WORLD METEOROLOGICAL ORGANIZATION

WMO AMDAR PANEL
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ITEM: 4.4

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PROJECTS, PLANNING AND WORK PROGRAMME

Development and Maintenance of the Aircraft Observing System QMS

Data Quality Issues

(Submitted by Jitze van der Meulen)

SUMMARY AND PURPOSE OF DOCUMENT

To inform the Panel on the current issues related with data quality

ACTION PROPOSED

1. The Panel is invited to note the information contained in the document.
2. The Panel is invited to comment to this information or make proposals for further improvements on data quality.

References:

1. Final report Workshop on Aircraft Observing System Data Management (Geneva, Switzerland, 5–8 June 2012)
2. AMDAR Reference Manual

DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

1. TBD

2. TBD

3. TBD

2012 U.S. AMDAR NCEP QC PROGRESS / ACTIVITY REPORT

4. On 12 September 2012, a large number of suspect South African AMDAR reports were found that had many track-check errors and large differences to the model background. Analysis showed that there were over 1100 reports that were duplicates from a month earlier. Extensive diagnostics tests were performed for all aircraft reports at NCEP in 2012 to see if there were other duplicates in time. A few other minor non-US AMDAR one or two day old duplicates were found, but a moderate number of duplicate US MDCRS reports from older aircraft of just one model type each from two airlines is a more serious problem that needs fixing. In addition, some time duplicates were found from aircraft that had stuck data problems lasting over 24 hours.

5. Analysis shows that there are many aircraft with serious stuck data problems or excessive track-check errors that are not reported in standard monthly reports. Although it was decided at the AMDAR workshop in Geneva that no changes are needed to the monthly aircraft monitoring reports, these stuck data and excessive track-check errors must be diagnosed and reported.

6. Codes still are being developed at NCEP to give very timely alerts for aircraft with quality problems, where combinations of large problems and rapid reporting rates will yield the quickest diagnoses of problems.

7. In cooperation with Dave Helms, NCEP could use current diagnostics on MDCRS data to allow ARINC to add data quality flags to the data before transmission on the GTS.

8. The above codes could help NCEP operational staff to be able to send email alerts to other NWP centers and the aviation community for serious data problems such as in item 1 above.

CURRENT ISSUES

The current data quality issues can be summarized into four categories:

1. Observational errors of the reported physical quantities, like air temperature and wind

   These quantities are primarily based on direct measurement with calibrated and adjusted sensors, but modified using algorithms providing the quantities as requested (e.g. static temperature, wind vector with regard to the ground). Any error can be controlled or checked with respect to a well-defined reference with a specified uncertainty. NWP background fields are typical examples of such a reference. Causes or error may not be related to the primary measured quantity, e.g. errors in temperature will also cause errors in the reported wind speed.

2. Meta data errors related to the reported physical quantities, horizontal and vertical position, time of observation

   Errors in meta data, in particular incorrect positions and time stamps will confuse the user or disturb any application and are there extremely critical. Typical examples of such errors are incorrect altitude reports (e.g. height in stead of pressure altitude), track errors and date errors. Because it's hard to investigate or determine such errors themselves, track control and gross error checking of the temperature may be used for detection.

3. Logistic and code errors in the dissemination and encoding data

   Typical errors are bulletins containing encoding errors, i.e. not in line with WMO regulations, or without relevant data. Other examples are retransmissions of bulletins.

4. Data and data-quality management shortcomings

   Typical issues are the inability to back trace the source of data (i.e. the provider, or the specific aircraft) and to control data ingestion of GTS hubs. A typical example is data dissemination over the GTS of ADS data.

OBSERVATIONAL ERRORS OF THE REPORTED PHYSICAL QUANTITIES

General

It is commonly stated that AMDAR data suffer from a warm temperature bias (*i.e.* a systematic positive error). Moreover it is found that the amount this error is aircraft type and airline dependent. As a result some NWP centers will introduce (or have already) an offset scheme to reduce the impact of such error. In some cases such 'adjustment' is done for each specific aircraft ID. Although this method is typical for NWP, it is still questionable what the uncertainty is of these systematic errors. To be convinced if the determined systematic errors are significant (*i.e.* larger than the average uncertainty of the background field itself, inclusive the differences in space and time) it is necessary to be convinced if the stated quantitative uncertainties of the NWP references are well defined and bias free. The assumption that NWP references are bias free is not trivial and differences between global scale NWP and high resolution limited area models are found. As a consequence the quality of such NWP back ground fields as sources for references should be investigated, inclusive the methods of inter- and extrapolation in time and space.

Quality of air temperature data

Apart from differences found between aircraft type or sub-type, differences are recognized between fleets reporting air temperature over different regions. These differences are the result of a study carried out by Michael Esler, BoM see Annex I).

META DATA ERRORS RELATED TO THE REPORTED PHYSICAL QUANTITIES

Track errors and incorrect time stamps

Bradley Ballish (NCEP) recently noticed recently significant track errors and date stamp errors in South African AMDAR Data. Extreme jumps in space during a short time interval of one single aircraft were recognized. Further investigation demonstrated that an incorrect date stamp was causing the trouble (*i.e.* old data was resend a next month as recent data together with correct dated data). In principle track errors can be identified before reporting based on the assumption that the speed of the aircraft will have a maximum value. Such a check is implemented in E-AMDAR.

Altitude errors

It is observed that for a set of aircraft height (*i.e.* w/r airport elevation) (or altitude w/r MSL) is reported and not pressure altitude. In the case when aircraft are reporting altitude (w/r MSL) such reports will not easily be recognized by a specific temperature bias, because <u>on average</u> *p*[MSL] = 1013.2 hPa, which is the standard reference pane for pressure altitude. The impact however is that the reported temperature will have an extra measurement uncertainty of about 1.1 hPa. Analysis the reported pressure altitude with respect to reported QNH values during ASC and DES are useful to determine such aircraft.

LOGISTIC AND CODE ERRORS IN THE DISSEMINATION AND ENCODING DATA

Nil reports and reports missing relevant data

It was found that Australian AMDAR was reporting AMDAR nil reports every hour (like for routine messages such as FM12 SYNOPs). Because FM42 AMDAR reports do not belong to the set of "routine hourly message bulletins" it was arranges to stop sending NIL bulletins for AMDAR bulletins bij BoM.

Incorrect altitude reporting

FM42 AMDAR reasonably well defines how altitude should be encoded (see ANNEX II). The format as stated in the WMO Code Manual is also published in the WMO AMDAR Reference Manual. It is allowed to report 'Flight Level' as height above the aerodrome (incorrectly defined in the Manual on Codes however) in section 3 of this code. This practice is operational for the Japanese AMDAR reports. In a number of reports, however, it was found that in such cases only the altitude in section 3 was reported, whereas the pressure altitude in section 2 (the default section for reporting altitude) was filled with slashes, like in:

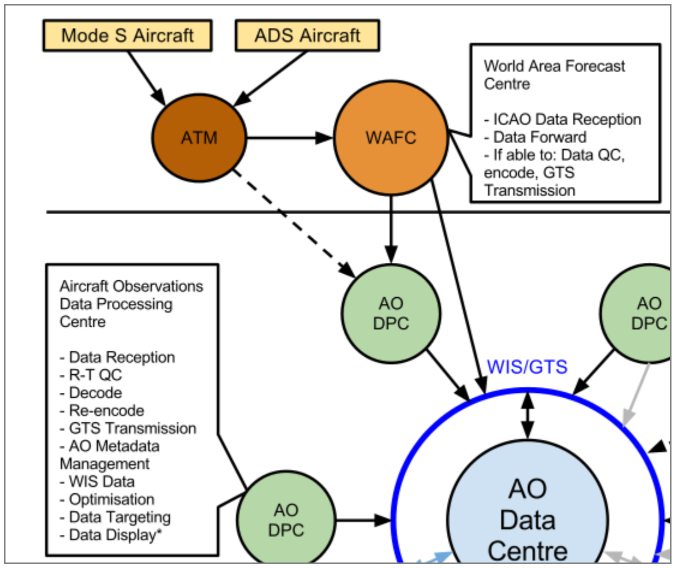
```
UDAS01 RJTD 170900 RRX
AMDAR 1709
LVR JP9Z5W59 3523N 13505E 170759 F199 MS070 270/009 TB/ S031
333 F199 VG///=
LVR JP9ZVWY9 3344N 13713E 170800 F275 MS230 023/019 TB/ S031
333 F275 VG///=
ASC JP9ZXYU9 3533N 13947E 170754 //// PS280 226/016 TB/ S031
333 F001 VG///=
ASC JP9ZXYU9 3532N 13947E 170754 //// PS280 213/017 TB/ S031
333 F002 VG///=
```

Some research on this phenomenon resulted in the conclusion that the encoding application generates //// because of the inability to process negative pressure altitudes (*i.e.* when the aircraft is below the 1013.2 hPa datum plane). This issue is under further investigation.

