



Development and Testing of the VAHIRR Radar Product



Joe H. Barrett III, Juli Miller, Debbie Charnasky, Bob Gillen
ENSCO, Inc./Applied Meteorology Unit

Richard Lafosse, Brian Hoeth, Doris Hood
National Weather Service, Spaceflight Meteorology Group, Houston, TX

Todd McNamara and William Roeder
45th Weather Squadron, Patrick AFB, FL



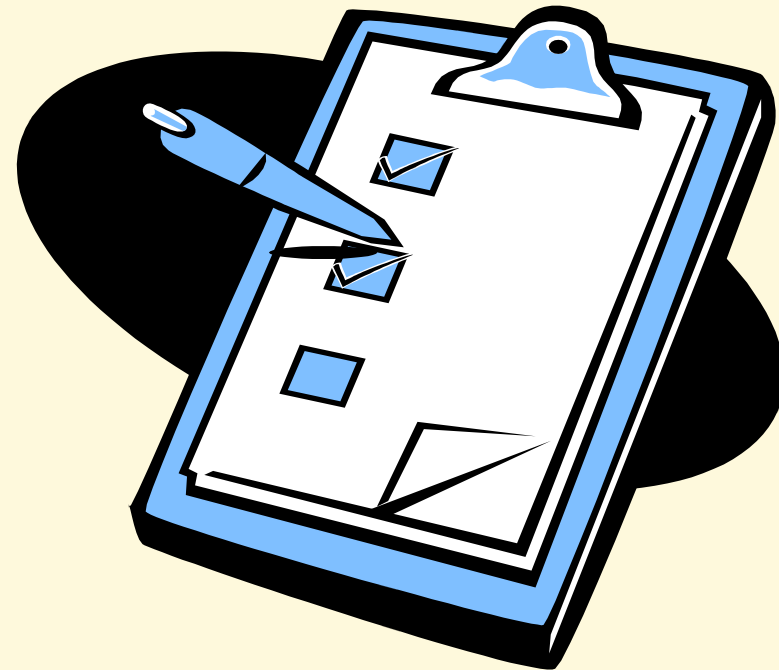
Paper 12.5



Outline

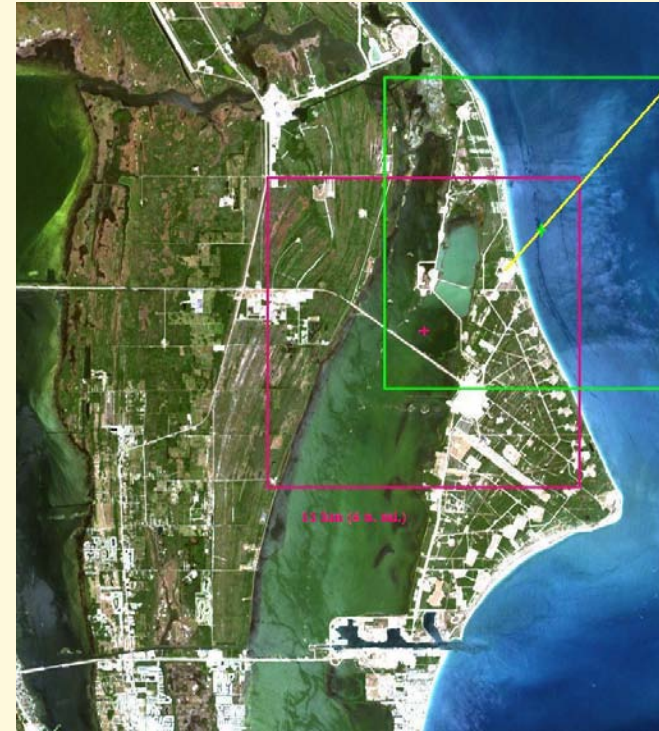


- Volume Averaged Height Integrated Radar Reflectivity (VAHIRR) Background
- Developing and Testing the Automated VAHIRR Product
- Summary



