1.1_AEGIS

January 18, 2018

0.1 EGS master catalogue

0.2 Preparation of AEGIS data

This resource contains the near-infrared catalogue of Extended Groth Strip observations with the WIRC instrument at the Palomar Observatory.: the catalogue comes from `dmu0_AEGIS`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The magnitude for each band in 2 arcsecond aperture.
- The auto magnitude to be used as 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:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

0.3 I - Column selection

```
WARNING: UnitsWarning: 'vega' did not parse as fits unit: At col 0, Unit 'vega' not supported by
```

```
/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>
```

0.4 II - Removal of duplicated sources

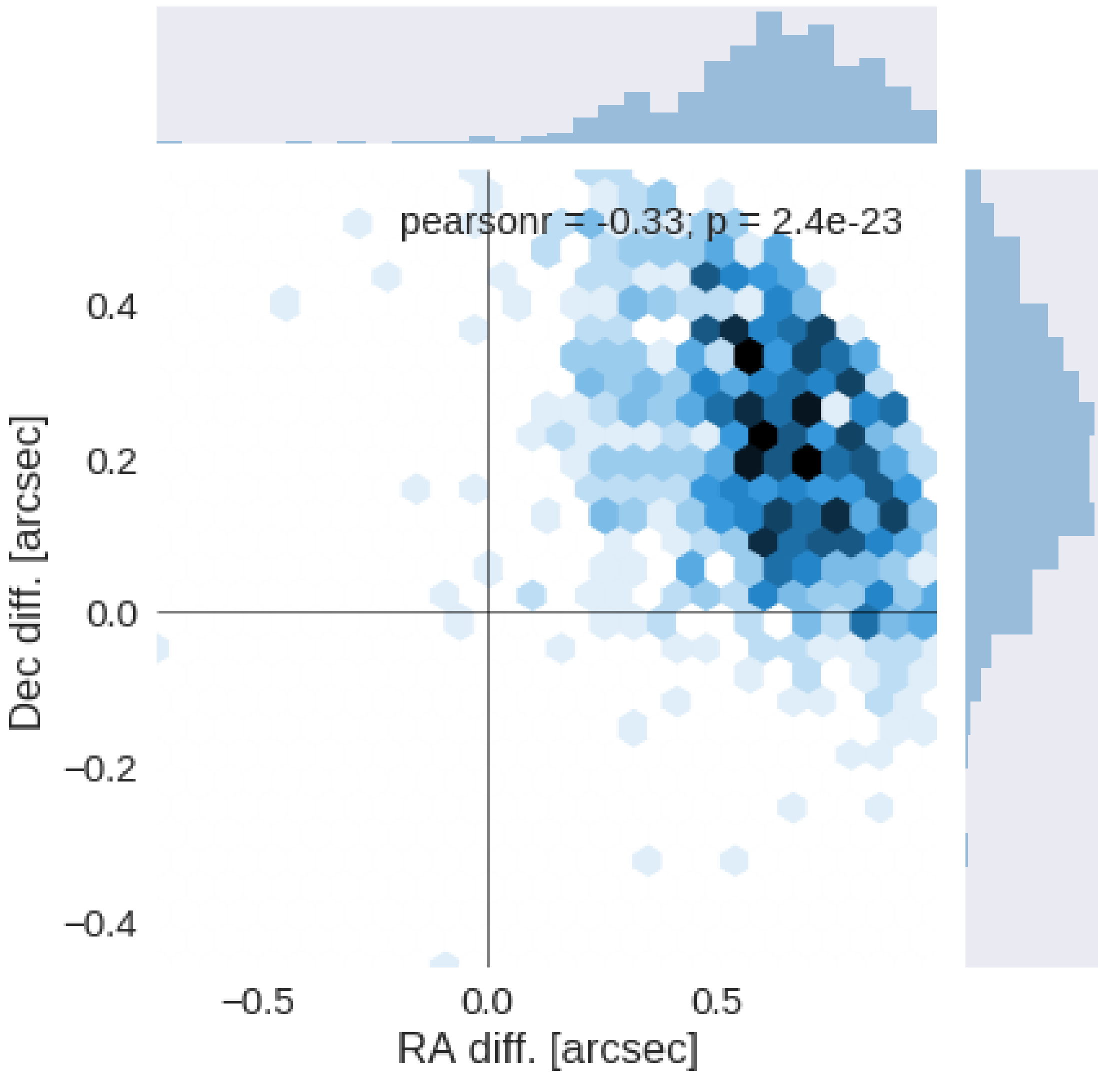
We remove duplicated objects from the input catalogues.

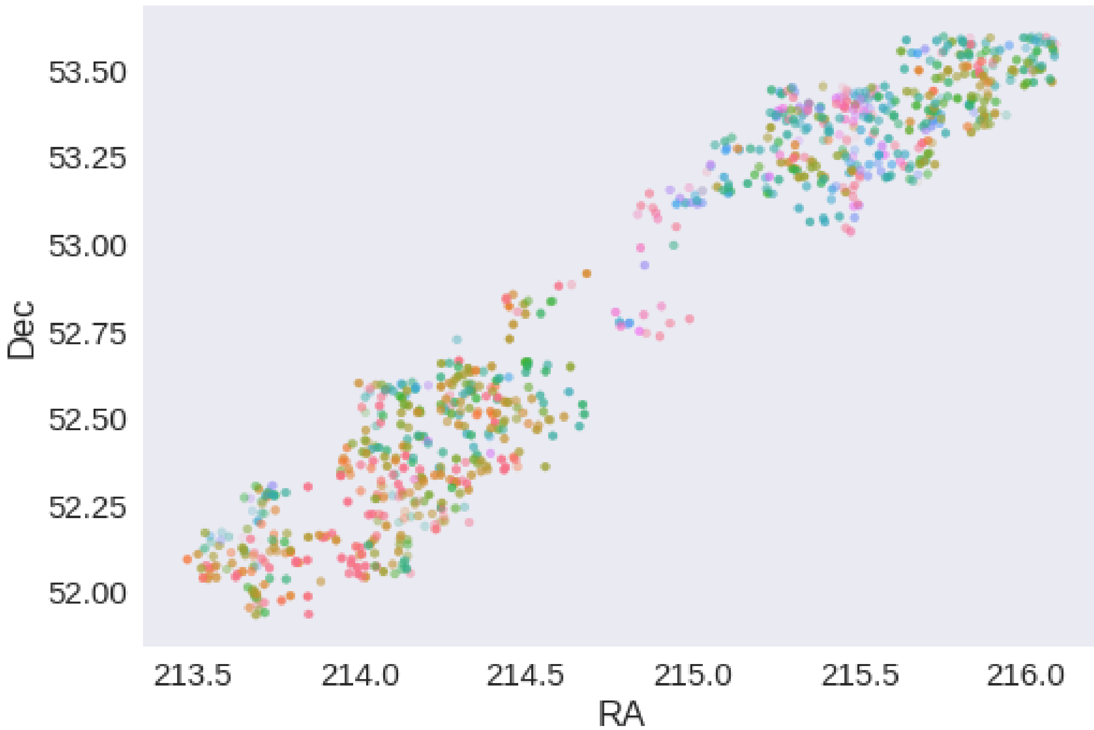
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 45065 sources.
The cleaned catalogue has 45065 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

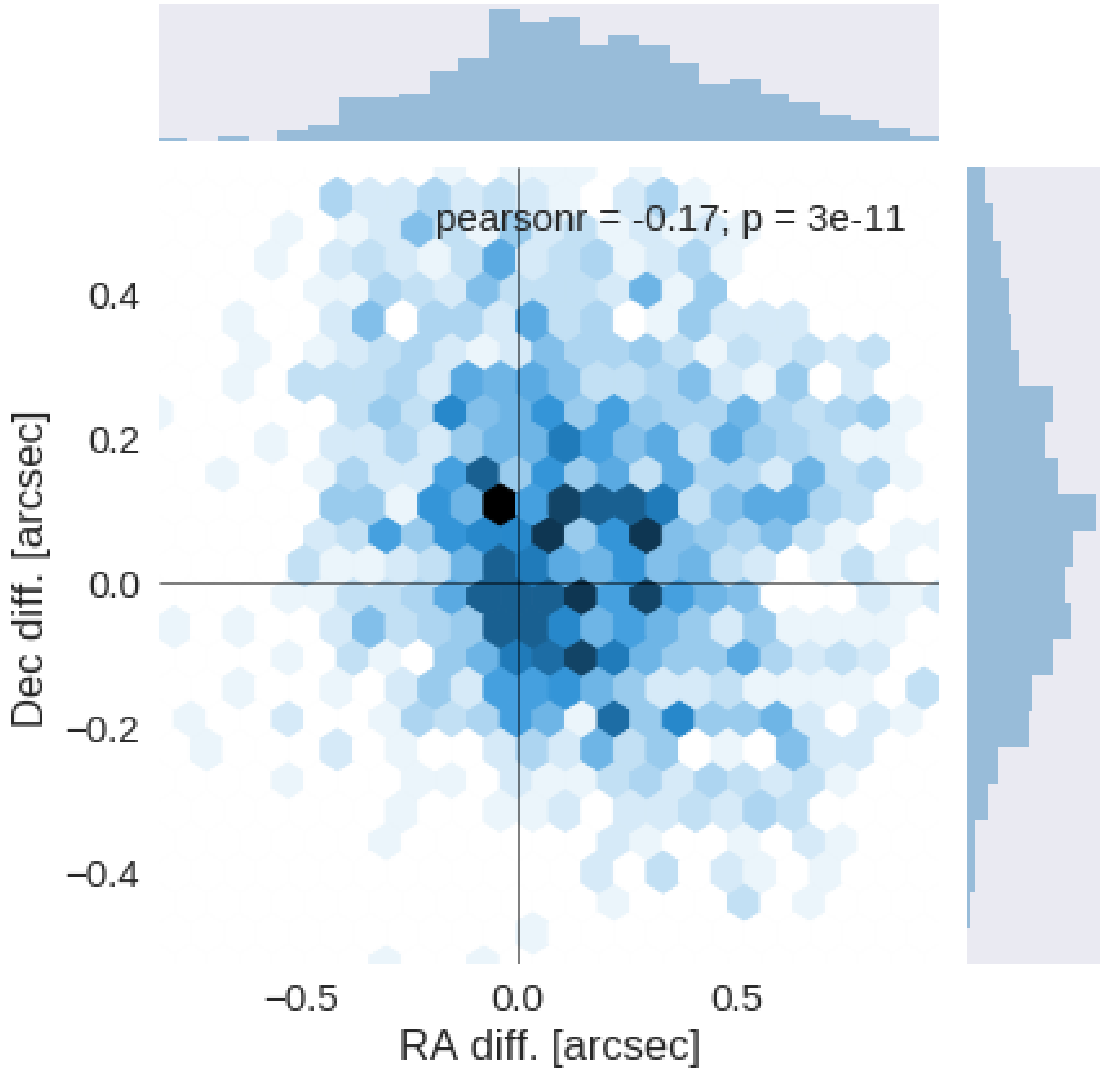
0.5 III - Astrometry correction

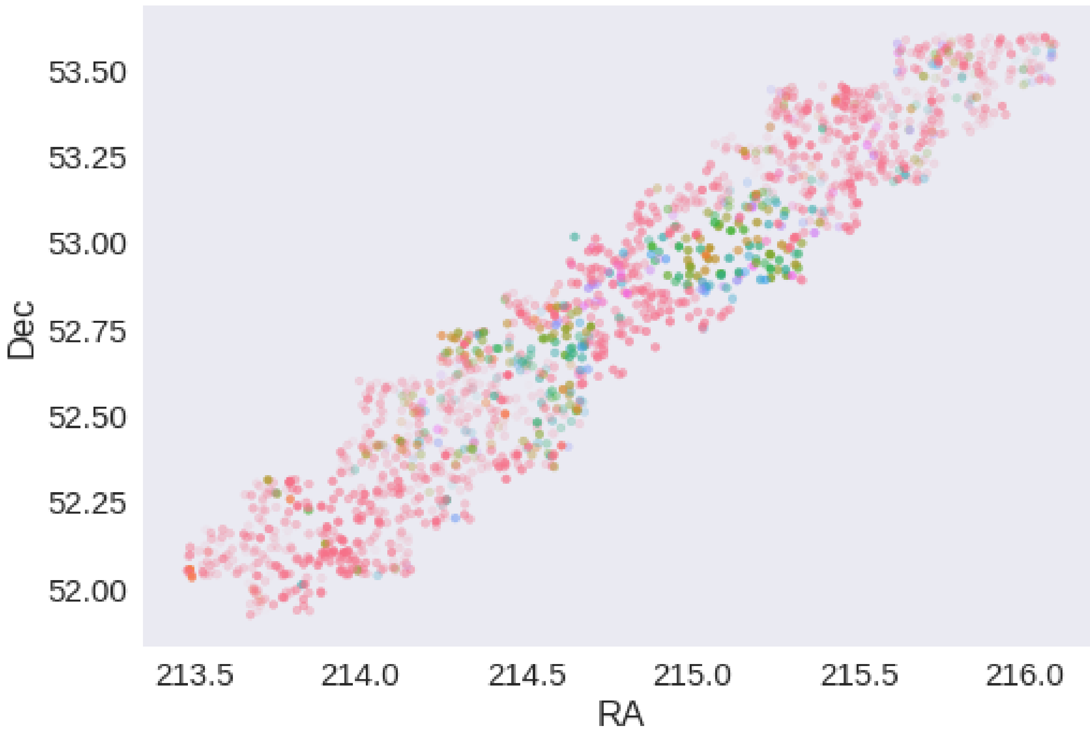
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: -0.6291472751286165 arcsec
Dec correction: -0.21136460382251698 arcsec
```


pearsonr = -0.17; p = 3e-11
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]



0.6 IV - Flagging Gaia objects

```
1680 sources flagged.
```

1 V - Saving to disk

1.2_CANDELS-3D-HST

January 18, 2018

1 EGS master catalogue

1.1 Preparation of HST CANDELS-3D data

The catalogue comes from `dmu0_CANDELS-3D-HST`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The kron magnitude, there doesn't appear to be aperture magnitudes. This may mean the survey is unusable.

```
This notebook was run with herschelhelp_internal version:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

1.2 I - Column selection

```
WARNING: UnitsWarning: '0.3631uJy' did not parse as fits unit: Numeric factor not supported by F
WARNING: UnitsWarning: '[Msun]' did not parse as fits unit: Invalid character at col 0 [astropy.


/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: invalid value enco
  errors = 2.5 / np.log(10) * errors_on_fluxes / fluxes
/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

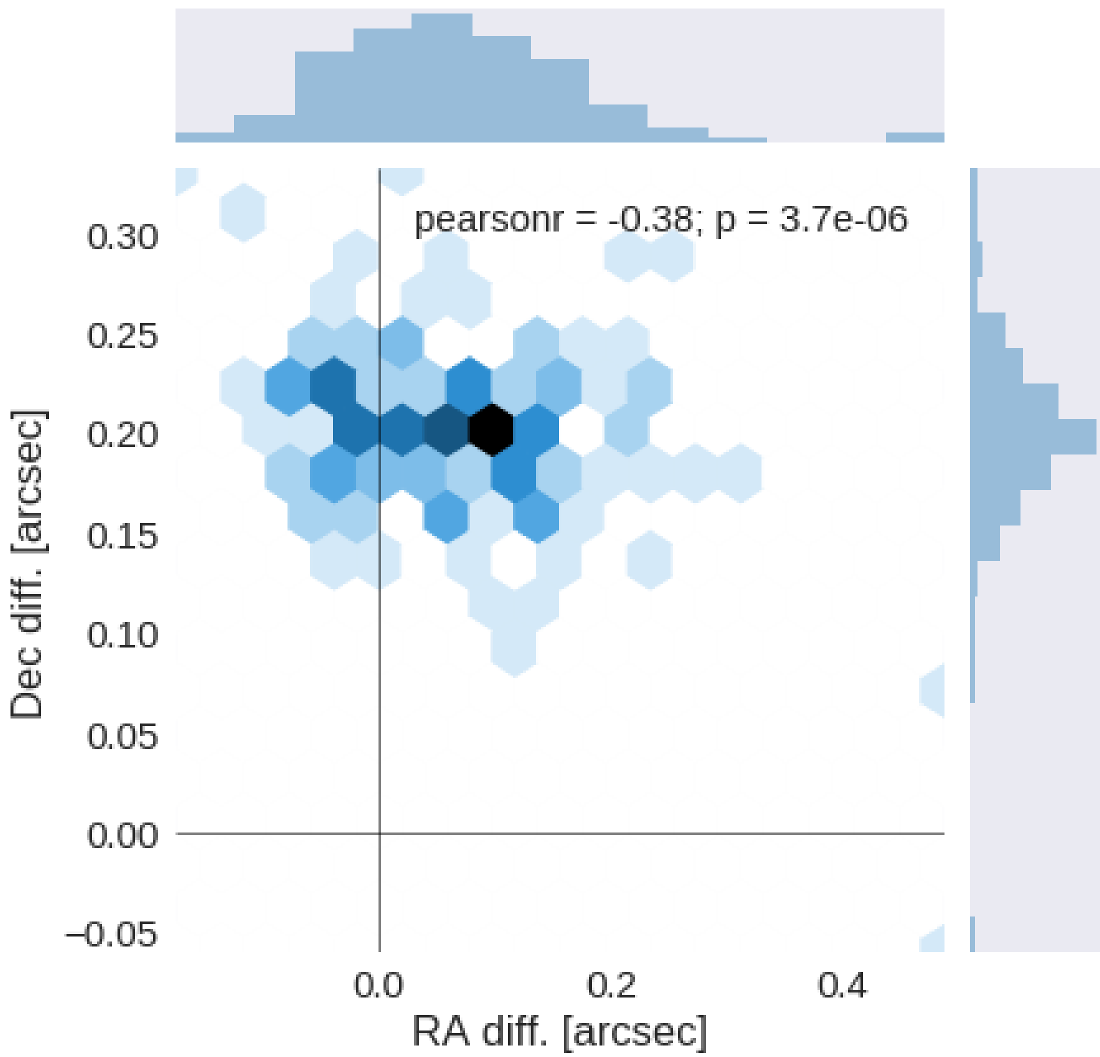
We remove duplicated objects from the input catalogues.

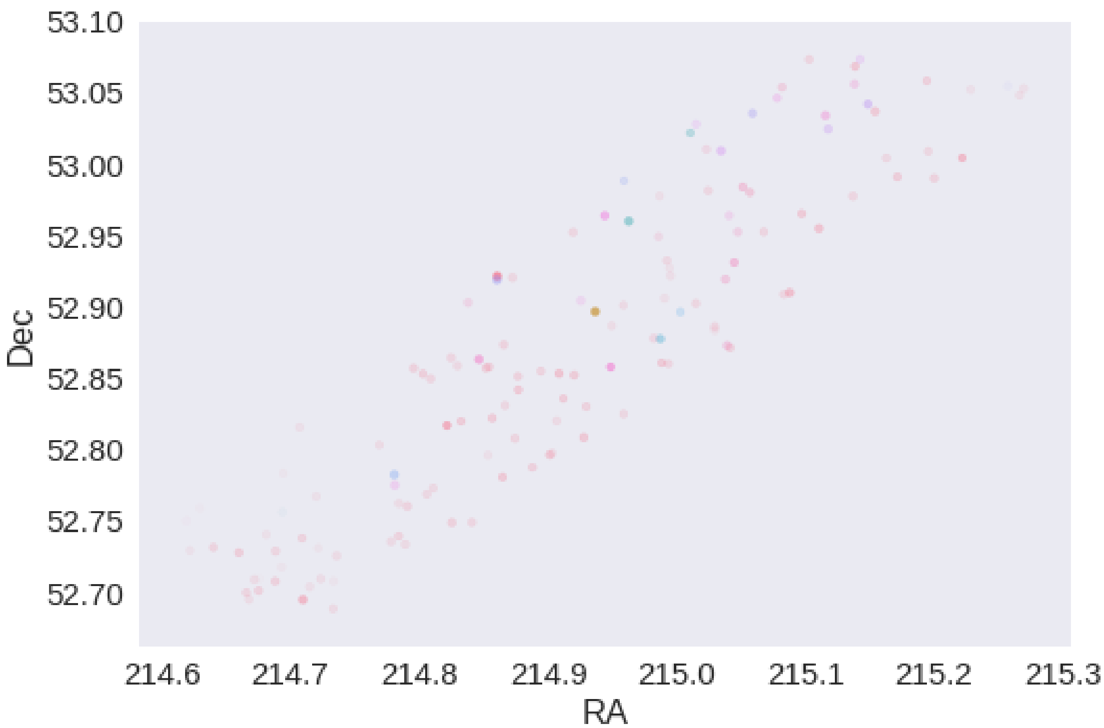
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 41200 sources.
The cleaned catalogue has 41067 sources (133 removed).
The cleaned catalogue has 133 sources flagged as having been cleaned
```

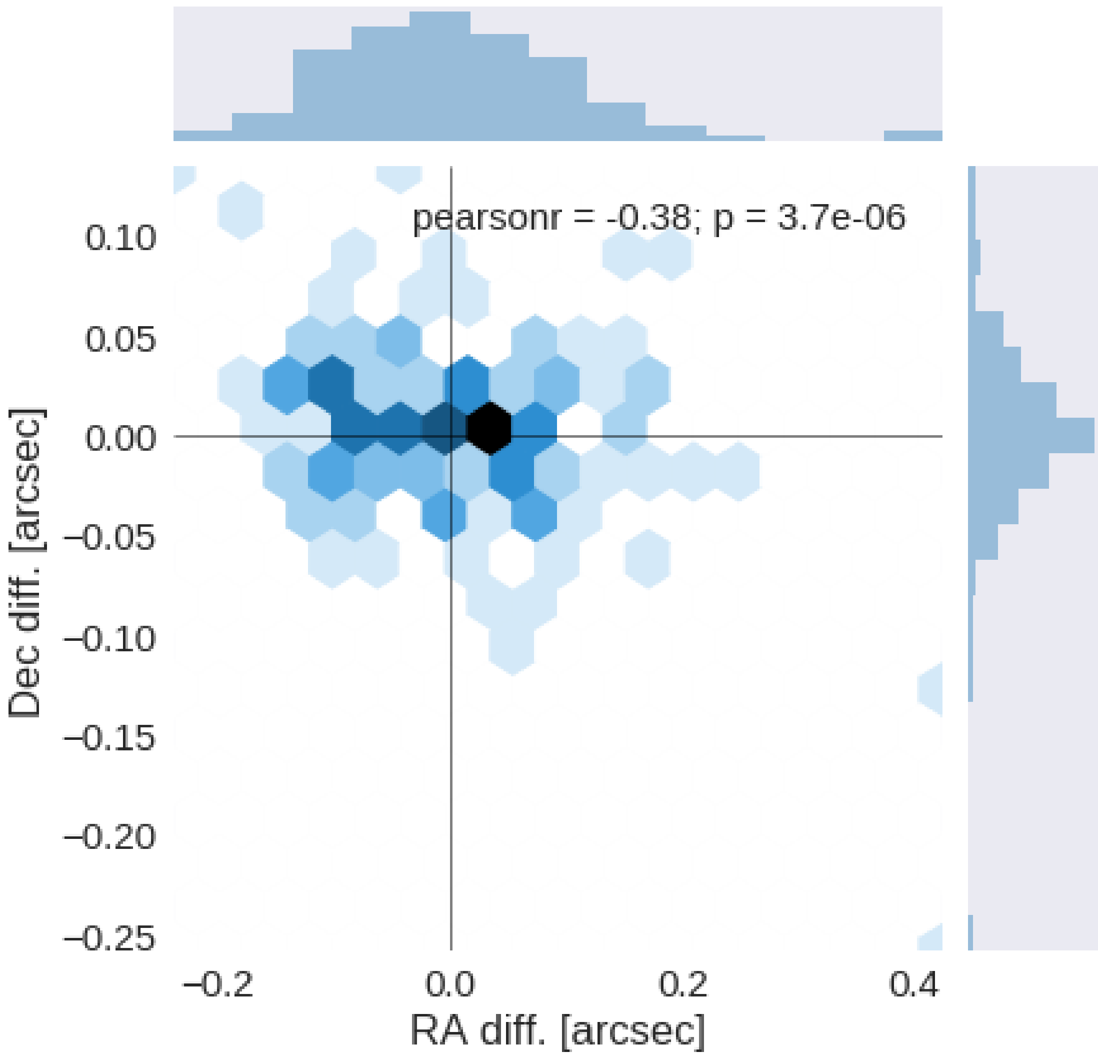
1.4 III - Astrometry correction

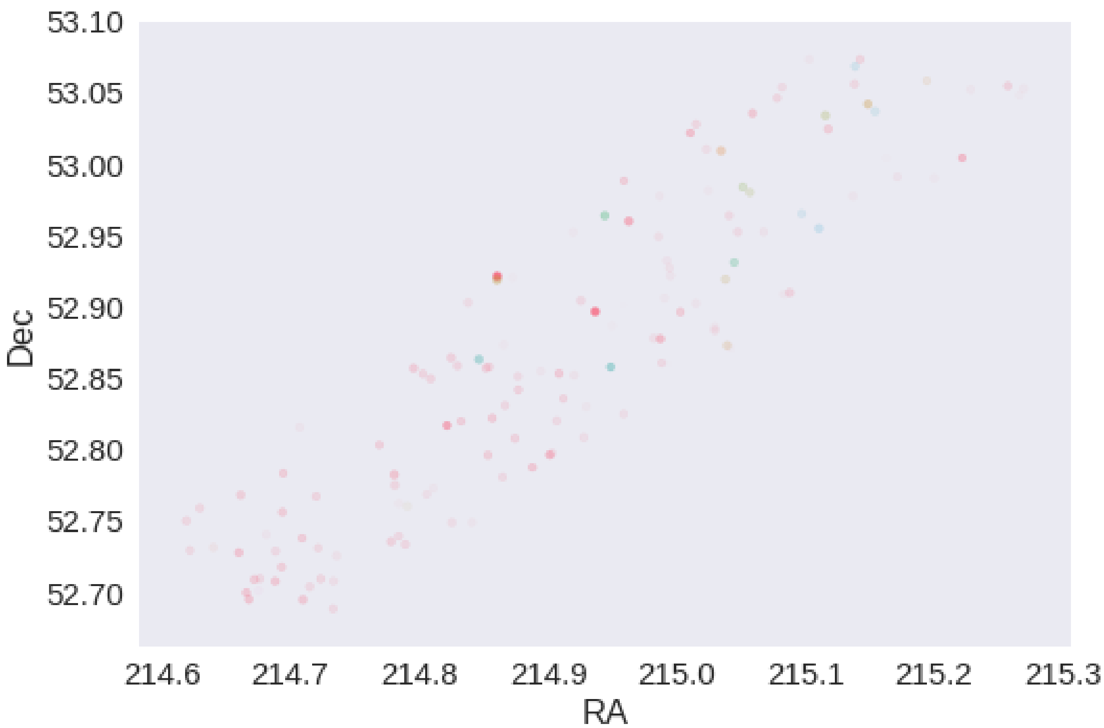
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: -0.06336958314250296 arcsec
Dec correction: -0.19814636340669267 arcsec
```


pearsonr = -0.38; p = 3.7e-06
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
−0.25
Dec diff. [arcsec]
−0.2
0.0
0.2
0.4
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
145 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.3_CFHT-WIRDS

January 18, 2018

1 EGS master catalogue

1.1 Preparation of Canada France Hawaii Telescope WIRDS Survey (CFHT-WIRDS) data

The catalogue is in `dmu0_CFHT-WIRDS`.

In the catalogue, we keep:

- The position;
- The stellarity;
- The aperture magnitude (3 arcsec).
- The total magnitude (Kron like aperture magnitude).

```
This notebook was run with herschelhelp_internal version:
44f1ae0 (Thu Nov 30 18:27:54 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)
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:63:
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:64:
```

```
Out[5]: <IPython.core.display.HTML object>
```

1.3 II - Removal of duplicated sources

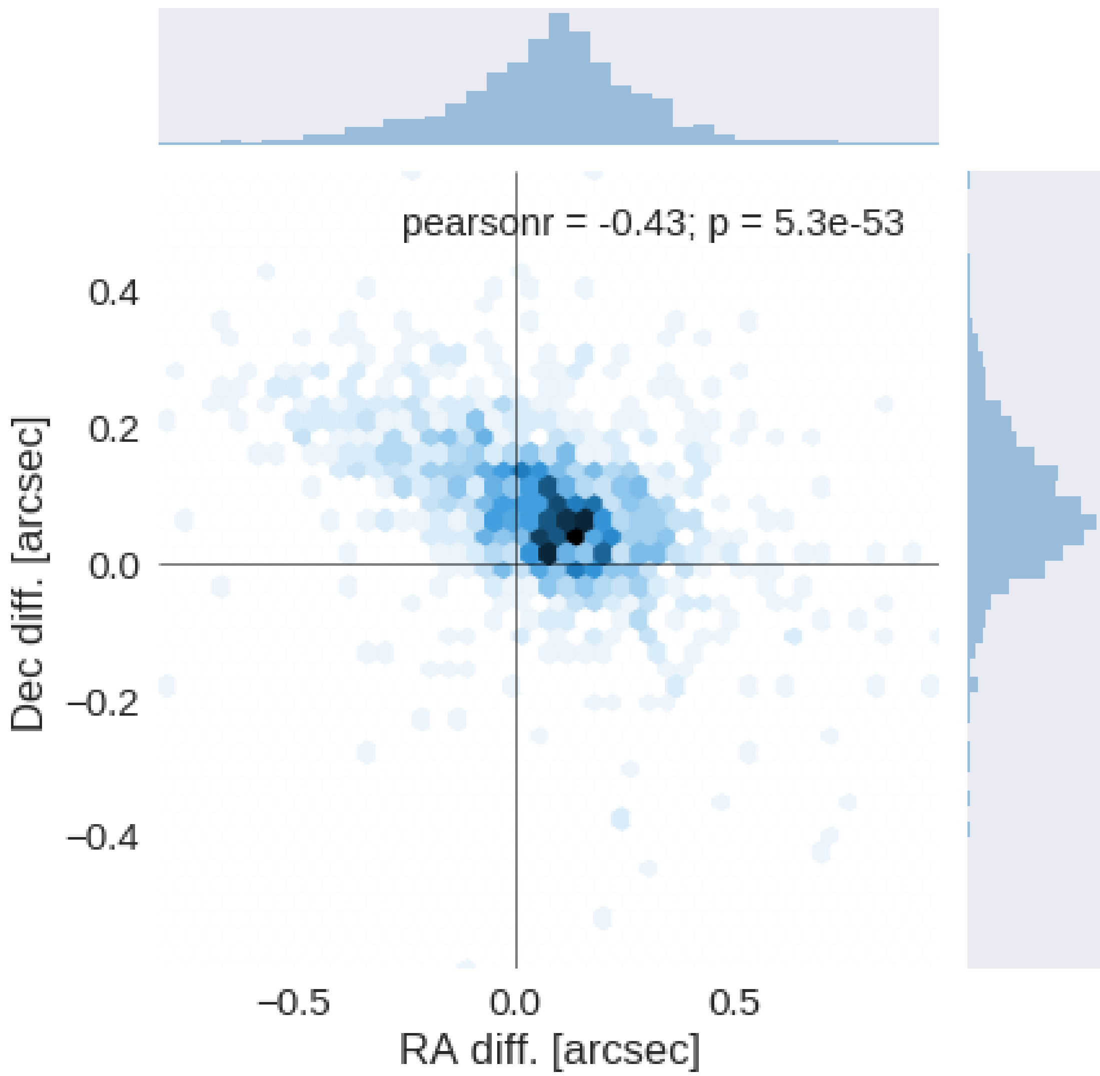
We remove duplicated objects from the input catalogues.

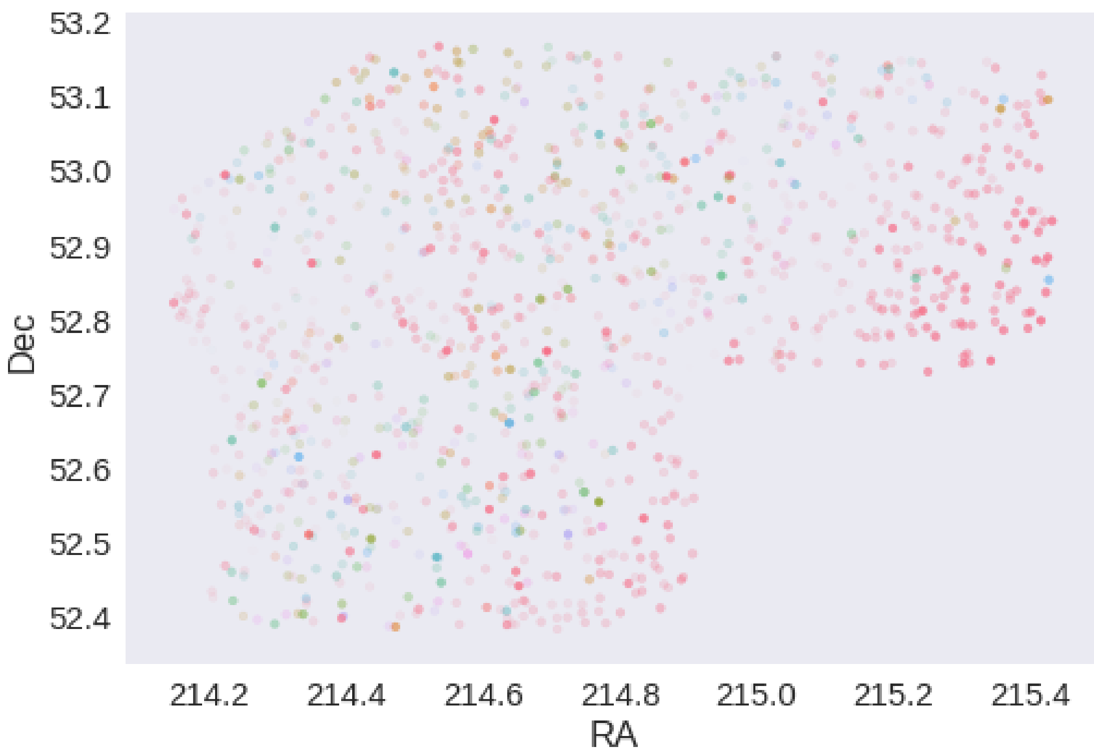
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 100317 sources.
The cleaned catalogue has 100317 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

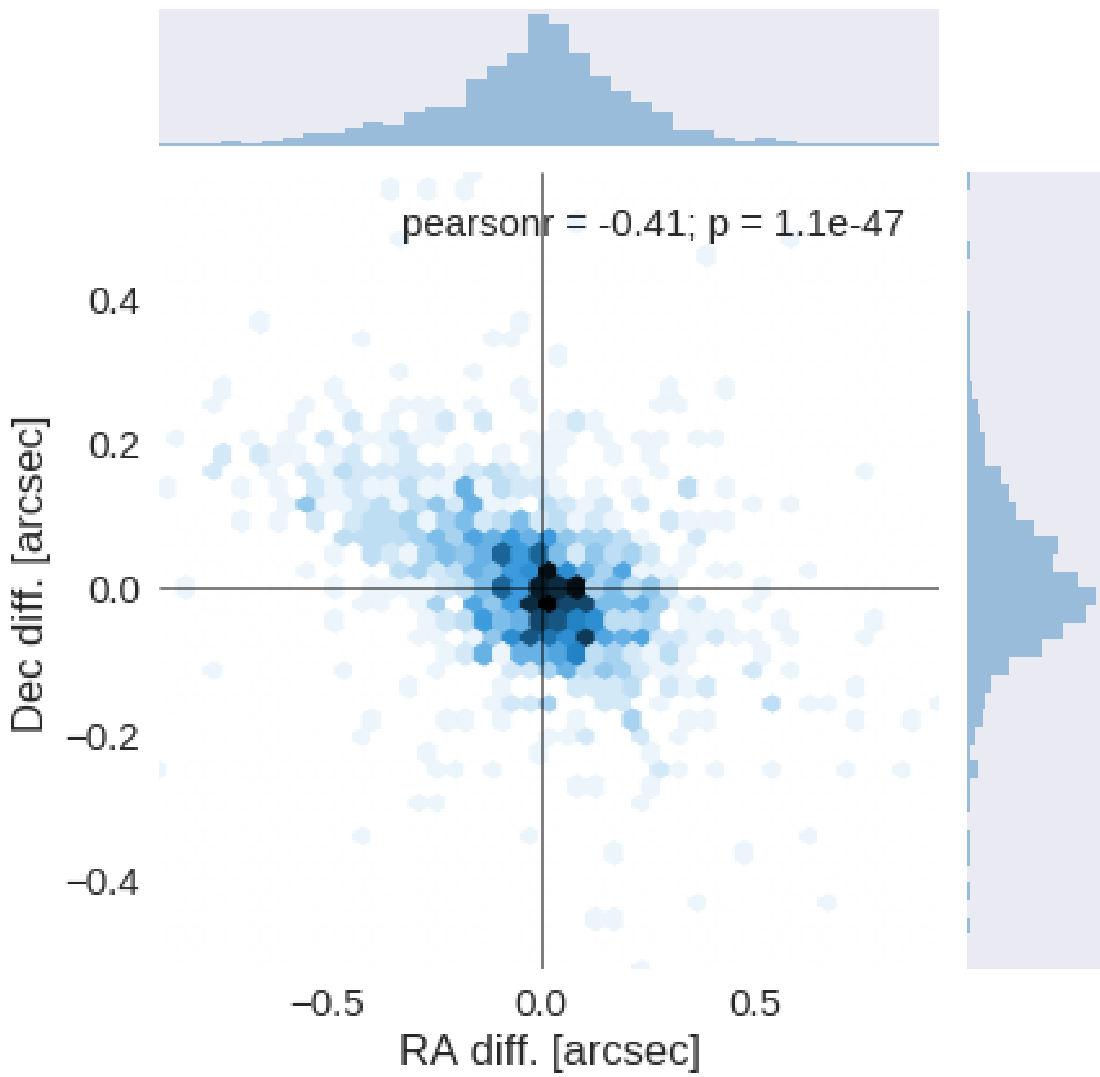
1.4 III - Astrometry correction

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.

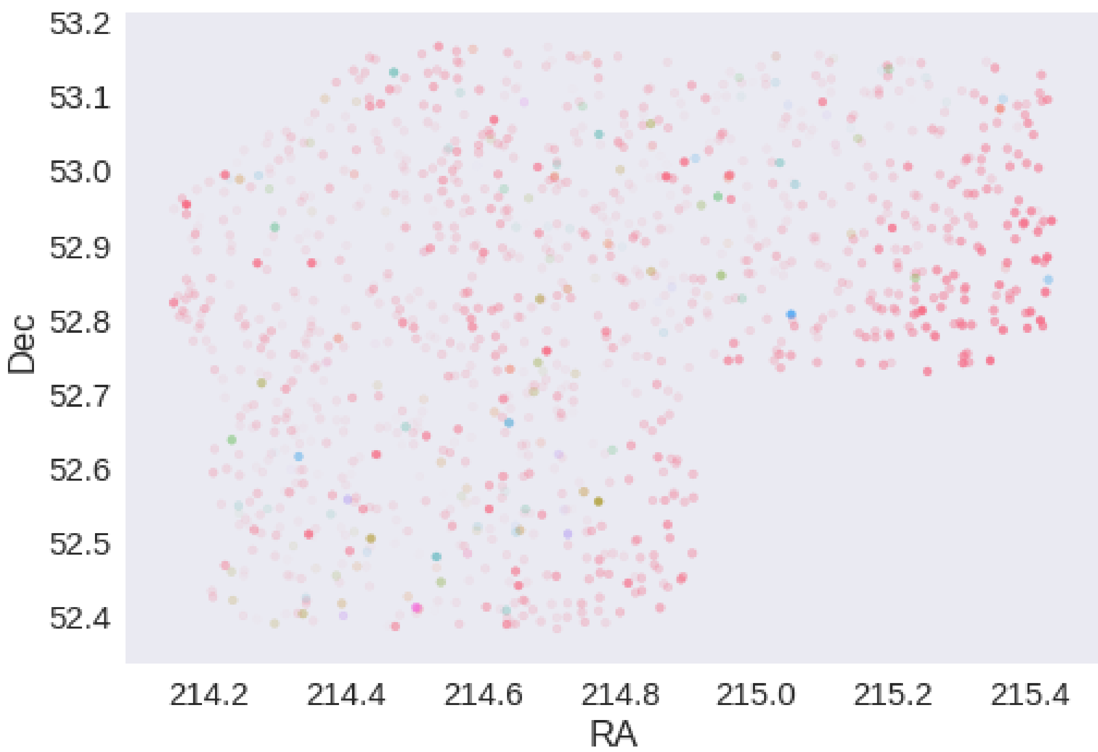





```
RA correction: -0.08794029236014467 arcsec
Dec correction: -0.0733593735006366 arcsec
```



pearsonr = -0.41; p = 1.1e-47
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
1193 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.4a_CFHTLS-WIDE

January 18, 2018

1 EGS master catalogue

1.1 Preparation of Canada France Hawaii Telescope Legacy Survey (CFHTLS) wide data

CFHTLS has both a wide area across EGS and a smaller deep field. We will process each independently and add them both to the master catalogue, taking the deep photometry where both are available.

The catalogue is in `dmu0_CFHTLS`.

In the catalogue, we keep:

- The position;
- The stellarity (g band stellarity);
- The aperture magnitude (3 arcsec).
- The total magnitude (Kron like aperture magnitude).

We use the 2007 release, which we take as the date.

```
This notebook was run with herschelhelp_internal version:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

1.2 I - Column selection

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

1.3 II - Removal of duplicated sources

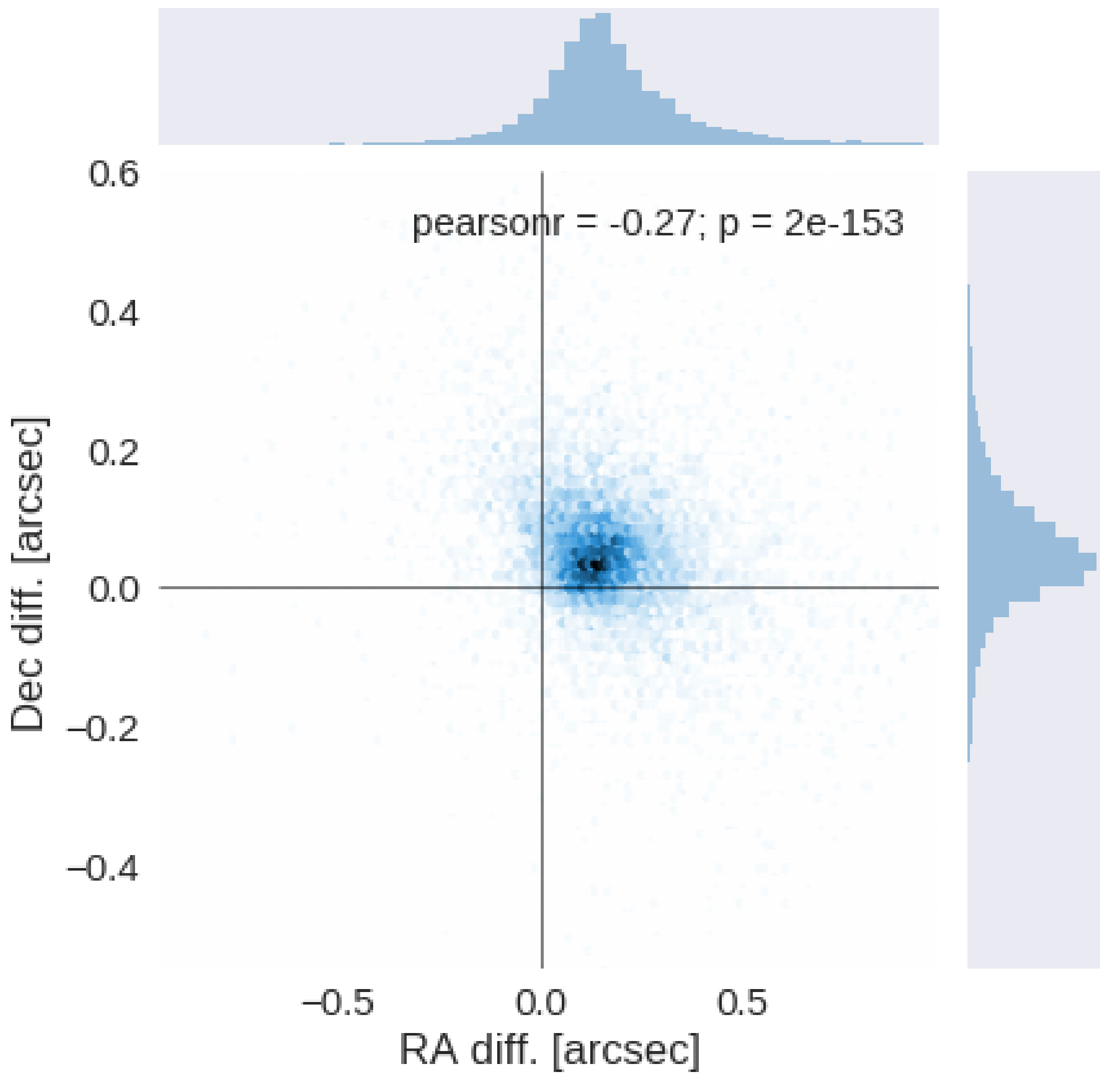
We remove duplicated objects from the input catalogues.

