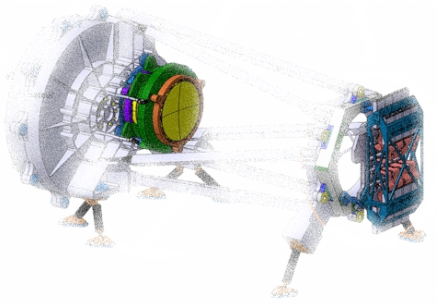

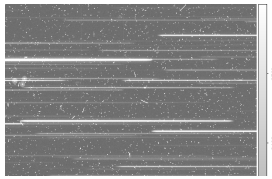

Euclid Survey and Dithering strategy:
Clustering Perspective
(*EUCL-CPP-RP-7-0xx*)

NISP/GC Considerations on Survey and dithering strategies

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calibration workshop
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Outline

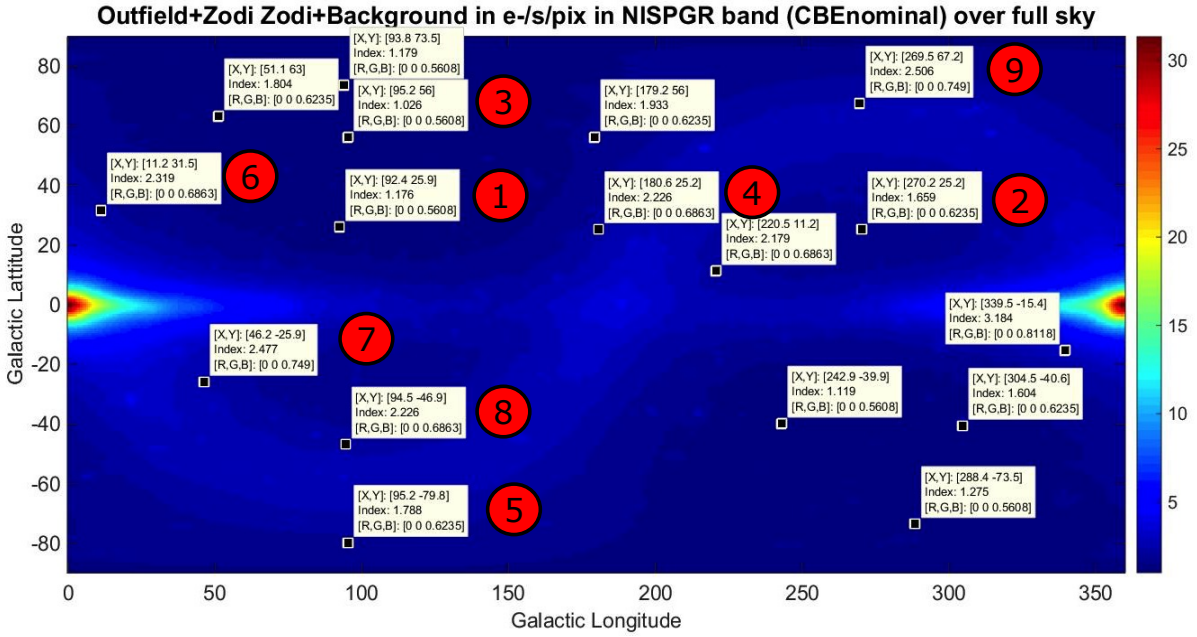
In the context of the mission PDR, we have done a verification of the performance of the current reference survey for clustering by a full simulation included:

