

The spatial distribution of low mass star-formation and clusters



Eli Bressert, L. Testi, N. Bastian, and J. Patience



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C. Battersby, J. Di Francesco, D.
Elia, A. Facchini, A. Ginsburg,
S. Longmore, T. Megeath,
S. Molinari, M. Pestalozzi,
S. Pezzuto, S. Sadavoy, E. Schisano,
D. Kruijssen, GB/HiGAL Herschel,
GB/Orion Spitzer teams,
& et al.

**1 Do all stars form
in clusters?**

**2 Can we determine
global SF peaks?**

1 No

2 Yes

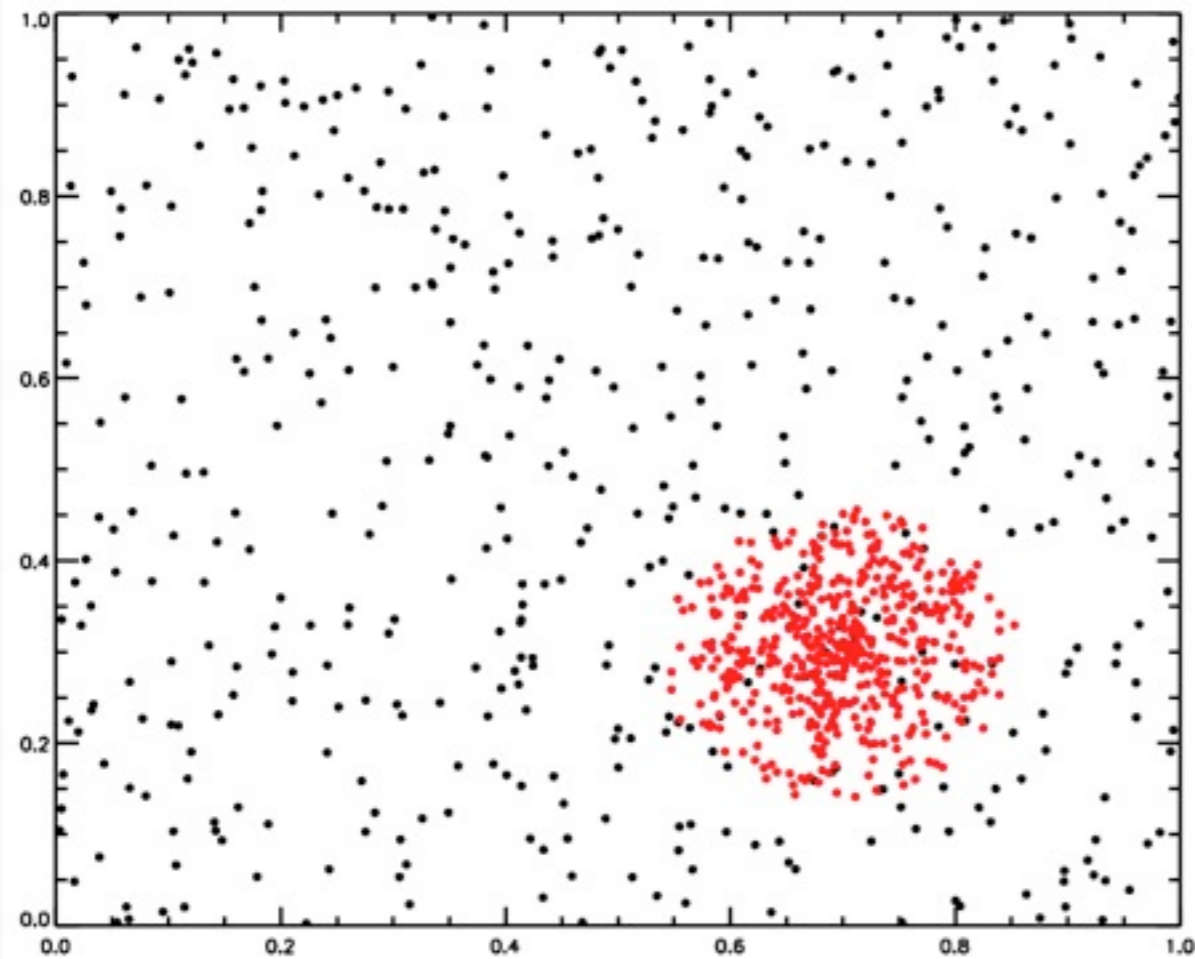
1 **YSO surface density analysis**
Bressert et al. 2010

2 **Prestellar core followup**
Bressert et al. 2011 (submitted)

**1 Do all stars form
in clusters?**

**2 Can we determine
global SF peaks?**

MULTIPLE MODES

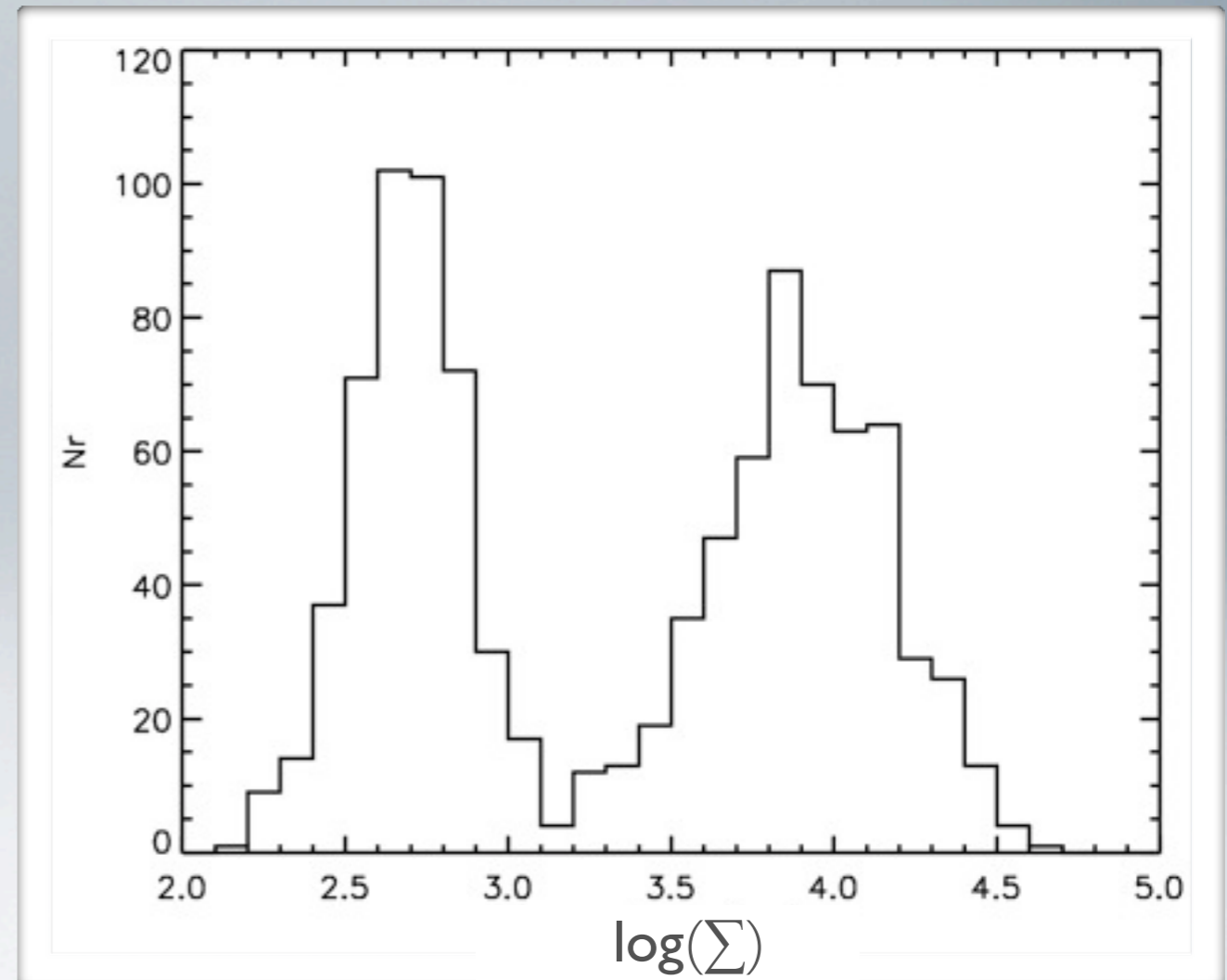
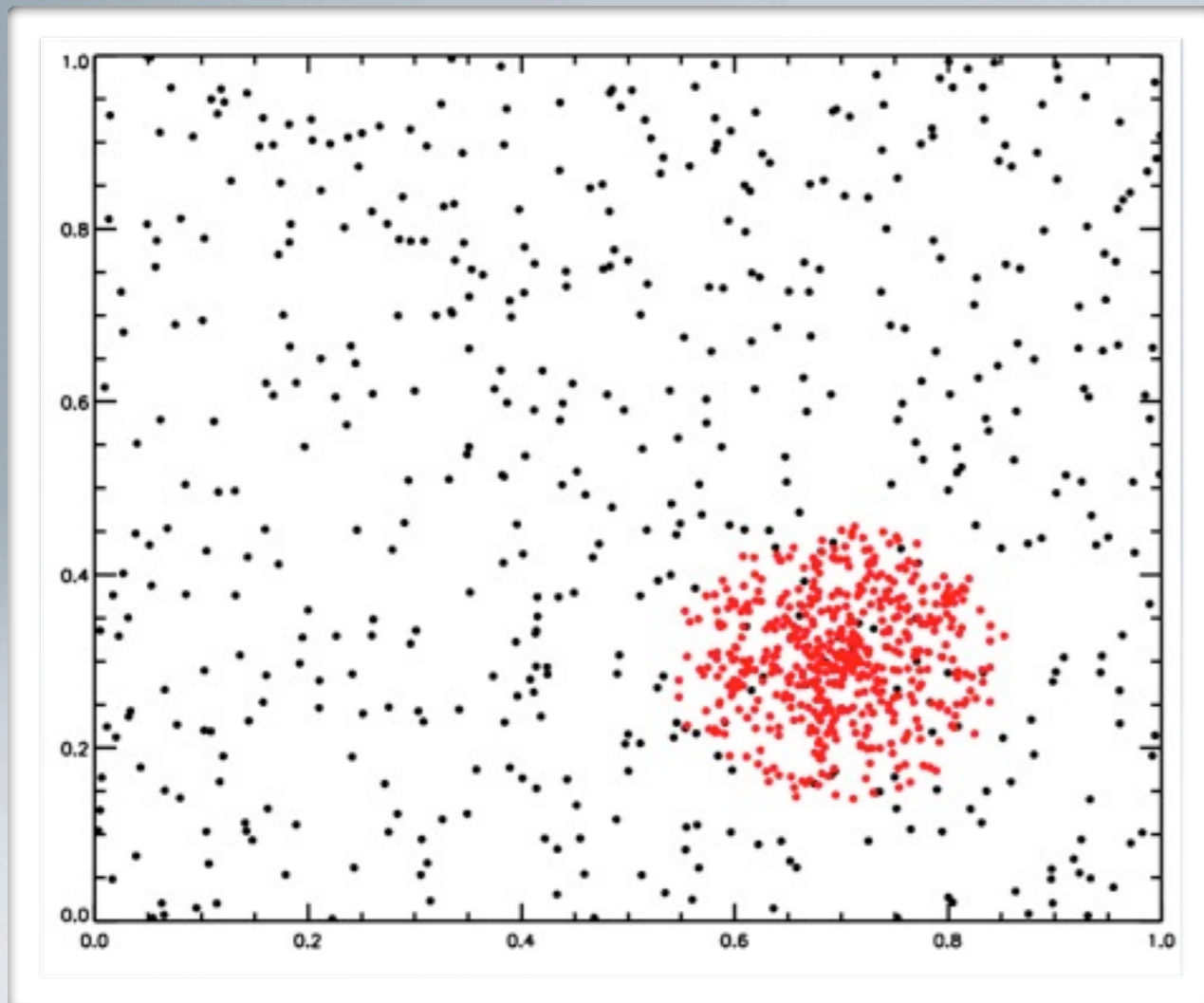