DATA AND DATA-QUALITY MANAGEMENT SHORTCOMINGS

Recommendations for DM Framework and QMS for ADS Data

One of the outcomes of the DM Workshop was a proposed Aircraft Observations Global Management Framework (see doc. 4.4.3, Annex II). Within this framework ADS and Mode-S data management is indicated, inclusive data quality management:



In this framework ATM and World Area Forecast Centre (WAFC) is placed inside the ICAO aviation area and the Aircraft Observations Data Processing Centre (AO DPC) inside the WMO area. As shown in this figure two straight data lines can be configured (ATM to WAFC to AO DPC), or a direct line from ATM to AO DPC. In this figure it is assumed that the WAFC will care about quality control, *i.e.* outside the WMO area. So the following three options can be regarded:

1. WAFCs can process and QC the data for BUFR transmission onto the GTS (require specification and resourcing from WMO).
2. WAFCs can receive the data in original format and transmit it in this format (minus proprietary information) to an AO DPC (e.g. E-ADAS) for data processing and GTS transmission in BUFR.
3. ATM centres can also transmit the data in original format (minus proprietary information) directly to a AO DPC for data processing and GTS Transmission in BUFR.

The question will be if QC outside the WMO will be appropriate, *i.e.* manageable and controllable (for option 1). Options 2 and 3 should be preferred because all AO DPCs are under WMO responsibility and should guarantee that all DPCs follow the same QM and BUFR conversion rules. Any change needed in a QM and BUFR procedure can be done within the WIS and there will be no need to request a "foreign" DPC to implement these changes (avoiding time delay and frustration), *i.e.* QM remains our own hands. An overview of such QC is shown in Annex IV.

To start up further discussion within ICAO, Mr Scylla Sillayo has represented the WMO Aeronautical Meteorology in the ICAO WAFSOPSG-7 meeting (WAFSOPSG: World Aera Forecast System Operations Group). This meeting was held from 17 to 21 September in Lima, Peru. On behalf of IATA a working paper was presented to improve the current situation (WAFSOPSG/7-WP/21). Results of the discussion will be in the final report of the meeting when it becomes available. Nevertheless a draft version is already available, containing the outcome of this issue (see ANNEX III). It is stated that ADS reports are automatically forwarded by the ANSP to the WAFCs and that issues on quality management will be reported for the next WAFSOPSG.

GTS bulletin issues related to ADS data

ADS data is regarded as part of AIREP data (aircraft report). Although in alphanumerical codes AIREP reports may be encoded as FM42 AMDAR (but FM 41 AIREP is preferred), the bulletin header for alphanumerical codes distinguishes AIREP from AMDAR (see: Manual on the GTS). As a consequence bulletins may be selected (or filtered out) before decoding and storage into a observational database. This filtering may be extremely useful in case of QM applications. For BUFR encoded bulletins however such method is not available because the bulletin header for AMDAR and AIREP encoded reports are identical ("IU A", see ANNEX V). Using a specific table (presently, to be updated as well), defined as part of the new AMDAR BUFR template is will be possible to make any distinction. However, any analyses can only be performed after decoding, *i.e.* when the data is already stored in the database and after filtering by the decoder of code errors and duplications. As a result specific QM on BUFR encode ADS bulletins will be rather complicated. Therefore it is recommended to update the bulletin header format (as defined in the Manual on the GTS) by extending the list report types indicated by A_1 in the $T_1T_2A_1A_2$ii CCCC standard header format.

ANNEX I

Information provided by Michael Esler, Data Quality & Improvement Section, Observations & Engineering Branch, Bureau of Meteorology (Australia)

SOME PROGRAM-SCALE STATISTICS DERIVED FROM MONTHLY MONITORING REPORTS

At the end of each calendar month there are two AMDAR data quality monitoring reports that are made available. Each provides analysis of the AMDAR observations broadcast on the GTS in the preceding month, with particular reference to the output of a NWP (numerical weather prediction) model.

The Meteo-France report (‘*Monthly monitoring statistics for aircraft observations between 300 hPa and 150 hPa’*) is distributed by Herve Benichou by email (herve.benichou@meteo.fr) and covers the nine regional/national AMDAR programs: Australia, EU, USA, Japan, Canada, South Africa, China, New Zealand and Hong Kong. (This raises the question - why is the Korean AMDAR program not on this list?).

Similarly, Brad Ballish of the US-NWS NCEP (National Weather Service, National Centers for Environmental Prediction), posts two reports each month at the website http://www.nco.ncep.noaa.gov/pmb/qap/. One of these, the ‘*Monthly AMDAR Statistics Report*’ covers the non-US AMDAR programs. The other, the ‘*Monthly ACARS Statistics Report*’ covers the US-AMDAR program only (known in the US as the ACARS Program). Together the two cover the same nine national/regional programs as the Meteo France report.

Each of these reports, for all AMDAR reporting aircraft, takes the ensemble of observations by a particular aircraft and aggregates them to a handful of statistics which serve to characterise the overall data contribution of that aircraft for the month. That is, several thousand observations are aggregated to yield one line of descriptive statistics per aircraft. The present report takes this process one cycle further, and aggregates the statistics for the many aircraft in a regional AMDAR program to yield a small set of statistics that characterise the overall data contribution of that program for the month.

We have applied this further data aggregation process to: (a) the Meteo-France reports over the period June 2010-September 2012 inclusive; and (b) the US-NWS reports over the period December 2010-September 2012 inclusive. The complete description of this process, and its results, comprise a proposed Bureau of Meteorology (Australia) Technical Note, still in preparation. We have extracted a few of the more interesting figures from that document in order to present them here. The following text will introduce the figures only briefly.

Figures 1 and 2 illustrate, for the nine regional programs, estimates of measurement bias in AMDAR T (temperature) observations, with respect to Meteo-France NWP data and US-NWS NWP data, respectively. Note that Figure 1 pertains only to T observations in the pressure altitude range 300 hPa to 150 hPa; (the Meteo-France report constrains its analysis to observations acquired in this pressure altitude range). Figure 2, however, effectively covers T observations acquired through the entire pressure altitude range, and furthermore resolves it into the following categories: High (p < 300 hPa); Mid (300 hPa < p < 700 hPa) and Low (p >700 hPa). The two figures are consistent in indicating a systematic T measurement bias of almost +0.5 °C for Japan and Hong Kong, and somewhat less for the other regional programs.

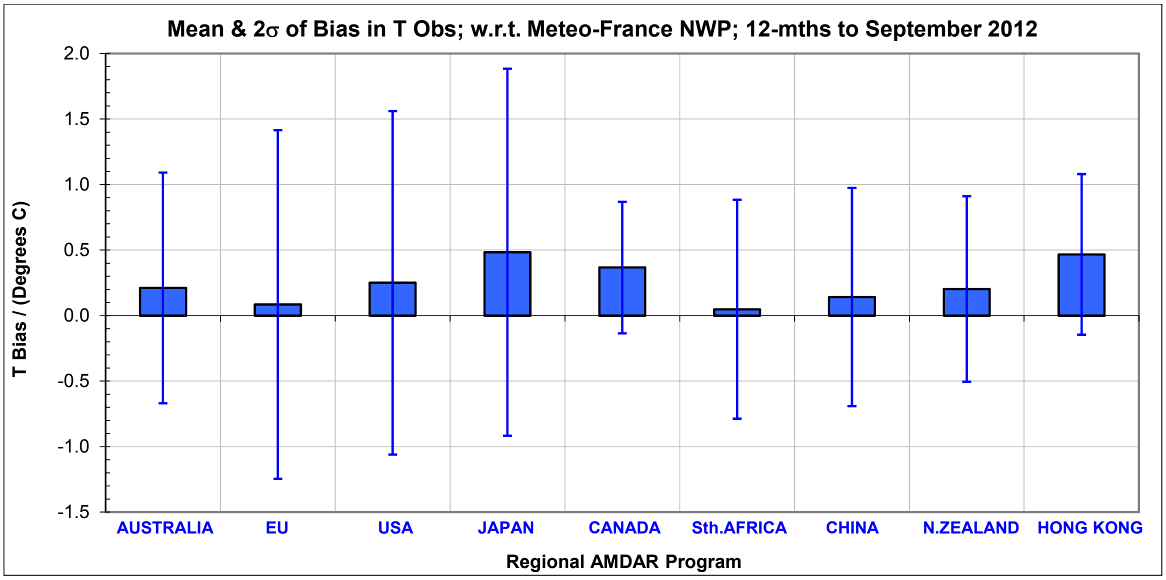


Figure 1. Estimate of the overall bias, and its dispersion, in AMDAR T (temperature) observations. Record of the Mean and ±2σ of the aircraft Bias (w.r.t. Meteo-France NWP) of T observations, on average, over the period October 2011-September 2012, for nine regional/national AMDAR programs.

