

Weird convection regimes in Mini Neptunes: Implications for K2-18b

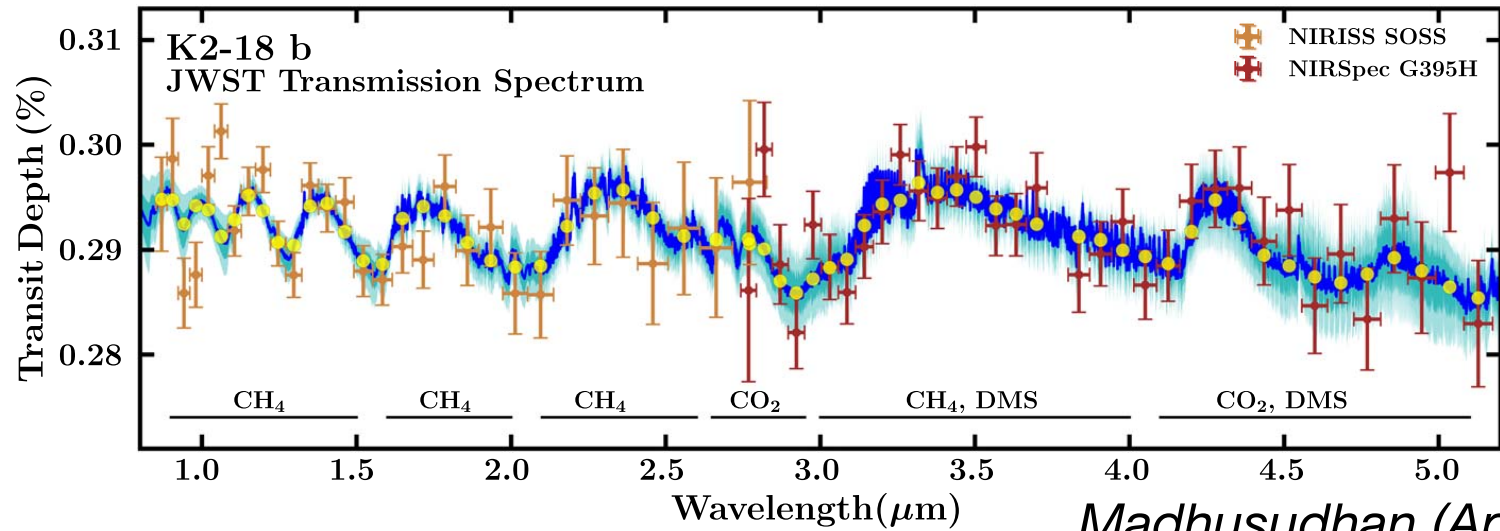
Jérémy Leconte

CNRS | University of Bordeaux

A. Spiga, N. Clément, G. Milcareck, F. Selsis, B. Charnay, T. Guillot

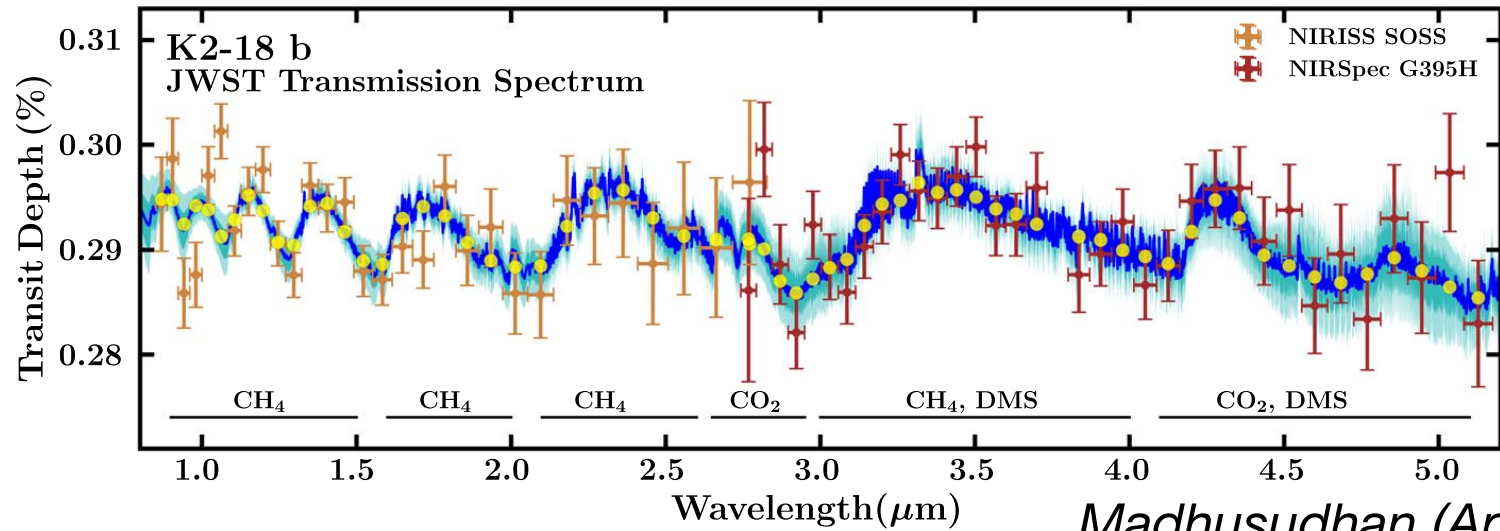


The *K2-18b* mystery



Madhusudhan (ApJL, 2023)

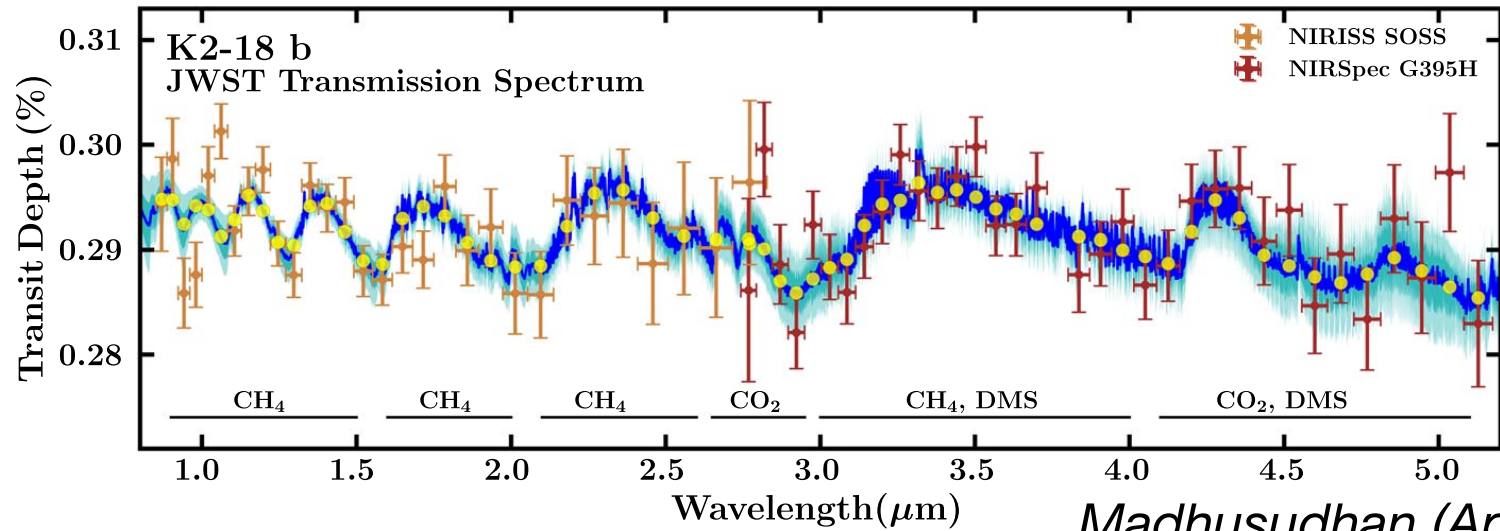
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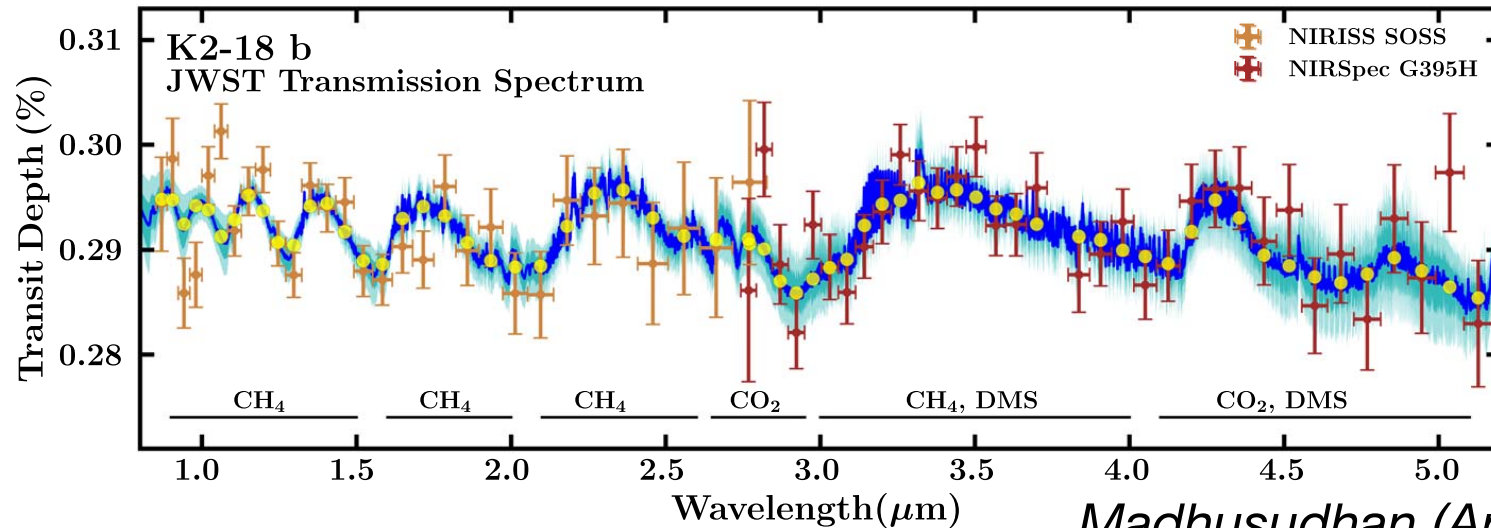


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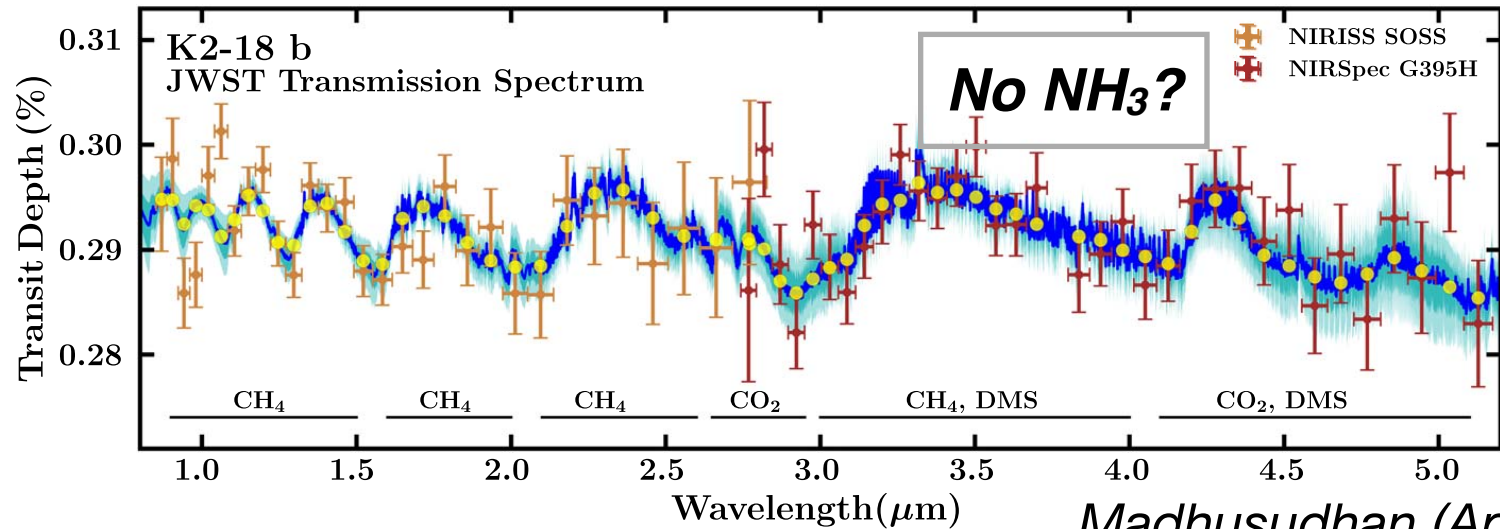


Madhusudhan (ApJL, 2023)

First Detection of Exoplanetary Cannabinoids: Evidence for THC and CBD in the Atmosphere of K2-18b

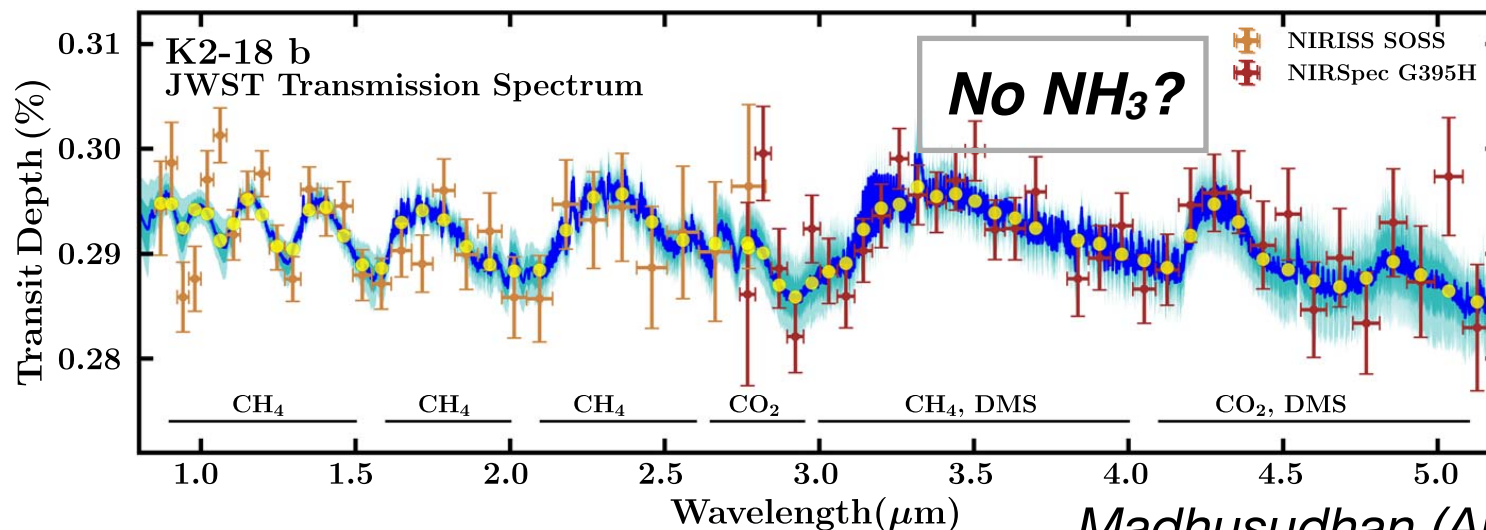
AMIE J. CHISM,¹ MARY JANE VAN DER POT,^{2,3} BLAISE P. HASHEAU,^{4,5} HANS-JOACHIM GRASMANN,^{6,7} BONNIE McTOKE,^{8,9}
BUD WELLINGTON-KUSH,^{10,11} MARÍA HIERBA-VERDE,^{12,13} AND PUFF D. MAGIC^{14,15}

