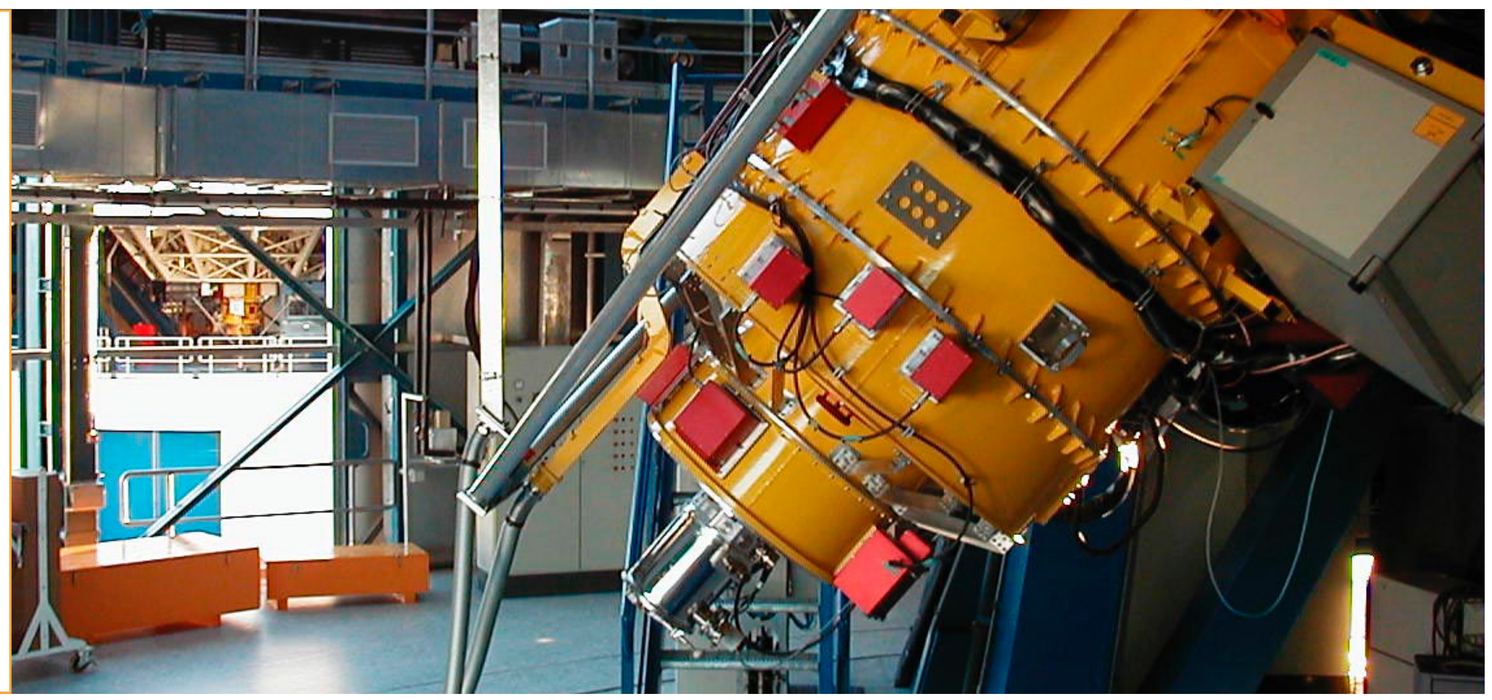
Stability of FORS2 Sky Flats

Henri M.J. Boffin, Danuta Dobrzycka, Christian Hummel, Sabine Moehler, Jonathan Smoker, Joe Anderson, Bruno Dias

THE FORS2 CALIBRATION PLAN STATED THAT THE VALIDITY OF A SKY FLAT FOR IMAGING WAS 4 DAYS, PUTTING A LOT OF STRESS ON THE OBSERVERS, ESPECIALLY DURING PERIODS OF BAD WEATHER. WE THEREFORE DECIDED TO ANALYSE A SERIES OF FLATS TO CHECK IF IT IS POSSIBLE TO EXTEND THIS VALIDITY RANGE AND IF YES, TO WHAT LEVEL. THIS ANALYSIS ALLOWED US TO CHANGE THE FORS2 CALIBRATION PLAN, INCREASING THE VALIDITY OF A SKY FLAT TO 14 DAYS.



Method

We analysed a series of 16 certified master sky flats taken through broadband filters between 29 April and 11 June 2015, under clear conditions in twilight.
The frame used as reference to which to compare the others is the one of the second epoch, i.e. the one obtained on 2 May 2015. All master flats were divided by this reference frame, and the unvignetted part was extracted to compute the statistics with MIDAS.

