Lab: Monitoring QLCS Events with Radar

Objective:

In this lab exercise we will investigate several different QLCS events and practice identifying different radar features including: bowing segments, mesovortices, inflow notches, rear inflow notches, and outflow boundaries.

Instructions:

You will need to use the latest version of RadarFirst to complete this lab. Please read each question carefully and answer them as best you can in the space provided. You are welcome to work on your own or in a group.

Note: The instructions in this exercise are for the Windows version of RadarFirst. The Mac version is similar but some functions (like short cuts) are not available. Please ask us if you have any questions.

Region of Focus for this Exercise:

The different parts of this lab exercise will focus on different locations. Follow the directions in each part closely.

Terminology:

The following are definitions of several terms relevant to this exercise:

- **Base Reflectivity** – Return signal to the radar that indicates the location and intensity of particles in the atmosphere such as rain, hail, snow, or other targets (such as bugs, buildings, trees, and other non-weather items). The more intense or reflective the 'echo', the higher the reflectivity value.
- **Base Velocity** – Return signal to the radar indicating the velocity of a target toward or away from the radar beam. Much like a radar gun used in baseball, weather radar can only fully see targets moving directly toward or away from it. When winds become perpendicular to the radar beam, the radar can no longer see them.
- **Bookend Vortex** – An area of rotation at the end of a QLCS. A bookend vortex on the northern end of a line typically rotates counterclockwise; the vortex on the southern end typically rotates clockwise.
- **Bow Echo** – A bow-shaped line of thunderstorms that is often associated with swaths of damaging straight-line winds and sometimes tornadoes.
- **Fine Line** – A subtle radar reflectivity feature that marks the location of fronts and boundaries (such as cold fronts, dry lines, and outflow boundaries). Fine lines are most

easily observed close to a radar since due to the low-level nature of fronts and boundaries.

- **Inflow Notch** – A radar reflectivity feature associated with inflow into a thunderstorm that resembles a small bite taken out of the storm.
- **Mesovortex** – An area of rotation 1 to 12 miles in size that lasts for up to an hour and occurs within the lowest 1 mile of the atmosphere. Mesovortices can enhance straight-line winds at the ground and sometimes produce brief tornadoes.
- **Outflow boundary** – A surface boundary formed by the spreading out of thunderstorm-cooled air. These features appear in radar reflectivity as something called a "fine line."
- **Quasi-Linear Convective System (QLCS)** – A contiguous area of thunderstorms in a semi-linear orientation that is associated with heavy rain and high winds. The word quasi emphasizes that these systems do not have to be perfectly straight, but rather can be "kind of" straight.
- **Rear Inflow Jet** – A relatively strong current of air that travels from the weaker precipitation area behind a QLCS towards the front.
- **Storm Relative Velocity** – Similar to Base Velocity, except that it subtracts off the speed of the weather phenomena. This is particularly useful for diagnosing rotation in storms when they are moving very fast (such as 40+ mph) or when the rotation is weak.

RadarFirst Cheat Sheet:

- **To zoom in** – Double left mouse click, mouse scroll wheel, or finger pinch apart (touch screens only). Additional town names will appear as you zoom in.
- **To zoom out** – Double right mouse click, mouse scroll wheel, or finger pinch together (touch screens only). Fewer town names will appear as you zoom out.
- **To pan the map** – Click and drag with a left mouse click or finger touch and drag (touch screens only)
- **To change the date or time** – At the top of the RadarFirst window click "Edit" and then "Date…". From there you can change the date and time as needed. Click "Set Date" to apply your changes. (Short cut: *Shift D*)
- **To animate –** At the bottom of the window click the large triangle for a 1-hour loop. If you would like to animate more than 1 hour click the "2" or "3" that appear further to the right. (Short cut: *Space bar*)
- **To change radar product** – Next to the time at the top of the RadarFirst window click the abbreviated radar product name (such as "BREF1") to open the product selection menu. From there click the product you need to view.
- **To change the radar site** – At the top of the RadarFirst window click the radar site name (such as "KTLX – Oklahoma City") to open the radar selection menu. From the map that appears you can select the radar you need to view.
- **To activate 2 panel mode** – At the top of the RadarFirst window click "View" and then "Two Panes". (Short cut: *Shift 1 or 2*)

Part 1: March 28, 2017 Event (Southwest and Central OK)

Open the RadarFirst software and change your site to the Frederick, OK radar (**KFDR**). Next, go to **Edit → Date...** (short cut **Shift D**) and change the date to **3/28/2017** and the time to **7:00 PM** and then click **Set Date**. View the data in 2-pane mode (**View → Two Pane** or use short cut **Shift 2**). Make sure cities are visible on the map (**Edit → Options… → Cities and Towns** or use short cut **Shift C**). Load "**BREF1**" in the left pane and "**BVEL1**" in the right pane. Please hide Tornado, Severe Storm, and Flash Flood Warnings (**Edit → Options… →** uncheck **Warnings** or use short cut **Shift W**).