The *K2-18b* mystery

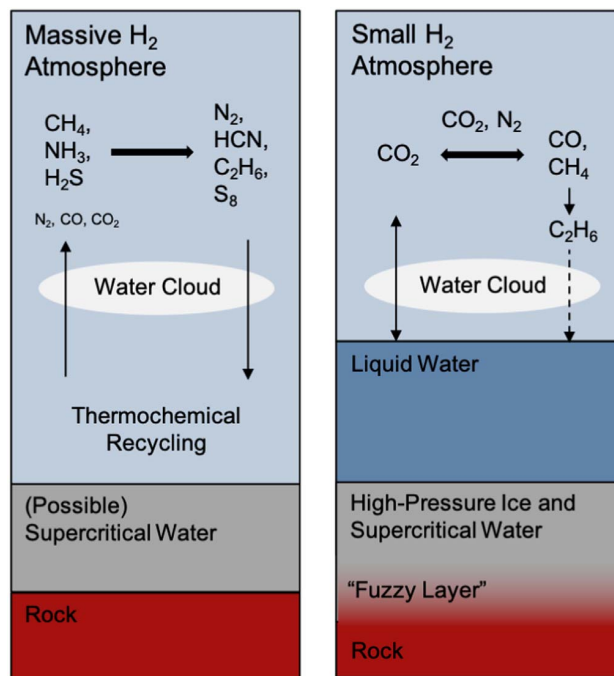


Madhusudhan (ApJL, 2023)

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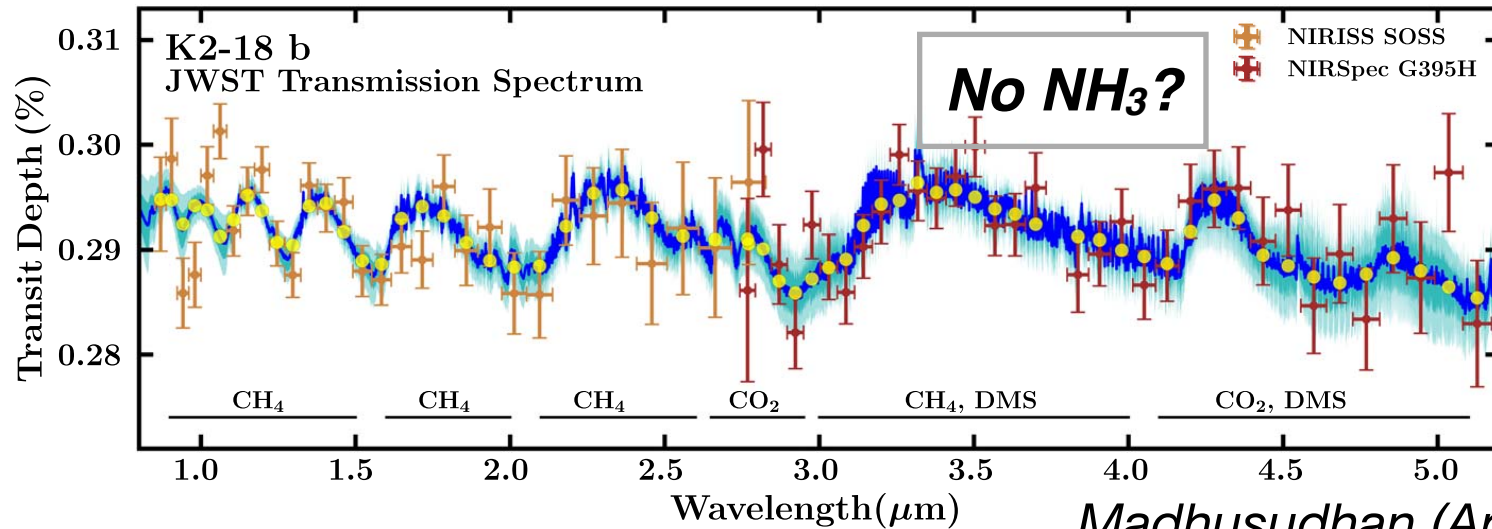


Madhusudhan (ApJL, 2023)



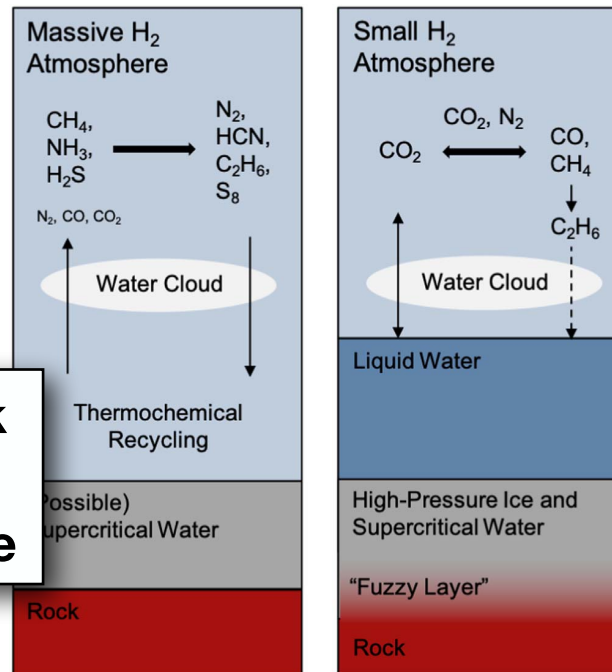
Hu et al.
(ApJL, 2021)

The *K2-18b* mystery



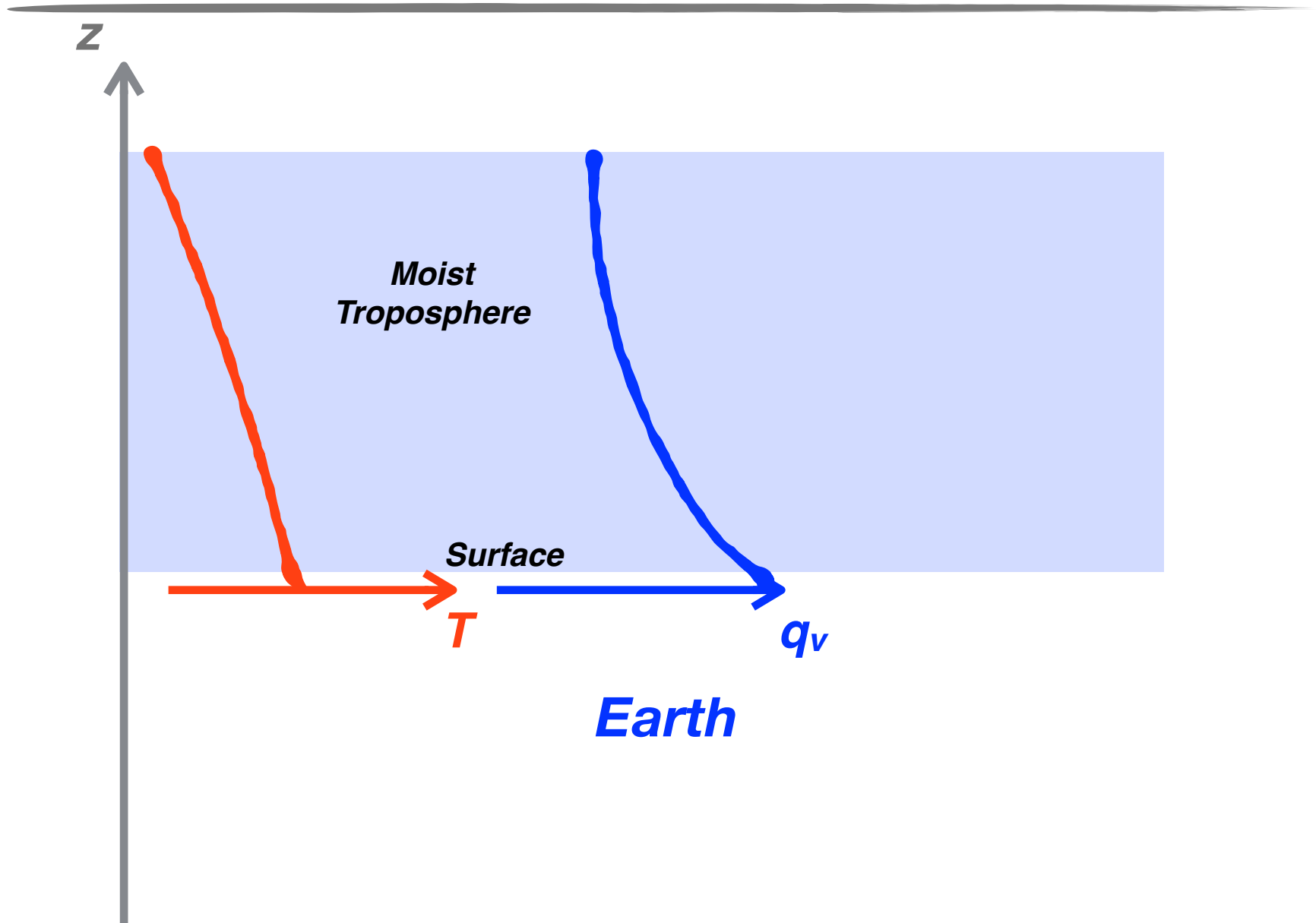
Madhusudhan (ApJL, 2023)

