

The September 17th, 2025, Gigantic Jet off the Puerto Rican Coast: A Case Study

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1. Introduction/Background

Gigantic jets (GJs) are an electrical discharge that propagates upward from the top of a thunderstorm, reaching altitudes between 70 and 90 km, terminating in the lower ionosphere (Lazarus et al., 2021). This GJ event occurred on 5:33:53 UTC on September 17th, 2025. Despite the rarity of gigantic jets, tropical regions like Puerto Rico have a higher likelihood of occurrence due to more available convection. This GJ event was caught on radar. This provides additional data helpful for analyzing this case

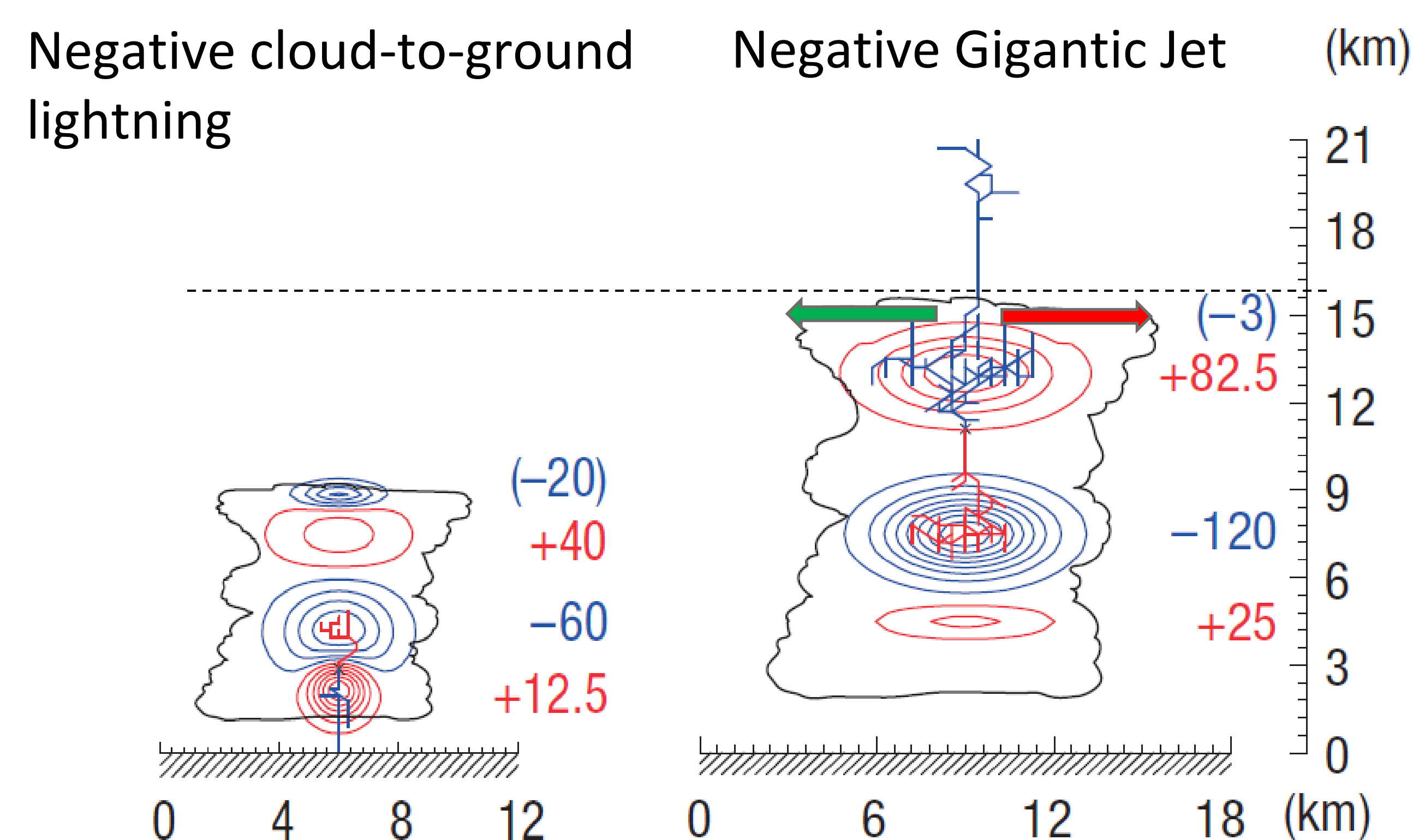


Figure 1: Typical charge structure of a negative cloud-to-ground lightning-producing storm (Left), and a negative gigantic jet-producing storm (Right). The blue and red contours and numbers indicate negative and positive charge regions, respectively, along with the corresponding charge amounts (in C). Dashed line on 12 km to show height difference. (Source: Krehbiel et al., 2008).