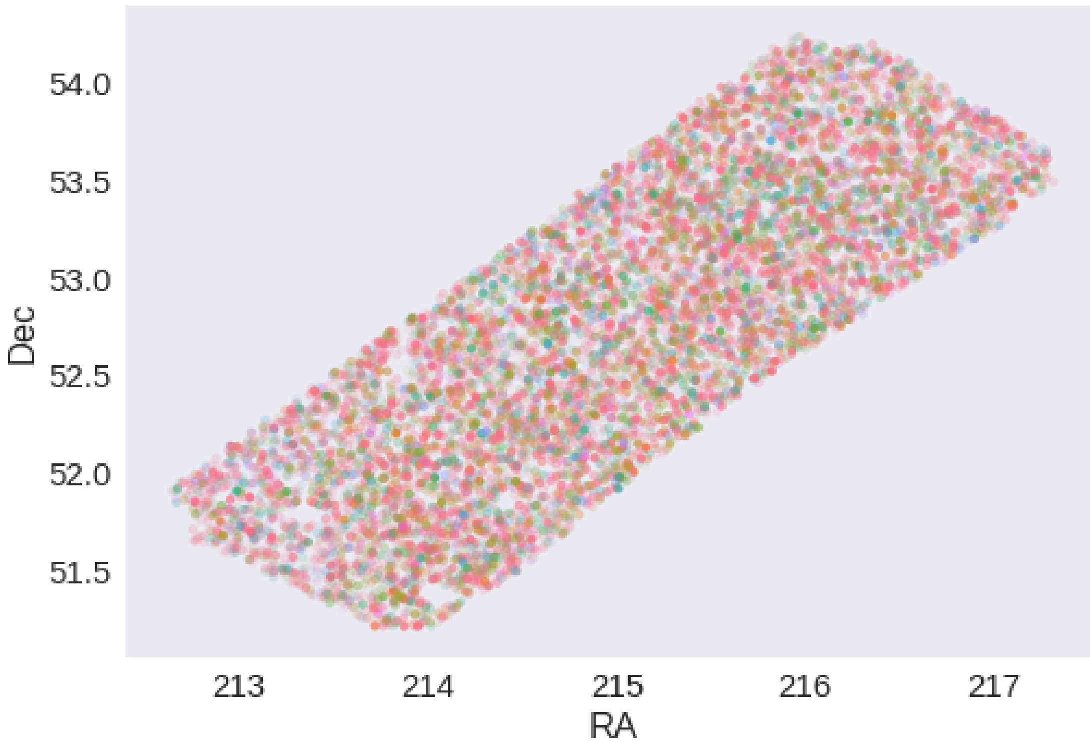
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 780583 sources.
The cleaned catalogue has 780559 sources (24 removed).
The cleaned catalogue has 24 sources flagged as having been cleaned
```

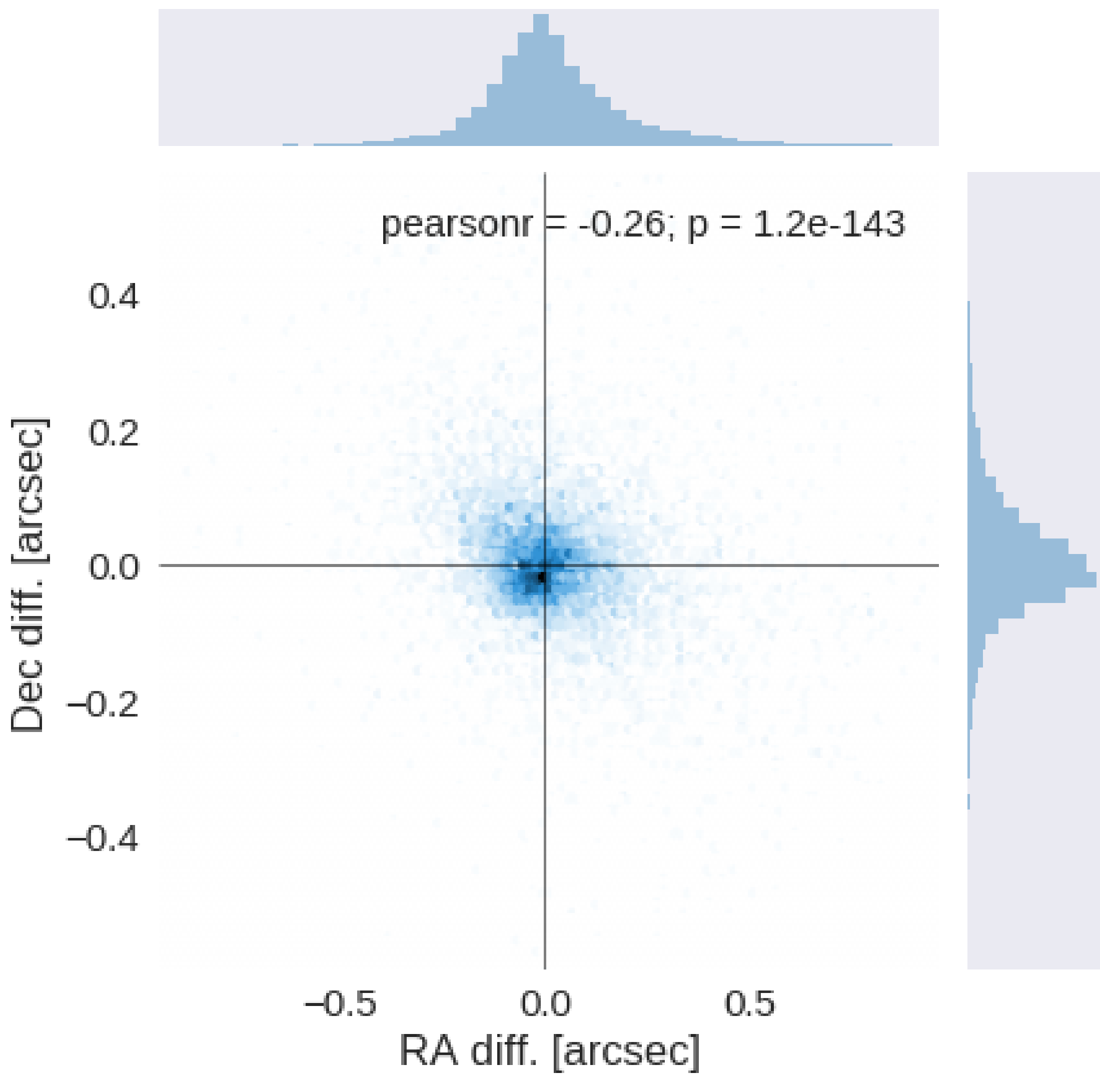
1.4 III - Astrometry correction

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.

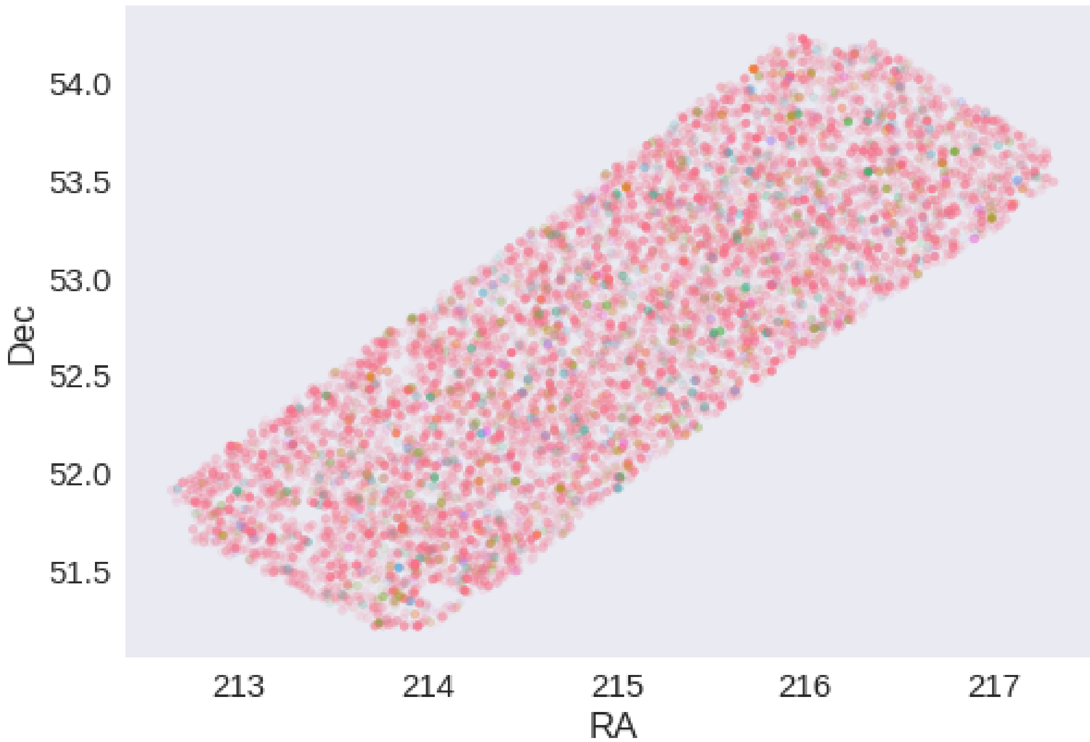





```
RA correction: -0.148947314437746423 arcsec
Dec correction: -0.04603114763597205 arcsec
```



pearsonr = -0.26; p = 1.2e-143
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
9254 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.4b_CFHTLS-DEEP

January 18, 2018

1 EGS master catalogue

1.1 Preparation of Canada France Hawaii Telescope Legacy Survey (CFHTLS) data

The catalogue is in `dmu0_CFHTLS`.

In the catalogue, we keep:

- The position;
- The stellarity (g band stellarity);
- The aperture magnitude (3 arcsec).
- The total magnitude (Kron like aperture magnitude).

We use the 2007 release, which we take as the date.

```
This notebook was run with herschelhelp_internal version:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

1.2 I - Column selection

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

1.3 II - Removal of duplicated sources

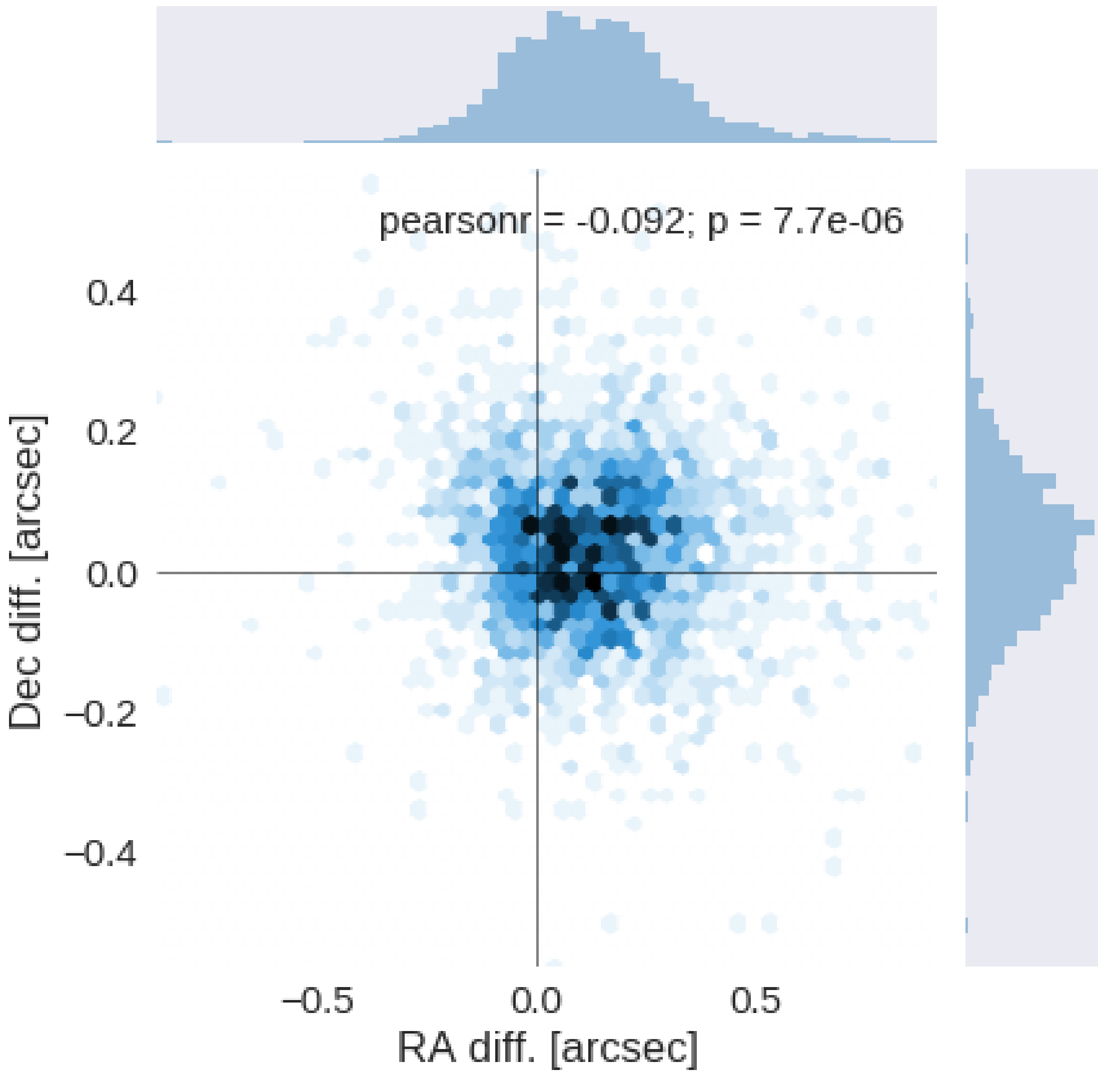
We remove duplicated objects from the input catalogues.

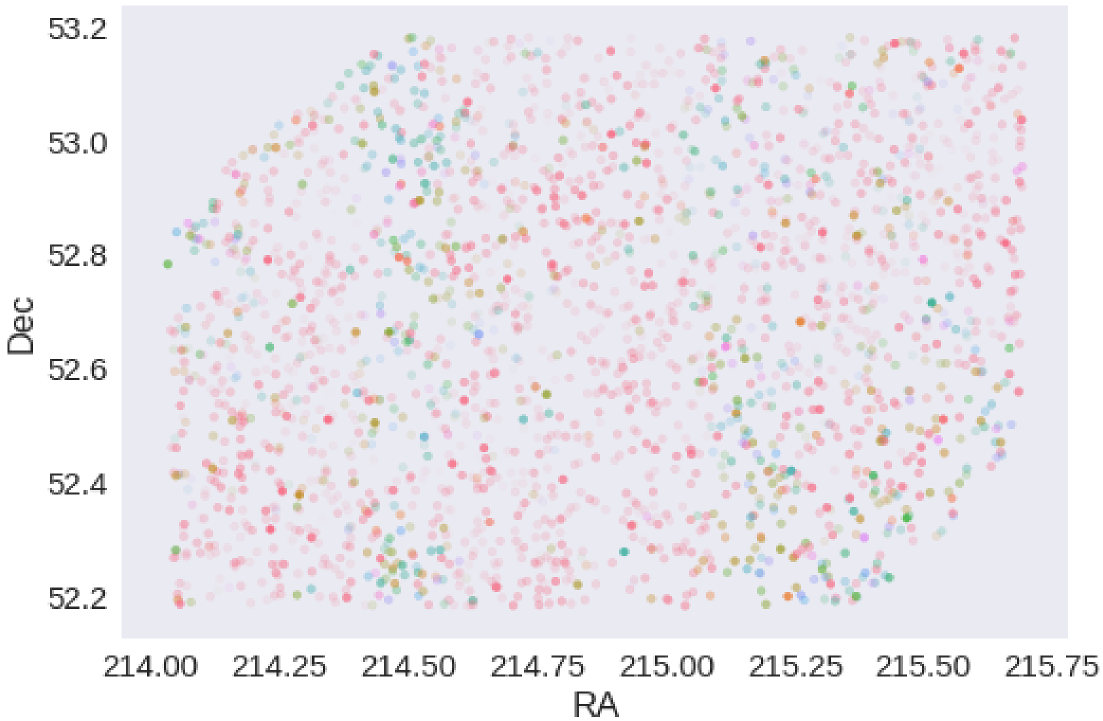
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)


The initial catalogue had 566572 sources.
The cleaned catalogue has 566572 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

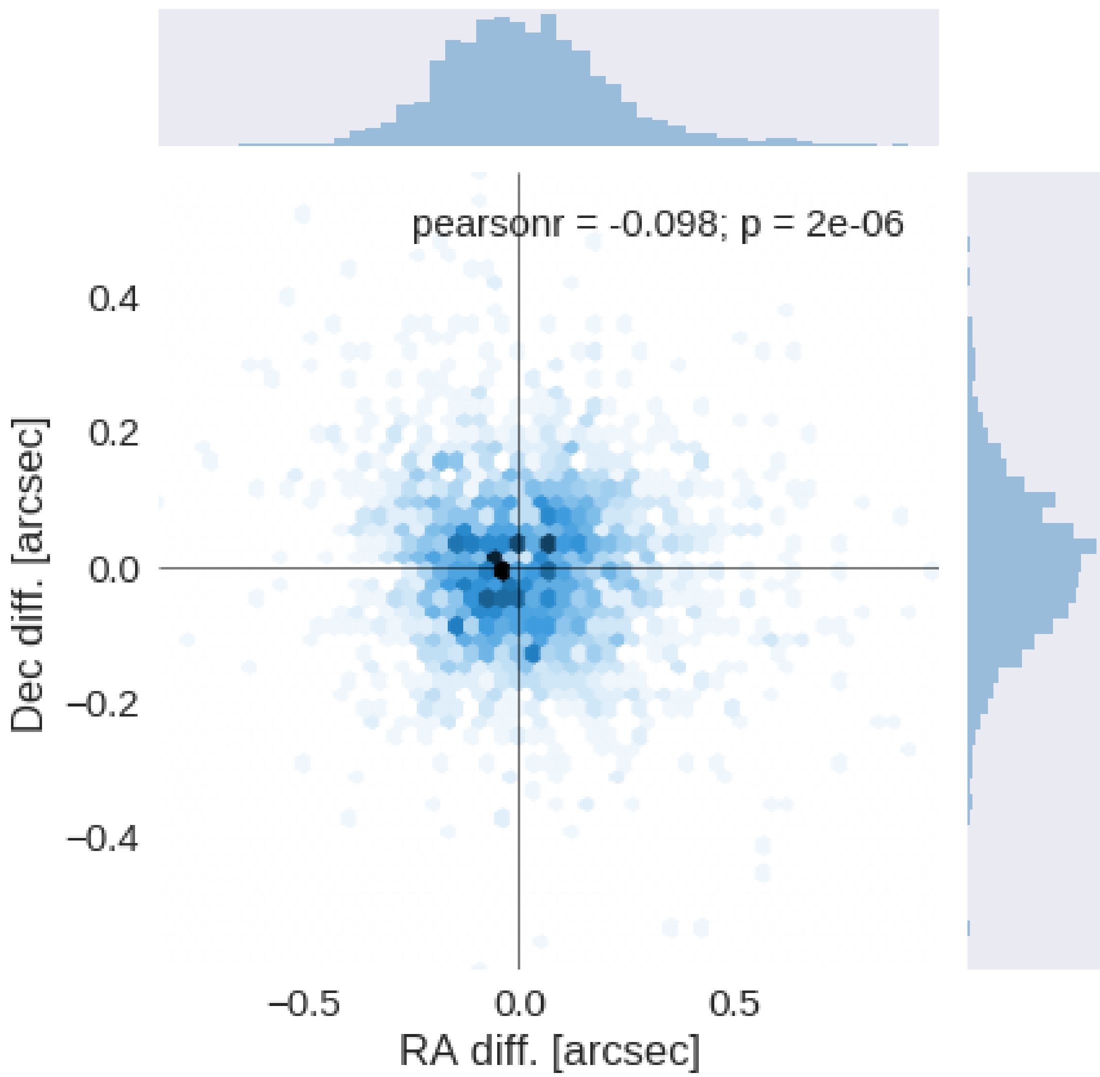
1.4 III - Astrometry correction

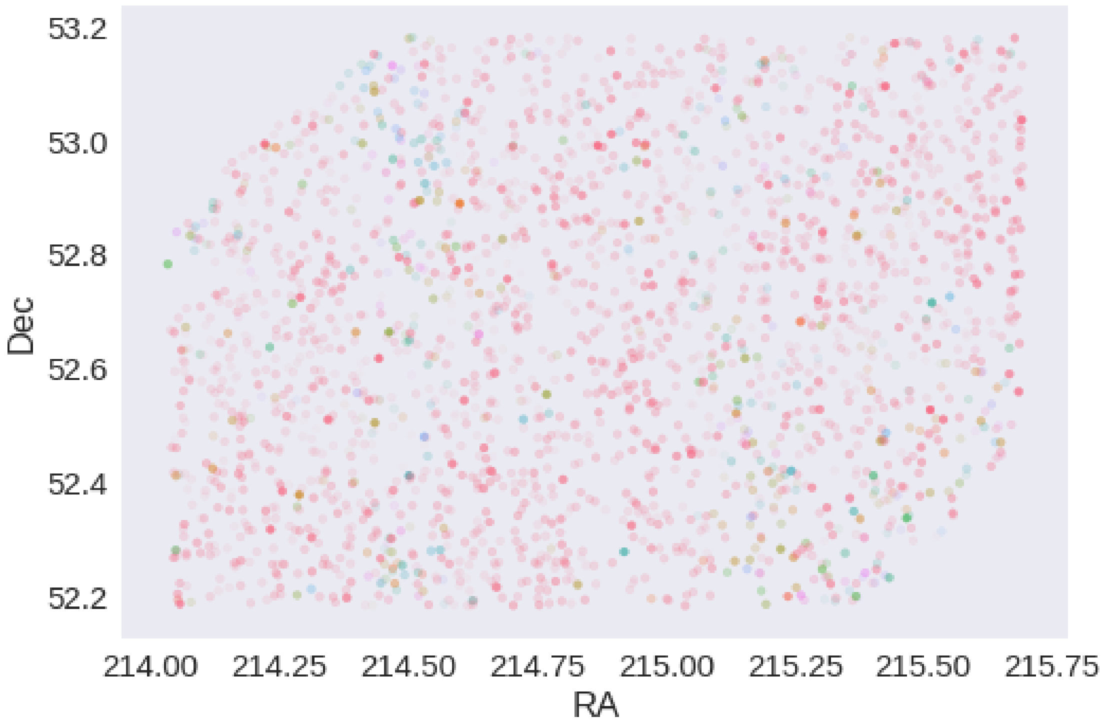
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: -0.11242272060485448 arcsec
Dec correction: -0.033367632829595095 arcsec
```


pearsonr = -0.098; p = 2e-06
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
2390 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.5_CFHTLenS

January 18, 2018

1 EGS master catalogue

1.1 Preparation of Canada France Hawaii Telescope Lensing Survey (CFHTLenS) data

CFHTLenS catalogue: the catalogue comes from `dmu0_CFHTLenS`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The kron magnitude, there doesn't appear to be aperture magnitudes. This may mean the survey is unusable.

We use the publication year 2012 for the epoch.

```
This notebook was run with herschelhelp_internal version:
44f1ae0 (Thu Nov 30 18:27:54 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)
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:10:
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:11:
```

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

1.3 II - Removal of duplicated sources

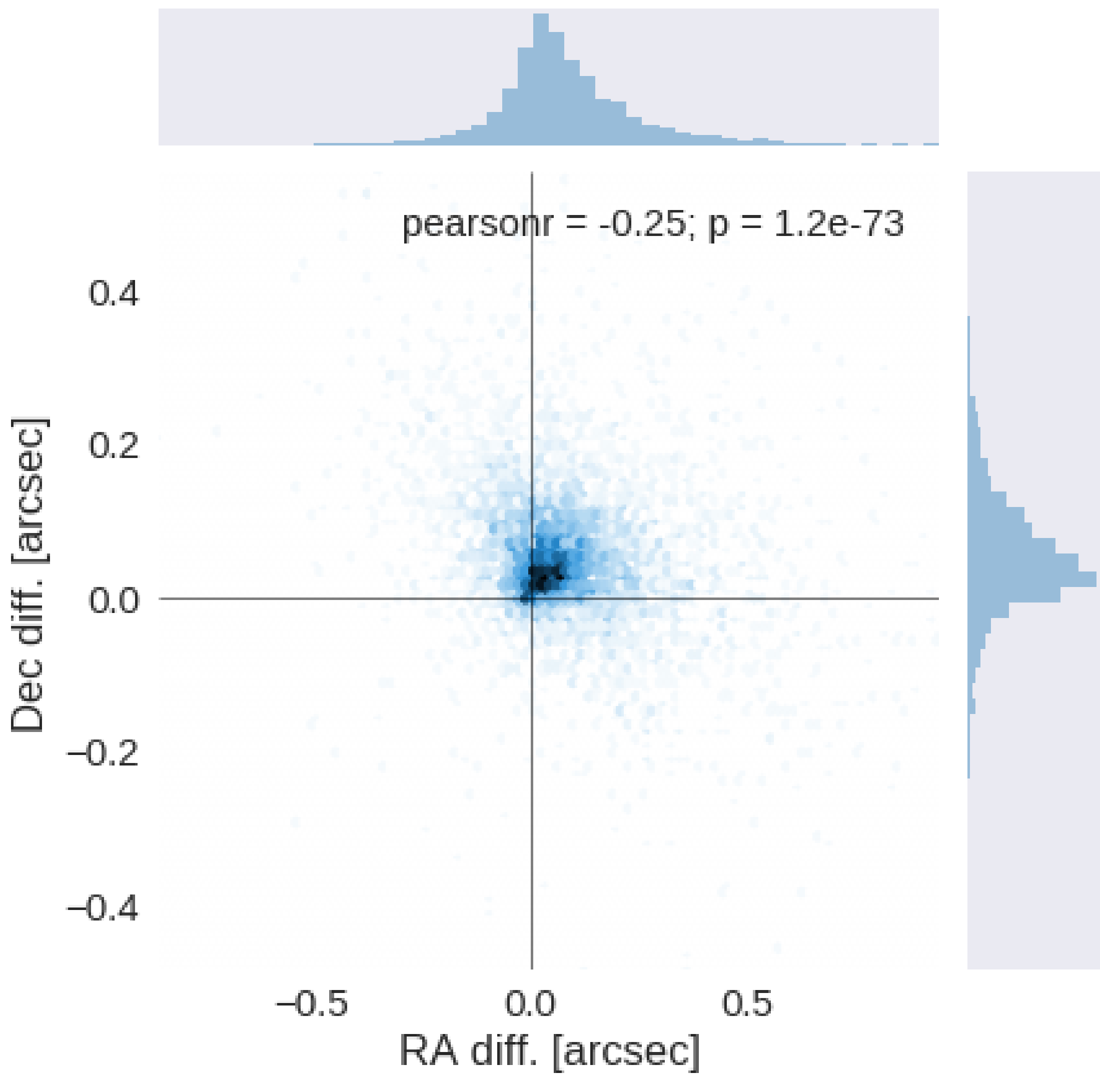
We remove duplicated objects from the input catalogues.

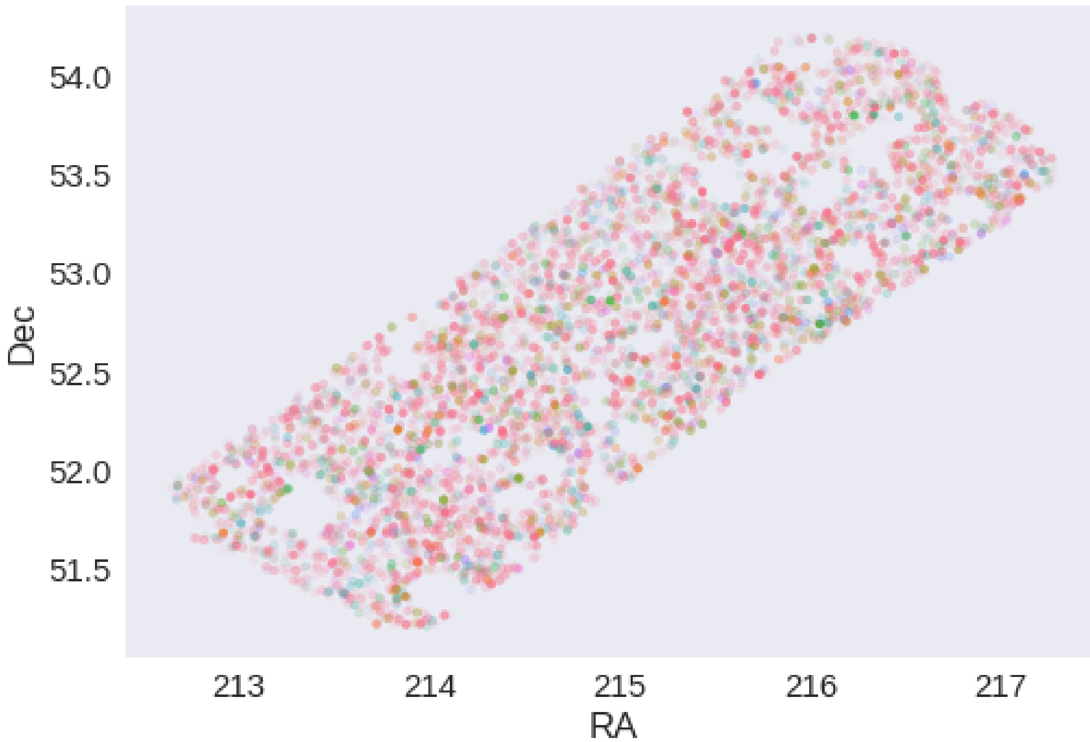
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 466735 sources.
The cleaned catalogue has 466731 sources (4 removed).
The cleaned catalogue has 4 sources flagged as having been cleaned
```

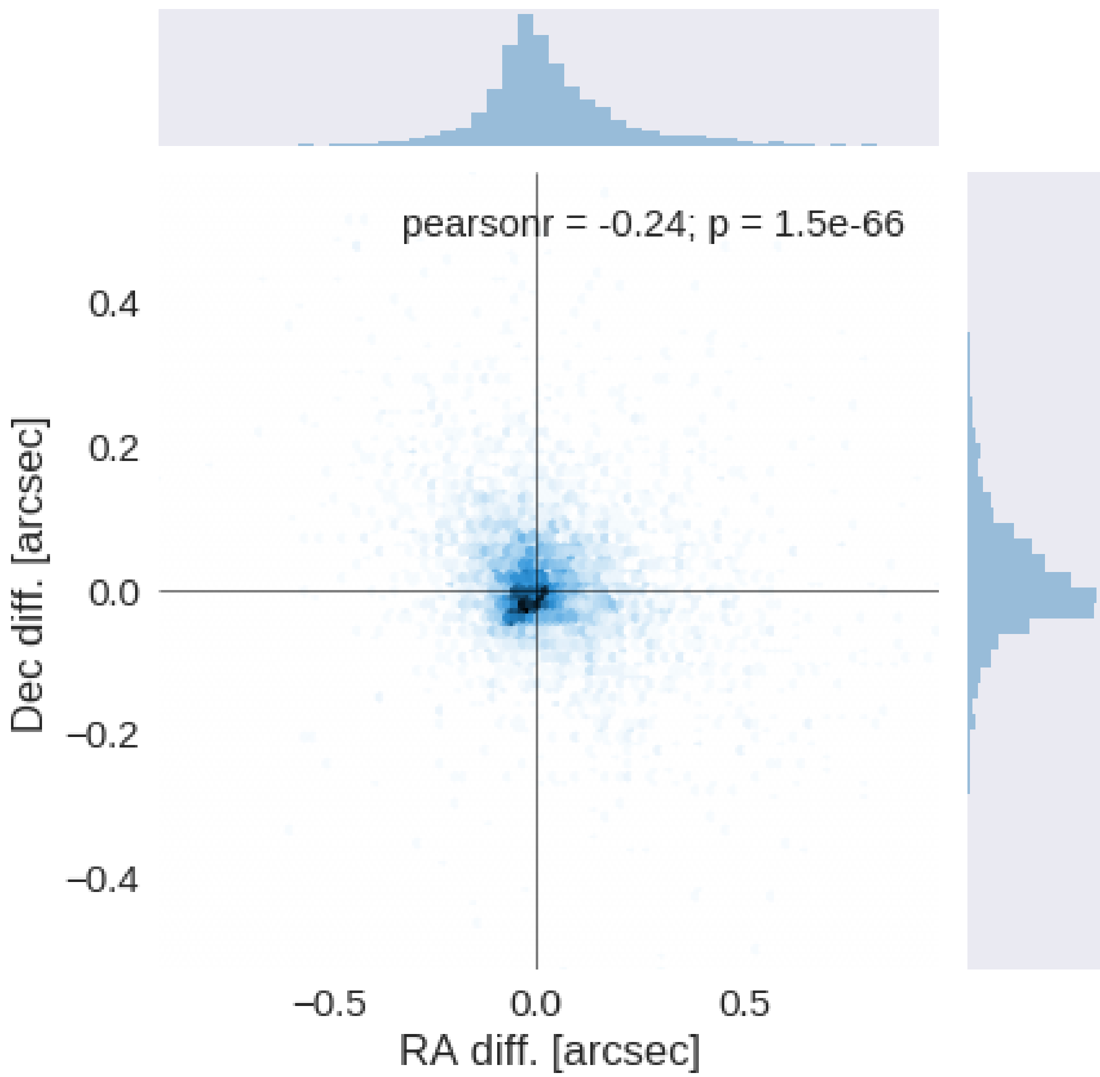
1.4 III - Astrometry correction

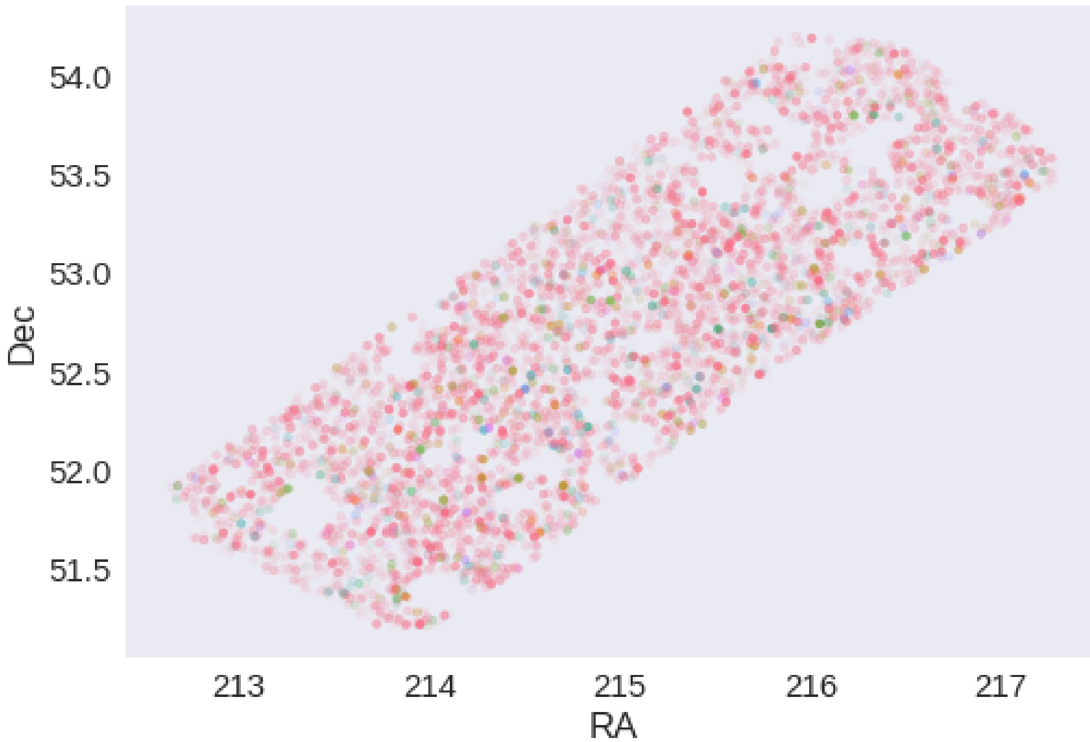
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: -0.054139660204555184 arcsec
Dec correction: -0.043344491388097595 arcsec
```


pearsonr = -0.24; p = 1.5e-66
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
5159 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.6_CANDELS-EGS

January 18, 2018

1 EGS master catalogue

1.1 Preparation of CANDELS-EGS data

CANDELS-EGS catalogue: the catalogue comes from `dmu0_CANDELS-EGS`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The magnitude for each band in 2 arcsec aperture (aperture 10).
- 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:
44f1ae0 (Thu Nov 30 18:27:54 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>
```

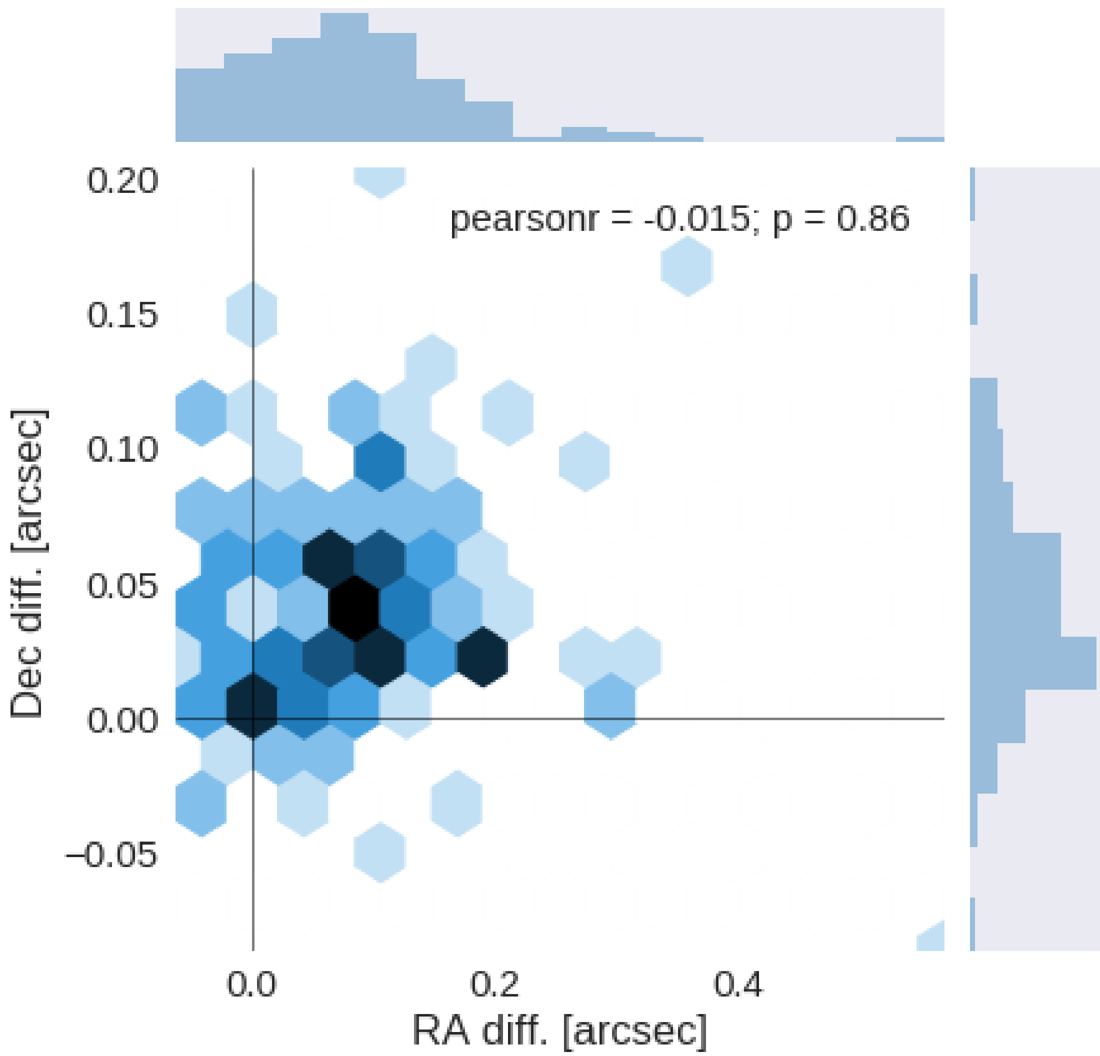
1.3 II - Removal of duplicated sources

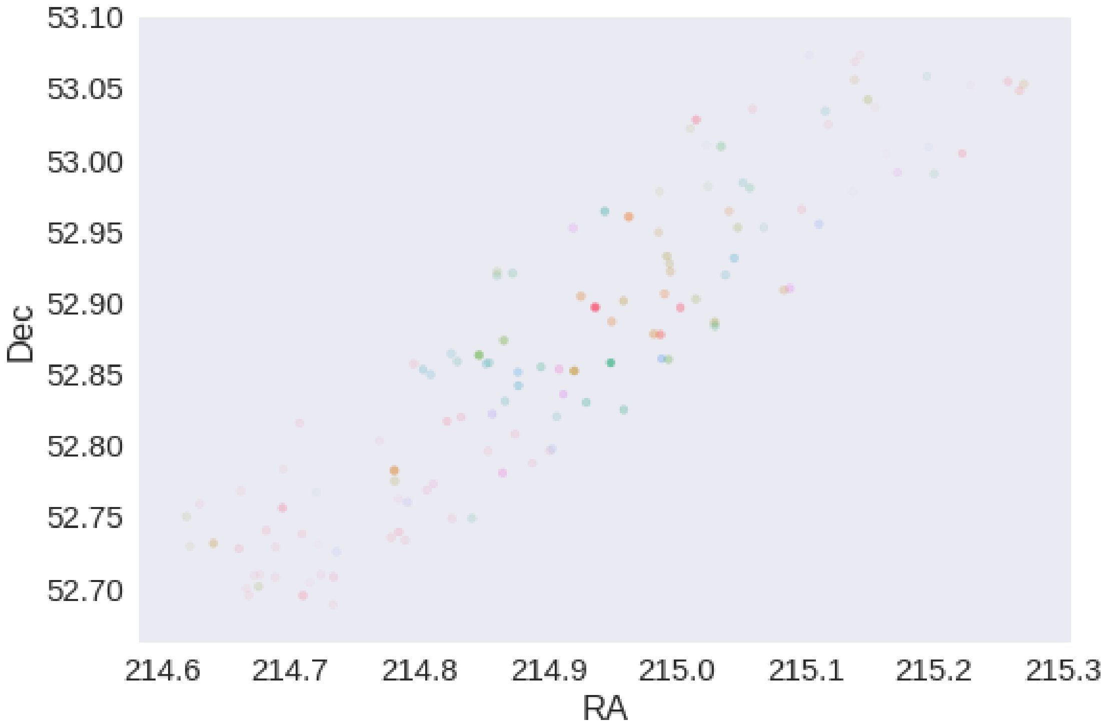
We remove duplicated objects from the input catalogues.

```
The initial catalogue had 41457 sources.
The cleaned catalogue has 41449 sources (8 removed).
The cleaned catalogue has 8 sources flagged as having been cleaned
```

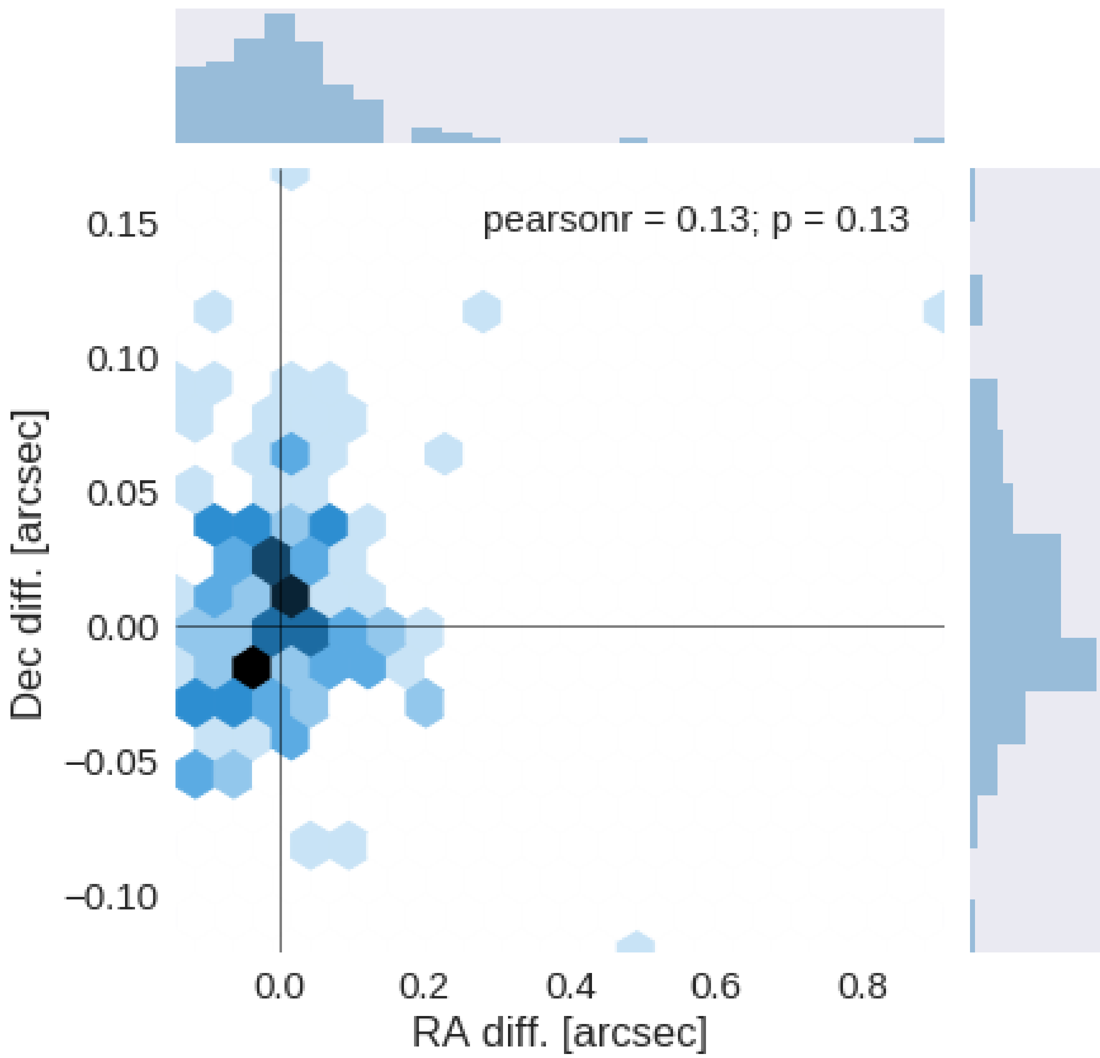
1.4 III - Astrometry correction

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.

