



# PACIFIC REGION TECHNICAL NOTES

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## Preliminary Uses of a Densitometer at the Pacific Weather Centre

Larry Funk, Satellite Meteorologist  
Pacific Weather Centre, Vancouver, B.C.

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### INTRODUCTION

The information obtained from satellite flown sensors is often presented as a picture with shades of black, grey, and white representing the radiance measurement levels. This composite results in an "image".

The Pacific Weather Centre uses Unifax recorders to produce hard copies of satellite images reconstructed from analog data transmitted through facsimile lines. Previously quality control has been a haphazard affair based on subjective assessment. This has resulted in some problems since image appearance can vary for a number of reasons. Among them are signal quality, machine response, paper response, age and quality of chemicals, varying perceptions by the human eye, etc.

With the increasing emphasis on satellite imagery in the Pacific Weather Centre forecast and service operations, there is the need to make quality control more standard and objective.

### INSTRUMENT

The densitometer is a graphic arts instrument which can measure the density of print on a flat surface. It can be used to obtain high resolution reflected light measurements from the printed images. A densitometer is on loan from AES Downsview.

### PROCEDURE

A test pattern illustrating the density slicing between grey shades is shown in Figure 1. This "barchart" is included with every picture and is found just below the annotation. As well, the UNIFAX is capable of displaying contrast steps in the form of a test pattern (Figure 2). As the chemical or machine performance drops off, the contrast between black and white and the steps in between diminishes and becomes less discrete. By plotting densitometer readings from the "barcharts", a "response curve" can be produced and some information may be obtained as to the quality of images after machine tuning and chemical change.

### EXPERIMENT

PWC receives image data from its own system and through the American GOES-TAP network. Response curves for each of these sources are compared. Also comparisons will be made before and after a change in chemicals.

## RESULTS

Figures 3 and 4 illustrates the change in the density steps before and after a chemical change. Also note the difference in the "after new chemicals" curves between PWC-FAX1 (Figure 3) and GOES-TAP values (Figure 4). Figure 5 displays these differences for the two UNIFAX machines. The imagery produced by the respective machines can vary extensively as a result. Since both machines have new chemicals, the differences are a result of differences in the tuning of the machines.

Figure 6 shows how the ZA enhanced imagery produced on the facsimile unit shown in Figure 4 would vary. Contrast in the infrared imagery can be related to temperature. In this case the GOES-TAP imagery shows a much steeper enhancement in the range where most of the meteorological data exists. The PWC image produces a picture with more grey tones and less contrast.

## SUMMARY REMARKS

In order to standardize imagery over a period of time, some objective standards have to be set. These standards have to be objective in nature and obtained by instruments such as a densitometer.

The main problem in setting up objective procedures is to differentiate between machine and chemical related characteristics. A more systematic procedure for monitoring image quality is needed. For example, images should be subjectively rated versus the densitometer readings of the barchart. The subjective rating categories could range from good to poor and be recorded with the bargraph response curve. Machine substitution or chemical changes should be made after the imagery is below an acceptable level. Objective criterias may be set after a large enough information base is obtained.

In the future, PWC plans to calibrate the densitometer to the more universally accepted photographic gray scale value. True black and white shades are very difficult to reproduce on the UNIFAX. As well the contrast range for most infrared satellite imagery falls between black and white. The shifting of the standard gray scale value by several positions on the contrast bar accompanying the imagery appears to signal a significant drop in picture quality. However, more work will have to be done to quantatively relate the shift of the gray scale to the picture quality.

