# **Delta Air Lines -**
# Data Access Issues, Human in the Loop & Forecasting Challenges

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Turbulence Impact Mitigation Workshop
Presented: Sep 4, 2014

# Theme

## Teaming w/ Delta Pilots & Ops Center

# Topics

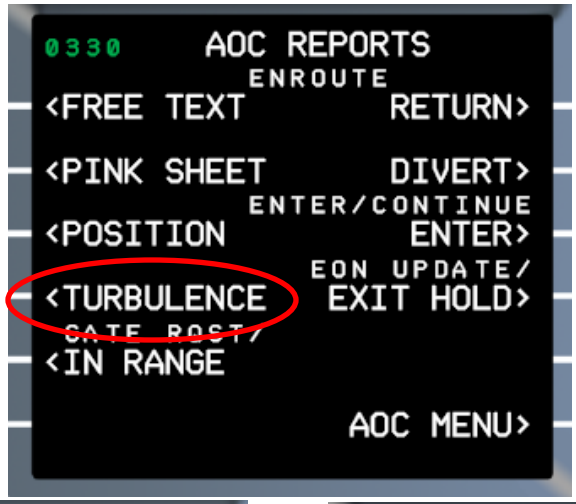
- Current Turbc Obs & Data Access
- Current Human-in-the-Loop Process
- Future Plans: Forecasting & Display

# How does Delta Air Lines produce Turbulence Reports?

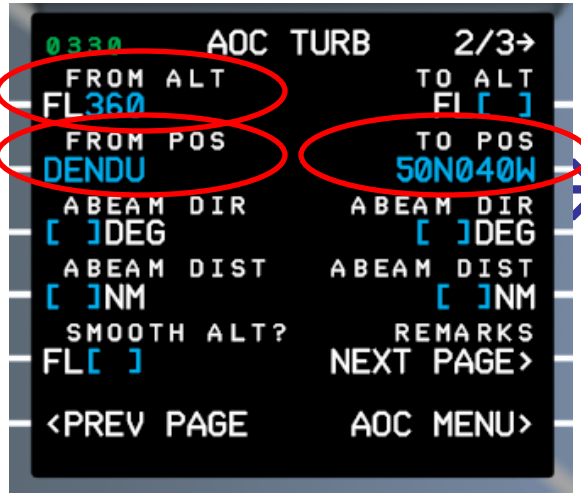
# Delta Turbulence Reporting

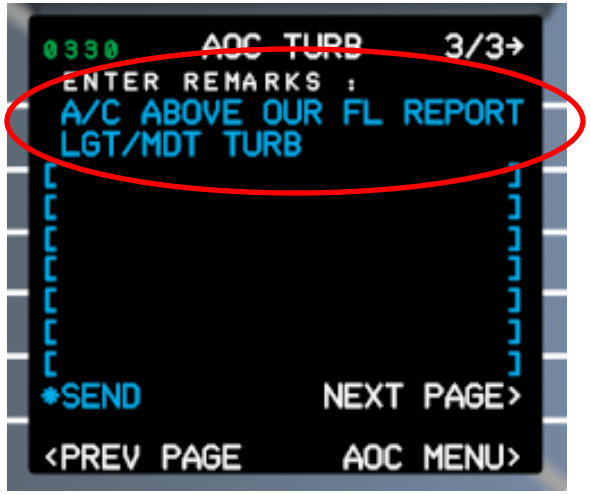
## **Manual Reporting via ACARS:** Detailed Version

- Flt Progress → Turbulence → Intensity



→Detail (Options)



# Delta Turbulence Reporting

## **Manual Reporting**: Text of Turbc Area Report

REPORTED TURB LEVEL: **SMOOTH**.
FROM FL: **360** TO **---**
FROM FIX: **DENDU** TO FIX: **50N040W**.
FROM ABEAM: / TO ABEAM: /
SMOOTH FLIGHT LEVEL: **360**.
PILOT REMARKS: **A/C ABOVE OUR FL REPORT LGT/MDT TURB**

## **Automated Reporting:** g-Load

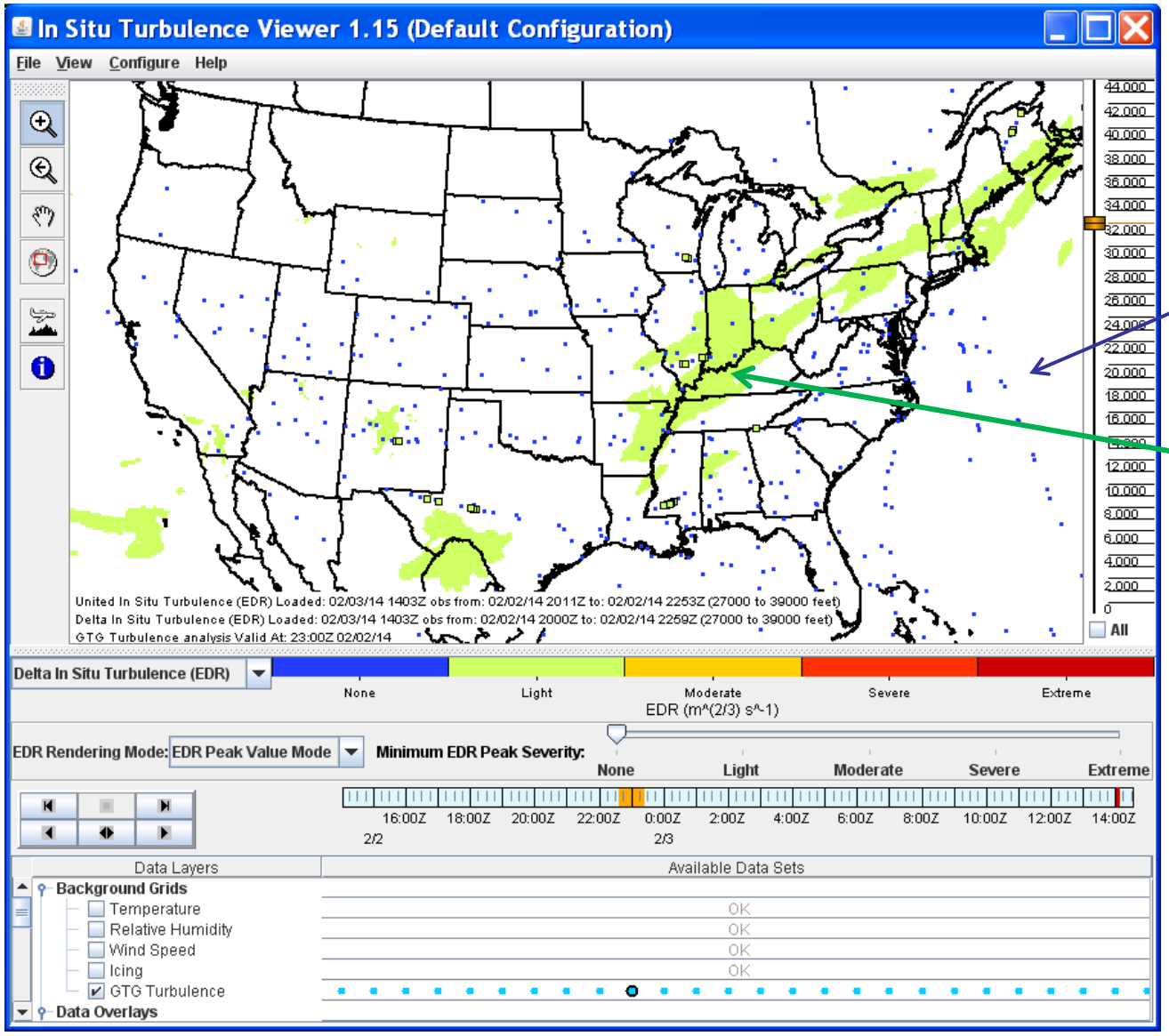
**Not accessed real-time. Pulled & Used for accident investigations.**

## **Automated Reporting:** EDR Text

N33829W1187430656098 6P0952140120XXXX25::**30NXW**
N33755W1187220657130 0P0422402 50XXXX25::**30W/X**
N33721W1186130658148 2P0022310440XXXX2500**1Y20)**

- The last 5 chars are EDR info & base64 encoded.
- Delta has no internal method to decode & read the info.

# Used by Delta OCC in the past
# EDR Turbulence Viewer 1.15




Included Display of:

- Delta's EDR Reports (color coded dots)

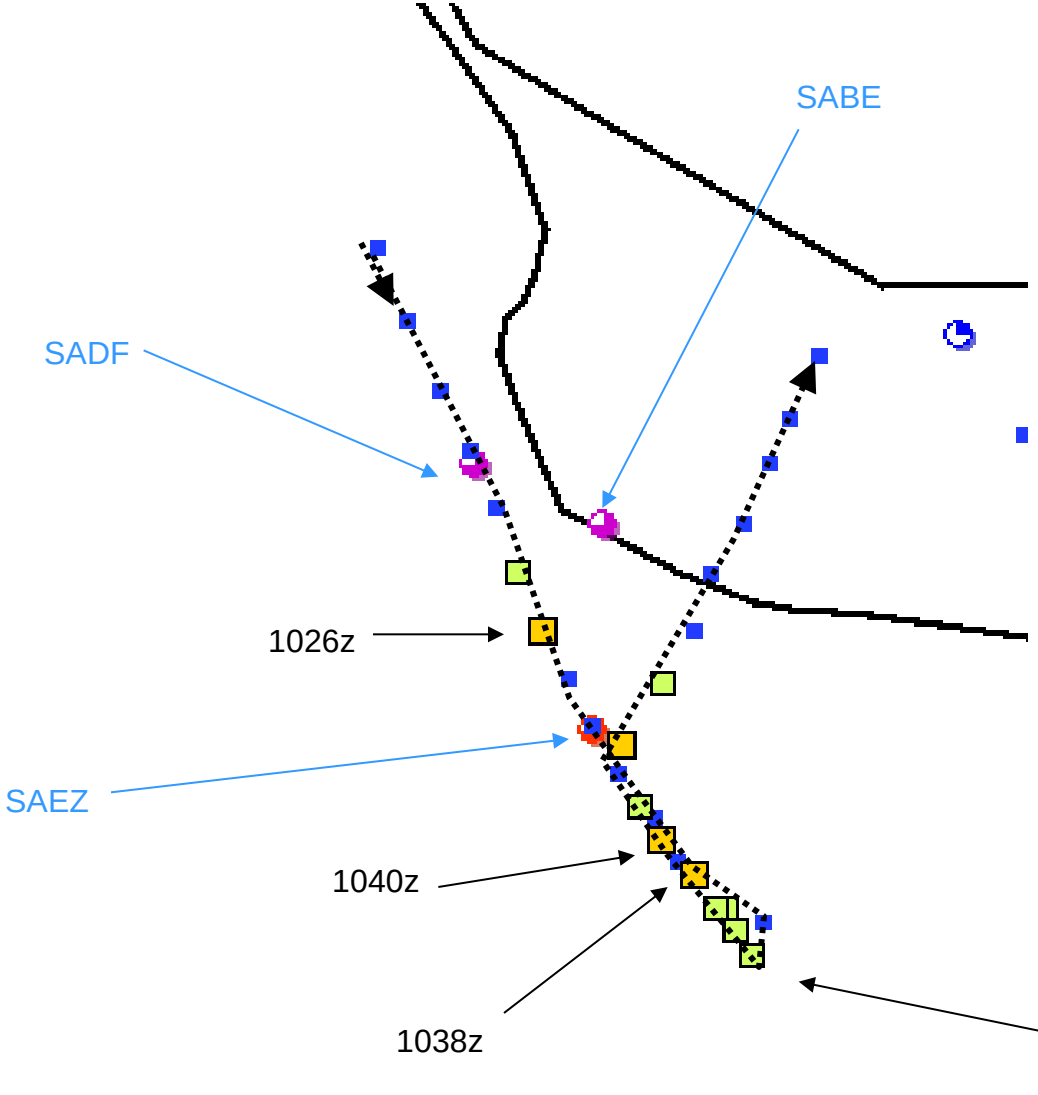
&

- GTG Forecasts (color coded areas)

Currently Working w/ Delta IT to be able to Access:

