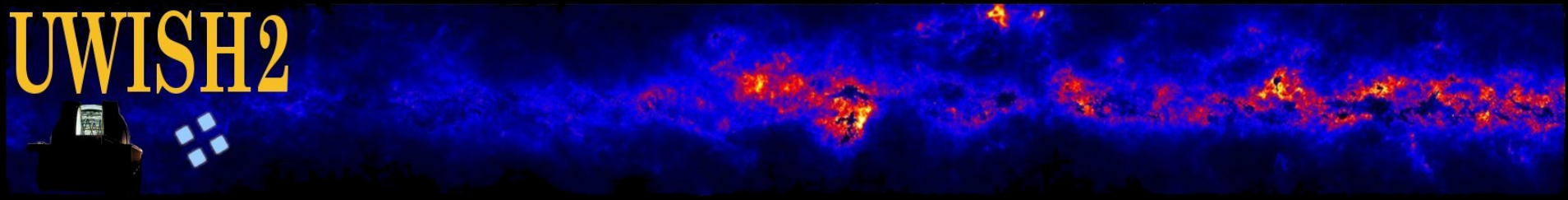


H2 Outflows in Serpens and Aquila from UWISH2

Georgios Ioannidis

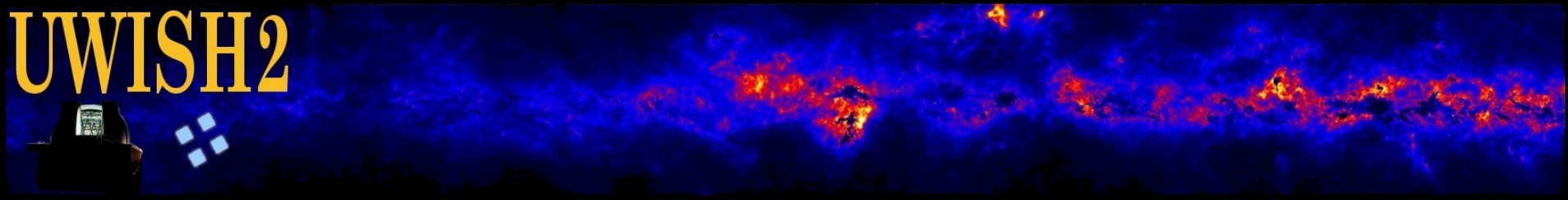
Dirk Froebrich

Centre for Astrophysics and Planetary Science (CAPS)

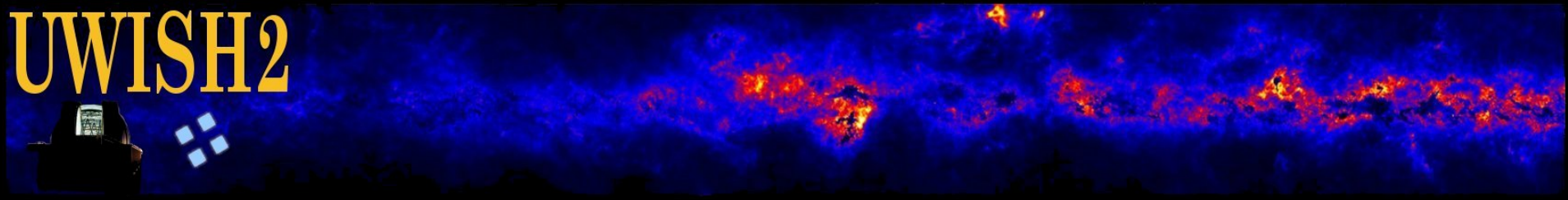
University of Kent

Joint Astronomy Centre

JCMT UKIRT



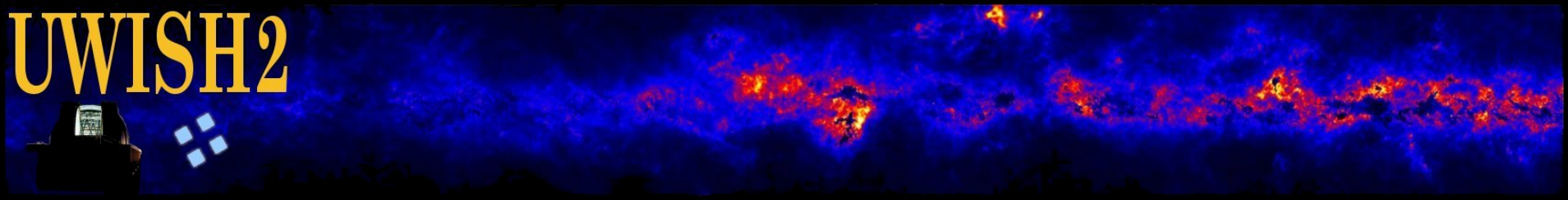
- UWISH2 - Scientific objectives
- Covered Area
- Outflow distribution
- Distance calculation
- Results
- Work in progress
- Future work



