

iPads/EFBs and Weather the cockpit

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Technology and Flight Test

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How we use weather-

- 40-50% of all primary delays due to Weather unpredictability!
- Flight Planning/SABRE
- Enroute weather via ACARS
- MDCRS input into system
- ENSCO Turbulence prediction
- Inflight Icing
- Ground De-Icing
- Mobile applications – Smartphone/iPad
- Ramp Lightning
- Passenger prediction and protection
- NextGen weather “cube”

Example United Airlines Weather projects-

- First airline to implement Weather Radar!
- Meteorological Data Collection and Reporting System (MDCRS) – over 16,000,000 Annual atmospheric measurements – EDR, winds, temperature, pressure
- Oceanic cloud top uplink – anything above 30,000’
- NCAR Turbulence Detection Algorithm (NTDA) – Nexrad Doppler uplink
- Graphical Turbulence Guidance (GTG) design and use
- Aviation Digital Data Service (ADDS) website redesign input
- Multiple NASA “Weather in the Cockpit” trials
- WSSDM and other ground Icing programs
- Discussion with Vendor of the pacific weather dropsonde program
- ITWS to Cockpit

Graphical weather in the cockpit

- A game changer!
 - Graphical updates while airborne via broadband data-link
 - Situational Awareness - no longer limited to the preflight weather briefing
 - Beyond the range of the airborne weather radar
 - Much more effective than voice or textual updates via Flight Watch or Dispatch
 - Having the cockpit updated to the same level as ATC and dispatch will allow for more efficient use of airspace, while improving safety

Use of graphical weather in the cockpit:

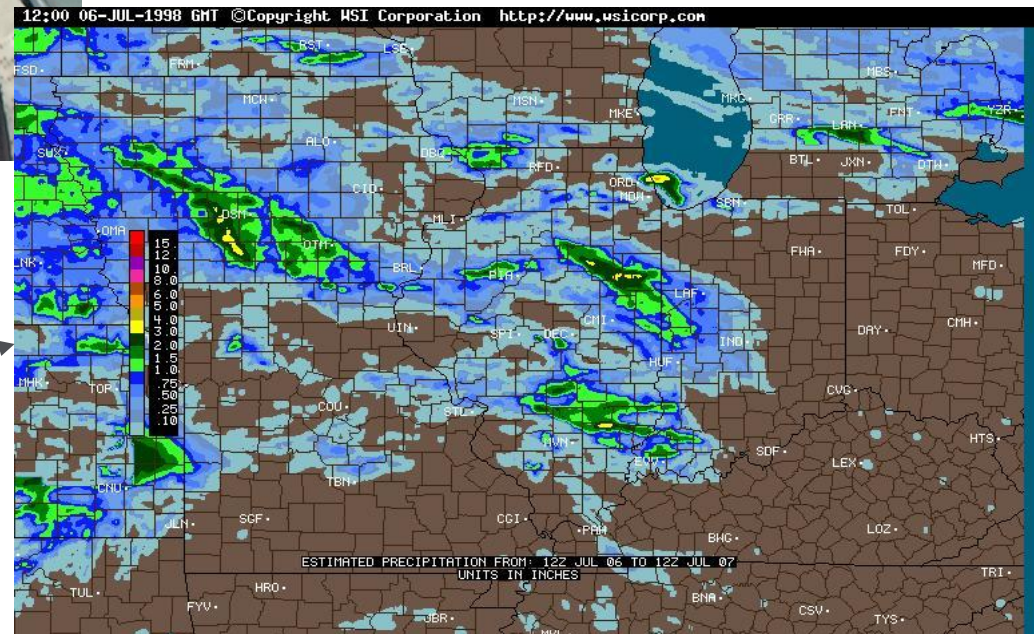
- Better tactical decisions when deviating around convective weather (efficiency):
 - EFB displays with long range convective weather
 - Allows for strategic decisions in coordination with dispatchers and ATC
 - Gives pilots a better tool to advocate for a more efficient solution
- Potential turbulence products for uplink (safety):
 - Updated Graphical Turbulence Guidance (GTG)
 - Turbulence Remote Sensing
 - NCAR's NEXRAD Turbulence Detection Algorithm
 - Oceanic convection and cloud top uplinks

