1.1_VISTA-VIDEO

January 18, 2018

1 CDFS-SWIRE Master List Creation

1.1 Preparation of VIDEO/VISTA/VIRCAM data

The catalogue comes from `dmu0_VISTA_VIDEO-private`.

There is an old public version of the catalogue but we are using the newer private version in the hope that it will be public by the time we publish the masterlist.

Filters: Z, Y, J, H, Ks

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position (degrees);
- The stellarity;
- The magnitude for each band in apertude 3, which is 2 arcsec (rs548 presumes same for private catalogue).
- The "auto" magnitude is provided, we presume this is standard Sextractor units etc.

Yannick said the dates of observation for VIDEO are from 2009/11 to 2016/12. There is a paper from 2012 (Jarvis et al). So will use 2012.

```
This notebook was run with herschelhelp_internal version:
04829ed (Thu Nov 2 16:57:19 2017 +0000)
```

```
Out[3]: 'en_GB'
```

1.2 I - Column selection

```
Out[8]: <IPython.core.display.HTML object>
```

1.3 II - Correct z band fluxes and magnitudes

We discovered that the catalogue contains some wrong z magnitudes in the CDFS-SWIRE field. Strangely, Sextractor affected some magnitudes to sources which are not on the z image. Boris found a way to get rid of these magnitudes: all the wrong sources have a Z_MAGERR_AUTO to 0.

But we have to look at these sources in another catalogue because the VIDEO catalogue we use has been processed to correct for wrong error. We use the `video_id` column (which is unique within a field) to find the sources identified in the other catalogue and set their flux, magnitudes, and associated errors to NaN.

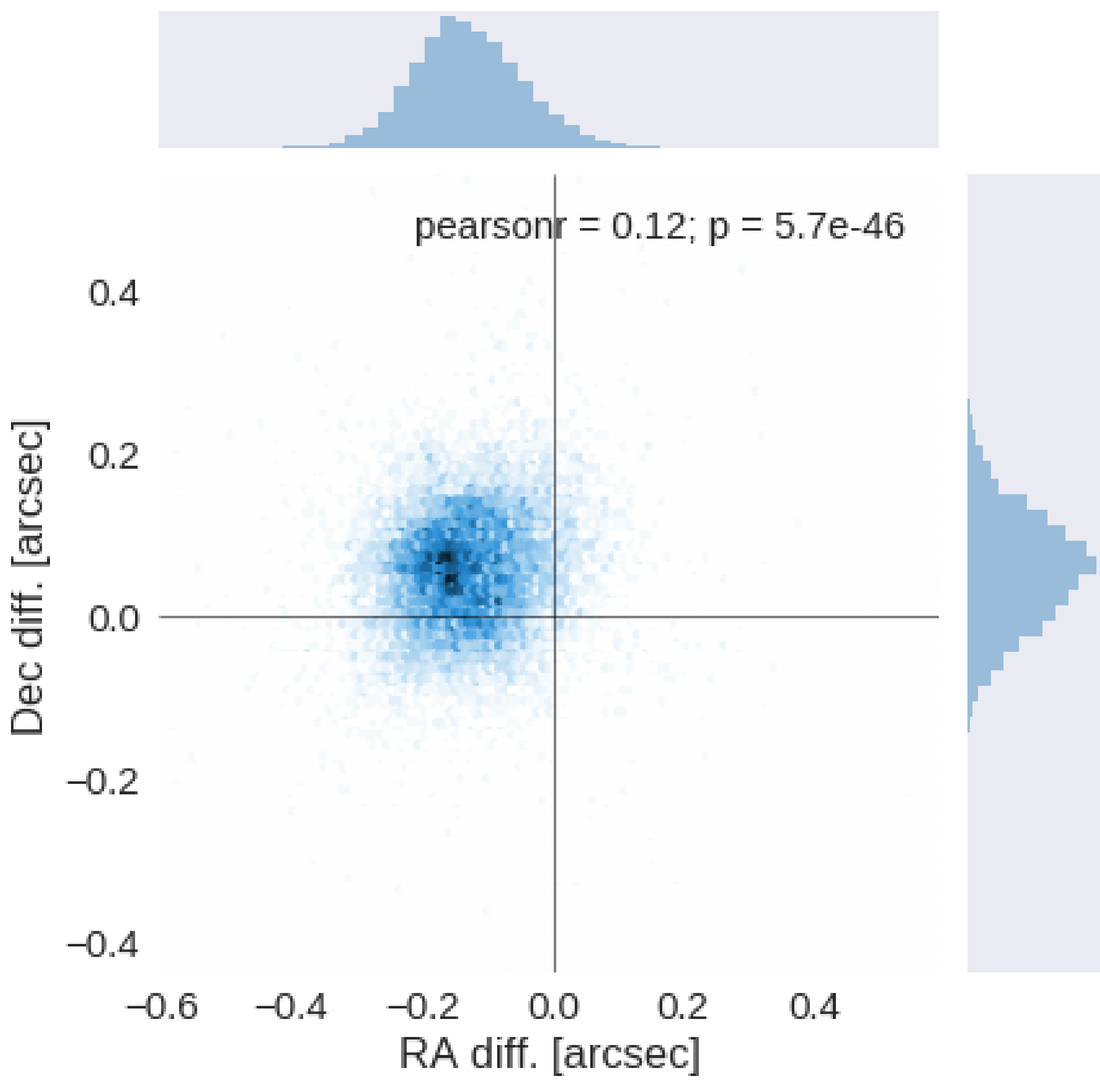
1.4 III - Removal of duplicated sources

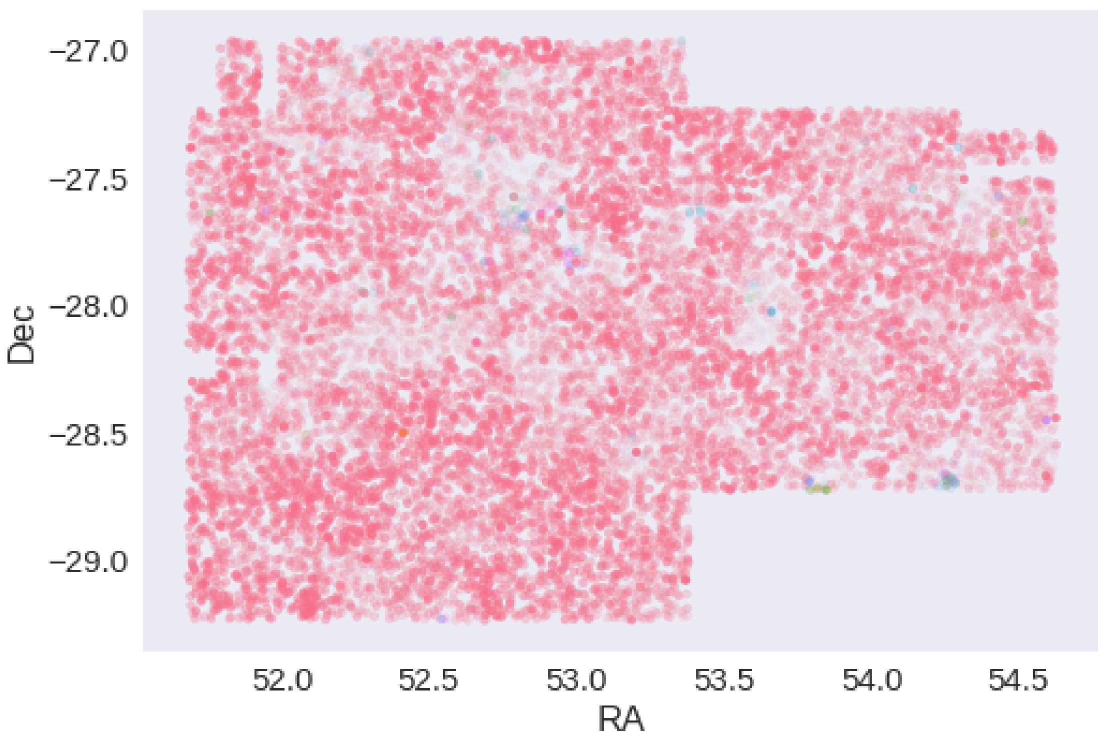
We remove duplicated objects from the input catalogues.

```
The initial catalogue had 1073655 sources.
The cleaned catalogue has 1071323 sources (2332 removed).
The cleaned catalogue has 2319 sources flagged as having been cleaned
```

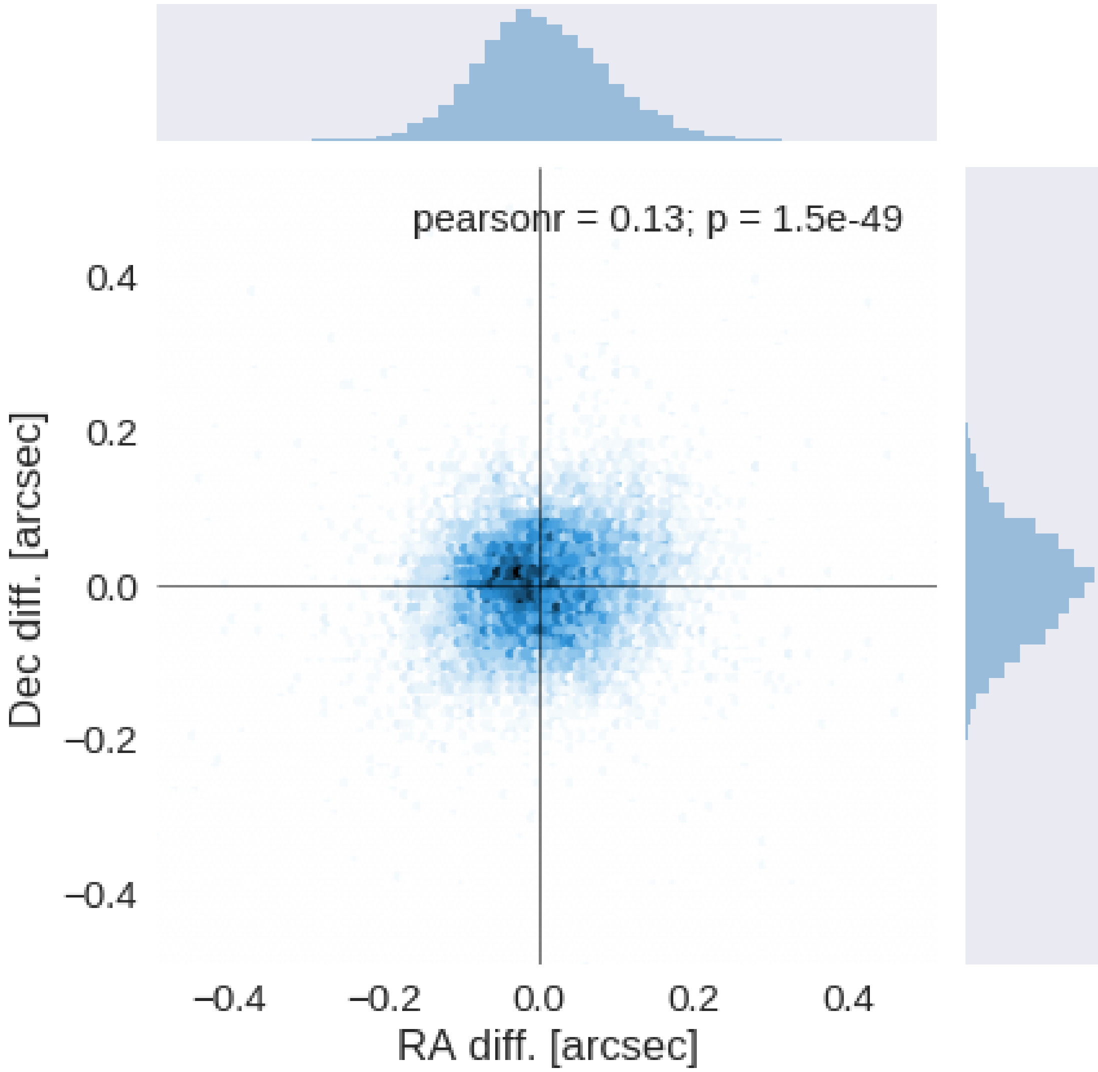
1.5 IV - Astrometry correction

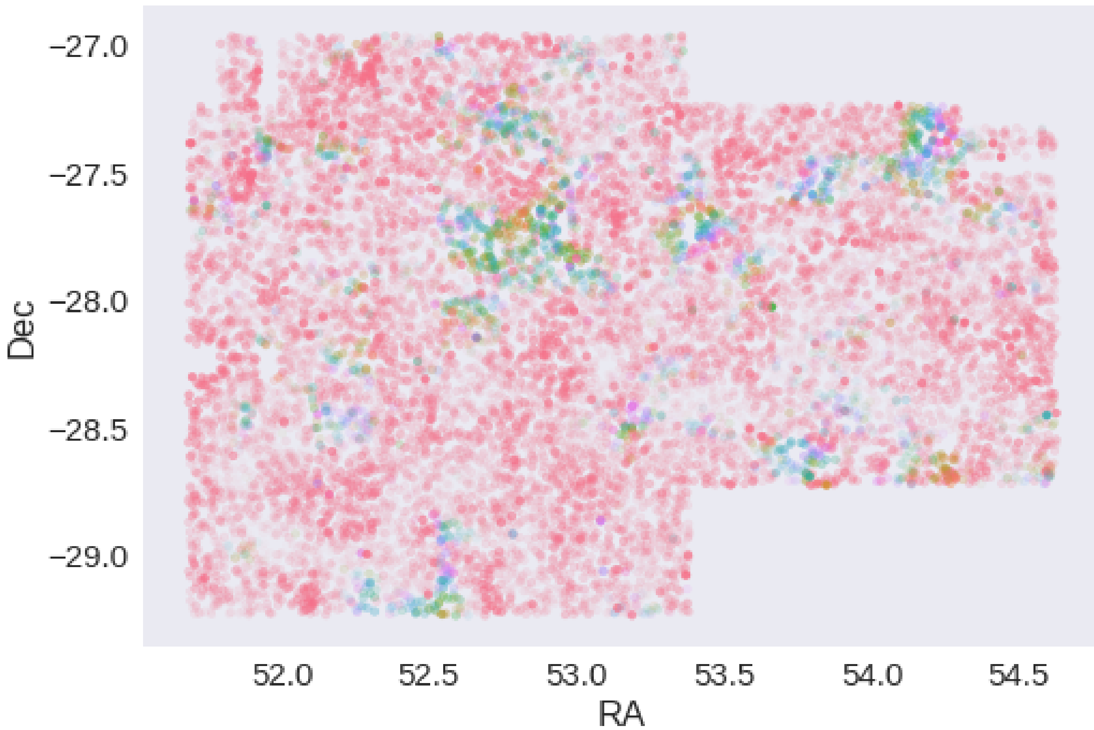
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.13464397878237833 arcsec
Dec correction: -0.05622936663485234 arcsec
```


pearsonr = 0.13; p = 1.5e-49
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
0.4
RA diff. [arcsec]



1.6 V - Flagging Gaia objects

```
13687 sources flagged.
```

1.7 VI - Saving to disk

1.2_SERVS

January 18, 2018

1 CDFS SWIRE master catalogue

1.1 Preparation of Spitzer datafusion SERVS data

The data is in 'dmu0_DataFusion-Spitzer'

The Spitzer catalogues were produced by the datafusion team are available in the HELP virtual observatory server. They are described there: http://vohedamtest.lam.fr/browse/df_spitzer/q.

Lucia told that the magnitudes are aperture corrected.

In the catalouge, we keep:

- The internal identifier (this one is only in HeDaM data);
- The position;
- The fluxes in aperture 2 (1.9 arcsec);
- The "auto" flux (which seems to be the Kron flux);
- The stellarity in each band

A query of the position in the Spitzer heritage archive show that the SERVS-ELAIS-N1 images were observed in 2009. Let's take this as epoch.

```
This notebook was run with herschelhelp_internal version:
04829ed (Thu Nov 2 16:57:19 2017 +0000)
```

1.2 I - Column selection

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:76: RuntimeWarning: invalid value enco
  magnitudes = 2.5 * (23 - np.log10(fluxes)) - 48.6
```

```
Out[6]: <IPython.core.display.HTML object>
```

1.3 II - Removal of duplicated sources

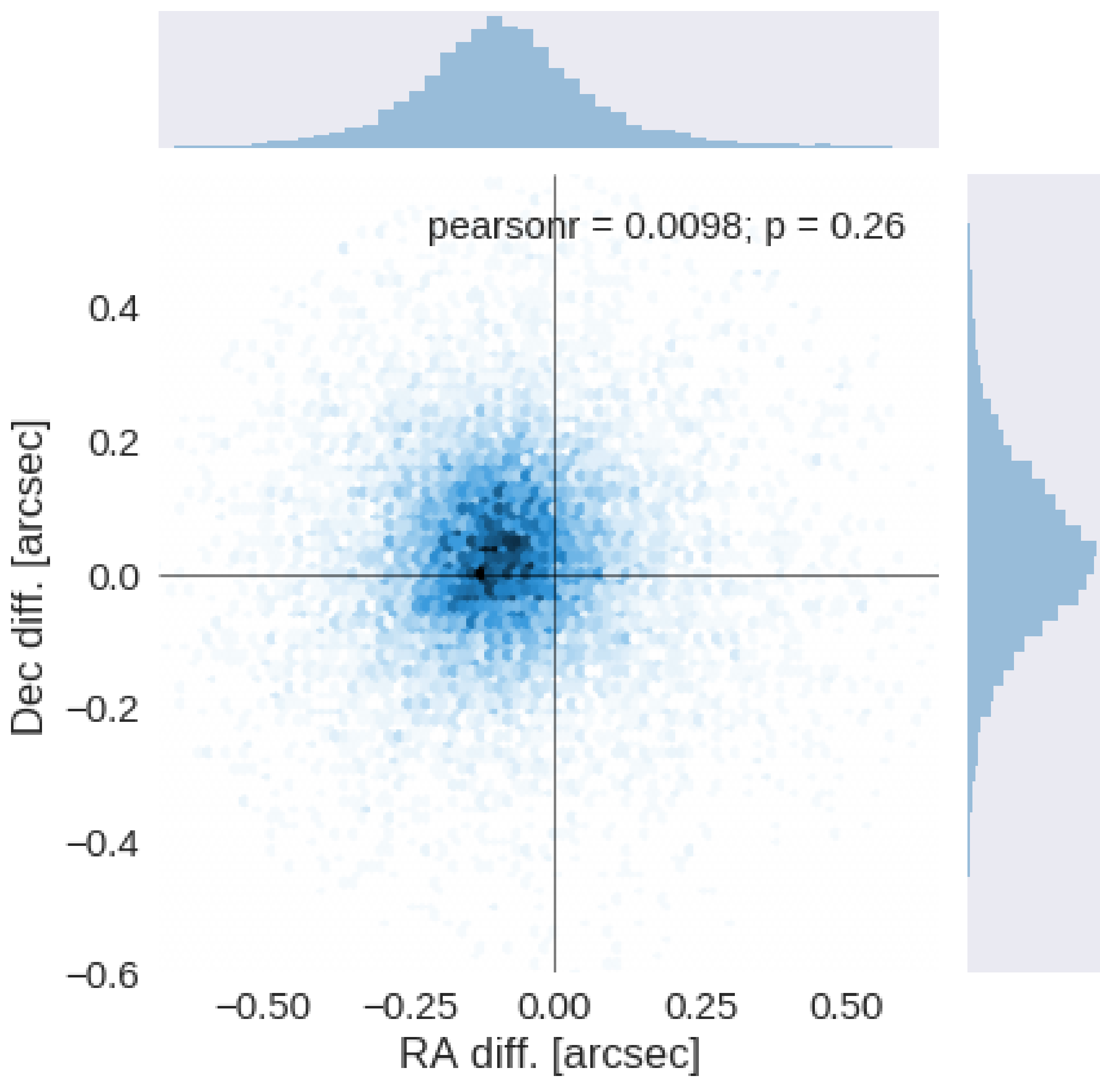
We remove duplicated objects from the input catalogues.

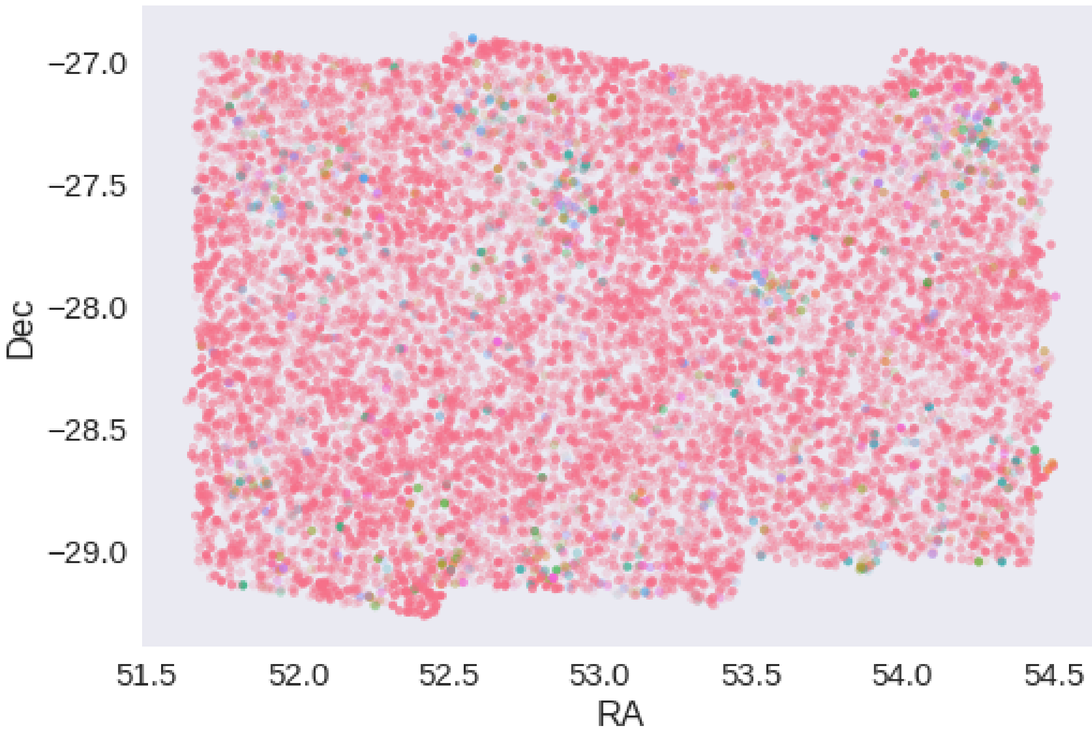
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 829191 sources.
The cleaned catalogue has 829191 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

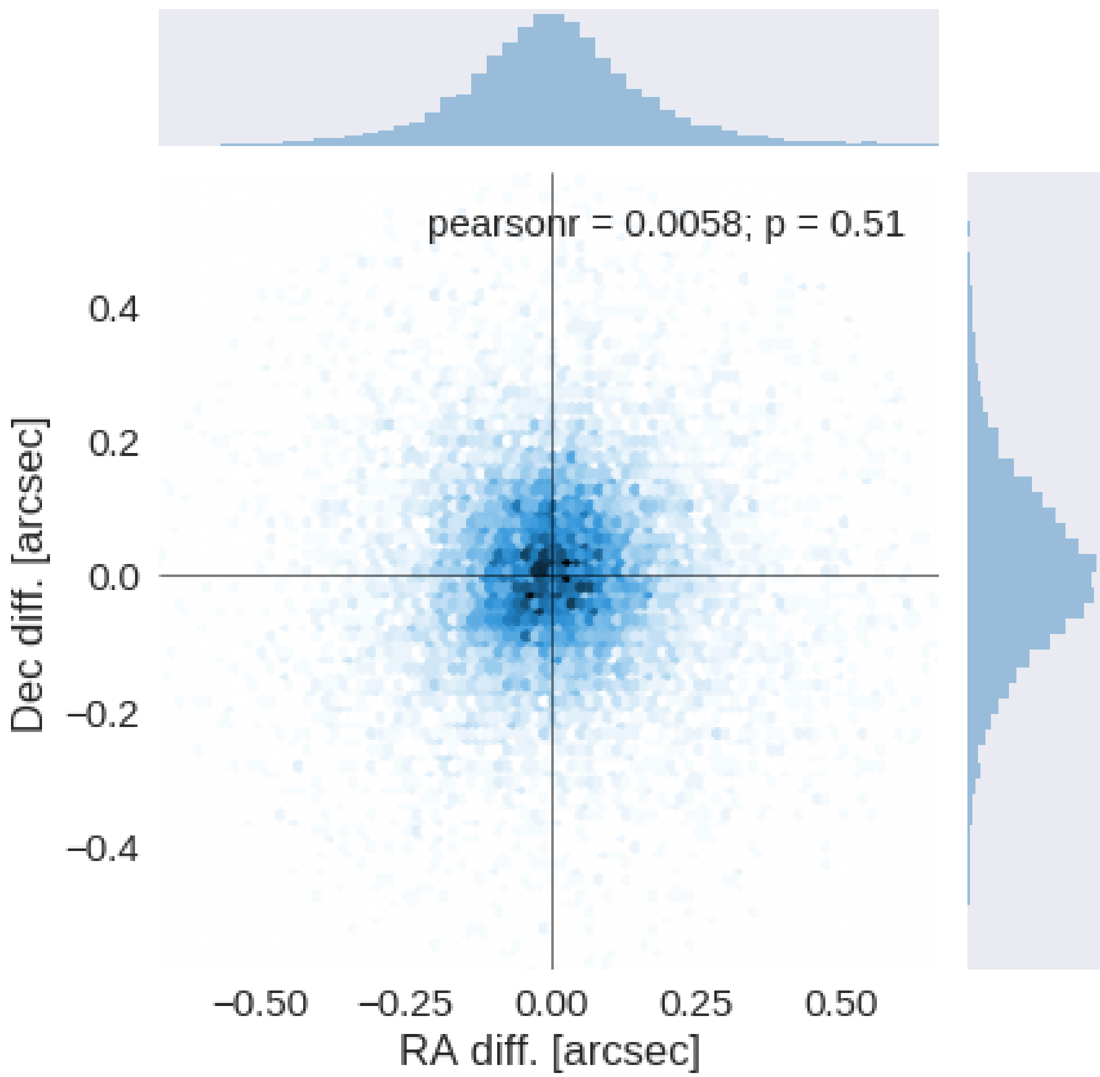
1.4 III - Astrometry correction

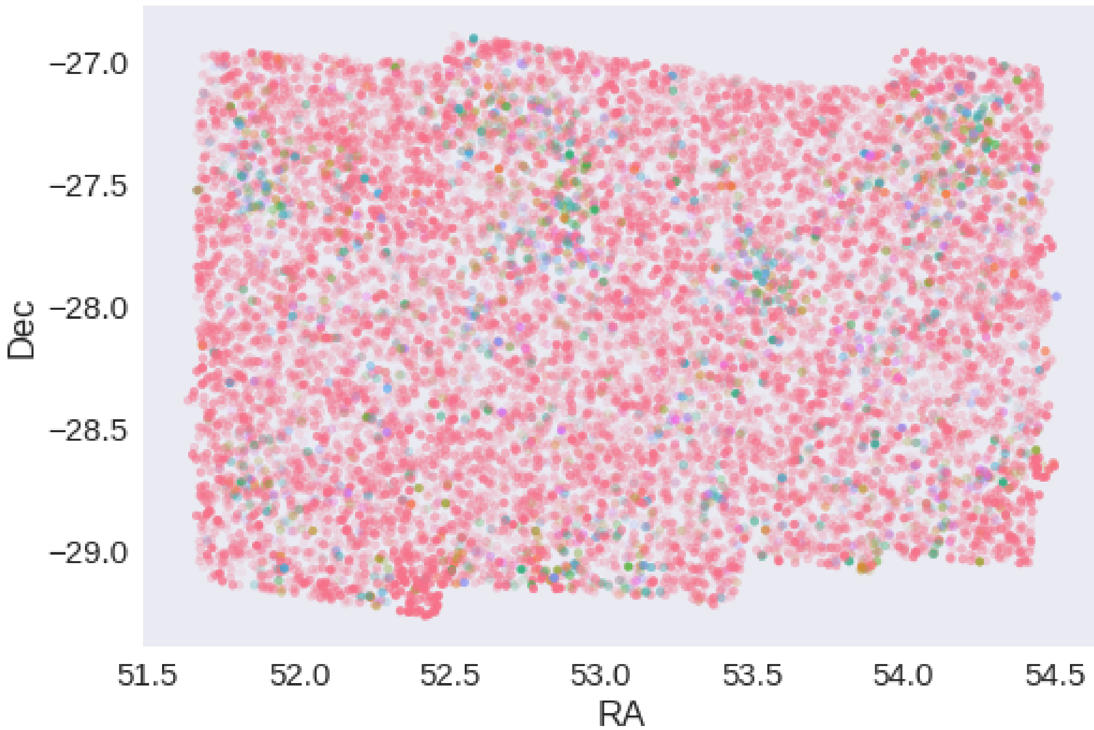
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.09465175745901888 arcsec
Dec correction: -0.023302447203832344 arcsec
```


pearsonr = 0.0058; p = 0.51
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.50
−0.25
0.00
0.25
0.50
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
13977 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.3_SWIRE

January 18, 2018

1 CDFS SWIRE master catalogue

1.1 Preparation of Spitzer data fusion/SWIRE data

The data is available at 'dmu0_DataFusion-Spitzer'.

The Spitzer catalogues were produced by the datafusion team are available in the HELP virtual observatory server. They are described there: http://vohedamtest.lam.fr/browse/df_spitzer/q.

Lucia told that the magnitudes are aperture corrected.

In the catalouge, we keep:

We keep: - The internal identifier (this one is only in HeDaM data); - The position; - The fluxes in aperture 2 (1.9 arcsec) for IRAC bands. - The Kron flux; - The stellarity in each band

A query of the position in the Spitzer heritage archive show that the ELAIS-N1 images were observed in 2004. Let's take this as epoch.

We do not use the MIPS fluxes as they will be extracted on MIPS maps using XID+.

```
This notebook was run with herschelhelp_internal version:
04829ed (Thu Nov 2 16:57:19 2017 +0000)
```

1.2 I - Column selection

```
Out[6]: <IPython.core.display.HTML object>
```

1.3 II - Removal of duplicated sources

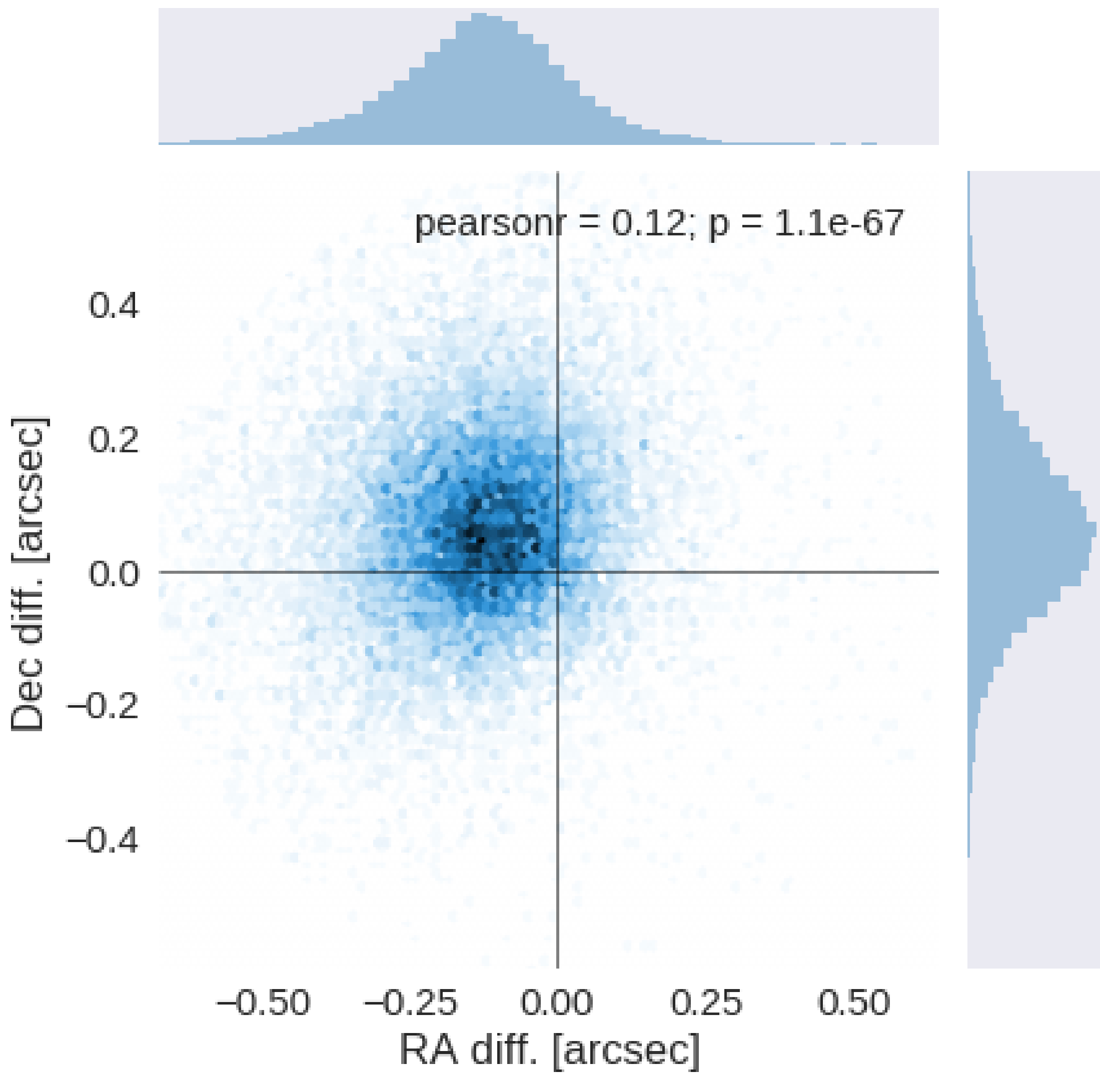
We remove duplicated objects from the input catalogues.

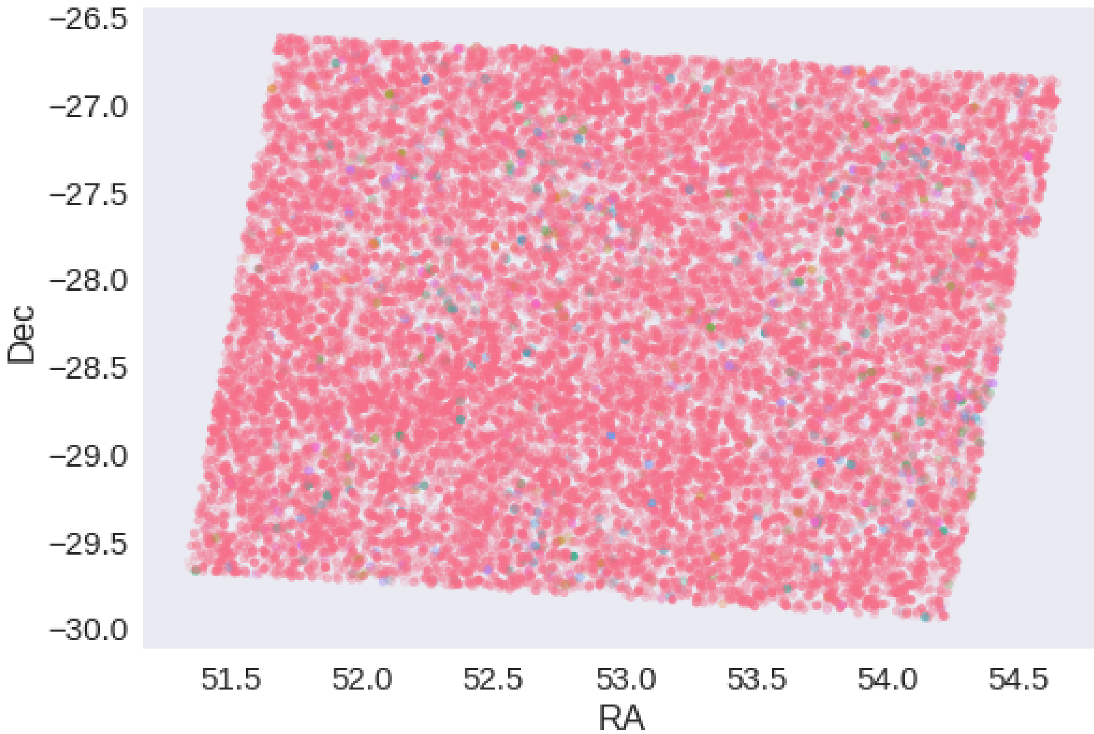
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)


The initial catalogue had 464084 sources.
The cleaned catalogue has 464051 sources (33 removed).
The cleaned catalogue has 33 sources flagged as having been cleaned
```

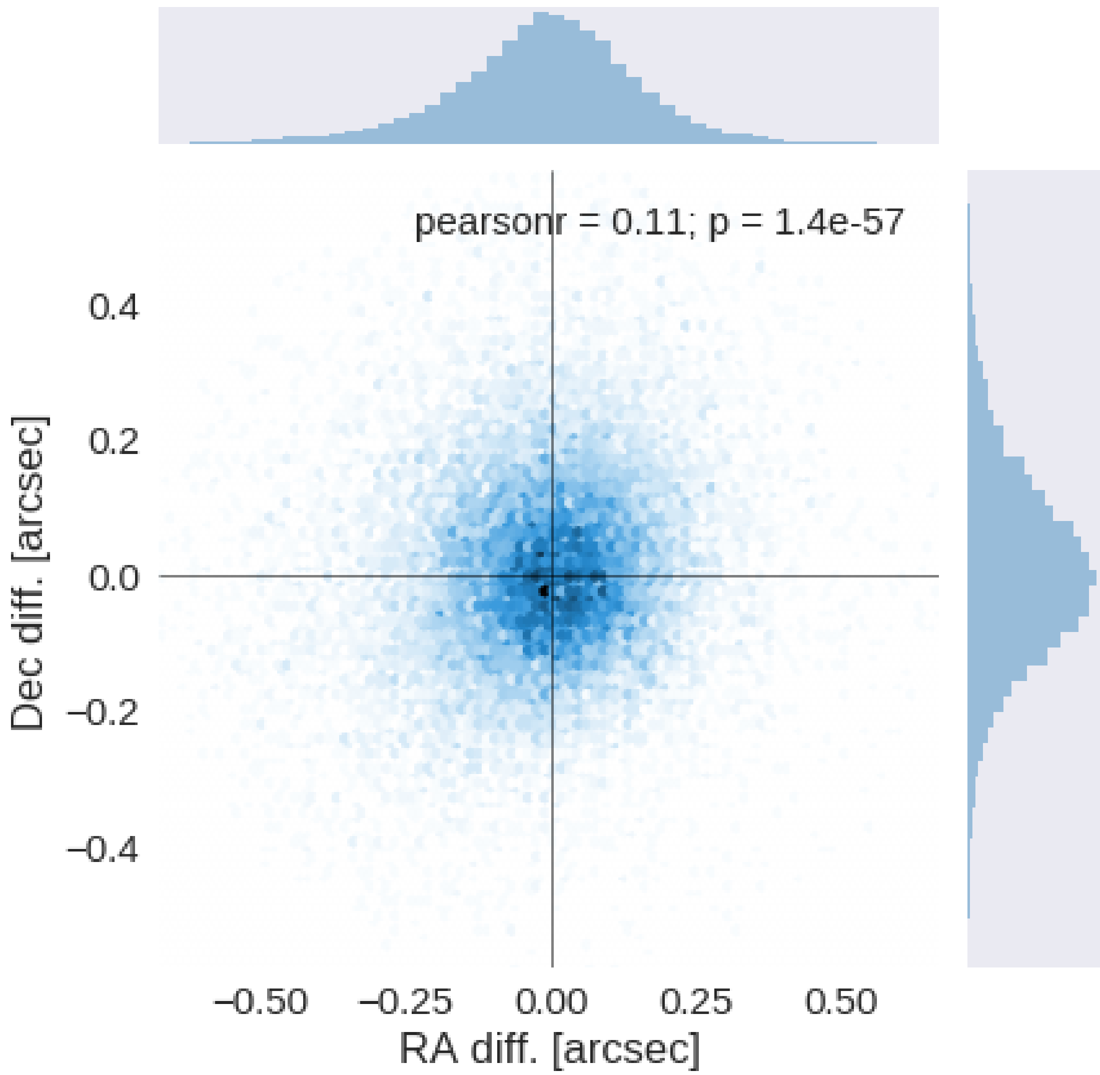
1.4 III - Astrometry correction

We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.

