



Vertically Integrated Ice – A New Lightning Nowcasting Tool



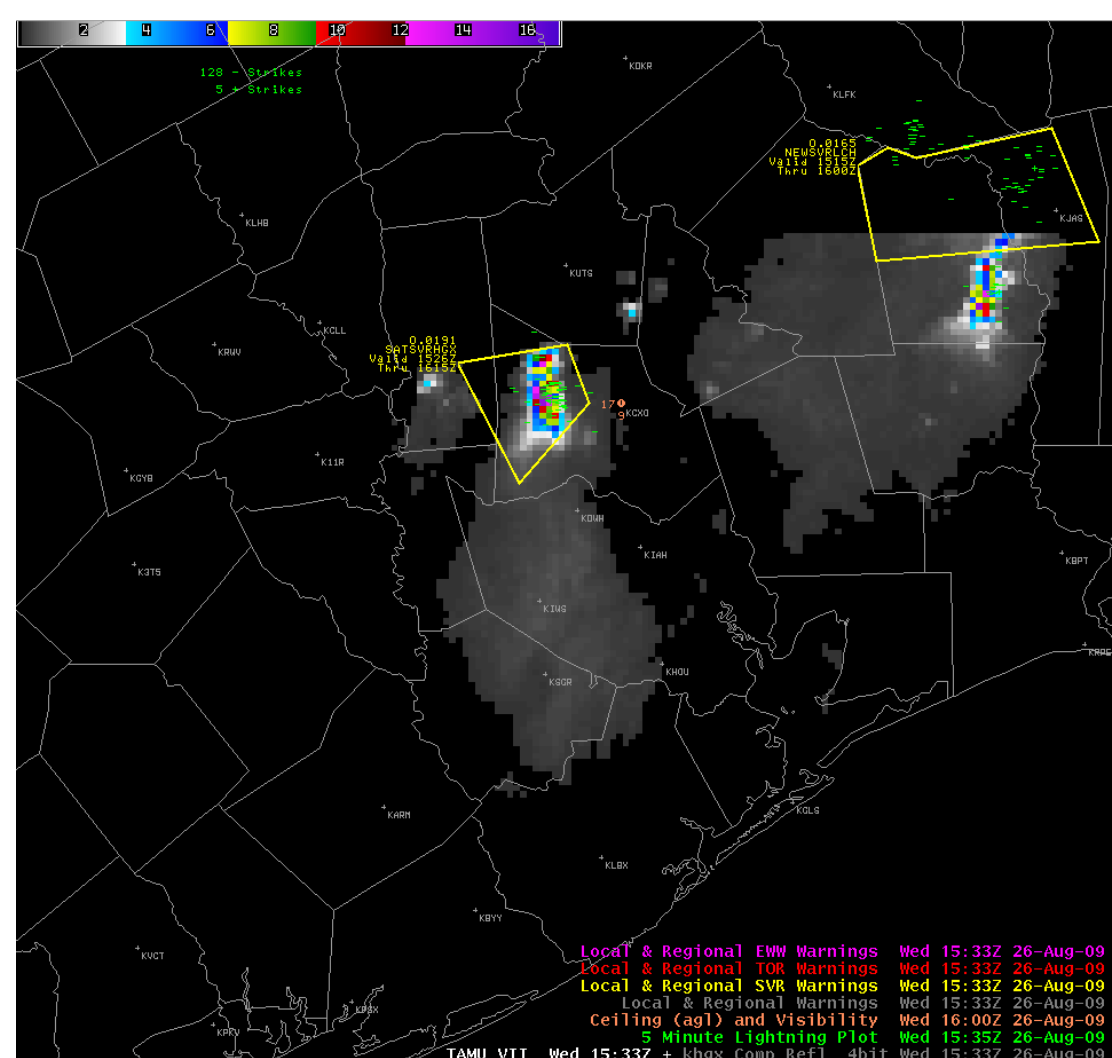
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Motivation and Methodology

- Lightning is a frequent and dangerous phenomenon, especially in the summer along the Gulf Coast.
- Despite its dangers, only a few techniques exist to accurately nowcast lightning.
- Vertically integrated ice (VII), was developed and tested on 10 years of Houston, TX radar data to determine its viability in lightning nowcasting.



