1.1_CANDELS-3D-HST

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of HST CANDELS-3D data

THIS IS NO LONGER MERGED INTO THE MASTERLIST. We instead use the CANDELS-UDS catalogue which also includes forced photmetry from other imaging 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:
33f5ec7 (Wed Dec 6 16:56:17 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: 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

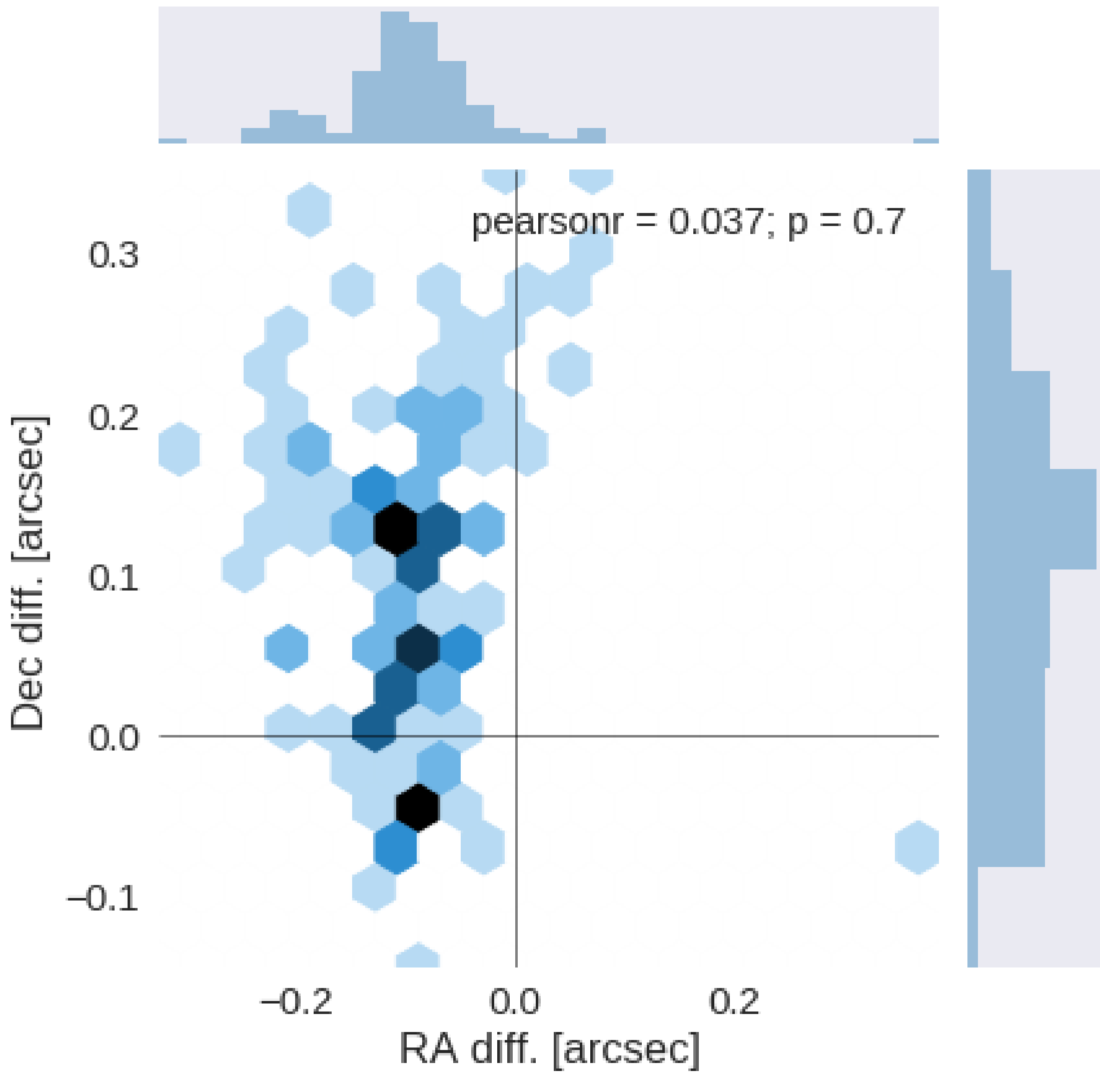
We remove duplicated objects from the input catalogues.

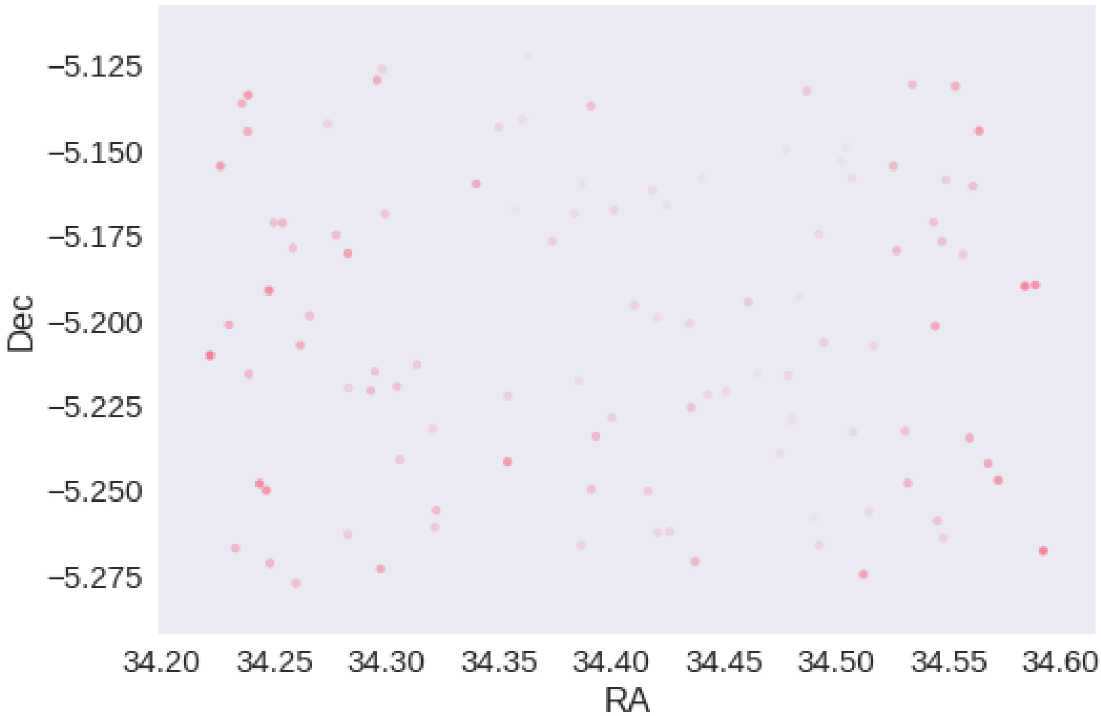
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 44102 sources.
The cleaned catalogue has 43863 sources (239 removed).
The cleaned catalogue has 236 sources flagged as having been cleaned
```

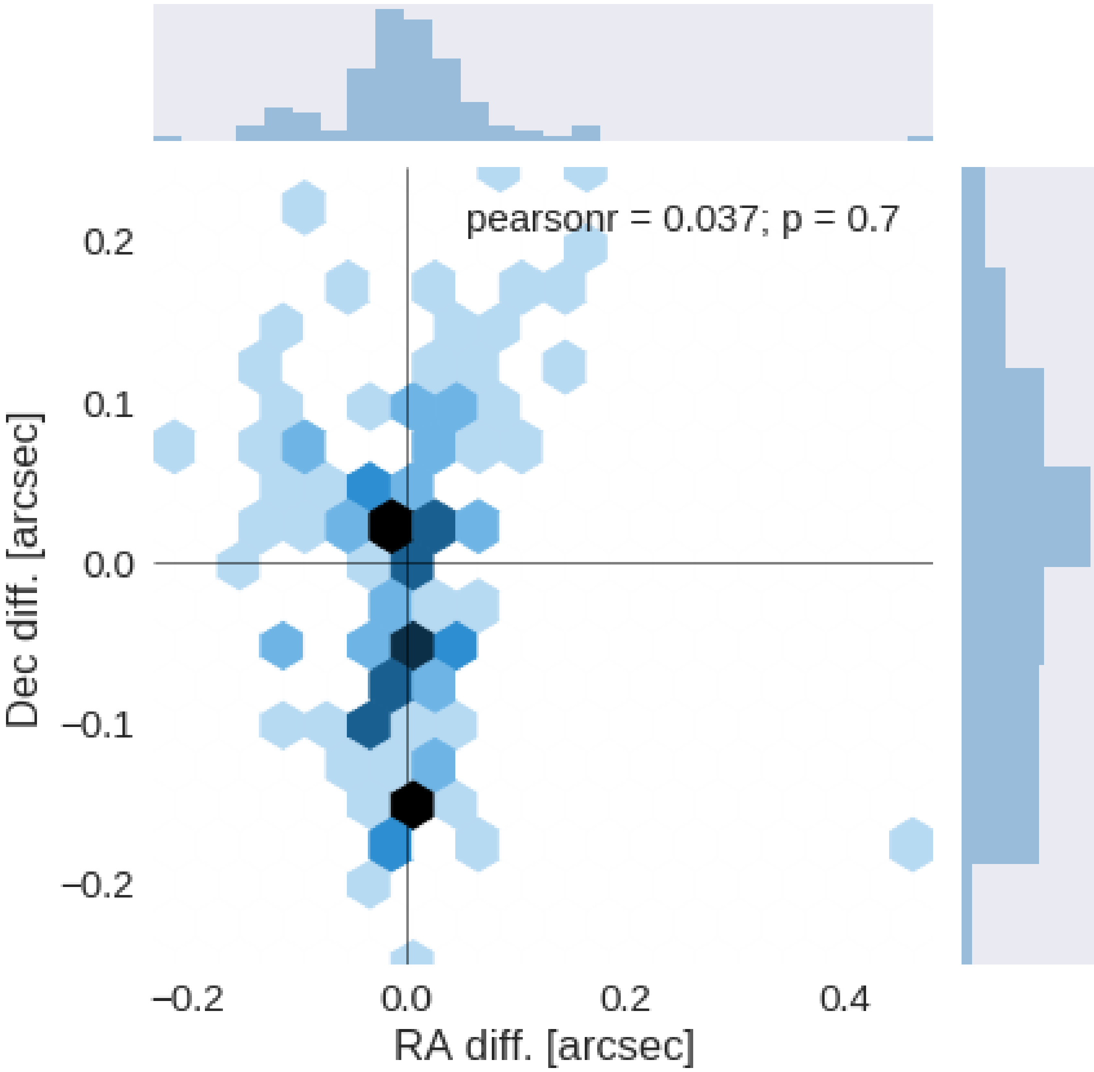
1.4 III - Astrometry correction

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.

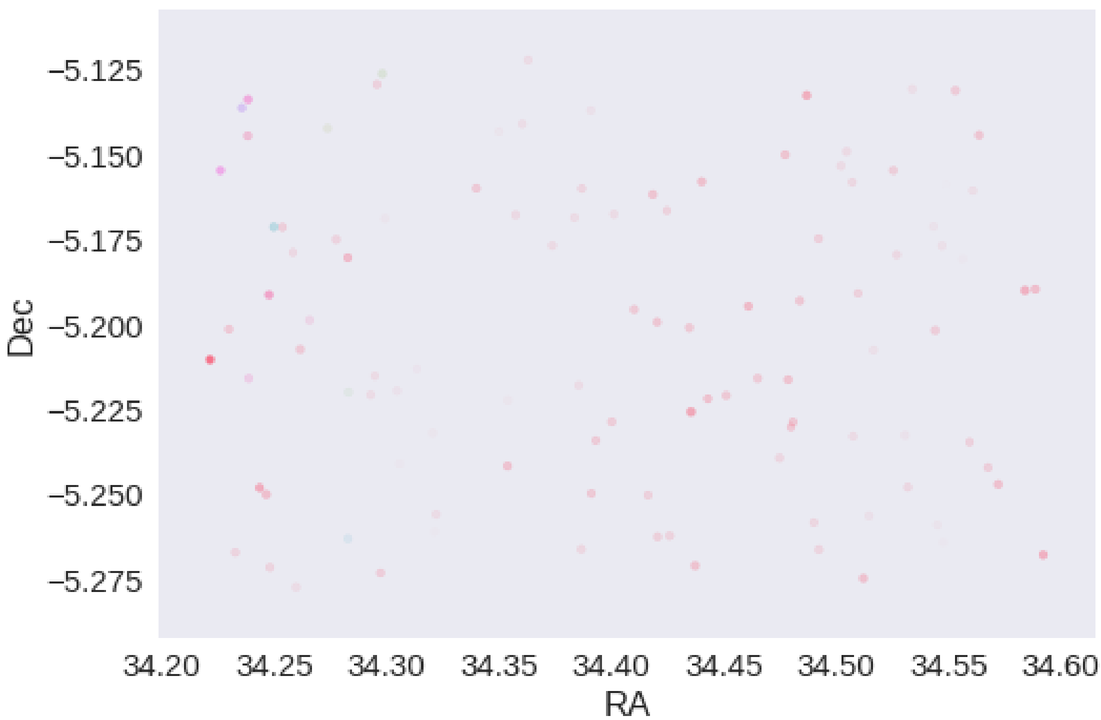





```
RA correction: 0.09405840634997276 arcsec
Dec correction: -0.10633781055542357 arcsec
```



pearsonr = 0.037; p = 0.7
0.2
0.1
0.0
−0.1
−0.2
Dec diff. [arcsec]
−0.2
0.0
0.2
0.4
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
127 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.2_CANDELS-UDS

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of HST CANDELS-UDS data

The UDS survey appears to be a cross match between CANDELS-3D-HST with various other multiwavelength catalogues that we are already including across XMM-LSS. We use this catalogue since these forced photometries are for onjects at much greater depths than the blod catalogues.

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

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:
0246c5d (Thu Jan 25 17:01:47 2018 +0000)
```

```
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/seaborn/apionly.py:
  warnings.warn(msg, UserWarning)
```

1.2 I - Column selection

```
/Users/rs548/GitHub/herschelhelp_internal/herschelhelp_internal/utils.py:76: RuntimeWarning: inv
  magnitudes = 2.5 * (23 - np.log10(fluxes)) - 48.6
/Users/rs548/GitHub/herschelhelp_internal/herschelhelp_internal/utils.py:76: RuntimeWarning: div
  magnitudes = 2.5 * (23 - np.log10(fluxes)) - 48.6
/Users/rs548/GitHub/herschelhelp_internal/herschelhelp_internal/utils.py:80: RuntimeWarning: div
  errors = 2.5 / np.log(10) * errors_on_fluxes / fluxes
```

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

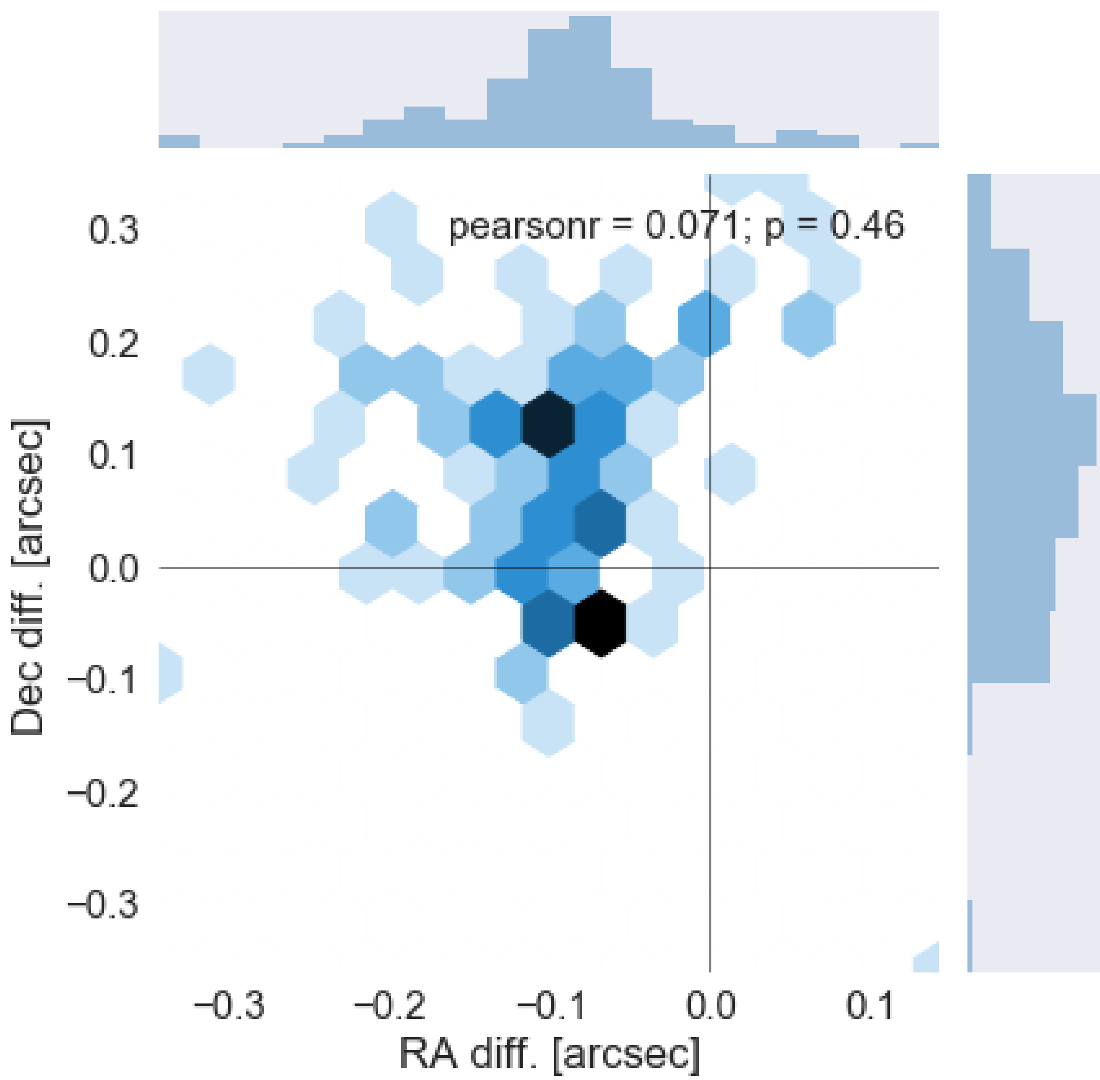
1.3 II - Removal of duplicated sources

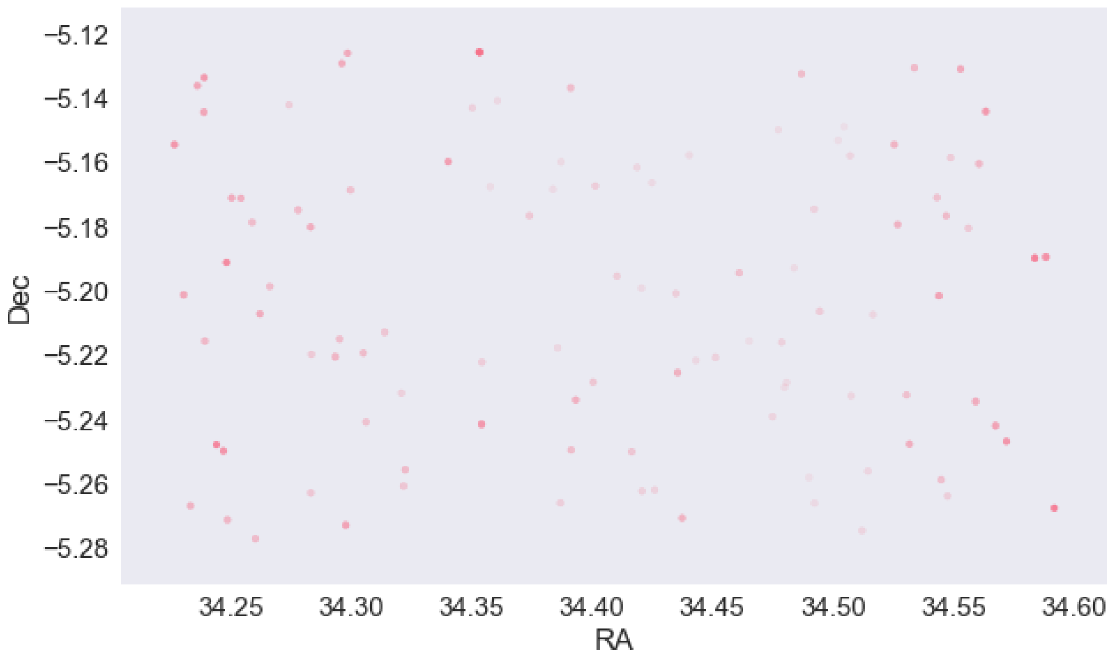
We remove duplicated objects from the input catalogues.

```
The initial catalogue had 35932 sources.
The cleaned catalogue has 35931 sources (1 removed).
The cleaned catalogue has 1 sources flagged as having been cleaned
```

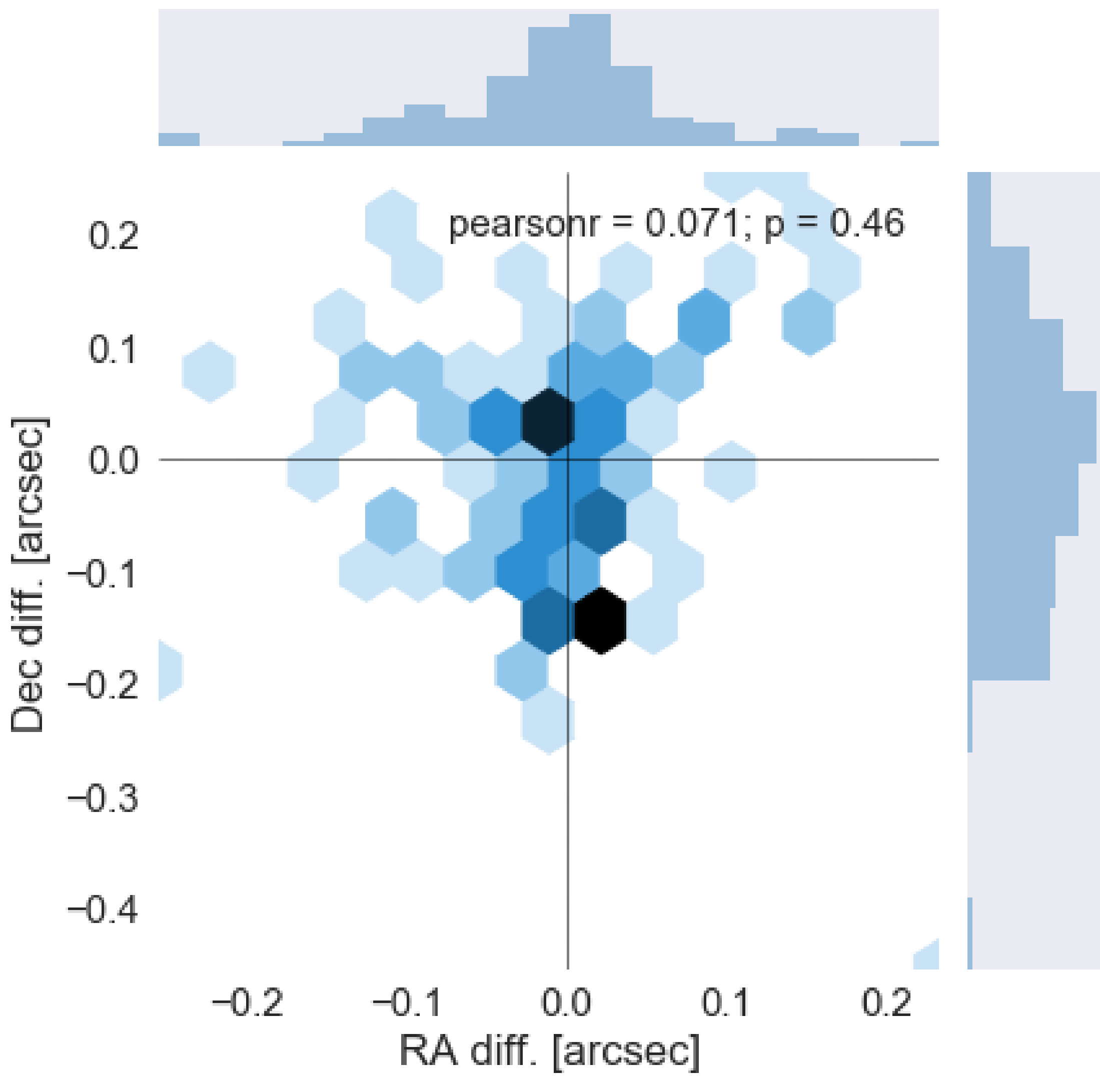
1.4 III - Astrometry correction

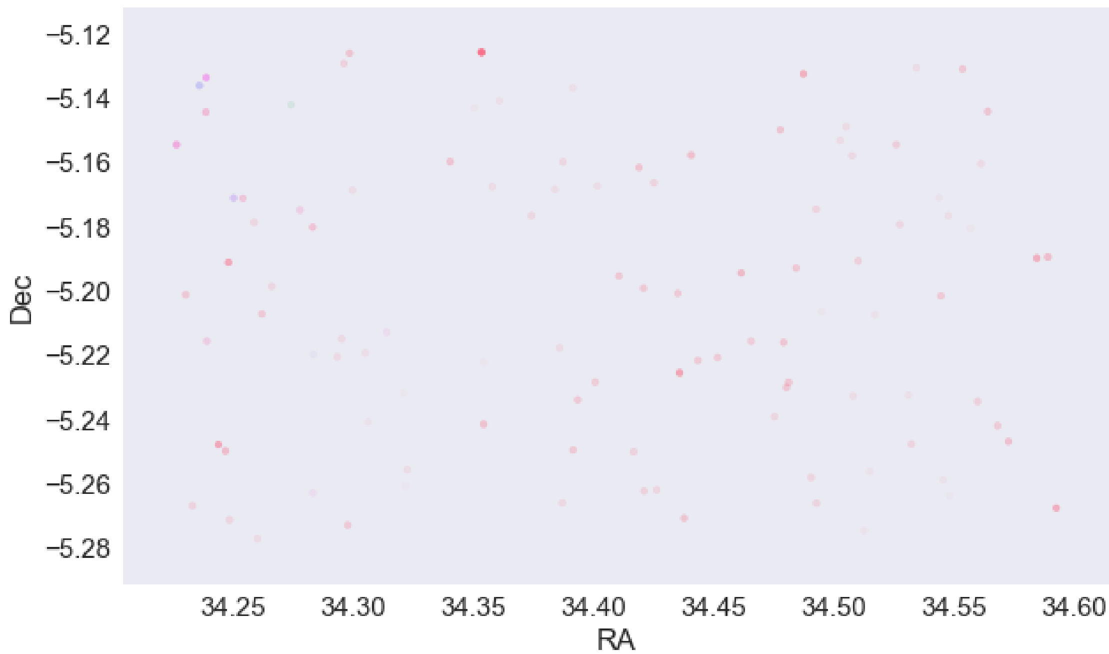
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.08916959699263316 arcsec
Dec correction: -0.09309502868433128 arcsec
```


pearsonr = 0.071; p = 0.46
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
Dec diff. [arcsec]
−0.2
−0.1
0.0
0.1
0.2
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
124 sources flagged.
```

2 V - Saving to disk

1.3_CFHT-WIRDS

March 8, 2018

1 XMM-LSS 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:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
```

```
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/seaborn/apionly.py:
  warnings.warn(msg, UserWarning)
```

1.2 I - Column selection

```
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
```

```
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
  return getattr(self.data, op)(other)
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/colum
```

```
  return getattr(self.data, op)(other)
```

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

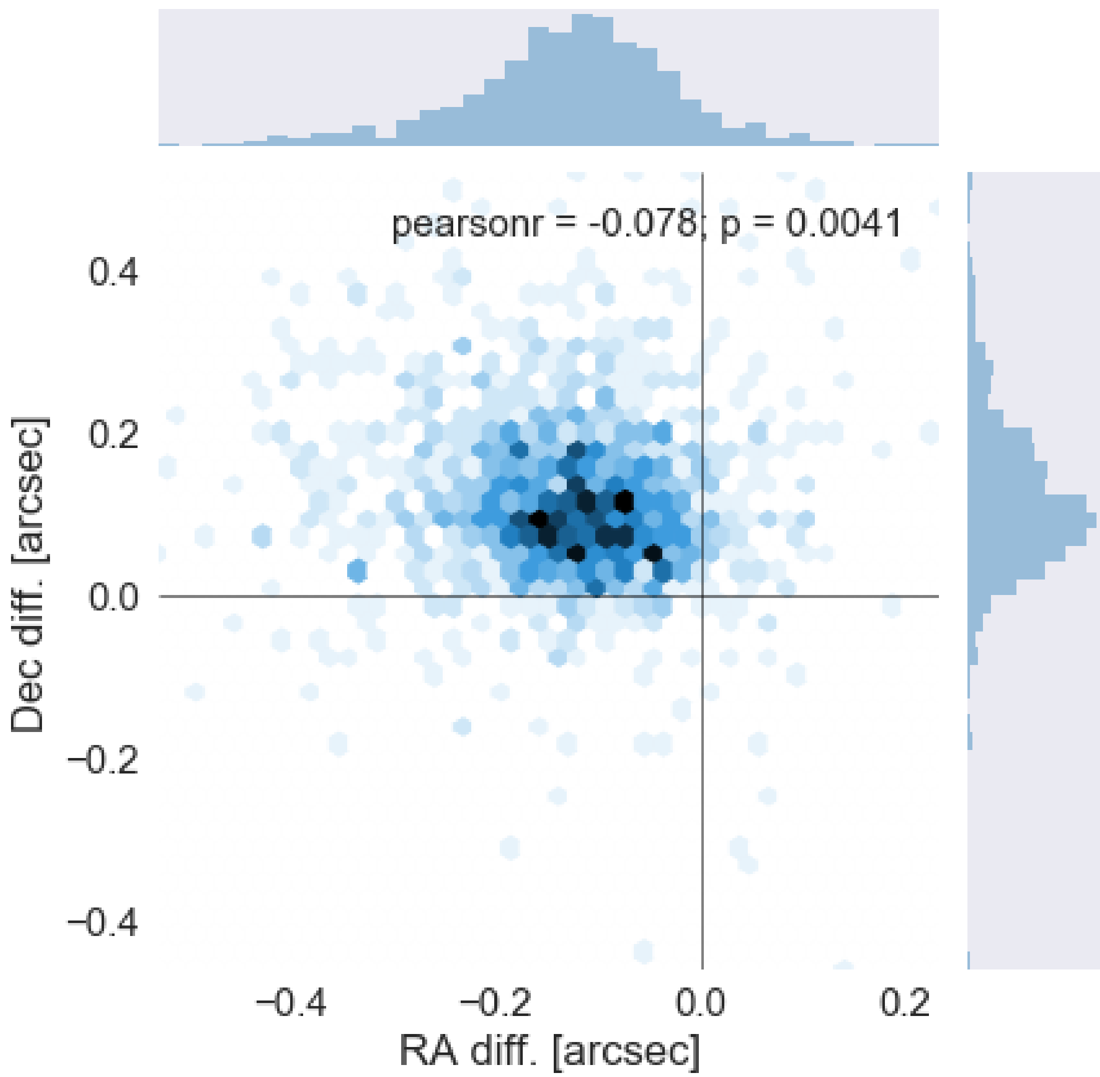
1.3 II - Removal of duplicated sources

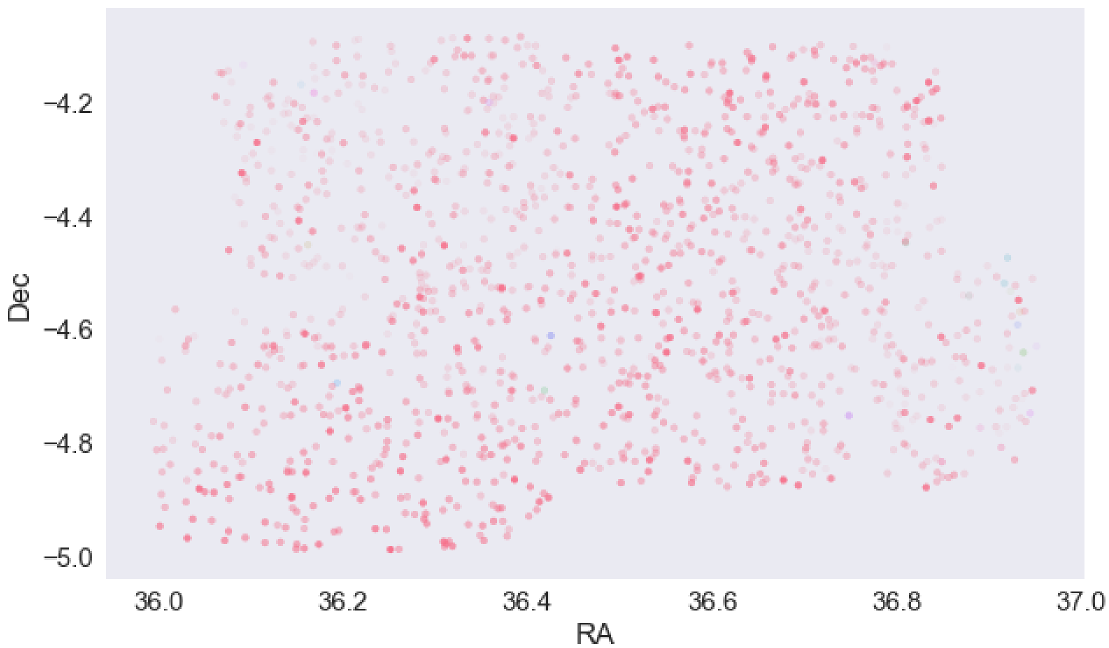
We remove duplicated objects from the input catalogues.

```
The initial catalogue had 160394 sources.
The cleaned catalogue has 160394 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

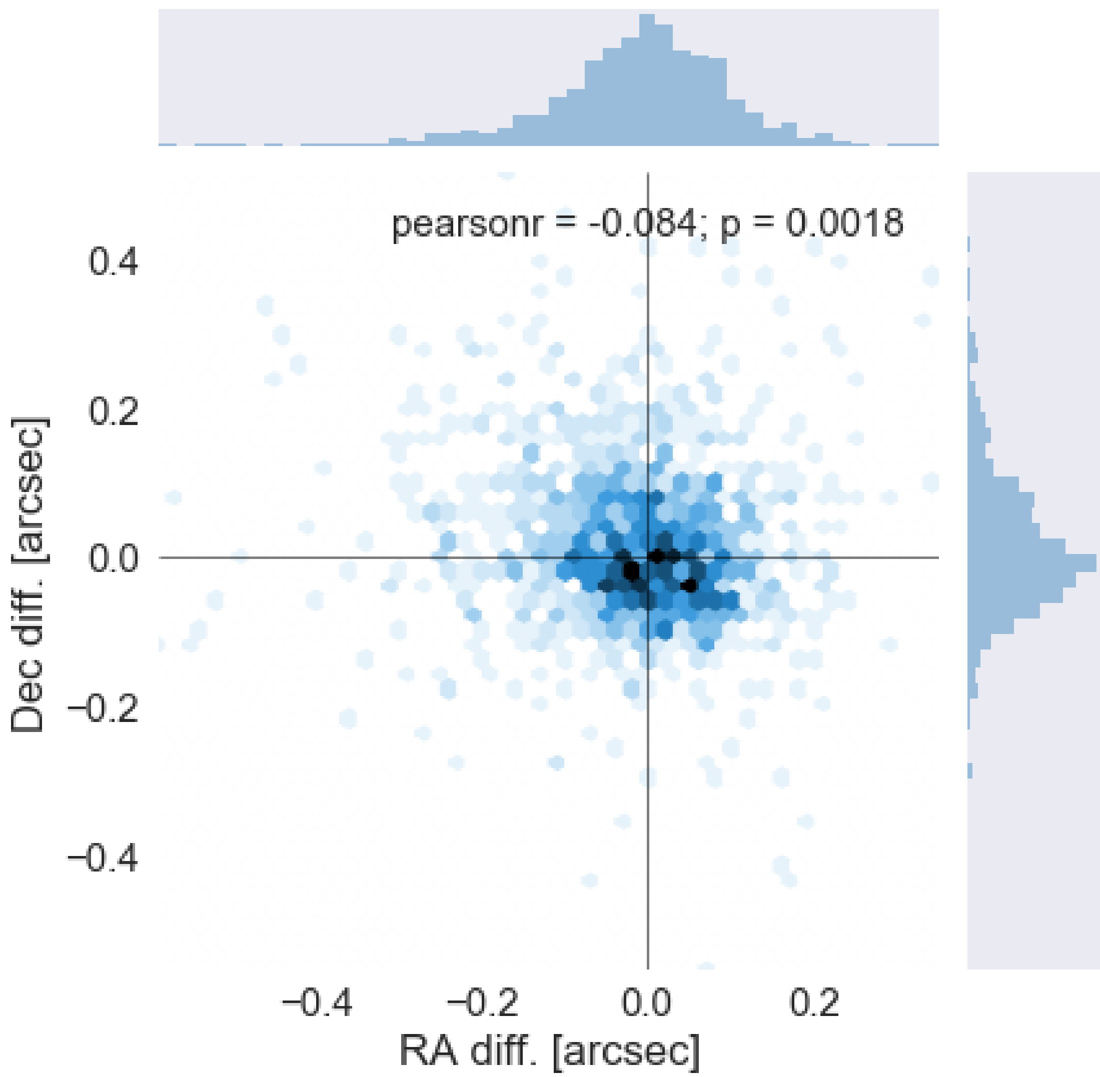
1.4 III - Astrometry correction

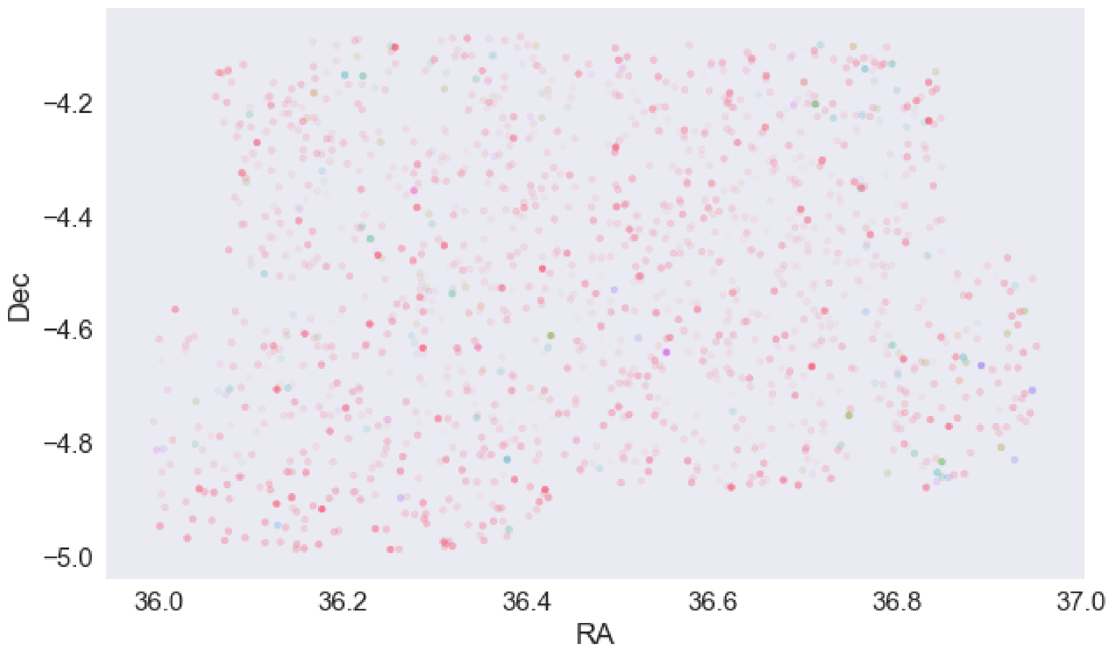
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.


pearsonr = -0.078; p = 0.0041
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
RA diff. [arcsec]




```
RA correction: 0.11931722784197518 arcsec
Dec correction: -0.10371734931702292 arcsec
```


pearsonr = -0.084; p = 0.0018
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
1422 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.4.1_CFHTLS-WIDE

March 8, 2018

1 XMM-LSS master catalogue

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

CFHTLS has both a wide area across XMM-LSS 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:
33f5ec7 (Wed Dec 6 16:56:17 2017 +0000)
```

1.2 I - Column selection

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

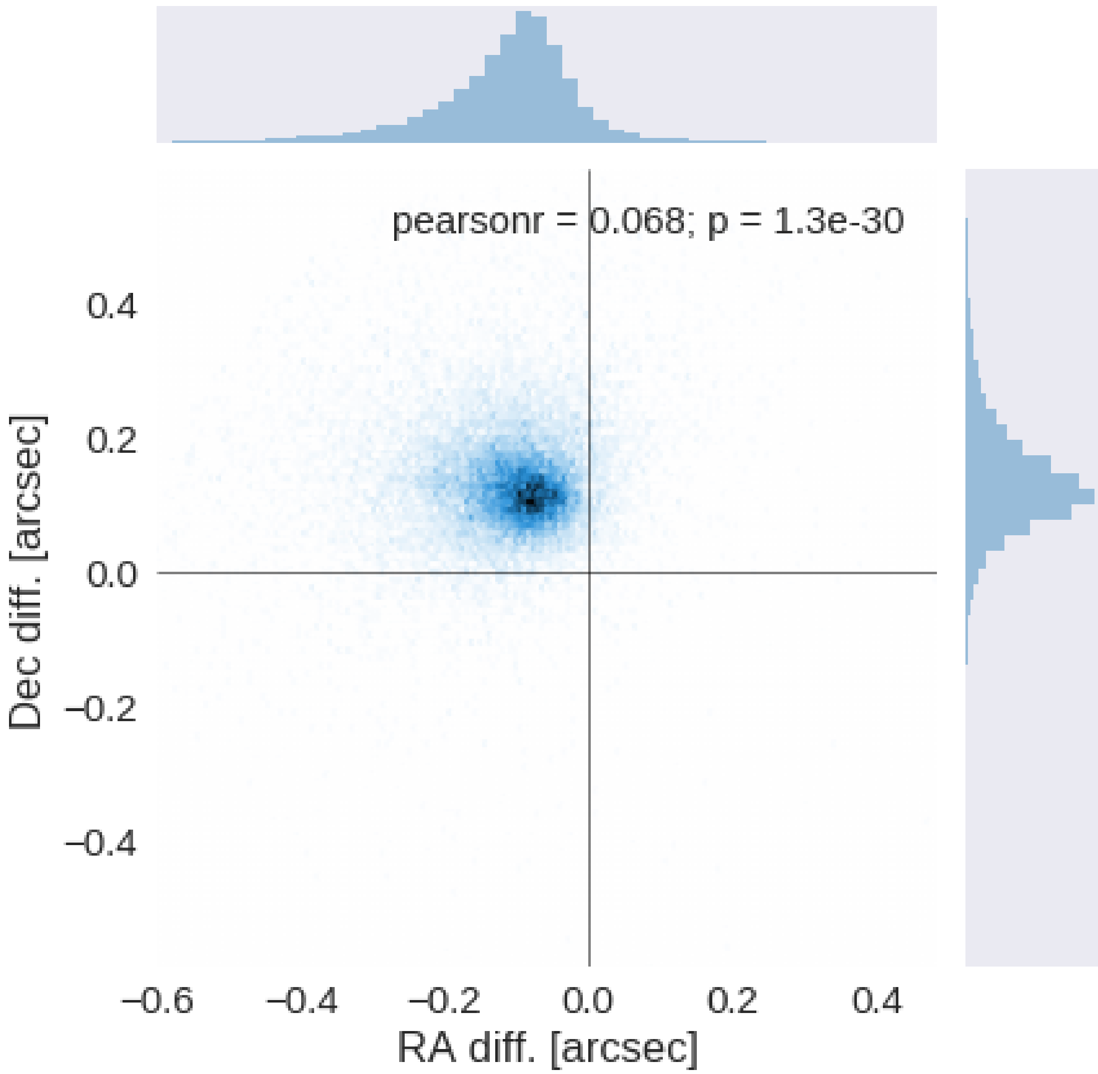
1.3 II - Removal of duplicated sources

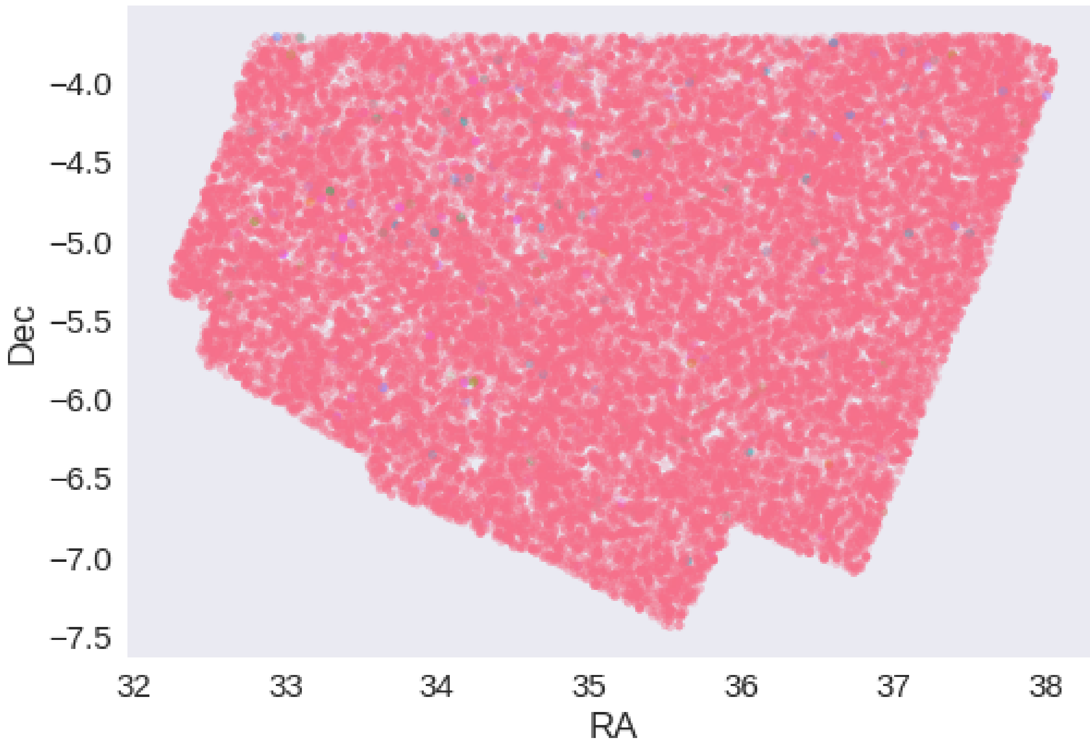
We remove duplicated objects from the input catalogues.

```
/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 3565362 sources.
The cleaned catalogue has 3565219 sources (143 removed).
The cleaned catalogue has 143 sources flagged as having been cleaned
```

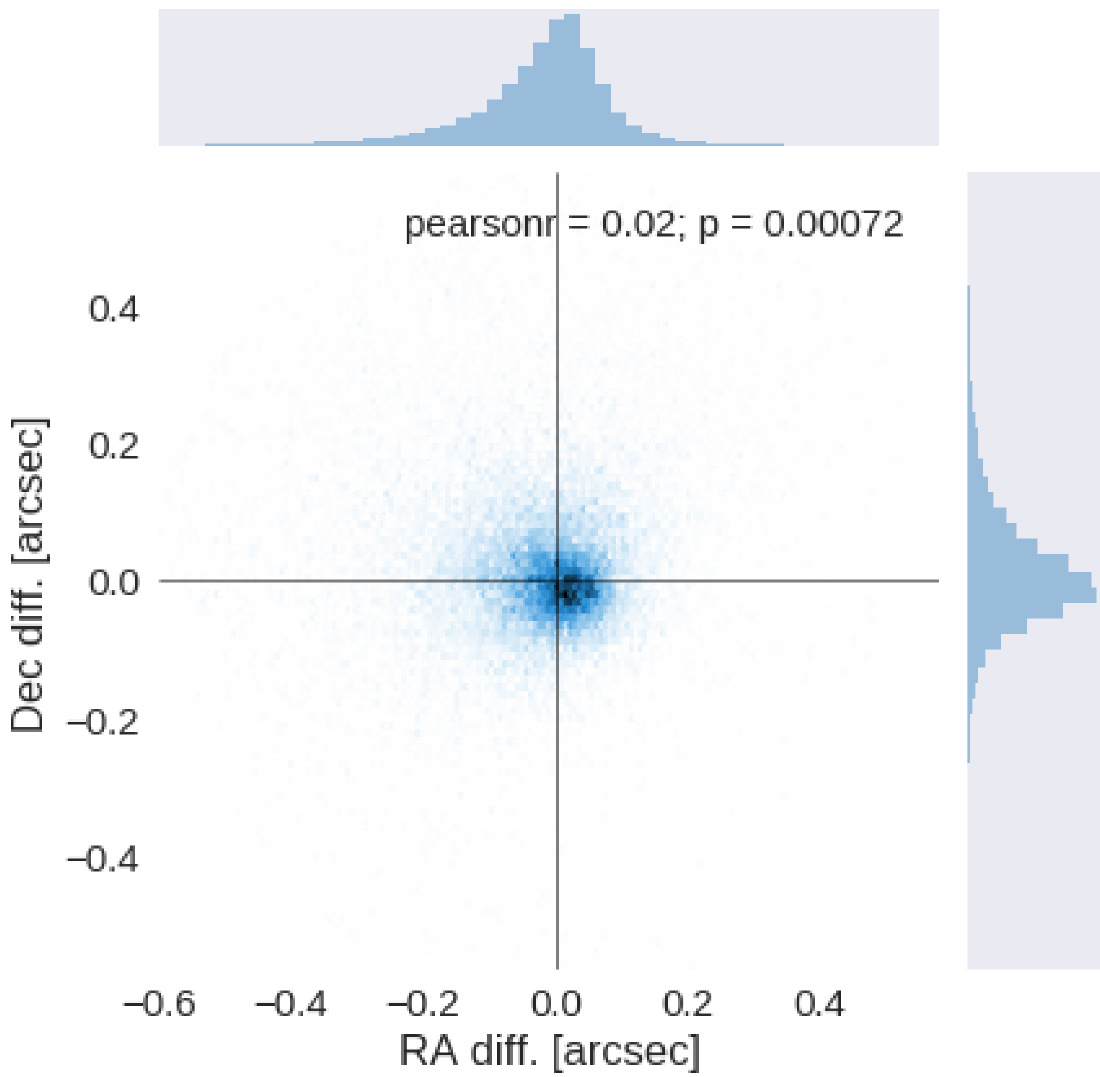
1.4 III - Astrometry correction

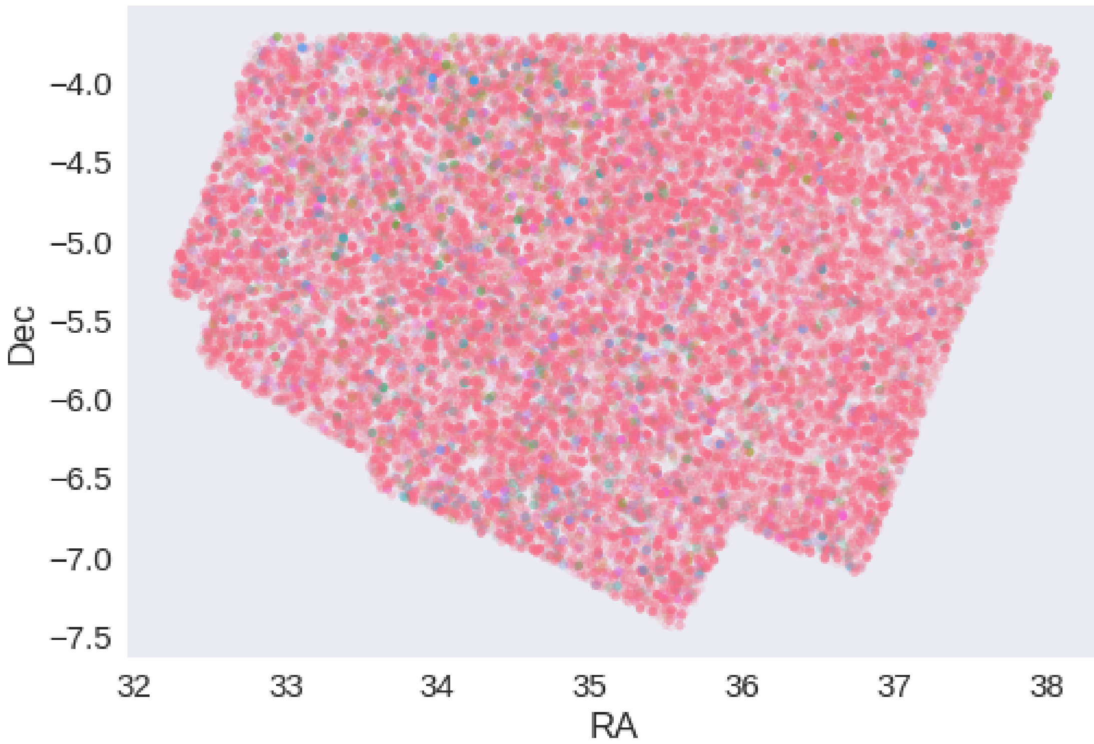
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.09701123327374717 arcsec
Dec correction: -0.12296987141358073 arcsec
```


pearsonr = 0.02; p = 0.00072
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.6
−0.4
−0.2
0.0
0.2
0.4
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
29367 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.4.2_CFHTLS-DEEP

March 8, 2018

1 XMM-LSS master catalogue

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

CFHTLS has both a wide area across XMM-LSS 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:
33f5ec7 (Wed Dec 6 16:56:17 2017 +0000)
```

1.2 I - Column selection

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

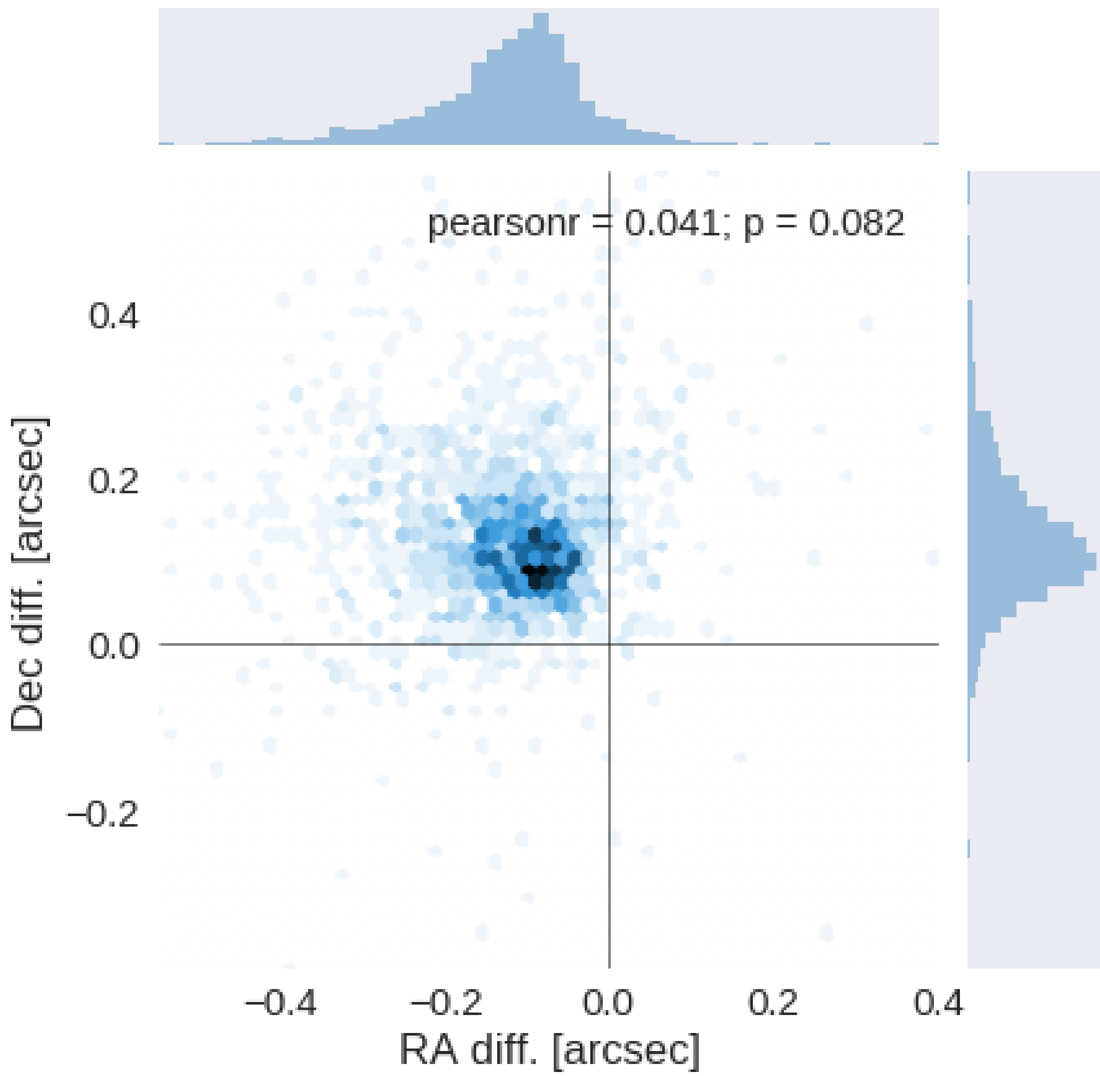
1.3 II - Removal of duplicated sources

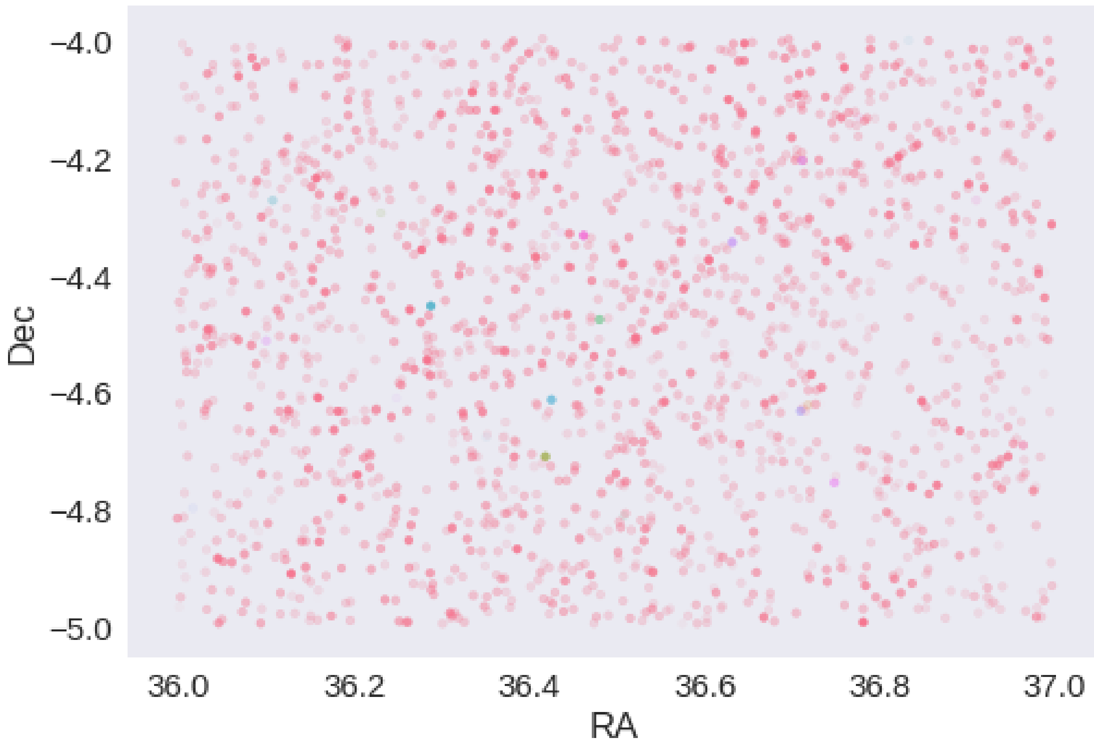
We remove duplicated objects from the input catalogues.

```
/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 592457 sources.
The cleaned catalogue has 592457 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

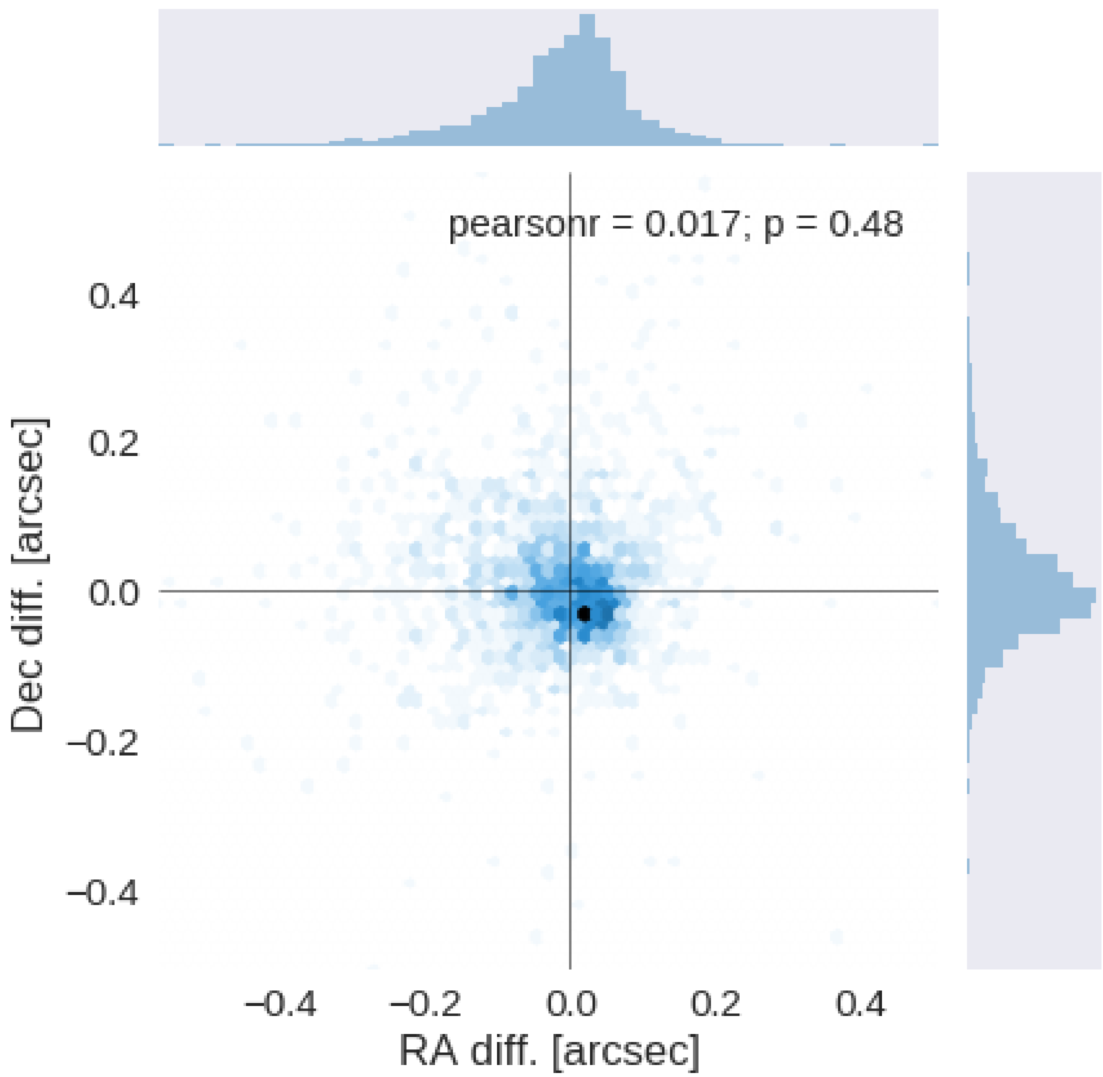
1.4 III - Astrometry correction

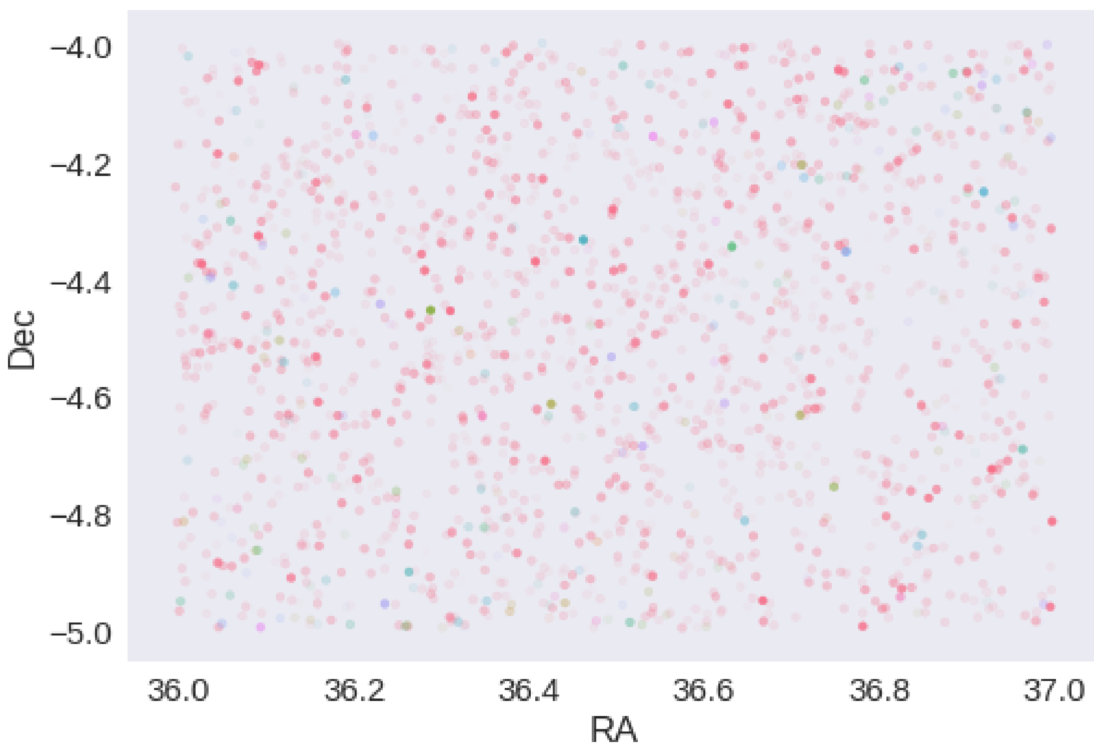
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.10748285569093241 arcsec
Dec correction: -0.11697437952022938 arcsec
```


pearsonr = 0.017; p = 0.48
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]



1.5 IV - Flagging Gaia objects

```
1839 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.5_CFHTLenS

March 8, 2018

1 XMM-LSS 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:
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)
/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

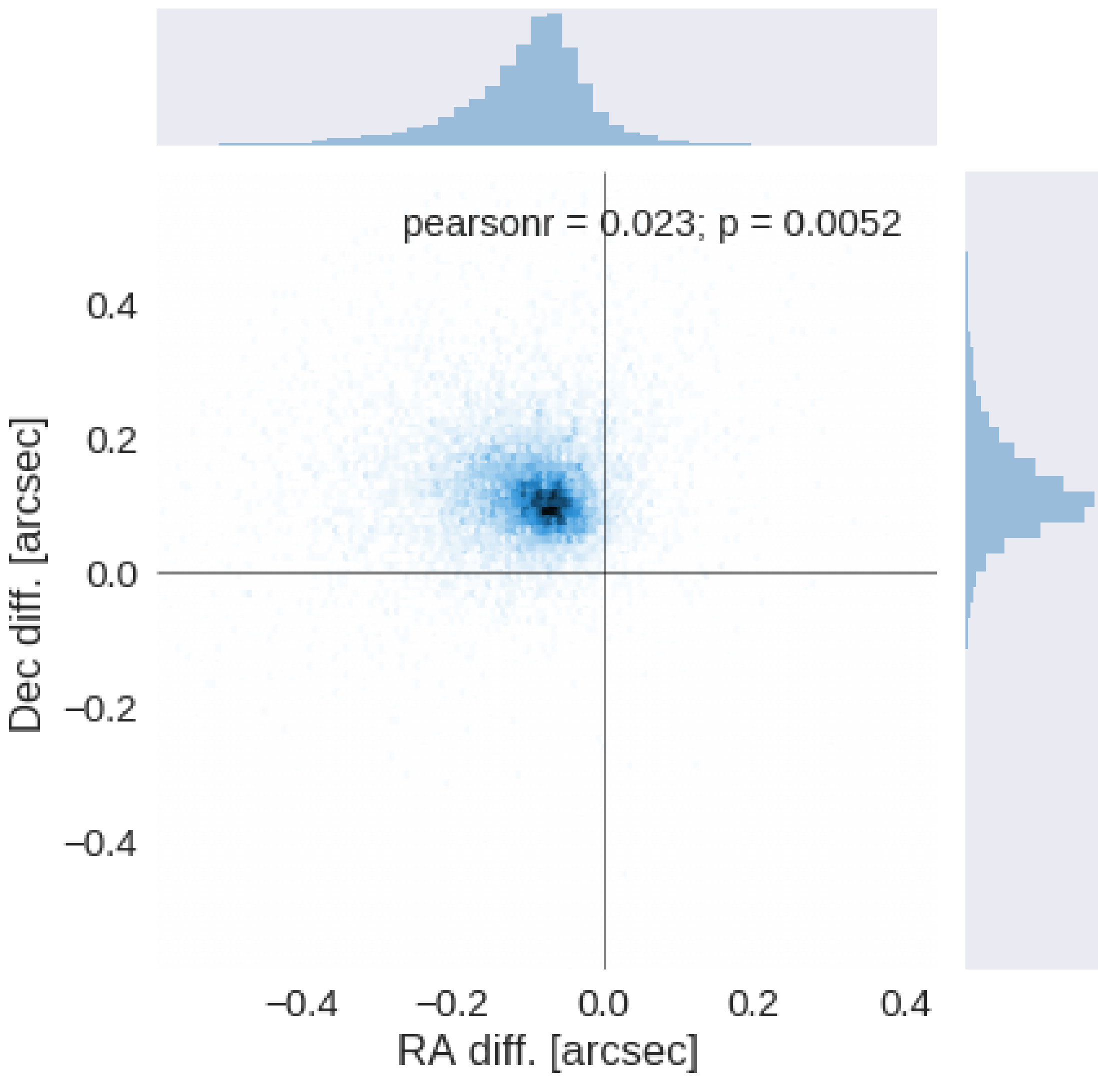
We remove duplicated objects from the input catalogues.

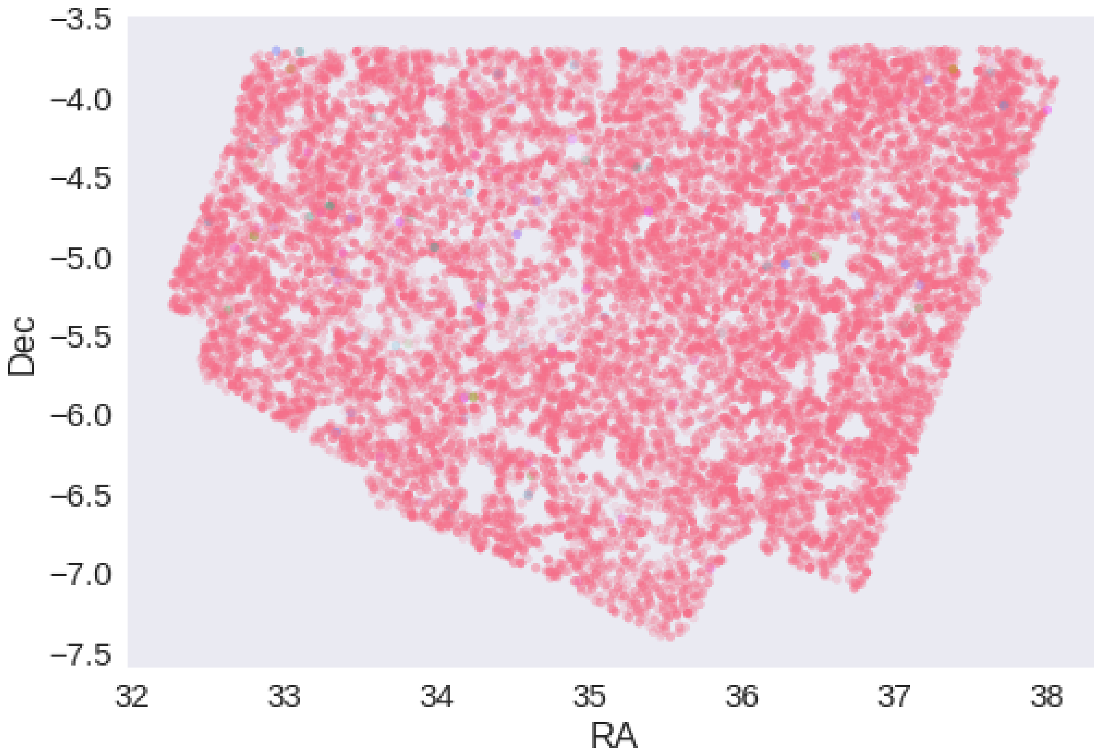
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 2317959 sources.
The cleaned catalogue has 2317937 sources (22 removed).
The cleaned catalogue has 22 sources flagged as having been cleaned
```

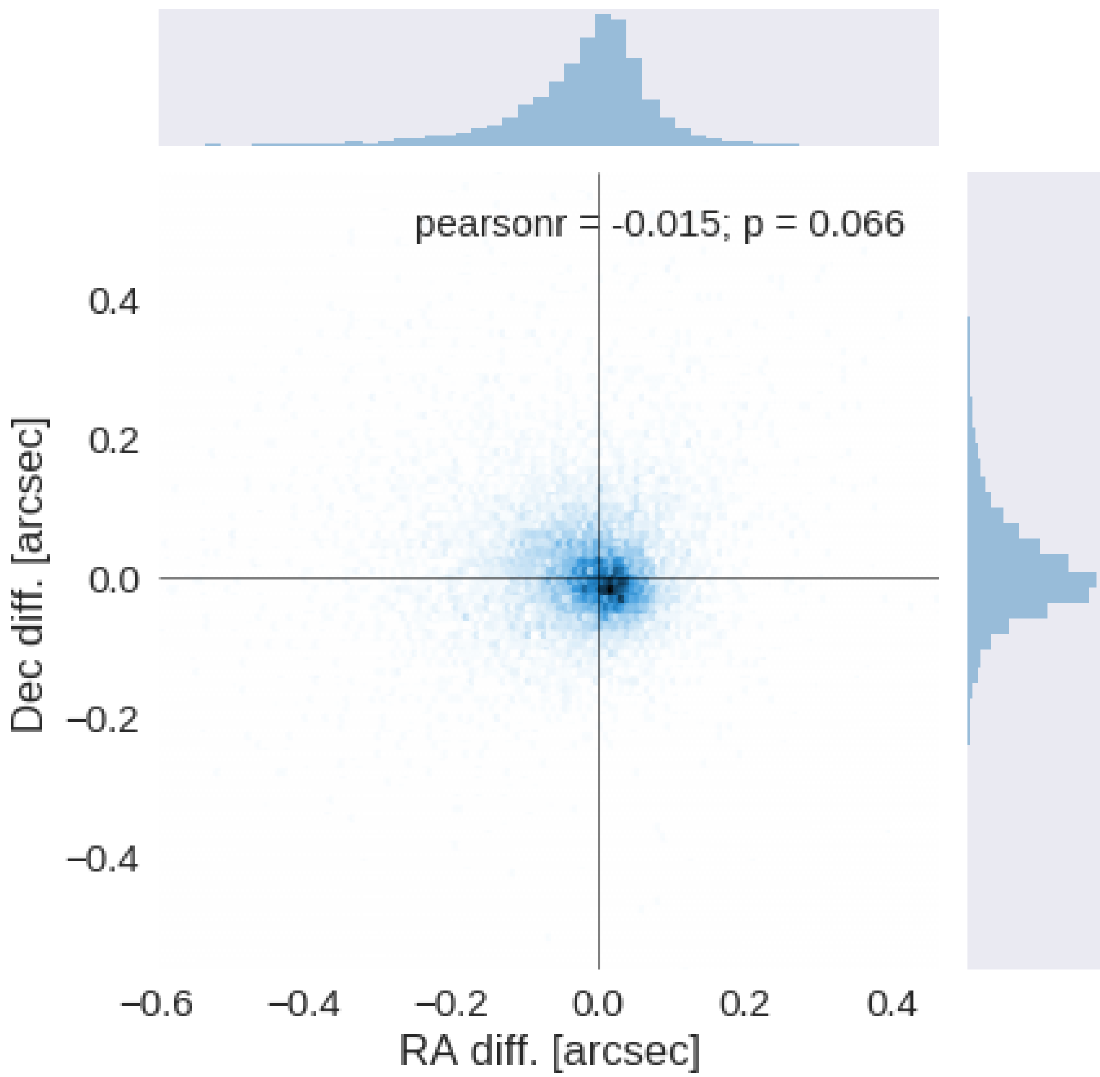
1.4 III - Astrometry correction

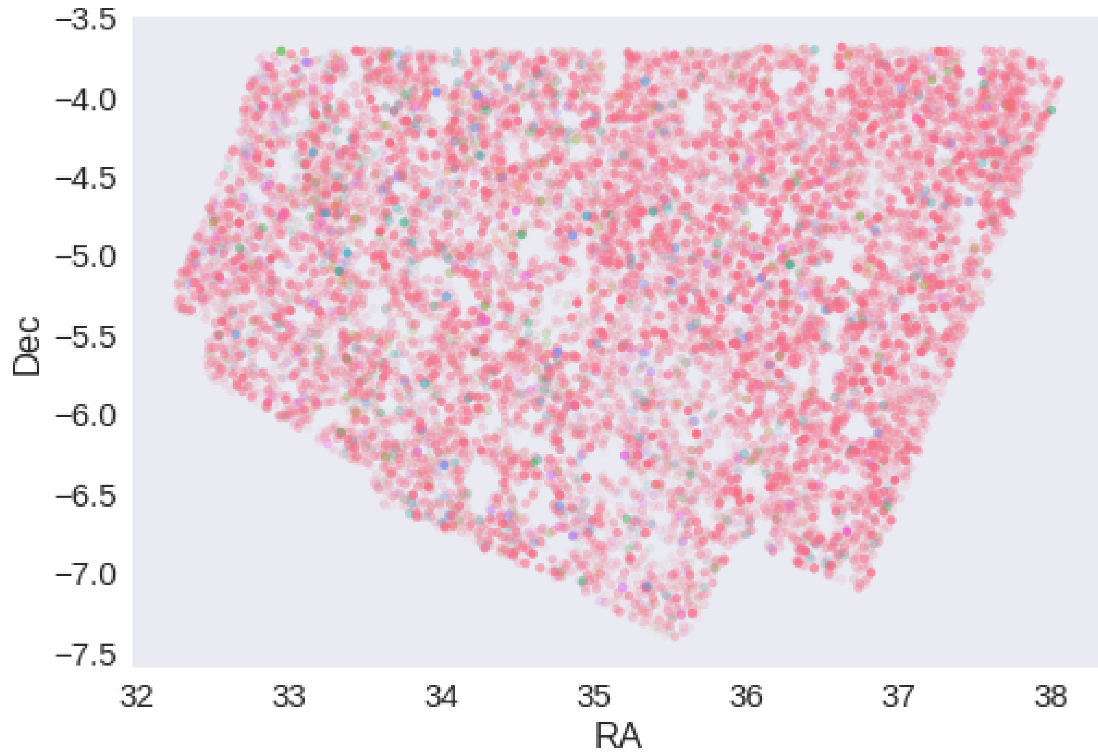
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.08798053969201192 arcsec
Dec correction: -0.11095108088596817 arcsec
```


pearsonr = -0.015; p = 0.066
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.6
−0.4
−0.2
0.0
0.2
0.4
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
15171 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.6.1_DECaLS

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of DECam Legacy Survey data

This catalogue comes from `dmu0_DECaLS`.

In the catalogue, we keep:

- The `object_id` as unique object identifier;
- The position;
- The u, g, r, i, z, Y aperture magnitude (2");
- The u, g, r, i, z, Y kron fluxes and magnitudes.

We check for all ugrizY then only take bands for which there are measurements

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

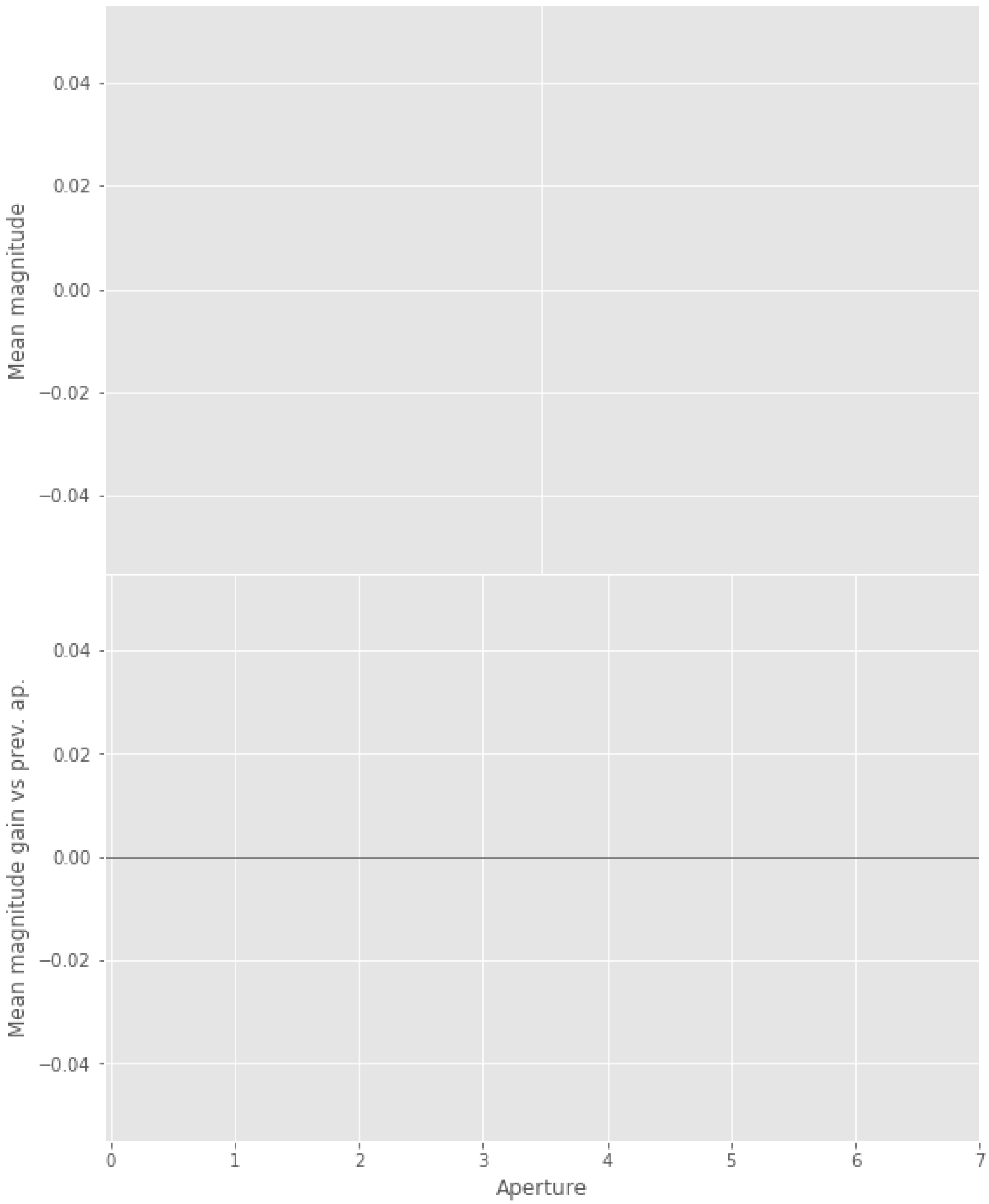
As target aperture, we should use the smallest (i.e. less noisy) aperture for which most of the flux is captures.

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: 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
```

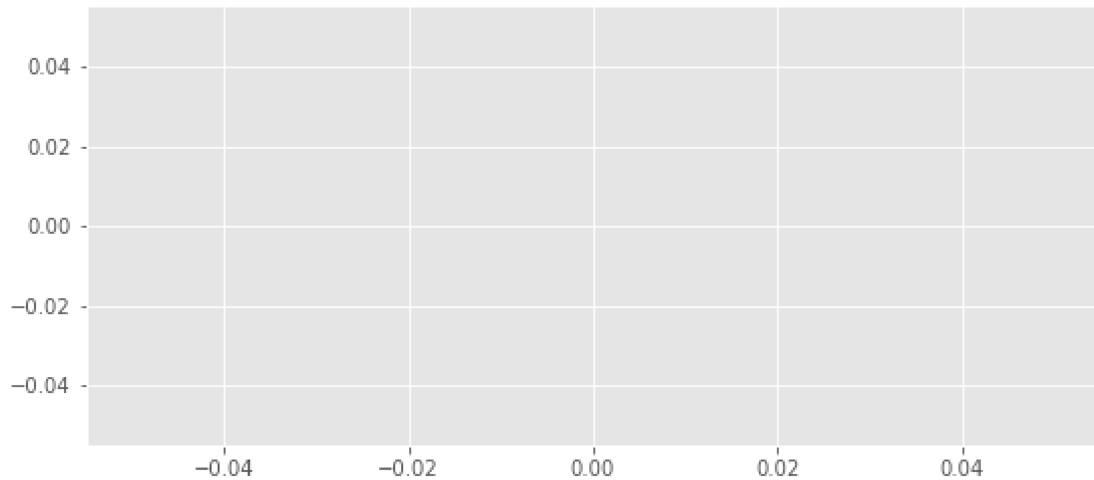
1.2.1 1.a u band

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

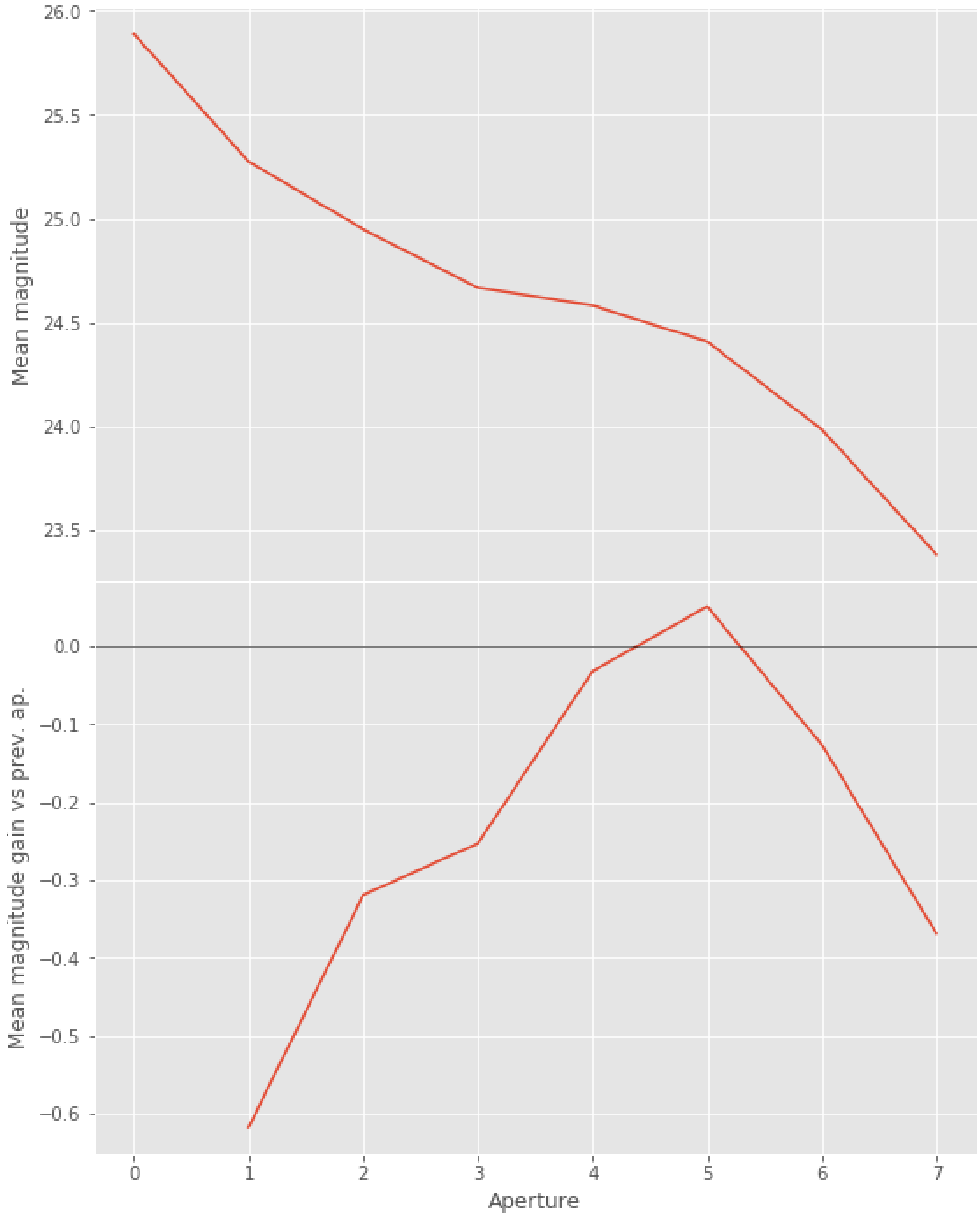


u band is all nan

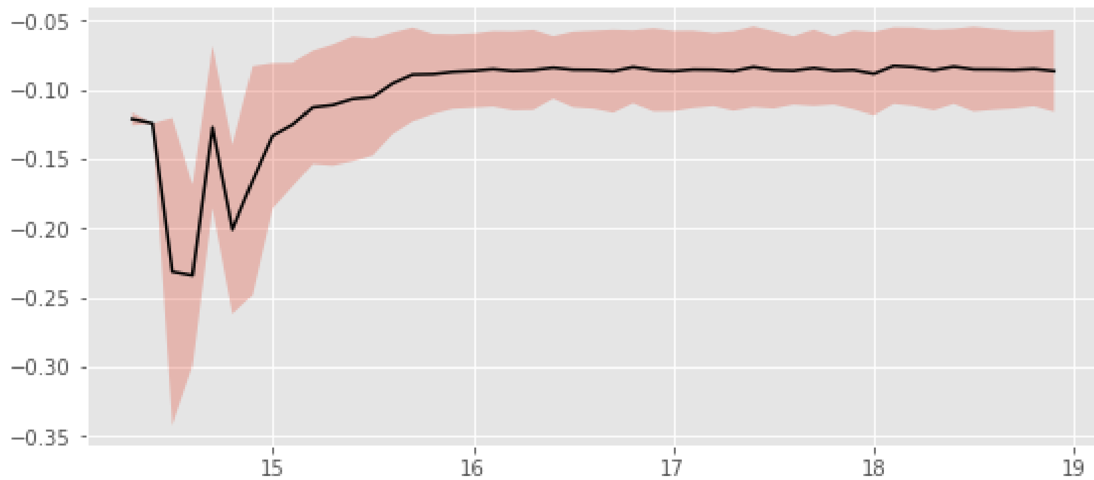
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/numpy/lib/nanfunctions.py:
  warnings.warn("All-NaN slice encountered", RuntimeWarning)
```


0.04
0.02
0.00
−0.02
−0.04
−0.04
−0.02
0.00
0.02
0.04

1.2.2 I.a - g band



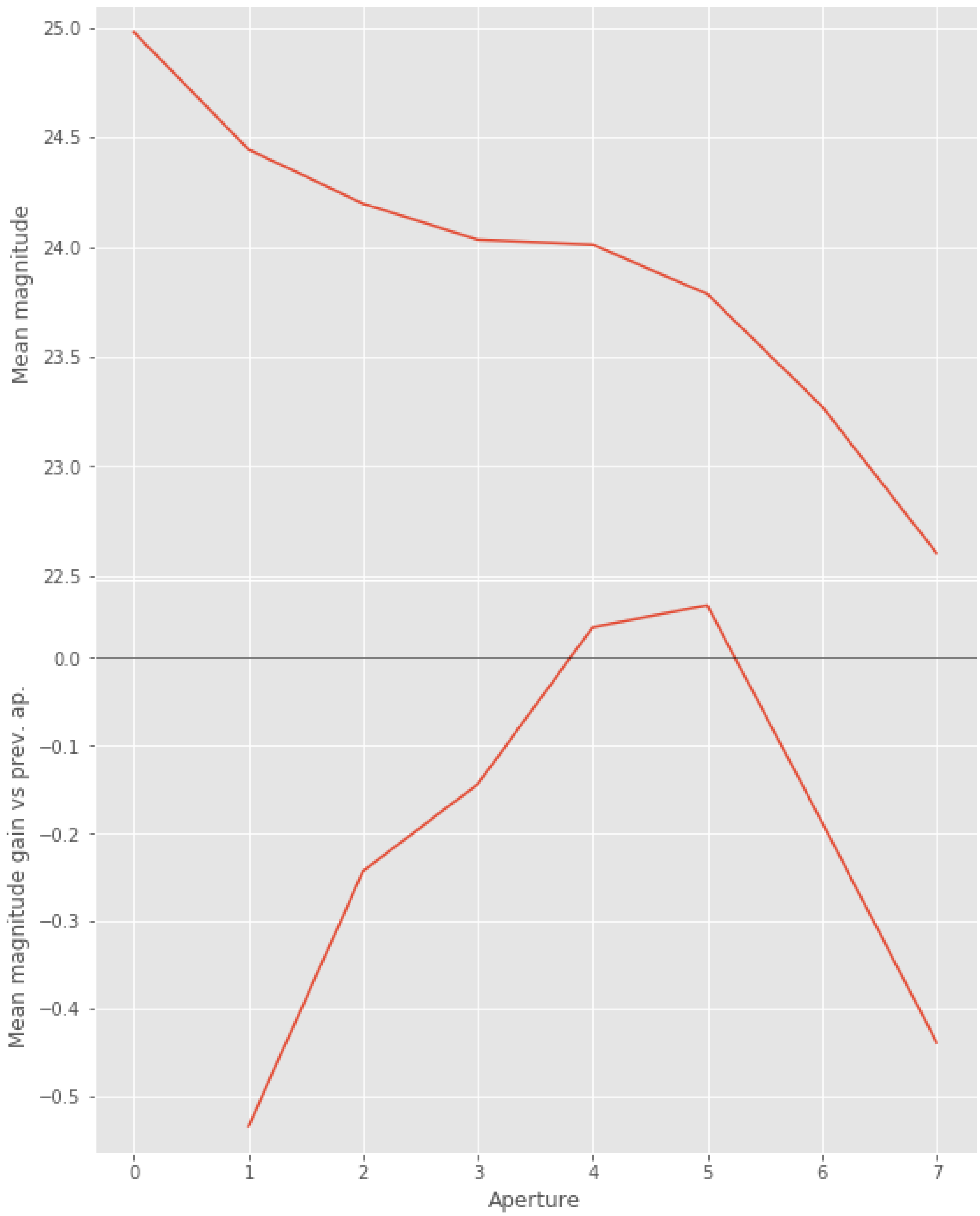
We will use aperture 5 as target.



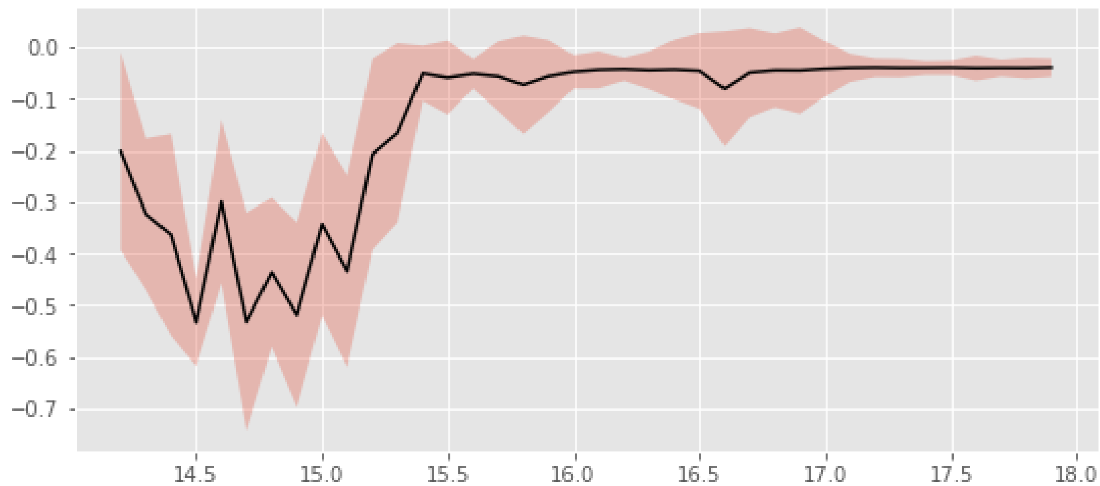
We will use magnitudes between 16.0 and 19.0

```
Aperture correction for g band:
Correction: -0.08519500668633384
Number of source used: 10752
RMS: 0.028076768731770316
```

1.2.3 I.b - r band



We will use aperture 5 as target.

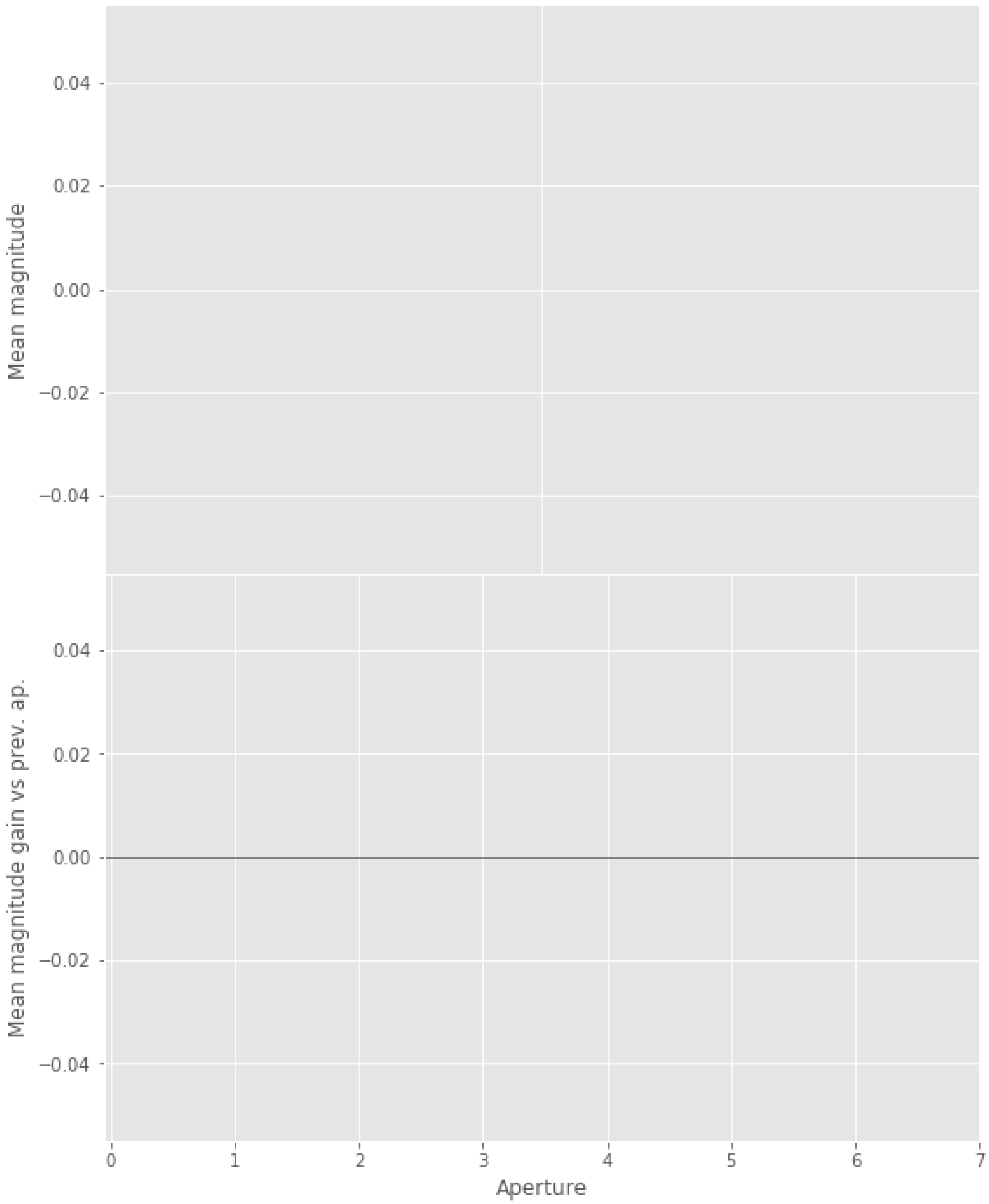


We use magnitudes between 16.0 and 18.0.

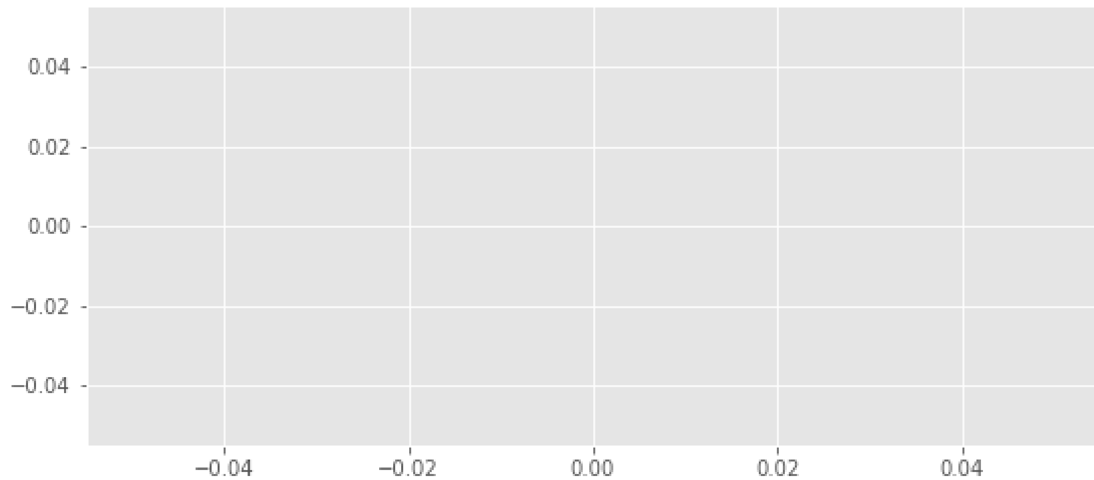
```
Aperture correction for r band:
Correction: -0.04148028156868122
Number of source used: 10646
RMS: 0.034286856718686975
```

1.2.4 I.d - i band

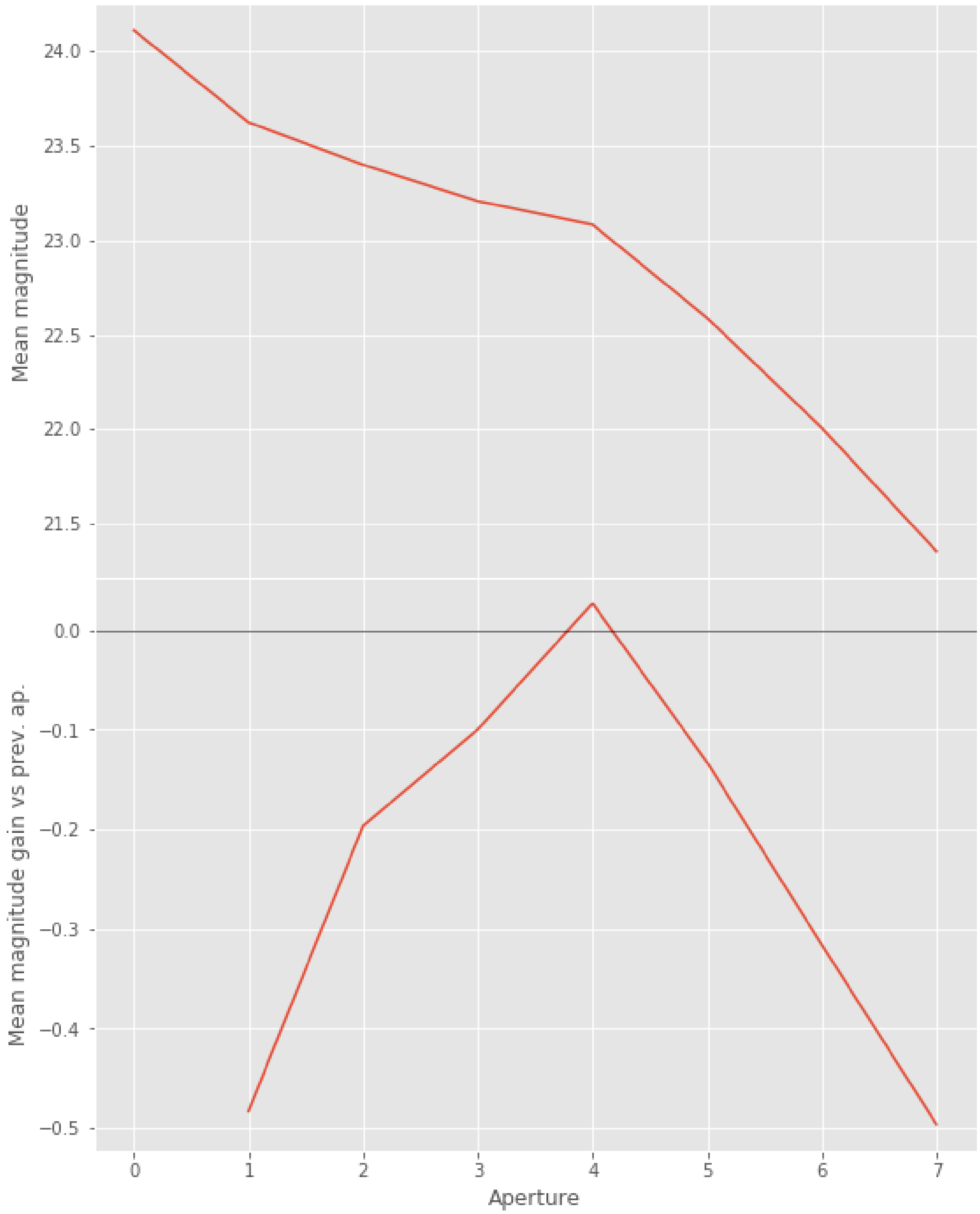
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/numpy/lib/nanfunctions.py:
  warnings.warn("Mean of empty slice", RuntimeWarning)
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/numpy/lib/nanfunctions.py:
  warnings.warn("Mean of empty slice", RuntimeWarning)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



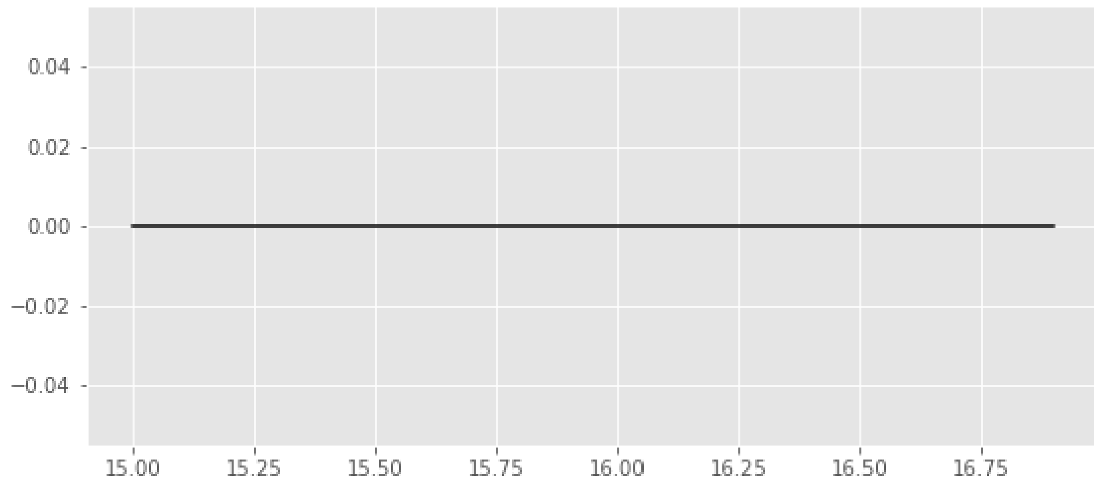

```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/numpy/lib/nanfunctions.py:
  warnings.warn("All-NaN slice encountered", RuntimeWarning)
```


0.04
0.02
0.00
−0.02
−0.04
−0.04
−0.02
0.00
0.02
0.04

1.2.5 I.e - z band



We will use aperture 4 as target.