$$\Sigma_* = \frac{j-1}{(\pi r_j^2)}$$

Casertano & Hut 1985

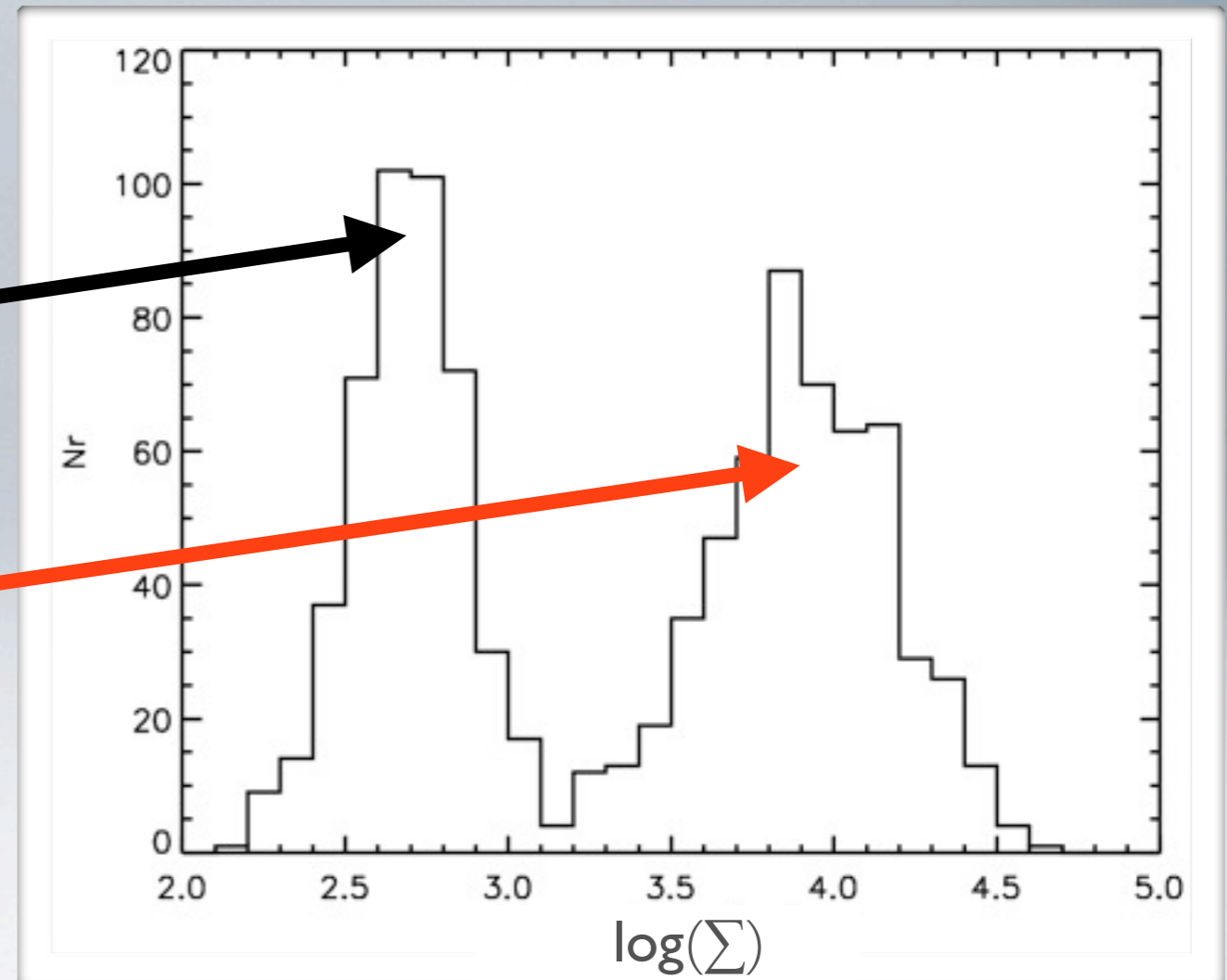
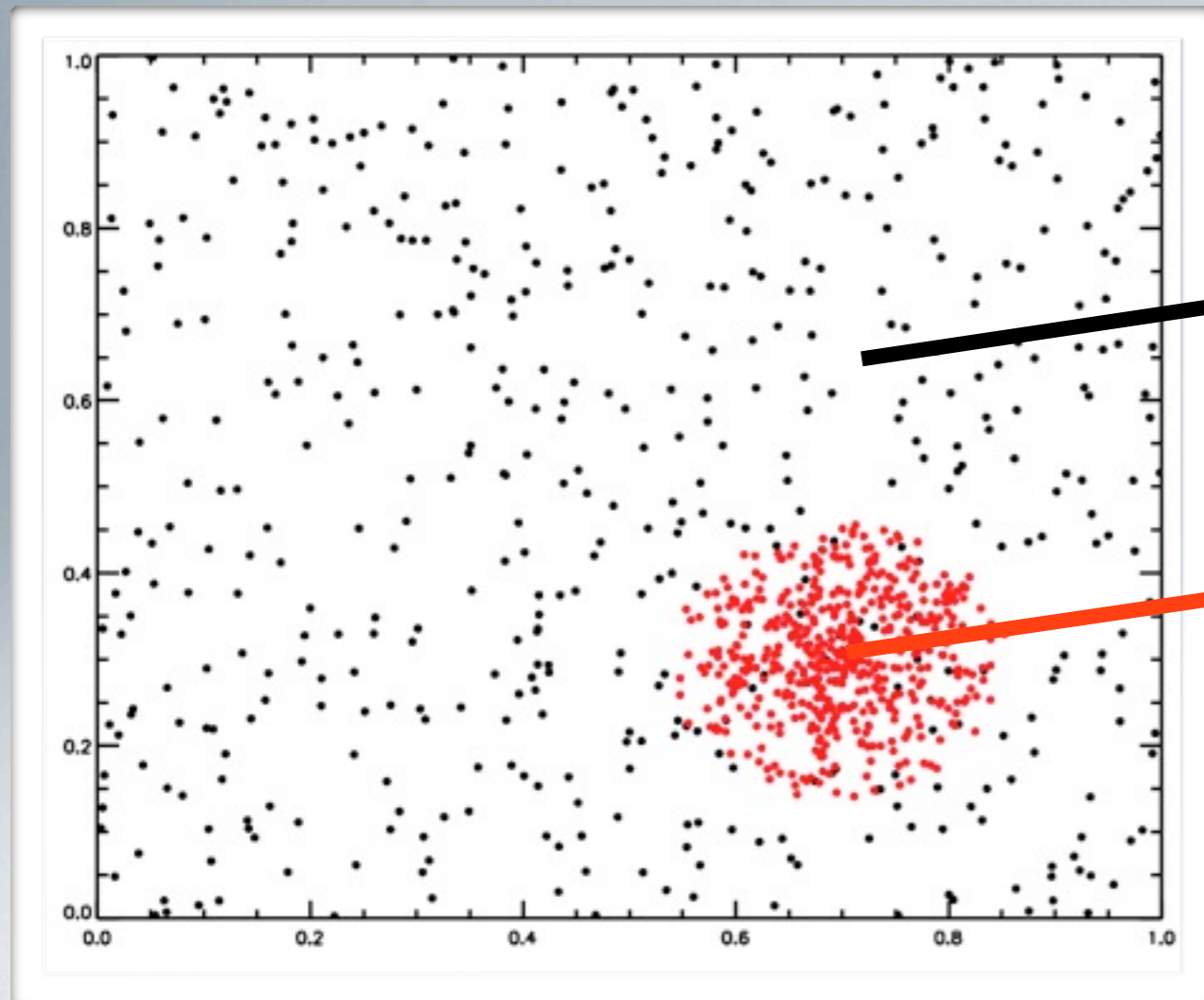
Clustered
Distributed

MULTIPLE MODES



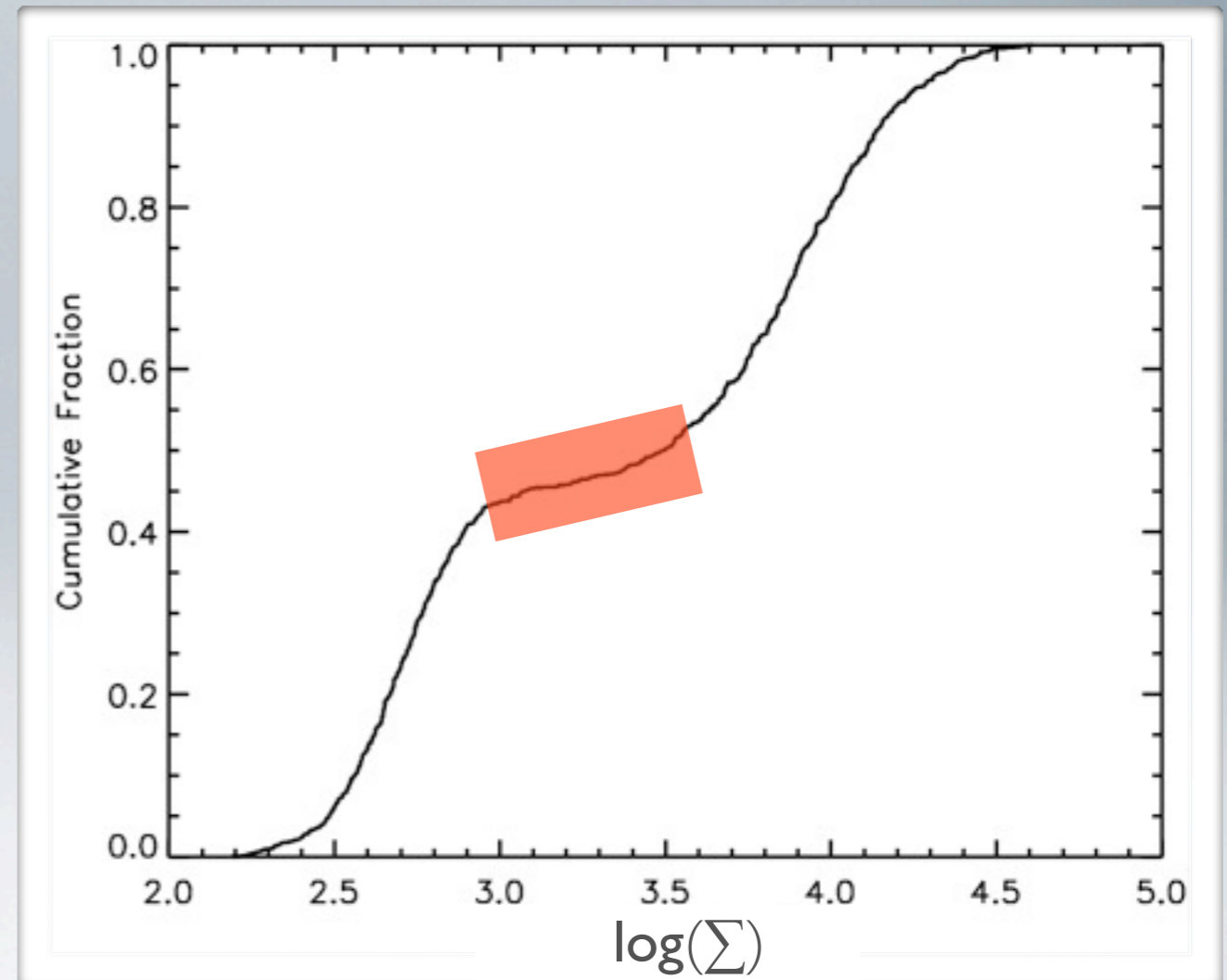
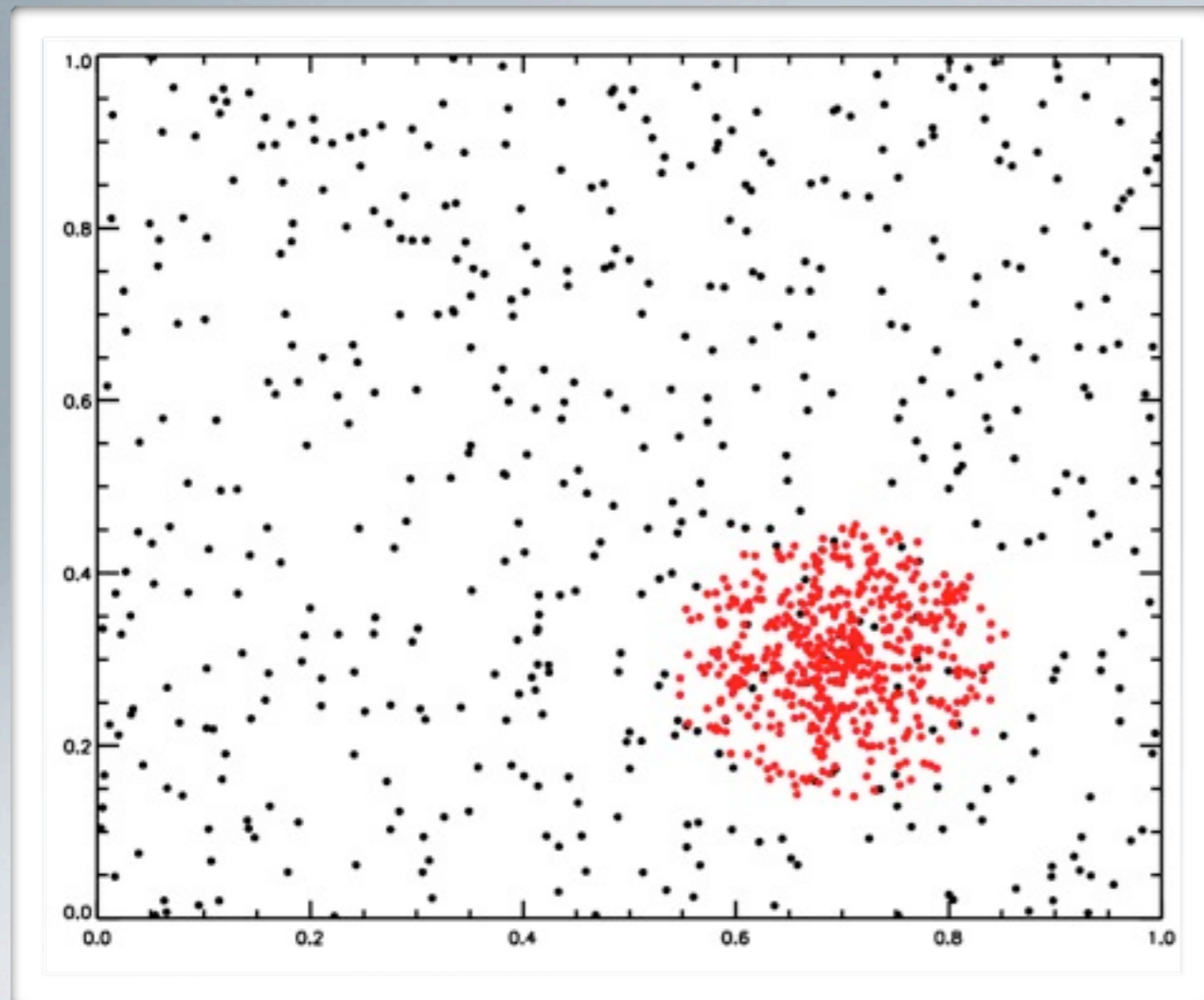
Clustered
Distributed