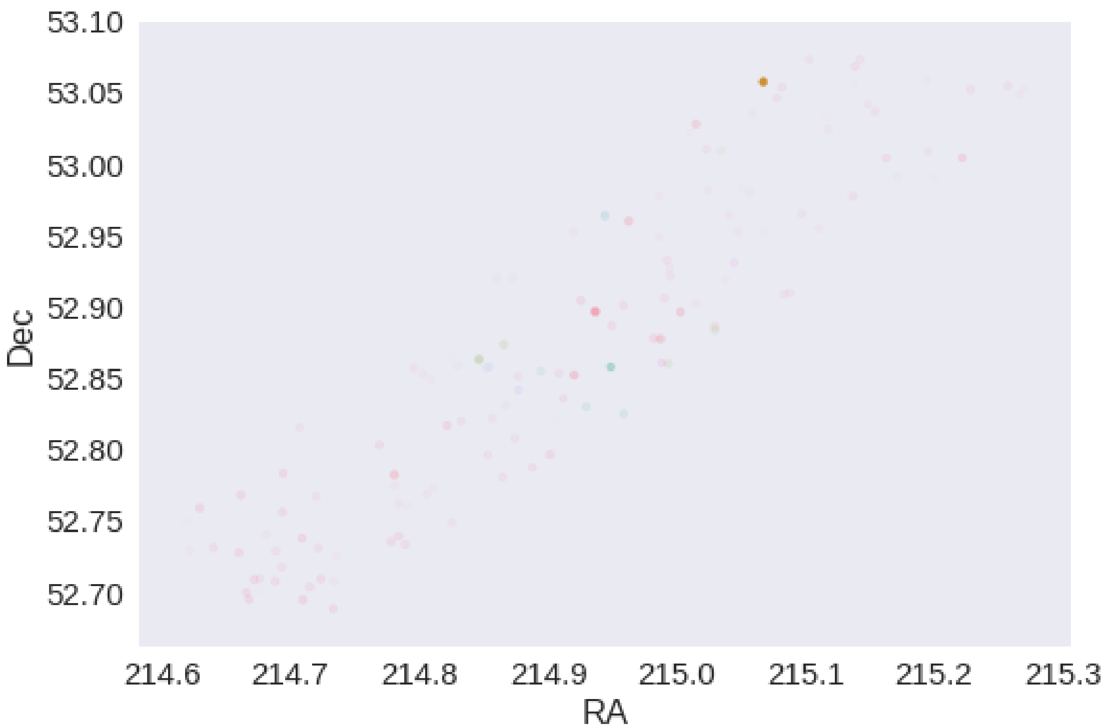





```
RA correction: -0.07893977393678142 arcsec
Dec correction: -0.034441607530766305 arcsec
```



pearsonr = 0.13; p = 0.13
0.15
0.10
0.05
0.00
−0.05
−0.10
Dec diff. [arcsec]
0.0
0.2
0.4
0.6
0.8
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
160 sources flagged.
```

2 V - Saving to disk

1.7_DEEP2

January 18, 2018

1 EGS master catalogue

1.1 Preparation of DEEP2 data

DEEP2 catalogue: the catalogue comes from `dmu0_DEEP2`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The total magnitude. No aperture magnitudes are given.

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:
44f1ae0 (Thu Nov 30 18:27:54 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

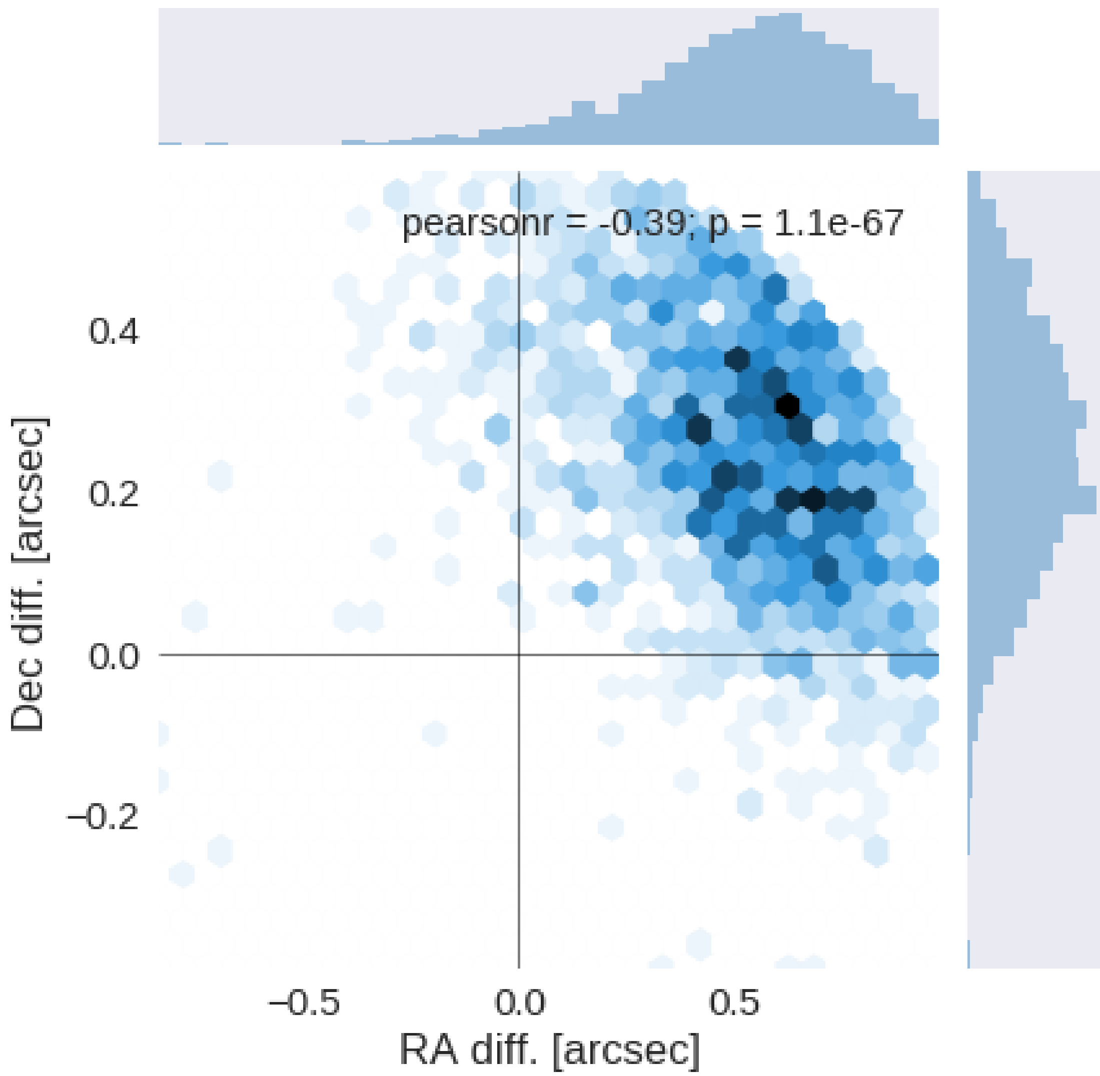
We remove duplicated objects from the input catalogues.

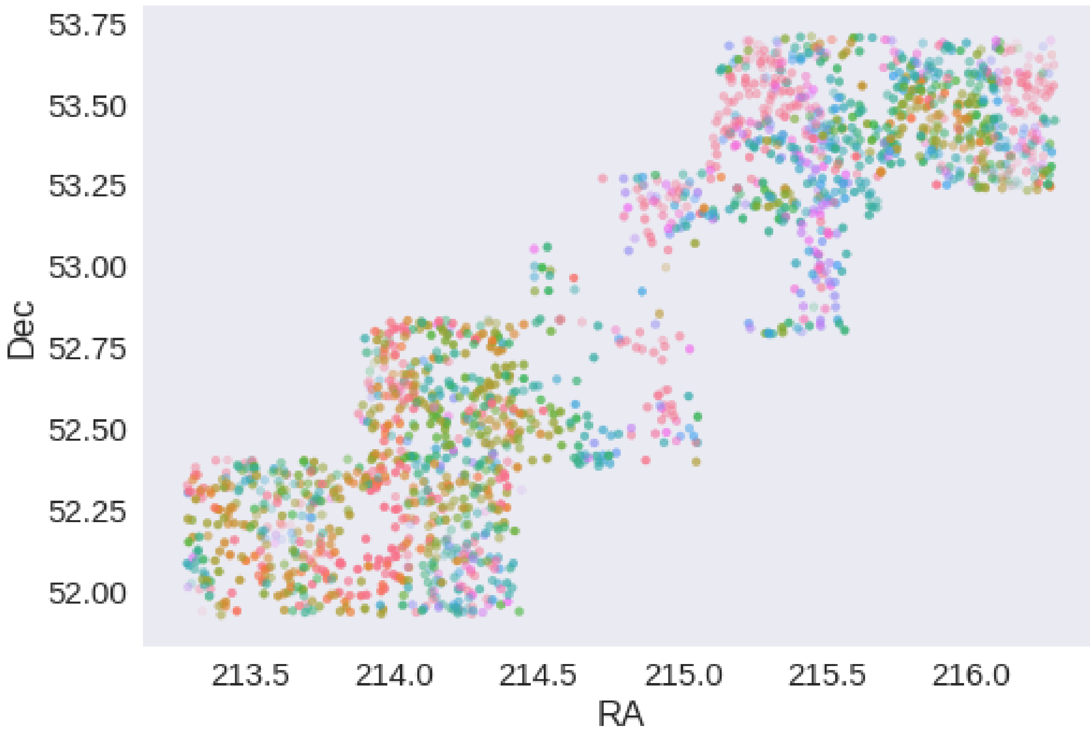
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 208517 sources.
The cleaned catalogue has 204382 sources (4135 removed).
The cleaned catalogue has 4134 sources flagged as having been cleaned
```

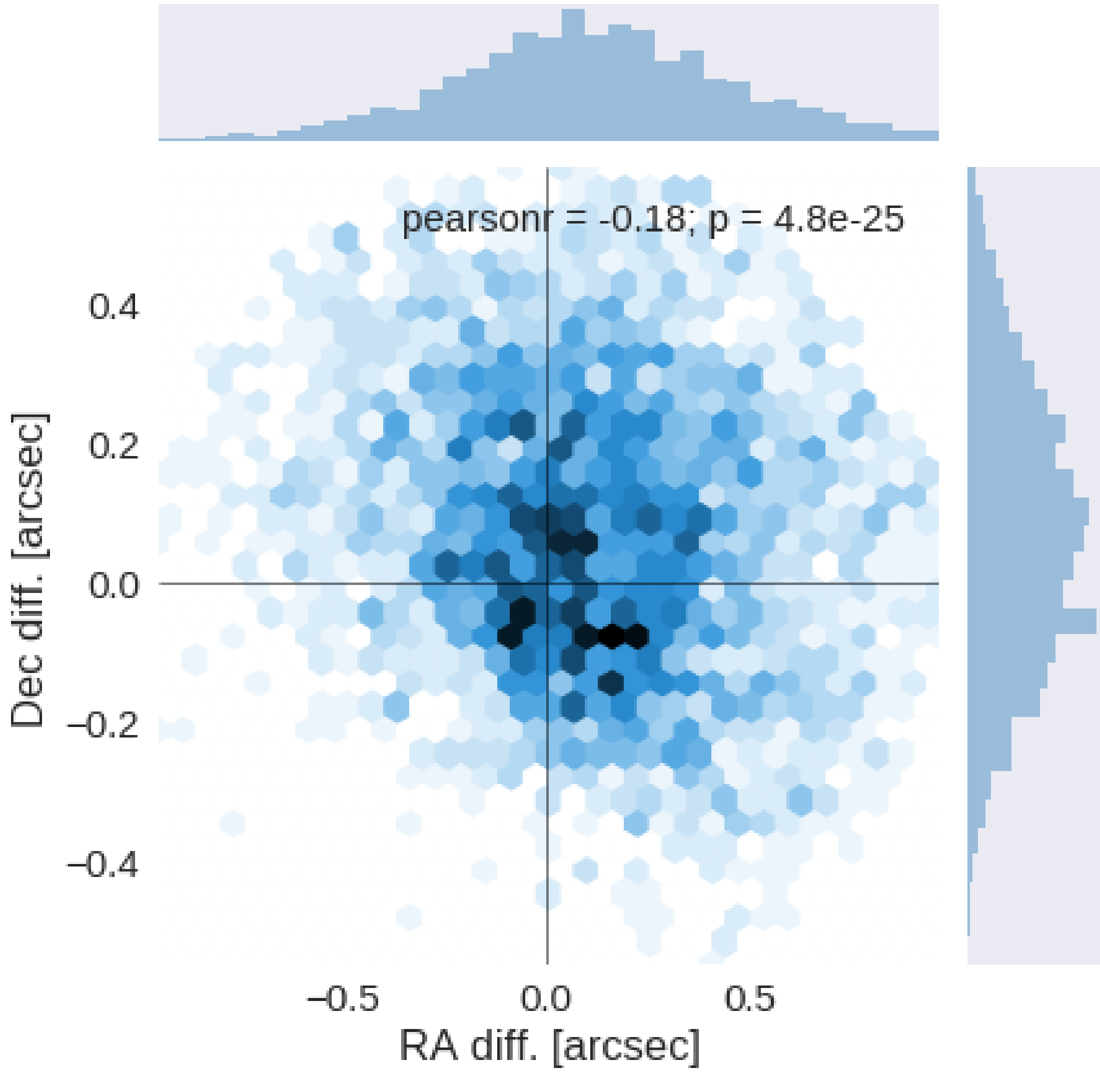
1.4 III - Astrometry correction

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: -0.5583843305942082 arcsec
Dec correction: -0.24953763438304577 arcsec
```


pearsonr = -0.18; p = 4.8e-25
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]

1.5 IV - Flagging Gaia objects

```
3592 sources flagged.
```

2 V - Saving to disk

1.8_IRAC-EGS

January 18, 2018

1 EGS master catalogue

1.1 Preparation of IRAC-EGS data

IRAC-EGS catalogue: the catalogue comes from `dmu0_IRAC-EGS`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The total flux (no aperture fluxes given).

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:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

1.2 I - Column selection

```
/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>
```

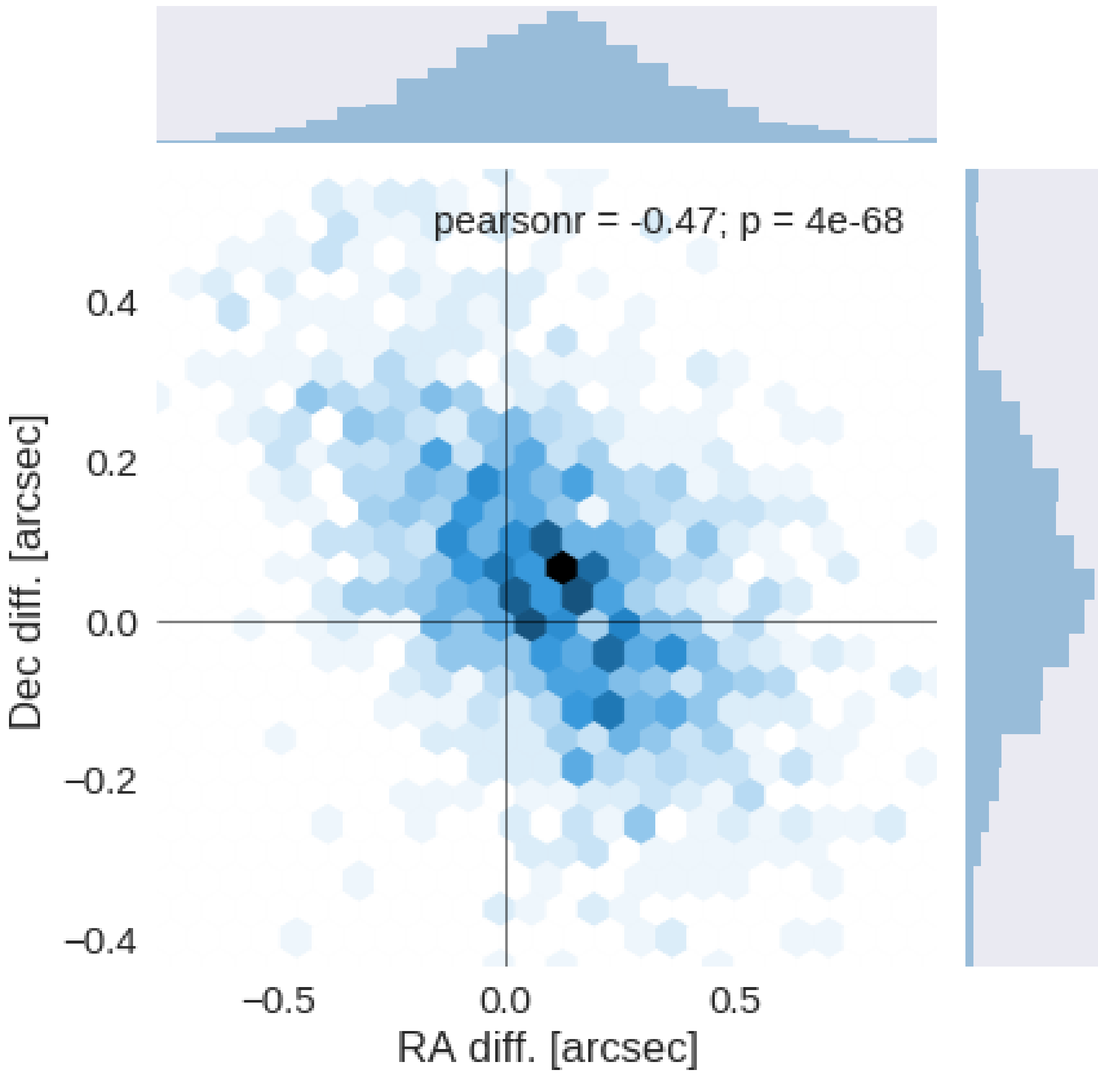
1.3 II - Removal of duplicated sources

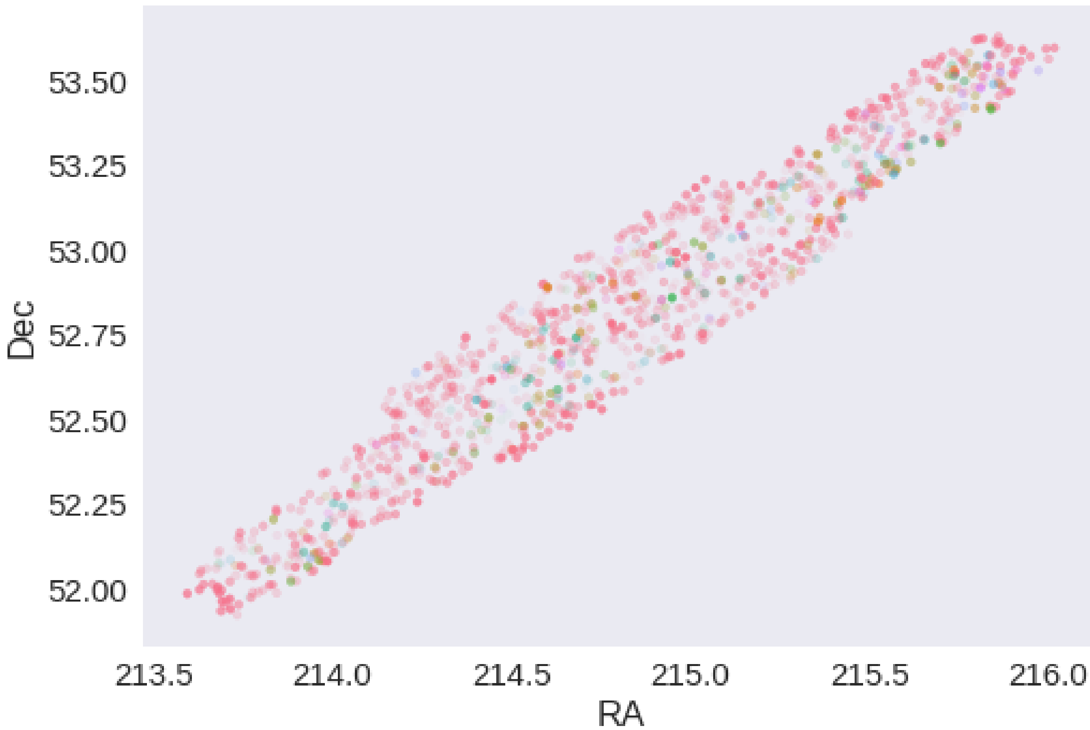
We remove duplicated objects from the input catalogues.

```
The initial catalogue had 117929 sources.
The cleaned catalogue has 117929 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

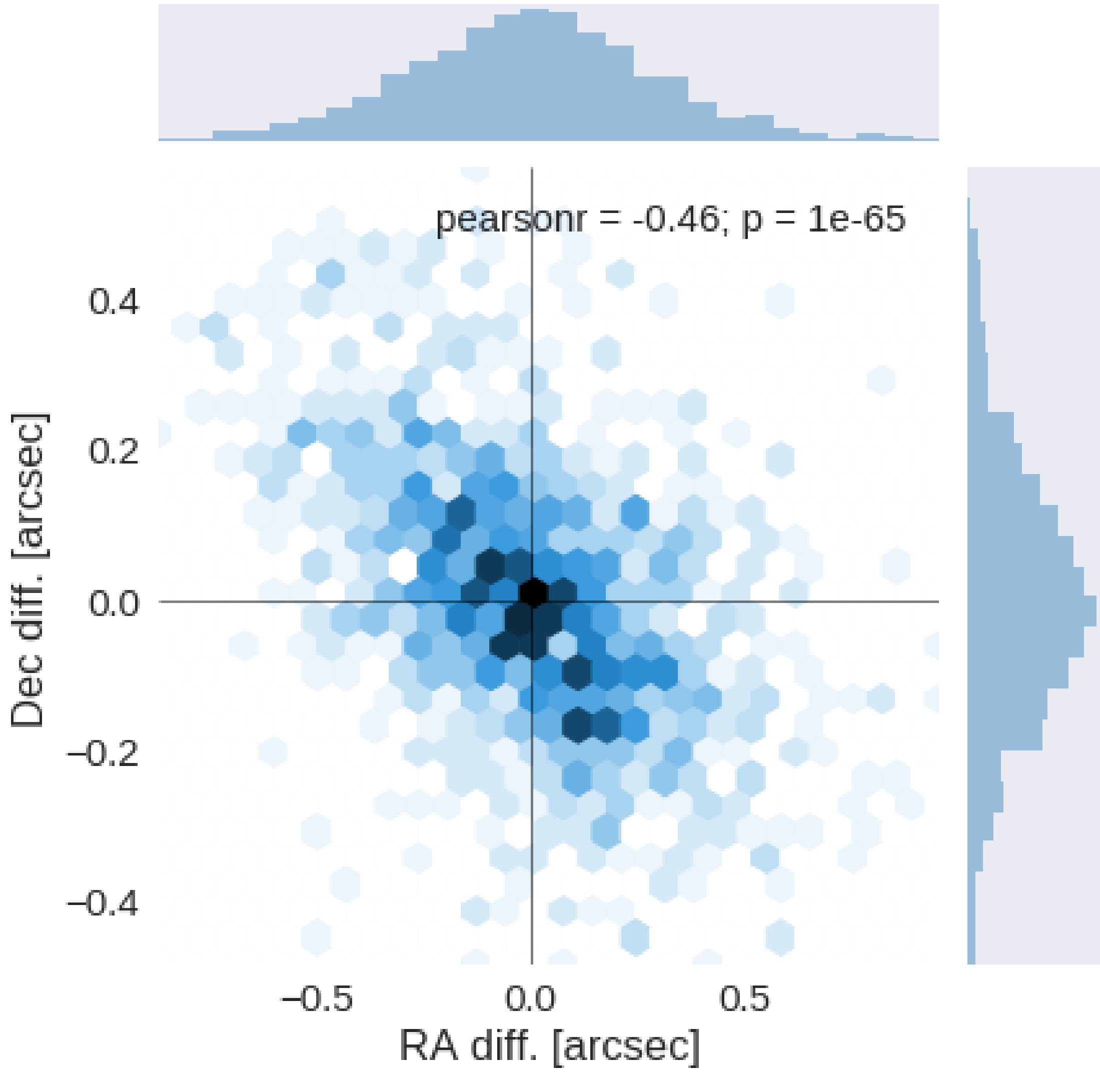
1.4 III - Astrometry correction

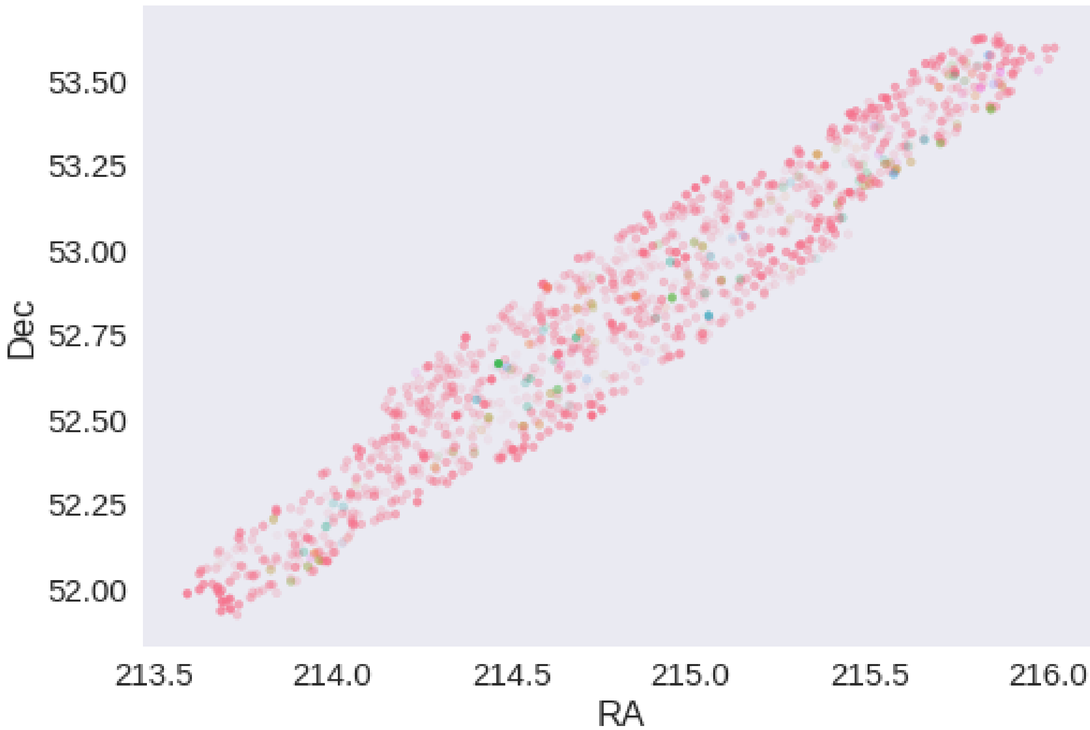
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: -0.10139878082782161 arcsec
Dec correction: -0.05154244758358573 arcsec
```


pearsonr = -0.46; p = 1e-65
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
1297 sources flagged.
```

2 V - Saving to disk

1.9_HSC

January 18, 2018

1 EGS master catalogue

1.1 Preparation of Hyper Suprime-Cam Subaru Strategic Program Catalogues (HSC-SSP) wide data

This catalogue comes from `dmu0_HSC`. We only have n921 and n816 photometry on the ultradeep field.

In the catalogue, we keep:

- The `object_id` as unique object identifier;
- The position;
- The g, r, i, z, y aperture magnitude in 2" that we aperture correct;
- The g, r, i, z, y kron fluxes and magnitudes.
- The extended flag that we convert to a stellariy.

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:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

1.2 I - Aperture correction

To compute aperture correction we need to dertermine two parametres: the target aperture and the range of magnitudes for the stars that will be used to compute the correction.

Target aperture: To determine the target aperture, we simulate a curve of growth using the provided apertures and draw two figures:

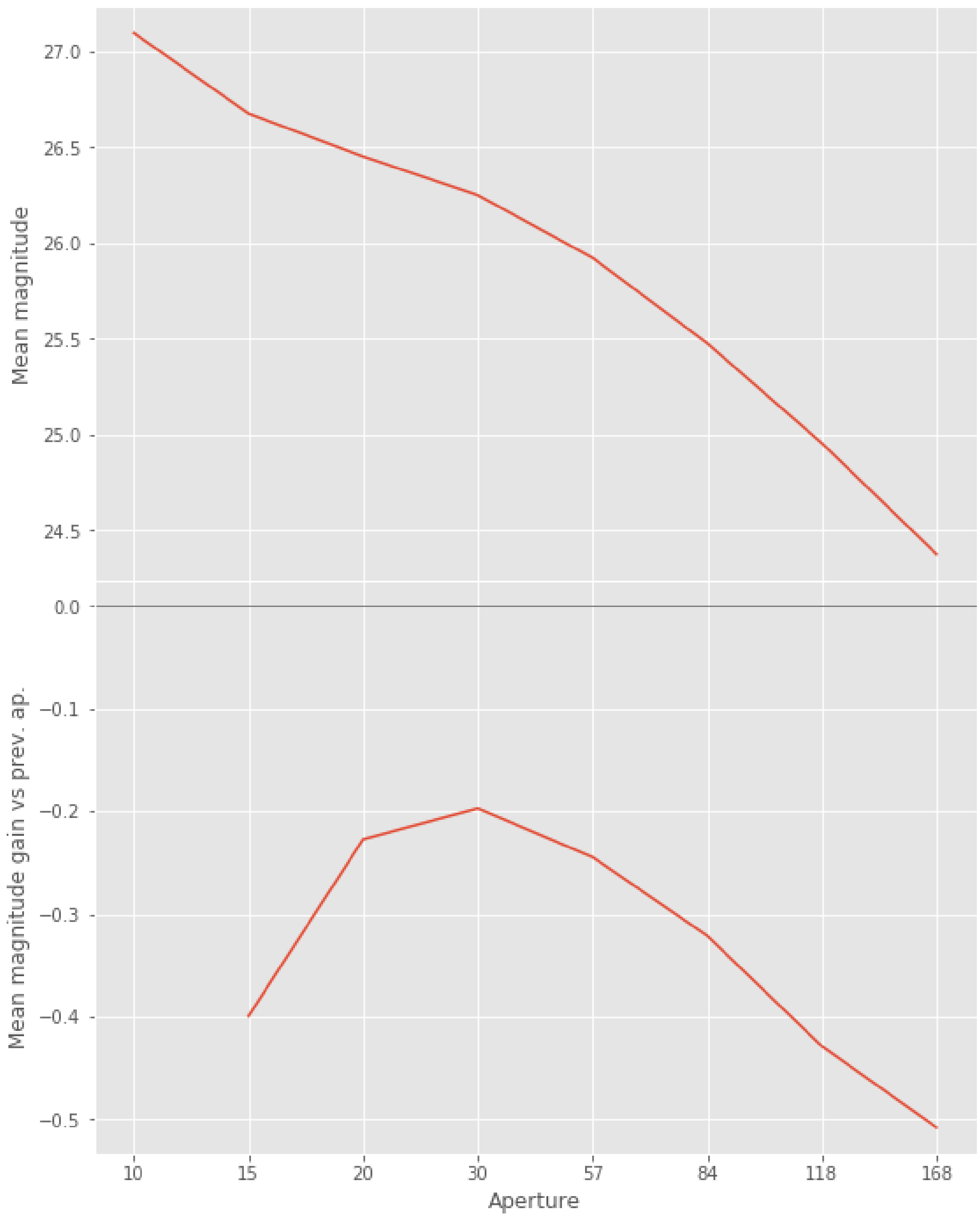
- The evolution of the magnitudes of the objects by plotting on the same plot aperture number vs the mean magnitude.
- The mean gain (loss when negative) of magnitude is each aperture compared to the previous (except for the first of course).

As target aperture, we should use the smallest (i.e. less noisy) aperture for which most of the flux is captures.

Magnitude range: To know what limits in aperture to use when doing the aperture correction, we plot for each magnitude bin the correction that is computed and its RMS. We should then use the wide limits (to use more stars) where the correction is stable and with few dispersion.

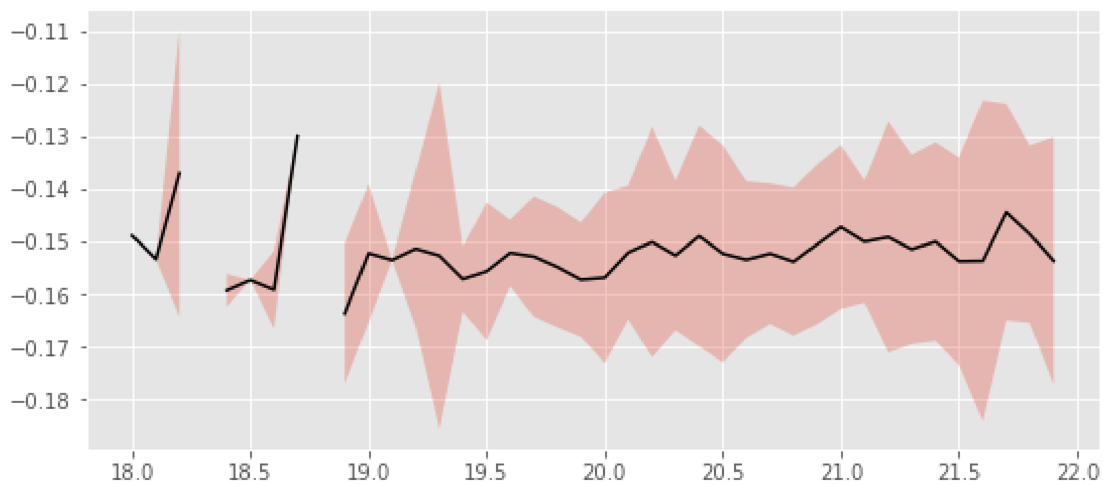
1.2.1 I.a - g band

```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



We will use aperture 57 as target.

```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:903: RuntimeWarning: invalid valu
  mask = stellarity > .9
/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)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```



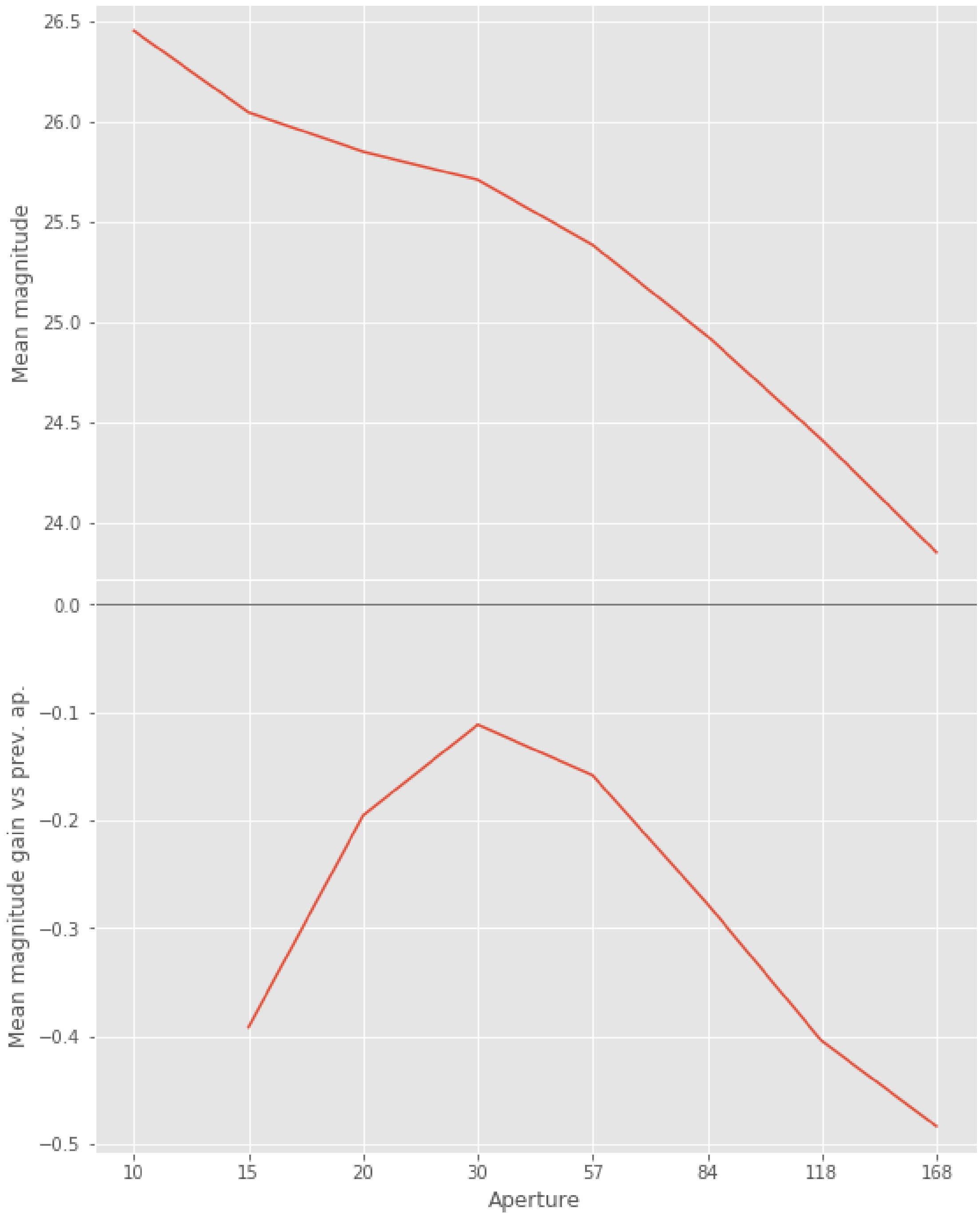
We will use magnitudes between 18.5 and 20.8

```
Aperture correction for g band:
Correction: -0.1536693572998047
Number of source used: 477
RMS: 0.013336935836438763
```

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```

1.2.2 I.b - r band

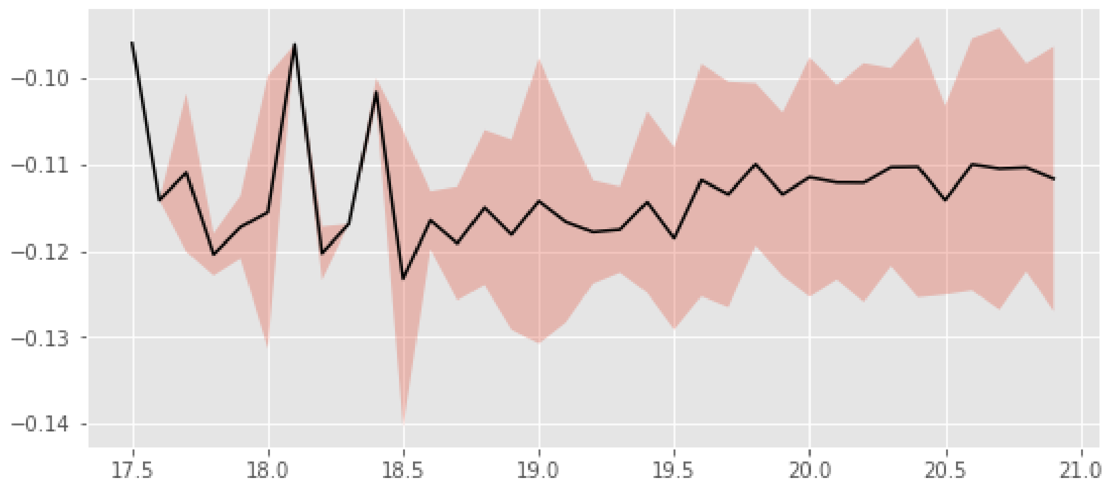
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



We will use aperture 57 as target.

```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:903: RuntimeWarning: invalid valu
  mask = stellarity > .9
/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)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```



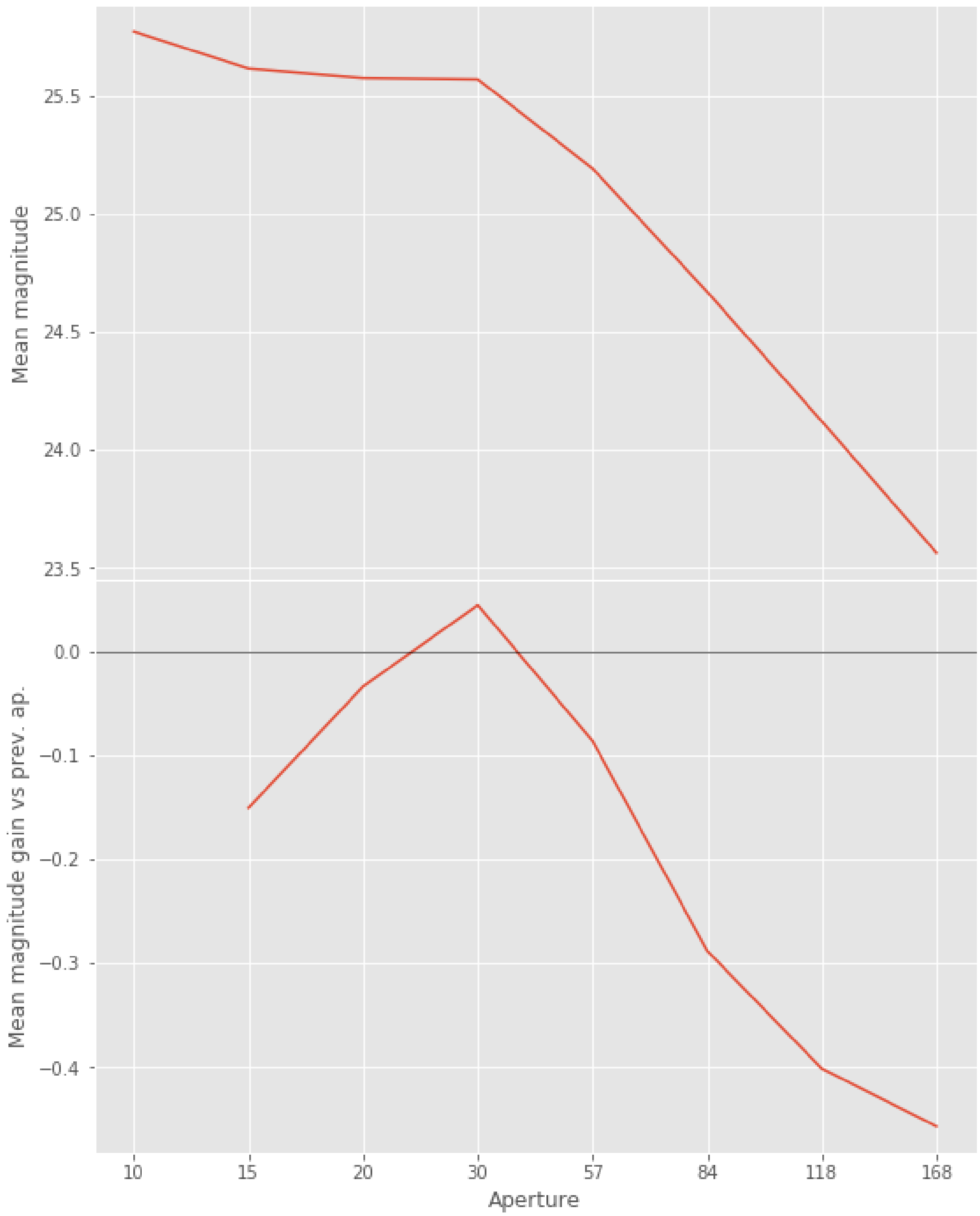
We use magnitudes between 19.5 and 20.5.

```
Aperture correction for r band:
Correction: -0.11204338073730469
Number of source used: 606
RMS: 0.012112590040337011
```

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```

1.2.3 I.c - i band

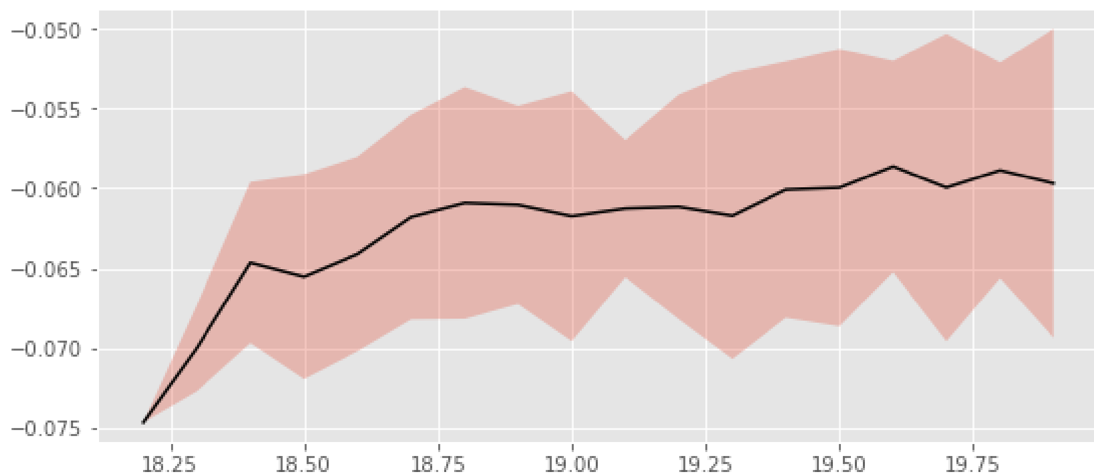
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



We will use aperture 57 as target.

```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:903: RuntimeWarning: invalid valu
  mask = stellarity > .9
/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)
```

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```



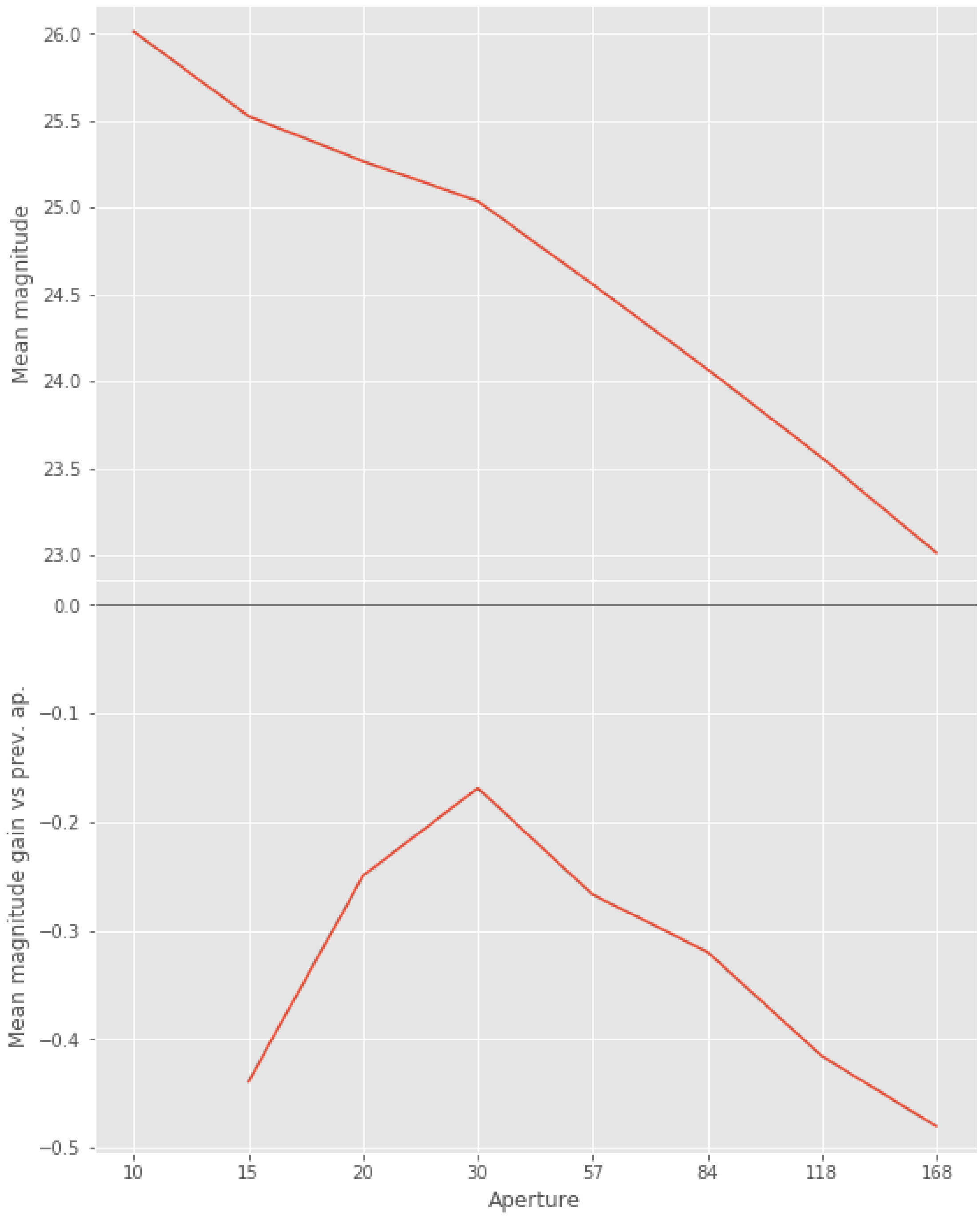
We use magnitudes between 18.5 and 19.8.

```
Aperture correction for i band:
Correction: -0.06093025207519531
Number of source used: 831
RMS: 0.007157356612245586
```

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```

1.2.4 I.d - z band

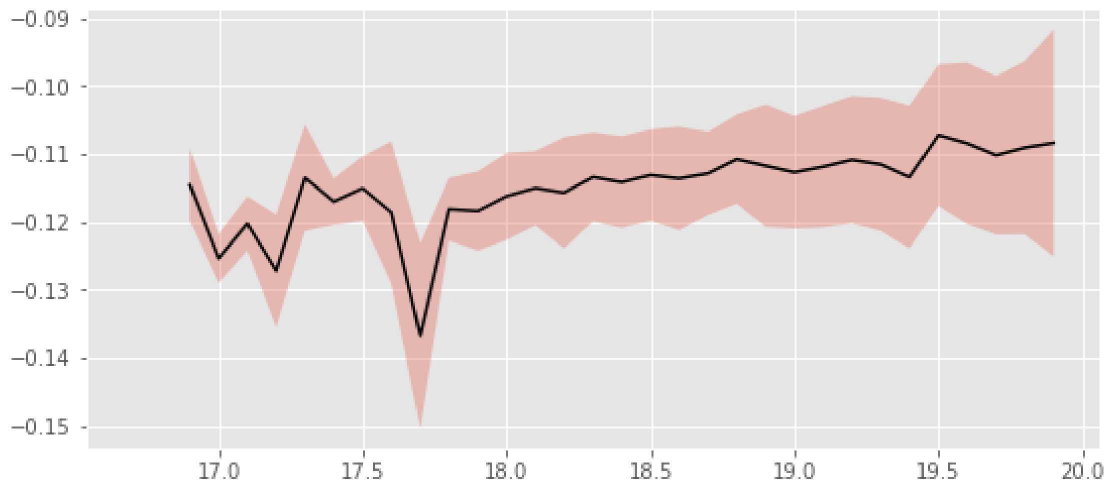
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



We will use aperture 57 as target.

```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:903: RuntimeWarning: invalid valu
  mask = stellarity > .9
/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)
```

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```



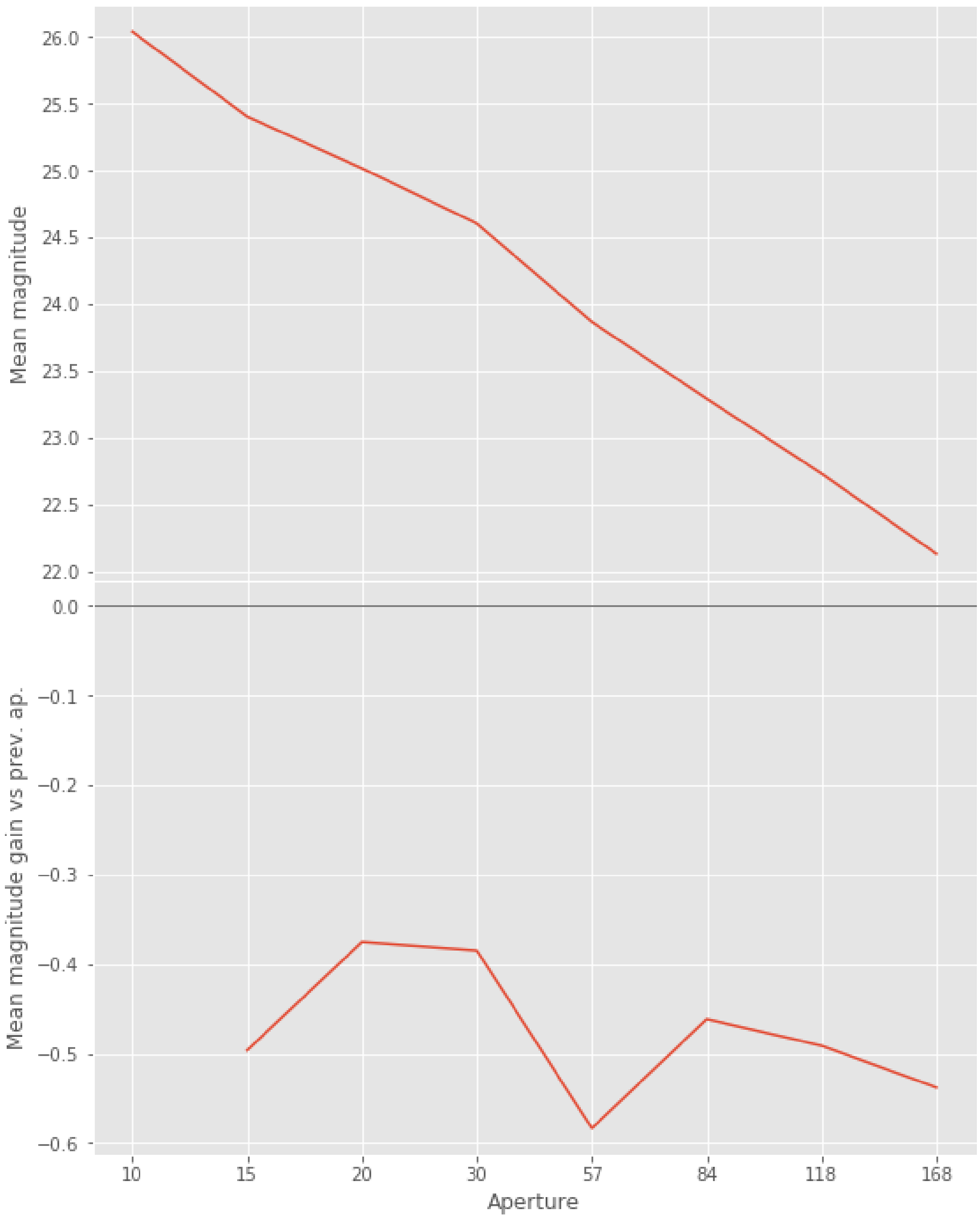
We use magnitudes between 17.5 and 18.8.

