Derived Backscatter Values from JERS-1 Digital Number Distributions Over Ross Island, Antarctica (McMurdo Station)
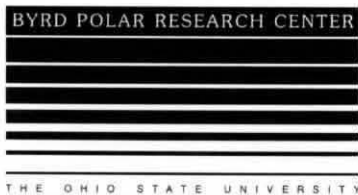
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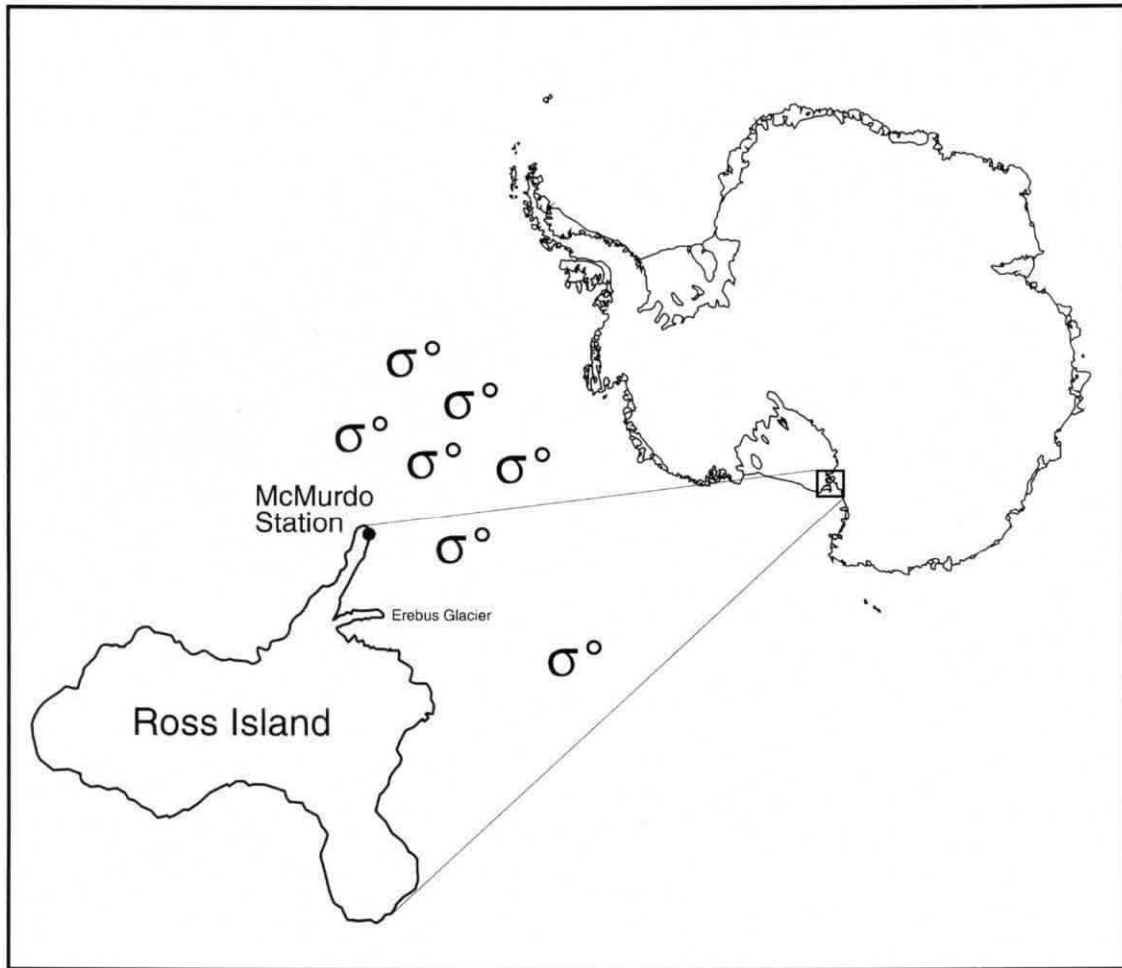# DERIVED BACKSCATTER VALUES FROM JERS-1 DIGITAL NUMBER DISTRIBUTIONS OVER ROSS ISLAND, ANTARCTICA (MCMURDO STATION)

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TABLE OF CONTENTS

ABSTRACT

This report examines the derived backscatter values for different physical properties from one JERS-1 image over Hut Point Peninsula on Ross Island in the McMurdo Station area. The results discussed in this report will be used to determine a suitable location for transponder testing for the Radarsat Antarctic Mapping Project.

Histograms of digital number (DN) values (0-255) were created to determine the DN distribution and approximate backscatter value for five locations on a single JERS-1 image. Two locations were chosen over first year sea ice, and one location each over glacial ice, exposed rock, and the McMurdo Station. From published backscatter values for first year ice of -15dB and a DN of 40, estimated from histograms, an approximation of the calibration constant K was calculated and subsequent backscatter coefficients were computed for the remaining locations. Digital numbers peaked at 255 for both glacial ice and McMurdo Station indicating that an area outside of McMurdo Station would be preferable for transponder testing.