**For this scenario to work
=>
The ocean must be stable**

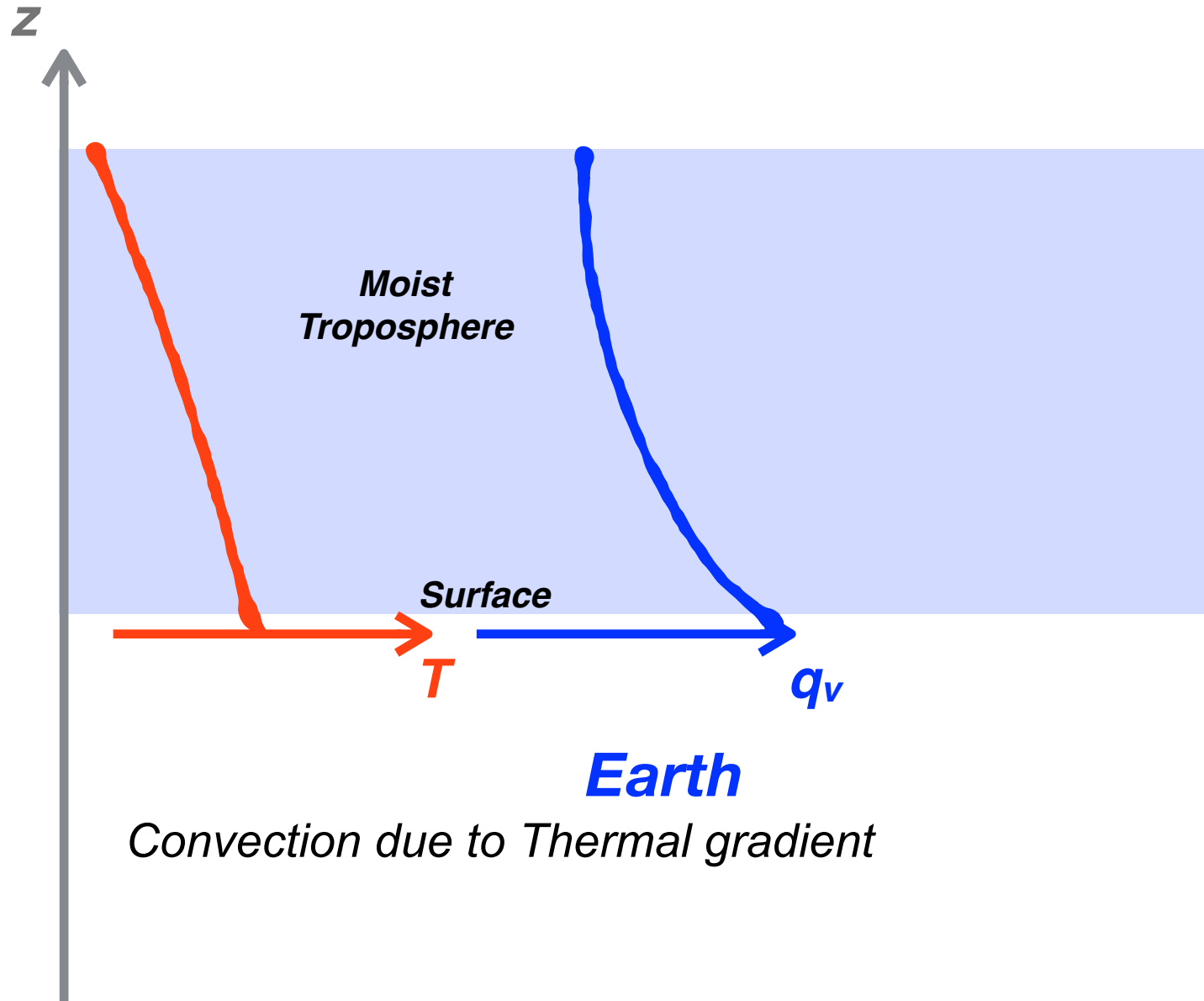


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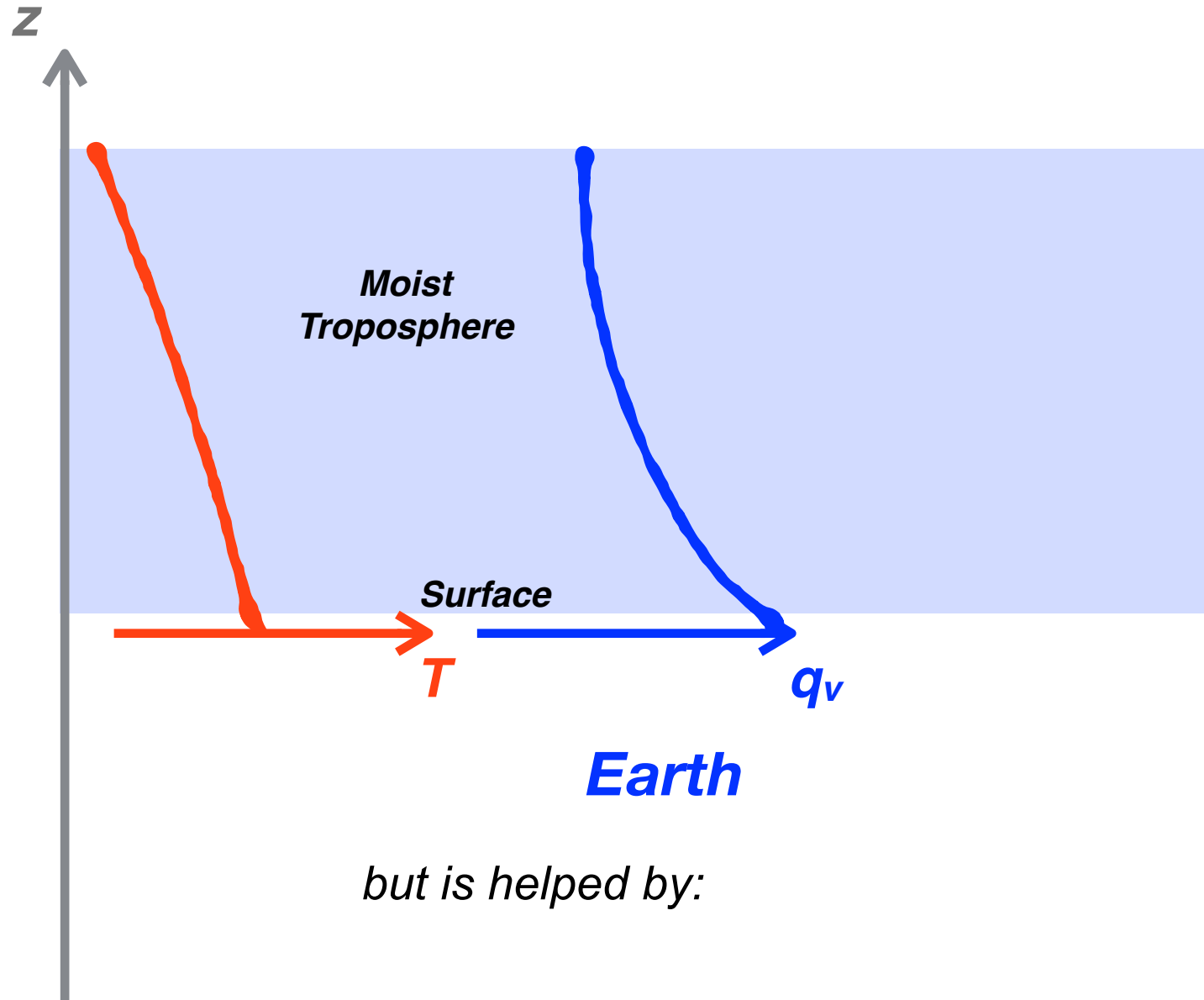
Why would convection in *Hydrogen* be different?



