WORLD METEOROLOGICAL ORGANIZATION

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Requirements of Aircraft Observations data and Data Management Framework for Services and Other Data Users

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SUMMARY AND PURPOSE OF DOCUMENT

Summaries in broad terms and defines the requirements of Aircraft Observations data and the Data Management Framework for Data Users other than NWP as well as make recommendations to resolve issues associated with Aircraft Observation Data use.

ACTION PROPOSED

1. The Workshop is invited to note the information contained in the document.

References:

1. ICAO Annex 3
2. WMO CIMO Guide
3. AMDAR Panel Flyer
4. Final Report Joint Meeting ofWMO AMDAR Panel*(14th Session)*and WMO CBS/Expert Team on Aircraft Observations*(3rd Session)*

INTRODUCTION

1. This paper aims to identify the data user and service requirements for Aircraft Observations data in relation to the following areas:

   a. Data parameters;
   b. Data quality;
   c. Data timeliness;
   d. Data access and display;
   e. Metadata

2. As well as identifying user and service requirements this paper identifies some of the issues with the current DM Framework from a Data User and Services perspective.

Background

3. It has been shown that the use of AMDAR data has a positive impact in weather forecast operations. The real time use of high quality vertical profiles of AMDAR temperature and wind in numerous NMHSs has proven to contribute significantly to the improvement in the short to medium-term forecasting applications. However, they are particularly useful for now-casting situations where conditions are changing rapidly and are therefore of special use to the aviation industry. Such applications include:

   a. Surface and upper air forecasts of wind and temperature (including severe wind, onset of sea breeze and local topographical weather);

   b. Thunderstorm genesis, location and severity;

   c. Differentiation between rain, snow and freezing rain;

   d. Wind-shear location and intensity e.g. dangerous low-level jets;

   e. Low cloud formation, location and duration;

   f. Fog formation, location and duration;

   g. Turbulence location and intensity;

   h. Jetstream location and intensity; and

   i. Environmental control information (trapping inversions etc.).

4. For many years the AMDAR Panel examined ways where NMHSs implement their own national or regional AMDAR Program as well as how they could better utilize their own or other AMDAR Program data. As part of this work the AMDAR Panel has worked closely with a number AMDAR Programs includingthe United States (US) National Weather Service (NWS) Global Systems Division (GSD) on their development of an interactive web-based AMDAR data viewer. As well as providing an excellent method for viewing local US based MDCRS and TAMDAR reports this web-based display system, which is still platform independent, provides many NMHSs with the opportunity to display AMDAR profiles and on-route data for aviation and other users, such as public and severe weather forecasters.

5. For many NMHSs it has been difficult to implement autonomous national or regional AMDAR programs. As a consequence some NMHSs have required the assistance from existing AMDAR

programs to provide much needed upper-air information in the form of AMDAR reports from visiting aircraft to supplement their existing upper-air programs.

Requirements for Aircraft Observations

6. Another component of using AMDAR or aircraft data from users/forecasters perspective is the requirement for high quality observational data. Users/Forecasters are using many different data sets, from NWP output to many varied observations, in order to generate various forecasting products that meet national and/or international standards. In order for the user/forecaster to use these varied data forms they should have a basic understanding or an appreciation of the data being used, such as how the data is being generated, and in the case of observations, the parameters being measured, the location of report, availability/timeliness, accuracy/uncertainty in measurement and most crucially how the information is made available or displayed to the user/forecaster. As noted there are systems available that can provide some basic functionality that provides user/forecasters with a simple display of AMDAR data.

7. From a whole of Service perspective the various observation networks used, including the distribution of those networks much be cost effective. With all NMHSs facing increasing costs, in particular those associated with operating expensiveradiosondestations many are considering how to use or implement alternative systems, such as AMDAR and other aircraft based observations, such as ADS-C. These systems would provide a serious alternative or supplementary system to existing networks that would meet forecaster and NWP requirements.

Forecasting Systems Requirements

8. The major tasks associated with Weather Services; in particular those associated with the provision of an Aerodrome and Area Meteorological Watch include undertaking:

- Detailed surveillance of weather conditions over the aerodrome and its immediate vicinity
- Broad scale surveillance of weather conditions over the area of responsibility.
- Issue of aerodrome weather reports and reports of other relevant weather occurrences;
- Review and amendment of aerodrome and area forecasts;
- Issue of warnings and advices relevant to the aerodrome and area of responsibility;

In order to undertake these key tasks the forecaster is required to pay particular attention toward the surveillance of many observations types including AWS and synoptic observations, vertical wind and temperature profile data including AMDAR as well as satellite imagery.One of the principle requirements for guidance for issuing a Wind Shear Warning is the method of detection and forecasting wind shear, these include analyzing a range of observations, such as Doppler radar, Ground-based wind shear detection equipment, balloon flights as well as AMDAR and other available aircraft reports.

