

Visualisation of Gaia data

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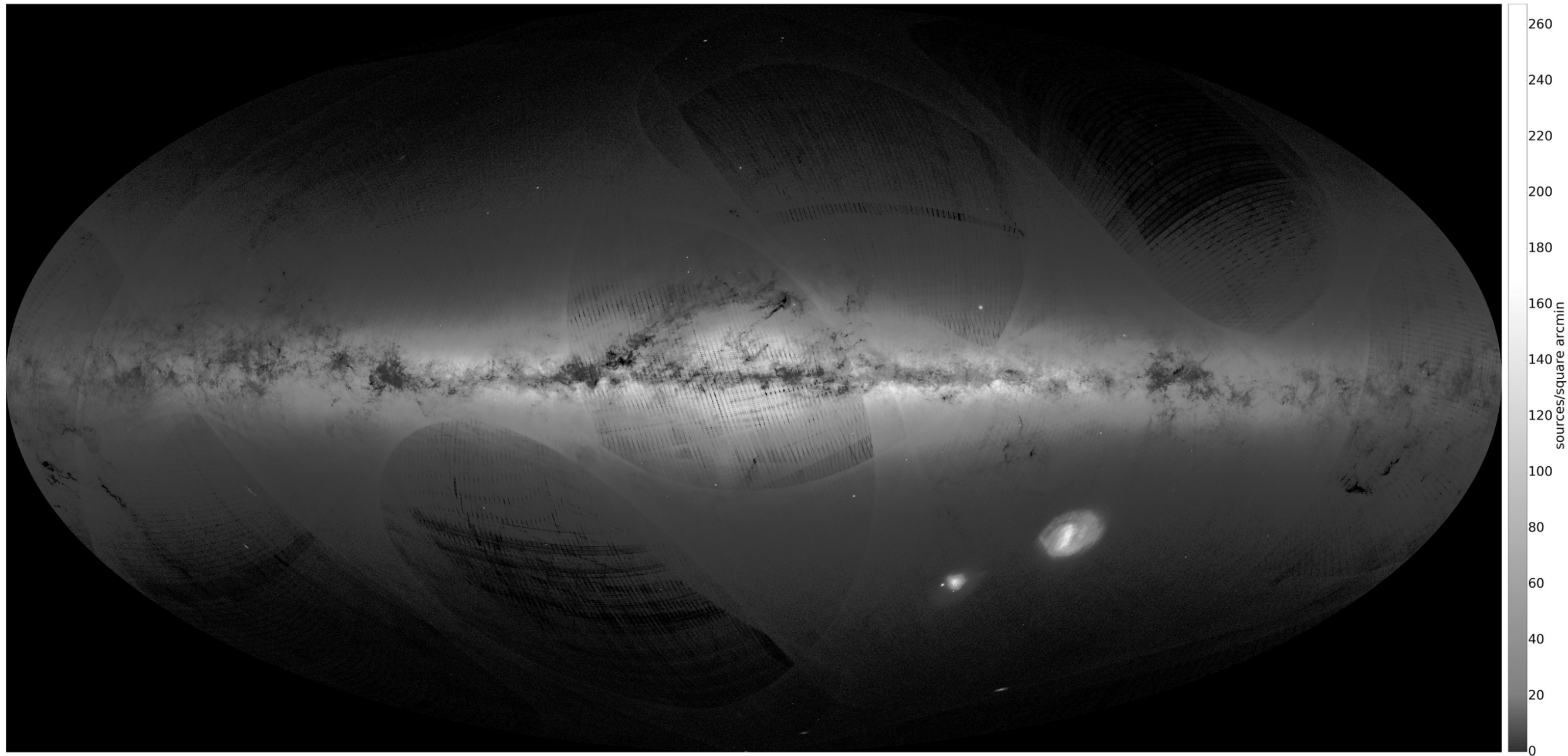
This is Gaia

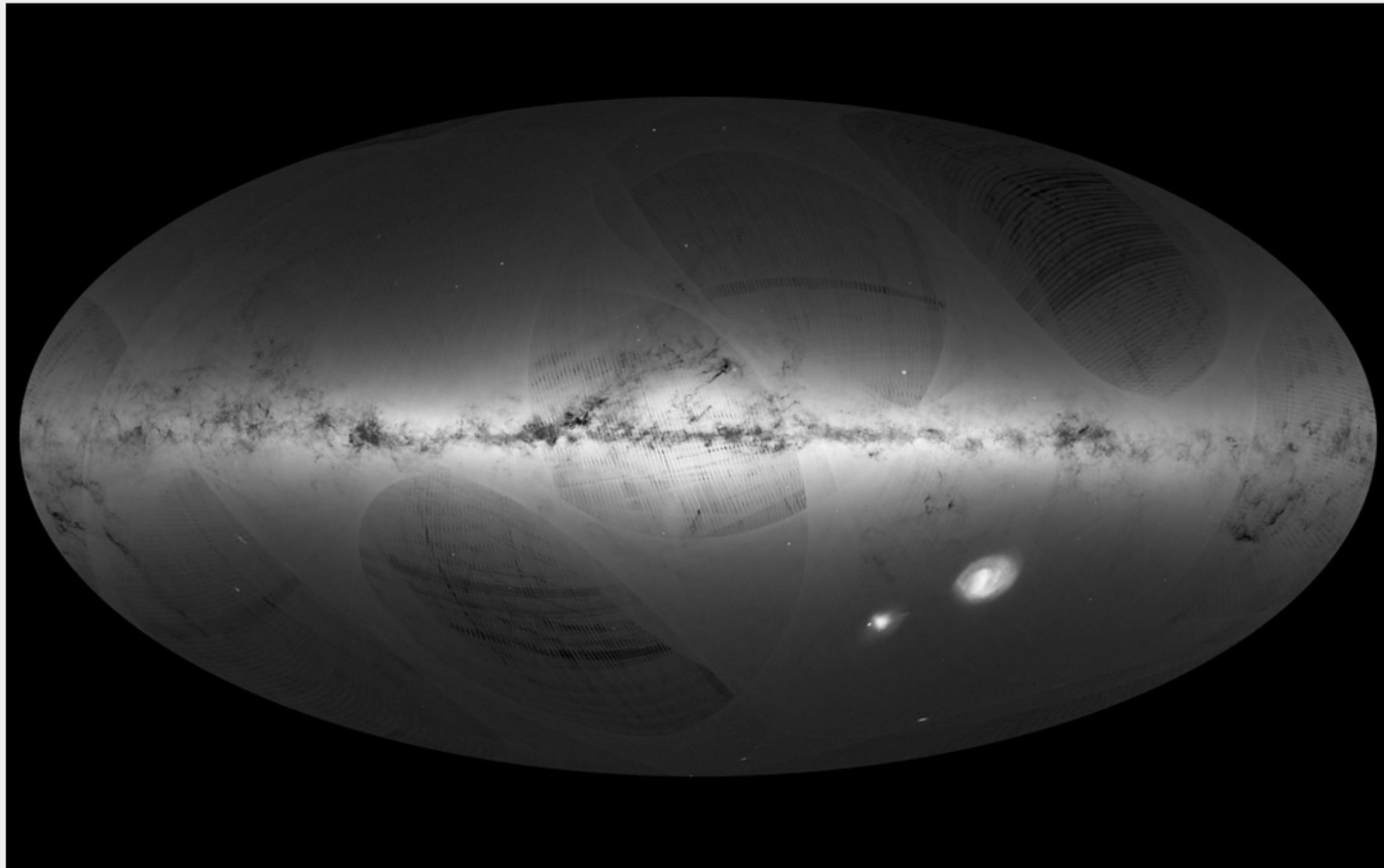


it was launched in Dec 19, 2013



First Data Release: Wednesday, Sep 14 2016





5 Coolest Things On Earth The Week

Sep 16, 2016 by Tomas Kellner



Gaia and other large surveys

- Gaia - 1 billion - Spectrophotometry, parallaxes, proper motions, radial velocities, time series
- SDSS - ~2 billions, mostly extra gal. ~750.000 MW spectra. Optical/NIR
- LSST - Future - Optical/NIR
- PanSTARRS - Interesting releases in the future. Optical
- IPHAS - 219 million, R,I, Ha
- VVV - Millions. NIR, Inner MW
- How can we deal with all these data?

Gaia visualisation challenges

- 1 billion objects, ~Petabyte archive
- **Physical size of the archive → Hardware challenges:**
 - Cannot store data locally in common hardware available to researchers
 - Transferring from remote archive limited by bandwidth

Gaia visualisation challenges

- **Physical size of the archive:** Hardware resources, incl. bandwidth: leads to server-client architecture [take the programs to the data]
- **Interactivity.** Exploration is interactive.
- **Analytics:** Too many data to represent and too many high-dimensional interrelations: Data stunning!

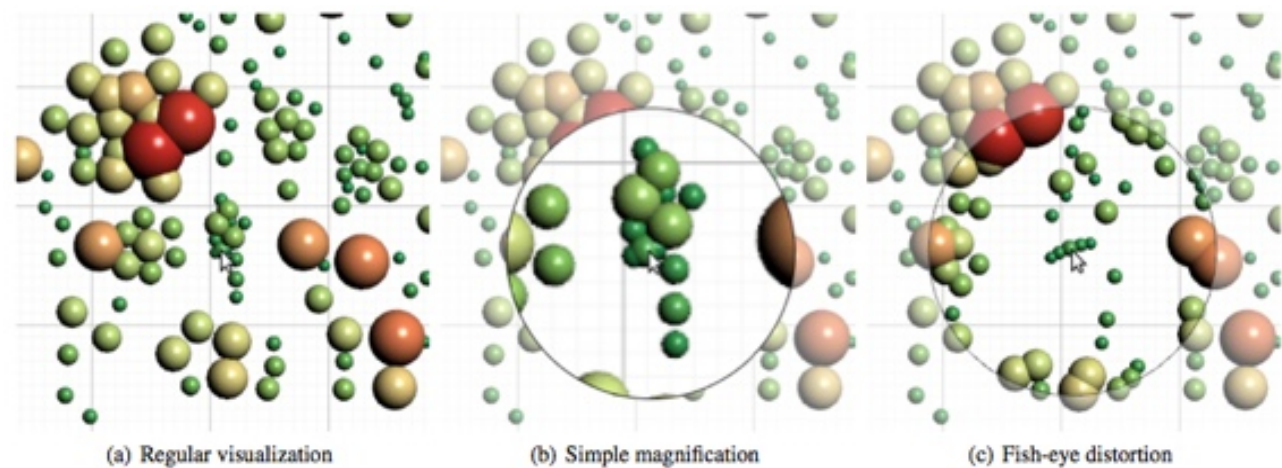
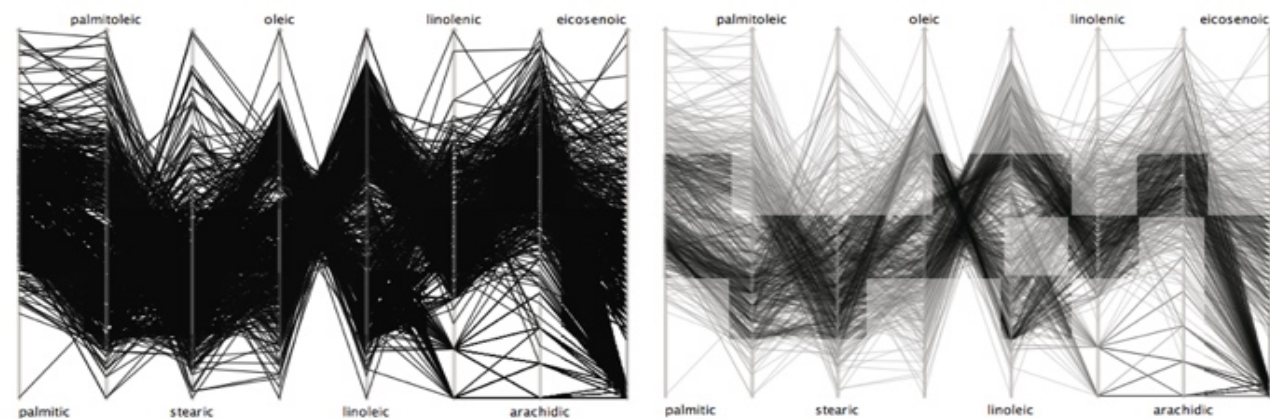
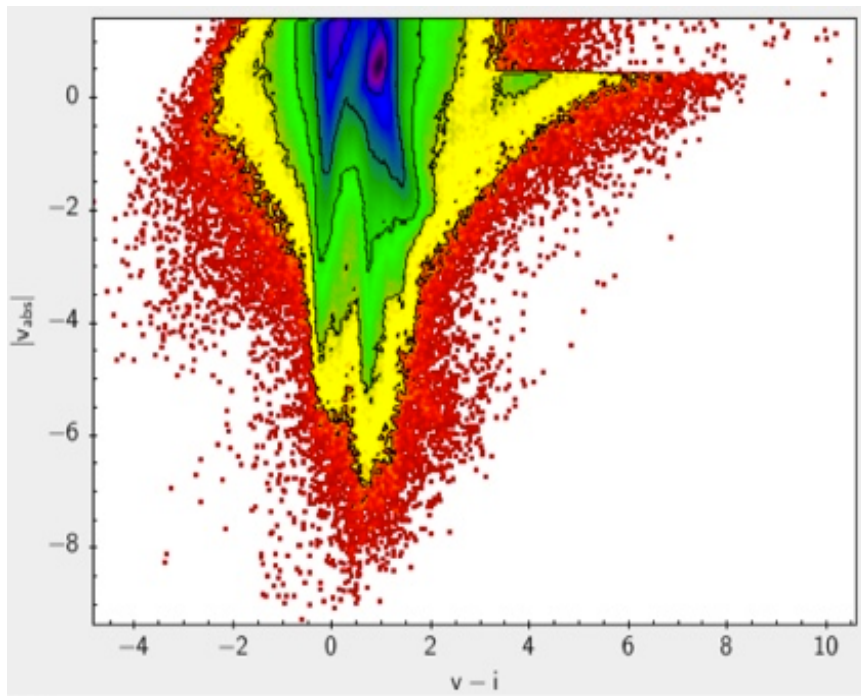
Gaia visualisation challenges

- **Physical size of the archive:** Hardware resources, incl. bandwidth: leads to server-client architecture [take the programs to the data]
- **Interactivity.** Exploration is interactive.
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might not be a
problem for
high end
machines

