Icing Hazard Detection with NEXRAD IHL

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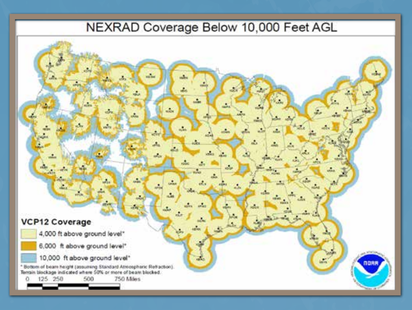
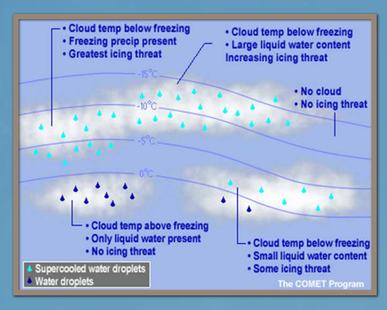
Introduction

- In-flight icing hazards are an aviation safety challenge
- Dual polarization NEXRAD provides hydrometeor classification (HCA) and frequent sampling of potential icing regions
- NEXRAD Icing Hazard Levels (IHL) algorithm produces radar-based with model-enhanced icing hazard detection





Hydrometeor Classifications Related to Icing

- Graupel class from HCA indicates supercooled liquid water (SLW) in close proximity and likely somewhat above the altitude of the signature
- Further improvements are needed to account for presence of SLW interspersed with primary HCA categories

Thresholds \ Categories	Ground Clutter/AP GC	Biological BI	No Echo NE	Heavy Rain HR	Big Drops BD	Ice Crystals IC	Light/Mod Rain RA	Wet Snow WS	Unknown UK	Dry Snow DS	Rain and Hail RH	Graupel GR
Above			■			■			■	■	■	■
Mostly Above	■		■		■	■		■	■	■	■	■
Within	■	■	■		■			■	■	■	■	■
Mostly Below	■	■	■	■	■		■	■	■		■	■
Below	■	■	■	■	■		■		■		■	

