# SCIAMACHY: New Level 0-1 Processor and Plans for the Future


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## Introduction

Level 0-1 processing provides calibrated radiances. The calibration of the data is done with a combination of on-ground thermal vacuum measurements, on-ground ambient measurements (to correct for the different incidence angles of light) and in-flight measurements. The flow diagram below shows the individual calibration steps, the different types of data are colour coded.

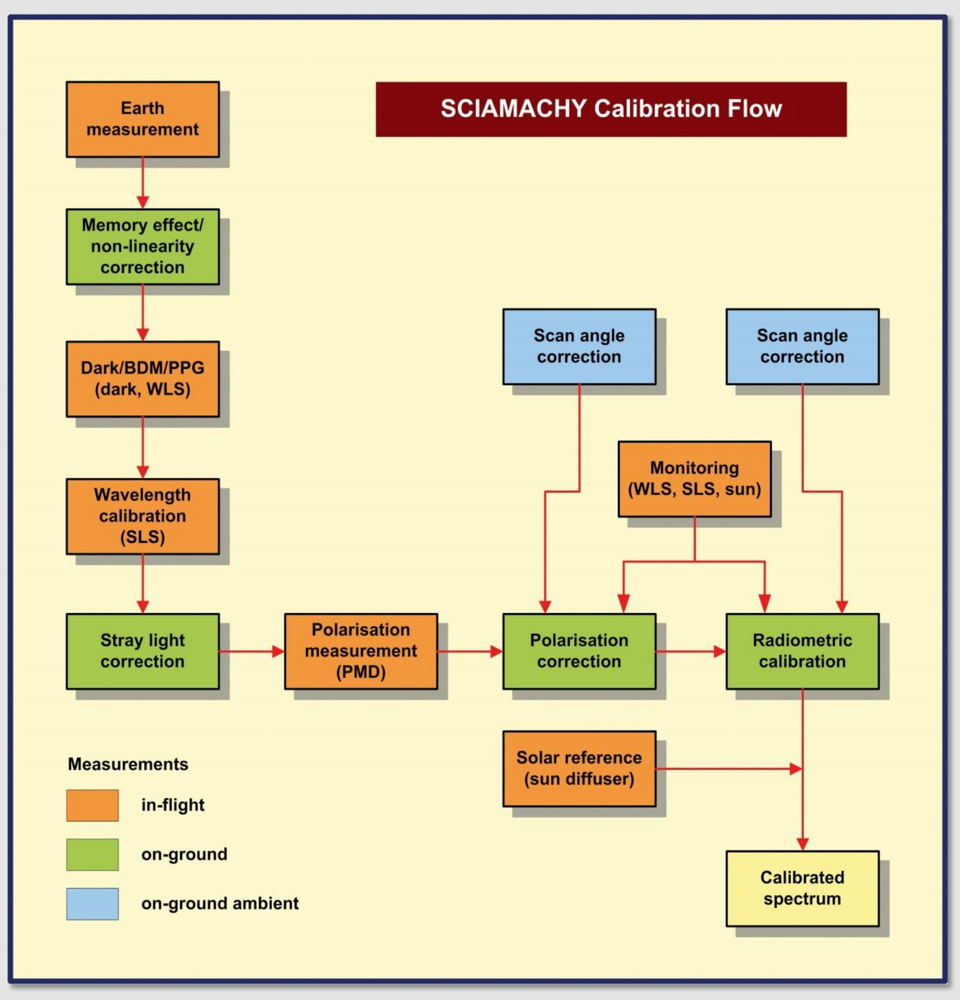


Fig. 1: Calibration steps for L0-1 Processing.

