

Turbulence

Challenges & Potential Solutions

Turbulence Basics

- Drivers – Safety, Capacity, & Efficiency/Emissions
- Primary users- Meteorologist, Dispatcher, Pilot, & Controller
- Solution Components
 - Forecast
 - Tactical/Now cast
 - Reporting
- Challenges

Potential Benefits

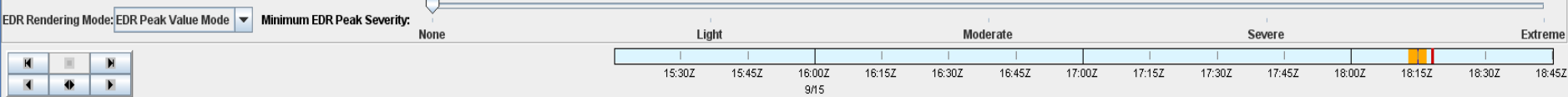
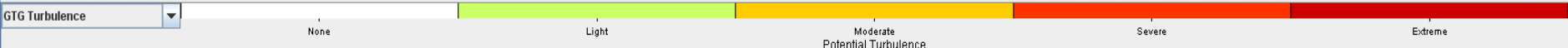
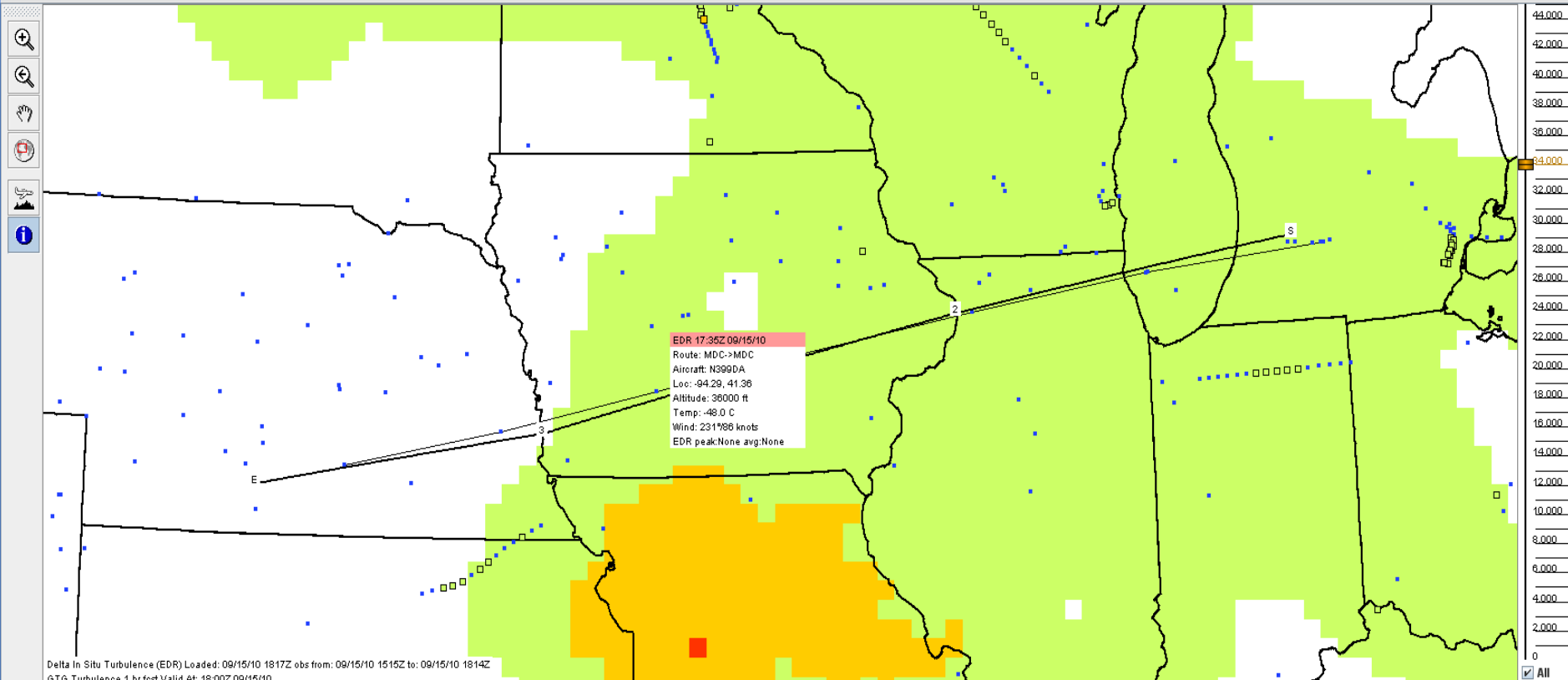
- Safety
 - IF EVERYONE IS STRAPPED IN WITH CARTS STOWED, NO ONE GETS HURT.
 - KEY IS NOT TO CRY WOLF & F/A IGNORE WARNINGS
- Efficiency/Emissions
 - Assumptions
 - Range of primary variables - %, Altitude, Time
- Capacity – FAA FOCUS
- Overall - The solutions for all 3 drivers might appear to conflict, but BETTER TURBULENCE KNOWLEDGE CAN DRIVE BETTER SOLUTIONS FOR ALL 3.

