

SDQA Metrics for LSST

This document defines the data quality metrics that will be implemented for DC3b.

Metric Attributes

The attributes for each metric are:

- **Name:** name of the field in the database for each metric
- **Units:** physical units of each metric; quantities with no physical units should be so indicated. Note that the units should follow the IAU recommendation for basic units, with additional allowed units and formatting guidelines as recommended in the FITS standard (see http://fits.gsfc.nasa.gov/fits_standard.html, Table 4.2).
- **Type:** data type to be used in the database for each metric
- **Stage:** the pipeline stage where the metric is computed (see: [DC3bProcessingStages](#)). Value will be one of:
 - ◆ "ISR" for Instrument Signature Removal
 - ◆ "CrSplit" for Cosmic Ray Removal
 - ◆ "ImgChar" for image characterization
 - ◆ "AstroCal" for astrometric calibration
 - ◆ "DiffIm" for Image Difference processing
 - ◆ "MOPS" for Moving Object processing
- **Entity:** the entity or collection of entities over which the metric is computed. Possible values are:
 - ◆ "Amp" for a 512x2048 amplifier section of an image
 - ◆ "CCD" for a single 4Kx4K CCD sensor
 - ◆ "Raft" for a physical block of 3x3 co-mounted CCDs
 - ◆ "FPA" for the entire focal plane array of sensors
 - ◆ "Source" for all entries in the Source database
- **Description:** Brief description of the meaning for each metric, and how it will be calculated

Exposure-level Metadata

Certain exposure-level metadata will be recorded for each image in order to make best use of the QA metrics. Most of the quantities listed below will be harvested from the image headers (for the CFHT-LS data), or from TBD for the simulation data.

Name	Units	Type	Description
ccdId	[None]	Int32	Unique identifier for this CCD
offsetFpaX	pixel	Float	Separation between a reference point on the FPA and the first X pixel of a CCD
offsetFpaY	pixel	Float	Separation between a reference point on the FPA and the first Y pixel of a CCD
dateObs	dateTime	double	Timestamp for the start of this exposure, formatted per ISO8601
expTime	s	Float	Duration of the exposure
filterId	[None]	Int32	Unique identifier for the filter (i.e., bandpass) in use

Metrics for Basic Image Characterization

The following are basic, descriptive statistics for LSST raw images. All quantities that describe native brightness (BUNIT) are anticipated to be in units of *ADU* for Amp, and in *electrons* for CCDs after ISR pipeline processing. Note that several of the metrics below (in *italic*) are naturally derived from image histograms. Metrics **in bold** are required for DC3b.

Name	Units	Type	Stage	Entity	Description
nGoodPix	[None]	Int32	ISR	CCD	Number of good pixels, i.e., 1.0 - (nBadCalibPix+nSaturatePix+nSpurPix)
nBadCalibPix	[None]	Int32	ISR	CCD	Number of pixels with compromised values (charge traps, bad columns, hot pixels).
nSpurPix	[None]	Int32	ImgChar	CCD	Number of pixels compromised by non-astronomical transients (Rad hits, mux bleeds, satellite trails, etc.).
nSaturatePix	[None]	Int32	ISR	Amp, CCD	Number of pixels compromised by detector saturation, including pixels with uncorrectable non-linearity.
fracGhostBg	percent	Float	ImgChar	CCD	Fraction of image area affected by ghost images with surface brightness gradients exceeding 0.333 of sky noise. [SRD: "GhostAF"]
overscanMean	ADU	Float	ISR	Amp	Mean of overscan pixels, with outlier rejection
overscanStdDev	ADU	Float	ISR	Amp	Standard deviation about mean of overscan pixels, computed from Good pixels
overscanMedian	ADU	Float	ISR	Amp	Median of overscan pixels, computed from Good pixels; used as robust estimate of CCD bias level
overscanMin	ADU	Float	ISR	Amp	Minimum value of non-rejected overscan pixels
overscanMax	ADU	Float	ISR	Amp	Maximum value of non-rejected overscan pixels
imageClipMean4Sig3Pass	BUNIT	Float	ISR	CCD	Mean of image, computed from Good pixels, with 4-sigma clipping and 3 reject cycles (i.e., passes)
imageSigma	[None]	Float	ISR	CCD	Standard deviation about imageClipMean4Sig3Cycle, computed from Good pixels
imageMedian	BUNIT	Float	ISR	CCD	Median of image, computed from Good pixels
imageMode	BUNIT	Float	ISR	CCD	Mode of image, computed from Good pixels. This is an excellent measure of the background level if the mode is well