## Summary of Changes

| Change | Description |
|---|---|
| Version 8 (Level 1b release 2015) | |
| Stray Light Ch. 3-8 | Extend matrix correction approach |
| MEC Limb | Improve the estimate of signal |
| PMD Scaling NL | Improve scaling for low signal cases |
| Hot Pixel Limb | More robust hot pixel detection |
| SAA Check | Switched Off for Etalon , not needed |
| Dark Selection | Implement a selection option |
| New Key Data | New key data are used for calculation |
| Degradation Correction | Mirror model from SRON is used to correct degradation |
| PMD m-factor correction | Include in Level 1b product. |
| Version 9 (planned release 2017) | |
| Degradation Correction | Better correction from a re-analysis of on-ground and in-flight calibration data |
| Bad Pixel Mask | Based thresholds for individual pixels instead of channel wide thresholds. |
| Dark Correction | Using in-flight data of the whole mission, the dark correction will be improved |
| Spectral Calibration SWIR | The spectral calibration of the SWIR channels 6-8 will be improved |
| Polarisation Calibration | An improvement of the polarisation correction will be investigated |
| netCDF Data Format | The format of the Level 1 data will be changed to the standard netCDF format |
| Pointing | Improve misalignment correction |

## Calibration Data Handling

In Level 0-1processing calibration data need special attention: while they are not measured as often as the science data, they are needed for each science measurement. Therefore, calibration data must be stored and tagged. For the calibration of science data, the proper parameters are looked up, read in and applied to the measurement in question. An example are solar irradiance spectra, which are measured once a day and are used to calculate reflectances for all radiance measurements of that day.

In previous processor versions, multiple calibration parameters were stored in files with the filename containing the validity time. This led to multiple problems: since more than one parameter was stored, the traceability of individual entries was lost. The re-generation of the calibration parameters for re-processing was complicated, because thousands of files had to be written and read in the right sequence. Therefore DLR proposed to use a database for the storage of calibration data. This was implemented for version 8 of the processor. Figure 2 shows a typical data flow

Another advantage is the easier maintenance and quality control. Databases have functions for arbitrary selection of data and statistical data analysis already built in. Therefore, quality control documents can be automatically generated. Figure 3 was generated with an automated script and shows the channel average of the fixed pattern noise over the mission duration. The top figure shows the values for the UV/VIS channels and the bottom plot shows the SWIR channels. Shaded regions show decontamination periods.

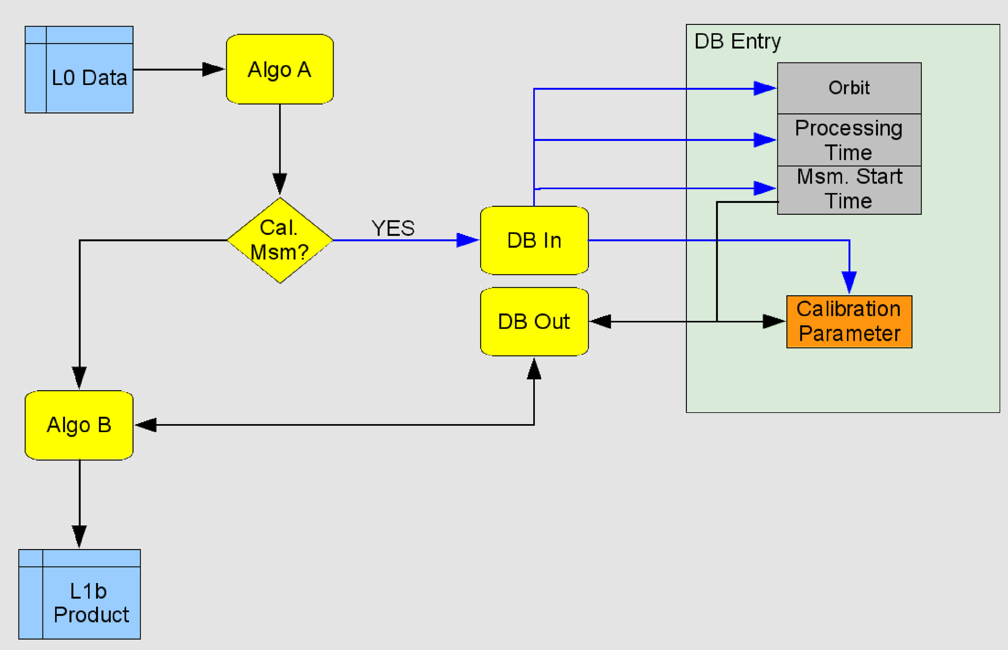


Fig. 2: Calibration data handling.

