MODELLING AND FITTING OF BACKGROUND SOURCE CONTINUA IN MOLECULAR CLOUD ICE SPECTRA

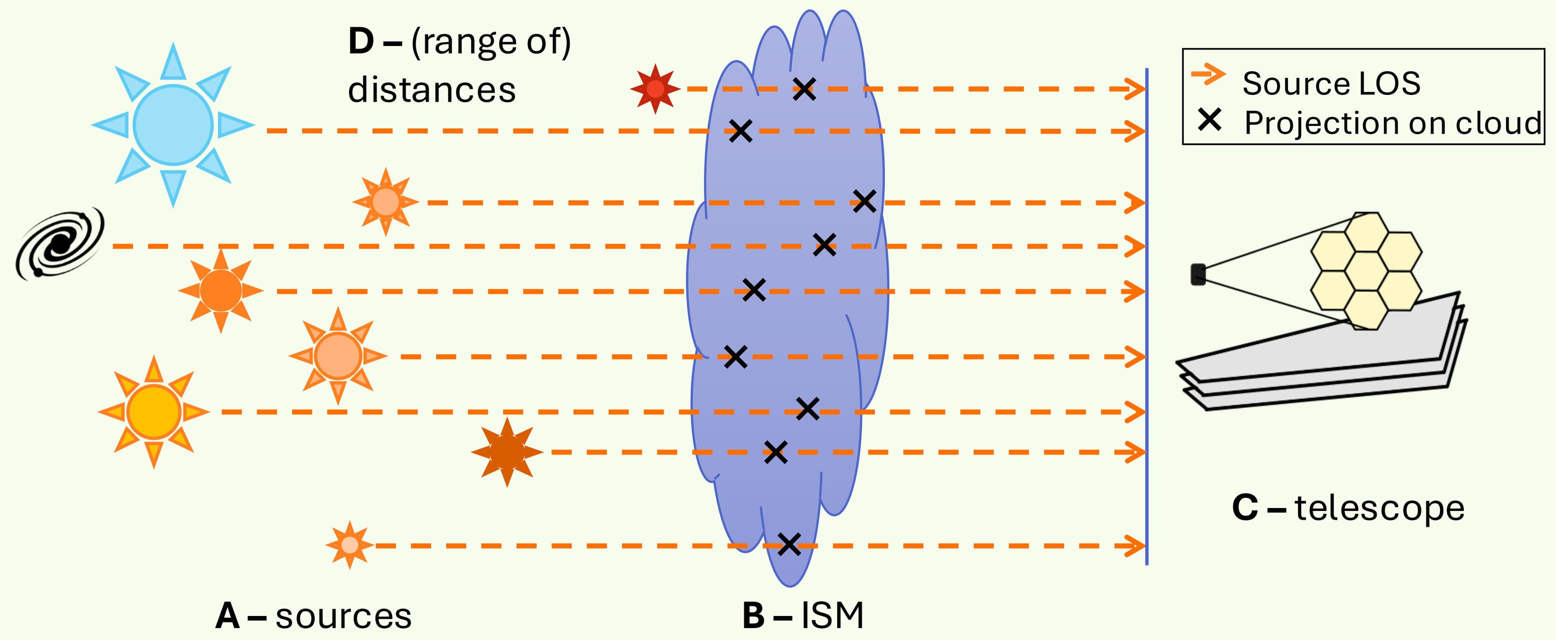
Lorenzo Demaria[1] (lorenzo.demaria@open.ac.uk), H. Fraser[1], J. Bromley[1], E. Tsiakaliari[1], M. Rashman[1], H. Dickinson[1]

[1]*School of Physical Sciences, Open University, Walton Hall, MK7 6AA, UK*

Why do we study molecular cloud ices?

Molecular clouds are the cradle of *stars*, precursors to the protostars and protoplanets. The elemental and molecular *budget* of stars and planets is tied to that of the molecular clouds that came before. The **icy** mantles on the clouds' dust grains are the largest molecular reservoir in the ISM, and can only be observed in molecular clouds (cold and dense). These are the building blocks of ***life***.