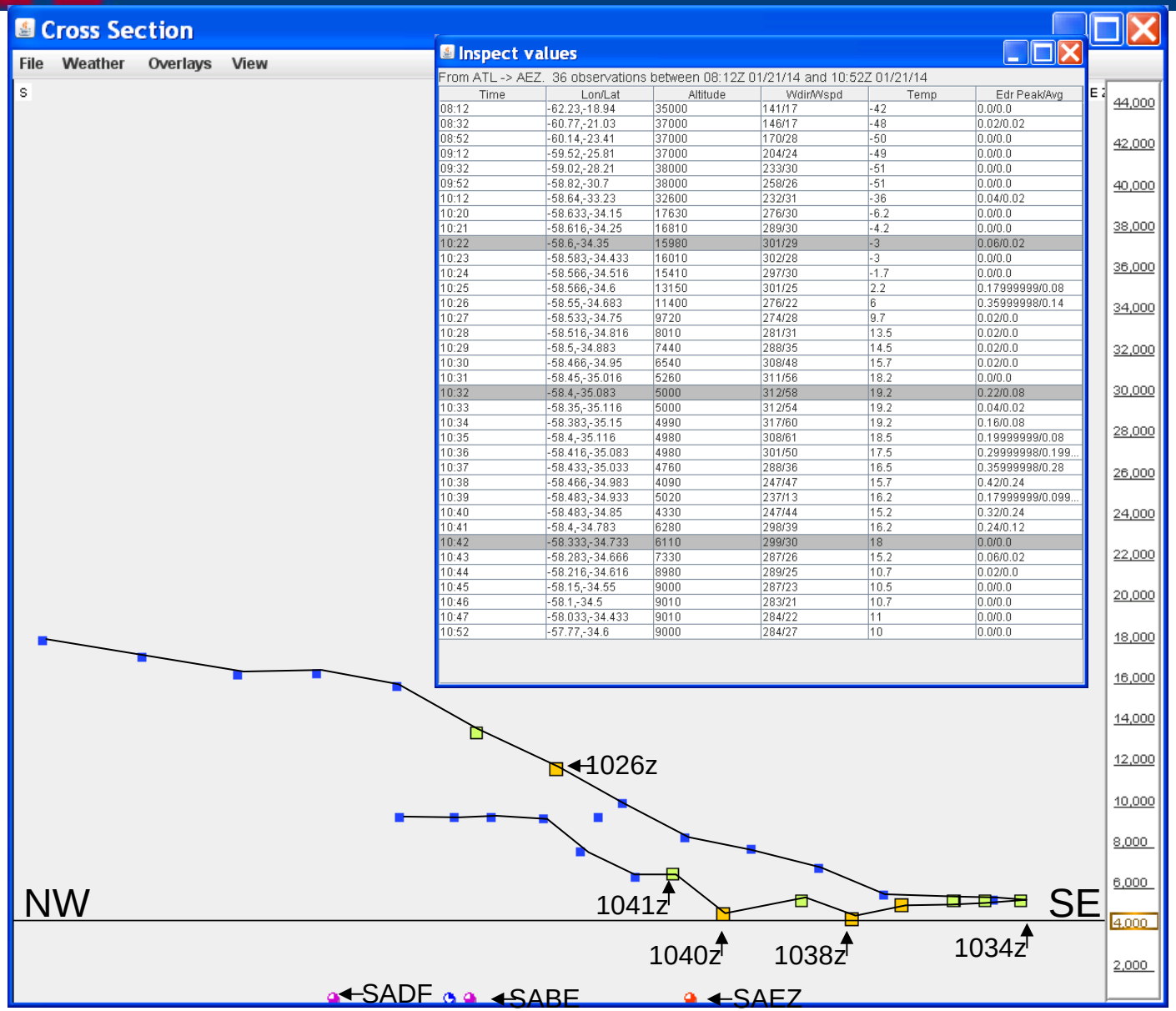
- Viewer 2.2.9

# Viewer 1.15 Capability
# EDR Turbulence Plotted w/ Flight Path




Looking to be able to once again Access Historical Delta a/c EDR Reports & Display.

# Viewer 1.15 Capability
# Cross Section with Flight Path & Values




**Delta Appreciates**

All the Efforts by NCAR & FAA over the years to provide display capability of EDR.

**Delta's now Focusing on** capability to display both:

- **EDR Reports &**
- **GTG Forecasts**

On Delta tools

# How does Delta Air Lines prepare for En Route Turbulence & other Weather Hazards?

SK

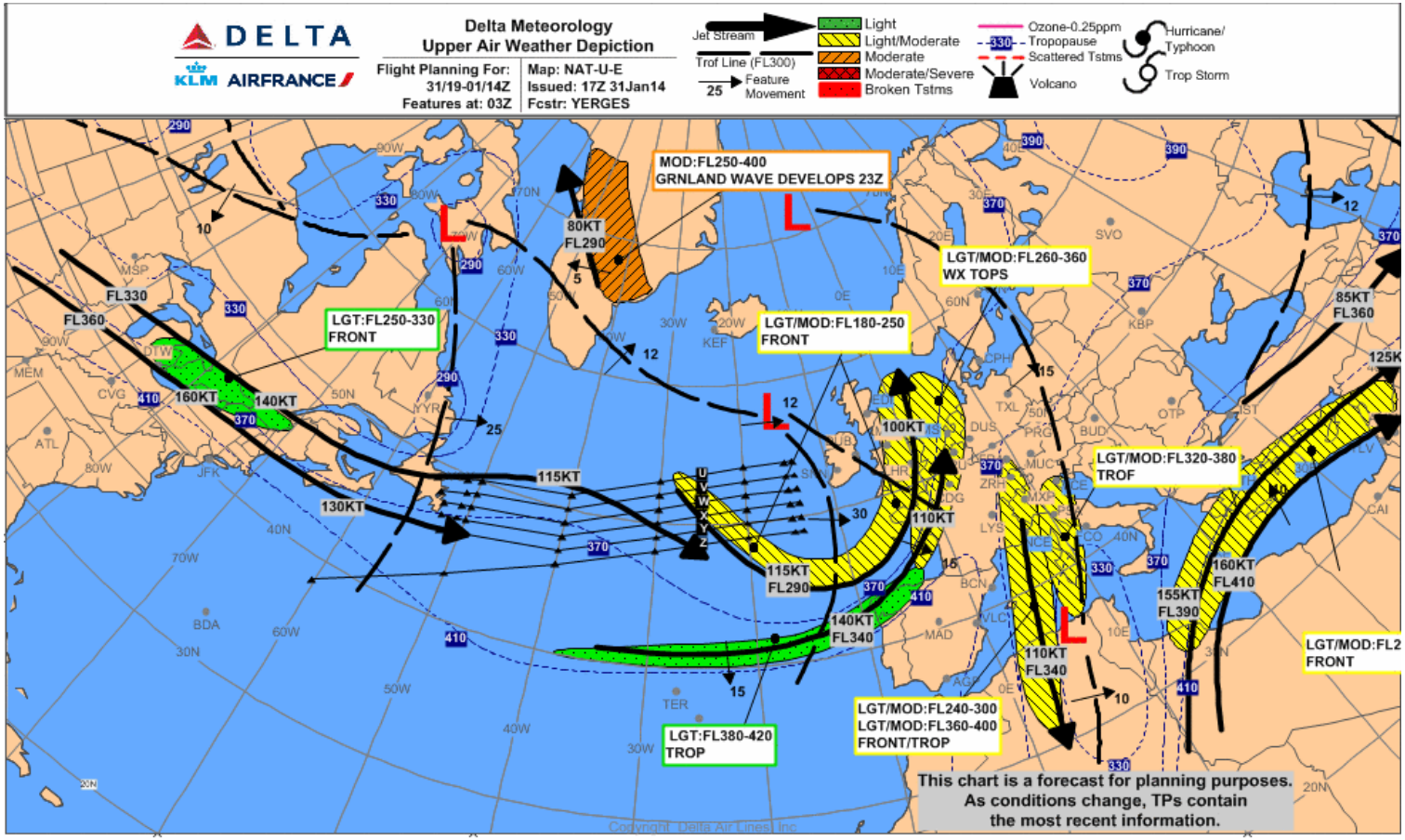
# En Route Weather Hazards

**Delta has products & processes in place for these en route weather hazards:**

- Turbulence
- Mountain Waves
- Thunderstorms
- Ozone
- Volcanic Ash
- Space Weather

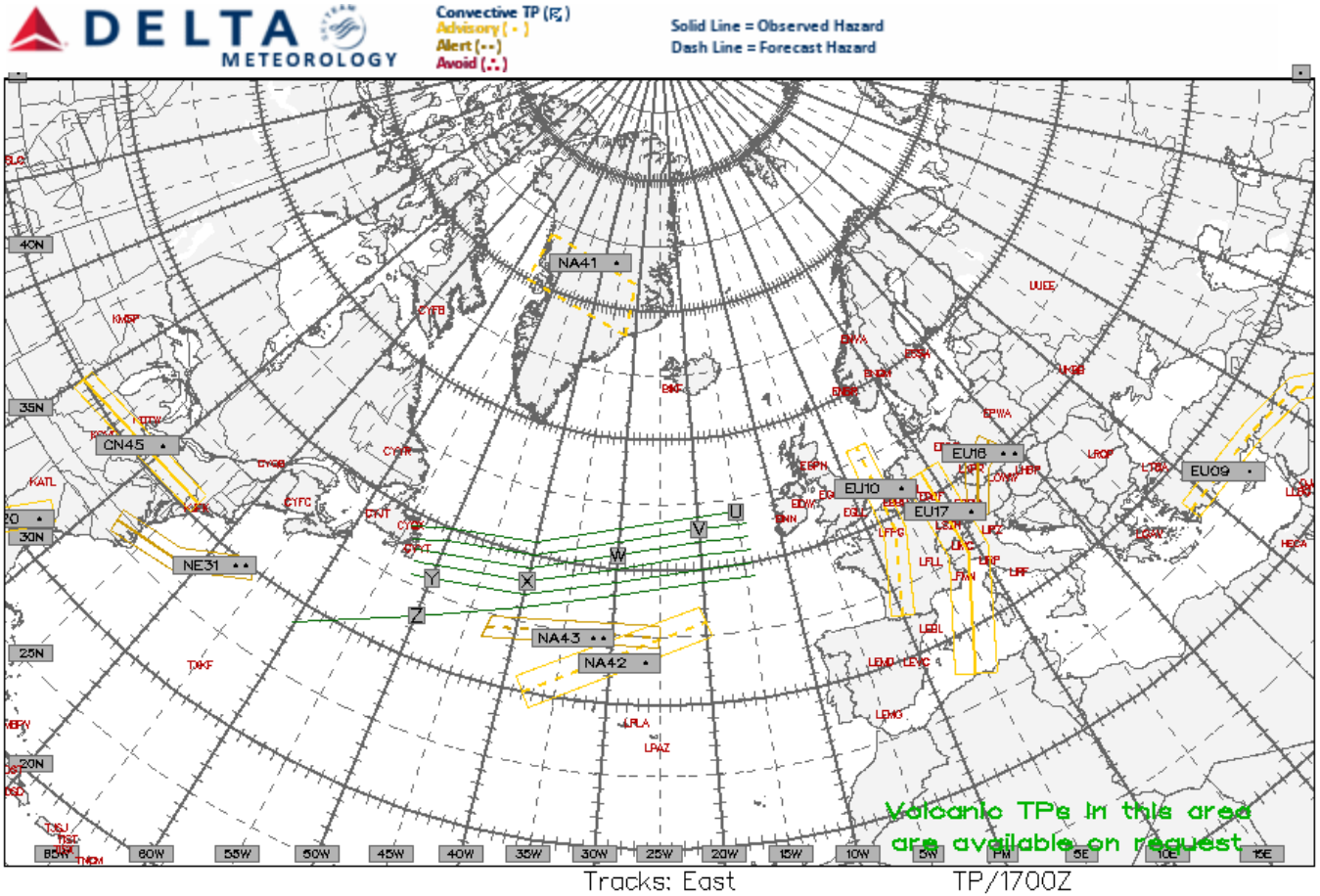
# En Route Hazards – Depictions

The Upper Air Depiction is a strategic flight planning tool that is issued before the first flight in the bank departs. They are created for anywhere Delta flies.



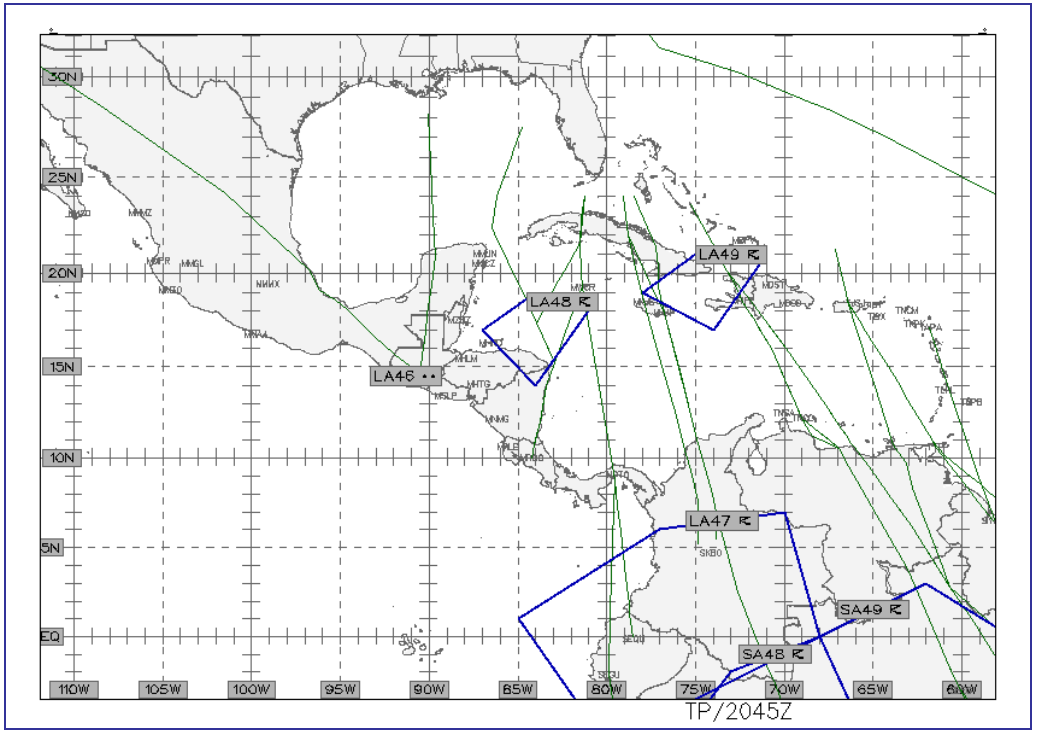
# En Route Hazards – TP's

Turbulence Plots (TPs) are tactical flight planning/ flight following tool that are issued and updated as conditions warrant and contain most current info.

