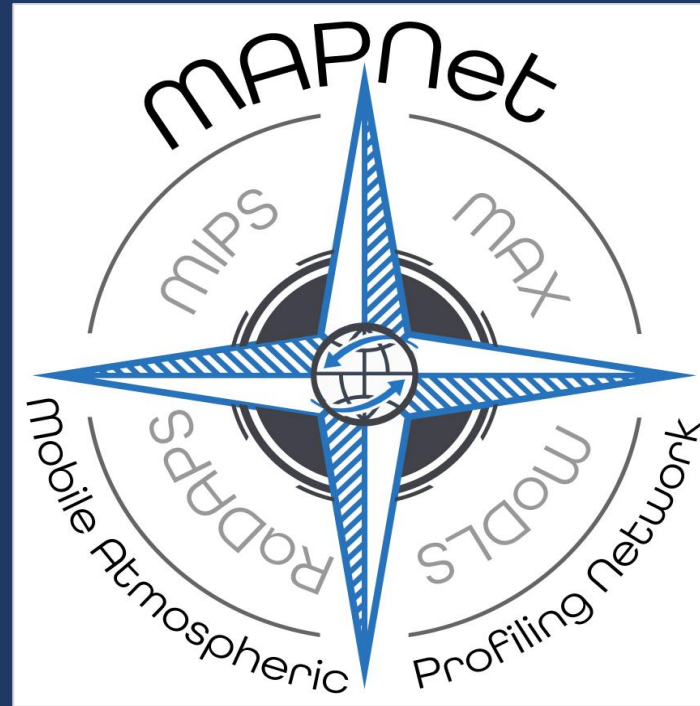# MAPNet (Mobile Atmospheric Profiling Network) General Description

***K. Knupp**, L. Carey, R. Wade, P. Pangle, and D. Phillips*
Univ. of Alabama in Huntsville

Facilities for Atmospheric Research and Education (FARE, National Science Foundation)

https://www.nsf.gov/geo/ags/programs/fare/

Lower Atmosphere Observing Facilities

- UW King Air
- NSF/NCAR C-130
- NSF/NCAR GV
- NCAR airborne instrumentation
- NCAR Integrated Sounding System
- NCAR Integrated Surface Flux System
- NCAR S-Pol dual-pol radar

Community Instruments and Facilities (CIF)

Radars
- UIUC FARM
- OU RaxPol Mobile Doppler radar
- Stony Brook mm-wave radar facility
- CSU SEA-POL radar

Remote Sensing Suites
- SSEC/UW SPARC
- **UAH MAPNet**   ⬅

Laboratory facilities
- Clemson Soot Photometer
- Michigan Tech PI Chamber
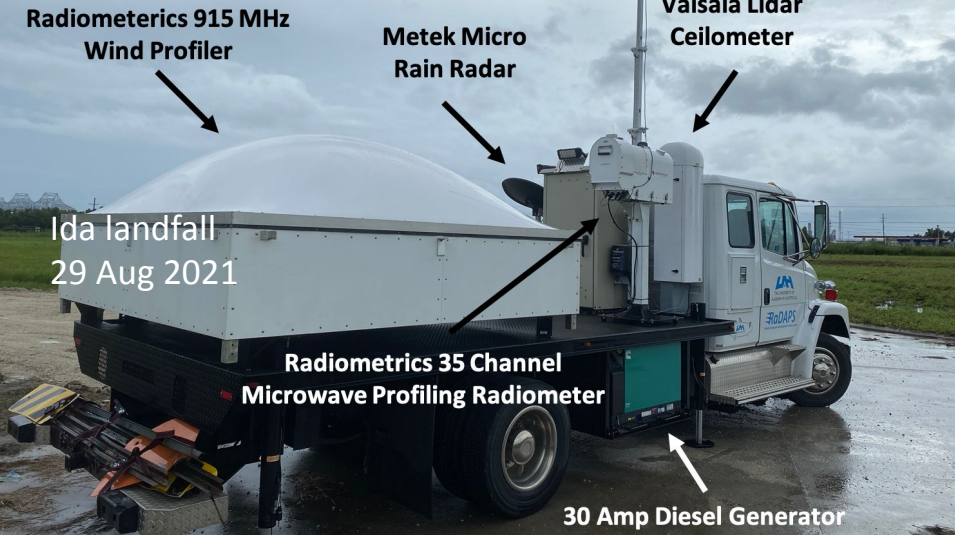- NCSU Nucleation Cold Stage
- Univ Utah Storm Peak Lab

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MAPNet Platforms

Mobile Integrated Profiling System (MIPS)

Pre-PERiLS, 11 Dec. 2021
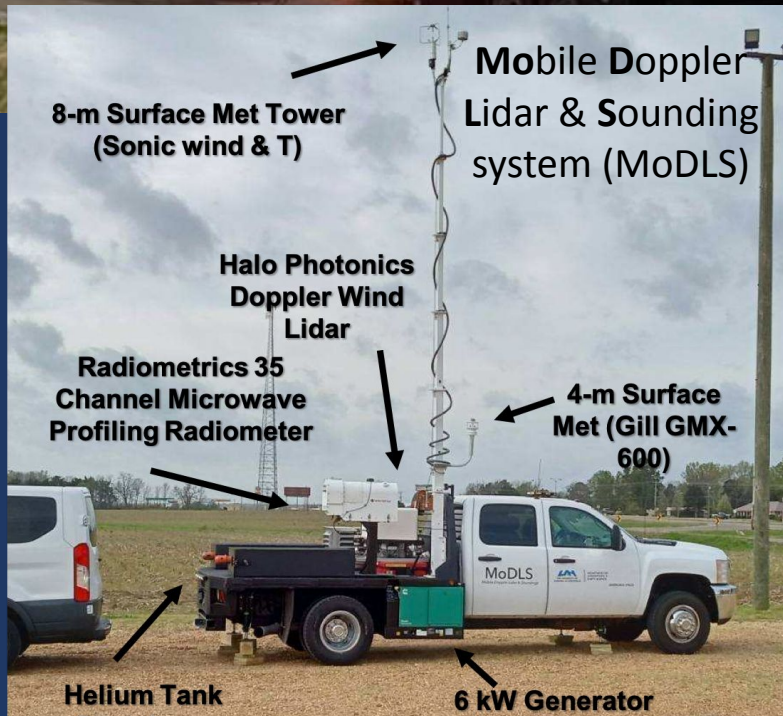
Rapidly Deployable Atmospheric Profiling System (RaDAPS)

6- m Vaisala WXT 520

Radiometerics 915 MHz Wind Profiler

Metek Micro Rain Radar

Vaisala Lidar Ceilometer

Ida landfall 29 Aug 2021

Radiometrics 35 Channel Microwave Profiling Radiometer

30 Amp Diesel Generator

RM Young Wind Moni

Mobile Doppler Lidar & Sounding system (MoDLS)

8-m Surface Met Tower (Sonic wind & T)

Halo Photonics Doppler Wind Lidar

Radiometrics 35 Channel Microwave Profiling Radiometer

4-m Surface Met (Gill GMX-600)

Helium Tank

6 kW Generator

Mobile Alabama X-band radar (MAX)

