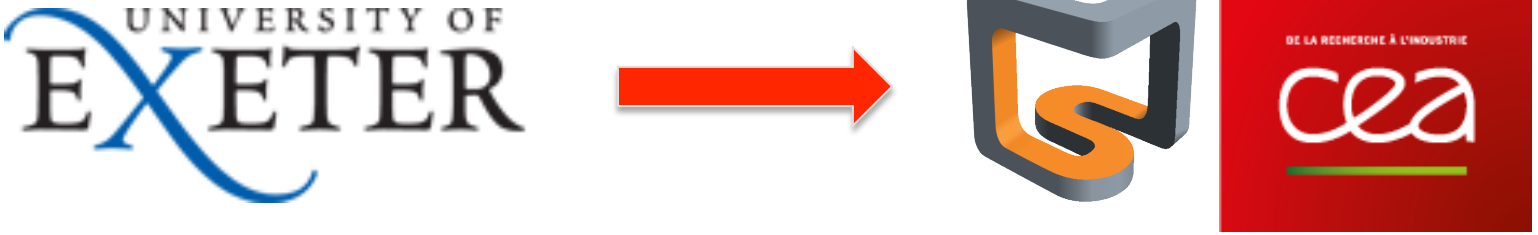
Vertical mixing and fingering convection in cool brown dwarf atmospheres