MULTIPLE MODES



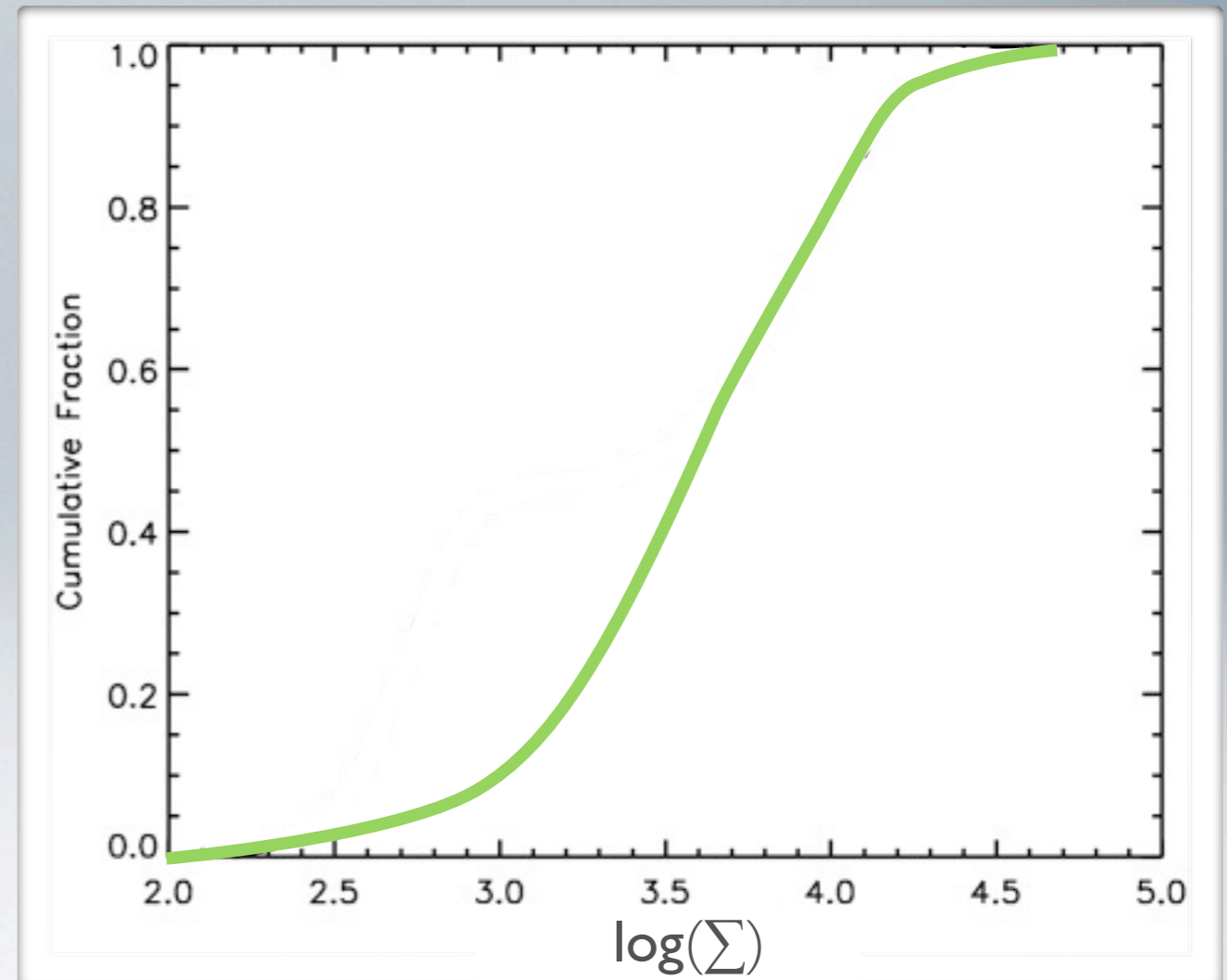
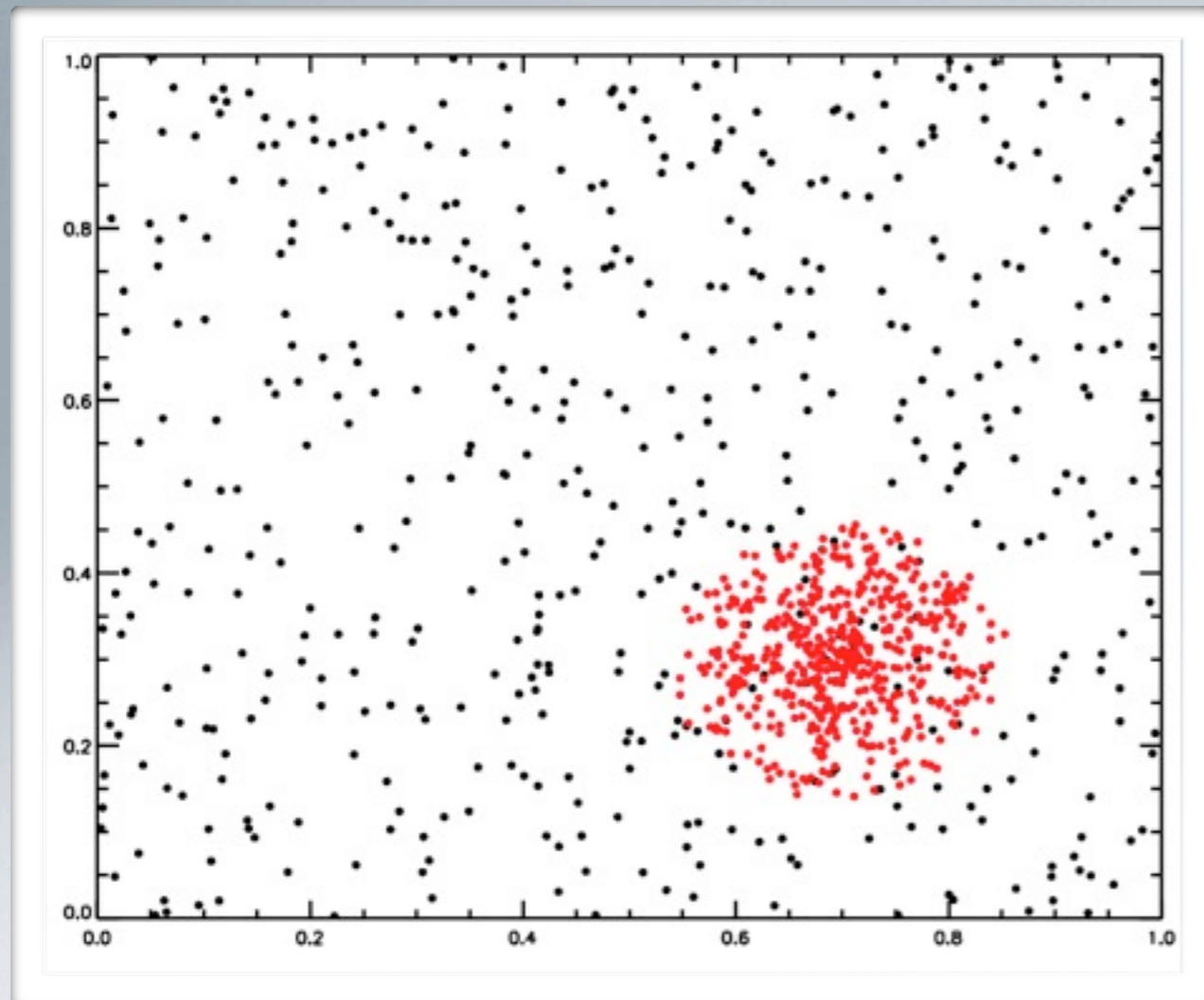
Clustered
Distributed

