
Icing Hazard Levels Decision Briefing

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August 29, 2012





Outline

- **Icing Hazard Levels Algorithm : Motivation**
- **Icing Hazard Levels Algorithm : Details**
- **Sample Performance**
- **Future Enhancements**
- **Summary**



IHL Algorithm – Motivation

- **Icing is a hazard to aviation and currently there are no icing products available via NEXRAD**
 - **12% of Aviation Accidents are caused by icing**
- **Dual Polarization provides unique insight into icing regions**
 - **Current HCA has been developed over a 15 year period**
 - **Does not detect icing directly, but, Graupel category can be used to identify regions of icing aloft**
 - **Provides 5 minute updates**
 - **High confidence icing regions**
- **Model data (RAP) can provide enhanced analysis**
 - **Already in NEXRAD via AWIPS**
- **Collaborative effort: NSSL, NCAR, OS&T**





Dual Polarization Enables Hydrometeor Classification

HCA Category Relationship to Icing Potential

Categories		No Echo	Dry Snow	Wet Snow	Ice Crystals	Graupel	Big Drops	Light/Mod Rain	Heavy Rain	Rain and Hail	Ground Clutter/AP	Biological	Unknown
		NE	DS	WS	IC	GR	BD	RA	HR	RH	GC	BI	UK
Melting Layer	Above	Unknown	None	None	Icing	Icing	Icing	Icing	Icing	Icing	Unknown	Unknown	Unknown
	Mostly Above	Unknown	None	None	Icing	Icing	Icing	Icing	Icing	Icing	None	Unknown	Unknown
	Within	Unknown	None	None	Unknown	Icing	Conditional	Conditional	Conditional	Icing	None	None	Unknown
	Mostly Below	None	None	None	Unknown	Conditional	None	None	None	None	None	None	None
	Below	None	None	None	None	None	None	None	None	None	None	None	None

HCA Classification Key	
	Current HCA Category
	Not in HCA
	Not enough information to classify

Icing Hazard Key	
Icing:	Definitive icing region
Conditional:	Potential hazard based on fluctuations in freezing level
None:	No icing
Unknown:	More research is needed

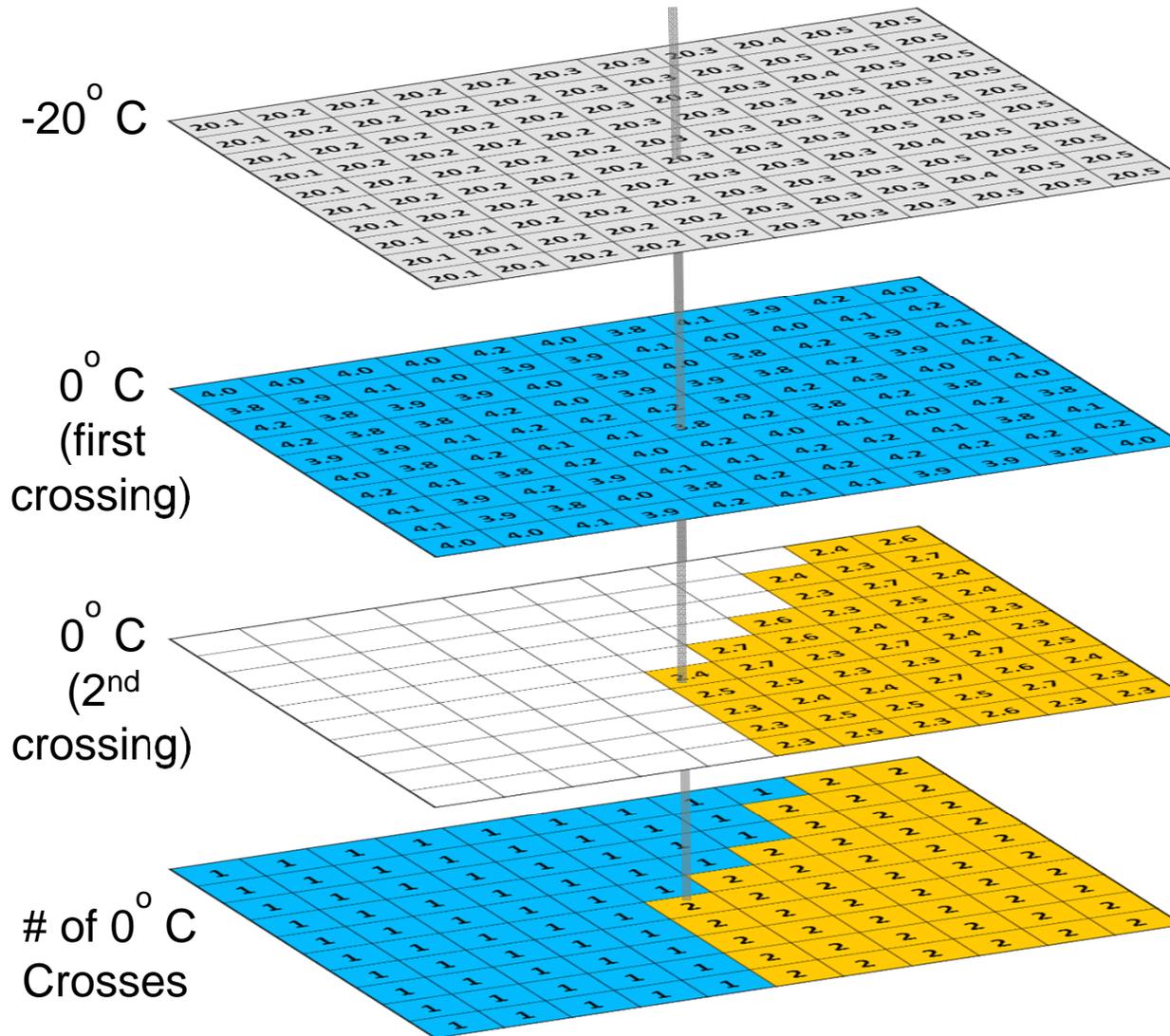


Key Components

- **Update_alg_data (environmental settings from model)**
 - **Modified to produce linear buffer grids of thermal data and icing potential**
- **MLDA – Melting Layer Detection Algorithm**
 - **Changes to how missing bright-band radar radials are handled & Model enhancements**
- **IHL – Icing Hazard Levels**
 - **New algorithm to produce Icing Hazard Levels product**
 - **Uses HCA Graupel class as base**
 - **Expanded based on RAP model data**

