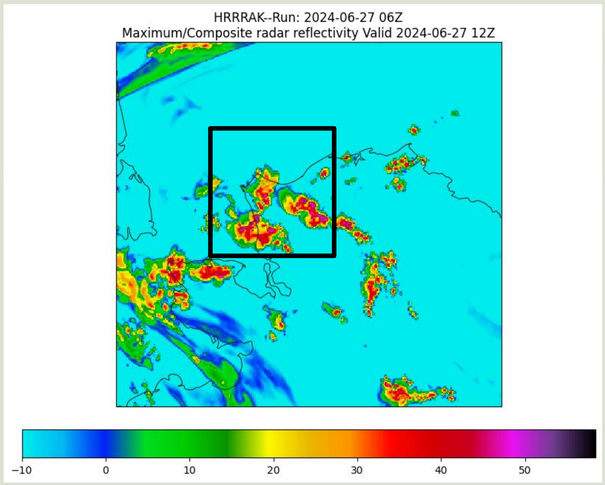
Environmental Analysis of the Farthest Northwest Severe Thunderstorm Warning Ever Issued

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Abstract

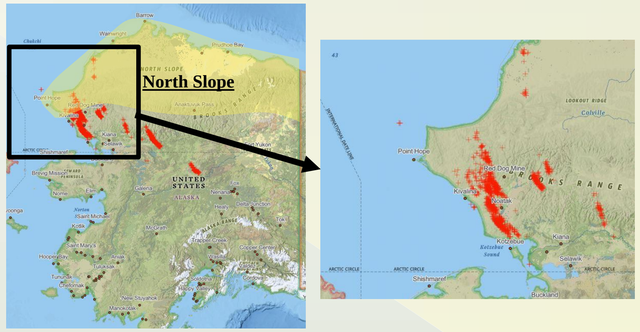
On 27 June, 2024, the Weather Forecast Office in Fairbanks issued the National Weather Services' farthest northwest Severe Thunderstorm Warning to date (Fig. 6). The warning was issued at 67.6°N, 163.0°W where no radar coverage exists, surface observations are sparse, and substantial satellite parallax complicates convective warning decision making. This work presents model data leading up to the event, synoptic and mesoscale parameters during the event, and available observational data. Preliminary analysis found two periods of intense lightning activity (>400 strokes per hour) punctuated by passage across a cold body of water – Selawik Lake – when lightning activity paused. Infrared cloud top temperatures of overshooting tops cooled to as low as -52.69°C on the Suomi-NPP satellite (Bachmeier 2024) coinciding with periods of intense lightning activity. Severe wind gusts and hail stones were not reported, but webcam imagery in Noatak showed a well-defined shelf cloud and the closest automated observation site in Kotzebue (~56 km away) recorded a 34-knot wind gust. Collective results indicate an unusual convective environment that may highlight severe thunderstorms as an emerging forecasting challenge within a rapidly warming Arctic climate.



(Fig. 1) Re-analysis HRRR Reflectivity, 4 AM AKDT Courtesy of David Levin, Physical Scientist (ESSD).

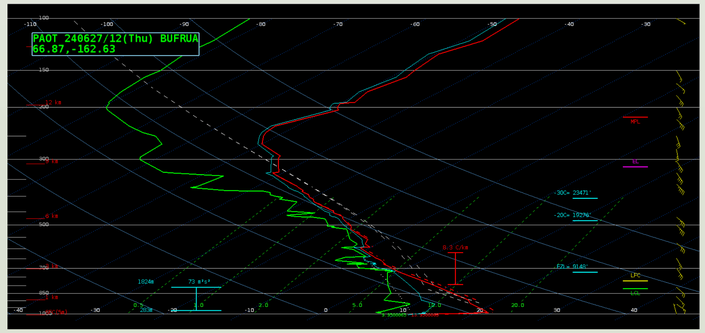
What Prompted the Warning?

Several hundred lightning strokes per hour were observed which is uncommon in Northwest Alaska.



(Fig. 2) Lightning Data was provided by Vaisala and plotted by David Levin – Physical Scientist, Environmental Science & Services Division (ESSD), Anchorage, Alaska.

