OmegaCAM in the ESO Quality Control Paradigm

Mark Neeser
(Quality Control Group and ESO Survey Team)
QC Mission:

• ensure that all science data can be calibrated to a known and documented level

• ensure that the instrument is operating optimally

• pipeline process all VLT and VLTI data

• certify calibration products . . . store in archive

• process science data . . . store products in archive

• create data packages for PI’s.
• 8 astronomers supporting all Paranal instruments (11 VLT and 2 VLTI + 2 survey telescopes: VISTA/VIRCAM, VST/OmegaCAM)

works via a close interaction with:

• Paranal Science Operations (PSO)
• User Support Department (USD)
• Archive Department
Monthly Statistics

- 50,000 processing jobs (20k VLT; 30k VIRCAM) ==> a 150% increase in the last year.

- 6 TB of raw data processed (uncompressed)

- ~ 1 TB of products created and archived

==> proof that we can handle these extreme data rates
Data transfer

- Paranal → Antofagasta (via microwave link: 10Mbit/sec)
  → Santiago → Garching (sustained rate: 50 Mbit/s)

- this is currently sufficient for all VLT and VLTI data
  as well as all VIRCAM calibration data

- significant improvement expected with the Gbit/s fibre link connecting
  Paranal with Antofagasta (EVALSO expected end of 2010/early 2011)
OmegaCAM will be integrated into the current QC paradigm

*Incremental and fully automatic processing (24/7):*
- headers are used to match calibration data and define dependencies (creation of Association Blocks)
- check for new calibration data once per hour and pipeline process them
- ancillary scripts (python) evaluate pipeline products for QC and create images and plots of crucial parameters (*QC reports*).
- scores are calculated (==> all QC parameters are compared to configured thresholds and graded as **OK/NOK**)
- all this information is accessible on the web
- pseudo real-time quality control and feedback that is evaluated by the QC scientist and the Paranal daytime/night time astronomers.
Quality Control Workflow continued

First line of defense *calChecker* (real-time feedback to Paranal to ensure that all science data has its required calibrations):

[http://www.eso.org/observing/dfo/quality/]
Quality Control Workflow continued

First line of defense *calChecker* (real-time feed back to Paranal to

http://www.eso.org/observing/dfo/quality/

![Calibration completeness monitor](http://www.eso.org/observing/dfo/quality/SINFONI/calChecker_SINFONI.html)
This is the detailed calChecker report about the calibrations for all science OBs from the indicated date.
- All science data with PROC_ID starting with 60, or 060, are ignored.
- This report flags calibrations that are formally missing (marked in yellow or red). In exceptional cases, this formal result may be overridden by the analysis of the QC scientists (as indicated in the ANALYSIS notes). Then this analysis result, as displayed on the main calChecker interface, is the final word.
- OB comments are truncated after 40 characters. Point your mouse on the comment in the field to read the full comment, or check the nightlog (‘NR’).
- Files are sorted by DATA TYPE, then by SETUP.

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<thead>
<tr>
<th>DATE</th>
<th>PROC_ID</th>
<th>MODE</th>
<th>OB_ID</th>
<th>OBS_ID</th>
<th>GRID</th>
<th>OB Comment</th>
<th>RAW FILE</th>
<th>DATA_TYPE</th>
<th>SETUP</th>
<th>CALIBRATIONS</th>
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VST Review Sept. 28, 2010

Calibration report for all SINFONI science files, for date 2010-09-21
Quality Control Workflow continued

Quality Control review and certification:

- done off-line (Mon. - Fri.) on the results of the automated data matching and data processing
- all red scores are reviewed, as well as a fraction of the green scores
- all monitored QC parameters are put in a data base, and may also be plotted as a function of time (published as Health Check plots)
- any issues (mostly red scores) are analyzed and if necessary communicated to PSO
- calibrations are then rejected or certified
- all results are published on the web
- certified calibration products are ingested into the archive
Quality Control Workflow continued

Quality Control review and certification:

SINFONI dfoMonitor for 2010-09-22
### AB product monitor (instrument: SINFONI, date: 2010-09-22)

This is the AB product monitor, with an overview of the processing status of all ABs and the quality of the products.