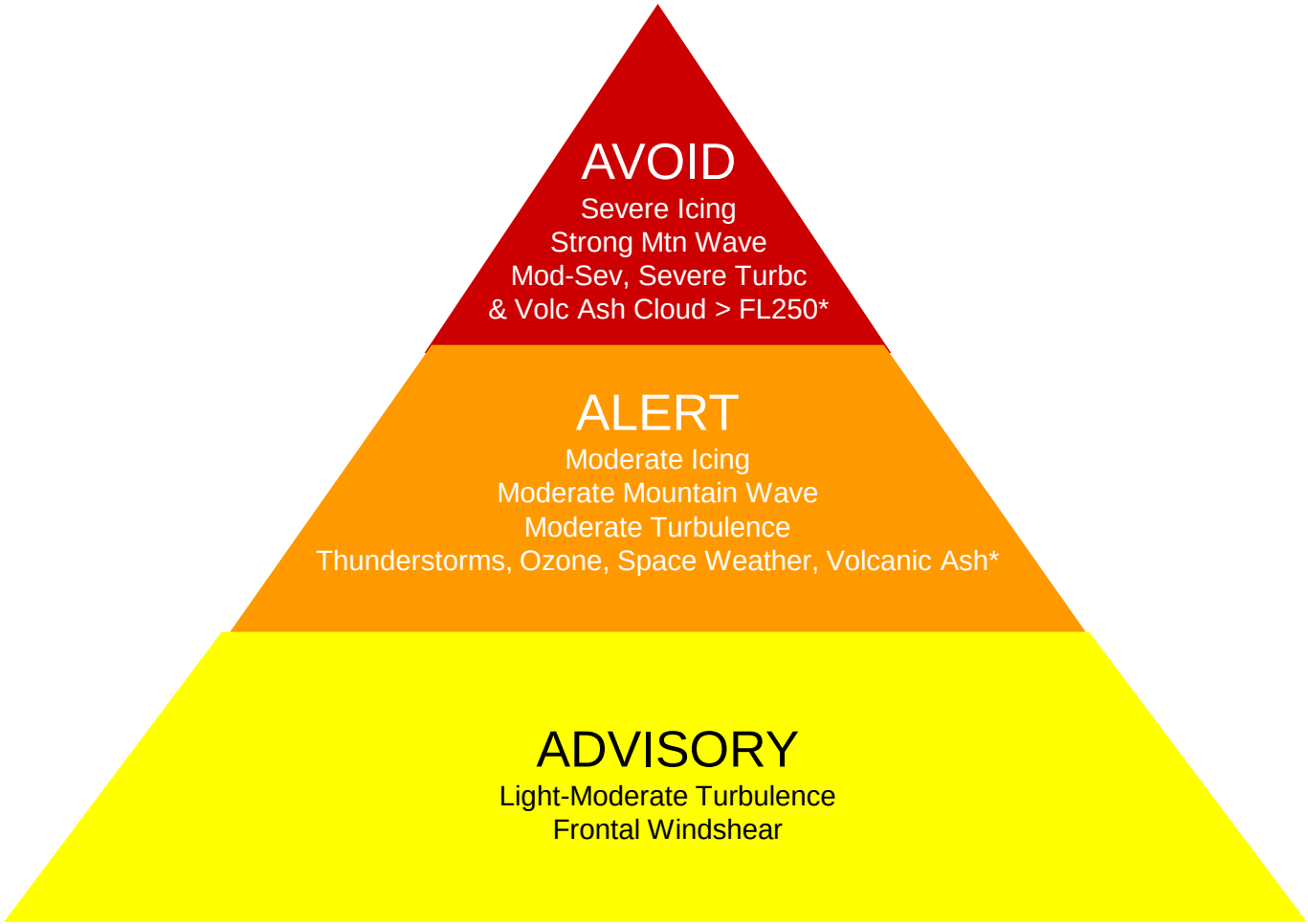


# TP's Benefits

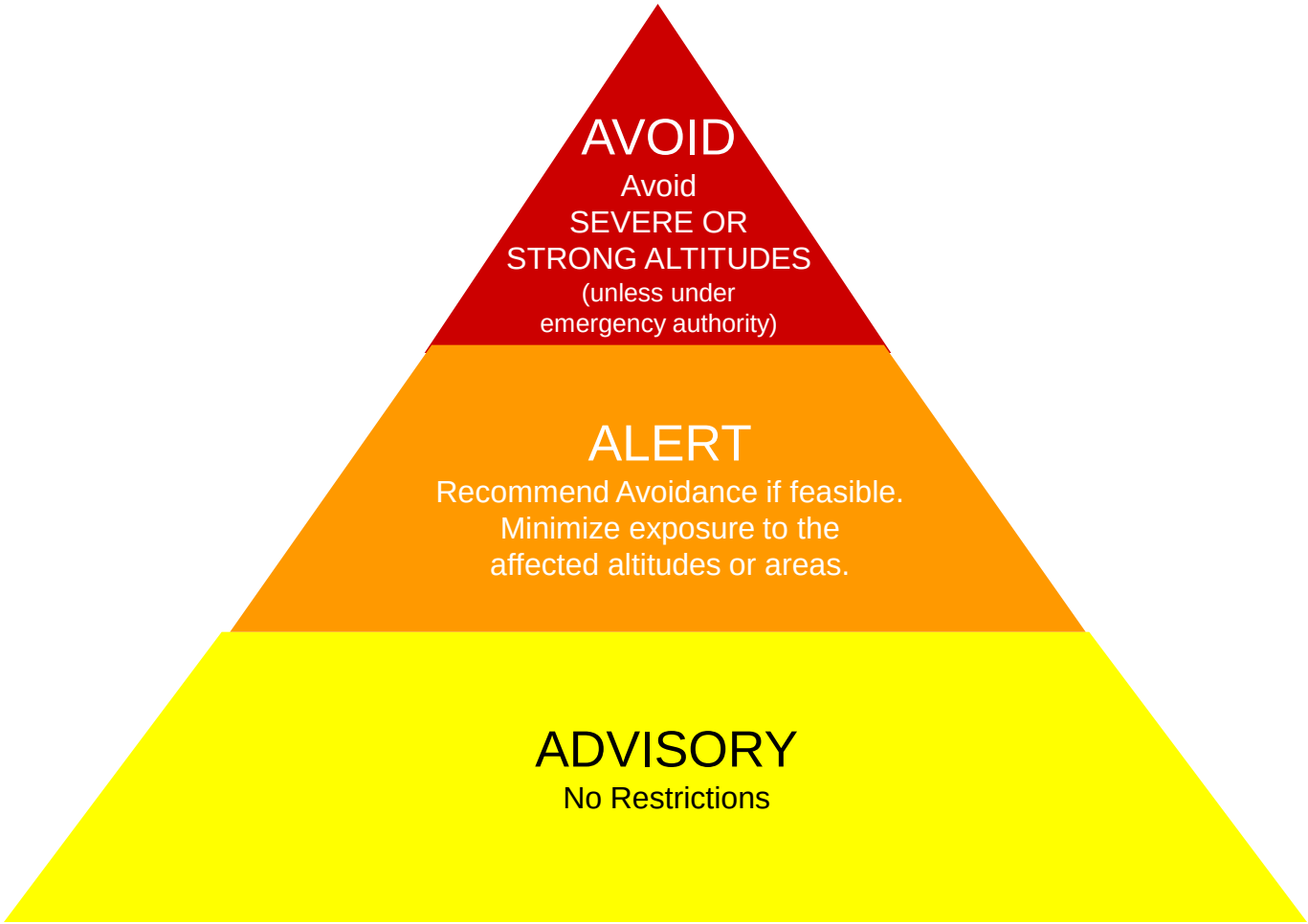
- Consistent product no matter where in the world
- All hazards
- Delta size aircraft
- Updated as needed



# TP Types and Hazard Intensity



# Avoidance Policy and Procedures



What tools do Delta Meteorologist use to create these manual and human-in-the-loop products?

SK

# Meteorology Tools – Looper

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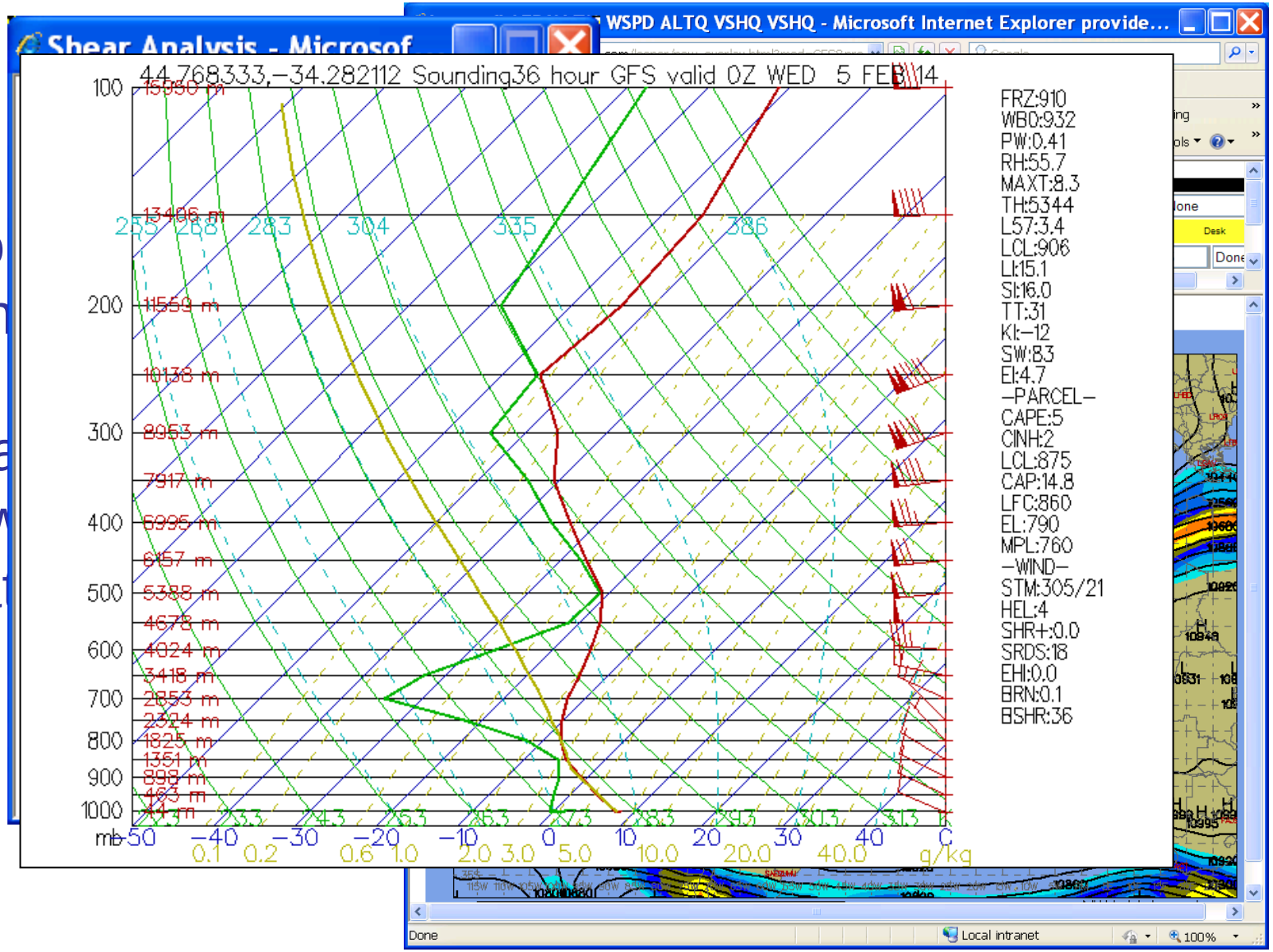
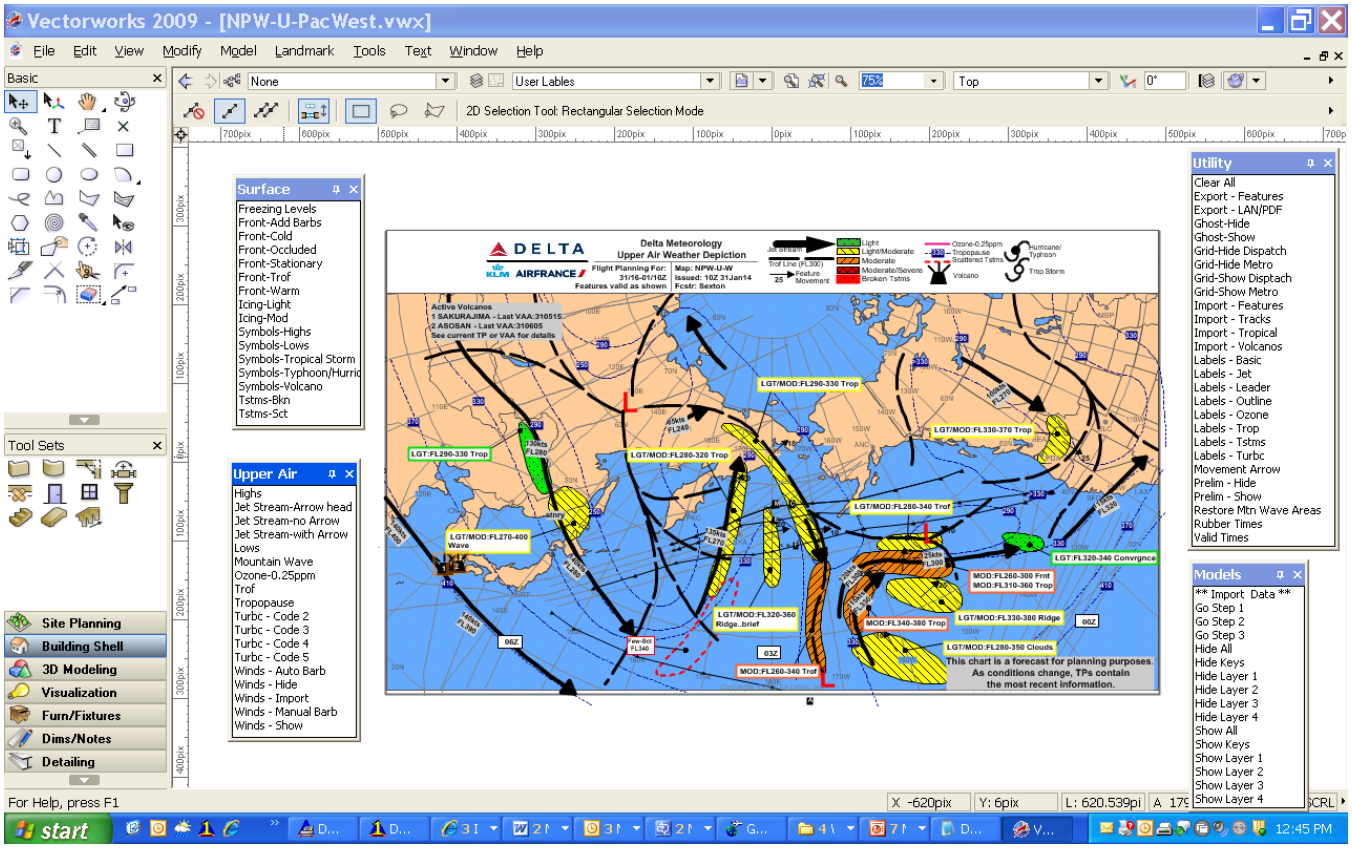


