Impact of choices made when creating average proximity soundings: Feature versus Height averaging and moisture variable considerations

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Introduction

- There are two ways that previous authors have characterized a *mean* near-storm environment and both are compared herein
  - **Height averaging** of each sounding variable at a fixed altitude above ground for a group of soundings (e.g., Fawbush and Miller 1952). Smoothing. Used by Rasmussen and Straka (1998)
  - **Feature averaging**: among a group of soundings in certain variables (temperature, moisture, and wind) and their corresponding heights are averaged separately (Brown 1993)
- Purpose:
  - Compare the two types of compositing for different supercell classes
  - Investigate the sensitivity of results to which moisture parameter is averaged (Most previous studies averaged Td)

Methodology

1) Collect Soundings

- From Rasmussen and Straka (1998) and Beatty et al. (2009)
- HP, LP, and Classic (CL) supercell environments
- For each environmental class, both compositing techniques below are performed

2) Prepare Hodographs

- Apply proper rotation, etc. (following, e.g., Rasmussen and Straka 1998)

3) Prepare thermodynamics

- Compute theta first
- Compute each moisture variable separately prior to averaging (RH%, *Td, qv, e,* and, θ*w*)

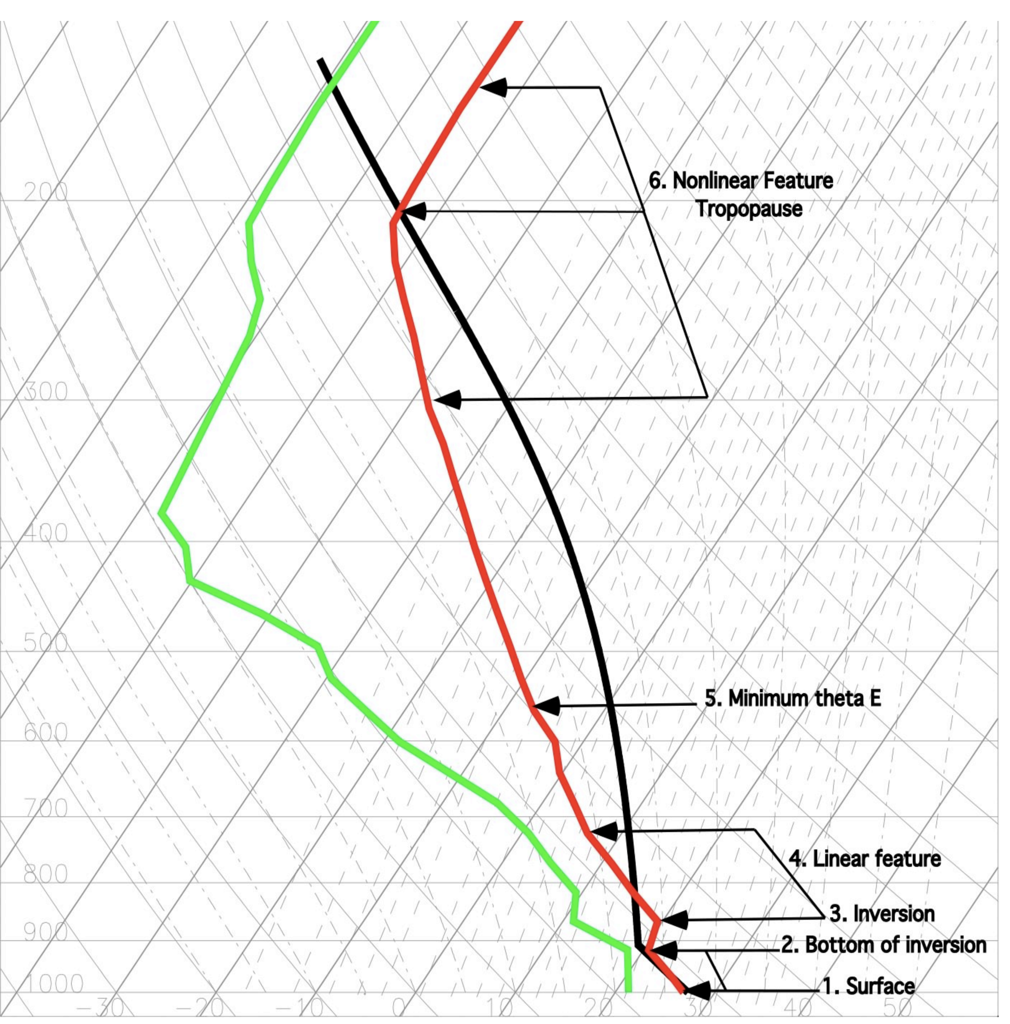

Fig. 1. Thermodynamic features to be averaged

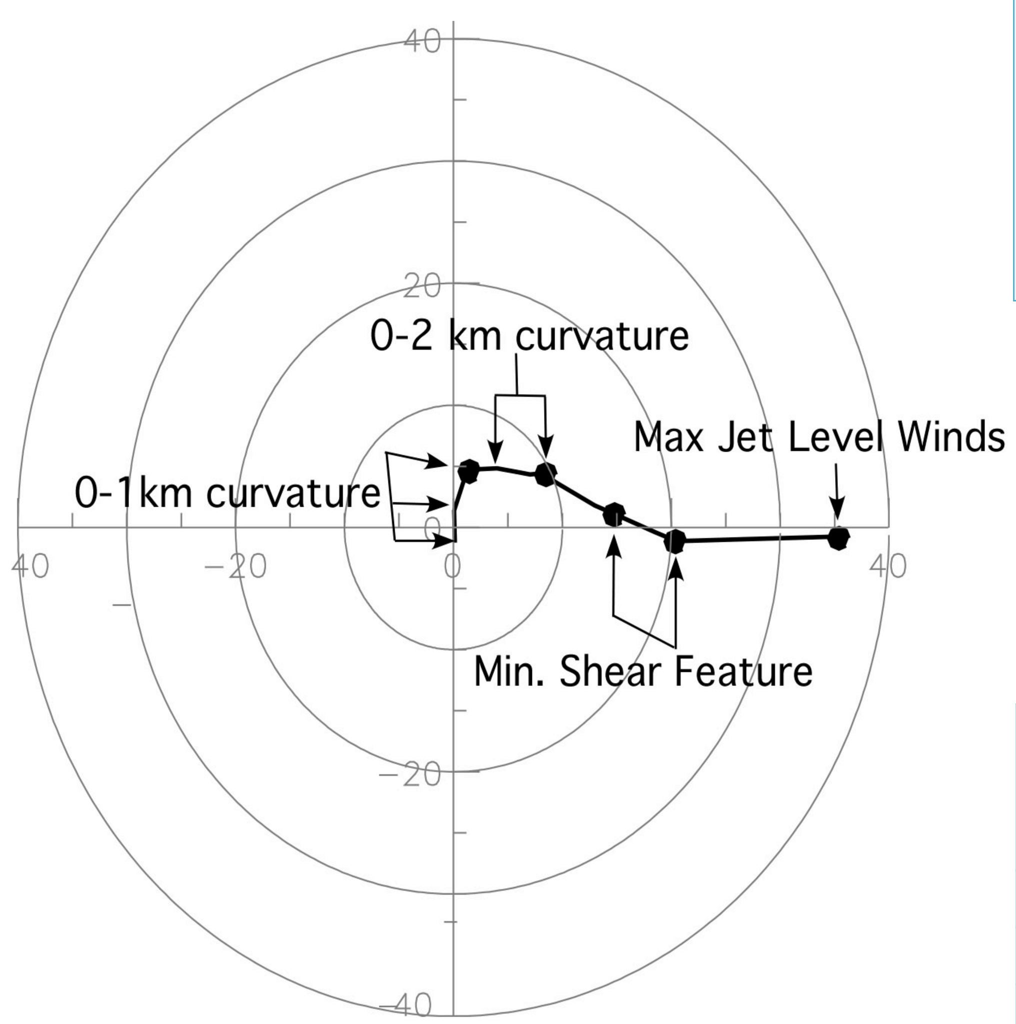

Fig. 2. Hodograph features to be averaged

4) Perform Compositing for n soundings

$$\bar{X} = \frac{X1 + X2 + \ldots + Xn}{n}$$

Height Averaging Technique

- Averages *T* (K), theta, *moisture*, *u (m/s)*, and *v* (m/s) at each height (m; AGL) in 100m increments

Feature Averaging Technique

- Performed among *n* soundings that have the feature (following Brown 1993)
- "Features" herein may be a single point, two points describing a linear change with height, or series of points approximating a curved feature (nonlinear) in the T or u,v
- Done separately for thermodynamics and winds
- Merge thermo/winds with one another creating a single composite
- Repeated for RH%, *Td, qv, e,* and, θ*w*