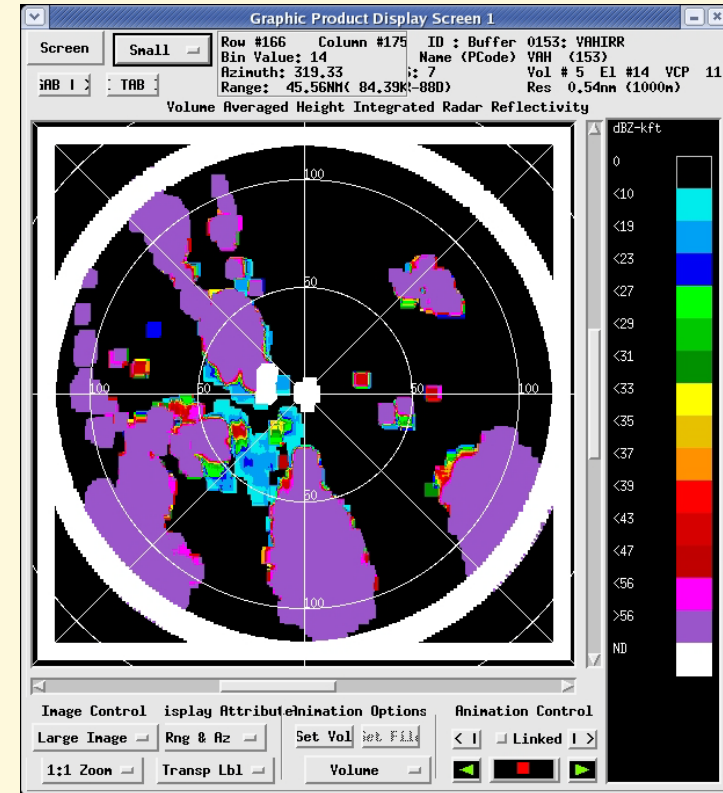
VAHIRR Background

- Previous Lightning Launch Commit Criteria (LLCC) overly restrictive
- VAHIRR resulted from 2000/2001 ABFM II project
 - Electric field magnitudes inside thunderstorm anvils compared to radar parameters
 - VAHIRR was best performing parameter
 - 3 kV/m or less electric fields deemed safe from triggered lightning
 - When VAHIRR ≤ 10 dBZ-km, chance of 3 kV/m or greater electric field is less than 1 in 10,000
- VAHIRR = Volume Averaged Radar Reflectivity X Average Cloud Thickness (within a Specified Volume)
- Specified Volume
 - Horizontal extent: 5.5 km N, S, E and W of the point
 - Bounded by freezing level on bottom, cloud on top