UKIRT Widefield Infrared Survey

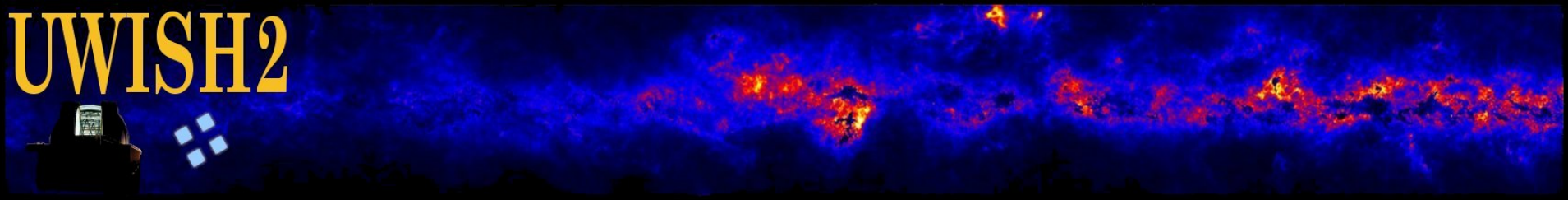
for H2

7° < l < 65° ; -1.5° < b < +1.5°

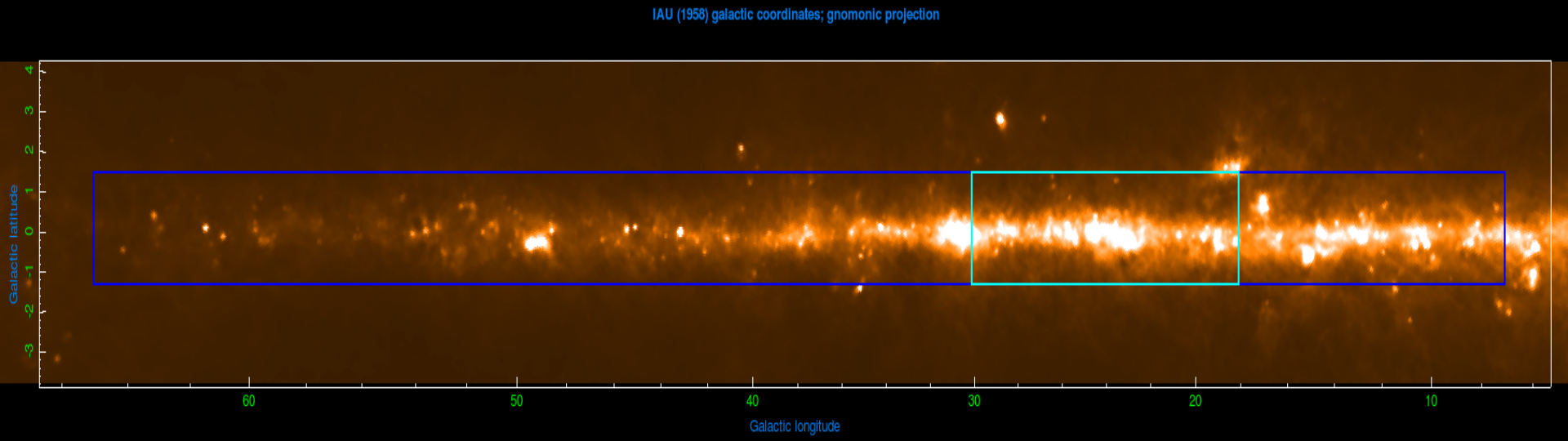


SCIENTIFIC OBJECTIVES

- Characterise the dynamic component of star formation along a large fraction of the Galactic Plane in an unbiased manner.
- Determine the duration of the jet/outflow phase in YSO evolution (fraction of sources with jets/outflows).
- Determine the star formation rate along the Galactic Plane.
- How do jet/outflow properties (length, opening angle, power) relate to the source properties (mass, luminosity, age, accretion rates) and/or parental cloud (mass, structure) and/or mode of star formation (isolated/clustered)?



SEARCHED AREA FOR OUTFLOWS

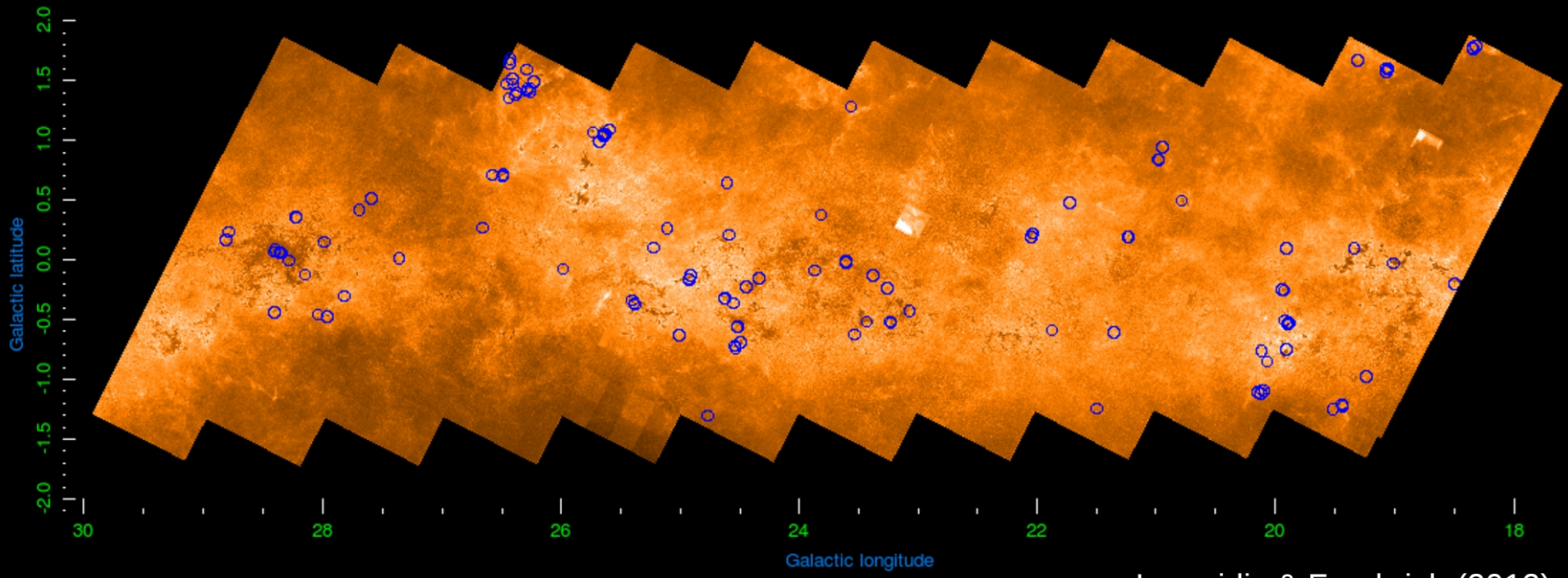


Froebrich et al. (2011)
Ioannidis & Froebrich (2012)

