Facility operation - Key issues and opportunities

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Severe Weather Institute – Radar and Lightning Laboratories
University of Alabama in Huntsville

Facilities available for use by the atmospheric science community

Other groups that manage mobile atmospheric facilities:
Next slide

NSF Supported Observing Facilities used for Atmospheric Science Research

Lower Atmosphere Observing Facilities (NCAR & U. Wyoming)

https://www.nsf.gov/geo/ags/programs/fare/index.jsp#cif

University of Wyoming King Air - https://www.uwyo.edu/atsc/uwka/
NSF/NCAR C-130 - https://www.eol.ucar.edu/observing_facilities/c-130
NSF/NCAR GV - https://www.eol.ucar.edu/observing_facilities/nsfncar-hiaper-gulfstream-gv
NCAR Airborne Instrumentation - https://www.eol.ucar.edu/airborne-instrumentation
NCAR Integrated Sounding System (ISS) - https://www.eol.ucar.edu/observing_facilities/iss
NCAR Integrated Surface Flux System (ISFS) - https://www.eol.ucar.edu/observing_facilities/isfs
NCAR S-Pol Doppler Radar (S-POL) - https://www.eol.ucar.edu/instrumentation/remote-sensing/s-pol

Community Instruments and Facilities (CIF)

Radars

University of Illinois at Urbana-Champaign - Flexible Array of Radars and Mesonets (FARM)
University of Oklahoma Norman Campus - Mobile Rapid Scan Doppler Radar
SUNY at Stony Brook - Millimeter-wavelength Radar Facility for Cloud and Precipitation Research
Colorado State University - Sea-Going and Land Deployable Polarimetric (SEA-POL) Radar

Remote Sensing Suites

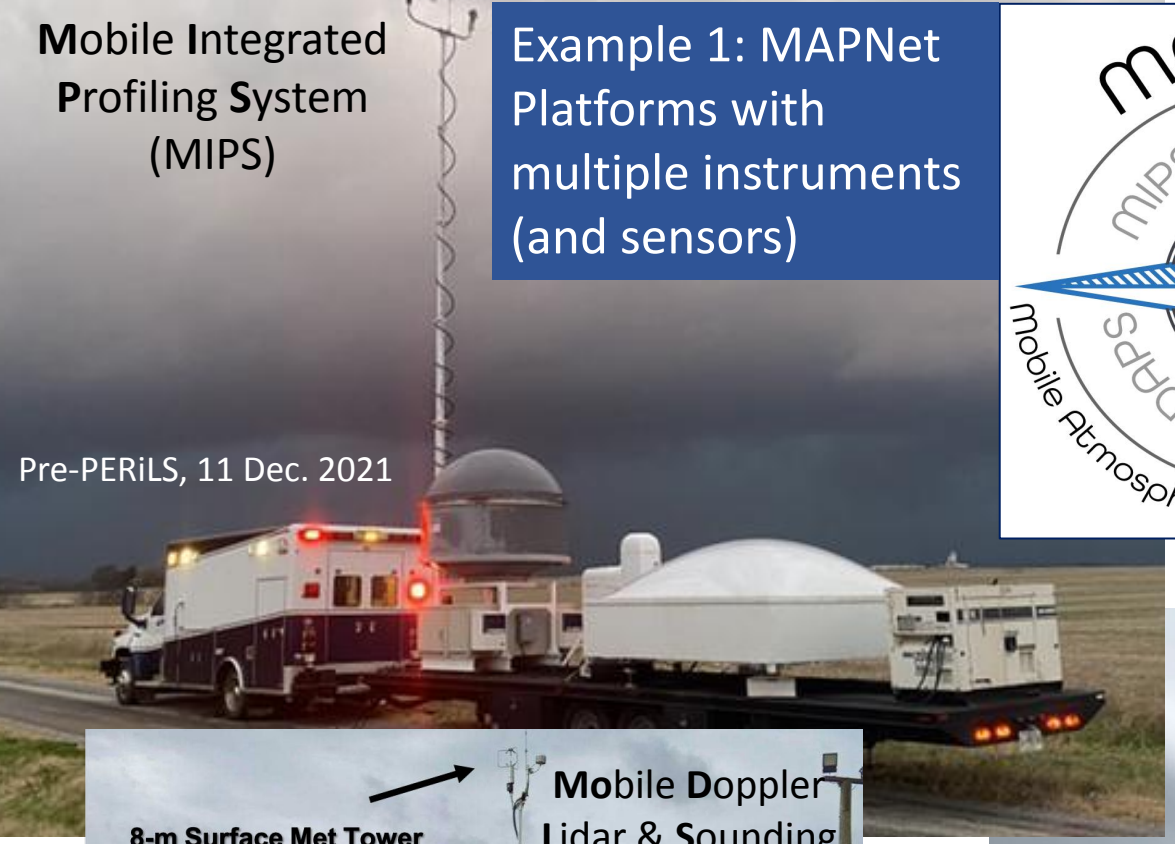
University of Wisconsin-Madison - SSEC Portable Atmospheric Research Center (SPARC)
University of Alabama in Huntsville - MAPNet

