

A network diagram consisting of numerous blue circular nodes of varying sizes connected by thin blue lines, set against a dark blue background. The nodes are distributed across the frame, with a higher density on the right side.

**Panasonic**

# TAMDAR-Edge and Unmanned Aerial Systems

**FPAW**

**November 19, 2015**

# Panasonic Weather Solutions (PWS)

## A part of Panasonic Avionics Corporation

- Experience/Personnel:
  - 2 Locations:
    - Raleigh, North Carolina
    - Denver, Colorado
  - 12 years of operation
  - 40+ atmospheric scientists, meteorologists, and engineers (aviation & HPC)
- Technology and Intellectual Property:
  - Highly sophisticated and proprietary weather forecasting models
  - \$100M invested over the last decade, three key patents
  - Global, real-time communications and data management infrastructure
- Current Markets Served and Developing Relationships:
  - Airlines, Airport Operations, Utilities, Governments, Energy, Commodity Trading

**We are the *only* private entity on the planet that develops and runs custom global weather models**

# Panasonic 4D Weather

What makes a better weather forecast

Highest  
Value Data



Unmatched  
Data QC



Custom  
Modeling



Expert  
Meteorologists

Panasonic Weather Solutions leads the industry in each of these requirements and the resulting combination is superior weather forecasting

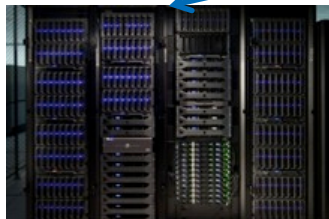
# Panasonic Weather Solutions

## Creation of a Better Weather Forecast

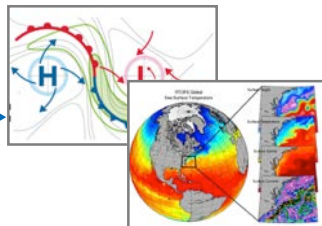
275+ PWS Sensor  
Equipped  
Commercial Aircraft



Iridium Global  
Data-Link Communication  
System



PWS Super  
Computers



4D Data Assimilation &  
High Resolution Weather  
Forecasting Models



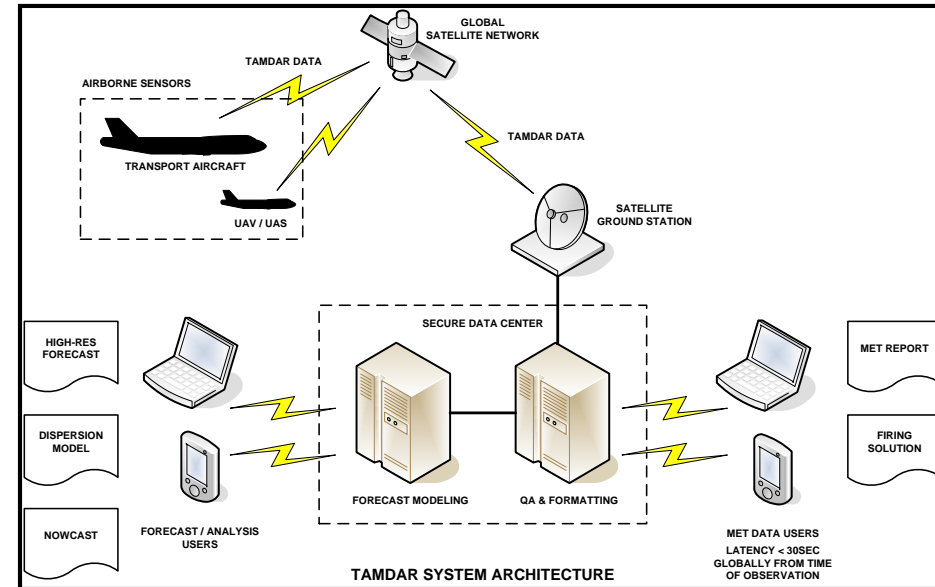
Custom Weather Products &  
Expert Meteorologists





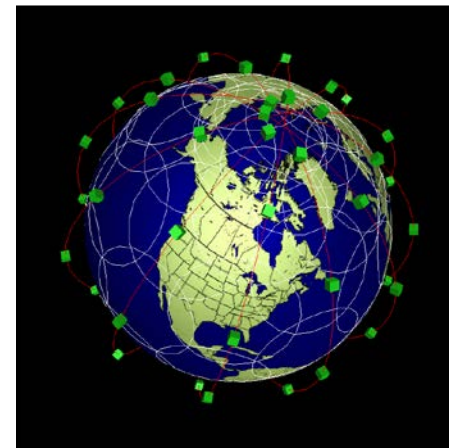
# Panasonic 4D Weather Global Atmospheric Data Acquisition → Superior Forecasting

