Weather Technology in the Cockpit (WTIC)
Shortfall Analysis of Weather Information in Remote Airspace
Friends and Partners of Aviation Weather Summer Meeting

Tim Myers – Metron Aviation

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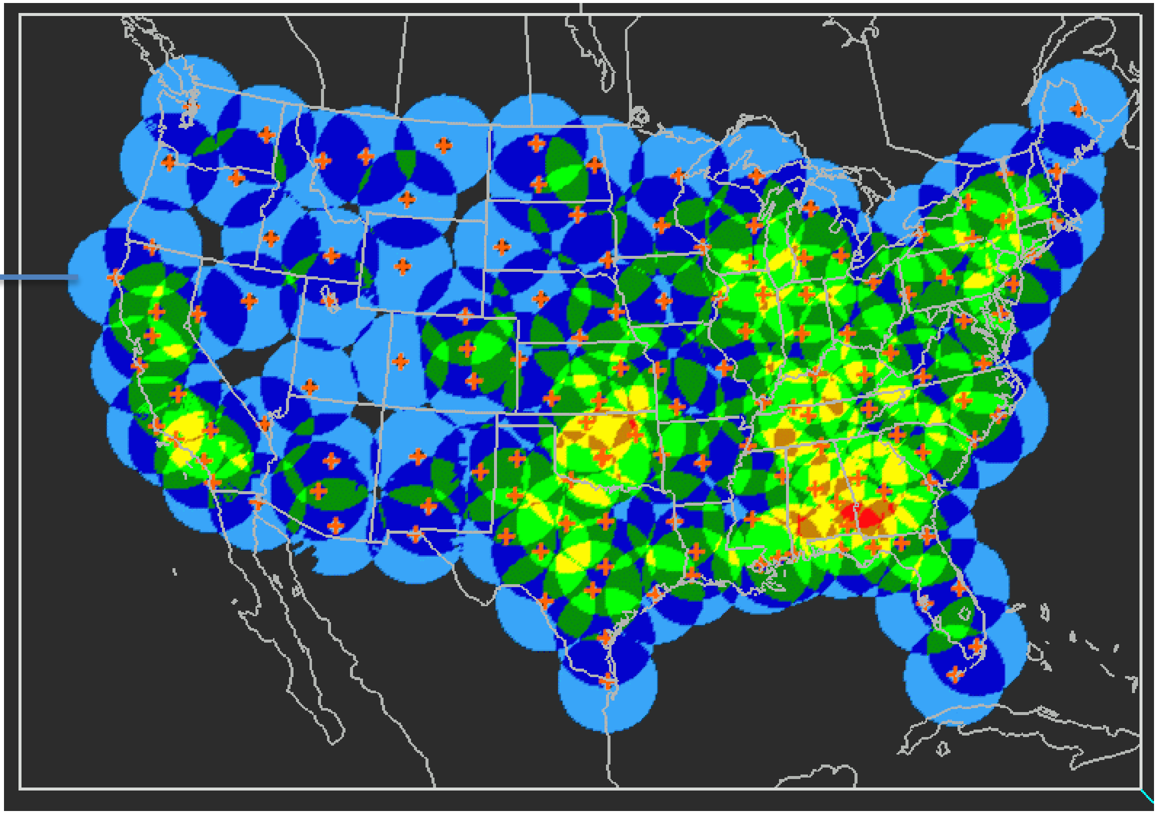
Purpose

- Evaluate weather-related operational inefficiencies or safety hazards in remote, non-radar controlled airspace
- Focus on oceanic airspace

NEXRAD Coverage at 33,000 ft AGL



http://www.cimms.ou.edu/~jzhang/radcov/US_lamb.radcov_10kmagl.gif

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Current MET Information Sources

Preflight

Weather Briefing Packet

- **Graphical depiction of current and forecast conditions**
- **Satellite imagery**
- **Temperature, wind, lightning data, METARs, TAFs, PIREPs, SIGMETs, NOTAMs**

