

High Ice Water Content

Nowcasting Tools Development



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High Ice Water Content (HIWC): Observations from Ice Crystal Engine Icing Events

Common Meteorological Conditions

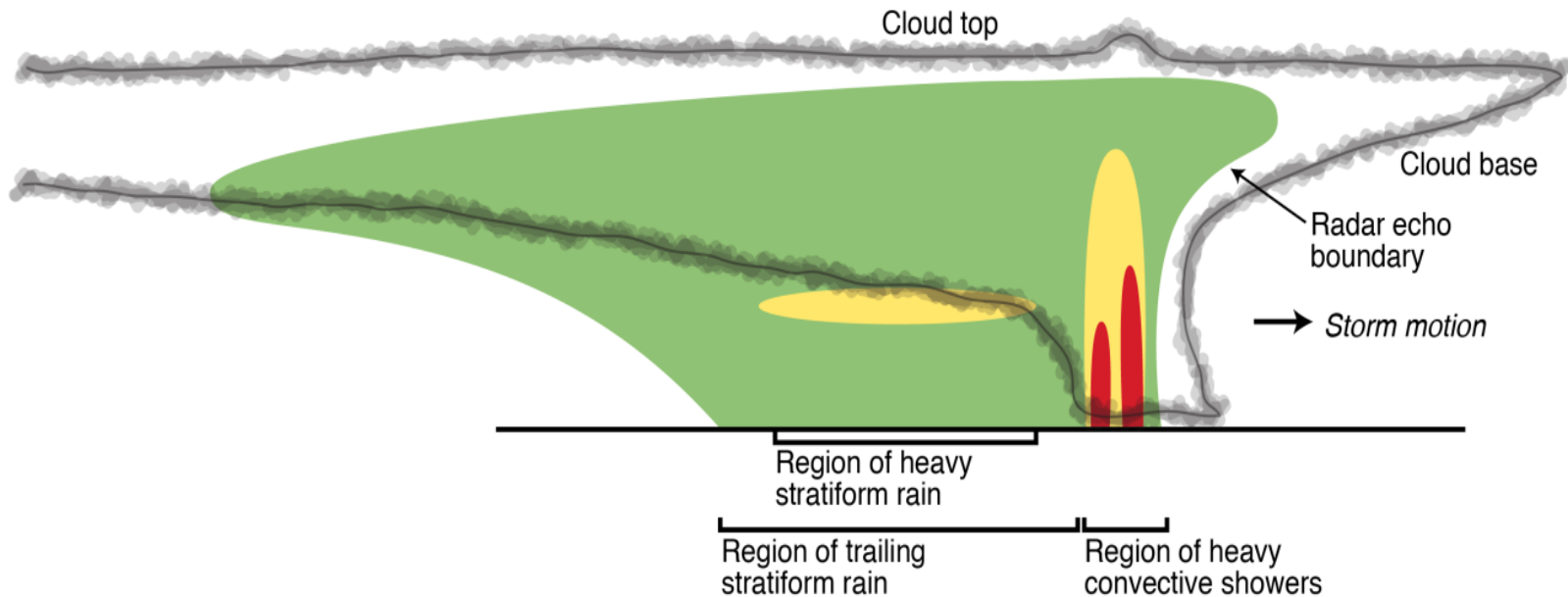
- High altitude, cold ambient temperature
- Convective clouds or thunderstorms in the vicinity
- Ambient temperature warmer than corresponding standard atmosphere temperature
- Visible moisture (in cloud)
- Moderate to heavy rain below aircraft
- Light or no radar echoes at flight altitude on pilot's radar
- Light to moderate turbulence
- No significant airframe icing
- No hail or lightning observations

Global Distribution of Engine Icing Events



Based on 67 engine icing events analyzed by Boeing;
map adapted from Mason (2007)

HIWC in Deep Convective Clouds: Conceptual Model



Engine icing events have occurred in the trailing anvil where radar echoes are low or non-existent

HIWC

Nowcasting Tool Development

- Objectives
 - Produce a 3-dimensional estimate of probability of hazardous HIWC conditions in real-time
 - Use routinely available meteorological data as input (satellite, radar, numerical weather prediction models)
 - Verify accuracy of product using research quality cloud microphysical data
 - Determine appropriate application for product
 - Tactical or strategic planning
 - Identify potential users