DERIVED BACKSCATTER VALUES FROM JERS-1 DIGITAL NUMBER DISTRIBUTIONS OVER ROSS ISLAND, ANTARCTICA (MCMURDO STATION)

1.0 INTRODUCTION:

This report examines the derived backscatter values for different physical properties from one JERS-1 image over Hut Point Peninsula on Ross Island in the McMurdo Station area. The JERS-1 SAR operates at L-band, HH polarization, and with a viewing geometry (incidence angle) of $40°$. The results discussed in this report will be used to determine a suitable location for transponder testing for the Radarsat Antarctic Mapping Project.

2.0 DERIVED BACKSCATTER VALUES FROM JERS-1 DIGITAL NUMBER DISTRIBUTIONS:

Histograms of digital number (0-255) values (figures 1-5) were created to determine the digital number distribution and subsequent backscatter value for five locations on a single JERS-1 image over Hut Point Peninsula, Antarctica (figures 6 and 7). Two locations were chosen over first year sea ice (figures 1 and 2), and one location each over glacial ice, bare rock, and the McMurdo Station (figures 3-5).

2.1 Procedure:

The JERS-1 image (figure 6) is a April 5, 1995, 8-bit, 1-byte uncompressed image obtained from ASF processed 8 mm tape. A section of the image (figure 7) indicates where the locations of each of the histograms (figures 1-5) were sampled from.

A backscatter value ($\sigma°$) for first year sea ice of -15dB (figure 8) (Onstott, 1992) and a digital number, DN, of 40 estimated from patch1 and patch2 (figures 3 and 4) were used to estimate the calibration constant K value as follows:

$$\sigma^{\circ}{}_{dB} = <I>{}_{dB} - K_{dB}$$

where,

$<I>{}_{dB} = 10 \log (DN^2)$, where I is the pixel intensity and DN is the digital number

of a given pixel (0-255).

$K_{dB} = 47 \pm 2$.

Figure 8 shows the resulting σ° approximations versus digital number distribution for $K_{dB} = 47 \pm 2$.

2.2   Discussion:

Histograms of digital number (0-255) values were created to determine the digital number distribution and subsequent backscatter value for five locations on a single JERS-1 image over Hut Point Peninsula, Antarctica. The average digital number for first year ice ranged from 35 to 40. The corresponding estimated σ° for first year sea ice ranged from -15dB to -16dB. The average digital number for bare rock was 90 with a corresponding estimated σ° of -8dB. The digital number for both McMurdo Station and glacial ice peaked at 255 giving an estimated σ° of +1dB.

The results discussed above are summarized in the following table:

Table 1

Site	Average DN	Average $\sigma^{\circ}{}_{dB}$
Figure 1 (First year sea ice)	40	-15
Figure 2 (First year sea ice)	35	-16
Figure 3 (McMurdo Station)	255	+ 1
Figure 4 (Glacial Ice)	255	+ 1
Figure 5 (Bare Rock)	90	- 8

For K=47

According to these results an area outside of McMurdo Station would be preferable for transponder testing.

2

REFERENCE:

Onstott, R. G., 1992. SAR and Scatterometer Signatures of Sea Ice. *In F. D. Carsey (ed.). Microwave Remote Sensing of Sea Ice.* A.G.U. Geophysical Monograph Series 68, 73-104.
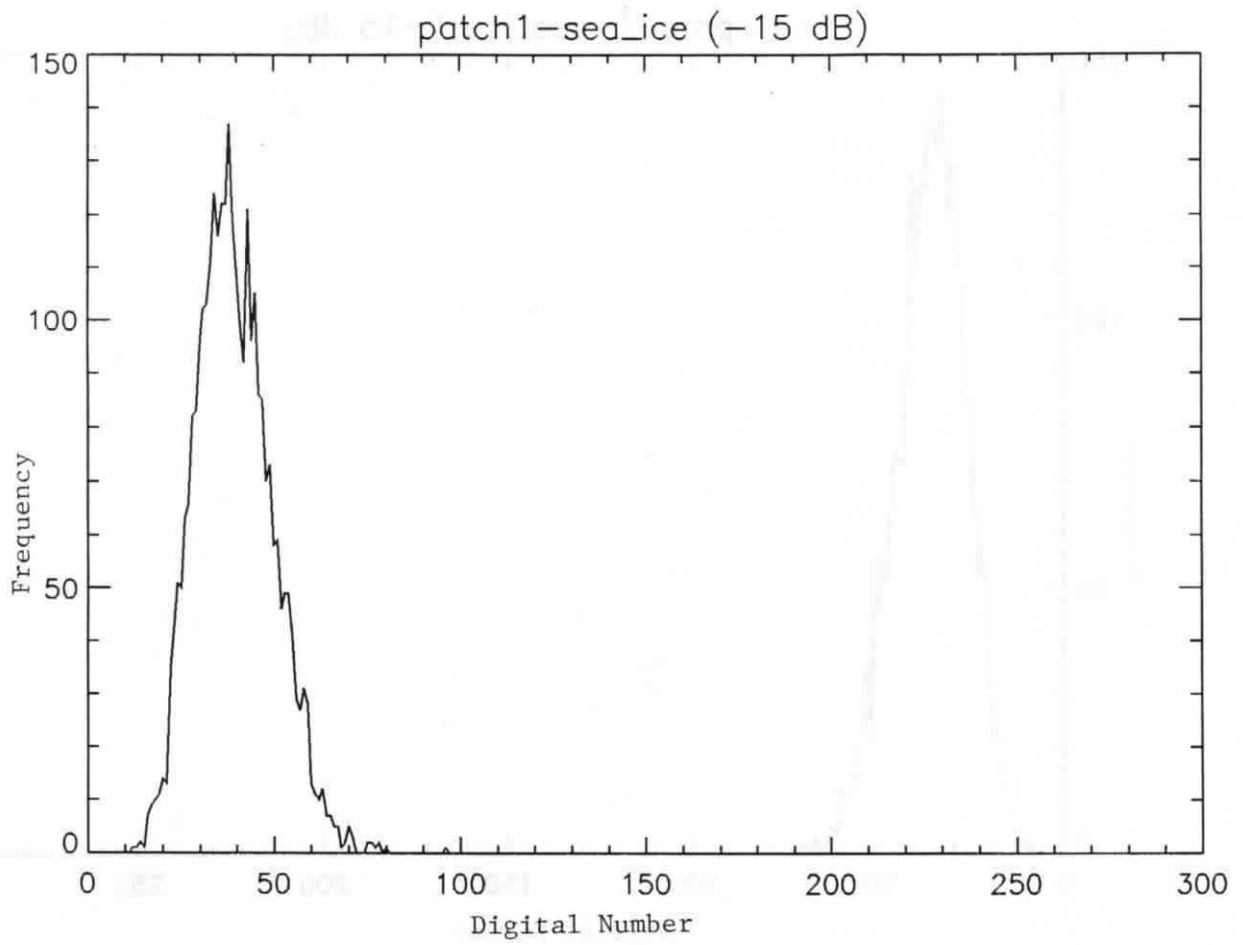
APPENDIX

