DC3 Ground Facilities Alabama

21-22 February 2012
DC3 Science Team Meeting

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UAHuntsville
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

NASA

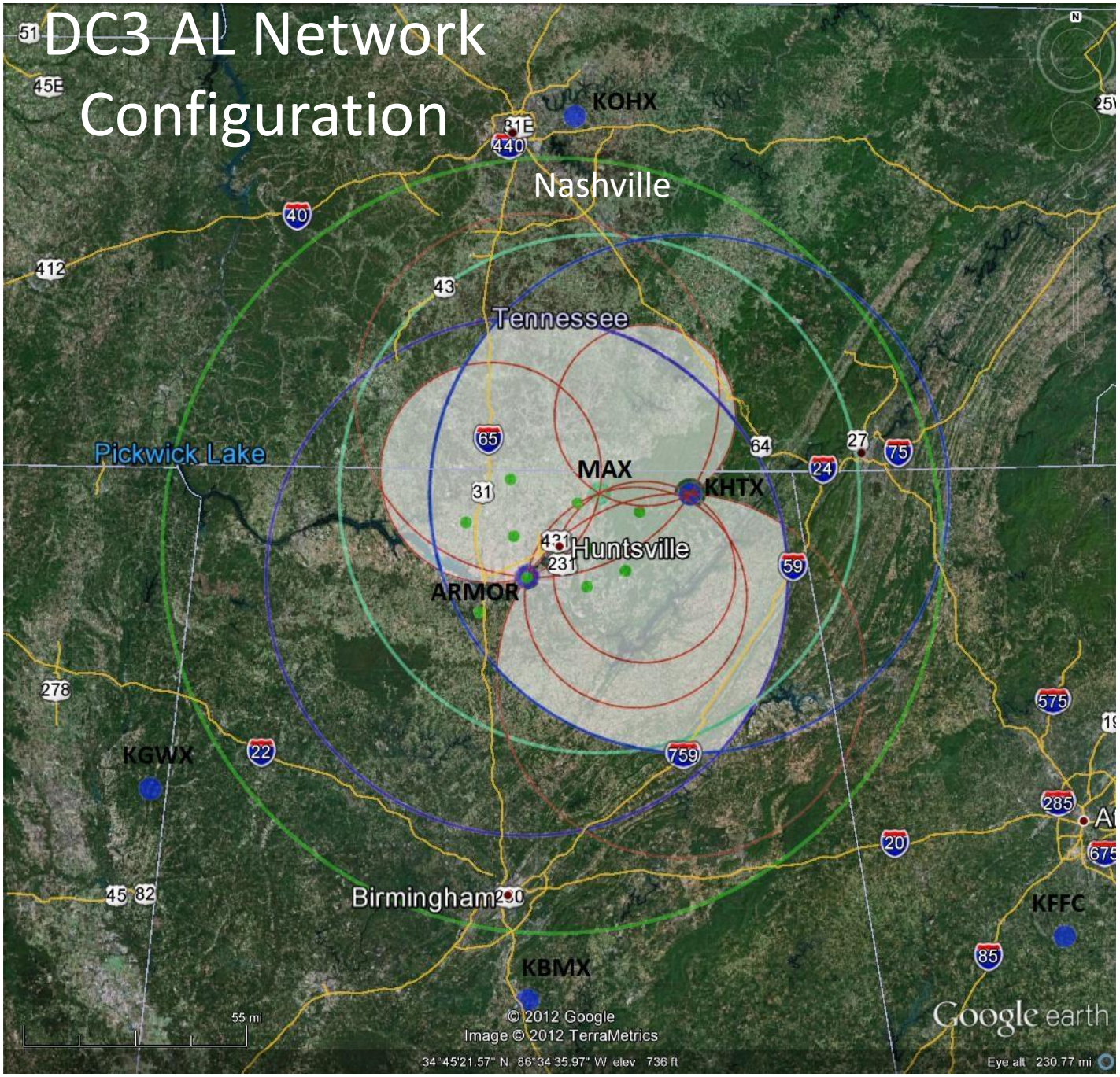
DC3 Alabama Ground Facilities

- UAHuntsville
  - Advanced Radar for Meteorological and Operational Research (ARMOR) C-band dual-polarimetric radar
  - Mobile Alabama X-band (MAX) dual-polarimetric radar
  - Mobile Integrated Profiling System (MIPS)
  - iMET-3150 GPS sounding system

- NASA MSFC
  - Northern Alabama - Lightning Mapping Array (NA-LMA)
  - Other lightning data (Regional/Global LF/VLF networks such as Vaisala NLDN, Vaisala GLD360, Earth Networks ENTLN)

- Other
  - Army Redstone Arsenal 12z sounding
  - KHTX Hytop (also KBMX, KOHX, KFFC) WSR-88D S-band upgraded dual-polarimetric radars
  - KGWX WSR-888D (not upgraded)

DC3 AL Network Configuration



KEY:

Radars:

Triple-Doppler (30°)
ARMOR: 100 km
MAX: 100 km
KHTX/Hytop*: 100 km

Other WSR-88D's
KBMX/Birmingham*
KOHX/Nashville*
KFFC/Atlanta*
KGWX/Columbus AFB

*dual-pol upgraded

NA-LMA:

NA-LMA sensors, 150 km range ring

UAHuntsville ARMOR: Advanced Radar for Meteorological and Operational Research.

C-band Dual-Polarimetric

ARMOR at HSV

http://www.nsstc.uah.edu/ARMOR/

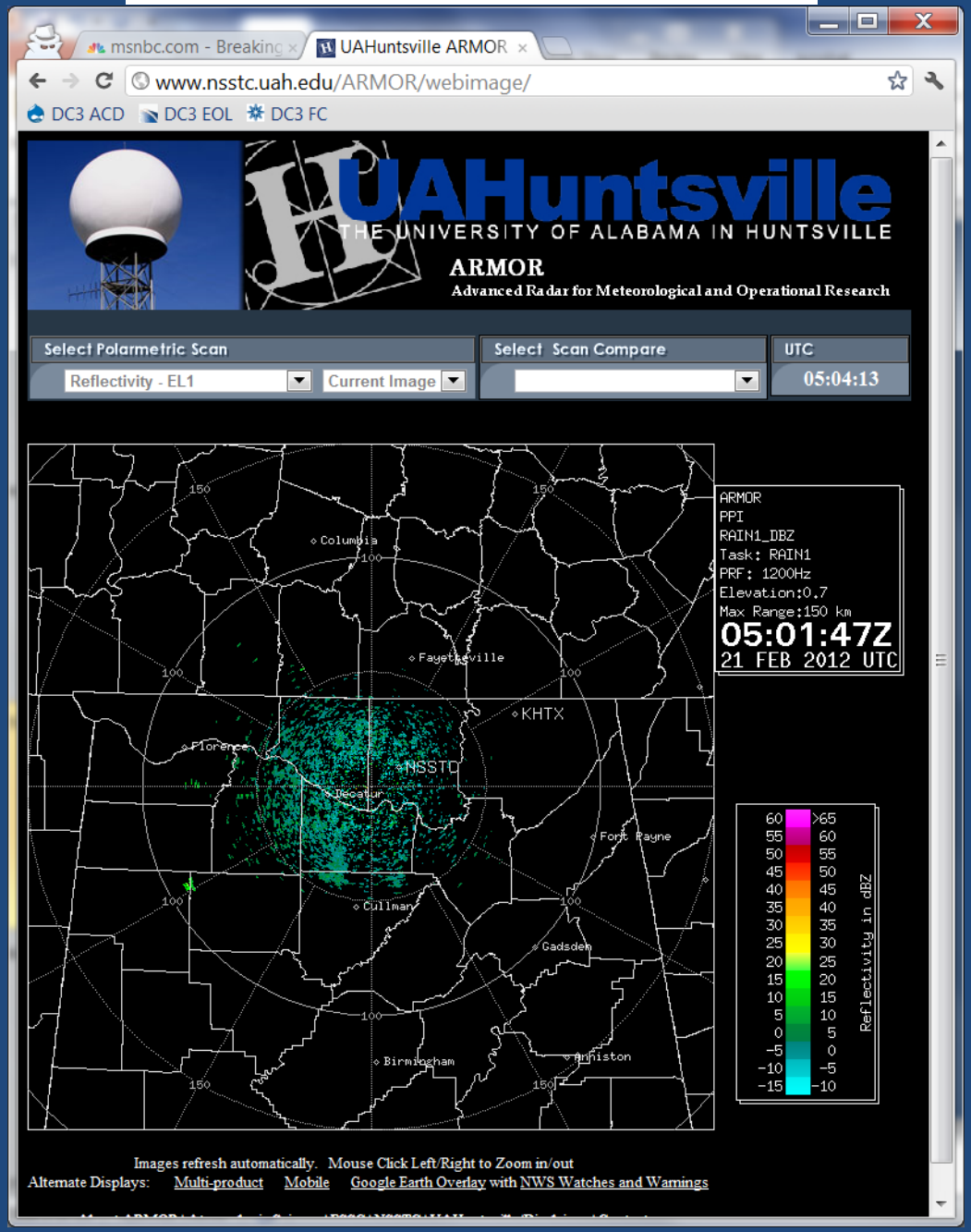
• Location :	Huntsville Intl. Airport
• Altitude (antenna MSL):	206 m
• Transmit frequency:	5625 MHz (C-band)
• Peak Power:	350 kW (Magnetron)
• Pulse width:	0.4 – 2.0 μs
• Maximum PRF:	250-2000 s^{-1}
• Antenna Diameter	3.7 m (12 ft CF Parabolic)
• Antenna Beam width:	1.0°
• First side-lobe:	-30 dB
• Cross-pol isolation:	< -41 dB
• Maximum rotation rate:	36° s^{-1}
• Transmit polarization:	Simultaneous H and V, [or H]
• Receive polarization:	Vaisala Sigmet dual-channel; H + V, or H
• Signal Process:	Vaisala Sigmet RVP/8
• Variables:	Z, V_r, W, Z_{dr}, ρ_{HV}, ϕ_{dp}, K_{dp},, [LDR]