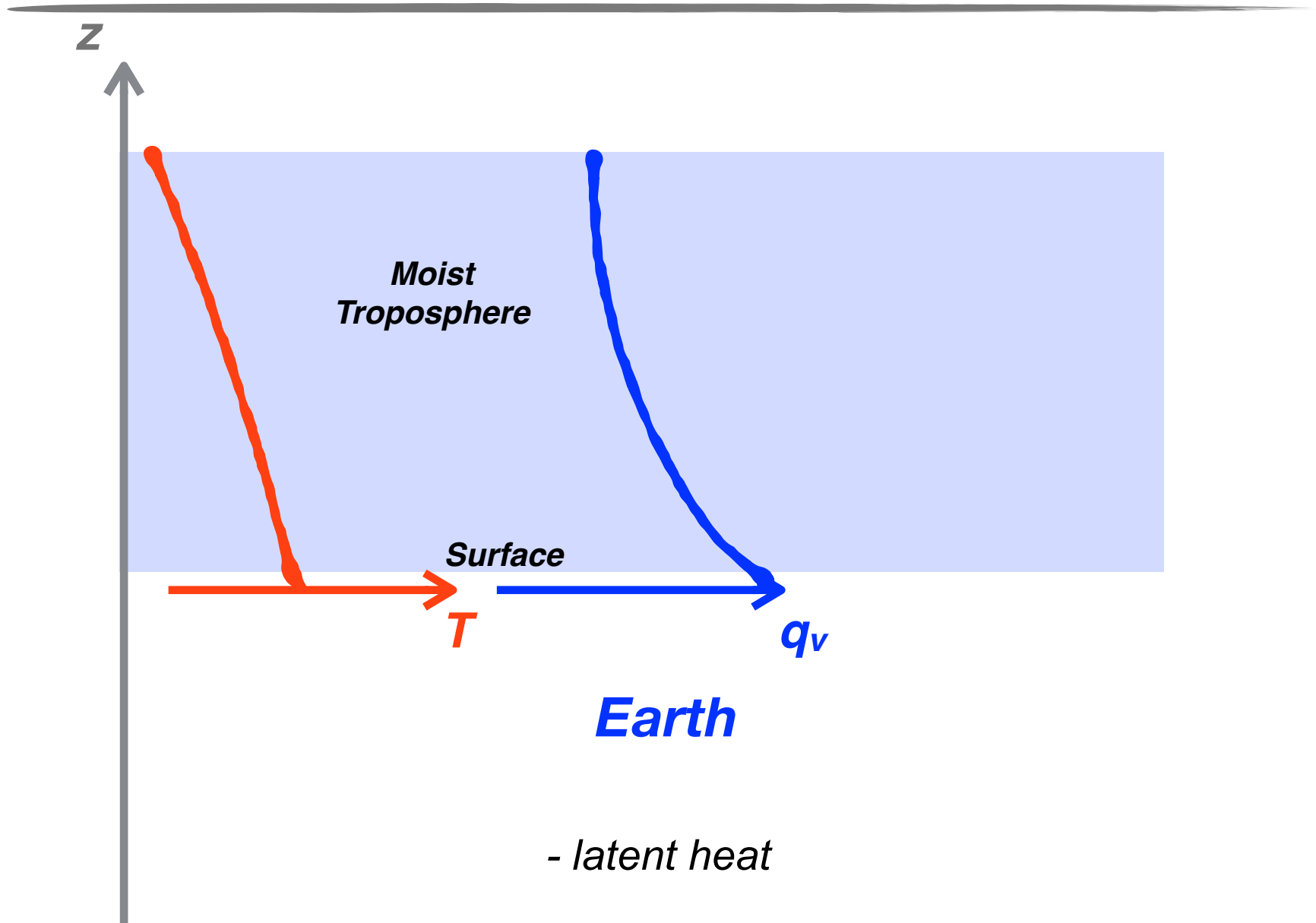
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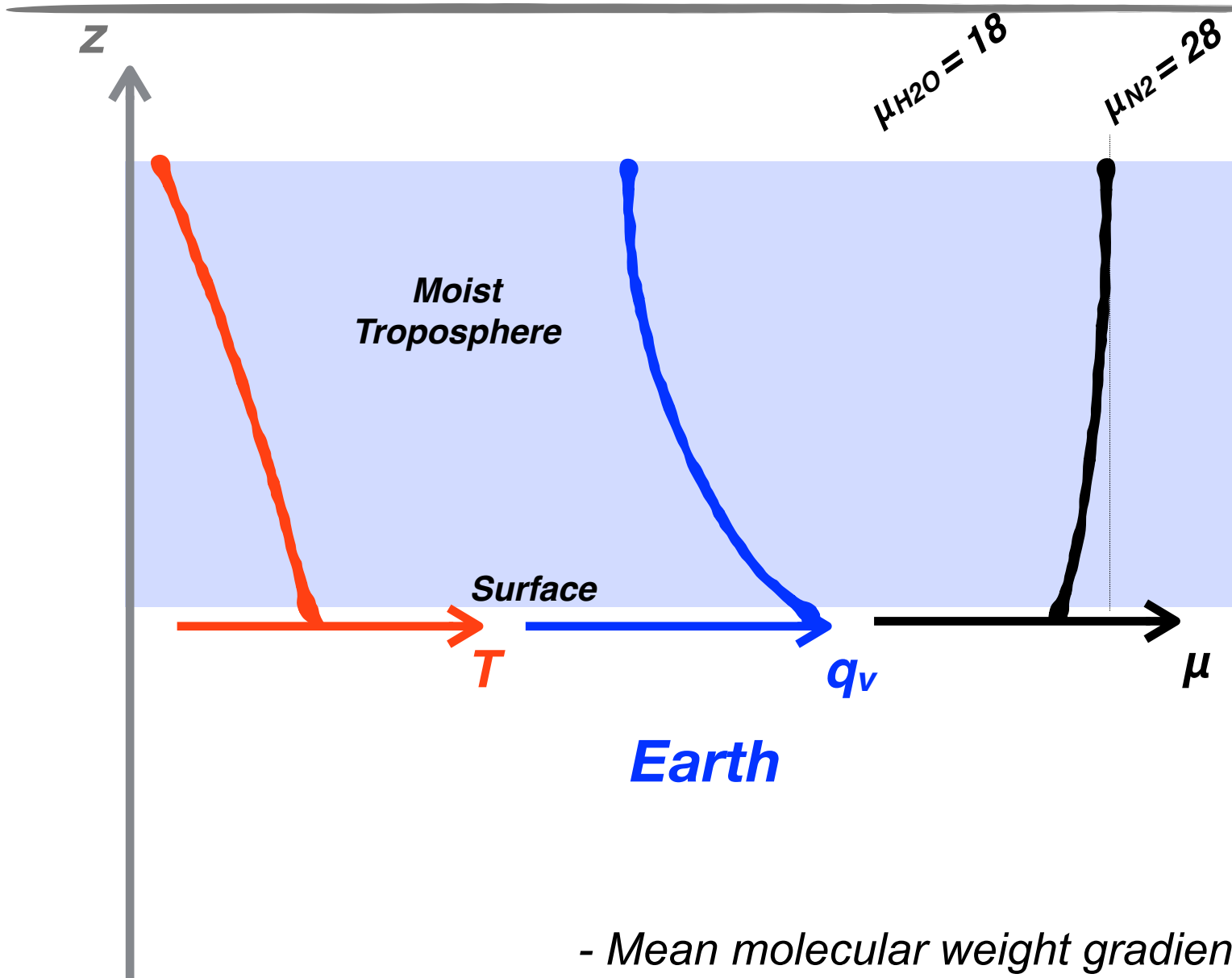
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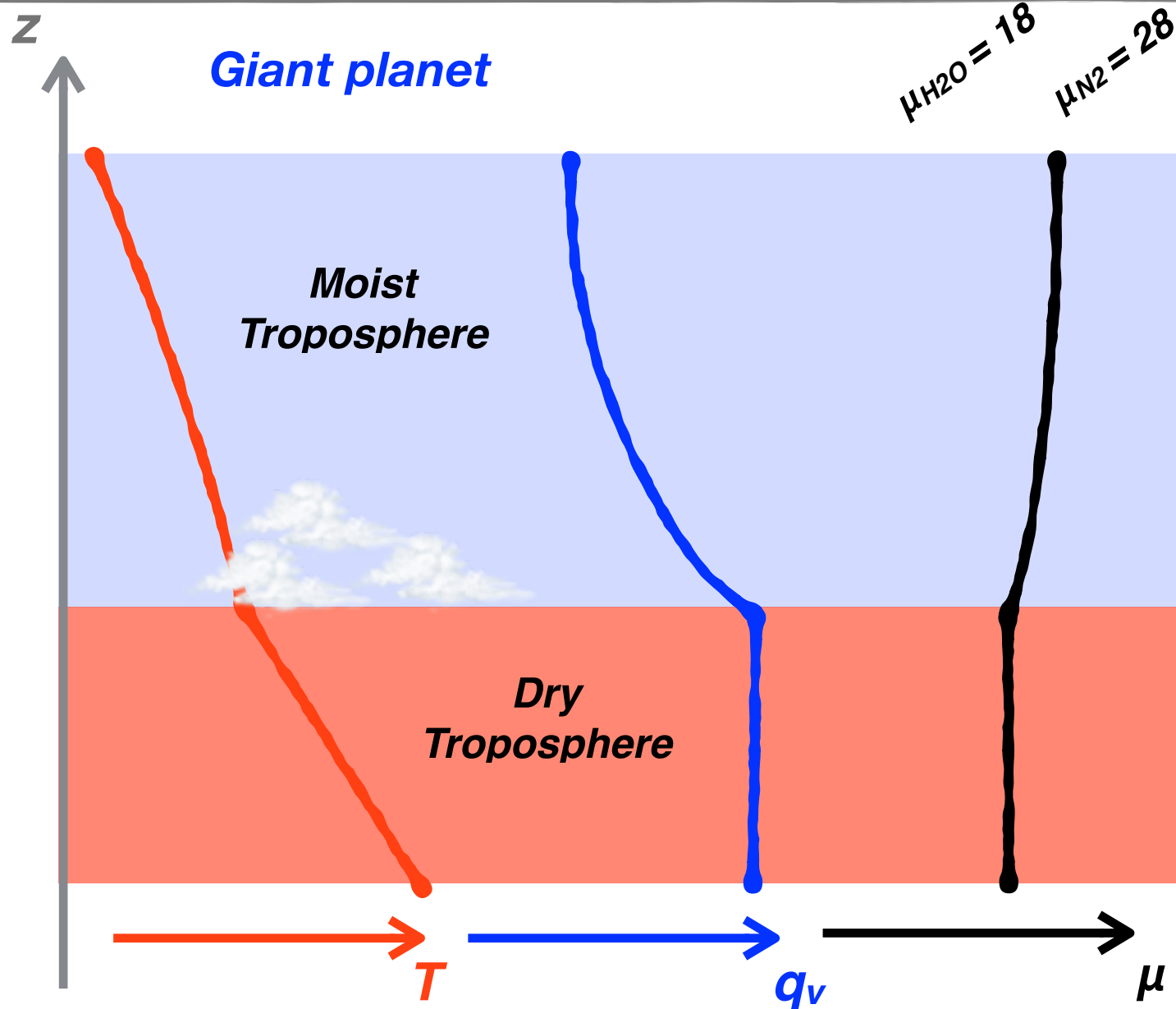
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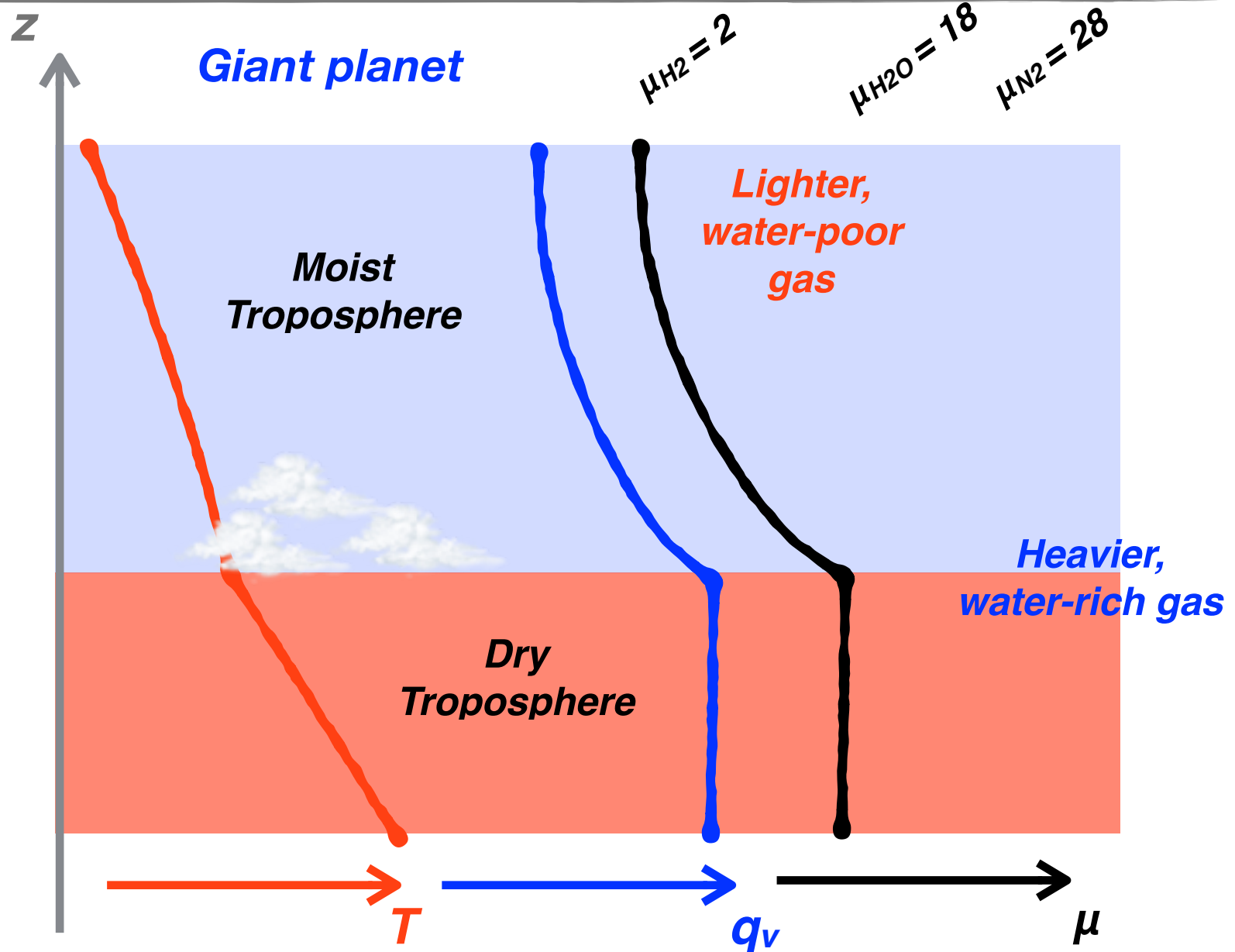
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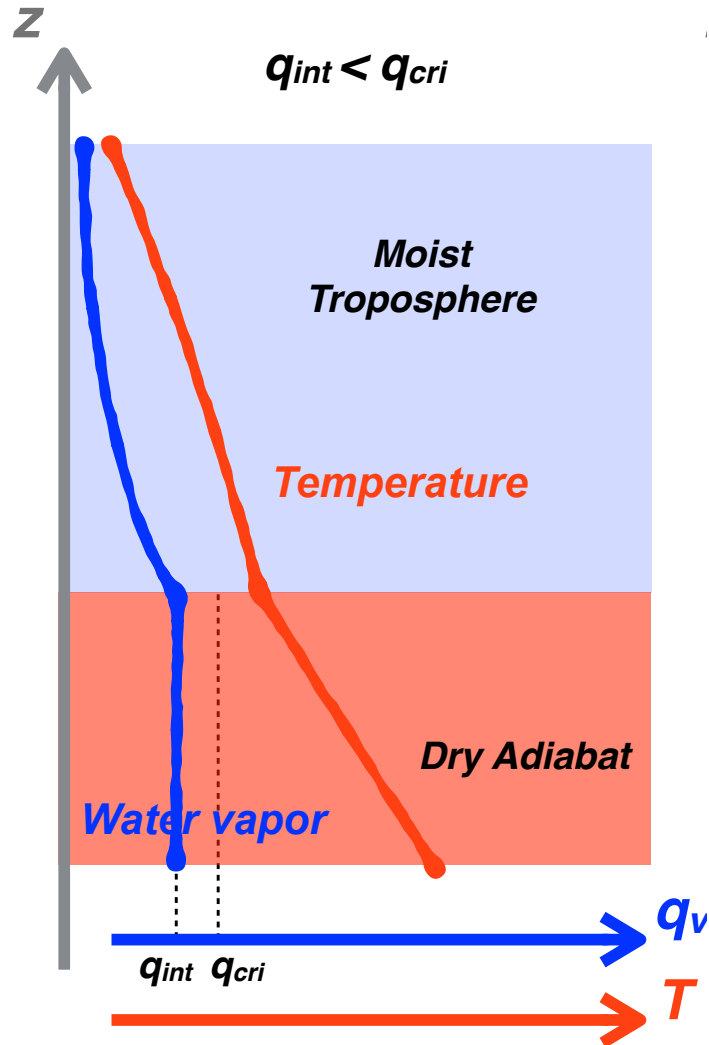
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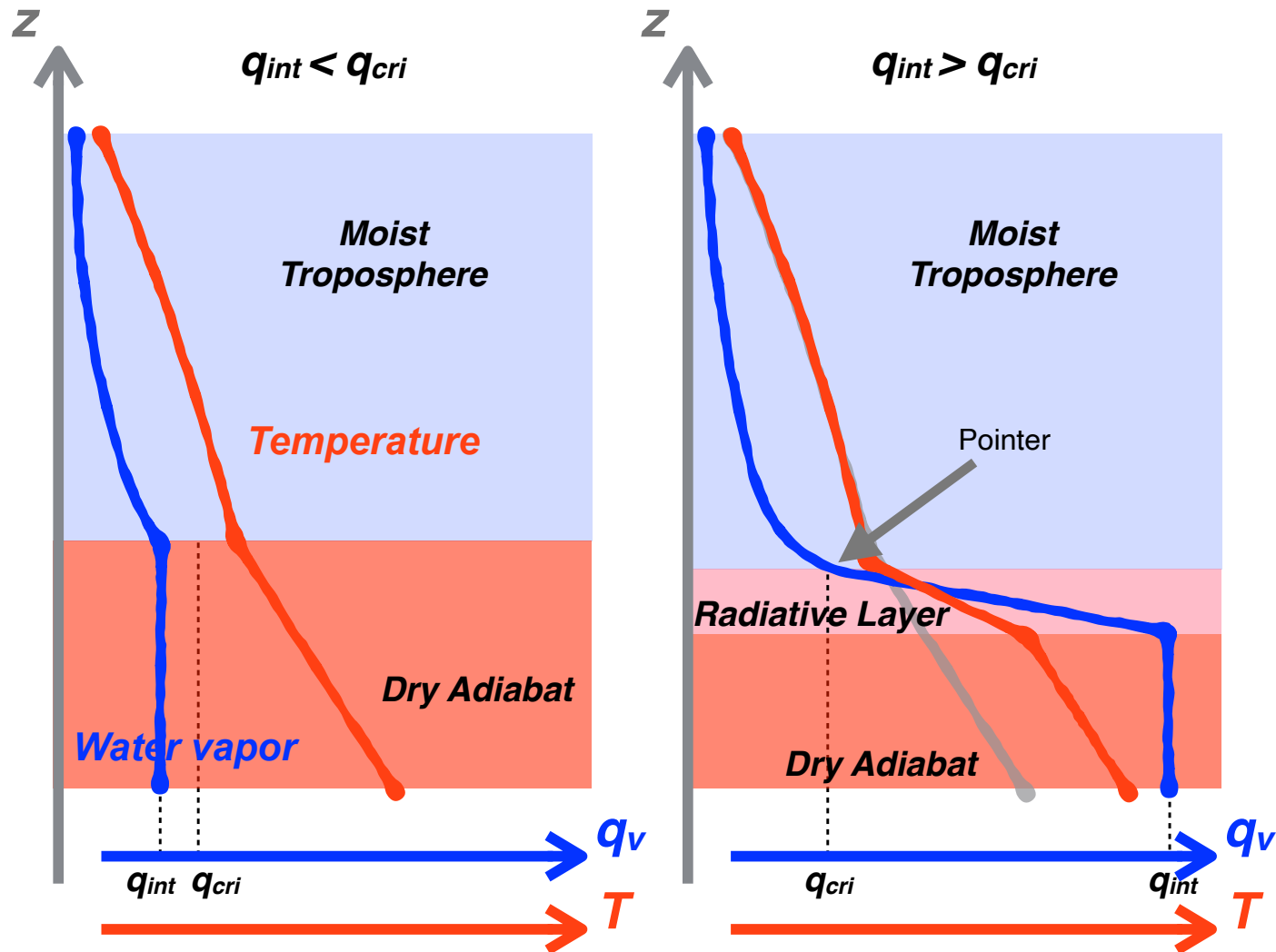
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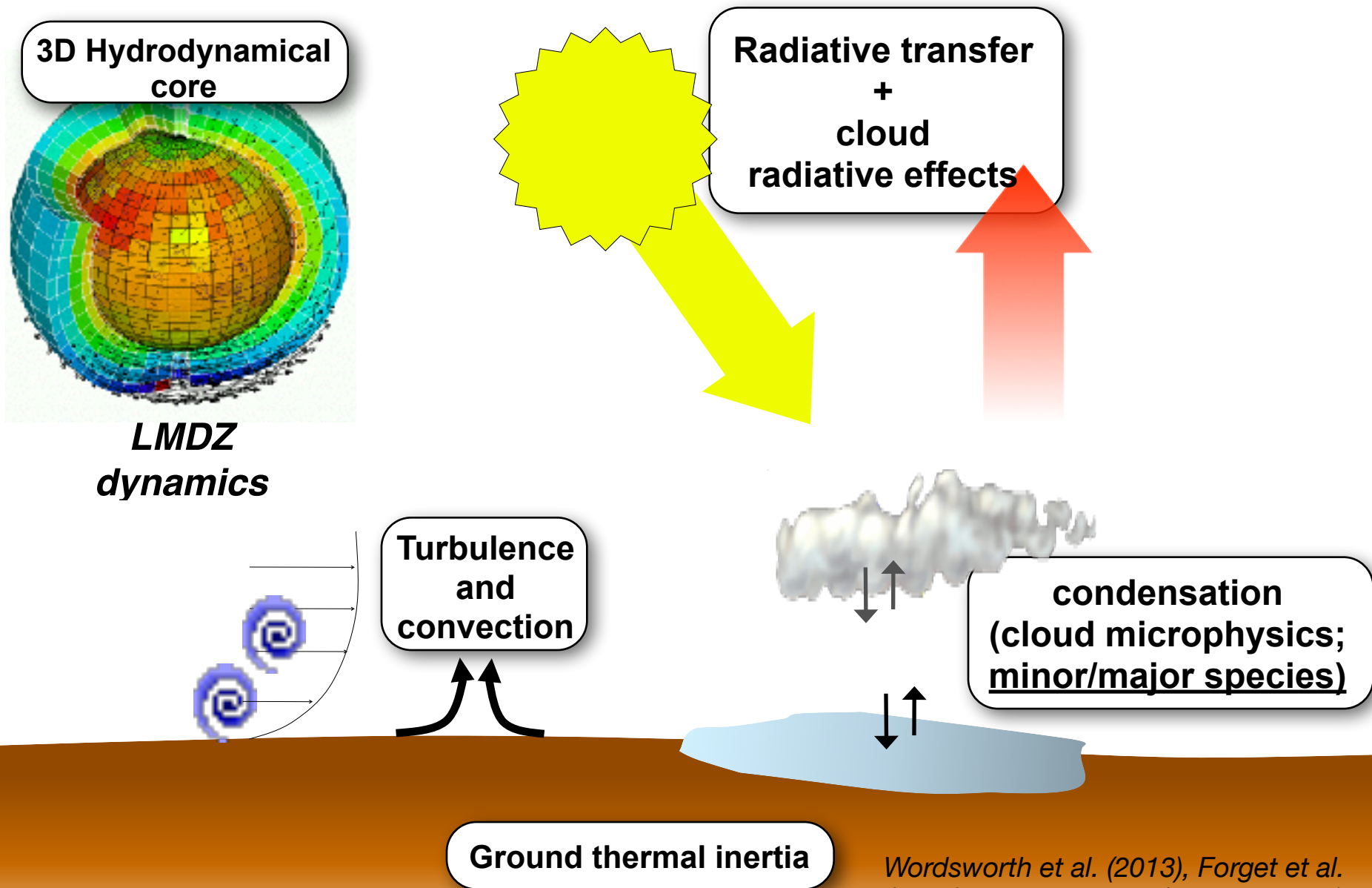
Formation of a *stable layer* above a critical abundance



