DUAL POLARIZATION STORM

OF THE WEEK PILOT PROJECT

Prepared By The

ROC Applications Branch
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Norman, Oklahoma
06 July, 2011

EXECUTIVE SUMMARY:
The Warning Decision Training Branch (WDTB), Radar Operations Center (ROC) and National Severe Storms Laboratory (NSSL) collaborated to produce a "Pilot" version of a weekly Dual Polarization (DP) training program called "Storm of the Week" (SOTW). The program lasted 5 weeks ending on 10 May 2011. The purpose of the project was to build forecaster expertise by:

1) Introducing DP radar products to field forecasters
2) Illustrating DP warning and forecasting applications
3) Resolving any questions forecasters may have about DP.

The resulting SOTW weekly meetings were short and scheduled in order to get maximum attendance. Team members producing the SOTW meetings used Go To Meeting Webinar and a WDTB teleconference service to host the sessions. Additionally, to provide easy access to forecasters, the sessions were recorded, both video and audio, and place on the WDTB site for easy access.

At the end of the project, the ROC Applications Branch solicited forecaster feedback concerning the relevance and effectiveness of the SOTW training as well as the potential benefits of DP to the field forecaster.

1) *All of the survey respondents unanimously agreed that the SOTW program improved their knowledge of DP products and applications and increased their confidence in using DP data in operations.*
2) *Almost all (18 out of 19) forecasters agree or strongly agree that DP products will positively impact their warning and forecasting operations.*

The results clearly show that forecasters see the potential benefits of incorporating DP data into their operations and that their confidence in using the new data was increased by the SOTW program. The results also illustrate how a National SOTW training initiative could have a major impact in quickly and efficiently transitioning DP data into the warning and forecasting operations. However, *funding will need to be procured for WDTB to continue the SOTW program in FY12.*

Introduction

Forecaster feedback from the 17-19th August 2010 Operational Assessment of pre-deployment Dual Polarization (DP) radar data indicated the need for training that supports continuous learning. Specifically, forecasters were looking for supplemental training that would illustrate DP benefits using recently collected DP data. To meet this need, the Warning Decision Training Branch (WDTB) planned to provide, dependent upon funding, a weekly training program to share key DP forecasting applications with National Weather Service (NWS) forecasters from all Weather Forecast Offices (WFOs) nationwide.

In February 2011, the Vance AFB, OK Weather Surveillance Radar – 1988 Doppler (WSR-88D, KVNX) was upgraded to DP capabilities as part of an extended field test to support ROC operations testing. Shortly after the DP upgrade, data from KVNX proved to be very stable and relevant to operational use. With the existence of two DP WSR-88D's, the opportunity existed to solicit forecaster feedback on how the nearby WFOs used DP data in their operations. WDTB, Radar Operations Center (ROC) and National Severe Storms Laboratory (NSSL) collaborated to provide a "Pilot" version of the weekly training program called "Storm of the Week" (SOTW).

In planning this program, SOTW team members placed an emphasis on examining radar data from recent weather events to demonstrate how DP data can provide forecasters insight during warning and forecasting operations. The purpose of the project was to build forecaster expertise by:

1) Introducing DP radar products to field forecasters
2) Illustrating DP warning and forecasting
3) Resolving any questions forecasters may have about DP.

The resulting SOTW weekly meetings were short (30-40 minutes) and occurred at a time of day when the forecaster workload was lightest in order to get maximum attendance, e.g. just after the publishing of the morning zone forecasts. The SOTW meetings were held via Go To Meeting Webinar with audio provided by a WDTB teleconference service. Additionally, to provide easy access to forecasters, the sessions were recorded, both video and audio, and place on the WDTB training website for easy access.

SOTW sessions were hosted alternately by DP experts from WDTB, ROC and NSSL. 'Hosting' consisted of a single team member selecting and examining a DP radar data case for DP teaching points to share with forecasters. The host would then conduct a SOTW "dry run" in front of the

rest of the SOTW team. This process ensured that each presentation would be clearly communicated prior to a session and that DP teaching examples were consistent with previous SOTW examples. For the actual webinar, each SOTW "host" displayed DP data via a combination of Weather Event Simulator (WES) software, installed on a laptop, and power-point slides. Finally, the webinar, including audio, was recorded by WDTB staff members and later placed on the WDTB web site (URL: http://www.wdtb.noaa.gov/courses/dualpol/, SOTW section near bottom of webpage). The SOTW pilot project lasted for 5 weeks beginning 12 April and ending on 10 May 2011.