Gaia visualisation challenges

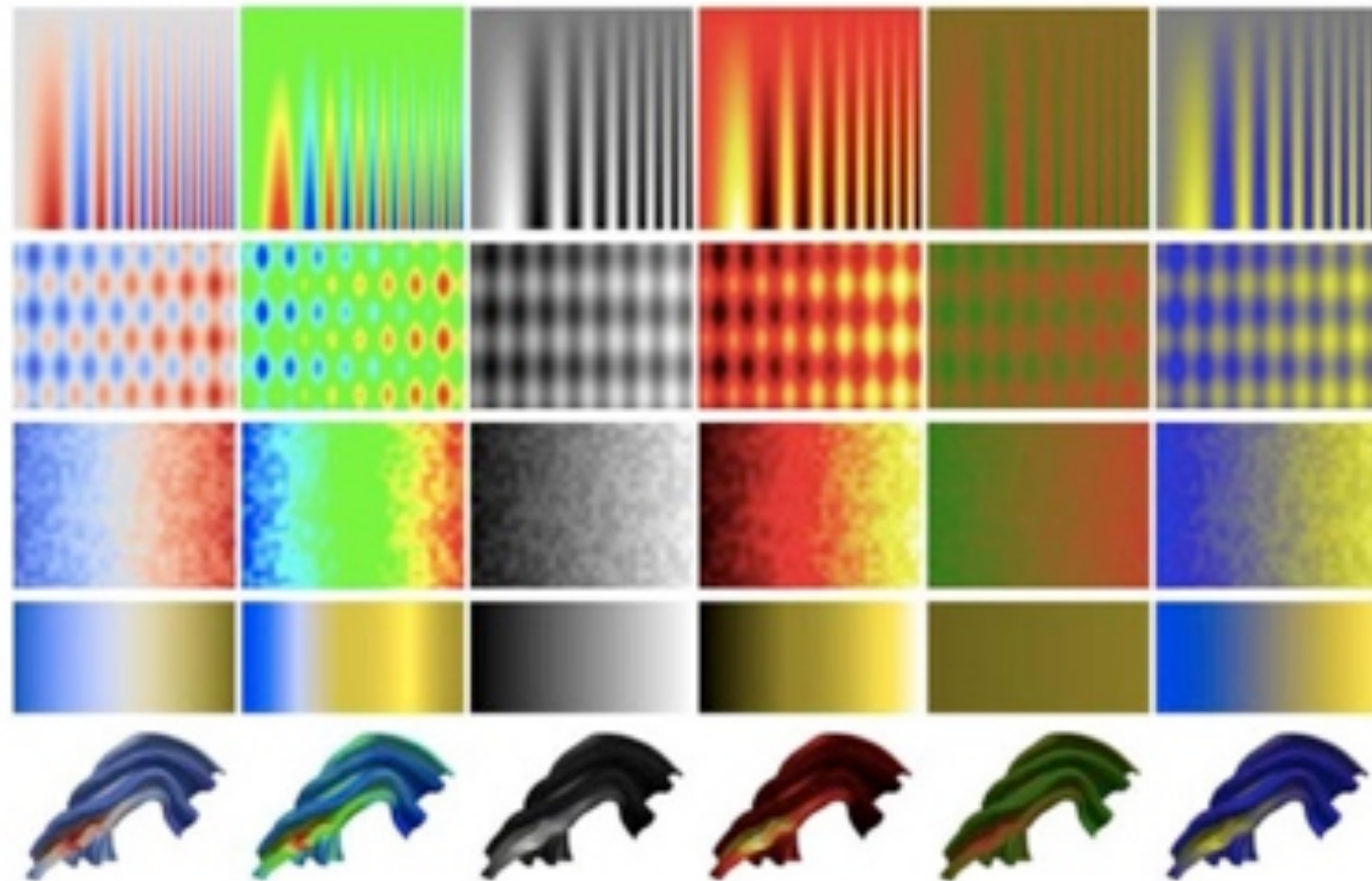
- **Visualisation and analysis challenges** → **Data stunning (Confusion)**



People need to be educated on how to explore Big Data

Gaia visualisation challenges

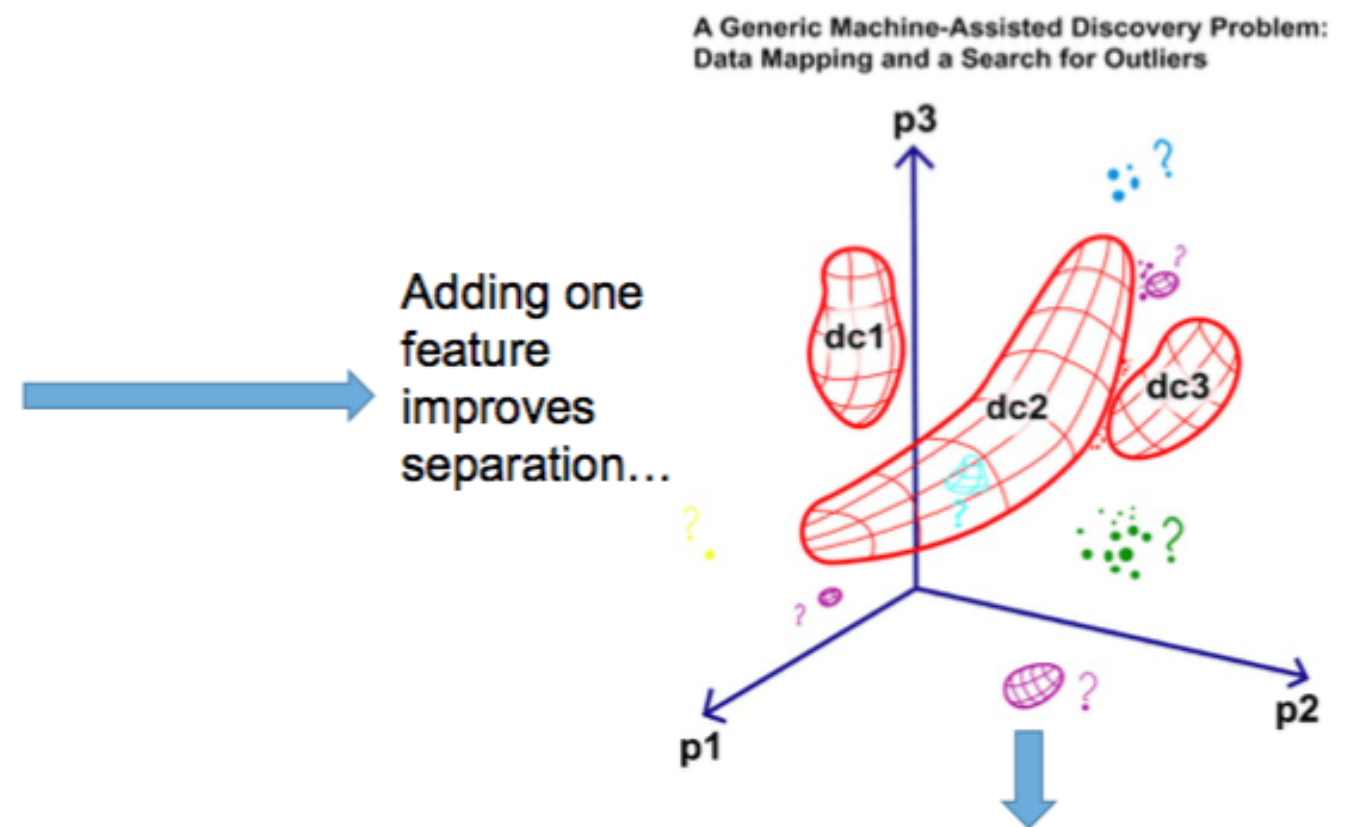
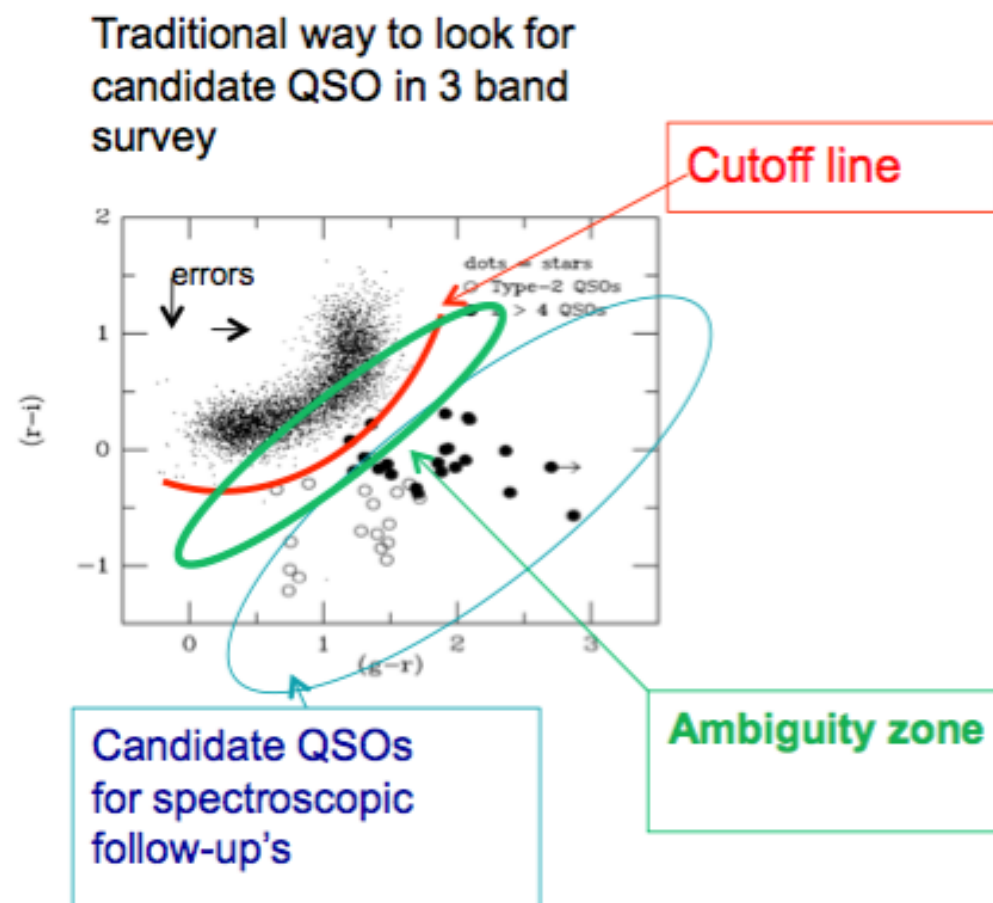
- Visualisation and analysis challenges
 - **Habits !!**



Comparison of colour maps. From left to right, cool-warm, rainbow, grayscale, heated body, isoluminant, and blue-yellow. And from top to bottom, representations showing spatial contrast, a low-frequency, high-frequency noise, approximation of how the colour map is viewed deuteranope colour-deficient vision and its effect in 3D shading. From Moreland, 2009.

Gaia visualisation challenges

- Visualisation and analysis challenges
 - Data stunning (many dimensions)
 - 2D -> 3D. The extra dimension does make a difference

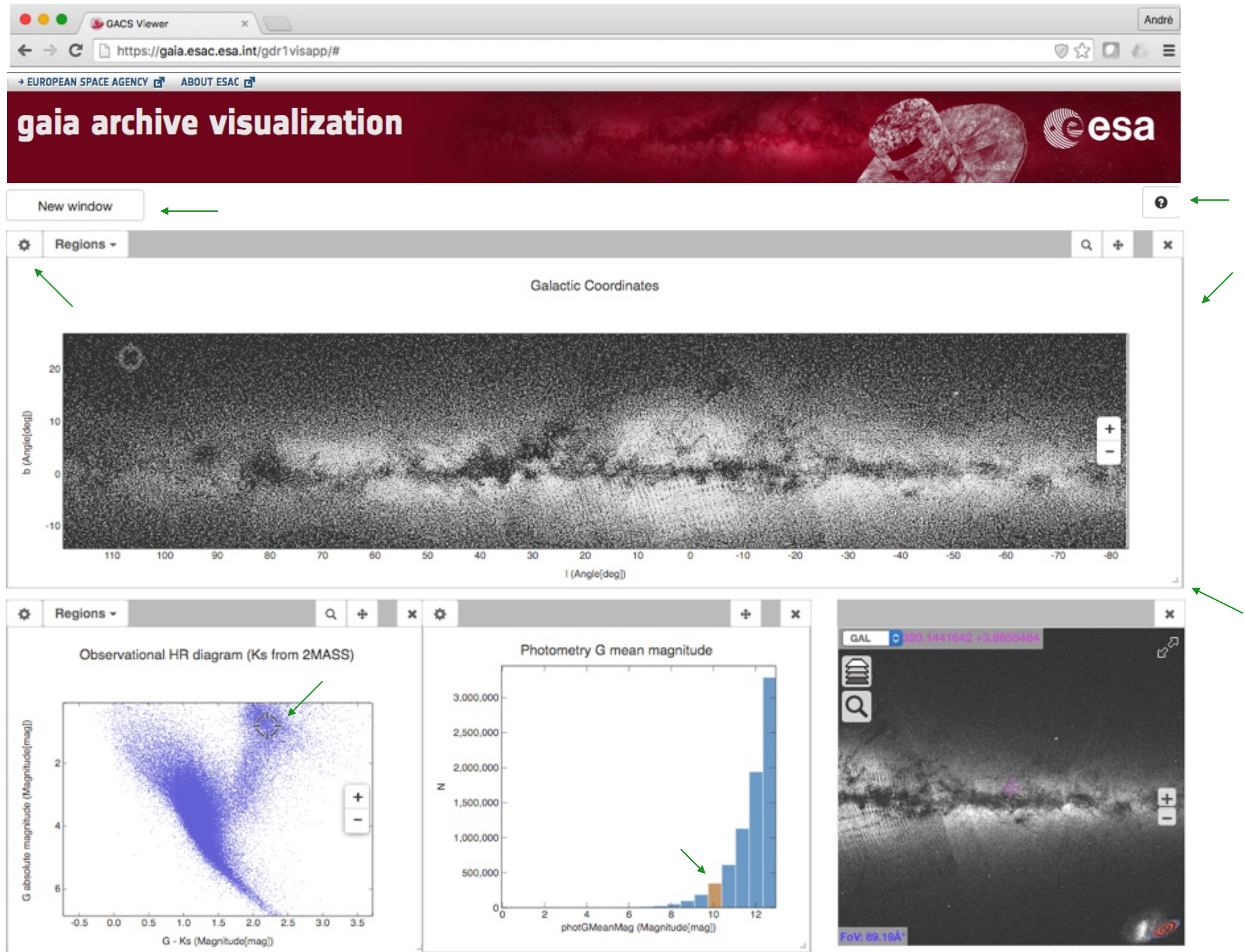


Challenges in interactivity

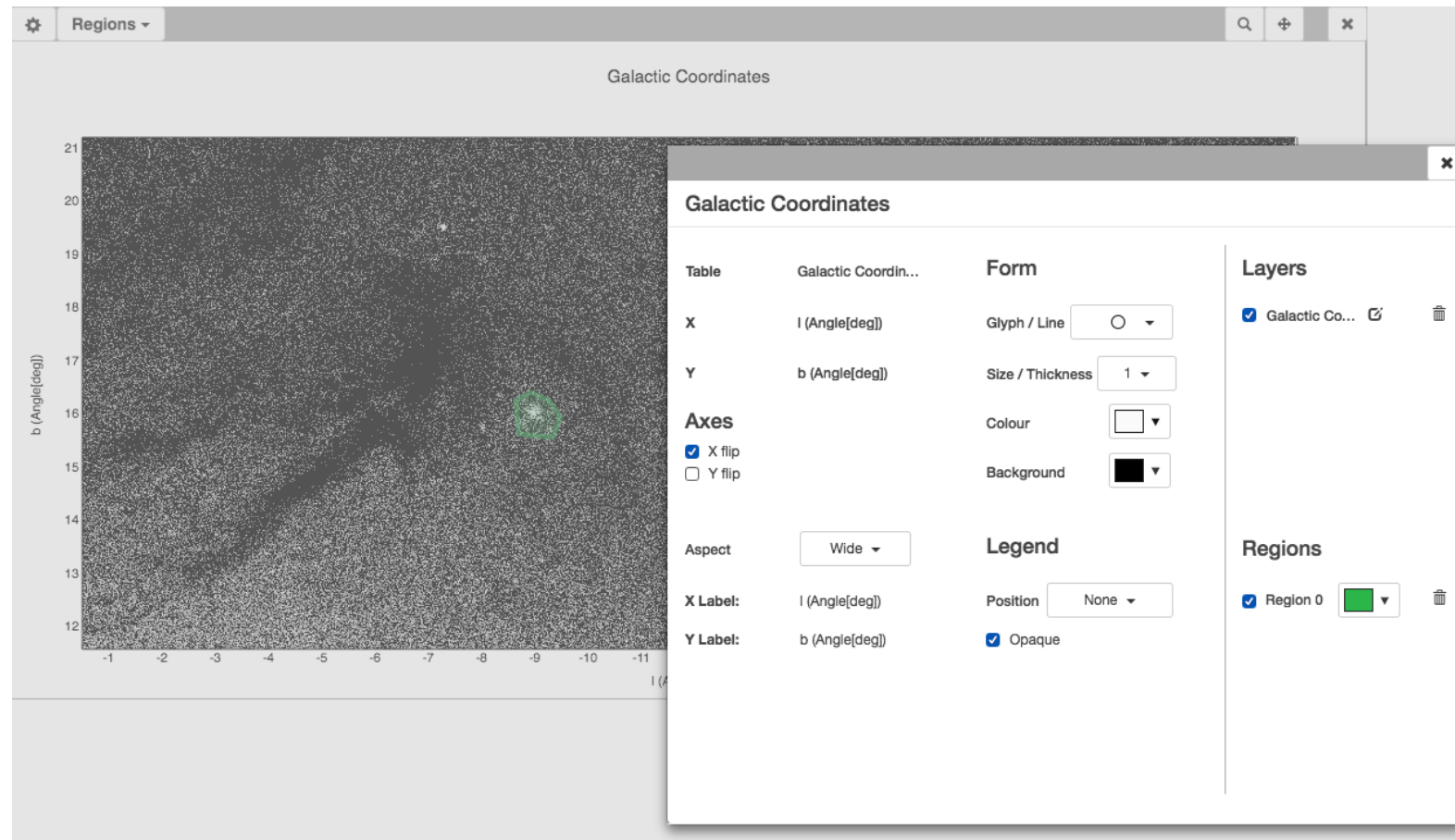
So we need a system that

- is up to the technical challenges
- provides the necessary functionalities
- configured for Big Data exploration