Common ices: H_2O, CO_2, CO, CH_4, NH_3, CH_3OH



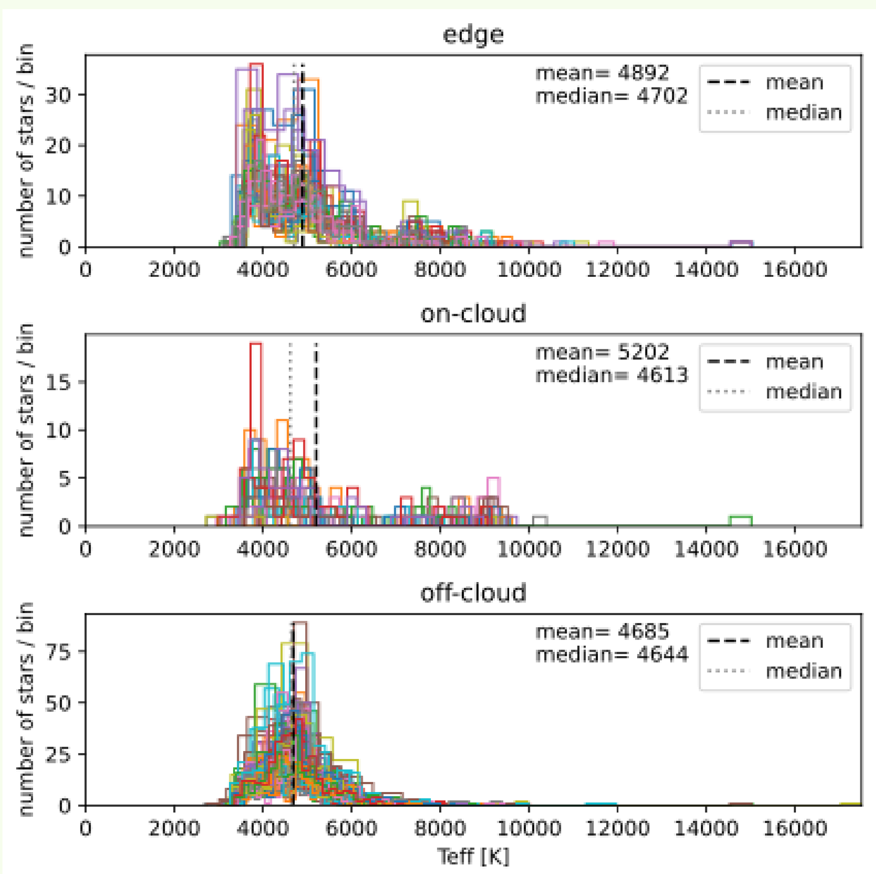
ICE MAPPING: It's a technique to study the spatial *extent* of molecular clouds by concurrent observation of multiple LOS (lines of sight) probing the molecular cloud. *Ices* are seen as absorption features against a continuum emission from background sources [2].

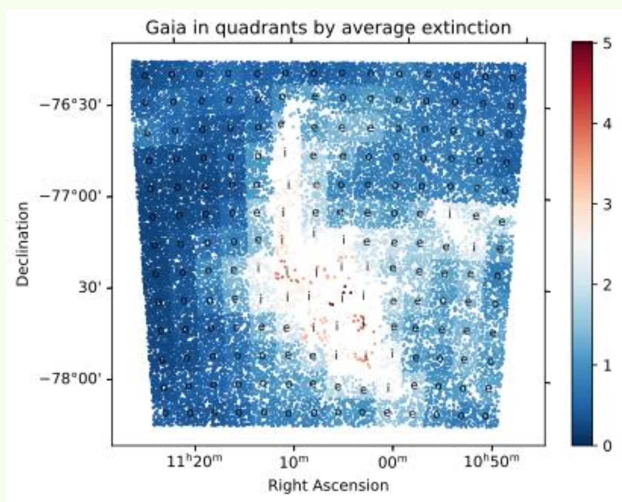
BUT! The photospheric lines from the sources, as well as gas and dust effects make it difficult to *qualify* and *quantify* the ices