En Route

- **Onboard radar**
- **Pilot-to-Pilot VHF comm**
- **Visual "out-the window" deviation**
- **Ground-based updating of MET information textually via satellite datalink (typically through AOC)**

Electronic Flight Bag available to pilots of many airlines

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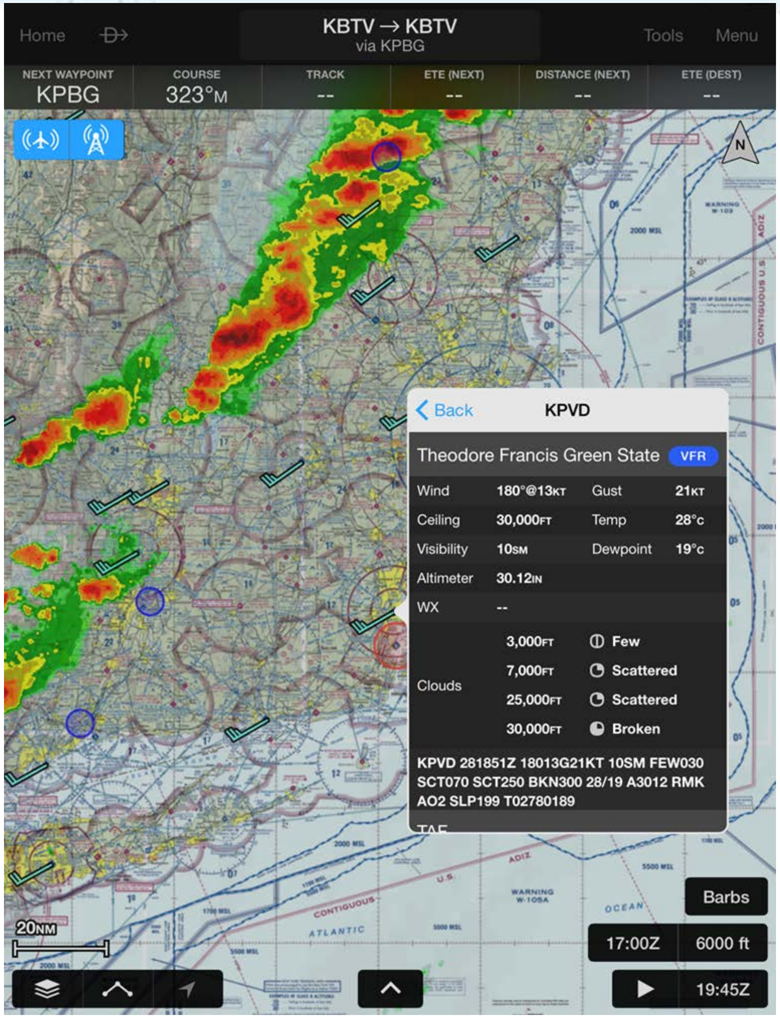
Electronic Flight Bag



Hardware

Class 1

- No FAA design, production, or installation approval.
- Not mounted
- Not connected to aircraft systems for data
- Cannot display own-ship position while in flight