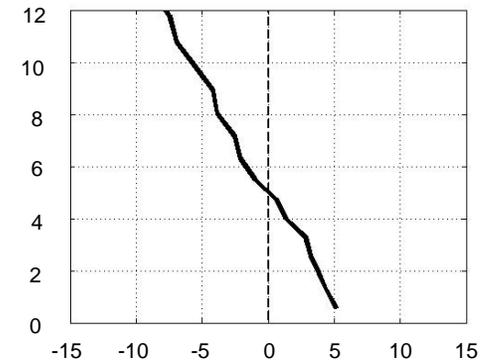


Update_alg_data Changes Gridded Freezing Height LB

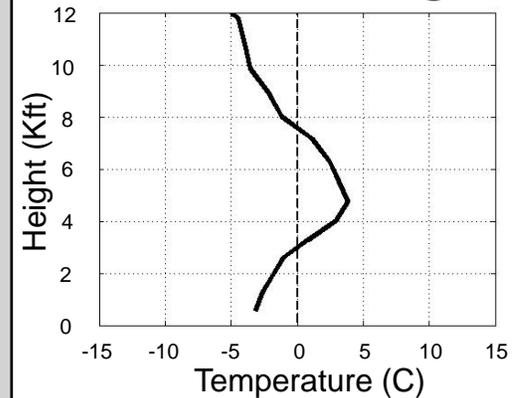


Temperature Profiles

Single Crossing ■



Dual Crossing ■



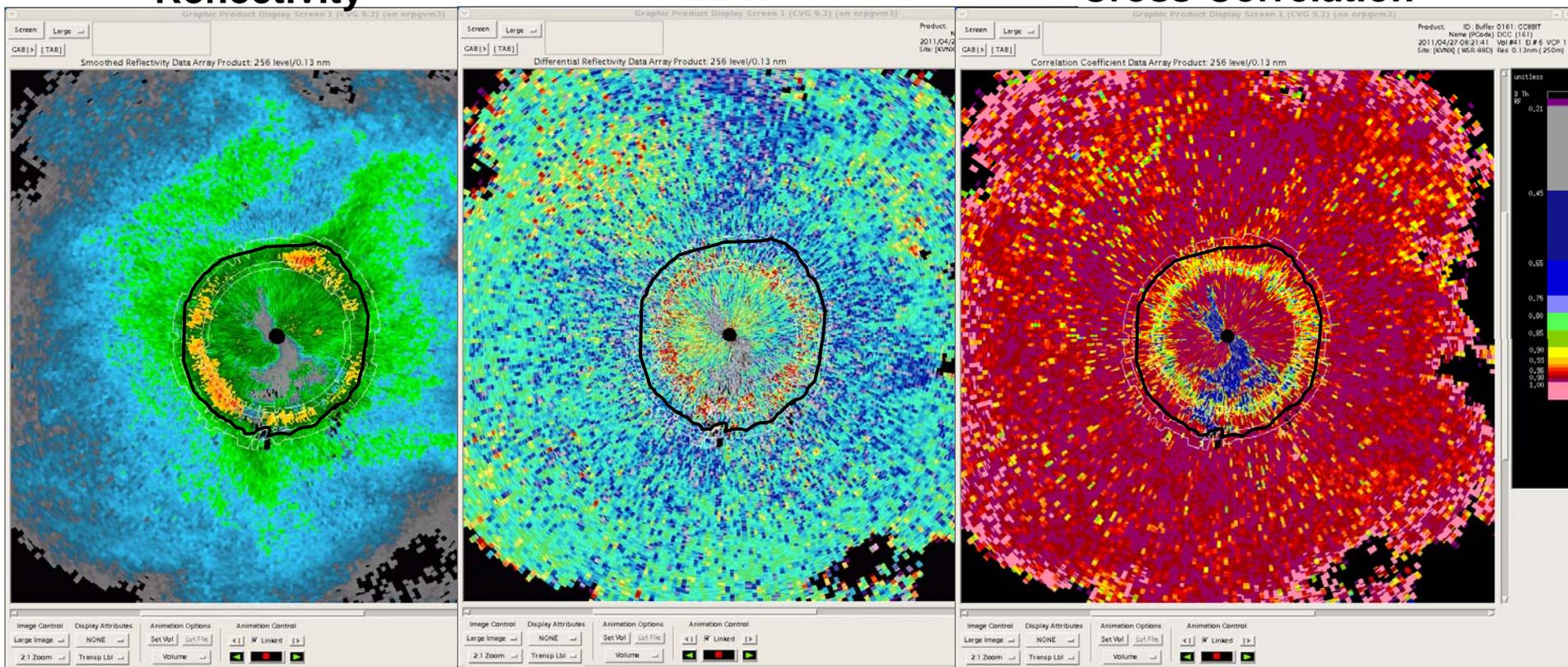


MLDA Example – 4/27/2011 8Z KVNK

Reflectivity

ZDR

Cross-Correlation



Uses 4.0 – 10.0 degree tilts



MLDA Issues / Modifications

- **MLDA Issues**
 - Designed for single melting layer scenario typically found in warm weather events
 - Does not create product without significant wet snow
 - Impacted by detection environment / scan strategy
 - Missing radials are filled with average of good radials
 - Default ML top is the model height 0°C isotherm at radar