## ACKNOWLEDGEMENT

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GOES E F1 \*\* IR 830414 2001Z 40.0 -110.0 4 A ZA CNNR04

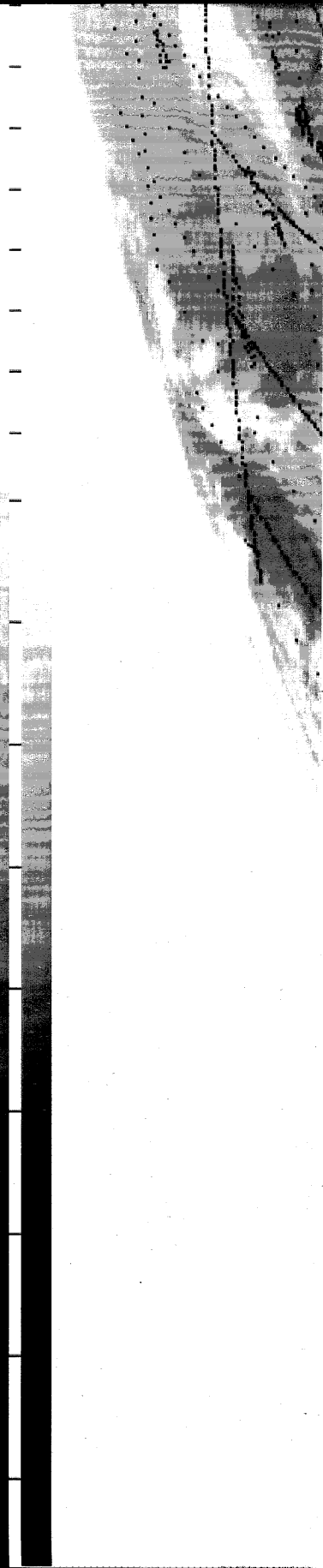


