The IC 348 surface density in the Perseus molecular cloud

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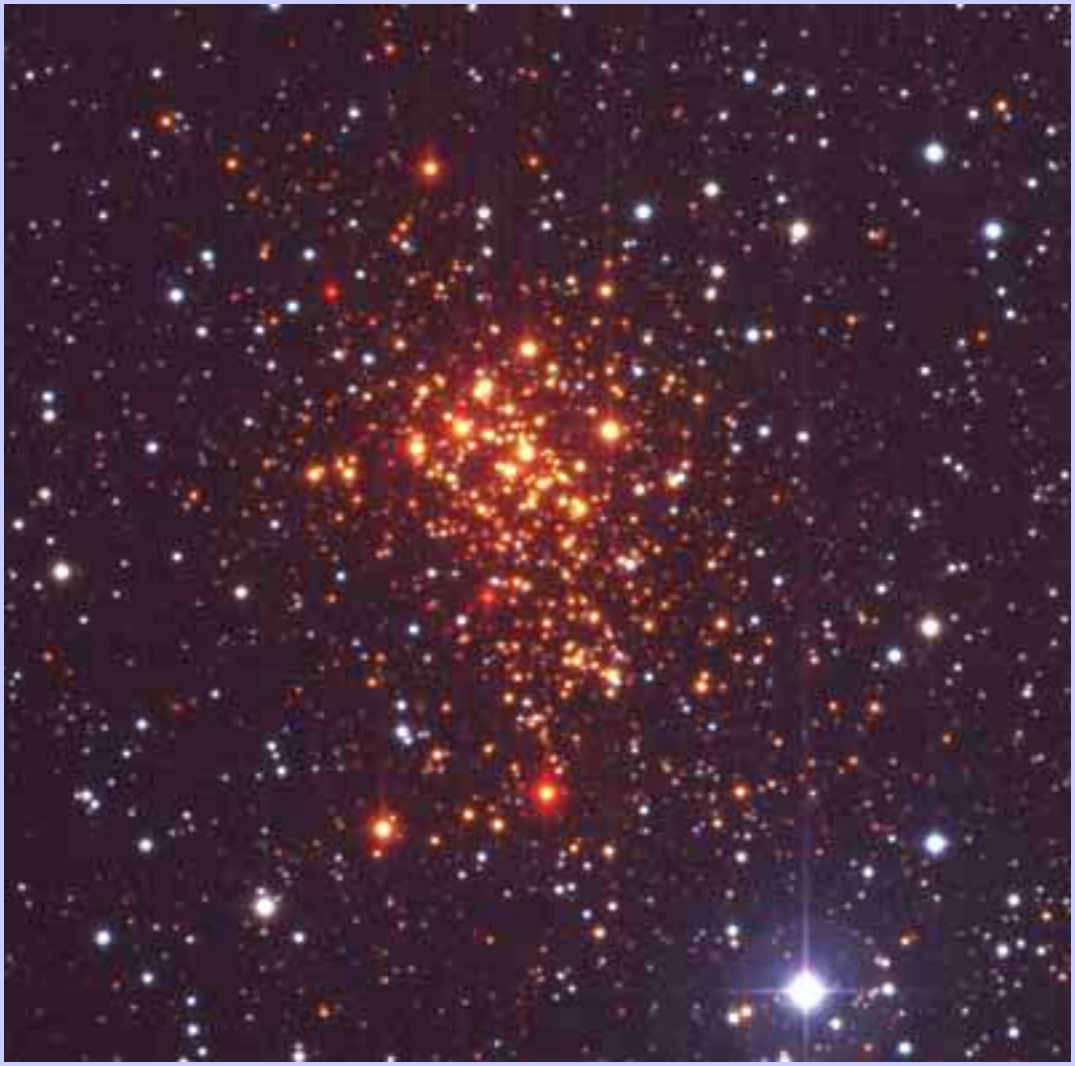
