Calibration Procedures and Quality Aspects for the ENVISAT Atmospheric-Chemistry Instruments

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GOMOS calibration aspects

Self-calibrating instrument

★GOMOS operating principle is inherently self-calibrating ensured on the assumption that the instrument transfer function does not change in the time between two measurements. However, parameters related to spectral assignment and precise knowledge of the dispersion are needed due to thermal distortion and settling of the optical bench.

★After the ENVISAT launch, specific observations in monitoring mode were performed in order to verify the nominal operation of all instrument components. The outputs of this phase allowed to confirm that most of the in-flight performances were consistent to the ground measurements performed before the launch. It had also highlighted a high sensitivity of the CCD measurements to the proton radiation and the subsequent need to calibrate the dark charge at each orbit.

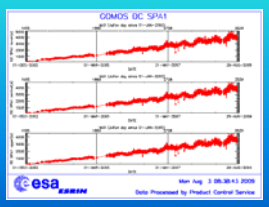
Operational Calibration

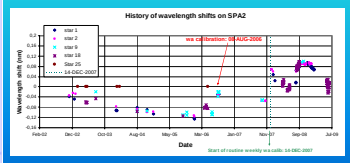
★**Dark Charge (DC) calibration**: data taken over a Dark Sky Area (no input flux expected) every orbit are used for removing the DC from the star signal

★**Wavelength calibration**: A routine wavelength calibration is performed once a week

Long term monitoring of Calibration

The Dark Charge signal and the wavelength assignment are closely monitored in order to check that the routine calibration has worked fine.





MIPAS calibration aspects

Operational Data Calibration

For MIPAS, the output of the Level 1b processor is an atmospheric spectrum showing radiance as a function of wavenumber. Three types of calibration are required for MIPAS:

★**Radiometric calibration**: The process of assigning absolute values in radiance units, (W/(cm2 sr cm−1)) to the intensity axis

★**Spectral calibration**: The process of assigning absolute values in cm−1 to the wavenumber axis

★**Line-of-Sight (LOS) calibration**: The process of assigning an absolute LOS pointing value to a given spectrum accuracy

The radiometric calibration requires a set of black body and deep space measurements that allow to calculate the gain functions and to characterize the variation of the detector response over time.

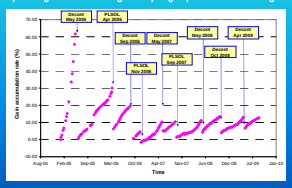
The spectral calibration is performed every sweep by aligning the measured spectra to well defined atmospheric emission lines.

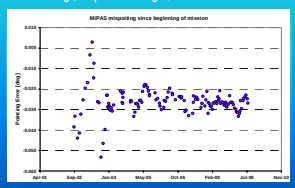
The LOS calibration is done every two weeks in order to determine the mispointing. The LOS measurements consist in observing stars with fixed mirrors and measuring the actual time of passage of a star through the FOV with respect to the expected time.

Long term monitoring of Calibration

The changes of the gain functions over time is mainly induced by changes in the instrument transmission, due to ice. The long term monitoring of the gain calibration allowed to analyze the detector ice contamination along the mission (see plot in the left).

The mispointing trend shows the problems occurred at the beginning of mission, due to a wrong on-board software. Since 2003 the mispointing of MIPAS changed only slightly around an average value of -25 mdeg (see plot on the right).





SCIAMACHY calibration aspects

Operational Data Calibration

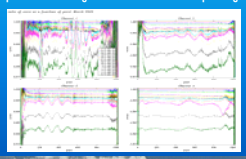
SCIAMACHY level 0 data is converted into "calibrated radiance" level 1b products by applying calibration algorithms and calibration parameters, for details see: http://atmos.caf.dlr.de/projects/scops/sciamachy_book/sciamachy_book.html

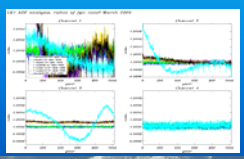
There are two major groups of calibration parameters that are made available via Auxiliary Data Files (ADF) :

★**Pre-flight instrument calibration data**, the so called Key Data based on on-ground calibration campaigns

★**In flight-calibration measurements**: (i) Leakage Current Calibration - SCI_LK1_AX, (ii) Solar Reference Calibration - SCI_SU1_AX, (iii) Spectral calibration - SCI_SP1_AX, (iv) Pixel-to-Pixel Gain (PPG) and Etalon - SCI_PE1_AX

The latter are generated operationally, using level 0 data as input for the calibration tool *SCICAL*. The ADFs are routinely monitored in order to assure the best data quality can be obtained applying the calibration in the scientific data retrieval. The figures below show examples of SCI_SU1_AX and SCI_LK1_AX monitored over a month for channels 1-4, building the ratio over a reference solar spectra and leakage dark current of a corresponding month.