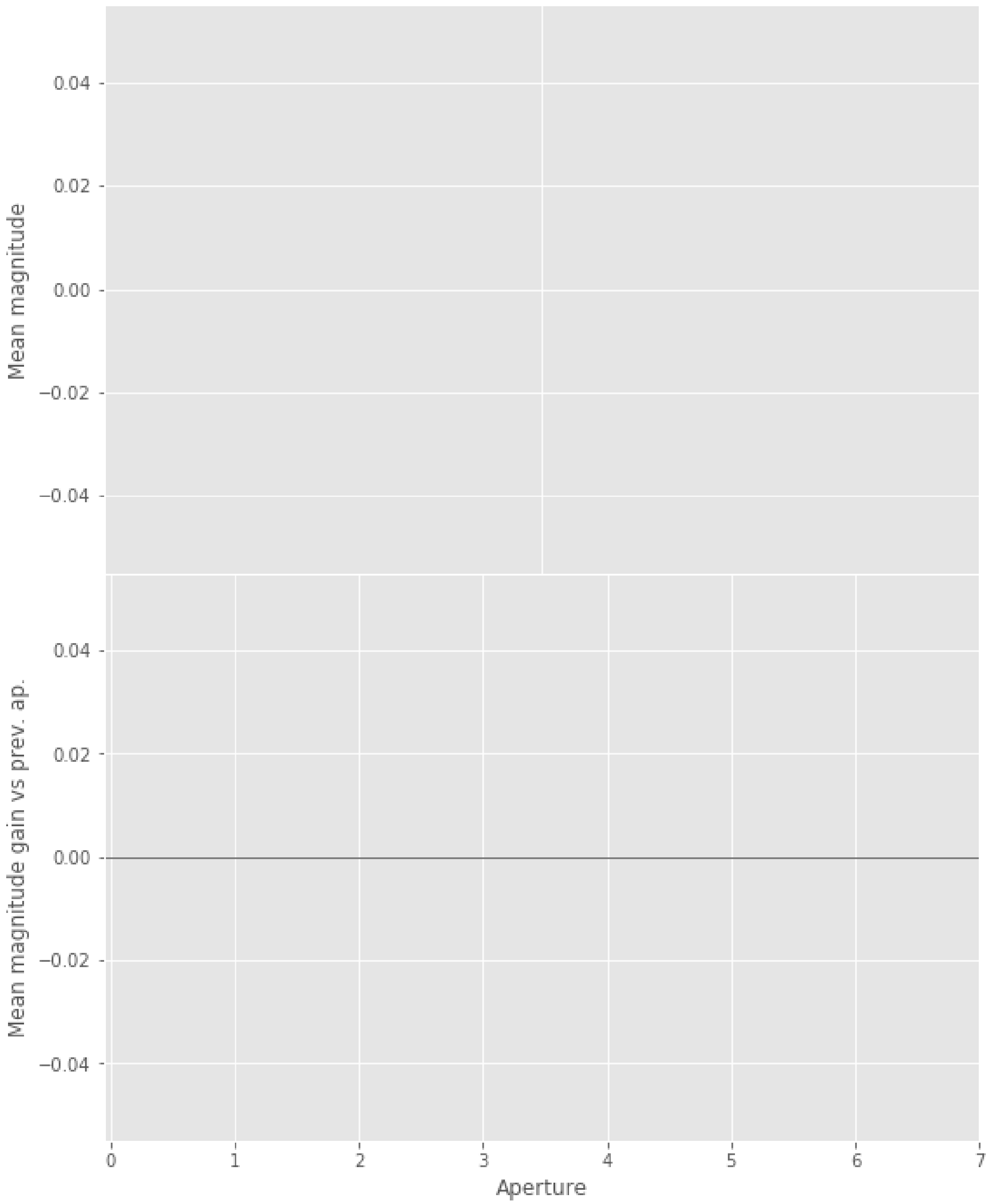


We use magnitudes between 16.0 and 17.5.

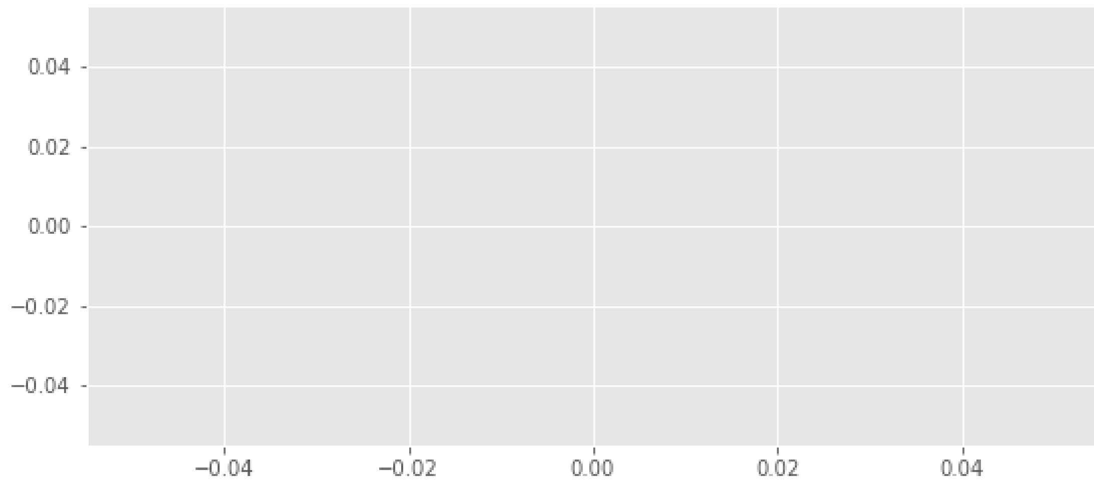
```
Aperture correction for z band:
Correction: -0.047606678474458874
Number of source used: 12624
RMS: 0.04539733727184199
```

1.2.6 I.f - Y band

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




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



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

```
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


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

```
Out[27]: <IPython.core.display.HTML object>
```

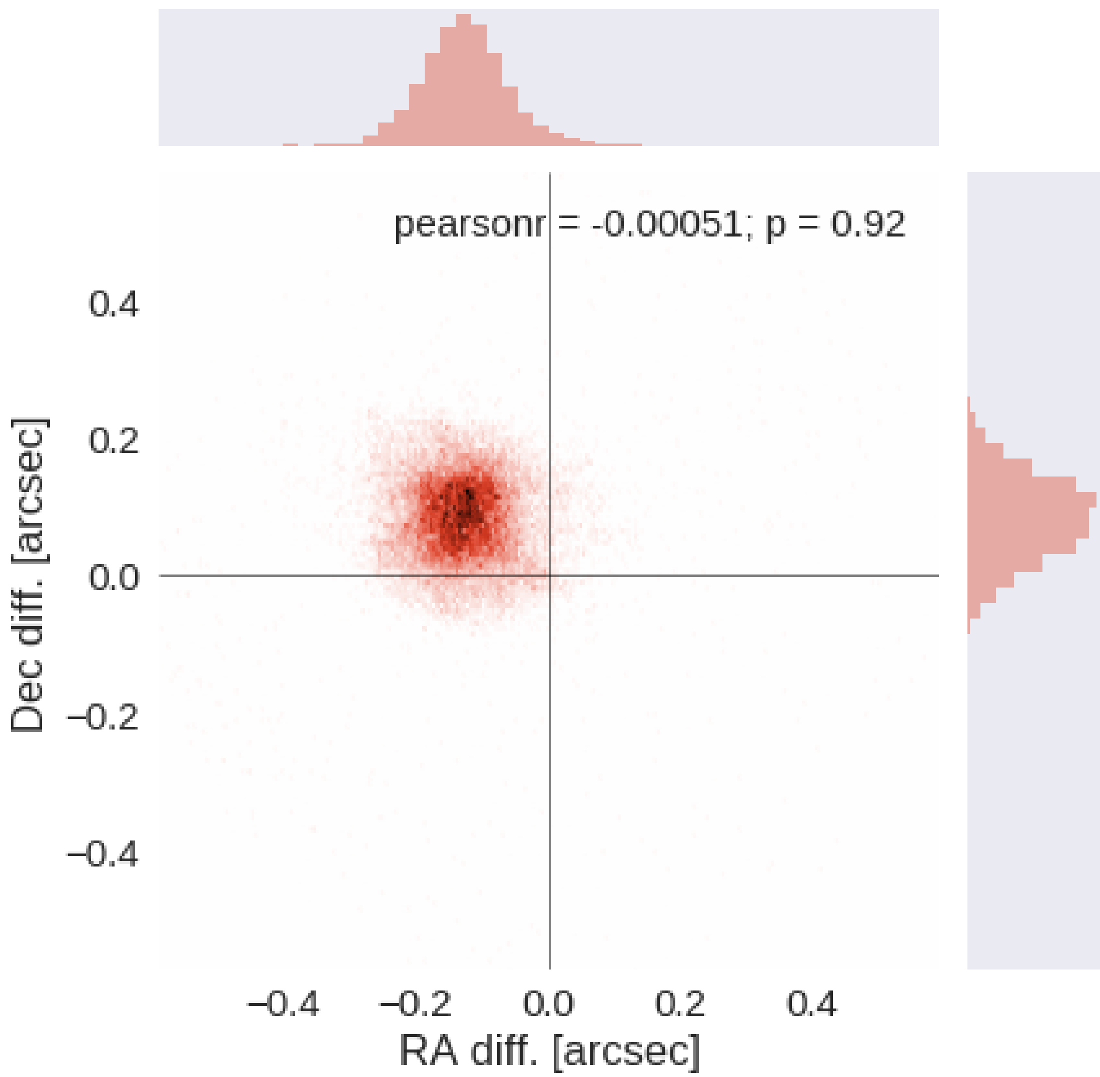
1.5 III - Removal of duplicated sources

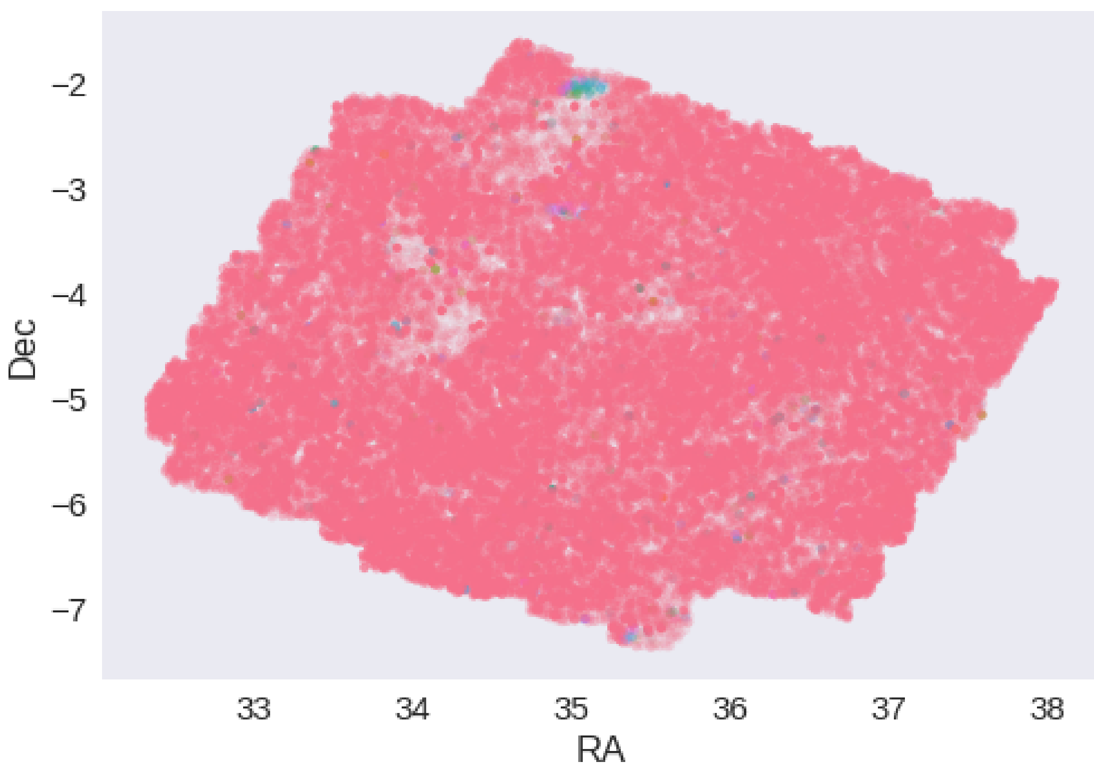
We remove duplicated objects from the input catalogues.

```
/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 1828232 sources.
The cleaned catalogue has 1827824 sources (408 removed).
The cleaned catalogue has 407 sources flagged as having been cleaned
```

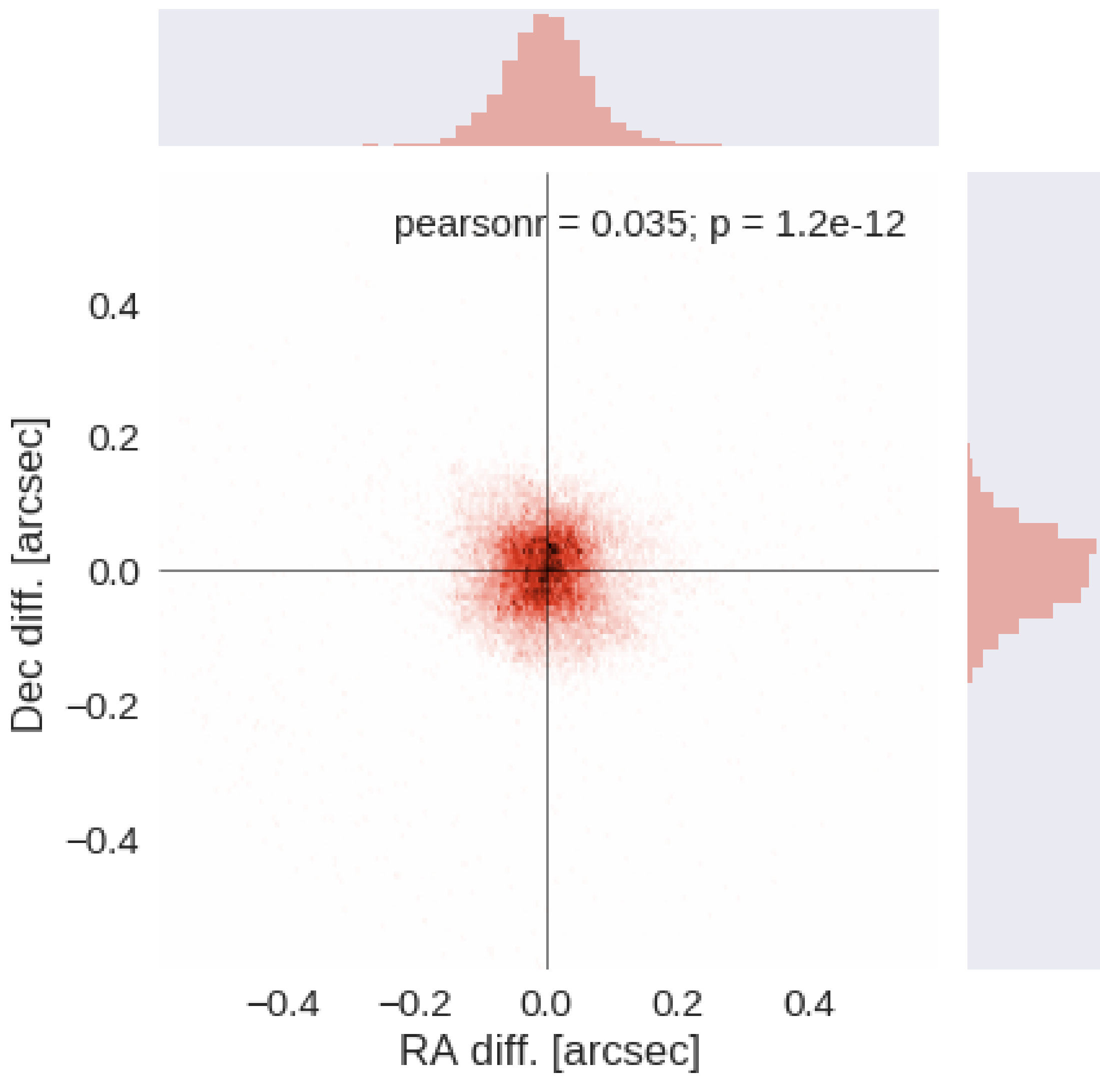
1.6 III - Astrometry correction

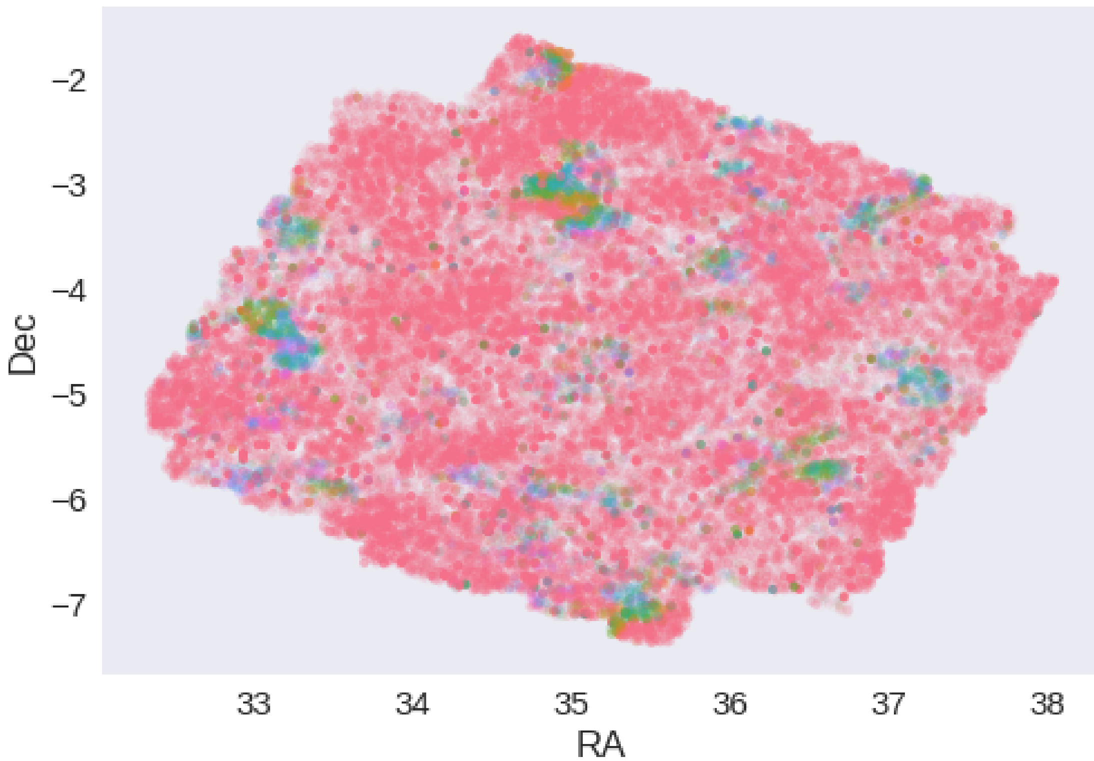
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.


pearsonr = -0.00051; p = 0.92
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]




```
RA correction: 0.12760236888880172 arcsec
Dec correction: -0.08586082651023119 arcsec
```


pearsonr = 0.035; p = 1.2e-12
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]



1.7 IV - Flagging Gaia objects

```
42351 sources flagged.
```

2 V - Saving to disk

1.6.2_DES

March 8, 2018

1 XMM-LSS 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 aperture magnitudes, which are used to compute a corrected 2 arcsec aperture magnitude.

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:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
This notebook was executed on:
2018-02-21 16:14:46.354073
```

1.2 1 - Aperture correction

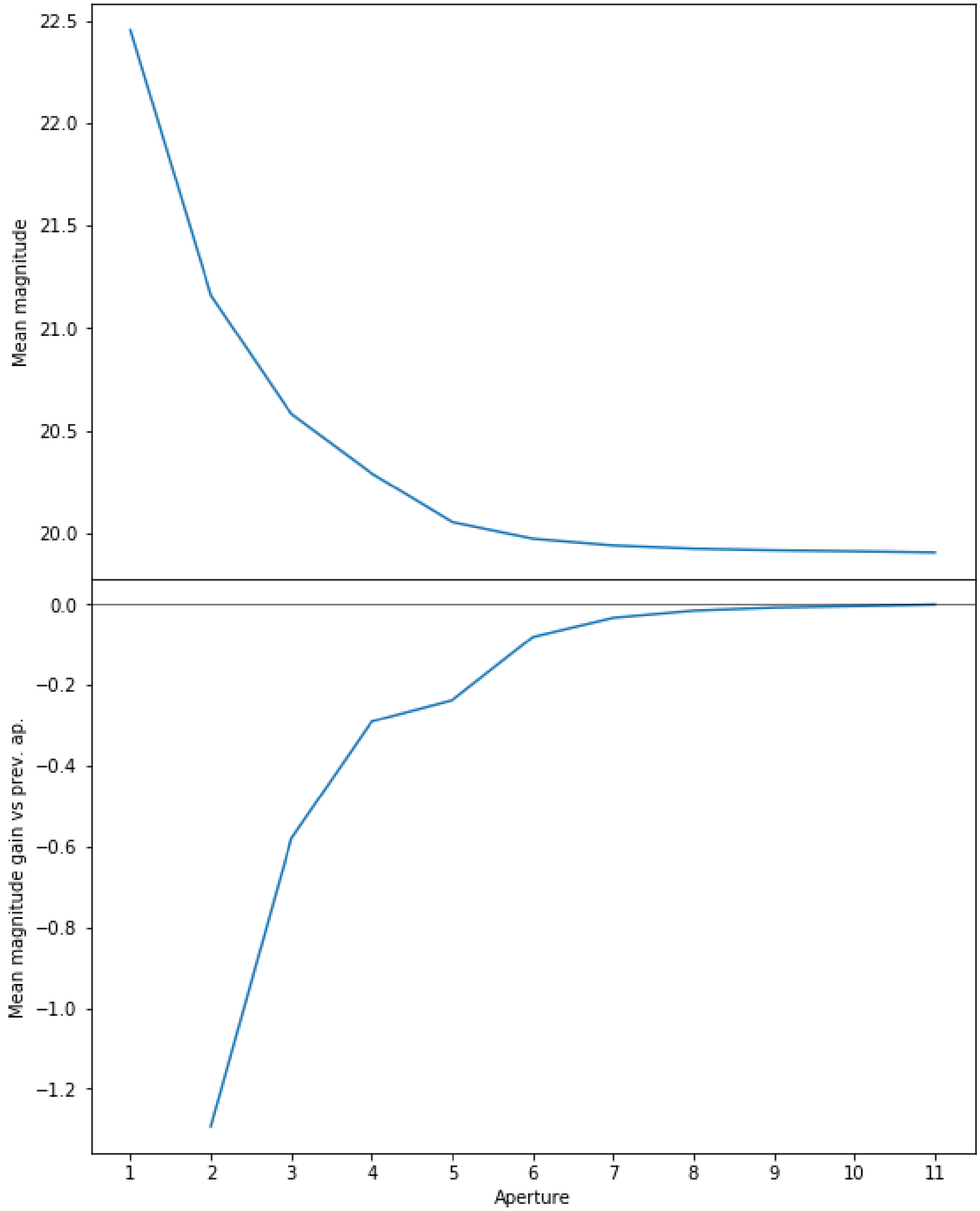
To compute aperture correction we need to dertermine two parametres: the target aperture and the range of magnitudes for the stars that will be used to compute the correction.

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

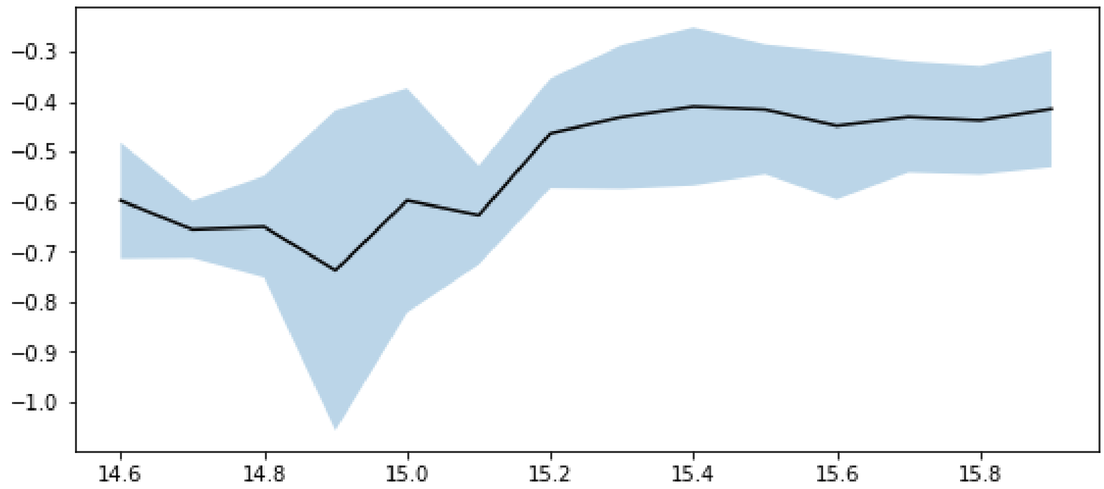
The evolution of the magnitudes of the objects by plotting on the same plot aperture number vs the mean magnitude. The mean gain (loss when negative) of magnitude is each aperture compared to the previous (except for the first of course). As target aperture, we should use the smallest (i.e. less noisy) 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



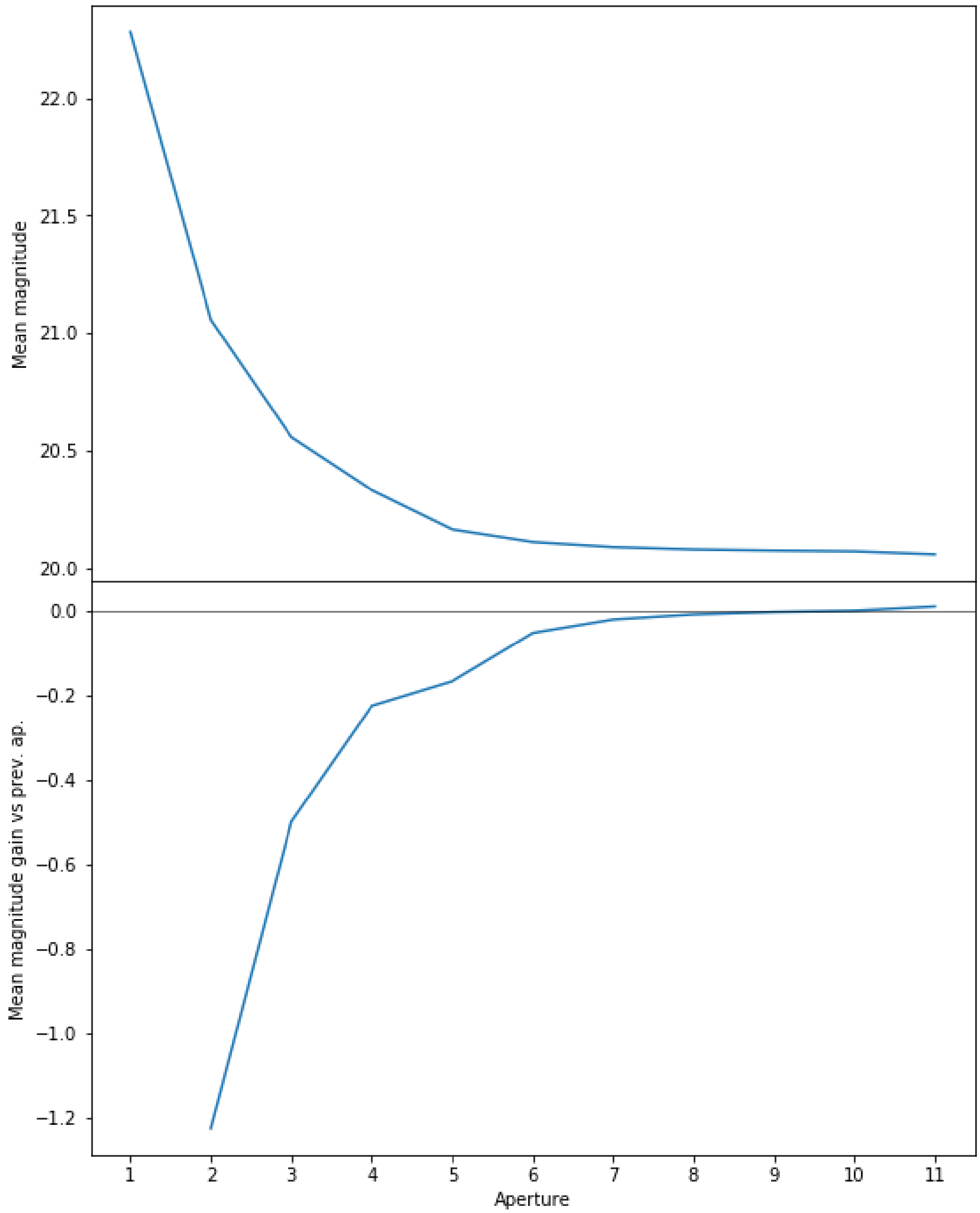
We will use aperture 10 as target.



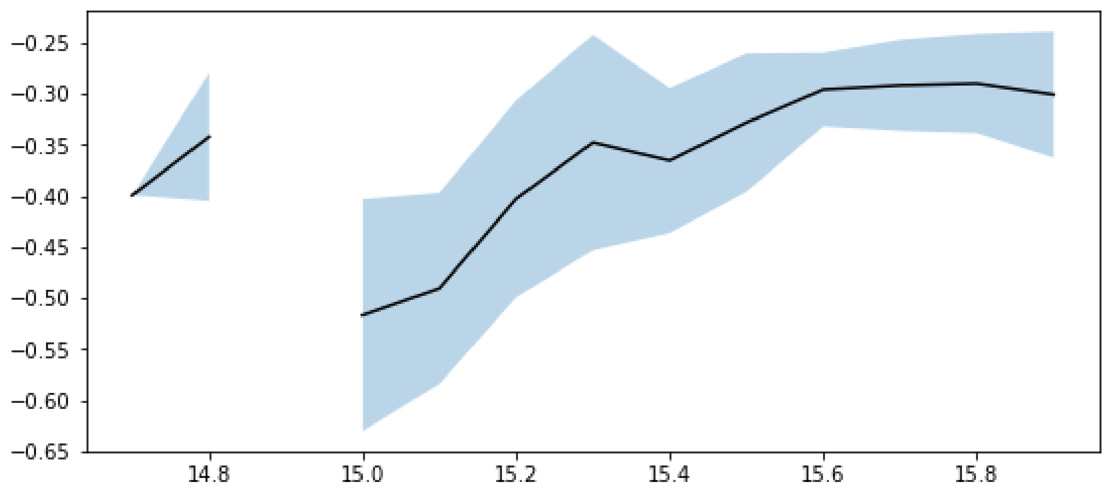
We will use magnitudes between 15.0 and 16.0

```
Aperture correction for g band:
Correction: -0.43033790588378906
Number of source used: 1406
RMS: 0.12299967427344391
```

1.2.2 I.b - r band



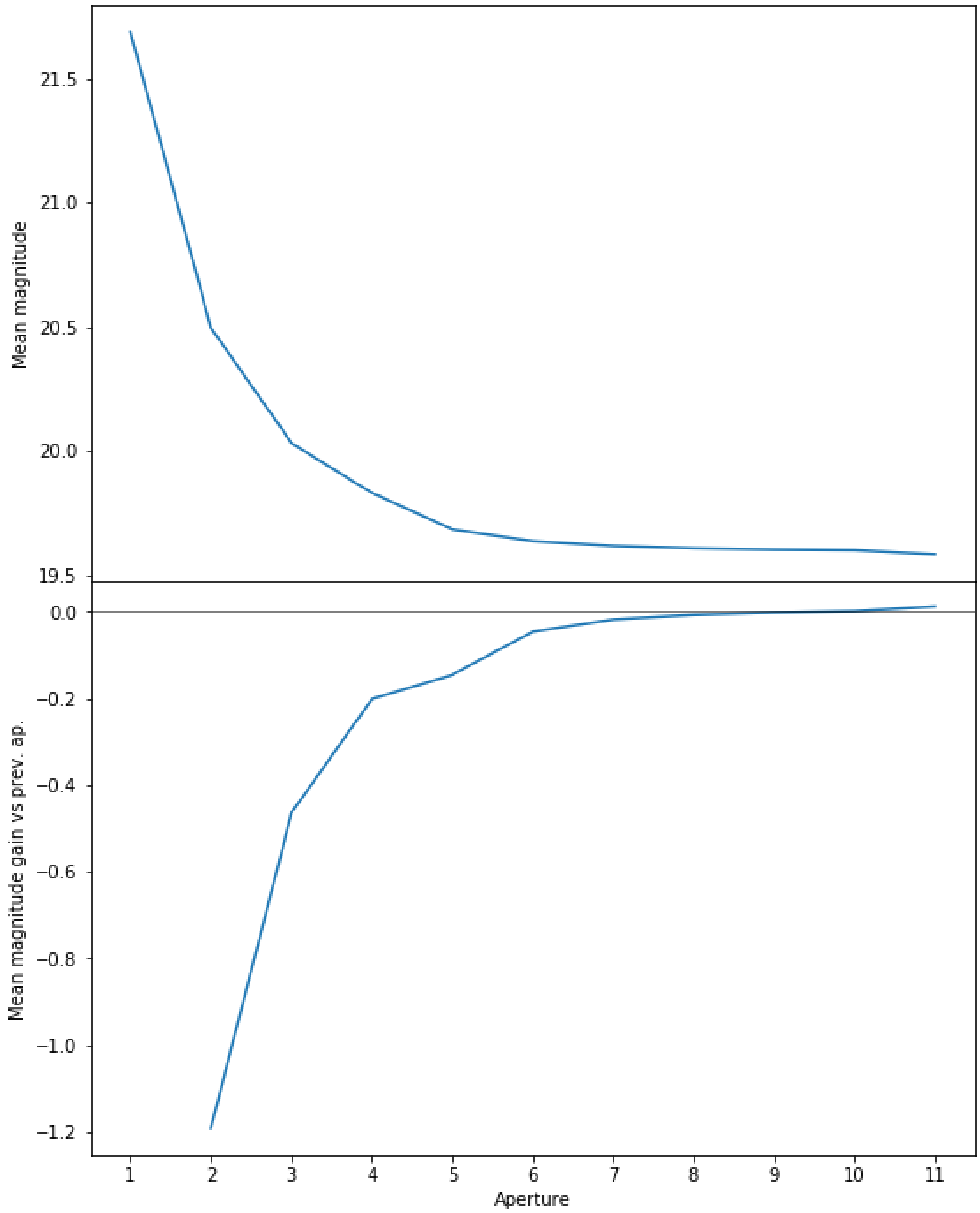
We will use aperture 10 as target.



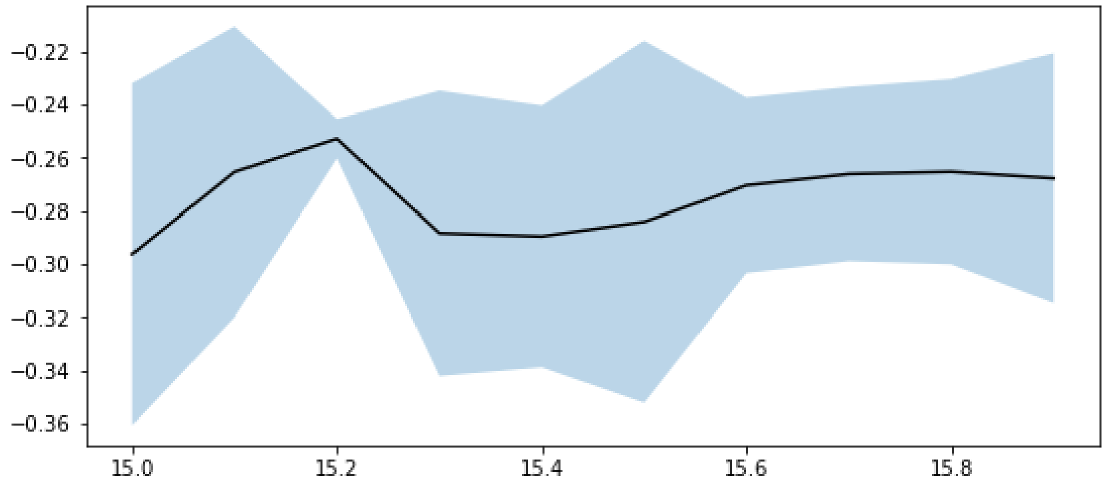
We use magnitudes between 15.0 and 16.0.

```
Aperture correction for r band:
Correction: -0.29843902587890625
Number of source used: 932
RMS: 0.05432696846887861
```

1.2.3 I.b - i band



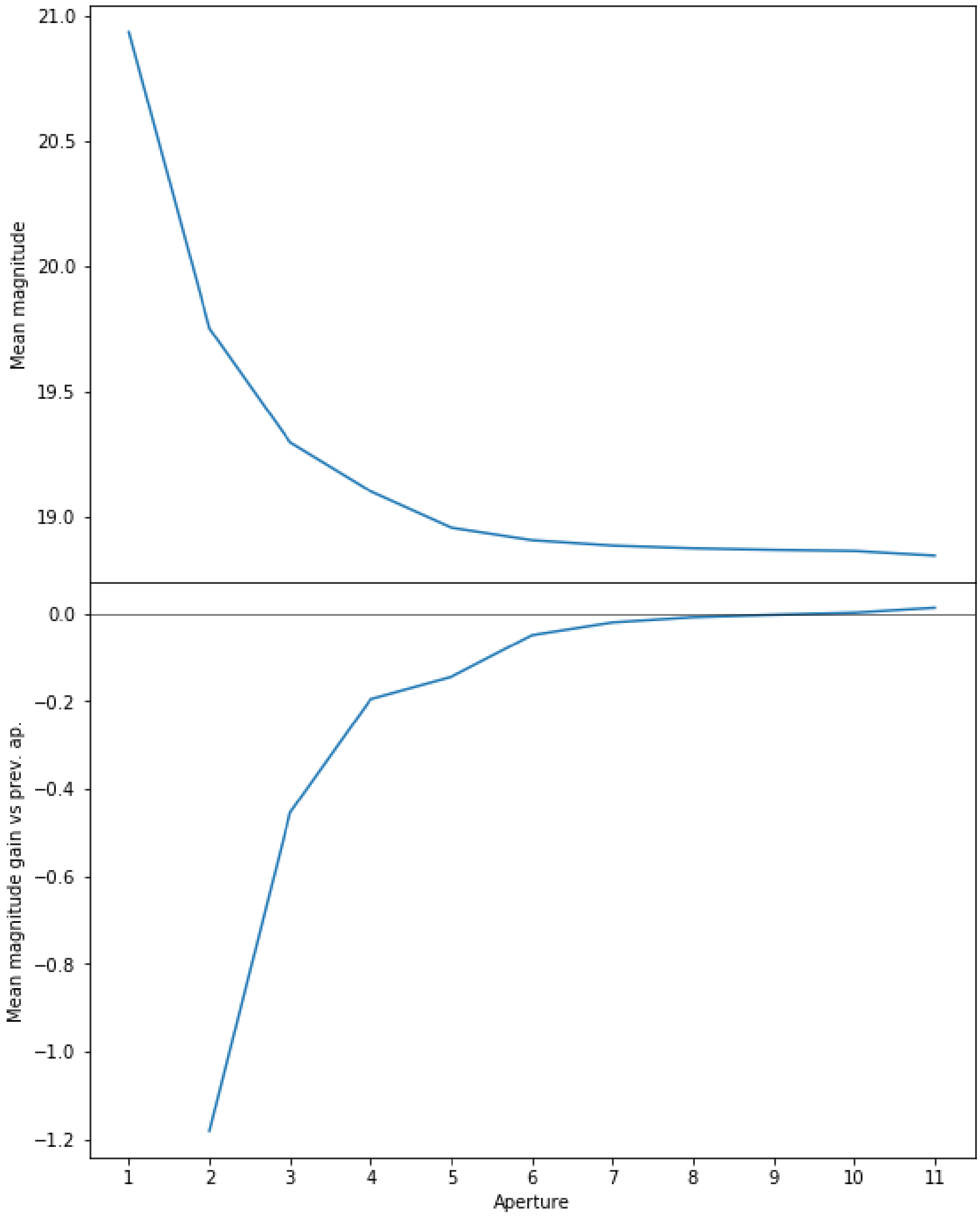
We will use aperture 10 as target.



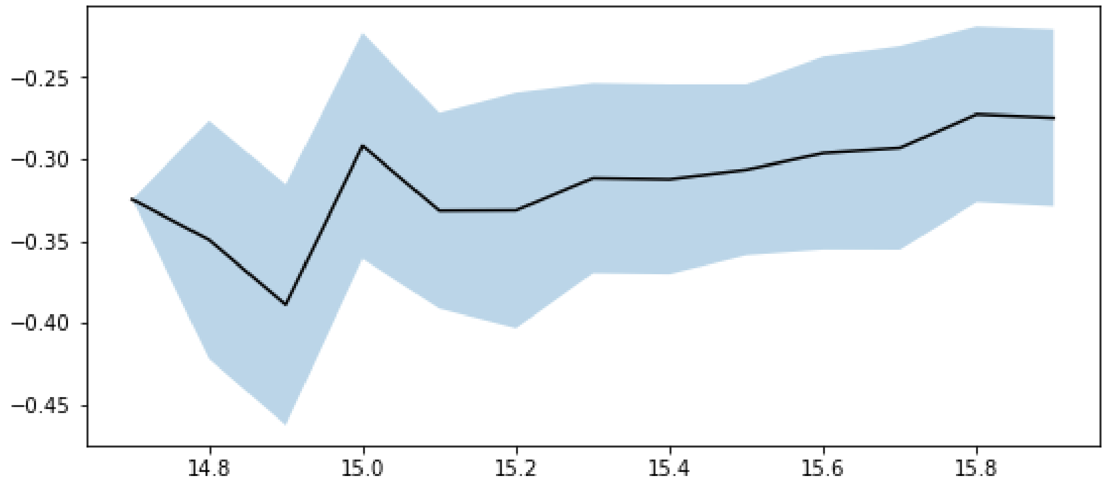
We use magnitudes between 15.0 and 16.0.

```
Aperture correction for i band:
Correction: -0.2677316665649414
Number of source used: 789
RMS: 0.037678857641501536
```

1.2.4 I.b - z band



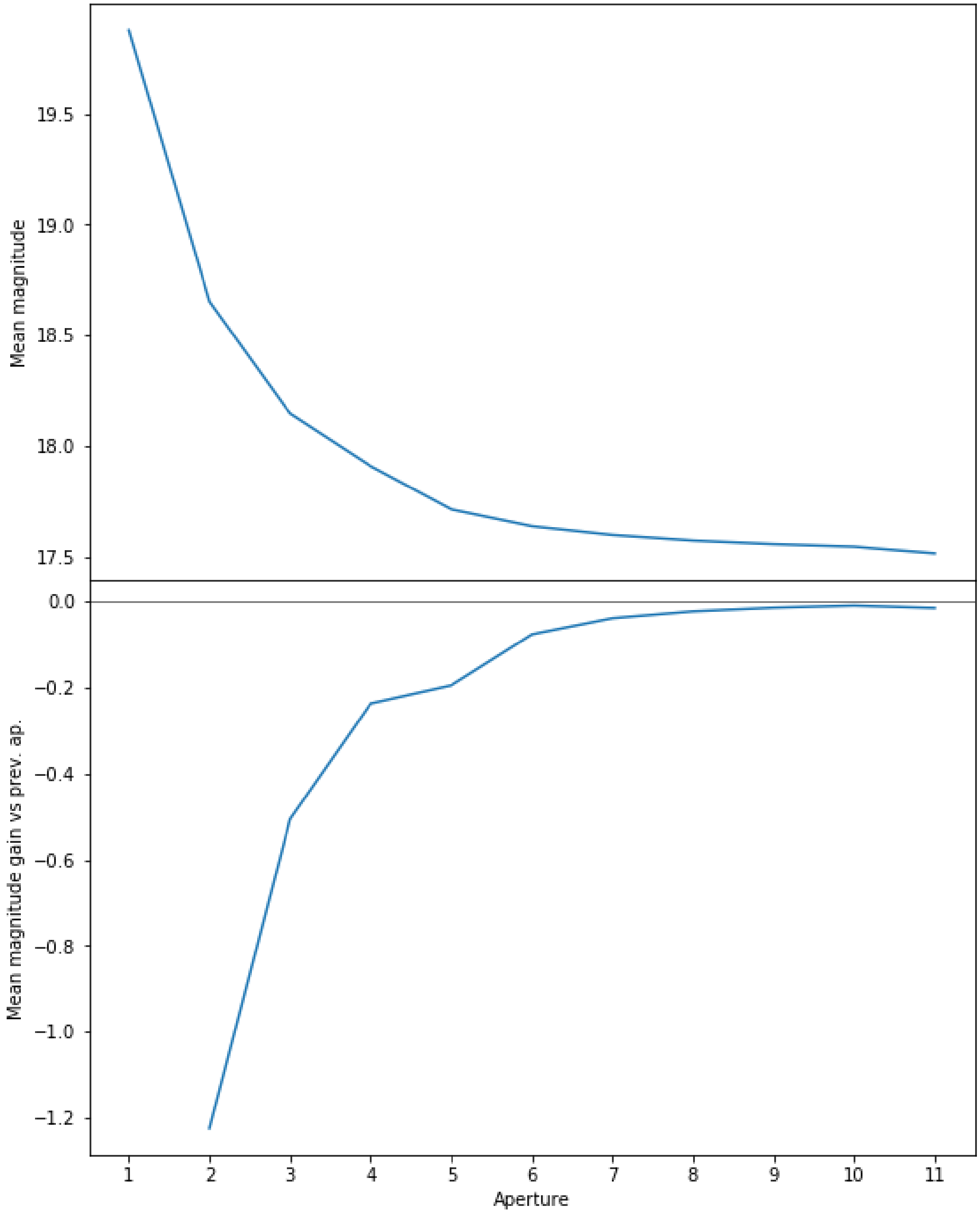
We will use aperture 57 as target.



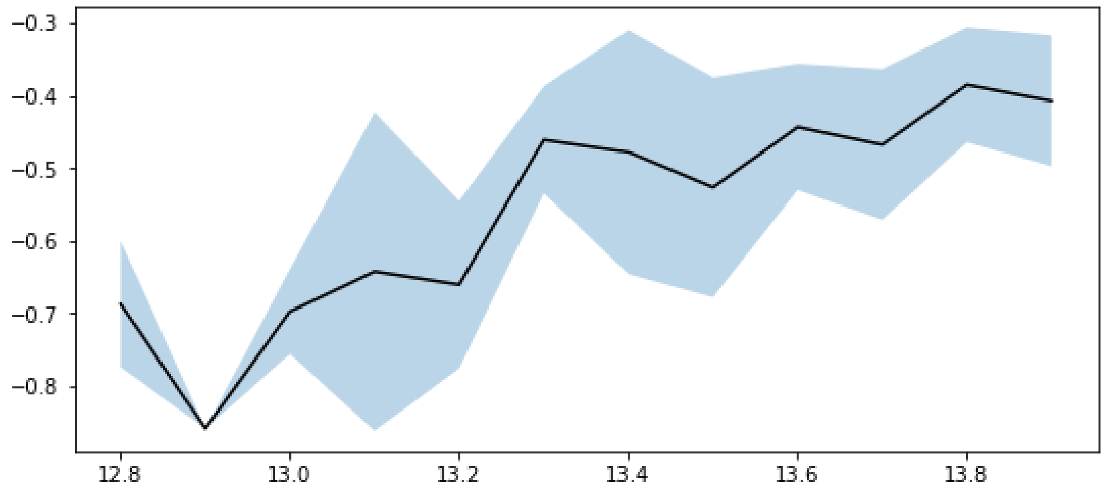
We use magnitudes between 15.0 and 16.0.

```
Aperture correction for z band:
Correction: -0.28620338439941406
Number of source used: 1398
RMS: 0.058145394697278134
```

1.2.5 I.b - y band



We will use aperture 10 as target.



We use magnitudes between 15.0 and 16.0.

```
Aperture correction for y band:
Correction: -0.3375415802001953
Number of source used: 1261
RMS: 0.06273244499184624
```

1.3 2 - 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[24]: <IPython.core.display.HTML object>
```

1.4 II - Removal of duplicated sources

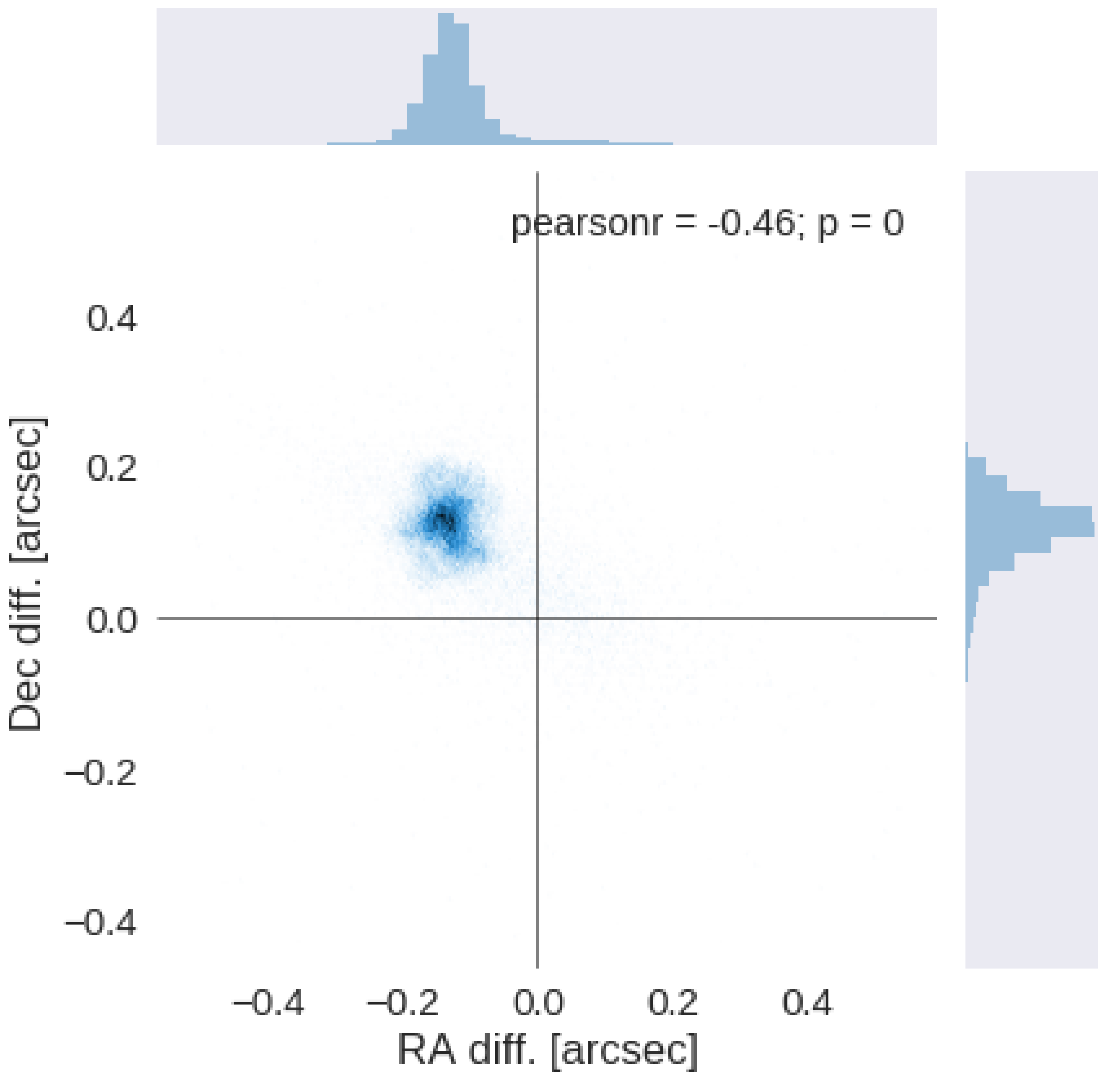
We remove duplicated objects from the input catalogues.

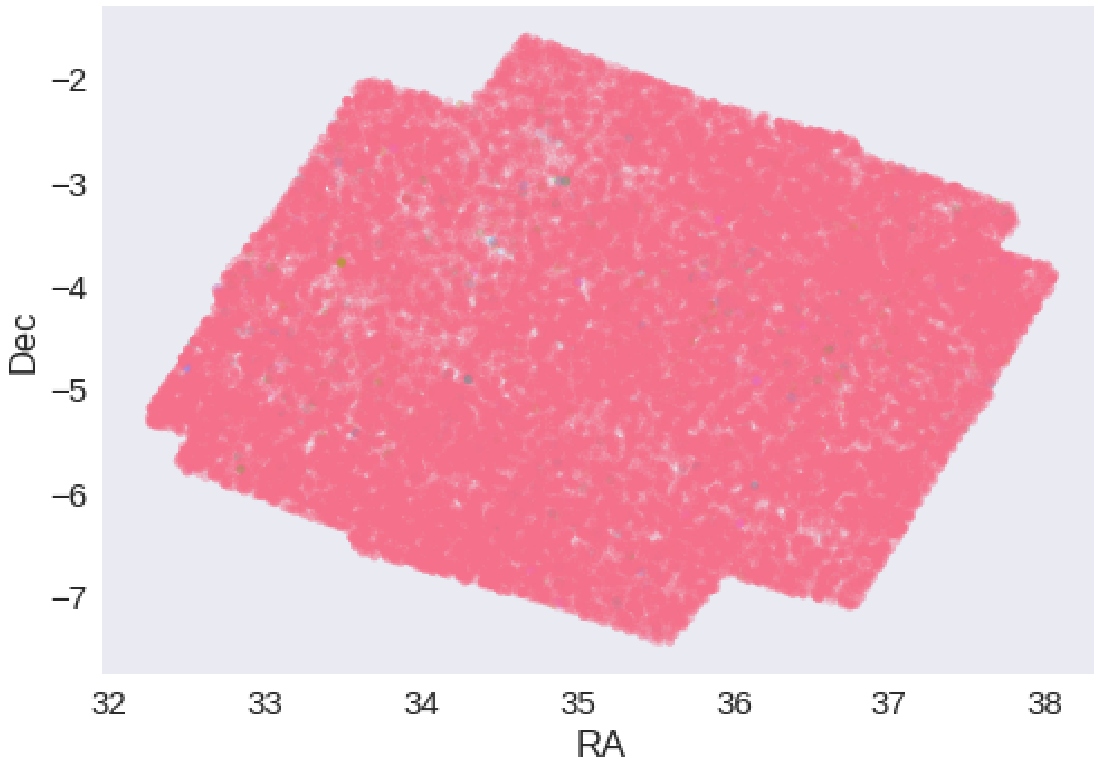
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 1512170 sources.
The cleaned catalogue has 1512151 sources (19 removed).
The cleaned catalogue has 19 sources flagged as having been cleaned
```

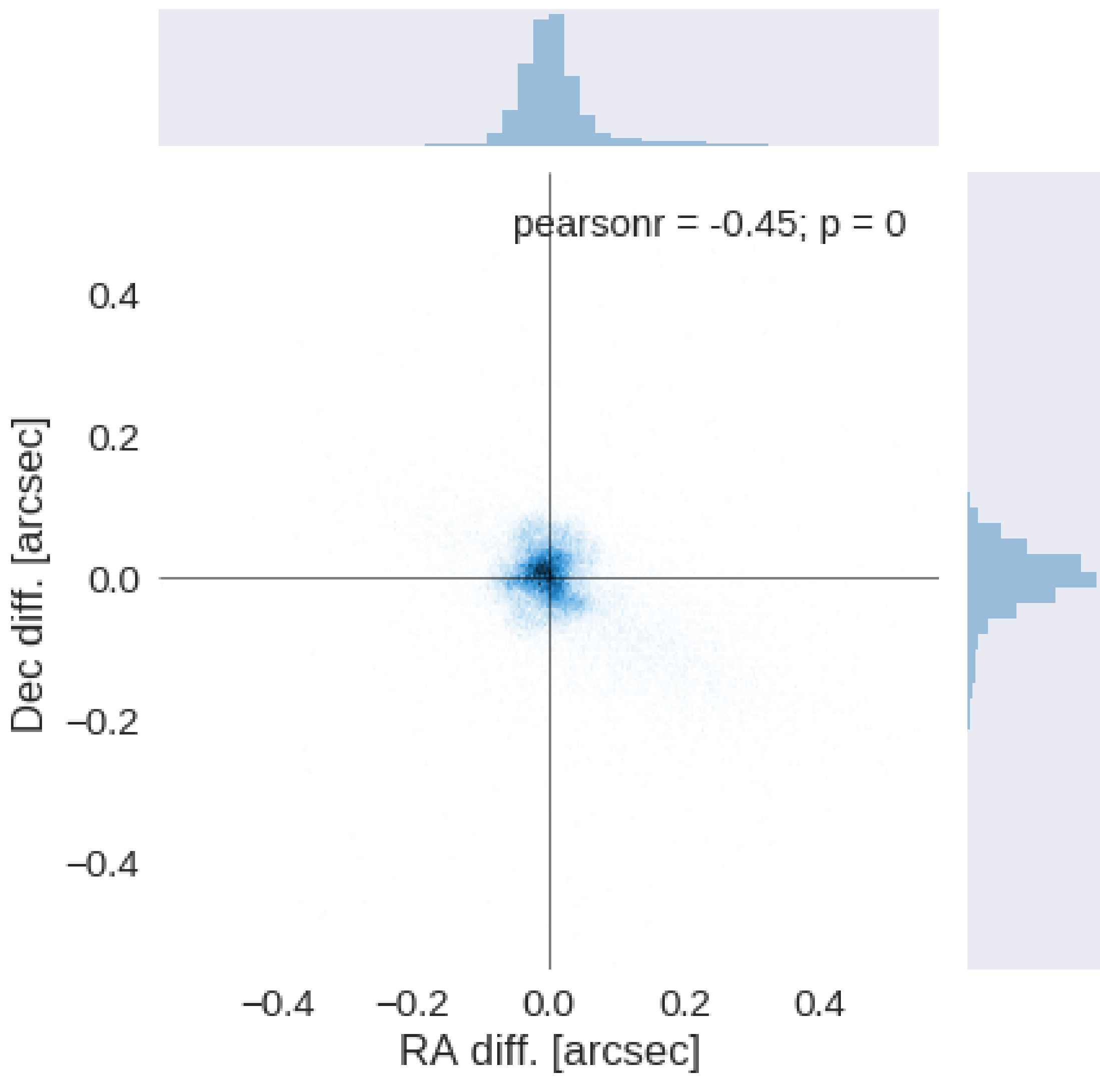
1.5 III - Astrometry correction

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.

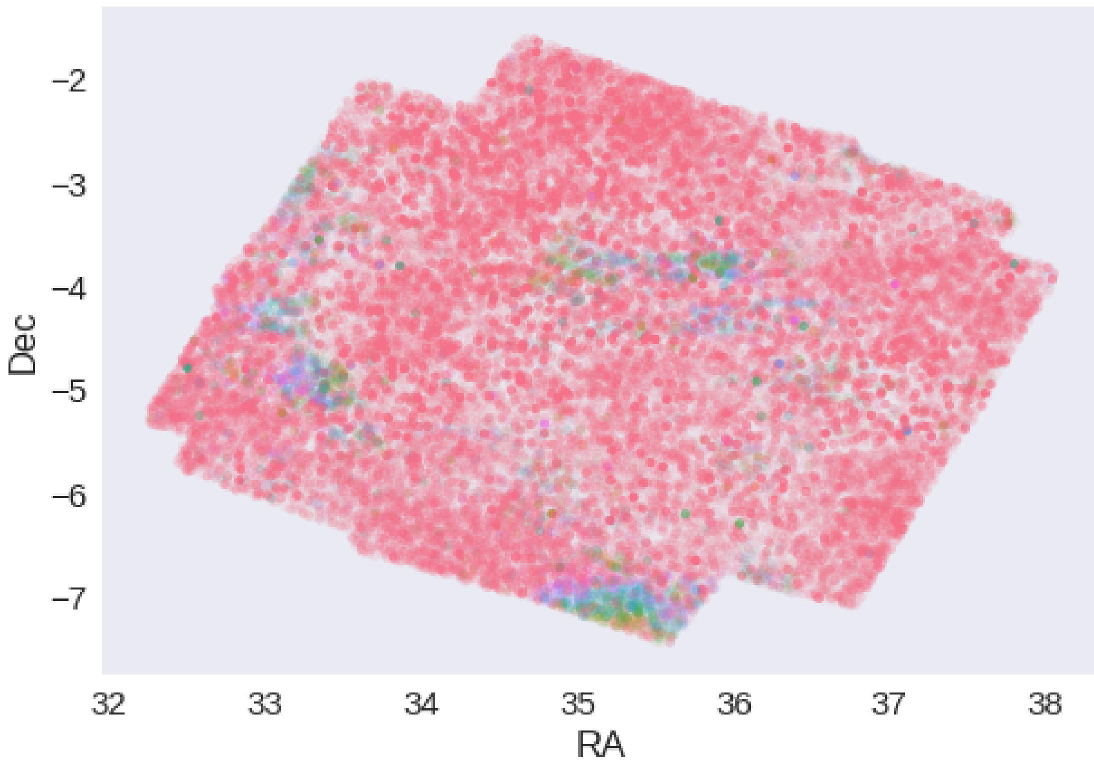





```
RA correction: 0.12987986778227878 arcsec
Dec correction: -0.12313008565225658 arcsec
```



pearsonr = -0.45; p = 0
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 IV - Flagging Gaia objects

```
42128 sources flagged.
```

1.7 V - Flagging objects near bright stars

2 VI - Saving to disk

1.7_SWIRE

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of Spitzer datafusion SWIRE data

The Spitzer catalogues were produced by the datafusion team are available in `dmu0_DataFusion-Spitzer`. 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:
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
```

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

1.3 II - Removal of duplicated sources

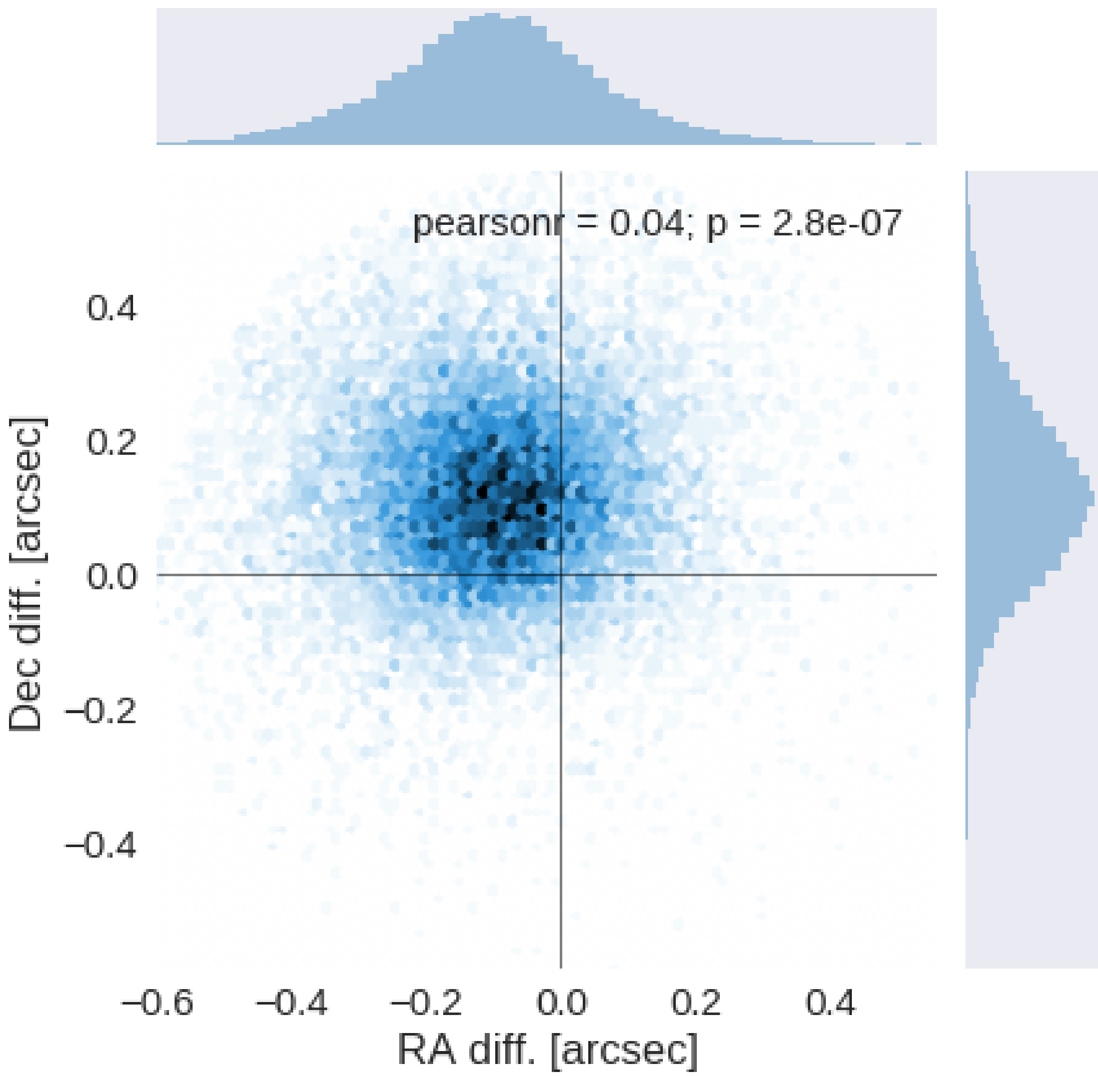
We remove duplicated objects from the input catalogues.

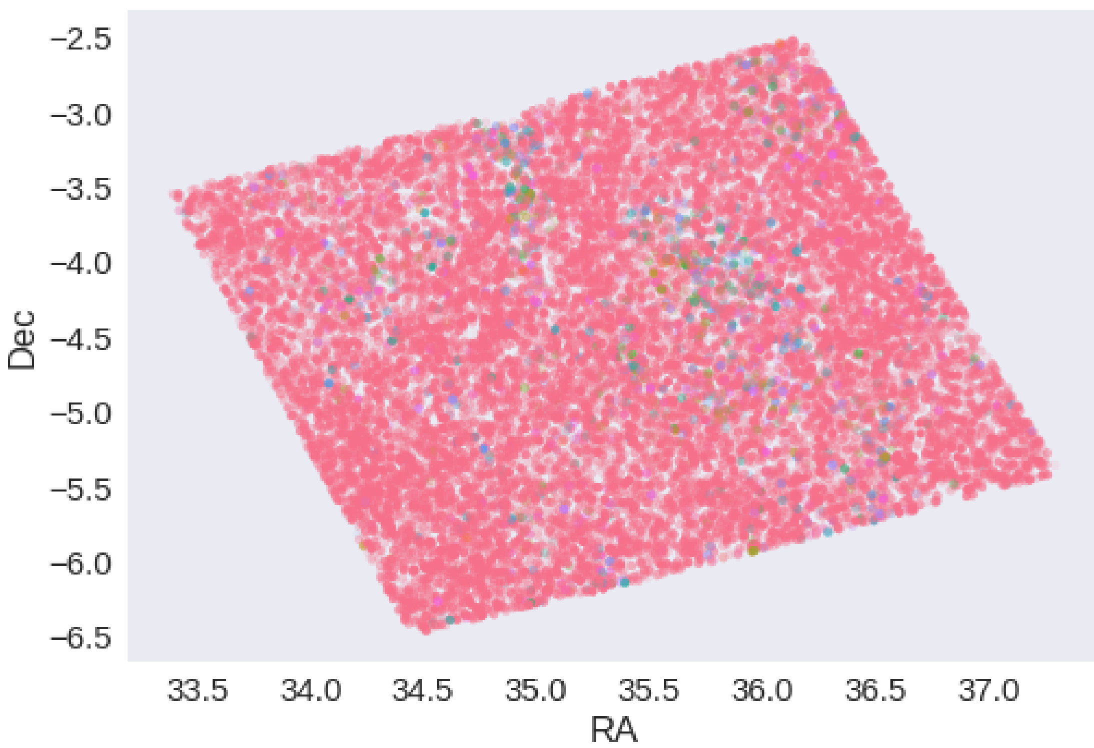
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 497404 sources.
The cleaned catalogue has 497381 sources (23 removed).
The cleaned catalogue has 23 sources flagged as having been cleaned
```

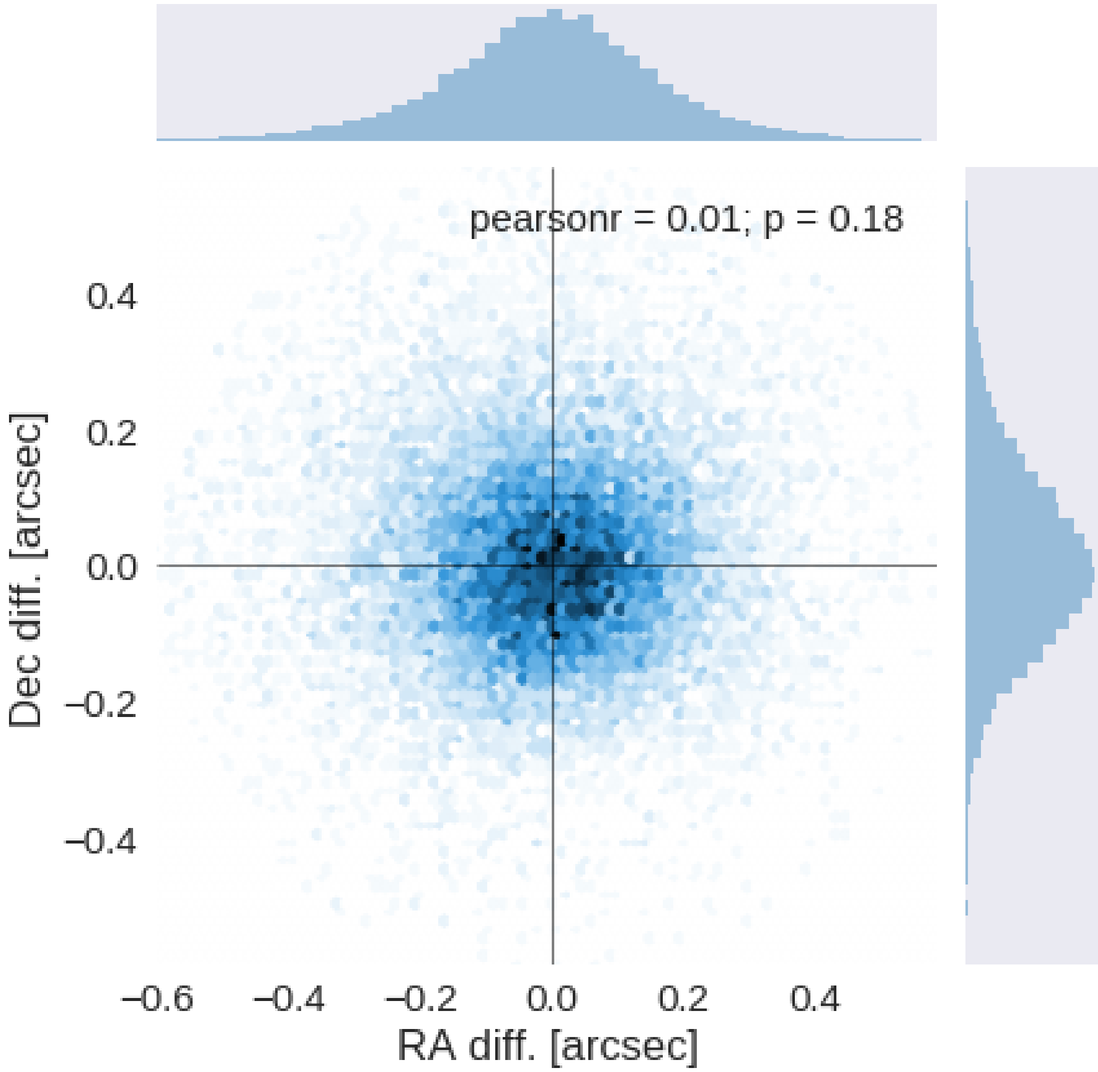
1.4 III - Astrometry correction

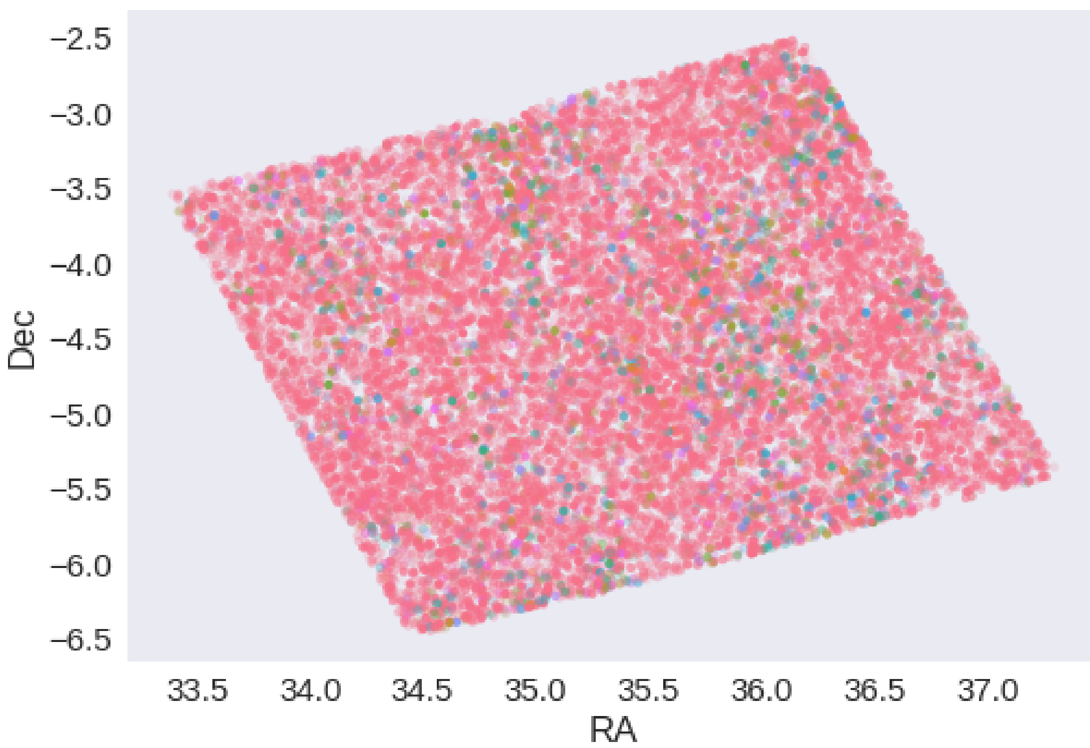
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.09761311656575344 arcsec
Dec correction: -0.11673921999317827 arcsec
```


pearsonr = 0.01; p = 0.18
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.6
−0.4
−0.2
0.0
0.2
0.4
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
17983 sources flagged.
```

2 V - Saving to disk

1.8_SERVS

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of Spitzer datafusion SERVS data

The Spitzer catalogues were produced by the datafusion team are available in `dmu0_DataFusion-Spitzer`. 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:
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
```

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

1.3 II - Removal of duplicated sources

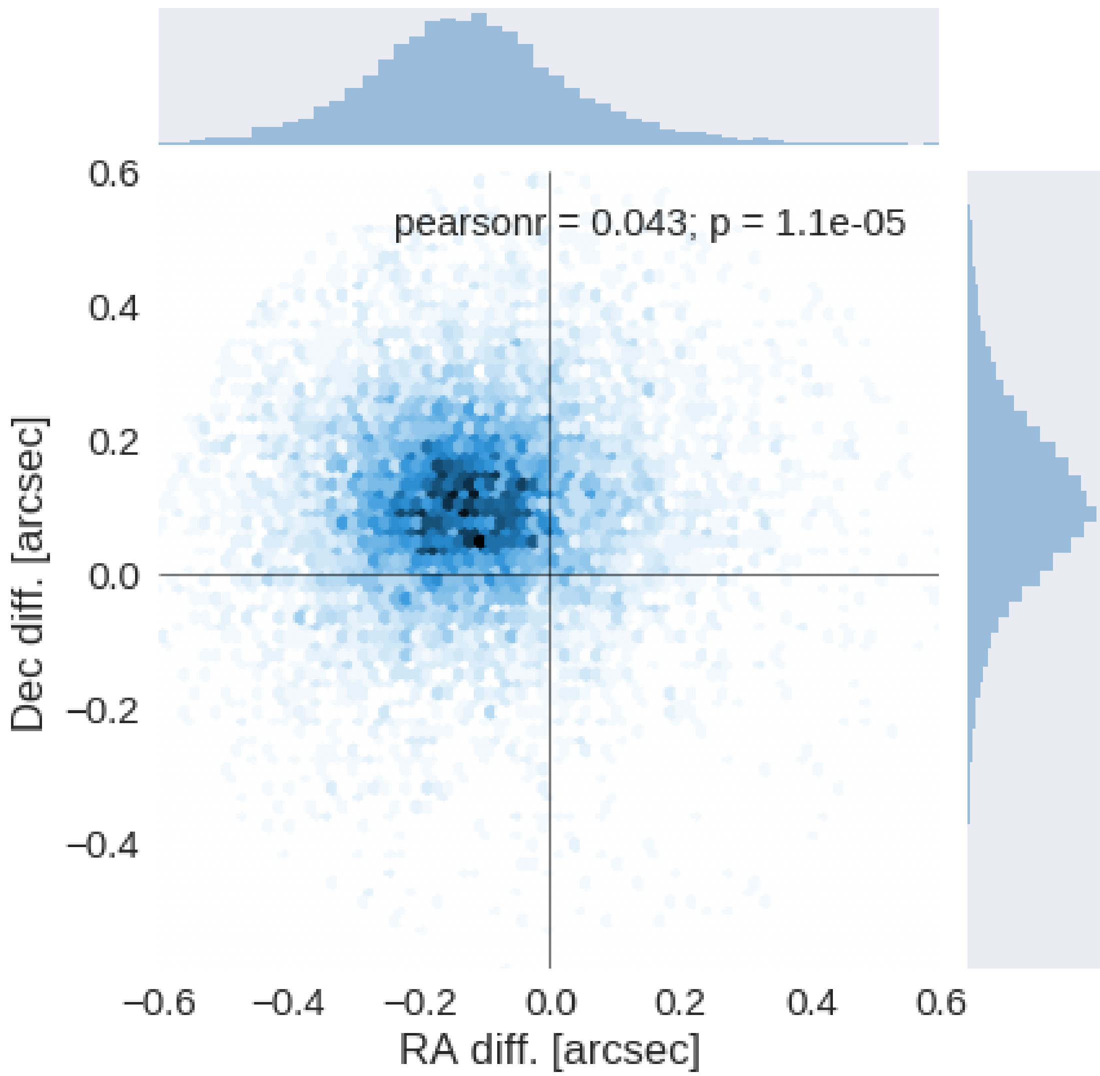
We remove duplicated objects from the input catalogues.

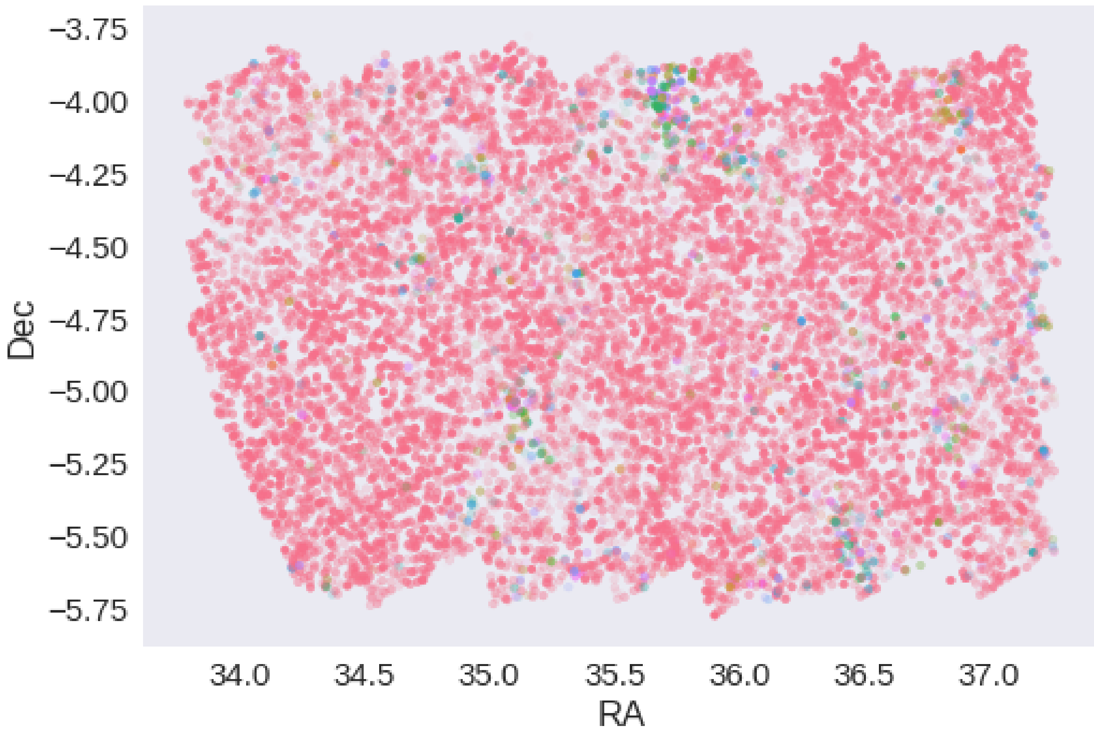
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 958421 sources.
The cleaned catalogue has 958421 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

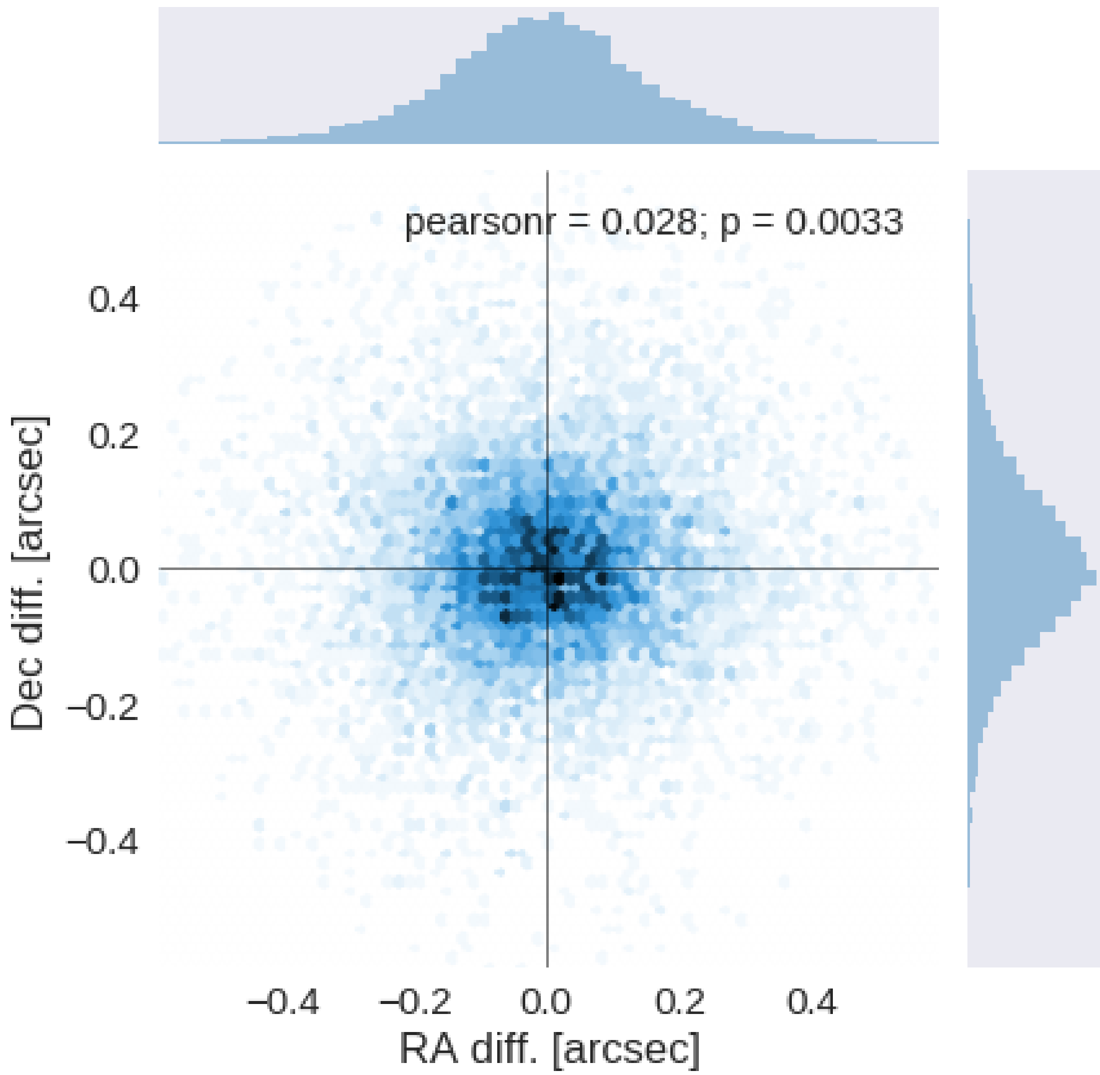
1.4 III - Astrometry correction

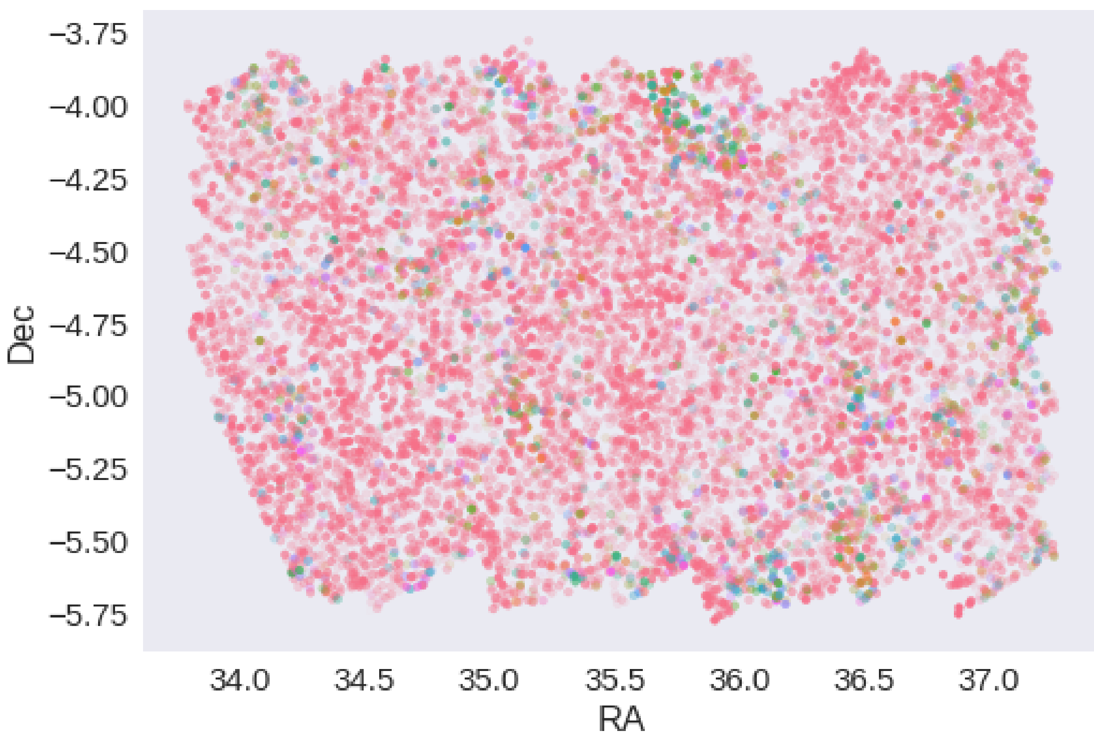
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.12892081194593175 arcsec
Dec correction: -0.10182401164797739 arcsec
```


pearsonr = 0.028; p = 0.0033
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]



1.5 IV - Flagging Gaia objects

```
11230 sources flagged.
```

1.6 V - Saving to disk

1.9.1_HSC-WIDE

March 8, 2018

1 XMM-LSS 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.

TODO: Check that the magnitudes are AB.

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 - 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:

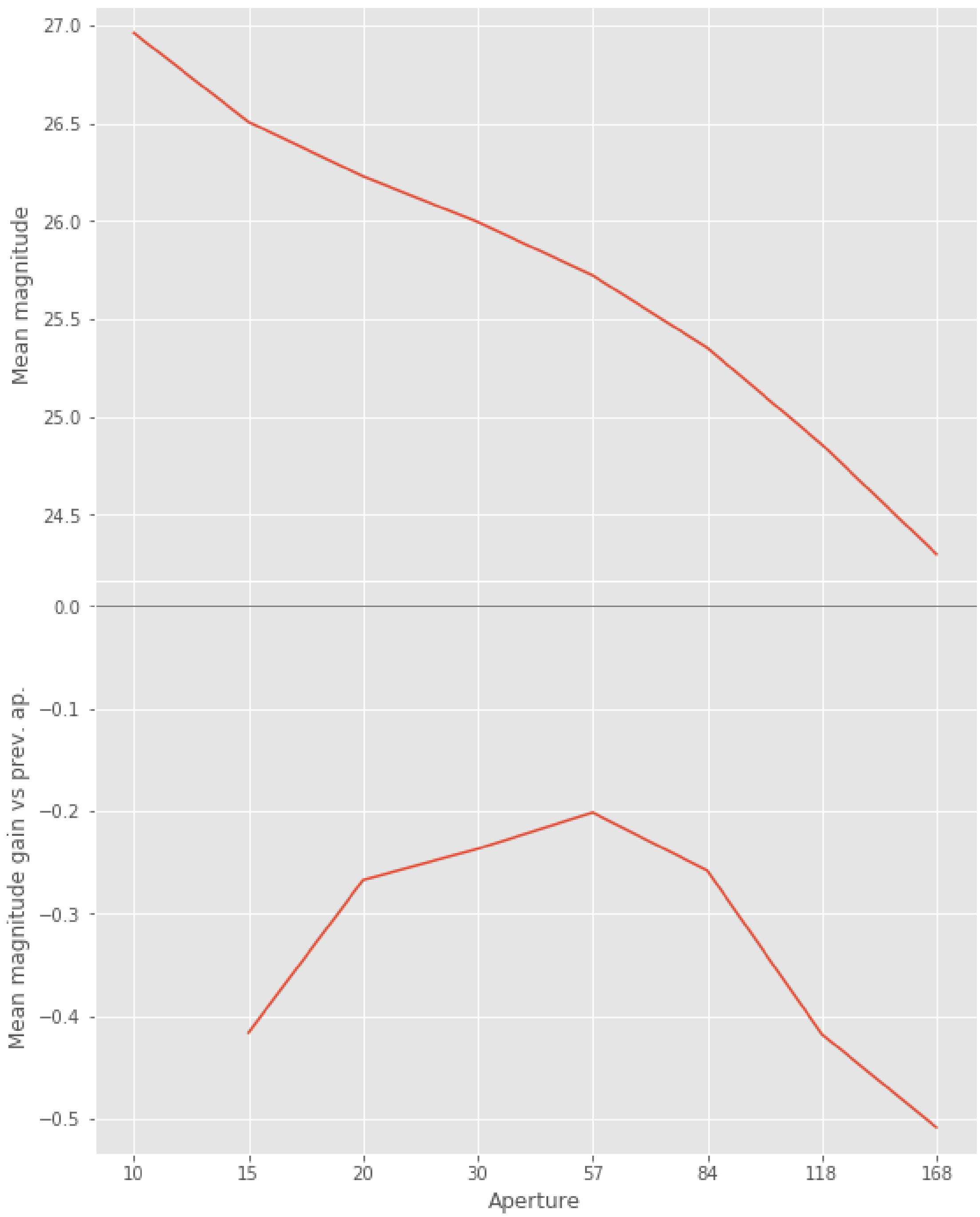
- The evolution of the magnitudes of the objects by plotting on the same plot aperture number vs the mean magnitude.
- The mean gain (loss when negative) of magnitude is each aperture compared to the previous (except for the first of course).

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.

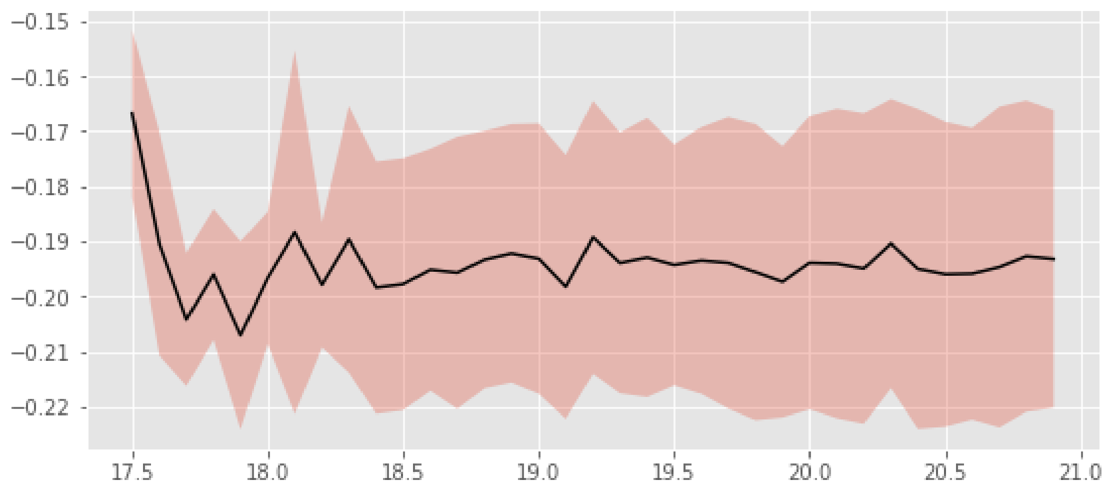
1.2.1 I.a - g band

```
/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: -0.19431591033935547
Number of source used: 5833
RMS: 0.026450276767739297
```

```
/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)
```

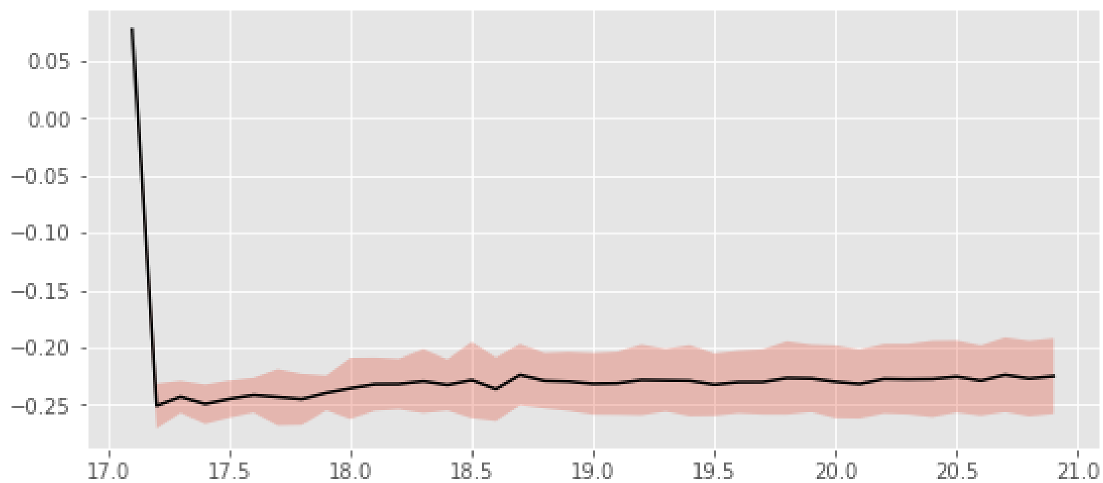
1.2.2 I.b - r band

```
/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)
```



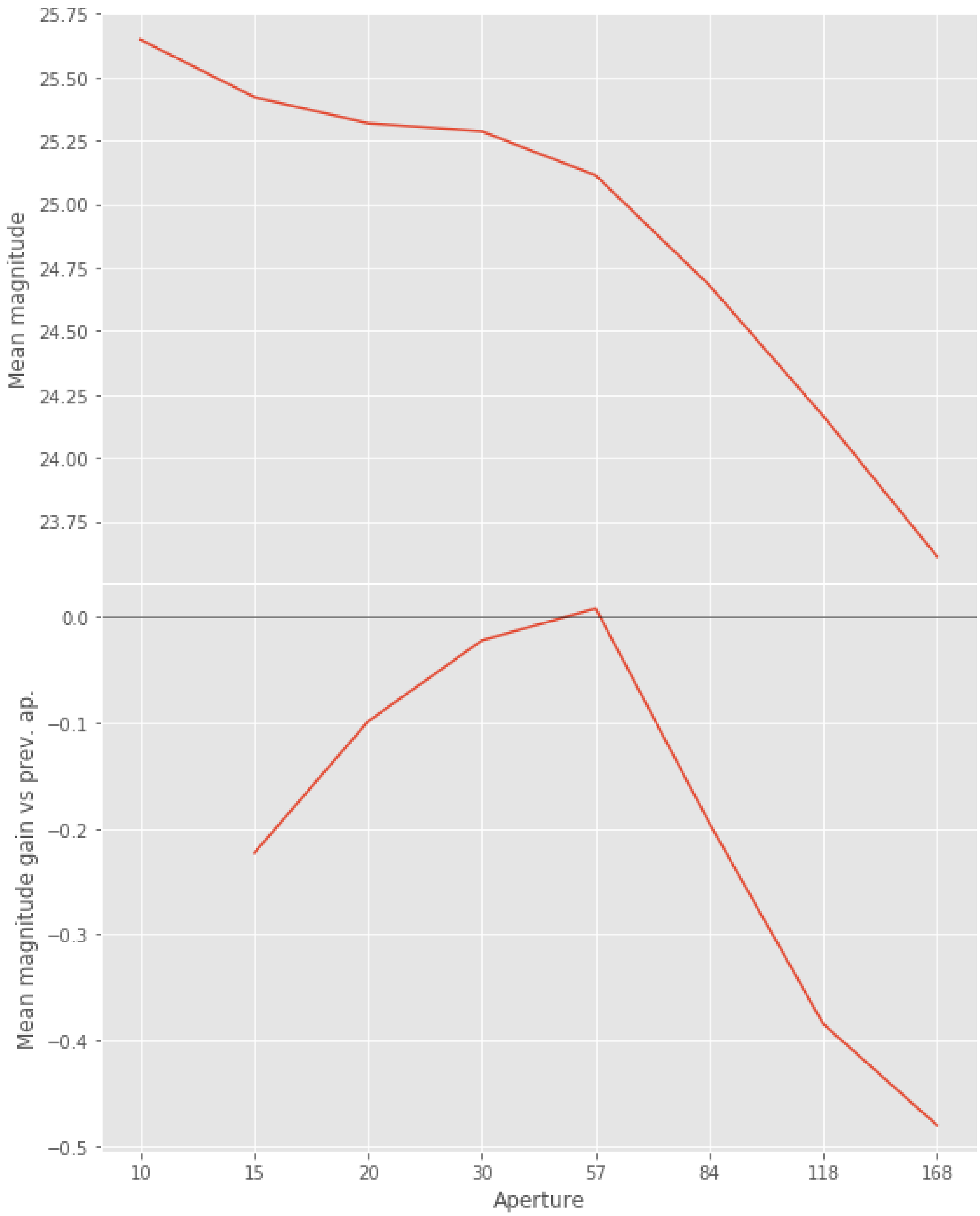
We use magnitudes between 19.5 and 20.5.

```
Aperture correction for r band:
Correction: -0.2287282943725586
Number of source used: 6824
RMS: 0.030347691570742935
```

```
/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

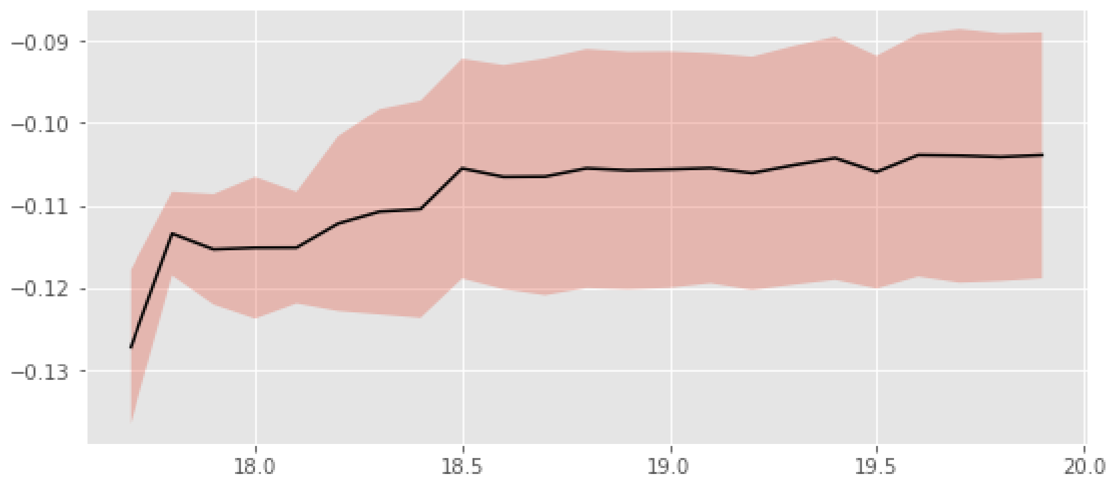
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



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)
```



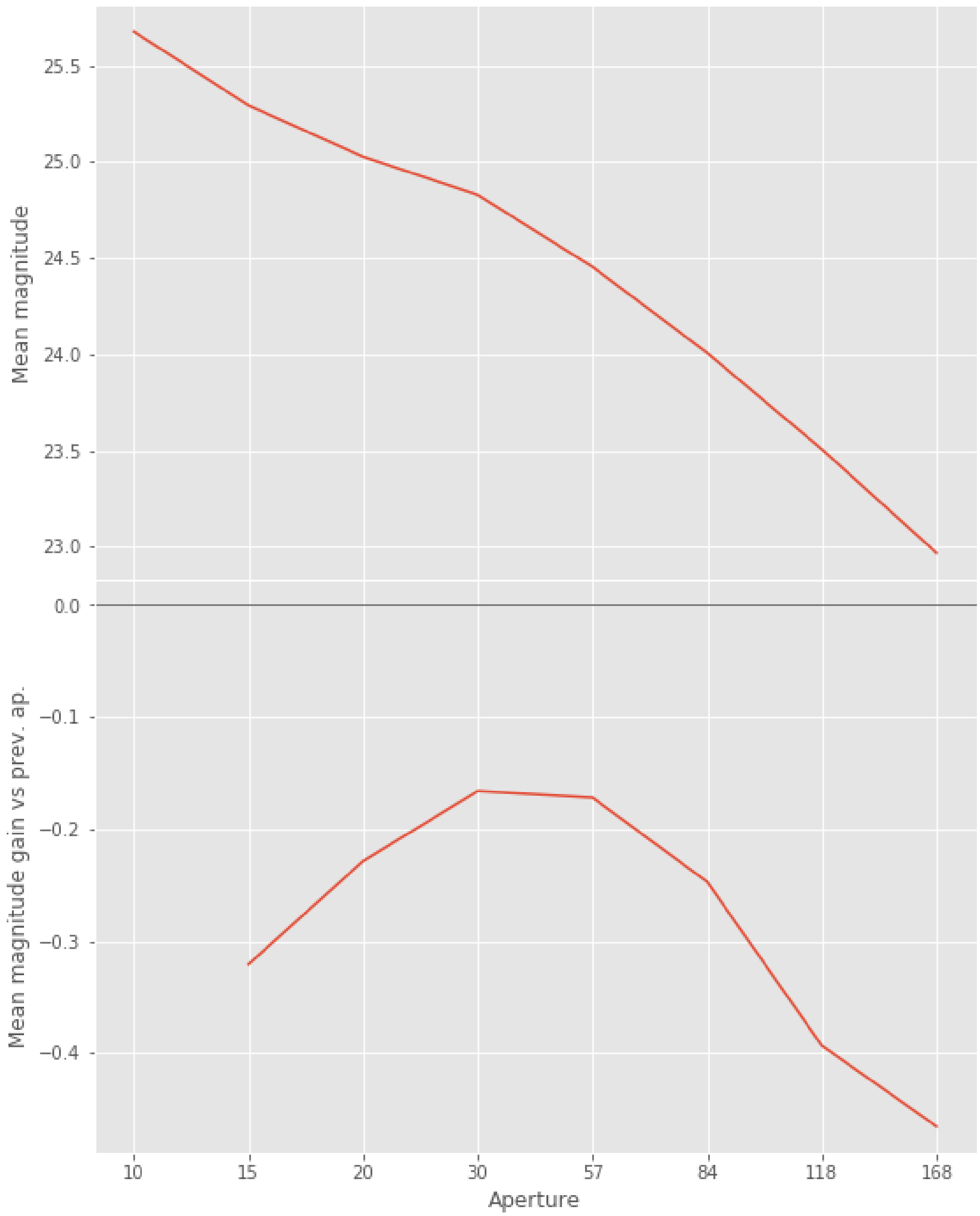
We use magnitudes between 18.5 and 19.8.

```
Aperture correction for i band:
Correction: -0.10515594482421875
Number of source used: 9726
RMS: 0.014409932108072392
```

```
/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

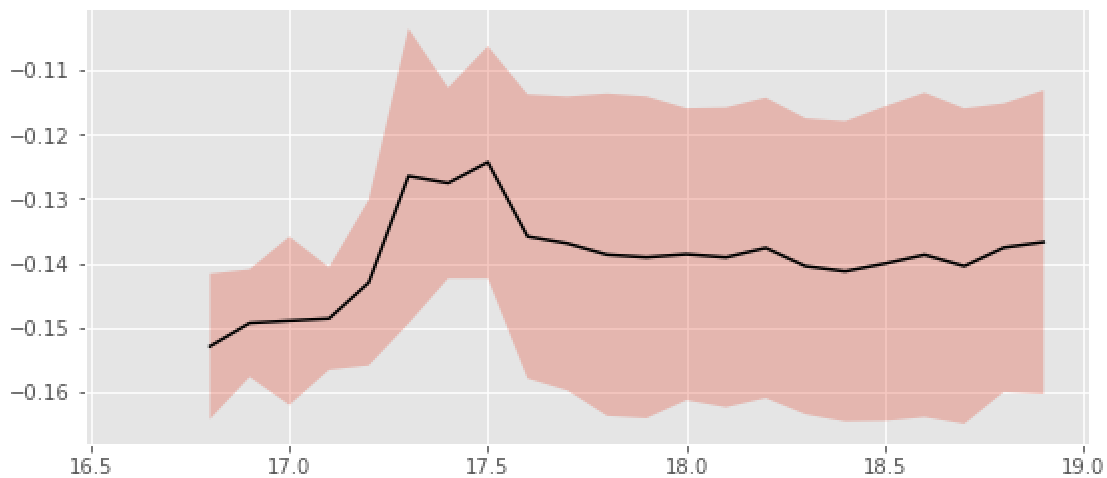
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



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)
```