Datalink weather beyond our X-Band weather radar

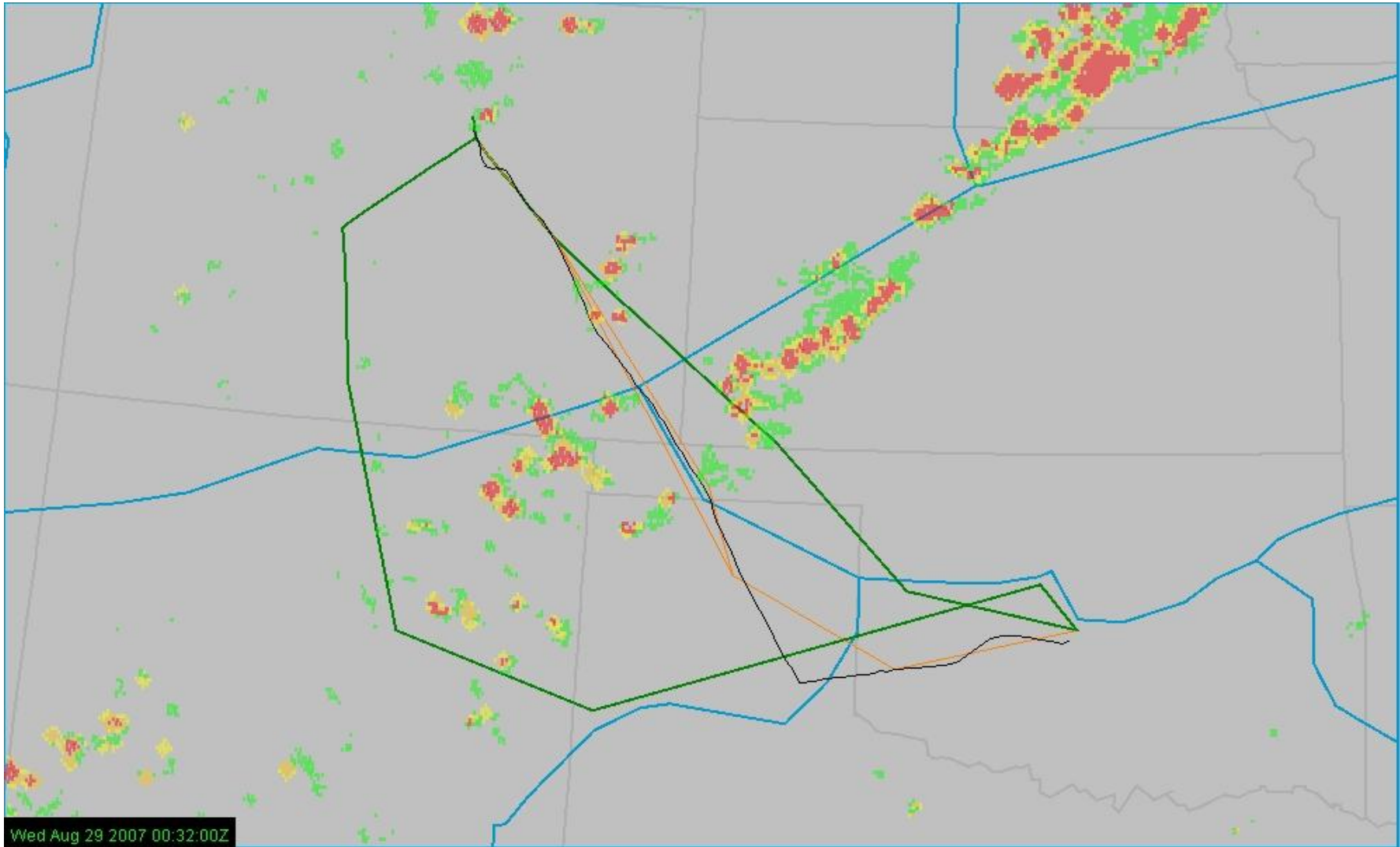


Live EFB Weather on
our A320

