

# Archeology of interstellar archipelagos

**Stitching together the interstellar medium in and  
around molecular clouds**

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Roma, Italia

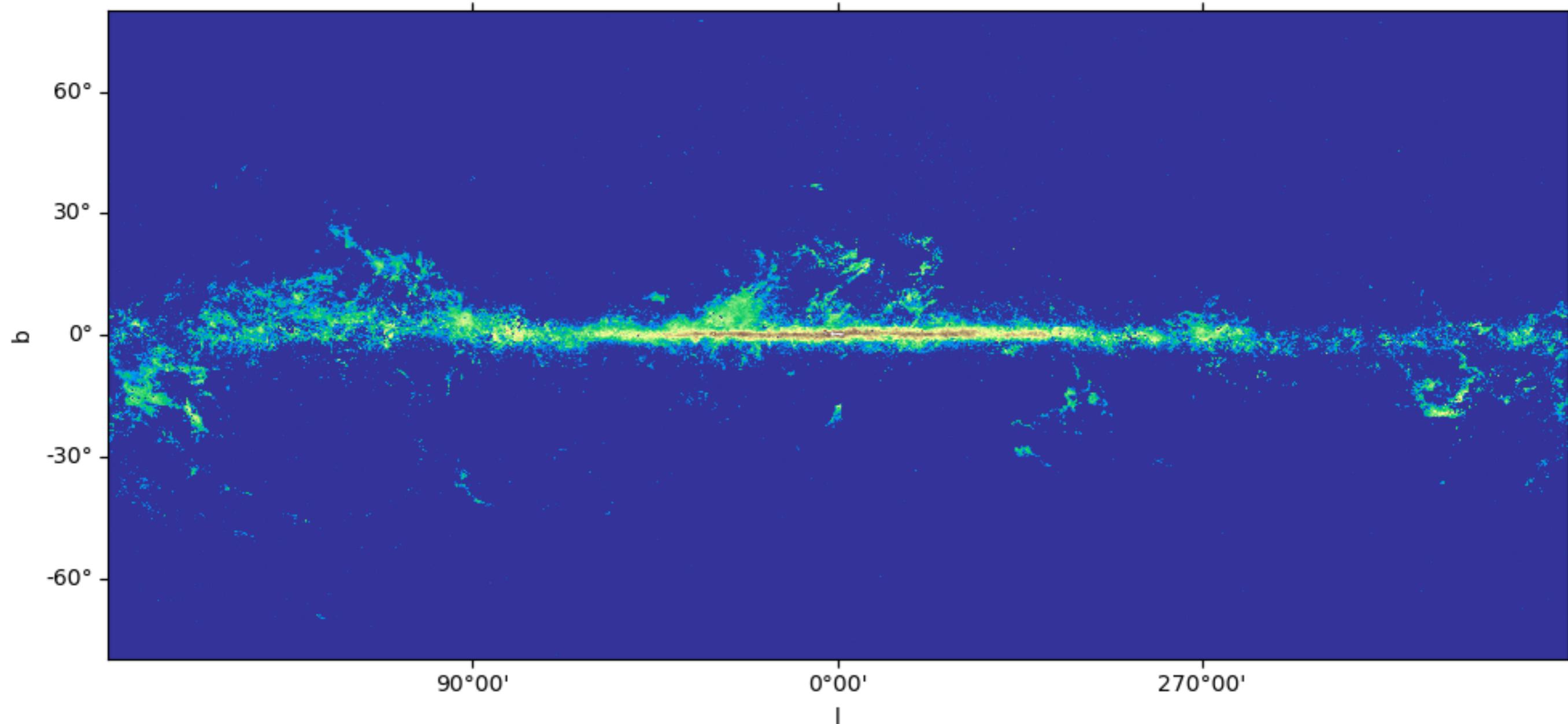
**In collaboration with:**

C. Zucker, J.E.G. Peek, E. Zari, P. Goldsmith, M. Heyer

**ECOGAL:** S. Molinari, R.S. Klessen, P. Hennebelle, L. Testi,  
S.C.O. Glover, A. Trafficante, E. Schisano, D. Elia,  
P. Girichidis, M. Sormani, R., Treß, T. Colman, R. J. Smith

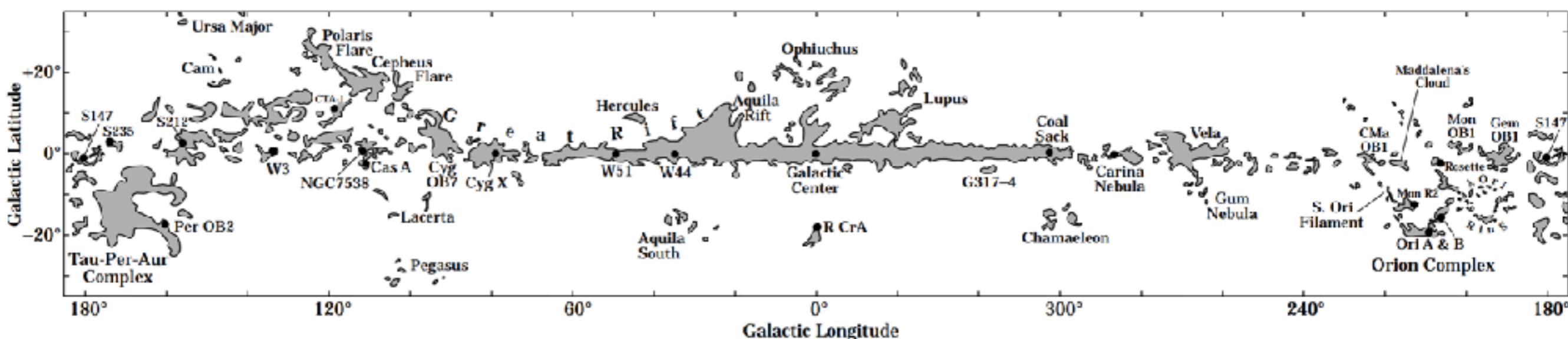
# Carbon monoxide (CO) emission

Planck 2013 results. XIII. A&A (2014)



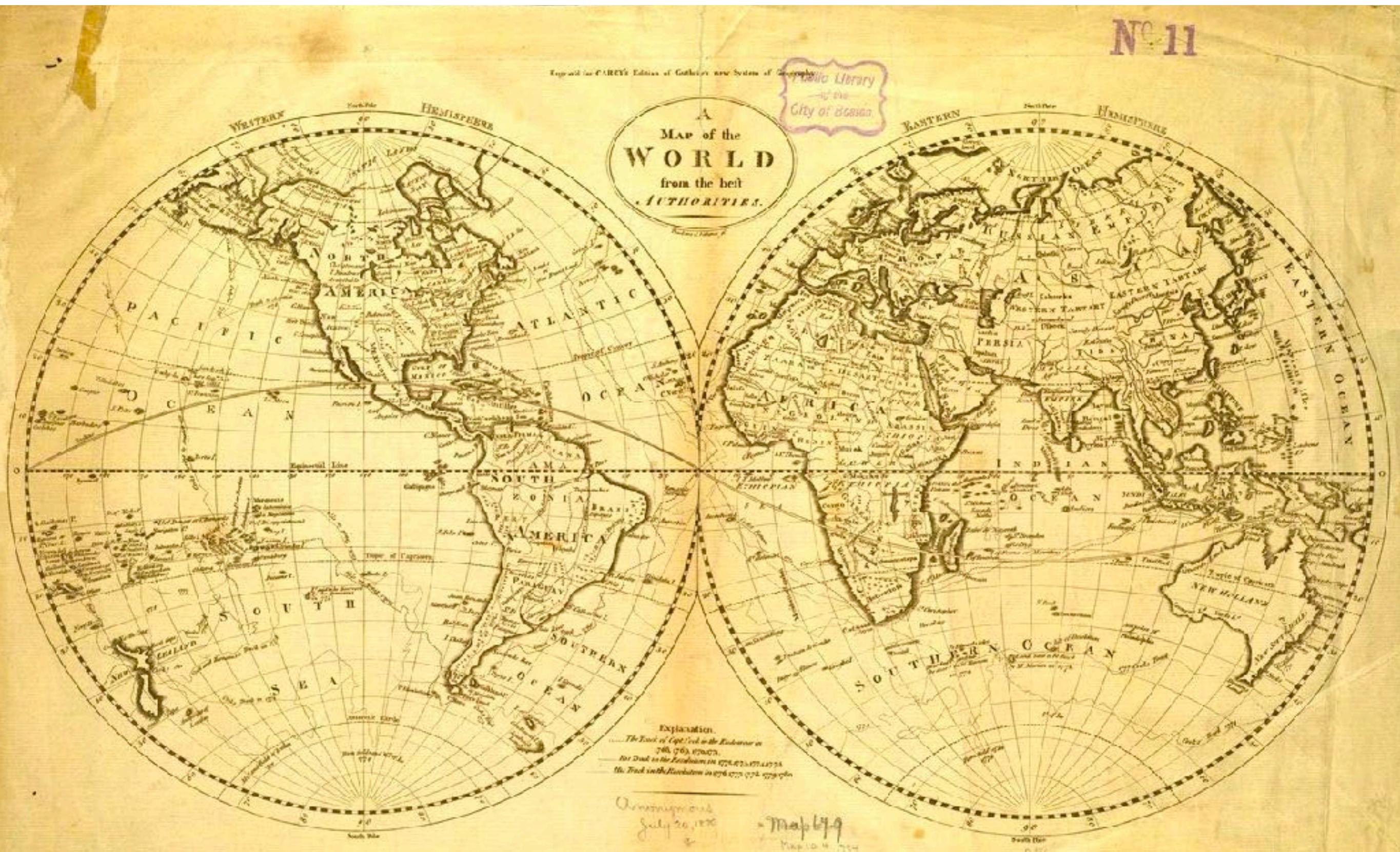
# Carbon monoxide (CO) emission

Planck 2013 results. XIII. A&A (2014)



# Map of the World from the best authorities

Carey, M. Guthrie's new System of Geography (1795)



# HMS Challenger

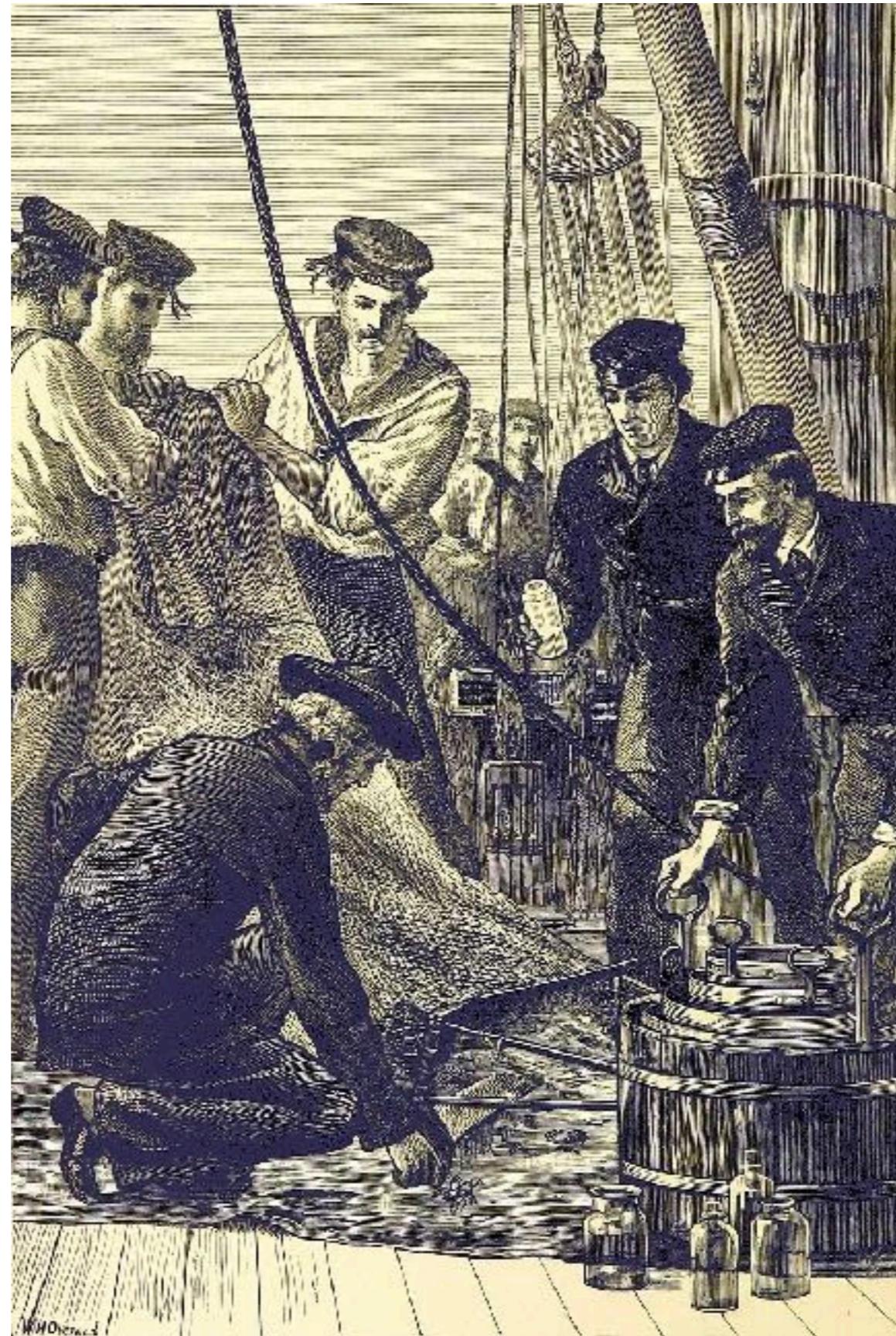
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1872



