

# Launch Weather Decision Support System

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# Launch Weather Decision Support System (LWDSS)

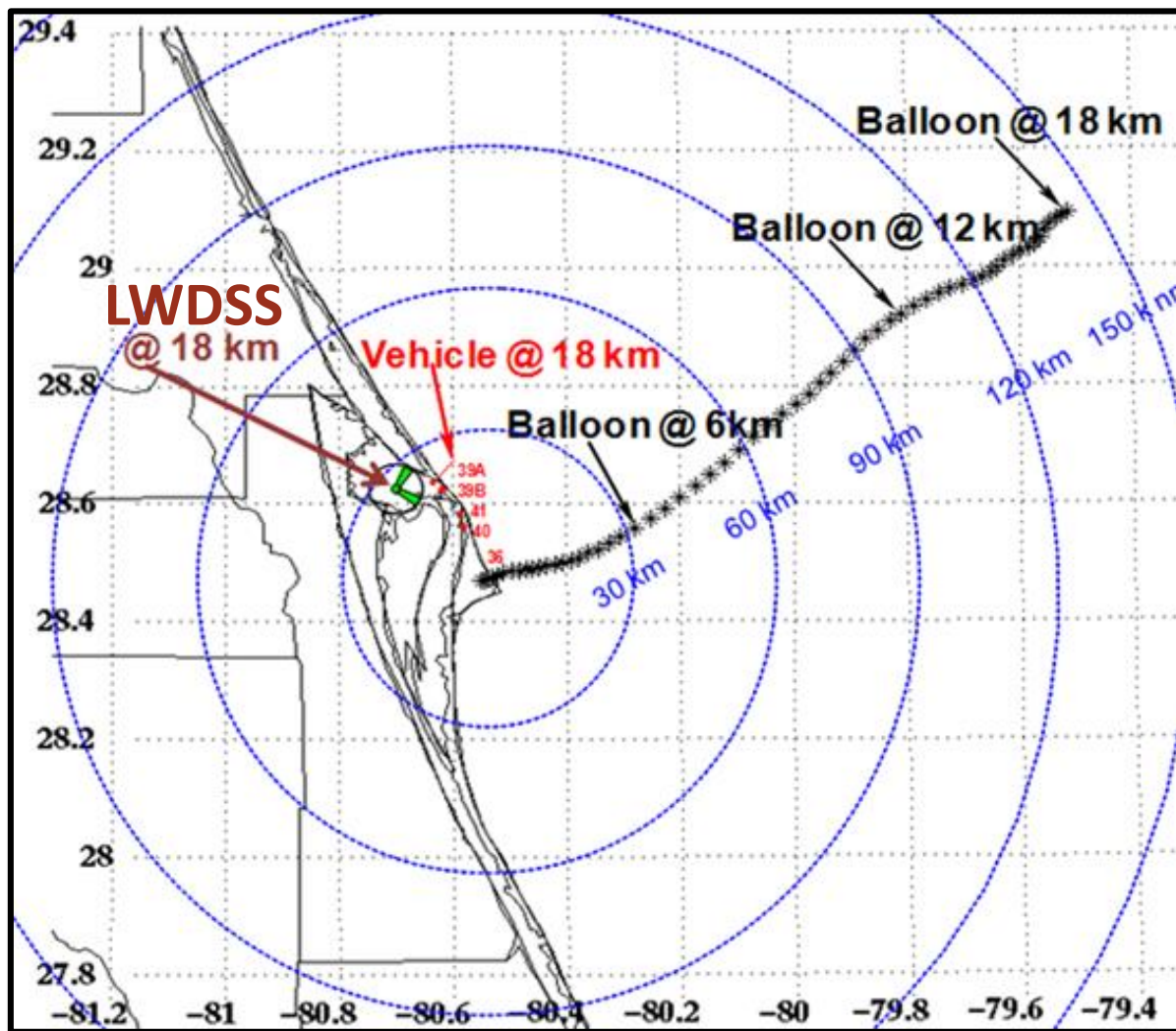
- Delivers continuous high-accuracy vector wind ( $\sim 1 \text{ ms}^{-1}$ ), temperature ( $< 2 \text{ }^{\circ}\text{C}$ ), humidity ( $< 2 \text{ gm}^{-3}$ ) and pressure ( $< 0.9 \text{ hpa}$ ) soundings (rms) up to 20-km height.
- Also provides liquid water path, cloud base temperature and cloud base height.
- Beta operations starting in 2019 at the Cape Canaveral Launch Complex under NASA contract.