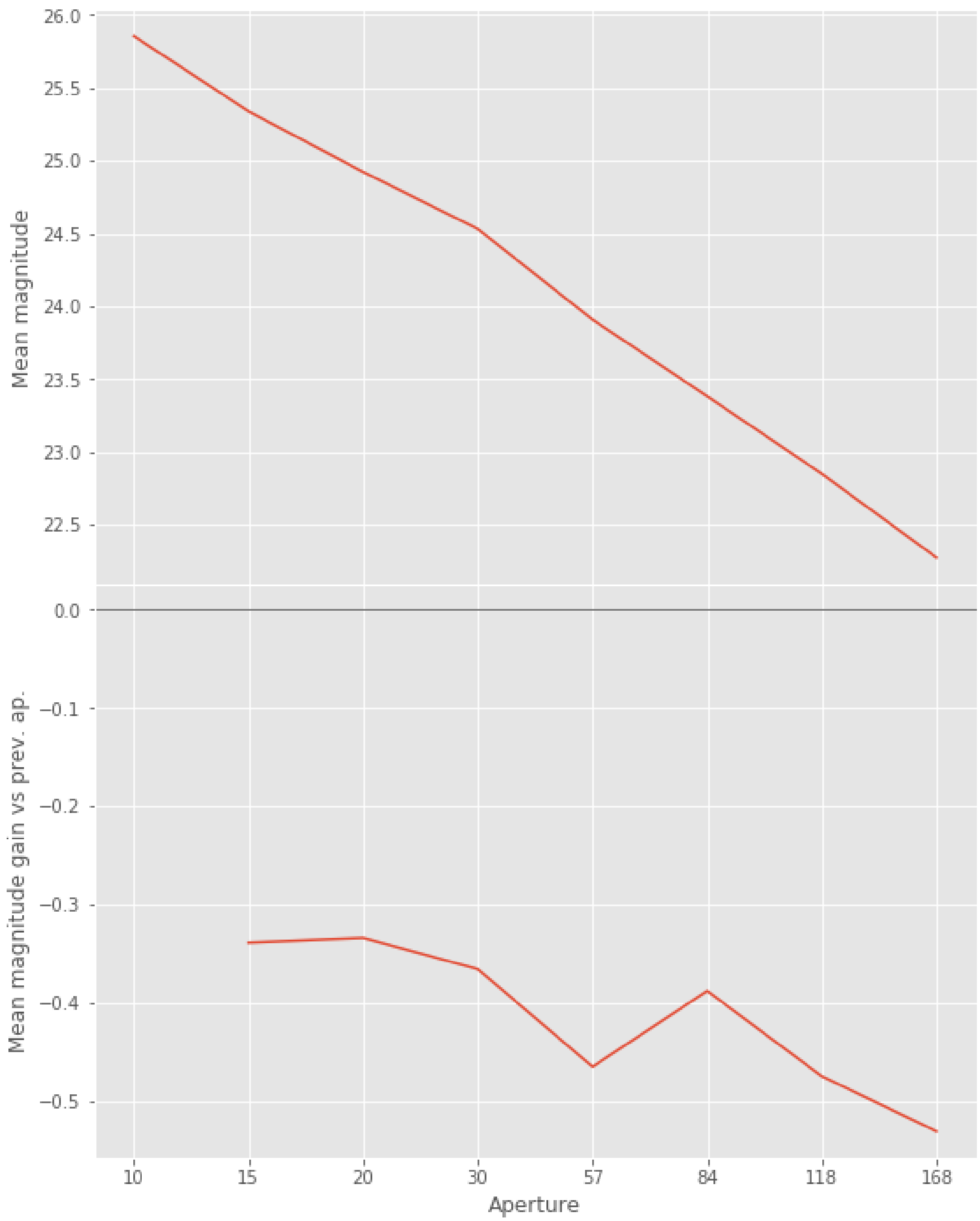
We use magnitudes between 17.5 and 18.8.

```
Aperture correction for z band:
Correction: -0.13919830322265625
Number of source used: 5793
RMS: 0.02398529710992674
```

```
/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

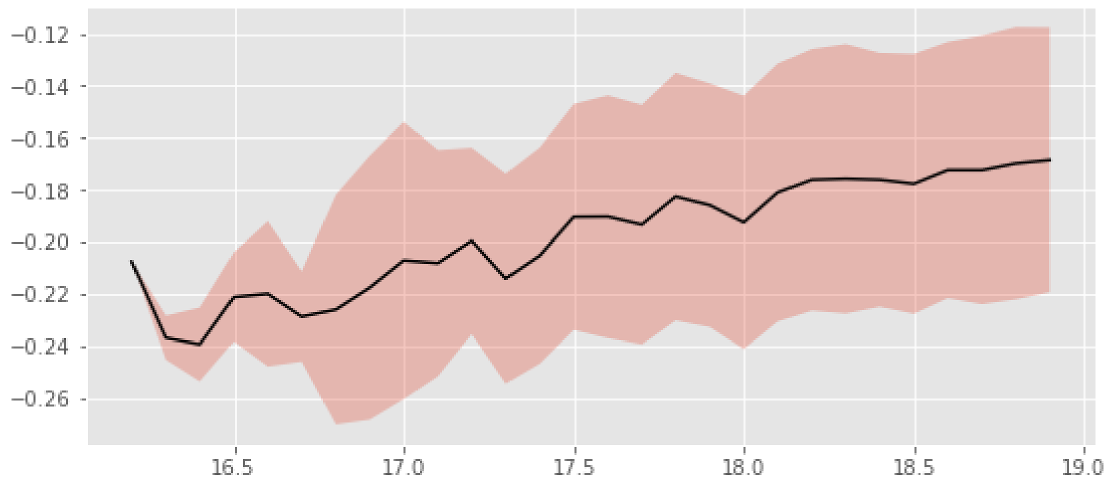
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



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: -0.18083953857421875
Number of source used: 5837
RMS: 0.049393831306902114
```

```
/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)
```

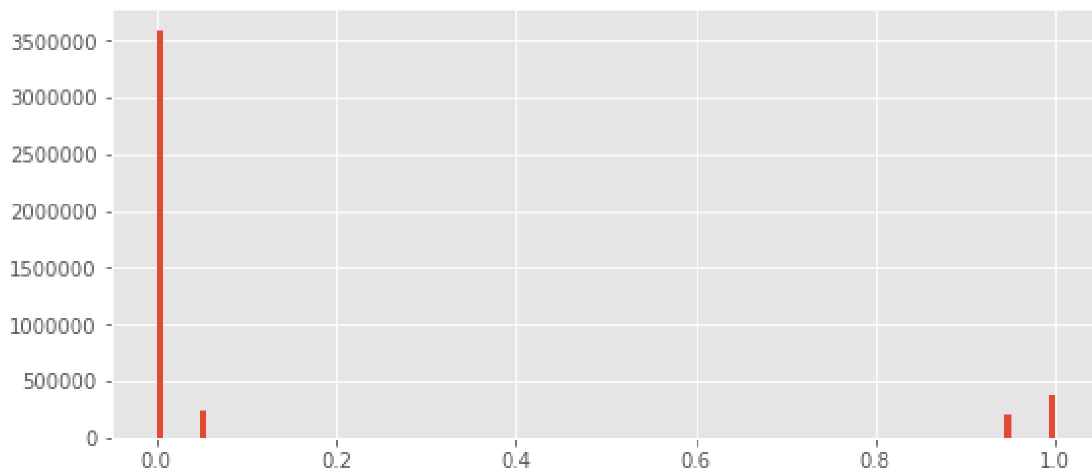
1.3 II - Stellarity

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>

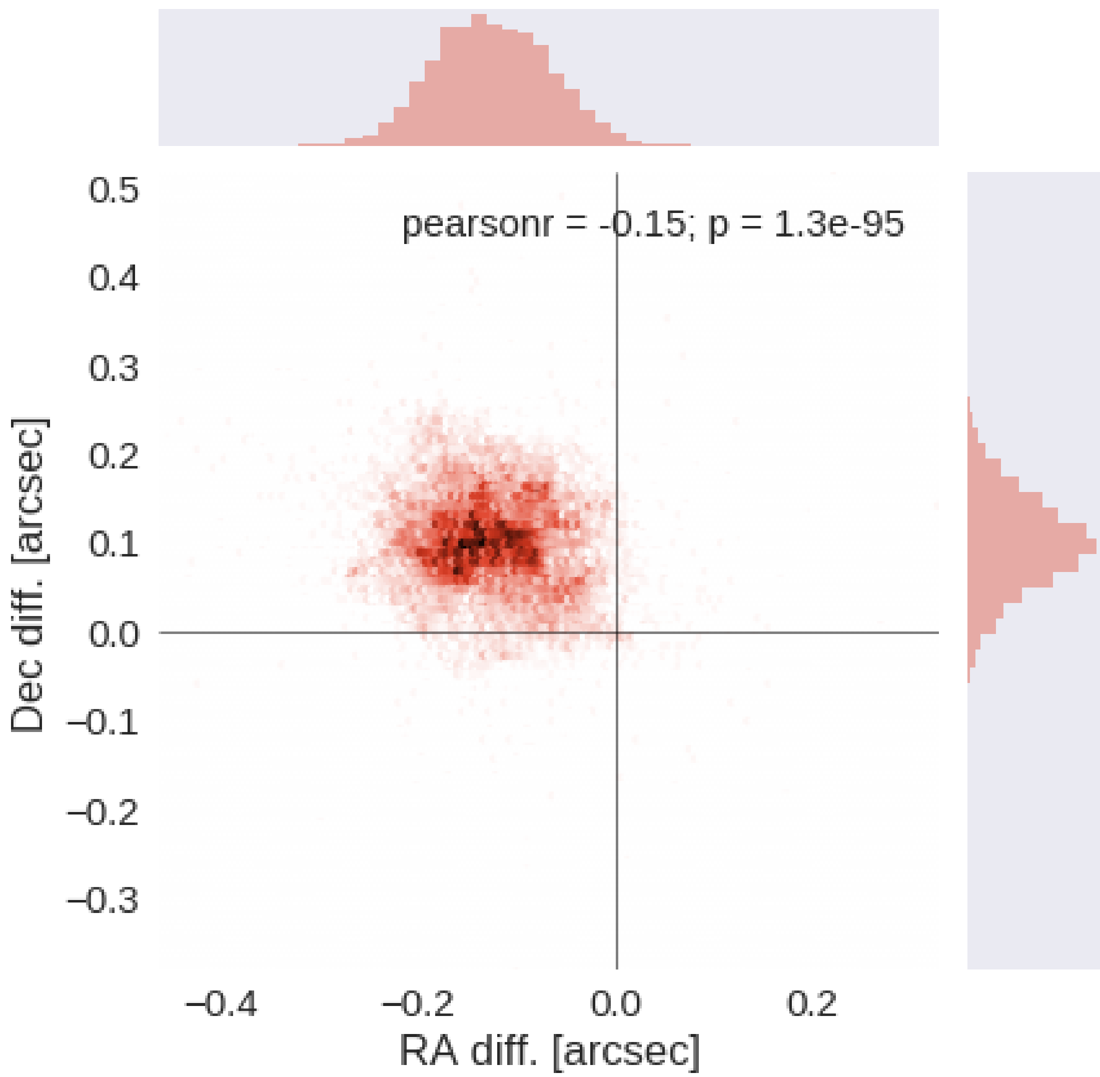
1.5 III - Removal of duplicated sources

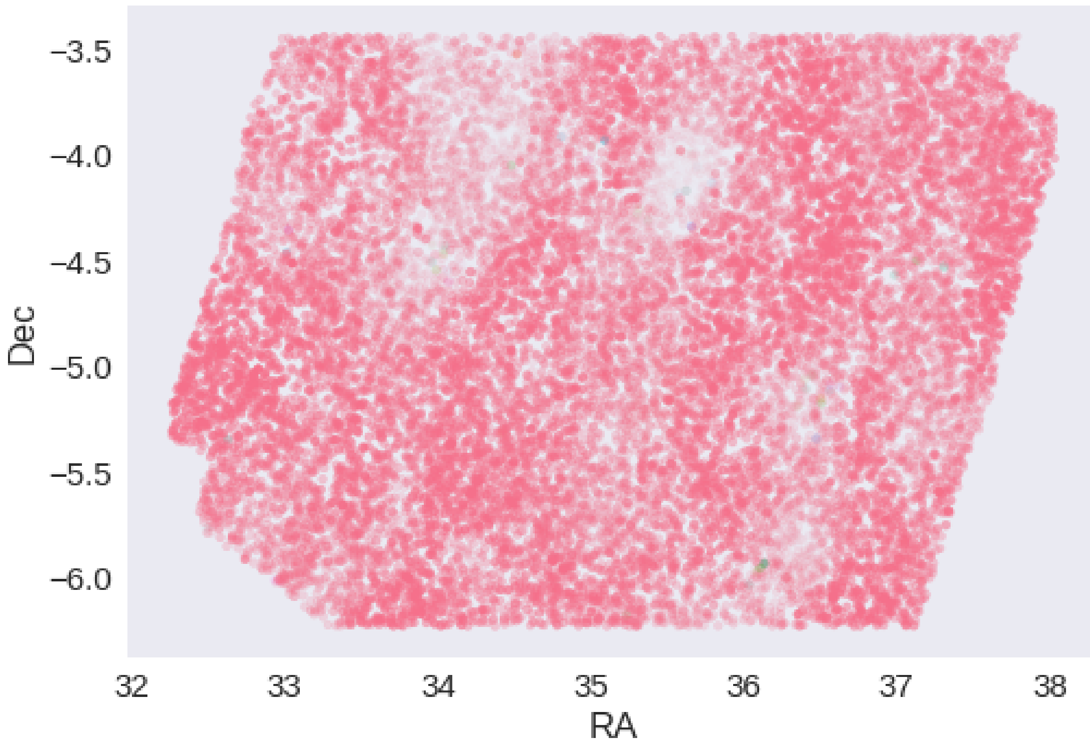
We remove duplicated objects from the input catalogues.

```
/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 4421152 sources.
The cleaned catalogue has 4421020 sources (132 removed).
The cleaned catalogue has 132 sources flagged as having been cleaned
```

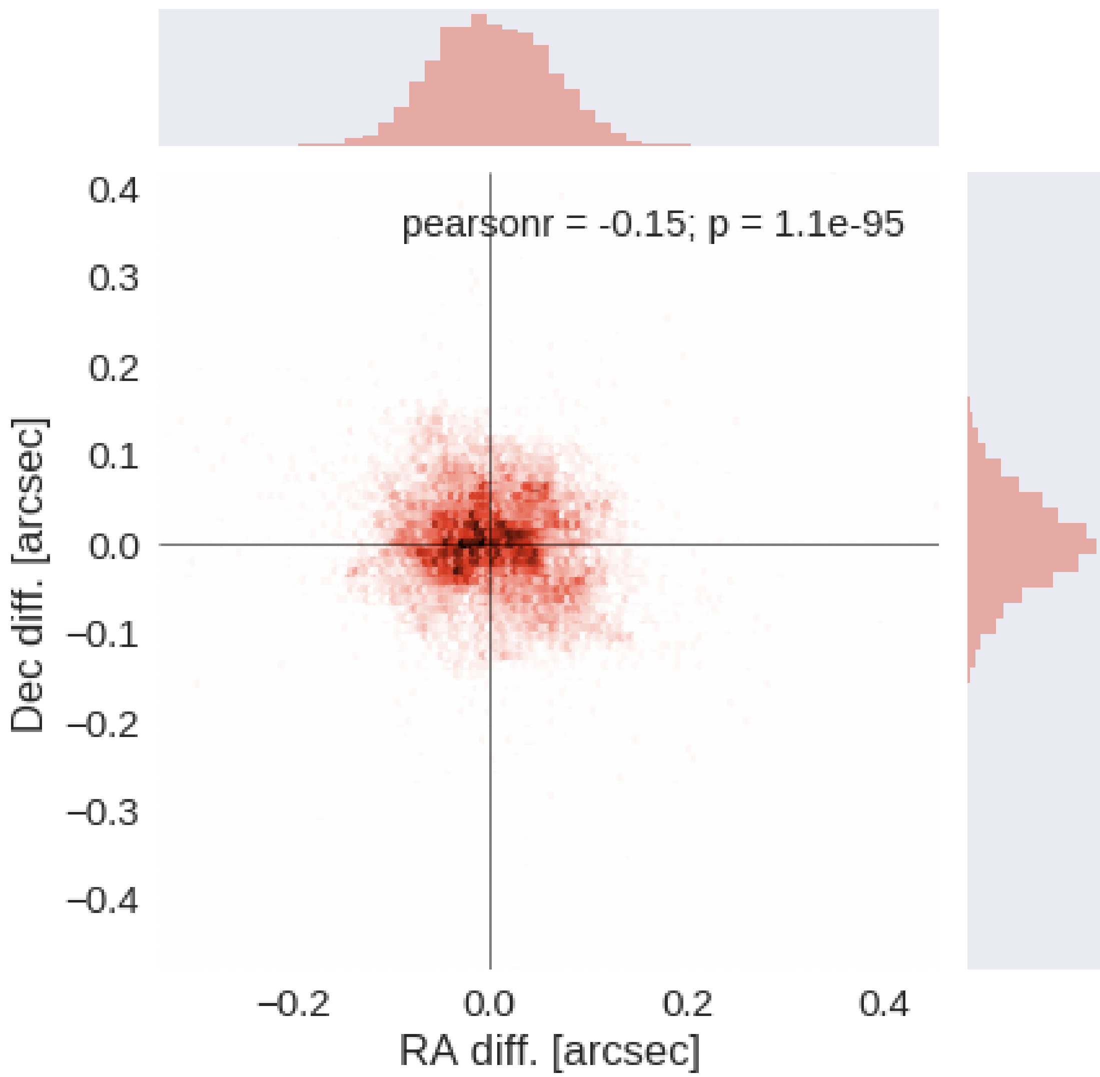
1.6 III - Astrometry correction

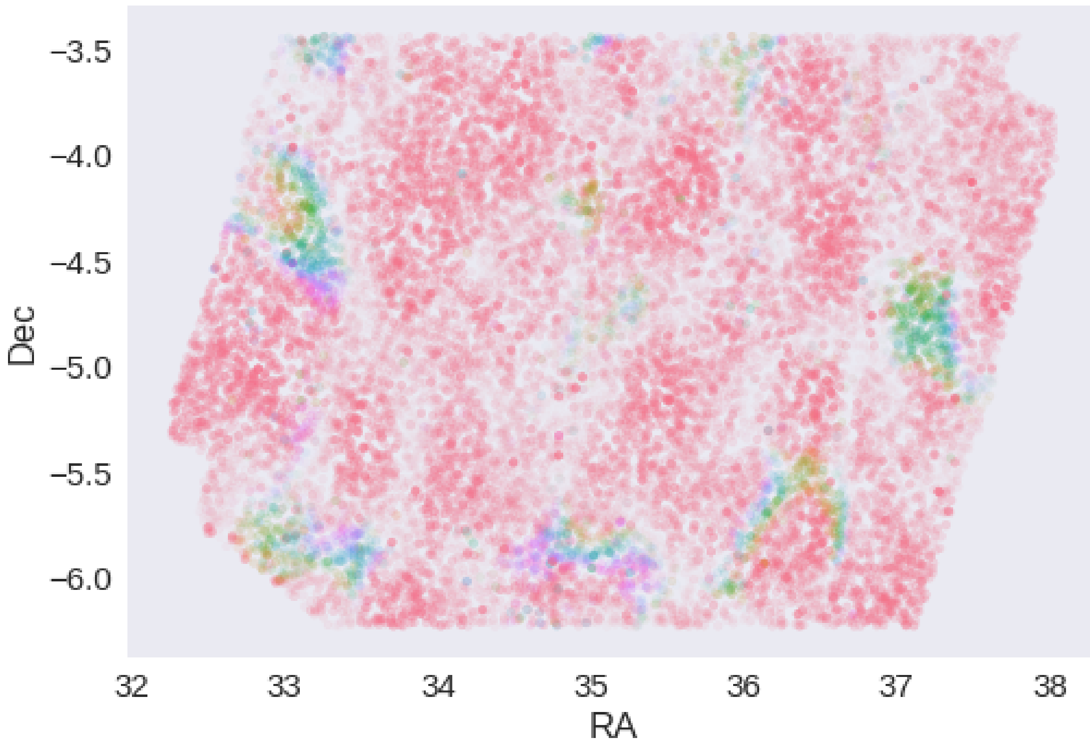
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.


pearsonr = -0.15; p = 1.3e-95
0.5
0.4
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]




```
RA correction: 0.1269925983379494 arcsec
Dec correction: -0.09919436644878488 arcsec
```


pearsonr = -0.15; p = 1.1e-95
Dec diff. [arcsec]
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
−0.2
0.0
0.2
0.4
RA diff. [arcsec]



1.7 IV - Flagging Gaia objects

```
18401 sources flagged.
```

2 V - Saving to disk

1.9.2_HSC-DEEP

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of Hyper Suprime-Cam Subaru Strategic Program Catalogues (HSC-SSP) deep 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.

TODO: Check that the magnitudes are AB.

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 - 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:

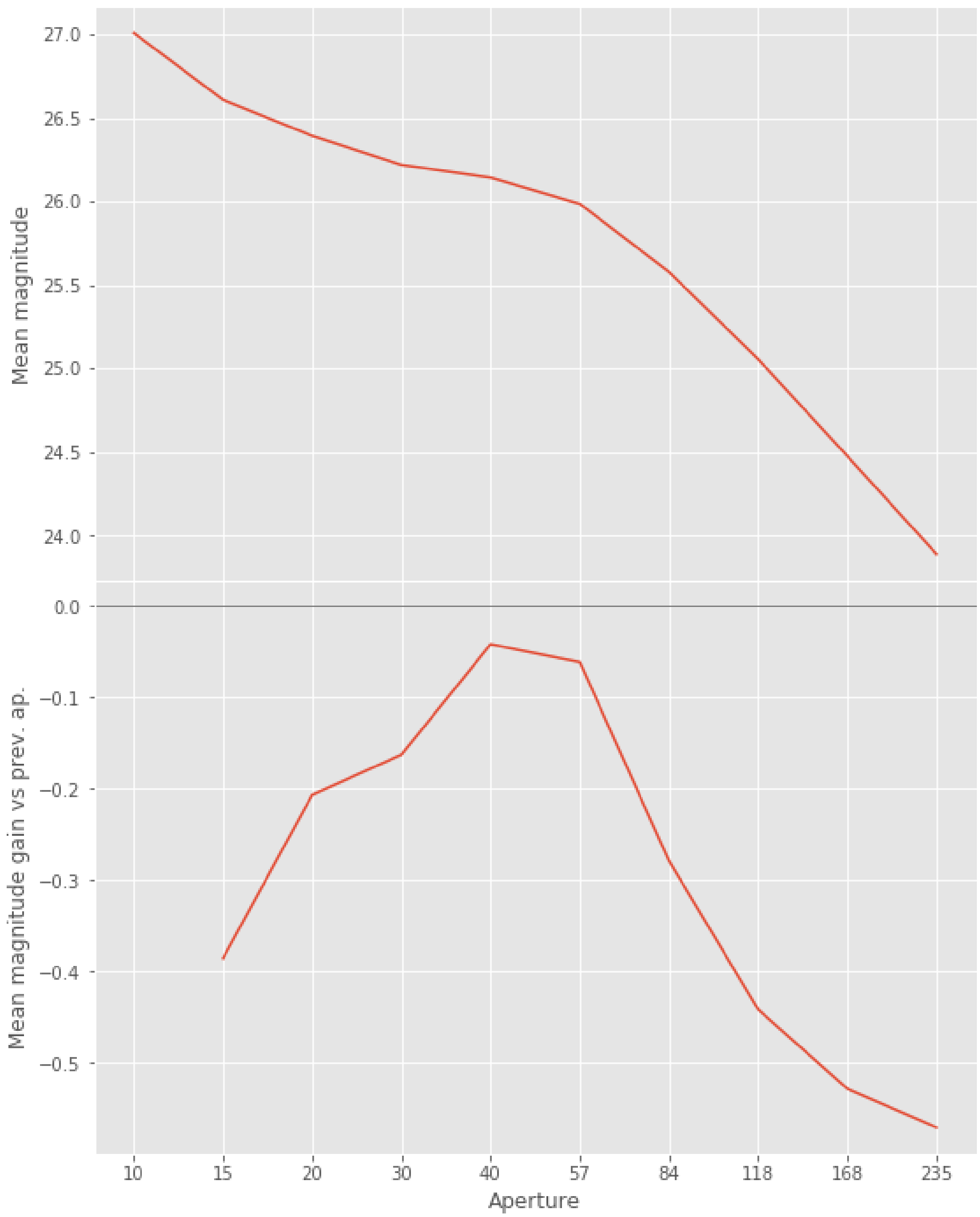
- The evolution of the magnitudes of the objects by plotting on the same plot aperture number vs the mean magnitude.
- The mean gain (loss when negative) of magnitude is each aperture compared to the previous (except for the first of course).

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.

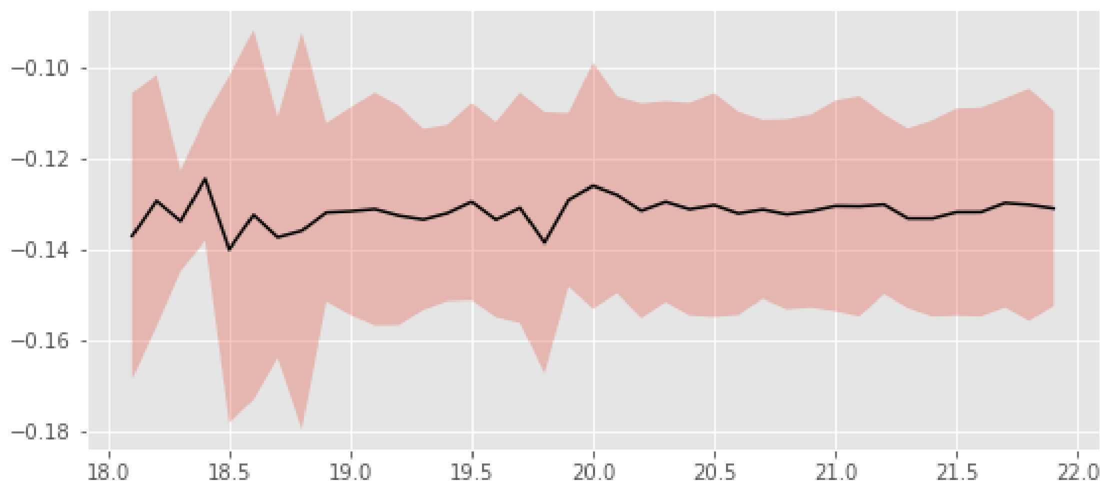
1.2.1 I.a - g band

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



We will use aperture 40 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: -0.13086223602294922
Number of source used: 2519
RMS: 0.022805425014163726
```

```
/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)
```

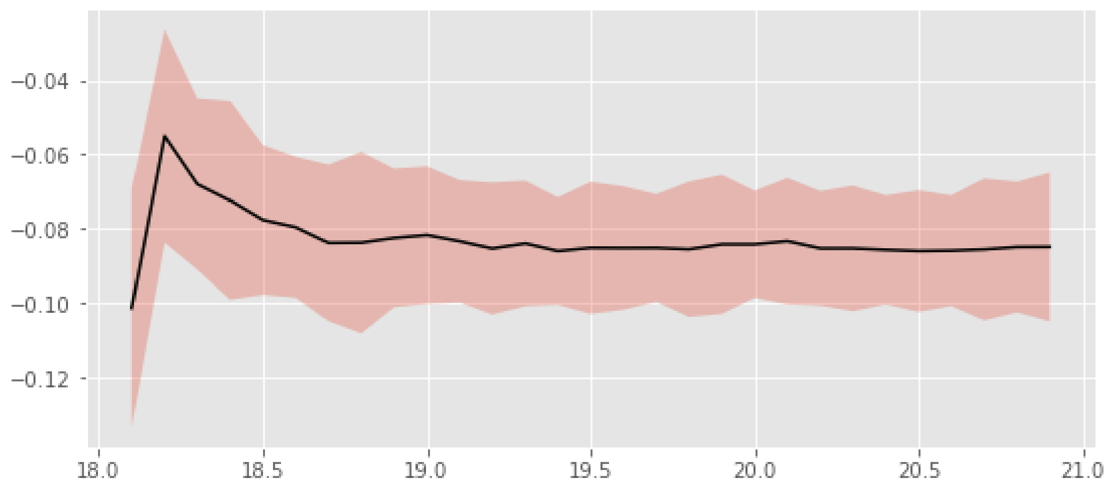
1.2.2 I.b - r band

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

We will use aperture 40 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 19.75.

```
Aperture correction for r band:
Correction: -0.08403396606445312
Number of source used: 1851
RMS: 0.018014916888614004
```

```
/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)
```

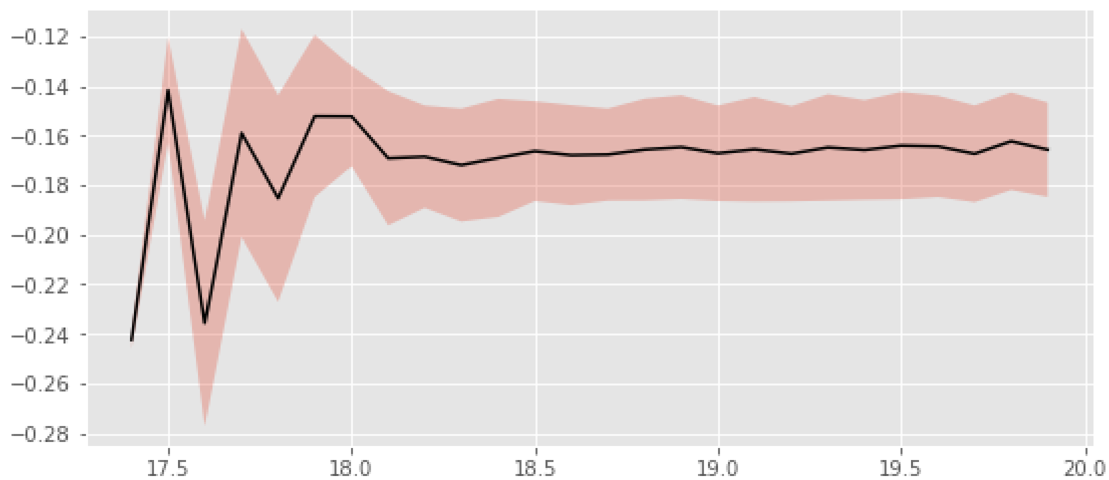
1.2.3 I.c - i band

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

We will use aperture 40 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 18.0 and 19.8.

```
Aperture correction for i band:
Correction: -0.16637039184570312
Number of source used: 4269
RMS: 0.020601125090626168
```

```
/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)
```

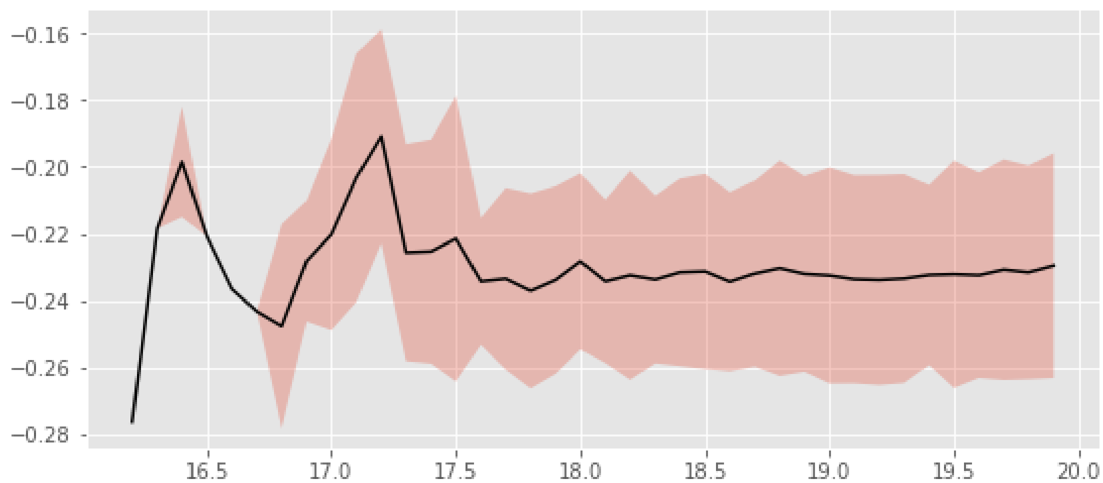
1.2.4 I.d - z band

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

We will use aperture 40 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 19.5.

```
Aperture correction for z band:
Correction: -0.2327556610107422
Number of source used: 4553
RMS: 0.029492398076254384
```

```
/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)
```

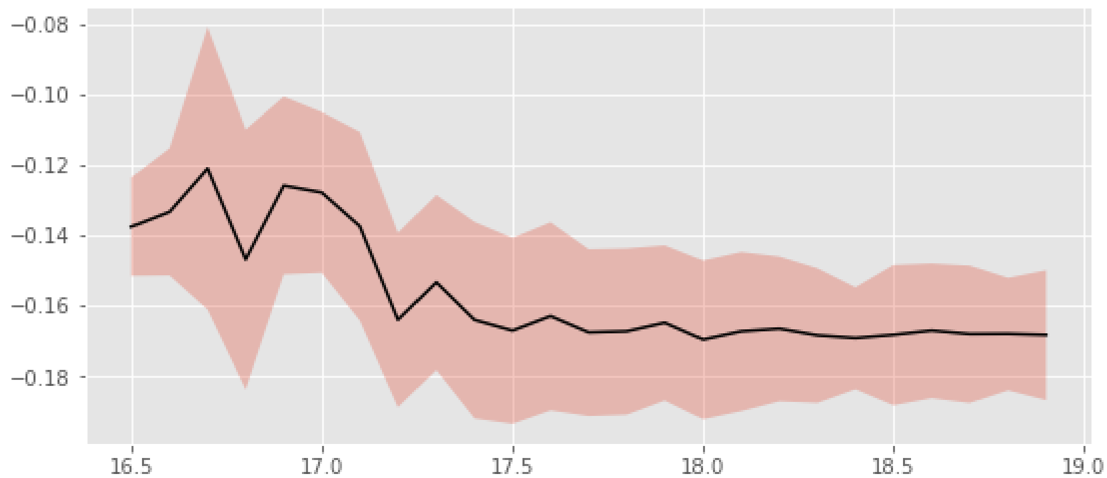
1.2.5 I.e - y band

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

We will use aperture 40 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: -0.16762733459472656
Number of source used: 2431
RMS: 0.020809063812093947
```

```
/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)
```

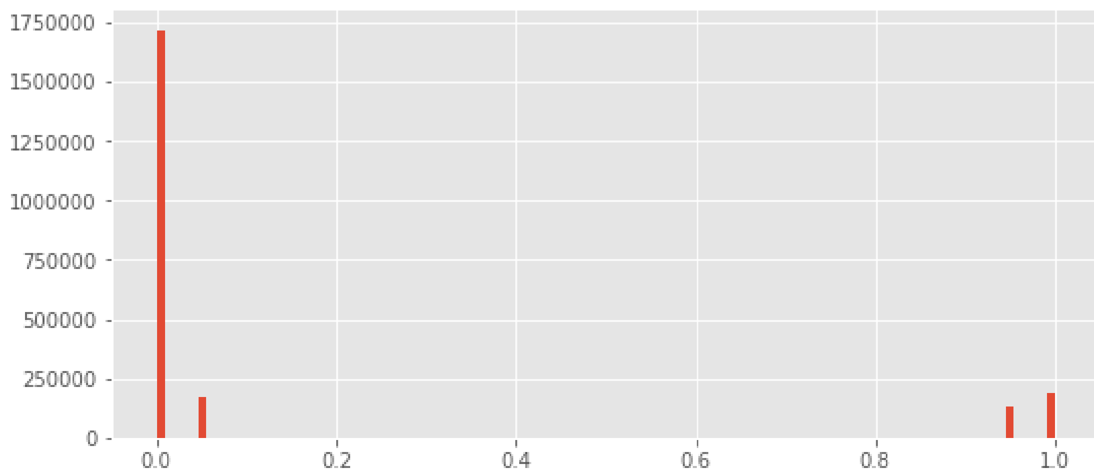
1.3 II - Stellarity

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>

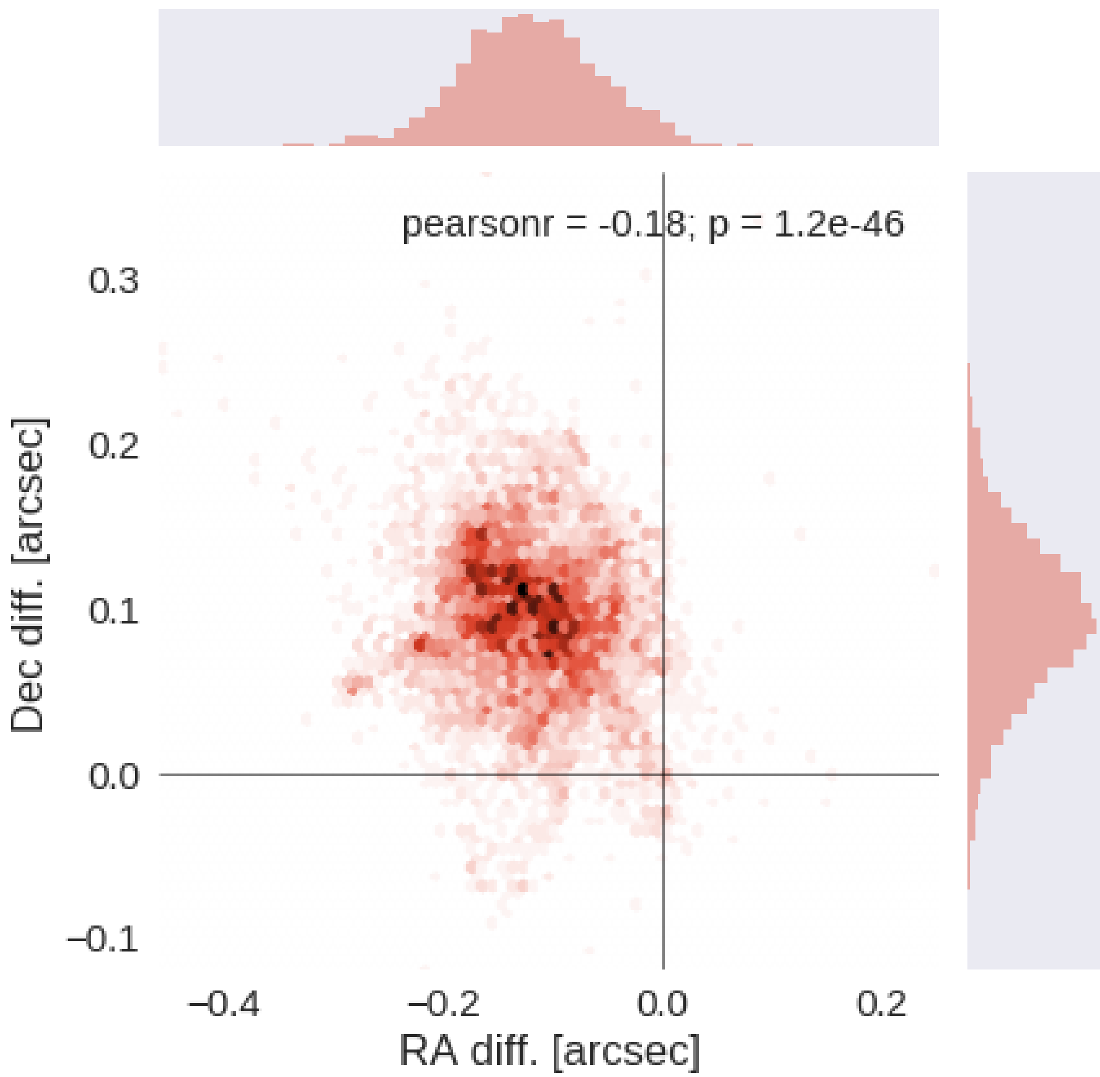
1.5 III - Removal of duplicated sources

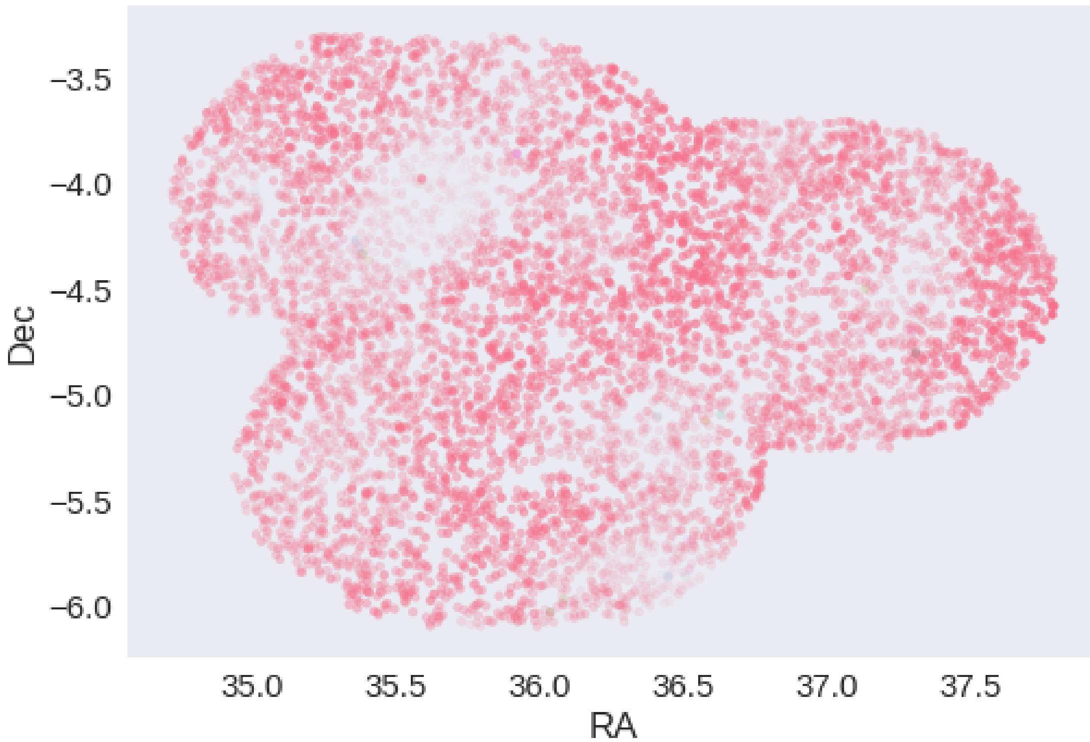
We remove duplicated objects from the input catalogues.

```
/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 2213258 sources.
The cleaned catalogue has 2213165 sources (93 removed).
The cleaned catalogue has 89 sources flagged as having been cleaned
```

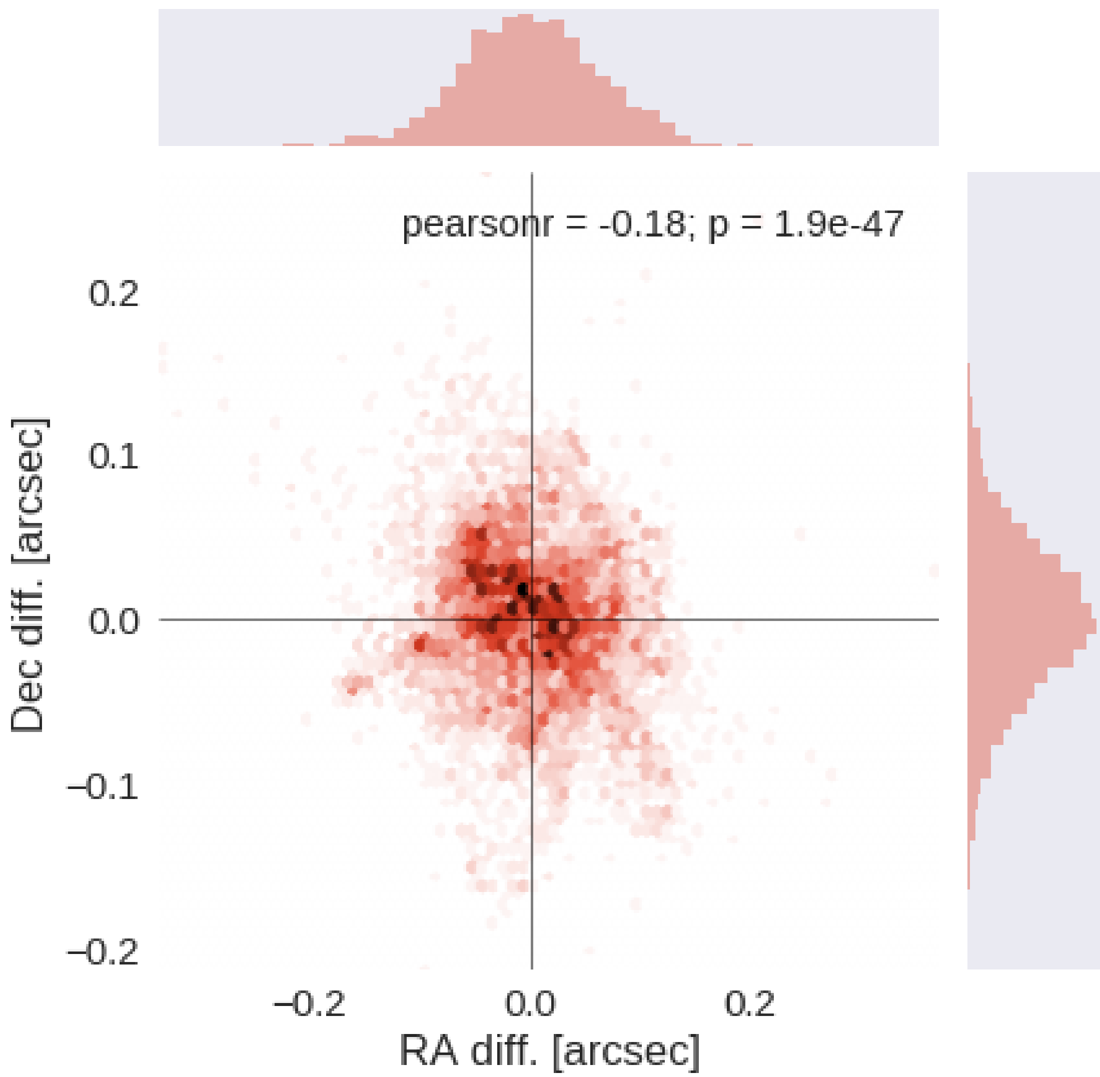
1.6 III - Astrometry correction

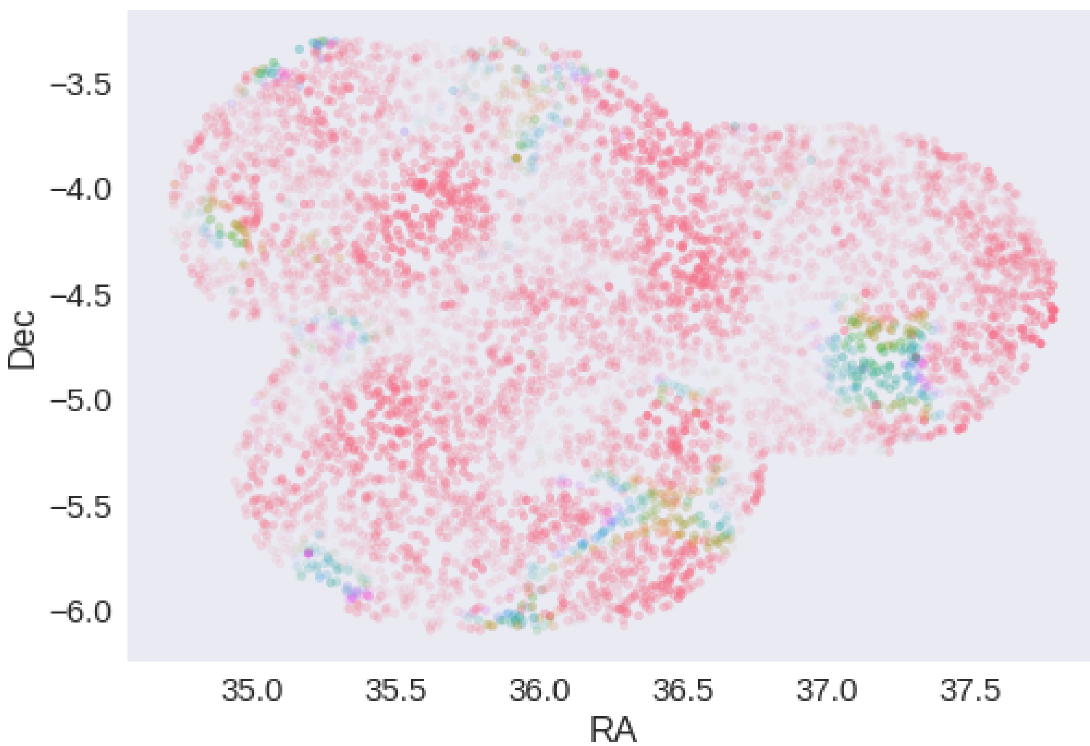
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.


pearsonr = -0.18; p = 1.2e-46
0.3
0.2
0.1
0.0
−0.1
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
RA diff. [arcsec]




```
RA correction: 0.12037082196911797 arcsec
Dec correction: -0.09338932542011236 arcsec
```


pearsonr = -0.18; p = 1.9e-47
0.2
0.1
0.0
−0.1
−0.2
Dec diff. [arcsec]
−0.2
0.0
0.2
RA diff. [arcsec]



1.7 IV - Flagging Gaia objects

```
6656 sources flagged.
```

2 V - Saving to disk

1.9.3_HSC-UDEEP

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of Hyper Suprime-Cam Subaru Strategic Program Catalogues (HSC-SSP) ultradeep 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, n921, n816 aperture magnitude in 2" that we aperture correct;
- The g, r, i, z, y, n921, n816 kron fluxes and magnitudes.
- The extended flag that we convert to a stellariy.

TODO: Check that the magnitudes are AB.

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 - 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.

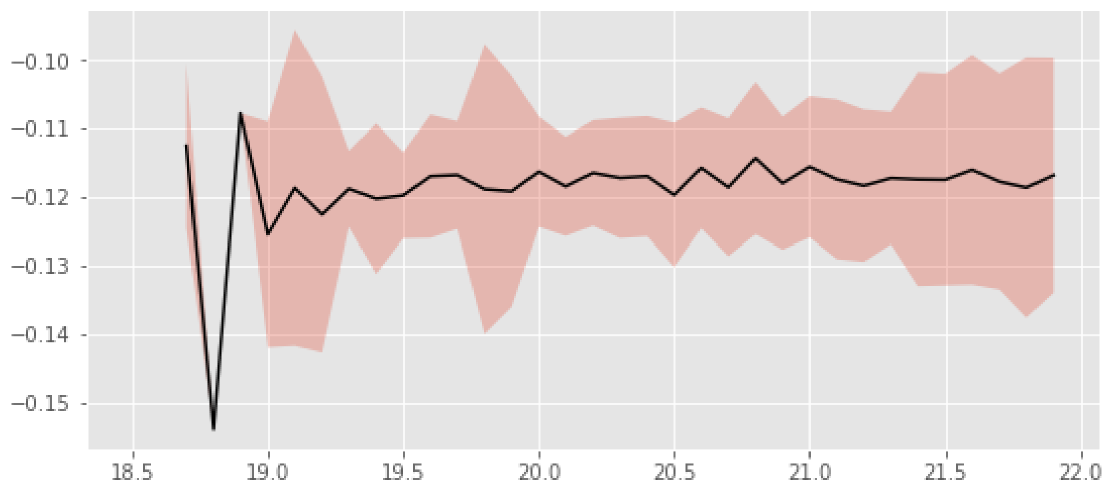
Magnitude range: To know what limits in aperture to use when doing the aperture correction, we plot for each magnitude bin the correction that is computed and its RMS. We should then use the wide limits (to use more stars) where the correction is stable and with few dispersion.

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 40 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)
```



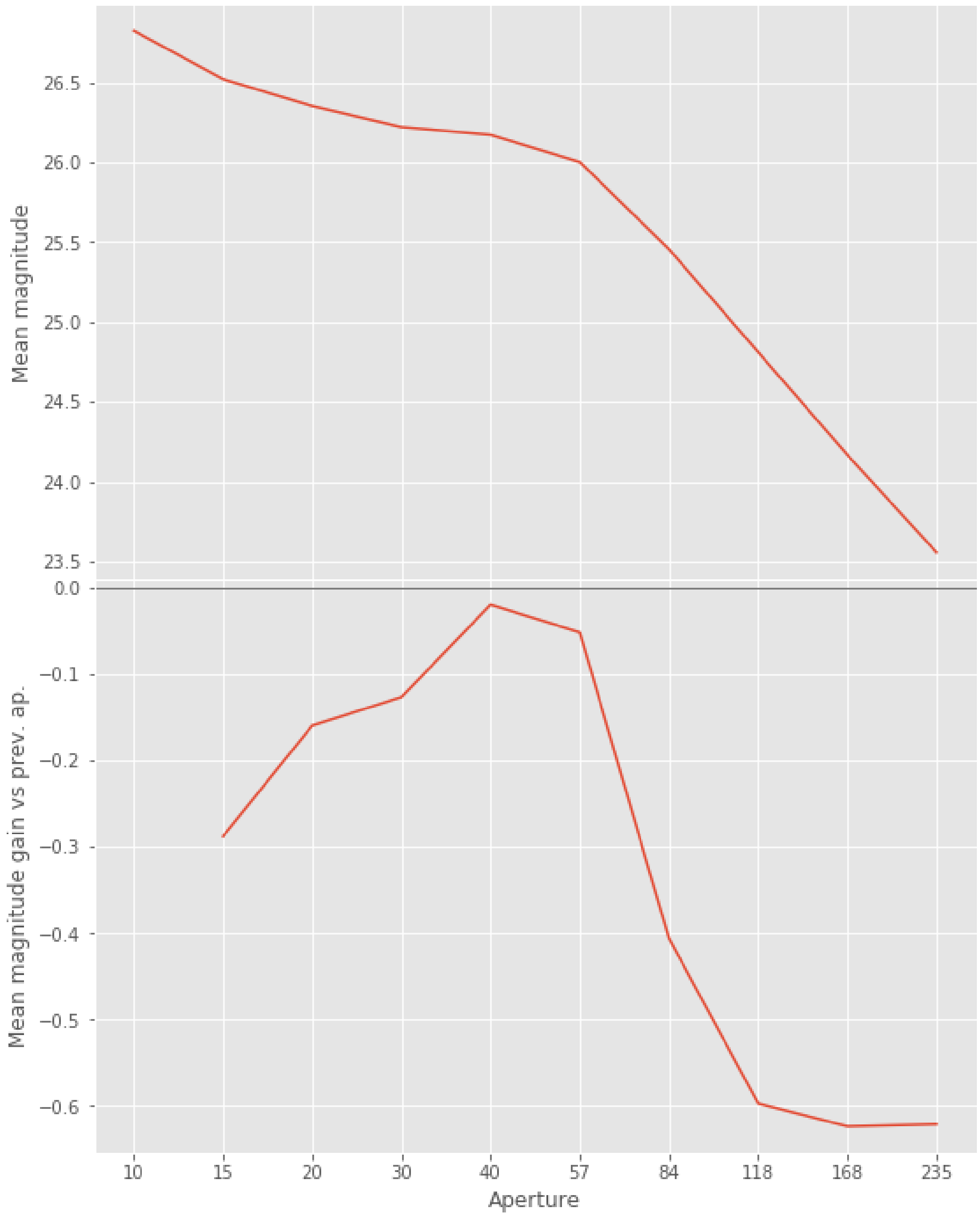
We will use magnitudes between 20.0 and 21.5

```
Aperture correction for g band:
Correction: -0.11709976196289062
Number of source used: 1468
RMS: 0.010006448273662748
```

```
/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

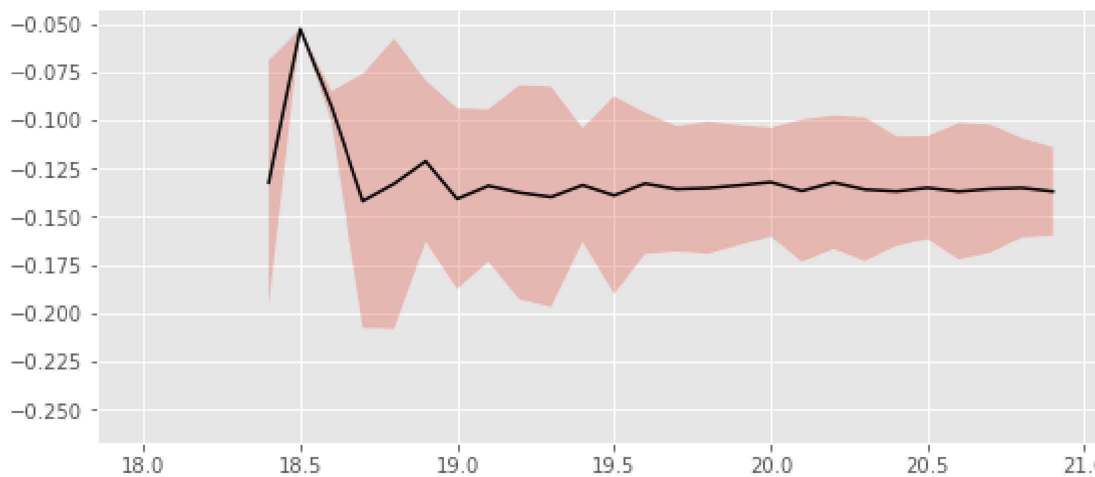
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



We will use aperture 40 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 19.0 and 20.5.

```
Aperture correction for r band:
Correction: -0.1352062225341797
Number of source used: 1132
RMS: 0.03414906800433681
```

```
/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)
```

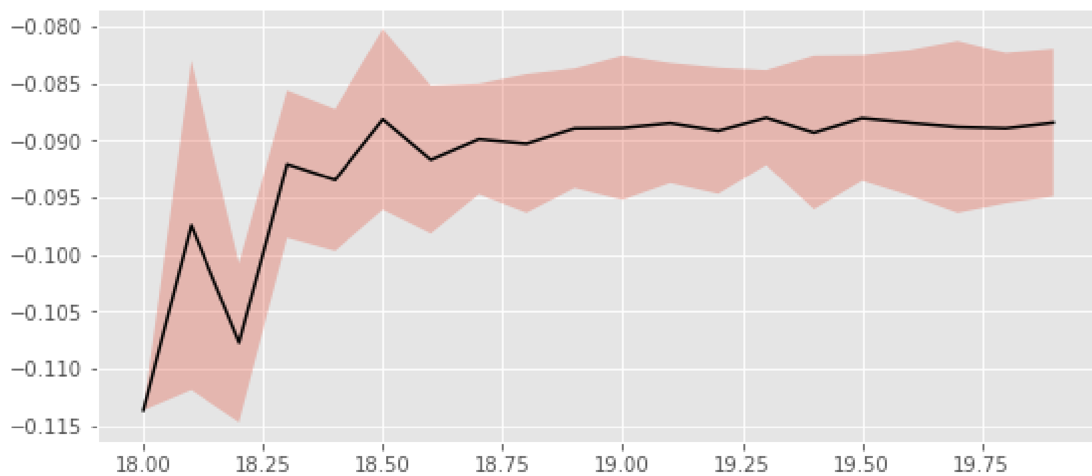
1.2.3 I.c - i band

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

We will use aperture 40 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: -0.08892059326171875
Number of source used: 1474
RMS: 0.005790887515601094
```

```
/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)
```

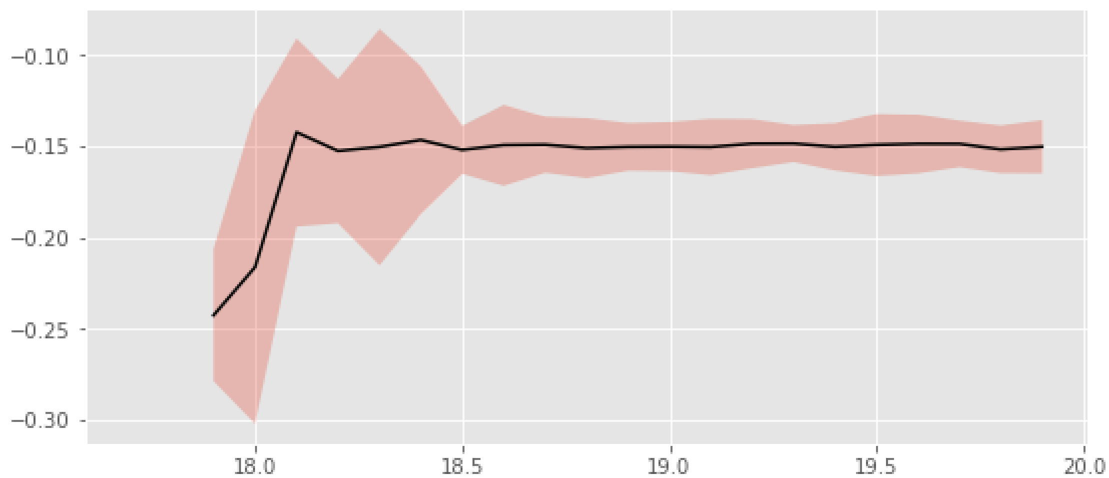
1.2.4 I.d - z band

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

We will use aperture 40 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)
```



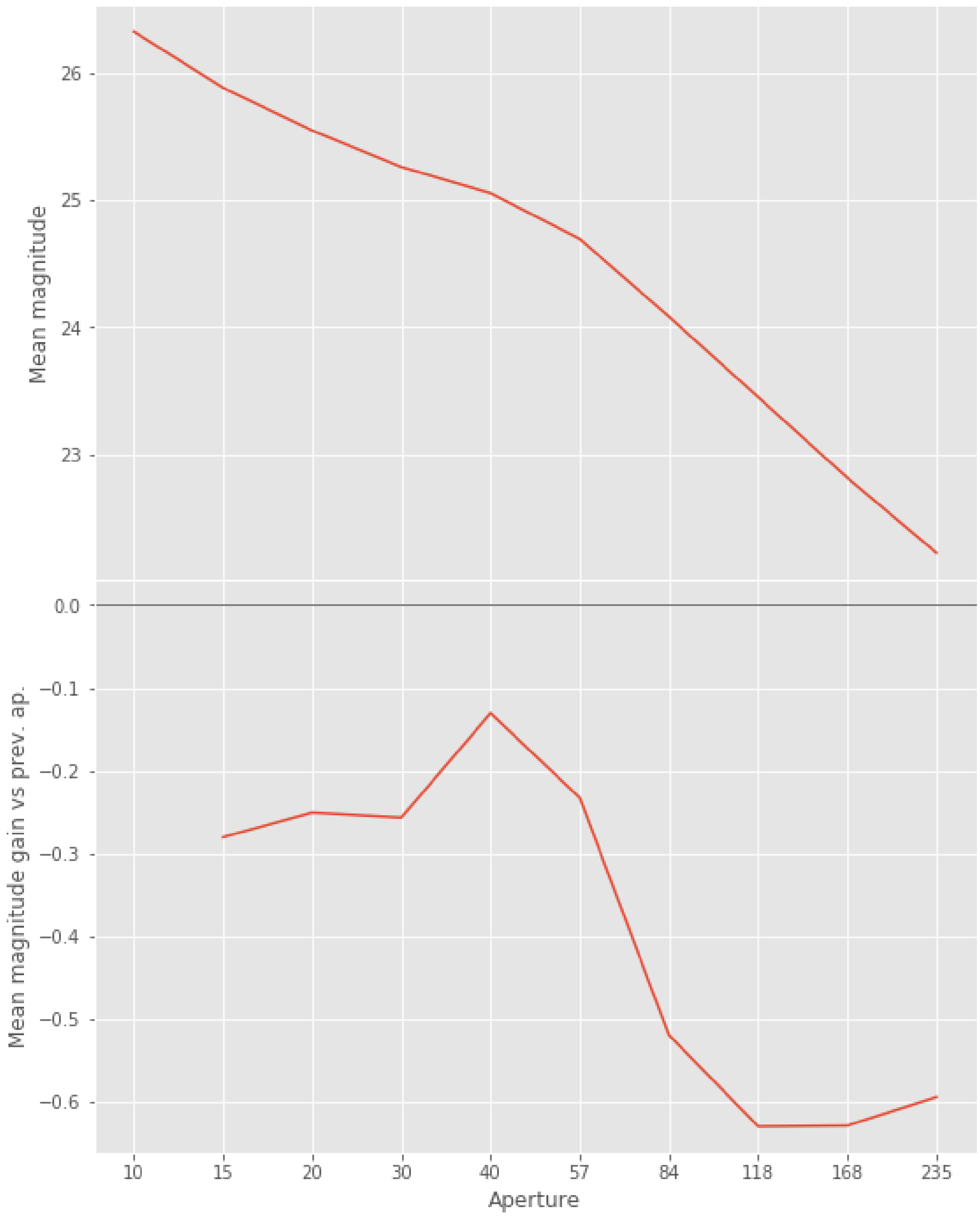
We use magnitudes between 18.5 and 19.8.

```
Aperture correction for z band:
Correction: -0.14960098266601562
Number of source used: 1770
RMS: 0.013925026504311305
```

```
/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

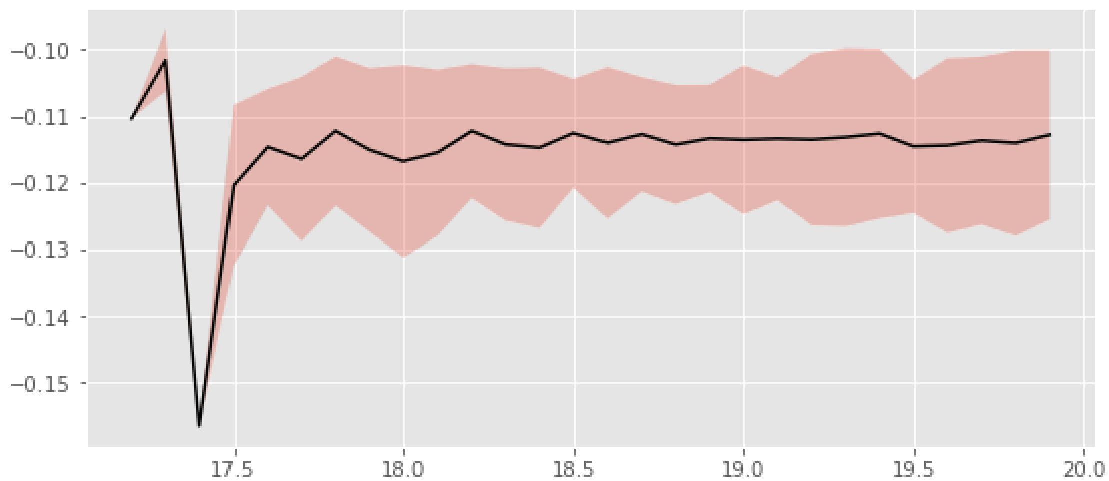
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



We will use aperture 40 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)
```



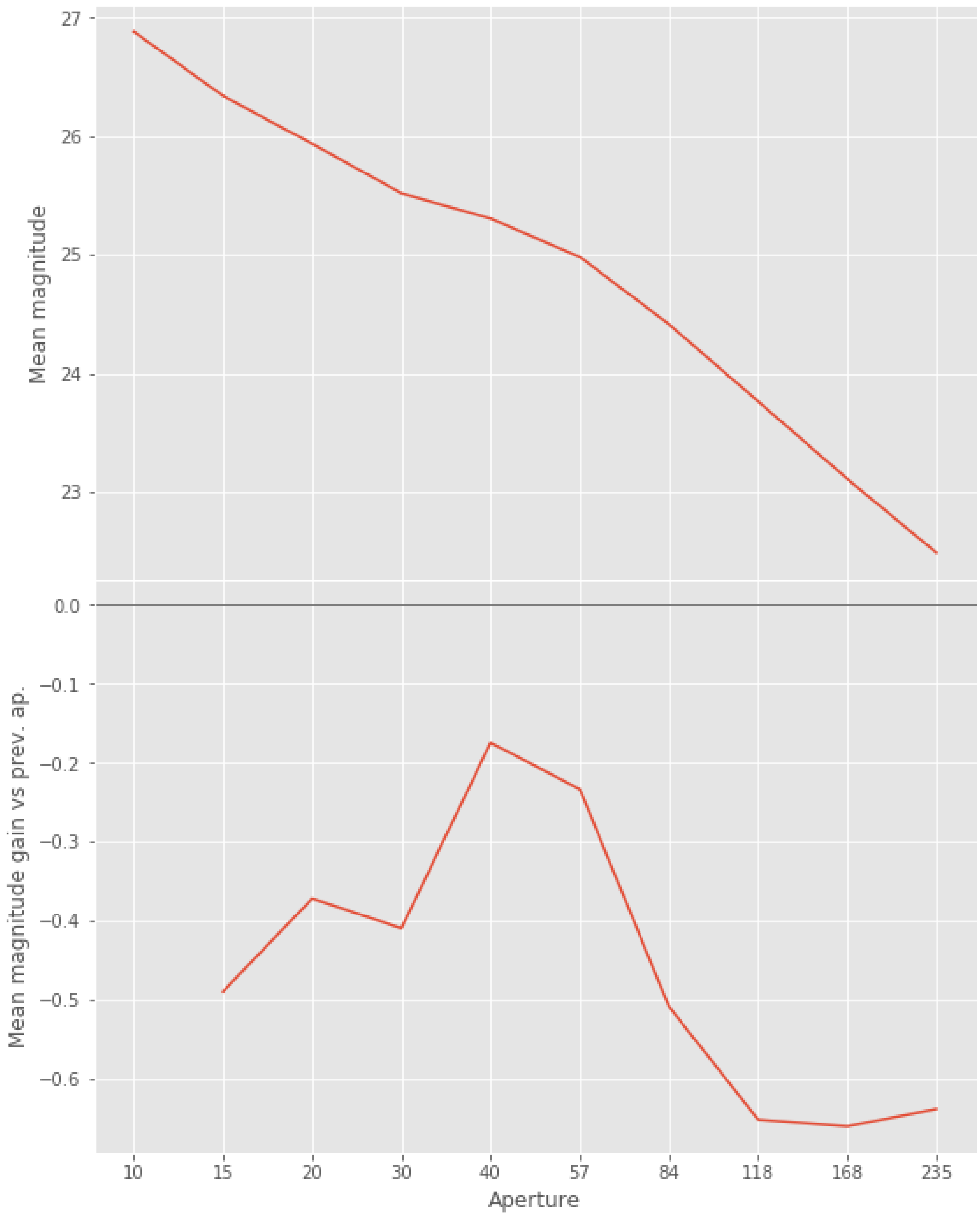
We use magnitudes between 18.0 and 19.5.

```
Aperture correction for y band:
Correction: -0.11351203918457031
Number of source used: 1913
RMS: 0.010453534442076362
```

```
/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)
```

1.2.6 I.f - n921 band

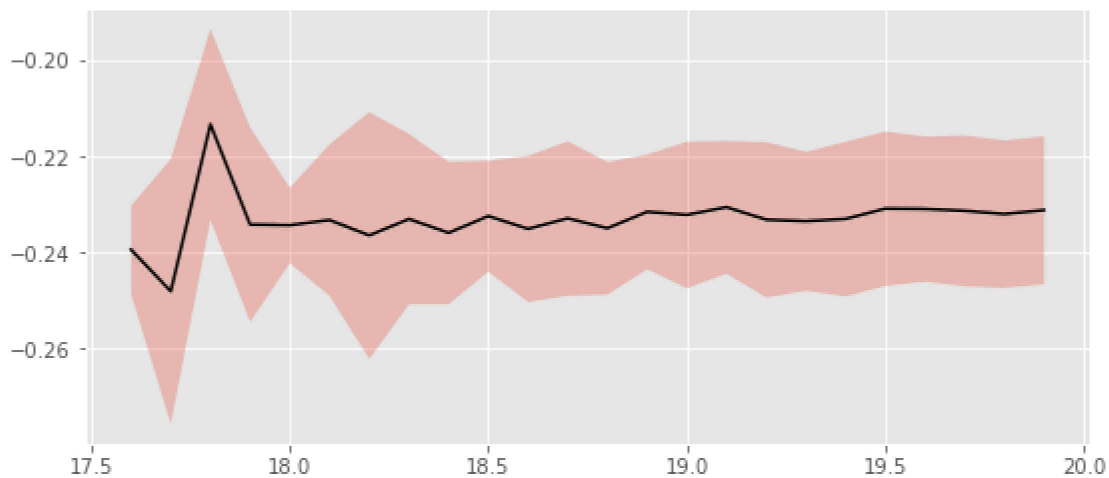
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



We will use aperture 40 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)
```



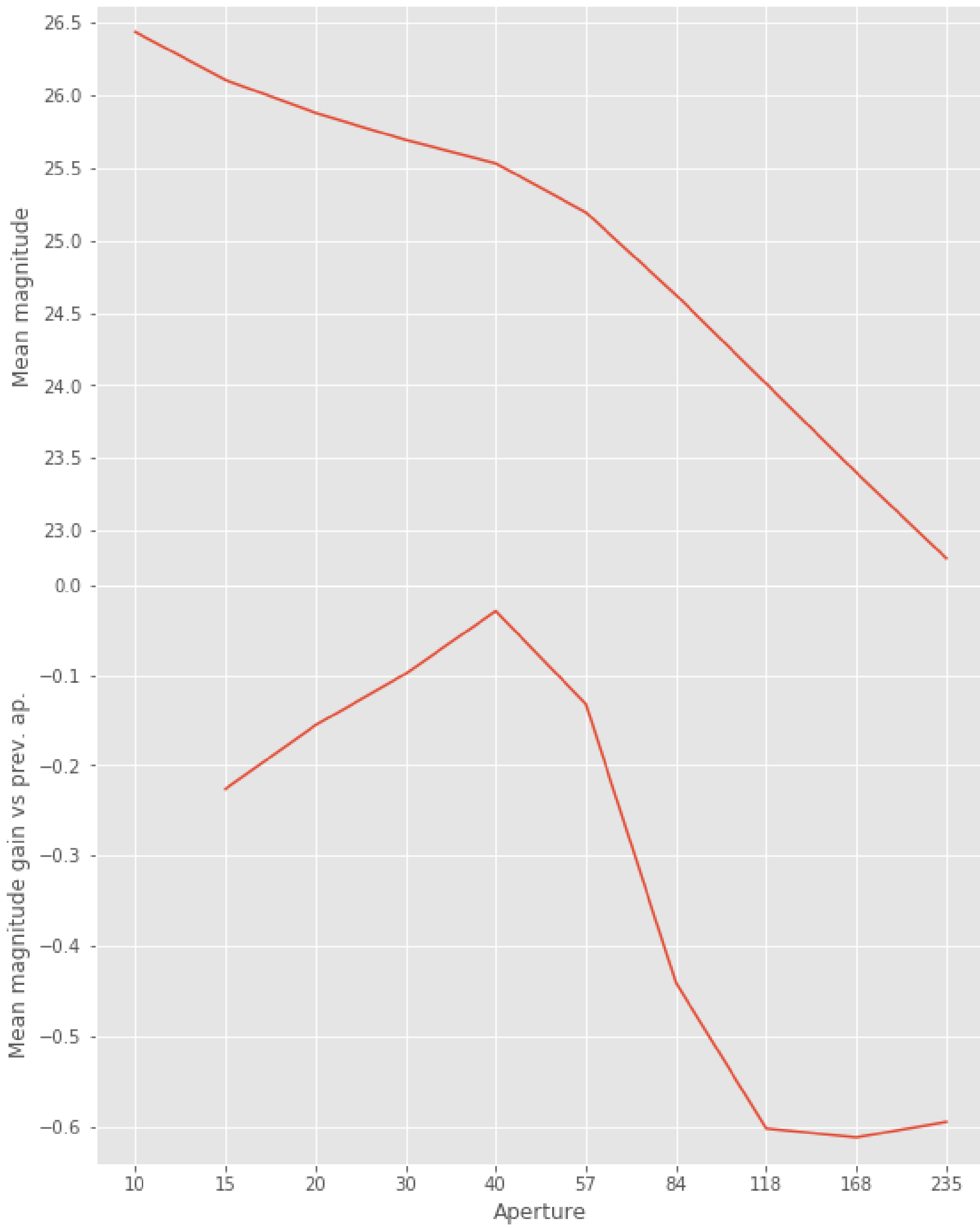
We use magnitudes between 18.0 and 19.5.

```
Aperture correction for n921 band:
Correction: -0.23302078247070312
Number of source used: 1549
RMS: 0.014689342783144942
```

```
/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)
```

1.2.7 I.g - n816 band

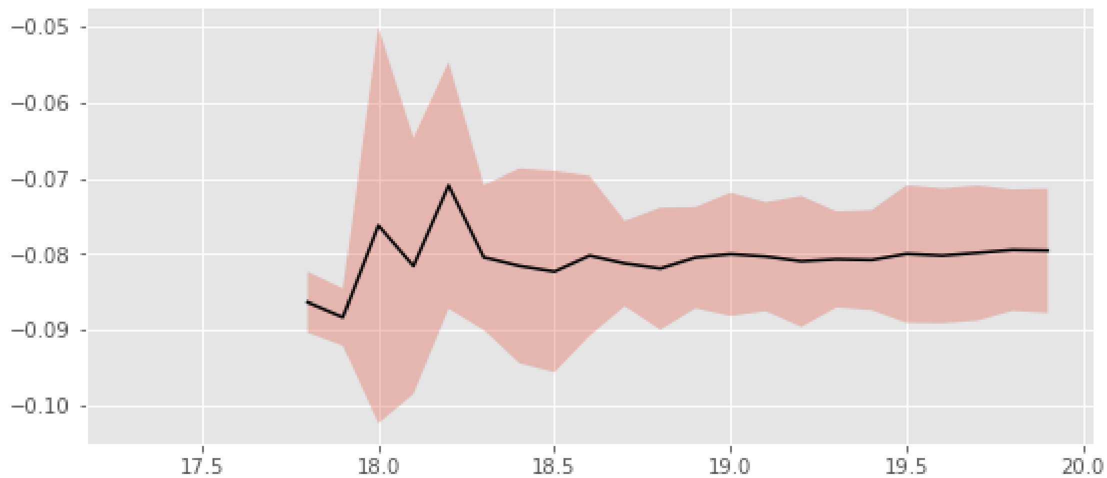
```
/opt/herschelhelp_internal/herschelhelp_internal/masterlist.py:850: RuntimeWarning: invalid valu
  mags = magnitudes[:, stellarity > stel_threshold].copy()
```



We will use aperture 40 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 18.0 and 19.5.

```
Aperture correction for n816 band:
Correction: -0.11351203918457031
Number of source used: 1199
RMS: 0.007980501010658921
```

```
/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)
```

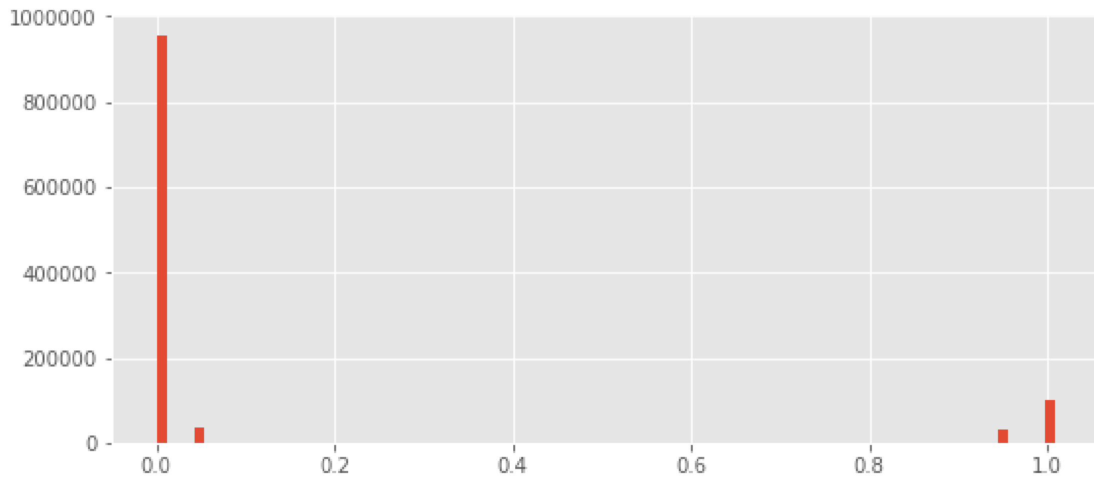
1.3 II - Stellarity

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[35]: <IPython.core.display.HTML object>

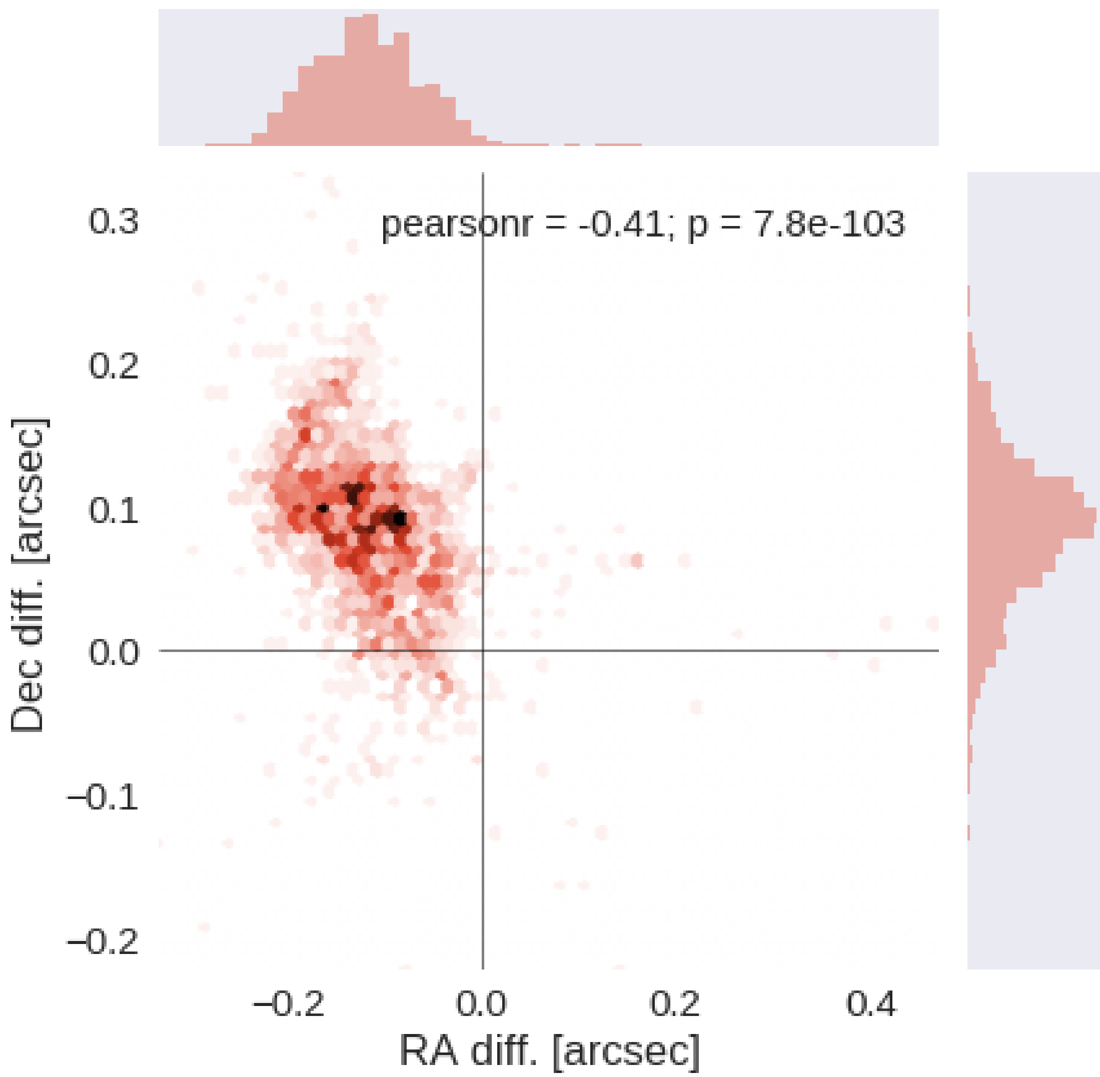
1.5 III - Removal of duplicated sources

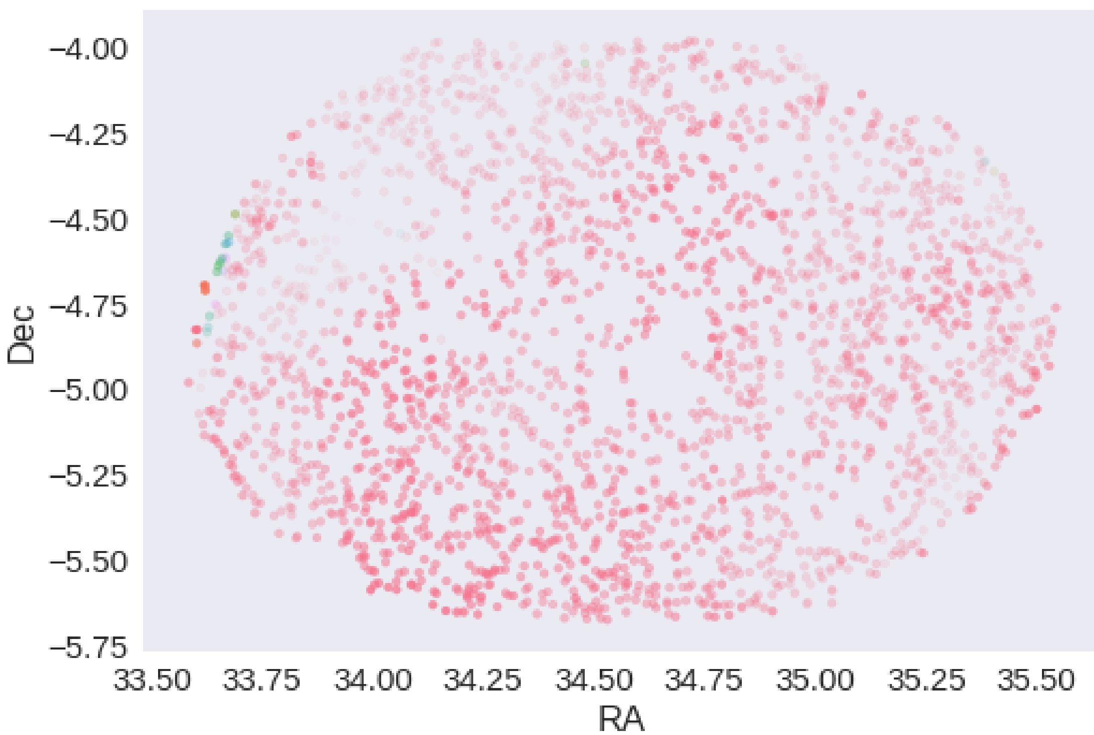
We remove duplicated objects from the input catalogues.

```
/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 1128935 sources.
The cleaned catalogue has 1128841 sources (94 removed).
The cleaned catalogue has 79 sources flagged as having been cleaned
```

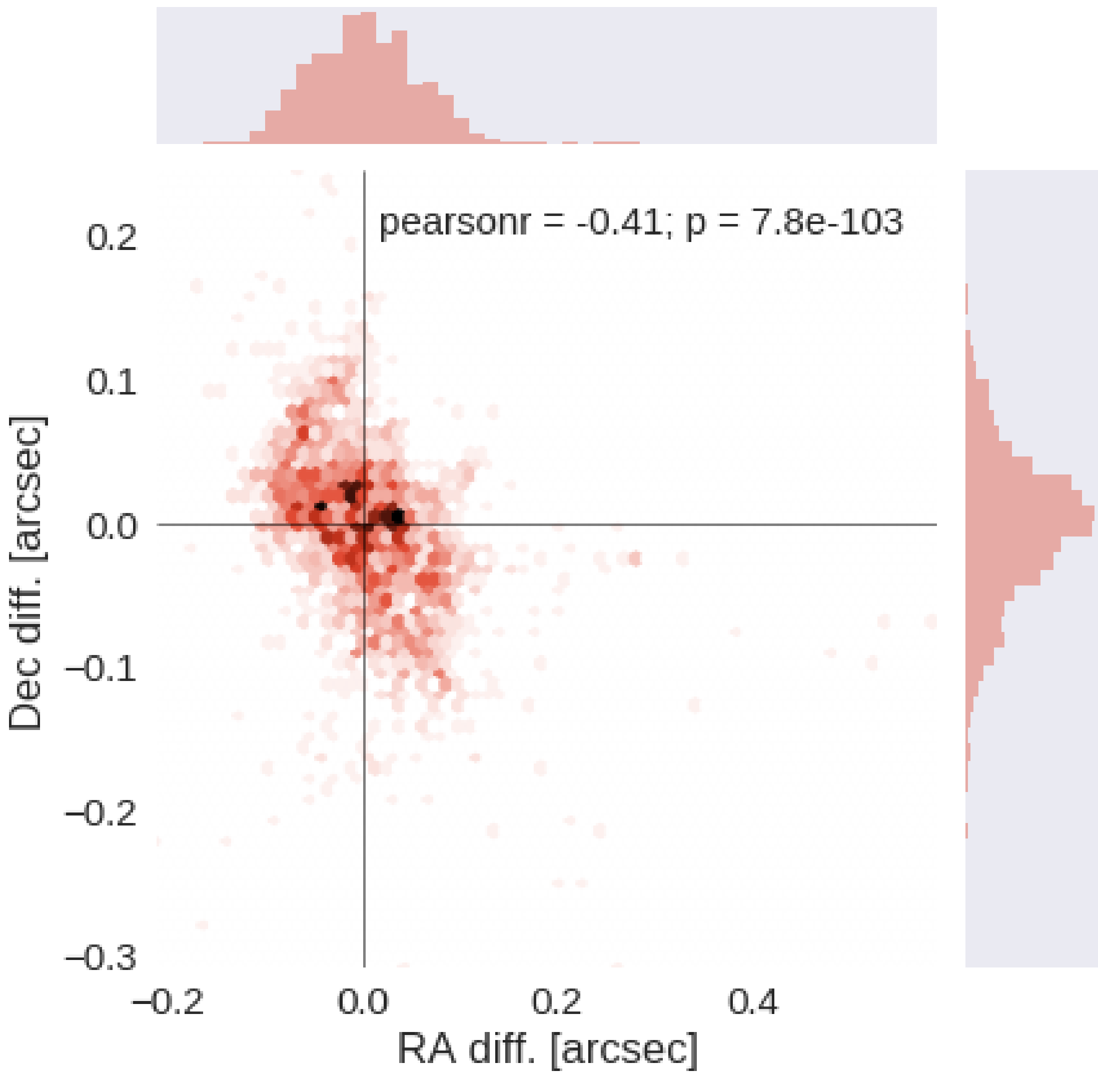
1.6 III - Astrometry correction

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.

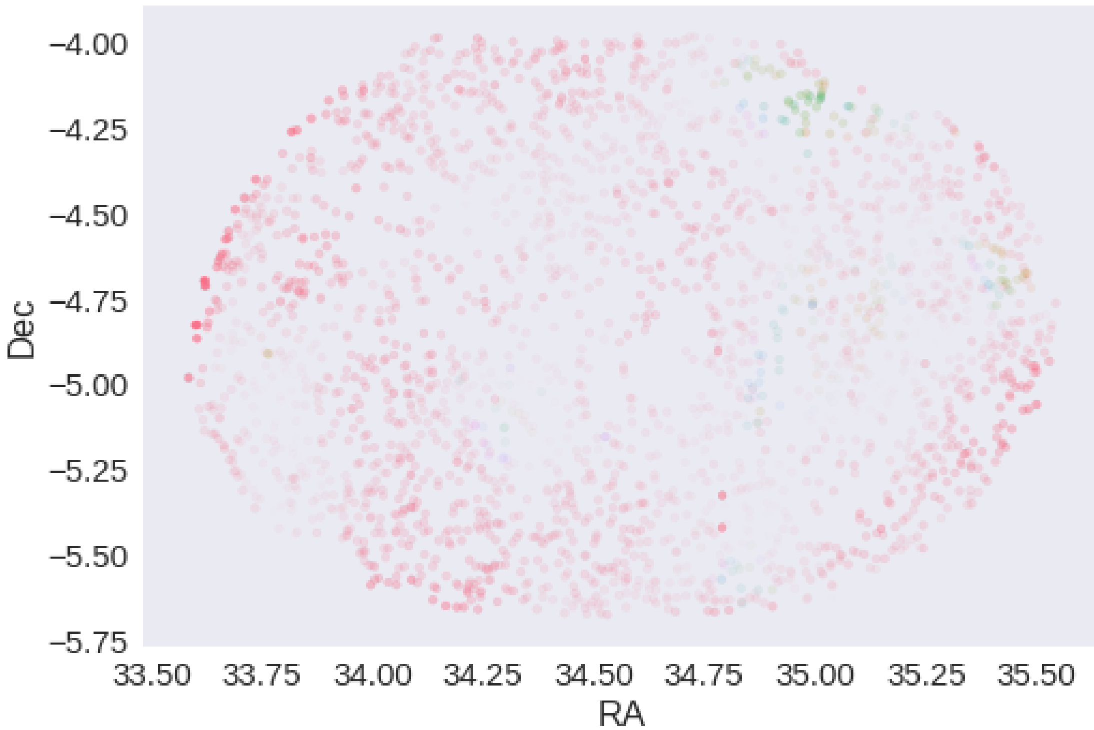

pearsonr = -0.41; p = 7.8e-103
0.3
0.2
0.1
0.0
−0.1
−0.2
Dec diff. [arcsec]
−0.2
0.0
0.2
0.4
RA diff. [arcsec]




```
RA correction: 0.11995867840823848 arcsec
Dec correction: -0.08751257112411537 arcsec
```



pearsonr = -0.41; p = 7.8e-103
0.2
0.1
0.0
−0.1
−0.2
−0.3
Dec diff. [arcsec]
−0.2
0.0
0.2
0.4
RA diff. [arcsec]



1.7 IV - Flagging Gaia objects

```
2532 sources flagged.
```

2 V - Saving to disk

1.10_PanSTARRS1-3SS

March 8, 2018

1 XMM-LSS 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:
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

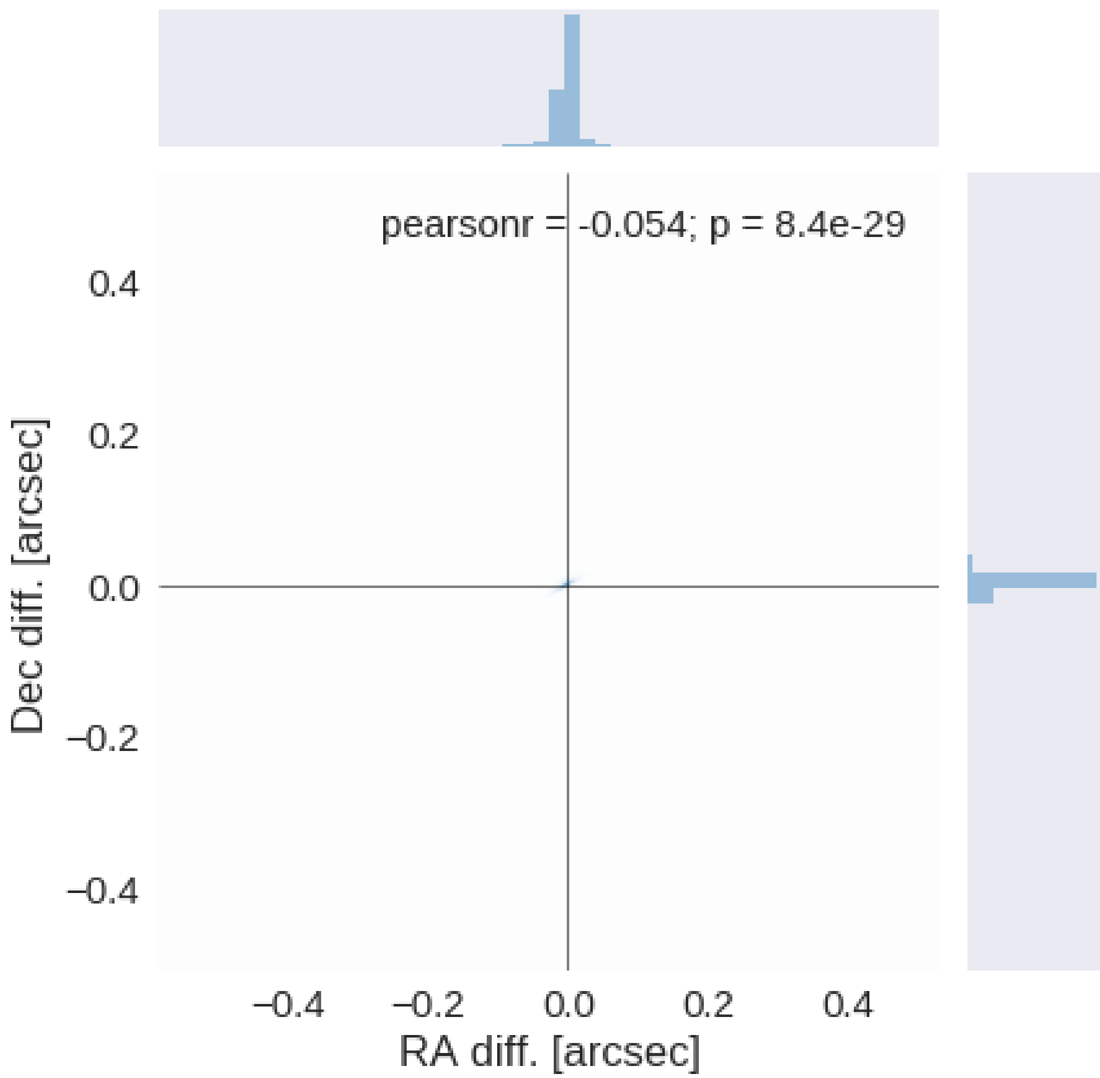
We remove duplicated objects from the input catalogues.

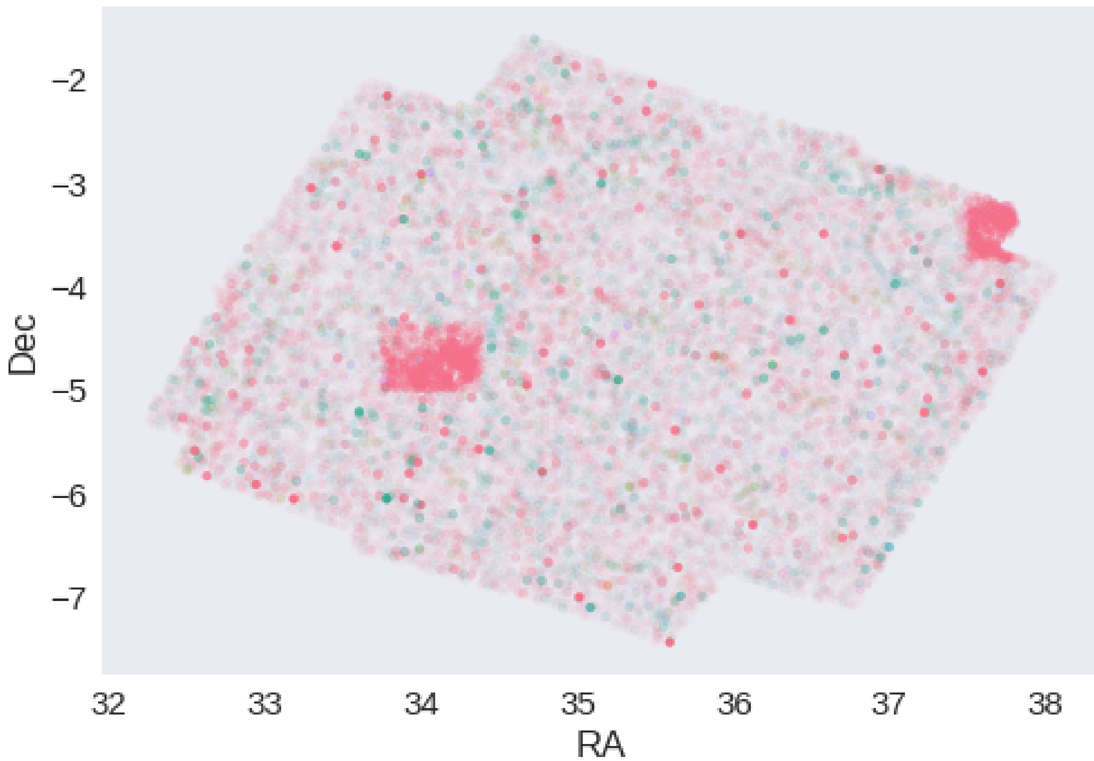
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 384755 sources.
The cleaned catalogue has 384643 sources (112 removed).
The cleaned catalogue has 112 sources flagged as having been cleaned
```

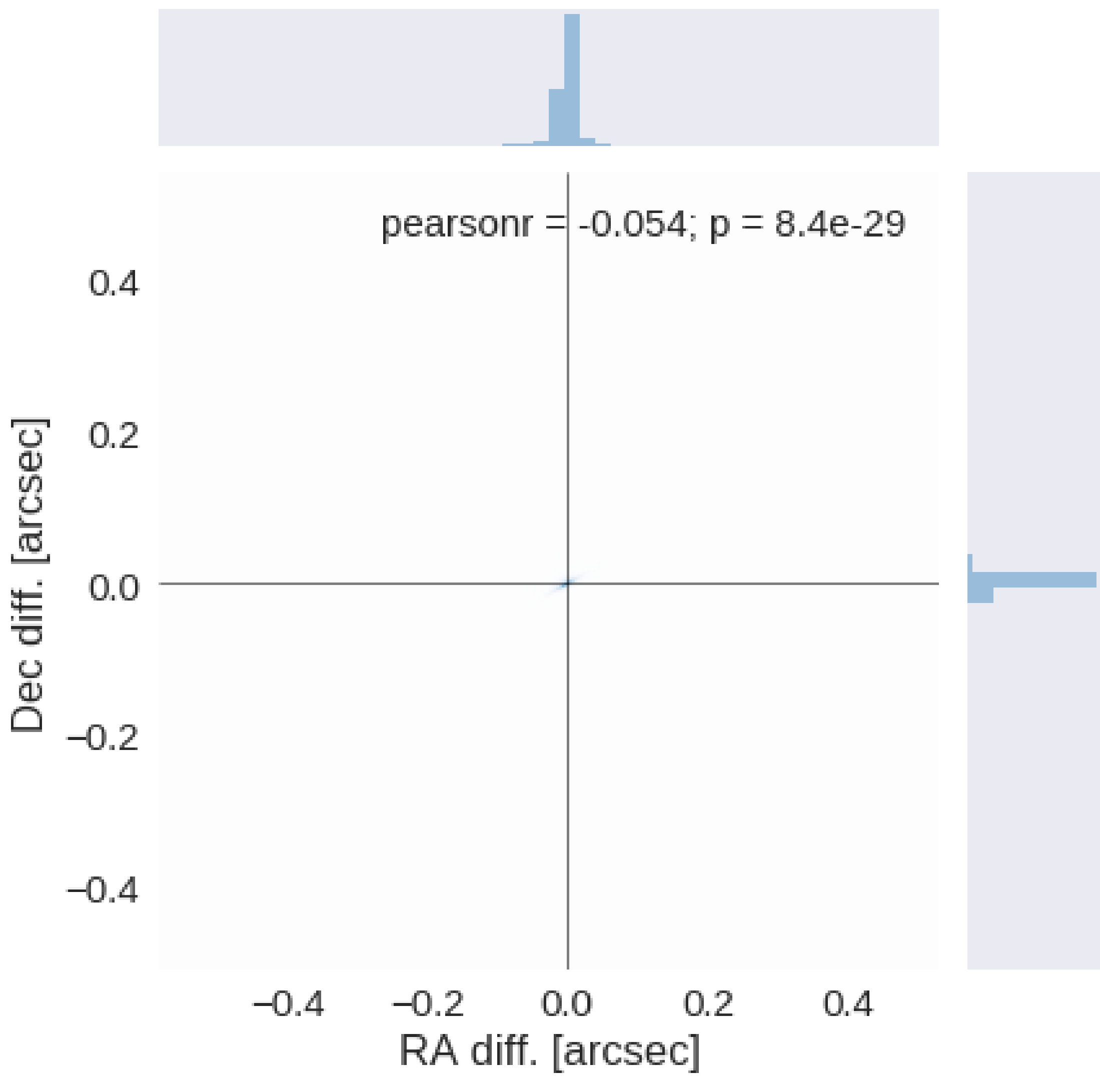
1.4 III - Astrometry correction

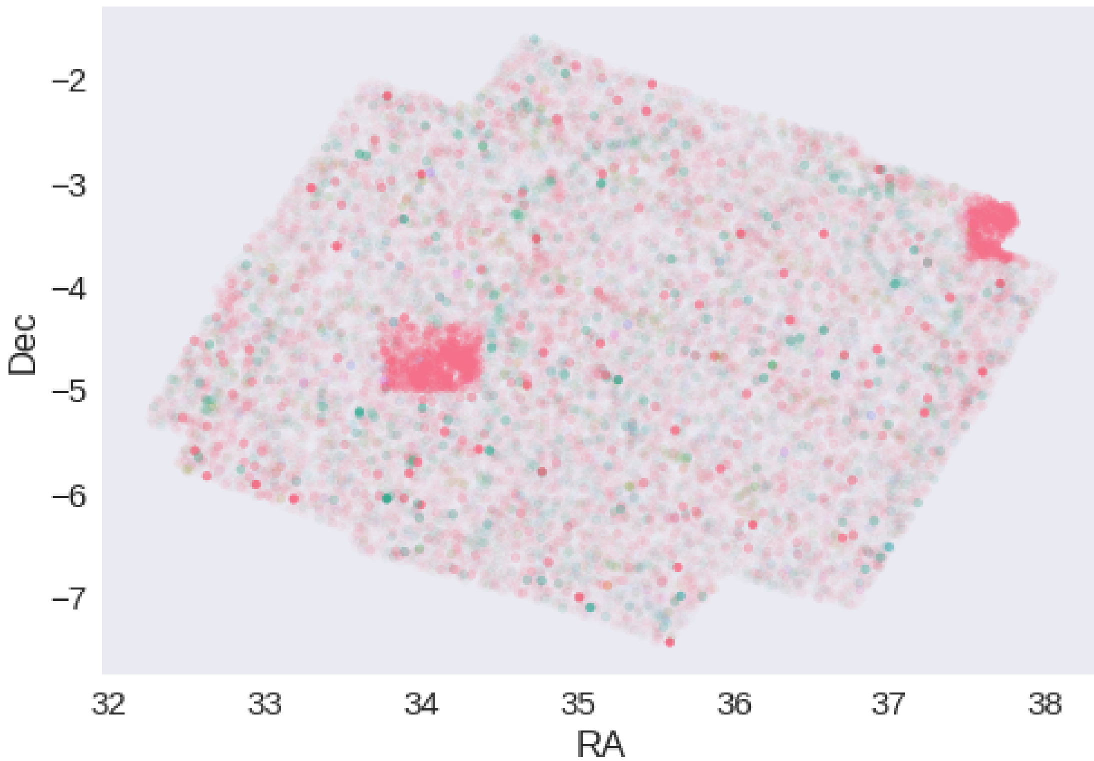
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.00022419935987727513 arcsec
Dec correction: -0.0008451836286837988 arcsec
```


pearsonr = -0.054; p = 8.4e-29
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]



1.5 IV - Flagging Gaia objects

```
42278 sources flagged.
```

2 V - Saving to disk

1.11_SXDS

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of the Subaru/XMM-Newton Deep Survey (SXDS) data

The catalogue is in `dmu0_SXDS`.

In the catalogue, we keep:

- The position;
- The stellarity;
- The aperture magnitude B, V, R, i, z (2 arcsec).
- The total magnitude B, V, R, i, z (Kron like aperture magnitude).

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
This notebook was executed on:
2018-02-19 15:51:17.589099
```

1.2 I - Column selection

For each band we have 5 independent and overlapping catalogues. We must first stack the catalogues and remove duplicates then merge the bands together.