- **Atmospheric Sensor**  
manned and unmanned
- **Iridium Communications**  
global, two-way, data link
- **Expert Wx Modeling & Forecasting**
  - data distribution and archiving
  - sophisticated multi-tiered data QA
  - custom, predictive weather models with 4-dimensional data assimilation
  - tailored solutions, including user interfaces and decision support tools



# Global Communications for UAS operations

- Bi-directional communication to any equipped aircraft at any altitude or location globally
- Low message latency (near real-time)
- Channel also available for:
  - ◆ Other payload data transmission
  - ◆ BLOS (global) command and control
  - ◆ Aircraft tracking
  - ◆ High security encryption possible

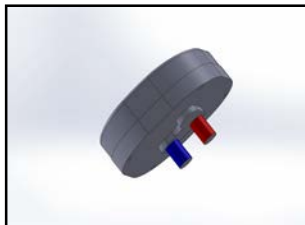


Iridium satellite constellation  
(global, secure, high availability)

# Previous TAMDAR-Edge Prototype R&D



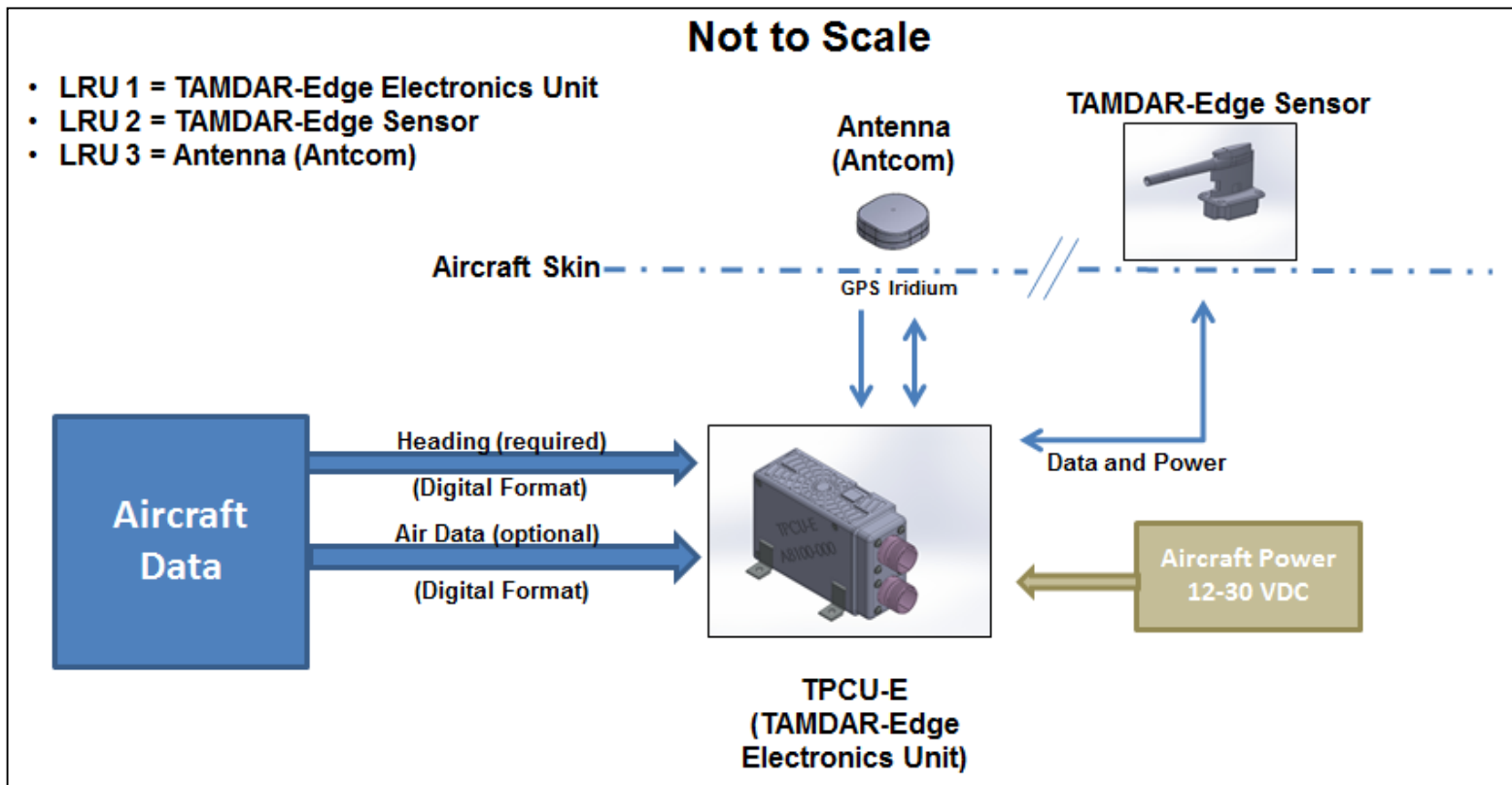
# TAMDAR-Edge Sensor Detail (SWaP)



