Airborne In Situ Weather Observations

Presented to: Friends and Partners of Aviation Weather

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Airborne In Situ Weather Observations

• Overview
  – Terminology
  – US program/MDCRS

• FAA Turbulence Detection/EDR Program
  – Delta Airlines EDR Proof of Concept Demo
  – Turbulence Forecasting/GTG2 Development

• Water Vapor Sensing System II

• Future Plans
Airborne In Situ Weather Observations

Terminology

- **AMDAR** – Aircraft Meteorological Data and Relay: A WMO-sanctioned international program of nations with air carriers that provide automated weather observations.


- **ACARS** - Aircraft Communications, Addressing, and Reporting System: The name of a datalink service provided by Aeronautical Radio, Inc. (ARINC) that sends information between aircraft and ground stations.

- **TAMDAR** - Tropospheric Airborne Meteorological Data Reporting: “AirDat's network of patented airborne sensors…which provide a continuous stream of real time observations….”  (http://www.airdat.com./index.php)
Airborne In Situ Weather Observations

MDCRS

• Participants
  – AAL, SWA, FedEx, UAL, UPS, DAL/NWA
  – NOAA, FAA

• > 1500 reporting aircraft

• > 100,000 observations/day, >3 million/month

• Much more cost effective than individual radiosonde soundings
MDCRS Optimization

Spatial Coverage

SFC-FL150

FL150-400

Temporal Coverage

• The selection of specific aircraft to obtain the data required to meet the government’s forecasting needs while reducing redundant or unnecessary observations that increase communications and processing costs.
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Turbulence Detection/EDR Program

• FAA Aviation Weather Research Program developed EDR algorithms
• Current Deployment
  – UAL: Accelerometer-based algorithm on ~19 737’s and ~97 757’s
  – DAL: Improved winds-based algorithm on ~80 737-700/800’s
  – SWA: Winds-based algorithm currently on 8 737-700’s for testing. Planned 2010 deployment on 340 total aircraft.
• UAL and DAL EDR data displayed on Aviation Digital Data Service (ADDS) In Situ Turbulence Viewer
  – Access restricted to participating airlines at this time
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Delta Airlines EDR Proof of Concept Demo

• Goals
  – To document how EDR usage results in increased airspace capacity by minimizing unnecessary deviations around turbulence
  – To gain experience with the data integration and dissemination issues that the NextGen era will present
  – To verify and document improvements in airline operations

• Demo kick-off in May 09, operational data collection begun Sep 09

• Anecdotal evidence of positive impact on NAS capacity and flight ops
  – 10/6/09: B757 experienced choppy conditions. Pilot requested change in altitude, ATC provided recommendation. EDR data showed smooth air 4000 ft closer to target altitude than ATC recommendation, dispatcher relayed to pilot. Result - 30 minutes shorter time off target altitude
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GTG2 Development

- GTG2 incorporates EDR observations
- GTG2 expected operational at AWC early 2010
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Water Vapor Sensing System II

- Sensor re-design in 2008
- UPS: Replacement of old sensors on 757s on-going, ~5 new sensors flying
- SWA: Awaiting certification to proceed with implementation
- Field test scheduled for late October 2009
- Long-range goal – 400 sensors flying by 2016
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The Future

• In Situ Strategy Plan is work in progress
  – MDCRS Management Team
    • Government (FAA/NOAA)
    • Airlines, Aviation Industry

• Issues
  – Optimization
  – Goal of free and open data access
  – Standardization of formats
  – Accommodation of new data types and sources
  – Funding (government vs. industry)
• Back Up Slides
ADDS In Situ EDR Viewer
EDR Viewer Flight Path Tool
# DAL Dispatch EDR Feedback Form

<table>
<thead>
<tr>
<th>Flight #/ Aircraft type</th>
<th>Date/Time</th>
<th>Target Altitude</th>
<th>Flt Altitude Change</th>
<th>Distance/time off alt. &amp; Comments</th>
<th>Impact of EDR on altitude change</th>
</tr>
</thead>
</table>
| Flt# _______ A/C Type  | Date: ____ Time: ____ | b Pilot requested change  b Pilot reported change  b Flight plan change by OCC  b Change observed by OCC | Requested alt. change not needed after EDR info reviewed  
Alt. change closer to target alt. (How much closer? _______ ft)  
Shorter time/distance off altitude (How much shorter? _______ )  
Alt. change during flight planning  
EDR info had no impact on altitude change. |
EDR Wake Vortex Incident
### Projected GTG releases – next 7 years (updated)

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<th>Version</th>
<th>Capabilities</th>
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<td>RUC20</td>
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<td>GTG2</td>
<td>Improved GTG1</td>
<td>Early 2010</td>
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<td>Mid levels</td>
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<td>GTG3a</td>
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<td>13 km WRF RR (pre-impl 08, final early 10)</td>
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<td>All altitudes</td>
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<td>&gt; 10,000 ft</td>
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<td>Improved GTG3b</td>
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<td>Ensembles/Probabilistic forecasts</td>
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<td>out-of-cloud turb (CIT) forecasts</td>
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<td>GTG5</td>
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<tr>
<td>GTG/TFO?</td>
<td>Global – GFS based</td>
<td>FY16</td>
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**NextGen IOC versions**

MDCRS Coverage

07-Oct-2009 14:00:00 -- 08-Oct-2009 01:59:59 (160924 obs loaded, 62214 in range, 18770 shown)

NOAA / ESRL / GSD  Altitude: -1000 ft. to 45000 ft. all MDCRS
ACARS Coverage

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

Aircraft loaded: 1500 regular, 0 g, 82 edr, 4 rh, 101 v0, 0 ice, 123 TAMDAR
Aircraft loaded: 1250 regular, 0 g, 80 edr, 4 rh, 56 v0, 0 ice, 115 TAMDAR
Aircraft loaded: 0 regular, 0 g, 90 edr, 0 rh, 0 v0, 0 ice, 115 TAMDAR
MDCRS Temporal Coverage

ACARS - Total Observations by Day
May 13 to June 2, 2001 (Conus)
Airborne In Situ Weather Observations
Current Use

**Integrated Terminal Weather System (ITWS)**

- Fully automated, integrated terminal weather information system
- Uses sophisticated algorithms to integrate data from FAA and NWS sensors, radars, weather models, and *from aircraft in flight*
- Users: FAA (TRACON, ATCT, ARTCC, ATCSCC), airport authorities, airline dispatch offices