XMM-Newton CCF Release Note

XMM-CCF-REL-226

RGS Bad Pixels

C. Gabriel

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1 CCF components

Name of CCF	VALDATE	EVALDATE	Blocks changed	XSCS flag
RGS1_BADPIX_0020	2006-01-01T00:00:00	—	BADPIX	NO
RGS2_BADPIX_0020	2006-01-01T00:00:00	—	BADPIX	NO

2 Changes

This release adresses two issues concerning bad pixels / columns:

- flagging of two areas with increased offsets ("hot spots"), on both upper part sides of CCD 1 in RGS1, so each one corresponding to a readout node. This is done through a number of advisory hot segments masking the area of the spots, as long as they are not uploaded to the instrument,
- the natural increase of persistent hot columns, as observed in the science data but not detected in the diagnostic data, asks for flagging them as advisory bad columns, to ease the data analysis making it more efficient at the same time.

3 Analysis

As part of the continous monitoring of the RGS instruments, offset maps are produced, as the averages of the diagnostic images over three consecutive revolutions. They are then taken into the ODF data for the offset subtraction. The two hot spots are clearly seen in Figure 1a, showing the offset map corresponding to revolution 1323. The hot spots are attributed to stress produced in

CCD1 at the bond places. The temporal evolution of the "spot" central pixel signal (Fig. 1b) shows that the signal is still increasing, although flattening, and has surpassed the threshold level. This means that a definitive signal is contributing more and more to increased telemetry (although part of the spots are filtered on board - see next paragraph). Since further expansion of the spot could be compromise telemetry rates, provision has been made to upload bad column segments soon, which will fully mask off the spot areas.

For data collected already, there are several implications:

- the central hot spot areas get very often filtered on board, thus not being telemetered as science data, due to a continuous signal with a strange pattern. This is positive on one side, as it reduces the telemetry. On the other side, however, if such areas are not marked as bad in the data analysis, a wrong effective area is derived. This is due to the fact that such information is not part of the telemetry and gets lost. This is a small effect which can be however solved by marking the area as composed of bad segments;
- the rest of the area affected gets telemetered as part of science data, but is found by the task "rgsbadpix" and marked with a high probability as bad pixel area, therefore it is eliminated from the analysis. Masking the area with bad pixel segments helps to ensure a full avoidance;
- with a certain probability continuous charge in such an area as the hot spots, leads to appearance of hot columns. Figure 2 shows a bad pixel image from data taken during almost two years. The map represents the frequency of pixels / columns recognized as bad in science observations. The frequent occurrence of bad columns only under the bright telemetered parts of the spot suggests two possibilities: either a) a connection with charge transfer, which can be only avoided by uploading the spot regions as bad segments, or b) a bias introduced by a hot segment increasing the probability of "rgsbadpix" declaring the whole column as hot. In this latter case the inclusion of an advisory hot segment would recover the rest of the columns.

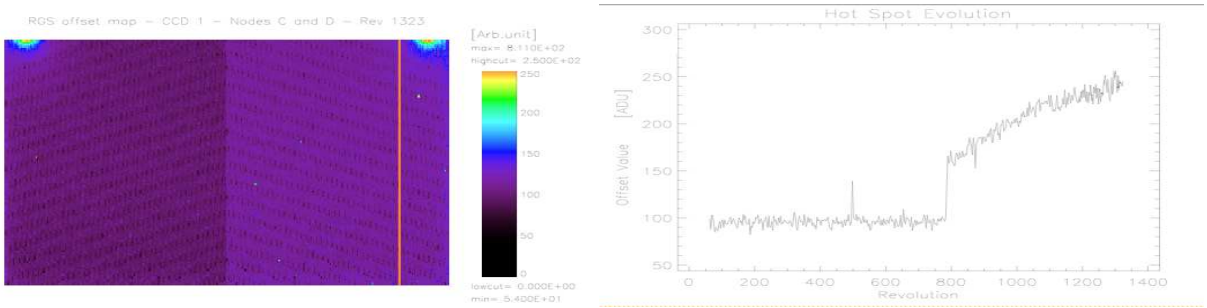

Figure 1: Left: RGS1 - CCD1 offset map showing the two "hot spots". Right: time evolution of signal from one spot central pixel.