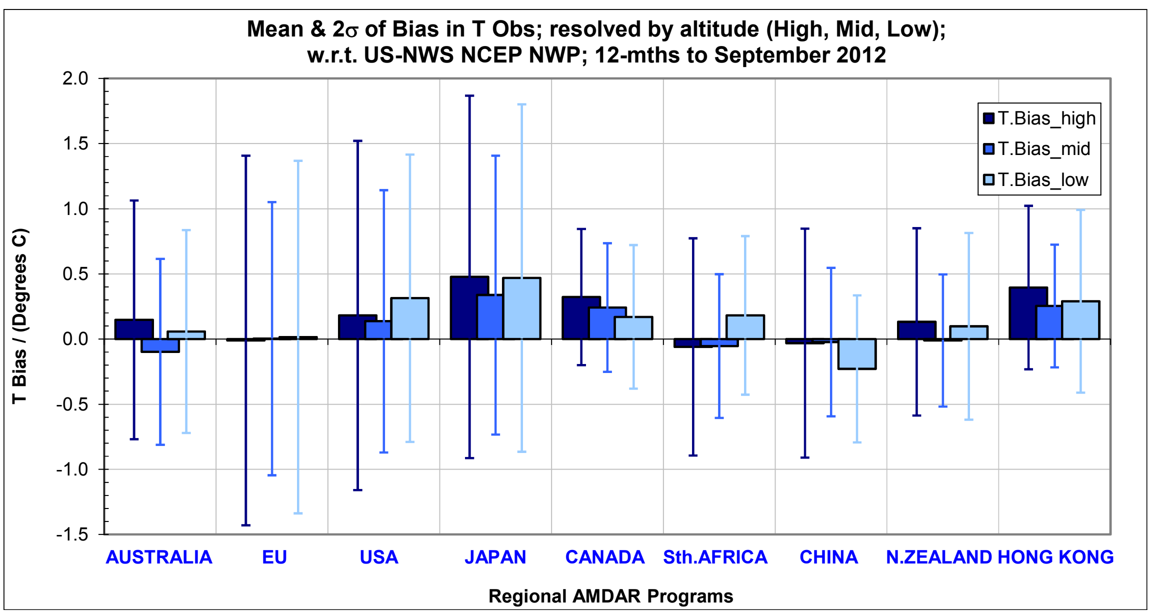


Figure 2. Estimate of the overall bias, and its dispersion, in AMDAR T observations. Record of the Mean and ±2σ of the aircraft Bias (w.r.t. US-NWS NCEP NWP) of T observations, on average, over the period October 2011-September 2012, for nine regional AMDAR programs. Resolved by altitude range.

Similarly, Figures 3 and 4 illustrate the estimated bias in *WS* (wind speed) observations. Again, the two figures are consistent and suggest the existence of small systematic *WS* bias, ranging from -0.5 $m.s^{-1}$ at low altitudes to +0.6 $m.s^{-1}$ at high altitudes.

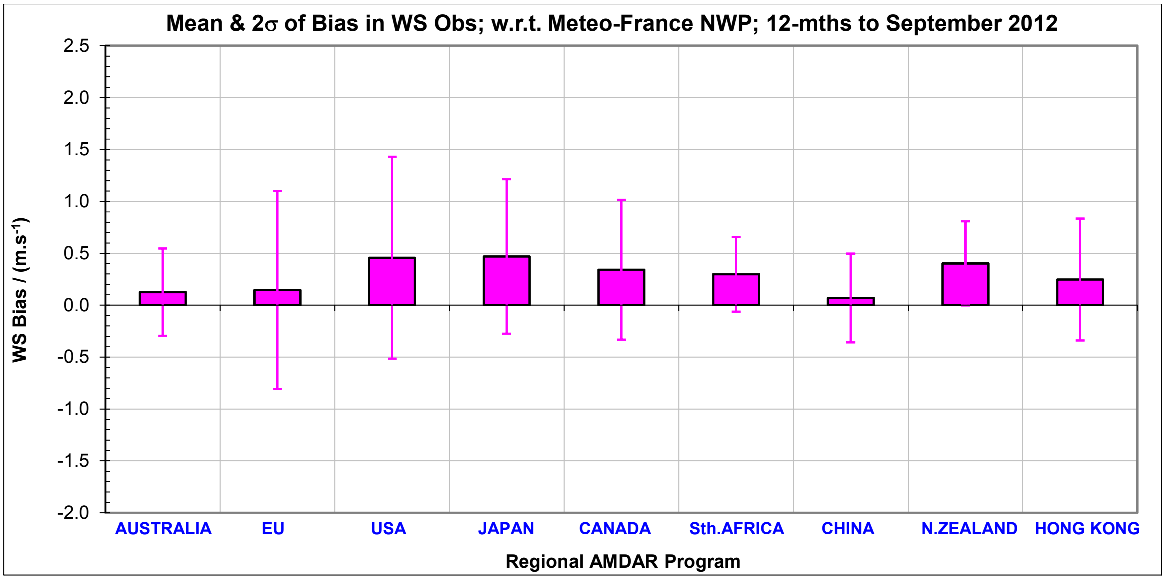


Figure 3. Estimate of the overall bias, and its dispersion, in AMDAR WS (wind speed) observations. Record of the Mean and ±2σ of the aircraft Bias (w.r.t. Meteo-France NWP) of WS observations, on average, over the period October 2011-September 2012, for nine AMDAR programs.

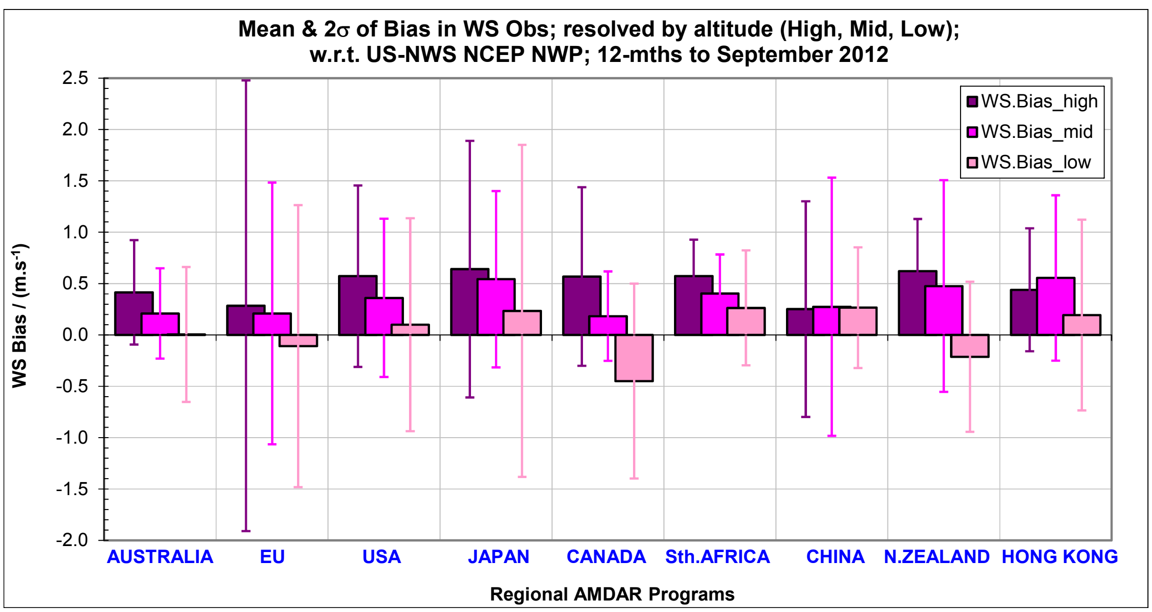


Figure 4. Estimate of the overall bias, and its dispersion, in AMDAR WS observations. Record of the Mean and ±2σ of the aircraft Bias (w.r.t. US-NWS NWP NCEP model) of WS observations, on average, over the period October 2011-September 2012, for nine AMDAR programs. Resolved by altitude range.