At the end of the project, the ROC Applications Branch solicited forecaster feedback via an online survey. SOTW survey questions focused on soliciting feedback concerning:

1) How relevant or effective was the training provided by SOTW in familiarizing forecasters with DP data?
2) From what they learned about DP from SOTW, did forecasters agree or disagree that DP data could positively impact their forecasting and warning operations?

Forecaster Survey Results

At the start of the SOTW project, only the WFO sites using the Vance AFB, OK were invited. However, as the project matured the attendance increased. By the end of the fifth week, representatives from a number of WFO field offices, DoD and NWS Regional and National Headquarters were participating (see Table 1). This included the five DP Beta Test Sites in the DP Radar Upgrade Program.

Table 1: List of participants during the SOTW five week pilot project with red denoting a DP Beta Test Site.

WFO Field Units	Norman, OK; Tulsa, OK; Amarillo, TX; Topeka, KS; Dodge City, KS; **Wichita, KS**; Goodland, KS **Phoenix, AZ; Newport/Morehead City, NC; Pittsburgh, PA**
DoD Field Units	**Vance AFB, OK**
Regional HQ Organizations	Central Region WSR-88D Focal Point Southern Region WSR-88D Focal Point
National HQ Organizations	Office of Science and Technology Office of Hydrological Development Radar Operations Center Testing and Hotline Support

At the end of the SOTW pilot project, the SOTW team sent participants, via email, a link to an on-line survey. The complete list of the survey questions can be found in Appendix A. A total of 19 participants responded to the survey with the majority of SOTW survey respondents (14) being field forecaster personnel (MICs, SOOs and Forecasters) from the NWS. A handful of representatives from the NWS Regional or National Headquarters and one from the Department of Defense also responded (see Figure 1).

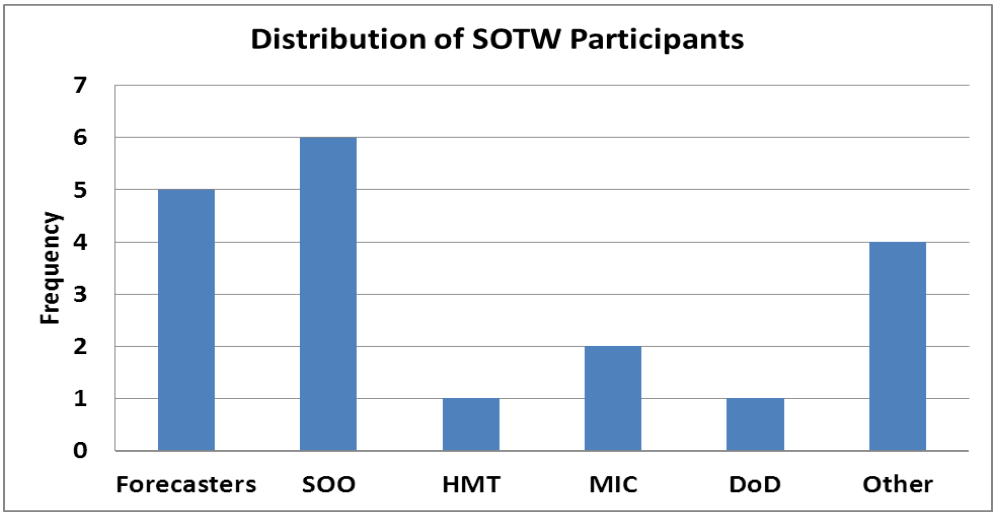

Figure 1: Distribution of the respondents to the SOTW survey. The "Other" category included Regional and National Headquarters personnel.

All of the survey respondents unanimously agreed that the SOTW program improved their knowledge of DP products and applications, e.g. SOTW helped to build DP expertise. Forecasters were asked to what degree, based on a scale of 1 (minimum) to 10 (maximum), was their knowledge of the DP products and forecasting applications improved by attending the SOTW sessions. Figure 2 shows that the majority of participants, 74%, believed SOTW provided a moderate or higher (ratings of 5 or more) improvement to their DP knowledge. Some key comments:

"I haven't had any practical experience with the dual pol products. So being able to see them and what they can show is helpful."

