E-AMDAR (Aircraft Meteorological DAita Relay)
Wind Shear Conference, AEMET, Tenerife, 10 Junio 2016
Stewart Taylor, E-AMDAR Technical Coordinator
(on behalf of Steve Stringer, E-AMDAR Programme Manager)
Content of Presentation

- Overview of AMDAR and the E-AMDAR Programme.
- Why do we need aircraft observation data?
  - Impacts & benefits
- How do we get aircraft observations?
  - What is E-AMDAR?
- What airlines need to do to participate in E-AMDAR.
- Other ABO platforms
  - Mode-S EHS/MRAR data
  - Aireps/ADS-C data
  - AFIRS, TAMDAR
- ABO use in Wind Shear Forecasting
  - Some examples
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AMDAR: Network Coverage 1.

04-Dec-2017 00:00:00 -- 04-Dec-2017 23:59:59 (812638 obs loaded, 704134 in range, 33119 shown)

**NOAA / ESRL / GSD** Altitude: -1000 ft. to 45000 ft.

*Good w and T*
Global aircraft observations

Further information: http://www.wmo.int/pages/prog/www/GOS/ABO/
## Global Participating Airlines - by Programme

<table>
<thead>
<tr>
<th>Programme</th>
<th>Number</th>
<th>Airlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>6</td>
<td>Qantas Airways, JetConnect (Qantas), Jetstar Airways, Jetstar Asia, SkyTraders, Air Vanuatu</td>
</tr>
<tr>
<td>Canada</td>
<td>2</td>
<td>Air Canada Jazz, NAV Canada</td>
</tr>
<tr>
<td>China</td>
<td>2</td>
<td>China Southern Airlines, Shandong Airlines</td>
</tr>
<tr>
<td>E-AMDAR</td>
<td>14</td>
<td>Air France, Austrian Airlines, KLM, Lufthansa Passage, Lufthansa CityLine, Lufthansa Cargo, British Airways, Finnair, Scandinavian Airlines, easyJet, Thomas Cook Scandinavia, GermanWings, Eurowings, Aer Lingus</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>1</td>
<td>Cathay Pacific</td>
</tr>
<tr>
<td>China</td>
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<td></td>
</tr>
<tr>
<td>Japan</td>
<td>2</td>
<td>Air Nippon Airways, Japan Airlines</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1</td>
<td>Air New Zealand</td>
</tr>
<tr>
<td>Korea</td>
<td>2</td>
<td>Korean Air, Asiana Airlines</td>
</tr>
<tr>
<td>South Africa</td>
<td>1</td>
<td>South African Airways</td>
</tr>
<tr>
<td>USA</td>
<td>9</td>
<td>Alaska Airlines, American Airlines, Continental, Delta Airlines, Northwest Airlines, Federal Express, United Airlines, United Parcel Service (UPS), Southwest Airlines</td>
</tr>
</tbody>
</table>
EUMETNET

- **31 Members:** National Met. & Hydro. Services (NMHS)
- **3 Programmes**
  - Observations
  - Forecasting
  - Climate
- **Obs Programme**
  - E-AMDAR (*aircraft*)
  - E-ASAP (*ship Wx balloon*)
  - E-GVAP (*GNSS humidity*)
  - E-PROFILE (+ *lidar*)
  - E-SURFMAR (*ship, buoy*)
  - OPERA (*radar*)

Economic Interest Grouping, EIG EUMETNET: provides a framework to organise co-operative programmes between its Members in the various fields of basic meteorological activities. [www.eumetnet.eu](http://www.eumetnet.eu)
E-AMDAR: Network Coverage 1 - Global

<table>
<thead>
<tr>
<th>E-AMDAR</th>
<th>14</th>
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</thead>
<tbody>
<tr>
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<td></td>
</tr>
</tbody>
</table>
E-AMDAR: Network Coverage 2 - Europe
E-AMDAR - Why measure humidity?