Laboratory Facilities

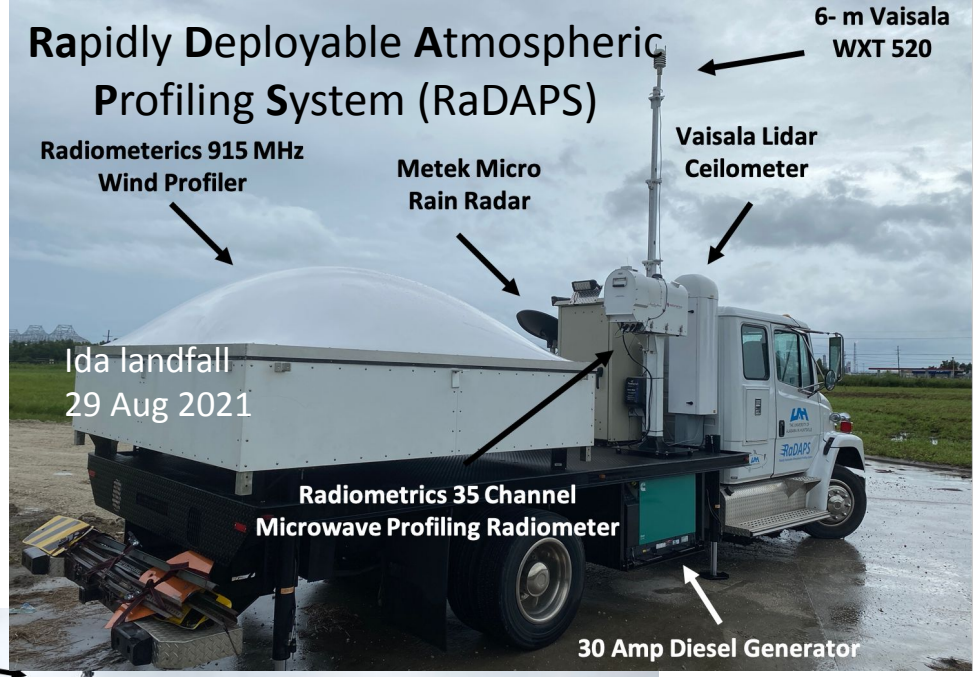
Clemson University - Clemson Soot Photometer
Michigan Technological University - PI Chamber
North Carolina State University - NC State Ice Nucleation Cold Stage
University of Utah - Storm Peak Laboratory

Example 1: MAPNet Platforms with multiple instruments (and sensors)

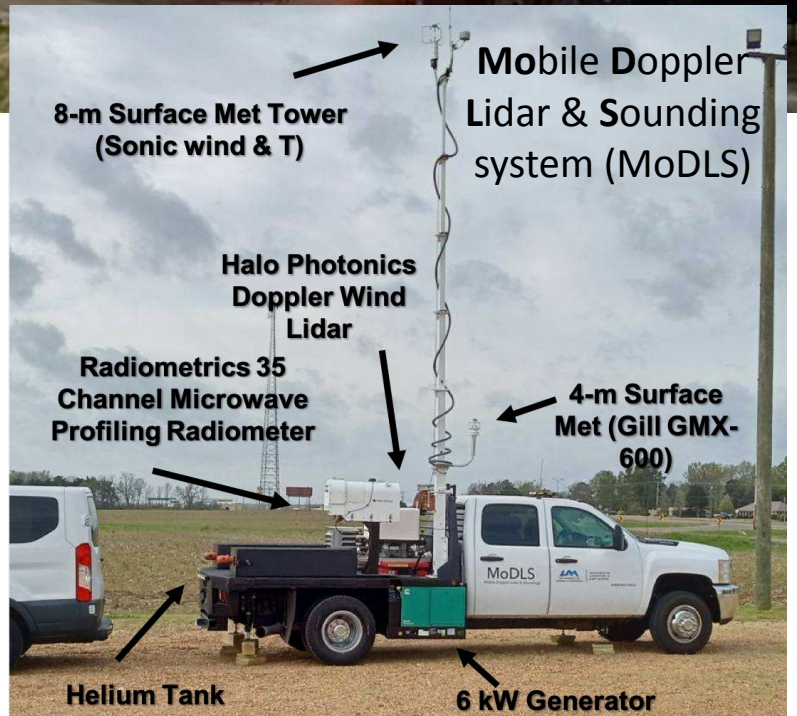
Mobile **I**ntegrated **P**rofiling **S**ystem (MIPS)



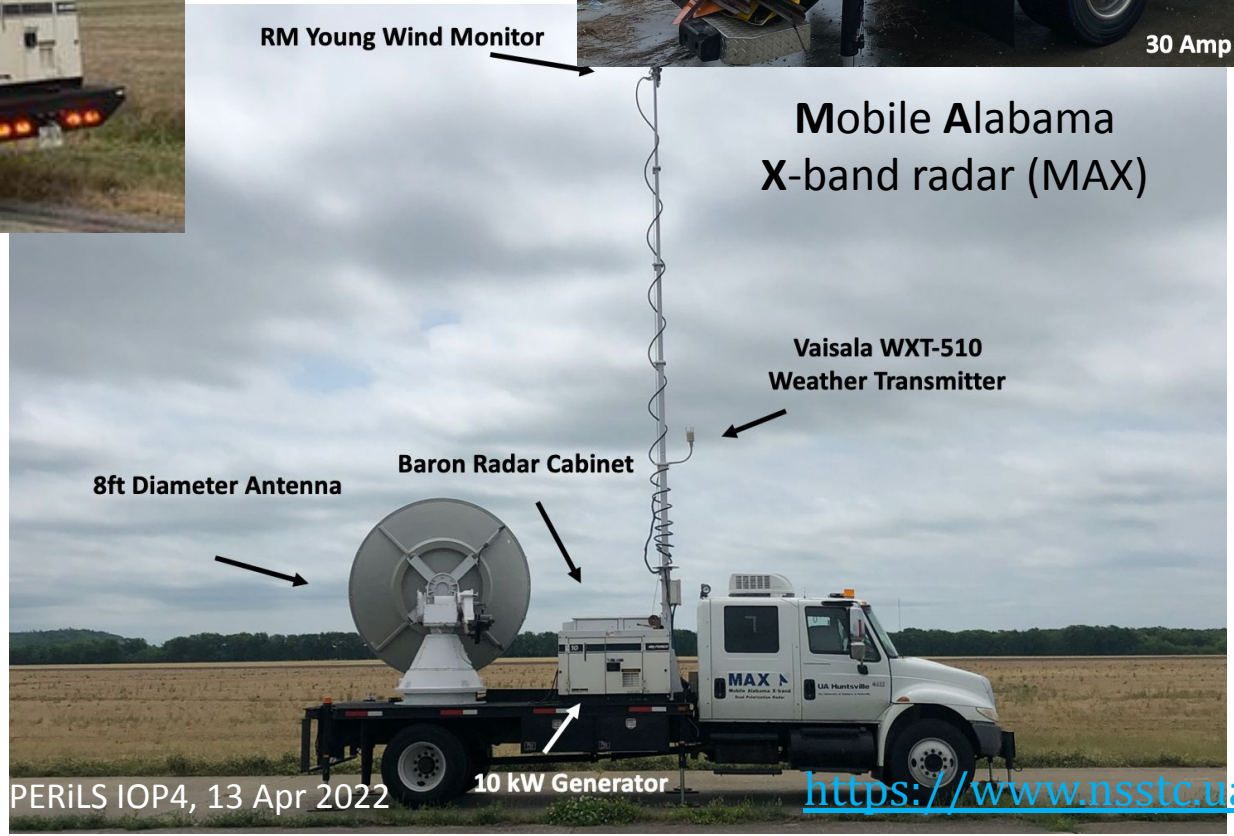
Rapidly **D**eployable **A**tmospheric **P**rofiling **S**ystem (RaDAPS)