2. Data and Methods

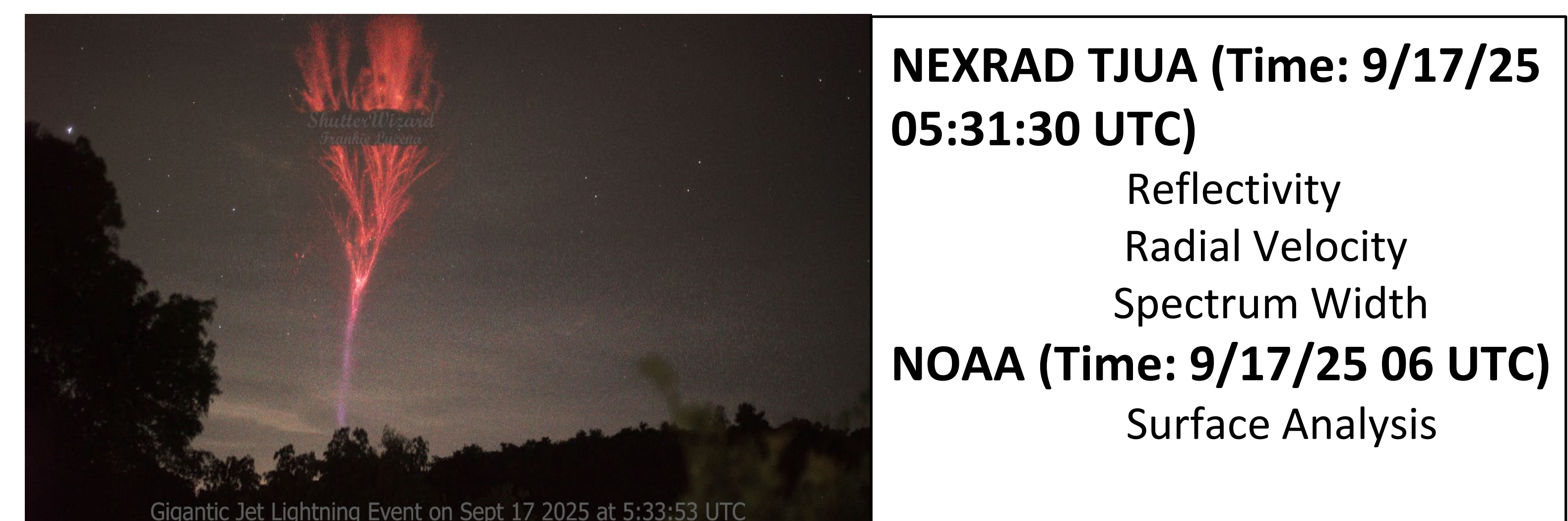


Figure 2: Photograph of GJ event (Source: Lucena, 2025)

GJ turbulence-related signatures for charge dilution at cloud top: Divergence (radial velocity differential) > **26 m/s**; Spectrum width > **9 m/s** (Boggs et. al.; 2018). Additional GJ storm characteristics include: a vertical column (**Base – 12 km**) with Reflectivity > **30 dBZ** centered on the cloud top divergence, a convective trigger (tropical wave), and evidence of a vortical hot tower (VHT).