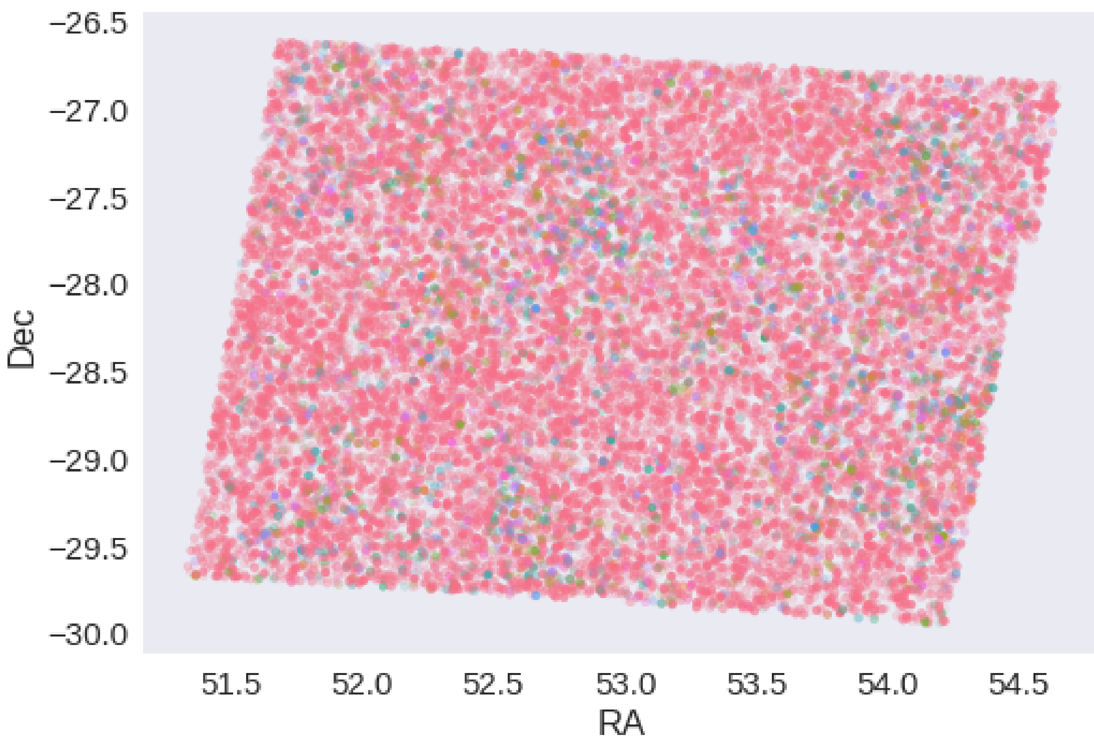





```
RA correction: 0.1236081218308982 arcsec
Dec correction: -0.059570162281374905 arcsec
```



pearsonr = 0.11; p = 1.4e-57
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.50
−0.25
0.00
0.25
0.50
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
21407 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.4_PanSTARRS

January 18, 2018

1 CDFS SWIRE master catalogue

1.1 Preparation of PanSTARRS data

The catalogue comes from `dmu0_PanSTARRS1-3SS`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The aperture magnitude
- The kron magnitude to be used as total magnitude (no "auto" magnitude is provided).

```
This notebook was run with herschelhelp_internal version:
04829ed (Thu Nov 2 16:57:19 2017 +0000)
```

1.2 I - Column selection

```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
Out[6]: <IPython.core.display.HTML object>
```

1.3 II - Removal of duplicated sources

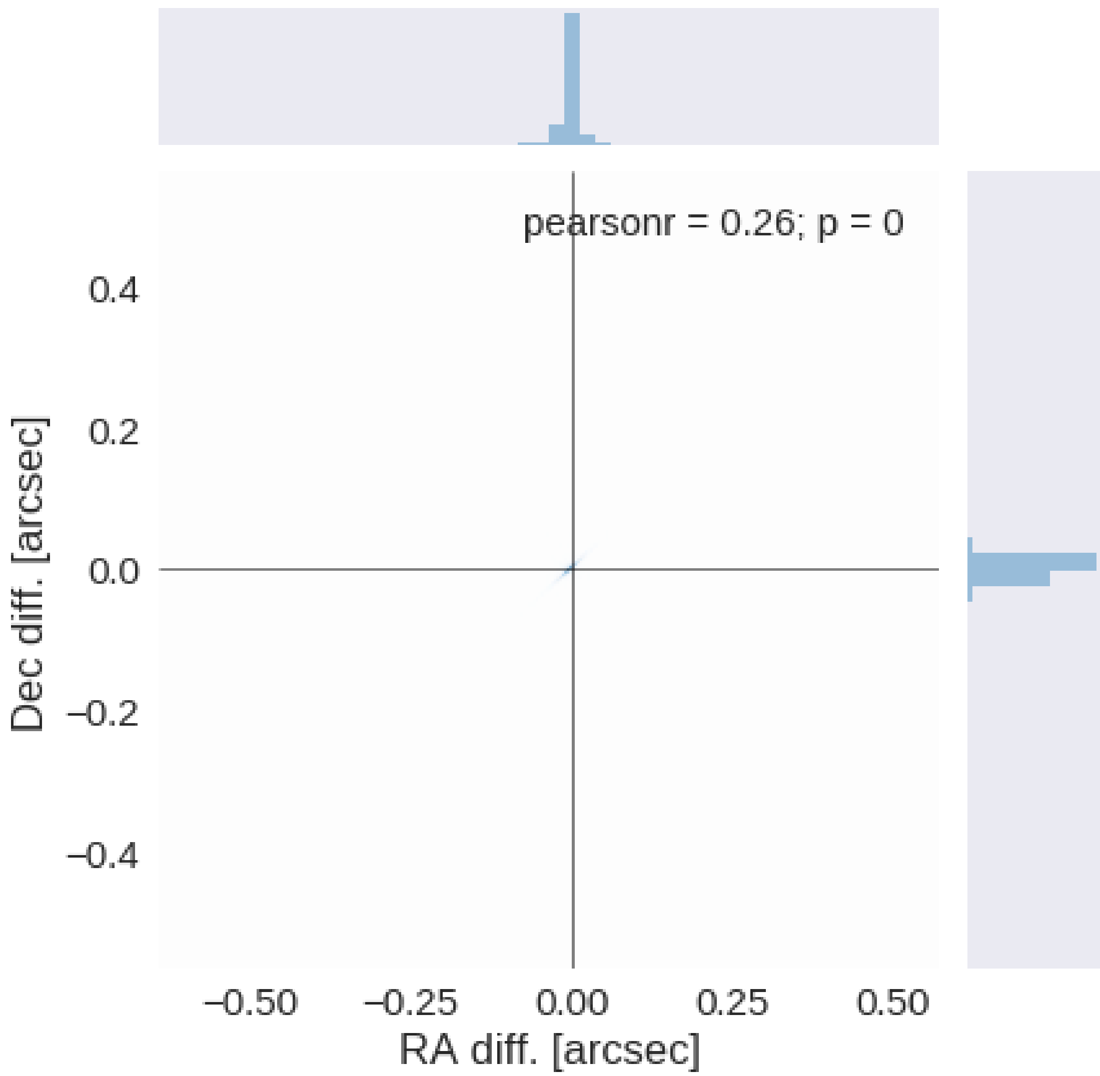
We remove duplicated objects from the input catalogues.

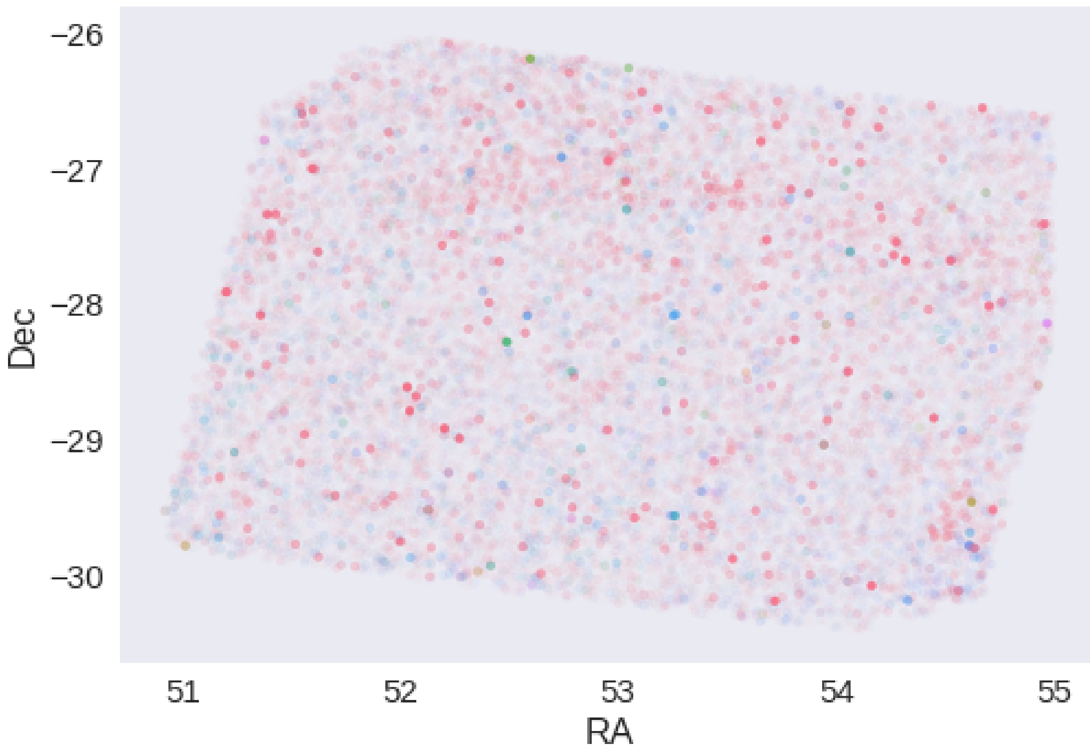
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 216352 sources.
The cleaned catalogue has 179224 sources (37128 removed).
The cleaned catalogue has 32982 sources flagged as having been cleaned
```

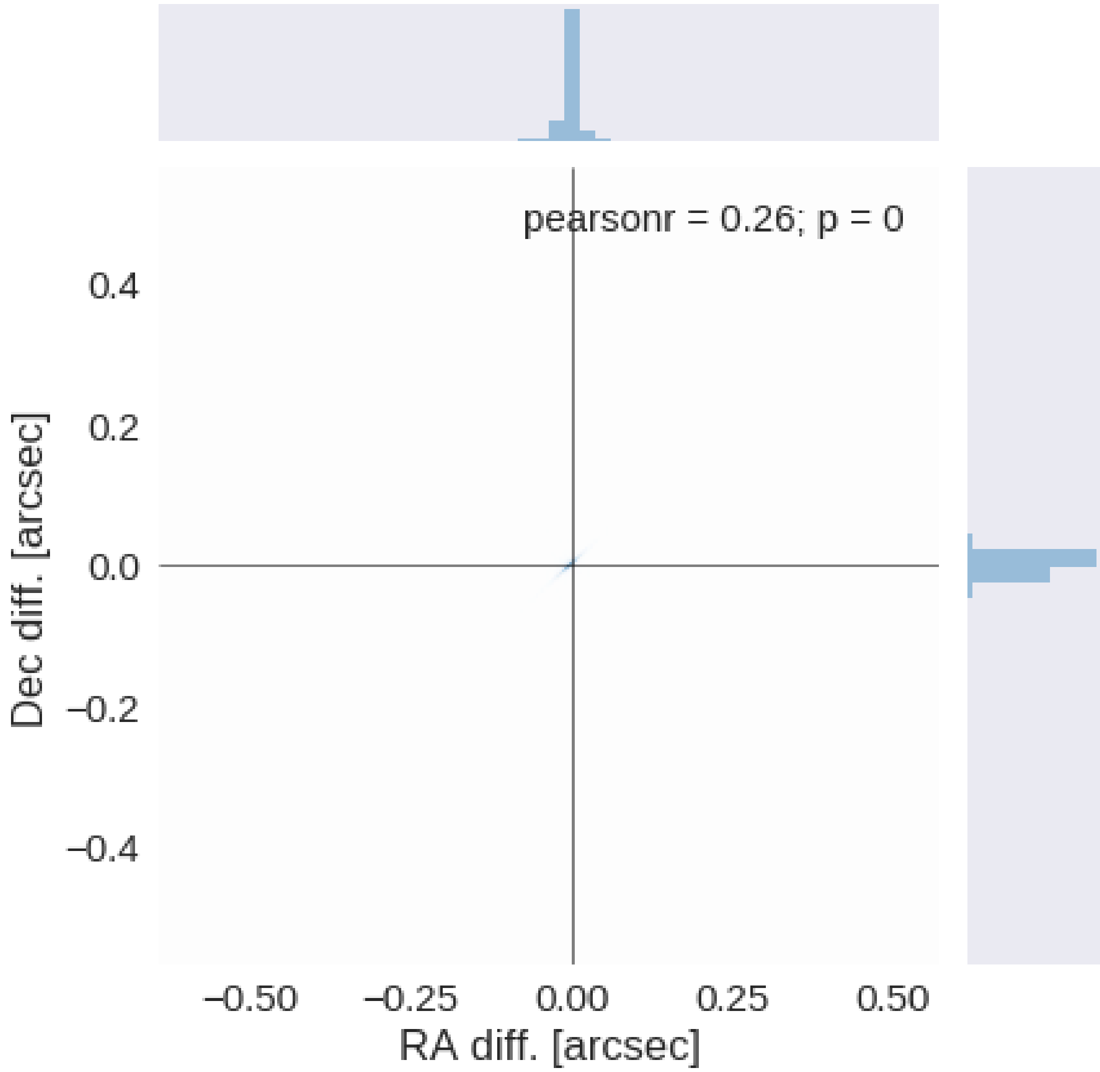
1.4 III - Astrometry correction

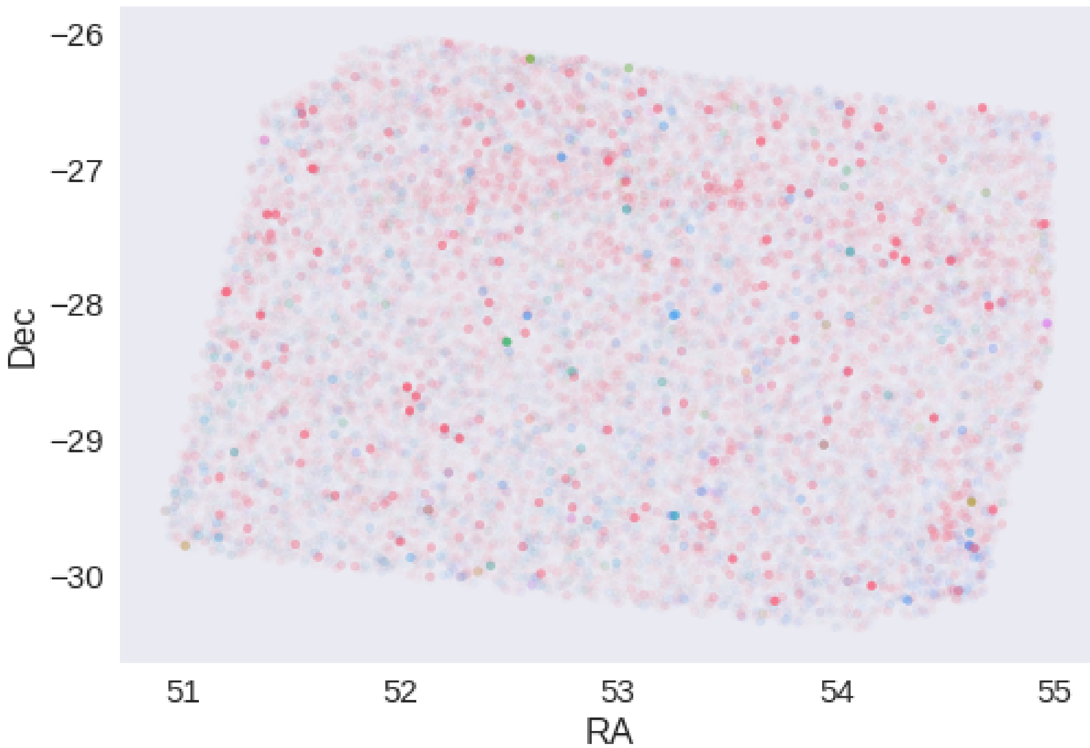
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.0001800822658992729 arcsec
Dec correction: -0.0003455704778332347 arcsec
```


pearsonr = 0.26; p = 0
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.50
−0.25
0.00
0.25
0.50
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
34655 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.6_Fireworks

January 18, 2018

1 CDFS SWIRE master catalogue

1.1 Preparation of Fireworks data

FIREWORKS photometry of GOODS CDF-S catalogue: the catalogue comes from `dmu0_Fireworks`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The total magnitude.

```
This notebook was run with herschelhelp_internal version:
04829ed (Thu Nov 2 16:57:19 2017 +0000)
```

1.2 I - Column selection

```
Out[6]: <IPython.core.display.HTML object>
```

1.3 II - Removal of duplicated sources

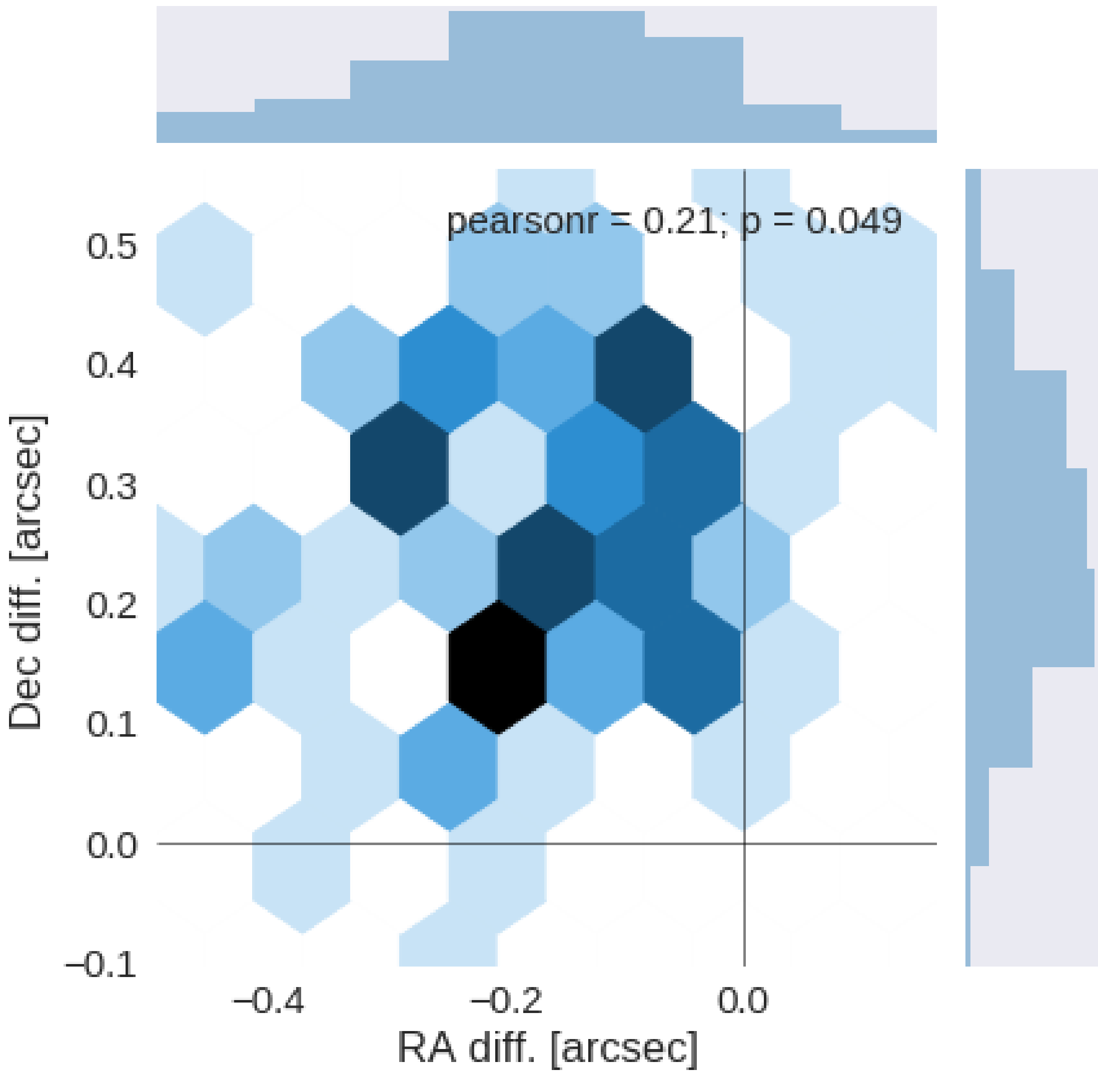
We remove duplicated objects from the input catalogues.

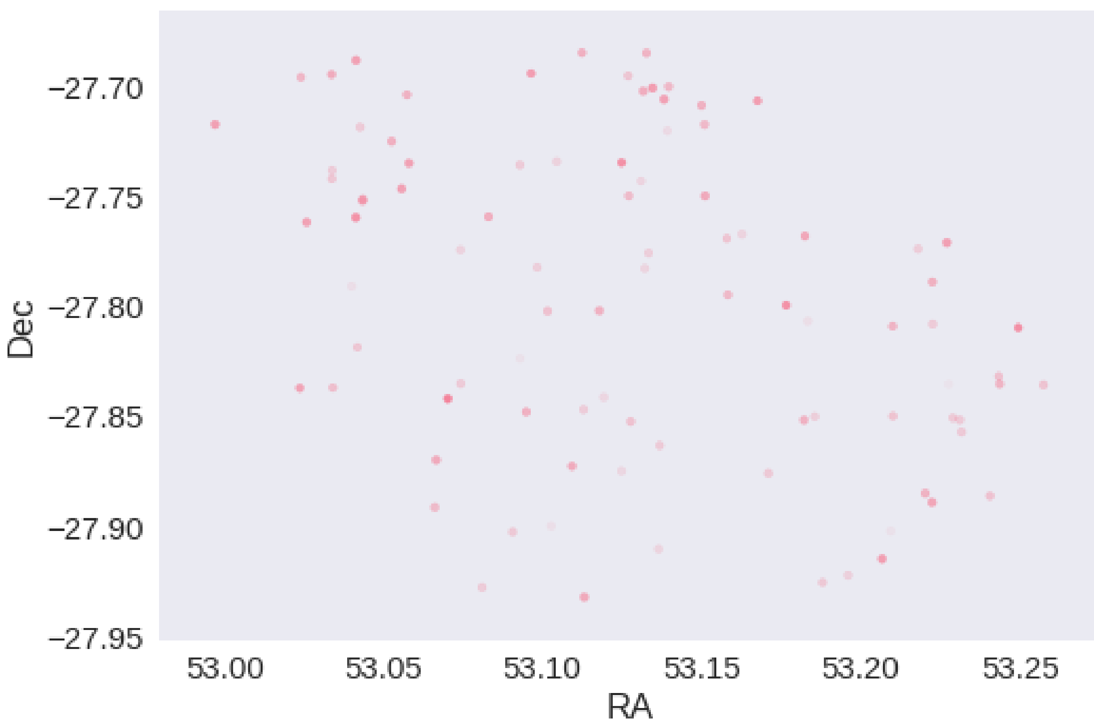
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)


The initial catalogue had 6308 sources.
The cleaned catalogue has 6308 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

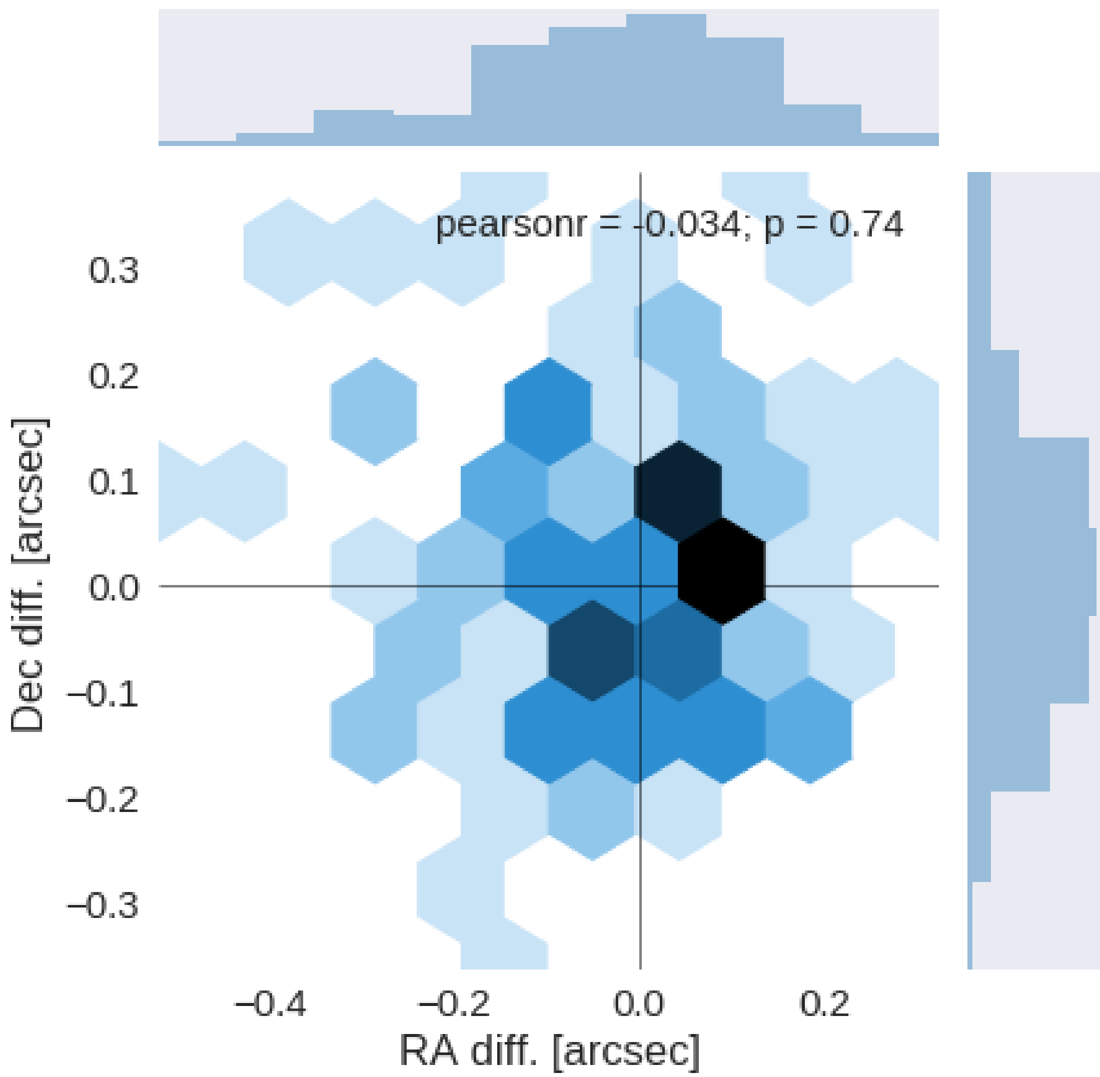
1.4 III - Astrometry correction

We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.16079856930133474 arcsec
Dec correction: -0.2589072199192799 arcsec
```



pearsonr = -0.034; p = 0.74
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
RA diff. [arcsec]

1.5 IV - Flagging Gaia objects

```
102 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.7_ATLAS

January 18, 2018

1 CDFS SWIRE master catalogue

1.1 Preparation of ATLAS/VST data

ATLAS/VST catalogue: the catalogue comes from `dmu0_ATLAS`.
In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The aperture corrected aperture magnitude in each band (2")
- The Petrosian magnitude to be used as total magnitude (no "auto" magnitude is provided).

