

Thoughts on turbulence

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Overview

- Turbulence information, what do we do with it?
- Turbulence information needs
- Is the turbulence forecast be good enough to create a “turbulence policy” around it? How can it be improved?
- 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?

- Ideally – deterministic information on exactly where and when turbulence will be present
- Realistically - probabilistic information can be used to
 - Adjust planned trajectory – both strategically (flight planning) and tactically (flight execution)
 - Strategic adjustment of flight path
 - Based on what is an acceptable risk level
 - However, we plan for an optimum flight, and any change costs \$\$\$
 - Horizontal adjustments cost more \$\$\$
 - Fuel can be added to the optimum horizontal trajectory to allow for “off optimum altitude” flying
 - Tactical adjustment of flight path
 - Vertical flight path adjustments, chasing the “smooth altitudes” (as defined by the “ATC chat room”)
 - Horizontal deviation around convection

Turbulence – what information do we need (2)?

- If the decision is made to not adjust the flight path, use turbulence reporting or forecasts to determine when to turn the seat belt sign “on” and have the flight attendants seated
 - 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 Policy

- Are turbulence forecasts good enough to create policies around them?
- Examples of possible turbulence policies:
 - Have the seat belt sign “on” whenever in an area where GTG forecasts light turbulence
 - What is the percentage of time that light turbulence is forecast and isn’t there?
 - Flight attendants must be seated, carts stowed, galleys picked-up whenever transiting an area where GTG forecasts moderate turbulence
- Challenge to the research community: How can we best improve turbulence forecasts
 - No missed encounters and minimal “over-forecasting”

Turbulence tactics and mitigation

- We emphasize to our pilots that there are three “C’s” to mitigate turbulence
 - Communicate (both with the flight attendants and passengers)
 - How much time until we encounter turbulence?
 - Cabin preparation
 - Compliance (both flight attendants and passengers)
 - 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

Summary

- Only two things we can do to mitigate turbulence
 - Change the aircraft trajectory
 - Prepare the cabin for turbulence
- Turbulence information needs
 - Strategic vs. tactical trajectory adjustments
 - When will the turbulence be encountered?
- Are turbulence reports and forecasts good enough so that policies can be created around them? How can turbulence forecasting be improved?

Thank You!

