

Specialized Vertical Profiles of Winter Storms to Aid Physical Interpretation

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Motivation

The skew-T/log-P thermodynamic diagram is a common format for viewing atmospheric soundings, and numerous parameters can be graphically determined from it. Many of the indices and methods taught alongside skew-T diagrams are focused on summer surface-based convection. A specialized display is desired to interpret different aspects of winter storms, highlighting regions of ice growth, ice maintenance, and instability.

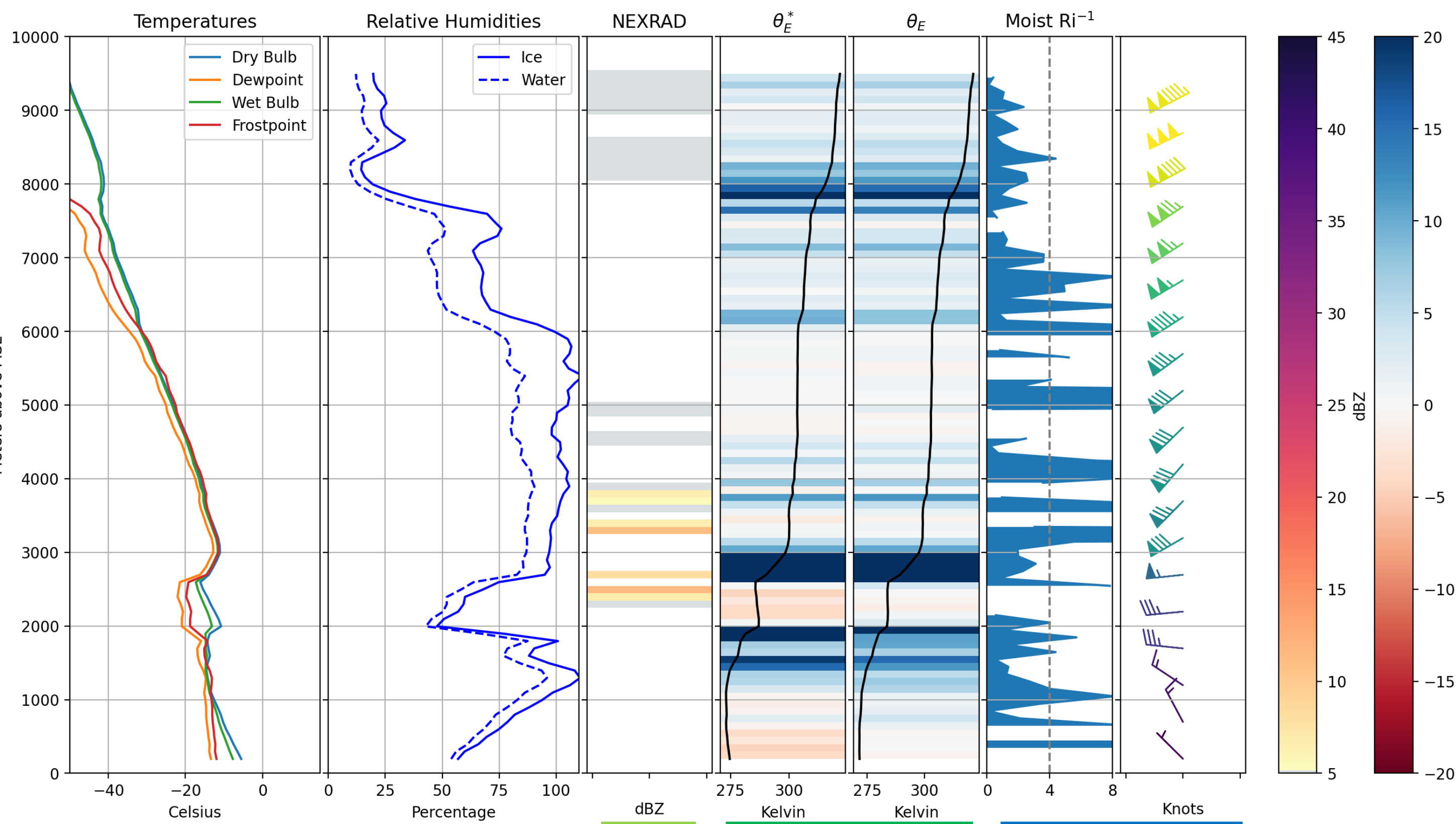
Methods

The vertical axis is plotted by altitude above MSL instead of pressure to allow easy comparison with radar data.