# Maximum Dynamic Stress on a Launch Vehicle (Max Q)

- Determined by wind vectors and air density at 10 to 18-km height.
- Wind vector profiles up to 20-km height are provided by a ***Stratospheric Radar Wind Profiler***.
- Microwave air density profiling to 20-km height demonstrated at Cape Canaveral in 2018. Beta operations are planned to start in April 2019.

# One-Dimensional Variational Analysis (1DVAR)

- Thermodynamic soundings from model forecast combined with microwave profiler data (MP-1DVAR).
- A ***SkyCast***<sup>®</sup> Wind and Thermodynamic Profiler combines MP and Radar Wind Profiler (RWP) soundings.



## Winds and Thermodynamics

- **Balloons:** variable sampling interval and up to 100-km away from the launch path at Max Q height.
- **LWDSS:** continuous observations close to the launch path for *improved launch safety and efficiency.*

LWDSS provides high-accuracy thermodynamic and wind profiles close to the vehicle launch path.

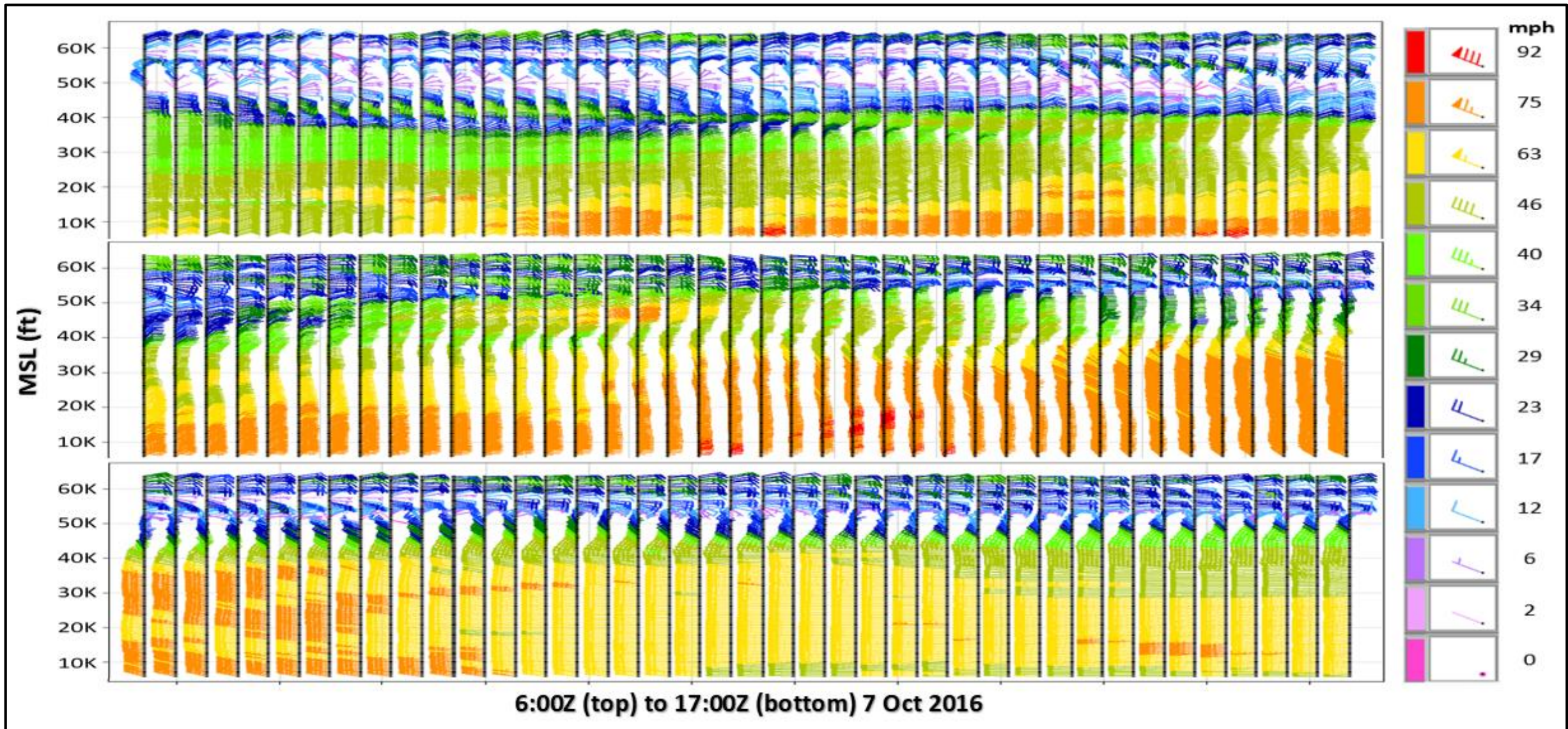




NASA *Stratospheric Wind Profiler* observes winds up to 20-km height at the Eastern Test Range.