# Meteorology Tools – Vectorworks

Upper Air Depictions manually drawn in VectorWorks, CAD software heavily modified by Delta Technology for Wx Charts.

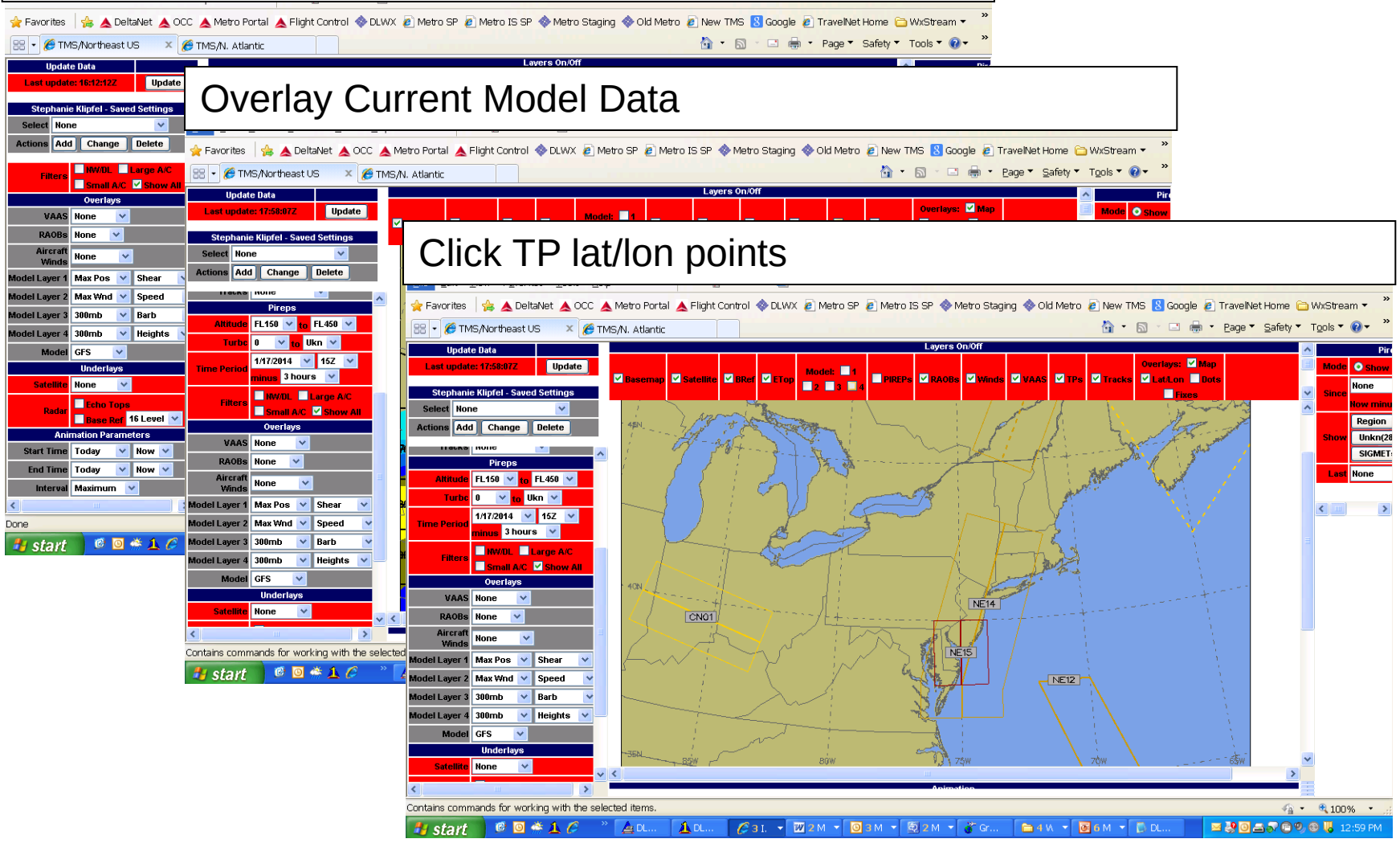


# Meteorology Tools – Turbulence Management System

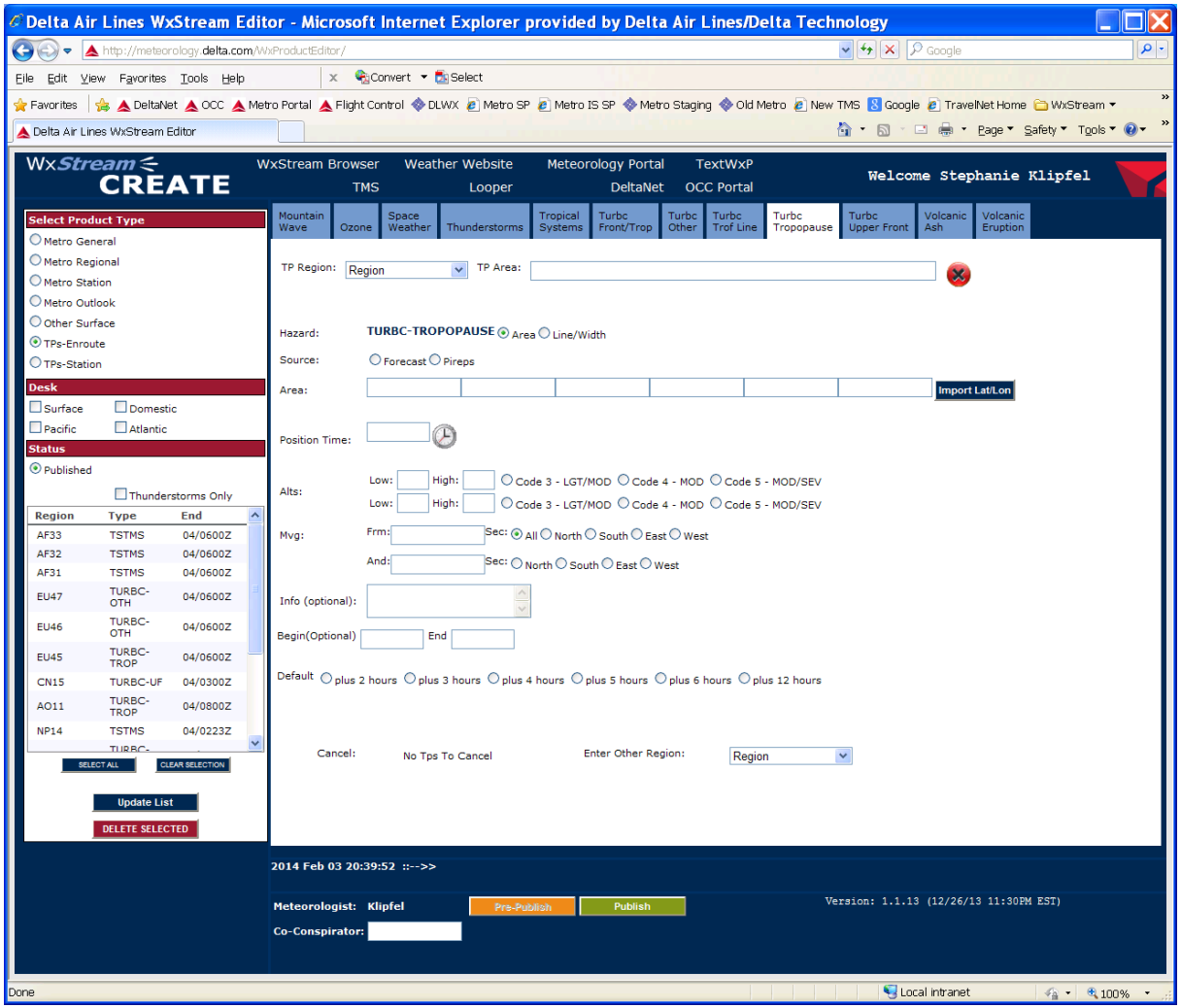
Plots PIREPS

Overlay Current Model Data

Click TP lat/lon points



# Meteorology Tools – WxStream




Template for all our products: Import TP lat/lon from TMS.

# How do weather products get distributed at Delta?

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# Who’s Responsible?

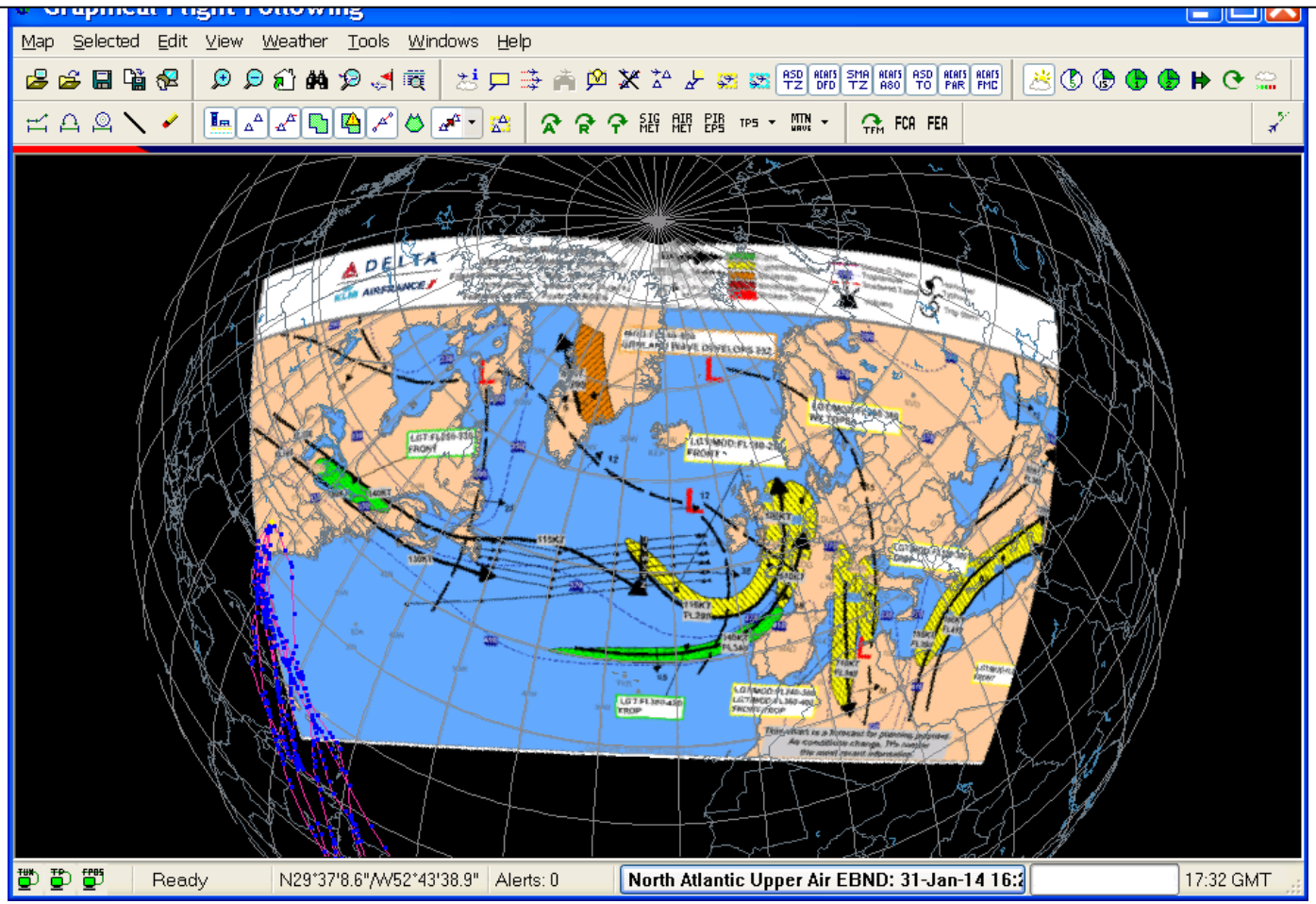
The Dispatcher and Pilot-in-Command are jointly responsible for the preflight planning, delay and dispatch release of a flight in compliance with Part 121 and the Operations Specifications.