"I feel the webinars have been very good for convincing ops staff skeptical on Dual-Pol use in operations."

"Having someone with expertise identify features discussed in training helps with real life application of dual polarization data."

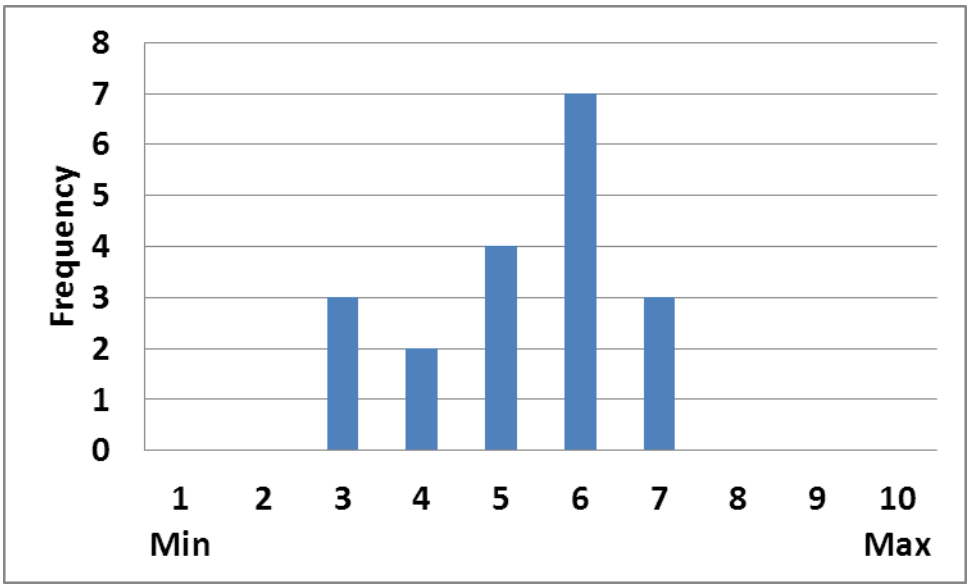

Figure 2: Distribution of forecaster responses on the degree of improvement SOTW provided to their DP knowledge. A rating with a value of '5' or above was considered to represent at least a moderate improvement in DP knowledge.

Forecasters were also asked, based on what they learned from SOTW, whether they agree or disagree that DP products could positively impact their forecasting and warning operations. *Figure 3 shows that most (over 94%) forecasters agree or strongly agree that DP products will positively impact their operations. This is critical as it illustrates that forecasters clearly see the potential benefits of incorporating DP data into their operations.* The majority of forecasters (84%) stated that as a result of attending SOTW sessions they had increased confidence in using DP products in their future forecasting operations. Of those who stated this, the majority (12 out of 16) believed the information provided about DP during SOTW would moderately or greatly (rating of 5 or more) improve their confidence in forecasting operations (figure 4). Similar results were obtained when forecasters were asked if DP knowledge from SOTW would improve their confidence in warning operations (18 out of 19 said "yes") and the degree of improvement to their confidence was rated as moderate or higher (89%).

Some key comments that forecasters shared concerning the amount of improvement DP could provide were the following:

"The products have only been available to me (KVNX) for a short time. With any emerging technology there is a period of evaluation when routines are modified and new practices readily accepted. I can't say for certain that the Storm of the Week has answered all of my questions, but it has pushed me along quicker."

