Technical Memo

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MEASURE OF THE STABILITY OF THE SKYFLATs in FORS1

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1 Motivation

These tests have been carried on as part of the on going feasibility studies for the realization of the FORS1 Secondary Standard Star Project (FSSSP). The goals were to monitor the stability of the SKYFLATs frames both on large and small scale and to evaluate its impact on the flatfielding procedures and its implications on the photometric accuracy.

To this aim, we have used as a reference a set of master SKYFLATs from observations performed during Period 72 (October 2003-April 2004). The master SKYFLATs have been produced by the recipe *fors_s_img_master_skyflat* of the FORS pipeline [1]. To expand our sample as much as possible both in number and in covered time span, we have used only master SKYFLATs taken in the most-used broad band U,B,V,R and I Bessel filters. Of these, we have considered only frames taken in Standard Resolution (SR) mode, 1×1 binning, high gain and four ports (ABCD) readout. Only one master SKYFLAT per night, per filter, has been considered in our analysis.
Our final sample includes then

- 37 master SKYFLATs in U_BESS
- 48 master SKYFLATs in B_BESS
- 52 master SKYFLATs in V_BESS
- 54 master SKYFLATs in R_BESS
- 51 master SKYFLATs in I_BESS

2 Large Scale variations

To measure large scale variations of the SKYFLATs we proceeded as follows. Per each filter we choose a reference master SKYFLAT, typically the first in the sequence, to be compared with the sequence of test master SKYFLATs. After normalizing each SKYFLAT (reference and tests) to its mean, each test SKYFLAT was divided by the reference SKYFLATS. The *flatness parameter* and its error were defined as the average of the output frame and its RMS, respectively. The trend of the *flatness parameter* is shown in Figure 1 for SKYFLATS taken with all the filters. As it is seen, night-to-night variations of the *flatness parameter* are well within the $\sim 1\%$ error and do not show any evidence for a systematic trend on medium/long timescales. The same is true also for the other filters.

3 Small Scale variations

We also carried on a test to assess the stability of the SKYFLATs on smaller scales. The used dataset is the same used for the previous test. To this aim, we have selected 12 different test regions in the CCD, each with a size of 300×300 pixels, and evenly distributed to sample adequately each of the four CCD ports. The position of the test regions have been chosen both to sample areas close to the center and to edges of the CCD and to avoid bad pixels. In addition, a reference region has been chosen at the bottom right of port C [2], close to the junction between the four ports. The location of the test and reference regions is shown in Figure 2.

Each frame of the sequence has been normalized to its median. Then, from each normalized frame we have extracted subframes corresponding to the 13 regions defined above (one reference and 12 tests). Each subframe has been then normalized, with the normalization factor defined as the median of the reference region. Then, per each of the 12 test regions we have defined a local *flatness parameter* and its error as the median and the RMS of the normalized region, respectively.

The trending of the *flatness parameters* and its error for each of the 12 reference regions is shown in Figure 3 for SKYFLATs taken with the R_BESS filter.

[1] www.eso.org/observing/dfo/quality/FORS1/pipeline/recipe_calib.html
[2] see www.eso.org/observing/dfo/quality/FORS1/pipeline/ports_FORS.gif