1/10/2019





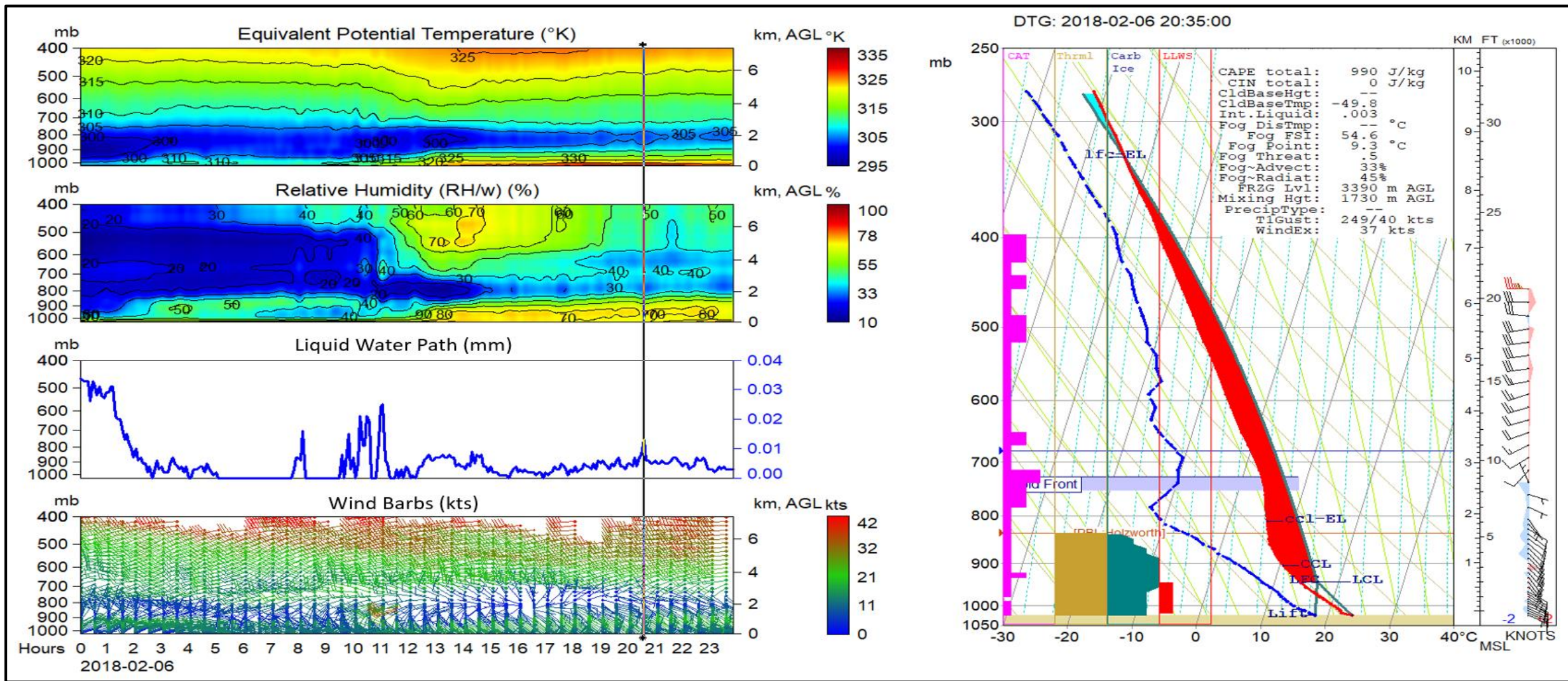
**Stratospheric Wind Profiler** observations at Cape Canaveral during hurricane passage.