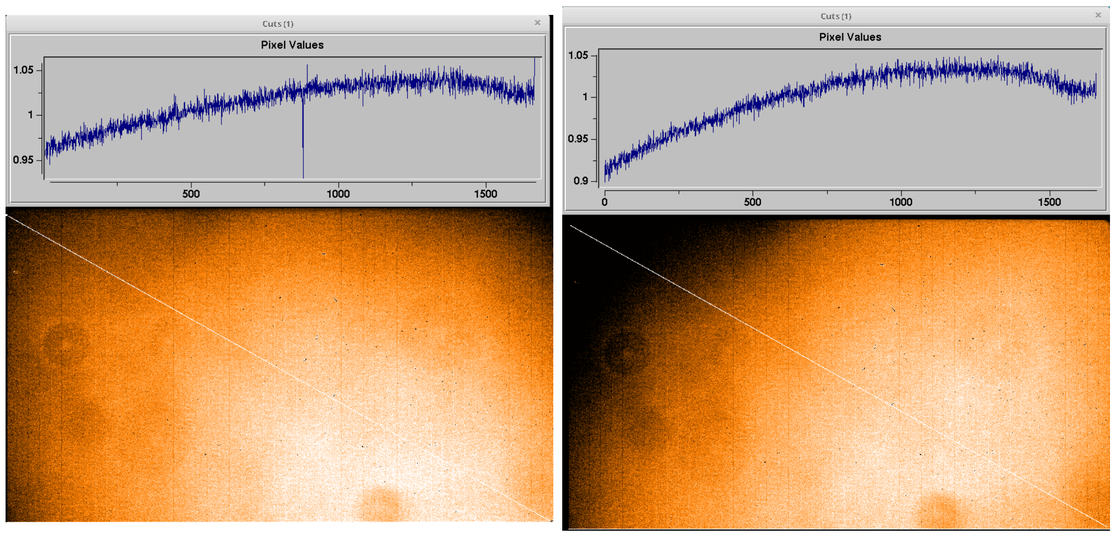


Fig. 1 : Some examples of the flat fields (I_BESS, CHIP1, 2x2 binning).

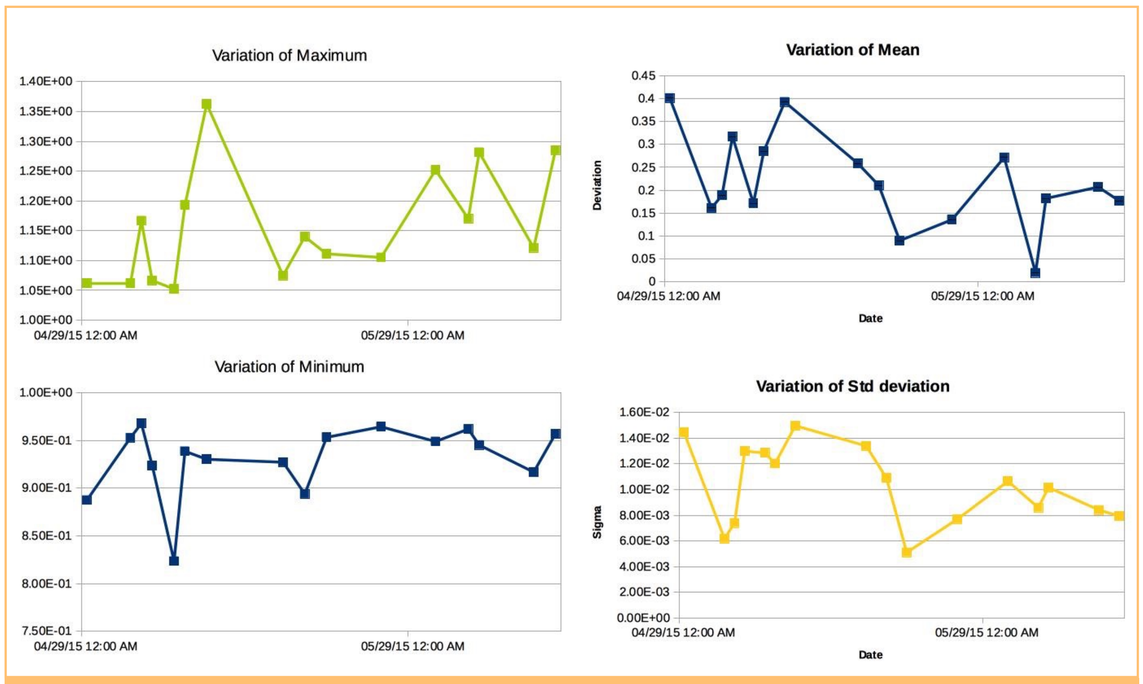


Fig. 2: Variation of the mean, standard deviation and minimum and maximum values of all sky flats. It is obvious that no trend is present and the values are clearly as good at later times than at the beginning – in fact, sometimes they are even better.