MULTIPLE MODES



Clustered
Distributed

MULTIPLE MODES



Clustered
Distributed

IC348
2MASS

1 pc

IC348
2MASS



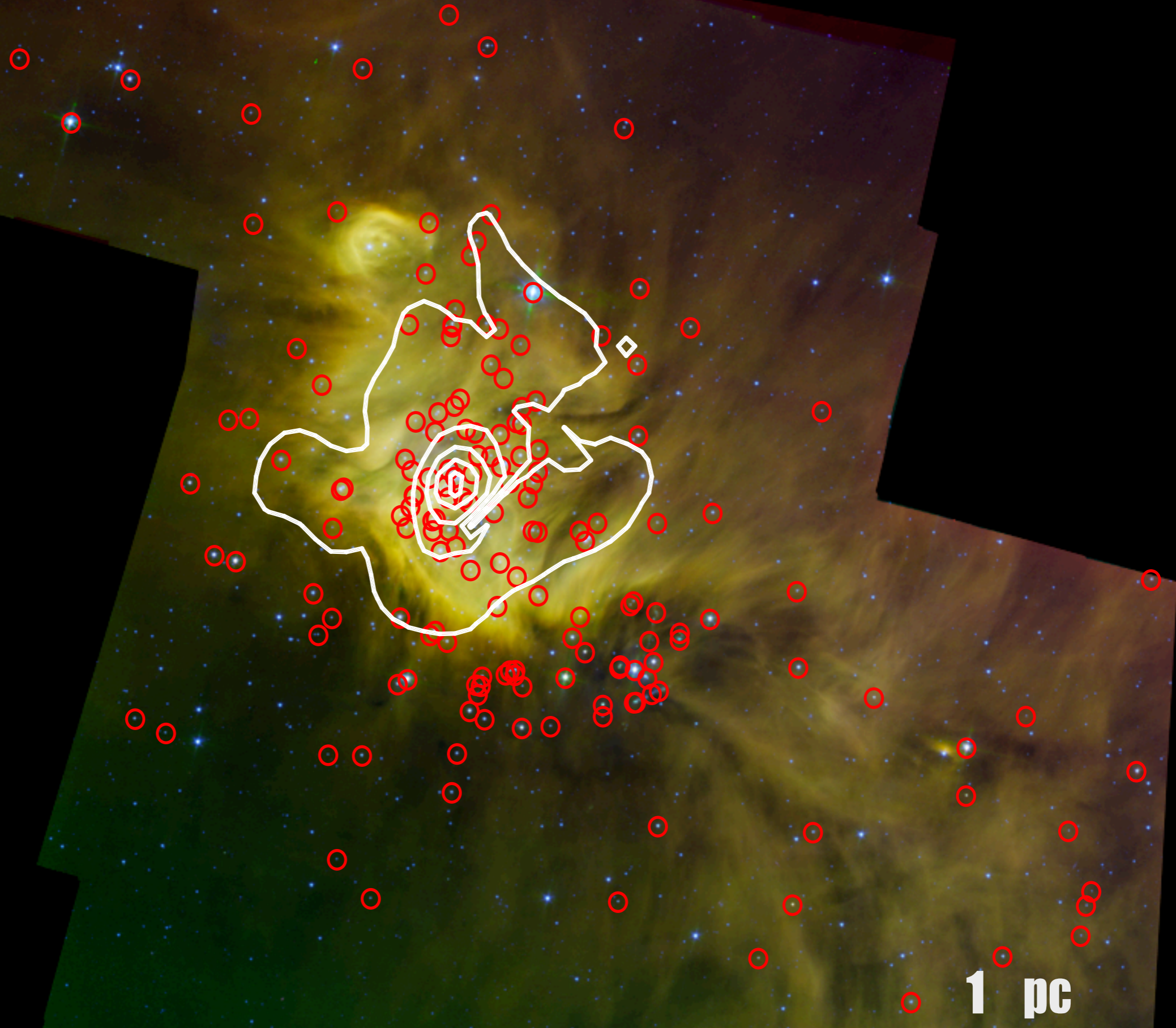
IC348
Spitzer



Carpenter 2000

1 pc

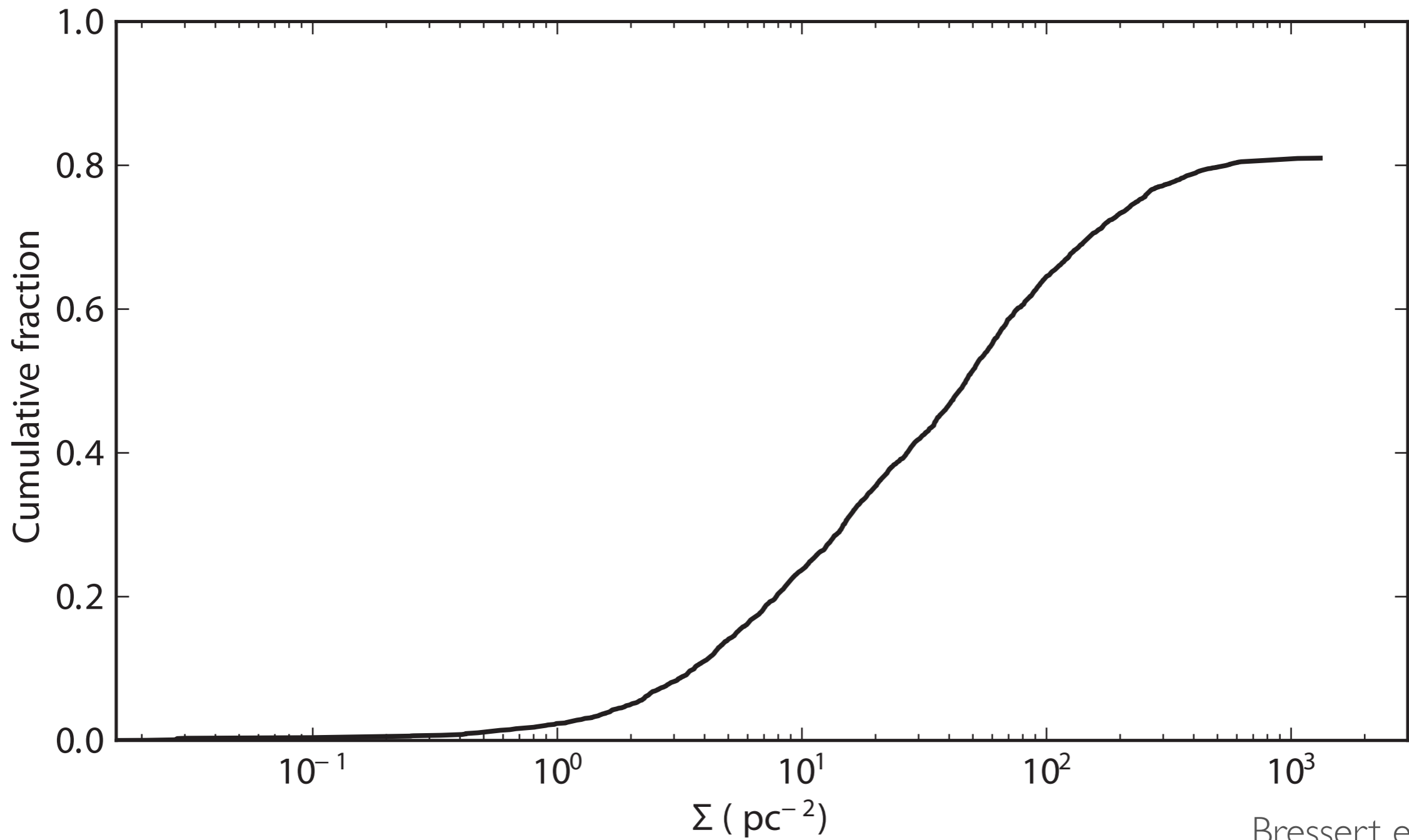
IC348
Spitzer



Carpenter 2000

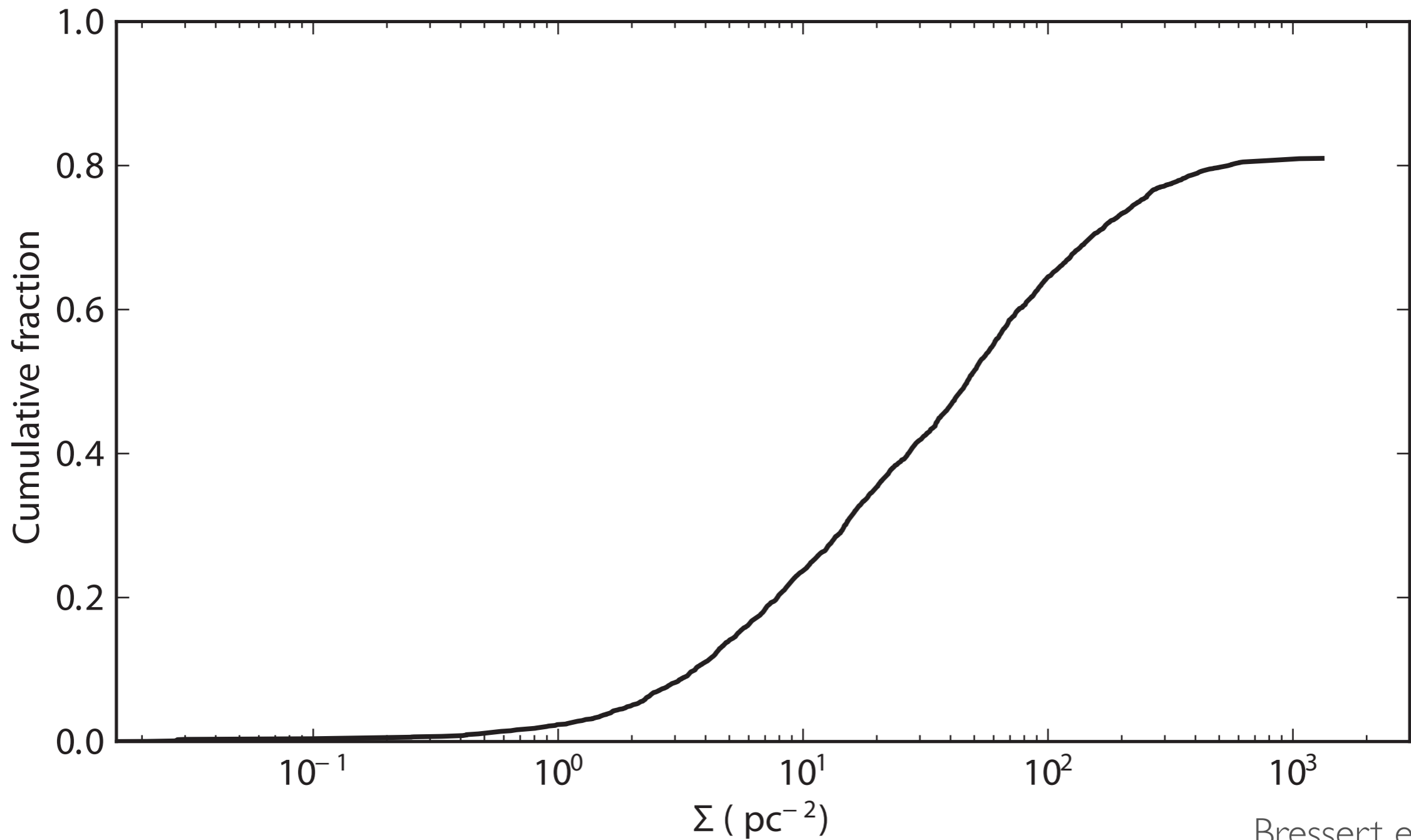
1 pc

CLUSTERS REVISITED



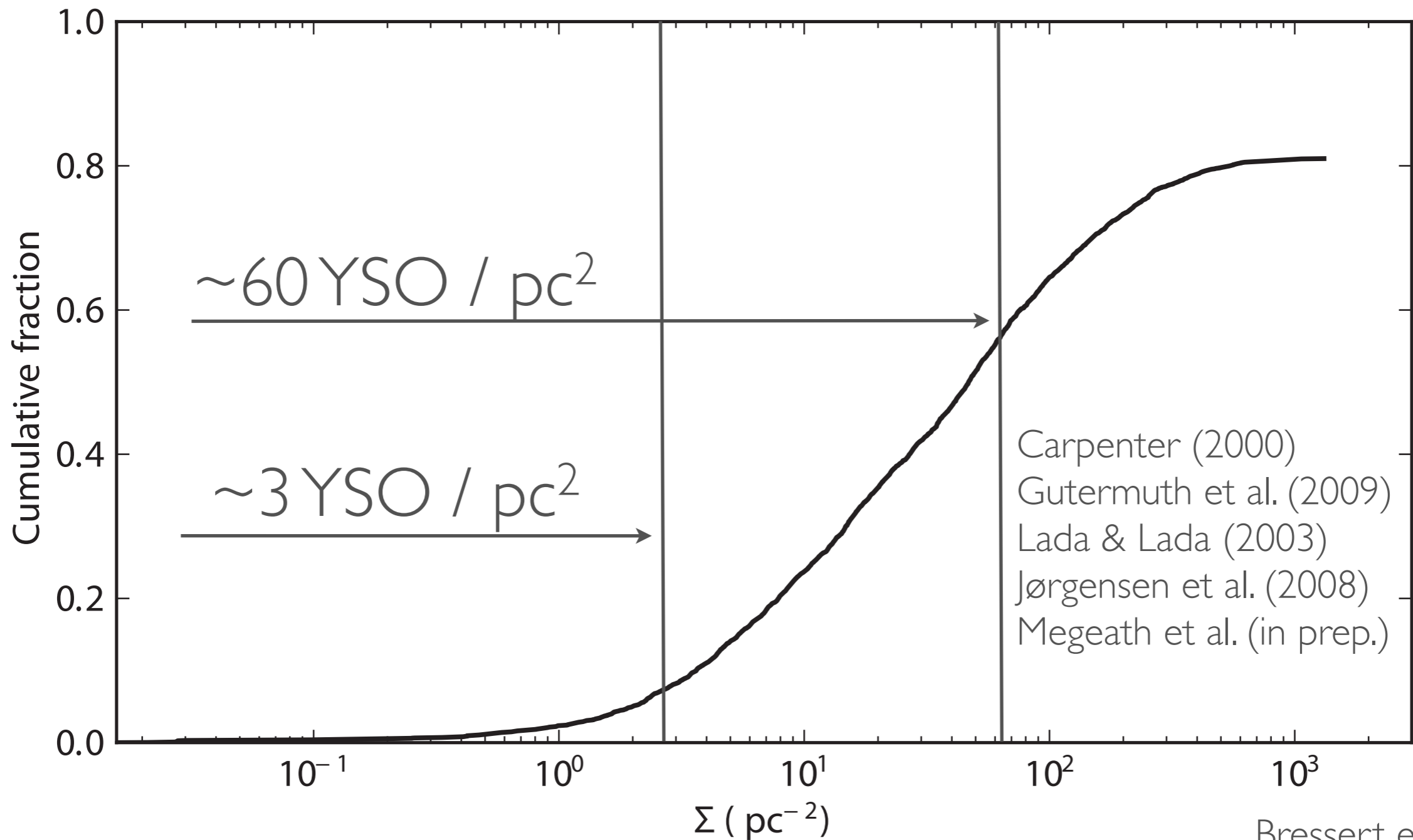
Bressert et al. 2010

