Seven years of data quality of the ENVISAT atmospheric-chemistry missions: highlights, lessons learned and perspectives

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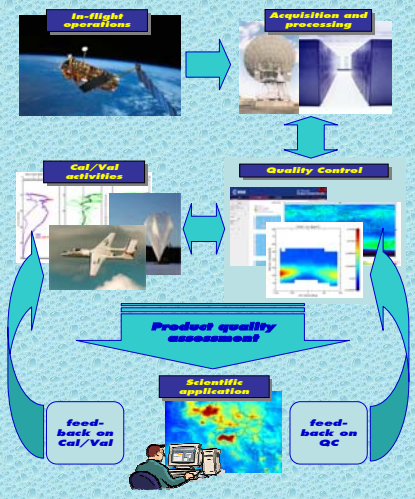


The Quality Control (QC) Service

Ensure data are adequate for your application

The QC service is performed on behalf of ESA by the IDEAS (Instrument Data Quality Evaluation and Analysis Service) team. IDEAS is a consortium of several European companies that is responsible for the operational data calibration and monitoring, for the instrument performance assessment, and for the verification and maintenance of the Instrument Processor Facility (IPF) in the Ground Segment (GS).

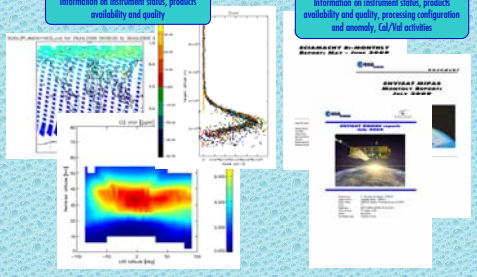
The QC team works in close collaboration with the following teams:

- The QWG (Quality Working Groups) is a consortium of research groups and laboratories that is in charge of the definition of the scientific baseline to be applied for the operational processor
- The ESL (Engineer Support Laboratory) translates the scientific inputs of the QWG in an engineered software (the prototype) used as reference for developing the IPF
- The Ground Segment (GS) team is responsible for the operational data acquisition, processing and dissemination to the users community
- The Validation teams provide the independent measurements to be used for the scientific validation of the operational products
- The PLSO (Post Launch Support Office at ESTEC) is responsible for monitoring the overall satellite equipments (service modules and payloads), and for the global performance evolution (e.g.: mission extension)
- The FOC (Flight Operations Center at ESOC) is in charge of the satellite in-flight operations
- The science community is the end-user of the data, but it is also part of the QC and validation process, since the scientific inputs are often important in order to tune the data quality assessment

On-line daily and cyclic reporting

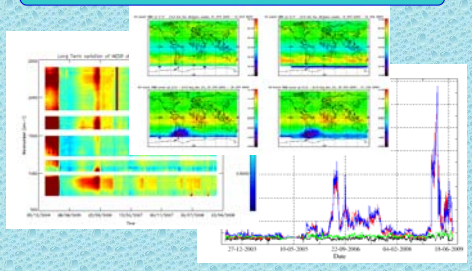
Daily reports
Information on instrument status, products availability and quality

Monthly reports
Information on instrument status, products availability and quality, processing configuration and anomaly, Cal/Val activities



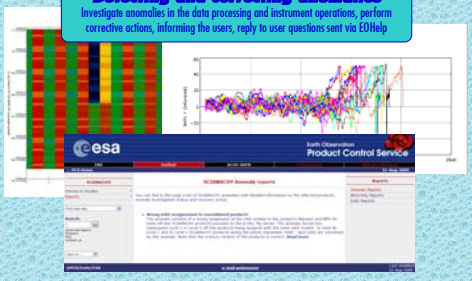
Assessing instrument and processing performances

Monitoring instrument aging, and long term instrument and products quality
Drive corrective actions in order to meet the mission objectives



Detecting and correcting anomalies

Investigate anomalies in the data processing and instrument operations, perform corrective actions, informing the users, reply to user questions sent via EOHelp



How the QC service will evolve in the future

Third party missions, future ESA missions, toward the GEOSS vision

QC service for science

The QC service for the science community can be summarized as follows:

- Ensure that the products delivered to the users fit for their intended scientific applications taking into account the constraints of the operational processing (e.g.: fast delivery)
- Investigate any anomaly in the data processing or in the instrument performances and perform the needed corrective actions, this task includes the reply to any users request coming via the EOHelp account
- Provide a regular reporting on the instrument status and data availability and quality
- Implement and maintain the operational processor and calibration chain in the Ground Segment
- Guarantee the periodic in-flight calibration of the products
- Support the definition of the scientific baseline and the scientific exploitation of the data
- Support the reprocessing and the validation activities

Highlights and lessons learned

The QC analysis applied to the ENVISAT operations in the past seven years proved to be an essential tool for monitoring the instruments health and the operational processing performances. Some highlights and lessons learned of the QC service related to the ENVISAT Atmospheric-Chemistry instruments are reported below.