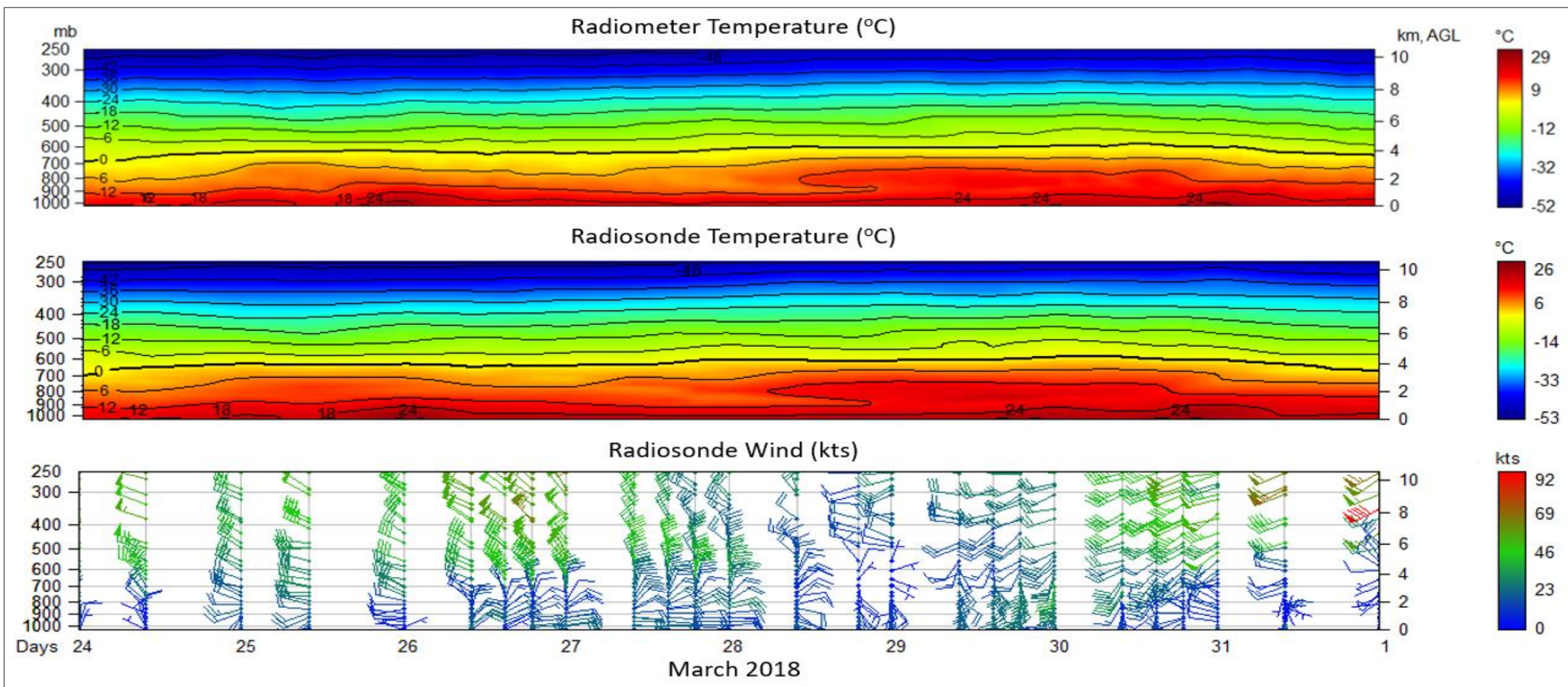
**SkyCast<sup>®</sup>** wind (left) and thermodynamic (right) profilers at the Eastern Test Range (ETR).