UWISH2 ~ 180 square degrees
SEARCHED AREA ~ 33 square degrees

UWISH2

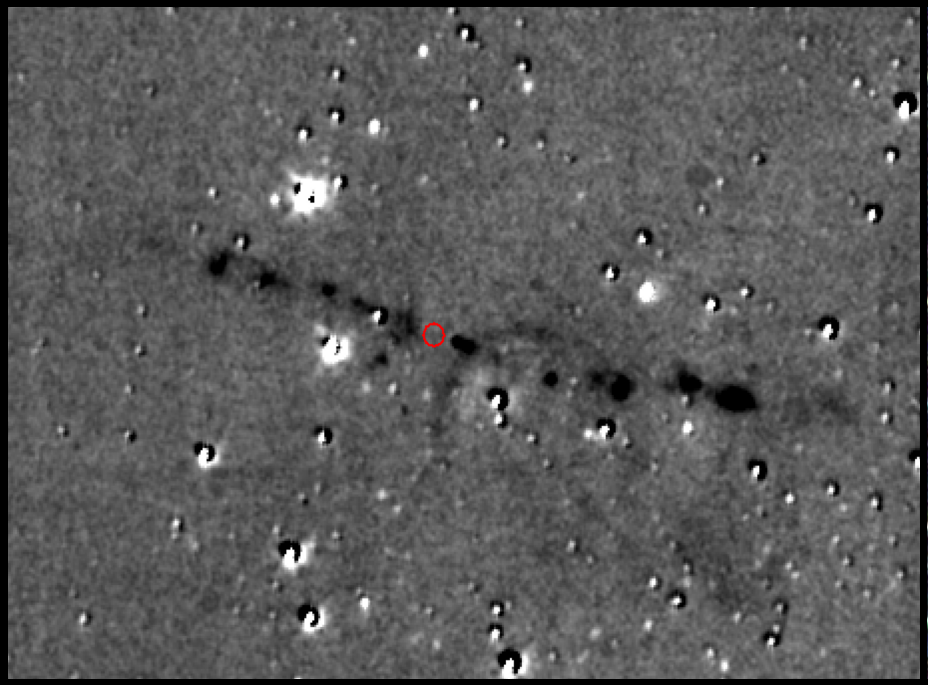
OUTFLOWS ON GPS AV MAP

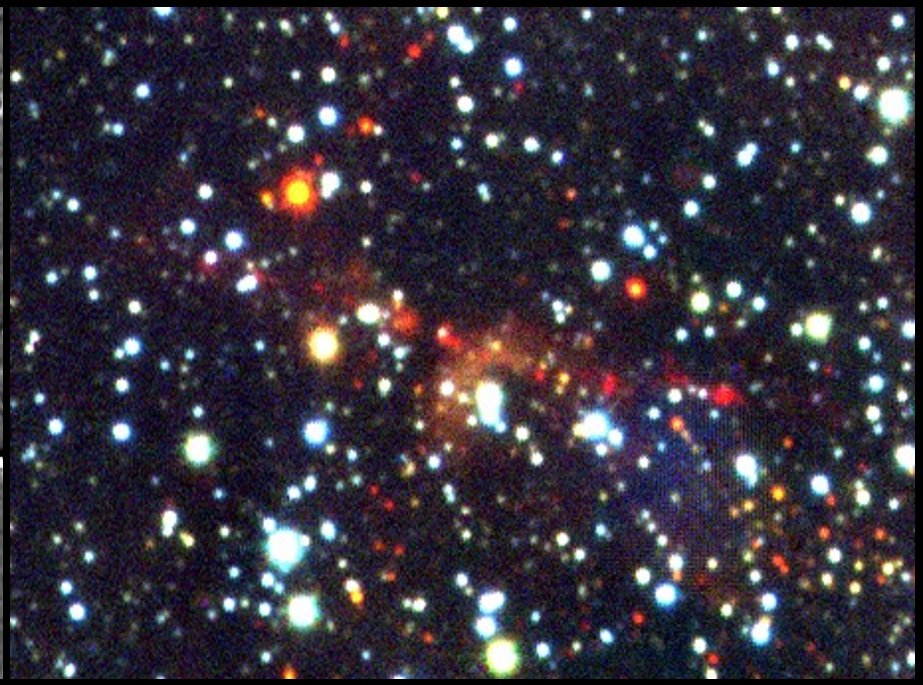


Ioannidis & Froebrich (2012)