9. There are many National Meteorological and Hydrological Services (NHMS) that are currently using or looking at using how to better use or visualise NWP output andobservational data, including that of aircraft-based observations. This information delivered to forecaster workstations/systemsnow has the ability to provide users/forecasterswith a method of simultaneously plottingobservations and NWP output, see figure 1. The advantage of moving towards a more integrated display system, is it allows observations and other data, such as NWP and satellite imagery, to be overlaid as well as

customizing the display/data delivery for specific forecasting applications and user requirements. With the older type single purpose systems, such as those provided by GSD, it requires separate workstationsand/or window to view real-time aircraft profiles to those of other application specific information. This type of single purpose display makes the process of weather watch and forecasting a little more time consuming, especially in rapidly conditions. Withinthe Aviation Weather Services area and other application areas such as severe weather time is critical and decisions are required fast so an integrated display system does offer many advantages.

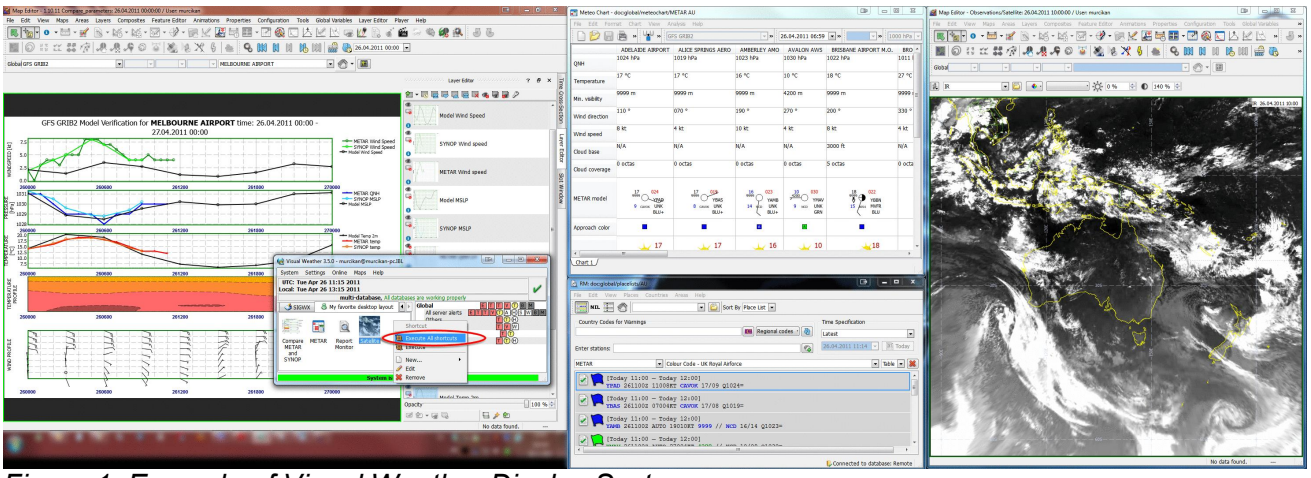

Figure 1. Example of Visual Weather Display System.

10. Additionally the system currently being employed in a number of NMHSs, Visual Weather, has the ability to simultaneously plot multiple sounding profiles data sets, including AMDAR, as well as NWP sounding information, see figure 2