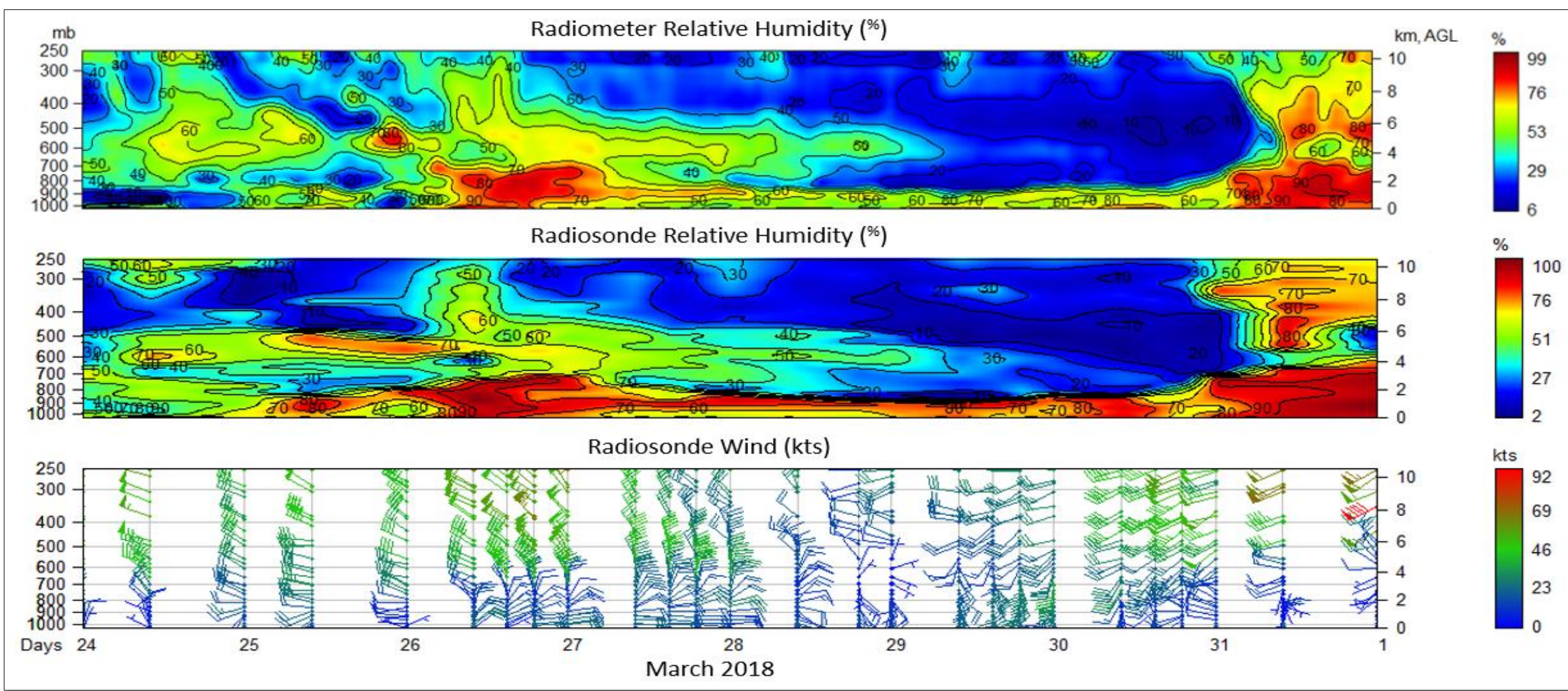
Falcon Rocket launch time (vertical black line) and **SkyCast**<sup>®</sup> temperature, humidity and wind profiles and liquid water path time series at the ETR. Moist frontal passage is evident at mid-day.