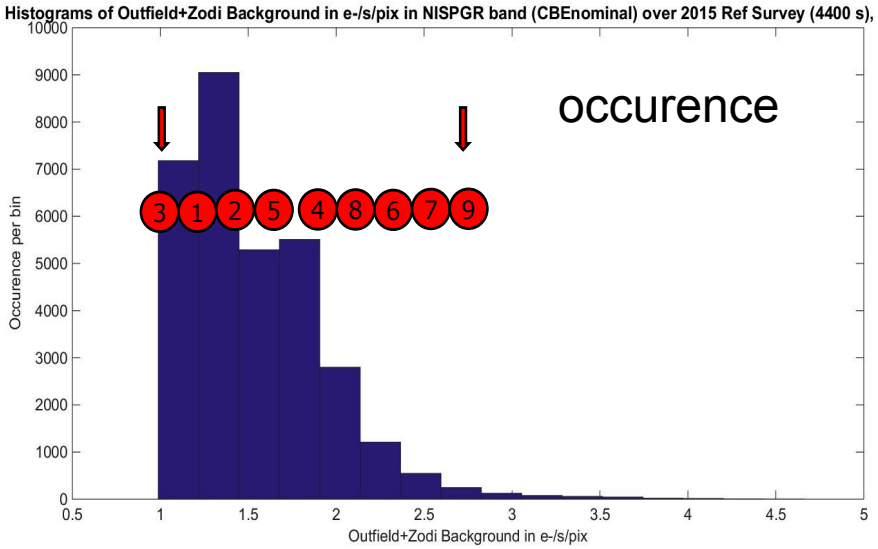
-a full image simulation of realistic fields including noise, straylight, cosmic and persistence.
- a full processing of this images
- a redshift extraction

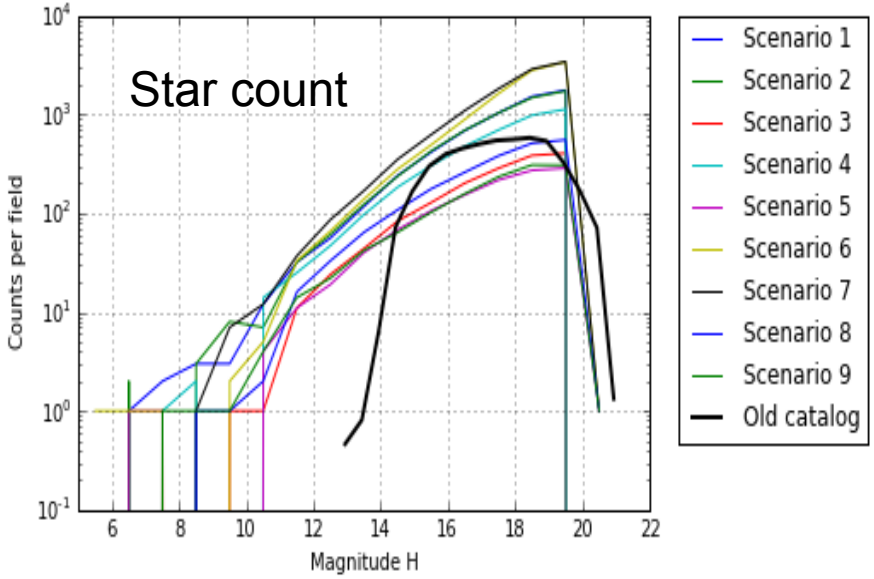
-verification of completeness/purity performance
-use this evaluation to estimate if the survey is close to optimal for the clustering point of view

The reference survey

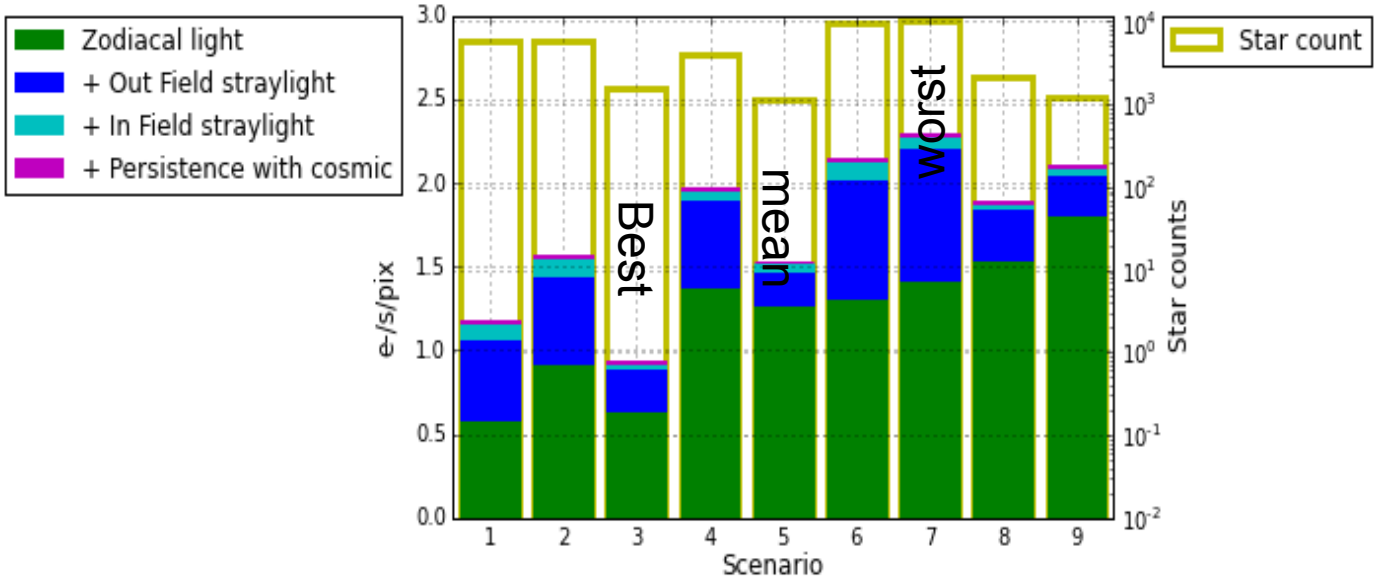
- 9 fields distributed within all representative regions of the reference survey, including the borders, have been selected.
- Called *observing scenarios #1-9*