FIGURE 1. EXAMPLE OF DENSITY SLICED CONTRAST BAR CHART  
(BELOW ANNOTATION) ON SATELLITE PICTURE

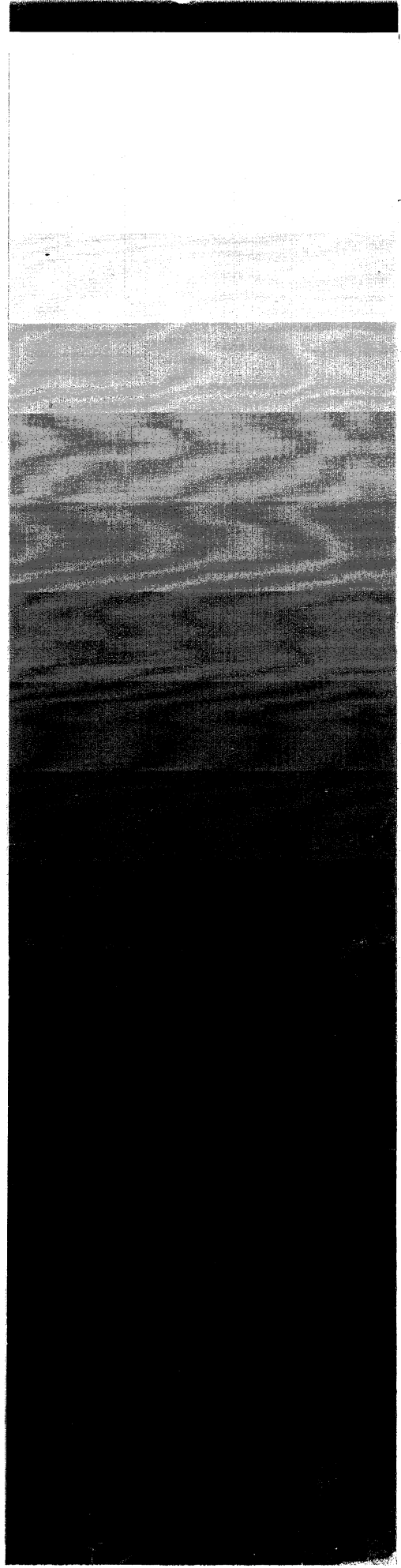
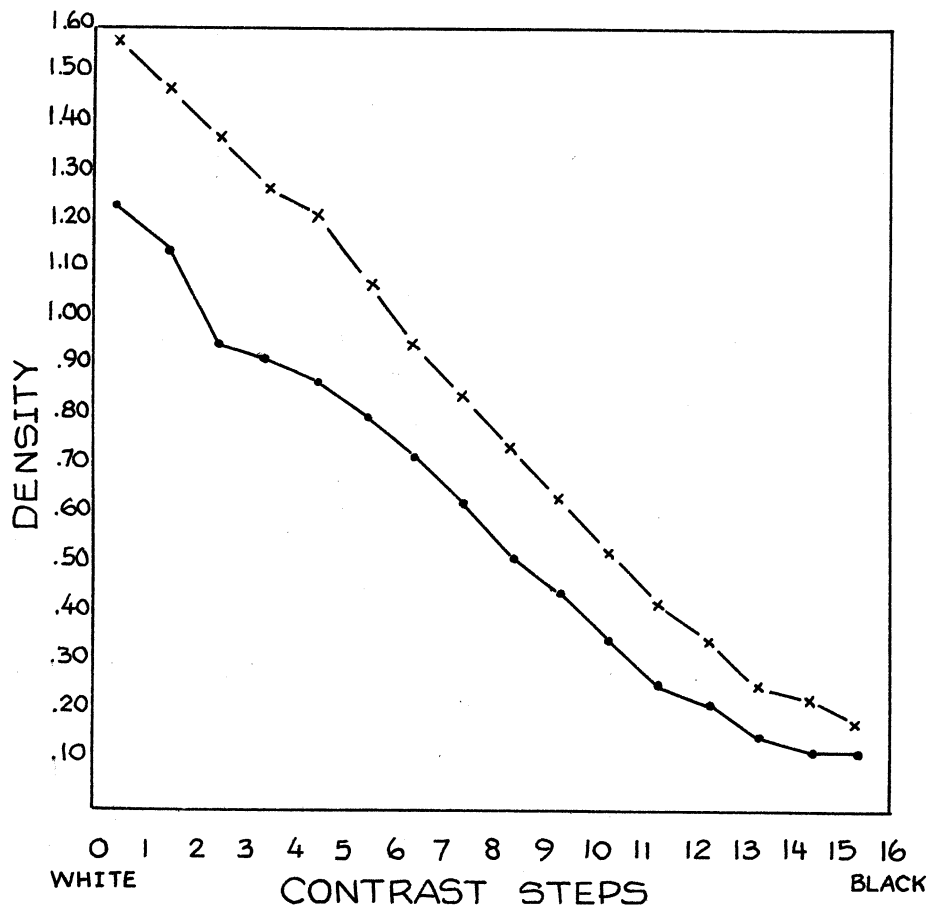