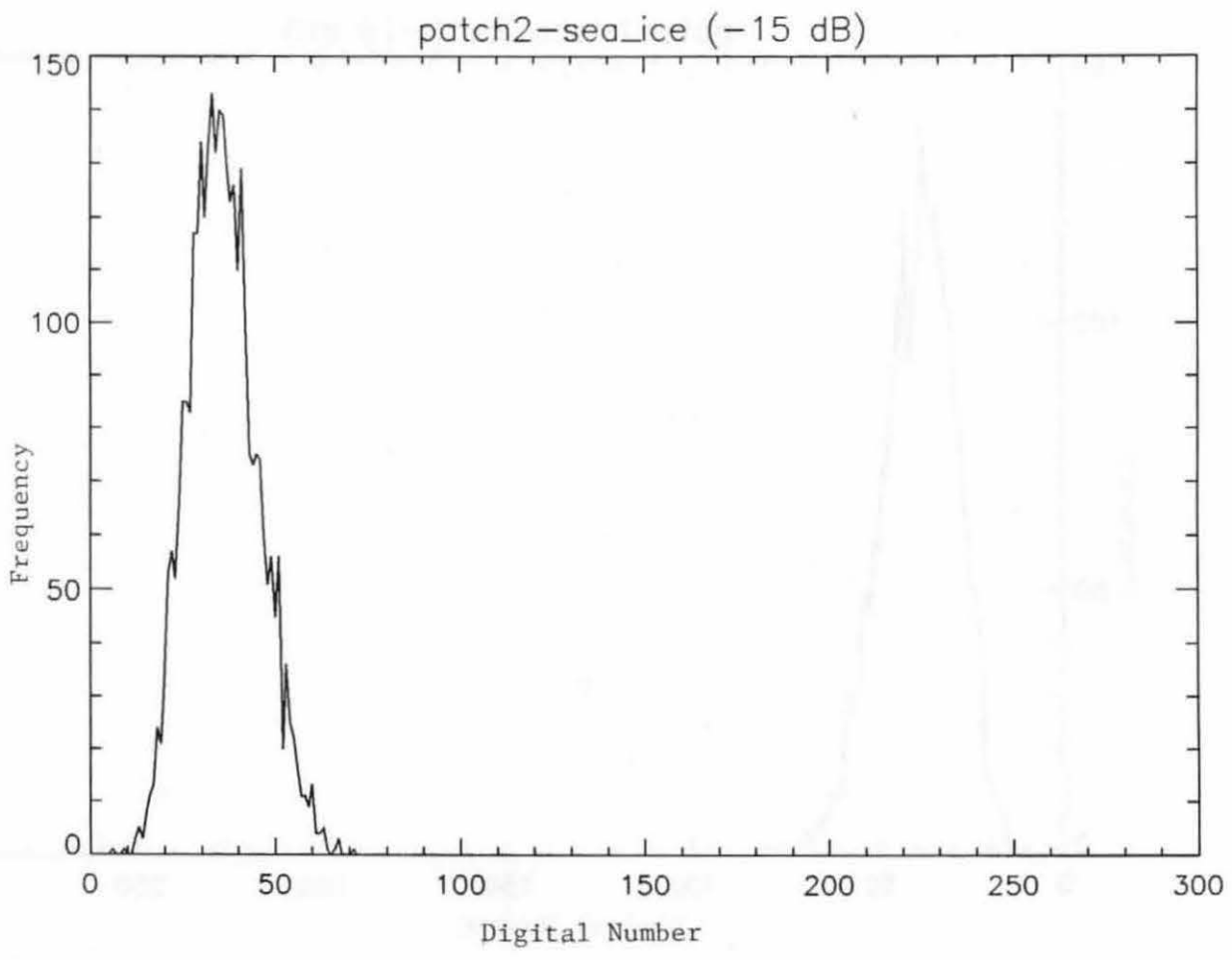Figure 1.   Digital number (0-255) distribution of first year sea ice.

