NWS-CR-TA-89-29

CRH SSD
SEPTEMBER 1989

CENTRAL REGION TECHNICAL ATTACHMENT 89-29

THE MILWAUKEE WARM TOP AND LOW LEVEL SATELLITE ENHANCEMENT CURVES

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1. Introduction

Two color enhancement curves for SWIS, developed at WSFO Milwaukee in 1987, have proved to be very useful to forecasters here. We would like to share them with fellow field forecasters. The first curve is a warm top color enhancement and the second is a low level black-and-white enhancement. They are meant to be used with any ZA-enhanced satellite picture.

2. The Warm Top Enhancement Curve

The best feature of the warm top enhancement curve (or GAF curve, as it has come to be called) is that it detects developing showers 30-60 minutes before they turn into thunderstorms (during the convective season). This is because it starts enhancing at -23°C, whereas the standard MB curve does not begin enhancing until -32°C. Thus, one can see two distinct shades of blue (see attached chart) before an MB-enhanced picture would show a medium-gray color.

During the warm season, these shades of blue correlate well with light showers. There have been countless instances when the radar would suddenly light up with a batch of VIP 1 showers and the corresponding satellite subsector picture would show clouds enhanced with just a few speckles of blue (-23°C). Turquoise or purple shades correspond to heavier showers with green quite often being the threshold for thunderstorms. The color scheme is such that thunderstorms are very noticeable, with menacing black inside a pastel light green. Also, since most forecasters are used to working with the standard MB curve, the warm top curve is designed so that the black enhancement is achieved for the same temperature range as the MB curve (-58°C to -62°C). This serves as a good frame of reference.

The warm top enhancement curve was also very useful during the past two winters in Wisconsin. Subtle changes in the enhancement have correlated well with significant snowfall tendencies. The curve applies to both synoptic snowfall and Great Lake-induced snows. In lake effect snow situations, clouds moving southward from Lake Superior often were unenhanced, but when they cooled only slightly to around -23°C (dark blue), snow showers (sometimes heavy) began being reported.

.......THE WARM TOP CURVE.......

COLOR COUNT	TEMP (Deg C)	DIGITAL COUNT	COLOR
DARK BLUE	-23 TO -28	160-169	162
LIGHT BLUE	-28 TO -33	170-177	191
TURQUOISE	-33 TO -38	178-182	154
DARK PURPLE	-38 TO -44	183-189	2
LIGHT PURPLE	-44 TO -52	190-197	26
LIGHT GREEN	-52 TO -58	198-207	127
BLACK	-58 TO -62	208-218	194
DARK GRAY	-62 TO -66	219-229	224
MEDIUM GRAY	-66 TO -70	230-240	239
WHITE	< -70	241-255	255

In synoptic scale snow situations, one often looks for the "southern edge" of the enhanced band (as viewed on MB curves) to locate the heaviest snow band. This can sometimes be misleading because significant light snows might still be occurring in the unenhanced portion just south of this "southern edge." Because the warm top curve begins enhancing at warmer temperatures than the MB curve, its "southern edge" will be farther south than on the MB curve. Significant light snows usually were occurring along its blue "southern edge" with turquoise or purple shades signifying the heaviest snow band.

During the past two winters, there were numerous times when snowfall (as viewed both on radar and out the window) suddenly increased in areal coverage and intensity --- for no apparent reason. In almost all instances, the warm top curve (viewed on the subsector) showed a cooling of tops from a blue shade into a purple shade. When tops cooled beyond the purple and into the green or black shades, this often was related to thunder-snows or bursts of sleet.

The main drawback of the warm top enhancement curve is that when there is a lot of cirrus around, it can become quite cluttered. One must learn how to interpret the curve in order to be able to differentiate between cirrus and other more important features. Also, the subsectors, when enhanced, become very grainy. This is a SWIS problem and has nothing to do with the enhancement curve.

Forecasters in the Southern and Eastern Regions, as well as the Central Region might benefit from the warm top curve, since this is where frequent popcorn-type convection occurs during the warm season. During the cool season, the correlations of colors to weather would most likely apply only to the upper Midwest and Great Lakes region.

3. The Low Level Enhancement Curve

From mid-October to mid-April, the warm top enhancement curve can be complemented by another curve, the low level black-and-white enhancement curve. The low level enhancement curve simply provides more black-and-white contrast, thereby allowing forecasters to more easily identify low and middle level clouds. This curve can be applied to any ZA-enhanced picture. It also works well when applied to a picture which has already been enhanced with the CC curve.

.......THE LOW LEVEL (BLACK AND WHITE) ENHANCEMENT CURVE.......

DIGITAL COUNT	COLOR COUNT
1-99	193
100-103	195
104-107	197
108-112	199
113-119	201
120-124	203
125-129	205
130-132	207
133-136	210
137-140	213
141-143	216
144-147	221
148-150	223
151-153	226
154-157	228
158-161	230
162-167	233
168-172	236
173-176	241
177-181	247
182-196	251
197-255	255

During the cool season, WSFO Milwaukee uses a combination of the low level enhancement curve and the warm top enhancement curve. This is accomplished by entering the color values for the black-and-white curve up through digital count value 159, then the warm top curve from digital counts 160 to 255. With these curves, cloudiness can easily be spotted over Lakes Michigan or Superior before it suddenly moves inland and spoils a cloud-free or precipitation-free forecast. Pockets of low level cloudiness over the land can be detected better than with the MB or CC curves alone.

The low level curve works best in Wisconsin from mid-October through mid-April. At other times, the weather is too warm and the curve looks too dark. Different offices will have to experiment to determine when it's cold enough for the low level enhancement to work for their state. It should also be noted that so-called "black stratus" shows up very well during the winter, especially in the South [see paper by James Gurka in the Weather Service Forecasting Handbook #6 (Satellite Imagery Interpretation for Forecasters)].

Equipped with these two curves, as well as with the water vapor enhancement curve described in a prior Technical Attachment (Morris and Field, 1988), it is hoped that forecasters will be better able to detect and predict thunderstorms, low clouds, increased snowfall rates, lake effect snows, etc.

4. References

Gurka, J. J., 1980: Observations of Advection-Radiation Fog Formation From Enhanced IR Satellite Imagery. Preprints, 8th Conference on Weather Forecasting and Analysis (Denver, CO), Amer. Meteor. Soc., Boston, MA, 108-114.

Morris, T. R. and G. A. Field, 1988: Where's the Jet Max--A Dry Band Color Enhancement Technique. National Weather Service Central Region Technical Attachment 88-22.