Wet-bulb and frost-point are plotted with the air and dewpoint temperatures to show the potential for evaporative cooling and ice formation.

Relative humidity with respect to ice and water are shown to identify layers of ice cloud and preferential ice mass growth.

Albany Sounding
2022-02-13 1103 UTC

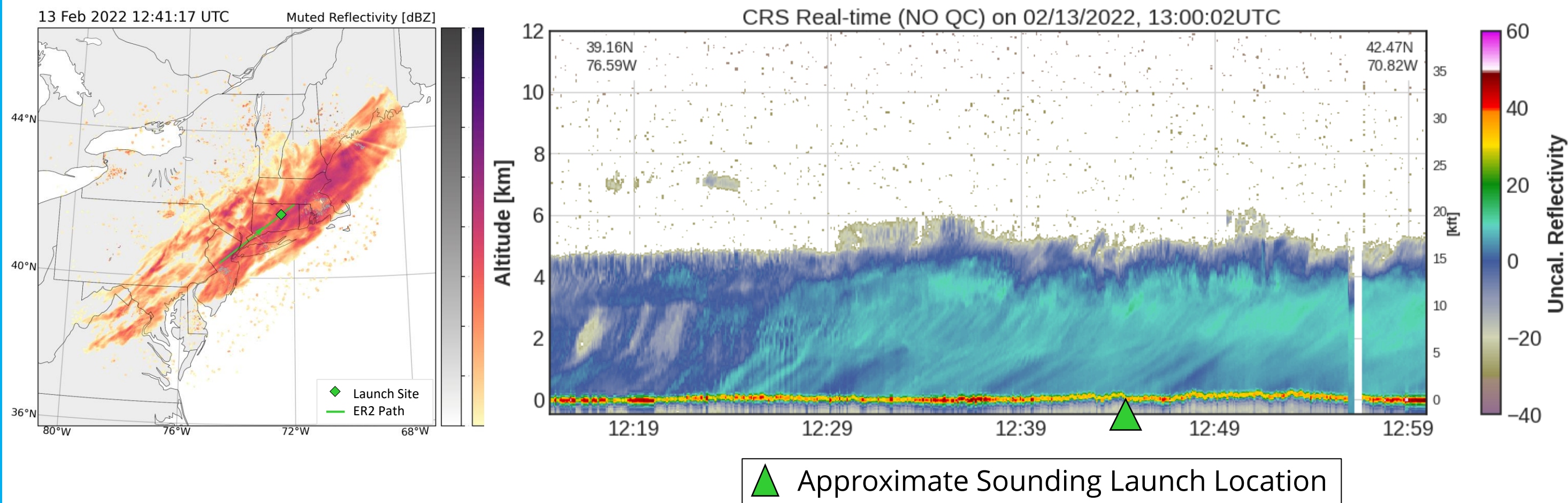
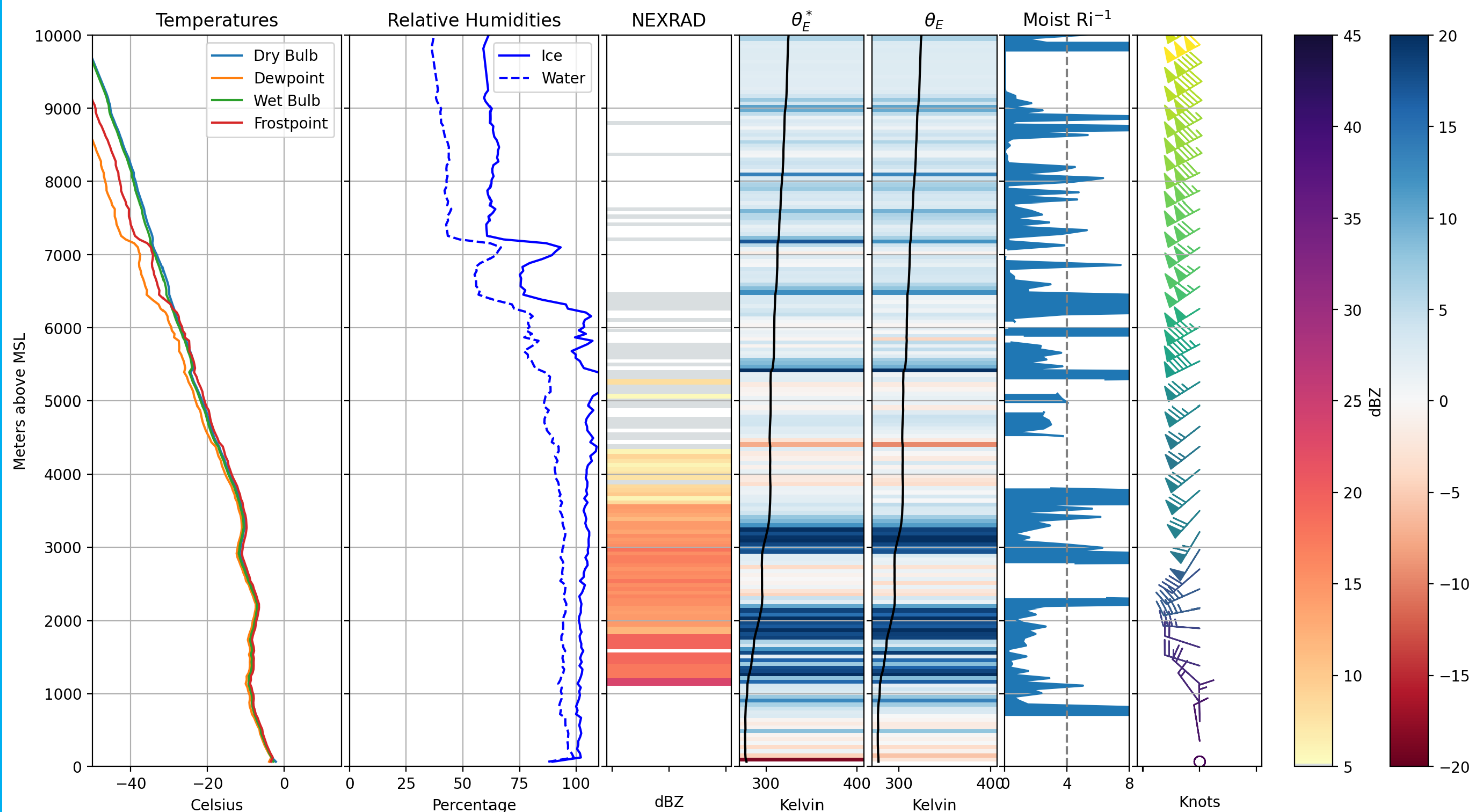


