

VENUS
as an
EXOPLANET

michael l. wong | @miquai | #ExoPAG23

Image: JAXA/ISAS/DARTS/Damia Bouic



VICTORIA S. MEADOWS



GIADA ARNEY



PAUL K. BYRNE

and many others!





GOAL

IDENTIFY SIGNS OF
HABITABILITY AND
SIGNS OF **LIFE**



CHALLENGE

CHARACTERIZE AND DISTINGUISH
“EARTH-LIKE-NESS” FROM OTHER
PLANETARY POSSIBILITIES

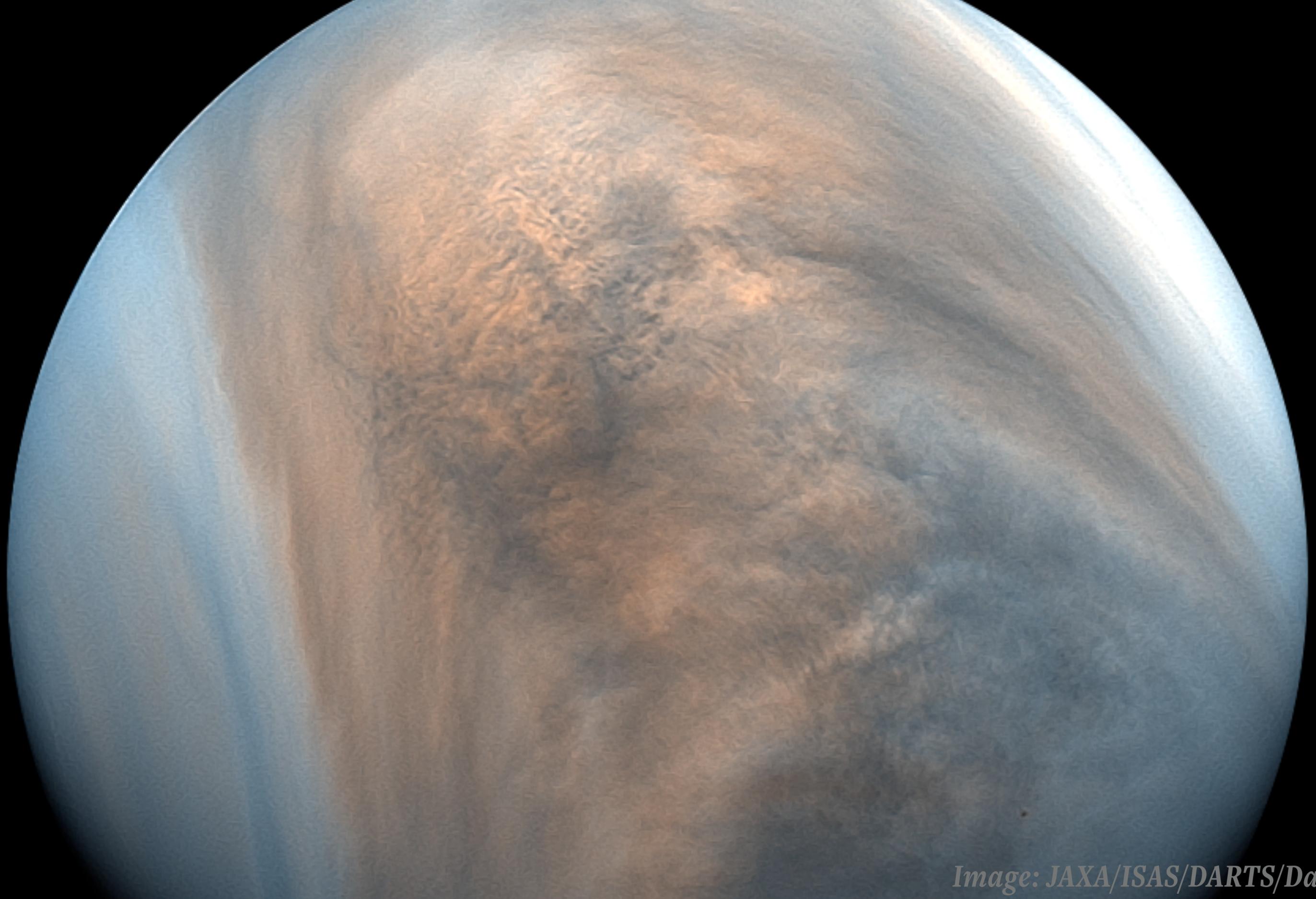
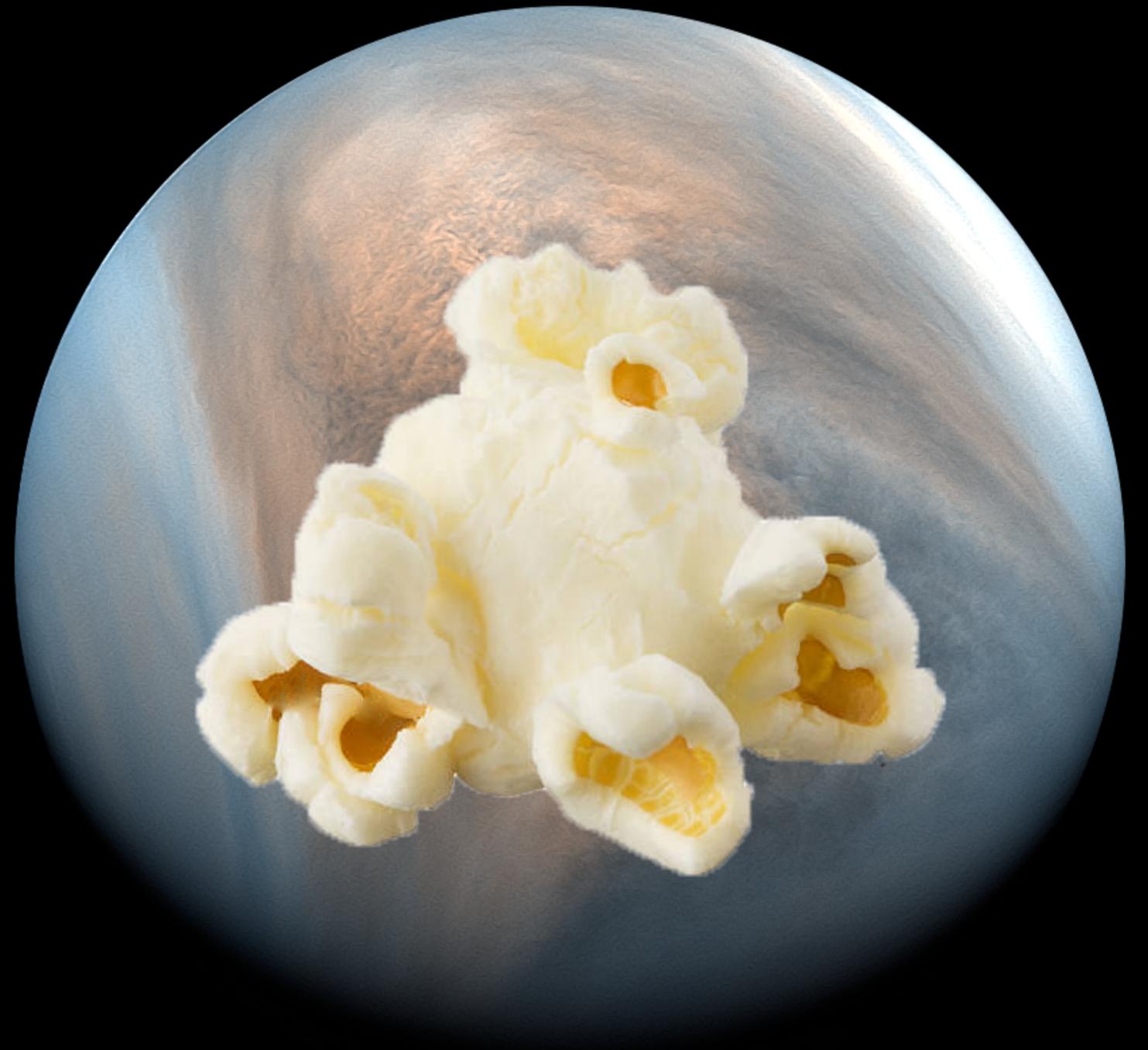
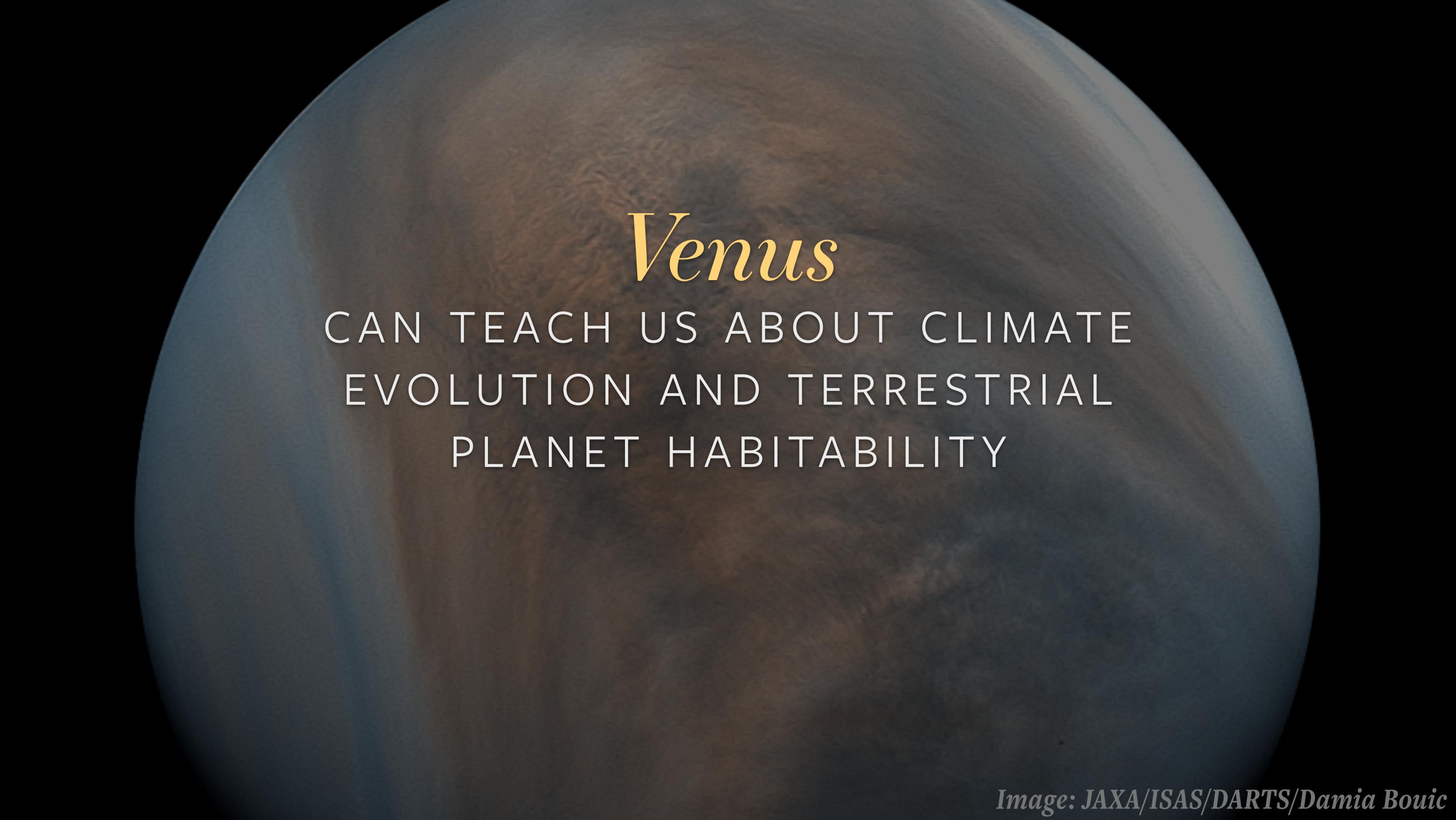


