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Purpose

The aim of this study is to test the capability of a short-term, stormscale ensemble to resolve and predict cyclic mesocyclogenesis and whether this process is physically representative of the current understanding for cyclic supercells.

Background/Methodology

- Cyclic mesocyclogenesis is the process by which a supercell produces multiple mesocyclones with similar lifecycles (Adlerman et al. 1999 JAS).
 - Two types of cyclic mesocyclogenesis: occluding (OCM) and nonoccluding (NOCM; Adlerman and Droegemeier 2002, 2005 MWR).
- Three experiments were performed to test the sensitivity of cyclic mesocyclogenesis to horizontal grid resolution, physical parameterizations, and environmental effects.
- 4 cases of cyclic supercells are analyzed to compare with NEWS-e forecasts:
 - 9 May 2017 Morton Supercell
 - 16 May 2017 Elk City Supercell
 - 18 May 2017 Corn and Hennessey Supercells
- Control observations are found by analyzing WSR-88D data (e.g. Thompson et al. 2012, Smith et al. 2012 WAF).



Mesocyclone Cri				
Classification	Rotational Velocity (m/s)	Diameter (km)		
Mesocyclone	≥ 20	1-10		
Weak Mesocyclone	≥ 15 < 20	1-10		
TVS	≥ 20	< 2		
VS	≥ 20	< 2		

Interpretation of WSR-88D data when finding the diameters and rotational velocities of each mesocyclone. White circle indicates the highest inbound velocity, the yellow circle shows the highest outbound velocity, the dashed, black line is the diameter, and the dashed, black circle is the general mesocyclone.

	NEWS-e				
Parameter	Value/Description	Par	ameterizations	by Ensemble Mem	ber
Horizontal Grid Resolution	3 km	Member	PBL	Shortwave Radiation	Lo Ri
3-km Grid Domain Size	750 x 750 km	1	YSU	Dudhia	
Location of 3-km Grid	Event Specific	2	YSU	RRTMG	F
1-km Grid Domain Size	Approx. 350 x 350 km	3	MYJ	Dudhia	
Number of vertical levels	51	4	MYJ	RRTMG	F
Vertical Grid Resolution	$100 \text{ m} < \Lambda x < 1 \text{ km}$	5	MYNN	Dudhia	
Microphysical scheme (all	NSSI 2 moment microphysical	6	MYNN	RRTMG	F
		7	YSU	Dudhia	
members)	parameterization	8	YSU	RRTMG	F
Land surface	RAP Land Surface model	9	MYJ	Dudhia	
Number of ensemble members	36	10	MYJ	RRTMG	F
Number of forecast members	18	11	MYNN	Dudhia	
		12	MYNN	RRTMG	F
Table 1: System conf	13	YSU	Dudhia		

Table 1. System configuration and physical parameterizations for NEWS-e. See Wheatley et al. 2015 (WAF) for more details.



16	May 2017			18 May 2
	18	MYNN	RRTMG	RRTMG
	17	MYNN	Dudhia	RRTM
	16	MYJ	RRTMG	RRTMG
	15	MYJ	Dudhia	RRTM
	14	YSU	RRTMG	RRTMG
	13	YSU	Dudhia	RRTM
-	12	MYNN	RRTMG	RRTMG
	11	MYNN	Dudhia	RRTM
	10	MYJ	RRTMG	RRTMG
	9	MYJ	Dudhia	RRTM
	8	YSU	RRTMG	RRTMG
	7	YSU	Dudhia	RRTM







3-km and 1-km NEWS-e Domains

Domains for the 3-km and 1-km NEWS-e grids for all three cases. The full domain corresponds to the 3-km grid, the black square indicates the 1-km domain, and the red circles indicate the supercells of interest. Images for 9 May, 16 May, and 18 May 2017 were taken at the beginning of the 2300, 2100, and 2200 UTC forecasts, respectively. The domains remain constant for all forecast times.

Strengths and Limitations of Using NSSL's Experimental Warn-on-Forecast System for Ensembles (NEWS-e) in Forecasting Cyclic Mesocyclogenesis







1-km vs. 3-km Cycling

Each color represents a different mesocyclone. The dotted, colored lines (dotted, colored lines with circles on either end) between mesocyclones indicate the mesocyclone went through OCM (NOCM). The beginning of the cycle is defined as when the updraft develops a two-celled structure due to being undercut by the downdraft, and the cycle ends when the old mesocyclone has fully decayed. Only the last two hours of each

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Summary

- Cycling is observed at 3 km, but is more frequent at 1 km.
- As the number of control (observed) cycles increases, so does the number of cycles predicted by 1-km forecast members.

Supercell	# of Control Cycles	Total # of Cycles	Ensemble Mean # of Cycles (average cycles per member)
Hennessey	5	42	2.33
Corn	2	2	0.11
Elk City	2	22	1.22
Morton	7	31	1.72

- NEWS-e is able to forecast the potential for cycling, but shows little to no skill in predicting the timing compared to observations.
- 1-km members predict the existence of a supercell for longer periods of time, but are not necessarily more accurate.