Variability in Forecast Tools

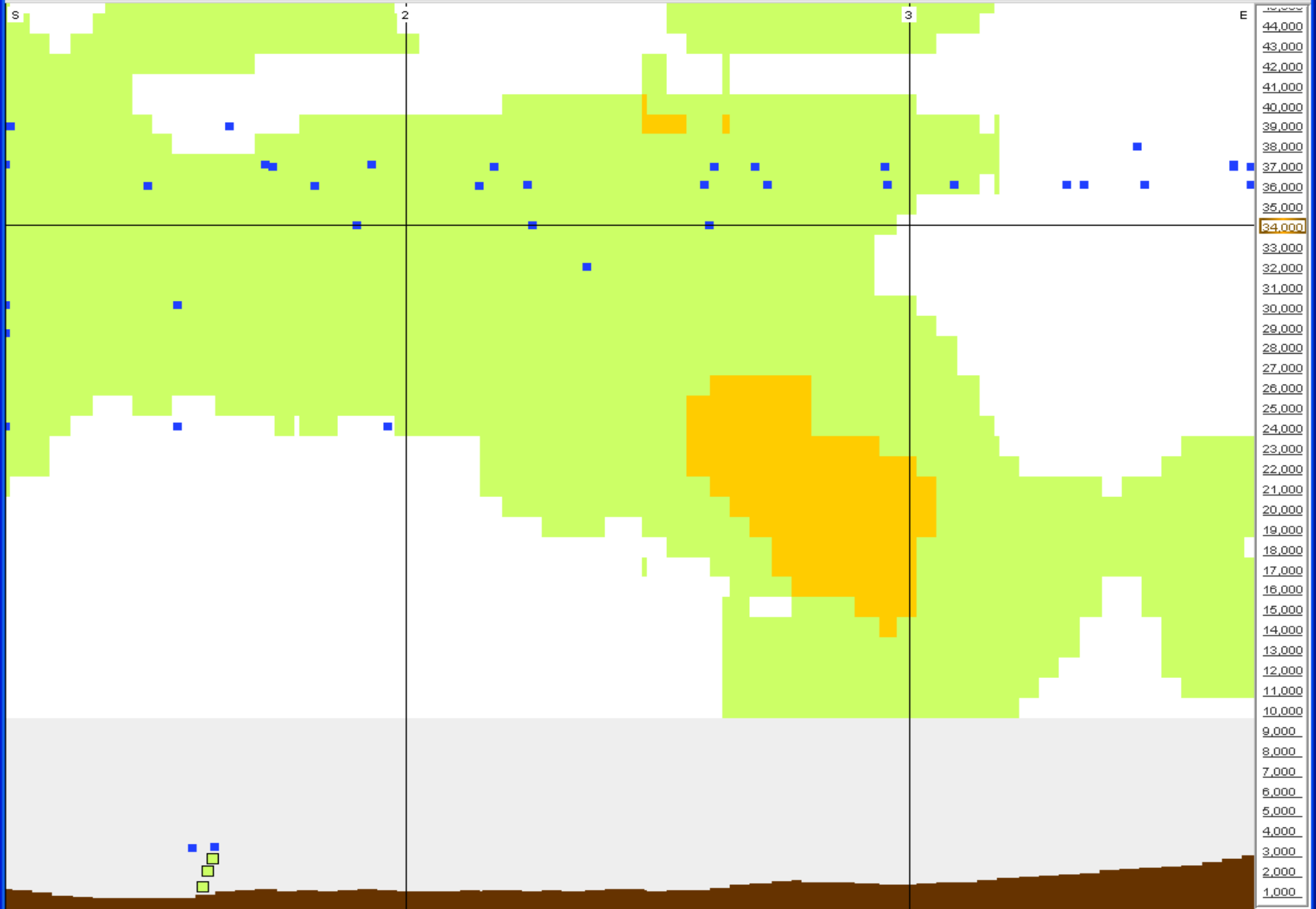
- Tools
 - Individual Preference
 - PIREPS (Orville & Wilbur) – Chat Room
- Users – Forecaster, Dispatcher, Pilot
 - Subjectivity & Risk considerations
 - Cumulative Variability
- Results
 - Cabin management – Cry wolf syndrome
 - Bad data & processes = Bad decisions