The Dispatcher is responsible for:

- Monitoring the progress of each flight.
- Issuing necessary information for the safety of the flight.
- Canceling or re-dispatching a flight if, in their opinion or the opinion of the pilot-in-command, the flight cannot operate or continue to operate safely as planned or released.

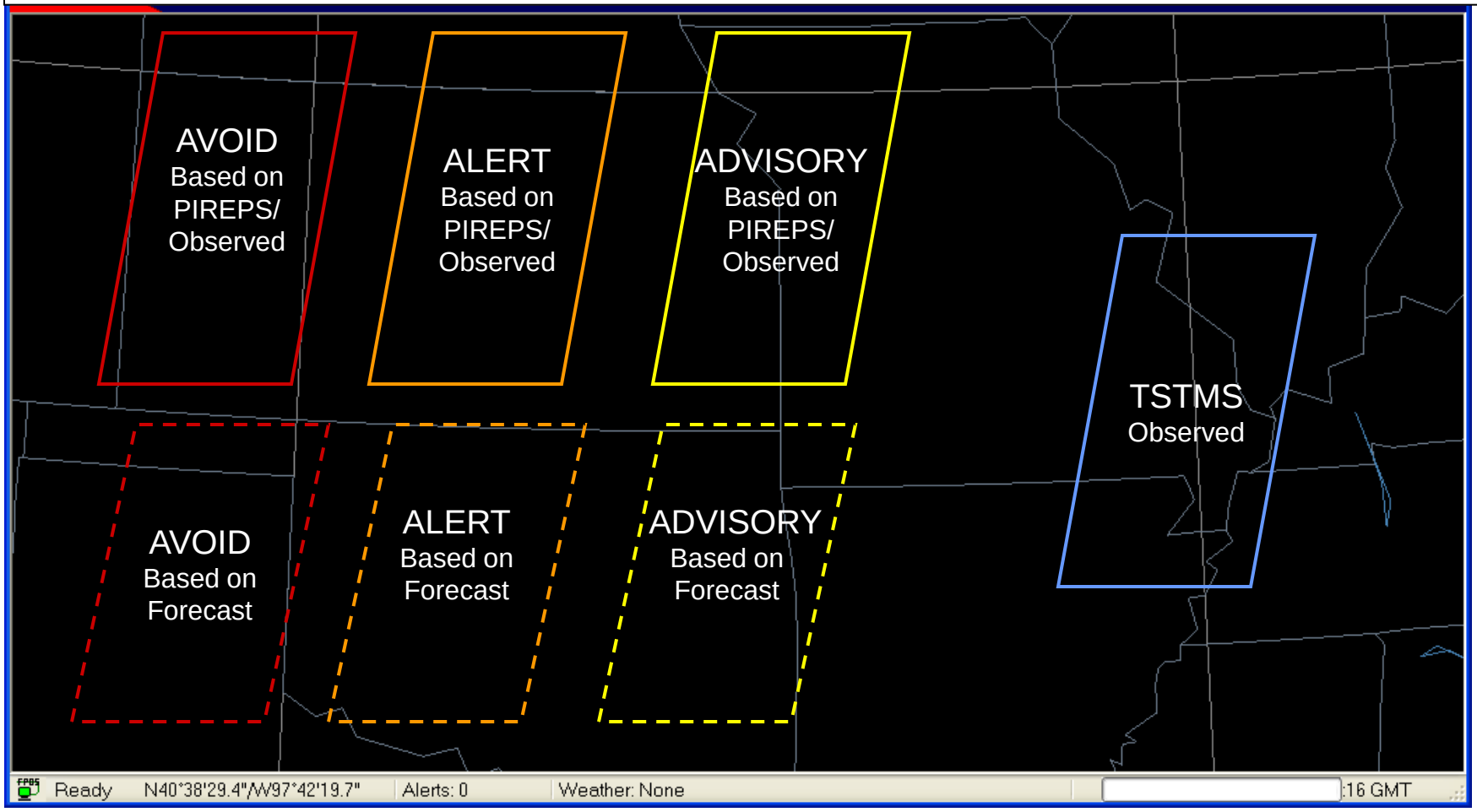
# Depiction Distribution to Dispatchers

Upper Air Depictions can be an overlay on Graphical Flight Planning tool

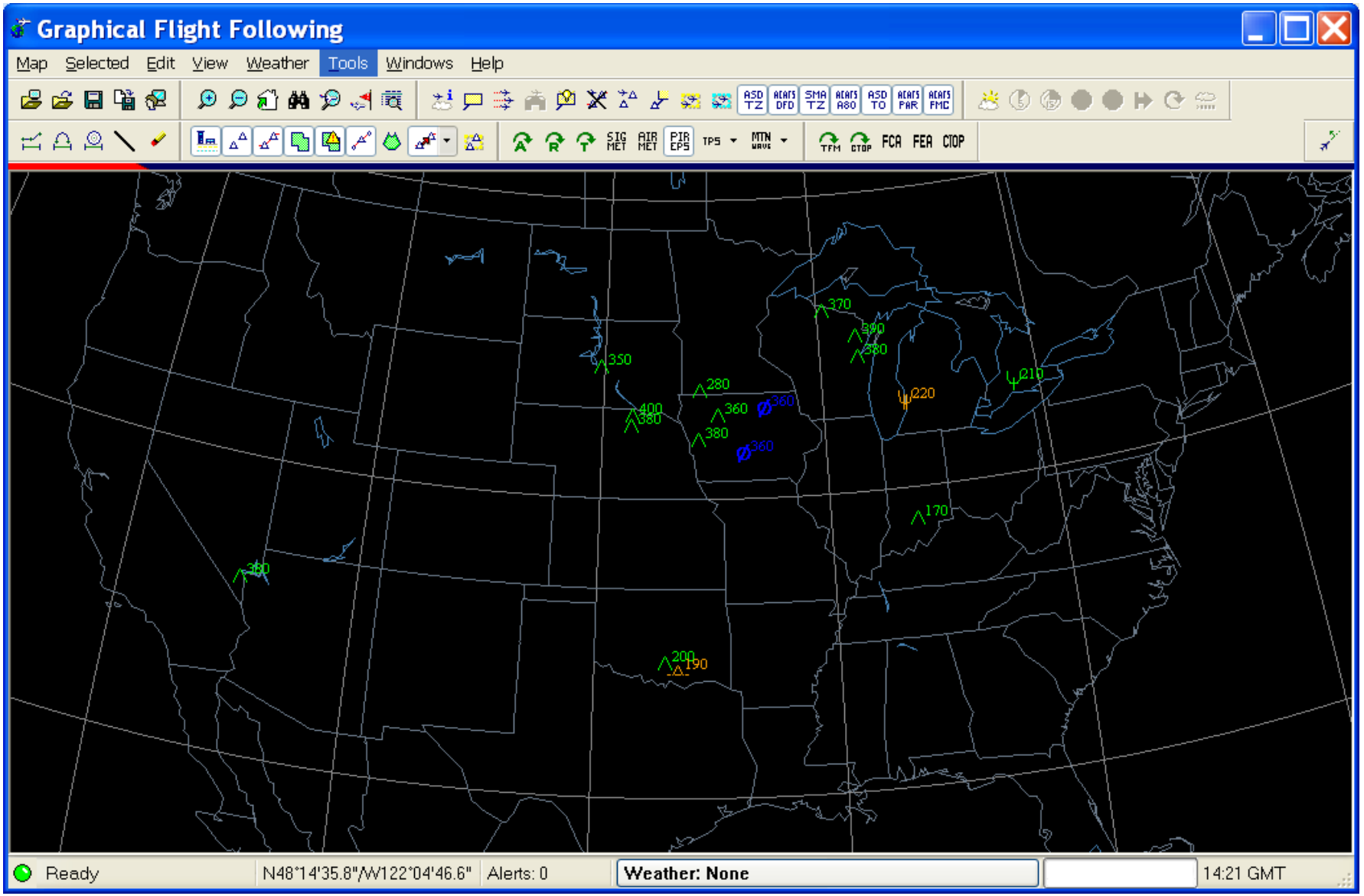


# TP Distribution to Dispatchers

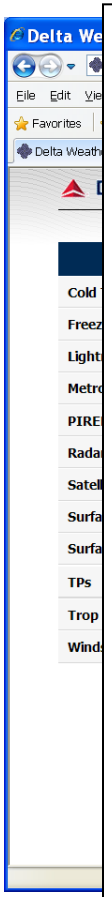
As soon as TP's are issued, they are sent to the applicable dispatcher queue and displayed on GFF.



# PIREP Distribution to Dispatchers



# Product Distribution to Pilots - Preflight




TP's are also included in every flights pre-flight paperwork

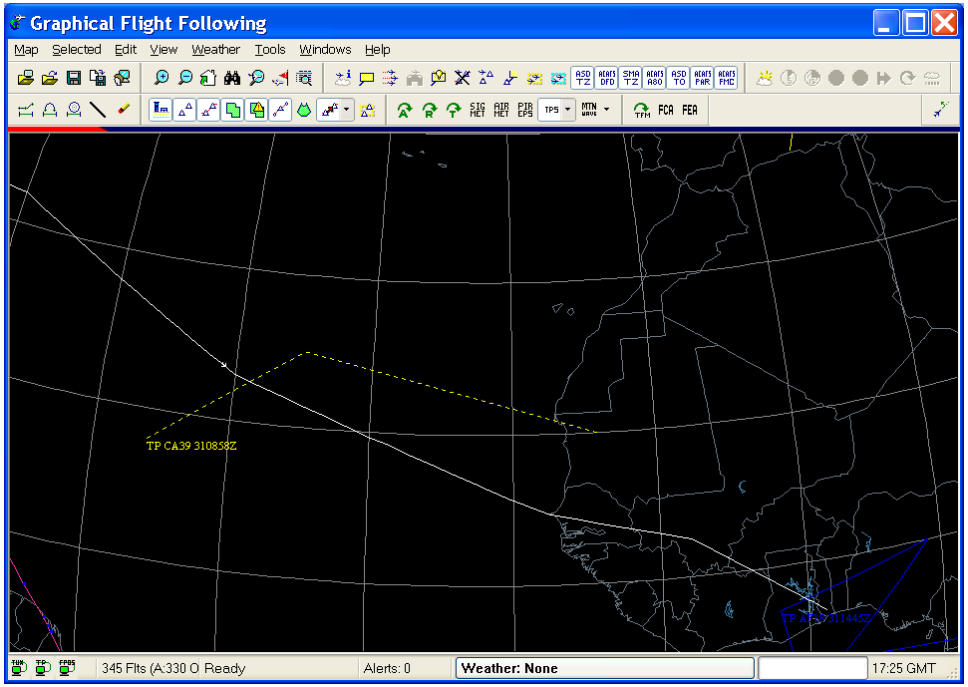
TPS-ENROUTE

```
NE13 271355-271755
     TP NE13 271355Z
     1.OH PA WV
     2.* ADVISORY *
     VOR:HVQ EWC
     HAZ:TURBC-OTHER
     SOURCE:PIREPS
     LINE:39N082W 41N080W
     WIDTH:125NM
     TIME:POSN AT 27/1353Z
     ALTS:FL320-380 LGT/MOD
     MVG FROM:STNRY
     INFO:AREA OF
       CONVERGENCE
     3.VALID 271355Z/271755Z
     4.CANCEL NONE
```

her Depictions,
& other weather
ucts are available
e intranet.

