NOAA-KLMN HIRS Level 1b Data Issues

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Data Representation

The HIRS instrument generates 13-bit radiometric data (bits 0-12) with the 13th bit, that is bit 12, set to 1 for positive values and to 0 for negative values. Bits 0-11 are the measurement's amplitude. This is the way the readings appear in the data stream downloaded from the spacecraft and how they appear to the preprocessor, which interprets the data as follows: If bit 12 is set to 1, it is set to 0, and the result is used; otherwise, the number is multiplied by -1 and that result is used.

The KLM User's Guide states that the original 13-bit data are stored in 2-byte words in the 1b data set, i.e., that the 13 bits generated by the HIRS instrument are placed, unchanged, in the low order bits of the 2-byte word and that the other bits (bit 13-15) are set to 0. This however, is not the case. The 1b* to 1b converter builds 1b data sets from 1b* data sets. The 1b* data contains HIRS data in an unpacked format, that is, in the natural (i.e., 2's complement) format used by most computers. The data are converted before they are inserted into a 1b data record as follows: If the number is negative, its value is ANDed with a mask in which bits 0-11 are 1s and bits 12-15 are 0s. This effectively turns bits 12-15 off and leaves bits 0-11 as they appeared in the 2's complement representation. Notice that for negative numbers in the range that the HIRS produces, this has exactly the same effect as would adding 2^{12}, i.e., 4096. For example if the HIRS produced a reading of 0 0010 0000 1001, the preprocessor would interpret it as -521. The converter could compute the value to be output by simply adding 4096 to -521, which produces exactly the same bit pattern as does ANDing -521 with 4095. Thus to convert HIRS 1b radiometric data for internal use by a computer, one need only put the1b data into an integer variable and subtract 4096. Most users have already discovered this.

Histogram Anomolies

Figure 1 gives an example of the HIRS-3 count histogram near zero. The black lines are the linear fit to the positive and negative counts. The yellow markers are the extrapolation of the negative counts and the green markers are the extrapolation of the positive counts. The red line and markers accentuate the area of interest from -0 to plus 2 counts. There are several observations to be made: 1) Negative and positive values appear to be of different populations, 2) Odd values are more common than even values, 3) -0 is heavily overpopulated, 4) +0 is unpopulated, 5) +1 and +2 are underpopulated, and 6) -0 has a net gain of about 200 over the loss from +0,+1,+2. From these observations we conclude that counts destined for -0,+0 and +1 are showing as -0.

Calibration Flag Channel Order

According to the specification of HIRS level 1b format, the Channel Calibration Quality Flags (bytes 37-76) are to be in telemetry order (1, 17, 2, 3, 13, 4, 18, 11, 19, 7, 8, 20, 10, 14, 6, 5, 15, 12, 16, 9). However, the implementation was in sequential order. This has been corrected when the NOAA-N format became operational on 28 April 2005.
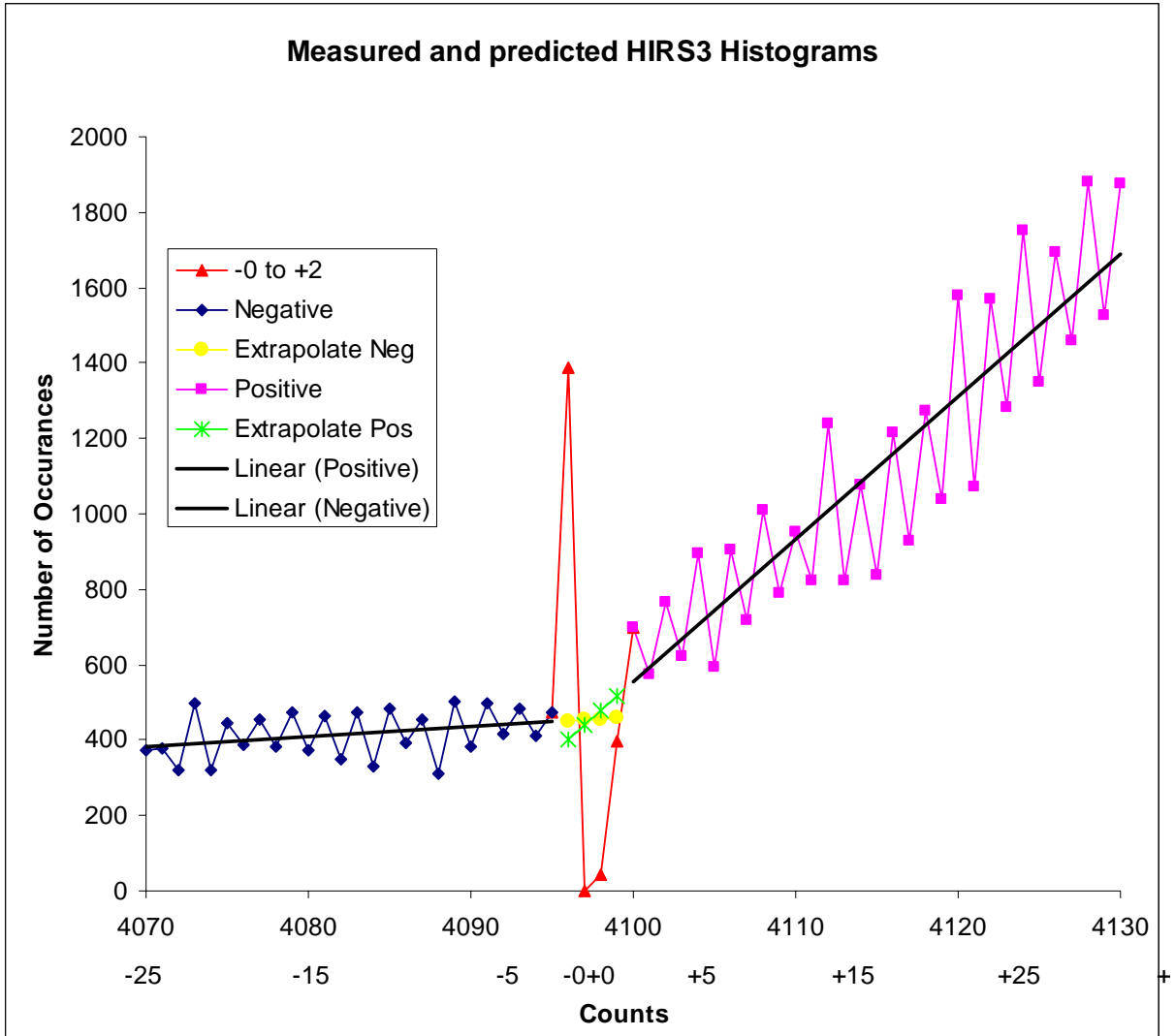
Acknowledgments

Figure 1. Histogram of HIRS counts near zero.