radiometrics
Ahead of the Weather®

Wind & Thermodynamic Surveillance for Local Weather Forecasting

Met Tech World Expo
12 Oct 2017 – Amsterdam

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Outline

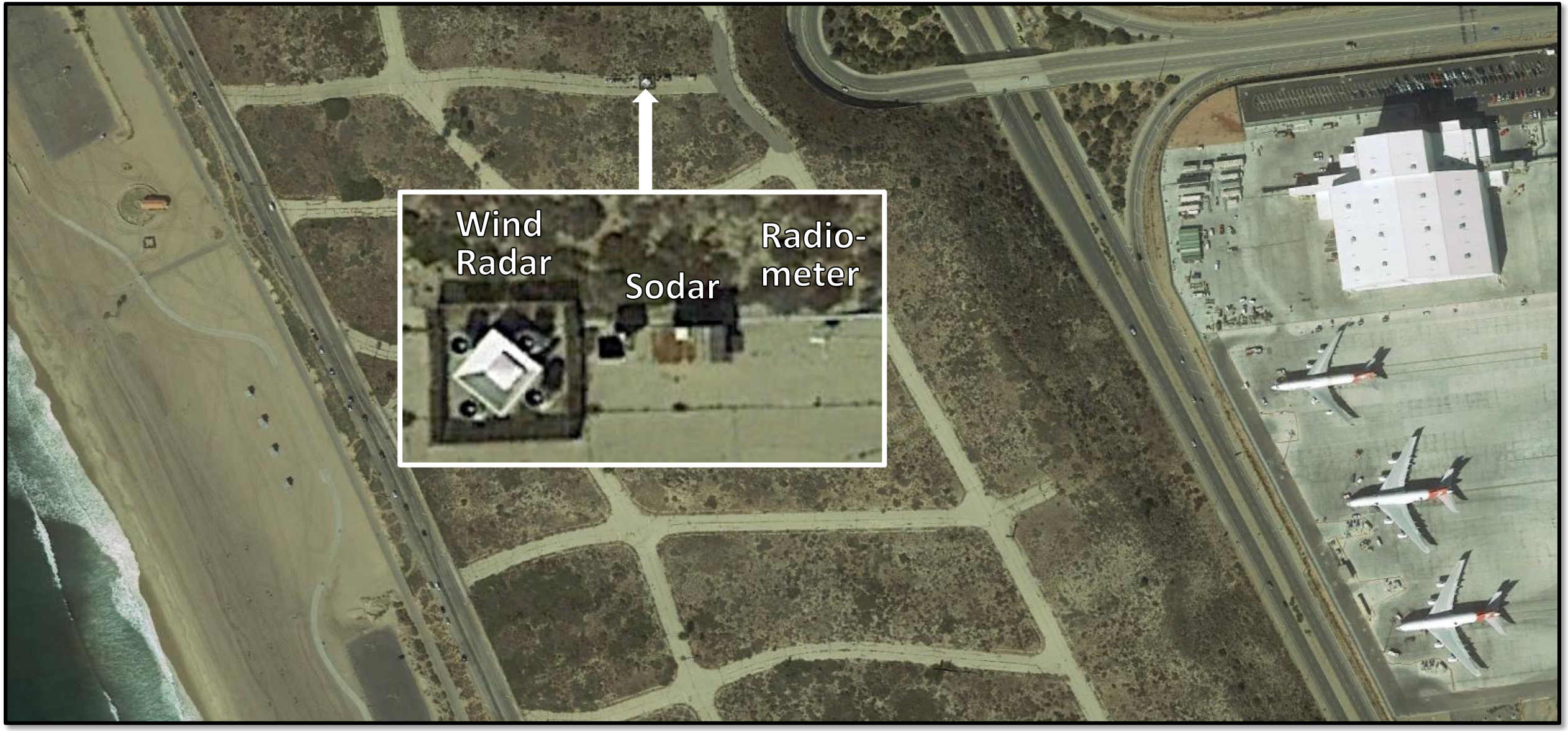
- Importance of Thermodynamic and Wind Surveillance
- Thermodynamic and Wind Surveillance Signatures
  - Sea Breeze and Fog at Los Angeles International Airport
  - Frontal Passage observed by New York State Mesonet
  - Colorado Precipitating Cold Front
- Tropical Cyclone and Tornado Signatures
  - Hato (2017) and Matthew (2016) Cyclones, Max-Q
  - Moore Tornado (2013)

Atmospheric Boundary Layer

- We are immersed in boundary layer fluid
- Its our most intimate connection with nature
- Its where severe weather originates and exacts its personal and economic tolls
- Thermodynamic and wind surveillance is essential for accurate local high impact weather forecasting

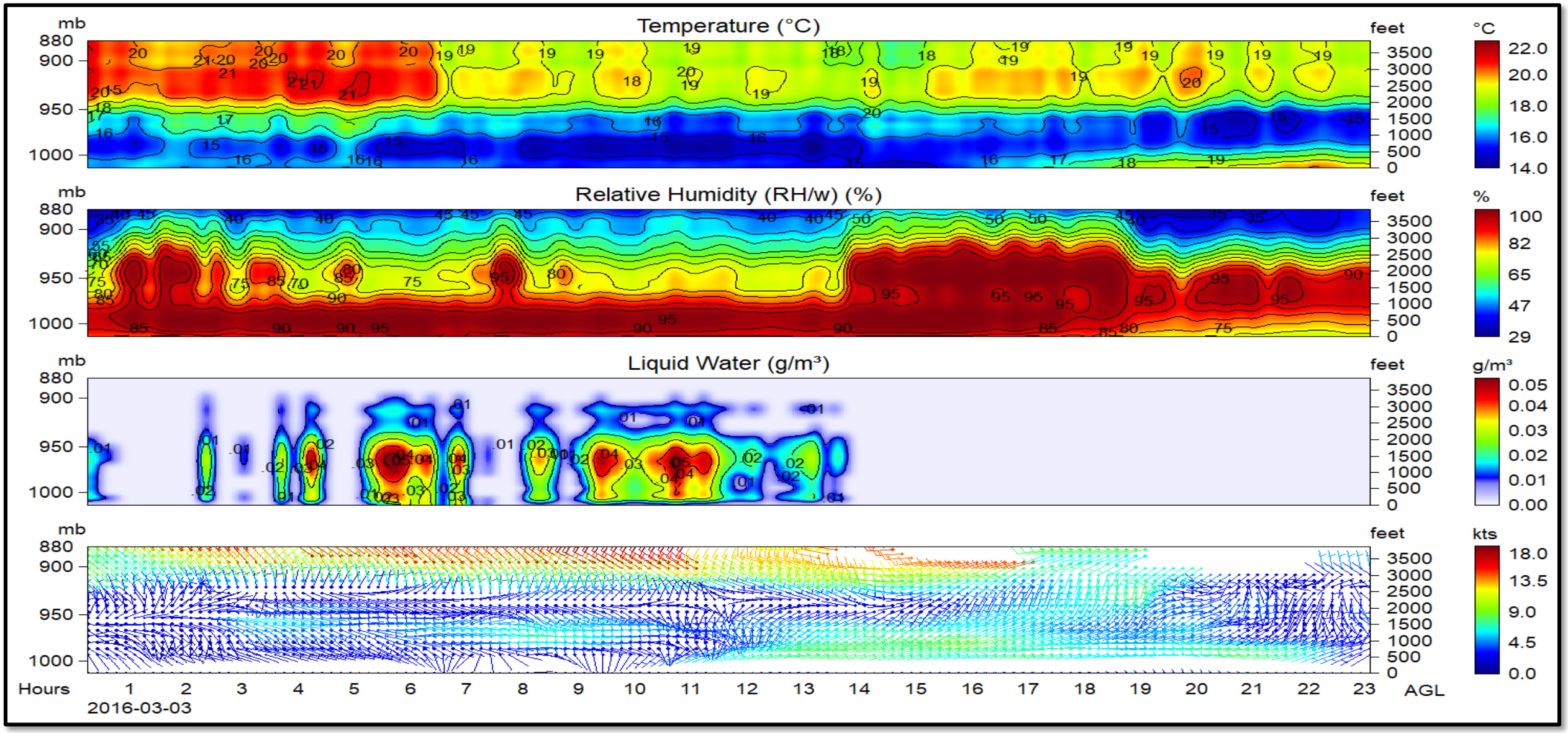
Sea Breeze and Fog

- Thermodynamic and Wind Profilers at Los Angeles International Airport (LAX)
- Operated by Southern California Edison and South Coast Air Quality Management District
- Wind, solar and electric load forecasting, and Air Quality applications