```
Aperture correction for z band:
Correction: -0.1141510009765625
Number of source used: 333
RMS: 0.00688200402082919
```

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```

1.2.5 I.e - y band

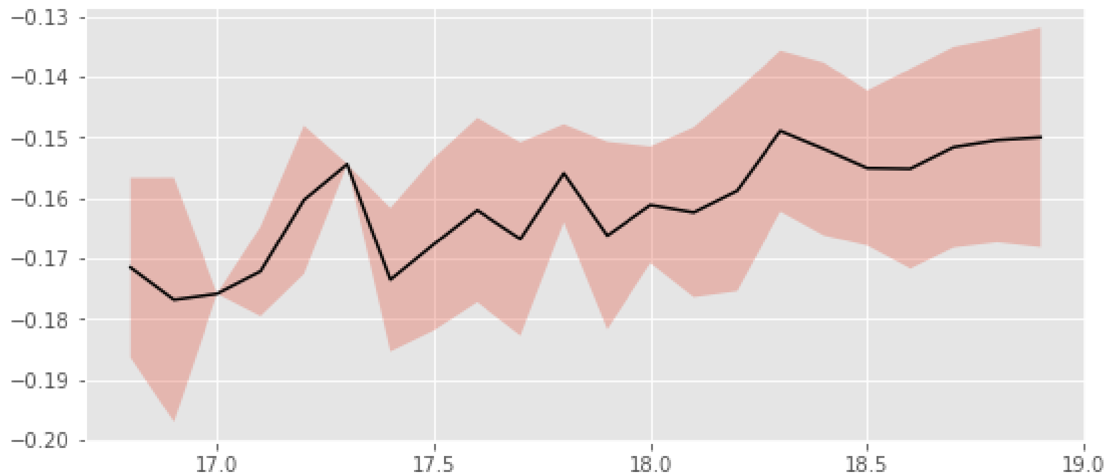
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



We will use aperture 57 as target.

```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:903: RuntimeWarning: invalid valu
  mask = stellarity > .9
/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)
```

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```



We use magnitudes between 17.6 and 18.7.

```
Aperture correction for y band:
Correction: -0.15555763244628906
Number of source used: 334
RMS: 0.015017790515423833
```

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:129: RuntimeWarning: invalid value enc
  mask &= (stellarity > 0.9)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```

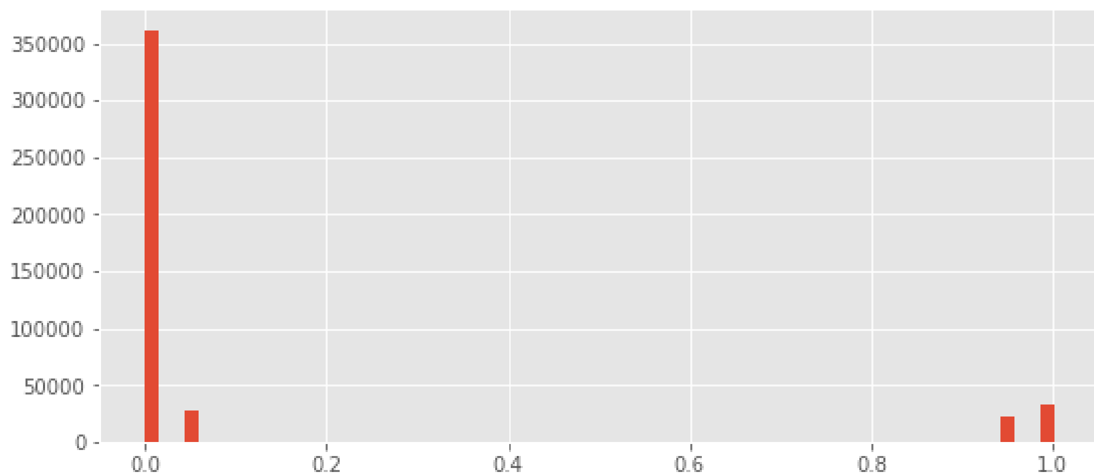
1.3 II - Stellarity

HSC does not provide a 0 to 1 stellarity value but a 0/1 extended flag in each band. We are using the same method as UKIDSS (cf this page) to compute a stellarity based on the class in each band:

$$P(star) = \frac{\prod_i P(star)_i}{\prod_i P(star)_i + \prod_i P(galaxy)_i}$$

where i is the band, and with using the same probabilities as UKDISS:

HSC flag	UKIDSS flag	Meaning	P(star)	P(galaxy)	P(noise)	P(saturated)
	-9	Saturated	0.0	0.0	5.0	95.0
	-3	Probable galaxy	25.0	70.0	5.0	0.0
	-2	Probable star	70.0	25.0	5.0	0.0
0	-1	Star	90.0	5.0	5.0	0.0
	0	Noise	5.0	5.0	90.0	0.0
1	+1	Galaxy	5.0	90.0	5.0	0.0



1.4 II - Column selection

```
Out[29]: <IPython.core.display.HTML object>
```

1.5 III - Removal of duplicated sources

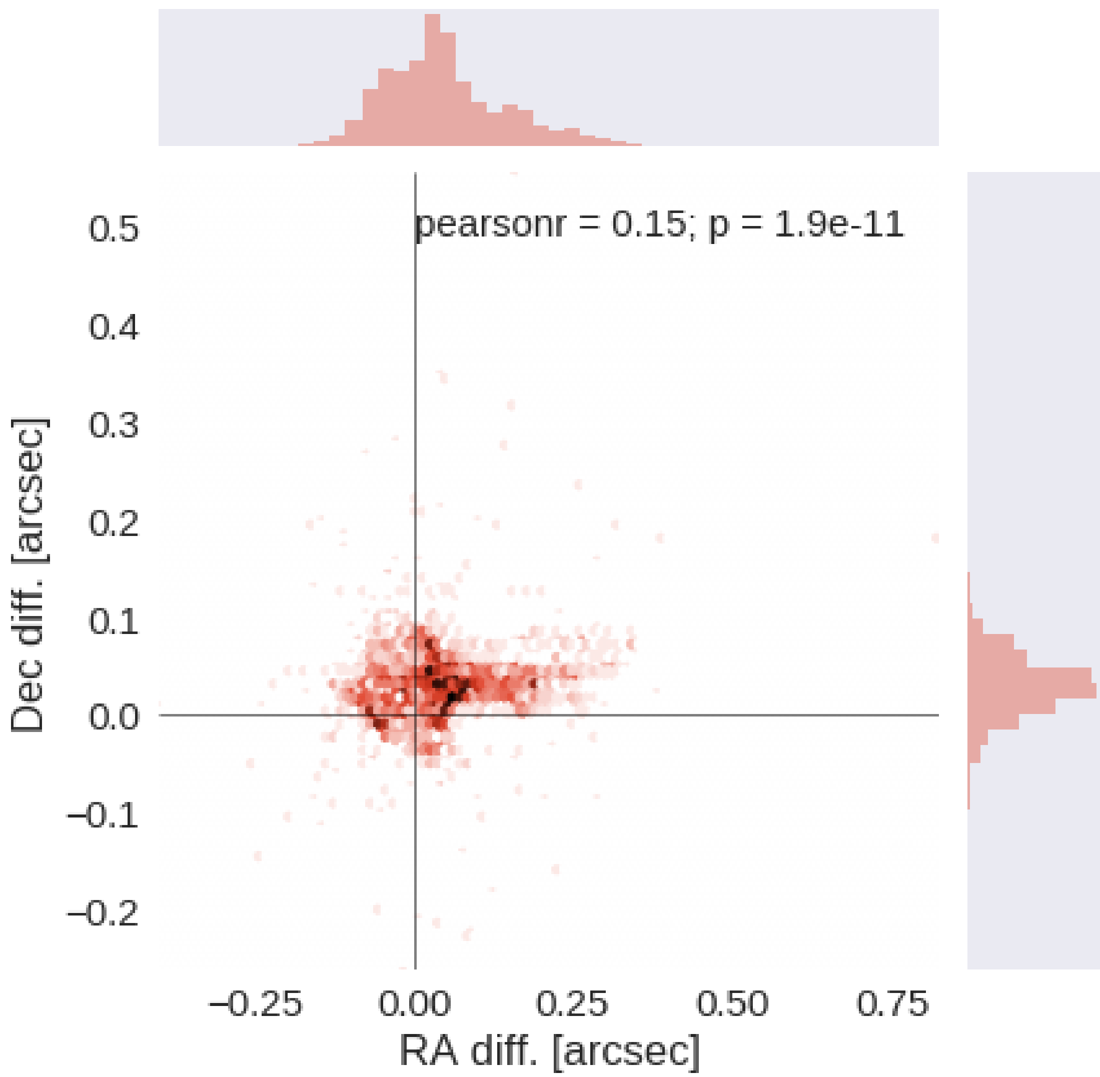
We remove duplicated objects from the input catalogues.

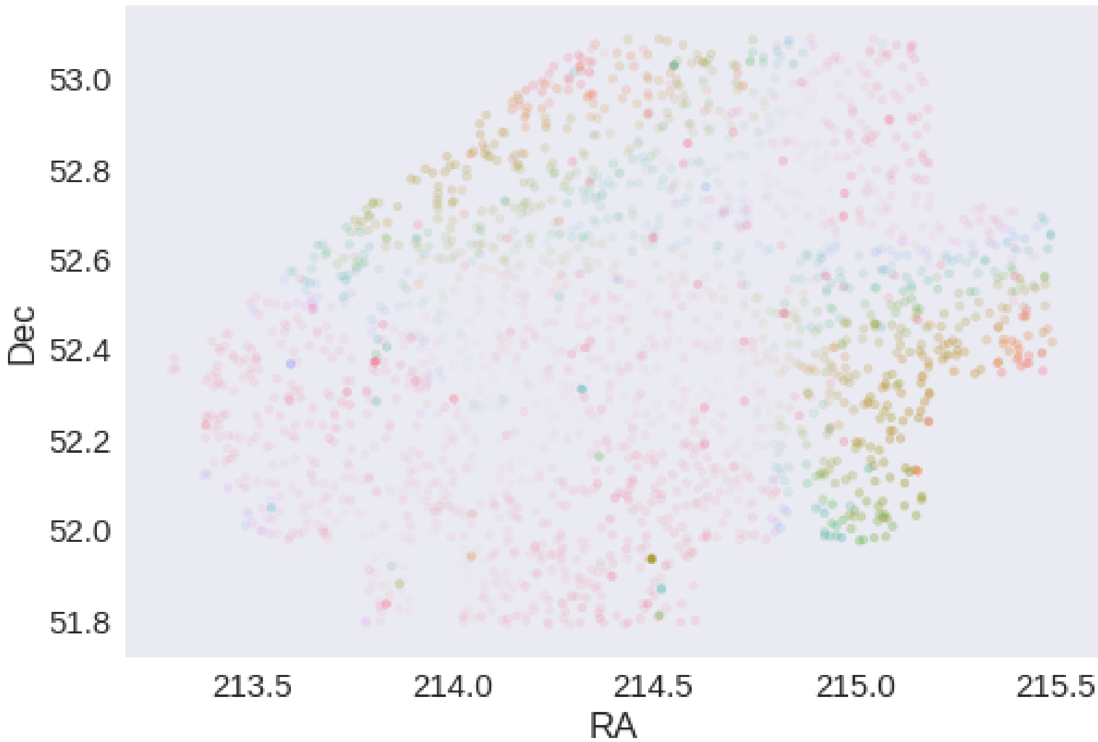
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)


The initial catalogue had 444602 sources.
The cleaned catalogue has 444573 sources (29 removed).
The cleaned catalogue has 29 sources flagged as having been cleaned
```

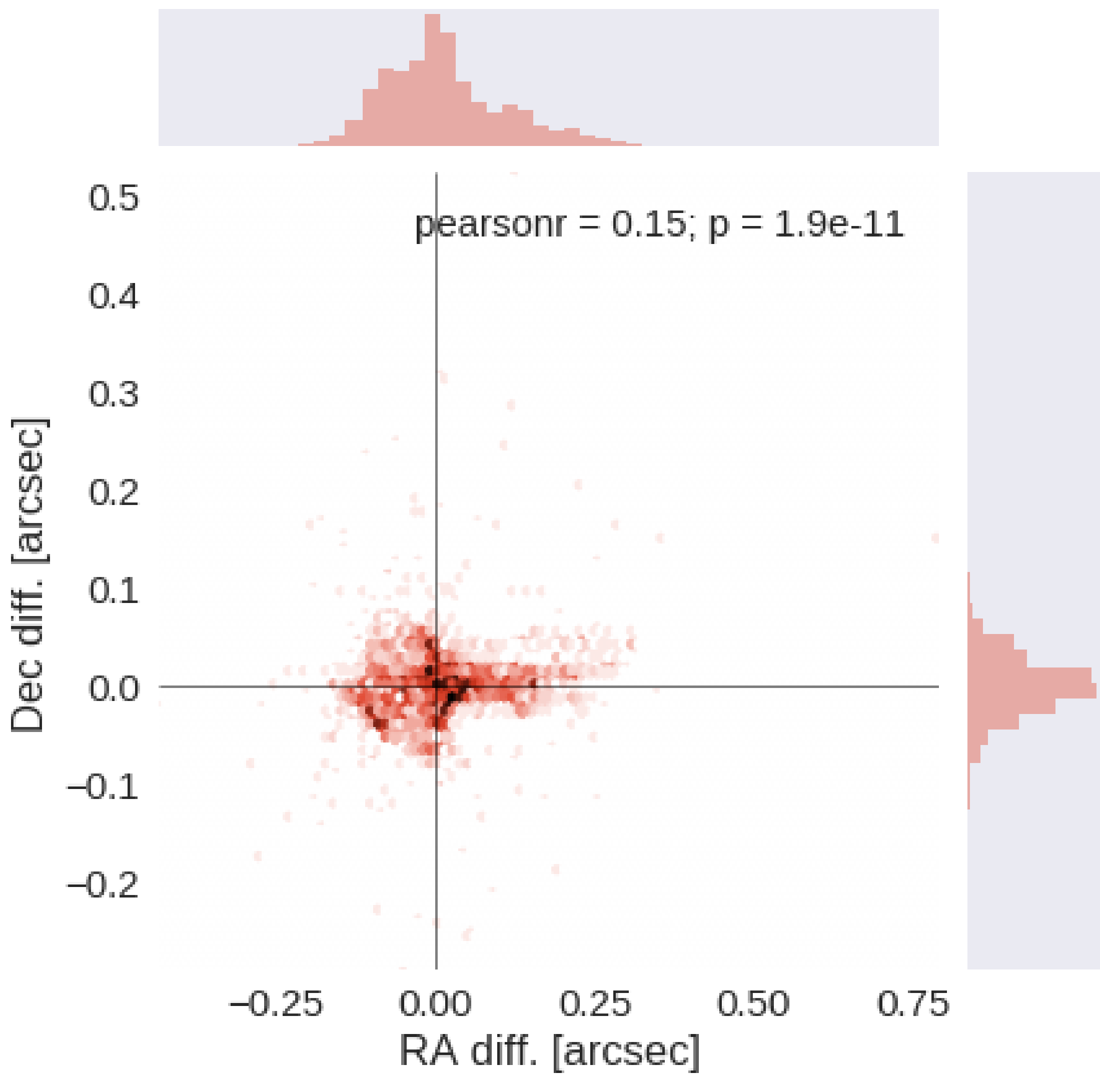
1.6 III - Astrometry correction

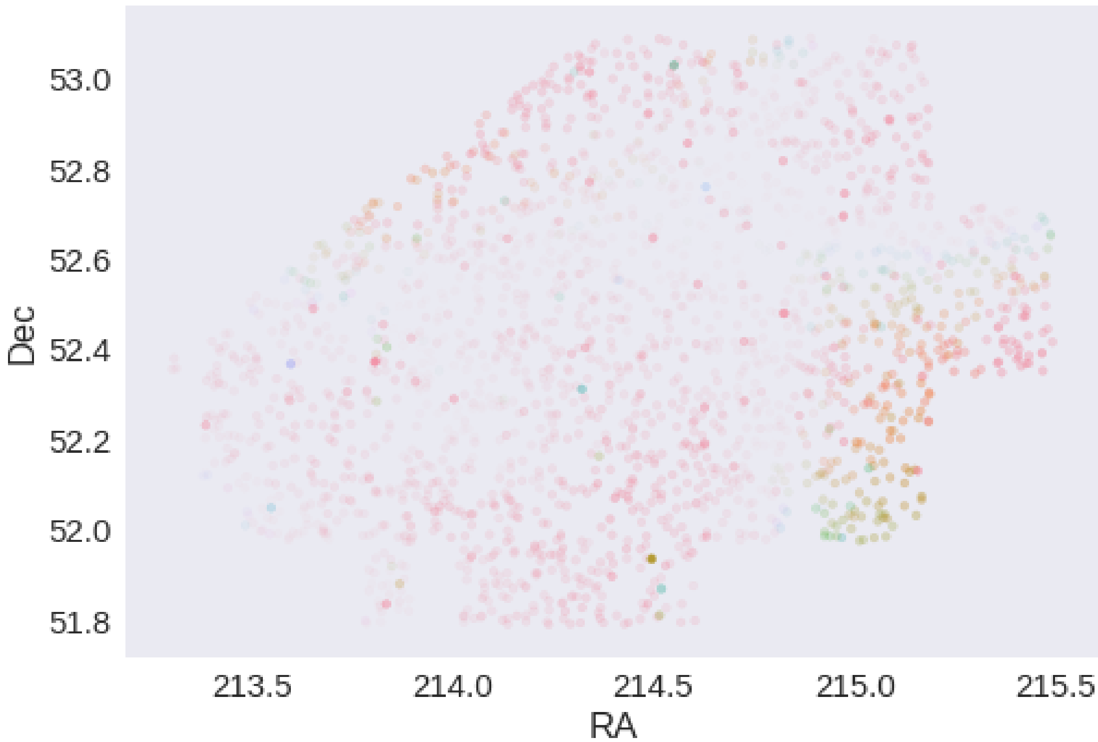
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.


pearsonr = 0.15; p = 1.9e-11
0.5
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
Dec diff. [arcsec]
−0.25
0.00
0.25
0.50
0.75
RA diff. [arcsec]




```
RA correction: -0.03406401734764586 arcsec
Dec correction: -0.03037861431209876 arcsec
```


pearsonr = 0.15; p = 1.9e-11
0.5
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
Dec diff. [arcsec]
−0.25
0.00
0.25
0.50
0.75
RA diff. [arcsec]



1.7 IV - Flagging Gaia objects

```
2264 sources flagged.
```

2 V - Saving to disk

1.10_PanSTARRS1-3SS

January 18, 2018

1 EGS master catalogue

1.1 Preparation of Pan-STARRS1 - 3pi Steradian Survey (3SS) data

This catalogue comes from `dmu0_PanSTARRS1-3SS`.

In the catalogue, we keep:

- The `uniquePspsSTid` as unique object identifier;
- The r-band position which is given for all the sources;
- The grizy `<band>FApMag` aperture magnitude (see below);
- The grizy `<band>FKronMag` as total magnitude.

The Pan-STARRS1-3SS catalogue provides for each band an aperture magnitude defined as "In PS1, an 'optimal' aperture radius is determined based on the local PSF. The wings of the same analytic PSF are then used to extrapolate the flux measured inside this aperture to a 'total' flux."

The observations used for the catalogue where done between 2010 and 2015 (ref).

TODO: Check if the detection flag can be used to know in which bands an object was detected to construct the coverage maps.

TODO: Check for stellarity.

```
This notebook was run with herschelhelp_internal version:
44f1ae0 (Thu Nov 30 18:27:54 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

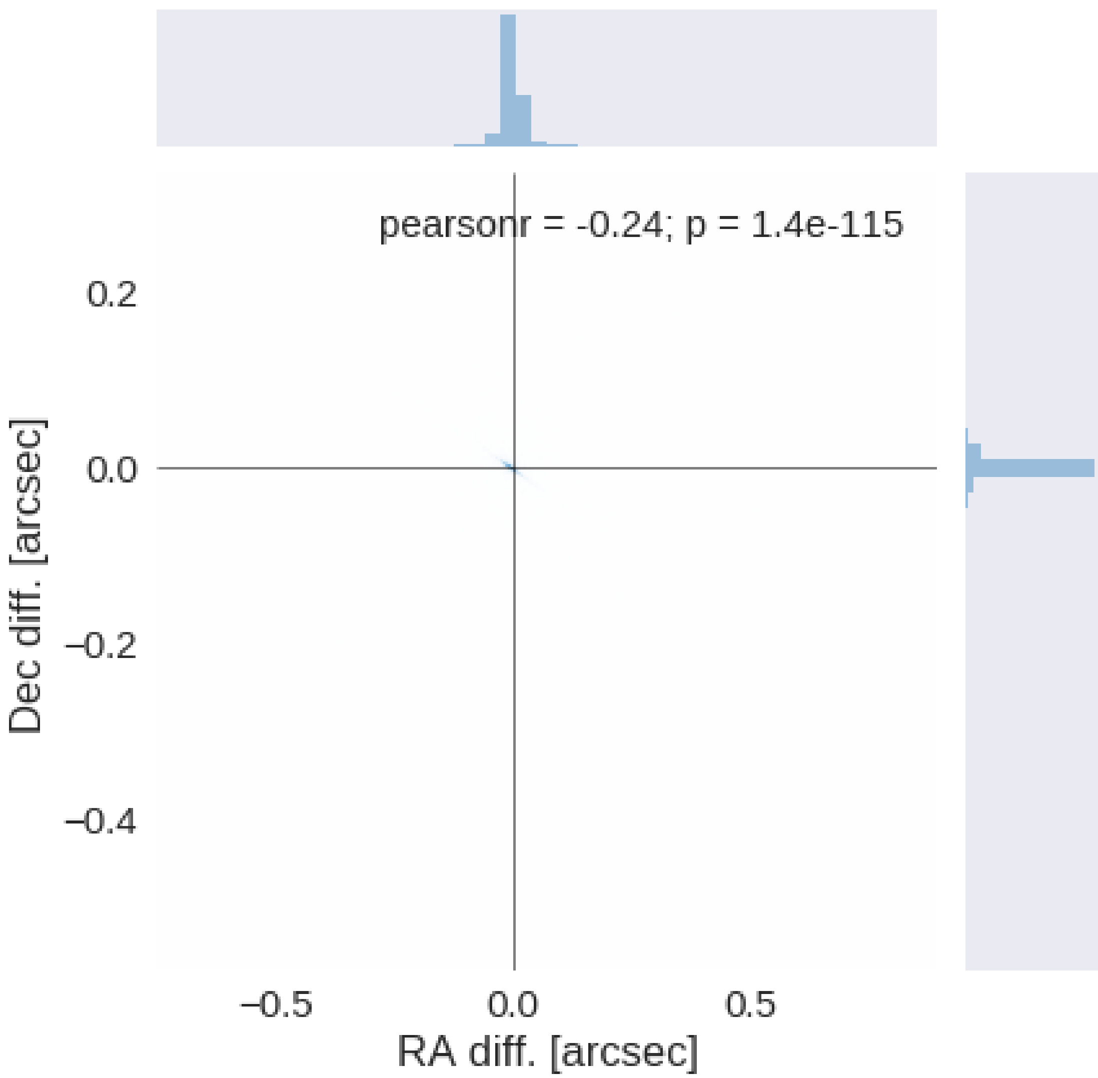
We remove duplicated objects from the input catalogues.

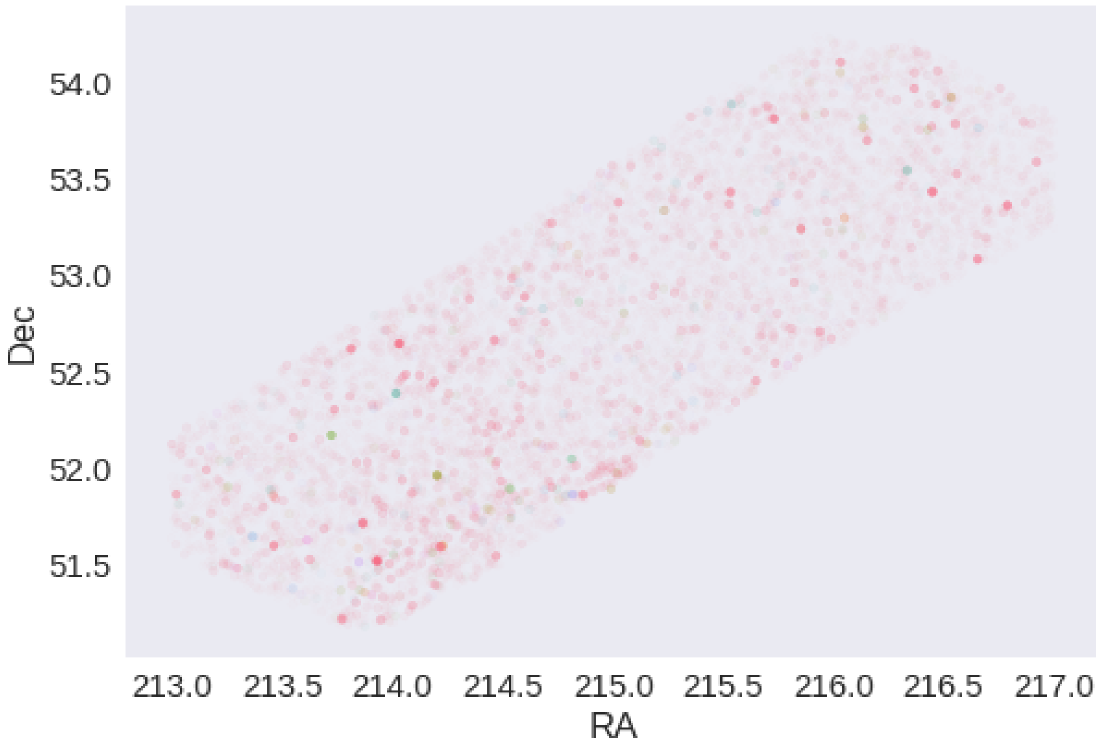
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 59217 sources.
The cleaned catalogue has 59207 sources (10 removed).
The cleaned catalogue has 10 sources flagged as having been cleaned
```

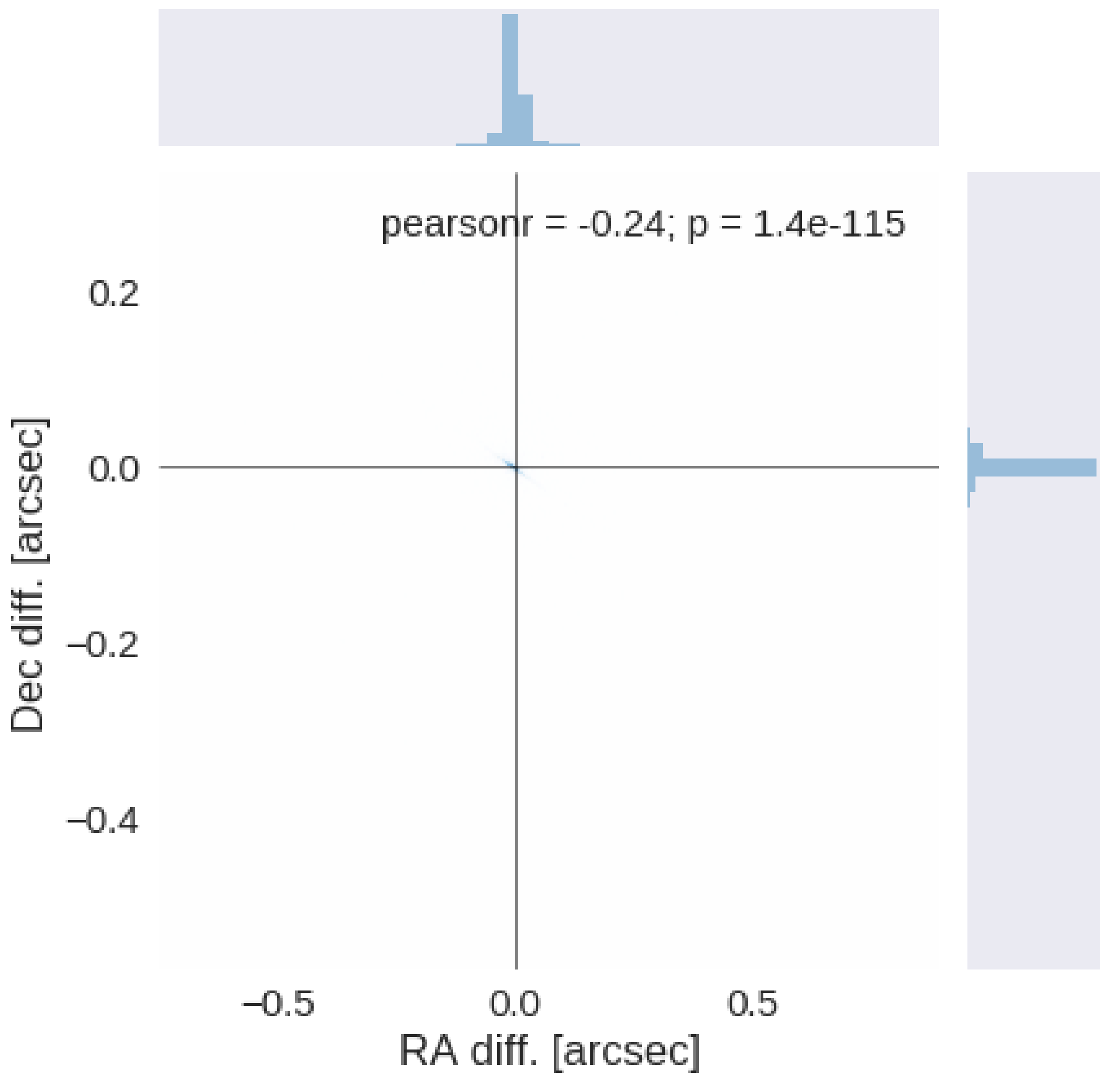
1.4 III - Astrometry correction

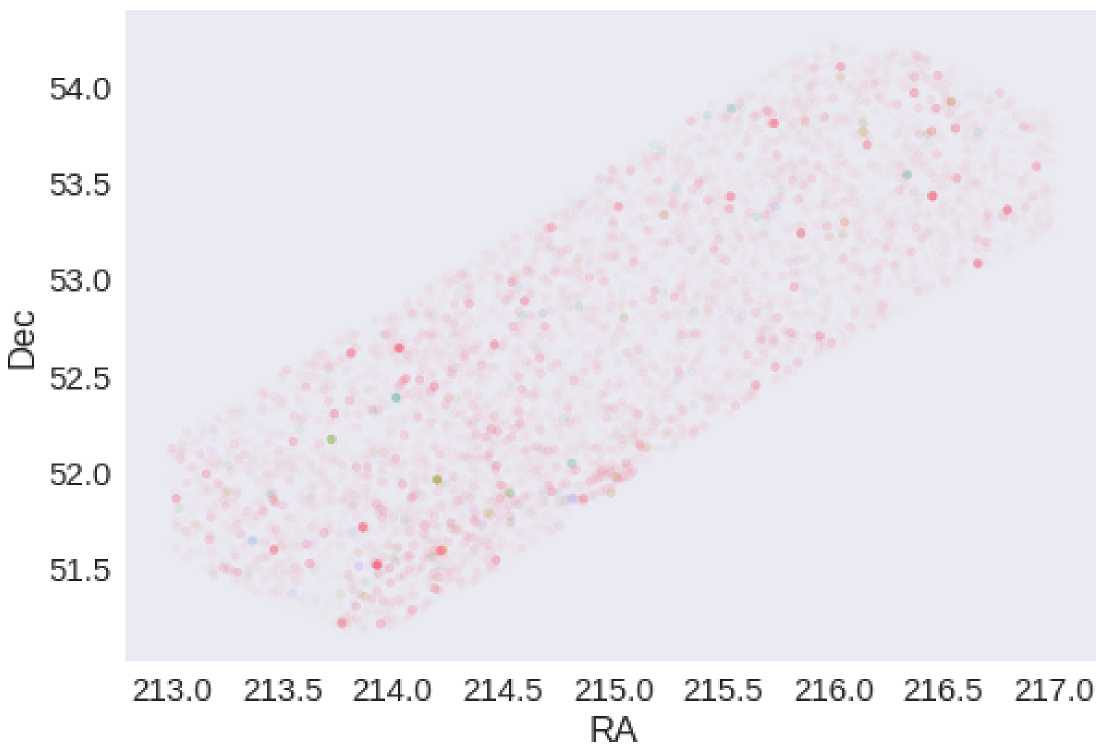
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.0004886441843154898 arcsec
Dec correction: -0.000554433862021142 arcsec
```


pearsonr = -0.24; p = 1.4e-115
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
9109 sources flagged.
```

2 V - Saving to disk

1.11_LegacySurvey

January 18, 2018

1 EGS master catalogue

1.1 Preparation of Legacy Survey data

The catalogue comes from `dmu0_LegacySurvey`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The aperture fluxes. Are these aperture corrected?
- 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:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

```
WARNING: UnitsWarning: '1/deg^2' did not parse as fits unit: Numeric factor not supported by FIT
WARNING: UnitsWarning: 'nanomaggy' did not parse as fits unit: At col 0, Unit 'nanomaggy' not su
WARNING: UnitsWarning: '1/nanomaggy^2' did not parse as fits unit: Numeric factor not supported 
WARNING: UnitsWarning: '1/arcsec^2' did not parse as fits unit: Numeric factor not supported by 
```

1.2 I - Aperture correction

To compute aperture correction we need to dertermine two parametres: the target aperture and the range of magnitudes for the stars that will be used to compute the correction.

Target aperture: To determine the target aperture, we simulate a curve of growth using the provided apertures and draw two figures:

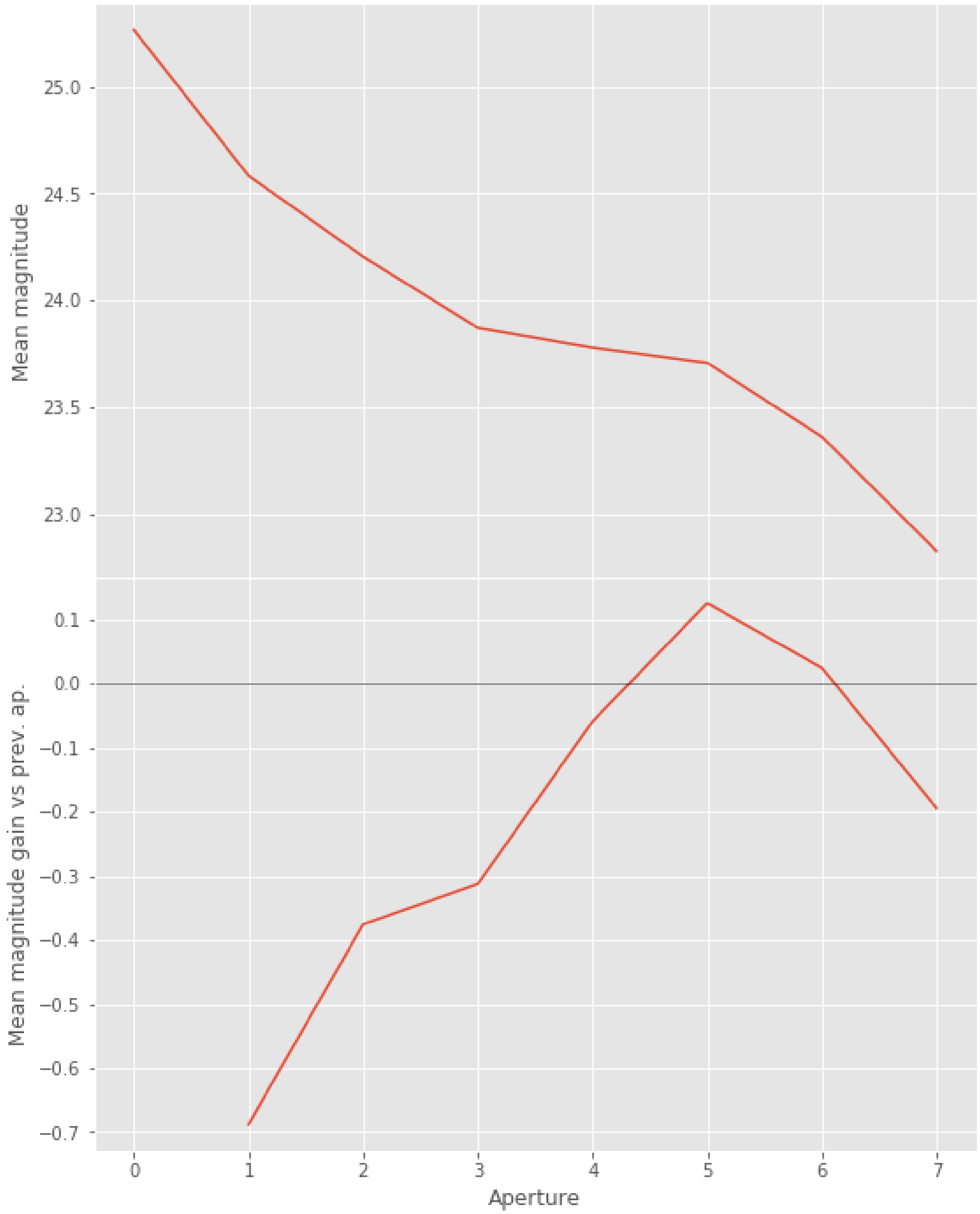
- The evolution of the magnitudes of the objects by plotting on the same plot aperture number vs the mean magnitude.
- The mean gain (loss when negative) of magnitude is each aperture compared to the previous (except for the first of course).

As target aperture, we should use the smallest (i.e. less noisy) aperture for which most of the flux is captures.

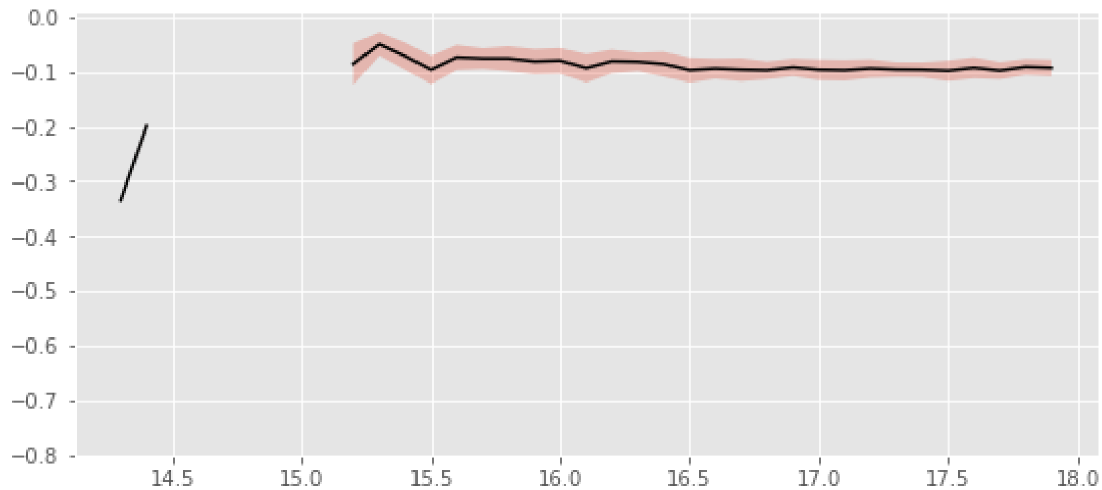
Magnitude range: To know what limits in aperture to use when doing the aperture correction, we plot for each magnitude bin the correction that is computed and its RMS. We should then use the wide limits (to use more stars) where the correction is stable and with few dispersion.

```
/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: invalid value enco
  errors = 2.5 / np.log(10) * errors_on_fluxes / fluxes
```

1.2.1 I.a - g band



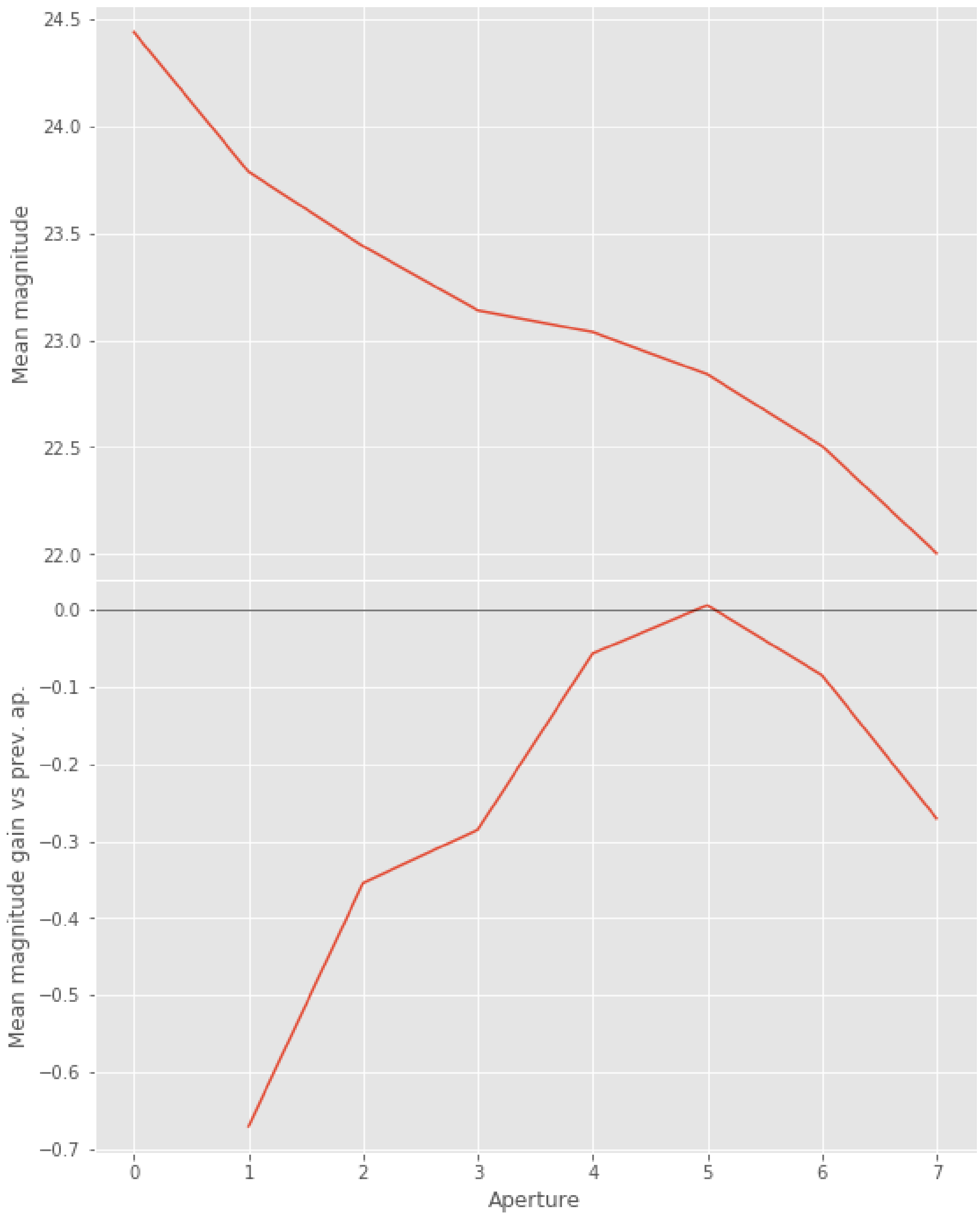
We will use aperture 5 as target.



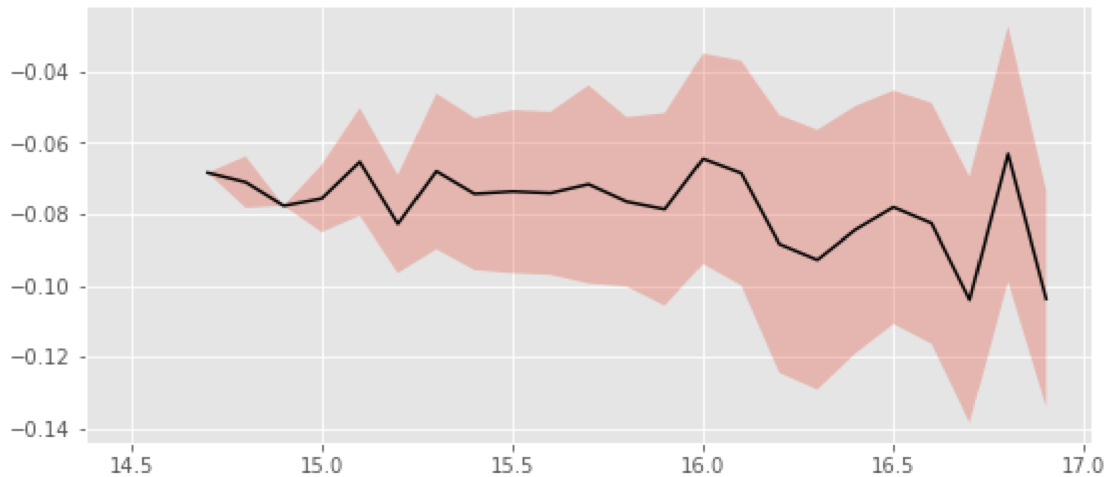
We will use magnitudes between 17.0 and 18.5

```
Aperture correction for g band:
Correction: -0.09441636798258202
Number of source used: 1084
RMS: 0.01606272315484677
```

1.2.2 I.b - r band



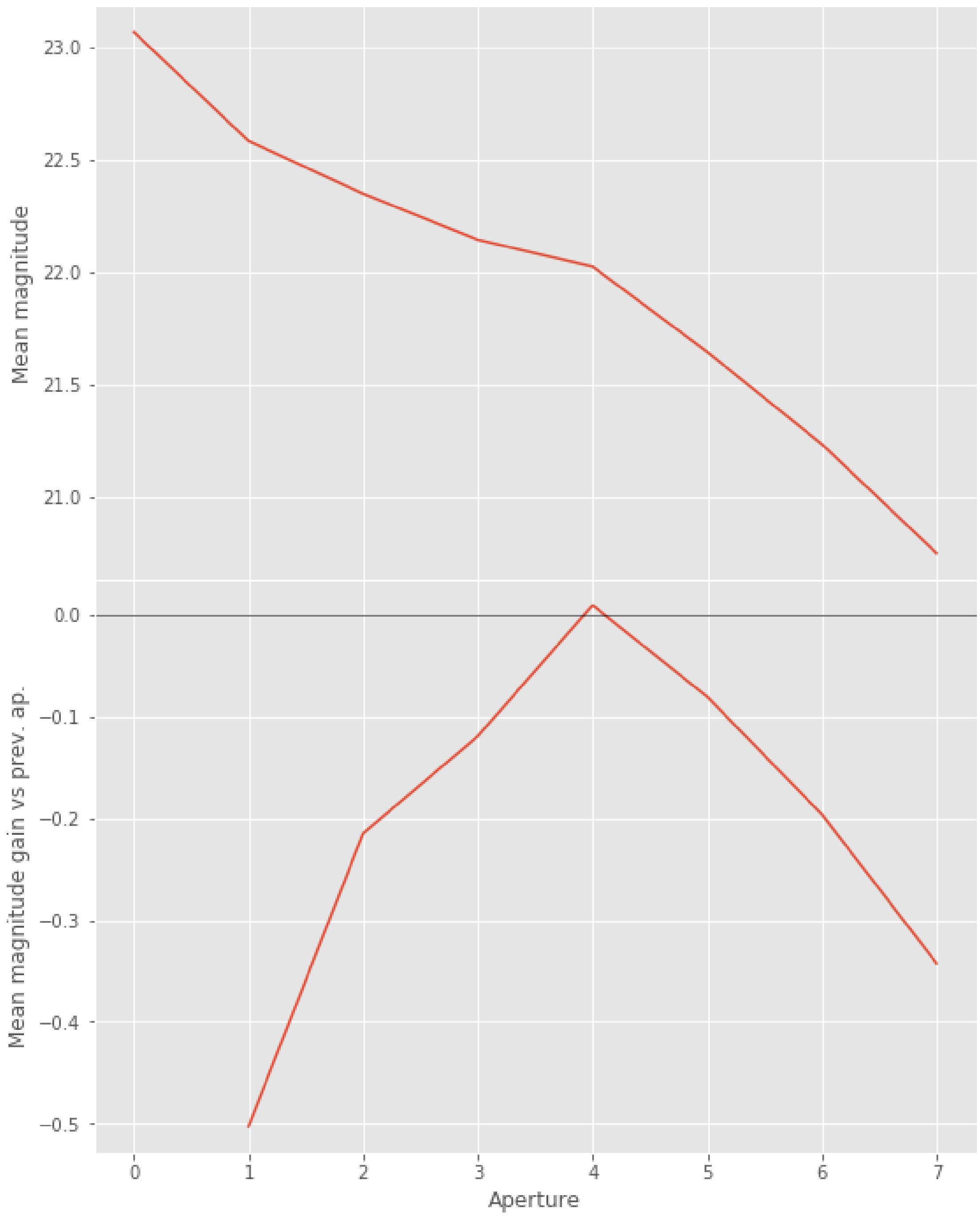
We will use aperture 5 as target.