Image: JAXA/ISAS/DARTS/Damia Bouic

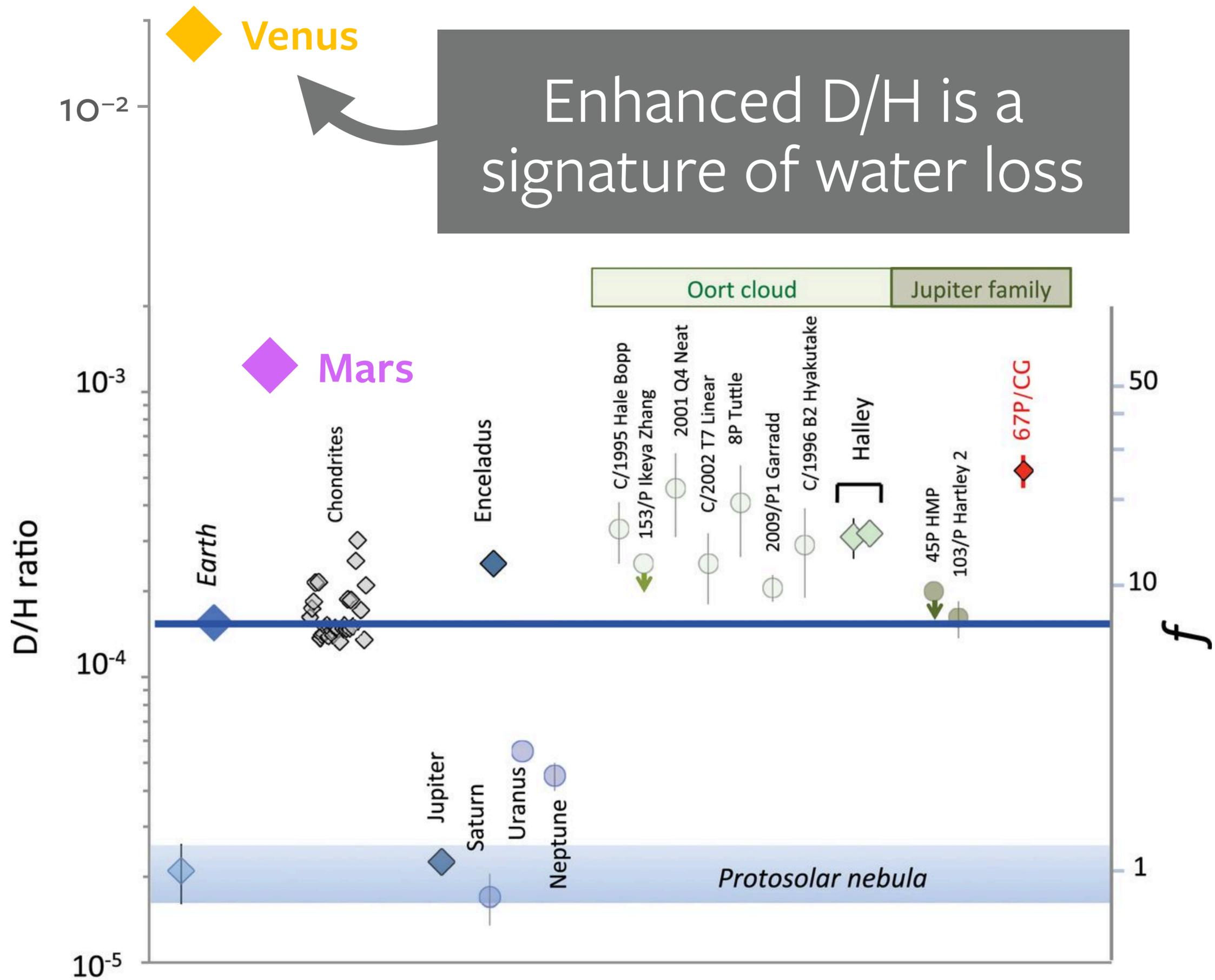




Venus

CAN TEACH US ABOUT CLIMATE
EVOLUTION AND TERRESTRIAL
PLANET HABITABILITY

Image: JAXA/ISAS/DARTS/Damia Bouic



Climate history of Venus

HOT START

- + Water loss occurs during the magma ocean stage (first ~10–100 Myr)
- + Magma ocean provides an efficient oxygen sink
- + Liquid water never stable on planet's surface

