

# WES-1 Exercise - SAILS in AWIPS Familiarization

## Objective:

- Use the May 31, 2013 El Reno case to develop basic proficiency with incorporating the extra 0.5 degree SAILS Z, V, SRM, and SW data into AWIPS four panels and all-tilts analysis.

**WES-1 Case Name:** 2013May31\_SAILS

**Analysis Time:** 2200-2359 UTC May 31, 2013

- **Threats** - large hail, damaging winds, tornadoes (including widest tornado on record near El Reno), and later flash flooding
- **Evolution** – cluster of supercells developed near a dryline/stalled front intersection in western OK around 2130 UTC and moved into the west side of Oklahoma City
- **SPC Guidance**
  - Moderate risk of severe weather for analysis area with 60%+ hatched severe hail, 15-30% hatched tornado, and 15-30% severe winds
  - Particularly Dangerous Situation (PDS) tornado watch in effect
  - SPC mesoanalysis showed SBCAPE 5000+ J/kg with CIN 0-75 J/kg, MLCAPE 4000+ J/kg with MLCIN 0-75 J/kg, 0-6km shear 50-60kt, 1km shear 15-20kt, 0-3km SRH 150-225 m2/s2, 0-1km SRH 75-125 m2/s2, Supercell Composite Parameter 15-20, Sig Tor Parameter 2-3, effective Sig Tor Parameter 6-7

**Available Data:** KOUN WSR-88D test radar & 40km RUC from 2000-2359 UTC May 31, 2013

## Exercises

1. Jobsheet: Descending Hail Core, Dual-Pol Analysis, and Tornadogenesis (20 min)
  - a. In case review mode (no simulation), identify key aspects of SAILS behavior in AWIPS and develop basic proficiency with effectively interrogating SAILS data in four panels and all tilts.
  - b. Do this first before running the simulation.
2. Simulation Practice (20 min)
  - a. In a simulation, develop basic proficiency with interrogating SAILS data in a simulated real-time warning environment.
  - b. Focus more on getting used to the SAILS update behavior in the time pressure of warning operations (WarnGen optional).
  - c. Spotter images and tornado track information from El Reno lessons learned study are included in WESSL popups.

# Jobsheet: Descending Hail Core, Dual-Pol Analysis, and Tornadoogenesis (20 min)

## Instructions:

1. Launch D2D by running **start\_awips** in a shell window (or your local D2D starting convention) and select the **2013May31\_SAILS** case with **OUN** as the localization.
2. **Clear** out all panes prior to starting this jobsheet if they are not already blank.
3. **Left click on the D2D clock** in the lower-right part of D2D.
4. Using the “**Set Time**” window, set the D2D clock to **2013 May 31 2225 UTC** and ensure the “**Freeze Time at This Position**” box is selected with a yellow box. Click **OK**.
  - a. **Note:** The clock text in the bottom right part of D2D will turn yellow, and it should read 22:25 Z 31-May-13.
5. Set Map Scale to “**WFO**” and set frames to **12**.

## Four Panel Lowest 4 Tilts Z/SRM8 – Descending Hail Core

6. Load a koun four panel of the lowest four tilts of Z/SRM8 data by clicking on the **koun** menu, the **koun four panel** submenu, and the “**0.5 1.5 2.4 3.4**” submenu from under the Z+SRM8 section.
7. Make sure your **text legend labels are in the more verbose mode** (e.g. koun 0.5 Z 8bit Fri 22:14Z) by cycling through the legends with the **Enter** key on the keypad.
8. Toggle to the **Z** side of the four panel using the “.” key on the keypad.
9. Use the **left/right arrow keys** to navigate the upper-left panel to **2159 UTC** and **zoom** in to the small intensifying storm at **50nm@280 degrees**.
10. Then **step forward in time** with the four panel using the right keyboard arrow and notice the extra 0.5 degree SAILS tilt in the upper-left panel updates between each full volume scan.
  - a. **Note:** The extra 0.5 degree SAILS tilts **from 2214-2216 UTC** and **2219-2221 UTC** provide an earlier heads up on the descending hail core in low levels.
11. Using the left/right arrow keys, navigate the **0.5 degree Z** in the upper-left panel to **2214 UTC**. **Step** through the **next three frames** while noticing the time stamps in each panel:
  - a. Frame 8: all panels have the 2214 UTC label
  - b. Frame 9: 0.5 degree extra SAILS tilt in upper-left panel is 2216 UTC with the other panels labeled 2214 UTC
  - c. Frame 10: all panels have the 2219 UTC label

Notice in Frame 9 that D2D matches the extra SAILS tilt time, **2216 UTC**, to the nearest full volume scan time available, **2214 UTC**.