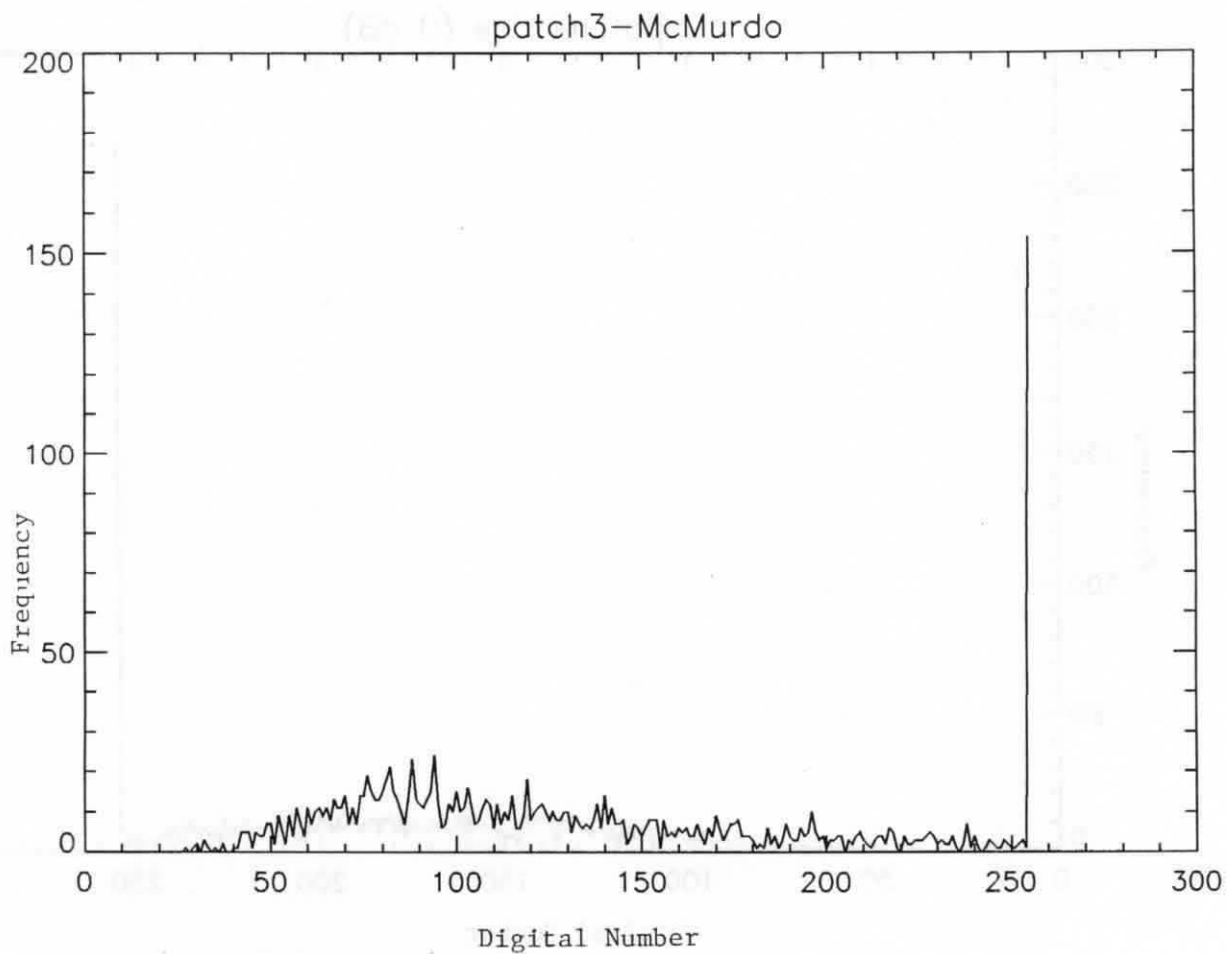Figure 2.   Digital Number distribution of first year sea ice.