We don't know when the maps have been observed. We will use the year of the reference paper.

```
This notebook was run with herschelhelp_internal version:
04829ed (Thu Nov 2 16:57:19 2017 +0000)
```

1.2 I - Column selection

```
Out[6]: <IPython.core.display.HTML object>
```

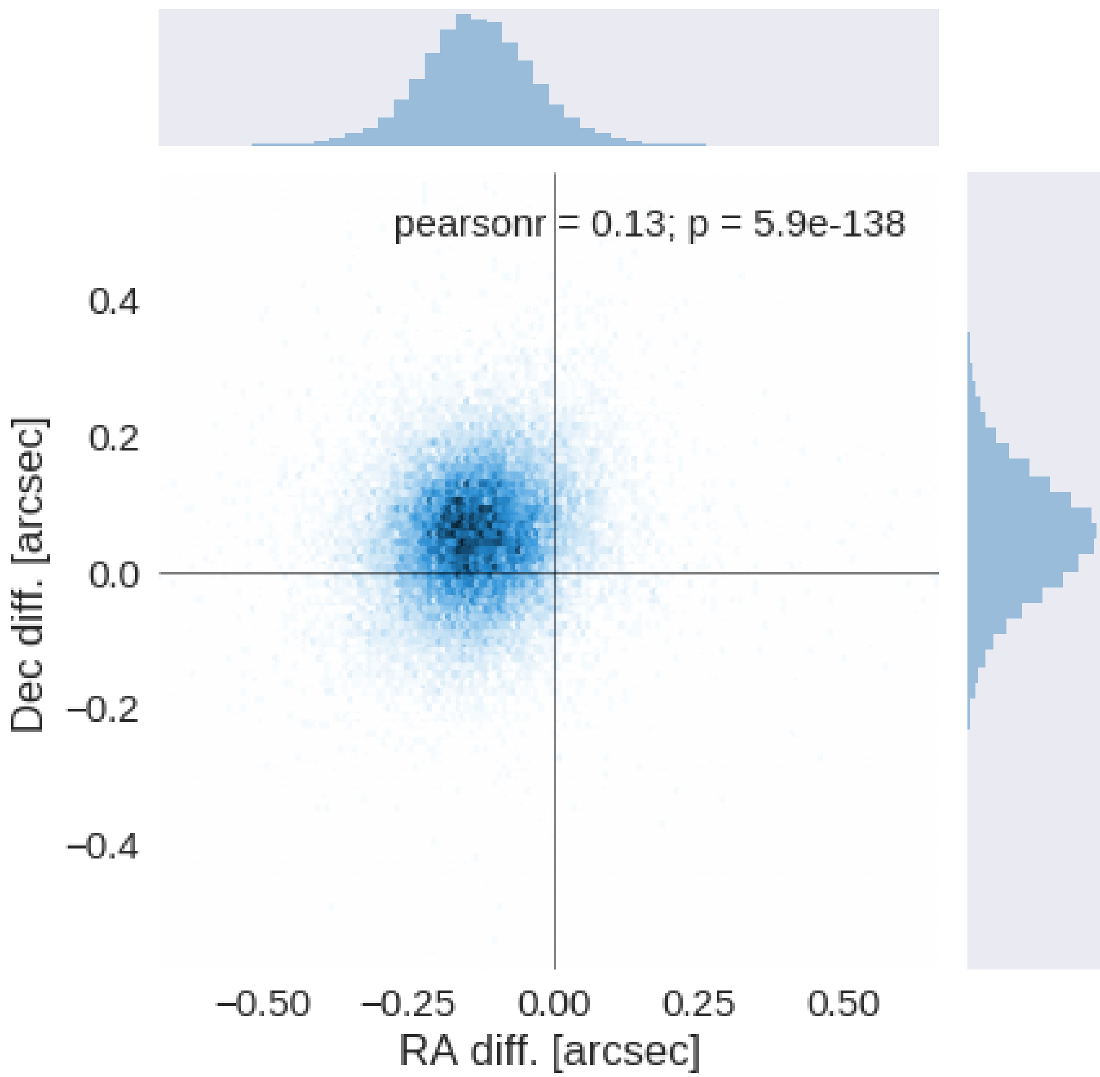
1.3 II - Removal of duplicated sources

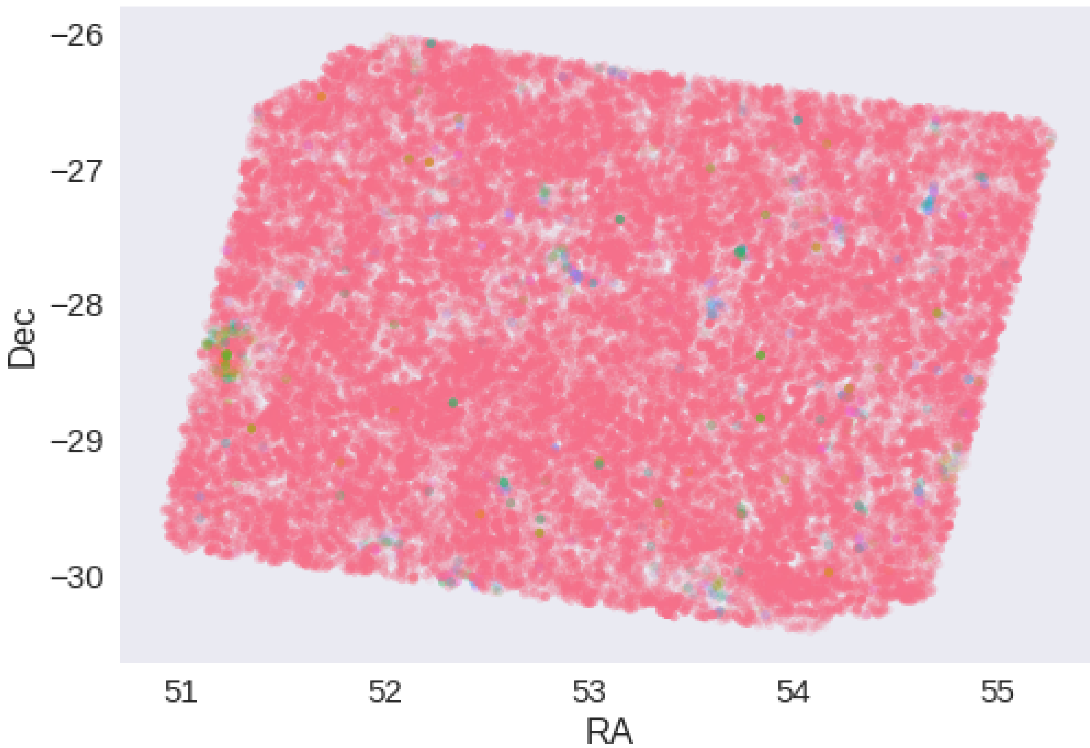
We remove duplicated objects from the input catalogues.

```
The initial catalogue had 316547 sources.
The cleaned catalogue has 301248 sources (15299 removed).
The cleaned catalogue has 14639 sources flagged as having been cleaned
```

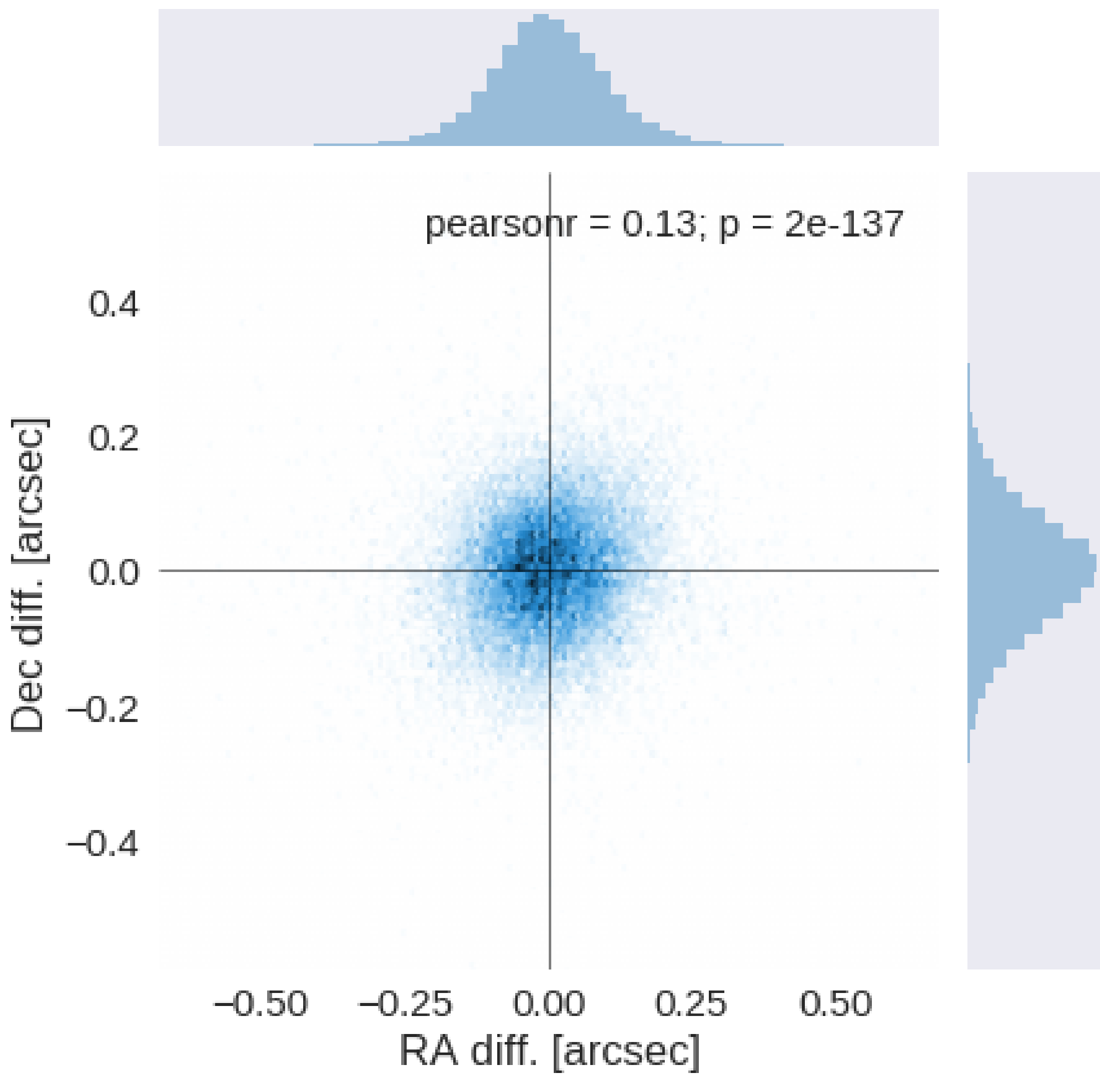
1.4 III - Astrometry correction

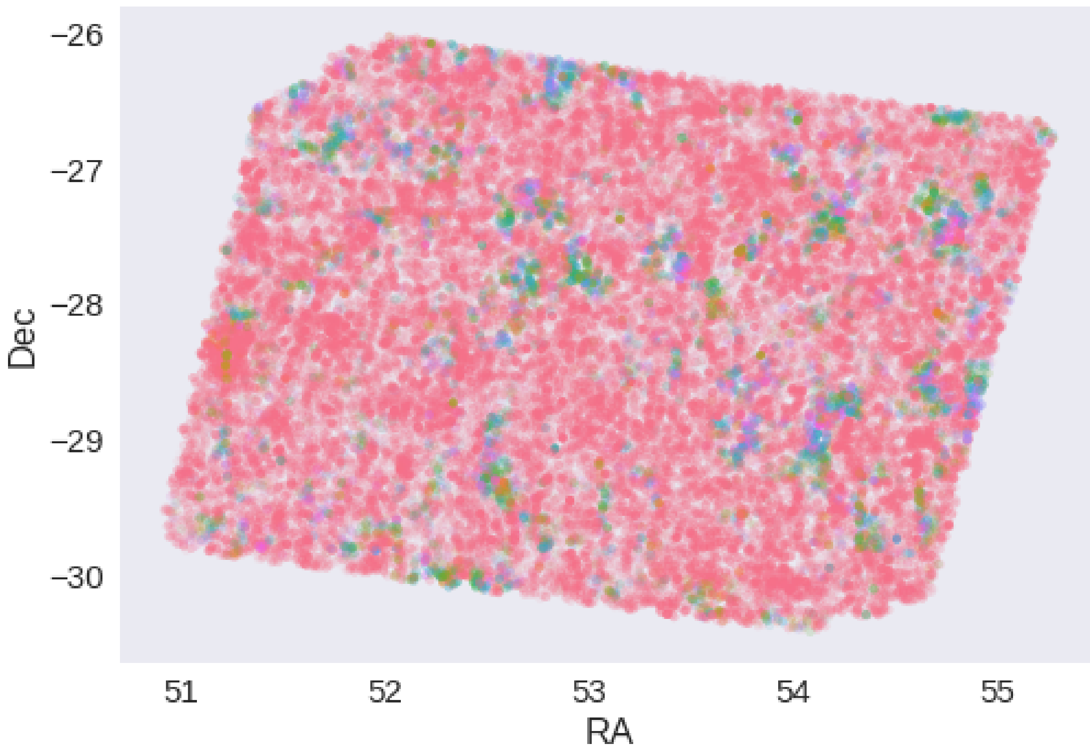
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.


pearsonr = 0.13; p = 5.9e-138
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.50
−0.25
0.00
0.25
0.50
RA diff. [arcsec]




```
RA correction: 0.13242675666447212 arcsec
Dec correction: -0.0507013146410884 arcsec
```


pearsonr = 0.13; p = 2e-137
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.50
−0.25
0.00
0.25
0.50
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
35746 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.8_VISTA-VHS

January 18, 2018

1 CDFS SWIRE master catalogue

1.1 Preparation of VHS data

VISTA telescope/VHS catalogue: the catalogue comes from `dmu0_VHS`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The magnitude for each band.
- The kron magnitude to be used as total magnitude (no "auto" magnitude is provided).

We don't know when the maps have been observed. We will use the year of the reference paper.

```
This notebook was run with herschelhelp_internal version:
04829ed (Thu Nov 2 16:57:19 2017 +0000)
```

1.2 I - Column selection

```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
Out[7]: <IPython.core.display.HTML object>
```

1.3 II - Removal of duplicated sources

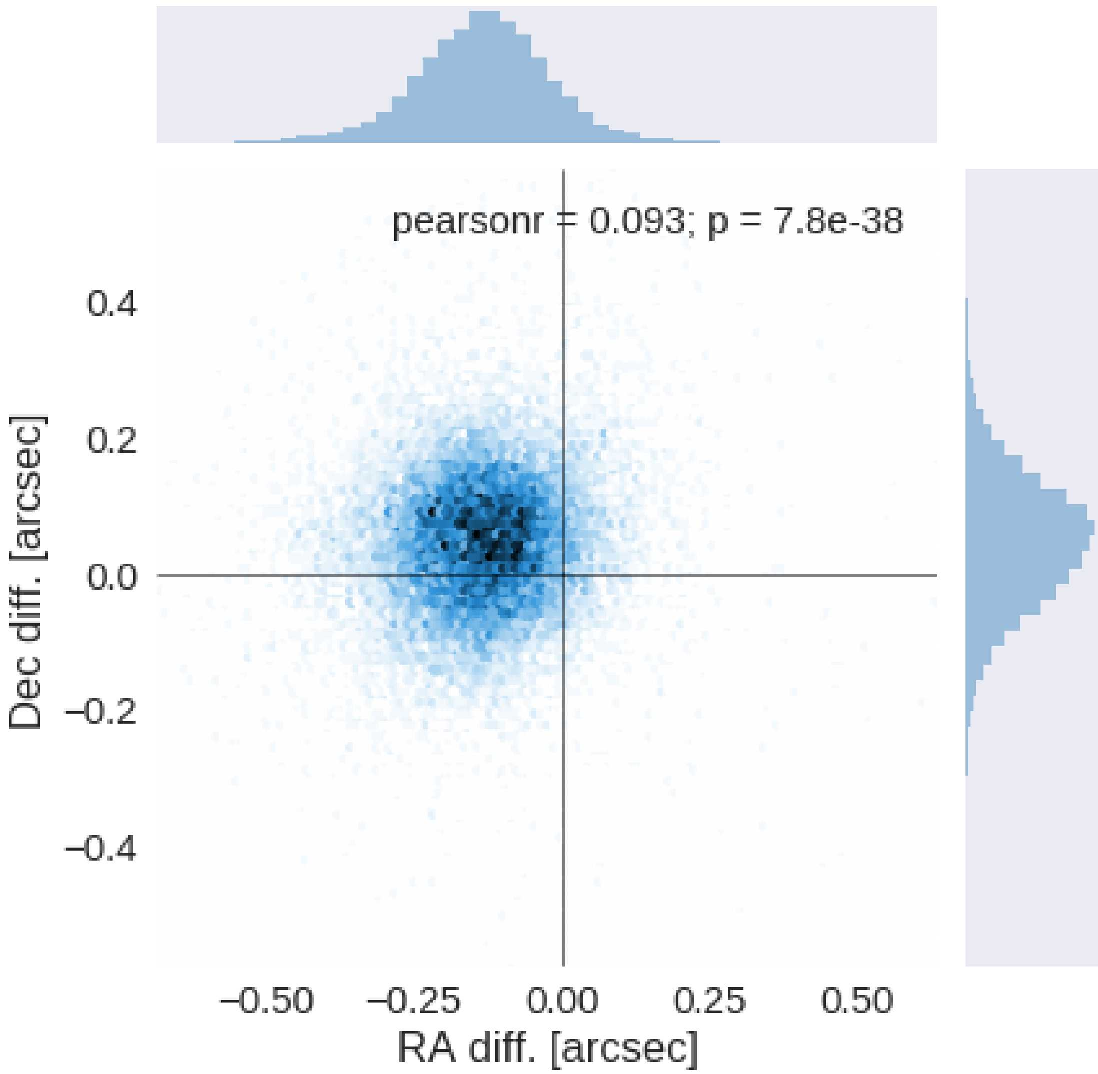
We remove duplicated objects from the input catalogues.

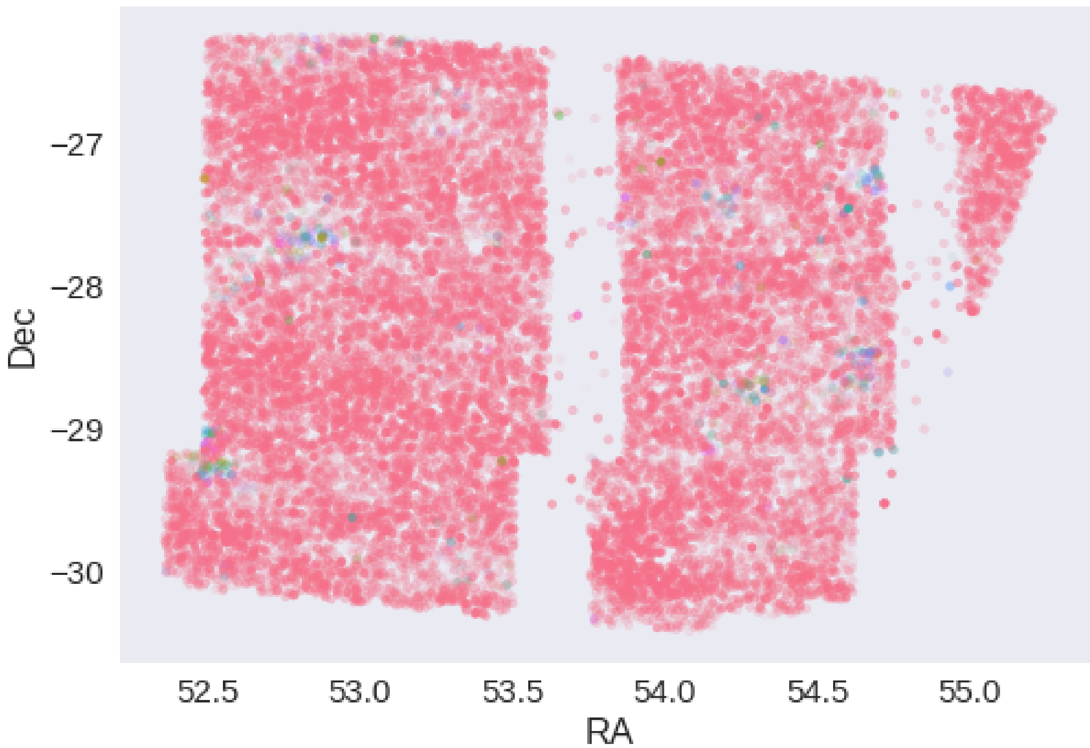
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 130365 sources.
The cleaned catalogue has 130357 sources (8 removed).
The cleaned catalogue has 8 sources flagged as having been cleaned
```

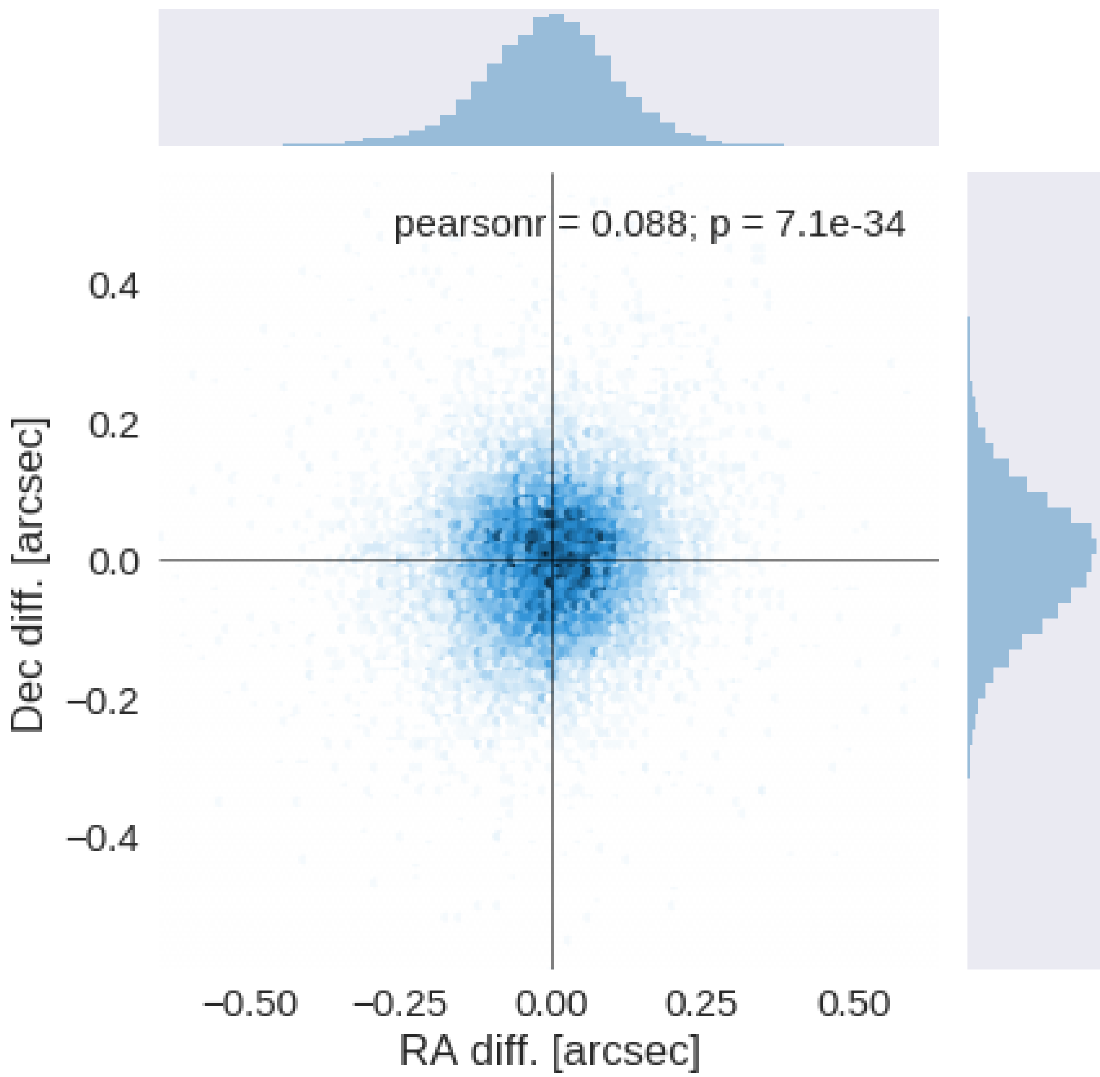
1.4 III - Astrometry correction

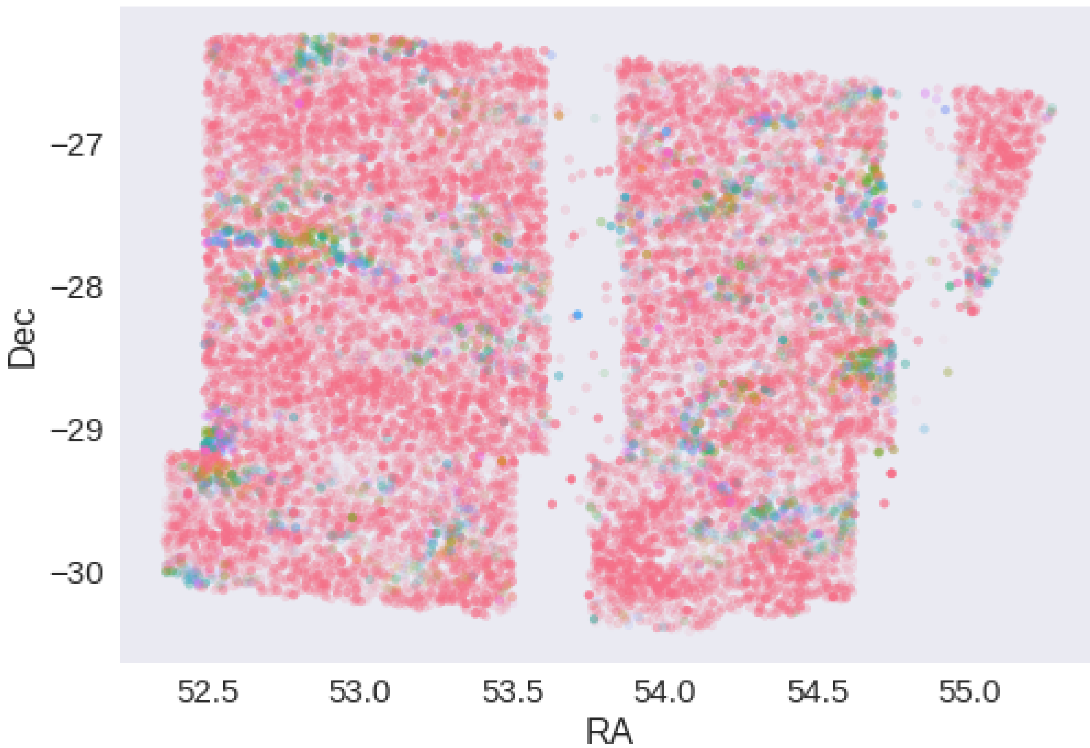
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.12950658218784383 arcsec
Dec correction: -0.046652433941574145 arcsec
```


pearsonr = 0.088; p = 7.1e-34
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.50
−0.25
0.00
0.25
0.50
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
19163 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.9_DES

January 18, 2018

1 CDFS SWIRE master catalogue

1.1 Preparation of DES data

Blanco DES catalogue: the catalogue comes from `dmu0_DES`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The G band stellarity;
- The magnitude for each band.
- The auto/kron magnitudes/fluxes to be used as total magnitude.
- The PSF fitted madnitudes/fluxes are used as aperture magnitudes.

We don't know when the maps have been observed. We will take the final observation date as 2017.

```
This notebook was run with herschelhelp_internal version:
33f5ec7 (Wed Dec 6 16:56:17 2017 +0000)
```

1.2 I - Column selection

```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
Out[6]: <IPython.core.display.HTML object>
```

1.3 II - Removal of duplicated sources

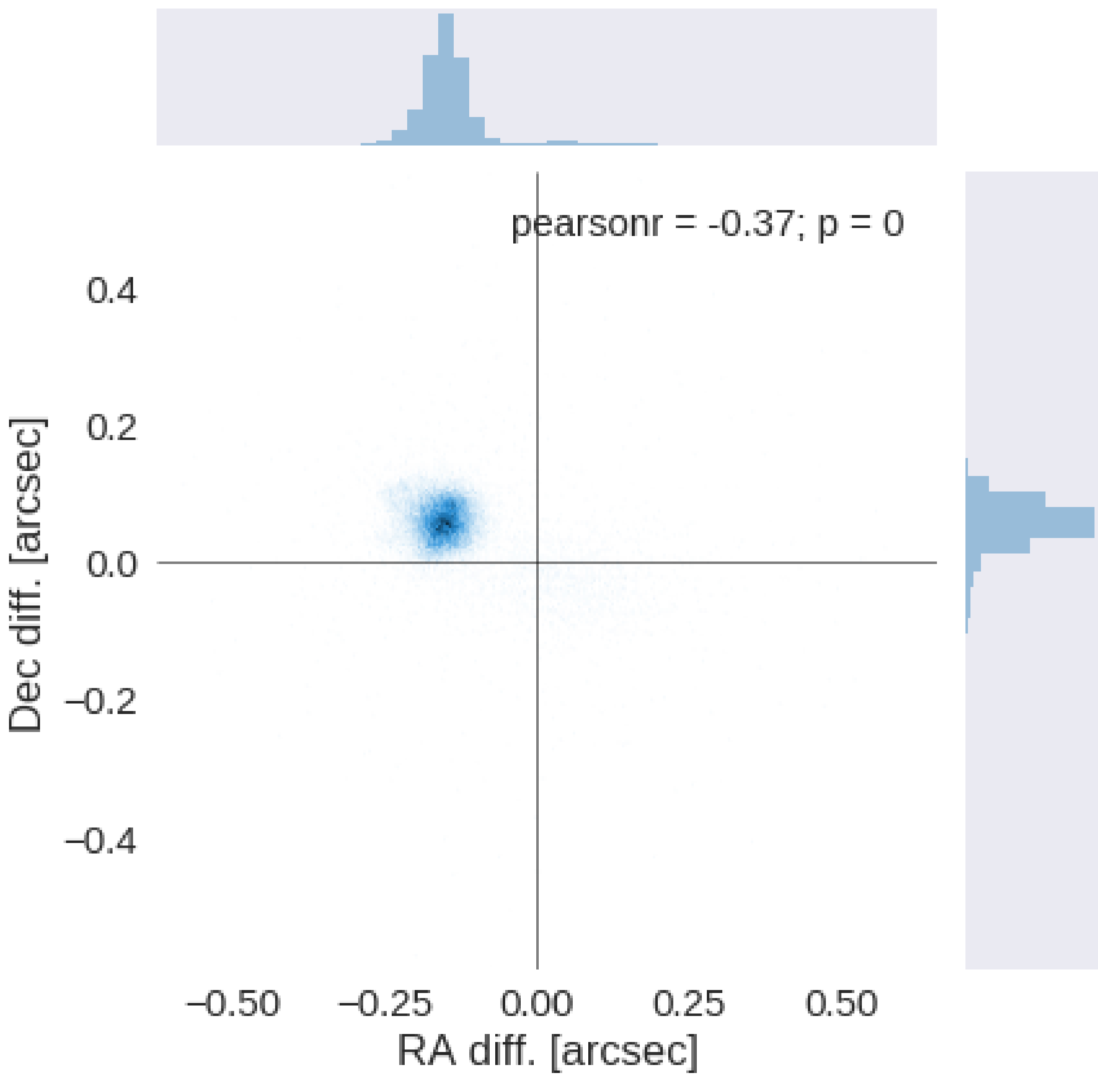
We remove duplicated objects from the input catalogues.

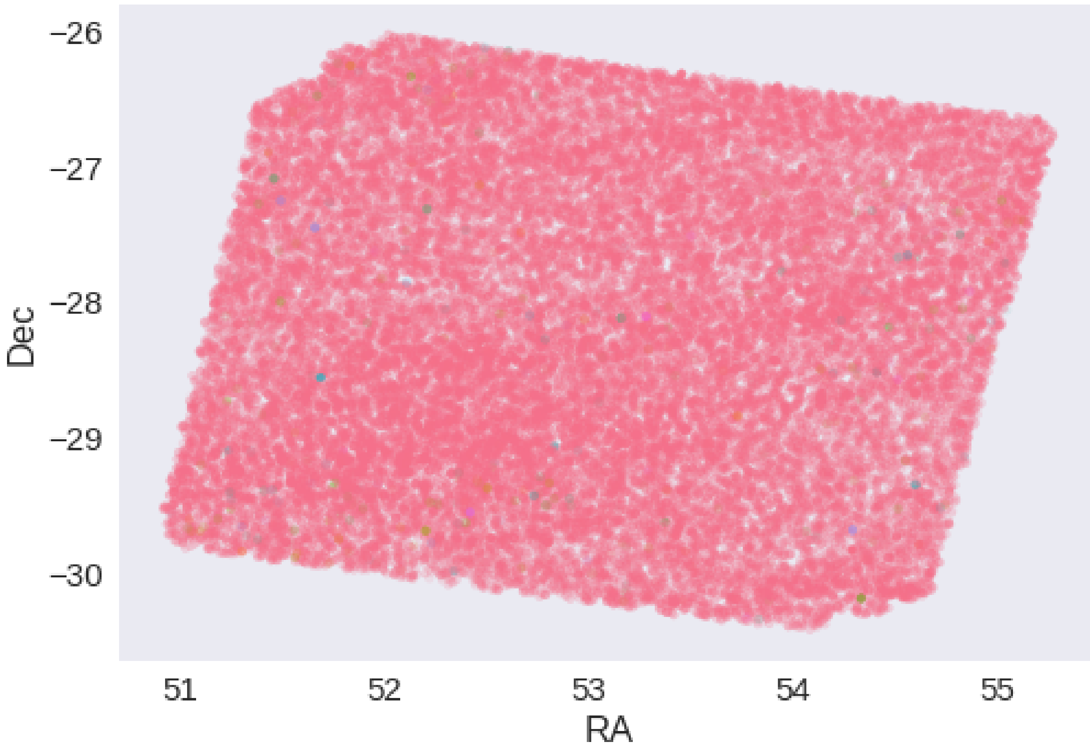
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 999553 sources.
The cleaned catalogue has 999544 sources (9 removed).
The cleaned catalogue has 9 sources flagged as having been cleaned
```

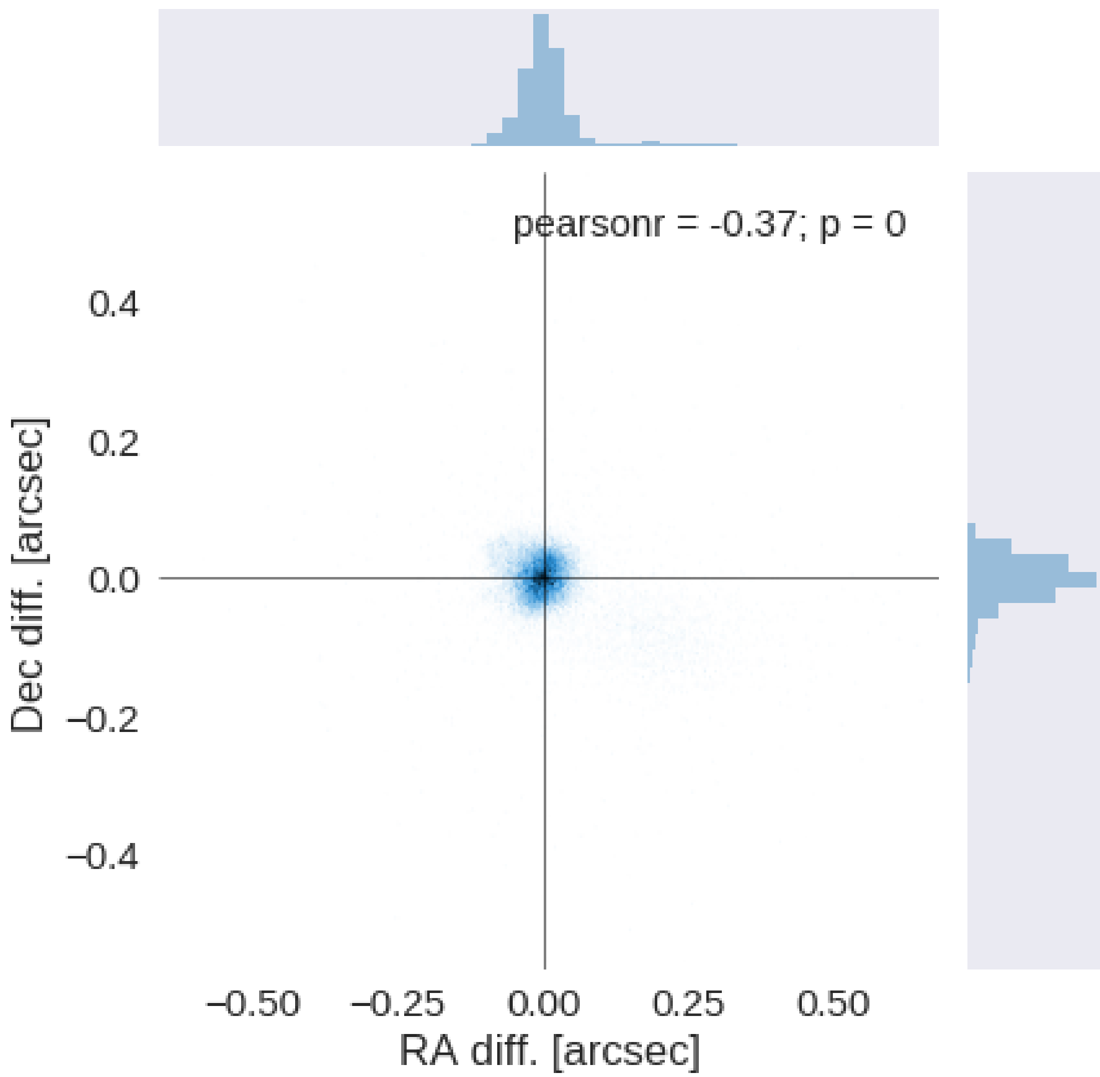
1.4 III - Astrometry correction

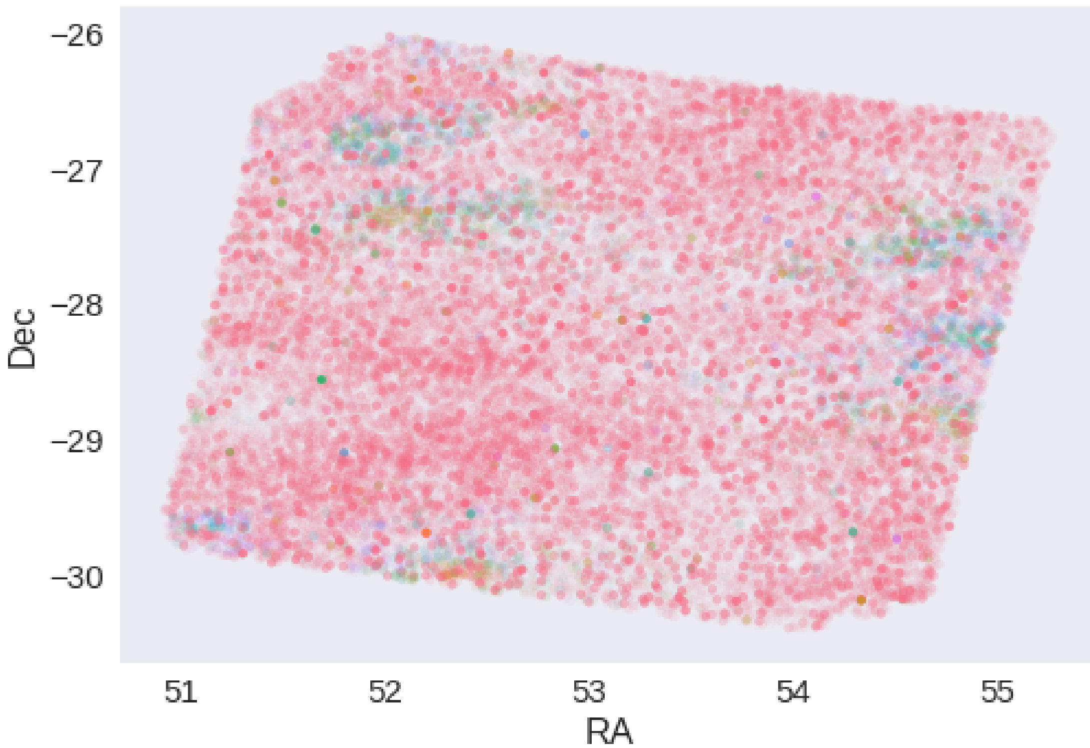
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.151487537777939 arcsec
Dec correction: -0.057696934679540846 arcsec
```


pearsonr = -0.37; p = 0
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.50
−0.25
0.00
0.25
0.50
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
35223 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.10_CANDELS-GOODS-S

January 18, 2018

1 CDFS-SWIRE master catalogue

1.1 Preparation of CANDELS-GOODS-S data

CANDELS-GOODS-N catalogue: the catalogue comes from `dmu0_CANDELS-GOODS-S`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The total magnitude.