- 2002: NWS Doppler WSR-74C donated to UAHuntsville
- 2004: Upgraded to dual-polarimetric using the SIGMET Antenna Mounted Receiver
- 2005: Upgrade to solid state transmitter by Baron Services
- 2006: Upgrade to high performance Seavey antenna and Orbit pedestal with integration by Baron Services
- More information regarding the ARMOR can be found at **http://nsstc.uah.edu/armor/**

ARMOR

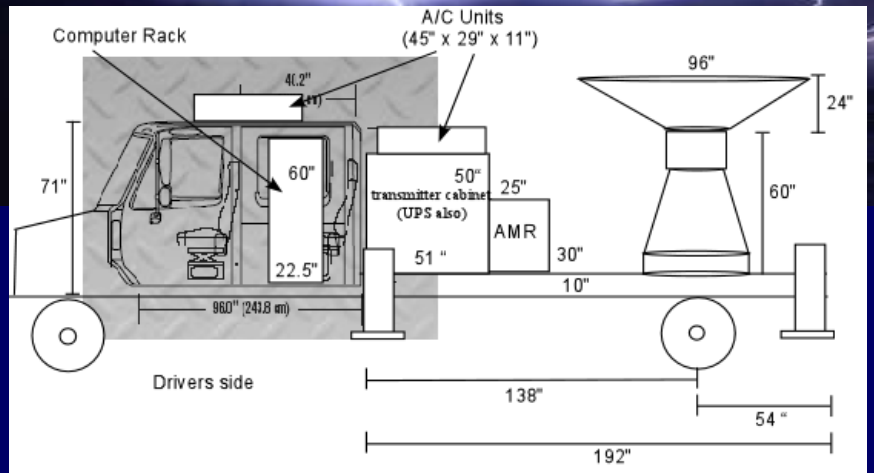
- Continuous research operations/scanning
- RVP-8 IRIS control from UAHuntsville NSSTC network computer
- 2 person team: 1 Radar Operator, 1 Nowcaster & Comms
- Real-time quality control, propagation correction, preliminary product generation (HID, QPE)