Figure 5 illustrates the estimated bias in *WD* (wind direction) observations based on Meteo-France reports. There is no corresponding figure for US-NWS reports as those reports consider only *T* and *WS* observations. There appears to be a small systematic *WD* bias of approximately +0.5 degrees from North.

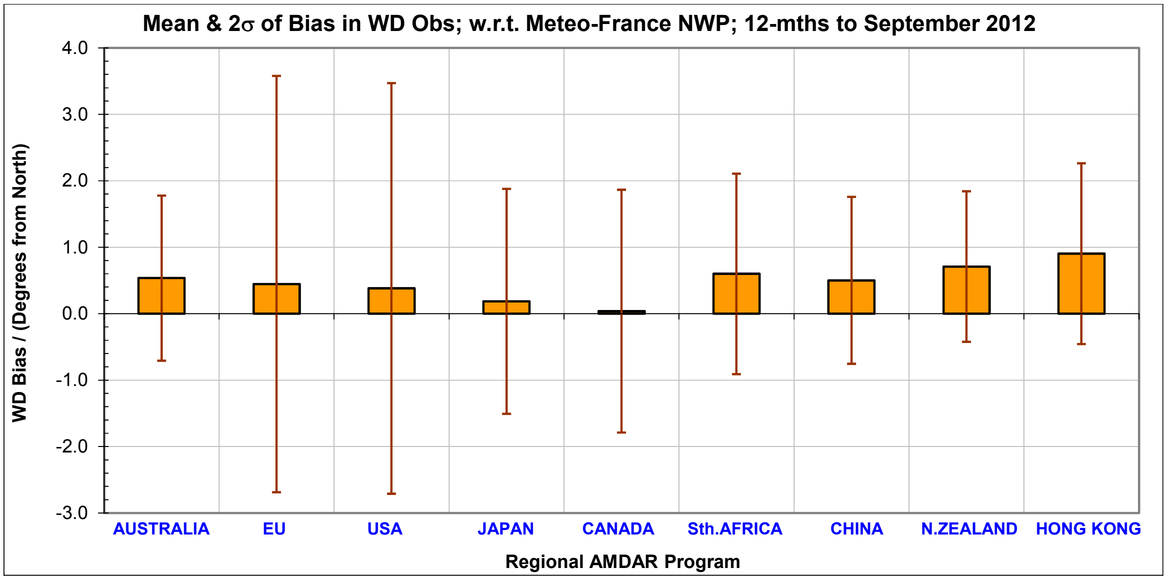


Figure 5. Estimate of the overall bias, and its dispersion, in AMDAR WD (wind direction) observations. Record of the Mean and ±2σ of the aircraft Bias (w.r.t. Meteo-Fr NWP) of WD (wind direction) observations, on average, over the period October 2011-September 2012, for nine AMDAR programs.

The rest of the figures, Figures 6-12, pertain to the estimated accuracy of the *T*, *WS* and *WD* observations in the nine AMDAR regional programs. With the exception of Figure 9 they are derived from Meteo-France reports.

Figure 6 illustrates the estimated accuracy of the *T* observations, according to regional program. Observe that they are all fairly close, ranging from ±0.82 °C (South Africa) to ±1.16 °C (Japan), and averaging ±0.96 °C across all regional programs.

In Figure 7, we plot the monthly estimates of *T* measurement accuracy for the last 28 months, for several Northern Hemisphere programs and one Southern Hemisphere program (Australia; we couldn't use data from the New Zealand or South Africa programs since they both suffered confounding data quality issues during 2011). This is in order to illustrate the possibility that there is a seasonal cycle in AMDAR *T* measurement accuracy (with respect to the reference frame of NWP data). Although the signal is noisy, we tentatively conclude that the divergence of AMDAR *T* observations from NWP *T* data is greatest in early spring (i.e., September-October in the southern hemisphere, and February-March in the northern hemisphere).

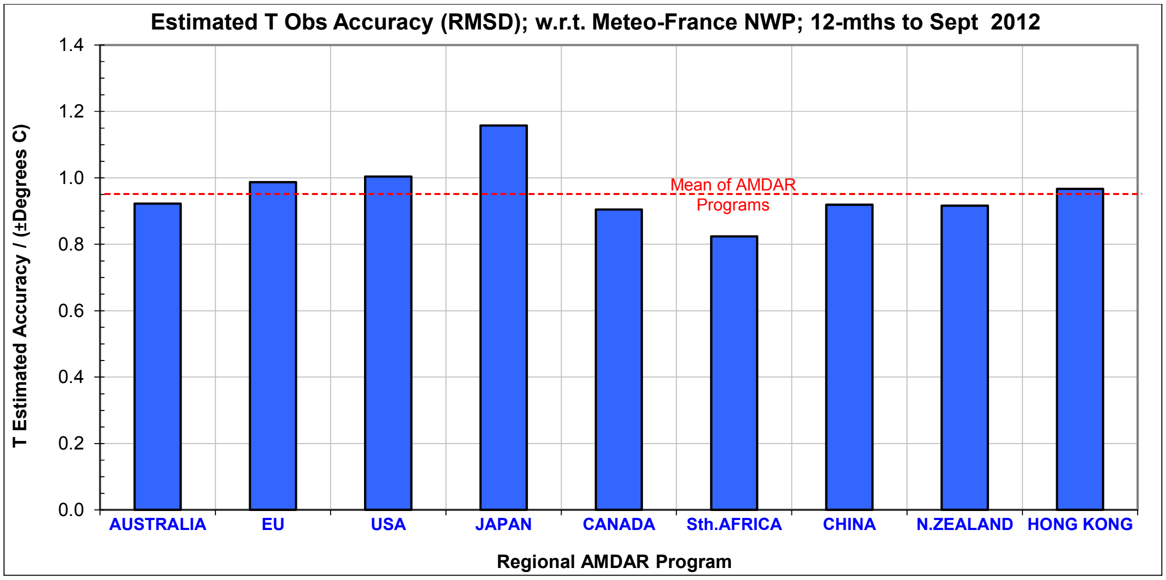


Figure 6. An estimate of the overall accuracy of AMDAR T (temperature) observations. RMSD (root-mean-square deviation) of the aircraft residuals w.r.t. Meteo-France NWP, ΔT (=$T_{observed} - T_{NWP}$), on average, over the period October 2011-September 2012, for nine AMDAR programs.

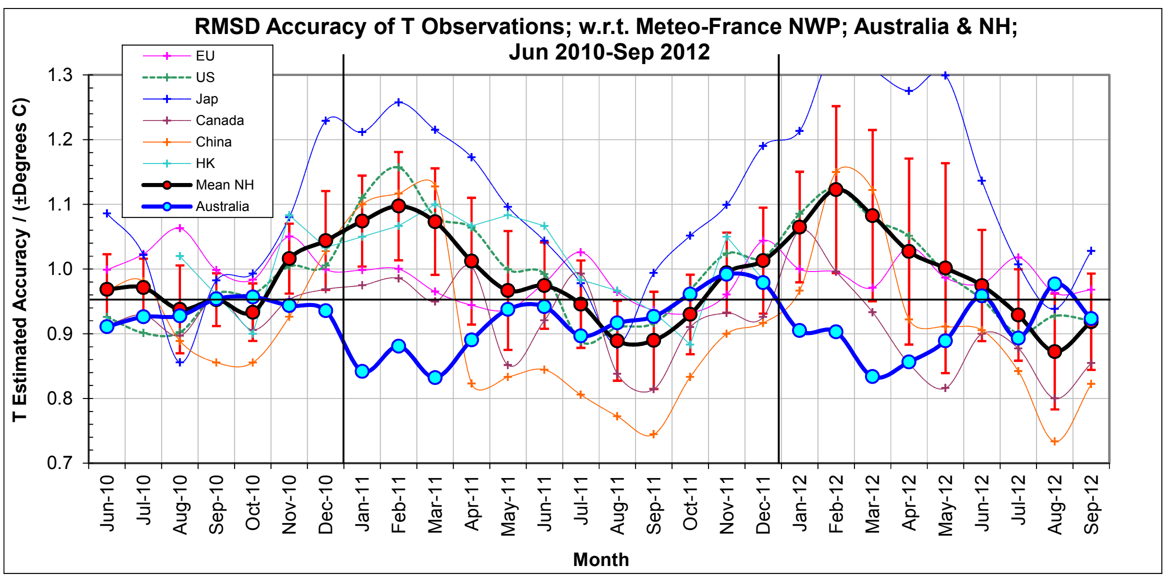


Figure 7. Illustrating a possible seasonal cycle in the accuracy of AMDAR T observations. The dashed lines plot the accuracy of T observations, estimated as the RMSD of the aircraft residuals, ΔT (=$T_{observed} - T_{NWP}$), month by month, for each of the six Northern Hemisphere AMDAR Programs (EU, USA, Japan, Canada, China and Hong Kong). The solid black line with red circles plots the mean value of the six individual NH accuracy values, month by month. The red uncertainty bars show $\pm 2\sigma_{mean}$ (N = 6). The solid blue line with blue circles plots the mean value of the accuracy of T observations in the Australian (Southern Hemisphere) AMDAR Program. [A simplified figure is provided in the Appendix].