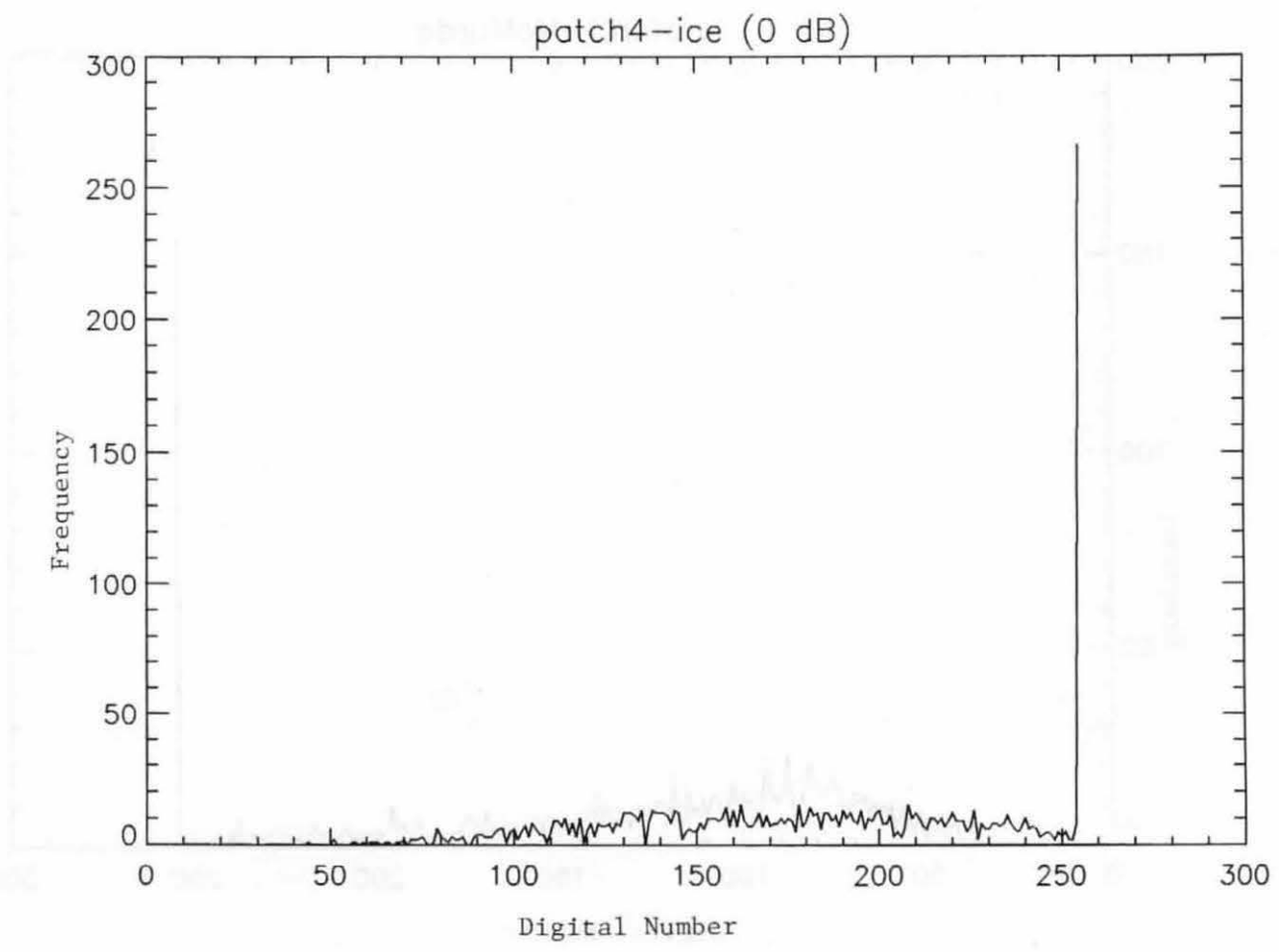Figure 3.   Digital number (0-255) distribution over McMurdo Station.

patch4-ice (0 dB)

