GR1 Caveats

GR1 users should be aware of caveats in the following categories.

Data units:

Fragmentation of extended sources:

Photometry:

Search uniformity and duplication:

Astrometry:

Artifacts:

Data units:

1. Data units for pixels in the intensity (*-int.fits, *-intbgsub.fits, and *-skybg.fits images) is counts per second per pixel (pixels are 1.5"x1.5"). Units for the various sextractor fluxes and magnitudes FUV/NUV_MAG/FLUX_*) are counts per second. The nuv/fuv_mag columns are AB magnitudes, and nuv/fuv_flux columns are micro-Janskys.

Fragmentation of extended sources:

2. Resolved objects are often fragmented by the source extractor, contaminating search results. No standard, widely-used way of identifying extended objects has yet been developed, but excluding the NGS survey from large area searches will help.

Photometry:

3. Large objects (or extremely bright objects) can disrupt the local background estimation and cause source extractor to provide poorer-than-average local photometry for nearby objects.

4. Photometry for bright objects will be poor due to the non-linear response behavior of the detector. For unresolved objects, the response rolls off by 10% at 13.9 mag (89 cps) FUV, and 13.4 mag (471 cps) NUV. See "The on orbit performance of the Galaxy Evolution Explorer," ApJL preprint as updated by "GALEX GR1 Instrument Performance and Calibration Review," in this GR1 documentation.

Search uniformity and duplication:

5. Since exposure times on fields can vary by factor of 1000, uniformity in large searches may benefit from a limitation on exposure time or survey type.

6. Extractions with mag_auto_err > 0.54 (SNR < 2) are not candidates for merging. Thus many NUV sources will have no merged FUV counterpart despite the presence of a positionally coincident FUV extraction.

7. Searches which involve multiple visits (as opposed to searches of coadds) will return duplicated sources from repeated observations, which the user will have to resolve. Similarly, there is overlap in the sky coverage between tiles, so even coadd searches of sky covered by multiple tiles (including most large-area searches), will return duplicates. This is still true for searches restricted to a single survey. In the future, the MAST team will develop tools to help deal with this issue.

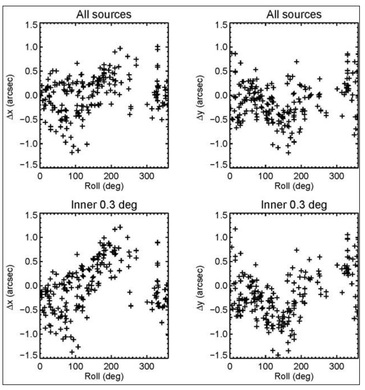
8. There is small difference in the relative response limit used in single visits vs. coadded images, even for coadds that only consist of a single visit. When dividing the cnt images (in units of photons) by the relative response image (the exposure time modified by the flat field), the image is masked where the relative response falls below a certain value. The difference in setting this value between visits and coadds has the result that the images and catalogs for coadds derived from a single visit are not identical copies of their single visit counterparts as one might expect. The difference in the images is entirely at the edges of the field. While the vast majority of the sources will be the same, there will be some minor differences in the catalogs. Most of the differences in the catalogs are in the mostly spurious sources detected right at the detector edge. However, these differences in the pixels in the edge can occasionally affect the detection of faint sources in the inner part of the field as well. This was included in detail in one of the fields with a single visit: MISDR1_03292_0444. For sources in this field within a radius of 0.55 deg from the field center, only 0.5% of NUV sources in the visit catalog have no match in the coadd catalog using a search radius of 2 pixels. The corresponding percentage for the FUV is 0.2%.

Astrometry:

9. We checked the astrometry for each field against the Tycho2/ACT catalog. The typical astrometry error issues we found in individual fields were overall shifts as well as rotations in some cases. In the end, our requirement for the astrometry to be "good" was a total shift of less than 1.5 arcsec (1 pixel) and a rotation of less than 0.04 deg. This rotation angle corresponds to a shift of 1.5 arcsec at the edge of the field relative to the center. This can be compared with the uncertainty in the positions of individual Tycho stars, 80% of which lie within 1.1-1.2 arcsec of their catalog positions. The 1.5 arcsec cut used for the astrometry of the entire field is therefore significantly larger than the expected errors due to residual spatial distortions in the field.