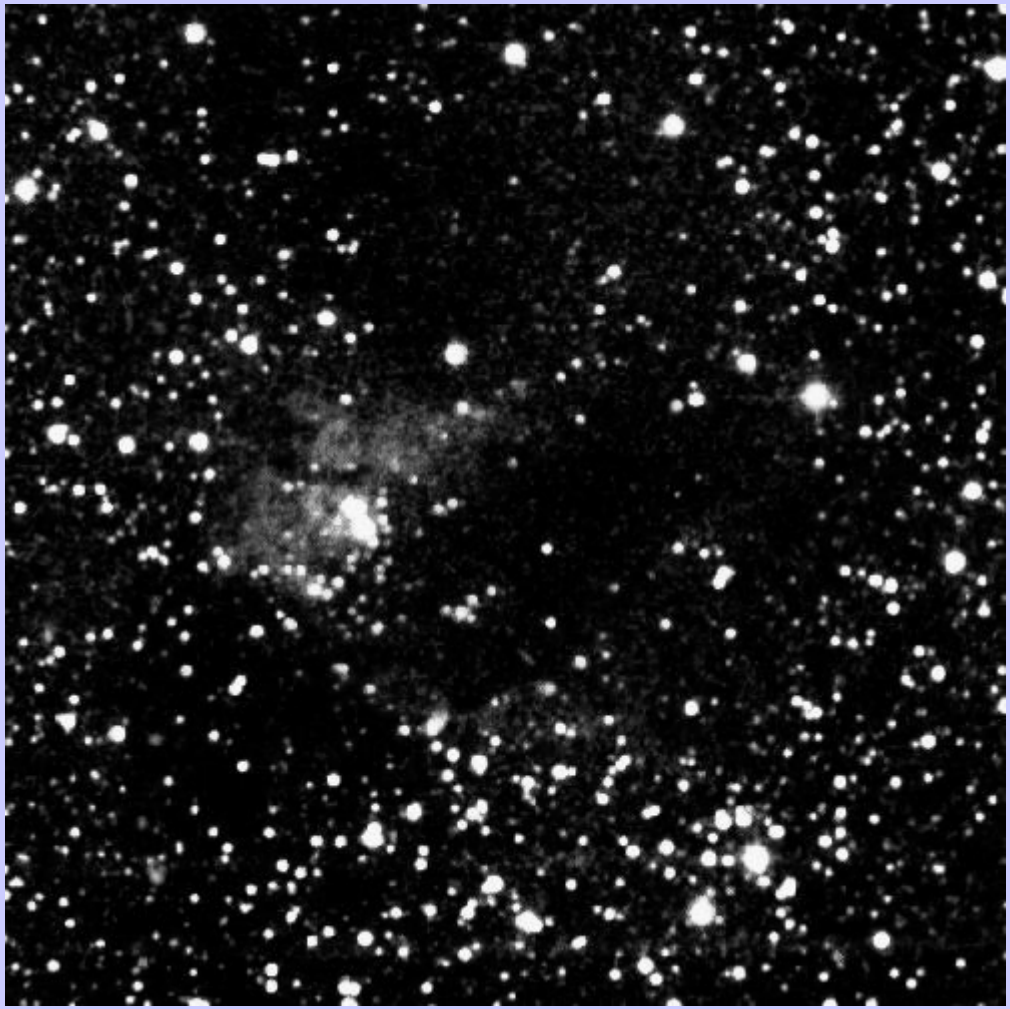
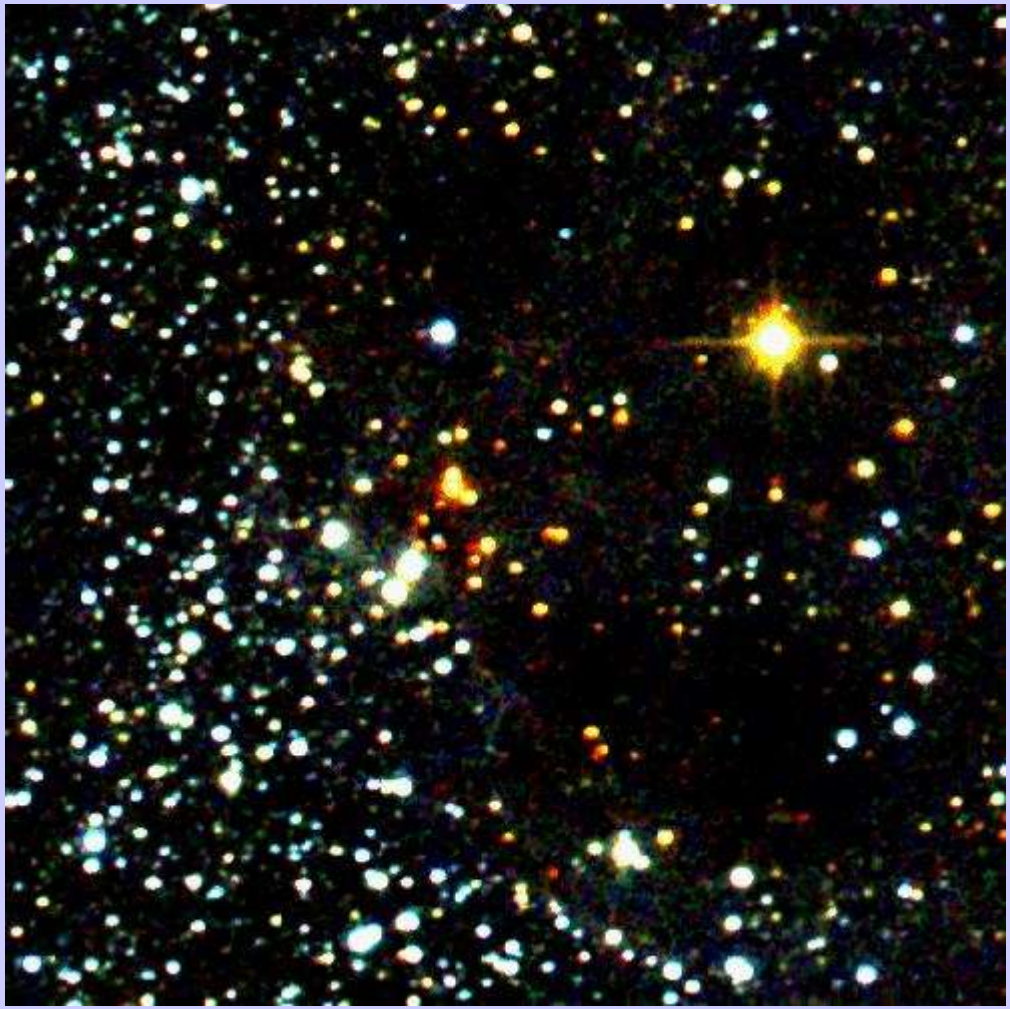
Stellar clusters = star overdensities