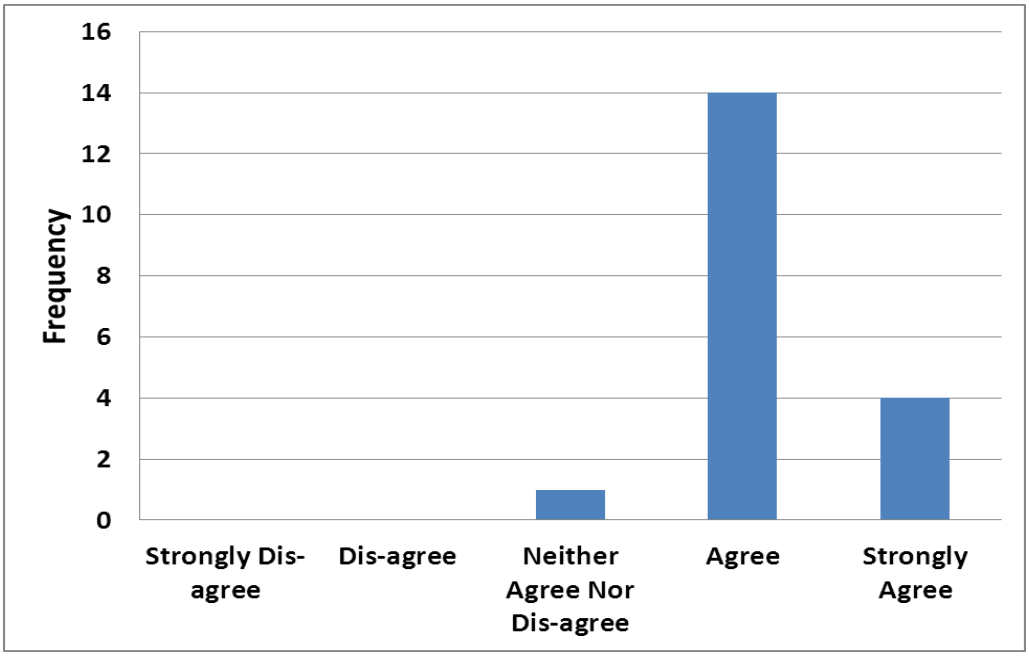

Figure 3: Distribution of survey participants responses on whether they agree or disagree that DP products could positively impact their forecasting and warning operations.

"In our CWA, flash flooding rather than river flooding is a big problem. These products, I feel, can help us get better lead times on flash flood warnings."

"Again, I already have had quite a bit of training on the products and already feel there is usefulness in the products. However, I do think the Storm of the week has been an excellent way for other members of my office to gain confidence in the products etc. I think the Storm of the Week is a great tool for the research and development side of the field to speak directly to the forecast operations folks."

"SOTW hasn't added too much to my warning decision making skills...but I will definitely use dual pol variables to help me determine potential for very heavy rain, large hail, and identification of very strong updraft development (ZDR columns)."

"Association between ZDR columns and severe hail, as well as detection of TBSS features by ZDR and CC, are immediately applicable to severe weather ops. I would be interested to see how dual pol QPE products compare to legacy bias corrected products, thinking about flash flooding."

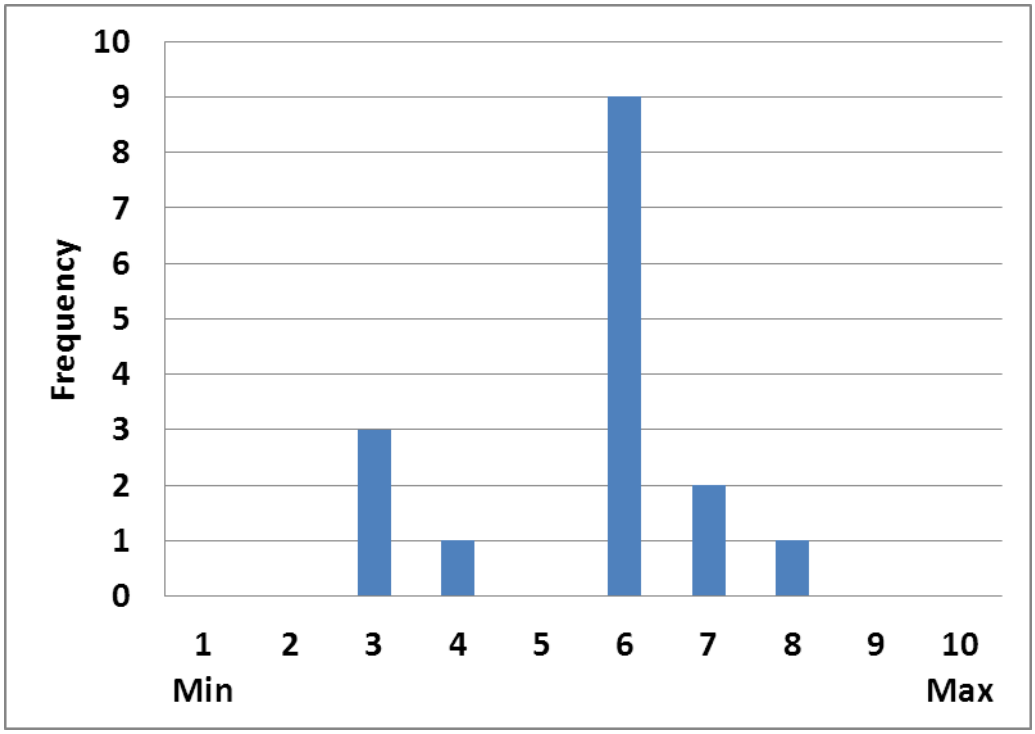

Figure 4: Survey distribution on the degree of improvement SOTW sessions had on forecaster confidence in using DP products during forecasting operations.