Figure 8 illustrates the estimated accuracy of the *WS* observations, derived from Meteo-France reports, according to regional program. Observe that they are all fairly close, ranging from ±2.7 $m.s^{-1}$ (EU) to ±3.2 $m.s^{-1}$ (USA), and averaging ±3.05 $m.s^{-1}$ across all regional programs. Figure 9 illustrates the equivalent results derived from the US-NWS reports. The estimated accuracies are apparently poorer, ranging from ±3.5 $m.s^{-1}$ (Low altitude, EU) to ±5.1 m.s^{-1} (High altitude, Hong Kong). However, bear in mind that the frame of reference is now US-NWS NWP and no longer Meteo-France NWP.

In Figure 10, we plot the monthly estimates of *WS* measurement accuracy for the last 28 months, for several Northern Hemisphere programs and one Southern Hemisphere program (Australia). This is in order to illustrate the possibility that there is a seasonal cycle in AMDAR *WS* measurement accuracy (with respect to the reference frame of NWP data). Although the signal is noisy, we tentatively conclude that the divergence of AMDAR WS observations from NWP WS data is greatest in early summer (i.e., November-December in the southern hemisphere, and May-June in the northern hemisphere).

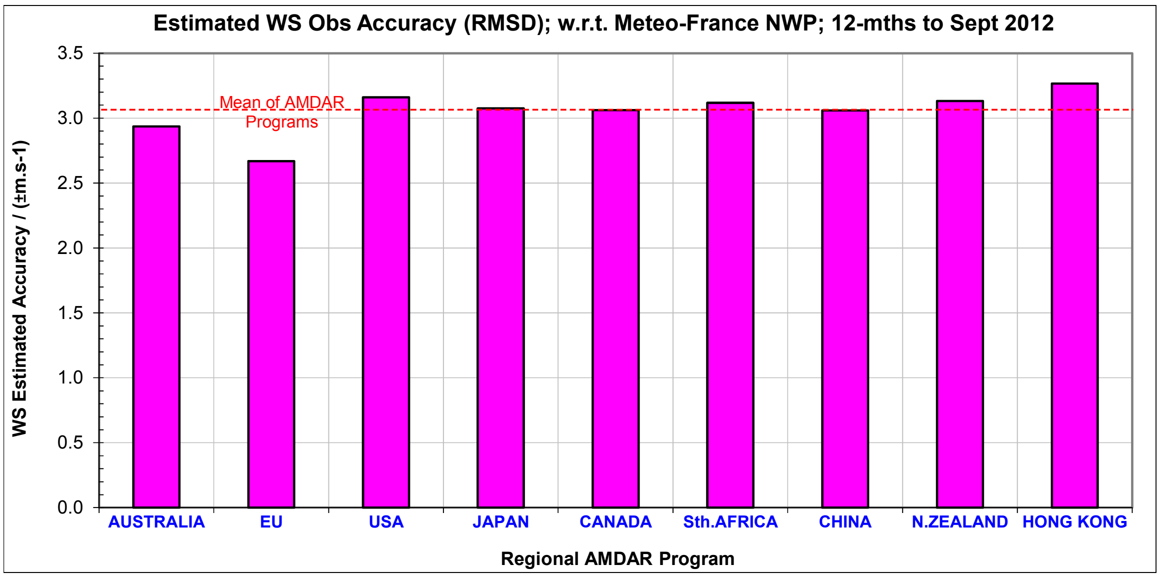


Figure 8. An estimate of the overall accuracy of AMDAR WS (wind speed) observations. RMSD (root-mean-square deviation) of the aircraft residuals w.r.t. Meteo-France NWP, ΔWS (=$WS_{observed} - WS_{NWP}$), on average, over the period October 2011-September 2012, for nine AMDAR programs.

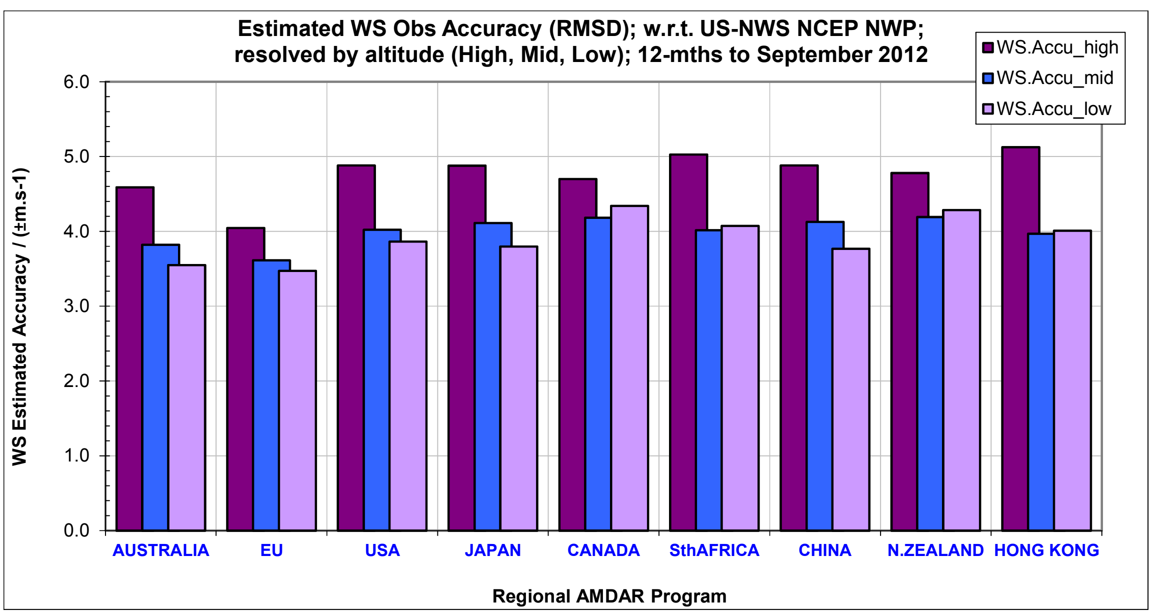


Figure 9. An estimate of the overall accuracy of AMDAR WS observations. RMSD (root-mean-square deviation) of the aircraft residuals w.r.t. US-NWS NCEP NWP, ΔWS (=$WS_{observed} - WS_{NWP}$), on average, over the period October 2011-September 2012, for nine AMDAR programs.

