

# Wide Field Planetary Camera 2 Status Update

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## Abstract

We review the status of the Wide Field and Planetary Camera 2 (WFPC2) onboard the Hubble Space Telescope, as well as recent enhancements to calibration and user support. WFPC2 was successfully recovered after Servicing Mission 3B, and we describe here the results from our extensive Observatory Verification observations. We find no significant changes in the operational behavior of the camera with respect to its pre-SM3B performance. We also use our standard photometric monitoring observations between 1994 and 2002 to update the UV contamination rates, which have declined by roughly 50% for most of the UV filters during this period. Parametric fits that will allow observers to remove the effects of contamination from their WFPC2 photometry are provided. Analysis of WFPC2 pointings from the last three years confirm small relative misalignments of the apertures with respect to the Fine Guidance Sensors, on the level of a few arcseconds. These have also been previously seen with STIS. We present an overview of the overall calibration strategy for WFPC2, covering the design of the observational programs as well as analysis of the results and their incorporation into the calibration pipeline. In addition, we discuss special close-out calibration programs planned for the remaining cycles of WFPC2 operation. We solicit community input which will play a key role in further defining these plans.

References discussed in this poster are available in a handout. We have limited copies of several of the latest ISRs underneath this poster. If you don't find what you need please either check our website, or leave your name, address, and a list of the document(s) you'd like mailed.

## WFPC2 Instrument Science Reports. New ISRs since the last AAS Meeting:

- 2002-04 "An Analysis of WFPC2 Filter Positional Anomalies", Shireen Gonzaga et al.
- 2002-05 "WFPC2 Cycle 11 Calibration Plan", Shireen Gonzaga, and the WFPC2 Group
- 2002-06 "WFPC2 SMOV3b", Anton Koekemoer et al.
- 2002-07 "Updated Contamination Rates for WFPC2 UV Filters", Matt McMaster, Brad Whitmore

The ISRs can be accessed on the web at [http://www.stsci.edu/instruments/wfpc2/wfpc2\\_bib.html](http://www.stsci.edu/instruments/wfpc2/wfpc2_bib.html)