UWISH2

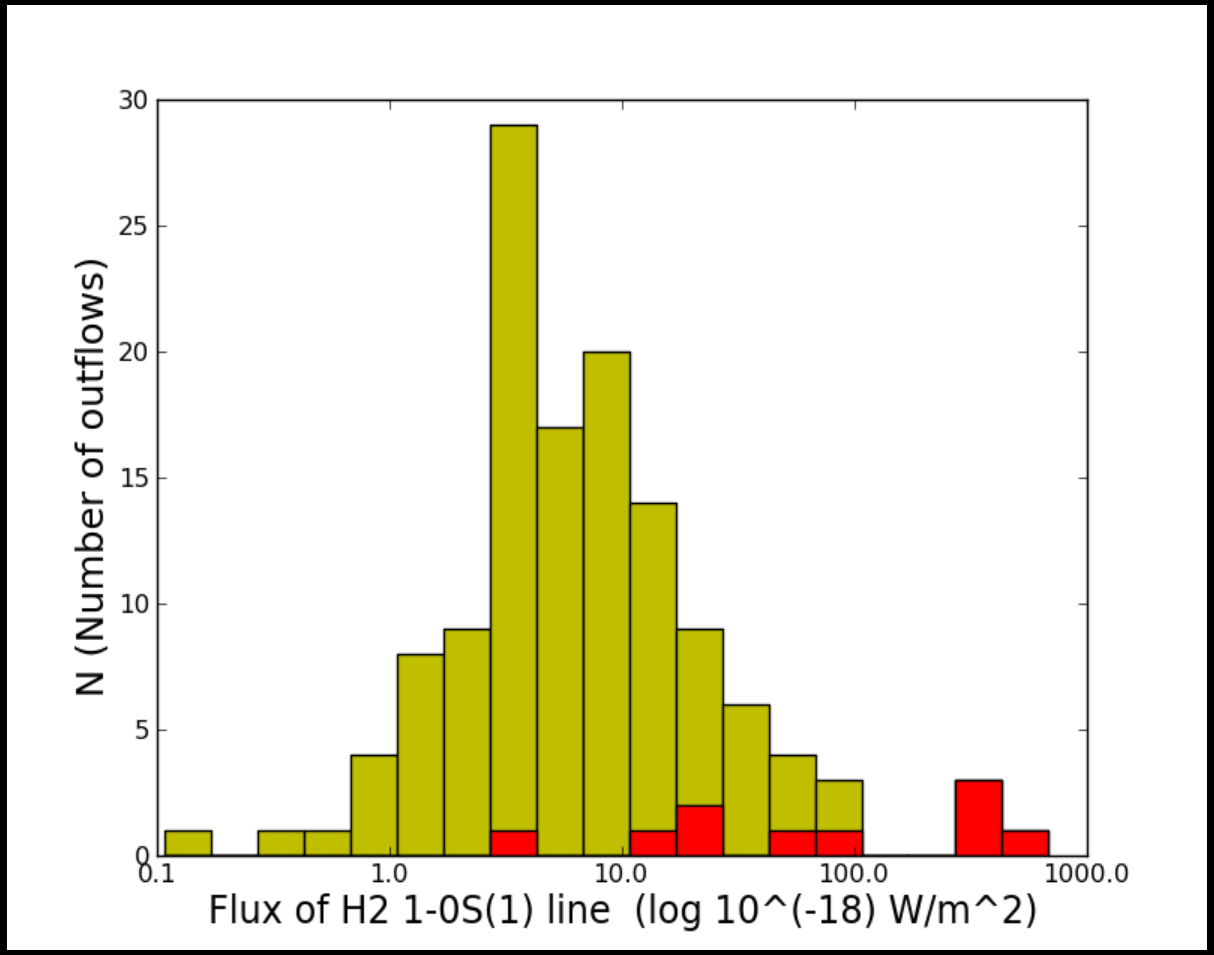
SOURCES OF OUTFLOWS





UWISH2

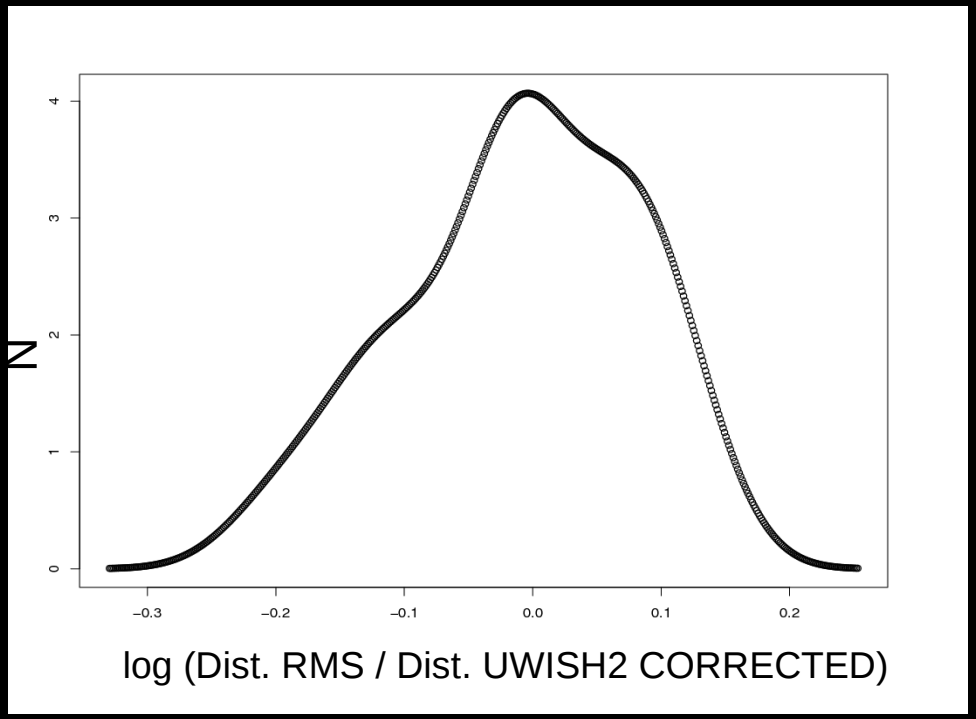
Flux distribution



Ioannidis & Froebrich (2012)