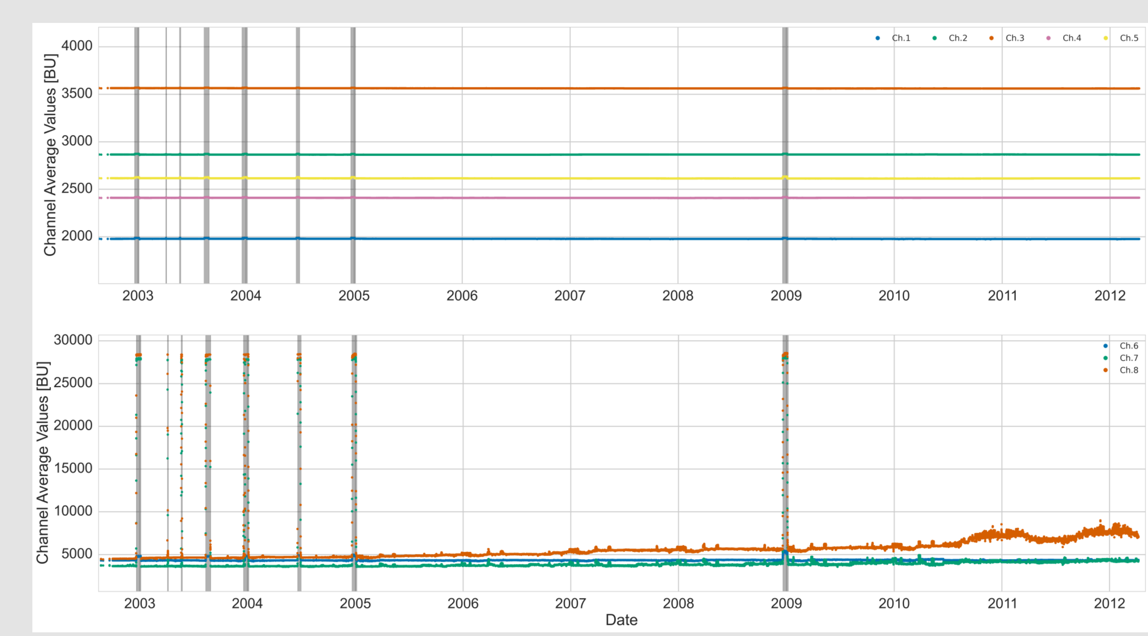


Fig. 3: FPN quality check. Bars mark decontamination periods

## Degradation Correction

The degradation correction is based on a scan mirror model that fits the thickness of contaminant layers. The reflectivity of the mirror with the contaminant on top is calculated with the Fresnel equations. Regular monitoring measurements using the sun and the white light source with different light paths are used during processing to determine a degradation correction factor for the appropriate time and incidence angles on the mirrors. Figure 4 shows an example of the correction. In the top the solar reference spectrum “E0” for channel 2 (UV spectral region) without degradation correction for the whole mission is shown; the bottom shows the degradation corrected spectrum. In the lower plot only the difference due to the changing solar distance is left, the throughput degradation is corrected.