## Other WFPC2 Documents.

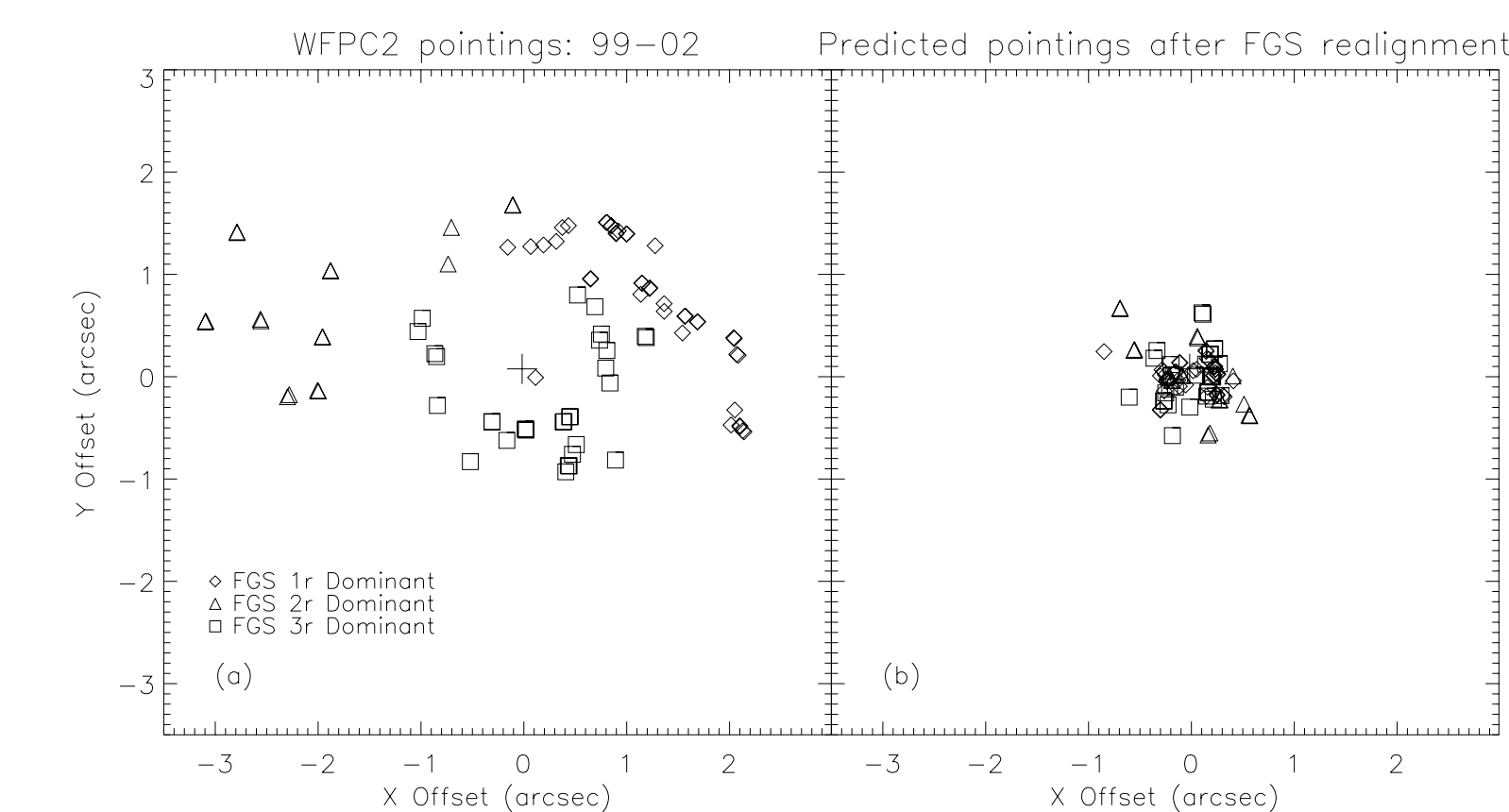
- The WFPC2 Instrument Handbook has been updated for Cycle 12. ([http://www.stsci.edu/instruments/wfpc2/Wfpc2\\_hand/wfpc2\\_handbook.html](http://www.stsci.edu/instruments/wfpc2/Wfpc2_hand/wfpc2_handbook.html))
- A new edition of the HST Data Handbook is available. ([http://www.stsci.edu/instruments/wfpc2/Wfpc2\\_dhb/WFPC2\\_longdnhbcover.html](http://www.stsci.edu/instruments/wfpc2/Wfpc2_dhb/WFPC2_longdnhbcover.html))
- A new edition of the WFPC2 Data Analysis Tutorial is available. ([http://www.stsci.edu/instruments/wfpc2/wfpc2\\_doc.html](http://www.stsci.edu/instruments/wfpc2/wfpc2_doc.html))

## An Improved Distortion Solution for HST's WFPC2.

A preprint of a new paper by Jay Anderson and Ivan King on an improved distortion solution for WFPC2 is available on the WFPC2 website. The paper will appear in the January 2003 edition of the PASP. A Fortran routine that implements the distortion solution is also available. For details see [http://www.stsci.edu/instruments/wfpc2/wfpc2\\_advisory.html](http://www.stsci.edu/instruments/wfpc2/wfpc2_advisory.html)