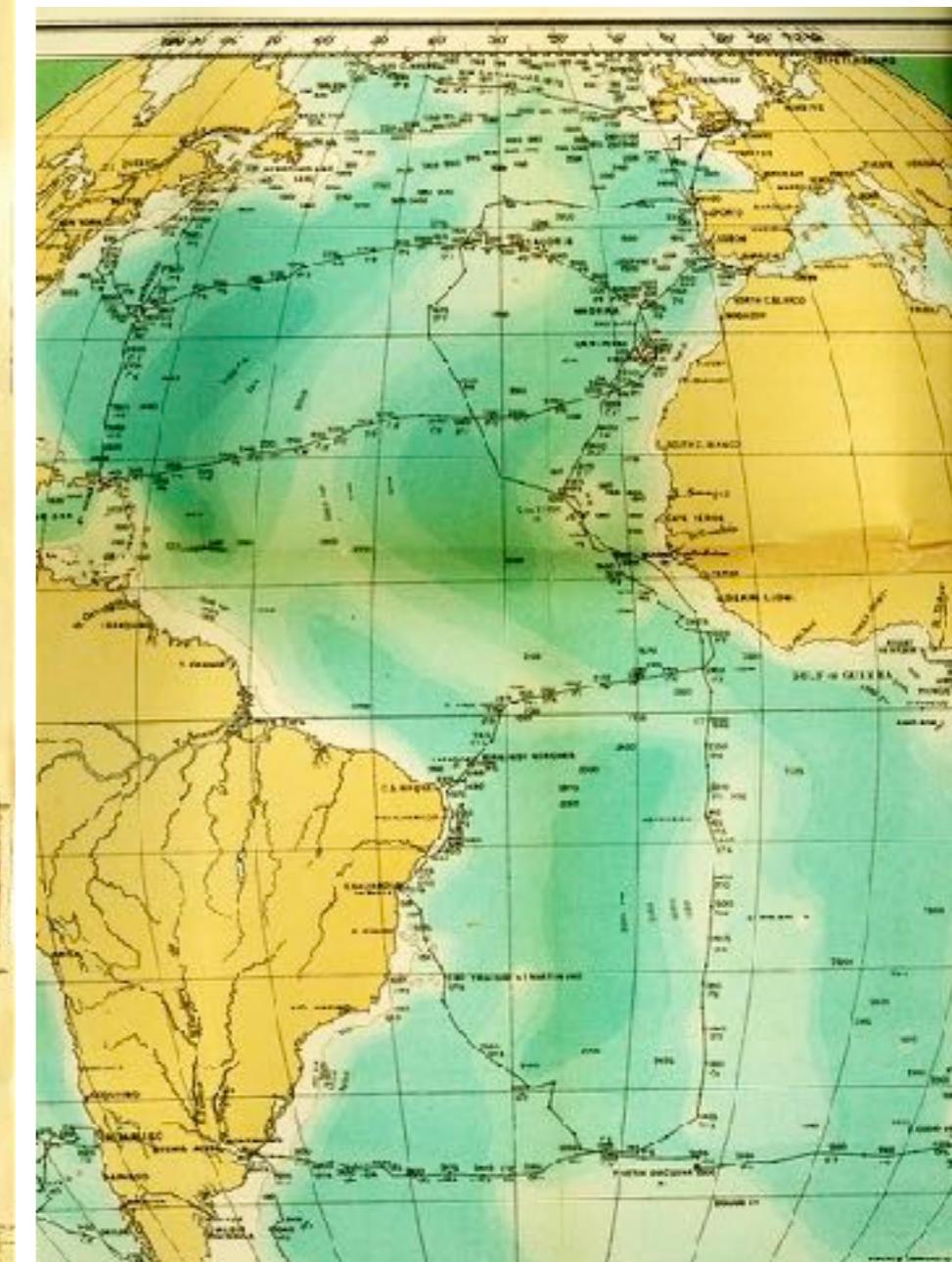
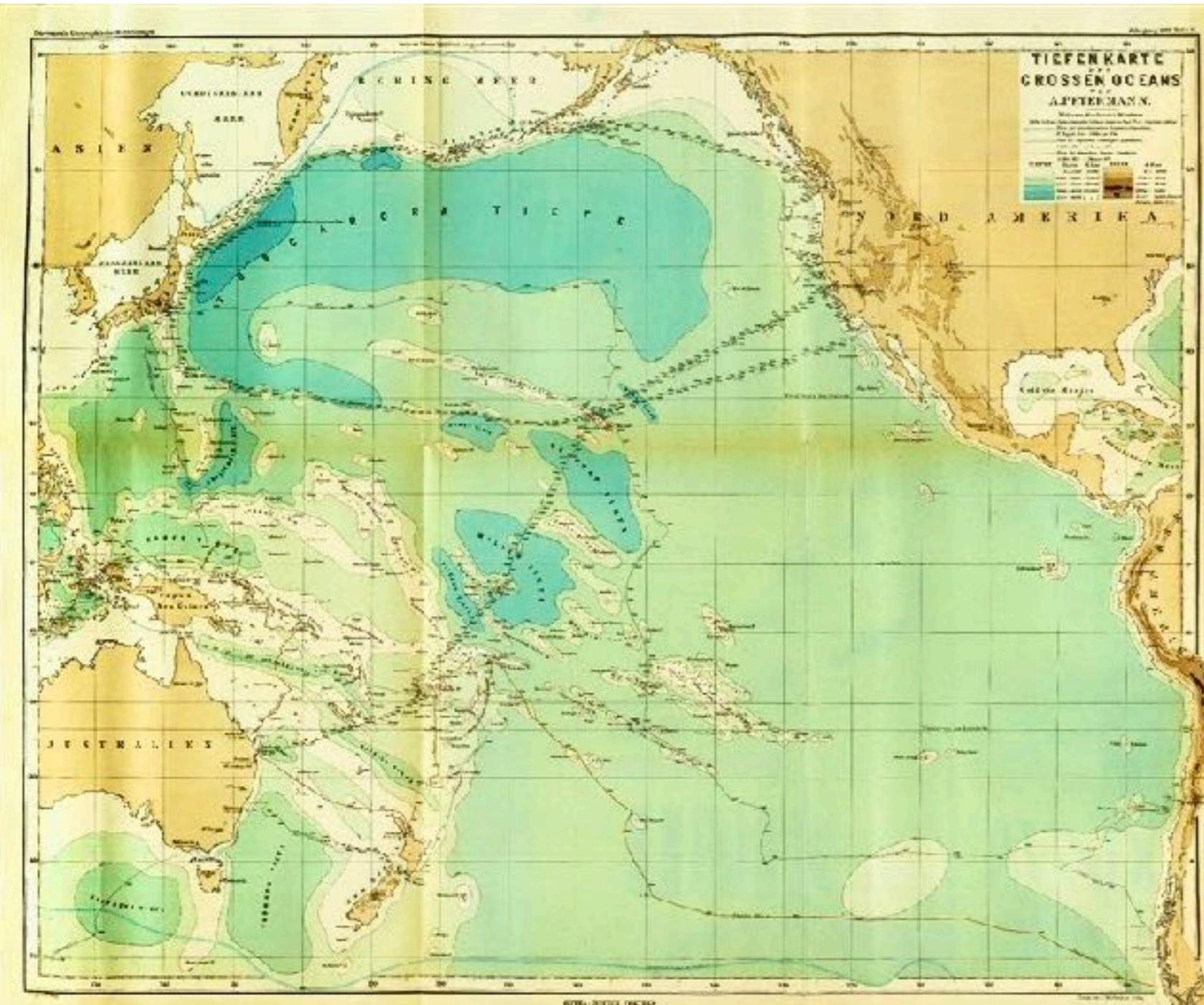
# Challenger expedition

1872-1876



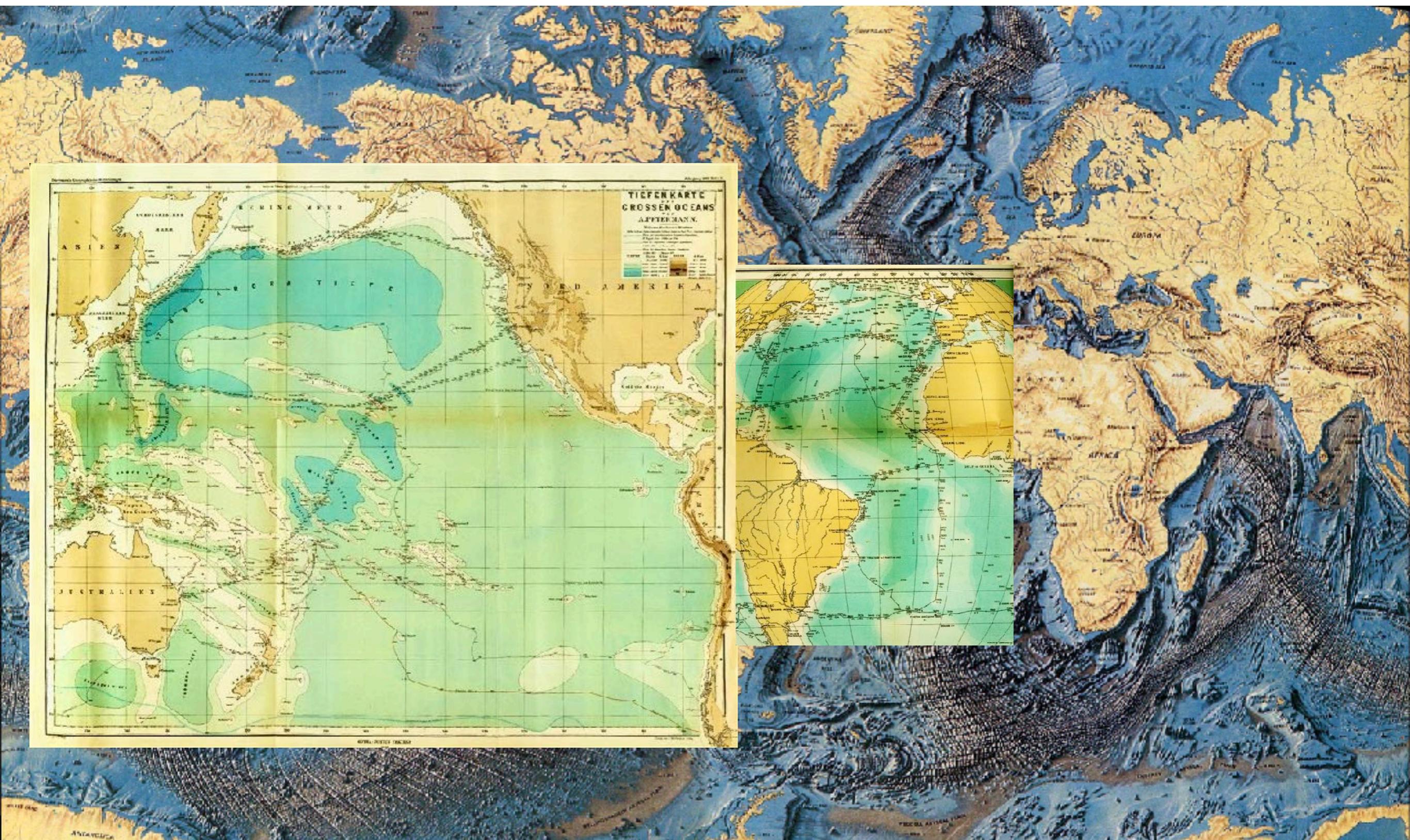
# Challenger expedition

First bathymetric map of the oceans. A. Petermann (1877)



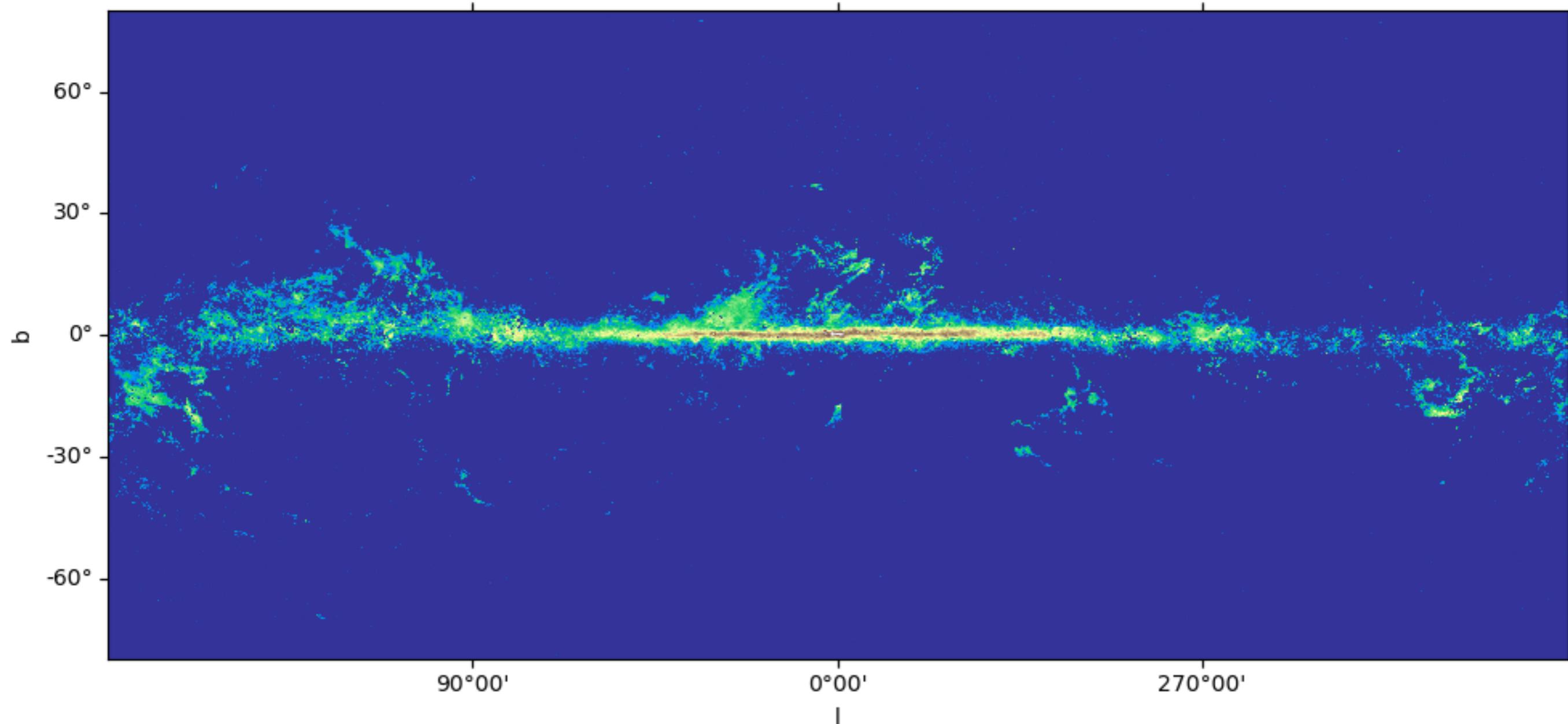
# The bottom of the oceans

Berann, Tharp, and Heezen (1967). National Geographic Image Collection



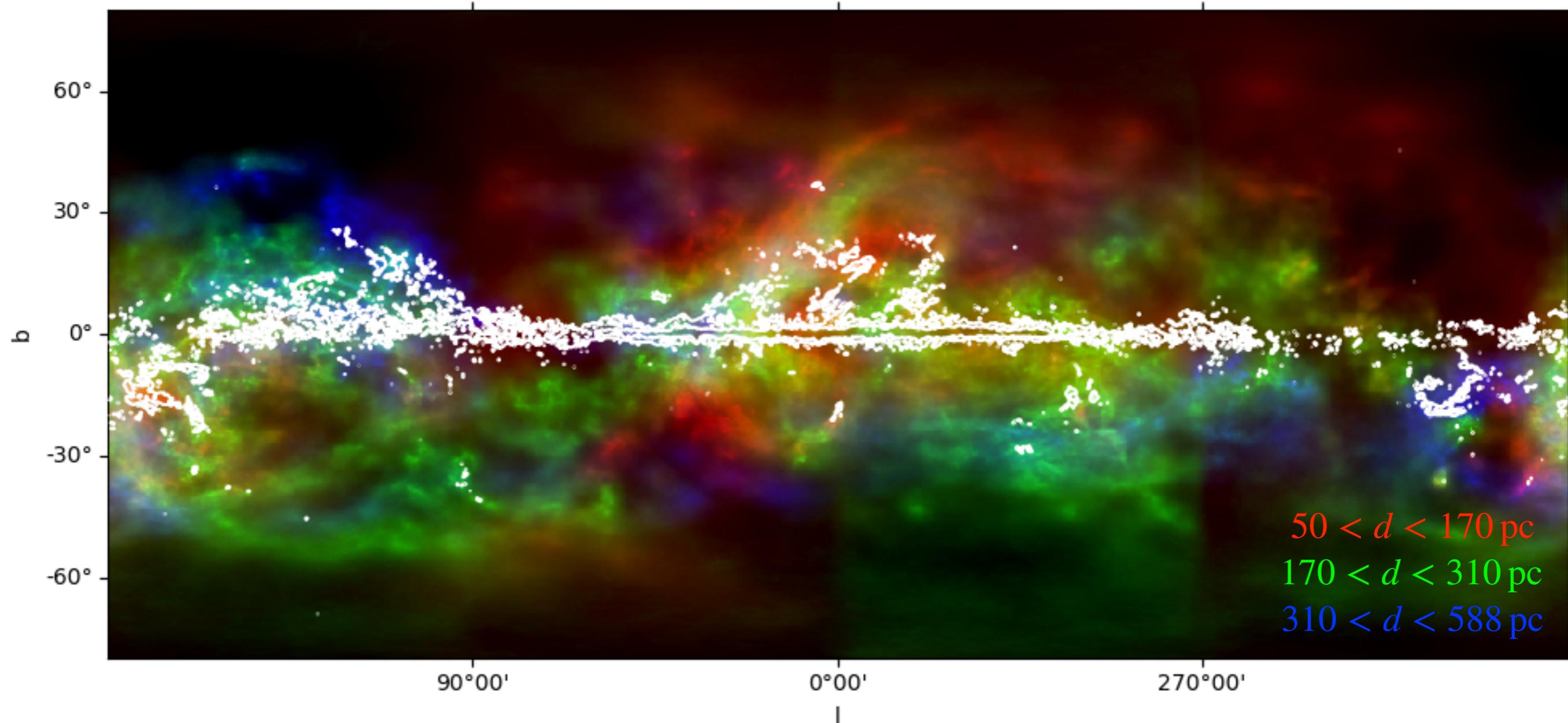
# Carbon monoxide (CO) emission

Planck 2013 results. XIII. A&A (2014)