Gaia interactive visualisation portal

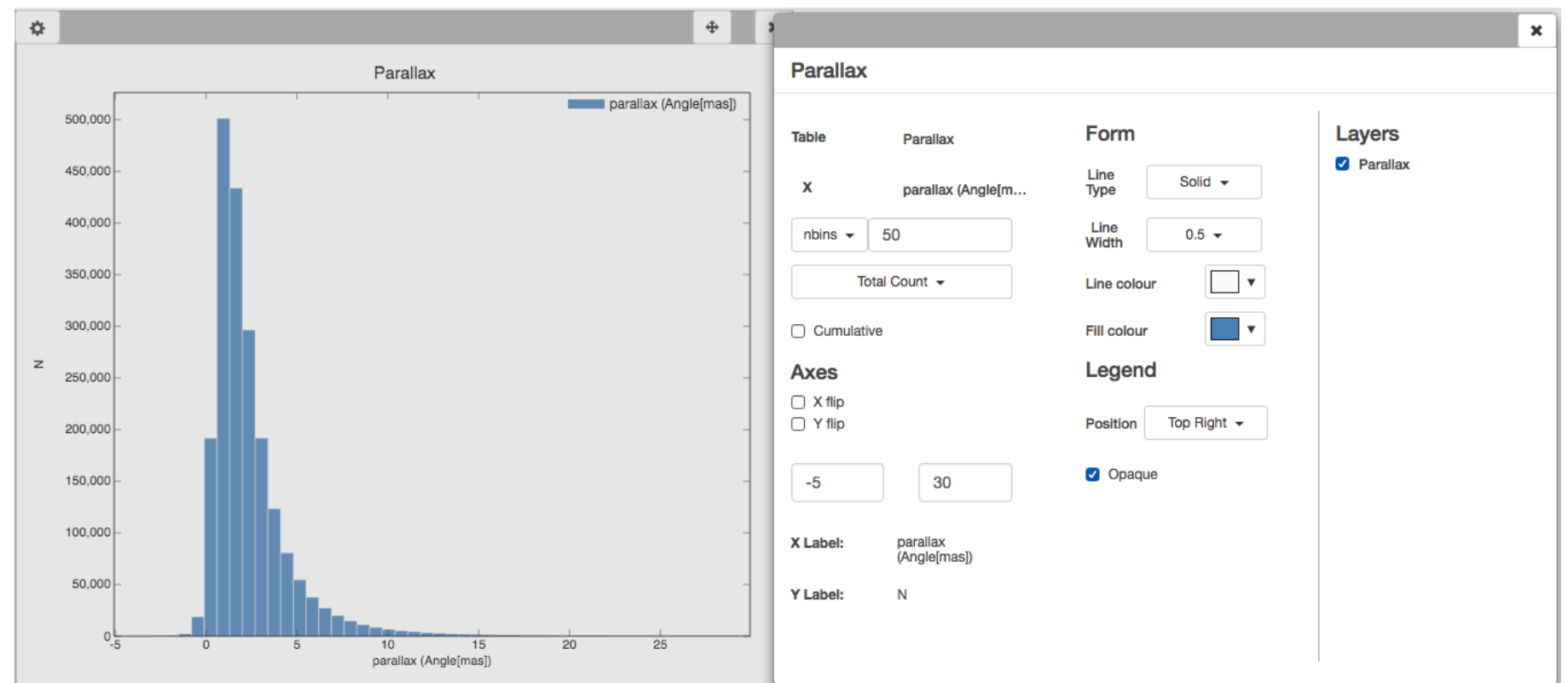


Gaia interactive visualisation portal

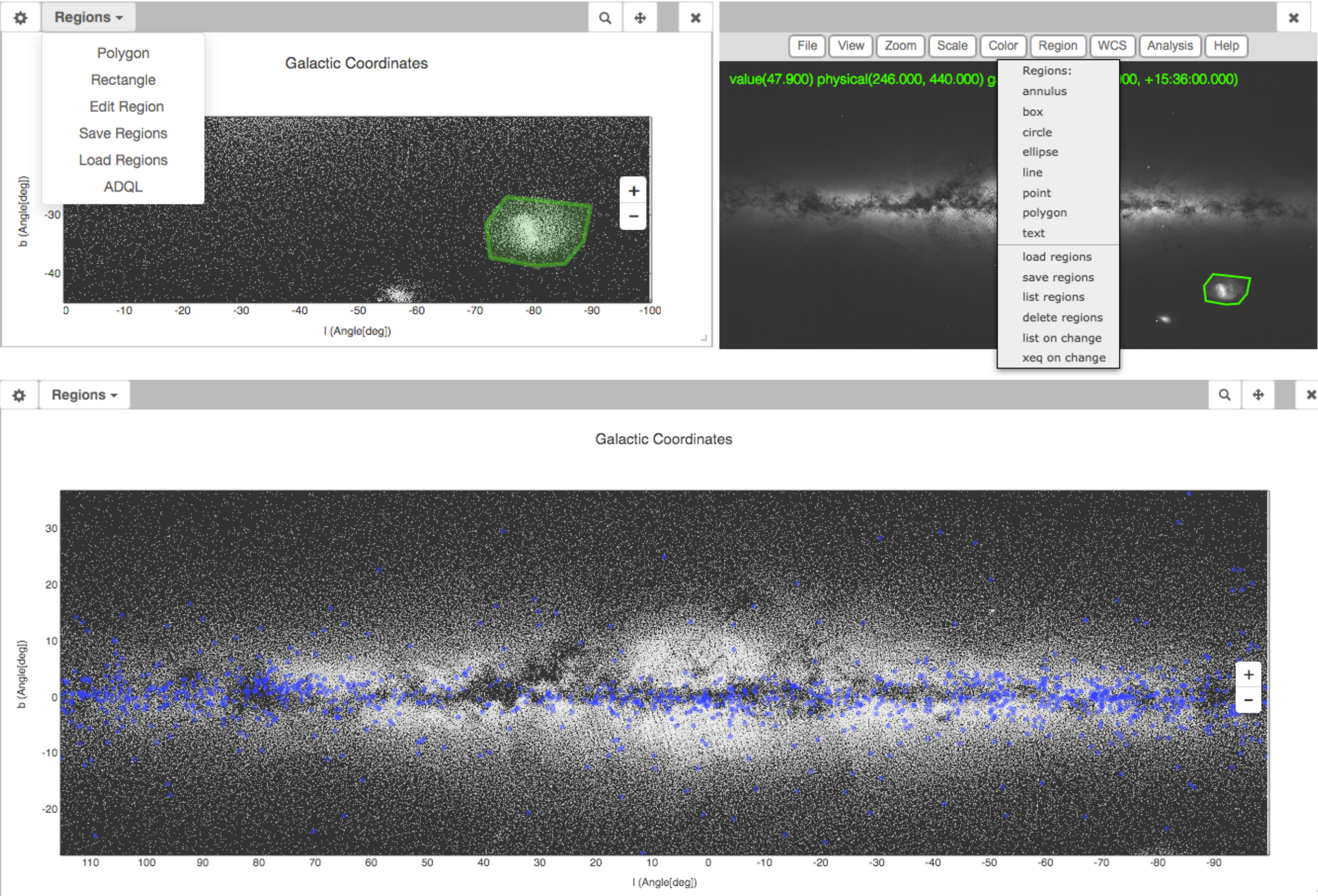


Configuration GUI should be

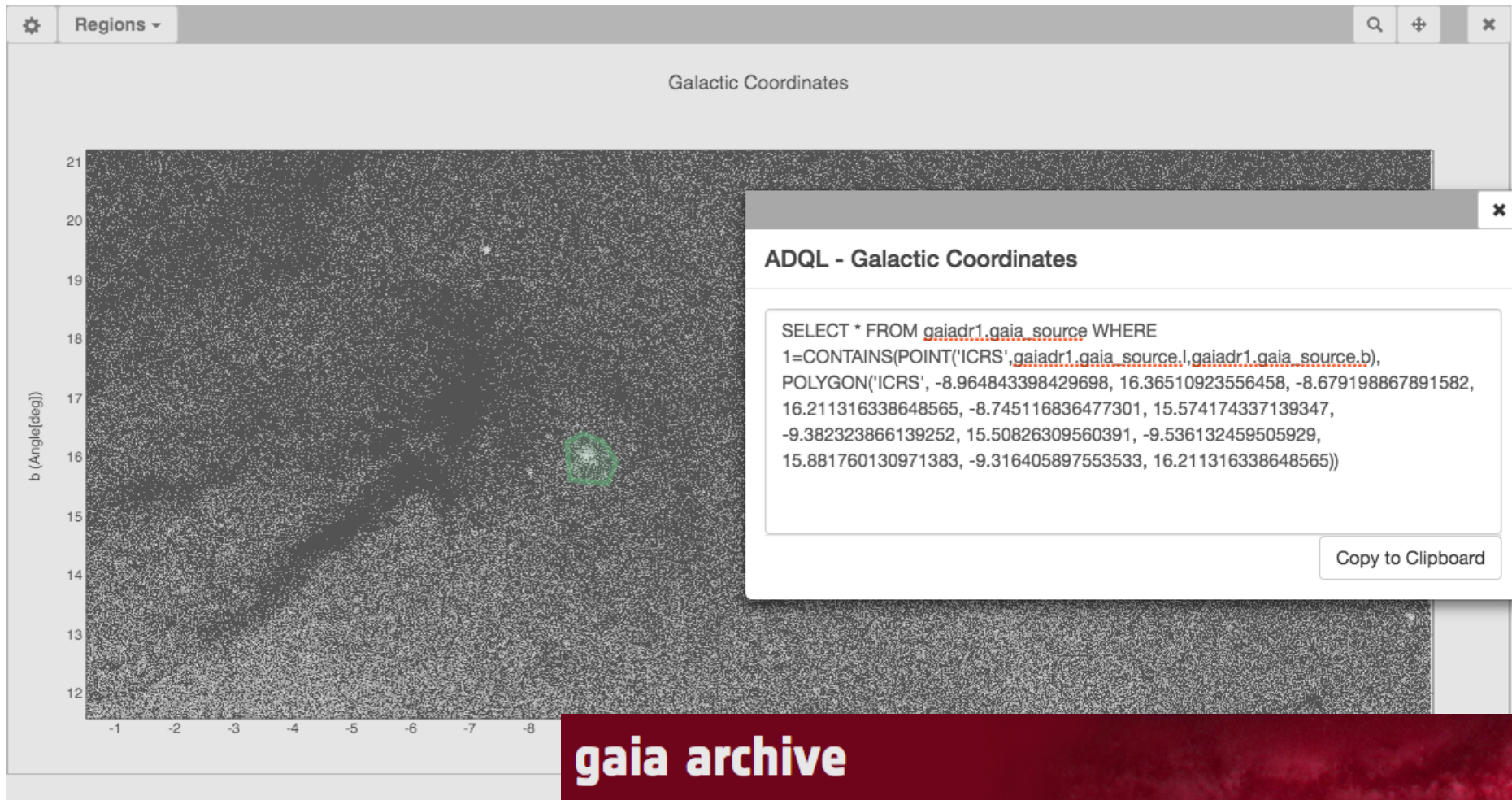
- intuitive
- minimal
- powerful



Gaia interactive visualisation portal - Regions



Gaia interactive visualisation portal - integrated archive service



Simple ADQL
visual queries

The screenshot shows the Gaia archive search interface. The top navigation bar includes links for HOME, SEARCH, STATISTICS, VISUALIZATION, HELP, and DOCUMENTATION. The main section is titled 'gaia archive' and features a red background with the ESA logo. Below the navigation bar, there are tabs for 'Simple Form', 'ADQL Form', and 'Query Results'. The 'ADQL Form' tab is active, showing a 'Job name:' field and a text area for the ADQL query. The query is the same as the one shown in the previous screenshot. Below the query text area are buttons for 'Reset Form' and 'Submit Query'. The 'Query Results' tab is also visible, showing a table with columns for Status, Job, Creation date, Num. rows, and Size. The table contains one row of results for job 14780657160940, created on 02-Nov-2016, with 50419 rows and a size of 9 MB. The bottom of the page includes a footer with the copyright notice 'COPYRIGHT 2000 - 2016 © EUROPEAN SPACE AGENCY. ALL RIGHTS RESERVED.' and the version number '(v1.1.0)'.

gaia archive

HOME SEARCH STATISTICS VISUALIZATION HELP DOCUMENTATION

Simple Form **ADQL Form** Query Results

Job name:

Query examples

```
1 SELECT * FROM gaiadr1.gaia_source WHERE 1=CONTAINS(POINT('ICRS',gaiadr1.gaia_source.l,gaiadr1.gaia_source.b),
POLYGON('ICRS', -8.964843398429698, 16.36510923556458, -8.679198867891582, 16.211316338648565, -8.745116836477301,
15.574174337139347, -9.382323866139252, 15.50826309560391, -9.536132459505929, 15.881760130971383,
-9.316405897553533, 16.211316338648565))
```

Reset Form Submit Query

Status	Job	Creation date	Num. rows	Size
✓	14780657160940	02-Nov-2016, 05:48:36	50419	9 MB

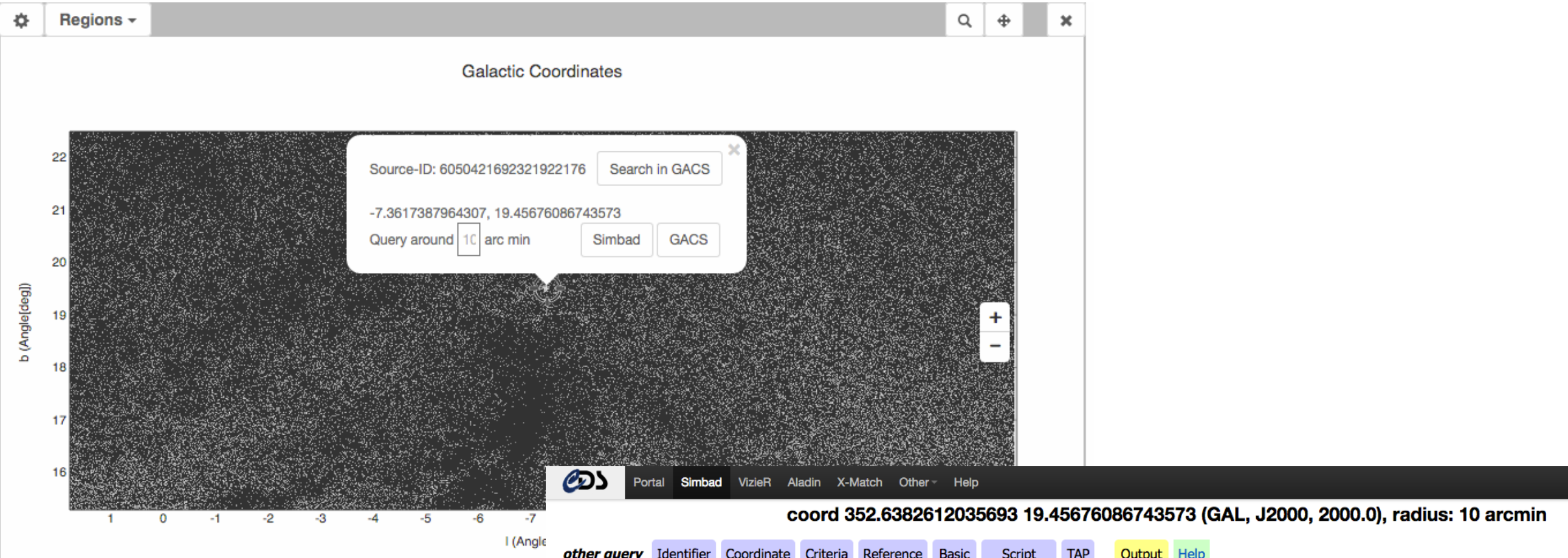
1-1 of 1

Apply jobs filter Filter this session ☒ Select all jobs ☐ Delete selected jobs

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Gaia interactive visualisation portal