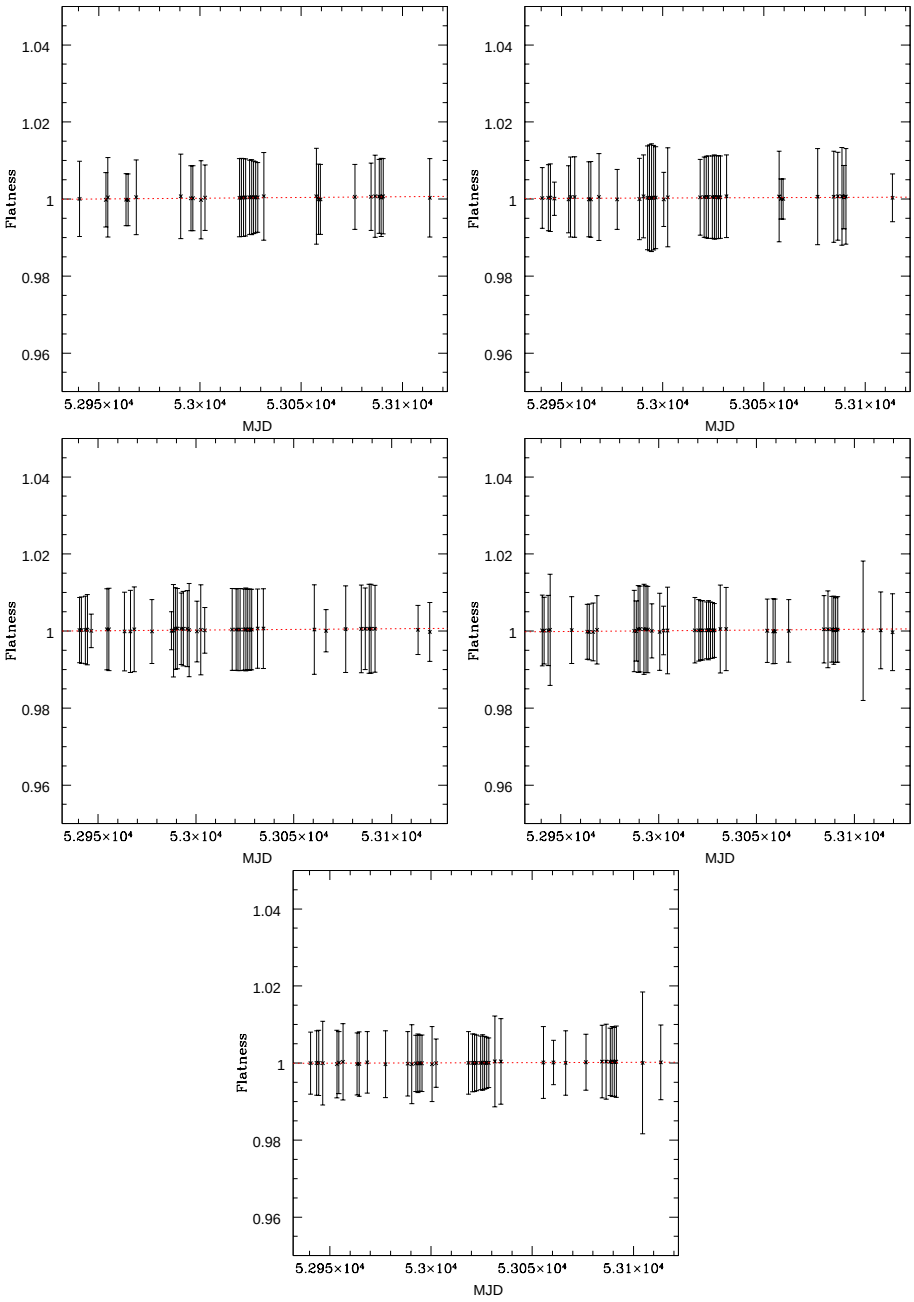

Figure 1: Values of the *flatness parameter* for the U, B, V, R, I filters (from top left to bottom center, respectively) plotted as a function of the observing date (in MJD). The horizontal dotted line indicates the least square fit of the distribution.