## Pointing Uncertainties.

An offset of 1-2 arcsec is found between the predicted and actual pointing positions of a set of observations of the standard star GRW+70D5824 taken between Jan 1999 and Aug 2002. The direction of the offset in chip coordinates changes throughout the course of the year as the telescope orientation changes, causing the overall uncertainty in the absolute pointing of WFPC2 to be somewhat higher than the ~1 arcsec uncertainty in guide star positions. The r.m.s. of the pointings is approximately 1.5 arcsec, but two individual pointings of the same target observed about 6 months apart could differ by as much as 5 arcsec in the worst cases. This scatter is primarily due to misalignments of the three Fine Guidance Sensors, and is expected to be improved by an update to the observatory aperture file implemented on 20 Oct, 2002. Users requiring high absolute astrometric precision for a given image should measure positions relative to an astrometric standard found on the same frame, if possible. For more information, see the paper by Brammer, Whitmore, and Koekemoer in the proceedings of the 2002 HST Calibration Workshop (to be published in 2003).



(a) GRW+70D5824 positions on the PC from Jan 1999 to Aug 2002. The different point styles indicate which fine guidance sensor was dominant for the particular observation. The annular distribution of the pointing positions is caused by an offset due to misalignments between the guidance sensors whose direction on the chip changes as the telescope orientation changes.  
(b) Predicted pointing scatter for observations made after the FGS alignment correction was implemented on October 20, 2002. The rms scatter decreases by a factor of 3. The actual effect of the alignment correction will be determined from GRW+70 observations made over the coming months. The offsets are relative to the PC1 aperture position, marked by '+'. The plate scale of the PC is ~0.05 arcsec/pixel.

## Re-organization of WFPC2 Documents on the Website.

The documents section on the WFPC2 website has been re-organized to make documents easier to find. The documents have been grouped into Documents (Instrument Handbook, manuals, etc.) and General Resources (reference file lists, memos, etc.). Each section has an overview, and in addition, we have created a one-page sheet to list the primary references needed for proposal preparation and data reduction. Community feedback on this re-organization is welcomed.

Check out [http://www.stsci.edu/instruments/wfpc2/wfpc2\\_top.html](http://www.stsci.edu/instruments/wfpc2/wfpc2_top.html)

## WFPC2 Calibration

### WFPC2 Close-Out Calibration Programs.

Cycle 12 is currently planned to be the last full cycle for WFPC2, which will be de-orbited during the next Servicing Mission (SM4) when it is scheduled to be replaced with WFC3. Therefore, we are currently soliciting input from the community as to whether there are any additional calibration programs that should be carried out with WFPC2 before it is de-orbited, in order to improve or augment calibration accuracies or explore new types of calibration. In conjunction with the recent HST Calibration Workshop, a special splinter session was devoted to the topic of WFPC2 close-out, and a number of possible programs were identified. Some examples of these included further refinements to the geometric solution, improvements to the filter photometric characterizations, better measurements of the PSF wings on large scales, and improving the CTE characterization.

We therefore encourage any interested members of the community to contact us with suggestions for Cycle 12 calibration observations, which we will be defining in the next few months. These may fall under the above categories or alternatively address other issues that may be required in order to improve the scientific value of archival WFPC2 data. We also remind observers of the opportunity to submit Calibration Outsourcing proposals of your own in Cycle 12. These may be observational, archival, or both. Additional topics for Calibration Outsourcing programs are listed at this website: [http://www.stsci.edu/instruments/wfpc2/wfpc2\\_out.html](http://www.stsci.edu/instruments/wfpc2/wfpc2_out.html).