- Humidity – is one of the most significant parameters for weather evolution. Highly variable in time & space.
- Improvements to aviation meteorological products can be expected in the areas of:
  - Convection, precipitation and fog (forming/clearance) forecasts
  - Reliability of short and long term weather prognoses
  - Nowcasting procedures for fog and icing prognoses.
- The improvements to aviation meteorological products will have affects on:
  - Flight safety
  - Airport operations/flow control (optimisation of the start/landing frequency)
Humidity Sensor hardware (WVSS-II)

- Near-Infrared Absorption Spectrometer based on Tunable Diode Laser
- Heated Inlet Hose
- Output: Water Vapor Mass Mixing Ratio
AMDAR Humidity Current Coverage

WVSS-II coverage over 7 day period with 9 sensors
AMDAR Humidity: Atmospheric Profiles

**AMDAR Profile 19.05.2016 12:47:37 UTC (ASC) Aircraft: EU0884 Airport: LONDON HEATHROW (STUEV)**

Dewpoint calculation Buck approach: Wagner & Prüß above freezing point, Murphy & Koop below freezing point.
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WMO Global Observing System

WMO – World Meteorological Organization (http://www.wmo.int)
Forecasting the weather

Customer

Forecaster consultant media presenters

local centre

Research and development

Operations Centre

Numerical models

Worldwide observations

Satellite, land, ship, aircraft, radar, radiosonde, buoy

International Emergency/Severe Weather Warnings
Defence
Civil Aviation

Global aviation forecasts
Forecasting the weather
Ops Centre
AM DAR Impact on Weather Prediction (NWP)

- Provides both better accuracy than satellites
- and higher temporal coverage than radiosondes
- With improved horizontal coverage and water vapour – Impacts will be even greater.

When used together, AMDAR Wind and Temperature observations have the fourth largest impact of any observation type.

Note that both Research (~20%) and Operational (~80%) Satellite Sensors contribute.
ABO Impact on Weather Prediction

There are 3 elements of the Aircraft observing system which make it especially valuable:

- wind and temperature data are similar in data quality to radiosondes;
- can provide fine detailed structure within the vertical profiles;
- profiles can be produced every 3-hours (or much less) at many airports.

Forecasters use the data to improve forecasts of:

- Surface and upper air forecasts of wind and temperature;
- Thunderstorm genesis, location and severity;
- Wind shear location and intensity;
- Low cloud formation, location and duration;
- Fog formation, location and duration;
- Precipitation amounts and rates.
Benefits of Aircraft Data (to Meteorology and to the Aviation Industry)

Data Use
- Use in Numerical Weather Prediction Models
- Use in Forecast Applications
- Use in Climate Applications
- Use in Verification of Forecast Products

Benefit to Airline Operations
- Impact of Improved Weather Forecast Skill on Airline Operations
- Improved Flight Operations*
- Improved Safety
- Operational Cost Savings*
- Aircraft Sensor and System Monitoring

*South African Airways example will be provided.
Benefits to Aviation


- Improved and more accurate weather forecasts, products and diagnostics and aircraft sensor performance monitoring for the aviation industry ultimately lead to significant cost savings to airlines and safer flight operations.
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Aircraft Based Observations

Current & planned utilisation from as many aircraft data sources as possible

...including:

- AMDAR
- Mode-S (EHS & MRAR)
- ADS-C (via RC & SITA)
- Satellite ADS-B
- 3rd Party data (TAMDAR/AFIRS/others)
- Satellite IP data
What is AMDAR ?

**AMDAR** (Aircraft Meteorological Data Relay)

- Automated collection and transmission of various parameters using existing aircraft sensors and airline infrastructure:
  - Height (pressure derived)
  - Temperature
  - Wind speed
  - Wind direction

Additional parameters potential
  - Turbulence
  - Icing
  - Humidity
AMDAR observations

- AMDAR is a collaborative programme between Airlines and National Meteorological Services
- From aircraft systems, meteorological parameters are provided in real time via ACARS (Aircraft Communications Addressing and Reporting System):
AMDAAR observations

- TAT probes (temperature)
- Pitot-static tubes (pressure)
AMDAR observations

- AMDAR data can be reported in all phases of flight - series of observations at a height, latitude and longitude forming a profile, similar to a radiosonde

- AMDAR reporting can be triggered by time or pressure – dependant on software/avionics platforms installed on the airlines

- Reported observation resolution can be configured to meet specific requirements (i.e. cost saving or Continuous Descent Approach)
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1. AMDAR Software

An example of a typical Onboard AMDAR System is depicted in the figure below.