The saturation equivalent potential temperature and equivalent potential temperature profiles show layers of conditional and potential instability, respectively. Unstable layers are red.

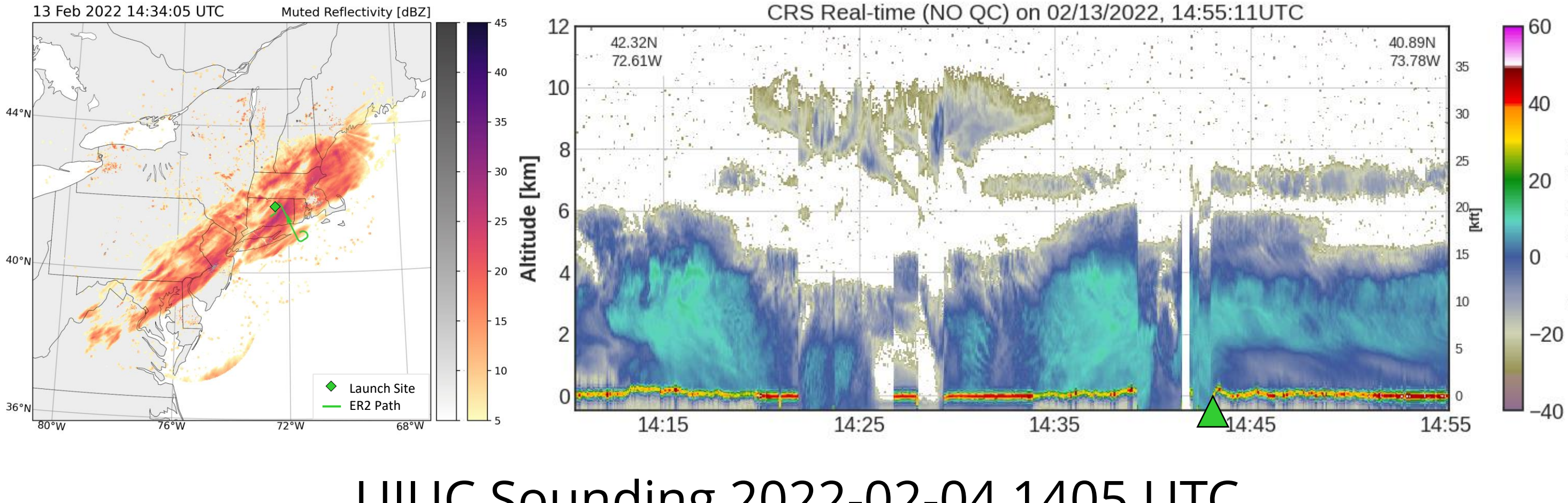