- integration with Gaia archive
- CDS services: simbad, sesame name resolver



Query : coord 352.6382612035693 19.45676086743573 (GAL, J2000, 2000.0), radius: 10 arcmin C.D.S. - SIMBAD4 re

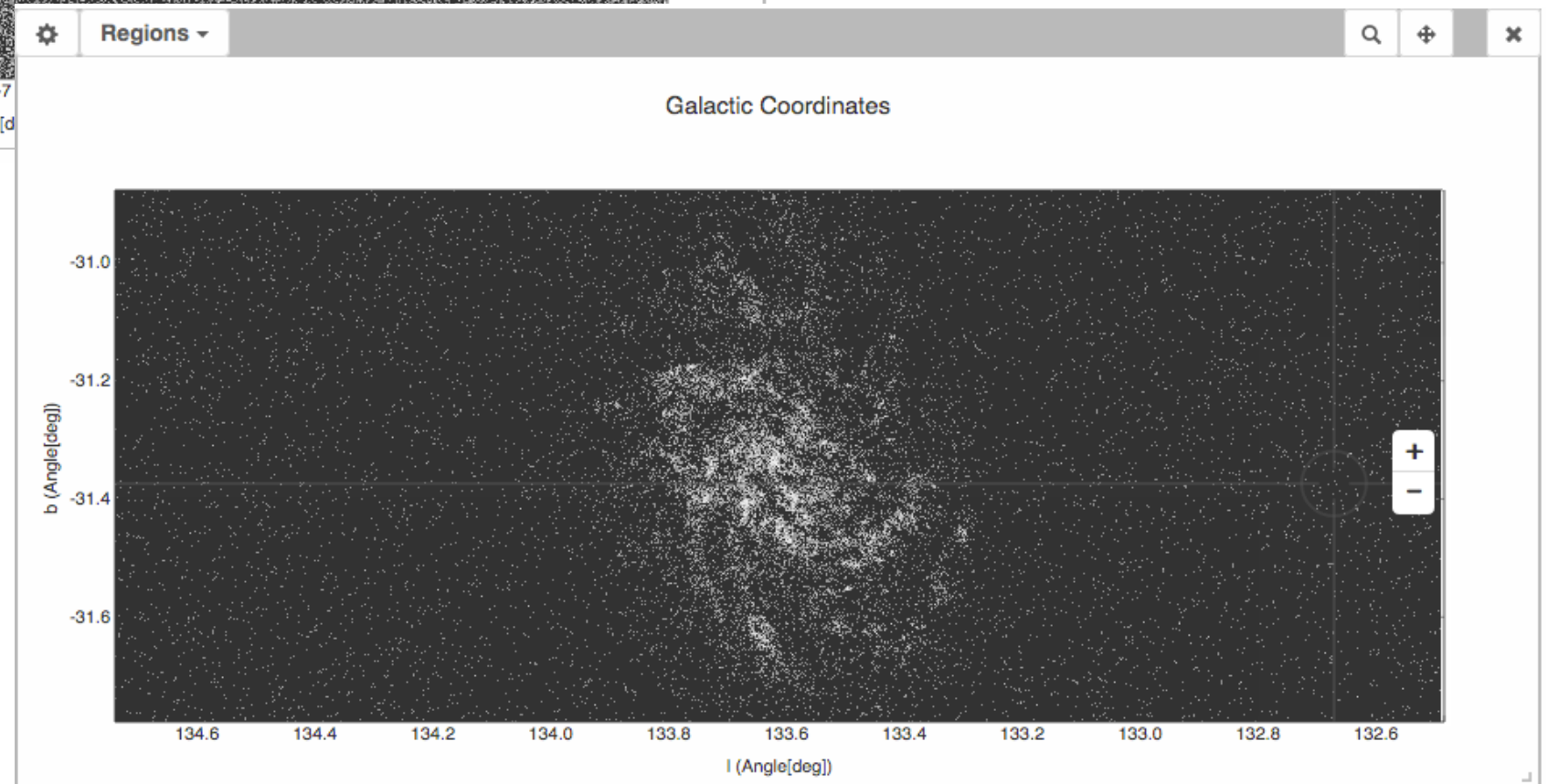
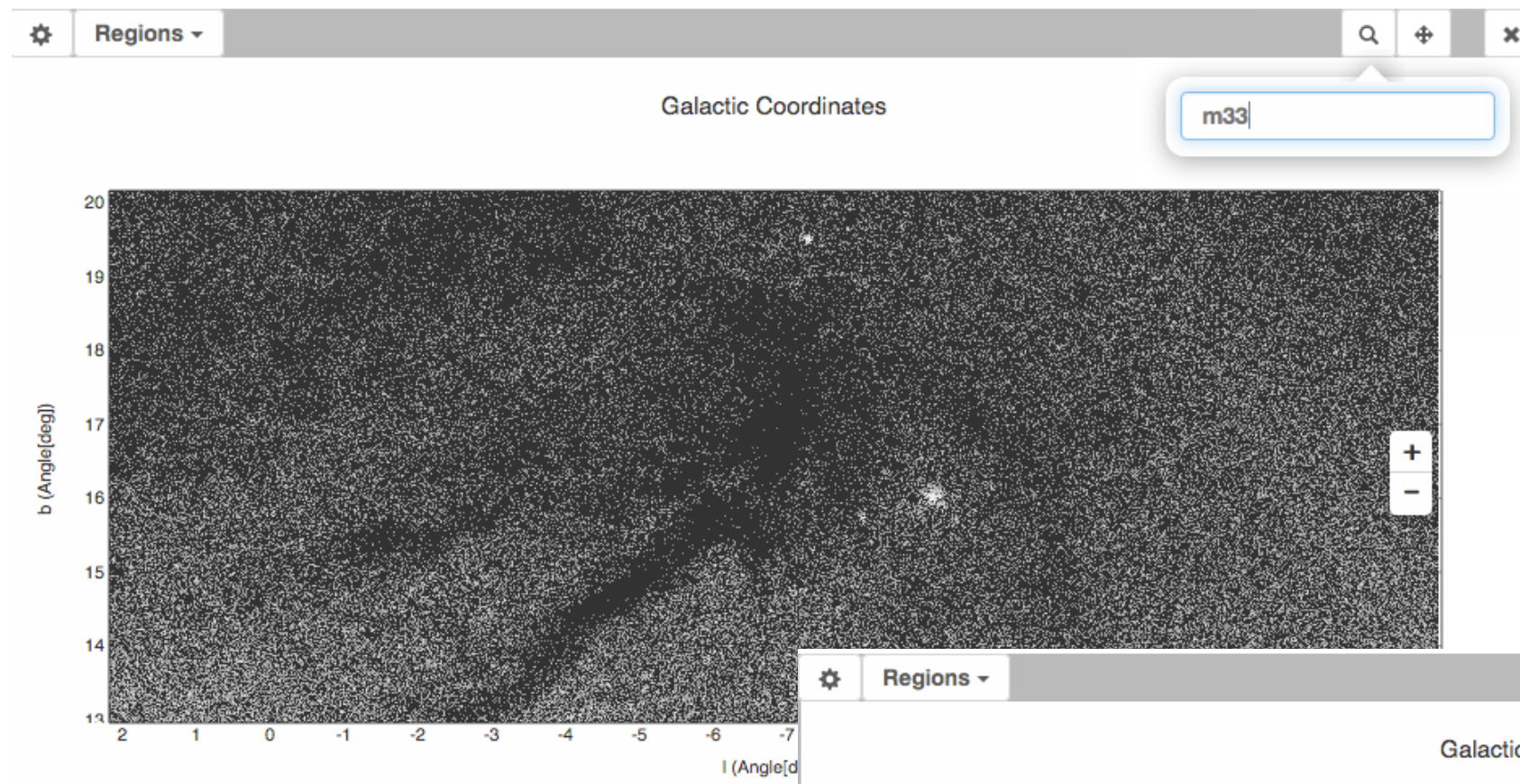
Number of rows : 152

Show 100 entries

N	Identifier	dist(asec)	Otype	ICRS (J2000) RA	ICRS (J2000) DEC	Mag U	Mag B	Mag V	Mag R	Mag I	Spectral type
1	[MMP2009] M80 13787	29.35	HB*	16 16 59.111	-22 59 53.45	18.056		18.261			~
2	[MMP2009] M80 14201	39.54	HB*	16 16 57.762	-22 59 37.14	17.727		17.898			~
3	CXOU J161659.8-225931	53.79	X	16 16 59.88	-22 59 31.1						~
4	CXOU J161655.5-225925	59.56	X	16 16 55.58	-22 59 25.7						~
5	CXOU J161702.0-230033	60.76	X	16 17 02.05	-23 00 33.0						~

Gaia interactive visualisation portal

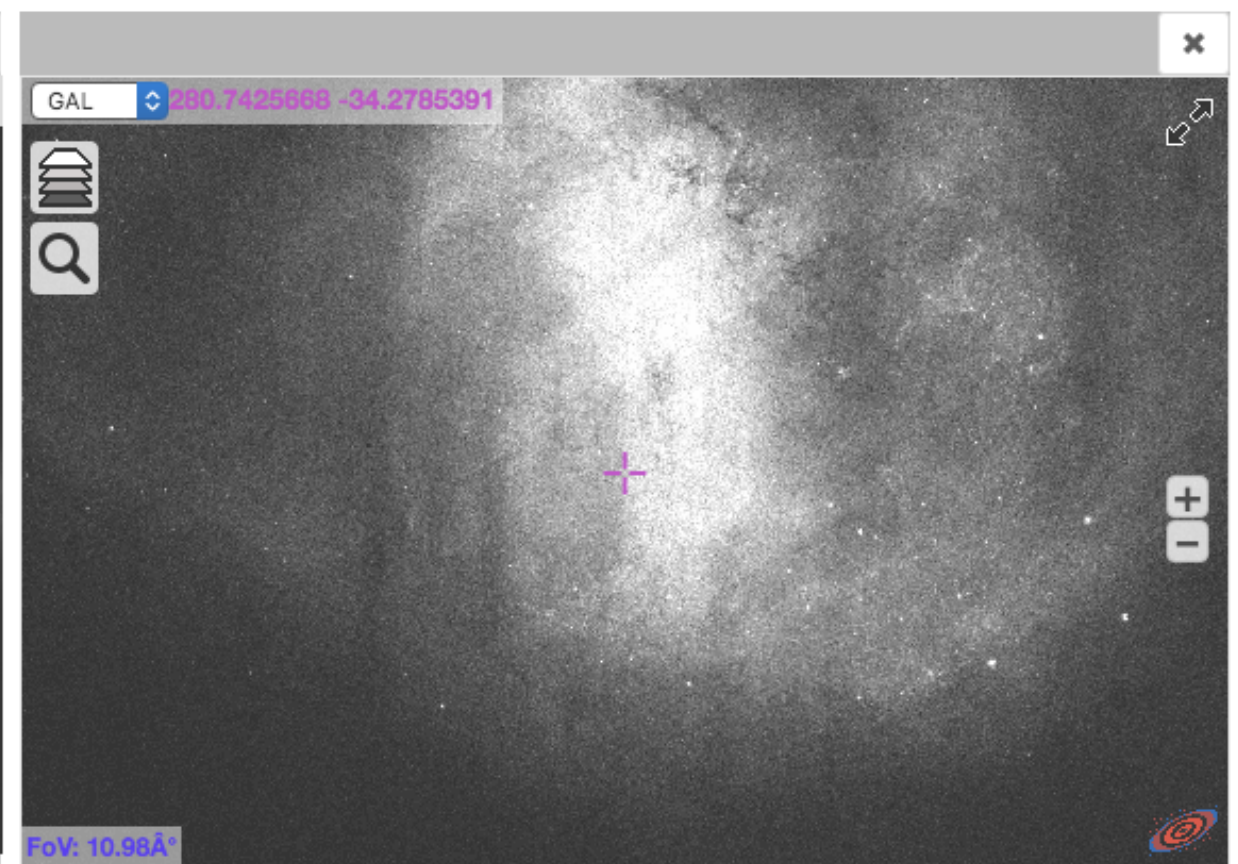
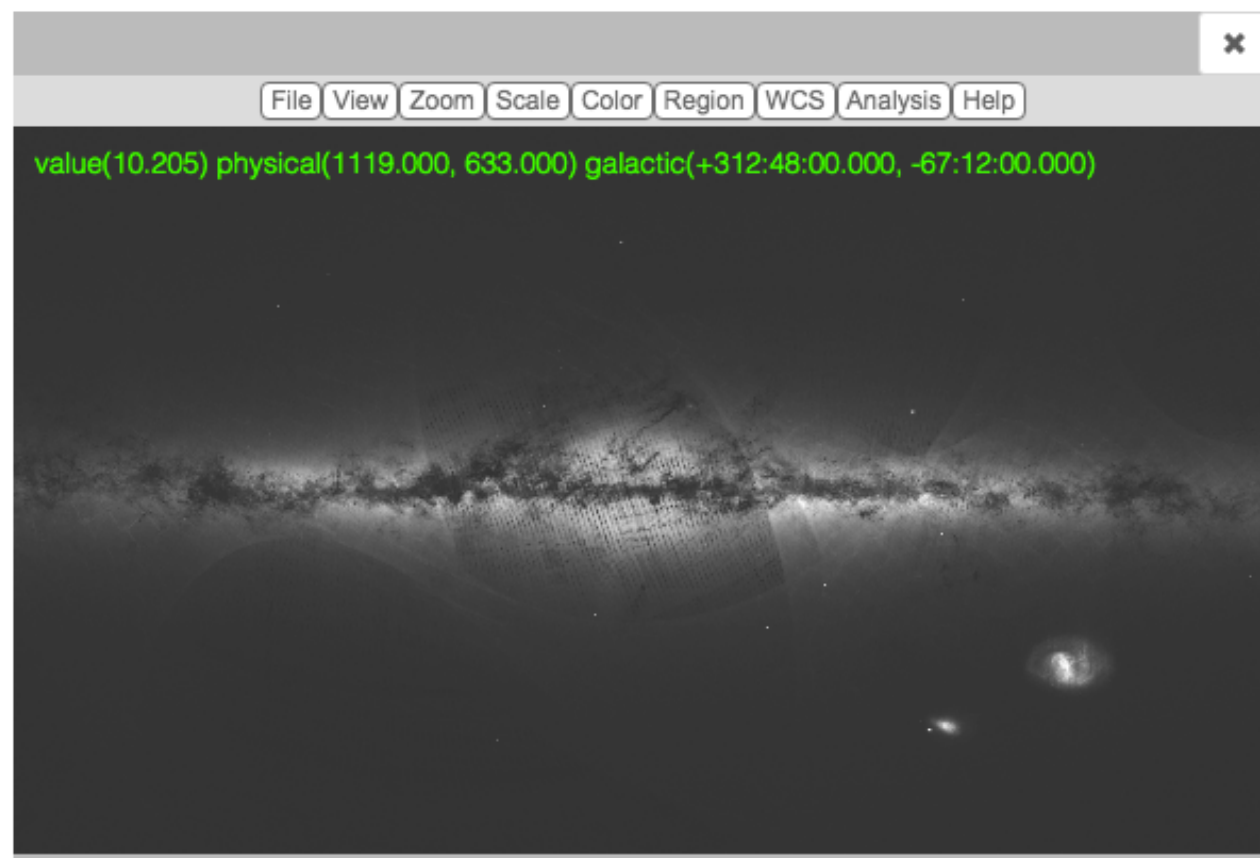
- integration with Gaia archive
- CDS services: sesame name resolver - and vice versa!