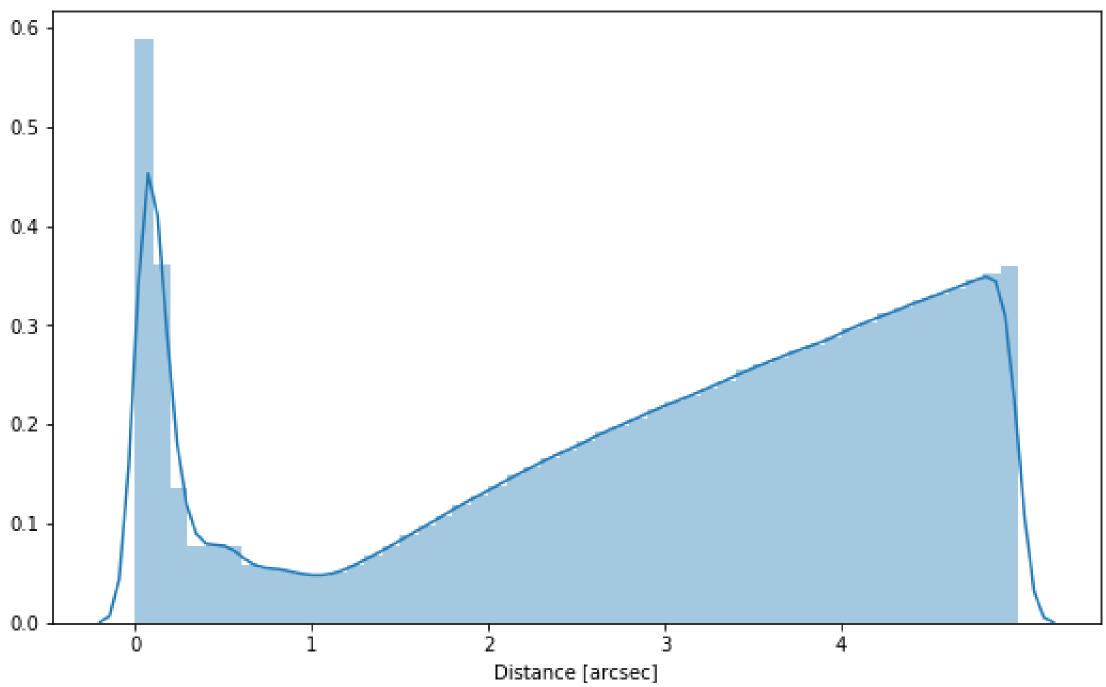
```
The initial catalogue had 940853 sources.
The cleaned catalogue has 908480 sources (32373 removed).
The cleaned catalogue has 32244 sources flagged as having been cleaned


The initial catalogue had 1002561 sources.
The cleaned catalogue has 970203 sources (32358 removed).
The cleaned catalogue has 32252 sources flagged as having been cleaned


The initial catalogue had 901094 sources.
The cleaned catalogue has 873890 sources (27204 removed).
The cleaned catalogue has 27129 sources flagged as having been cleaned
```

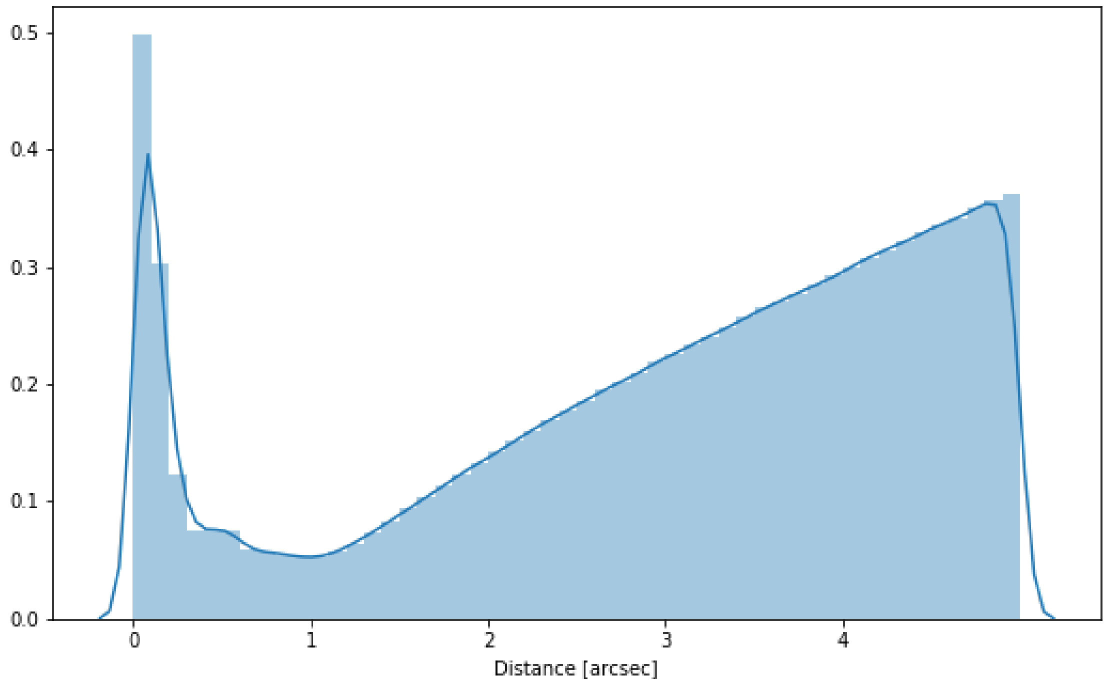
```
The initial catalogue had 899484 sources.
The cleaned catalogue has 870730 sources (28754 removed).
The cleaned catalogue has 28686 sources flagged as having been cleaned
```

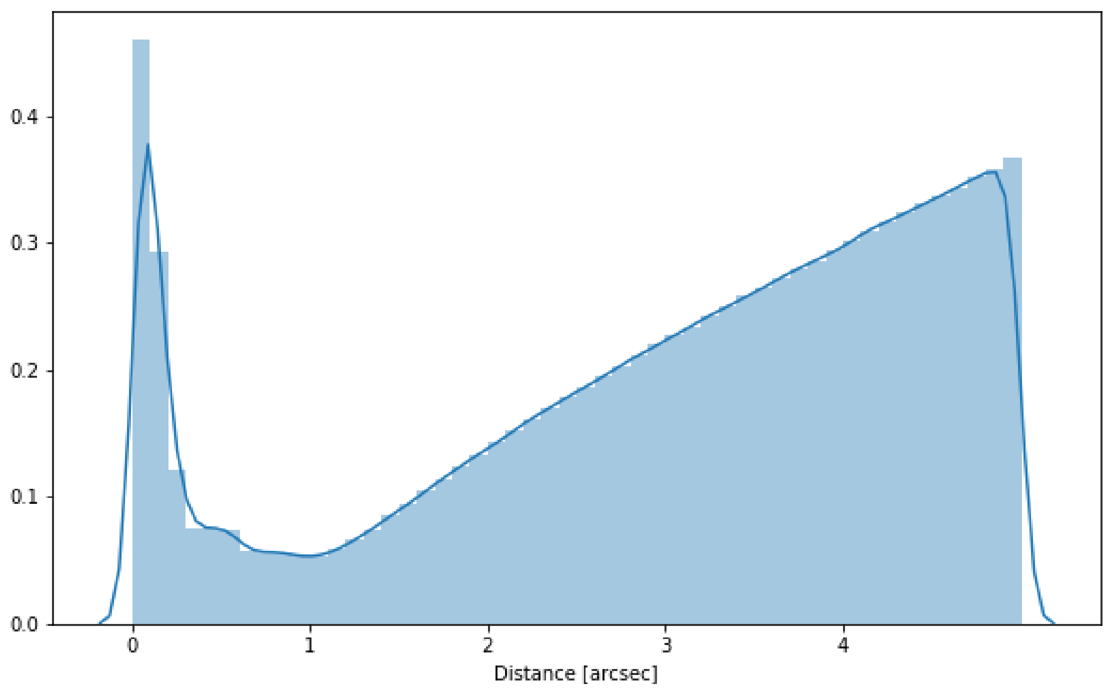
```
The initial catalogue had 842590 sources.
The cleaned catalogue has 818902 sources (23688 removed).
The cleaned catalogue has 23589 sources flagged as having been cleaned
```

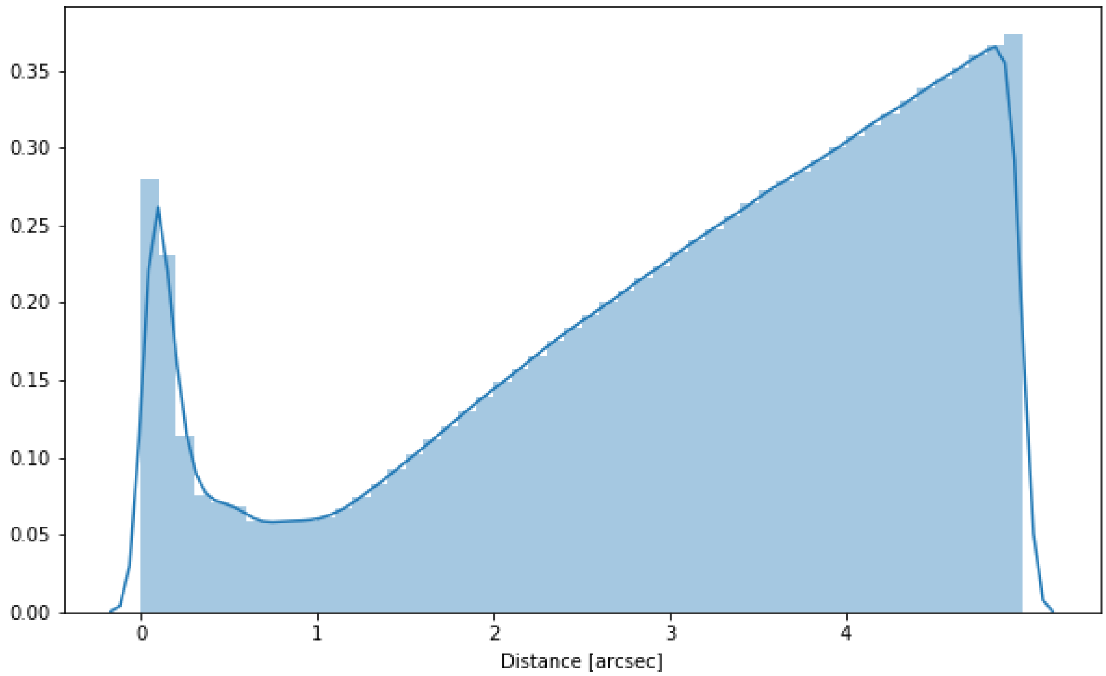
1.3 Merging different bands

SXDS has indivdual extractions from each band. We must therefore merge them as if they were individual catalogues (they have different




0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
Distance [arcsec]


0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
Distance [arcsec]



1.4 Fill masked values and add fluxes and nans

```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:9: R
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:10:
```

```
Out[26]: <IPython.core.display.HTML object>
```

1.5 Combine stellarities

```
sxds_b_stellarity, sxds_v_stellarity, sxds_r_stellarity, sxds_i_stellarity, sxds_z_stellarity
```

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

1.6 II - Removal of duplicated sources

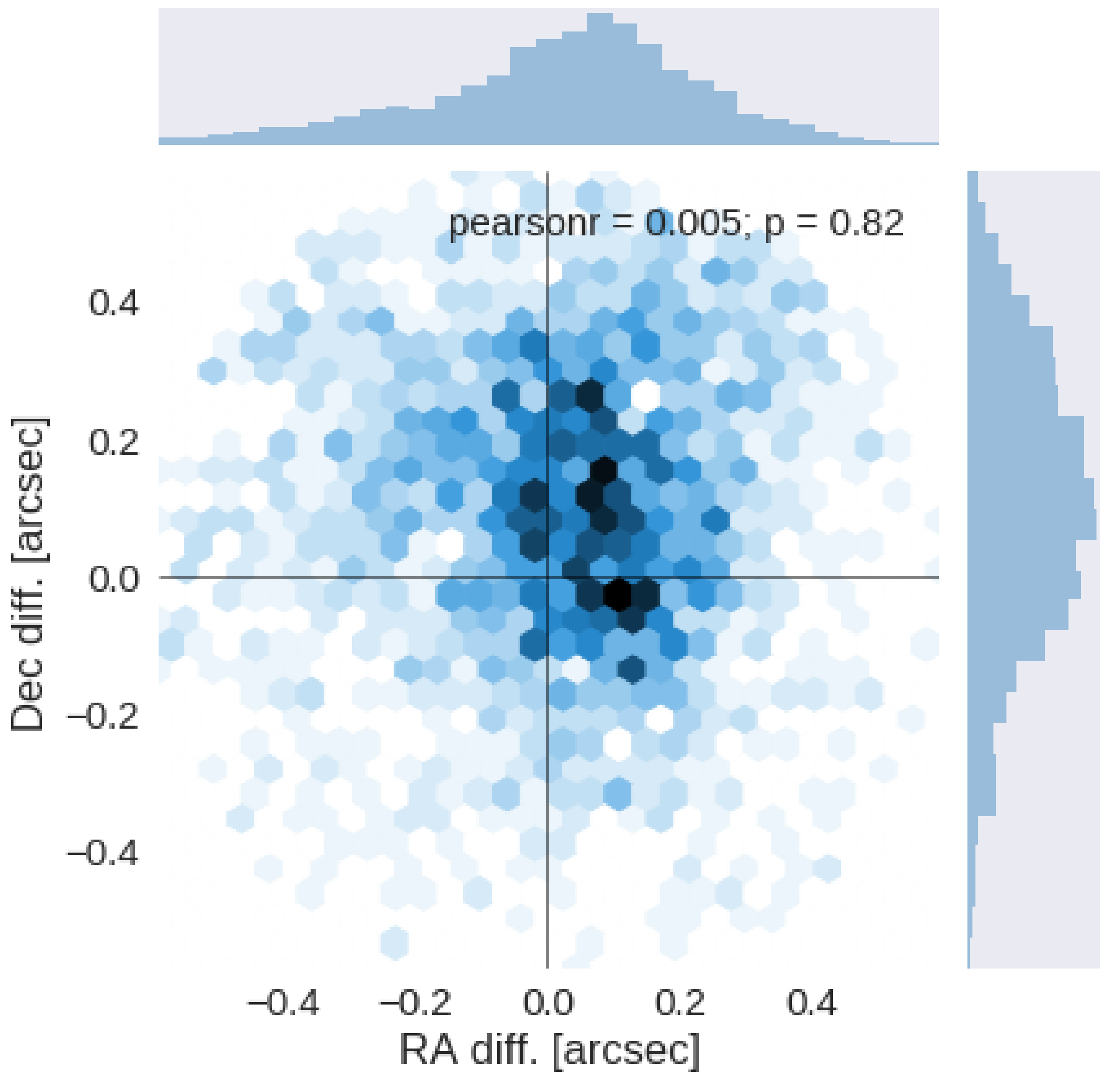
We remove duplicated objects from the input catalogues.

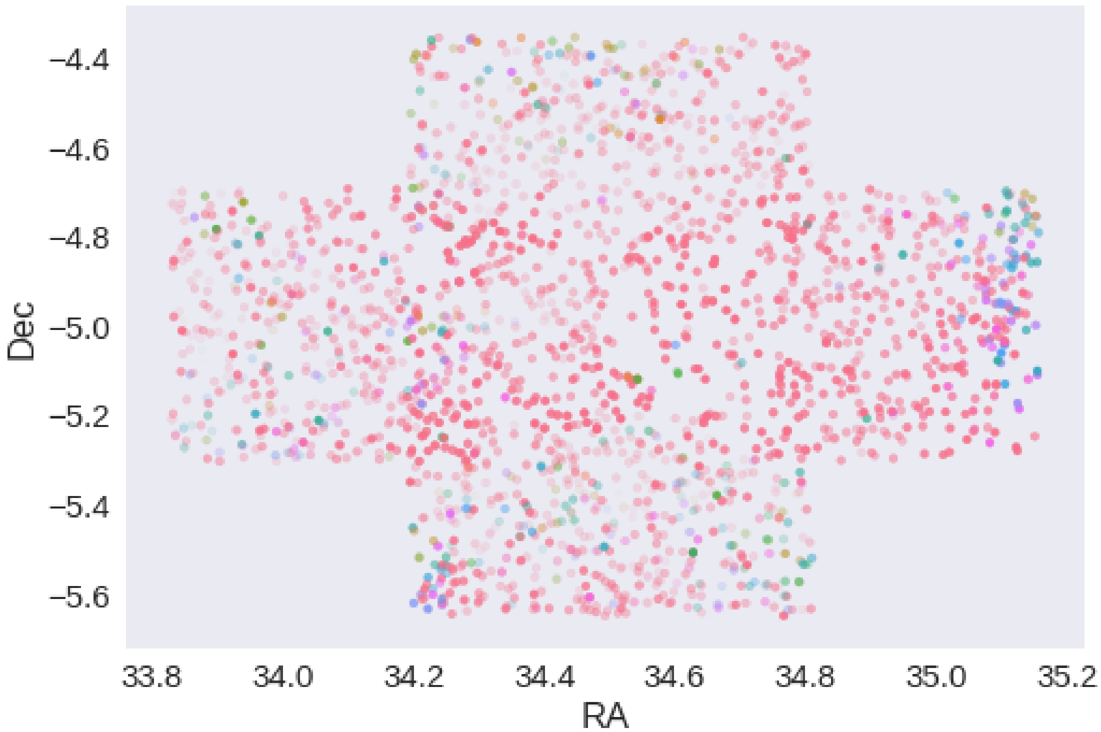
```
The initial catalogue had 1522678 sources.
The cleaned catalogue has 1512687 sources (9991 removed).
The cleaned catalogue has 10007 sources flagged as having been cleaned
```

```
Out[33]: <IPython.core.display.HTML object>
```

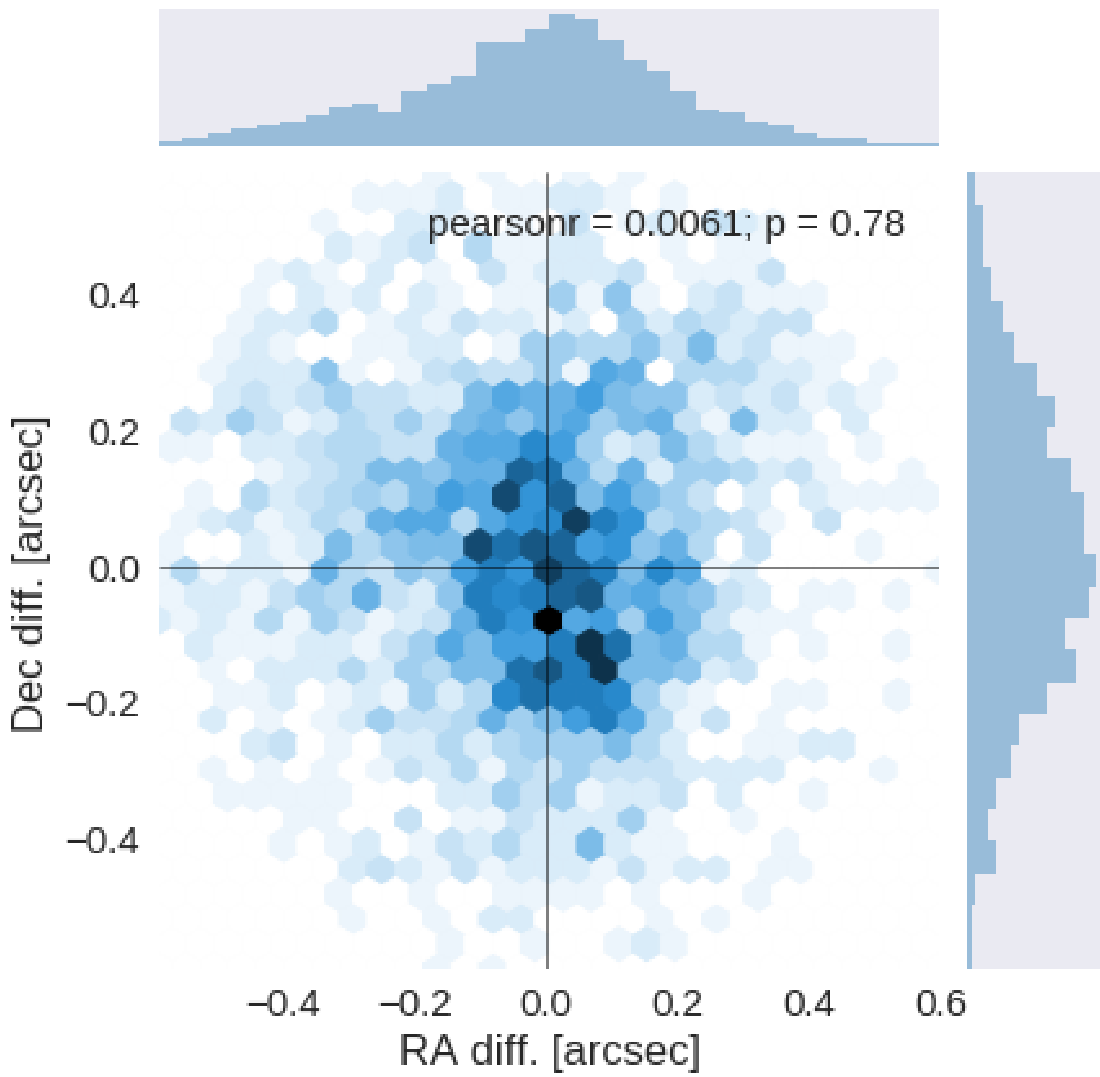
1.7 III - Astrometry correction

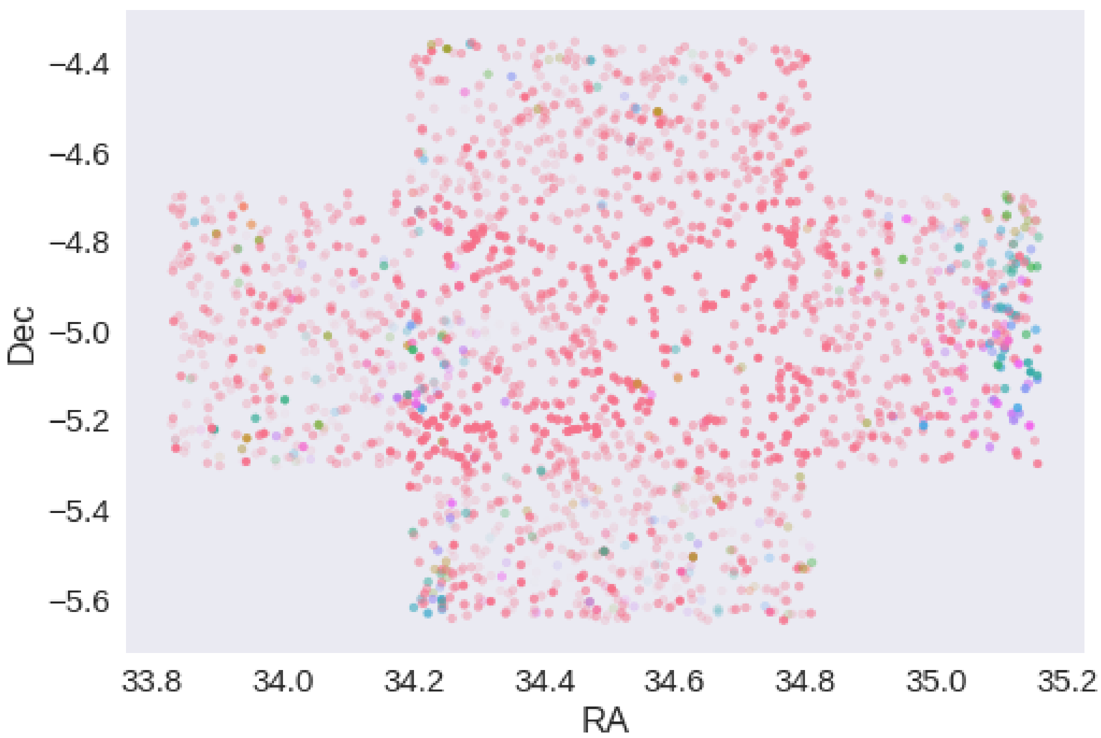
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: -0.050656639996304875 arcsec
Dec correction: -0.1055842856297673 arcsec
```


pearsonr = 0.0061; p = 0.78
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
0.4
0.6
RA diff. [arcsec]



1.8 IV - Flagging Gaia objects

```
2954 sources flagged.
```

2 V - Saving to disk

1.12_SpARCS

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of Spitzer Adaptation of the Red-sequence Cluster Survey (SpARCS) data

This catalogue comes from `dmu0_SpARCS`. Alexandru Tudorica confirmed that the magnitudes are AB ones and are not aperture corrected.

In the catalogue, we keep:

- The internal identifier (this one is only in HeDaM data);
- The position;
- The ugrzy magnitudes in the 8th aperture (11Œ0.186=2.046 arcsec).
- The "auto" magnitudes.

The maps on the web page indicate they were observed in 2012 (or late 2011). Let's use 2012 as epoch.

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

1.2 I - Parametres for 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.

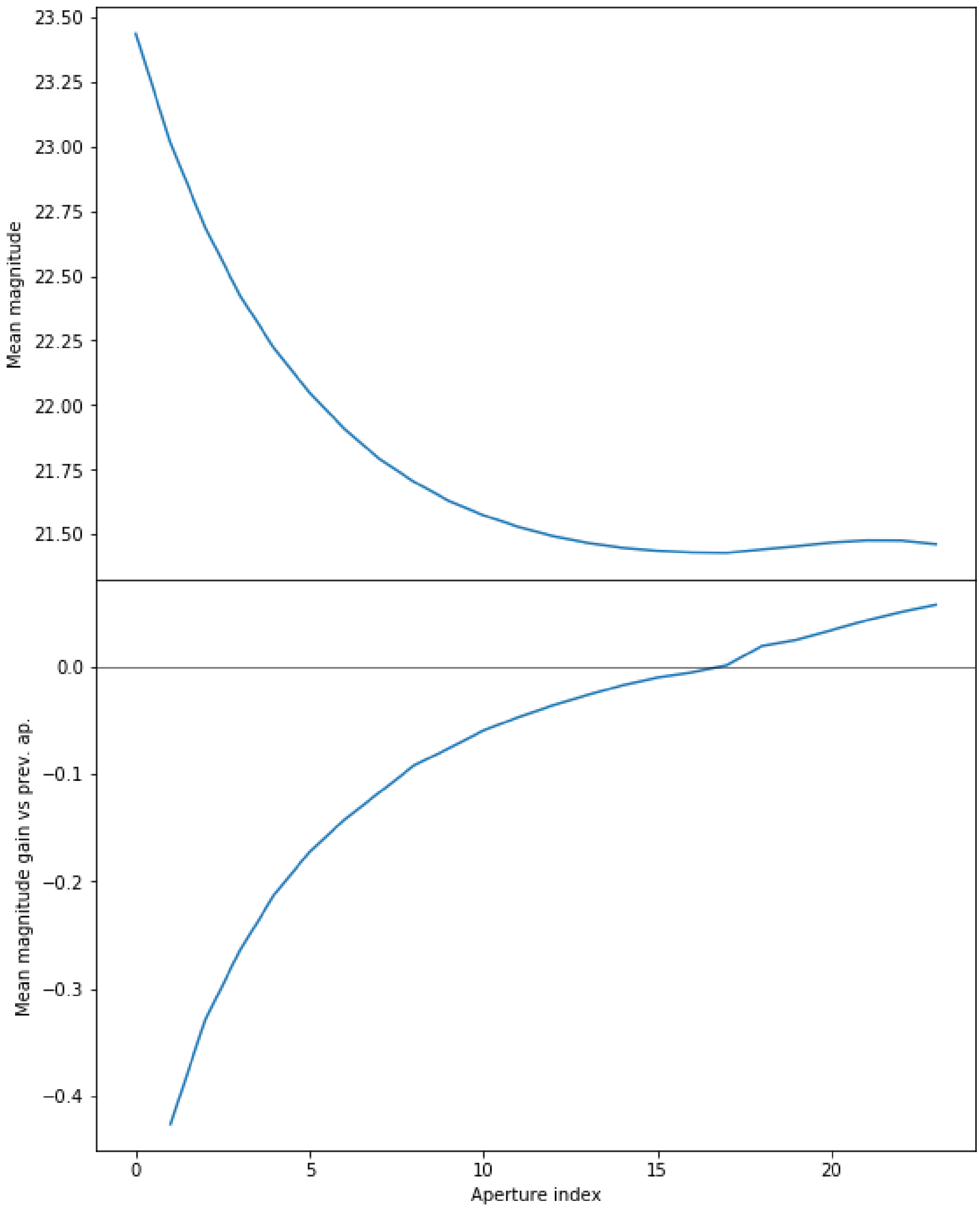
Target aperture: To determine the target aperture, we simulate a curve of growth using the provided apertures and draw two figures: - The evolution of the magnitudes of the objects by plotting on the same plot aperture number vs the mean magnitude. - The mean gain (loss when negative) of magnitude is 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.

```
WARNING: UnitsWarning: '""' did not parse as fits unit: Invalid character at col 0 [astropy.unit
```

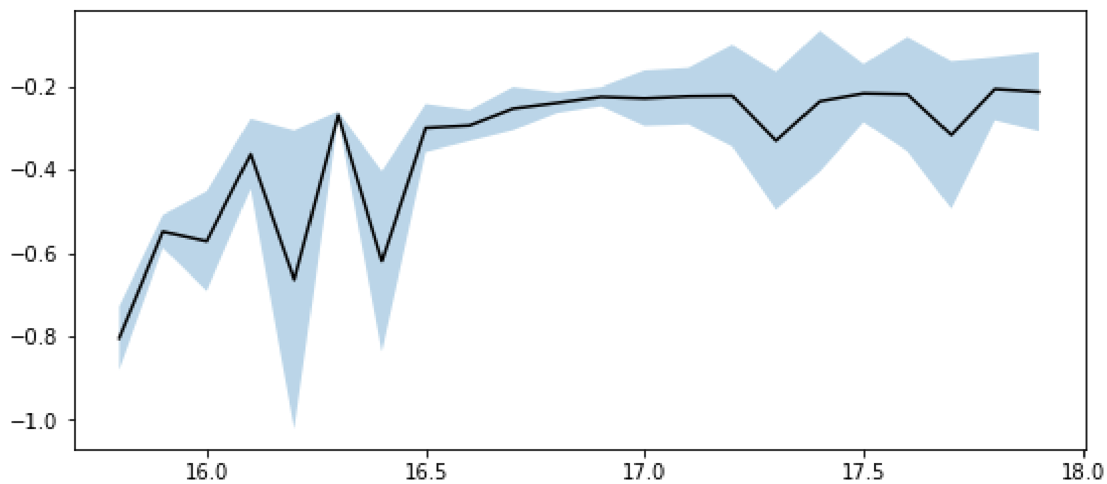
1.2.1 I.a r-band



We will use the 16th (aperture number above begin to 0) aperture as target.

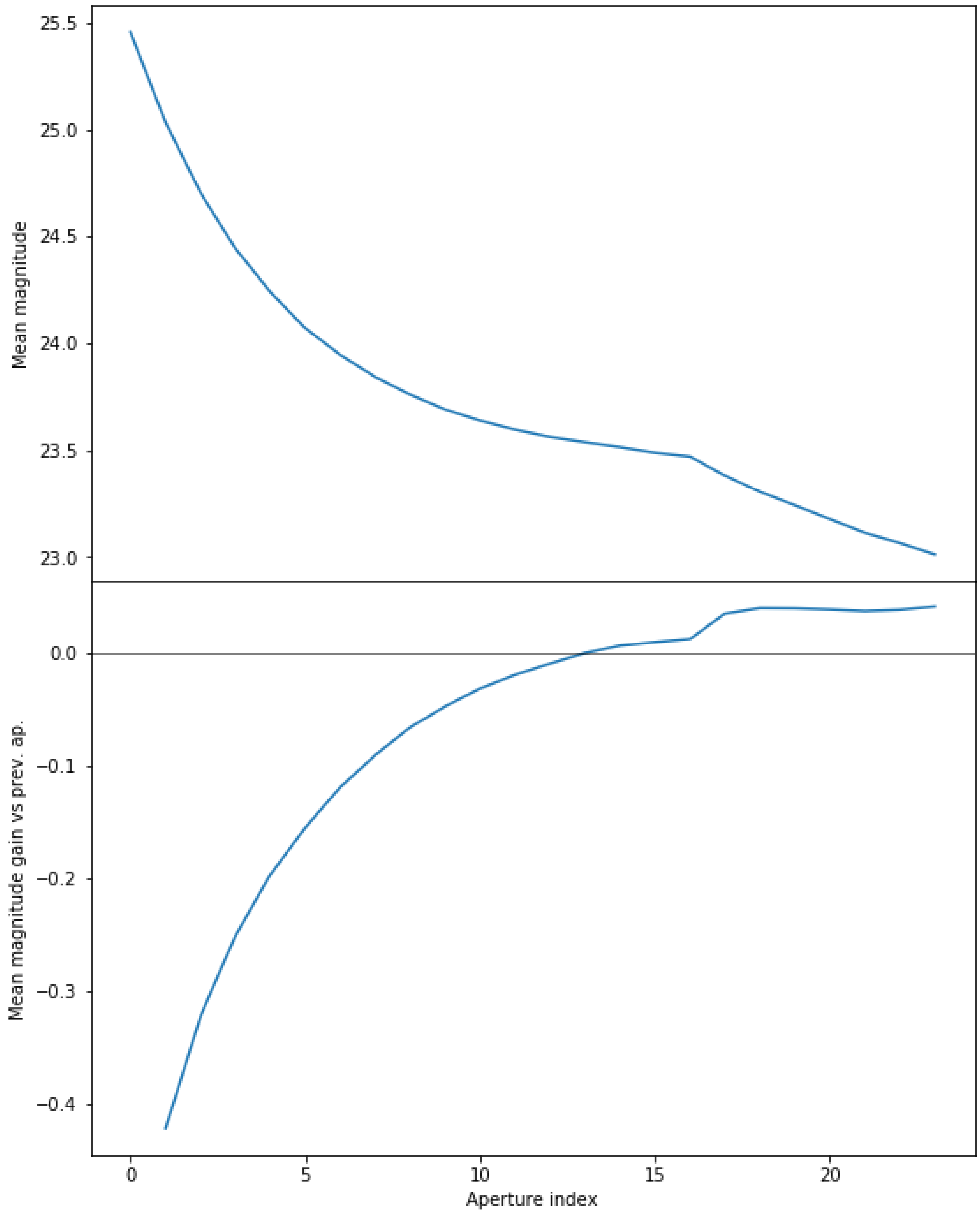
```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
```

```
mask &= (mag <= mag_max)
```



We use magnitudes between 17 and 17.9.

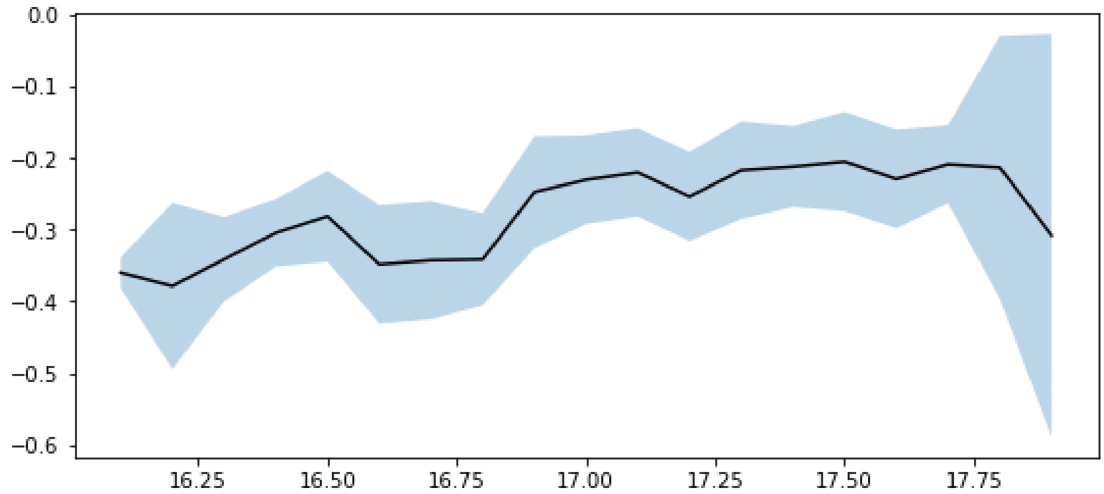
1.2.2 I.b u-band



We will use the 16th (aperture number above begin to 0) aperture as target. Should we use the 12nd because of the increasing magnitude?

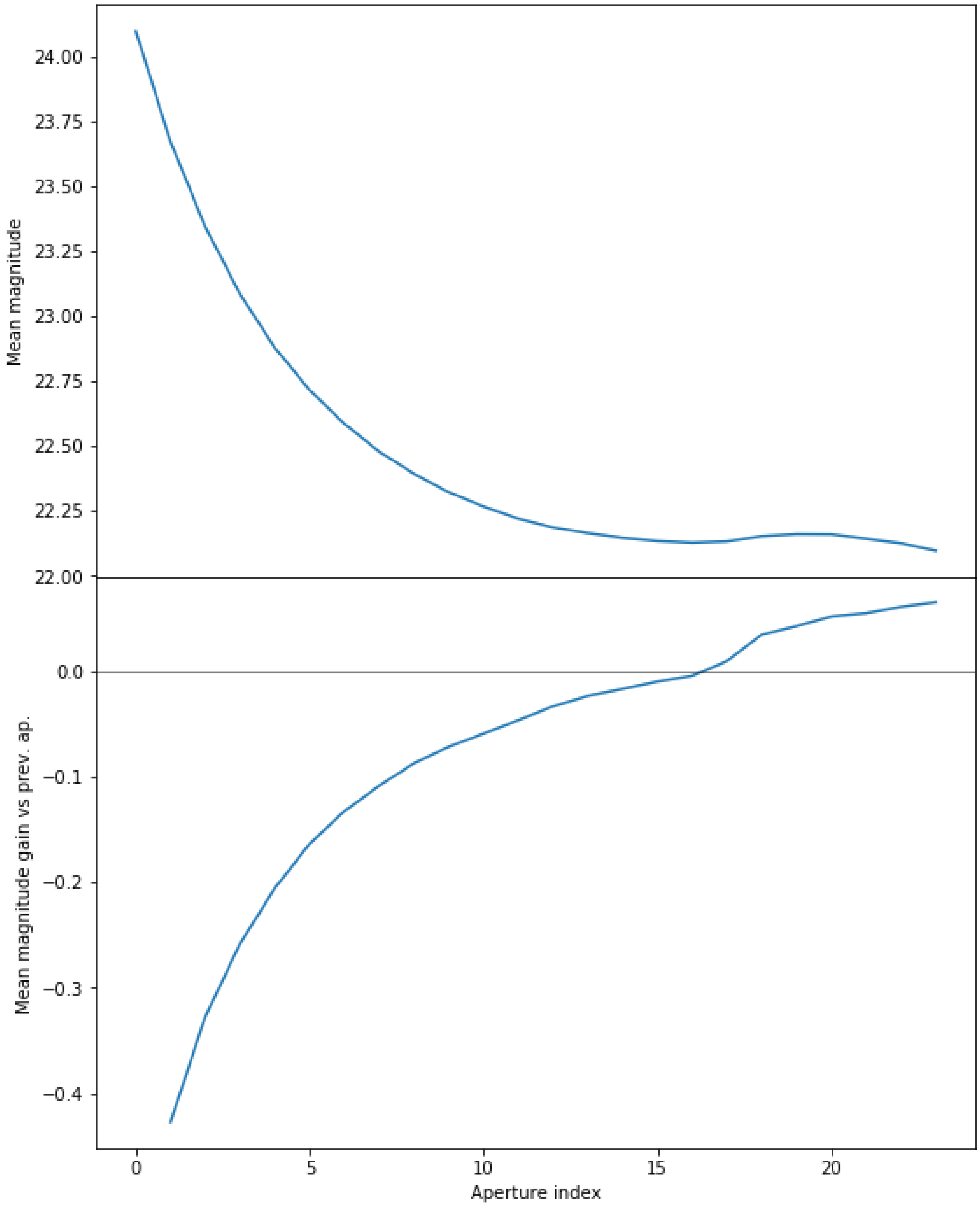
```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
```

```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
  mask &= (mag <= mag_max)
```



We use magnitudes between 17 and 17.9.

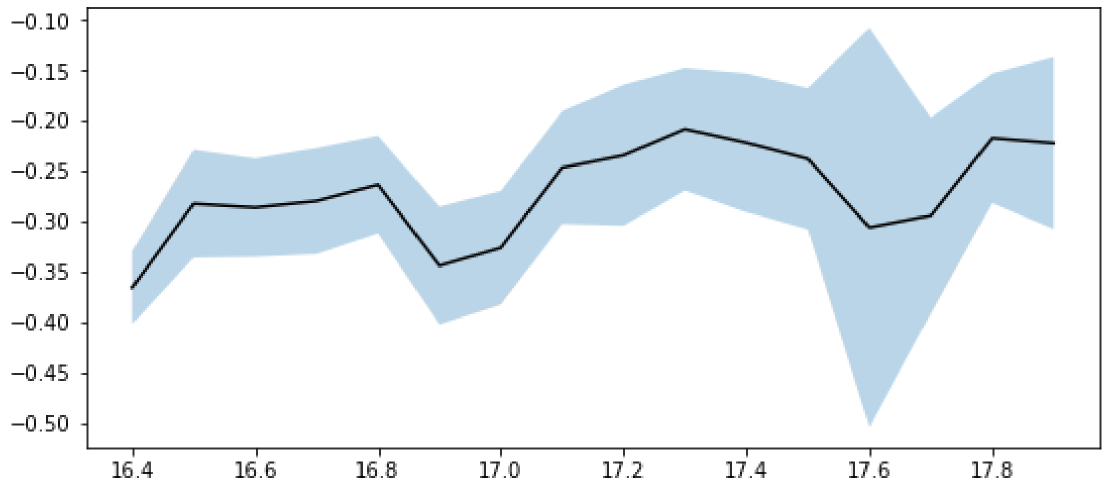
1.2.3 I.c g-band



We will use the 16th (aperture number above begin to 0) aperture as target.

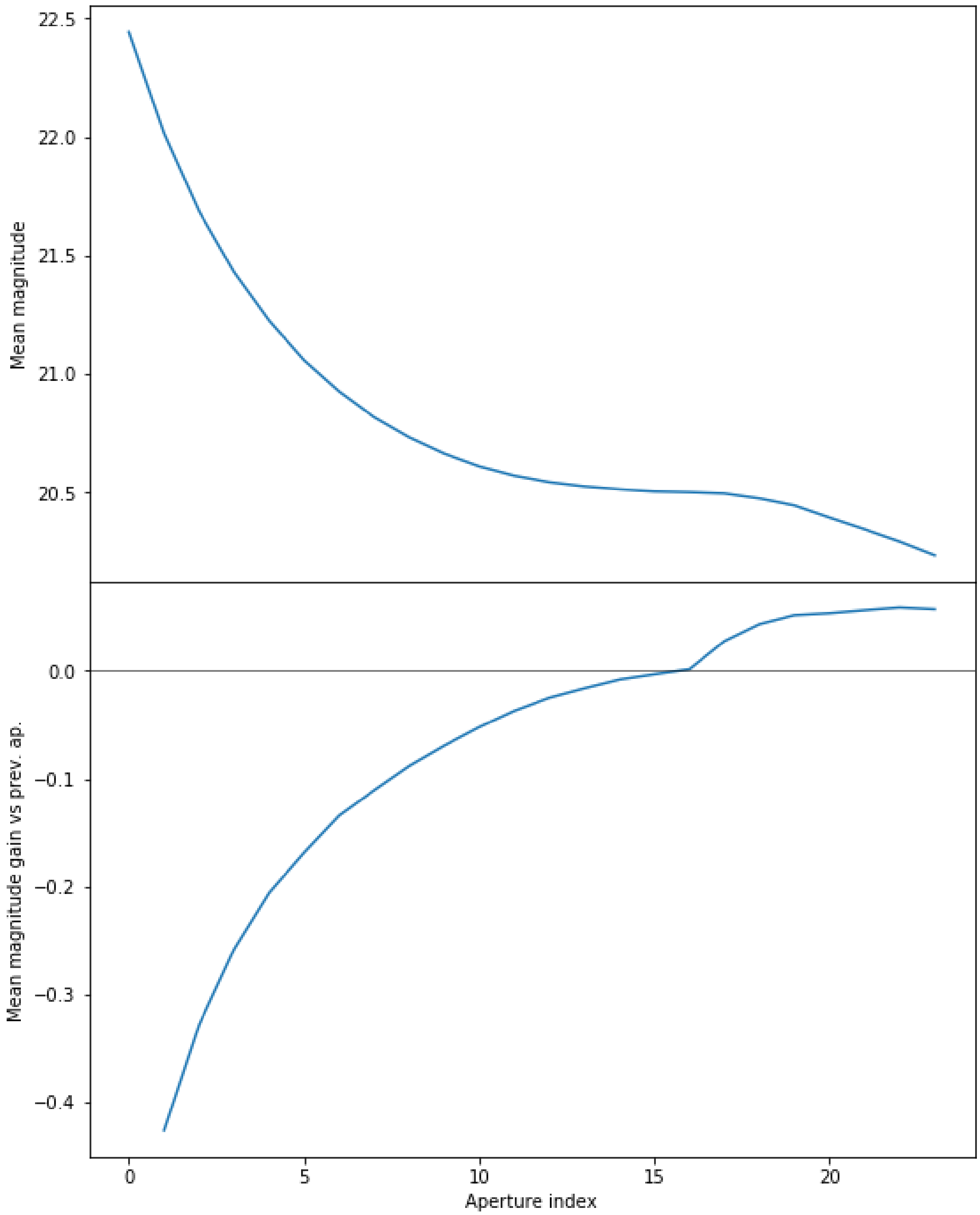
```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
```

```
mask &= (mag <= mag_max)
```



We use magnitudes between 17.2 and 18.

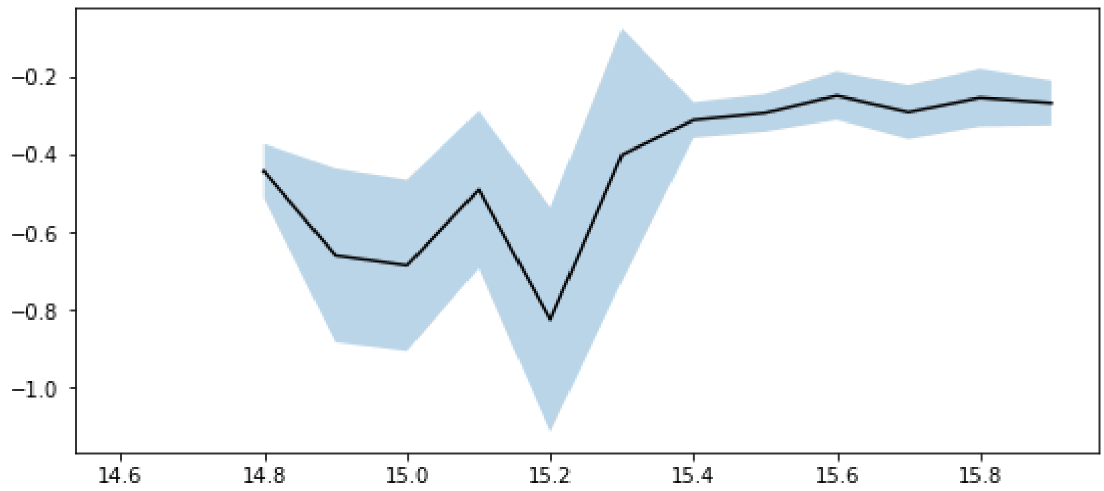
1.2.4 I.d z-band



We will use the 16th (aperture number above begin to 0) aperture as target.

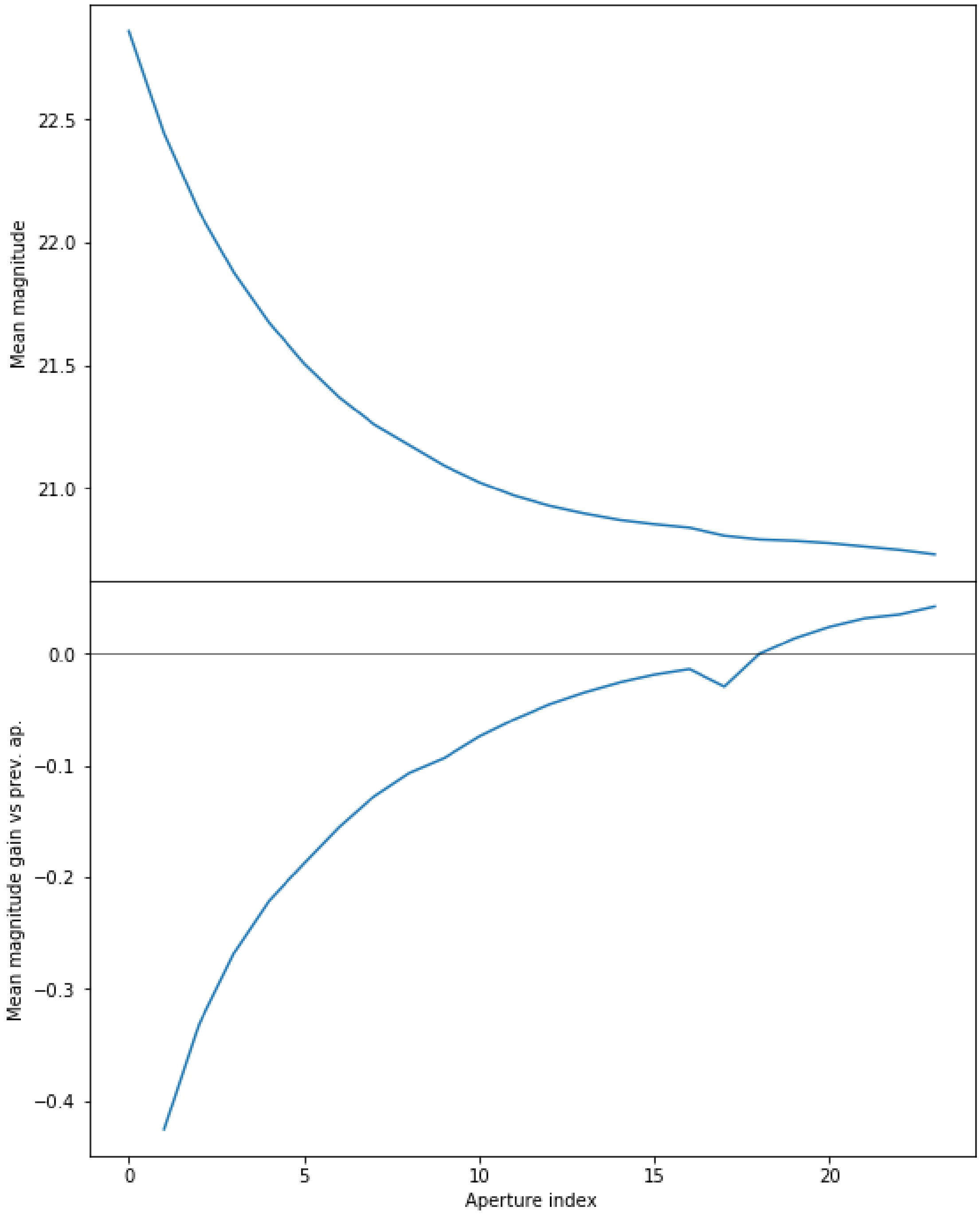
```
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:131: RuntimeWarning: invalid value enc
  mask &= (mag >= mag_min)
/opt/herschelhelp_internal/herschelhelp_internal/utils.py:133: RuntimeWarning: invalid value enc
```

```
mask &= (mag <= mag_max)
```



We use magnitudes between 16 and 17.

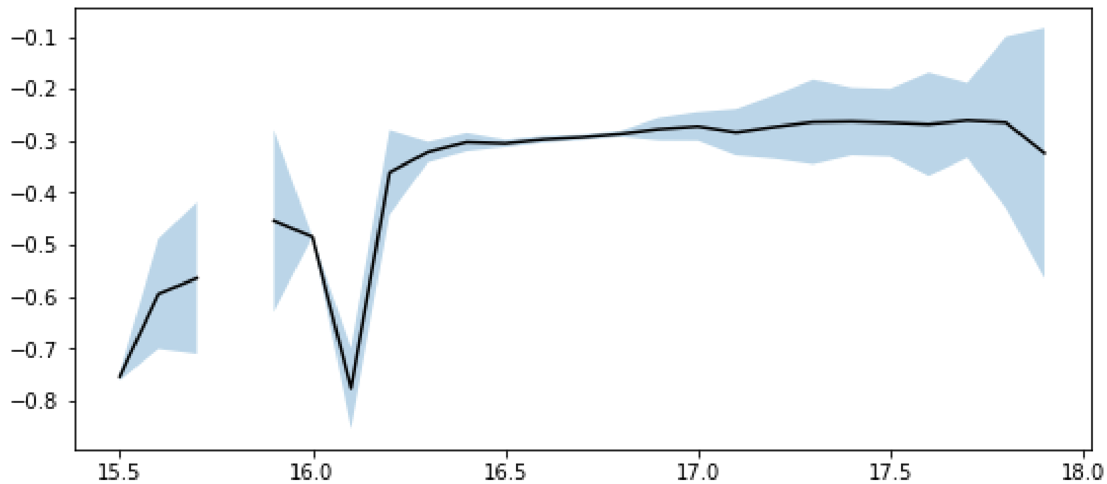
1.2.5 I.e y-band



We will use the 16th (aperture number above begin to 0) aperture as target.

```
/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 mags between 16.5 and 17.5

1.3 II - Column selection

```
WARNING: UnitsWarning: '""' did not parse as fits unit: Invalid character at col 0 [astropy.unit
/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: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)


Aperture correction for SpARCS band u:
Correction: -0.21997451782226562
Number of source used: 325
RMS: 0.06430433467975358

Aperture correction for SpARCS band g:
Correction: -0.23264789581298828
Number of source used: 487
RMS: 0.06903040173673632

Aperture correction for SpARCS band r:
Correction: -0.2197418212890625
Number of source used: 821
RMS: 0.10640508916122655
```

```
Aperture correction for SpARCS band z:
Correction: -0.2187061309814453
Number of source used: 1058
RMS: 0.06586610521457599

Aperture correction for SpARCS band y:
Correction: -0.2814064025878906
Number of source used: 521
RMS: 0.055379872136121035
```

```
Out[17]: <IPython.core.display.HTML object>
```

1.4 II - Removal of duplicated sources

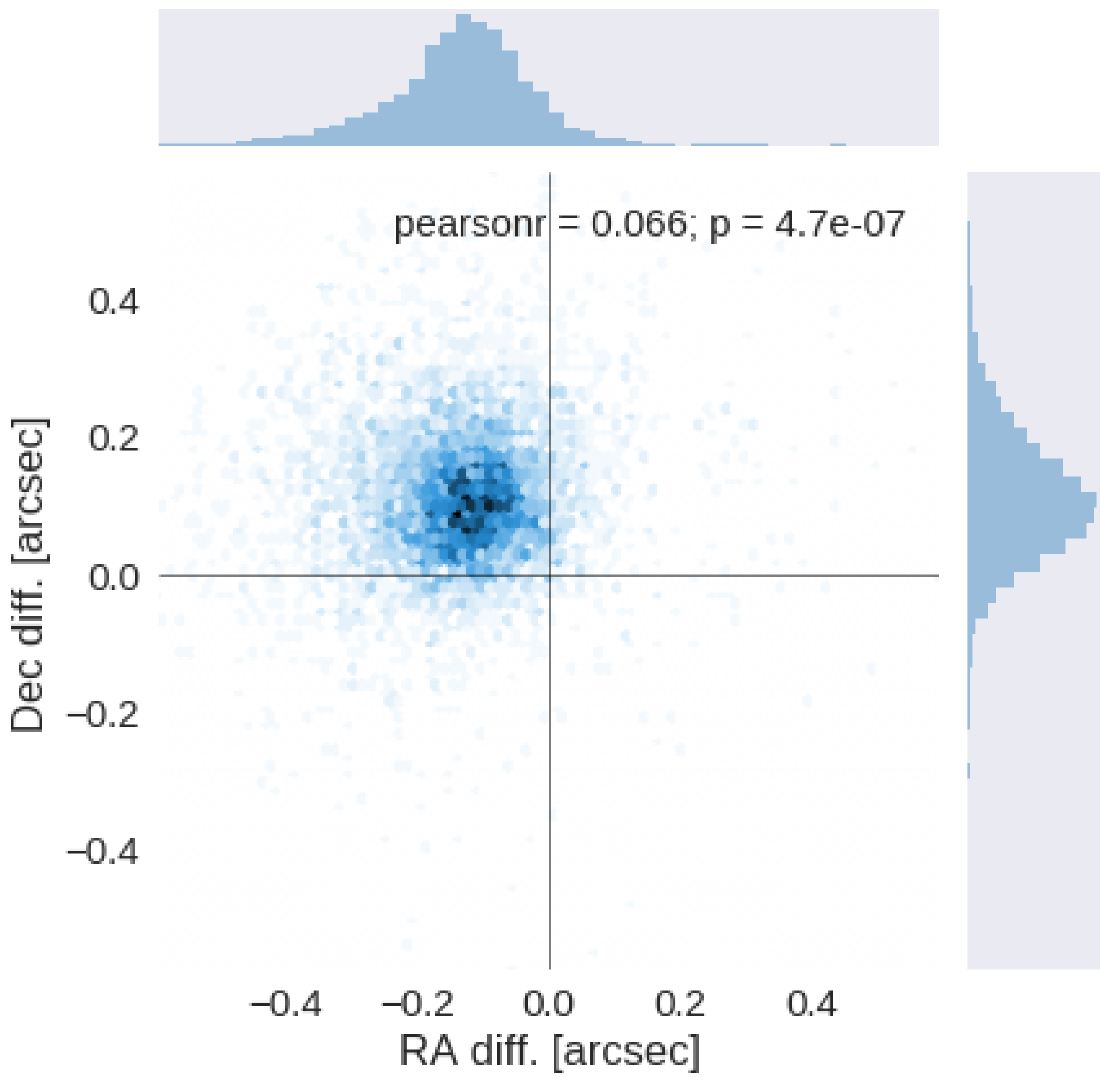
We remove duplicated objects from the input catalogues.

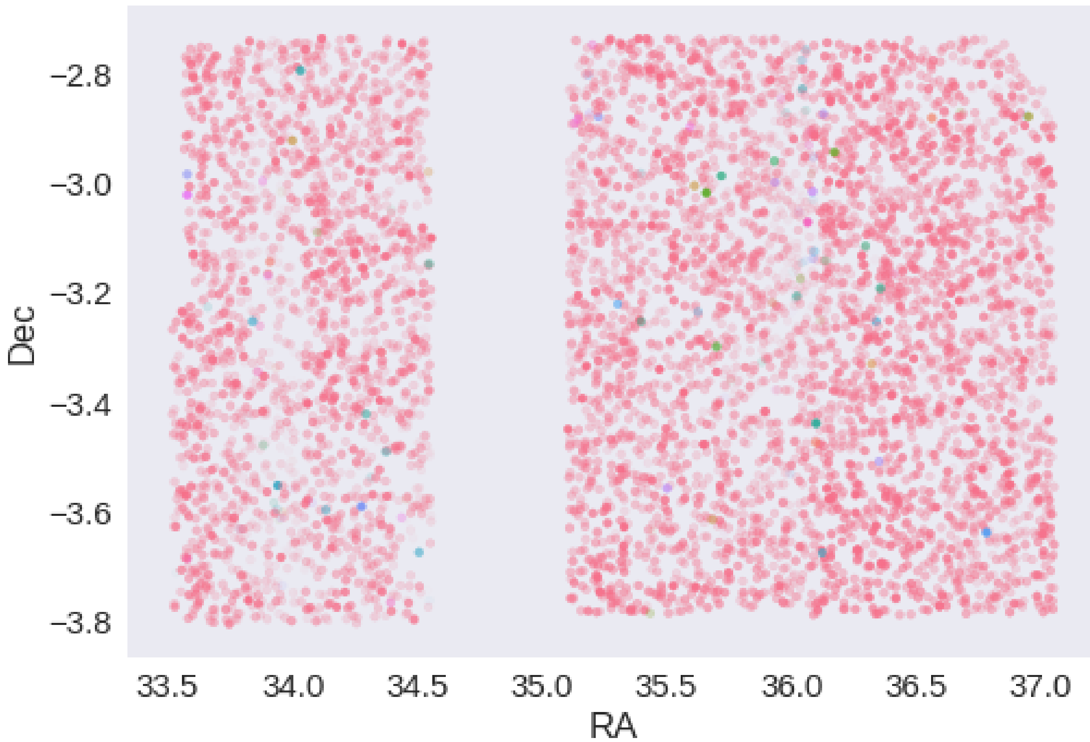
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 447768 sources.
The cleaned catalogue has 447768 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

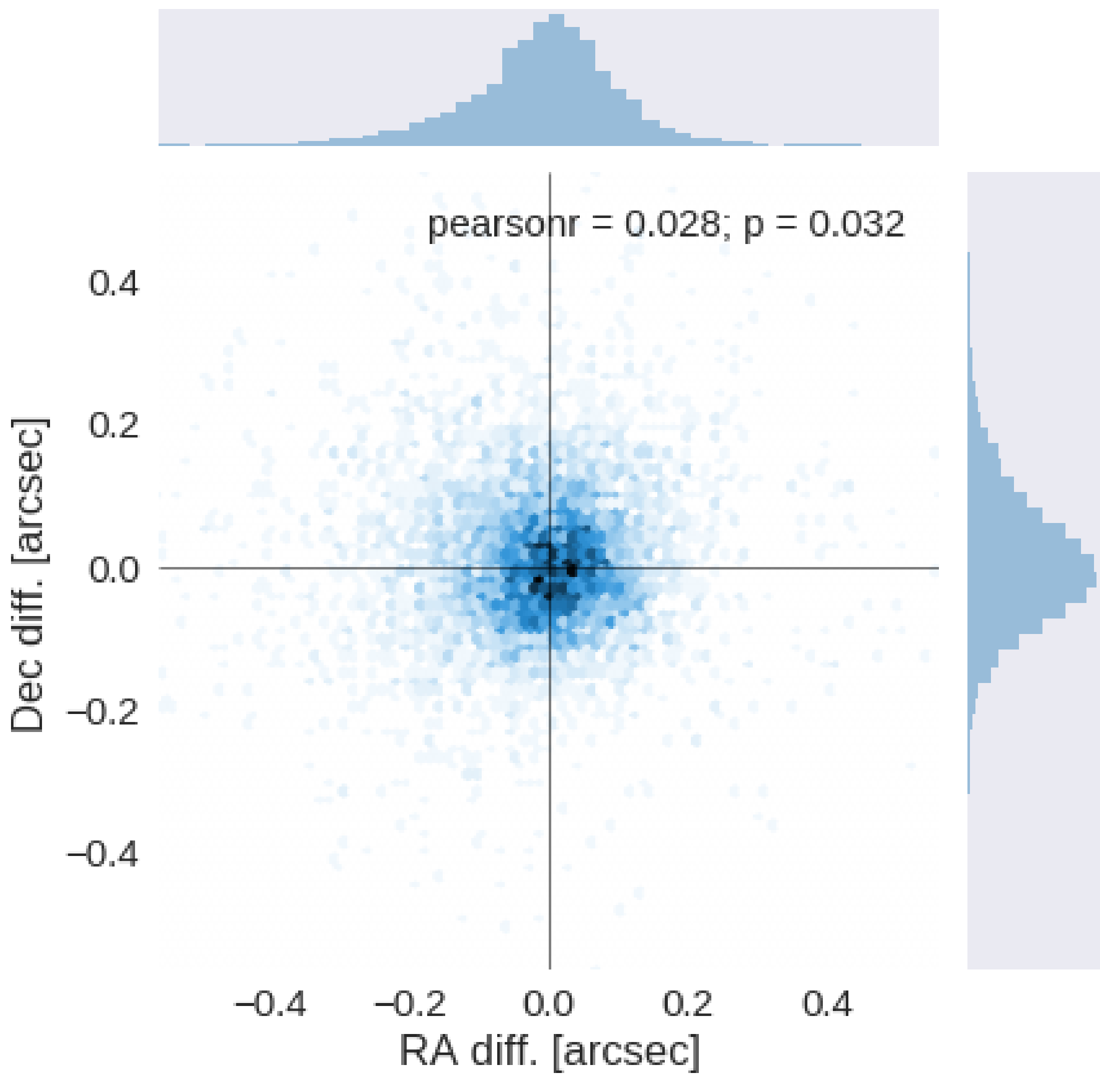
1.5 III - Astrometry correction

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.

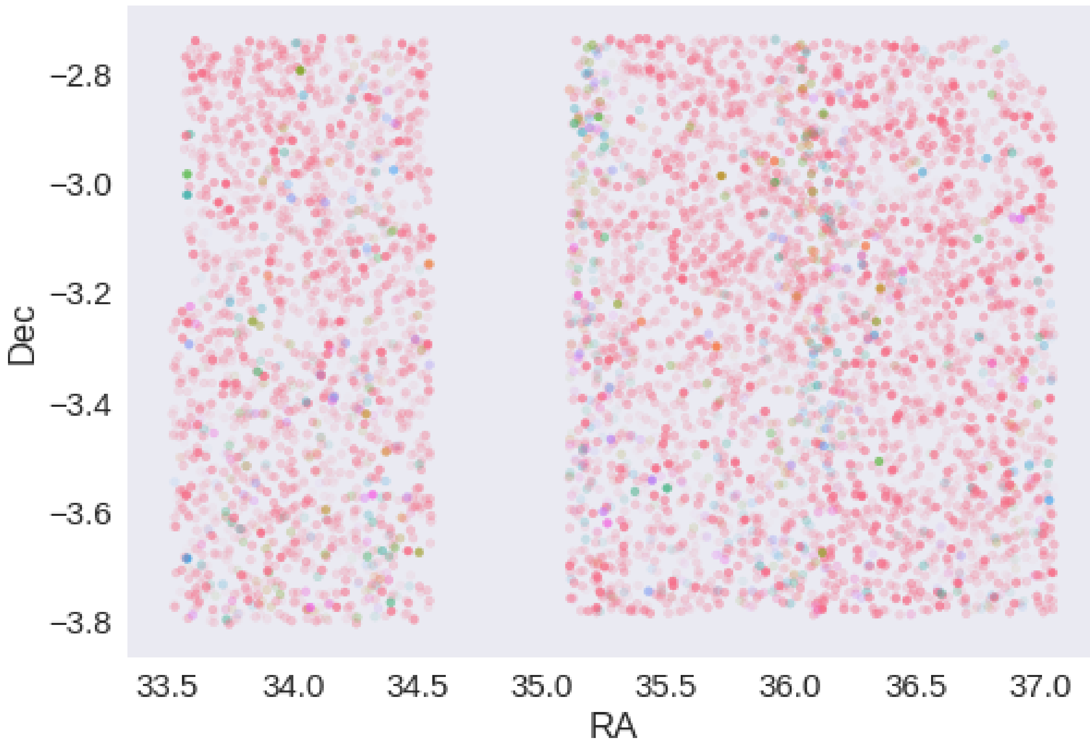

pearsonr = 0.066; p = 4.7e-07
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
0.4
RA diff. [arcsec]




```
RA correction: 0.1243786283438908 arcsec
Dec correction: -0.10356365148096458 arcsec
```



pearsonr = 0.028; p = 0.032
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 IV - Flagging Gaia objects

```
6126 sources flagged.
```

1.7 V - Saving to disk

1.13_UKIDSS-DXS

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of UKIRT Infrared Deep Sky Survey / Deep Extragalactic Survey (UKIDSS/DXS)

The catalogue comes from `dmu0_UKIDSS-DXS_DR10plus`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The magnitude for each band in apertude 3 (2 arcsec).
- The kron magnitude to be used as total magnitude (no "auto" magnitude is provided).

The magnitudes are "*Vega like*". The AB offsets are given by Hewett *et al.* (2016):

Band	AB offset
J	0.938
H	1.379
K	1.900

A query to the UKIDSS database with 242.9+55.071 position returns a list of images taken between 2007 and 2009. Let's take 2008 for the epoch.

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

1.2 I - Column selection

```
WARNING: UnitsWarning: 'degrees' did not parse as fits unit: At col 0, Unit 'degrees' not suppor
```

```
/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

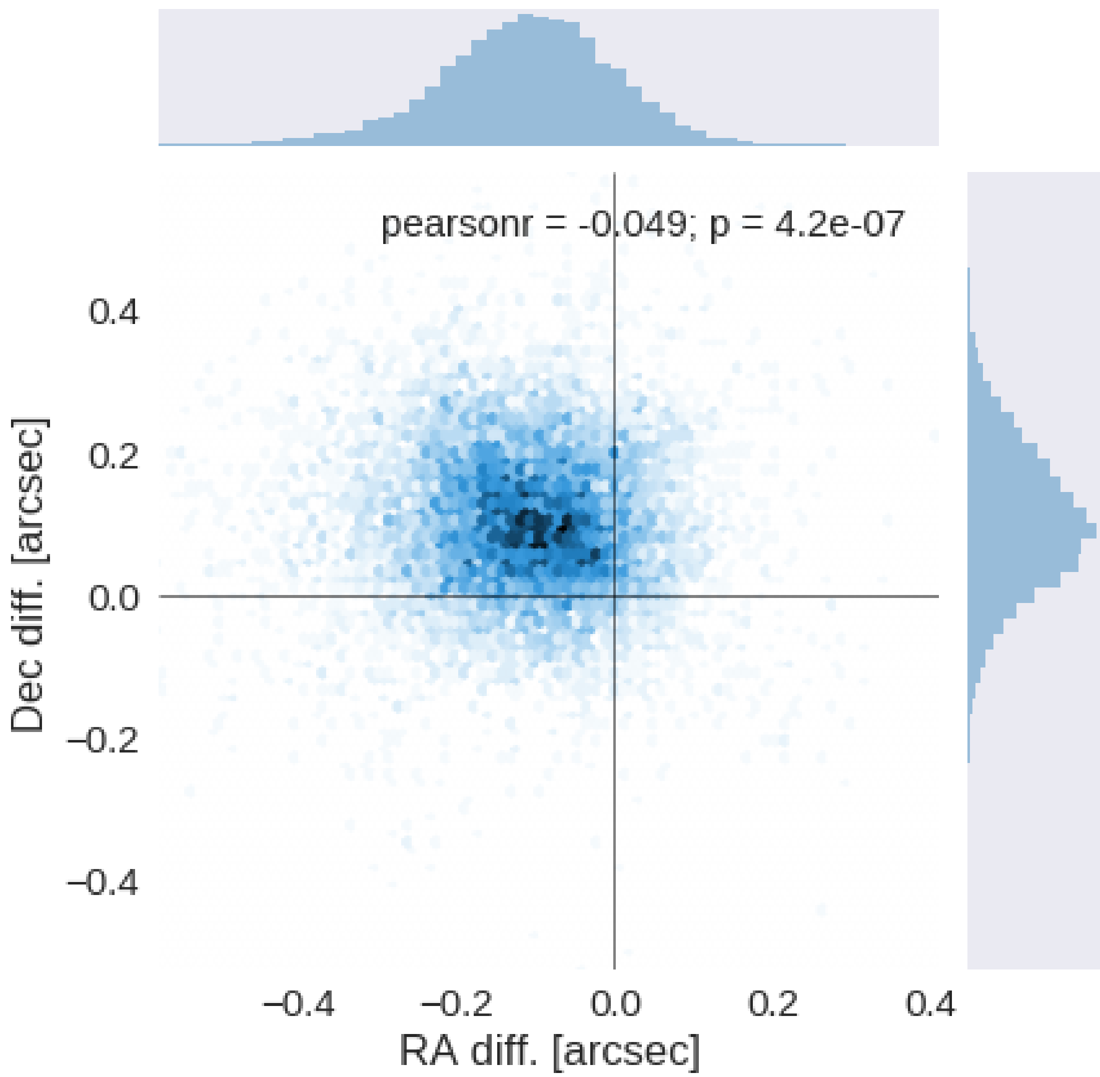
We remove duplicated objects from the input catalogues.

```
/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)
```

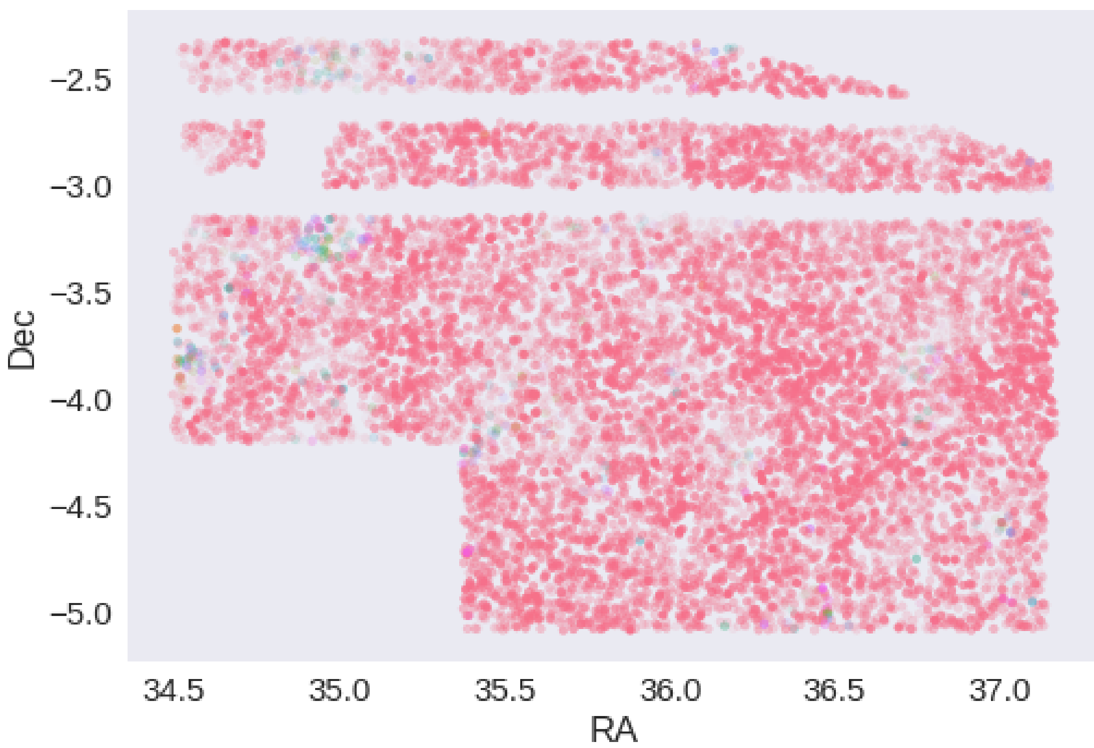
```
The initial catalogue had 428666 sources.
The cleaned catalogue has 428225 sources (441 removed).
The cleaned catalogue has 439 sources flagged as having been cleaned
```

1.4 III - Astrometry correction

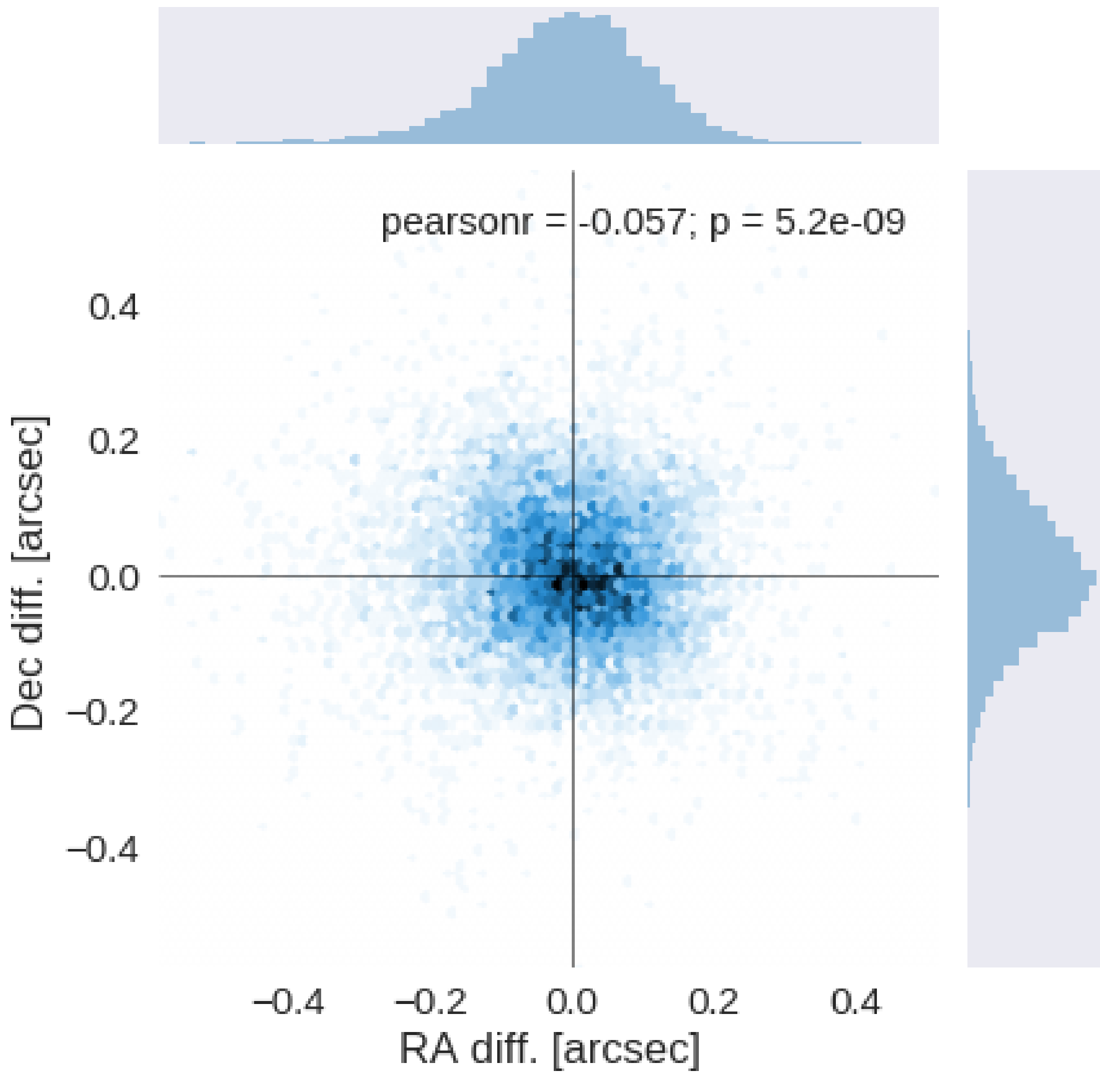
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.

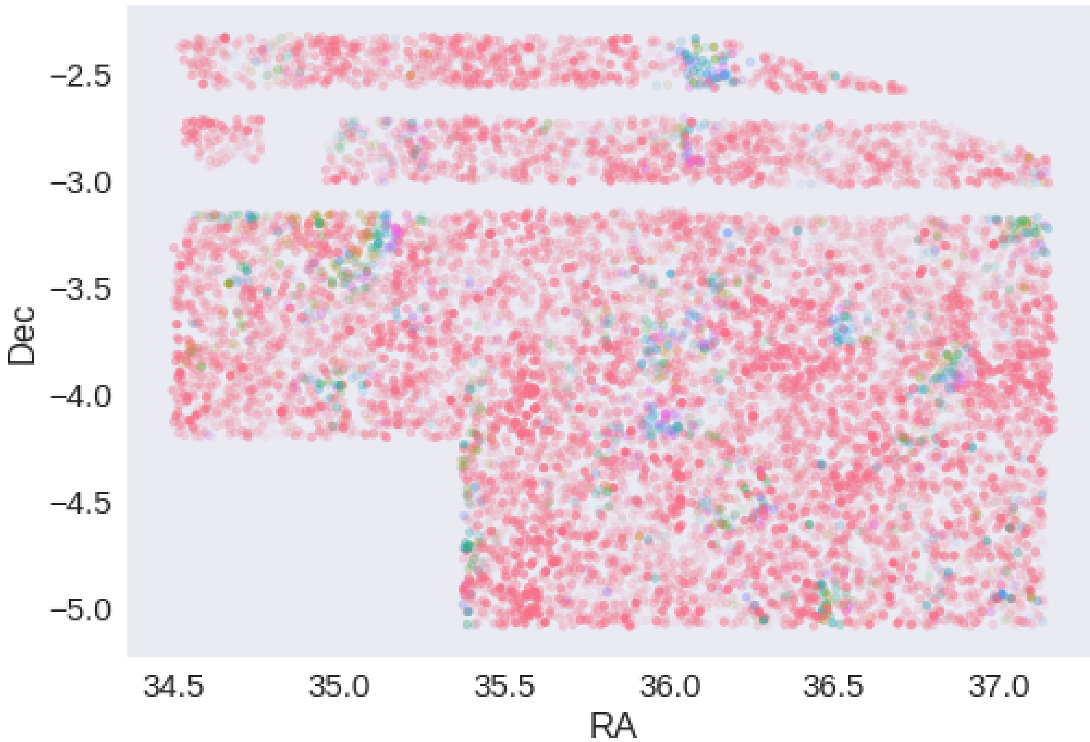


pearsonr = -0.049; p = 4.2e-07
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
0.4
RA diff. [arcsec]




```
RA correction: 0.10588225883907398 arcsec
Dec correction: -0.09947294019285735 arcsec
```


pearsonr = -0.057; p = 5.2e-09
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]



1.5 IV - Flagging Gaia objects

```
10794 sources flagged.
```

2 V - Saving to disk

1.14_UKIDSS-UDS

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of UKIRT Infrared Deep Sky Survey / Ultra Deep Survey (UKIDSS/DXS)

The catalogue comes from `dmu0_UKIDSS-UDS`.

In the catalogue, we keep:

- The identifier (it's unique in the catalogue);
- The position;
- The stellarity;
- The magnitude for each band in apertude 3 (2 arcsec).
- The kron magnitude to be used as total magnitude (no "auto" magnitude is provided).

The magnitudes are "*Vega like*". The AB offsets are given by Hewett *et al.* (2016):

Band	AB offset
J	0.938
H	1.379
K	1.900

A query to the UKIDSS database with 242.9+55.071 position returns a list of images taken between 2007 and 2009. Let's take 2008 for the epoch. TODO: Update for UDS.

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

1.2 I - Column selection

```
WARNING: UnitsWarning: 'degrees' did not parse as fits unit: At col 0, Unit 'degrees' not suppor


/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>
```

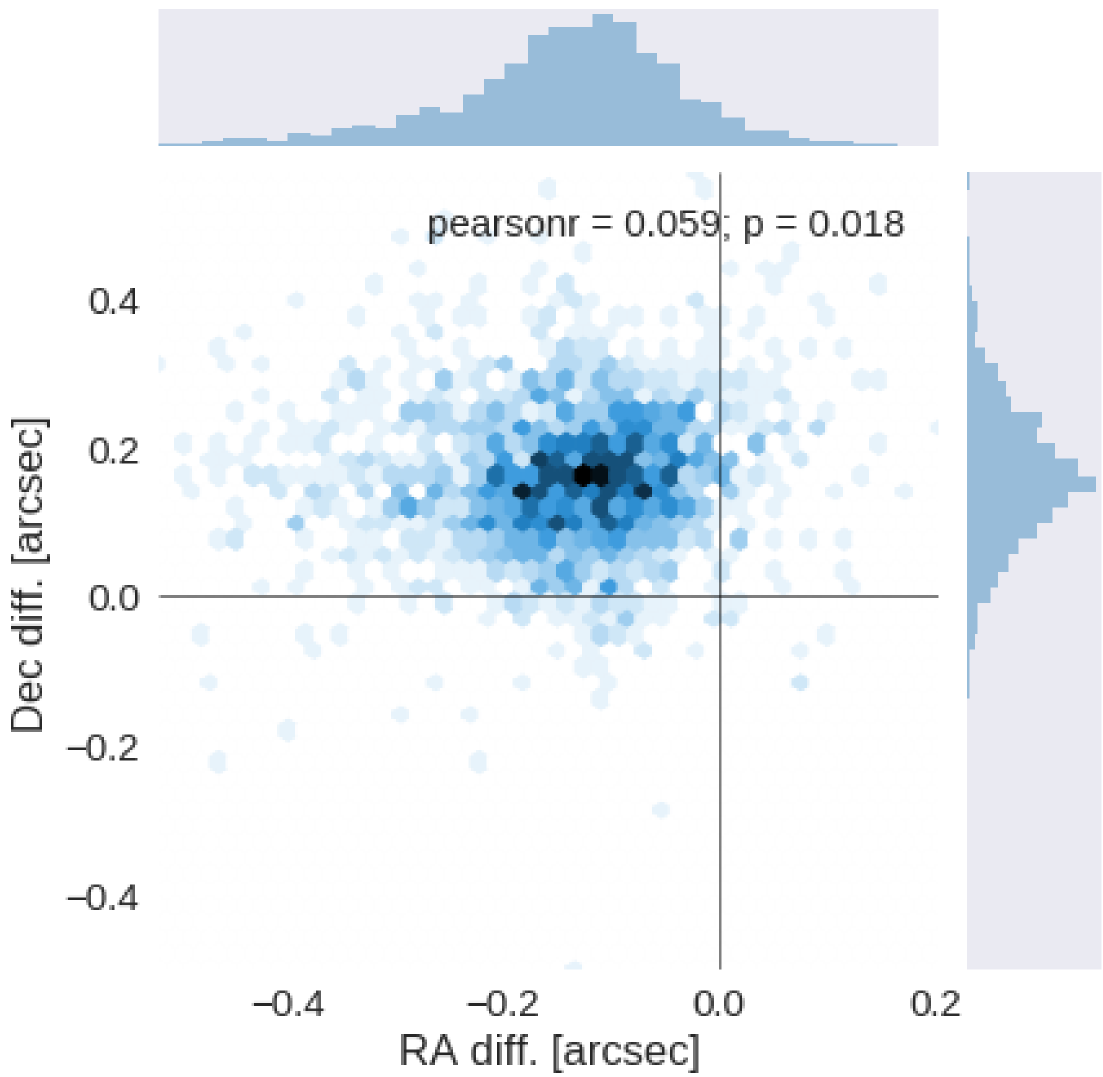
1.3 II - Removal of duplicated sources

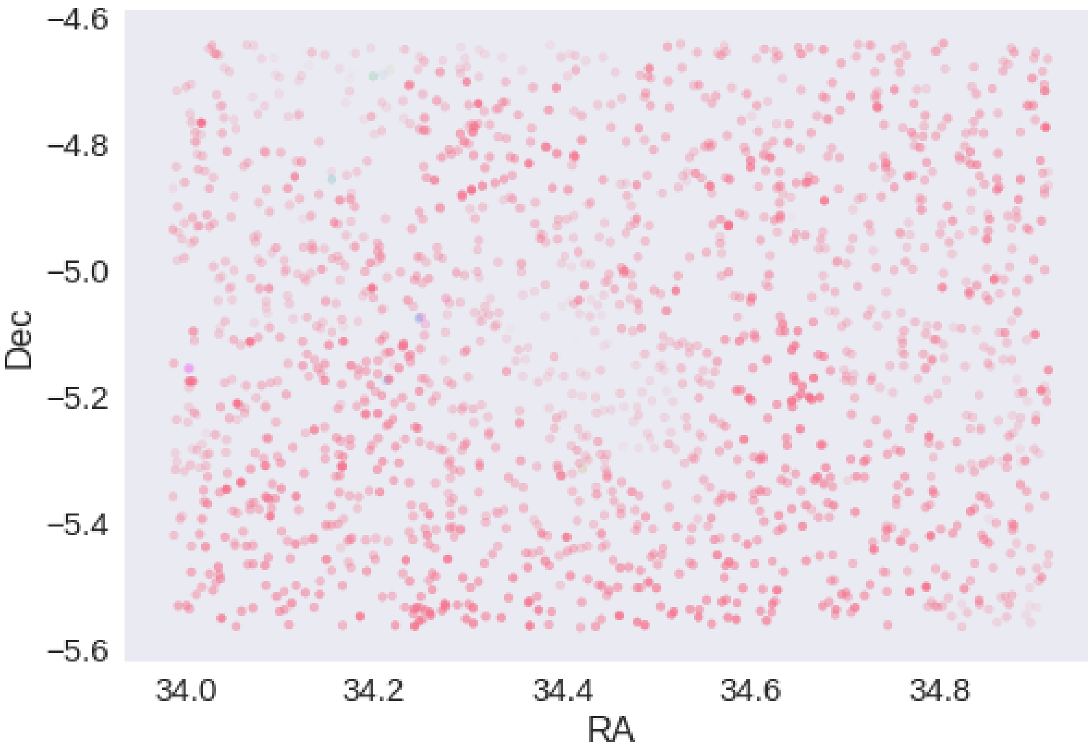
We remove duplicated objects from the input catalogues.

```
/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 296026 sources.
The cleaned catalogue has 296026 sources (0 removed).
The cleaned catalogue has 0 sources flagged as having been cleaned
```

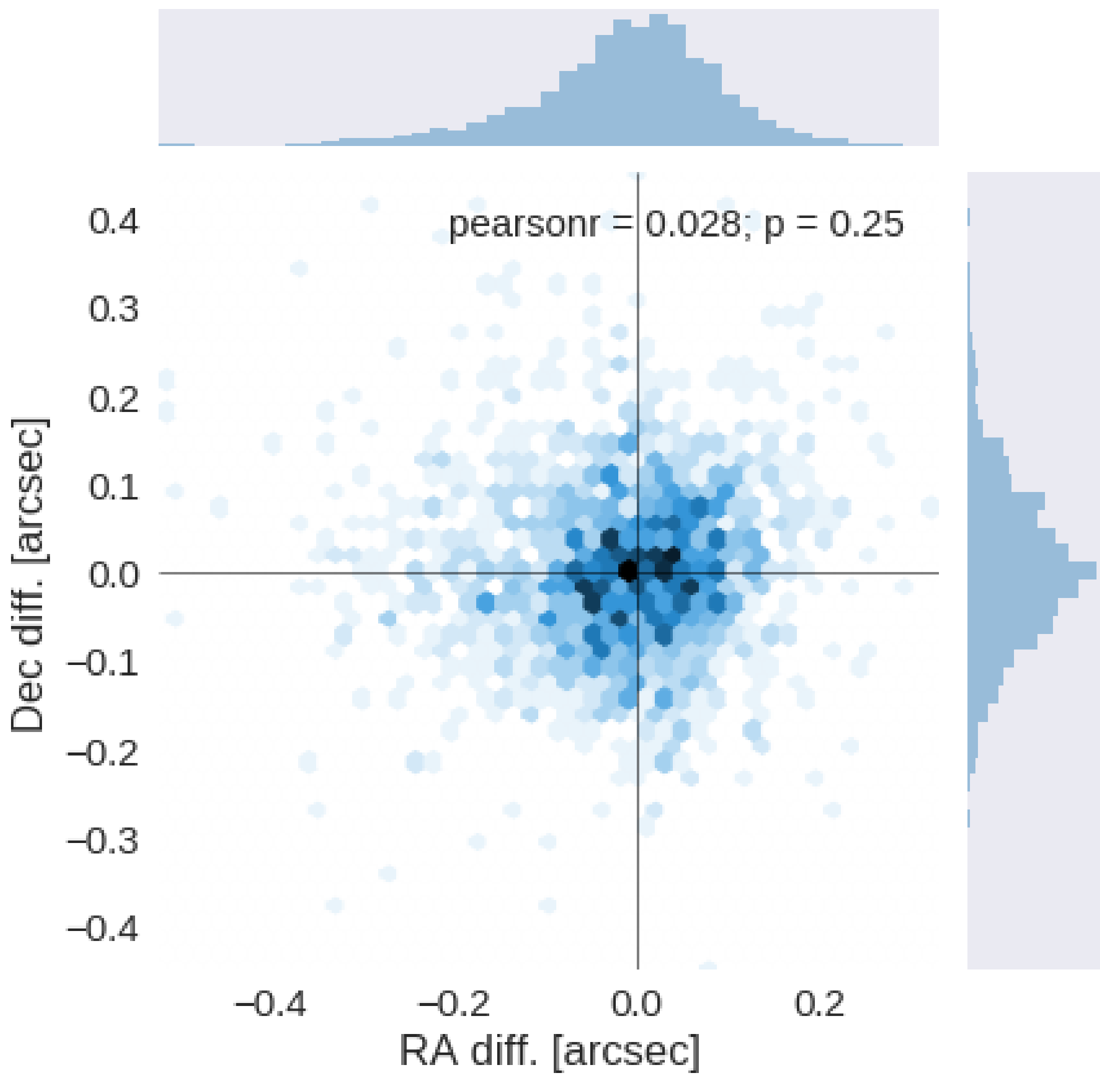
1.4 III - Astrometry correction

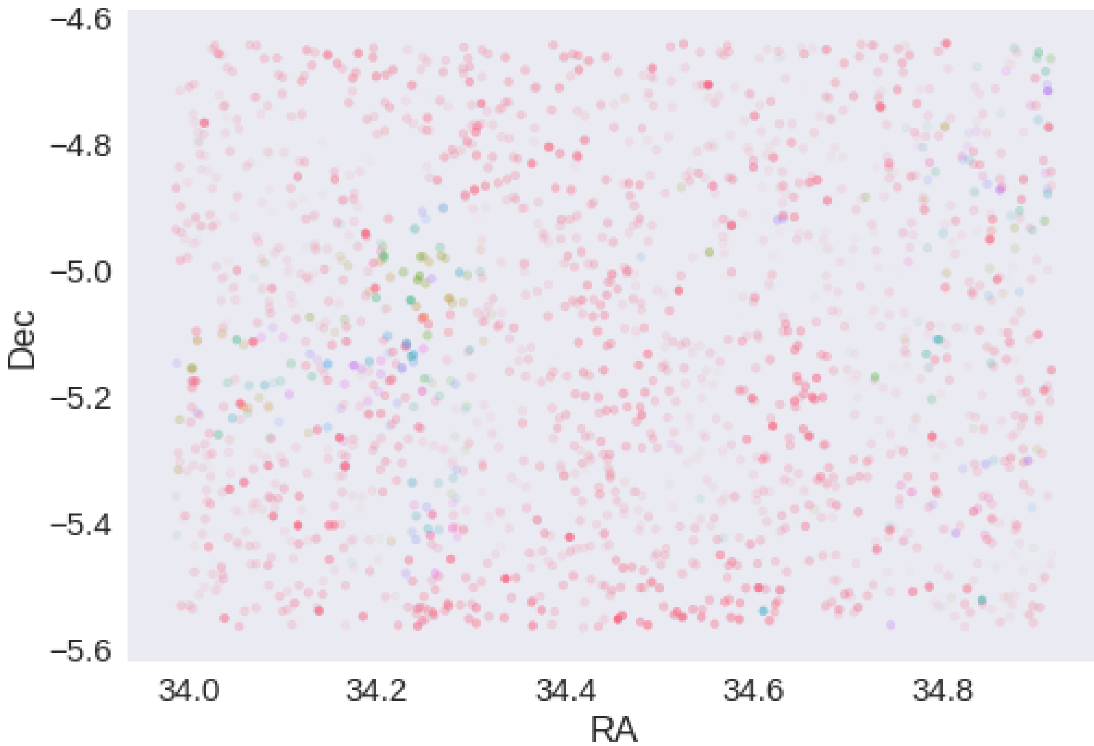
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.


pearsonr = 0.059; p = 0.018
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
RA diff. [arcsec]




```
RA correction: 0.12895760060445127 arcsec
Dec correction: -0.15744215684776464 arcsec
```


pearsonr = 0.028; p = 0.25
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
Dec diff. [arcsec]
−0.4
−0.2
0.0
0.2
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
1683 sources flagged.
```

2 V - Saving to disk

1.15_VIPERS

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of VIMOS Public Extragalactic Redshift Survey (VIPERS) - Multi Lambda Survey (MLS) data

This catalogue comes from `dmu0_VIPERS`.

In the catalogue, we keep:

- The `ident` as unique object identifier;
- The position which is given for all the sources;
- The ugrizy ks total magnitude.

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
```

```
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/seaborn/apionly.py:
  warnings.warn(msg, UserWarning)
```

1.2 I - Column selection

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

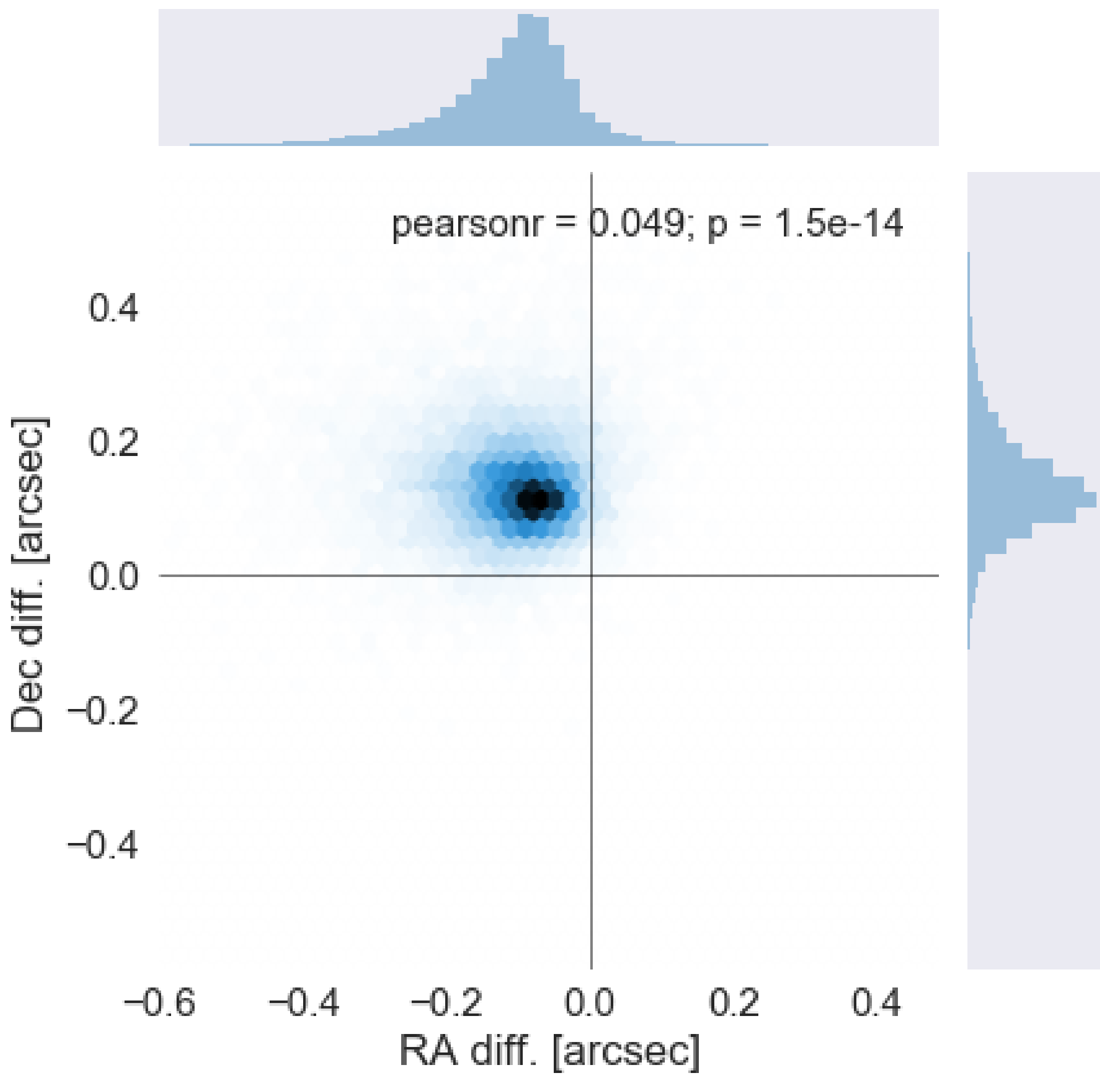
1.3 II - Removal of duplicated sources

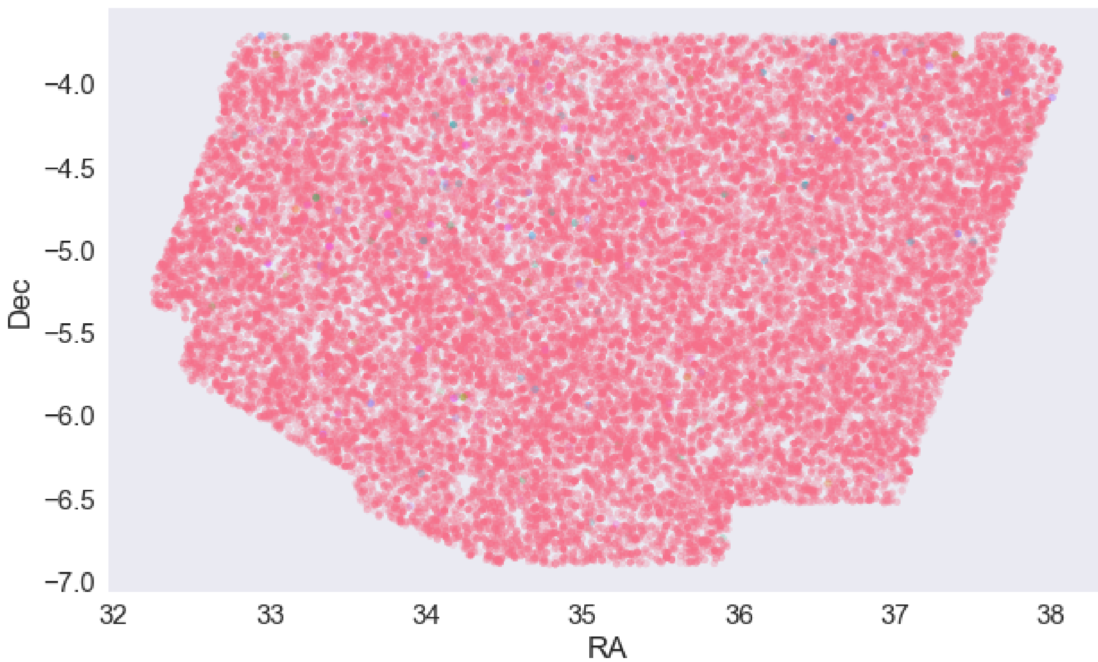
We remove duplicated objects from the input catalogues.