Any cluster here ?



Embedded clusters toward the North America Nebula

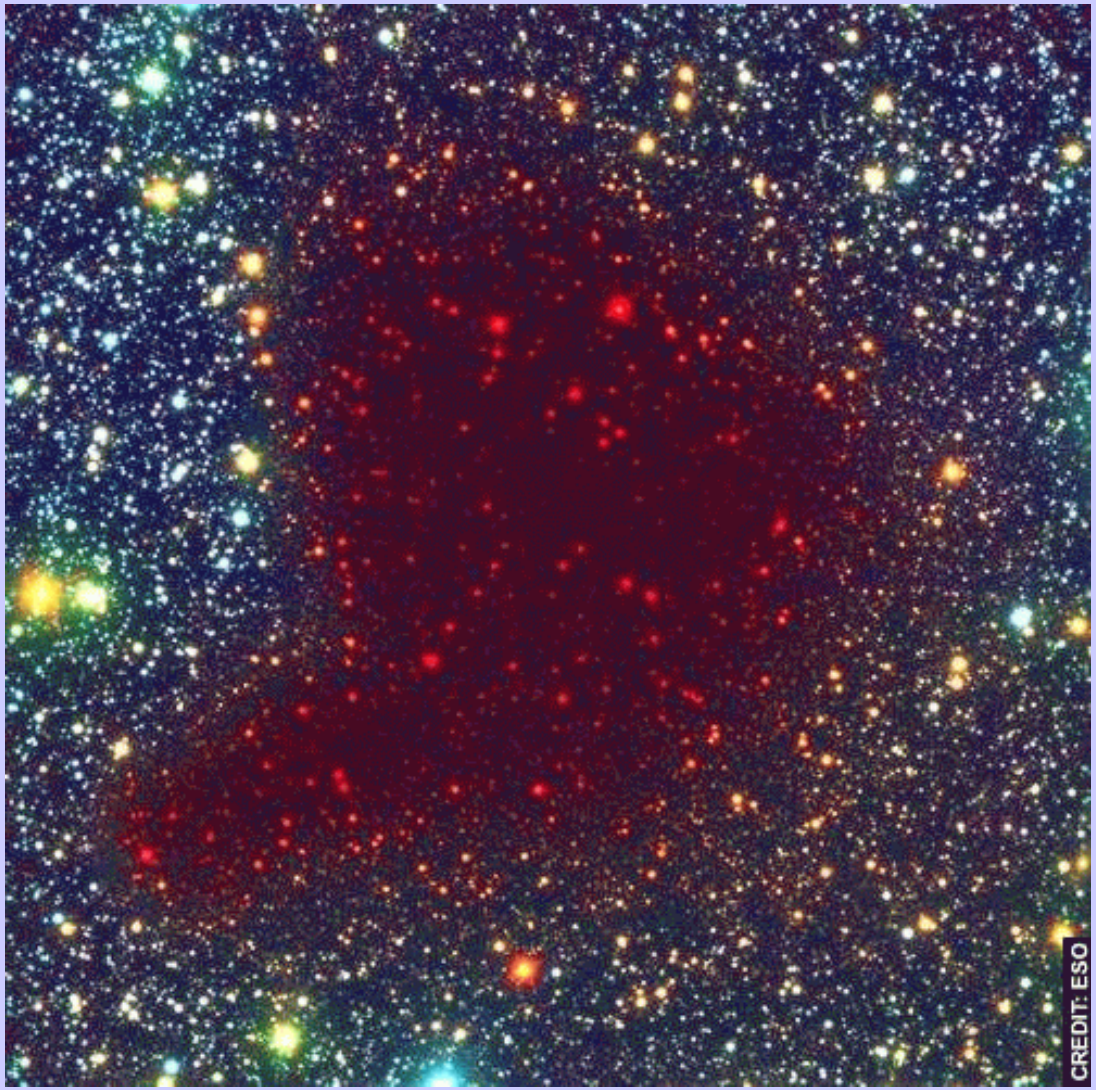


2MASS JHKs images

Cambrésy et al. 2002

B68, a starless dense core

- How do we know that?
  - No star in the optical = high extinction
  - Star density increases with wavelength in the globule
- How to compare star density and star color?



Alves et al. 2001

Star counts, Reddening and Extinction

- Star counts (Wolf 1923)

$$A_V \propto \log \frac{1}{N}$$

- Reddening (Lada et al. 1994)

$$A_V \propto H - K_s$$

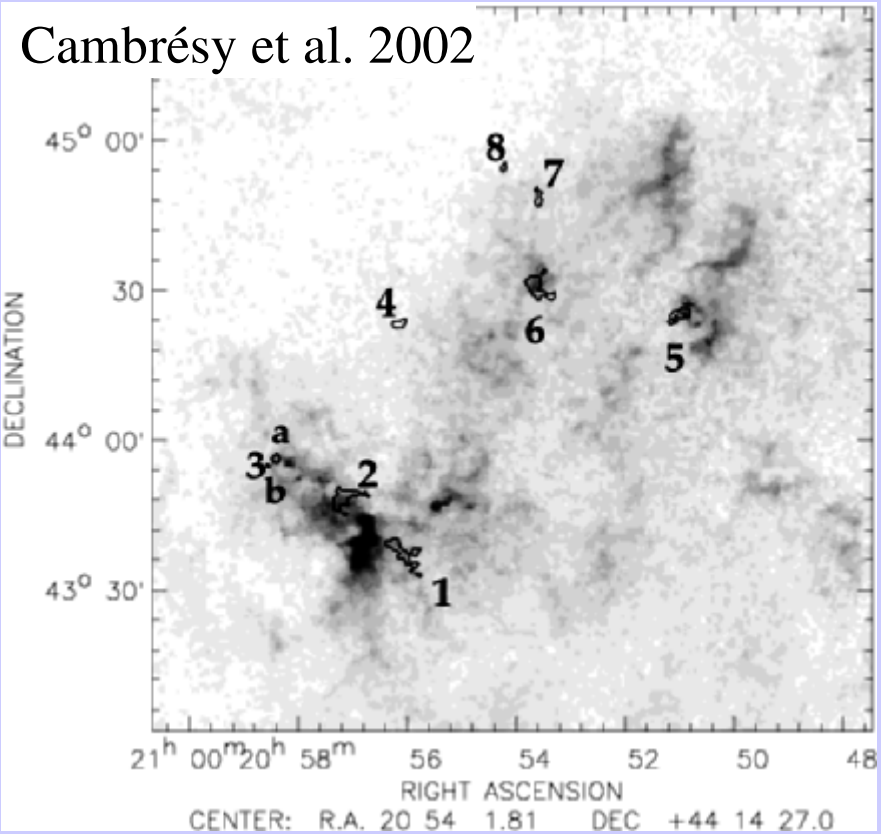
- Both techniques assume
  - homogeneous stellar population
  - background stars