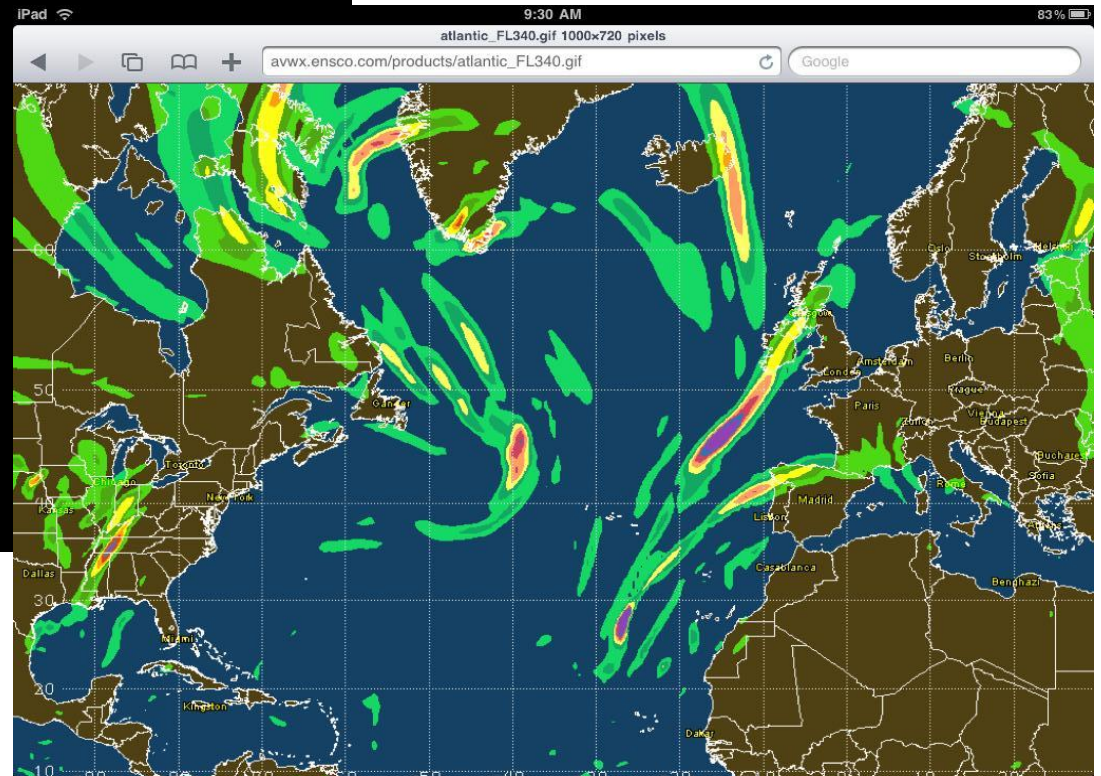
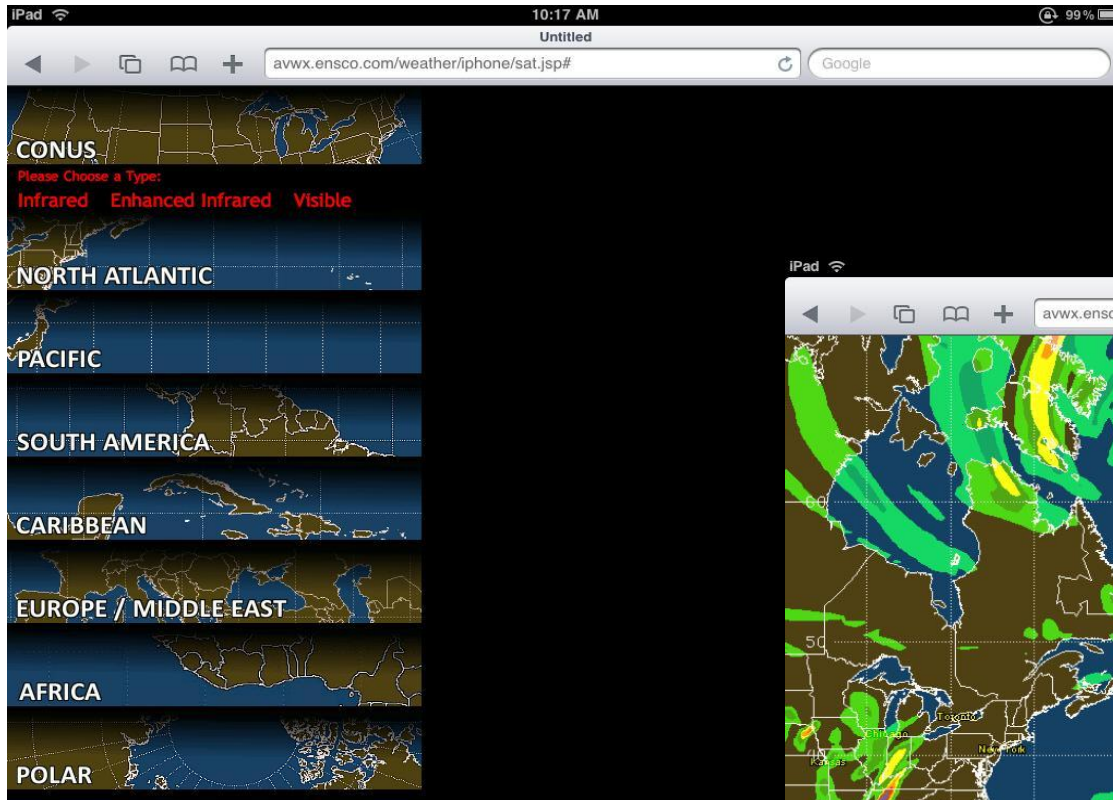
Actual DD view of
weather using WiFi
connection