<table>
<thead>
<tr>
<th>BOQ</th>
<th>AB NAME</th>
<th>COMPL.</th>
<th>AB LOG</th>
<th>RECIPE</th>
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<th>SETUP</th>
<th>AB STATUS</th>
<th>PLOG</th>
<th>T_EXEC</th>
<th>QF REPORT</th>
<th>SCORE</th>
<th>CERTIF</th>
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**Parameter score report**

SINFO.2010-09-23T02:51:05.383_tpl.ab  
RAW TYPE: STD  
time range: 2010-03-31 ... 2010-09-27

**Quality Control Workflow continued**

VST Review Sept. 28, 2010

Quality Control review and certification:
SINFONI dfoMonitor for 2010-09-22

Information on demand

---

### QC report(s):

- **qc_net_flux**
- **qc_strehl_med**
- **qc_persist_danger**
- **qc_Npersist**
- **qc_delta_fwhm**

**HC plot(s):**  
- **HC_STD_median_flux**  
- **HC_STD_strehl**  
- **HC_STD_persistence**  
- **HC_STD_IO**  
- **HC_STD_IO_H**  
- **HC_STD_IO_K**

---

**Score data:**

- **score result:** 1/5 best: 0/5

---

powered by QC [scoreQC v1.5.1]
### Parameter score report

**SINFO.2010-09-23T02:51:05.383_tpl.ab**

**RAW TYPE:** STD  
**setup:** S3_K_0.25  
**time range:** 2010-03-31 ... 2010-09-27

**AB | ALOG | PLOG | QC1_plotter | factsheet**  

[back to AB monitor]

#### Quality Control workflow continued

**VST Review Sept. 28, 2010**

**Quality Control review and certification:**

**SINFONI dfoMonitor for 2010-09-22**

Information on demand

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**Point your mouse on QC1 parameter name for short documentation.**

- **qc_net_flux HC**
- **qc_strehl_med HC**
- **qc_persist_danger HC**
- **qc_Npersist HC**
- **qc_delta_fwhm**

**HC plot(s):** HC_STD_median_flux | HC_STD_strehl | HC_STD_persistence | HC_STD_IQ | HC_STD_IQ_H | HC_STD_IQ_L | HC_STD_IQ_M

**QC report:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Score</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>qc_net_flux</td>
<td>5/5</td>
<td>OK</td>
</tr>
<tr>
<td>qc_strehl_med</td>
<td>5/5</td>
<td>OK</td>
</tr>
<tr>
<td>qc_persist_danger</td>
<td>5/5</td>
<td>OK</td>
</tr>
<tr>
<td>qc_Npersist</td>
<td>5/5</td>
<td>OK</td>
</tr>
<tr>
<td>qc_delta_fwhm</td>
<td>5/5</td>
<td>OK</td>
</tr>
</tbody>
</table>

**Score data:** details

- **score result:** 1/5 best: 0/5

---

**powered by QC [scoreQC v1.5.1]**

- **SINFO.2010-09-23T05:20:23.812_tpl.ab compl.** OK  
  - sinfo_rec_jitter: STD  
  - sinfo_rec_jitter: OK  
  - sinfo_rec_jitter: 3.476 ± 0.25  
  - sinfo_rec_jitter: DONE

- **SINFO.2010-09-23T05:27:21.444_tpl.ab compl.** OK  
  - sinfo_rec_jitter: STD  
  - sinfo_rec_jitter: OK  
  - sinfo_rec_jitter: 3.144 ± 0.25  
  - sinfo_rec_jitter: DONE