Question 1. Focus your attention on the line of storms in SW Oklahoma along the Red River. What do we call the storm feature in Base Reflectivity (left pane) just west of the radar (in Frederick, OK) that appears to stick out further? What hazard is usually associated with these?

Question 2. Hit the play button to animate radar data for 1-hour and watch the storms evolve. There is an interesting QLCS feature in Base Reflectivity that travels over Chillicothe, TX and then north and east towards Elmer, OK. What is it called? What do you see happening in Base Velocity where this feature is?

Stop the animation, change the time to 9:03 PM (**Edit → Date…**), and change your radar to Oklahoma City (**KTLX**).

Question 3. The bowing segment that was in SW OK at 7 PM is now near El Reno. At 9:03 PM what reflectivity feature do you see SW of El Reno (near Hinton)? What causes it?

Question 4. Looking at Base Velocity at 9:03 PM, what feature appears just to the NW of El Reno? What feature do you notice in Base Reflectivity at the same location?

Part 2: August 6, 2017 Event (Northeast Oklahoma)

Change your radar site to the Tulsa, OK (KINX) radar. Go to **Edit → Date...** (Short cut **Shift D**) and change the date to **8/6/2017** and the time to **1:15 AM**. Make sure "**BREF1**" is in the left pane and "**BVEL1**" is in the right pane.

Question 5. Hit the play button to animate radar data for 1-hour (12:16 AM to 1:15 AM). What QLCS radar feature do you see in Base Reflectivity moving from Barnsdall to Ramona (north of Tulsa)? What are you seeing in Base Velocity over the same area?

Question 6. What QLCS feature develops in Base Reflectivity extending from Tulsa northward to Ramona? What hazard do these usually produce?

Pause the animation and change your time to 1:24 AM (**Edit → Date...**). Zoom in to Tulsa.

Question 7. The buttons on either side of the play button let you step forward and backward 1 frame at a time. Using these buttons and watching Tulsa, step through from 1:10 AM to 1:24 AM. What do you think you are seeing in Base Velocity tracking from central to SE Tulsa? What other radar product might help to see this feature more clearly?

Change your time to 1:45 AM and step frame-by-frame from 1:28 AM to 1:45 AM. Watch Base Velocity data from Talala, OK down the QLCS line to Inola, OK (the radar is located in Inola).

Question 8. How many mesovortices do you observe in this 17-minute period? What features do you notice in Base Reflectivity at the location of the mesovortices?

Part 3: October 21, 2017 (Southwest and Central Oklahoma)

Change your radar site to the Frederick, OK (KFDR) radar. Go to **Edit → Date...** (Short cut **Shift D**) and change the date to **10/21/2017** and the time to **7:00 PM**. Make sure "**BREF1**" is in the left pane and "**BVEL1**" is in the right pane.

Question 9. Animate the radar data for 1-hour (6:01 PM to 7:00 PM) and watch the area of storms SW of OKC. What kind of storm (air mass, multicell, supercell) appears to be tracking from Medicine Park, OK to Apache, OK? Watch the storms SW of the Apache storm – what is happening to them by the end of the animation?

Change your radar site to the Oklahoma City, OK (KTLX) radar and your time to 8:00 PM (**Edit → Date...**) and animate for 1-hour (7:01 PM to 8:00 PM). Watch the storms SW of OKC.

Question 10. What subtle radar feature begins to show up ahead of the QLCS (near and NE of Rush Springs, OK) near the end of the animation?

Pause the animation and change your time to 9:05 PM (**Edit → Date...**). Step through one frame at a time (8:05 PM to 9:05 PM) and watch the storm that tracks over Norman, OK.

Question 11. It appears that there are two outflow boundaries that interact with the storm. At what time do you see the strongest rotation in Base Velocity? What do you notice about the outflow boundaries at that time?

Change your time to (**Edit → Date...**) 10:09 PM and animate for 1-hour (9:09 PM to 10:09 PM). Shift your attention to east of the OKC Metro area.

Question 12. What feature develops in Base Velocity and moves over Seminole, OK? What feature in Base Reflectivity appears in the same area?