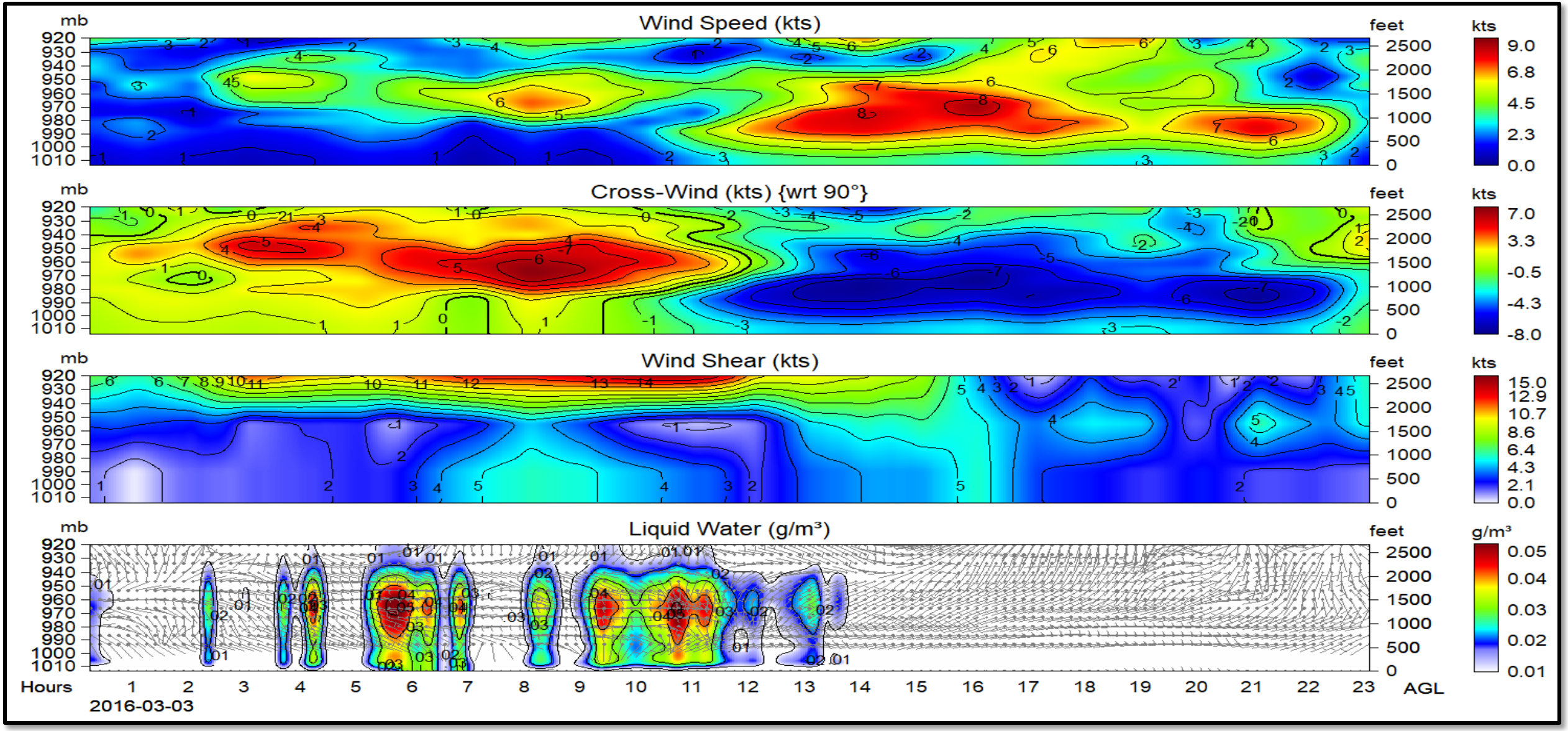


Wind and thermodynamic profilers at LAX

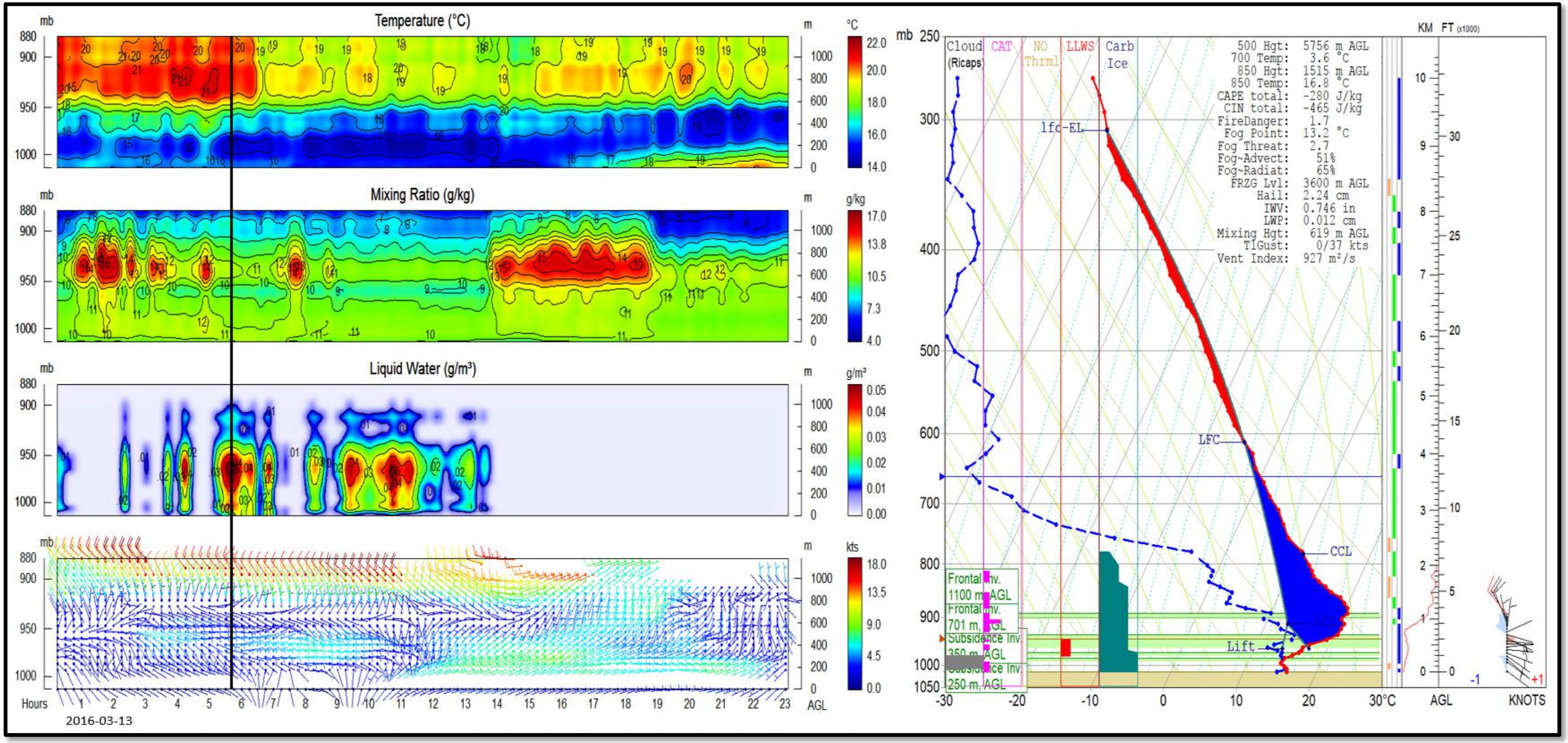
Microwave profiler at LAX – looking northeast past Santa Monica toward the Malibu Hills



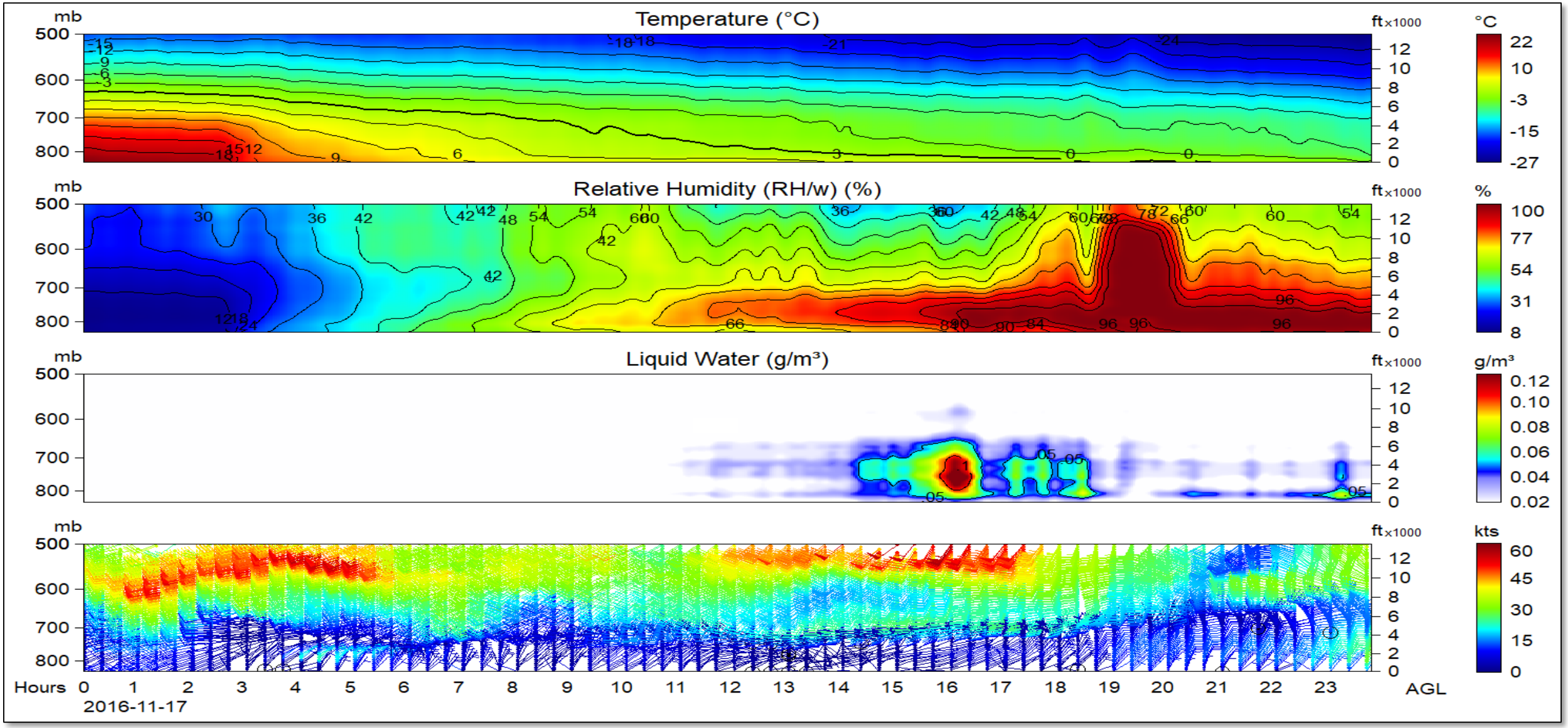
Sea breeze and fog at LAX -- thermodynamic and wind signatures



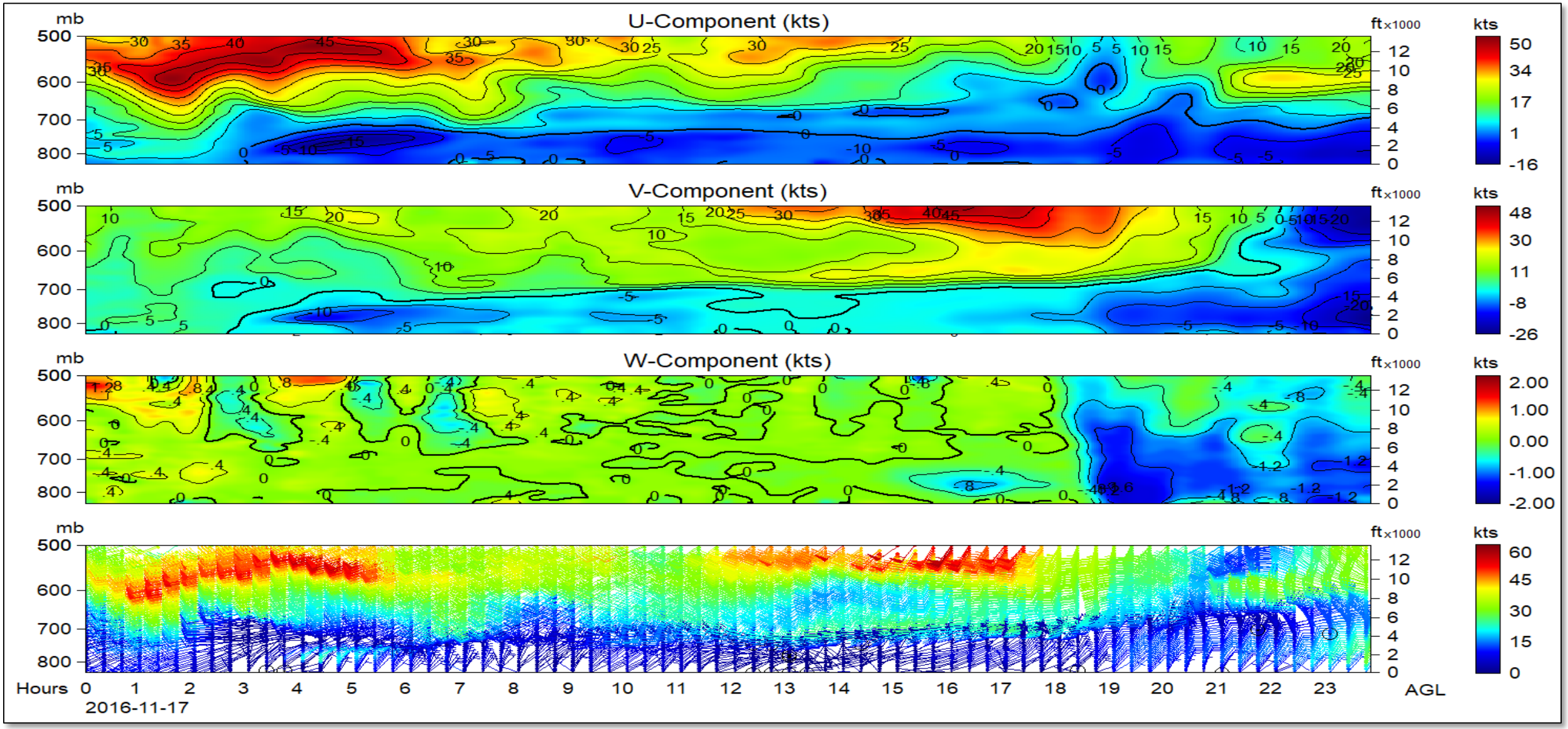
Airport winds and fog at LAX – aviation wind and liquid water signatures