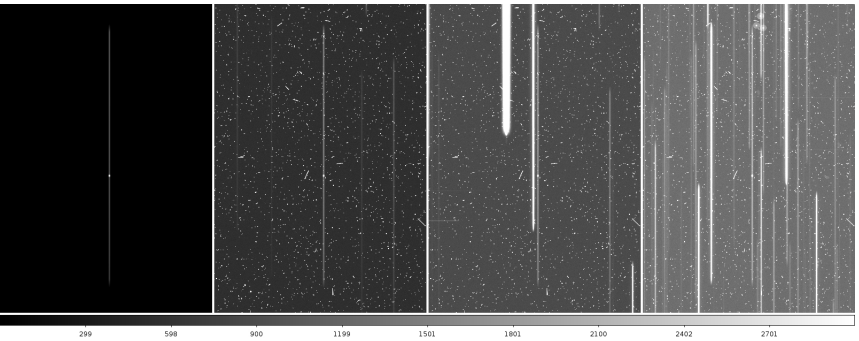


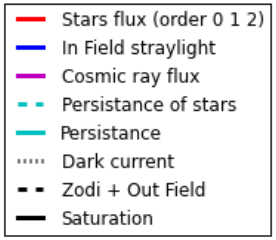


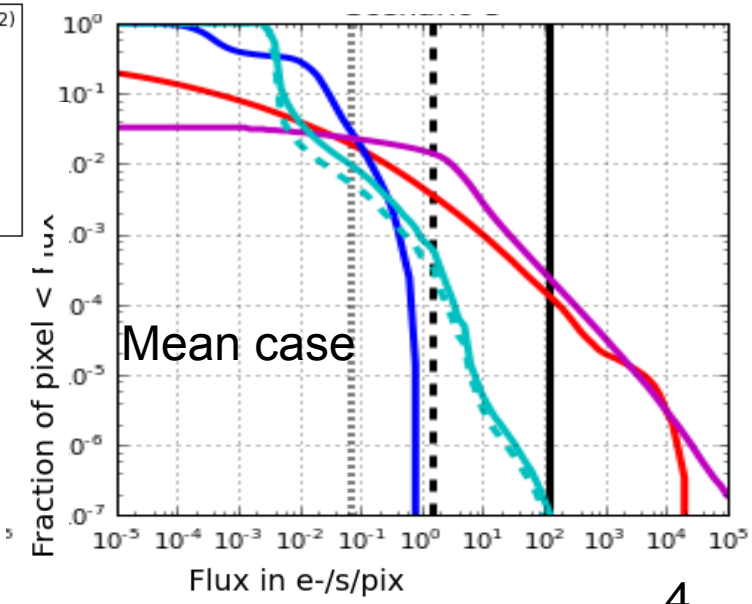


Adding all contaminations in the 9 scenarios



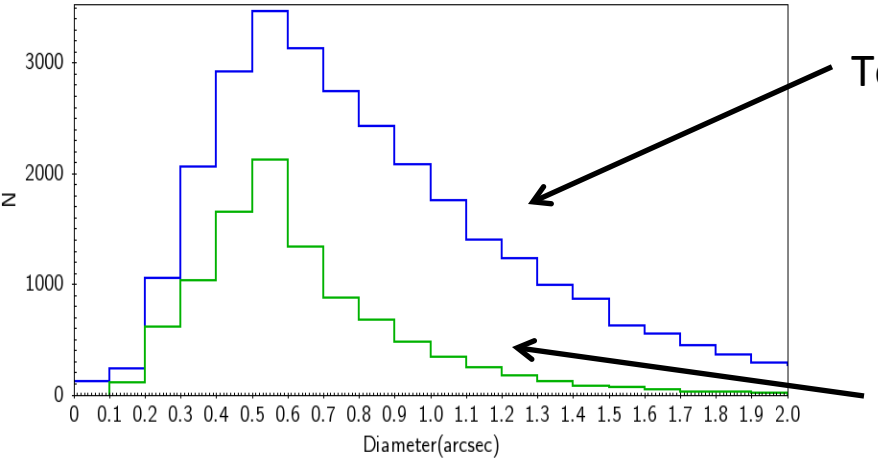






Imodel pipeline simulation

- Add galaxies
- Add noise maps (= only the poisson effect)
- Run each pointing in the e2e pipeline
- Compute redshift , completeness and purity