# Local 3D dust density reconstruction

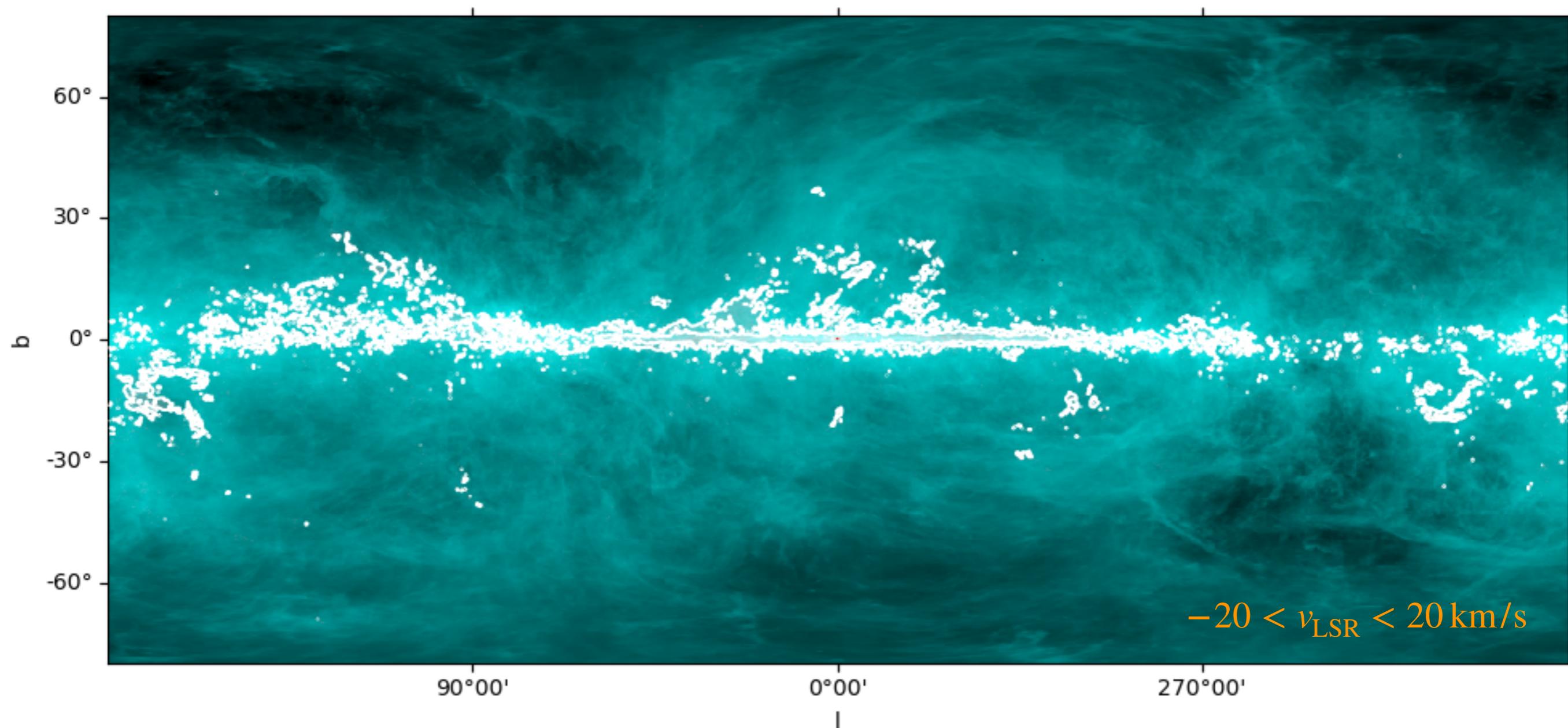
Leike et al. A&A (2020); Leike et al. A&A (2019);



# Neutral atomic hydrogen (HI) emission

HI4PI Collaboration. A&A (2016)

McClure-Griffiths, Stanimirović, & Rybczak. ARA&A (2023)

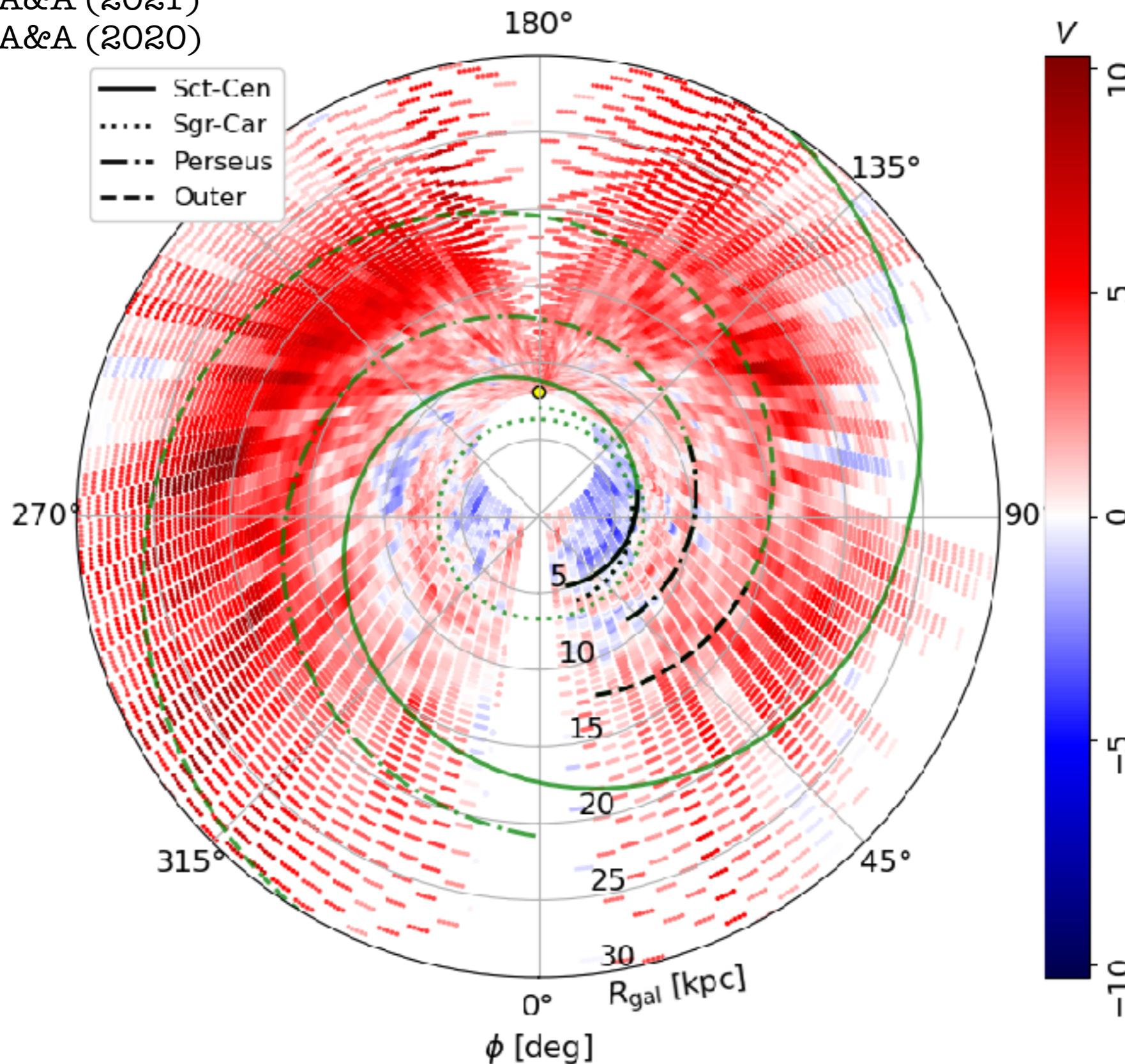


# HI filament orientation trilogy

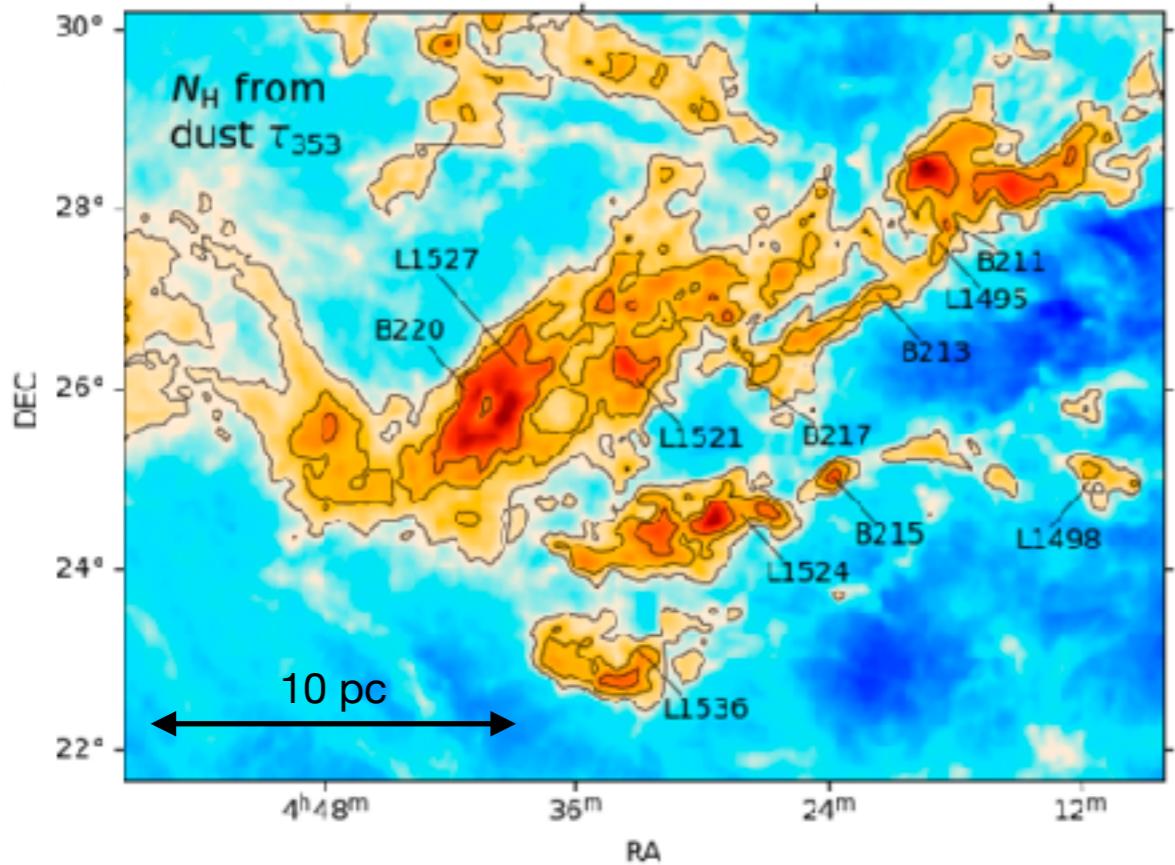
Soler, J.D., MAMD, et al. A&A (2022)

Soler, J.D., et al. A&A (2021)

Soler, J.D., et al. A&A (2020)



# Two examples of interstellar archeology

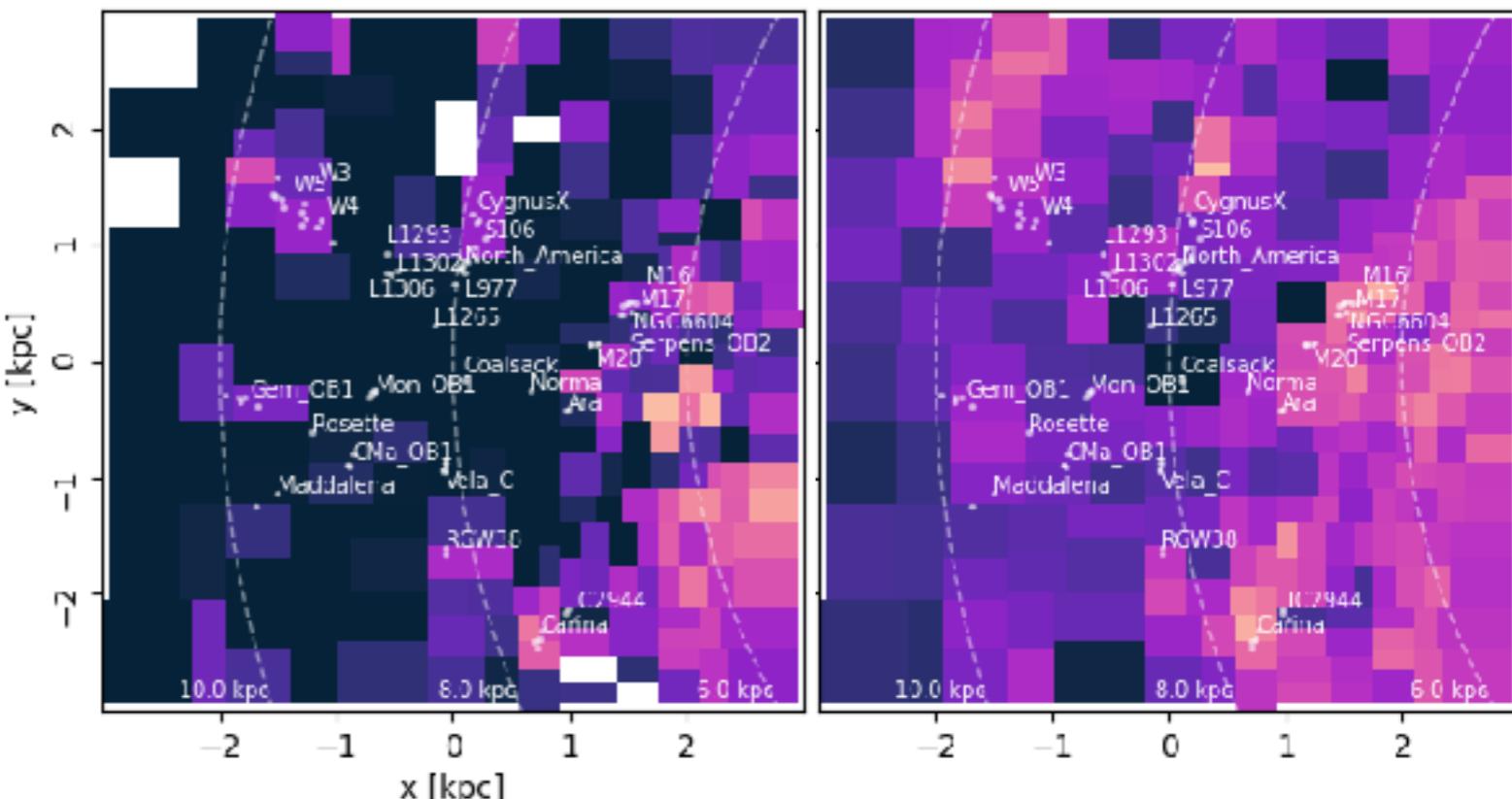


## Dynamics of the Taurus molecular cloud

Soler, Zucker, Peek &  
the ECOGAL collaboration  
A&A (2023)

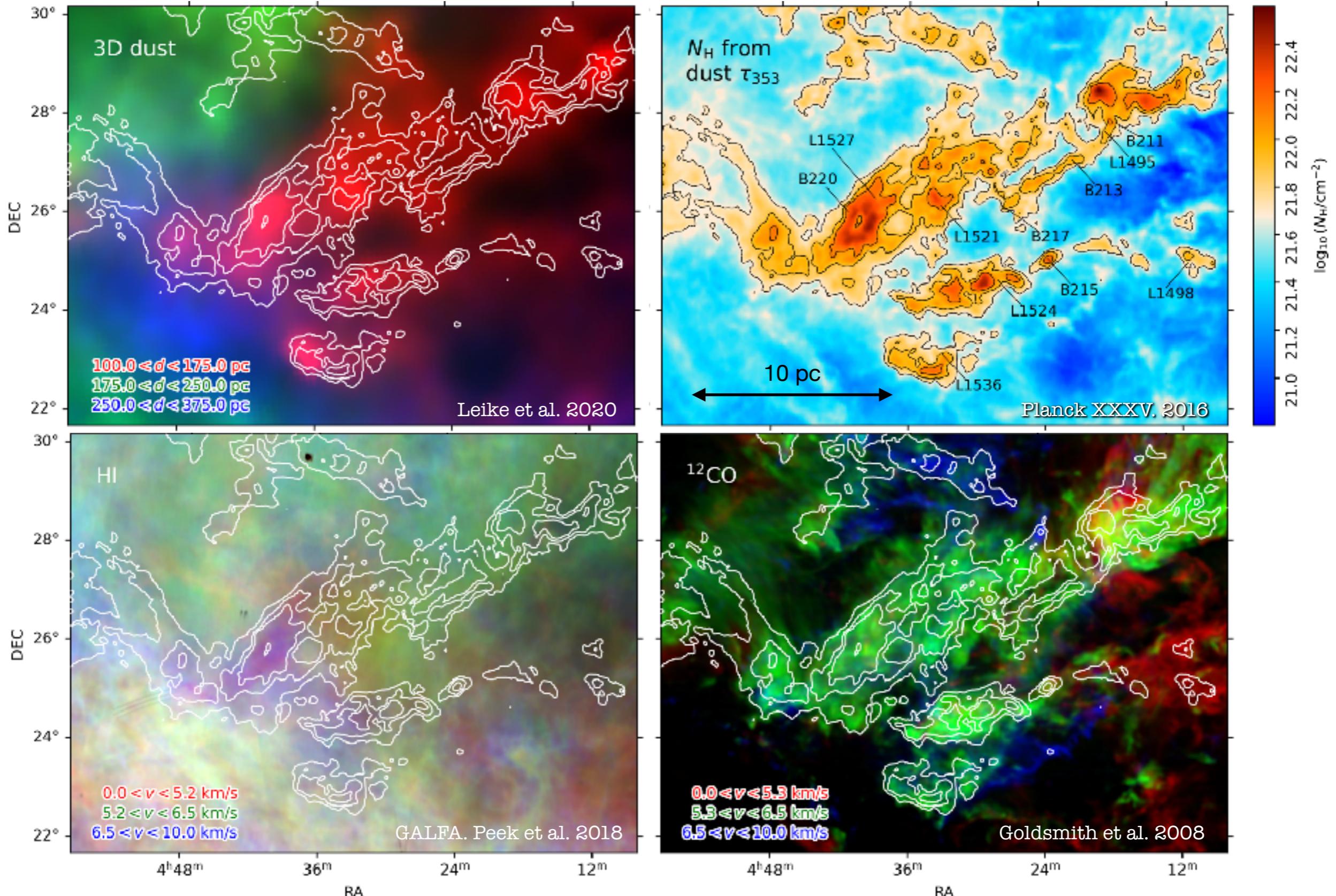
## Star formation from dust thermal emission and high-mass stars

Soler, Zari, Elia &  
the ECOGAL collaboration  
About to be submitted.