P. Tremblin, B. Drummond, P. Mourier, D. Amundsen, N. Mayne, I. Baraffe (Exeter), J. Manners (Met-office)

In collaboration with O. Venot (Leuven), F. Selsis (Bordeaux), D. Homeier, G. Chabrier, F. Allard (Lyon)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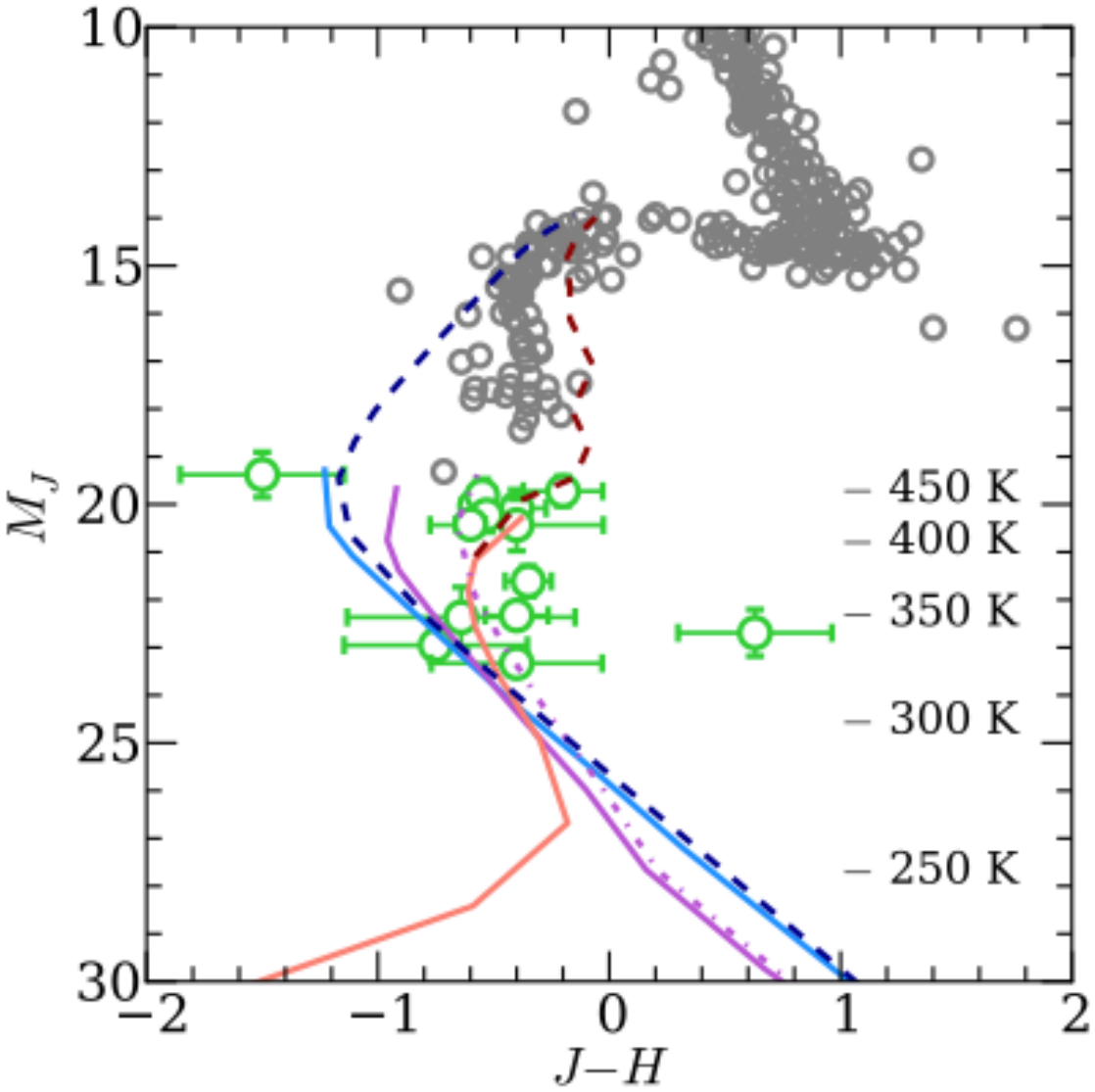
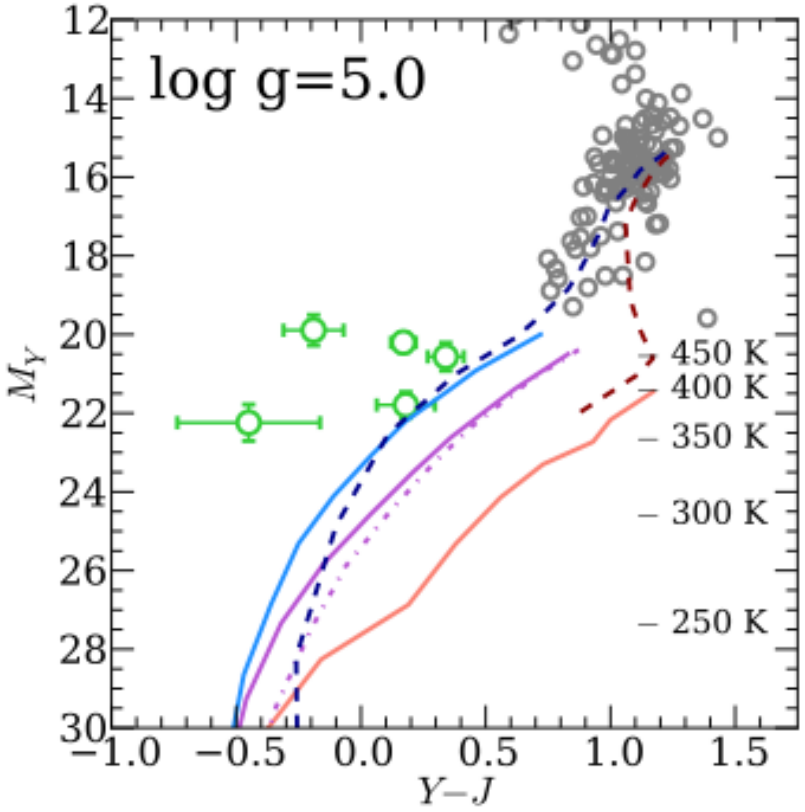
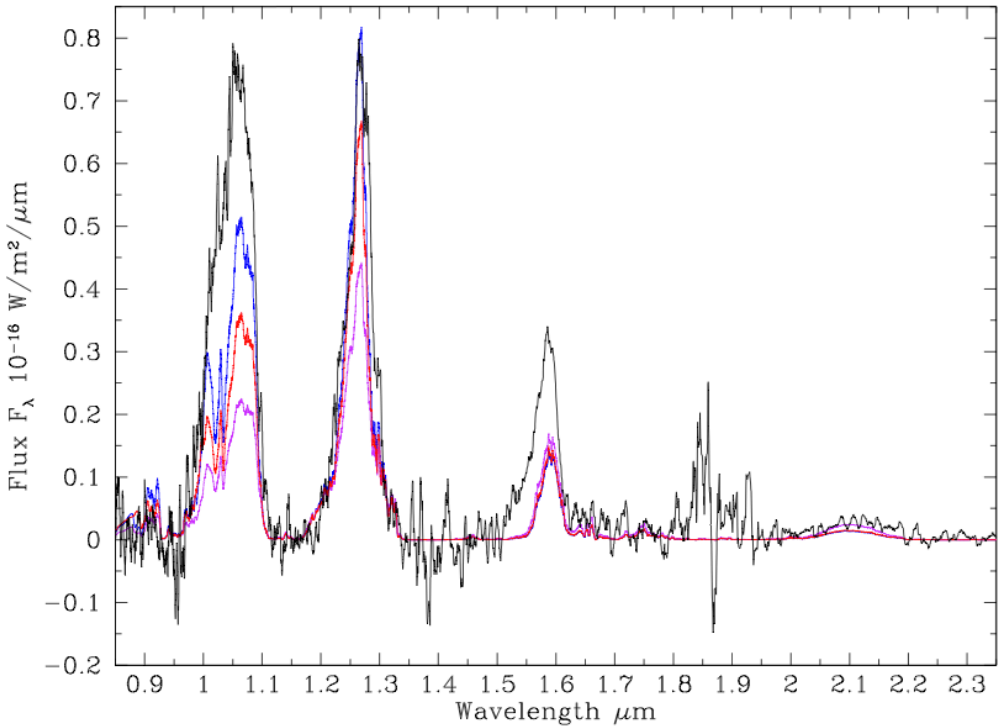


