Mesoscale Meteorology – Assignment #1 – Radar Exercise

Due 9 February 2017

In this assignment, you will gain experience with interrogating WSR-88D weather radar data to gain insight about mesoscale meteorological phenomena. First, please download and install the NOAA Weather and Climate Toolkit, available at https://www.ncdc.noaa.gov/wct/. Note that you will not be able to install this on the iMacs in EMS W434, as we do not have administrator access on those machines. On Windows 10, you may get a "Windows protected your PC" message about preventing an unrecognized app from starting; choose "More info," then "Run anyway." On a Mac, you may need to Control-Click on the app icon and choose "Open" to run. Independent of operating system, you will need to install Java before running the app if it is not already installed.

1) Request KMKX (Milwaukee, WI) "Level III (Products) (ALL)" data for 9 January 2017 between 2000-2200 UTC from NCEI (https://www.ncdc.noaa.gov/nexradinv/map.jsp). Copy the Order ID (which starts with HAS) from the e-mail notification once it arrives; you do not need to download the data from their website. Once the Weather and Climate Toolkit has loaded, choose the NCEI/CLASS order tab if it is not already selected and paste your Order ID into the entry box, then click on "List Files" in the lower left of this window. In the background display window, zoom in to the western Great Lakes.
    a. (6.25 pts) Create an animation of Base Reflectivity (3.4 elev angle) data from 2000-2200 UTC. Describe what you see and how it evolves with time.
    b. (6.25 pts) Close the animation and return to the Data Selector. Load a single image: Base Reflectivity (0.5 elev angle) at 2026 UTC. Choose View -> Range Rings and accept the default values to add range rings to the radar display. Zoom to southern Wisconsin and northern Illinois. Focus on the radar echoes southwest of the radar site. Use your mouse cursor to hover along the leading precipitation edge. From the readout at the lower right, at approximately what elevation (km) are these echoes found? Uncheck the "Reset Zoom" box in the Data Selector window and repeat for the 1.5, 2.4, and 3.4 elev angles. What shape do you see in the radar data at each tilt, and how does it change between each tilt?
    c. (6.25 pts) Repeat (b) in its entirety at 2125 UTC. How do things change over this 1 h period?
    d. (6.25 pts) Based on your answers to (b) and (c), why do you believe that there are no radar echoes at the radar location at any time or elevation angle? What can you infer about the lower tropospheric vertical relative humidity profile at 2026 UTC and 2125 UTC from the radar information? Be specific; use your answers to (b) and (c) to provide quantitative information in your answer.

2) Request KTLX (Oklahoma City [Norman], OK) “Level III (Products) (ALL)” data for 13 March 2015 between 2200-2300 UTC from NCEI and load the file list as described above. Use the Hand tool to move the display to central Oklahoma.
   a. (6.25 pts) Create an animation of Base Reflectivity (0.5 elev angle) data from 2204-2256 UTC. Describe what you see and how it evolves with time.
   b. (6.25 pts) Close the animation window and return to the Data Selector. Load a single image: Correlation Coefficient (0.5 elev angle) at 2256 UTC. Describe what you see: what does it imply? Next, use your mouse cursor to hover along the edge of any gradients in CC values. From the readout at the lower right, at approximately what elevation (km) are these echoes found? Repeat for Differential Reflectivity (0.5 elev angle). Do these data support your answers to (b)?
   c. (6.25 pts) Repeat (b) in its entirety for the 1.5, 2.4, and 3.4 elev angles.
   d. (6.25 pts) Based on your answers to (b) and (c), what can you infer about the lower troposphere vertical temperature profile? Be specific; use your answers to (b) and (c) to provide quantitative information in your answer.

3) Request KMKX (Milwaukee, WI) “Level III (Products) (ALL)” data for 31 August 2016 between 1800-2300 UTC from NCEI and load the file list as described above. Use the Hand tool to move the display back to southeast Wisconsin.
   a. (8.33 pts) Create an animation of Base Reflectivity (0.5 elev angle) data from 1804-2255 UTC. Describe what you see and how it evolves with time.
   b. (8.33 pts) Focus on the period 2030-2255 UTC. Describe differences in echo motion between locations immediately inland from and over Lake Michigan. If these echoes move with the wind, what does their motion imply about wind direction immediately inland versus over Lake Michigan? Assume that altitude differences between these locations are inconsequential.
   c. (8.33 pts) Create an animation of Correlation Coefficient (0.5 elev angle) data from 1804-2255 UTC. What are the correlation coefficient values for the features that you identified in (a)? What does this imply about the nature of these features?

4) Request KDMX (Des Moines, IA) “Level III (Products) (ALL)” data for 30 June 2014 between 1700-1800 UTC from NCEI and load the file list as described above. Use the Hand tool to move the display to central Iowa.
   a. (6.25 pts) Create an animation of Base Reflectivity (0.5 elev angle) data from 1700-1757 UTC. Describe what you see and how it evolves with time.
   b. (6.25 pts) Close the animation window and return to the Data Selector. Load a single image: Base Reflectivity (0.5 elev angle) at 1732 UTC. Zoom in tight on the high reflectivity region along I-80 (solid east-west red line) west of the radar. Describe what you see. Repeat for three 3.4 elev angle fields: Base Reflectivity,

Correlation Coefficient, and Differential Reflectivity. What do these fields show, particularly in comparison to Base Reflectivity (0.5 elev angle)? What can you infer about salient storm structure from these fields?

c. (6.25 pts) Load Base Reflectivity (0.5 elev angle) at 1742 UTC, remaining zoomed in on the same feature as in (b). Describe what you see. Repeat for Base Velocity (0.5 elev angle). Would you classify this as cyclonic rotation, convergence, or a combination of the two? Why? At what altitude (km) is this feature located? Repeat for Base Velocity at the 0.9, 1.5, 1.8, 2.4, and 3.4 elev angles. To at least what altitude (km) does this feature exist?

d. (6.25 pts) Load Base Reflectivity (0.5 elev angle) at 1757 UTC and move the display window northward to the feature just west of the radar. Describe what you see. Repeat for Base Velocity at the 0.5, 0.9, 1.5, 1.8, 2.4, and 3.4 elev angles. Describe what you see; what would you classify this feature as? Where in relation to the feature you identified in Base Reflectivity (0.5 elev angle) data is it located?