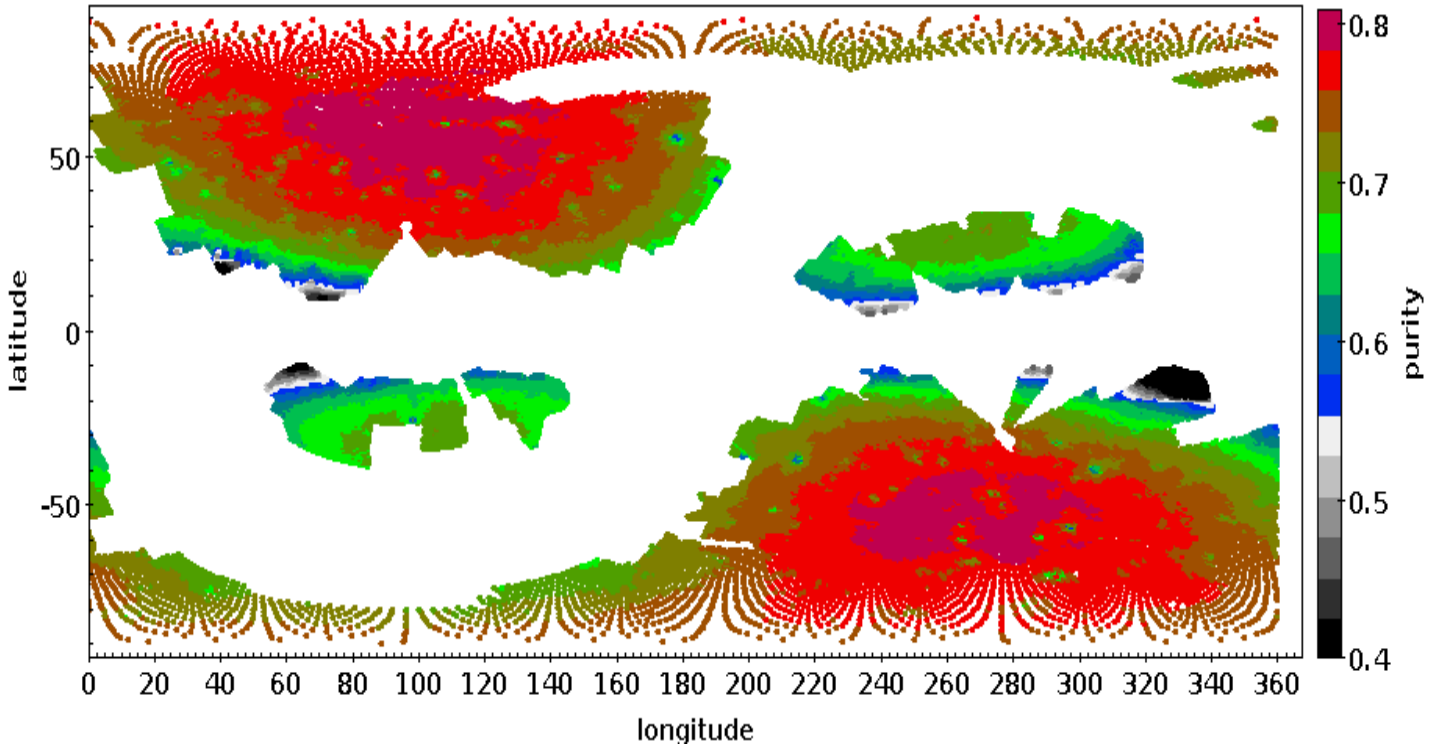
Total # galaxies of the catalogue

galaxies of the catalogue with Hα flux > 2 10^{-16} e/s/pixel and 0.9 < z < 1.8 used to compute Purity (P) and Completeness (C)

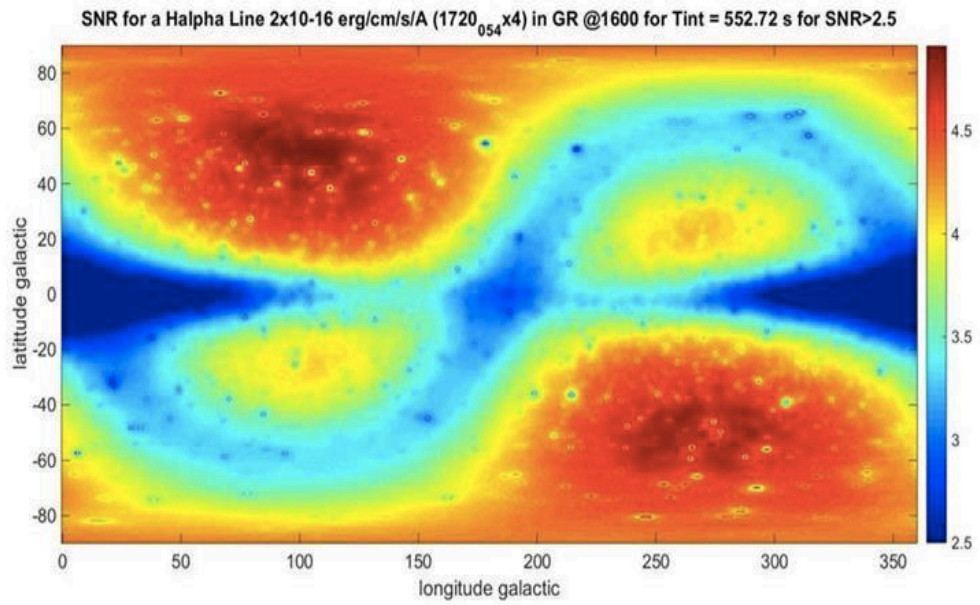
Purity

We found that only half of the current pointing area in the survey is well inside the GC requirement in purity and completeness.

Purity is not compliant for more than half of the survey (purity > 80 %)