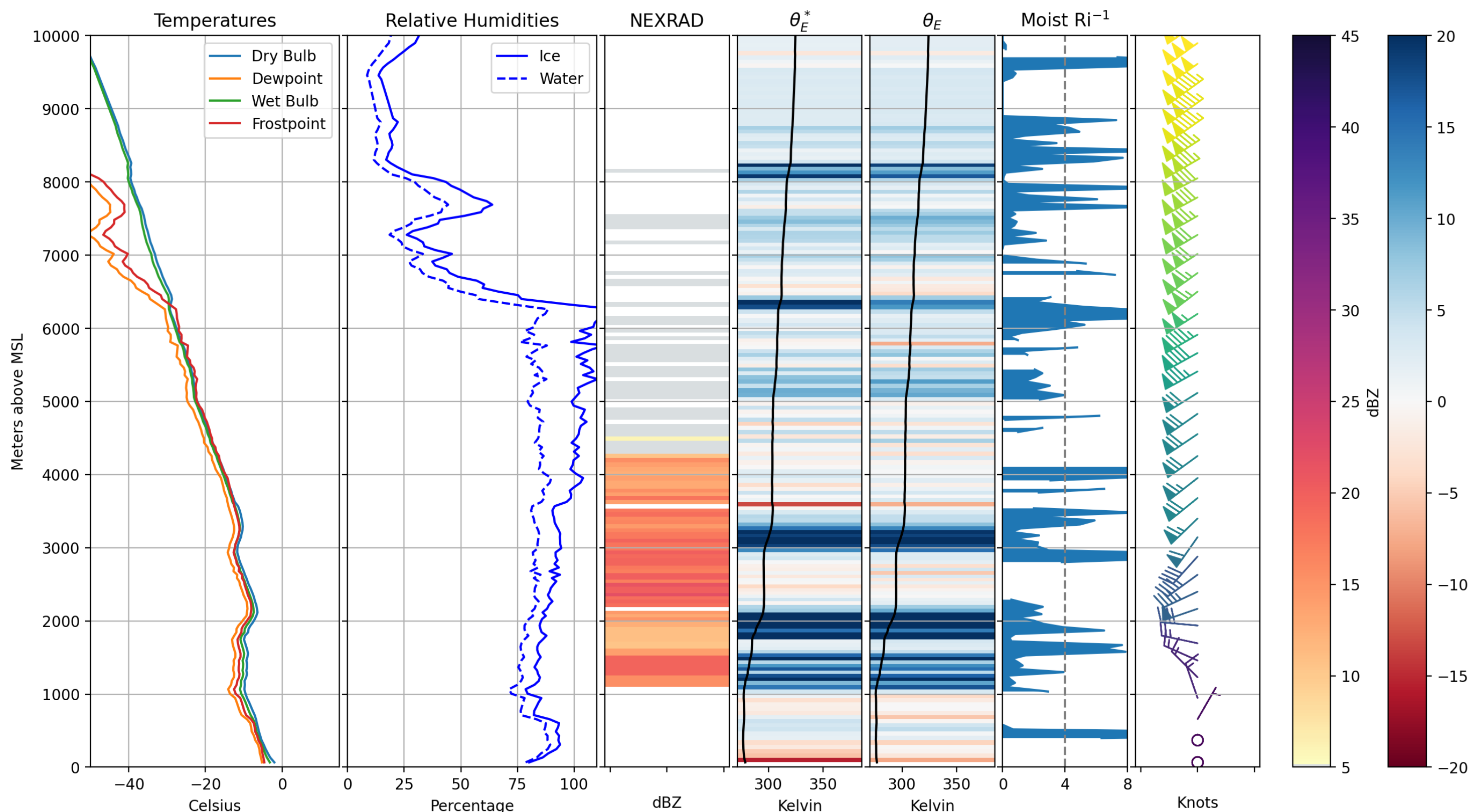
The moist Richardson number (mRi) and wind profile represent the shear instability. The inverse mRi is plotted so unstable layers are easily identified when $mRi > 4$.