# Dynamics of the Taurus molecular cloud

Soler, Zucker, et al. A&A (2023)



# Histogram of oriented gradient (HOG) method

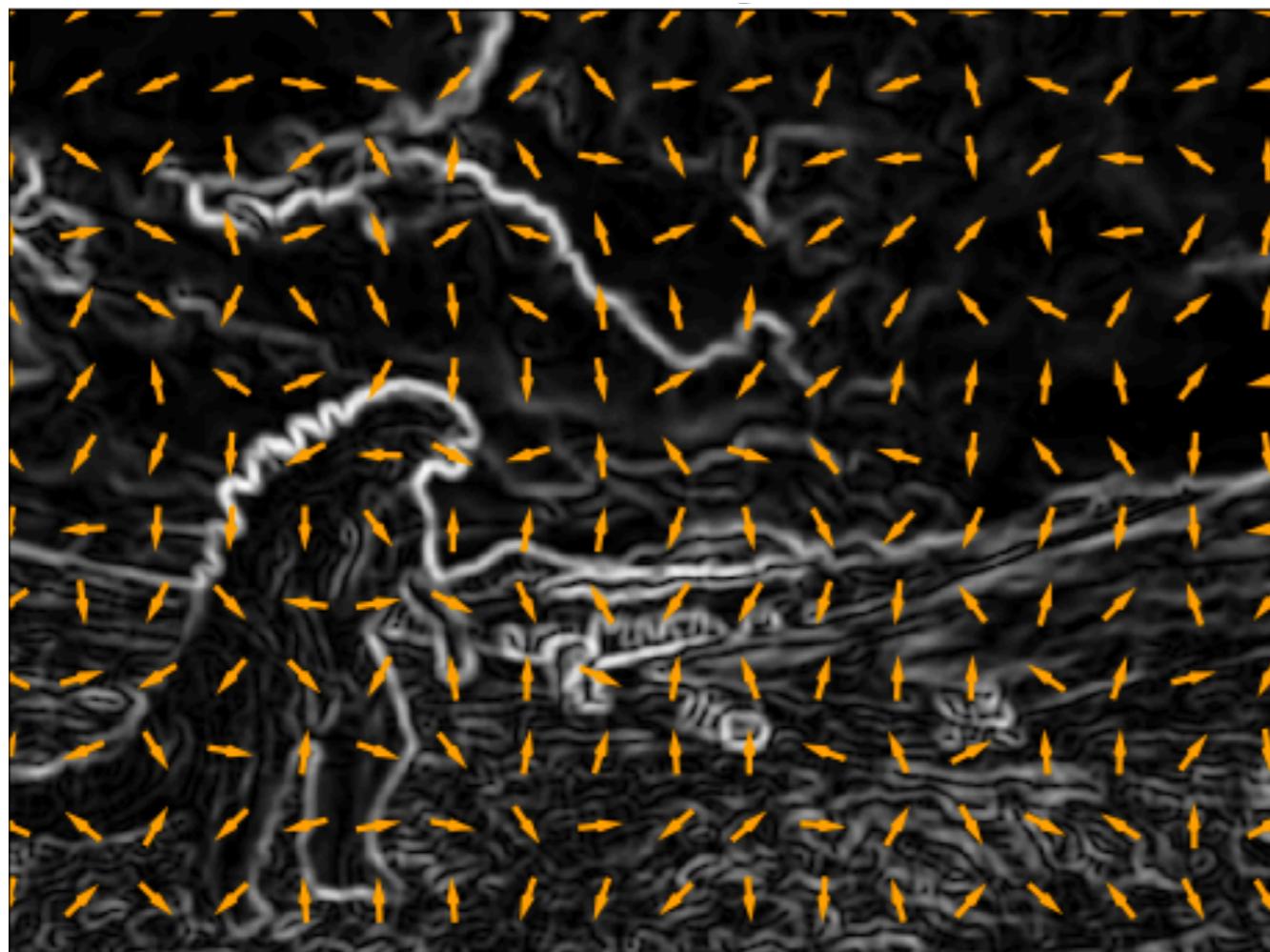
Soler, Beuther, et al. A&A (2019)



<https://github.com/solerjuan/astrohog>

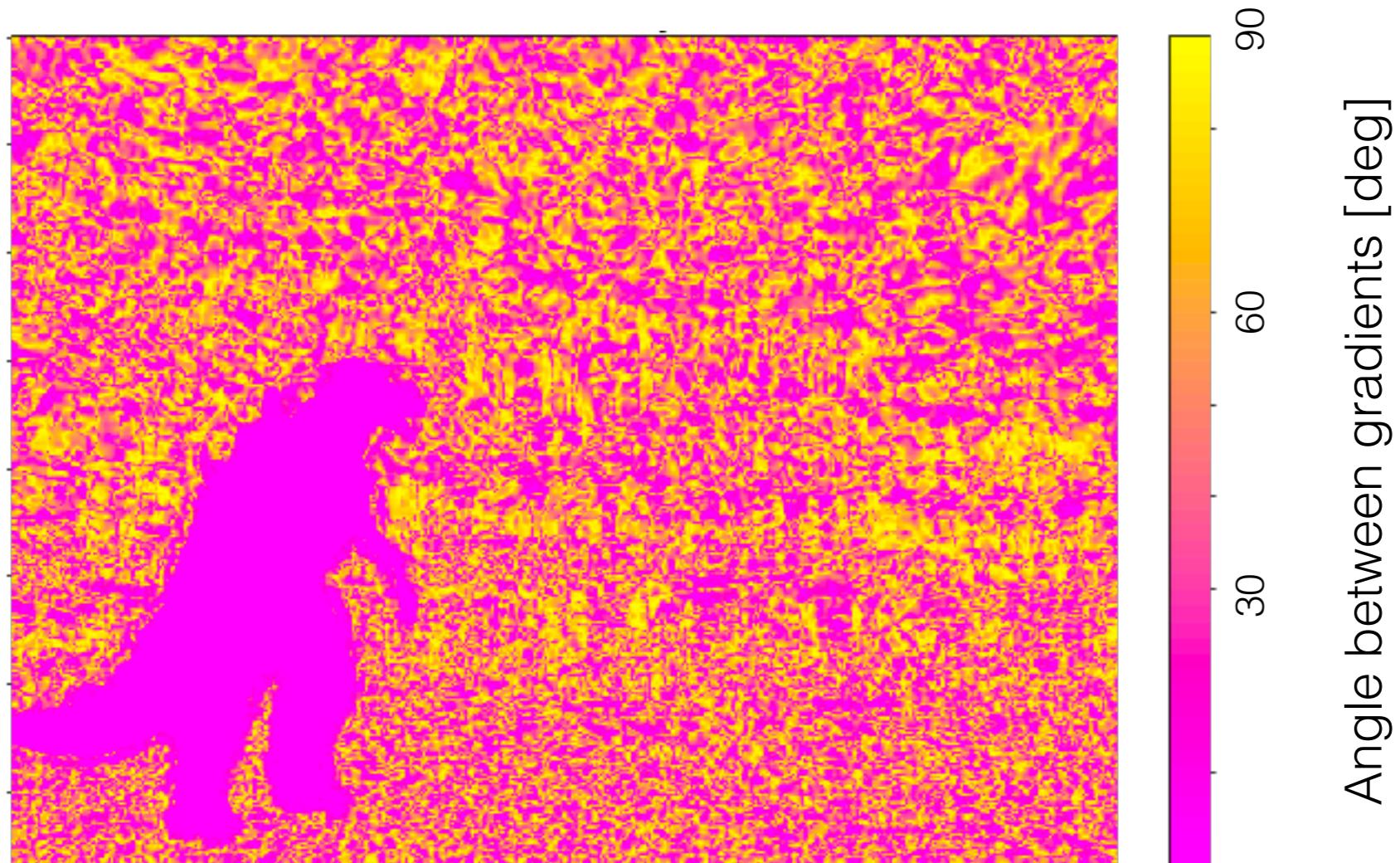
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Soler, Beuther, et al. A&A (2019)



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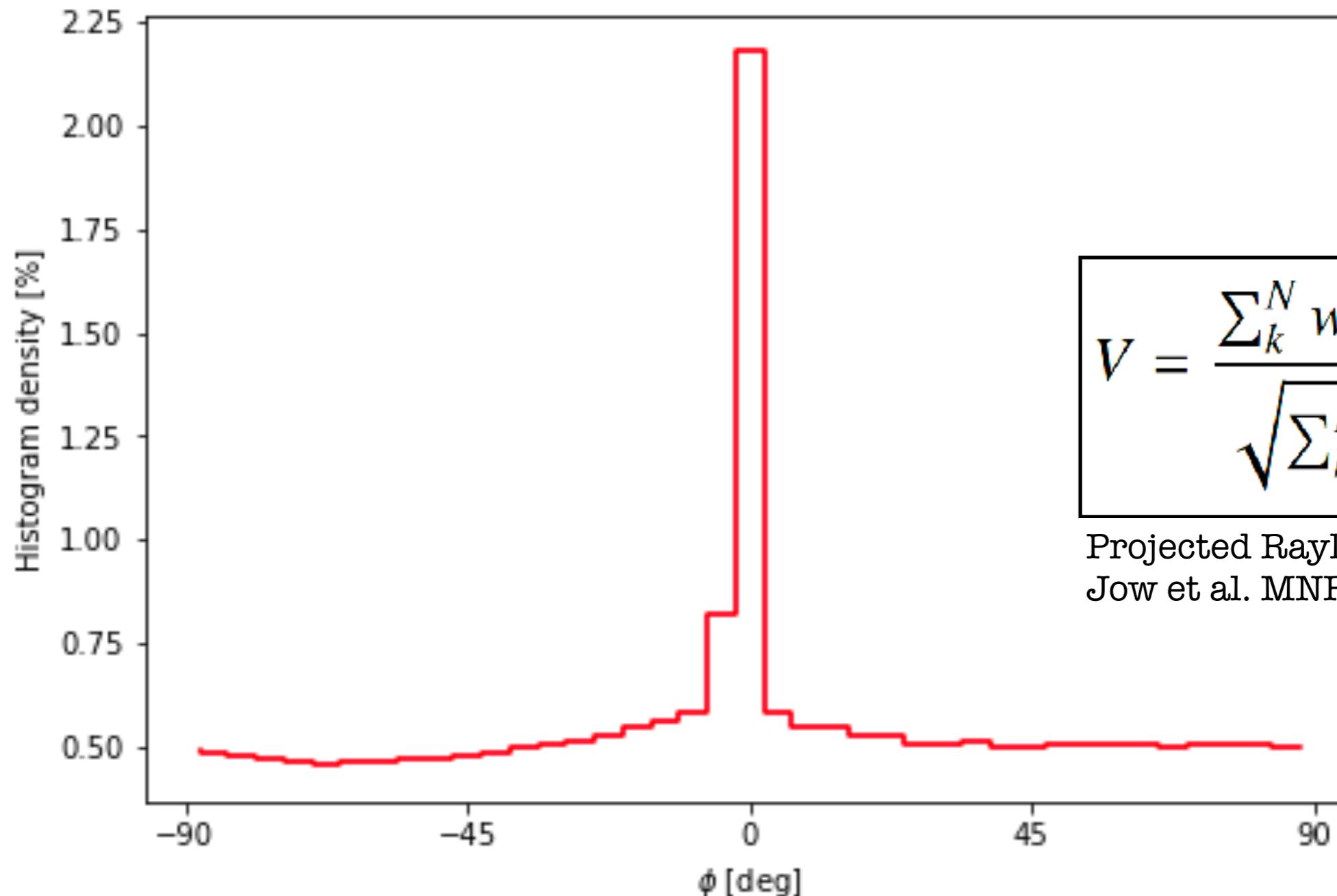
Soler, Beuther, et al. A&A (2019)



# Histogram of oriented gradient (HOG) method



Soler, Beuther, et al. A&A (2019)

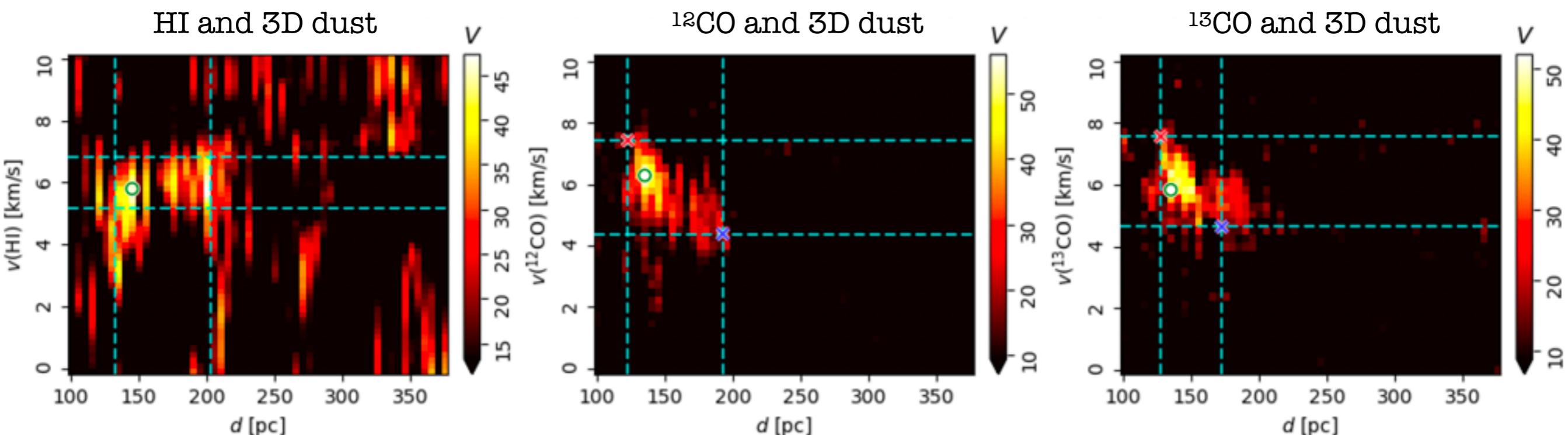


$$V = \frac{\sum_k^N w_k \cos 2\phi_k}{\sqrt{\sum_k^N (w_k)^2 / 2}}$$

Projected Rayleigh statistic  
Jow et al. MNRAS (2018)

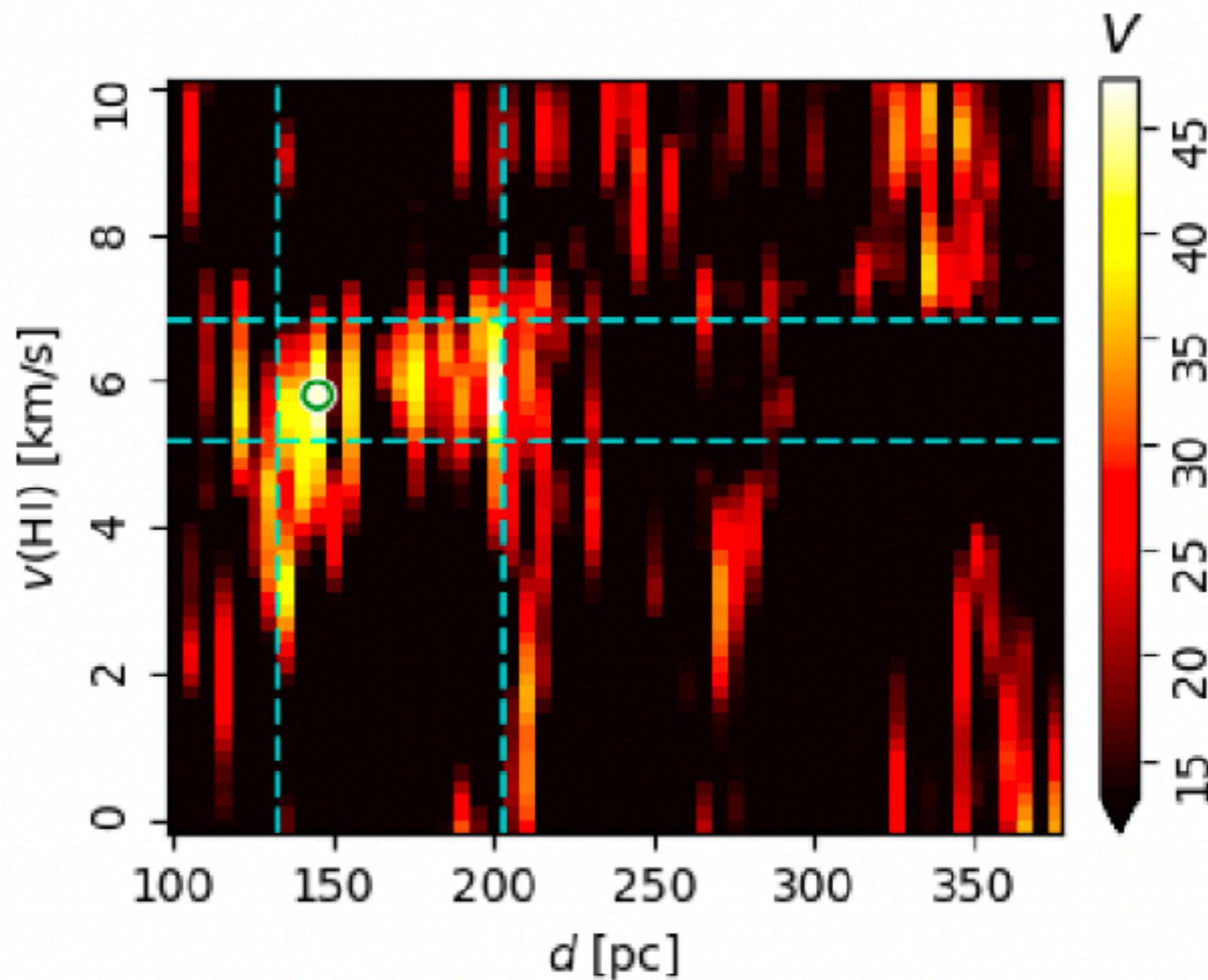
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Soler, Zucker, et al. A&A (2023)