5) Compute Sounding Variables from Composites

- Such as CAPE, CIN, and others using a lowest-100-mb mixed-layer parcel

6) Plot soundings and hodographs

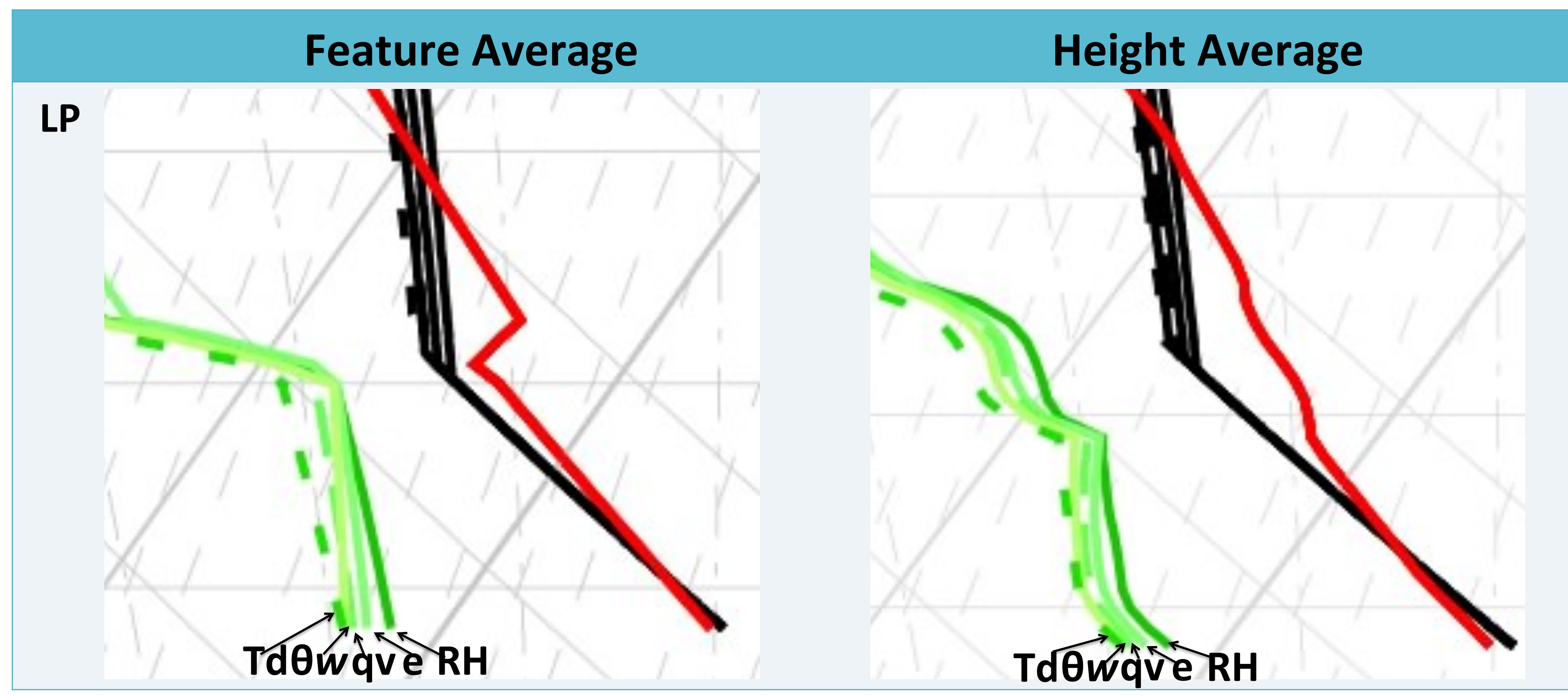

Fig. 3. Feature average and height average soundings for each moisture variable averaged (*Td*, θ*w*, *qv*, *e*, and *RH)*. Moisture profile (green), updraft adiabats (black) and average temperature (red) are shown.

Table 1. Sensitivity of CAPE and CIN to the moisture variable chosen for averaging: *Td*, θ*w*, *qv, e*, and *RH* for both the feature-average soundings (F) and height average soundings (H).

Moisture Variable Averaged	LP				Classic				HP			
	CAPE		CIN		CAPE		CIN		CAPE		CIN	
	F	H	F	H	F	H	F	H	F	H	F	H
RH	**2426**	**1935**	**53**	**79**	**2862**	**2506**	**41**	**42**	***2432***	***1909***	**40**	**48**
Vapor p	2182	1740	64	92	2735	2429	47	45	*2466*	*1990*	38	42
Mixing Ratio	1995	1613	75	101	2551	2275	56	53	2199	1787	54	57
Theta-w	1964	1522	76	108	2525	2245	57	54	2117	1685	59	64
Dewpoint T.	1814	1460	85	113	2486	2193	60	57	2025	1629	66	69