```
The initial catalogue had 956549 sources.
The cleaned catalogue has 956536 sources (13 removed).
The cleaned catalogue has 13 sources flagged as having been cleaned
```

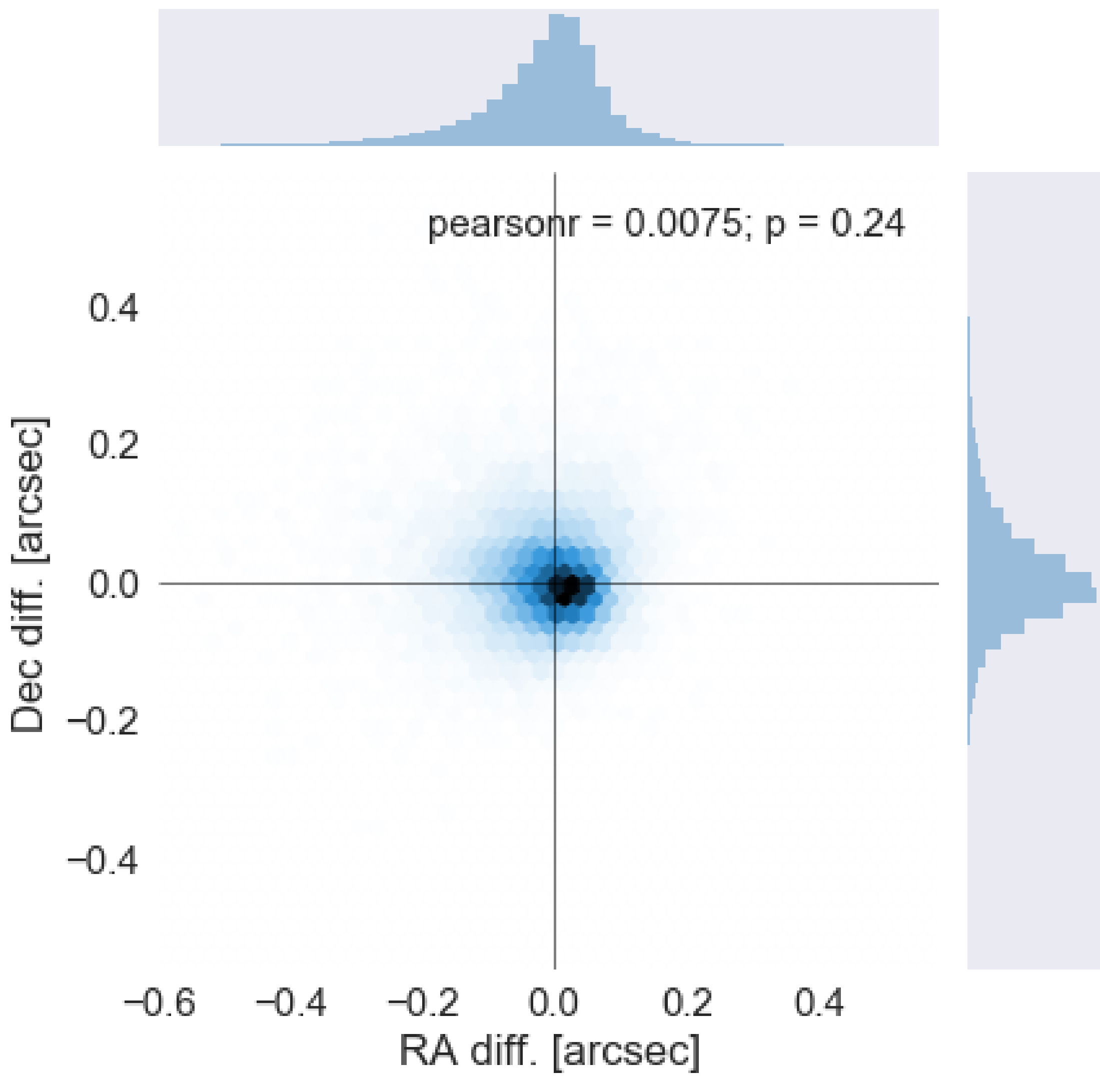
1.4 III - Astrometry correction

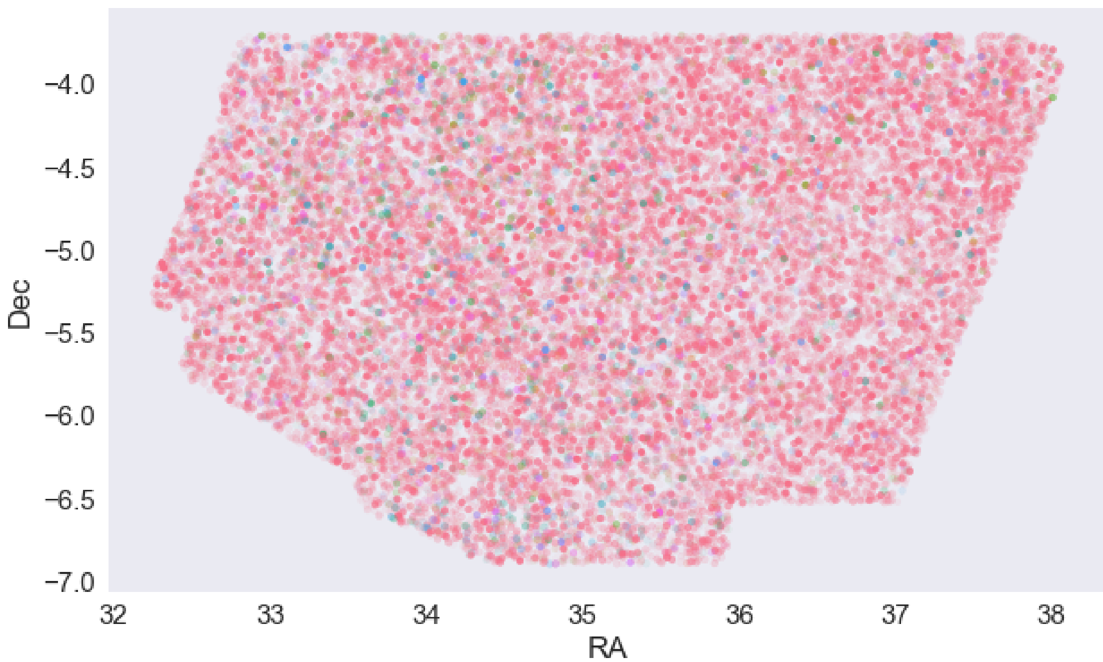
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.


pearsonr = 0.049; p = 1.5e-14
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.6
−0.4
−0.2
0.0
0.2
0.4
RA diff. [arcsec]




```
RA correction: 0.09501634402795389 arcsec
Dec correction: -0.12179129389160437 arcsec
```


pearsonr = 0.0075; p = 0.24
0.4
0.2
0.0
−0.2
−0.4
Dec diff. [arcsec]
−0.6
−0.4
−0.2
0.0
0.2
0.4
RA diff. [arcsec]



1.5 IV - Flagging Gaia objects

```
25364 sources flagged.
```

2 V - Saving to disk

1.16_VISTA-VHS

March 8, 2018

1 XMM-LSS 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). These are Vega magnitudes and must be corrected to AB.

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/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

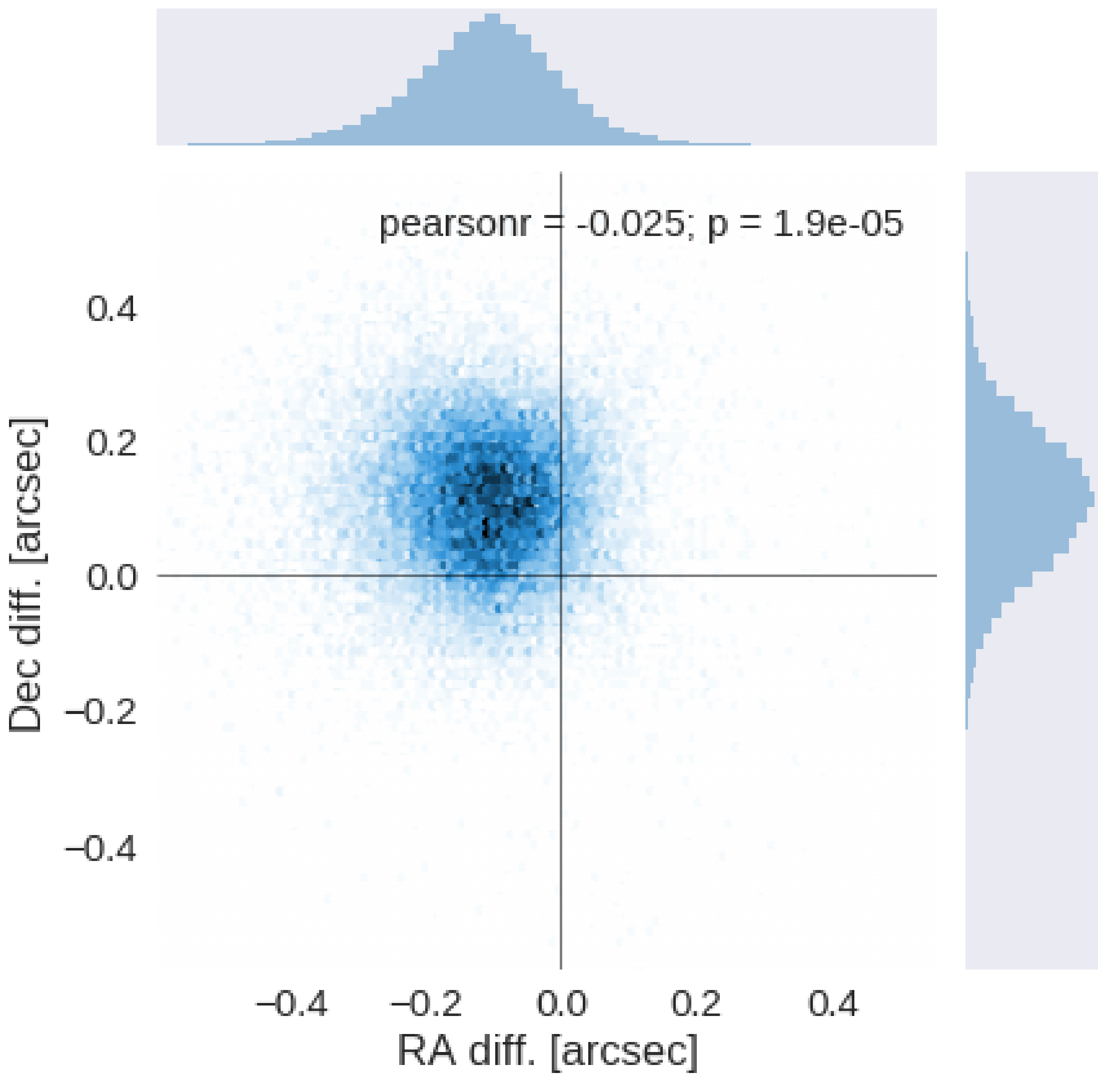
We remove duplicated objects from the input catalogues.

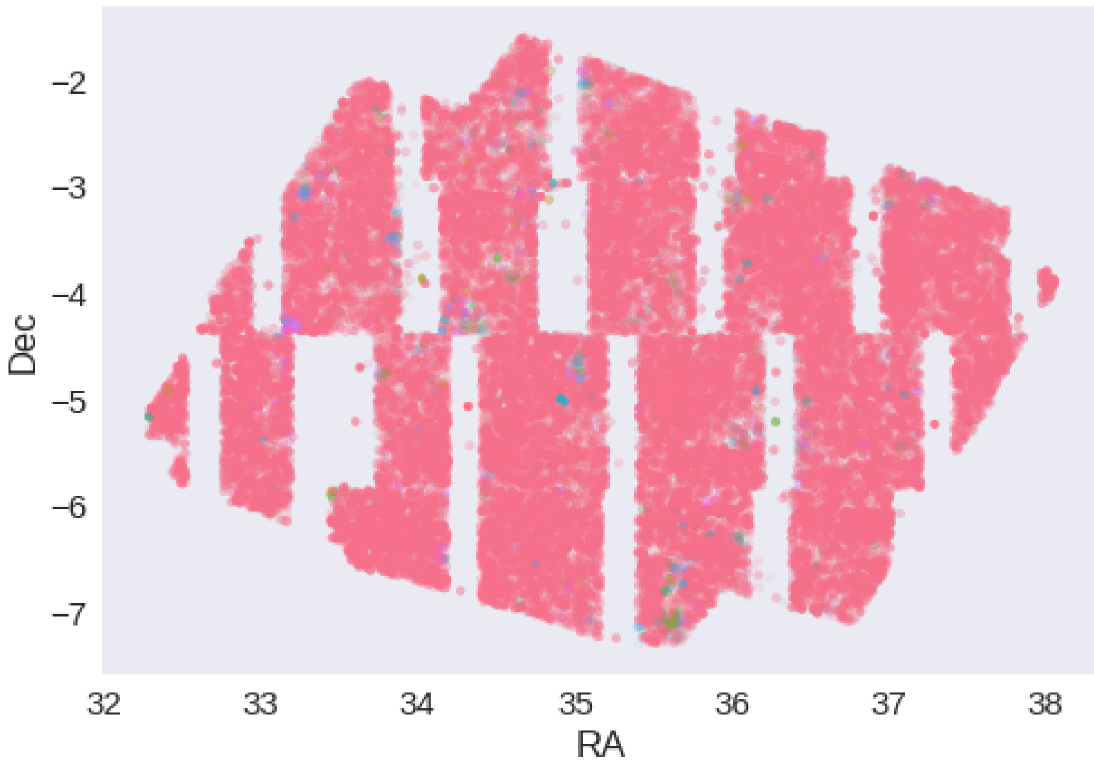
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 437968 sources.
The cleaned catalogue has 428066 sources (9902 removed).
The cleaned catalogue has 9901 sources flagged as having been cleaned
```

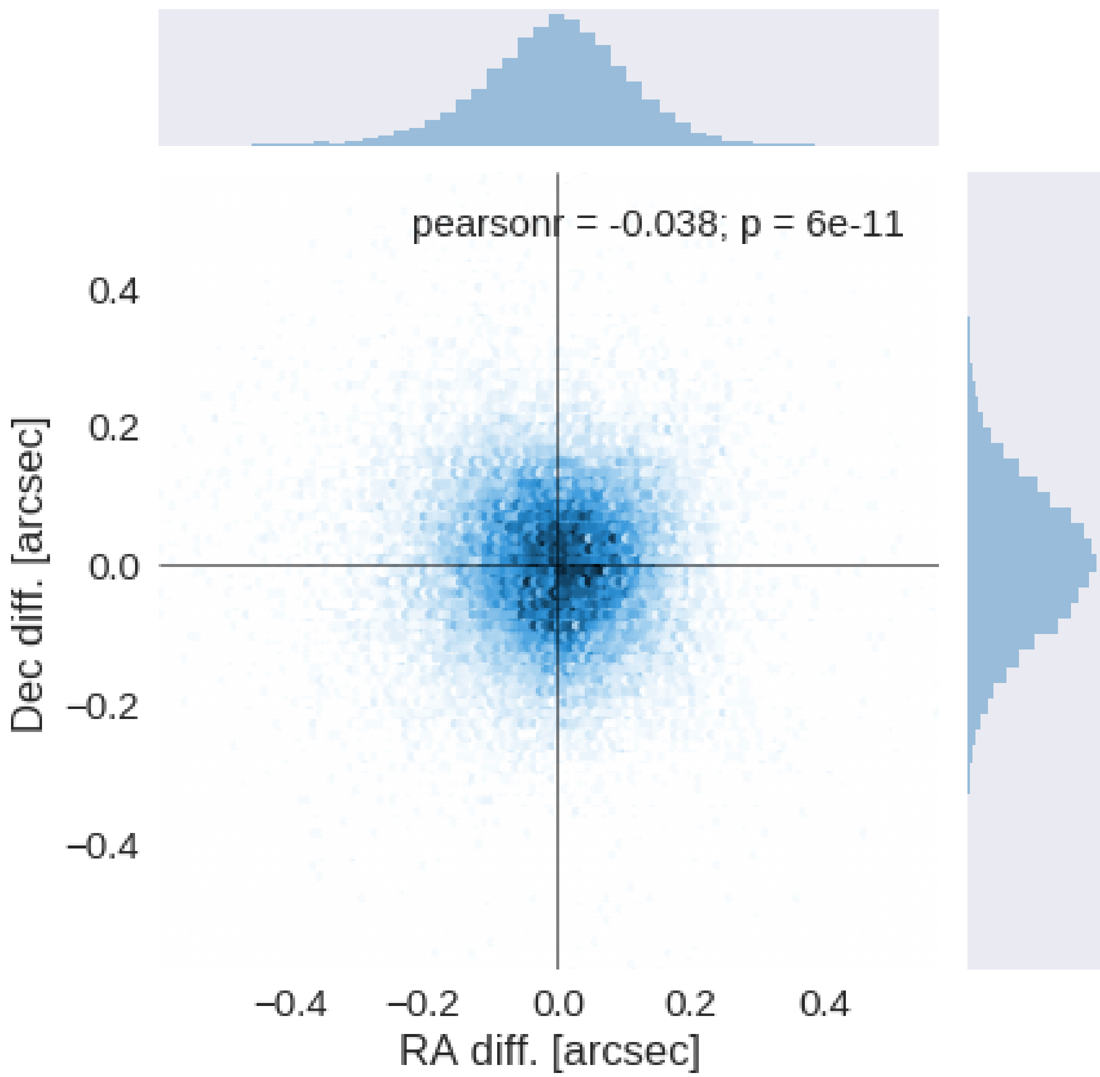
1.4 III - Astrometry correction

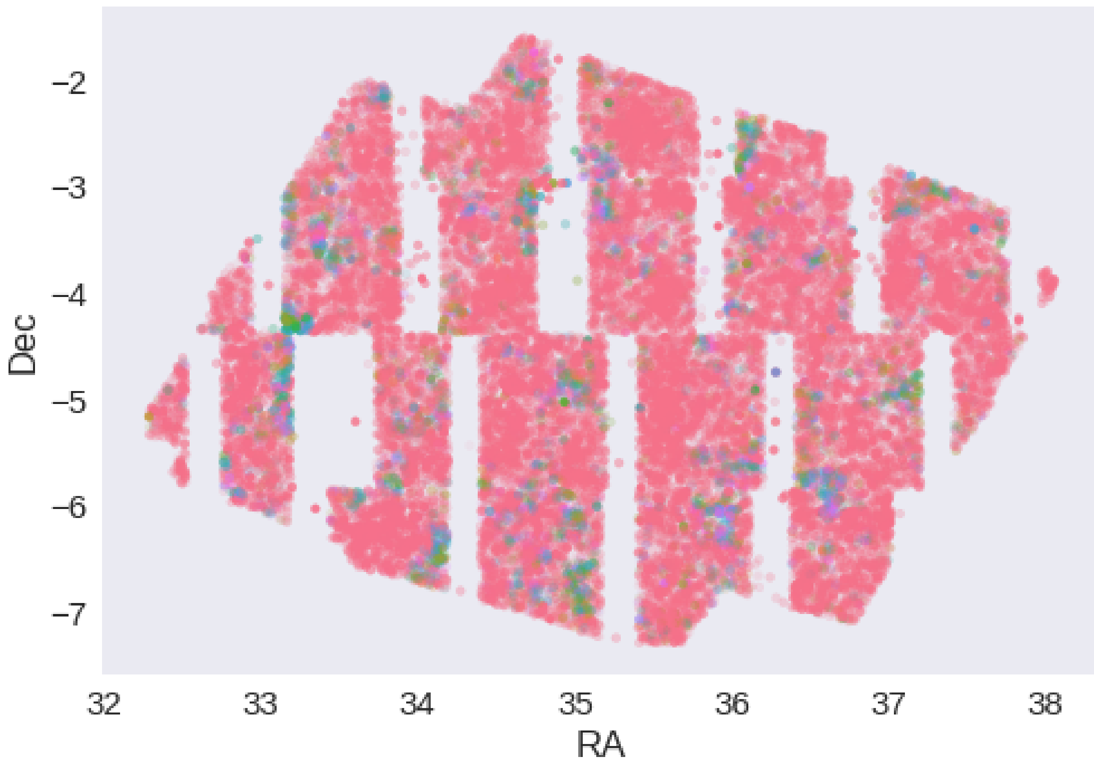
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.10875042168549953 arcsec
Dec correction: -0.10968037218450633 arcsec
```


pearsonr = -0.038; p = 6e-11
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]



1.5 IV - Flagging Gaia objects

```
30732 sources flagged.
```

1.6 V - Flagging objects near bright stars

2 VI - Saving to disk

1.17_VISTA-VIDEO

March 8, 2018

1 XMM-LSS 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:
33f5ec7 (Wed Dec 6 16:56:17 2017 +0000)
```

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

1.2 I - Column selection

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

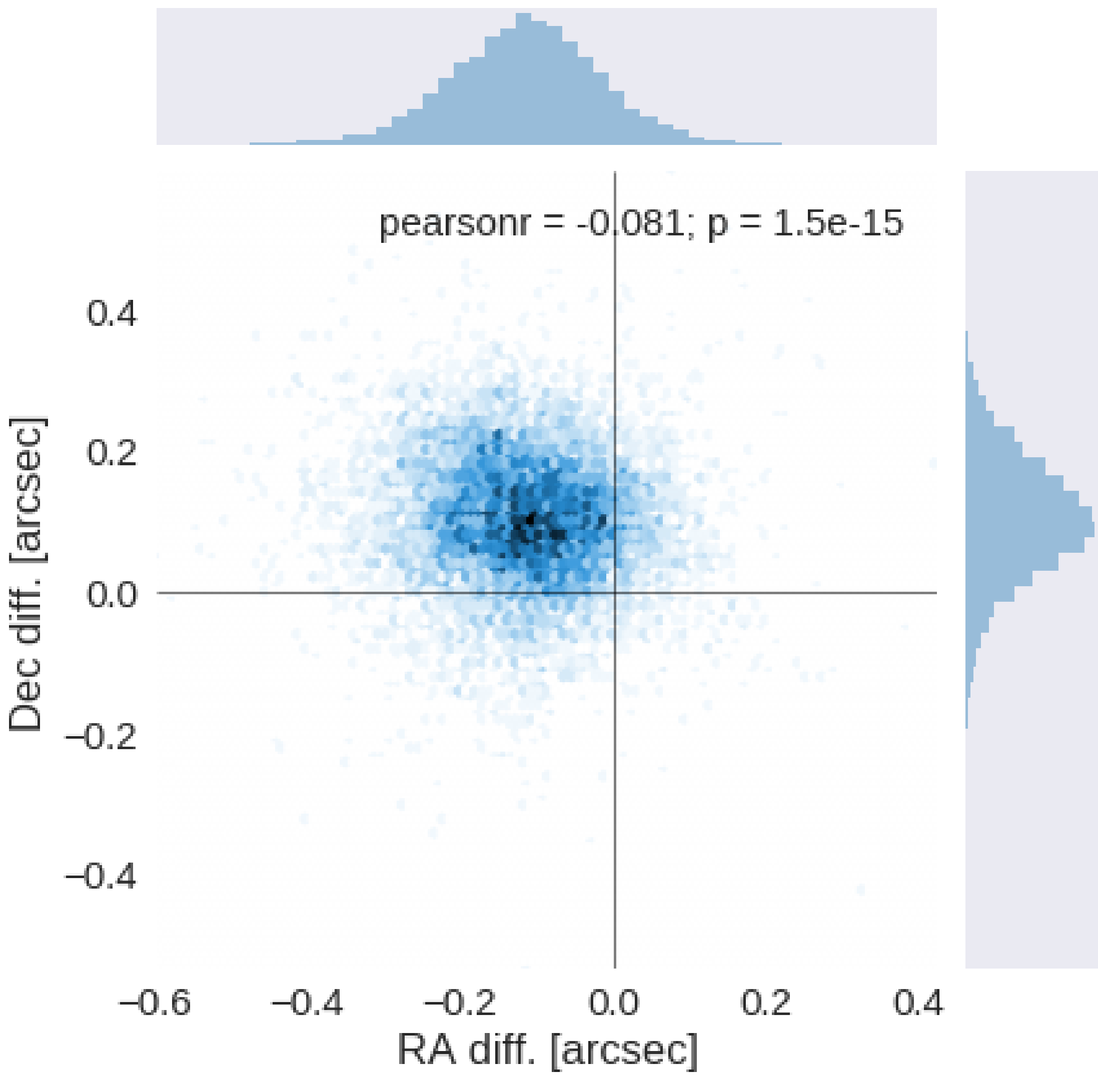
1.3 II - Removal of duplicated sources

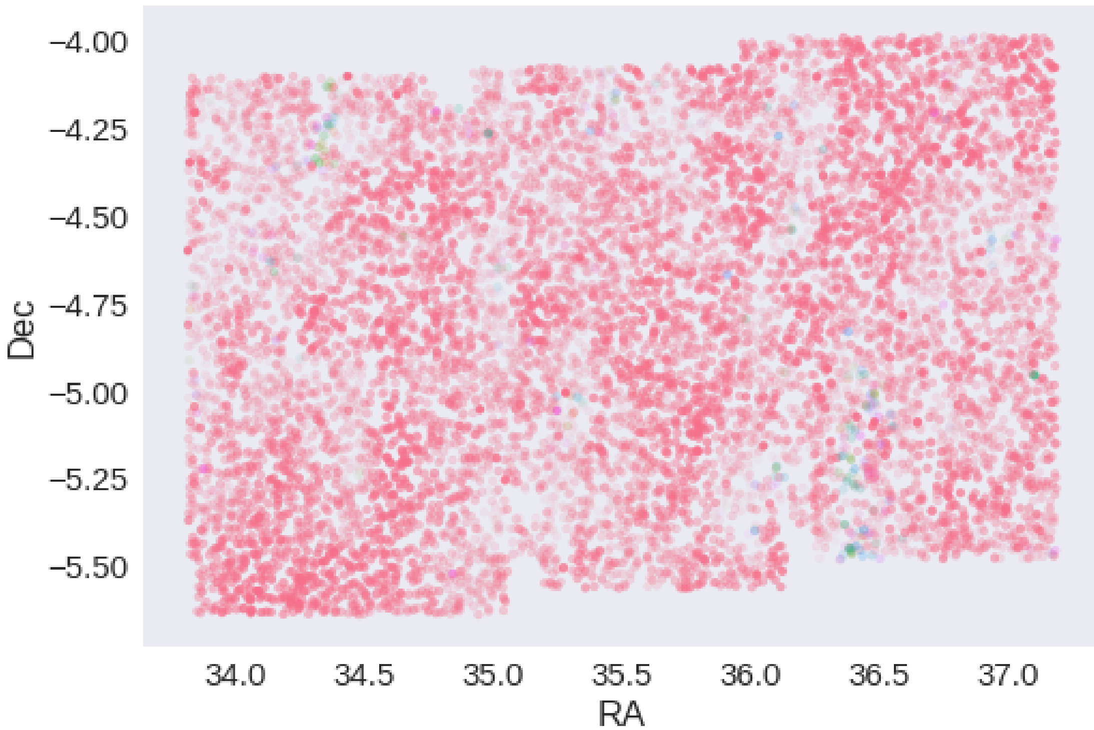
We remove duplicated objects from the input catalogues.

```
The initial catalogue had 1242993 sources.
The cleaned catalogue has 1238657 sources (4336 removed).
The cleaned catalogue has 4293 sources flagged as having been cleaned
```

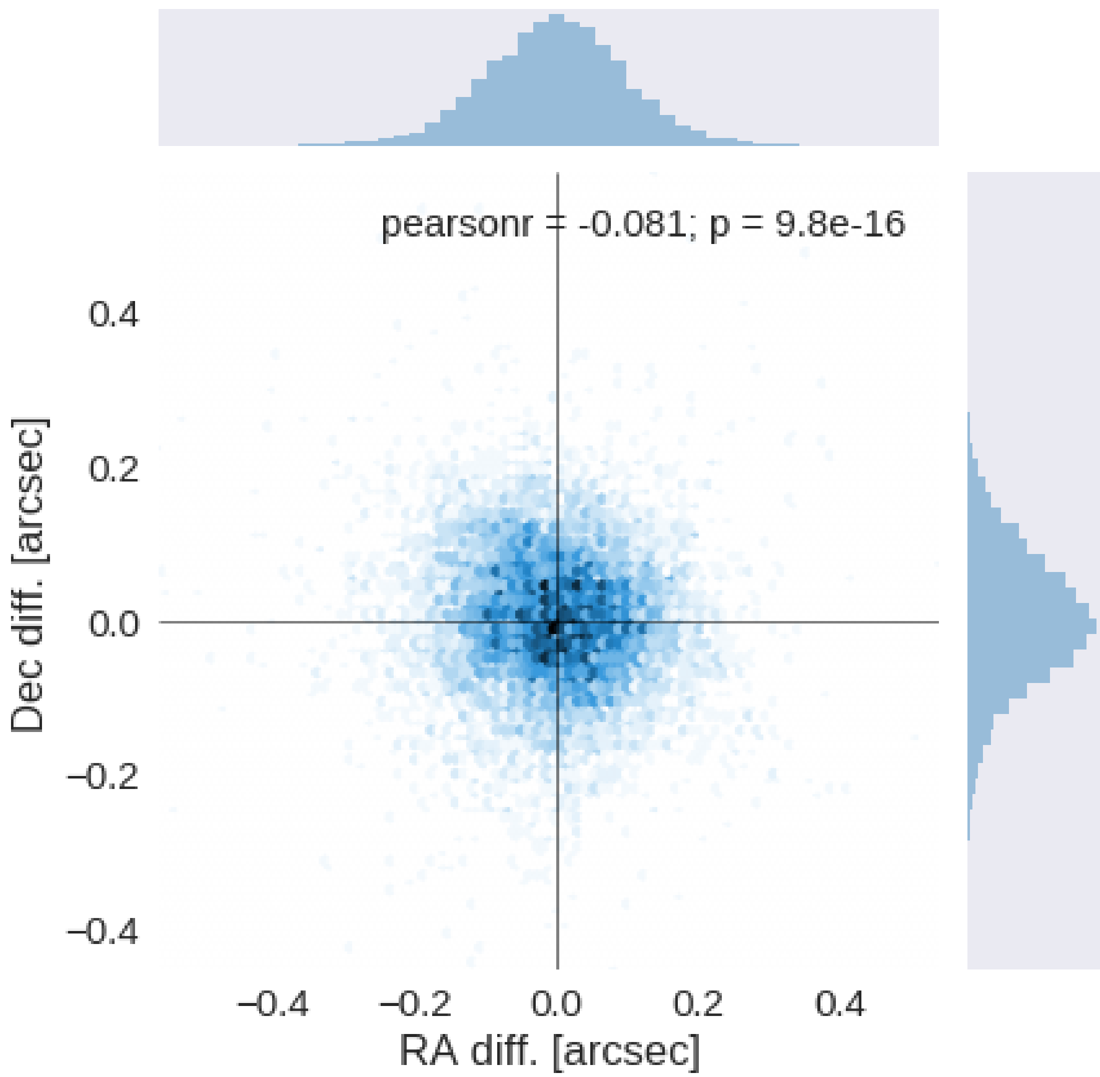
1.4 III - Astrometry correction

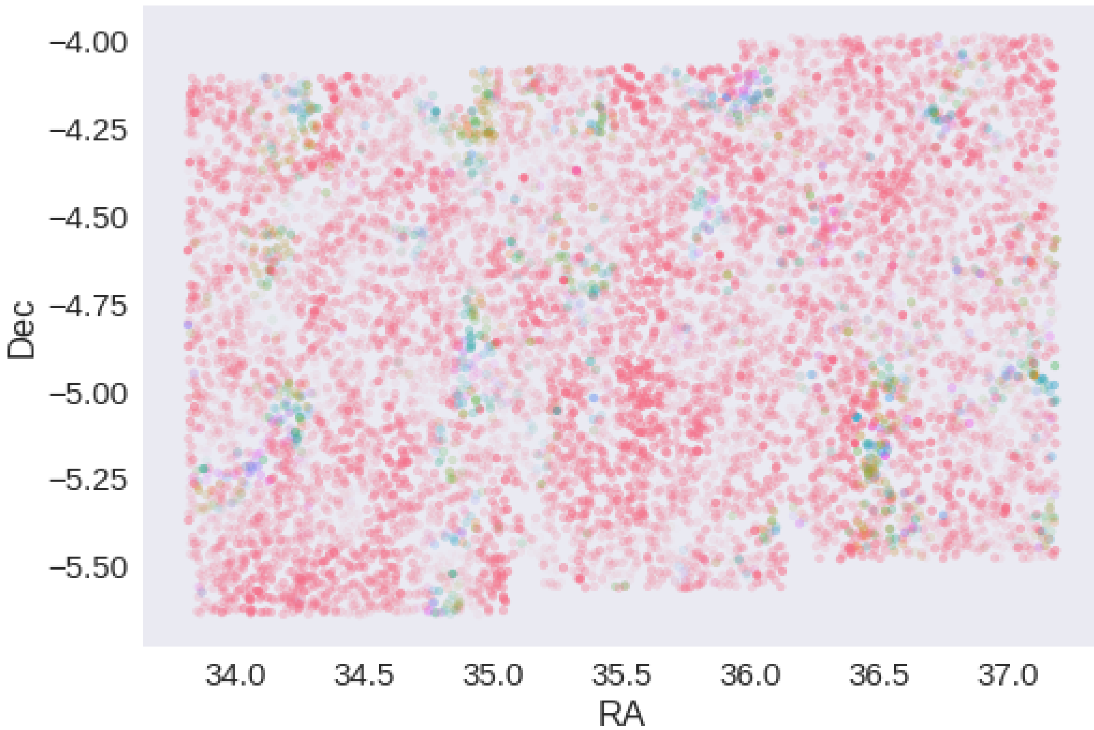
We match the astrometry to the Gaia one. We limit the Gaia catalogue to sources with a g band flux between the 30th and the 70th percentile. Some quick tests show that this give the lower dispersion in the results.






```
RA correction: 0.11299088805714064 arcsec
Dec correction: -0.10236686479601076 arcsec
```


pearsonr = -0.081; p = 9.8e-16
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]



1.5 IV - Flagging Gaia objects

```
9963 sources flagged.
```

1.6 V - Saving to disk

1.18_VISTA-VIKING

March 8, 2018

1 XMM-LSS master catalogue

1.1 Preparation of VIKING data

VISTA telescope/VIKING catalogue: the catalogue comes from `dmu0_VIKING`.

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). These are Vega magnitudes and must be corrected.

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/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

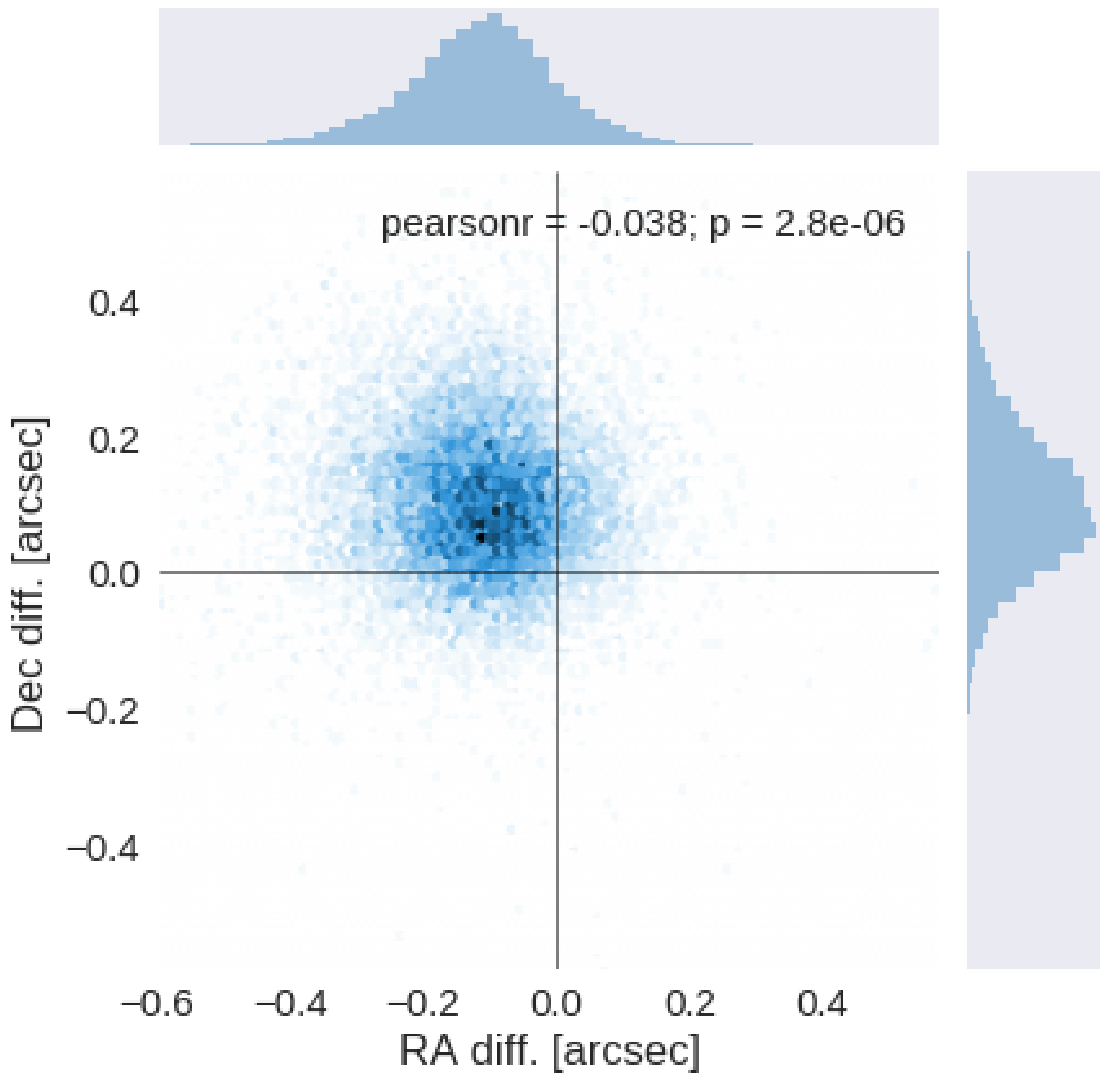
We remove duplicated objects from the input catalogues.

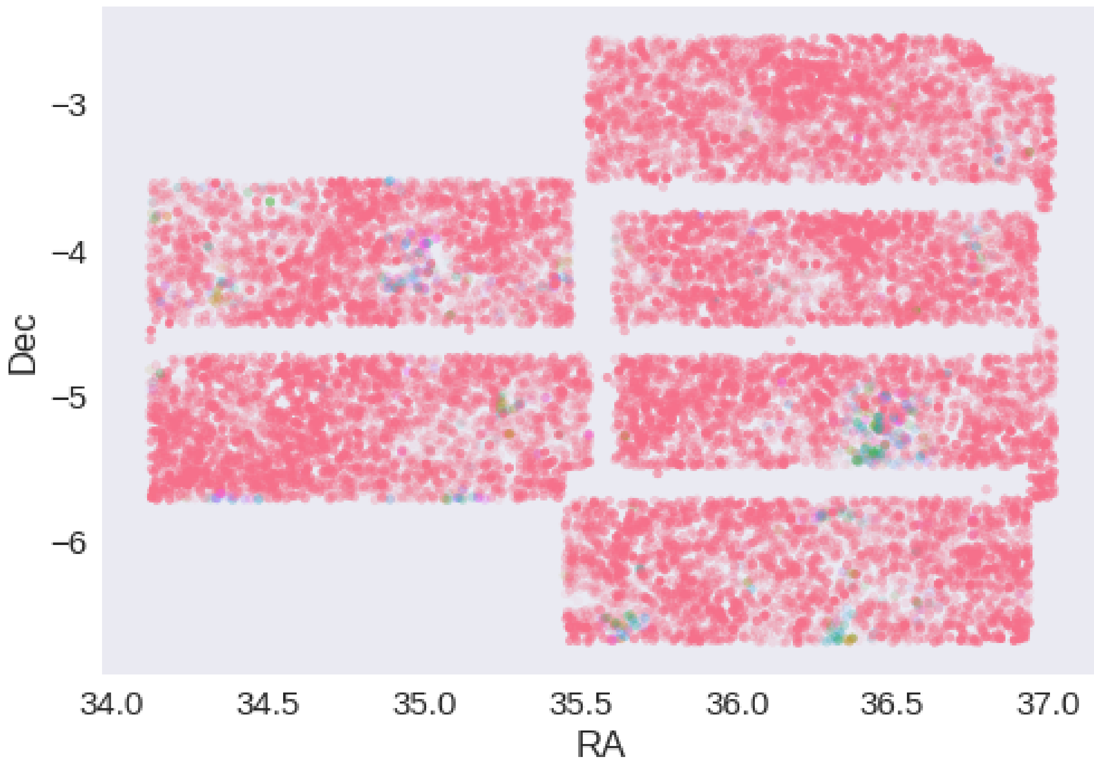
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/astropy/table/column.py:10
Check the NumPy 1.11 release notes for more information.
  ma.MaskedArray.__setitem__(self, index, value)
```

```
The initial catalogue had 325881 sources.
The cleaned catalogue has 325849 sources (32 removed).
The cleaned catalogue has 32 sources flagged as having been cleaned
```

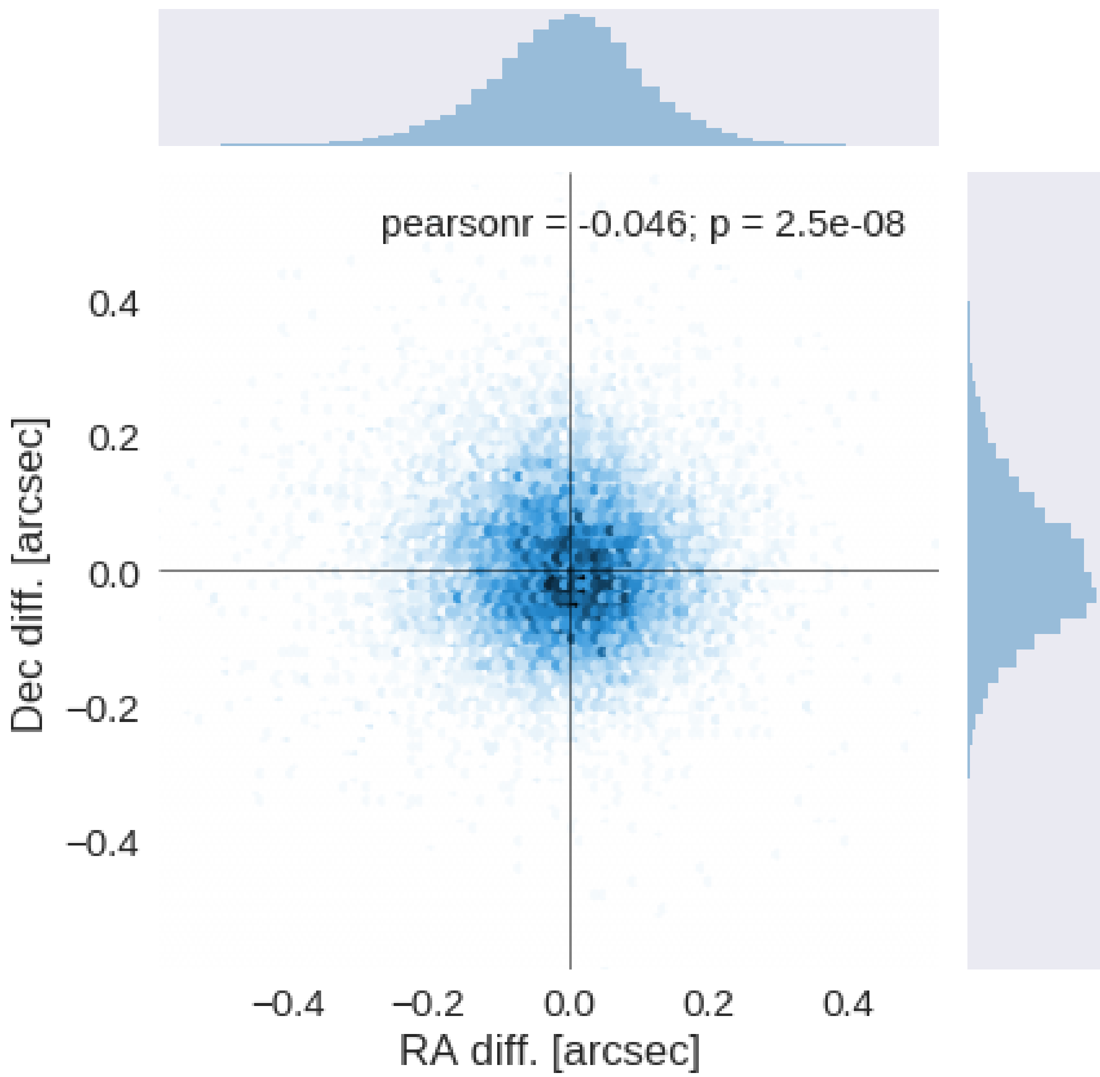
1.4 III - Astrometry correction

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.

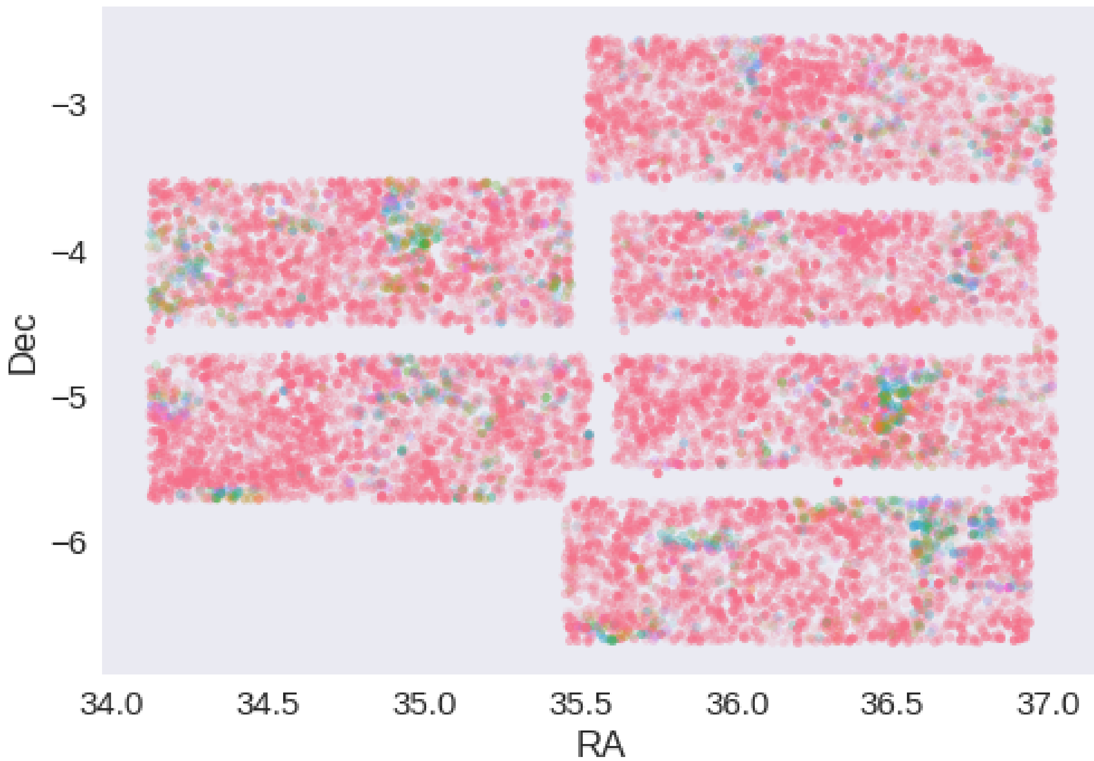





```
RA correction: 0.10746290045346996 arcsec
Dec correction: -0.0979660293879192 arcsec
```



pearsonr = -0.046; p = 2.5e-08
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]



2 IV - Flagging Gaia objects

```
15270 sources flagged.
```

3 V - Saving to disk

2.1_CFHT_merge

March 8, 2018

1 XMM-LSS master catalogue

This notebook presents the merge of the pristine catalogues from CFHT Megacam. This has to be conducted separately on XMM-LSS due to the large amount of memory required on this field.

This notebook also ingests all the CANDELS-UDS data apart from the photometry that needs to be merged in other 2.x notebooks.

Since this is where we ingest all the CANDELS fluxes apert from UKIDSS and IRAC we take the opportunity here to merge them in with SXDS Suprime fluxes.

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
This notebook was executed on:
2018-02-20 16:14:27.605065
```

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. We start with PanSTARRS because it coevrs the whole field.

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 Start with CANDELS

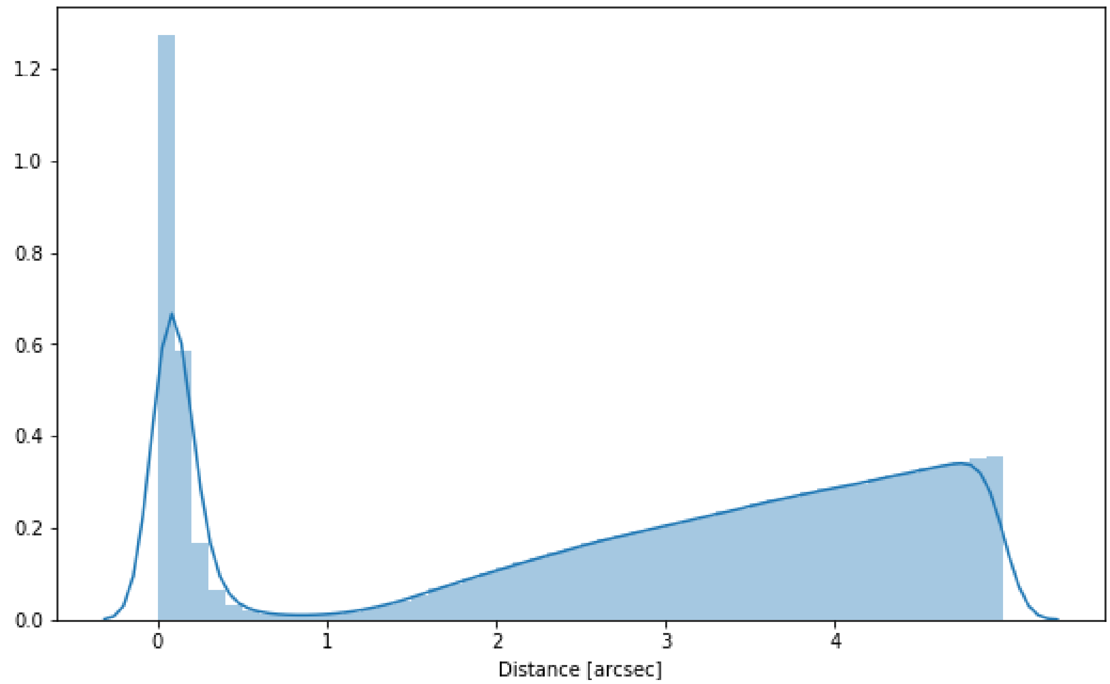
```
f_candels-ukidss_j  removed.
ferr_candels-ukidss_j  removed.
f_candels-ukidss_h  removed.
ferr_candels-ukidss_h  removed.
f_candels-ukidss_k  removed.
ferr_candels-ukidss_k  removed.
f_candels-irac_i1  removed.
ferr_candels-irac_i1  removed.
f_candels-irac_i2  removed.
ferr_candels-irac_i2  removed.
f_candels-irac_i3  removed.
ferr_candels-irac_i3  removed.
```

```
f_candels-irac_i4  removed.
ferr_candels-irac_i4  removed.
m_candels-ukidss_j  removed.
merr_candels-ukidss_j  removed.
flag_candels-ukidss_j  removed.
m_candels-ukidss_h  removed.
merr_candels-ukidss_h  removed.
flag_candels-ukidss_h  removed.
m_candels-ukidss_k  removed.
merr_candels-ukidss_k  removed.
flag_candels-ukidss_k  removed.
m_candels-irac_i1  removed.
merr_candels-irac_i1  removed.
flag_candels-irac_i1  removed.
m_candels-irac_i2  removed.
merr_candels-irac_i2  removed.
flag_candels-irac_i2  removed.
m_candels-irac_i3  removed.
merr_candels-irac_i3  removed.
flag_candels-irac_i3  removed.
m_candels-irac_i4  removed.
merr_candels-irac_i4  removed.
flag_candels-irac_i4  removed.
```

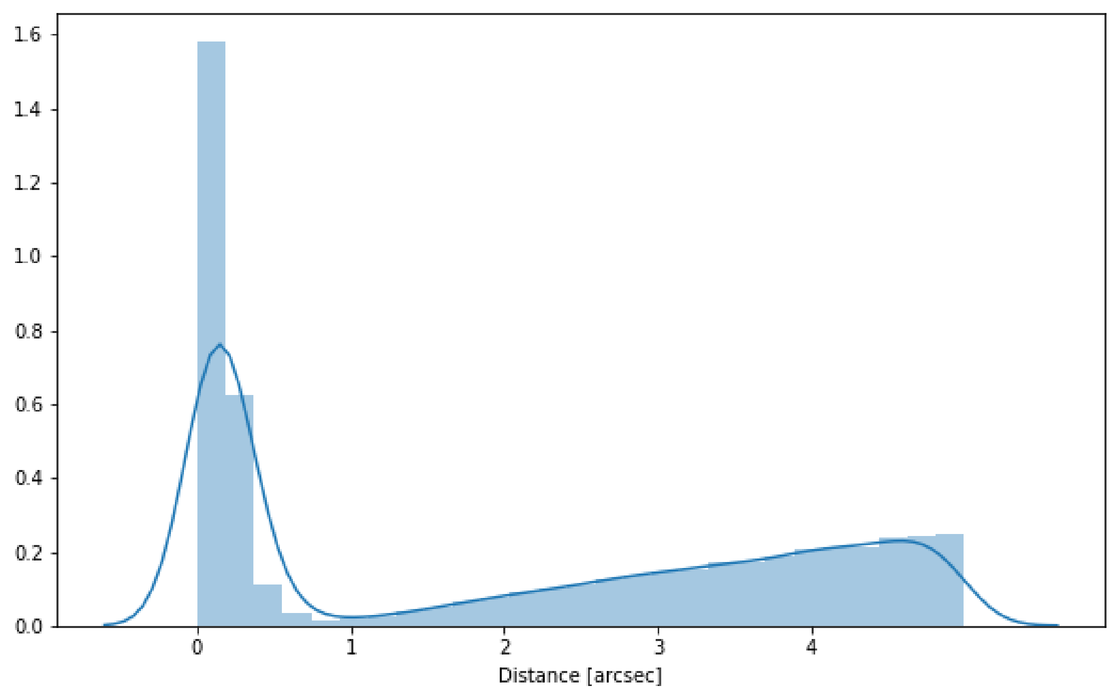
1.2.2 Add CFHTLS-DEEP

```
HELP Warning: There weren't any cross matches. The two surveys probably don't overlap.
```

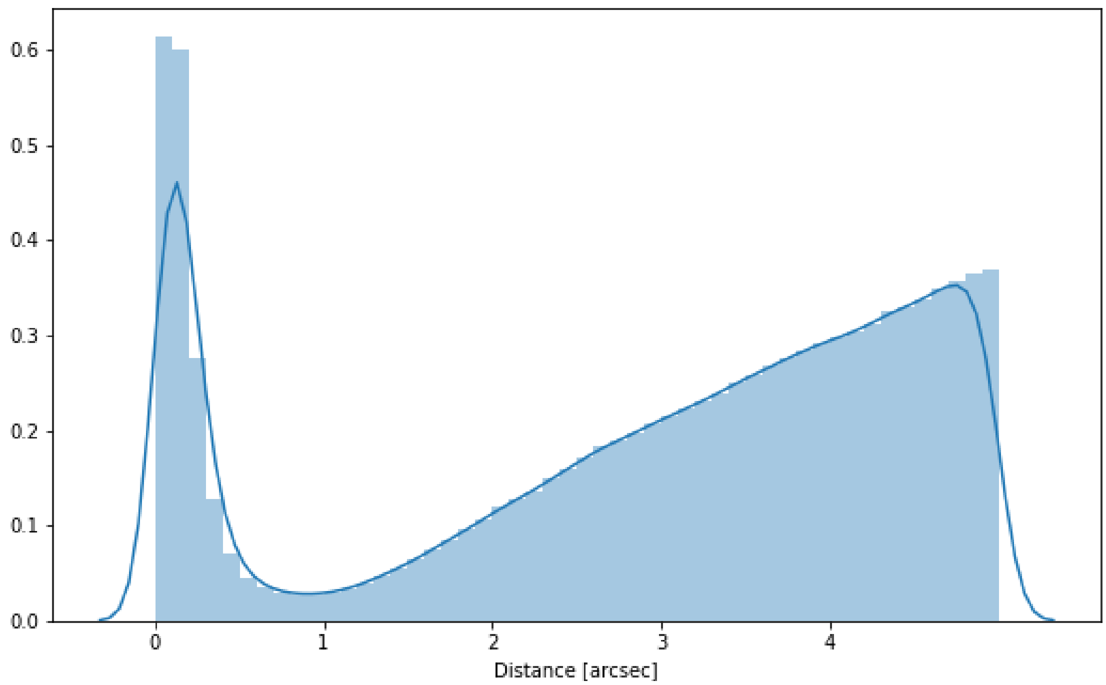
1.2.3 Add CFHTLS-WIDE



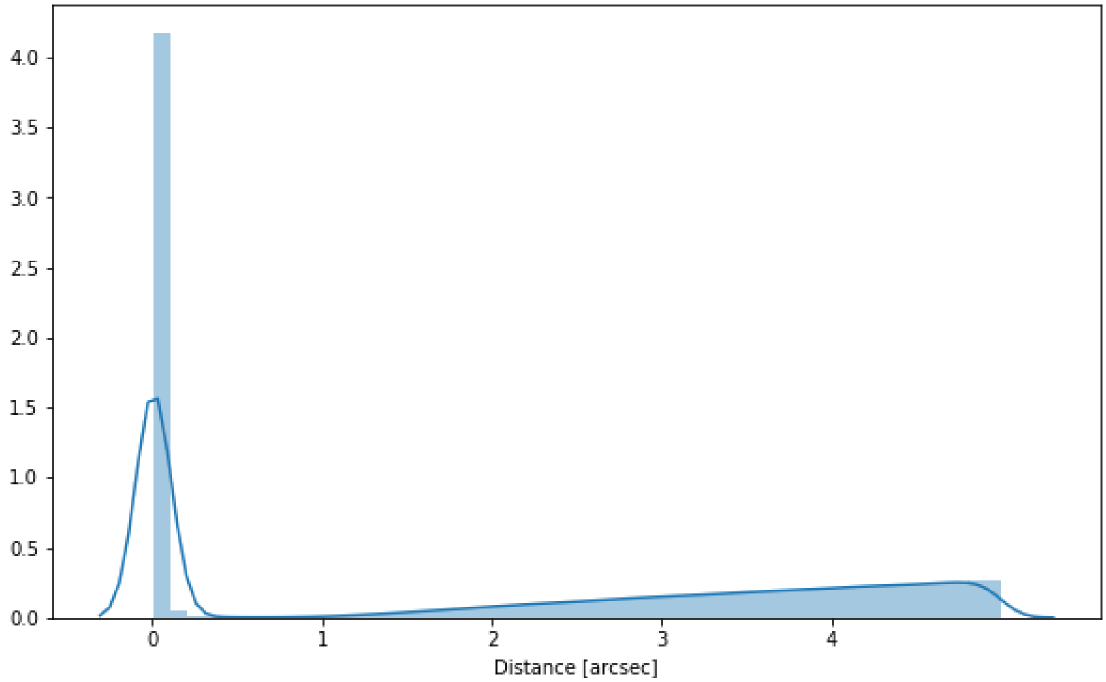
1.2.4 Add SpARCS



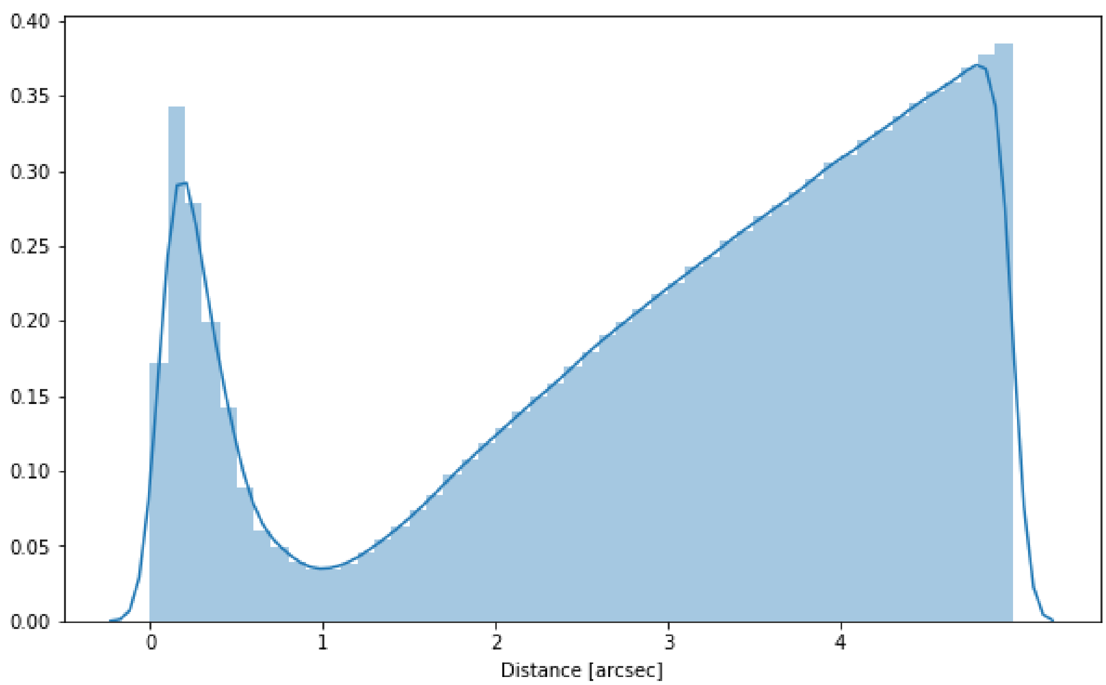
1.2.5 Add CFHT-WIRDS



1.2.6 Add VIPERS



1.3 Add SXDS



1.3.1 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[20]: <IPython.core.display.HTML object>
```

```
['candels_id', 'cfhtls-deep_id', 'cfhtls-wide_id', 'sparcs_intid', 'wirds_id', 'vipers_id', 'sxd
```

1.4 VII - Choosing between multiple values for the same filter

VII.a CFHT Megacam fluxes: CFHTLS-DEEP, CFHTLS-WIDE SpARCS, CANDELS, CFHT-WIRDS and VIPERS

According to Mattia CFHTLenS is built on the same data as CFHTLS-WIDE and should not be included. I have therefore excluded it from the merge above.

CFHTLS-DEEP is prefferred to CFHTLS-WIDE which is prefferred to SpARCS… CANDELS… WIRDS… VIPERS

Survey (in HELP use order)	Bands	notes
CFHTLS-DEEP	u, g, r, i, z, y	
CFHTLS-WIDE	u, g, r, i, z	
SpARCS	u, g, r, z, y	
CANDELS	u	Total fluxes only
CFHT-WIRDS	u, g, r, i, z (+ WIRCAM J, H, Ks)	
VIPERS	u, g, r, i, z, y (+ WIRCAM Ks)	Total fluxes only

```
/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[26]: <IPython.core.display.HTML object>
```

1.4.1 VII.b CFHT WIRCAM fluxes: CFHT-WIRDS and VIPERS

We take WIRDS over VIPERS

```
There are 157497 objects with WIRDS Ks fluxes and 644584 with VIPERS Ks.
We use all 157497 Ks fluxes and take the remaining 644510 VIPERS Ks fluxes.
```

1.4.2 VII.c Subaru SuprimeCam fluxes: SXDS and CANDELS-UDS

We take SXDS over CANDELS so that there are not objects with total and ap mags from different source.

```
/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[36]: <IPython.core.display.HTML object>
```

```
Out[38]: <IPython.core.display.HTML object>
```

1.5 XI - Saving the catalogue

2.2_UKIDSS_merge

March 8, 2018

1 XMM-LSS master catalogue

This notebook presents the merge of the various pristine catalogues to produce the HELP master catalogue on XMM-LSS.

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +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. We start with PanSTARRS because it coevrs the whole field.

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 Start with CANDELS

```
f_acs_f606w  removed.
ferr_acs_f606w  removed.
f_ap_acs_f606w  removed.
ferr_ap_acs_f606w  removed.
f_acs_f814w  removed.
ferr_acs_f814w  removed.
f_ap_acs_f814w  removed.
ferr_ap_acs_f814w  removed.
f_wfc3_f125w  removed.
ferr_wfc3_f125w  removed.
f_ap_wfc3_f125w  removed.
ferr_ap_wfc3_f125w  removed.
f_wfc3_f160w  removed.
ferr_wfc3_f160w  removed.
f_ap_wfc3_f160w  removed.
ferr_ap_wfc3_f160w  removed.
f_candels-megacam_u  removed.
ferr_candels-megacam_u  removed.
```

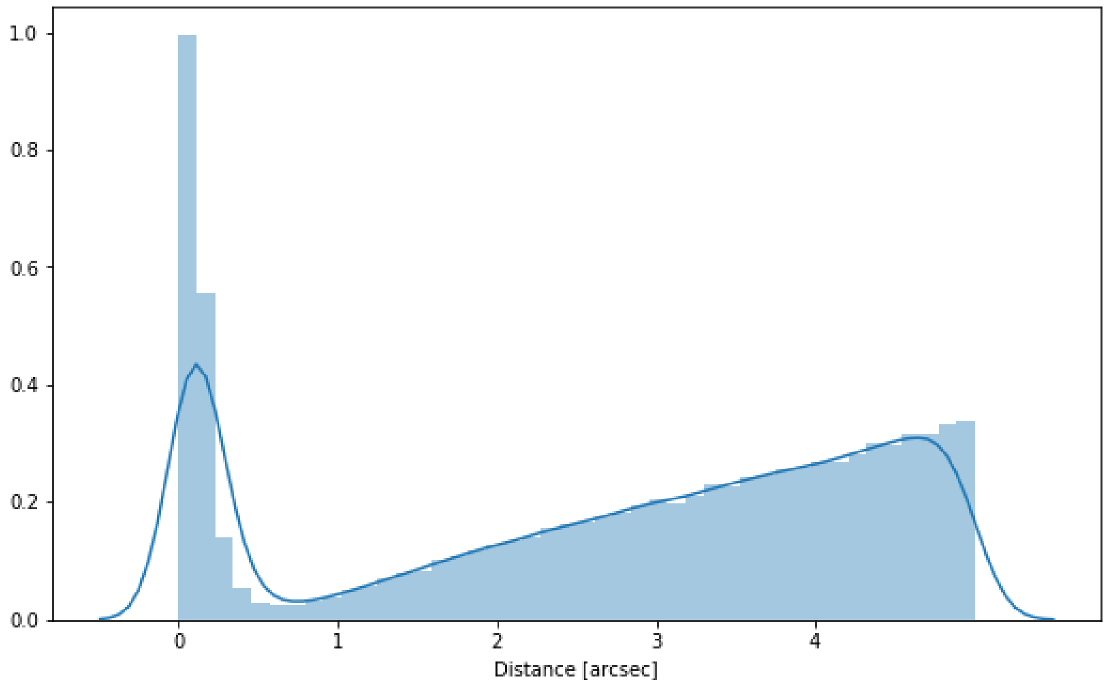
```
f_suprime_b  removed.
ferr_suprime_b  removed.
f_suprime_v  removed.
ferr_suprime_v  removed.
f_suprime_rc  removed.
ferr_suprime_rc  removed.
f_suprime_ip  removed.
ferr_suprime_ip  removed.
f_suprime_zp  removed.
ferr_suprime_zp  removed.
f_hawki_k  removed.
ferr_hawki_y  removed.
ferr_hawki_k  removed.
f_candels-irac_i1  removed.
ferr_candels-irac_i1  removed.
f_candels-irac_i2  removed.
ferr_candels-irac_i2  removed.
f_candels-irac_i3  removed.
ferr_candels-irac_i3  removed.
f_candels-irac_i4  removed.
ferr_candels-irac_i4  removed.
m_acs_f606w  removed.
merr_acs_f606w  removed.
flag_acs_f606w  removed.
m_ap_acs_f606w  removed.
merr_ap_acs_f606w  removed.
m_acs_f814w  removed.
merr_acs_f814w  removed.
flag_acs_f814w  removed.
m_ap_acs_f814w  removed.
merr_ap_acs_f814w  removed.
m_wfc3_f125w  removed.
merr_wfc3_f125w  removed.
flag_wfc3_f125w  removed.
m_ap_wfc3_f125w  removed.
merr_ap_wfc3_f125w  removed.
m_wfc3_f160w  removed.
merr_wfc3_f160w  removed.
flag_wfc3_f160w  removed.
m_ap_wfc3_f160w  removed.
merr_ap_wfc3_f160w  removed.
m_candels-megacam_u  removed.
merr_candels-megacam_u  removed.
flag_candels-megacam_u  removed.
m_suprime_b  removed.
merr_suprime_b  removed.
flag_suprime_b  removed.
m_suprime_v  removed.
```

```
merr_suprime_v  removed.
flag_suprime_v  removed.
m_suprime_rc  removed.
merr_suprime_rc  removed.
flag_suprime_rc  removed.
m_suprime_ip  removed.
merr_suprime_ip  removed.
flag_suprime_ip  removed.
m_suprime_zp  removed.
merr_suprime_zp  removed.
flag_suprime_zp  removed.
m_hawki_k  removed.
merr_hawki_k  removed.
flag_hawki_k  removed.
m_candels-irac_i1  removed.
merr_candels-irac_i1  removed.
flag_candels-irac_i1  removed.
m_candels-irac_i2  removed.
merr_candels-irac_i2  removed.
flag_candels-irac_i2  removed.
m_candels-irac_i3  removed.
merr_candels-irac_i3  removed.
flag_candels-irac_i3  removed.
m_candels-irac_i4  removed.
merr_candels-irac_i4  removed.
flag_candels-irac_i4  removed.
```

1.2.2 Add DXS

```
HELP Warning: There weren't any cross matches. The two surveys probably don't overlap.
```

1.2.3 Add UDS



1.2.4 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[12]: <IPython.core.display.HTML object>
```

1.3 V - Adding unique identifier

```
['candels_id', 'dxs_id', 'uds_id', 'ukidss_intid']
```

1.4 VII - Choosing between multiple values for the same filter

1.4.1 VII. UKIDSS DXS and UDS

There is no overlap between UDS and DXS. We choose the UDS fluxes over CANDELS-UDS.

1.5 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.

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?**

1.6 XI - Saving the catalogue

```
Missing columns: {'dxs_id', 'ukidss_dec', 'uds_id', 'uds_flag_cleaned', 'ukidss_ra', 'candels_id
```

2.3_HSC_merge

March 8, 2018

1 XMM-LSS master catalogue

This notebook presents the merge of the various pristine catalogues to produce the HELP master catalogue on XMM-LSS.

```
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

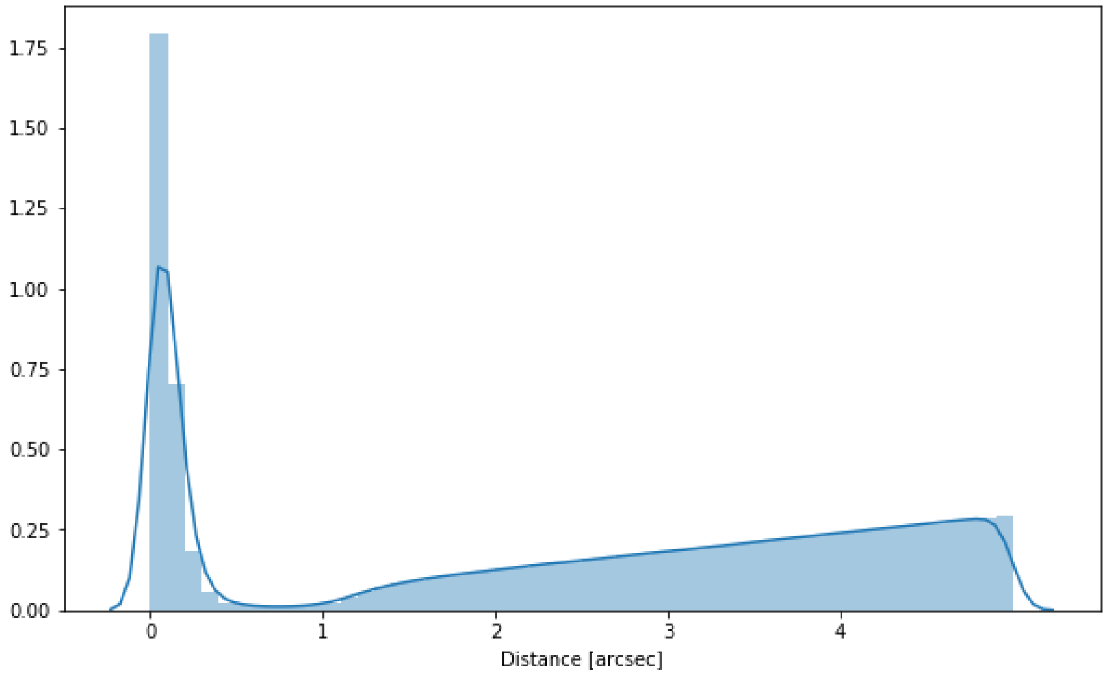
1.2 II - Merging tables

We first merge the optical catalogues and then add the infrared ones. We start with PanSTARRS because it coevrs the whole field.

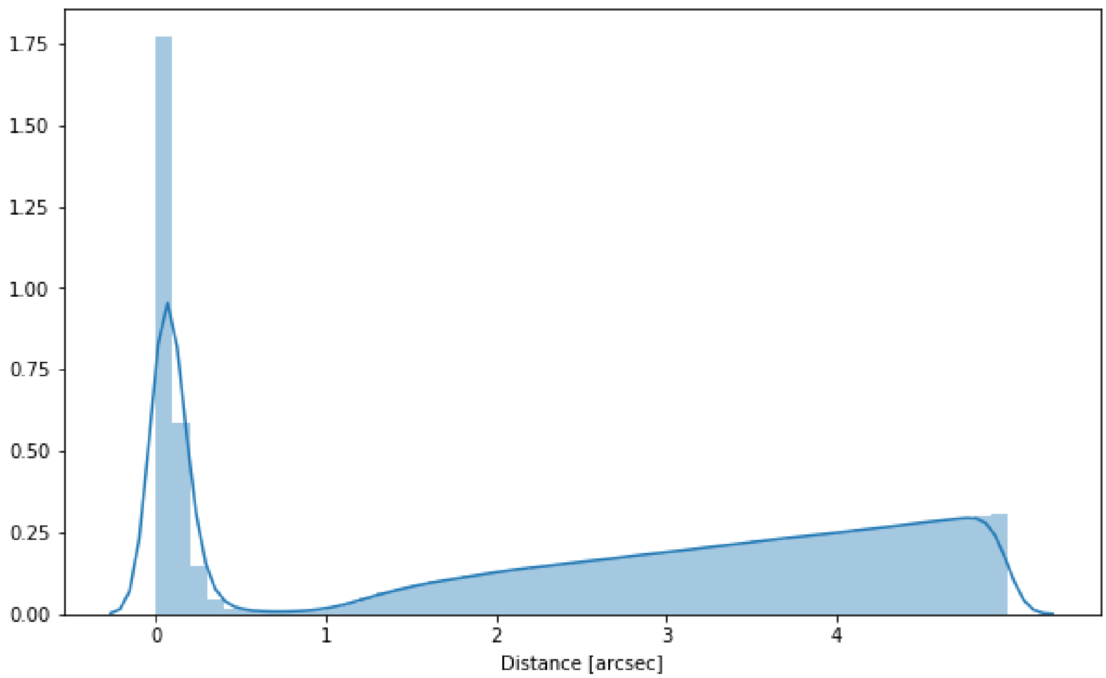
At every step, we look at the distribution of the distances to the nearest source in the merged catalogue to determine the best crossmatching radius.

1.2.1 Start with HSC-WIDE

1.2.2 Add HSC-DEEP



1.2.3 Add HSC-UDEEP



1.2.4 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[12]: <IPython.core.display.HTML object>
```

```
['hsc-wide_id', 'hsc-deep_id', 'hsc-udeep_id', 'hsc_intid']
```

1.3 VII - Choosing between multiple values for the same filter

VII. e HSC wide, deep and udeep Here we straightforwardly take the deepest

Survey	Bands observed
HSC-WIDE	grizy
HSC-DEEP	grizy
HSC-UDEEP	grizy n921 n816

```
/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[18]: <IPython.core.display.HTML object>
```

1.4 XI - Saving the catalogue

```
Missing columns: {'hsc-wide_flag_cleaned', 'hsc-udeep_flag_cleaned', 'hsc-udeep_flag_gaia', 'hsc
```

2.4_VISTA_merge

March 8, 2018

1 XMM-LSS master catalogue

This notebook presents the merge of the various pristine catalogues to produce the HELP master catalogue on XMM-LSS.

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
```

1.1 I - Reading the prepared pristine catalogues

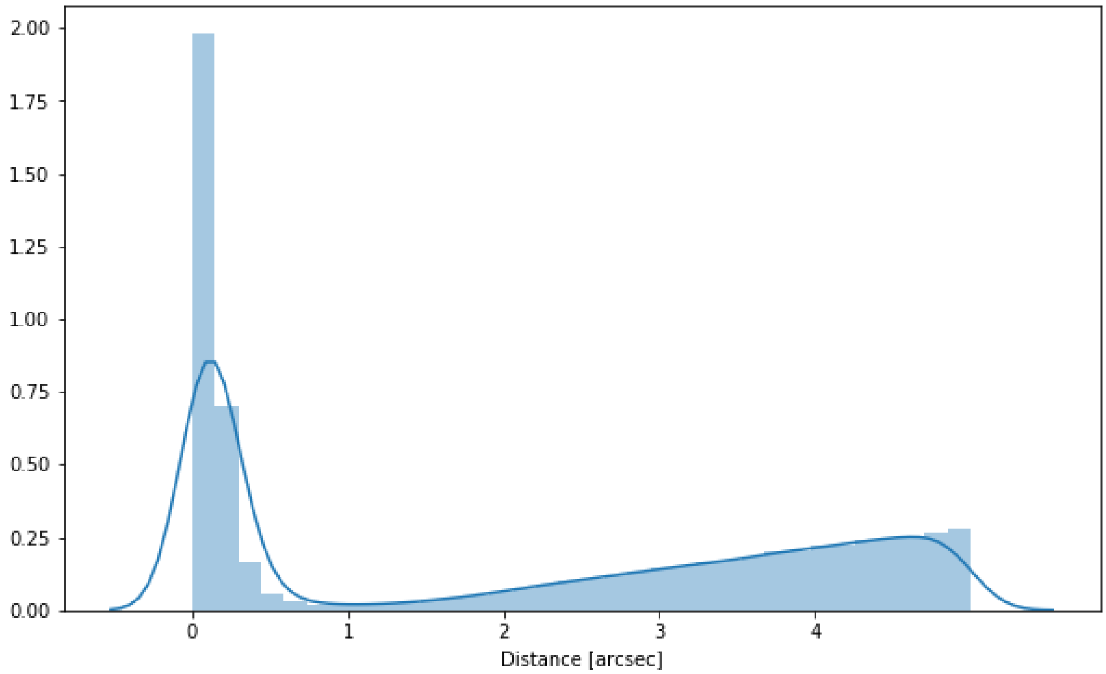
1.2 II - Merging tables

We first merge the optical catalogues and then add the infrared ones. We start with PanSTARRS because it coevrs the whole field.

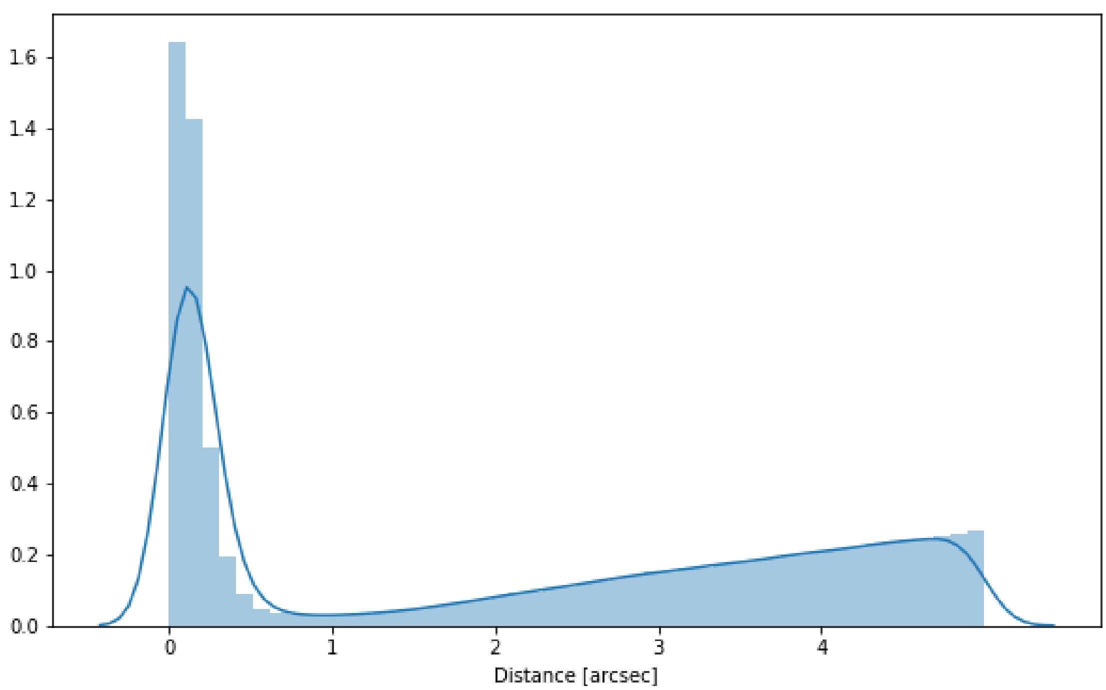
At every step, we look at the distribution of the distances to the nearest source in the merged catalogue to determine the best crossmatching radius.

1.2.1 Start with VHS

1.2.2 Add VIDEO



1.2.3 Add VIKING



1.2.4 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[12]: <IPython.core.display.HTML object>
```

```
['vhs_id', 'video_id', 'viking_id', 'vircam_intid']
```

1.3 VII - Choosing between multiple values for the same filter

1.3.1 VII.c VISTA VIDEO, VHS, and VIKING: VISTA fluxes

According to Mattia Vacari VIDEO is deeper than VIKING which is deeper than VHS

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

1.3.2 Vista origin overview

For each band show how many objects have fluxes from each survey for both total and aperture photometries.

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

1.4 XI - Saving the catalogue

```
Missing columns: {'viking_id', 'vhs_flag_gaia', 'vhs_id', 'viking_flag_gaia', 'vircam_dec', 'vir
```

2.5_IRAC_merge

March 8, 2018

1 XMM-LSS master catalogue - IRAC merging

This notebook presents the merge of the IRAC pristine catalogues to produce the HELP master catalogue on XMM-LSS.

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +0000)
```

```
/Users/rs548/anaconda/envs/herschelhelp_internal/lib/python3.6/site-packages/seaborn/apionly.py:
  warnings.warn(msg, UserWarning)
```

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. We start with PanSTARRS because it coevrs the whole field.

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 Start with CANDELS

```
f_acs_f606w  removed.
ferr_acs_f606w  removed.
f_ap_acs_f606w  removed.
ferr_ap_acs_f606w  removed.
f_acs_f814w  removed.
ferr_acs_f814w  removed.
f_ap_acs_f814w  removed.
ferr_ap_acs_f814w  removed.
f_wfc3_f125w  removed.
ferr_wfc3_f125w  removed.
f_ap_wfc3_f125w  removed.
ferr_ap_wfc3_f125w  removed.
f_wfc3_f160w  removed.
ferr_wfc3_f160w  removed.
```

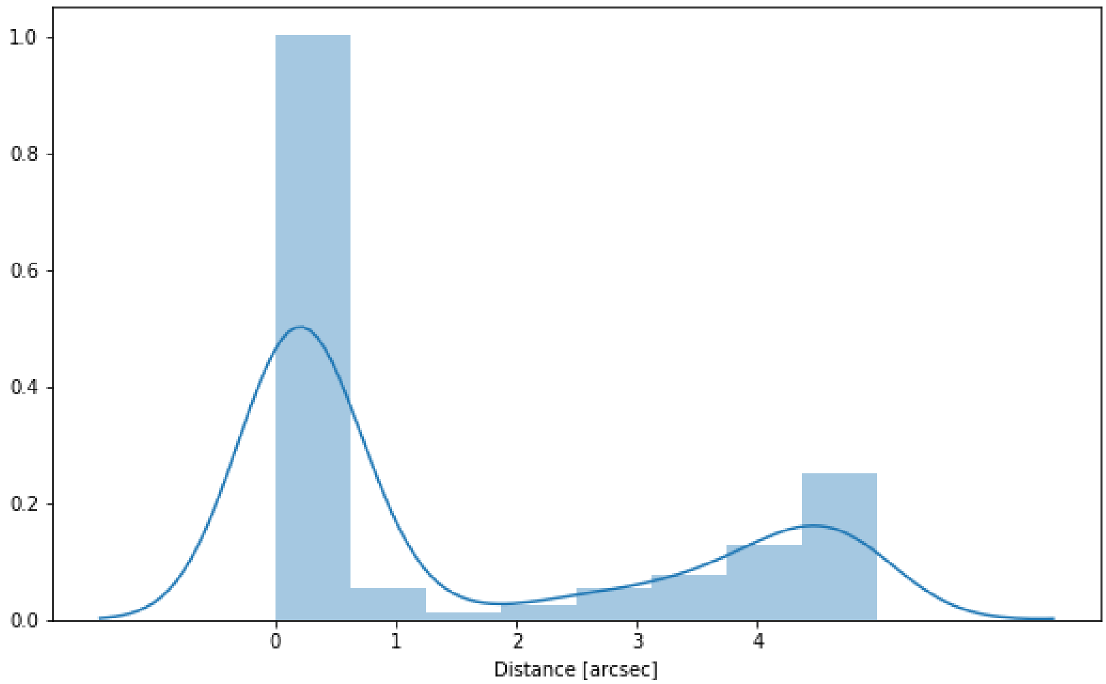
```
f_ap_wfc3_f160w  removed.
ferr_ap_wfc3_f160w  removed.
f_candels-megacam_u  removed.
ferr_candels-megacam_u  removed.
f_suprime_b  removed.
ferr_suprime_b  removed.
f_suprime_v  removed.
ferr_suprime_v  removed.
f_suprime_rc  removed.
ferr_suprime_rc  removed.
f_suprime_ip  removed.
ferr_suprime_ip  removed.
f_suprime_zp  removed.
ferr_suprime_zp  removed.
f_hawki_k  removed.
ferr_hawki_y  removed.
ferr_hawki_k  removed.
f_candels-ukidss_j  removed.
ferr_candels-ukidss_j  removed.
f_candels-ukidss_h  removed.
ferr_candels-ukidss_h  removed.
f_candels-ukidss_k  removed.
ferr_candels-ukidss_k  removed.
m_acs_f606w  removed.
merr_acs_f606w  removed.
flag_acs_f606w  removed.
m_ap_acs_f606w  removed.
merr_ap_acs_f606w  removed.
m_acs_f814w  removed.
merr_acs_f814w  removed.
flag_acs_f814w  removed.
m_ap_acs_f814w  removed.
merr_ap_acs_f814w  removed.
m_wfc3_f125w  removed.
merr_wfc3_f125w  removed.
flag_wfc3_f125w  removed.
m_ap_wfc3_f125w  removed.
merr_ap_wfc3_f125w  removed.
m_wfc3_f160w  removed.
merr_wfc3_f160w  removed.
flag_wfc3_f160w  removed.
m_ap_wfc3_f160w  removed.
merr_ap_wfc3_f160w  removed.
m_candels-megacam_u  removed.
merr_candels-megacam_u  removed.
flag_candels-megacam_u  removed.
m_suprime_b  removed.
merr_suprime_b  removed.
```

```
flag_suprime_b  removed.
m_suprime_v  removed.
merr_suprime_v  removed.
flag_suprime_v  removed.
m_suprime_rc  removed.
merr_suprime_rc  removed.
flag_suprime_rc  removed.
m_suprime_ip  removed.
merr_suprime_ip  removed.
flag_suprime_ip  removed.
m_suprime_zp  removed.
merr_suprime_zp  removed.
flag_suprime_zp  removed.
m_hawki_k  removed.
merr_hawki_k  removed.
flag_hawki_k  removed.
m_candels-ukidss_j  removed.
merr_candels-ukidss_j  removed.
flag_candels-ukidss_j  removed.
m_candels-ukidss_h  removed.
merr_candels-ukidss_h  removed.
flag_candels-ukidss_h  removed.
m_candels-ukidss_k  removed.
merr_candels-ukidss_k  removed.
flag_candels-ukidss_k  removed.
```

1.2.2 Add SERVS

```
HELP Warning: There weren't any cross matches. The two surveys probably don't overlap.
```

1.2.3 Add SWIRE



1.2.4 Cleaning

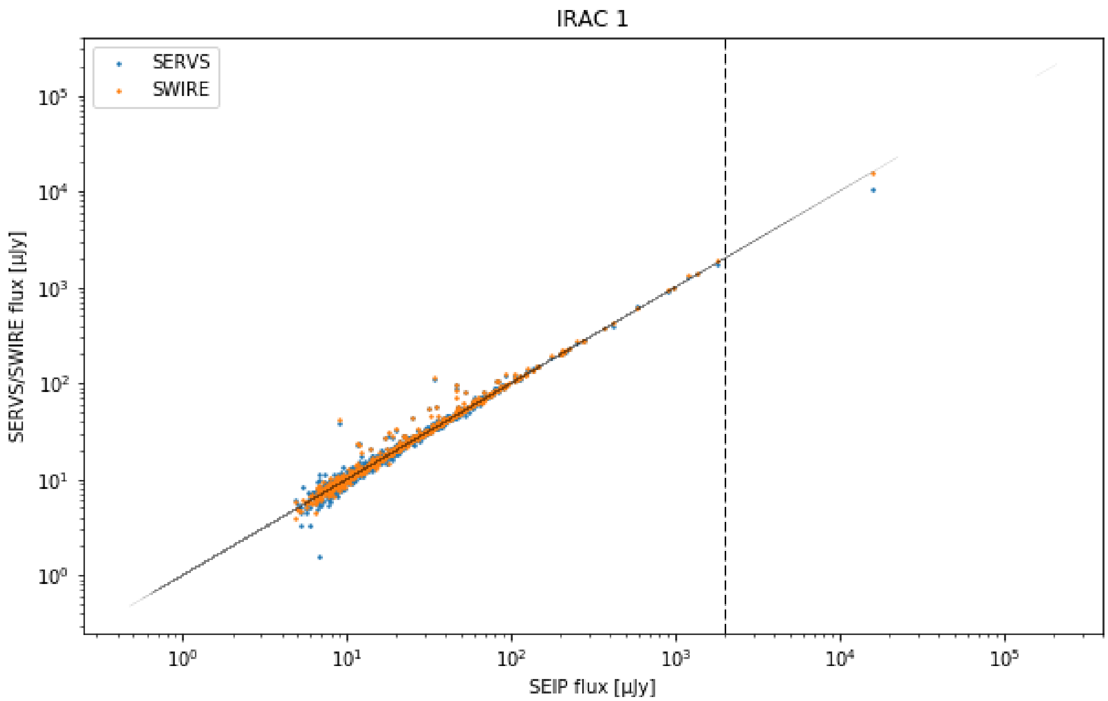
When we merge the catalogues, astropy masks the non-existent values (e.g. when a row comes only from a catalogue and has no counterparts in the other, the columns from the latest are masked for that row). We indicate to use NaN for masked values for floats columns, False for flag columns and -1 for ID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

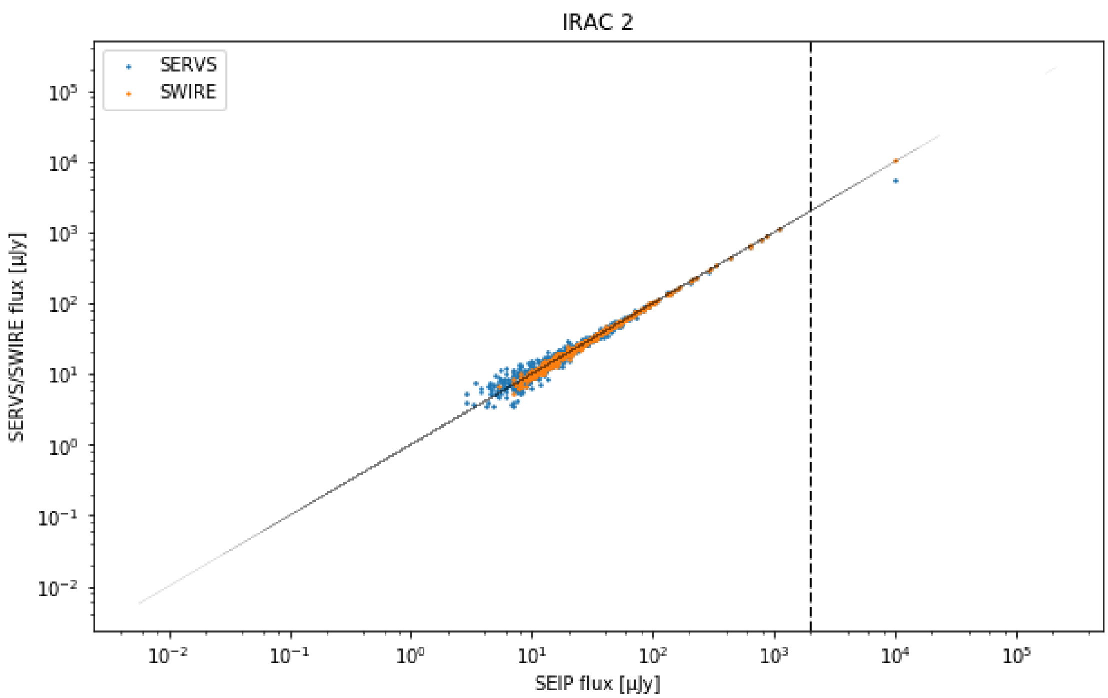
```
Out[12]: <IPython.core.display.HTML object>

['candels_id', 'servs_intid', 'swire_intid', 'irac_intid']
```

1.3 VII - Choosing between multiple values for the same filter

1.3.1 VII.a SERVS and SWIRE IRAC fluxes

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. we include CANDELS fluxes where no other flux is available. CANDELS includes all four IRAC bands.





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.

```
1776 sources with SERVS flux
735 sources with SWIRE flux
660 sources with SERVS and SWIRE flux
1775 sources for which we use SERVS
76 sources for which we use SWIRE
```

```
1776 sources with SERVS flux
735 sources with SWIRE flux
660 sources with SERVS and SWIRE flux
35931 sources with CANDELS flux
1775 sources for which we use SERVS
76 sources for which we use SWIRE
35931 sources for which we use CANDELS
```

```
1856 sources with SERVS flux
507 sources with SWIRE flux
486 sources with SERVS and SWIRE flux
1855 sources for which we use SERVS
22 sources for which we use SWIRE
```

```
1856 sources with SERVS flux
507 sources with SWIRE flux
486 sources with SERVS and SWIRE flux
35931 sources with CANDELS flux
1855 sources for which we use SERVS
22 sources for which we use SWIRE
35931 sources for which we use CANDELS
```

1.4 XI - Saving the catalogue

```
Missing columns: {'servs_flag_gaia', 'candels_id', 'swire_flag_cleaned', 'servs_stellarity_irac_
```

2.6_DECAM_merging

March 8, 2018

1 XMM-LSS DECAM merging

Both DES and DECaLS provide DECam fluxes which have overlapping coverage. We chose which to use DES preferentially. In this notebook we cross match both catalogues and take the DES fluxes where available, using DECaLS otherwise

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
This notebook was executed on:
2018-02-21 16:20:44.979073
```

1.1 I - Reading the prepared pristine catalogues

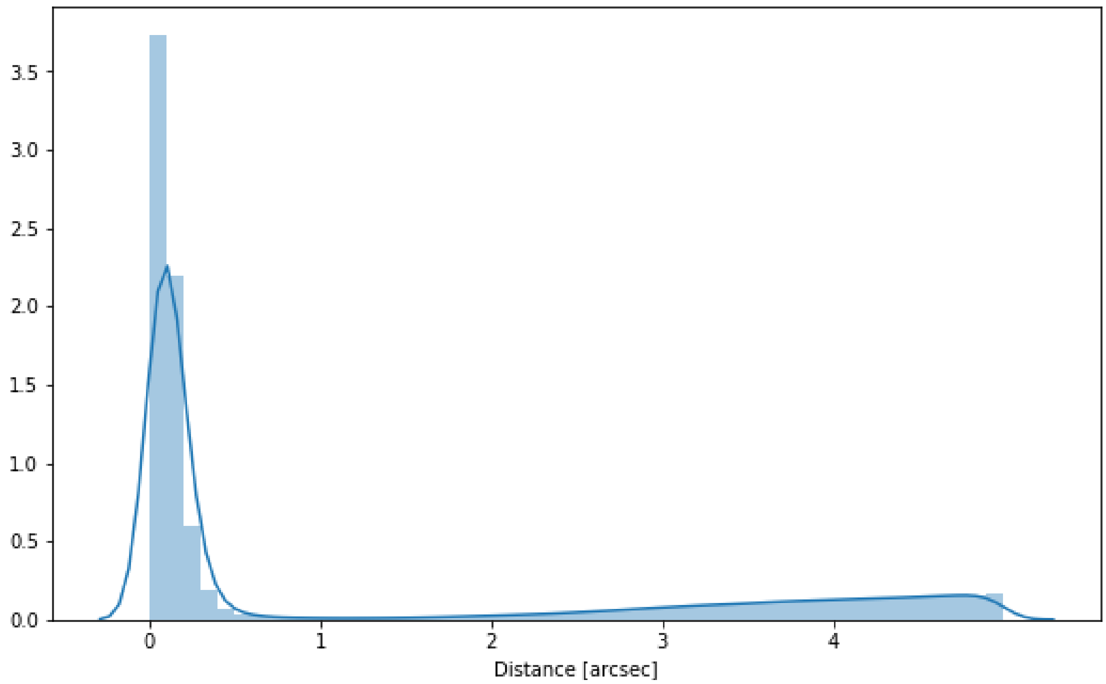
1.2 II - Merging tables

We first merge the optical catalogues and then add the infrared ones: HSC, VHS, VICS82, UKIDSS-LAS, PanSTARRS, SHELA, SpIES.

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 DES

1.3 Add DECaLS



1.3.1 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[10]: <IPython.core.display.HTML object>
```

1.4 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.

1.5 VIII - Cross-identification table

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

```
['des_id', 'decals_id', 'decam_intid']
```

1.6 VI - Choosing between multiple values for the same filter

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

1.7 IX - Saving the catalogue

```
Out[21]: ['des_id',
          'ra',
          'dec',
          'm_decam_i',
          'merr_decam_i',
          'm_ap_decam_i',
          'merr_ap_decam_i',
          'm_decam_y',
          'merr_decam_y',
          'm_ap_decam_y',
          'merr_ap_decam_y',
          'f_decam_i',
          'ferr_decam_i',
          'flag_decam_i',
          'f_ap_decam_i',
          'ferr_ap_decam_i',
          'f_decam_y',
          'ferr_decam_y',
          'flag_decam_y',
          'f_ap_decam_y',
          'ferr_ap_decam_y',
          'flag_merged',
          'decals_id',
          'decam_flag_cleaned',
          'decam_flag_gaia',
          'decam_stellarity',
          'decam_intid',
          'f_decam_g',
          'ferr_decam_g',
          'm_decam_g',
          'merr_decam_g',
          'flag_decam_g',
          'f_ap_decam_g',
          'ferr_ap_decam_g',
          'm_ap_decam_g',
```

```
          'merr_ap_decam_g',
          'f_decam_r',
          'ferr_decam_r',
          'm_decam_r',
          'merr_decam_r',
          'flag_decam_r',
          'f_ap_decam_r',
          'ferr_ap_decam_r',
          'm_ap_decam_r',
          'merr_ap_decam_r',
          'f_decam_z',
          'ferr_decam_z',
          'm_decam_z',
          'merr_decam_z',
          'flag_decam_z',
          'f_ap_decam_z',
          'ferr_ap_decam_z',
          'm_ap_decam_z',
          'merr_ap_decam_z']

Missing columns: set()
```

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

2.7_Merging

March 8, 2018

1 XMM-LSS master catalogue

This notebook presents the merge of the various pristine catalogues to produce the HELP master catalogue on XMM-LSS.

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
This notebook was executed on:
2018-02-21 16:29:22.897443
```

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. We start with PanSTARRS because it coevrs the whole field.

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.

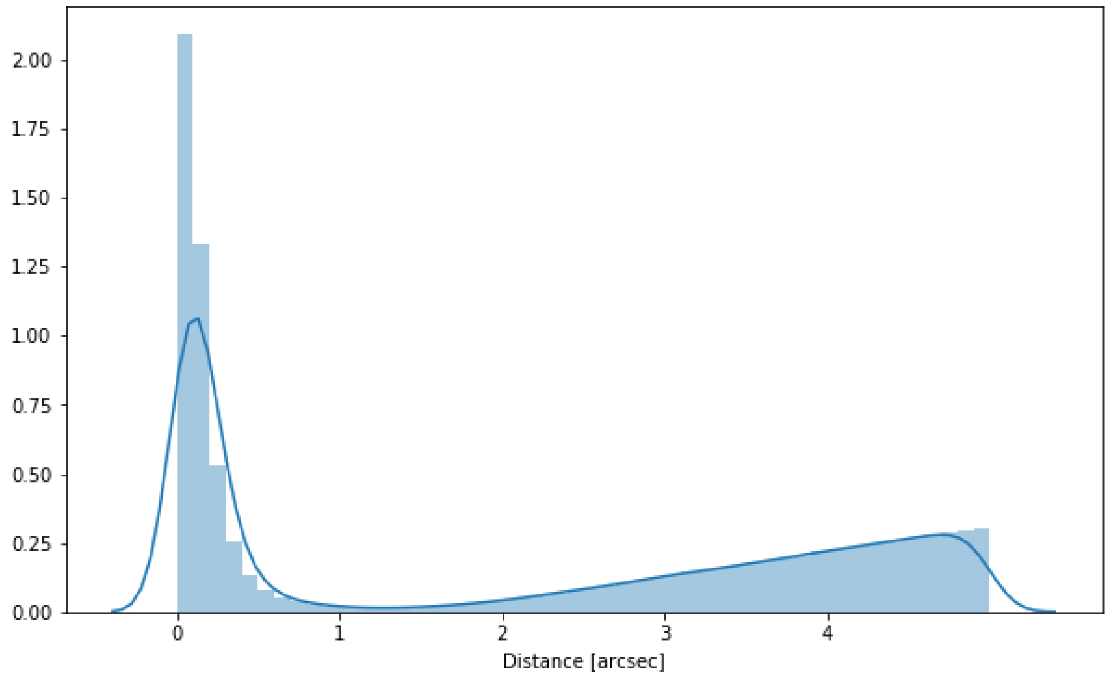
1.2.1 Add PanSTARRS

1.2.2 CANDELS

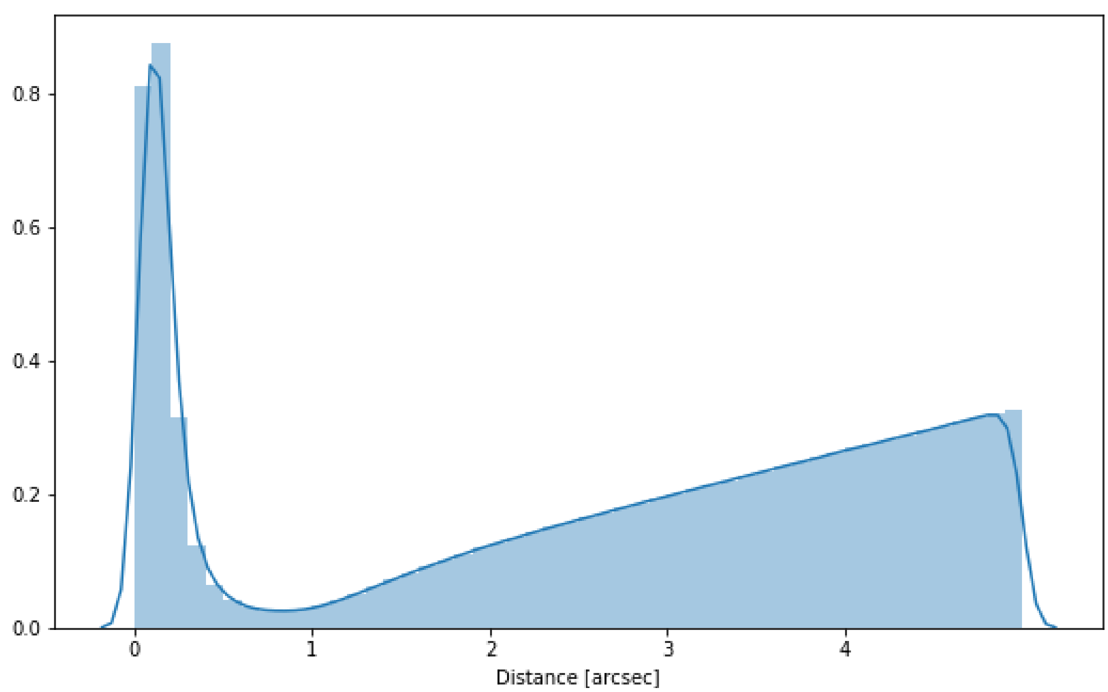
We now use CANDELS-UDS which must be individually merged with the merged catalogues since it has measurements from different instruments

1.2.3 Add CFHT

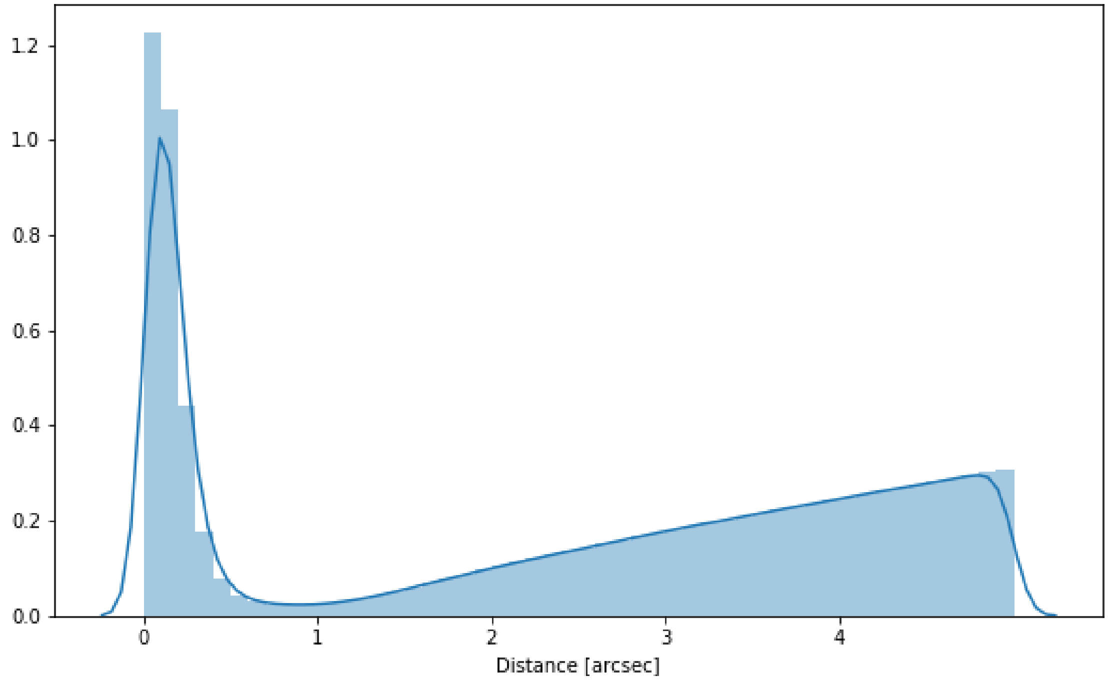
We independently merge all the CFHT Megacam and WIRCAM and some CANDELS in CFHT_Merge notebook



1.2.4 Add HSC-PSS



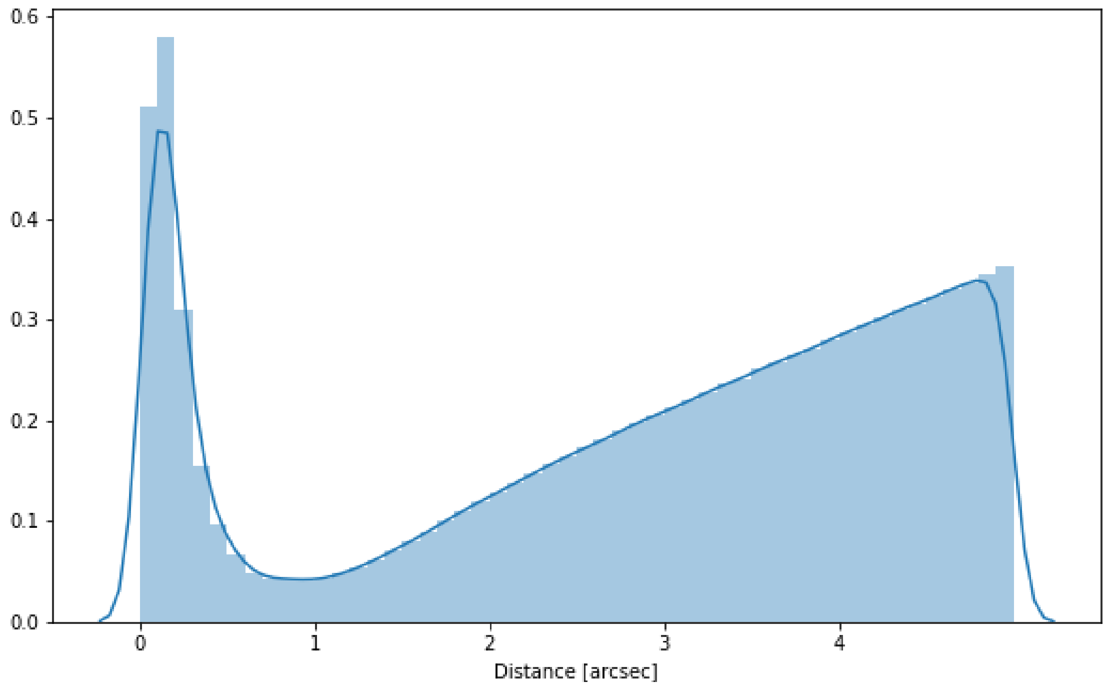
1.2.5 Add DECam (DES and DECaLS)



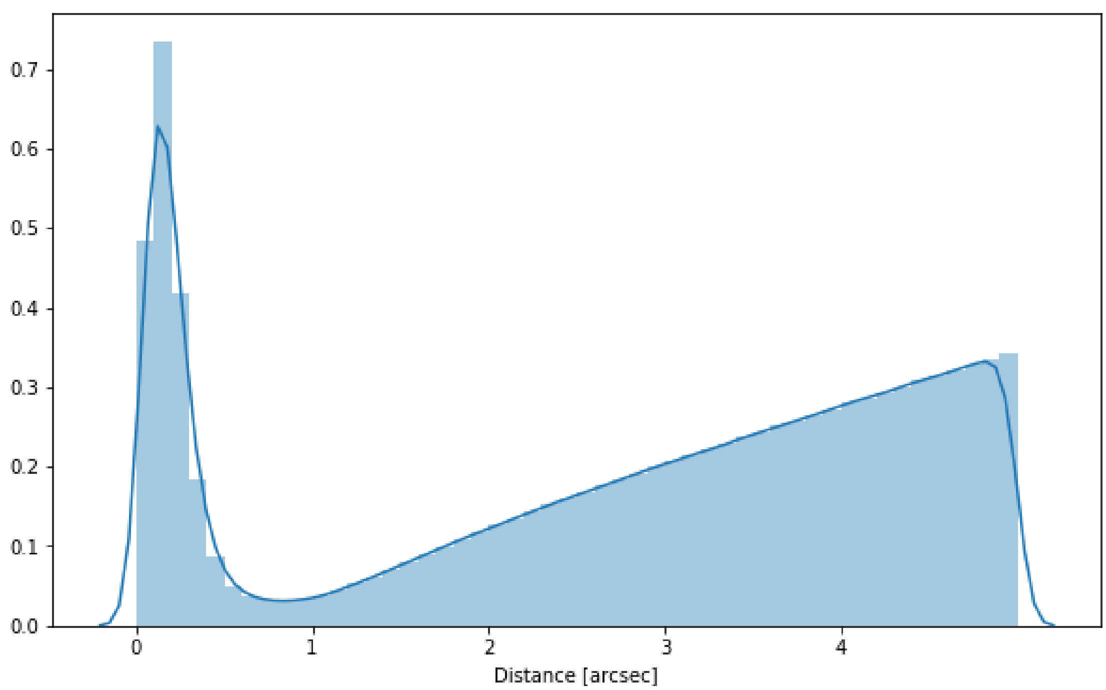
Add SXDS
This now happens in CFHT merging notebook because CANDELS contains Suprime fluxes which need merging

It is strange that this does not peak at zero. This is bservable in the original band cross match. It implies there is a persistent offset. Perhaps each band should be astrometrically corrected before the original merge.

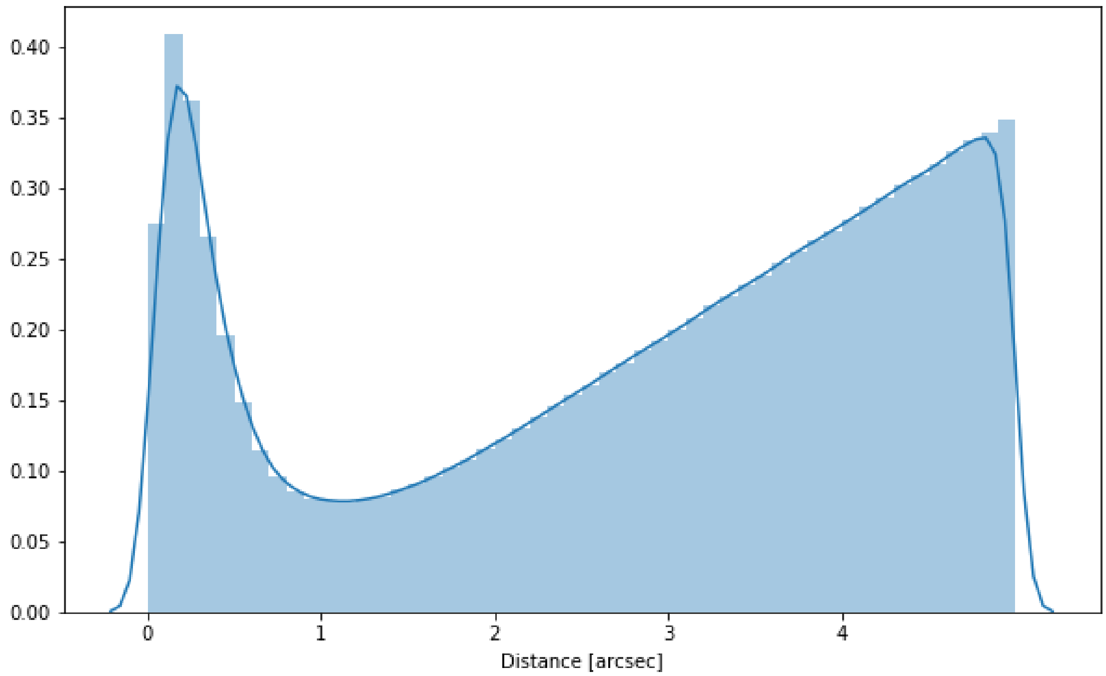
1.2.6 Add UKIDSS



1.2.7 Add VIRCAM



1.2.8 Add IRAC



1.2.9 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[24]: <IPython.core.display.HTML object>
```

1.3 III - Merging flags and stellarity

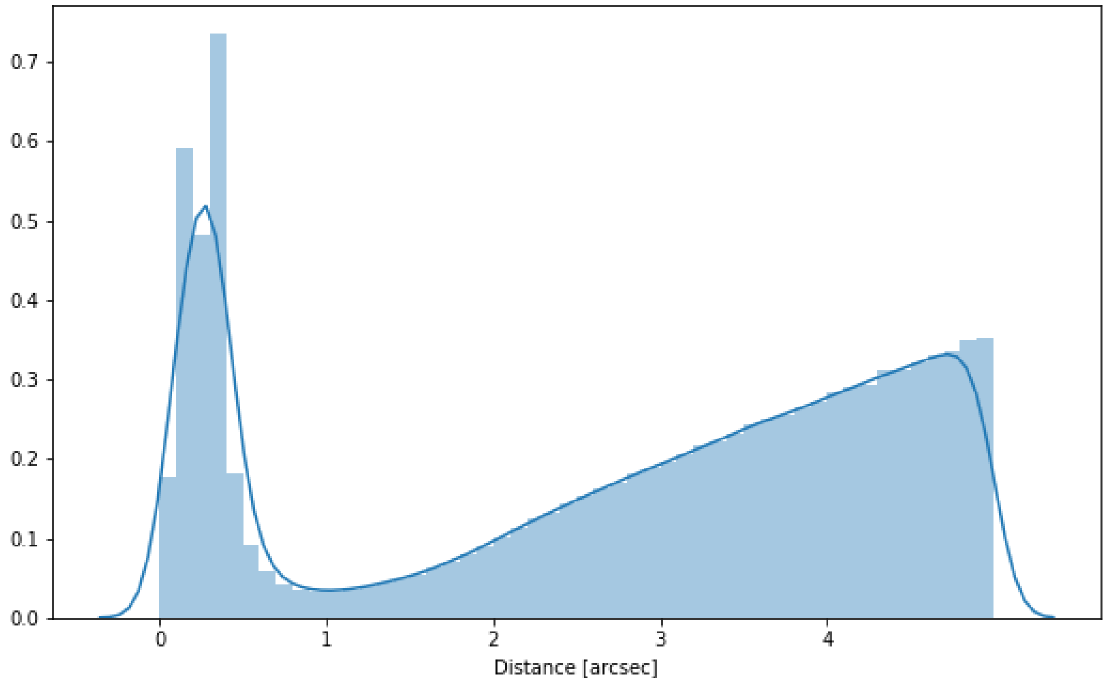
This all happens at the end now after the catalogue has been cut into strips.

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 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 the different depths in the catalogue we are using.

1.8 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.

1.9 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?**

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

```
['ps1_id', 'cfht_intid', 'candels_id', 'cfhtls-wide_id', 'cfhtls-deep_id', 'sparcs_intid', 'wird
```

1.10 X - Adding HEALPix index

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

1.11 XI - Saving the catalogue

```
Missing columns: {'sdss_id', 'des_id', 'swire_intid', 'decals_id', 'candels_id', 'viking_id', 'c
```

1.12 XII - folding in the photometry

On XMM-LSS there is too much data to load all in to memory at once so we perform the cross matching without photometry columns. Only now do we fold in the photometry data by first cutting the catalogue up in to manageable sizes.

