

# Impact of self-shadowing on the Jovian Circumplanetary disk ice composition

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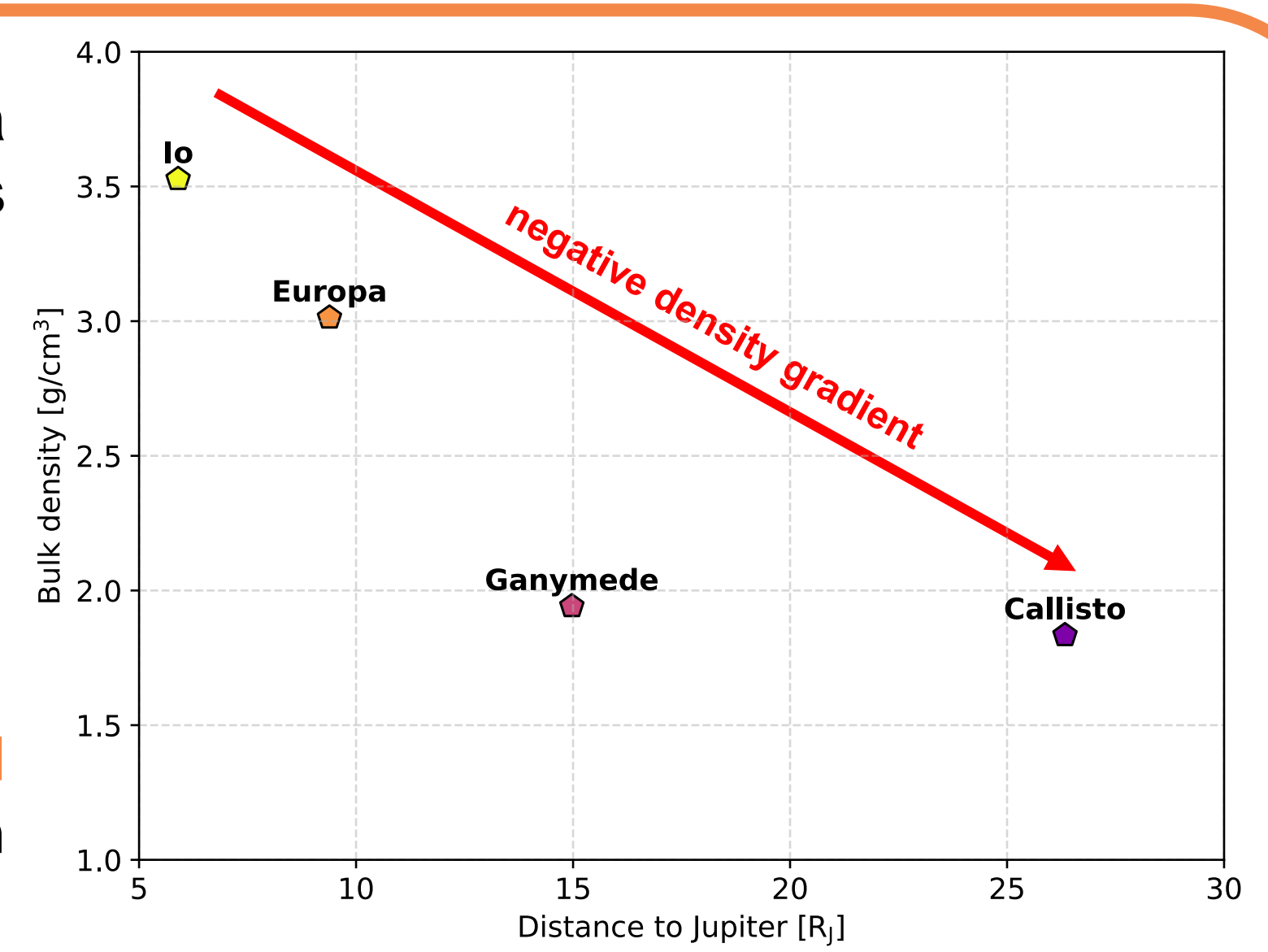
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## In a nutshell