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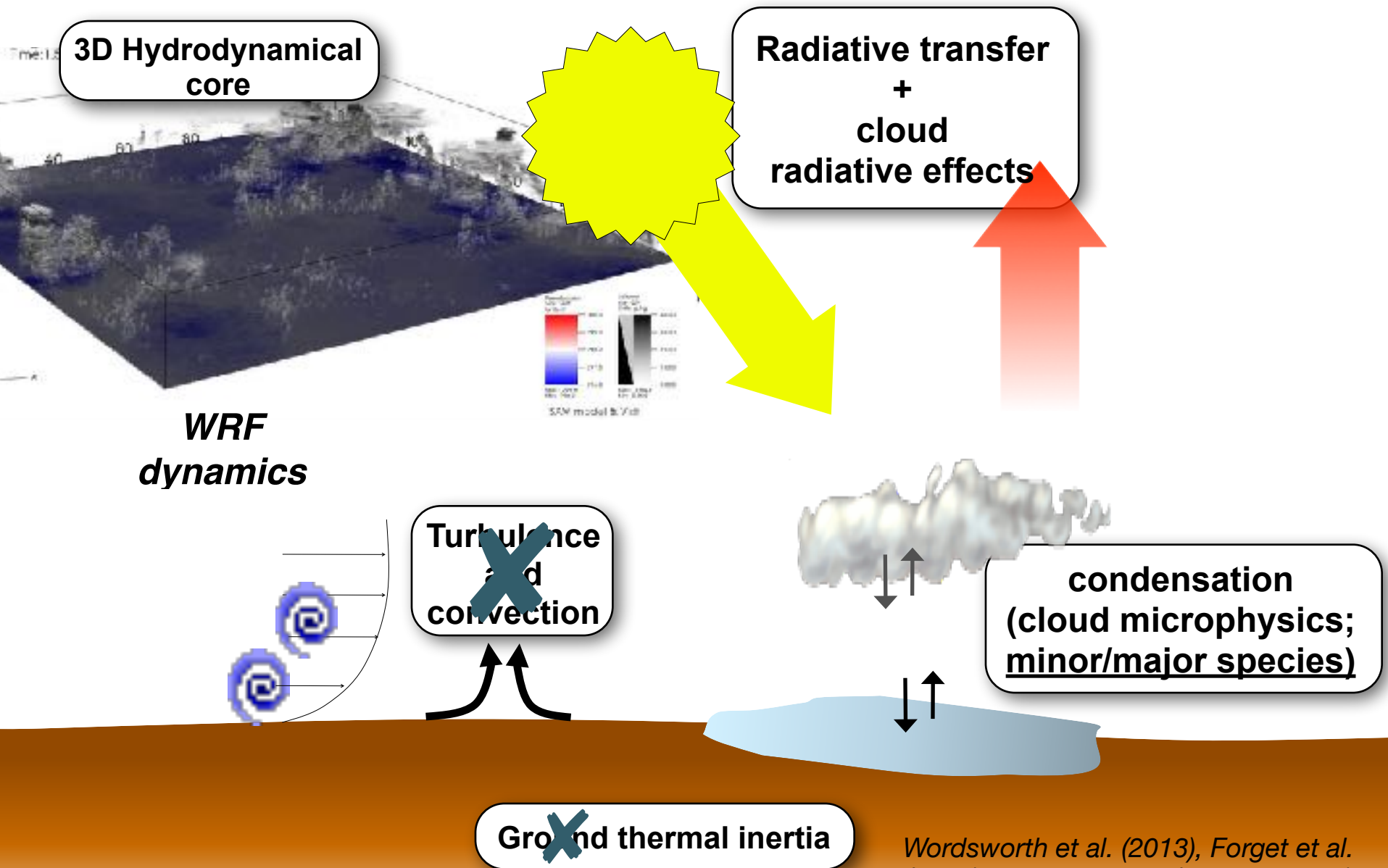


A «generic» convection/cloud resolving model

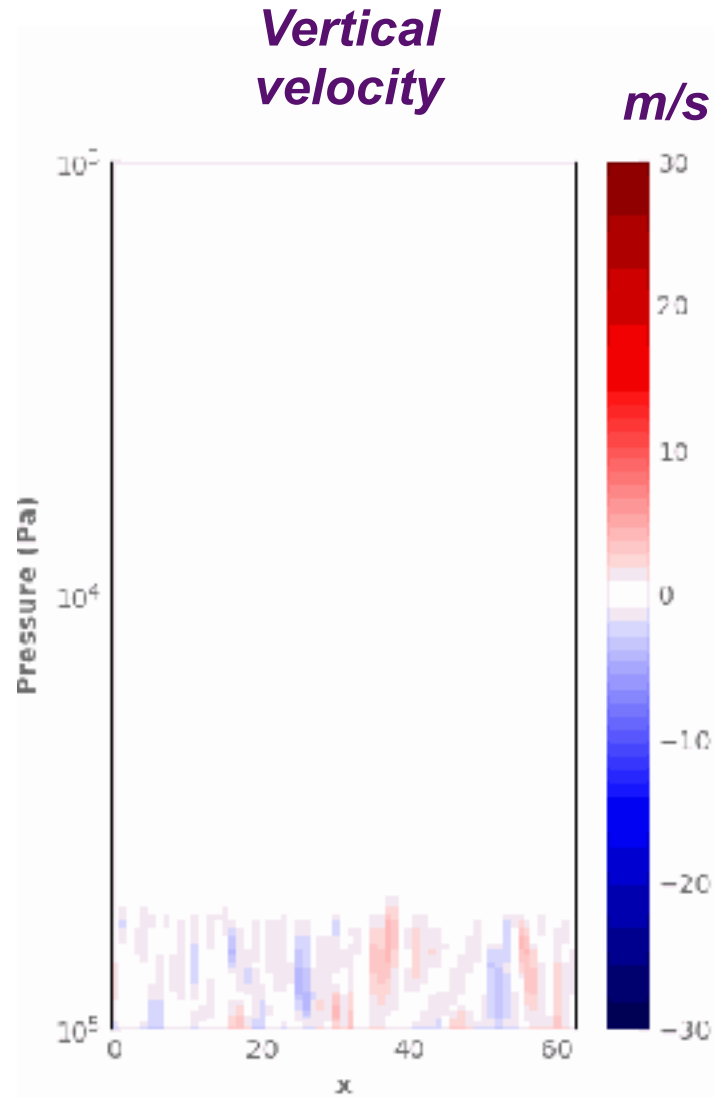


Wordsworth et al. (2013), Forget et al. (2013), Leconte, et al. (2013a; 2013b)

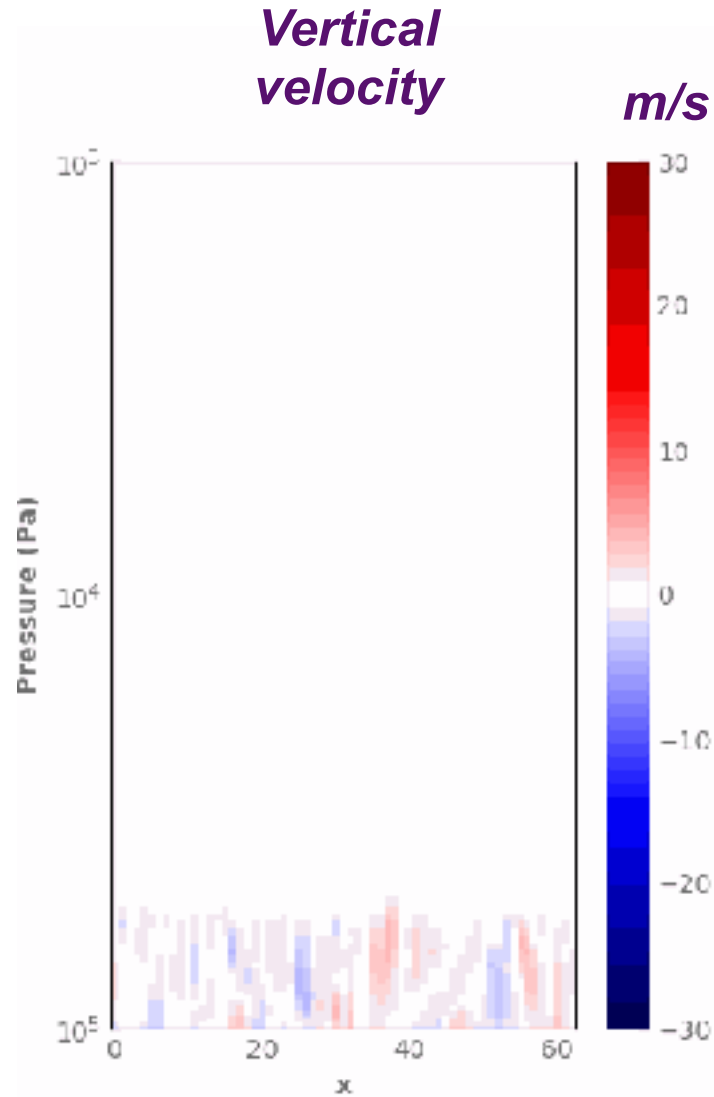
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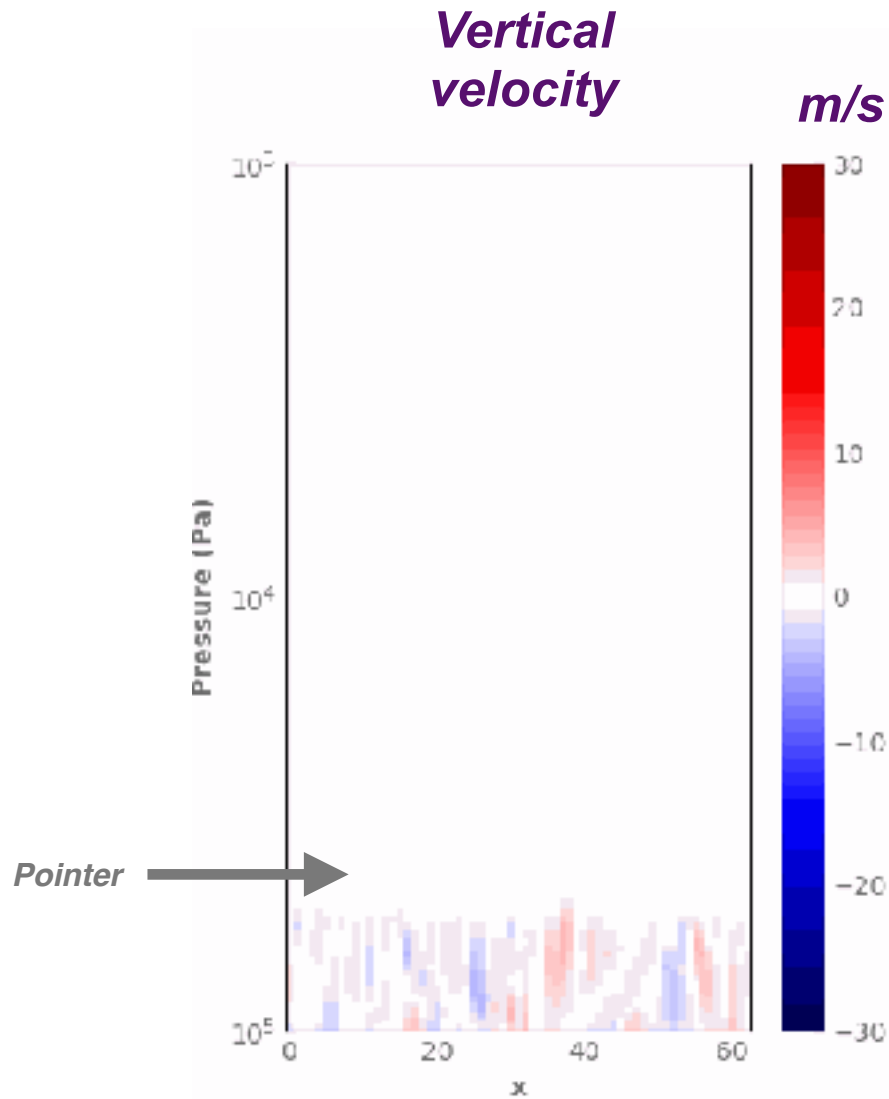
Atmospheric structure with *convection inhibition*



