

Lake Enhanced Thunderstorm Observational Study (LETOS)

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Motivation

- Investigate how the Great Lakes are able to modify thunderstorms in the warm season
- The temperature of the Great Lakes changes slower than the surrounding land
- The stability of the atmosphere is affected by vertical temperature contrasts
- Thunderstorms prefer to propagate in unstable conditions

Methodology (cont.)

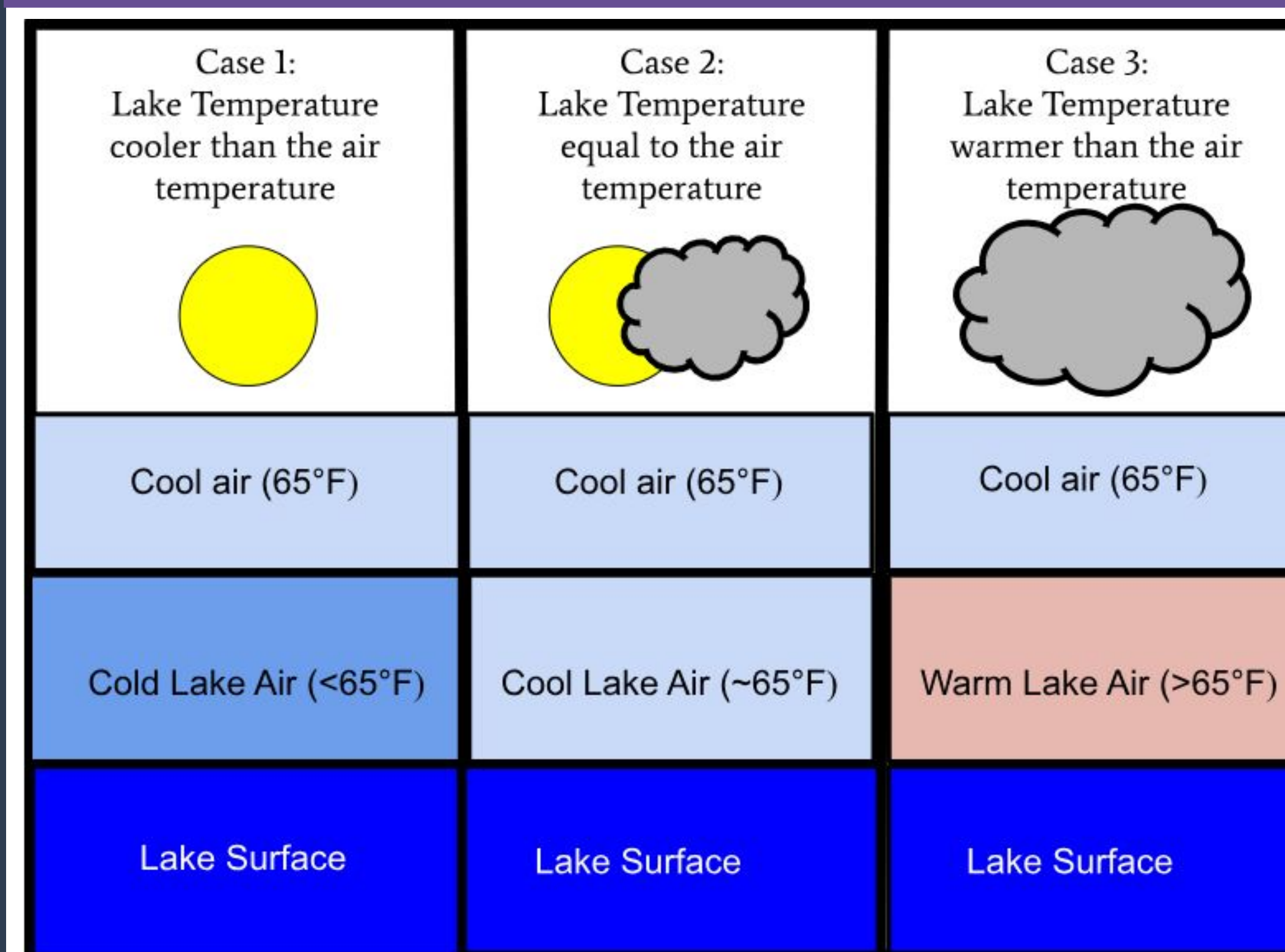


Figure 1: Temperature profiles of the atmosphere at different times of summer.

Results (cont.)

