

WORLD METEOROLOGICAL ORGANIZATION

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**JOINT MEETING:  
CBS EXPERT TEAM ON AIRCRAFT BASED  
OBSERVATIONS  
(Third Session)  
AND  
AMDAR PANEL  
(Fourteenth Session)**

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## **AMDAR Documentation Training and Outreach**

KNMI/KLM AMDAR Business Case

*(Submitted by Frank Grooters, The Netherlands)*

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### **Summary and purpose of document**

Final assessment of the KNMI-KLM AMDAR Business Case for providing evidence of “added value” by the use of hourly AMDAR data for improving nowcasting and airline operations.

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### **ACTION PROPOSED**

1. The Panel is invited to note the information contained in the document.
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## BACKGROUND

1. The Aircraft Meteorological DATA Relay (AMDAR) measurements of wind and temperature taken by ascending and descending aircraft are an important source of regular upper-air information for forecasters. These measurements are used to produce vertical profiles of the atmosphere and also provide key measurement data for Numerical Weather Prediction (NWP) Models. AMDAR provides data on temperature, wind direction, wind speed and aircraft position (i.e. location, altitude). Most AMDAR profiles do not yet include any information on humidity, which is why they are referred to in this project as “AMDAR-”<sup>1</sup>.
2. In 2009, KLM requested the development of a business case for the use of AMDAR. KLM is interested in AMDAR, but would like to have a clearer idea of the return (“added value”) from using AMDAR data before making investments in financial and human resources.
3. The nowcasting improvements that can be achieved with AMDAR benefit a broader group than simply airline companies like KLM. Air Traffic Control (e.g. determination and distribution of available capacity) and the airport (e.g. aircraft handling and servicing) also benefit from improved weather forecasts and nowcasting. In addition, AMDAR data might help mitigate environmental problems in the aviation sector in the future (e.g. contrails and noise pollution).
4. The current status of “AMDAR-” at KLM is that 35 MD11s and Boeing 747s have been equipped with first-generation AMDAR software. Compared to other airlines, KLM charges relatively high transmission costs for the provision of AMDAR data, as a result of which only limited use is made of this service (two to four aircraft carry active equipment). A more recent software version – based on the standard definitions for AMDAR software – offers two significant advantages: aircraft measurements involve fewer number of bytes (lower transmission costs per measurement), and the software is designed for the possibility that a humidity sensor may be added at a later date.
5. The business case addresses translating the meteorological improvements in quality into the economic value gained from using AMDAR. In other words, what is gained in terms of the bottom line (cost-benefit analysis)? The final result of the business case will be a joint KNMI-KLM report presenting the findings and the conclusions.
6. The following questions were asked in advance about added value:
  - How is the extra profile information used?
  - What is the impact on nowcasting?
  - What is the medium-term impact on product quality (model, six hours)?
  - How important is the frequency with which data is measured (every hour, every three hours)?
  - How important is geographical area (size in particular)?
  - To what extent is the lack of humidity measurements a problem?
  - Might improvements in nowcasting affect the working methods at Air Traffic Control Netherlands (LVNL)?
7. The following agreements were made in the lead-up to the business case:
  - AMDAR data would be used in the Amsterdam FIR.
  - Only the Boeing 737 Next Generation aircraft (types Boeing 737-700 and Boeing 737-800) would be used.

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<sup>1</sup> Only a limited number of aircraft worldwide are fitted with humidity sensors (“AMDAR+”). The quality of the data recorded using these sensors is still being investigated. Fitting humidity sensors requires modifications to the aircraft’s fuselage and therefore involves lengthy approval procedures and considerable expenditure.

- AMDAR software (version 3) would be used; version 3 entails lower communication costs compared to previous versions.
  - KNMI would use the profiles in the operational environment for a period of one year.
  - The target would be 18 hourly profiles per day; the software would therefore be installed in 30 Boeing 737 NG aircraft.
  - The project would be limited to what are known as “AMDAR-”, i.e. air pressure, temperature and wind measurements, but no humidity measurements.
8. Four Project Sections were identified:
- Software installation and data provision
  - Provision of AMDAR data in the Weather Centre
  - Special Case Studies by aeronautical forecasters
  - Study on the impact of AMDAR data on models used at KNMI
9. The joint KNMI-KLM project started in November 2008. The work required to implement software, arrange the infrastructure and test data transmission was initiated in 2009. The business case itself was compiled between 22 December 2009 and December 2010.
10. **Summary of the conclusions:**
- The results of the business case show that the current AMDAR profiles have become an important source of information for forecasters.
  - Based on the model studies conducted to date, the extra AMDAR data does not make a major contribution to the model forecast.
  - KLM has stated that they see demonstrable added value in AMDAR in two key areas: improved safety and reduced costs.
11. **Recommendations derived from the Business Case:**
- *Continue with AMDAR Boeing 737 NG aircraft using the current approach;*
  - *If possible, equip more aircraft with the AMDAR software required;*
  - *Further model studies of the impact of AMDAR measurements;*
  - *Add reliable measurements of humidity.*
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