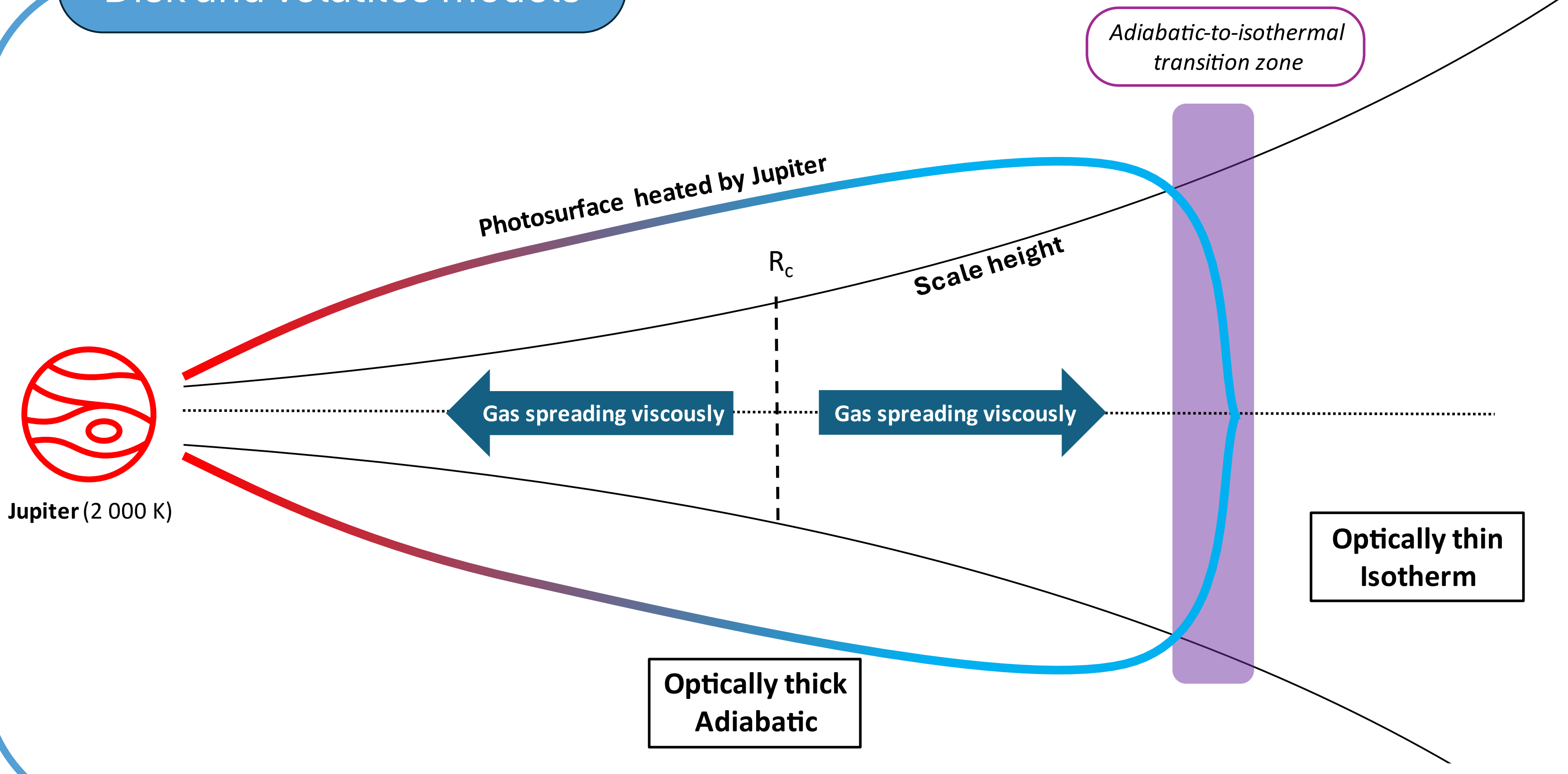
The combined effects of Jupiter's radiative heating and self-shadowing within its CPD lead to the formation of volatile **ice cold traps**, even in regions that are **otherwise hot**. These conditions enable the condensation of **CO<sub>2</sub>** and **NH<sub>3</sub>** ices at Europa's present-day orbital location.

## Moons formation bound to CPD evolution

- The Galilean satellites are believed to have formed within a circumplanetary disk (CPD) that surrounded Jupiter after its formation.
- We poorly understand:
  - Jovian CPD structure and composition
  - Origin of the Galilean moons
  - Origin of the Galilean system density gradient
- The exploration of the system by **JUNO**, **Europa-Clipper** and **JUICE** will provide constrains on the moons bulk composition and origins.