NCAR

- Team = FAA, NCAR, & Delta
- Metric
 - Sensors, Algorithm, Data link
 - Atmospheric (Sea) State
 - OPEN SOURCE
- Issues
 - Calibration effort
 - Atmospheric state vs. Aircraft response
 - Closure



Data Layers	Available Data Sets
Background Grids	
<input type="checkbox"/> Temperature	OK
<input type="checkbox"/> Relative Humidity	OK
<input type="checkbox"/> Wind Speed	OK
<input type="checkbox"/> Icing	OK
<input checked="" type="checkbox"/> GTG Turbulence	
Data Overlays	
<input type="checkbox"/> United In Situ Turbulence (EDR)	
<input checked="" type="checkbox"/> Delta In Situ Turbulence (EDR)	
<input type="checkbox"/> Wind Barbs	
<input type="checkbox"/> METARs	OK
<input type="checkbox"/> PIREPs	OK
<input type="checkbox"/> AIR/SIGMETs	
<input type="checkbox"/> TAFs	OK
Map Overlays	
<input type="checkbox"/> ARTCC Boundaries	Static Data
<input checked="" type="checkbox"/> Topography	Static Data Static Data



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Solutions

- Forecasting
 - Better forecasting models
 - Government & Commercial
- “Now-Casting”/Tactical – 5-10 minutes
 - Better airborne radars–Enhanced Turbulence
 - Blended NEXRAD Solution = GTG-N
- Reporting
 - EDR (Eddy Dissipation Rate) – ICAO
 - Aircraft response
 - Mix of both metrics – Market driven
- Blended solution using **Sensors, Data link, & Displays**

Issues

- Validation & Education on Accuracy of data
- Common Procedures for end users
- Displays – Dispatch & Pilot
- Infrastructure requirements
- Different airline business models
- **ICAO STANDARDS FOR REPORTING METRIC**

Next Steps

- Regulatory Agencies
 - Expand Turbulence Validation Program – Go International
 - Integrate Turbulence/Wx. into Future systems
 - Develop Business case for Turbulence
 - Increase Aircraft Installations
- Airlines
 - Validate Turbulence Impacts
 - Develop Industry Coordination
 - Develop Procedures & Processes
 - Move common picture to all end users

Future Path

- **Distractions**
 - Airline priority of the day – Mergers, Fuel, Economy
 - FAA Bias
- **Political Will**
 - FAA – NextGen 4D Weather Cube
 - Airlines – Validate Benefits
- **Alternatives for Data Location & Products**
 - Airline, Government, Commercial or Mix
 - Costs burden
- **Decision Time–Champion Needed**