3. Results

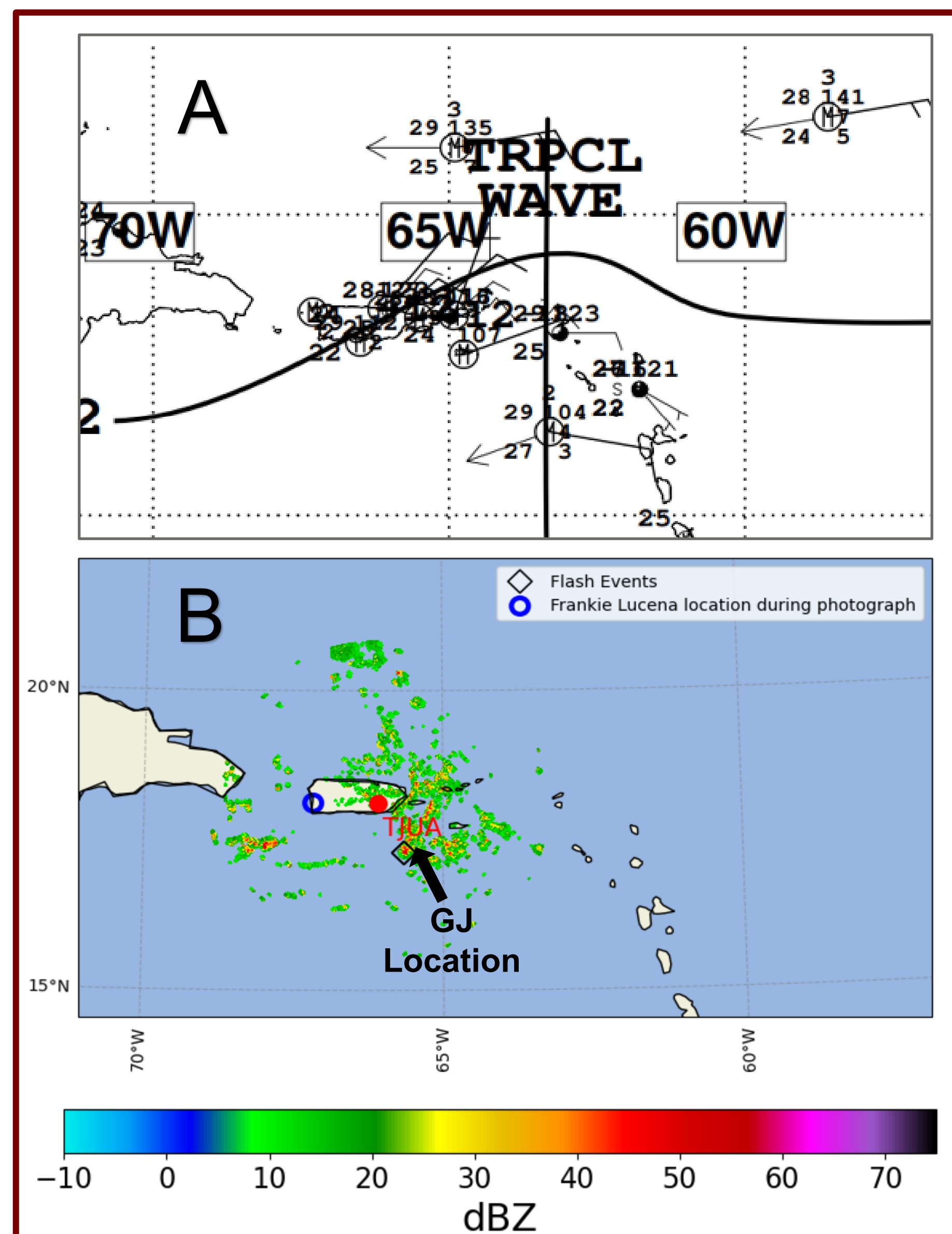


Figure 3: Plots with a focus on Puerto Rico showing the nearest time surface analysis (A) and the nearest time scan Base Reflectivity at sweep 0.5° from TJUA (B) (Source: NOAA & NEXRAD).