## Disk and volatiles models



## Self-Shadowing

- Shadow cast by the opaque photosurface on the disk
- Shadow located at the adiabatic-to-isothermal transition zone

## Time dependant accretion properties

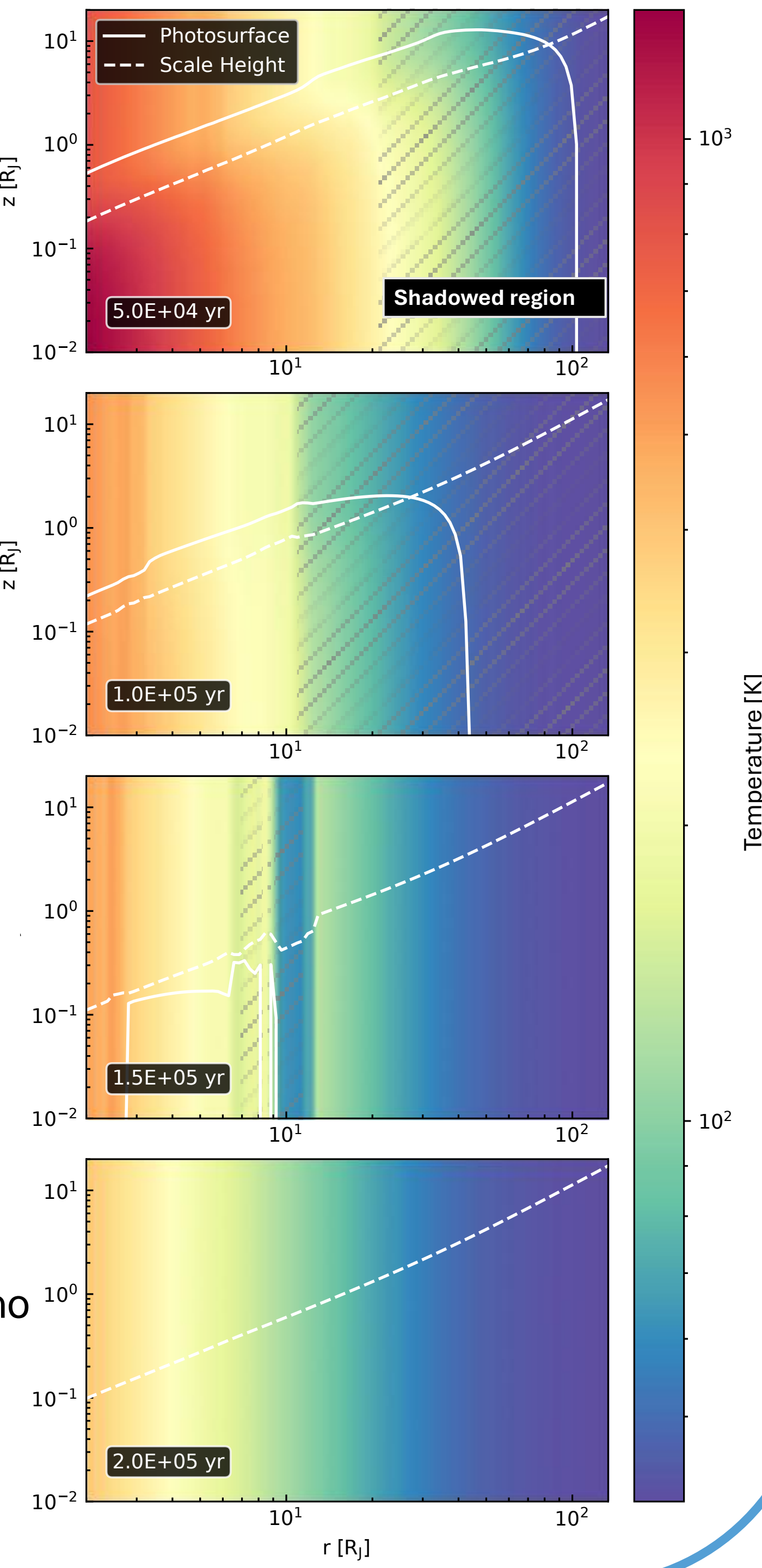
- Time dependant CPD accretion rate and Jupiter's luminosity fitted from a planet formation model [3], which considers the formation of a gap around the planet

## Midplane volatiles ices evolution model

- Grains growth and transport
- Ices vaporisation/condensation
- Grains and Vapor transport