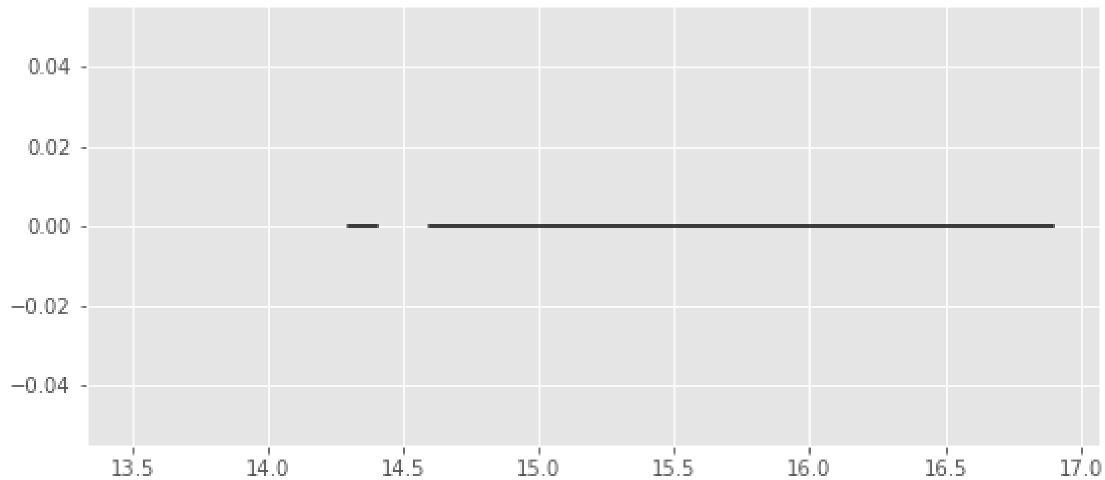
We use magnitudes between 17.0 and 18.5.

```
Aperture correction for r band:
Correction: -0.08614945231256144
Number of source used: 1513
RMS: 0.03438196144974404
```

1.2.3 I.c - z band



We will use aperture 4 as target.



We use magnitudes between 16.0 and 17.5.

```
Aperture correction for z band:
Correction: -0.033215372542812815
Number of source used: 1183
RMS: 0.012679290276947705
```

1.3 II - Stellarity

Legacy Survey does not provide a 0 to 1 stellarity so we replace items flagged as PSF accpording to the following table:

$$P(star) = \frac{\prod_i P(star)_i}{\prod_i P(star)_i + \prod_i P(galaxy)_i}$$

where i is the band, and with using the same probabilities as UKDISS:

HSC flag	UKIDSS flag	Meaning	P(star)	P(galaxy)	P(noise)	P(saturated)
	-9	Saturated	0.0	0.0	5.0	95.0
	-3	Probable galaxy	25.0	70.0	5.0	0.0
	-2	Probable star	70.0	25.0	5.0	0.0
0	-1	Star	90.0	5.0	5.0	0.0
	0	Noise	5.0	5.0	90.0	0.0
1	+1	Galaxy	5.0	90.0	5.0	0.0

1.4 II - Column selection

```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:17:
/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:76: RuntimeWarning: invalid value enco
  magnitudes = 2.5 * (23 - np.log10(fluxes)) - 48.6
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:43: RuntimeWarning: invalid value enco
  errors = np.log(10)/2.5 * fluxes * errors_on_magnitudes
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:80: RuntimeWarning: divide by zero enc
  errors = 2.5 / np.log(10) * errors_on_fluxes / fluxes
```

```
Out[19]: <IPython.core.display.HTML object>
```

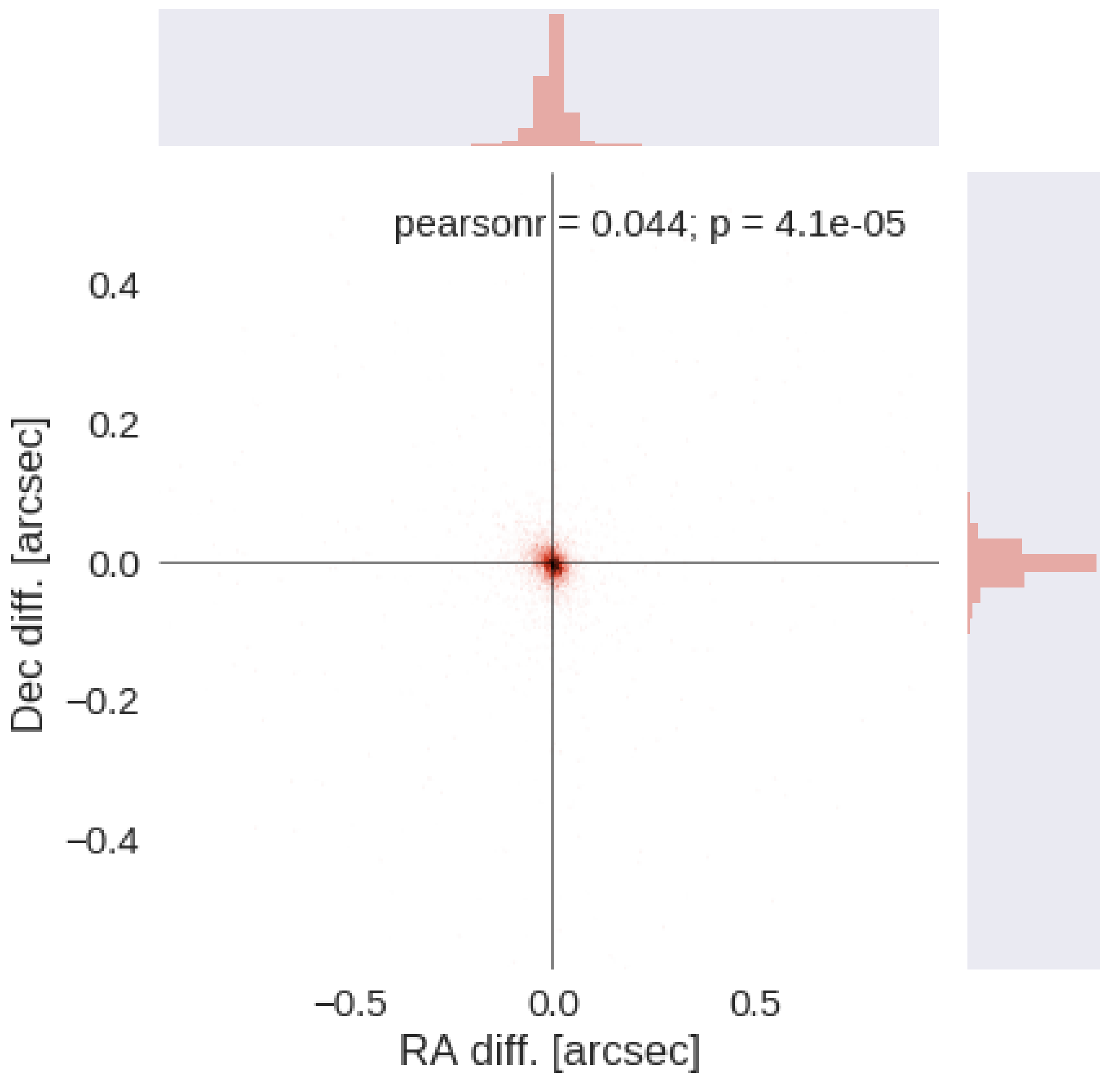
1.5 III - Removal of duplicated sources

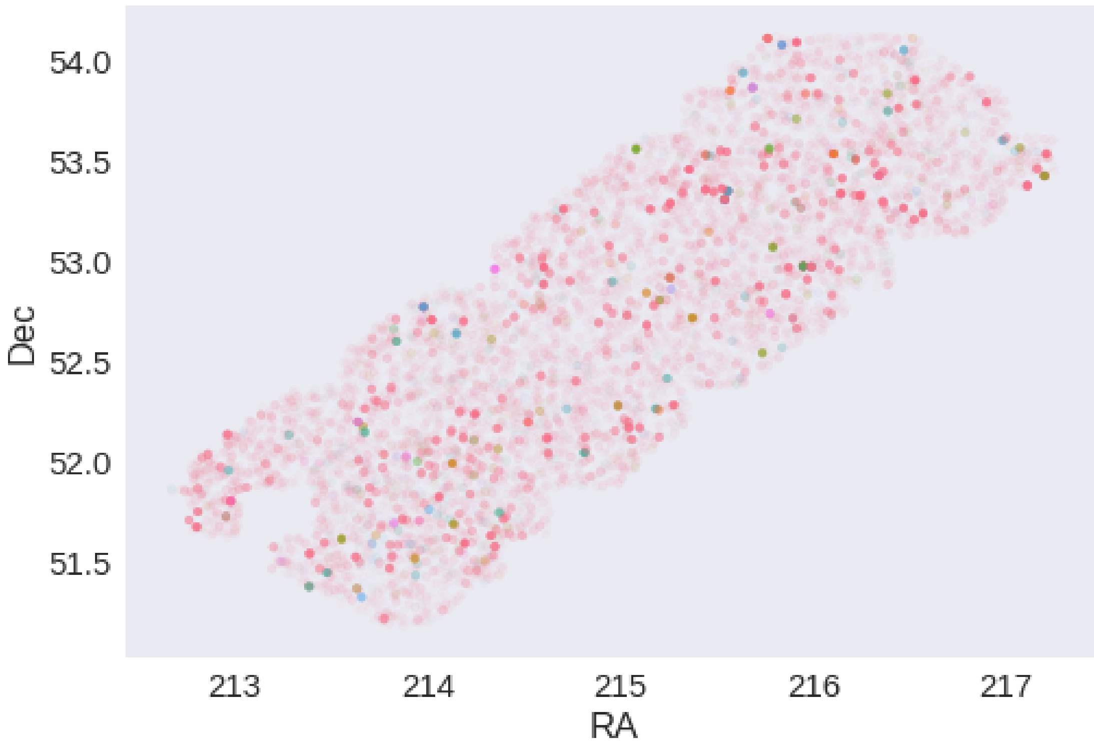
We remove duplicated objects from the input catalogues.

```
The initial catalogue had 166758 sources.
The cleaned catalogue has 163539 sources (3219 removed).
The cleaned catalogue has 3171 sources flagged as having been cleaned
```

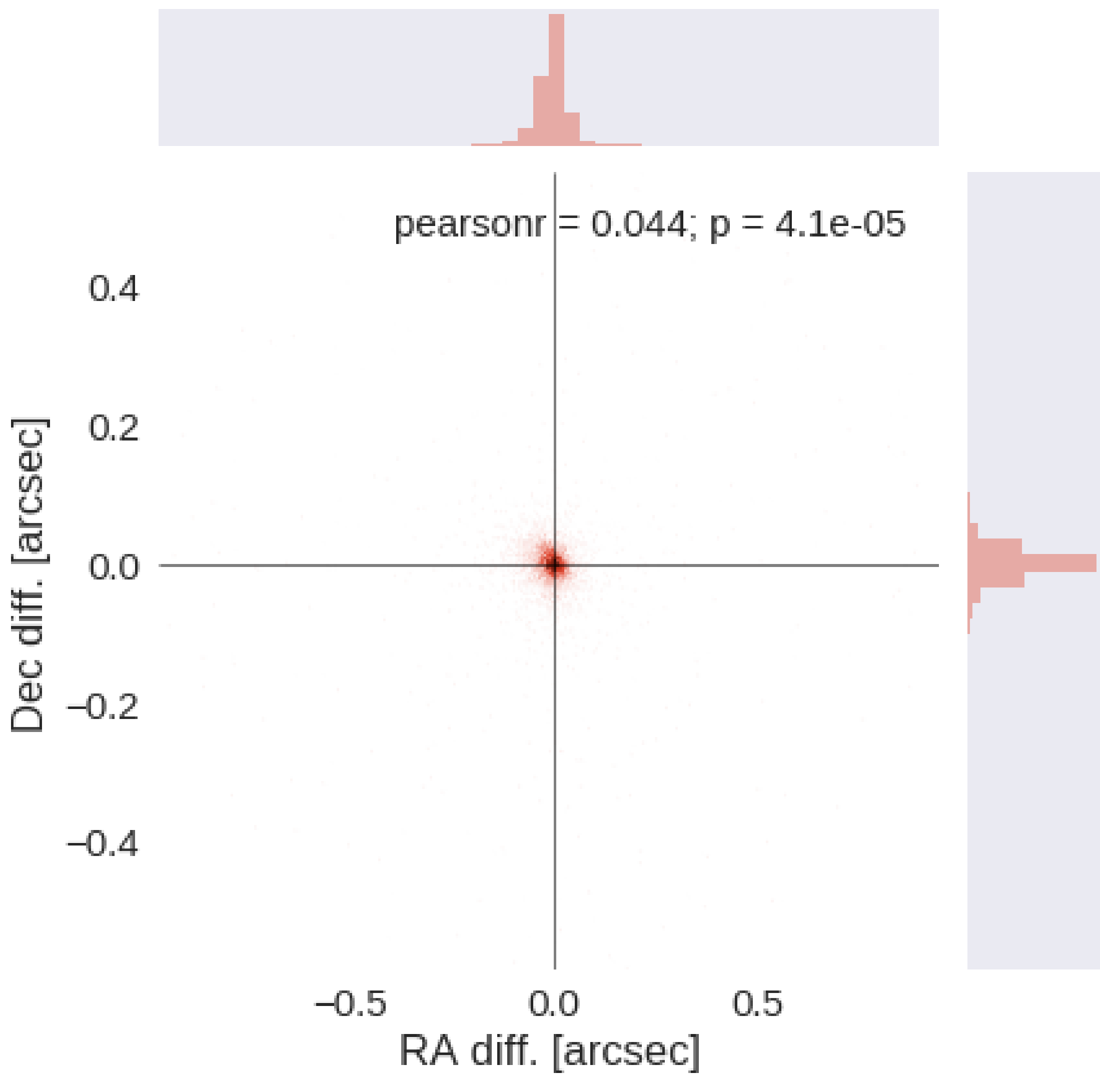
1.6 III - Astrometry correction

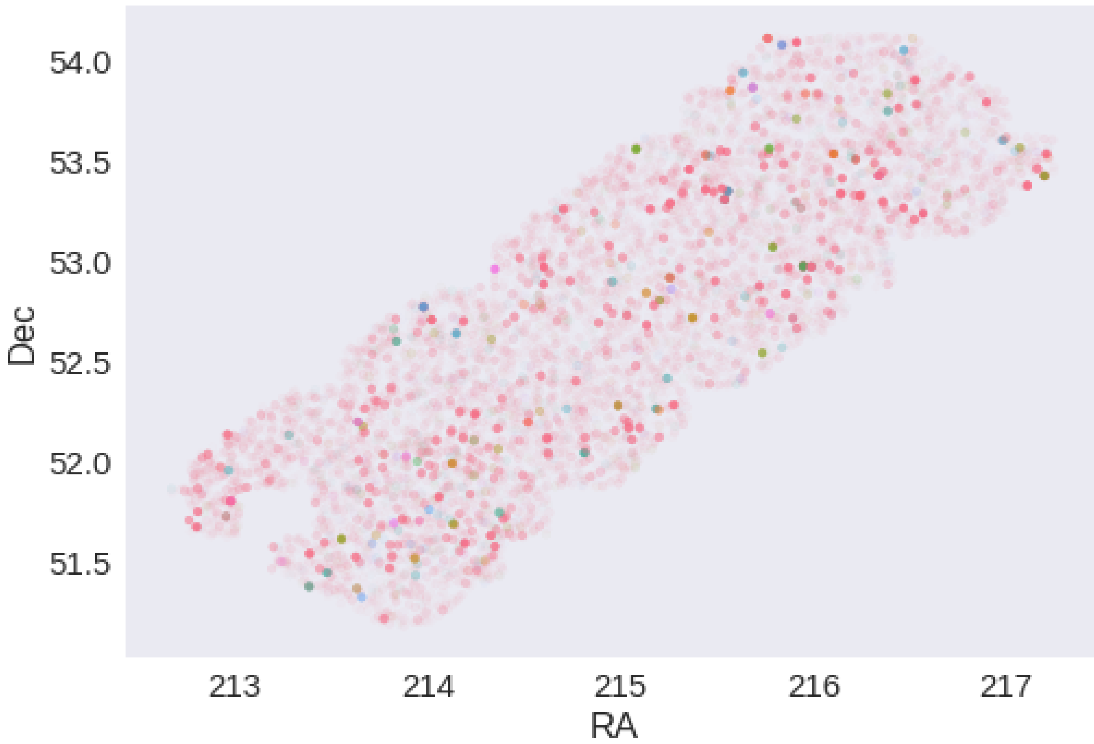
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.


pearsonr = 0.044; p = 4.1e-05
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]




```
RA correction: -0.003632177259760283 arcsec
Dec correction: 0.004341531230522833 arcsec
```


pearsonr = 0.044; p = 4.1e-05
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]



1.7 IV - Flagging Gaia objects

```
9145 sources flagged.
```

2 V - Saving to disk

1.12_UHS

January 18, 2018

1 EGS master catalogue

1.1 Preparation of UKIRT Hemisphere Survey (UHS) data

The catalogue comes from `dmu0_UHS`. This is a J band only survey documented in https://arxiv.org/pdf/1707.09975.pdf

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The magnitude for each band in aperture 4 (2 arcsec aperture corrected).
- 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:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

1.2 I - Column selection

```
0.925175419285
```

```
/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

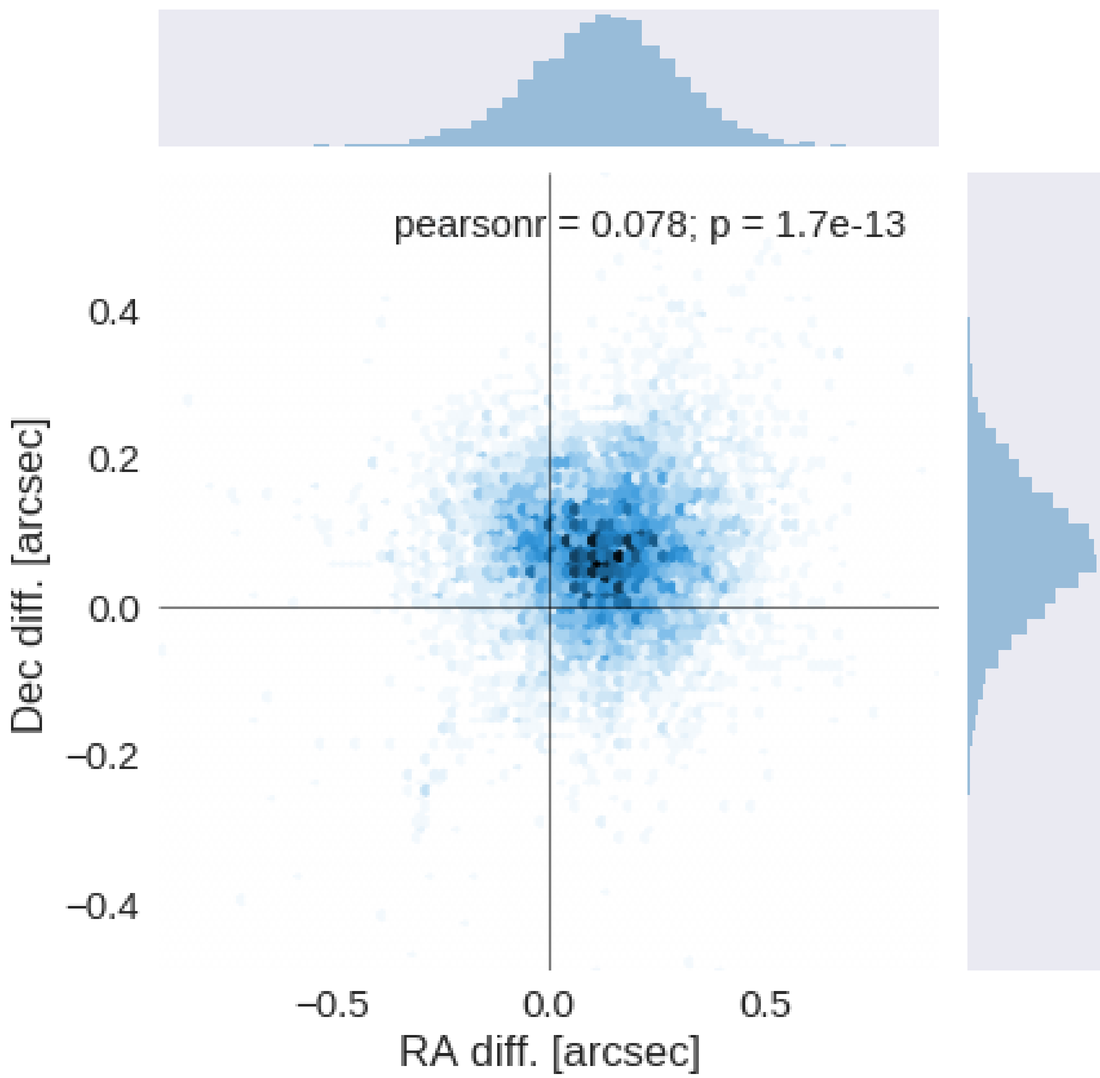
We remove duplicated objects from the input catalogues.

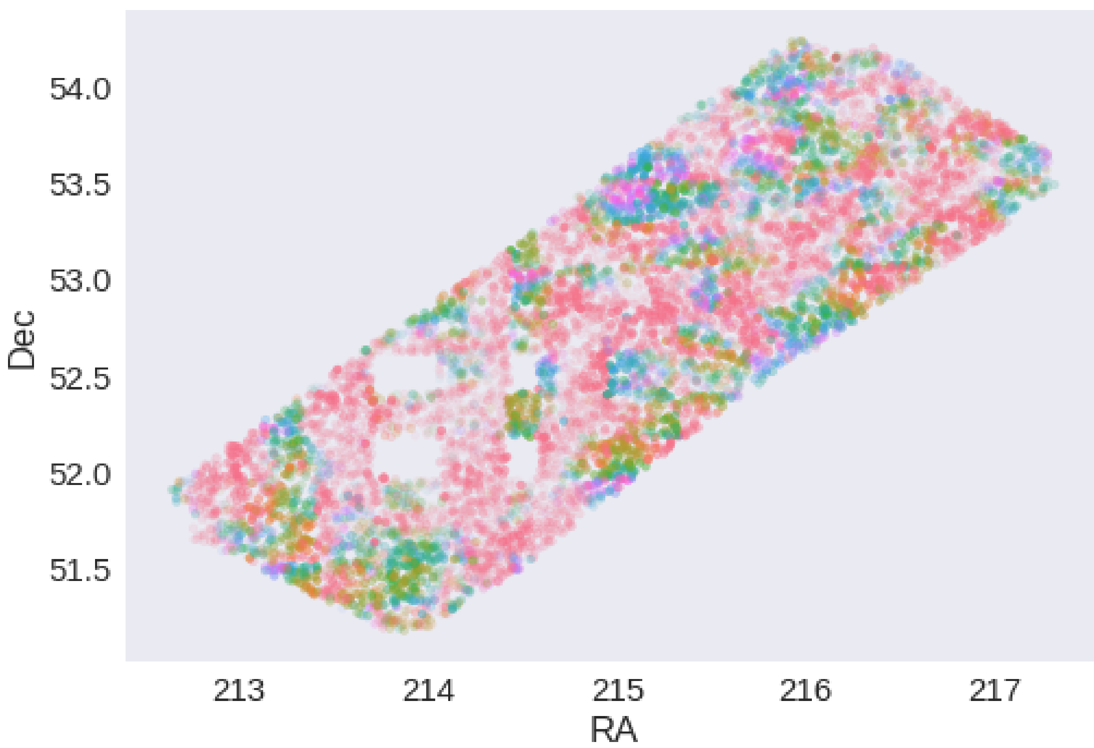
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 34310 sources.
The cleaned catalogue has 31771 sources (2539 removed).
The cleaned catalogue has 2427 sources flagged as having been cleaned
```

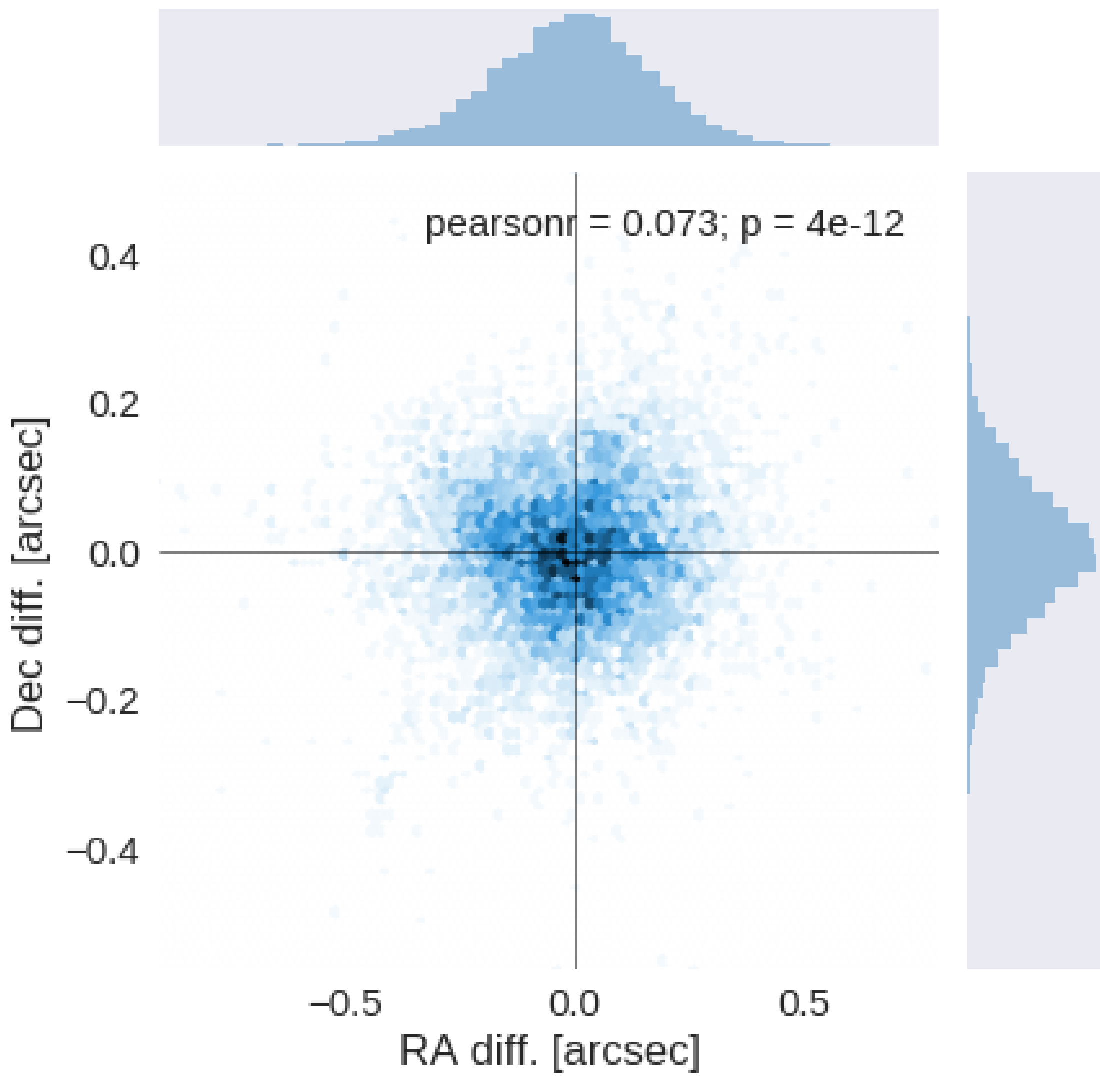
1.4 III - Astrometry correction

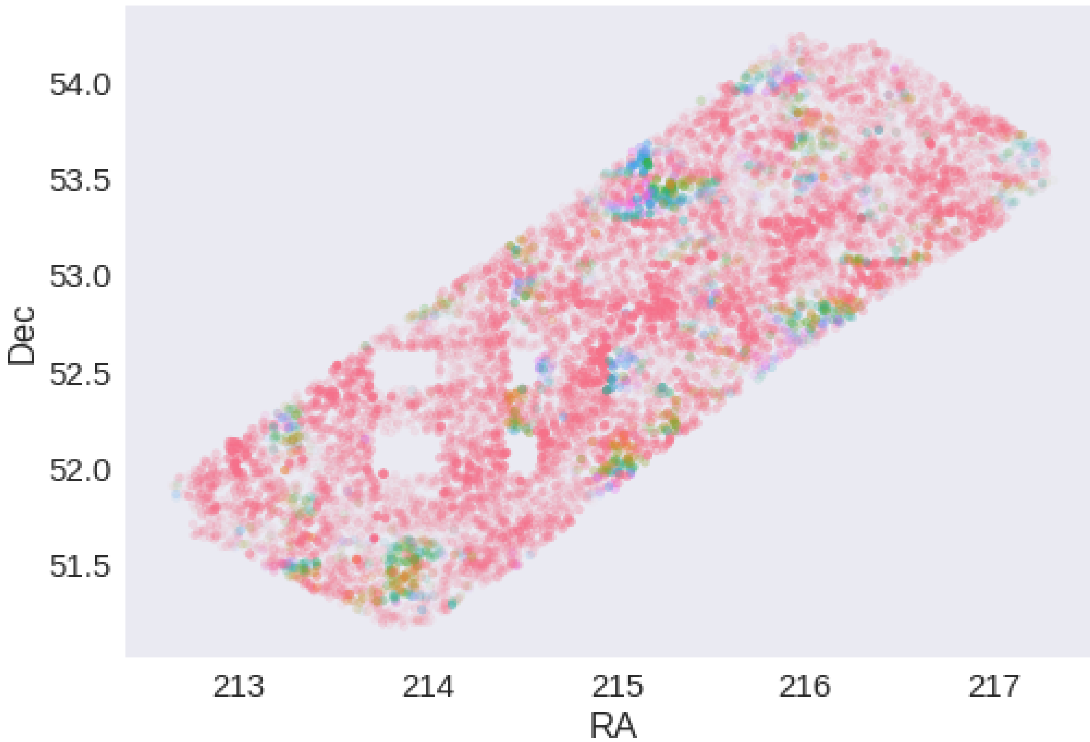
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: -0.13122841110089212 arcsec
Dec correction: -0.07189033726717753 arcsec
```


pearsonr = 0.073; p = 4e-12
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.5
0.0
0.5
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
9047 sources flagged.
```

2 V - Saving to disk

2_Merging

January 18, 2018

1 EGS master catalogue

This notebook presents the merge of the various pristine catalogues to produce HELP mater catalogue on EGS.

```
This notebook was run with herschelhelp_internal version:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

1.1 I - Reading the prepared pristine catalogues

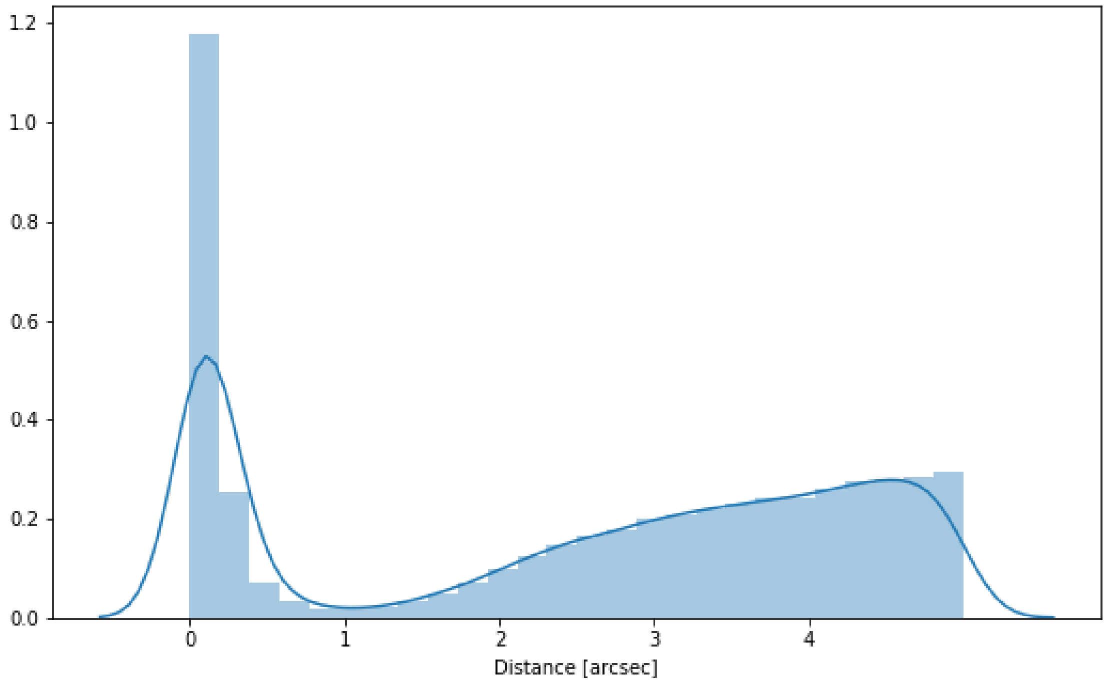
1.2 II - Merging tables

We first merge the optical catalogues and then add the infrared ones.

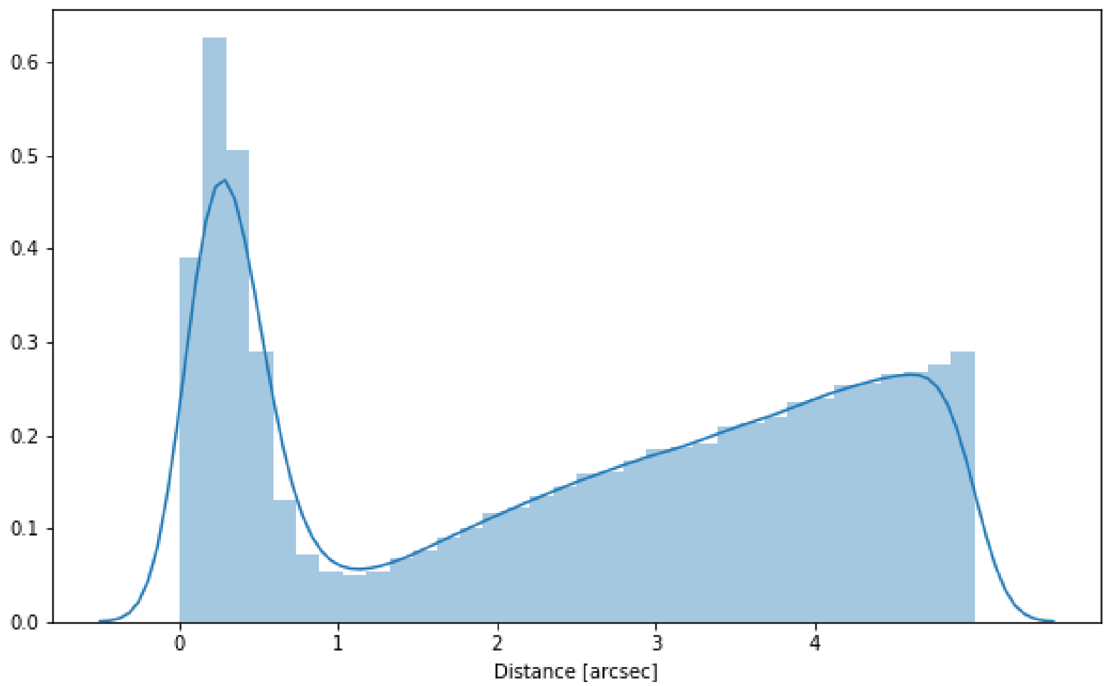
At every step, we look at the distribution of the distances to the nearest source in the merged catalogue to determine the best crossmatching radius.

1.2.1 HSC

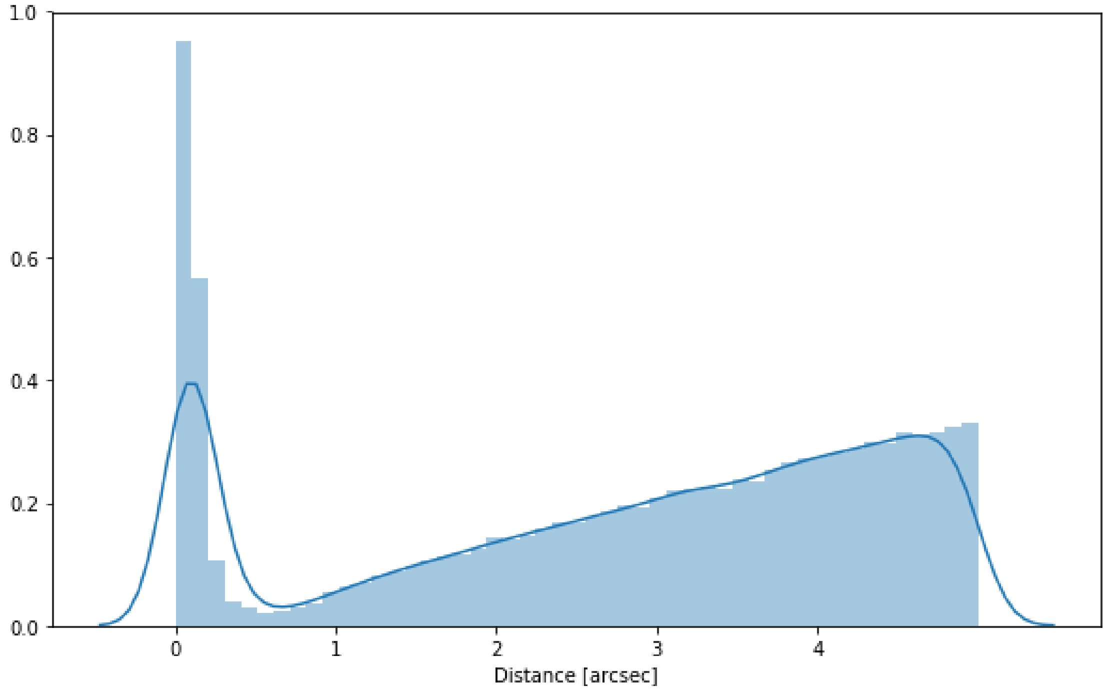
1.2.2 Add PanSTARRS



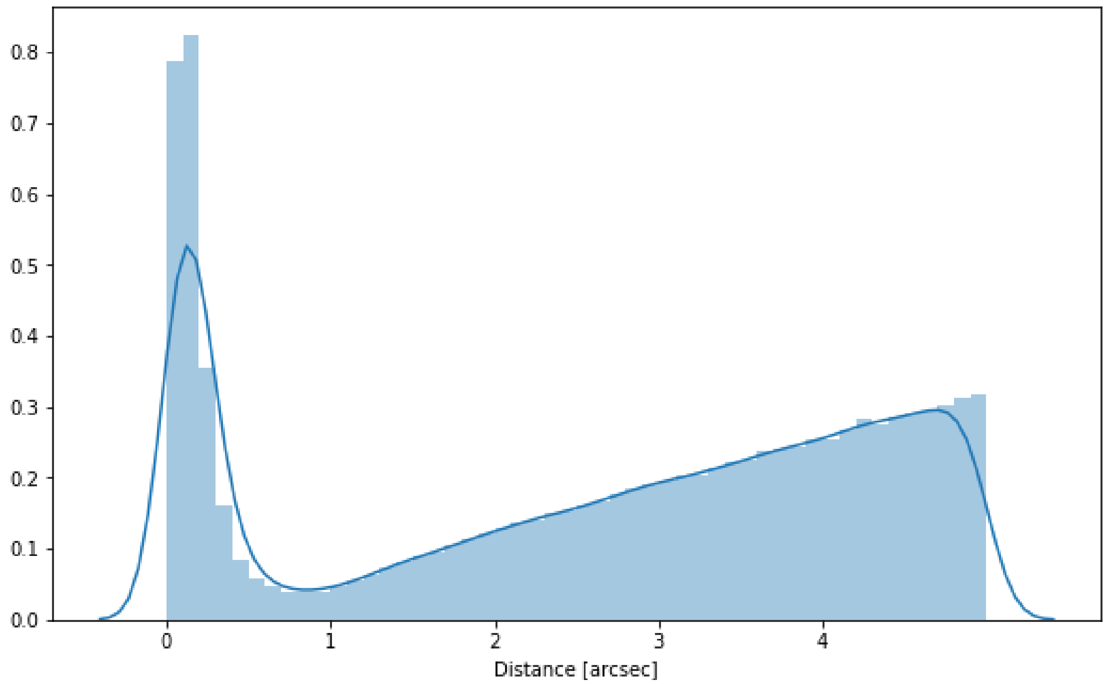
1.2.3 AEGIS



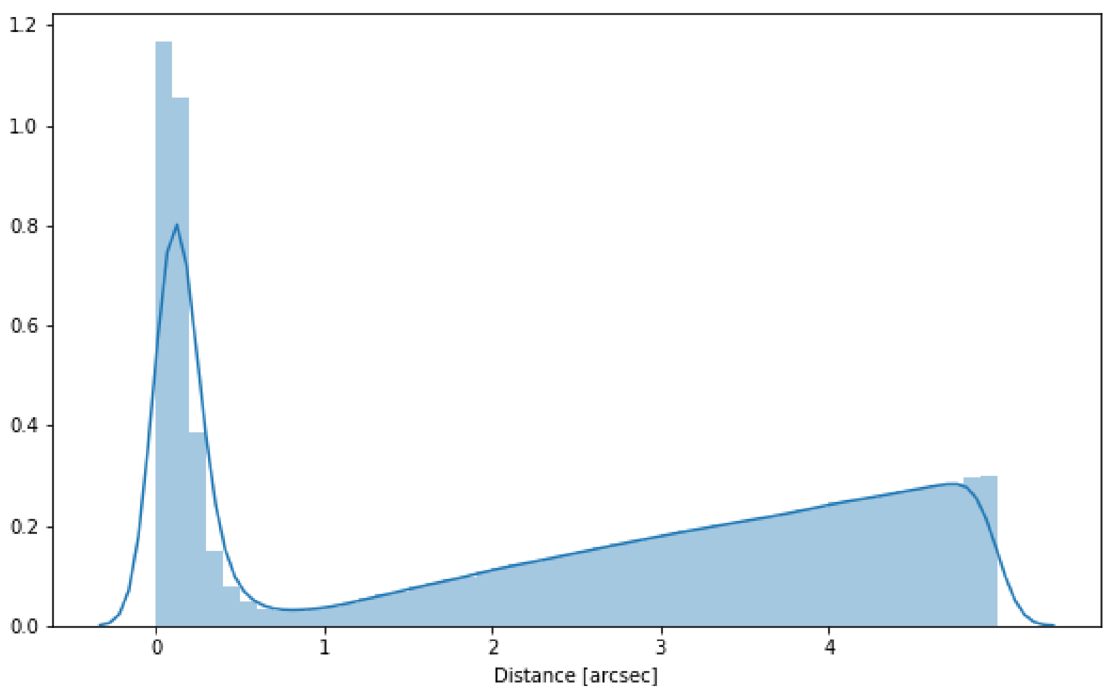
1.2.4 CANDELS



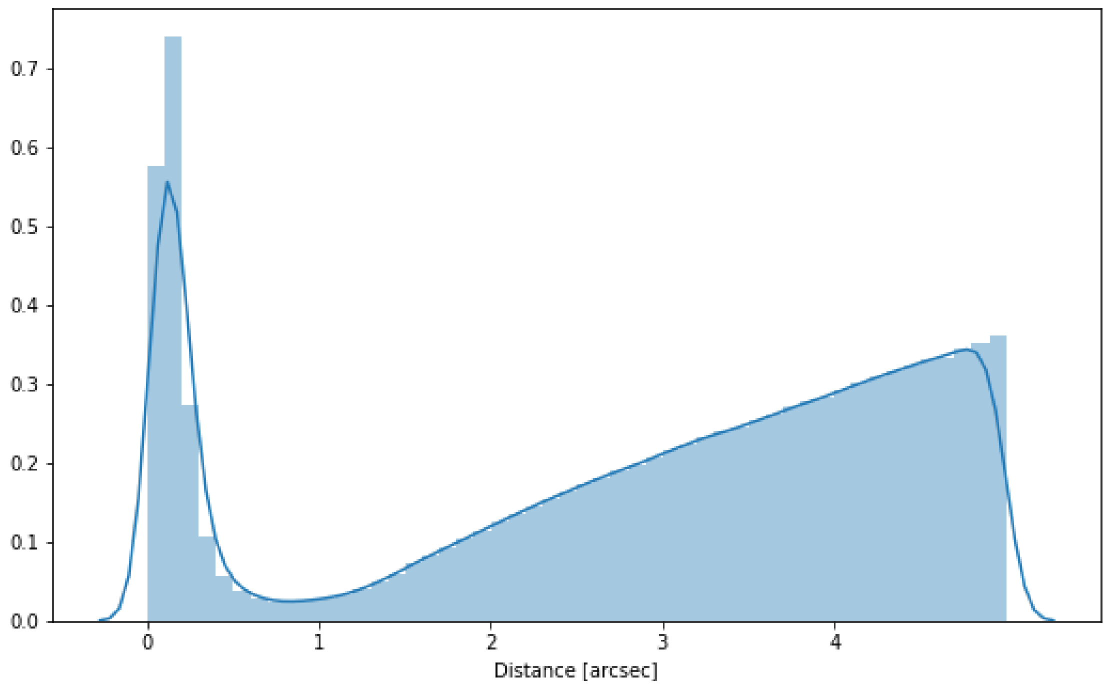
1.2.5 CFHT-WIRDS



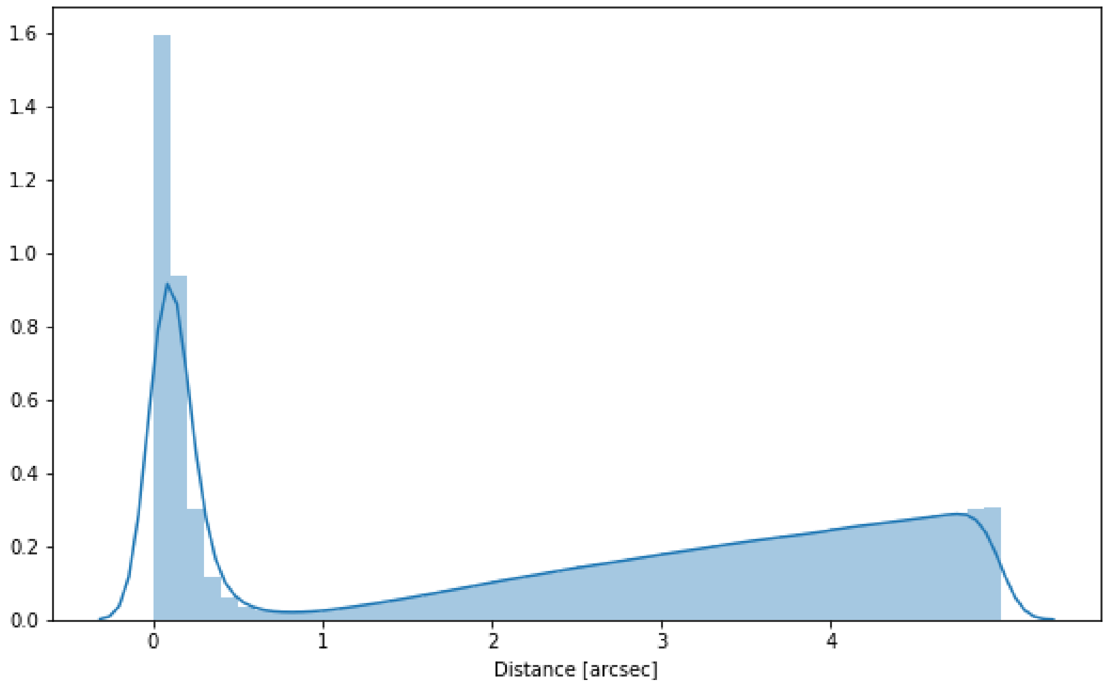
1.2.6 CFHTLS-WIDE



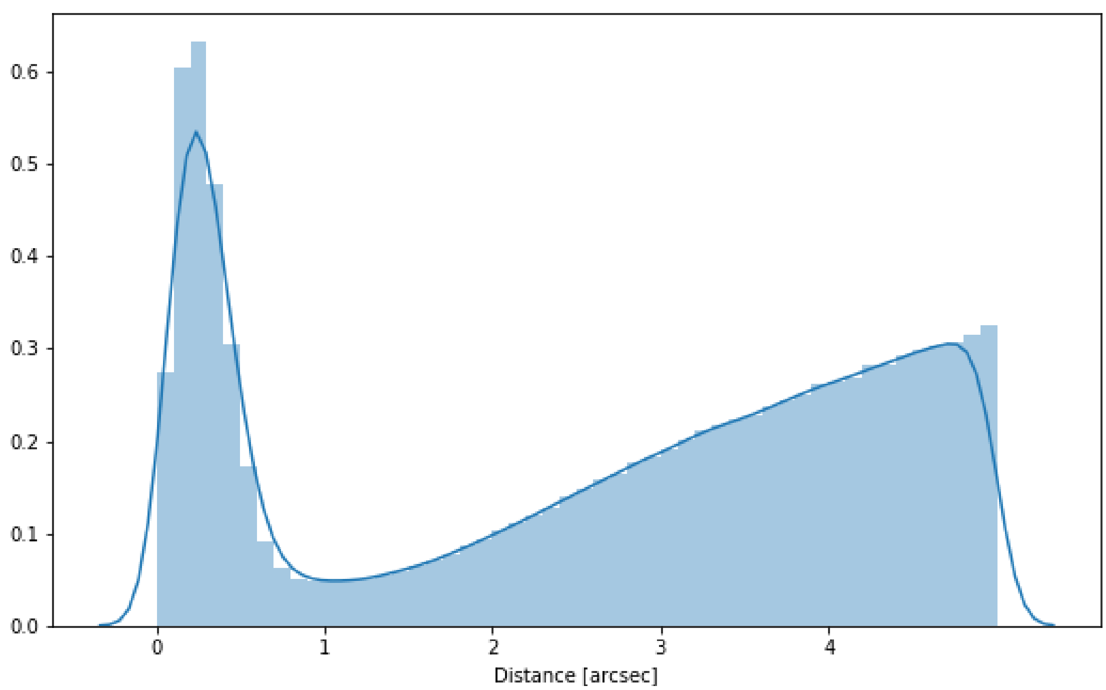
1.2.7 CFHTLS-DEEP



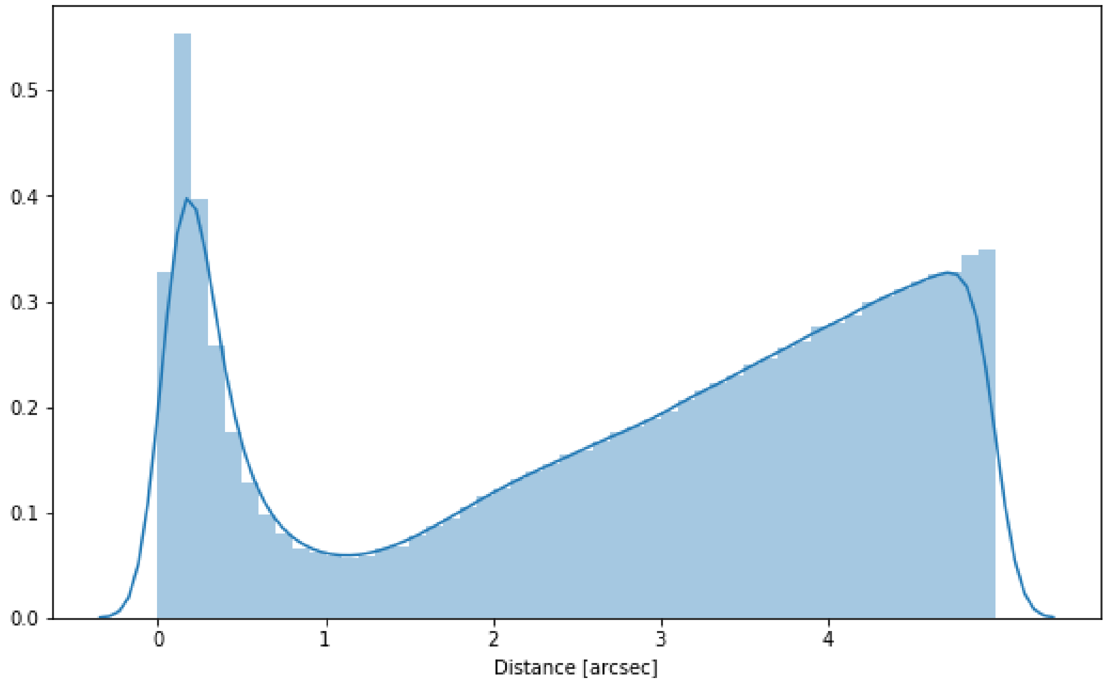
1.2.8 CFHTLenS



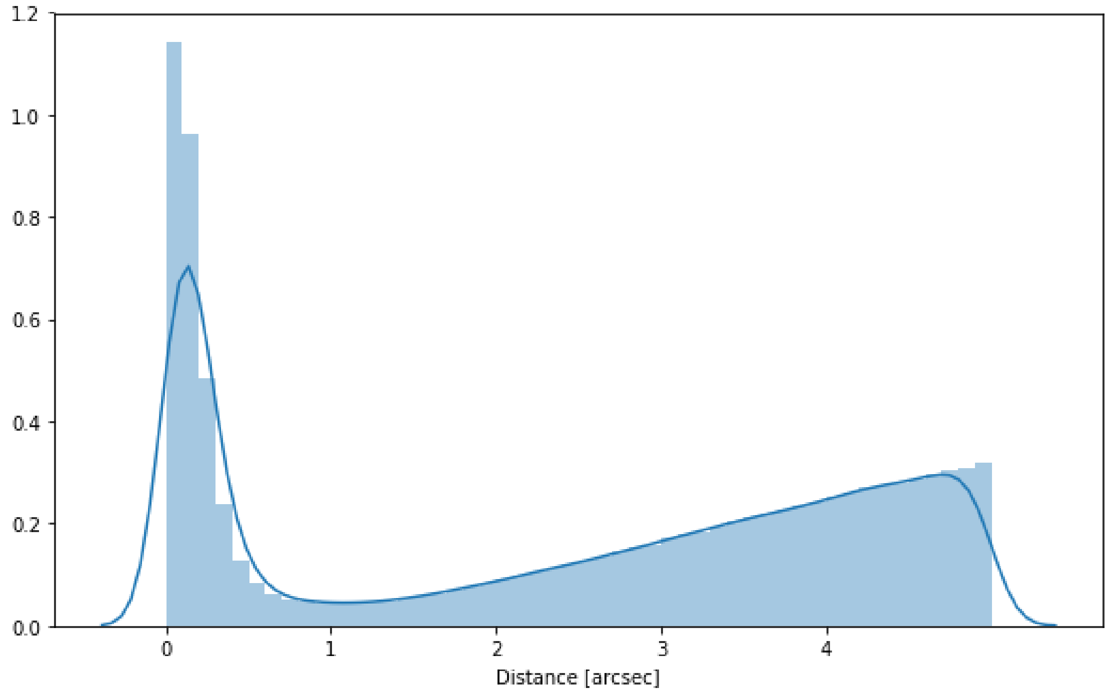
1.2.9 DEEP2



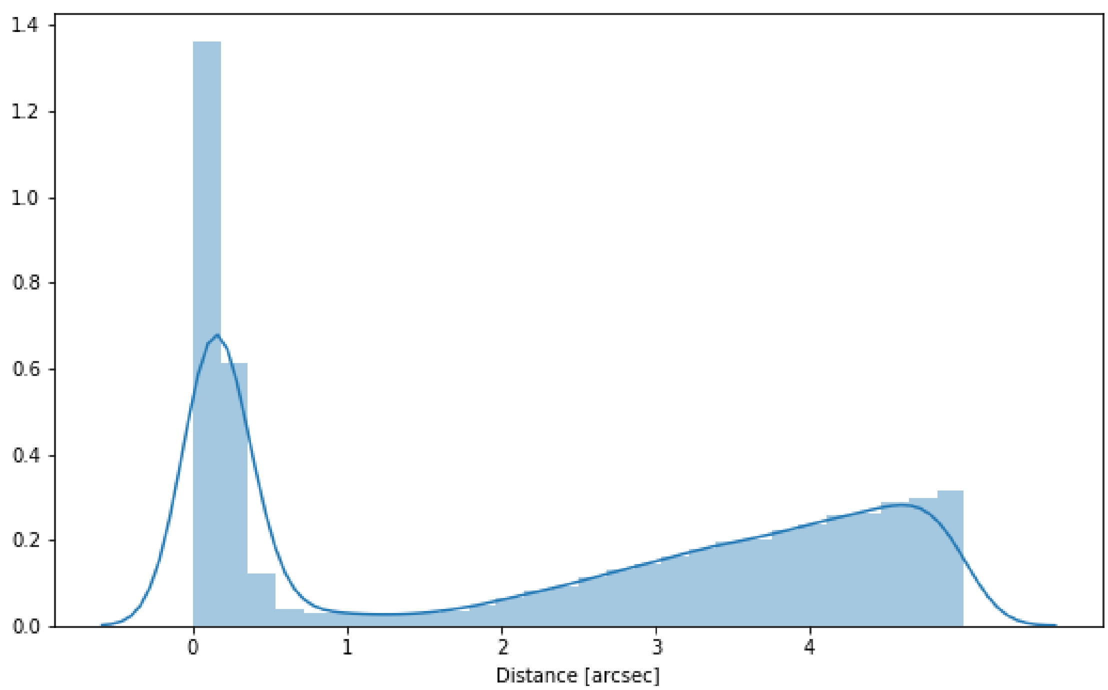
1.2.10 IRAC-EGS



1.2.11 Legacy Survey



1.2.12 UHS



1.2.13 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[29]: <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. We keep trace of the origin of the stellarity.

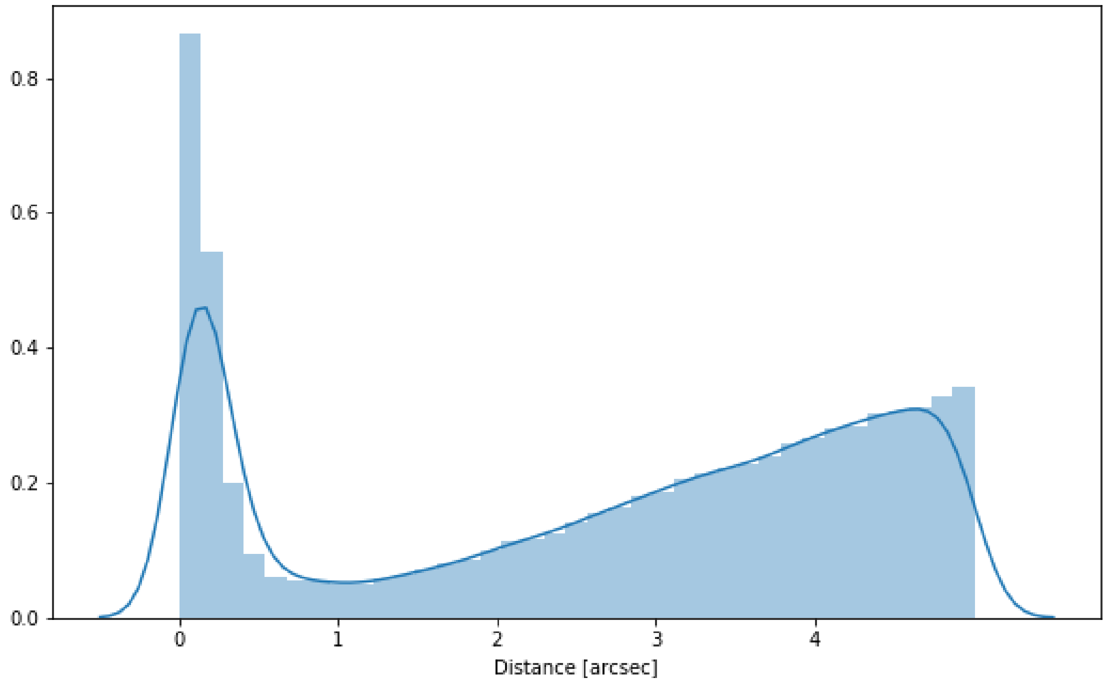
```
hsc_stellarity, candels-egs_stellarity, cfhtls-wide_stellarity, cfhtls-deep_stellarity, cfhtlens
```

1.4 IV - Adding E(B-V) column

1.5 V - Adding HELP unique identifiers and field columns