Component	Size – LxWxH (in.)	Weight (oz.)	Current (mA) @ 28vdc Nominal/Max
TAMDAR-Edge Sensor Probe	6.6 x 2.0 x 3.3	4.0	75/1150
TAMDAR-Edge Electronics Unit	4.6 x 1.7 x 3.0	8.0	70/340
TAMDAR-Edge Antenna	2.1 x 2.1 x 0.75	2.9	N/A
<b>Total Power @ 28vdc</b>		<b>Total Weight</b>	
4 Watts (not heating) 30 Watts (heating maximum)		14.9 oz. (plus cabling)	



# TAMDAR-Edge Integration – Notional (3 LRUs)



# In-Situ Weather Reports

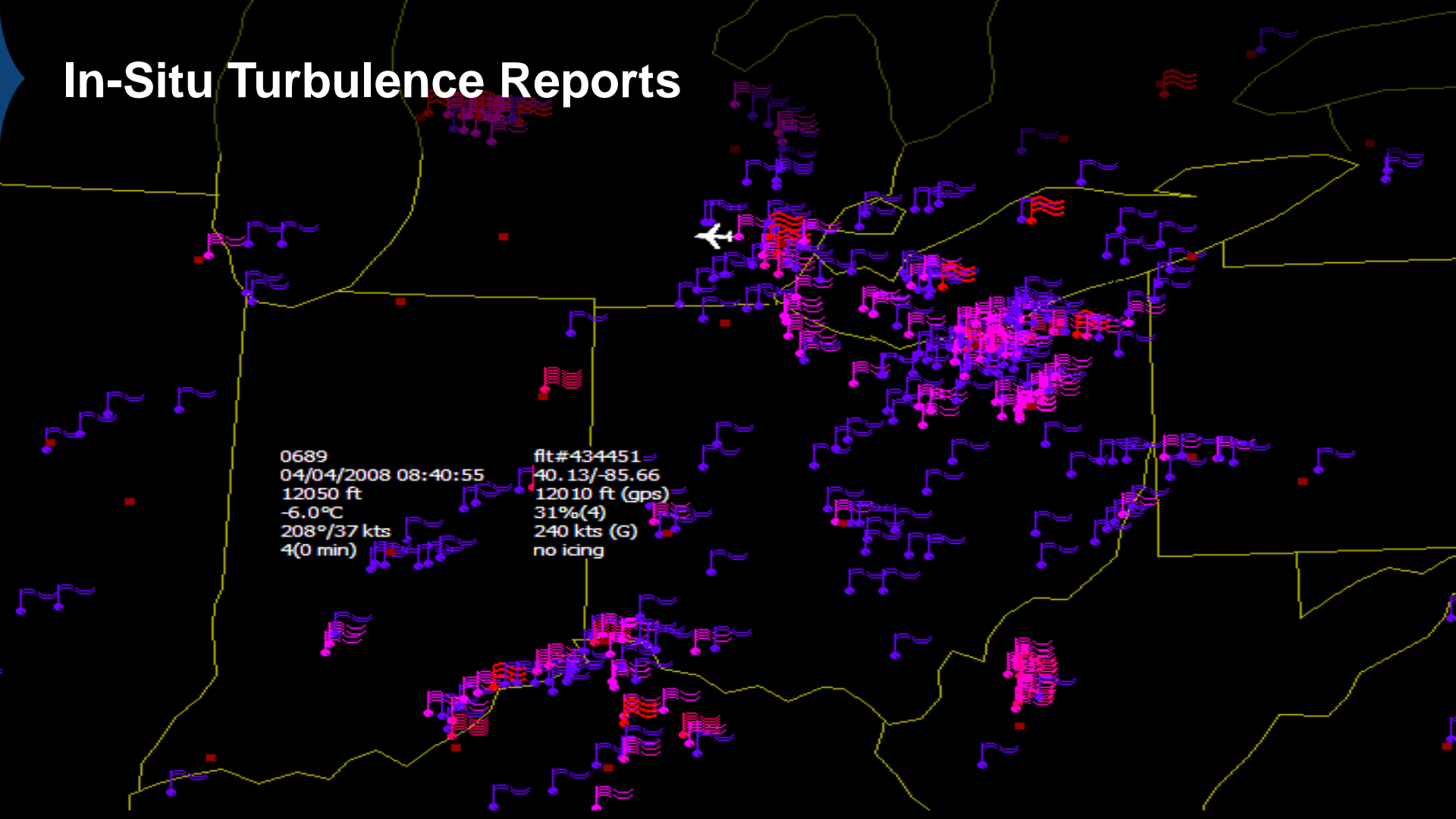


N839EX	0863
02/04/2011 16:18:07	41.01/-76.1
9960 ft	9770 ft (gps)
-6.2°C	15%(3)
272°/40 kts	212 kts (G)
0(2 min)	no icing

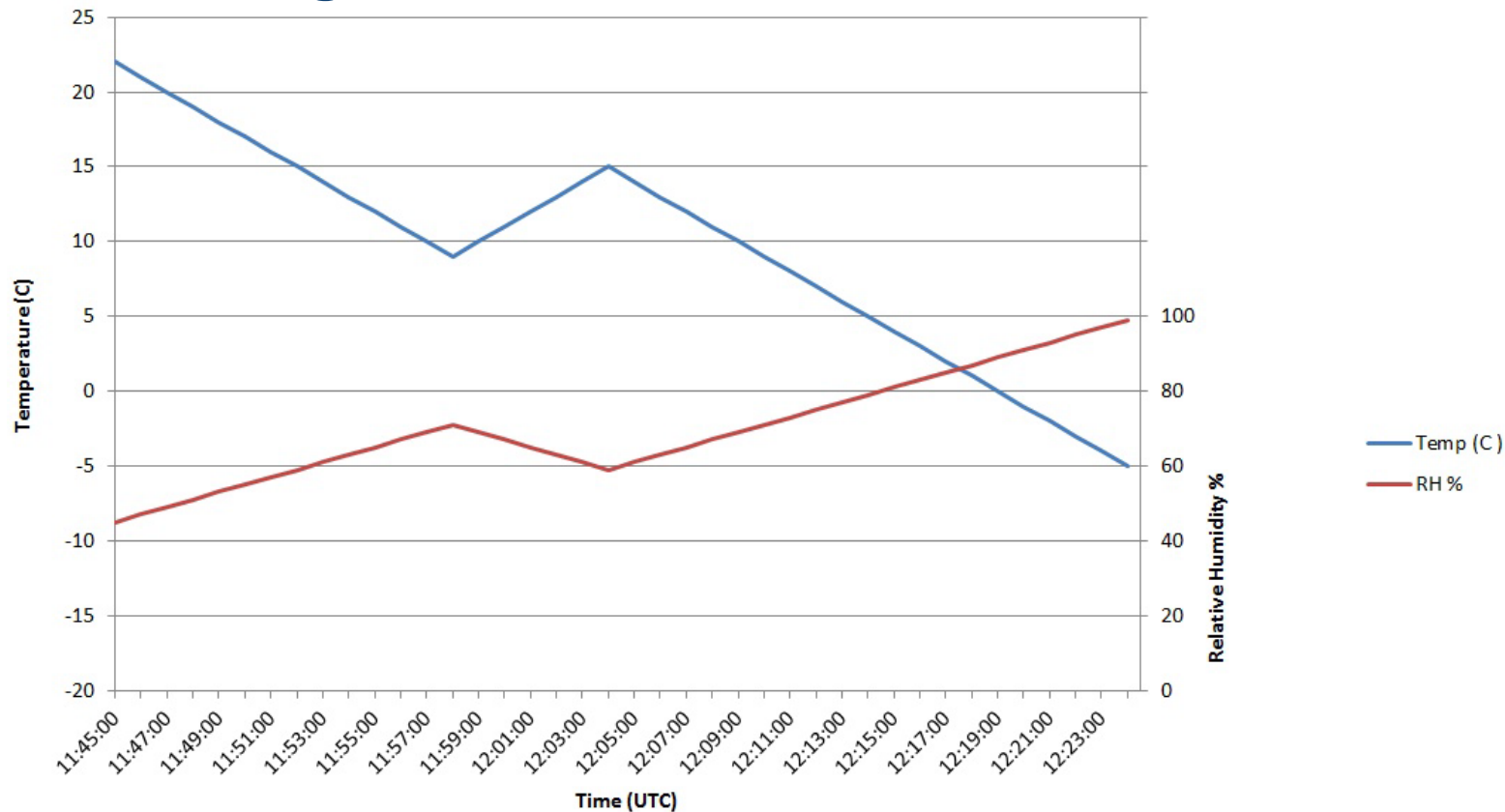
# In-Situ Turbulence Reports

0689  
04/04/2008 08:40:55  
12050 ft  
-6.0°C  
208°/37 kts  
4(0 min)

