Dual-Pol WES Exercises Overview

This document contains 4 jobsheets that step you through a dual-pol radar analysis in case review mode on the WES. All events are from central Oklahoma from the WSR-88D Dual-Pol KOUN. Each jobsheet in this document is specific to a particular high impact event and you don't have to work through them in any particular order. While completion times will vary from person to person, expect these exercises to take roughly 7 hours to work (including the self-contained answer keys). The jobsheets are:

1. **Winter Weather: ~90 min analysis time + 26 min answer keys**
2. **Heavy Rain: ~60 min analysis time + 22 min answer keys**
3. **Tornadoes and Hail: ~100 min analysis time + 60 min answer keys**
4. **Bow Echo: ~40 min analysis time + 20 min answer keys**

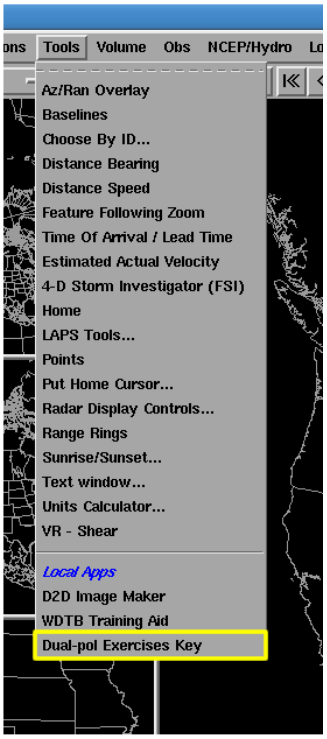
Answer Keys

Answer keys are provided on a question by question basis, and are loaded directly off the WES! They each consist of a narrated video screen capture, demonstrating how Paul Schlatter from WDTB would have answered each question on his WES. It's up to you *when* you want to view the answer key for each question, either immediately after you fill out the answer or at the end of the jobsheet. In any case, please load the answer key launch page right off the tools menu (right graphic below). A firefox window will open containing links to each of the jobsheet answer keys (left graphic below). These videos contain narration, so make sure your WES machine has a working sound card to hear the audio from each video screen capture answer key.

Dual-Pol WES Exercises Answer Key

This page has the links to view camtasia presentations of the answers to each of the questions that make up the dual-pol operations coures WES exercises. Each link below will launch an external window containing the answer(s) to the jobsheet and questions listed.

Winter Weather Jobsheet (12/24/09, 2/26/10, 3/20/10)	Heavy Rain Jobsheet (June 14, 2010)	Tornado/Hail Jobsheet (May 10, 2010)	Bow Echo Jobsheet (May 19, 2010)
Question 1 Key	Question 1 Key	Question 1 Key	Question 1 Key
Question 2 Key	Question 2 Key	Question 2 Key	Question 2 Key
Question 3 Key	Question 3 Key	Question 3 Key	Questions 3-4 Key
Question 4 Key	Question 4 Key	Question 4 Key	Question 5 Key
Questions 5-6 Key	Question 5 Key	Question 5 Key	Question 6 Key
Question 7 Key	Questions 6-7 Key	Question 6 Key	Question 7 Key
Question 8 Key	Question 8 Key	Question 7 Key	Question 8 Key
Question 9 Key	Question 9 Key	Questions 8-9 Key	Question 9 Key
Question 10 Key	Question 10 Key	Question 10 Key	
Questions 11-13 Key	Question 11 Key	Question 11 Key	
Question 14 Key	Question 12 Key	Question 12 Key	
Question 15 Key		Question 13 Key	
Question 16 Key		Question 14 Key	
Questions 17-18 Key		Question 15 Key	
		Question 16 Key	
		Question 17 Key	
		Question 18 Key	
		Question 19 Key	
		Question 20 Key	
		Question 21 Key	
		Question 22 Key	
		Question 23 Key	
		Question 24 Key	



Dual-Polarization Radar Operations Course
WES Exercises

Jobsheet #4: Bow Echo

Objective:

- Using the knowledge gained from training modules and with the aid of all training aids, integrate an analysis of dual-pol radar products into a bow echo event.

Case Data: 19 May 2010 in northern Oklahoma.