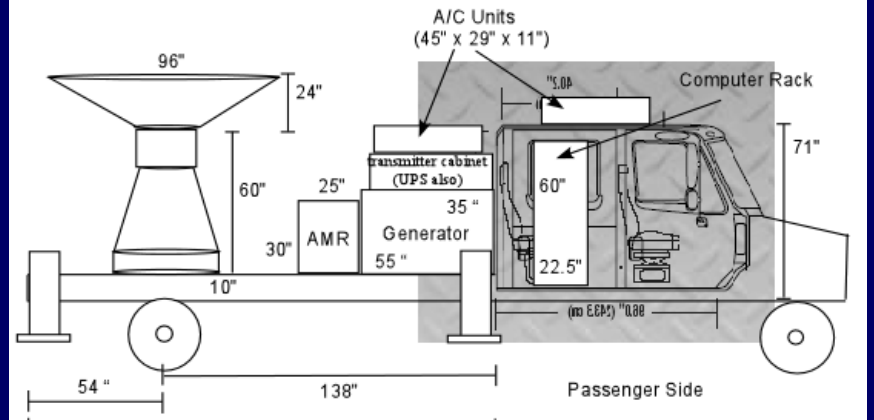
http://www.nsstc.uah.edu/ARMOR/



MAX: Mobile Alabama X-band dual polarimetric Doppler Radar

http://vortex.nsstc.uah.edu/mips/max/





Oct. 2006: Initial procurement of hardware

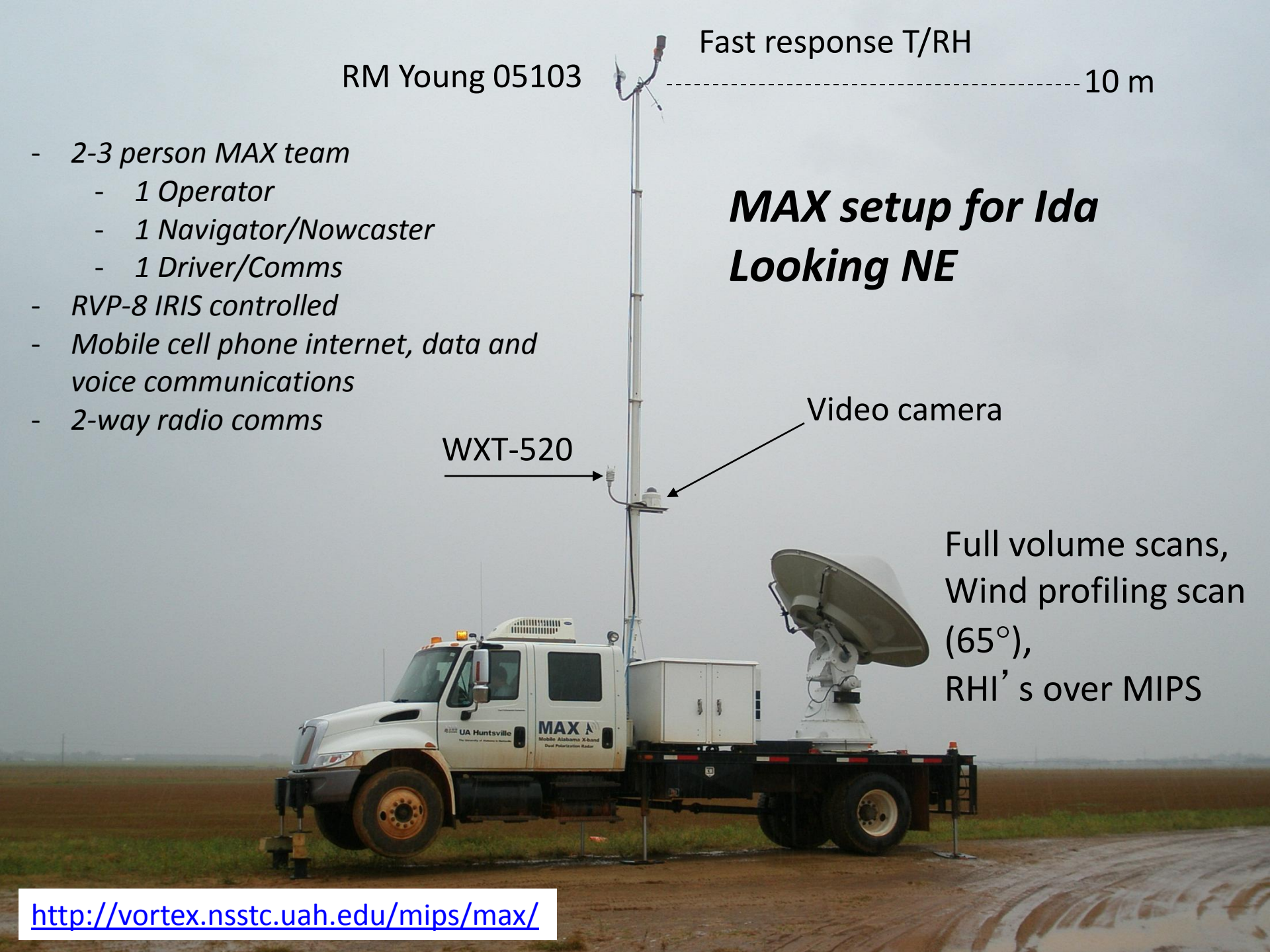
Nov. 2006 - Fall 2007: Construction

Fall 2007 - Winter 2008: Shakedown/field ready

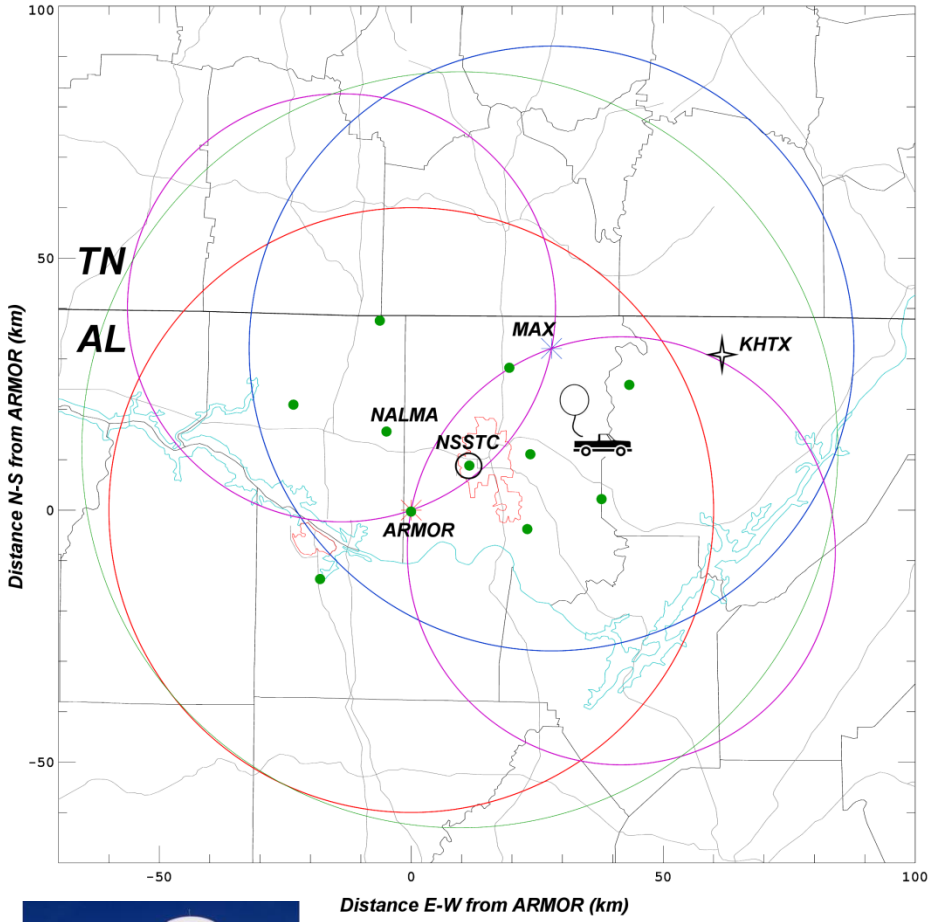
- Transmit frequency: 9450 MHz (H+V, H)
- Peak Power: 250 kW
- Pulse width: 0.4 – 2.0 μs
- Min/Max PRF: 250 / 2000 s^{-1}
- Antenna Diameter 2.4 m (8 ft, CF Parabolic)
- Antenna Gain 44.5 dB
- Antenna Beam width: 1°
- First side-lobe: -31 dB
- Cross-pol isolation: <-36 dB
- Receiver polarization: RVP/8
- Variables: Z, V, W, ZDR, ϕ_{DP}, KDP, ρ_{hv}, LDR

Radar Development

- Tx/Rx/Ant. Design/Integration: Baron Services, Huntsville
- MP-61 Pedestal (Radio Research): UAH with prep. work and checkout by Mr. Bob Bowie, CSU-CHILL
- Truck/generator/data system: UAH


Fast response T/RH
RM Young 05103
10 m
MAX setup for Ida
Looking NE
- 2-3 person MAX team
  - 1 Operator
  - 1 Navigator/Nowcaster
  - 1 Driver/Comms
- RVP-8 IRIS controlled
- Mobile cell phone internet, data and voice communications
- 2-way radio comms
Video camera
WXT-520
Full volume scans,
Wind profiling scan (65°),
RHI's over MIPS
UA Huntsville
MAX
http://vortex.nsstc.uah.edu/mips/max/

DC3 AL Research (ARMOR-MAX) dual-polarimetric, Dual-Doppler Network



Max located near New Market, AL.

Dynamics and Microphysics

ARMOR at HSV

Table 4. NSSTC (UAHuntsville and NASA MSFC) radar specifications.

Radar Characteristic	ARMOR (C-band)	MAX (X-band)
Location	Huntsville Intl. Airport	Mobile (truck-based)
Transmit frequency	5625 MHz (magnetron)	9450 MHz (magnetron)
Peak Power	350 kW	250 kW
Pulse width	0.4, 0.8, 1.0, 2.0 μs	0.4, 0.8, 1.0, 2.0 ms
PRF Range	250-2000 Hz	250-2000 Hz
Antenna diameter/beamwidth	3.7 m (CF parabolic)/ 1.0°	2.44 m (CF parabolic)/0.95°
First side-lobe	-30 dB	-31 dB
Transmit polarization mode	1. STAR (H+V) or 2. H	1. STAR (H+V) or 2. H
Receive polarization	H and V	H and V
Signal Processor, Controller	VAISALA-SIGMET RVP/8, RCP/8	VAISALA-SIGMET RVP/8, RCP/8
Variables (depends on transmit mode 1 or 2)	1. Z_h, V_r, W, Z_{dr}, Φ_{dp}/K_{dp}, ρ_{HV} or 2. Z_h, V_r, W, LDR	1. Z_h, V_r, W, Z_{dr}, Φ_{dp}/K_{dp}, ρ_{HV} or 2. Z_h, V_r, W, LDR

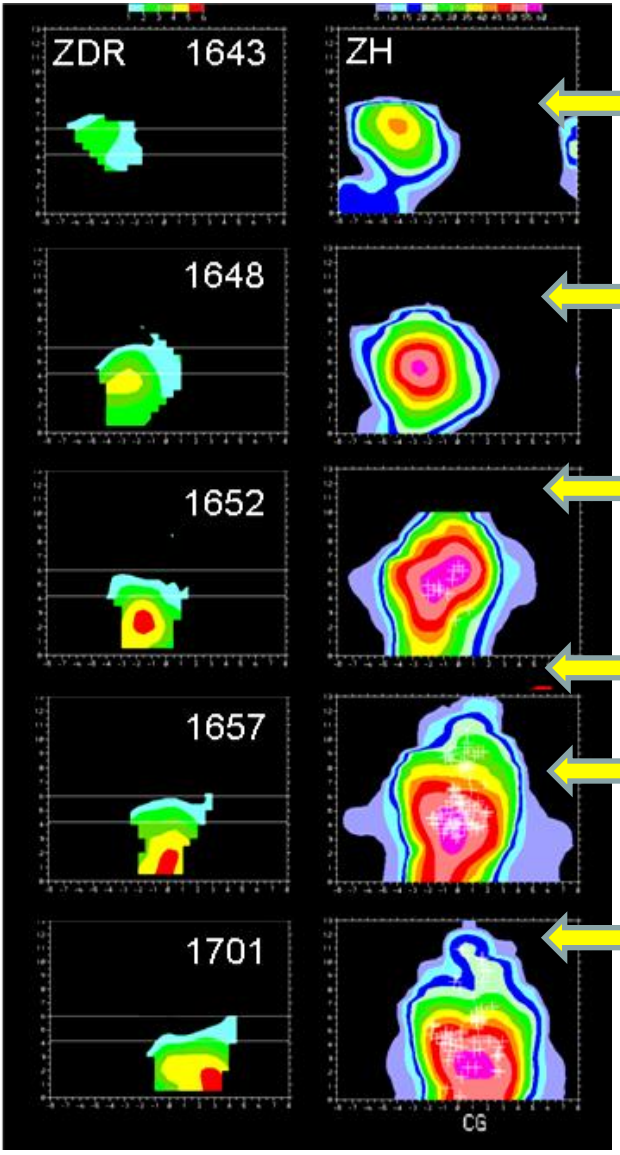
ARMOR Pulse Storm: Dual-pol, HID and IC and CG Lightning Initiation

