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Clutter Suppression Made Easy

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1. INTRODUCTION

One of the most obvious concerns utilizing the WSR-88D is the large amount of ground clutter it sometimes displays. Fortunately, there are clutter suppression programs in the radar. If these programs are used, many of these unwanted returns will be reduced or eliminated.

The purpose of this paper is to show how the basic clutter suppression programs can be used to filter these unwanted returns. This study will cover several topics: (1) why clutter should be removed; (2) types of clutter suppression and clutter suppression files; (3) techniques employed at NWSFO Indianapolis to filter clutter; (4) office procedure at NWSFO Indianapolis; and (5) examples of what the clutter suppression programs will remove. Topics not addressed are how the clutter suppression programs go about removing the clutter. This subject is covered in the WSR-88D operations manuals and other papers (Chrisman et al. 1994).

2. WHY BOTHER TO FILTER THE CLUTTER?

While the WSR-88D is an extremely useful remote sensing tool, its algorithms can be contaminated by non-meteorological returns. By eliminating these, the precipitation processing and other algorithms will be more accurate. Also, the Radar Coded Message (RCM) product will be more accurate. This will help to make the ROB, radar observation text product, and AFOS graphics 90(R, S) more closely indicate true weather returns. Radar products disseminated to our customers will be more-representative of meteorological returns.

3. TYPES OF CLUTTER SUPPRESSION

The WSR-88D filters clutter in two ways. One is automatic using the Bypass Map. The other is done manually using Clutter Suppression Region Files.

The Bypass Map is a spatial display of the normal ground clutter return. It should be generated at least twice a year by the site electronic technicians. This map is needed most of the time to suppress unwanted returns. During situations of super refraction the clutter pattern may be greatly enlarged, requiring manual suppression.

For manual clutter suppression the radar operator has a choice of four Clutter Suppression Region Files. The technicians who designed the radar called these files 11, 21, 31 and 32. **Although they are the same numbers as the VCP's they can be used with any VCP.** These designations may be changed with a future Build (OSF Hotline 1996, personal communication).

These files can be accessed at the UCP using the command **AD,WXMAN1,CL,C,#** (where # is the clutter file you want). For a complete explanation of how to edit and download the Clutter Suppression Region Files see the UCP Handbook job sheets 1-4.

4. TECHNIQUES EMPLOYED BY NWSFO INDIANAPOLIS TO REMOVE CLUTTER

NWSFO Indianapolis chose to set up its files with the least suppression in File 11 and gradually greater amounts with each higher numbered file (Table 1). This method ties the files to the most probable weather situation that might occur. Files 11 or 21 will most likely be used when the radar is in precipitation mode (VCP 11 or 21) while file 31 or 32 will most likely be used when the radar is in clear air mode (VCP 31 or 32). Files 31 or 32 may be needed when the radar is in precipitation mode during times of extreme clutter. This is the method OSF Hotline prefers (OSF Hotline 1996, personal communication).

TABLE 1
Clutter Suppression Region File Setup

DETAILS ON HOW THE FILES ARE SET UP

Region	Operator Sel Code	Channel D	Width S	Clutter File
1	1	2	2	11
2	1	2	2	
1	2	2	2	21
2	1	2	2	
1	2	3	3	31
2	2	2	2	
1	2	3	3	32
2	2	3	3	

Note: For all files the following values are identical. This is for uniform clutter suppression of the entire scope. Mountainous areas may need sectorized clutter suppression.

Start Range	Stop Range	Start Azimuth	Stop Azimuth	Elev Seg Number
2	510	0	36	1
2	510	0	360	2

NWSFO IND CLUTTER SUPPRESSION REGION FILE SETUP

FILE 11...Uses the Bypass Map only.

FILE 21...Moderate manual suppression for lowest elevation slices only.
Bypass Map used in higher slices.

FILE 31...Strong manual suppression for lowest elevation slices.
Moderate manual suppression for higher elevation slices.

FILE 32...Strong manual suppression for all elevation slices.

5. OFFICE PROCEDURE AT NWSFO INDIANAPOLIS

At NWSFO Indianapolis the normal status is for the radar to be in File 11 (Bypass Map only). When excessive clutter is indicated, the Hydro-Met Tech invokes some manual suppression, starting with File 21. Once or twice a shift the status of the clutter is checked by going back to the Bypass Map for one volume scan. If excessive clutter no longer exists then the radar is left in File 11. If excessive clutter remains then manual clutter suppression is again employed.

