

The cockpit perspective on turbulence

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Overview

- Turbulence information, what do we do with it?
- Turbulence information needs
- Pilot and dispatcher training
- Weather Technology in the Cockpit (WTIC) information
- Summary

Turbulence information – what do we do with it?

There are only two things aircraft do in reaction to turbulence information:

- Change the trajectory of the aircraft
 - Horizontal or vertical
 - Flight plan - dispatcher
 - Tactical deviation – pilot in coordination with dispatch
- Prepare the cabin for turbulence
 - Seat belt sign “on”, passengers seated and belted-in
 - Flight attendants seated and strapped-in
 - Galley and cabin secured
 - How much notice determines how much preparation is accomplished

What happens when the cabin is not prepared for turbulence?

- Example of turbulence damage to aircraft



Turbulence – what information do we need, what will we do with it?

- Ideally – deterministic information on exactly where and when turbulence will be present
- Realistically - probabilistic information could be useful to
 - Adjust planned trajectory
 - Based on what is an acceptable risk level
 - However, we plan for an optimum flight, and any change costs \$\$\$
 - Adjust cabin service times, pre-planning for when it may be appropriate for all to be seated
 - Adjust cabin “preparation for landing” execution, doing it early when turbulence is possible during the descent

Turbulence alerting

- Alerting is critical to informing the pilot and dispatcher about short term immanent hazards
 - Pilots don't know what they don't know
 - Automated, simultaneous alert should go both to the cockpit and the dispatcher
- Tablets with graphical weather capability are great, but most do not include any monitoring or alerting functions
 - Alerts via ACARS/SATCOM text message could direct pilots to specific graphical products to look at on the tablet

Pilot and Dispatcher education

- What can we teach our pilots and dispatchers about turbulence, especially CIT?
- 98% of the time, in clear air, it's okay (light turbulence)
- How do we tell the 2% of the time when it's not okay?

Preventing Turbulence Injuries

Produced by United Airlines

September 2012



In Brief: This publication will examine Convectively Induced Turbulence (CIT), as it relates to reducing the probability of injury at United Airlines.

"Turbulence, the state of motion which, by its complexity, constitutes the outstanding difficulty in hydrodynamics"

Sir Graham Sutton in
The Challenge of the Atmosphere

What are the odds?

If you were to fly through a thunderstorm painting *red* on the radar, what are the chances you'd be hit hard by injury causing turbulence: 100% or 0%?

Of course, 100%, *if you actually did it*, but more likely 0% because we would never knowingly fly through a thunderstorm's radar return.

Now more realistically, what are the odds of "getting pounded" as you pick your way *around* strong thunderstorms?

Turbulence tactics and mitigation

- The three “C’s”
 - Communicate
 - How much time until we encounter turbulence?
 - Cabin preparation
 - Compliance
 - Compliance increases as our information about turbulence improves (less “crying wolf”)
- Survey of flights through potential areas of CIT shows
 - Passengers seated with seat belt sign on 83% of the time
 - Flight attendants seated 19% of the time

Weather Technology in the Cockpit (WTIC)

- WTIC is the capability to receive updated weather information, including graphics, via data link to the cockpit
 - Not a specific product, but a capability
 - Envisioned to include new products with time critical information that allows for the either turbulence avoidance or preparing the cabin for turbulence

WTIC information – how can it improve the system?

- There needs to be differentiation between WTIC capable aircraft and non-WTIC capable aircraft
 - If aircraft with WTIC information are treated the same as all others, the system won't change
 - Products delivered to the aircraft need to be tailored for in-flight use, and many do not exist today
 - Convective initiation product
 - Near-term GTG with information on CIT
 - Convective tops product
 - WTIC information needs to be supplemented with traffic flow management information (i.e. ATC sector loading)
- Possible Traffic Flow Management (TFM) differentiators:
 - Parallel Airspace Flow Programs (AFPs), one for WTIC capable with a higher transit rate (hence lower delays)
 - Relief from the requirement to strictly adhere to playbook routing

Summary

- Only two things we can do to mitigate turbulence
 - Change the aircraft trajectory
 - Prepare the cabin for turbulence
- Turbulence information needs
 - Deterministic vs. probabilistic
 - Alerting
- There needs to be a business case for equipping to receive WTIC information
 - Preferential Traffic Flow Management (TFM) initiatives for WTIC capable aircraft

Thank You!