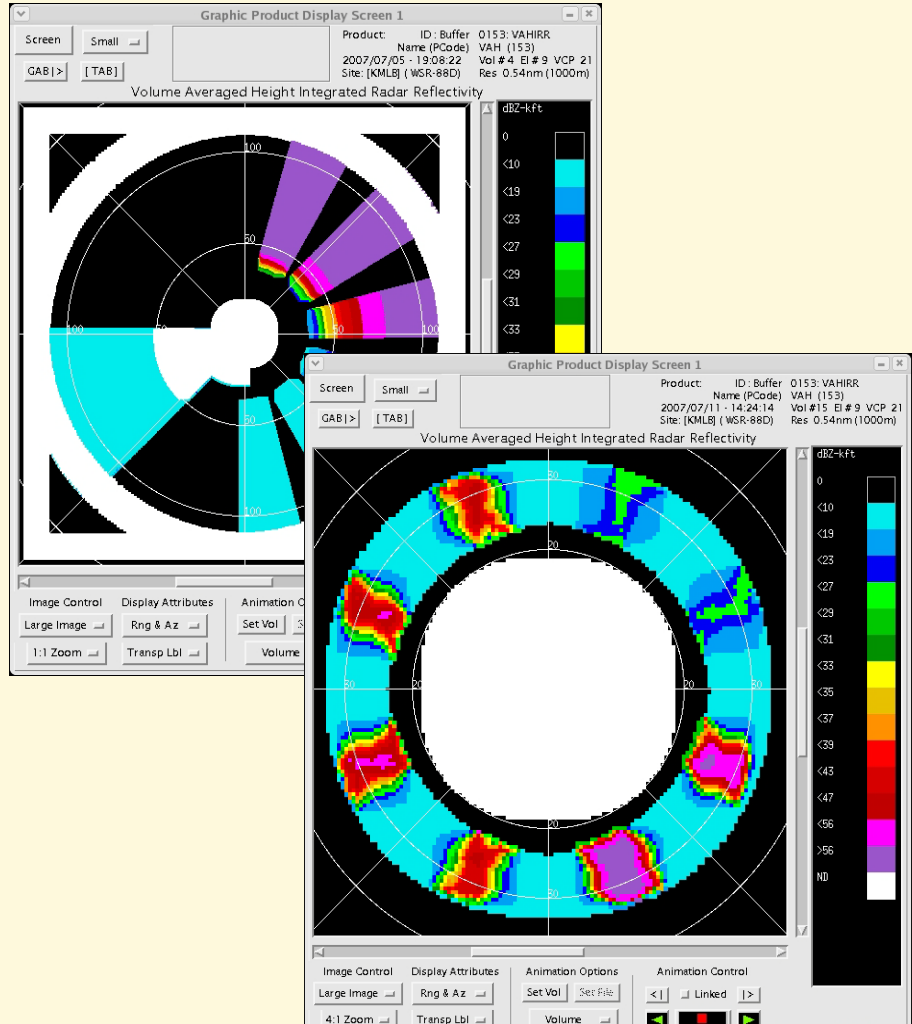
Developing the Automated VAHIRR Product

- Operationally, VAHIRR work-around uses existing radar products, is manually intensive and gives conservative values
- Applied Meteorology Unit (AMU) developed automated VAHIRR for WSR-88D
 - 1 km horizontal resolution
 - Vertical resolution varies due to:
 - Beam spreading with distance from radar
 - Non-evenly spaced elevation scans
 - 4-bit product: only 16 data levels displayed
- AMU testing of VAHIRR:
 - Synthetic data
 - Comparison with ABFM data



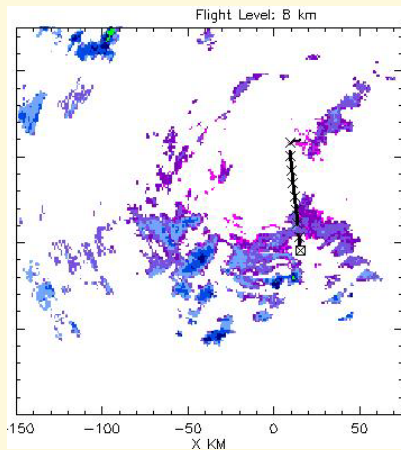
VAHIRR Testing – Synthetic Data

- Purpose
 - Demonstrate accuracy of product using artificial data
- Tests conducted
 - Cloud Top/Bottom
 - Freezing Level
 - Cone of Silence
 - Multiple Cloud Layers

