevant heads of government

departments responsible for meteorological services. The AMDAR Panel has had brief discussions with the heads of all 3 South American meteorological agencies. The main problem in Argentina and Brazil is the potential lack of resources that can be accessed to implement these programmes.

7.3 Activity has recently increased in the Middle East with Saudi Arabia continuing system development as the project leader and Oman expressing strong interest in developing a programme. Discussions are taking place with local and regional airlines exploring potential collaboration. The United Arab Emirates (UAE) is now actively working to develop a programme. The airline and the meteorological service are in discussions with the AMDAR Panel as well as Lufthansa/Lido on the initial steps that need to be taken. Iran has requested programme information and has informally indicated its desire to develop a programme. However, current international relations are preventing any concrete steps being taken. A number of coalition countries are working to re-establish meteorological services in Iraq. Initial planning included AMDAR and it is known that the ACARS communications infrastructure will be improved in 2004 with the establishment of 2 ground stations, one each in Basra and Baghdad. E-AMDAR provides targeted profiles in many of the cities in the region as part of its basic programme.

7.4 Poland and Hungary have indicated their intention to develop programmes and have been consulting with E-AMDAR, but recent changes in government situations have slowed progress. E-AMDAR keeps a monitoring watch on and provides encouragement to several countries in the region who have indicated interest in the past including Finland, Ireland, Spain, Portugal, Switzerland, Austria, Italy, Iceland and Belgium.

8. Workshops

8.1 The AMDAR Panel has been offering to assist countries considering the development of new programmes by holding national or preferably, regional workshops. Formal invitations to conduct workshops have been received from the following countries:
Morocco (national programme);
Argentina (South America regional programme); and
Hungary (East European regional programme).

8.2 Other countries have informally indicated interest in holding workshops including:
Saudi Arabia and Oman (Middle East regional programme)
The Russian Federation (national programme)
China (East Asia regional programme)

9. Targeted Programmes

9.1 Development of an extensive collaborative programme of targeted observations is well under way between E-AMDAR and ASECNA, an intergovernmental agency representing 14 Central and West African countries plus Madagascar. This follows a very successful 2-day workshop conducted by the AMDAR Panel in Dakar, Senegal in November 2002. E-AMDAR will provide controlled data from appropriate aircraft from 3 of its airlines that operate into the region. Data is being provided already for a small number of countries on a daily basis. Ghana and Nigeria although not part of the ASECNA, will also be included. ASECNA will in turn reimburse E-AMDAR for the marginal costs of providing the data. Once the targeted programme is fully operational, the next stage will commence to explore opportunities to develop AMDAR programmes in collaboration with local airlines.

9.2 E-AMDAR continues to provide data in a small demonstration targeted programme in the Caribbean region. This is controlled remotely by Meteo France as a further demonstration of how cost effective and easy targeting can be.

9.3 With the completion of a financial package and new data control elements in its data acquisition system, E-AMDAR now has the infrastructure to provide similar targeted programme services any where in the world, provided the data are either exchanged on the GTS or sent direct.

10. Data Optimisation

10.1 Improvements to the E-AMDAR automated optimisation system have continued that further enhance this very sophisticated and powerful system. It was used on several occasions to quickly adjust regional coverage taking advantage of built-in redundancy when short, unexpected circumstances (such as airline strikes) caused large blocks of AMDAR reporting aircraft from flying. The system could be expanded and adapted to provide similar services for almost any airline in the world. The system is also used on an irregular basis to fine tune the volume and coverage of data to help meet budgetary targets. The next major component will be to develop the remaining infrastructure to use the system to meet special short or long term meteorological events.

10.2 Canada has also developed an optimisation system and the US and Australia are also planning the development of similar control systems.

11. Other AMDAR Systems

11.1 Significant progress has been made in several alternative forms of AMDAR systems. Design of the US TAMDAR system has been finalised and prototype testing has been completed. Various versions are being developed for the first operational trials. In addition to those being undertaken by the company, an extensive operational trial is due to commence in the north central US early in 2004 with 62 systems being installed on Saab 340 regional aircraft. Data impact studies as well as detailed system performance will be studied by a number of NOAA and NASA agencies. Additionally, Meteo France will commence testing a system on behalf of the E-AMDAR group later this year. Possibilities exist for Germany and the UK to also conduct independent evaluation programmes. The company has been working closely with Canada to test a system as part of a new fully integrated AMDAR system on a variety of different aircraft. Australia has also expressed interest in exploring the system's potential.

11.2 The Canadian meteorological service in collaboration with another company, has also taken the first steps to develop a second alternative system using aircraft already equipped with appropriate sensors but with different on-board data collection and communication technologies.

11.3 The system being developed by Air Services Australia as an appropriate alternative to be fitted on small aircraft operating in data sparse areas underwent some basic testing, but the programme is on hold subject to new funding being identified.

12. Sensors

12.1 As mentioned earlier, initial testing of the TAMDAR system that contains a full set of sensors, has been completed and the first operational trials will take place later this year. A

great deal of interest has been shown by a number of countries in different parts of the world in this system as a potential provider of humidity data in the boundary layer and lower troposphere. It will not have the capability of humidity measurements in the mid to upper troposphere. Work continues in the US and UK on development of aviation humidity sensors. Interest in accelerating work on the UK sensor being developed by Cambridge University has increased with several groups indicating interest in deploying it.

12.2 Testing of the Eddy Dissipation rate algorithm continues in the US by NCAR for the FAA and ICAO and new work has commenced in an alternative method at NOAA Forecast Systems Laboratory at a low level. The technique using pressure fluctuations in the Pitot static Tube is similar to the one adopted by TAMDAR.

12.3 Development and testing of icing sensors continue in several companies in the US with a reporting and operational evaluation trial under way. Canada is also planning to conduct its own evaluation programme. Changes have been introduced to the WMO FM94 BUFR code to be able to report basic icing “on/off” situations.

13. Data Impact

13.1 Evaluation work is continuing to better determine the impact AMDAR data has on NWP products and routine operational forecasting services. However, of interest is the work to relate improved forecasts to concrete benefits to recipients and users of forecasts. Several studies have been completed that produce hard numbers showing impacts on different aspects of aviation operations.