Demonstrated Cruise Efficiency using EFB and live Wx, UAL 387



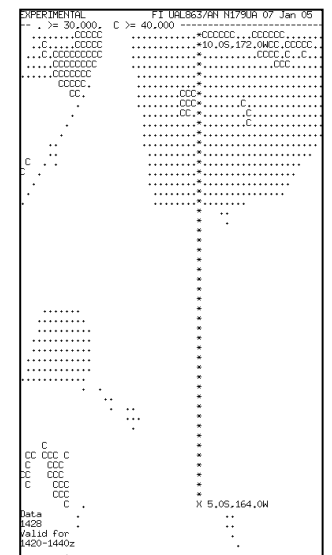
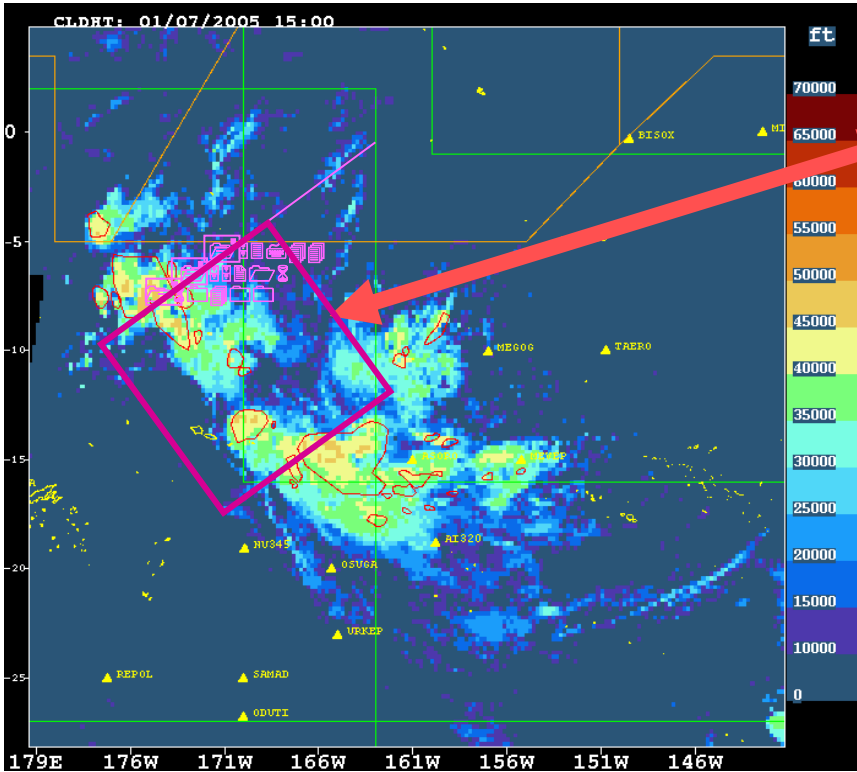
Class I (iPad) EFB Weather Displays