12. Now step forward and backward between the 3 frames and notice **the time matching logic does not change**, though it may appear different when stepping backward. The general time matching and stepping backward in time can take some getting used to, though when adding the time pressures of warning operations, some of these smaller details tend to be overlooked in the heat of battle.
13. **Step forward and backward in time** multiple times throughout the whole frame sequence while paying attention to the extra SAILS tilt time in the upper-left panel to get used to the time matching.
14. Navigate to **2214 UTC 0.5 Z** (upper-left panel) and hit the **Enter** key on the keypad multiple times until you get the **single-time text label (Fri 22:14Z 31-May-13)** to display.

15. Use the **right arrow** to step forward in time and notice that while the upper tilts don't change, the time stamp for the upper tilts changes incorrectly from **22:14Z** to **22:16Z** (the extra SAILS tilt time).
  - a. The condensed label can't differentiate the time difference between the extra SAILS tilt and the upper tilts. It is much easier to identify the extra 0.5 degree SAILS tilt with the verbose legends on, though the drawback is more clutter in the text legend.

### **All Tilts base data – Dual-Pol Analysis**

16. **Swap** the main pane and set the scale to **WFO scale** and frame count to **64 frames**.
17. Under the **koun** menu, load the **All Tilts base data** from the **4-Panel Z+SRM/ZDR+V/KDP+HC/CC+SW** section.
18. Toggle to the **Z** product in the upper-left panel by using the “.” key on the keypad and use the up/down arrows to navigate to the 0.5 degree tilt.
19. Make sure your **text legend labels are in the more verbose mode** (e.g. koun 0.5 Z 8bit 22:14Z) by cycling through the legends with the **Enter** key on the keypad.
20. Using the **left/right arrows**, navigate the **0.5 degree Z** panel (upper-left panel) to **2209 UTC** and **zoom** in to the storm out west at **50nm@280 degrees**.
21. Use the **up/down arrows** to interrogate the whole volume scan until you return to the **2209 UTC** 0.5 degree tilt.
22. Now use the **right arrow** to step the **0.5 Z** in upper-left panel forward in time from **2209 UTC** to the extra 0.5 degree SAILS tilt at **2211 UTC**.
23. While viewing the 2211 UTC extra SAILS tilt, try using the **up/down** arrows and notice nothing changes. All tilts treats the extra SAILS tilt as a single-tilt volume scan.
24. Step forward in time using the **right arrow** and interrogate each volume scan using the **up/down arrows**. Repeat this over multiple frames to get used to the extra SAILS tilt.
  - a. **Note:** Every time you are on the extra SAILS tilt at 0.5 degrees, the up/down arrows do not go anywhere on these single tilt volume scans. To return to the previous more complete volume scan you just need to step back in time before using the up/down arrows.
25. Navigate to the **0.5 degree tilt** with the up/down arrows and then use the left/right arrows to find the **2219 UTC 0.5 Z** product in the upper-left panel.
26. For the storm out west at **47nm@284 degrees** **sample** the low **CCs** (~0.66) in the lower-right panel and note this coincides with the southwestern side of the high reflectivity developing hail core.
  - a. 1.25” hail was reported 1 SSE of Hinton 1 min later at 2220 UTC
27. Now use the **right arrow** to step forward in time to **2221 UTC 0.5 Z** and notice the spatial offset between the 2219 UTC Dual-Pol products and the 2221 UTC extra SAILS tilt of reflectivity in the upper-left panel.
  - a. **Note:** The RPG does not create Dual-Pol products on the extra SAILS tilt.
  - b. **Note:** You need to pay extra attention to the time stamps when comparing the extra 0.5 SAILS tilt of Z, SRM, V, and SW with the Dual-Pol products at 0.5 degrees to make sure they are at the same time.
  - c. **Note:** AWIPS-2 was fielded with a bug where 0.5 degree V and SW data do not update in real-time operations, which adds another layer of complexity for AWIPS-2 sites. This AWIPS-2 defect may be fixed in spring or summer of 2014.
28. Toggle to the velocity data using the “.” key on the keypad and notice the **2221 UTC** SRM, V, and SW data with the extra SAILS tilt are also offset from the **2219 UTC** Dual-Pol HC (lower-left panel).