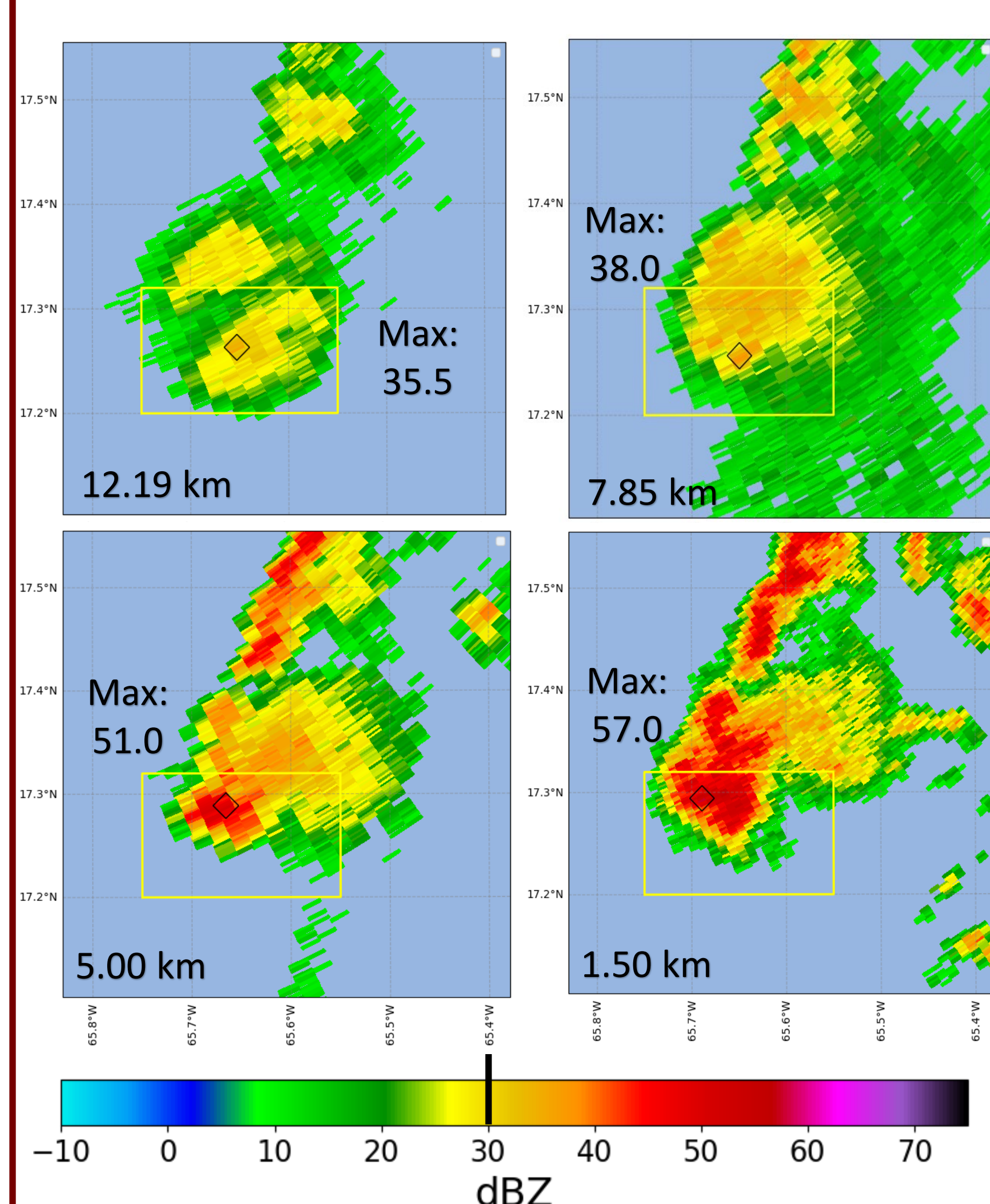


Figure 5: Nearest time scan base reflectivity for heights of 12.19 km (A), 7.85 km (B), 5.00 km (C), and 1.50 km (D) (Source: NEXRAD). This measure is of the returned energy from a radar scan, which tells the location of precipitation, particle size, and number of particles. Black line represents threshold.