COLD START

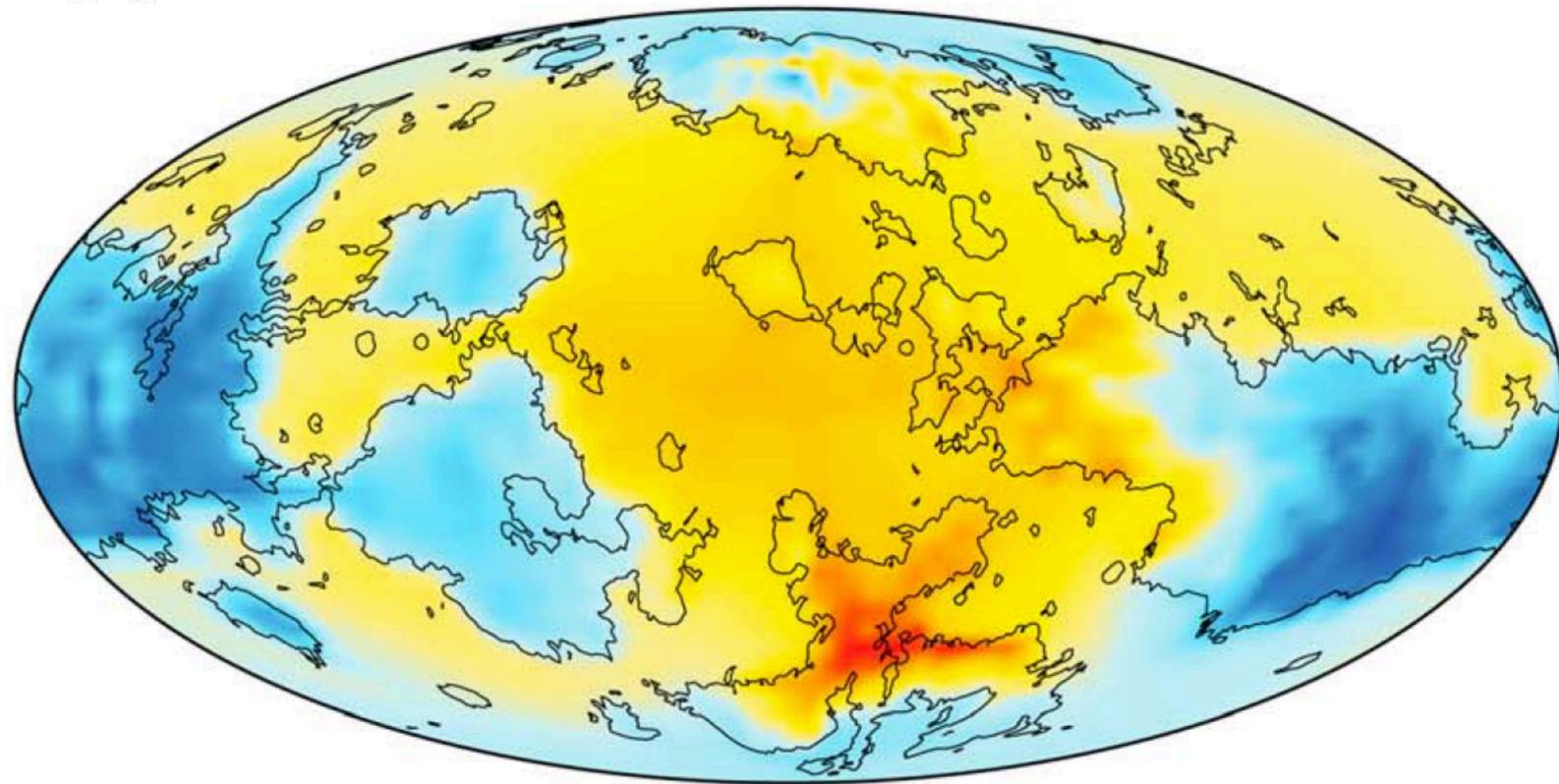
- + Experienced a runaway greenhouse transition sometime during planet's history due to...