Results

- Compared to height-average, the feature-averaged composite results in
  - Larger CAPE and lower CIN values
  - Stronger upper-level storm-relative winds
  - Higher boundary layer moisture amounts
- Regarding which moisture variable to average
  - *qv* averaging in theory is best (not p and *T* dependent)
  - RH averaging - larger CAPE values and lower CIN values
  - Td averaging - lowest CAPE values and largest CIN values

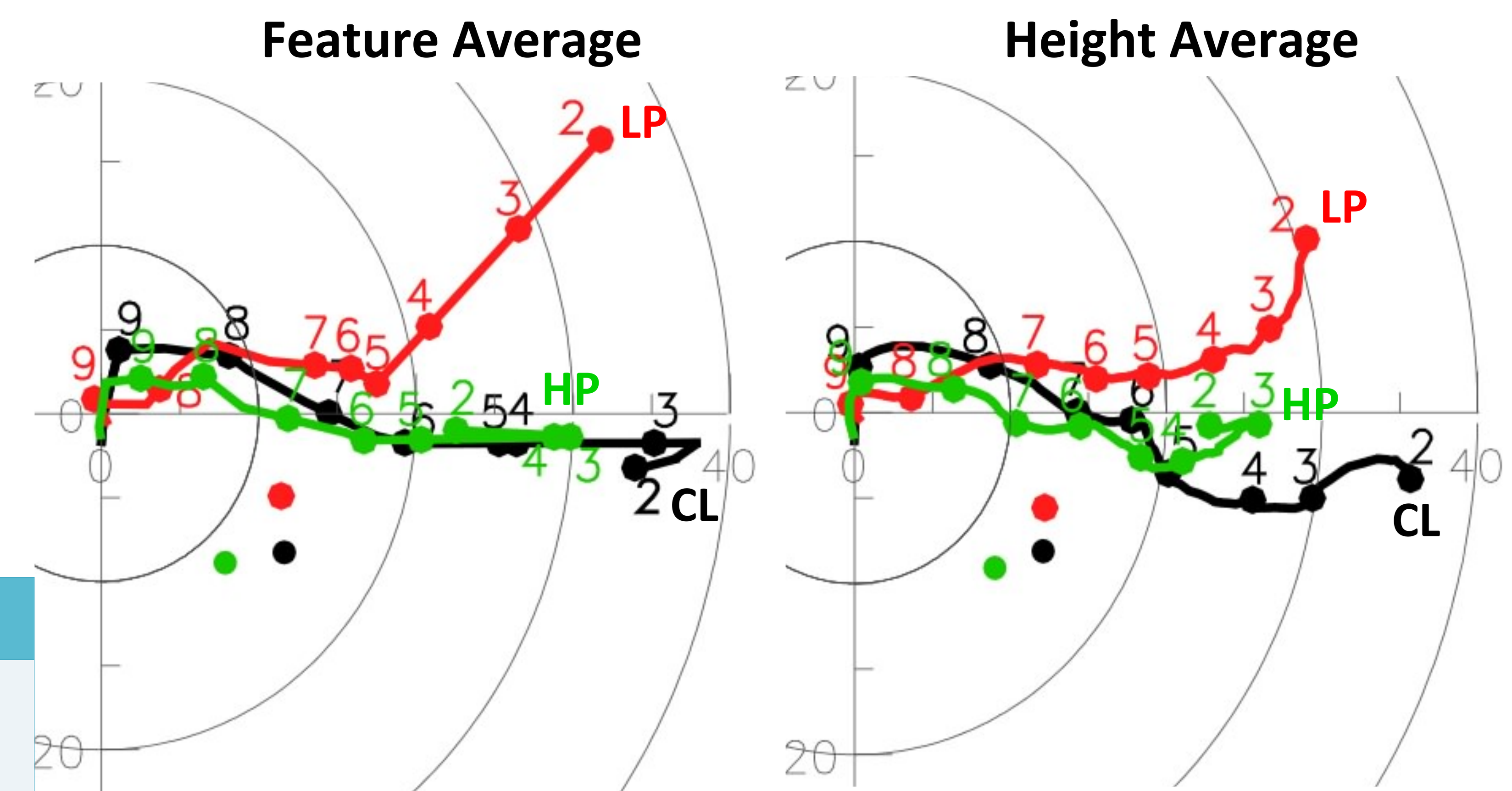

Fig. 4. Feature and height averaged hodographs with dot being corresponding Bunkers storm motion; LP (red), CL (black), HP (green).

Conclusion and Future Work

- Supercell modelers should use RH averaging when compositing if they are concerned about having large CAPE and minimal CIN
- Run simulations with the composite soundings in the Cloud Model 1 for each classification and technique

Acknowledgements

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References

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