Melting Layer

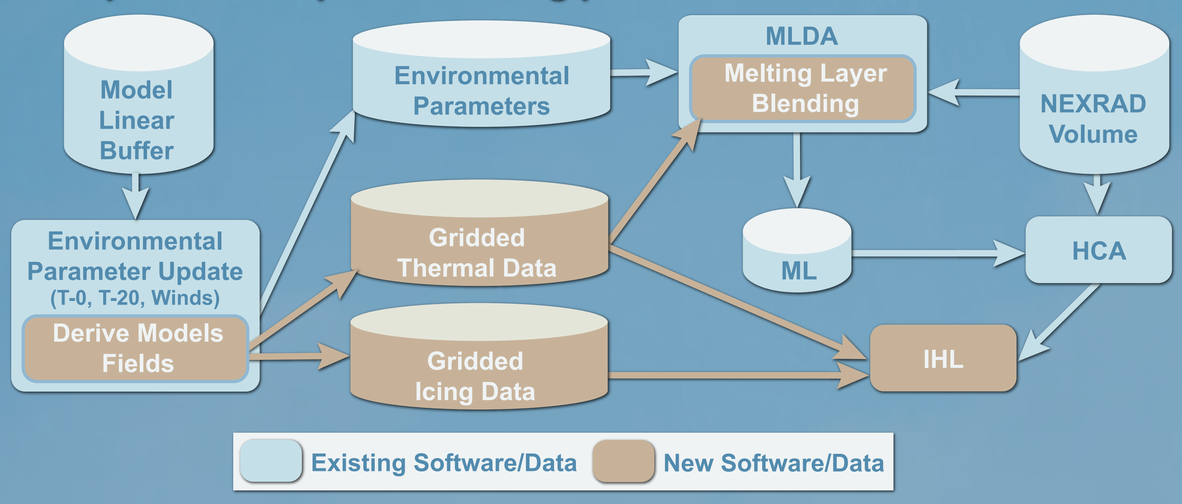
Increasing likelihood of icing

Category Key: ■ Allowed in HCA ■ Not Allowed

Hydrometeor Categories Allowed Relative to Melting Layer

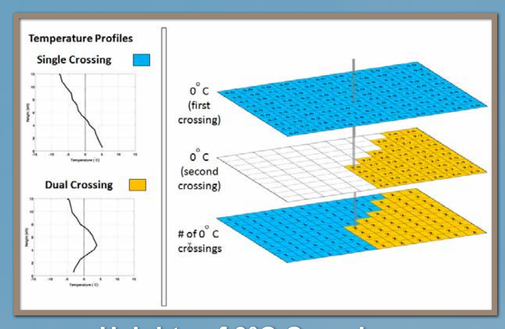
Algorithm Description

- Leverages existing NEXRAD products with icing related enhancements
- Creates thermal and icing interest fields based on hourly Rapid Refresh (RAP) model grid
- Melting Layer Detection Algorithm (MLDA) blends thermal grid data with radar melting layer (ML)
- IHL produces top/bottom icing product each volume scan

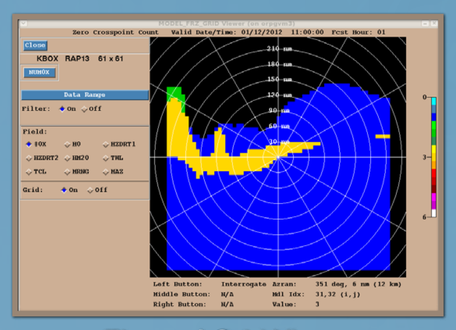


Improved Integration of Model Fields

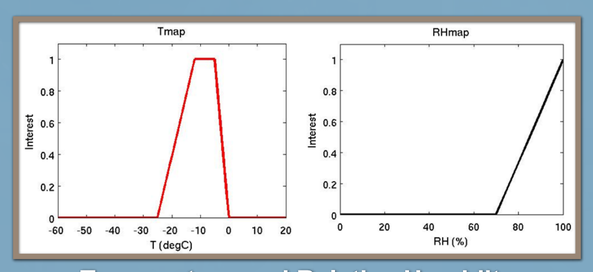
Obtaining model grid information over the entire radar coverage area is a necessary first step toward enhancing ML detection



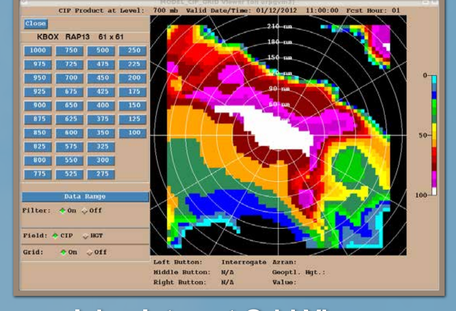
Heights of 0°C Crossings



Thermal Grid Viewer



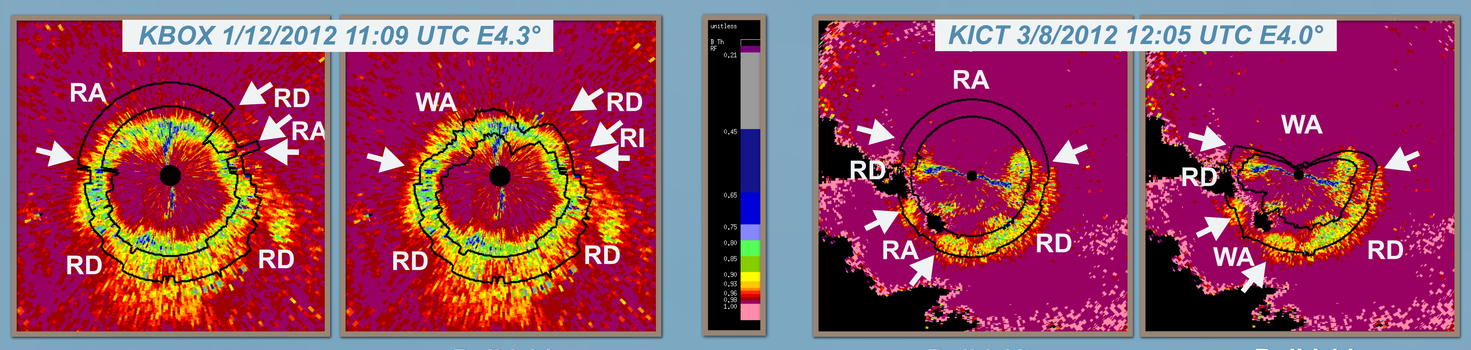
Temperature and Relative Humidity Interest Maps