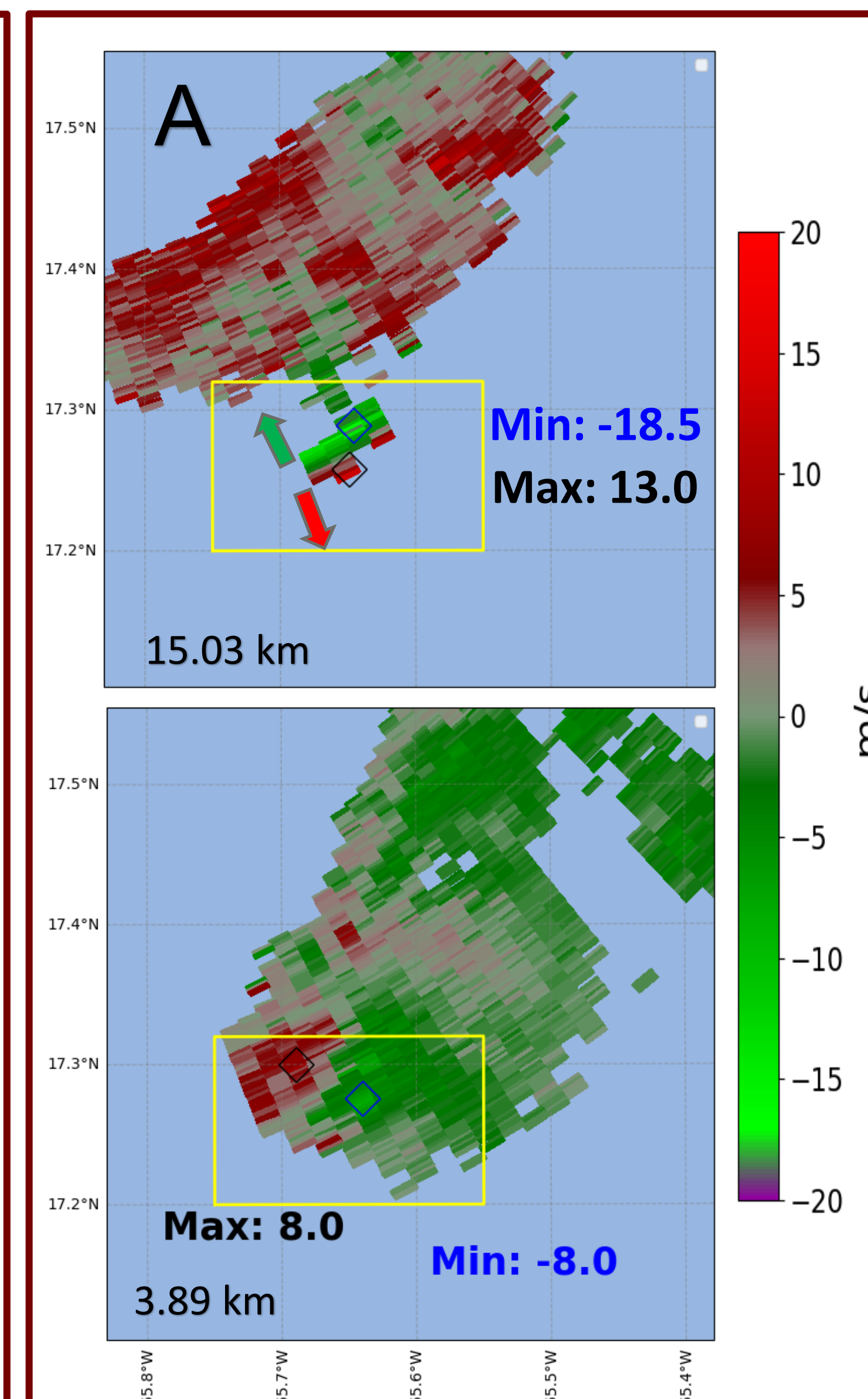


Figure 4: Nearest time scan radial velocity for heights of 15.03 km (A) and 3.89 km (B). Yellow outline indicates analyzed area of storm (Source: NEXRAD). This measure is of the direction of motion of precipitation either inbound or outbound from the radar. Arrows represent direction of motion.