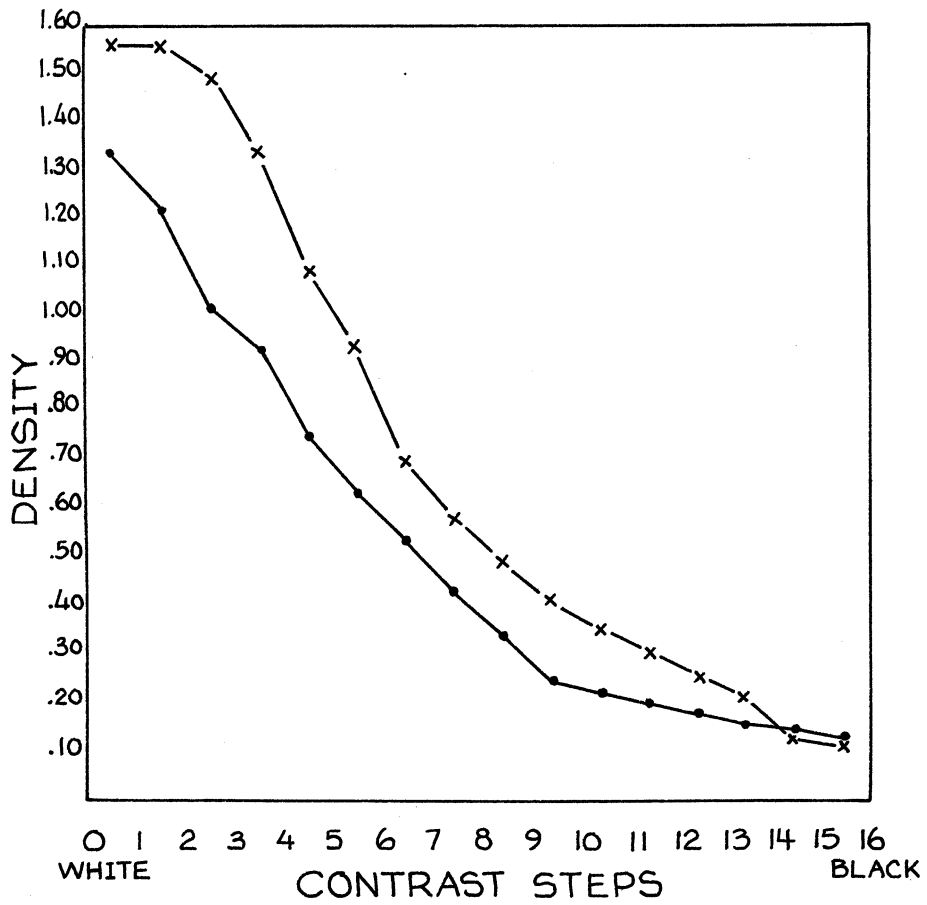
FIGURE 2. CONTRAST STEPS

FIGURE 3.  
 RESPONSE CURVES FOR UNIFAX  
 PWC FAX I



BEFORE NEW CHEMICALS 2001Z 830306 ●—●—●  
 AFTER NEW CHEMICALS 2230Z 830307 x—x—x

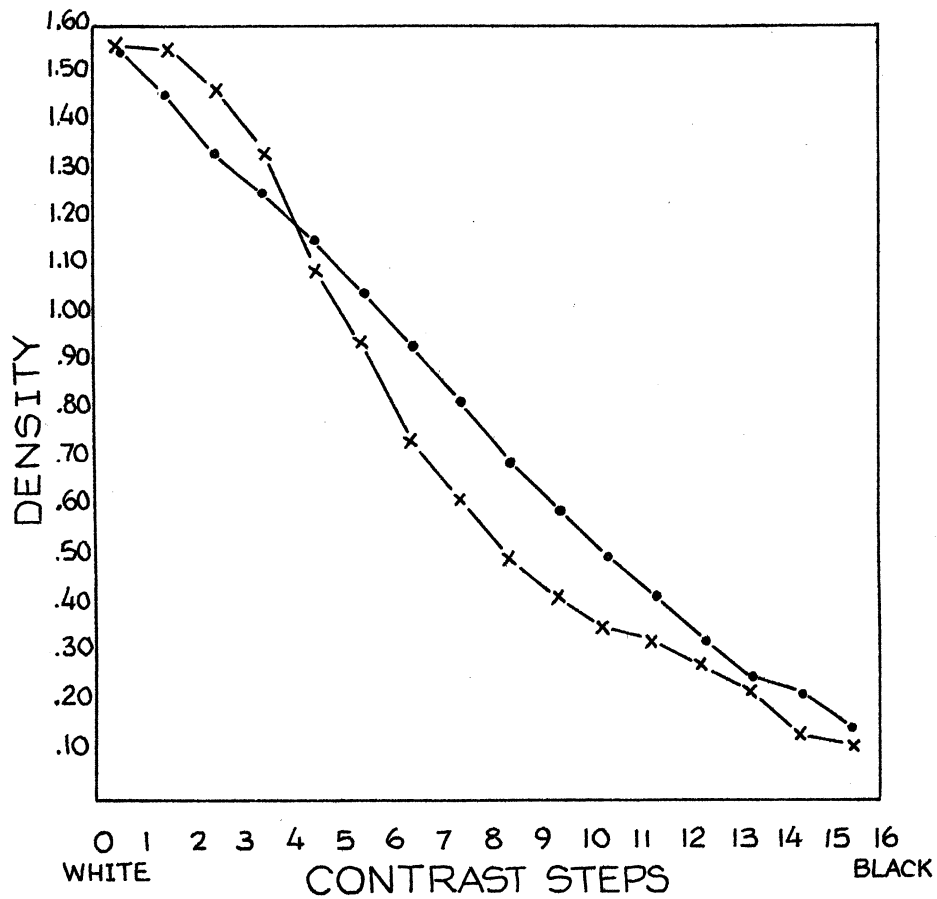
FIGURE 4.  
 RESPONSE CURVES FOR UNIFAX  
 GOES TAP



BEFORE NEW CHEMICALS 2130Z 830306 ●—●—●  
 AFTER NEW CHEMICALS 2130Z 830307 x—x—x

FIGURE 5.