```
OK!
```

1.6 VI - Cross-matching with spec-z catalogue



1.7 VII - Choosing between multiple values for the same filter

There are many different bands to choose between here.

1.7.1 CFHT Megacam

CFHT-WIRDS is the only survey that has J, H and Ks so we take them directly. After that we need to select ugriz bands from between CFHTLS, CFHT-WIRDS and CFHTLenS. We take these in order of depth.

Survey	Bands	Notes
CFHTLS-DEEP	u, g, r, i, z	
CFHTLS-WIDE	u, g, r, i, z	
CFHT-WIRDS	u, g, r, i, z	Ks selected so may have unique objects
CFHTLenS	u, g, r, i, z	Reprocessing of CFHTLS-WIDE so not used

Survey	Bands	Notes
CANDELS-EGS	u, g, r, i, z	Priors from very deep data so may have unique objects

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

Out[43]: <IPython.core.display.HTML object>

1.8 CFHT WIRCAM

We have WIRCAM J,H, and Ks from both CFHT-WIRDS (Ks prior and blind) and CANDELS-EGS. Since the CANDELS will have very deep priors the WIRCAM fluxes are worth keepting to constrain photo-z. We therefor take the CFHT-WIRDS fluxes if they are there but keep all the CANDELS fluxes for sources that only have those.

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

Out[48]: <IPython.core.display.HTML object>

1.9 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.

1.10 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.

1.11 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.

For convenience, we also cross-match the master list with the SDSS catalogue and add the objID associated with each source, if any. **TODO: should we correct the astrometry with respect to Gaia positions?**

```
30 master list rows had multiple associations.
```

```
['hsc_id', 'ps1_id', 'aegis_id', 'candels-egs_id', 'wirds_id', 'cfhtls-wide_id', 'cfhtls-deep_id
```

1.12 X - Adding HEALPix index

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

1.13 XI - Saving the catalogue

```
Missing columns: set()
```

3_Checks_and_diagnostics

January 18, 2018

1 EGS master catalogue

1.1 Checks and diagnostics

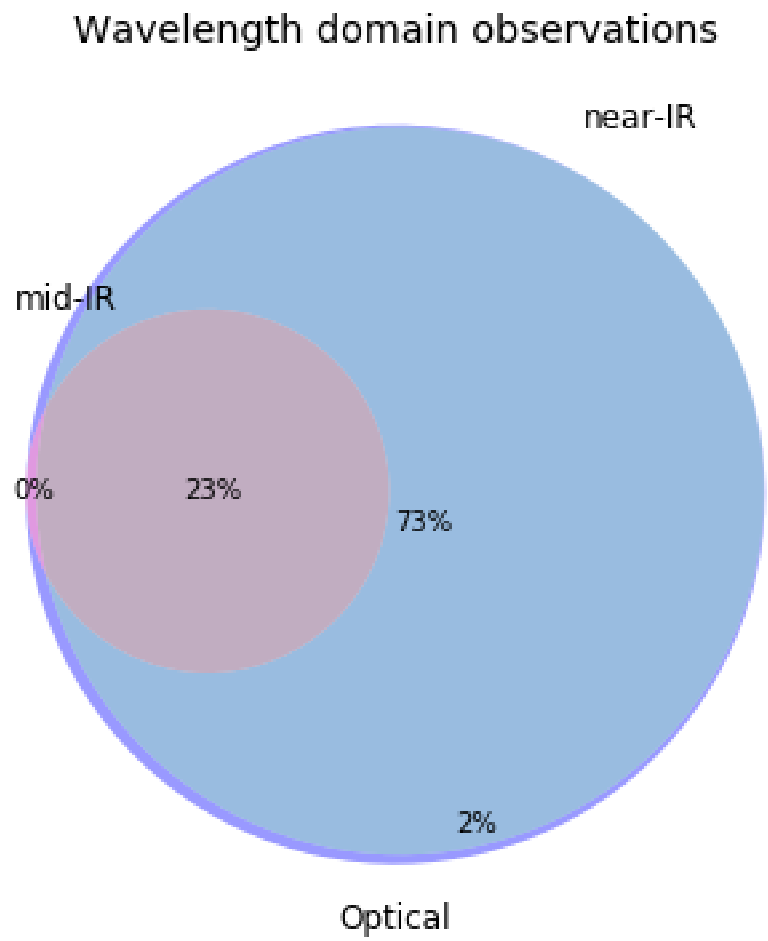
```
This notebook was run with herschelhelp_internal version:
44f1ae0 (Thu Nov 30 18:27:54 2017 +0000)
```

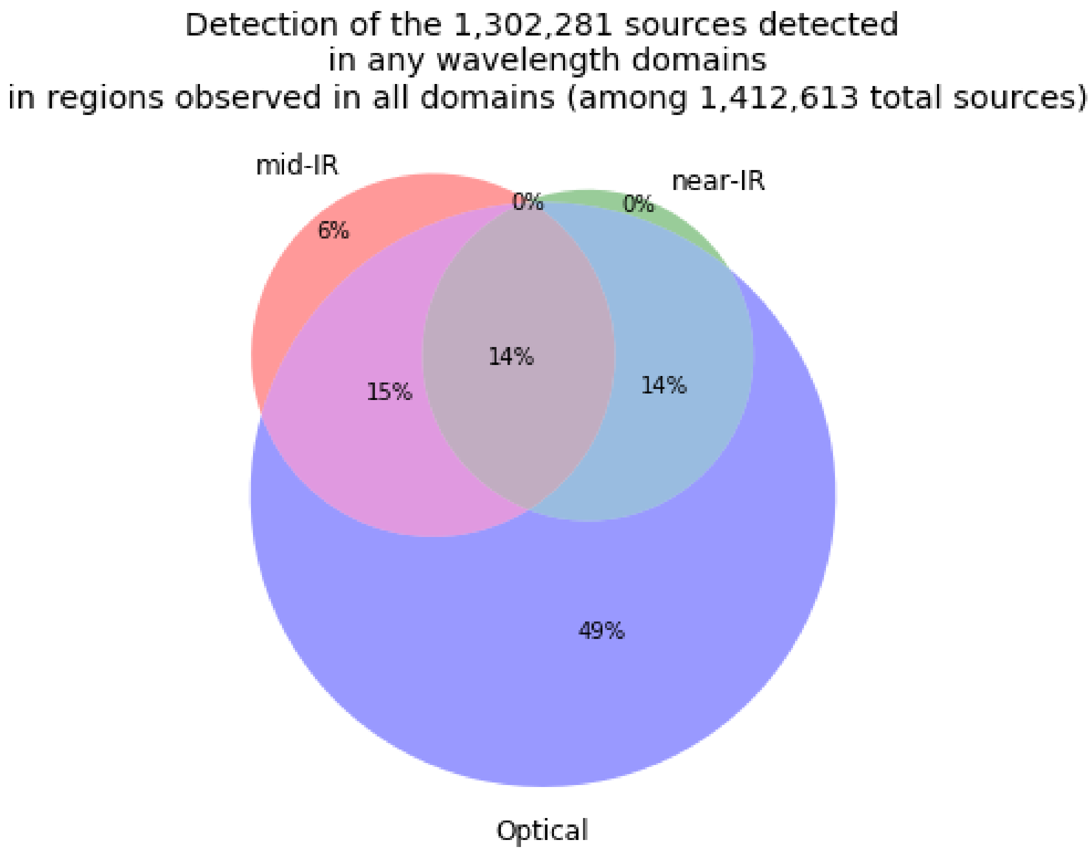
```
Diagnostics done using: master_catalogue_egs_20171202.fits
```

1.2 0 - Quick checks

1.3 I - Summary of wavelength domains

```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/matplotlib_venn/_venn3.py:
  warnings.warn("Bad circle positioning")
```


Wavelength domain observations
near-IR
mid-IR
0%
23%
73%
2%
Optical

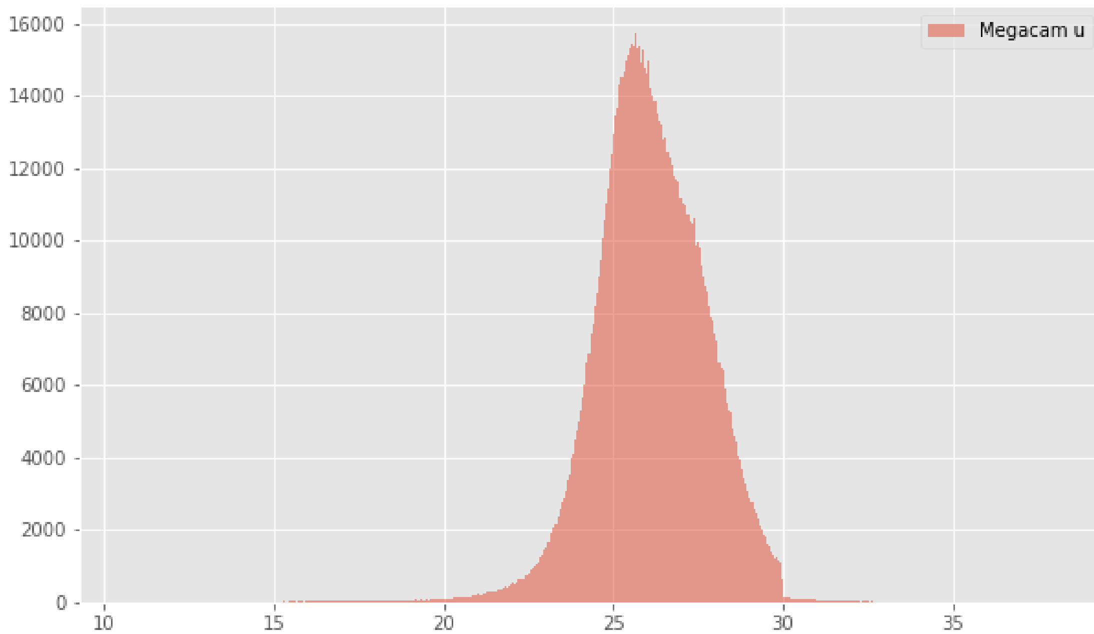


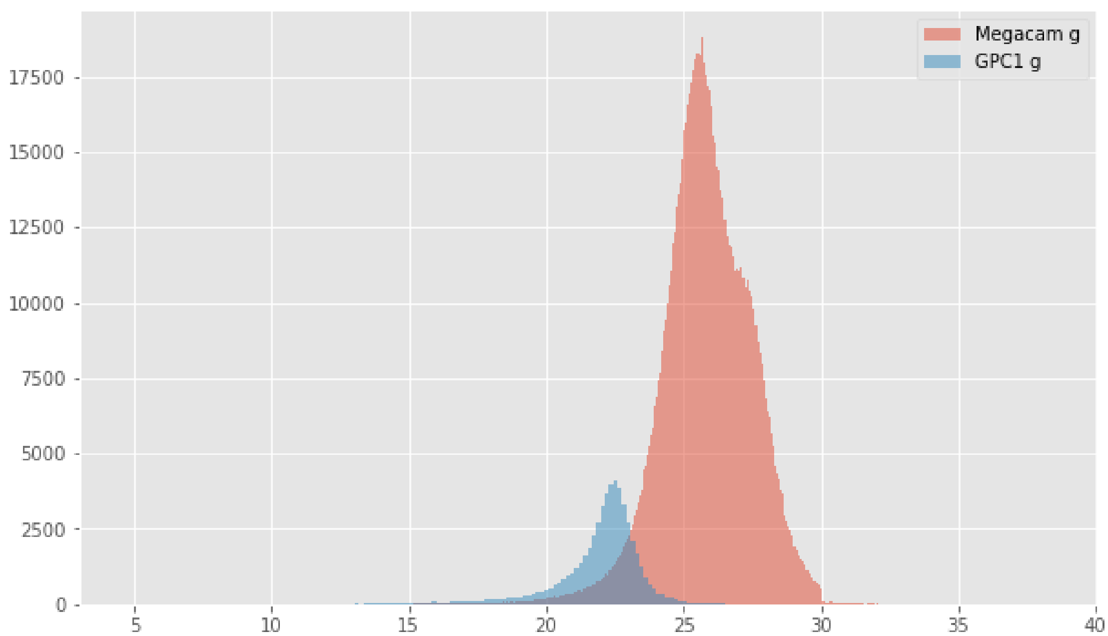
1.4 II - Comparing magnitudes in similar filters

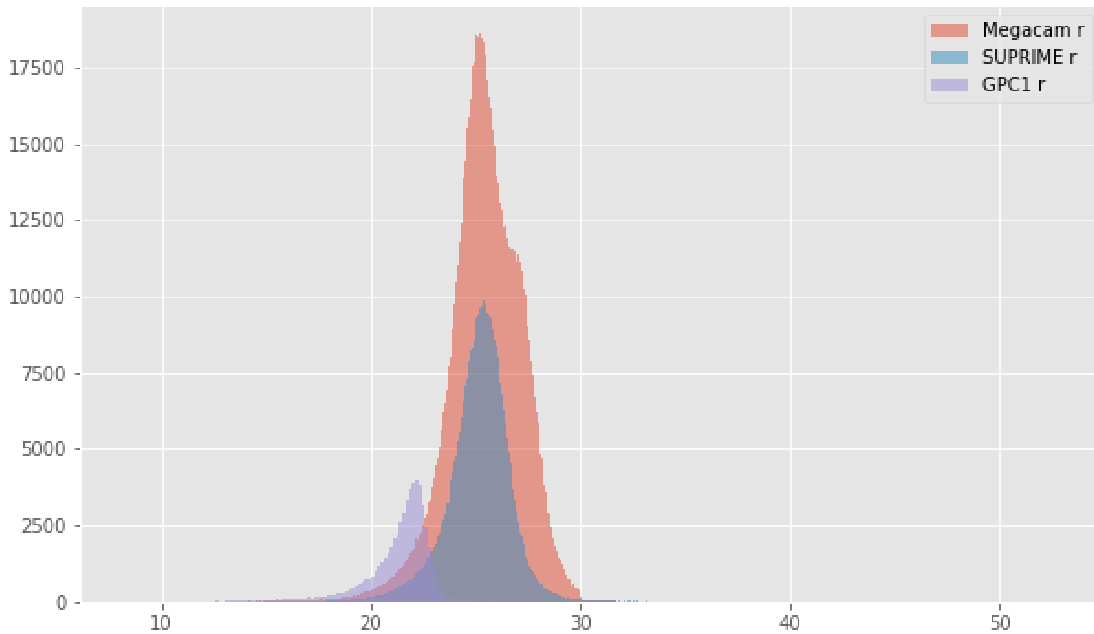
The master list if composed of several catalogues containing magnitudes in similar filters on different instruments. We are comparing the magnitudes in these corresponding filters.

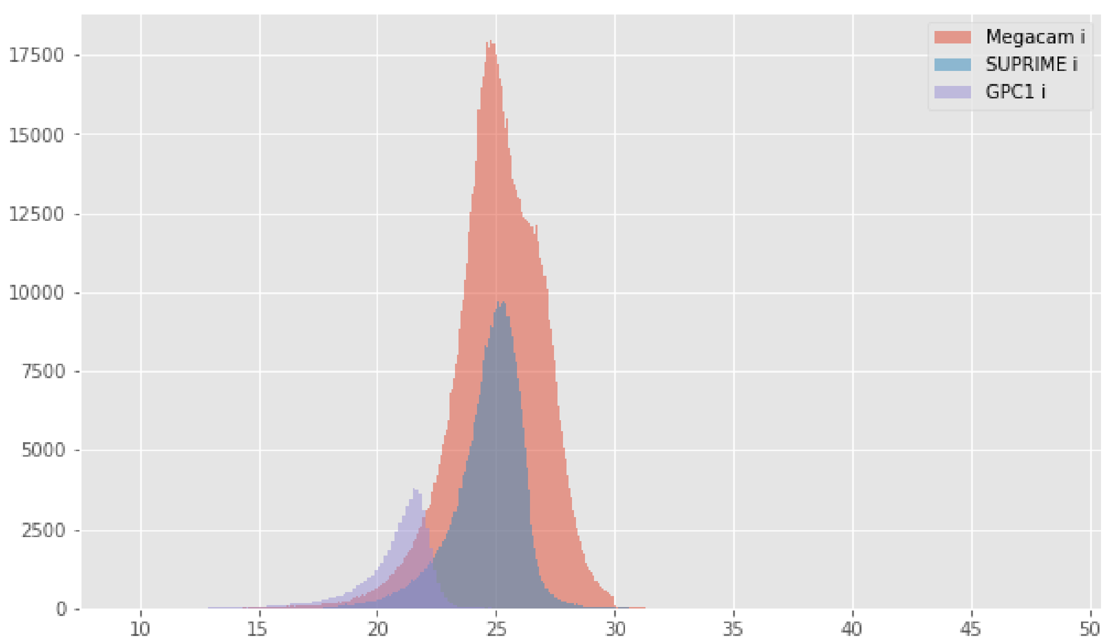
1.4.1 II.a - Comparing depths

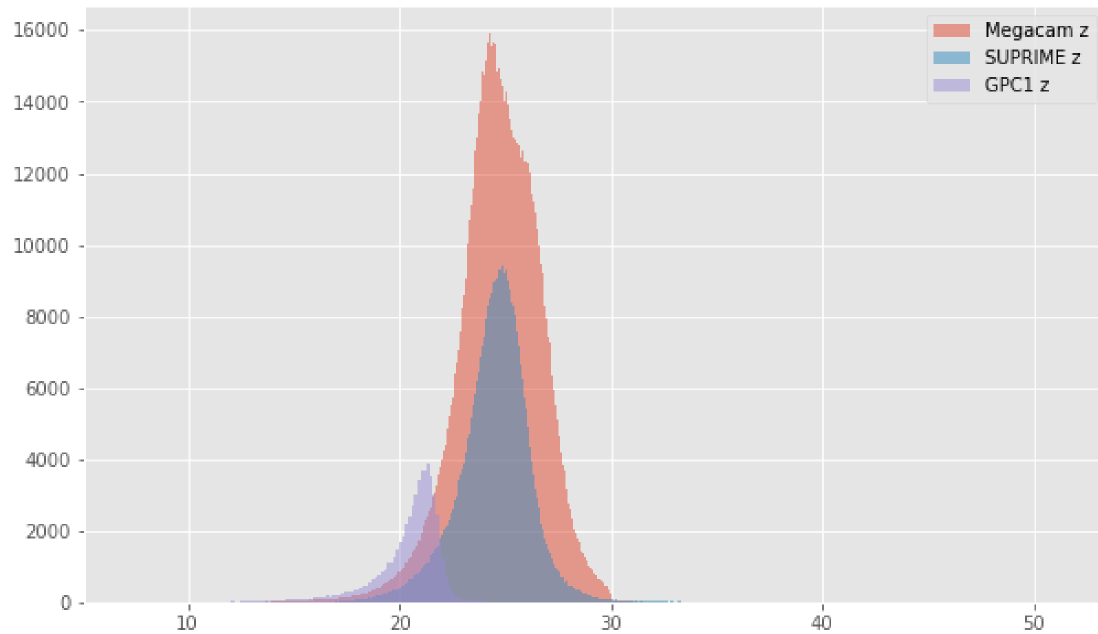
We compare the histograms of the total aperture magnitudes of similar bands.

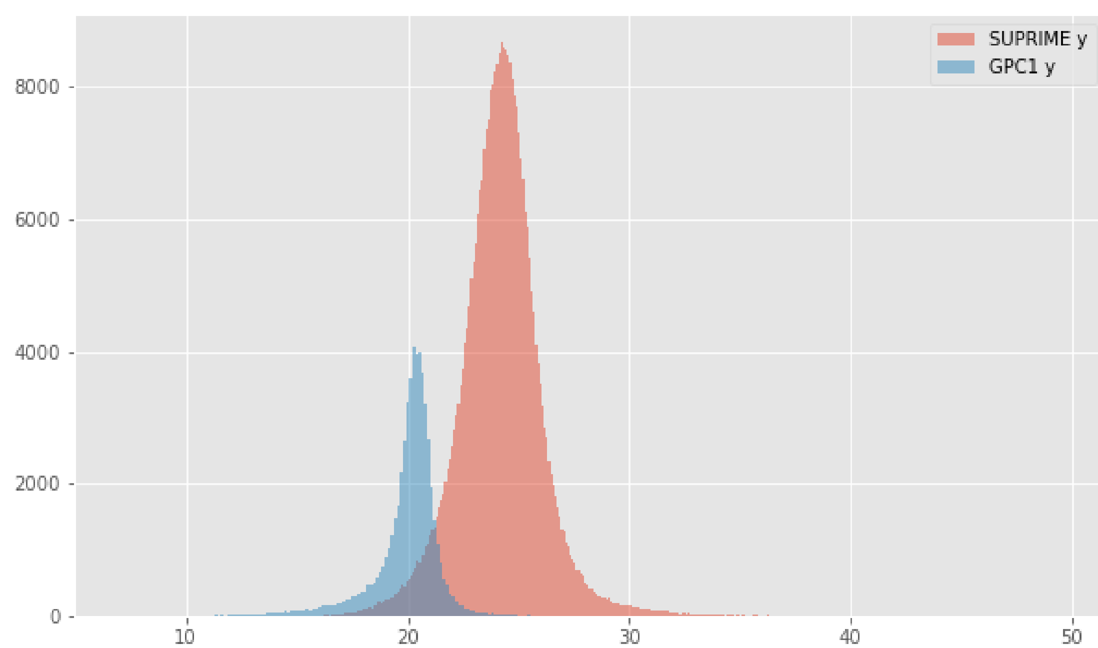

Megacam u
16000
14000
12000
10000
8000
6000
4000
2000
0
10
15
20
25
30
35


Megacam g
GPC1 g
17500
15000
12500
10000
7500
5000
2500
0
5
10
15
20
25
30
35
40


Megacam r
SUPRIME r
GPC1 r


Megacam i
SUPRIME i
GPC1 i

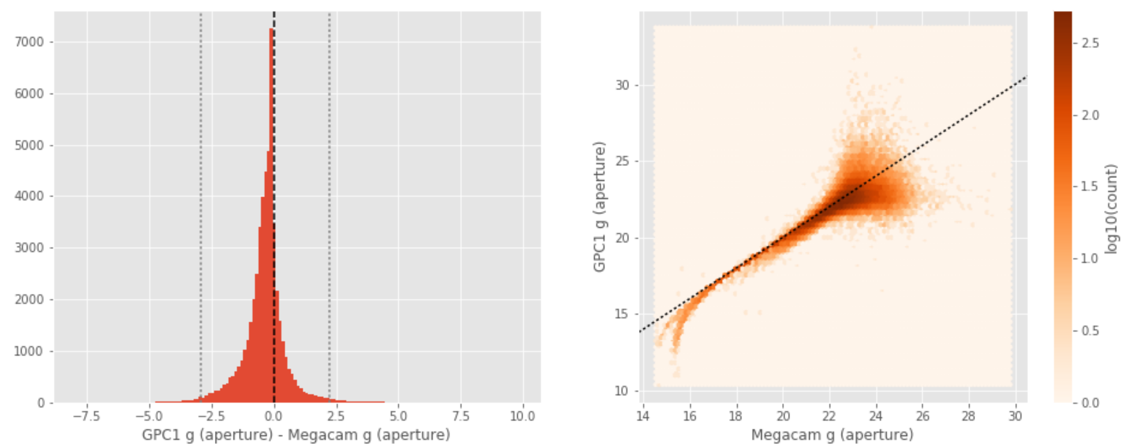




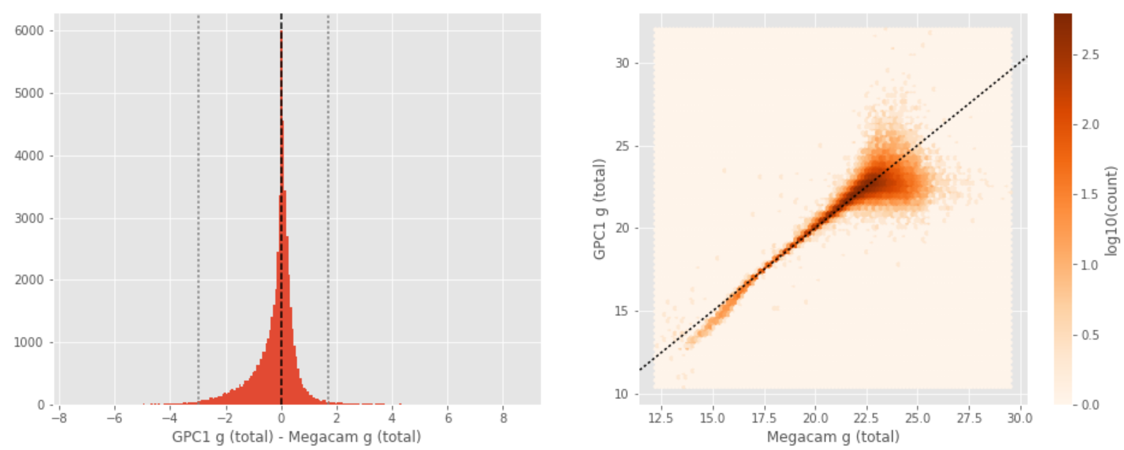
1.4.2 II.b - Comparing magnitudes

We compare one to one each magnitude in similar bands.

GPC1 g (aperture) - Megacam g (aperture):
- Median: -0.28
- Median Absolute Deviation: 0.32
- 1% percentile: -2.9472508430480957
- 99% percentile: 2.2309391975402826

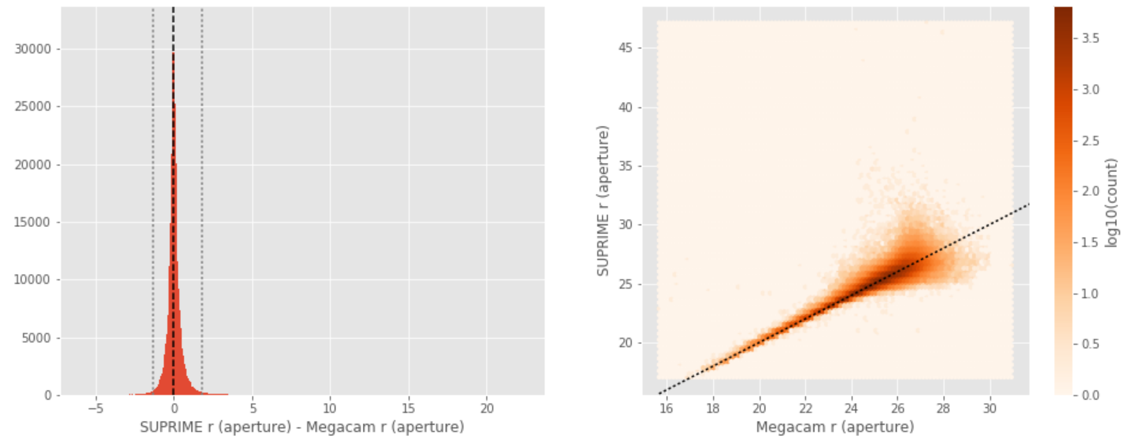


GPC1 g (total) - Megacam g (total):
- Median: -0.01
- Median Absolute Deviation: 0.27
- 1% percentile: -2.9708000183105465
- 99% percentile: 1.7024208068847675

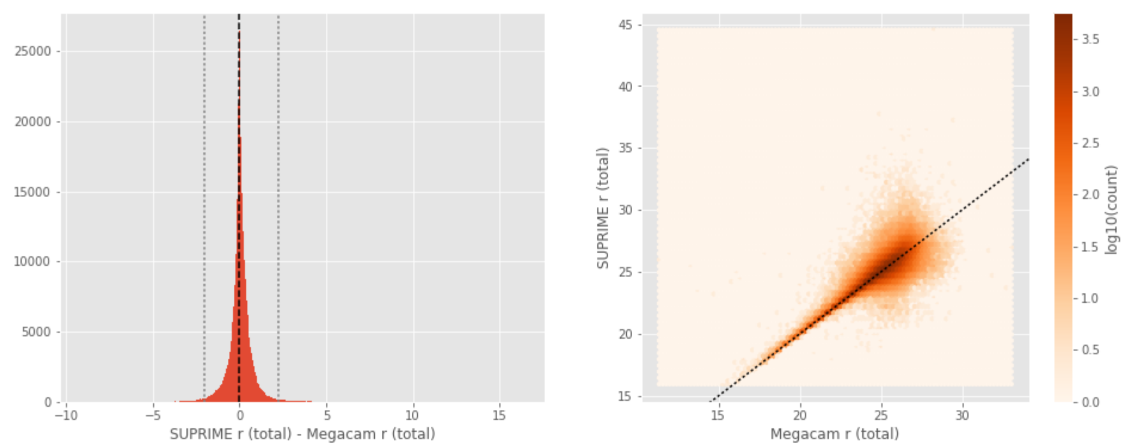


SUPRIME r (aperture) - Megacam r (aperture):
- Median: -0.01

- Median Absolute Deviation: 0.18
- 1% percentile: -1.3007946014404297
- 99% percentile: 1.773109951019285

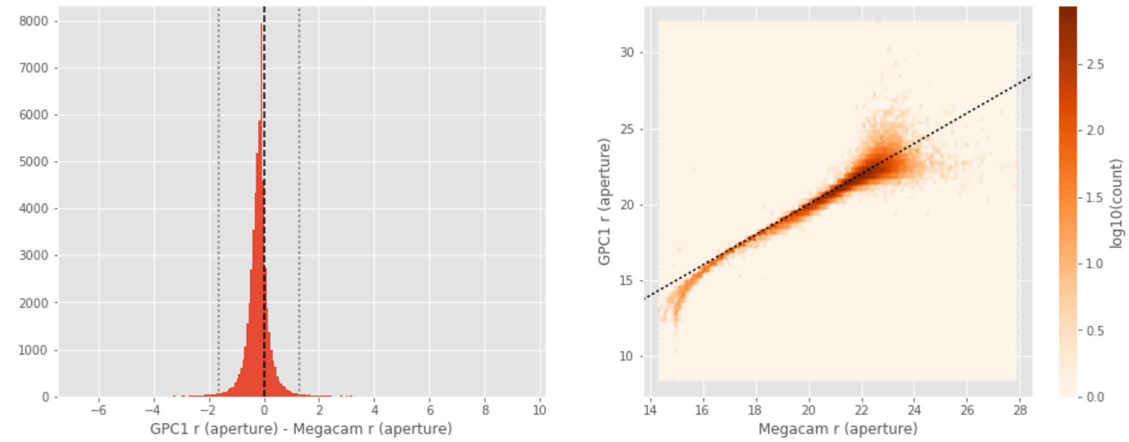


SUPRIME r (total) - Megacam r (total):
- Median: 0.02
- Median Absolute Deviation: 0.23
- 1% percentile: -2.022033271789551
- 99% percentile: 2.2642460632324197

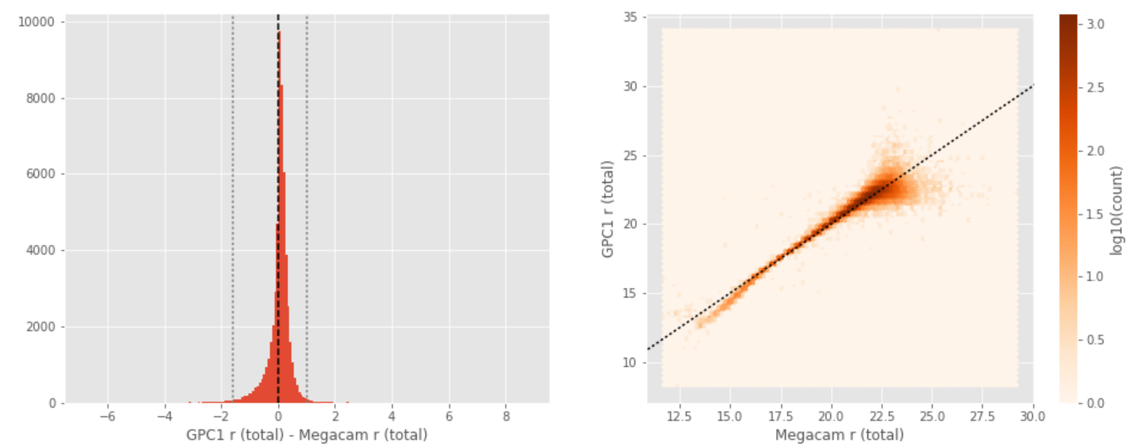


GPC1 r (aperture) - Megacam r (aperture):
- Median: -0.17
- Median Absolute Deviation: 0.17
- 1% percentile: -1.62568998336792

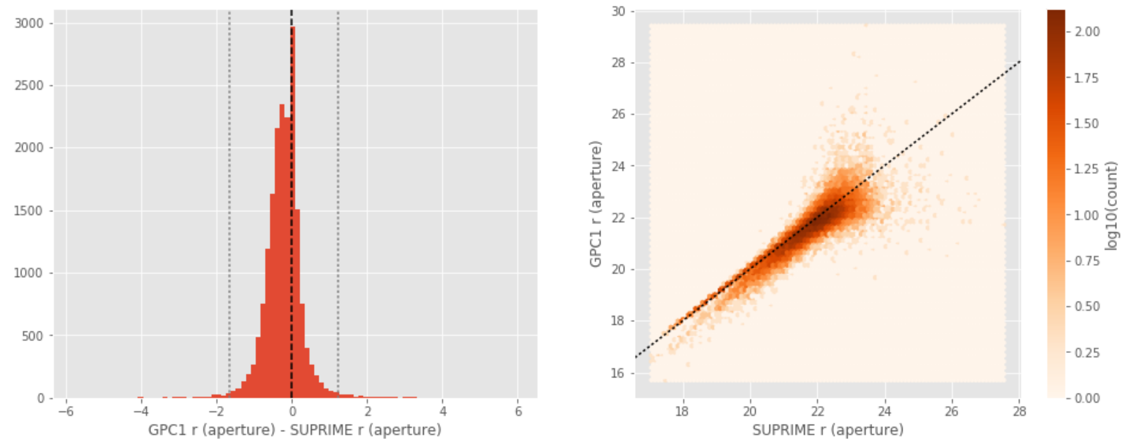
- 99% percentile: 1.2671497344970688



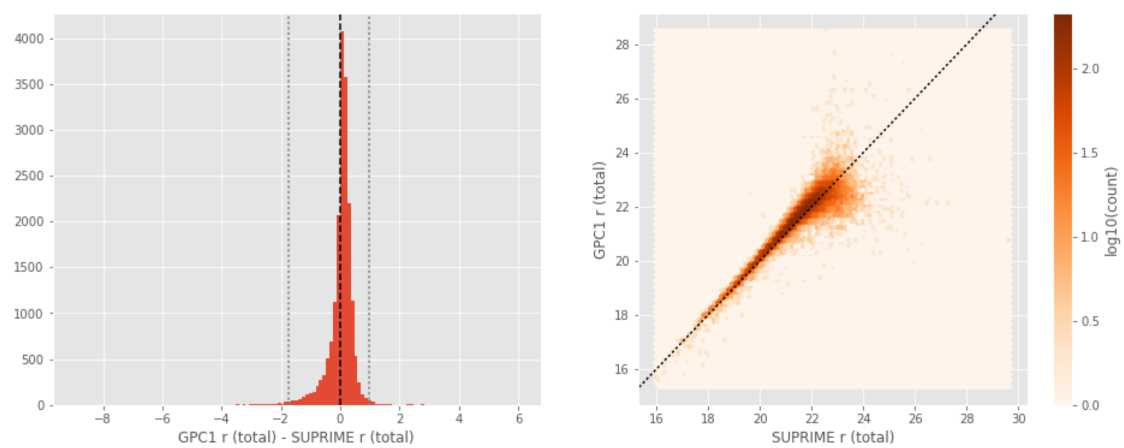
GPC1 r (total) - Megacam r (total):
- Median: 0.08
- Median Absolute Deviation: 0.14
- 1% percentile: -1.6139793395996094
- 99% percentile: 1.003040313720704



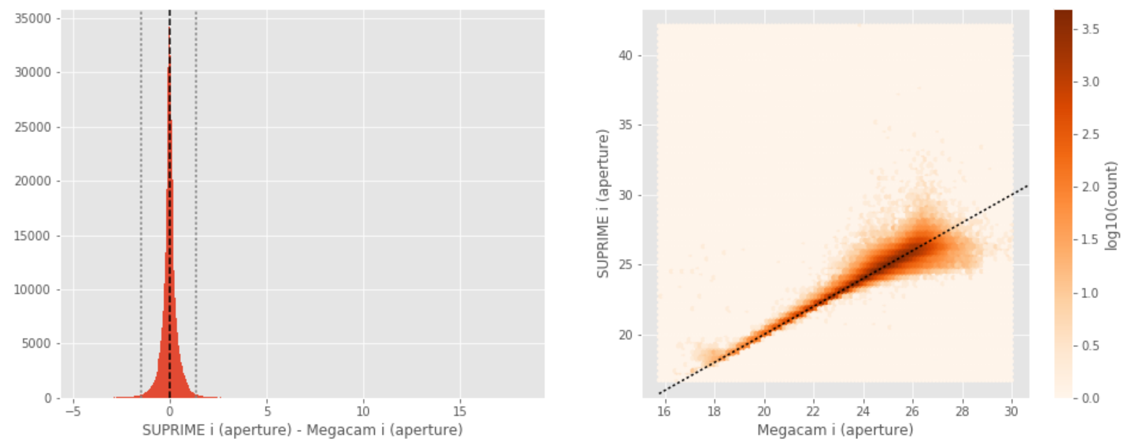
GPC1 r (aperture) - SUPRIME r (aperture):
- Median: -0.20
- Median Absolute Deviation: 0.25
- 1% percentile: -1.6588865661621093
- 99% percentile: 1.2223485565185546



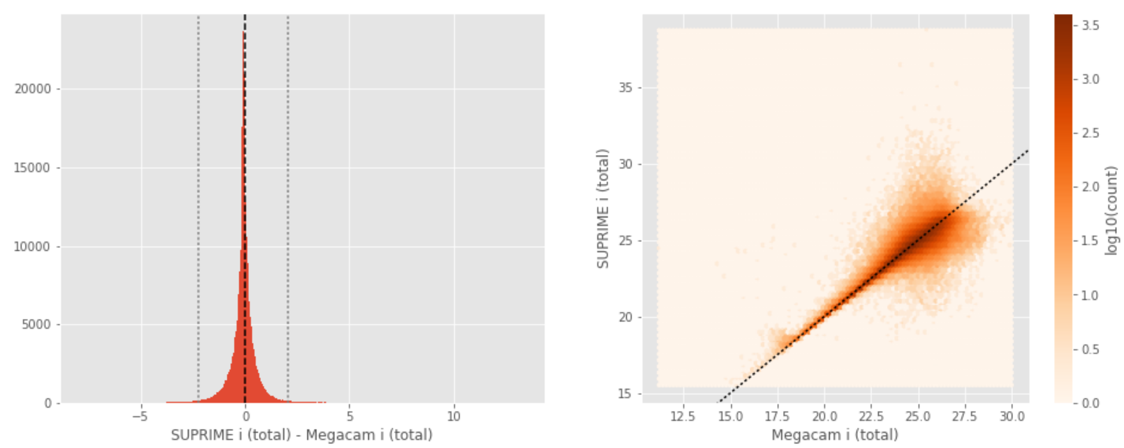