SOLAR NEIGHBOURHOOD

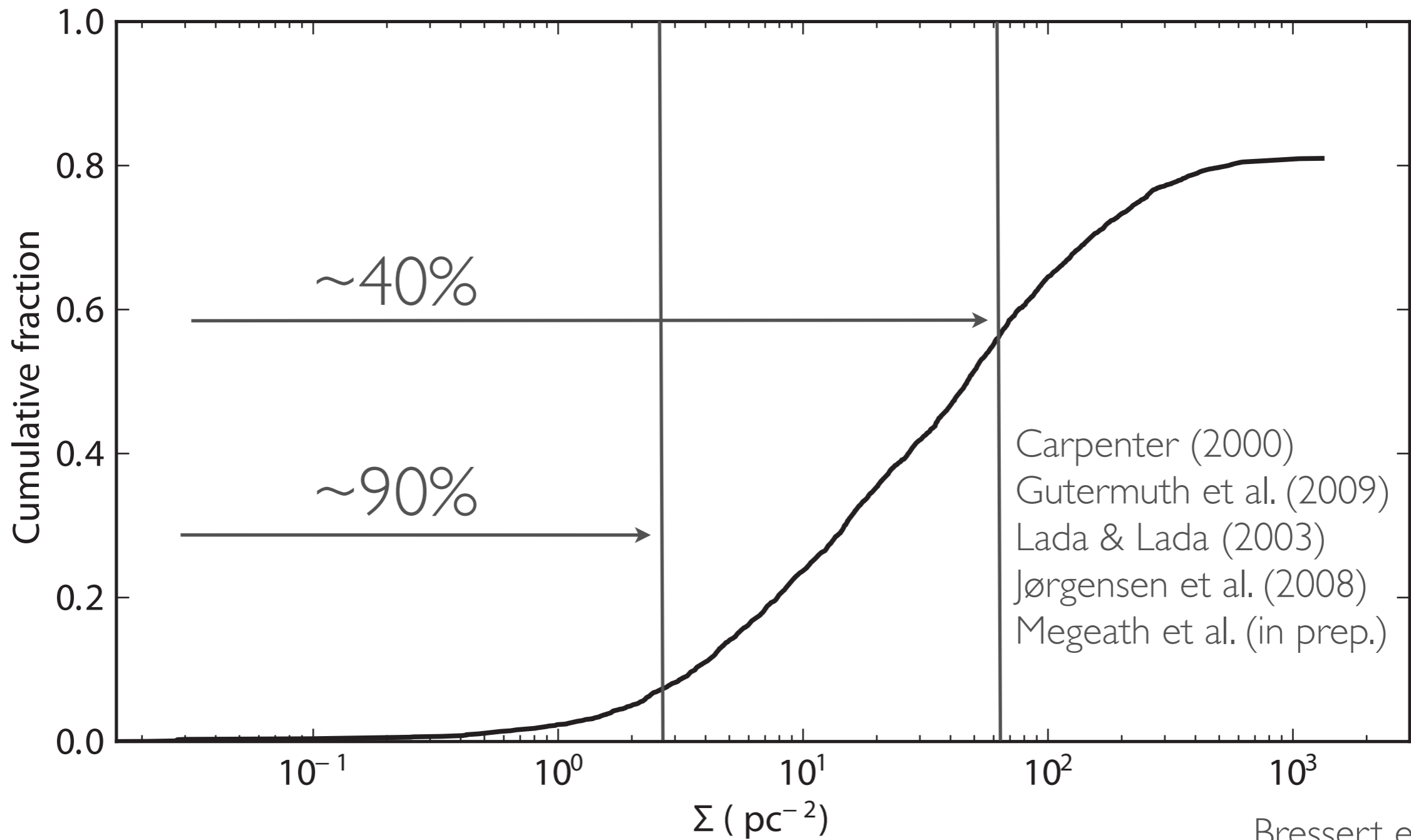


Bressert et al. 2010

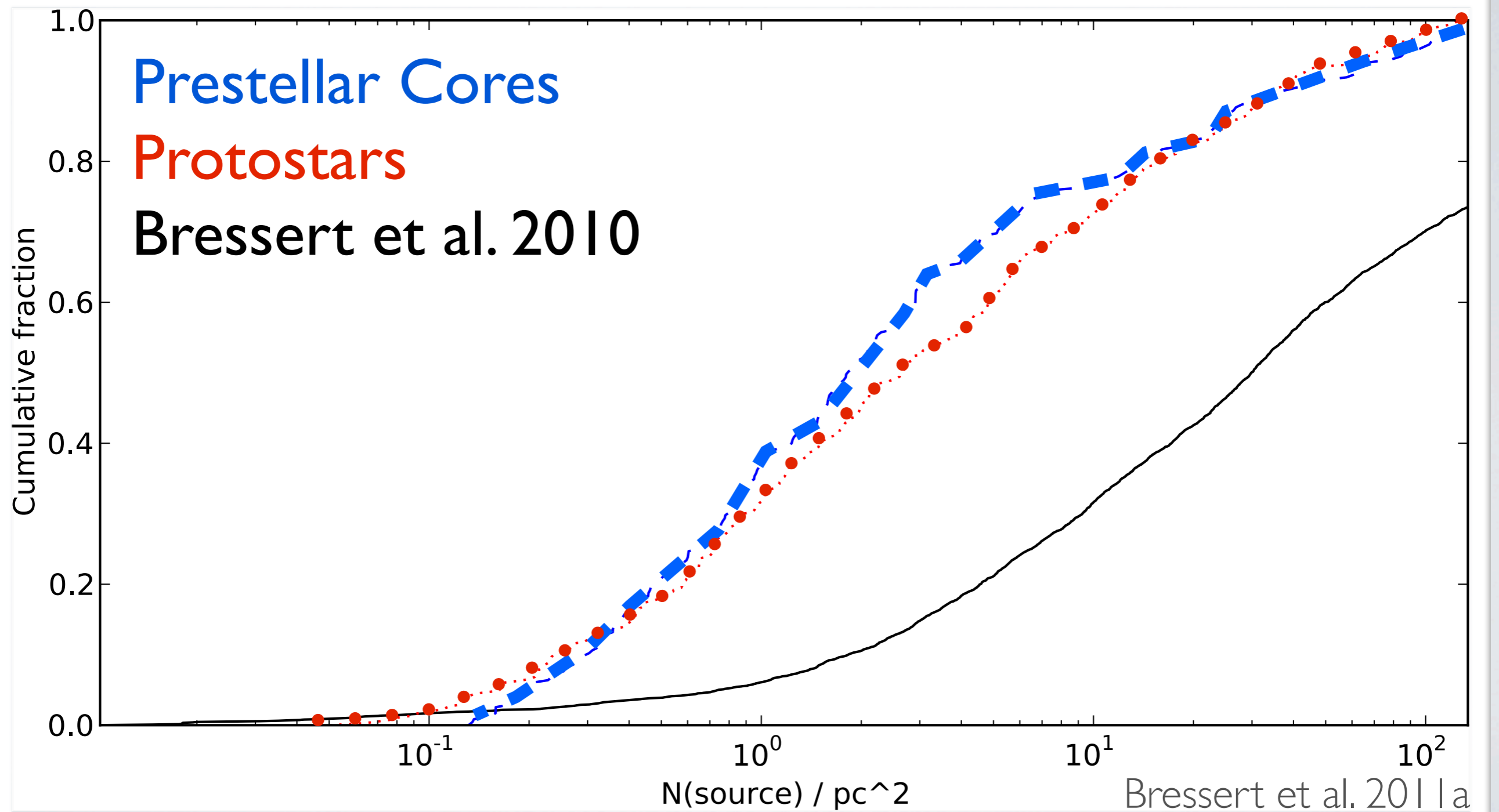
SOLAR NEIGHBOURHOOD



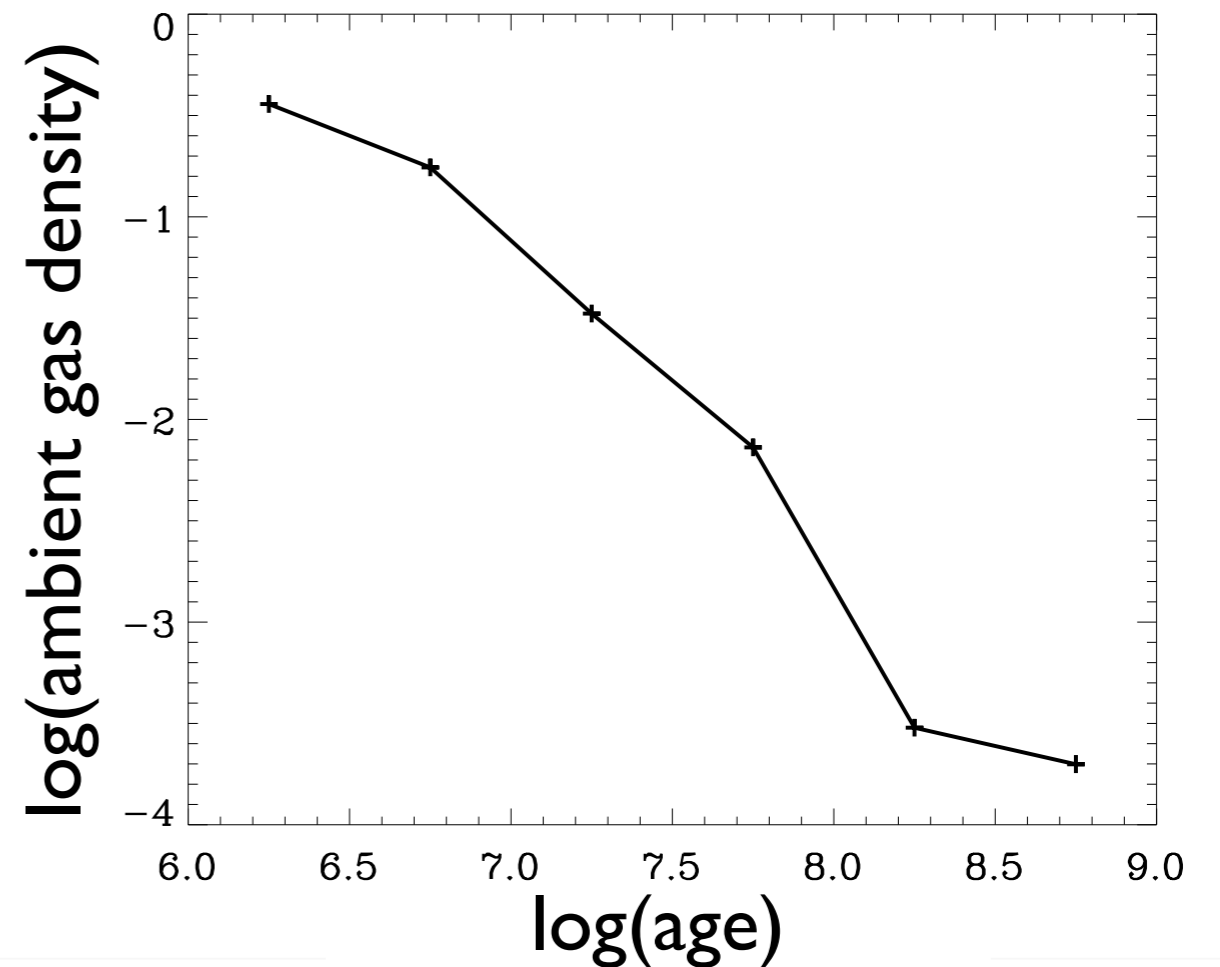
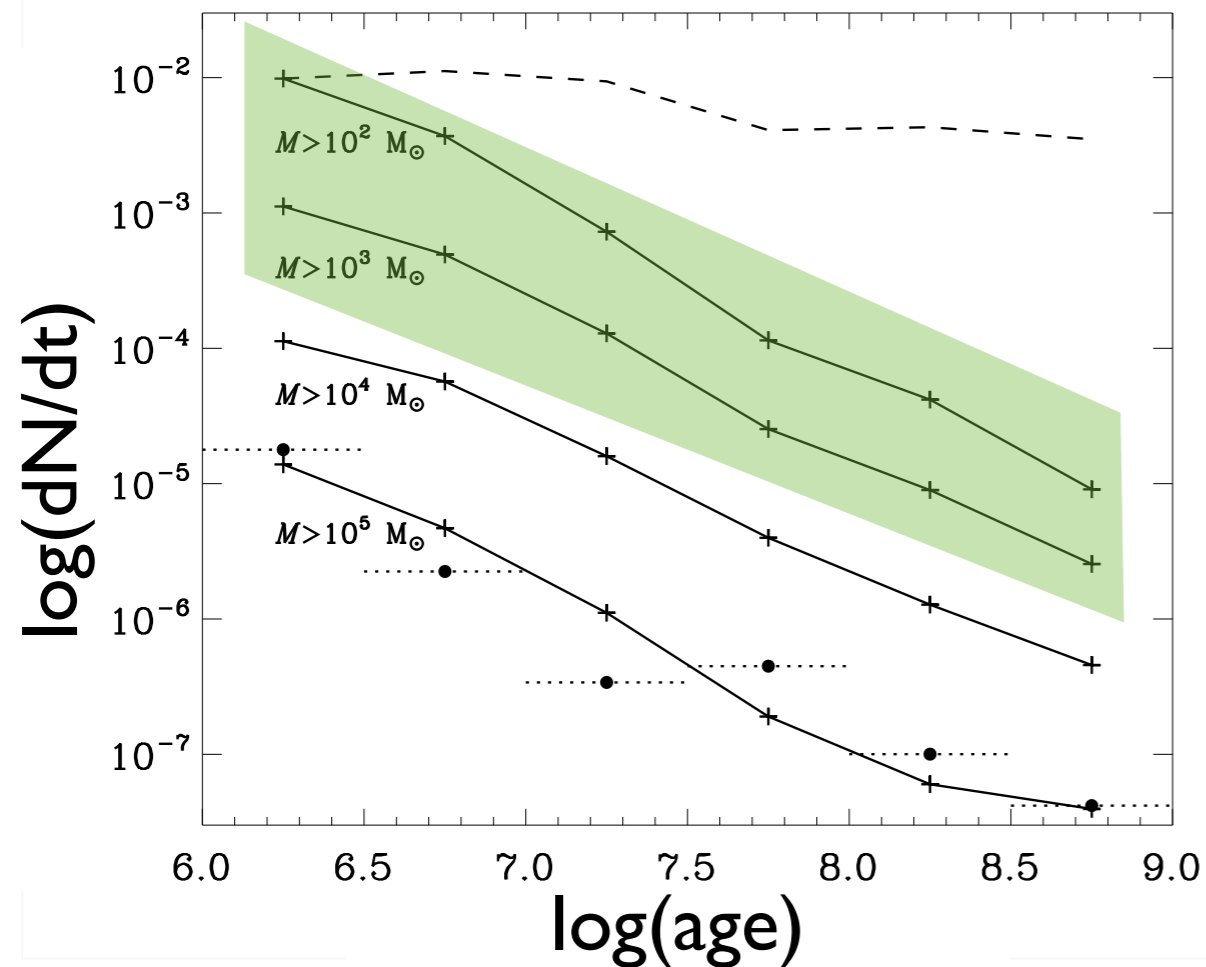
SOLAR NEIGHBOURHOOD



HERSCHEL PRESTELLAR CORES



EXTERNAL DISRUPTION

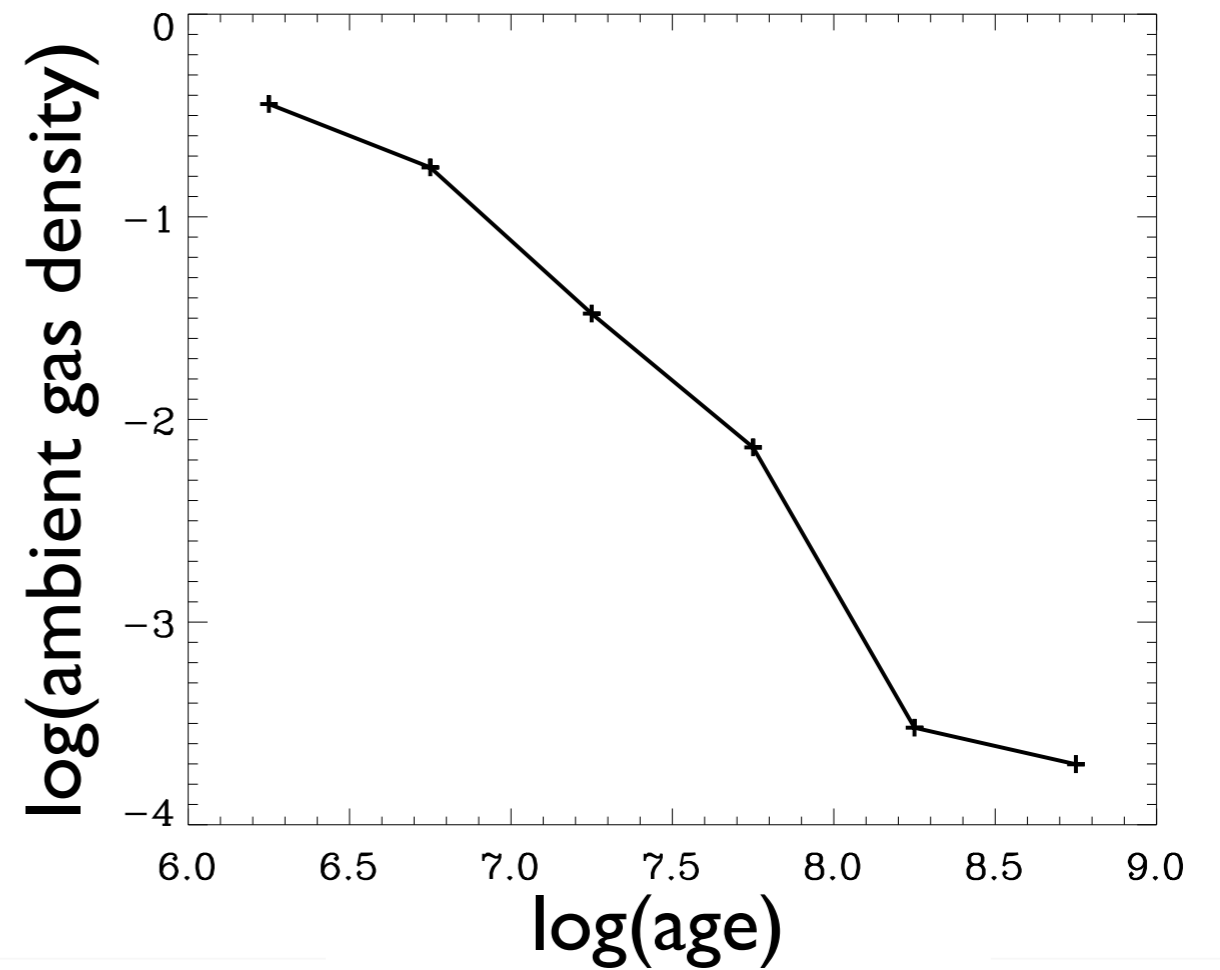
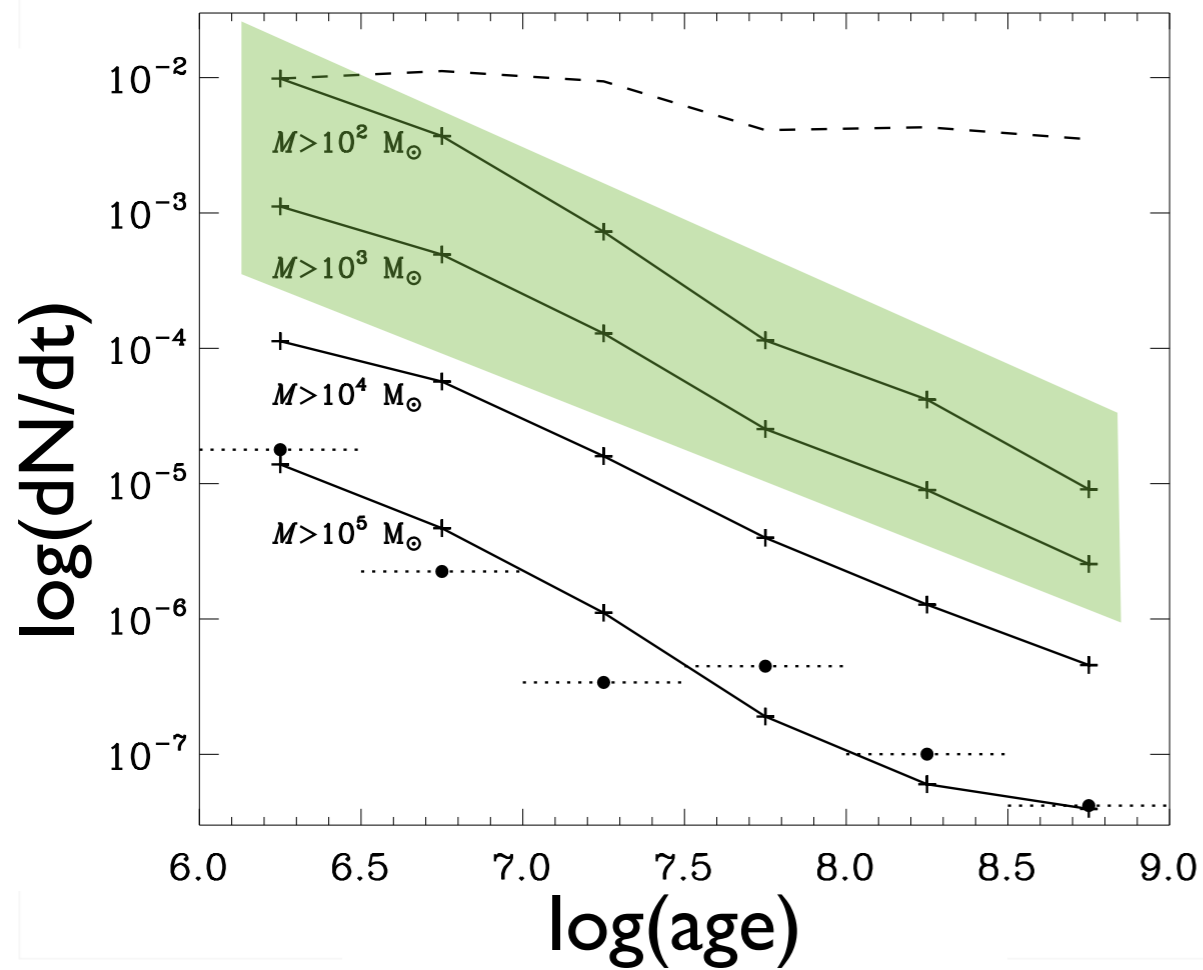