6. EXAMPLES OF WHAT CLUTTER SUPPRESSION REGION FILES WILL REMOVE

During a normal day, an afternoon with good vertical mixing, the Bypass Map should remove most of the clutter returns. From observations at Indianapolis, during times of extreme clutter, manual suppression may **greatly reduce or eliminate the very strong clutter returns.**

A. Example 1

This is a case of extreme ground clutter (Figures 1 and 2). Figure 1 is a case of extreme ground clutter with **only the Bypass Map used for suppression**. Figure 2 is the next volume scan with **manual suppression** in the lowest slices (File 21). Most of what is left could be eliminated by filtering out all returns 15 dBZ and less.

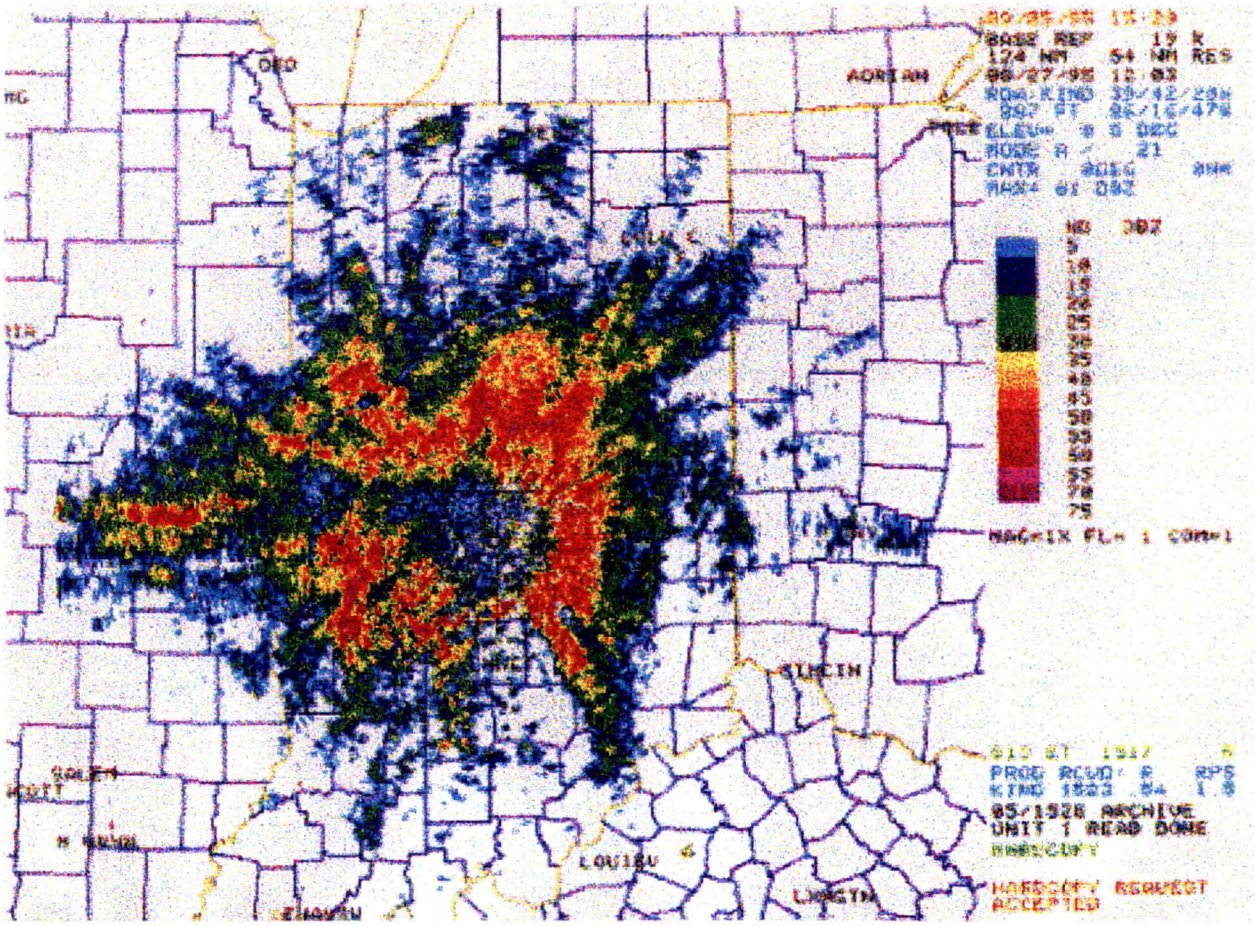

Figure 1. WSR-88D base reflectivity image from Indianapolis. Indiana with only the Bypass Map used for suppression.