We don't know when the maps have been observed. We will use the year of the reference paper.

```
This notebook was run with herschelhelp_internal version:
33f5ec7 (Wed Dec 6 16:56:17 2017 +0000)
```

1.2 I - Column selection

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:76: RuntimeWarning: invalid value enco
  magnitudes = 2.5 * (23 - np.log10(fluxes)) - 48.6
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:76: RuntimeWarning: divide by zero enc
  magnitudes = 2.5 * (23 - np.log10(fluxes)) - 48.6
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:80: RuntimeWarning: divide by zero enc
  errors = 2.5 / np.log(10) * errors_on_fluxes / fluxes
```

```
Out[6]: <IPython.core.display.HTML object>
```

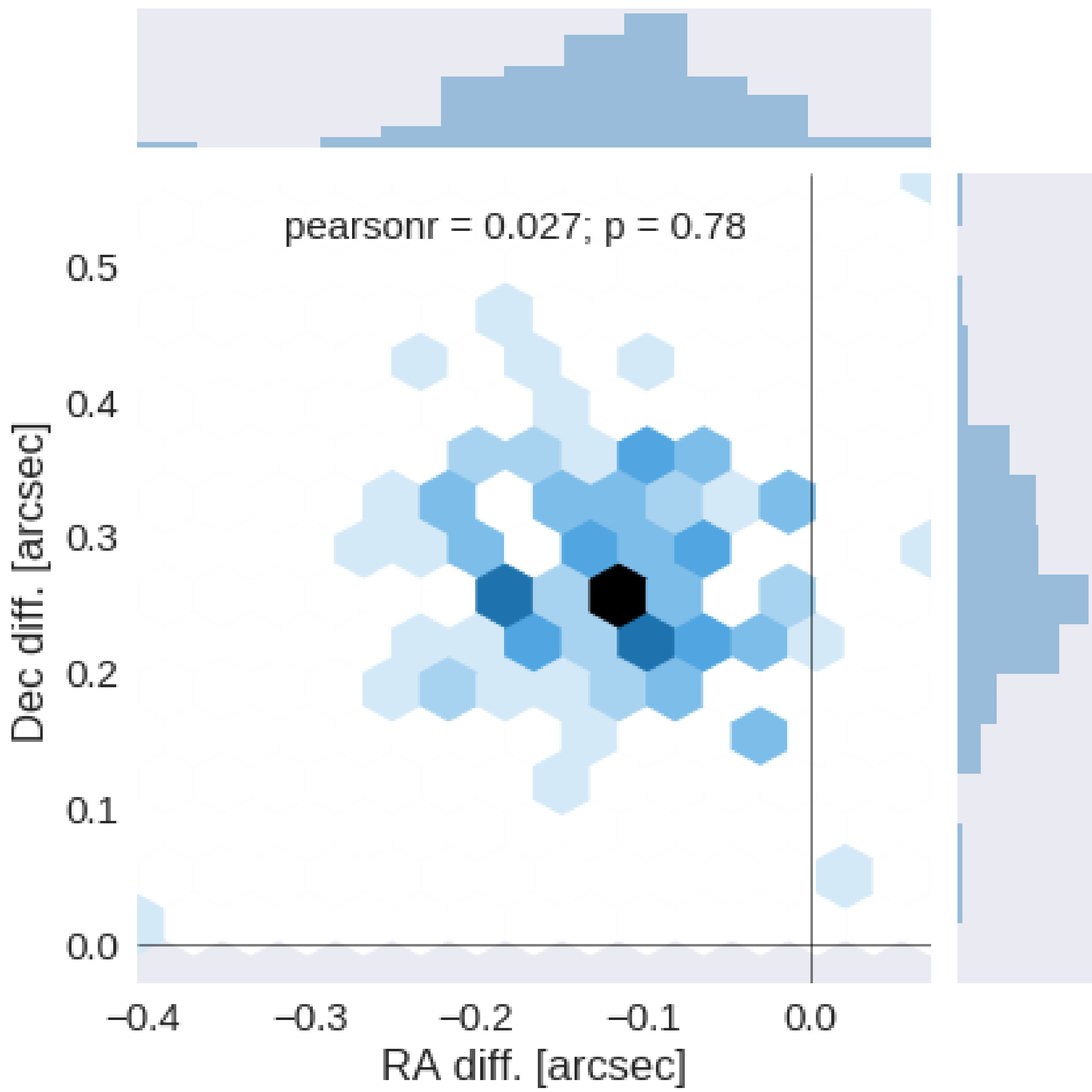
1.3 II - Removal of duplicated sources

We remove duplicated objects from the input catalogues.

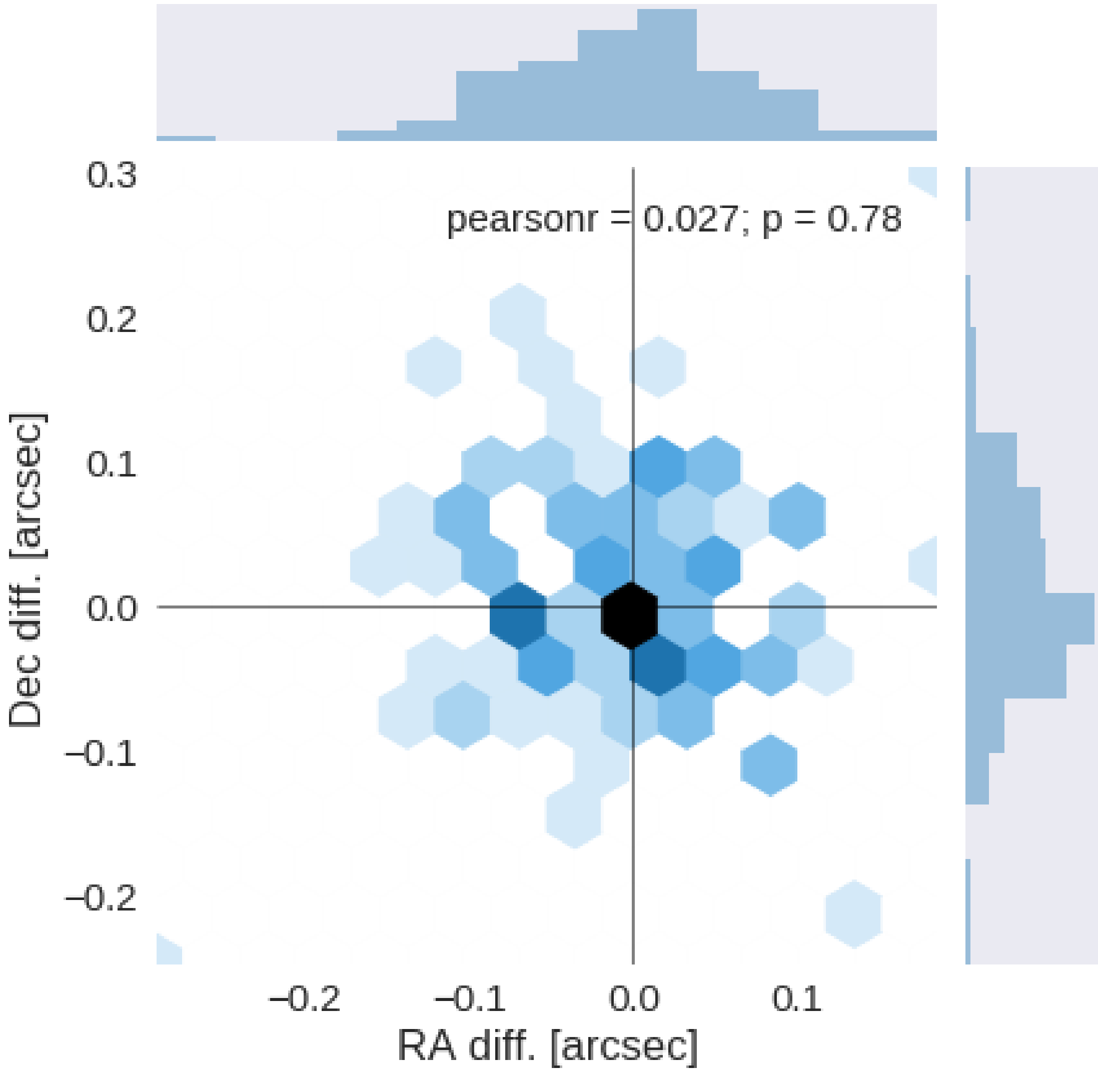
```
The initial catalogue had 34930 sources.
The cleaned catalogue has 34926 sources (4 removed).
The cleaned catalogue has 4 sources flagged as having been cleaned
```

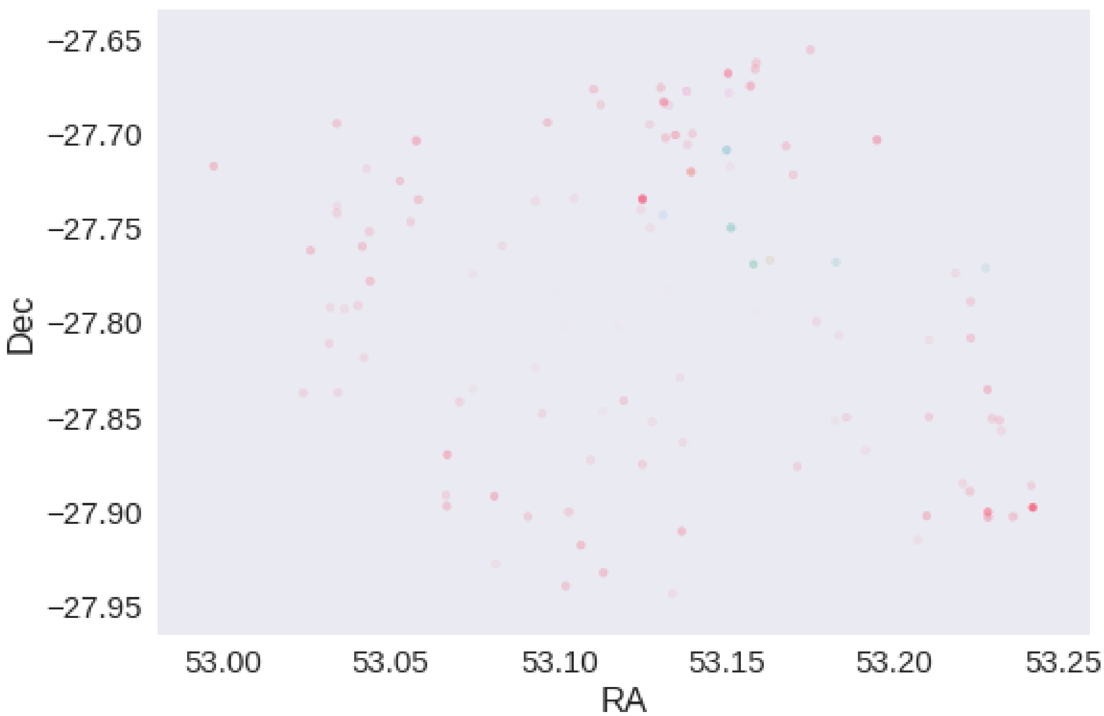
1.4 III - Astrometry correction

We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.




```
RA correction: 0.11352528611894286 arcsec
Dec correction: -0.2639050027212875 arcsec
```


pearsonr = 0.027; p = 0.78
0.3
0.2
0.1
0.0
−0.1
−0.2
Dec diff. [arcsec]
−0.2
−0.1
0.0
0.1
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
123 sources flagged.
```

2 V - Saving to disk

2_Merging

January 18, 2018

1 CDFS SWIRE master catalogue

This notebook presents the merge of the various pristine catalogues to produce HELP master catalogue on CDFS SWIRE.

```
This notebook was run with herschelhelp_internal version:
33f5ec7 (Wed Dec 6 16:56:17 2017 +0000)
```

1.1 I - Reading the prepared pristine catalogues

1.2 II - Merging tables

We first merge the optical catalogues and then add the infrared ones: PS1, COMBO, ATLAS, VIDEO, VHS, SERVS, SWIRE. Fireworks is no longer included.

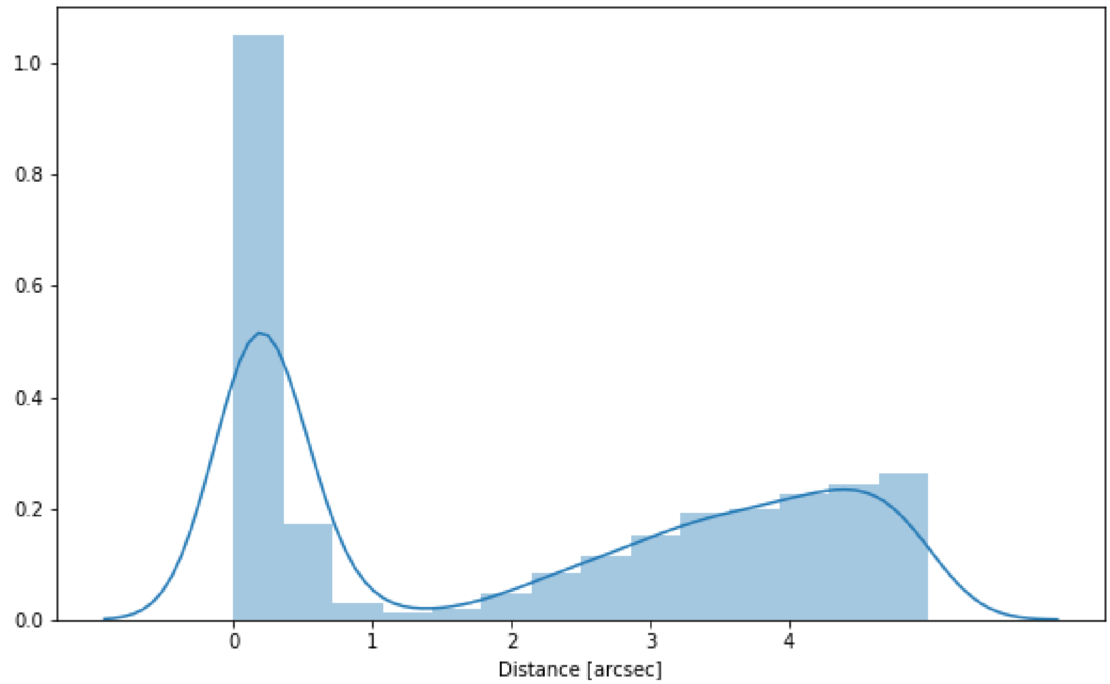
At every step, we look at the distribution of the distances to the nearest source in the merged catalogue to determine the best crossmatching radius.

1.2.1 PanSTARRS

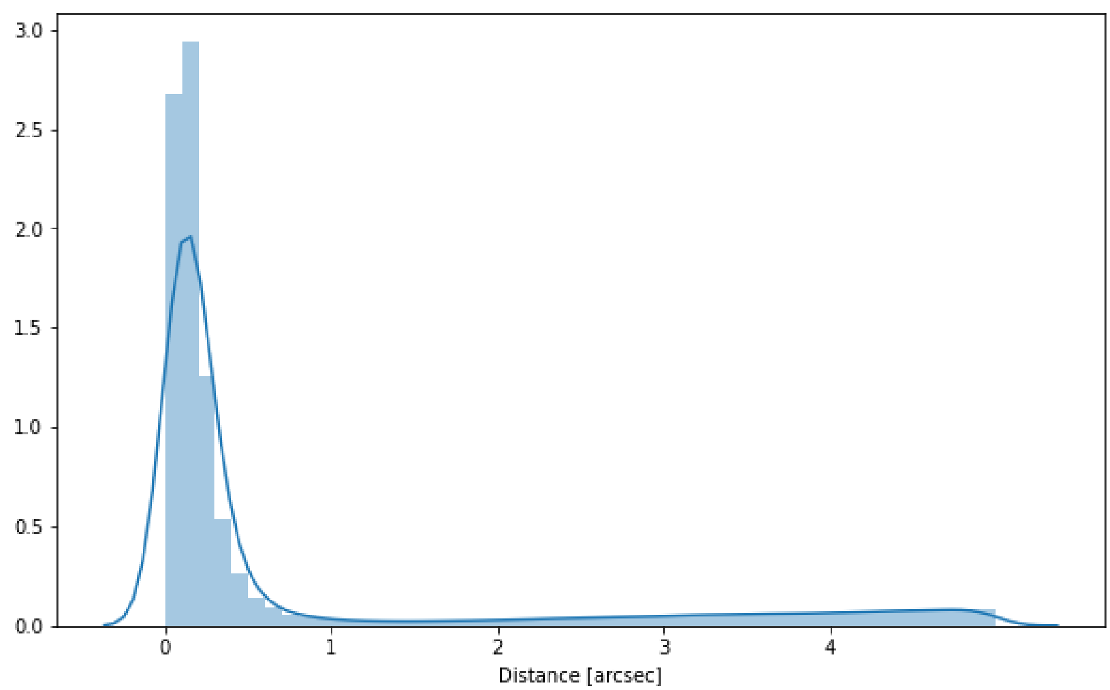
1.2.2 Add Fireworks

We are no longer including Fireworks under Mattia's advice. I leave the code in the notebook commented out in case the user wishes to include it.

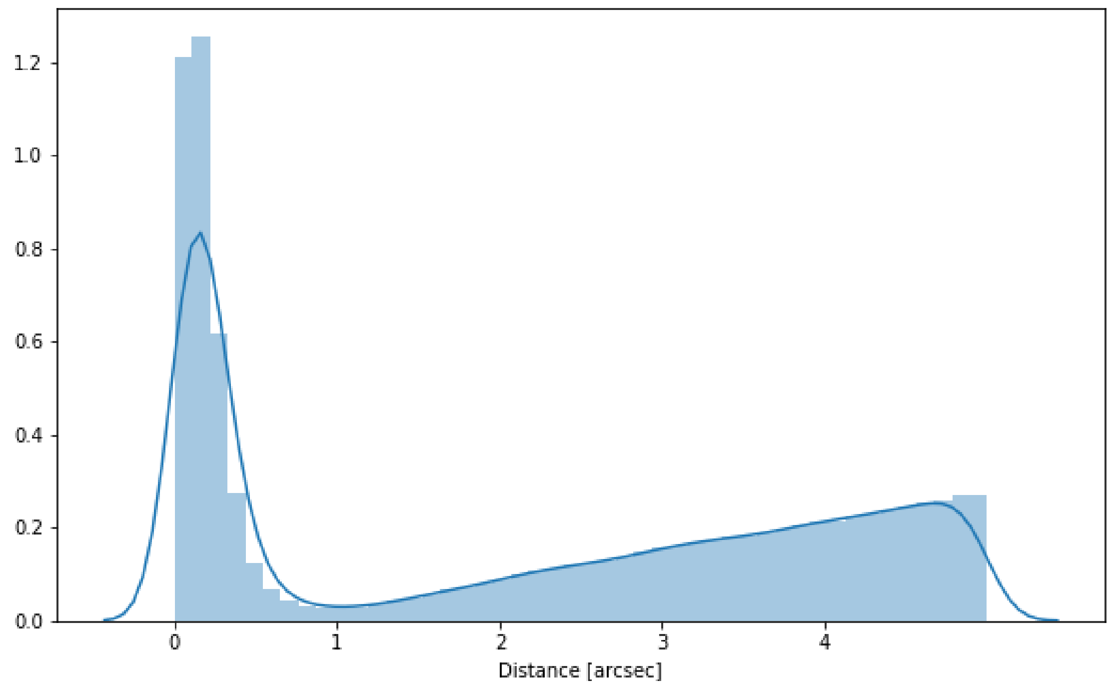
1.2.3 Add COMBO



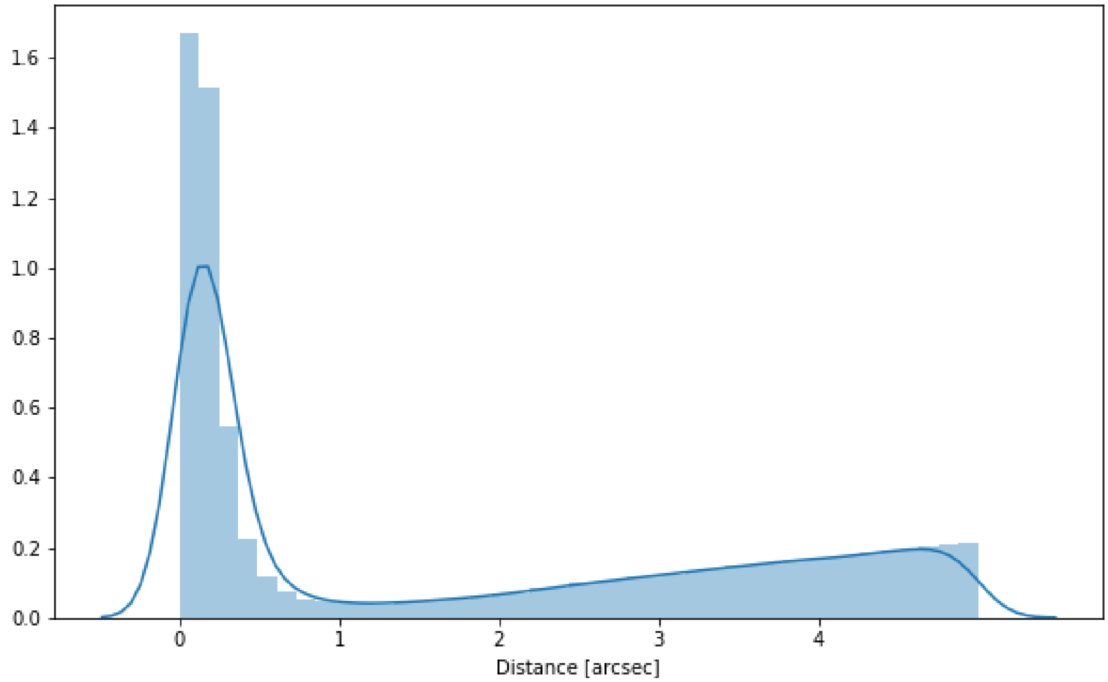
1.2.4 Add ATLAS



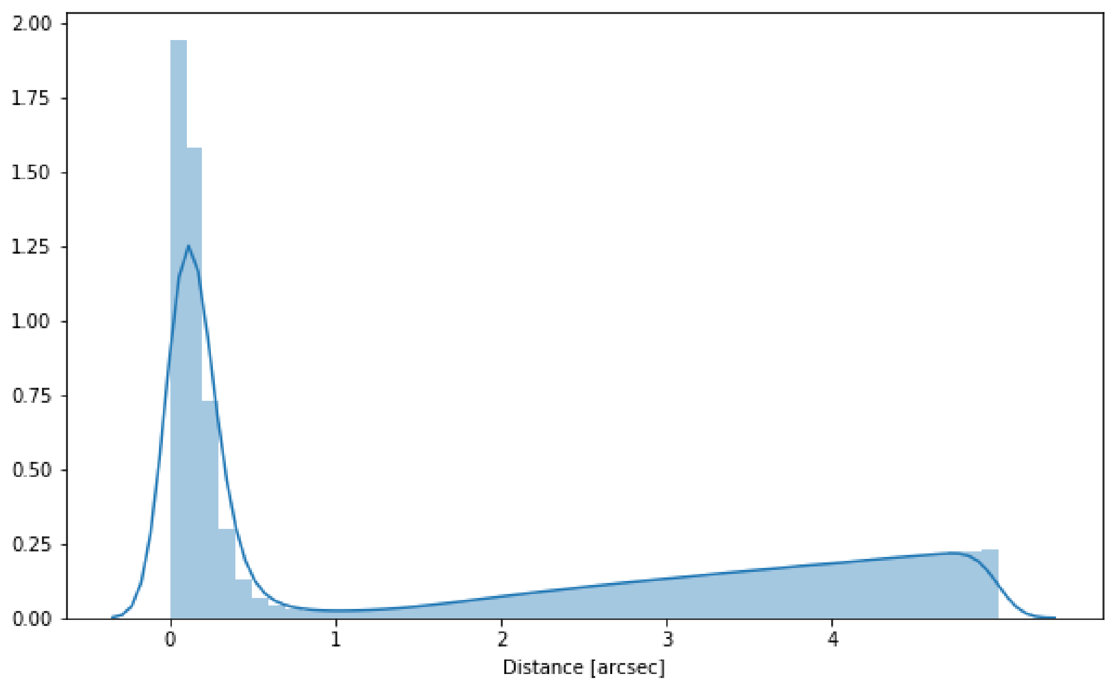
1.2.5 Add VIDEO



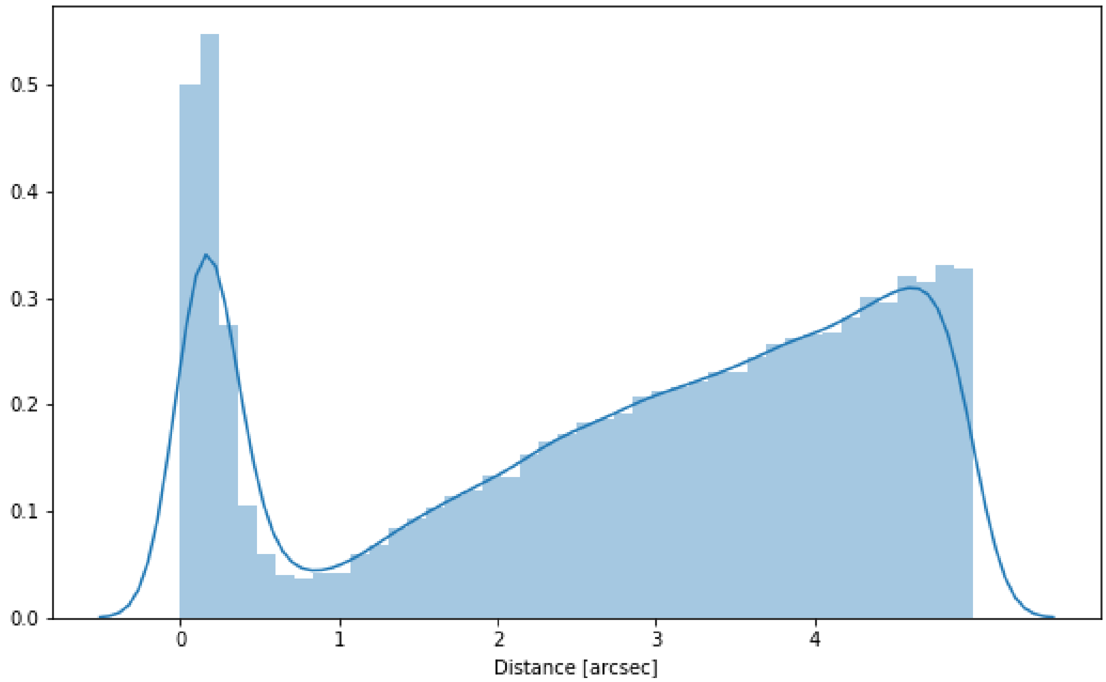
1.2.6 Add VHS



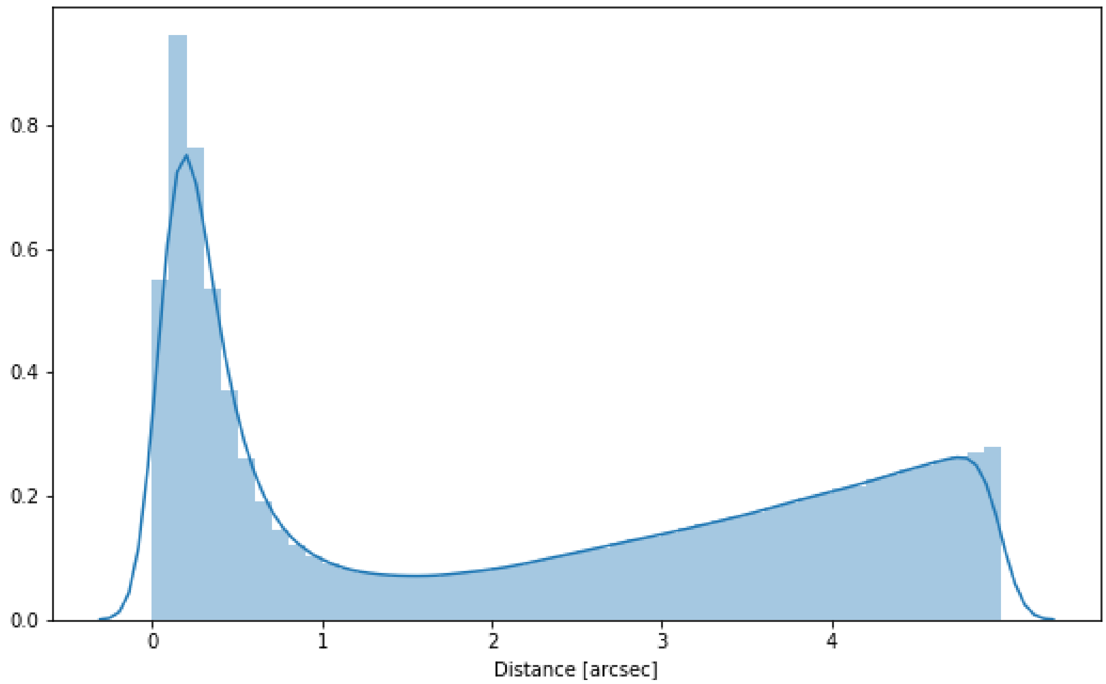
1.2.7 Add DES



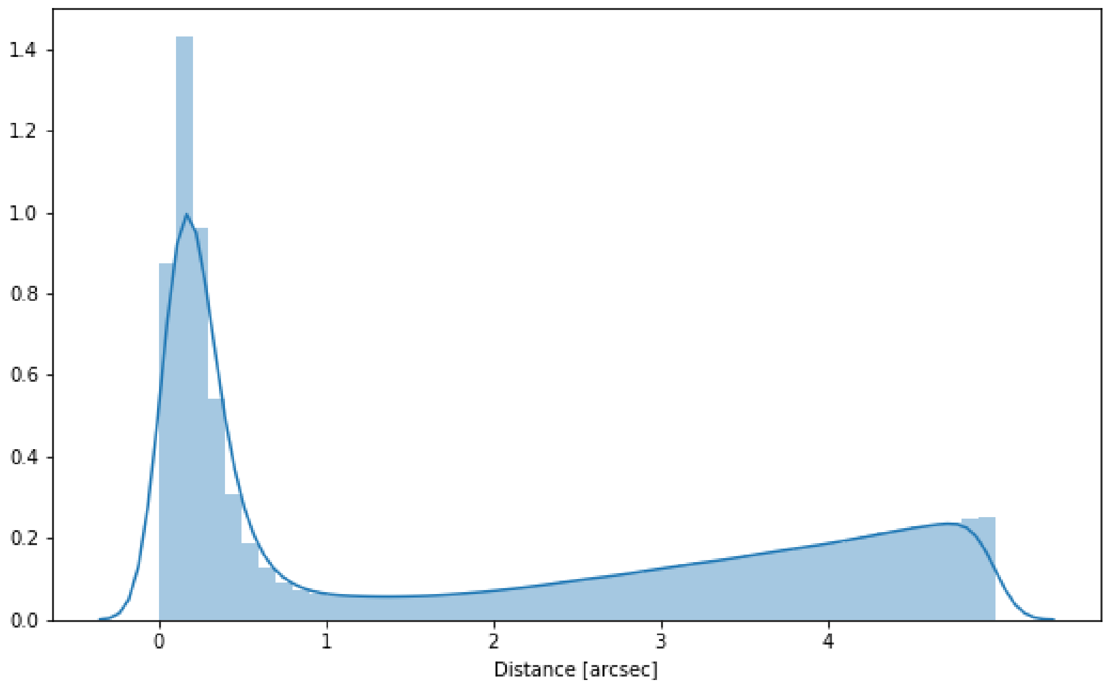
1.2.8 Add CANDELS



1.2.9 Add SERVS



1.2.10 Add SWIRE



1.2.11 Cleaning

When we merge the catalogues, astropy masks the non-existent values (e.g. when a row comes only from a catalogue and has no counterparts in the other, the columns from the latest are masked for that row). We indicate to use NaN for masked values for floats columns, False for flag columns and -1 for ID columns.

```
Out[25]: <IPython.core.display.HTML object>
```

1.3 III - Merging flags and stellarity

Each pristine catalogue contains a flag indicating if the source was associated to a another nearby source that was removed during the cleaning process. We merge these flags in a single one.

Each pristine catalogue contains a flag indicating the probability of a source being a Gaia object (0: not a Gaia object, 1: possibly, 2: probably, 3: definitely). We merge these flags taking the highest value.

Each prisitine catalogue may contain one or several stellarity columns indicating the probability (0 to 1) of each source being a star. We merge these columns taking the highest value.