- **ZDR and ZH (> 25 dBZ)**
- **LMA Sources ("+")**

18 Minutes to 1rst IC

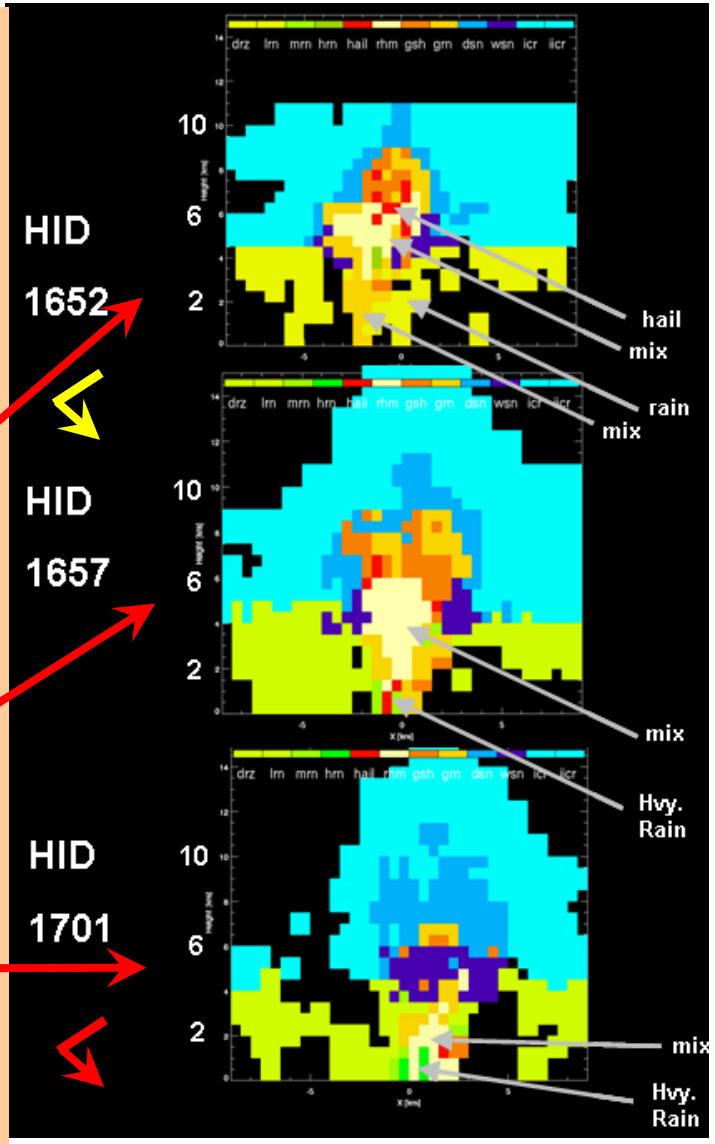
7 more minutes to 1rst CG

- **NCAR Fuzzy HID**



Sequence

- **1643 UTC: elevated rain core** ZDR > 2 dB to T = -10°C
- **1648-1652 UTC: Freezing (reduced ZDR) mixed phase**
- 1652 UTC: Rapid top growth
- **1655 UTC: First IC**
- 1657 UTC: Top still growing
- **1657-1701 UTC Core descent**
- **1702 UTC: First CG**; comes to ground in mixed phase core
- **1703 UTC: Last CG**
- **1705 UTC: Last IC**



Mobile Integrated Profiling System (MIPS)

Mobile Integrated Profiling System (MIPS)

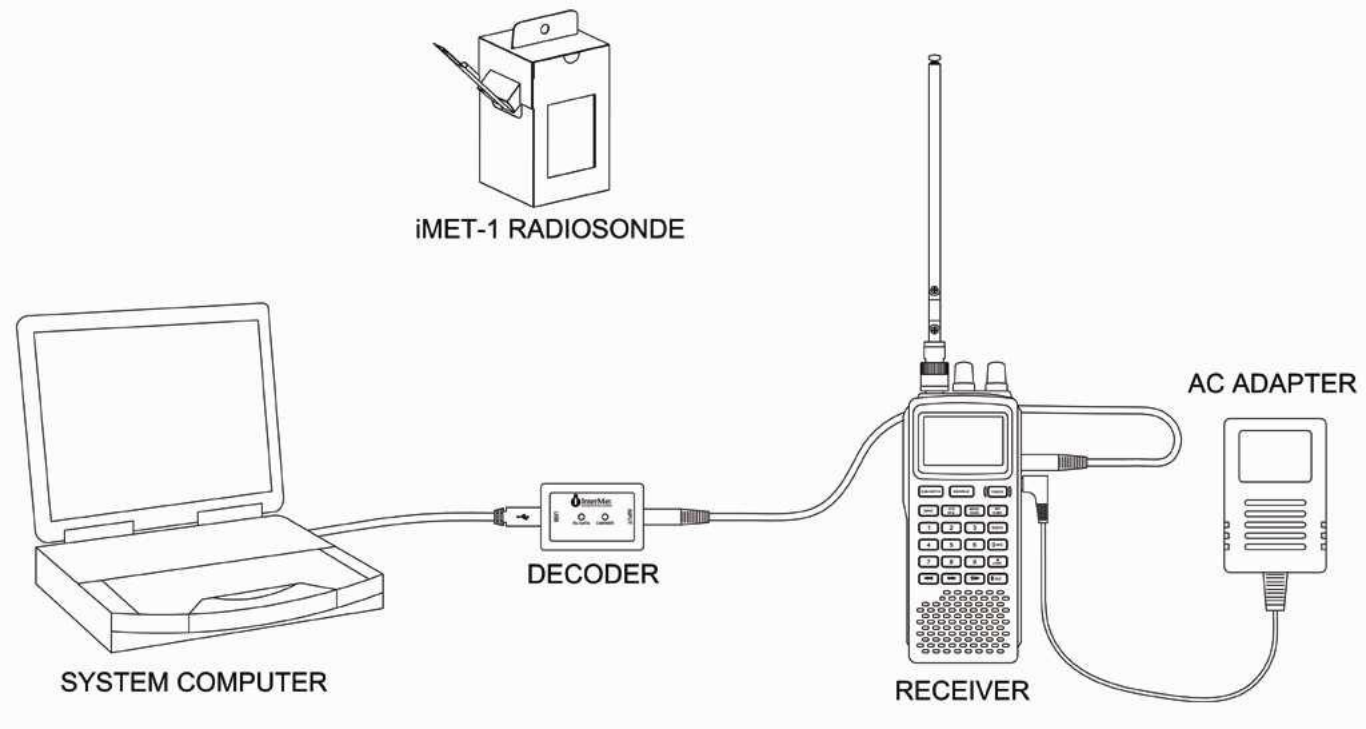
06/21/2011 13:39

2-3 person crew

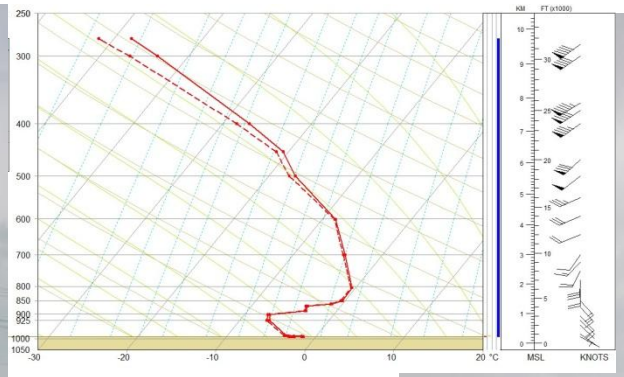
iMET-3150 (403 MHz GPS) Upper Air Sounding System

- iMetOS (Windows PC based) provides
  - Flight status display
  - Radiosonde data display
  - Real-time processing, quality control and reporting of met data
  - Graphical output (e.g., Skew-T Log-P) of T, Td, RH, wind speed & direction
  - Playback of previously recorded flights
  - Data editing and archiving
  - WMO, STANAG and custom reports

- iMet-1 radiosonde
  - Factory calibrated, 1 year accuracy
  - meets the current NWS radiosonde specification (NWS-J070-RS-SP005C.)