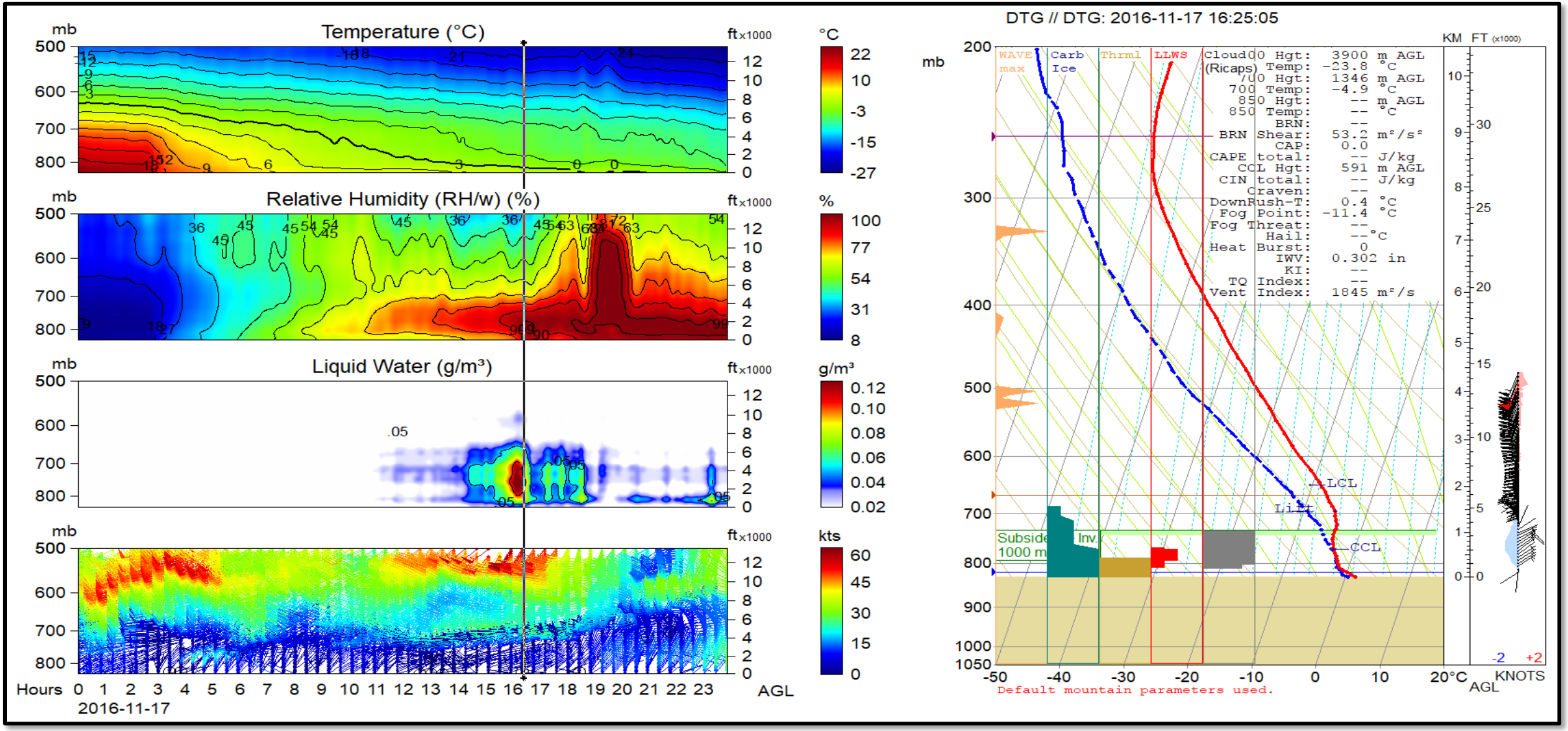
Forecast index time series – powerful new weather surveillance and Nowcasting tools



Colorado cold front with rain and snow -- thermodynamic and wind signatures.



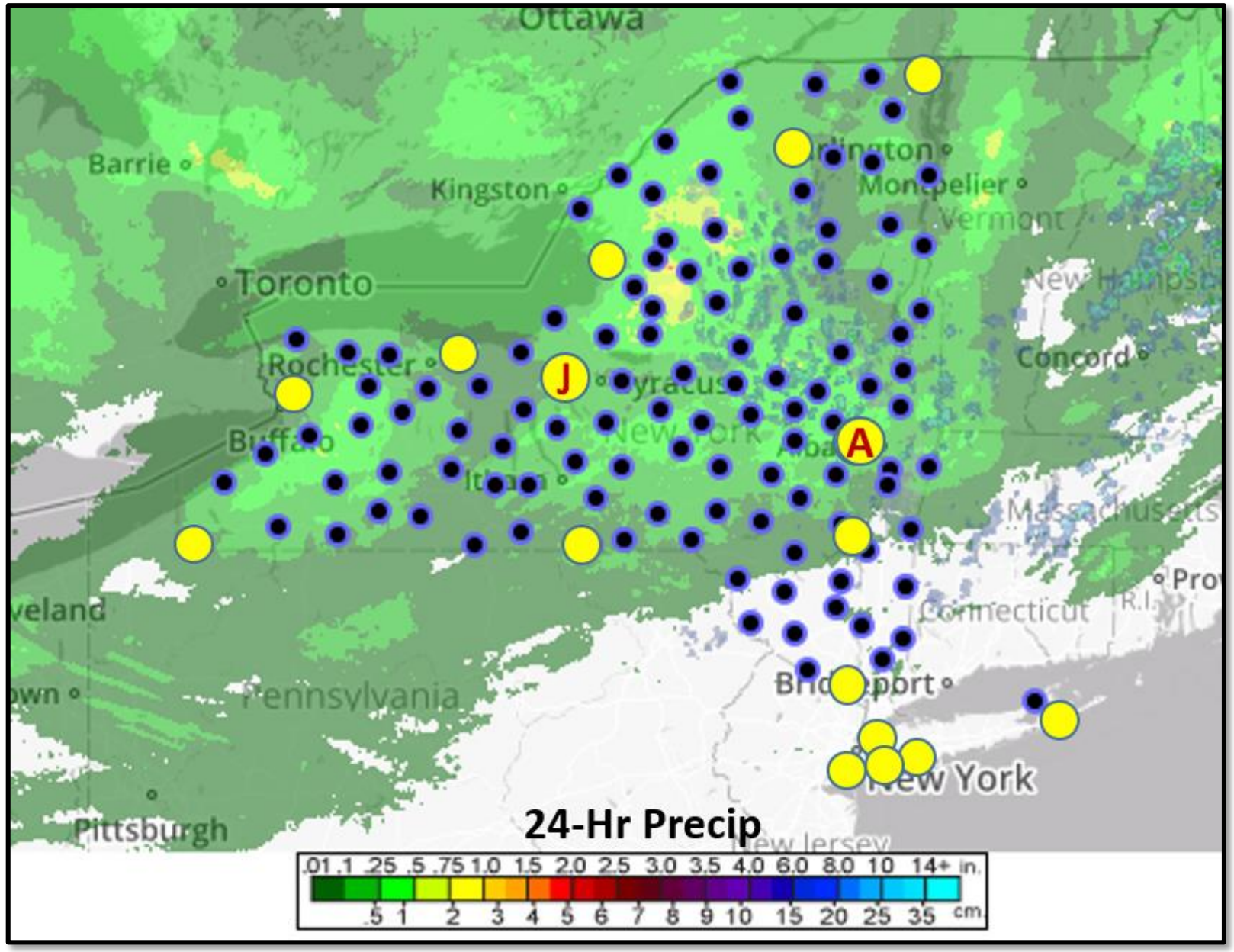
Colorado cold front with rain and snow -- wind signatures



