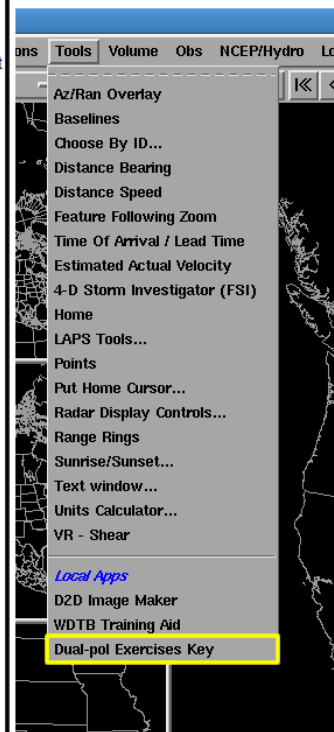# Dual-Pol WES Exercises Overview

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	

ons | Tools | Volume | Obs | NCEP/Hydro | Lo

Az/Ran Overlay
Baselines
Choose By ID...
Distance Bearing
Distance Speed
Feature Following Zoom
Time Of Arrival / Lead Time
Estimated Actual Velocity
4-D Storm Investigator (FSI)
Home
LAPS Tools...
Points
Put Home Cursor...
Radar Display Controls...
Range Rings
Sunrise/Sunset...
Text window...
Units Calculator...
VR - Shear

Local Apps
D2D Image Maker
WDTB Training Aid
Dual-pol Exercises Key

Jobsheet #2: Heavy Rain Detection

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 flash flood event.

Case Data: 14 June 2010 in central Oklahoma.

Available Data: KOUN radar and LAPS gridded data

Analysis Duration: 60 min
Answer Keys Duration: 22 min

<u>**Instructions:**</u>

1. Clear out all panes prior to starting this jobsheet.
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 June 14 12:13 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. 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 64
8. Swap panes to an empty pane
9. Set Map Scale to "WFO"
10. Click on the koun menu and load "0.5 Base Data"
11. While in the same pane as the 0.5 deg Base Data products, click on the Volume menu, then "Std Env Data Package", then "LAPS"
12. Set frames to 35
13. Modify map backgrounds and data magnification as you see fit

14. In the 0.5 deg base data pane, loop through the 35 fames at 4 panels and/or Panel Combo/Rotate, getting a broad scale view of the base products Z, ZDR, CC, and KDP. You may also want to get a feel for the character and movement of the precipitation echoes.

    With this event it's especially important to carefully examine loops of reflectivity near the radar. No ground clutter filtering was done north of the radar, so clutter contamination is a big problem in a few localized areas (see Fig. 2).

