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USE OF ARTC RADAR -- LOG VIDEO VS. MTI VIDEO

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I. Introduction

Air Route Traffic Control (ARTC) En Route Long Range radar data is now routinely available to NWS offices on a dial-up or dedicated line basis. It is available in digital format from Radar Remote Weather Display Systems (RRWDSs) for display on RADID (RADAR Display Device). Thus, forecasters can obtain data as frequently as desired from an assortment of radar systems. However, forecasters must provide their own interpretation of the displayed radar information.

Several guidelines on interpretation of RADID displays were covered in a recent technical memorandum (Pappas, 1986). This paper addresses one particular problem of echo interpretation that is characteristic of ARTC radar data that was mentioned only briefly in the technical memorandum. It stems from the fact that ARTC radars can provide radar echo data from two distinctly different kinds of radar receivers, Normal (log video) and Moving Target Indicator (MTI video). Both types of data are described below along with characteristics and limitations of data from each of these two kinds of receivers. It is important when viewing echo intensity displays on RADID for forecasters to know which type of receiver provided the data.

II. Normal Receiver (log video)

The normal receivers in ARTC radar systems are amplitude sensitive, similar to the receivers of conventional NWS radars. Their output is dependent upon the amplitude or signal strength of the reflected signal. In the case of weather, the output is a function of echo intensity. This type of receiver is useful for detection purposes (whether aircraft or weather) only in the absence of ground clutter because of the obscuring effect of the clutter. The range at which the normal receiver becomes useful depends upon the ground clutter pattern, which varies from radar to radar. For some en route radars, this could be as little as 20 or 30 miles; for others, it could be on the order of 150 miles, at least in some directions. Detection of weather within the ground clutter area, using the normal receiver, is not reliable since ground clutter cannot usually be distinguished from precipitation. Animation of a time sequence of radar images can help alleviate this problem since precipitation echoes will move and change with time while clutter echoes will remain stationary. Detection of weather not over ground clutter is comparable, usually within one VIP level, with that indicated by NWS network radars.

III. MTI Receivers (MTI video)

MTI (moving target indicator) receivers used in ARTC radar systems were developed to improve aircraft detection in the presence of other targets, including both ground clutter and weather. These MTI systems attempt to reject echoes from ground clutter based on the fact that ground clutter targets are stationary. The signal strength of a target's echo is partially a function of the target's radial velocity; that is, its component of velocity away from or toward the radar. In the case of fixed targets such as ground clutter, the radial velocity is theoretically zero, and the detected return signal is not processed through the MTI receiver. In reality return from fixed targets is imperfect, and some residue ground clutter may remain.

In the case of moving targets, strength of the echo on the display is a function of radial velocity as well as precipitation intensity. Therefore, a weak thunderstorm cell moving rapidly toward or away from the radar might appear as a stronger return than a heavier cell moving more slowly. For moving targets, the travel distance (and therefore, travel time) between successive pulses will be different. It is this characteristic which ARTC MTI systems use to separate moving from stationary targets.

MTI receivers are superior to normal receivers in detecting precipitation echoes over clutter areas. However, they may produce less than desirable results due to the effects of ground clutter. The detection capability of the MTI receiver decreases as the beam passes over strong ground clutter. While the MTI receiver cancels the ground clutter echoes, it also suppresses the strength of moving targets. If the clutter is strong enough, it may totally eliminate the return due to moving weather targets. Thus over strong ground clutter, it may be difficult to detect even severe weather. Outside clutter areas, it is, of course, more desirable to use normal receiver data in order to get an accurate echo intensity.

On the average, MTI receivers tend to underestimate the reflectivity values of echoes. However, in cases of rapid radial cell movement, they may actually overestimate reflectivity. Slow moving (less than 8 to 10 knots) precipitation targets may be eliminated almost entirely.

Nearly all ARTC radars have limited dynamic range in MTI mode that may vary from radar to radar. What this means is that only two or three VIP levels may be displayed. For example, VIP levels 1 and 2 only may be displayed. Level 3 and higher echoes would then be displayed as level 2. The FAA has plans to improve the dynamic range of the MTI on most radars, but the modification will take a year or two to implement.

IV. Summary

When using MTI video radar data, especially over areas of ground clutter, an unpredictable amount of inaccuracy can be expected in the displayed VIP levels. On the other hand, using log video displays causes weather echoes to be obscured by the clutter. MTI video data will usually present a lower intensity than actually exists. Exceptions are from storms of high radial velocity but low precipitation rate.

The above discussion clearly reveals the need for radar data users to know whether their output came from a normal or MTI receiver. Many times the output is presented in what is referred to as a gated mode. In a gated mode, data close to the radar site are presented in MTI mode, and the rest in normal mode. Weather observers at our ARTC radar offices control whether and at what range RRWDS displays are gated. Typically the data might be gated at about 100 nautical miles but will vary from radar to radar. RADID displays indicate whether data are from the MTI receiver and the range at which the display is gated.

If users of ARTC radar data are unsure of the echo intensities being displayed, they are encouraged to call the appropriate NWS office controlling the RRWDS. Observers at these offices have a lot of experience at interpreting echoes in MTI mode. Users of radar data are encouraged to draw on their expertise. Additionally, ground truth observations, data from another radar, satellite imagery, and interpretated data, such as radar coded messages, narratives, or RAFAX, are useful supplements to the RADID displays.

V. References:

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