					behaved (i.e., unless there are very extended targets in the image)
imageMin	BUNIT	Float	ISR	CCD	Minimum of image, computed from Good pixels
imageMax	BUNIT	Float	ISR	CCD	Maximum of image, computed from Good pixels
imageGradientX	BUNIT/pixel	Float	ISR	CCD	Image gradient, X-direction, computed from Good pixels in background regions
imageGradientY	BUNIT/pixel	Float	ISR	CCD	Image gradient, Y-direction, computed from Good pixels in background regions
diffimageMean	BUNIT	Float	DiffIm	CCD	Mean of difference image, computed from Good pixels
diffimageSigma	[None]	Float	DiffIm	CCD	Standard deviation about difference image mean, computed from Good pixels
diffimageKernelSum	BUNIT/pixel	Float	DiffIm	CCD	Difference image kernel sum
wcsOffsetX	arcsec	Float	AstroCal	CCD	Mean displacement between WCS solution and catalog stars along image Axis1
wcsSigmaX	arcsec	Float	AstroCal	CCD	RMS of WCS solution along image Axis1
wcsOffsetY	arcsec	Float	AstroCal	CCD	Mean displacement between WCS solution and catalog stars along image Axis2
wcsSigmaY	arcsec	Float	AstroCal	CCD	RMS of WCS solution along image Axis2
nWcsAvailStars	arcsec	Float	AstroCal	CCD	Number of catalog stars within the CCD footprint that could be used for WCS solution
nWcsGoodStars	arcsec	Float	AstroCal	CCD	Number of catalog stars within the CCD footprint that were actually used for WCS solution
amplFringe	[None]	Float	ISR	CCD	Amplitude of fringe pattern, relative to subtraction template
photDepth	ABmag	Float	ImgChar	CCD	Median photometric depth
diffCatVsInst	[mag]	Float	SFM	CCD	Median of differences of catalog mag and instrumental mag for all detected sources. Used to detect attenuation across the FOV due to partial cloud cover.
photZeropt	mag	Float	ImgChar	CCD	Photometric zero-point--i.e., magnitude corresponding to one count in the calibrated image.
photZeroptSigma	mmag	Float	ImgChar	CCD	Error distribution RMS of the internal photometric zero-point

psfWidth	arcsec	Float	SFM	CCD	Median of delivered seeing distribution, measured from bright point-sources on CCD
psfWidthSigma	arcsec	Float	SFM	CCD	Full-width at half-maximum of the delivered seeing distribution
psfEllipticity	[None]	Float	ImgChar	CCD	Median of point source ellipticity distribution
trackletEfficiency	percent	Float	DayMOPS	DIASource	Percent of sythetic DIASources with corresponding correct tracklet*
trackletAccuracy	percent	Float	DayMOPS	DIASource	Percent of tracklets containing at least one synthetic DIASource which are correct
trackEfficiency	percent	Float	DayMOPS	DIASource	Percent of sythetic DIASources with corresponding correct track*
trackAccuracy	percent	Float	DayMOPS	DIASource	Percent of track containing at least one synthetic DIASource which are correct
orbitRecoveryEfficiency	percent	Float	DayMOPS	DIASource	Percent of sythetic DIASources with corresponding correct orbit*
orbitRecoveryAccuracy	percent	Float	DayMOPS	DIASource	Percent of orbits with track containing at least one synthetic DIASource which are correct

*: all MOPS "Efficiency" metrics disregard DIASources for which tracklet or track creation was impossible, e.g. moving too quickly, not in sufficient images, etc.