Good cloud models (Na2S,KCl,H2O) for T and Y dwarfs in J-H
Morley et al 2014

But, some issues for the Y and H band…



Morley et al 2014

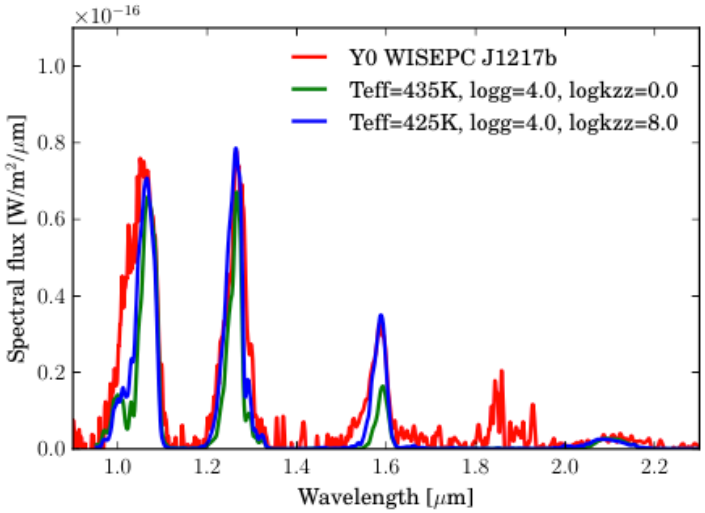


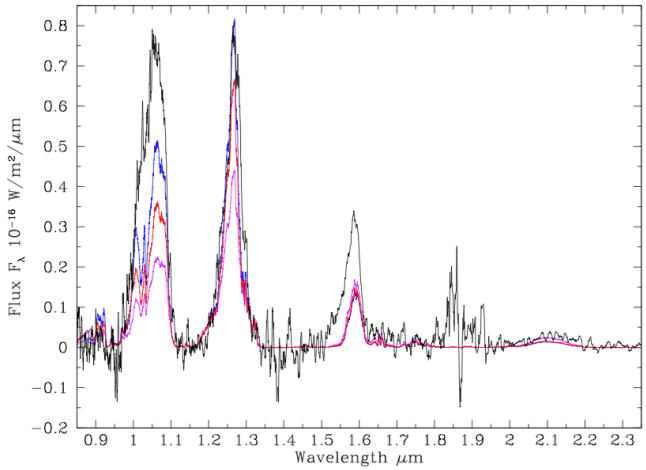
Leggett et al 2013, 2014 (w1217)