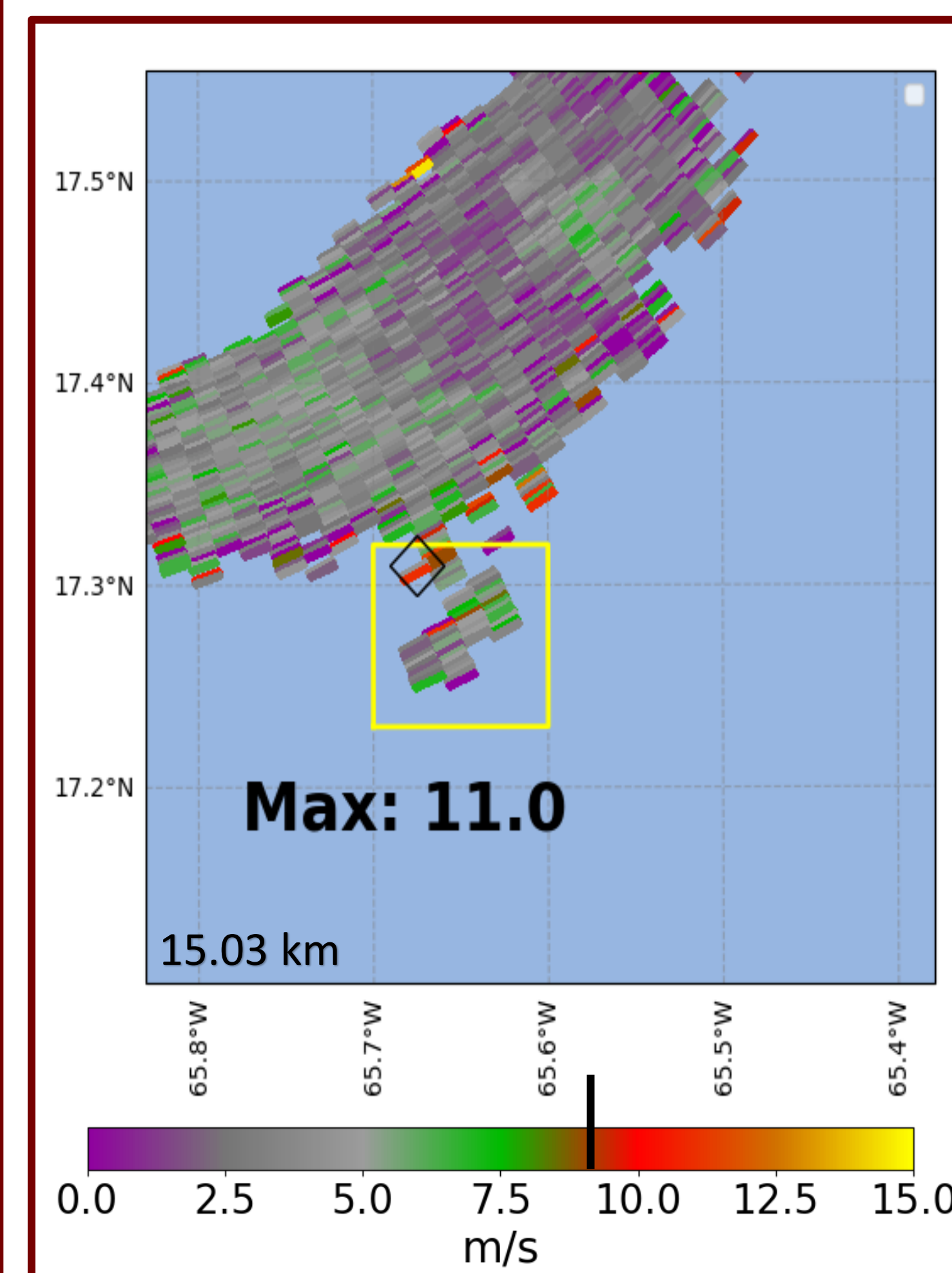


Figure 6: Nearest time scan spectrum width for a height of 15.03 km. (Source: NEXRAD). This measure is of the variation in particle speed and direction. The black line represents the threshold.

4. Discussion

- ❑ Tropical wave nearby while GJ occurred (Figure 3A)
- Provides a deep layer of moisture and instability.
- ❑ GJ event location confirmed from photo (Figure 3B + Figure 1).
- ❑ Radial velocity differential is above the threshold of 26 m/s (Figure 4A).
- Shows stretching of negative screening layer.
- ❑ Rotation in lower layer of storm (VHT) (Figure 4B).
- ❑ Reflectivity is above the threshold of 30 dBZ at 12 km (Figure 5A).
- Shows dense reservoir of mixed phase particles at top of storm.
- ❑ High reflectivity for vertical column centered on divergence (Figure 5A, 5B, 5C, 5D).
- Evidence of updraft and vertical charge continuity.
- ❑ Spectrum width is above the threshold of 9 m/s (Figure 6).
- Shows weakening of upper screen layer through turbulent mixing.

5. Conclusion/Future Work

All expected criteria present. Correlation between tropical waves and VHTs can be further investigated, as can the specific trigger for these upward flashes.

Acknowledgements

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References and Extra Graphics