- Only weak winds reported at Buffalo, though from the same system
- Lake temperature is 2°C cooler than the surrounding land at 18Z
- Case 2 depicts the formation of an EF2 tornado (Fig. 3) and associated storm during late summer, when the atmosphere is unstable
 - Stationary front over WNY
 - 12Z Buffalo sounding shows moderate helicity & speed shear (Fig. 4)
 - High helicity values ($>150 \text{ m}^2 \text{ s}^{-2}$) advect into WNY at 16Z
 - Lake sfc temp is less than ground temp at 12Z, but this reverses by 18Z

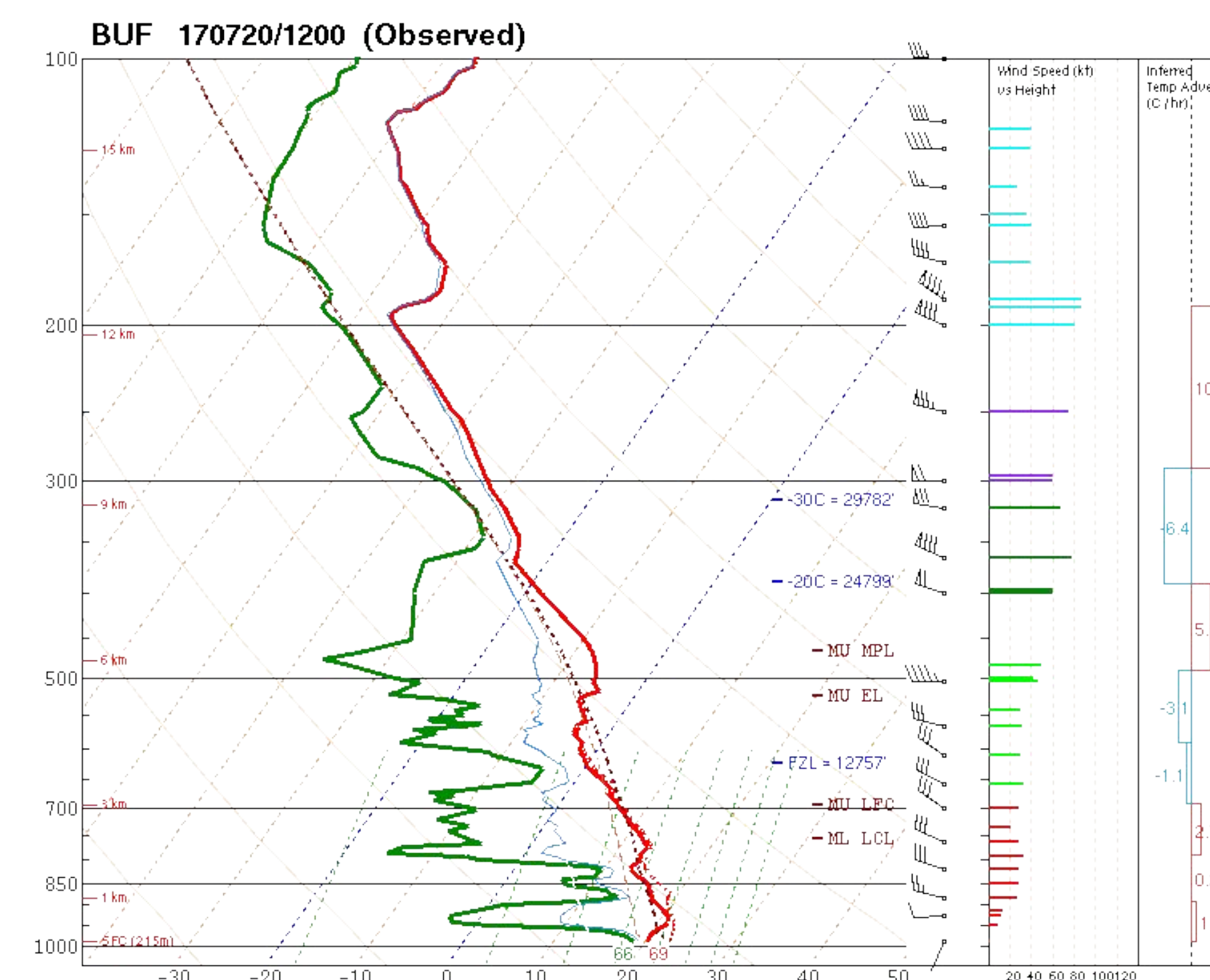


Fig. 4: KBUF 12Z sounding for Case 2 depicting a relatively stable atmosphere with moderate helicity and wind shear values, with both contributing to rotation.

Results (cont.)

