

XMM-Newton CCF Release Note

XMM-CCF-REL-378

OM Photometry. Update of the Time Dependent Sensitivity Degradation correction based on stars from OM Catalogue SUSS-4

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May 14, 2020

1 CCF components

Name of CCF	VALDATE	List of Blocks changed	CAL VERSION	XSCS flag
OM_PHOTTONAT_0008	2000-01-01T00:00:00	DEGRADATION		No

2 Changes

With this release of the OM_PHOTTONAT CCF, we provide an update on the time-dependent decline of the OM sensitivity measured in each of the OM lenticular filters and, consequently, their correction. This follows the previous update in 2018, described in XMM-CCF-REL-356.

We follow, here, the same approach used previously, i.e. we determine the degradation from a subset of sources from the OM Serendipitous UV Source Survey (SUSS) whose timeseries, when corrected for degradation using the previously available degradation correction functions, are deemed to show no significant long-term variability (see Talavera [1]). For this update, the results are based on the SUSS4 catalogue, released in 2018. Again, the correction curve, for each filter, is represented by a second order polynomial of the form

$$Correction_factor = A + B \times t_{MJD} + C \times t_{MJD}^2 \quad (1)$$

Where A and B are the polynomial coefficients and t_{MJD} is the observation epoch in MJD. The coefficients for the correction derived from the SUSS4 data, which are integrated into the OM_PHOTTONAT_0008 CCF file, are shown in Table 1

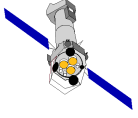


Table 1: New OM Time sensitivity degradation correction

filter	OM_PHOTTONAT_0008		
	A	B	C
UVW2	-4.9696703	0.00018393148	-1.3202377e-09
UVM2	-10.288245	0.00038538037	-3.2243471e-09
UVW1	-3.2548134	0.00013826678	-1.0790928e-09
U	-3.4284681	0.00014995325	-1.2441946e-09
B	-5.4538362	0.00022443232	-1.9278347e-09
V	-7.0742078	0.00026998934	-2.2057366e-09

3 Scientific Impact of this Update

The time dependent sensitivity degradation trend changes with time. Therefore we need to update the coefficients to be able to obtain a proper correction.

In figure 1, and also figure 2, where the data are binned to better highlight the data trends, we can see the variation with time of the count rates of a few hundreds stars selected from the OM catalogue. In each filter panel, the existing correction, based on data from the OM SUSS-3 Catalogue, containing observations till mid-2015, is represented by a blue dashed line, while the red line shows the newly computed degradation functions, now based on data from SUSS-4, with observations up to mid-2017. The largest change between the curves, when extrapolated to MJD=58849 (2020 Jan 01) is 1.2% in the UVM2 filter.

4 Estimated Scientific Quality

The correction coefficients have been thoroughly tested before releasing the new correction. The time dependent sensitivity degradation is monitored regularly to ensure the repeatability and stability of all corrections applied by SAS when new observations and new versions of SAS become available.

Table 2 shows the results of processing the regularly observed standard stars with the new corrections. We can see that the errors (standard deviation of the mean values) for each star and filter are $\sim 2\%$ or less in the majority of cases.

We note, however, that while the percentage errors in table 2 generally represent measurement scatter, For the V and UVW2 filters, they also reflect the fact that, since ~ 2010 , the standard stars, Hz2 and BPM16274, exhibit systematic deviations from the trend of the bulk set of stars in figure 1. The decline of these two standards appears flatter than the bulk stars, by 3-5%; a similar trend in the data of GD153 is probably present but is less pronounced. Systematic deviations are not clearly evident in the other filters. This issue is under investigation and will be discussed in a future technical note. At the current time, we believe the per-filter degradation and correction curves determined from the SUSS4 bulk star data, are reliable.