Figure 2 shows also a persistent hot column on the right side of the image, which is not found in the diagnostic data. Several columns found hot by "rgsbadpix" with a probability of near 100% have been established by adding science bad pixel images. A total number of 4 hot columns and 1 hot segment (31 pixels) for RGS1 and 7 hot columns for RGS2 have been included in this CCF release as advisory. The threshold for declaring a segment / column to be hot was set by an occurrence of at least 95% being found hot. The number of such occurrences is not yet high enough to justify uploading them as bad columns since the telemetry rate is not compromised. On top of this there

is a probability that some of the columns could recover, which should be seen by monitoring their evolution. This is obviously only possible if they are not uploaded.

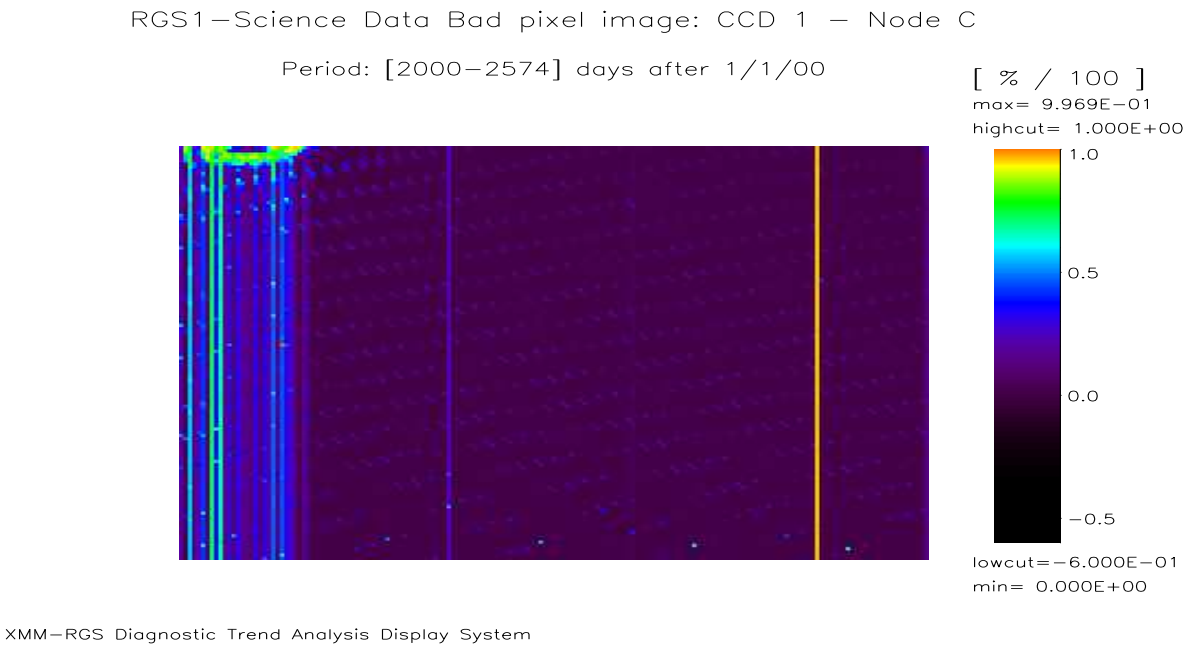

Figure 2: Bad pixel image of RGS1 - CCD1 - Node C, as derived from all science observations in revolutions 1014-1301

4 Scientific Impact of this Update

A more correct effective area derivation in the regions affected by the hot spots is one of the consequences of using these CCFs. Also a slightly more efficient bad column determination can be reached thanks to the advisory hot columns included in this release.