Class 2

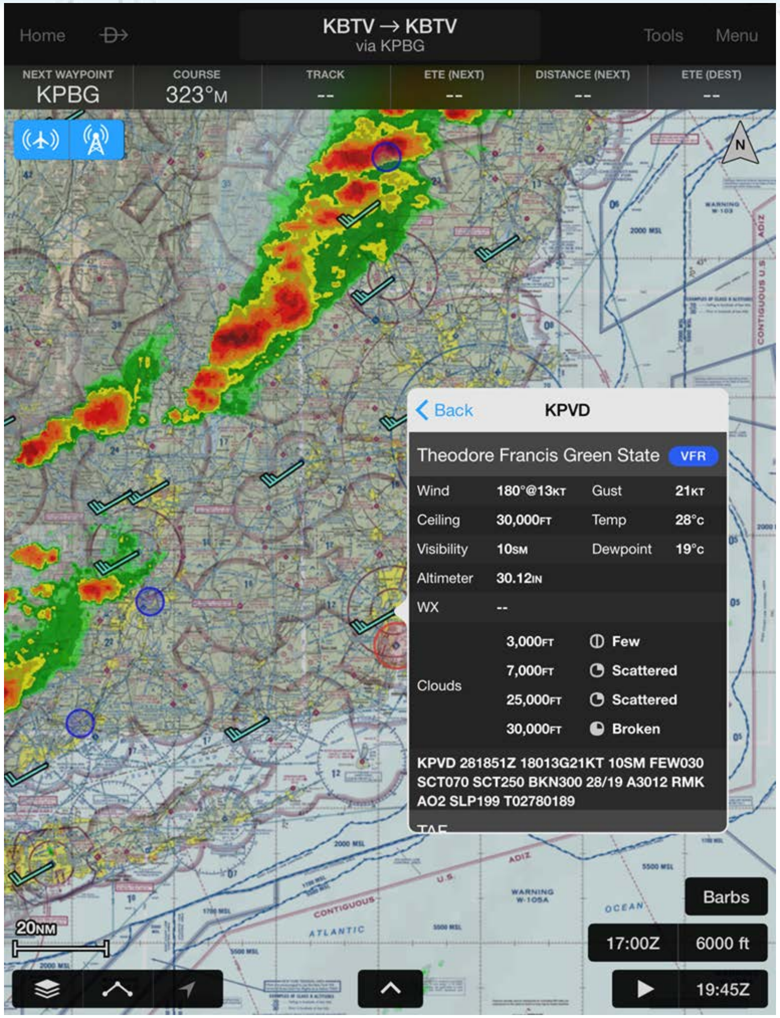
- Typically mounted
- May connect to aircraft data ports
- Cannot display own-ship position while in flight

Class 3

- Considered "installed equipment"
- Under design control

AC No: 120-76C - Guidelines for the Certification, Airworthiness, and Operational Use of Electronic Flight Bags
http://www.faa.gov/documentlibrary/media/advisory_circular/ac_120-76c.pdf

Electronic Flight Bag



Software

Type A

- Replace paper during flight planning, on the ground, or during non-critical phases of flight

Type B

- Intended for use during all phases of flight
- Weather and aeronautical data

Type C

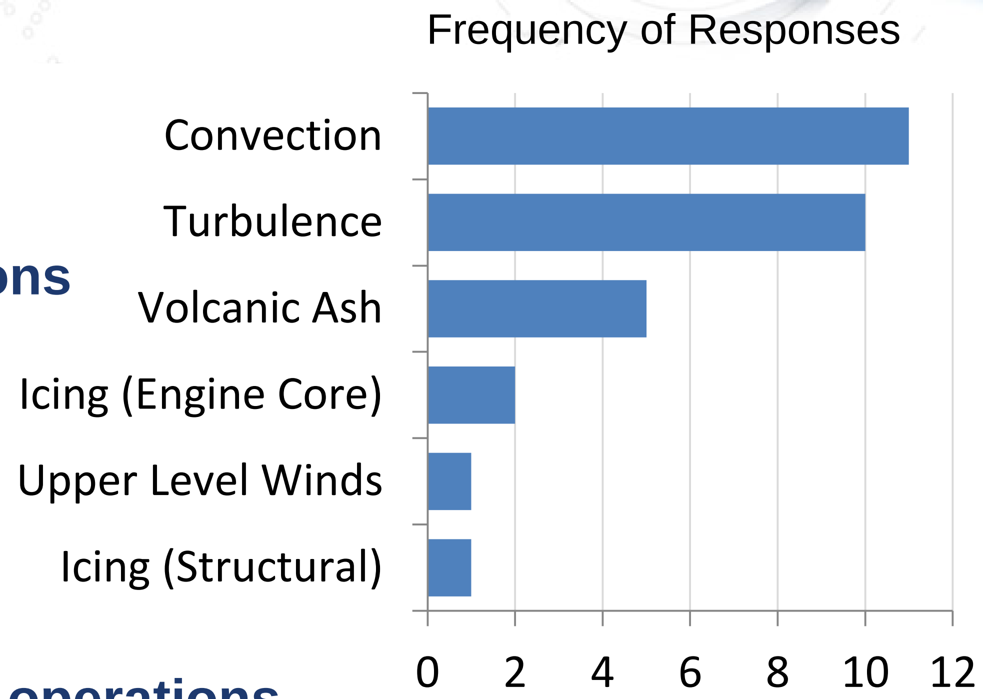
- Require FAA approval
- Can be used as a multi-function display