10. There is a systematic offset of approximately 0.75 arcsec between the FUV and NUV images of a field. The evidence for this offset can be seen in Figure 1. For each MIS or NGS field in the first release, we calculated a median offset between the x and y positions for sources detected in both bands. These median x and y offsets (in the sense of the FUV minus the NUV position) are plotted as a function of the detector roll angle. The offset is always in the same direction on the detectors. Once the data are transformed into sky coordinates, the offset therefore spins around with the roll angle.

Figure 1) Astrometric offsets between NUV and FUV as a function of spacecraft roll angle on the sky.



Artifacts:

11. Diffuse reflections from out-of-field bright stars are not flagged as artifacts and can artificially increase faint false source extractions locally. This affects only a very small area of sky.

12. Large area searches should exclude the detector edge (see fov_radius column) and regions potentially contaminated by reflection artifacts (see the nuv/fuv_artifact_flag columns). A conservative FOV radius limit is 0.5 degrees and 0.55 degrees is often used too. The artifact flag images include a "rim flag" which flags pixels at a more liberal 0.59 degrees and beyond (this flag is **not** incorporated into the nuv/fuv_artifact_flag columns for GR1). The user may wish to view the FITS images in detail and decide what limit is appropriate for a particular use. The main issues are 1) false detections due to reflection artifacts and the complex response pattern, and 2) distortion of the PSF due to spatial non-linearity.

13. After reprocessing the AIS data, an unmasked NUV hot spot was discovered near the center of the NUV detector. Since hot spots are always in the same place on the detector, in the de-dithered images, they follow the reverse of the path of the dither on the sky. This is usually a ring or part of a ring depending on the exposure time. This hot spot will result in a small number of spurious sources in the catalog. The NUV hot spot appears primarily in data taken after 2004 June 23 although it appeared occasionally as early as 2004 April.

14. Detector window (type 3) reflection artifact flags in the following fields are incorrect. This will slightly contaminate some searches relying on the 'nuv_artifact_flag' column if the search includes any of these fields.

Background:

Reflection artifacts are flagged using simple geometric models based on the known instrument boresight pointing and roll. Since the spacecraft dithers during an observation, the boresight position and roll fed to the geometric models are averages over the observation time. Of the three types of reflection artifacts -- 1) edge reflections, 2) dichroic reflections, and 3) detector window reflections -- only type 3 artifacts are dependent on roll. The geometric artifact regions are used to flag extracted objects as being at risk for artifact contamination (see section 12, above).

The Bug:

A bug in the computation of the average roll when the roll is near 0 caused 17 observations (see Table 1) to have type 3 artifact regions incorrectly placed, thus erroneously flagging small areas of the NUV FOV and leaving other areas erroneously unflagged (FUV was not affected). Since the artifact flags are carried into the catalog in the nuv_artifact_flags column, a small number of objects in these fields will be either improperly flagged or unflagged. Searches which use the artifact flags will thus be slightly contaminated.

Since the artifact flags from each visit are carried forward into the coadd (except for AIS tiles, which are not coadded), extractions from the coadded images are similarly affected.

Table 1) Tiles affected by nuv_artifact_flag errors

Survey	Tile	Visit	Sub-visit	Eclipse	Area (sq.arcmin)
AIS	AISCHV2_070_04911	2	1	1693	0.92
AIS	AISCHV2_144_16668	1	1	2451	0.56
AIS	AISCHV2_145_20932	1	1	1744	0.7
AIS	AISCHV2_145_20932	1	7	1744	0.72
AIS	AISCHV2_242_19630	1	1	1620	0.57
AIS	AISCHV2_242_19813	1	1	1722	0.94
AIS	AISCHV2_244_31764	1	1	1592	1
MIS	MISDR1_03167_0446	1	-	3843	0.43
MIS	MISDR1_03290_0447	1	-	3841	0.34
MIS	MISDR1_03569_0440	1	-	3801	0.48
MIS	MISDR1_03668_0441	1	-	3800	0.52
MIS	MISDR1_20309_0638	4	-	1705	0.74
MIS	MISDR1_29083_0381	2	-	1930	0.65
NGS	NGA_HCG092	4	-	1702	1
NGS	NGA_HCG092	7	-	1908	1.1
NGS	NGA_NGC5398_580_F5_19_15_8	1	-	580	0.88
DIS	VVDS22H	24	-	1909	0.53
All	**Total sky area affected**				**12**