- **MLDA Improvements**
 - Valid radar-based MLDA radials have highest priority
 - Missing radials are filled with interpolation between good radials
 - When available, model data is used to replace interpolated radar-based radials



Evolution of Ascending Melting Layer to the South

KBOX 1/12/12

10:06 UTC

Elev 4.3

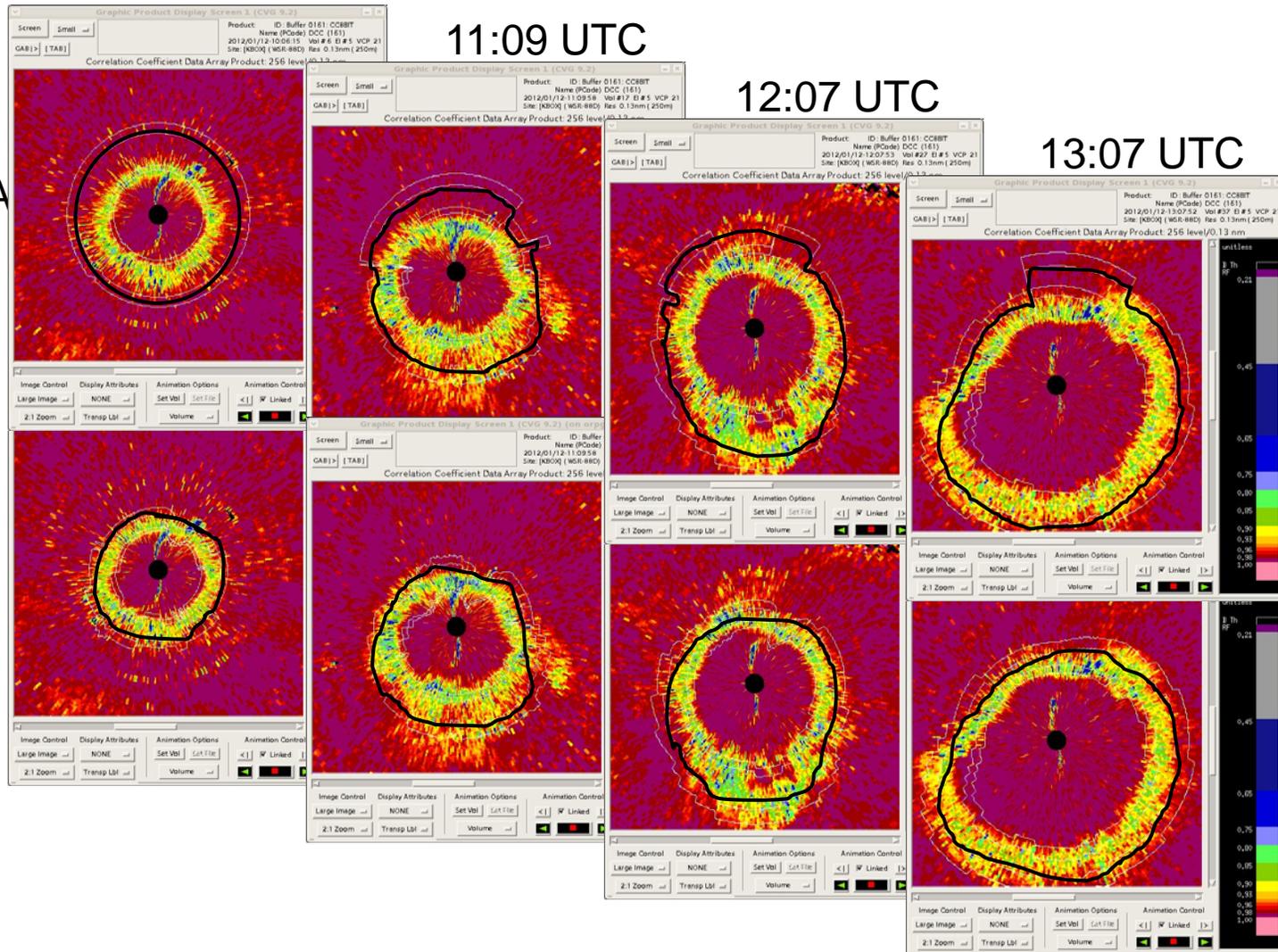
11:09 UTC

12:07 UTC

13:07 UTC

Current MLDA

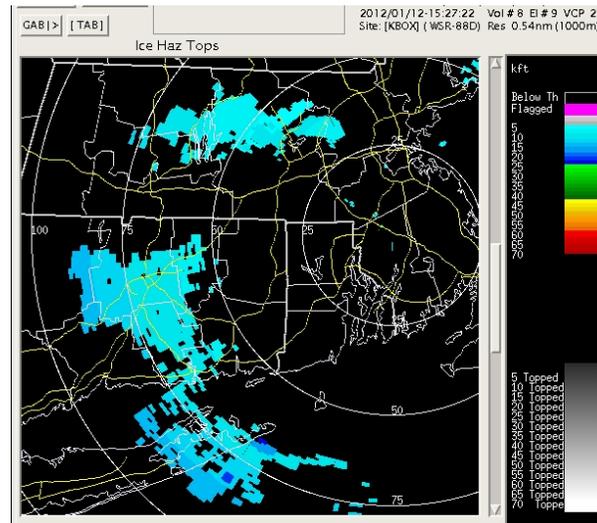
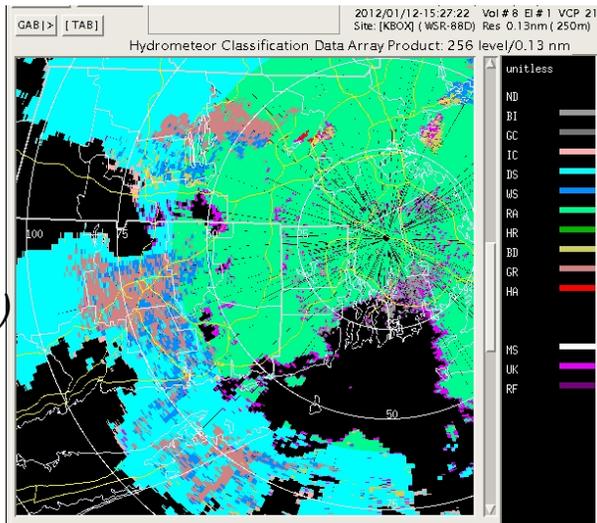
B14 MLDA





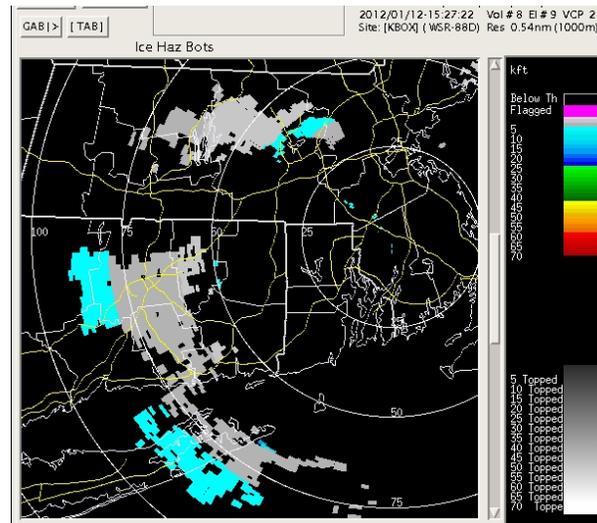
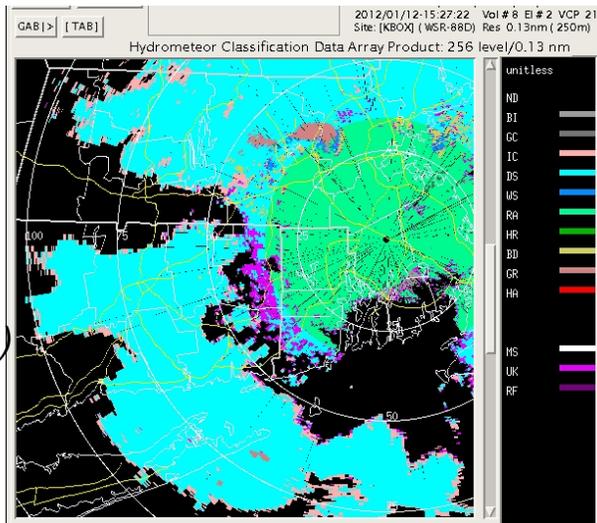
Example IHL Top/Bottom (Graupel-only)