Kotzebue 12Z Radiosonde Launch



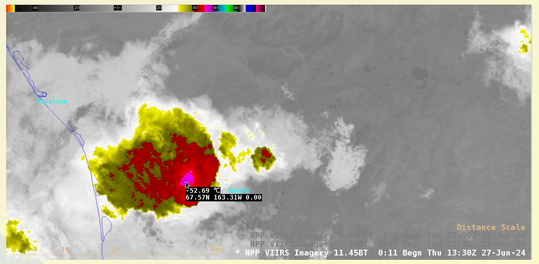
(Fig. 3) Observed radiosonde data from 27 June, 2024 at 12Z (4 AM AKDT) in Kotzebue, AK.



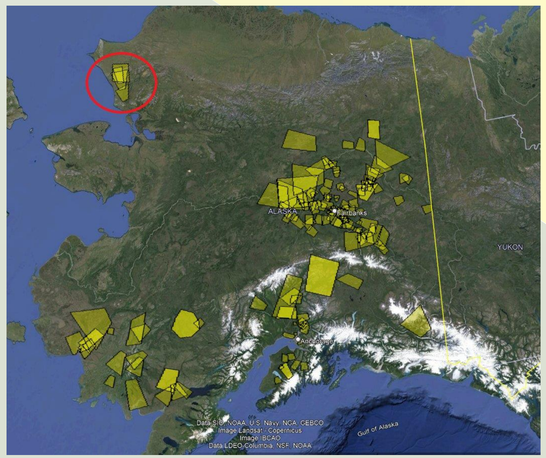
(Fig. 4) Panoramic Image of the storm from: Sam Mills. Noatak, AK Resident.

Materials and Methods

Of the tools utilized during the warning process, satellite and GLD Lightning Data were most important. An unusual amount of lightning (>400 strokes per hour) was observed (Fig. 2). Satellite also showed cloud top heights greater than 25,000 feet which was near the most unstable air parcel equilibrium (Fig. 7). Cloud top heights coupled with observed soundings (fig. 3) and model data supported MUCAPE (Most Unstable Convective Available Potential Energy) within the hail growth zone, promoting large hail growth for NW Alaska.



(Fig. 5) Suomi NPP Infrared Satellite Imagery. Bachmeier, S. "Severe Thunderstorm North of the Arctic Circle in Alaska", 27 June, 2024.

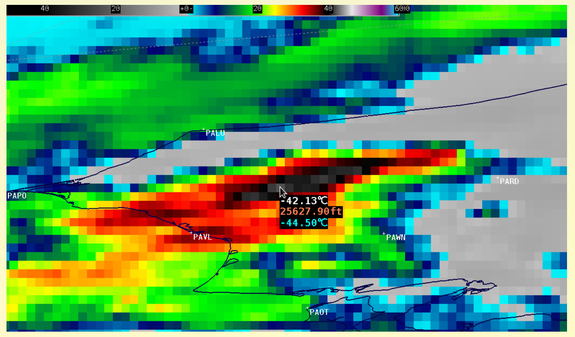


(Fig. 6) This map shows Alaska's distribution of severe thunderstorm warnings. Image configuration is distorted.

Graphic made by Brian Brettschneider.

Results and Discussion

Issuing a severe thunderstorm warning without radar support is not common practice for meteorologists across the United States. Even without radar data, conditions converging on the North Slope indicated a severe thunderstorm threat; prompting a DSS (Decisions Support Service) briefing for the region. Based on model data and forecaster analysis, the strongest thunderstorms were expected to occur in the afternoon; however radiosonde data from Kotzebue, satellite, lightning data and potential sea breeze convergence showed that warning level wind and hail producing conditions were present on the morning of this event.



(Fig. 7) GOES-18 Infrared Imagery. Bachmeier, S. "Severe Thunderstorm North of the Arctic Circle in Alaska", 27 June, 2024.

Conclusion

This event and the issuance of severe thunderstorm warnings without the availability of radar data is the first step towards providing better services to remote communities. Due to Alaska's sparse radar coverage and rapidly warming climate, severe convection is expected to become more common. The National Weather Service Fairbanks Forecast Office is already leveraging a suite of non-radar data sources to provide the best service to vulnerable communities across Northern Alaska.

Acknowledgements

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