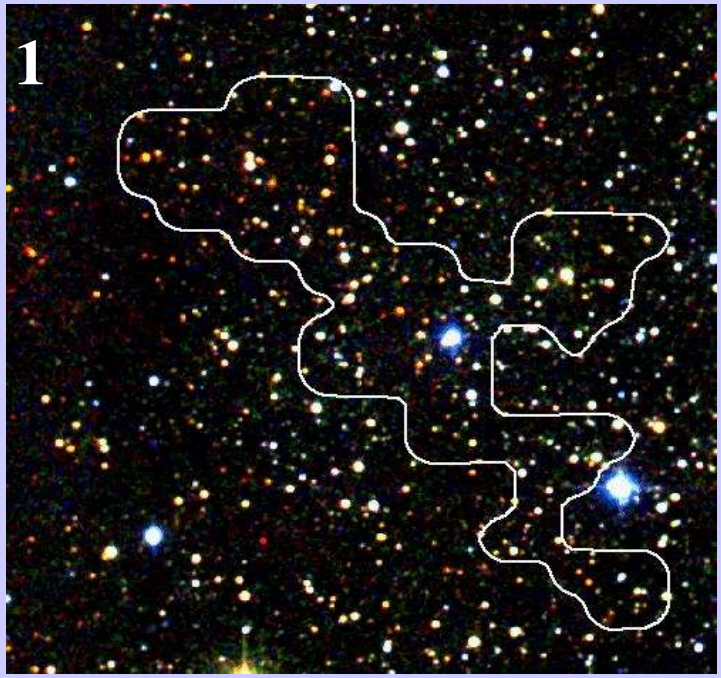
Cluster contamination

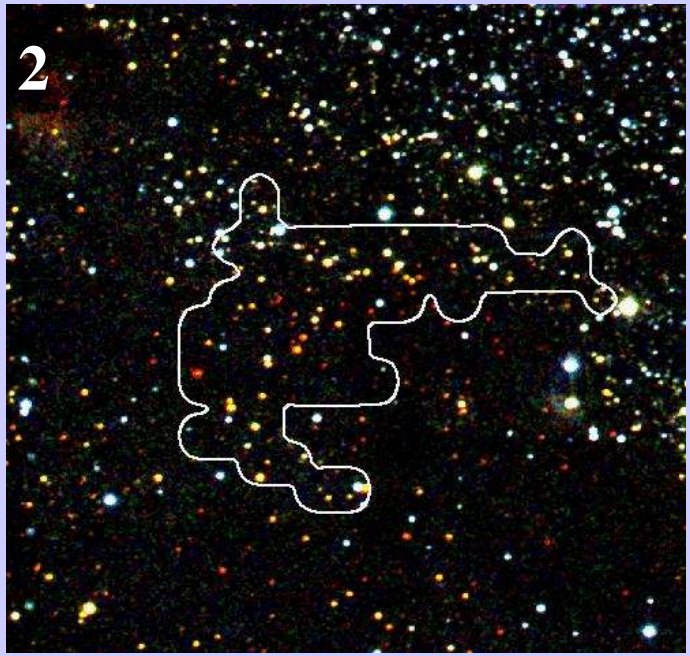
- Color is contaminated because
  - The cluster is embedded, not behind the cloud
  - YSO colors
    - Mass and age dependent
    - Circumstellar material reddens the low-mass stars younger than 2-3 Myrs
- Star counts
  - Av is underestimated because $N = N_{bg} + N_{cluster}$

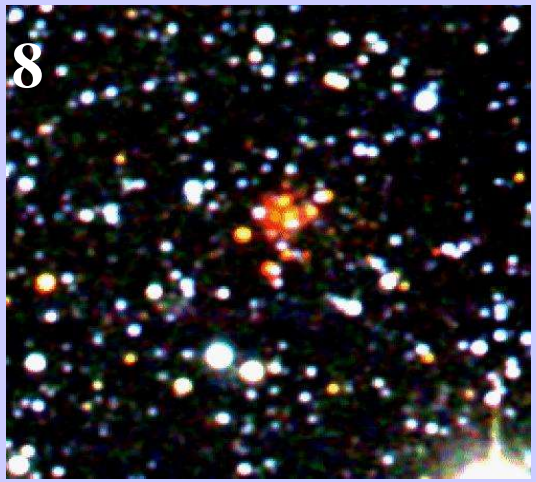
=> Structures is the Av(*H-Ks*) – Av(counts) map