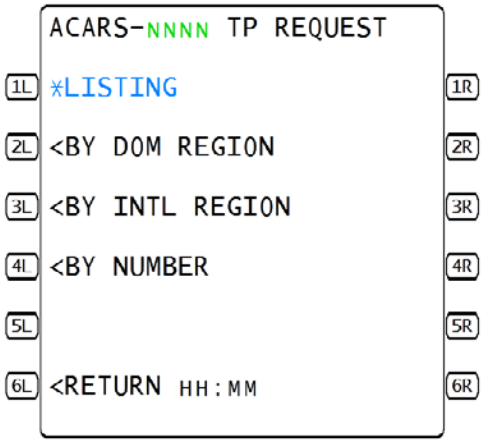
ternational flights
copy of Upper
epiction, TPs
ilot reports prior
parture.

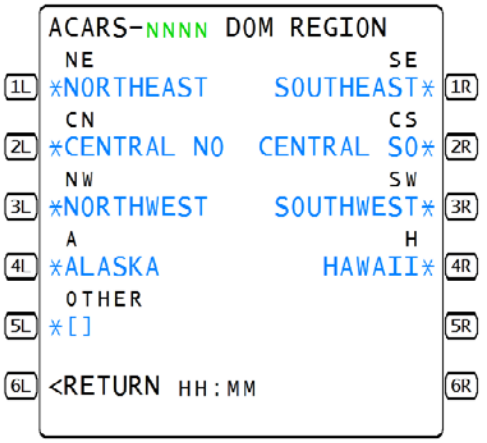
# Product Distribution to Pilots – En Route




When a TP issued/updated and is along the route of a flight in progress, the dispatcher manually sends and adjust plan if needed.

Pilots also have the ability to request TPs thru ACARS



# What’s Next?

SK

# Integrating Human & Model Forecast

Take advantage of advances in technology to move Delta into a real-time graphical world.

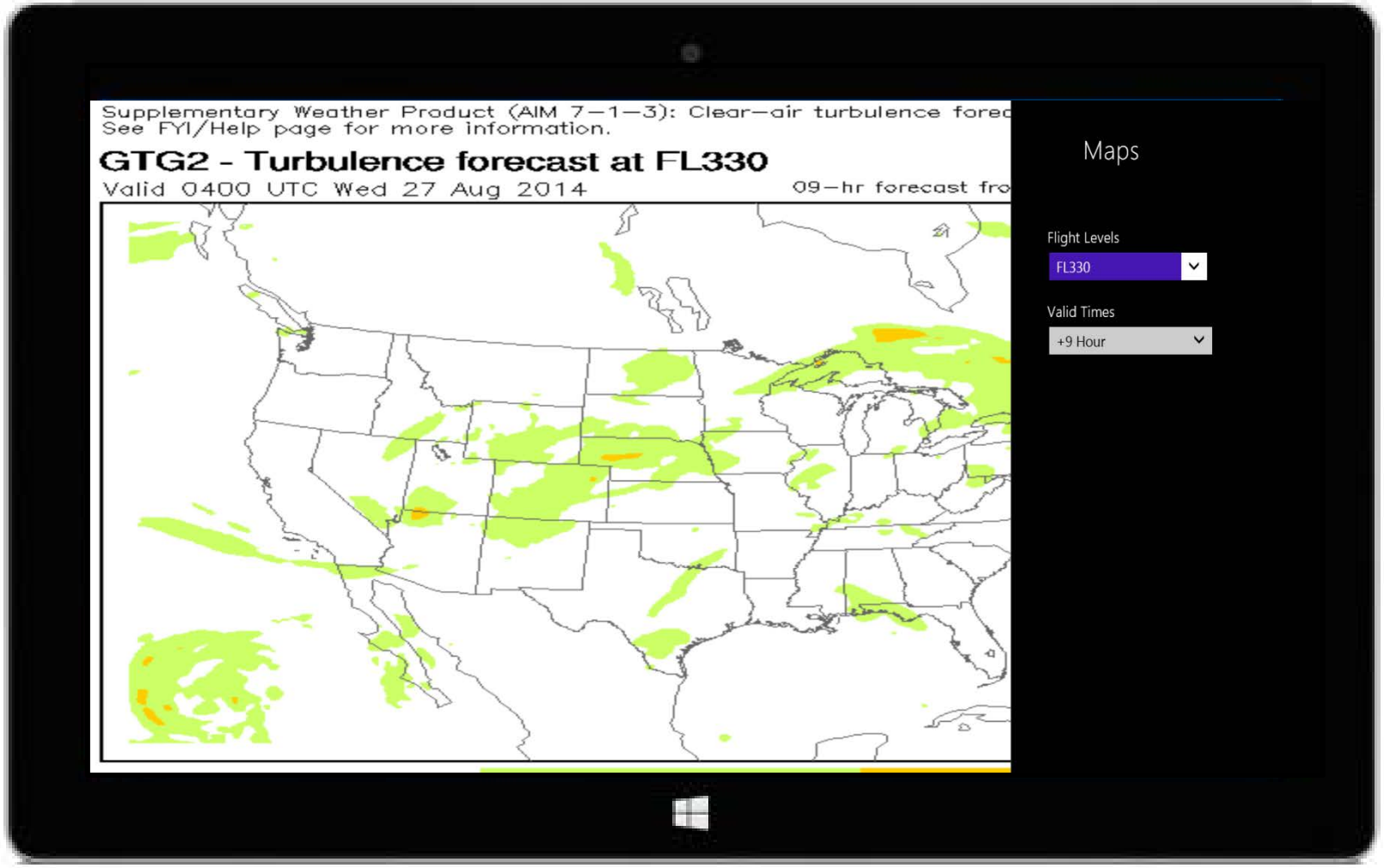
- Tablets in the cockpit
- Model based forecast

**Step 1:** Provide access to current products on tablet

**Step 2:** Enhance Products & integrate global data into dynamic display

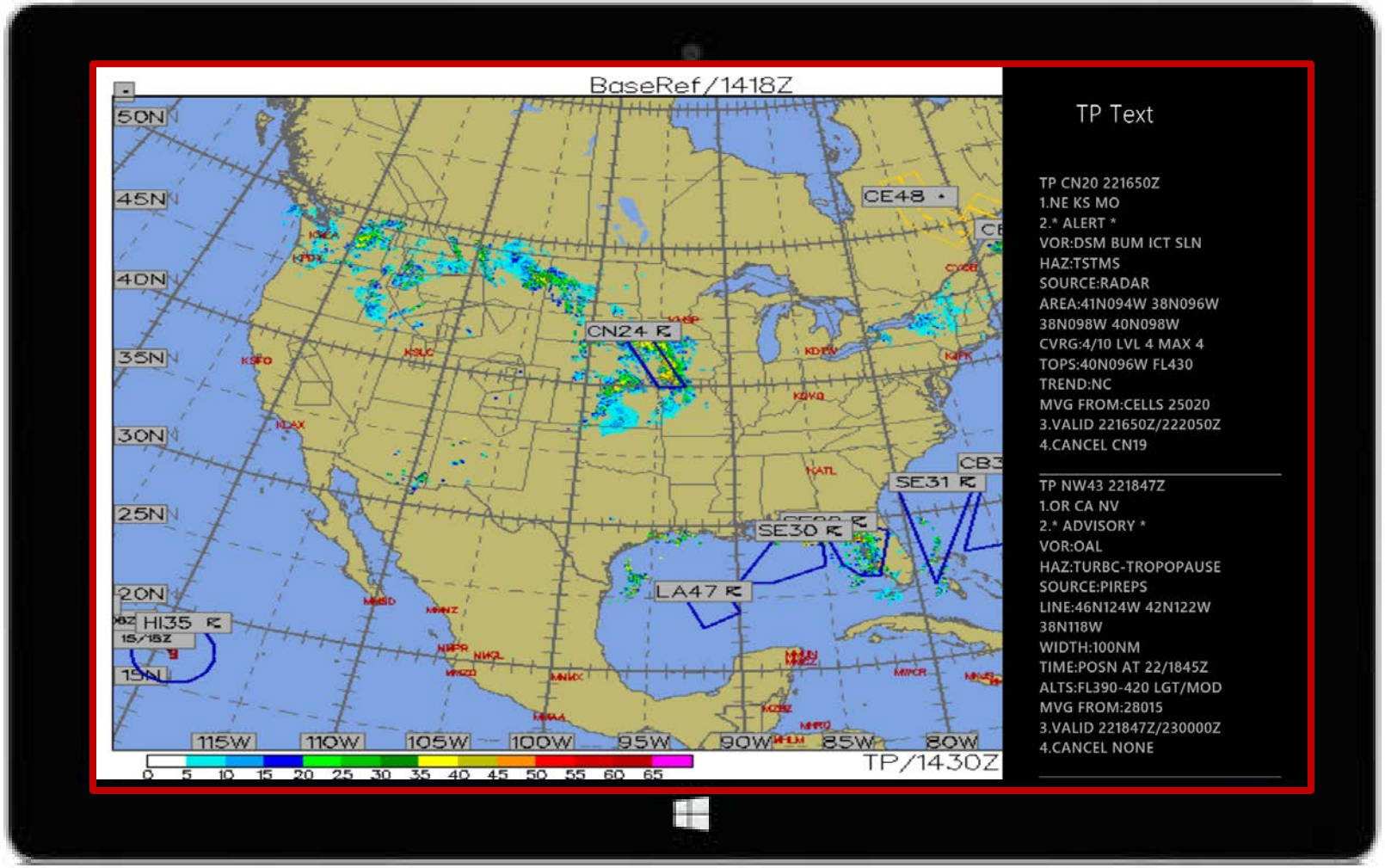
**Step 3:** Transition Meteorology to over-the-loop instead of manual & in-the-loop forecast and provide flight specific graphics