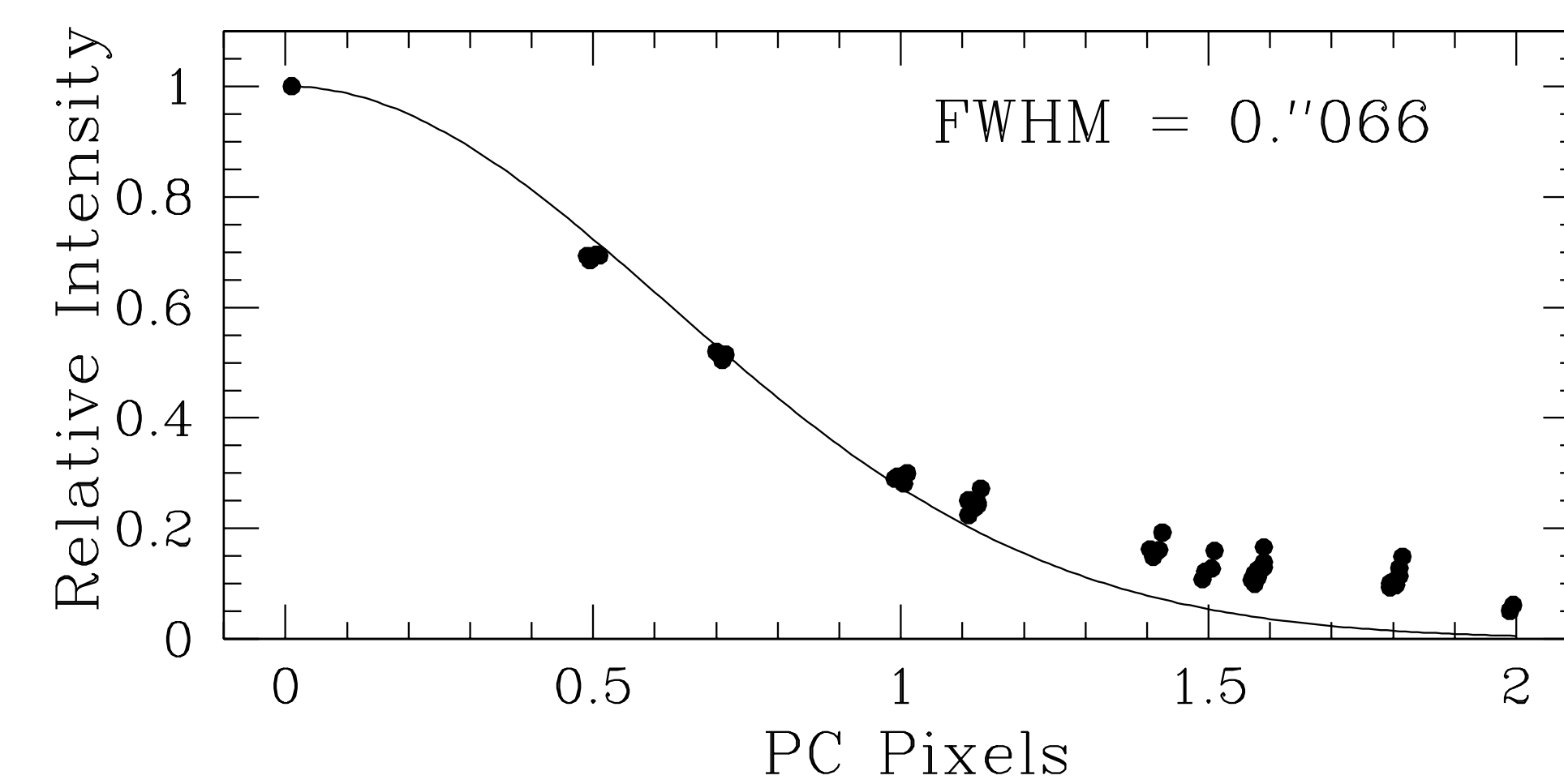
Consultation with the WFPC2 group at STScI is welcomed on any of these topics (just send an email to "help@stsci.edu" addressing the topic of WFPC2 Close-Out Calibration Programs). We will be happy to provide advice and collaborative input, and we strongly encourage members of the community to take the initiative in proposing any close-out programs that you feel would enhance the quality of some particular aspect of WFPC2 science.