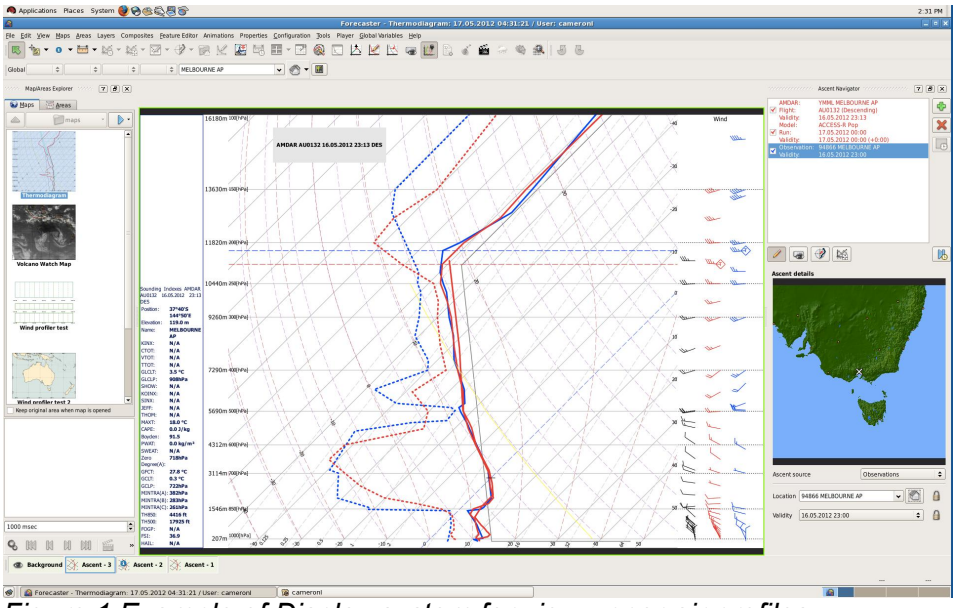

Figure 1 Example of Display system for view upper-air profiles

11. An additional aspect to any system used should be its flexibility, that is a user or forecaster should be able to adjust the number of profiles or on-route data that can be made available. From a service or organizationalperspective this requirement must be consistent with the organisations observation strategy, that is, the number of profiles generated must meet the basic cost/benefit requirements of the organisation, most NMHS are constrained even in their AMDAR programs.There

are a number of existing systems that have provided observation network manager as well as their weather service counterparts with flexible system such as these, including the European-based E-ADOS and the Australian/based A-ADOS.

12. Additionally to further enhance the ability of these systems a method of reporting user/forecaster identified data quality issues on a particular data group, like that for an individual aircraft, should be investigated. At present the users and/or forecaster will have first hand knowledge of any data quality issues associated with near-real observational data. This near real-time quality control checking technique would provide an advantageous method of identifying problem aircraft.

Data Requirements

13. As part of this report a number of NMHS were asked to complete a simple survey. While the number of returned surveys was not high enough information has been made available to develop an overview of requirements for non-NWP applications.It has been identified that outside the NWP area there are specific requirements for data user as well as service requirements for aircraft observations data in relation to the following areas:

a. Data parameters;
b. Data quality;
c. Data timeliness;
d. Data access and display;
e. Metadata

14. Outside of the NWP area of interest generally the only users of AMDAR and aircraft observations are weather services forecasters.

15. As far as parameters for observational data is concerned the requirements for forecast applications are covered by the obvious time stamp and coordinate requirements as well as the standard set of pressure, temperature, wind speed and direction. As a priority more humidity information should be made available, as the coverage of the more traditional radiosonde networks reduce. With financial pressures increasing in many NMHSs the cost of operating a radiosonde network that meets WMO requirements for coverage is becoming increasing more difficult to maintain. In order to fill the current and future gaps in these networks that are required for operational forecasters a cheap and accurate system is required.

16. The special group of parameters that would greatly assist forecasters, in particular aviation forecasting applications is the better information on turbulence. It is also becoming increasingly important from a forecasting perspective to look towards better verification of forecast products. Currently there is a lack of broad scale coverage of reliable turbulence reporting. Often forecasters will contact Air Traffic Control (ATC) for information on manual pilot reports on turbulenceobserved. Currently there are two systems of turbulence reporting, the ICAO approved eddy dissipation rate (EDR) and the AMDAR *Derived equivalent vertical gust* (DEVG). These need to be better understood by forecasters so the information can be reliably used operationally. As well as turbulence a reliable method of reporting icing would also provide a distinct advantage to forecasters for verification and identification of icing.

17. In regards to the timeliness of data delivery the requirements will vary on the application. For low lever wind shear detection there is a requirement for early detection, this requirements dictates that update information on wind speed and direction is required on frequent basis. In other situations, such as a report on mod/severe turbulence the requirements demand immediate delivery of that data. In other situation the requirements will not be demanding. Those NMHS who responded to the short survey indicated that the data quality should be aligned to those requirements as specified by ICAO and WMO.

18. Amongst the various NMHSs surveyed there is understanding that there is Metadata available for AMDAR data and with the implementation of BUFR and improved BUFR formats this will increase. The general requirement for Metadata from a forecast or service perspective is limited. The systems being used by various NMHS to visual information and network systems, such as E-ADOS or A-ADOS, that control observation delivery will have a greater dependence on Metadata than those required by the forecaster. Generally from a service point of view the requirement would be limited to Aircraft type, navigation type, and possible the precision for each parameter.

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