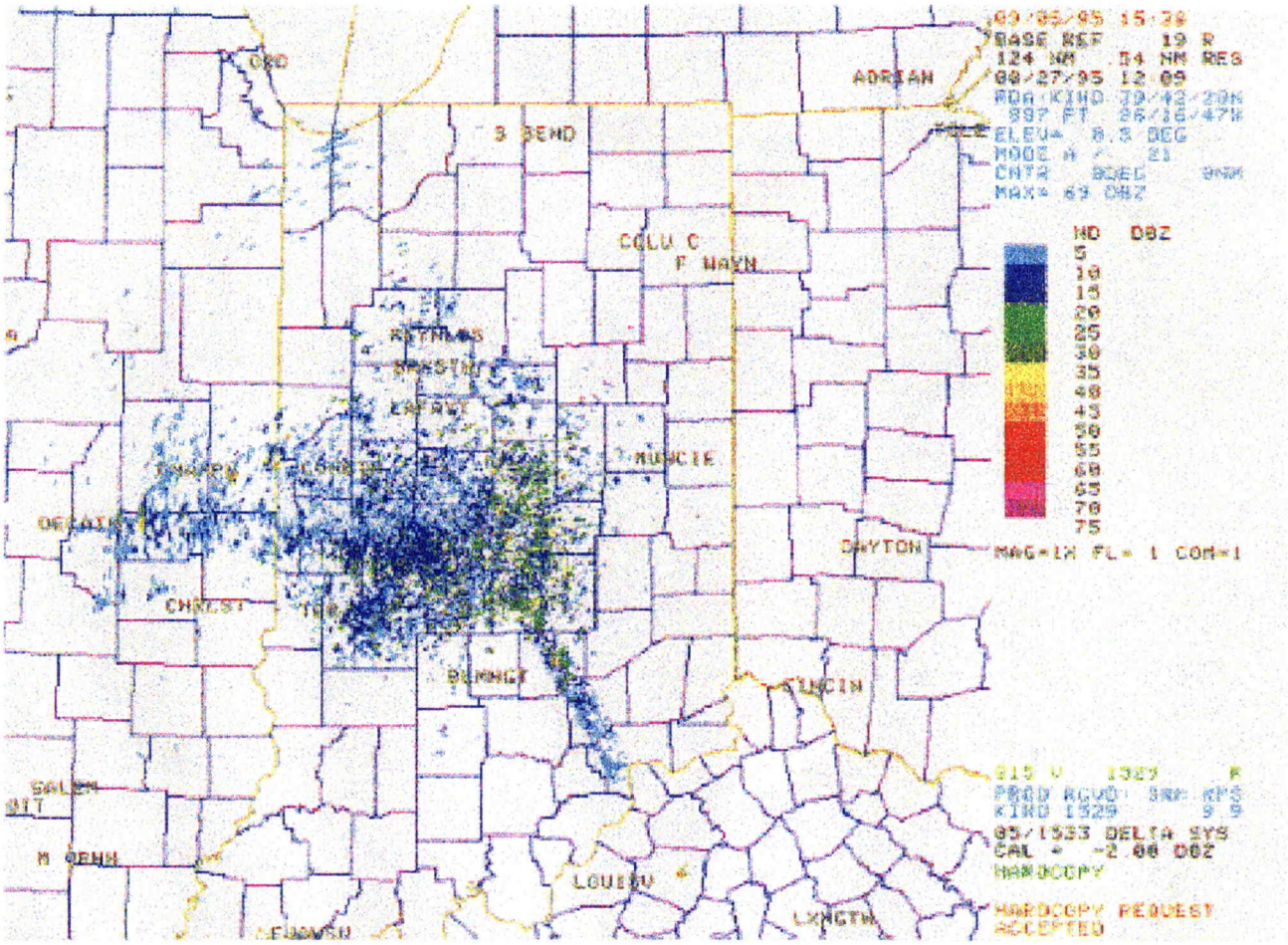

Figure 2. WSR-88D base reflectivity image from Indianapolis, Indiana with moderate suppression in the lowest slices and Bypass Map used in the upper slices (File 21).