15. When ready, go the 0.5 deg 4 panel layout of base data at **12:13 UTC**, focusing on the band of heavy precipitation north of the radar from 10-40 nm. Be ready to utilize Panel Combo/Rotate to answer the following questions.
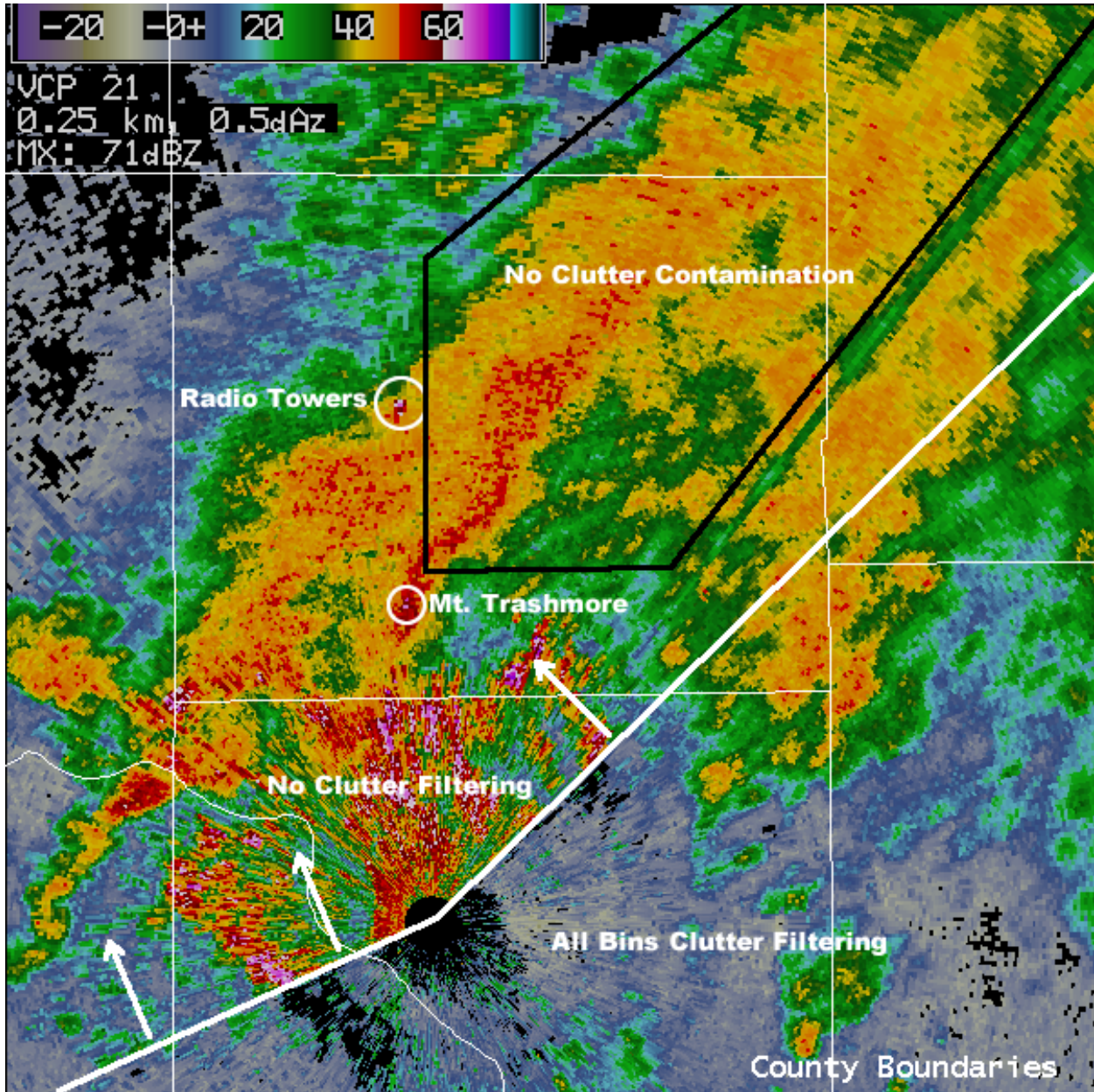
Figure 10. KOUN 0.5 deg reflectivity on 14 June 2010 at 1213 UTC. Inside the black polygon is where the radar products are NOT contaminated by clutter and should be used in this analysis. Below and to the right of the white line is where All Bins clutter filtering was enabled, above and to the left of the line no clutter filtering was done.

Question 1: Starting with a toggle between Z and CC (buttons 1 and 3), what is a mean value of CC to the nearest hundredth in reflectivity above 20 dBZ north of the radar in the band of heavy precipitation from 10-40 nm range? (Ignore the clusters of very low CC embedded in the precipitation shield which are unfiltered ground clutter)

CC ~ _____

Question 2: Use All Tilts CC and ZDR to find a melting layer, and alternately you can use cursor readout and look at the temperature values associated with the environment near the band of heavy precip. What is the height of the middle of the melting layer?

Height of the Middle of the Melting Layer: _____ ft MSL

Question 3:   Using Z, ZDR, and CC, identify any regions in the band of heavy precipitation just north of the radar that might contain hail. List each potential region by range and azimuth. You'll need to see Z greater than 55 dBZ, ZDR less than +1 dB, and CC less than 0.95. Again, stay away from ground clutter (see Fig. 2). If nothing looks like hail, state "None".