- 60 radiosondes for DC3 (40/20 reserved for flight/non-flight operations)
  - iMet-1-AB 403 MHz GPS Radiosonde C/A code GPS receiver with solid state pressure sensor
  - De-reeler, pre-wound with 30 m string
  - 300 gm Latex meteorological balloon (24.7 km burst altitude), parachute



2-3 person crew

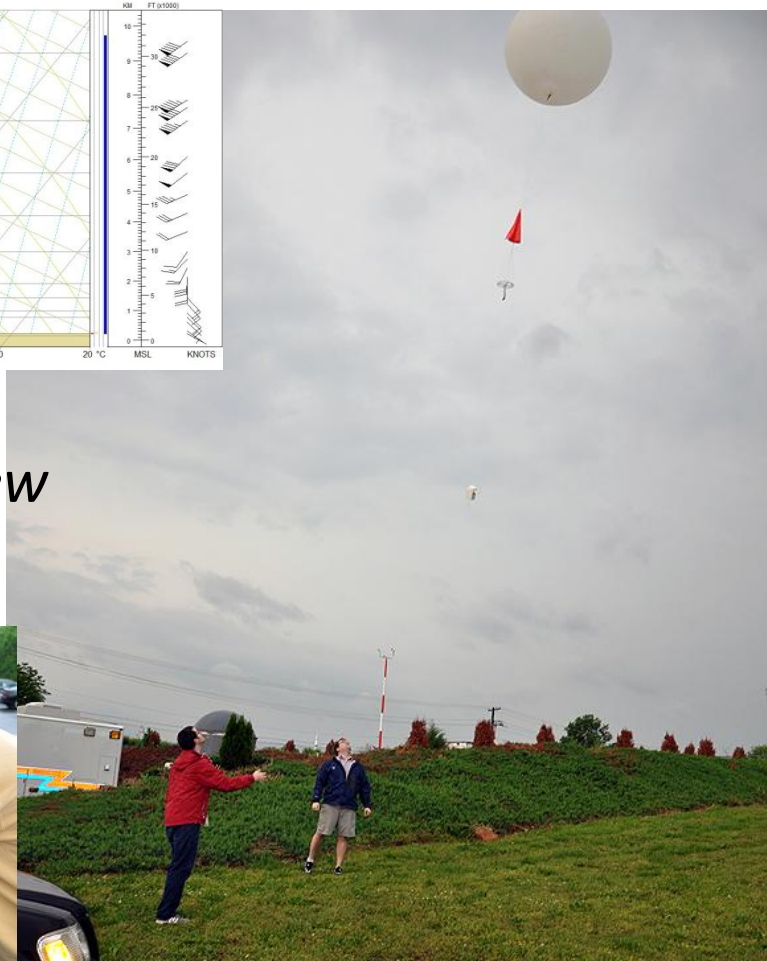
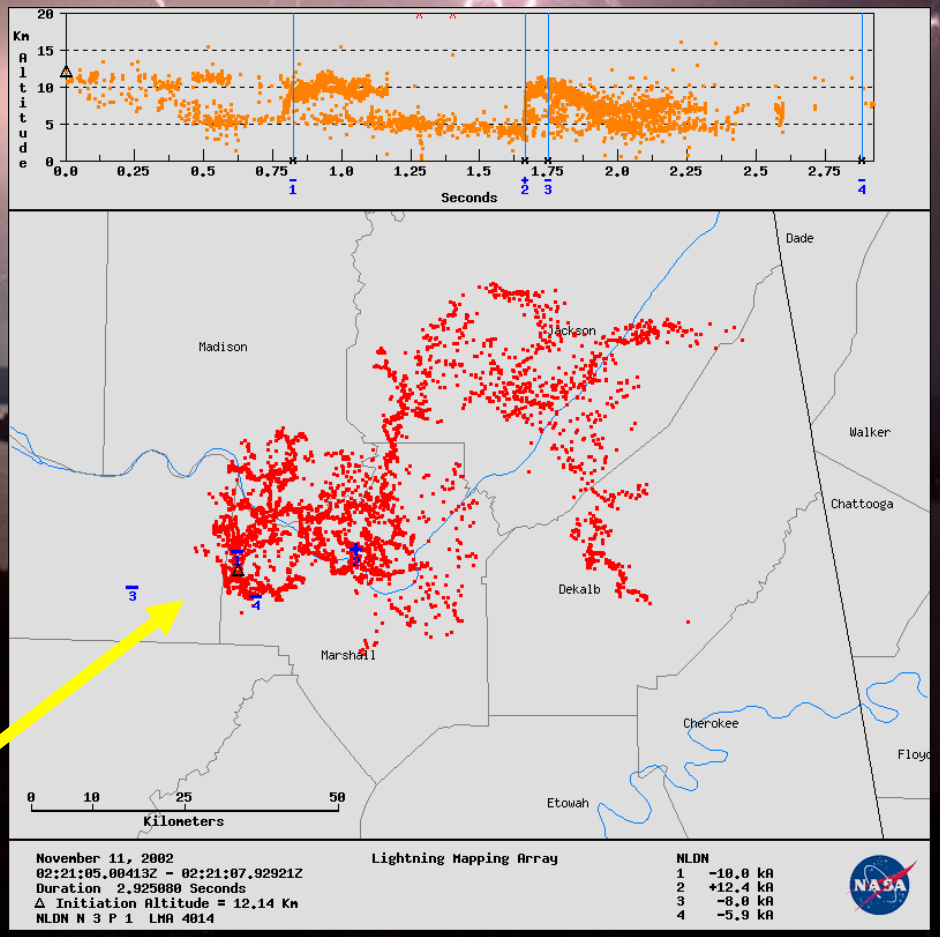


Table 3-1: iMet-1-AB Radiosonde

COMPONENT	DESCRIPTION
Temperature Sensor	Glass bead thermistor
Humidity Sensor	Variable capacitance polymer
Pressure Sensor (optional)	Piezo-resistive silicon
Transmitter	High stability with crystal controlled oscillator
GPS Receiver	12-channel, fully coded
Fixation device (optional)	De-reeler with 30m string pre-wound
Batteries	Four alkaline AA type
Protective case	Expanded polystyrene with non-hydroscopic paper cover
Signal processor	Texas instruments micro processor
Ability to add additional sensors	Can be integrated with En-Sci Model 2Z-V7Ozone sensor
Transmission type	Digital, FM
Data Rate	1 record per second
Transmit Frequencies	Four frequencies selectable by switch (402, 403, 404 & 405 MHz)

NASA's North Alabama Lightning Mapping Array (NALMA)

- Network of 11 detectors centered about Huntsville, AL (NMT heritage)
- Operational since ~ November 2001
- Detects VHF (76-82 MHz, "Ch. 5") radiation along the lightning channel - up to 1000s of sources per flash
- Computes 4-D location of <u>all</u> electrical discharges ("flashes") within LMA (CG…*and* IC, CC, CA)



Example of lightning flash detected by NALMA

SPORT

transitioning unique NASA data and research technologies to the NWS

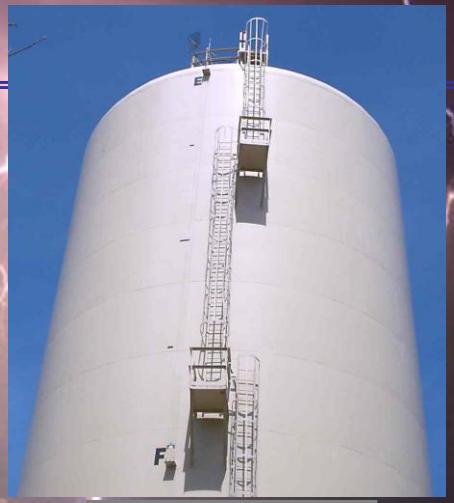
LMA Hardware

New Mexico Tech System

- LMA Sensor Sites
  - VHF ground plane antenna
  - Sensor electronics / site computer (first generation)
  - Communications (mostly 2.4 GHz wireless Ethernet network link)
- Relay Sites and Central Station
  - PC router (up to 4 network links)
  - Communications (multiple antennas require great care in channel selection)
  - Cell phone modems used at some sites