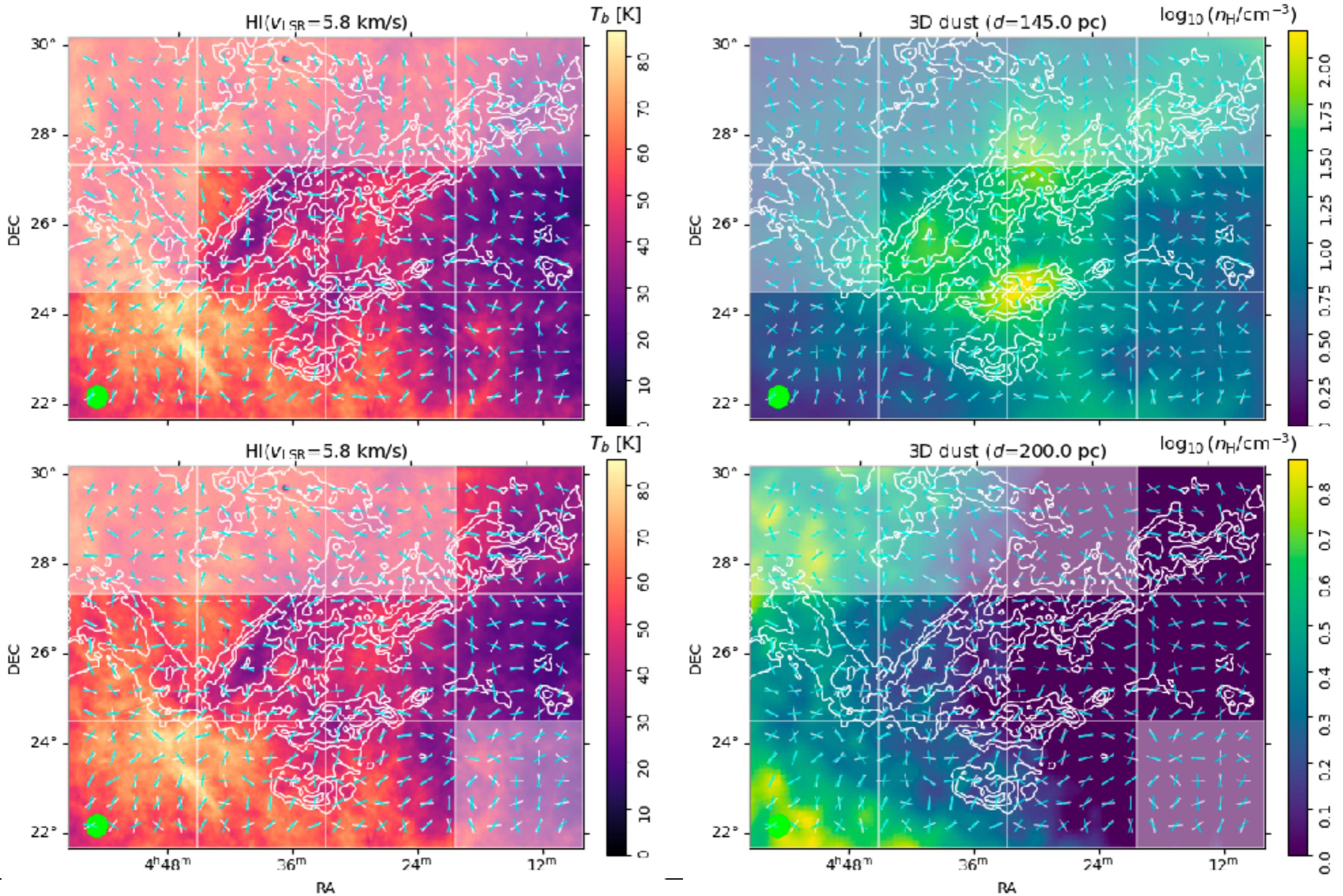
# Taurus MC: HI and 3D dust

Soler, Zucker, et al. A&A (2023)



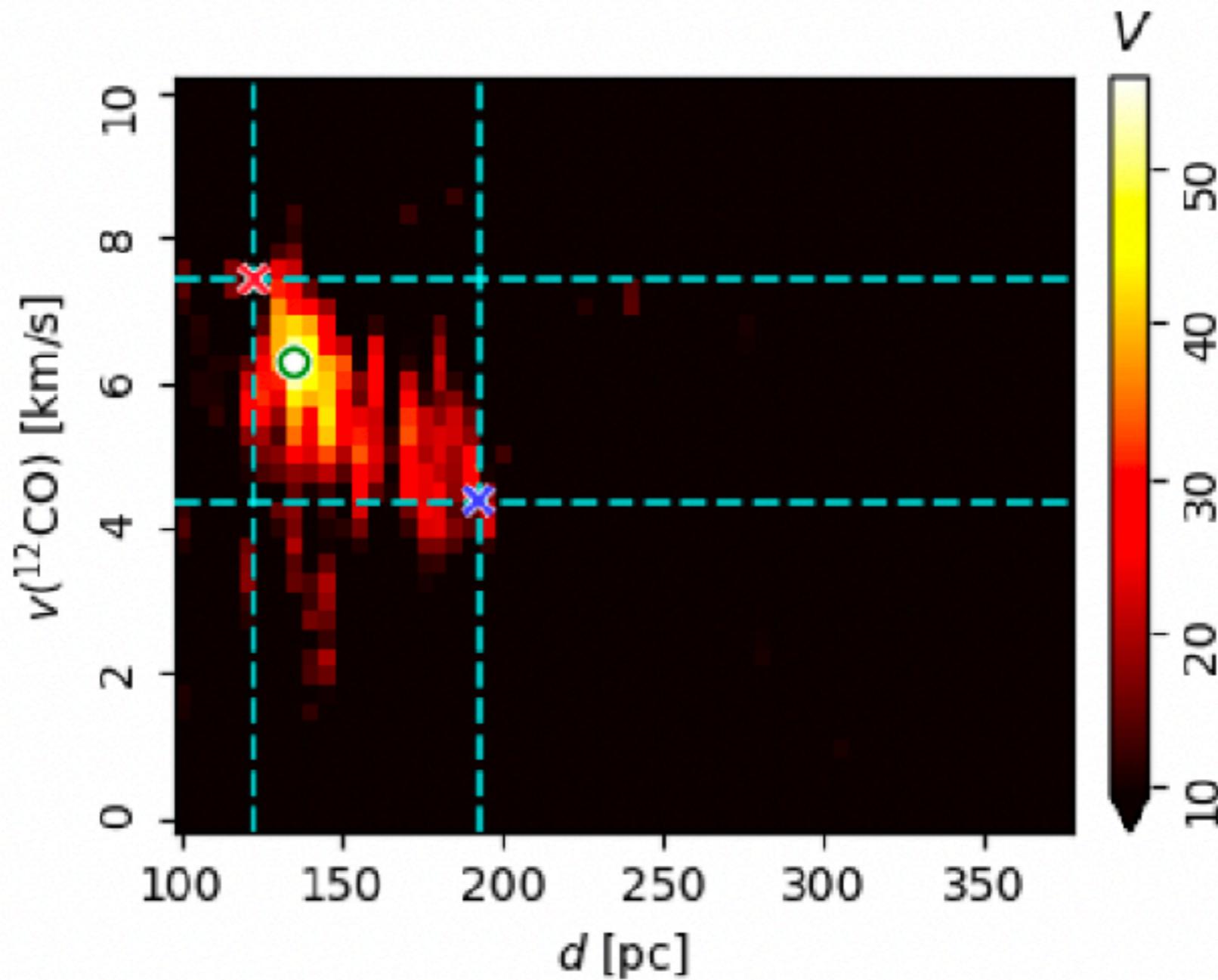
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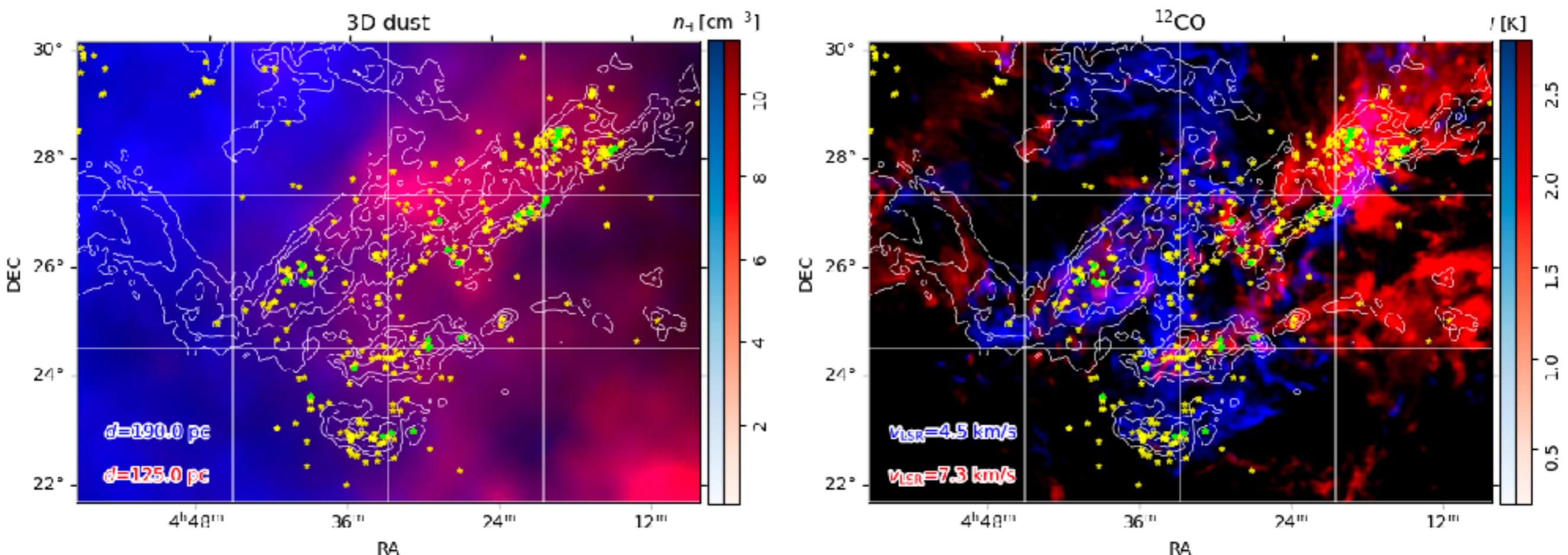
# Taurus MC: $^{12}\text{CO}$ and 3D dust

Soler, Zucker, et al. A&A (2023)