B. Example 2

Sometimes strong clutter returns mix with true precipitation returns (Figures 3 and 4). Figure 3 only used the Bypass Map for suppression.

Now imagine you are a TV or radio weather caster or another office that has "dialed up" the radar. What type of weather appears to be indicated? Do the high reflectivities indicate significant precipitation echoes to the east and southeast of the station? Possibly severe weather?

Figure 4 used strong manual suppression in the lowest slices and moderate manual suppression in the upper elevation slices (File 31). Now what type of weather is indicated? After clutter suppression was applied, the strong returns to the east and southeast of the station were eliminated.

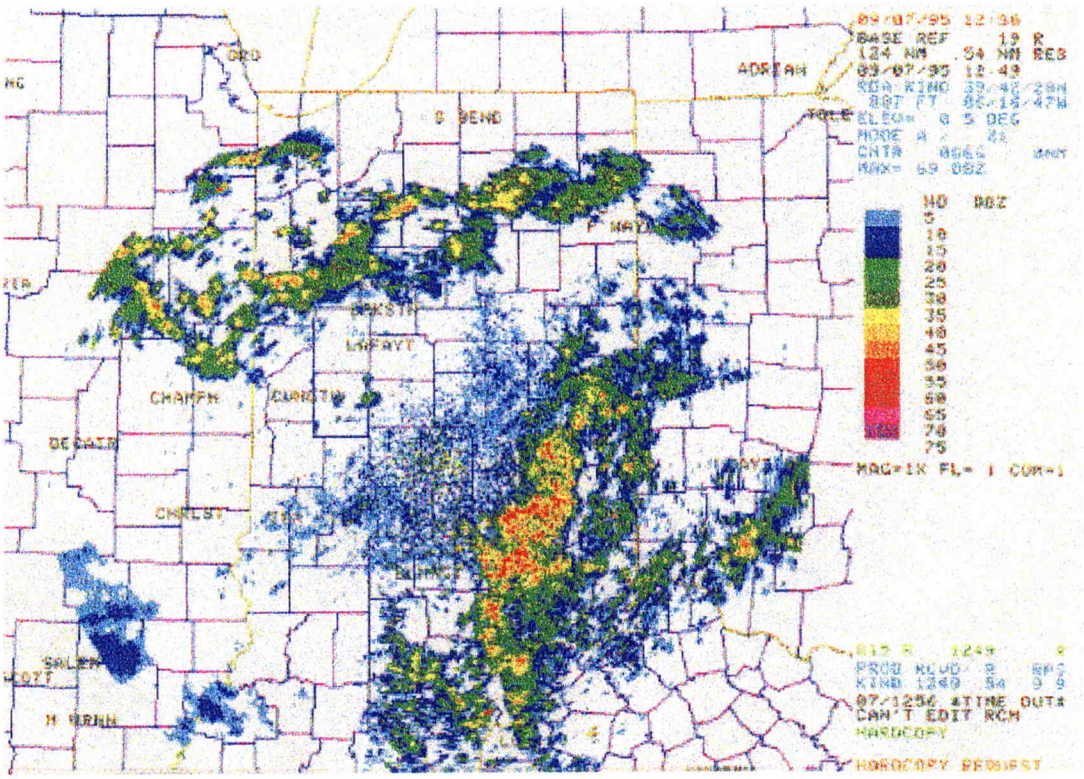

Figure 3. WSR-88D base reflectivity image from Indianapolis, Indiana with only the Bypass Map used for suppression.