AC No: 120-76C - Guidelines for the Certification, Airworthiness, and Operational Use of Electronic Flight Bags
http://www.faa.gov/documentlibrary/media/advisory_circular/ac_120-76c.pdf

Information Gaps in Oceanic Airspace

16 Interviews

- **ATC Coordinators**
- **Dispatchers**
- **Pilots - International Operations**
- **Meteorologists**
- **Operations Managers**
- **Program Managers**
- **Principal Engineer**



Primarily involved with Oceanic operations
Typically 20+ years of experience
One expert had 48 years of experience with an airline

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Convection in Oceanic Airspace

“I was on a flight over the Atlantic which was rerouted into an area of thunderstorms. The data we had was several hours old and was not accurate. We had to guess how best to deviate around the storms”

– Airline pilot with 36 years of experience

“The onboard radar only goes out 120 nmi or so. If there is something 500 or 1,000 nmi away, the pilots can’t see it”

– Head of dispatch

“Between Puerto Rico and New York, there are 2-3 waypoints where it’s still HF and hard to get a word in. Hard to get clearances for deviations around weather.”

– Airline Captain

Delta Flight 159 Detroit to Seoul

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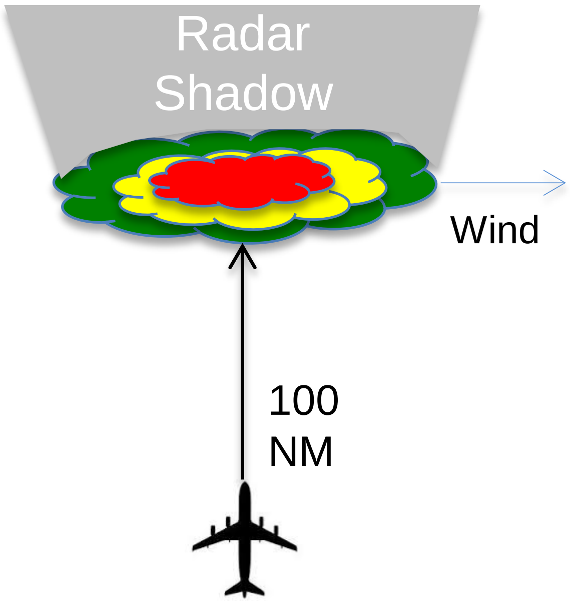
Convection: Scenario – Puerto Rico to NY

- **Onboard radar unable to display weather beyond TS due to radar shadow**
- **First consideration is to stay upwind of TS**
- **Contact ZNY on HF radio to request deviation left of course**



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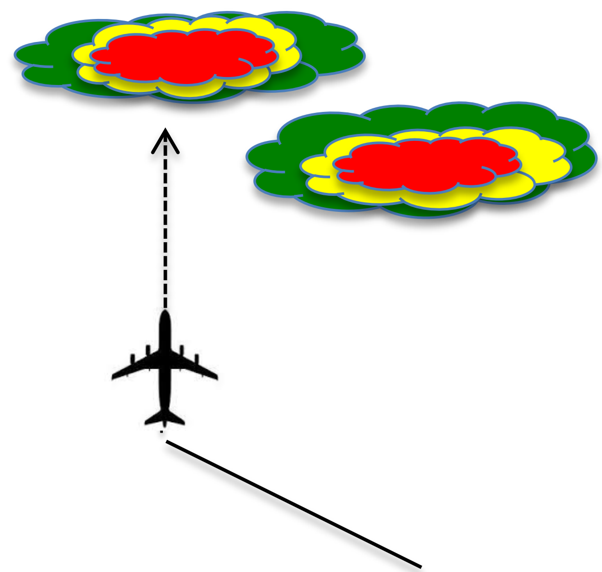
Convection: Scenario – Puerto Rico to NY