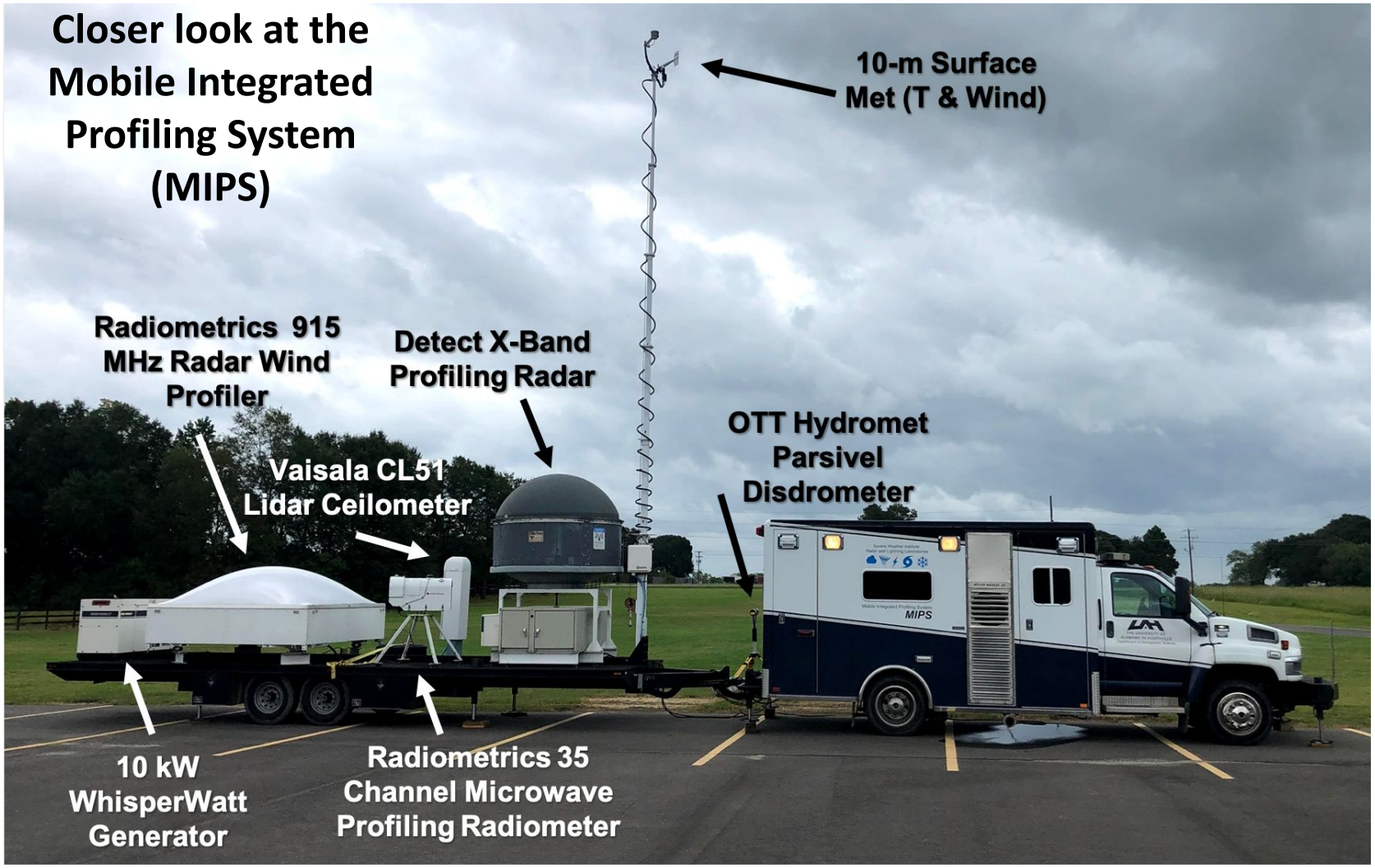
Mobile **D**oppler **L**idar & **S**ounding system (MoDLS)



Mobile **A**labama **X**-band radar (MAX)



https://www.nsstc.uah.edu/mapnet/



Deployment for Hurricane Laura landfall

MIPS instruments and sensors

Instruments

1) 915 MHz Radar Wind Profiler
2) X-band Profiling Radar
3) Microwave Profiling Radiometer
4) CL61 lidar ceilometer
5) Ka-band profiling radar (can be added; shared with MoDLS)
6) Parsivel (laser) disdrometer\Digital camera
7) Sonic anemometer (RM Young 8100, 3 m)

Sensors

a) RM Young 05103 wind monitor (10 m)
b) Temperature sensor (10 m)
c) Temp & Relative Humidity (2 m)
d) Pressure (2 m)
e) Rainfall
f) PM2.5

MAPNet is a facility with four platforms. MIPS is a platform with multiple instruments and sensors. Some instruments also have embedded sensors.