UWISH2

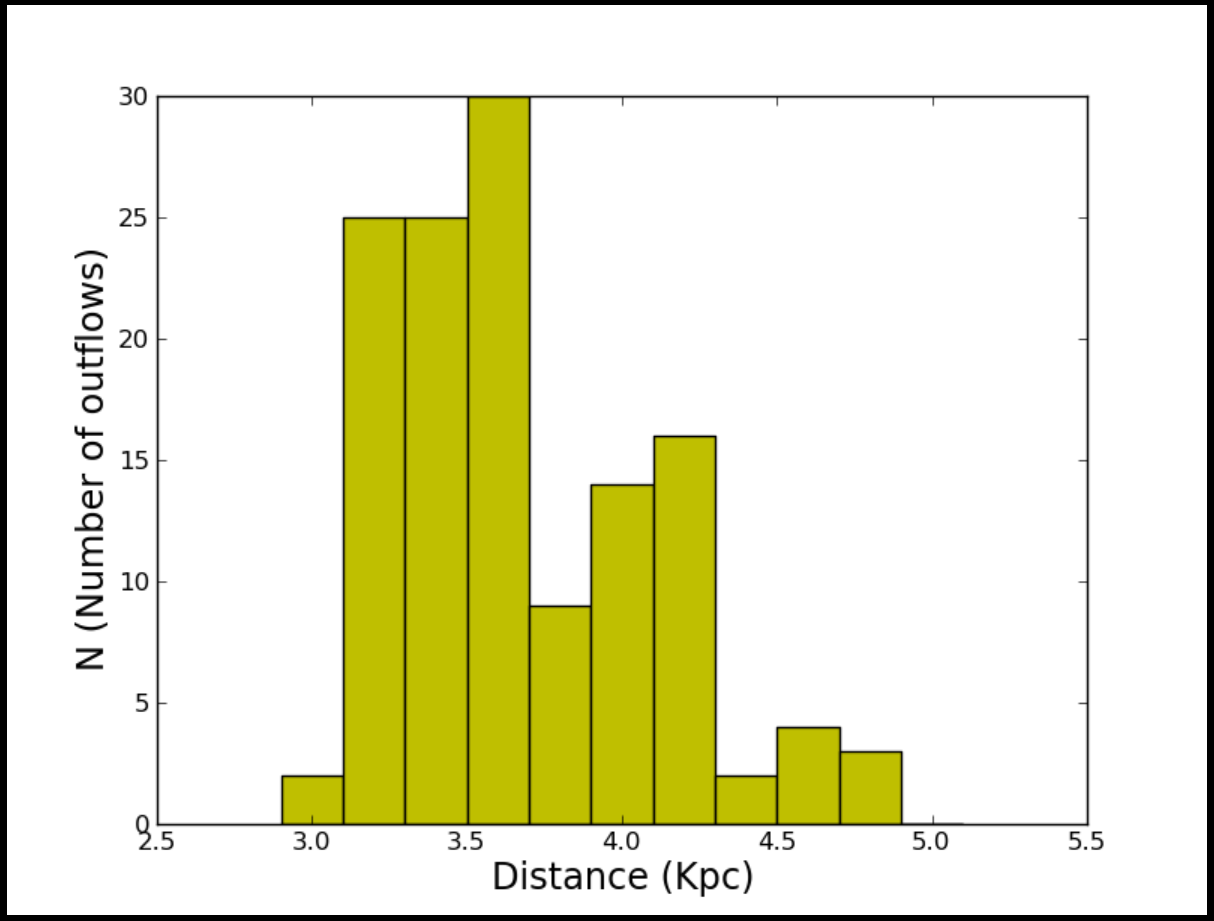
DISTANCE CALCULATION



Measure density of foreground stars.
Besancon Galaxy model (Robin at al. 2003).
Calibration with RMS sources (Urquhart et al. 2008)