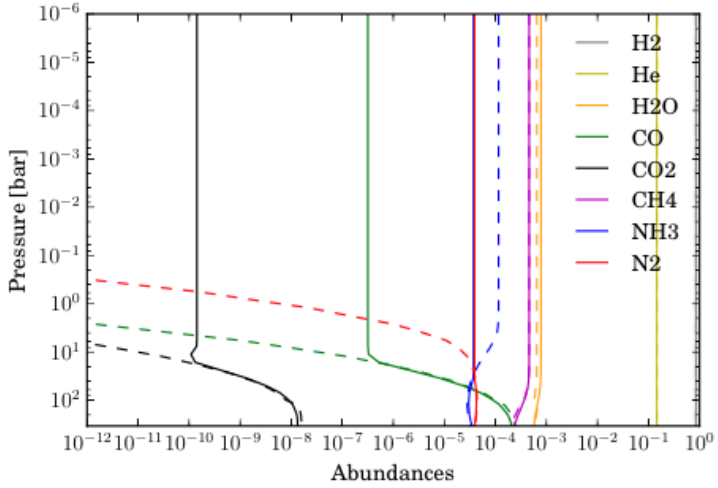
- 1D radiative/convective spectral code with out-of-equilibrium chemistry: ATMO
  - Chemistry:
    - ✓ Equilibrium chemistry by minimization of Gibbs-free energy
    - ✓ Chemical network with photochemistry and mixing from Venot et al. 2012: 109 species ~2000 reactions with C,N,O,H based species up to 2C (+TiO, VO, Na, K)
    - ✓ Condensation of H2O and NH3 and silicates (MgSiO3, KAlSi3O8, etc…, no rainout for the moment)

  - Radiative transfer (Comparison in Amundsen et al. 2014):
    - ✓ Line by line computation at a resolution of 0.001 cm^{-1}: 5E7 frequencies
    - ✓ Correlated-K method with 32 bands and 10 coefficient per band
    - ✓ Discrete ordinate method (Gauss legendre quadrature) with 16 rays
    - ✓ H2-H2 and H2-He CIA, NH3, CH4 (Exomol), CO, CO2, H2O, TiO, and VO, Na and K.

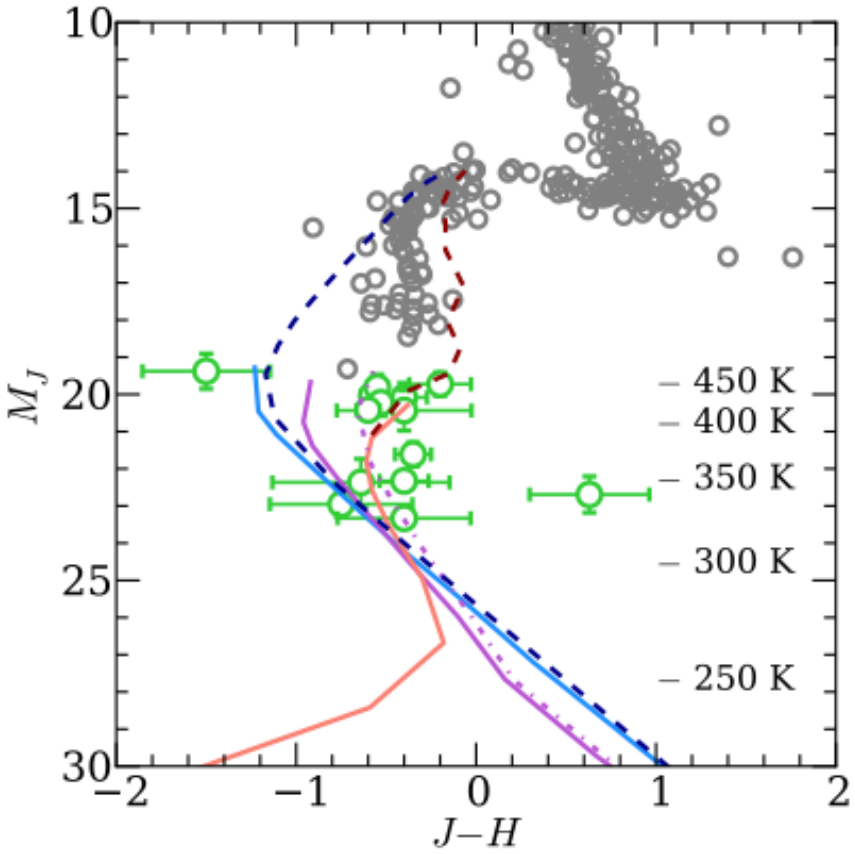
- Application to Y dwarf WISE1217, vertical mixing NH3 reduced by a factor 3