Example 2
FARM: Flexible Array of Radars and Mesonets

Truck	DOW6	DOW7	COW	CROW	CROW	CROW
Configuration Name				DOW8	RSDOW	Mini-COW
Configuration	dual-freq, dual-pol	dual-freq, dual-pol	dual-freq, dual-pol	single-pol	7-beam rapid-scan	dual-pol
Band	X	X	C	X	X	C
Tx Power Peak (kW)	2x 250	2x 250	2x 1000	1x 250	40	1x 1000
PRF Range (Hz)	500-6000 stagger	500-6000 stagger	500-6000 stagger	500-6000 stagger	500-6000 stagger	500-6000 stagger
Pulse Length (us)	0.167-1.0	0.167-1.0	0.167-1.0	0.167-1.0	0.1-1.0	0.15-1.0
Scan Rate deg/s	50	50	24	50	7-s vols	50
Products (typical)	LDR, ZDR, ρHV, V, Z, SW, NCP, full IQ			Z, V, SW, NCP, full IQ		ZDR, ρHV, V, Z, SW, NCP, full IQ
Beamwidth (deg)	0.93	0.93	1	0.93	0.8 x 0.9	1.5
Gate Length Range (m)	12.5-600	12.5-600	12.5-600	12.5-600	11-600	12.5-600
Met/Comm Mast (m)	18	18		14	14	14

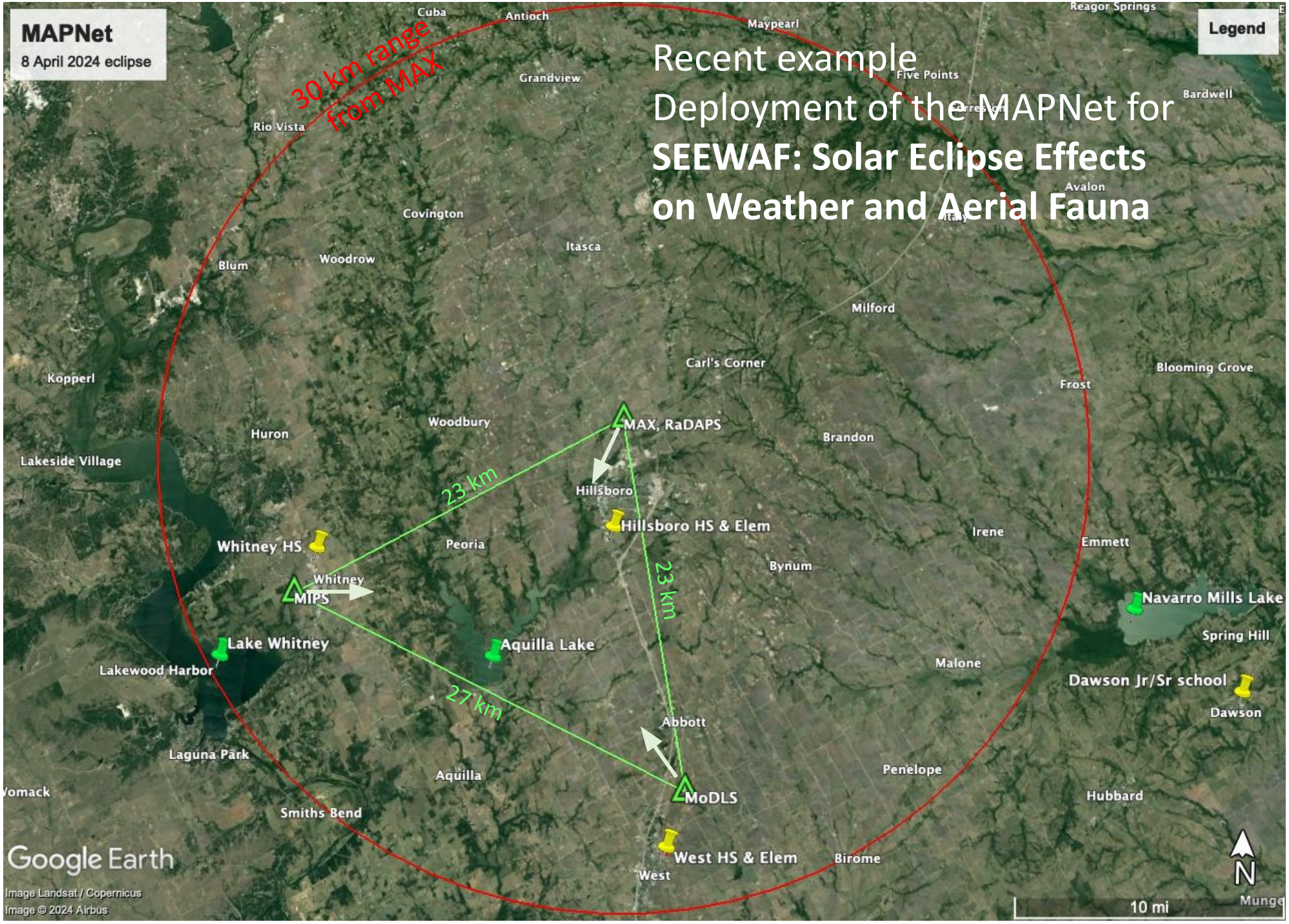
- Six radars and numerous other surface systems

Research aircraft

- NSF-supported
- Also NOAA, NASA, DOE, NPS, etc
- Most can be configured with various instruments (science goal dependent)
- Moving measurements present challenges (for aircraft remote sensing instruments in particular), but much has been done to improve data quality