Kruijssen, D. & Maschberger, T., et al. 2011b
Kruijssen, D. & Bastian, N. in prep.

dashed line (fig a) is SFH from simulation
simulated age distribution (solid)
observations for same lower-mass limit

fig b
mean density within 200 pc (SPH smoothing length)

CRUEL CRADLE EFFECT



Kruijssen, D. & Maschberger, T., et al. 2011b
Kruijssen, D. & Bastian, N. in prep.

dashed line (fig a) is SFH from simulation
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fig b
mean density within 200 pc (SPH smoothing length)

1 Do all stars form
in clusters?

2 Can we determine
global SF peaks?

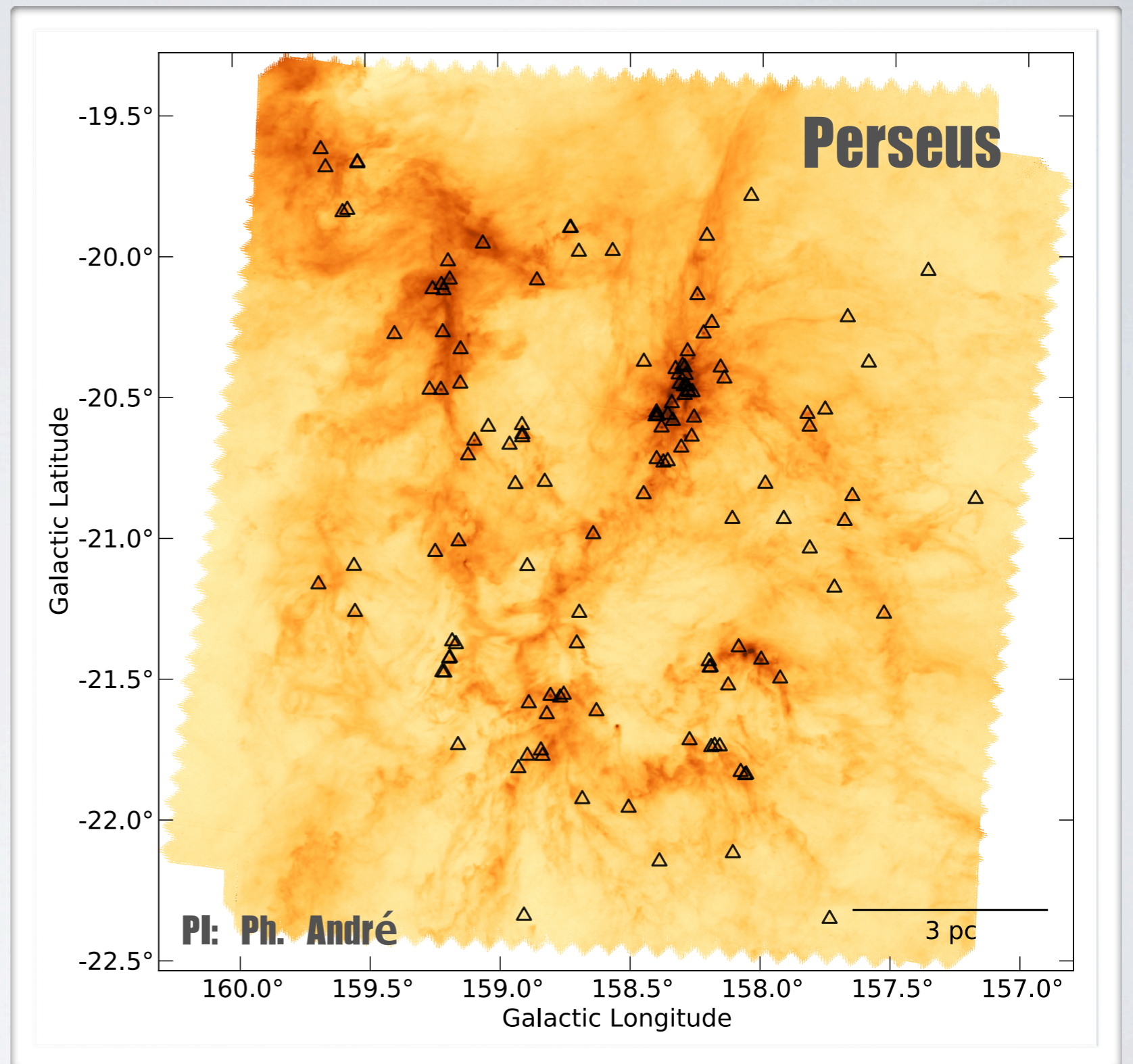
PSC sources

Basic MST

MST groups

Convex hulls

Comparison



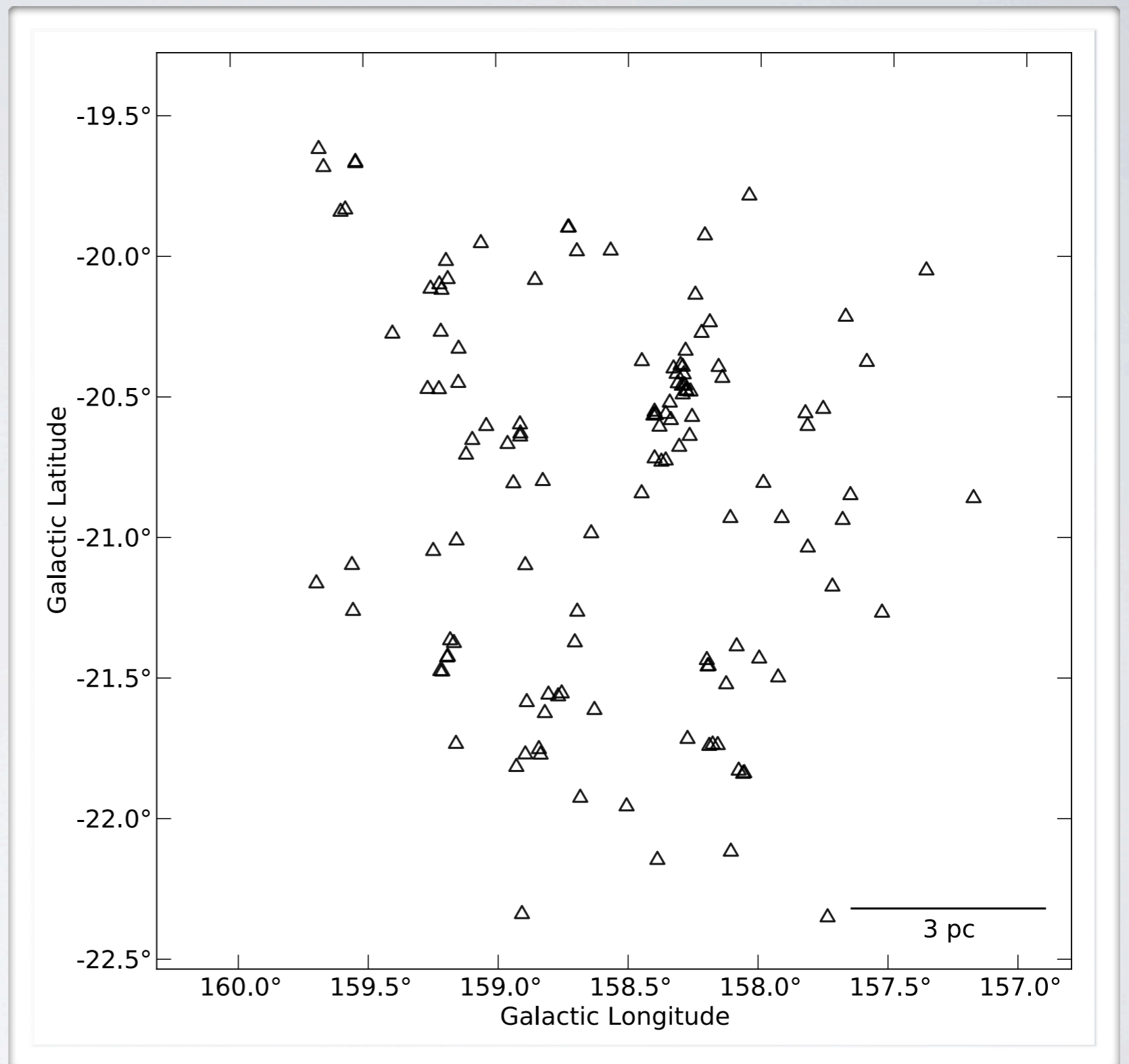
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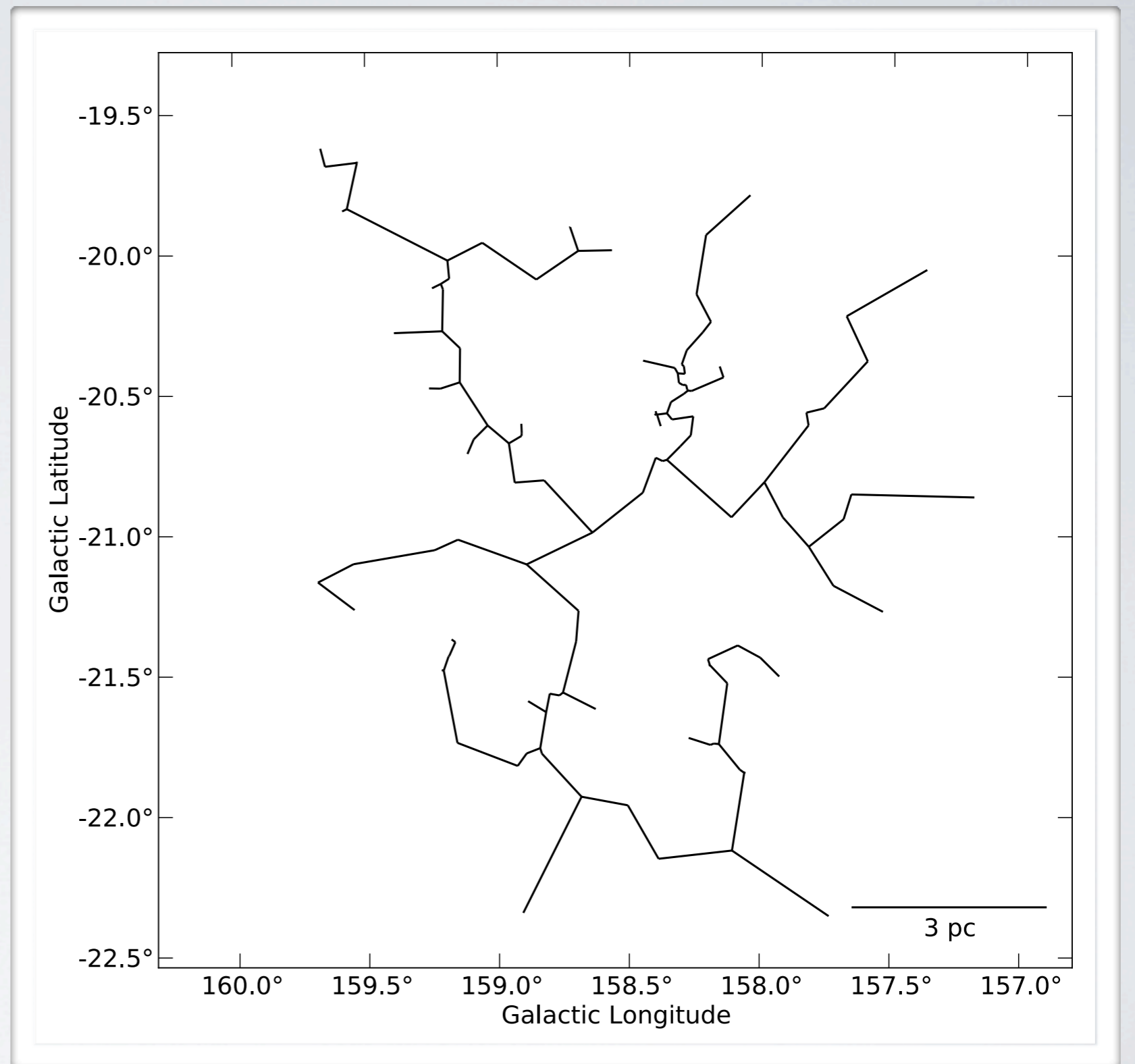
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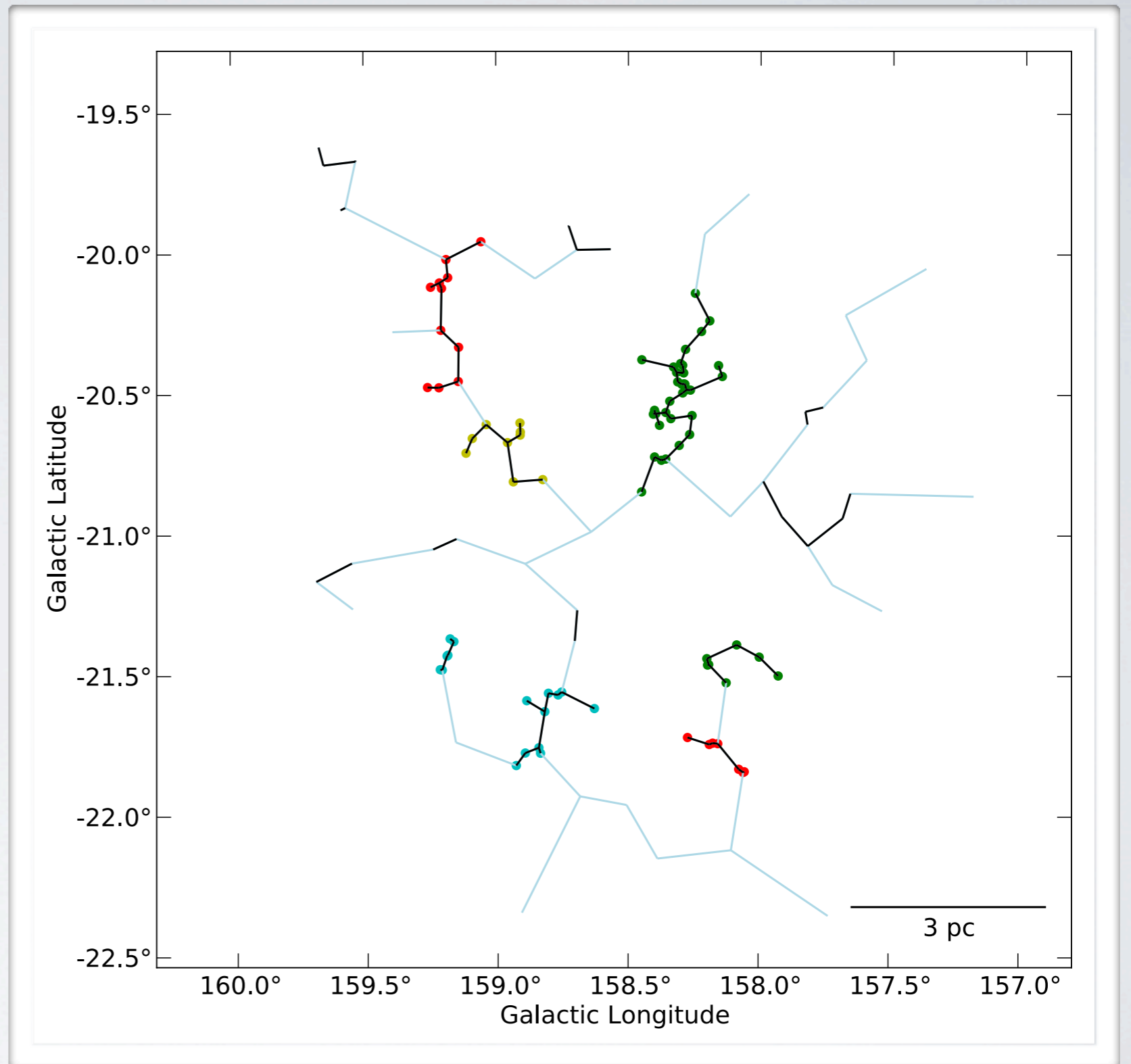
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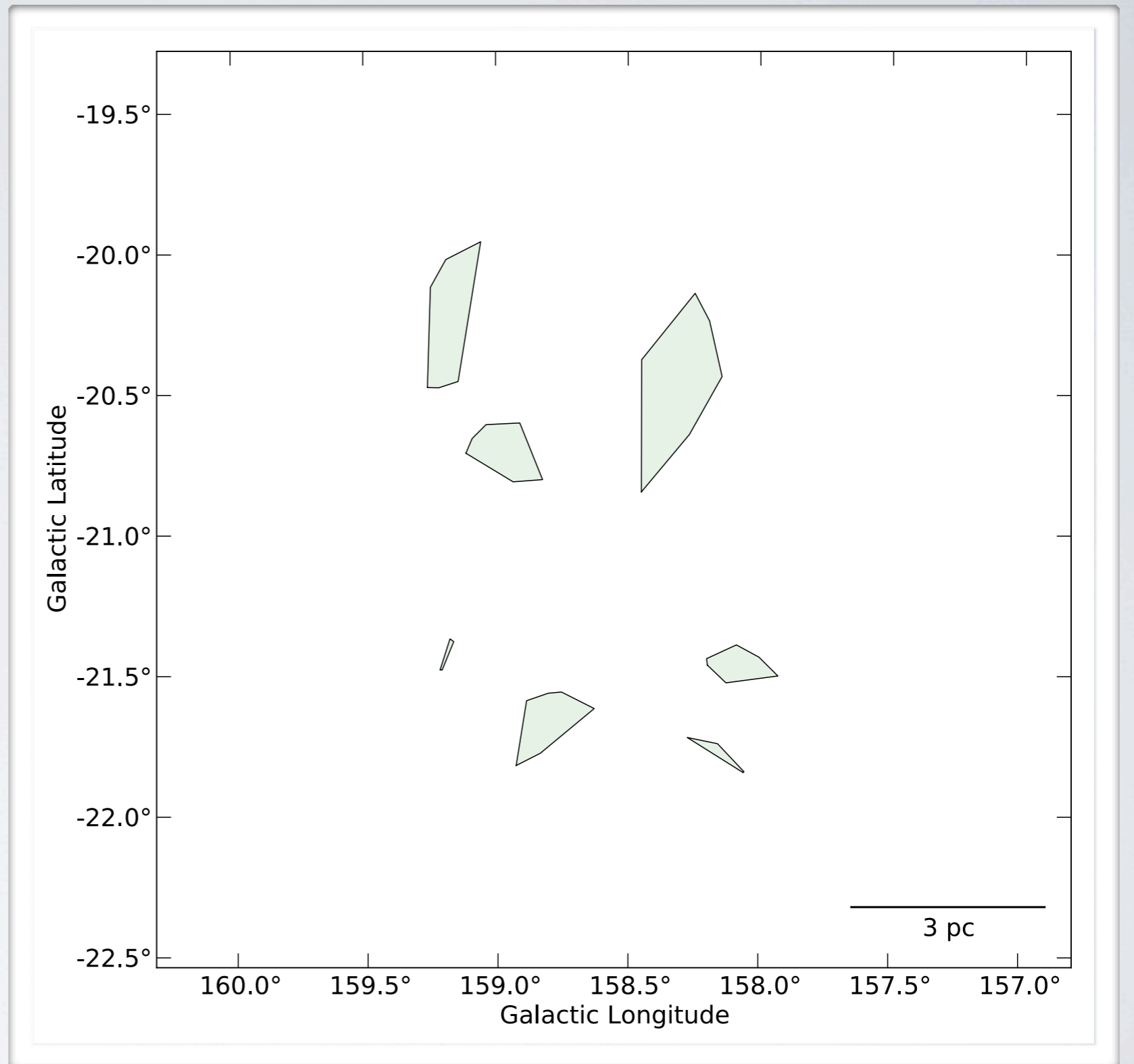
PSC sources