The North America Nebula

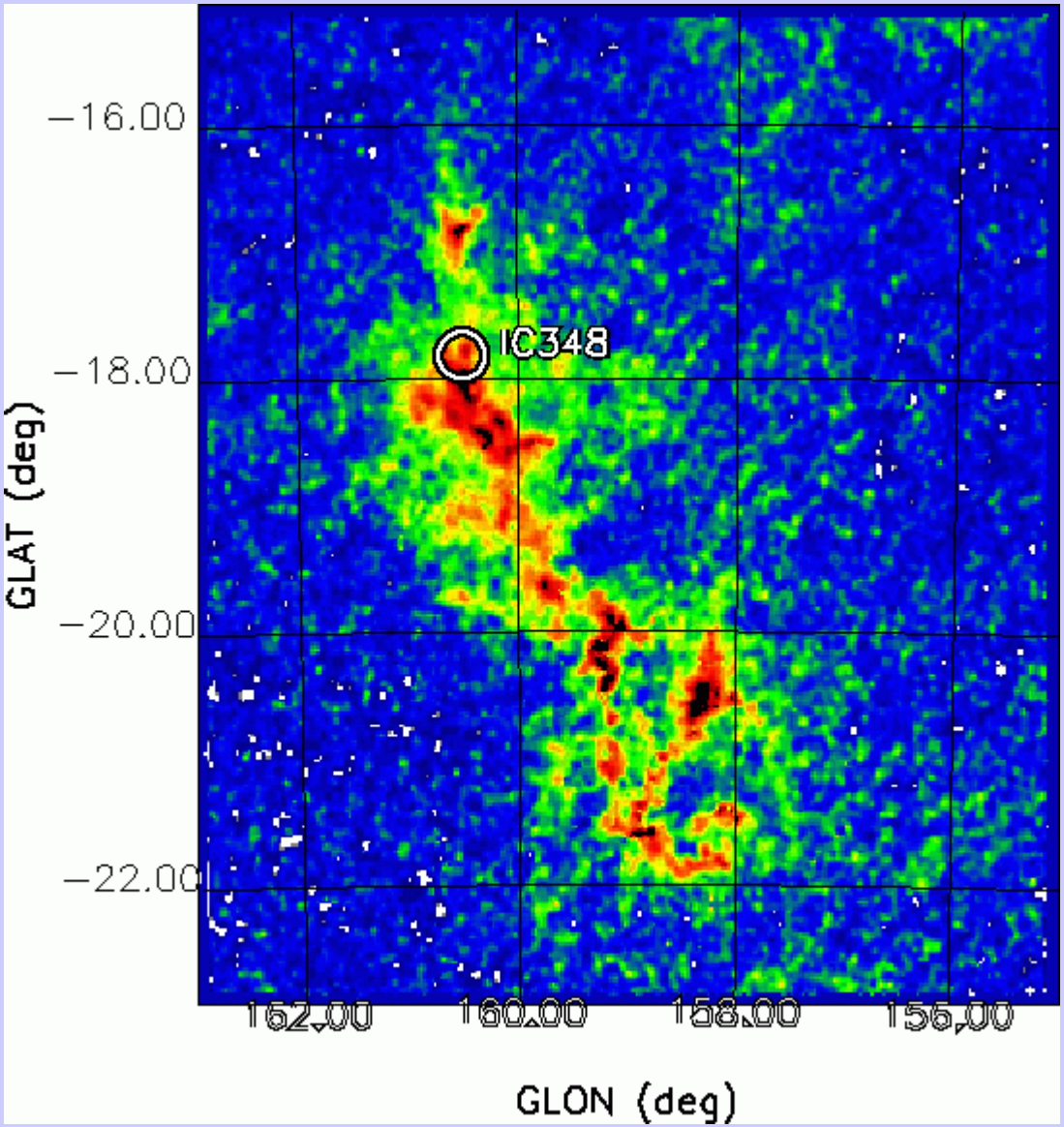




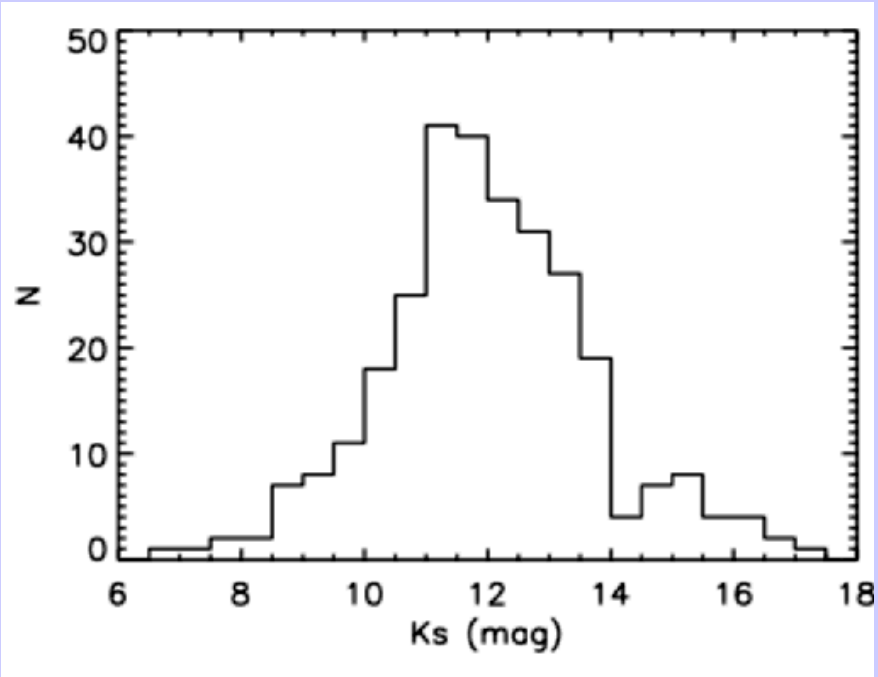




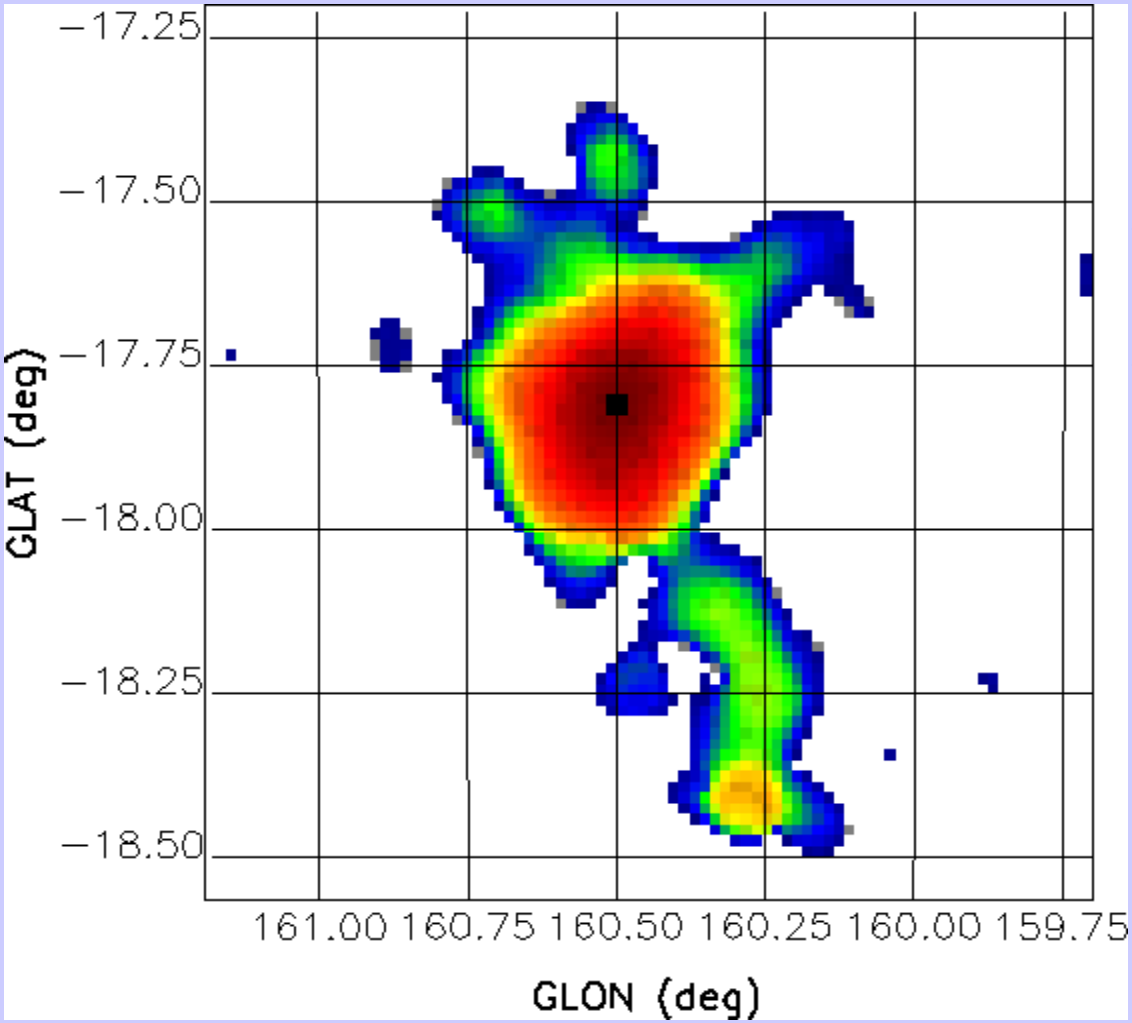
IC 348 in Perseus



- Av map from 2MASS *H-Ks*
- ~300 IC348 members (Luhman 2003, 2005)
- 2 Myr, IMF peak at 0.2 $M_{\odot}$