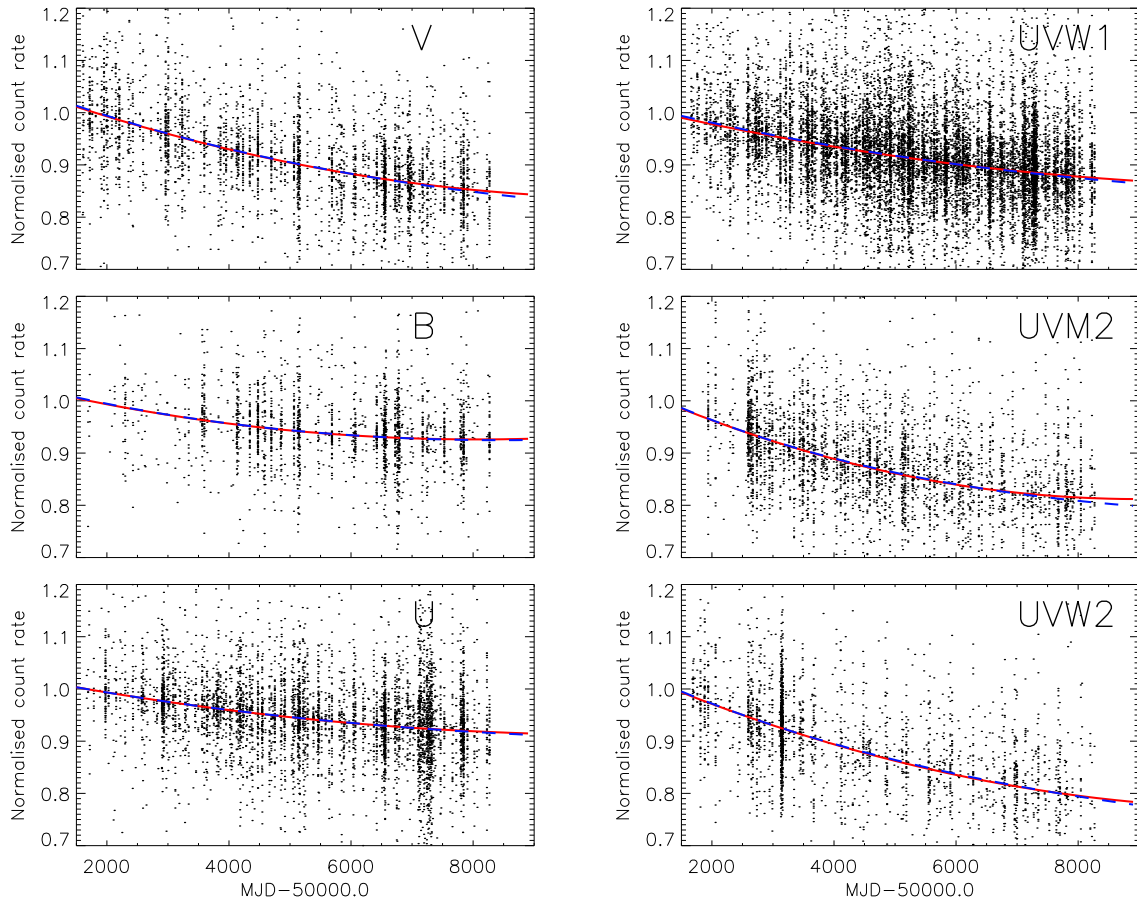
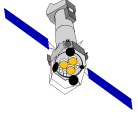


Figure 1: OM time dependent sensitivity degradation in each OM filter: black dots are the normalised, uncorrected rates of many stars from the OM SUSS4 catalogue. Blue dashed curves show the decline characterised from SUSS3, while the red curves show the new quadratic fits from SUSS4, reflected in OM_PHOTTONAT_0008. By 'normalised', we mean that the uncorrected count rates in the timeseries of each star are scaled by a factor $1/M$ where M is the mean of its corrected timeseries (as corrected by the previous correction functions). Note that the coefficients in the CCF, and presented in Table 1, characterise the correction function, i.e. the inverse of the degradation profiles shown here.