VII from a severe storm near Houston, TX

VII Equation

$$VII = 1000 \pi \rho_i N_0^{3/7} \left(\frac{5.28 \times 10^{-18}}{720} \right)^{4/7} \int_{H_{-10}}^{H_{-40}} Z^{4/7} dH$$

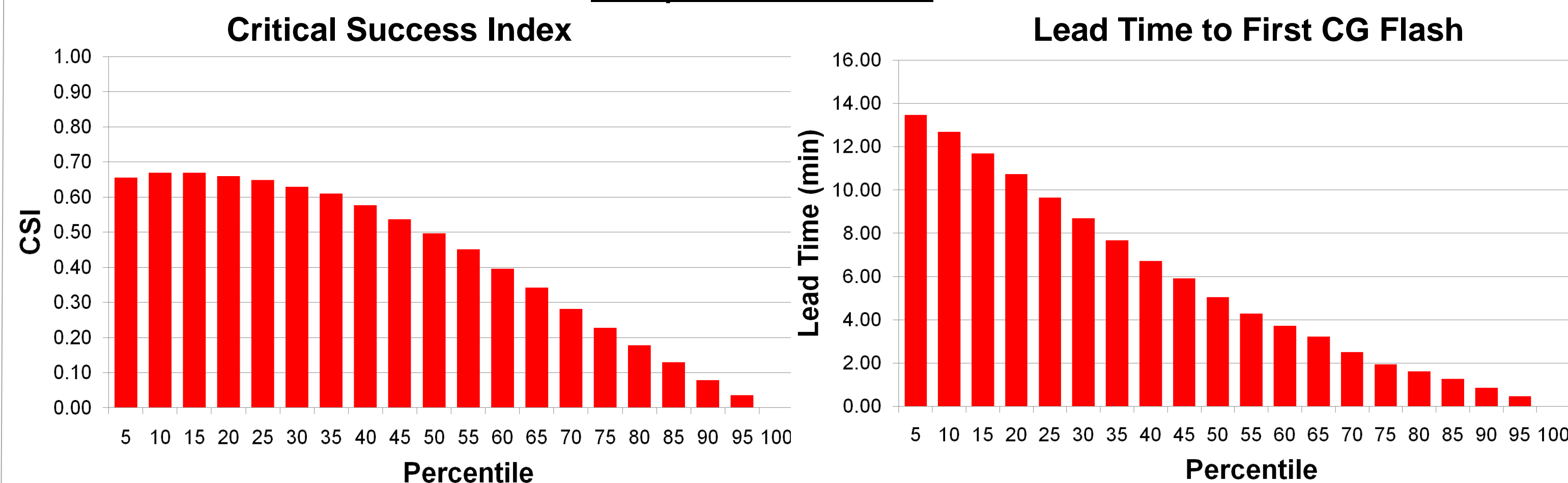
- H_{-10} and H_{-40} indicate the heights of the -10 and -40 °C environmental levels in meters, respectively.
- ρ_i is the density of ice (917 kg m⁻³)
- N_0 is the intercept parameter (4 x 10⁶ m⁻⁴) of an exponential size distribution of precipitation-sized ice.