Daily and cyclic reporting

The level of reporting on QC has drastically improved since the launch of the ENVISAT satellite. Today we provide on-line daily and monthly reports publicly available to all users on the pcs web site. The consultation of these reports allows for a quick and exhaustive insight on the instrument status and on the products availability and reliability.

Assessing instrument and processing performances

The role of the QC process was often crucial during the mission lifetime in order to assess the instrument and products performances. The investigation on Star Acquisition Tracking Unit (SATU) anomaly for GOMOS or on the interferometer slides velocity errors for MIPAS are good examples on how the QC process contributes in tuning the mission scenario, preventing further degradation and drive correcting actions. The investigation on the ice contamination for MIPAS and SCIAMACHY are highlights and lessons learned to be mentioned, where the QC analysis was valuable in avoiding products quality degradation and adapting the planning baseline.

Detecting and correcting anomalies

The main goal of the QC task is to quickly detect anomalies on the processor or on the instrument operations. Many example can be made when the prompt anomaly detection allows to prevent data quality loss or identify inconsistencies in the instrument operations. This happens for instance when the daily monitoring of detectors response in MIPAS channels revealed the usage of wrong gain parameters with resulting saturation in all measured spectra. This was also the case of GOMOS mission, when the daily check on the tangent altitude at which a star is lost gave evidence of a critical problem in the star tracking unit and was used to decide on a temporary mission interruption.

Implementing the IPF and the calibration chain

One of the main duty of the QC team is the implementation of the operational processor and of the calibration chain in the GS. In this frame the QC team supported all the processor upgrades and re-processing campaigns carried out since launch, certifying the availability and reliability of the operational products to the users community. An example on how the QC service was essential in supporting the IPF and calibration tool implementation is the SCIAMACHY case. During the SCIAMACHY mission many processor upgrades were successfully supported by the QC team allowing to provide to the science community a continuously improving dataset (e.g.: Level 2 limb products and fast delivery).

Supporting the definition of the scientific baseline

The QC team, as part of the QWG, follows directly the definition and evolution of the scientific baseline. The QC team has a proactive role within the QWG and the inputs coming from the data assurance process were often relevant for tuning the scientific algorithm. We can report the case of the MIPAS Level 1b processor development as an example. In fact a long term analysis of the spectral calibration performances highlighted a high noise in the determination of the linear spectral calibration factor. This study induced the QWG to rethink about the calibration strategy that was reformulated using an extended statistics. A similar example on how the QC team directly supports science was the ENVISAT restituted pitch assessment. This analysis contributes significantly in assessing the platform attitude and was used as reference for some scientific studies on the instrument's mispointing.

Future and perspectives

Toward QC standard methods and tools

The strategy for the QC service in the near future can be summarized in the following two main points:

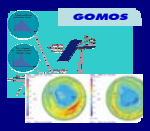
- Including the ESA third party mission (e.g.: SCISAT-ACE-FTS, JAXA-GOSAT) in the current monitoring baseline by making a synergetic use of coherent dataset
- Preparing for future ESA missions (Sentinel 5-precursor and Sentinel 4-5). In this sense the lessons learned with ERS/ENVISAT missions will be important to prepare the future monitoring scheme

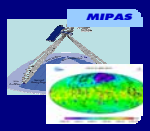
The long term evolution of the QC service should be driven by the guiding principles defined within the QA4EO (A Quality Assurance Framework for Earth Observation) project, namely:

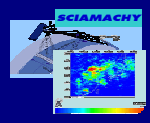
- Transition from tailored QC tools and methods to multi-mission successors
- Global harmonization of the quality assurance process across the EO Cal/Val community
- Definition of standard QI (Quality Indicators) and procedures

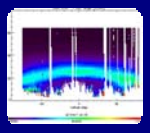
Monitoring the ENVISAT Atmospheric-Chemistry missions

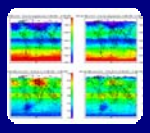
The IDEAS team

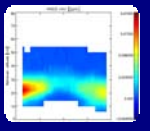


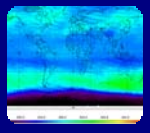


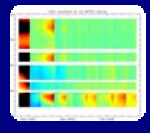


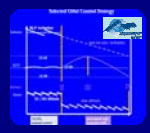












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