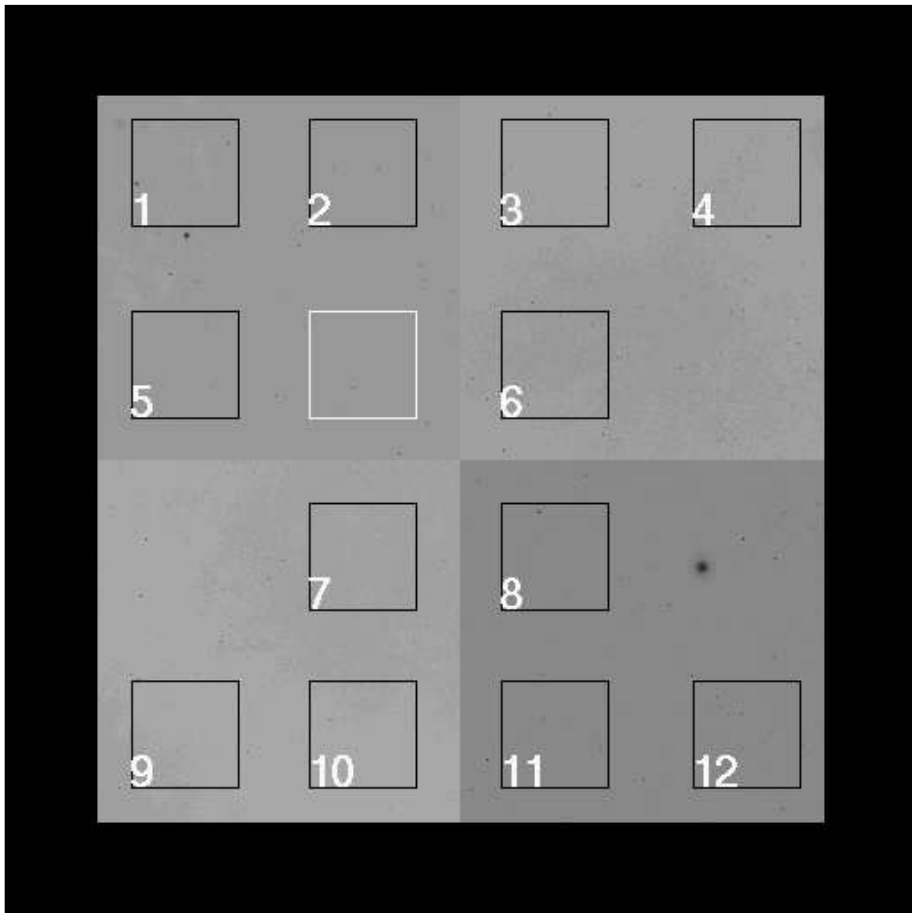

Figure 2: Position of the 12 test regions (black squares, numbered 1-12) and of the reference one (white square).