➔ need to accurately *baseline* the continuum behind the ices

METHODOLOGY

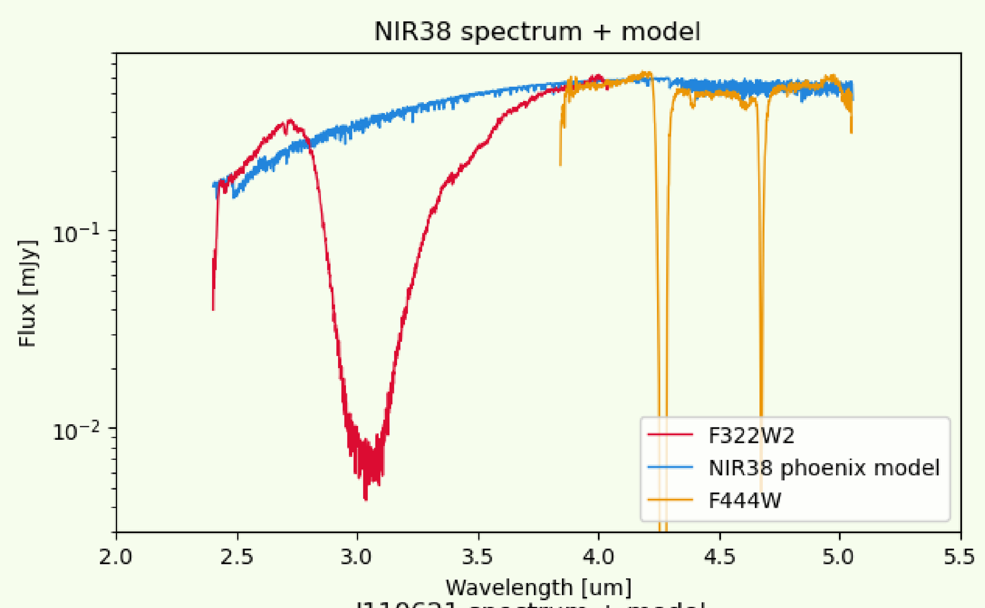
RESULTS

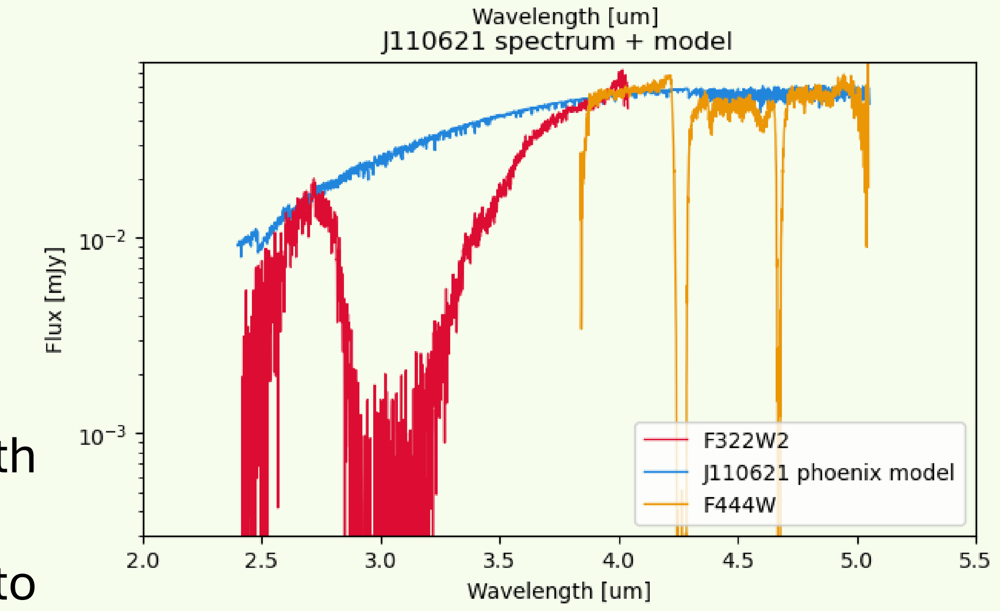




Cataloguing stars using Gaia DR3 to determine the stellar population distribution in the background field.

- The distribution remains consistent across the field, with median T about 4600 K.
- In the cloud, there is a second peak around 8000 K, due to observational bias (only see bright sources through the cloud).