ft#434451  
40.13/-85.66  
12010 ft (gps)  
31%(4)  
240 kts (G)  
no icing



# Icing Watch Dog

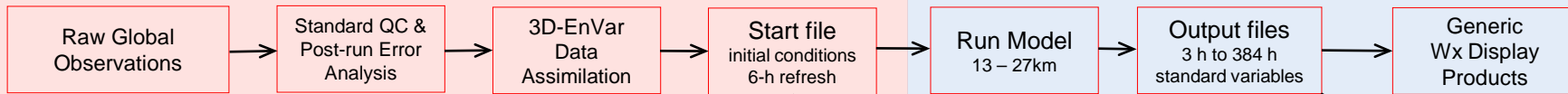


# Steps to Generating Superior Forecasts

## Higher Importance

## Lower Importance

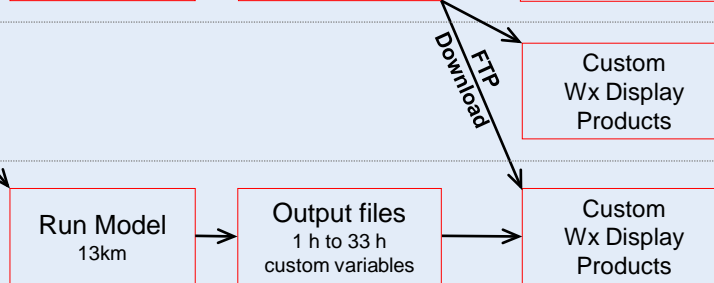
### NOAA/NWS



### Web providers, weather applications

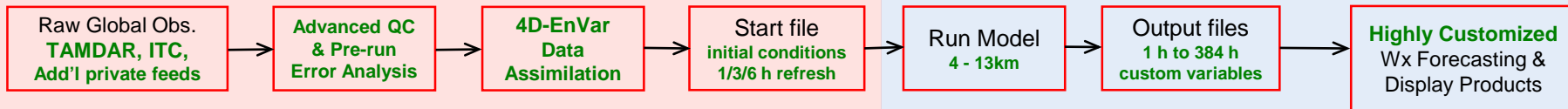
FTP Download

FTP Download



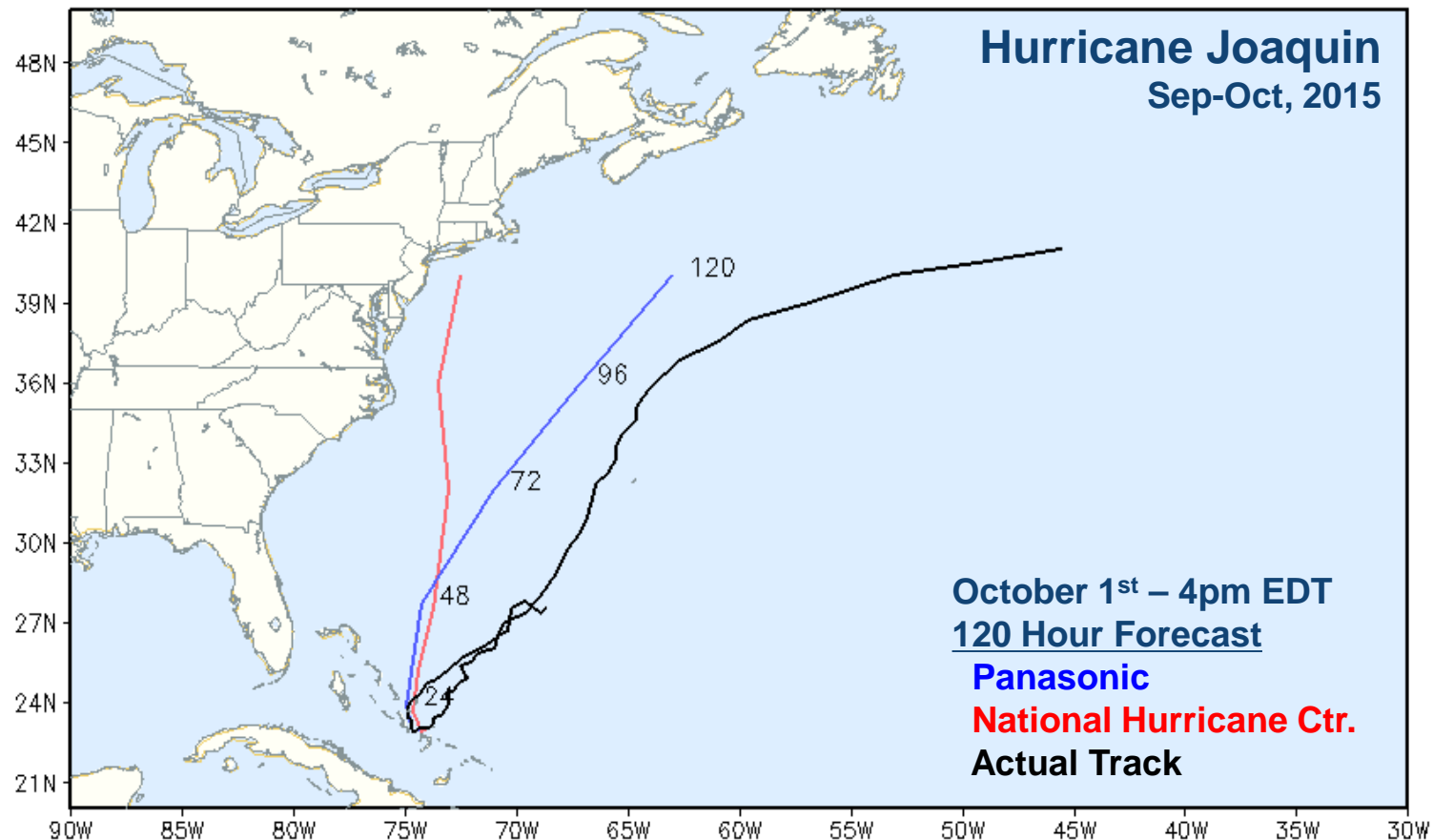
### Other weather forecasting service

### Panasonic 4D Weather

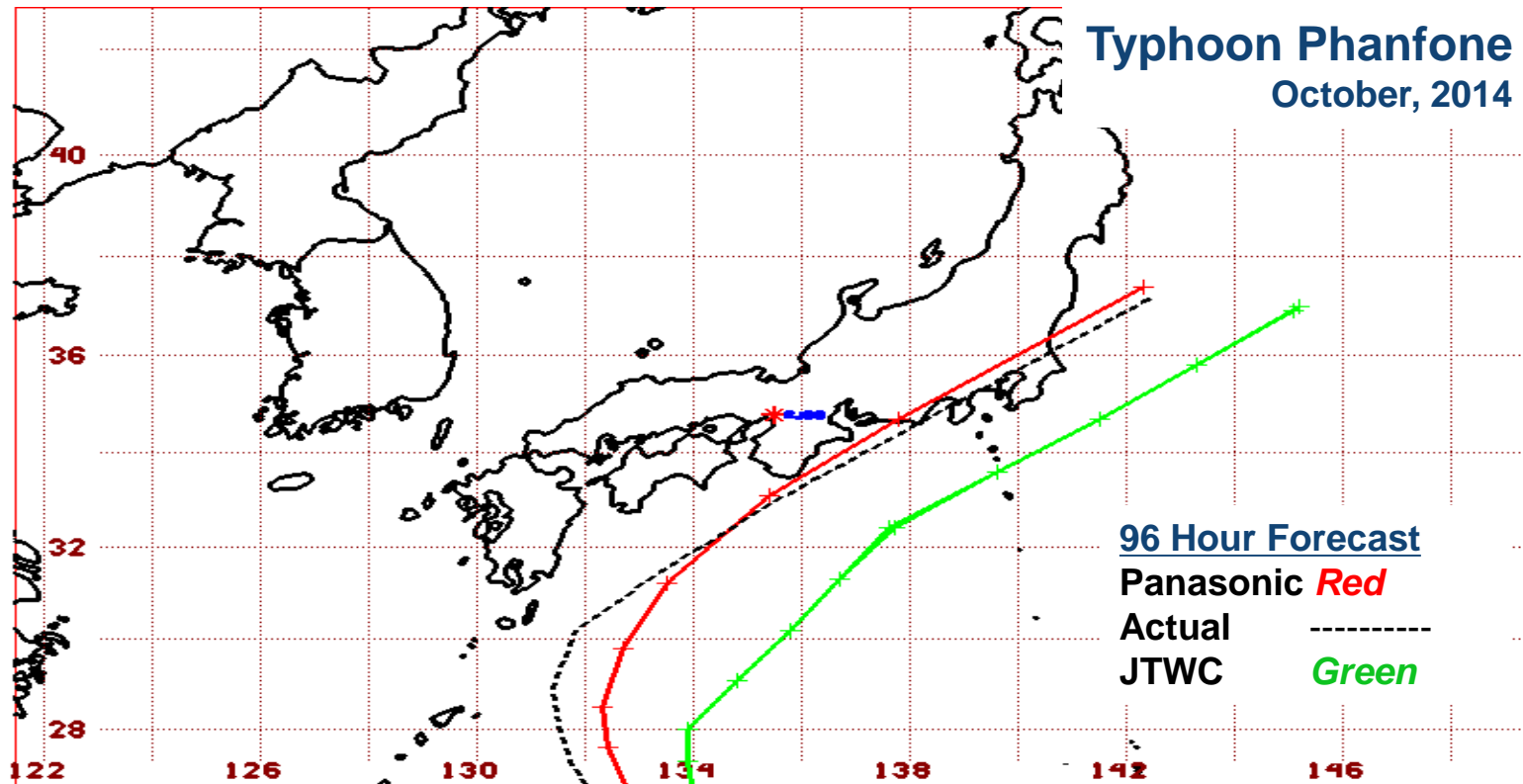




# Severe Weather Forecasting – Tropical Storms



# Severe Weather Forecasting – Tropical Storms



20141001/18z Cycle Phanfone JTWC=Green. PHS= Red. Actual = Green D