Definitions

Descriptor	Definition	Examples
sensor	a device that provides a measurement when used in conjunction with a data logger that converts the signal (e.g., voltage, current, pulses) into a meteorological quantity and records the data.	Temperature or humidity sensor, pressure transducer, raingage (tipping bucket), wind monitor,
instrument	a device that acquires measurements of interest	Lidar, radar, radiometer, dipstick raingage, electric field meter, sonic anemometer, camera
platform	collection of multiple instruments, in many cases mounted on a vehicle (trailer), ship, or aircraft	MIPS, RaDAPS, DOW7, COW C-130
facility	one or more platforms or instruments that can operate independently and provide multiple measurements	MAPNet, FARM, Wyoming King Air, C-130,
network	multiple platforms or instruments usually arranged into a preconceived (but sometimes ad hoc) pattern	MAPNet, FARM, AMF3, NCAR ISFS



MAPNet network
8 April 2024 eclipse

Old Hillsboro Airport

- MAX
- RaDAPS

Whitney City Park

- MIPS

County Line venue

- MoDLS

Red circle: range ring of 30 km from the MAX radar very good bird detection within this range covering:

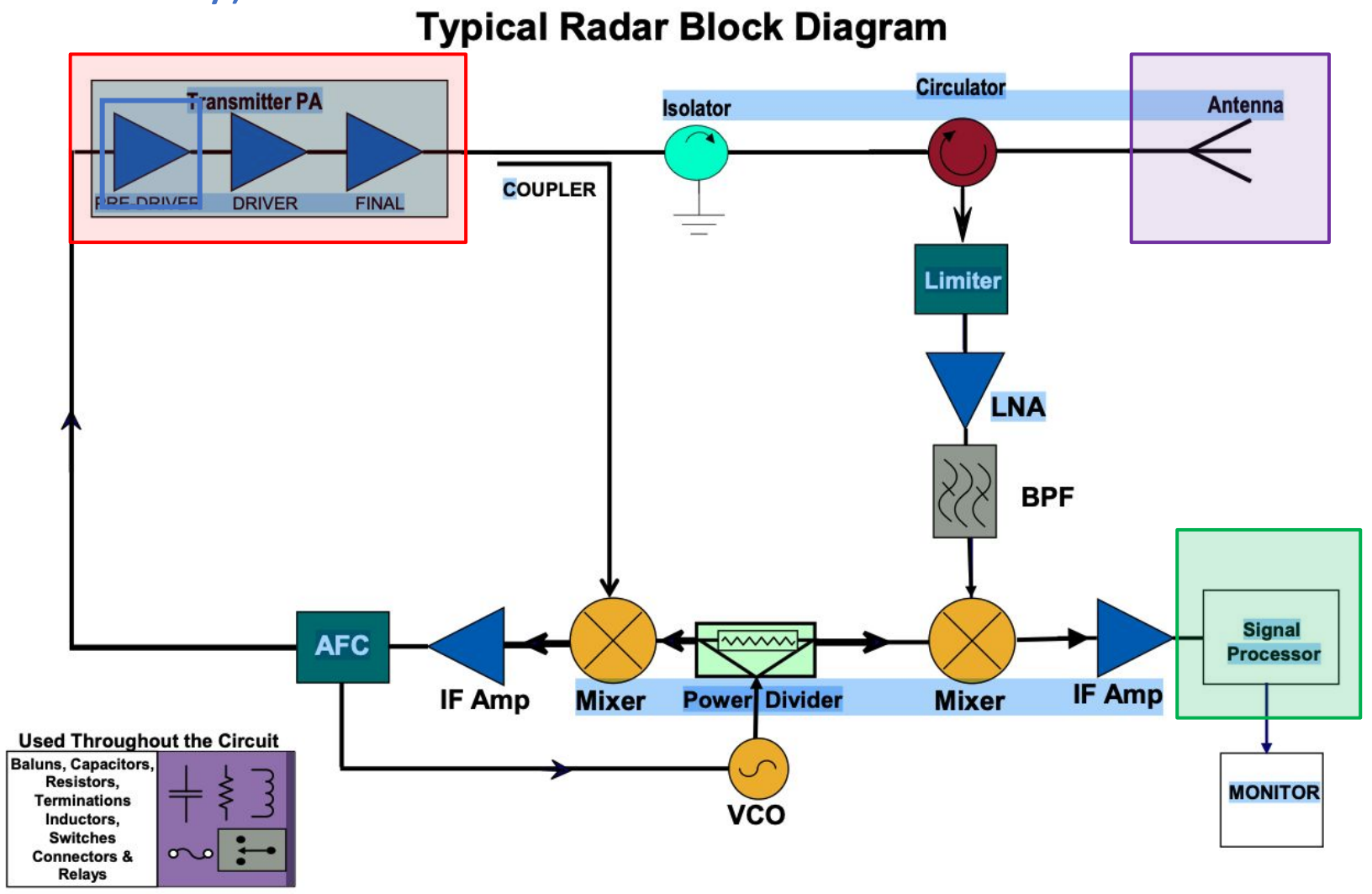
a) Lake Whitney
b) Aquilla Lake
c) Navarro Mills Lake

Complexities of radars and other instruments: some things that can change (blue/green items more common):

a) Transmitter
b) Magnetron (part of transmitter assembly)
c) Signal processor (receiver)
d) Antenna dish

Consider also:

i. Calibration
ii. Maintenance schedule

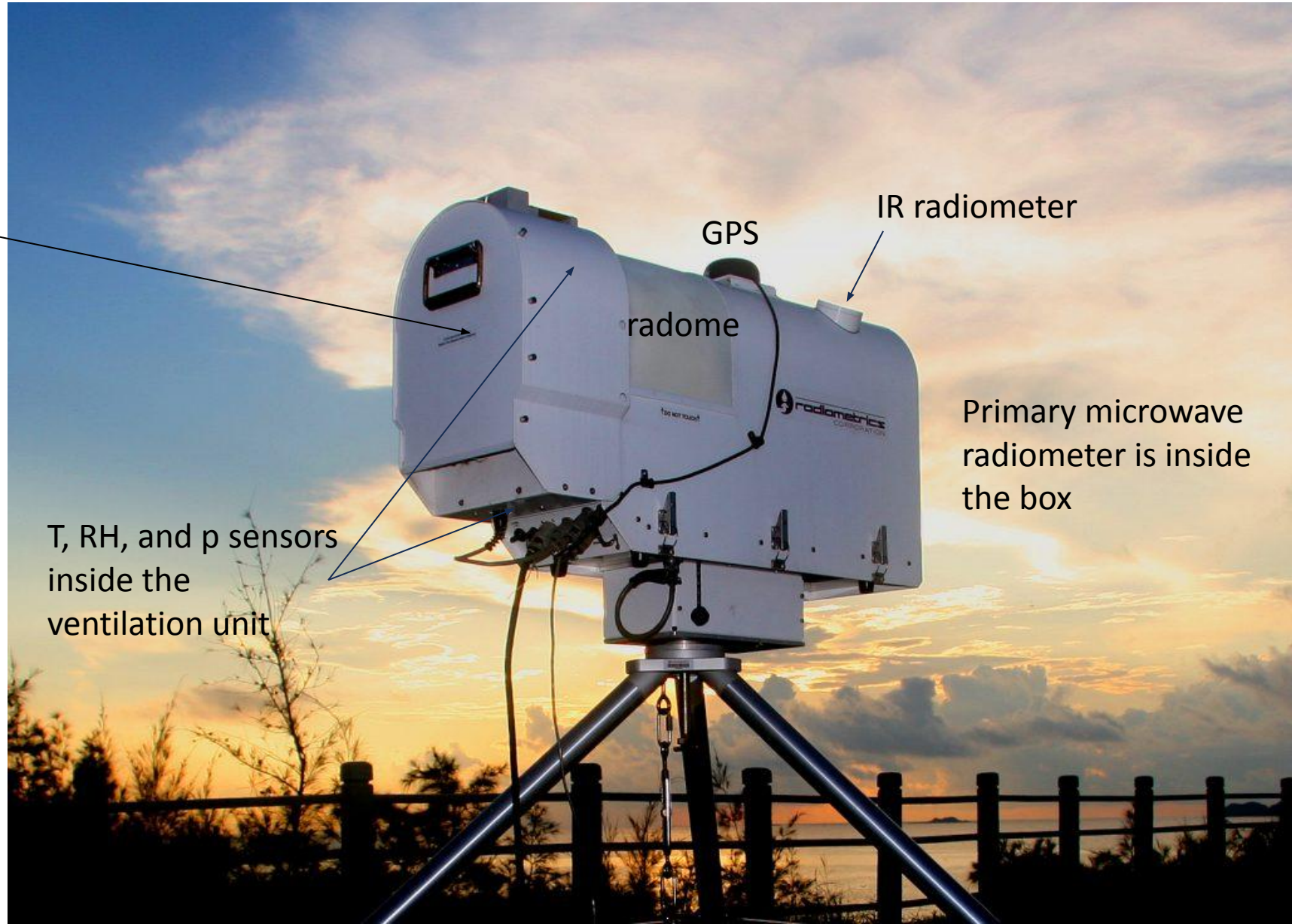


“Complex” instruments: primary instrument with additional sensors

https://radiometrics.com/wp-content/uploads/2022/04/TechNote-MP-3000_Features_150515.pdf

https://radiometrics.com/products/

An important maintenance item is replacement of fan and filter within the ventilation unit. This can make a difference in measurement fidelity.



Some Key Issues for (MAPNet) and mobile facility operation

1. MAPNet is a small facility with limited personnel. One FTE (research associate) currently.
2. Managing frequent changes/upgrades/maintenance. Consider the MIPS example with many instruments and sensors.
3. Maintaining high data quality data.
4. Striving to be at the forefront with measurements needed to promote *transformational science* *upgrade or enahnce when the budget allows*

With mobile operations, reproducibility of measurements may be difficult to impossible:

- Blocking by topography, trees, buildings, etc.
  - affects both in situ surface measurements and ground based remote sensing measurements
- Contamination by ground clutter, especially problematic for lower-frequency radar profilers
- Presence of radio frequency interference is also location-dependent

DOE/ARM* Supported Observing Facilities used for Atmospheric Science Research

https://www.nsf.gov/geo/ags/programs/fare/index.jsp#cif

Instruments and networks of instruments

Example: ARM Mobile Facility 3 (AMF3)

Some networks are fixed, others may vary over some time interval

Network characteristics require documentation

*ARM: Atmospheric Radiation Measurement (not Adjustable Rate Mortgage)

DOE/ARM Supported Observing Facilities (Networks) used for Atmospheric Science Research