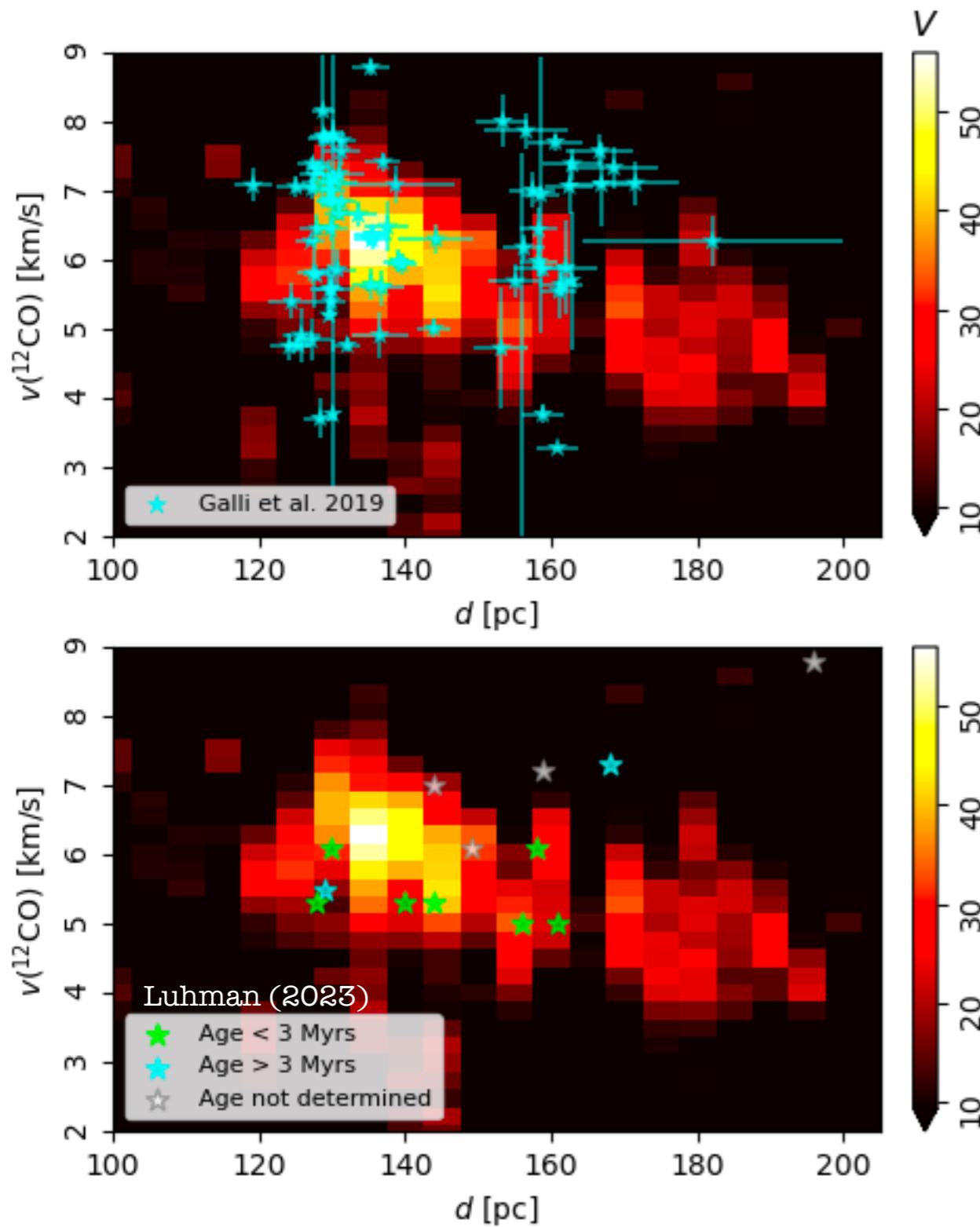
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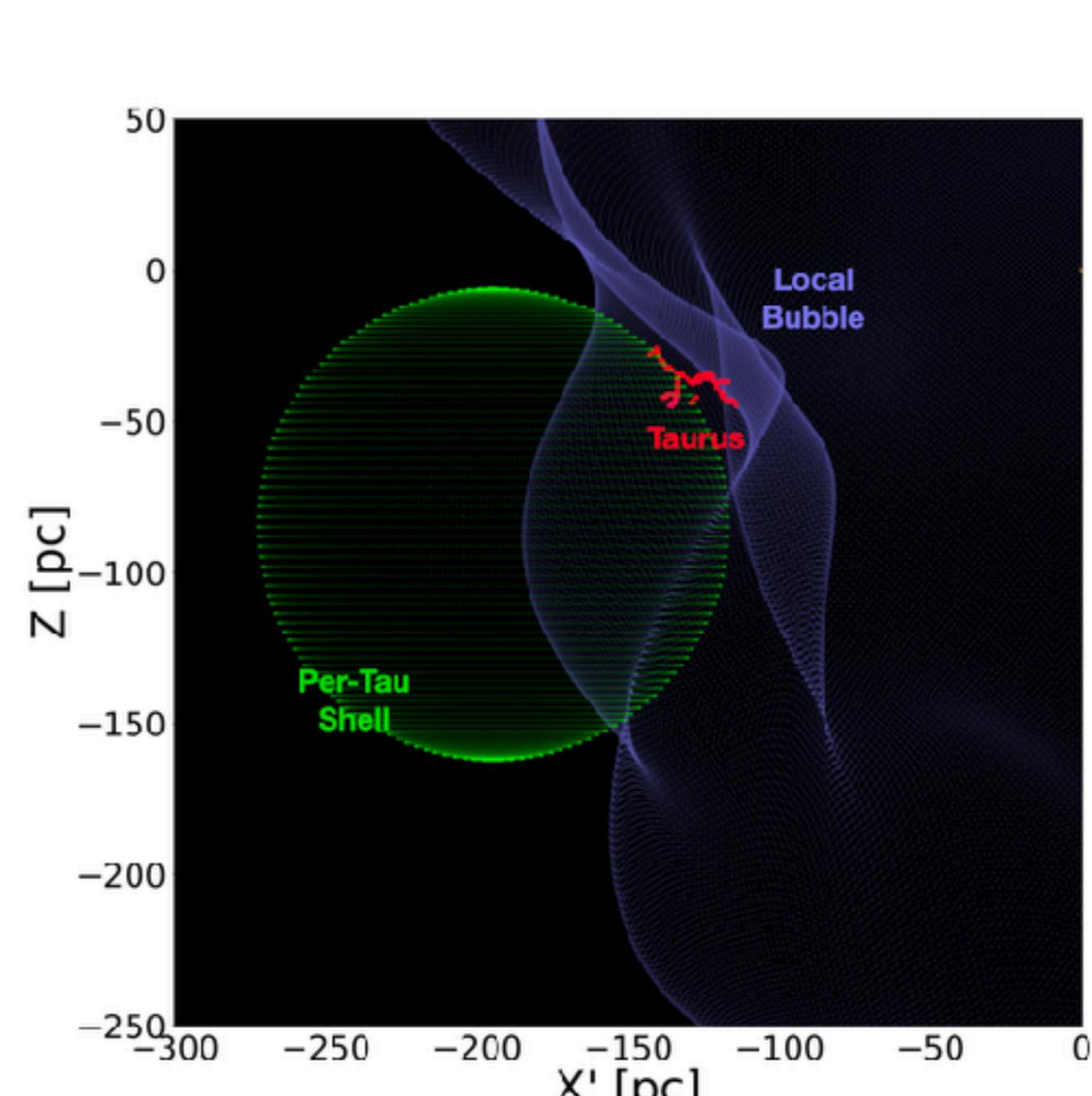
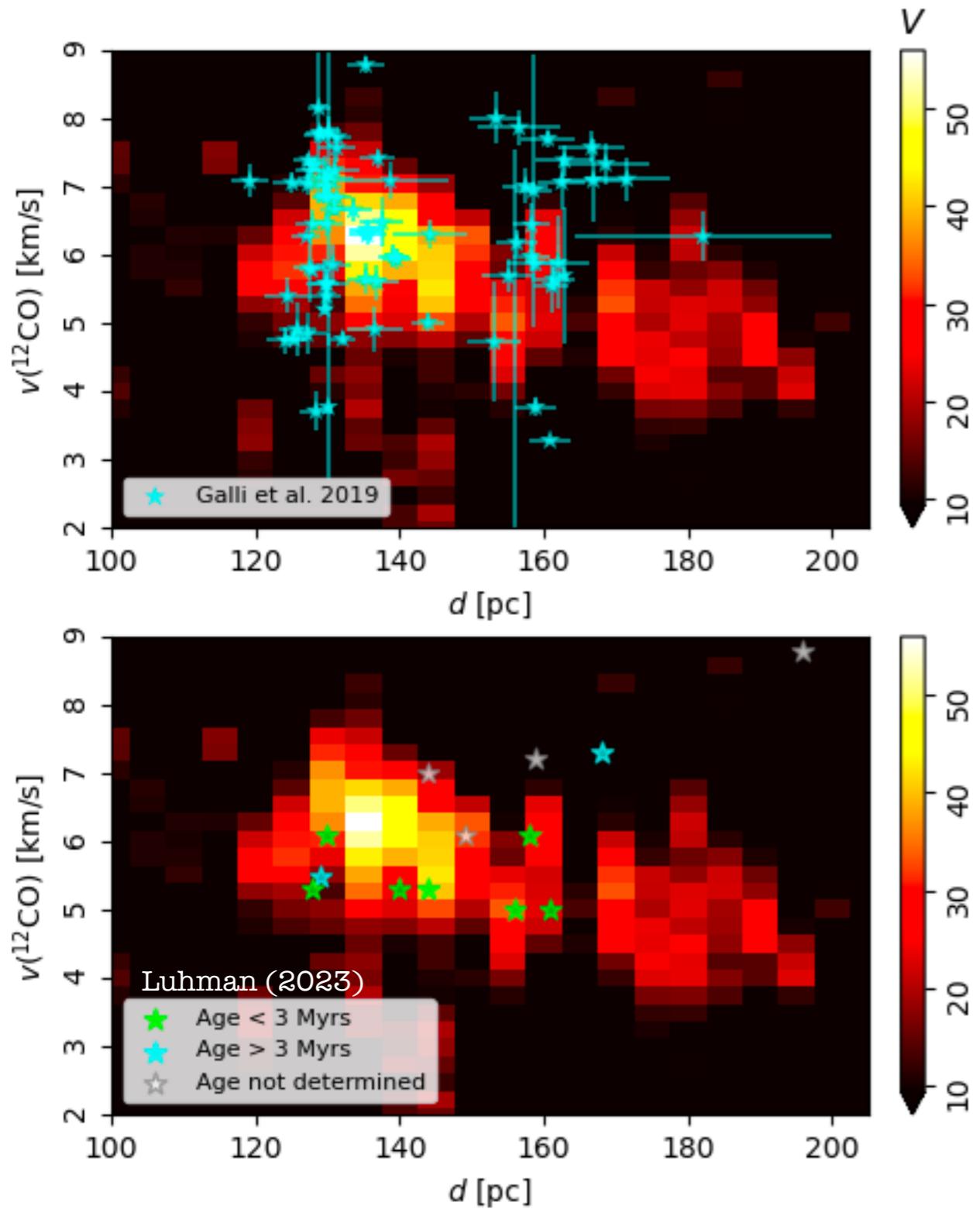
# Taurus MC: $^{12}\text{CO}$ and 3D dust

Soler, Zucker, et al. A&A (2023)



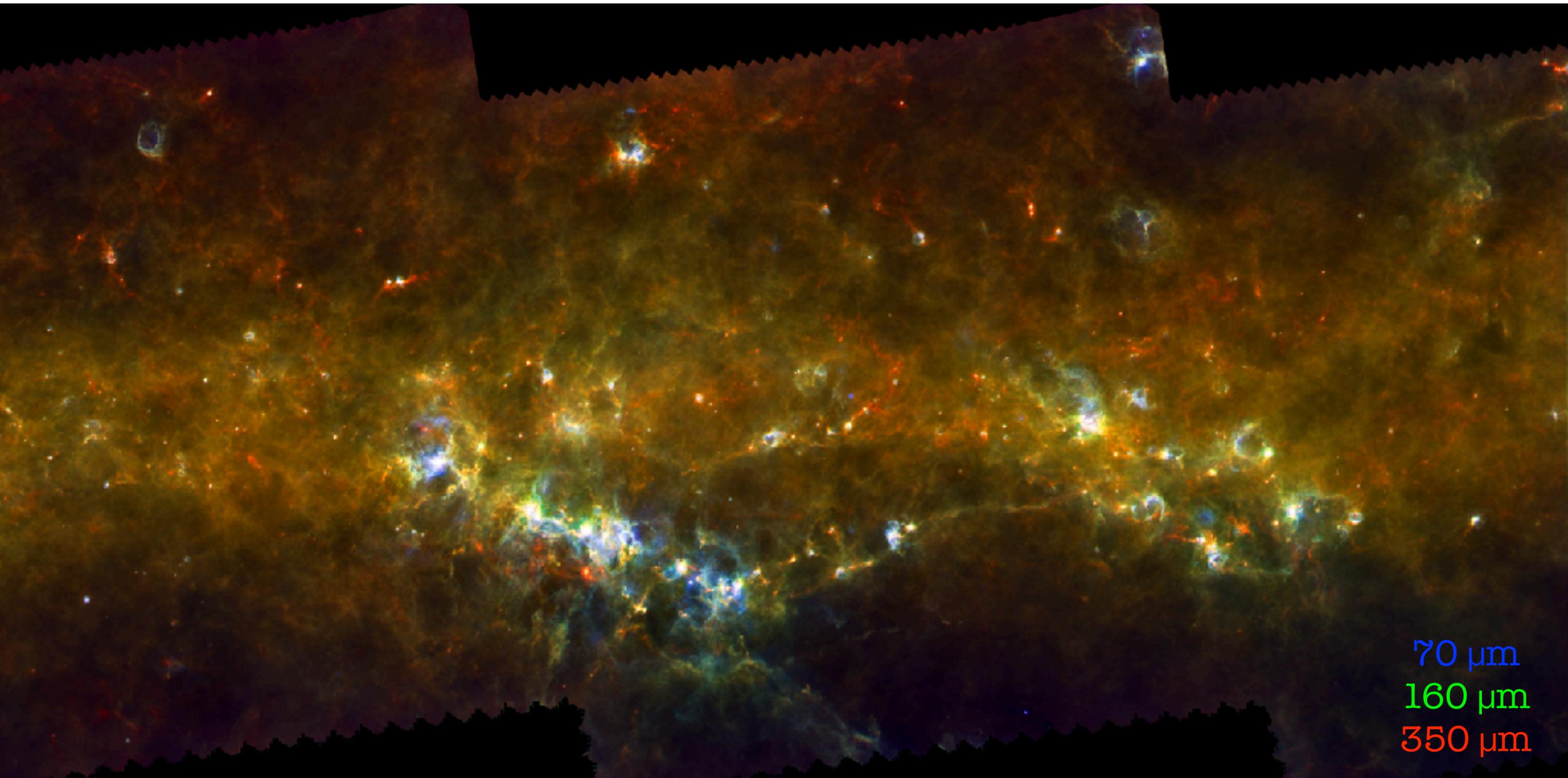
# Taurus MC: $^{12}\text{CO}$ and 3D dust

Soler, Zucker, et al. A&A (2023)



# Herschel infrared Galactic Plane Survey (Hi-GAL)

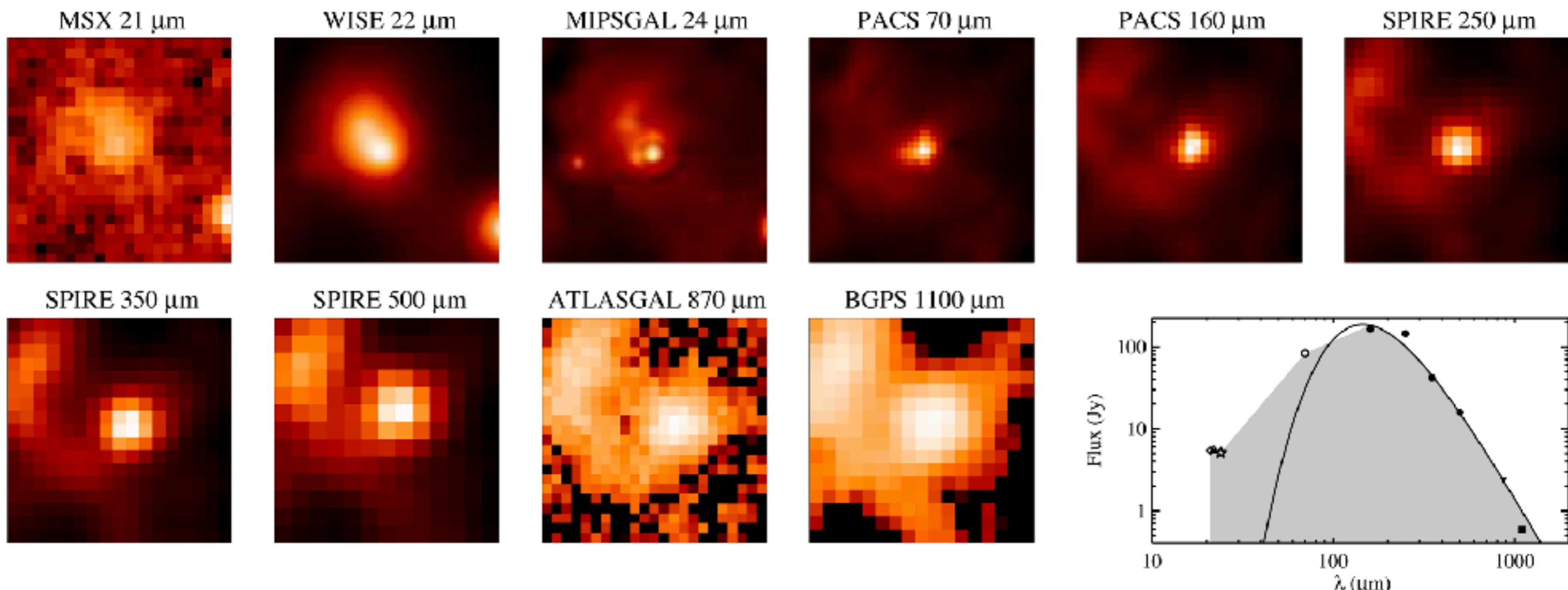
Molinari, Schisano, Elia et al. A&A (2014)



# Star formation from dust thermal emission

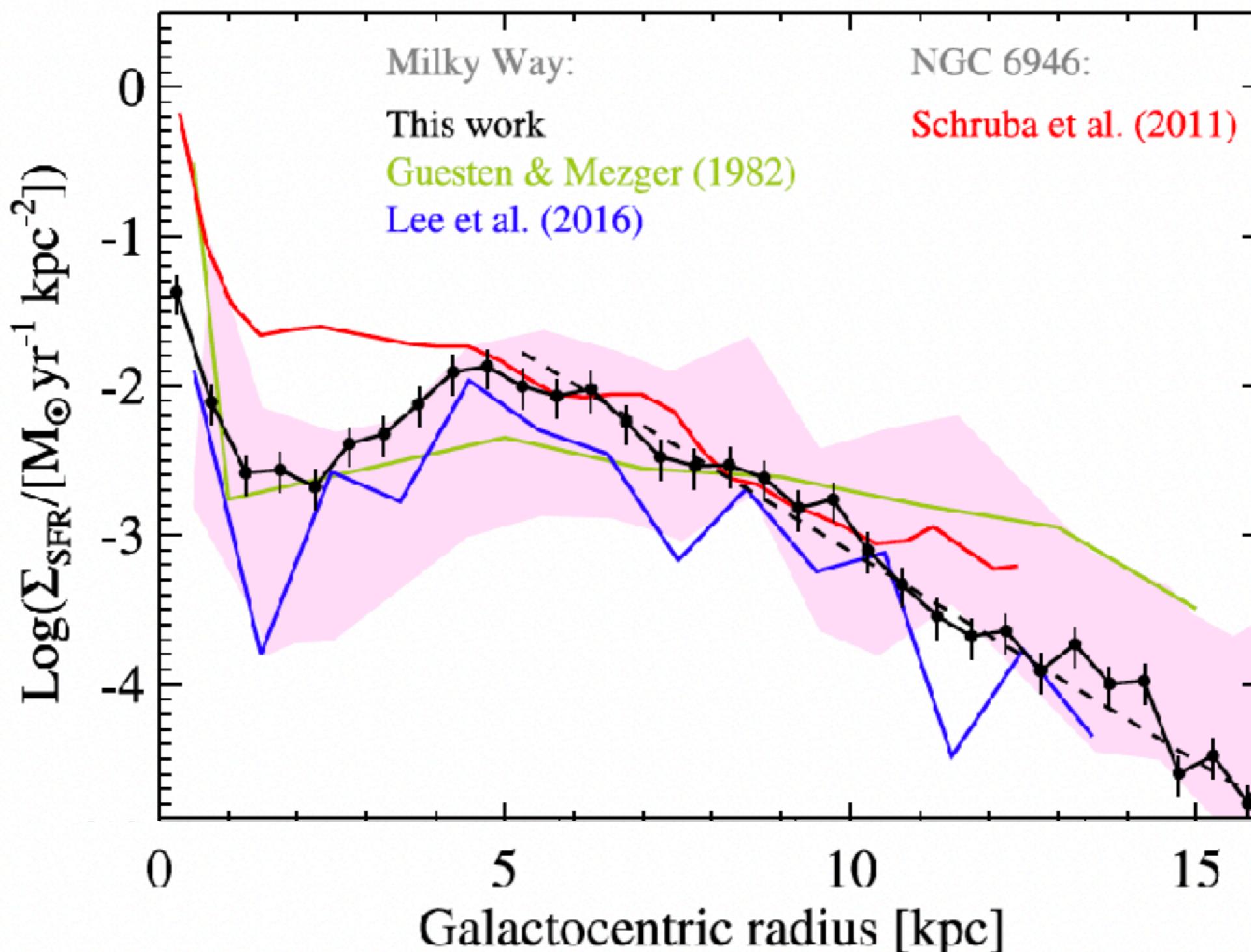
Elia, Molinari, Schisano, et al. MNRAS (2017)