```
88
```

1.13 How to generate final catalogue

After this notebook has been run there will be a set of sub catalogues in data/tiles/

These need to be stacked using stilts:

For many purposes this file may be too large. In order to run checks and diagnostics we typically take a subset using something like:

3_Checks_and_diagnostics

March 8, 2018

1 XMM-LSS master catalogue

1.1 Checks and diagnostics

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
This notebook was executed on:
2018-02-21 23:51:15.510091
```

```
Diagnostics done using: master_catalogue_xmm-lss_20180221.fits
```

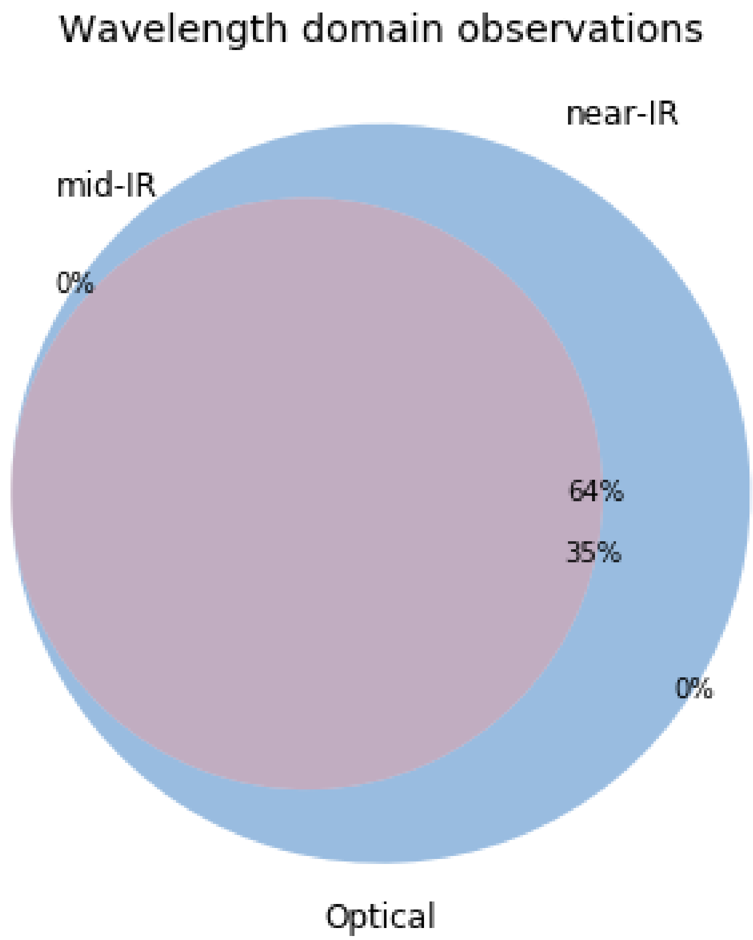
1.2 0 - Quick checks

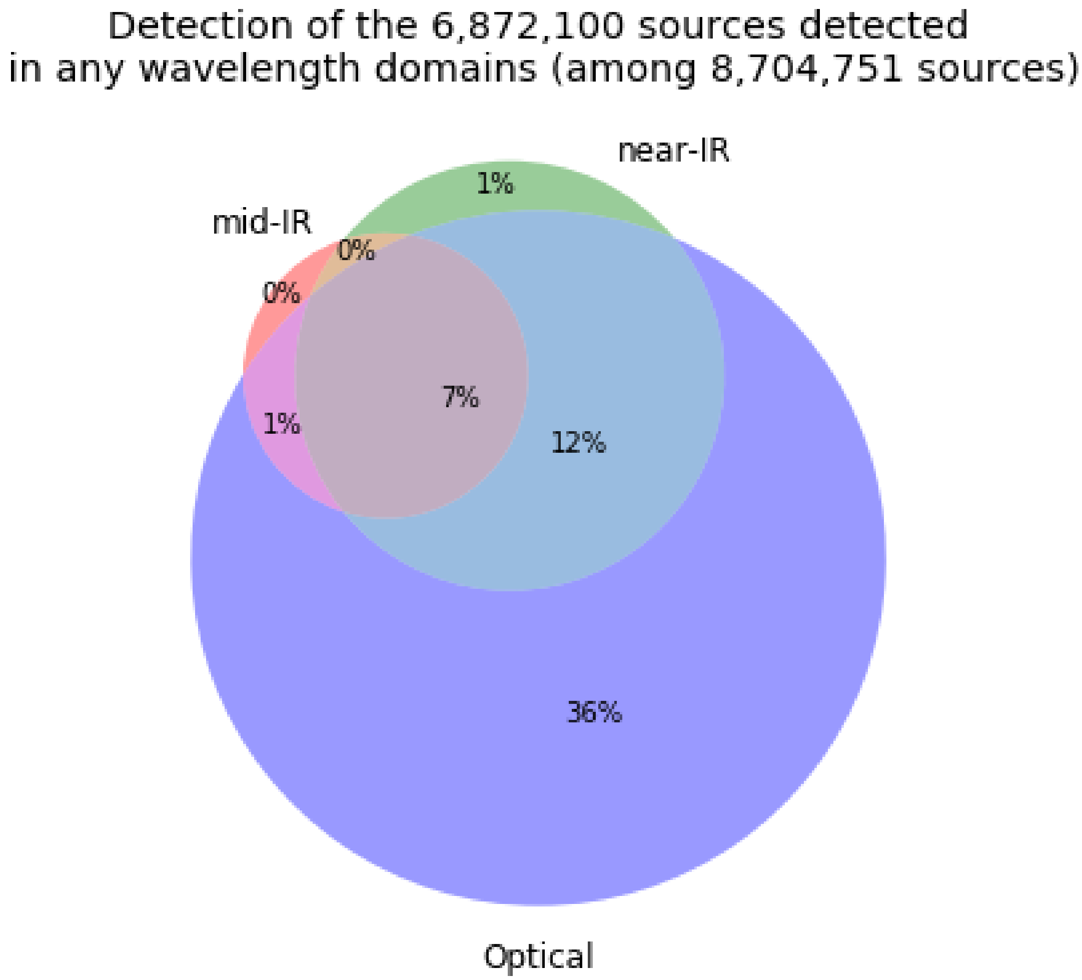
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/numpy/core/numeric.py:301:
  format(shape, fill_value, array(fill_value).dtype), FutureWarning)
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/numpy/core/numeric.py:301:
  format(shape, fill_value, array(fill_value).dtype),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

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

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

1.3 I - Summary of wavelength domains



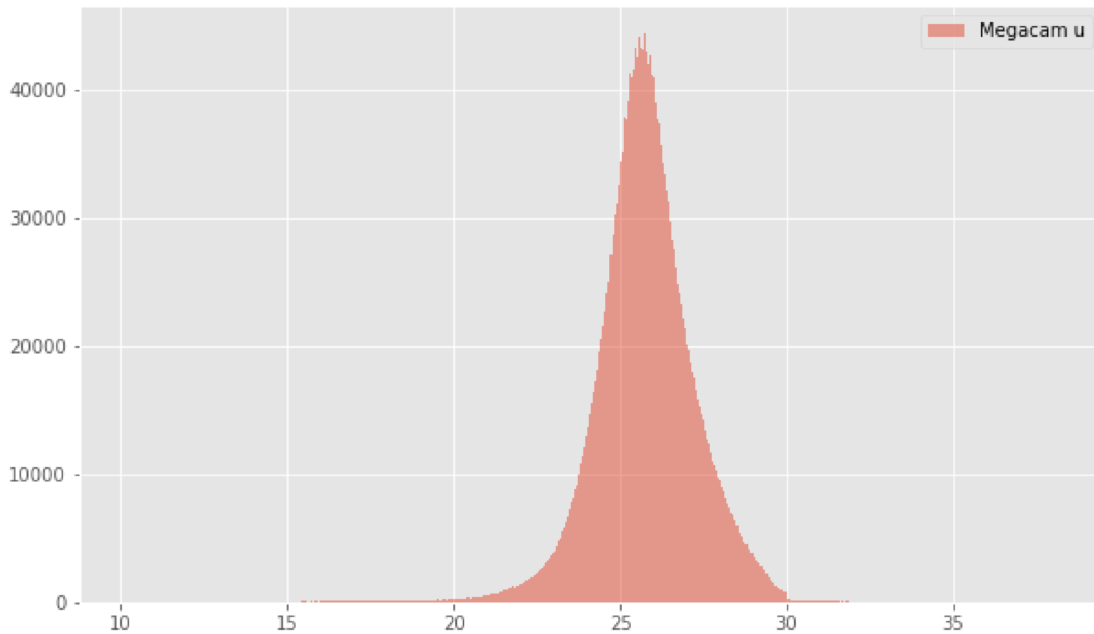


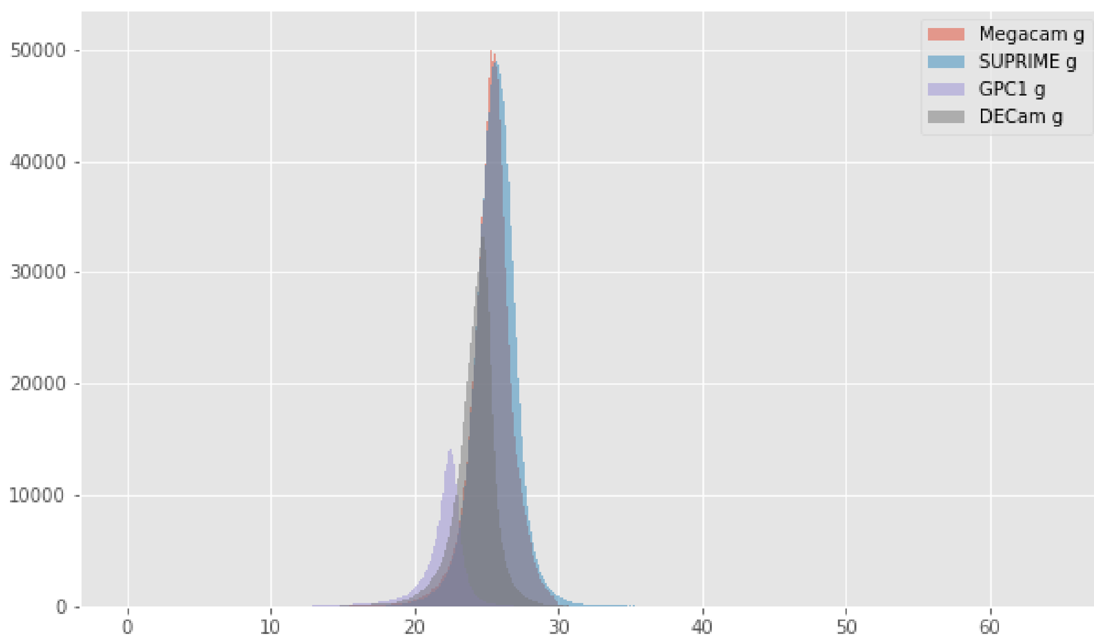
1.4 II - Comparing magnitudes in similar filters

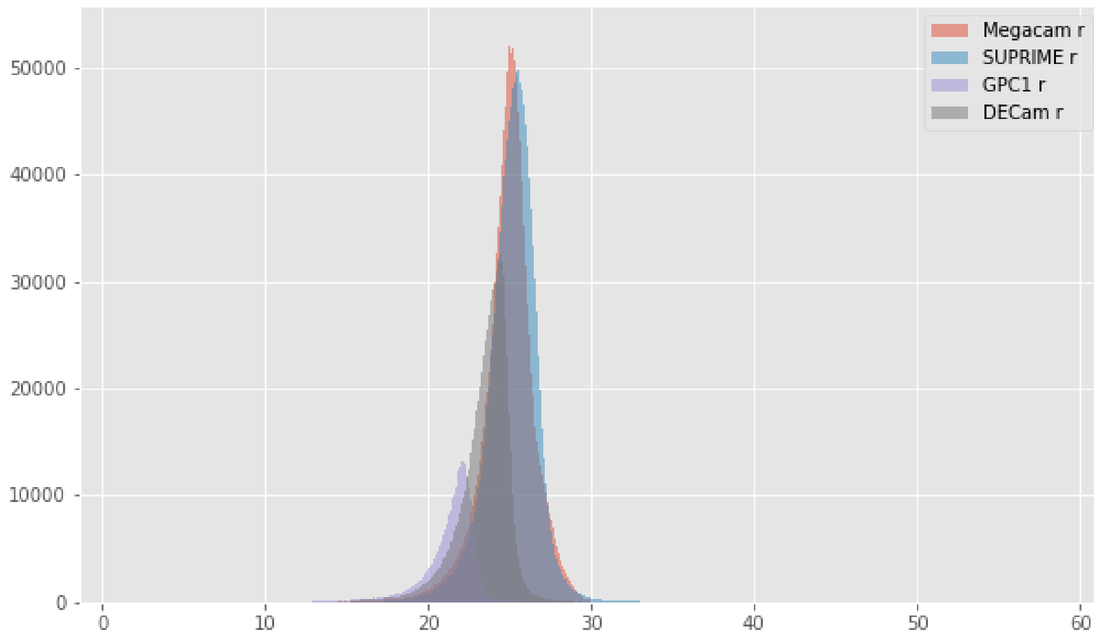
The master list if composed of several catalogues containing magnitudes in similar filters on different instruments. We are comparing the magnitudes in these corresponding filters.

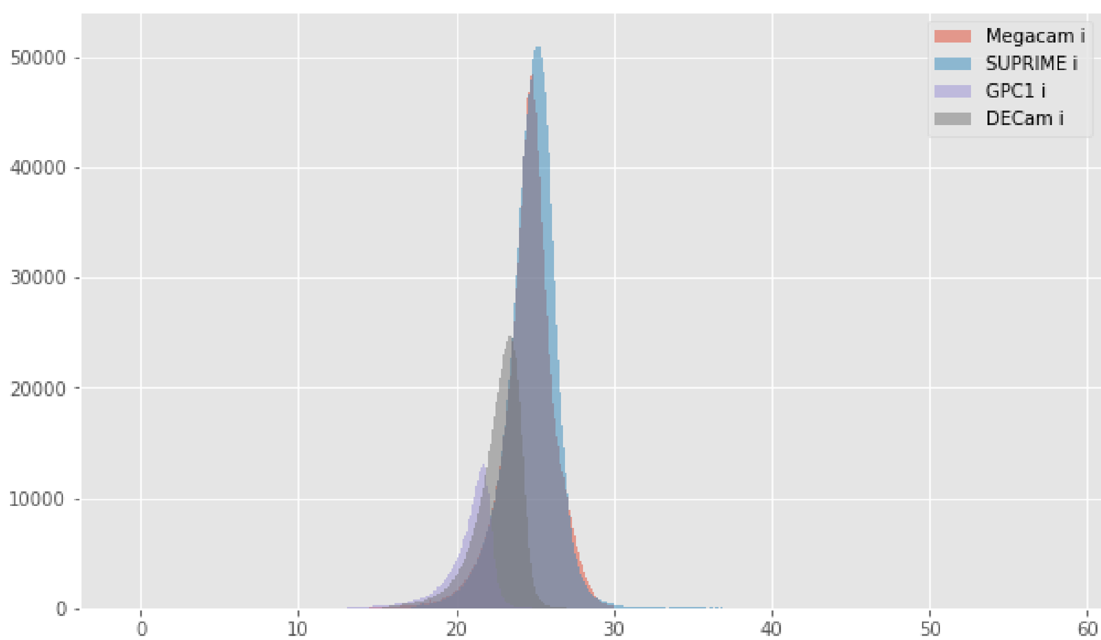
1.4.1 II.a - Comparing depths

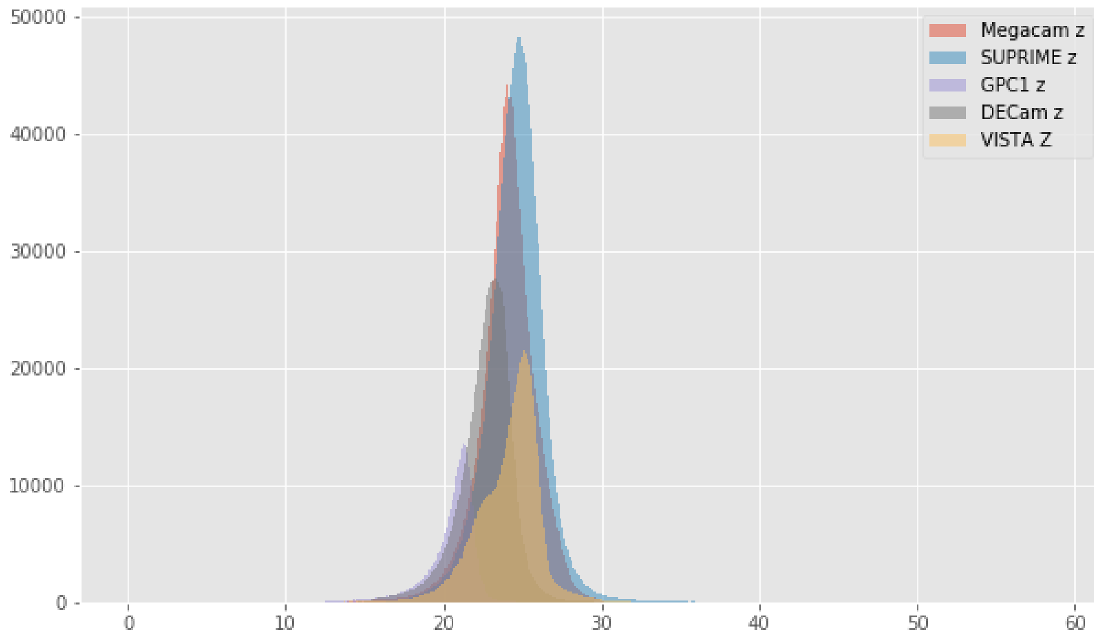
We compare the histograms of the total aperture magnitudes of similar bands.


Megacam u
40000
30000
20000
10000
0
10
15
20
25
30
35

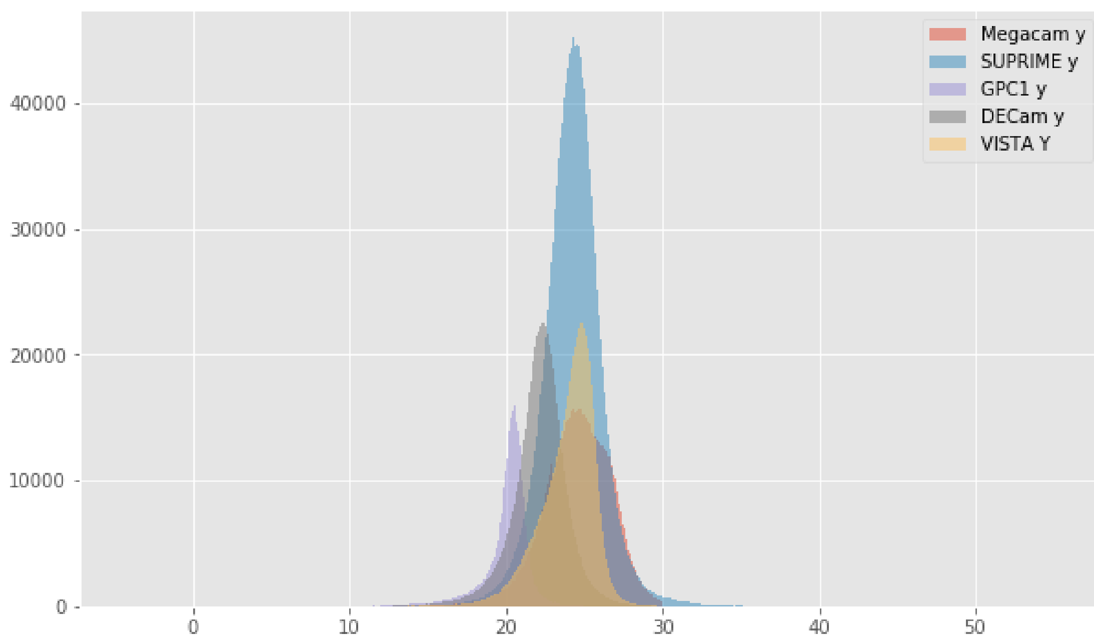

Megacam g
SUPRIME g
GPC1 g
DECam g
50000
40000
30000
20000
10000
0
0
10
20
30
40
50
60


Megacam r
SUPRIME r
GPC1 r
DECam r
50000
40000
30000
20000
10000
0
0
10
20
30
40
50
60

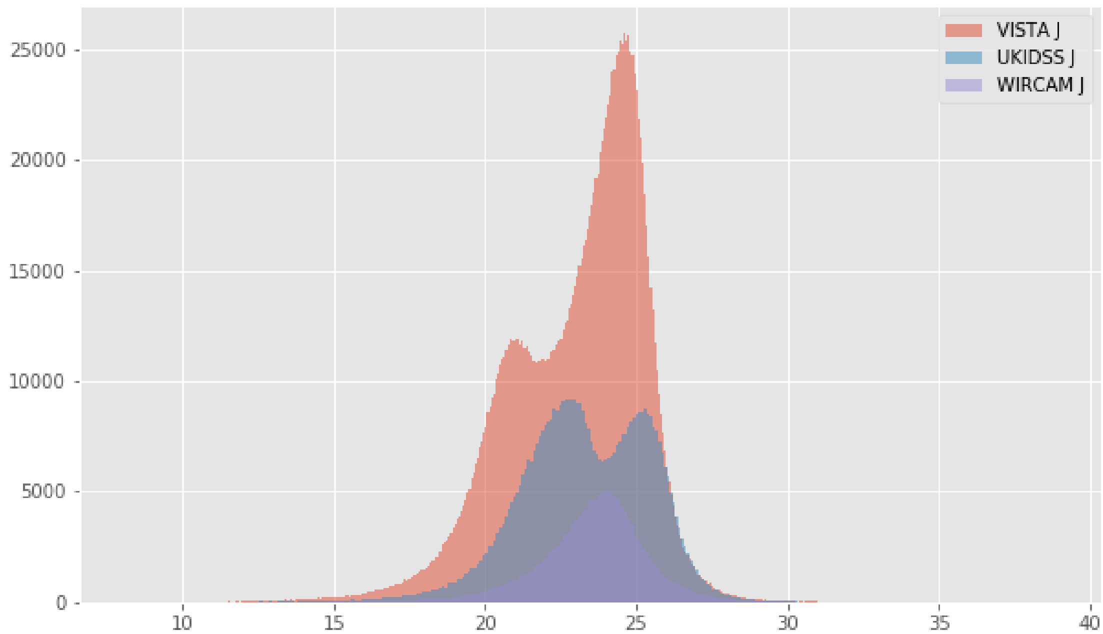

Megacam i
SUPRIME i
GPC1 i
DECam i
50000
40000
30000
20000
10000
0
0
10
20
30
40
50
60

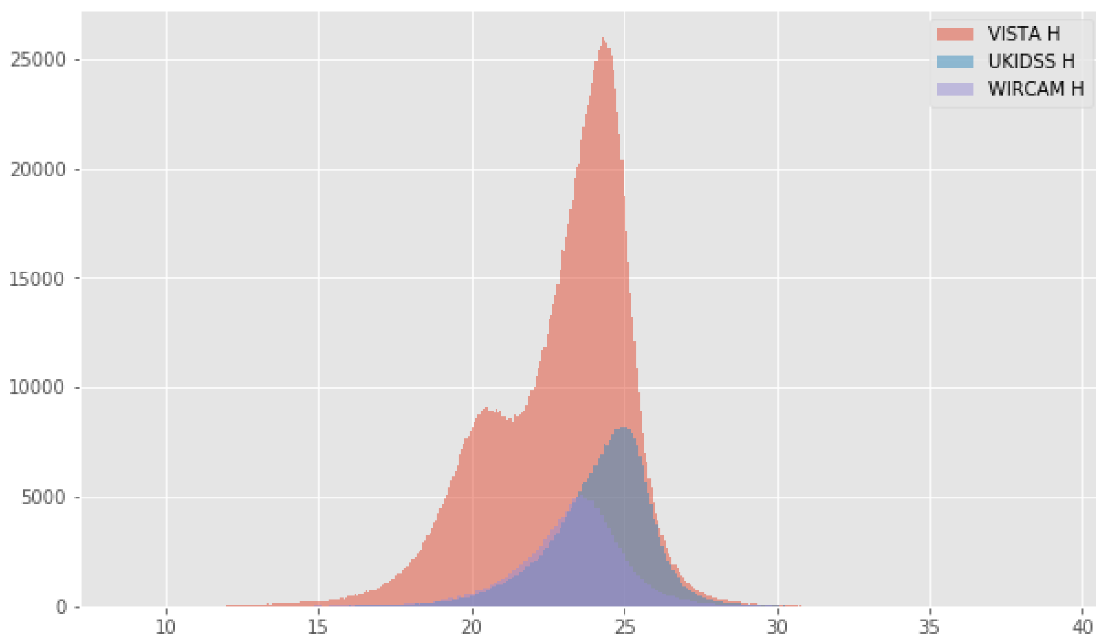


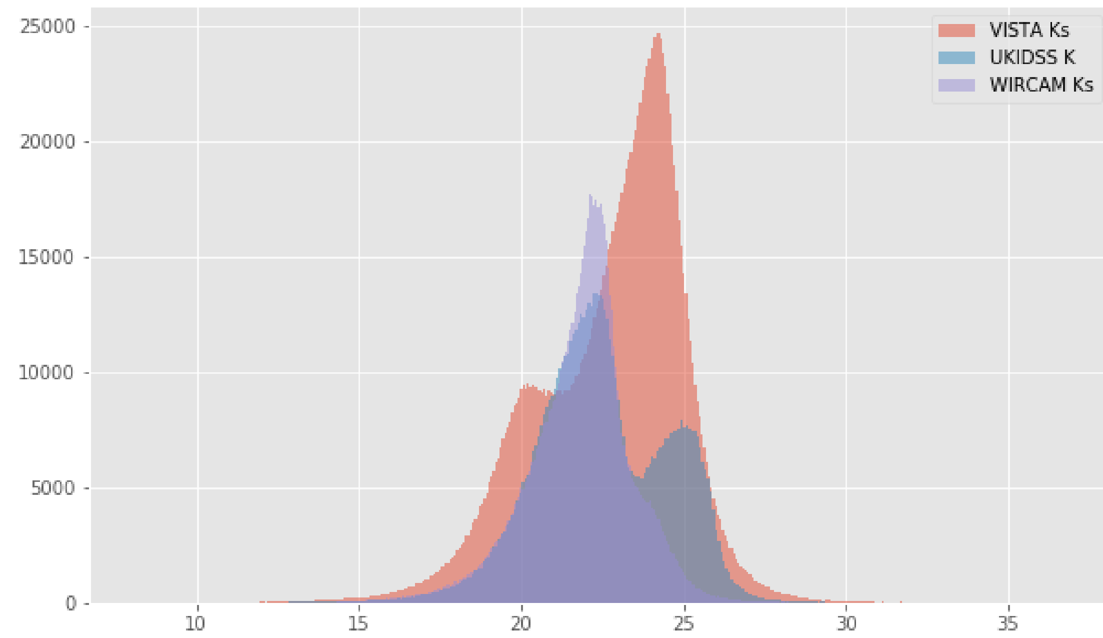
Megacam z
SUPRIME z
GPC1 z
DECam z
VISTA Z



Megacam y
SUPRIME y
GPC1 y
DECam y
VISTA Y


VISTA J
UKIDSS J
WIRCAM J
25000
20000
15000
10000
5000
0
10
15
20
25
30
35
40

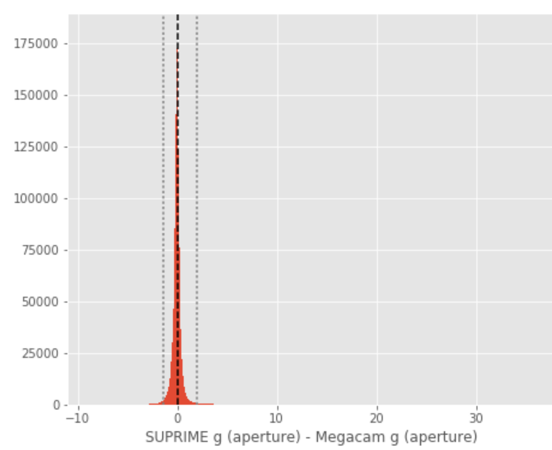

VISTA H
UKIDSS H
WIRCAM H
25000
20000
15000
10000
5000
0
10
15
20
25
30
35
40

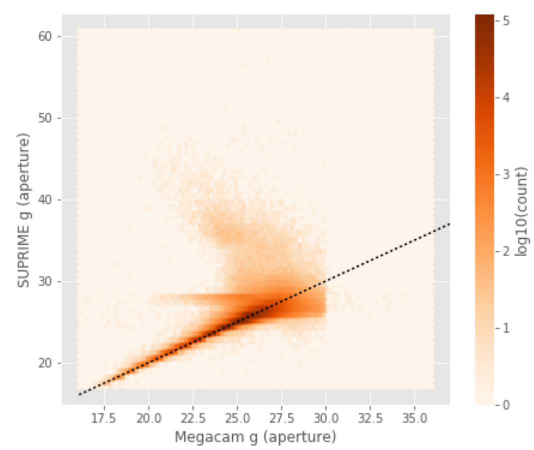


1.4.2 II.b - Comparing magnitudes

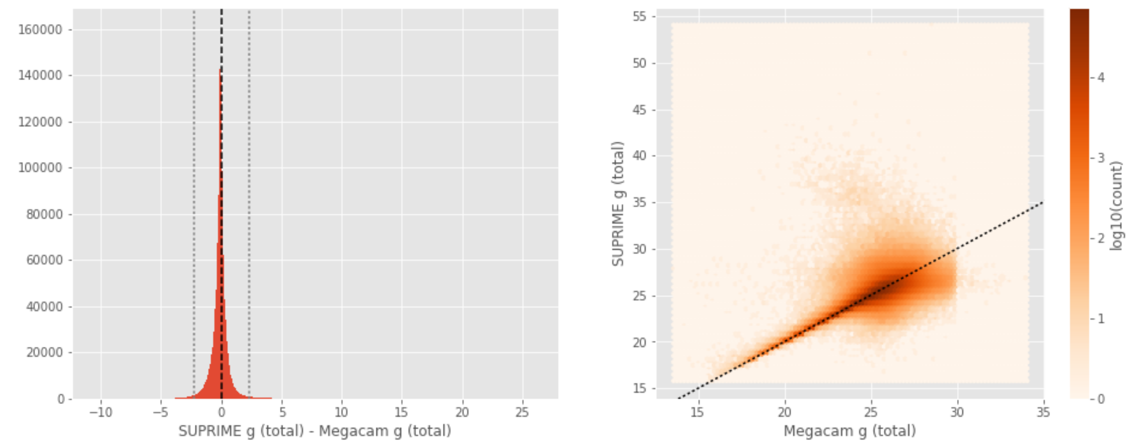
We compare one to one each magnitude in similar bands.

```
SUPRIME g (aperture) - Megacam g (aperture):
- Median: -0.04
- Median Absolute Deviation: 0.17
- 1% percentile: -1.4489594459533692
- 99% percentile: 2.01410663604735
```

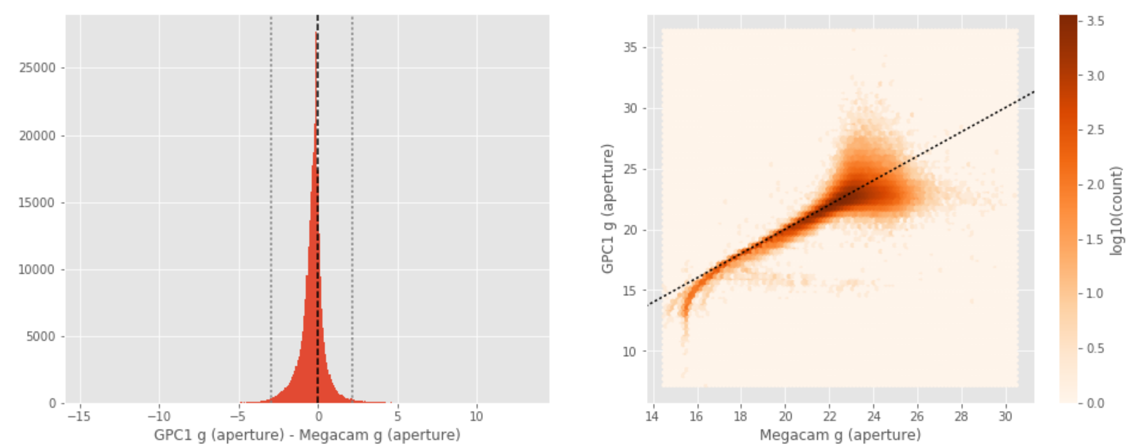




SUPRIME g (total) - Megacam g (total):
- Median: -0.09
- Median Absolute Deviation: 0.24
- 1% percentile: -2.283849220275879
- 99% percentile: 2.3356558609008804

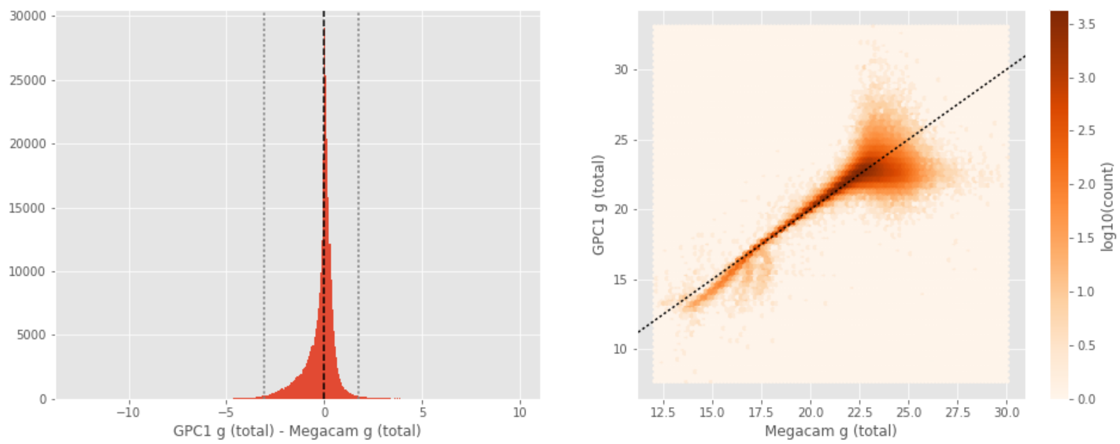


GPC1 g (aperture) - Megacam g (aperture):
- Median: -0.26
- Median Absolute Deviation: 0.32
- 1% percentile: -2.923695011138916
- 99% percentile: 2.1538532829284662

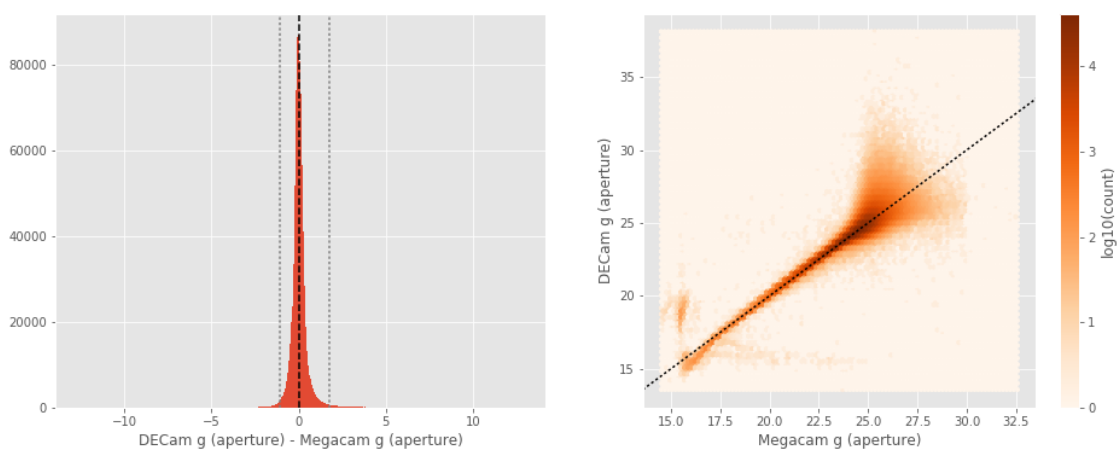


GPC1 g (total) - Megacam g (total):
- Median: 0.01

- Median Absolute Deviation: 0.26
- 1% percentile: -3.0604218292236327
- 99% percentile: 1.7563431167602528

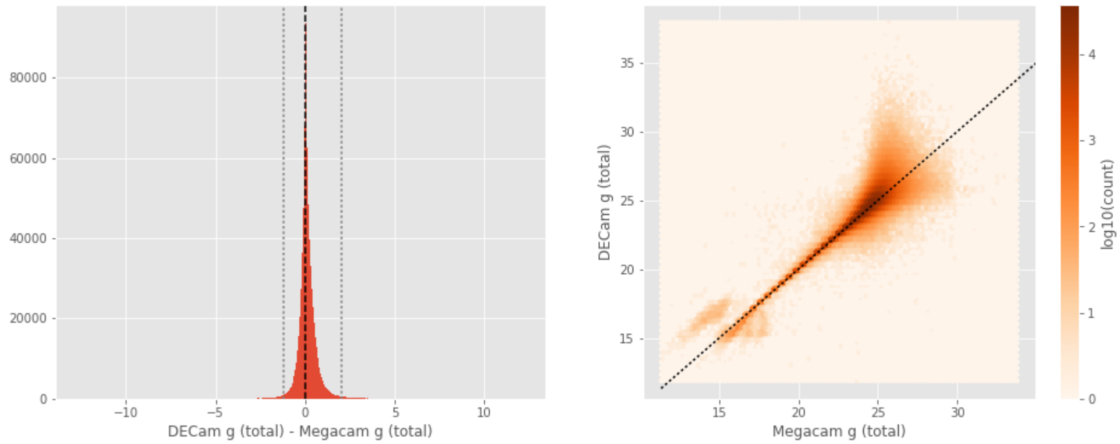


DECam g (aperture) - Megacam g (aperture):
- Median: -0.00
- Median Absolute Deviation: 0.18
- 1% percentile: -1.107715129852295
- 99% percentile: 1.7712550163269043

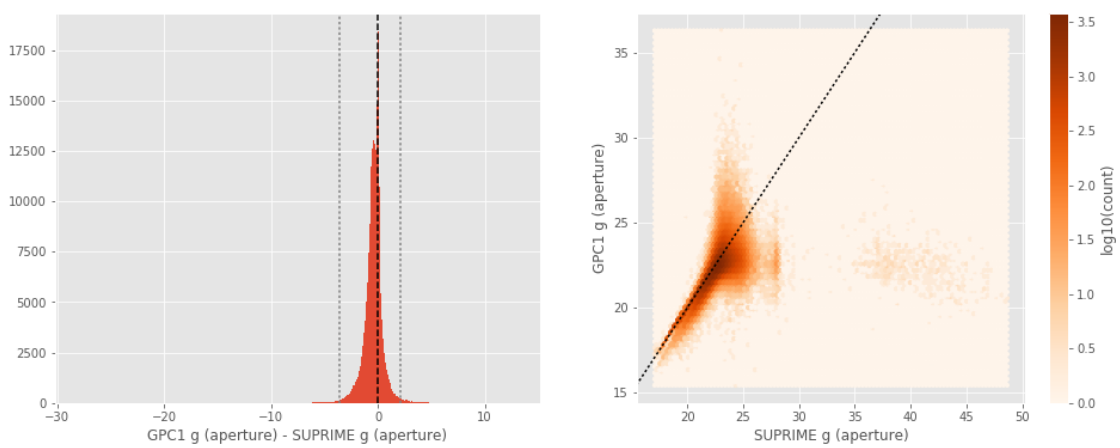


DECam g (total) - Megacam g (total):
- Median: 0.06
- Median Absolute Deviation: 0.19
- 1% percentile: -1.2402504920959472

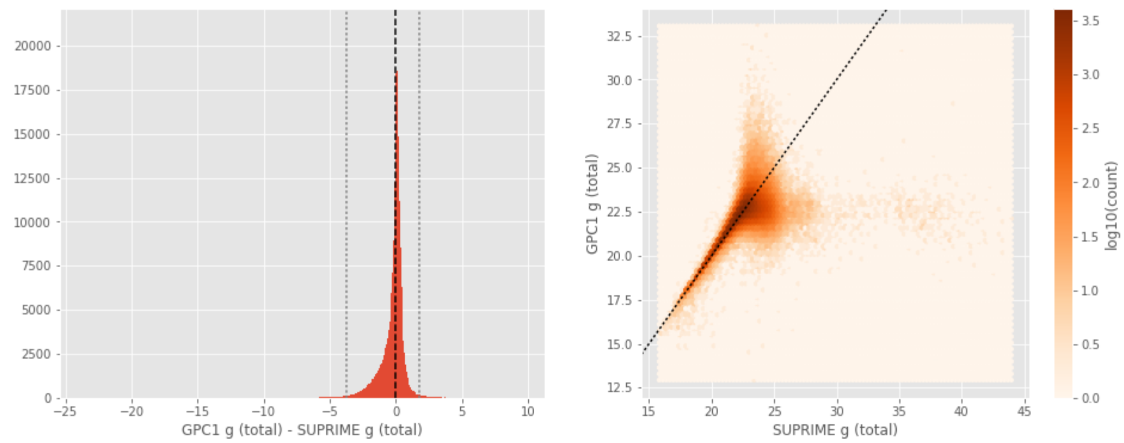
- 99% percentile: 1.996587505340575



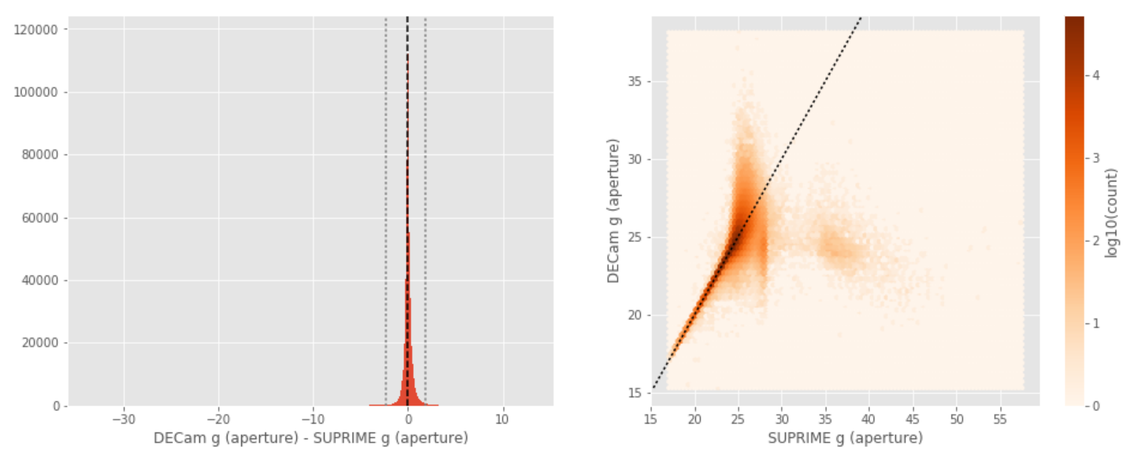
GPC1 g (aperture) - SUPRIME g (aperture):
- Median: -0.34
- Median Absolute Deviation: 0.40
- 1% percentile: -3.6355240631103514
- 99% percentile: 2.1407448959350557



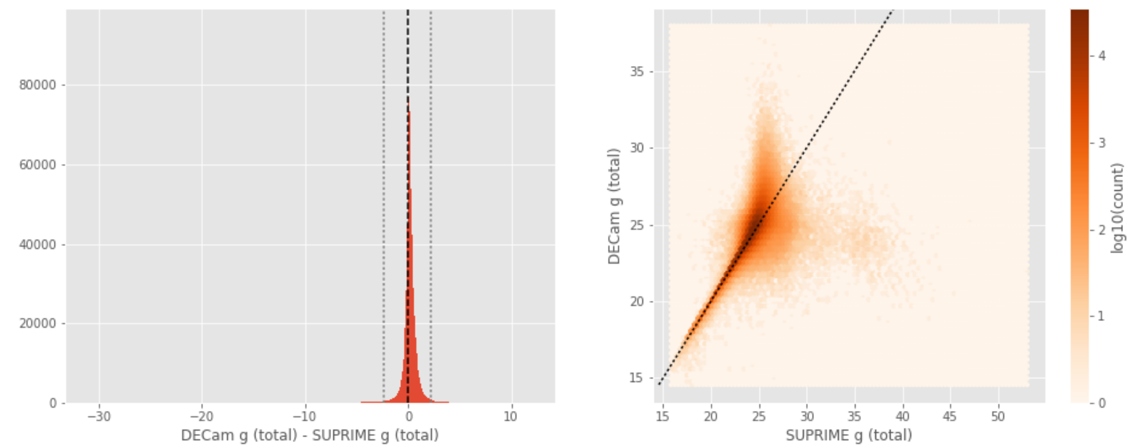
GPC1 g (total) - SUPRIME g (total):
- Median: 0.01
- Median Absolute Deviation: 0.28
- 1% percentile: -3.7431604385375974
- 99% percentile: 1.7456127166748274



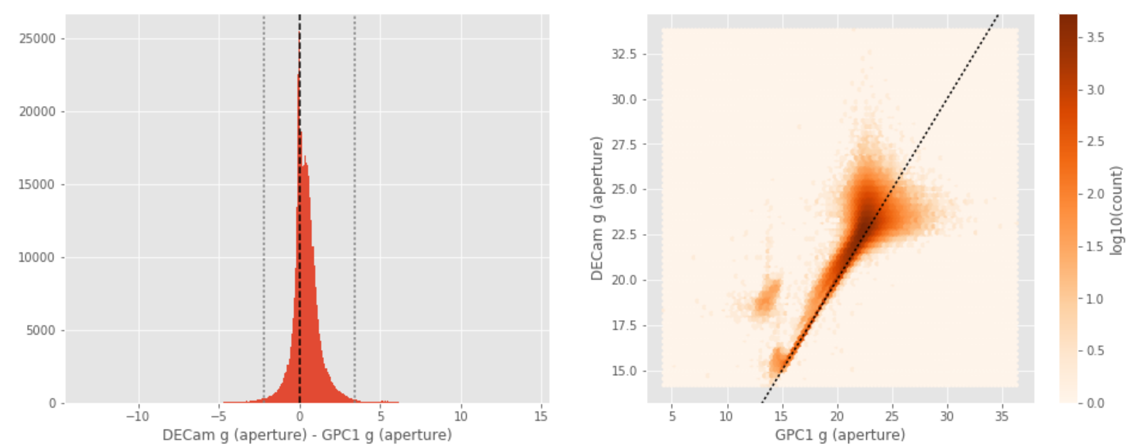
DECam g (aperture) - SUPRIME g (aperture):
- Median: -0.01
- Median Absolute Deviation: 0.15
- 1% percentile: -2.38048599243164
- 99% percentile: 1.7926739501953115



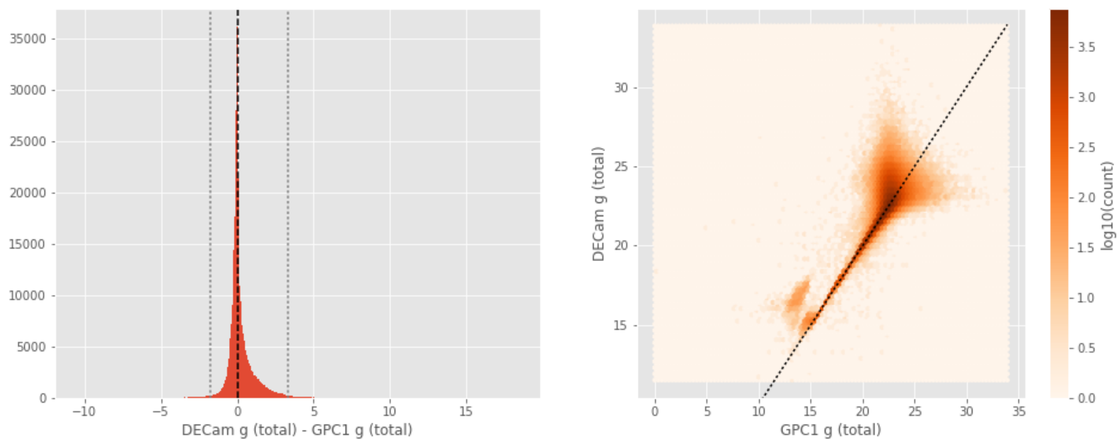
DECam g (total) - SUPRIME g (total):
- Median: 0.13
- Median Absolute Deviation: 0.22
- 1% percentile: -2.4151158905029297
- 99% percentile: 2.1798719024658197



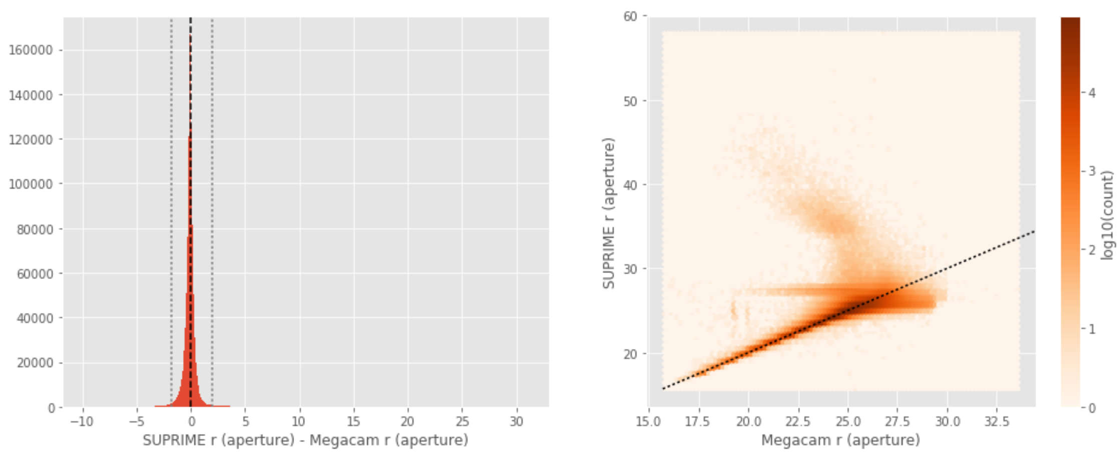
DECam g (aperture) - GPC1 g (aperture):
- Median: 0.31
- Median Absolute Deviation: 0.40
- 1% percentile: -2.204970932006836
- 99% percentile: 3.40045722961426



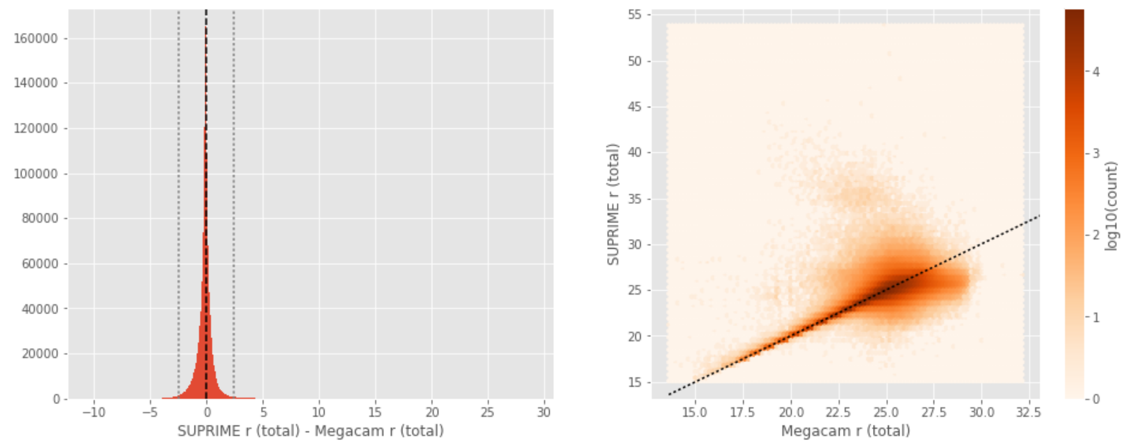
DECam g (total) - GPC1 g (total):
- Median: 0.00
- Median Absolute Deviation: 0.25
- 1% percentile: -1.7627799224853515
- 99% percentile: 3.3172676658630387



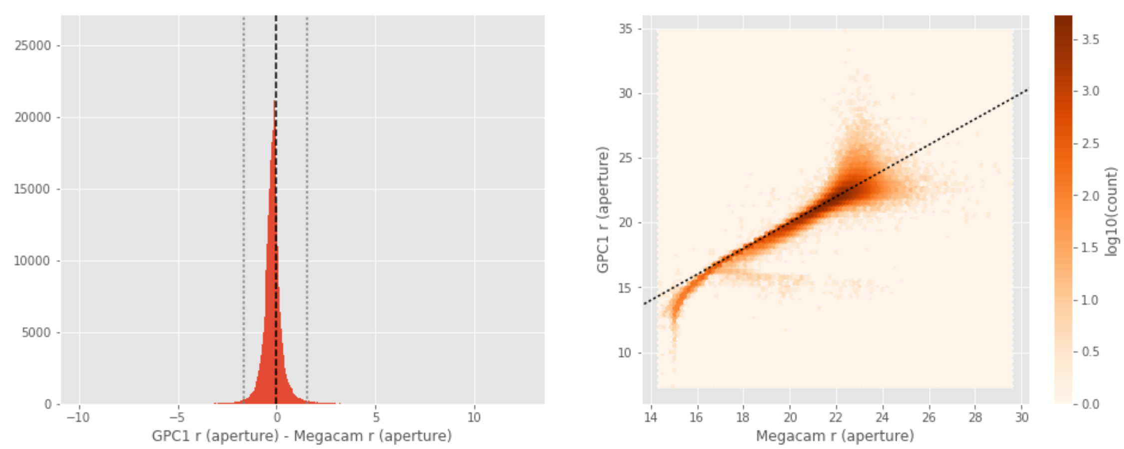
SUPRIME r (aperture) - Megacam r (aperture):
- Median: -0.07
- Median Absolute Deviation: 0.19
- 1% percentile: -1.741839771270752
- 99% percentile: 1.9862741279602076



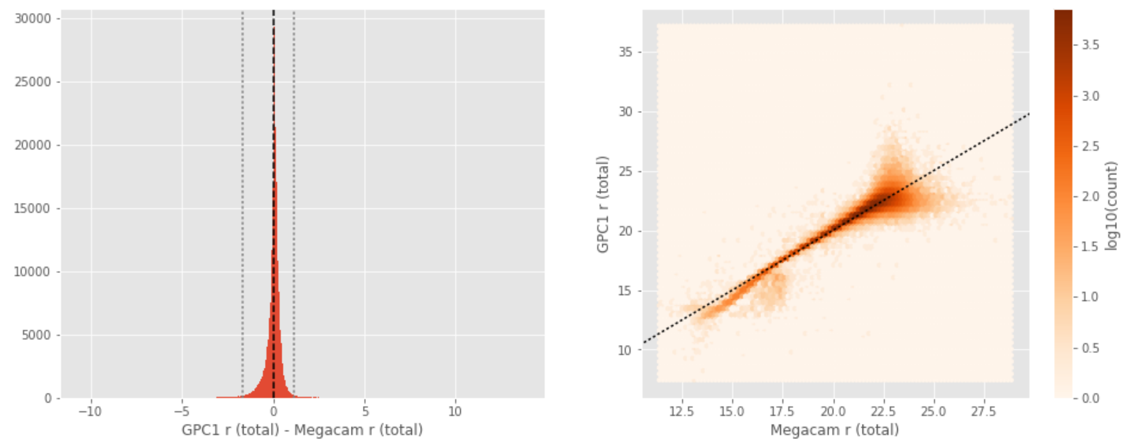
SUPRIME r (total) - Megacam r (total):
- Median: -0.11
- Median Absolute Deviation: 0.25
- 1% percentile: -2.4686038017272947
- 99% percentile: 2.417576599121091



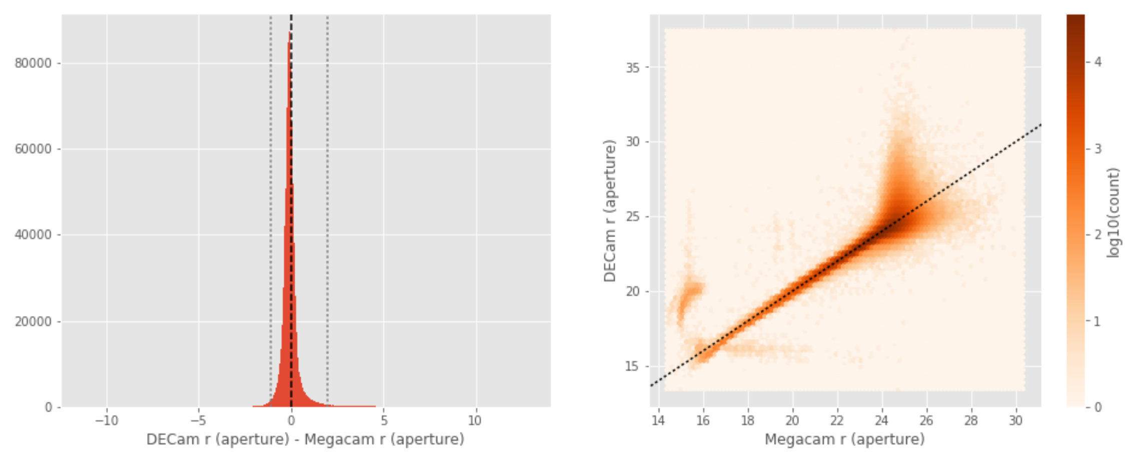
GPC1 r (aperture) - Megacam r (aperture):
- Median: -0.18
- Median Absolute Deviation: 0.20
- 1% percentile: -1.6846182918548585
- 99% percentile: 1.524917507171636



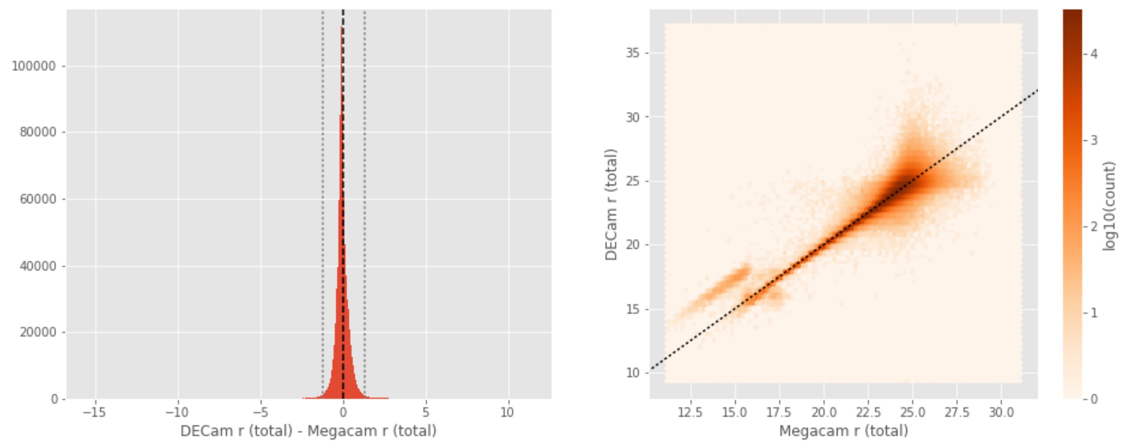
GPC1 r (total) - Megacam r (total):
- Median: 0.06
- Median Absolute Deviation: 0.14
- 1% percentile: -1.698433837890625
- 99% percentile: 1.1222000122070312



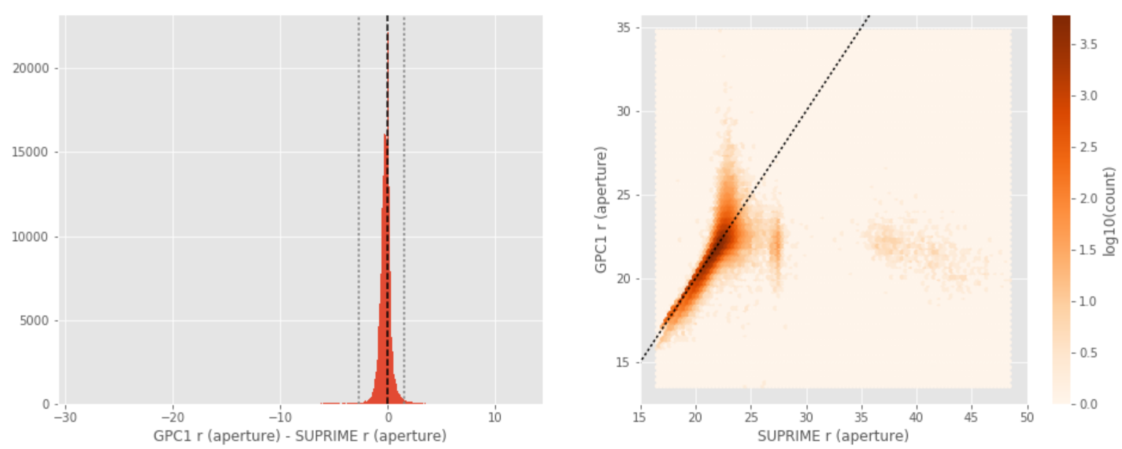
DECam r (aperture) - Megacam r (aperture):
- Median: -0.09
- Median Absolute Deviation: 0.17
- 1% percentile: -1.0815669631958007
- 99% percentile: 1.9723520851135259



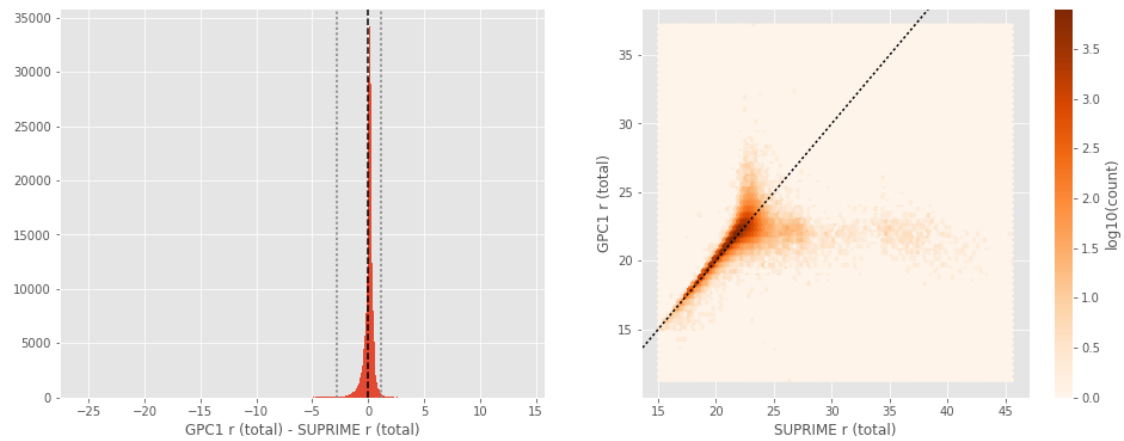
DECam r (total) - Megacam r (total):
- Median: -0.07
- Median Absolute Deviation: 0.18
- 1% percentile: -1.1824758529663084
- 99% percentile: 1.3057351684570353



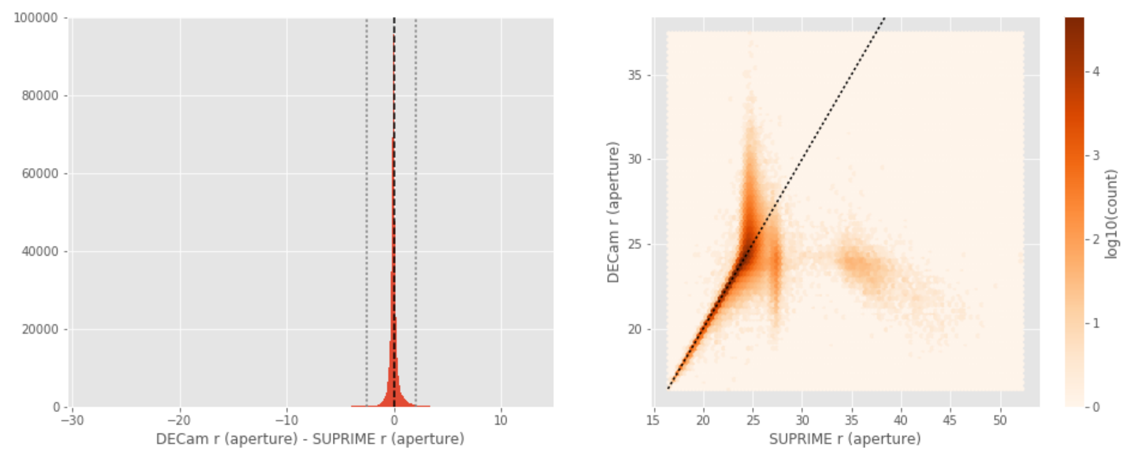
GPC1 r (aperture) - SUPRIME r (aperture):
- Median: -0.18
- Median Absolute Deviation: 0.27
- 1% percentile: -2.6781114959716796
- 99% percentile: 1.5765098571777345



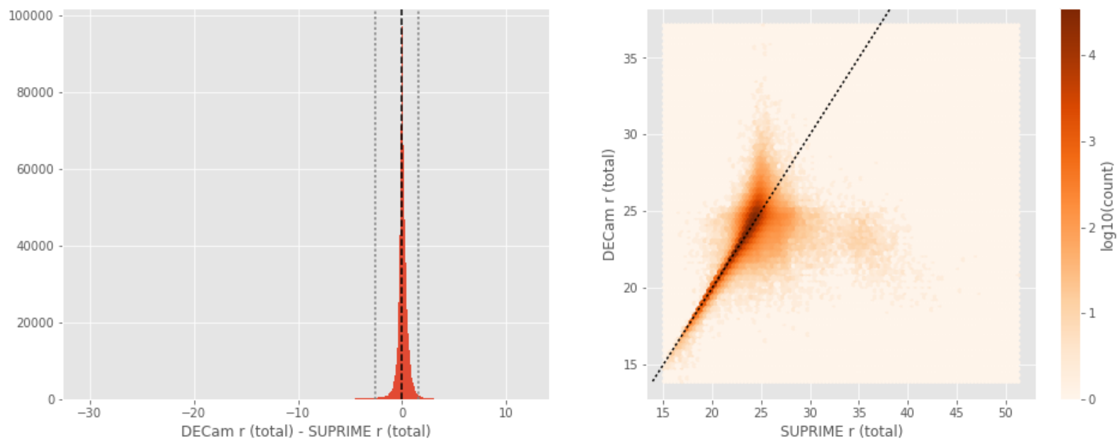
GPC1 r (total) - SUPRIME r (total):
- Median: 0.12
- Median Absolute Deviation: 0.16
- 1% percentile: -2.7883457565307617
- 99% percentile: 1.156285095214844



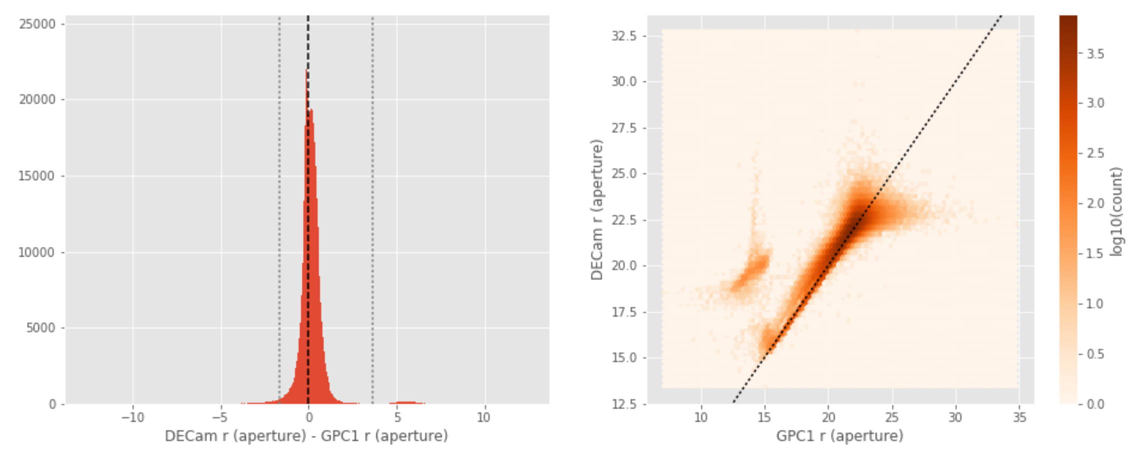
DECam r (aperture) - SUPRIME r (aperture):
- Median: -0.04
- Median Absolute Deviation: 0.14
- 1% percentile: -2.5140983963012697
- 99% percentile: 2.0019435119628906



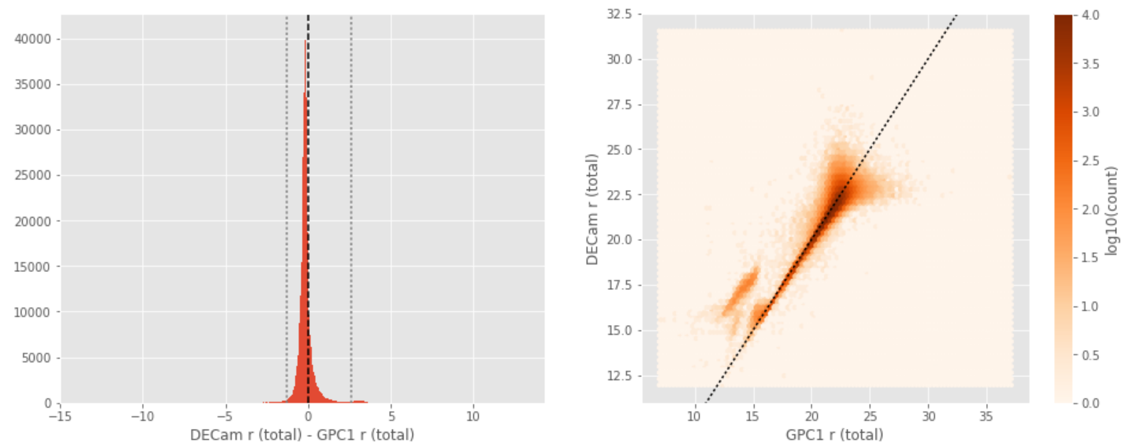
DECam r (total) - SUPRIME r (total):
- Median: 0.03
- Median Absolute Deviation: 0.20
- 1% percentile: -2.5913173675537107
- 99% percentile: 1.527161788940429



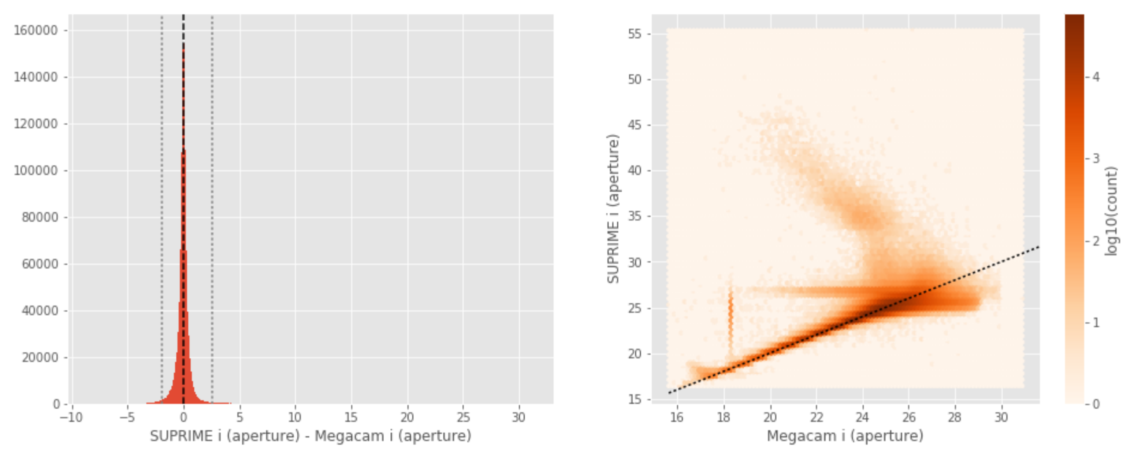
DECam r (aperture) - GPC1 r (aperture):
- Median: 0.10
- Median Absolute Deviation: 0.28
- 1% percentile: -1.6749701309204101
- 99% percentile: 3.6438082408905066



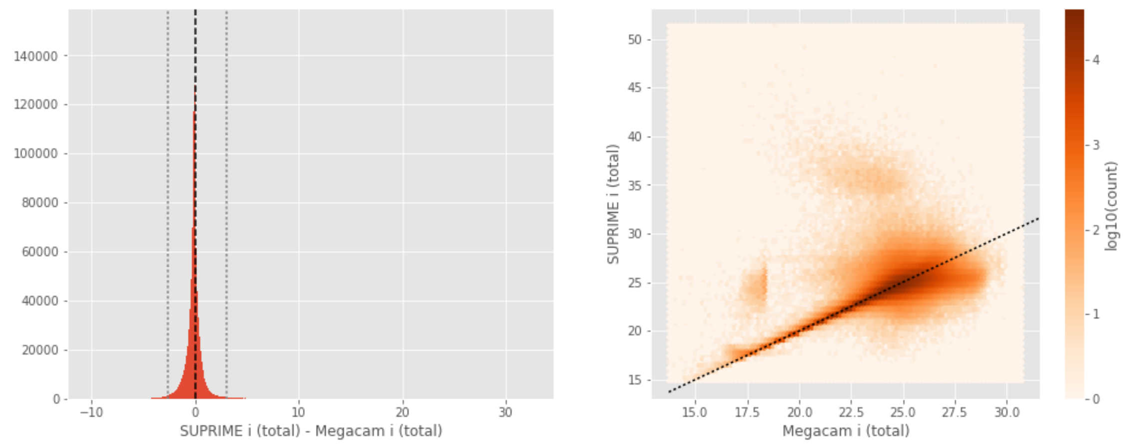
DECam r (total) - GPC1 r (total):
- Median: -0.17
- Median Absolute Deviation: 0.14
- 1% percentile: -1.259248275756836
- 99% percentile: 2.631193618774417



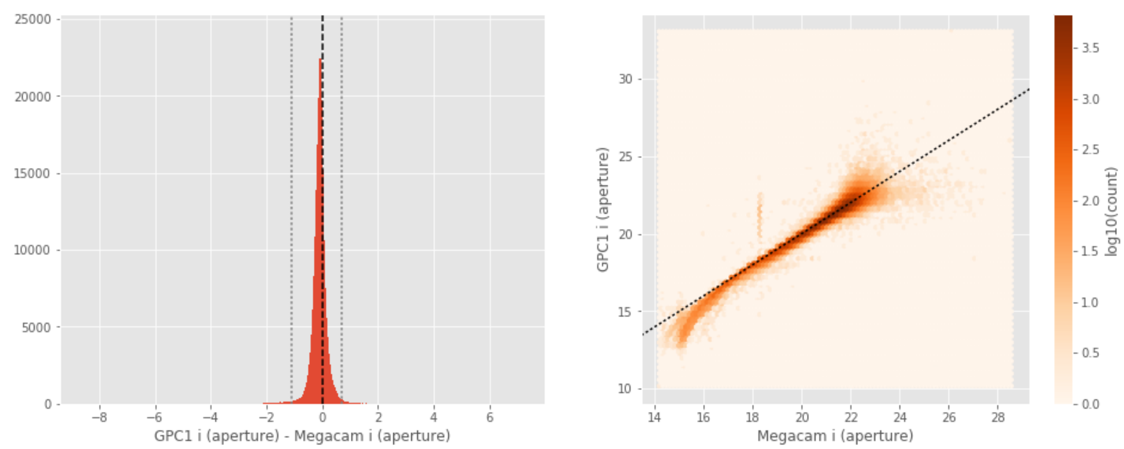
SUPRIME i (aperture) - Megacam i (aperture):
- Median: -0.01
- Median Absolute Deviation: 0.20
- 1% percentile: -1.9167156982421876
- 99% percentile: 2.5837923431396455



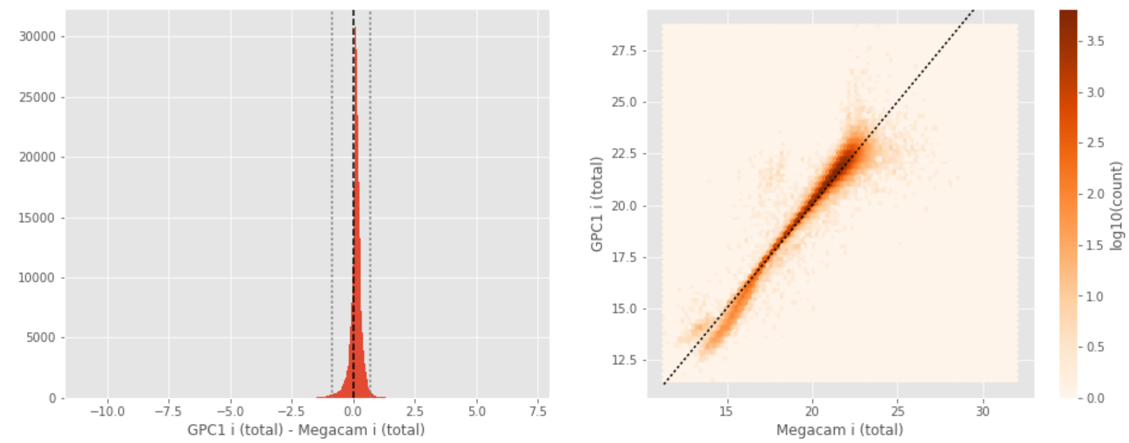
SUPRIME i (total) - Megacam i (total):
- Median: -0.10
- Median Absolute Deviation: 0.27
- 1% percentile: -2.636057662963867
- 99% percentile: 3.0795284271240213



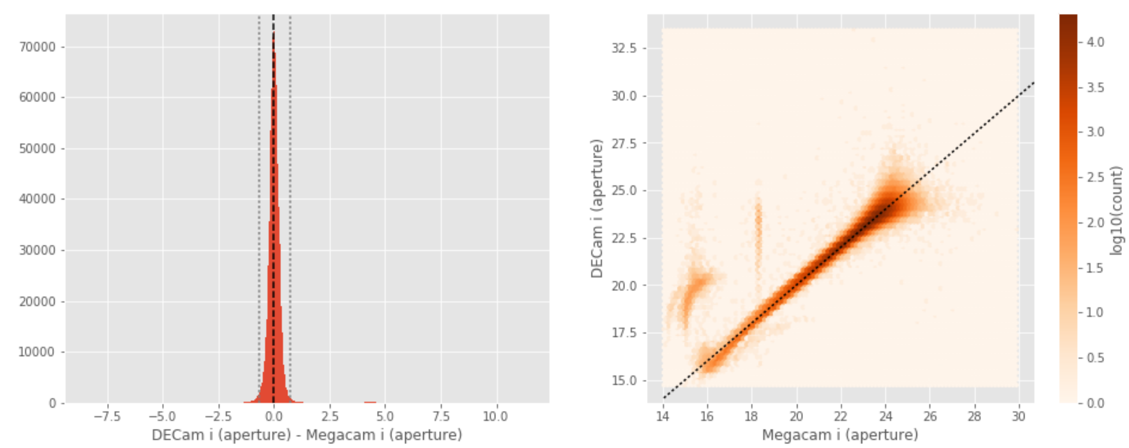
GPC1 i (aperture) - Megacam i (aperture):
- Median: -0.09
- Median Absolute Deviation: 0.12
- 1% percentile: -1.1014163970947266
- 99% percentile: 0.6853575515747057



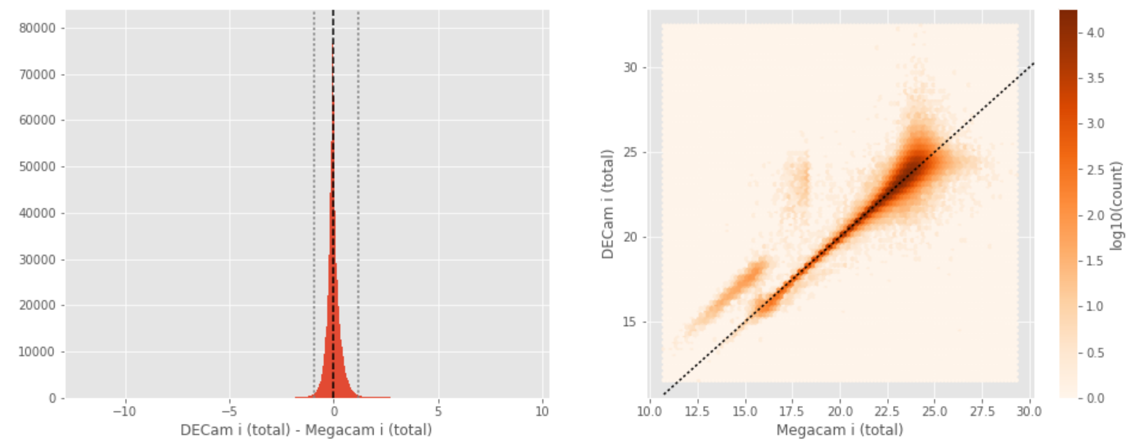
GPC1 i (total) - Megacam i (total):
- Median: 0.12
- Median Absolute Deviation: 0.10
- 1% percentile: -0.8628997802734375
- 99% percentile: 0.7098175811767562



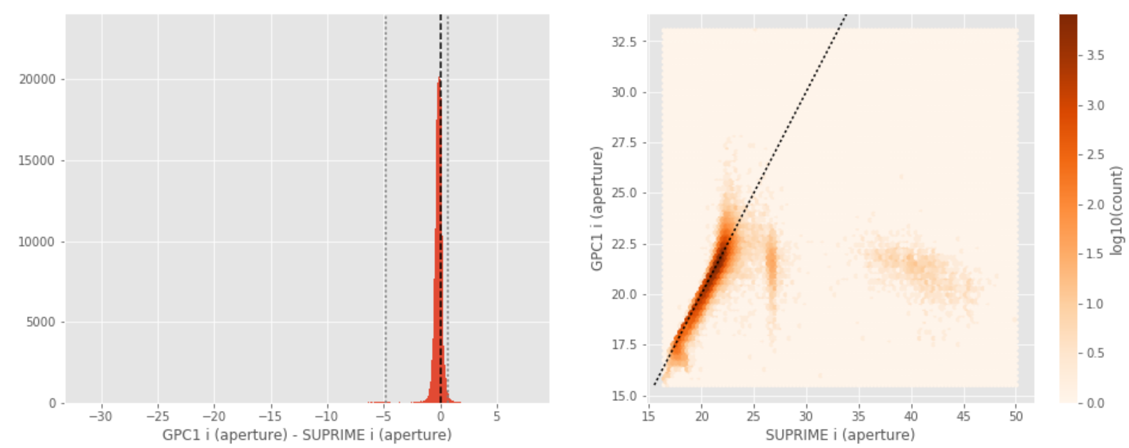
DECam i (aperture) - Megacam i (aperture):
- Median: 0.00
- Median Absolute Deviation: 0.14
- 1% percentile: -0.6786011123657226
- 99% percentile: 0.7076372909545956



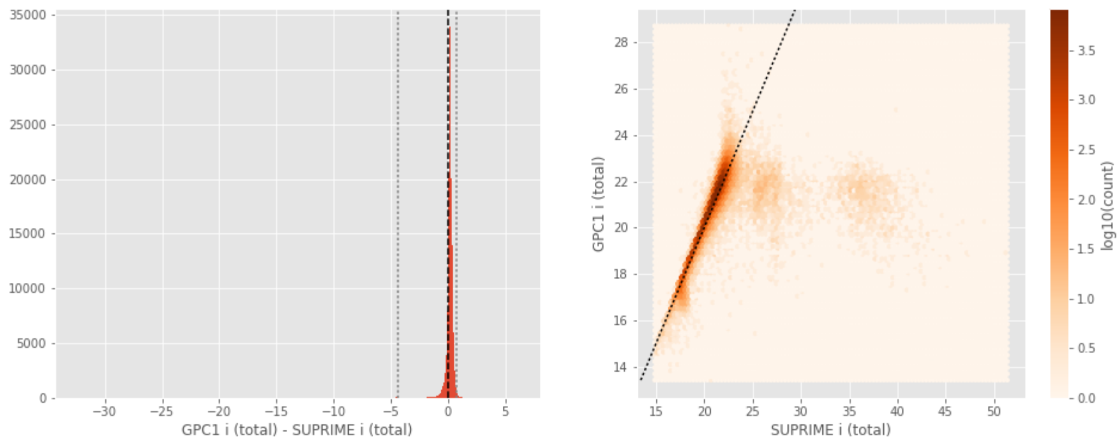
DECam i (total) - Megacam i (total):
- Median: -0.03
- Median Absolute Deviation: 0.14
- 1% percentile: -0.9132747650146484
- 99% percentile: 1.1931896209716797



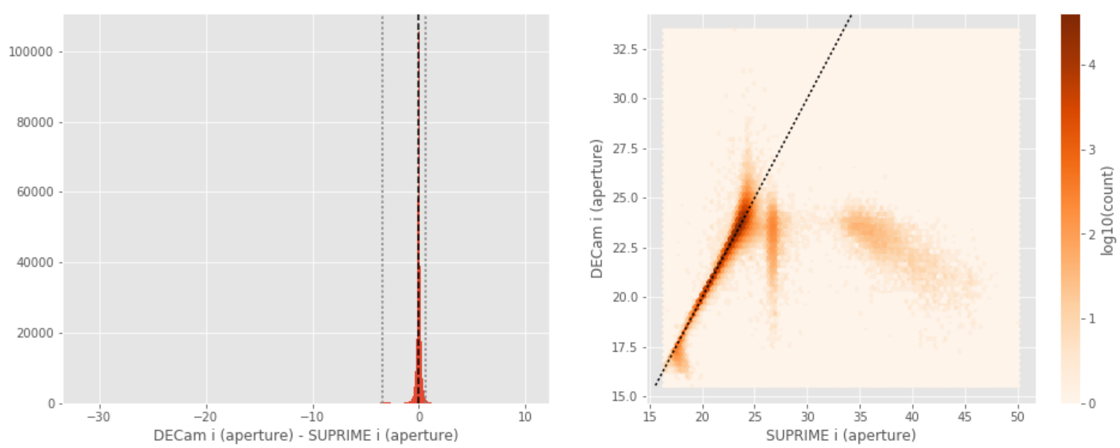
GPC1 i (aperture) - SUPRIME i (aperture):
- Median: -0.13
- Median Absolute Deviation: 0.20
- 1% percentile: -4.7828536796569825
- 99% percentile: 0.6963841056823731



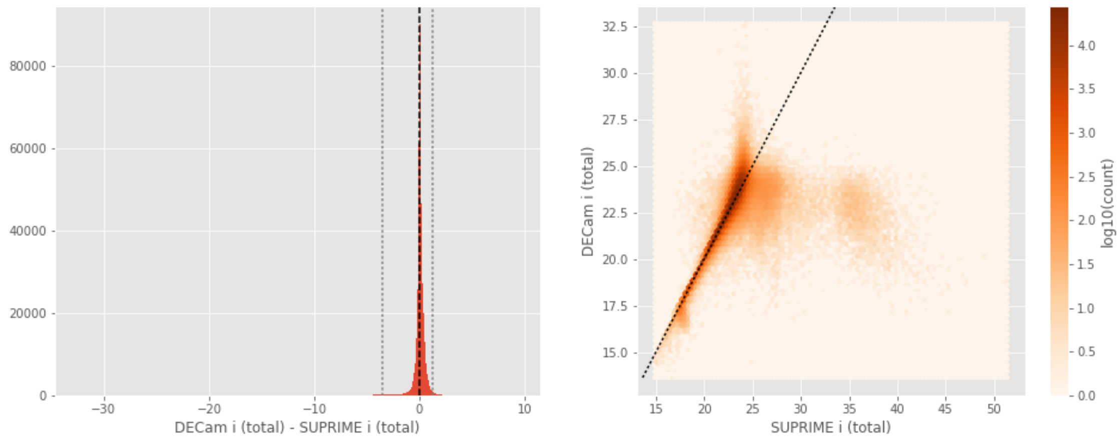
GPC1 i (total) - SUPRIME i (total):
- Median: 0.19
- Median Absolute Deviation: 0.11
- 1% percentile: -4.401985321044922
- 99% percentile: 0.7501154327392573



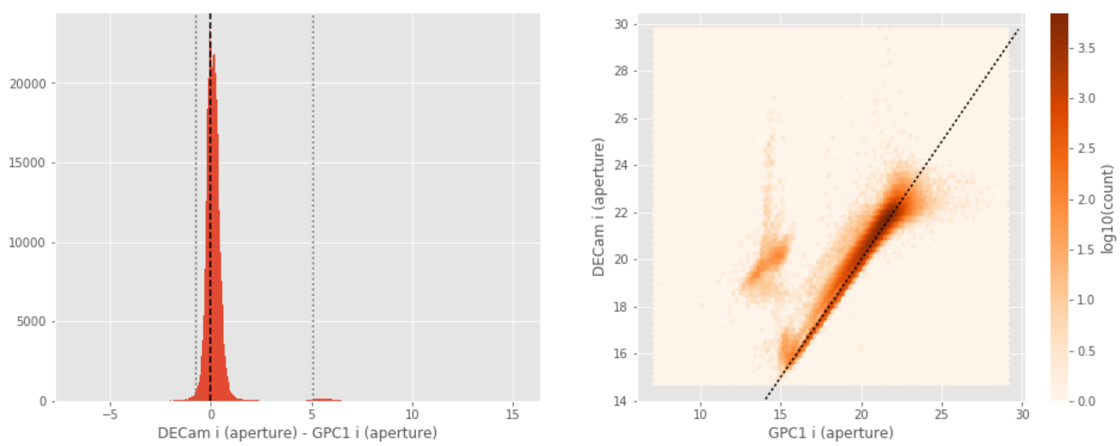
DECam i (aperture) - SUPRIME i (aperture):
- Median: -0.02
- Median Absolute Deviation: 0.09
- 1% percentile: -3.423588180541992
- 99% percentile: 0.6003108978271494



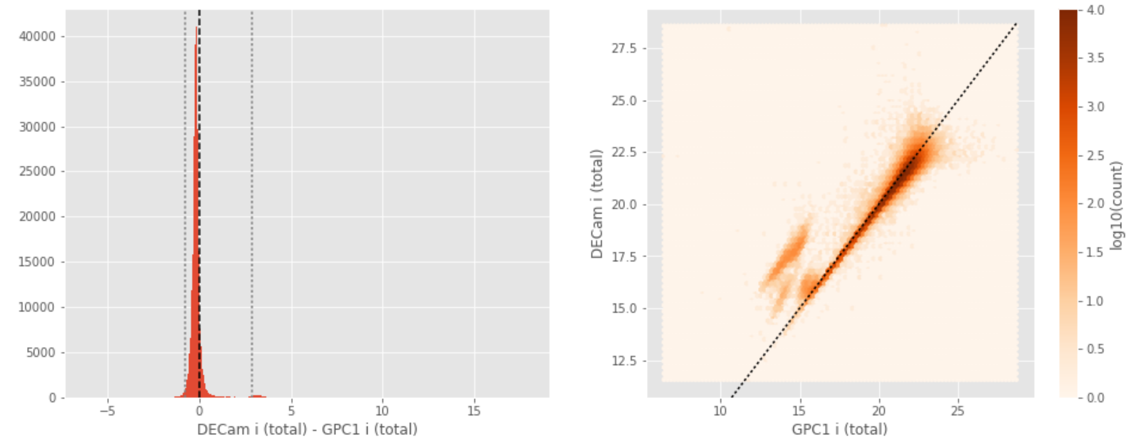
DECam i (total) - SUPRIME i (total):
- Median: 0.06
- Median Absolute Deviation: 0.15
- 1% percentile: -3.5717692375183105
- 99% percentile: 1.1974482536315918



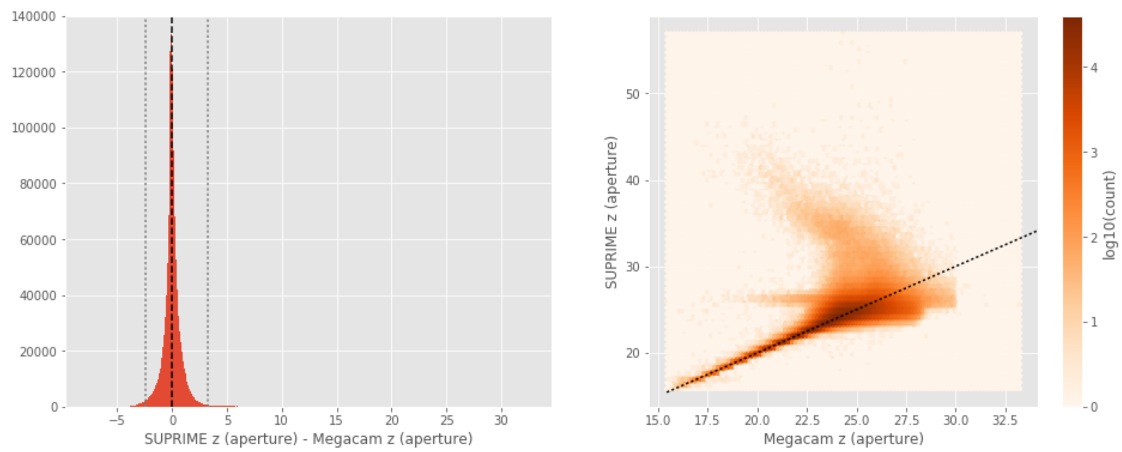
DECam i (aperture) - GPC1 i (aperture):
- Median: 0.10
- Median Absolute Deviation: 0.21
- 1% percentile: -0.7455041885375977
- 99% percentile: 5.089320182800294



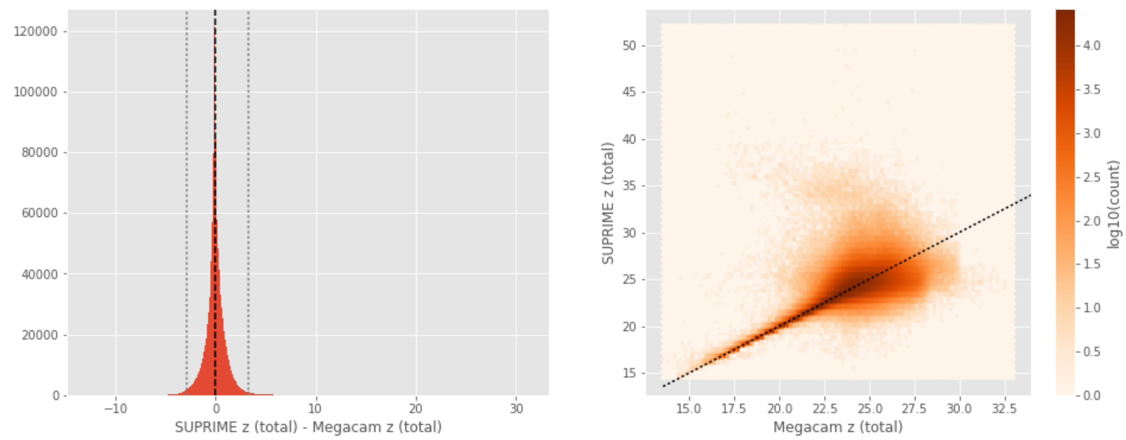
DECam i (total) - GPC1 i (total):
- Median: -0.17
- Median Absolute Deviation: 0.10
- 1% percentile: -0.771400260925293
- 99% percentile: 2.869143295288107



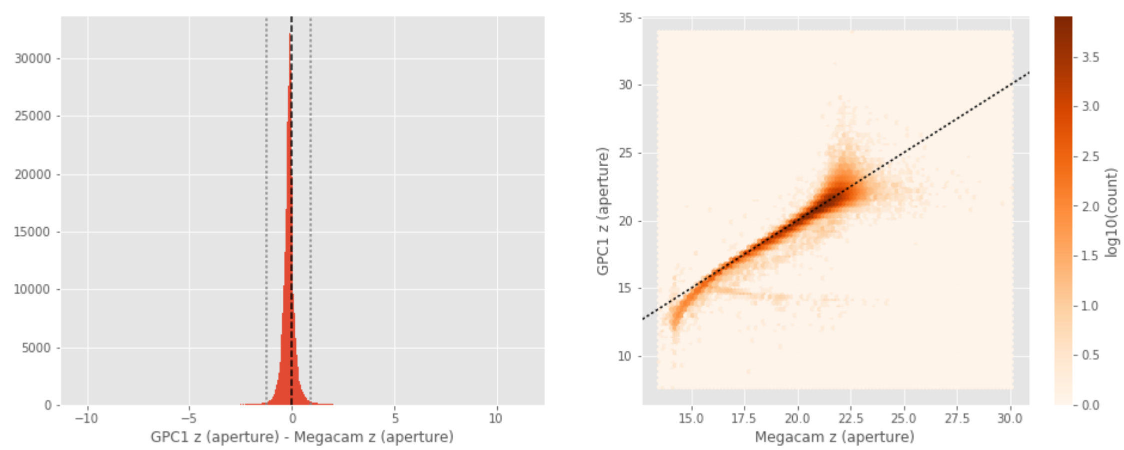
SUPRIME z (aperture) - Megacam z (aperture):
- Median: -0.02
- Median Absolute Deviation: 0.32
- 1% percentile: -2.447485733032227
- 99% percentile: 3.3047220611572143



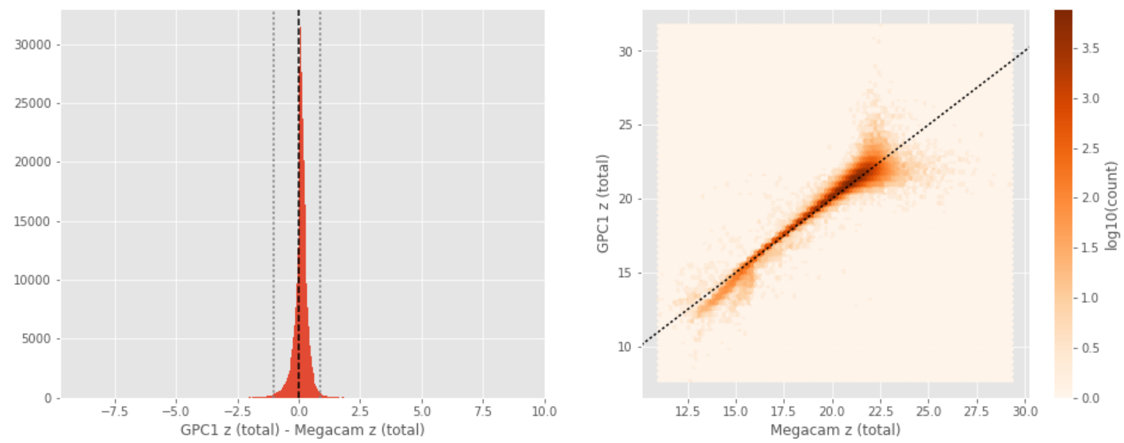
SUPRIME z (total) - Megacam z (total):
- Median: -0.07
- Median Absolute Deviation: 0.42
- 1% percentile: -2.9348392486572266
- 99% percentile: 3.2758159637450888



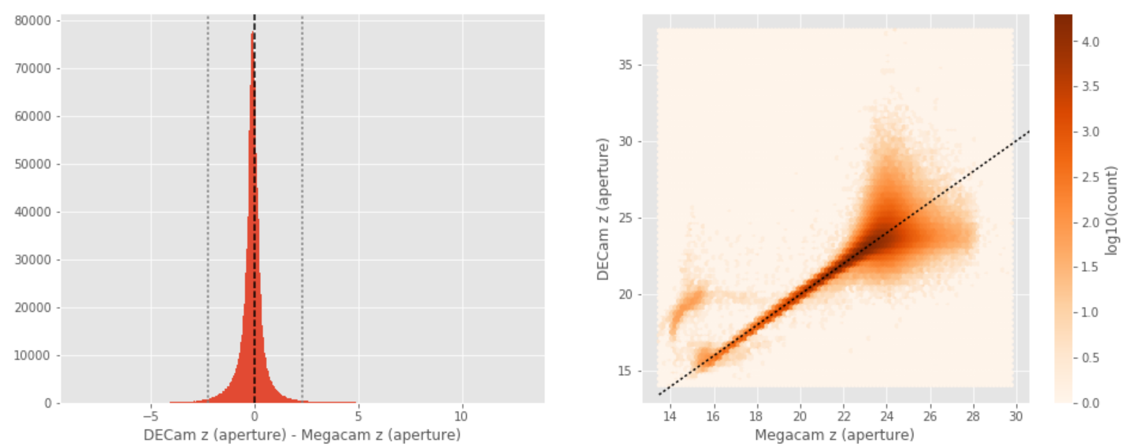
GPC1 z (aperture) - Megacam z (aperture):
- Median: -0.13
- Median Absolute Deviation: 0.14
- 1% percentile: -1.229004096984863
- 99% percentile: 0.9082548332214402



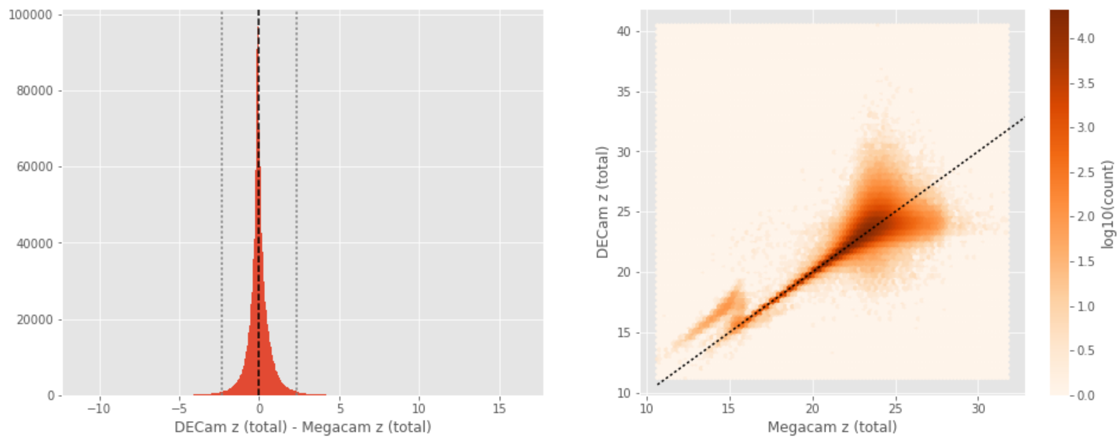
GPC1 z (total) - Megacam z (total):
- Median: 0.10
- Median Absolute Deviation: 0.12
- 1% percentile: -1.0418992614746094
- 99% percentile: 0.8804988861083984



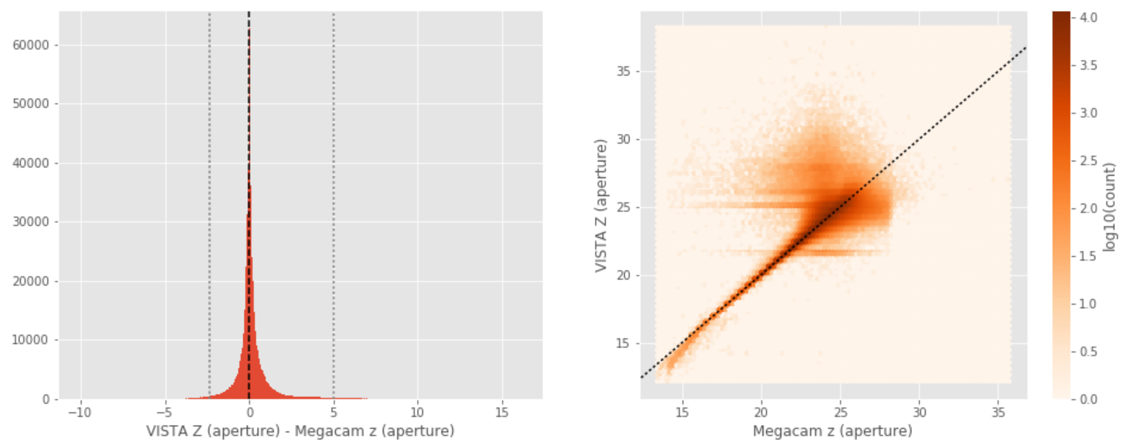
DECam z (aperture) - Megacam z (aperture):
- Median: -0.09
- Median Absolute Deviation: 0.22
- 1% percentile: -2.2596270751953123
- 99% percentile: 2.2798955154418707



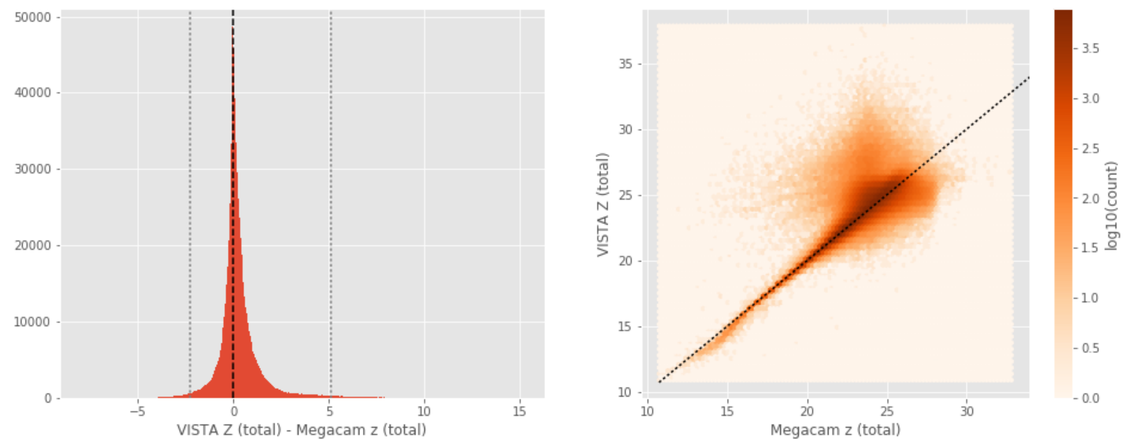
DECam z (total) - Megacam z (total):
- Median: -0.06
- Median Absolute Deviation: 0.27
- 1% percentile: -2.336577758789062
- 99% percentile: 2.3574640655517594



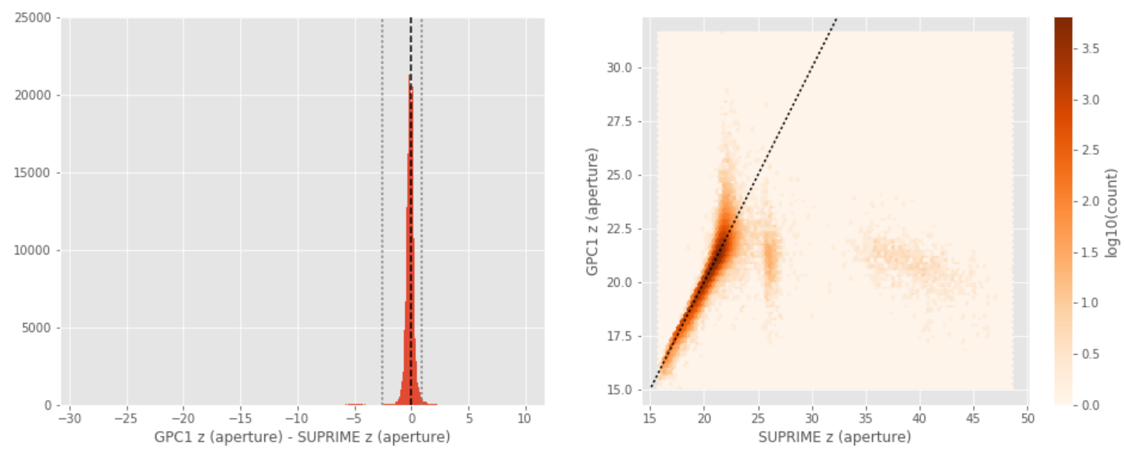
VISTA Z (aperture) - Megacam z (aperture):
- Median: 0.03
- Median Absolute Deviation: 0.23
- 1% percentile: -2.3203365325927736
- 99% percentile: 5.049309539794924



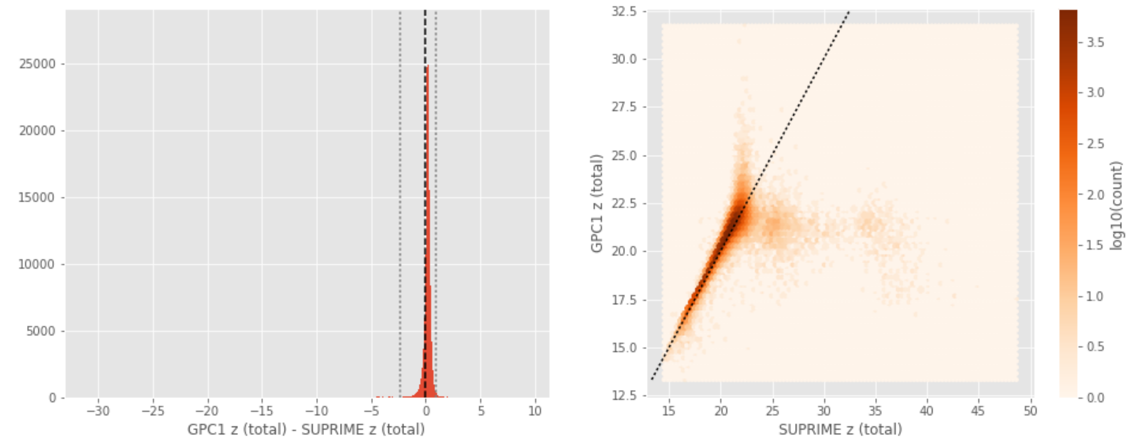
VISTA Z (total) - Megacam z (total):
- Median: 0.09
- Median Absolute Deviation: 0.33
- 1% percentile: -2.2616295623779297
- 99% percentile: 5.118752098083502



