The Preliminary Assessment of a Clear-Air Turbulence Product

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Background Ways CAT is Produced: - Eddies - Kelvin-Helmholtz Instability - Internal Gravity Wave Effects of CAT Indicators of CAT: - Jet Stream - Transverse Cirrus Bands

Pilot Report (PIREPS)

- Used to enhance flight safety
- Pilots report the occurrence of turbulence to the FAA and the FAA lets all other aircrafts know about this
- They are highly subjective
 - Size, structure and shape or aircraft
 - Experience of pilot

PIREP Codes

Code				
0	None			
1	Light			
2	Light-Moderate			
3	Moderate			
<u>4</u>	Moderate-Severe			
5	Severe			
6	Extreme			

DVSI algorithm

 DVSI, also known as the Turbulence Index (TI), is the product of resultant deformation (A) and vertical wind shear (B).

 $\frac{[(\delta u/\delta x - \delta v/\delta y)^2 + (\delta v/\delta x + \delta u/\delta y)^2]^{\frac{1}{2}} (\delta V/\delta z)}{A}$

Methods

Goal: To try to correlate the PIREPS to the turbulence index (unit less)

1. Collect images of forecasted CAT

- 2. Highlight notable regions
- 3. Collect data
- 4. Refine the data
- 5. Graph and correlate

Highlight Notable Regions



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Type of images

Satellite
Radar
Model Forecasted



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Fig.1: Image of forecasted CAT, point in Illinois removed

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Fig.2 Radar image, doubtful point in Illinois due to storm in the indicated radius

GOES-E Infrared Imagery

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Fig. 3 Satellite Image, doubtful point in Illinois due to storm in the indicated radius



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Fig.4: Image of forecasted CAT, point in Nebraska not removed

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Fig.5: Radar image, doubtful point in Nebraska is not affected by the storms

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Fig. 6 Satellite Image, doubtful point in Nebraska not removed



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Fig. 7 Image of forecasted CAT, points in Kentucky, Ohio, and Maryland



Fig. 8 Radar image of forecasted CAT, points in Kentucky, Ohio, and Maryland

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Fig. 9 Satellite image of forecasted CAT, points in Kentucky, Ohio, and Maryland

DVSI vs. PIREPS



Fig.10 The correlation between the DVSI and PIREPS after the removal of doubtful points

Types Of Aircraft Tested

E145

49 passengers
Travels at 833km/h,
Cruising altitude: 11278m

A320

162 passengers
Travels at 900km/h
Cruising altitude: 11,700m







Fig.11 The correlation between the DVSI and PIREPS specific to the aircraft type E145

A320



Fig.12 The correlation between the DVSI and PIREPS specific to the aircraft type A320

Conclusions

Goal: To try to correlate the PIREPS to the turbulence index (unit less)

- The turbulence index and the PIREPS did not have a high correlation factor
- Type of aircraft does not have an affect
- Aircrafts using this product are content because understand that the forecasted TI is relative
- Best used in the combination of all three images
- Product tends to overestimate
- Only a primary assessment, further testing is needed



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