Operating through Oceanic areas:

- Convection in remote areas, especially over the inter-tropical convergence zone, can be difficult to paint with weather radar
 - Low moisture content in the upper stratosphere
 - Current pilot technique:
 - Turn off all cockpit lights, and look out the window! (doesn't work all that well without moon illumination)
 - Graphical weather updates critical to improving crew situational awareness that there is convective weather ahead

Convective Oceanic weather to aircraft



Both Display formats available with EFB

Current ACARS display

Electronic Flight Bags

- Electronic Flight Bag – Chart/document Viewer, En-route Charts, Airport Moving Map, Intelligent Search Engine, Weather and ADS-B ITP
- Implementing all classes – 1, 2, & 3
 - B747 to have Class 3s
 - B777 to have either Class 2 or 3s
 - B737, A319/320, B757, B767 to have Class 2s
 - All pilots will have Class 1 iPad personal device
 - Huge savings in paper distribution, weight, & WX availability
 - Need for “paperless” due to merger integration



EFB Roadmap - Current and End State



“UA Subsidiary” current state:
Shipsets on all aircraft - A320, B757, B767,
B777 & B747
Class 3 EFB on 12 of 24 B747s



“CAL Subsidiary” current state:
Pilot Carried paper on all aircraft
Class 2 EFB on 59 of 62 B757
Class 2 EFB on 1 of 26 B767
Class 3 EFB on 7 of 22 B777

End 2011



Electronic AFM/FOM/QRH (Class 1 EFB – iPad
2s) to all pilots
Shipsets on all fleets for Nav Charts
Some Class 2/3 EFBs

2 Years



End State – no paper:
Electronic AFM/FOM/QRH (Class 1 EFB)
Class 2/3 EFBs on all A/C & Class 1 for
each pilot

United Airlines EFB programs

- iPad – Class 1 EFB for every pilot
 - Flight Manuals, Charts, Graphical Weather
- Class 2 or 3 EFB for every aircraft
 - Surface Moving Map, In-Trail Procedures, other ADS-B In applications



iPad as Class 1 EFB

Phase One (current deployment):

- Document Viewer/Document Library
 - iBooks then Airwatch Viewer
 - FOM, AFM, WOM (World Ops Manual)
- Jepp Mobile FD Terminal and Enroute charts
- Real Time Weather on the ground via WiFi
- Airwatch Mobile Device Manager data updates using UA WiFi
- Pilot email