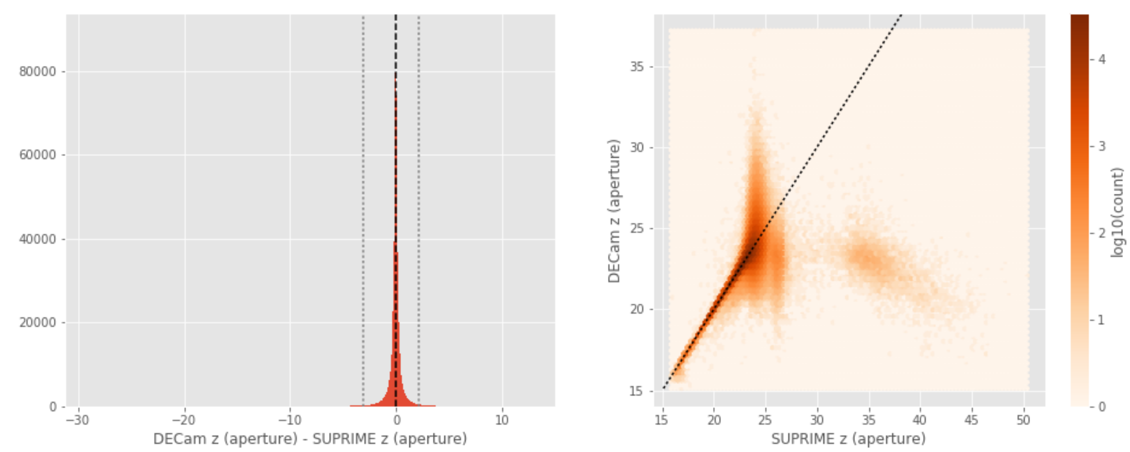
GPC1 z (aperture) - SUPRIME z (aperture):
- Median: -0.09
- Median Absolute Deviation: 0.20
- 1% percentile: -2.5357738494873048
- 99% percentile: 0.9684913253784179



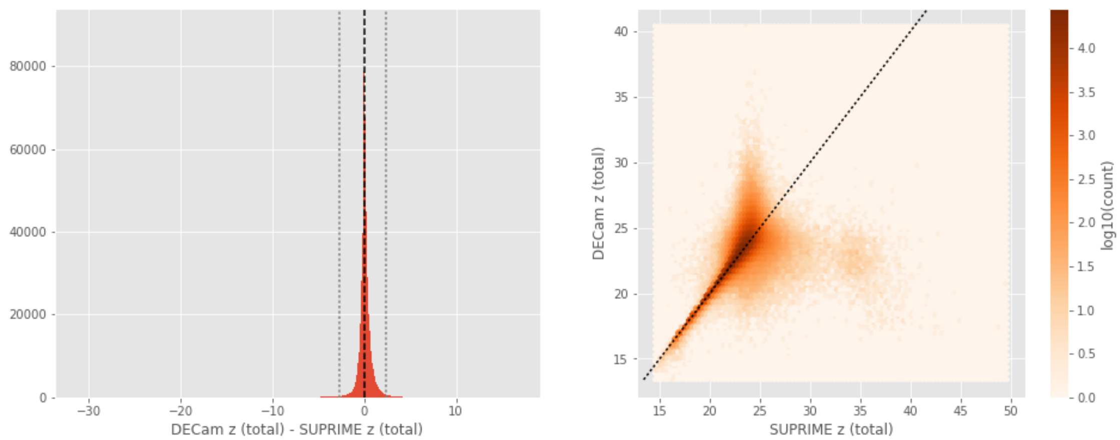
GPC1 z (total) - SUPRIME z (total):
- Median: 0.19
- Median Absolute Deviation: 0.13
- 1% percentile: -2.3870449638366704
- 99% percentile: 0.9100053024291974



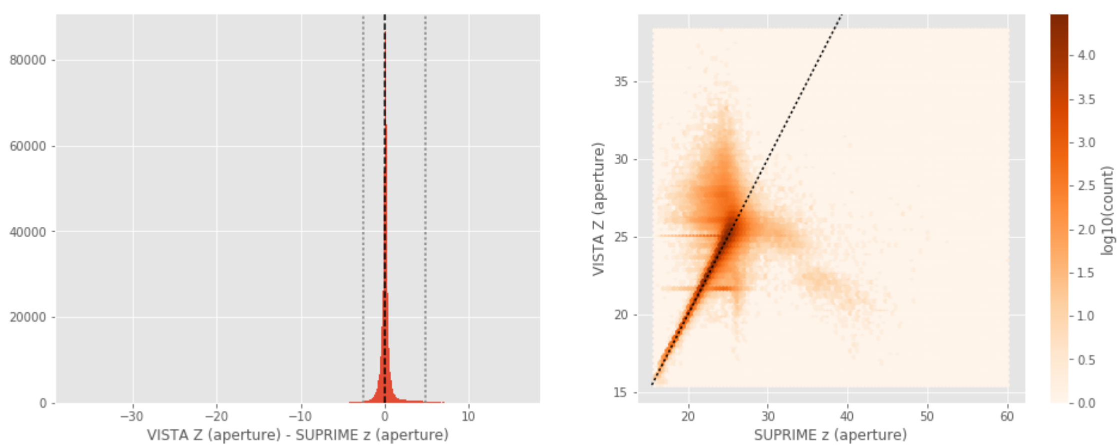
DECam z (aperture) - SUPRIME z (aperture):
- Median: -0.03
- Median Absolute Deviation: 0.16
- 1% percentile: -3.121656150817871
- 99% percentile: 2.133588409423824



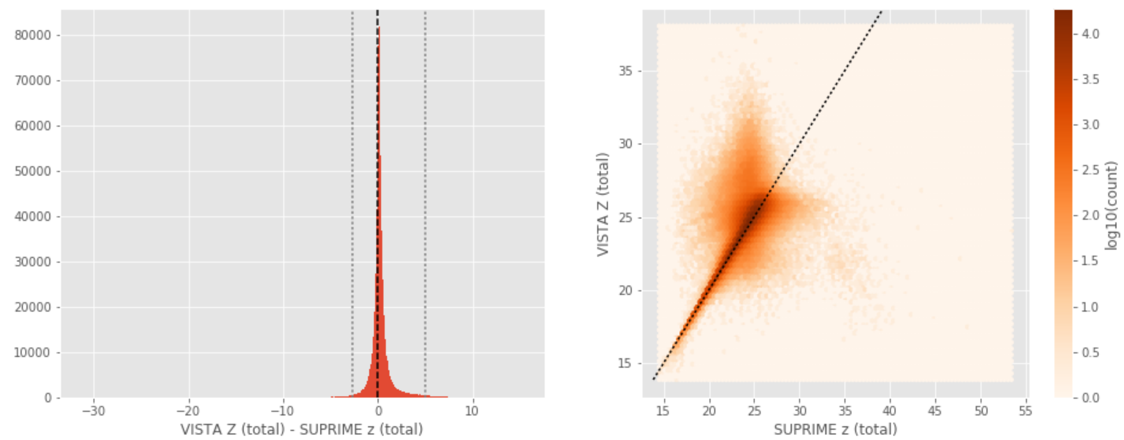
DECam z (total) - SUPRIME z (total):
- Median: 0.05
- Median Absolute Deviation: 0.24
- 1% percentile: -2.77428596496582
- 99% percentile: 2.375800323486325



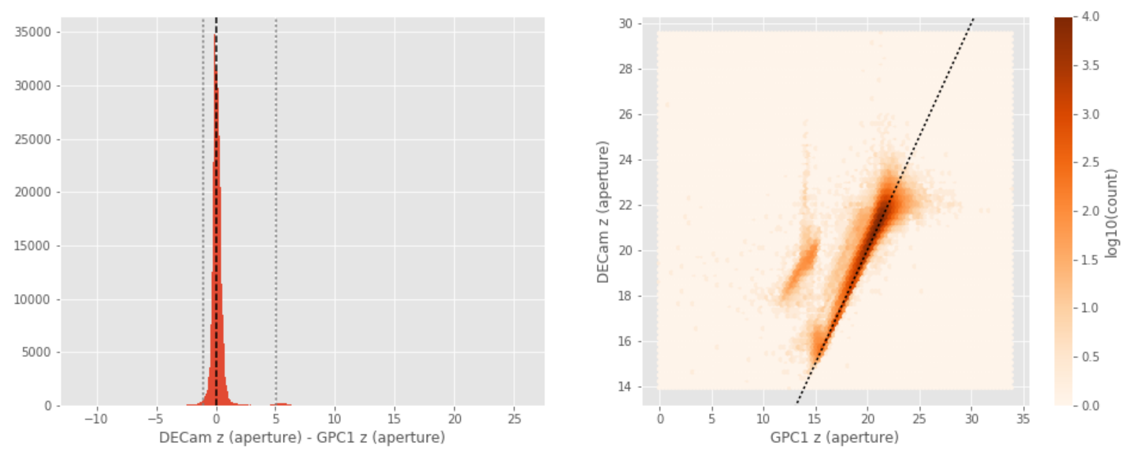
VISTA Z (aperture) - SUPRIME z (aperture):
- Median: 0.06
- Median Absolute Deviation: 0.18
- 1% percentile: -2.592559814453125
- 99% percentile: 4.79986572265625



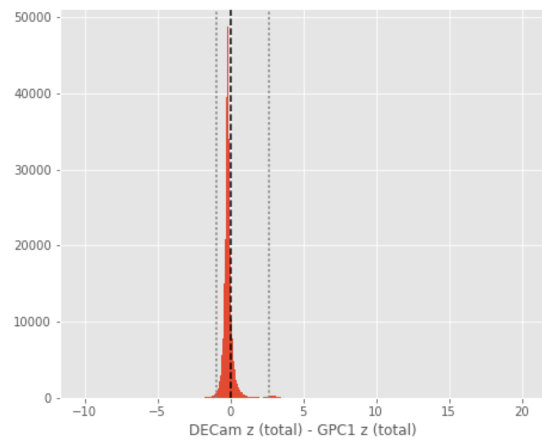
VISTA Z (total) - SUPRIME z (total):
- Median: 0.15
- Median Absolute Deviation: 0.29
- 1% percentile: -2.666861820220947
- 99% percentile: 5.025450191497788

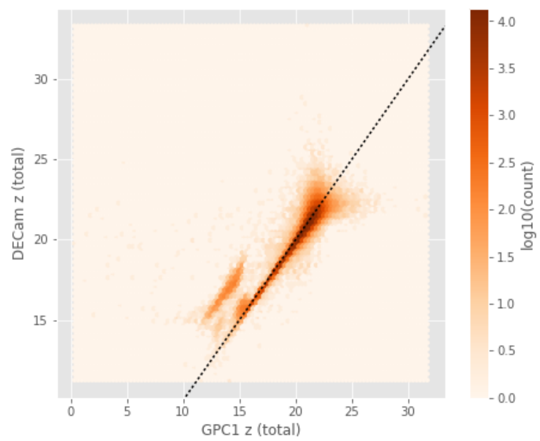


DECam z (aperture) - GPC1 z (aperture):
- Median: 0.08
- Median Absolute Deviation: 0.21
- 1% percentile: -1.0201219749450683
- 99% percentile: 5.041556749343871

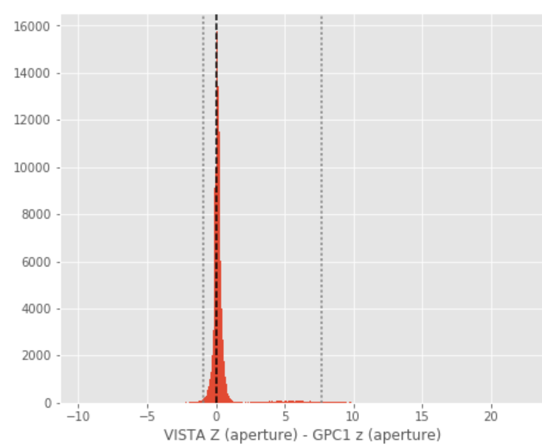


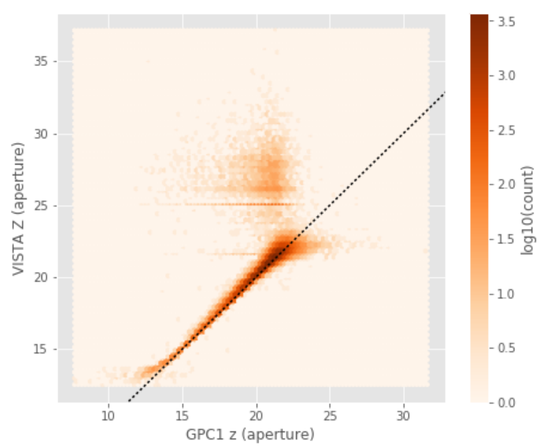
DECam z (total) - GPC1 z (total):
- Median: -0.18
- Median Absolute Deviation: 0.12
- 1% percentile: -0.9738799285888672
- 99% percentile: 2.6826425075530977



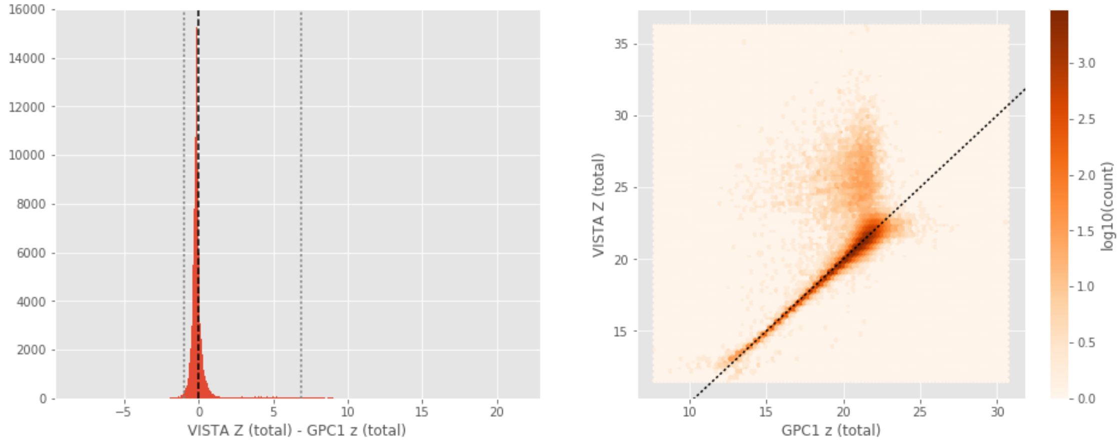


VISTA Z (aperture) - GPC1 z (aperture):
- Median: 0.14
- Median Absolute Deviation: 0.16
- 1% percentile: -0.8950440406799316
- 99% percentile: 7.7044631385803255

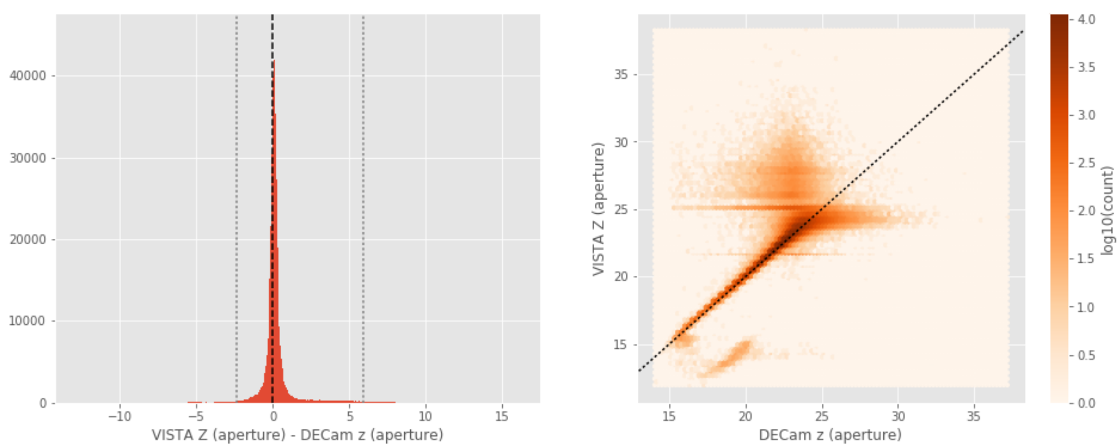




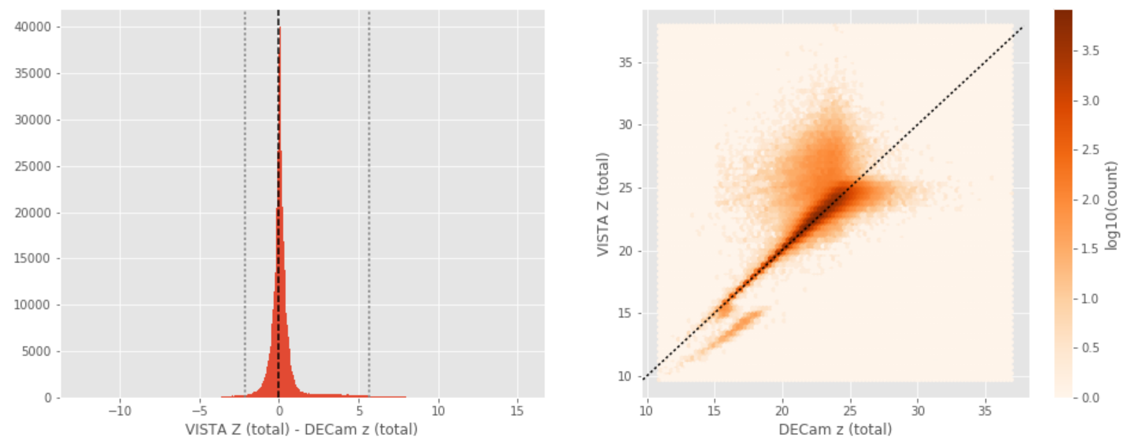
VISTA Z (total) - GPC1 z (total):
- Median: -0.13
- Median Absolute Deviation: 0.14
- 1% percentile: -0.9852363395690917
- 99% percentile: 6.875684700012207



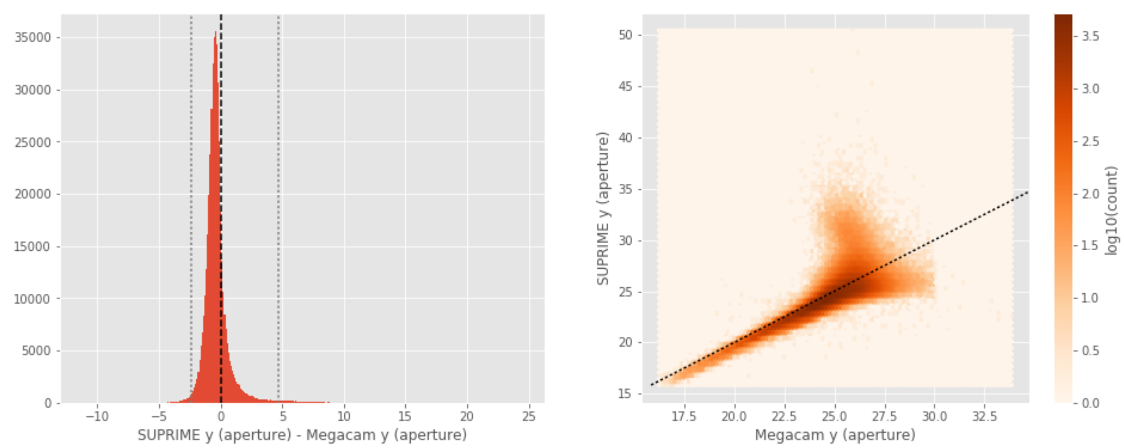
VISTA Z (aperture) - DECam z (aperture):
- Median: 0.09
- Median Absolute Deviation: 0.18
- 1% percentile: -2.39511360168457
- 99% percentile: 5.928247776031494



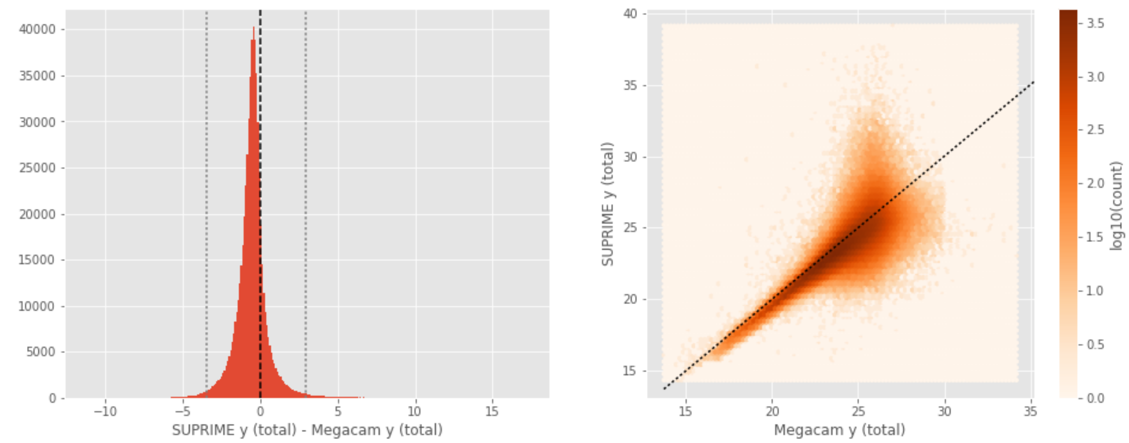
VISTA Z (total) - DECam z (total):
- Median: 0.06
- Median Absolute Deviation: 0.23
- 1% percentile: -2.1579328918457032
- 99% percentile: 5.653548698425289



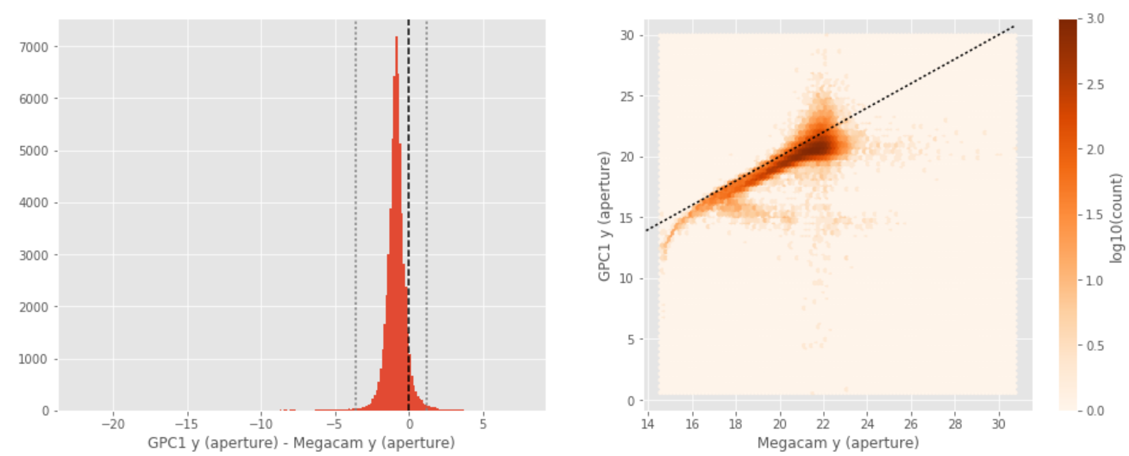
SUPRIME y (aperture) - Megacam y (aperture):
- Median: -0.44
- Median Absolute Deviation: 0.38
- 1% percentile: -2.362483768463135
- 99% percentile: 4.718506317138713



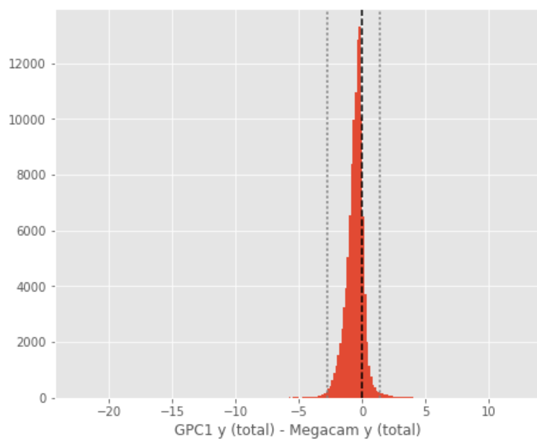
SUPRIME y (total) - Megacam y (total):
- Median: -0.51
- Median Absolute Deviation: 0.43
- 1% percentile: -3.4871426582336427
- 99% percentile: 2.9167009544372267

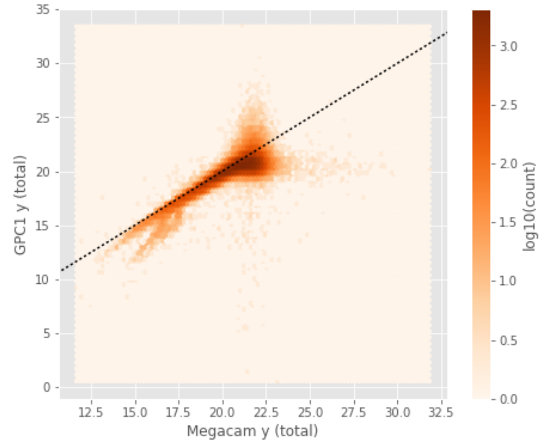


GPC1 y (aperture) - Megacam y (aperture):
- Median: -0.85
- Median Absolute Deviation: 0.33
- 1% percentile: -3.60290412902832
- 99% percentile: 1.2515487289428668

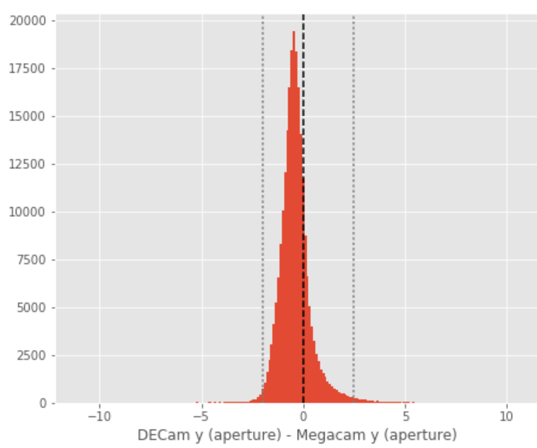


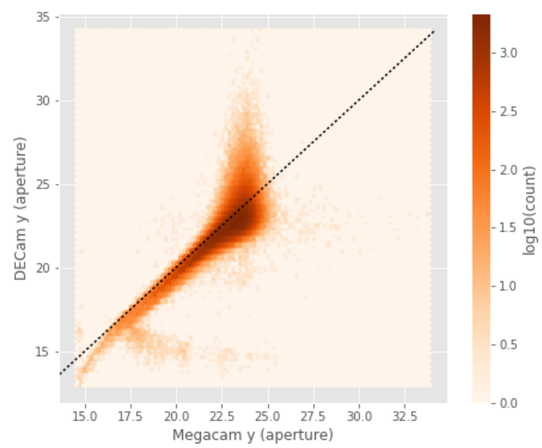
GPC1 y (total) - Megacam y (total):
- Median: -0.47
- Median Absolute Deviation: 0.38
- 1% percentile: -2.7168086242675784
- 99% percentile: 1.4016079711914065



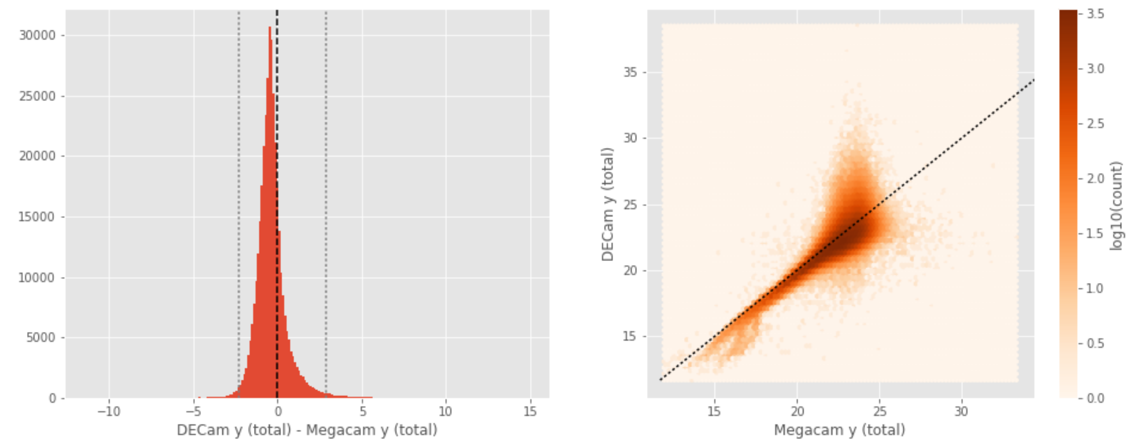


DECam y (aperture) - Megacam y (aperture):
- Median: -0.45
- Median Absolute Deviation: 0.38
- 1% percentile: -2.0142159271240234
- 99% percentile: 2.4878184509277337

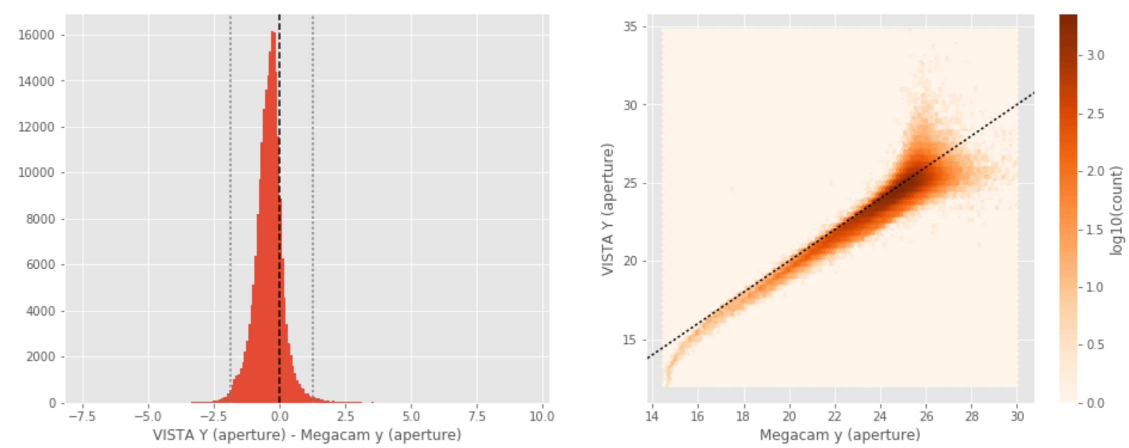




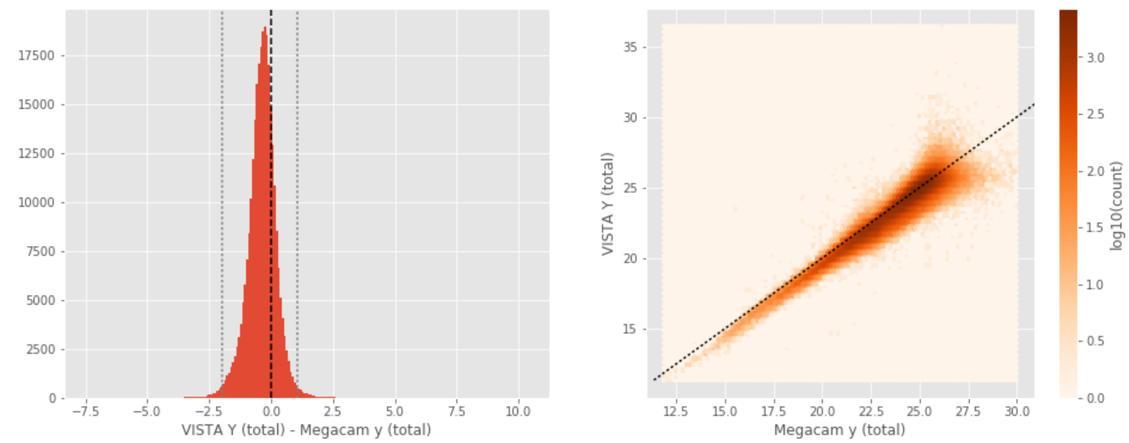
DECam y (total) - Megacam y (total):
- Median: -0.43
- Median Absolute Deviation: 0.42
- 1% percentile: -2.306287536621094
- 99% percentile: 2.8485866546630865



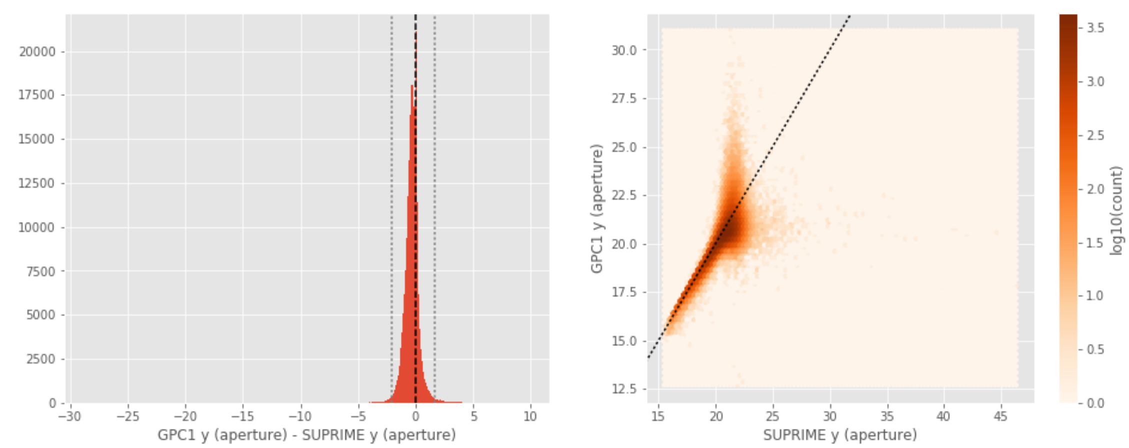
VISTA Y (aperture) - Megacam y (aperture):
- Median: -0.39
- Median Absolute Deviation: 0.30
- 1% percentile: -1.8950813293457032
- 99% percentile: 1.2401432037353475



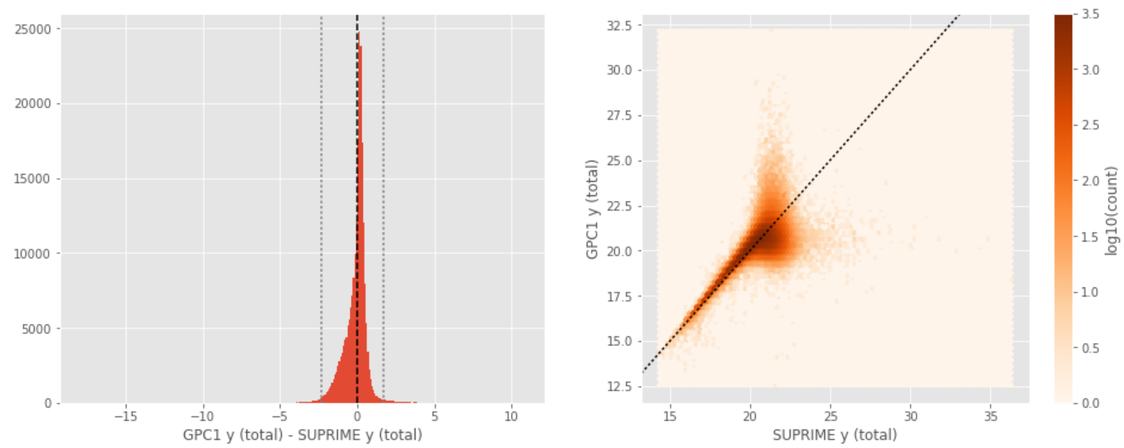
VISTA Y (total) - Megacam y (total):
- Median: -0.33
- Median Absolute Deviation: 0.33
- 1% percentile: -1.9636022949218748
- 99% percentile: 1.0820082664489747



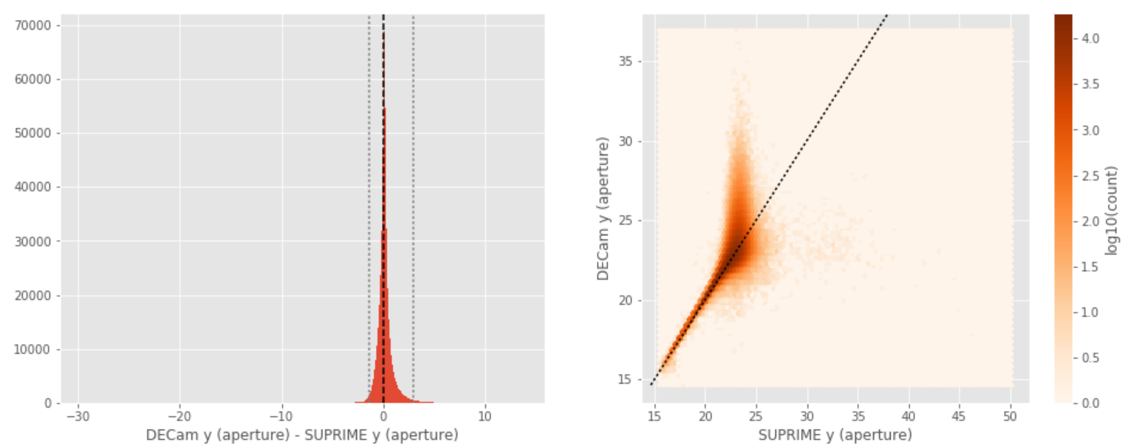
GPC1 y (aperture) - SUPRIME y (aperture):
- Median: -0.29
- Median Absolute Deviation: 0.32
- 1% percentile: -2.0775110626220705
- 99% percentile: 1.6714744949340825



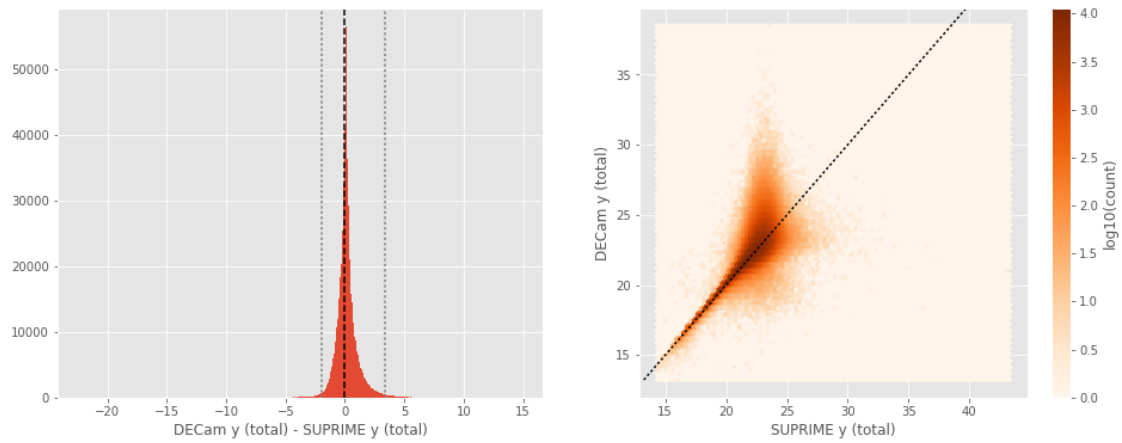
GPC1 y (total) - SUPRIME y (total):
- Median: 0.07
- Median Absolute Deviation: 0.29
- 1% percentile: -2.2872619819641113
- 99% percentile: 1.6790031433105388



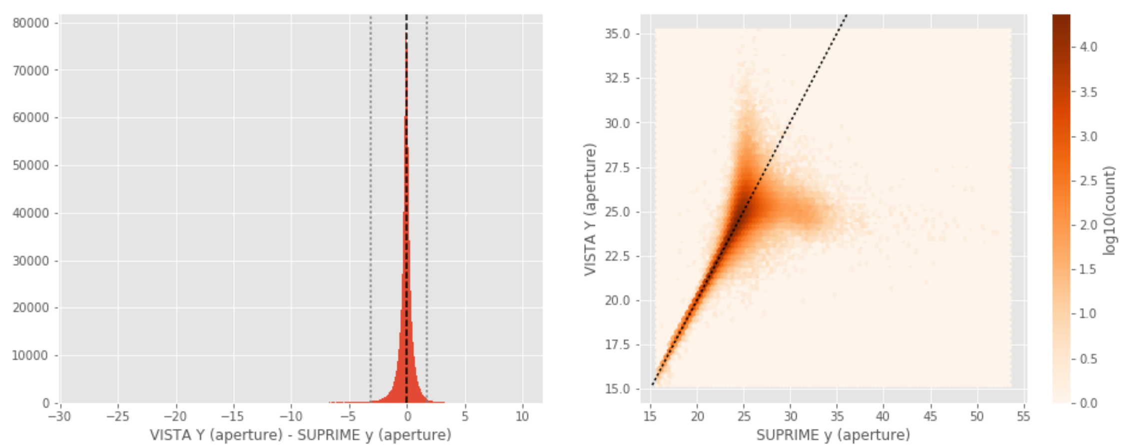
DECam y (aperture) - SUPRIME y (aperture):
- Median: 0.09
- Median Absolute Deviation: 0.26
- 1% percentile: -1.4609357070922853
- 99% percentile: 2.9194031906127877



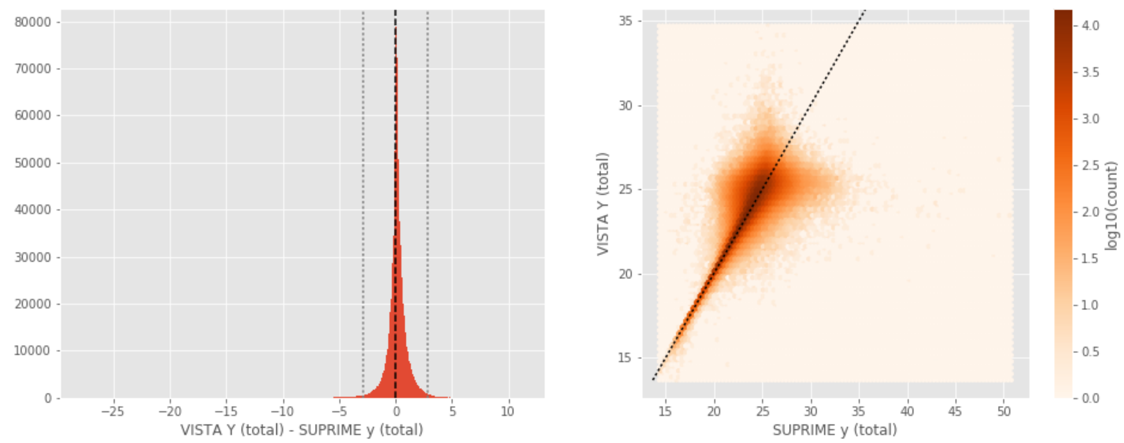
DECam y (total) - SUPRIME y (total):
- Median: 0.09
- Median Absolute Deviation: 0.35
- 1% percentile: -2.0030963134765623
- 99% percentile: 3.3678937530517645



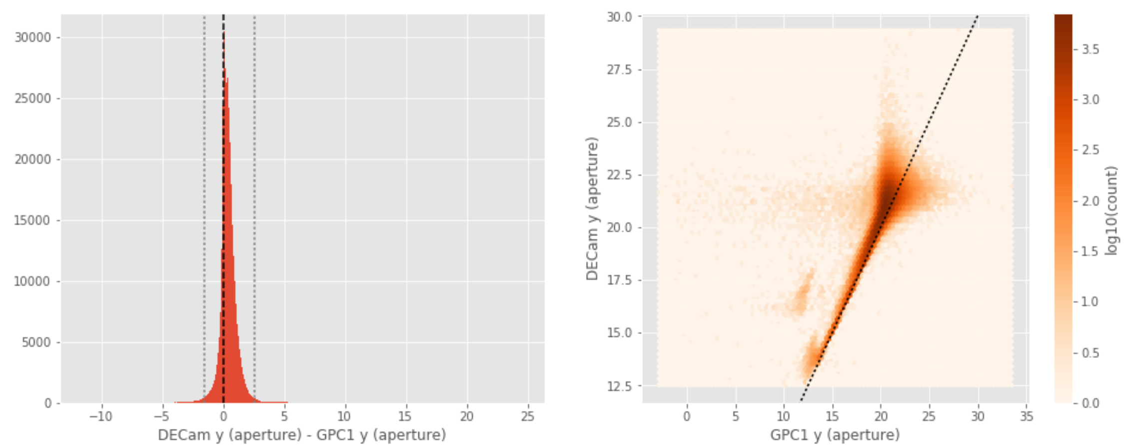

```
VISTA Y (aperture) - SUPRIME y (aperture):
- Median: -0.02
- Median Absolute Deviation: 0.23
- 1% percentile: -3.087427635192871
- 99% percentile: 1.6947448730468935
```



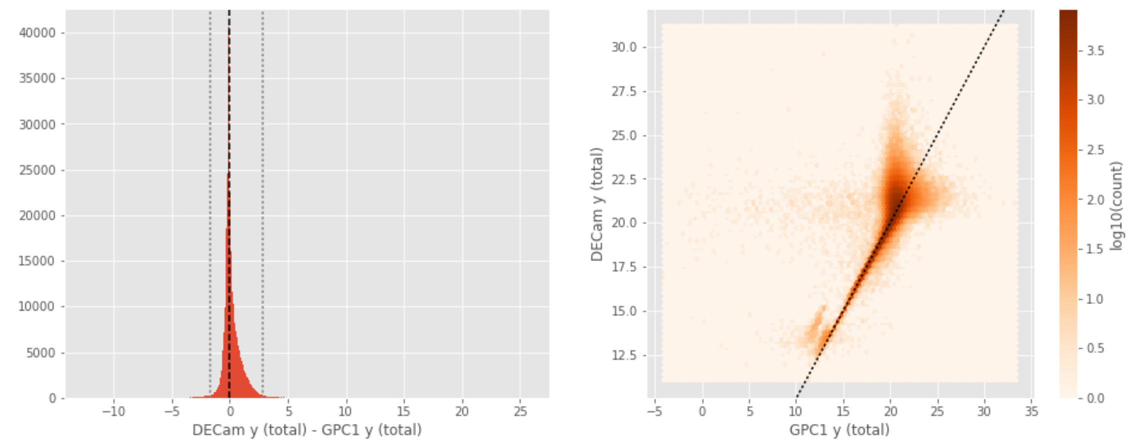

```
VISTA Y (total) - SUPRIME y (total):
- Median: 0.10
- Median Absolute Deviation: 0.33
- 1% percentile: -2.8650838851928713
- 99% percentile: 2.790845870971678
```



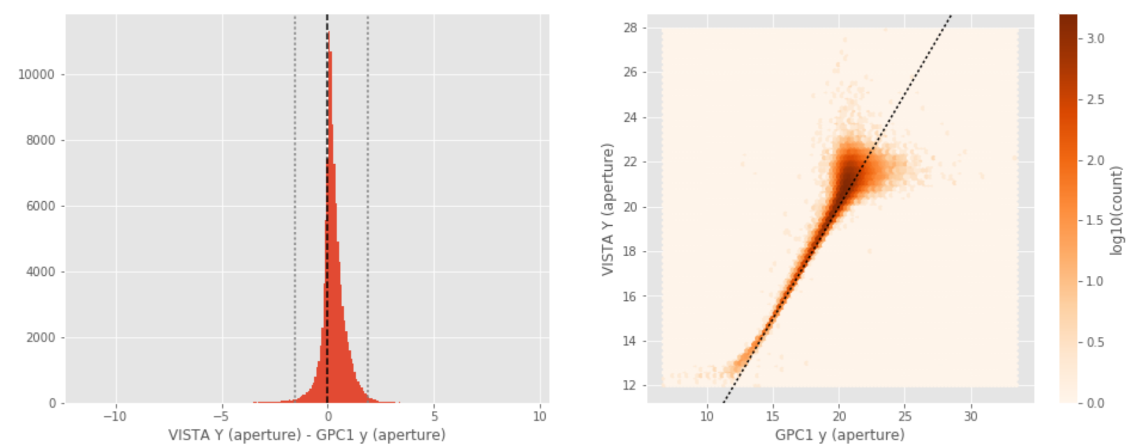
DECam y (aperture) - GPC1 y (aperture):
- Median: 0.38
- Median Absolute Deviation: 0.33
- 1% percentile: -1.5393833351135253
- 99% percentile: 2.6004552078247065



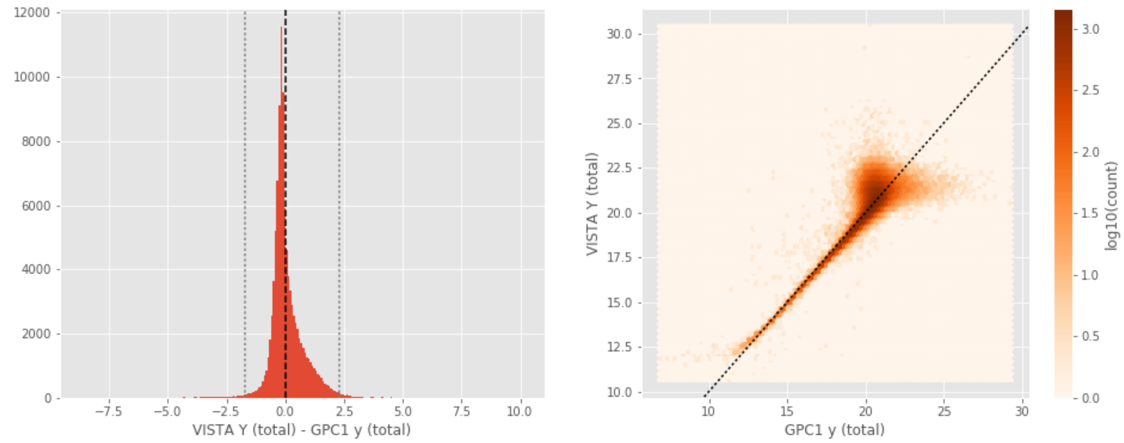
DECam y (total) - GPC1 y (total):
- Median: -0.02
- Median Absolute Deviation: 0.27
- 1% percentile: -1.6514144897460938
- 99% percentile: 2.8469280242919908



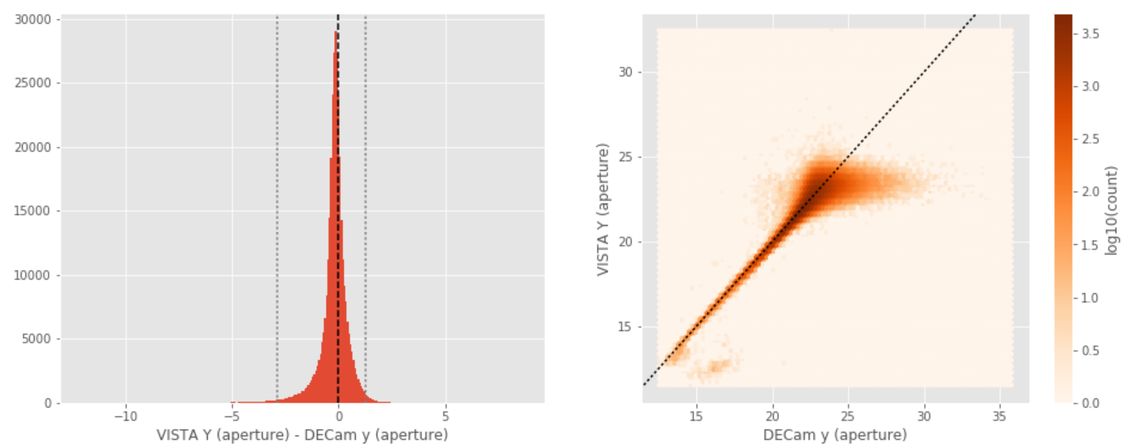
VISTA Y (aperture) - GPC1 y (aperture):
- Median: 0.20
- Median Absolute Deviation: 0.25
- 1% percentile: -1.5711625671386718
- 99% percentile: 1.9135727691650388



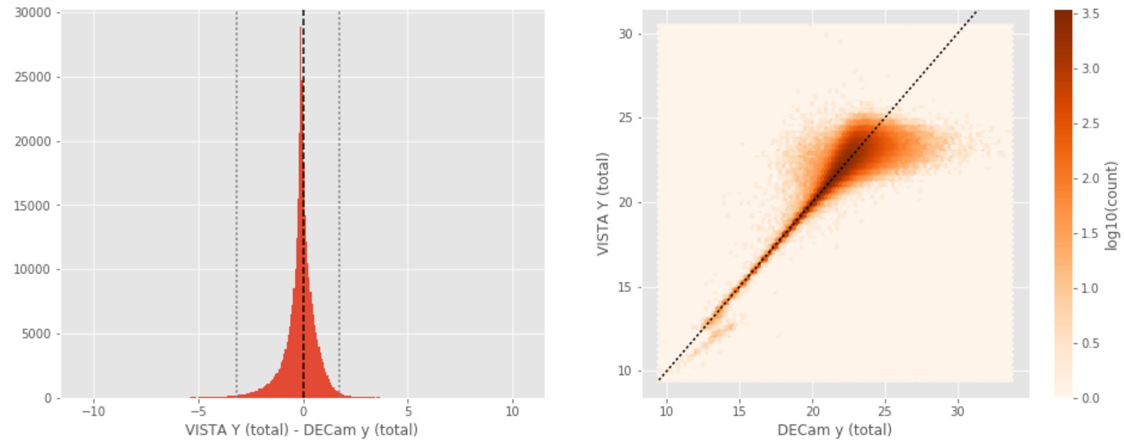
VISTA Y (total) - GPC1 y (total):
- Median: -0.10
- Median Absolute Deviation: 0.27
- 1% percentile: -1.6935344505310055
- 99% percentile: 2.2822624969482423



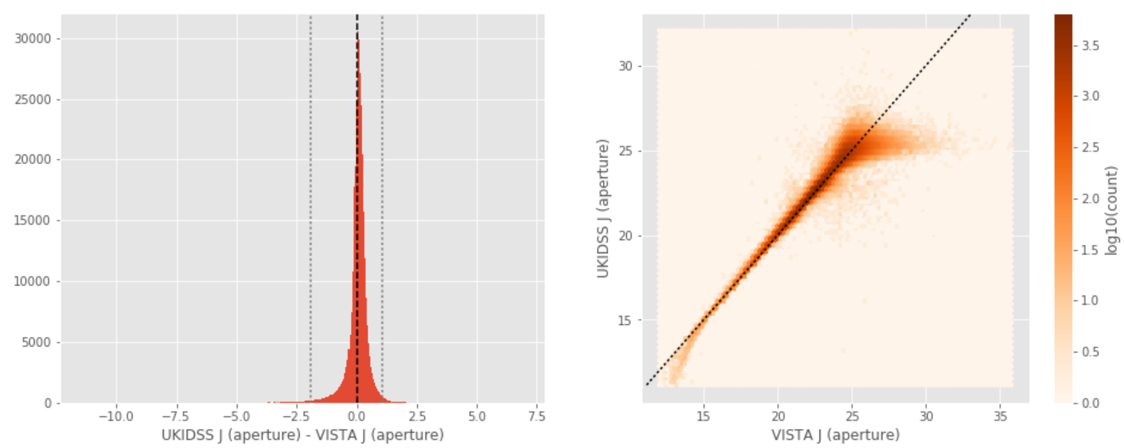
VISTA Y (aperture) - DECam y (aperture):
- Median: -0.15
- Median Absolute Deviation: 0.25
- 1% percentile: -2.877870559692383
- 99% percentile: 1.2529420852661133



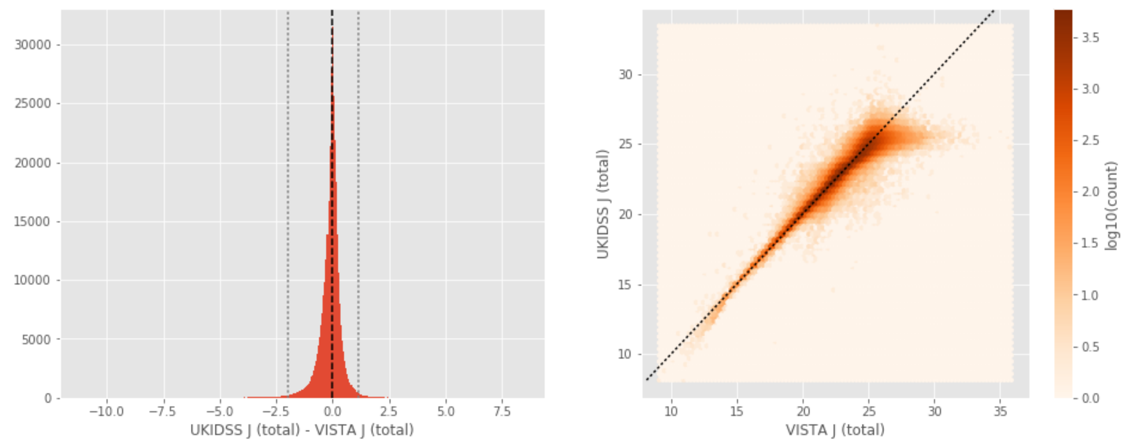
VISTA Y (total) - DECam y (total):
- Median: -0.09
- Median Absolute Deviation: 0.31
- 1% percentile: -3.1509500885009762
- 99% percentile: 1.7540818977355808



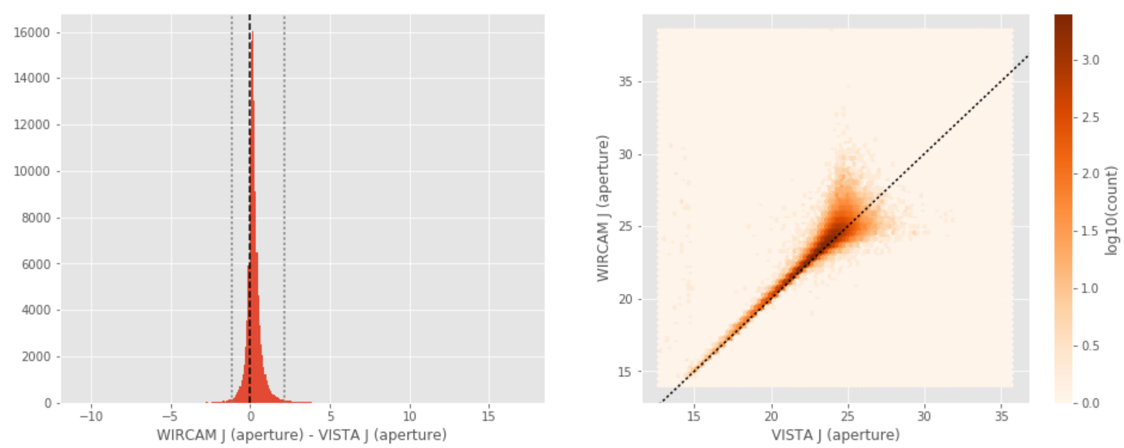
UKIDSS J (aperture) - VISTA J (aperture):
- Median: 0.07
- Median Absolute Deviation: 0.16
- 1% percentile: -1.9190846061706544
- 99% percentile: 1.0688185501098633



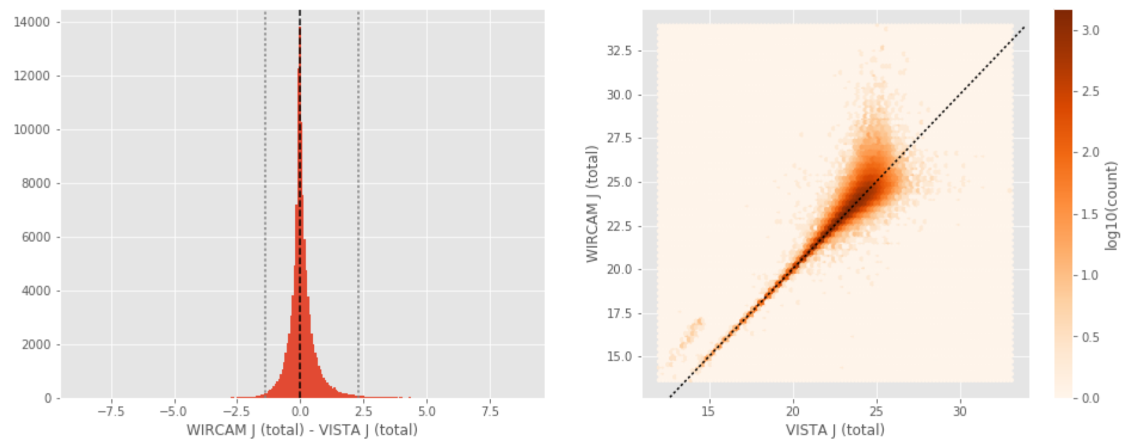
UKIDSS J (total) - VISTA J (total):
- Median: -0.04
- Median Absolute Deviation: 0.20
- 1% percentile: -1.996765956878662
- 99% percentile: 1.1238769531250008



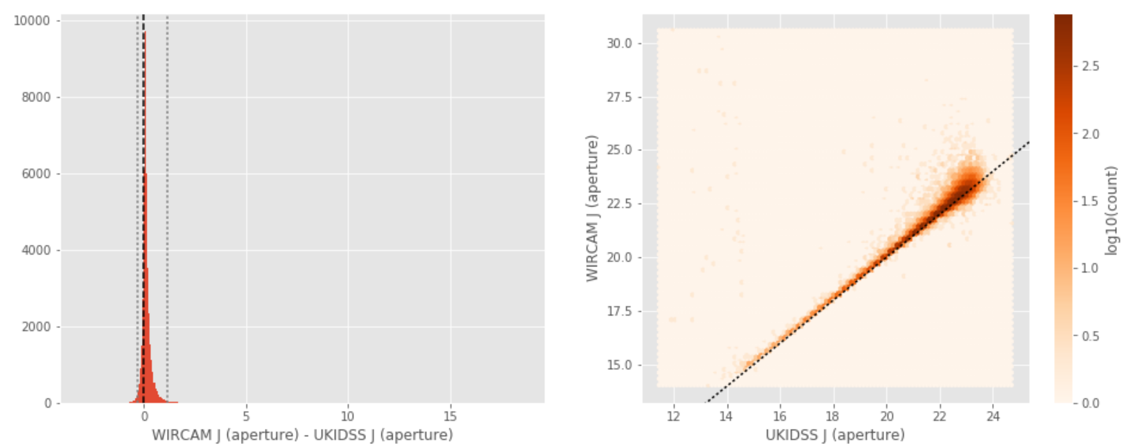
WIRCAM J (aperture) - VISTA J (aperture):
- Median: 0.17
- Median Absolute Deviation: 0.18
- 1% percentile: -1.1215943145751952
- 99% percentile: 2.141083145141601



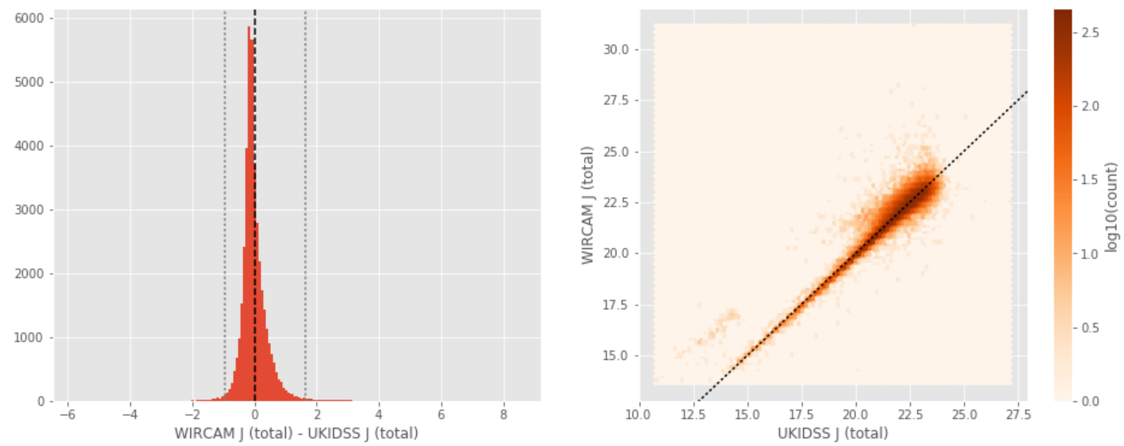
WIRCAM J (total) - VISTA J (total):
- Median: -0.00
- Median Absolute Deviation: 0.20
- 1% percentile: -1.3996848678588867
- 99% percentile: 2.288000526428222



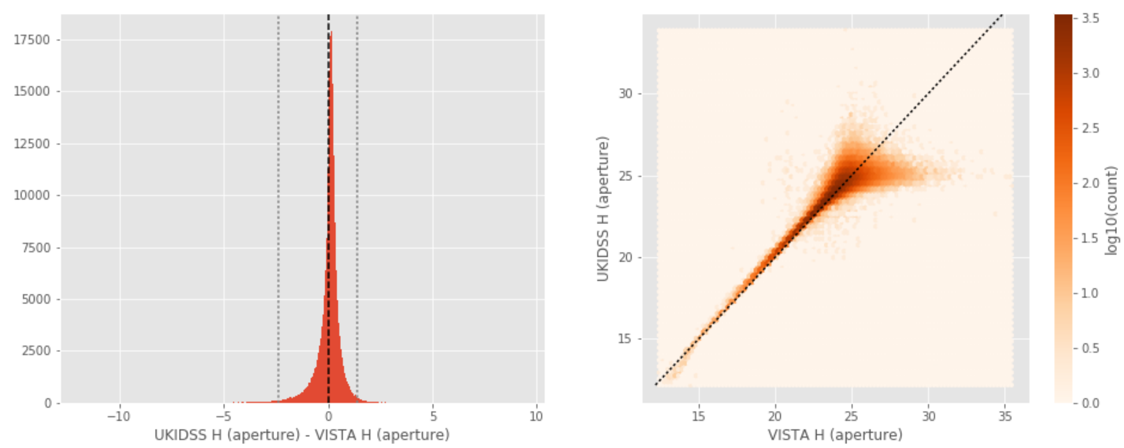
WIRCAM J (aperture) - UKIDSS J (aperture):
- Median: 0.11
- Median Absolute Deviation: 0.08
- 1% percentile: -0.32466945648193357
- 99% percentile: 1.1296821784973141



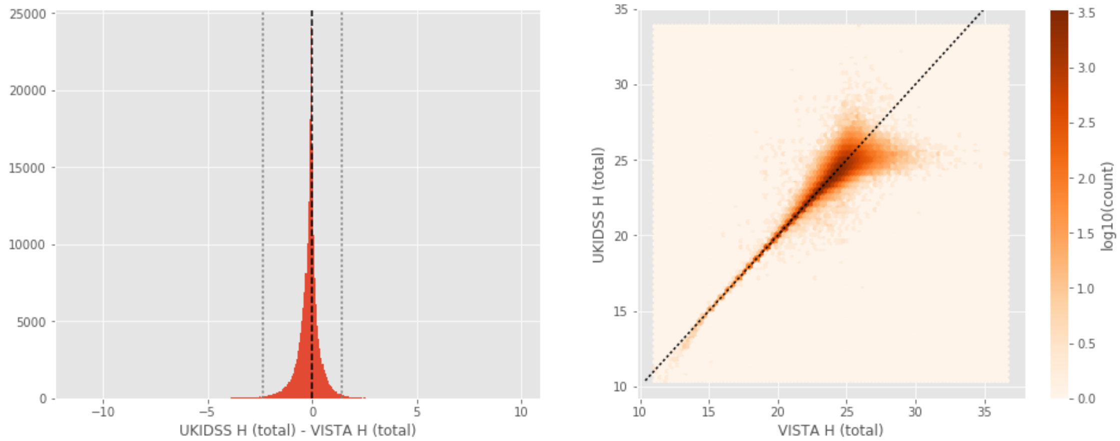
WIRCAM J (total) - UKIDSS J (total):
- Median: -0.08
- Median Absolute Deviation: 0.17
- 1% percentile: -0.9389879035949706
- 99% percentile: 1.6195438385009657



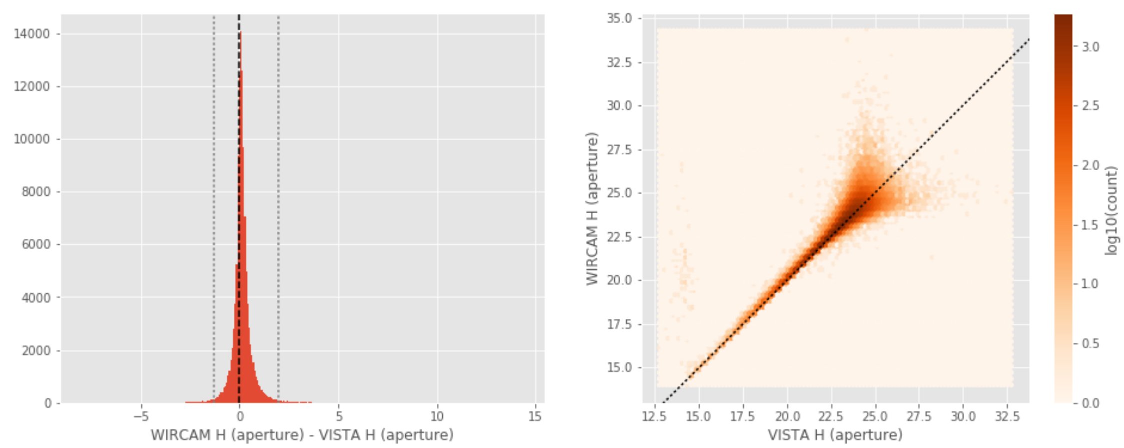
UKIDSS H (aperture) - VISTA H (aperture):
- Median: 0.15
- Median Absolute Deviation: 0.19
- 1% percentile: -2.3486846351623534
- 99% percentile: 1.417771091461188



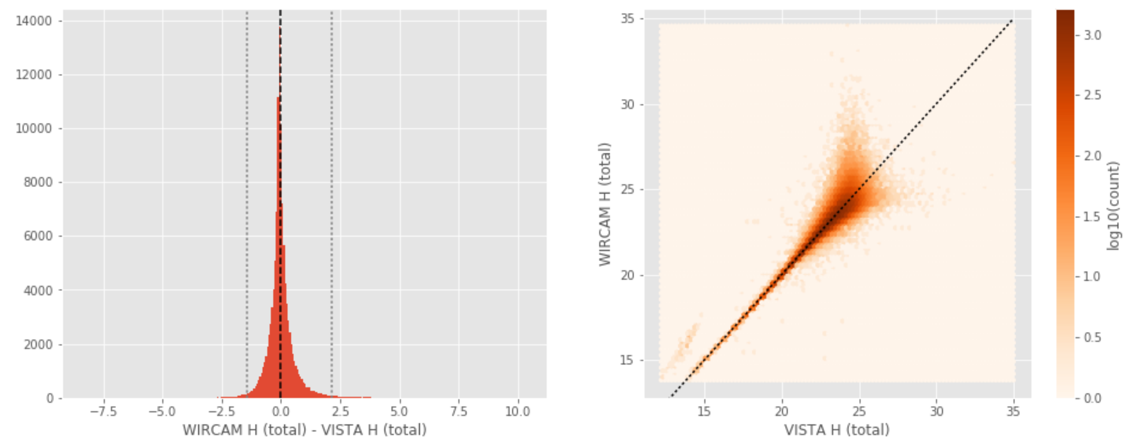
UKIDSS H (total) - VISTA H (total):
- Median: -0.09
- Median Absolute Deviation: 0.20
- 1% percentile: -2.3609312438964842
- 99% percentile: 1.3909326171875



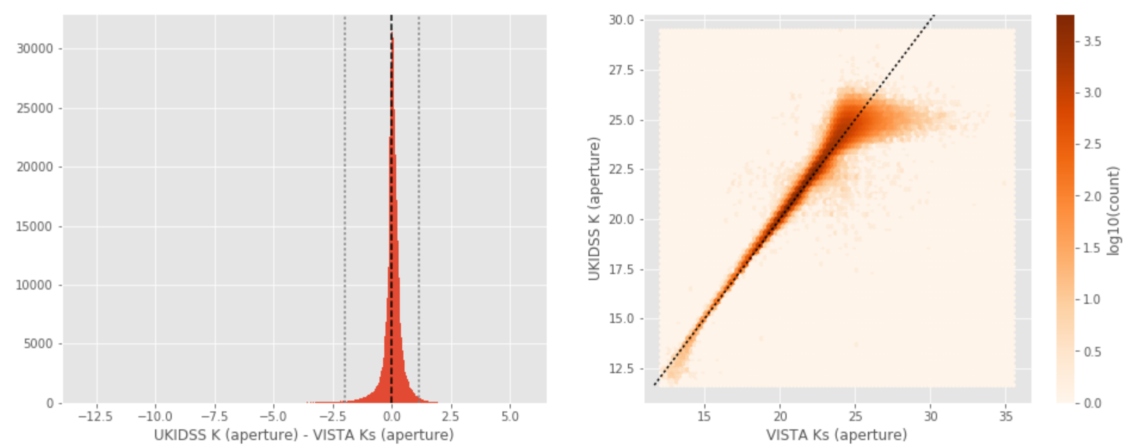
WIRCAM H (aperture) - VISTA H (aperture):
- Median: 0.09
- Median Absolute Deviation: 0.17
- 1% percentile: -1.3035173034667968
- 99% percentile: 1.9530482482910159



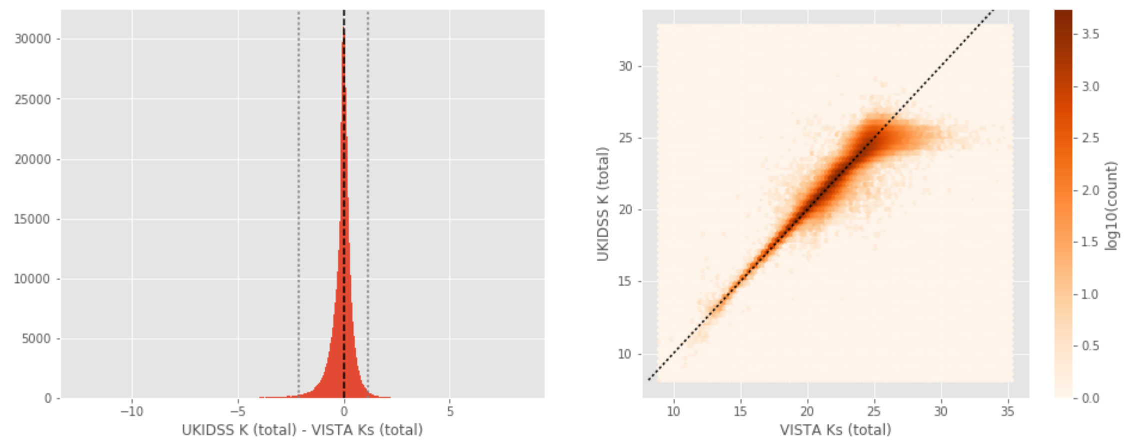
WIRCAM H (total) - VISTA H (total):
- Median: -0.05
- Median Absolute Deviation: 0.20
- 1% percentile: -1.459299545288086
- 99% percentile: 2.1663842773437487



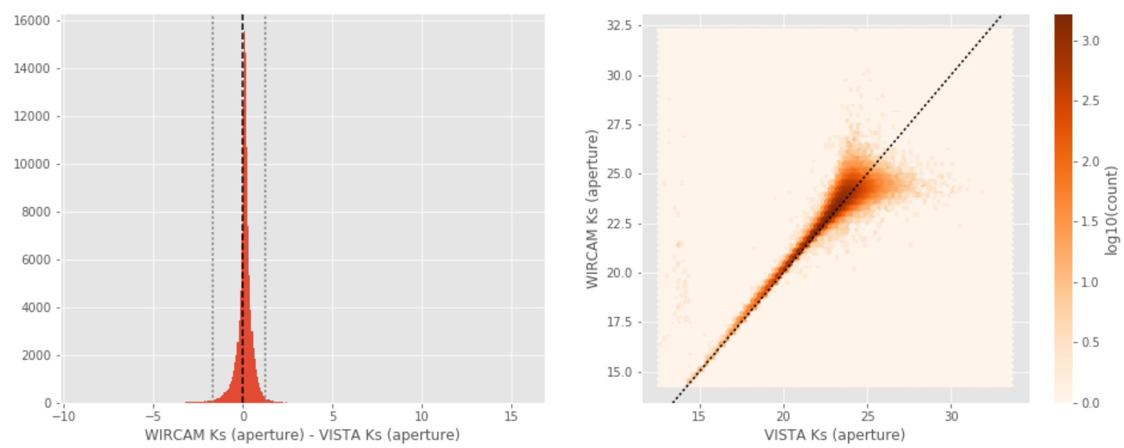
No sources have both UKIDSS H (aperture) and WIRCAM H (aperture) values.
No sources have both UKIDSS H (total) and WIRCAM H (total) values.
UKIDSS K (aperture) - VISTA Ks (aperture):
- Median: 0.06
- Median Absolute Deviation: 0.14
- 1% percentile: -1.9586513710021973
- 99% percentile: 1.1346926116943385



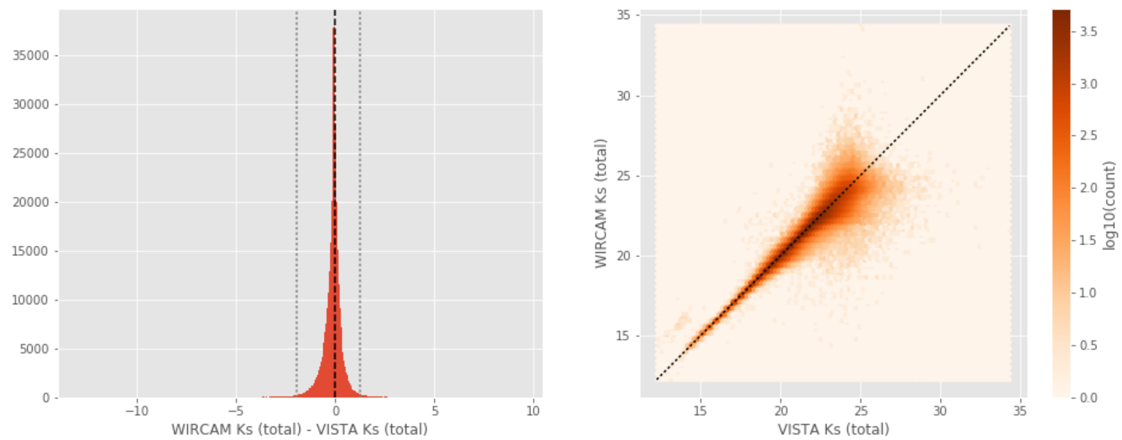
UKIDSS K (total) - VISTA Ks (total):
- Median: -0.00
- Median Absolute Deviation: 0.20
- 1% percentile: -2.1291068267822264
- 99% percentile: 1.141293087005619



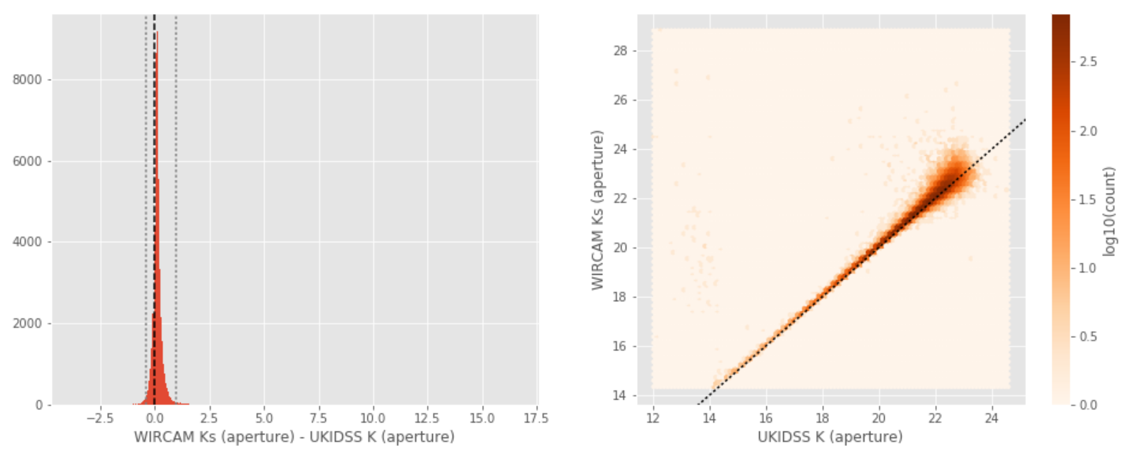
WIRCAM Ks (aperture) - VISTA Ks (aperture):
- Median: 0.11
- Median Absolute Deviation: 0.16
- 1% percentile: -1.7124255752563475
- 99% percentile: 1.2553991127014184



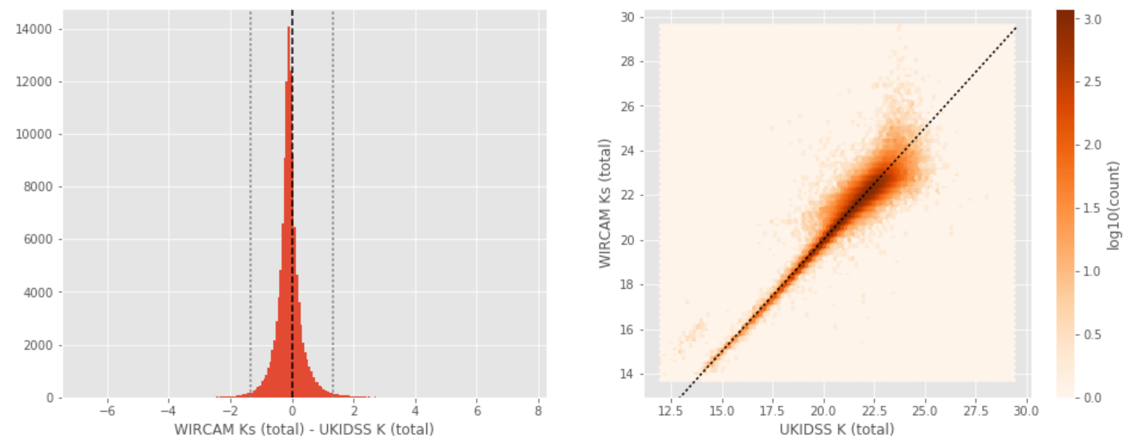
WIRCAM Ks (total) - VISTA Ks (total):
- Median: -0.07
- Median Absolute Deviation: 0.17
- 1% percentile: -1.9729717254638672
- 99% percentile: 1.2284774780273449



WIRCAM Ks (aperture) - UKIDSS K (aperture):
- Median: 0.09
- Median Absolute Deviation: 0.08
- 1% percentile: -0.4083726501464844
- 99% percentile: 0.9650620651245115



WIRCAM Ks (total) - UKIDSS K (total):
- Median: -0.09
- Median Absolute Deviation: 0.17
- 1% percentile: -1.3401906776428223
- 99% percentile: 1.3497693443298213



1.5 III - Comparing magnitudes to reference bands

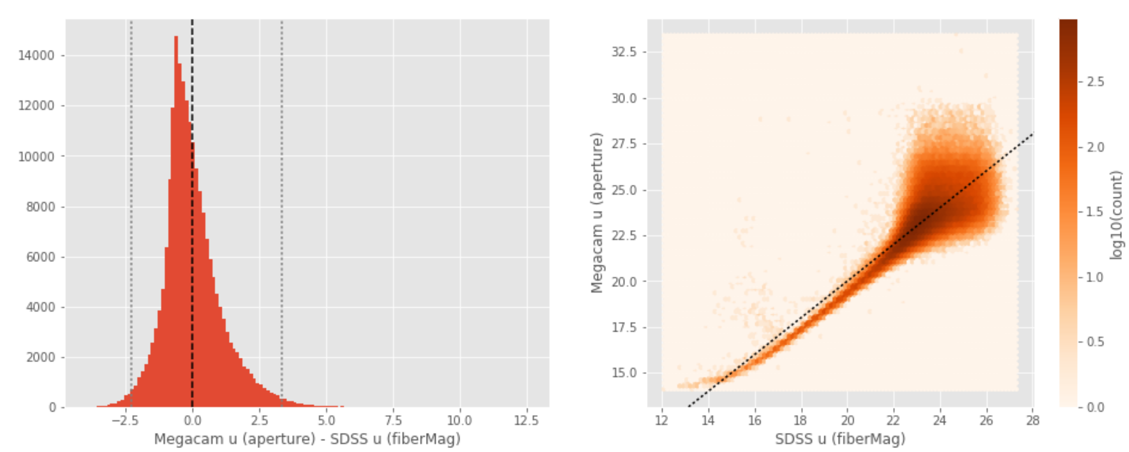
Cross-match the master list to SDSS and 2MASS to compare its magnitudes to SDSS and 2MASS ones.

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

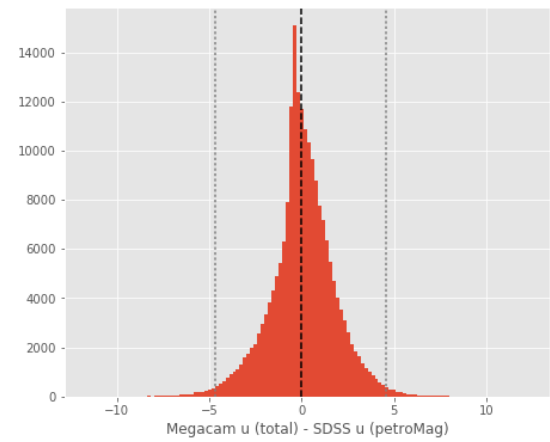
The catalogue is cross-matched to SDSS-DR13 withing 0.2 arcsecond.

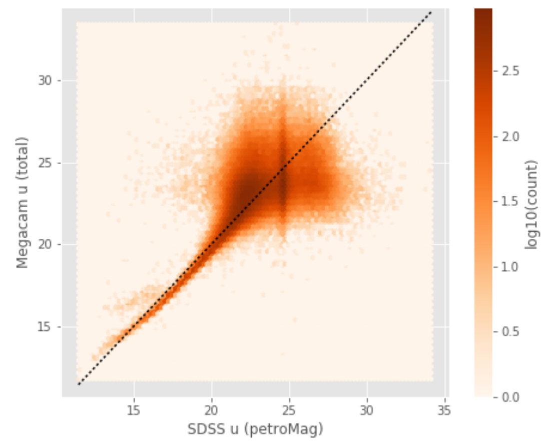
We compare the u, g, r, i, and z magnitudes to those from SDSS using `fiberMag` for the aperture magnitude and `petroMag` for the total magnitude.

```
Megacam u (aperture) - SDSS u (fiberMag):
- Median: -0.16
- Median Absolute Deviation: 0.57
- 1% percentile: -2.2747928047180177
- 99% percentile: 3.36533878326415
```

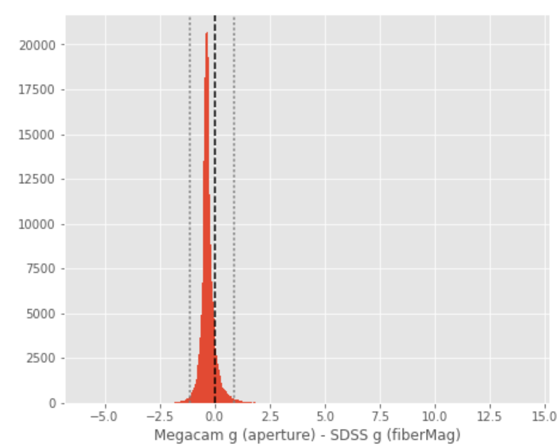


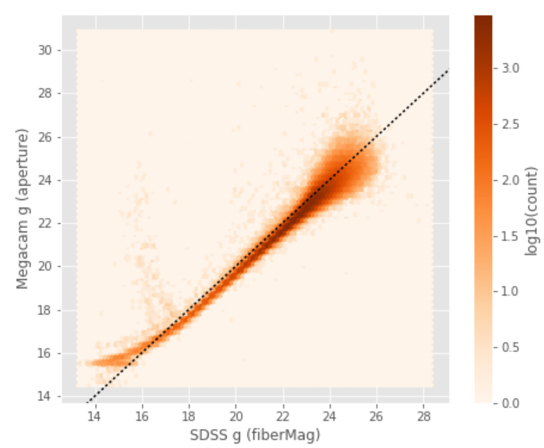
```
Megacam u (total) - SDSS u (petroMag):
- Median: 0.03
- Median Absolute Deviation: 0.93
- 1% percentile: -4.693710289001465
- 99% percentile: 4.555381507873536
```



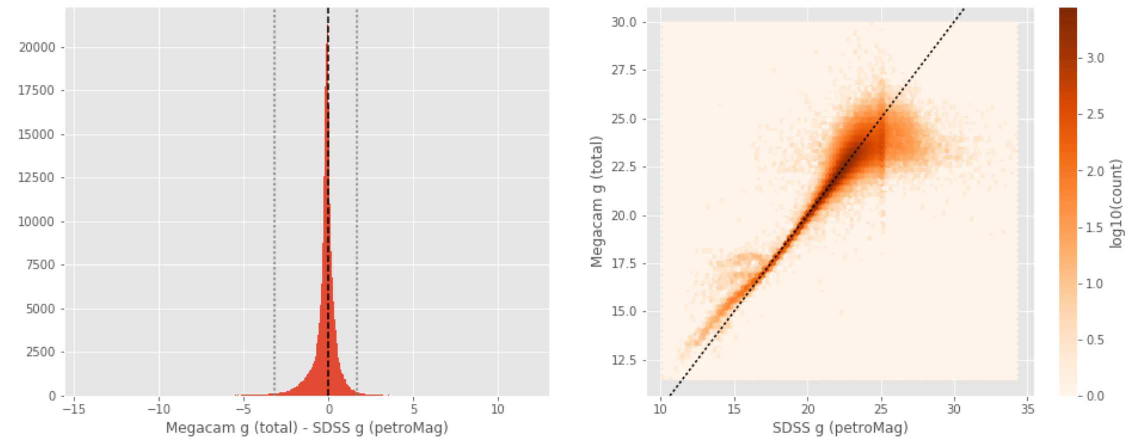



```
Megacam g (aperture) - SDSS g (fiberMag):
- Median: -0.34
- Median Absolute Deviation: 0.13
- 1% percentile: -1.1238826751708983
- 99% percentile: 0.9107955932617195
```

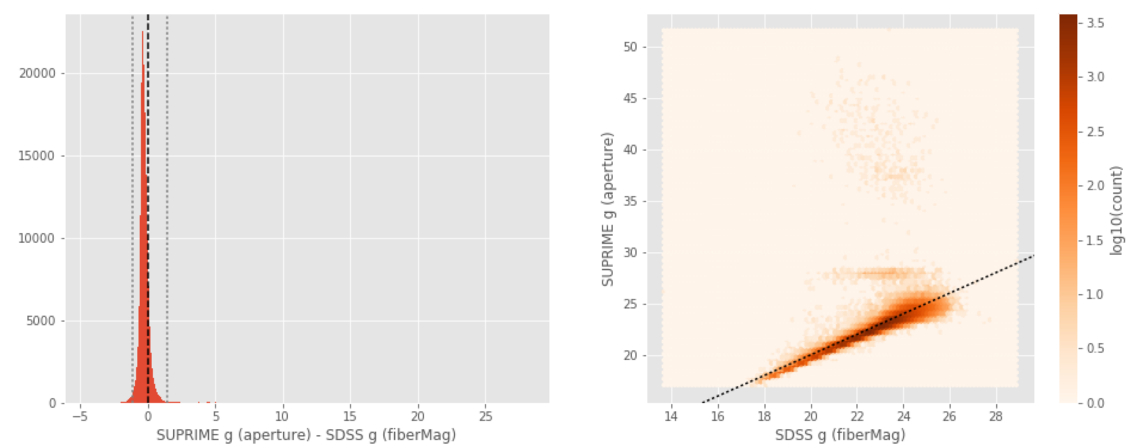




Megacam g (total) - SDSS g (petroMag):
- Median: -0.12
- Median Absolute Deviation: 0.22
- 1% percentile: -3.1879452896118163
- 99% percentile: 1.630353927612306

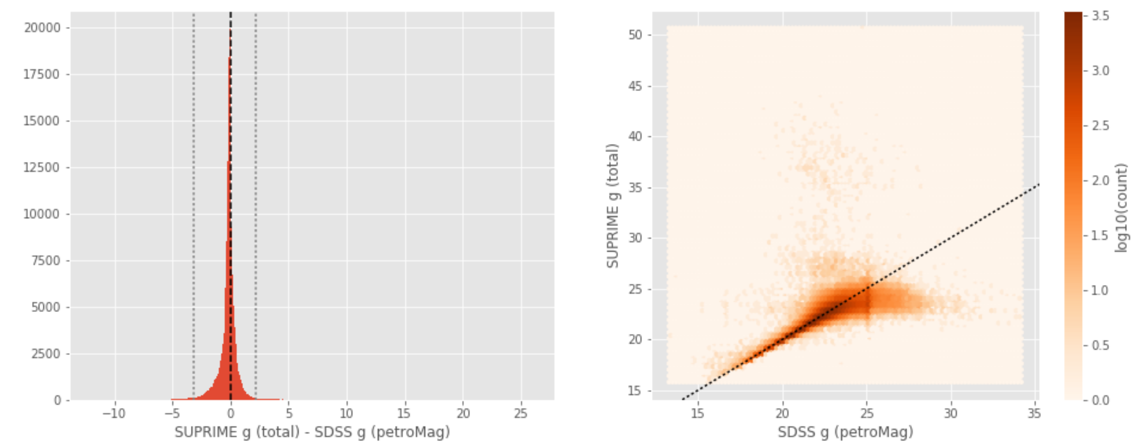


SUPRIME g (aperture) - SDSS g (fiberMag):
- Median: -0.30
- Median Absolute Deviation: 0.17
- 1% percentile: -1.1416707611083985
- 99% percentile: 1.4411949539184539

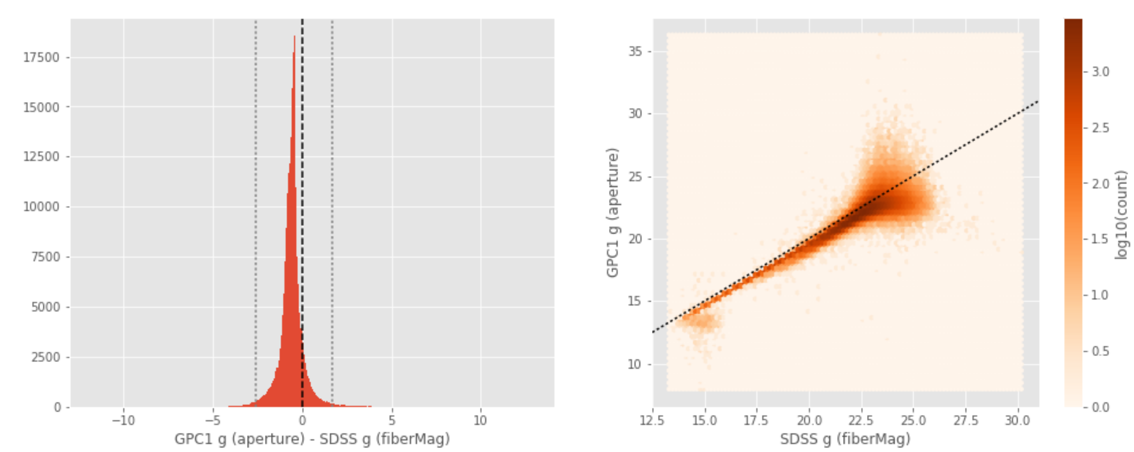


SUPRIME g (total) - SDSS g (petroMag):
- Median: -0.12

- Median Absolute Deviation: 0.23
- 1% percentile: -3.2103882789611813
- 99% percentile: 2.1886862277984545

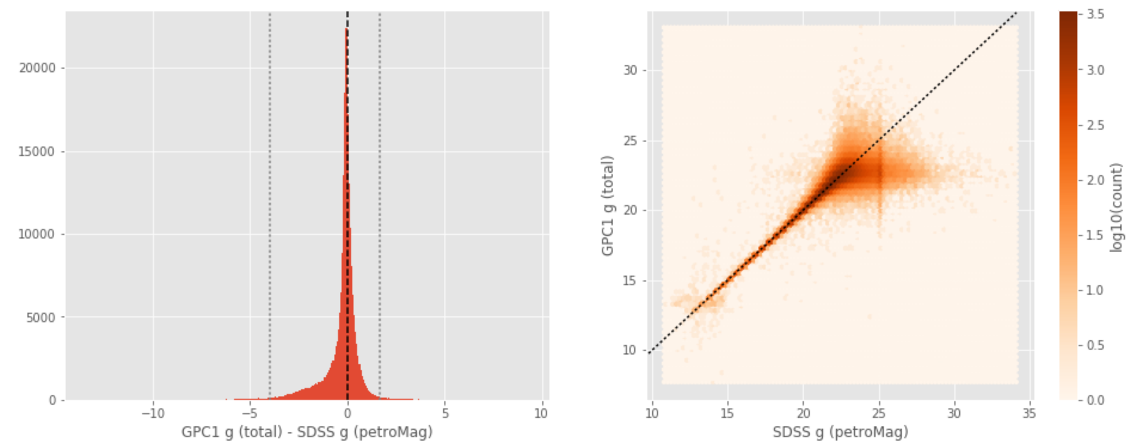


GPC1 g (aperture) - SDSS g (fiberMag):
- Median: -0.56
- Median Absolute Deviation: 0.26
- 1% percentile: -2.6218787002563477
- 99% percentile: 1.695670928955073

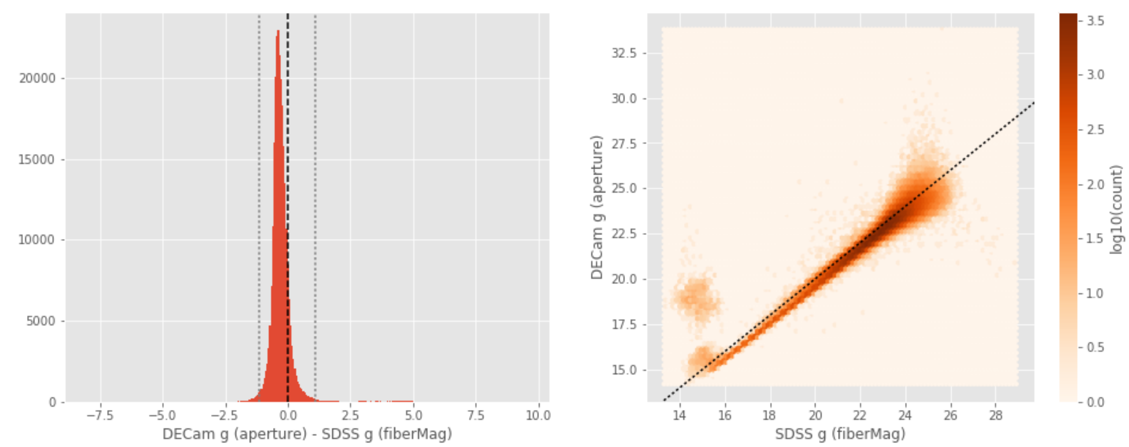


GPC1 g (total) - SDSS g (petroMag):
- Median: -0.08
- Median Absolute Deviation: 0.25
- 1% percentile: -3.995189914703369

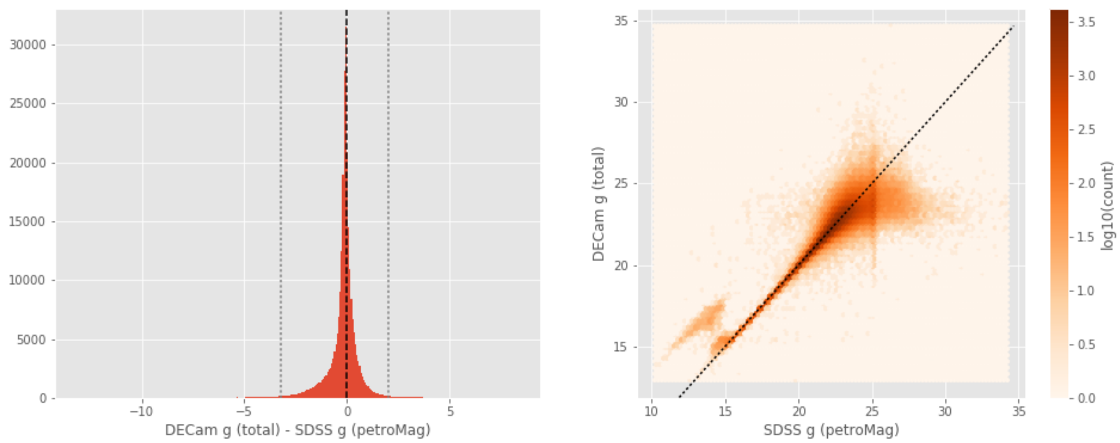
- 99% percentile: 1.6608183288574219



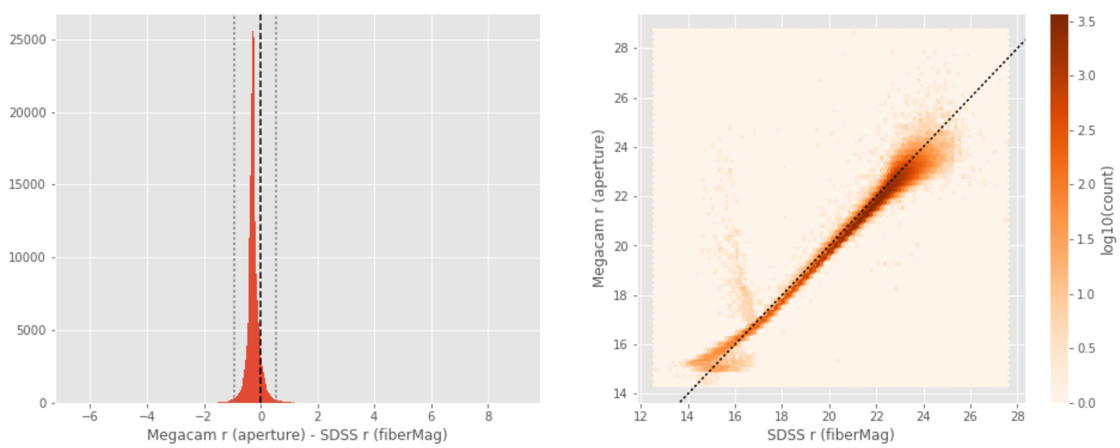
DECam g (aperture) - SDSS g (fiberMag):
- Median: -0.32
- Median Absolute Deviation: 0.17
- 1% percentile: -1.161762390136719
- 99% percentile: 1.0842285919189467



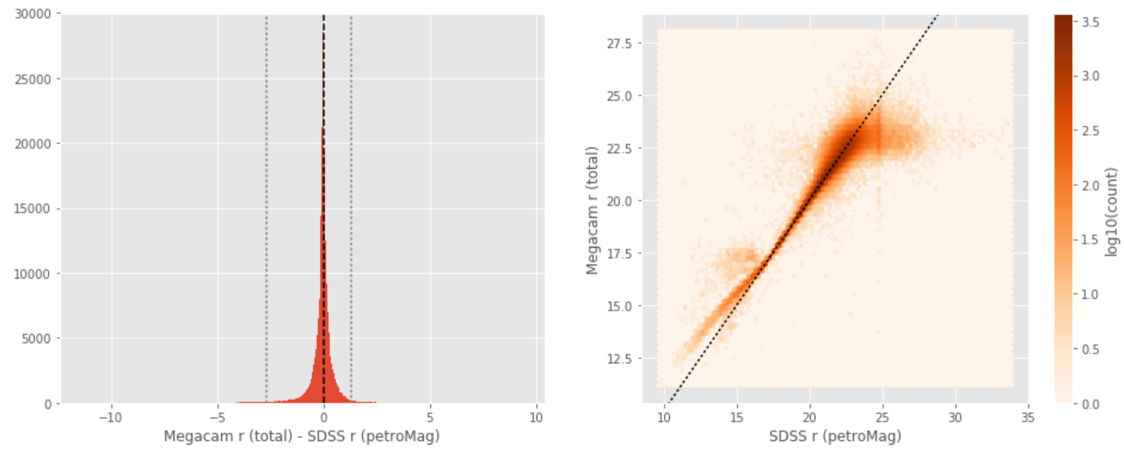
DECam g (total) - SDSS g (petroMag):
- Median: -0.09
- Median Absolute Deviation: 0.21
- 1% percentile: -3.2205306816101076
- 99% percentile: 2.0388721084594716



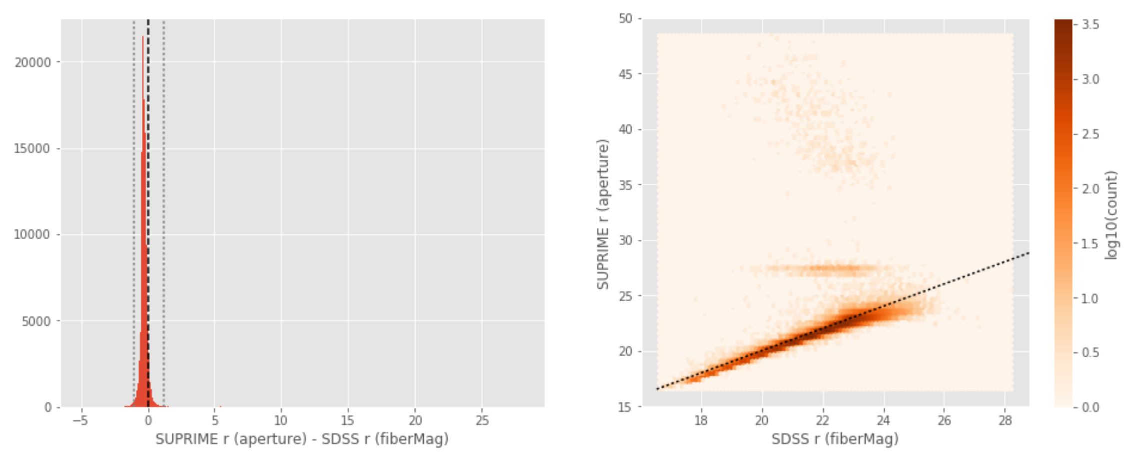

```
Megacam r (aperture) - SDSS r (fiberMag):
- Median: -0.27
- Median Absolute Deviation: 0.09
- 1% percentile: -0.9251380729675294
- 99% percentile: 0.5400785827636716
```



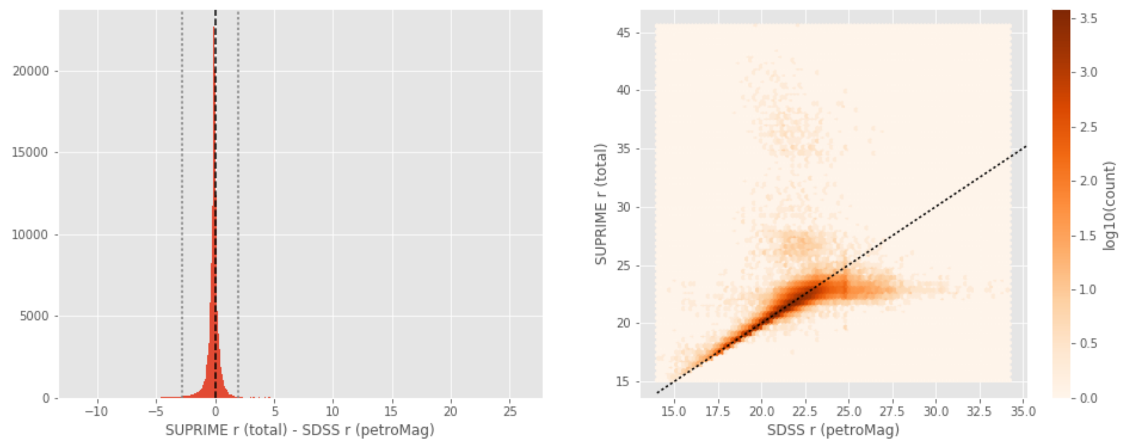

```
Megacam r (total) - SDSS r (petroMag):
- Median: -0.02
- Median Absolute Deviation: 0.15
- 1% percentile: -2.6643548011779785
- 99% percentile: 1.324775218963623
```



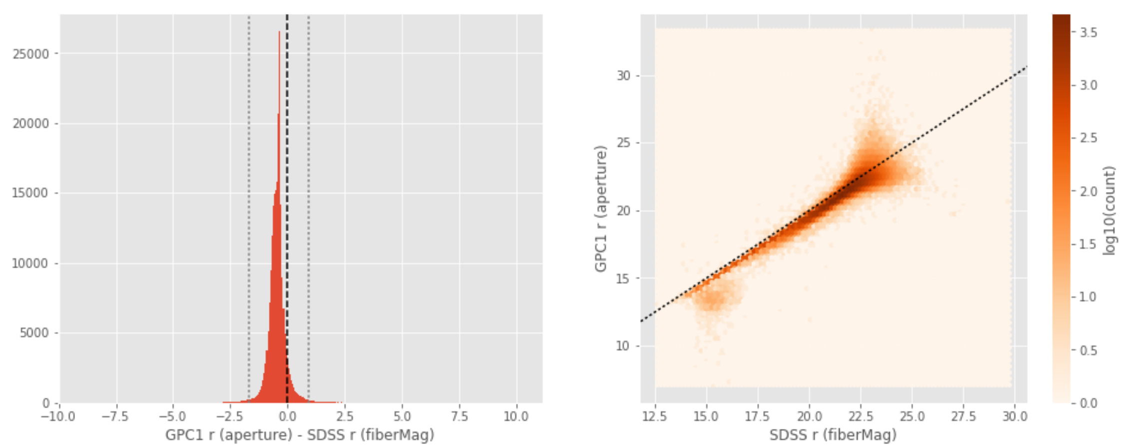
SUPRIME r (aperture) - SDSS r (fiberMag):
- Median: -0.29
- Median Absolute Deviation: 0.13
- 1% percentile: -0.9902065849304199
- 99% percentile: 1.1700545120239263