### WFPC2 Cycle 11 Calibration Plan.

The Cycle 11 Calibration Program, extending from July 1, 2002, to June 30, 2003, will continue to monitor the health of WFPC2, using the standard suite of calibrations, as well as some special programs to characterize other aspects of the instrument. The most significant change in the routine monitors concerns the length of time between decontaminations. This period has been increased from 28 days to 49 days because data from the last few cycles indicate that the contamination rate has been decreasing. Special programs include more efforts to characterize CTE, a revisit of the long-vs.-short anomaly, photometry of non-standard filters for creating new zero-points, as well as a program to cross-calibrate WFPC2 and ACS filters. Because there are significantly fewer primary WFPC2 science observations in Cycle 11, with the advent of ACS, the calibration plan has been significantly scaled back, but without sacrificing the quality of data required to calibrate the instrument. For Cycle 11, 40 external orbits will be used, compared to 61 in Cycle 10. For details see [http://www.stsci.edu/instruments/wfpc2/Wfpc2\\_isr/wfpc2\\_isr0205.html](http://www.stsci.edu/instruments/wfpc2/Wfpc2_isr/wfpc2_isr0205.html)

Servicing Mission 3B (SM3B) took place in March 2002, and the Wide Field and Planetary Camera 2 (WFPC2) resumed operations on March 23, 2002, after having been placed in an inactive mode during the Servicing Mission. We describe the results from an extensive series of tests and observations that we carried out with WFPC2 as part of the subsequent Observatory Verification phase. These tests included UV monitoring of possible contamination, performance checks of the biases, darks and other internal calibrations, as well as PSF measurements and flatfield verification. The results from these tests show that there are no significant changes in the operational behavior of the camera with respect to its pre-SM3B performance. For details see [http://www.stsci.edu/instruments/wfpc2/Wfpc2\\_isr/wfpc2\\_isr0206.html](http://www.stsci.edu/instruments/wfpc2/Wfpc2_isr/wfpc2_isr0206.html)

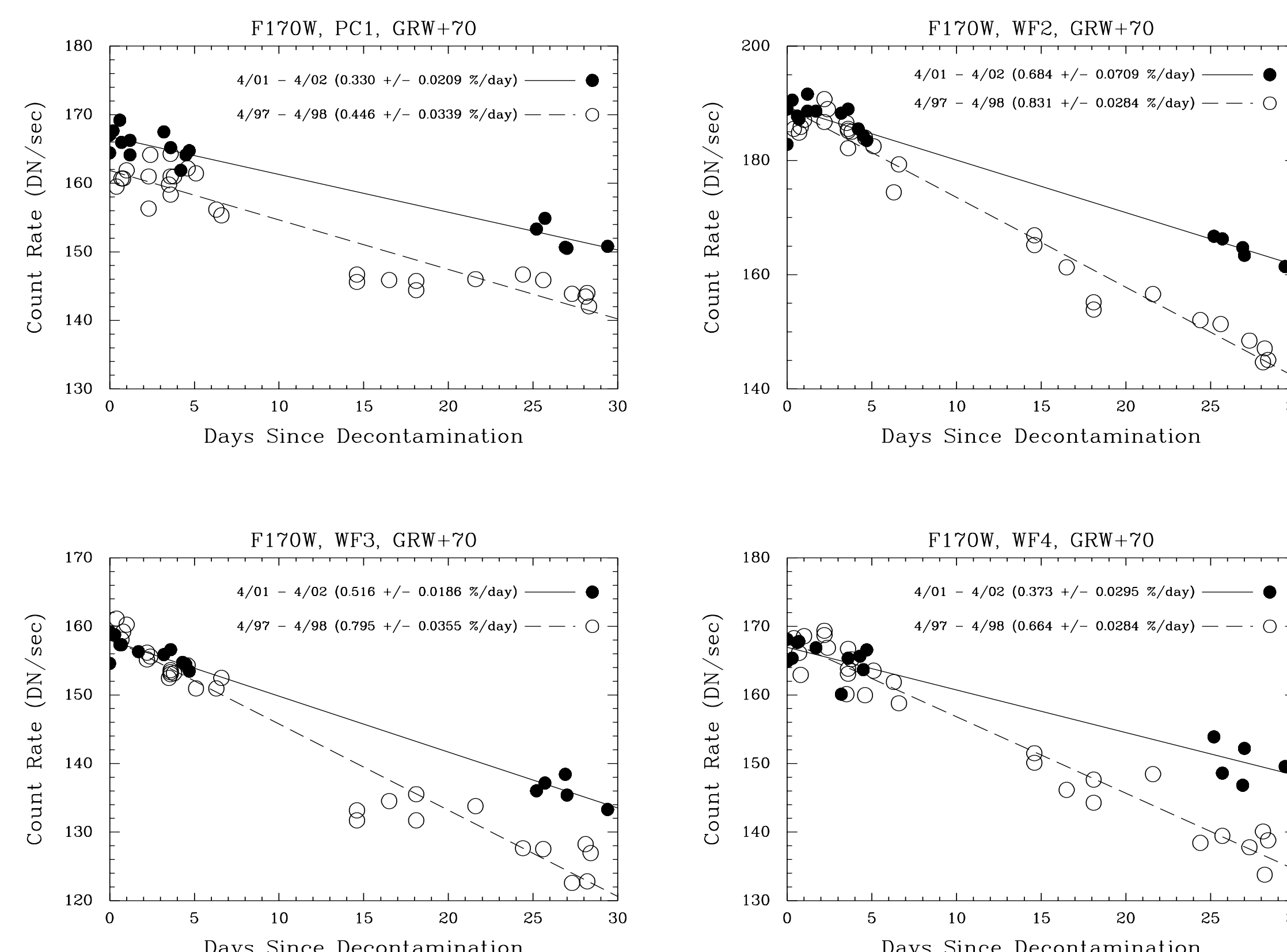
## WFPC2 SMOV3B.