- **Request 35NM deviation left of course for 120NM**
- **Clear TS by 20 NM upwind**
- **Time requirements**
  - 2 minutes for radio break
  - 1 minute request
  - 3 minute response
  - **6 minutes elapsed time**
- **Distance requirements**
  - 6 min = 42 NM at 420 knots
  - **Now 58 NM from TS**



Onboard radar can now detect several additional TS's beyond original storm

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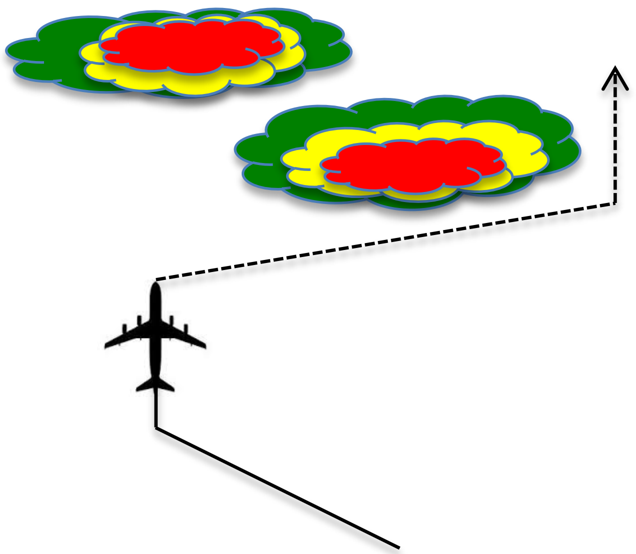
Convection: Scenario – Puerto Rico to NY

- Must now go through ATC clearance process again
- Request revised deviation 35NM right of original course
- Still unsure if the route will be adequate
- The additional time required to coordinate revised deviation with ZNY results in aircraft coming even closer to TS's.



Convection

Shortfall

- Inefficient rerouting to avoid convective activity

Information Gap

- Vertical profile of convective weather
- Lateral extent of convective weather

Factors

- Absence of ground-based observation
- Limited in-situ observation and reporting
- Latency and bandwidth issues
- Coordination with ATC in oceanic airspace

Impact

- Safety, efficiency, workload

Minimum Weather Service (MWS) Recommendations

Convection

Tactical Planning

- Enhanced onboard radar that displays lateral and vertical extent of convection
- Display relative to the own-ship position
- Frequency of updates sufficient to support tactical maneuvering

Strategic Planning

- Graphic depiction of convective activity showing the lateral extent, vertical profile (cloud top height), and the presence of precipitation within the clouds
- The ability to detect changes in clouds (building/dissipating/movement)
- The ability to detect the location of lightning
- Access to updated convective SIGMETs

Shortfall Analysis Summary

	Shortfall - Inefficiency or Risk	MET Information Recommendations
Convection	Inefficient rerouting to avoid convective activity	Vertical profile, lateral extent, intensity, growth, decay of convection
Turbulence	Unintentional turbulence encounters, unnecessary maneuvers to avoid turbulence	Forecasted and observed turbulence location, intensity, and duration
Volcanic Ash	Engine failure or damage and additional maintenance due to exposure to volcanic ash	Observed lateral and vertical extent of volcanic ash cloud, forecast movement of ash cloud
Engine Core Icing	Ice accretion inside the engine core at higher cruise altitudes have resulted in thrust loss or engine flameout	Forecasted regions with high ice water content (HIWC)
Upper-Level Winds	FMCs onboard may have difficulty analyzing the wind impact of proposed reroutes	More efficient means of computing wind impact of reroutes needed

Thank You

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