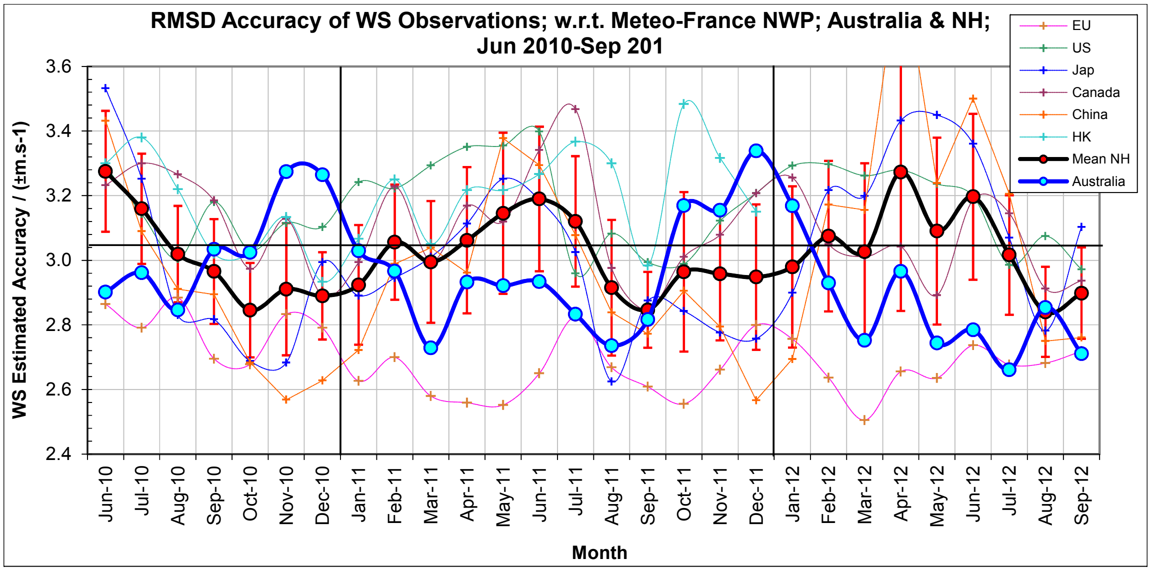


Figure 10. Illustrating a possible seasonal cycle in the accuracy of AMDAR WS observations. The dashed lines plot the accuracy of WS observations, estimated as the RMSD of the aircraft residuals w.r.t. Meteo-France NWP, ΔWS (=$WS_{observed}$ – WS_{NWP}), month by month, for each of the six Northern Hemisphere AMDAR Programs (EU, USA, Japan, Canada, China and Hong Kong). The solid black line with red circles plots the mean value of the six individual NH accuracy values, month by month. The red uncertainty bars show ±2σ_{mean} (N = 6). The solid blue line with blue circles plots the mean value of the accuracy of WS observations in the Australian (Southern Hemisphere) AMDAR Program. [A simplified figure is provided in the Appendix].

Figure 11 illustrates the estimated accuracy of the *WD* observations, derived from Meteo-France reports, according to regional program. Observe that they are reasonably divergent, ranging from ±7.5 degrees (Japan) to ±19 degrees (South Africa), and averaging ±11.5 degrees across all regional programs.

In Figure 12, we plot the monthly estimates of *WD* measurement accuracy for the last 28 months, for several Northern Hemisphere programs and one Southern Hemisphere program (Australia). This is in order to illustrate the possibility that there is a seasonal cycle in AMDAR *WD* measurement accuracy (with respect to the reference frame of NWP data). Compared to the cases with *T* and *WS,* (Figures 7 and 10, above), the seasonal signal with *WD* is relatively clear. We tentatively conclude that the divergence of AMDAR WD observations from NWP WD data is greatest in late summer (i.e., January-February in the southern hemisphere, and July-August in the northern hemisphere).

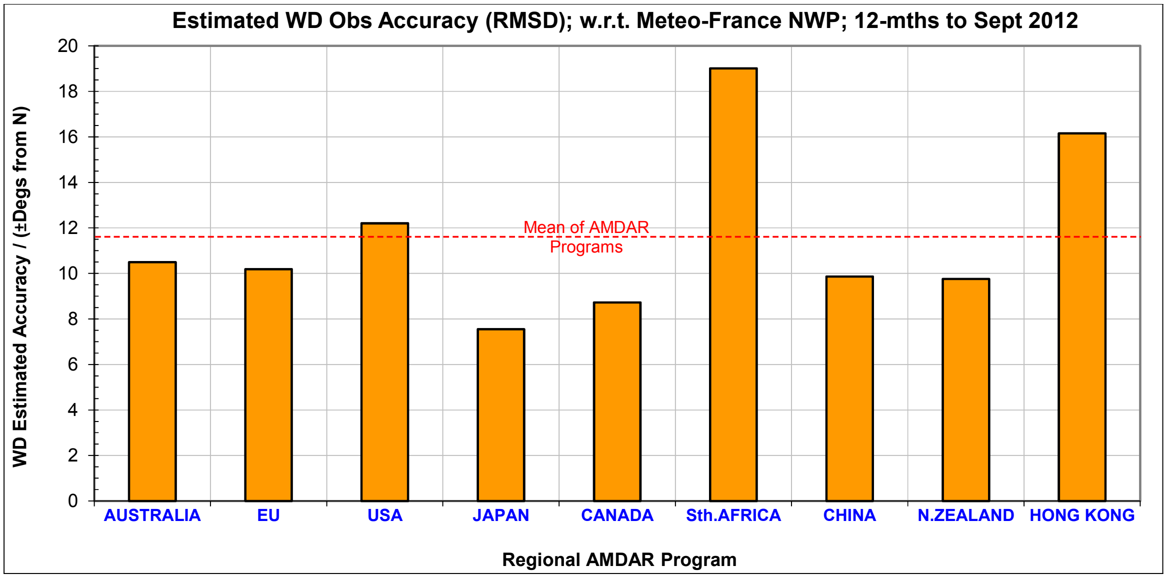
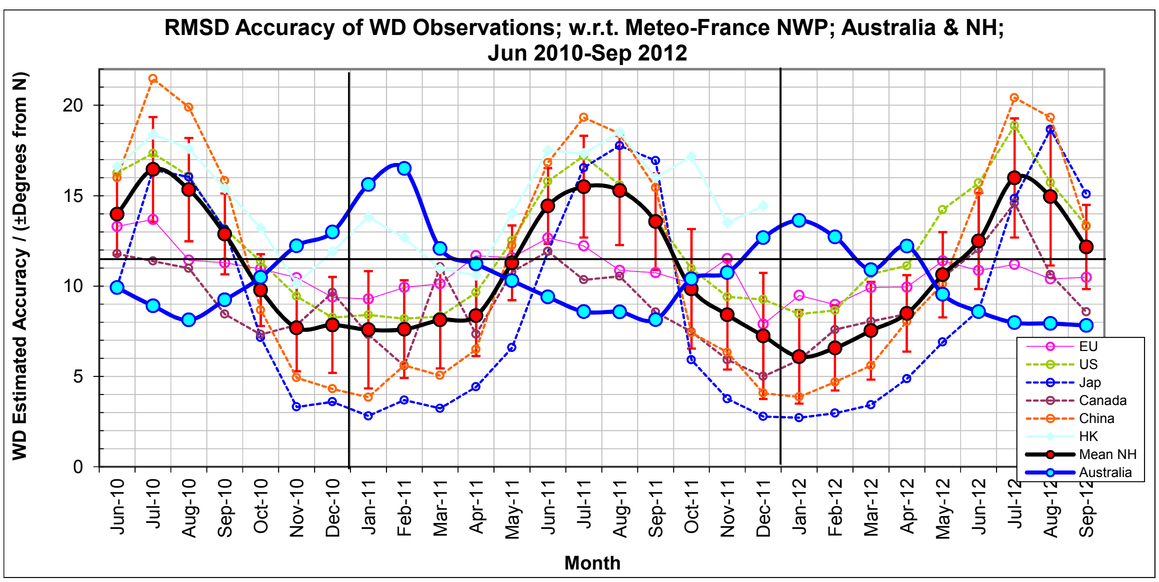


Figure 11. An estimate of the overall accuracy of AMDAR WD (wind direction) observations. RMSD (root-mean-square deviation) of the aircraft residuals w.r.t. Meteo-France NWP, ΔWD (=$WD_{observed}$ – WD_{NWP}), on average, over the period October 2011-September 2012, for nine AMDAR programs.