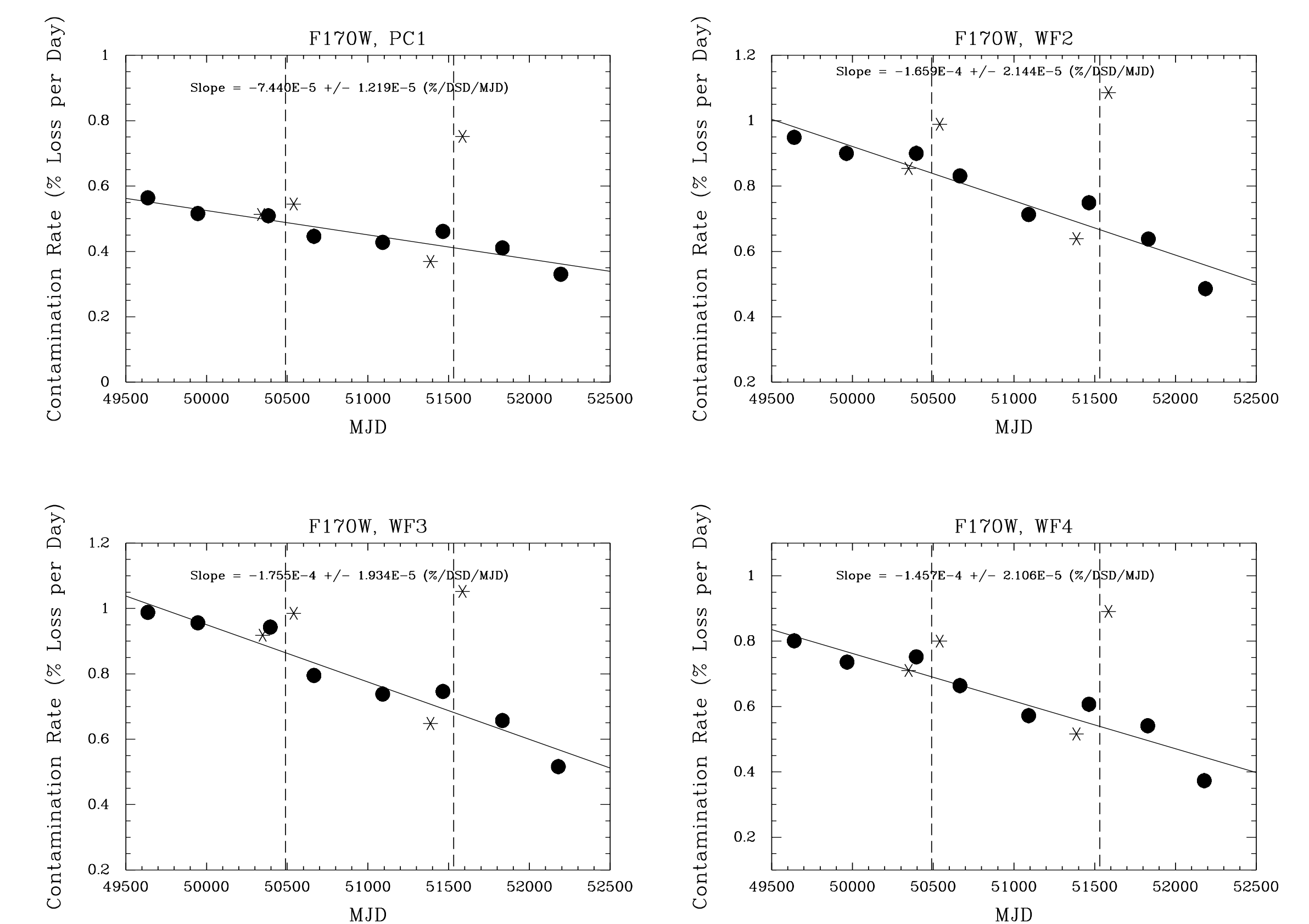
Radial profile of the PSF in the central region of the WFPC2 PC image of Omega Cen taken after SM3B. A composite stellar image was created using about 30 isolated, unsaturated stars near the center of chip with the IRAF task `psf`. The radial profile was measured using the IRAF task `radprof`. The best-fit Gaussian model with FWHM = 0.066" is shown by the solid line. No changes from pre-SM3B PSFs are noted.