Applications

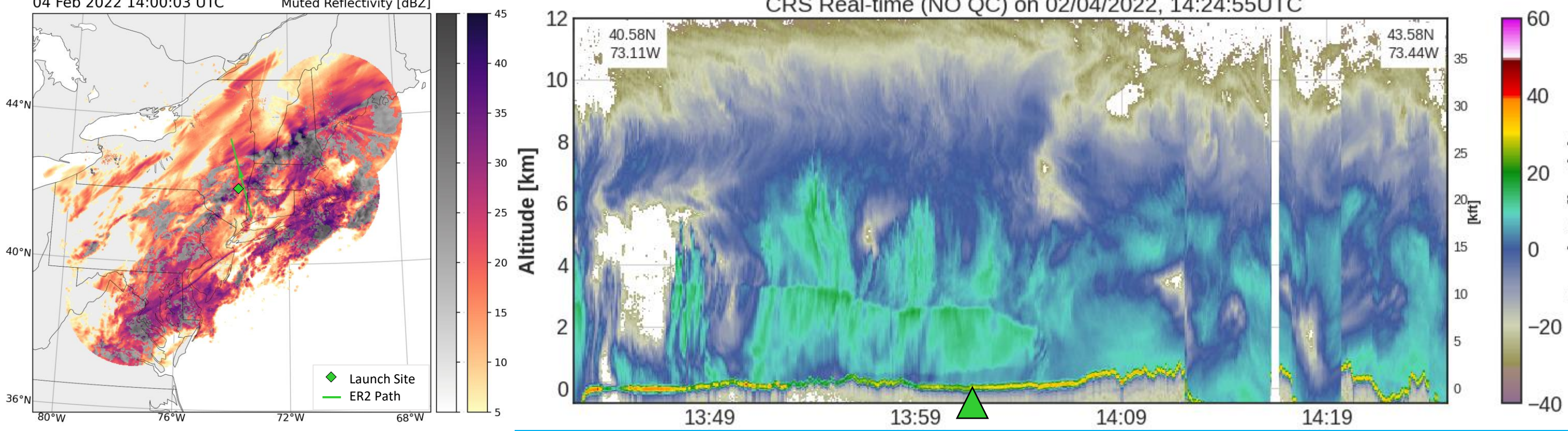
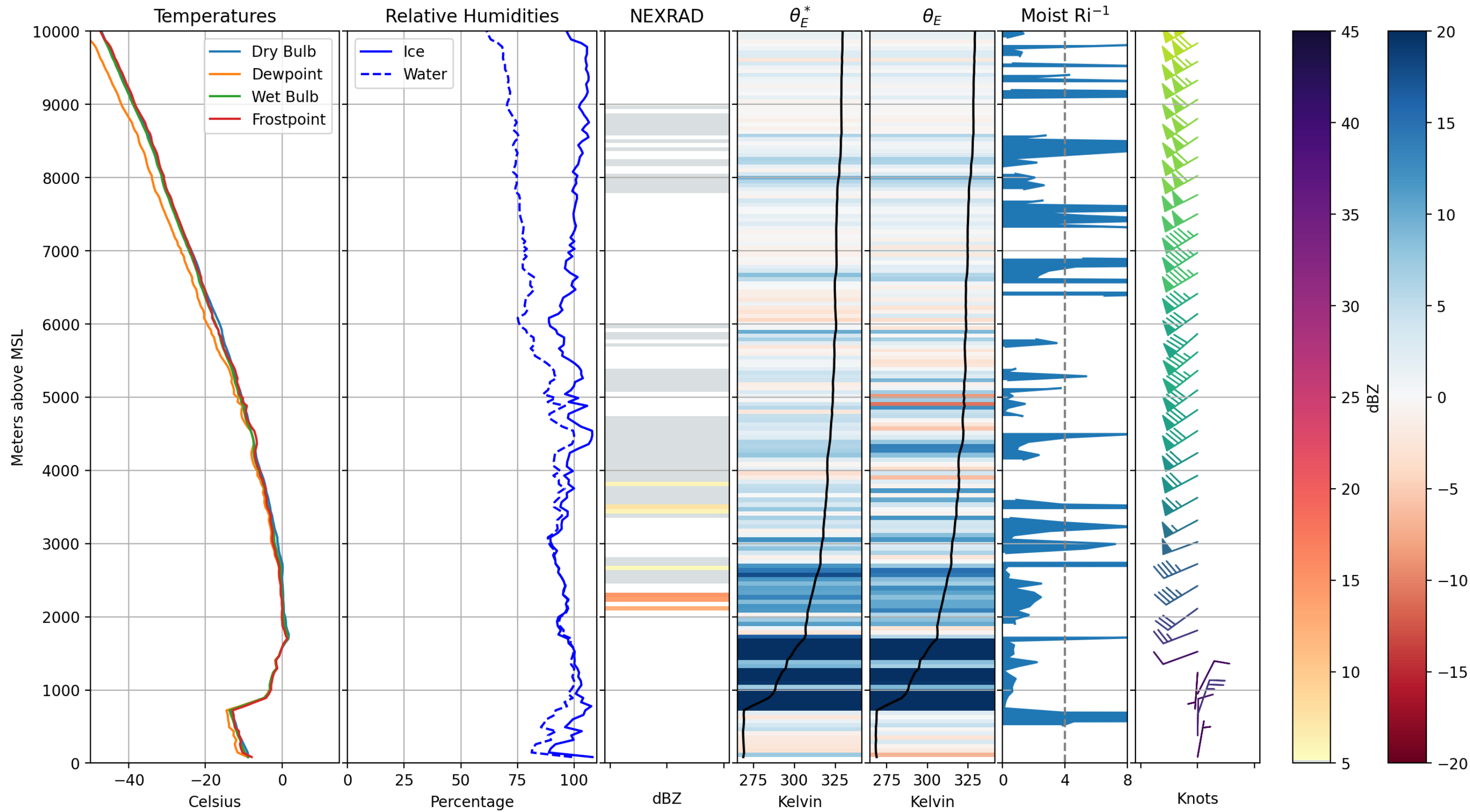
UIUC Sounding 2022-02-13 1245 UTC