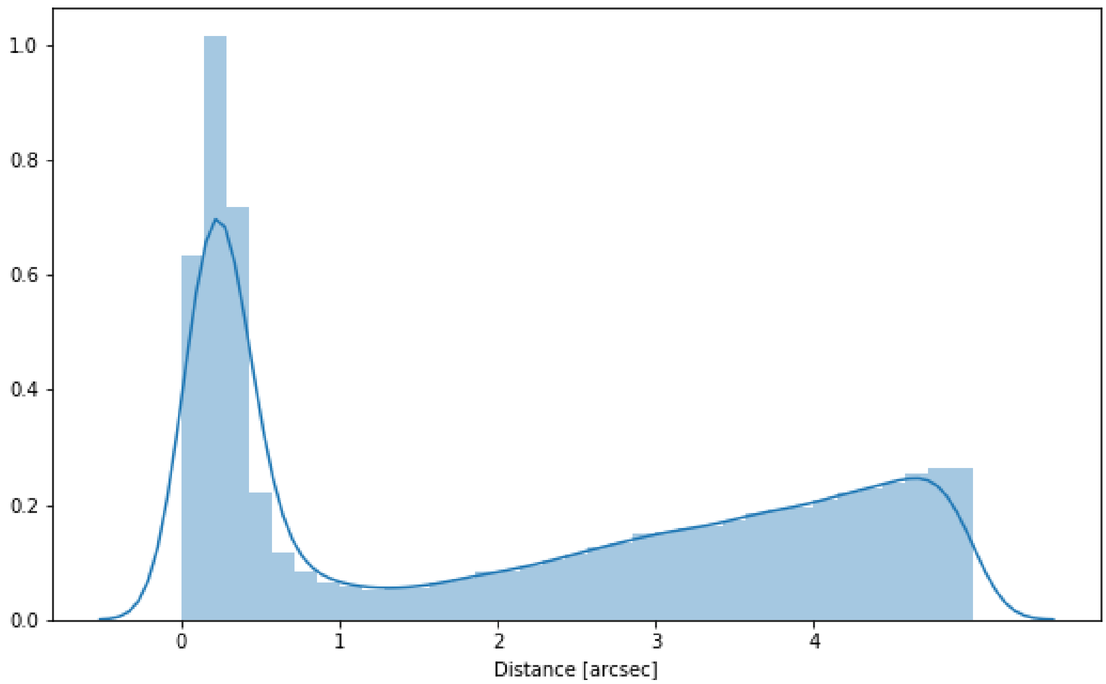
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/numpy/lib/nanfunctions.py:
  warnings.warn("All-NaN slice encountered", RuntimeWarning)
```

1.4 IV - Adding E(B-V) column

1.5 V - Adding HELP unique identifiers and field columns

```
OK!
```

2 VI - Cross-matching with the spec-z catalogue

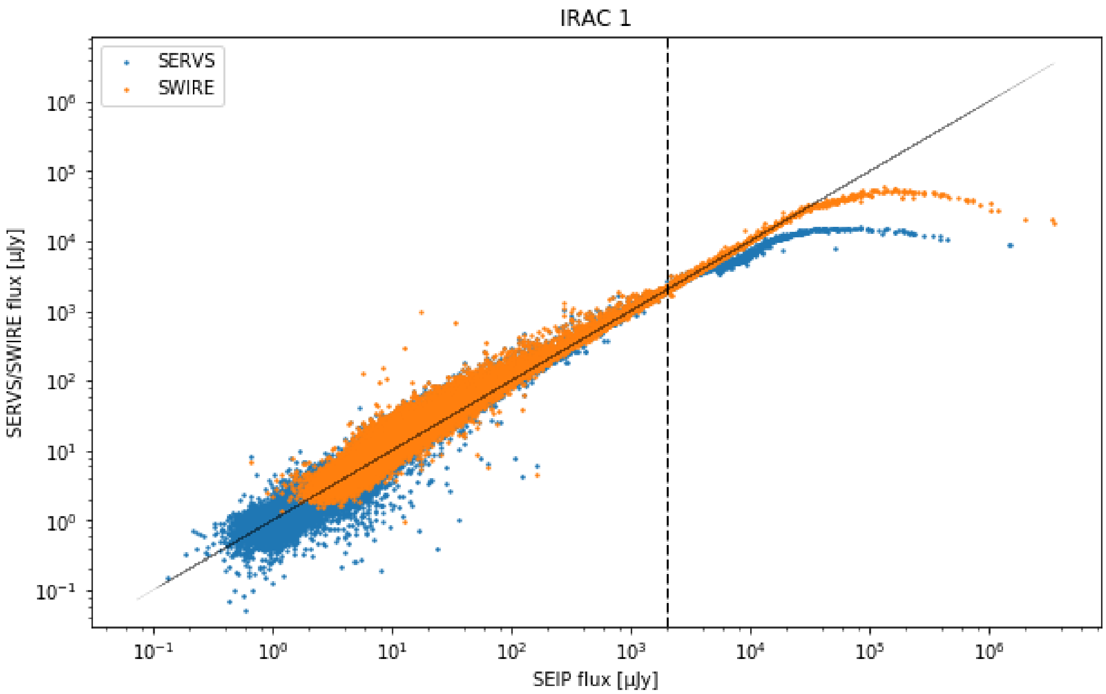


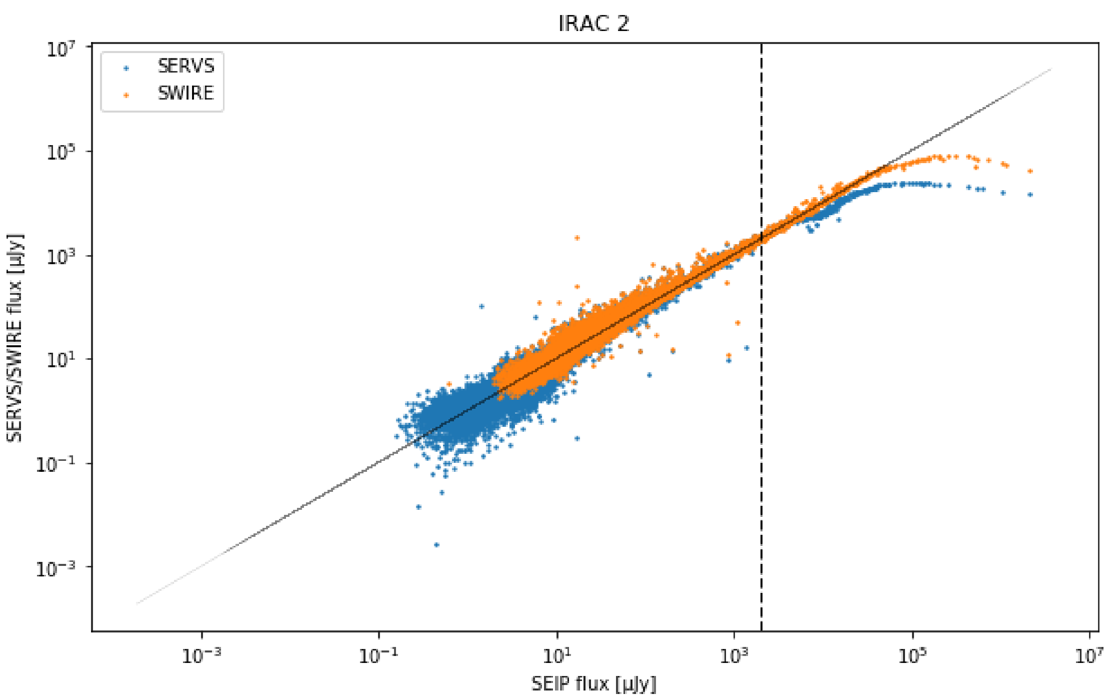
2.1 VII - Choosing between multiple values for the same filter

2.1.1 VII.a SERVS vs SWIRE

Both SERVS and SWIRE provide IRAC1 and IRAC2 fluxes. SERVS is deeper but tends to underestimate flux of bright sources (Mattia said over 2000 ţJy) as illustrated by this comparison of SWIRE, SERVS, and Spitzer-EIP fluxes.

```
WARNING: UnitsWarning: 'e/count' did not parse as fits unit: At col 0, Unit 'e' not supported by
WARNING: UnitsWarning: 'image' did not parse as fits unit: At col 0, Unit 'image' not supported
```





When both SWIRE and SERVS fluxes are provided, we use the SERVS flux below 2000 Jy and the SWIRE flux over.

We create a table indicating for each source the origin on the IRAC1 and IRAC2 fluxes that will be saved separately.

```
620841 sources with SERVS flux
433129 sources with SWIRE flux
246953 sources with SERVS and SWIRE flux
619865 sources for which we use SERVS
187152 sources for which we use SWIRE


620841 sources with SERVS flux
433097 sources with SWIRE flux
246953 sources with SERVS and SWIRE flux
619825 sources for which we use SERVS
187160 sources for which we use SWIRE


634320 sources with SERVS flux
318895 sources with SWIRE flux
186379 sources with SERVS and SWIRE flux
633672 sources for which we use SERVS
133164 sources for which we use SWIRE


634320 sources with SERVS flux
318886 sources with SWIRE flux
186379 sources with SERVS and SWIRE flux
633650 sources for which we use SERVS
133177 sources for which we use SWIRE
```

2.2 VII.b VIDEO vs VHS

VIDEO is deeper than VHS so we take VIDEO flux for any source that has both.

```
For VISTA band y:
1063464 sources with VIDEO flux
14179 sources with VHS flux
10792 sources with VIDEO and VHS flux
1063464 sources for which we use VIDEO
3387 sources for which we use VHS
1061411 sources with VIDEO aperture flux
14179 sources with VHS aperture flux
10791 sources with VIDEO and VHS aperture flux
1061411 sources for which we use VIDEO aperture fluxes
3388 sources for which we use VHS aperture fluxes
For VISTA band j:
1061794 sources with VIDEO flux
105677 sources with VHS flux
```

```
31304 sources with VIDEO and VHS flux
1061794 sources for which we use VIDEO
74373 sources for which we use VHS
1058115 sources with VIDEO aperture flux
105674 sources with VHS aperture flux
31305 sources with VIDEO and VHS aperture flux
1058115 sources for which we use VIDEO aperture fluxes
74369 sources for which we use VHS aperture fluxes
For VISTA band h:
1051715 sources with VIDEO flux
82037 sources with VHS flux
25260 sources with VIDEO and VHS flux
1051715 sources for which we use VIDEO
56777 sources for which we use VHS
1039701 sources with VIDEO aperture flux
82025 sources with VHS aperture flux
25256 sources with VIDEO and VHS aperture flux
1039701 sources for which we use VIDEO aperture fluxes
56769 sources for which we use VHS aperture fluxes
For VISTA band k:
1040547 sources with VIDEO flux
73765 sources with VHS flux
24516 sources with VIDEO and VHS flux
1040547 sources for which we use VIDEO
49249 sources for which we use VHS
1024472 sources with VIDEO aperture flux
73760 sources with VHS aperture flux
24518 sources with VIDEO and VHS aperture flux
1024472 sources for which we use VIDEO aperture fluxes
49242 sources for which we use VHS aperture fluxes
```

2.3 VIII.a Wavelength domain coverage

We add a binary `flag_optnir_obs` indicating that a source was observed in a given wavelength domain:

- 1 for observation in optical;
- 2 for observation in near-infrared;
- 4 for observation in mid-infrared (IRAC).

It's an integer binary flag, so a source observed both in optical and near-infrared by not in mid-infrared would have this flag at 1 + 2 = 3.

Note 1: The observation flag is based on the creation of multi-order coverage maps from the catalogues, this may not be accurate, especially on the edges of the coverage.

Note 2: Being on the observation coverage does not mean having fluxes in that wavelength domain. For sources observed in one domain but having no flux in it, one must take into consideration de different depths in the catalogue we are using.

2.4 VIII.b Wavelength domain detection

We add a binary `flag_optnir_det` indicating that a source was detected in a given wavelength domain:

- 1 for detection in optical;
- 2 for detection in near-infrared;
- 4 for detection in mid-infrared (IRAC).

It's an integer binary flag, so a source detected both in optical and near-infrared by not in mid-infrared would have this flag at 1 + 2 = 3.

Note 1: We use the total flux columns to know if the source has flux, in some catalogues, we may have aperture flux and no total flux.

To get rid of artefacts (chip edges, star flares, etc.) we consider that a source is detected in one wavelength domain when it has a flux value in **at least two bands**. That means that good sources will be excluded from this flag when they are on the coverage of only one band.

2.5 IX - Cross-identification table

We are producing a table associating to each HELP identifier, the identifiers of the sources in the pristine catalogues. This can be used to easily get additional information from them.

2.6 X - Adding HEALPix index

We are adding a column with a HEALPix index at order 13 associated with each source.

2.7 XI - Renaming columns

We rename some columns to follow the intrument_filter standard.

2.8 XII - Saving the catalogue

```
Missing columns: {'flag_ap_servs_irac_i1', 'merr_acs_f435w', 'f_acs_f606w', 'ferr_candels-irac_i
```

3_Checks_and_diagnostics

January 18, 2018

1 CDFS SWIRE master catalogue

1.1 Checks and diagnostics

```
This notebook was run with herschelhelp_internal version:
33f5ec7 (Wed Dec 6 16:56:17 2017 +0000)
```

```
Using masterlist ./data/master_catalogue_cdfs-swire_20180117.fits
```

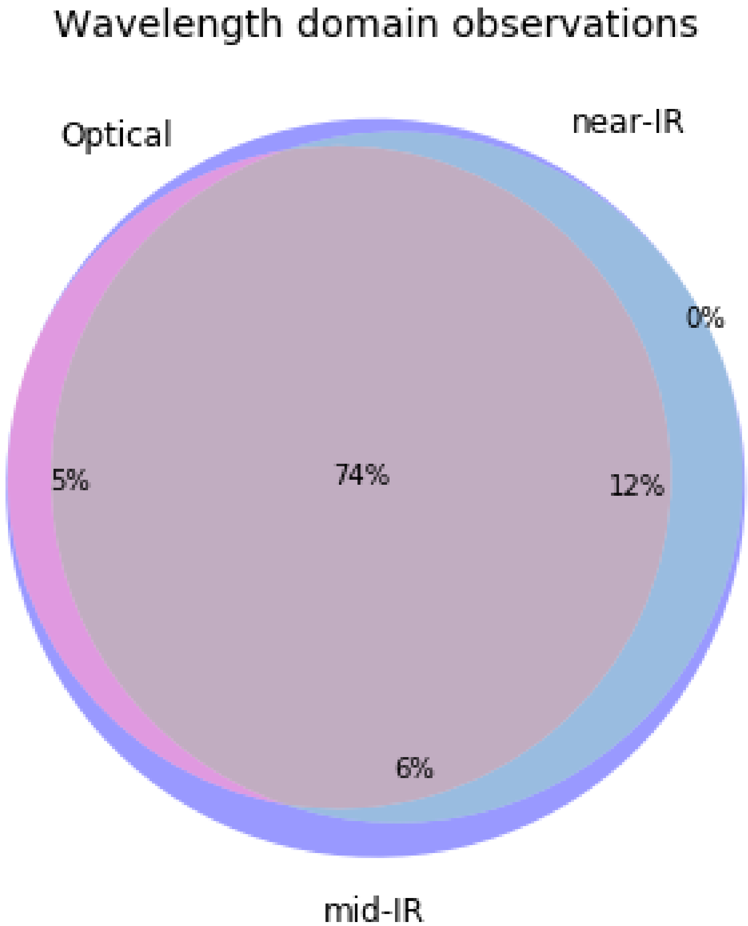
1.2 0 - Quick checks

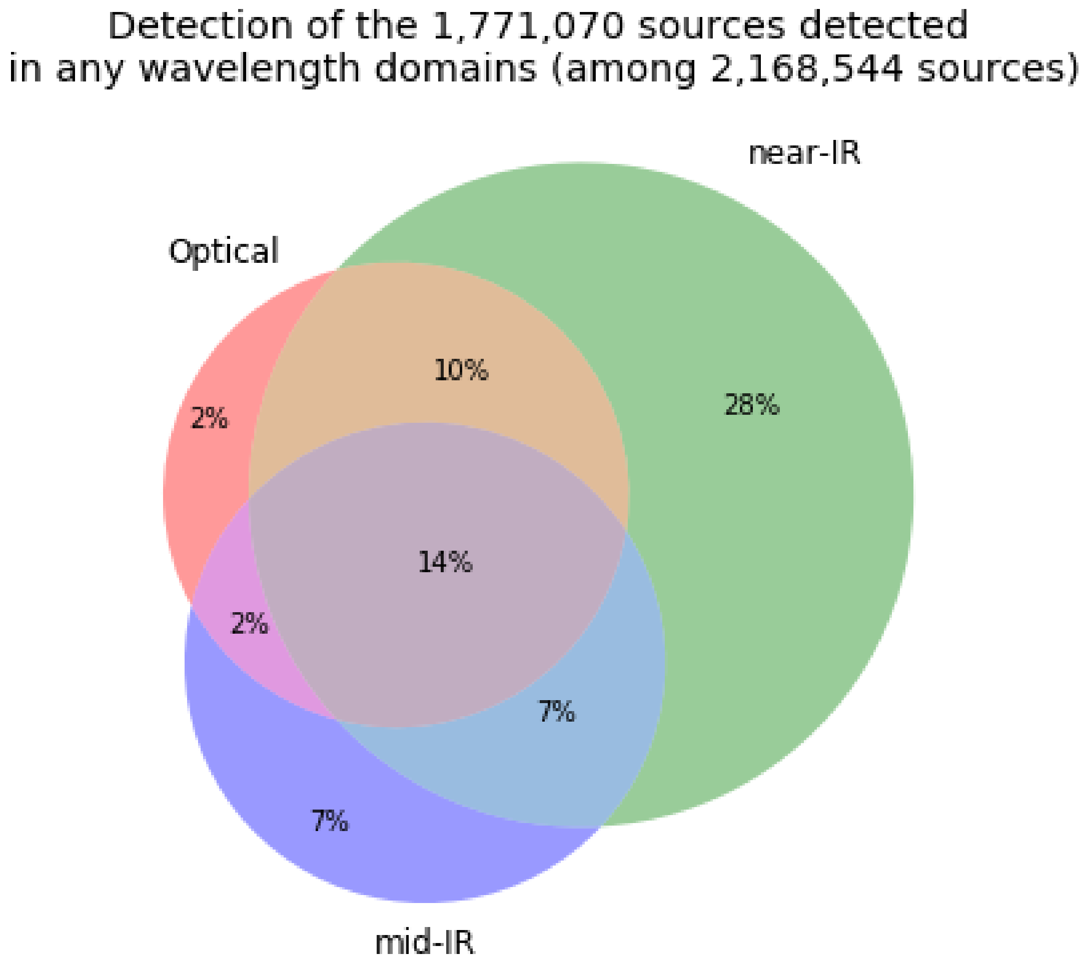
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/numpy/core/numeric.py:301:
  format(shape, fill_value, array(fill_value).dtype), FutureWarning)
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/numpy/core/numeric.py:301:
  format(shape, fill_value, array(fill_value).dtype), FutureWarning)
```

```
Table shows only problematic columns.
```

```
Out[4]: <IPython.core.display.HTML object>
```

1.3 I - Summary of wavelength domains





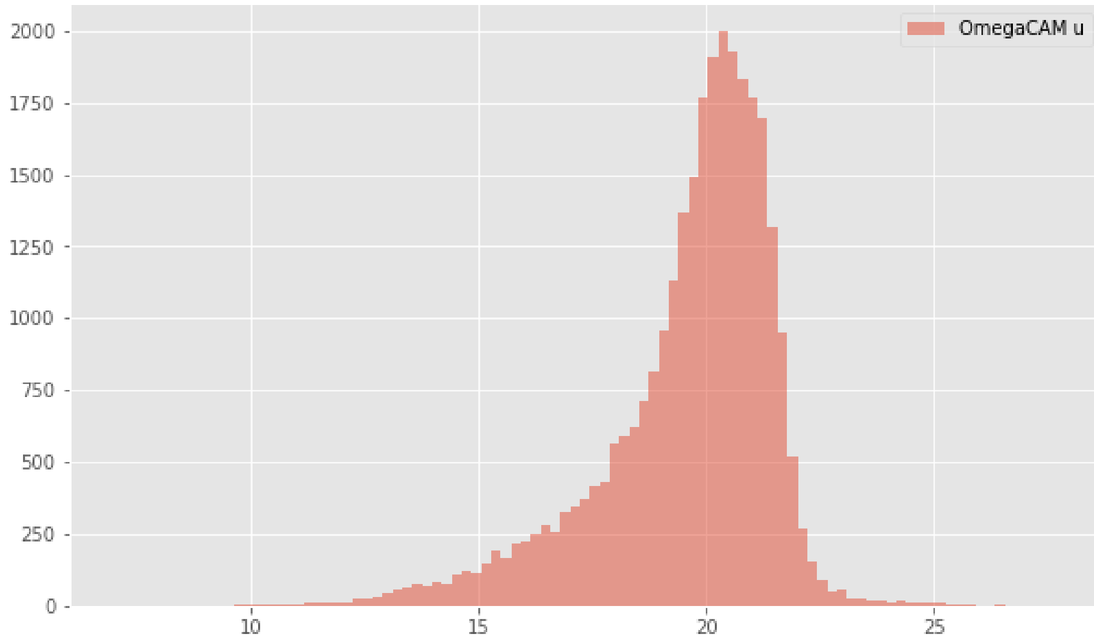
1.4 II - Comparing magnitudes in similar filters

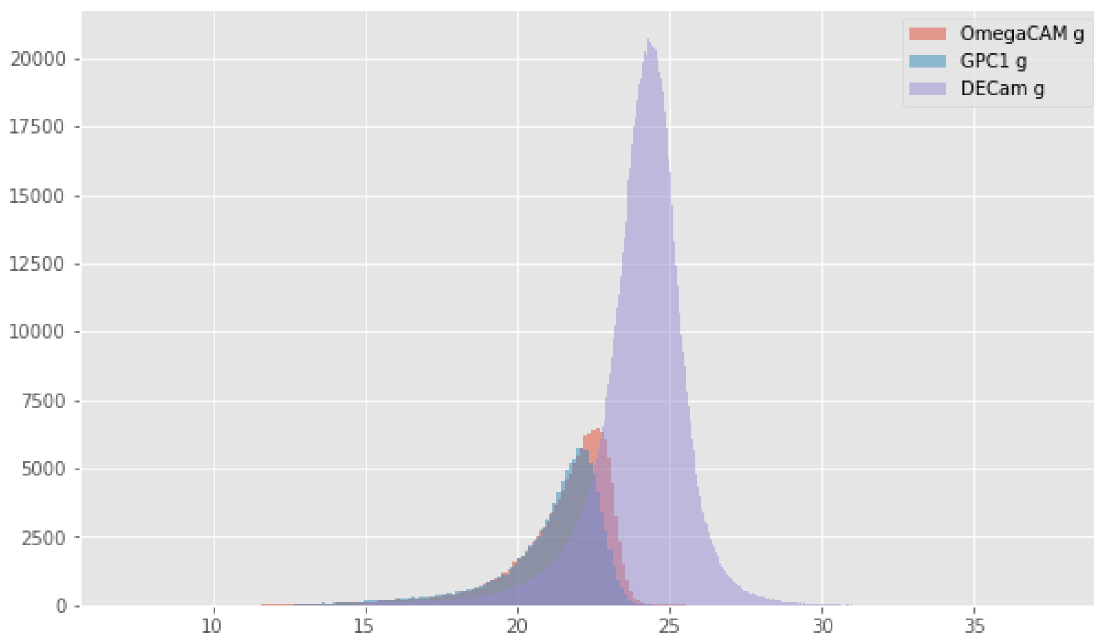
The master list if composed of several catalogues containing magnitudes in similar filters on different instruments. We are comparing the magnitudes in these corresponding filters.

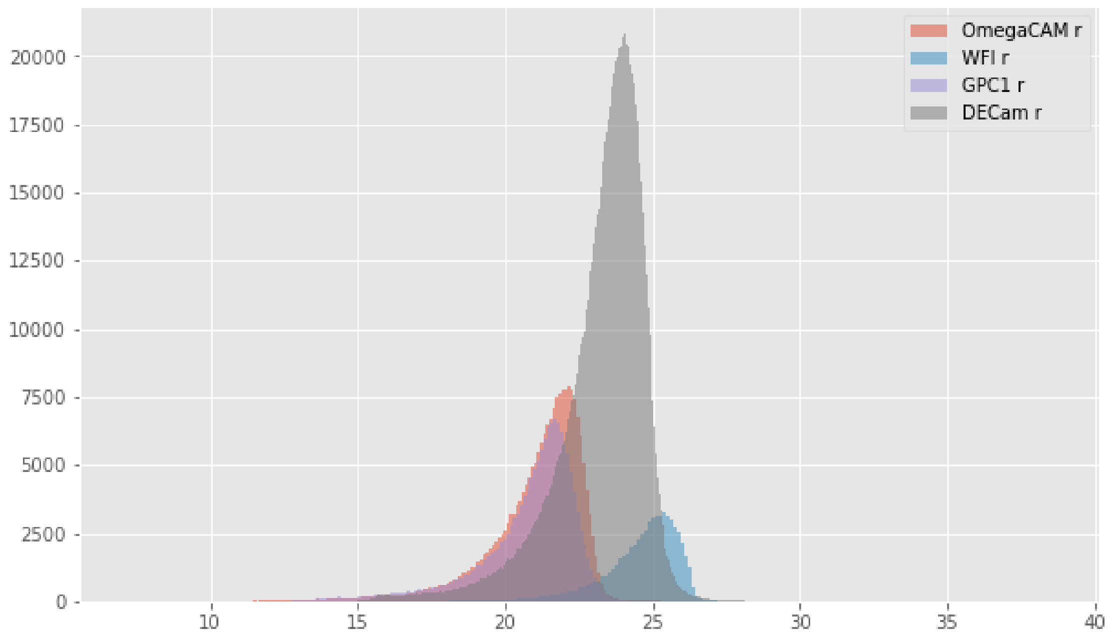
1.4.1 II.a - Comparing depths

We compare the histograms of the total aperture magnitudes of similar bands.

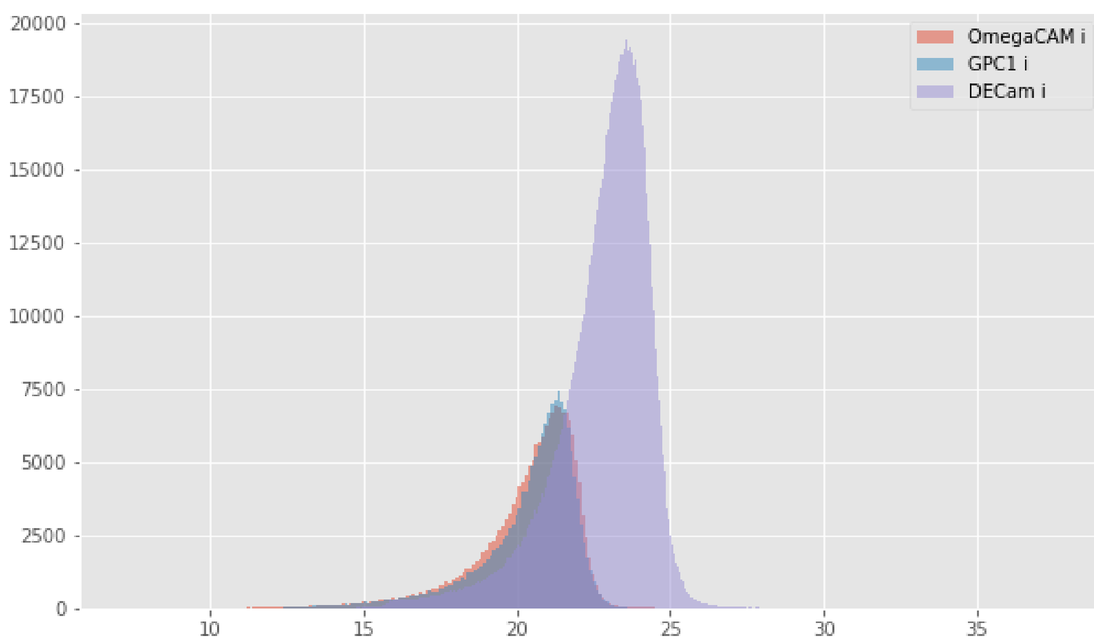
```
HELP warning: the column m_wfi_u (WFI u) is empty.
```

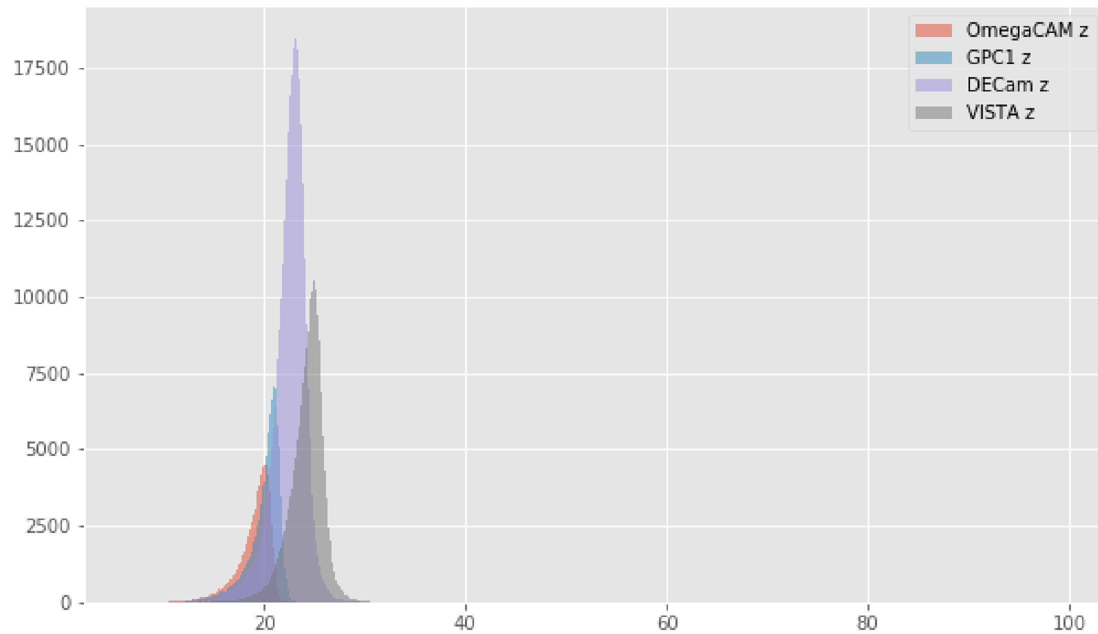

OmegaCAM u
2000
1750
1500
1250
1000
750
500
250
0
10
15
20
25

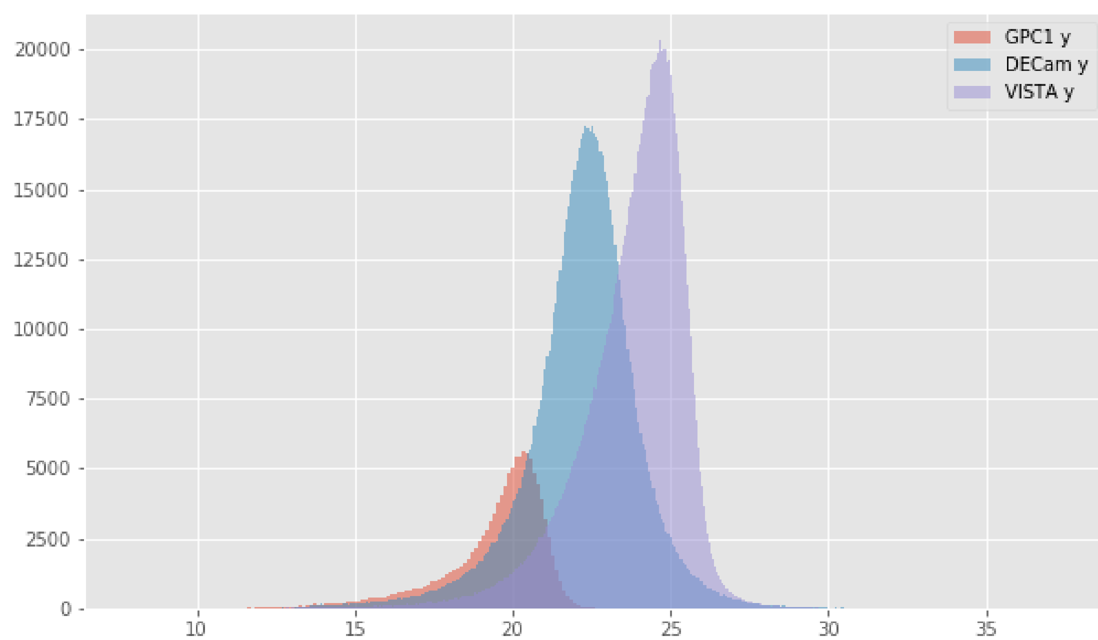

OmegaCAM g
GPC1 g
DECam g
20000
17500
15000
12500
10000
7500
5000
2500
0
10
15
20
25
30
35




```
HELP warning: the column m_wfi_i (WFI i) is empty.
```



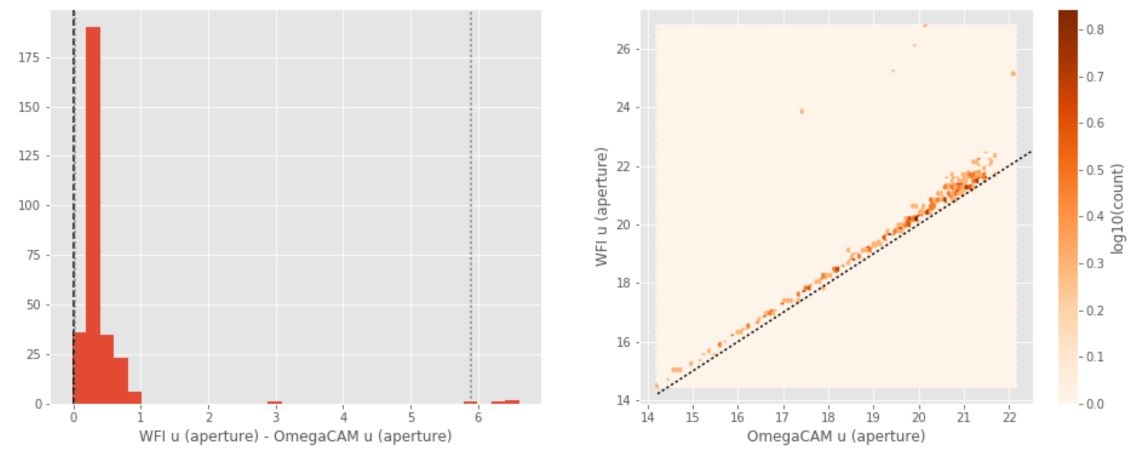




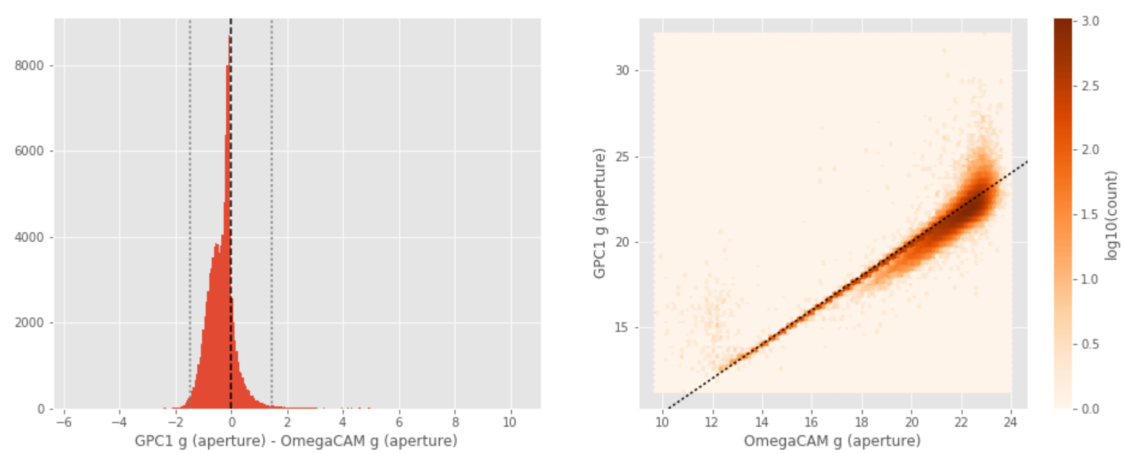
1.4.2 II.b - Comparing magnitudes

We compare one to one each magnitude in similar bands.