In reality, the Onboard AMDAR System is a combination of existing sensors and systems on the aircraft, combined with the AMDAR Onboard Software or AMDAR software application.
1. AMDAR Software

How do we* know if you have the right software?

• Once airline identified for AMDAR integration, we initiate discussions with airline and NMHS representatives,

• An avionics questionnaire is given to airline.

• This provides information on whether airlines are AMDAR capable and level of development that may be required.

* WMO, NMHS or regional collaboration
1. AMDAR Software


Example of Honeywell AMDAR compatible hardware/AOC

<table>
<thead>
<tr>
<th>Product name</th>
<th>HW part number</th>
<th>Core software PN</th>
<th>AOC/application PN</th>
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</thead>
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<tr>
<td>ACARS</td>
<td>965-0728-xxx</td>
<td>Note 1</td>
<td>998-1375-508 or newer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Note 2</td>
</tr>
<tr>
<td>CMU</td>
<td>965-0758-xxx</td>
<td>Note 1</td>
<td>998-2141-509 or newer</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Notes 3, 4</td>
</tr>
<tr>
<td>ATSU</td>
<td>Any HPS compatible with the AOC is acceptable</td>
<td>Note 5</td>
<td>998-2459-505 or 998-2794-501 or newer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Note 4</td>
</tr>
</tbody>
</table>
1. AMDAR Software

http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/resources/AMDAR_Standards.html

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEW</strong> AMDAR Onboard Software Functional Requirements Specification (AOSFRS), Version 1.1 (CIMO, IOM Report No. 115)</td>
<td>This specification provides the primary WMO meteorological-based specification for AMDAR onboard software.</td>
</tr>
<tr>
<td></td>
<td>The AOSFRS defines the recommended formats for AMDAR data uplink and downlink for ACARS applications of AMDAR onboard software. This specification will be consistent with and provide the functional requirements for the AEEC 620-8 Meteorological Report Version 6.</td>
</tr>
<tr>
<td></td>
<td>AOSFRS Version 1.1 is an update of version 1.0 and has the following primary elements and additions:</td>
</tr>
<tr>
<td></td>
<td>▪ Contains several additional recommended downlink and uplink formats (see Appendix A) that will provide consistency with the AEEC ARINC 620 Meterological Report Version 6 (ARINC 620-8)</td>
</tr>
<tr>
<td></td>
<td>▪ Several extensions have been made to appendices to provide further information and clarity for applications developers.</td>
</tr>
<tr>
<td></td>
<td>▪ Several corrections have been made to various sections. Changes made are documented within Appendix H, AOSFRS Version Control.</td>
</tr>
<tr>
<td></td>
<td>The AOSFRS is published and will be maintained as a CIMO, Instruments and Observing Methods (IOM) technical report.</td>
</tr>
</tbody>
</table>

This document is also available from the WMO FTP Website here.
1. AMDAR Software

Once we have AMDAR developed on aircraft, we carry out testing.

- Airline generates test WXM messages
- Routed to data processing system and message content quality control
- Airline then integrated into data processing system
1. AMDAR Software

<table>
<thead>
<tr>
<th>WID</th>
<th>Aircraft</th>
<th>Phase</th>
<th>Time</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Height (m)</th>
<th>AirTemp (K)</th>
<th>WindDir (degs)</th>
<th>WindSpd (m/s)</th>
<th>Turb</th>
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<tbody>
<tr>
<td>G-EZOG</td>
<td>ASC</td>
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<td>40:53:30N</td>
<td>014:17:48E</td>
<td>101</td>
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<td>G-EZOG</td>
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<td>G-EZOG</td>
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<td>014:17:24E</td>
<td>454</td>
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<td>278</td>
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<td>5.7</td>
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<td>19:11:00</td>
<td>40:51:06E</td>
<td>014:17:00E</td>
<td>728</td>
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<td>272</td>
<td>5.7</td>
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<tr>
<td>G-EZOG</td>
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<td>278.8</td>
<td>306</td>
<td>7.2</td>
<td>/</td>
<td></td>
</tr>
</tbody>
</table>
2. Stakeholders