The Algorithm for Prediction of HIWC Areas (ALPHA)

Satellite

Find highest, coldest,
thickest clouds from Total
Water Path, Cloud Top
Height and Cloud Top
Temperature
Total Satellite Interest

Model

Find deep cloud layer,
heavy precipitation, high
condensate, updrafts,
temperature below -15°C
Total Model Interest

**3D Radar
Mosaic**

Find active updrafts, high
reflectivity in column
along with heights of 10
and 30 dBz echo tops
Total Radar Interest

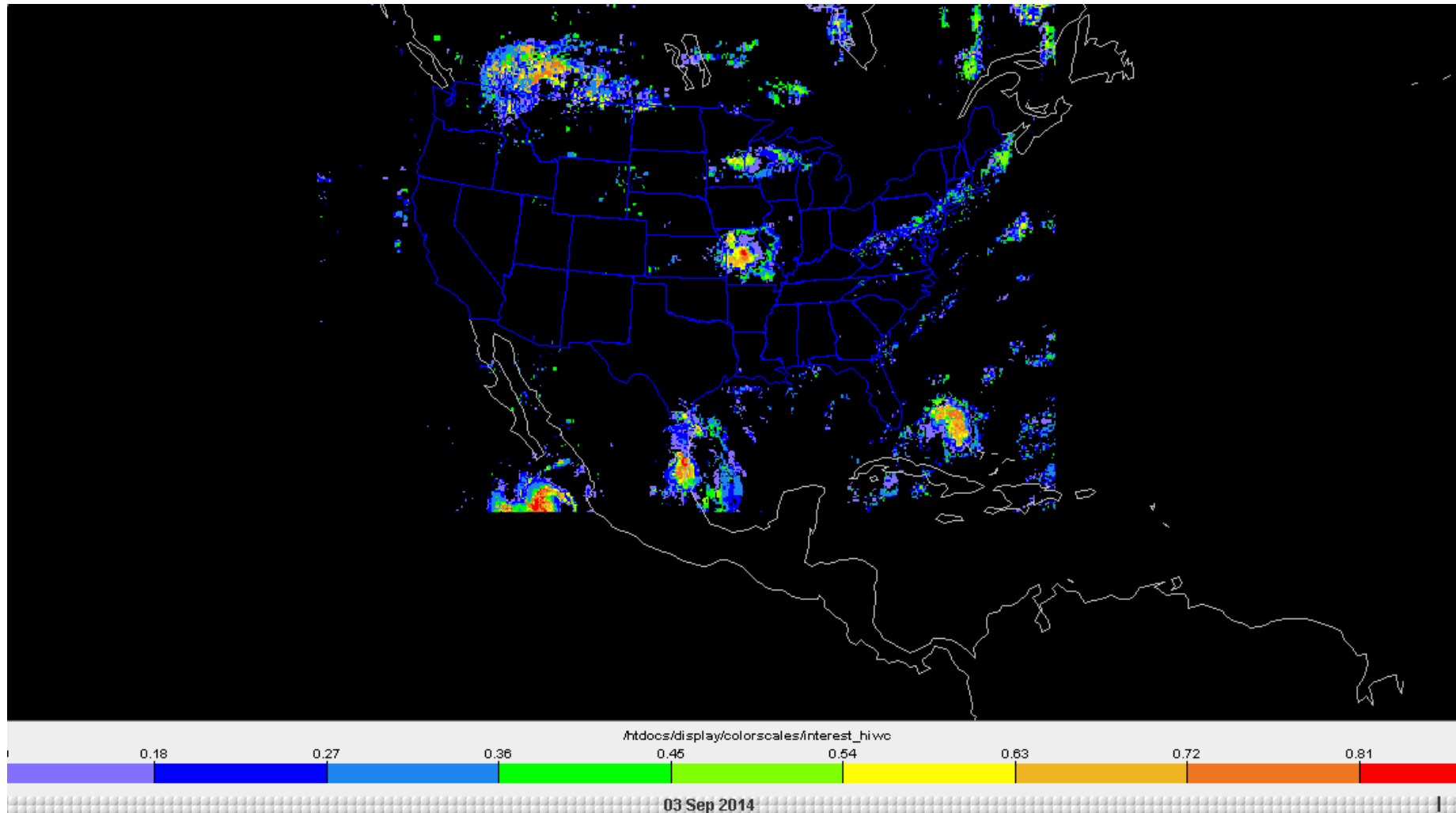
Calculate Total HIWC Interest

Weighted Combination of Satellite, Model, and Radar Interest
= Total HIWC Interest