# Step 1: Provide Access to current products with prototype app




GTG Forecast available on the AWC website

# Step 1: Provide Access to current products with prototype app



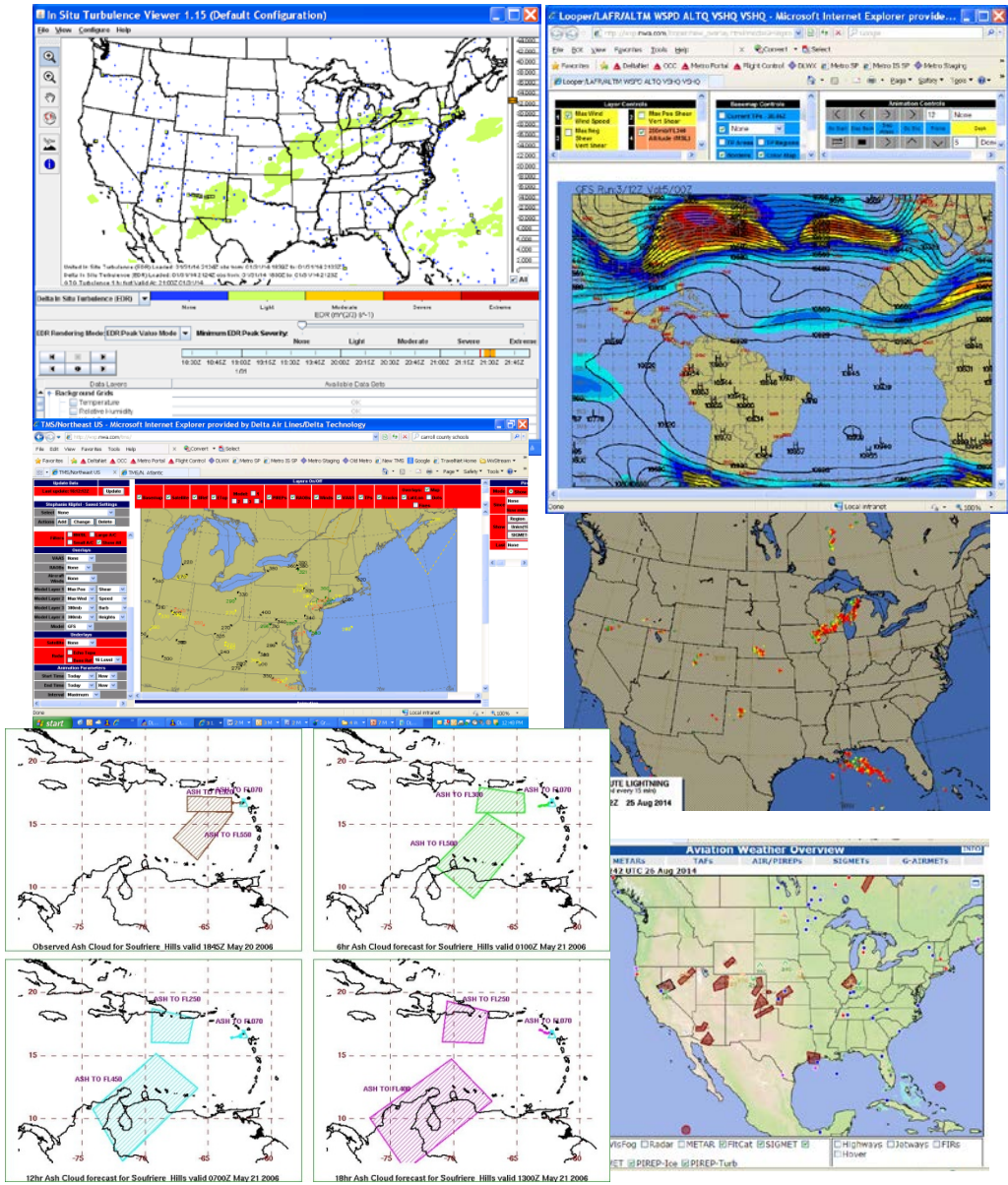

Delta Meteorology TPs (graphic & text) with radar overlay

# Step 2: Enhance Products & Integrate Data on a Dynamic Display

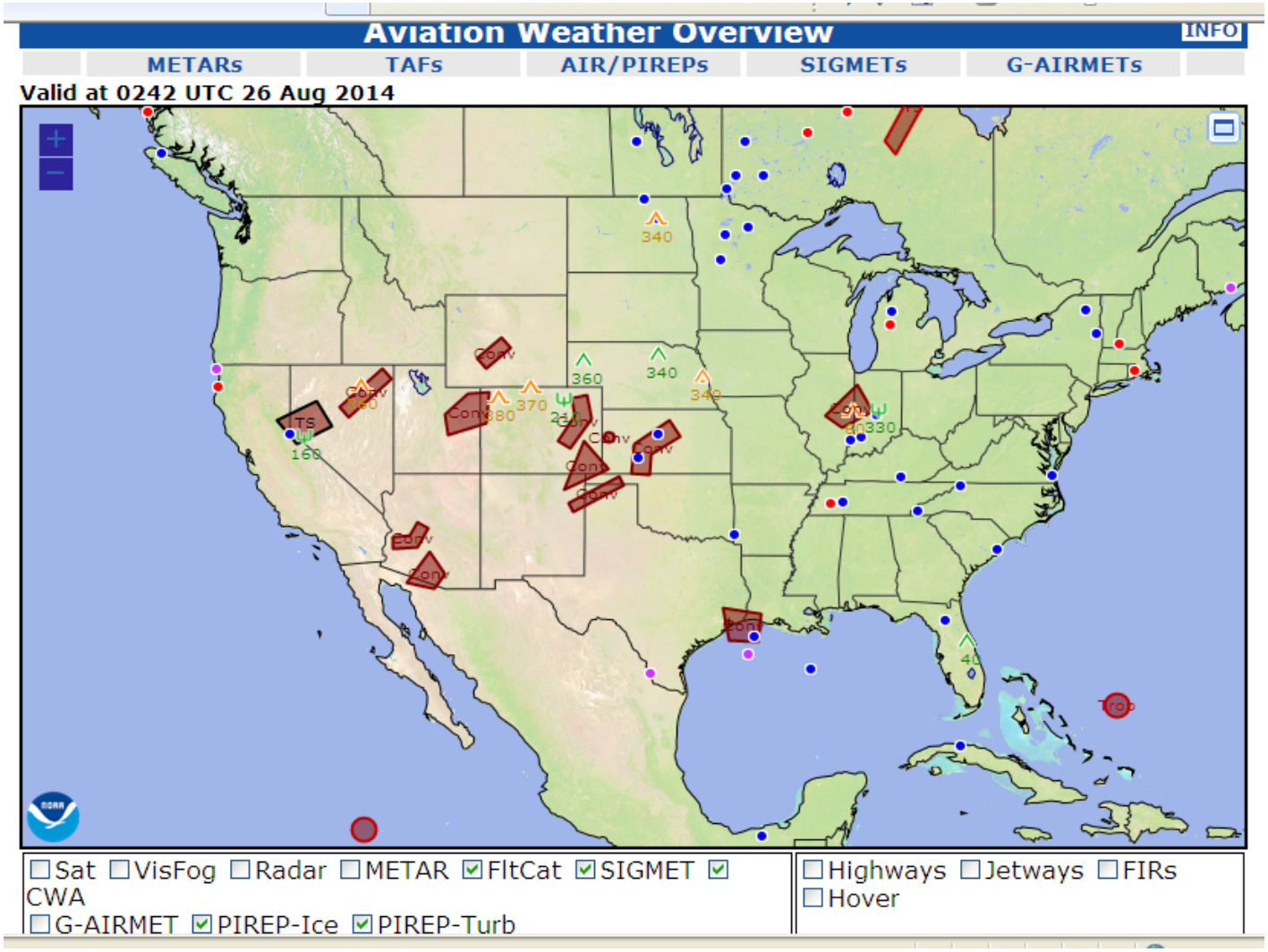
Build a system that can integrate global data:

- Model data, including GTG
- TP's & Depictions
- Turbulence Reports, including traditional and auto-generated
- Satellite
- Lightning
- Radar
- SIGMETS
- Volcanic Ash Advisory

Develop tools for pilots, dispatchers & meteorologist using same data for common operation picture.

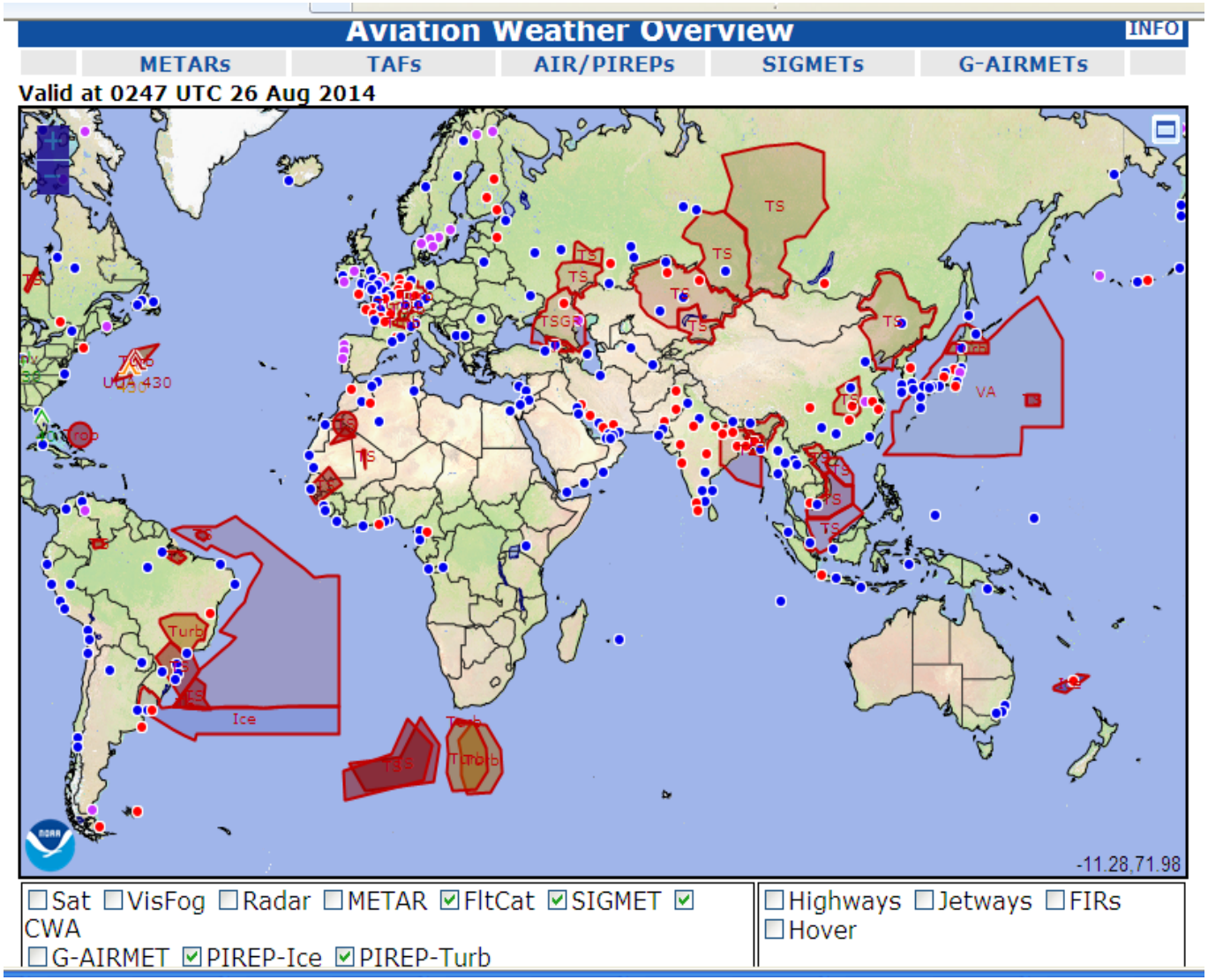


# Aviation Wx Center
# Display Capability Excellent & Detailed Info



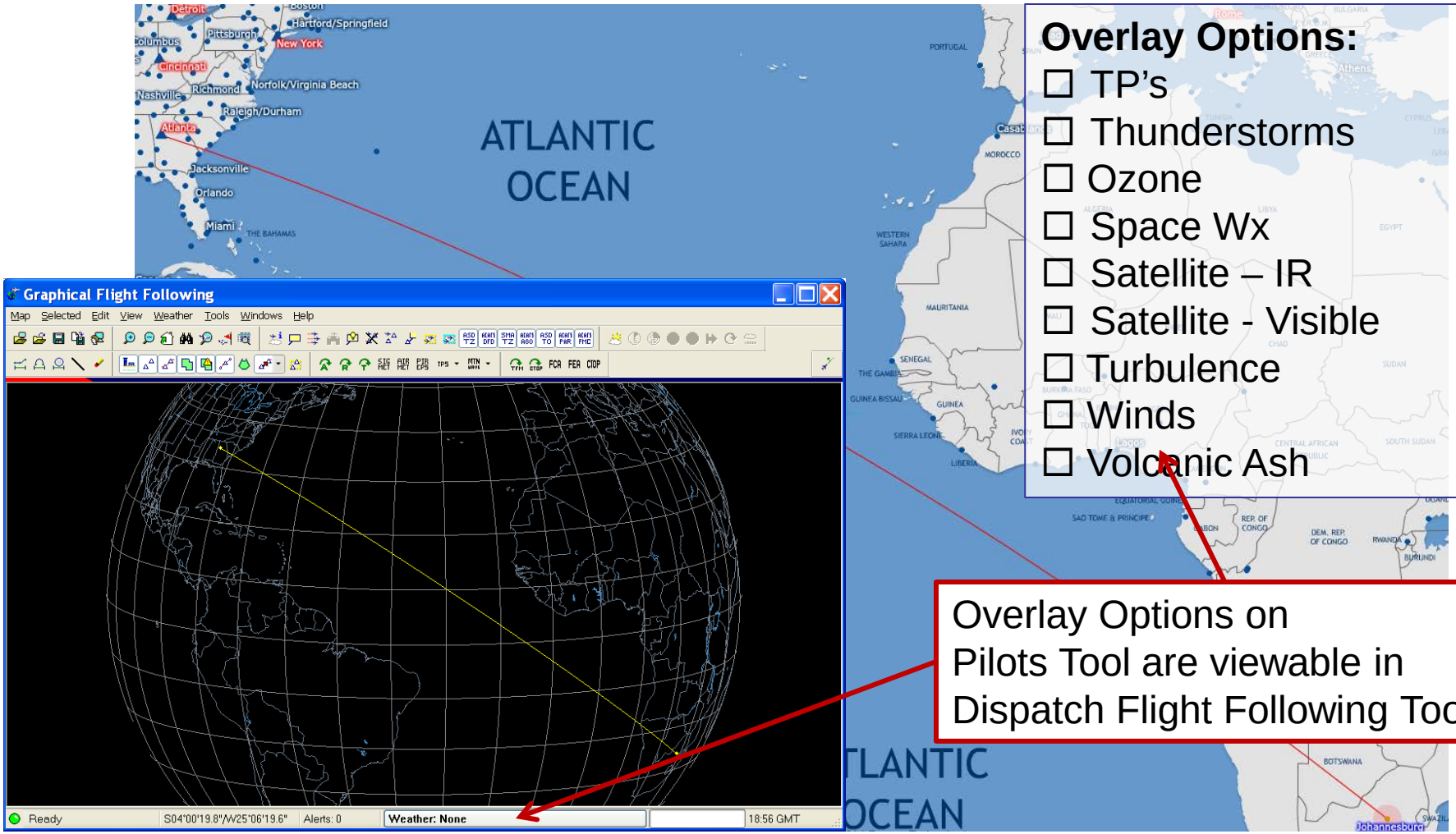

- Detailed & consistent information over US
- Dynamic display with overlay options