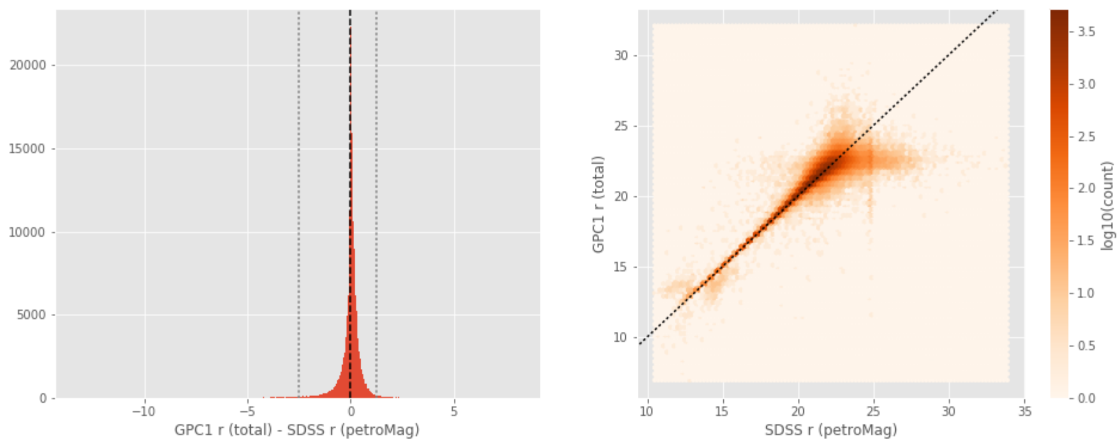
SUPRIME r (total) - SDSS r (petroMag):
- Median: -0.08
- Median Absolute Deviation: 0.17
- 1% percentile: -2.7669961929321287
- 99% percentile: 2.01519500732422



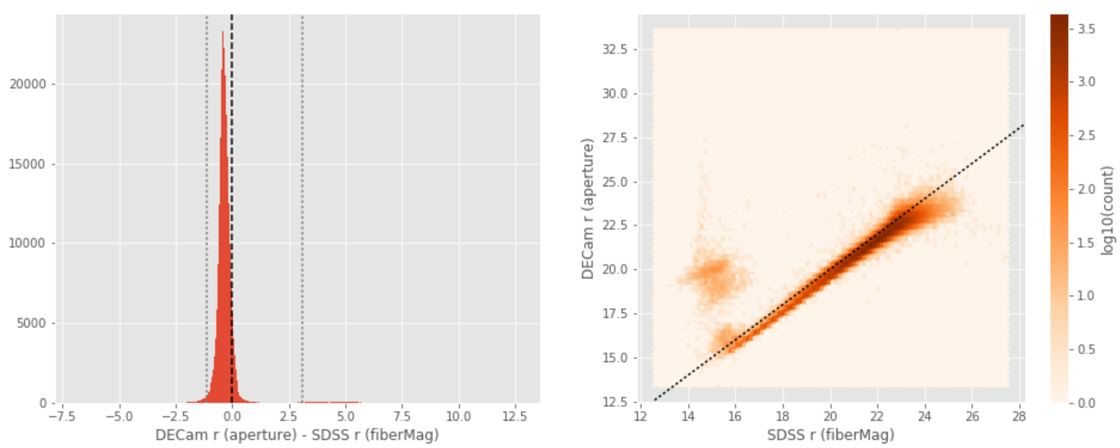
GPC1 r (aperture) - SDSS r (fiberMag):
- Median: -0.43
- Median Absolute Deviation: 0.17
- 1% percentile: -1.6574340057373047
- 99% percentile: 0.9487522697448594



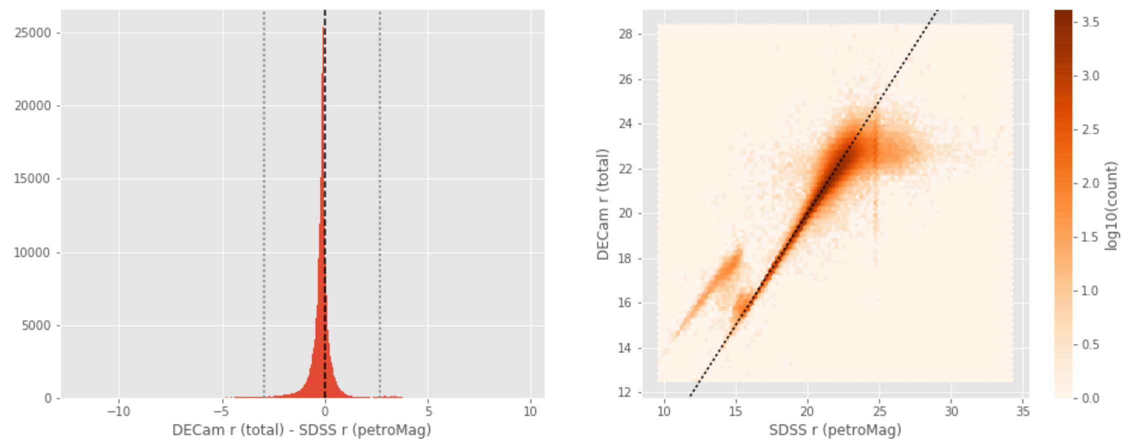
GPC1 r (total) - SDSS r (petroMag):
- Median: 0.04
- Median Absolute Deviation: 0.14
- 1% percentile: -2.530843811035156
- 99% percentile: 1.2362999725341777



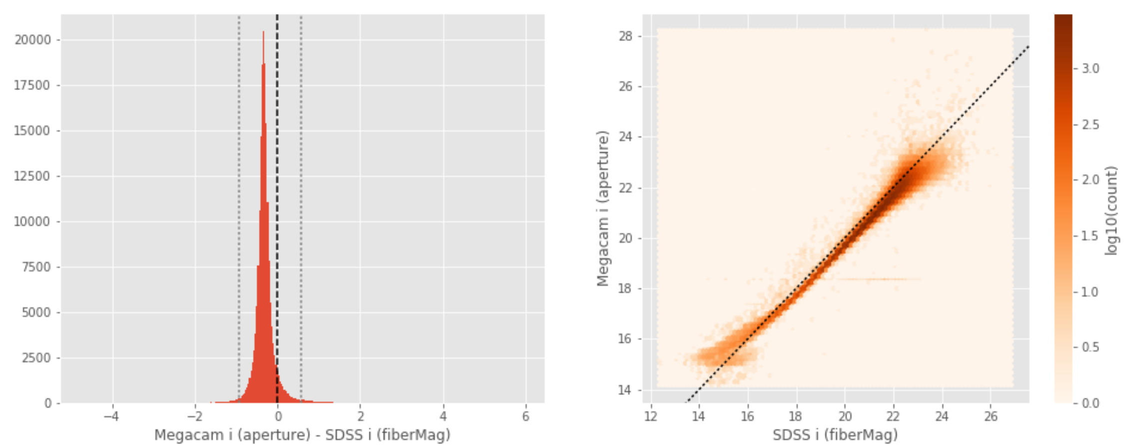
DECam r (aperture) - SDSS r (fiberMag):
- Median: -0.36
- Median Absolute Deviation: 0.15
- 1% percentile: -1.119642448425293
- 99% percentile: 3.1019559001922388



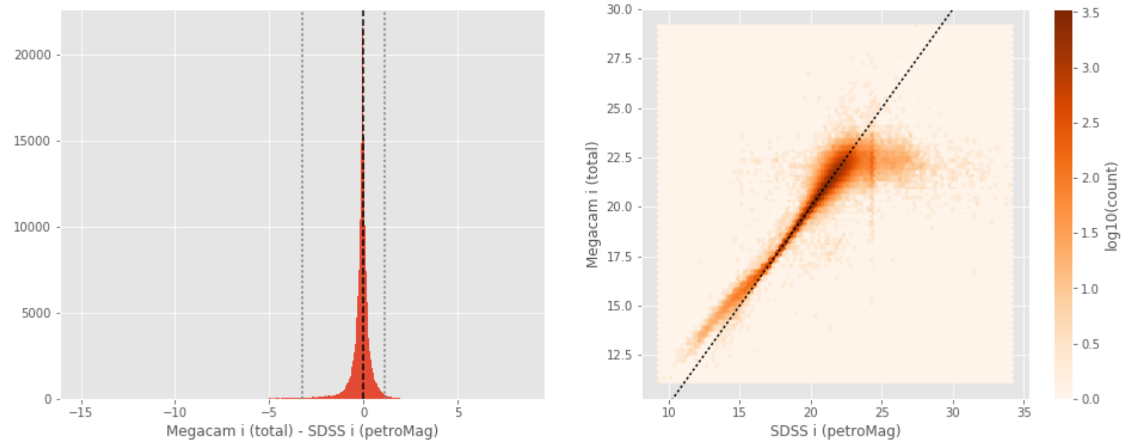
DECam r (total) - SDSS r (petroMag):
- Median: -0.13
- Median Absolute Deviation: 0.15
- 1% percentile: -2.9229142379760744
- 99% percentile: 2.688230495452861



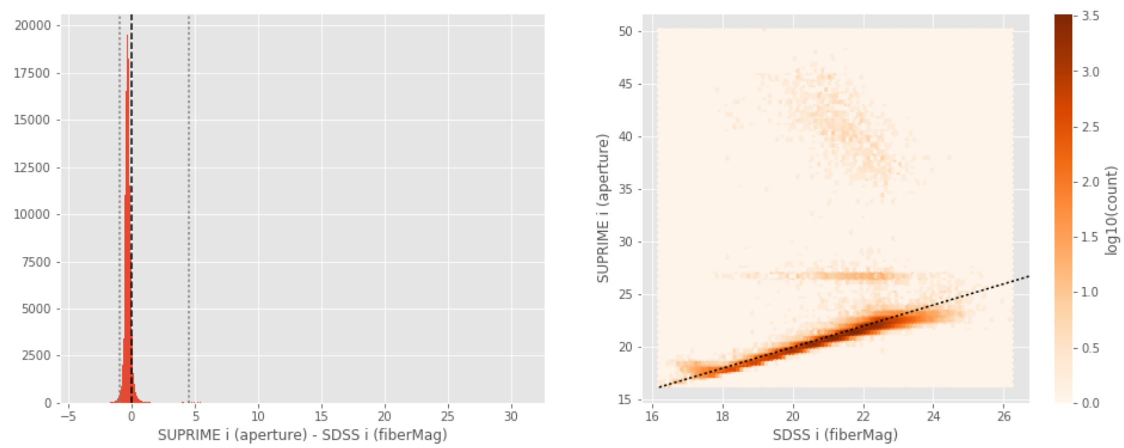

```
Megacam i (aperture) - SDSS i (fiberMag):
- Median: -0.33
- Median Absolute Deviation: 0.09
- 1% percentile: -0.9270371246337892
- 99% percentile: 0.5741112899780275
```



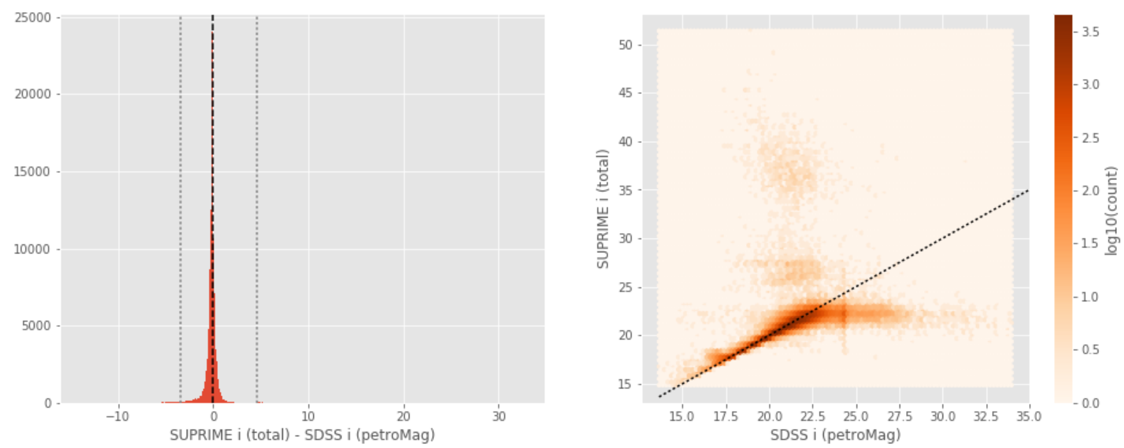

```
Megacam i (total) - SDSS i (petroMag):
- Median: -0.05
- Median Absolute Deviation: 0.15
- 1% percentile: -3.2480274200439454
- 99% percentile: 1.1342208862304668
```



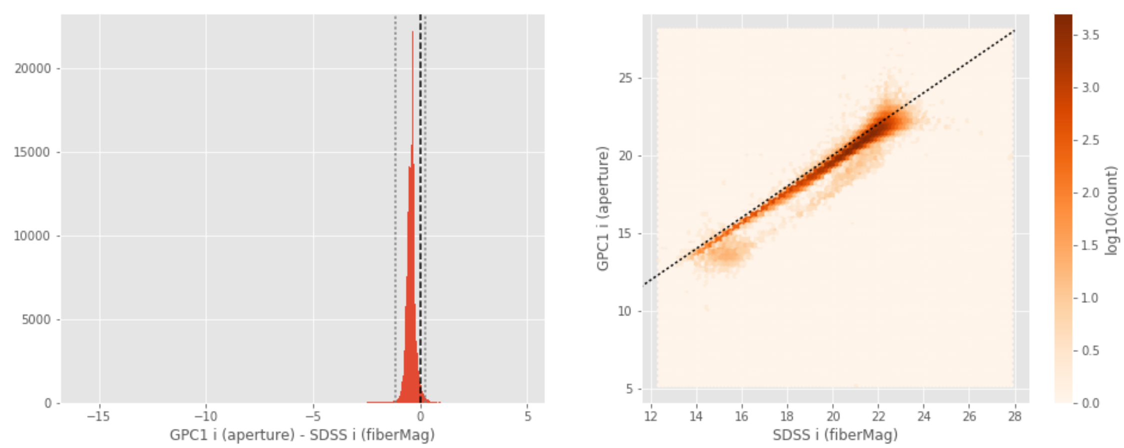
SUPRIME i (aperture) - SDSS i (fiberMag):
- Median: -0.30
- Median Absolute Deviation: 0.13
- 1% percentile: -0.943689136505127
- 99% percentile: 4.505843524932862



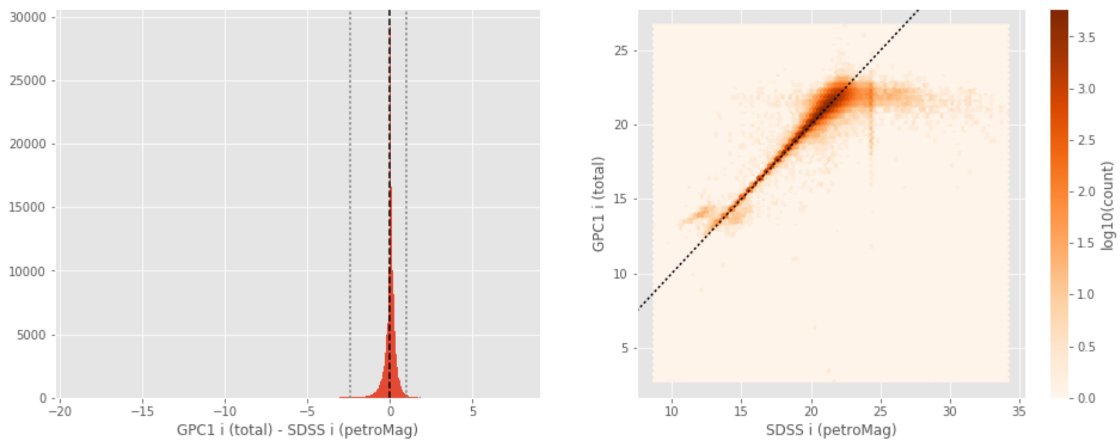
SUPRIME i (total) - SDSS i (petroMag):
- Median: -0.13
- Median Absolute Deviation: 0.17
- 1% percentile: -3.391044464111328
- 99% percentile: 4.58060661315921



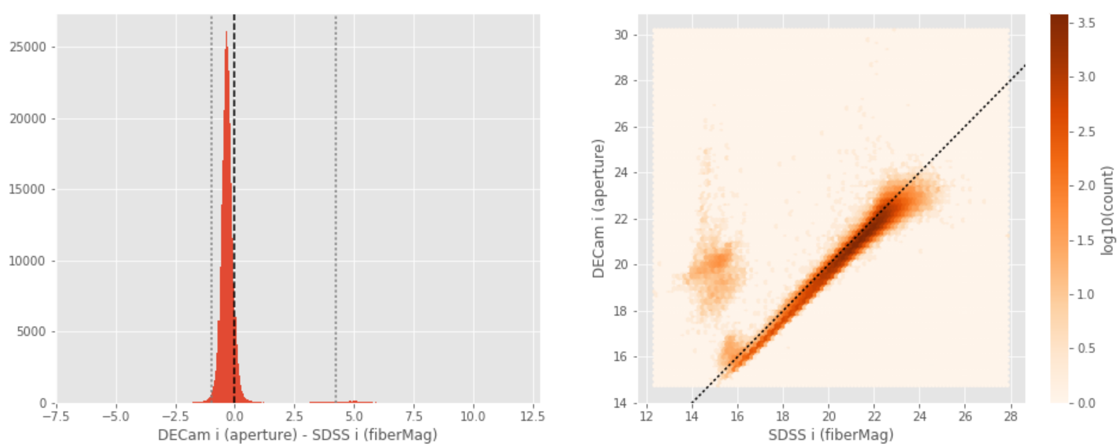
GPC1 i (aperture) - SDSS i (fiberMag):
- Median: -0.41
- Median Absolute Deviation: 0.11
- 1% percentile: -1.1639885711669922
- 99% percentile: 0.26225265502929745



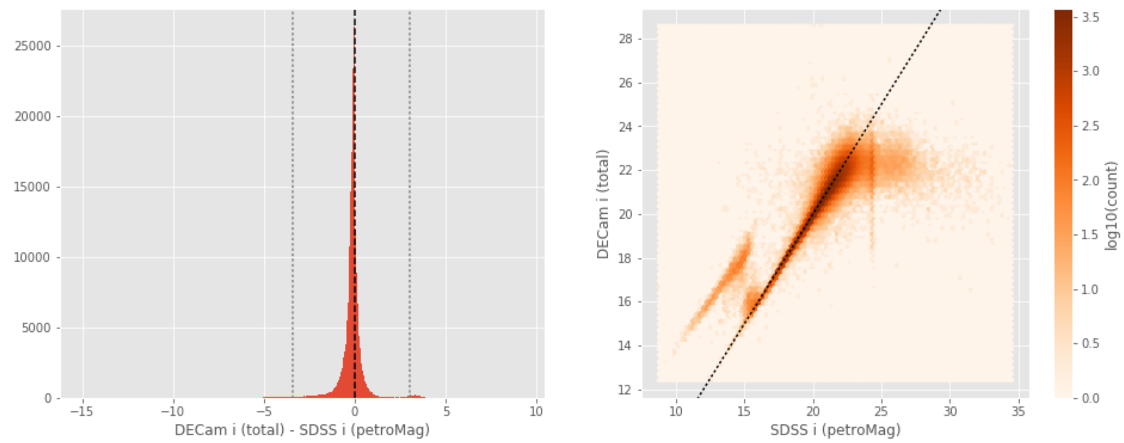
GPC1 i (total) - SDSS i (petroMag):
- Median: 0.04
- Median Absolute Deviation: 0.12
- 1% percentile: -2.395317916870117
- 99% percentile: 0.9681842041015645



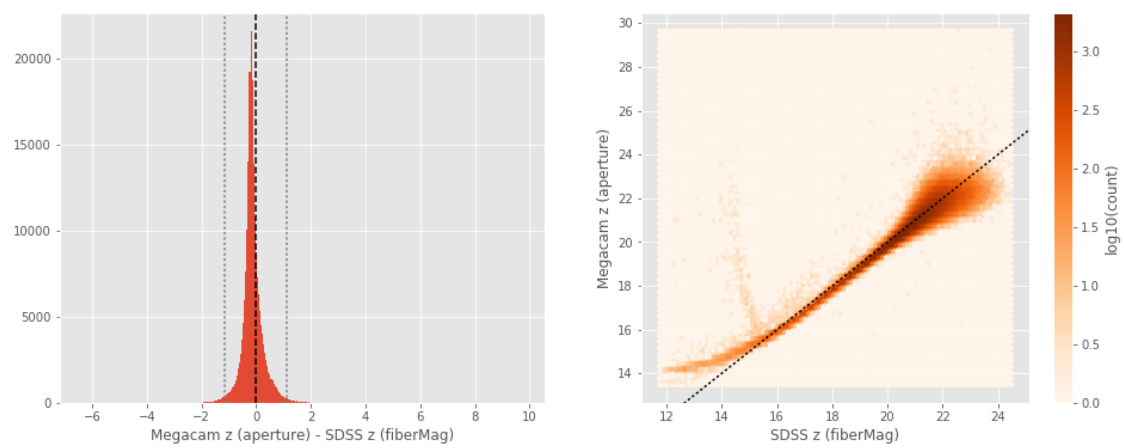
DECam i (aperture) - SDSS i (fiberMag):
- Median: -0.33
- Median Absolute Deviation: 0.15
- 1% percentile: -0.9735076904296875
- 99% percentile: 4.221790027618398



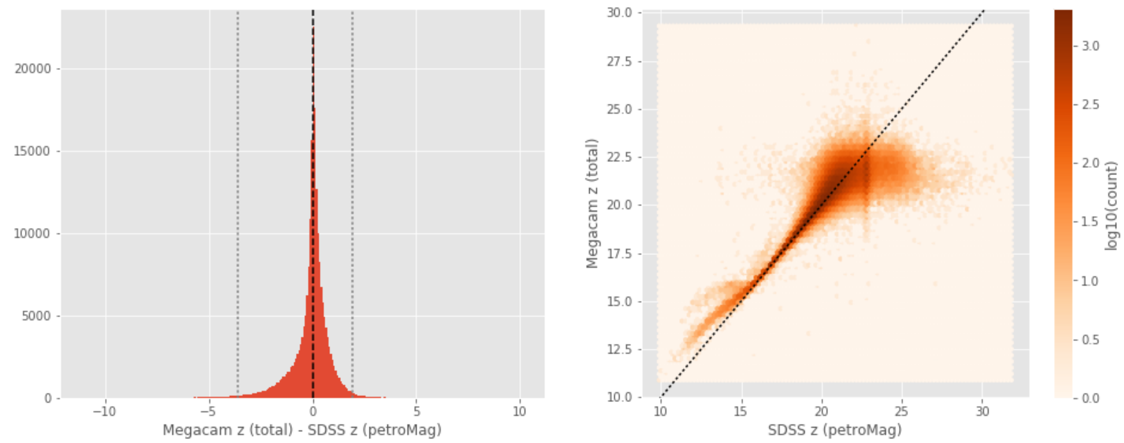
DECam i (total) - SDSS i (petroMag):
- Median: -0.11
- Median Absolute Deviation: 0.16
- 1% percentile: -3.4034982299804692
- 99% percentile: 3.0517770004272413



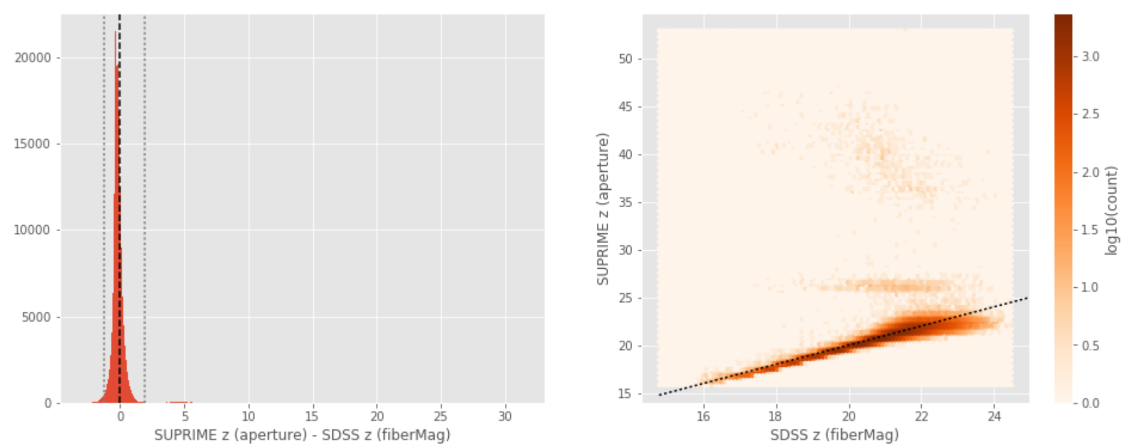
Megacam z (aperture) - SDSS z (fiberMag):
- Median: -0.17
- Median Absolute Deviation: 0.15
- 1% percentile: -1.1774997901916504
- 99% percentile: 1.1188054084777836



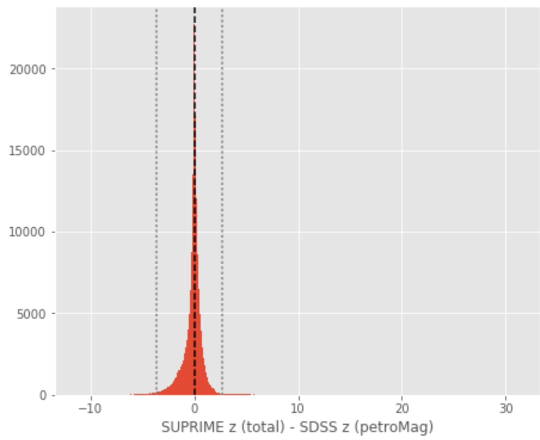
Megacam z (total) - SDSS z (petroMag):
- Median: 0.05
- Median Absolute Deviation: 0.31
- 1% percentile: -3.574903450012207
- 99% percentile: 1.9357566261291472

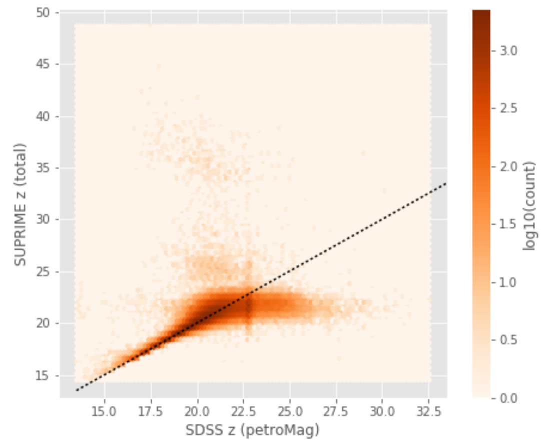


SUPRIME z (aperture) - SDSS z (fiberMag):
- Median: -0.21
- Median Absolute Deviation: 0.19
- 1% percentile: -1.2239848136901856
- 99% percentile: 1.9439543151855416

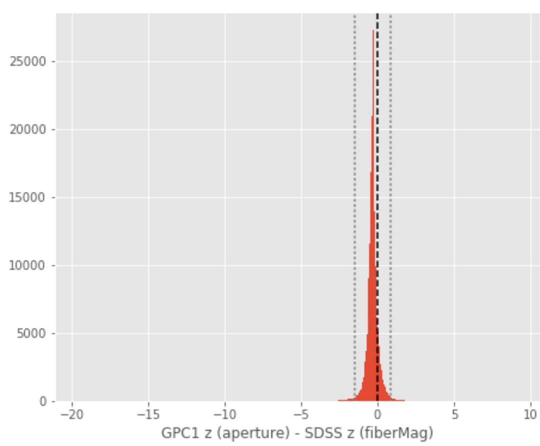


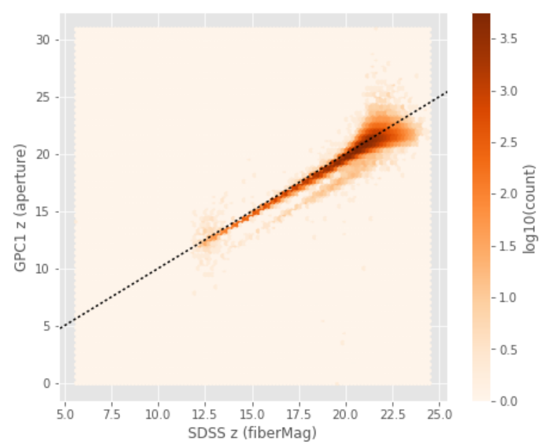
SUPRIME z (total) - SDSS z (petroMag):
- Median: -0.02
- Median Absolute Deviation: 0.32
- 1% percentile: -3.659994201660156
- 99% percentile: 2.711654281616212



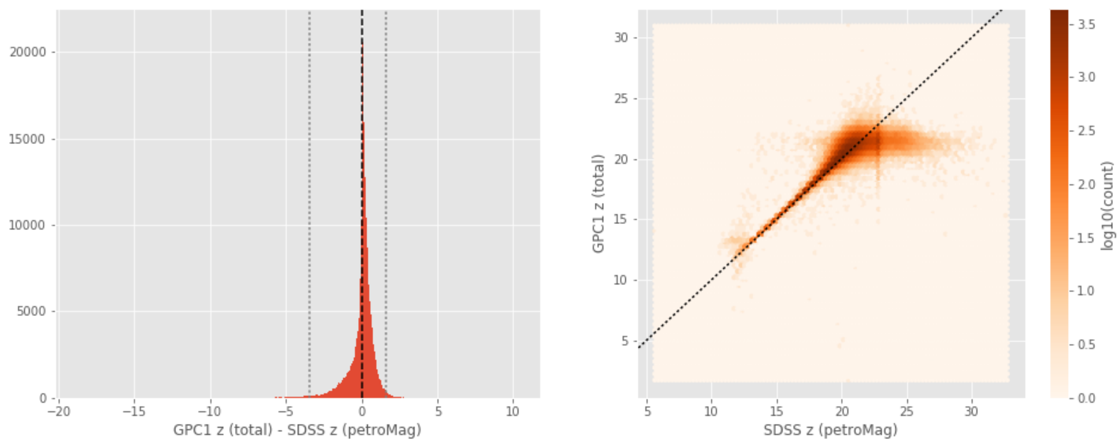


GPC1 z (aperture) - SDSS z (fiberMag):
- Median: -0.31
- Median Absolute Deviation: 0.16
- 1% percentile: -1.5094199180603027
- 99% percentile: 0.8233609199523926

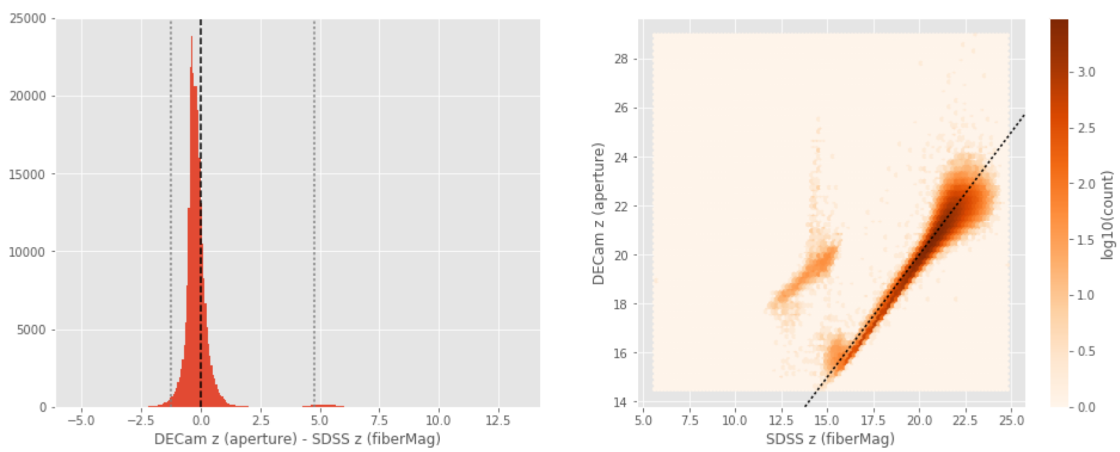




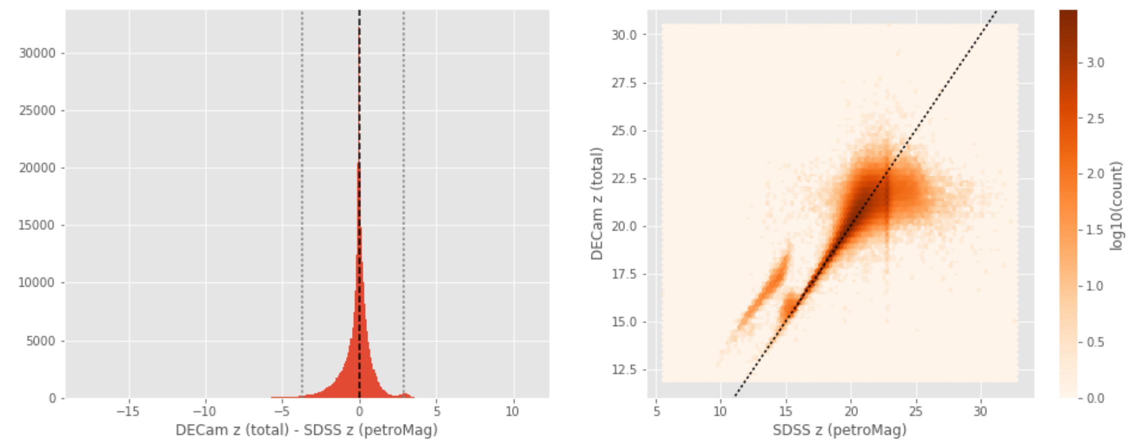
GPC1 z (total) - SDSS z (petroMag):
- Median: 0.12
- Median Absolute Deviation: 0.26
- 1% percentile: -3.4634826660156253
- 99% percentile: 1.6262537765502847



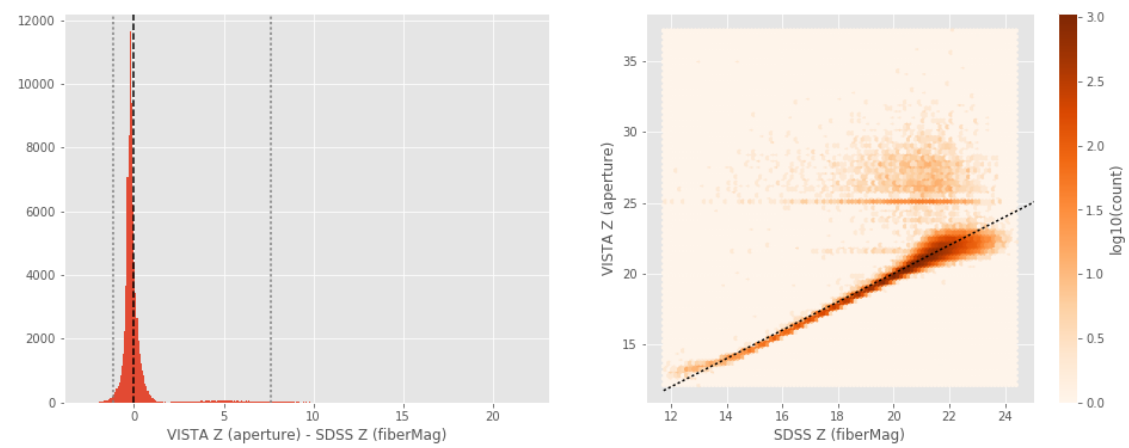
DECam z (aperture) - SDSS z (fiberMag):
- Median: -0.23
- Median Absolute Deviation: 0.20
- 1% percentile: -1.268011703491211
- 99% percentile: 4.757902879714976



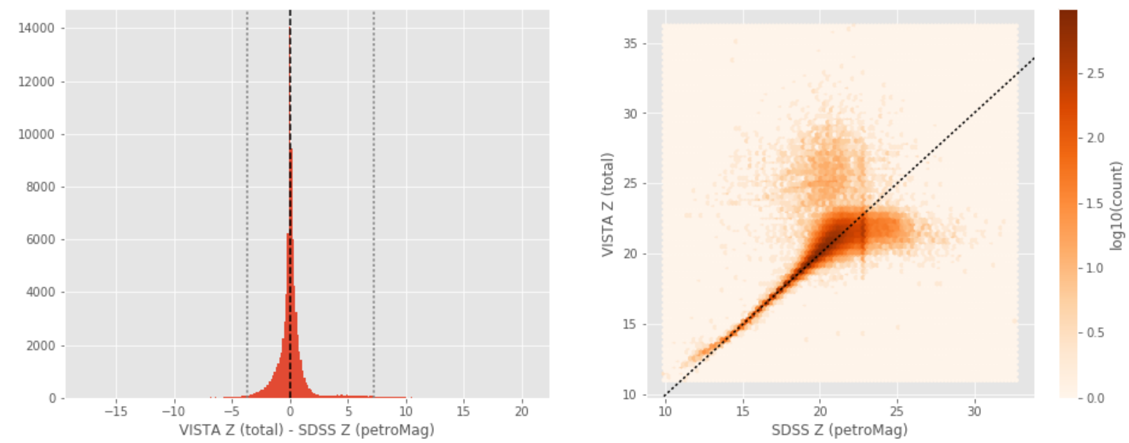
DECam z (total) - SDSS z (petroMag):
- Median: -0.03
- Median Absolute Deviation: 0.32
- 1% percentile: -3.720550765991211
- 99% percentile: 2.8797466278076174



VISTA Z (aperture) - SDSS Z (fiberMag):
- Median: -0.18
- Median Absolute Deviation: 0.17
- 1% percentile: -1.1833677864074708
- 99% percentile: 7.613141555786134



VISTA Z (total) - SDSS Z (petroMag):
- Median: 0.01
- Median Absolute Deviation: 0.34
- 1% percentile: -3.6963905906677246
- 99% percentile: 7.246332988739018



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 UKIDSS total J and K magnitudes to those from 2MASS.

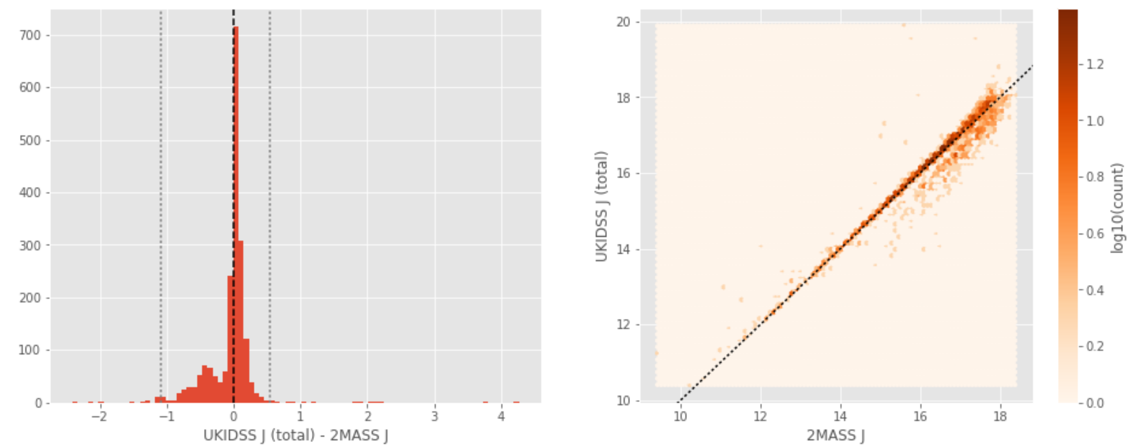
The 2MASS magnitudes are "*Vega-like*" and we have to convert them to AB magnitudes using the zero points provided on this page:

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

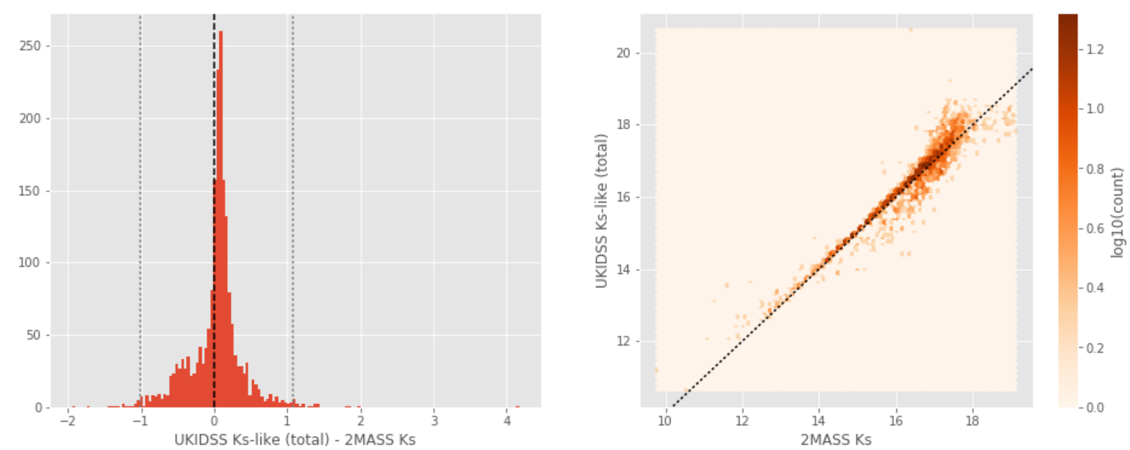
In addition, UKIDSS uses a K band whereas 2MASS uses a Ks ("short") band, this page give a correction to convert the K band in a Ks band with the formula:

$$K_{s(2MASS)} = K_{UKIRT} + 0.003 + 0.004 * (JK)_{UKIRT}$$

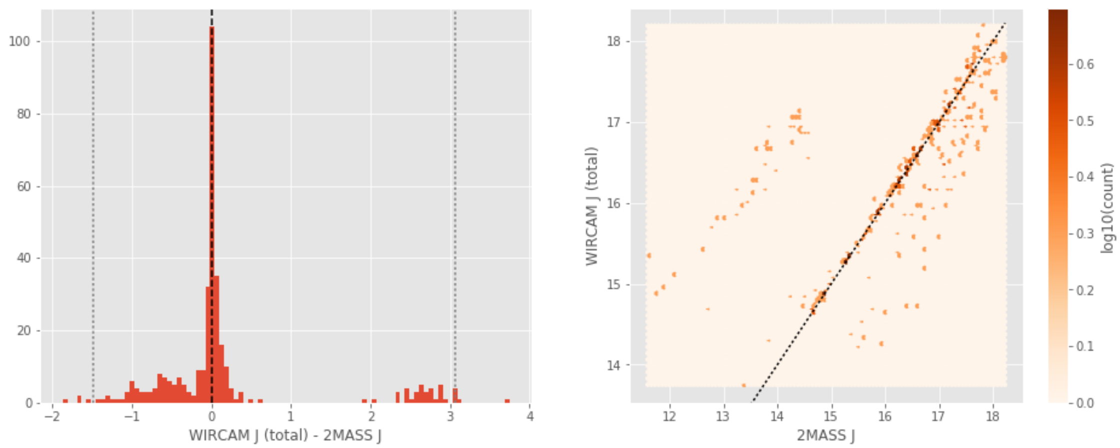
```
UKIDSS J (total) - 2MASS J:
- Median: 0.02
- Median Absolute Deviation: 0.07
- 1% percentile: -1.0931878080655886
- 99% percentile: 0.5409187387178599
```



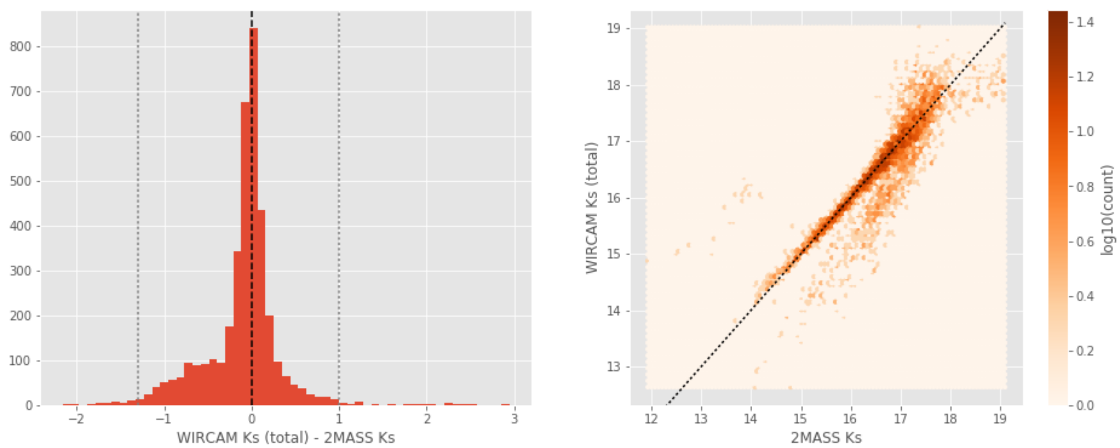
UKIDSS Ks-like (total) - 2MASS Ks:
- Median: 0.07
- Median Absolute Deviation: 0.11
- 1% percentile: -1.0089076529558705
- 99% percentile: 1.0822636930219156



WIRCAM J (total) - 2MASS J:
- Median: -0.00
- Median Absolute Deviation: 0.10
- 1% percentile: -1.4933099580289682
- 99% percentile: 3.0649023654268435




```
WIRCAM Ks (total) - 2MASS Ks:
- Median: -0.03
- Median Absolute Deviation: 0.13
- 1% percentile: -1.3042394424303563
- 99% percentile: 1.0053103998700583
```

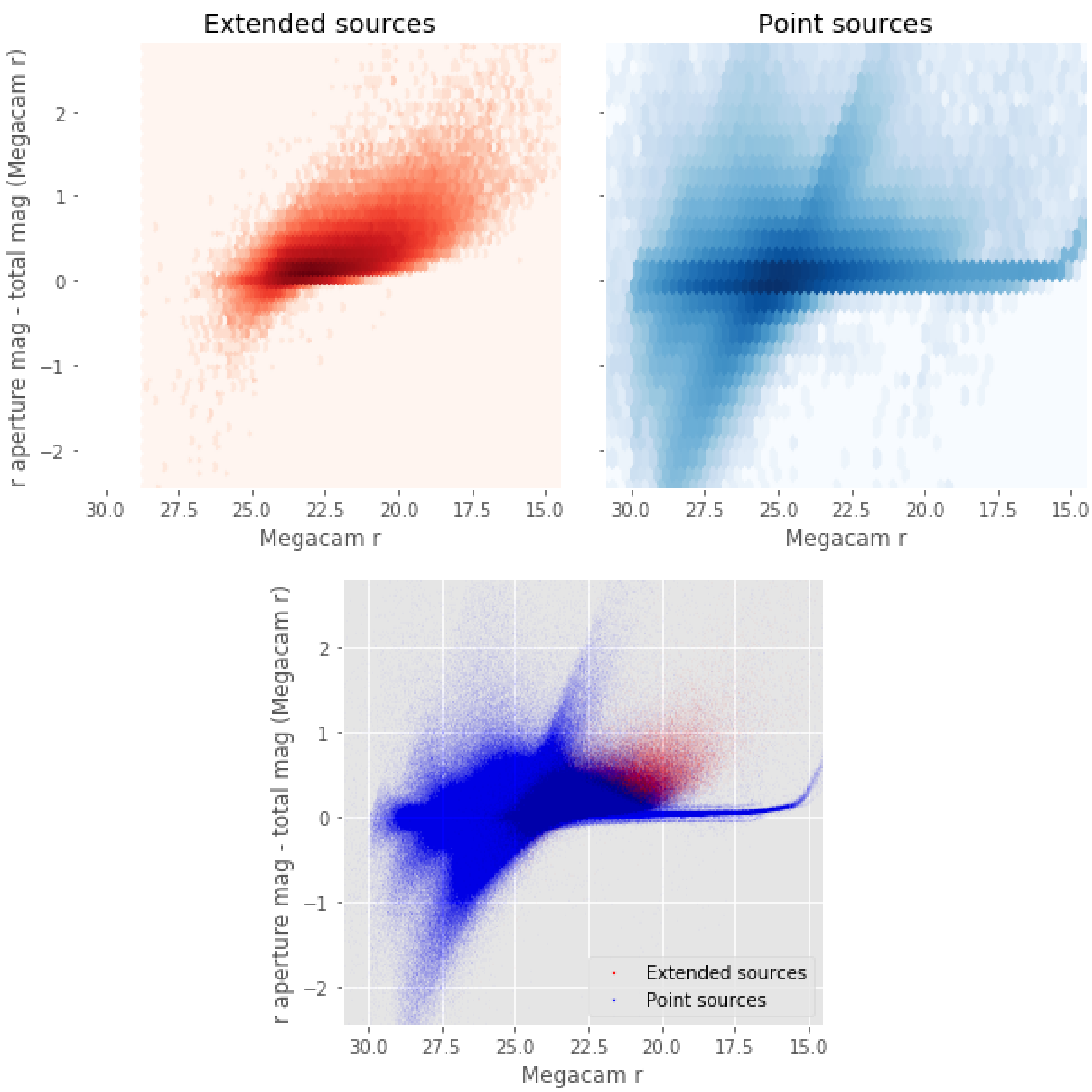


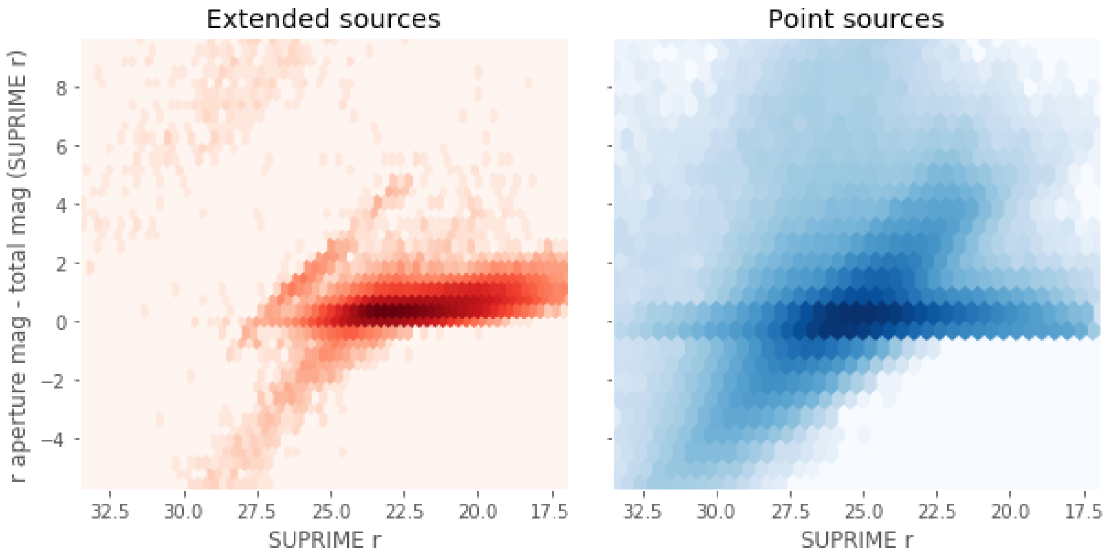
1.6 IV - Comparing aperture magnitudes to total ones.

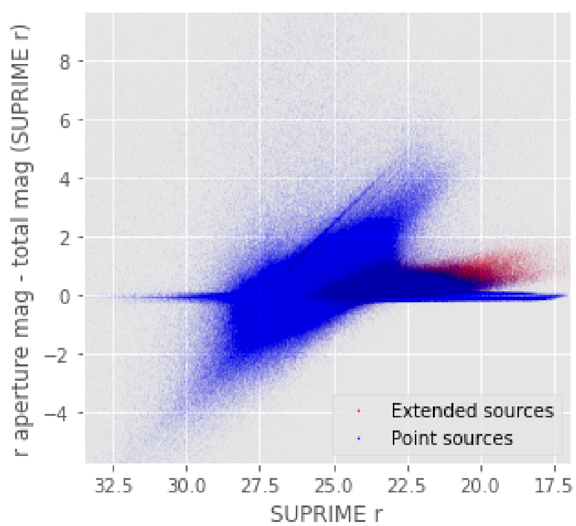
```
Number of source used: 4150670 / 8704751 (47.68%)
```

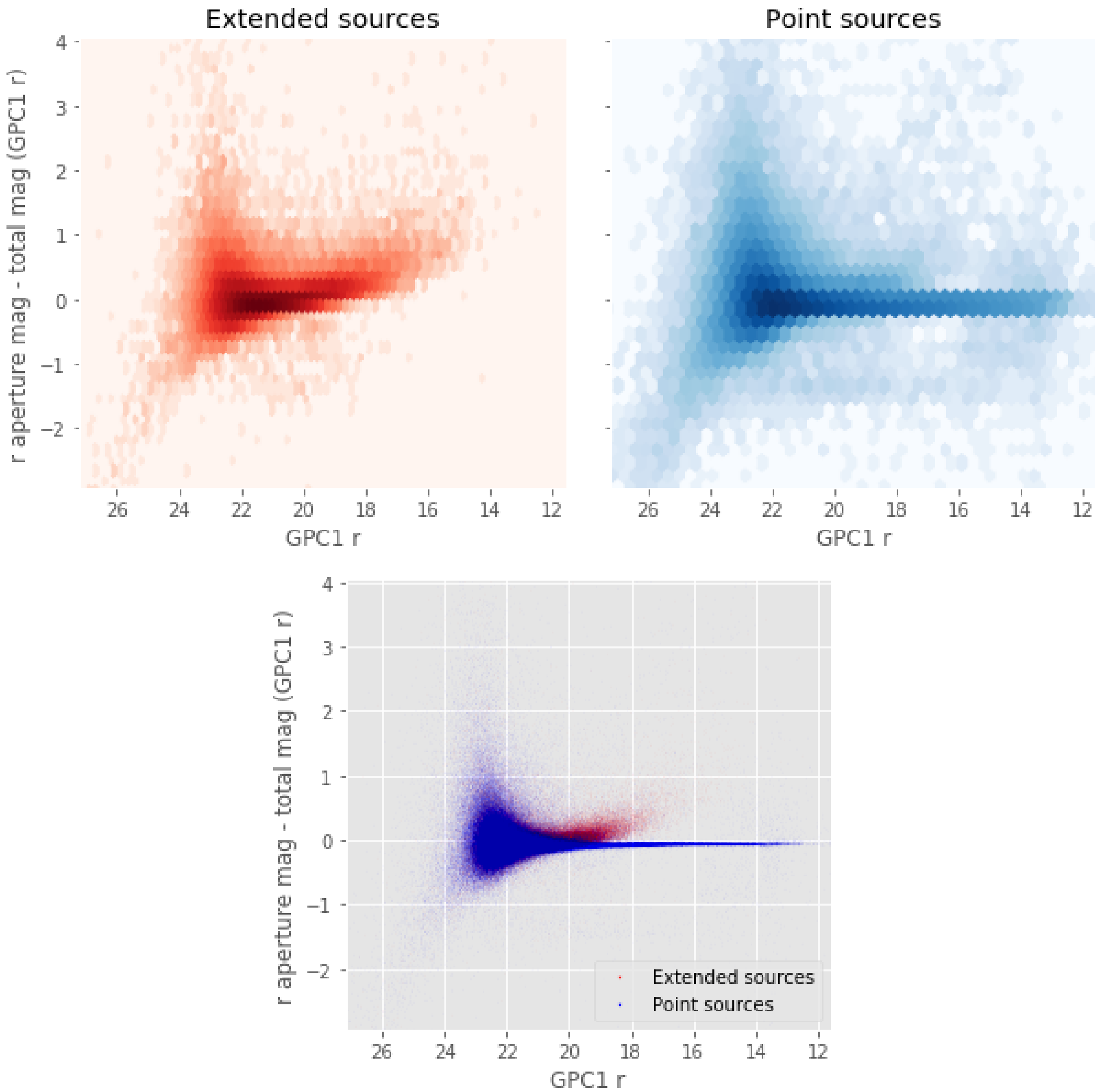
```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:4: R
```

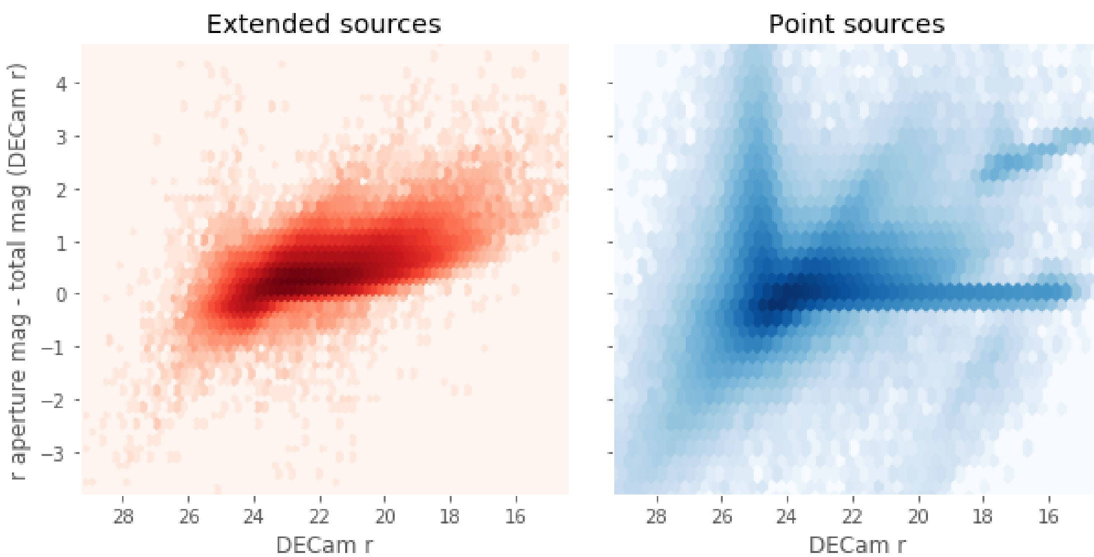
```
Number of source used: 4718862 / 8704751 (54.21%)
Number of source used: 373246 / 8704751 (4.29%)
Number of source used: 1911606 / 8704751 (21.96%)
```

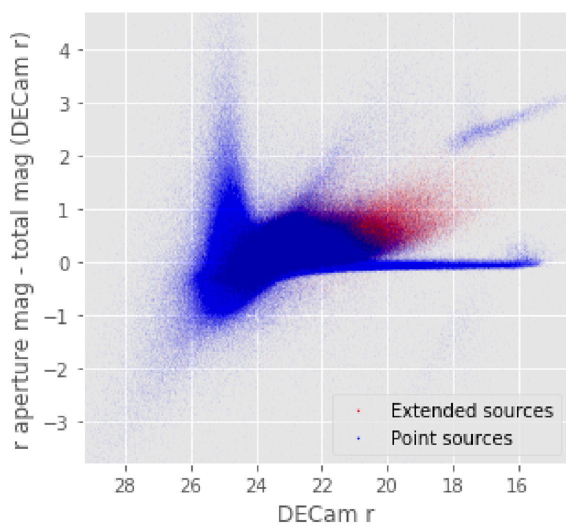



Extended sources
Point sources
r aperture mag - total mag (SUPRIME r)
SUPRIME r
SUPRIME r


r aperture mag - total mag (SUPRIME r)
SUPRIME r
Extended sources
Point sources


Extended sources
Point sources
r aperture mag - total mag (GPC1 r)
GPC1 r
Extended sources
Point sources

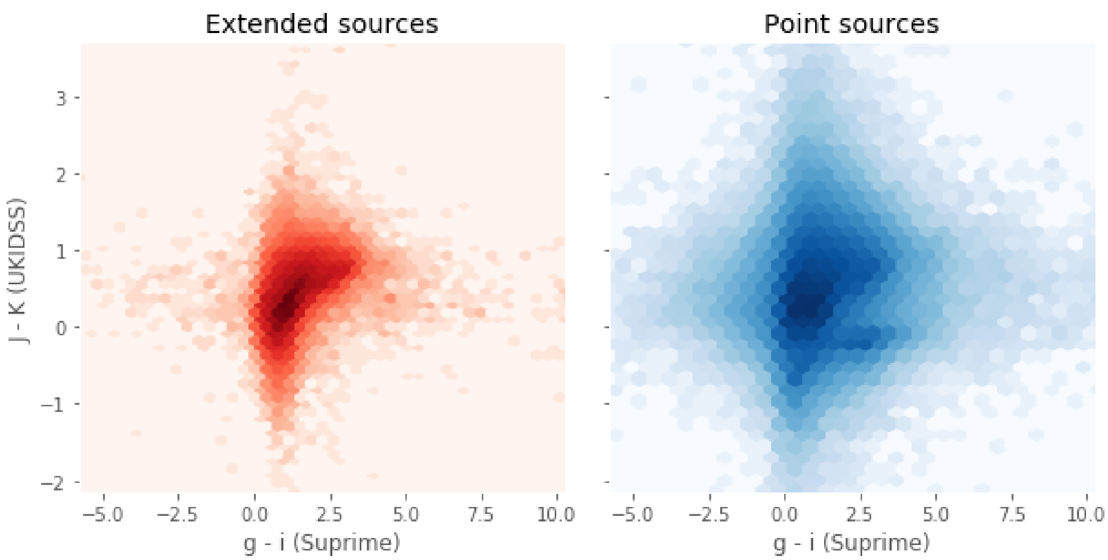


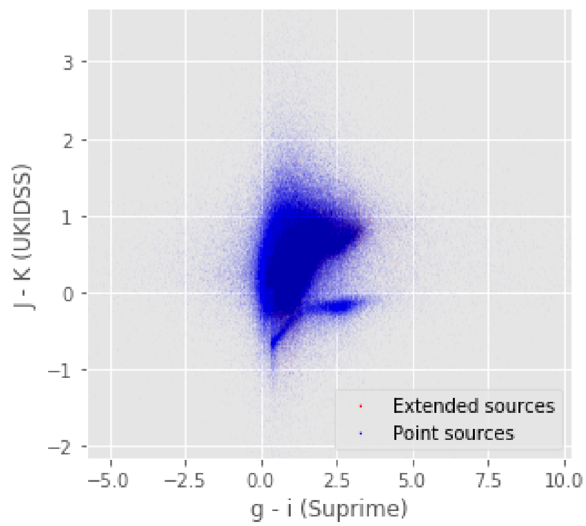


1.7 V - Color-color and magnitude-color plots

```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:2: R
  from ipykernel import kernelapp as app
```

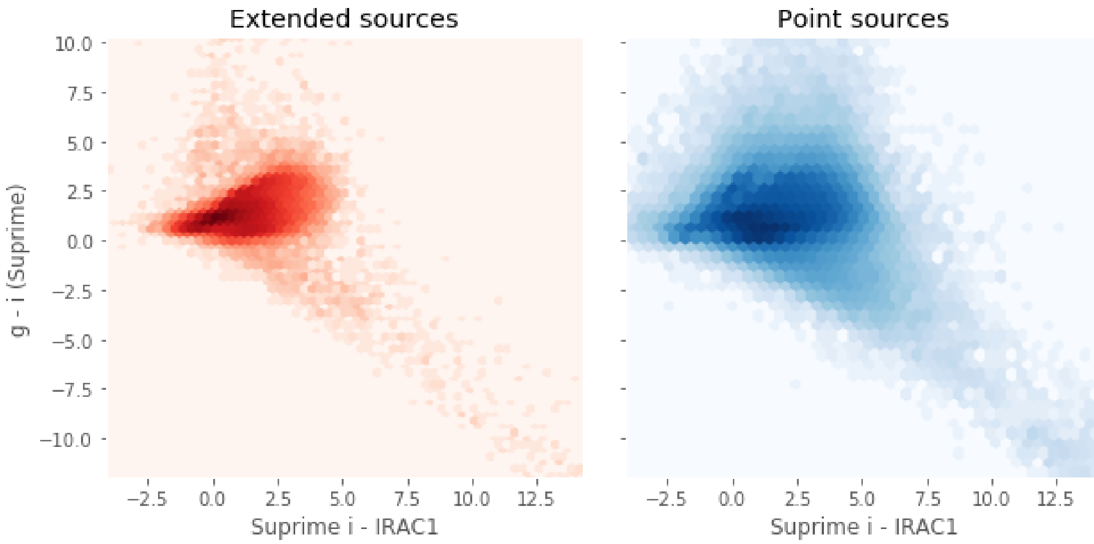
```
Number of source used: 400163 / 8704751 (4.60%)
```

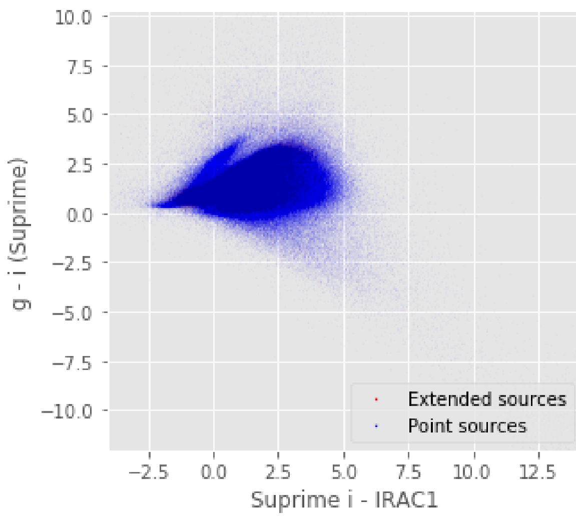




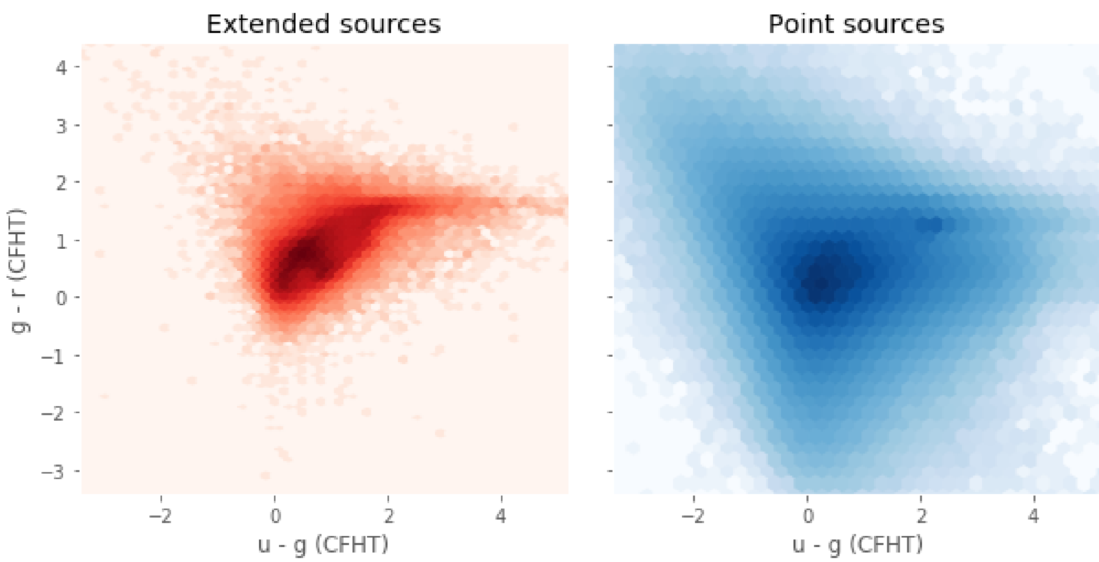

```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:3: R
  app.launch_new_instance()
```

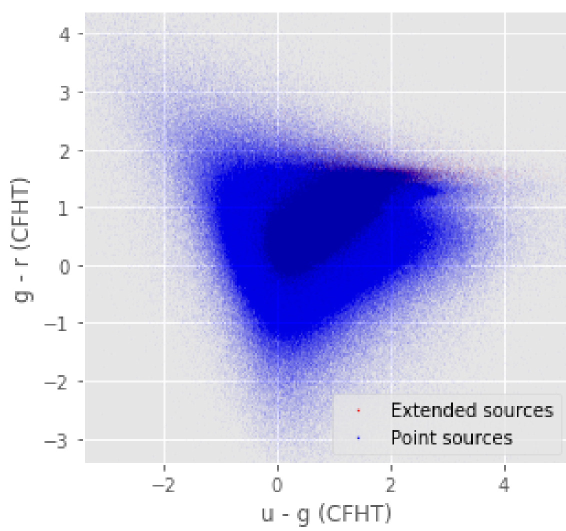
```
Number of source used: 726028 / 8704751 (8.34%)
```



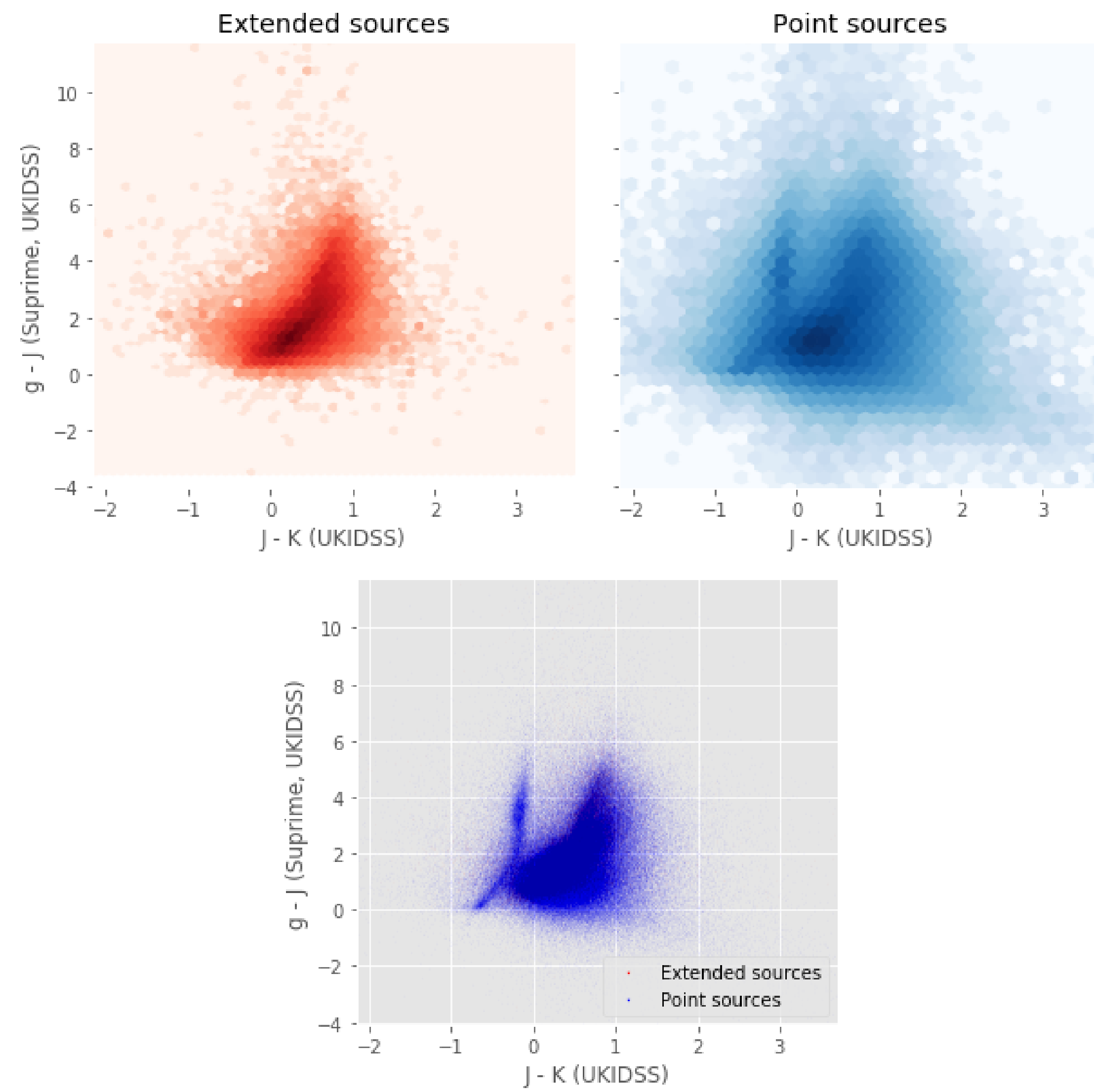



```
Number of source used: 3640711 / 8704751 (41.82%)
```



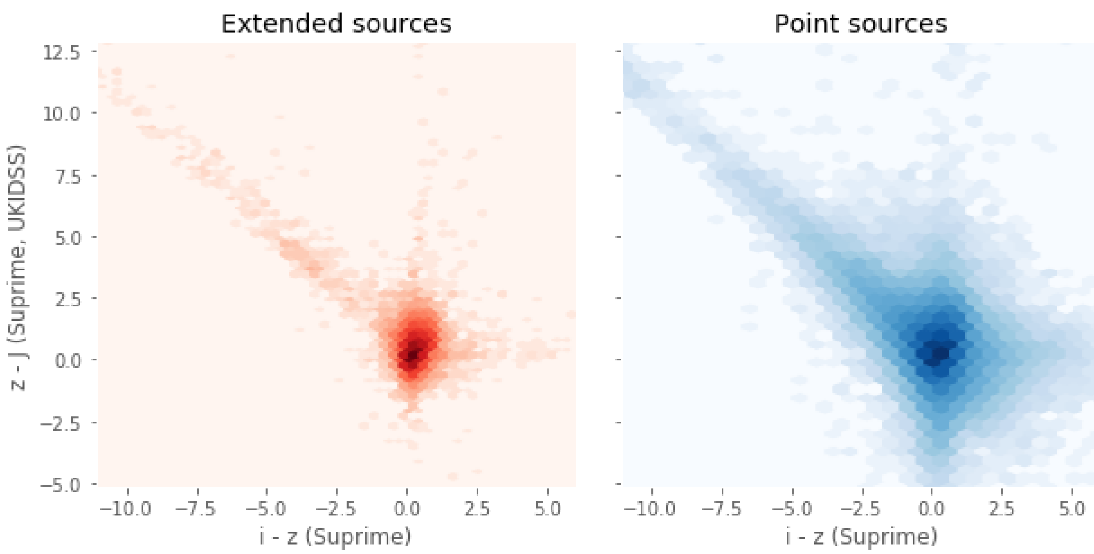


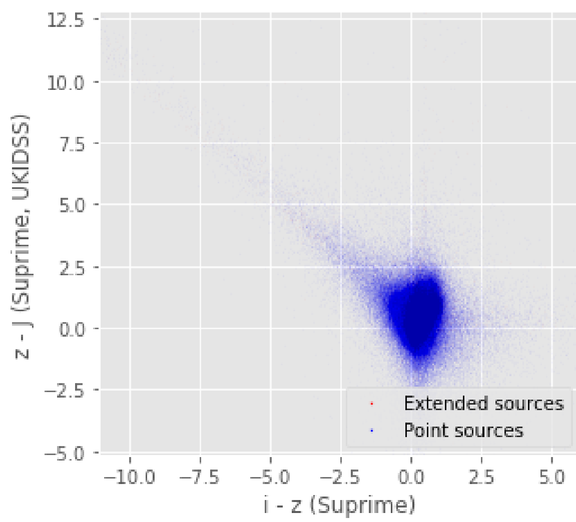
Number of source used: 403445 / 8704751 (4.63%)




```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:2: R
  from ipykernel import kernelapp as app
```

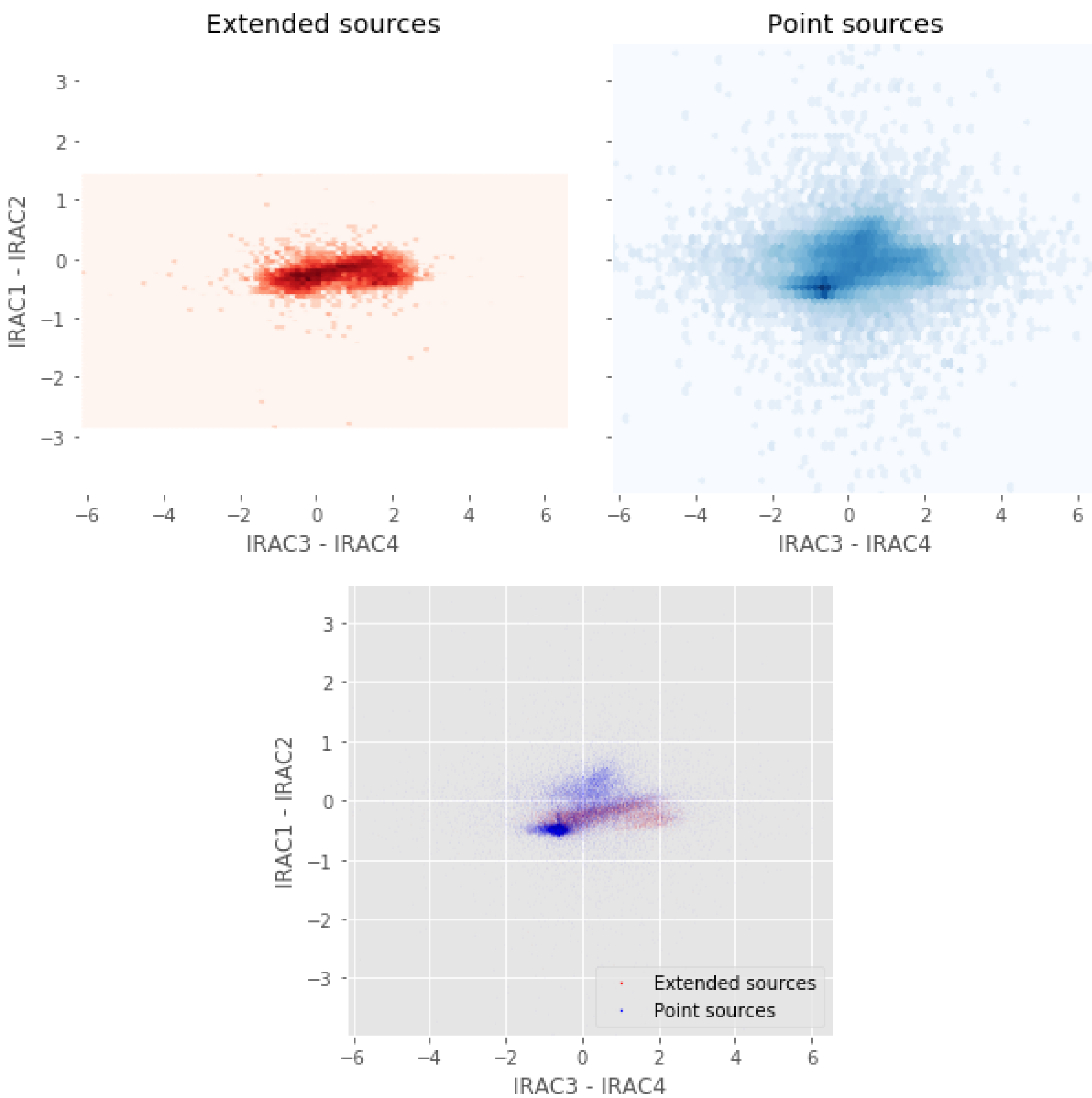
```
Number of source used: 426099 / 8704751 (4.90%)
```






```
/opt/anaconda3/envs/herschelhelp_internal/lib/python3.6/site-packages/ipykernel/__main__.py:3: R
  app.launch_new_instance()
```

```
Number of source used: 35564 / 8704751 (0.41%)
```


Extended sources
Point sources
IRAC1 - IRAC2
IRAC3 - IRAC4
3
2
1
0
−1
−2
−3
−6
−4
−2
0
2
4
6
Extended sources
Point sources

4_Selection_function

March 8, 2018

1 XMM-LSS Selection Functions

1.1 Depth maps and selection functions

The simplest selection function available is the field MOC which specifies the area for which there is Herschel data. Each pristine catalogue also has a MOC defining the area for which that data is available.

The next stage is to provide mean flux standard deviations which act as a proxy for the catalogue's 5σ depth

```
This notebook was run with herschelhelp_internal version:
0246c5d (Thu Jan 25 17:01:47 2018 +0000) [with local modifications]
This notebook was executed on:
2018-02-28 00:49:12.570461
```

```
Depth maps produced using: master_catalogue_xmm-lss_20180221.fits
```

1.2 I - Group masterlist objects by healpix cell and calculate depths

We add a column to the masterlist catalogue for the target order healpix cell per object.

1.3 II Create a table of all Order=13 healpix cells in the field and populate it

We create a table with every order=13 healpix cell in the field MOC. We then calculate the healpix cell at lower order that the order=13 cell is in. We then fill in the depth at every order=13 cell as calculated for the lower order cell that that the order=13 cell is inside.

```
Out[9]: <IPython.core.display.HTML object>
```

```
Out[11]: <IPython.core.display.HTML object>
```

```
Out[12]: <IPython.core.display.HTML object>
```

1.4 III - Save the depth map table

1.5 IV - Overview plots

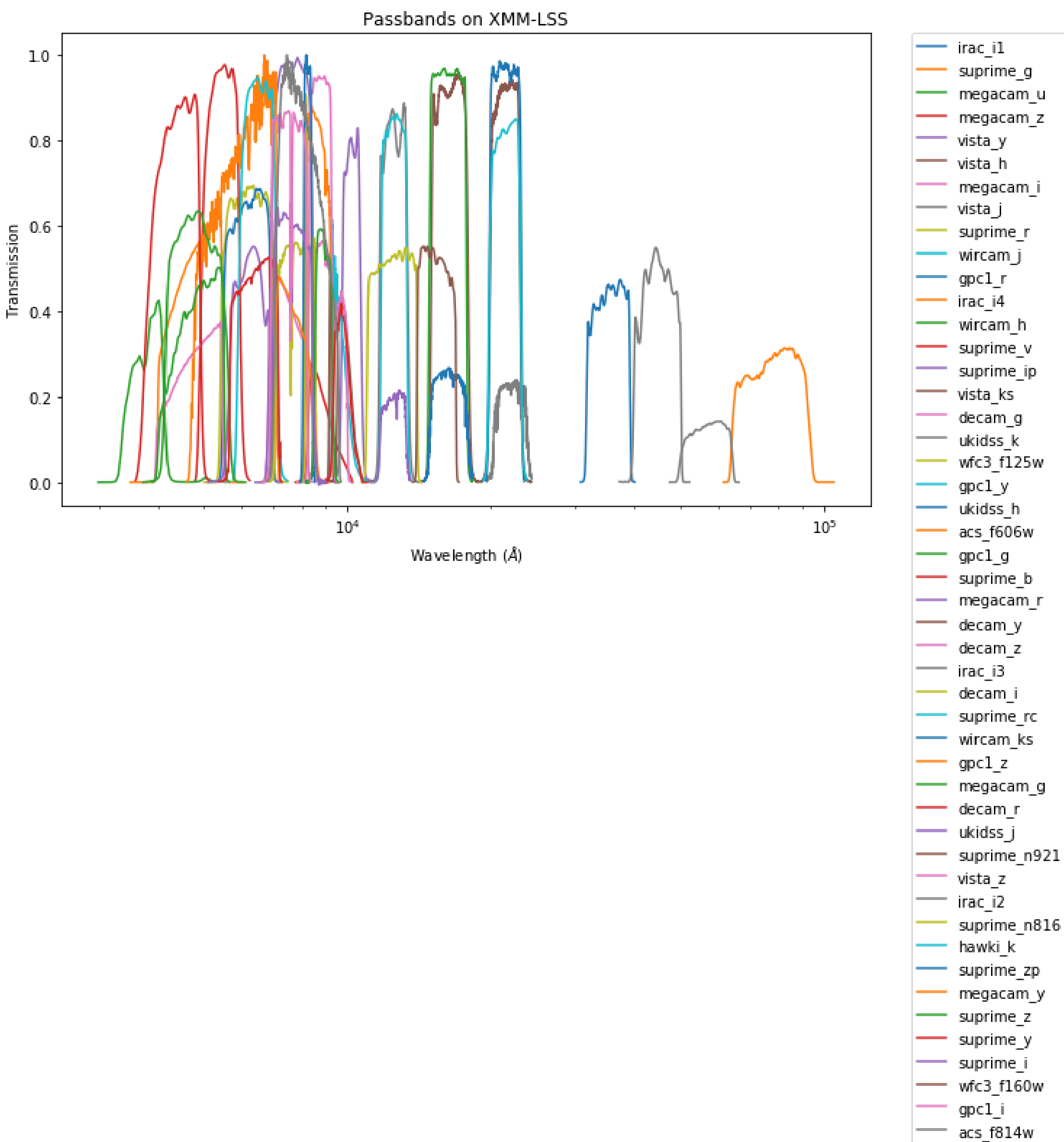
1.5.1 IV.a - Filters

First we simply plot all the filters available on this field to give an overview of coverage.

```
Out[14]: {'acs_f606w',
          'acs_f814w',
          'decam_g',
          'decam_i',
          'decam_r',
          'decam_y',
          'decam_z',
          'gpc1_g',
          'gpc1_i',
          'gpc1_r',
          'gpc1_y',
          'gpc1_z',
          'hawki_k',
          'irac_i1',
          'irac_i2',
          'irac_i3',
          'irac_i4',
          'megacam_g',
          'megacam_i',
          'megacam_r',
          'megacam_u',
          'megacam_y',
          'megacam_z',
          'suprime_b',
          'suprime_g',
          'suprime_i',
          'suprime_ip',
          'suprime_n816',
          'suprime_n921',
          'suprime_r',
          'suprime_rc',
          'suprime_v',
          'suprime_y',
          'suprime_z',
          'suprime_zp',
          'ukidss_h',
          'ukidss_j',
          'ukidss_k',
          'vista_h',
          'vista_j',
          'vista_ks',
```

```
'vista_y',
'vista_z',
'wfc3_f125w',
'wfc3_f160w',
'wircam_h',
'wircam_j',
'wircam_ks'}
```

```
Out[15]: <matplotlib.text.Text at 0x7f02ed82df28>
```



1.5.2 IV.a - Depth overview

Then we plot the mean depths available across the area a given band is available

```
acs_f606w: mean flux error: 0.03692979521501443, 3sigma in AB mag (Aperture): 26.288754614736526
acs_f814w: mean flux error: 0.04123826041554609, 3sigma in AB mag (Aperture): 26.168946021130417
wfc3_f125w: mean flux error: 0.056718056593746666, 3sigma in AB mag (Aperture): 25.8228935091504
wfc3_f160w: mean flux error: 0.05377904756057176, 3sigma in AB mag (Aperture): 25.88066409695283
wircam_j: mean flux error: 0.13655678485308673, 3sigma in AB mag (Aperture): 24.86891365563553
wircam_h: mean flux error: 0.19576976594174827, 3sigma in AB mag (Aperture): 24.477832809223123
wircam_ks: mean flux error: 0.1798913201198185, 3sigma in AB mag (Aperture): 24.569671341093333
suprime_b: mean flux error: 0.0027978256516699987, 3sigma in AB mag (Aperture): 29.0901452440629
suprime_v: mean flux error: 0.004022897010205734, 3sigma in AB mag (Aperture): 28.69584957724365
suprime_rc: mean flux error: 0.004608231248651188, 3sigma in AB mag (Aperture): 28.5483612017608
suprime_ip: mean flux error: 0.00487398365441117, 3sigma in AB mag (Aperture): 28.48748669224185
suprime_zp: mean flux error: 0.011937951532295495, 3sigma in AB mag (Aperture): 27.5148723348573
megacam_u: mean flux error: 0.04313484289960267, 3sigma in AB mag (Aperture): 26.12012631159319
megacam_g: mean flux error: 0.03200225178382337, 3sigma in AB mag (Aperture): 26.444245518738377
megacam_r: mean flux error: 0.0566098180885274, 3sigma in AB mag (Aperture): 25.824967464916917
megacam_i: mean flux error: 0.09472815276420636, 3sigma in AB mag (Aperture): 25.26599919200938
megacam_z: mean flux error: 0.17113277116211503, 3sigma in AB mag (Aperture): 24.623863905799418
megacam_y: mean flux error: 0.025984041836505836, 3sigma in AB mag (Aperture): 26.67043009616957
decam_i: mean flux error: 0.23982591961296398, 3sigma in AB mag (Aperture): 24.257456567080204
decam_y: mean flux error: 1.501875442615403, 3sigma in AB mag (Aperture): 22.265612072855212
decam_g: mean flux error: 0.09556131641469269, 3sigma in AB mag (Aperture): 25.256491553733035
decam_r: mean flux error: 0.11856658278981028, 3sigma in AB mag (Aperture): 25.022291105111215
decam_z: mean flux error: 0.3750435715395243, 3sigma in AB mag (Aperture): 23.771992548681972
irac_i3: mean flux error: 6.6325316127319605, 3sigma in AB mag (Aperture): 20.652998541592318
irac_i4: mean flux error: 6.860851274114714, 3sigma in AB mag (Aperture): 20.616251850641753
irac_i1: mean flux error: 0.8203037464007862, 3sigma in AB mag (Aperture): 22.922260125657466
irac_i2: mean flux error: 0.9884778368871704, 3sigma in AB mag (Aperture): 22.719779522590805
suprime_n921: mean flux error: inf, 3sigma in AB mag (Aperture): -inf
suprime_n816: mean flux error: inf, 3sigma in AB mag (Aperture): -inf
suprime_g: mean flux error: inf, 3sigma in AB mag (Aperture): -inf
suprime_r: mean flux error: inf, 3sigma in AB mag (Aperture): -inf
suprime_i: mean flux error: inf, 3sigma in AB mag (Aperture): -inf
suprime_z: mean flux error: 0.08763867287990093, 3sigma in AB mag (Aperture): 25.350457382253133
suprime_y: mean flux error: inf, 3sigma in AB mag (Aperture): -inf
gpc1_g: mean flux error: 7395.972953279289, 3sigma in AB mag (Aperture): 13.03470857746131
gpc1_r: mean flux error: 4060.6169625861476, 3sigma in AB mag (Aperture): 13.685716801985528
gpc1_i: mean flux error: 10560.790126131738, 3sigma in AB mag (Aperture): 12.647955833193556
gpc1_z: mean flux error: 64703.003754379766, 3sigma in AB mag (Aperture): 10.679885756441323
gpc1_y: mean flux error: 1166618.1787697275, 3sigma in AB mag (Aperture): 7.539875014403641
ukidss_j: mean flux error: 0.5733349880793455, 3sigma in AB mag (Aperture): 23.311175749100208
ukidss_k: mean flux error: 0.5498752707057964, 3sigma in AB mag (Aperture): 23.356536391226136
ukidss_h: mean flux error: 0.09734060653288552, 3sigma in AB mag (Aperture): 25.236461743148972
vista_y: mean flux error: 30.51731341982688, 3sigma in AB mag (Aperture): 18.995831118163856
vista_j: mean flux error: 16.445693937755426, 3sigma in AB mag (Aperture): 19.667066354275995
vista_h: mean flux error: 24.554497892416, 3sigma in AB mag (Aperture): 19.231869218699735
```

```
vista_ks: mean flux error: 32.95189802720365, 3sigma in AB mag (Aperture): 18.912495775739153
vista_z: mean flux error: 15.475866587843816, 3sigma in AB mag (Aperture): 19.733059420298197
acs_f606w: mean flux error: 0.02204410235849068, 3sigma in AB mag (Total): 26.848965815851948
acs_f814w: mean flux error: 0.02434285858178763, 3sigma in AB mag (Total): 26.741267922980832
wfc3_f125w: mean flux error: 0.03433806987877893, 3sigma in AB mag (Total): 26.36775716296983
wfc3_f160w: mean flux error: 0.03582830724376341, 3sigma in AB mag (Total): 26.32163113863117
suprime_b: mean flux error: 0.003995076422492452, 3sigma in AB mag (Total): 28.70338413464571
suprime_v: mean flux error: 0.005362450380377634, 3sigma in AB mag (Total): 28.383788646665458
suprime_rc: mean flux error: 0.006435282549135992, 3sigma in AB mag (Total): 28.185777813446087
suprime_ip: mean flux error: 0.006874485301605927, 3sigma in AB mag (Total): 28.114096393868785
suprime_zp: mean flux error: 0.015243460697671306, 3sigma in AB mag (Total): 27.249487924812335
hawki_k: mean flux error: -1.4173159688104233, 3sigma in AB mag (Total): nan
wircam_j: mean flux error: 0.22339072772792126, 3sigma in AB mag (Total): 24.334534005935943
wircam_h: mean flux error: 0.3183679477423727, 3sigma in AB mag (Total): 23.949873518452215
wircam_ks: mean flux error: 0.8541589271863473, 3sigma in AB mag (Total): 22.878350152583373
megacam_u: mean flux error: 0.05516615175559l024, 3sigma in AB mag (Total): 25.853015138742528
megacam_g: mean flux error: 0.0438785461188276, 3sigma in AB mag (Total): 26.101566290364794
megacam_r: mean flux error: 0.07635727551734181, 3sigma in AB mag (Total): 25.500070803056452
megacam_i: mean flux error: 0.1263595951144977, 3sigma in AB mag (Total): 24.95317629906355
megacam_z: mean flux error: 0.22280919111862385, 3sigma in AB mag (Total): 24.337364108237345
megacam_y: mean flux error: 0.0737065278764846, 3sigma in AB mag (Total): 25.538431980215726
decam_i: mean flux error: 0.40085751869047304, 3sigma in AB mag (Total): 23.69972177854782
decam_y: mean flux error: 2.411953652604469, 3sigma in AB mag (Total): 21.751274467519274
decam_g: mean flux error: 0.1738593118200814, 3sigma in AB mag (Total): 24.60670197259288
decam_r: mean flux error: 0.2869334718081514, 3sigma in AB mag (Total): 24.062743830215048
decam_z: mean flux error: 8.270440386245802, 3sigma in AB mag (Total): 20.41337527425771
irac_i3: mean flux error: 6.584783264161411, 3sigma in AB mag (Total): 20.66084315099574
irac_i4: mean flux error: 7.56309666822307, 3sigma in AB mag (Total): 20.51044773471238
irac_i1: mean flux error: 1.0771259740400239, 3sigma in AB mag (Total): 22.626530616490108
irac_i2: mean flux error: 1.2232433631721282, 3sigma in AB mag (Total): 22.48841469287411
suprime_n921: mean flux error: inf, 3sigma in AB mag (Total): -inf
suprime_n816: mean flux error: inf, 3sigma in AB mag (Total): -inf
suprime_g: mean flux error: inf, 3sigma in AB mag (Total): -inf
suprime_r: mean flux error: inf, 3sigma in AB mag (Total): -inf
suprime_i: mean flux error: inf, 3sigma in AB mag (Total): -inf
suprime_z: mean flux error: 0.160336304020679, 3sigma in AB mag (Total): 24.69461719251911
suprime_y: mean flux error: inf, 3sigma in AB mag (Total): -inf
gpc1_g: mean flux error: 9141.189867768899, 3sigma in AB mag (Total): 12.80469003924562
gpc1_r: mean flux error: 2972.5739935480774, 3sigma in AB mag (Total): 14.024365178405752
gpc1_i: mean flux error: 6931.425735723087, 3sigma in AB mag (Total): 13.105140426934014
gpc1_z: mean flux error: 80144.78971331251, 3sigma in AB mag (Total): 10.447508628893068
gpc1_y: mean flux error: 2356405.0275016846, 3sigma in AB mag (Total): 6.776572011568888
ukidss_j: mean flux error: 0.7364947786543414, 3sigma in AB mag (Total): 23.03927268250353
ukidss_k: mean flux error: 0.7483705781258455, 3sigma in AB mag (Total): 23.02190510055356
ukidss_h: mean flux error: 0.1331250579023932, 3sigma in AB mag (Total): 24.896547339005615
vista_y: mean flux error: 60.47617315294928, 3sigma in AB mag (Total): 18.253236108651997
vista_j: mean flux error: 32.62155086797097, 3sigma in AB mag (Total): 18.92343535300126
vista_h: mean flux error: 47.86834195763384, 3sigma in AB mag (Total): 18.507075901093067
```

```
vista_ks: mean flux error: 63.25103998162054, 3sigma in AB mag (Total): 18.20452768662208
vista_z: mean flux error: 33.4398719532244, 3sigma in AB mag (Total): 18.896535348738134


ap_acs_f606w (4835.3999, 7088.4702, 2253.0703)
ap_acs_f814w (7069.6699, 9138.1104, 2068.4404)
ap_wfc3_f125w (10993.5, 13997.47, 3003.9697)
ap_wfc3_f160w (13996.34, 16869.92, 2873.5801)
ap_wircam_j (11748.0, 13334.0, 1586.0)
ap_wircam_h (14855.0, 17760.0, 2905.0)
ap_wircam_ks (19870.0, 23135.0, 3265.0)
ap_suprime_b (3827.0, 4906.0, 1079.0)
ap_suprime_v (4941.6001, 5925.7998, 984.19971)
ap_suprime_rc (5919.8999, 7079.5, 1159.6001)
ap_suprime_ip (6895.0, 8437.5, 1542.5)
ap_suprime_zp (8073.5, 8416.0, 342.5)
ap_megacam_u (3500.0, 4100.0, 600.0)
ap_megacam_g (4180.0, 5580.0, 1400.0)
ap_megacam_r (5680.0, 6880.0, 1200.0)
ap_megacam_i (6831.7305, 8388.5557, 1556.8252)
ap_megacam_z (8280.0, 9160.0, 880.0)
ap_megacam_y (7040.0, 8360.0, 1320.0)
ap_decam_i (7090.0, 8560.0, 1470.0)
ap_decam_y (9510.0, 10170.0, 660.0)
ap_decam_g (4180.0, 5470.0, 1290.0)
ap_decam_r (5680.0, 7150.0, 1470.0)
ap_decam_z (8490.0, 9960.0, 1470.0)
ap_irac_i3 (50246.301, 64096.699, 13850.398)
ap_irac_i4 (64415.199, 92596.797, 28181.598)
ap_irac_i1 (31754.0, 39164.801, 7410.8008)
ap_irac_i2 (39980.102, 50052.301, 10072.199)
ap_suprime_n921 (9146.5, 9279.0, 132.5)
ap_suprime_n816 (8117.8999, 8220.2998, 102.3999)
ap_suprime_g (4090.0, 5460.0, 1370.0)
ap_suprime_r (5440.0, 6960.0, 1520.0)
ap_suprime_i (6980.0, 8420.0, 1440.0)
ap_suprime_z (8540.0, 9280.0, 740.0)
ap_suprime_y (9360.0, 10120.0, 760.0)
ap_gpc1_g (4260.0, 5500.0, 1240.0)
ap_gpc1_r (5500.0, 6900.0, 1400.0)
ap_gpc1_i (6910.0, 8190.0, 1280.0)
ap_gpc1_z (8190.0, 9210.0, 1020.0)
ap_gpc1_y (9200.0, 9820.0, 620.0)
ap_ukidss_j (11695.0, 13280.0, 1585.0)
ap_ukidss_k (20290.0, 23820.0, 3530.0)
ap_ukidss_h (14925.0, 17840.0, 2915.0)
ap_vista_y (9740.0, 10660.0, 920.0)
ap_vista_j (11670.0, 13380.0, 1710.0)
```

```
ap_vista_h (15000.0, 17900.0, 2900.0)
ap_vista_ks (19930.0, 23010.0, 3080.0)
ap_vista_z (8300.0, 9260.0, 960.0)
acs_f606w (4835.3999, 7088.4702, 2253.0703)
acs_f814w (7069.6699, 9138.1104, 2068.4404)
wfc3_f125w (10993.5, 13997.47, 3003.9697)
wfc3_f160w (13996.34, 16869.92, 2873.5801)
suprime_b (3827.0, 4906.0, 1079.0)
suprime_v (4941.6001, 5925.7998, 984.19971)
suprime_rc (5919.8999, 7079.5, 1159.6001)
suprime_ip (6895.0, 8437.5, 1542.5)
suprime_zp (8073.5, 8416.0, 342.5)
hawki_k (19820.0, 23061.0, 3241.0)
wircam_j (11748.0, 13334.0, 1586.0)
wircam_h (14855.0, 17760.0, 2905.0)
wircam_ks (19870.0, 23135.0, 3265.0)
megacam_u (3500.0, 4100.0, 600.0)
megacam_g (4180.0, 5580.0, 1400.0)
megacam_r (5680.0, 6880.0, 1200.0)
megacam_i (6831.7305, 8388.5557, 1556.8252)
megacam_z (8280.0, 9160.0, 880.0)
megacam_y (7040.0, 8360.0, 1320.0)
decam_i (7090.0, 8560.0, 1470.0)
decam_y (9510.0, 10170.0, 660.0)
decam_g (4180.0, 5470.0, 1290.0)
decam_r (5680.0, 7150.0, 1470.0)
decam_z (8490.0, 9960.0, 1470.0)
irac_i3 (50246.301, 64096.699, 13850.398)
irac_i4 (64415.199, 92596.797, 28181.598)
irac_i1 (31754.0, 39164.801, 7410.8008)
irac_i2 (39980.102, 50052.301, 10072.199)
suprime_n921 (9146.5, 9279.0, 132.5)
suprime_n816 (8117.8999, 8220.2998, 102.3999)
suprime_g (4090.0, 5460.0, 1370.0)
suprime_r (5440.0, 6960.0, 1520.0)
suprime_i (6980.0, 8420.0, 1440.0)
suprime_z (8540.0, 9280.0, 740.0)
suprime_y (9360.0, 10120.0, 760.0)
gpc1_g (4260.0, 5500.0, 1240.0)
gpc1_r (5500.0, 6900.0, 1400.0)
gpc1_i (6910.0, 8190.0, 1280.0)
gpc1_z (8190.0, 9210.0, 1020.0)
gpc1_y (9200.0, 9820.0, 620.0)
ukidss_j (11695.0, 13280.0, 1585.0)
ukidss_k (20290.0, 23820.0, 3530.0)
ukidss_h (14925.0, 17840.0, 2915.0)
vista_y (9740.0, 10660.0, 920.0)
vista_j (11670.0, 13380.0, 1710.0)
```

```
vista_h (15000.0, 17900.0, 2900.0)
vista_ks (19930.0, 23010.0, 3080.0)
vista_z (8300.0, 9260.0, 960.0)
```

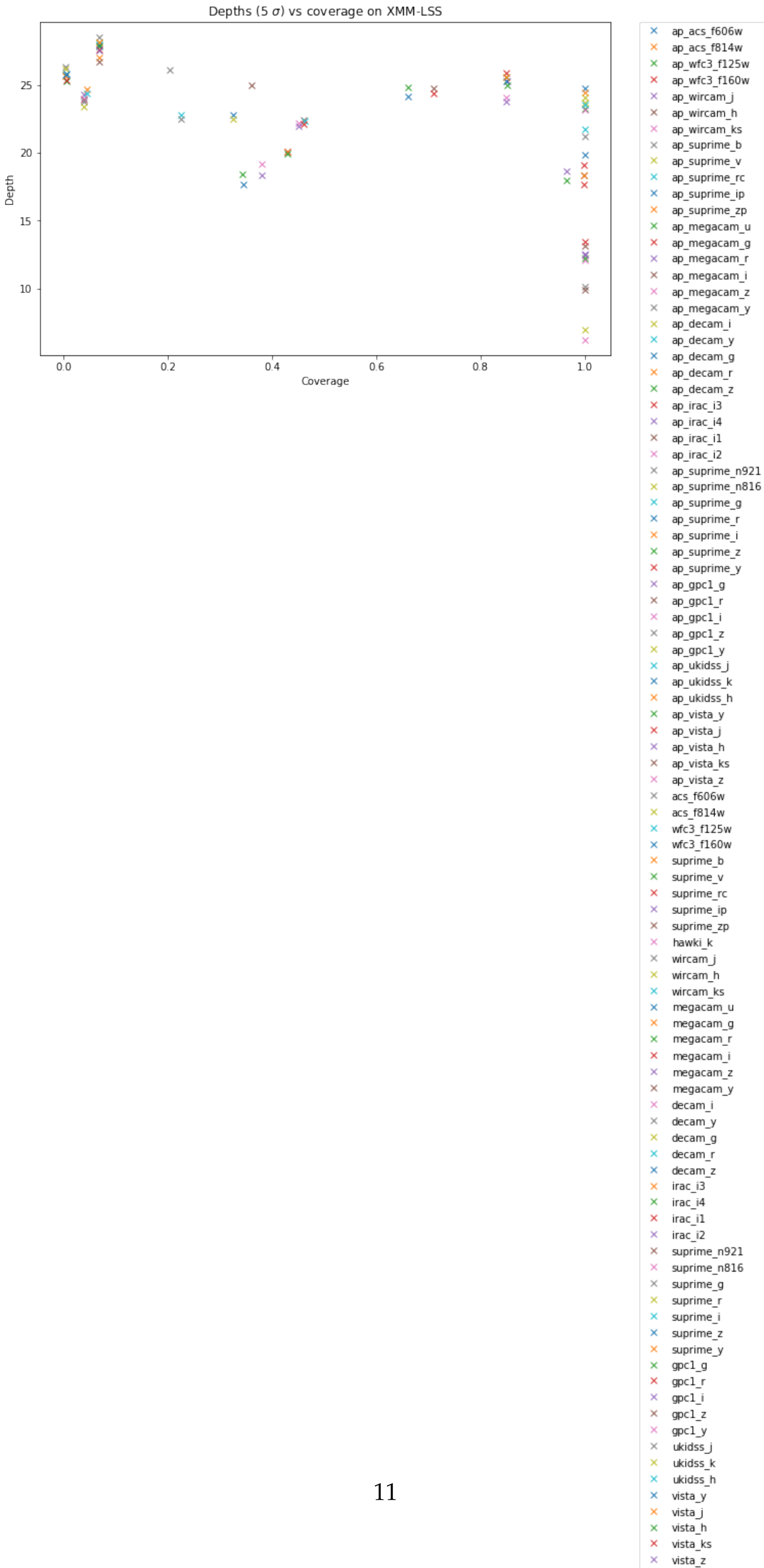
Out[20]: <matplotlib.text.Text at 0x7efc547e2ac8>


Depths on XMM-LSS
Depth
25
20
15
10
10^4
10^5
Wavelength (Å)
ap_acs_f606w
ap_acs_f814w
ap_wfc3_f125w
ap_wfc3_f160w
ap_wircam_j
ap_wircam_h
ap_wircam_ks
ap_suprime_b
ap_suprime_v
ap_suprime_rc
ap_suprime_ip
ap_suprime_zp
ap_megacam_u
ap_megacam_g
ap_megacam_r
ap_megacam_i
ap_megacam_z
ap_megacam_y
ap_decam_i
ap_decam_y
ap_decam_g
ap_decam_r
ap_decam_z
ap_irac_i3
ap_irac_i4
ap_irac_i1
ap_irac_i2
ap_suprime_n921
ap_suprime_n816
ap_suprime_g
ap_suprime_r
ap_suprime_i
ap_suprime_z
ap_suprime_y
ap_gpc1_g
ap_gpc1_r
ap_gpc1_i
ap_gpc1_z
ap_gpc1_y
ap_ukidss_j
ap_ukidss_k
ap_ukidss_h
ap_vista_y
ap_vista_j
ap_vista_h
ap_vista_ks
ap_vista_z
acs_f606w
acs_f814w
wfc3_f125w
wfc3_f160w
suprime_b
suprime_v
suprime_rc
suprime_ip
suprime_zp
hawki_k
wircam_j
wircam_h
wircam_ks
megacam_u
megacam_g
megacam_r
megacam_i
megacam_z
megacam_y
decam_i
decam_y
decam_g
decam_r
decam_z
irac_i3
irac_i4
irac_i1
irac_i2
suprime_n921
suprime_n816
suprime_g
suprime_r
suprime_i
suprime_z
suprime_y
gpc1_g
gpc1_r
gpc1_i
gpc1_z
gpc1_y
ukidss_j
ukidss_k
ukidss_h
vista_y
vista_j
vista_h
vista_ks
vista_z

1.5.3 IV.c - Depth vs coverage comparison

How best to do this? Colour/intensity plot over area? Percentage coverage vs mean depth?

```
Out[21]: <matplotlib.text.Text at 0x7efc5440ecf8>
```


Depths (5 σ) vs coverage on XMM-LSS
Depth
Coverage
25
20
15
10
0.0
0.2
0.4
0.6
0.8
1.0
ap_acs_f606w
ap_acs_f814w
ap_wfc3_f125w
ap_wfc3_f160w
ap_wircam_j
ap_wircam_h
ap_wircam_ks
ap_suprime_b
ap_suprime_v
ap_suprime_rc
ap_suprime_ip
ap_suprime_zp
ap_megacam_u
ap_megacam_g
ap_megacam_r
ap_megacam_i
ap_megacam_z
ap_megacam_y
ap_decam_i
ap_decam_y
ap_decam_g
ap_decam_r
ap_decam_z
ap_irac_i3
ap_irac_i4
ap_irac_i1
ap_irac_i2
ap_suprime_n921
ap_suprime_n816
ap_suprime_g
ap_suprime_r
ap_suprime_i
ap_suprime_z
ap_suprime_y
ap_gpc1_g
ap_gpc1_r
ap_gpc1_i
ap_gpc1_z
ap_gpc1_y
ap_ukidss_j
ap_ukidss_k
ap_ukidss_h
ap_vista_y
ap_vista_j
ap_vista_h
ap_vista_ks
ap_vista_z
acs_f606w
acs_f814w
wfc3_f125w
wfc3_f160w
suprime_b
suprime_v
suprime_rc
suprime_ip
suprime_zp
hawki_k
wircam_j
wircam_h
wircam_ks
megacam_u
megacam_g
megacam_r
megacam_i
megacam_z
megacam_y
decam_i
decam_y
decam_g
decam_r
decam_z
irac_i3
irac_i4
irac_i1
irac_i2
suprime_n921
suprime_n816
suprime_g
suprime_r
suprime_i
suprime_z
suprime_y
gpc1_g
gpc1_r
gpc1_i
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ukidss_j
ukidss_k
ukidss_h
vista_y
vista_j
vista_h
vista_ks
vista_z