Available Data: KOUN radar and LAPS gridded data

Analysis Duration: 40 min
Answer Keys Duration: 20 min

Instructions:

1. Clear out all panes prior to starting this jobsheet, if they are not already blank.
2. Left click on the D2D clock in the lower right part of D2D.
3. Using the "Set Time" window, set the D2D clock to **2010 May 19 1045 UTC** (don't bother changing the seconds) and check the "Freeze Time at This Position" box.
4. Set Map Scale to "WFO"
5. Click on the koun menu and load "All Tilts Base Data"
6. Set frames to 64
7. Modify map backgrounds and data magnification as you see fit

8. In the All Tilts base data pane, loop through 0.5 deg frames, getting a broad scale view of the base products Z, ZDR, CC, and KDP. Pay attention to the character and movement of the precipitation echoes. For this event, feel free to also utilize velocity/SRM and spectrum width. It is a bow echo!.

   With this event you may notice severe data quality issues aligned along the radial. Towards the end of the case study we'll examine them and discuss why they exist in this dataset, as well any implications they may have.

9. When ready, go the 0.5 deg elevation angle in your 4 panel layout at **10:45 UTC.**

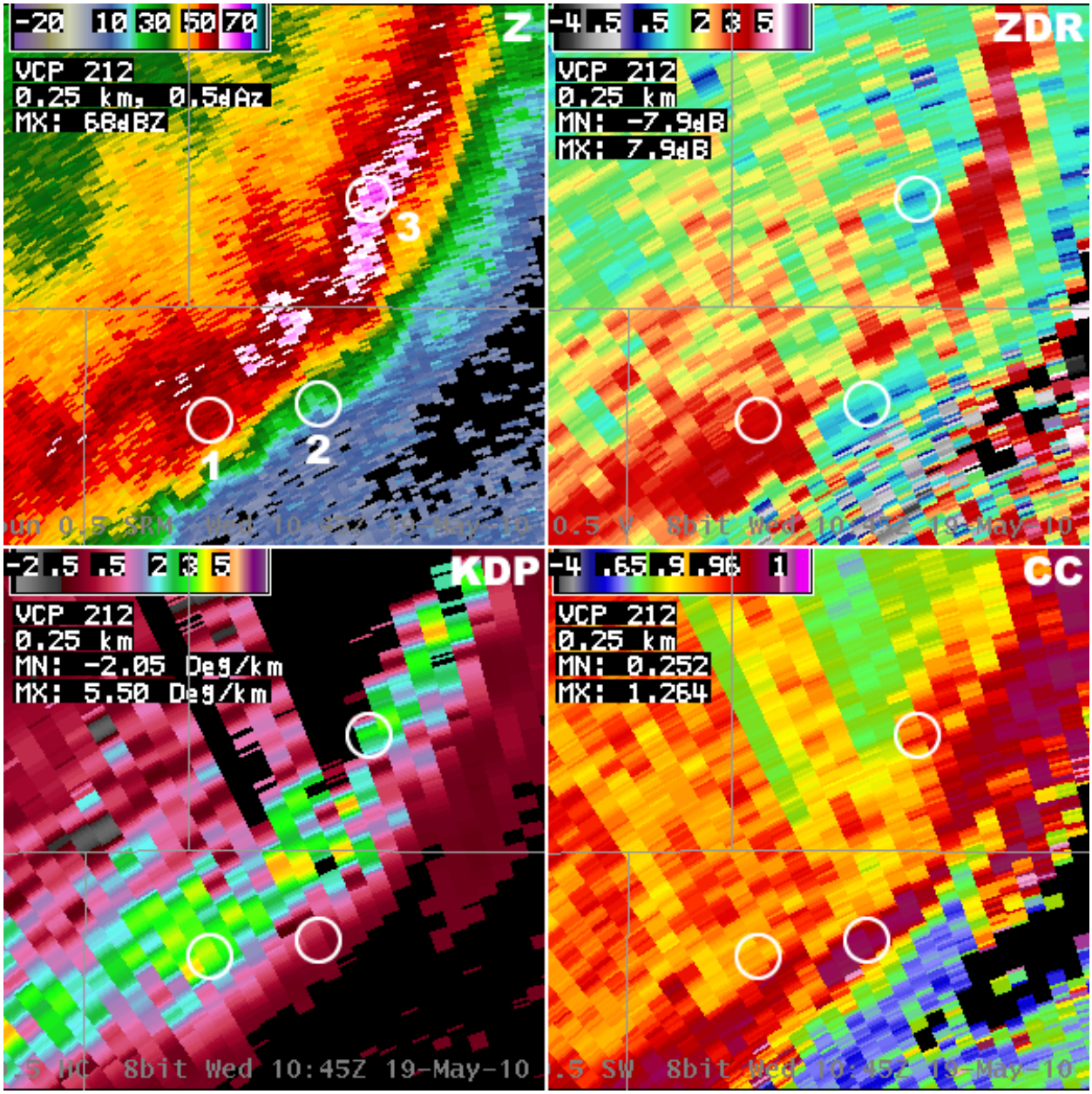


Figure 16. 4-panel 0.5 deg KOUN dual-pol product display from 19 May 2010 at 1045 UTC. The circles are areas you should examine on your own workstation to fill out the table associated with Question 1. Circles corresponding to label #1 are the area surrounding Range/Az 59 nm @ 330 deg, circles #2 are for 57 nm @ 3335 deg, and circles #3 are for 65 nm at 341.

Question 1: Toggle between Z (button 1), ZDR (button 2), CC (button 3), and KDP (button 4). Scan several bins around each range and azimuth to determine the general value from each radar product listed in the table. Use Figure 16 as a guide to help you see where you should be checking for data values. Then, in the row below each range and azimuth, fill in the row with the most likely dominant precipitation type from the list of choices on the next page:

- **Hail not mixed with much rain**
- **Rain and Hail mixture**