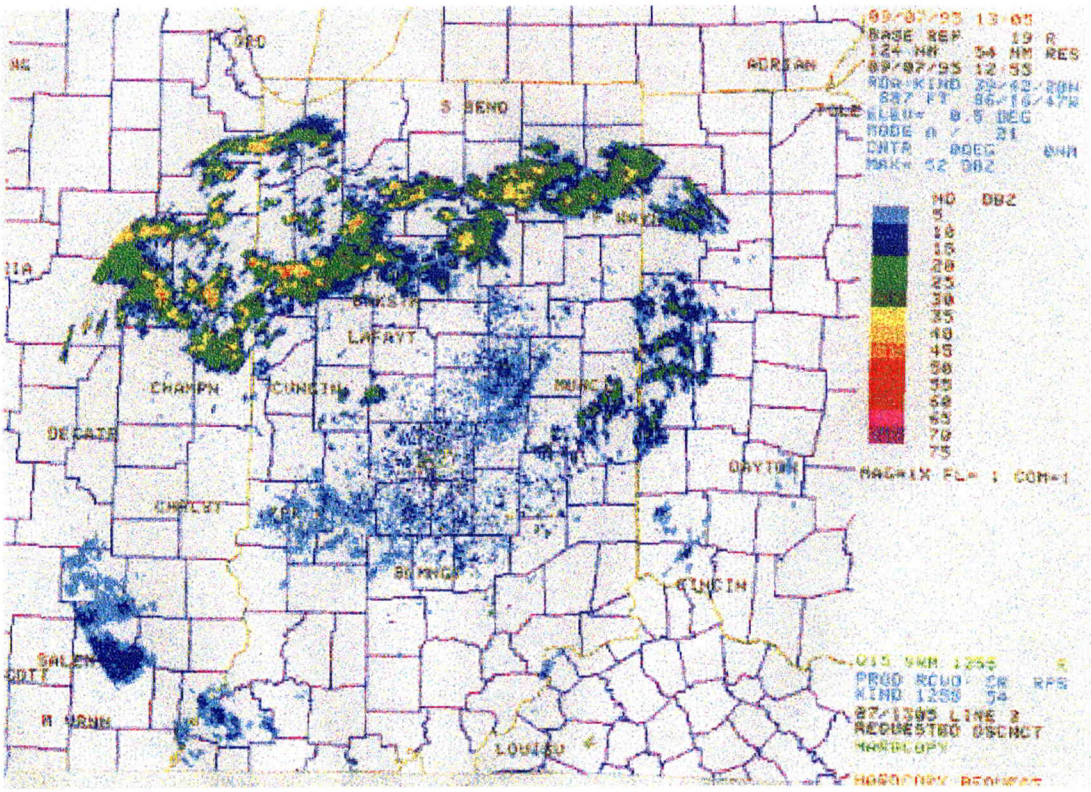

Figure 4. WSR-88D base reflectivity image from Indianapolis, Indiana with strong manual suppression in the lowest slices and moderate suppression in the upper slices (File 31).

C. Example 3

There are situations where manual suppression will not remove all clutter returns (Figures 5 and 6). Figure 5 used the Bypass Map only. Figure 6 employed moderate manual suppression (File 21).

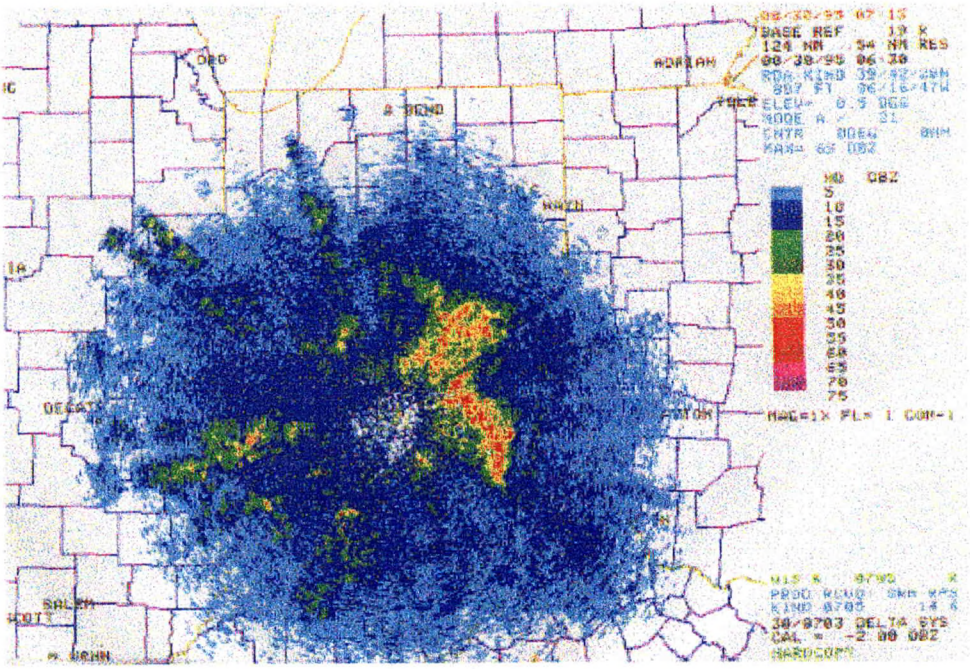

Figure 5. WSR-88D base reflectivity image from Indianapolis, Indiana with only the Bypass Map used for suppression.