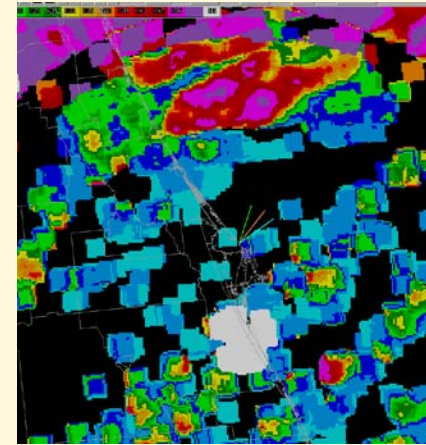


VAHIRR Testing – ABFM Comparison

- Purpose: Compare AMU VAHIRR to ABFM VAHIRR
- Methodology:
 - ABFM VAHIRR values only available along aircraft's flight track at 10-second intervals
 - AMU VAHIRR values displayed across entire radar coverage every volume scan (every 5-6 minutes in precipitation mode)
 - Values from both VAHIRR products compared for same location and volume scan, using AWIPS lat/lon
 - Data gathered from multiple days of ABFM project, to have a large and representative sample data set



ABFM Display



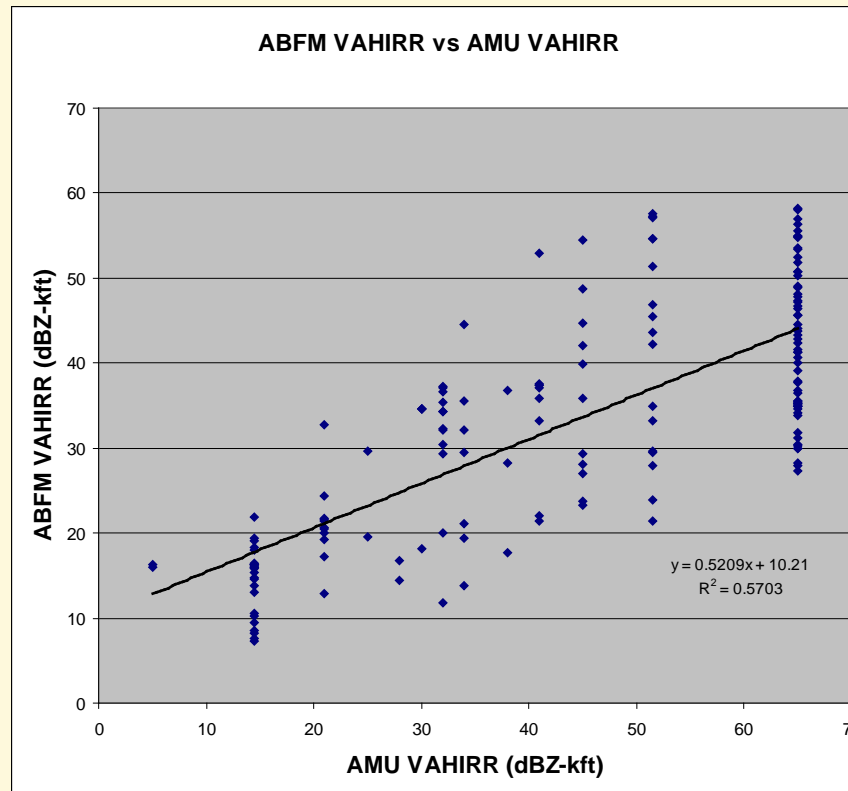
AMU VAHIRR Display



VAHIRR Testing – ABFM Comparison

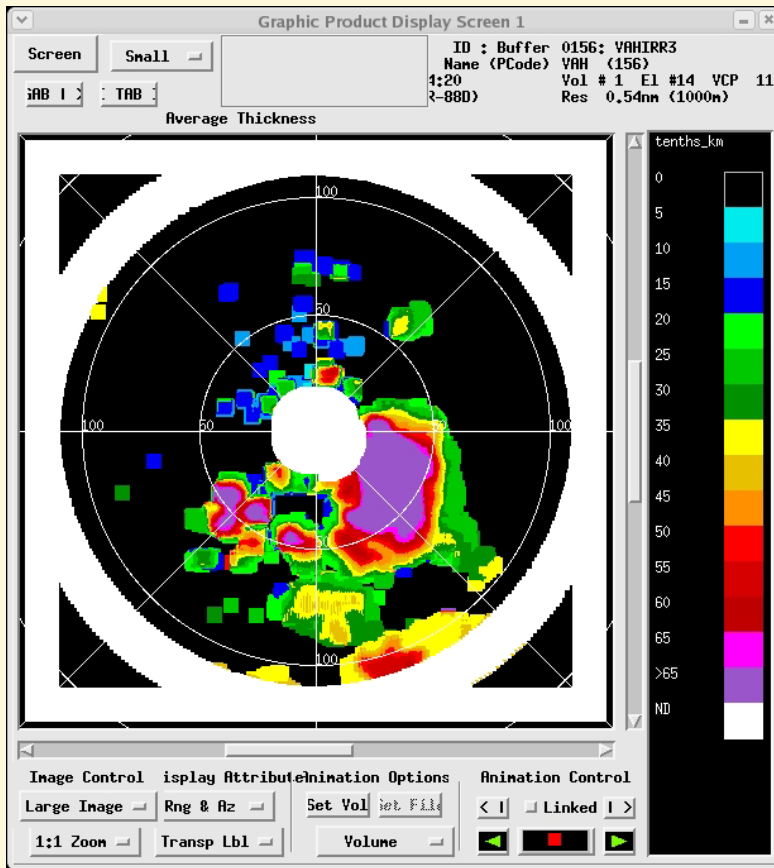


- Initial Results:
 - Large differences found between AMU and ABFM VAHIRR products
 - 33% positive bias in AMU VAHIRR product