- **Airlines:** Identify appropriate focal points e.g. within datalink, operations/dispatch and IT departments.
- **NMHSs:** As with the airline, identify focal points to capture national meteorological requirements – this has the advantage of “speaking the language”!
- **DSPs:** In addition to software, the airline provides information on their data service provider – we have good contacts with both Rockwell Collins (ARINC) and SITA.
- **Avionics Vendors:** Good relations with Rockwell, Honeywell, Teledyne and others (AMDAR representation at Avionics forums e.g. AEEC DLUF)
2. Stakeholders

• **Aviation Industry:** Collaboration with identified organisations;
  – IATA, utilise their contacts with member airlines to assist with technical aspects,
  – ICAO for ADS and policy issues,
  – AEEC for industry standards (DataLink Users Forum etc)

• **WMO:** Use of experts within the ET-ABO/ET-AO;
  – assistance with software issues, implementation of AMDAR, development of a National (or regional) Programme,
  – Relationships with DSPs and avionics vendors.
Benefits for regional collaboration.

The immediate benefits are:

Shared costs and development of infrastructure

- NMHSs, airlines, agencies/stakeholders can work together to develop and manage data in their region.

The following points have all been achieved in current Regional Programmes, technical support can be provided.

- Development of data processing system,
- Development of optimisation system (and QEv),
- Negotiations on data costs with participating airlines,
  - The more airlines, the greater potential for data volumes and associated “tiered” pricing,
- NMHS combined voice in the region – assists in discussions with airlines.
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Mode-S System

- **Primary radars**
  - a pulse is reflected back by the aircraft, enabling its position to be computed

- **Secondary radar systems**
  - transponder on board the aircraft transmits its identity, as well as the aircraft’s altitude

- **Mode-S**
  - selective communication between airframe and ground station (possibility to transmit various 56-bit data registers, up to 5 for a standard system).
### Types of Mode-S Meteorological data

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MODE-S MRAR</strong></td>
<td><strong>Meteorological routine air report</strong></td>
</tr>
<tr>
<td><strong>MODE-S EHS</strong></td>
<td><strong>Enhanced surveillance (report)</strong></td>
</tr>
</tbody>
</table>

#### Data

- **(BDS 4,4)** - met. routine air report
  - wind speed, direction, temperature, turbulence, humidity
- **(BDS 4,5)** - met. hazard report
  - turbulence, wind shear, microburst, icing
- **(BDS 4,0)** selected vertical intent
- **(BDS 5,0)** track and turn report
  - roll angle, true track angle and rate, ground speed and true air speed
- **(BDS 6,0)** heading and speed report
  - indicated air speed and mach, barometric altitude rate, magnetic heading

#### Type

- Direct data
- Indirect (temperature) data

#### Representation

- around 5% of all Mode-S equipped aircraft (depends on the transponder configuration)
- all Mode-S equipped aircraft
Aircraft Based Observing with Mode-S Enhanced Surveillance (EHS)

- Huge potential to supplement E-AMDaR data at some airport locations.
- KNMI developing a European Meteorological Aircraft Derived Data Centre (EMADDC) – Operational in 2019.
- Business case for Mode-S (E-ADD) data to be included in E-ABO Programme – from 2020

*UK Met Office Mode-S operational coverage, 2018*
Aircraft Based Observing with Mode-S Enhanced Surveillance (EHS)

- Example of 10-minute wind charts derived from Mode-S EHS (E-ADD) data

10 min averaged winds around Gatwick, latest wind 2016-09-13 12:30:00 UTC
Potential for Mode-S EHS coverage in Europe

Current Mode-S Interrogator Code Allocations (dd. 28/08/2015)
ADS-C

• uses the same aircraft systems to transmit - aircraft position, altitude, speed, elements of navigational intent and meteorological data.