- **Heavy rain, small drops**
- **Heavy rain, large drops**
- **Light rain, large drops**
- **Stratiform rain (small drops, moderate rain rates)**
- **Tiny rain drops**

0.5 deg Products	Z	ZDR	CC	KDP
59 nm @ 330°	dBZ	dB		deg/km
Dominant Precip Type:				
57 nm @ 335°	dBZ	dB		deg/km
Dominant Precip Type:				
65 nm @ 341°	dBZ	dB		deg/km
Dominant Precip Type:				

10. Now use All Tilts and step up in elevation angle, through at least 2.4 degrees. Toggle between Z and ZDR (buttons 1 and 2) in between 0.5 and 2.4 degrees. Look for vertical continuity of strongest ZDR values. Note that on 1.8 and 2.4 deg elevation angles, the large blanked out areas are Range Folding (RF). A week or so after this event RF was properly coded purple, and will look that way at deployment on the dual-pol batch cuts.

Question 2: Focus on Z and ZDR at 2.4 degrees with the bow echo, and roughly between 50 and 62 nm in range. What are the mean values of the enhanced ZDR and roughly how high are they (in feet MSL)?

ZDR ~ _____dB at _____ ft MSL

Question 3: In a storm relative sense, where are these elevated values located? (Circle One):

In the Storm Core / In the Stratiform Region / Along the Leading Edge

Question 4: Given that the freezing level is 12.8 kft MSL, is this region of enhanced ZDR above the freezing level? Is this enhanced ZDR feature a ZDR column? Does this signature make sense in terms of its appearance along this bow echo? Fill out the check boxes table below:

Check Yes or No for:	YES	NO
Enhanced ZDR Above Freezing Level?		
Is it a ZDR Column?		
Enhanced ZDR where you expect to find it in terms of this bow echo?		

Question 5: At 0.5 deg and above, toggle between Z and CC (buttons 1 and 3) and focus on the azimuths 334 to 348 degrees. Where do the radially aligned, very low CC values seem to be originating from on the 0.5 deg elevation angle? This will be discussed in the answer key.)

Question 6: Toggle to HCA output (button 8). In those radials affected with poor data quality (334 to 348 degrees) at 0.5 degrees, what are some of the classifications it is coming up with? Is the HCA on the right track in this area?