Question 4: Let's shift the focus to an examination of the nature of the rain in the heavy band of precipitation north of the radar at 1213 UTC. Toggling between Z, ZDR, and KDP, scan several bins around each range and azimuth to determine the general value from each radar product listed in the table. Based on those values, also rank each rain rate and rain drop size relative to each other, such that of the 3 range and azimuths, the one with the highest rain rate is ranked #1 in rain rate. Circle 1, 2, or 3 for each one.

0.5 deg Products	Z	ZDR	KDP
22 nm @ 10°	dBZ	dB	deg/km
	Rank Drop Size: 1, 2, 3 **Rank Rain Rate: 1, 2, 3**		
20 nm @ 11°	dBZ	dB	deg/km
	Rank Drop Size: 1, 2, 3 **Rank Rain Rate: 1, 2, 3**		
20 nm @ 62°	dBZ	dB	deg/km
	Rank Drop Size: 1, 2, 3 **Rank Rain Rate: 1, 2, 3**		

Figure 11: FSI time entry window for June 14th, 2010 event. Enter the numbers just as they are shown in the graphic.

Steps to Use FSI for this Event

1. Next, examine the 4-dimention Storm Investigator (FSI). Load this off the Tools menu onto either of your 4-panel displays.
2. In the pane with FSI loaded, right click in Oklahoma County, which is the rectangular county just north of the radar in the heaviest rain.
3. Enter the Mid-Point to match the above graphic (Fig. 11)
4. Wait about 15-30 seconds for FSI to load. Then navigate to the 1213 UTC volume scan at 0.5 deg (In FSI it will show up as 121401 UTC).
5. Orient your cross section to pass through the band of heaviest precipitation, as shown in Figure 12.
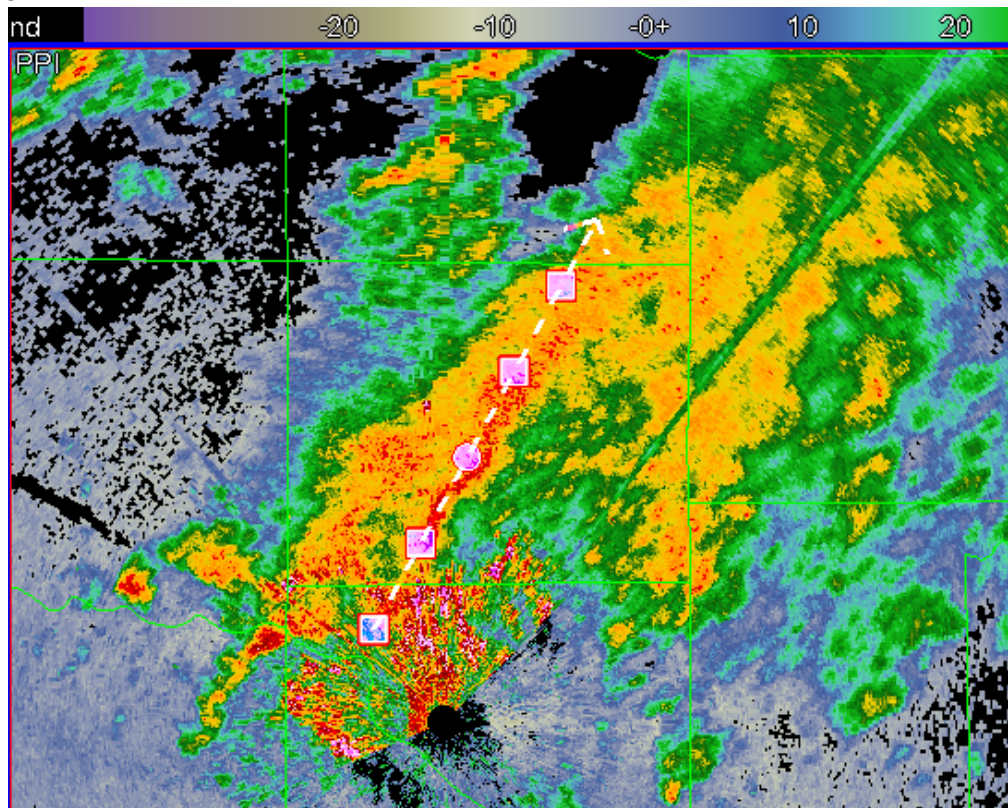