- **SINFO.2010-09-23T05:30:59.325_tpl.ab compl.** OK  
  - sinfo_rec_jitter: STD  
  - sinfo_rec_jitter: OK  
  - sinfo_rec_jitter: 2.928 ± 0.25  
  - sinfo_rec_jitter: DONE

- **SINFO.2010-09-23T05:35:10.323_tpl.ab compl.** OK  
  - sinfo_rec_jitter: STD  
  - sinfo_rec_jitter: OK  
  - sinfo_rec_jitter: 2.621 ± 0.25  
  - sinfo_rec_jitter: DONE

- **SINFO.2010-09-23T05:37:58.119_tpl.ab compl.** OK  
  - sinfo_rec_jitter: STD  
  - sinfo_rec_jitter: OK  
  - sinfo_rec_jitter: 2.474 ± 0.25  
  - sinfo_rec_jitter: DONE

- **SINFO.2010-09-23T05:27:56.007_tpl.ab compl.** OK  
  - sinfo_rec_madark: 300.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.367 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:44:07.210_tpl.ab compl.** OK  
  - sinfo_rec_madark: 850.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:16:11.212_tpl.ab compl.** OK  
  - sinfo_rec_madark: 600.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:14:22.299_tpl.ab compl.** OK  
  - sinfo_rec_madark: 1800.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:14:17.388_tpl.ab compl.** OK  
  - sinfo_rec_madark: 300.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:14:06.972_tpl.ab compl.** OK  
  - sinfo_rec_madark: 300.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:13:11.344_tpl.ab compl.** OK  
  - sinfo_rec_madark: 600.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:25:22.100_tpl.ab compl.** OK  
  - sinfo_rec_madark: 850.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:26:29.538_tpl.ab compl.** OK  
  - sinfo_rec_madark: 500.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:28:01.687_tpl.ab compl.** OK  
  - sinfo_rec_madark: 100.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:31:42.444_tpl.ab compl.** OK  
  - sinfo_rec_madark: 300.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:46:16.107_tpl.ab compl.** OK  
  - sinfo_rec_madark: 300.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 0.365 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:44:00.631_tpl.ab compl.** OK  
  - sinfo_rec_madark: 300.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 1.000 ± 0.25  
  - sinfo_rec_madark: DONE

- **SINFO.2010-09-23T05:52:26.390_tpl.ab compl.** OK  
  - sinfo_rec_madark: 300.000000  
  - sinfo_rec_madark: OK  
  - sinfo_rec_madark: 1.512 ± 0.25  
  - sinfo_rec_madark: DONE
Quality Control Workflow continued

Where do these scores fit in with the history of the instrument?
Quality Control Workflow continued

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Health Check and History Monitor
Quality Control Workflow continued

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Health Check and History Monitor
Quality Control Workflow continued

For the survey instruments there is the added complexity of multiplicity (the operational example of VIRCAM)
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Quality Control Workflow continued

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**VIRCAM trending system: HEALTH CHECK plot**

**VIRCAM trending system: SCORES (quick-look)**

Last update: 2010-09-27T01:40:42 (UT) (0d 07h 43m ago)

### Vircam TWILIGHTFLAT.RMS H (last 60 days)

**OPSLG DATA RANGE: 2010-07-30 ... 2010-09-25**

Scores (quick-look version)

This is the quick-look version of the HealthCheck Monitor. It displays scores for each HC report. Scores are flags assessing the compliance of data points with configured thresholds. A green score symbol indicates that the corresponding instrument component is performing as expected (OK) in the monitored time range.

If they exist, a table with quality comments (entered by the QC scientist) is displayed which usually (but not necessarily) refers to data with red scores. A comment may refer to the quality of the pipeline products and not necessarily to the exact parameter scored in this report. Quality comments are entered upon certification and, therefore, cannot be guaranteed to be available at the same time as the automatic scoring. These comments are also visible on the AB product monitors.