## Shadows produce regions up to 100 K colder

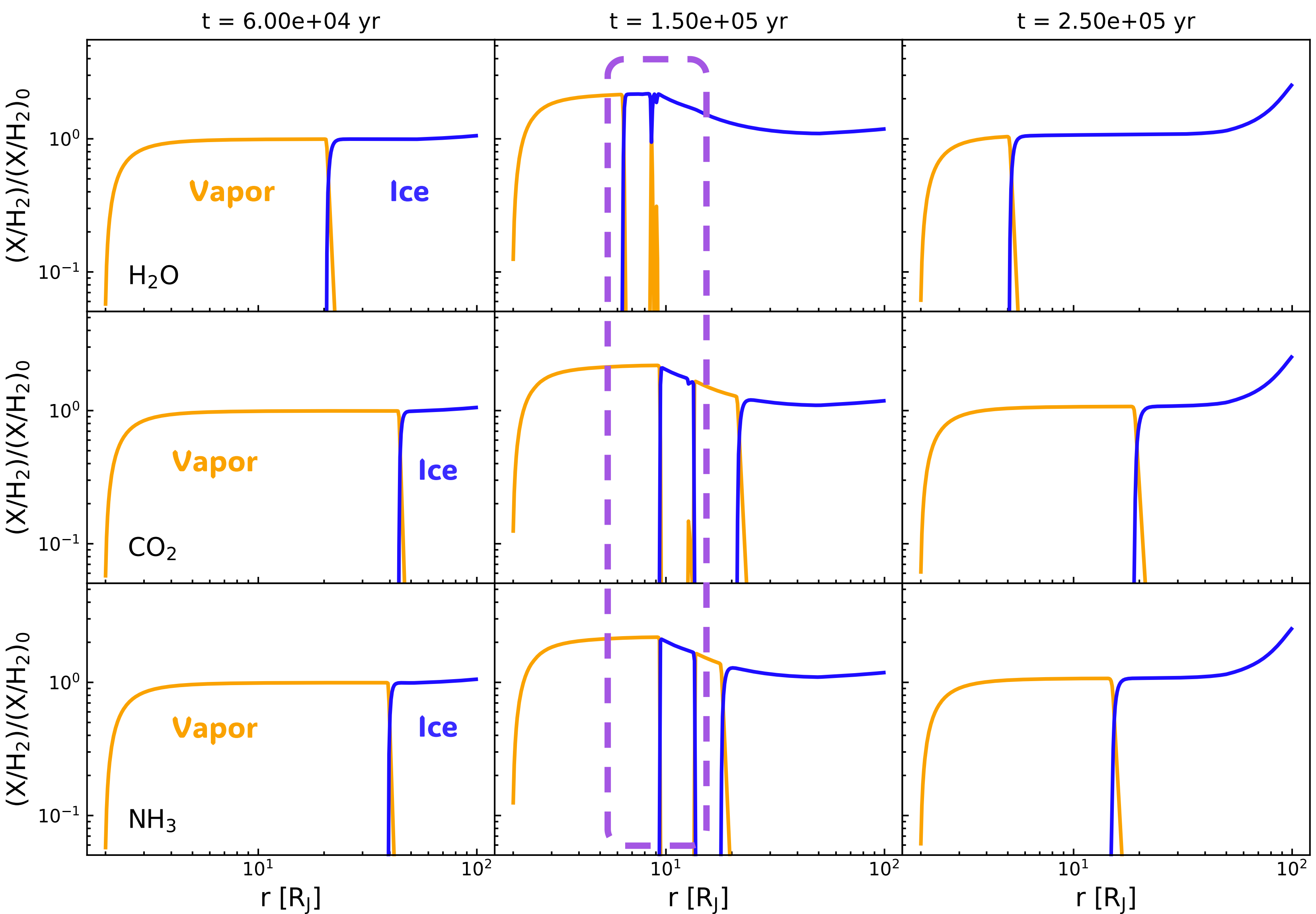
Shadowing don't impact the thermal structure



Narrow Shadow between 9 and 12 R<sub>J</sub> forming a region 100 K colder

Transparent CPD with no shadows

## Cold trap formation between 120 and 180 kyr



Volatiles ices forming with enrichments of 2-3 times the initial abundances

## References

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## Cold traps could impact the Galilean moons formation

### Cold trap enable formation of volatile ices close to Jupiter...

- Formation of CO<sub>2</sub> and NH<sub>3</sub> ices at Europa present day location
- Could Europa building blocks been volatile rich ?
- ... but it exists on a short timescales (less than 10 kyr)...
- Might not be long enough to impact the moons' bulk composition
- ... and at times when the CPD is very light
- CPD mass is down to 10<sup>-5</sup> M<sub>J</sub> when cold traps are significant
- Potentially not enough solids to form the Galilean moons ( ~10<sup>-4</sup> M<sub>J</sub>)