Gaia interactive visualisation portal

integration with external applications - DS9/JS9 and Aladin

- provide HiPS and fits maps
- regions
- panel with web versions in visualisation portal



Gaia interactive visualisation portal

Scalable: (at 19:00 CEST, Sep 14)

Single accesses: 4286

Accesses to help: 173

Histograms: 145

Scatter plots: 5650

Scatter plot tiles: 1557153

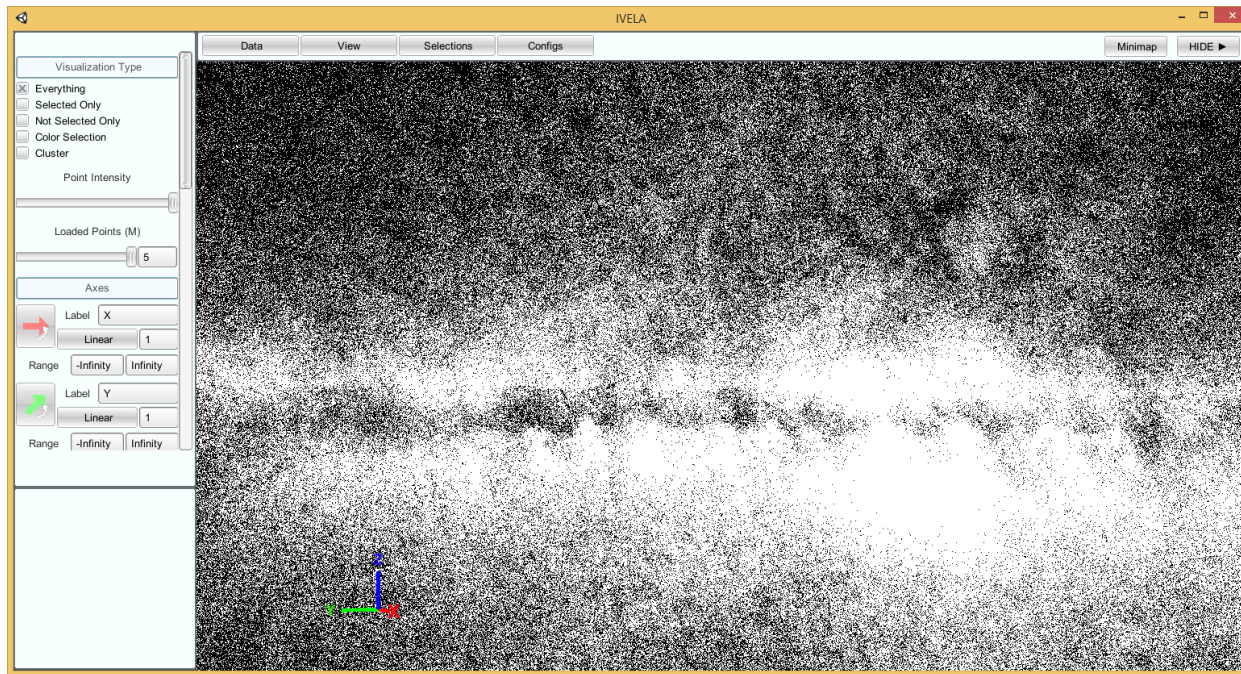
Beyond Gaia DR1

- Further integration with Archive: authentication, user space, ADQL
- More plot types (density 2D, KDE, projections, 3D)
- Multiple layers, user tables
- GAVIDAV

To be discussed in the visualisation splinter

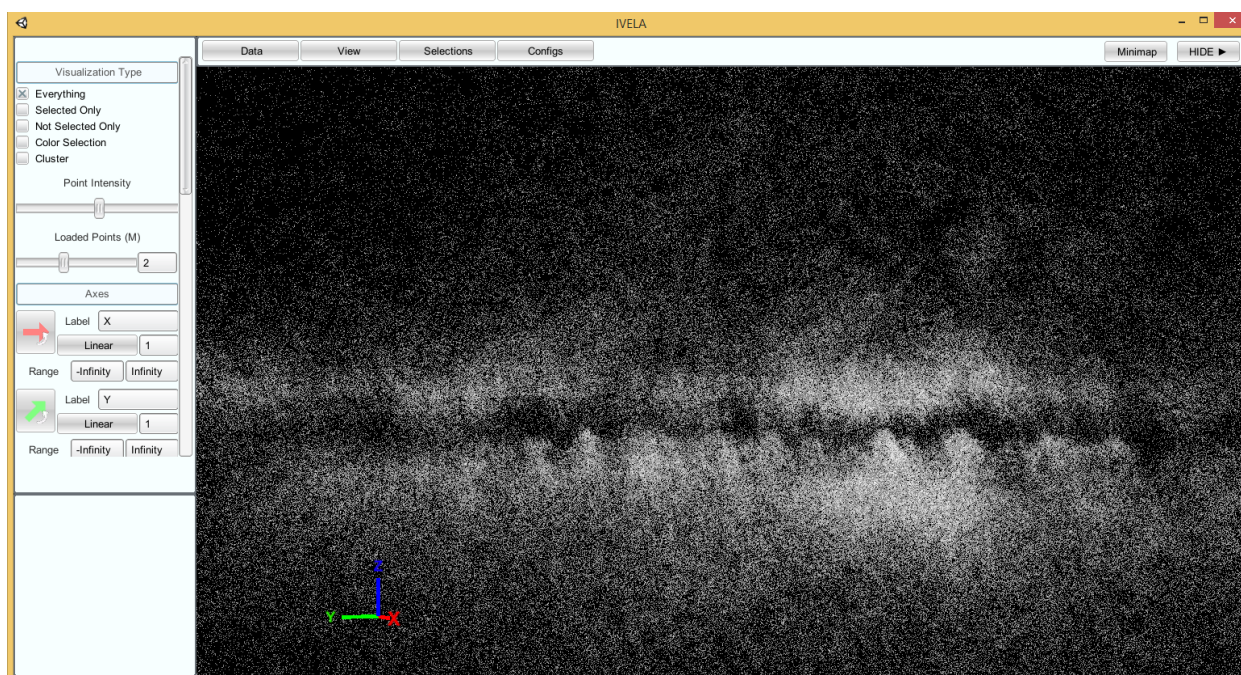
Gaia visualisation challenges

- 2D -> 3D. The extra dimension does make a difference



External 3D navigator
receiving from Vis Server at
ESAC

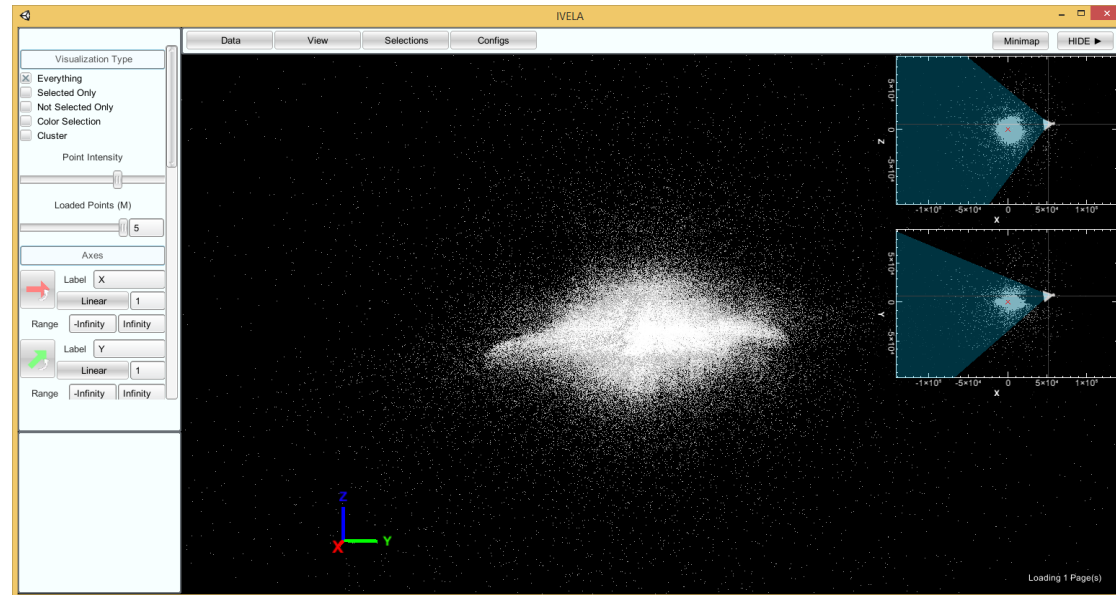
View of the GUMS GC. Full
point intensity and
maximum simultaneous
points



Limited to 2 million and
medium point intensity

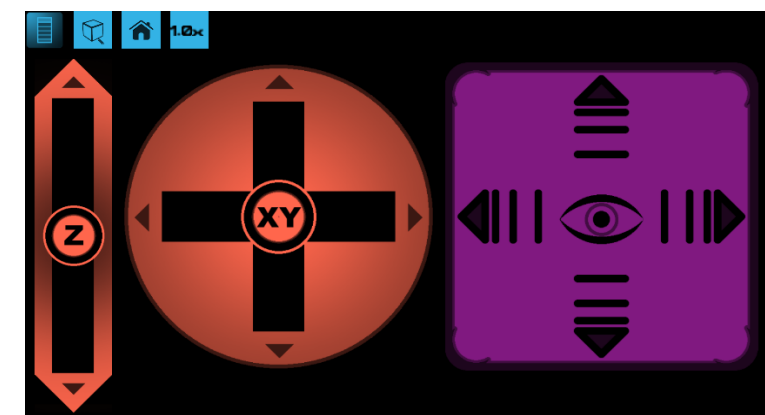
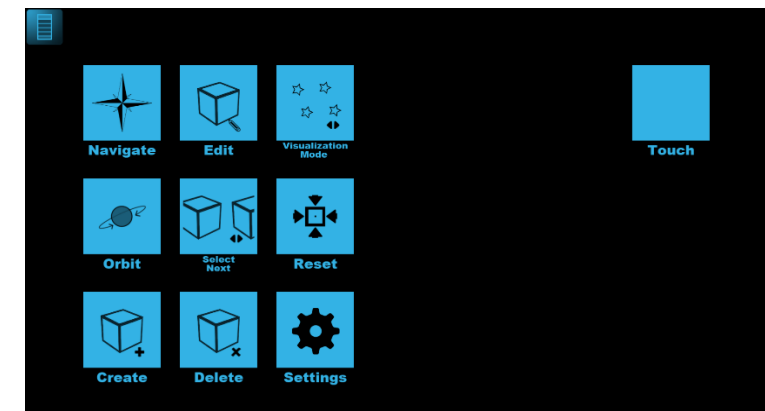
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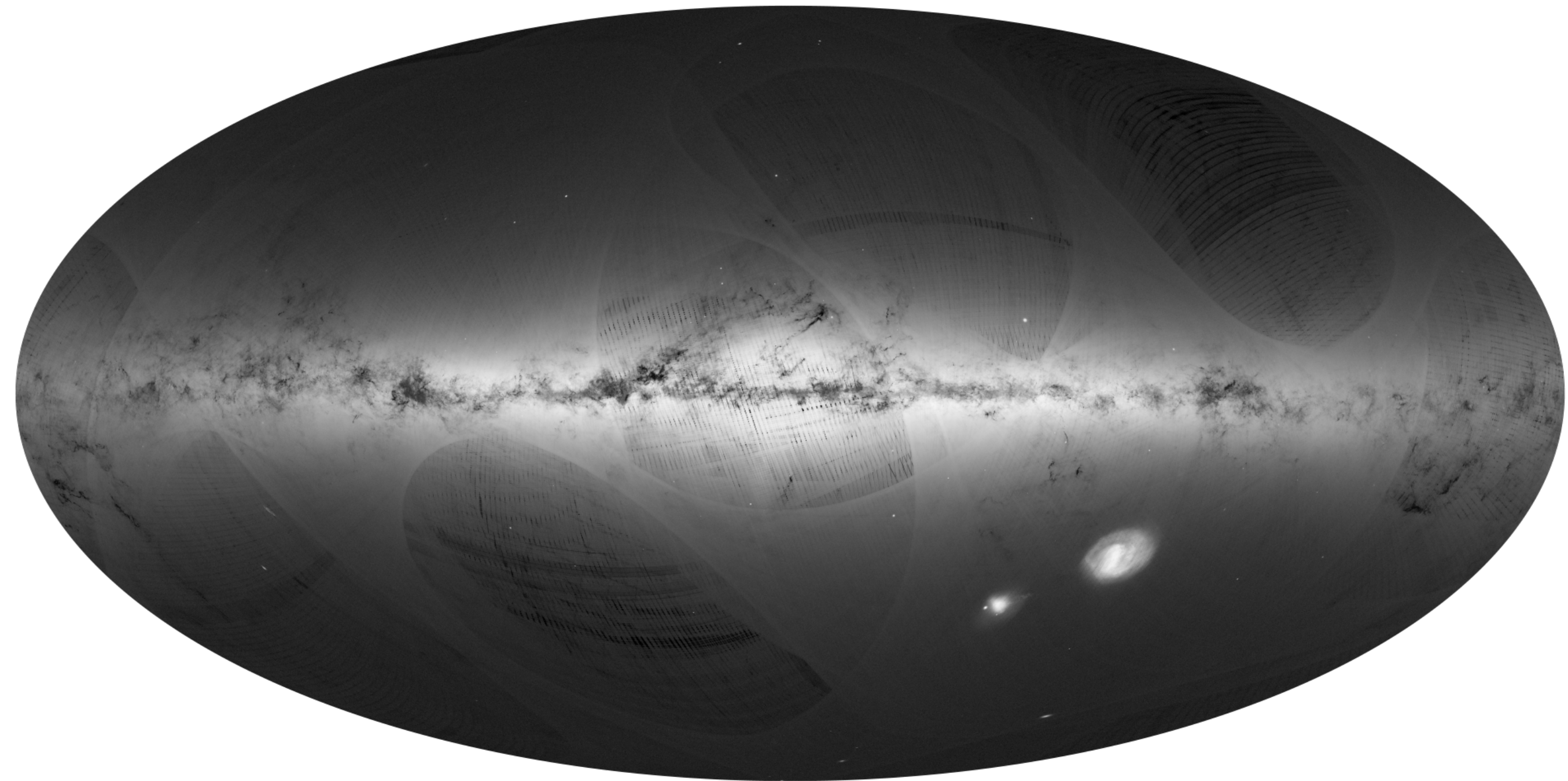