Scores are based on the QC data for the last 7 days before the indicated date (the last one with data for this report). For each HC plot, these scores are checked against the upper and lower thresholds, searching for outliers. If no outlier is found, the corresponding plot is scored OK and marked green. Outliers get a NOK score and are marked red. More...
Quality Control Workflow continued

For the survey instruments there is the added complexity of multiplicity (the operational example of VIRCAM)

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1. Parameter score report

Scores are sorted per QC1 parameter:
- Point your mouse on QC1 parameter name for short documentation.
- The large orange square links to a dynamic plot for all detectors.
- Smaller squares link to AVG and RMS values (if configured).

**Quality Control Workflow continued**

For the survey instruments there is the added complexity of multiplicity
(the operational example of VIRCAM)

**VIRCAM trending system**

Last update: 2010-09-27T01:40:42 (UTC)

**Score report**

VIRCAM.2010-09-18T23:14:30.675_tpl1.ab
RAN_TYPE: TWIL
setup: H
time range: 2010-06-21 ... 2010-09-19

**Score report**

VIRCAM.2010-09-18T23:29.18.334_tpl1.ab
RAN_TYPE: TWIL
setup: H
time range: 2010-06-21 ... 2010-09-19

**2. Detector score report**

The same scores, sorted per detector:

**Score data: details...**

- Score result: 0/36 best: 0/36
- Score result: 35/36 best: 0/36

**2. Detector score report**

The same scores, sorted per detector:

**Remarks**

- TWIRLMS scoring values, average over all detectors
- TWIRLMS scoring values, individual detector values
- TWIRLMS scoring values, column over all detectors
Quality Control Workflow continued

Quality Control process for science data:

• pipeline processing is done off-line (not automatic)

• currently, ~10% of all VIRCAM science data is processed. This will be the baseline starting point for OmegaCAM.

• science data is processed using certified master calibrations
• no strict science certification. The initial data quality is graded by SciOps (ABCD) based on PI constraints and conditions. QC issues are fed back to USD and SciOps and may affect grading
• science products are ingested into the archive
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OmegaCAM

- current processing platform is a cluster consisting of 20, dual-core blades
OmegaCAM

• current processing platform is a cluster consisting of 20, dual-core blades

• pipeline and cluster tests ongoing using a full night of OmegaCAM data
  (ESO version of pipeline has been tested with ILT, WFI, and artificial data)

  bias readnoise
  shutter timing
  gain and linearity
  bias
  dark current and particle rate
  dome flat fields
  twilight flat fields
  secondary standard fields
  dithered science data
Artificial OmegaCAM dithered science field
## OmegaCAM QC:

<table>
<thead>
<tr>
<th>Pipeline products</th>
<th>QC Parameters Monitored and Scored</th>
</tr>
</thead>
<tbody>
<tr>
<td>master bias/hot pixel map</td>
<td>$N_{\text{hotpix}}$, detector statistics, structure, comparision to reference</td>
</tr>
<tr>
<td>master dome flat/cold pixel map</td>
<td>$N_{\text{coldpix}}$, detector and lamp statistics, structure, comparision to reference</td>
</tr>
<tr>
<td>master dark</td>
<td>dark current and particle rate, comparision to reference</td>
</tr>
<tr>
<td>master twilight flat/master flat/ bad pixel map</td>
<td>$N_{\text{badpix}}$, detector and sky statistics, structure, comparision to reference</td>
</tr>
<tr>
<td>reduced standard star/zeropoints table</td>
<td>extinction and zeropoints monitoring, image quality</td>
</tr>
<tr>
<td>coadded science frames/sky flat/fringe flat/weight map</td>
<td>coadded science frame statistics, number counts, PSF distribution (orient. and ellip. maps), image quality, astrometric error distribution</td>
</tr>
</tbody>
</table>
but, please explore the ESO Quality Control web presence:

http://www.eso.org/observing/dfo/quality/

Comments and criticisms are always welcome.