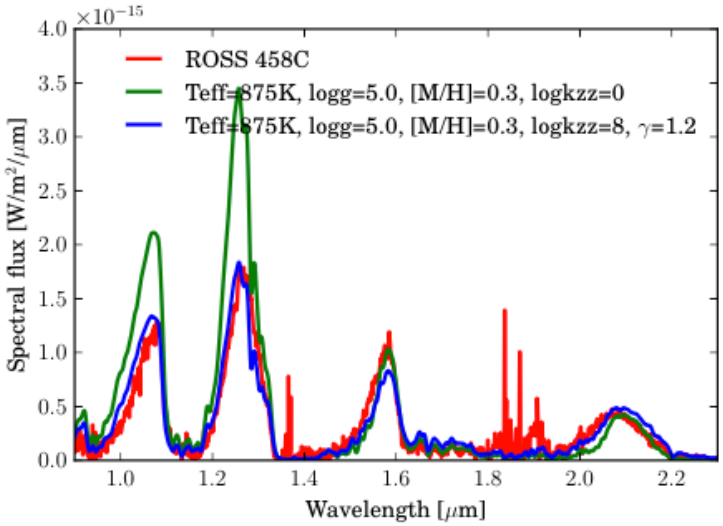


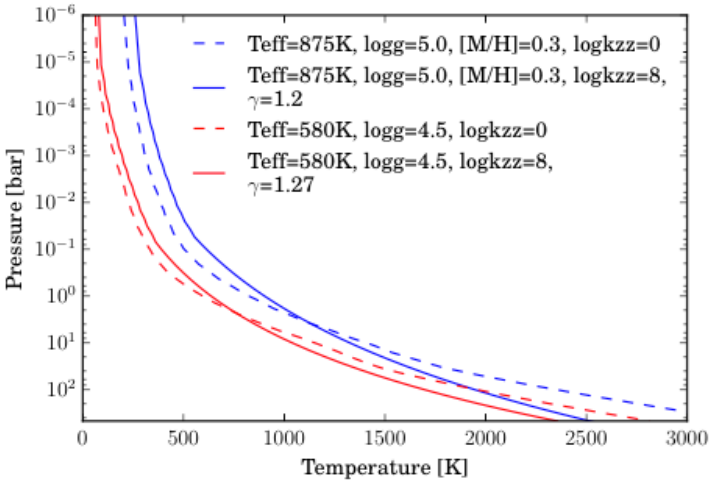
- Application to T dwarfs? Presence of clouds?