Icing Interest Grid Viewer

Blending MLDA with Model Grid Data

- Current methods to define the ML in regions lacking sufficient evidence of wet snow can lead to incorrect diagnoses
- Model enhanced blending in MLDA improves detection of non-uniform melting layers and hydrometeor classification



Build 13 Build 14 Build 13 Build 14

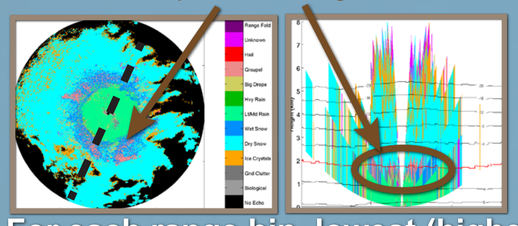
Blending Method

DM – default model
RD – radar diagnosed
RA – radar averaged

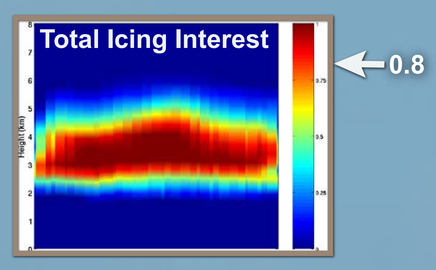
RI – radar interpolated
MD – model diagnosed
WA – weighted average

Product Description

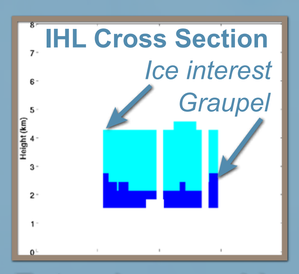
Graupel near freezing level



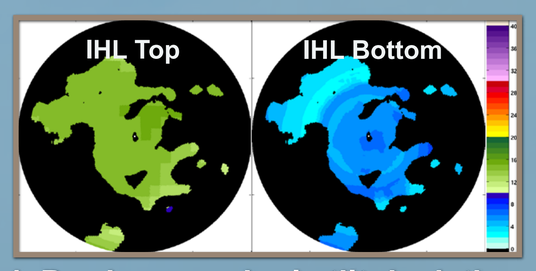
1. For each range bin, lowest (highest) beam angle where graupel is found determines altitude of icing bottom (top)



2. Search top-down to identify highest altitude where icing interest ≥0.8



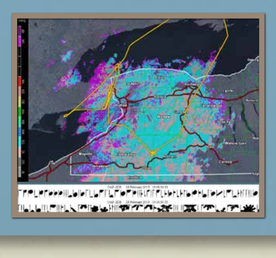
3. Extend graupel based icing top to icing interest altitude

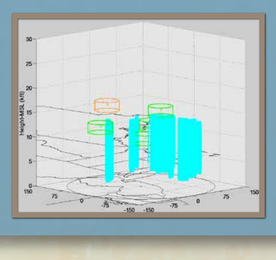


4. Produces a single tilt depiction of the top and bottom of the icing hazard region

Verification

- Surface observations provide clues ice crystals encountered SLW
- In situ measurements and pilot reports (PIREPs) support presence of icing





Conclusions

- NEXRAD IHL provides high spatial/temporal detection of icing within the sensitivity limits of the radar
- Significant enhancements made to the MLDA product and model utility
- Future enhancement to MLDA, HCA, and IHL based on verification studies will extend IHL initial capability to non-graupel icing regions

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