# An example of a substantially better forecast: Northeast “Blizzard?”

PWS’ forecast was far more accurate than other models and forecasts

Table of average forecasted snowfall totals in inches, 48 hours in advance of storm

January, 2015

	ECMWF	NAM-12	NWS	PWS	Actual
<b>PHL</b>	13	8	10-15	3	1.2
<b>LGA</b>	21	21	20-25	8	11.0
<b>EWR</b>	21	18	20-25	6	6.5
<b>BOS</b>	23	22	25-30	28	24.6

**ECMWF:** European Center for Medium-Range Weather Forecasts, **NAM-12:** North American Mesoscale Forecast System, **NWS:** National Weather Service Forecast, **PWS:** Panasonic Weather Solutions Forecast Model

## National Weather Service

Before

*“crippling and potentially historic blizzard” with 20 to 30 inches of snow, “locally, higher amounts possible”*

After

*“We recognize the need to work harder and smarter to produce better forecasts and to **better communicate forecast uncertainty and manage expectations.**”*

Regions: Switzerland

Weather

Initialization hour: 00:00z April 7, 2015

Parameters: Drag weather parameters to map or graph

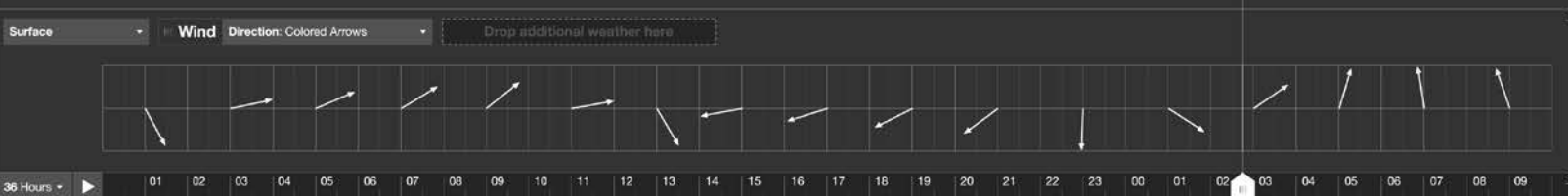
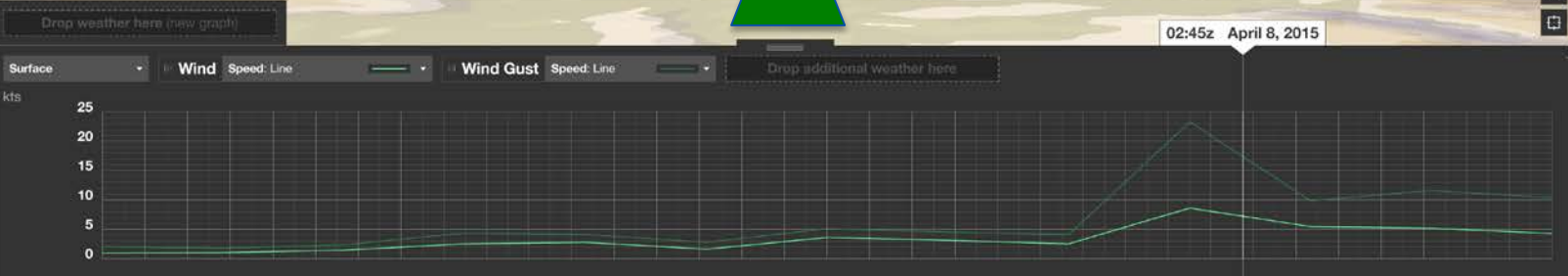
- Wind
- Wind Gust
- Reflectivity
- Temperature
- Fog
- Snow
- Precipitation
- Precipitation Type