*Hydrometeor Classification
(0.5 deg. elevation)*



IHL Top

*Hydrometeor Classification
(1.5 deg. elevation)*

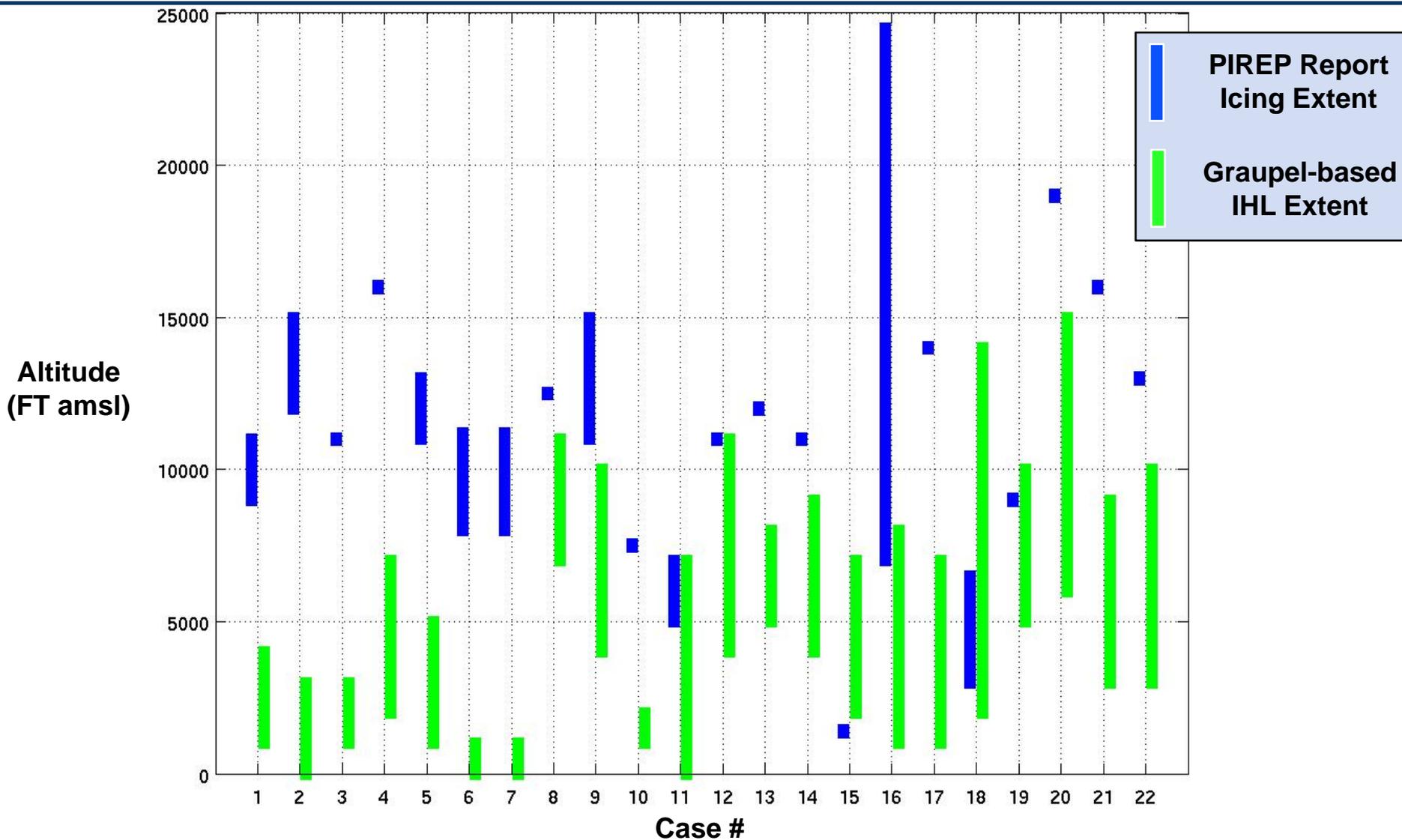


IHL Bottom

**KBOX
1/12/2012
15:27 UTC**



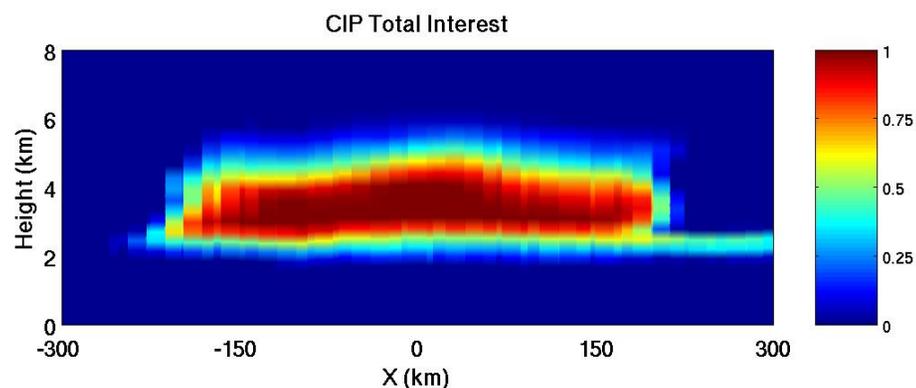
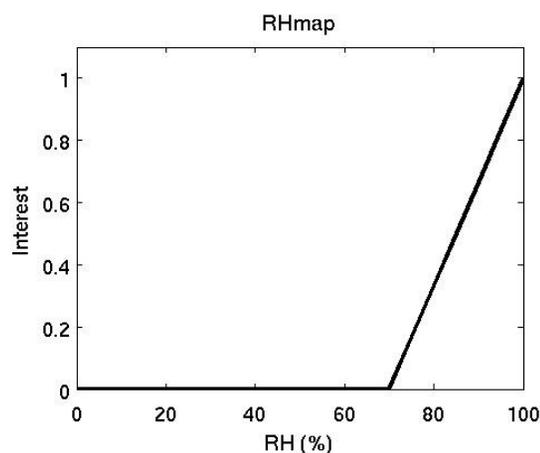
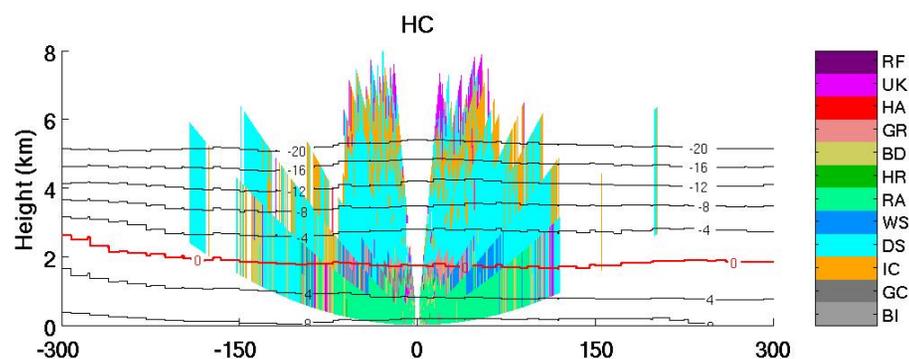
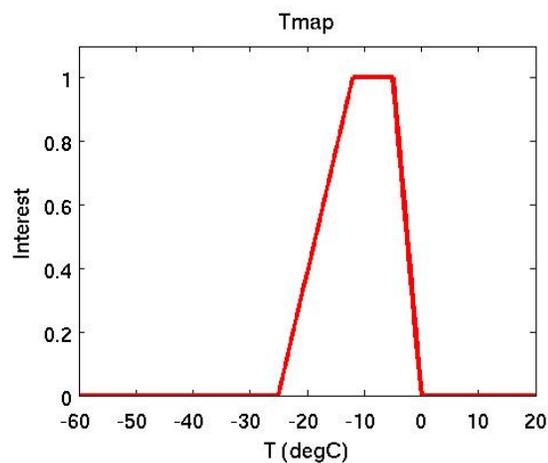
PIREP vs Graupel-only IHL