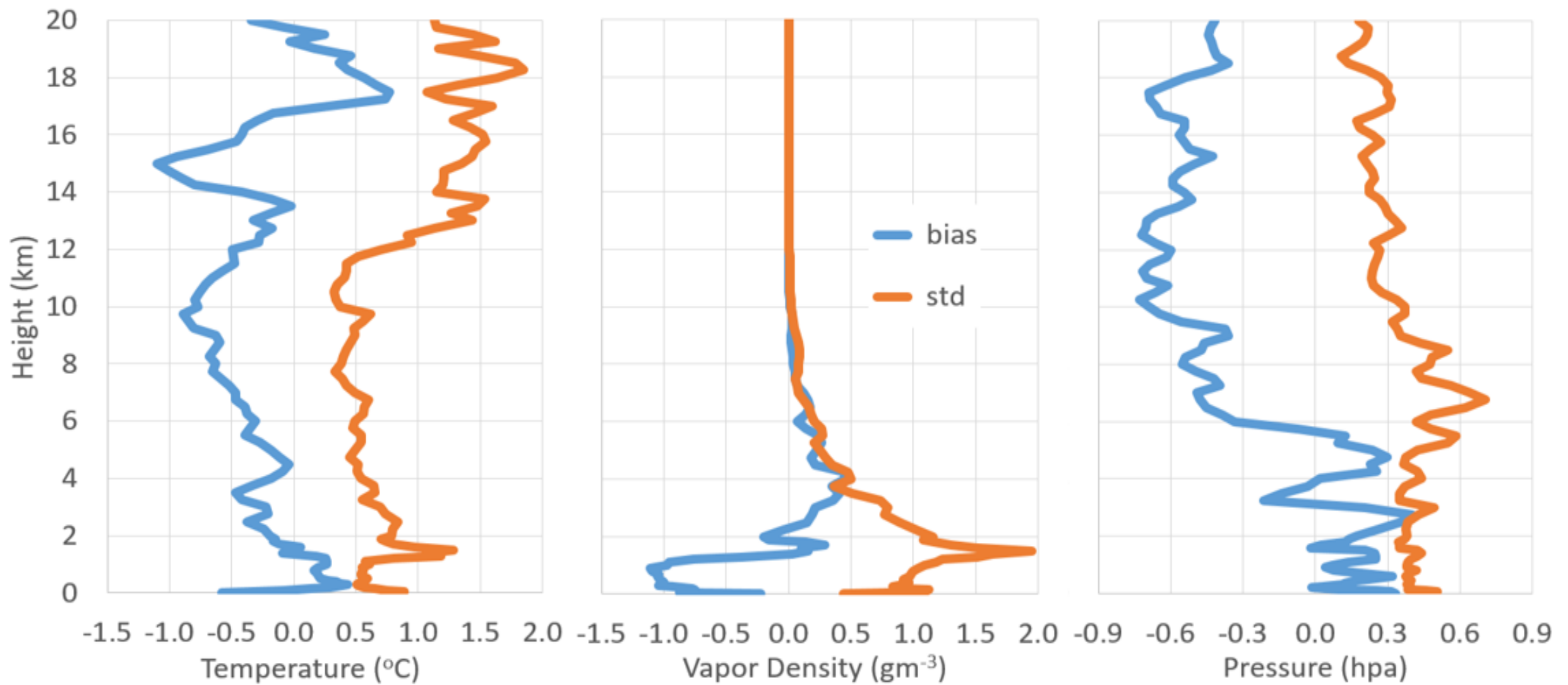


Good agreement is seen, considering aliasing, between 8-day MP-1DVAR (top) and radiosonde (middle, 26 soundings) temperature profiles; radiosonde winds and launch times (bottom).