At this point, we focused our survey questions on the participant feedback concerning the format of SOTW. Figure 5 shows that the reasons people attended were varied, while figure 6 indicates that most participants (74%) believed the level of detail was about right. Participants unanimously believed that enough time was allowed for questions and discussion and 95% of participants would like future SOTW sessions be held at the same time each week. However, we polled participants on whether they used the archived video and audio made available on-line by WDTB. The survey comments and results (see figure 7) indicated that some personnel had difficulty downloading or viewing the videos, or either viewed the videos rarely or not at all. This indicates the methodology used to distribute the archived SOTWs on-line needs to be reviewed and perhaps better advertisement is needed.

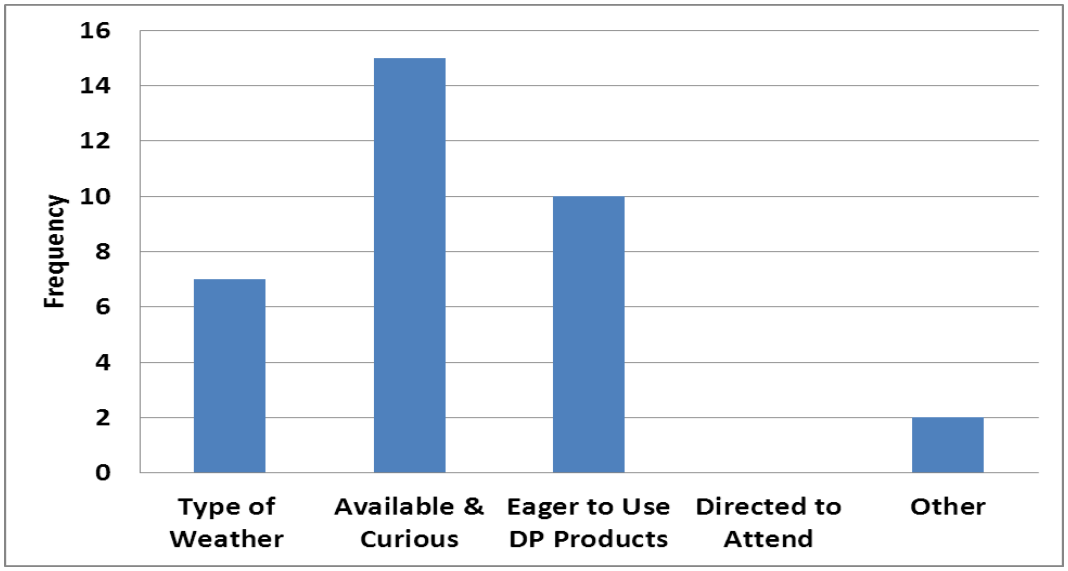

Figure 5: Forecaster feedback on why they participated in SOTW sessions.