LMA Site Installations

- Sites selected on basis of noise level, ability to establish wireless com link, and low / no cost access
- Installations include: water towers, public/private radio towers, user supplied towers/masts, utility poles, even a firetower and a building



Water tower
(Keel)

User supplied tower
(Owen)

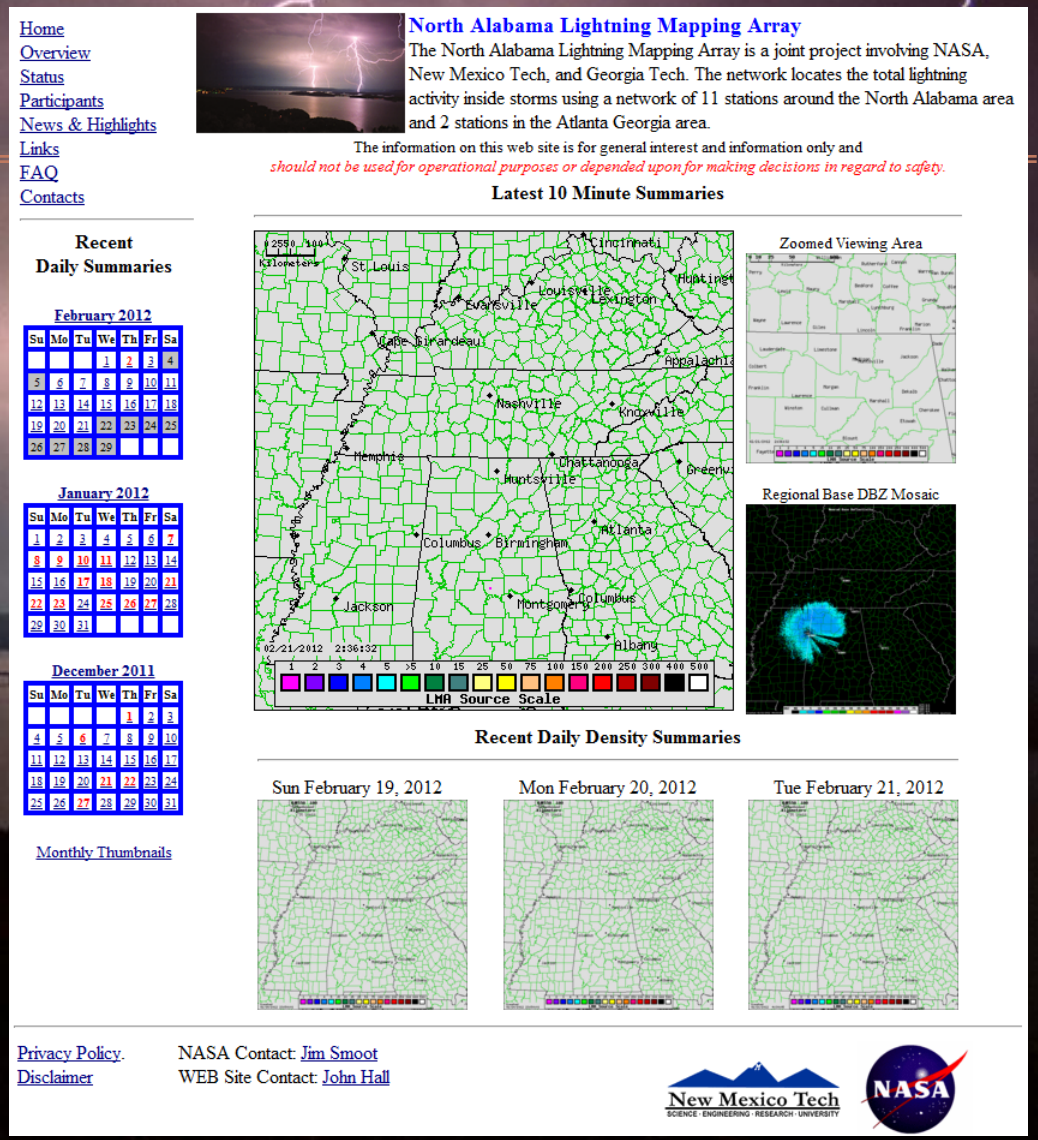
Utility pole
(AAMU)

Commercial radio tower
(Drake)