Vaisala WXT-510 Weather Transmitter

Baron Radar Cabinet

8ft Diameter Antenna
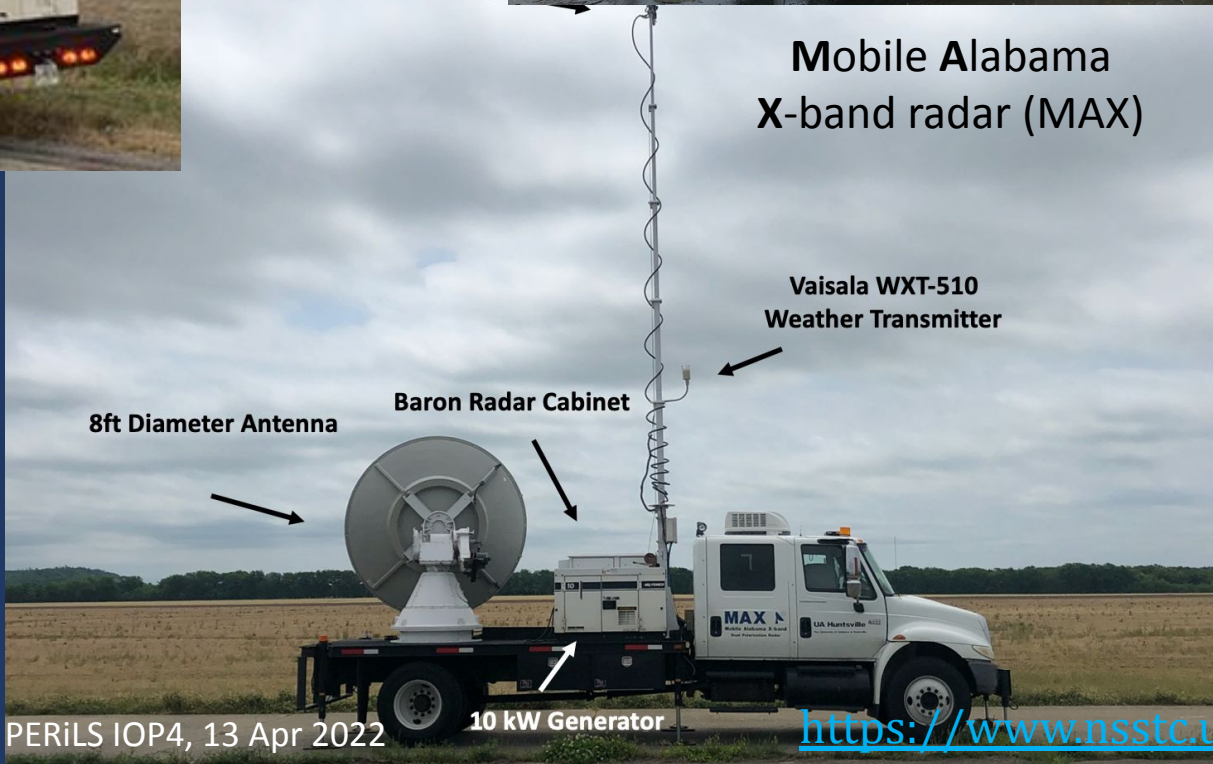
PERiLS IOP4, 13 Apr 2022

10 kW Generator

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

Instruments for

Profiling of:
- Wind
- T/RH
- Precip.
- Aerosols
- Cloud

<u>In situ</u>
Radiation
E field
Photography
DSD

MIPS
- 915 MHz Radar Wind Profiler
- Doppler sodar (option)
- X-band Profiling Radar
- Microwave Radiometer (35 channel)
- Vaisala CL51 ceilometer
- iMet sounding system
- Surface: T/RH (2 m), p, solar radiation, wind (10 m)
- Parsivel disdrometer

RaDAPS
- 915 MHz Radar Wind Profiler
- Doppler sodar (option)
- Micro Rain Radar (Metek)
- Microwave Radiometer (35 channel)
- Vaisala CL51 ceilometer
- iMet sounding system
- Surface: T/RH (2 m), p, solar radiation, wind (4 m)
- Parsivel disdrometer

MoDLS
- Halo scanning Doppler lidar (1.5 μm)
- Microwave Radiometer (35 channel)
- CHM 15k ceilometer
- Windsond or iMet sounding system
- Surface: T/RH (2 m), p, solar radiation, IR radiometer, wind (7 m)
- Electric field meter (CS110)
- Sonic anemometer (CSAT3, 7 m)
- K_a band profiling radar, KaPR (future)

MAX
- Scanning X-band dual polarization radar
- Windsond sounding system (option)
- Surface: T/RH, p (3 m), solar radiation, wind (10 m)

Valuable for providing the context of profiling measurements.

https://www.nsstc.uah.edu/mapnet/facilities/index.php

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Supporting infrastructure

Relevant activities

- MAPNet maintenance
- Research
- Education and Outreach

SWIRLL infrastructure

- 5 high-bay spaces
- Operations Center (outreach)
- Classroom
- Conference Room
- Laboratories
- Office space (staff + students)
- Open lobbies on 1st and 2nd levels (outreach)
- Roof-top platforms
- Berm 70 m to the south

SWIRLL* facility (below) and ARMOR radar (15 km SW)


*Severe Weather Institute, Radar and Lightning Laboratories

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Research capabilities

- **Boundary Layer processes**
- **Precipitation processes**
- Severe storms
- Cloud structure and evolution
- Mesoscale meteorology
- Landfalling tropical systems
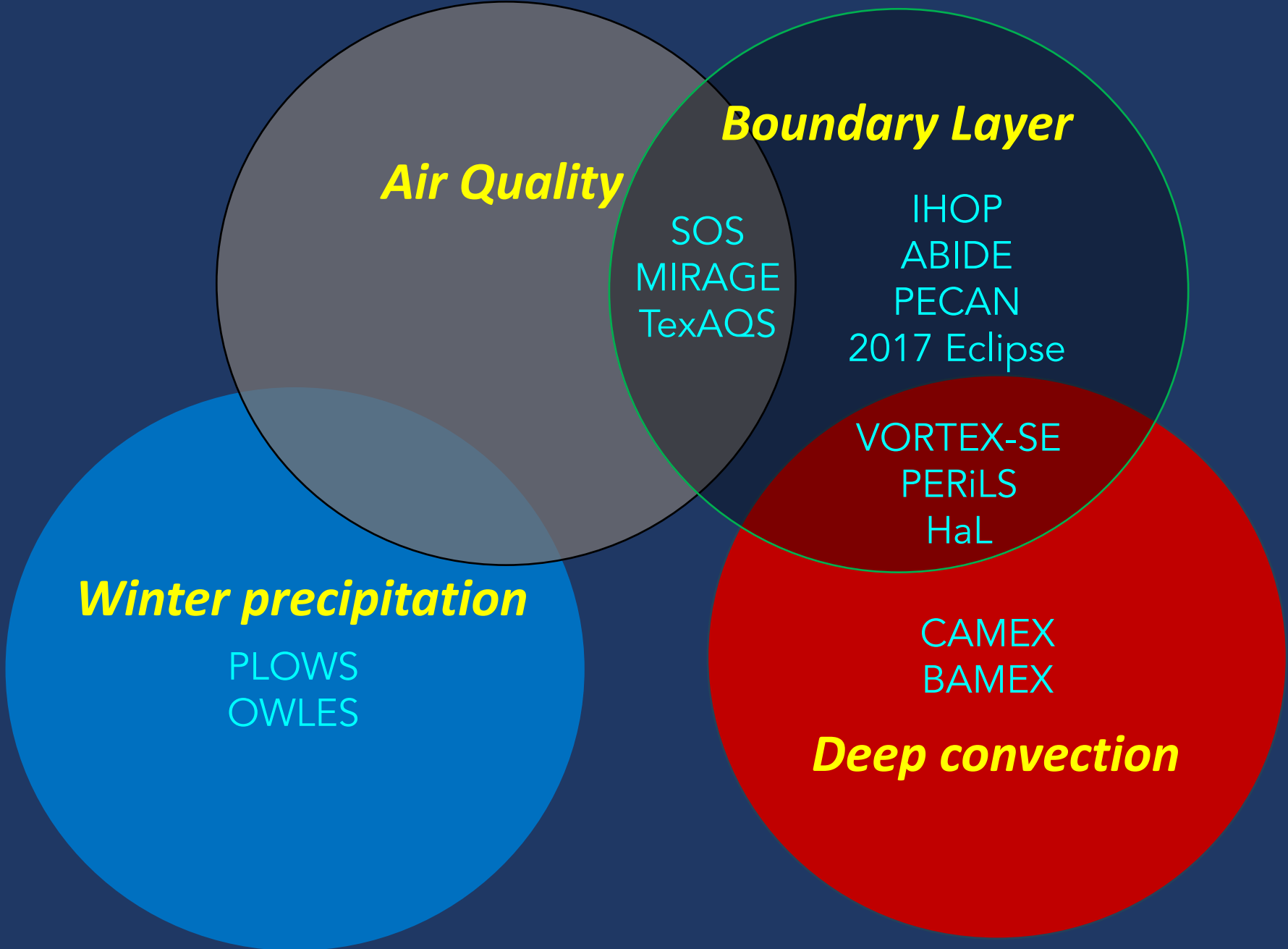- Air Quality studies
- Entomology and Ornithology