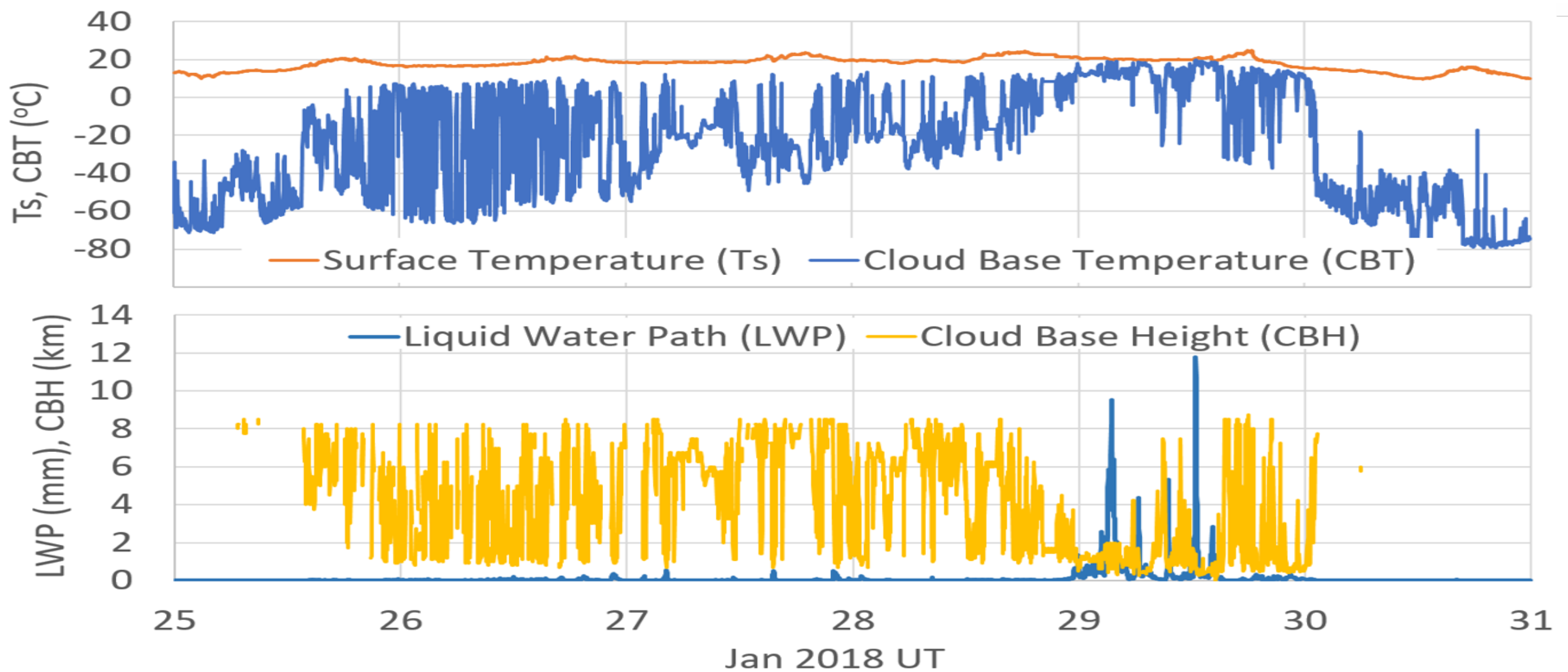


Good agreement is seen, considering aliasing, between 8-day MP-1DVAR (top) and radiosonde (middle, 26 soundings) humidity profiles; radiosonde winds and launch times (bottom).



Radiosonde minus MP-1DVAR profile statistics at ETR 25-31 Mar 2018.



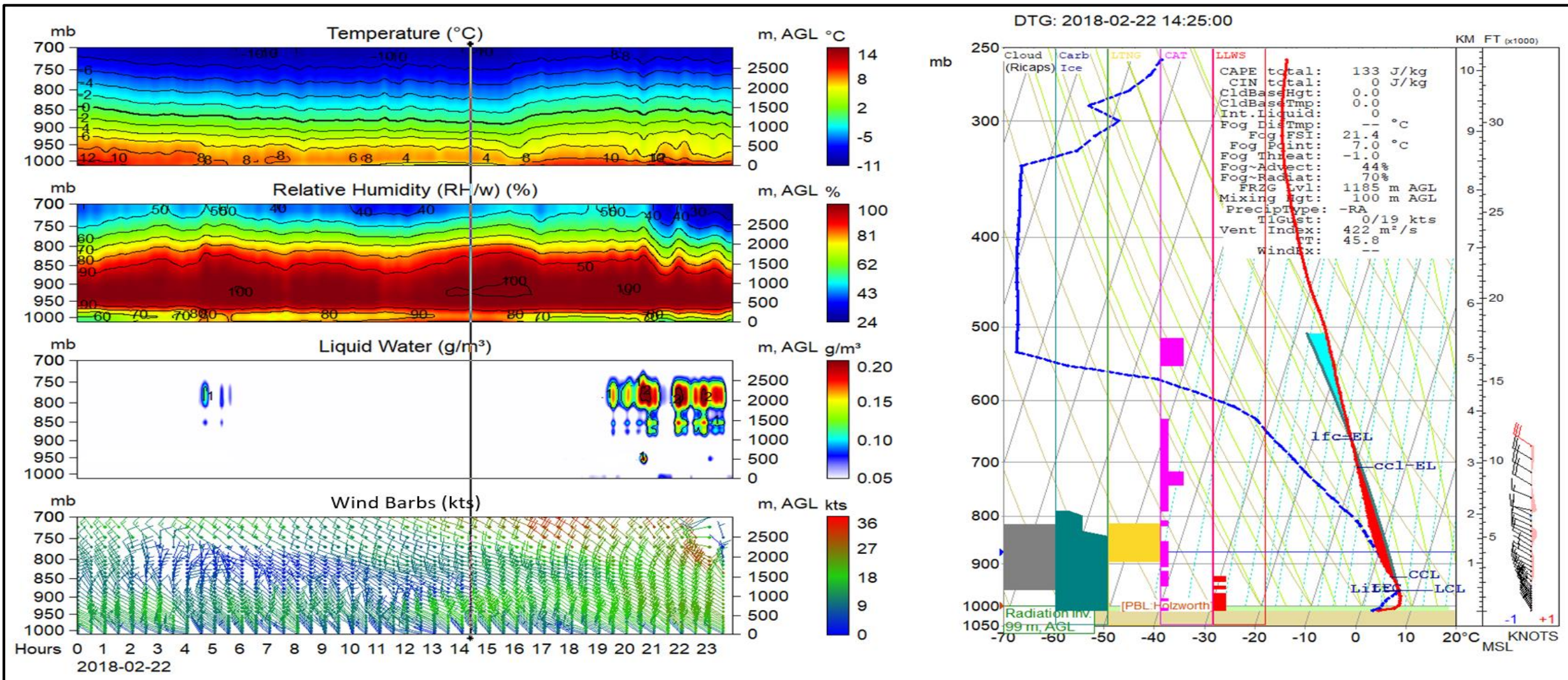


MP cloud base temperature, liquid water path and cloud base height at ETR  
-- valuable Launch Commit Criteria parameters.