## Updated Contamination Rates for WFPC2 UV Filters.

Photometric monitoring observations of a white dwarf standard (GRW+70D5824) have been used to update the contamination rates for WFPC2 UV filters. Observations from April 1994 through May 2002 were used in the analysis. In general, the contamination rates have declined by roughly 50% for most of the filters during this period. Least-squares fits have been made to the data to allow observers to remove the effects of contamination in their WFPC2 observations. For details see the ISR at [http://www.stsci.edu/instruments/wfpc2/Wfpc2\\_isr/wfpc2\\_isr0207.html](http://www.stsci.edu/instruments/wfpc2/Wfpc2_isr/wfpc2_isr0207.html)



Contamination rates for 1997-1998 (open circles) and 2001-2002 (filled circles) for F170W. The count rates at 0 Days Since Decontamination for the PC are generally higher for the more recent data.



Fits to the contamination rates for F170W. Note the step-like structure in the plots; this is probably an indication of an effect after Servicing Missions 2 and 3A, MJD=50490.03 and 51531.16, respectively (dashed lines in the plots). Only the solid points were used in determining the fits, including the third and sixth points which span the two servicing missions mentioned; note that the asterisks (\*) were not used in determining the fits. The asterisks to the left of the dashed lines are the contamination rates before the servicing missions (from several months to a few days before), and those to the right are the contamination rates after the servicing missions (from a few days to a few months). Note that all of the asterisks to the right of the dashed lines are higher than those to the left, indicating an increase in the contamination rate just after a servicing mission. Note also that while the contamination rates immediately after a servicing mission can be quite high (almost twice as high after SM3A), they return to the general trend soon afterward.