Radiometer
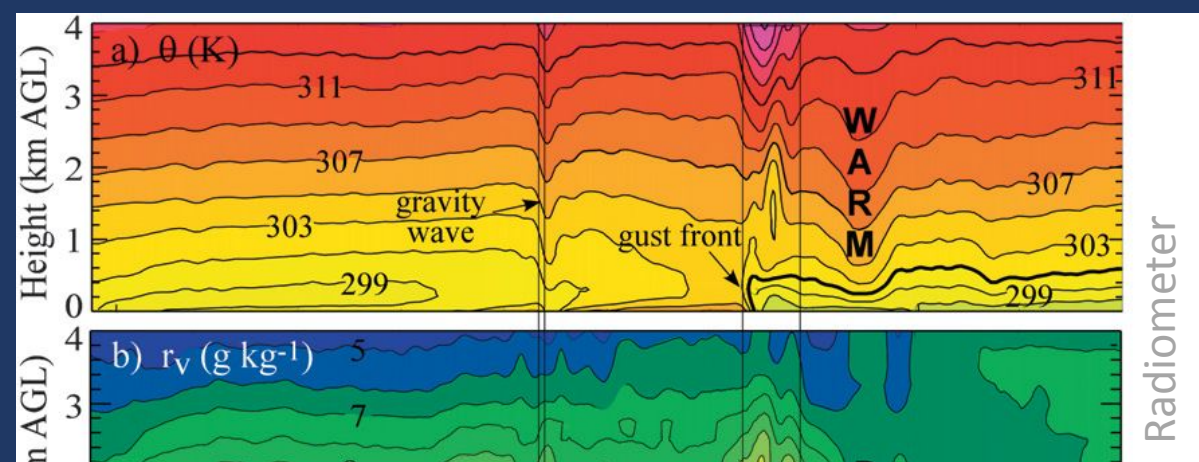
XPR reflectivity ☐ insect layer & point targets
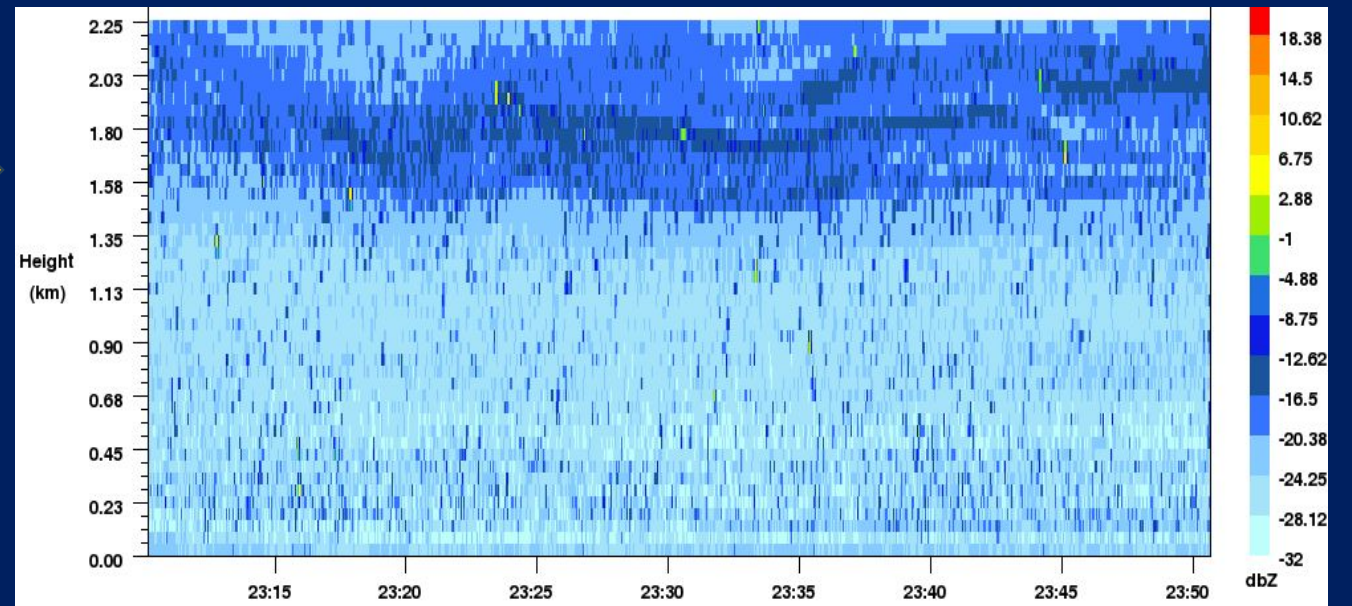
Doppler lidar vertical motion ☐ gust front
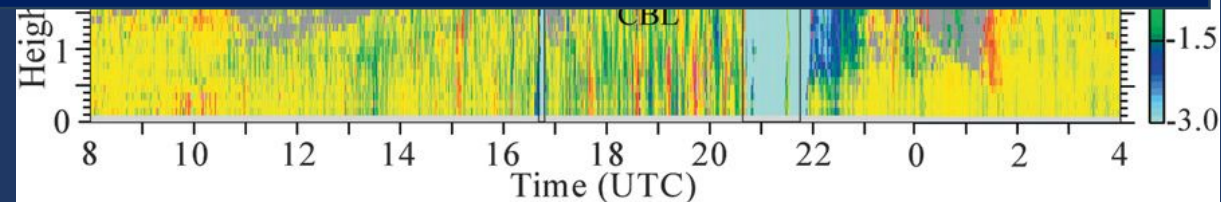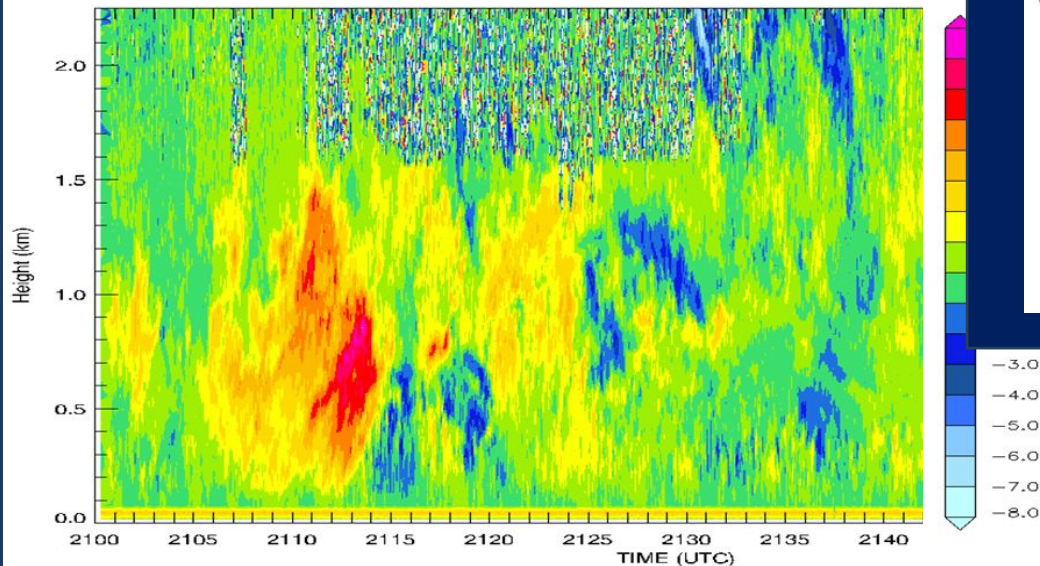
Emphasis in field campaigns, 2000-present