Mini map feature

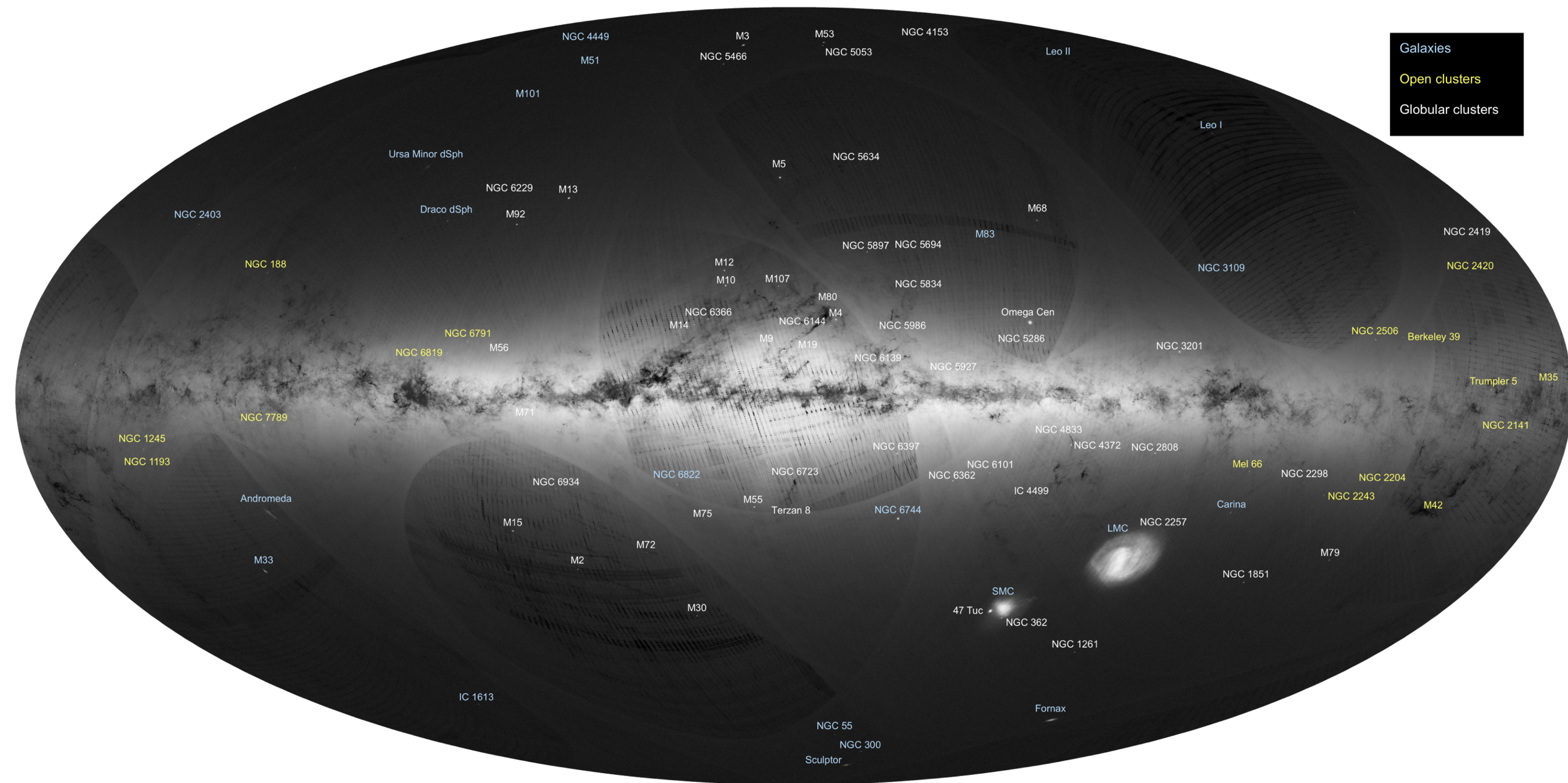
Advanced 3D selection and interfaces



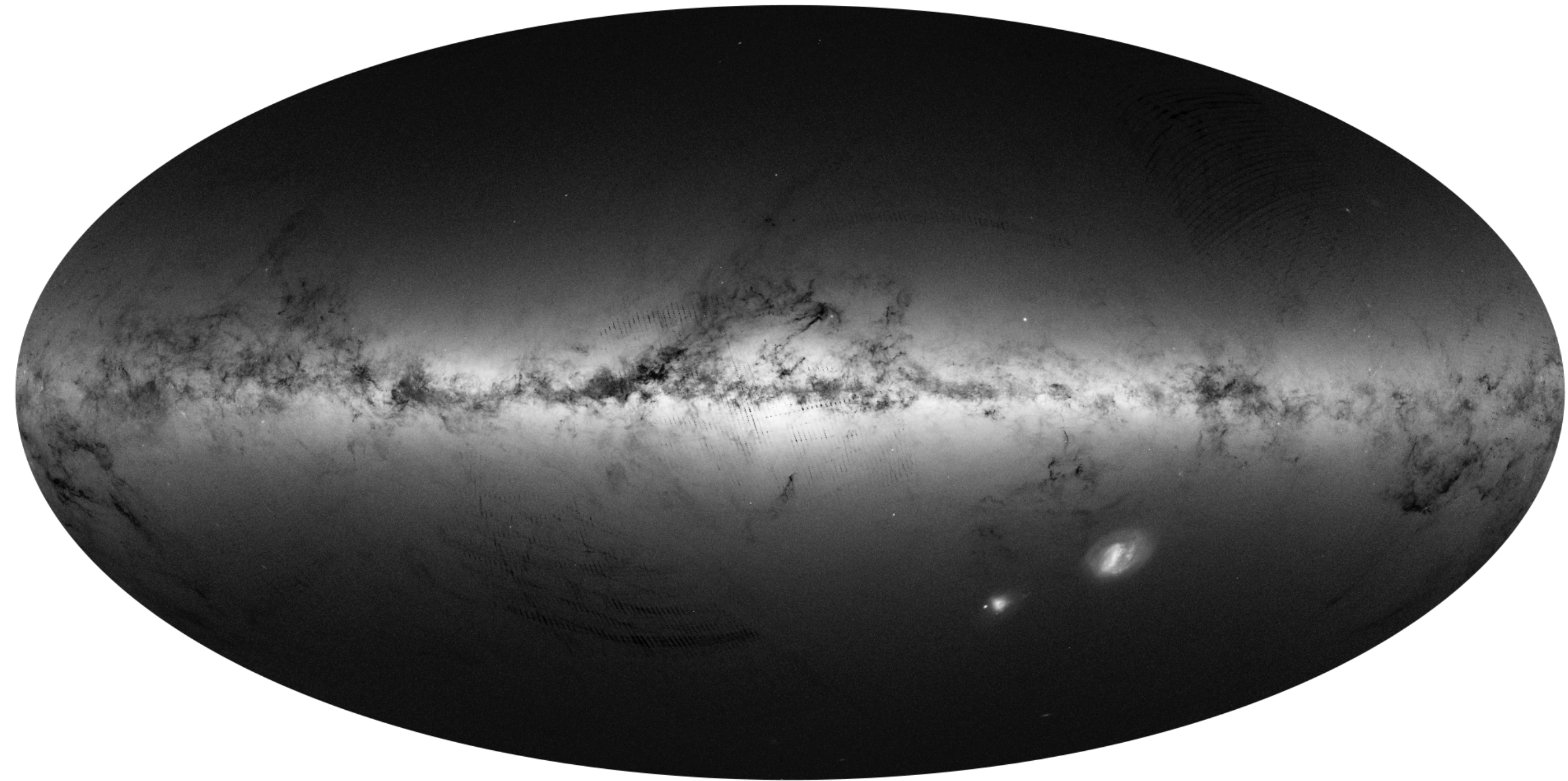
Gaia source density map - GDR1: September 14

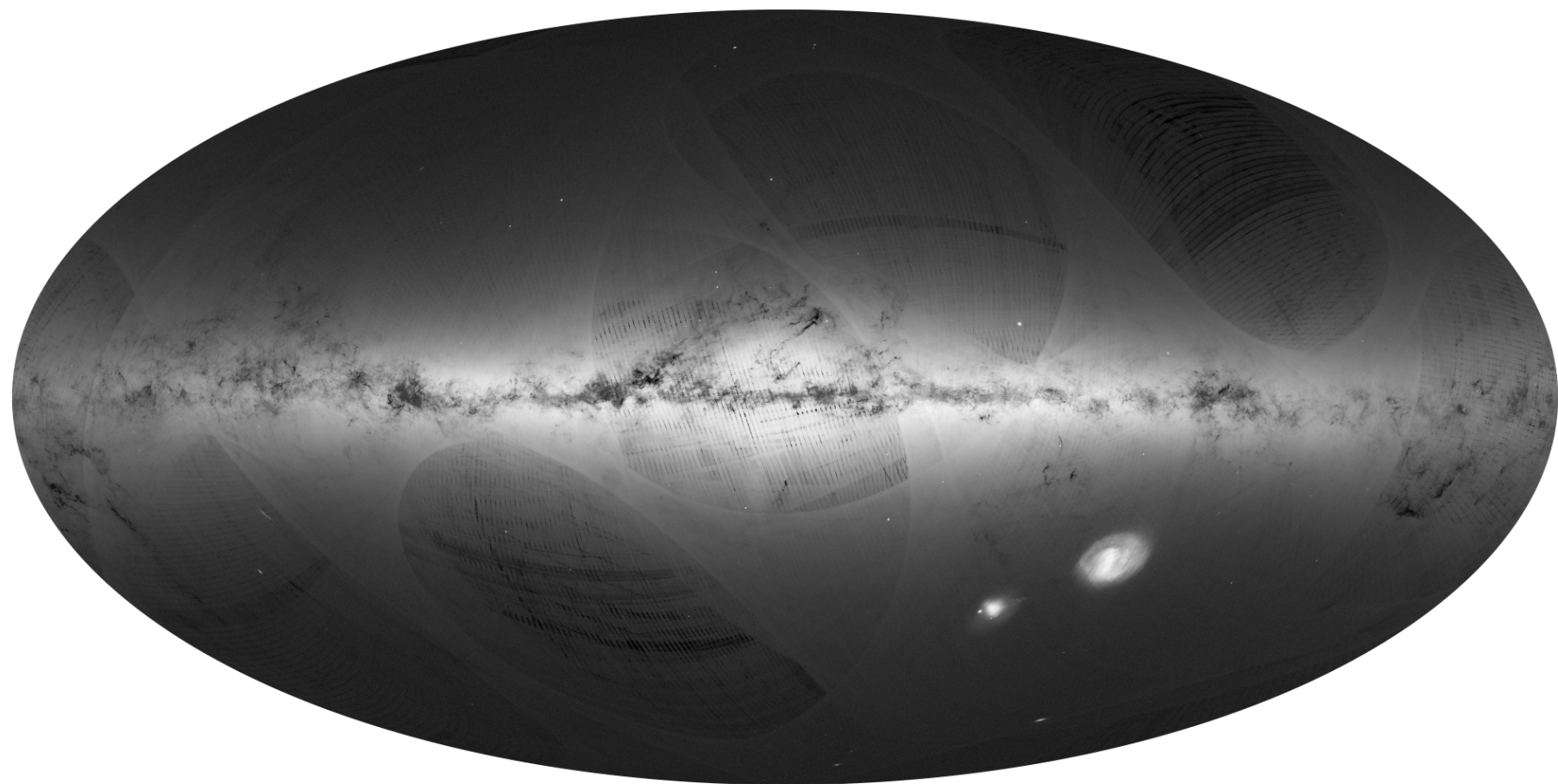


Gaia source density map - GDR1: September 14



Gaia source **flux** map -
GDR1: September 14

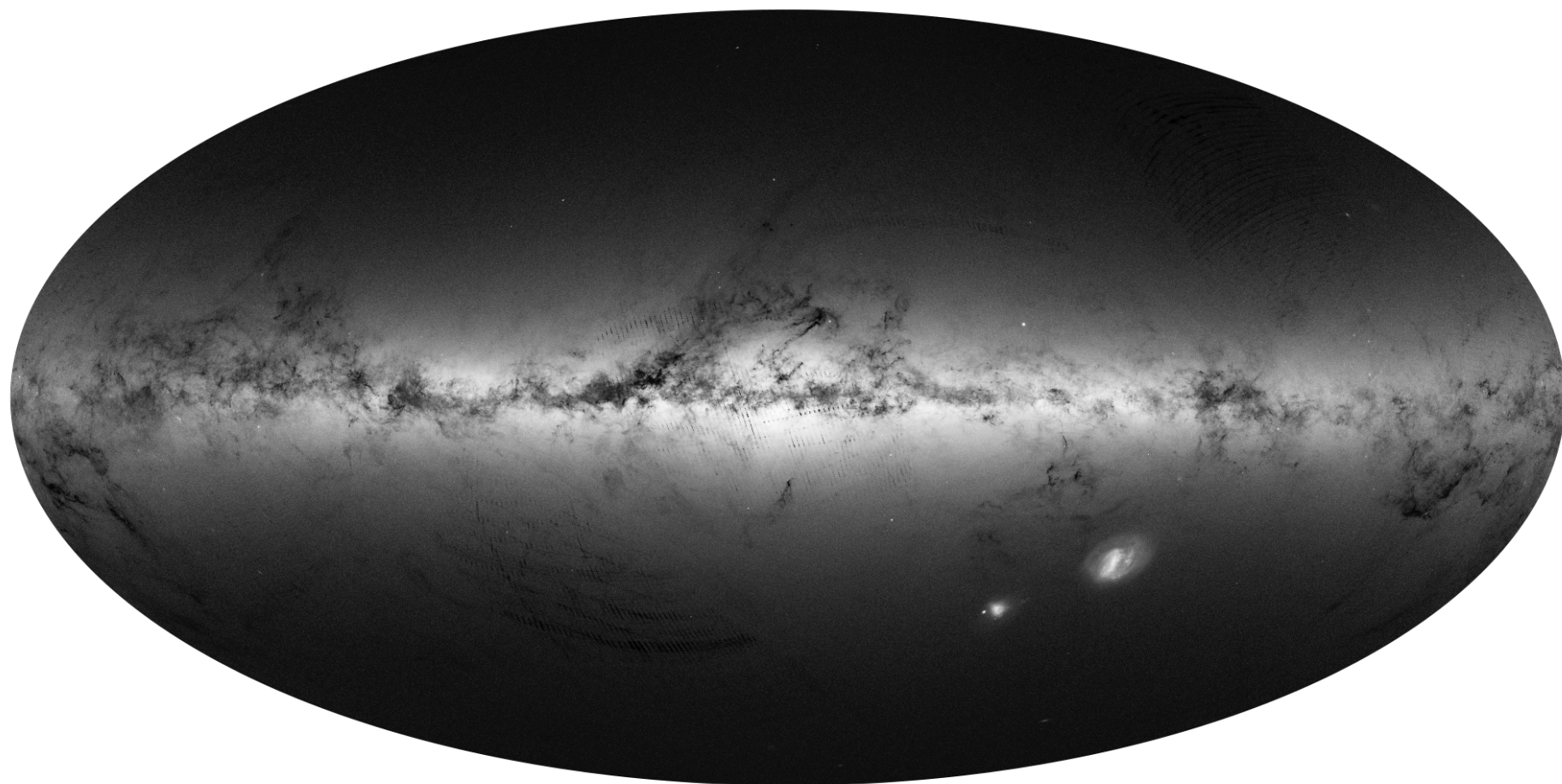




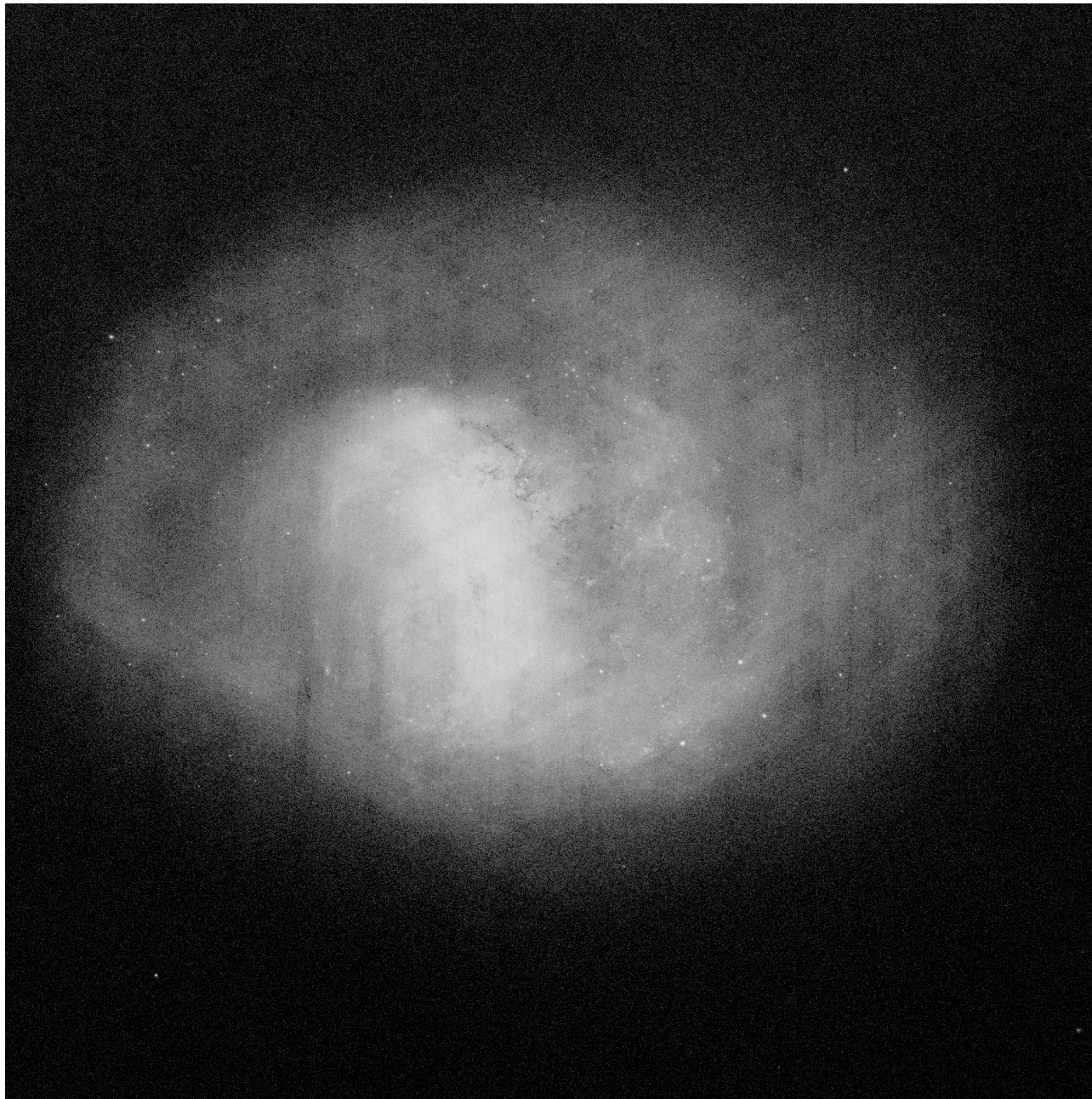
Gaia source
density and flux
representations:

complementary
views or **stories**

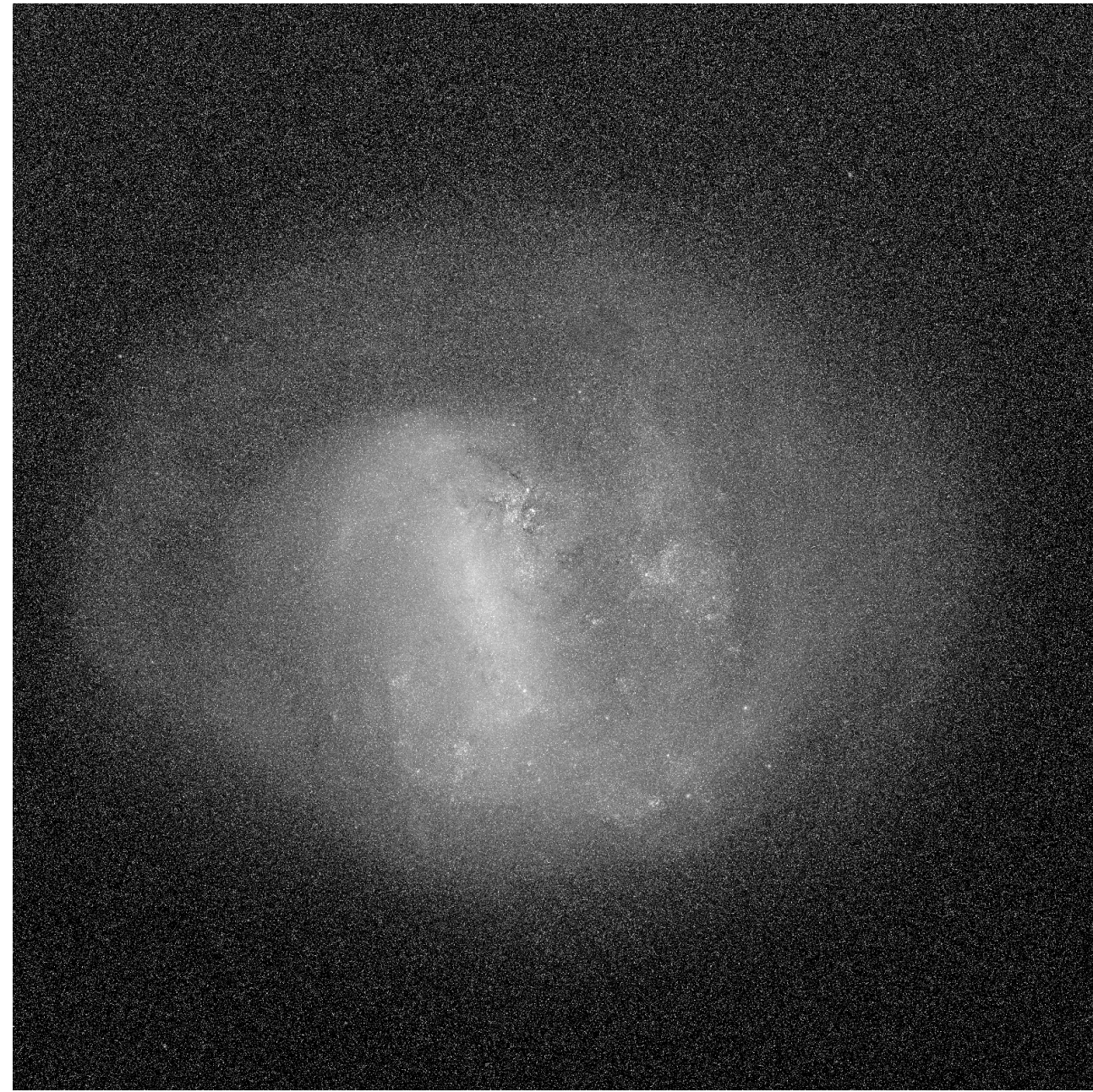
more stories out
there



Part of making
the richness of
the archive
intelligible

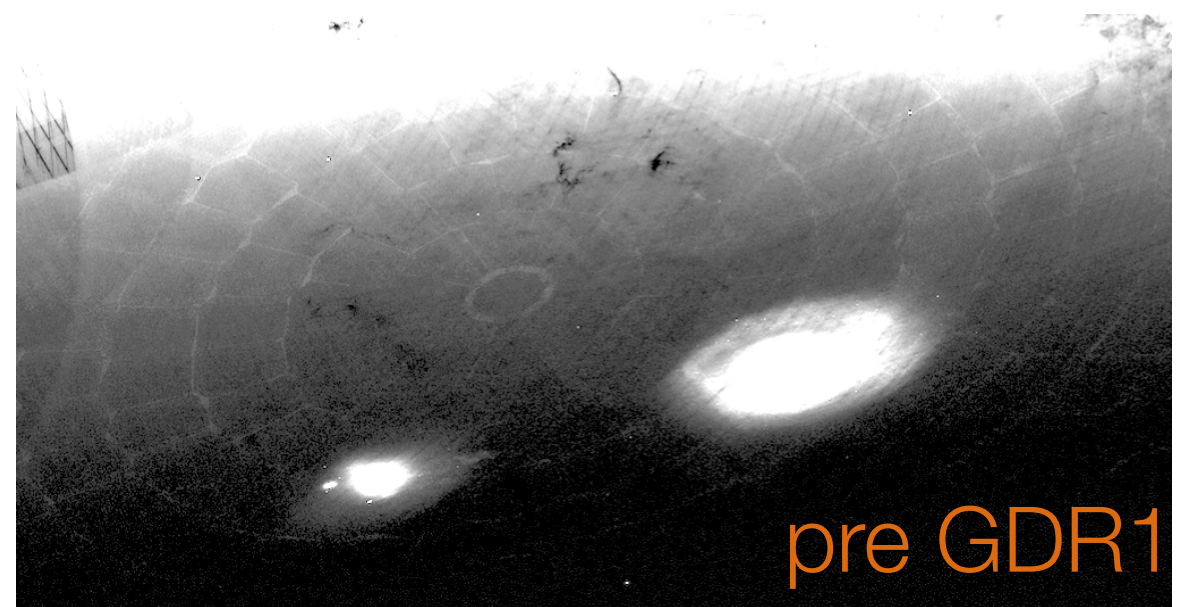
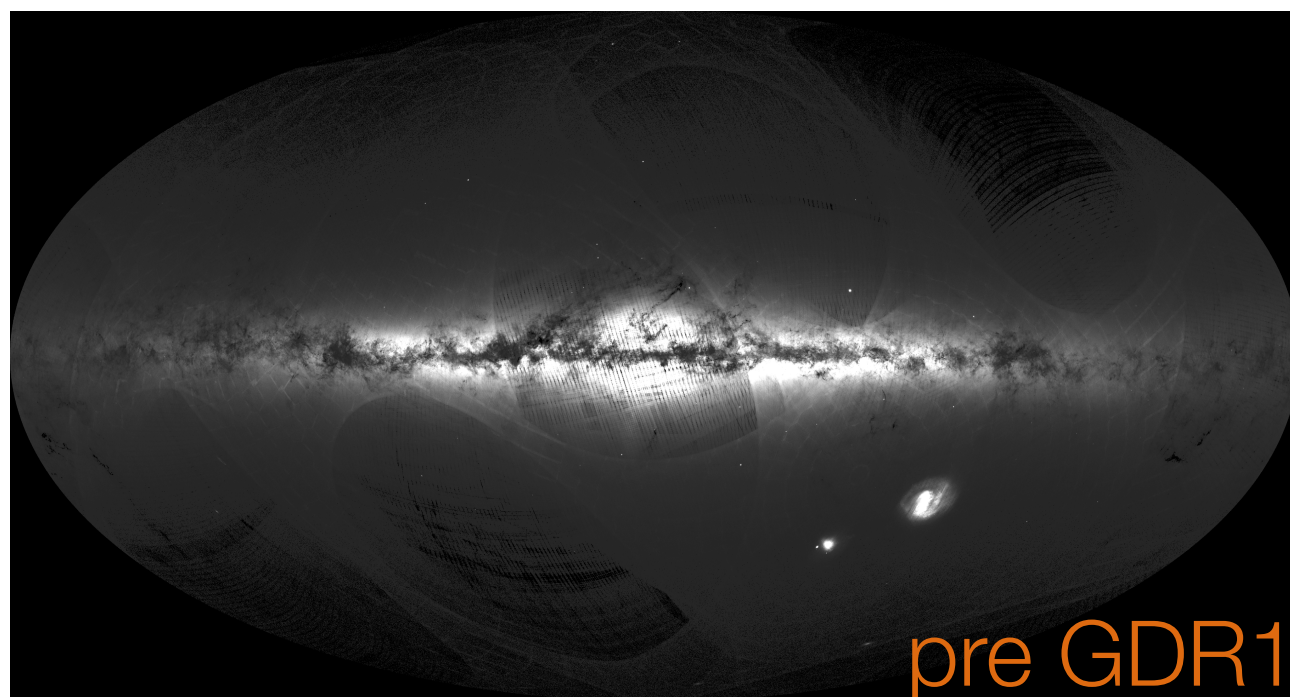
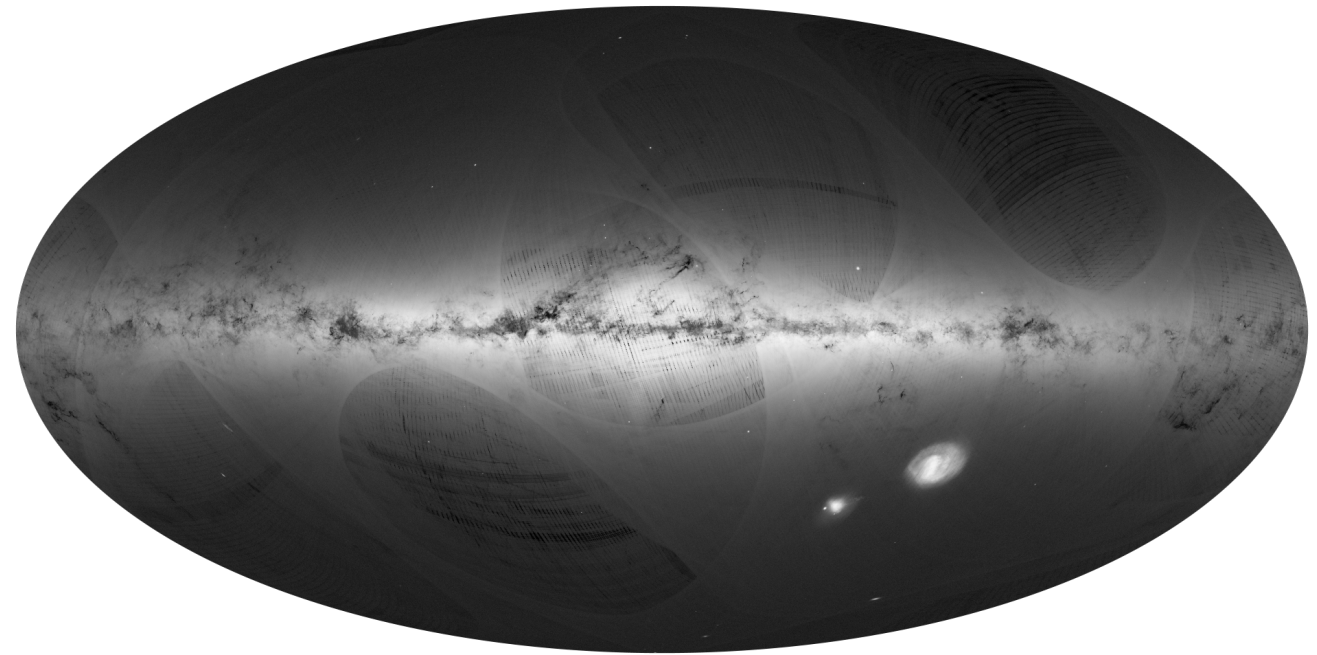
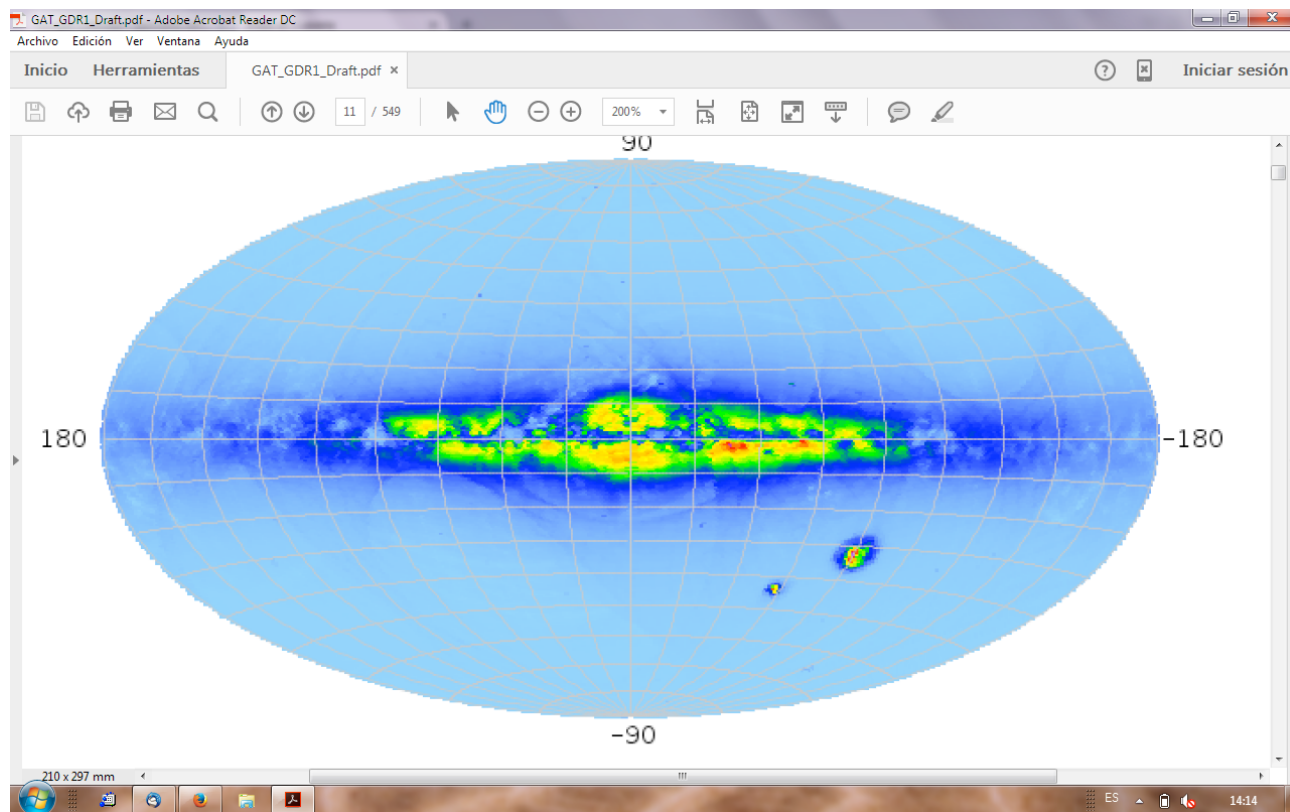