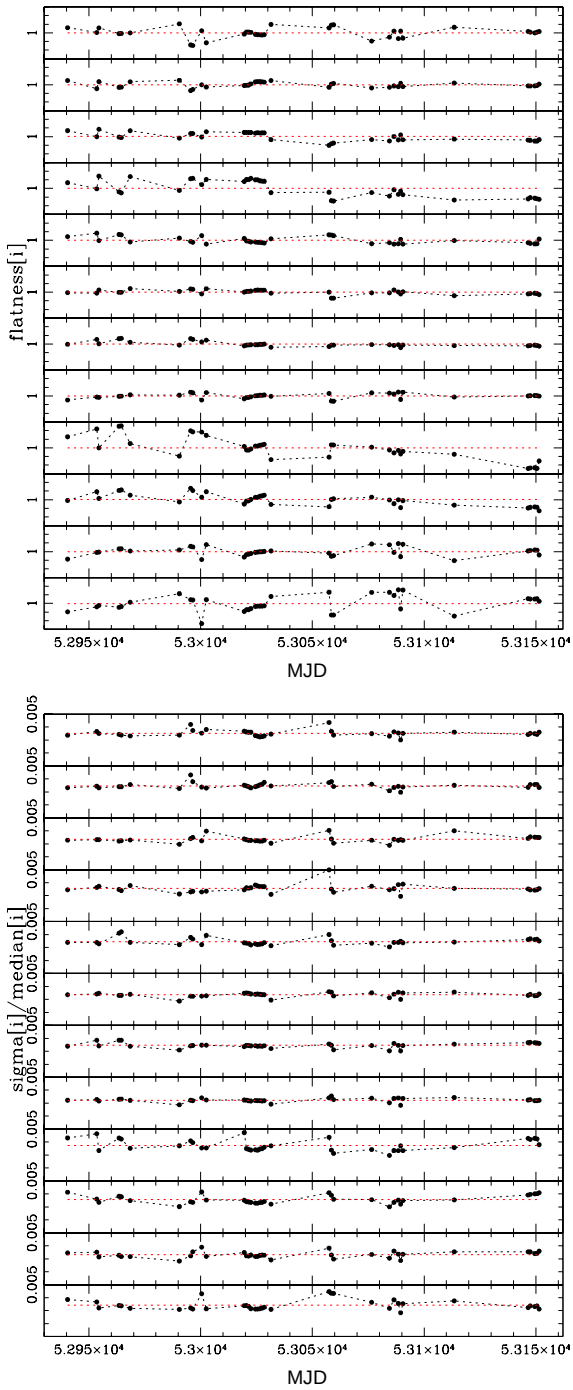

Figure 3: Values of the *flatness parameter* (top) and their σ below for each of the 12 defined test regions (1 to 12 from top to bottom) plotted as a function of the observing date (in MJD) for the U_BESS filter. In each case, the σ has been normalized to the median of the distribution. The horizontal dotted line indicates the least square fit of the distribution.

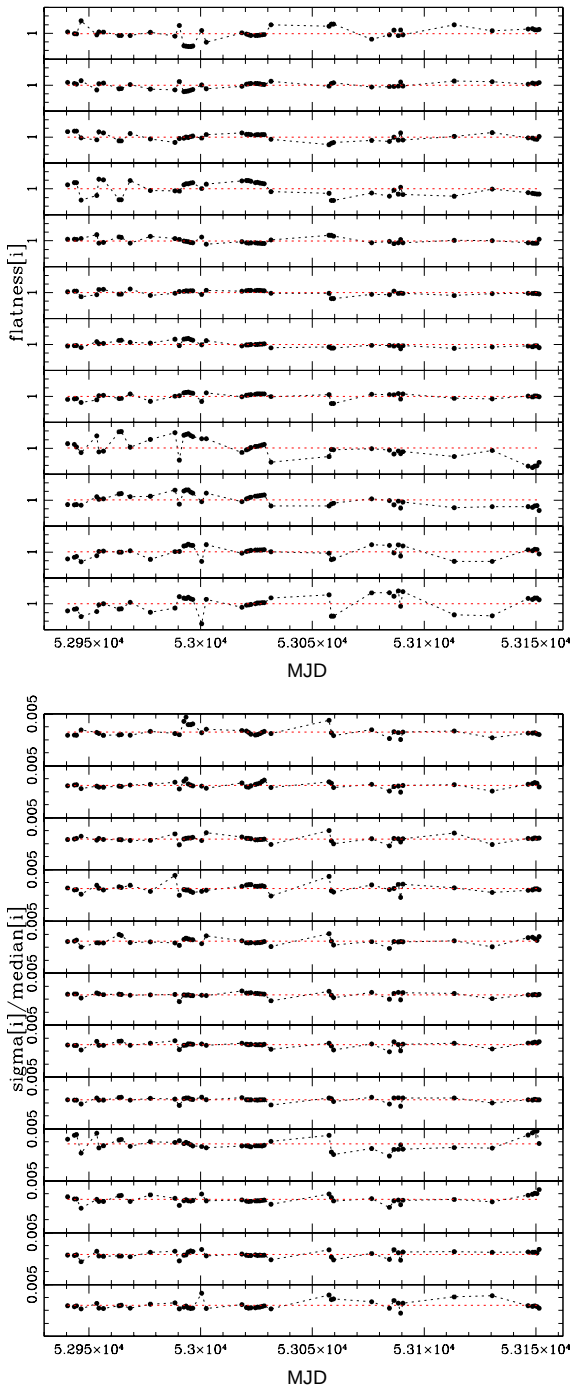

Figure 4: Same as Figure 3, but for the B_BESS filter.