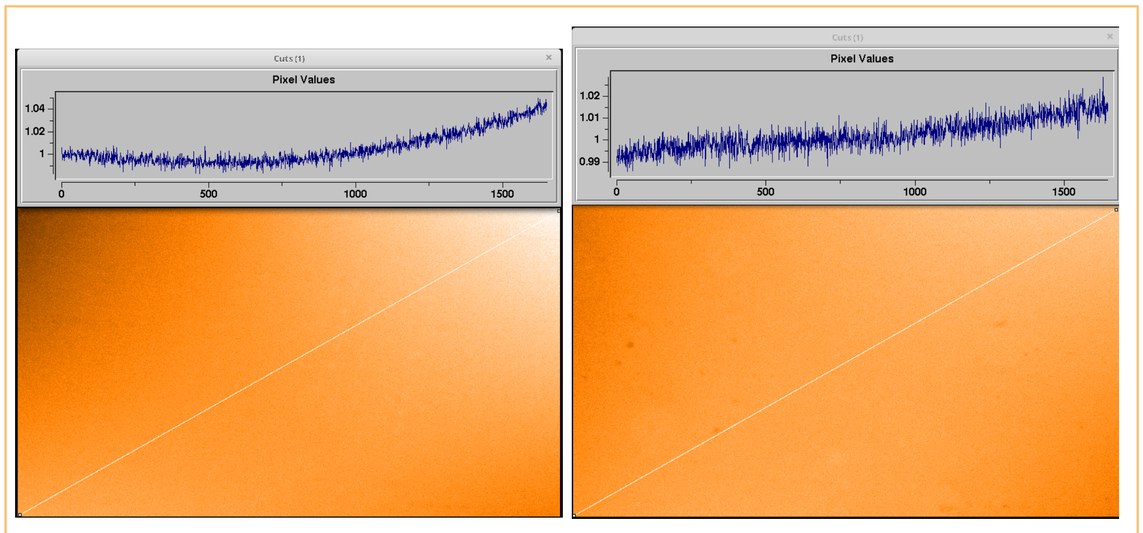


Fig. 3: (left) Division of the first sky flat (taken on 29/04) by the reference sky flat (02/05). (right) Division of the last sky flat (11/06) by the reference. As is clearly evident, there is some gradient in the ratio between two sky flats, but the magnitude of it does not increase with time – to the contrary, in this particular case, the variations are smaller with the last frames than with the first one.

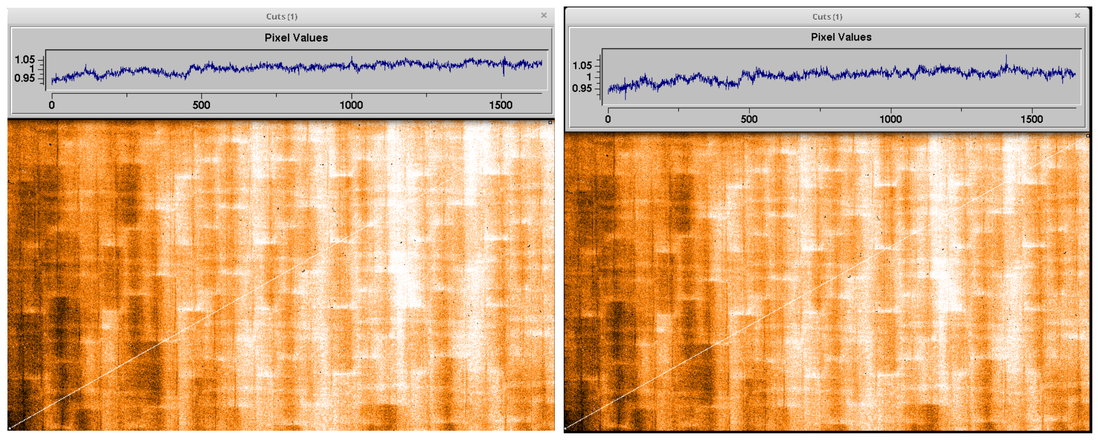


Fig. 4: (left) Median of all b_HIGH CHIP1 sky flats taken between 2 and 8 May; (right) Median of all b_HIGH CHIP1 sky flats. It thus appears that the additional flats are not adding noise to the data.

Conclusion

From the above analysis, it is clear that there is no degradation of the sky flats over the full period considered, i.e. between 29/04 and 11/06, that is, 44 days. One could consider extending this analysis to a much longer period, but this is not so crucial as we do not want to have a validity period which is too long, due to the possible risk of outside events (dust, CO cleaning, intervention, etc.). For this reason, although one could consider extending the validity range to 21 days, we recommend limiting it to 14 days, with the additional requirement that new flats should be taken in any case after an intervention (e.g., a change of the CCD, the cleaning or removal of the mirror). Moreover, sky flats can and should be taken whenever possible, especially to cover as many rotator angles as possible (as the gradient seen in the sky flats depends on the rotator angle).