Air Quality

Boundary Layer

SOS
MIRAGE
TexAQS

IHOP
ABIDE
PECAN
2017 Eclipse

VORTEX-SE
PERiLS
HaL

Winter precipitation

PLOWS
OWLES

CAMEX
BAMEX

Deep convection

Year of formation
MIPS – 1998
MAX – 2006
MoDLS – 2015
RaDAPS - 2017

Education and Outreach

- Various educational levels
  - K-12
  - Undergraduate, including REU activities
  - Graduate classes: Ground-Based Remote Sensing, Boundary Layer Meteorology – will develop modules that utilize MAPNet
- Weather Fests
- Other science and technology activities (e.g., Earth Day)
- E&O conducted both at SWIRLL and remotely at schools
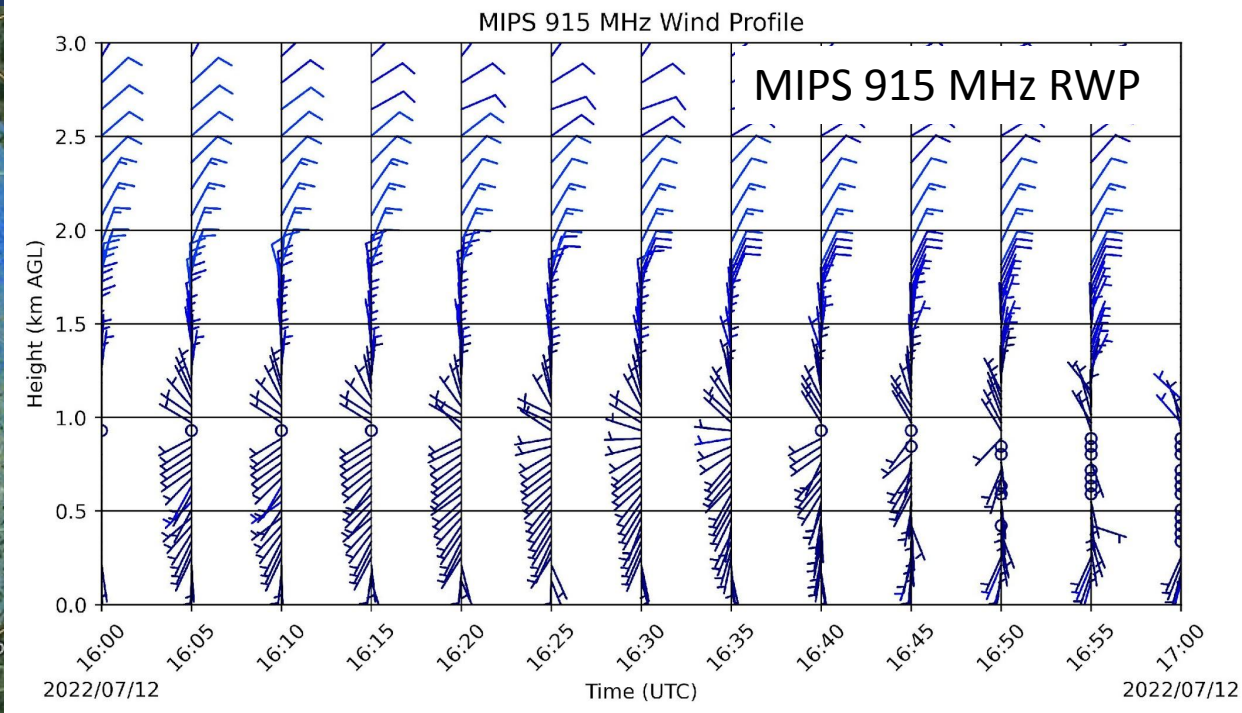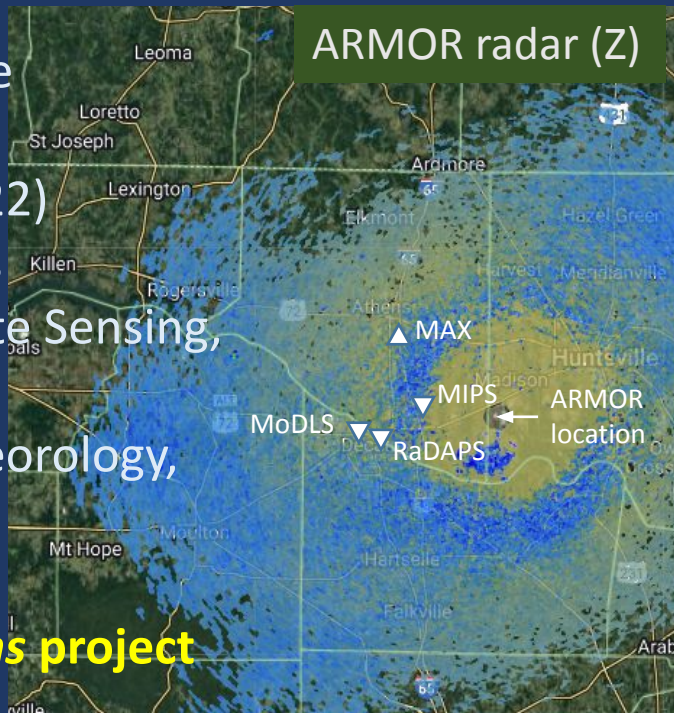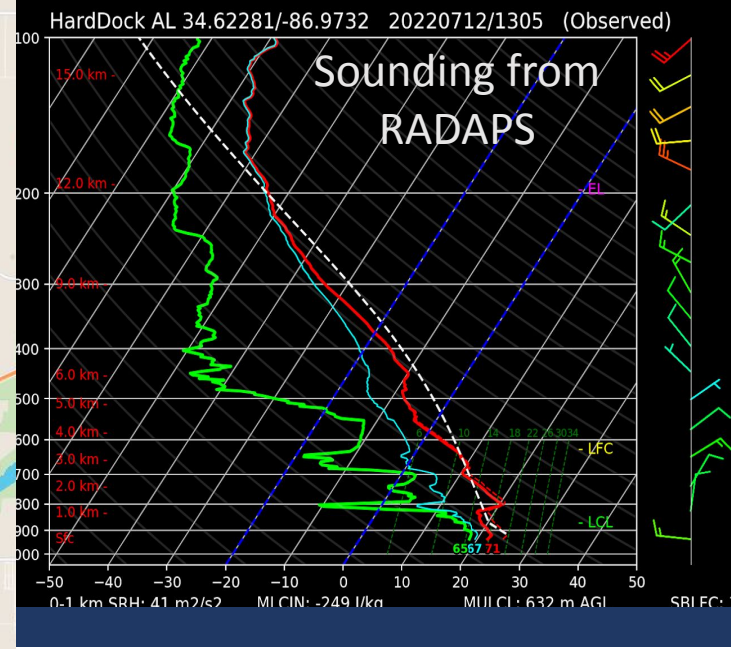- UAH undergraduate student group: *Profile Sounding Team for Operational and Research Meteorology* (UPSTORM)
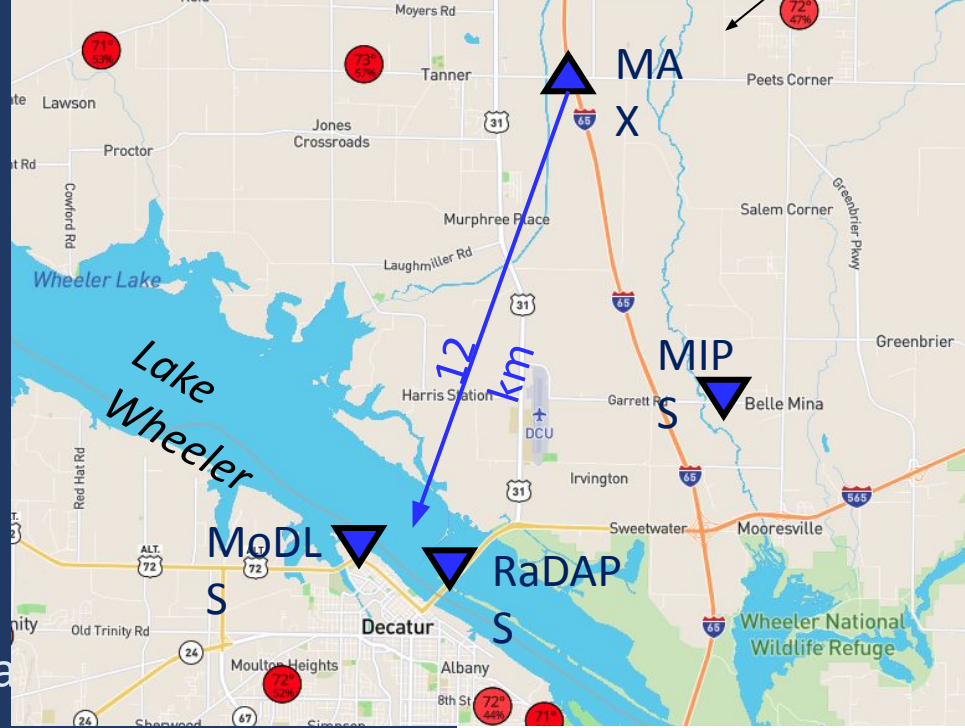
MIPS, 7/12/22