Source #110522 (proto-stellar),  $l = 24.7295^\circ$ ,  $b = 0.1537^\circ$ ,  $d = 9170$  pc,  $M = 1317 M_\odot$ ,  $T = 23.9$  K,  $L = 21225 L_\odot$



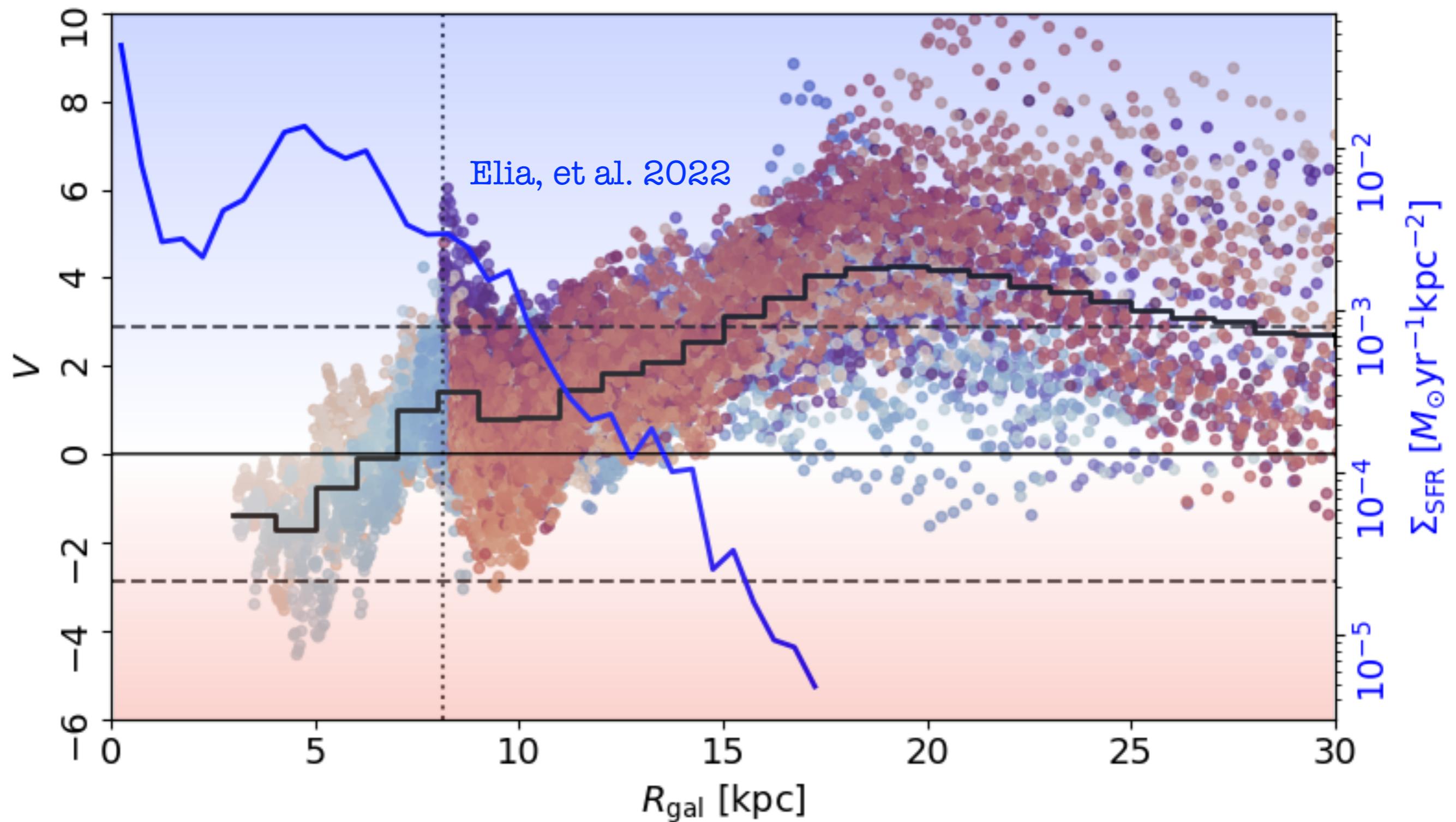
# Star formation from dust thermal emission

Elia, Molinari, Schisano, Soler et al. A&A (2022)



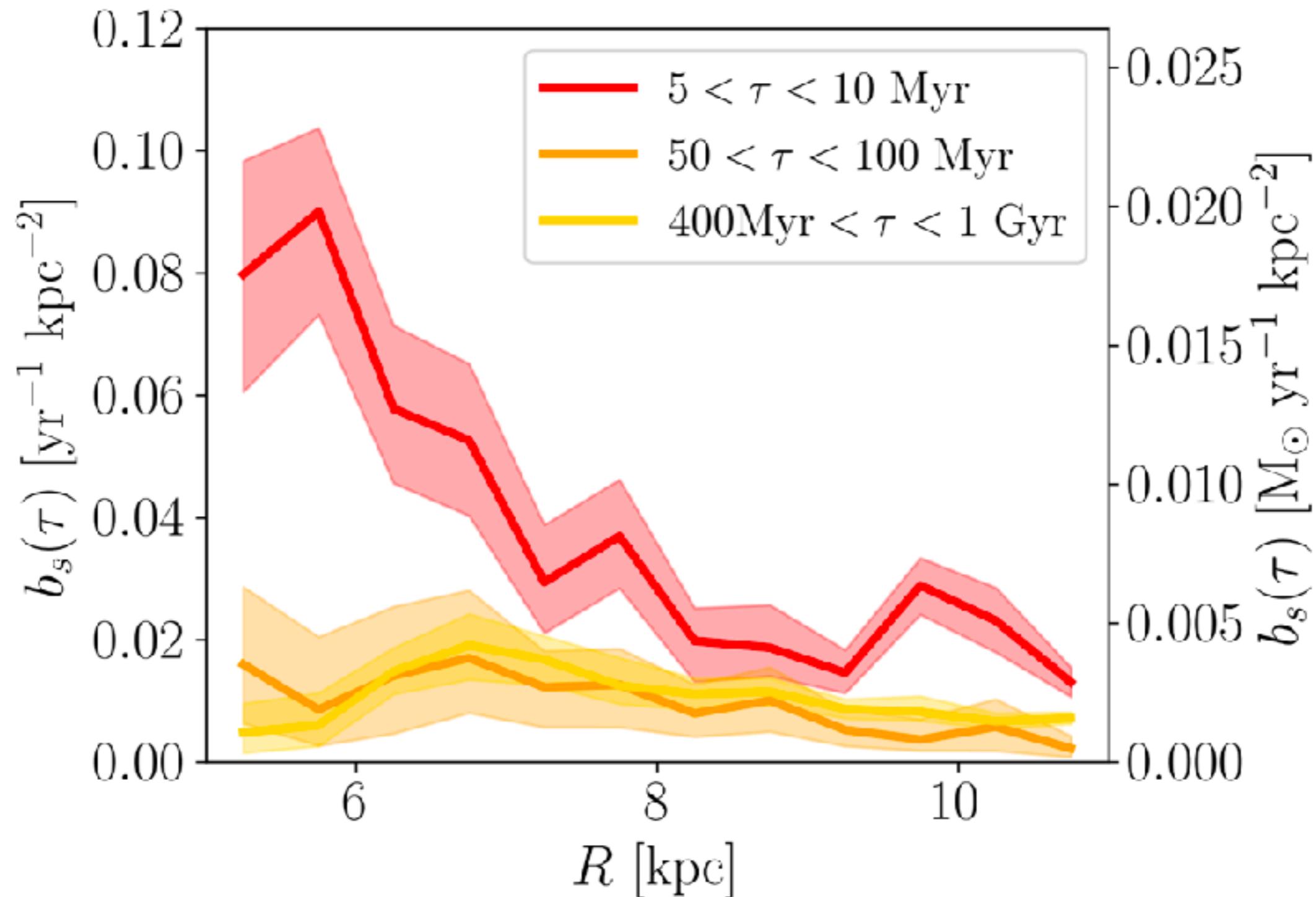
# Atomic filament orientation and star formation

Soler, J.D. et al. A&A (2022)



# SF from high-mass stars

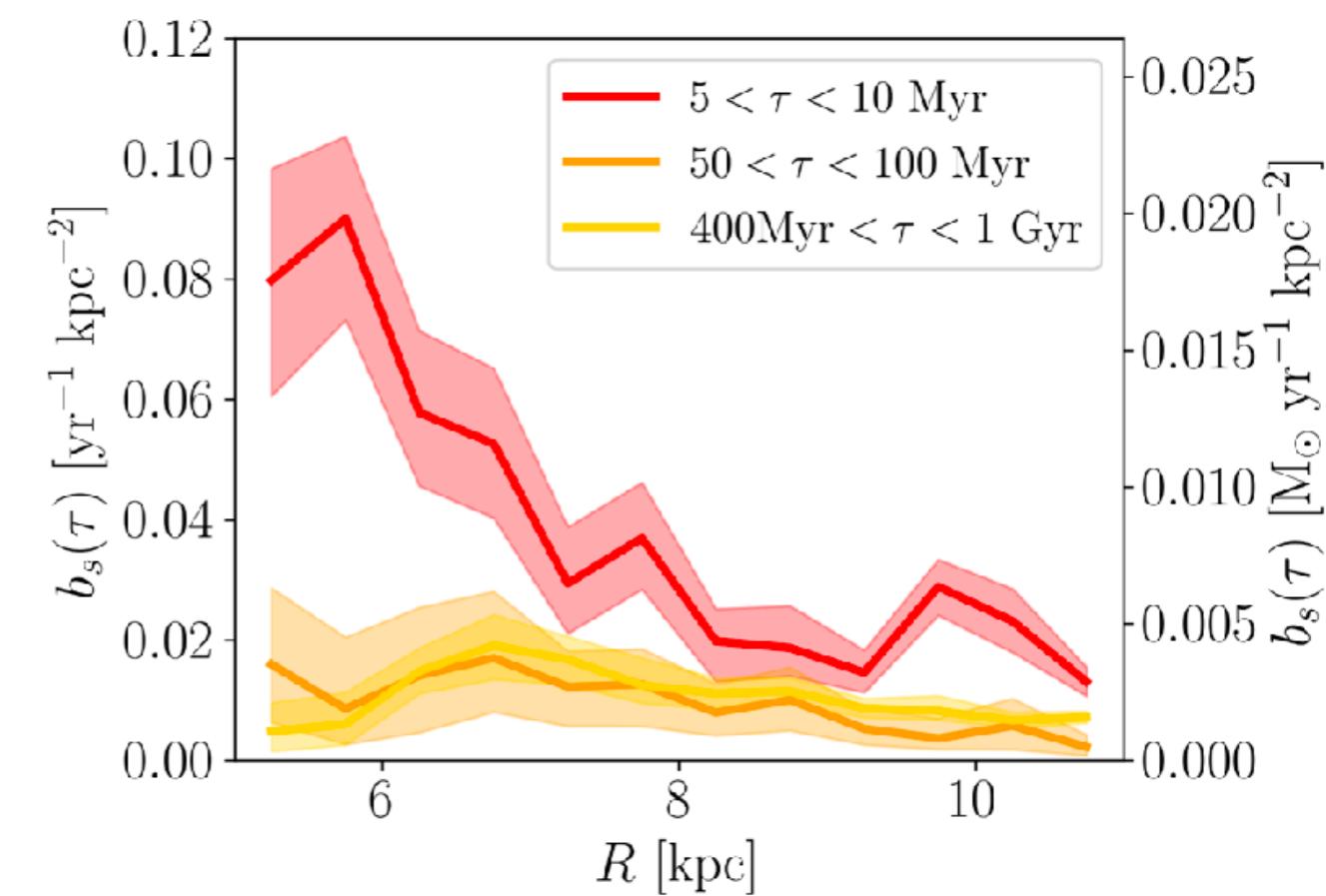
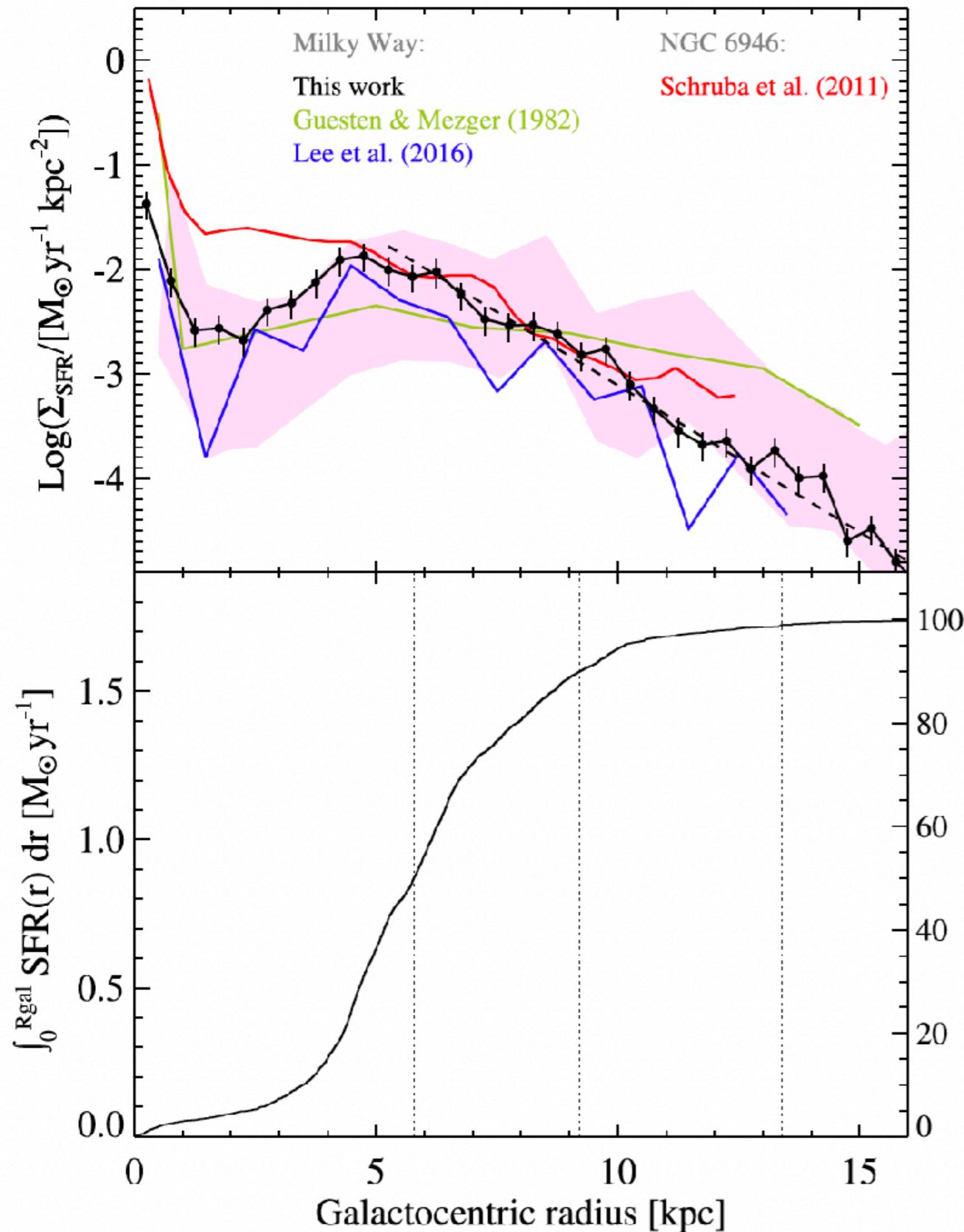
Zari, Frankel & Rix. A&A (2023)