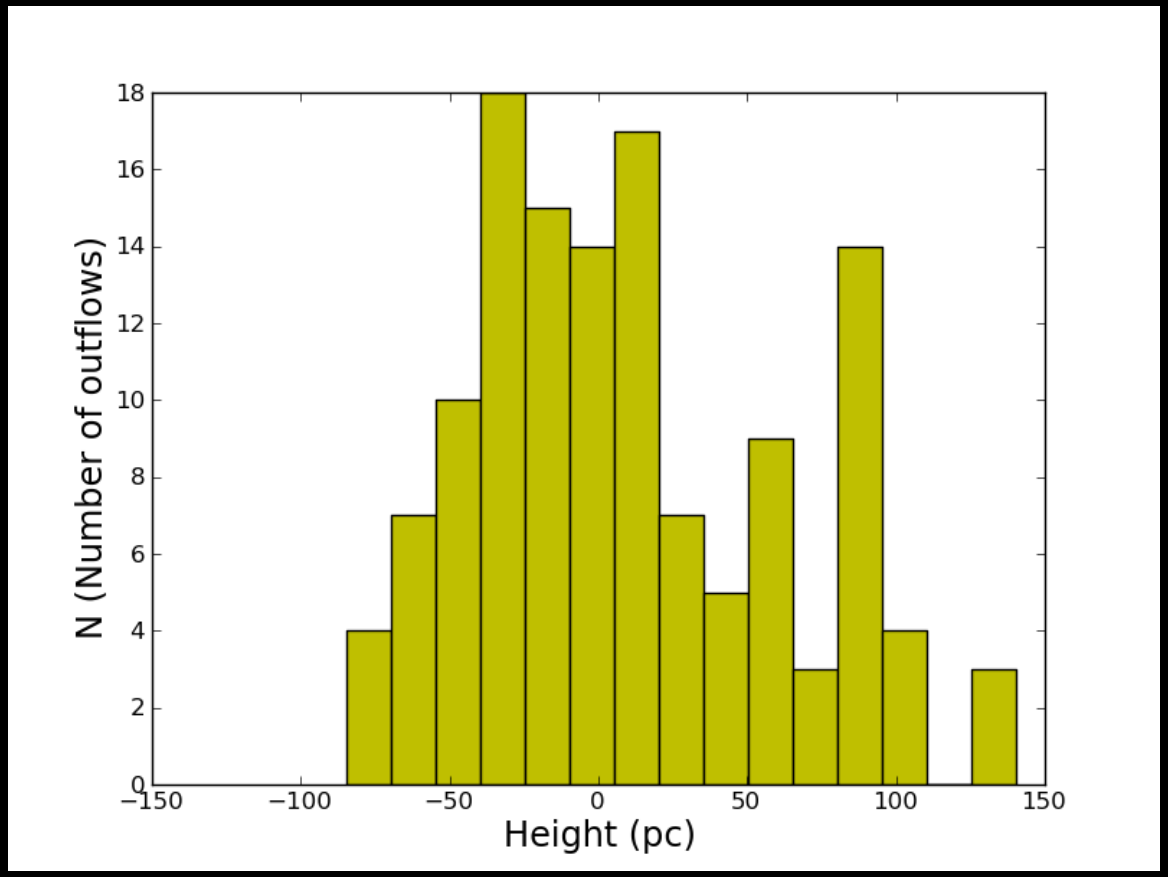
UWISH2

DISTANCE DISTRIBUTION



UWISH2

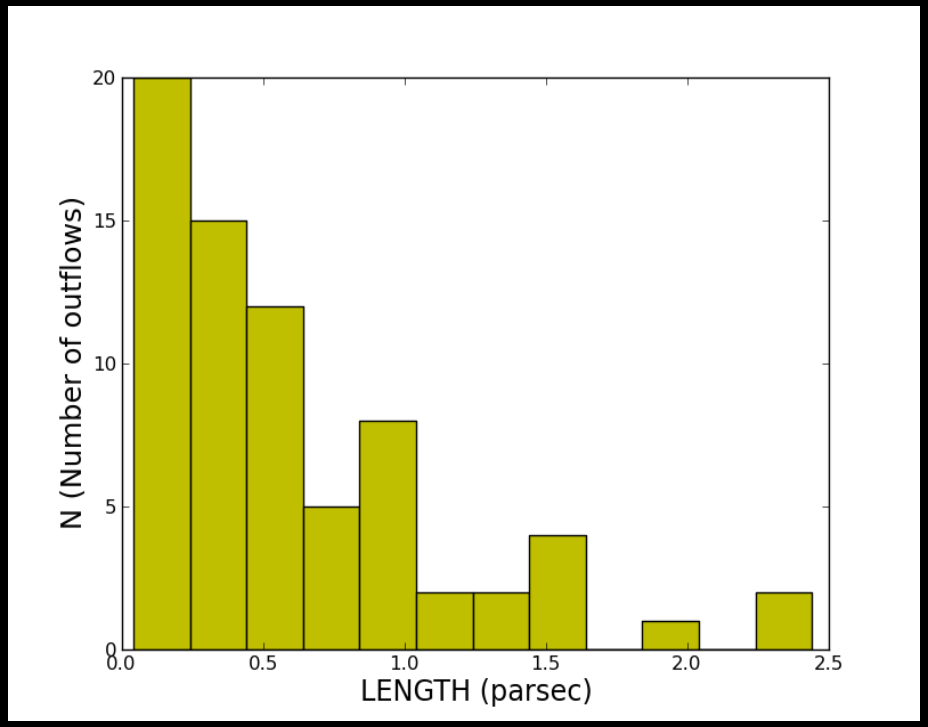
DISTANCE TO THE GALACTIC PLANE

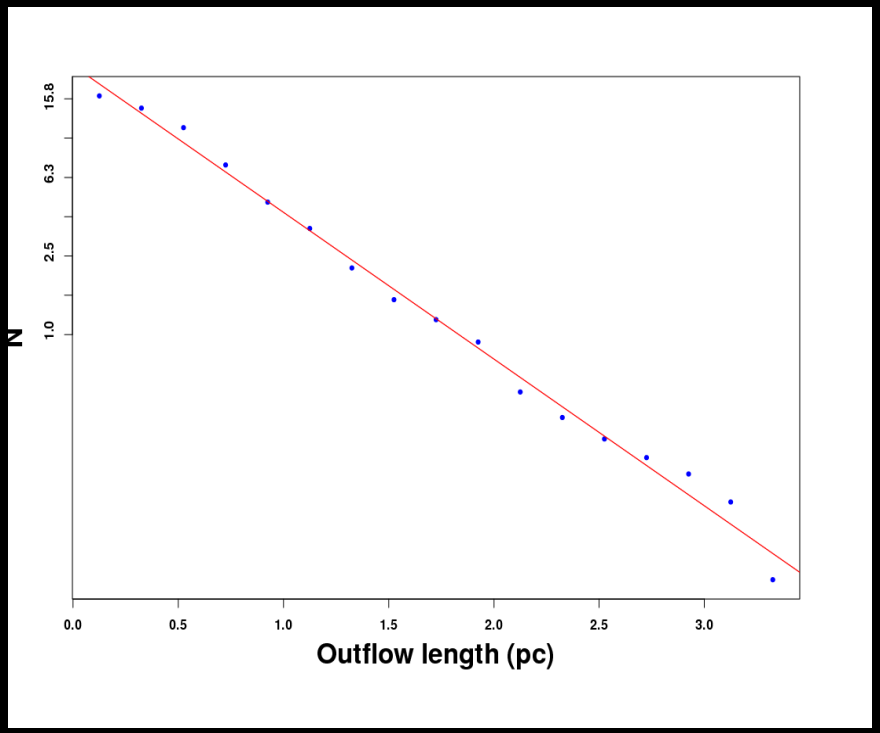


Scale height 30 pc

UWISH2

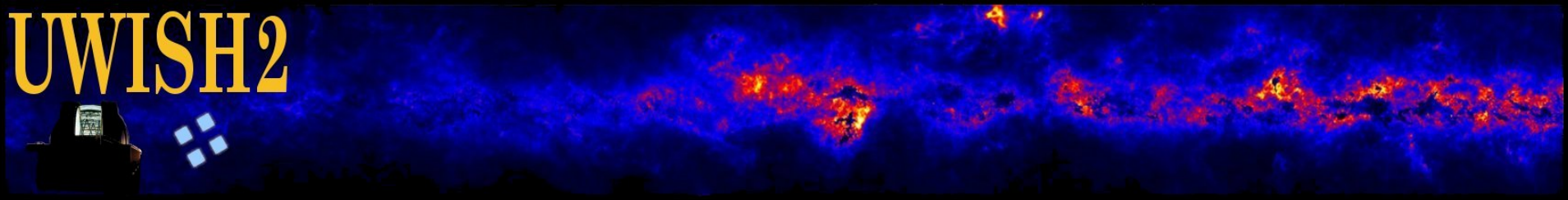
LENGTHS





Exponential relationship between N and length

$$N \propto 6^{-length\,(pc)}$$



LENGTHS MODELLING

Variables:

- **Velocity (0 – 150 km/s)**
- **Age (1000 – 30000 yrs)**
- **Inclination**

Best fitting models:

40 km/s – 130 km/s

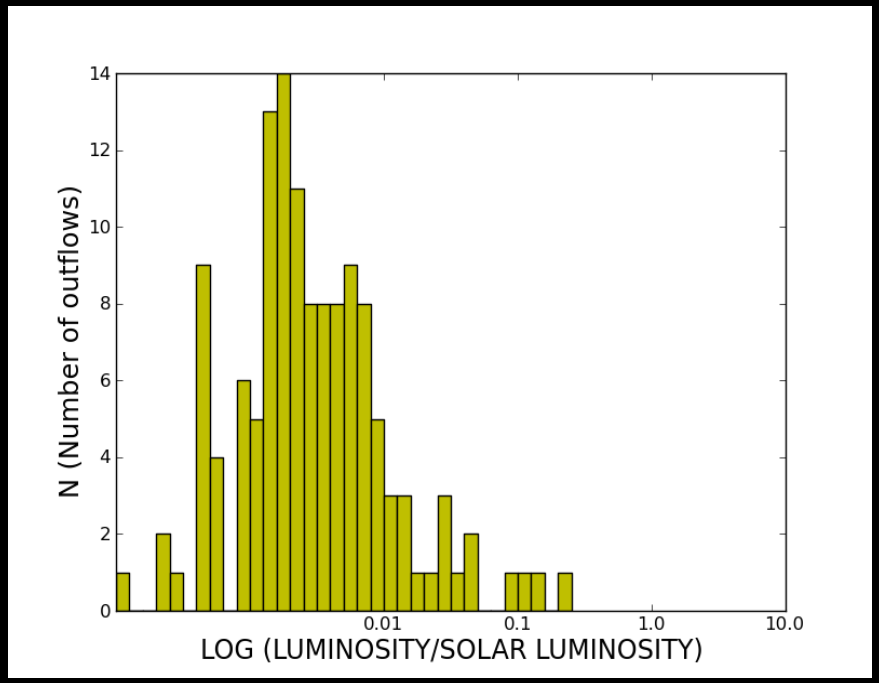
4000 yrs – 20000 yrs

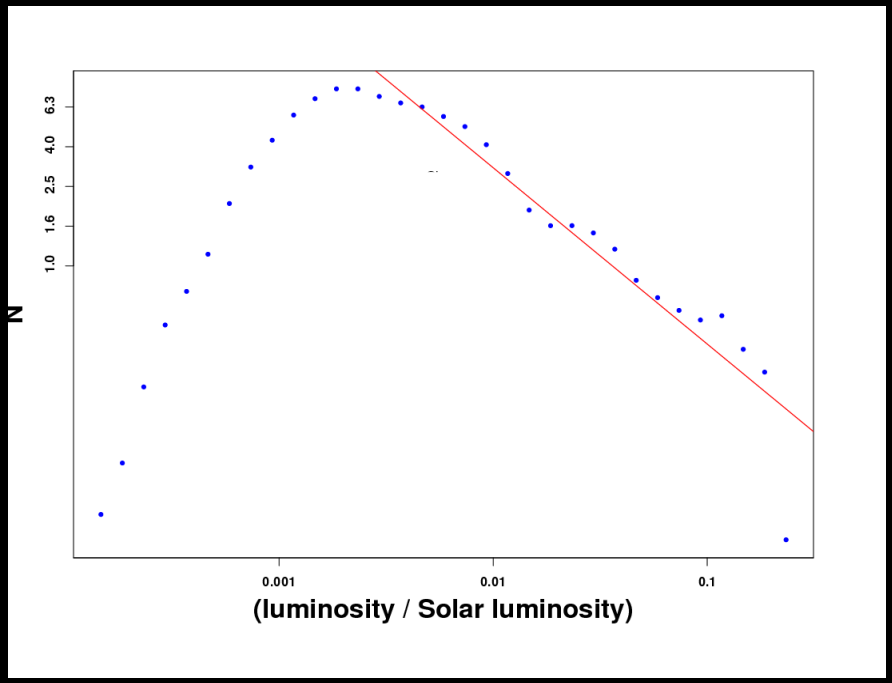
20 degrees – 90 degrees

Young/old and very slow objects are not common in our sample.

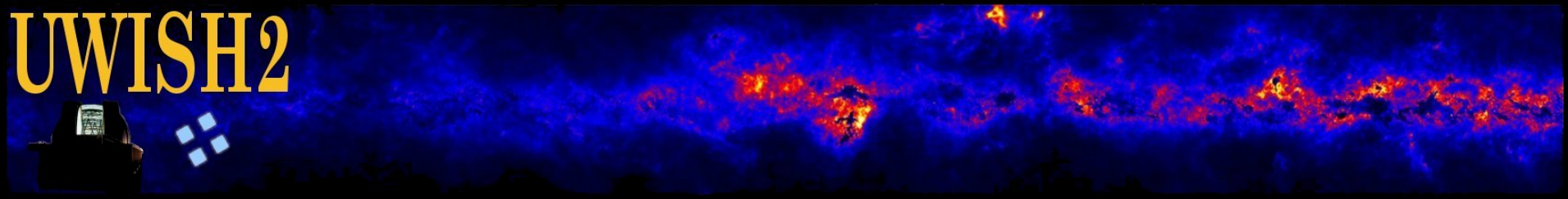
UWISH2

LUMINOSITY





$$N \propto L_{1-0S(1)}^{-1.9 \pm 0.1}$$



OUTFLOW LUMINOSITY FUNCTIONS

$$N \propto L_{1-0\mathrm{S}(1)}^{-1.9 \pm 0.1}$$

$$\log(L_{H2}) = 0.58 * \log(L_{bol}) - 1.4$$

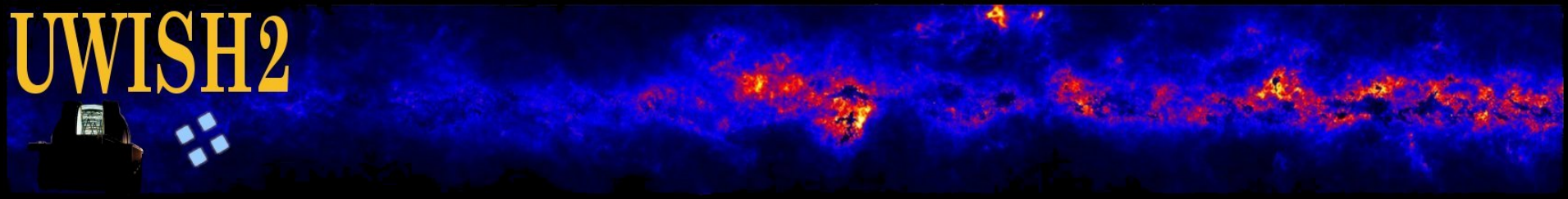
(Caratti o Garatti et al., 2006)

+

assumptions

$$\dot{M} \propto M^{1.3 \pm 0.2}$$

Rules out mass independent average mass accretion rate



STAR FORMATION RATE

H2 Luminosities range : 0.01 – 1.0 Solar luminosities

i.e. low - intermediate mass protostars

$$A_k = 1\text{mag} \rightarrow L_{H2} = 25 L_o \rightarrow L_{acc} = 6\text{x}10^4 L_o$$