The start date of validity is set to 1st January 2006 more or less arbitrarily as a compromise taking into account the evolution of the hot spots and the frequency of the hot columns found. This date avoids discarding valid data in the default analysis using SAS. Moreover, analysis of earlier data taking these new CCFs is always possible by including them under the general overriding SAS parameter “ccffiles”.

5 Estimated Scientific Quality

The inclusion of the new advisory hot segments and columns in the CCFs 0020 should improve the quality of spectral fitting, since the effective area for the channels affected by the hot spots will be properly calculated. In addition the 12 new advisory hot columns will be eliminated from the analysis, with a 100% effective rejection.

6 Expected Updates

An update is expected soon: the upload of segments masking off the hot spots area will have as consequence a change in the corresponding CCF from advisory into uploaded. Further analysis of bad pixels with science data should also lead to updates, although this is expected to happen very infrequently.

7 Test procedures

General checks:

- use fv (or another fits viewer) for file inspection. It should contain 2 binary extensions (BADPIX and BADPIX1)
- use the SAS task CALVIEW to see if the CAL digests and uses the new files.
- analyze a number of observations with the new files running rgsproc with overriding ccffiles parameter pointing to these new files.

8 Summary of the test results

The fits viewer fv was used to inspect both CCF files, wrt their structure, validity dates and contents of the first extension (BADPIX). Everything OK.

The SAS task cifbuild was run several times using data corresponding to periods covered and not covered by these CCFs in order to check the correct selections. Selections were correctly done.

The SAS task calview was used to prove that these calibration files are ingested correctly by the CAL, by pointing to the different Calibration Index Files and producing bad pixel plots.

A large sample of observations between revolutions 1200 and 1280 (appr. 350 exposures) was reduced using the new ccf files. The result for the hot spot regions (see Fig. 3) is an almost absolute correspondence of bad segments found by “rgsbadpix” by those columns, which were recognized as bad with the older CCFs, corresponding to the affected hot spot areas. Figure 4 shows the difference of the bad pixel images derived (old - new). The small fluctuations to the expected 0 in the hot columns region below the hot spot is just due to a non 100% correspondence of the exposures sample in both cases.