# Aviation Wx Center
# Global Products lack Consistency



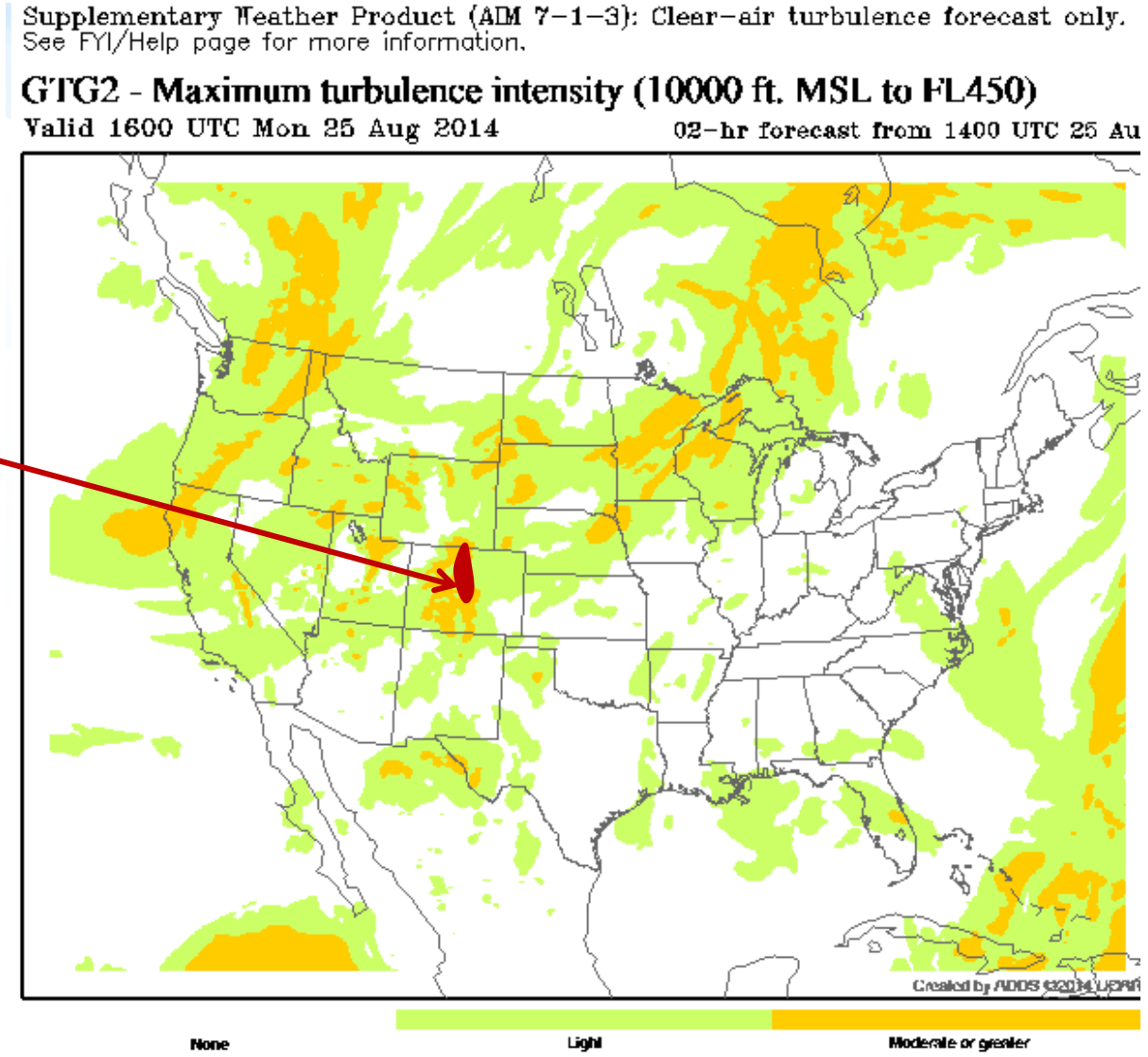

- Global Products lack detail and consistency
- Can not integrate Delta Meteorology Forecast

# Step 2: Enhance Products & Integrate Data: All Hazards for a Global Operation



# Step 3: Transition Meteorology to Human Over The Loop as Models Improve

Delta Meteorologist thinks there is potential severe turbulence and can increase intensity.

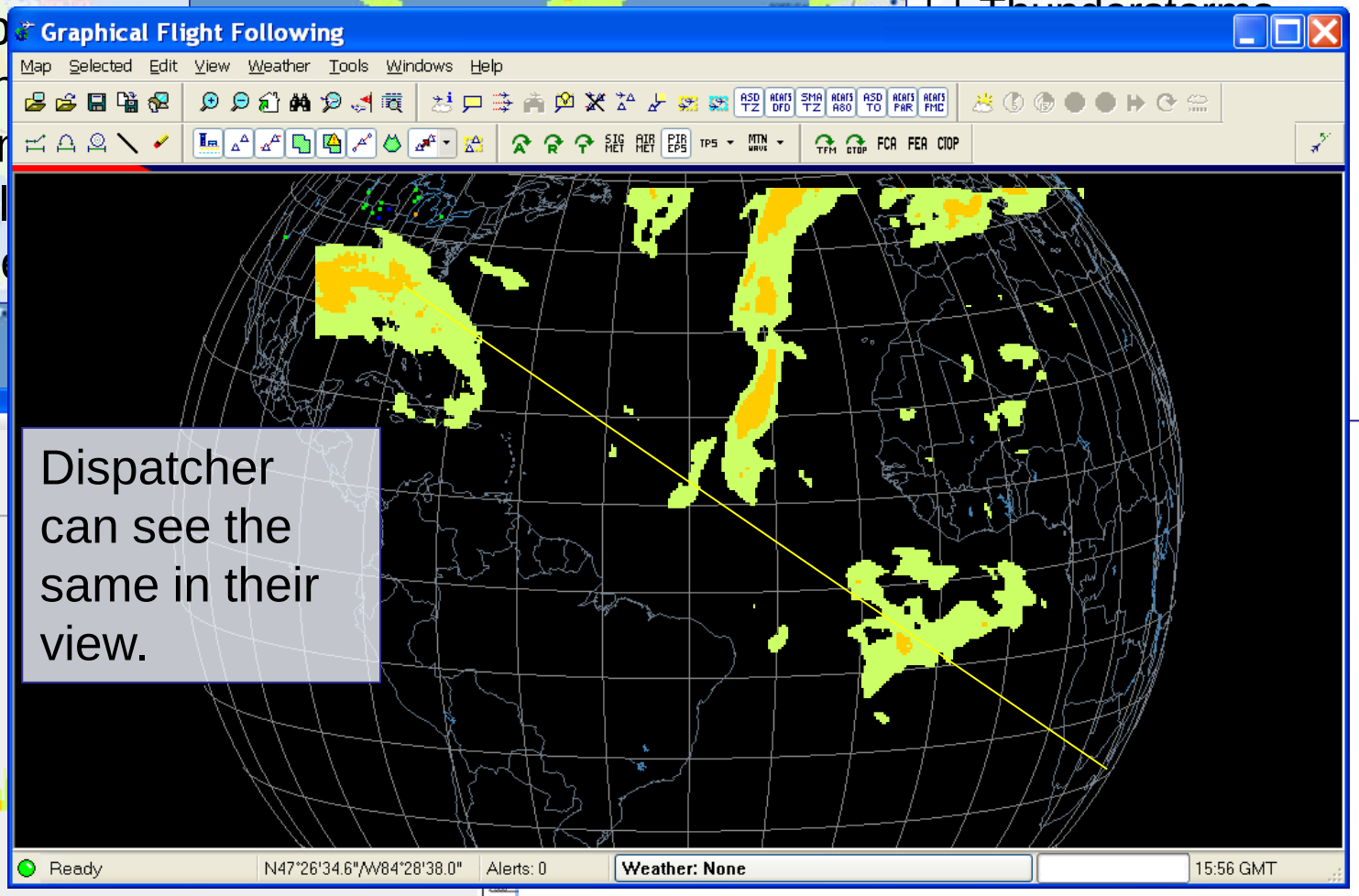


# Step 3: Flight Specific Graphics

Pilot can enter the flight number and see p
along with
hazards in
horizontal
vertical vi

**Overlay Options:**

- ☐ TP's
- ☐ Thunderstorms




Dispatcher can see the same in their view.

# Turbulence Forecast Challenges

# Process Challenges

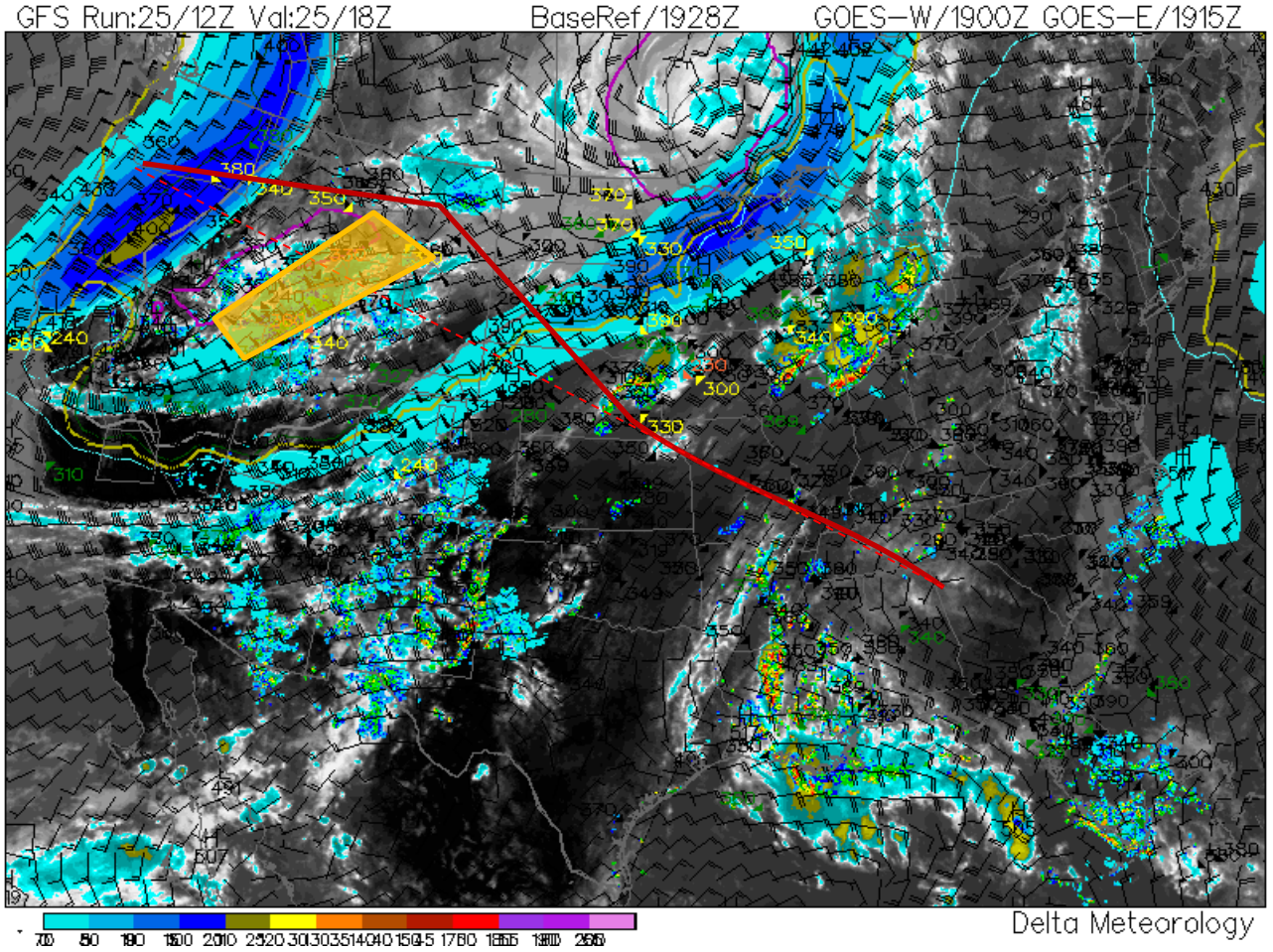
- Rapidly Changing Conditions and changing plans
  - Current: TP are pushed for notification
  - Future: Alert based on exceeding thresholds along the flight route
- Meteorologists editing 4-d gridded parameters on a global scale
- Meteorologists keeping situational awareness--Understanding why there is turbulence

# Turbulence Forecasting Challenges

- Able to Locate large area favorable for Turbulence
- Difficult to resolve detail:
  - exact location, timing & intensity
- Need Forecast Model Improvements
- Applying gridded based values to impact on different size aircraft

# Human Factor Challenges

## Managing data displays to highlight significant operational impacts



# Model & Human Produced Forecasts
# Delta's Goals

- Delta would like to Team with other org's to:
  - Compare Current Turbulence Forecast Methods:
    - Models (GTG & others)
    - Manual Forecasts
  - Evolution of Integrating Model(s) & Human input:
    - Human-in-the-Loop
    - Human-over-the-Loop &
    - Eventual Exclusive Use of Models for Turbulence Forecasting

# Conclusion

- **Observations**
  - AOC's as well as Pilots need EDR Access
  - We need a balance between simple & complicated
  - Both g-load & EDR info are useful.

- **Evolution of Turbulence Forecasting**
  - Delta's goal: Transition to Reliance on Models and Human-Over-the-Loop
  - Similar Evolution path as wind forecasts
    - » From manual to completely automated
- **Create common operating picture between AOC's and pilots for all hazards on global scale**
- **In 2040 will Turbulence be an issue?**