29. Navigate the **0.5 degree Z** panel in the upper left to **2209 UTC**. Then use the **up arrow** to navigate to the **0.9 degree Z at 2209 UTC**.
  - a. If you stay above the 0.5 degree tilt while doing all-tilts analysis you will find that you can roam freely in time and space using the up/down arrows and left/right arrows if you don't tilt down to the 0.5 degree tilt. The key to using all tilts with SAILS is to just be aware of the extra 0.5 degree SAILS tilt and step back a frame to return to the complete volume scan.

#### **Four Panel Lowest 4 Tilts Z/SRM8 – Tornadogenesis**

30. **Left click on the D2D clock** in the lower-right part of D2D.
31. Using the “**Set Time**” window, set the D2D clock to **2013 May 31 2255 UTC** and ensure the “**Freeze Time at This Position**” box is selected with a yellow box. Click **OK**.
  - a. **Note:** The clock text in the bottom right part of D2D will turn yellow, and it should read 22:55 Z 31-May-13.
32. **Swap** the main pain and set map scale to “**WFO**” with a frame count of **12**.
33. Load a koun four panel of the lowest four tilts of Z/SRM8 data by clicking on the **koun** menu, the **koun four panel** submenu, and the “**0.5 1.5 2.4 3.4**” submenu from under Z+SRM8.
34. Make sure your **text legend labels are in the more verbose mode** (e.g. koun 0.5 Z 8bit 22:14Z) by cycling through the legends with the **Enter** key on the keypad.
35. Toggle to the **SRM8** side of the four panel using the “.” key on the keypad and zoom in to the storm out west at **36nm@295 degrees**.
36. Use the **left/right arrows** to navigate to the **first frame** in the sequence and then step forward in time through the frames using the **right arrow** and notice the enhanced velocity evolution provided by the extra 0.5 degree SAILS tilt.
  - a. Pay particular attention to the strengthening mesocyclone from **2240-2242 UTC** and **2250-2252 UTC**.
  - b. The storm's first tornado (brief EF0) occurs from 2255-2256 UTC, and SAILS provides a more continuous view of the cyclic mesocyclones preceding the tornado: **old - 2250 UTC, 39nm@297, 2.4 degrees in the lower-right panel** and **new - 2252 UTC, 37nm@295, 0.5 degrees in the upper-left panel**.
37. You may notice that most of the extra SAILS tilts are 2 min ahead of the initial volume scan time, but some are 3 min ahead (e.g. **2227 UTC** and **2232 UTC**). When the extra SAILS tilt is 3 min ahead, it actually time matches to the next volume scan's upper tilts in four panels when they are all available (e.g. **0.5 2227 UTC extra SAILS tilt** from the **2224 UTC** volume scan time matches with the **2229 UTC upper tilts** because it is closer in time). Time matching the extra SAILS tilt with volume scans shortened by AVSET can be complicated, but the more you work with it, the less noticeable these things become.
38. Now that you are done with the case review steps, **left click on the D2D clock** in the lower-right part of D2D. Use the “**Set Time**” window to check the “**Use Current Real Time**” box and click **OK** (D2D clock text in lower right should turn from yellow to black).
39. **Clear the data in all your panes** before moving on to reviewing the fundamental concepts summary below and the simulation practice.