Forecast index time series surveillance and Nowcasting tools

New York State Mesonet

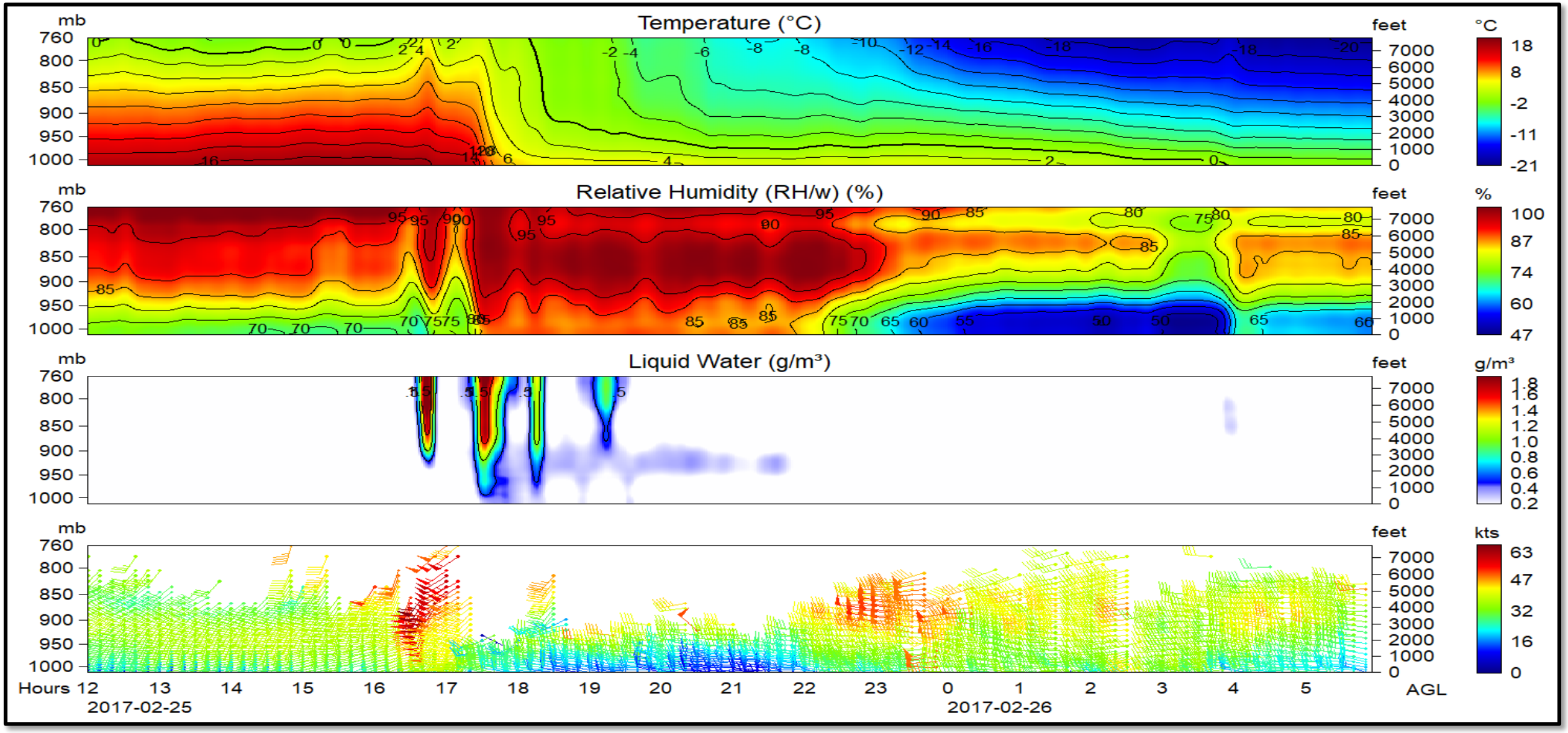
- Surface temperature, humidity, wind, pressure, radiation, and soil measurement (125 sites)
- Temperature, humidity, liquid and wind profile, flux and snow depth measurement (17 sites)
- World's leading high-resolution boundary layer observation and weather forecast test bed



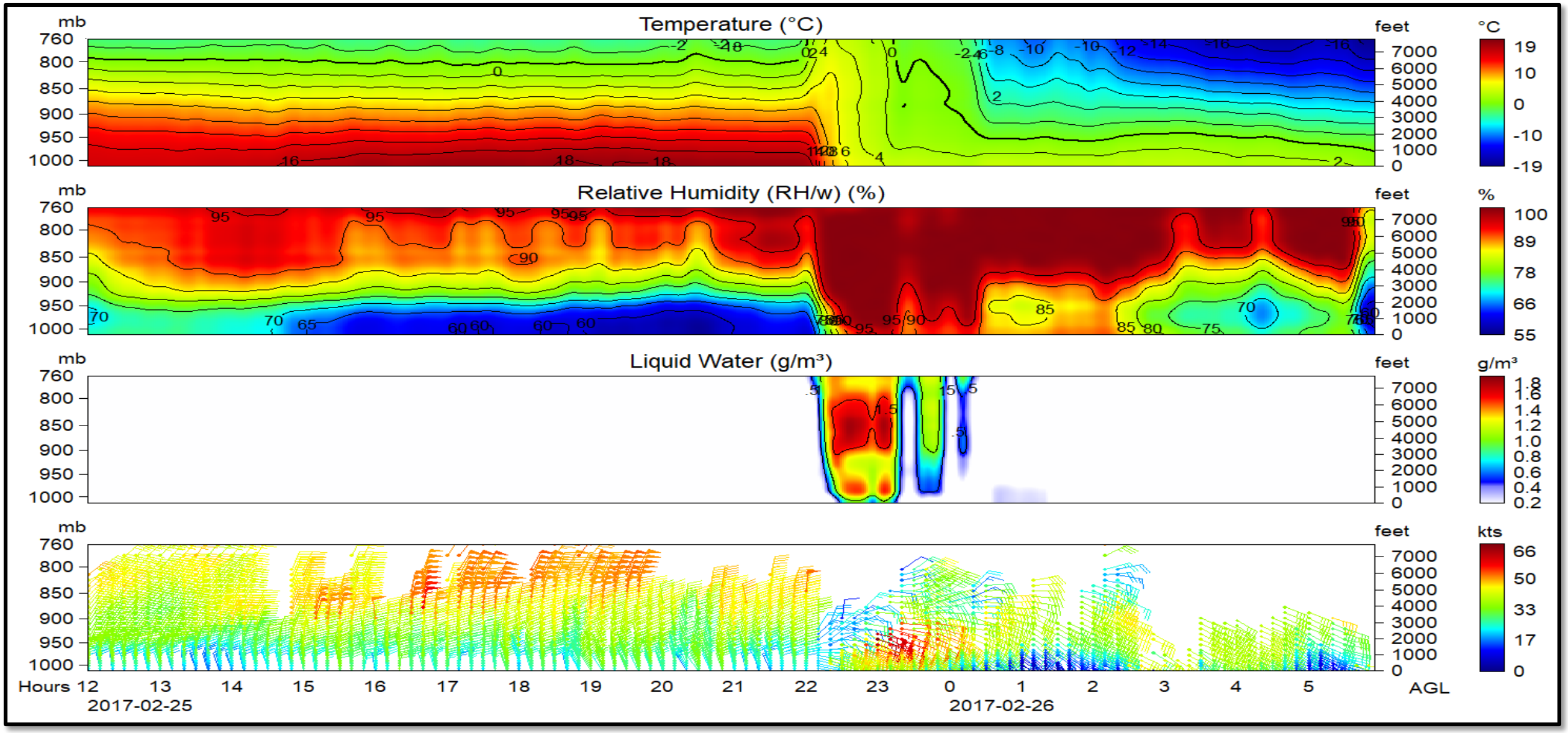
NY Mesonet Sites

- Weather (125)
- Thermodynamic & Wind Profiler (17)