IC 348 morphology

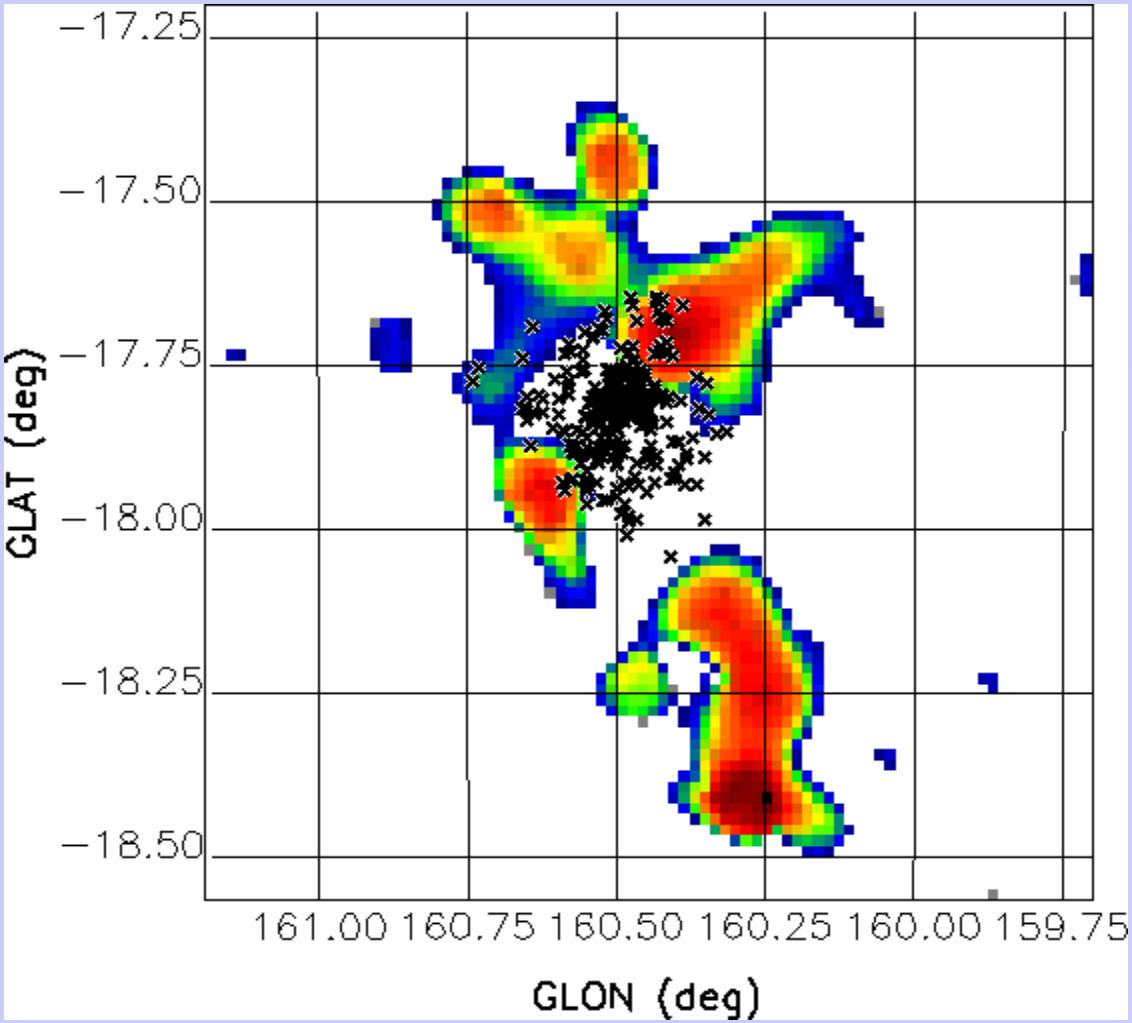


- Catalog restricted to *Ks*<13
- Av(*H*-*Ks*) – Av(counts)

  smoothed at 8' resolution

  >7 mag (=2σ)

IC 348 distribution of unknown members



- Catalog restricted to *Ks*<13
- Av(*H*-*Ks*) – Av(counts)