Figure 12: Top left pane of FSI, Reflectivity image at 121401 UTC 14 June 2010.

6. Examine the FSI cross section using reflectivity (Z button), ZDR (D button), CC (O button), and KDP (K button).

Question 5: <u>With only CC in the FSI cross section</u>, can you identify a melting layer? If so, what is the height?

Melting Layer via CC: _____ft MSL

Question 6: With ZDR and KDP in the FSI cross section, can you identify a melting layer? If so, what is the height?

Melting Layer via ZDR/KDP: _____ft MSL

Question 7: Toggle between KDP and Reflectivity. Where is the highest <u>KDP and Reflectivity</u> located in the vertical? (Circle one)

Above the melting layer / In the melting layer / Below the melting layer

Examine Precipitation Accumulation Products

1. You are done with FSI for this event. Let's examine precipitation products ending at 1600 UTC, with a disclaimer that things will likely change prior to deployment relative to what you see in this dataset. Open up procedures (control-O).
2. Double click on **DP_WESexercises**
3. Load or double click the procedure set "**DP-PPS Precip Comparison June 14**"
4. 8 products are loaded. To assist in your PCR analysis, here are the products that are loaded:

<u>Top Left Pane</u> PPS Storm Total Precip (1 key) + DP Storm Total Precip (5 key) Rain Gage totals overlaid (they precisely match the times in the storm total products)	<u>Top Right Pane</u> PPS One-Hour Precip (2 key) + DP One-Hour Precip (6 key)
<u>Bottom Left Pane</u> PPS Digitial Hybrid Reflectivity (4 key) + DP Hybrid Hydrometeor Classification (8 key)	<u>Bottom Right Pane</u> DP – PPS Storm Total Precip Difference (3 key) + DP – PPS One-Hour Precip Difference (7 key)

Note that PPS was running continental Z-R relationship $300R^{1.4}$

Question 8: Examine the storm total precipitation products (top left pane, keys 1 and 5). Which QPE algorithm seemed to perform the best relative to the gage reports, in particular north of the radar and out to roughly 50 nm? Be careful of regions of clutter. (Circle one)

Legacy PPS (STP) / DP QPE (STA)

Question 9: In your opinion, did either dual-pol or PPS QPE do an adequate job estimating storm total precipitation north of the radar out to roughly 50 nm? Explain your answer in the space provided below.

Question 10: Examine the one-hour precipitation accumulation products (top right pane, keys 2 and 6). Which QPE (dual-pol or PPS) seems to have higher amounts on average? Again avoid regions of clutter. (Circle one)

DP QPE (OHA) / Legacy PPS (OHP)

Question 11: Examine the precipitation accumulation difference (Dual-pol QPE – Legacy PPS) products (bottom right pane, keys 3 and 7). These are "messy" because of clutter contamination. The storm total difference product (DSD) is nearly useless because of the clutter targets and the resulting dynamic scaling of the DSD. Stick to the one hour difference product (DOD) to answer this question. Do these difference products agree with how you answered Questions 8 and 10?

Agree / Do Not Agree

Question 12: Final task is to load a dual-pol instantaneous precipitation rate product (DPR) in any open pane. It's on the koun radar menu under the "koun precip" submenu. What are the largest rates across Oklahoma County (rectangular county immediately north of the radar) at the 1213 UTC volume scan time? (Avoid azimuths 353 to 358 deg and look outside of 15 nm to avoid clutter)

_____._____in/hr