WORLD METEOROLOGICAL ORGANIZATION

WMO AMDAR PANEL WORKSHOP ON AIRCRAFT OBSERVING SYSTEM DATA MANAGEMENT

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USER REQUIREMENTS FOR THE AO DM FRAMEWORK

Requirements of AO data for NWP, Issues and Recommendations

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SUMMARY AND PURPOSE OF DOCUMENT

To provide the requirements of the NWP community and applications for the Aircraft Observations Data Management Framework.

ACTION PROPOSED

1. The Workshop is invited to note the information contained in the document.
2. The Workshop is invited to consider the recommendations made in the document.

BACKGROUND

1. Aircraft measurements of temperature and wind are very valuable for data assimilation systems for NWP. This is due to the large number and high accuracy of the data (thousands of aircraft reports per day). Furthermore, aircraft measurements provide profile information from their ascents and descents near airports. Together with measurements from radiosondes, they represent the main source of in-situ data and are a critical source of data for NWP.

2. A number of Issues and Recommendations in respect of AO related to NWP have been identified and will be discussed here in more detail.

ISSUES

Issue 1

Data quality differences between larger jet aircraft and smaller regional type aircraft (e.g. turboprops) and possible expansion of AMDAR into smaller regional carriers.

3. One would expect significant benefits from AMDAR expansion into less travelled routes. Not only would we get more data but we would also have very useful vertical profiles at more remote places, especially as they take off and land a number of times on a daily basis. Additionally, regional aircrafts fly at lower altitudes and therefore making their data quite useful.

4. On the quality side, Canadian experience with AC Jazz regional jet aircraft data was very good and was similar to data from major carriers. However, with data from their turboprops the story was very different. The issue was a strong temperature bias due to the temperature sensor being mounted on the fuselage, which eventually was corrected by the airline. A further problem was that biases differed depending on the flight phase (ascent vs descent). The belief was that it was because the avionics software uses the data averaging values typical for jet aircrafts which have different ascending and descending rates from the turboprops. However, since this issue could not be easily corrected as well as other issues related to funding eventually resulted to the removal of data from the turboprops from the Canadian AMDAR programme.

5. As highlighted above, it would be very beneficial if we could share the experience in dealing with issues of regional carriers. If these issues can be fixed (bias correction, observation error, etc.) there is so much we can gain from expanding AMDAR into regional carriers.

Issue 2

Aircraft data usage and monitoring at global NWP centres (ECMWF, NCEP …) and at the various data management centres (EUMETNET-E-AMDAR)

6. It would be great for the NWP community if the monitoring information produced among different centres in respect of AO data counts, usage, quality etc. can be exchanged on a regular and if possible in a near real-time manner with feedback to airlines or data producers. This may lead to establishing an (semi-)automatic “Alarm/Event” system to spot potential data problems and raise alarms or events.

Issue 3

What QA/QC should be carried out prior to delivery of AO data to NWP?

7. NWP centres data assimilation systems are normally well equipped to perform QA/QC tasks. However, that may not be the case for non-NWP users who tend to believe observational data. Therefore, a Data Management Framework (DMF) system should carry out as much QA/QC as possible before distribution but of course without compromising the distribution itself. Background (or first guess) check may be sufficient to prevent suspect data from being used. To that end, as suggested in the previous point, a two-way system between NWP centres and data providers should be in place.

Issue 4

What metadata is required by NWP?

8. For NWP purposes it may be sufficient to have information about aircraft identification and basic instrument specifications. The aircraft identification is essential for any bias correction scheme applied on individual aircrafts as well for proper QA and usage of data. However, if one wants to deal with issues mentioned earlier (point 1.) when trying to use and correct turboprops data one needs a lot more: type of aircraft, instruments type, calibration, how it is mounted on the aircraft, avionics software version, data corrections performed, etc.. Furthermore, metadata may also be important for any “post event” data discovery.