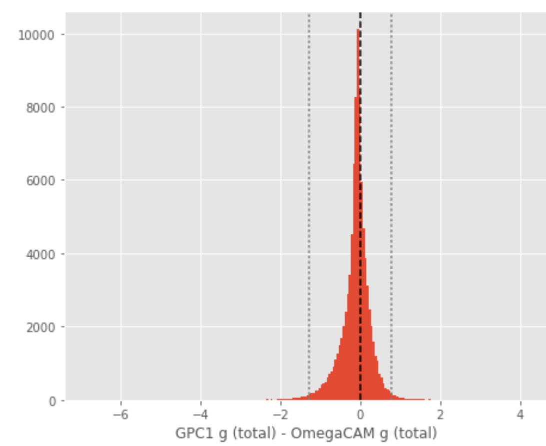
```
WFI u (aperture) - OmegaCAM u (aperture):
- Median: 0.30
- Median Absolute Deviation: 0.07
- 1% percentile: 0.026031494140625
- 99% percentile: 5.898116226196289
```

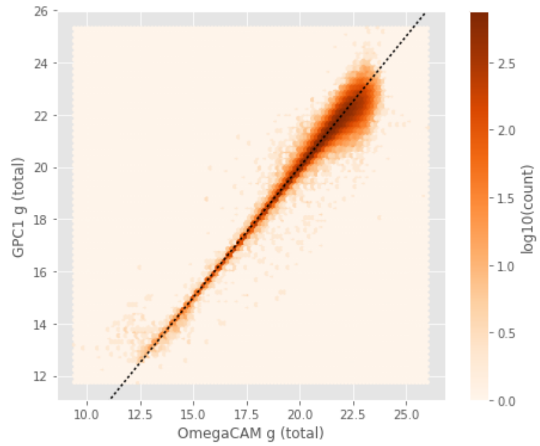



```
No sources have both OmegaCAM u (total) and WFI u (total) values.
GPC1 g (aperture) - OmegaCAM g (aperture):
- Median: -0.30
- Median Absolute Deviation: 0.27
- 1% percentile: -1.477933654785156
- 99% percentile: 1.4628313636779788
```

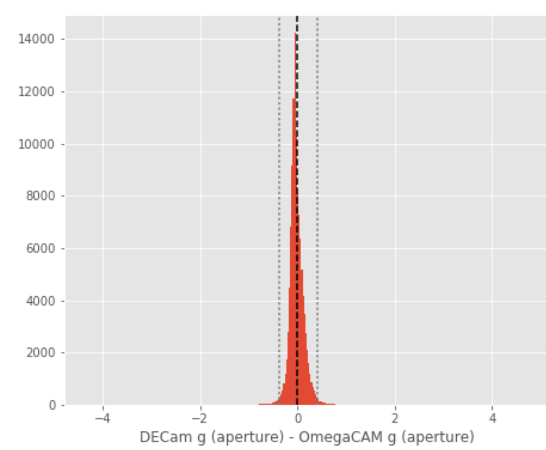


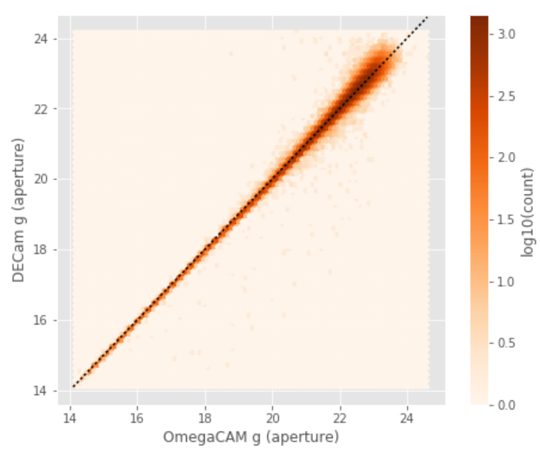
GPC1 g (total) - OmegaCAM g (total):
- Median: -0.07
- Median Absolute Deviation: 0.16
- 1% percentile: -1.296688632965088
- 99% percentile: 0.7950097846984904





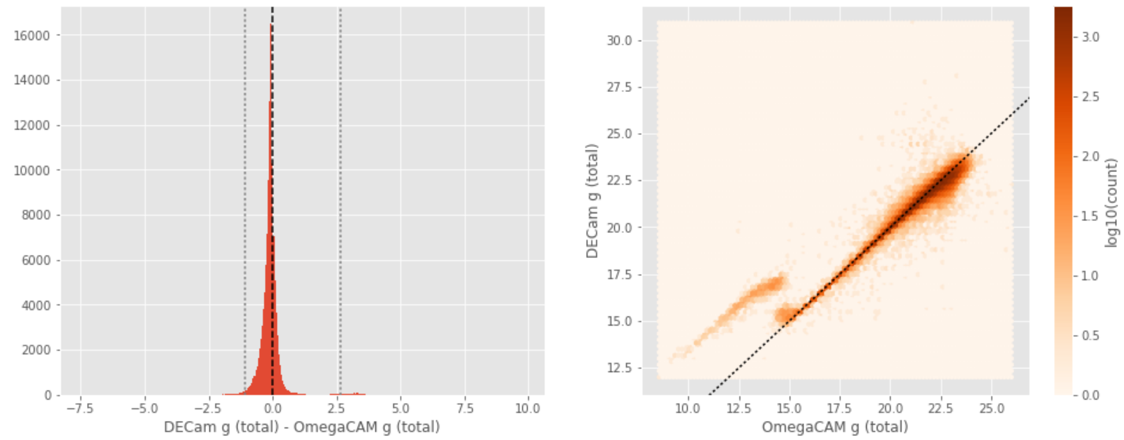
DECam g (aperture) - OmegaCAM g (aperture):
- Median: -0.04
- Median Absolute Deviation: 0.08
- 1% percentile: -0.36706384658813473
- 99% percentile: 0.40462675094604555



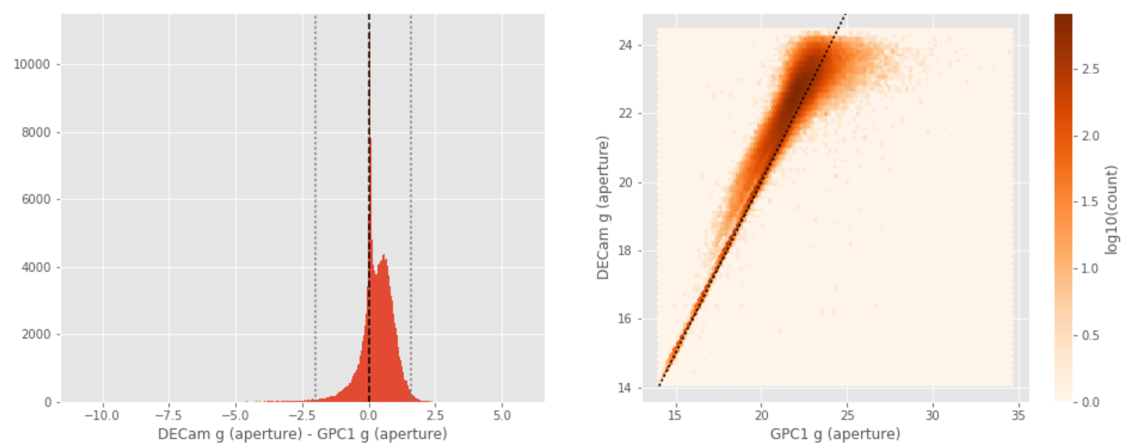


DECam g (total) - OmegaCAM g (total):
- Median: -0.10

- Median Absolute Deviation: 0.13
- 1% percentile: -1.087312183380127
- 99% percentile: 2.6726785278320295

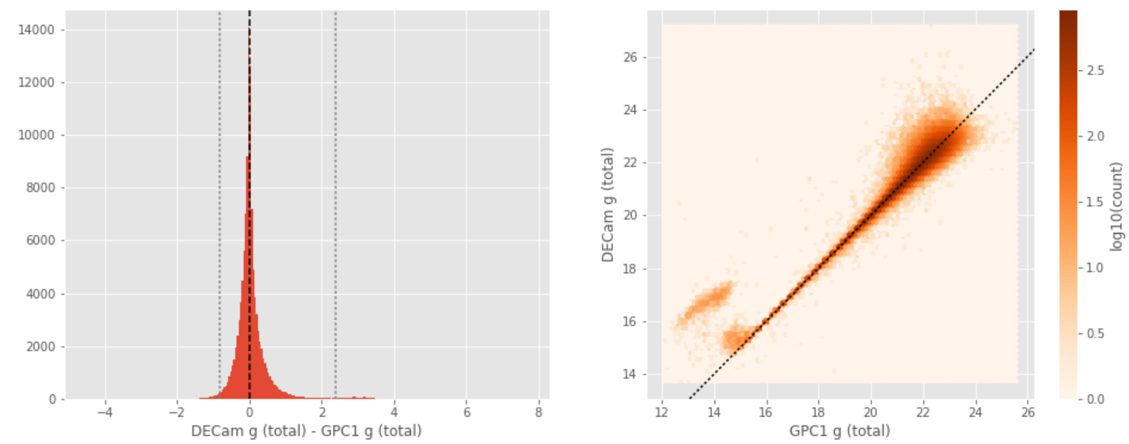


DECam g (aperture) - GPC1 g (aperture):
- Median: 0.31
- Median Absolute Deviation: 0.33
- 1% percentile: -2.0128673553466796
- 99% percentile: 1.5610710144042974

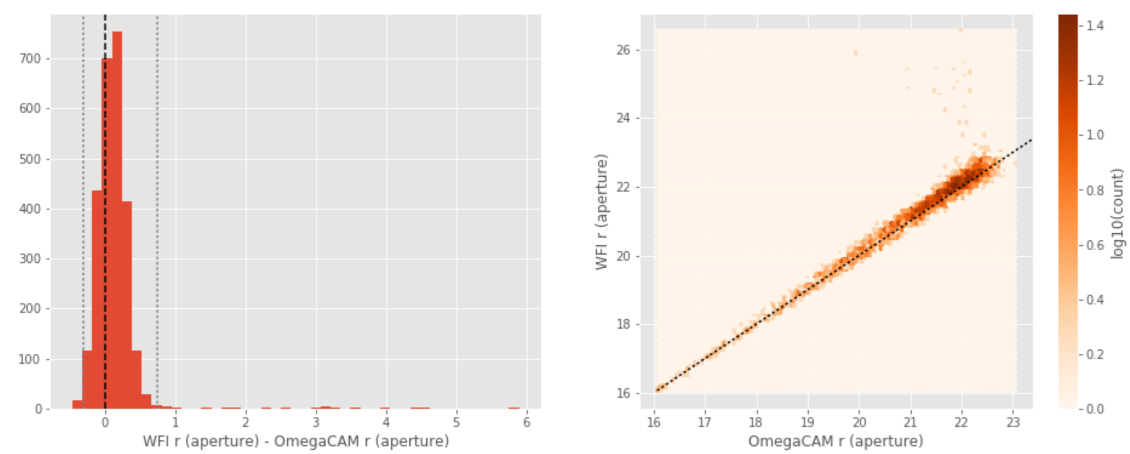


DECam g (total) - GPC1 g (total):
- Median: -0.00
- Median Absolute Deviation: 0.13
- 1% percentile: -0.8025470733642578

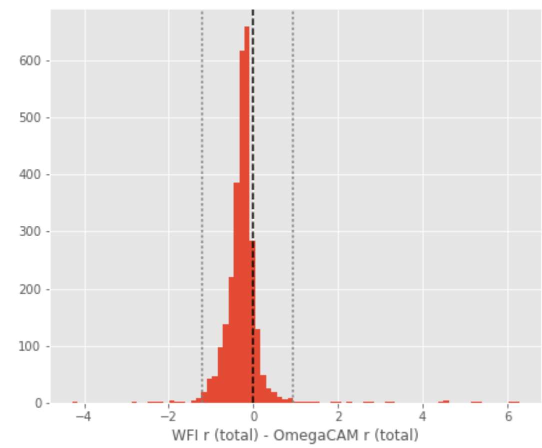
- 99% percentile: 2.3840057277679465

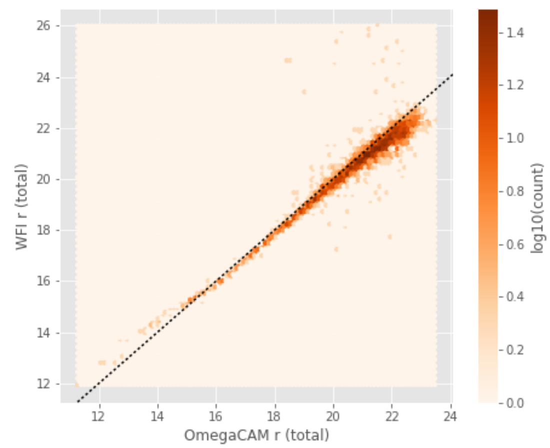


WFI r (aperture) - OmegaCAM r (aperture):
- Median: 0.10
- Median Absolute Deviation: 0.13
- 1% percentile: -0.3106356048583985
- 99% percentile: 0.7375316619873049

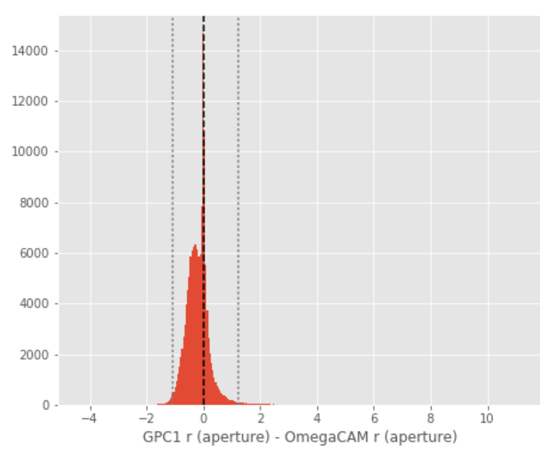


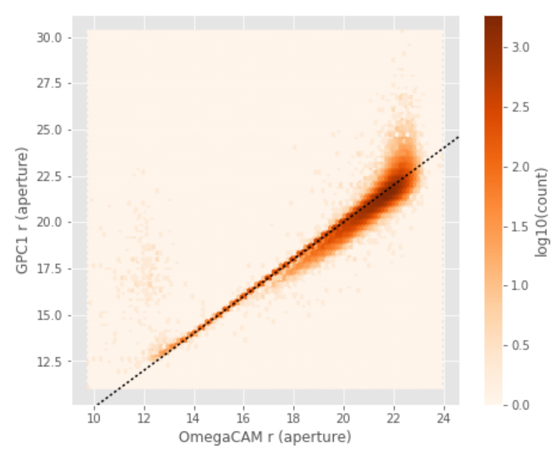
WFI r (total) - OmegaCAM r (total):
- Median: -0.25
- Median Absolute Deviation: 0.15
- 1% percentile: -1.2209947586059569
- 99% percentile: 0.9199421310424809



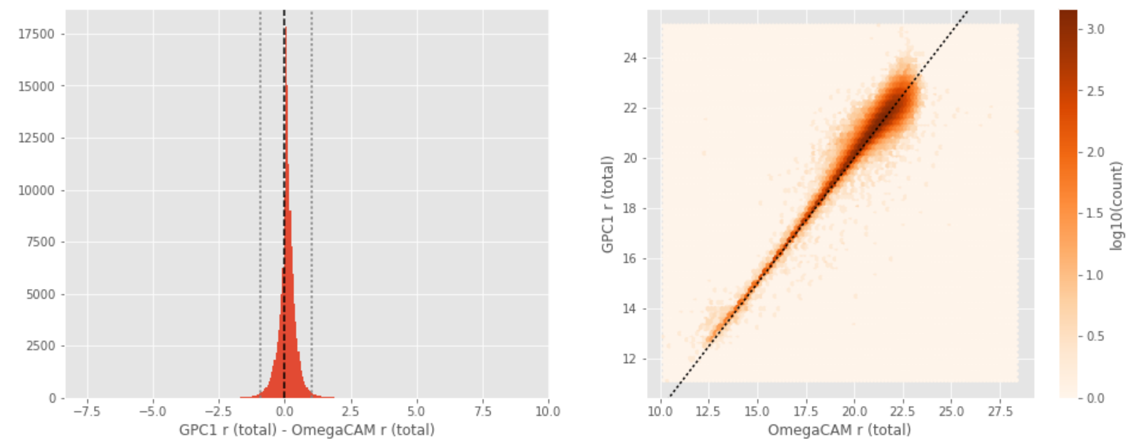


GPC1 r (aperture) - OmegaCAM r (aperture):
- Median: -0.16
- Median Absolute Deviation: 0.22
- 1% percentile: -1.072125778198242
- 99% percentile: 1.2293571472167972

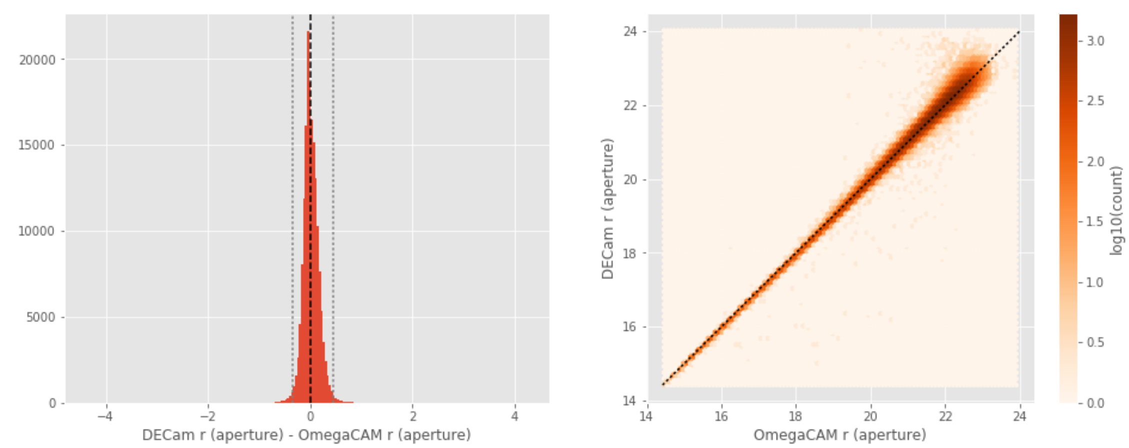




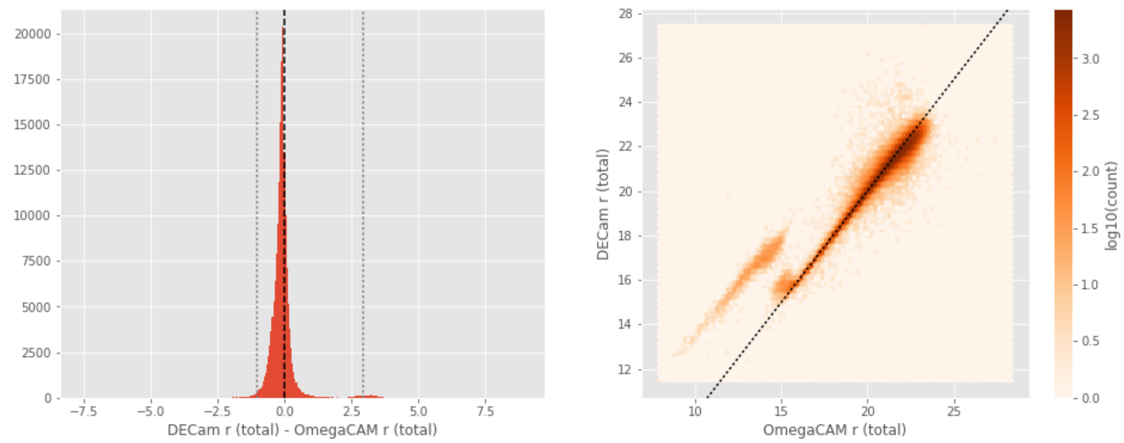
GPC1 r (total) - OmegaCAM r (total):
- Median: 0.08
- Median Absolute Deviation: 0.14
- 1% percentile: -0.922282371520996
- 99% percentile: 1.0283002471923828



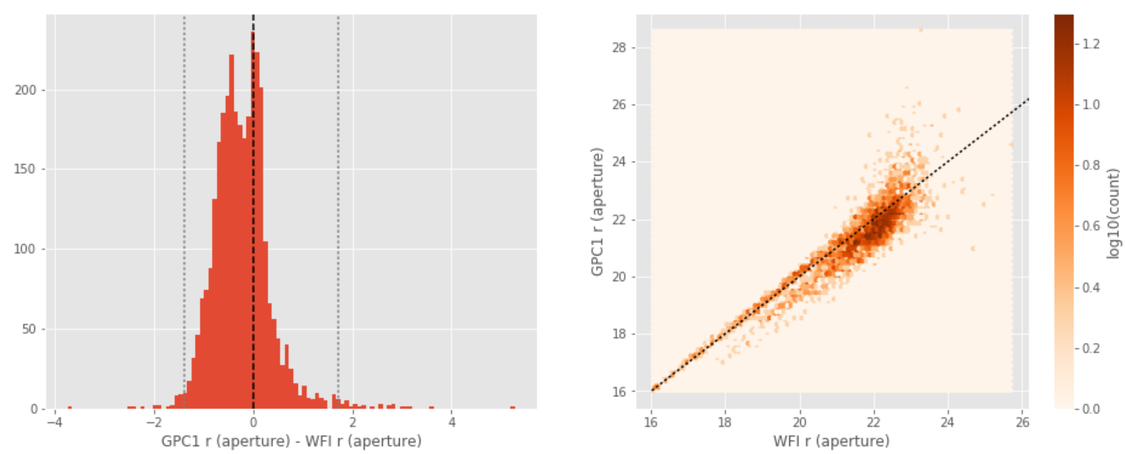
DECam r (aperture) - OmegaCAM r (aperture):
- Median: 0.00
- Median Absolute Deviation: 0.09
- 1% percentile: -0.3532426452636719
- 99% percentile: 0.44755035400390497



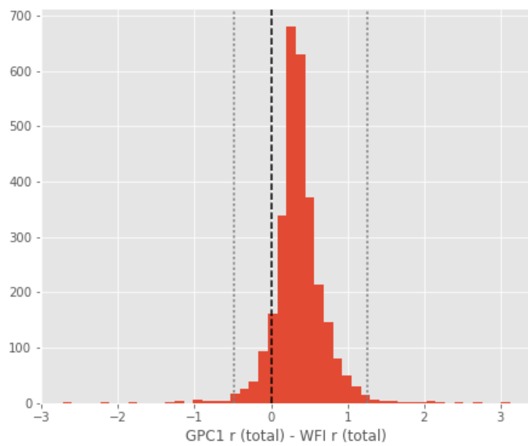
DECam r (total) - OmegaCAM r (total):
- Median: -0.10
- Median Absolute Deviation: 0.14
- 1% percentile: -1.0039896392822265
- 99% percentile: 2.9235151672363267

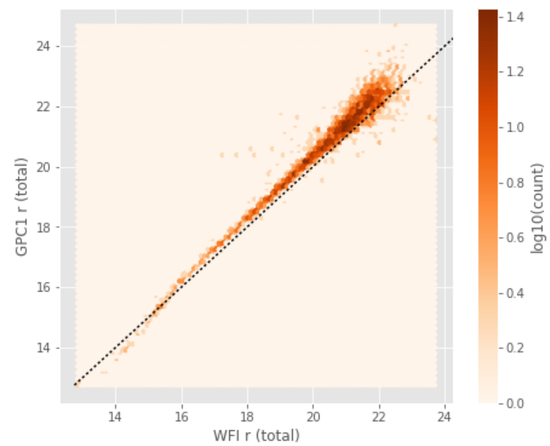


GPC1 r (aperture) - WFI r (aperture):
- Median: -0.25
- Median Absolute Deviation: 0.34
- 1% percentile: -1.379720687866211
- 99% percentile: 1.7204780578613306

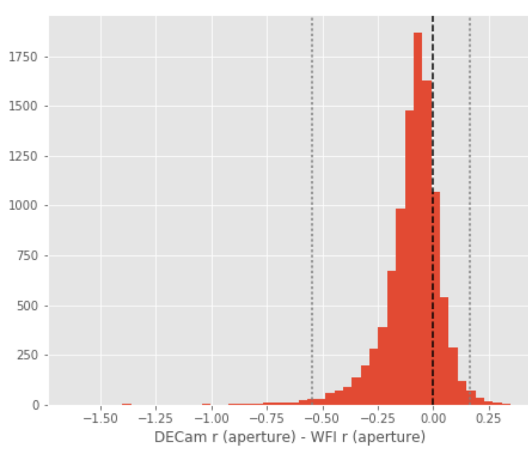


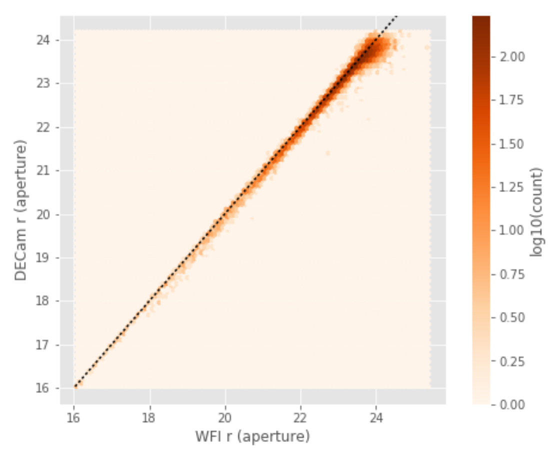
GPC1 r (total) - WFI r (total):
- Median: 0.34
- Median Absolute Deviation: 0.14
- 1% percentile: -0.486072883605957
- 99% percentile: 1.257844467163085



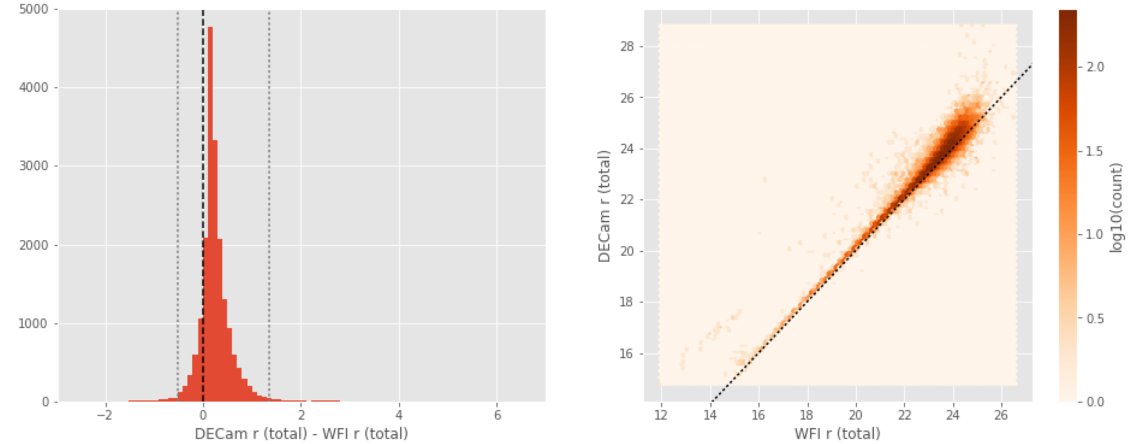


DECam r (aperture) - WFI r (aperture):
- Median: -0.08
- Median Absolute Deviation: 0.06
- 1% percentile: -0.5471199035644532
- 99% percentile: 0.16690835952758754

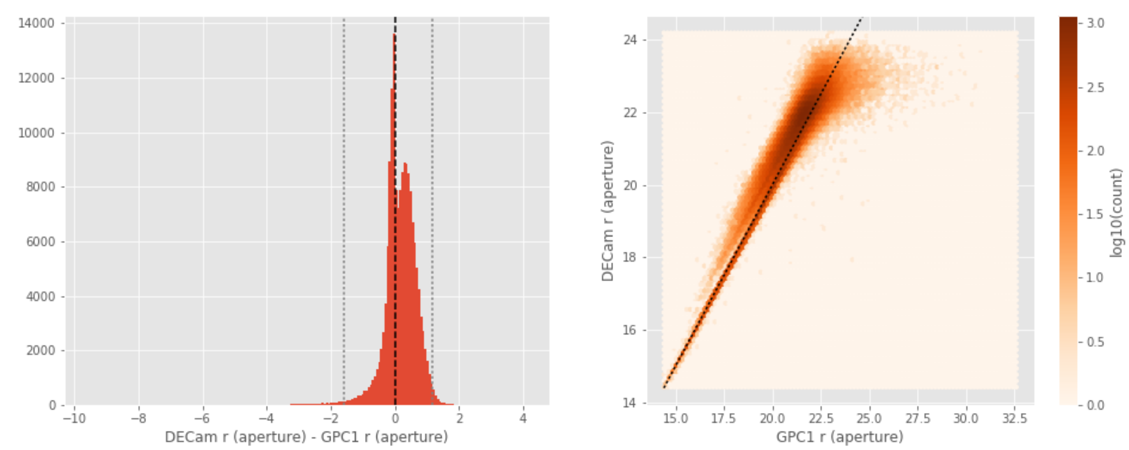




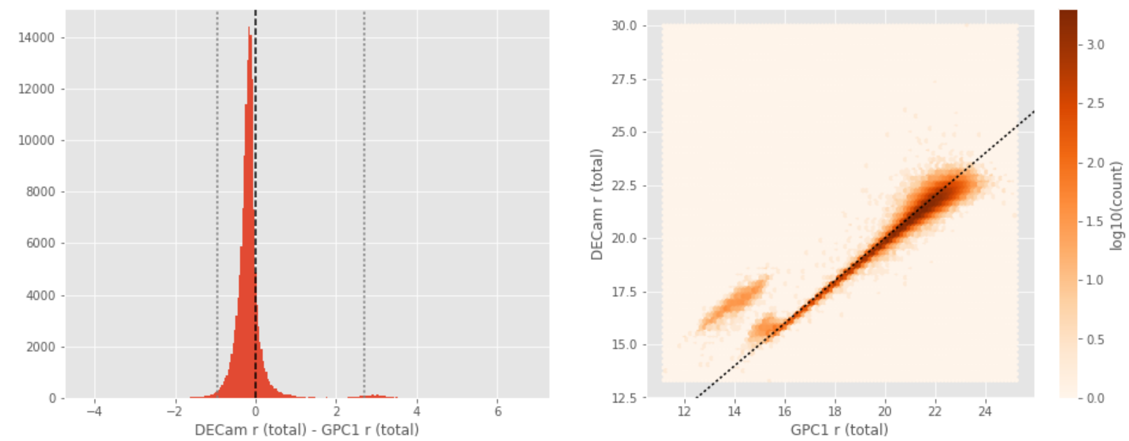
DECam r (total) - WFI r (total):
- Median: 0.20
- Median Absolute Deviation: 0.13
- 1% percentile: -0.5266014671325684
- 99% percentile: 1.3607005310058575



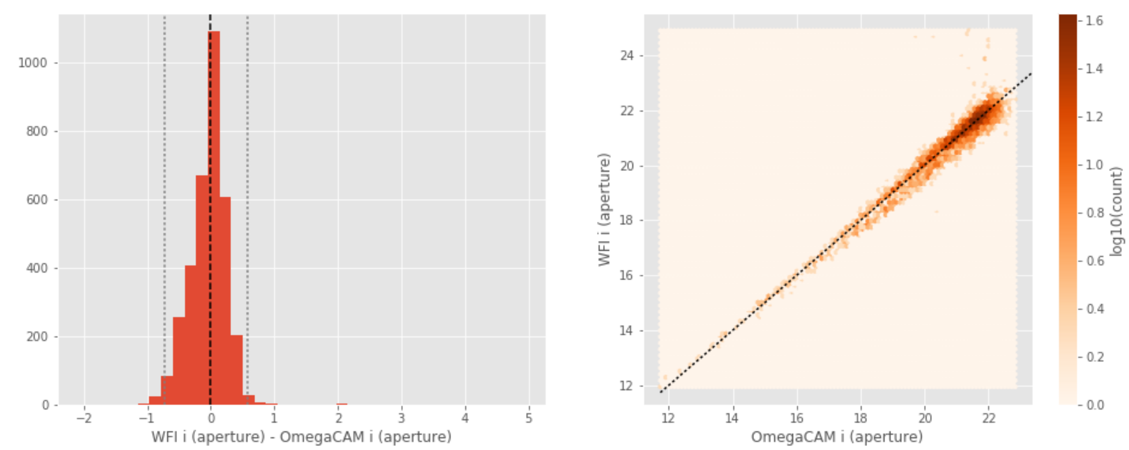
DECam r (aperture) - GPC1 r (aperture):
- Median: 0.18
- Median Absolute Deviation: 0.29
- 1% percentile: -1.5988021278381348
- 99% percentile: 1.172303848266603



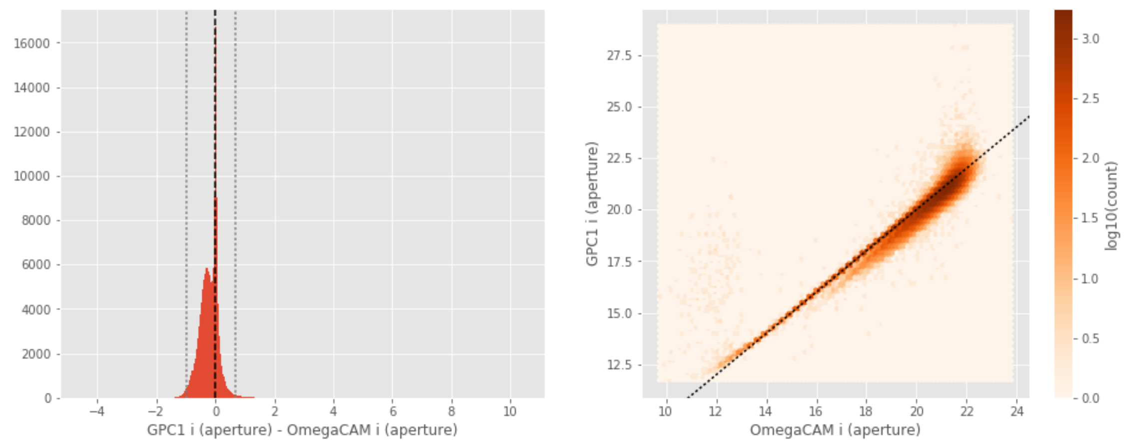
DECam r (total) - GPC1 r (total):
- Median: -0.18
- Median Absolute Deviation: 0.12
- 1% percentile: -0.9400785064697266
- 99% percentile: 2.704162712097168



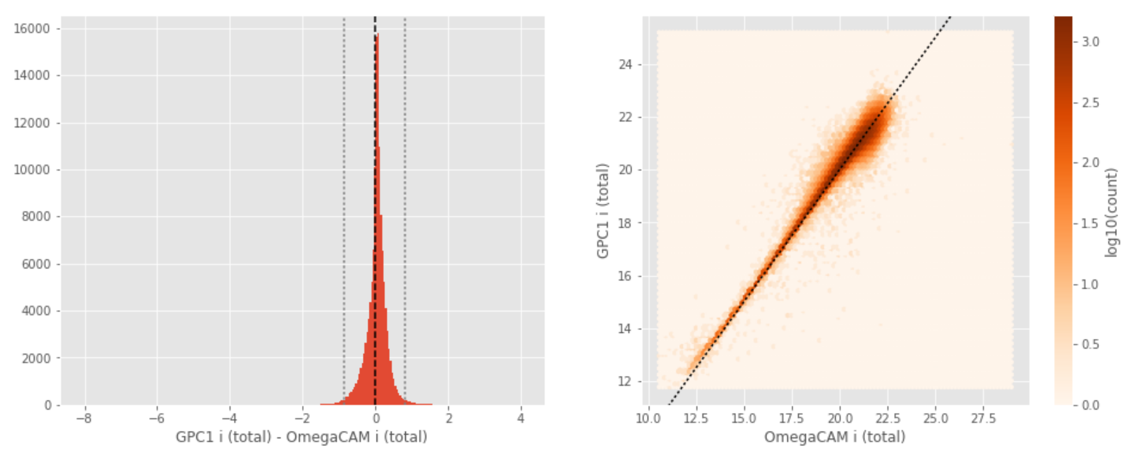
WFI i (aperture) - OmegaCAM i (aperture):
- Median: -0.00
- Median Absolute Deviation: 0.16
- 1% percentile: -0.7342316436767578
- 99% percentile: 0.5792187499999985



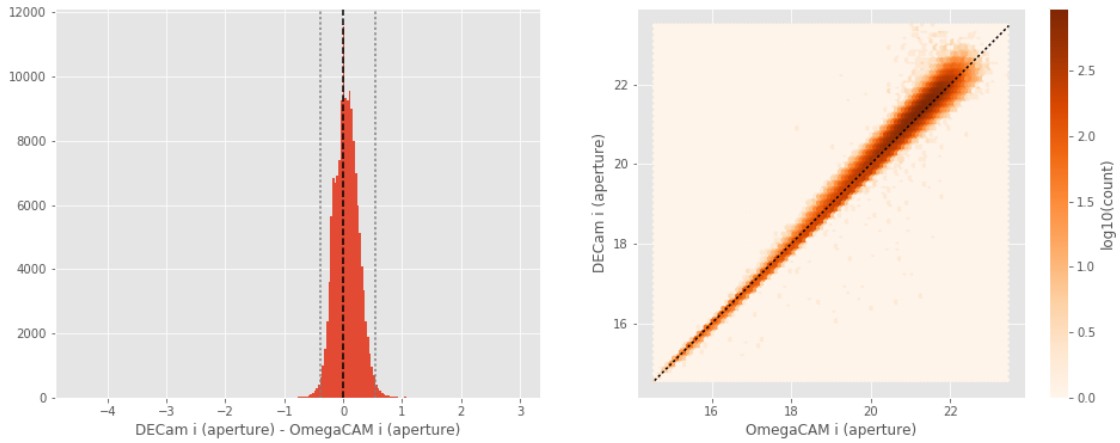
No sources have both OmegaCAM i (total) and WFI i (total) values.
GPC1 i (aperture) - OmegaCAM i (aperture):
- Median: -0.17
- Median Absolute Deviation: 0.19
- 1% percentile: -0.9848984146118165
- 99% percentile: 0.6653031349182128