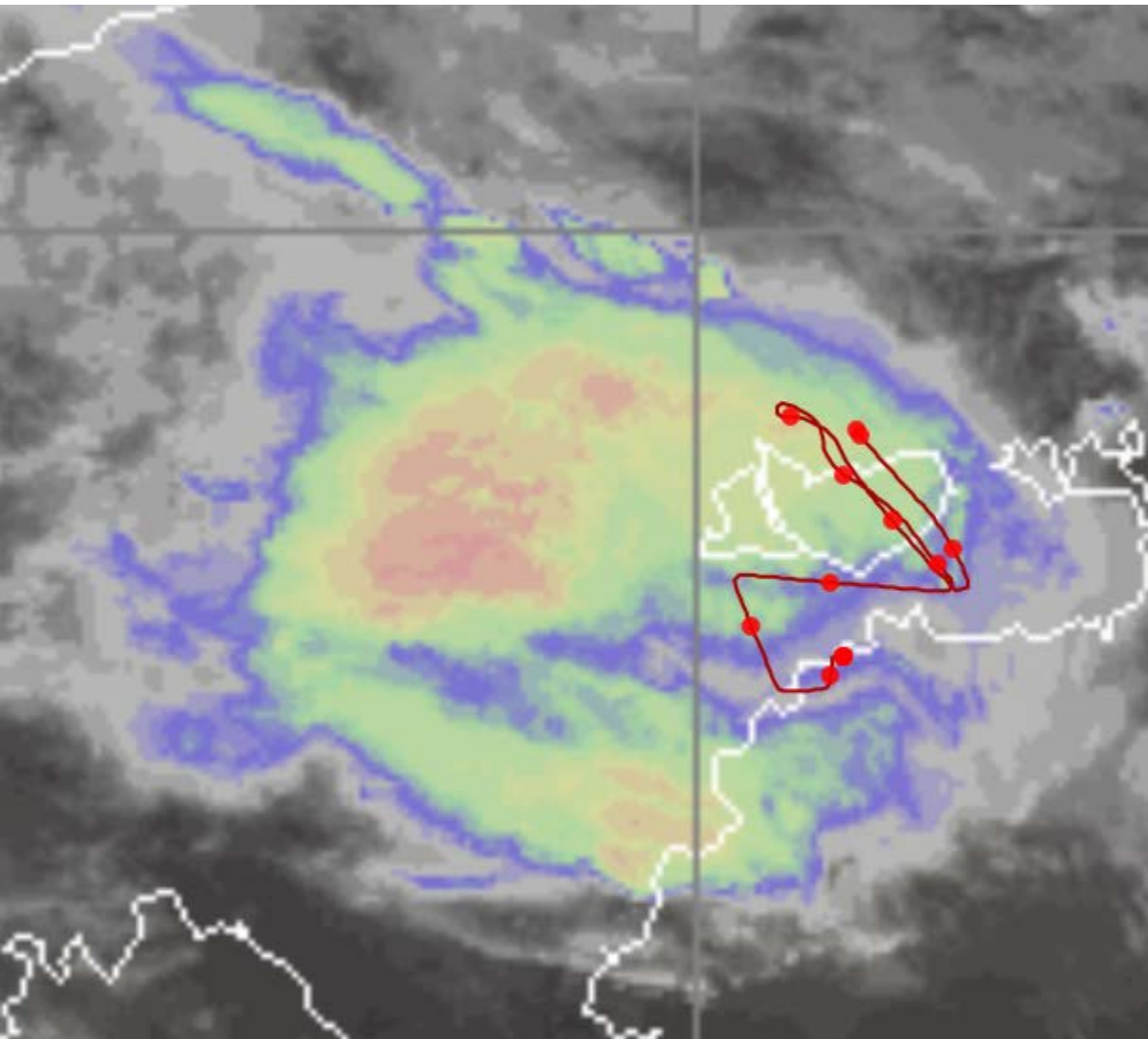
ALPHA-CONUS HIWC Product

3 September 2014

FL350

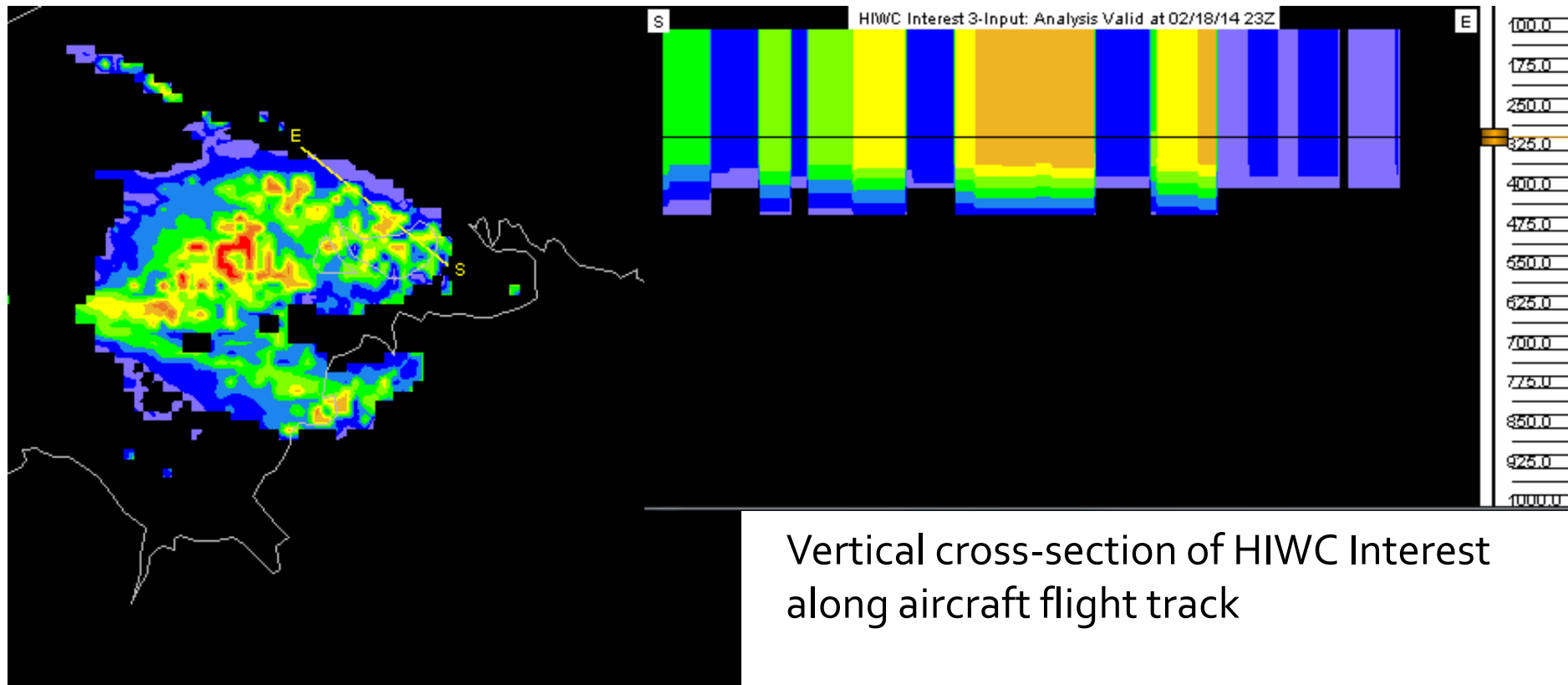


ALPHA-Darwin Verification HAIC-HIWC Field Campaign



- High Altitude Ice Crystal/High Ice Water Content field campaign
- International, inter-agency team of researchers
- 23 research flights with instrumented Falcon 20
- Darwin, Australia monsoon season; Jan – Mar 2014
- Flight plans targeted convective systems likely to exhibit high concentrations of ice crystals

ALPHA HIWC estimate for 18 Feb 2014 RF23 Flight Segment at FL280 (-24C)