2022 REU activity utilizing the MAPNet resources
Lake breeze study 30 km SW of UAH

REU: *Remote Sensing of Land-Atmosphere Systems*
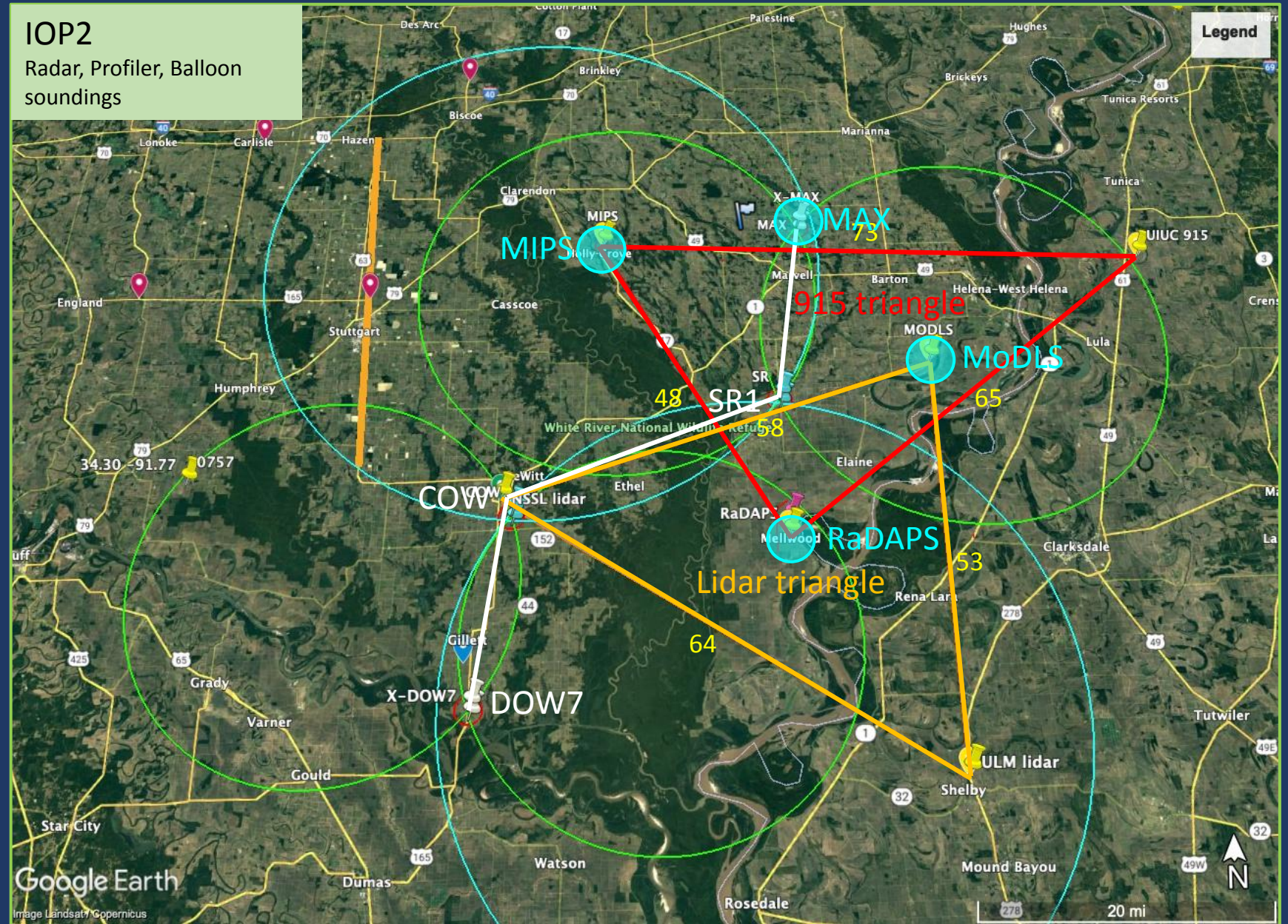
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Recent MAPNet activities

- PERiLS field campaign (2022, 2023)
- Interaction with potential CIF/ MAPNet users - field campaign planning (Arizona 2025, Utah 2024-25
- Demonstration research deployments
  - Solar eclipse 2017
  - Deployment for Hurricane Laura and Ida landfalls
  - Dauphin Island Ozone experiment
  - Pre-PERILS (2021-2022)
- Utilization in UAH courses
  - Ground-Based Remote Sensing, Spring 2022, 2024
  - Boundary Layer Meteorology, Spring 2021
- **REU: *Remote Sensing of Land-Atmosphere Systems* project (2022)**

Sounding from RADAPS

HardDock AL 34.62281/-86.9732   20220712/1305   (Observed)

ARMOR radar (Z)