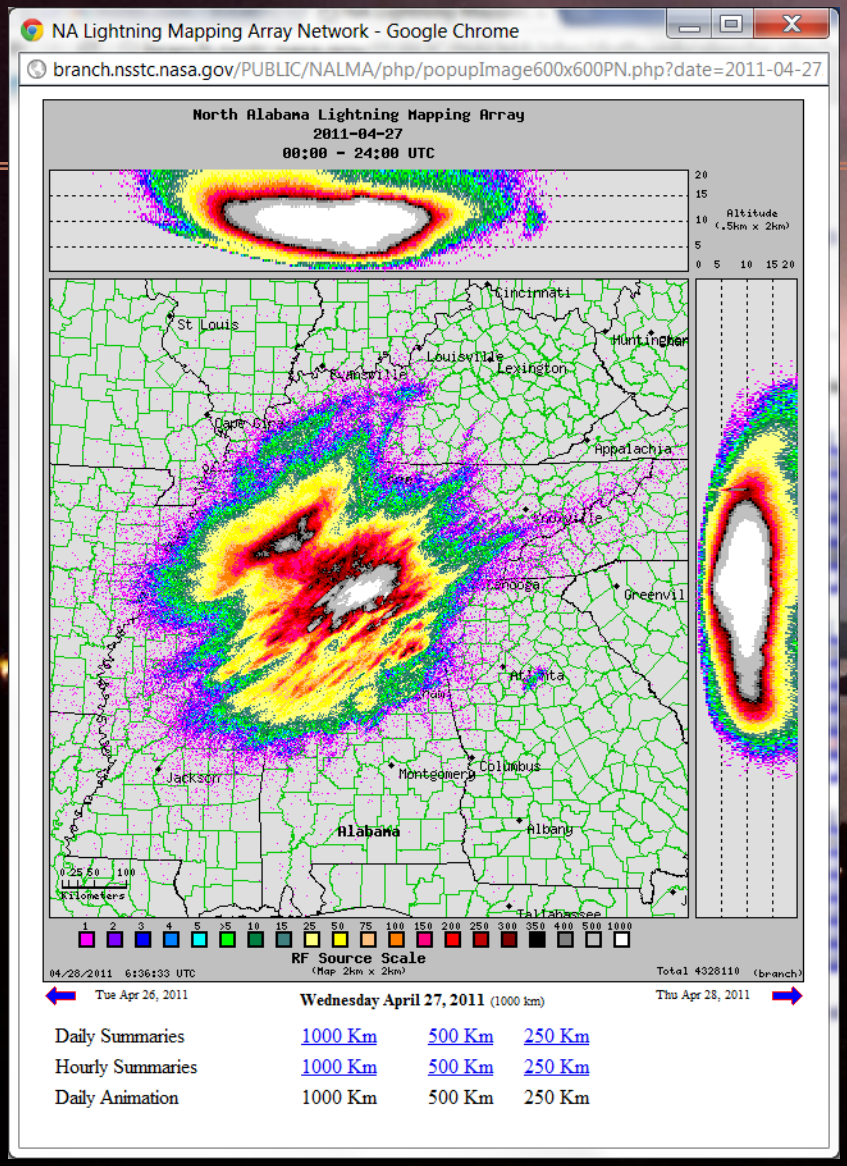
SPORT

transitioning unique NASA data and research technologies to the NWS

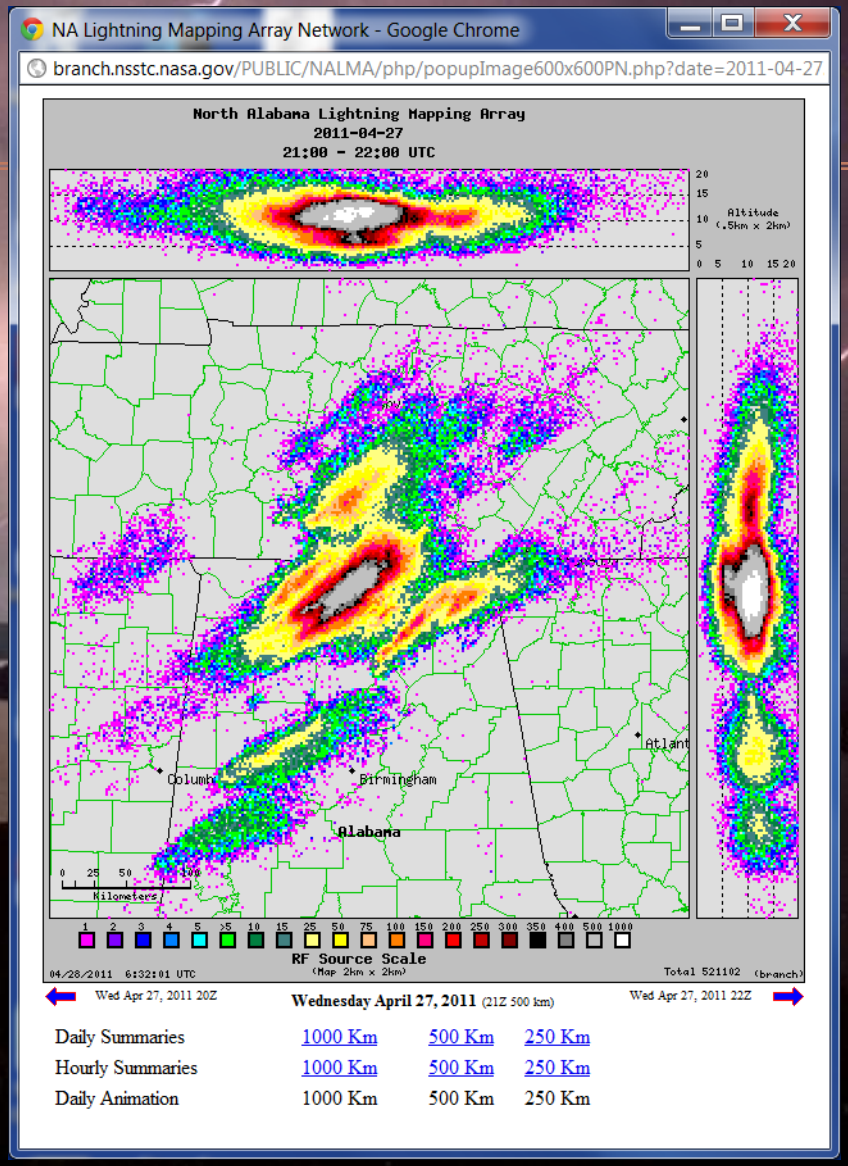
North Alabama LMA



http://branch.nsstc.nasa.gov/PUBLIC/NALMA/

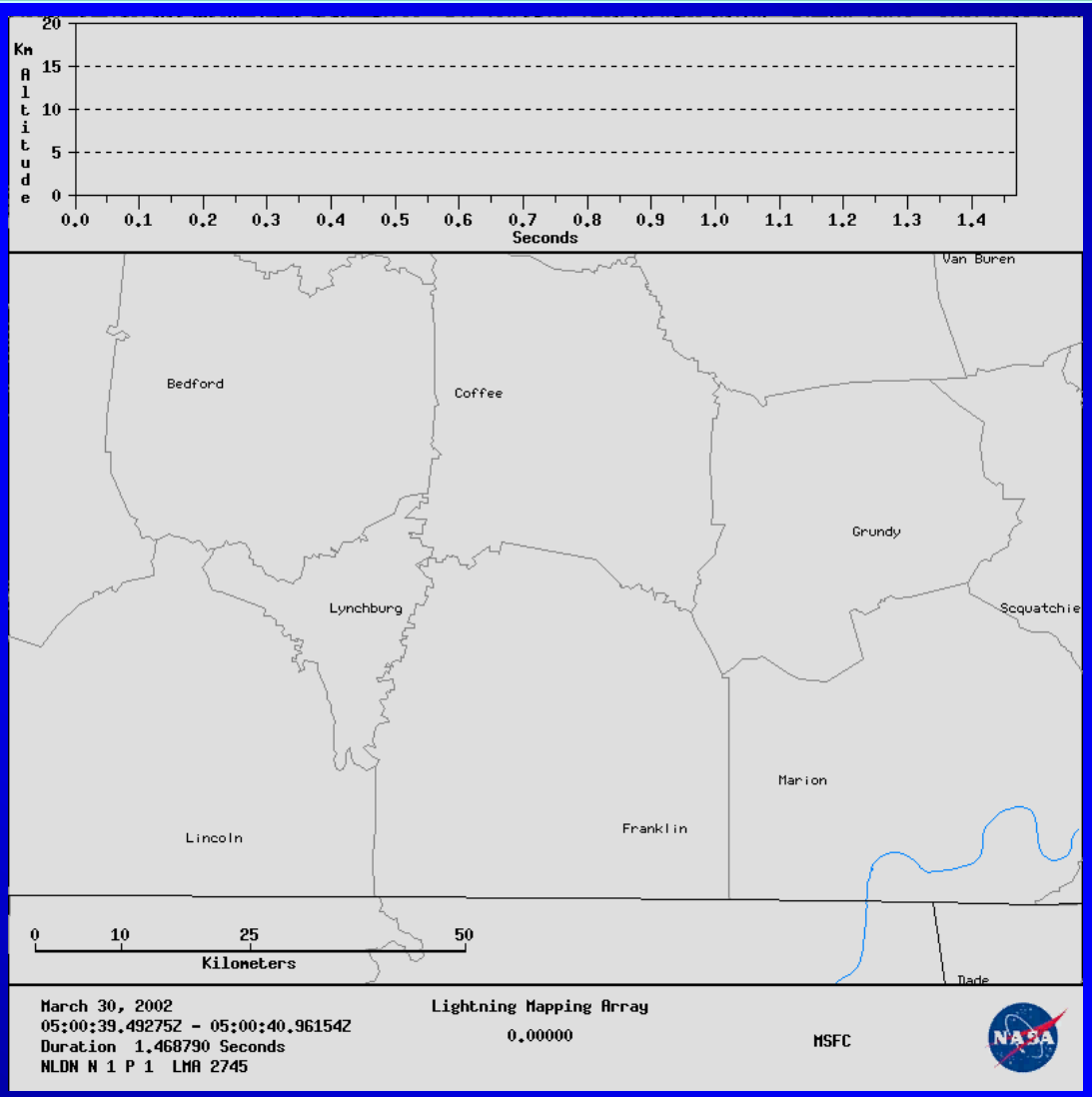


Daily Summary: 27 April 2011



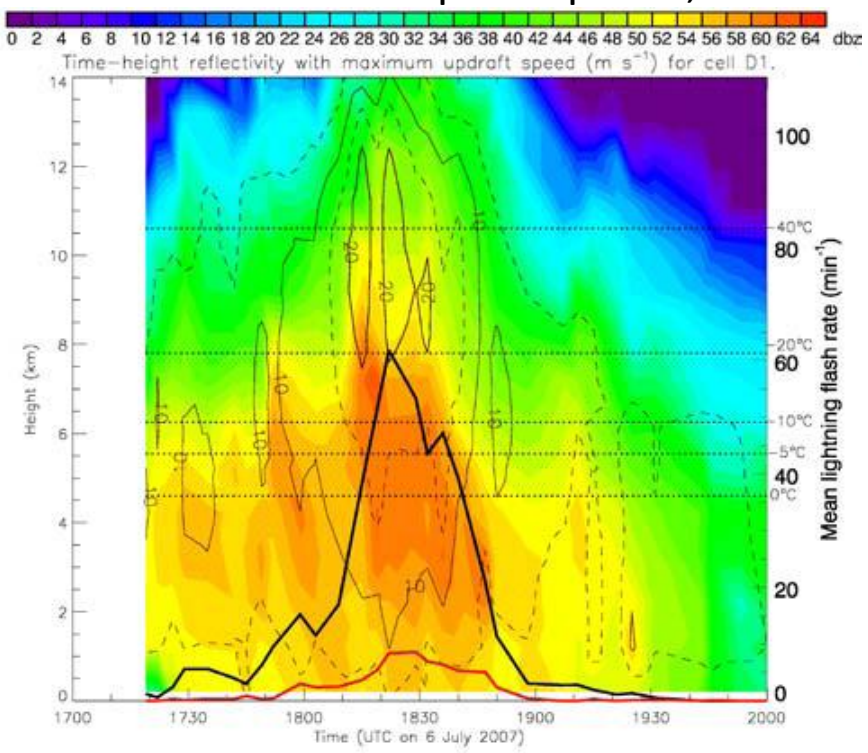
Hourly Summary: 21 UTC, 27 April 2011

Example of LMA Flash

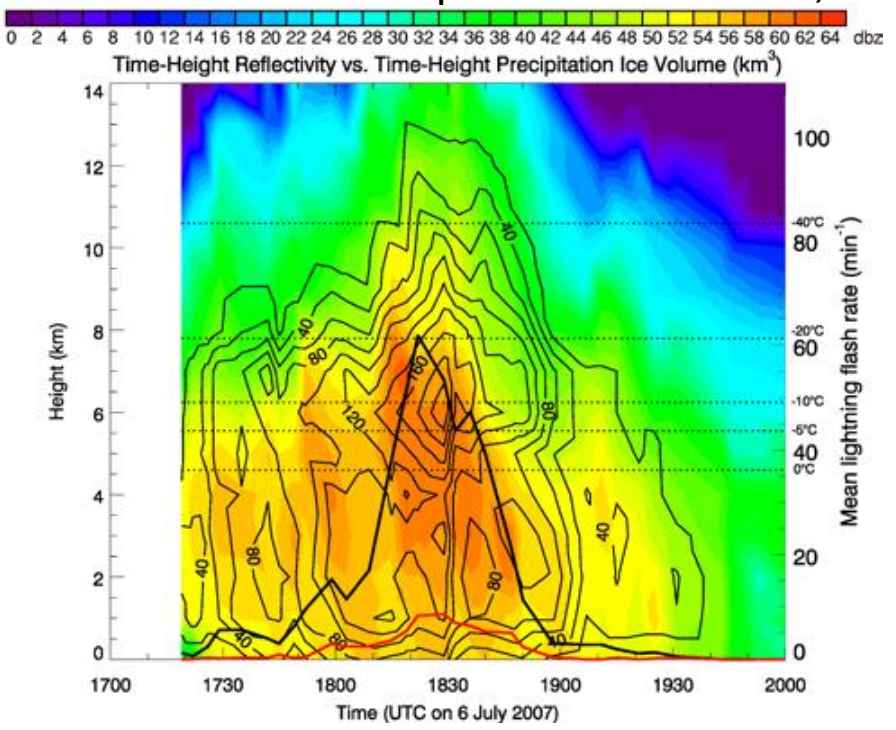


Radar-LMA Network Kinematics, Microphysics, and Lightning

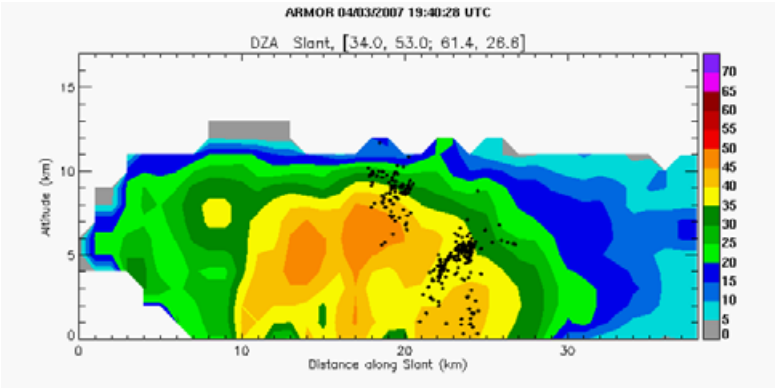
Total flash rate vs. peak updraft, dBZ



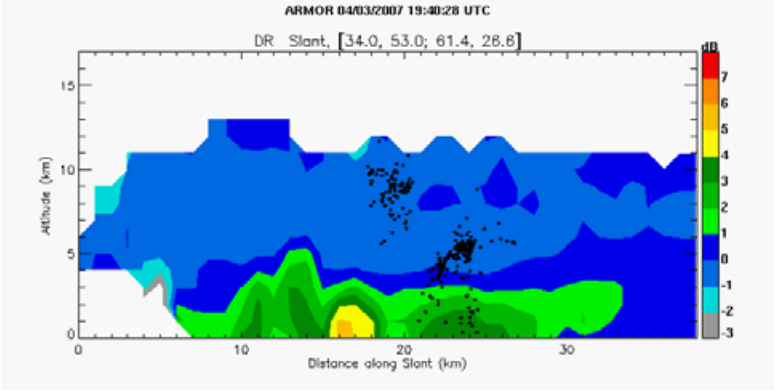
Total flash rate vs. Precipitation Ice Volume, dBZ