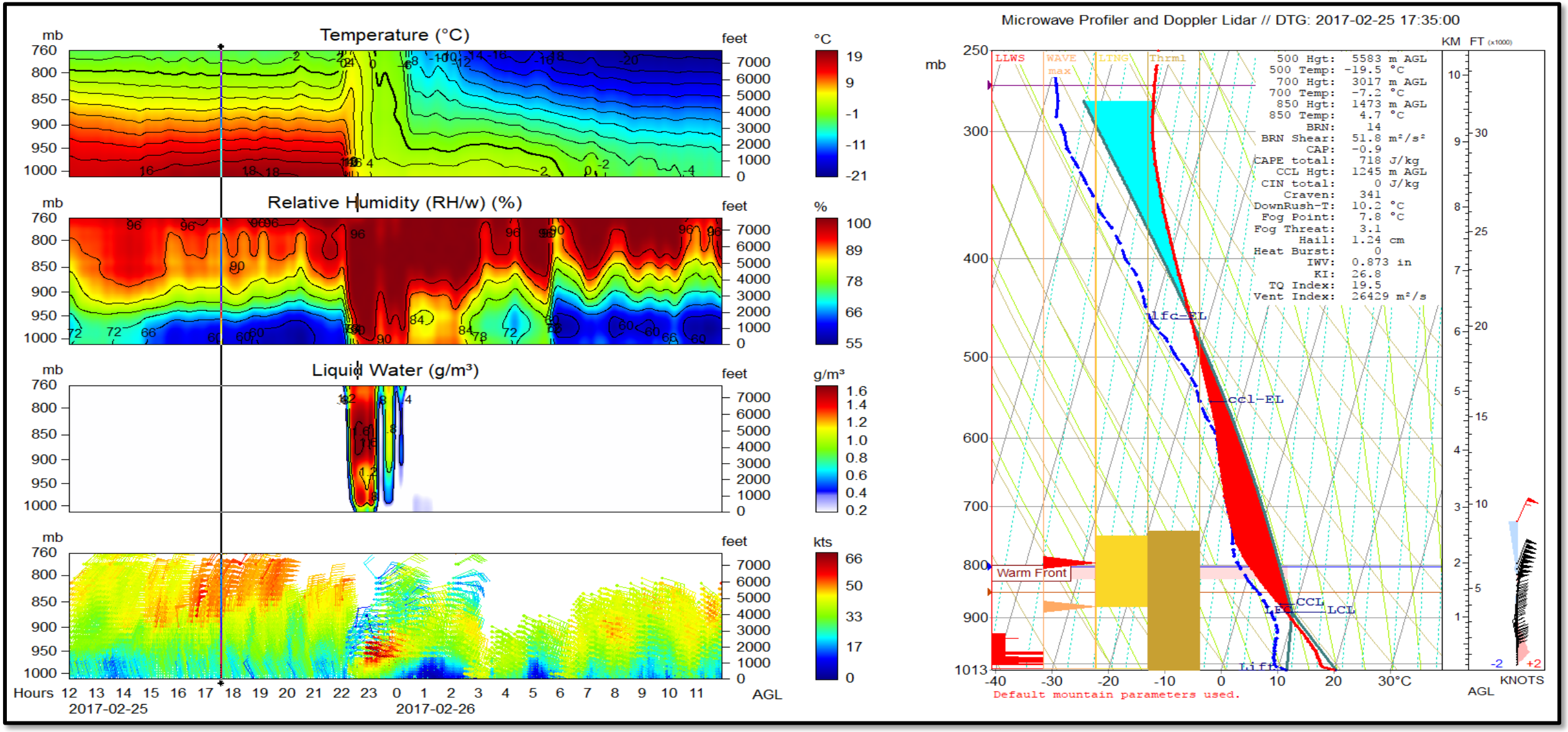
- J Jordan
- A Albany



Cold front with rain -- thermodynamic and wind signatures at Jordan



Cold front with rain -- thermodynamic and wind signatures at Albany



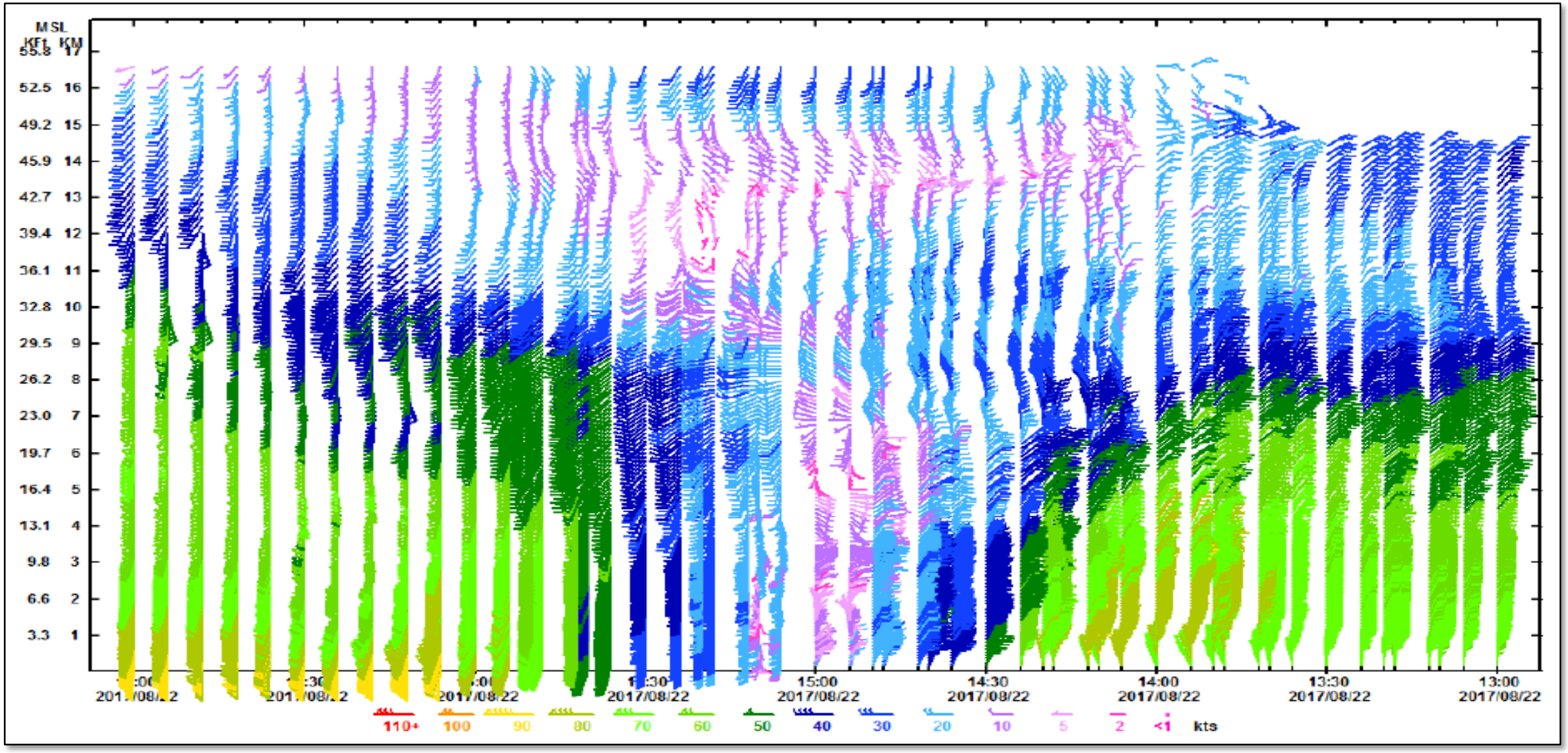
Frontal passage thermodynamic and wind signatures at Albany

Typhoon Hato

- Eyewall passed directly over a wind radar on Dongsha Island in the South China Sea
- Wind profiles to 58,000 ft (17 km) height
- Category 3 wind speeds >90 mph observed

Wind and thermodynamic profiler on Dongsha Island

Typhoon Hato track over Dongsha Island



Typhoon Hato eyewall passage observed by Dongsha Island wind radar

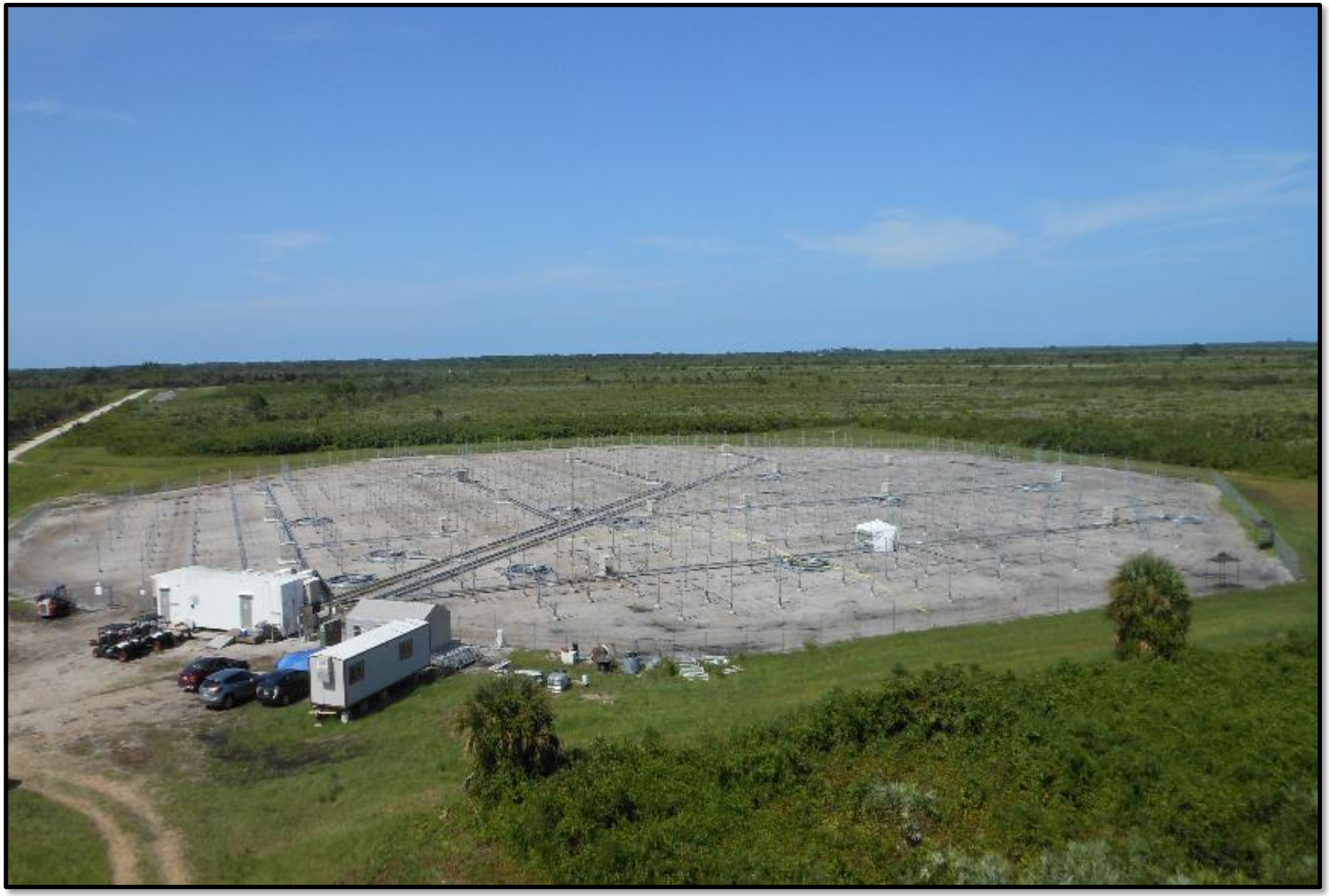
Wind and thermodynamic profiler operated by National Central University (Taiwan)

Max-Q

- Maximum mechanical stress on a launch vehicle, occurring near 14 km (46,000 ft) altitude
- Wind and air density dependent
- NASA Max-Q determination
  - Wind vector profiles via stratospheric wind profiler
  - Air density profiles via microwave radiometer (under development)

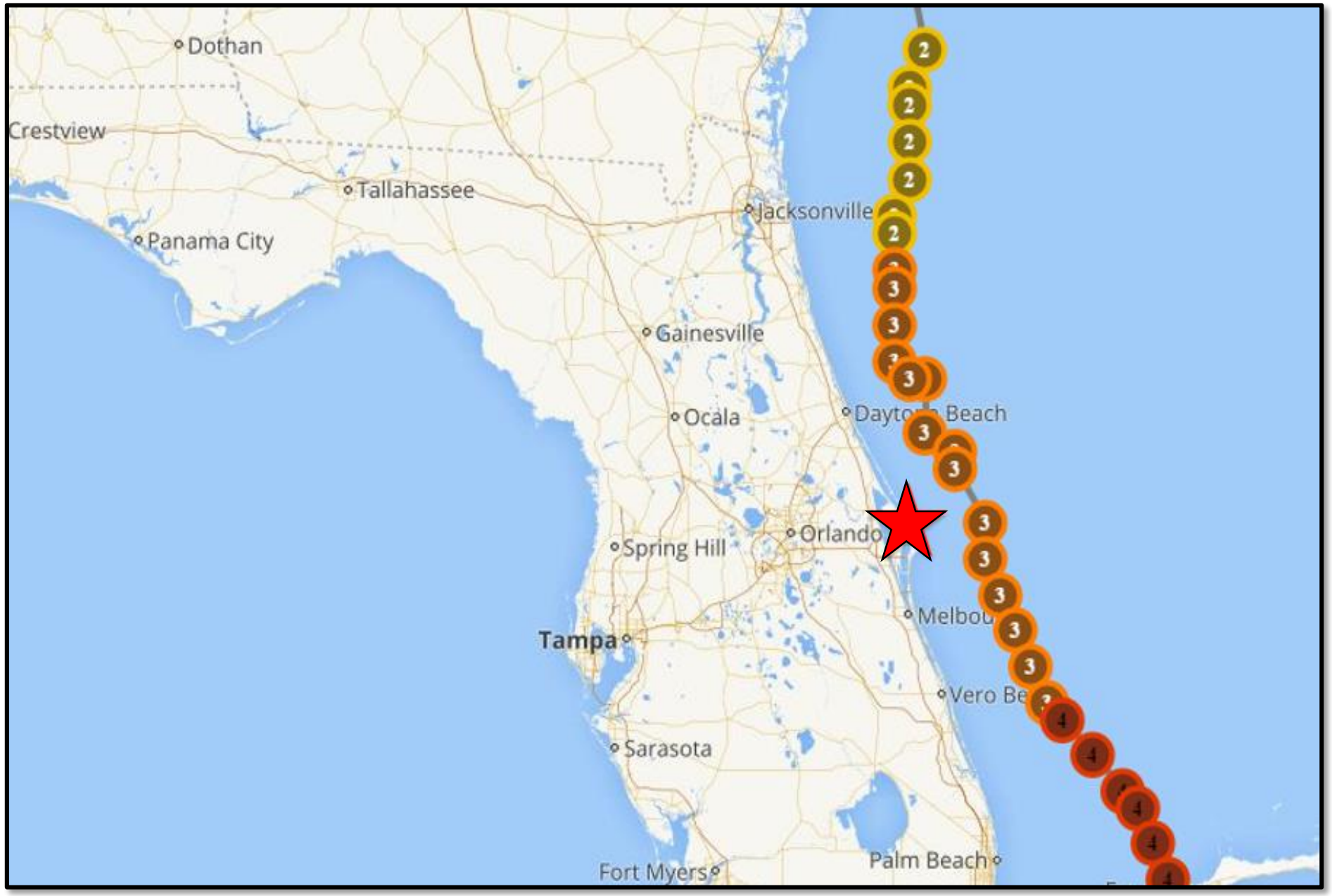
Hurricane Matthew

- Ground track along Florida East Coast
- Category 3 wind speeds >92 mph observed
- Eyewall passage 15 km from stratospheric wind profiler