Frequency

Digital Number

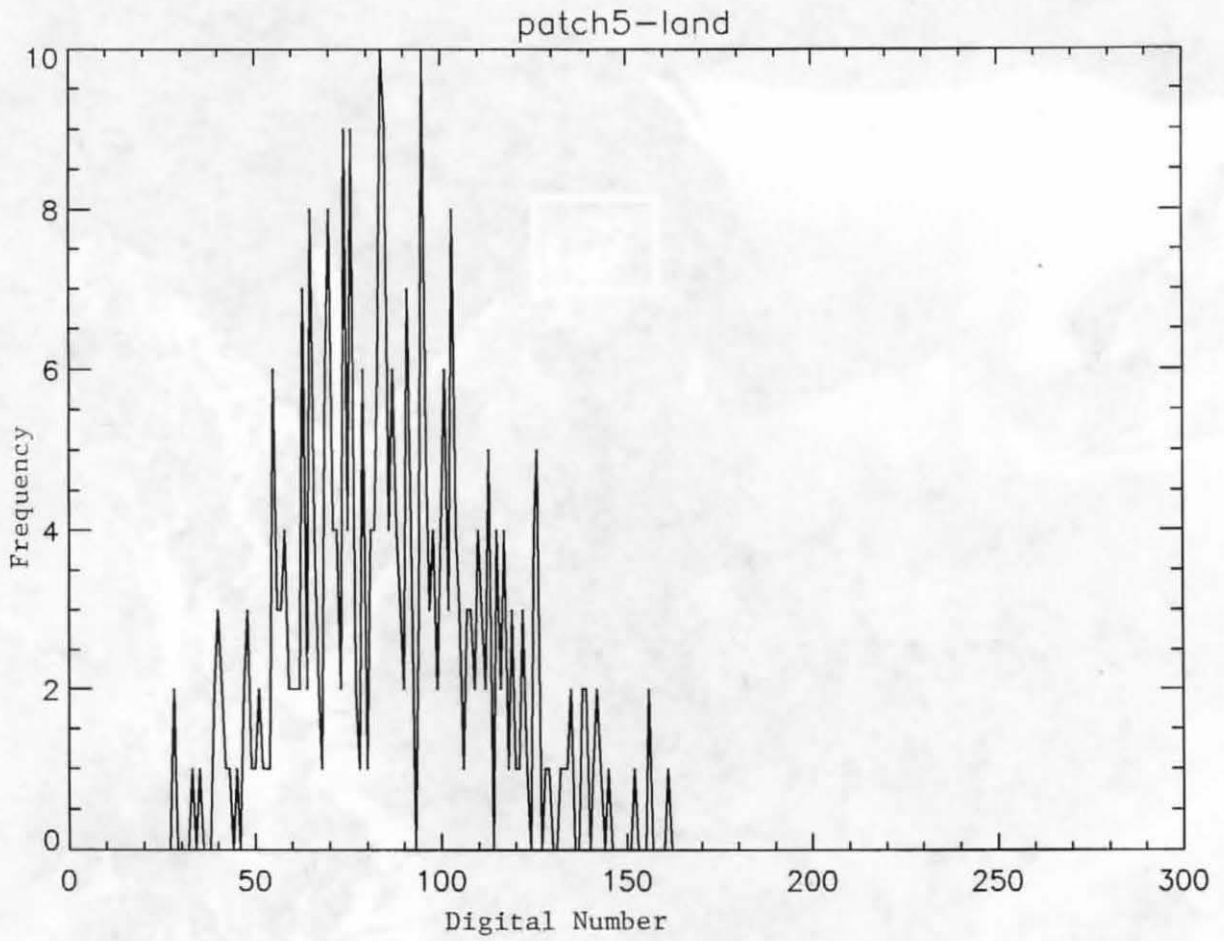Figure 4.   Digital Number distribution over glacial ice.

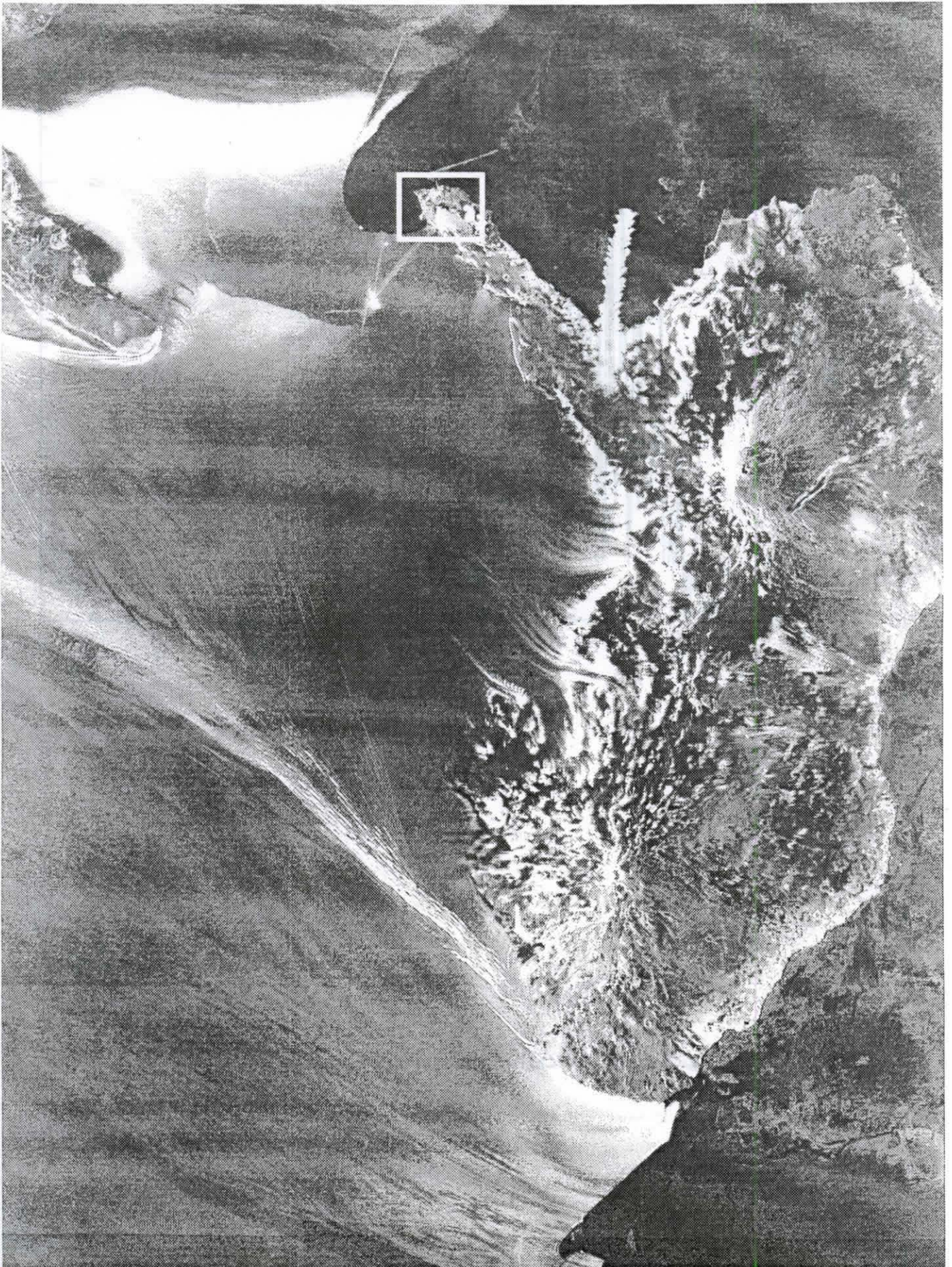Figure 5.   Digital number (0-255) distribution over bare rock.

