Airline Perspective on Turbulence

Evaluation of Models, Automated Reports and Weather Delivery
What is Turbulence?

- A Potential Disruptor of:
  - Safety
  - Crew and passenger experience
  - Efficiency/Emissions
  - Airspace Capacity
- Solution for one might adversely impact other factors

IMPROVED WEATHER DATA CAN DELIVER BETTER SOLUTIONS FOR ALL DRIVERS
Delta’s History

• Delta’s Role: 12+ Years with both NASA & FAA
  – Aircraft Installation of Automated Turbulence Reports
  – Use of Reports in the Ops. Control Center
  – 2013/14 FAA demo in the Cockpit (Windows OS)
    • Graphical Turbulence Guidance (GTG3) Forecast Model
    • Eddy Dissipation Reports (EDR)
  – Threat Based Weather App launched in 2016 (Windows OS)
  – Started Nowcast validation in 2017 (Windows OS)

• Delta’s Current State
  – iOS version launched June 5, 2018
  – Unique concept for delivering Weather to the Cockpit
Turbulence – Ambiguity vs Objectivity

• Antiquated Processes

• Wright Brothers PIREPS
  – ATC Chat Room
  – Subjective inconsistent reports

• Convergence of Events for Paradigm shift
  – Objective Data – Automated turbulence reports (EDR)
  – Models using multiple sources of data, e.g. EDR, NEXRAD
  – Tablets and connectivity for delivery to the cockpit
Types of automated turbulence reports

- FAA NCAR Developed Eddy Dissipation Rate (EDR) - Open
- WSI Accelerometer Based Conversion to EDR – Proprietary
- Panasonic Horizontal Wind Based EDR - Proprietary
- Boeing (NCAR) & Airbus (???)
- Other solutions – iPad accelerometer based
- RTCA Effort
  - Guidelines not Standards
  - First Step
What is Eddy Dissipation Rate (EDR)?

Sea State versus Vehicle Response

Little boat vs. Big Boat
• Data restrictions – Delta is concerned by any vendor’s potential to gain a monopoly on weather data particularly turbulence reports.
• Potential Sharing Solutions - IATA as a repository for open source data to be stored and made available to the industry members.
• Compatibility - Delta is working with the FAA to facilitate an operational correlation for turbulence reporting metric (EDR).
• Interim agreements – Peer to Peer
Turbulence Models

- **NCAR Graphical Turbulence Guidance (GTG)**
  - Forecast product – Updates every hour
  - Route Planning
- **NCAR Domestic Nowcast – In Validation**
  - Merged with short term GTG
  - NEXTRAD Convective inputs
  - Turbulence reports
- **NCAR Global Nowcast – In Development**
Next Steps?

- Data - Availability and compatibility
- Connection to the cockpit - Band width and reliability
- Weather product selection
  - Many choices for multiple categories of threats
  - Delta’s agnostic approach
- Distribution methodology – Quiet Dark Cockpit
- Coordination with Other Departments
  - AOC, Flight Ops, Safety, In Flight Service
  - Same data source with possible different presentations
Status Report?

• Injuries are trending down
  – Process improvements being implemented
  – Crew behavior changes required
  – Driven by confidence in tools

• Efficiencies/Emissions
  – Positive trends
  – Altitude decisions become more intuitive

• ATC Impact
  – Reduced number of inquires needed for turbulence info
  – More data points reduces calls and altitude changes
Delta Pilot Feedback

• “Overall, this tool was awesome!! We were like magicians of the sky as we seemed to always know where the best rides were and when to turn on the seatbelt sign.”
• “In summary, this was my first time using the weather app but it was great. Not just from a comfort standpoint, but also safety. I am highly impressed and excited to use it again in the future.”
• “The app worked GREAT on the previous three days and proved its worth several times. I LOVE the product!!! Your team is amazing.”
• “Functionality was spot on.....used it the entire trans con flight both ways and the app was spot on every time. We never even needed to query the controller about the "rides ahead"...we already knew them.”
• “Again, love the app, really think it can be a game changer for us.”
• “This is going to be one of the greatest aviation revolutions. Congrats.”
Be Wary of the Holy Grail

10 Different Weather Apps
Is this the Answer?
Teletype Weather with Decoder Ring

• FAUS42 KKCI 171745 FA2W MIAC FA 171745 SYNOPSIS AND VFR CLDS/WX SYNOPSIS VALID UNTIL 181200 CLDS/WX VALID UNTIL 180600...OTLK VALID 180600-181200 NC SC GA FL AND CSTL WTRS E OF 85W. SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN. TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS. NON MSL HGTS DENOTED BY AGL OR CIG. SYNOPSIS...CDFNT NRN ME. CDFNT SC CSTL WTRS WWD TO SRN GA. 06Z CDFNT GA CSTL WTRS TO EXTRM SWRN GA. 12Z CDFNT NERN ME-EXTRM NWRN PA. CDFNT NNRN FL CSTL WTRS TO FL PNHDL CSTL WTRS.

• What is “PY”?
Graphics?
Better or Worse?
Same Data

Terminal Aerodrome Forecast (TAF) plot for PREVAILING conditions valid at 1200 UTC 16 Jan 2014
Chart created using data no later than 1815 UTC 16 Jan 2014

Green (VFR) is good, and could be as low as 3000/5 mi.
Blue (MVFR) is sort of good, and could be as low as 1000/3mi
Red is not so good, and could be as low as 500/1mi.
Magneta is the worst and is anything less than 500/1mi.
Color Confusion - Is blue bad or good?
Color Confusion - 3 Examples

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Key enabler: Operator (Company) defined thresholds which drive operational decisions
Quiet Dark Cockpit Notification

Notification occurs when threat index is exceeded

What does integration really mean?
Lessons Learned

• Pilots are not meteorologists
• Weather compilation is not intuitive
• Information overload is common
• New technologies can work and be cost effective
• Delta Flight Weather Viewer is improving safety
• Outstanding Feedback from Crews - GAME CHANGER
• Education requirements need to be understood
Next Steps

• Say Goodbye to the Wright Brothers’ Expertise
• Maximize New Sensors and Technology
• Reduce confusion in Weather Delivery Systems
• Determine Weather Knowledge Requirements
• Embrace Digital Weather
Research Emphasis

• Focus on processes which identify threats

• Educational limitations in weather knowledge
  – Need to know vs. meteorology degree
  – Threat detection with digital tools

• Speed to market
  – EDR Correlation
  – Weather products i.e., Nowcast and Global Nowcast

• Facilitation of improved regulatory guidance