LMC density map

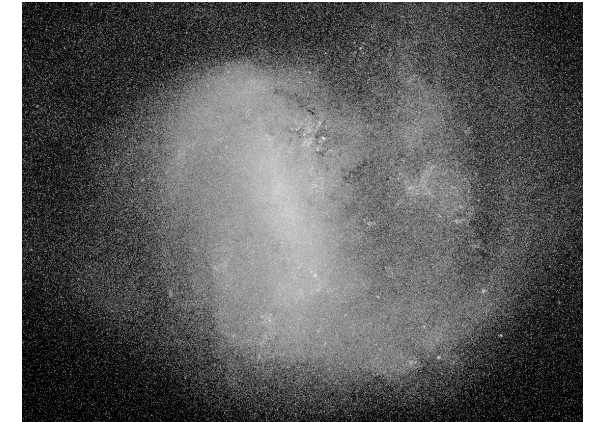
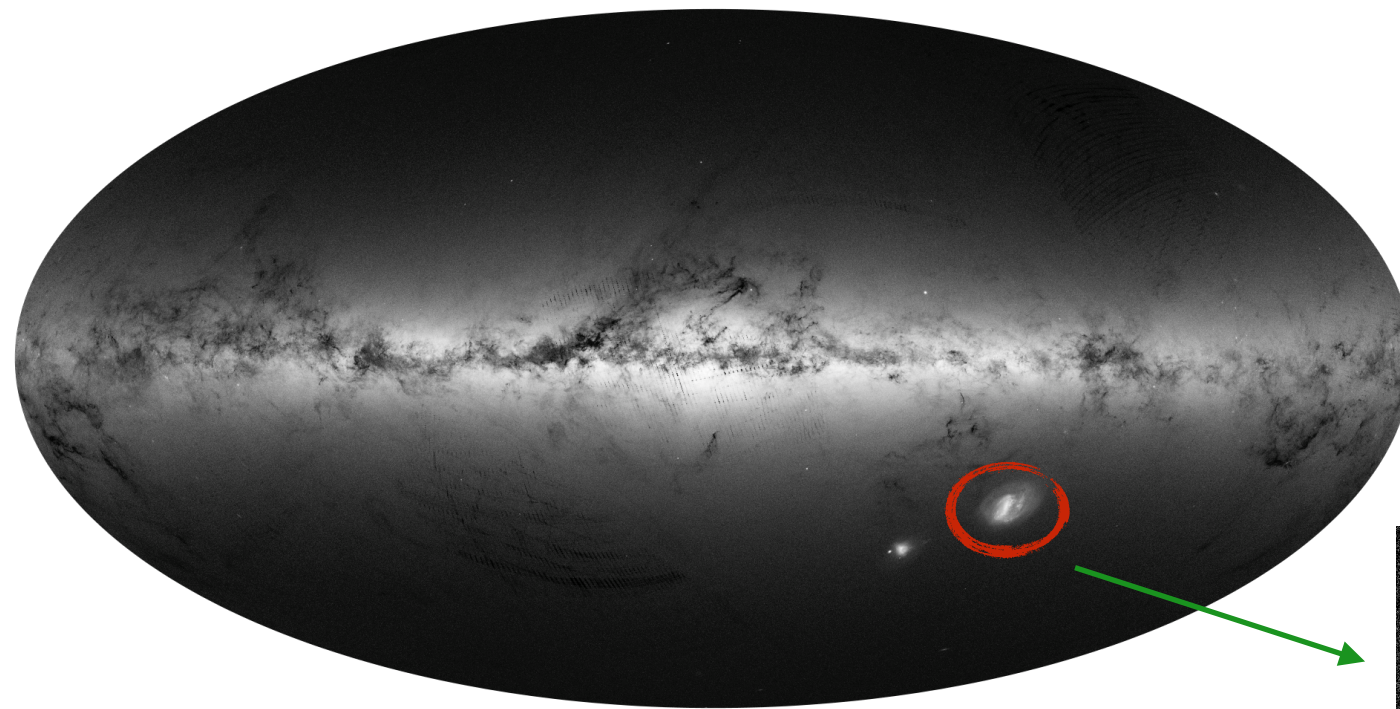


LMC G flux based map

Not straightforward!

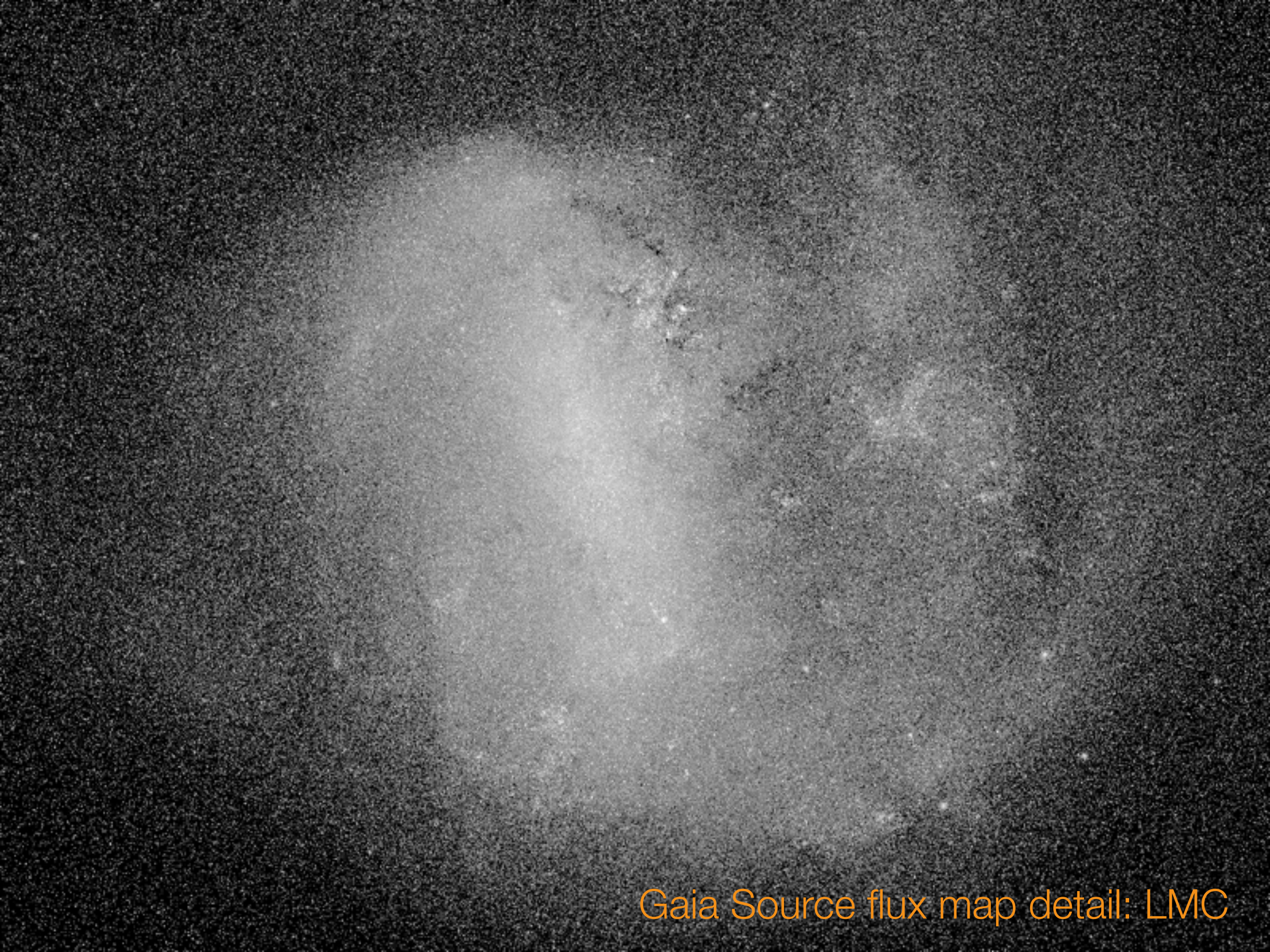


Zooming!



Levels of detail

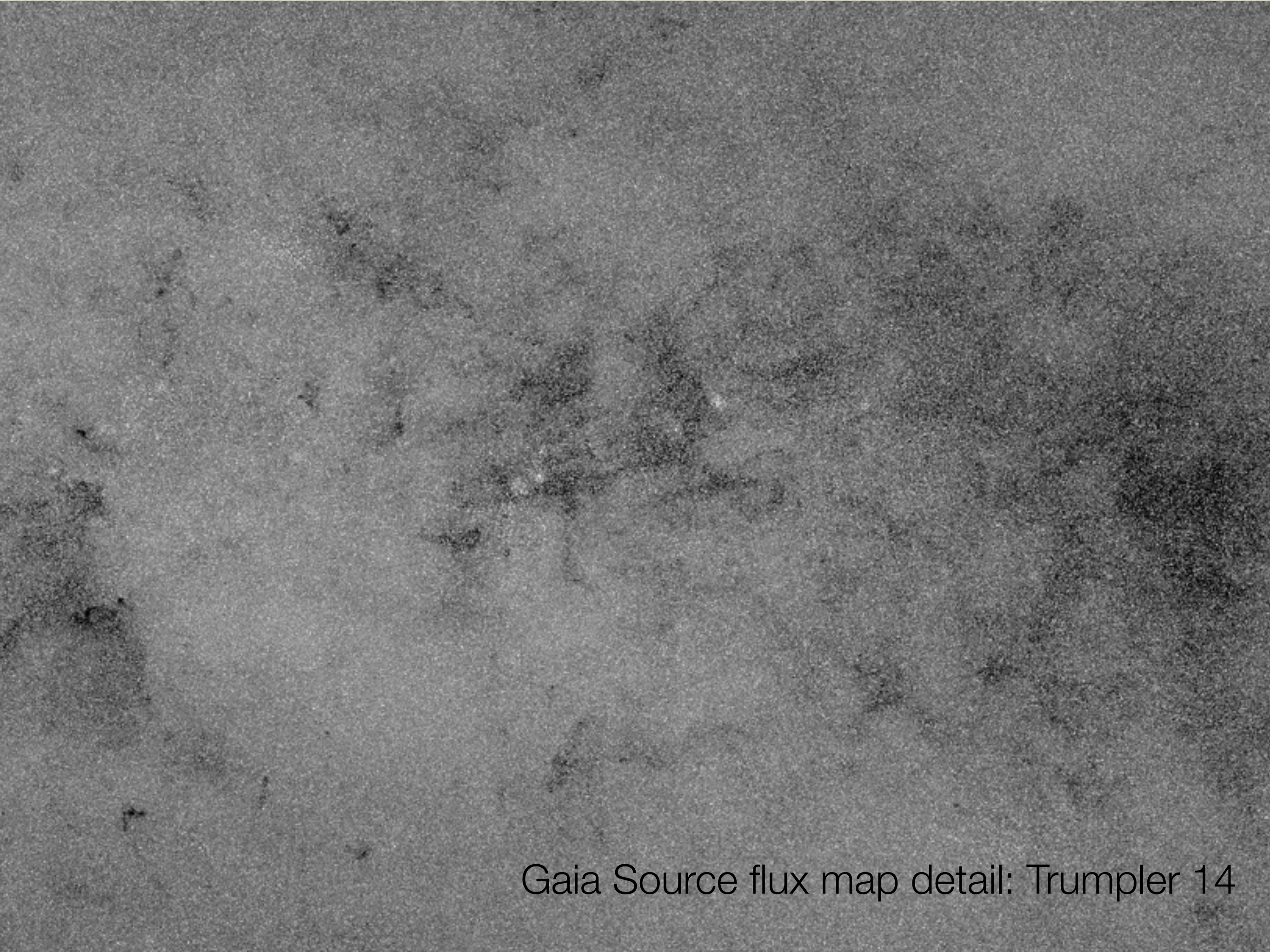
- Detail on demand: crucial for on-line serving, scalable service and smaller systems.
- Zoom levels must be computed specifically: Source properties are combined. Interpolation or re-binning is not combining and won't do.
- Each visualisation type (point clouds, fields, extended bodies, etc) require different approaches.



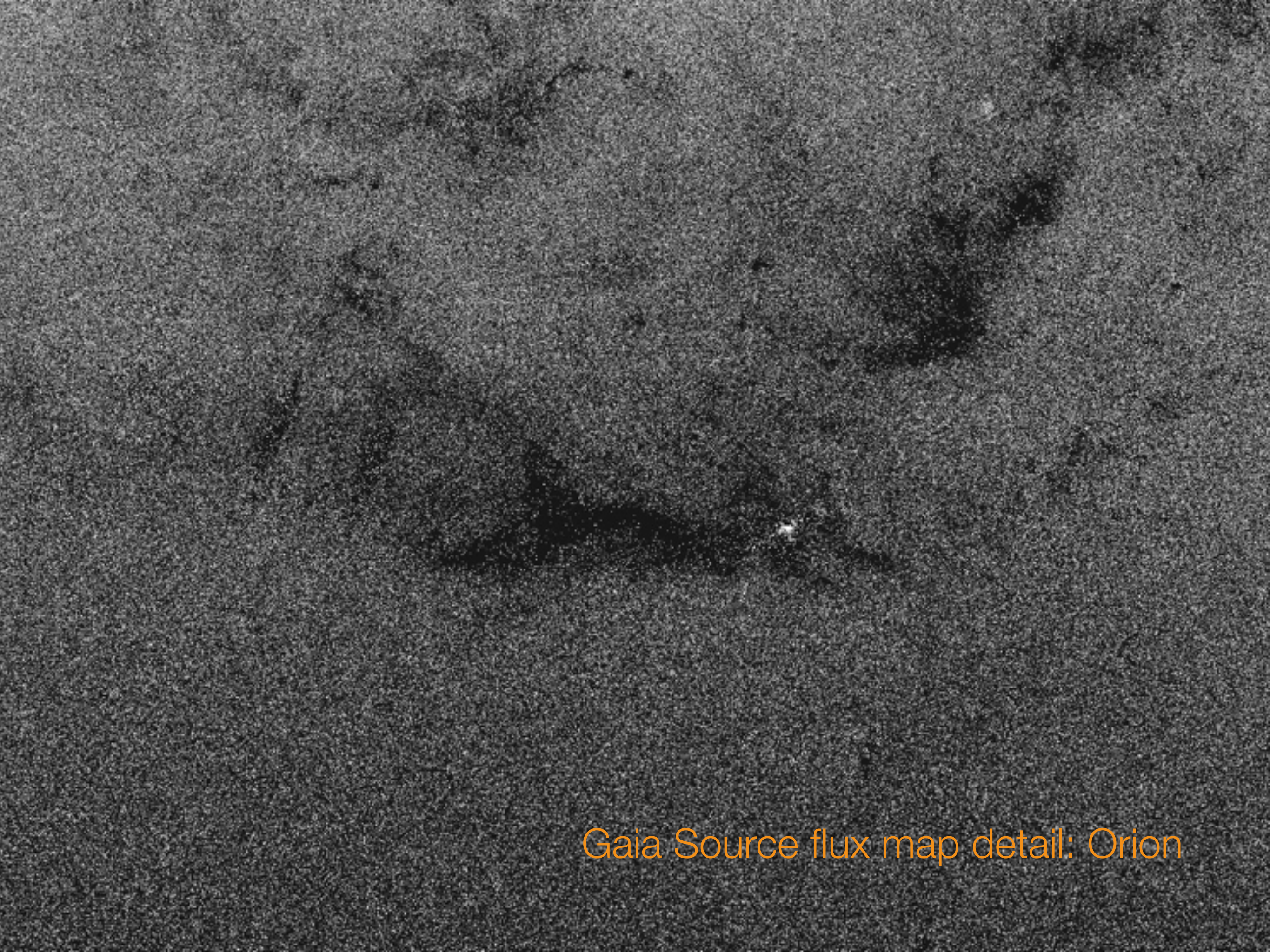
Gaia Source flux map detail: LMC



Gaia source flux map detail: Ophiuchus



Gaia Source flux map detail: Trumpler 14



Gaia Source flux map detail: Orion