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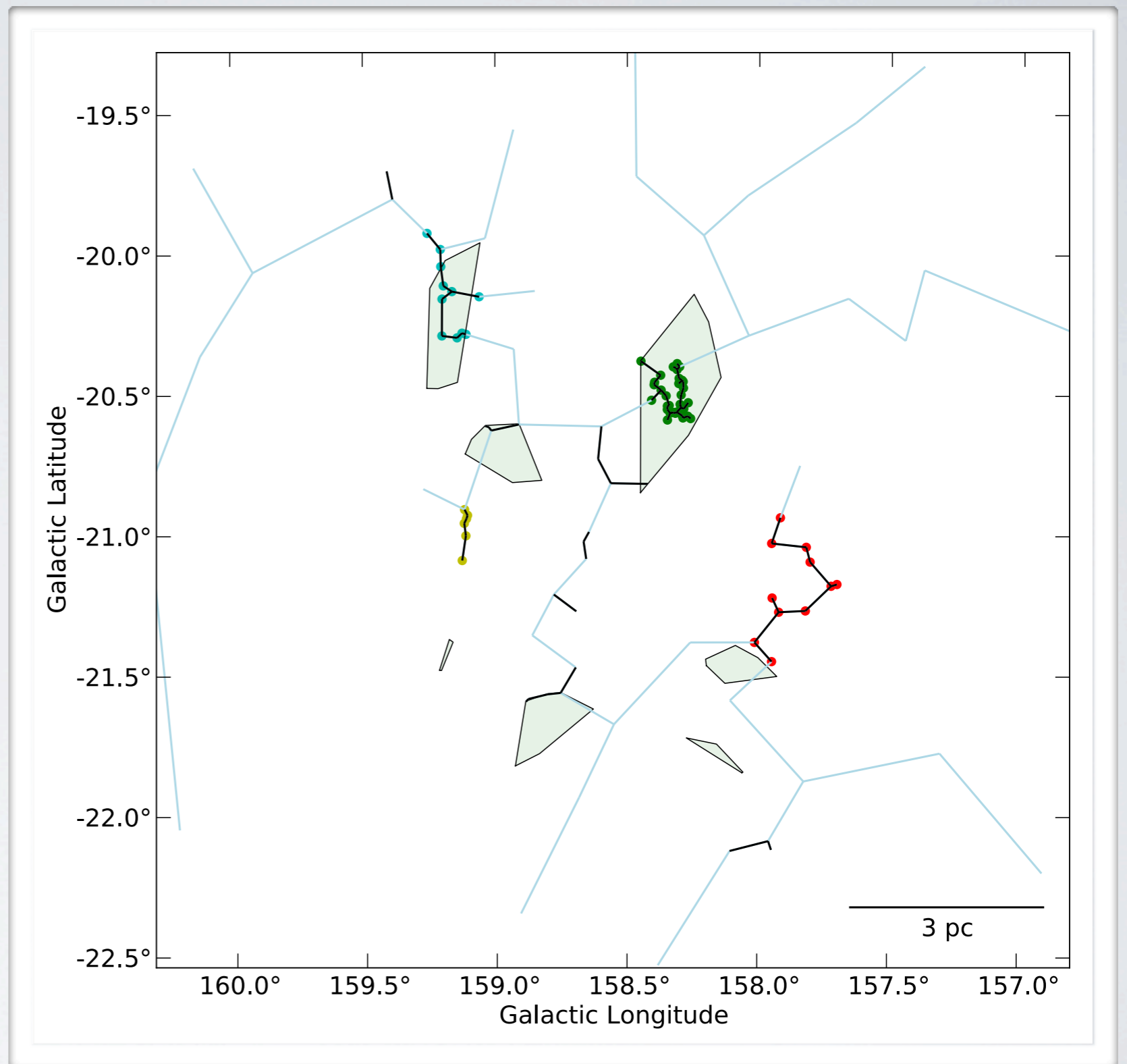
PSC sources