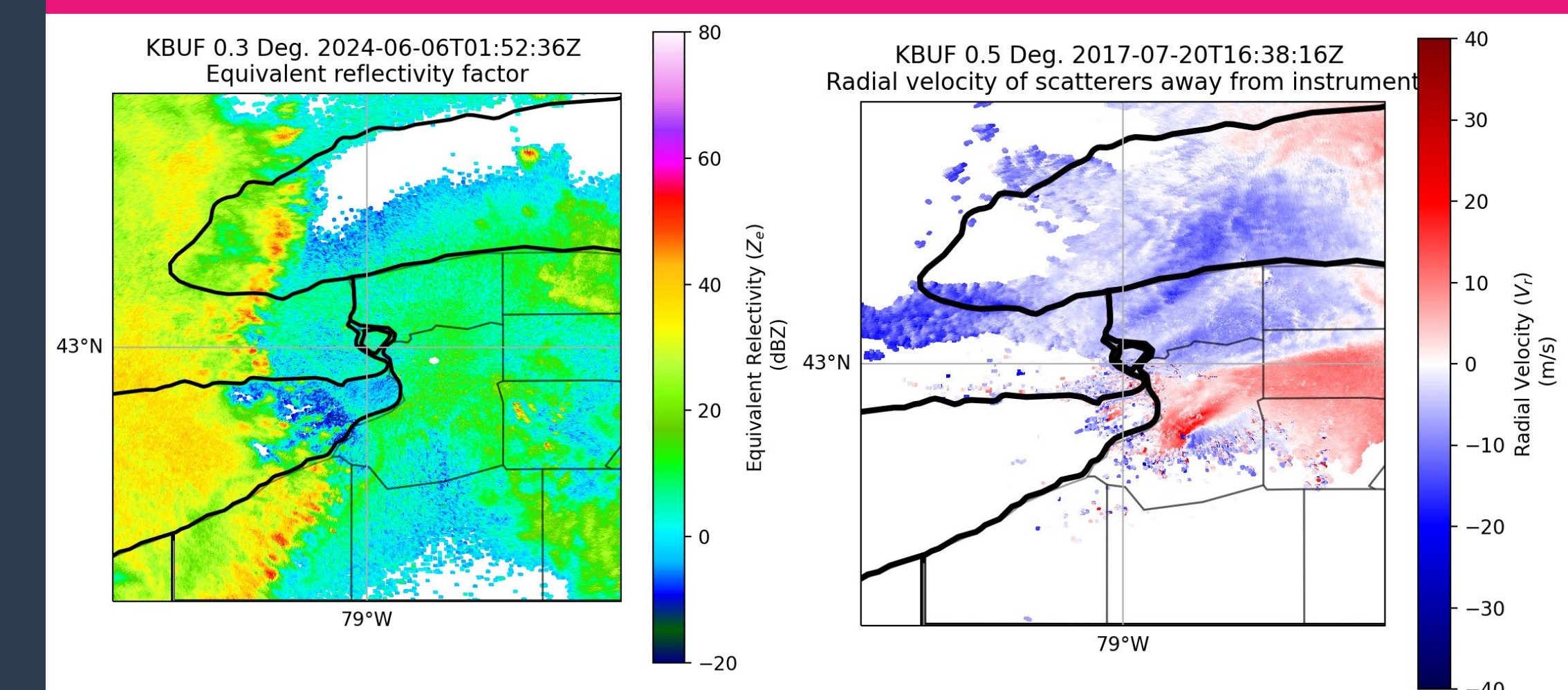


Fig 2: NEXRAD reflectivity for Case 1 at 0152 Z on 6/5/2024, revealing the weakened squall line and gust front approaching Buffalo

Fig 3: NEXRAD radial velocity for Case 2 at 1638 Z on 7/20/2017 revealing the location of the tornado, southeast of Buffalo

Methodology

- Two cases of severe weather around Lake Erie were selected to be analyzed
 - June 5-6, 2024 (Case 1) and July 20, 2017 (Case 2)
 - The temperatures of the lake and air were recorded and compared
 - PyART was used to visualize NEXRAD radar, velocity, and correlation data.
 - Satellite, soundings, and maps were also utilized for comparison.

Results

- Case 1 depicts the degradation of a squall line as it travels across Lake Erie during early summer.
 - Warm front draped across Western New York (WNY)
 - Cold front approaching Detroit
 - CAPE values under 200 J/kg over Lake Erie, but CAPE values greater than 1000 J/kg over the surrounding land
 - Remnant gust front moves ahead of weakened squall line near Buffalo (Fig. 2)
 - Radar indicated strong straight-line winds surrounding Detroit

Future Works

- Run high-resolution Weather Research and Forecasting Model simulations
- Conduct sensitivity simulations over lake surface temperature

Acknowledgements

- Oswego Student SCA Grant
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- NWS upper-air soundings
- NOAA GLERL
- PyART from DOE