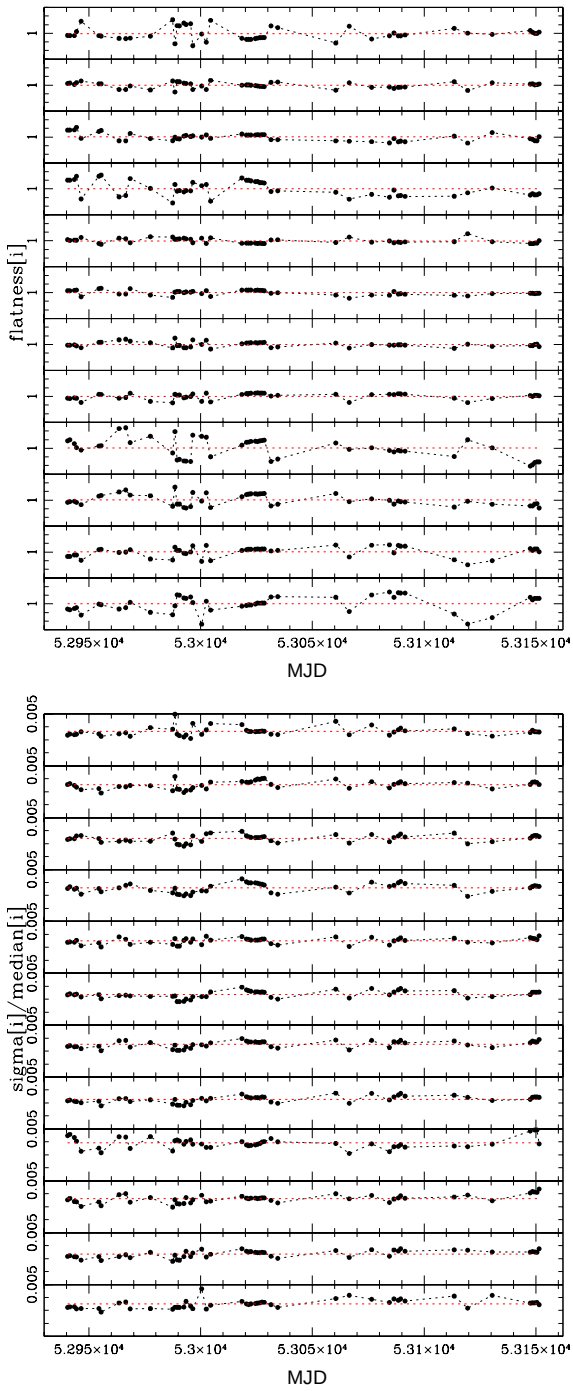

Figure 5: Same as Figure 3, but for the V_BESS filter.