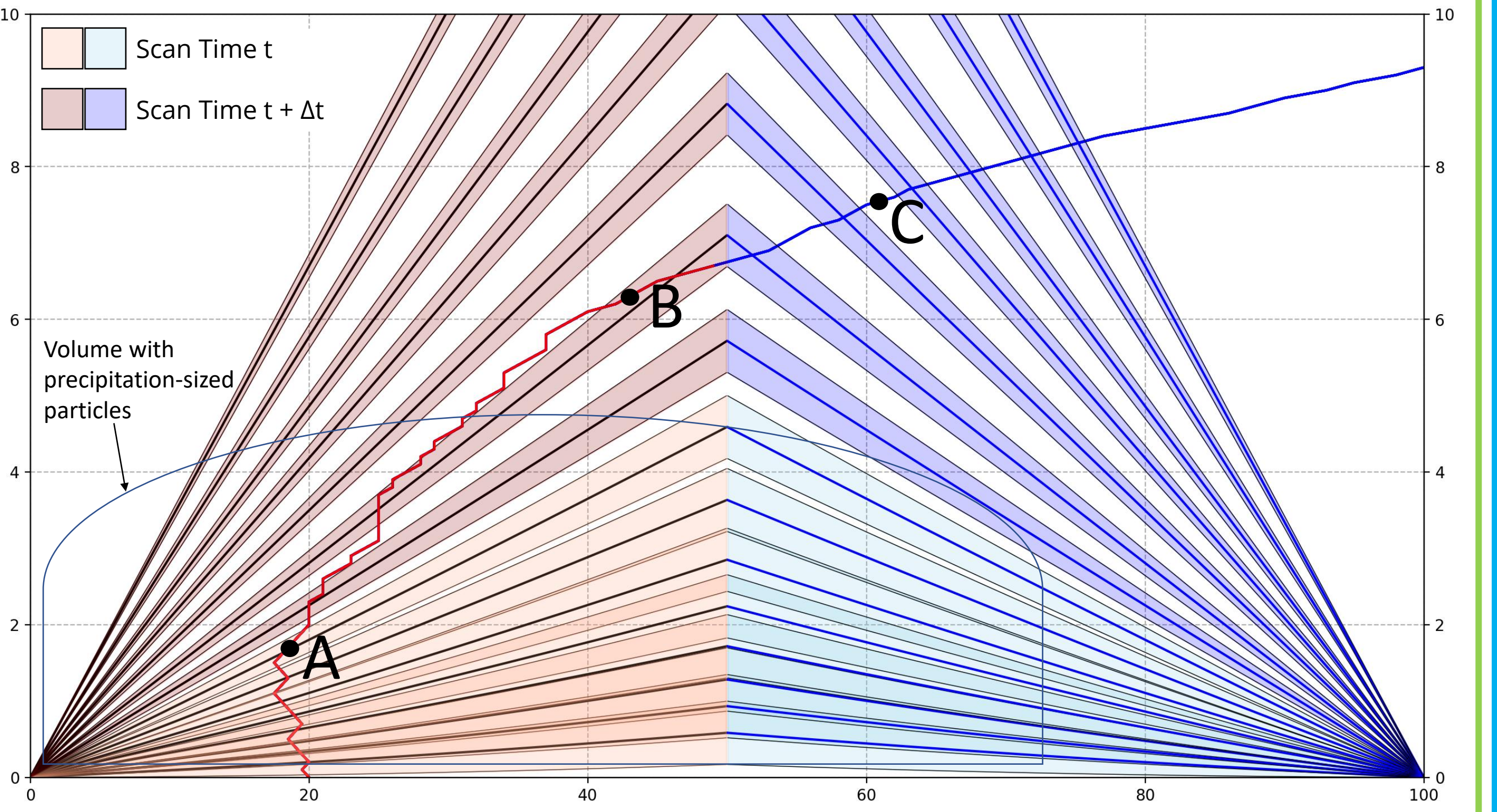
UIUC Sounding 2022-02-13 1410 UTC



UIUC Sounding 2022-02-04 1405 UTC



NEXRAD Reflectivity Schematic



The reflectivity values are determined from the sonde's path through the closest radar VCP in both time and space. When the sonde is inside the beamwidth of an elevation scan, the echo from the nearest gate is plotted (point A). If there is no echo (point B), the level is plotted in gray. If the sonde is outside of the beamwidth (point C), no data is plotted. The nearest NEXRAD site and scan time updates throughout the flight.

Data Sources:

- McMurdie, L.A., Heymsfield, G., Yorks, J.E., and Braun, S.A. 2019. Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) Collection. Data available online [<http://ghrc.nsstc.nasa.gov/>] from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/IMPACTS/DATA101>
- NEXRAD on AWS from <https://registry.opendata.aws/noaa-nexrad>
- Global BUFR Data Stream: Upper Air Reports from the National Weather Service Telecommunications Gateway (NWS TG). (n.d.). Retrieved July 18, 2022, from <https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ncdc:C01500>