```
GPC1 r (total) - SUPRIME r (total):
- Median: 0.09
- Median Absolute Deviation: 0.15
- 1% percentile: -1.7492075538635254
- 99% percentile: 0.959752445220943
```



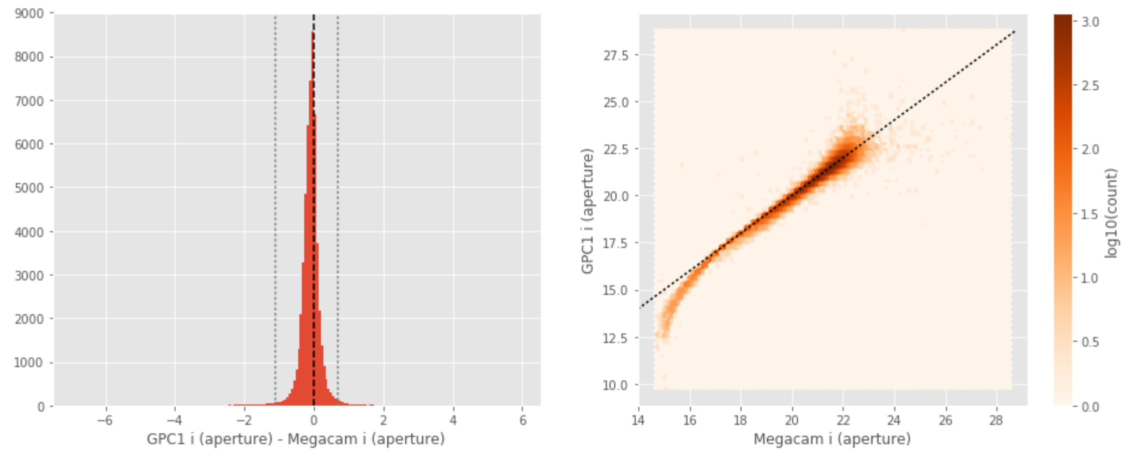

```
SUPRIME i (aperture) - Megacam i (aperture):
- Median: -0.02
- Median Absolute Deviation: 0.16
- 1% percentile: -1.4580886840820313
- 99% percentile: 1.3433338165283222
```



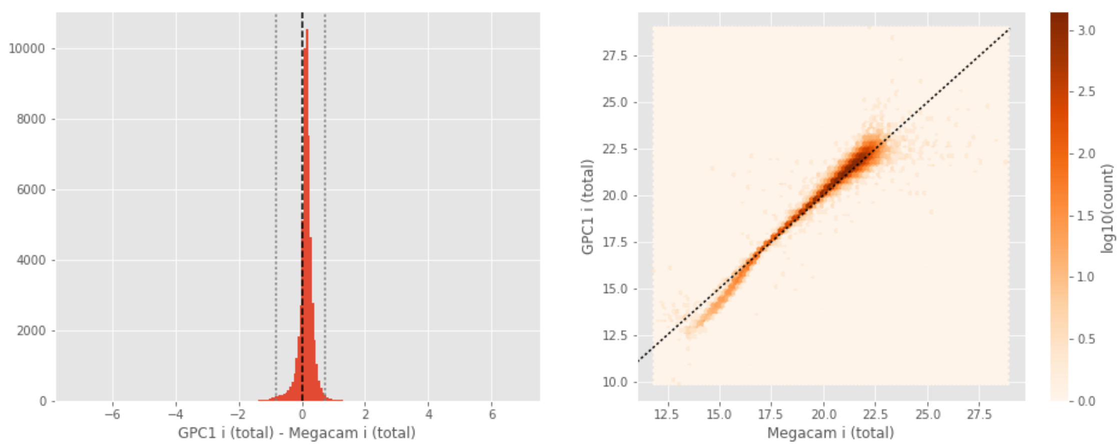
SUPRIME i (total) - Megacam i (total):
- Median: -0.07
- Median Absolute Deviation: 0.21
- 1% percentile: -2.209751625061035
- 99% percentile: 2.055141906738279



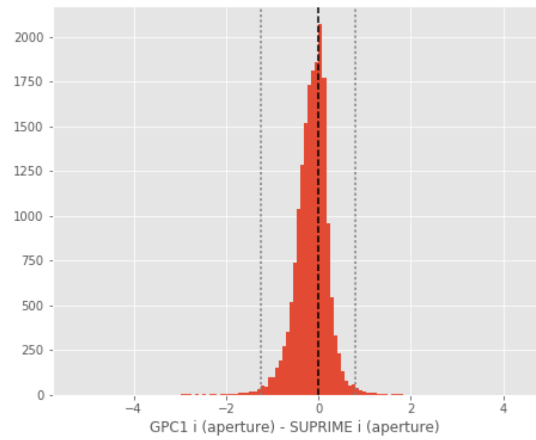
GPC1 i (aperture) - Megacam i (aperture):
- Median: -0.08
- Median Absolute Deviation: 0.12
- 1% percentile: -1.0892204284667968
- 99% percentile: 0.7077011108398423

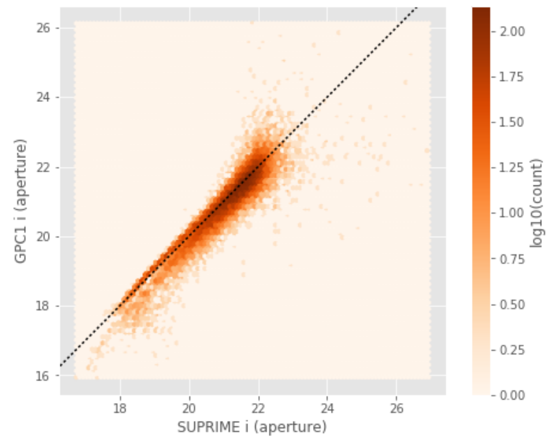


GPC1 i (total) - Megacam i (total):
- Median: 0.14
- Median Absolute Deviation: 0.09
- 1% percentile: -0.8024005889892578
- 99% percentile: 0.7248001098632812

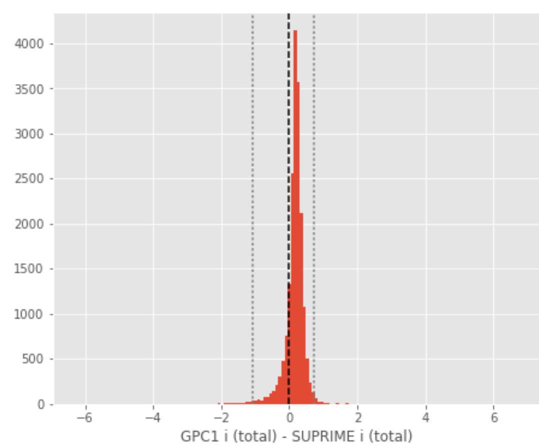


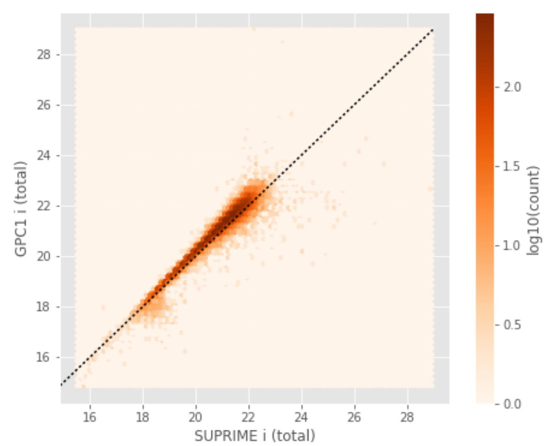
GPC1 i (aperture) - SUPRIME i (aperture):
- Median: -0.11
- Median Absolute Deviation: 0.20
- 1% percentile: -1.2585309600830077
- 99% percentile: 0.7960177612304704



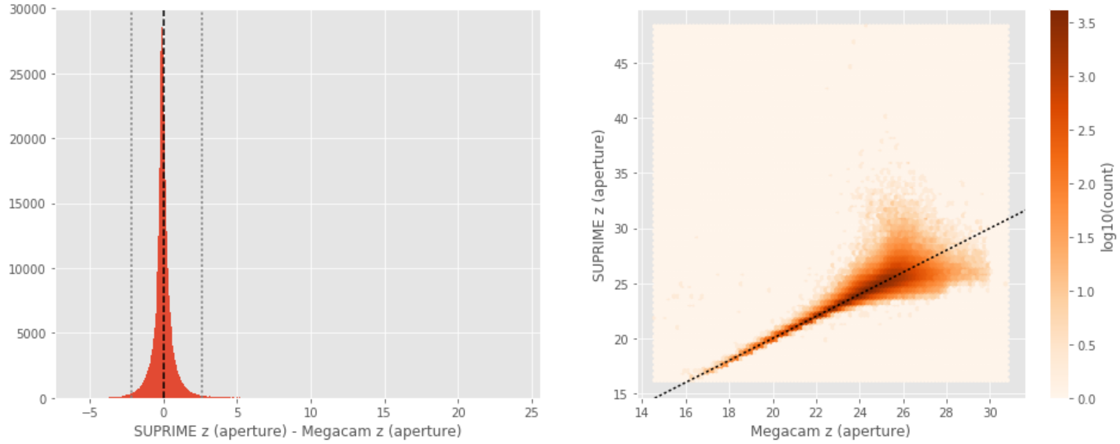


GPC1 i (total) - SUPRIME i (total):
- Median: 0.19
- Median Absolute Deviation: 0.11
- 1% percentile: -1.0757511711120604
- 99% percentile: 0.734667930603025

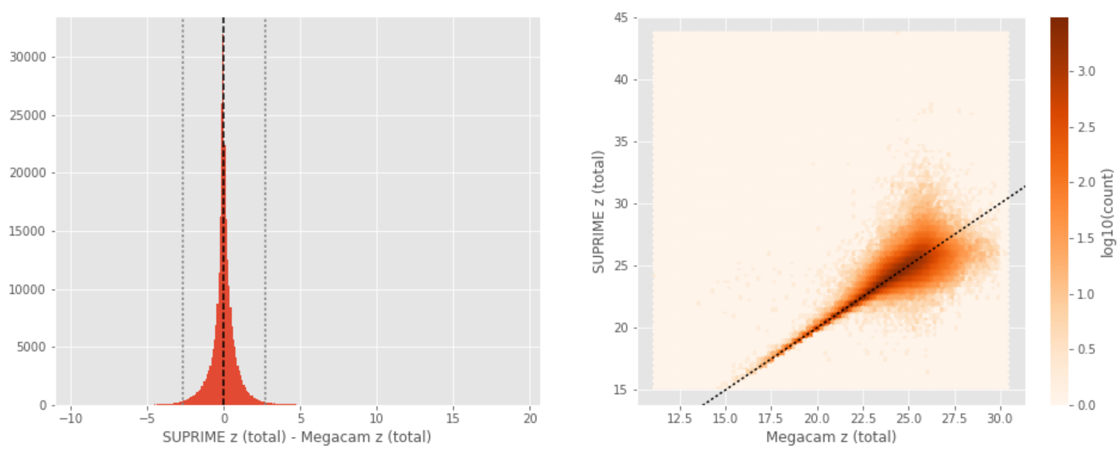




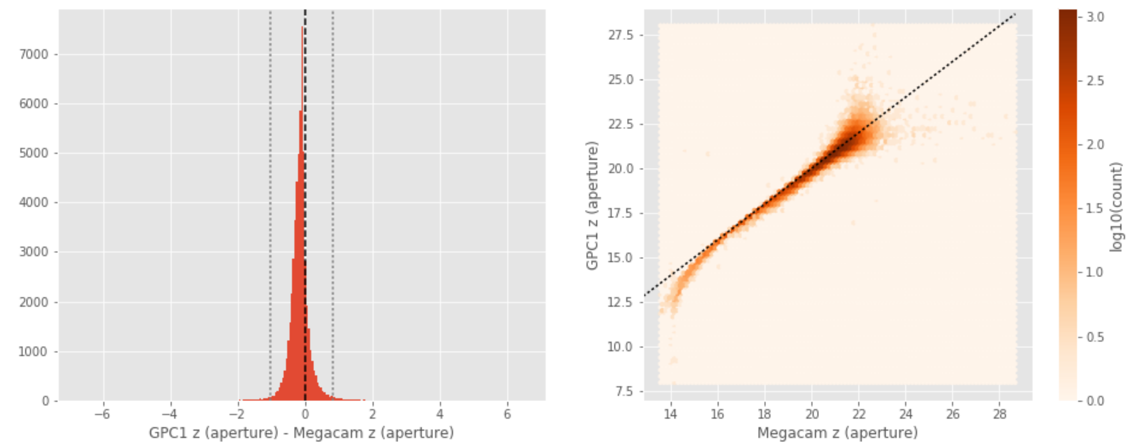
SUPRIME z (aperture) - Megacam z (aperture):
- Median: -0.04
- Median Absolute Deviation: 0.25
- 1% percentile: -2.159938545227051
- 99% percentile: 2.59332706451416



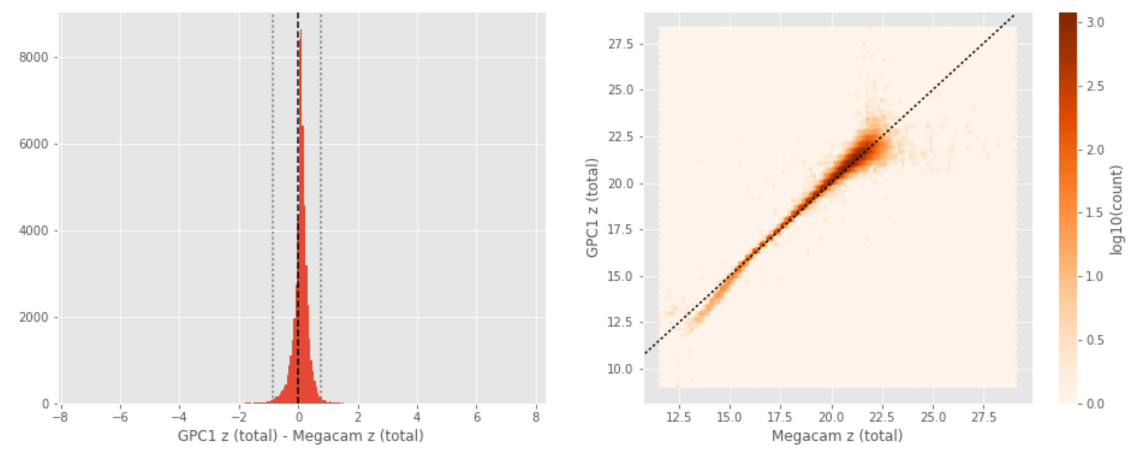
SUPRIME z (total) - Megacam z (total):
- Median: -0.03
- Median Absolute Deviation: 0.30
- 1% percentile: -2.643705654144287
- 99% percentile: 2.7141837120056165



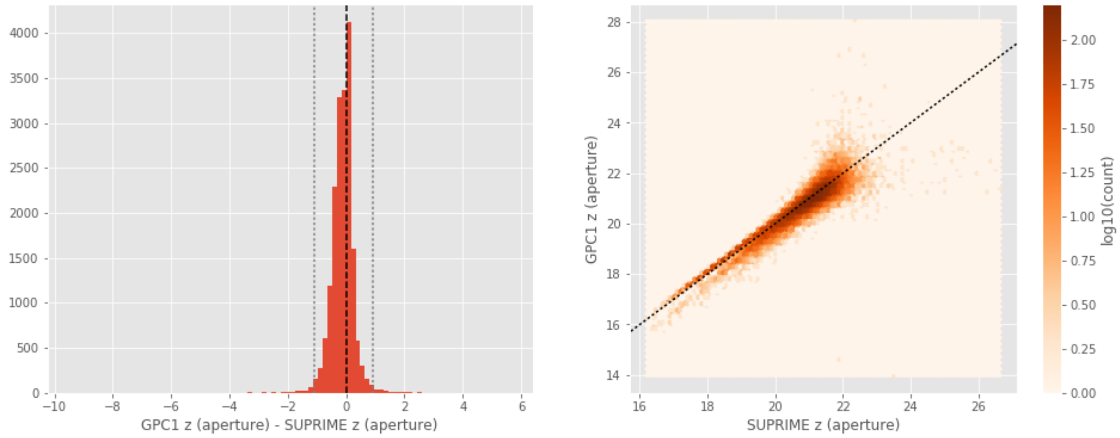
GPC1 z (aperture) - Megacam z (aperture):
- Median: -0.13
- Median Absolute Deviation: 0.12
- 1% percentile: -1.0188804626464845
- 99% percentile: 0.8210201263427732



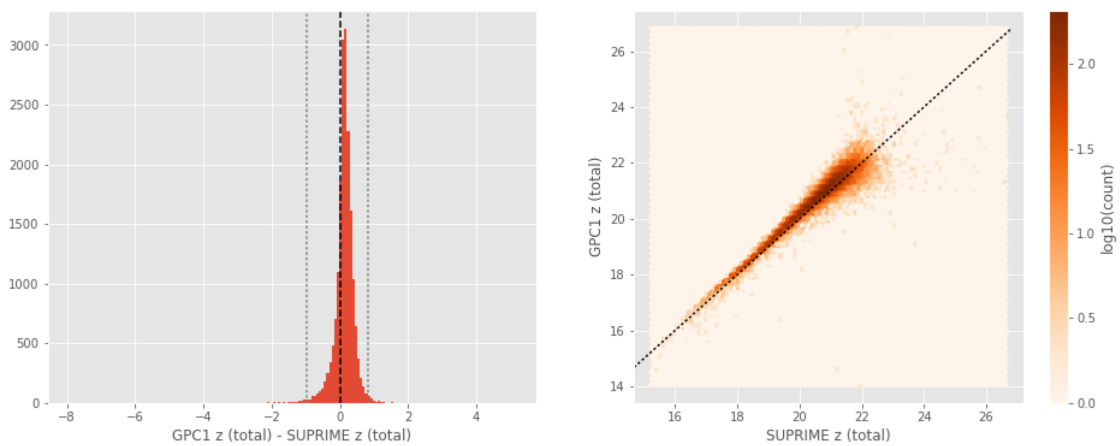
GPC1 z (total) - Megacam z (total):
- Median: 0.09
- Median Absolute Deviation: 0.11
- 1% percentile: -0.8396714782714844
- 99% percentile: 0.7753617477416994



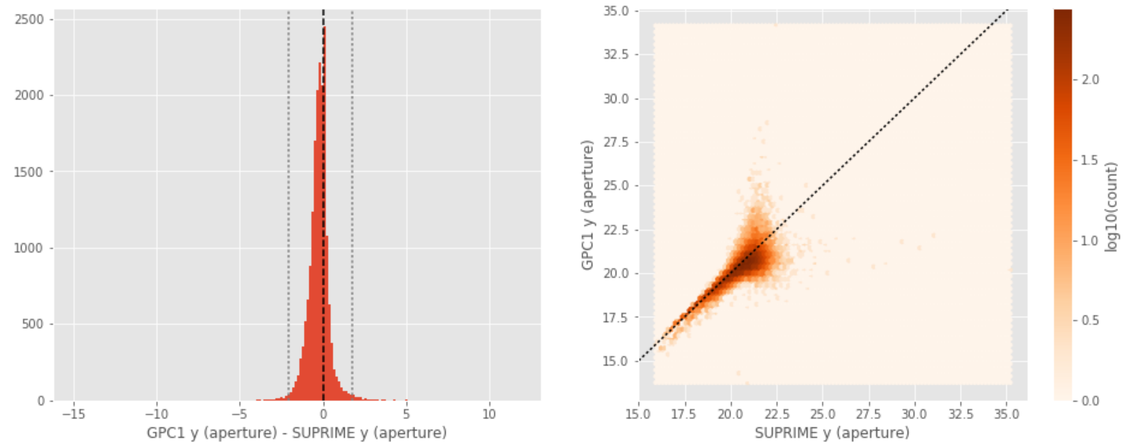
GPC1 z (aperture) - SUPRIME z (aperture):
- Median: -0.10
- Median Absolute Deviation: 0.21
- 1% percentile: -1.1059716796874999
- 99% percentile: 0.9145635223388655



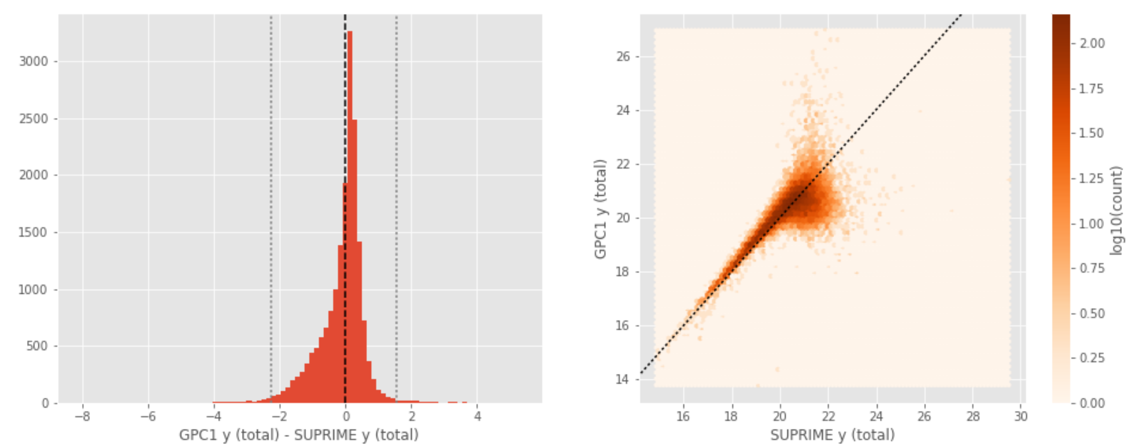

```
GPC1 z (total) - SUPRIME z (total):
- Median: 0.14
- Median Absolute Deviation: 0.12
- 1% percentile: -0.9915233230590821
- 99% percentile: 0.8064051818847633
```




```
GPC1 y (aperture) - SUPRIME y (aperture):
- Median: -0.24
- Median Absolute Deviation: 0.31
- 1% percentile: -2.071452808380127
- 99% percentile: 1.7521905326843257
```




```
GPC1 y (total) - SUPRIME y (total):
- Median: 0.05
- Median Absolute Deviation: 0.28
- 1% percentile: -2.2786521530151367
- 99% percentile: 1.549367561340333
```



1.5 III - Comparing magnitudes to reference bands

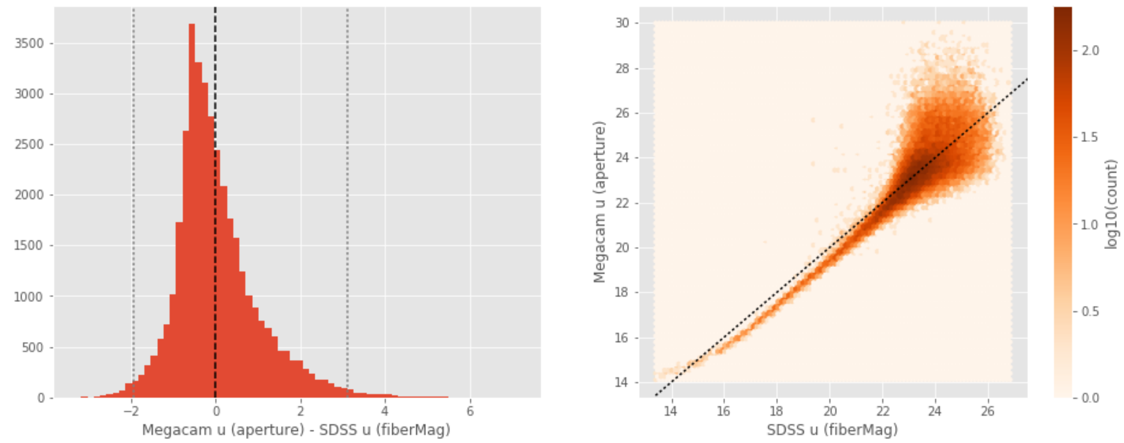
Cross-match the master list to SDSS and 2MASS to compare its magnitudes to SDSS and 2MASS ones.

1.5.1 III.a - Comparing u, g, r, i, and z bands to SDSS

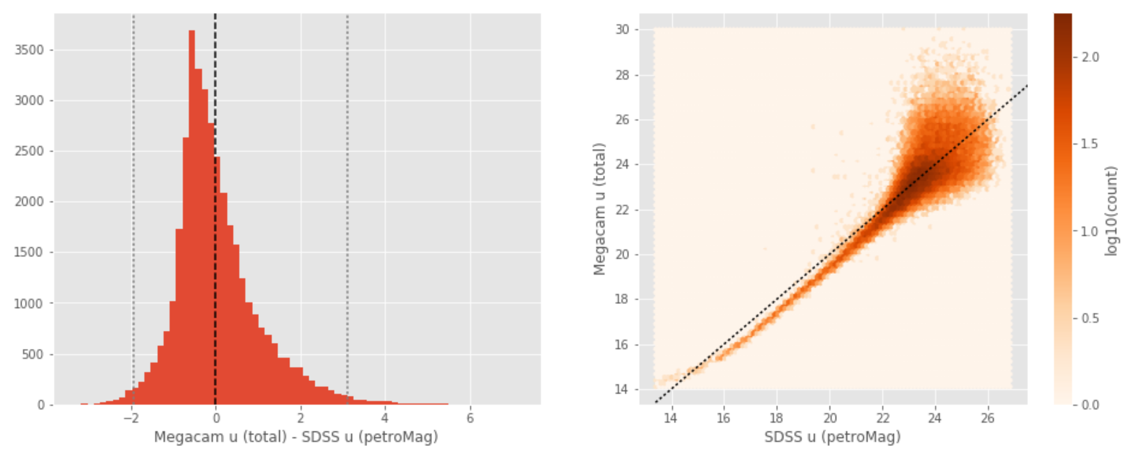
The catalogue is cross-matched to SDSS-DR13 withing 0.2 arcsecond.

We compare the u, g, r, i, and z magnitudes to those from SDSS using `fiberMag` for the aperture magnitude and `petroMag` for the total magnitude.

Megacam u (aperture) - SDSS u (fiberMag):
- Median: -0.16
- Median Absolute Deviation: 0.49
- 1% percentile: -1.9366635704040527
- 99% percentile: 3.1243225669860886

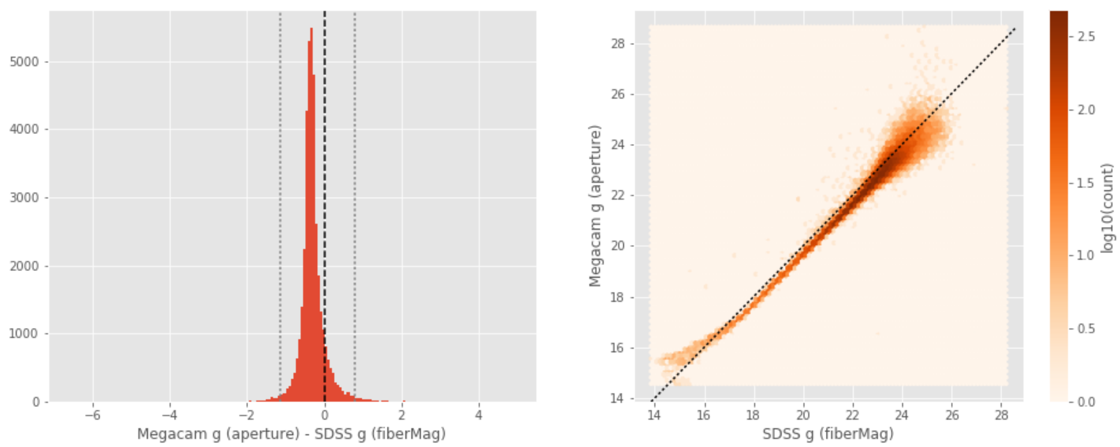


Megacam u (total) - SDSS u (petroMag):
- Median: -0.16
- Median Absolute Deviation: 0.49
- 1% percentile: -1.9366635704040527
- 99% percentile: 3.1243225669860886

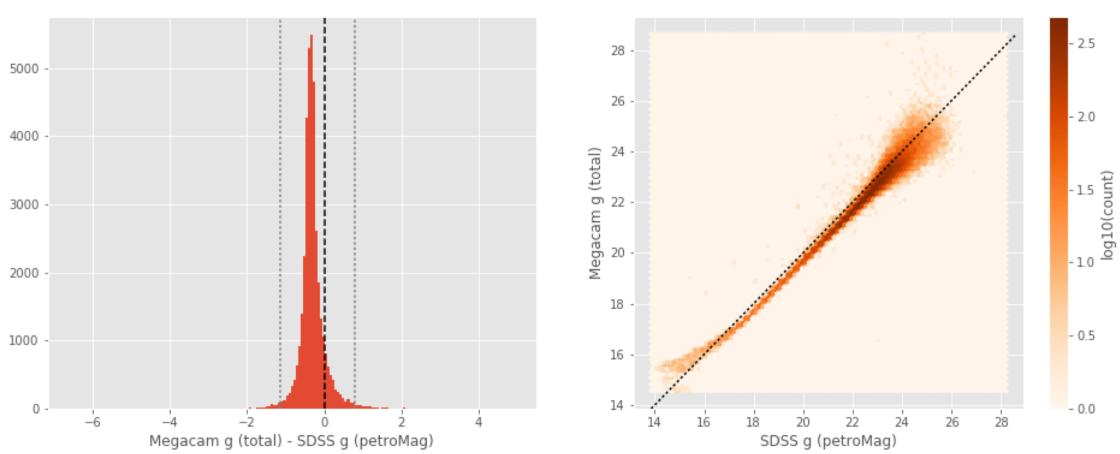


Megacam g (aperture) - SDSS g (fiberMag):
- Median: -0.34

- Median Absolute Deviation: 0.12
- 1% percentile: -1.1357846069335937
- 99% percentile: 0.7837402153015139

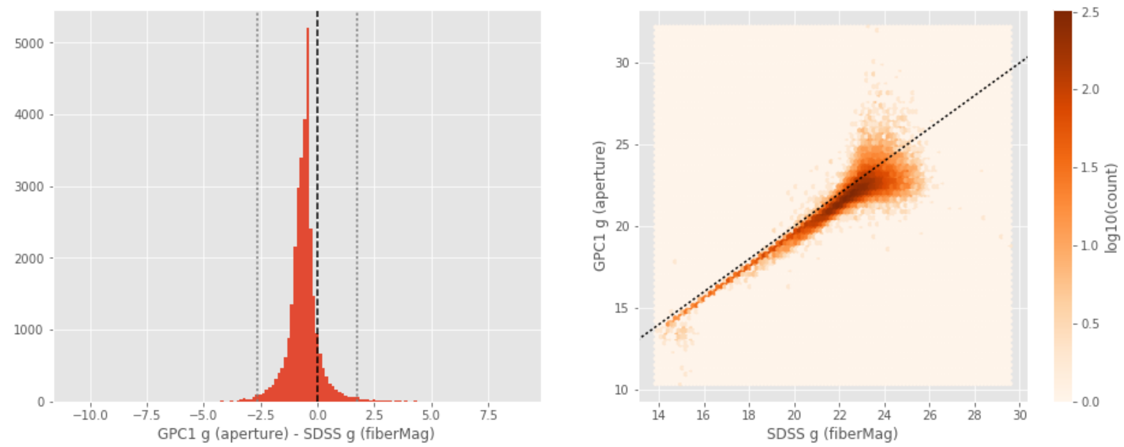


Megacam g (total) - SDSS g (petroMag):
- Median: -0.34
- Median Absolute Deviation: 0.12
- 1% percentile: -1.1357846069335937
- 99% percentile: 0.7837402153015139

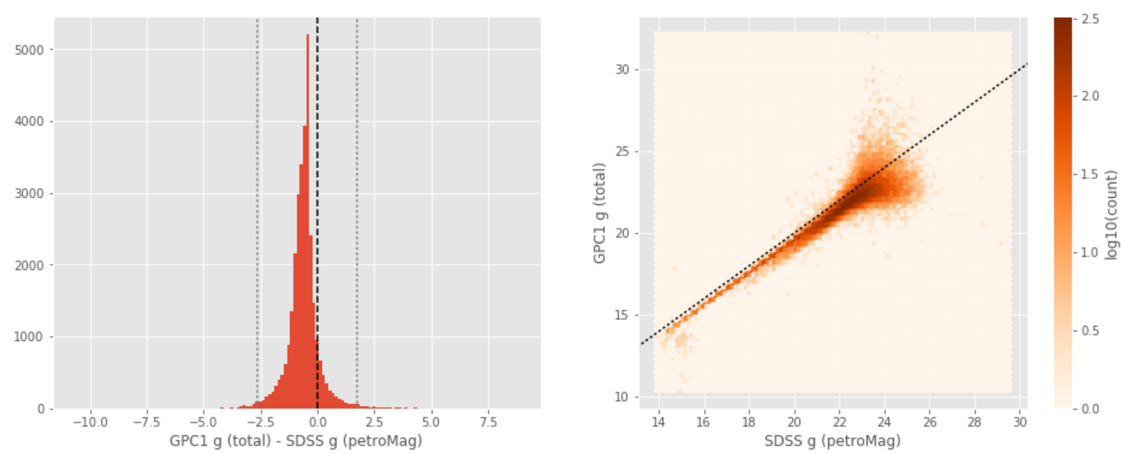


GPC1 g (aperture) - SDSS g (fiberMag):
- Median: -0.58
- Median Absolute Deviation: 0.27
- 1% percentile: -2.649733161926269

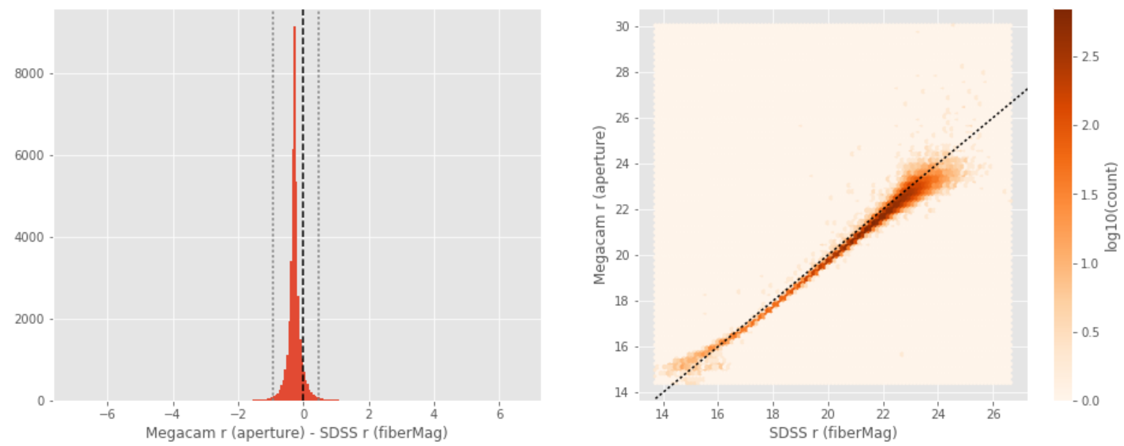
- 99% percentile: 1.7384460449218742



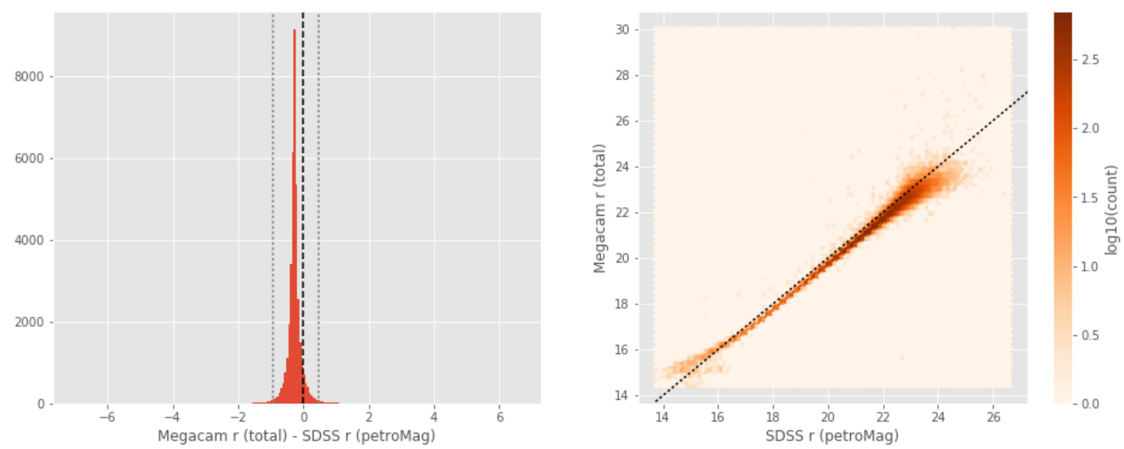
GPC1 g (total) - SDSS g (petroMag):
- Median: -0.58
- Median Absolute Deviation: 0.27
- 1% percentile: -2.649733161926269
- 99% percentile: 1.7384460449218742



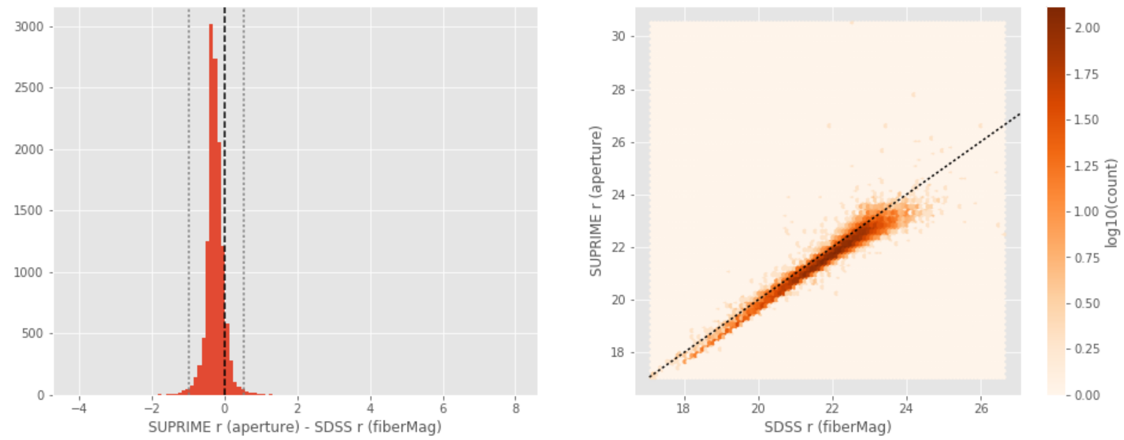
Megacam r (aperture) - SDSS r (fiberMag):
- Median: -0.28
- Median Absolute Deviation: 0.07
- 1% percentile: -0.9402611541748047
- 99% percentile: 0.4672513961791987



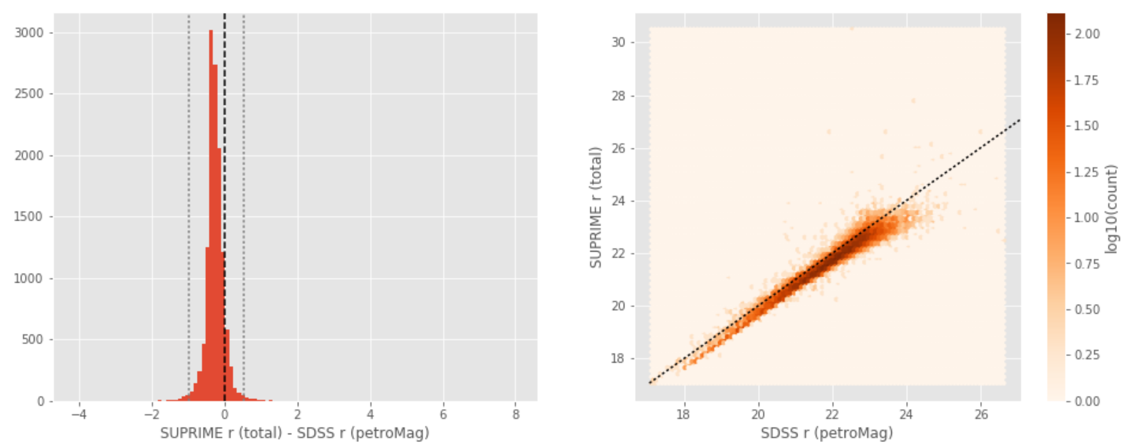
Megacam r (total) - SDSS r (petroMag):
- Median: -0.28
- Median Absolute Deviation: 0.07
- 1% percentile: -0.9402611541748047
- 99% percentile: 0.4672513961791987



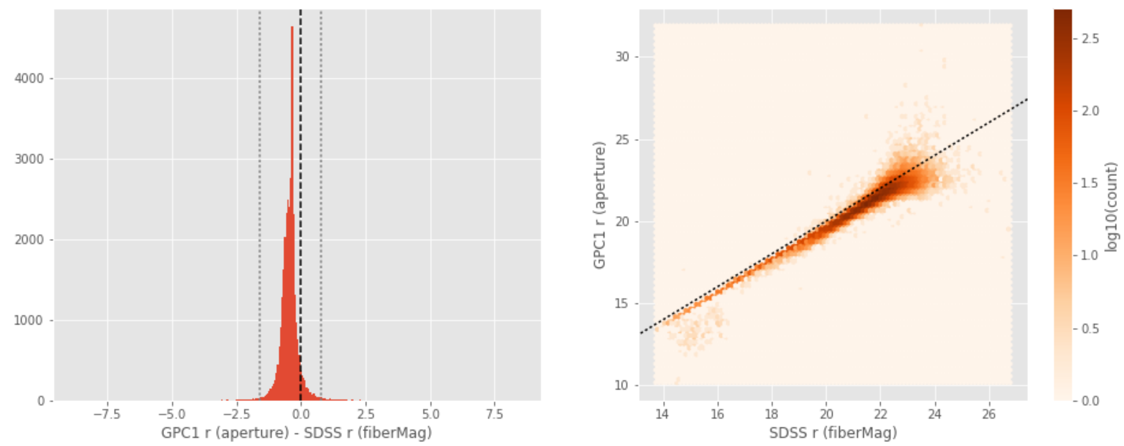
SUPRIME r (aperture) - SDSS r (fiberMag):
- Median: -0.27
- Median Absolute Deviation: 0.12
- 1% percentile: -0.9828863334655762
- 99% percentile: 0.5160082817077647



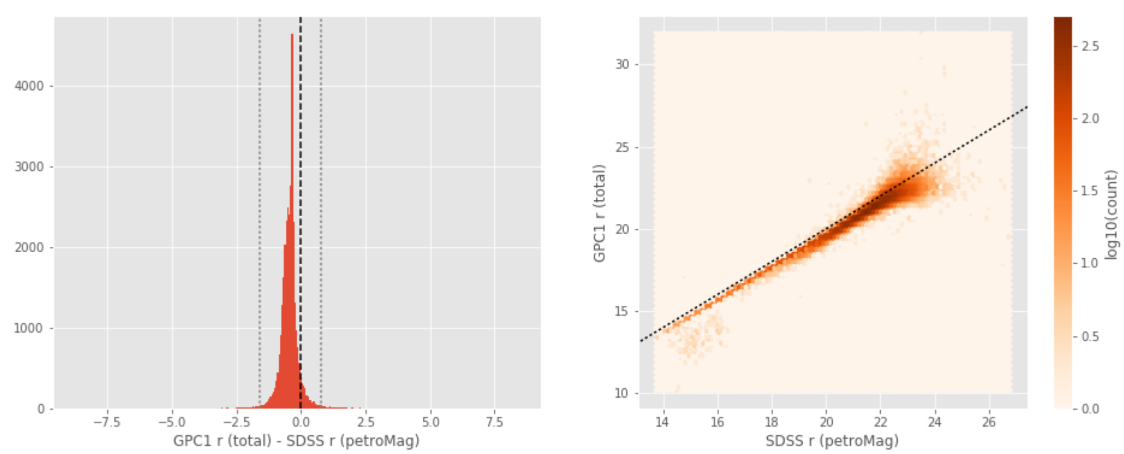
SUPRIME r (total) - SDSS r (petroMag):
- Median: -0.27
- Median Absolute Deviation: 0.12
- 1% percentile: -0.9828863334655762
- 99% percentile: 0.5160082817077647



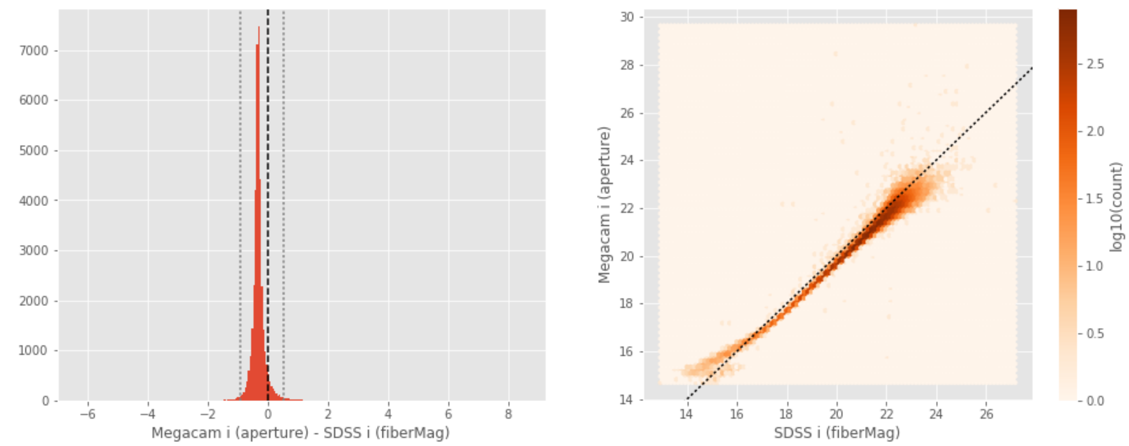
GPC1 r (aperture) - SDSS r (fiberMag):
- Median: -0.43
- Median Absolute Deviation: 0.15
- 1% percentile: -1.5799267196655273
- 99% percentile: 0.7769848442077639



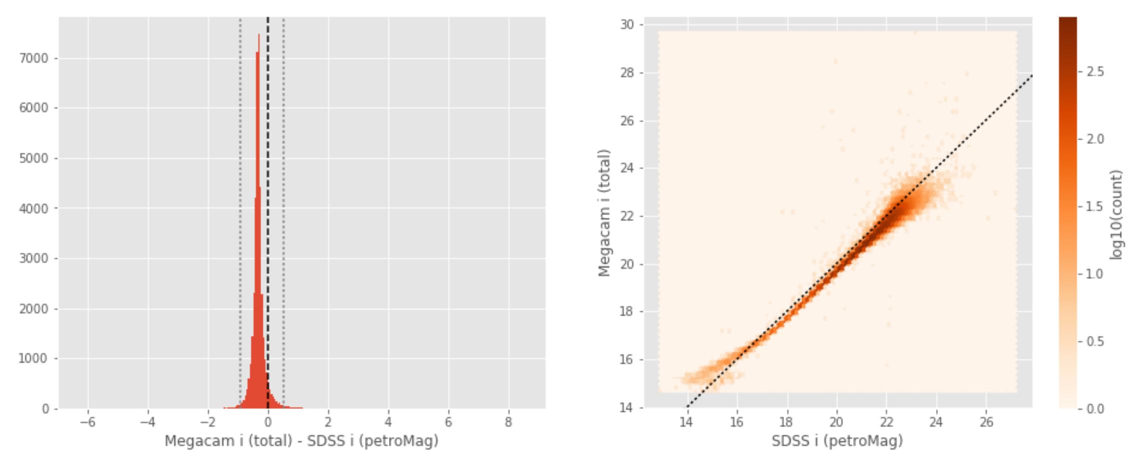
GPC1 r (total) - SDSS r (petroMag):
- Median: -0.43
- Median Absolute Deviation: 0.15
- 1% percentile: -1.5799267196655273
- 99% percentile: 0.7769848442077639



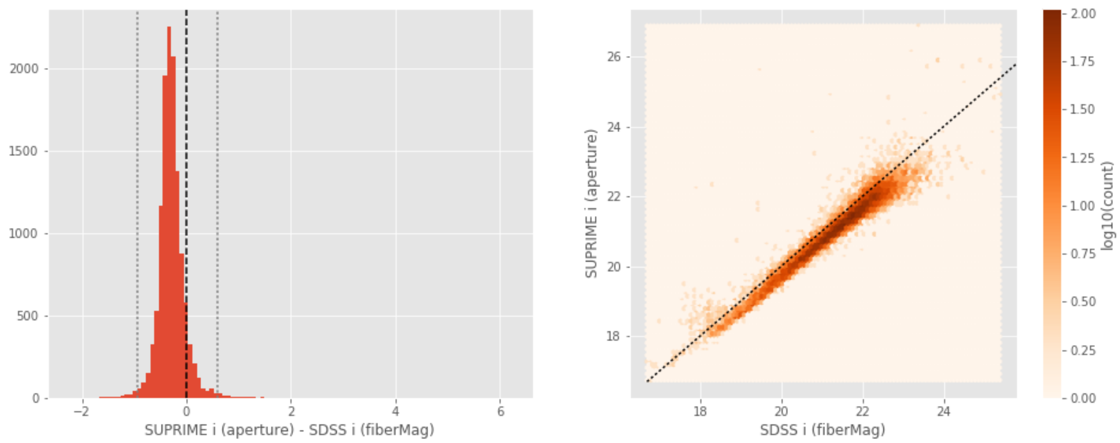
Megacam i (aperture) - SDSS i (fiberMag):
- Median: -0.33
- Median Absolute Deviation: 0.08
- 1% percentile: -0.9073835754394531
- 99% percentile: 0.5248305892944336



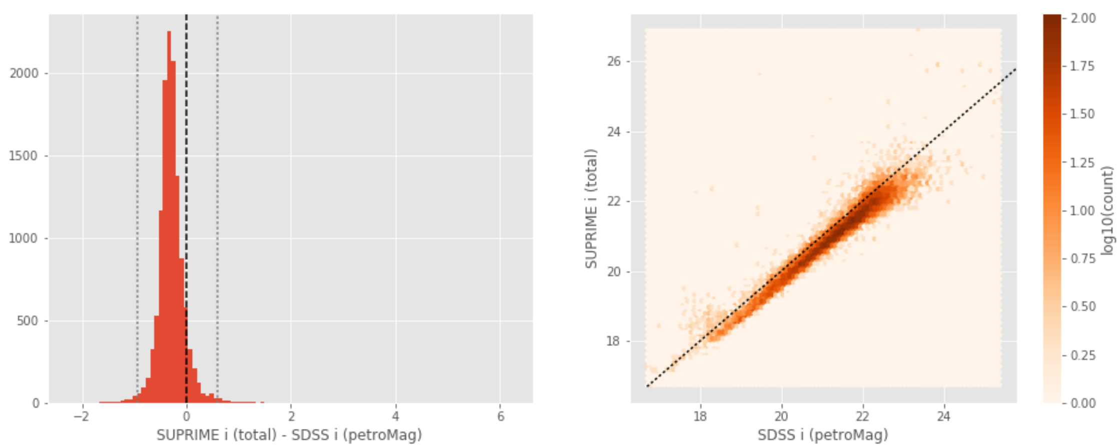
Megacam i (total) - SDSS i (petroMag):
- Median: -0.33
- Median Absolute Deviation: 0.08
- 1% percentile: -0.9073835754394531
- 99% percentile: 0.5248305892944336



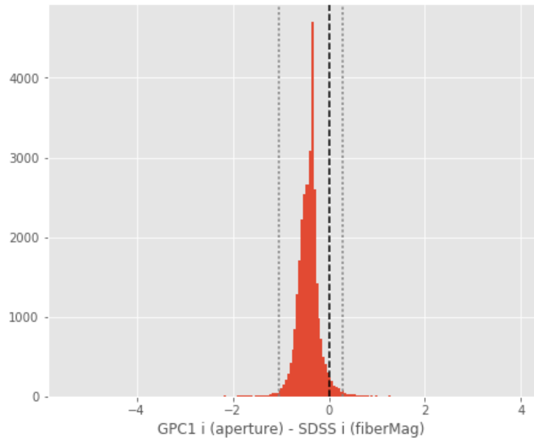
SUPRIME i (aperture) - SDSS i (fiberMag):
- Median: -0.31
- Median Absolute Deviation: 0.12
- 1% percentile: -0.9429589080810548
- 99% percentile: 0.5862416458129882

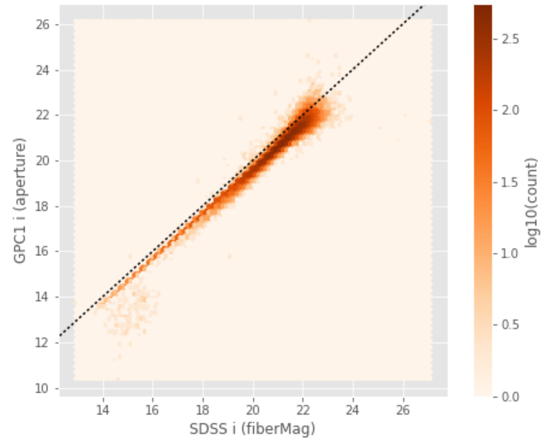


SUPRIME i (total) - SDSS i (petroMag):
- Median: -0.31
- Median Absolute Deviation: 0.12
- 1% percentile: -0.9429589080810548
- 99% percentile: 0.5862416458129882

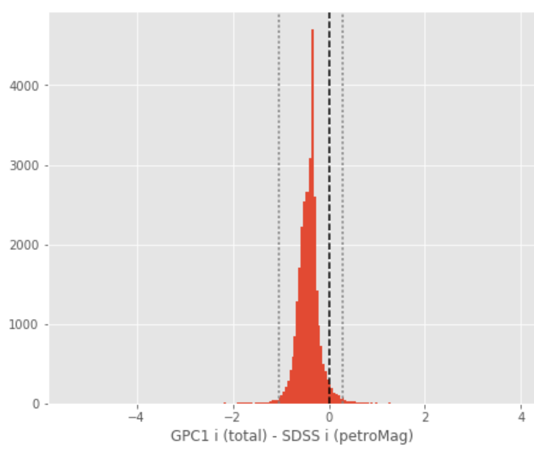


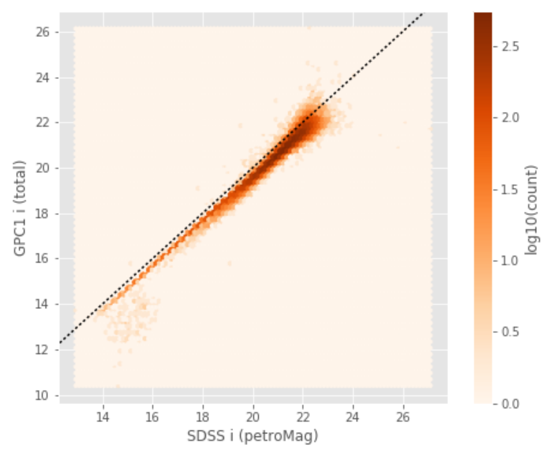
GPC1 i (aperture) - SDSS i (fiberMag):
- Median: -0.41
- Median Absolute Deviation: 0.11
- 1% percentile: -1.0385213470458985
- 99% percentile: 0.2873053741455075



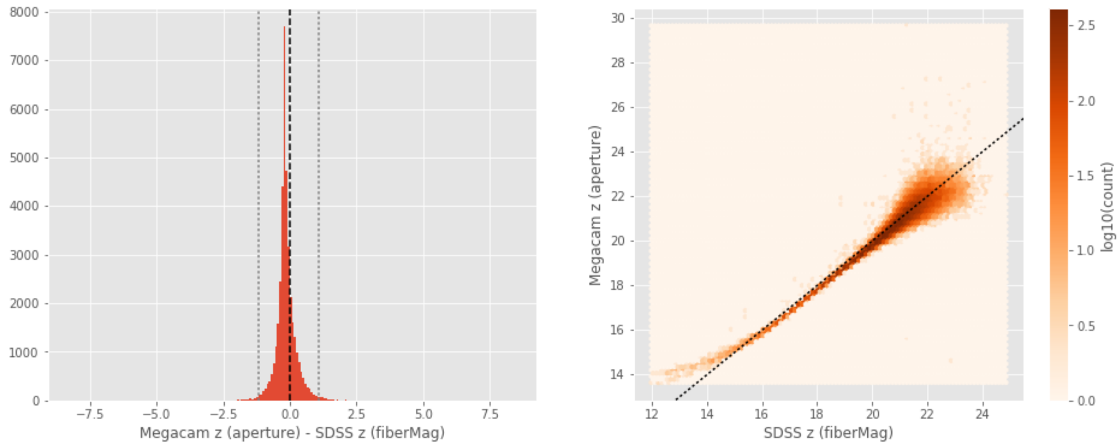


GPC1 i (total) - SDSS i (petroMag):
- Median: -0.41
- Median Absolute Deviation: 0.11
- 1% percentile: -1.0385213470458985
- 99% percentile: 0.2873053741455075

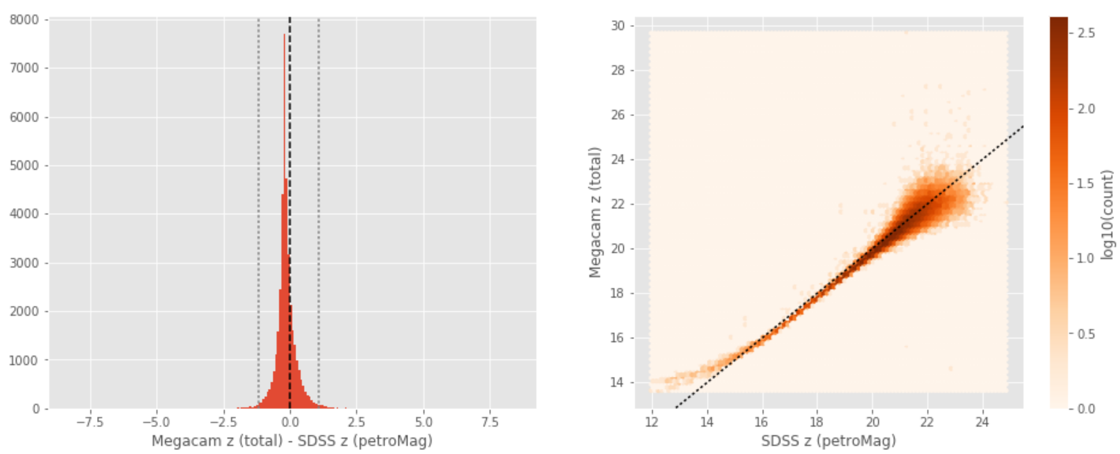




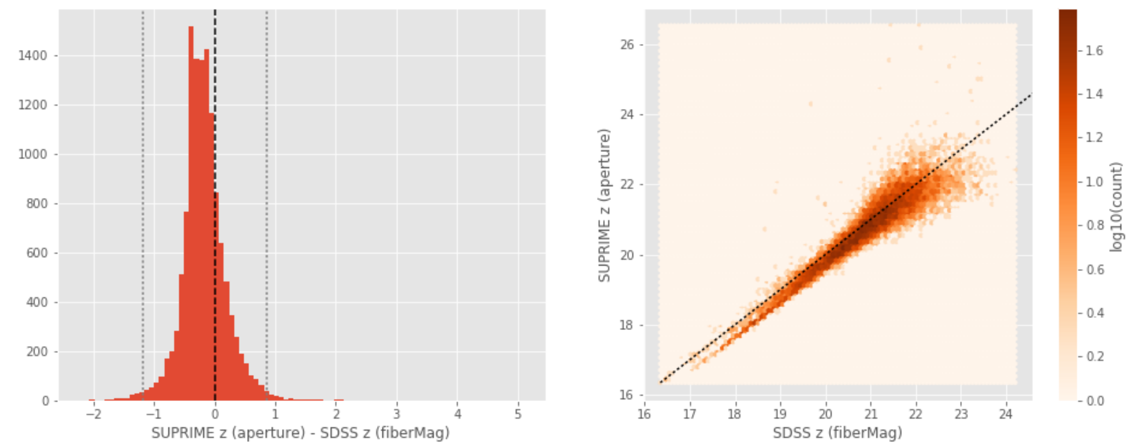
Megacam z (aperture) - SDSS z (fiberMag):
- Median: -0.18
- Median Absolute Deviation: 0.14
- 1% percentile: -1.1557494163513184
- 99% percentile: 1.0748854446411142



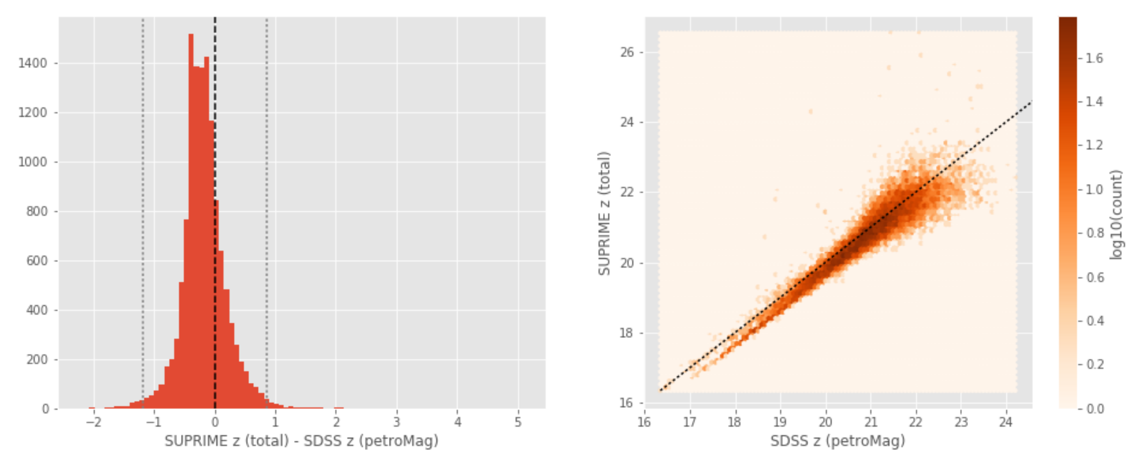
Megacam z (total) - SDSS z (petroMag):
- Median: -0.18
- Median Absolute Deviation: 0.14
- 1% percentile: -1.1557494163513184
- 99% percentile: 1.0748854446411142



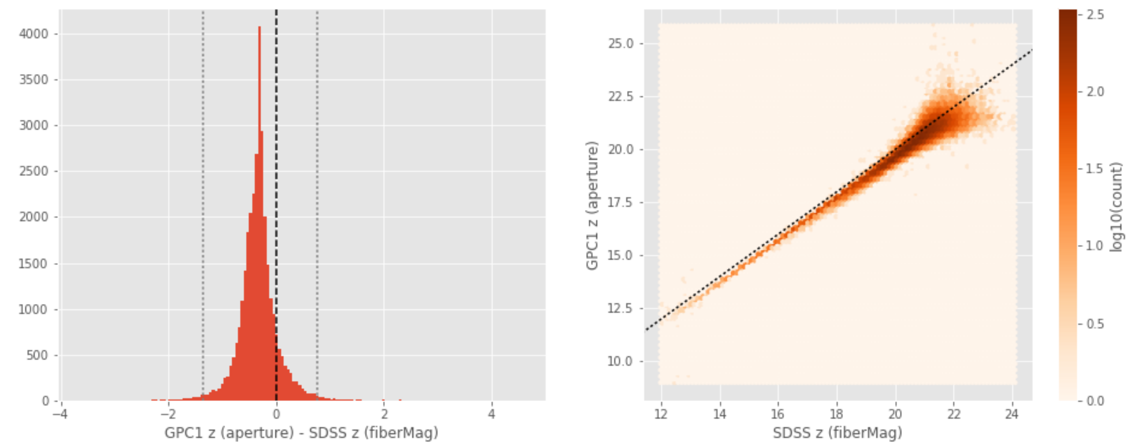
SUPRIME z (aperture) - SDSS z (fiberMag):
- Median: -0.20
- Median Absolute Deviation: 0.19
- 1% percentile: -1.1774482727050781
- 99% percentile: 0.8522415161132812



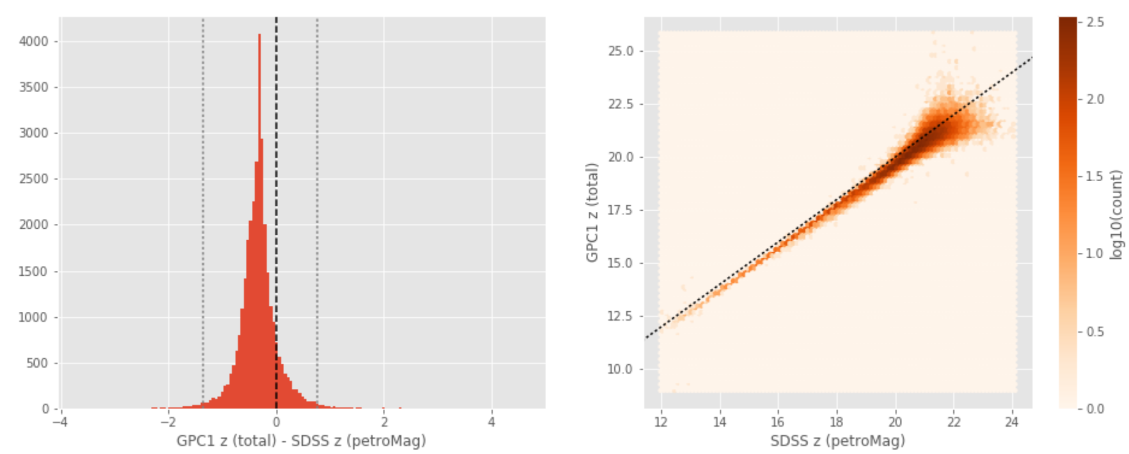
SUPRIME z (total) - SDSS z (petroMag):
- Median: -0.20
- Median Absolute Deviation: 0.19
- 1% percentile: -1.1774482727050781
- 99% percentile: 0.8522415161132812



GPC1 z (aperture) - SDSS z (fiberMag):
- Median: -0.33
- Median Absolute Deviation: 0.16
- 1% percentile: -1.3514610290527345
- 99% percentile: 0.7569400787353526



GPC1 z (total) - SDSS z (petroMag):
- Median: -0.33
- Median Absolute Deviation: 0.16
- 1% percentile: -1.3514610290527345
- 99% percentile: 0.7569400787353526



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

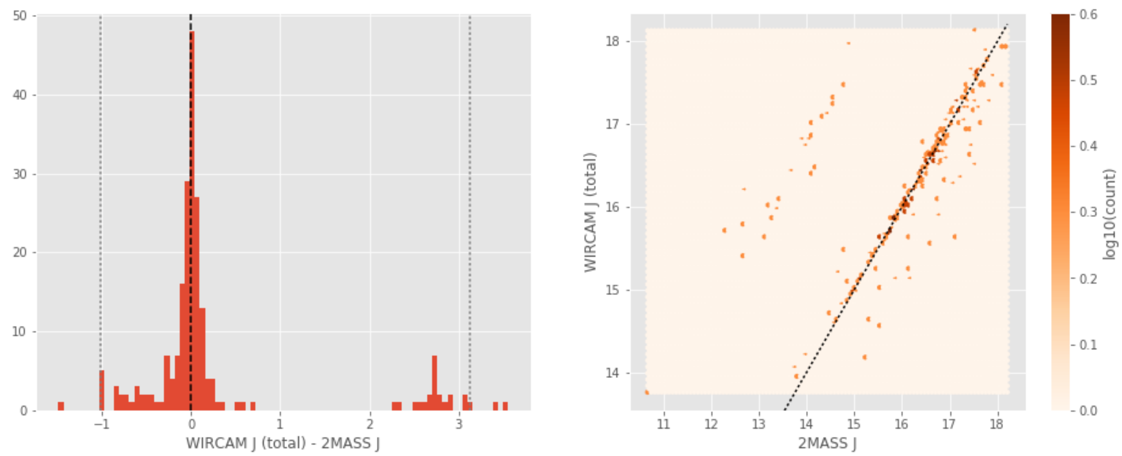
The catalogue is cross-matched to 2MASS-PSC withing 0.2 arcsecond. We compare the WIRCAM total J and K magnitudes to those from 2MASS.

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

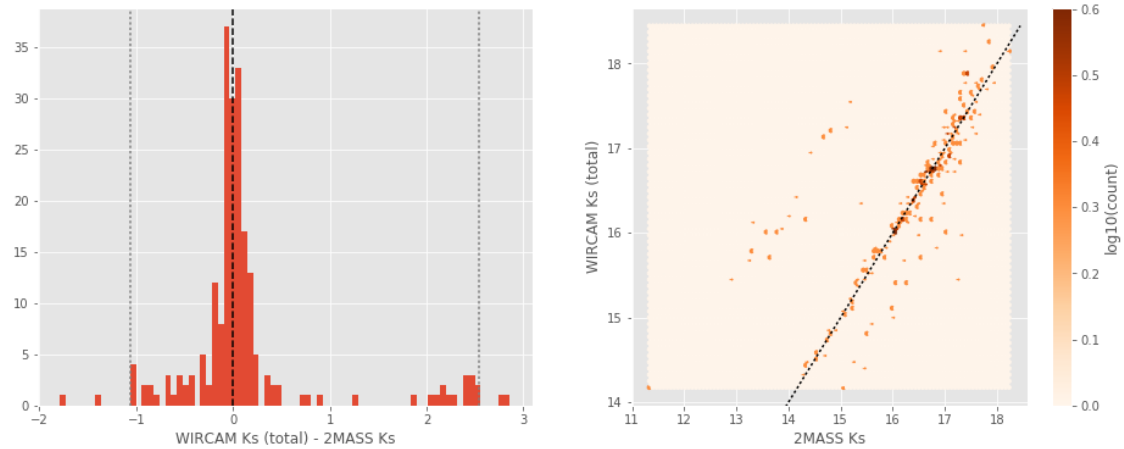
Band	F - 0 mag (Jy)
J	1594
H	1024
Ks	666.7

2MASS and WIRCAM both use Ks so no conversion is required.