• Transmits data to one or more specific Air Traffic Services Unit (ATSU) or AOC facilities for surveillance and/or route conformance monitoring.

• Data is generated in response to a request within the terms of the ADS contract held by the ground system.
ADS-C

• This contract identifies;
  – the types of information and the conditions under which reports are to be sent by the aircraft.
  – Some types of information are included in every report, while other types are provided only if specified in an ADS contract request.
  – The aircraft can also send ADS-C emergency reports to any ATSU that has an ADS contract with the aircraft.
5.3 Routine aircraft observations — designation

5.3.1 Recommendation.— When air-ground data link is used and automatic dependent surveillance (ADS) or secondary surveillance radar (SSR) Mode S is being applied, automated routine observations should be made every 15 minutes during the en-route phase and every 30 seconds during the climb-out phase for the first 10 minutes of the flight.
ADS-C

- NOAA and Rockwell Collins have a contract to receive and process all ADS-C data (from Rockwell customers),

- Prior to this arrangement none or very little QC was done on the data – now we have all RC data QC’d (similar to AMDAR data processes)
  - this has identified some data issues e.g. aircraft type bias and wind errors.
# AIREP/ADS

## Levels 100-SFC hPa

### April 2018

Average number of observations decoded in 24-hour periods = 29737

|   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 90|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 60|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 30|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

- The highlighted cells indicate a specific pattern or data point of interest in the grid.
• Discussions ongoing with SITAONAIR and E-AMDAR to try and implement similar arrangement to NOAA & Rockwell Collins,
• Currently looking at data processing options;
  – SITAONAIR address ADS-C data to E-AMDAR processing system for routing to GTS/WIS and NOAA carry out QC as with other ABO data.
AFIRS

- Real-Time Engine Exceedances
- Engine Trending
- Live FDR Streaming
- Satcom Voice/Text Messaging
- Global Flight Tracking
- ACARS Over Iridium
- Fuel Management
- Real-Time Airframe Exceedances
AFIRS

FLYHT is a leading provider of;
Iridium satellite communications,
Global flight tracking,
Live FDR streaming capability
Aircraft health monitoring solutions.
The AFIRS is specifically designed to;
Enhance operational control,
Improve dispatch reliability and safety
Reduce operational costs.
More than 70 customers (airlines, OEMs) worldwide
AFIRS

• So how does it work?
  – AFIRS is an Iridium based SATCOM device installed on the aircraft,
    – Uses proprietary software to acquire and transmit aircraft data to the ground in near real time,
    – Data is processed and distributed to customer via FLYHT’s ground server network (UpTime),
    – AFIRS also has expandable interface capabilities allowing connection to various aircraft systems.
<table>
<thead>
<tr>
<th>TCCA</th>
<th>FAA</th>
<th>EASA</th>
<th>CAAC</th>
<th>ANAC</th>
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<td>Bombardier CRJ 100, 200, 440</td>
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<td>Bombardier CRJ -700, 900</td>
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<td>McDonnell Douglas DC-10 (KC-10 military)</td>
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<td>McDonnell Douglas MD-83</td>
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<td>Hawker Beechcraft -750, 800XP, 850XP, 900XP</td>
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<td>Viking Air DHC -7 (LSTC)</td>
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<td>Embraer EMB 190</td>
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<td>A</td>
<td>Embraer Legacy 600 and EMB – 135/145</td>
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</table>
...from 3rd party suppliers

Future plans are to utilise as many aircraft data sources as possible. 
...to include:

- AMDAR
- Mode-S  
  (EHS & MRAR)
- ADS-C  
  (via RC & SITA)
- Satellite ADS-B
- 3rd Party data  
  (TAMDAR/AFIRS/others)
- Satellite IP data
Content of Presentation

• Overview of AMDAR and the E-AMDAR Programme.
• Why do we need aircraft observation data?
  ➢ Impacts & benefits
• How do we get aircraft observations?
  ➢ What is E-AMDAR?
• What airlines need to do to participate in E-AMDAR.
• Other ABO platforms
  ➢ Mode-S EHS/MRAR data
  ➢ Aireps/ADS-C data
  ➢ AFIRS, TAMDAR
• ABO use in Wind Shear Forecasting
  ➢ Some examples
E-AMDAR: Network Coverage 3 - Canaries

Canary Islands destinations served well by EZY fleets. If “hourly” data requested other E-AMDAR airlines would be recorded as well.