Issue 5

Additional observed quantities: humidity, icing, turbulence (chemical constituents) etc.

9. Humidity measurement is already available and some NWP centres are already using it and its values are reasonable (standard monitoring). Icing and turbulence would be very useful not only to aviation forecasting and users in general, but also for NWP diagnostics purposes. Adding sensors to measure chemical constituents could be useful too.

Issue 6

What data latency is required/acceptable?

10. This is difficult to answer and is a big issue. For some users such as: bench forecasters, nowcasting, LAM modellers and even global NWP centres with short cut-off time the answer would the sooner the better. However, this has to be offset by a reasonable QA/QC procedures.

11. The data latency and other requirements are contained in the WMO/CBS Rolling Review of Requirements Database (http://www.wmo-sat.info/db/). For example, as a guide for AO and AMDAR temperatures, it suggested that the most stringent goal for availability is 5 minutes to support nowcasting. However, AO would definitely struggle to meet this requirement, but something in the range of 15 to 30 minutes (with most of the delay due to ground-based processing and buffering) is realistic and we should be looking to at least maintain that.

Issue 7

What level of data QC is required?

12. AO data QC currently applied are: usual format checking, aircraft position checking, observed values within bounds check, background (or first guess) check etc. The background check is model

dependent and probably together with blacklisting should be left to individual NWP centres to do. However, a more regular (monthly) automatic exchange of information regarding measurement anomalies and blacklisting criteria should continue and be improved.

Issue 8

Could NWP systems benefit from "pulling" data from a single source point?

13. Simplifying the data distribution system while maintaining (or improving) data quality and latency is something to aim for. To that end having one (or two) global AO collection and processing centres would be very useful in the long run, however that would be a major undertaking.

Issue 9

Would an archive of historical AO data benefit NWP?

14. Historical data would be beneficial for any research experiments including "re-analysis" or "climate" runs from which the NWP would ultimately benefit. When we say historical data we always think of a "long term" archive, however if we have one or two processing centres it would be very good to keep the data "on-line" for as long as it is practically feasible (a month or a year).

15. Of course, all of this would depend on data agreements between airlines and meteorological services for provision of AO data. At this stage, it looks as if a long-term archive of the majority of AO data would be possible. However, categorisations of data such as: real-time use only, certain users only, etc. should be able to be handled in a single data repository with appropriate flags and access security as required.

RECOMMENDATIONS

1. Expansion of AMDAR into smaller regional carriers

- more data from less well travelled routes and from lower altitudes
- more frequent vertical profiles near (“remote”) airports

2. AO monitoring and information exchange

- Information related to AO data counts, usage, quality etc. should be automatically exchanged on a more regular (monthly) basis among NWP centres and data producers
- Near-real time (semi-)automatic “Alarm/Event” system should be established to raise alarms or events when there are data problems

3. AO data QA/QC

- AO DMF system should carry out as much QA/QC as possible prior to data distribution (format, position, physical bounds, background checks etc.)
- Although the background check is model dependent and should be left to individual NWP centres (together with blacklisting) to perform, however this type of information would be very useful to non-NWP users who often rely only on observational data
- Together with recommendation 6

4. Additional observed quantities

- Humidity, icing, turbulence, chemical constituents etc.

5. Metadata requirements

- Information related to: aircraft identification and type, instrument type and how it is mounted, avionics software version, data corrections performed etc.

6. Data latency

- To follow WMO/CBS Rolling Review of Requirements
- As short as possible, but 15 to 30 minutes looks acceptable and should be maintained

7. “Single” source to “pull” data from

- One (or two) global AO collection and processing centres would be very useful, although it would be a major undertaking
- Together with recommendation 3

8. Archive of historical AO data

- Research experiments as well as “re-analysis” or “climate” runs and ultimately NWP would benefit from this
- Archive categorisation: real-time use only, certain users, etc. to be handled with appropriate flags and security access codes to satisfy various data agreements

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