## **Jobsheet - SAILS Concepts Summary and Recommendations**

- **All-Tilts Extra 0.5 Degree Tilt Volume Scan** – The extra 0.5 degree SAILS tilt is essentially its own separate volume scan with a different time, so recognize there is no deeper volume analysis when analyzing the extra 0.5 tilt.
- **Normal All-Tilts Analysis Above 0.5 Degrees** – If you stay above 0.5 degrees, All tilts allows continuous stepping in time (left and right arrows) and space (up and down arrows) just as before.
- **Additional D2D Frame in 4-Panel Time Matching** – When the extra 0.5 degree SAILS tilt initially arrives, only the 0.5 degree tilt of Z, V, SRM, or SW will update (other tilts remain the same), creating one additional D2D frame of data with offset time matching.
  - **Note:** When the extra SAILS tilt is combined with other data, D2D consistently matches the extra SAILS tilt to the closest data available in time.
  - **Note:** AWIPS-2 was fielded with a bug where 0.5 degree V and SW data do not update. This AWIPS-2 defect may be fixed in spring or summer of 2014.
- **Use Verbose Text Legend Labels with SAILS and Don't "Enter" the Time Warp** – You can more easily track the time offsets in the extra 0.5 degree SAILS tilt when you have the verbose text legends displayed (e.g. koun Z 8bit Fri 22:16 compared to just Fri 22:16 31-May-13). Once you hit the Enter key on the keypad to change to a shortened time label, you have effectively "Enter"-ed a time warp where the data matched to the extra SAILS tilt are incorrectly labeled with the time from the extra SAILS tilt.
- **Do Not Compare Dual-Pol Products With the Extra 0.5 Degree SAILS Tilt** – Only Z, V, SRM, and SW products are created by the RPG with the extra 0.5 degree SAILS tilt, so pay close attention to the time offset between Dual-Pol products and Z, V, SRM, and SW products at 0.5 degrees. To properly interpret Dual-Pol data at 0.5 degrees you need to avoid comparing 0.5 degree Dual-Pol data to the extra 0.5 degree SAILS tilt because of the time mismatch.
- **Two-Step with the Extra 0.5 Degree SAILS Tilt to Help Identify Offset Time Matching** – If reading the text labels becomes too cumbersome to identify the offset time matching, many times just stepping forward and backward in time 2 frames (left and right arrows) can help in identifying the extra 0.5 degree SAILS tilt.
- **Stay in Tune with the Extra 0.5 Degree Tilt** – In real-time operations keeping track of the extra SAILS tilt is more challenging. If you have your 0.5 degree data loaded in another pane with an appropriate zoom level (e.g. WarnGen with 0.5 Z/SRM8 toggled to SRM8 and zoomed in on a storm for a tornado environment), then the auto-updates can catch your eye when there are significant changes. Another way to keep track is to tear off a radar menu, like koun Z, and read the times.

## Simulation Practice (20 min)

1. Run the WES-1 "**start\_simulator**" script from a shell window (or launch WES using your standard local convention) to configure your simulation.
2. Click the **Run Simulation** button, the **OK** button and the **Load Saved Settings** button.
3. Select the **SAILS\_Simulation\_May31\_2255** macro and click **OK**.
4. Click **OK** and when the simulation window pops up, click **Run Simulation** to start the simulation.
  - a. Once the popup says to start D2D, launch D2D on all your monitors using **start\_awips** (or your local D2D starting convention) with one of them having the text workstation box checked (for WarnGen). The simulation will run until 2359 UTC, but you can stop it when you have had enough practice before then.
5. **Left click on the D2D clock** in the lower-right part of D2D and use the "**Set Time**" window to check the "**Use Current Real Time**" box and click **OK**.
  - a. When a simulation is running you need to be using the current real time setting for products to update.
6. On one D2D main pane set the scale to **WFO** and load a **0.5 Z + SRM8** from the **koun** menu.
7. Zoom in to the storm out west at **35nm@296 degrees**.
8. Toggle to **SRM8** using the "." key on the keypad and leave it on the most current frame, so it will always keep updating.
  - a. Many times, overlaying the warning polygons on the 0.5 degree data and leaving it on the most recent frame will catch your eye more when something interesting updates in the extra 0.5 degree SAILS tilt.
  - b. When roaming around in time and space with four panels and all tilts, it is easy to miss when the new 0.5 degree SAILS tilt comes in.
9. To help keep track of the most recent radar tilts, create a tear-off menu of koun Z by clicking on the **koun** menu, **koun Z** submenu, and "----" at the top of the pullout menu.
  - a. To keep the window from getting lost, right click on the tear-off window and select "On Top" or "Keep Above Others" under the Advanced menu (depends on your Linux desktop).
10. On the other D2D set the scale to **WFO** and load a koun four panel of the lowest four tilts of Z/SRM8 data by clicking on the **koun** menu, the **koun four panel** submenu, and the "**0.5 1.5 2.4 3.4**" submenu from under the Z+SRM8 section.
11. **Swap** the main pane and set the scale to **WFO scale** and frame count to **64 frames**.
12. Under the **koun** menu, load the **All Tilts base data** from the **4-Panel Z+SRM/ZDR+V/KDP+HC/CC+SW** section.
  - a. Monitor the tilts as they come in using both of these tools. Remember that **Ctrl + right arrow** will return you to the most recent volume scan's tilt, which will many times be the extra 0.5 degree SAILS tilt.
  - b. **Note:** In four panels, as the new extra 0.5 SAILS tilt arrives, it replaces the existing 0.5 tilt, and it leaves the other upper tilts unchanged. When the new full

volume scan starts, the upper tilts clear out and eventually fill in when they arrive (standard AWIPS convention).