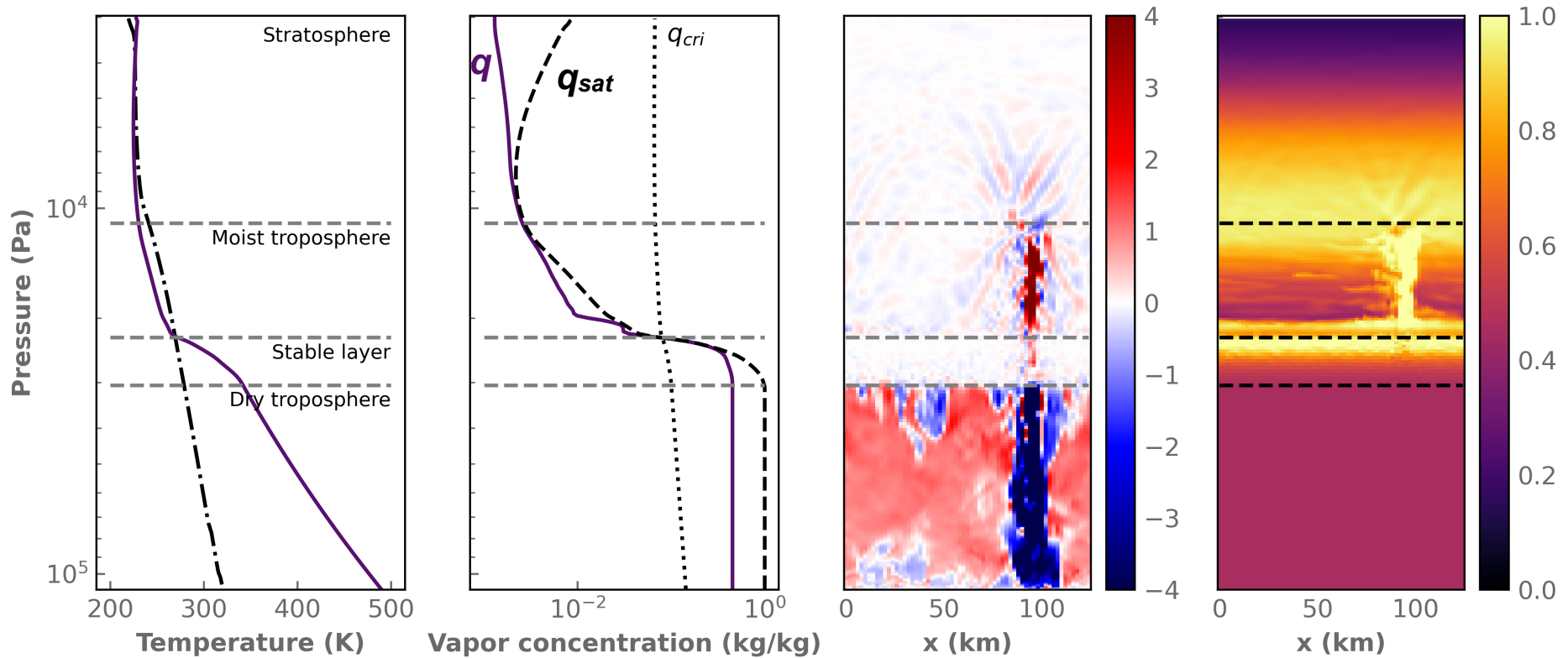
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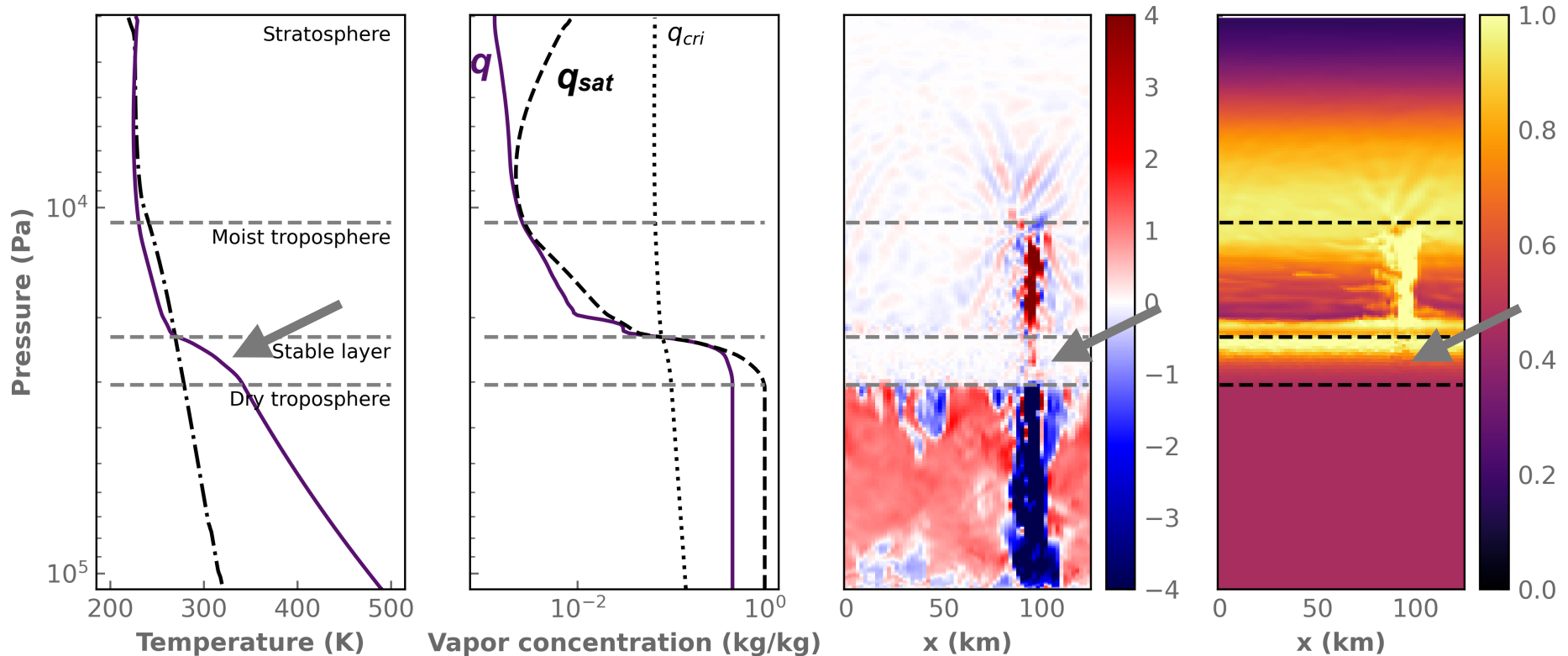
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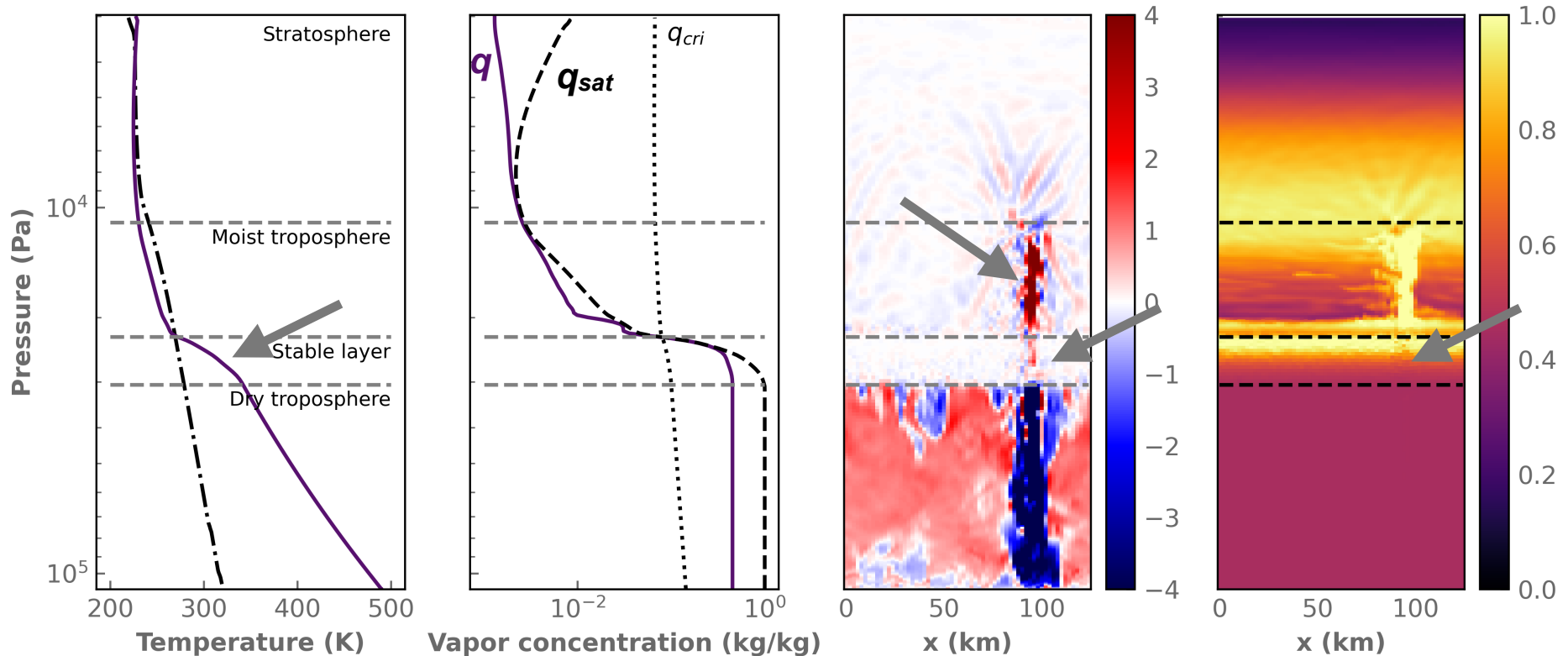


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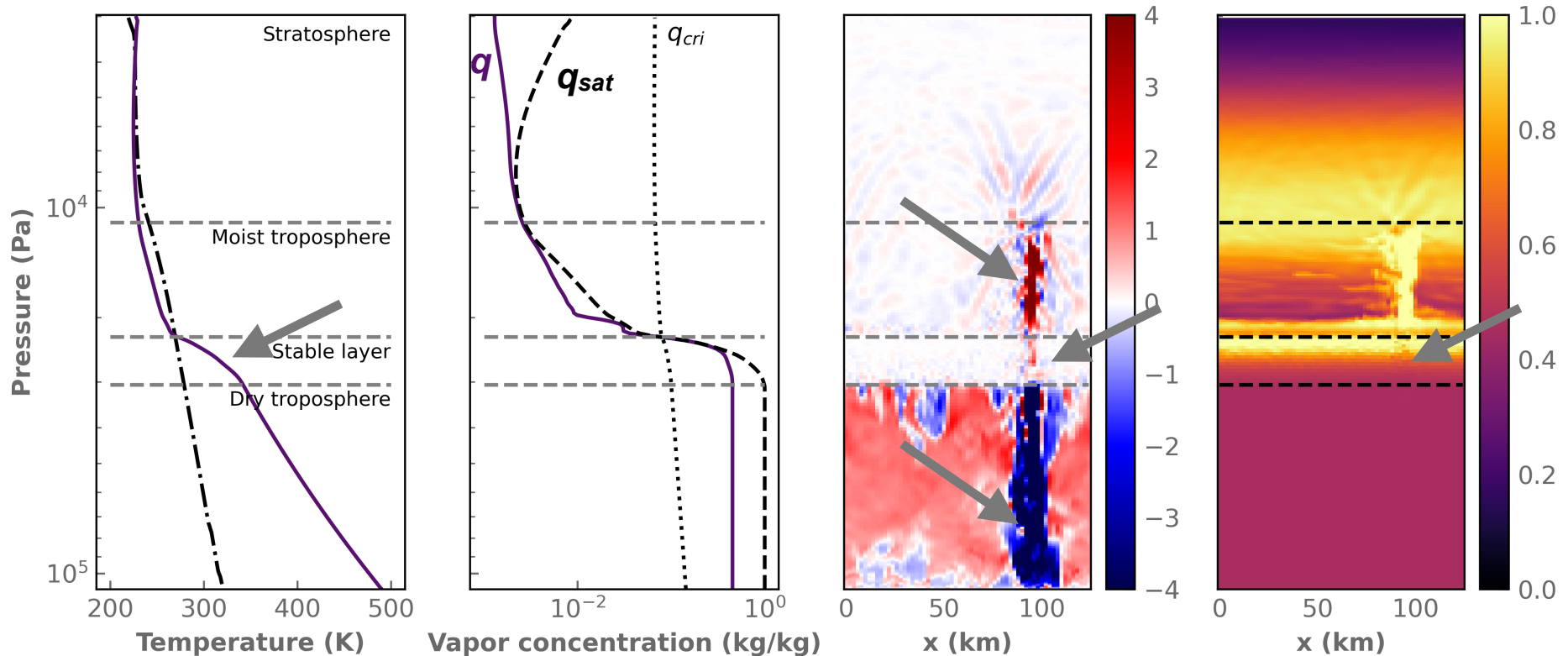
Not saturated in most of the stable layer!

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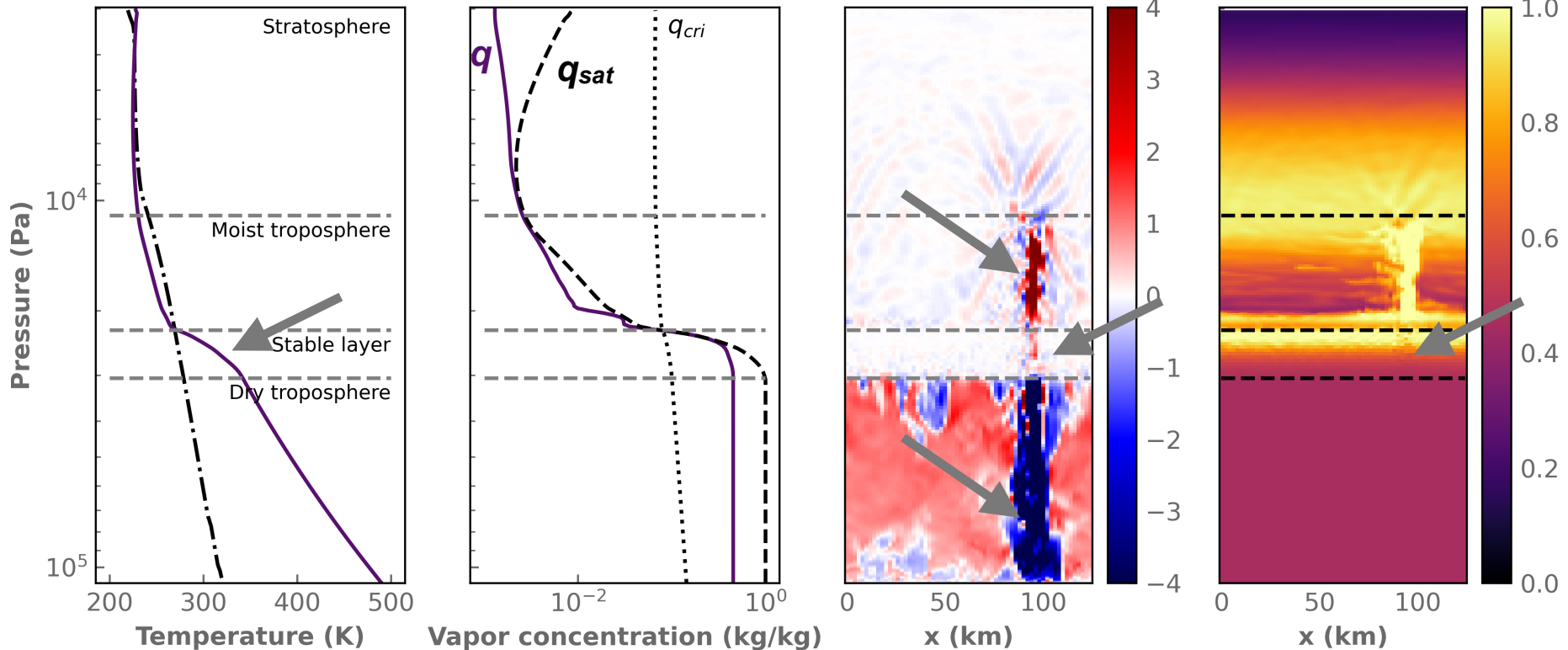
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Atmospheric structure with *convection inhibition*



Not saturated in most of the stable layer!

Atmospheric structure with *convection inhibition*



Not saturated in most of the stable layer!

Can we reproduce that in 1D?

*A fast but accurate 1D model: **Exo_k***

A fast but accurate 1D model: *Exo_k*



1.3.0

Search docs

- Getting *exo_k*
- Basic principles and objects
- Notes on units and formats
- Getting started
- Where to find data to use with *Exo_k*?
- A practical guide to atmospheric modeling with *Exo_k*

Exo_k

About *Exo_k*

Exo_k is a Python 3 based library to handle radiative opacities from various sources for atmospheric applications. It now comes with a full-fledged 1D atmospheric evolution model.