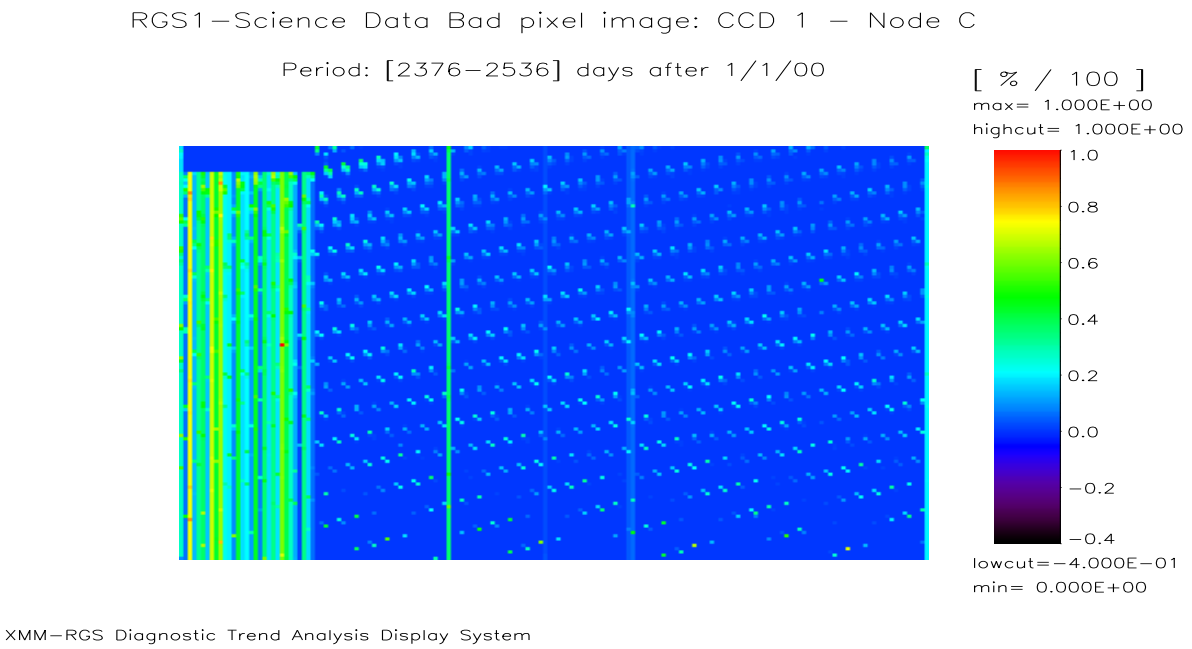

Figure 3: Bad pixel image of RGS1 - CCD1 - Node C, as derived from all science observations between revolutions 1200-1280, this time using the new CCF RGS1_BADPIX_0020.CCF

This is the proof that the origin of those hot columns is not due to a software effect faking the recognition of a hot column due to the presence of a hot segment, but probably lying in a continuous charge transfer caused by the hot spots. The strongly affected areas are expected to be recovered at large first after an upload to the instrument of the hot segments, so that they do not get read out. Operational constraints are making this upload first possible in 6-8 weeks, May 2007.

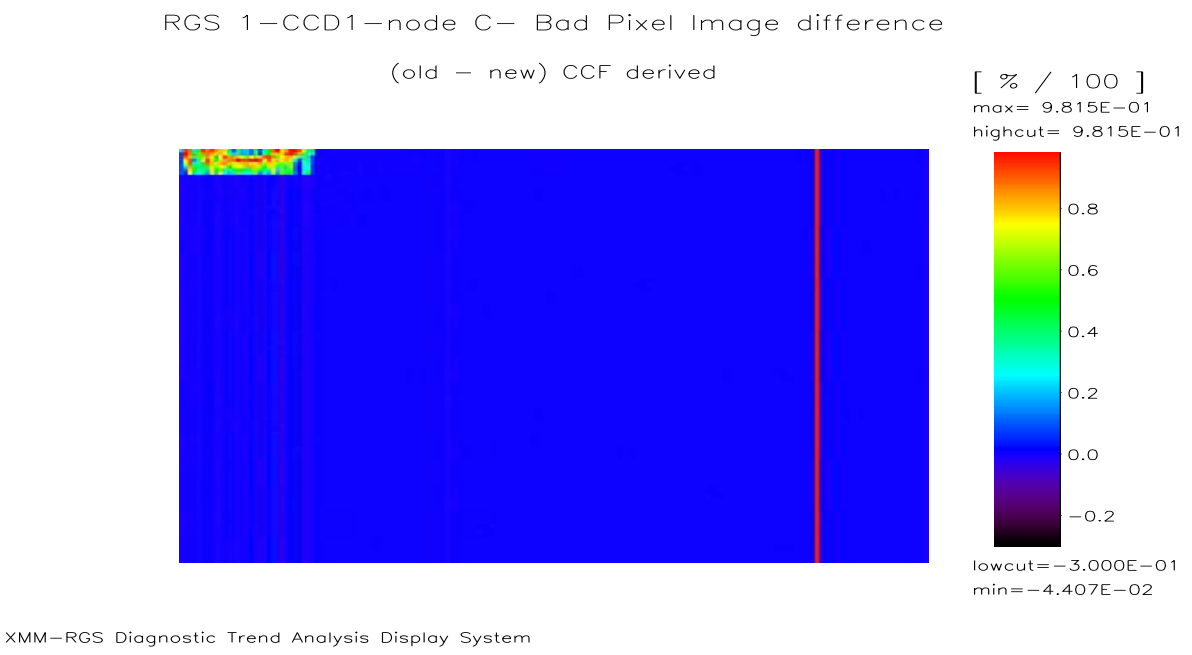

Figure 4: RGS1-CCD1-Node C bad pixel image difference (old - new)