13. Once you are comfortable with the updating of SAILS data, go ahead and issue warnings and follow-up statements for this storm.
  - a. Monitoring the SAILS data when issuing warnings and updates is a different experience than passively looking at data in case review. One particular challenge in this event is communicating the changing position and motion of the tornado which is aided by the use of SAILS data.
  - b. SAILS data gives you critical information on the increases and decreases of rotation as well as positioning and motion of the tornado.
14. By 2315 UTC you can stop the simulation if you have had enough. Or, keep on going and witness the widest tornado on record (2.6 mi wide). Some interesting features include:
  - a. 2255-2256 UTC - **First tornado** (EF0) of the storm 7 mi S Calumet
  - b. 2301 UTC – **radar data** showing 200-250kt delta-V storm-top divergence at 46Kft, BWER 18-40Kft, and ZDR column to 22-27 Kft (-15C to -28C environment and -6C to -15C updraft core)
  - c. 2303-2344 UTC - **EI Reno tornado** (EF3; 2.6 mi max width at around 2320 UTC) 8 mi S Calumet to 5.5 mi S EI Reno to 6 mi SSW Richland
  - d. 2311-2343 UTC - **Tornado Debris Signature** with low CCs and low ZDR coincident with the strong large vortex.
    - i. Make sure and limit your Dual-Pol analysis at 0.5 degrees to not use the extra 0.5 degree Z, V, SRM, or SW SAILS tilt due to the time difference.
  - e. 2312-2313 UTC - **Satellite tornado** (EF0) 6.5 mi SSW EI Reno
  - f. 2313-2314 UTC - **Satellite tornado** (EF0) 5.5 mi SW EI Reno
  - g. 2319 UTC - **Weather Channel vehicle destroyed**
  - h. 2320 UTC – first storm chaser **fatality** (Richard Henderson)
  - i. 2323 UTC – tornado researchers **fatalities** (Tim Samaras, Paul Samaras, and Carl Young)
  - j. 2329-2341 UTC - **Anticyclonic tornado** (EF2) 6 mi W to 4.5 SW Yukon
  - k. 2340 UTC – **Tornado Eye** pronounced weak reflectivity observed on 0.5 degree extra SAILS tilt
15. While the extra SAILS tilts add precious low-altitude radar data to warning decision making and makes radar loops look smoother and more continuous, mobile Doppler radar data still shows much finer details exist in time and space with severe storms. When you are done, feel free to view some of the University of Oklahoma RaXPoI mobile radar data compliments of Jeff Snyder (NSSL/NOAA) and Howard Bluestein (OU):
  - a. **cd /data/awips/2013May31\_SAILS/raxpol**
  - b. **firefox 4panel.gif**
    - i. **2257-2315 UTC**
    - ii. upper left (Z), upper right (ZDR), lower left (RHOHV i.e. CC), lower right (raw V with no dealiasing)
  - c. **firefox 2panel.gif**

- i. **2315-2315 UTC**
  - ii. left (Z) and right (raw V with no dealiasing)
  - iii. note satellite tornadoes west of main tornado are not resolved in the KOUN WSR-88D data
- d. RaxPol Mobile Radar Note
  - i. RaxPol is an X-band (3cm) radar (much smaller wavelength than the 10cm WSR-88D S-band) with a 1 degree beam at very close range (i.e. very high resolution) and 15-30 second volume scans, so expect different values.
- e. The OUN WFO has a detailed web page write-up on this event with a fascinating Youtube video of the storm chasing accounts and lessons learned from the El Reno tornado.
  - i. Web page
    - 1. <http://www.srh.noaa.gov/oun/?n=events-20130531>
  - ii. Youtube Video
    - 1. [https://www.youtube.com/watch?feature=player\\_embedded&v=TBjr-nvA2Jg](https://www.youtube.com/watch?feature=player_embedded&v=TBjr-nvA2Jg)