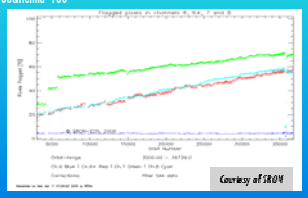




Calibration Quality improvements

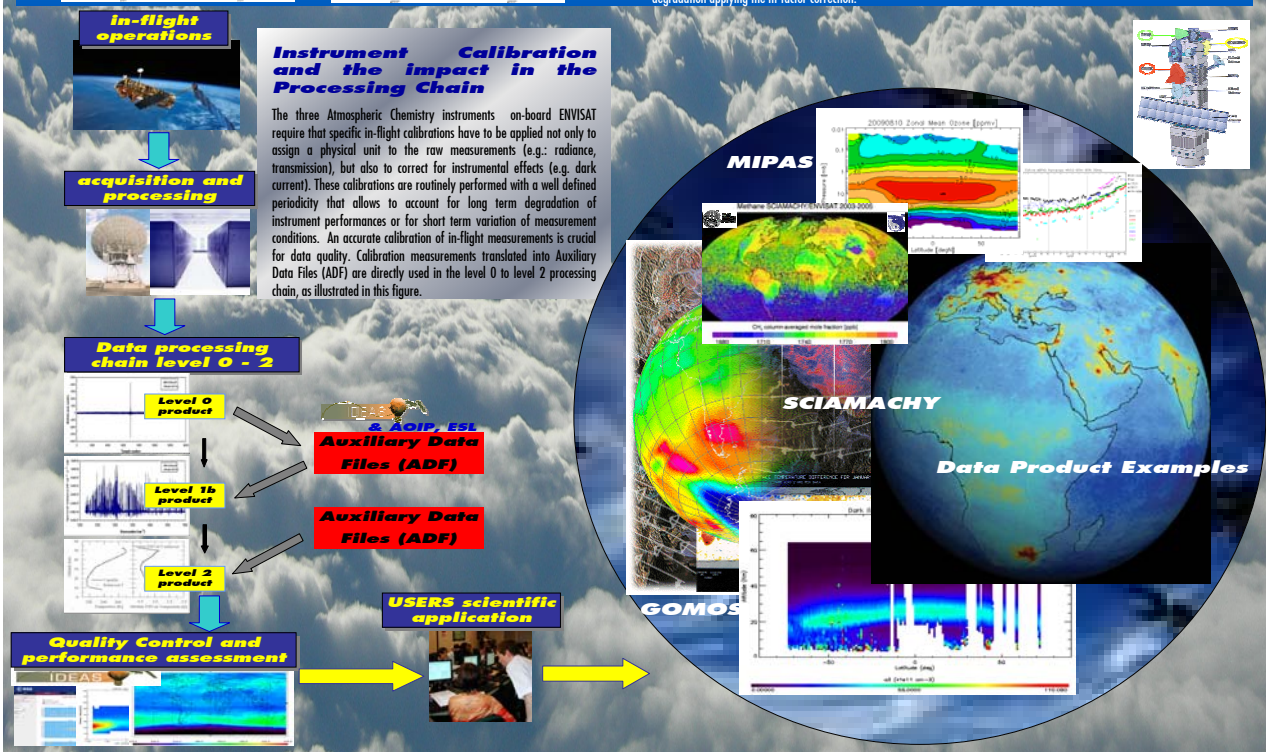
As a main activity of the Quality Working Group (QWG), the applied calibration is assessed and corresponding algorithms further updated. In the past improvements were applied on the leakage Current calibration: besides the **Fixed Pattern Readout Noise, the orbital variation** that corrects the infrared wavelength regions in order to retrieve trace gases like CO. With the upcoming processor version (operational switch planned in autumn 2009) an improved **Dead and Bad Pixel Mask** will be implemented in the operational SCI_PE1_AX generation with *SCICAL*. Below an example of the current DBPM analysis by SRON, http://www.sron.nl/index.php?option=com_content&task=view&id=908&Itemid=100

As a major improvement for radiometric calibration the **monitoring-factor** (m-factor) will be applied in the upcoming operational processor. The m-factor is calculated from measured sun spectra of the different light paths (nadir, limb, occultation). The m-factor calculation is performed by IFE-SOST, more details at http://www.iup.uni-bremen.de/sciamachy/mfactors/ and the dedicated poster by IFE-Bremen at this conference.



User Data Calibration with user tool SciaL1c

The science users can transform the Level 1b products into fully calibrated Level 1c products with the SciaL1c tool (http://envisat.esa.int/scial1c), selecting specific calibrations and extract for certain geographic areas, time intervals, spectral regions and measurement type of interest. The latest SciaL1c version includes also the possibility to correct the data for degradation applying the m-factor correction.



http://earth.esa.int/pcs/

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