Figure 6. Full JERS-1 image Hut Point Peninsula area on Ross Island. Boxed area corresponds to figure 7.
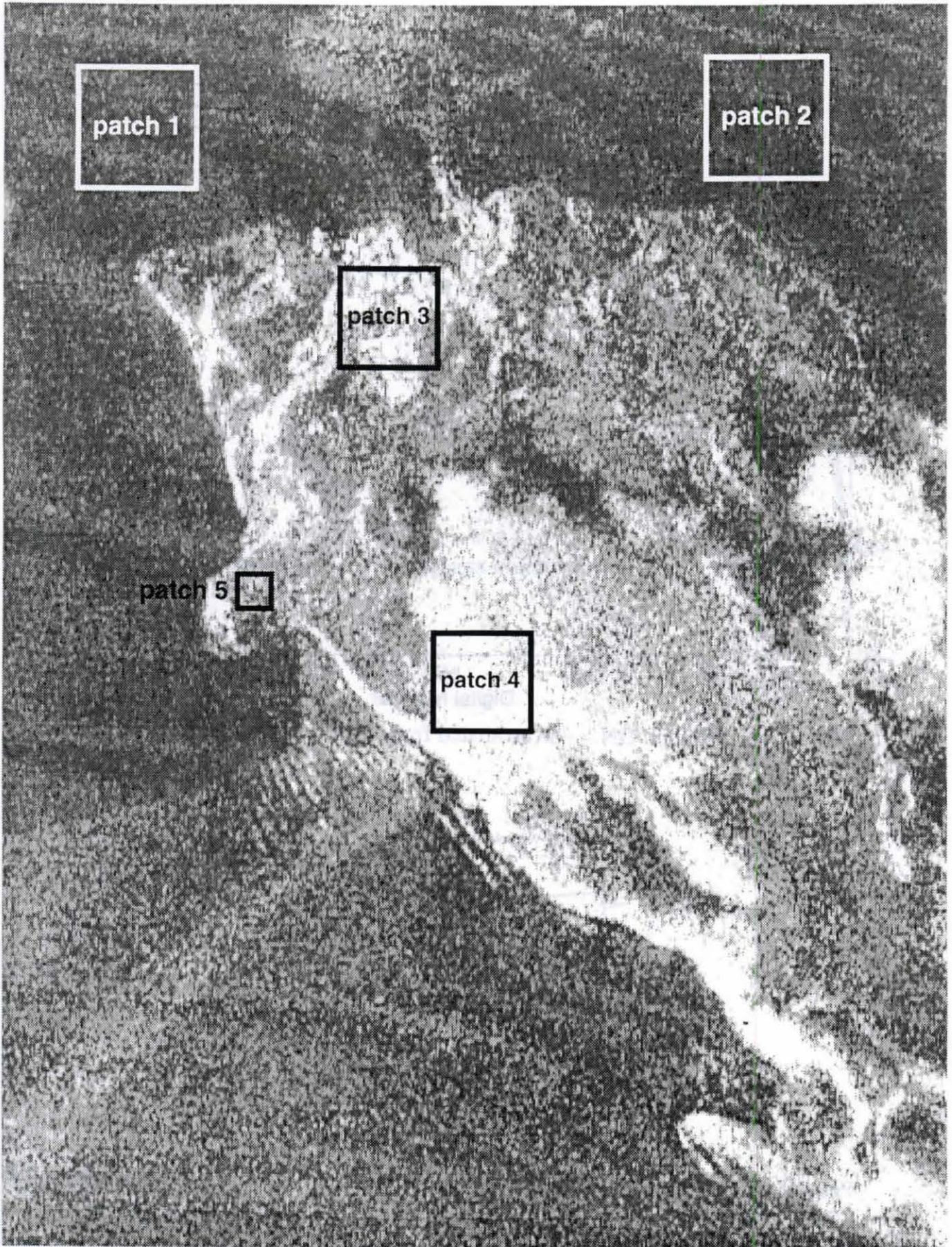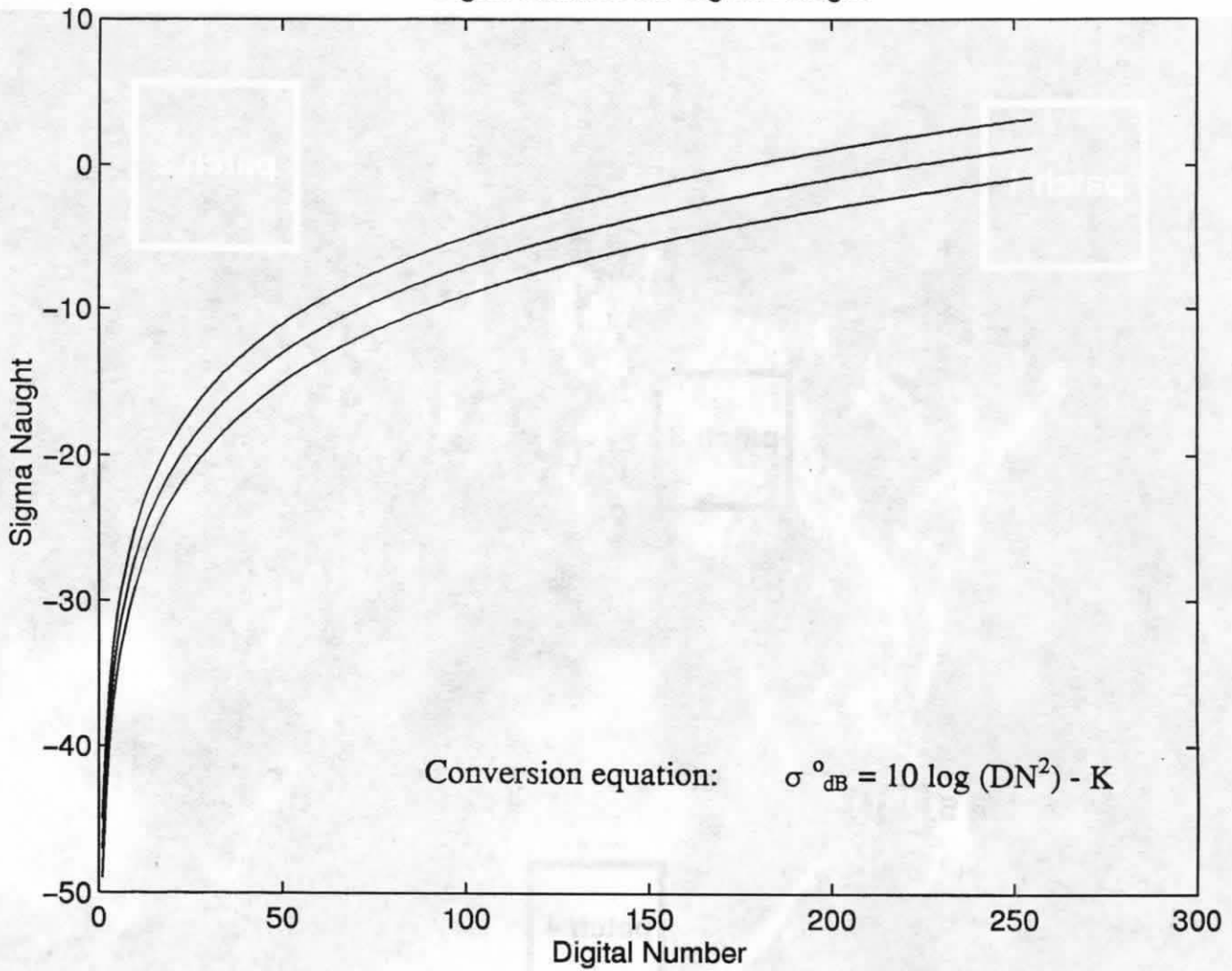
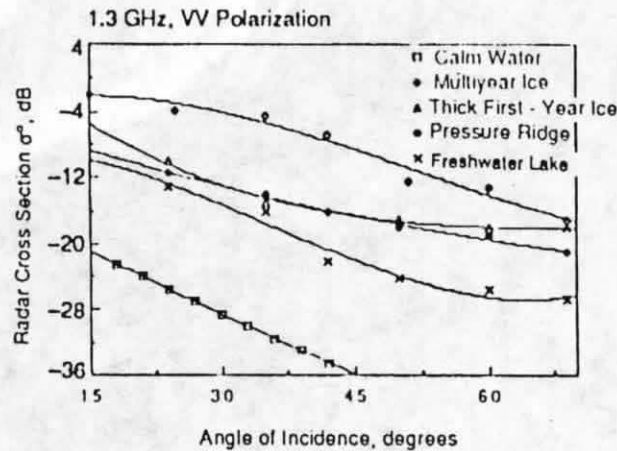Figure 7. Locations of digital number histograms (figure 1-5) where patch 1 corresponds to figure 1 and so on.

Figure 8. The top graph represents the range of estimated backscatter (sigma naught) versus digital number for calibration constant K=47±2. The bottom graph is the source for sigma naught value used for first year ice (-15dB) L-Band, 40° incidence angle used to estimate the calibration constant (Onstott, 1992).