Model-based Current Icing Potential (CIP) LB

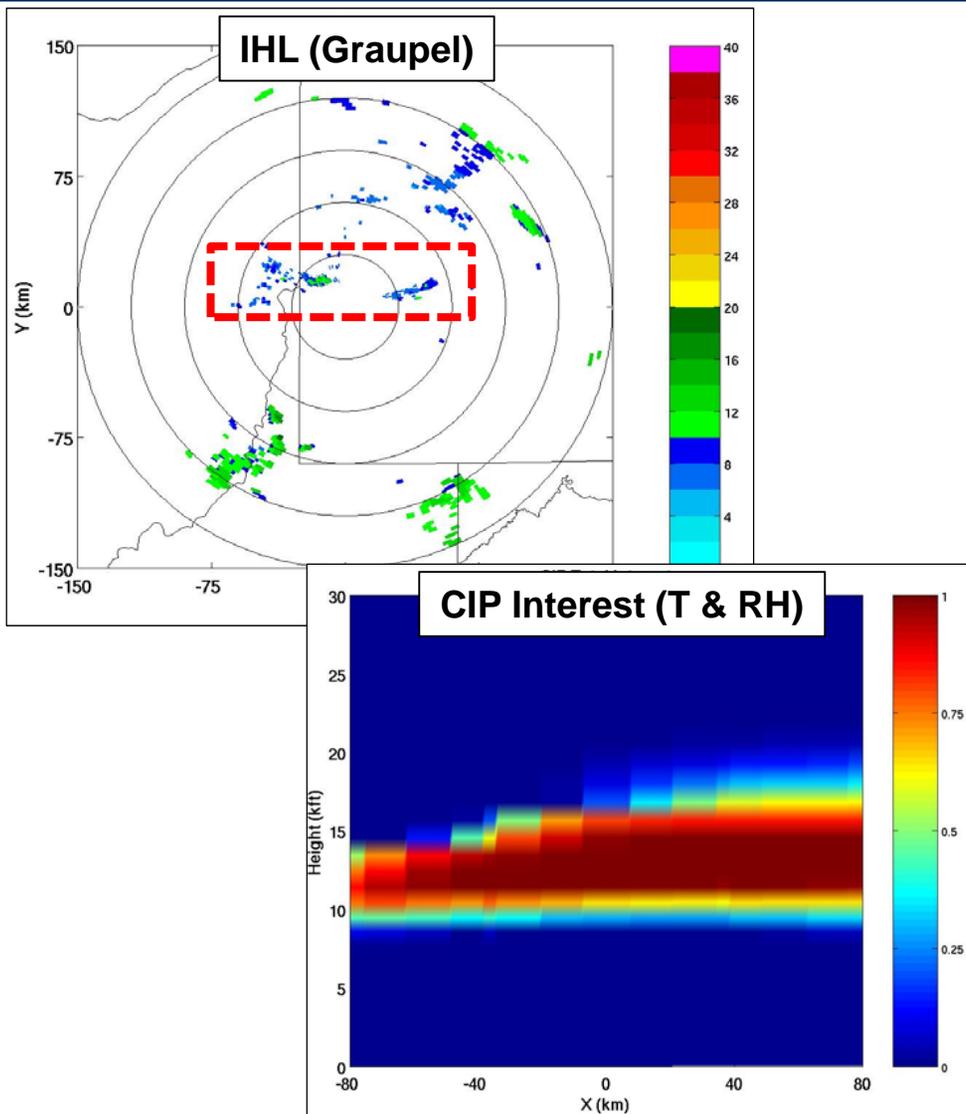
- Utilize subset of NCAR CIP interest fields (RH & T)



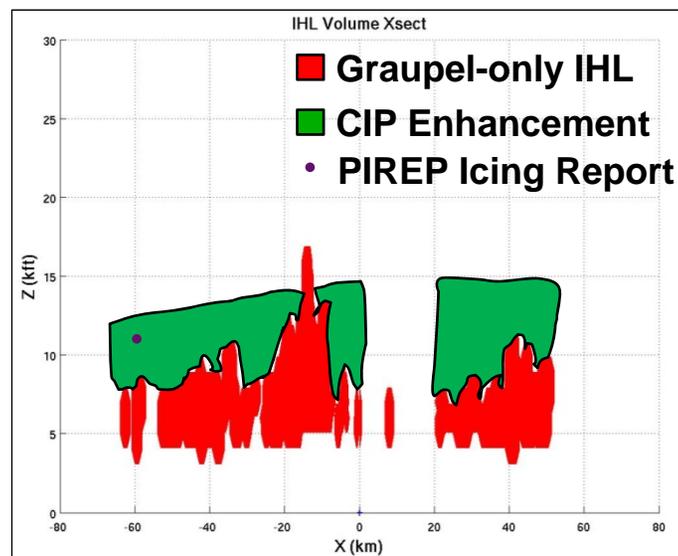


Combining HCA with CIP for IHL

KPBZ 2/24/2012 0509Z



- CIP Extension
 - Only where graupel is already present
 - CIP interest > 80%





Icing Hazard Levels (IHL) Algorithm

- **NEXRAD IHL performance evaluation and tuning**
 - Based on graupel class from HCA with model enhancements
 - Currently running 24/7 at 34 sites
 - Cross checked against PIREP reports
 - Product description:

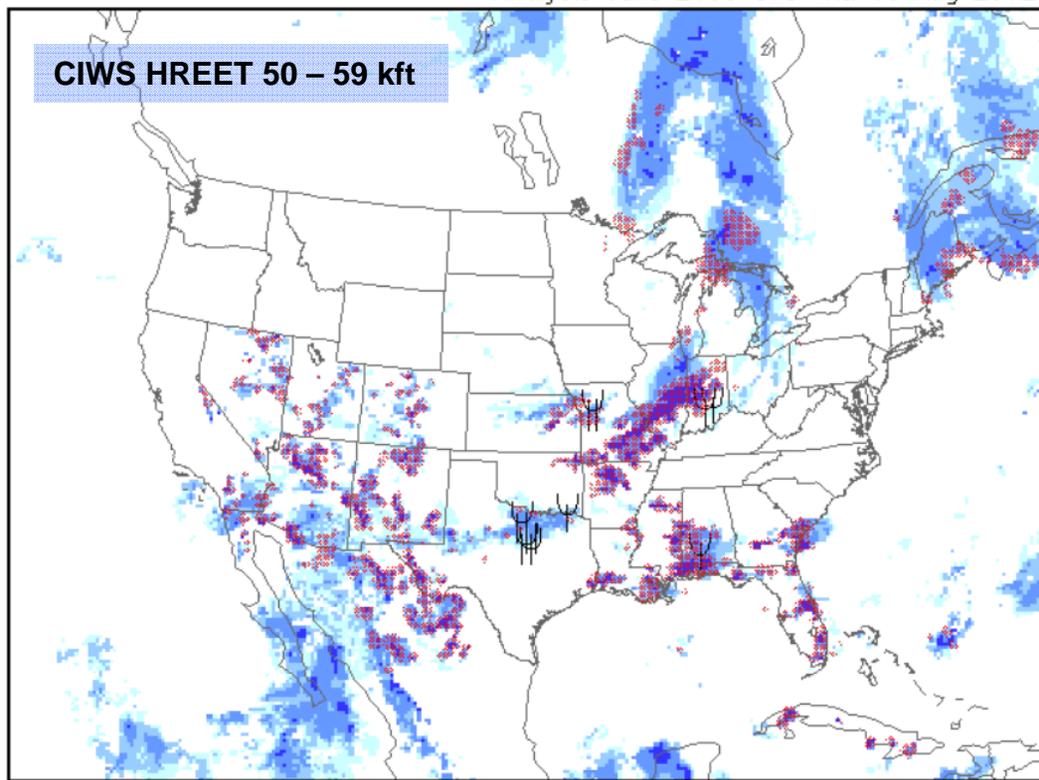
Range Coverage	300 km (dual pol range)
Azimuthal Coverage	360 degrees
Range Gate Resolution	1 km
Azimuth Resolution	1 degree
Volume Product Output (one group for top, one for bottom)	Altitude (in kft) Severity* (up to 5 levels) Confidence* (up to 10 levels) * - future version



IHL KLSX 08/16/2012 2100 UTC

Maximum icing severity (1000 ft. MSL to FL300)

Analysis valid 2100 UTC Thu 16 Aug 2012



SLD threat

None Trace Light Moderate Heavy

Trace-Light Light-Moderate Moderate-Severe

Icing PIREP Symbols

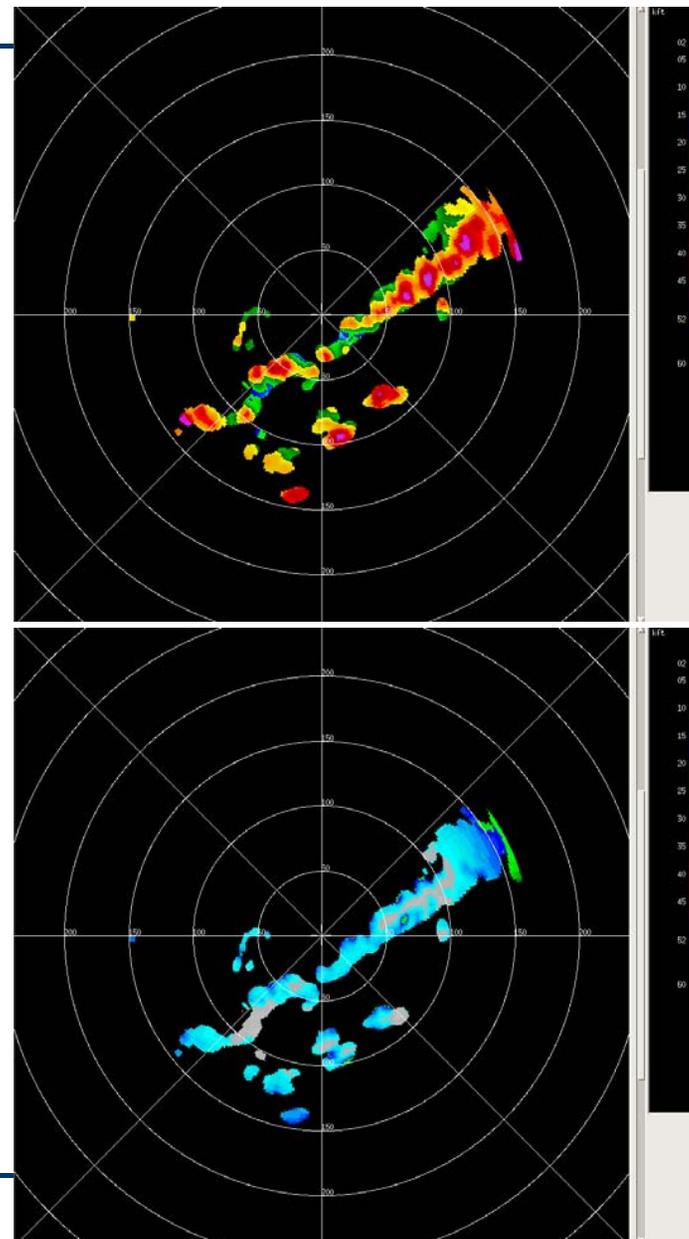
Trace

Light

Moderate

Severe

CIP shows SLD from 15 – max 30 kft. PIREP mod rime icing 20 kft LSX area. IHL bot alt ~ 15 kft; IHL top alt into 40 kft+ and higher in cores