It enables you to:

- Interpolate efficiently and easily in correlated-k and cross section tables.
- Convert easily correlated-k and cross section tables from one format to another (hdf5, LMDZ GCM, Exomol, Nemesis, PetitCode, TauREx, ExoREM, ARCIS, etc.).
- Adapt precomputed correlated-k tables to your needs by changing:
 - the spectral and quadrature (g) grids,
 - the pressure/temperature grid.
- Create tables for a mix of gases using tables for individual gases.
- Create your own tables from high-resolution spectra (for example from K-spectrum, Helios-K, etc.).
- Use your data in an integrated radiative transfer framework to simulate planetary atmospheres.
- Compute the physical state of planetary atmospheres in radiative-convective equilibrium.

A fast but accurate 1D model: *Exo_k*



atmospheric

S, LMDZ

Helios-K,

ospheres.
ium.

Search docs

- Getting exo
- Basic princi
- Notes on u
- Getting star
- Where to f
- A practical modeling w

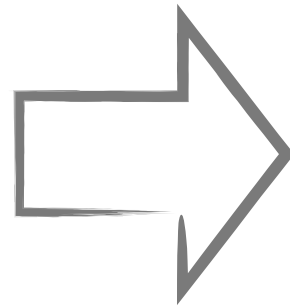
A fast but accurate 1D model: [Exo_k](#)



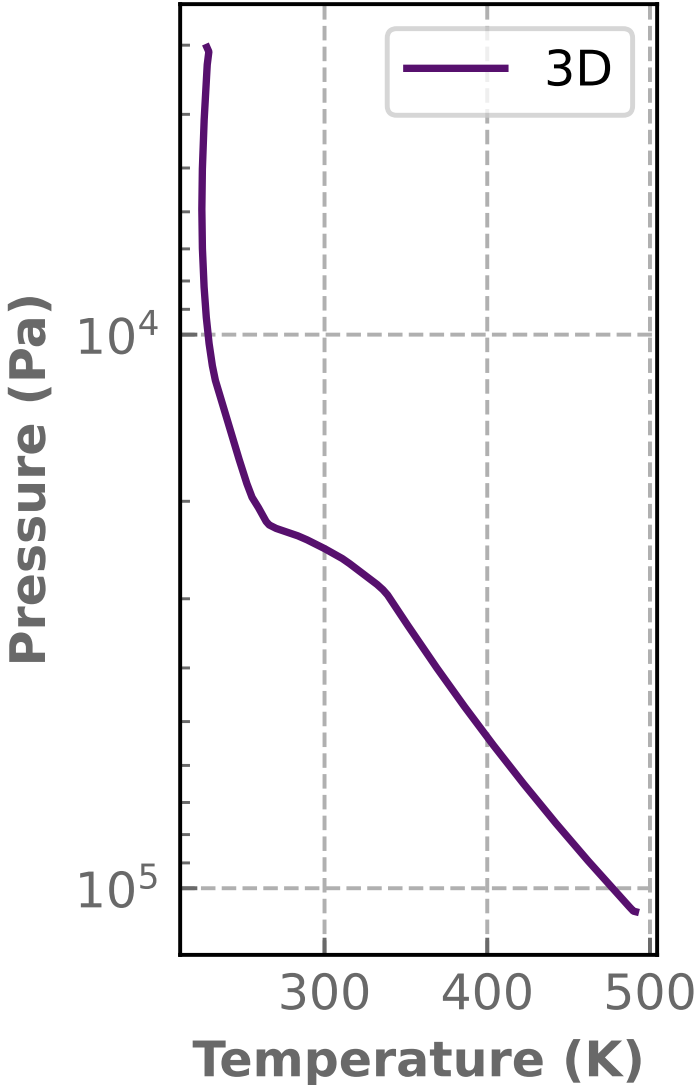
A fast but accurate 1D model: [Exo_k](#)



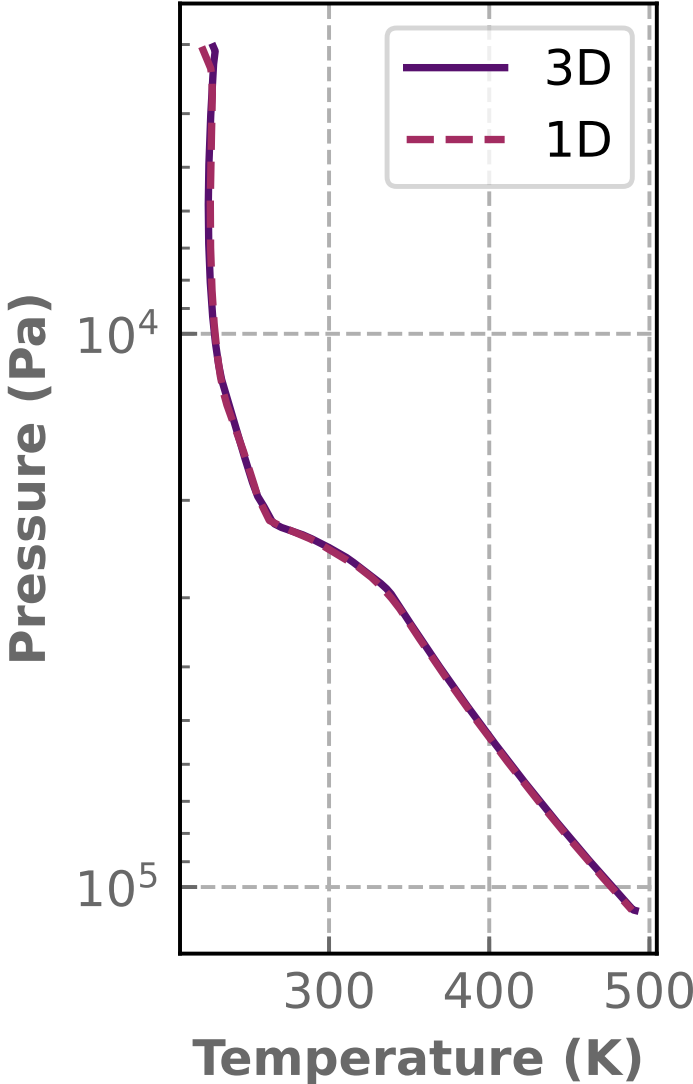
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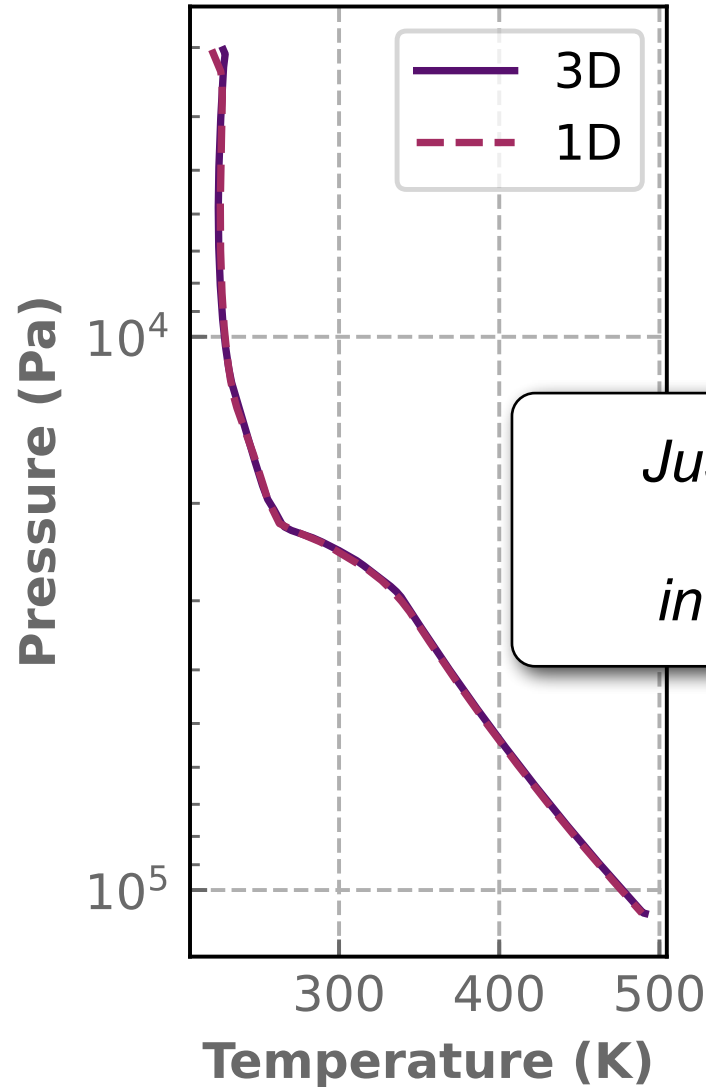
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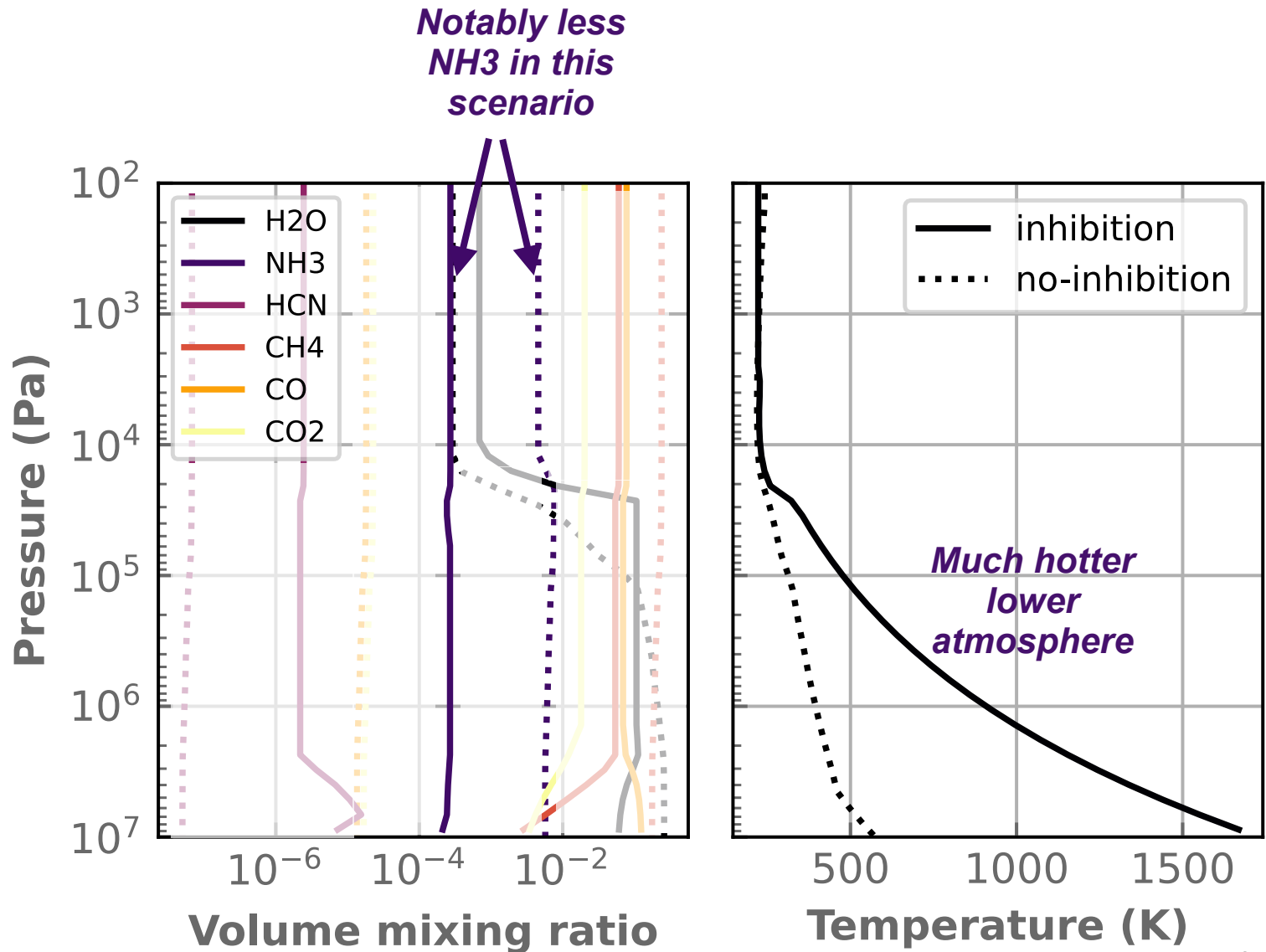
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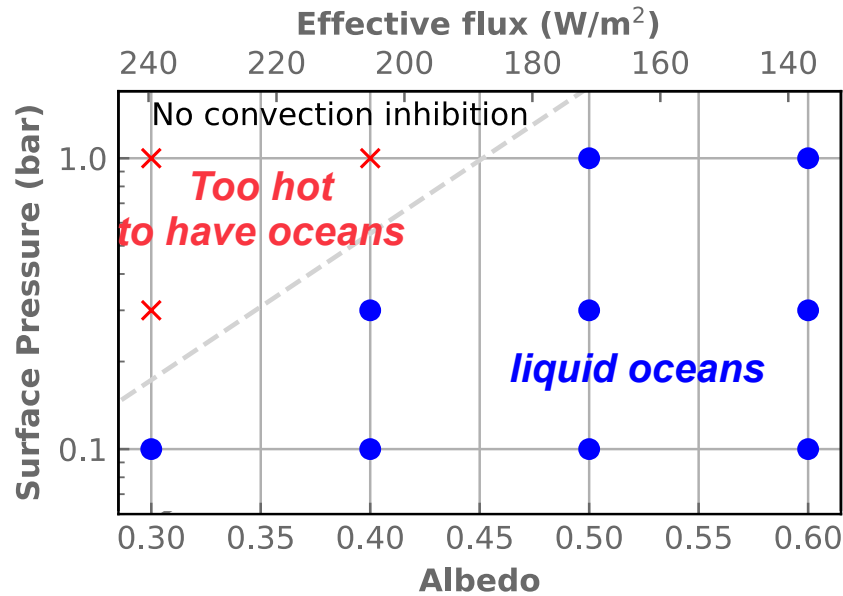
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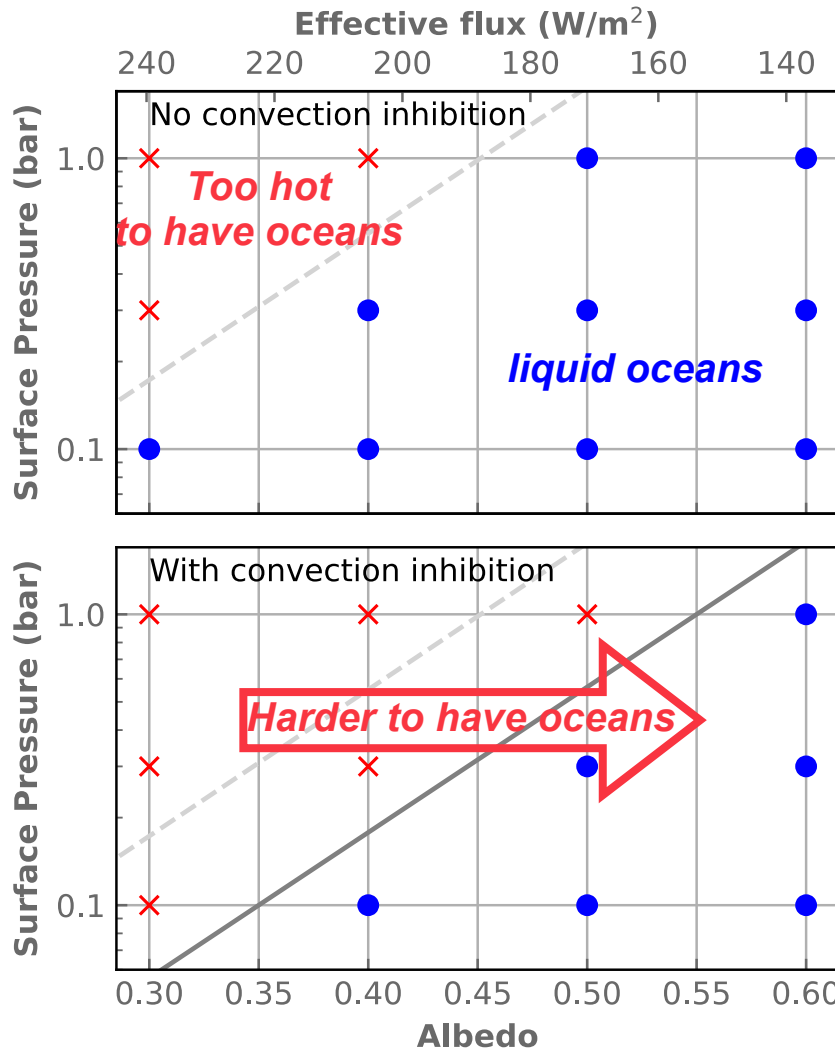
Solving the *Ammonia* crisis?