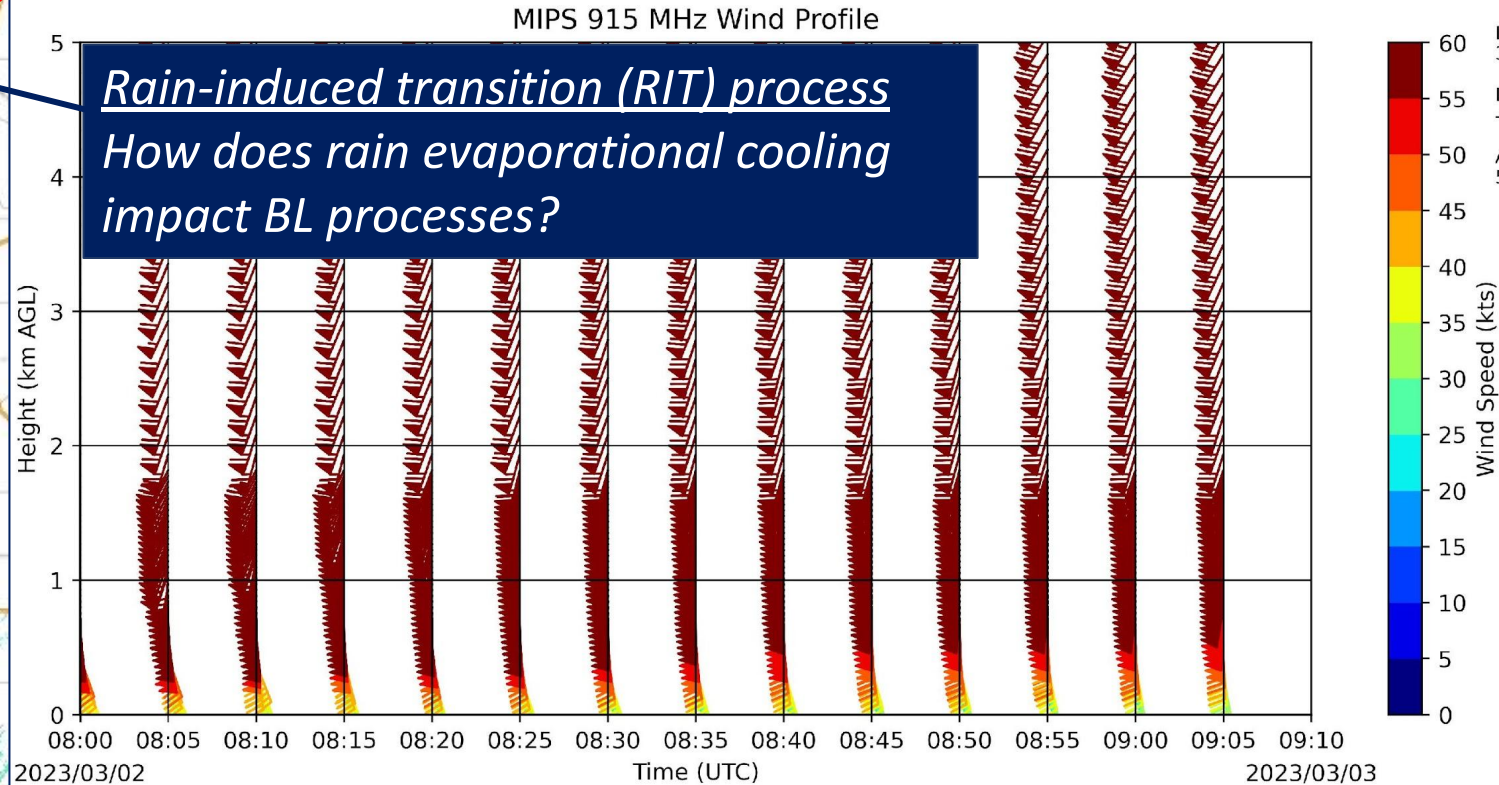MIPS 915 MHz Wind Profile

MIPS 915 MHz RWP
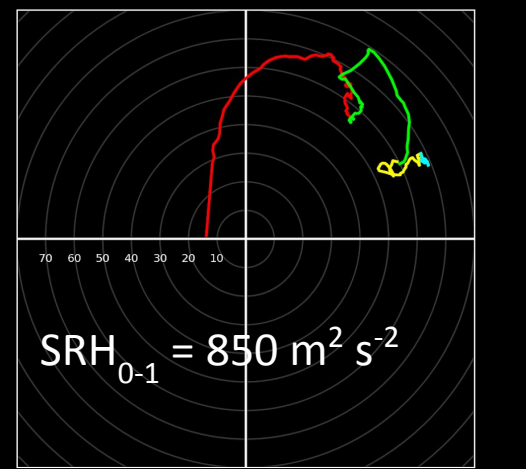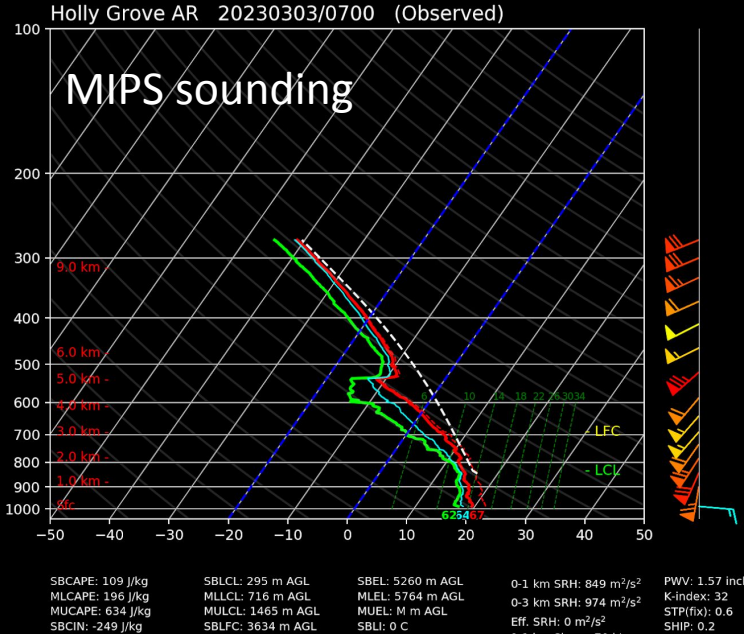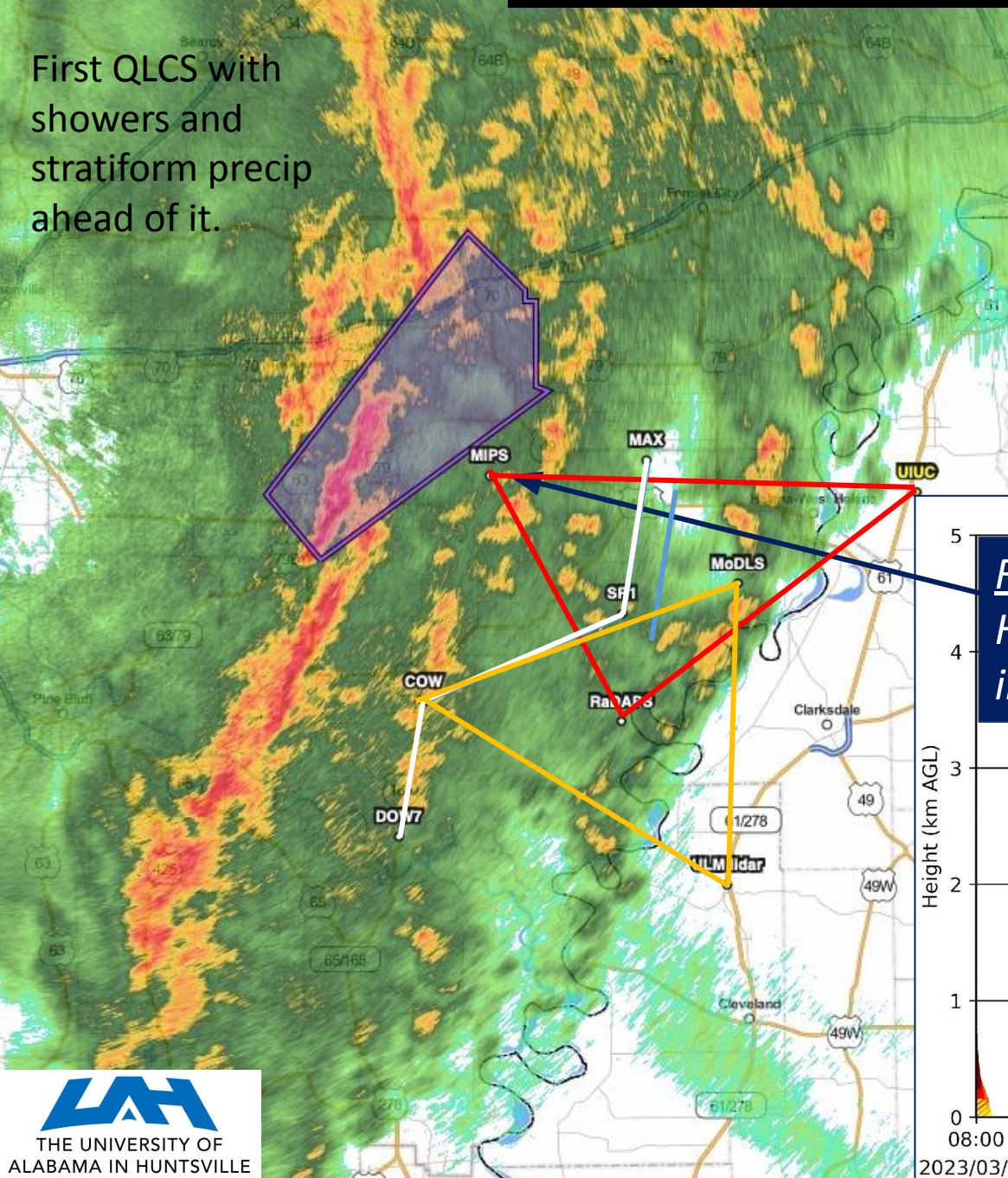
PERiLS IOP 2 (2023) example