1 week snapshot AMDAR data by altitude.
E-AMDAR Wind charts
E-AMDAR Wind charts
Low Level Wind Shear

- AMDAR are ideal for identifying and forecasting LLWS at airports, and to forecast turbulence over broad areas.

- The data are used frequently by NWS meteorologists, and sometimes mentioned in forecast discussions.

- Here are a few examples from Chicago, Anchorage, and Honolulu.
Area Forecast Discussion
National Weather Service
Chicago/Romeoville, IL
535 PM CST Fri Jan 19 2018

.AVIATION...
The main weather concerns tonight will be LLWS once again. Southwest winds continue to gust up around 22 KT at the surface early this evening, but these winds should gradually ease through the evening. Given that recent AMDAR soundings out of ORD are already indicating around 50KT of wind around 2500 FT AGL, LLWS shear will continue to be an issue at least through around 1 am tonight when the winds aloft should ease.

Ascent sounding from O’Hare airport shows Southwest winds at 55 knots at 2300’ MSL.
Low Level Wind Shear at Anchorage

The location of the airport near Cook Inlet, the Gulf of Alaska and mountains often create conditions conducive for low level wind shear and turbulence.

AMDAR is very important to the Anchorage WFO, CWSU and AAWU as the twice daily radiosonde does not provide sufficient temporal resolution to monitor low level wind shear.
Wind Shear - Anchorage

• The Alaska Aviation Weather Unit used AMDAR on September 19, 2012 to monitor the lowering of strong southeast winds aloft, creating over 60kts of wind shear in the lowest 2000 feet.

• The data increased forecaster confidence regarding the severity of the threat prior to coordinating with the FAA.
Notice how the strong winds aloft increase in velocity and lower from 4,500’ at 01:38am to 3,000’ at 05:51am to 2,200’ at 08:34am. Also notice the directional shear.

*Takeoffs on 25 or 33 will go from headwind to tailwind.*
Wind Shear - Anchorage

Update, 3:30 p.m.: Alaska Airlines spokeswoman Bobbie Egan said many flights bound for Anchorage today have been diverted to Fairbanks as they wait out the storm.

The flights - two from Seattle, one from Barrow, one from Nome and one from Chicago - had a total of about 500 passengers on board.

"It's currently not safe to fly into or out of Anchorage International Airport," she said.

Many cargo jets destined for Anchorage were diverted to Fairbanks on Sept 19, 2012
Low Level Turbulence at Honolulu

Area Forecast Discussion
National Weather Service Honolulu HI
355 PM HST Fri Oct 21 2016

.AVIATION...
Radar VAD wind profiles and AMDAR soundings from Honolulu/Lihue/Kahului show 30 knots of wind within a few thousand feet of the surface. Inversions remain weak and elevated, but winds this strong should still support turbulence in the lee of the mountains and an AIRMET is in effect for moderate low-level turbulence. The turbulence threat will increase tonight as the inversion lowers and low-level winds remain just as strong.

Ascent sounding from Honolulu shows northeast winds at 31 knots at 1600’ MSL and nearly calm winds at the surface.
Canary Islands – Strong Winds

- Wind shear and high winds velocities produced flight delays and diversions.

**CANARIES CHAOS** Thousands of Brits left stranded at airports as powerful storm batters the Canary Islands

Heavy rain and gale force winds have caused at least 34 flights from Tenerife, Lanzarote and La Palma to be grounded or diverted

By John Lucas
26th February 2018, 226 am | Updated: 26th February 2018, 11:07 am

THOUSANDS of Brits faced travel chaos last night after a powerful storm battered the Canary Islands.