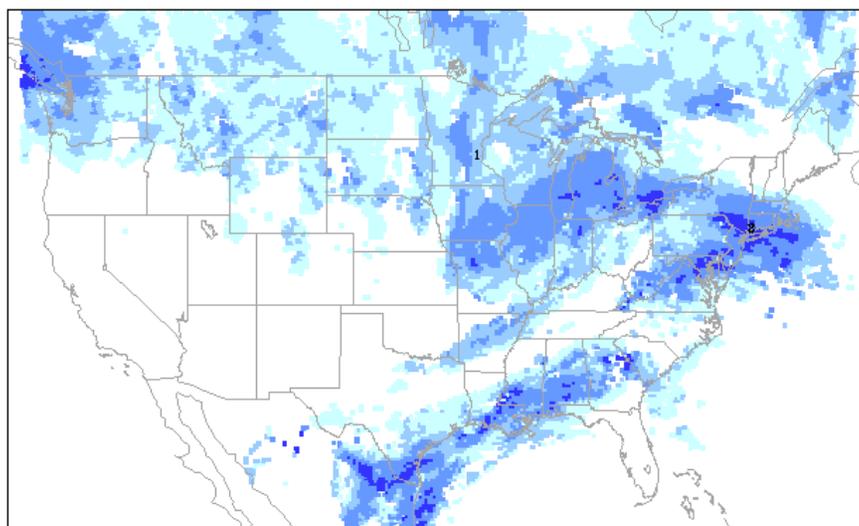


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IHL KOKX 02/24/2012 0952 UTC

CURRENT ICING PRODUCT (CIP) @ 02/24/2012 - 10 Z
ICING SEVERITY CATEGORY COMPOSITE
EXPERIMENTAL PRODUCT - RESEARCH USE ONLY!

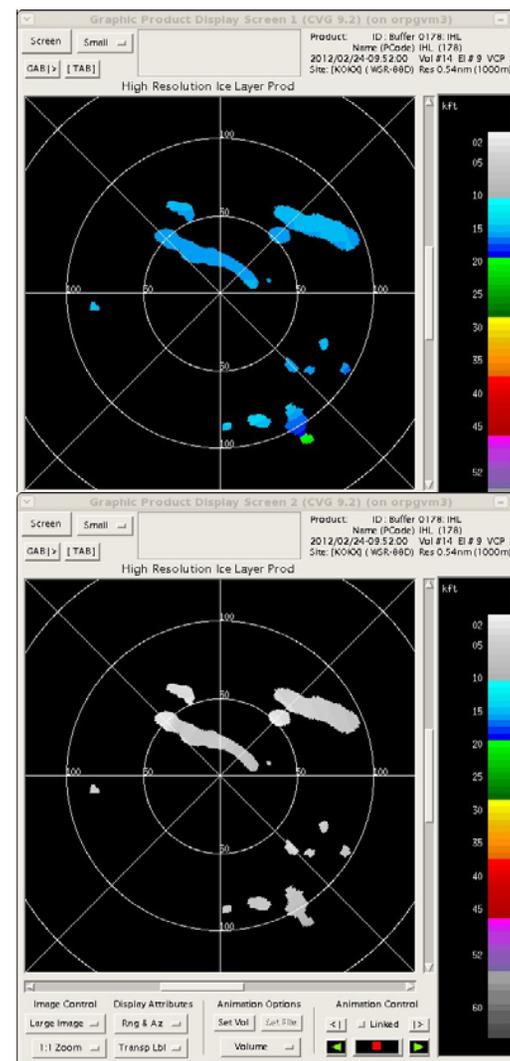


None Trace Light Moderate Heavy

ICING PILOT REPORT INDICATORS

MOD/SEV to SEV = Large Font (6, 7, 8)
LGT/MOD to MOD = Medium Font (4, 5)
TRC to LGT = Small Font (1, 2, 3)
NULL = Small Font (-1, 0)

**CIP shows moderate to heavy icing severity
PIREP light rime icing 9 kft 75 km NW of OKX
IHL bot alt ~ 6 kft; IHL top alt ~16 kft**





Development Path of IHL Algorithm

- **Continue to address IHL**
 - MLDA Refinements / CIP threshold
 - Sites running RUC 40km
- **Deliver NEXRAD IHL in August 2012**
 - Perform usual ROC reviews / ICD
- **Utilize additional HCA categories**
 - Ice crystals / Big drops (at top of melting layer)
 - ZDR Brightband
 - NCAR “Mixed Phase” and “Freezing Drizzle Aloft” Categories
 - Confusion matrix of HCA categories
- **Expand use of model data (HCA & IHL)**
 - Multiple crossings of 0 degree isotherm
 - Thickness/Temperature range of melting layers



Summary

- **IHL creates first icing hazard product from NEXRAD**
- **IHL is based on the dual pol graupel classification with enhancements from model-based CIP calculations**
- **Logical results observed between IHL and PIREPs**
- **Request a decision from the NEXRAD TAC**