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Appendix: Simplified Forms of Figures 7, 10 and 12

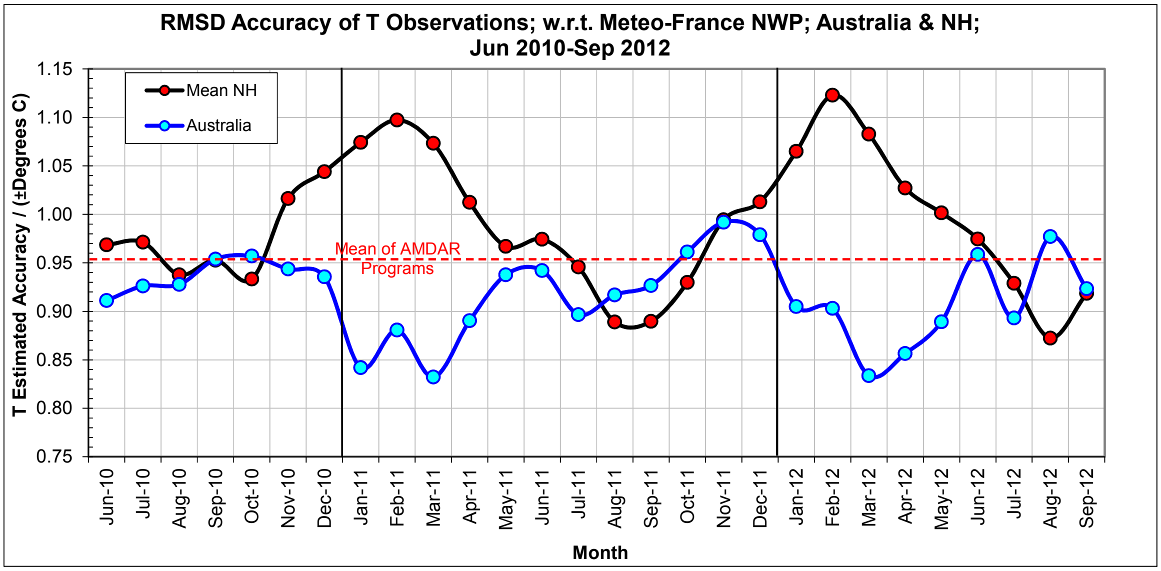

Figure 7a. Illustrating a possible seasonal cycle in the accuracy of AMDAR T observations. The solid blue line with blue circles plots the mean value of the accuracy of T observations in the Australian (Southern Hemisphere) AMDAR Program. Accuracy was estimated as the RMSD of the aircraft residuals, ΔT (=$T_{observed} - T_{NWP}$). The solid black line with red circles plots the mean value of the six individual NH accuracy values, month by month.

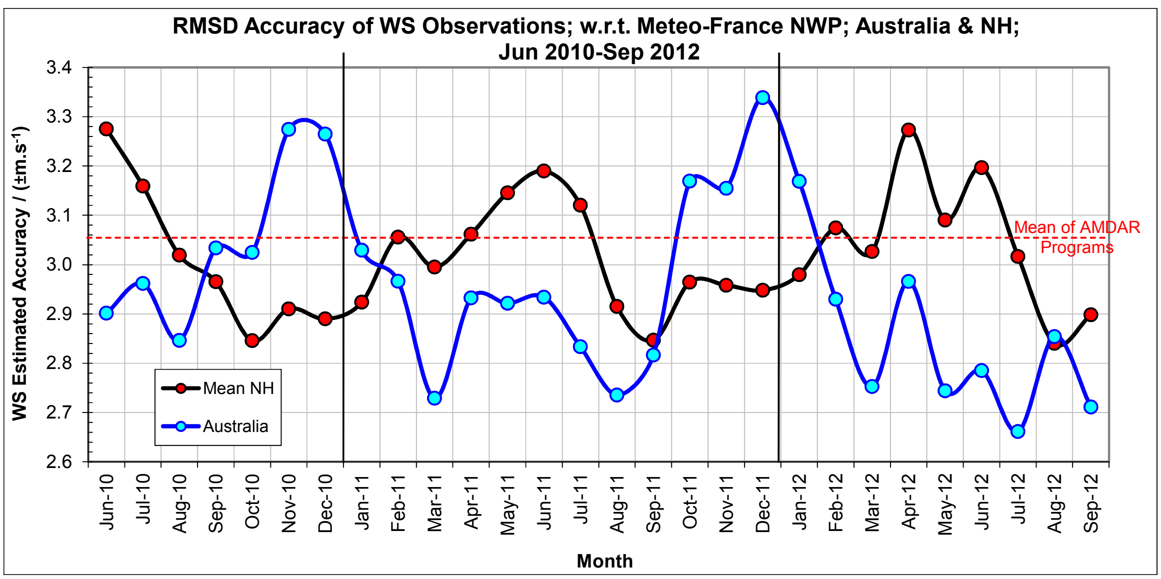

Figure 10a. Illustrating a possible seasonal cycle in the accuracy of AMDAR WS observations. The solid blue line with blue circles plots the mean value of the accuracy of WS observations in the Australian (Southern Hemisphere) AMDAR Program. Accuracy was estimated as the RMSD of the aircraft residuals, ΔWS (=$WS_{observed} - WS_{NWP}$). The solid black line with red circles plots the mean value of the six individual NH accuracy values, month by month.

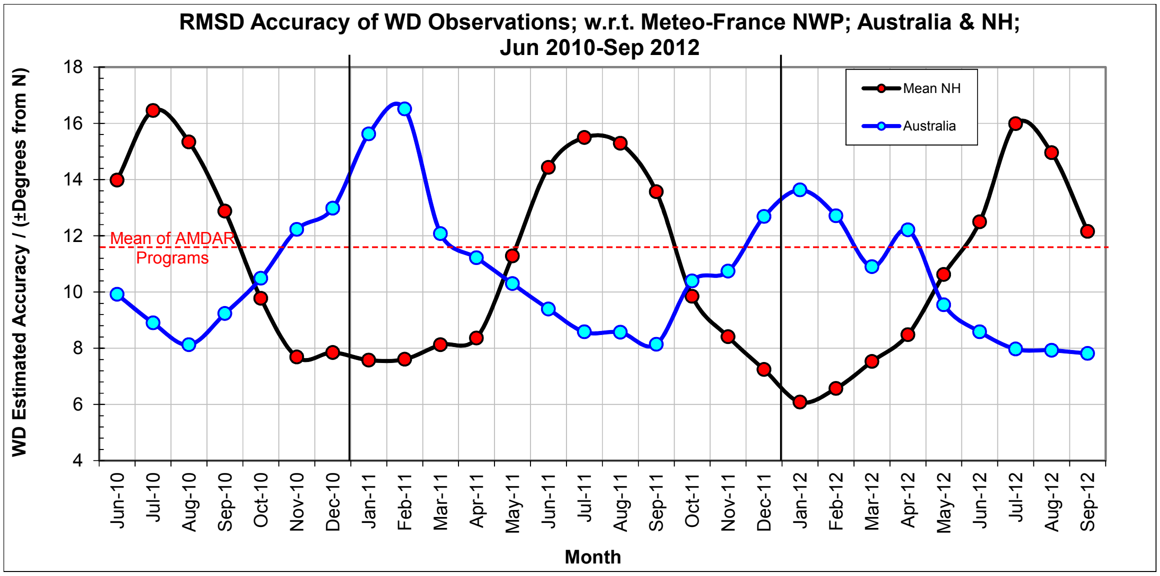

Figure 12a. Illustrating a possible seasonal cycle in the accuracy of AMDAR WD observations. The solid blue line with blue circles plots the mean value of the accuracy of WD observations in the Australian (Southern Hemisphere) AMDAR Program. Accuracy was estimated as the RMSD of the aircraft residuals, ΔWD (=$WD_{observed} - WD_{NWP}$). The solid black line with red circles plots the mean value of the six individual NH accuracy values, month by month.

Dr Michael Esler
Australian AMDAR Program Manager
Bureau of Meteorology, Australia
12 October, 2012

ANNEX II

FM42 AMDAR

Manual on Codes - WMO No. 306 Vol I.1 part A (alphanumerical codes)

CODE FORM:

SECTION 1 **AMDAR YYGG**

SECTION 2 **$i_pi_pi_p$ I_A. . . I_A $L_aL_aL_aL_aA$ $L_oL_oL_oL_oL_oB$ YYGGgg**

$S_hh_lh_lh_l$ $SST_AT_AT_A$ {$SST_dT_dT_d$ or UUU} ddd/fff TBB_A $Ss_1s_2s_3$

SECTION 3 **333 $Fh_dh_dh_d$ $VGf_gf_gf_g$**

where for altitude:

S_h Sign (positive: F, negative: A)
$h_lh_lh_l$ Pressure altitude, in hundreds of feet.
(1) Pressure altitude is a measure of height relative to the standard datum plane of 1013.2 hPa.

$h_dh_dh_d$ Flight level, in hundreds of feet.

REGULATIONS (section 3)
42.3.1 *Group* $Fh_dh_dh_d$
This group shall be used in an AMDAR report from an ACARS system to report the pressure altitude.

N O T E : Reports up to and including 700 hPa are considered to be above the aerodrome with height derived from the QNH value and the elevation of the aerodrome concerned. Heights above 700 hPa are included in accordance with the ICAO standard atmosphere.