A COMPARISON OF PWC FAX I UNIFAX  
AND GOES-TAP UNIFAX AFTER NEW CHEMICALS



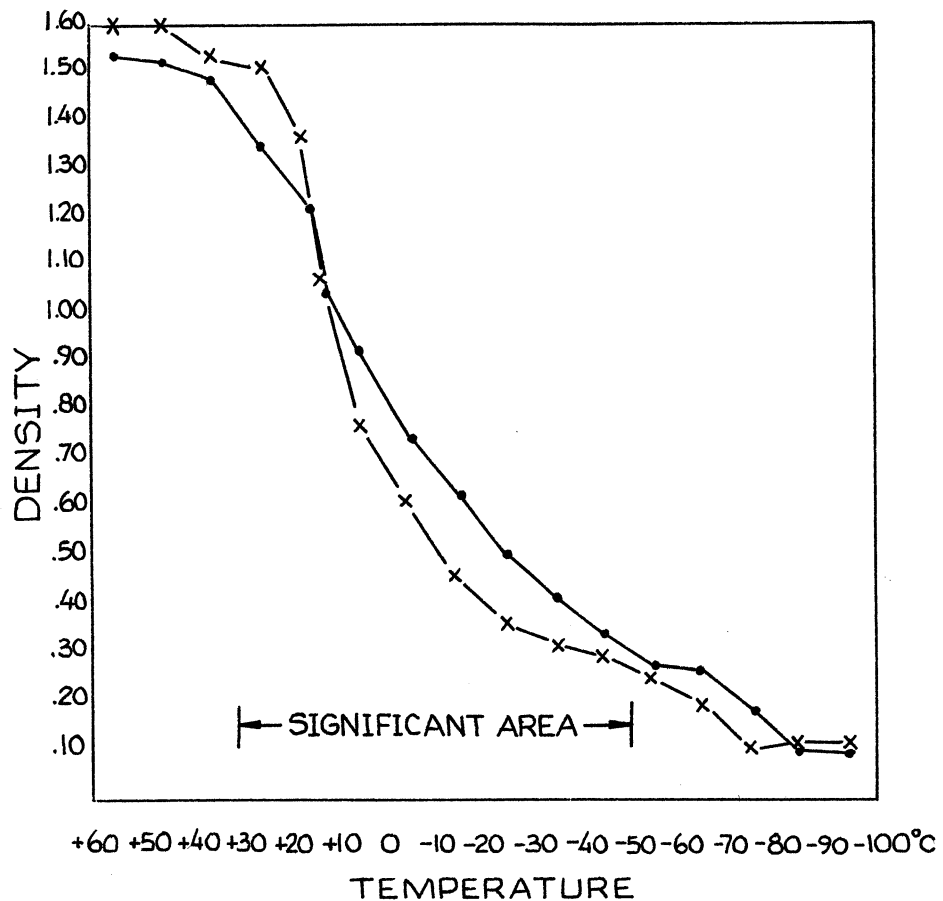
GOES TAP UNIFAX 2130Z 830307 x—x—x (AFTER NEW CHEMICALS)  
PWC FAX I UNIFAX 2230Z 830307 •—•—• (AFTER NEW CHEMICALS)

FIGURE 6.

MACHINE CONTRAST CHARACTERISTICS

AFTER A CHEMICAL CHANGE

STANDARD ZA ENHANCEMENT PUT ON IMAGERY



GOES TAP UNIFAX x—x—x (AFTER NEW CHEMICALS)  
PWC UNIFAX o—o—o (AFTER NEW CHEMICALS)