NASA Stratospheric Wind Profiler

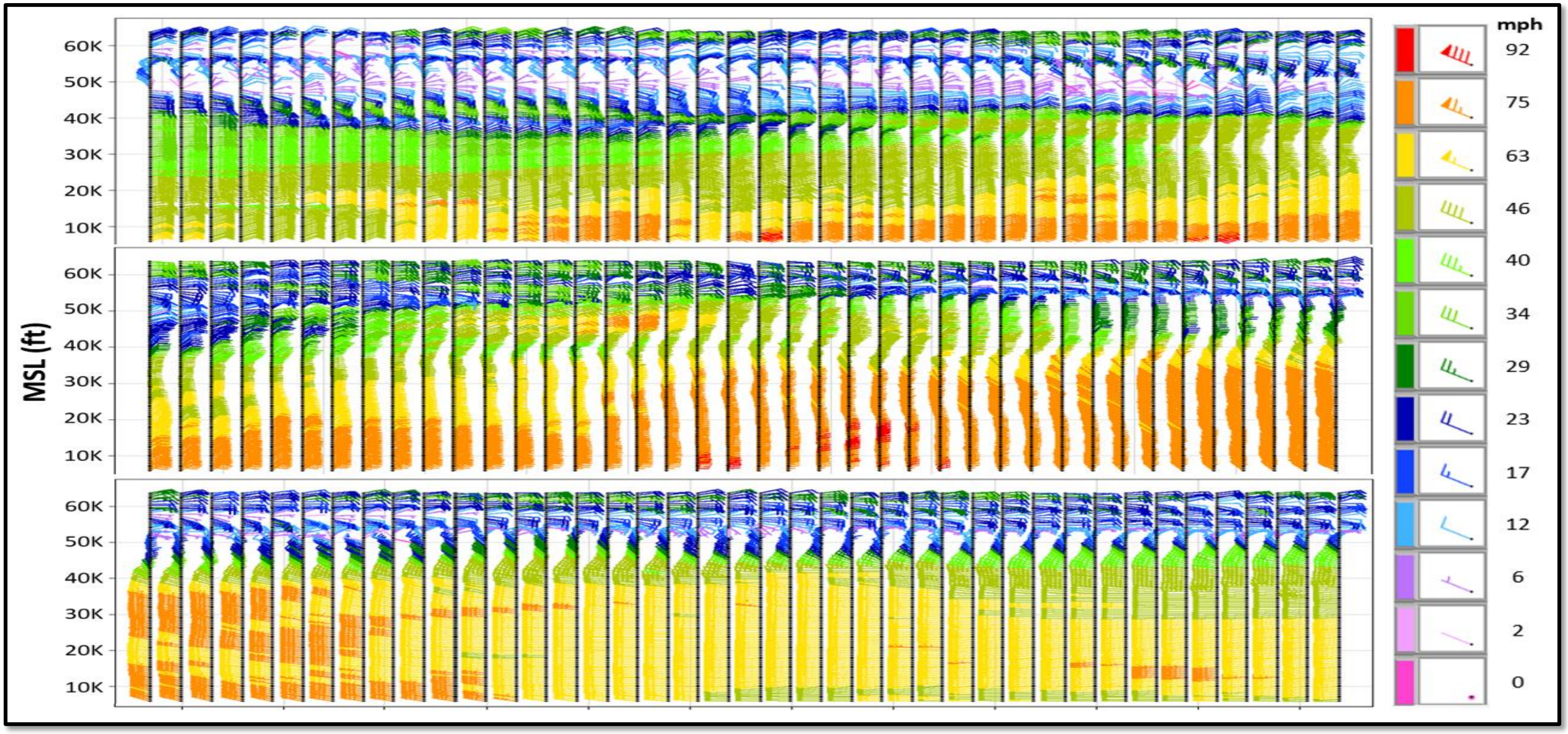
Cape Kennedy



Hurricane Matthew

Path & Intensity

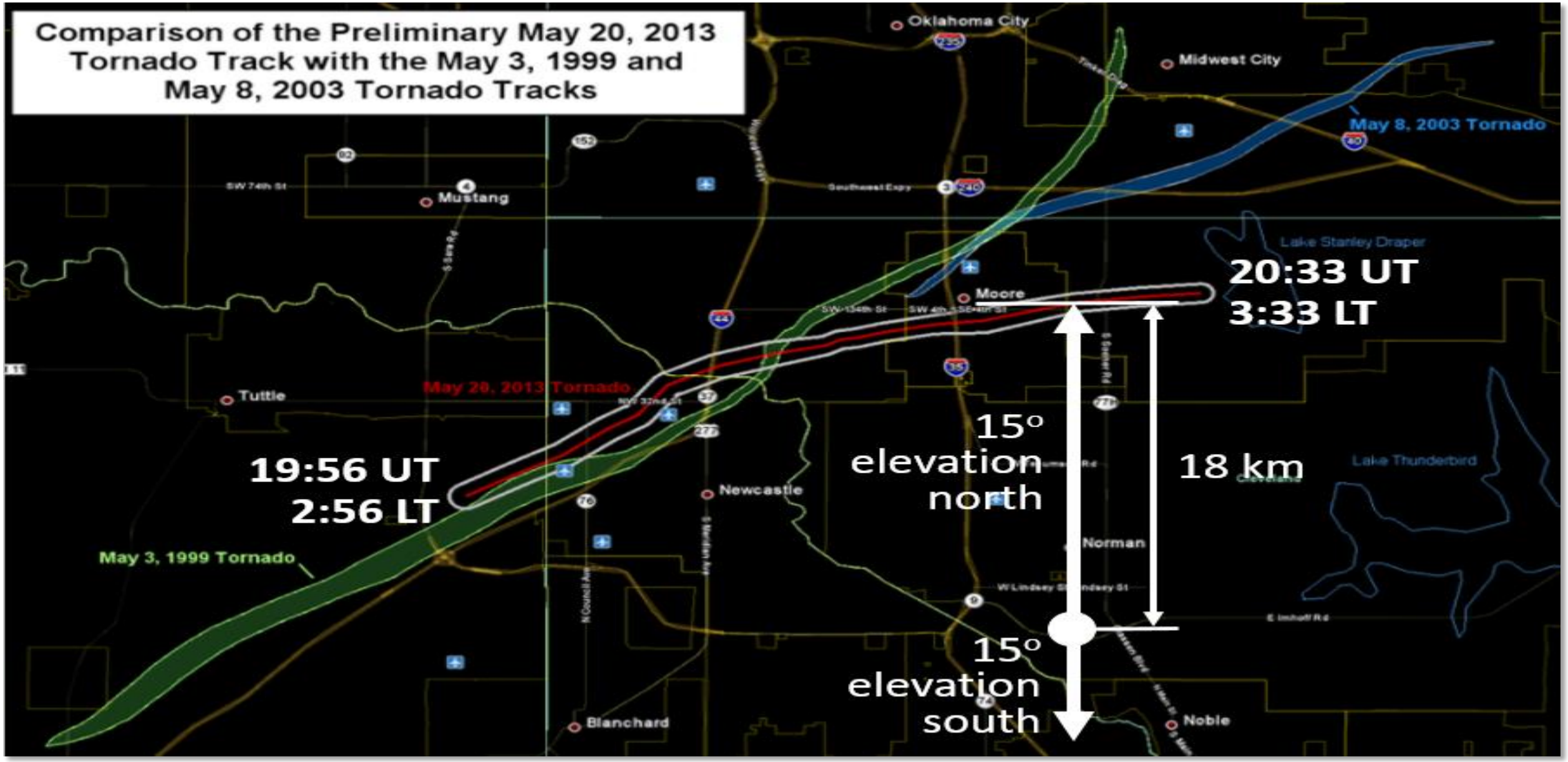
★ Wind Radar Location



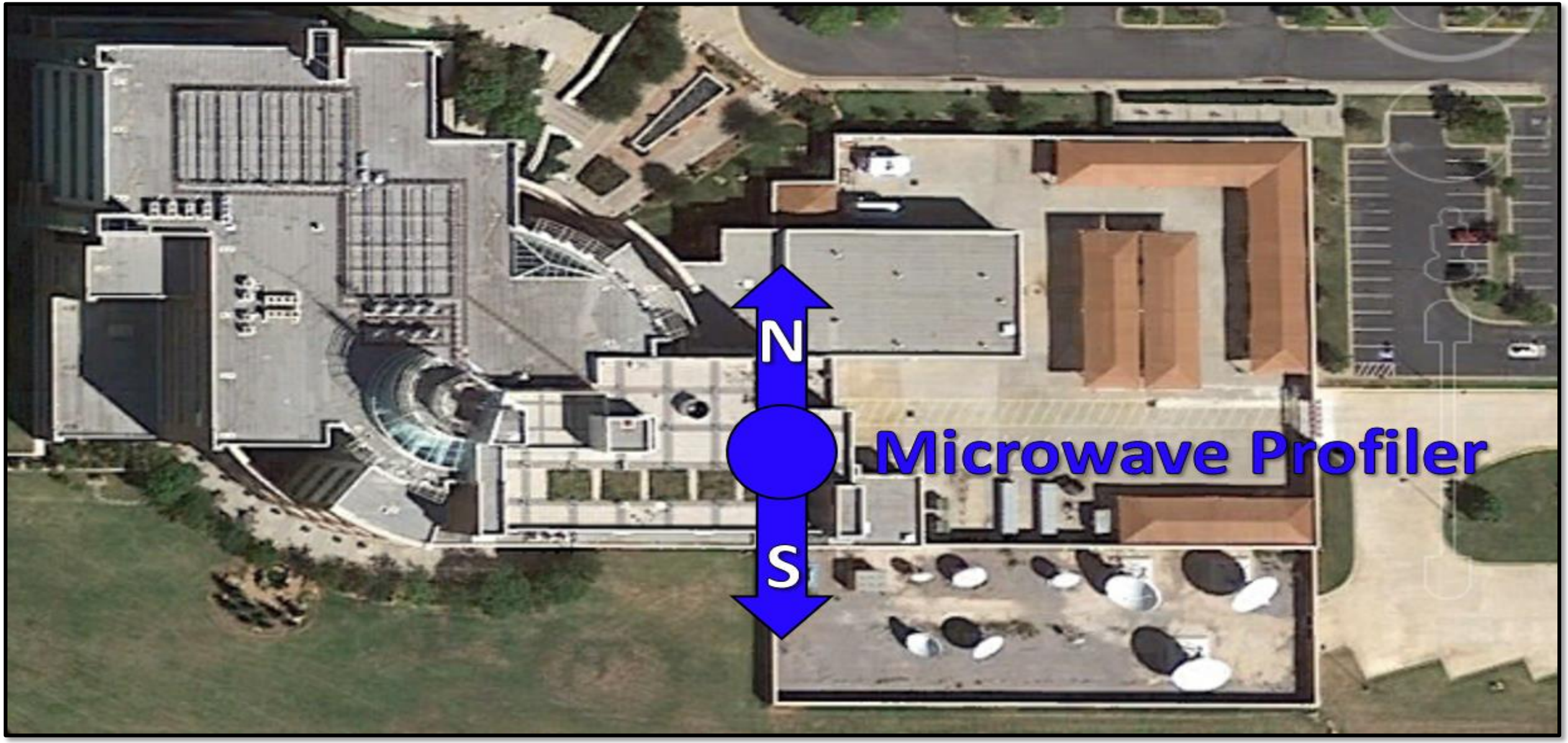
Wind radar observations of Hurricane Matthew, 06-17Z 7 Oct 2016