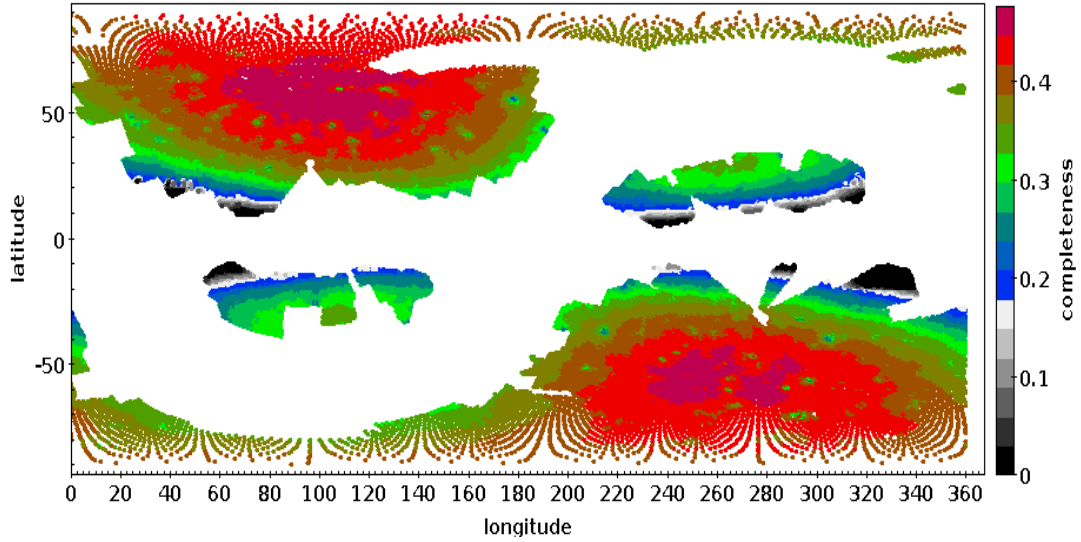


MPDR: SNR or completness



SNR for 0.5 ‘’ source
From an ETC approach

Seems inside requirement



in completness
⇒ large area are not compliant

=>We can probably optimized this map

Optimisation

To improve compliance for clustering for > 12000 sq.dg of sky: we can:

1. Change the exposure time
   (currently 565s + overheads per dither)

2. Increase/ decrease the number of dithers per sky field
   (currently 4)

3. Increase/decrease the overlap between the fields on the sky
   (currently 1%)

4. Change the offset pattern and sizes between different dithers
   (currently “J” pattern)

Change exposure time - I

Fixed exposure time

- performance evalution => shorter exposures are **NOT feasible**.
- Increased exposure times could be used to decrease the limiting line flux of the survey and increasing the galaxy density
- For a fixed time survey, doubling the exposure time typically would reduce the area under 10 000 deg^2
- Increasing by 20% will reduce the area by a similar percentage, and this should be traded off globally

Change exposure time -II

Variable exposure time

Change the exposure time over the survey

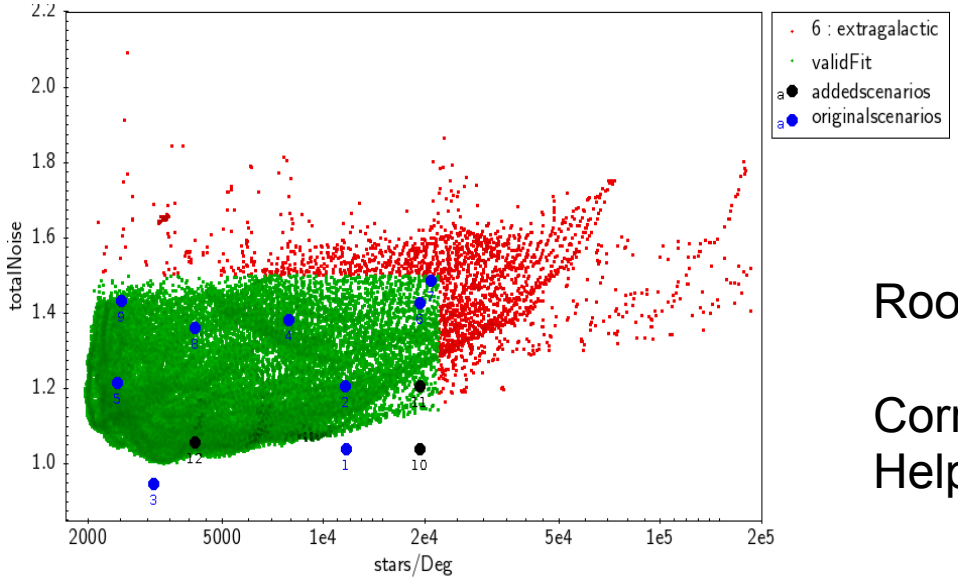
-Attractive to adjust the SNR and completeness

-Complicated for NISP operations:

- -different readout mode
- -different calibrations and corrections (non-linearity, dark persistence…)
- -difficult for WE and NISP operations
- -dificult to monitor (chi2 is changing with the readout mode)
- -difficult to reproduce in the deep field