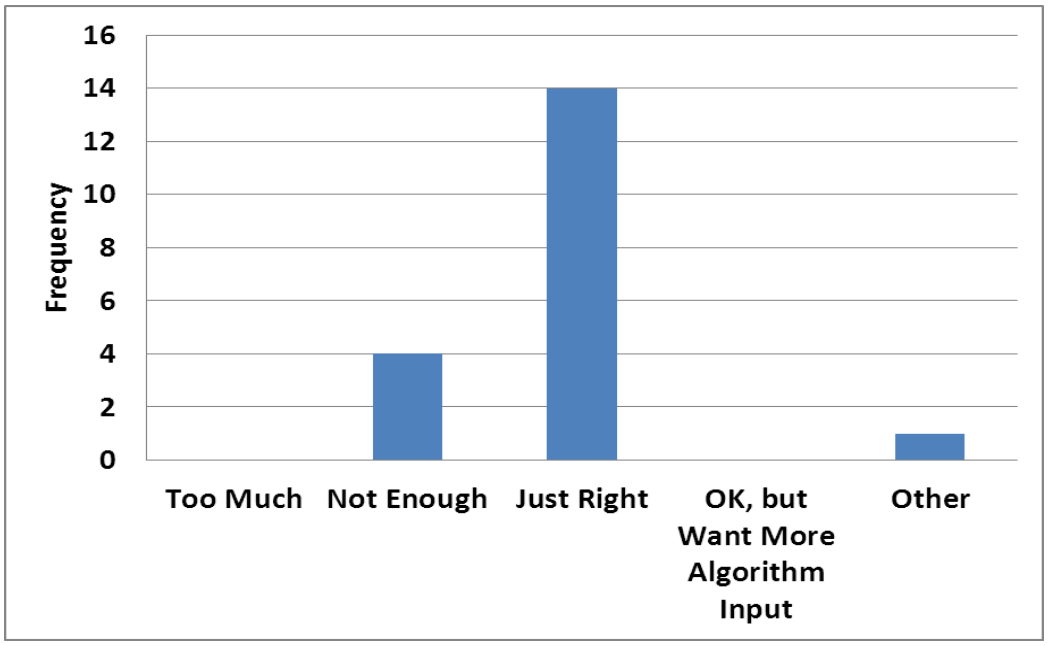

Figure 6: Survey distribution from participants concerning the level of detail SOTW sessions provided.

The following are some comments regarding the type of weather events participants would like to see at SOTW:

"More winter weather and tropical heavy rain"

"It'll take a few more months, but I'd like to see a Heavy Snow or Freezing Rain/sleet event."

"Precipitation estimates...legacy vs dual pol. Microbursts...relationship, if any, to ZDR column existence and c-g lightning strike frequency. Chaff identification. Clutter identification."

"Hydrometeor type interpretation. Usage of DP products for hail interpretation. More QPE type stuff, emphasizing limitations."

Finally, we asked participants if they had any additional comments they would like to make about the SOTW program and the following we believed were the key comments:

"Great concept, thank you for inviting me to join."

"SOTW is an excellent training idea! As more 88Ds become dual pol radars, more offices should be able to share what they've seen with others."

"I really think someone viewing it needs at least the first 4 modules of section 4 of the DP training. I had done this, but some others viewing had not, and likely didn't get much out of the training because of it. Perhaps state that as an expected prerequisite for viewing these DP storm of the week sessions."

"I really like the fact that the ROC is in the NWSChat! It is very easy to just chat with the various members about any questions that may arise. I've even utilized it to discuss more about a Storm of the week with the presenter of the week. It was very useful. I also think that having the status of the VNX radar in the chat room is very useful! Overall, having the ROCchat in NWSChat is an amazing tool and should be continued!!!!"