Rain and high winds caused at least 34 flights from Tenerife, Lanzarote and La Palma to be grounded or diverted, leaving holidaymakers stranded.
Descent Sounding into Las Palmas

Significant speed and directional wind shear
Hong Kong Observatory, use of AMDAR at HKIA

• The potential of using near real-time AMDAR ascent/descent data to support low-level wind shear alerting,

• Preliminary results indicate that the AMDAR temperature profiles are able to reveal low-level inversions and low-level jets.

• They usefully supplement the radiosonde ascent profiles in the forecasting of wind shear associated with waves trapped by low-level inversion and with low-level jets.”

Shun (2002), Doc 6(4), CAeM-XII
Hong Kong Observatory, use of AMDAR at HKIA

• Observation:
• Apart from windy situation, wind shear may also occur over the airport in lighter wind conditions, when the atmosphere is stable (e.g. presence of a low-level temperature inversion).
• In fact, wind shear has been known to occur even when winds of less than 15 knots blow across the hills on Lantau Island, in the spring months.

Reference: HKO (2010), Wind shear and Turbulence in Hong Kong – information for pilots
In 2005, experiments were conducted in applying the AMDAR observations for low-level wind shear reporting at HKIA.

Wind shear experienced by aircraft during the take-off phase was computed from the high-resolution AMDAR reports received and compared with the Flight Data Recorder (FDR) wind data at 1-second resolution recorder on the aircraft. The AMDAR wind reports showed good agreement with the FDR data in respect of the altitude and the headwind (along the runway direction).

In particular, AMDAR data at 4-second resolution was able to capture the significant headwind variations associated with wind shear events, even though 1-second data would be more useful to capture wind shear events with temporal scale of a few seconds.
Hong Kong Observatory, use of AMDAR at HKIA

Algorithms to identify changes of headwind of 15 knots or more in the AMDAR wind observations from ascending aircraft had been developed to automatically generate an automatic wind shear report. Since 17 August 2006, such AMDAR wind shear reports had been included in the wind shear warnings on the Automatic Terminal Information Service (ATIS) for HKIA with the same status as the pilot wind shear reports.

- To enhance the temporal resolution of AMDAR wind data, data during the ascent part 1 are recorded at an interval of every 3 seconds.
Case study – Severe Typhoon Khanun on 15 OCT 2017

Wind measurements by an aircraft in Hong Kong, China
AMDAR programme around 10:22 UTC

<table>
<thead>
<tr>
<th>Height (ft)</th>
<th>Wind speed (kt)</th>
<th>Wind direction (deg)</th>
<th>Headwind component (kt)</th>
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<tbody>
<tr>
<td>470</td>
<td>5</td>
<td>92</td>
<td>4.7</td>
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<tr>
<td>580</td>
<td>6</td>
<td>88</td>
<td>5.8</td>
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<td>710</td>
<td>8</td>
<td>84</td>
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<td>1180</td>
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<tr>
<td>1630</td>
<td>27</td>
<td>50</td>
<td>24.9</td>
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</table>

A windshear report from a pilot received at 10:27 UTC confirming presence, location and magnitude of windshear.
E-AMDAR
¿Preguntas?
Contact Details

Stewart Taylor
E-AMDAR Technical Co-ordinator
GIE/EIG EUMETNET

E-AMDAR Technical Co-ordinator
Met Office
Fitzroy Road
Exeter
DEVON EX1 3PB
United Kingdom
Tel: +44 (0) 7753 880 518
Fax: +44 (0)1392 88 5681
E-mail: stewart.taylor@metoffice.gov.uk
Web: www.eumetnet.eu

GIE EUMETNET Secretariat
c/o L’Institut Royal Météorologique de Belgique
Avenue Circulaire 3
1180 Bruxelles, Belgique
Tel: +32 (0)2 373 05 18
Fax: +32 (0)2 890 98 58
Email: info@eumetnet.eu
Web: www.eumetnet.eu