objects accrete onto 1M⊙ stars of 1.5R⊙

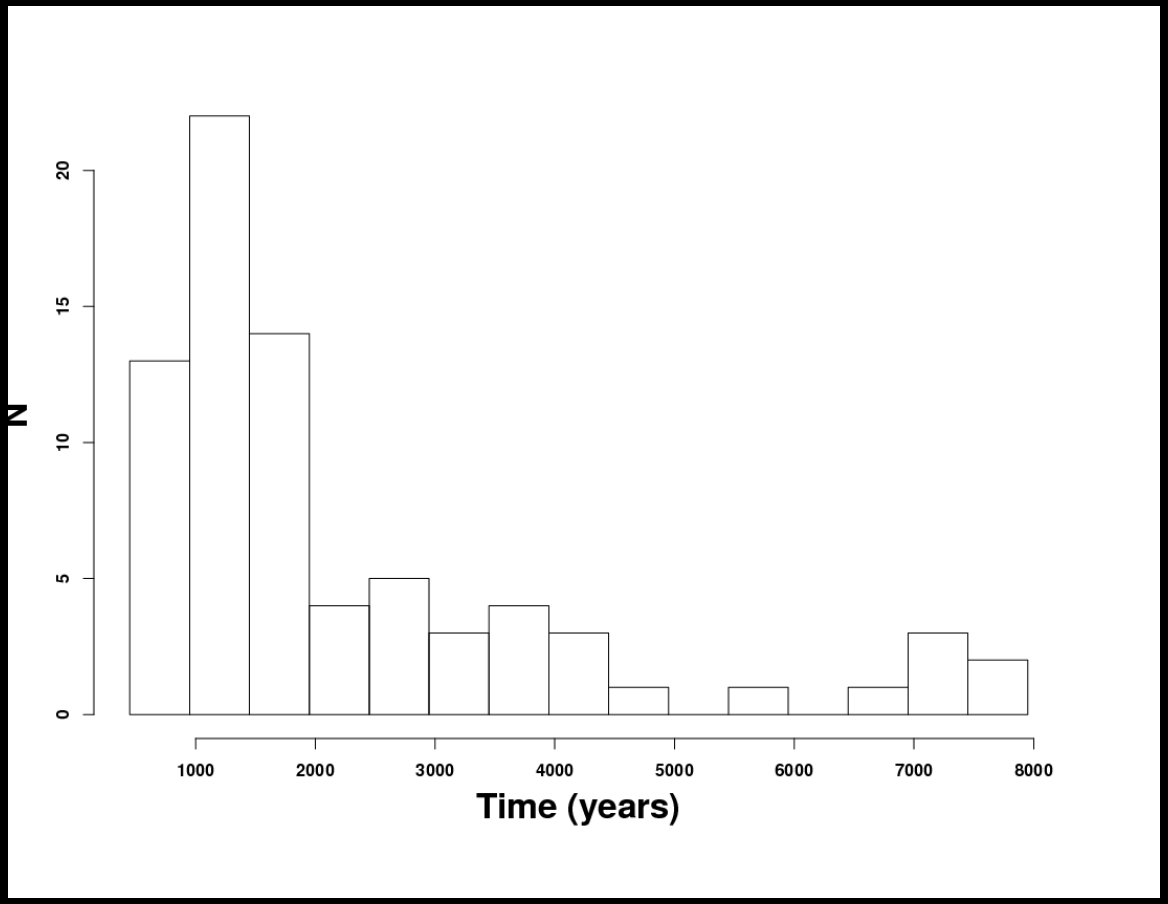
(Hosokawa et al., 2011)

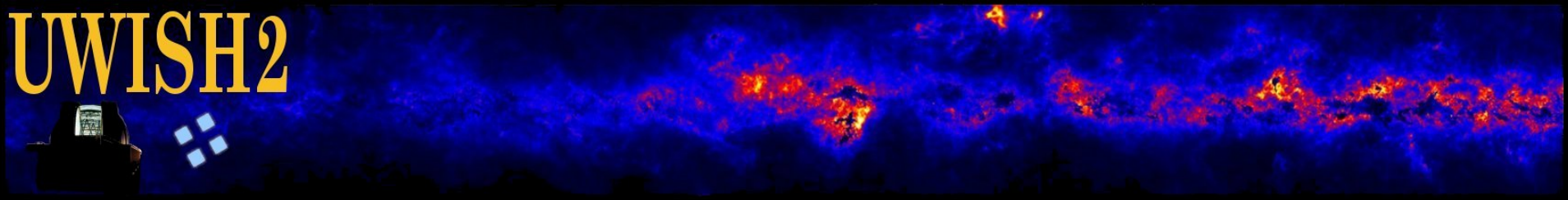
$$\dot{M} = 0.75\, x\, 10^{-3}\, M_o\, yr^{-1}\, kpc^{-2}$$

$$\dot{M}_G = 5\, M_o\, yr^{-1}$$

UWISH2

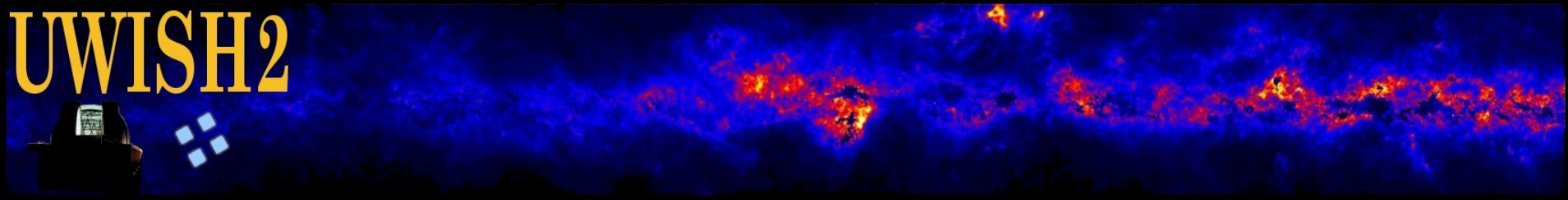
WORK IN PROGRESS





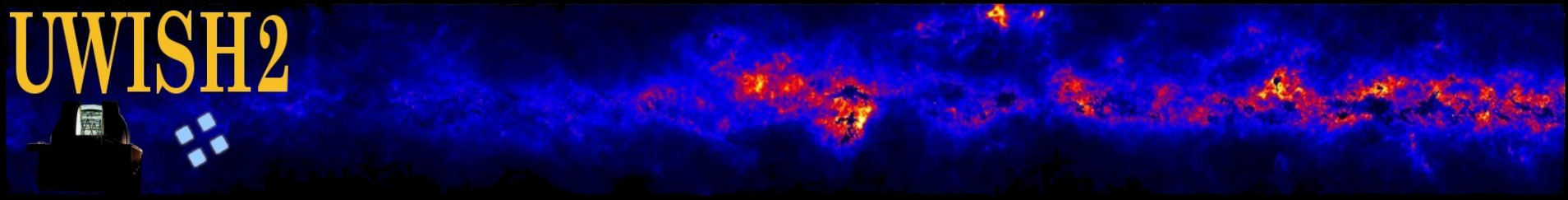
WORK IN PROGRESS

- Fraction of sources with jets/outflows - duration of the jet/outflow phase in YSO evolution.
- Source properties (mass, luminosity, age, accretion rates).
- How jet properties relate to source properties?



FUTURE WORK

- Cloud properties (mass, structure)
- Associate outflows with cloud cores – what percentage of clouds show active forming areas
- Is the star formation isolated or clustered?



FUTURE WORK

EXTEND THIS WORK TO

THE ENTIRE UWISH2 SURVEY