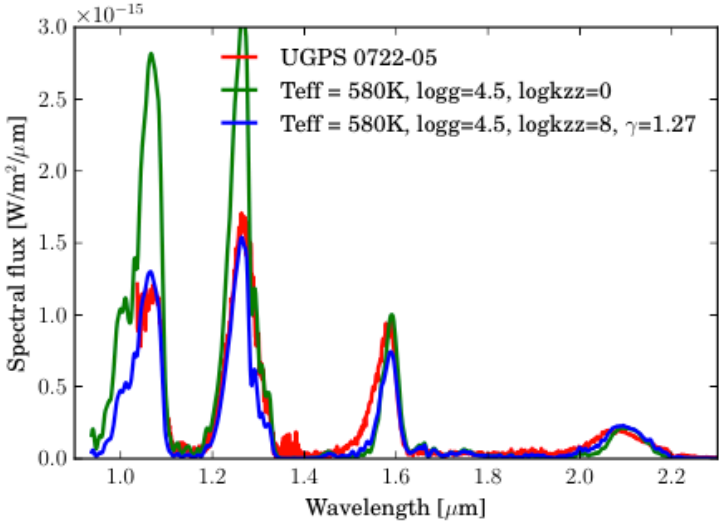


Morley et al 2014

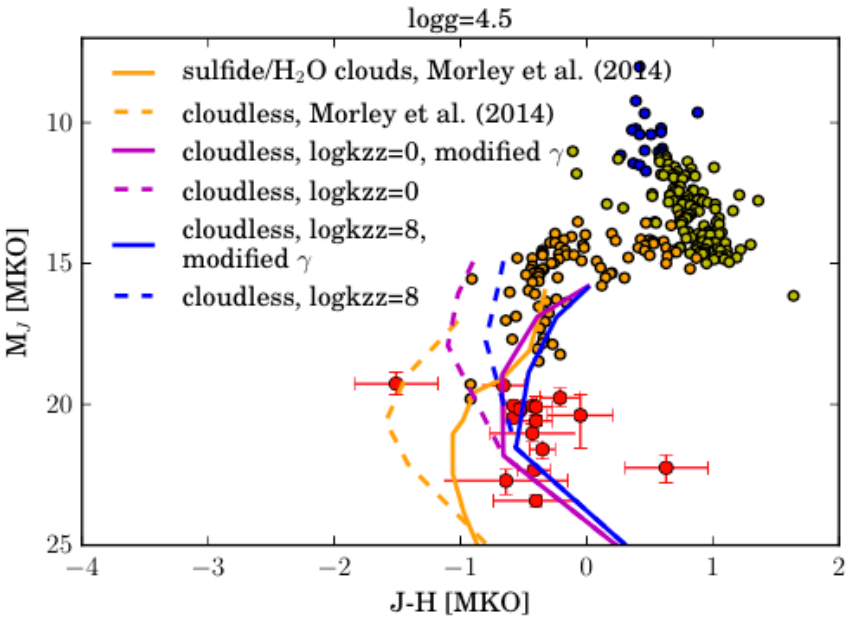
- Application to T dwarfs: Ross 458C UGPS 0722-05:

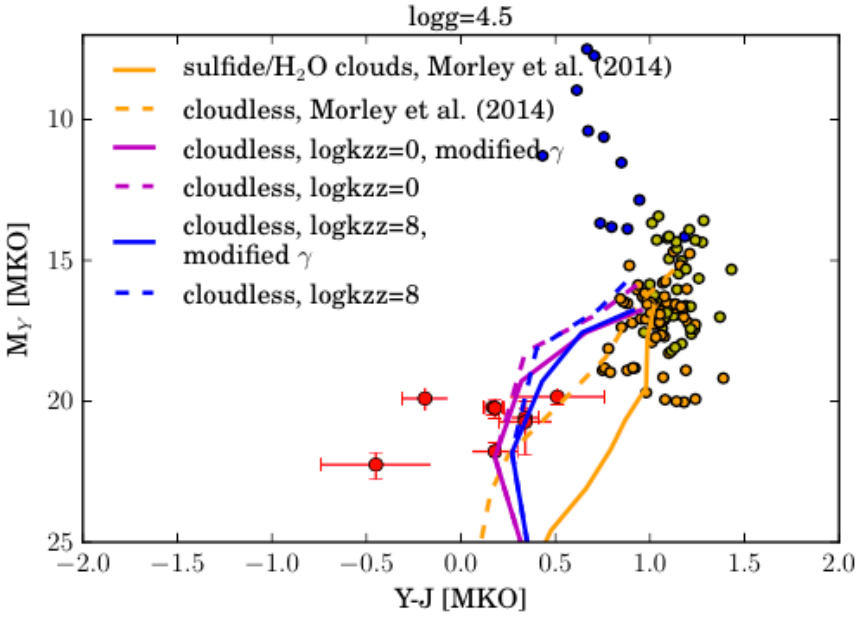




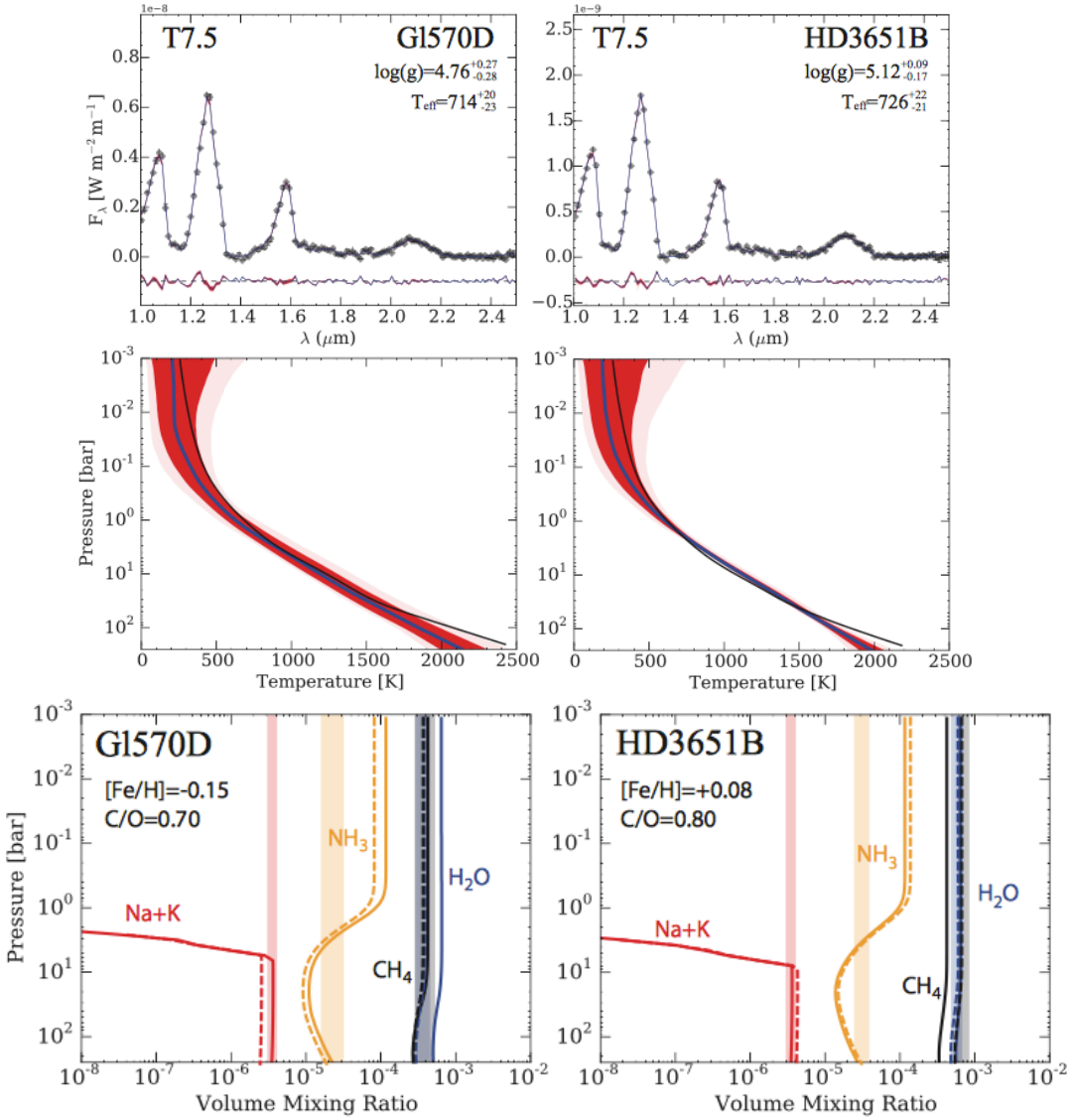


- Color magnitude diagram

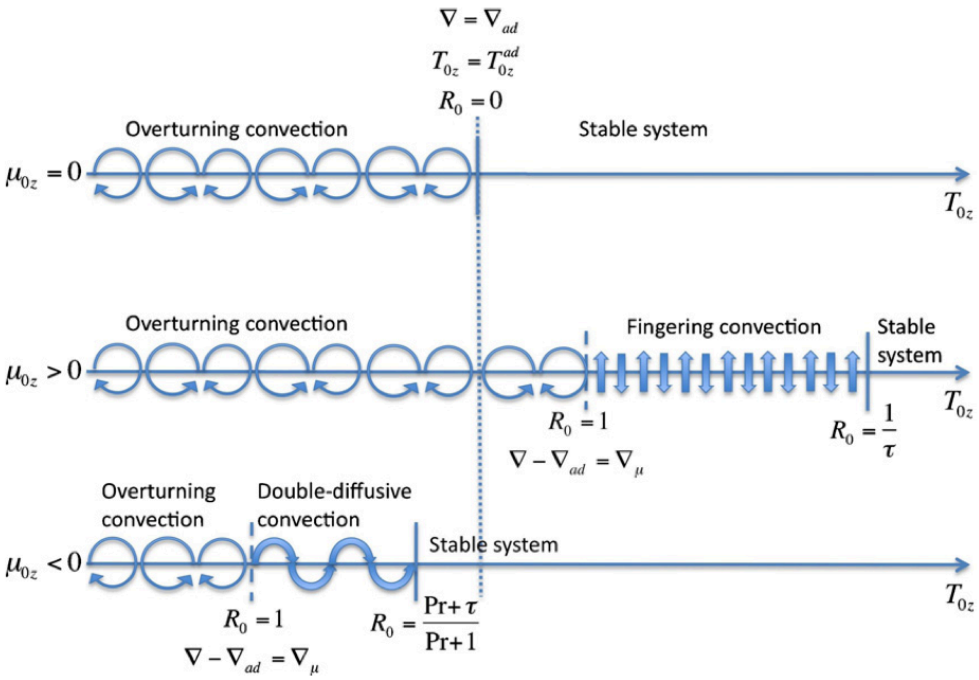


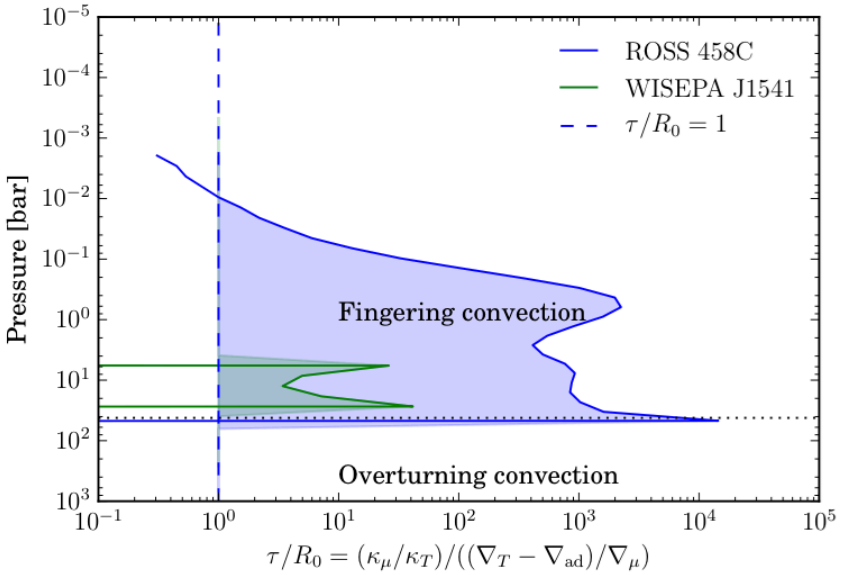


- Confirmed by Line et al. 2015 with retrieval methods:



- Modified adiabatic index, fingering convection or clouds?





Rosenblum et al 2012

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