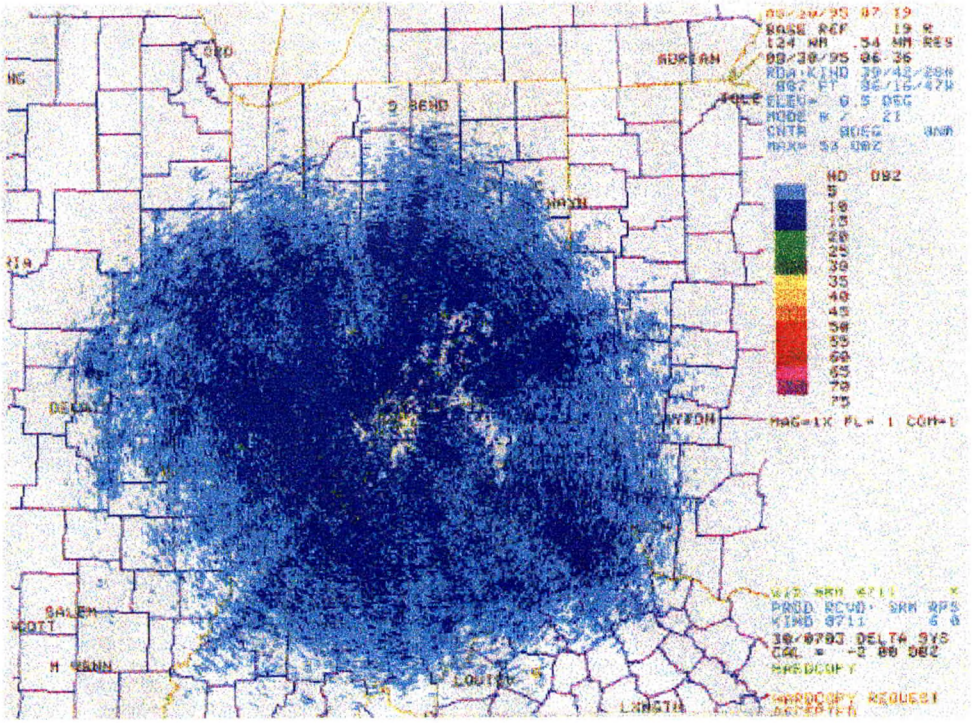

Figure 6. WSR-88D base reflectivity image from Indianapolis, Indiana with moderate suppression in the lowest slices and Bypass Map used in the upper slices (File 21).

The Storm Prediction Center did a study attempting to explain what causes such a return (OSF Hotline 1996). Their theory of why there is such a large area of 5 to 15 dBZ return is that the atmosphere is humid (that would enhance the return), there are bugs and birds in the area moving above the suppression levels, and there is a slight inversion. In addition there may be clouds, which are moving, which may give a radar return.

After manual clutter suppression is employed the 50 dBZ and higher returns have been completely suppressed. This eliminated any erroneous interpretation of thunderstorms that might have occurred without suppression.

7. CONCLUSION

Removing the most noticeable false returns from the radar is a **simple process**. Generally, the manual clutter suppression programs do a very good job.

From observations at Indianapolis there is very little difference noticeable between Files 21 and 32. If manual suppression is going to work, then suppressing the lowest elevation slices usually is all that is needed. Using manual clutter suppression, when needed, reduces non-meteorological targets and thus improves the quality of the radar products for our customers.

8. ACKNOWLEDGEMENTS

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9. REFERENCES

Chrisman, J.N., D.M. Rinderknecht, and R.S. Hamilton, 1994: WSR-88D Clutter Suppression and It's Impact on Meteorological Data Interpretation. *Postprints, First WSR-88D Users Conference*, 9-20.