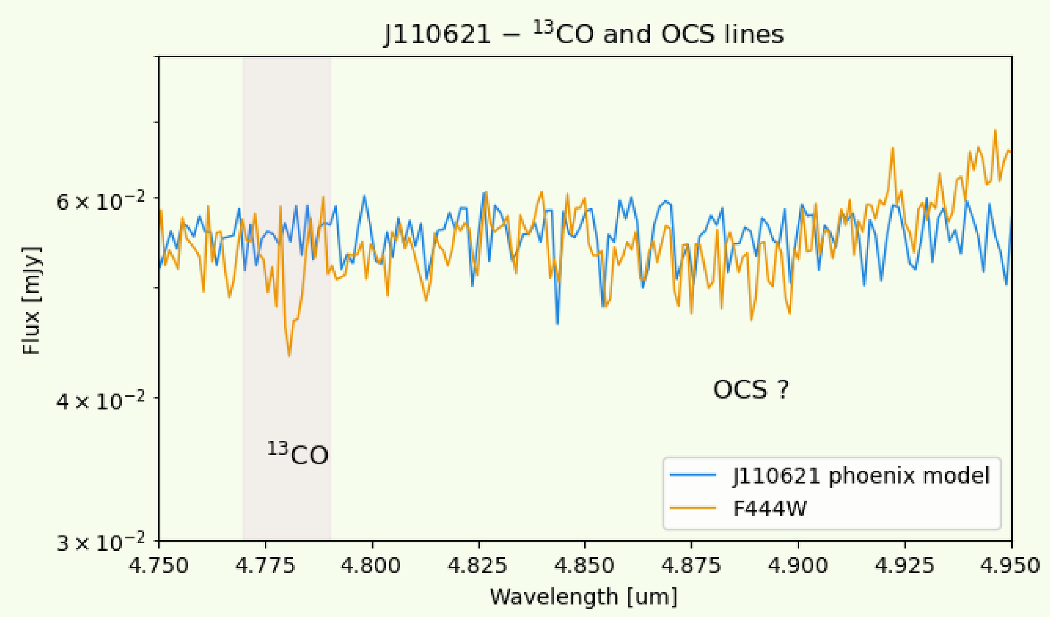


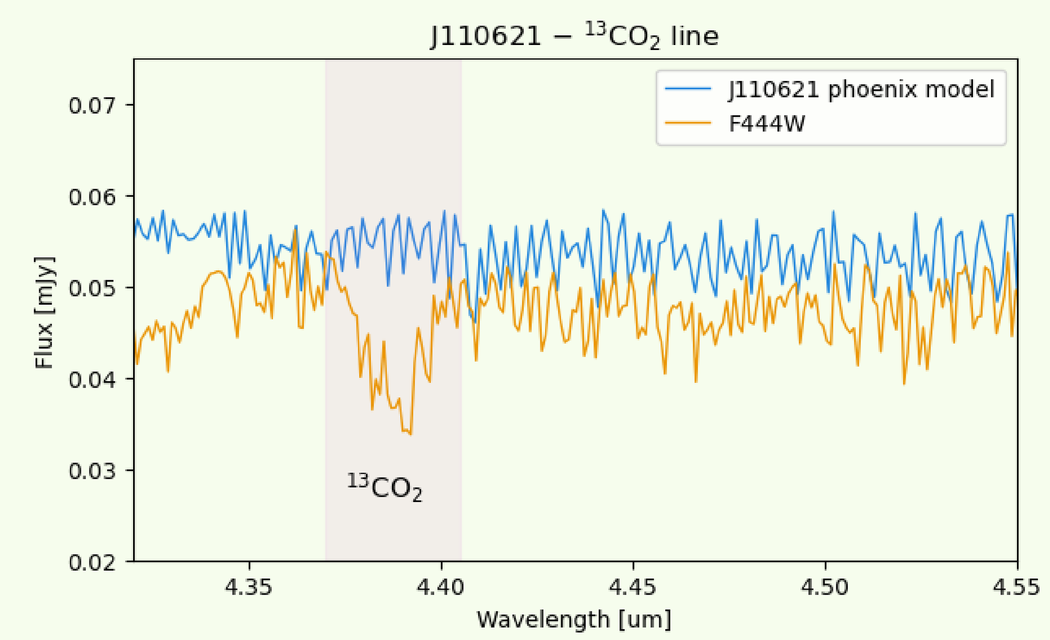
Right:

Comparison between observed spectra and simulated continuum for stars NIR38 and J110621. (data from *ICEAGE* [1])

Left:

Zoom-in on minor ice features present in J110621 spectrum. Note the good match between simulated and observed photospheric lines in the continuum. Despite [1], no OCS can be detected using an accurate baseline.





CONCLUSIONS

First results show accurate simulations of observations, highlighting the viability of this method to untangle the effects of gas, dust and ice in molecular clouds.

NEXT STEPS

- Implement ML/AI algorithm to find best fitting simulation for each LOSs
- Validate it with known stars
- Use this tool to analyse different clouds: Cha I, B335, B68, LDN 694-2
- Study how extinction may differ between clouds

REFERENCES: [1] McClure, M et al (2023); [2] Smith, Z et al (2025); *Image:* CTIO/NOIRLab/DOE/NSF/AURAImage