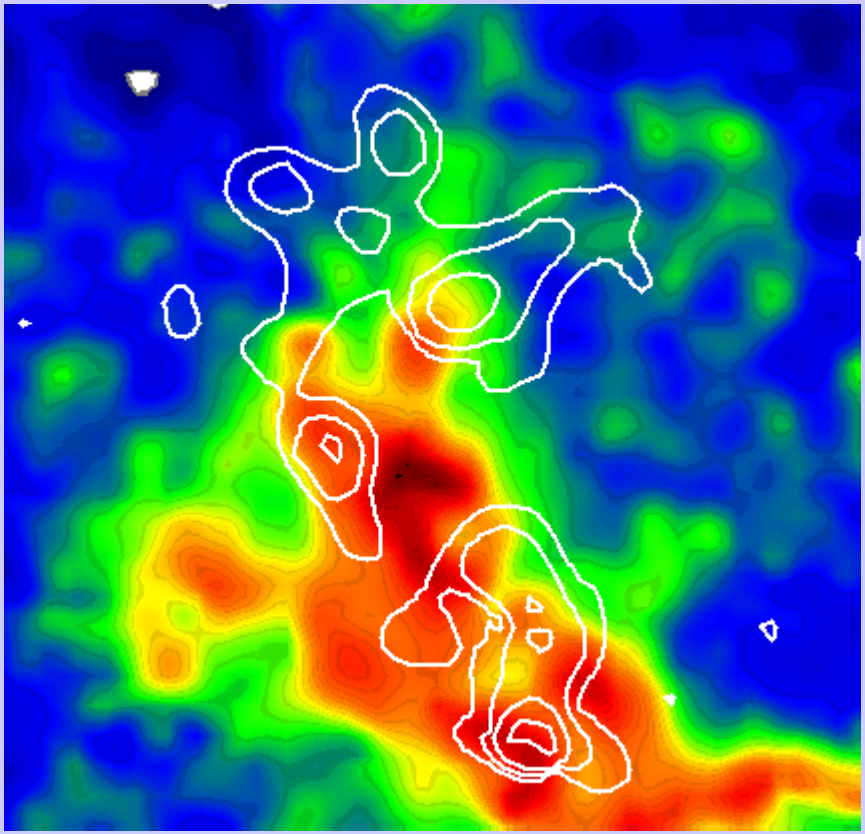
  smoothed at 8' resolution

  >7 mag (=2σ)

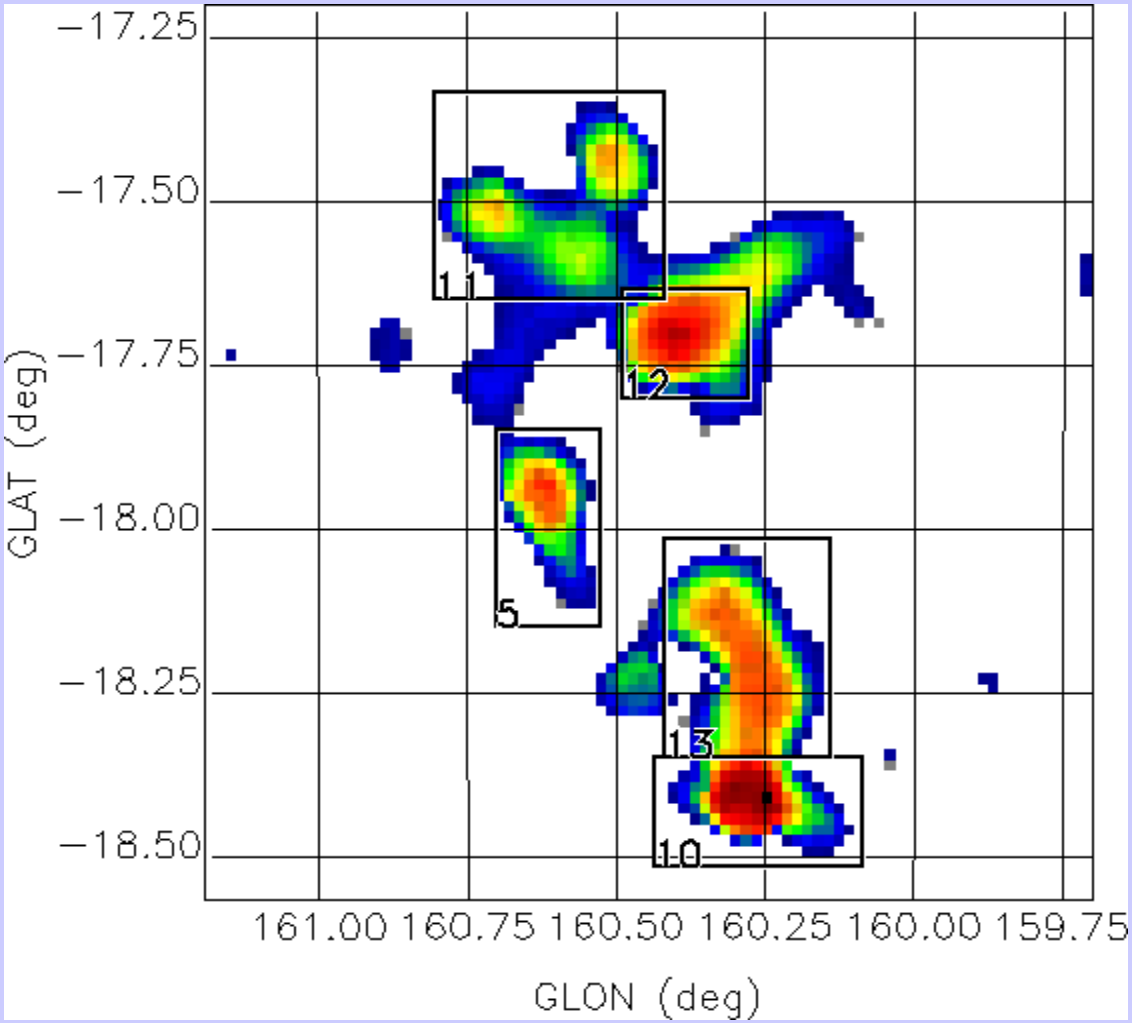
  Known YSOs are removed from the catalog

Extinction bias ?