- Four scanning radars

- Three 915 MHz wind profilers

- Three Doppler lidars

- 12 sounding sites (magenta symbols are balloon soundings only, plus balloon soundings at the RWP and lidar profiler sites, and at the COW & DOW7 radar sites.
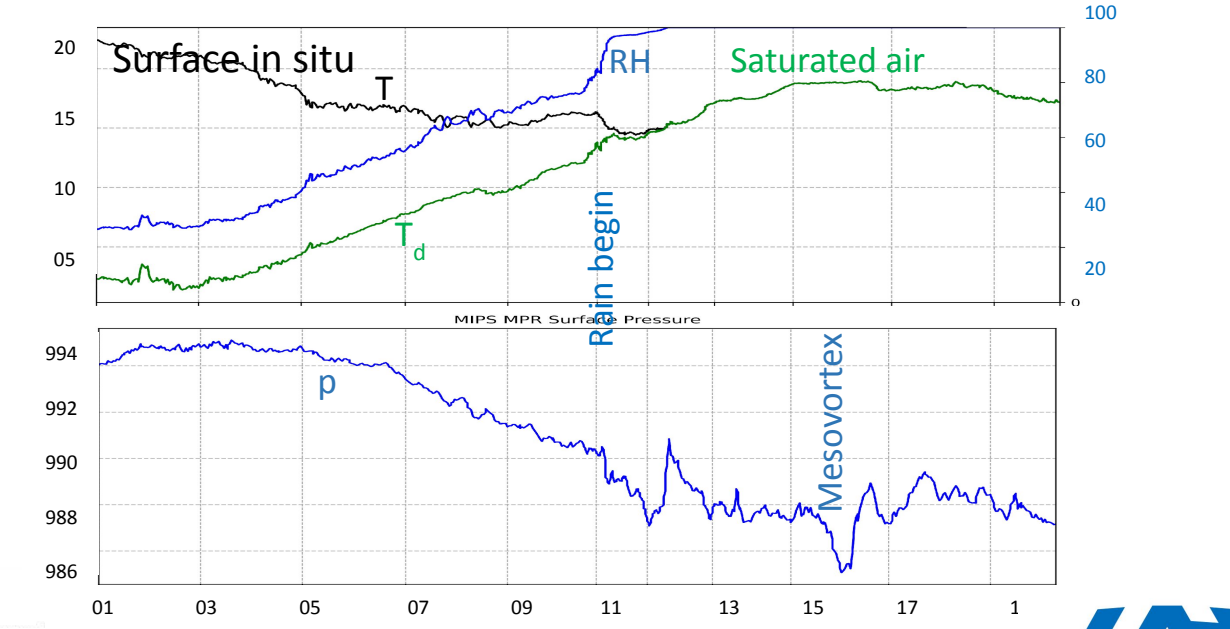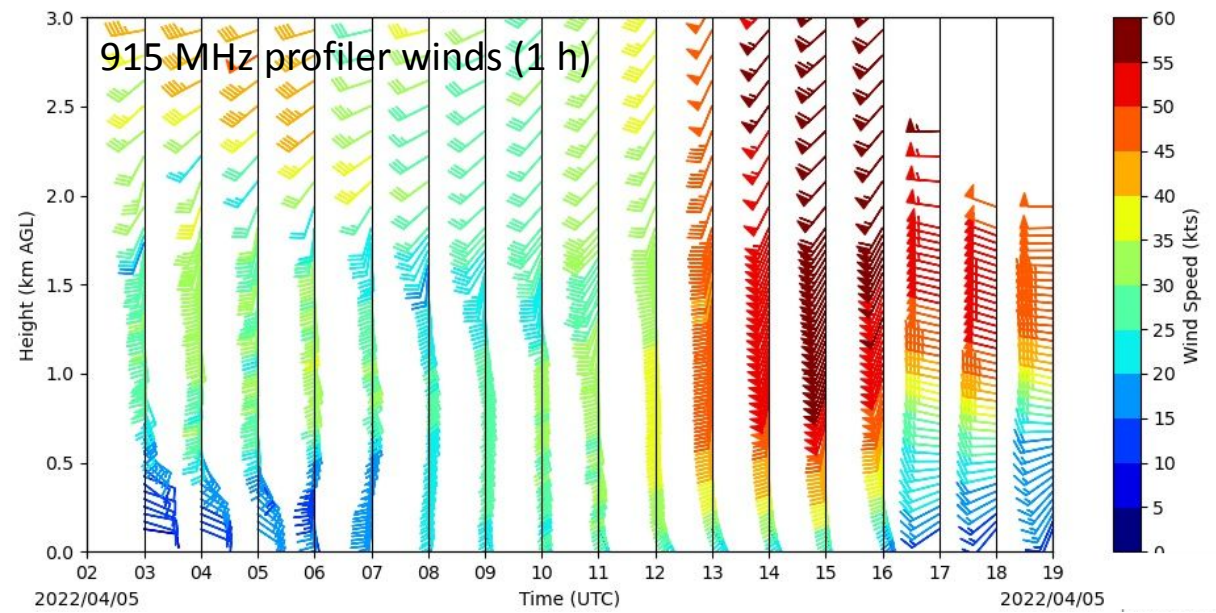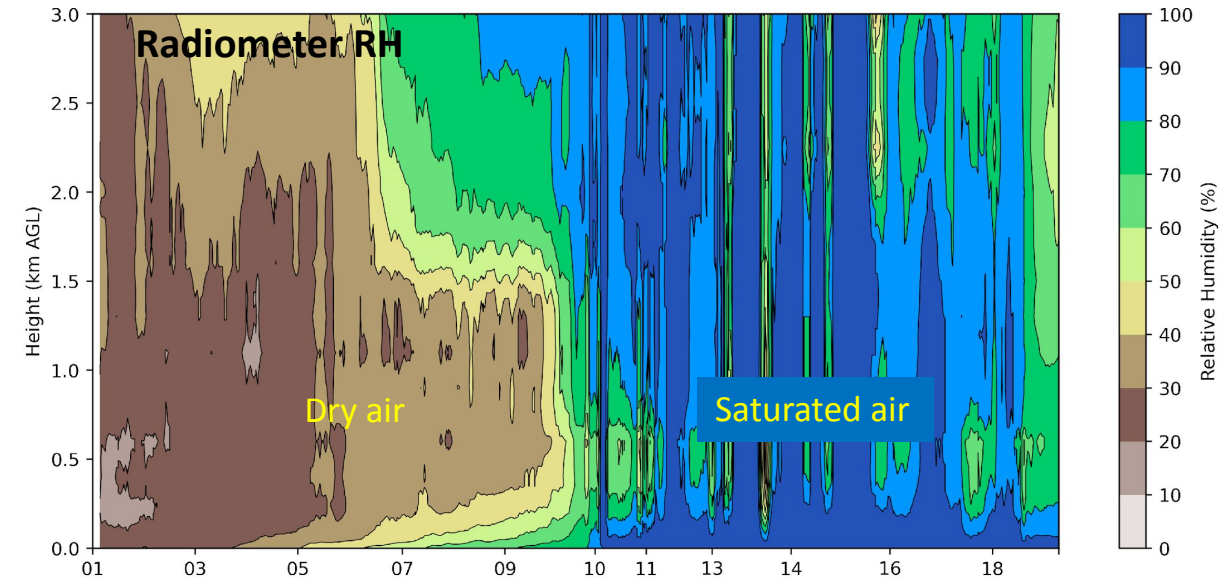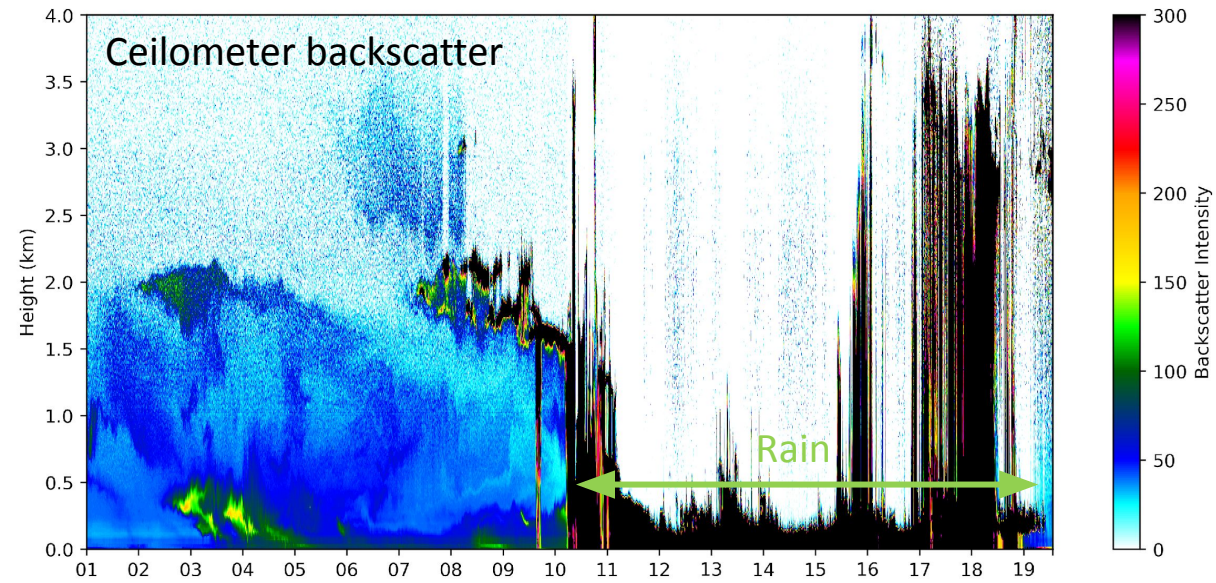
- StickNet (16 stations)