# SF from dust thermal emission and high-mass stars

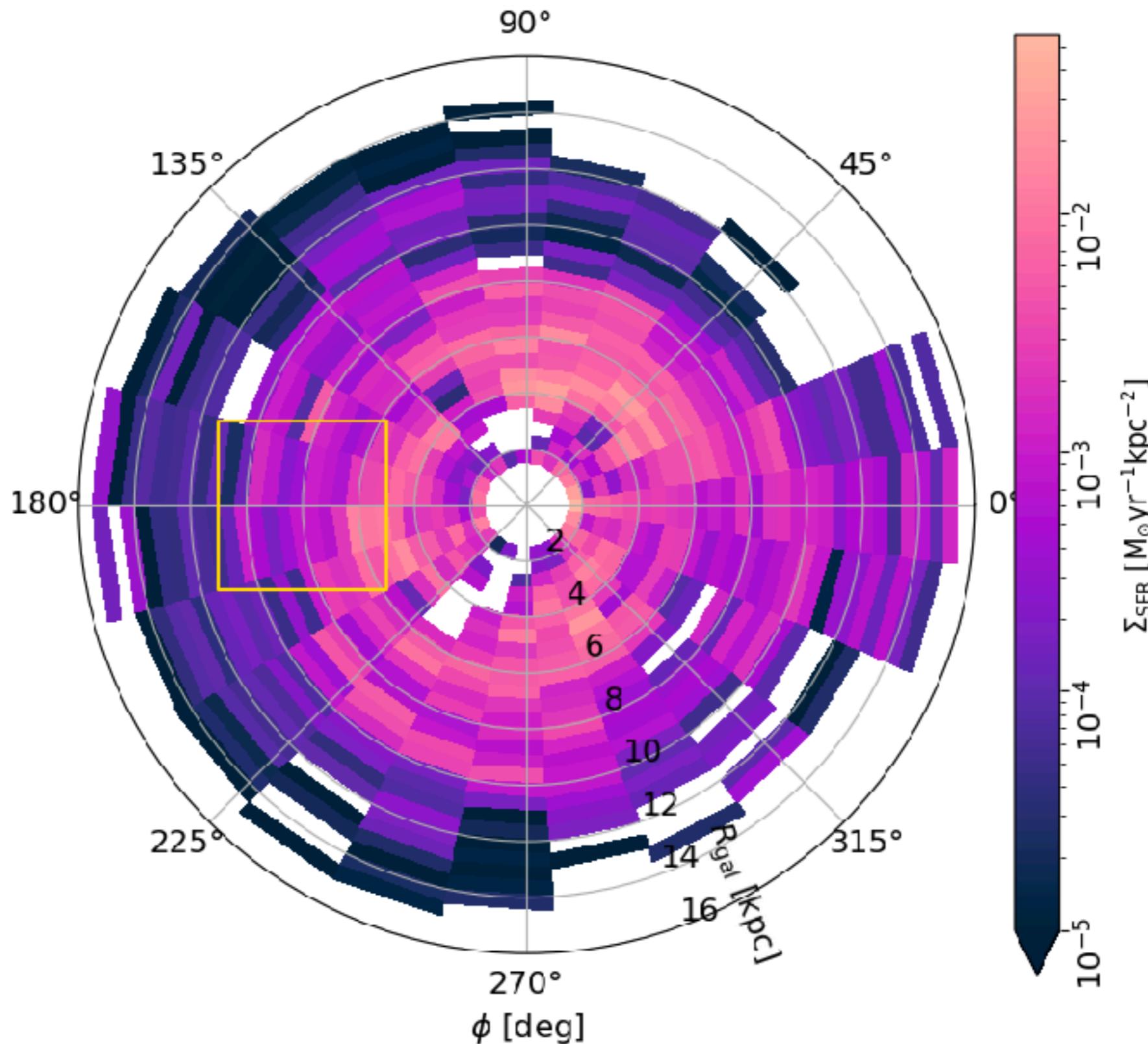
Elia, Molinari, Schisano, Soler et al. A&A (2022)

Zari, Frankel & Rix. A&A (2023)



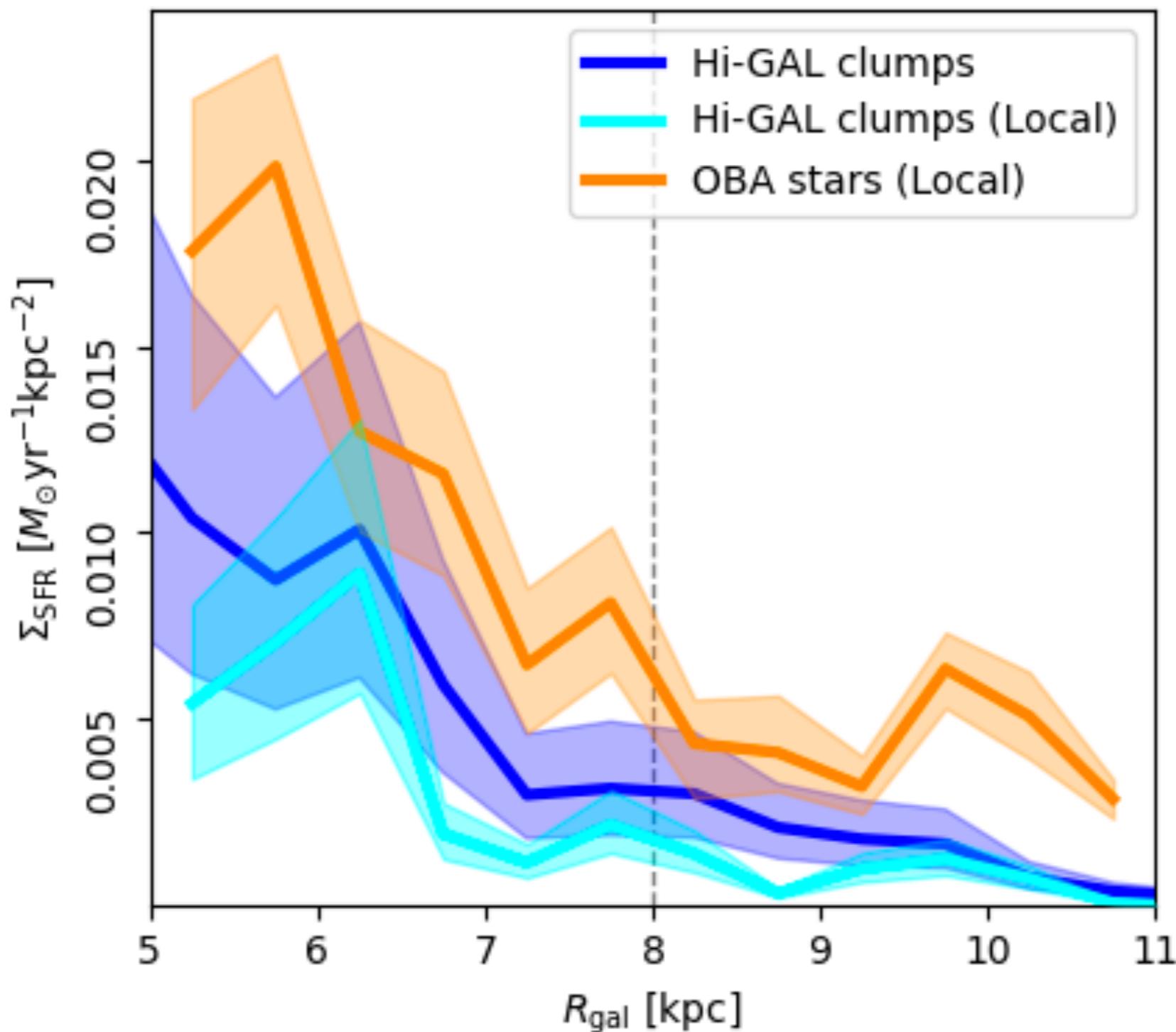
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Soler, Zari, Elia et al. A&A submitted.



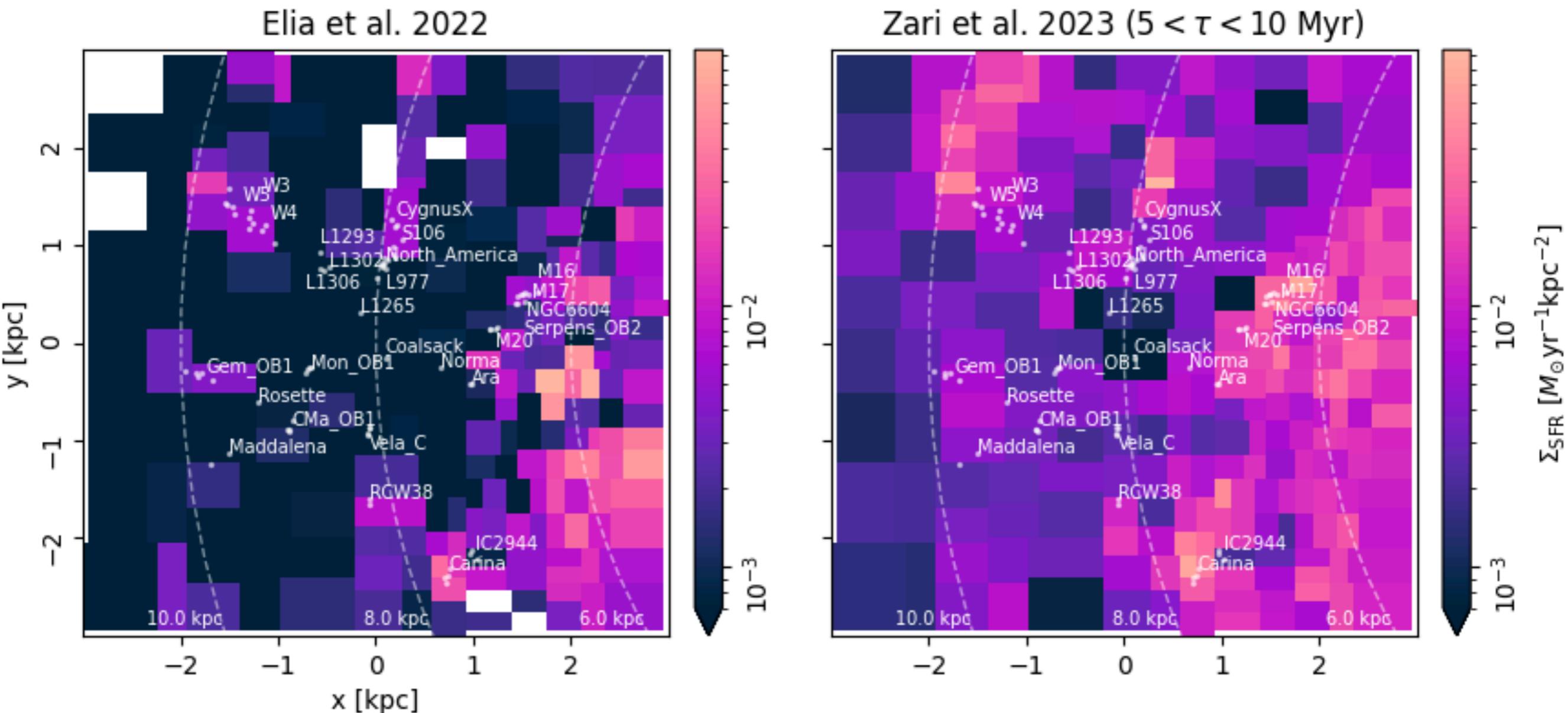
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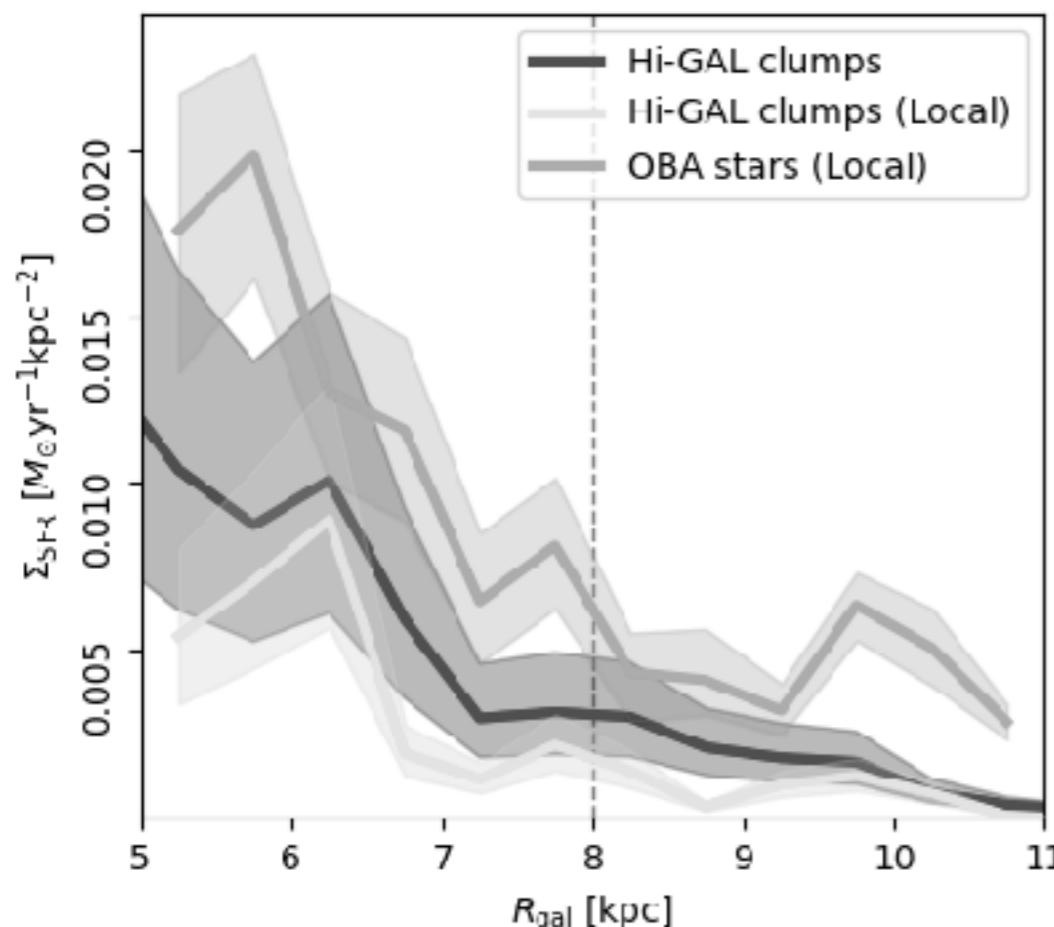
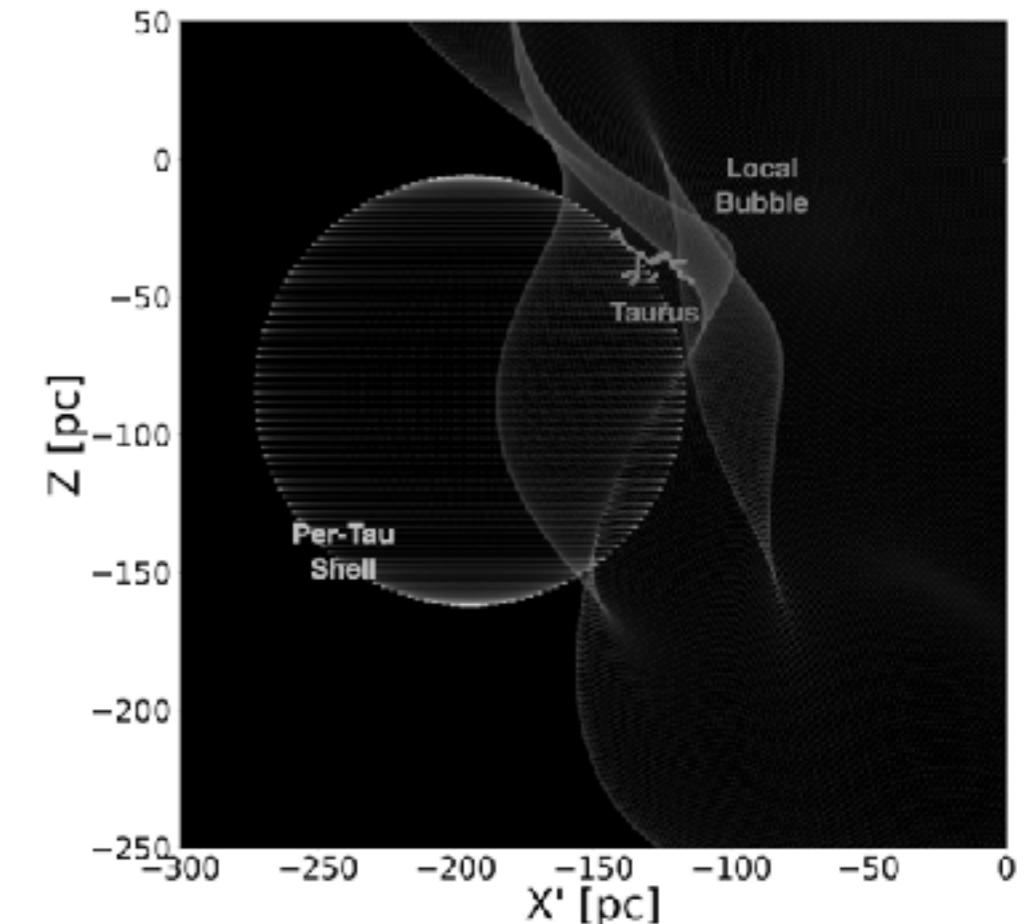
# Conclusions

## Dynamics of the Taurus molecular cloud

Soler, Zucker, Peek & the ECOGAL collaboration  
A&A (2023)



The Taurus MC is experiencing compressive motions that are not followed by the YSOs in that region. #StellarFeedback



## Star formation from dust thermal emission and high-mass stars

Soler, Zari, Elia et al. A&A submitted.

SF estimates from #DustThermalEmission and #HighMassStars agree (within a factor of 2) and indicate that MW's #SFR has been constant over last 10 Myrs.