Results

Distribution of VII Values for First CG Flashes

Percentile	5	10	15	20	25	30	35	40	45	50	60	70	80	90
VII (kg m ⁻²)	0.25	0.42	0.58	0.74	0.91	1.09	1.29	1.50	1.73	1.99	2.57	3.33	4.42	6.35

Graphical Results



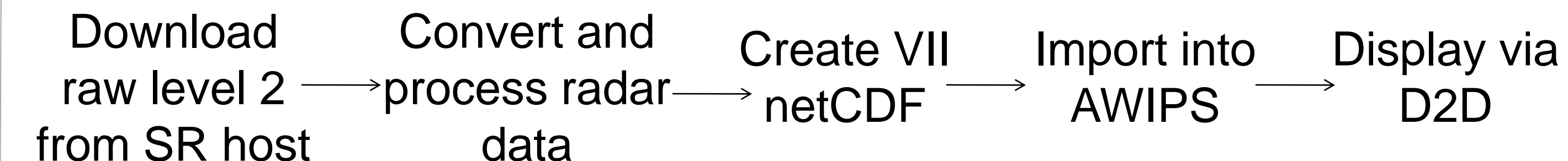
- 10th and 15th percentiles had the highest CSI value (0.67)
- CSI of 0.60 or greater for VII values less than 1.50 kg m⁻²

- Highest lead time was 13.5 min
- Average lead time was 5.9 min
- Median lead time was 5.1 min

Best Practices

Desired Result	Forecast Criteria	Reasoning
Maximize POD	Use a low (10 th percentile or less) value, such as 0.1 kg m ⁻²	98% POD using 0.25 kg m ⁻² (5 th percentile)
Minimize FAR	Use a high values (above 50 th percentile)	Less than 15% FAR after 2.00 kg m ⁻²
Maximize CSI	Use a lower percentiles (35 th percentile or less)	Greater than 0.60 CSI for percentiles less than 35 th percentile
Maximize Lead Time	Use a low value (10 th percentile or less)	13.5 min lead time using 0.25 kg m ⁻² (5 th percentile)