Moore Tornado

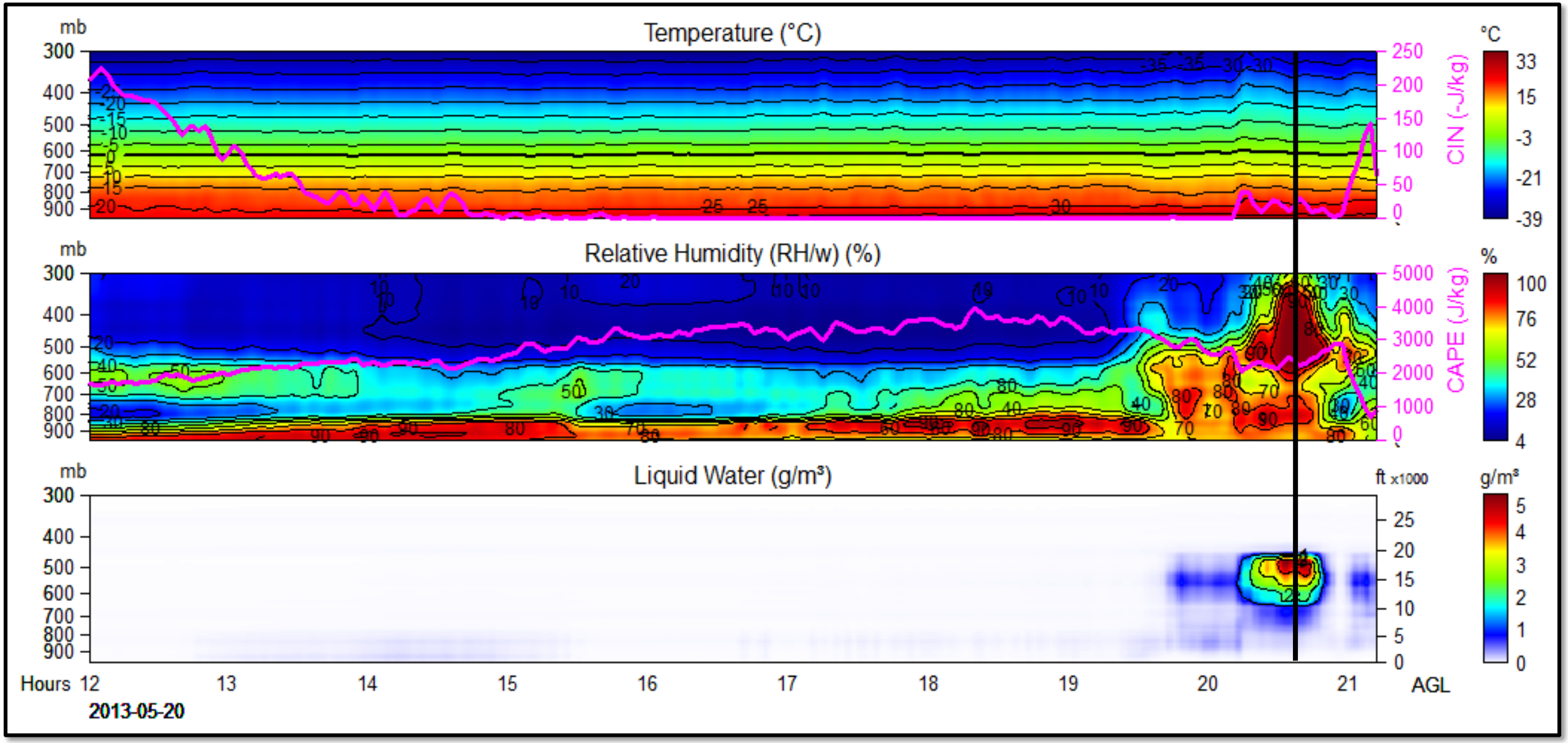
- Intense and destructive tornado struck Moore, Oklahoma on May 20, 2013
- Stayed on the ground for 37 minutes and crossed a heavily populated section of Moore
- 24 fatalities, 377 injured
- Direct tornado vortex observation by a radiometer at the National Weather Center



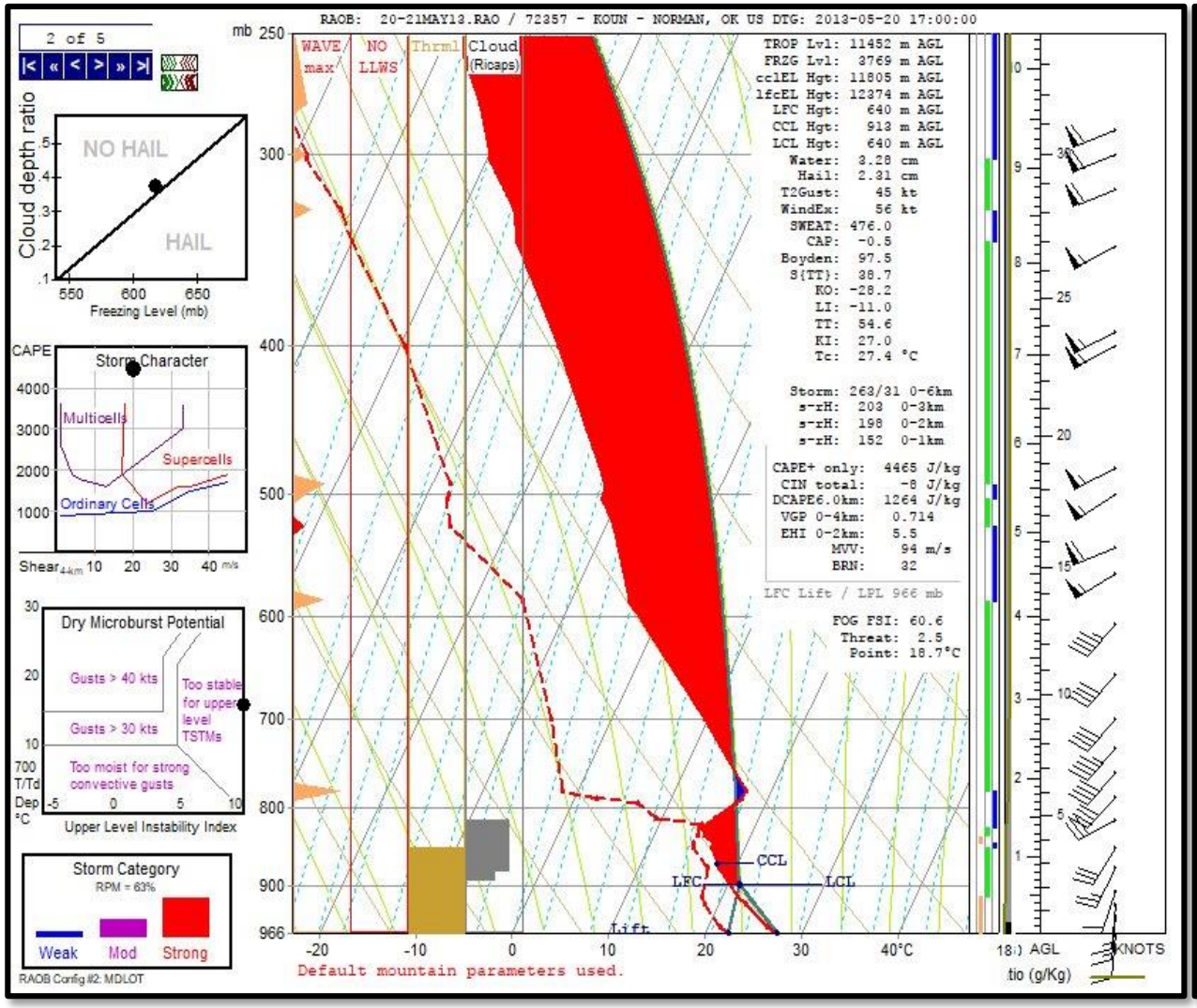
Ground track (red), radiometer location (white dot) and observation directions.
The tornado vortex crossed the radiometer field of view at 5 km height.