Note that **$Fh_dh_dh_d$ is always positive (because of fixed sign F)**

ANNEX III

ADS-C MET Reports, automatically disseminated: the issue of an appropriate quality management process.

general statement:
Automatically generated and disseminated MET reports require, like any other production unit, a real time monitoring facility to control and trace-back that the quality of the product continuously confirms to the stated functional requirements. This service shall be able to act in a timely manner if these products do not comply with these requirements. It is recommended that this service is certified as such in line with international standards.

Three relevant topics can be regarded:

1. Daily control of operations
2. Daily quality control
3. Metadata control

For each of these topics the following tasks and responsibilities should be defined

1. *Daily control of operations*:
   a. Has nominated a responsible operator (a person) who can be contacted directly for Q/C issues
   b. Is responsible for passing through and blocking of particular MET data streams
   c. Is responsible for the quality of the encoding of the data
   d. Shall archive and publish (on request) quality monitoring statistics
   e. Shall keep the required metadata up-to-date and available

2. *Daily quality control*:
   a. Continuous quality control, providing the *Daily control of operations* the input to filter out any data stream
   b. Delivers quality evaluation statistics to the *Daily control of operations* for feed back and improvements, and to have a general overview of the status quo of the quality of the data
   c. Provides monitoring statistics to the *Daily control of operation* for archiving

3. *Metadata control*
   a. For all MET reports, metadata shall be available and up-to-date and shall contain:
      i. Information on the data provider, the source of the observations
      ii. Information on the instance, responsible for compliance with the functional specifications of the MET data product
      iii. Traceability to the particular aircraft, related to the reported observation

ANNEX IV

EXCERPT FROM THE DRAFT REPORT OF THE WAFSOPSG-7 MEETING (SEPT 2012)

Agenda Item 9: Any other business

9.1.1 The group reviewed an IATA proposal regarding the increased availability of ADS-C reports and the need to perform an appropriate quality management process on such reports. In this regard, the group recalled that WAFSOPSG Decision 4/21 decided not to address automatic dependent surveillance (ADS) MET data to quality management due to the fact that other sources of data (e.g. aircraft meteorological data relay (AMDAR) data) was rapidly increasing and that ADS MET data was expected to be a tiny percentage of the total MET data. However, the group was informed that the situation had changed, and that ADS-C had rapidly increased in conjunction with future air navigation system/controller-pilot data link communications (FANS/CPDLC).

In accordance with PANS-ATM, Chapter 4 and Appendix 5, it was noted that these messages go directly to the ANSPs, where they are decoded to provide aircraft surveillance. Although the original report contains the aircraft registration, the final decoded report only gives the flight number. This decoded report is then passed to the WAFCs in accordance with Annex 3, Chapter 5 without any quality control process. The group noted that quality management experience had shown that monitoring aircraft by registration was essential to tracking down subtle but significant temperature and wind errors, and for reporting back to the operator a problem with a particular aircraft.

9.1.2 The group considered, in view of the increased availability of ADS-C reports, the need for implementation of procedures to ensure that all ADS MET reports, including those obtained during en-route and terminal area phases of operation, were automatically forwarded by the ANSP to the WAFCs and that such reports should be subject to an appropriate quality management process. Accordingly, the group formulated the following conclusions:

> **Conclusion 7/18** — Forwarding of ADS reports relating to meteorological information to WAFCs
> That the relevant ICAO groups, in coordination with the WAFC Provider States, ensure that all ADS reports relating to meteorological information, including those obtained during enroute and terminal area phases of operation, are automatically forwarded by the ANSP to the WAFCs in accordance with Annex 3, Chapter 5 and Appendix 4.
>
> **Conclusion 7/19** — Quality management of ADS reports relating to meteorological information
> That the Secretary investigates issues concerning the quality management of ADS reports relating to meteorological information and provide a report in time for WAFSOPSG/8.

ANNEX V

BULLETIN HEADERS ISSUE FOR AMDAR and AIREP

Source: Manual on the GTS

General bulletin format:

A starting line An abbreviated heading A text End-of-message signals	Meteorological bulletin	Meteorological message

Starting line with header, standard format:

$T_1T_2A_1A_2ii$ CCCC

T_1T_2 Data type and/or form designators.

A_1A_2 Geographical and/or data type and/or time designators.

ii It shall be a number with two digits. When an originator or compiler of bulletins issues two or more bulletins with the same $T_1T_2A_1A_2$ and CCCC the ii shall be used to differentiate the bulletins and will be unique to each bulletin.

T_1

- A Analyses
- B Addressed message
- C Climatic data
- D Grid point information (GRID)
- E Satellite imagery
- F Forecasts
- G Grid point information (GRID)
- H Grid point information (GRIB)
- I Observational data (Binary coded) – BUFR ← USED FOR BUFR
- J Forecast information (Binary coded) – BUFR
- K CREX
- L –
- M –
- N Notices
- O Oceanographic information (GRIB)
- P Pictorial information (Binary coded)
- Q Pictorial information regional (Binary coded)
- R –
- S Surface data
- T Satellite data
- U Upper-air data ← USED FOR ALPHA
- V National data
- W Warnings
- X GRID regional use
- Y GRIB regional use
- Z –

T_2 for alpha

T_1 = U Upper-air data ← USED FOR ALPHA

T_2 Designator	Data type	Code form (name)
A	Aircraft reports	FM 41 (CODAR), ICAO (AIREP)
D	Aircraft reports	FM 42 (AMDAR)
E	Upper-level pressure, temperature, humidity and wind (Part D)	FM 35 (TEMP)/FM 36 (TEMP SHIP)/ FM 38 (TEMP MOBIL)
F	Upper-level pressure, temperature, humidity and wind (Parts C and D) [National and bilateral option]	FM 35 (TEMP)/FM 36 (TEMP SHIP)/ FM 38 (TEMP MOBIL)
G	Upper wind (Part B)	FM 32 (PILOT)/FM 33 (PILOT SHIP)/ FM 34 (TEMP MOBIL)

} ← splitted

Table B3

Data type designator T_2 (when T_1 = I or J) ← BUFR

Instructions for the proper application of the data type designators

1. The designators specified in this table should be used to the greatest extent possible to indicate the type of data contained within the body of the BUFR bulletin.

2. Where more than one data type is contained in the bulletin, the designators for only one of the data types should be used.

3. When the table does not contain a suitable designator for the data type, an alphabetic designator which is not assigned in the table should be introduced and the WMO secretariat notified.

Designator	*Data type*
N	Satellite data
O	Oceanographic/limnographic (water property)
P	Pictorial
S	Surface/sea level
T	Text (plain language information)
U	Upper-air data
X	Other data types

T_2

A_1A_2 for ALPHA: (area), so not relevant,
T_2 informs FM42 (AMDAR) or FM41 (AIREP)

A_1 for BUFR, A_2: area

IU	A	Single level aircraft reports (automatic)	AMDAR
IU	A	Single level aircraft reports (manual)	AIREP/PIREP
IU	B	Single level balloon reports	n/a
IU	C	(used for single level satellite-derived reports – see Note 3)	SAREP/SATOB
IU	D	Dropsonde/Dropwindsondes	TEMP DROP
		....	
IU	O	Profiles of aircraft observations in ascending/ descending	AMDAR

} ← NOT splitted

← NOT USED

A_2

Table C3

Geographical area designator A_1 (when T_1 = D, G, H, O, P, Q, T, X or Y) and geographical area designator A_2 (when T_1 = I or J)

Instructions for the proper application of the geographical area designator

1. The designator specified in this table should be used to the greatest extent possible to indicate the geographical area of the data contained within the text of the bulletin.

2. Where the geographical area of the data does not correspond exactly with the designator, the designator for the area most approximating that of the data may be used.

3. When the table does not contain a suitable designator for the geographical area, an alphabetic designator which is not assigned in the table should be introduced and the WMO Secretariat notified.

Designator	*Geographical area*
A	0° – 90°W northern hemisphere
B	90°W –180° northern hemisphere
C	180° – 90°E northern hemisphere
D	90°E – 0° northern hemisphere
E	0° – 90°W tropical belt
F	90°W –180° tropical belt
G	180° – 90°E tropical belt
H	90°E – 0° tropical belt
I	0° – 90°W southern hemisphere
J	90°W –180° southern hemisphere
K	180° – 90°E southern hemisphere
L	90°E – 0° southern hemisphere
N	Northern hemisphere
S	Southern hemisphere
T	45°W –180° northern hemisphere
X	Global area (area not definable)