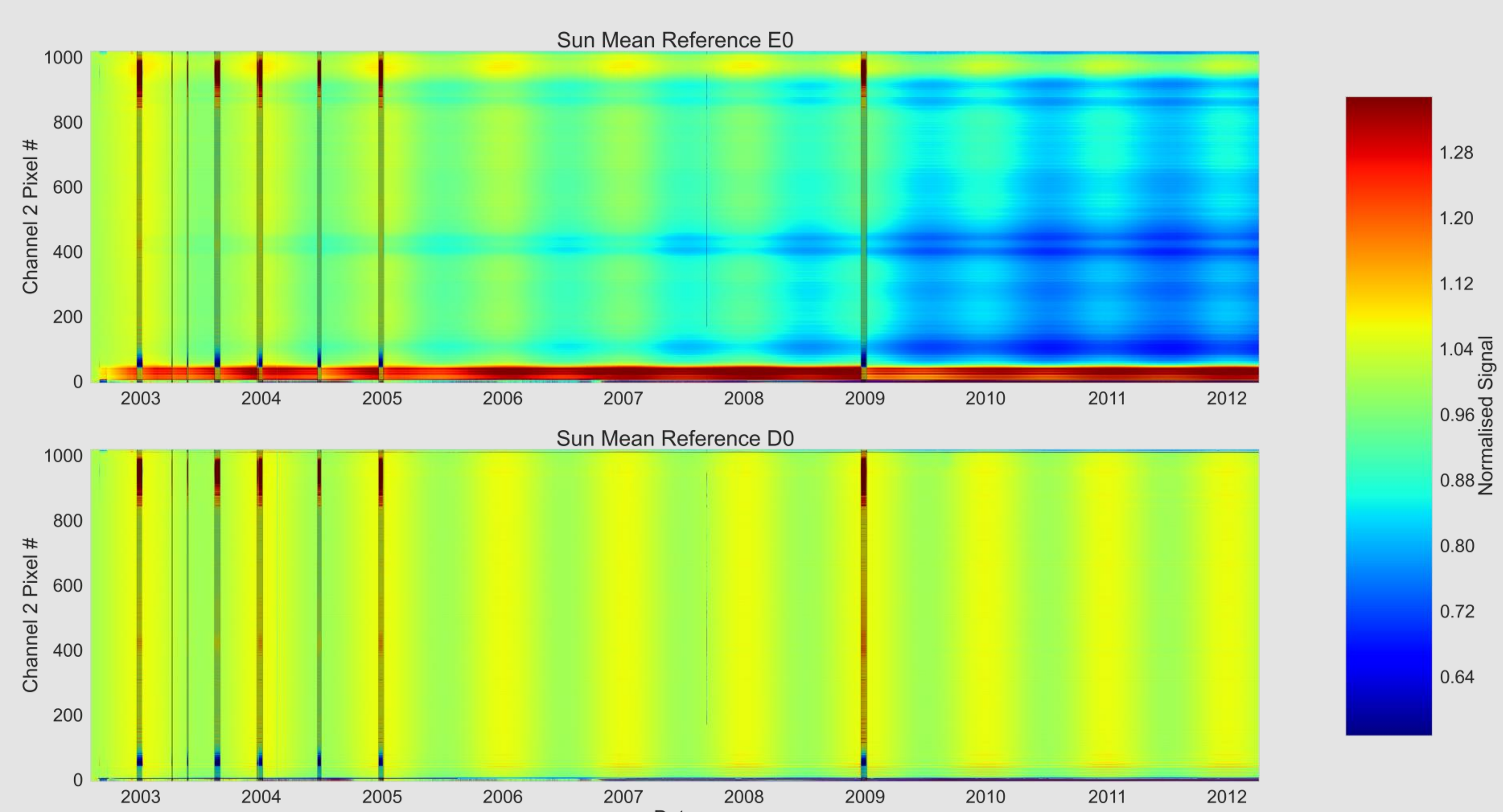


Fig. 4: Degradation correction of solar references. Vertical bars mark decontaminations

## Further Information

**Level 0-1c ATBD:** http://atmos.caf.dlr.de/sciamachy/documents/level_0_1b/scia01b_atbd_master.pdf

**Poster @ATMOS:** F. Azam et al: Development and verification of SCIAMACHY operational ESA Level 2 version 6/7 products in the framework of SQWG-3

**Poster @ATMOS:** M. Gottwaldet al: SCIAMACHY Operations History and the New Level 1b Product – an Approach for Long-term Data Preservation

**Poster @ATMOS:** Improved correction for contamination-induced in-flight instrument degradation of SCIAMACHY Snel, Ralph; Krijger, Matthijs

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