Basic MST

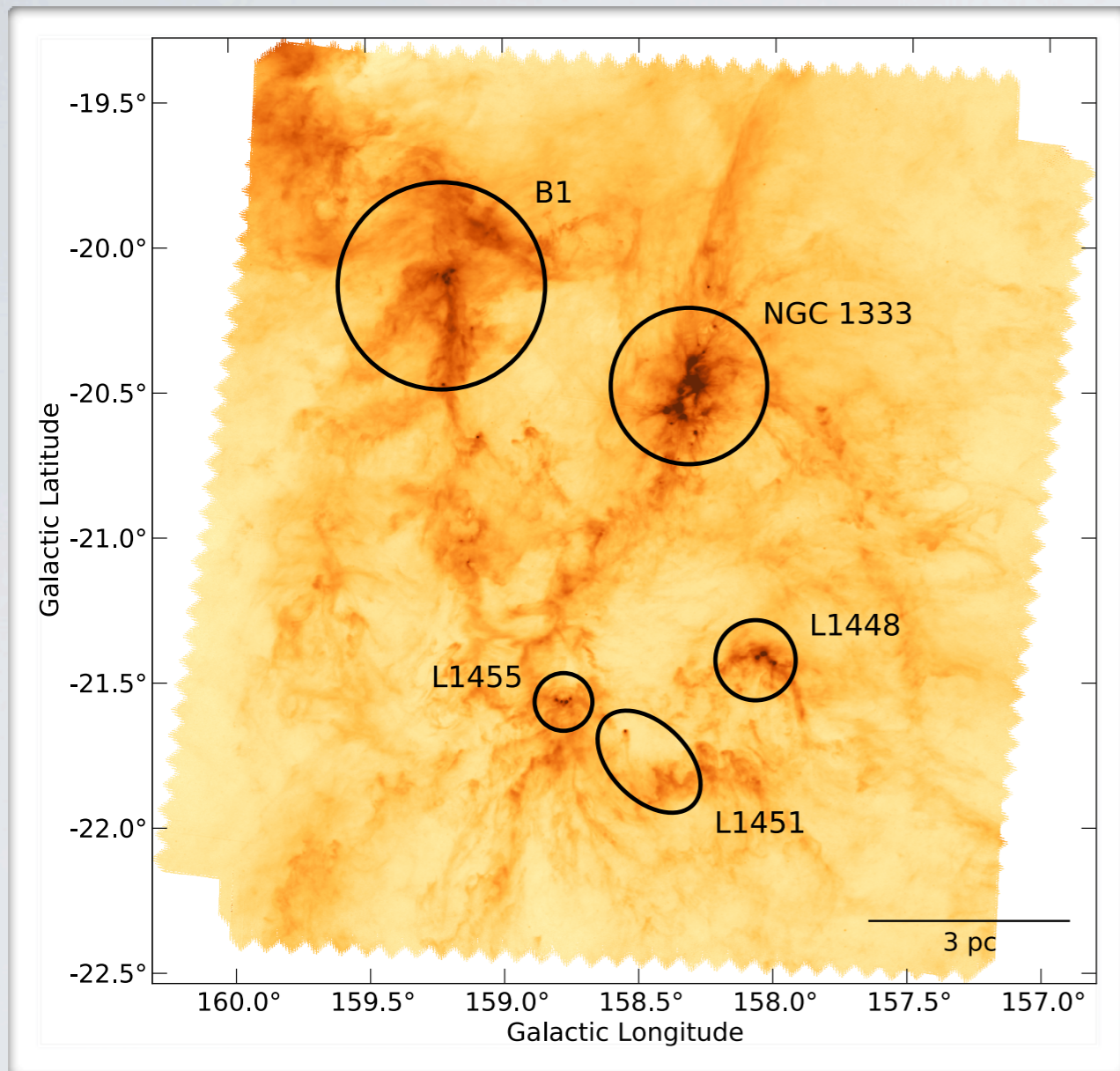
MST groups

Convex hulls

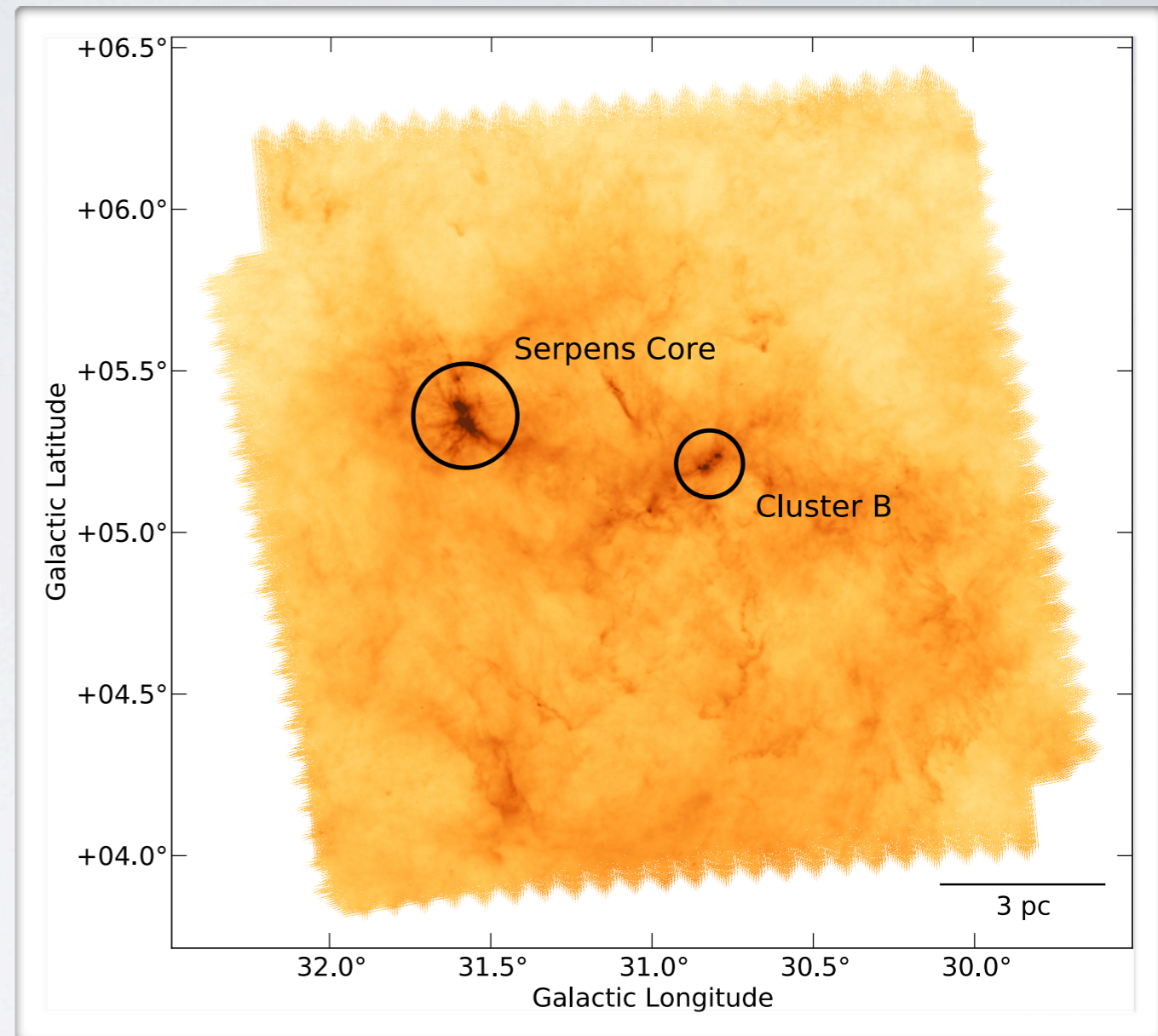
Comparison



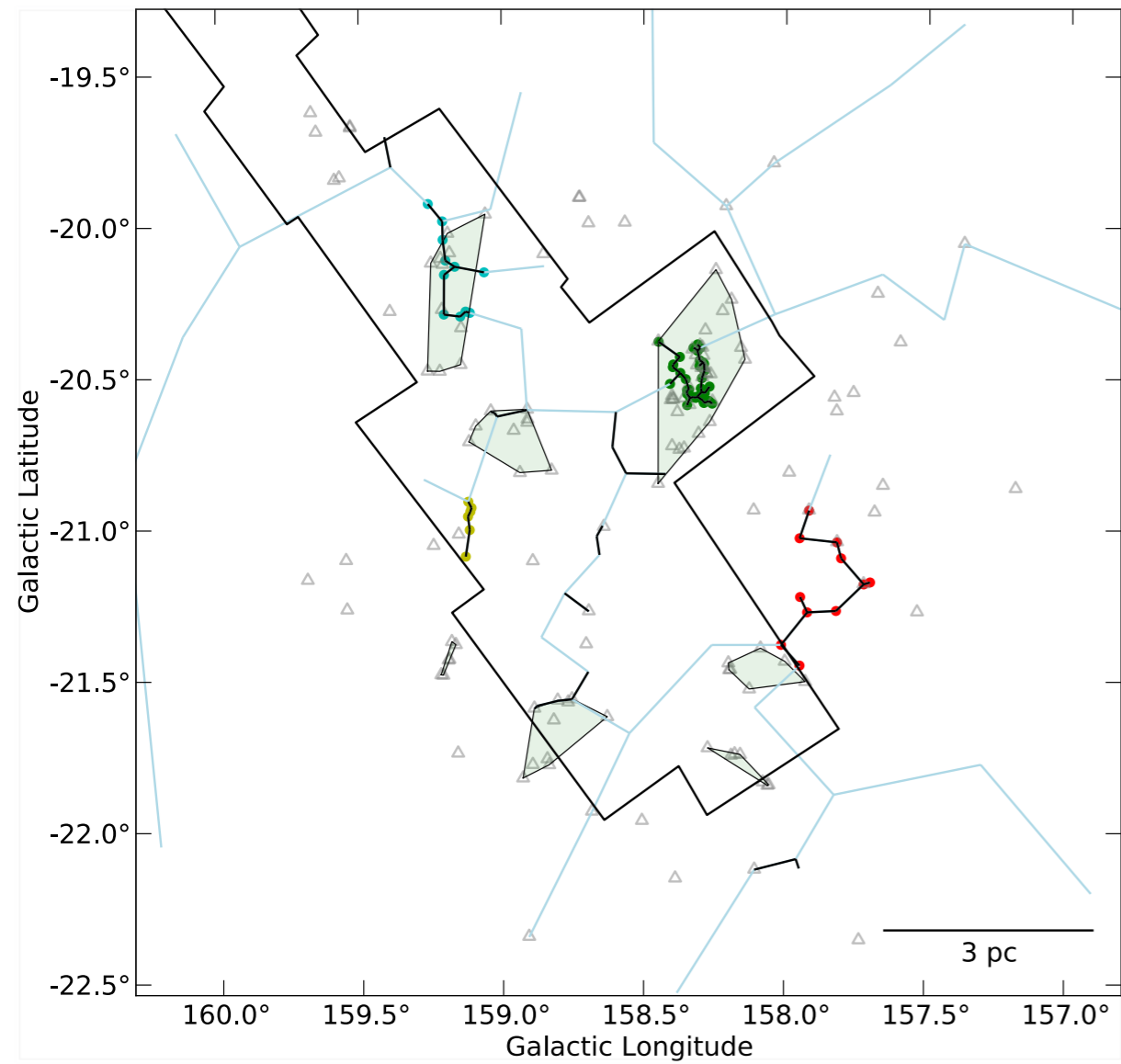
Perseus



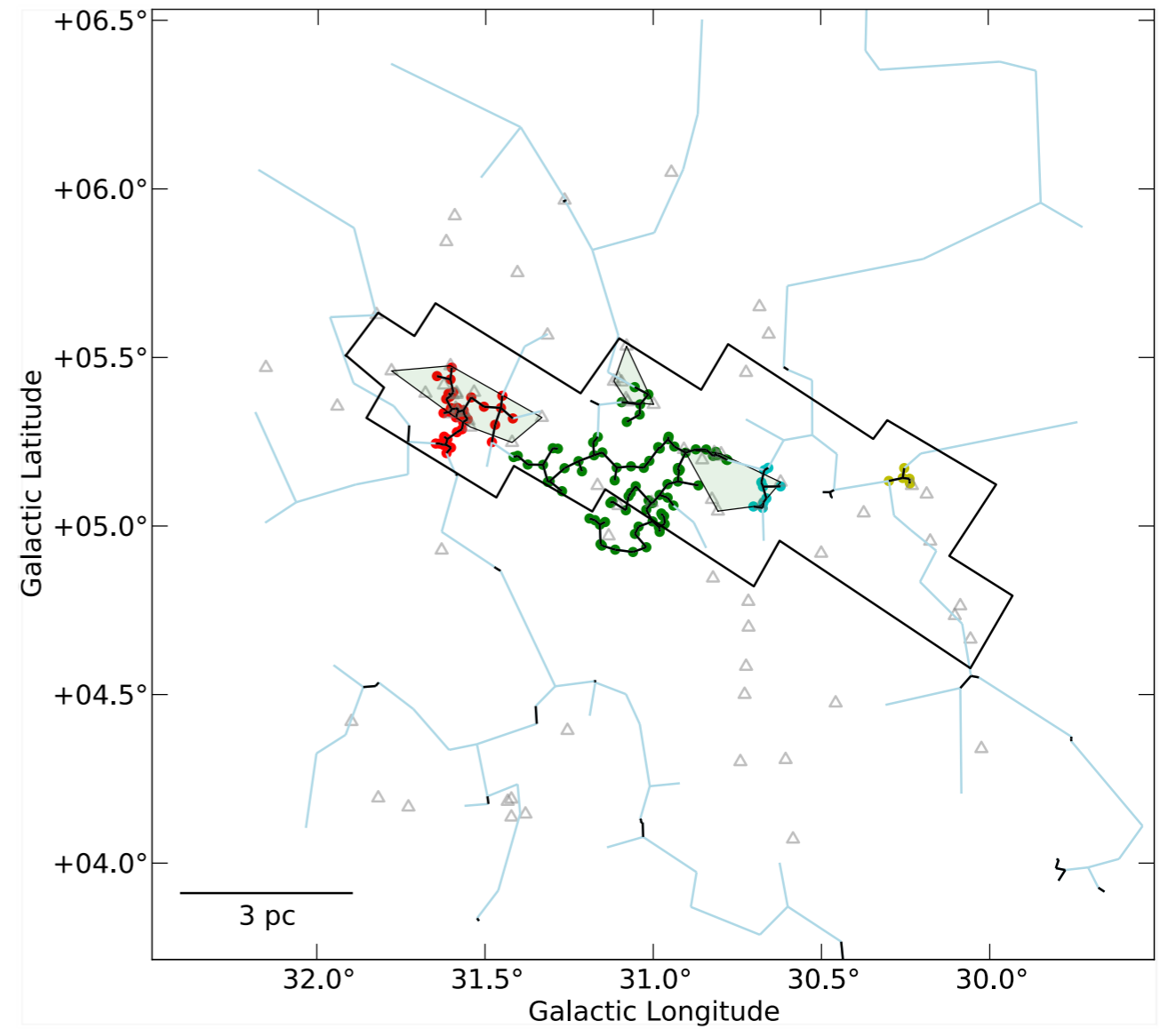
Serpens



Perseus



Serpens



Perseus

$$\frac{\text{Class II}}{\text{Class I}} = 0.8$$

$$\frac{\text{YSO}}{\text{PSC}} = 1.7$$

Serpens

$$\frac{\text{Class II}}{\text{Class I}} = 2.4$$

$$\frac{\text{YSO}}{\text{PSC}} = 4.9$$

GROUP PROPERTIES

Association	Type	l Deg	b Deg	R_{circ} pc	R_{hull} pc	Aspect Ratio	Area pc ²	Sources 6	σ_{mean} source pc ⁻²
P-None*	PSC	159.198554	-21.441304	0.34	0.12	8.65	0.04	6	138.92
P-None*	PSC	158.163623	-21.778657	0.79	0.23	12.16	0.16	7	43.187
P-L1448	PSC	158.104889	-21.460868	0.98	0.46	4.49	0.68	7	10.31
P-None	PSC	159.005871	-20.703711	1.04	0.62	2.79	1.22	9	7.36
P-L1455	PSC	158.824169	-21.682714	1.08	0.63	2.96	1.24	10	8.07
P-B1	PSC	159.198084	-20.285680	1.68	0.82	4.25	2.09	11	5.25
P-NGC 1333	PSC	158.313473	-20.508206	2.14	1.11	3.71	3.89	35	9.00
P-None*	YSO	159.120733	-21.006330	0.69	0.12	35.5	0.04	6	142.15
P-None	YSO	159.178789	-20.123723	1.39	0.60	5.34	1.14	11	9.61
P-None	YSO	157.907424	-21.201990	1.58	0.90	3.12	2.53	11	4.35
P-NGC 1333	YSO	158.348426	-20.474019	0.97	0.52	3.51	0.83	34	40.68
S-None	PSC	31.077813	5.426089	0.66	0.32	4.28	0.32	7	21.55
S-Cluster B	PSC	30.791506	5.161767	0.99	0.56	3.21	0.97	9	9.28
S-Core	PSC	31.580766	5.371815	1.42	0.68	4.30	1.46	17	11.62
S-None	YSO	31.062842	5.364585	0.34	0.22	2.30	0.16	6	38.15
S-None*	YSO	30.264122	5.142401	0.27	0.12	4.57	0.05	6	123.23
S-Cluster B	YSO	30.670696	5.105846	0.38	0.23	2.86	0.16	9	55.40
S-Core	YSO	31.563117	5.323380	0.92	0.66	1.97	1.35	38	28.09
S-Cluster B	YSO	31.117709	5.119352	2.15	1.18	3.34	4.35	75	17.22

$$\langle \sigma_{\text{PSC}} \rangle = 10.31 \pm 4.61$$

$$\langle \sigma_{\text{YSO}} \rangle = 27.64 \pm 17.02$$

1 **Not** all stars form
in clusters

2 We **can** determine
relative SF peak

**1 Cluster definitions
are arbitrary**

**2 We can determine
relative SF peak**

1 Cluster definitions
are arbitrary

2 $\sigma_{\text{PSC}} < \sigma_{\text{YSO}}$