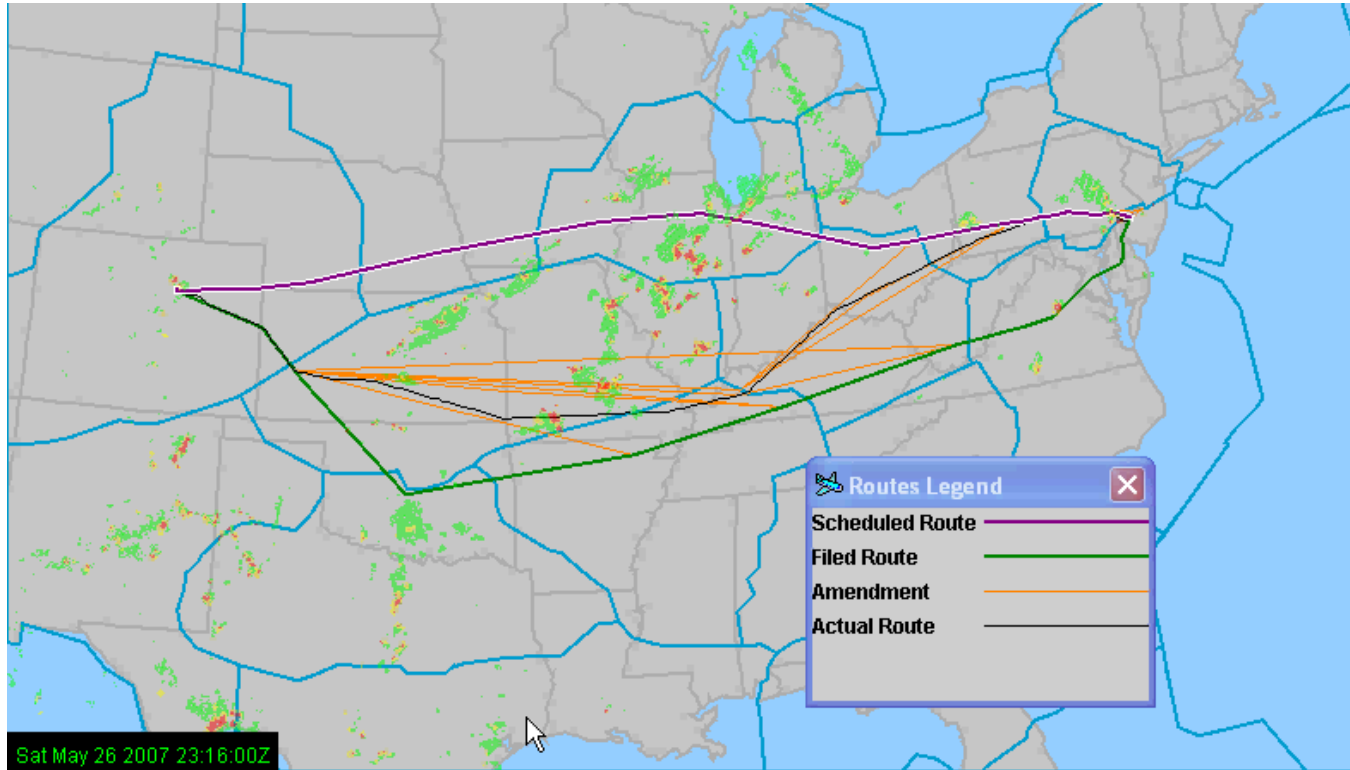
Phase Two:

- Flight Planning and Release via iPad (SABRE)
- Weather in the Cockpit – using WiFi
 - Radar, Turbulence, TAFS, METARS, Winds
- Other AOC messaging to reduce ACARS costs
- Pilot scheduling and communications apps
- Will have monthly “app review committee” to add new programs