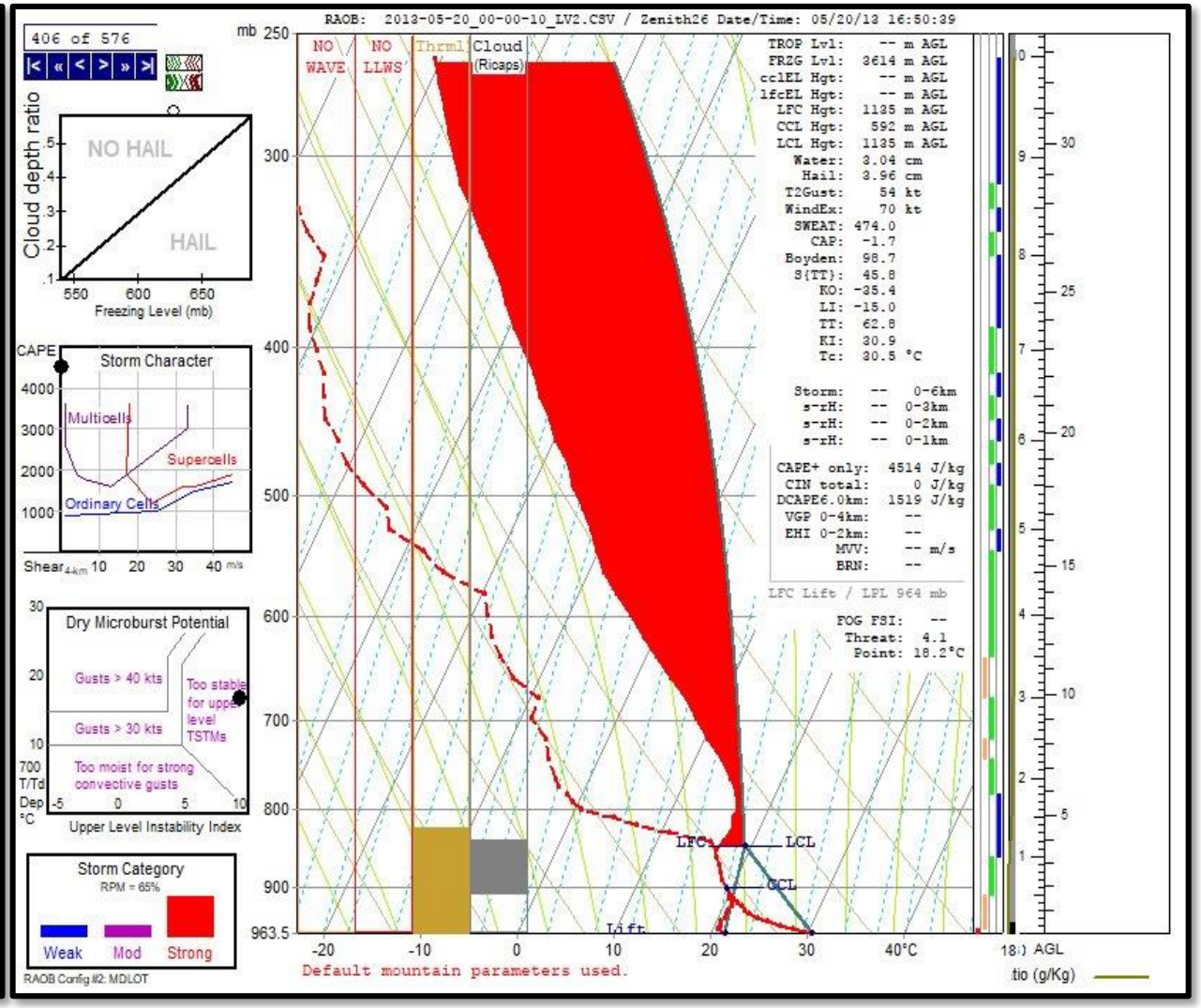


Radiometer location and viewing directions on the National Weather Center rooftop

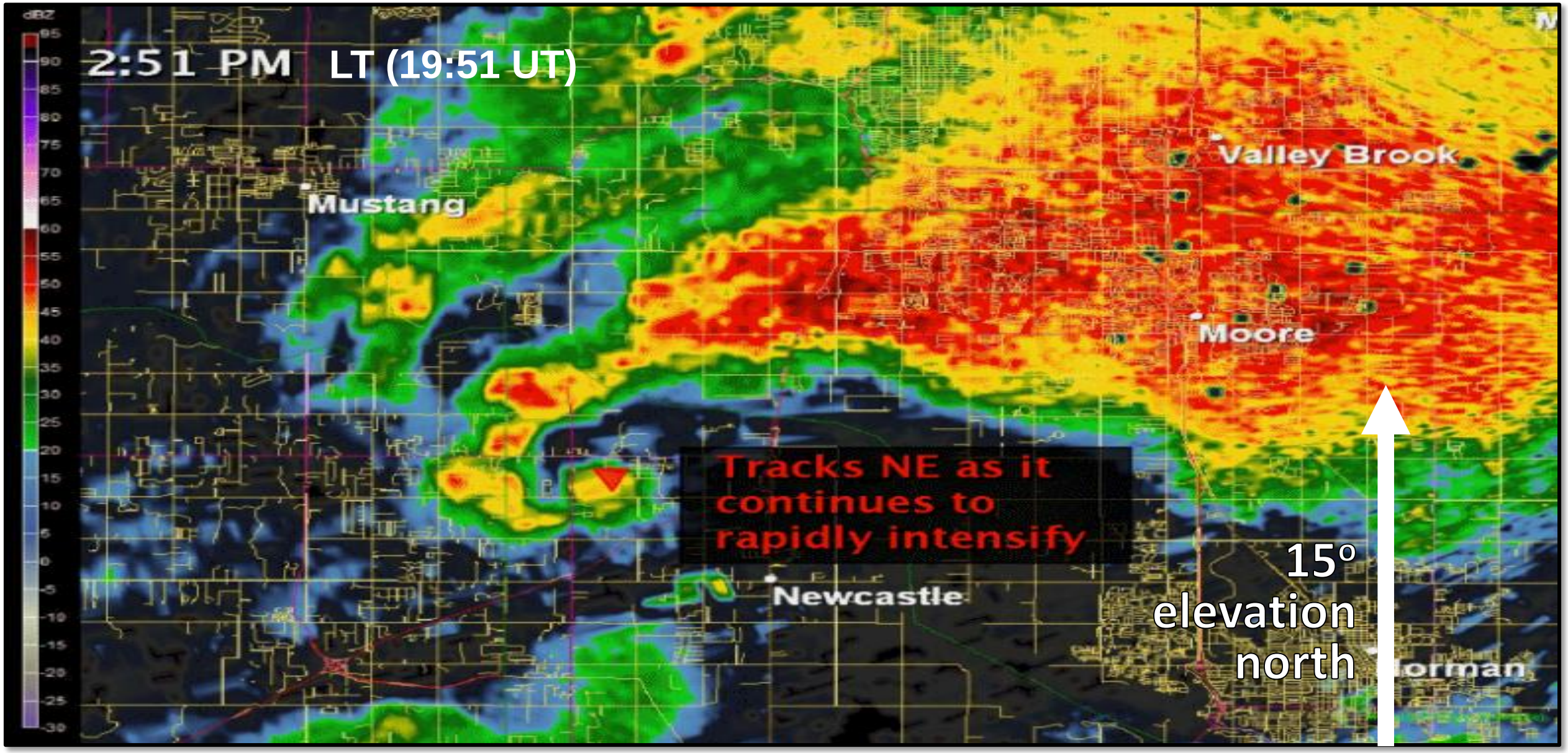


Stability index (CAPE and CIN) time series including tornado vortex traverse (black line)

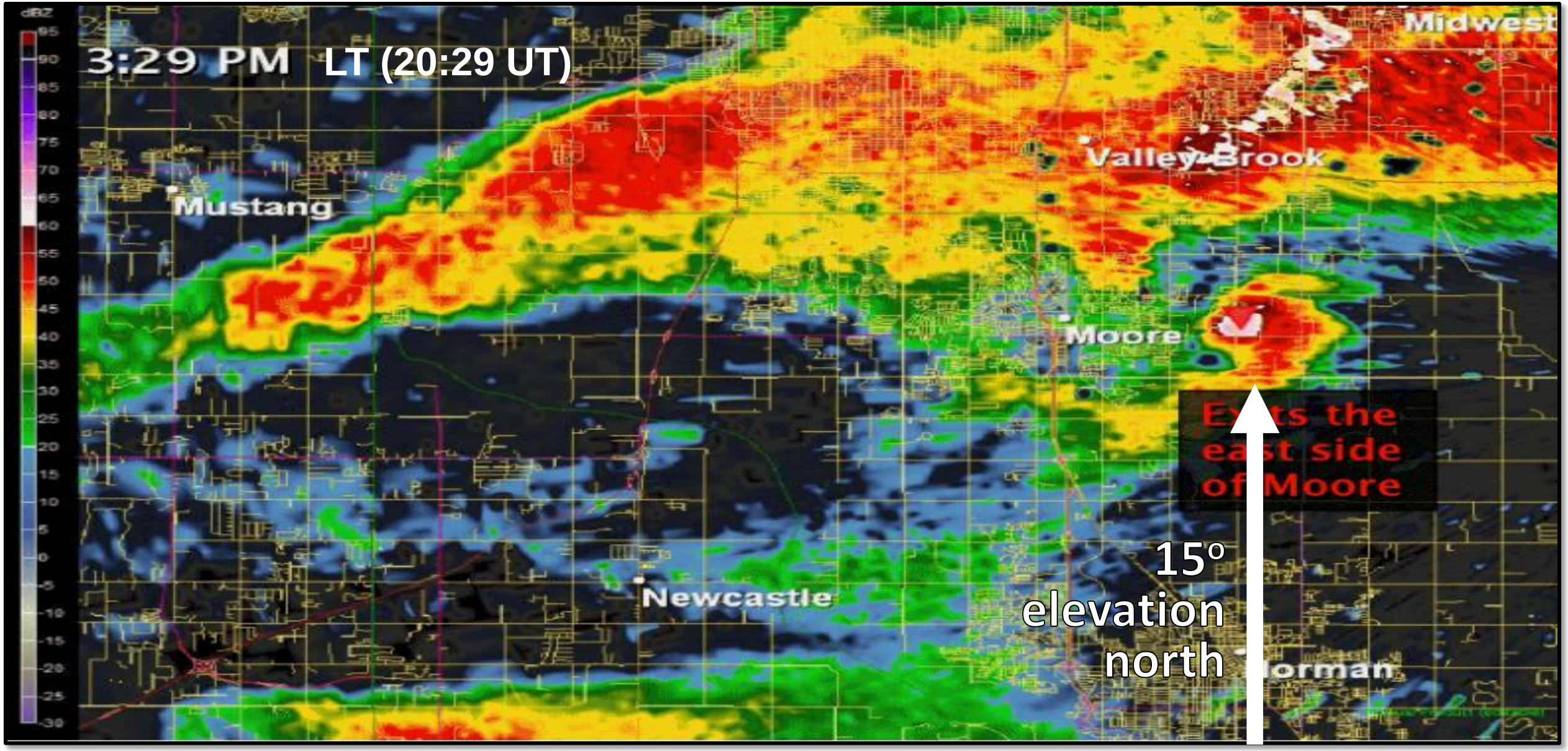




Radiosonde (left) and radiometer (right) three hours before tornado touchdown



Reflectivity at Tornado touchdown (2:51 pm) and radiometer field of view (arrow)



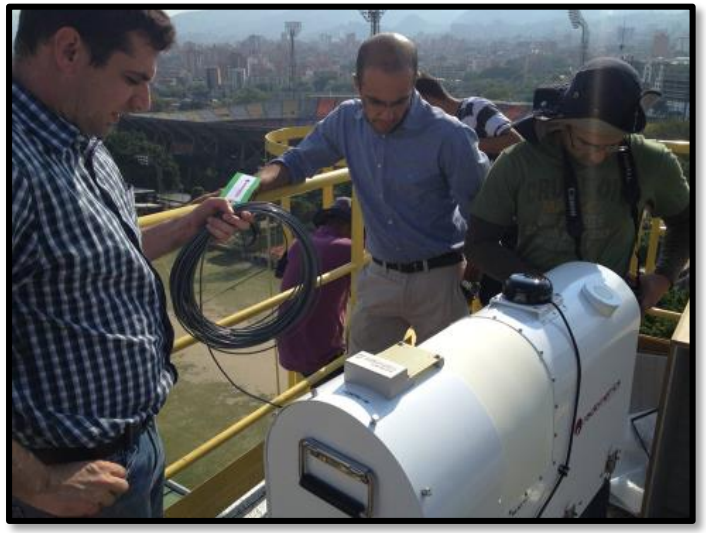
Moore Tornado traversing the radiometer 15° elevation north field-of-view (3:29 pm)

Devastated Moore subdivision









Thermodynamic and wind profiling
for typhoon studies, wind energy, aviation weather, air quality and disaster mitigation