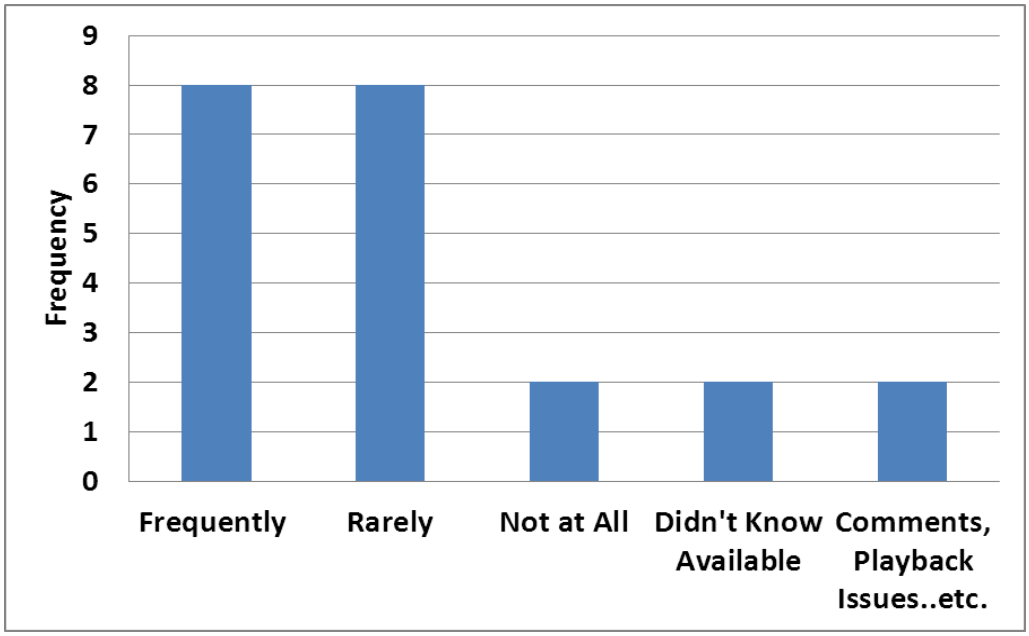

Figure 7: Survey distribution on the how much participants took advantage of the video and audio archived SOTW sessions placed on the WDTB training website.

SOTW Conclusions:

Based on the SOTW feedback, *SOTW survey respondents unanimously agreed that the SOTW program improved both their knowledge of DP products and applications and their confidence in using DP data in operations. Additionally, almost all of the survey respondents either agree or strongly agree that DP products will positively impact their operations. These findings illustrate that forecasters not only see that DP benefits will be very relevant for their operations but that the SOTW program increased their confidence in using the new data.*

Figure 8 below shows a schematic of the key benefits, as noted by previous researchers and DP experts, DP can provide to the field forecaster. Forecaster comments, from the August 2010 DP operational assessment and the 12 April – 10 May 2011 SOTW Pilot Project, supporting these benefits are included. The feedback from the Operational Assessment and the SOTW Pilot Project clearly shows a growing body of evidence that many forecasters are eagerly looking forward to using DP data and taking advantage of its benefits.

Figure 8: Schematic showing the key DP operational benefits for forecasters. Forecaster comments from the August 2010 Operational Assessment (red) and the 12 April – 10 May 2011 SOTW Pilot Project (blue) and are listed below the schematic. Superscripts at the end of a forecaster comment matched to the appropriate superscript in the benefit column in the schematic illustrate which benefit the comment validates.

Operational Benefits of Dual-Pol

Benefit	Base Data	Algorithms
Detection of Heavy Rain[1]	Significant Benefit	Significant Benefit
Rainfall Estimation[2]	Significant Benefit	QPE Not Yet Known
Detection of Hail[3]	Significant Benefit	Significant Benefit
Detection of Updrafts[4]	Significant Benefit	N/A
Discriminating Precipitation from clutter, biota…[5]	Significant Benefit	Significant Benefit
Detection of Melting Level[6]	Significant Benefit	Significant Benefit
Discriminating types of winter weather[7]	Significant Benefit	Significant Benefit
Tornadic Debris Signature[8]	Significant Benefit	N/A

COMMENTS:

"The products, I feel, can help us get better lead times on flash flood warnings"[1,2]

"There is great potential to assist us in monitoring and pinpointing heavy rain threats using dual pol radar, with the availability of KDP." [1,2]

"I will definitely use dual pol variables to help me determine potential for very heavy rain, large hail, and identification of very strong updraft development (ZDR columns)."[1,3,4]

"Association between ZDR columns and severe hail, as well as detection of TBSS features by ZDR and CC are immediately applicable to severe weather ops." [3,4]
"Determining the melting layer using the CC and to a lesser extent KDP will help to identify snow levels within winter storms. This has a huge impact on offices with complex terrain…it will not only aid situational awareness of snow levels but also help determine precipitation rates over the terrain…" [6,7]
"DP will infuse the now-casting and near-term forecasting of winter weather events with a boost of confidence" [6,7]
"I think that dual pol variables will be used in our office quite a lot in determining the location of hail (using ZDR/CC) as well as the location of the heaviest rain shafts (KDP)." [1,2,3]
"Using Dual-Pol data to identify debris can definitely add value to tornado warnings by identifying that a damaging tornado has been confirmed…I see this as a signature that we will all be closely looking for when dealing with potentially tornadic convection." [8]

APPENDIX A: SOTW Final Survey Questions:

Storm of the Week - End of Session

Created: May 09 2011, 7:46 AM
Last Modified: May 10 2011, 9:34 AM
Design Theme: Basic Blue
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Storm of the Week - End of Session

Page 1 - Question 1 - Choice - One Answer (Bullets) [Mandatory]

Please let us know your job position:

- ❍ Journeyman
- ❍ Lead Forecaster
- ❍ SOO
- ❍ WCM
- ❍ Intern
- ❍ HMT
- ❍ Other

Page 2 - Question 2 - Yes or No [Mandatory]

Has Storm of the Week improved your overall knowledge of the Dual-Pol products and their applications?