Class 2 & 3 EFB's

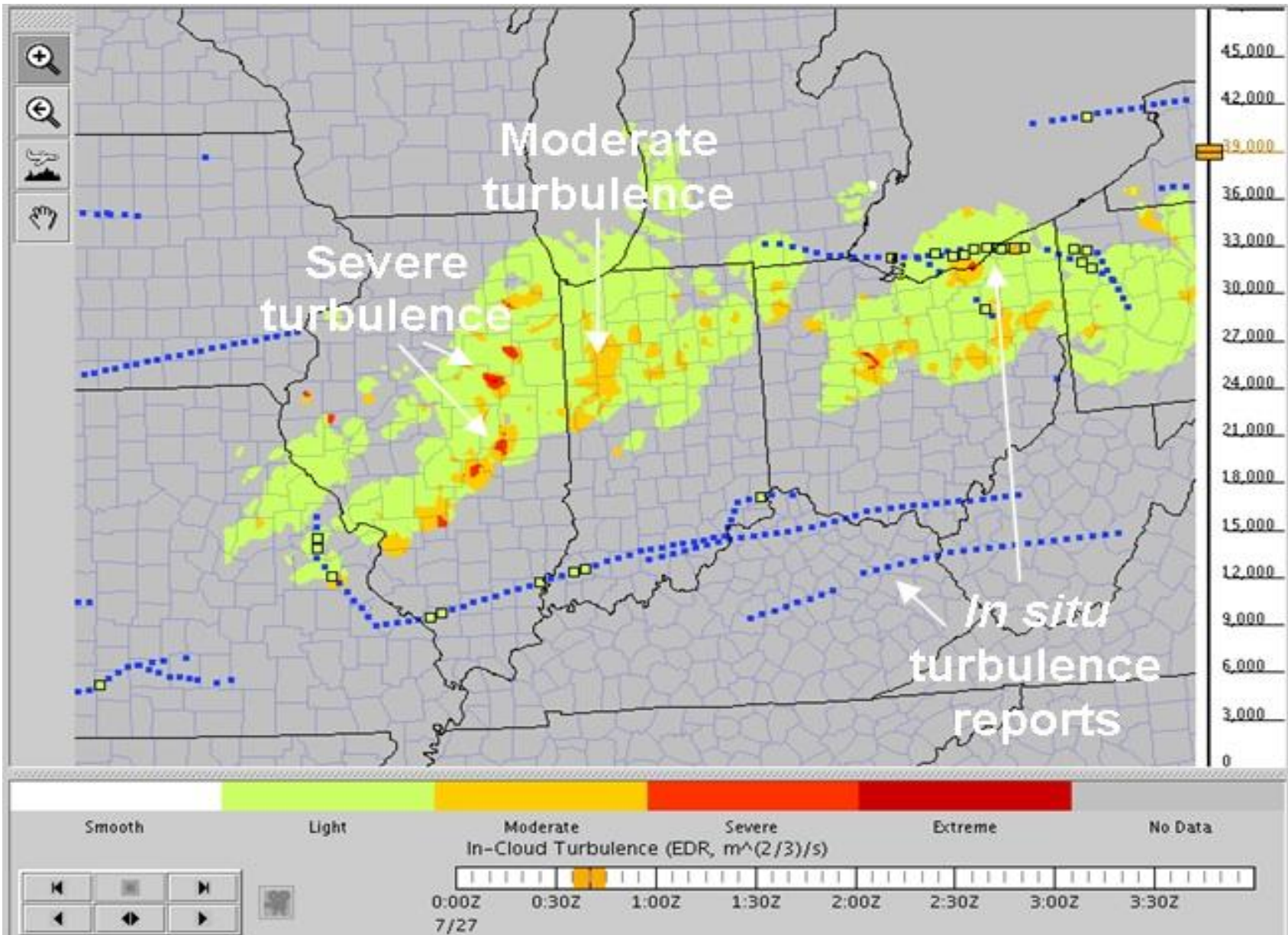
- Applications
 - Document Viewer/Document Library
 - FOM, AFM, WOM
 - Jepp Terminal and Enroute Charts
 - Airport Moving Map
 - Real Time Weather on the ground and in the air
 - UA Custom charts – ex: 10-7 pages
 - In-Trail Procedures/Interval Management -Class 3 only*
 - Flight Planning and Release via EFB using SABRE
 - Weight and Balance over EFB
 - Other AOC messaging to reduce ACARS costs
- Data and application update method
 - TWLU device with WiFi and cellular capability
 - Read-only 429 data access device