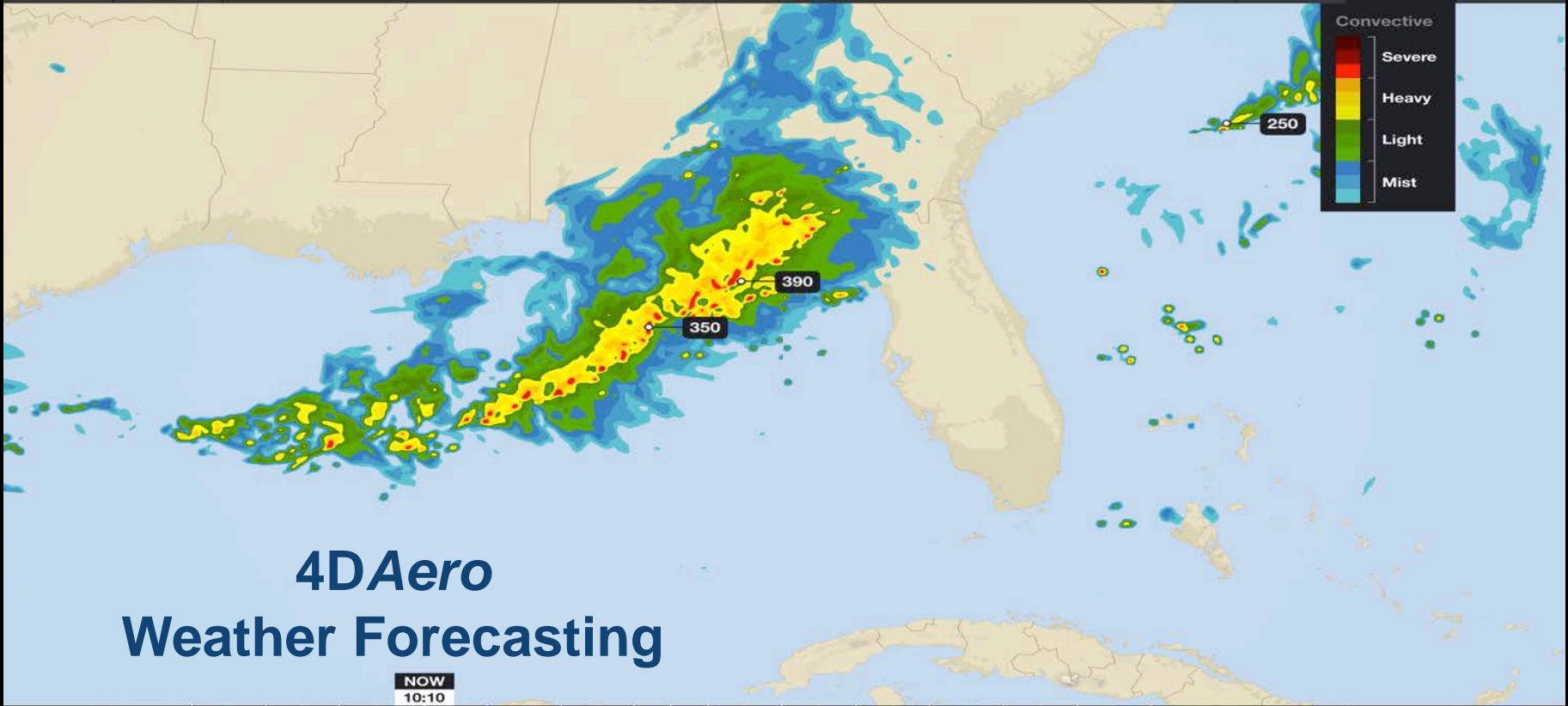
Airports: 1

DFW

Alerts: None defined

Preferences: Use Item Themes





# 4DAero Weather Forecasting

NOW  
10:10

08

10

12

14

16

18

20

PWS Fcst Conv  
Radar

13<sup>30</sup> Z  
|||||





## Summary

Today, as the only private entity in the world using custom-developed and operationalized global weather models, Panasonic Weather Solutions is working with leading aviation entities to **improve operational performance and safety**, as well as become more **environmentally friendly** due to reduced fuel burn and CO2 emissions via flight optimization.

Look for more PWS announcements soon...