- No correlation between the extinction map and the cluster morphology



IC 348 surface density of unknown members



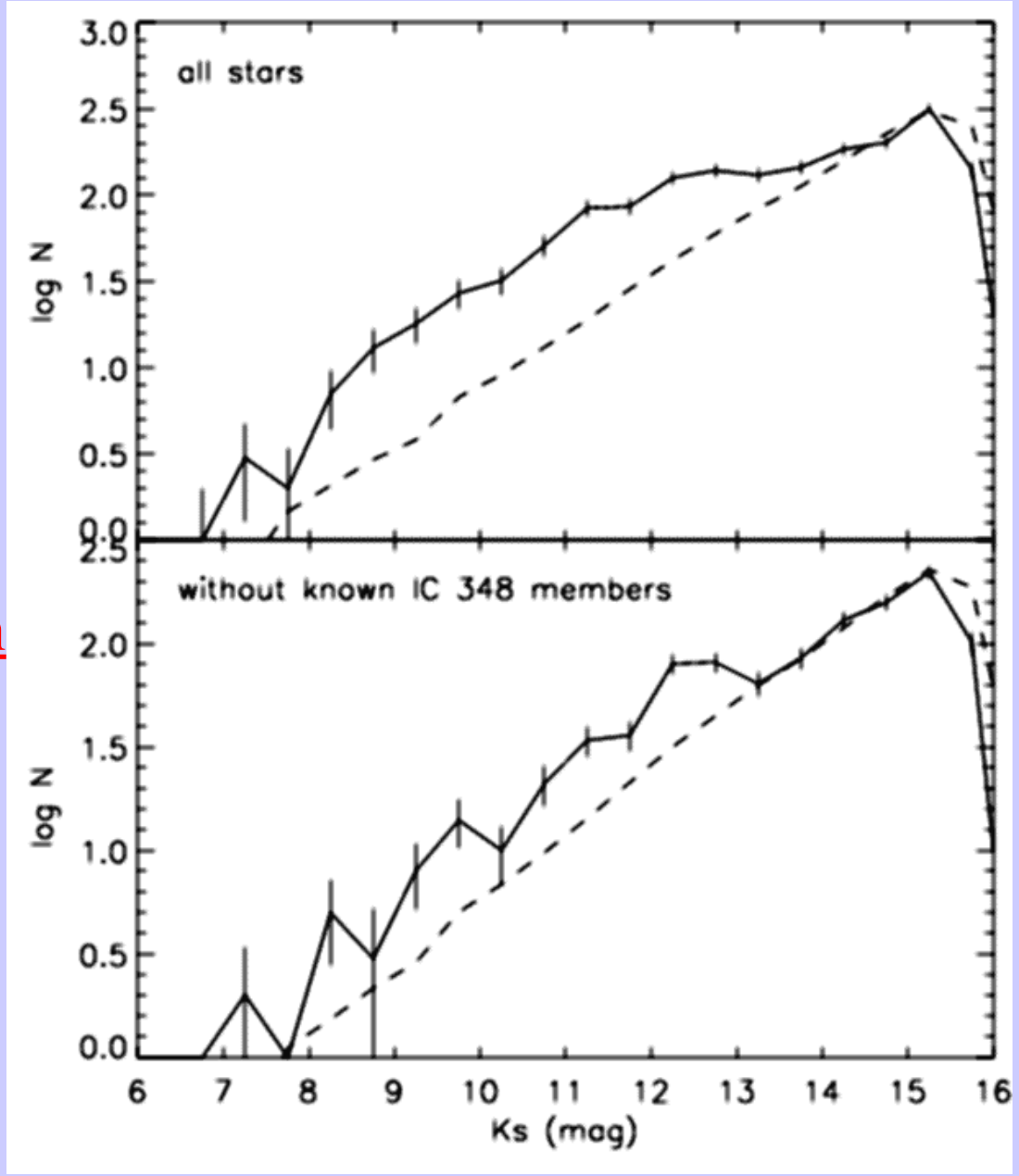
- Assuming that *H-Ks* gives the correct extinction, the number of stars in excess is:

$$N_{\text{cluster}} \propto 10^{a \times \Delta A_V} - 1$$

- About **55 new YSOs**

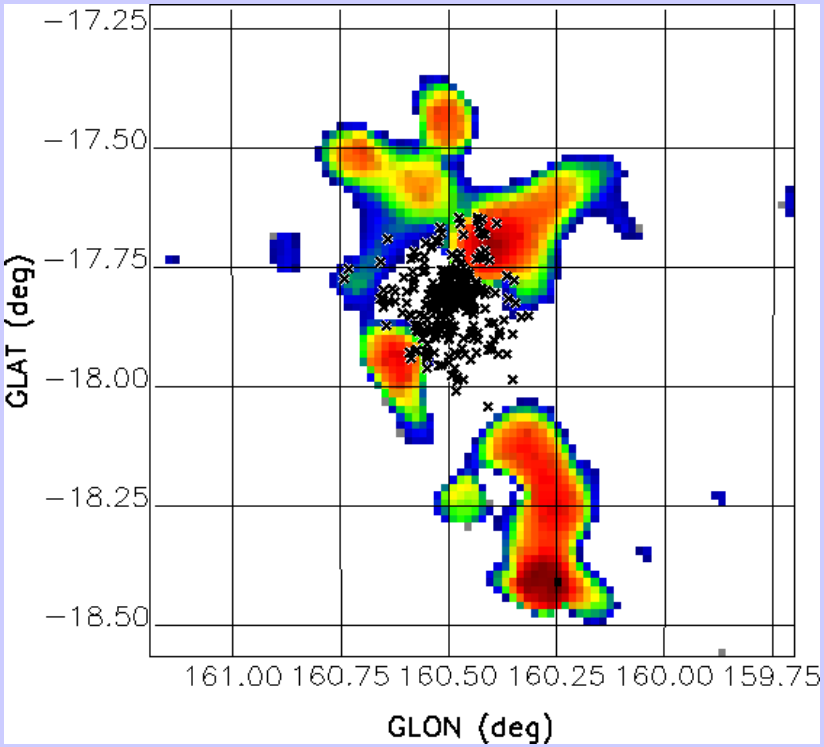
Luminosity function warning

- Resist the temptation !
  - The selected area contains an excess of stars brighter than *Ks*=13 by construction



Conclusion

- IC 348
  - About **55 unknown members** in the outer parts of the cluster
    - dynamical evolution of the cluster substructures?
    - Star formation history?



- Nearby embedded clusters
  - Color and density must be investigated simultaneously for statistical analysis
  - Large fields with multi-wavelength observations are needed (rather than very deep observations) to identify individual YSO