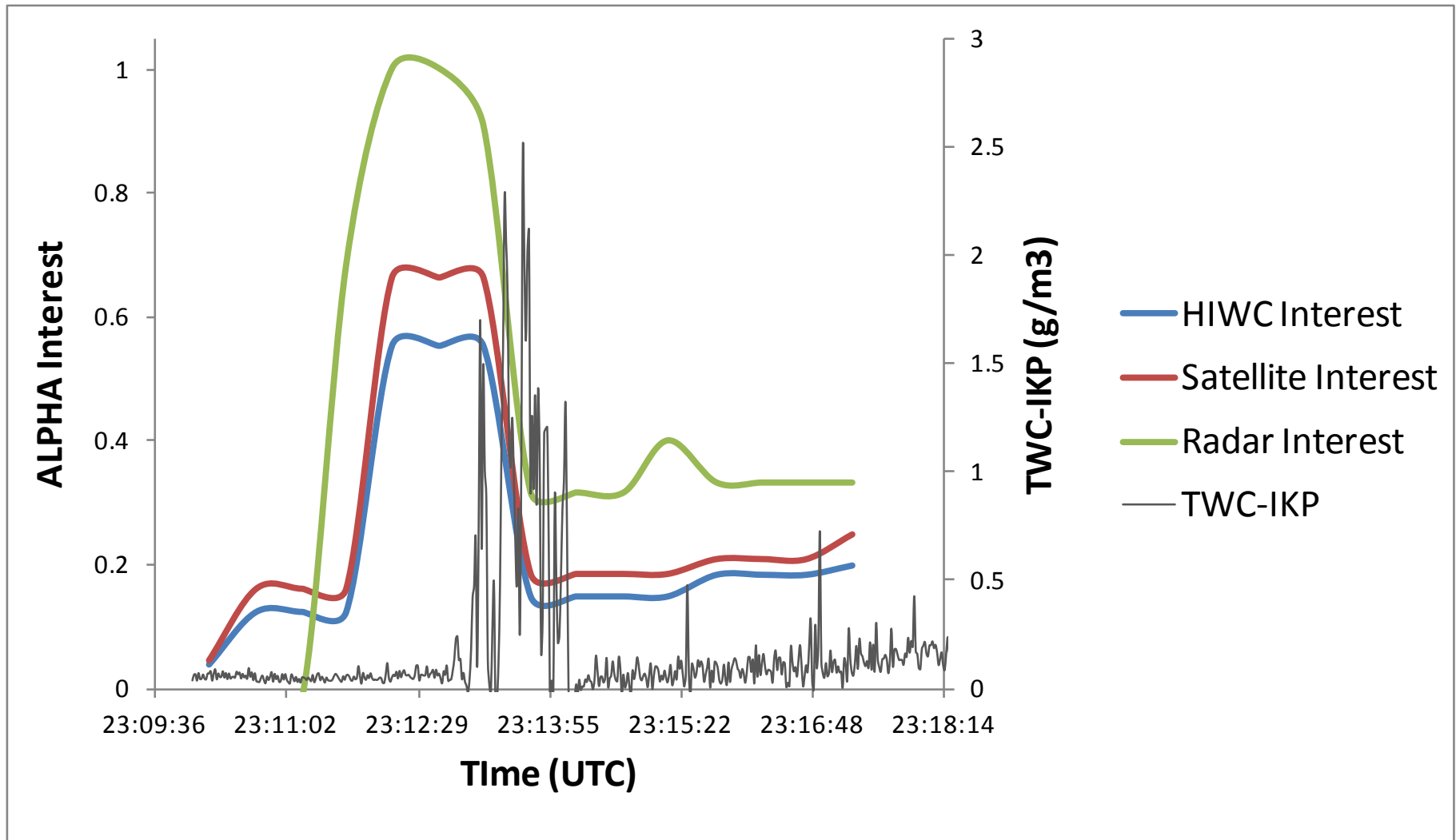


HIWC interest at 2300 UTC

3-input version (model, satellite, radar inputs)

Vertical level ~ 28 kft

ALPHA HIWC Interest Fields along Falcon Flight Track (FL280)



Ongoing Efforts

- Statistics provided by HAIC-HIWC field campaign data are being used to evaluate and calibrate ALPHA HIWC probability fields
- Second field campaign contemplated for Spring 2015
- Algorithm refinements based on comparisons with measurements
- Explore application for product (tactical vs. strategic planning) and define path to operations
- Obtain user feedback on utility of product
- Website with current ALPHA-CONUS products
 - Email haggerty@ucar.edu for link