WET MICROBURST EVENTS OBSERVED WITH PHASED ARRAY RADAR

Arthur Witt1, Travis M. Smith1,2, Pamela L. Heinselman1, Steven T. Irwin2, and Kevin L. Manross3
1NOAA/National Severe Storms Laboratory
2Cooperative Institute for Mesoscale Meteorological Studies, The University of Oklahoma, Norman, Oklahoma
3National Center for Atmospheric Research, Boulder, Colorado

Introduction

• Phased array radar (PAR) can scan the atmosphere much faster than current operational weather radars
• Microbursts are a rapidly evolving form of hazardous weather
• The faster volume scan times of PAR allow for better identification of microburst precursors, providing the opportunity for more timely and accurate prediction of microbursts
• We present here some initial PAR observations of microburst-producing storms in Oklahoma

Inclusion criteria for storms

• Maximum range from radar limited to 60 km
• Maximum reflectivity of 55 dBZ or higher
• Low-altitude divergence of 0.0025 s⁻¹ or higher

Data cases

• 25 storms on 8 days from 2007 – 2010 met the inclusion criteria
• 2 storms from April, 3 from June, 5 from July, and 15 from August

Parameters analyzed as microburst precursors

• Parameters are based on the downdraft forcing mechanisms of wet microbursts: precipitation drag and cooling from melting ice (hail)
• First parameter: Vertical extent of precipitation core, measured at the 55, 60 and 65 dBZ reflectivity levels
• Second parameter: Peak mid-altitude (2 – 6 km ARL) convergence associated with a descending precipitation core

Radar data processing procedures

• Calculate radial divergence using a linear least squares derivative
• Map reflectivity and divergence data to a 3D latitude-longitude-height grid

Results

• For each storm, time-series graphs of core base height, core top height and maximum mid-altitude convergence were produced for up to 17 min prior to initial observation of the microburst
• Substantial variations in the magnitude and trend patterns of the parameters was observed, but several distinct groups were apparent
• Groups varied based on the degree that the magnitude and trend patterns of the parameters matched the expected characteristics of microburst-producing storms from past research

Group 1: Intense, descending core with moderate to strong mid-altitude convergence

Group 2: Intense, descending core with moderate to strong mid-altitude convergence, but core base remains somewhat elevated

Group 3: Moderate to strong mid-altitude convergence, but without a distinctly descending core

Group 4: Weak mid-altitude convergence

Group 5: Relatively weak core (max Z < 60 dBZ)

Conclusions

• A majority of storms had all (Group 1; N=9) or most (Group 2; N=4) of the typical precursor characteristics associated with wet microbursts
• Another 20% of the storms (N=5) had moderate to strong mid-altitude convergence and an intense core, but the core did not notably descend (Group 3)
• The remaining 7 storms exhibited weak mid-altitude convergence and/or a relatively weak core (Groups 4 and 5)
• Moderate to strong mid-altitude convergence was the most common feature (28 storms), but there were no consistent patterns in the time trends
• Future project plans include comparing microburst-producing storms with storms that did not produce microbursts, and exploring alternate ways of measuring precursor parameters (e.g., volumetric vs maximum single value)
• The potential benefits of high temporal PAR observations versus the slower update rates of operational weather radars will also be examined