ARMOR Zh and NA-LMA sources



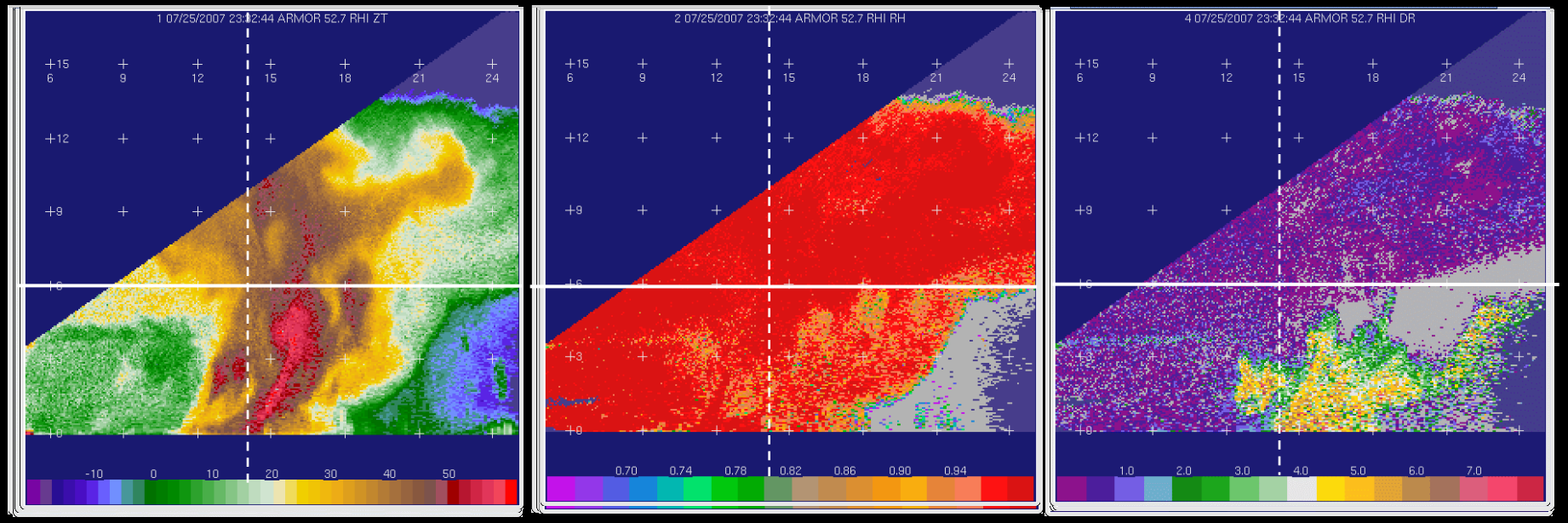
ARMOR Zdr and NA-LMA sources



Mixed phase and glaciation evolution in T-storm

ARMOR T-Storm Sequence: 25 July 2007 Rain/hail mix, large drops

Vert. Develop/Mixed Phase ⟶ Ext.Mixed phase ⟶ Glaciating ⟶ Glaciated



Z **ρ_{hv}** **ZDR**

Mixed phase extension

Glaciating

Glaciated

Toggle through images (time)

DC3 AL Research (ARMOR-MAX) dual-polarimetric, Dual-Doppler Network

- Secondary configuration
- MAX at Courtland, AL site west of HSV
- Site visibility and access not as good as New Market (primary MAX site)
- Coverage of LMA network not as good as New Market