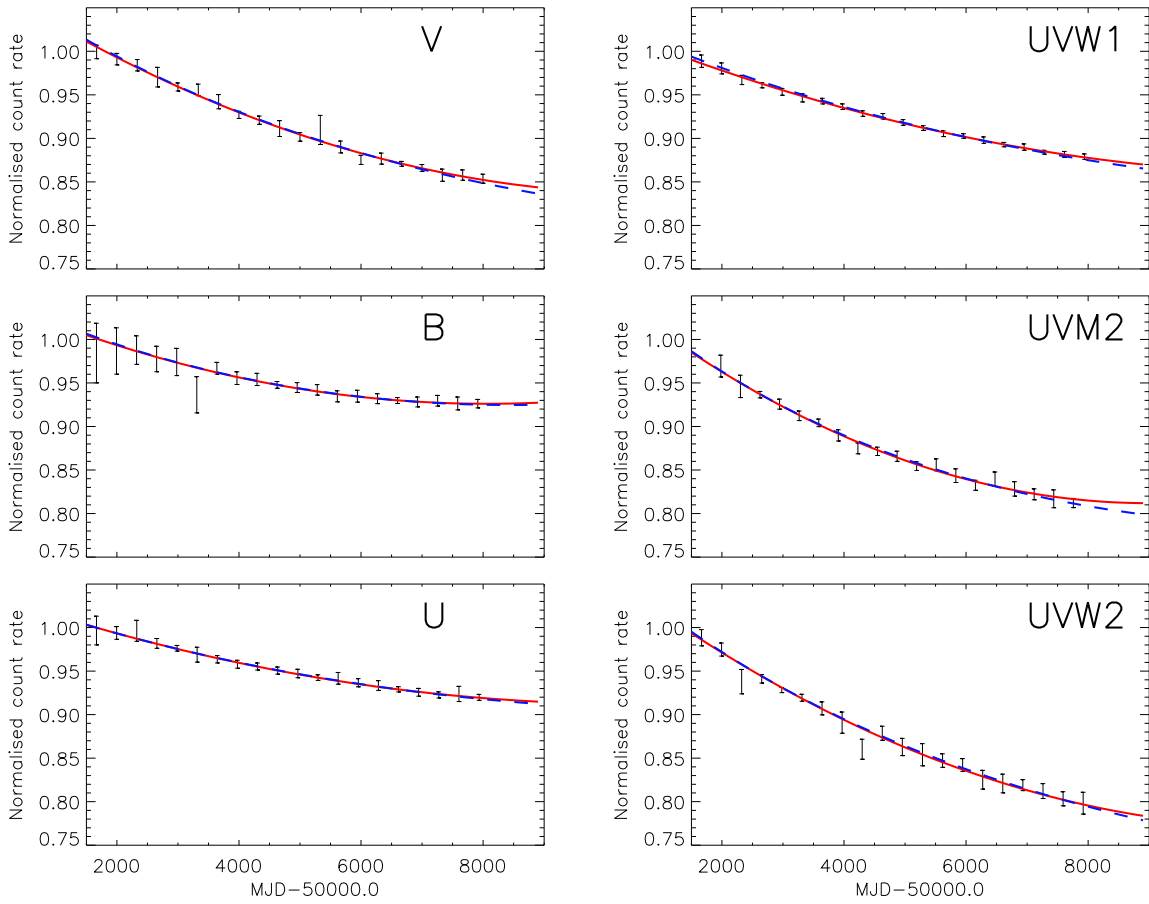
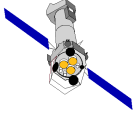


Figure 2: Similar to fig 1 except that the y-axis scale is expanded and the SUSS4 data points have been binned into 20 bins in time for clarity. Each binned point is the weighted mean of the n data points in each bin, while error bars are RMS/\sqrt{n} where RMS is the standard deviation of the bin.

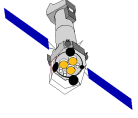


Table 2: Standard stars processed with SAS 18.0 and OM_PHOTTONAT_0008. Average count rates of several observations

star	N_obs	UVW2	UVM2	UVW1	U	B	V
GD153	16	83.13	160.98	328.66	419.07	281.01	71.20
error (%)		2.2	2.3	1.5	1.5	1.3	2.0
HZ2	17	23.67	47.75	110.99	168.05	147.64	43.81
error (%)		2.3	1.0	1.1	0.9	0.9	3.2
BPM16274	39	14.64	30.00	72.41	112.12	106.78	32.83
error (%)		1.7	1.3	1.1	0.9	1.0	2.2

5 Expected Updates

As the degradation trend changes in the future, a new version of the correction coefficients will become necessary.

We shall continue using data from updated versions of the OM catalogue with larger time coverage.

6 Test procedures

The testing of the new correction has two parts. First, the correction is applied directly to the uncorrected rates of the standard stars to confirm its correctness.

Second, we perform a functional test of the CCF in SAS. All observations of the standard stars have been processed with SAS 18 and the new CCF with the updated time sensitivity degradation correction, OM_PHOTTONAT_0008.

7 Summary of the test results

As shown in Table 2 the errors in mean count rates obtained with the new correction are less than 2 % in the majority of cases, thus within the accuracy limits of OM photometry.

References

[1] Talavera A., 2017, XMM-SOC-TN-0207, available at:

<https://xmmweb.esac.esa.int/docs/documents/CAL-TN-0207-2-2.pdf>