DOE AMF3 network

Central Facility at BNF

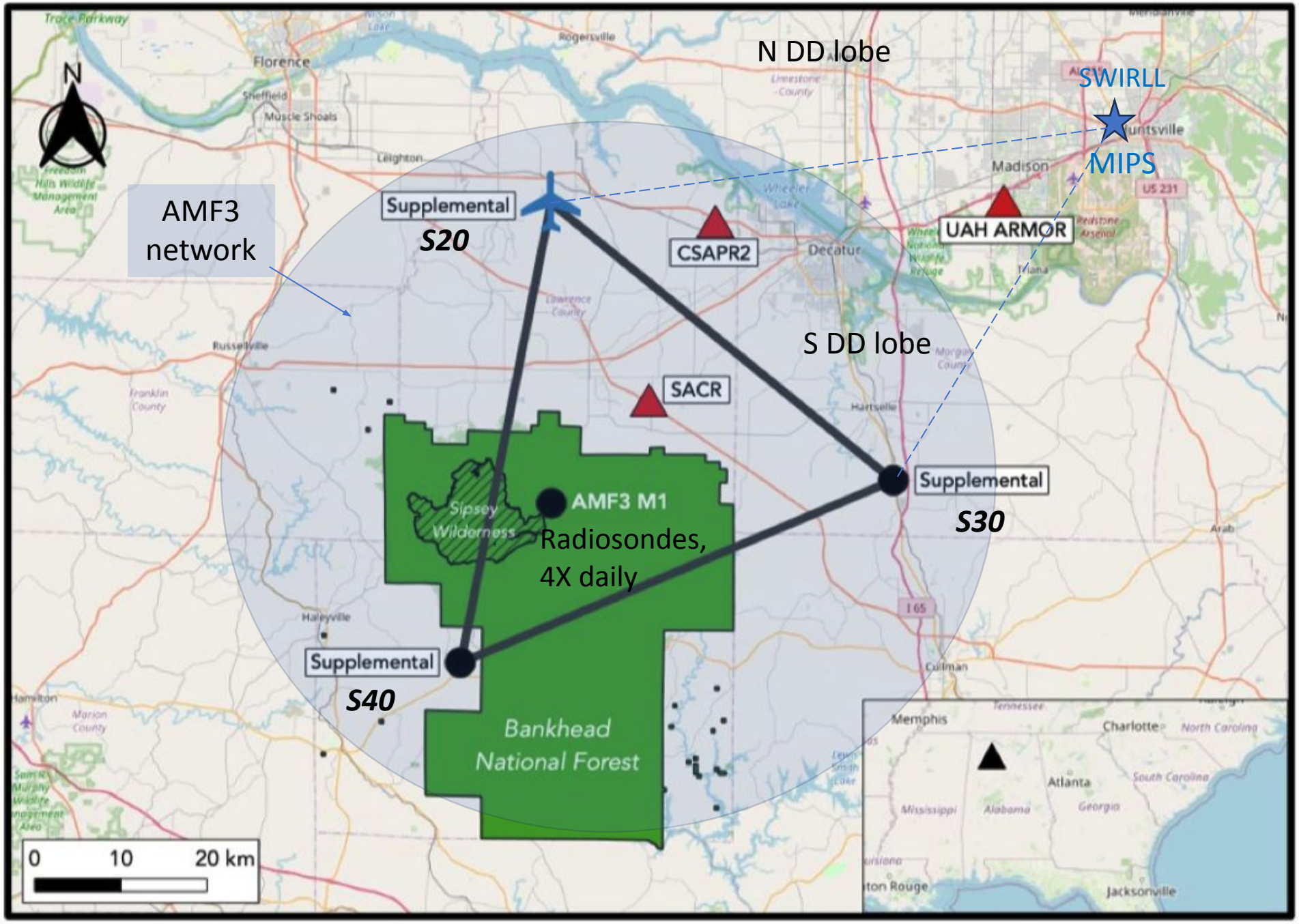
- Numerous instruments
- 4 balloon soundings /day
- Guest instruments

Three supplemental profiling sites

1) **S20**: ECS, DWL, MWR3C, IRT, MET, MFRSR, SIRS, EBS, STAMP, NOAA 449 MHz RWP
2) **S30**: 915, ECOR, IRT, LDIS, MET, MDRSR, SIRS, SEBS, STAMP
3) **S40**: ECS, DWL, MWR3C, IRT, MET, MFRSR, SIRS, EBS, STAMP, NOAA 449 MHz RWP

Radars

- CSAPR – C-band radar
- SACR – Scanning K_a/W -band radar



DOE AMF3 network + MAPNet

Central Facility at BNF

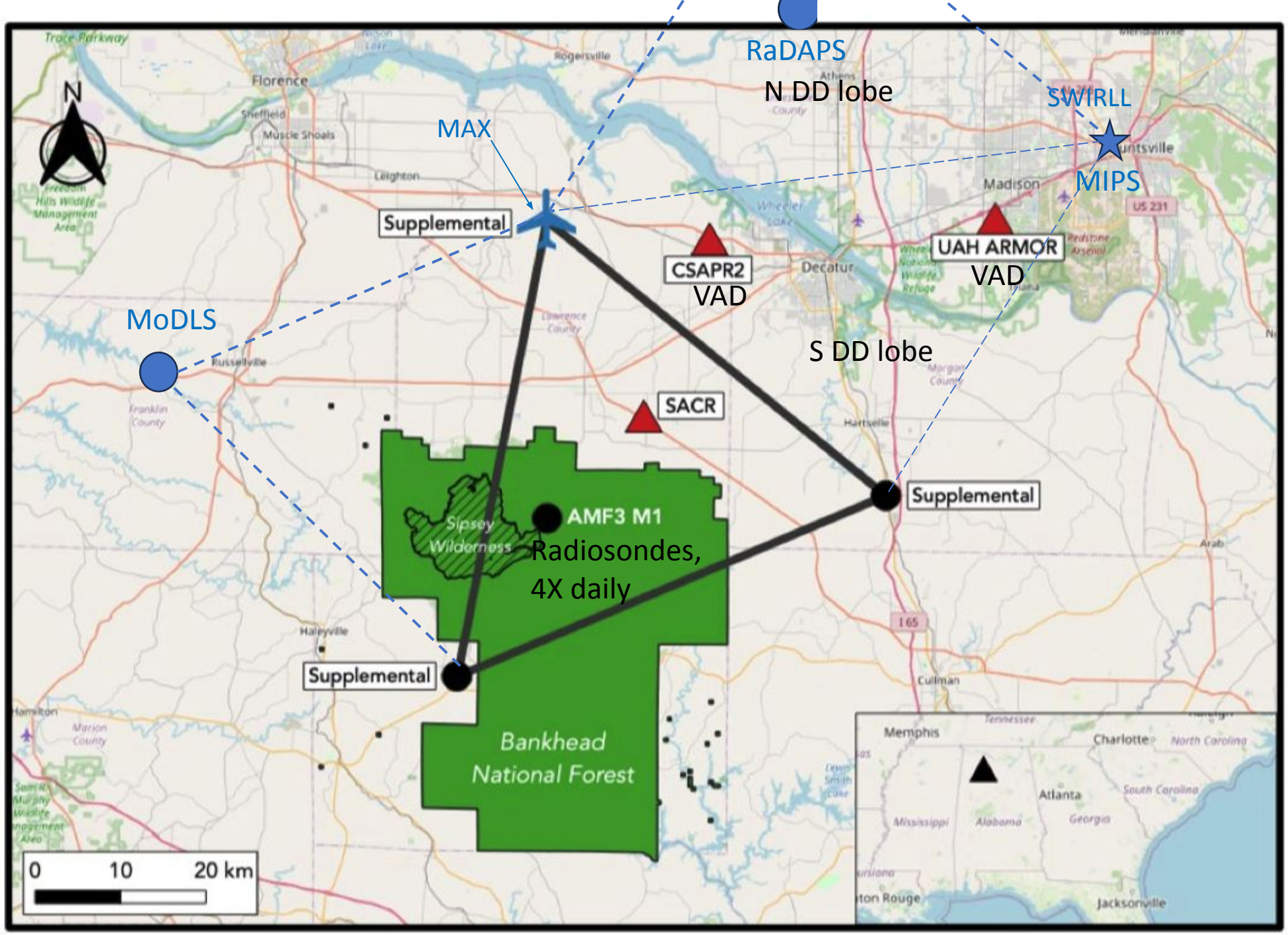
- Numerous instruments
- 4 balloon soundings per day
- Guest instruments
- Ribbon cutting in March