**SkyCast®** wind (right) and thermodynamic (left) profiler at the Western Test Range (WTR).





Falcon Rocket launch time (vertical black line) and **SkyCast**® profiles at the WTR. Launch risk increased later in the day due to higher winds and the presence of cloud liquid.



# Aviation Weather Advisories

The National Weather Service uses MP-1DVAR observations to *fill the gap* between 12-hr radiosonde soundings and improve Aviation Weather Advisories to Federal Aviation Administration Air Traffic Control.



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
National Weather Service Forecast Office, WS1  
Boulder, Colorado 80305  
Tuesday, January 23, 2018

Memorandum For:

NOAA Grant Evaluation Committee

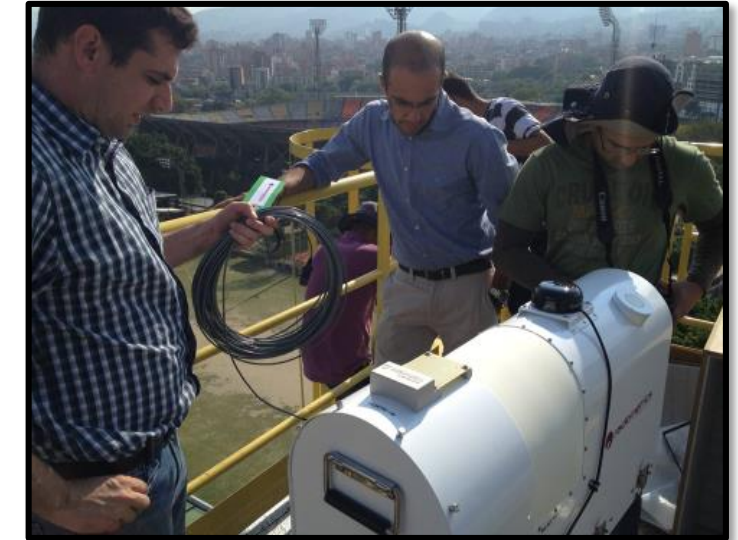
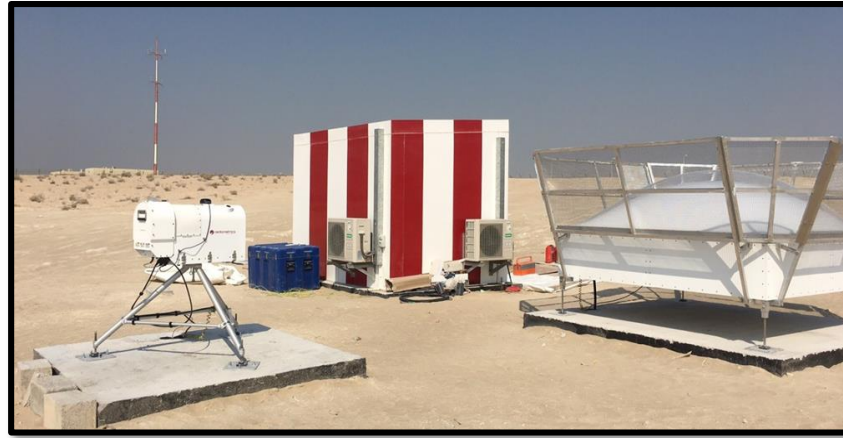
From:

Nezette Rydell, Meteorologist in Charge  
National Weather Service Forecast Office, Boulder, CO

A handwritten signature in blue ink, appearing to read "Nezette Rydell", is written over the typed name and title.

National Weather Service Denver Center Weather Service Unit (CWSU) and Weather Forecast Office Boulder, CO (WFO) meteorologists have used continuous thermodynamic sounding information when it has been available via <http://weatherview.radiometrics.com> to improve aviation advisories and forecasts to the FAA over the last several years. This information has been helpful in forecasting near-term weather for Denver International Airport (DIA) and surrounding areas, particularly in regard to convection, inversions, and with freezing drizzle, snow, and icing.





***LWDSS and SkyCast®*** wind and thermodynamic surveillance for safe and efficient airport, launch facility and drone operations.