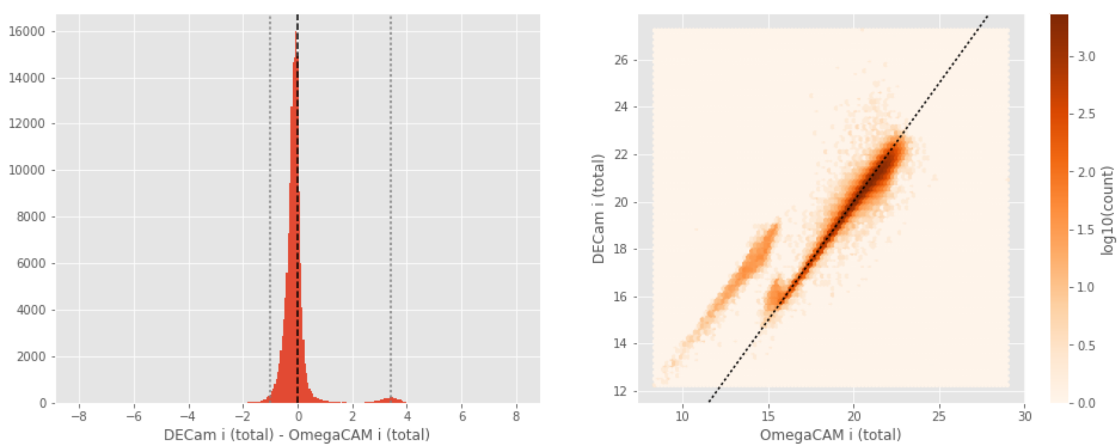
GPC1 i (total) - OmegaCAM i (total):
- Median: 0.05
- Median Absolute Deviation: 0.12
- 1% percentile: -0.8688420867919922
- 99% percentile: 0.8083547973632813



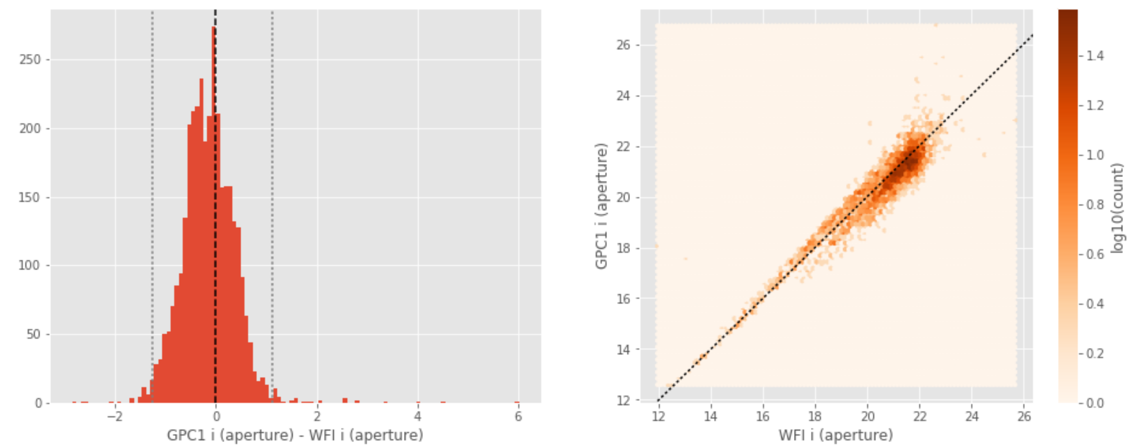
DECam i (aperture) - OmegaCAM i (aperture):
- Median: 0.05
- Median Absolute Deviation: 0.14
- 1% percentile: -0.3935373687744141
- 99% percentile: 0.5509270668029798



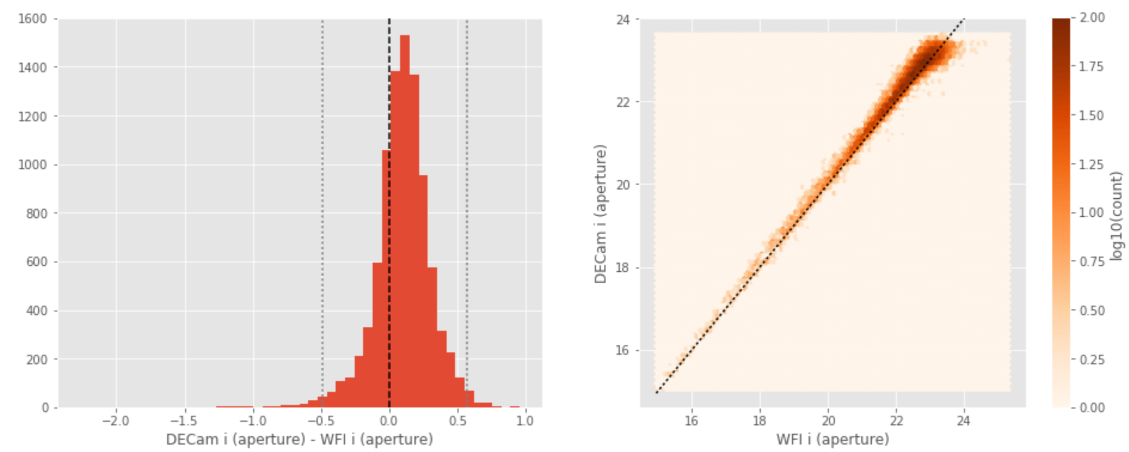
DECam i (total) - OmegaCAM i (total):
- Median: -0.13
- Median Absolute Deviation: 0.14
- 1% percentile: -1.020422763824463
- 99% percentile: 3.4286825561523466



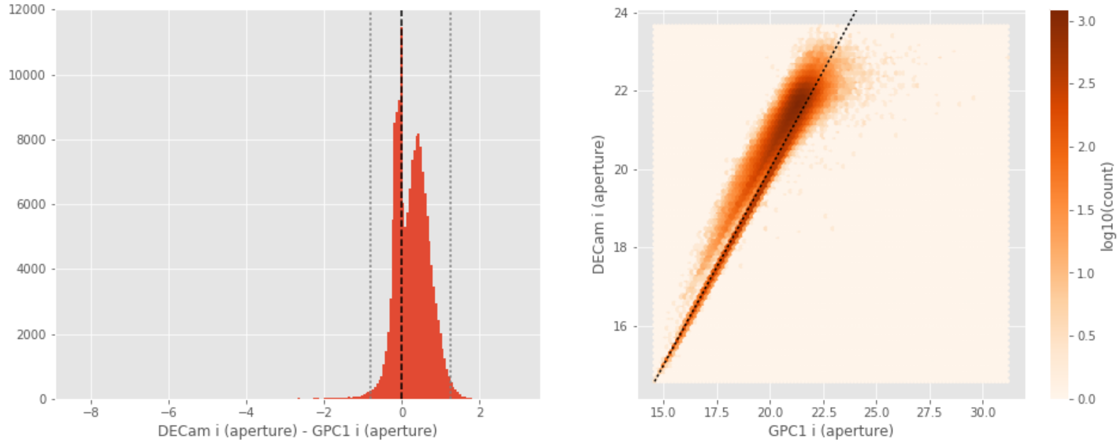
GPC1 i (aperture) - WFI i (aperture):
- Median: -0.15
- Median Absolute Deviation: 0.32
- 1% percentile: -1.2702113151550294
- 99% percentile: 1.1307513236999518



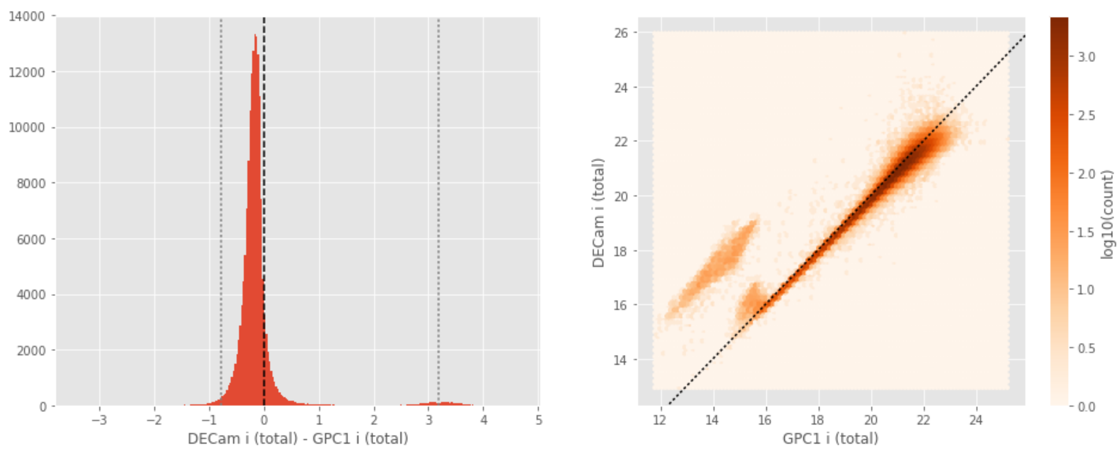
No sources have both WFI i (total) and GPC1 i (total) values.
DECam i (aperture) - WFI i (aperture):
- Median: 0.11
- Median Absolute Deviation: 0.11
- 1% percentile: -0.49341890335083005
- 99% percentile: 0.5684973335266115



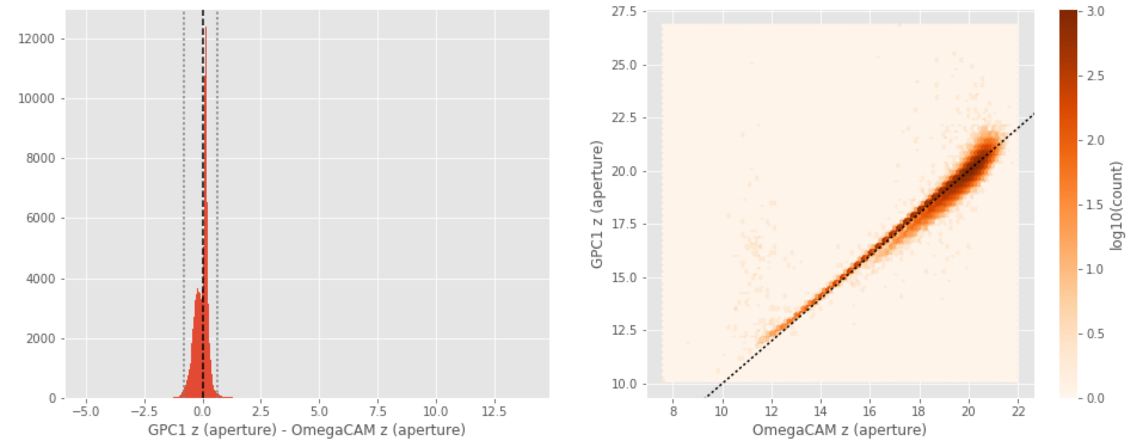
No sources have both WFI i (total) and DECam i (total) values.
DECam i (aperture) - GPC1 i (aperture):
- Median: 0.26
- Median Absolute Deviation: 0.31
- 1% percentile: -0.7910162544250487
- 99% percentile: 1.266036949157715



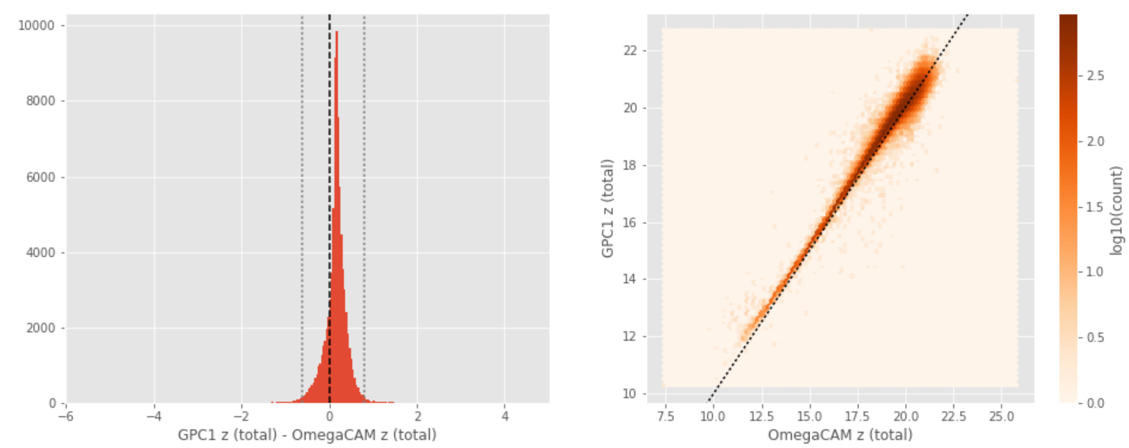
DECam i (total) - GPC1 i (total):
- Median: -0.17
- Median Absolute Deviation: 0.10
- 1% percentile: -0.7834041595458985
- 99% percentile: 3.1839383888244632



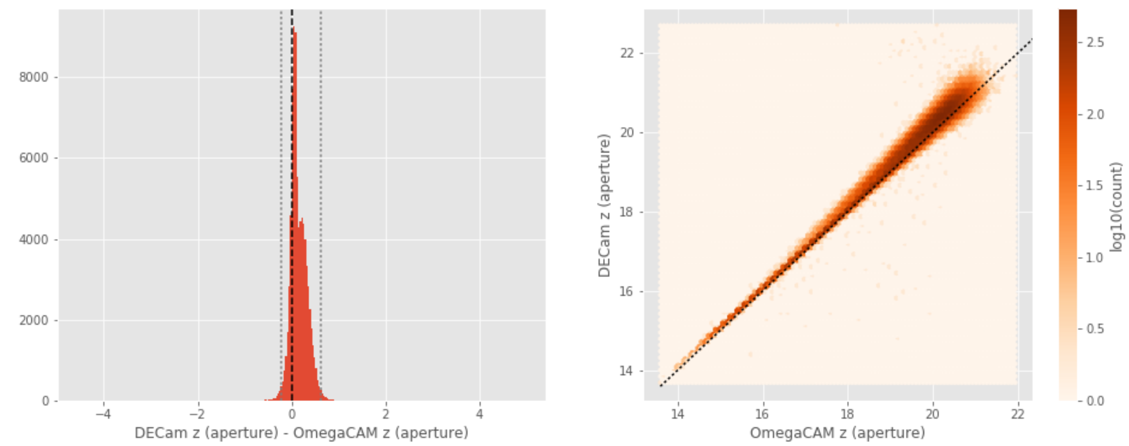
GPC1 z (aperture) - OmegaCAM z (aperture):
- Median: 0.05
- Median Absolute Deviation: 0.14
- 1% percentile: -0.806519775390625
- 99% percentile: 0.6441340255737295



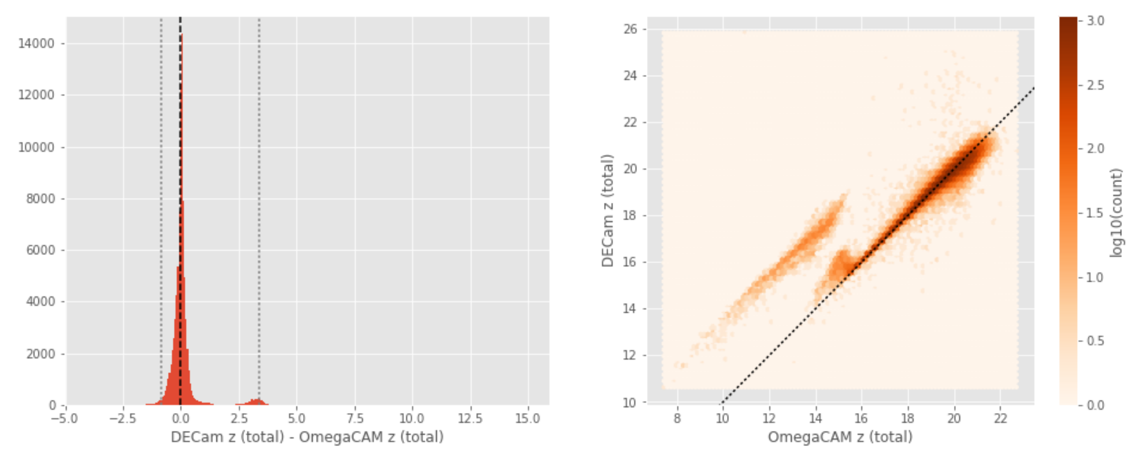
GPC1 z (total) - OmegaCAM z (total):
- Median: 0.17
- Median Absolute Deviation: 0.11
- 1% percentile: -0.6282771301269532
- 99% percentile: 0.7950209236145019



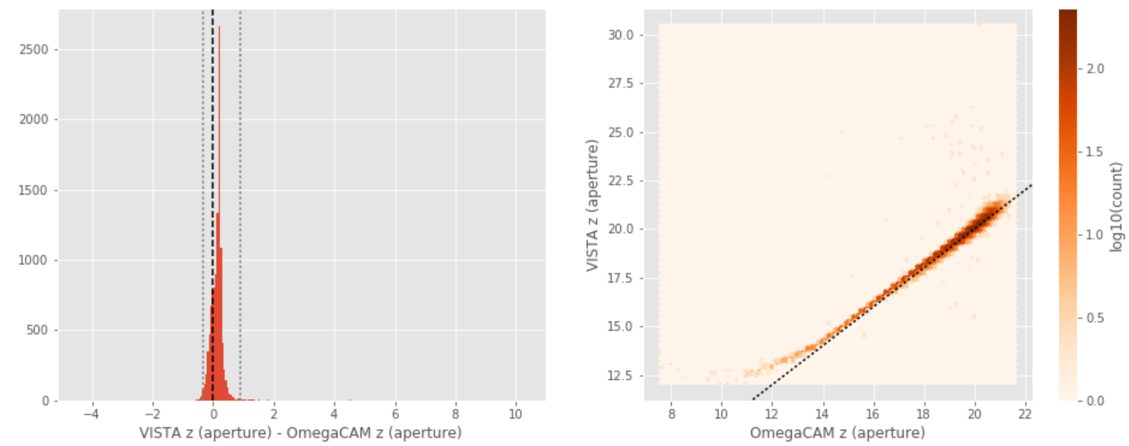
DECam z (aperture) - OmegaCAM z (aperture):
- Median: 0.11
- Median Absolute Deviation: 0.10
- 1% percentile: -0.23049186706542965
- 99% percentile: 0.6151915931701665



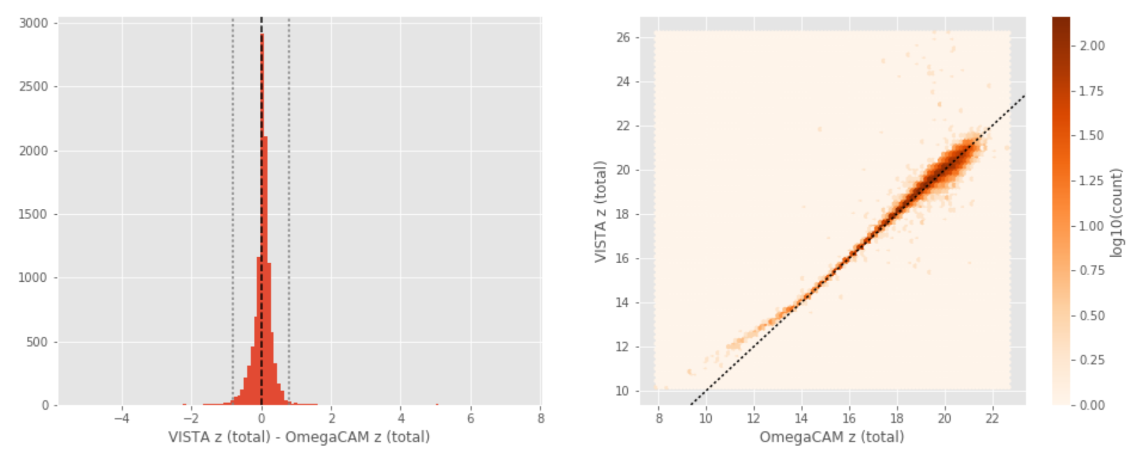
DECam z (total) - OmegaCAM z (total):
- Median: 0.01
- Median Absolute Deviation: 0.12
- 1% percentile: -0.8286170196533202
- 99% percentile: 3.3931300640106197



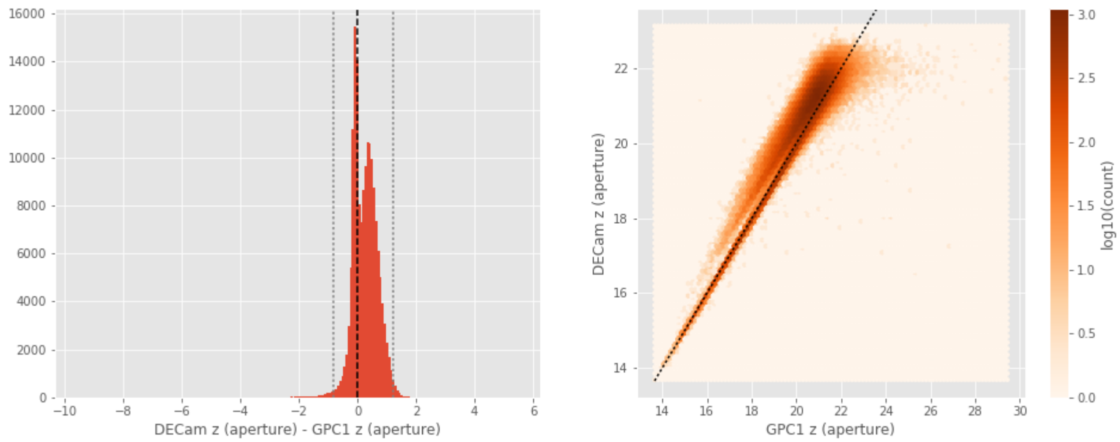
VISTA z (aperture) - OmegaCAM z (aperture):
- Median: 0.16
- Median Absolute Deviation: 0.09
- 1% percentile: -0.33622013092041014
- 99% percentile: 0.8982582283020007



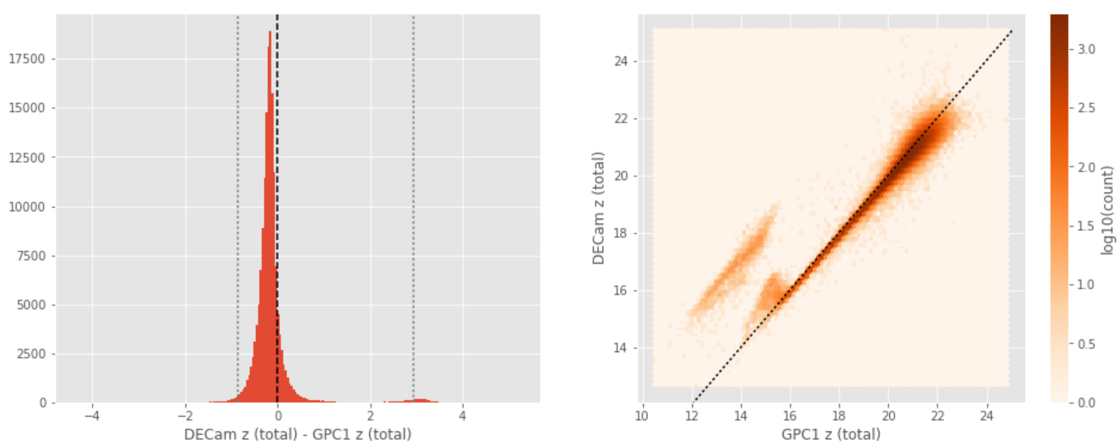
VISTA z (total) - OmegaCAM z (total):
- Median: 0.05
- Median Absolute Deviation: 0.11
- 1% percentile: -0.8182351684570313
- 99% percentile: 0.7913664817810039



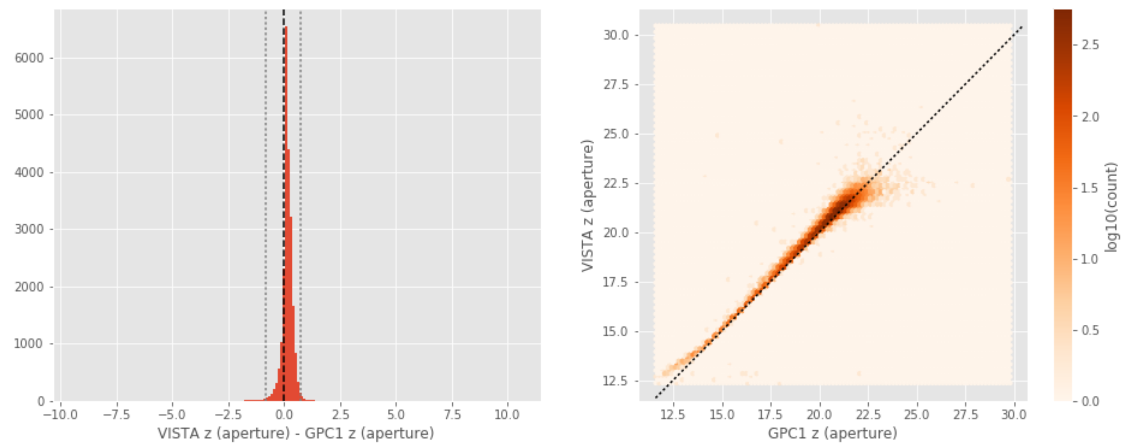
DECam z (aperture) - GPC1 z (aperture):
- Median: 0.25
- Median Absolute Deviation: 0.30
- 1% percentile: -0.8205214500427246
- 99% percentile: 1.2088318824768067



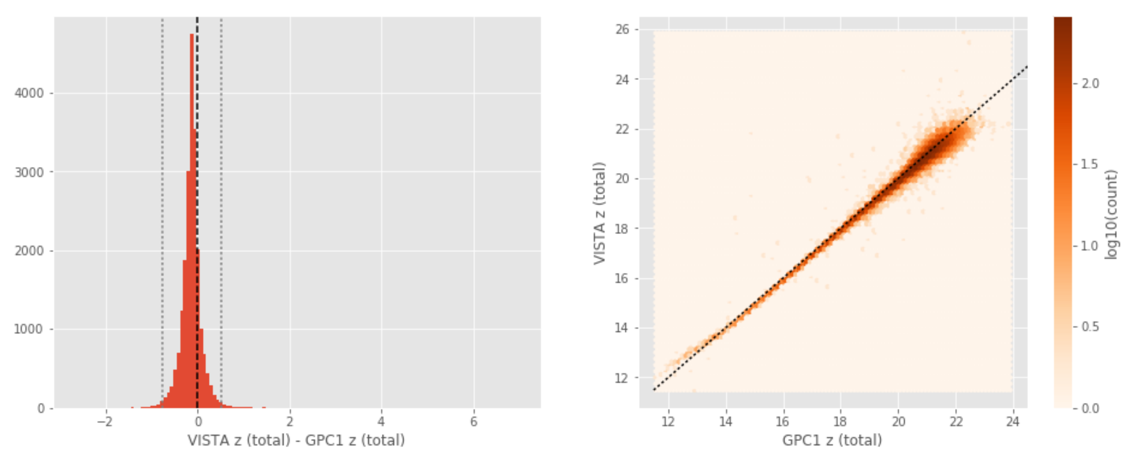
DECam z (total) - GPC1 z (total):
- Median: -0.18
- Median Absolute Deviation: 0.10
- 1% percentile: -0.8591748046875
- 99% percentile: 2.946851081848142



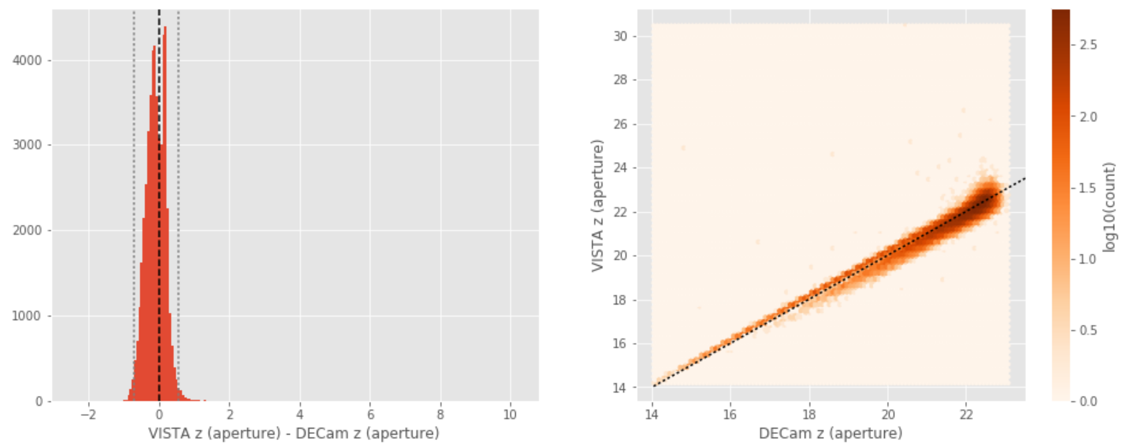
VISTA z (aperture) - GPC1 z (aperture):
- Median: 0.12
- Median Absolute Deviation: 0.11
- 1% percentile: -0.8292744445800782
- 99% percentile: 0.7439142608642577



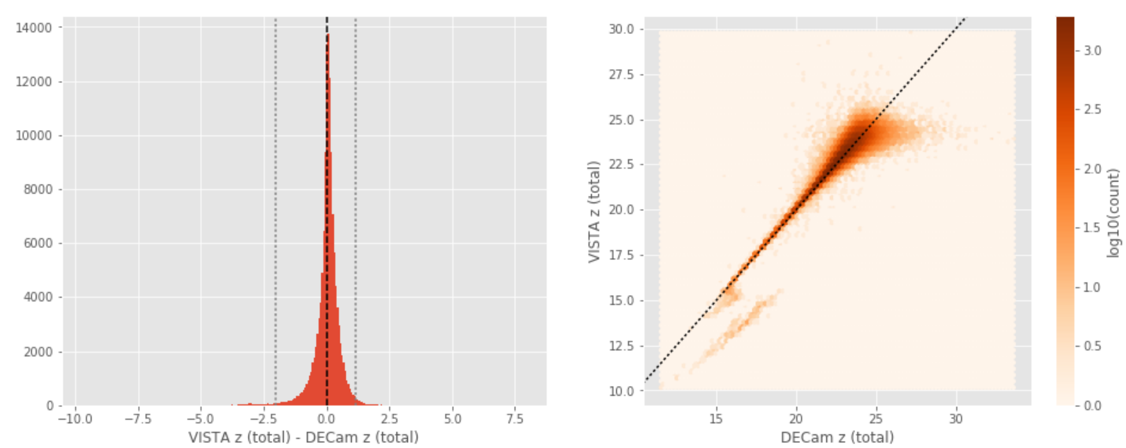
VISTA z (total) - GPC1 z (total):
- Median: -0.13
- Median Absolute Deviation: 0.10
- 1% percentile: -0.7600824356079102
- 99% percentile: 0.5232796287536614



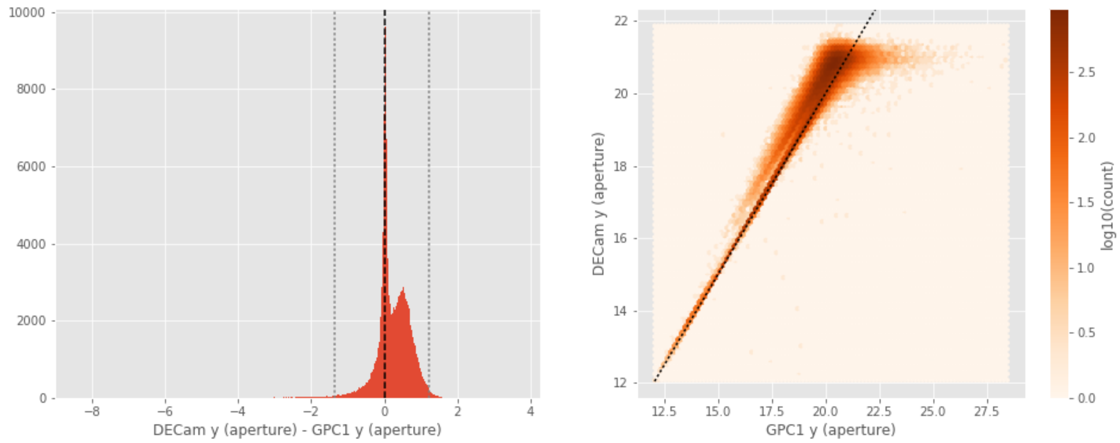
VISTA z (aperture) - DECam z (aperture):
- Median: -0.09
- Median Absolute Deviation: 0.21
- 1% percentile: -0.7185096740722656
- 99% percentile: 0.5554208755493164



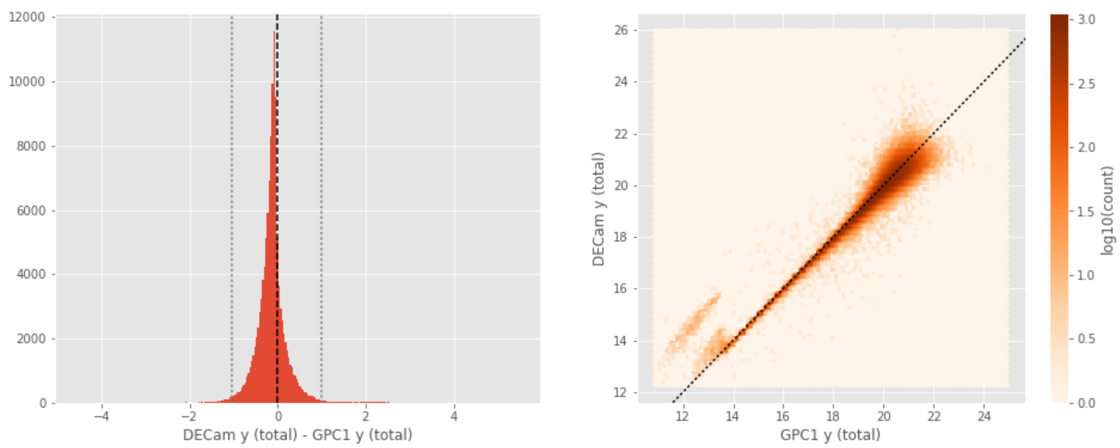
VISTA z (total) - DECam z (total):
- Median: 0.07
- Median Absolute Deviation: 0.19
- 1% percentile: -2.0058786392211916
- 99% percentile: 1.170486259460449



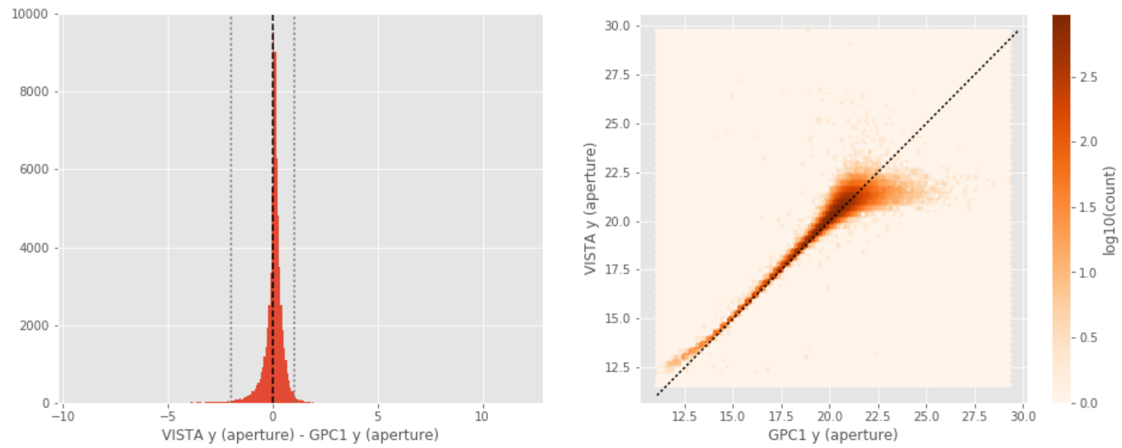
DECam y (aperture) - GPC1 y (aperture):
- Median: 0.20
- Median Absolute Deviation: 0.25
- 1% percentile: -1.3568295669555663
- 99% percentile: 1.2080453109741205



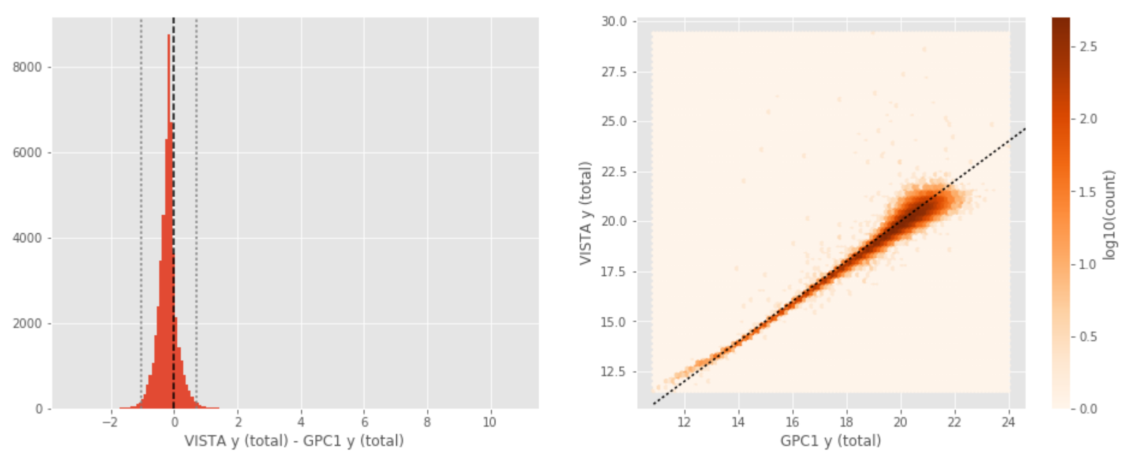
DECam y (total) - GPC1 y (total):
- Median: -0.12
- Median Absolute Deviation: 0.14
- 1% percentile: -1.0285805511474608
- 99% percentile: 0.9867723846435557



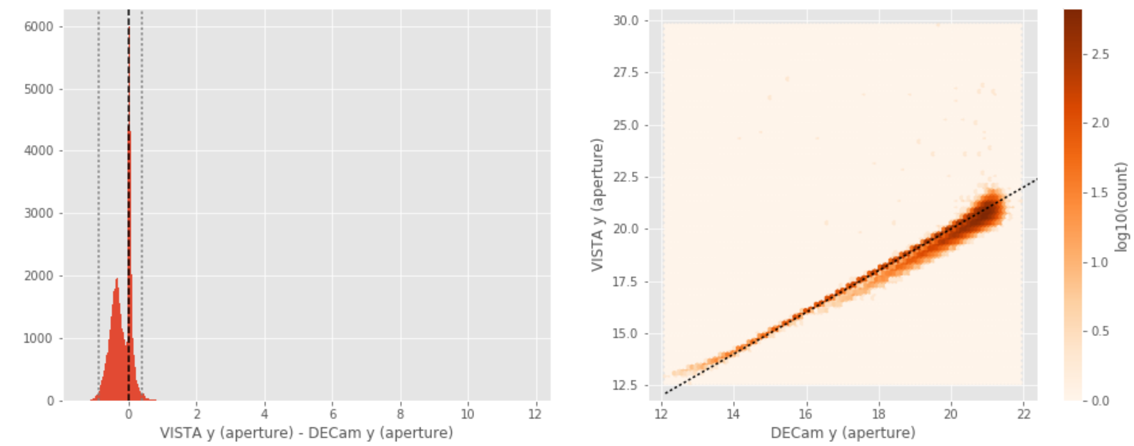
VISTA y (aperture) - GPC1 y (aperture):
- Median: 0.09
- Median Absolute Deviation: 0.16
- 1% percentile: -1.9527296447753906
- 99% percentile: 1.0630077362060548



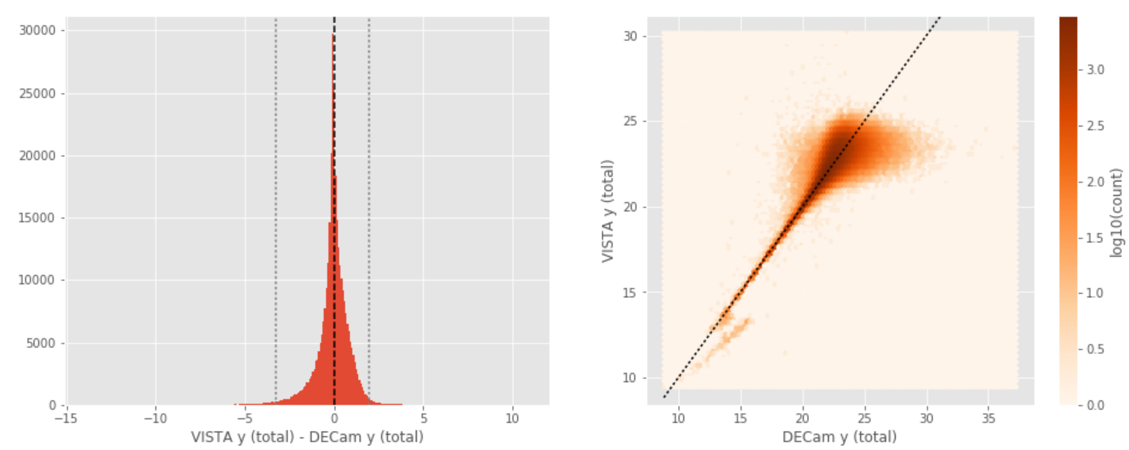
VISTA y (total) - GPC1 y (total):
- Median: -0.19
- Median Absolute Deviation: 0.15
- 1% percentile: -1.0352452850341796
- 99% percentile: 0.7106719207763674



VISTA y (aperture) - DECam y (aperture):
- Median: -0.14
- Median Absolute Deviation: 0.20
- 1% percentile: -0.8559646606445312
- 99% percentile: 0.4185153007507322




```
VISTA y (total) - DECam y (total):
- Median: -0.04
- Median Absolute Deviation: 0.38
- 1% percentile: -3.277728614807129
- 99% percentile: 1.957741127014161
```



1.5 III - Comparing magnitudes to reference bands

Cross-match the master list to 2MASS to compare magnitudes.