```
WIRCAM J (total) - 2MASS J:
- Median: 0.00
- Median Absolute Deviation: 0.09
- 1% percentile: -1.0202204724027446
- 99% percentile: 3.129319943551843
```




```
WIRCAM Ks (total) - 2MASS Ks:
- Median: -0.00
- Median Absolute Deviation: 0.10
- 1% percentile: -1.0586832237871677
- 99% percentile: 2.5413844028607815
```



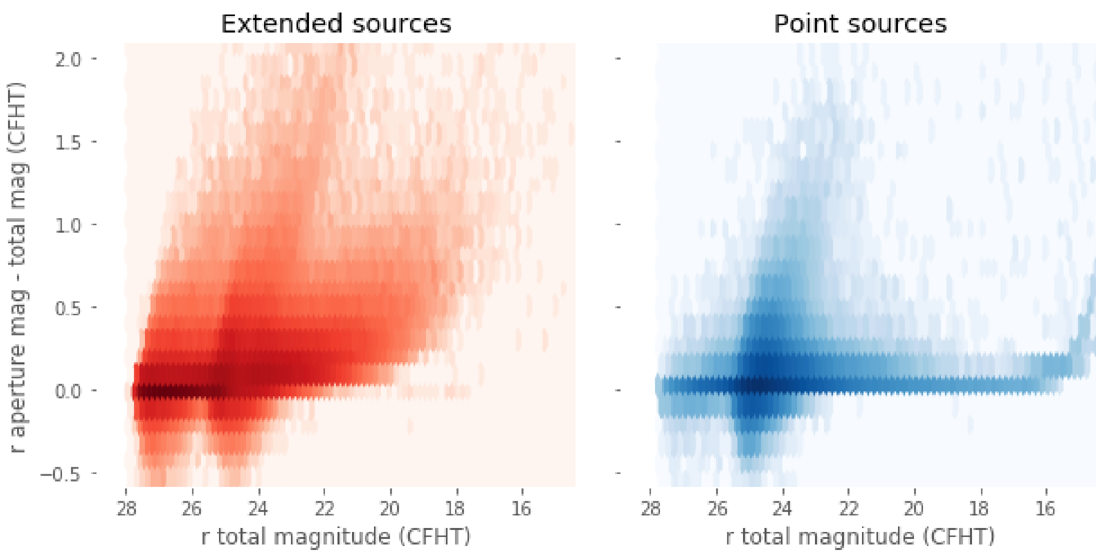
1.6 Keeping only sources with good signal to noise ratio

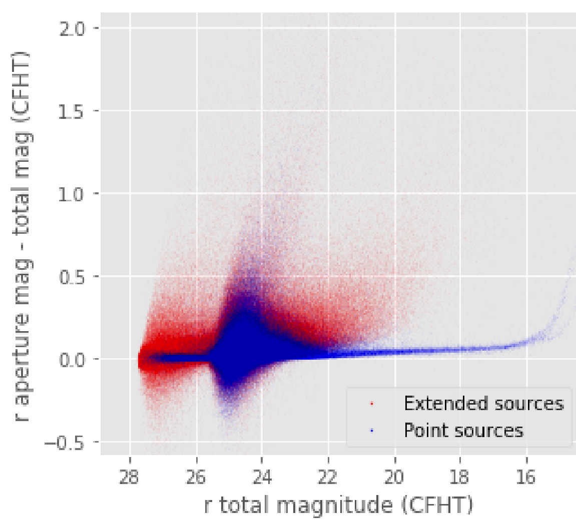
From here, we are only comparing sources with a signal to noise ratio above 3, i.e. roughly we a magnitude error below 0.3.

To make it easier, we are setting to NaN in the catalogue the magnitudes associated with an error above 0.3 so we can't use these magnitudes after the next cell.

1.7 IV - Comparing aperture magnitudes to total ones.

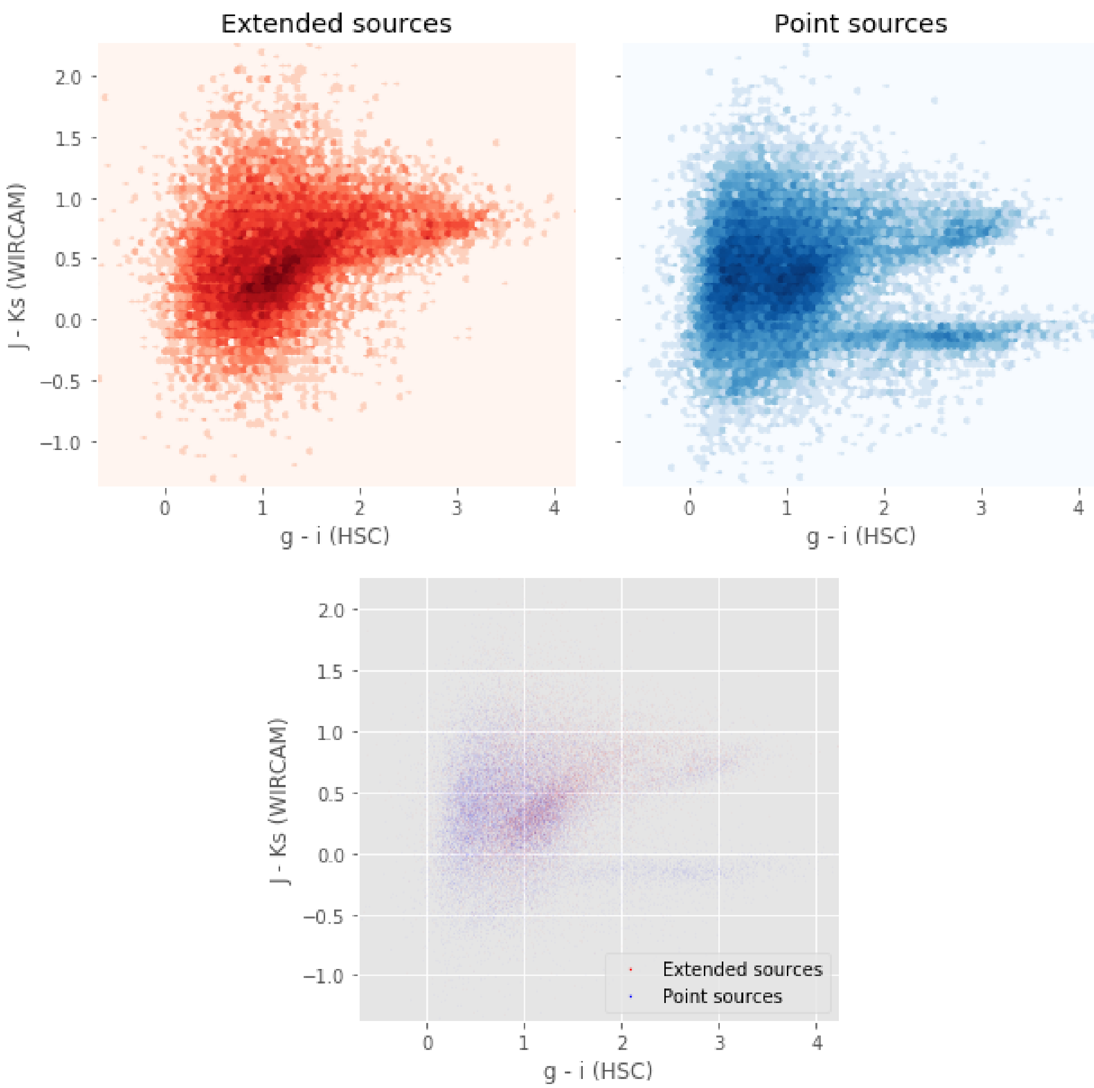
```
Number of source used: 830340 / 1412613 (58.78%)
```



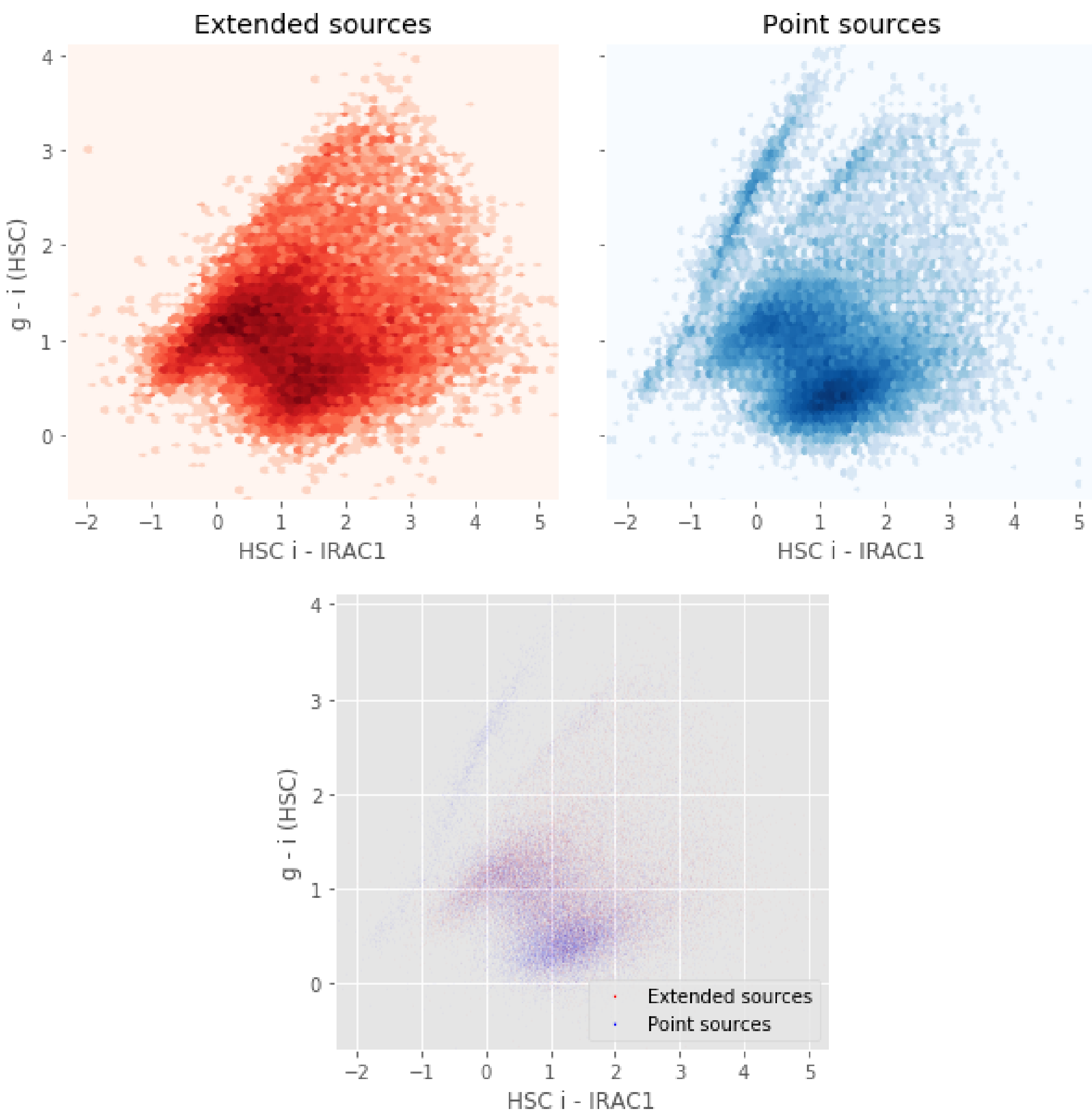


1.8 V - Color-color and magnitude-color plots

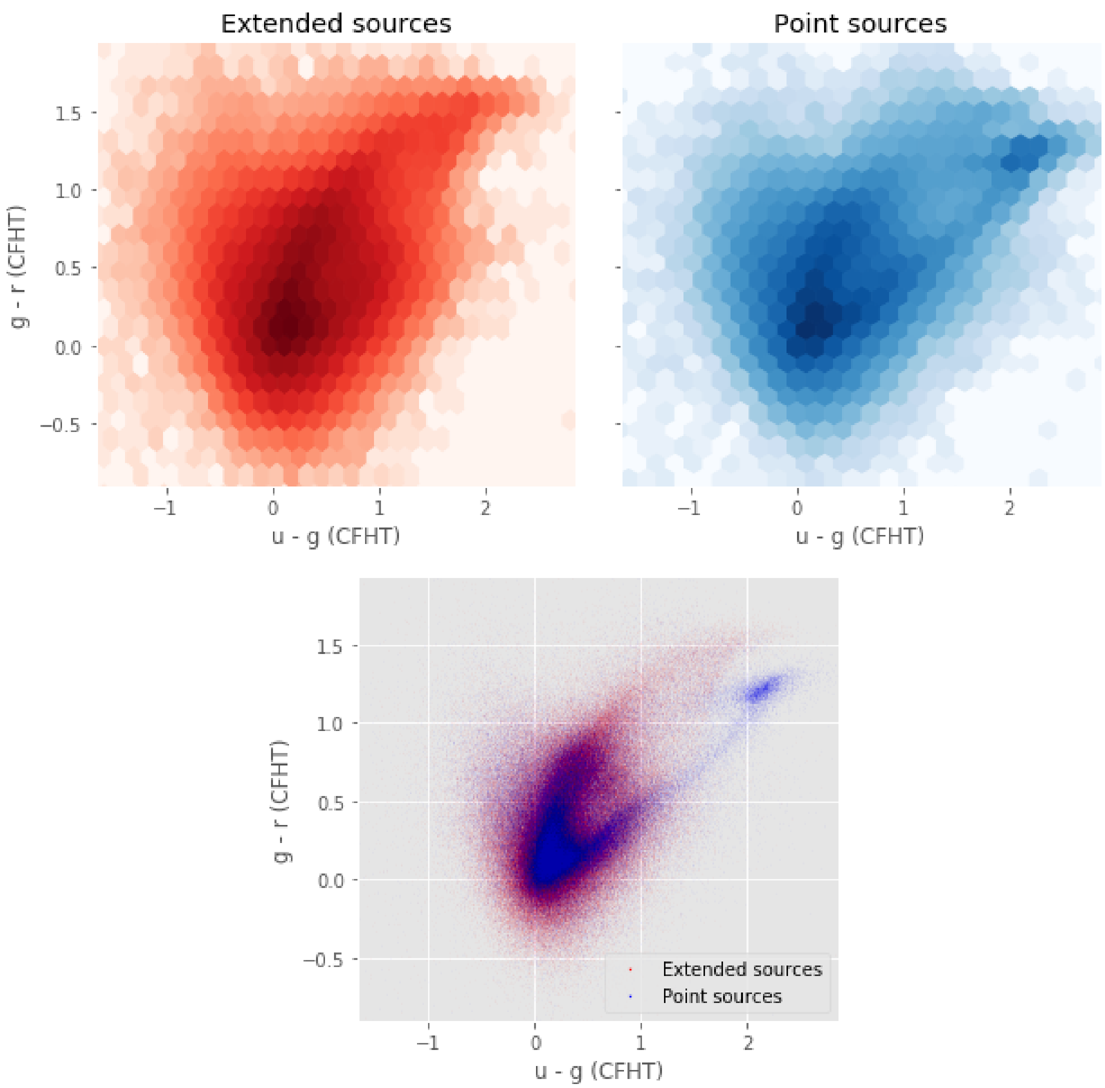
```
Number of source used: 41504 / 1412613 (2.94%)
```



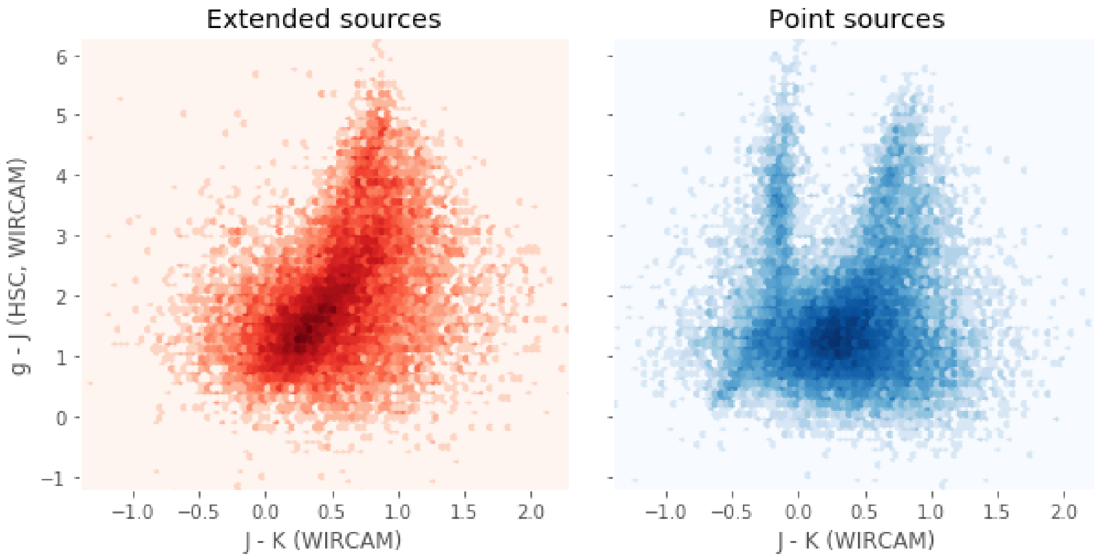
Number of source used: 48502 / 1412613 (3.43%)

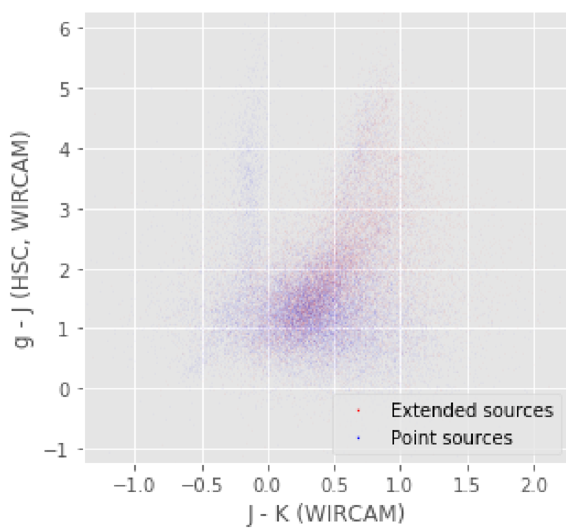


Number of source used: 493682 / 1412613 (34.95%)

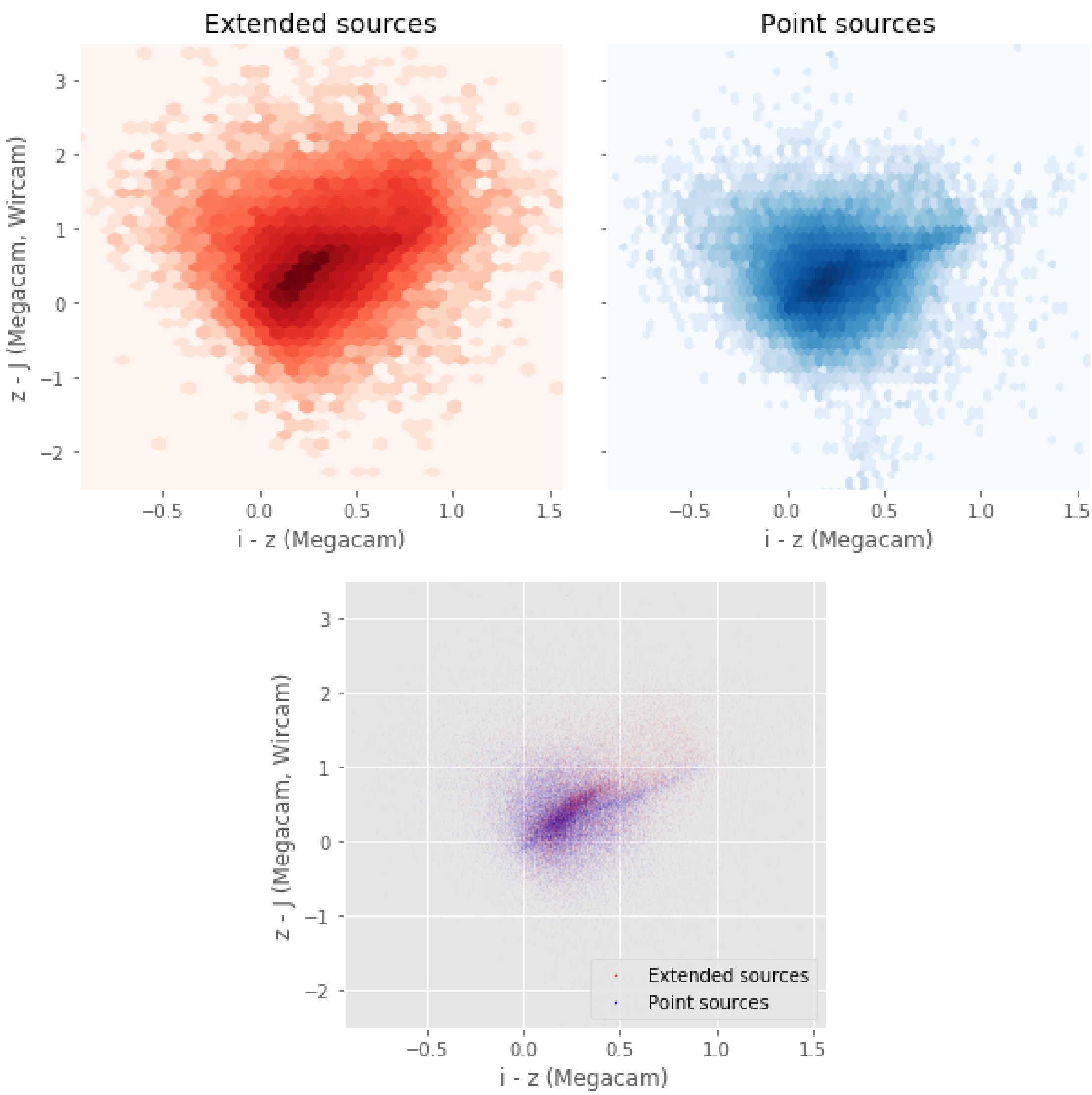


Number of source used: 42964 / 1412613 (3.04%)

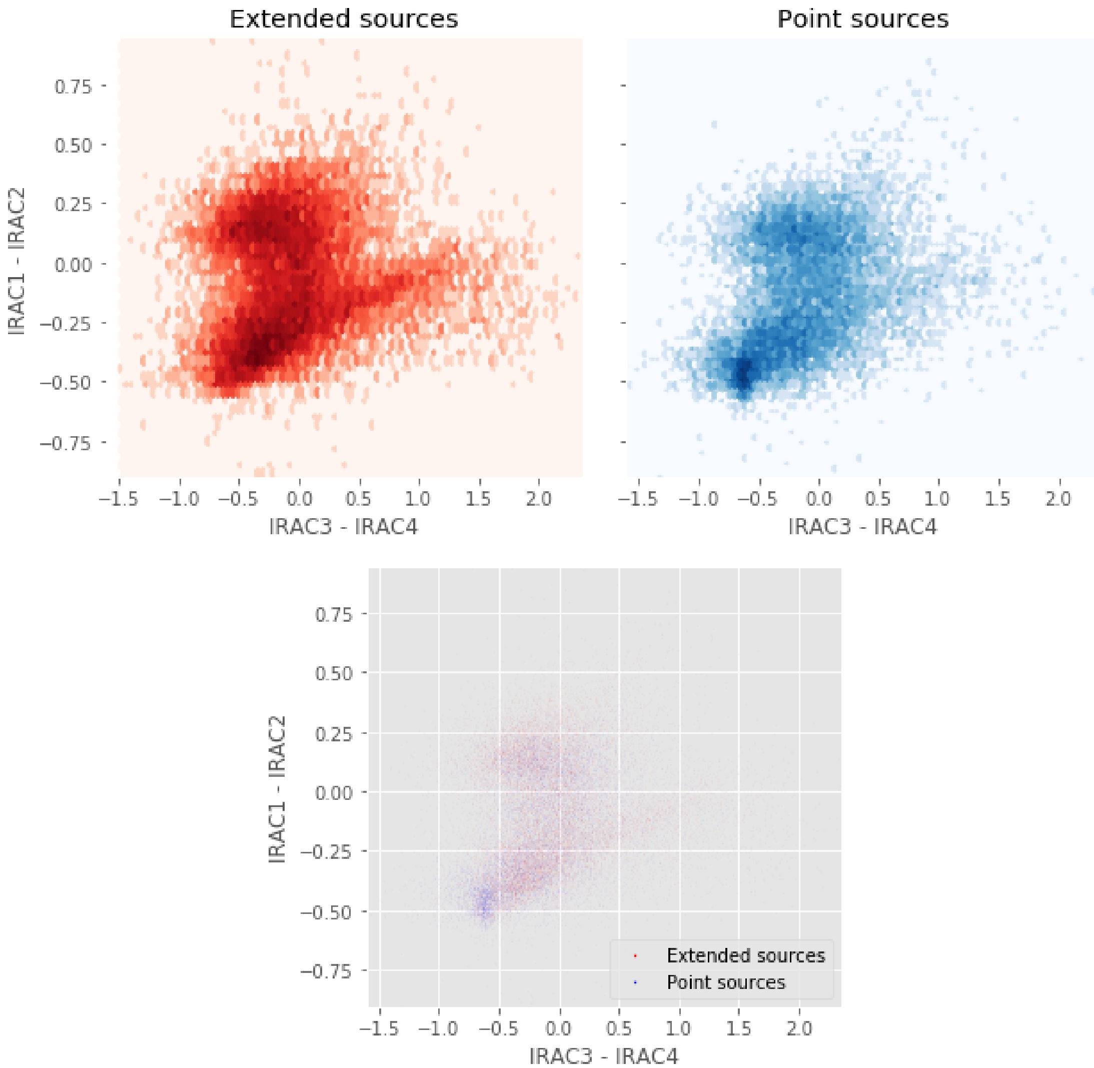





```
Number of source used: 62941 / 1412613 (4.46%)
```



Number of source used: 26811 / 1412613 (1.90%)


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