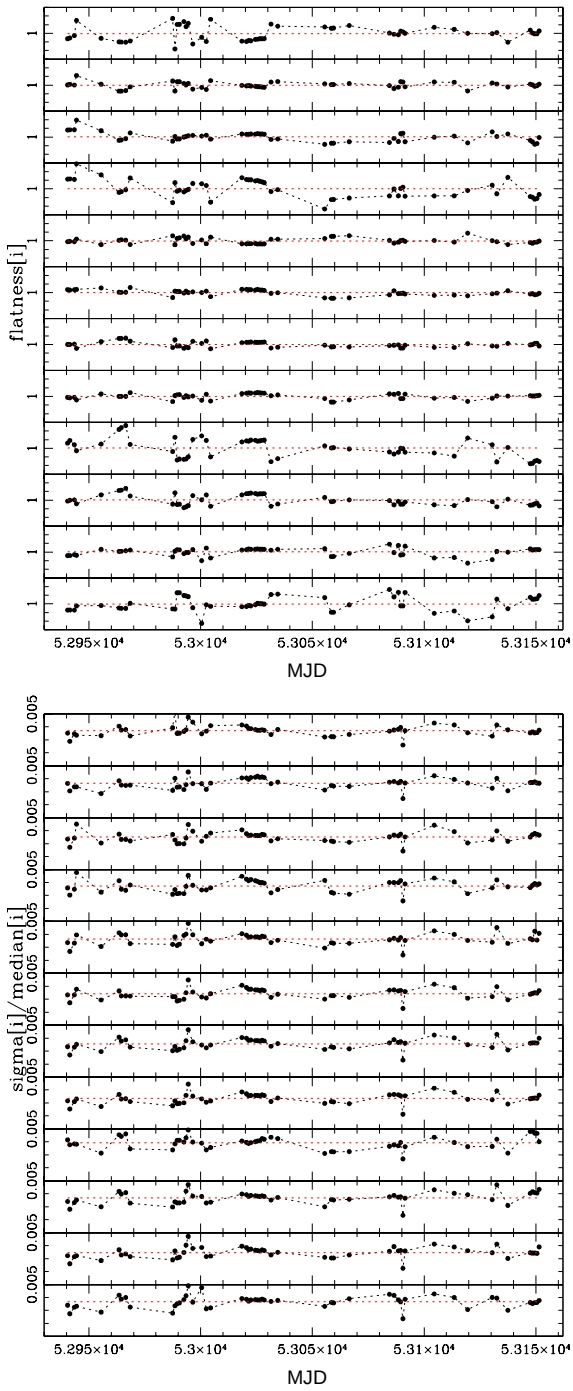

Figure 6: Same as Figure 3, but for the R_BESS filter.

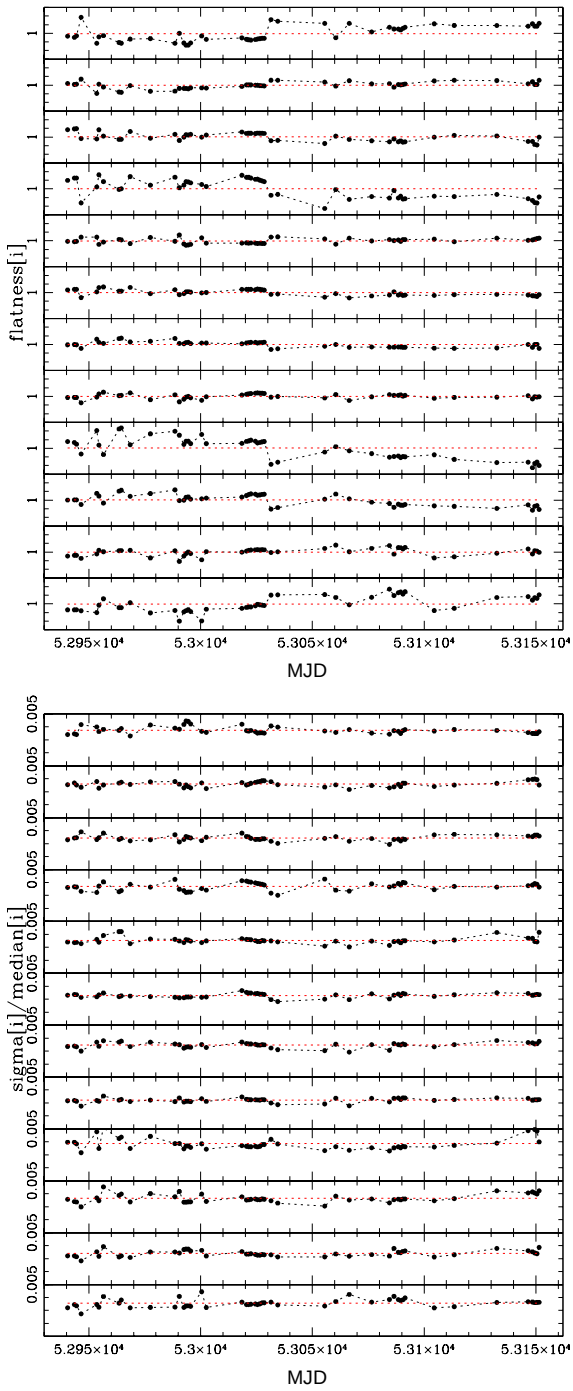

Figure 7: Same as Figure 3, but for the *I_BESS* filter.