Three supplemental profiling sites

1) Courtland: ECS, DWL, MPR
   NOAA 449 MHz RWP
   Other UAH instr TBD
   Guest instr (UAH host)
2) SW: DWL, MPR, met
3) E: 915 MHz RWP, MPR, met

Radars

- CSAPR – C-band radar
- SACR – Scanning K_a/W -band radar



DOE/UAH combined network, Option 2

Central Facility at BNF

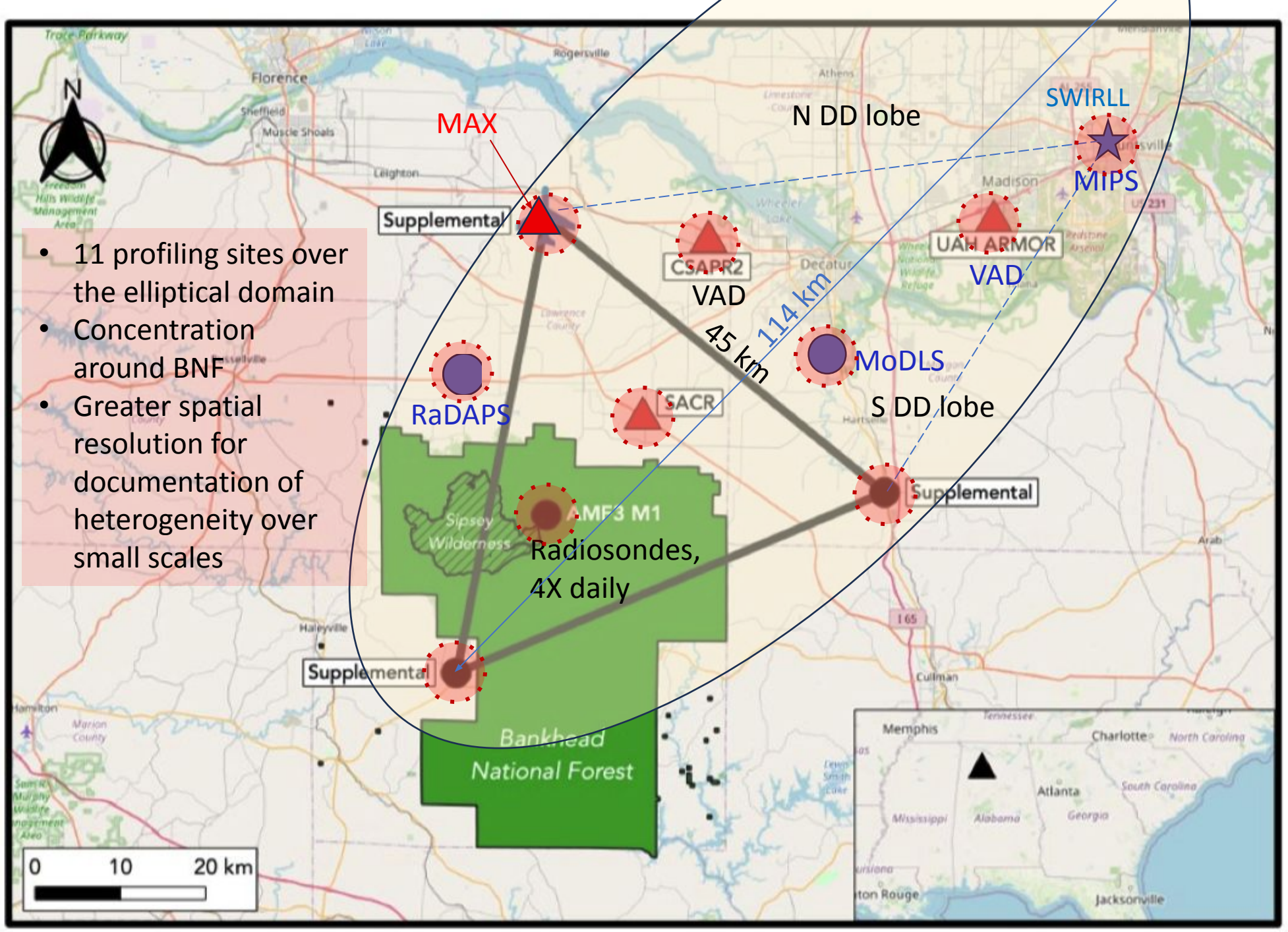
- Numerous instruments
- 4 balloon soundings per day
- Guest instruments
- Ribbon cutting in March

Three supplemental profiling sites

1) Courtland: ECS, DWL, MPR
   NOAA 449 MHz RWP
   Other UAH instr TBD
   Guest instr (UAH host)
2) SW: DWL, MPR, met
3) E: 915 MHz RWP, MPR, met

Radars

- CSAPR – C-band radar
- SACR – Scanning K_a/W -band radar



Questions?

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