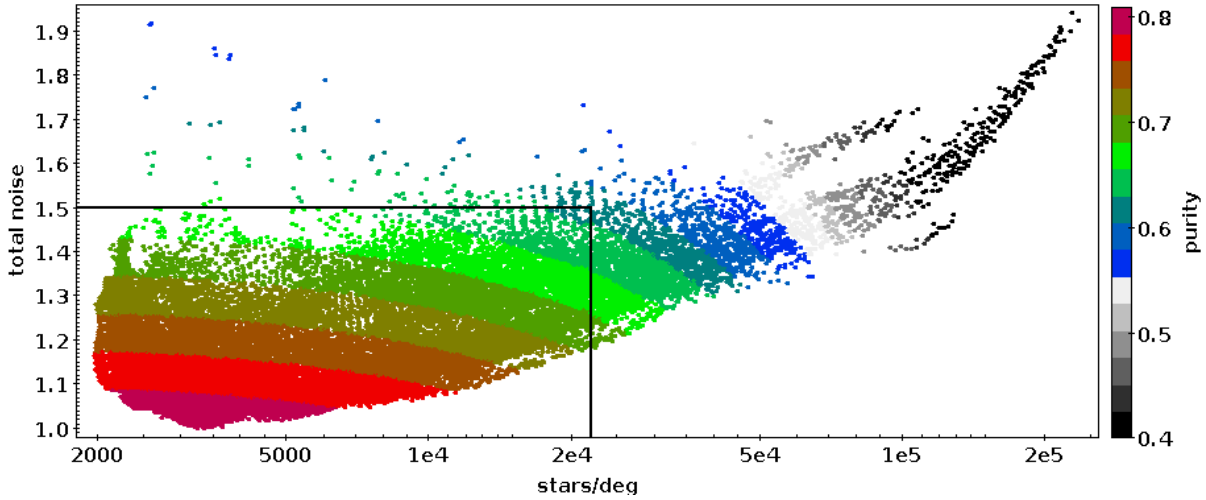
Varying the exposure time to meet a S/N threshold means that Euclid would spend more time looking at regions with “more noise”, compared to those with “less noise”.