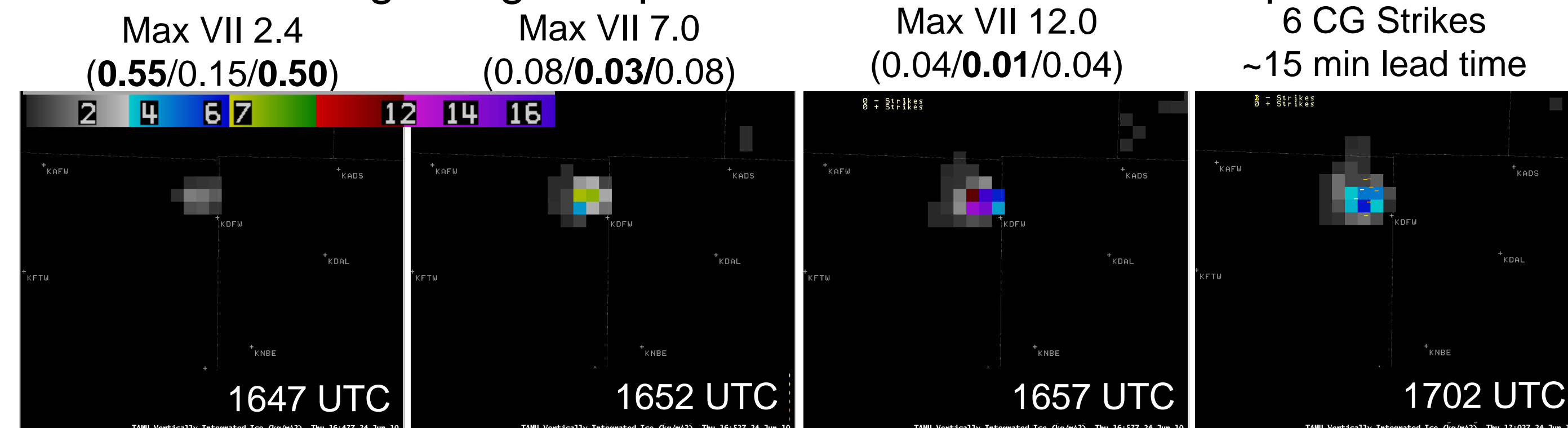
VII in AWIPS



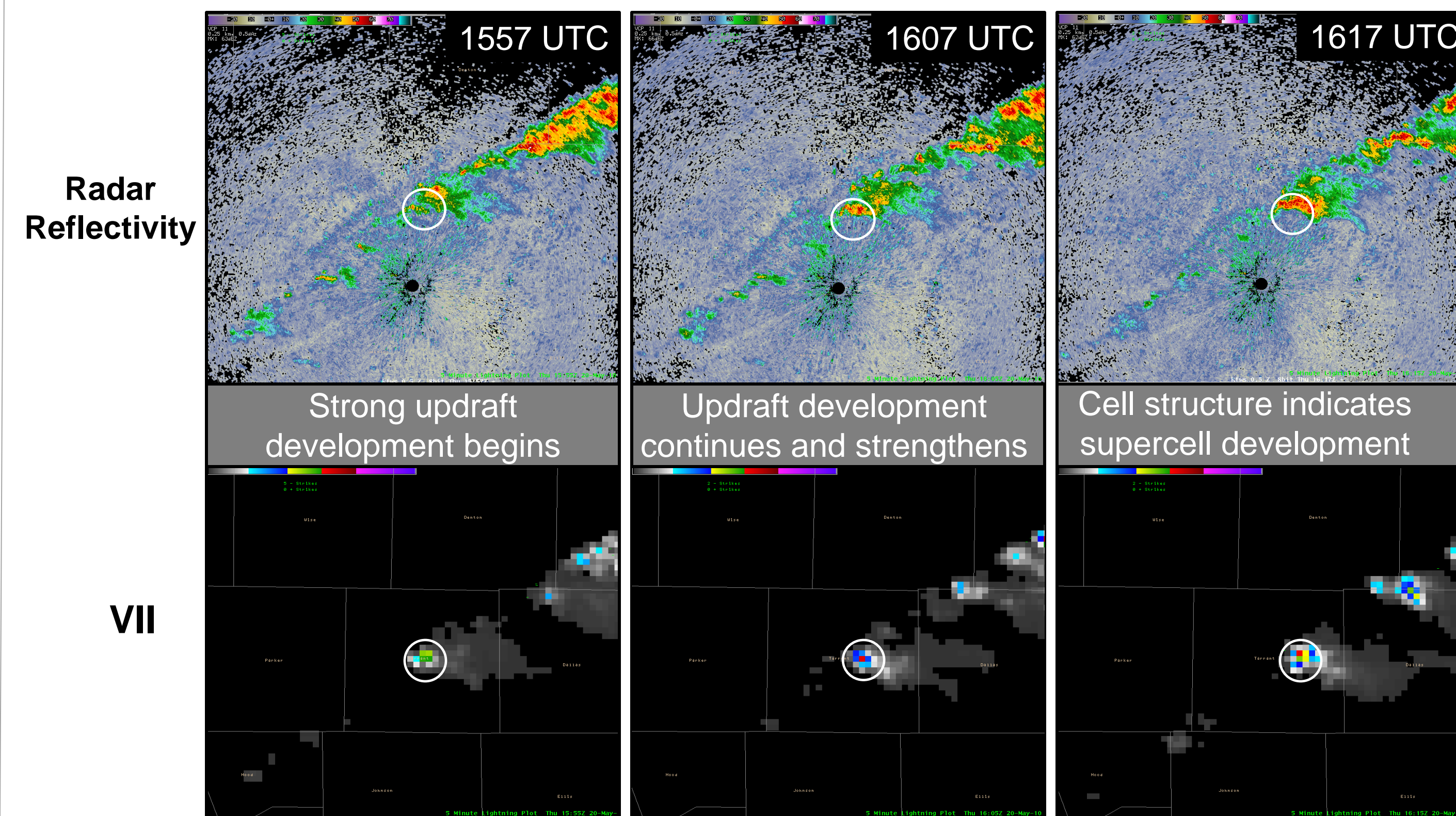
Examples

Airport Weather Warning at DFW Airport

- Issued when lightning is expected within 10 nm of the airport



Strong Updraft Identification



VII