Moving Ahead a Few Hours

1. Skip ahead a couple hours, to a time when the DP products are not as affected by the poor data quality. Using the WES workstation, left click on the D2D clock in the lower right part of D2D
2. Using the "Set Time" window, set the D2D clock to **2010 May 19 1246 UTC** (don't bother changing the seconds) and check the "Freeze Time at This Position" box.
3. Swap to an empty pane.
4. Set Map Scale to "WFO"
5. Click on the koun menu and load "All Tilts Base Data"
6. While in the same pane as the All Tilts products, click on the Volume menu, then "Std Env Data Package", then "LAPS"
7. Set frames to 14
8. Modify map backgrounds and data magnification as you see fit

Question 7: Using All Tilts and toggling between Z, ZDR, and CC, try to identify the melting layer. You'll probably want to use just the 0.5 deg elevation angle because of how far away from the radar the stratiform region is. What is the height of the top of the melting layer, and what is the height of the bottom of the melting layer, in feet MSL?

ML Top: _____ ft MSL

ML Bottom: _____ ft MSL

Question 8: Using cursor sampling of environmental data on the 0.5 deg tilt, what height is the 0°C level? Does it agree with your base data analysis of the melting layer? Why or why not?

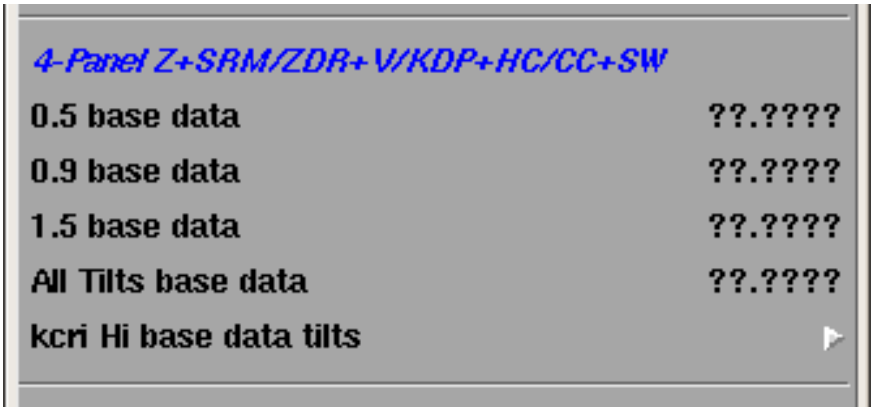
LAPS 0°C Height: _____ ft MSL

LAPS 0°C Does / Does Not Agree with radar analysis ML
(Circle One, then explain why or why not)

Question 9: In the same All Tilts base data pane, go to the koun menu, click on "koun Algorithm Overlay", then "Melting Layer (ML)", and finally "Melting Layer All". This loads the melting layer overlay product on all elevation angles. Check CC: Does the melting layer algorithm place the melting layer at the same height/range that you identified in Question 7? (Hint, focus on the solid rings) Does it seem to be identifying the melting layer adequately?

Panel Combo/Rotate (PCR) Review

1. Load a koun All Tilts Base Data display from the koun radar menu that will look similar to the one below.



2. Starting from the 4 panel layout you had from the previous set of instructions, hit the "Delete" key on the keyboard.

3. You'll notice that the display shifts to single panel, focused on what was the top left panel. Use the number keys shown above in the yellow rectangle to toggle from product to product, though you can still toggle between 2 products with the keypad ./Del key if you like. At the bottom of this page are the numbers associated with the products the loaded with the product menu button in step #1:

1. Reflectivity (Z)
2. Differential Reflectivity (ZDR)
3. Correlation Coefficient (CC)
4. Specific Differential Phase (KDP)
5. Storm Relative Mean Radial Velocity (SRM)
6. Velocity (V)
7. Spectrum Width (SW)
8. Hydrometeor Classification (HC)

4. One final addition you may not be familiar with is the all panel sample. While in PCR mode, enable cursor sampling. Then hold down right click and enable "All Panel Sample". To access it, hold down right click in any pane while in Panel Combo Rotate mode. Select the button to turn on "**All Panel Sample**", and the box to the left of the menu entry should be yellow (See graphic on next page). Clicking the "**Sampling**" button as well will allow the All Panel Sample to be on as you roam the cursor around, otherwise you'll have to hold down left click to view the full All Panel Sample cursor readout (right image on next page). You can toggle All Panel Sampling on and off using the space bar, changes take effect when you move the mouse. Play around with this for a bit.