An example of convective weather reroute savings

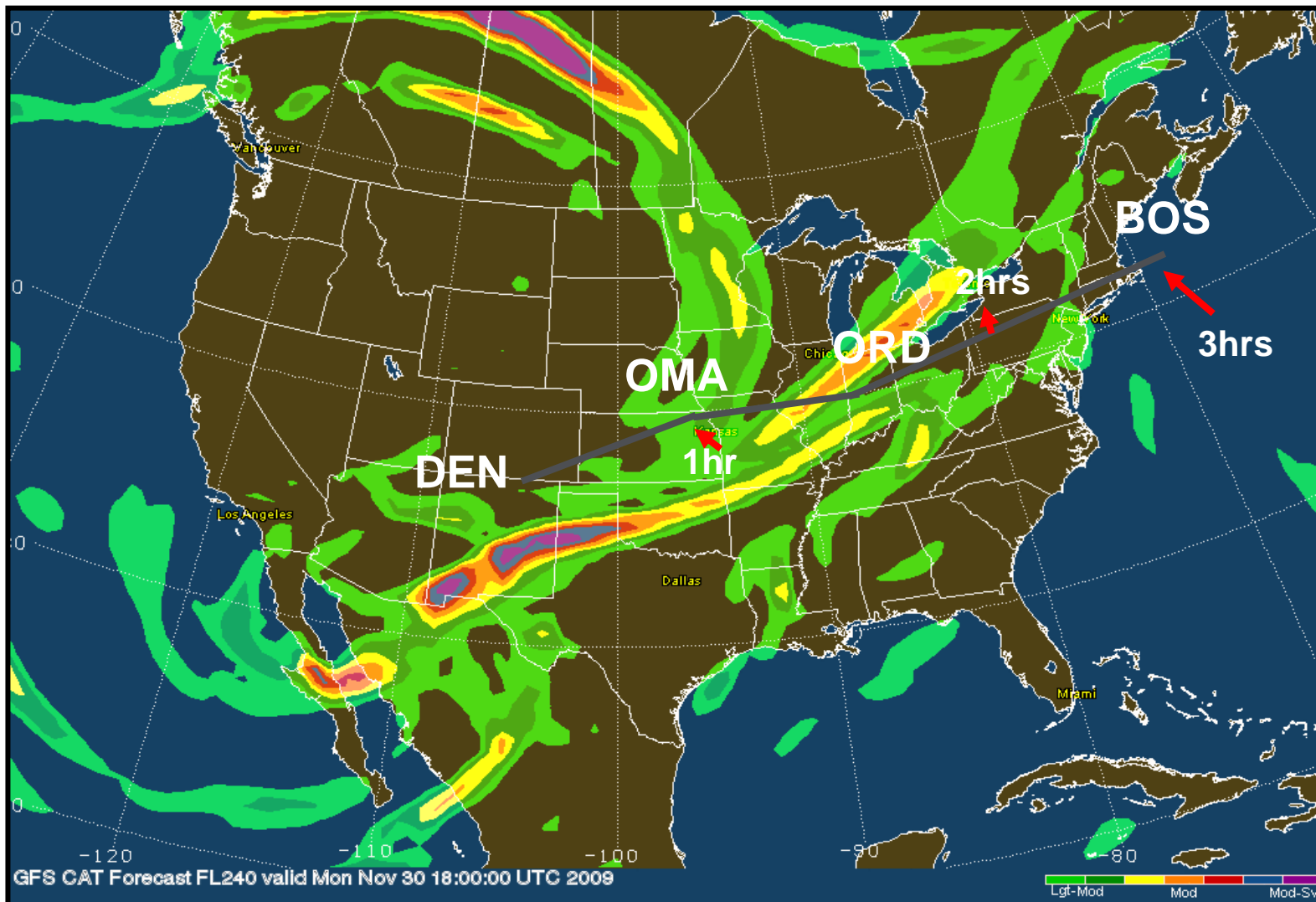


- Normal flight plan time = 3:00
- Playbook routing flight plan time = 3:45
- Actual flight time = 3:20

Tracking GTG 2/2.5/3 Turbulence with iPad and datalink



Integrating ENSCO Turbulence Product into Plotting charts and F/A maps



Typical Hardware to receive WX in the Cockpit

EFB (class I, II, or III)



Weather Receiver, Swift BB, Iridium, LAN, FIS-B, or WiFi connection



EFB



FMS

ARINC 429 or AFDX



AWLU or Ethernet switch/ protocol converter

Conclusions

- Increasing the “real time” graphical weather information in the cockpit will improve capacity, efficiency, and safety during weather events
- The iPad as a Class 1 EFB can be a powerful weather tool for routine flight operations
- We need to acknowledge the pivotal role of updated graphical weather information in the cockpit to achieve expected NextGen efficiencies during weather events

Thank you!



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