- ❍ Yes [Skip to page 3]
- ❍ No [Skip to page 5]

Page 3 - Question 3 - Rating Scale - One Answer (Horizontal) [Mandatory]

Please select the degree of improvement that Storm of the Week has had on your knowledge of the Dual-Pol products and applications.

Minimum Improvement	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Maximum** Improvement
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Page 3 - Question 4 - Open Ended - Comments Box

Comments on the degree of improvement that Storm of the Week has had on your knowledge of the Dual-Pol products and applications:

Page 4 - Question 5 - Rating Scale - One Answer (Horizontal) [Mandatory]

From what you have learned about Dual-Pol products from Storm of the Week, do you agree/disagree that Dual-Pol products could positively impact your forecasting and warning operations?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
❍	❍	❍	❍	❍

Page 5 - Question 6 - Yes or No [Mandatory]

Has Storm of the Week improved your confidence in using Dual-Pol products in your future forecasting operations?

- ❍ Yes [Skip to page 6]
- ❍ No [Skip to page 7]

Page 6 - Question 7 - Rating Scale - One Answer (Horizontal) [Mandatory]

Please select the degree of improvement that Storm of the Week has had on your confidence in using Dual-Pol products in your future forecasting operations.

Minimum Improvement	2	3	4	5	6	7	8	9	Maximum Improvement
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Page 6 - Question 8 - Open Ended - Comments Box

Comments on how Storm of the Week has improved your confidence in using Dual-Pol products in your future forecasting operations:

Page 7 - Question 9 - Yes or No [Mandatory]

Has Storm of the Week improved your confidence in using Dual-Pol products in your future warning operations?

- ❍ Yes [Skip to page 8]
- ❍ No [Skip to page 9]

Page 8 - Question 10 - Rating Scale - One Answer (Horizontal) [Mandatory]

Please select the degree of improvement that Storm of the Week has had on your confidence in using Dual-Pol products in your future warning operations.

Minimum Improvement	2	3	4	5	6	7	8	9	Maximum Improvement
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Page 8 - Question 11 - Open Ended - Comments Box

Comments on how the Storm of the Week improved your confidence in using Dual-Pol products in your future warning operations:

Page 9 - Question 12 - Choice - Multiple Answers (Bullets) [Mandatory]

Check any of the following that contributed to your decision to attend any or all of the Storm of the Week sessions (multiple answers can be selected)?

- ❑ Type of weather event presented
- ❑ I was available and curious about the Storm of the Week concept
- ❑ I am really eager to start using Dual-Pol products
- ❑ I was directed to attend
- ❑ Other, please specify

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Page 9 - Question 13 - Choice - One Answer (Bullets) [Mandatory]

The level of detail presented in the session(s) was:

- ○ Too much
- ○ Not enough
- ○ Just right
- ○ OK, but wanted to see more algorithm output
- ○ Other, please specify

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Page 9 - Question 14 - Yes or No [Mandatory]

The session leaders allowed enough time for discussion and encouraged questions from the audience.

- ○ Yes
- ○ No
- ○ Comment(s) or Suggestion(s)?

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Page 9 - Question 15 - Open Ended - Comments Box

In regards to future Storm of the Week sessions, please list the type of weather events you would be interested in seeing:

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Page 9 - Question 16 - Yes or No [Mandatory]

I prefer that future Storm of the Week sessions be offered at the same time on the same day of the week.

- ○ Yes
- ○ No
- ○ Suggestions for different day/time and reason(s) for the change?

.....

Page 9 - Question 17 - Choice - Multiple Answers (Bullets) [Mandatory]

The recorded sessions have been reviewed by members of our staff (multiple answers can be selected):

- ❑ Frequently
- ❑ Rarely
- ❑ Not at all
- ❑ Didn't know the session were available

- ❑ Comments, playback issues, or ideas to improve recordings:

Page 9 - Question 18 - Open Ended - Comments Box

Any additional comments to share with the ROC or WDTB?