Implications for K2-18b: hard to have an ocean



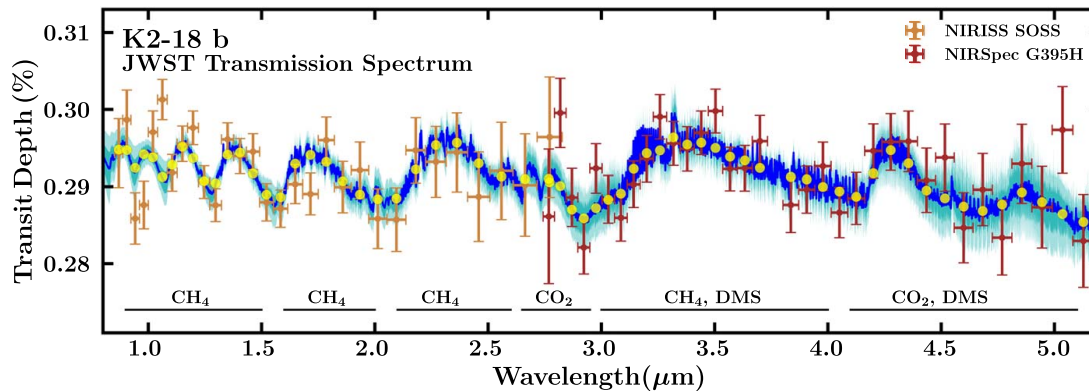
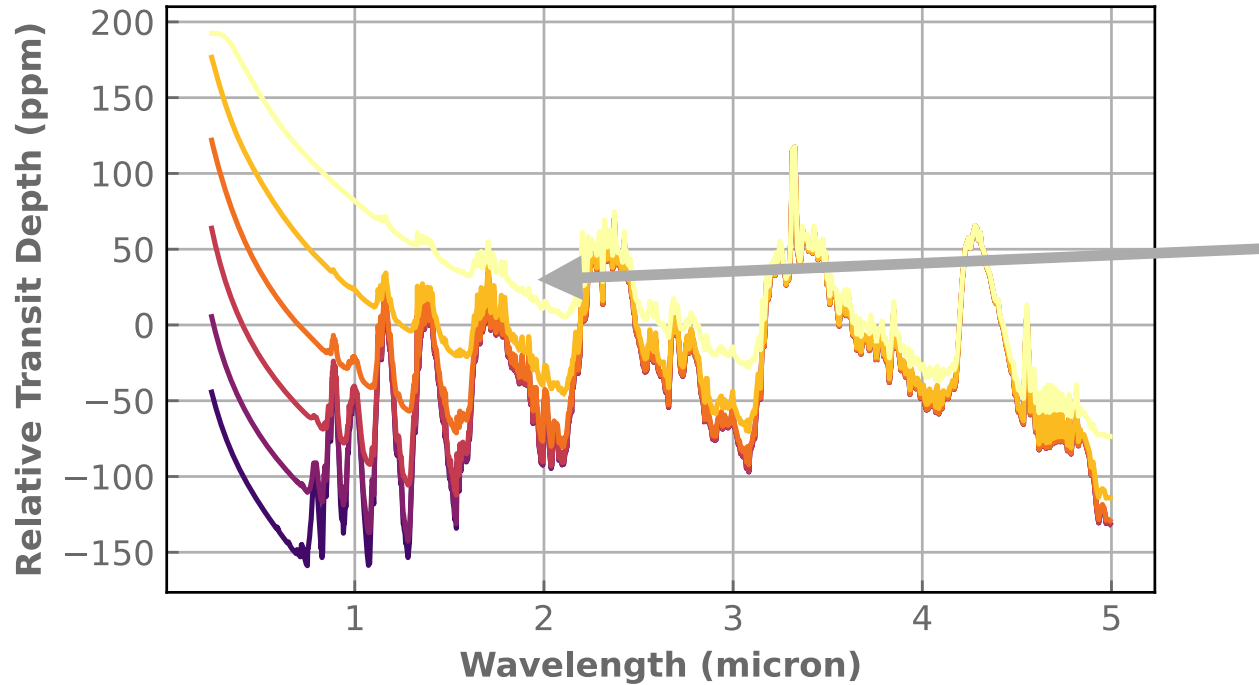
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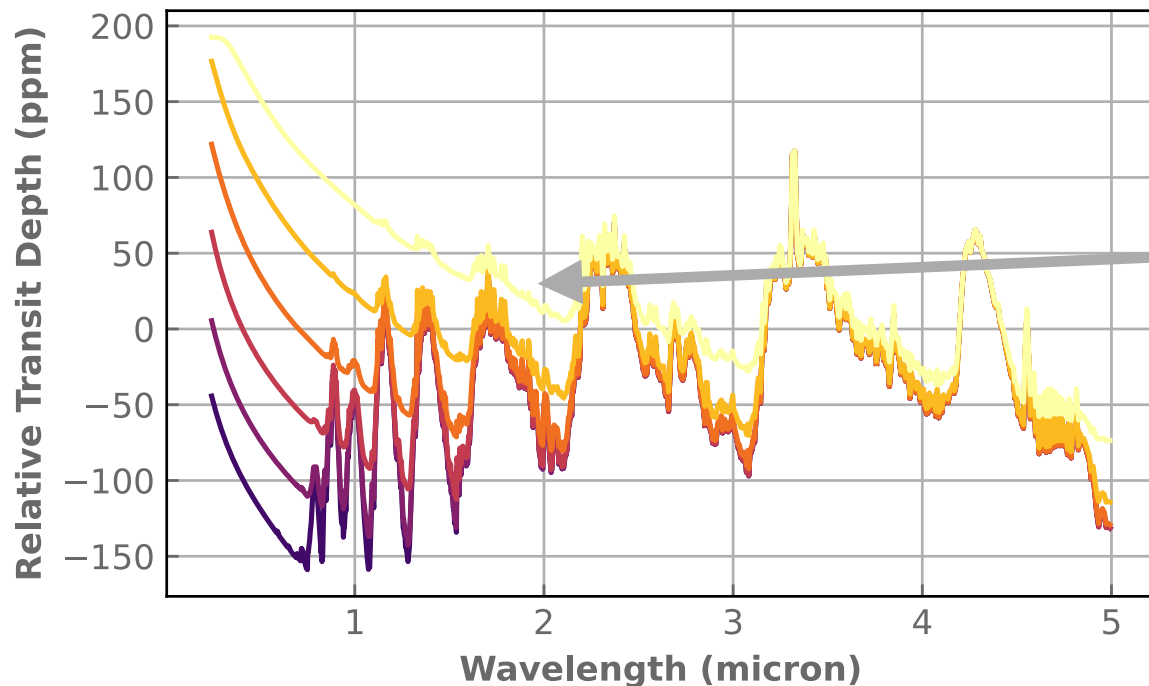
- **With Convection inhibition:**
➔ **hotter lower atmosphere**
➔ **Harder to keep an ocean**

- **Is it realistic to have such a high albedo?**

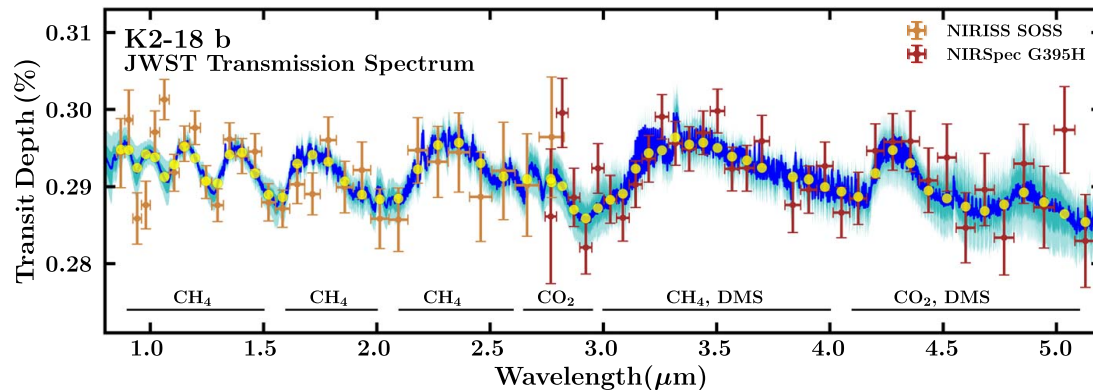
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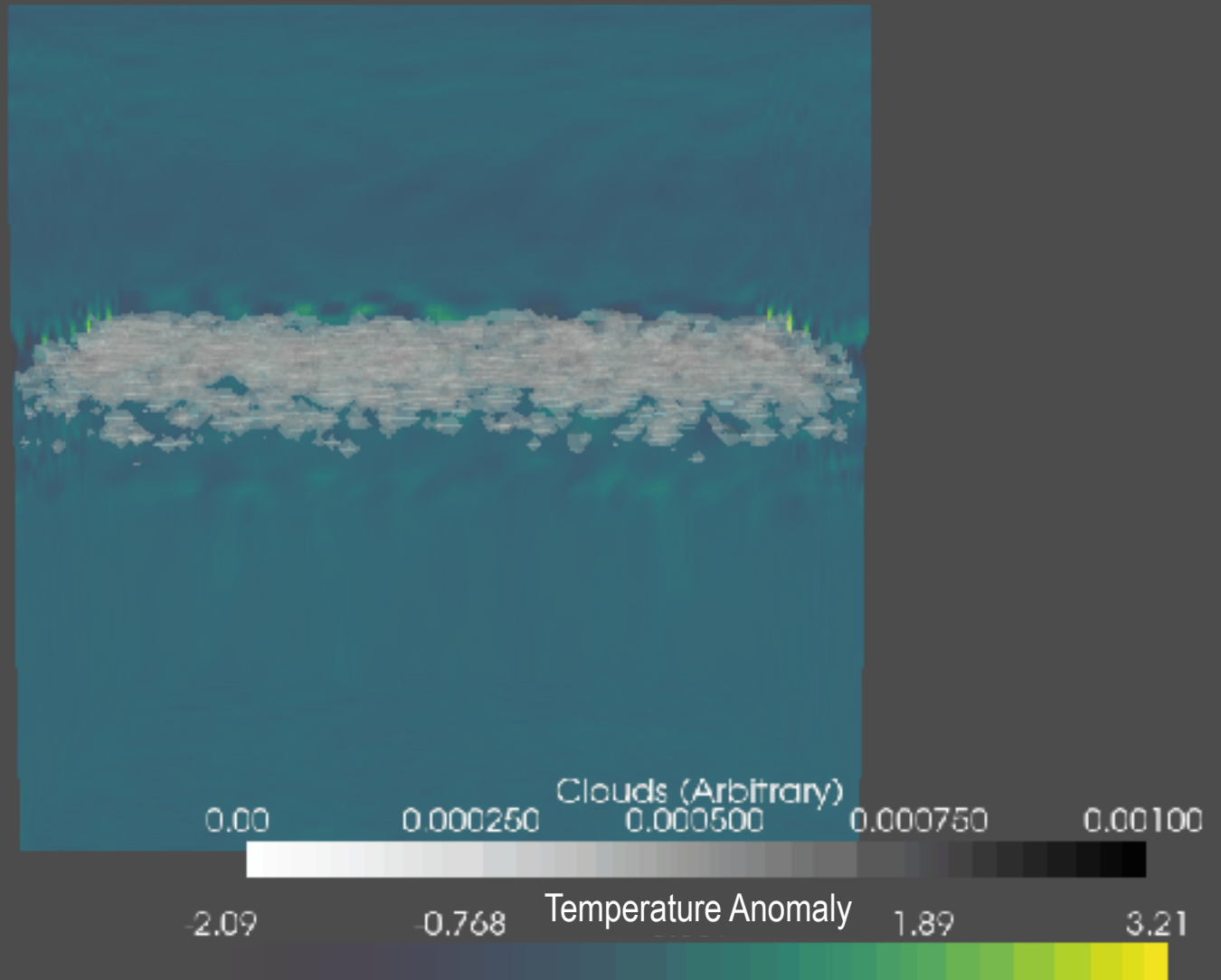
**Aerosol-driven High-Albedos
lead to flat spectra...**



**Difficult to reconcile with the
observed spectra...**

**... But wait for Yassin's
presentation!**

Thank you



Thank you