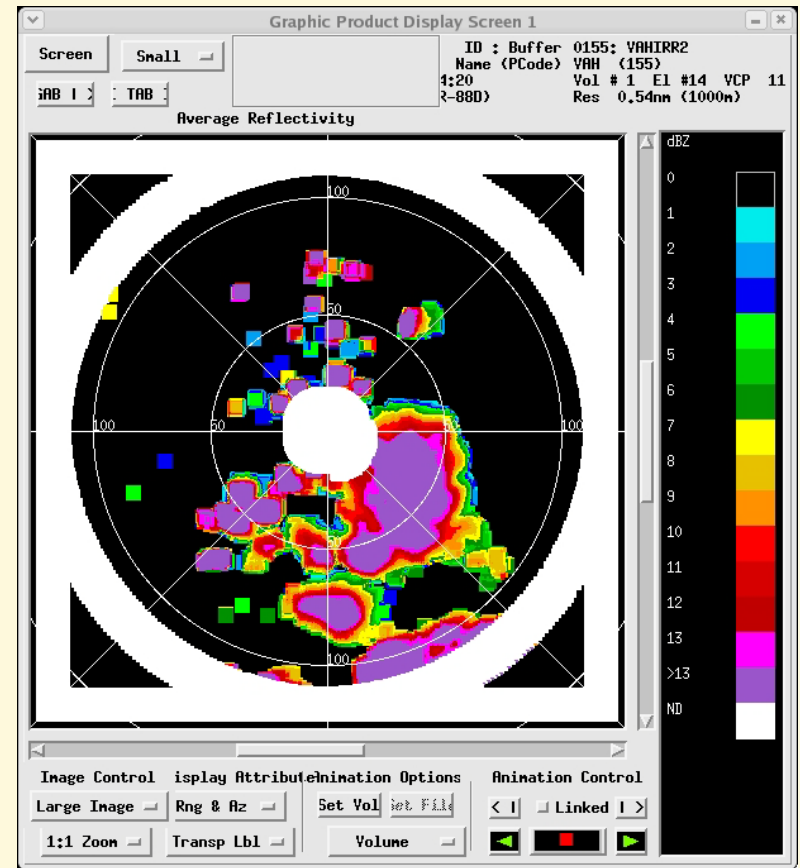


VAHIRR Testing – ABFM Comparison

- AMU created two products to investigate differences in VAHIRR values



Average Cloud Thickness



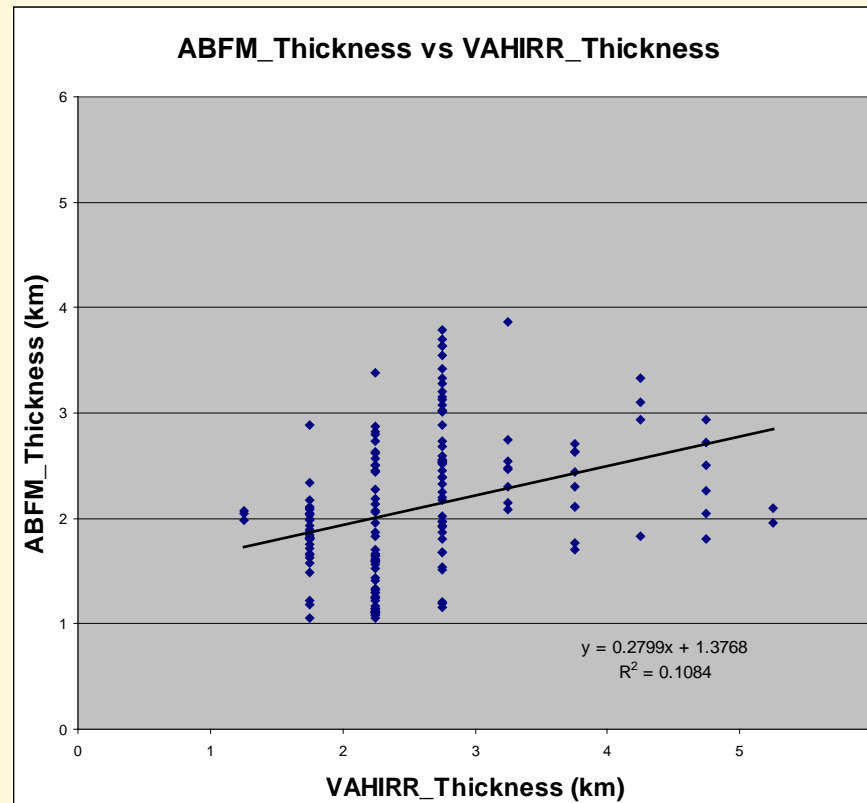
Volume Average Reflectivity



VAHIRR Testing – ABFM Comparison



- Comparison of average cloud thickness
 - Poor agreement between AMU and ABFM
 - 23% positive bias in AMU's average cloud thickness