- Mobile LMA

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0827 UTC

First QLCS with showers and stratiform precip ahead of it.

PERiLS IOP2 (2 March 2023)

MIPS sounding

SRH_{0-1} = 850 m^2 s^{-2}

Rain-induced transition (RIT) process
How does rain evaporational cooling impact BL processes?

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MIPS measurements during PERiLS IOP3 (01-19 Z, 5 April 2022)

Future plans and opportunities
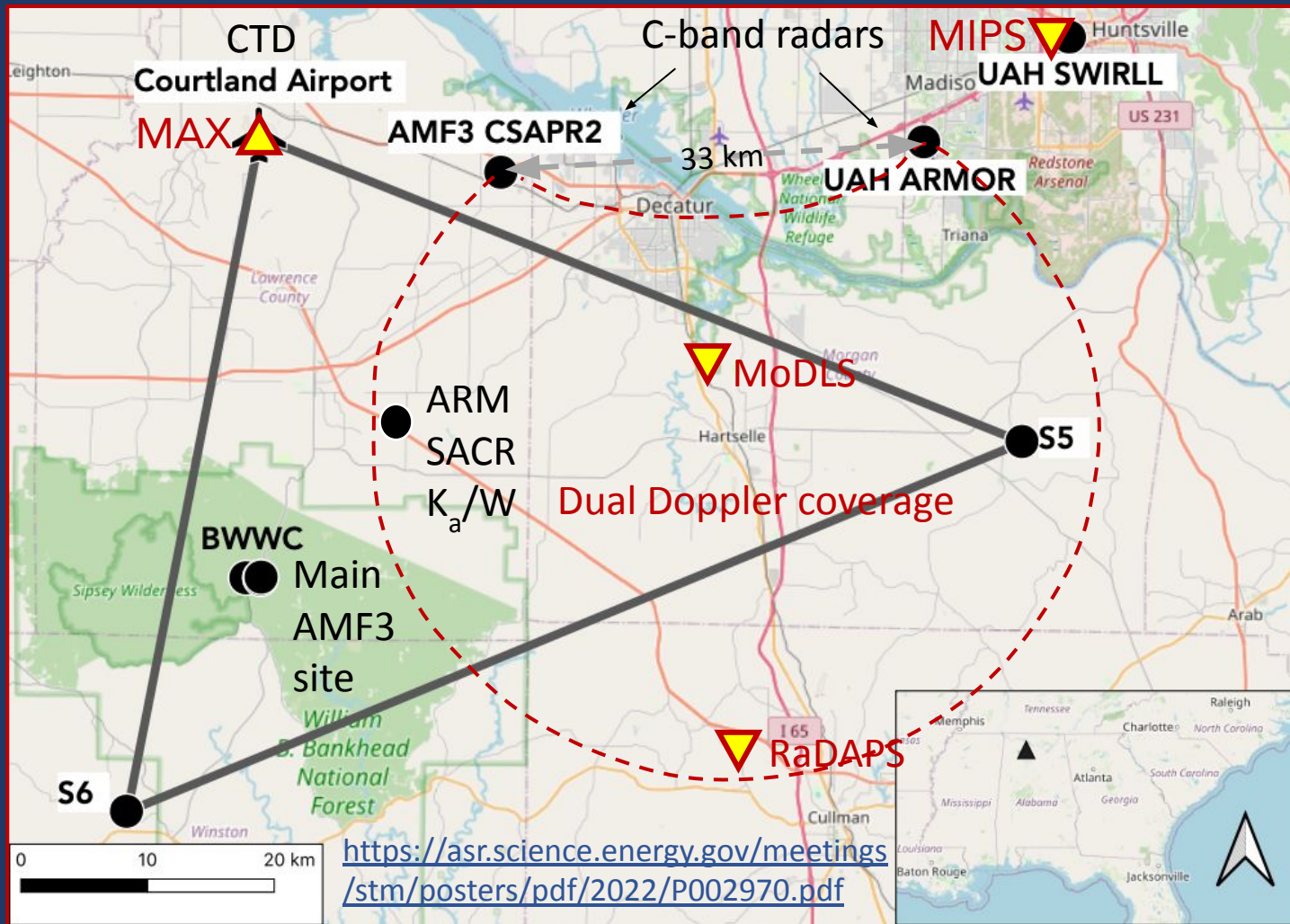

DOE AMF3 activity over N AL

Addition of MAPNet platforms will form a very comprehensive observational network.

This can serve as another paradigm for use of MAPNet resources by interested investigators.

MAPNet involvement in long-term field measurement activities over NW Alabama, starting in early 2024. This will be a collaborative effort with the DOE AMF3 program, and will provide inclusive measurements over a very well instrumented mesoscale domain. The S5 and S6 supplemental site locations are tentative.

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Summary

- The MAPNet is a requestable facility for use in research and education projects

- Strengths: boundary layer processes, precipitation processes

- Mobility provides flexibility in experimental design

- Each profiling platform will offer some level of configurability

- We will strive to continuously upgrade the MAPNet capabilities
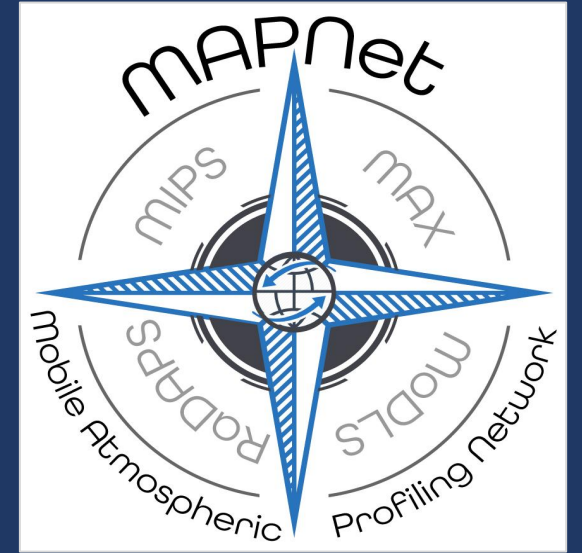
The request process is documented at the following we sites:

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

- FARE: https://www.nsf.gov/geo/ags/programs/fare/

Current instrumentation and facilities available for request under the Facility and Instrumentation Request Process (FIRP) Solicitation:
https://beta.nsf.gov/funding/opportunities/facility-and-instrumentation-request-process-firp