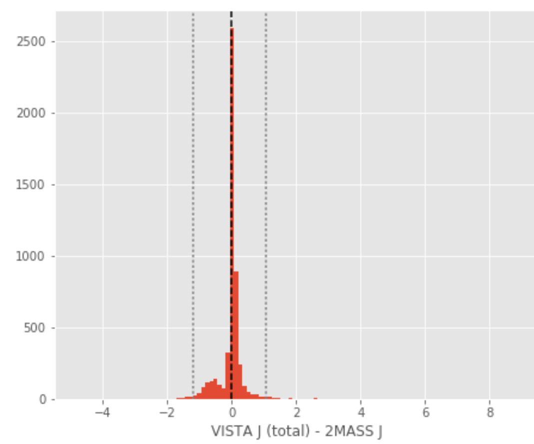
1.5.1 III.b - Comparing J and K bands to 2MASS

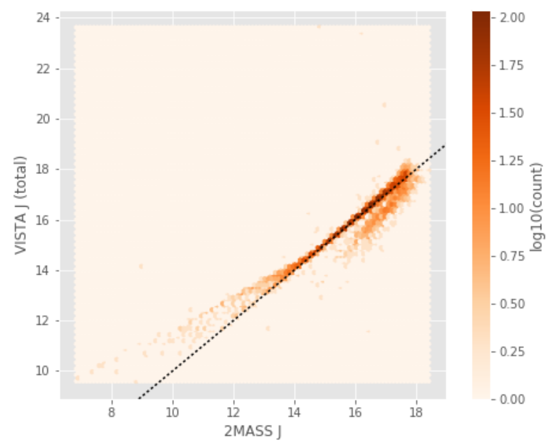
The catalogue is cross-matched to 2MASS-PSC withing 0.2 arcsecond. We compare the UKIDSS total J and K magnitudes to those from 2MASS.

The 2MASS magnitudes are “*Vega-like*” and we have to convert them to AB magnitudes using the zero points provided on this page:

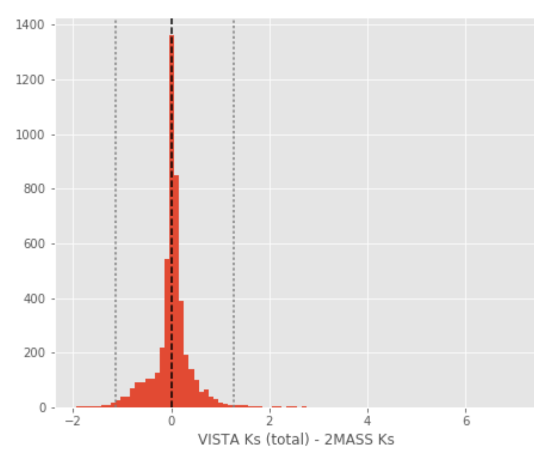
Band	F - 0 mag (Jy)
J	1594
H	1024
Ks	666.7

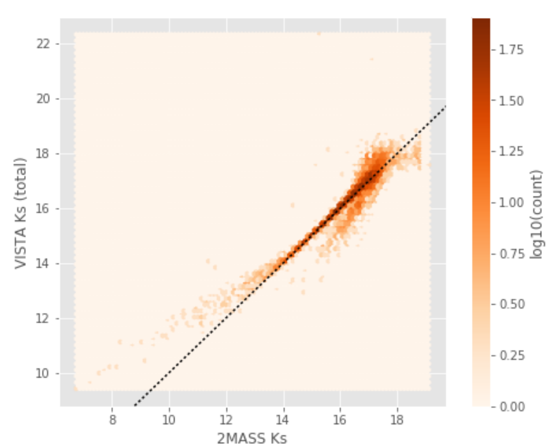
```
VISTA J (total) - 2MASS J:
- Median: 0.03
- Median Absolute Deviation: 0.06
- 1% percentile: -1.2033101961423698
- 99% percentile: 1.0771015779970339
```





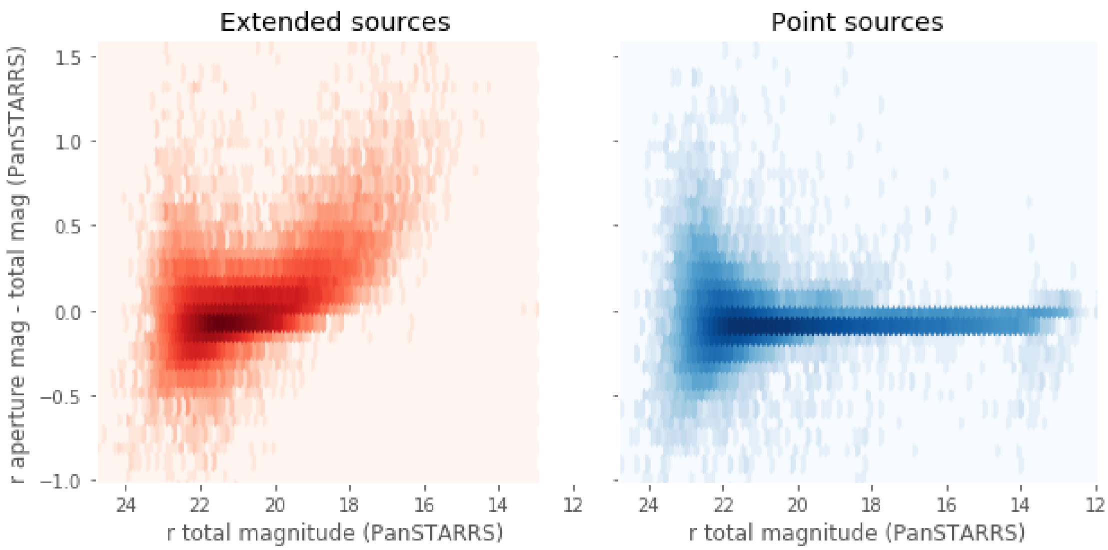

```
VISTA Ks (total) - 2MASS Ks:
- Median: 0.03
- Median Absolute Deviation: 0.11
- 1% percentile: -1.1203042906816978
- 99% percentile: 1.2803789119092368
```

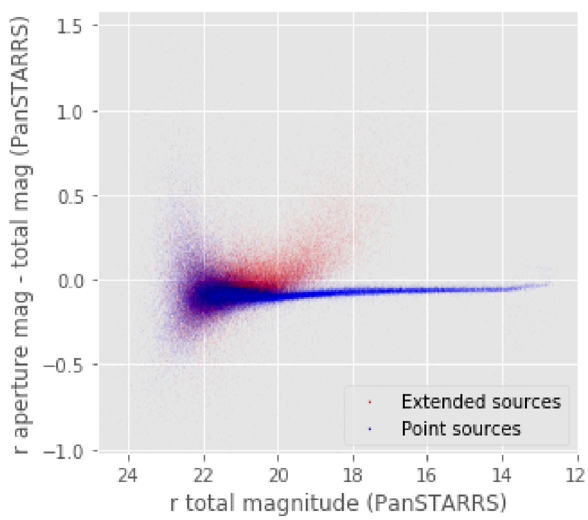




1.6 IV - Comparing aperture magnitudes to total ones.

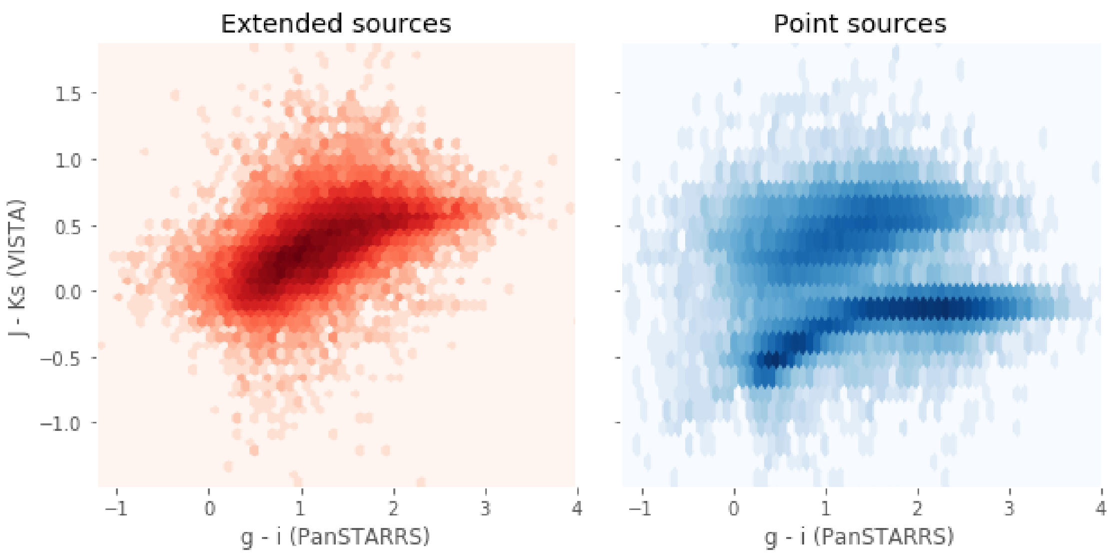
```
Number of source used: 148283 / 2168544 (6.84%)
```

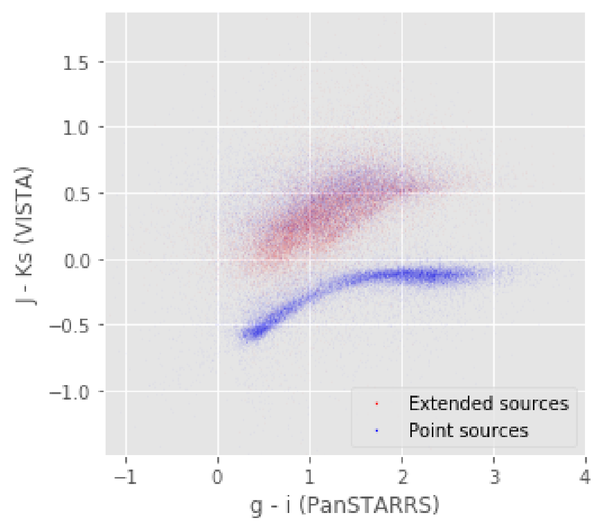




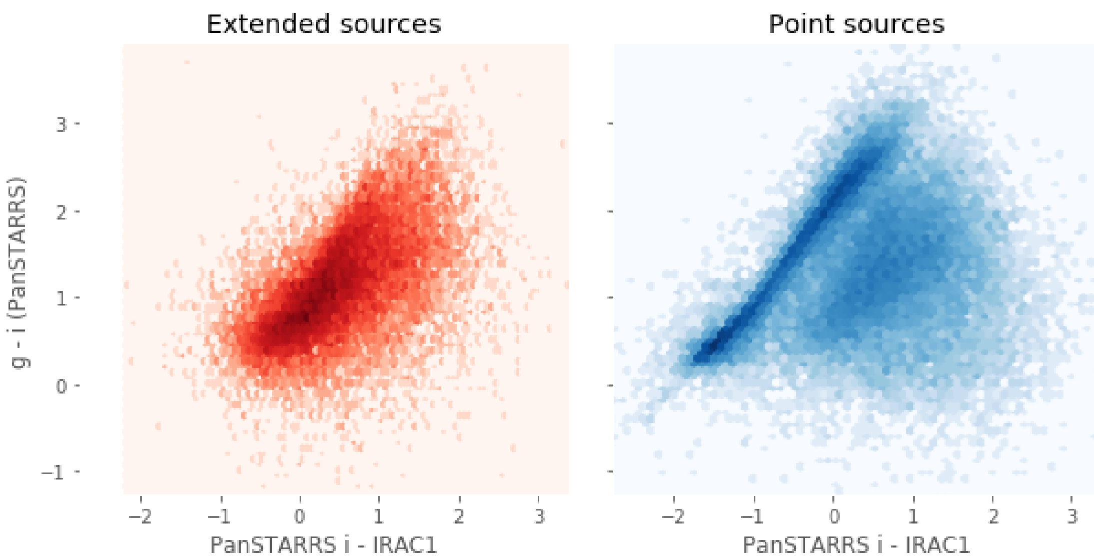
1.7 V - Color-color and magnitude-color plots

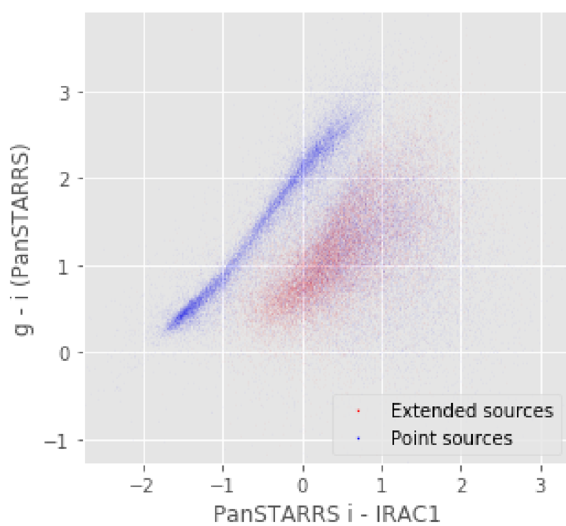
```
Number of source used: 63057 / 2168544 (2.91%)
```



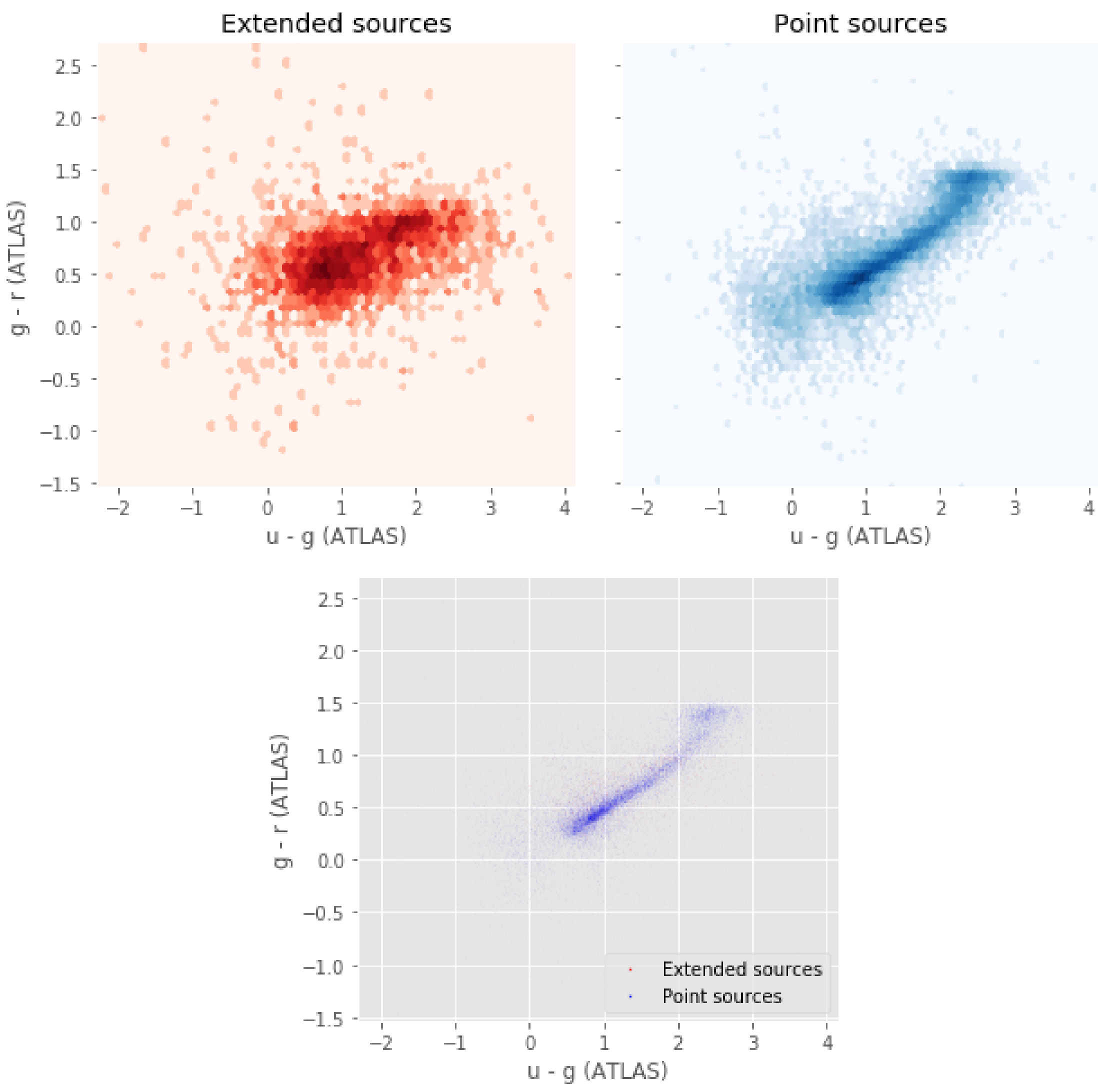



```
Number of source used: 64707 / 2168544 (2.98%)
```

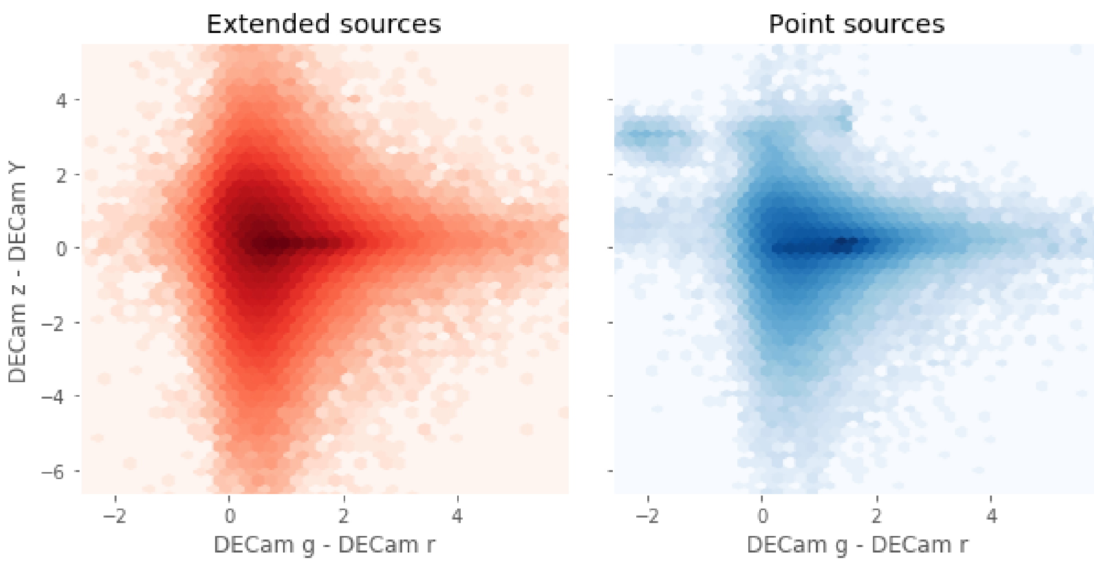


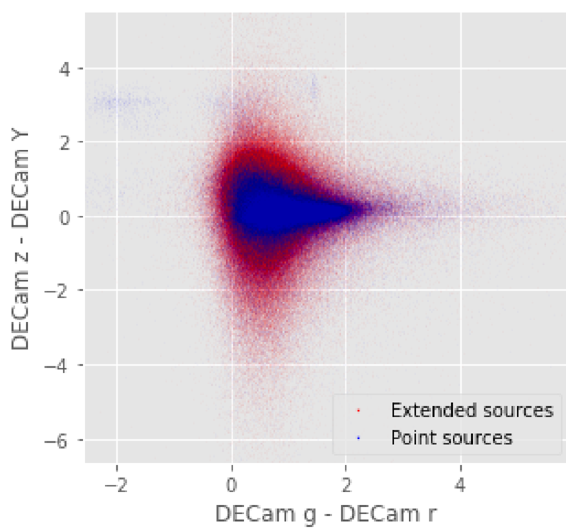



```
Number of source used: 18258 / 2168544 (0.84%)
```

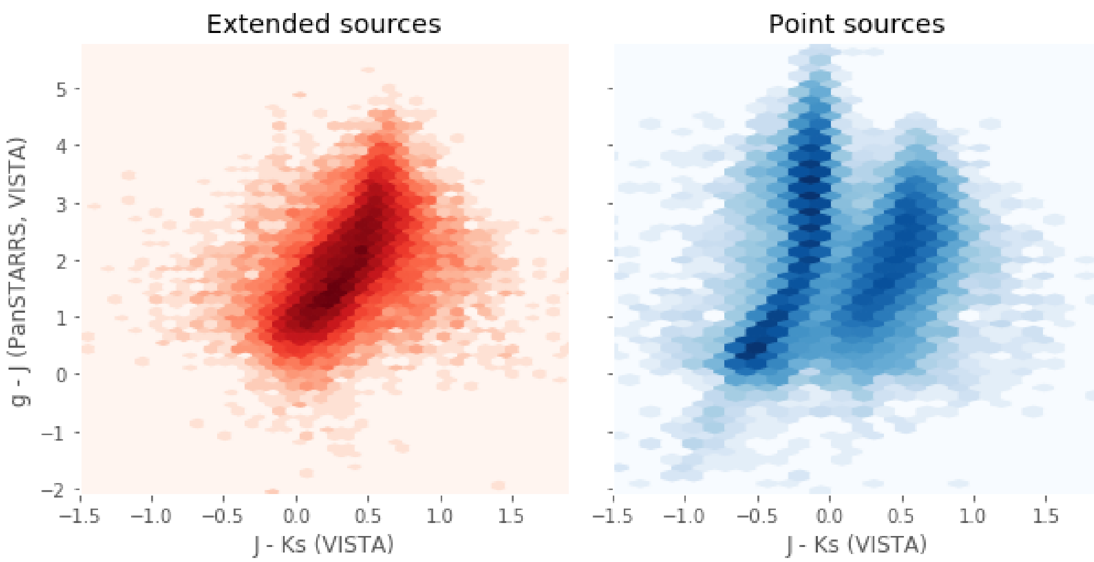


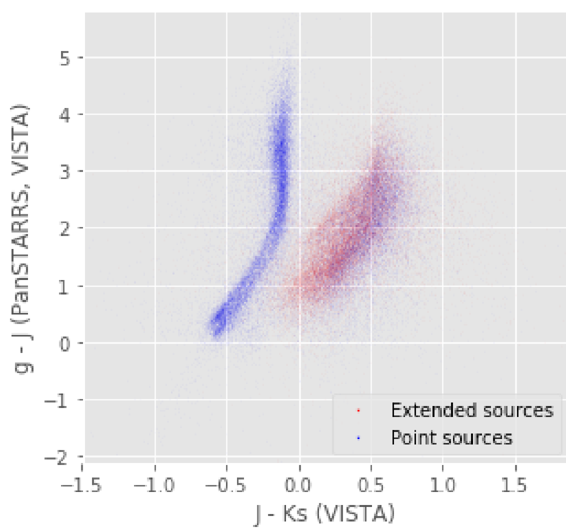
Number of source used: 826224 / 2168544 (38.10%)



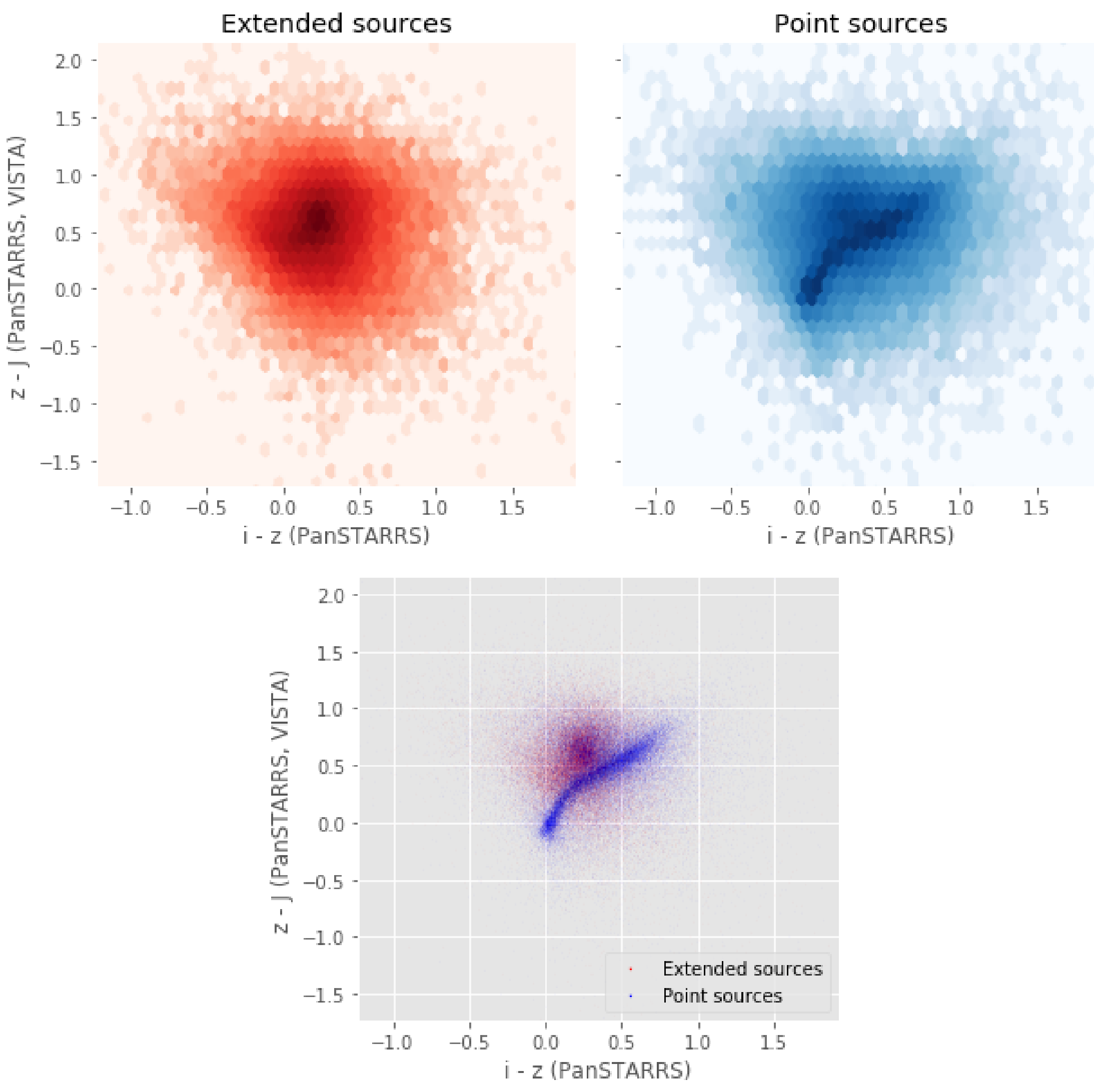



```
Number of source used: 64049 / 2168544 (2.95%)
```

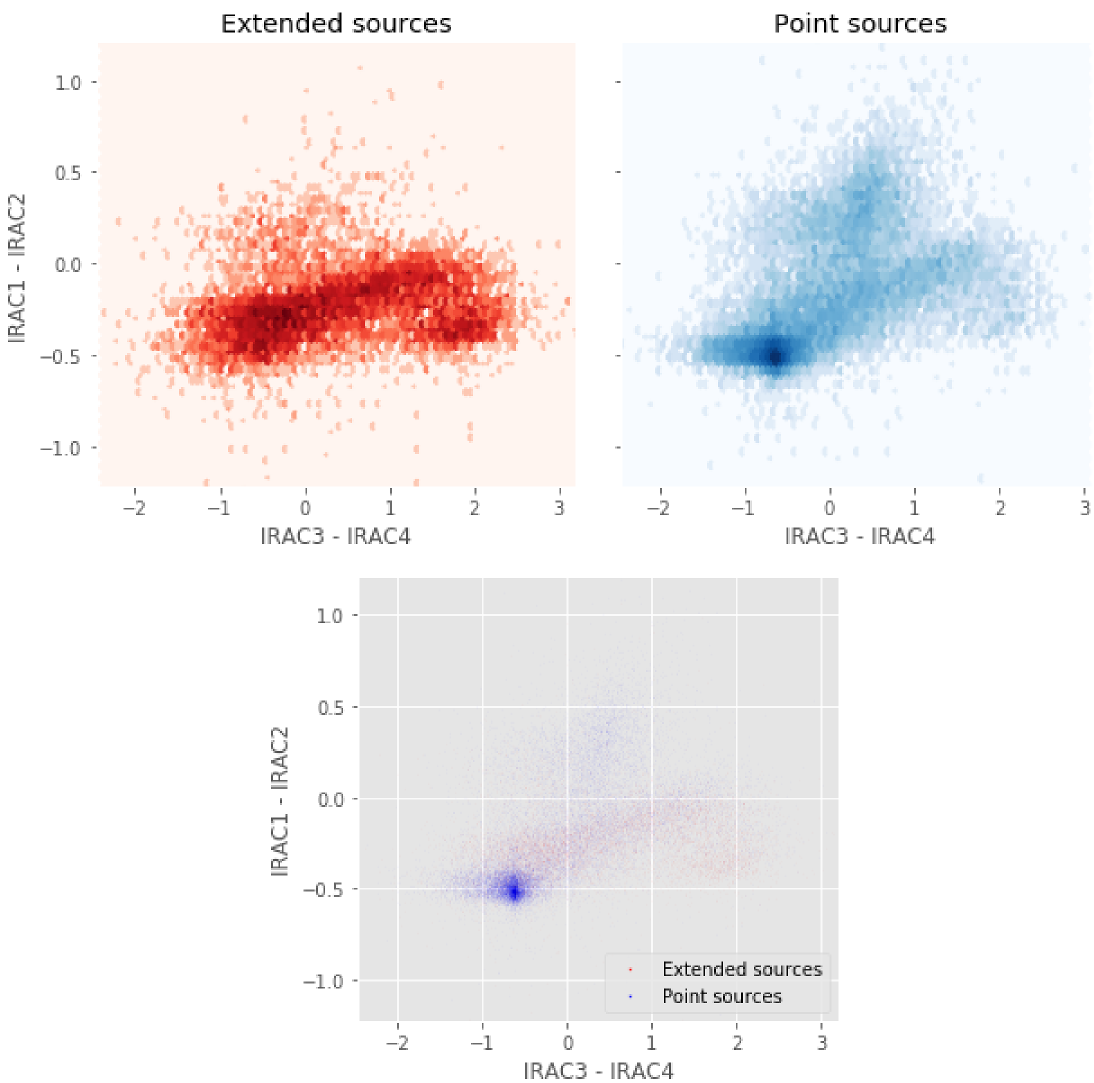





```
Number of source used: 101174 / 2168544 (4.67%)
```



Number of source used: 28901 / 2168544 (1.33%)


Extended sources
Point sources
IRAC1 - IRAC2
IRAC3 - IRAC4
IRAC3 - IRAC4
IRAC1 - IRAC2
IRAC3 - IRAC4
Extended sources
Point sources