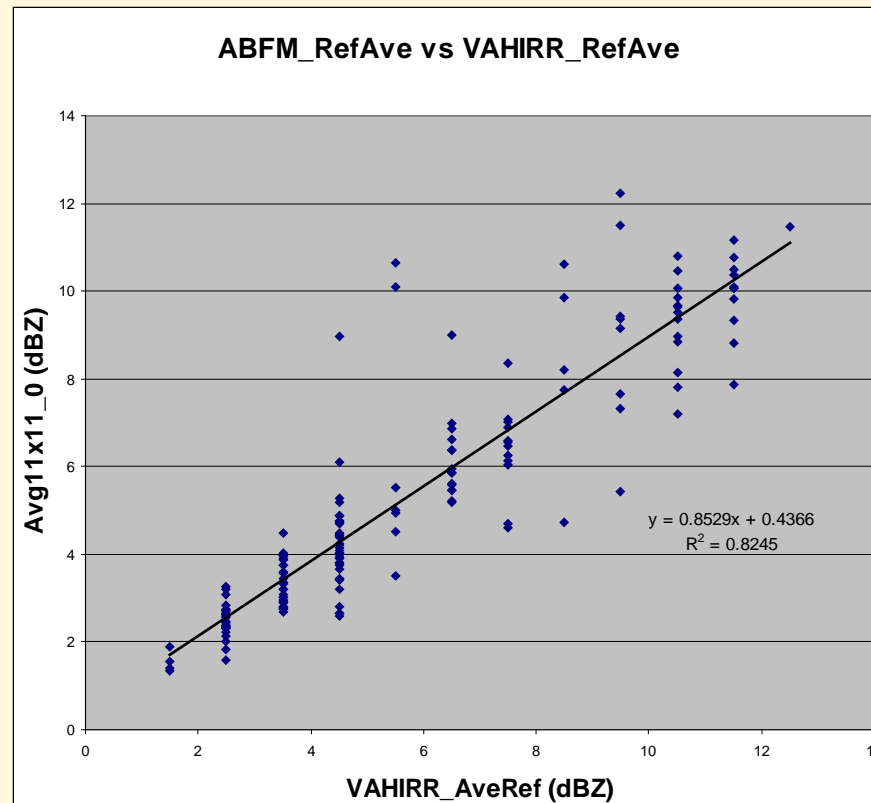




VAHIRR Testing – ABFM Comparison



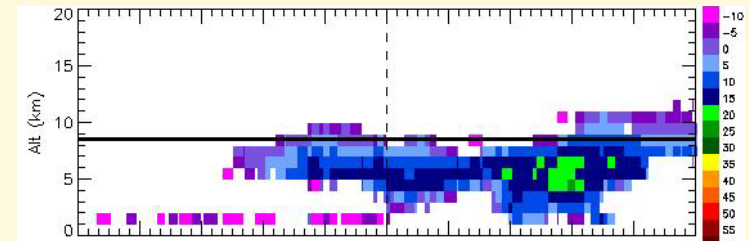
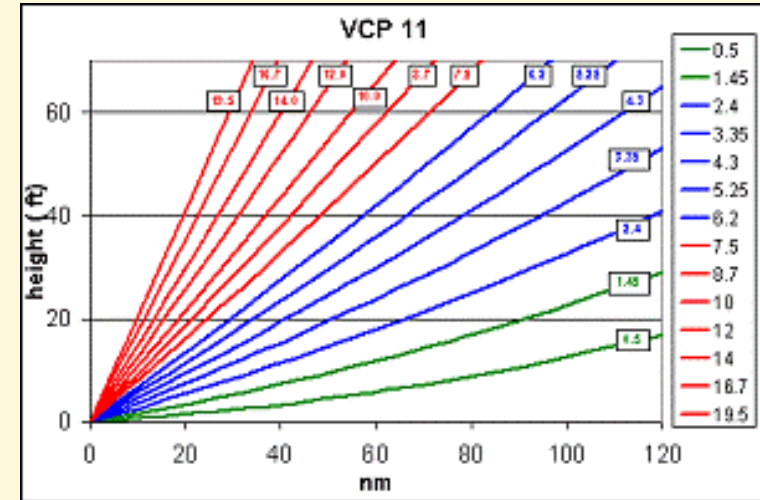
- Comparison of volume average reflectivity
 - Good agreement between AMU and ABFM
 - 8% positive bias in AMU's volume average reflectivity



Testing the Automated VAHIRR Product

Investigating Differences Between Two Products

- Possible contributors to differences revealed in ABFM Comparison
 - Errors in lat/lon position of ABFM aircraft or VAHIRR values
 - Errors in calculating cloud heights
 - ABFM's product uses reflectivity values at all levels to calculate cloud top and base, while AMU's product only uses reflectivity values at or above the freezing level
 - Differences in vertical grid spacing
 - Compare cloud thickness, average reflectivity, and VAHIRR ratios as function of distance from radar (constant thickness)
 - Compare same ratios as a function of cloud thickness (constant distance from radar)





Summary



- The ABFM II project developed the VAHIRR product, leading to less restrictive Lightning Launch Commit Criteria
- ABFM Comparison Test showed large differences between AMU's and ABFM's VAHIRR products
- As a result, AMU is investigating the differences between the two products
- VAHIRR work-around will be used until automated VAHIRR product is certified and passes all testing procedures