Optimisation



Room for optimisation

Correlation of noise and purity
Help to increase purity

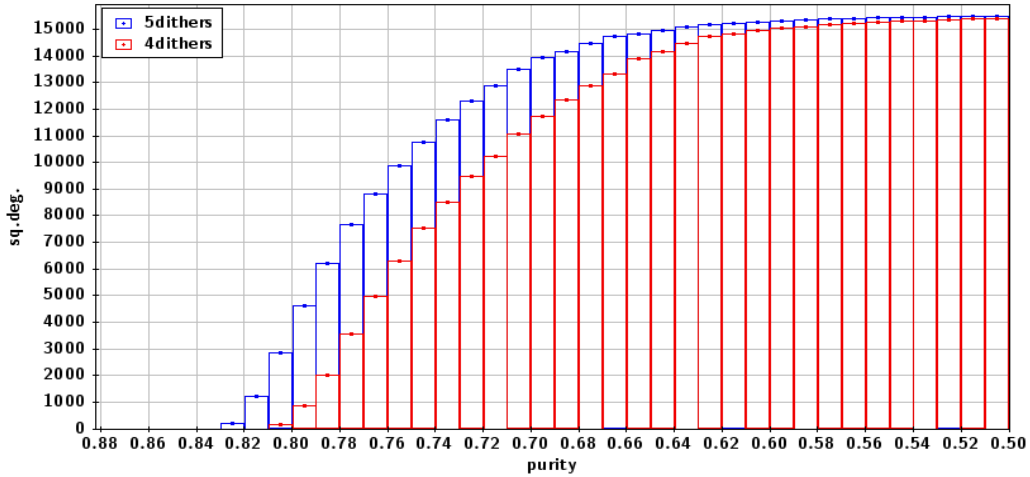


optimize survey

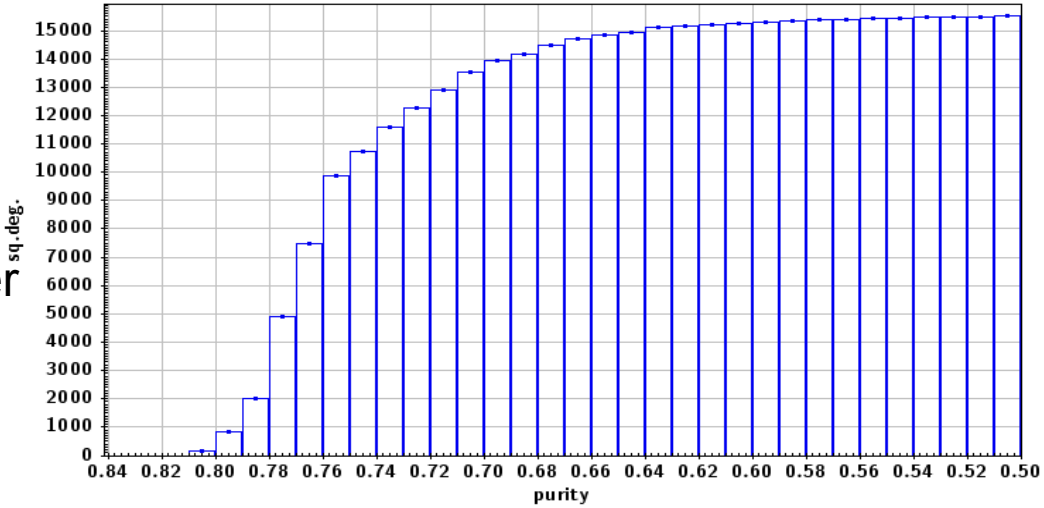
- **Changing the number of dithers**

potential gain adding a 5 dither

Purity
for all the survey
In red 4 dither
In blue 5 dither



40% pointings
With 4 dither
60% with 5 dither



- This exercise demonstrates that some gain can be obtained by tuning the exposure time only in a “quantized” way that would avoid the drawbacks of a varying exposure time strategy

- This exercise use the list of pointings currently in the reference survey. A second iteration in the optimization of the survey lay-out, should be also to choose pointing with less stars.

Dithering

- **Dithering strategy**

  - ✓ Strategy should avoid few pixels dithering because we want to cover detector gaps

  - ✓ Small dithers (<half a detector) result in the same stars remaining within the field of view, and hence are needed to perform the spectro-photometric calibration. This also reduces the number of variables needed to model the spectral energy distribution.

  - ✓ Not clear reason seen to prefer very large dither (>half a detector). and this will be more complicated for the prime for stability etc..it is not proposed as a primary option

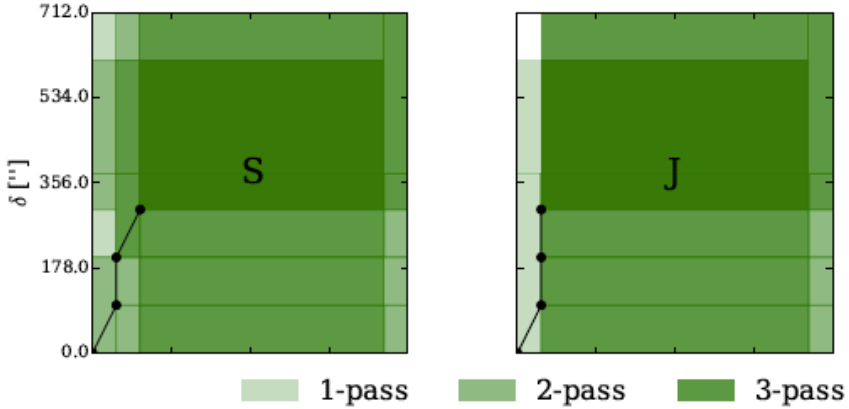
=> small scale dithering (~up to half detector) is the preferred option

Dithering

- **Optimizing dithering strategy (pattern and step)**

(based on Dida Markovic et al arXiv: 1606.07061 *)*

- Overlap are used to improve relative large scale spectro-photometry if we are not using the self cal field (called ubercal).
- There is enough star density in current 1% overlap .
- Even with the same overlap and size, the dithering pattern can be optimized to improve stability of the calibration at large scale



- The pattern S has been show to potentially improve the calibration compared to J even without changing step.
- Changing step in a 'reasonnable amount' can help too.

Multi passes

- **Survey sequence optimisation=multi passes**
  - We can imagine to have passes at different time in the survey with 2+2 or 3+2 in case of 5 dithers.
    - This is probably good for controlling evolution in time and calibration
    - As clustering need all rolls to do science, to separate passes will add a risk on science

⇒There seems to be a large risk on science to implement a multi pass option, then it is not the prefered option as calibration stability can be controled with the ubercal approach

Conclusions

- Pending further information from science , a range of survey areas, say 12,000 – 15,000 deg2 should be considered.

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- Area reductions within this range allow the potential for 5 dithers rather than the current 4.

- There is interesting gain when modifying slightly the current dither pattern (e.g. the S compared to the J) on spectro-photometric calibration

- Need an iteration with the survey to optimize the choice of the pointings, which takes into account also the impact of the background noise and stellar density quantified by the results of this study.