(a) Growing luminosity of the Sun

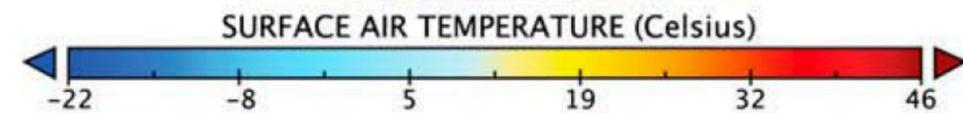
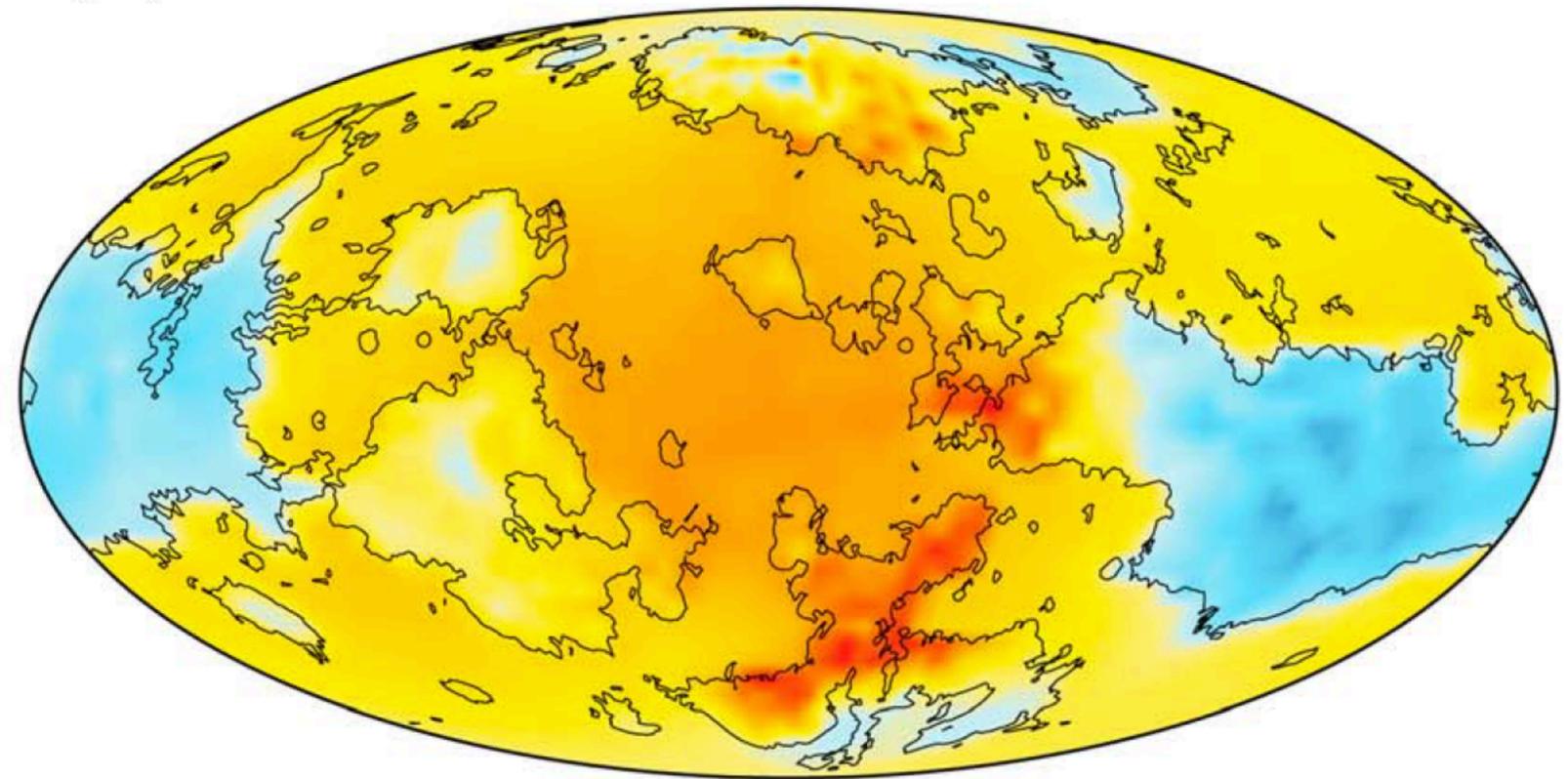
(b) Eruption of large igneous provinces

Ancient Venus: a habitable world?

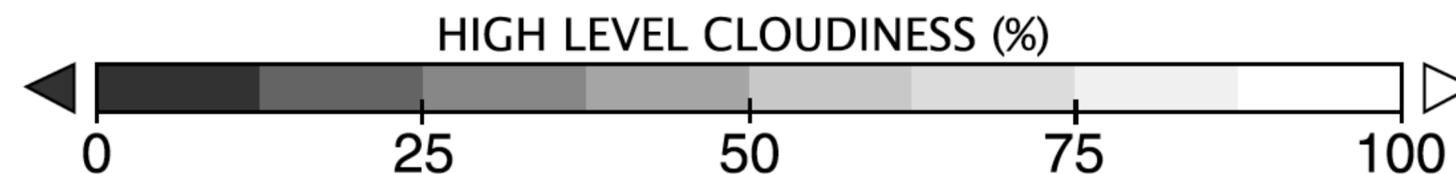
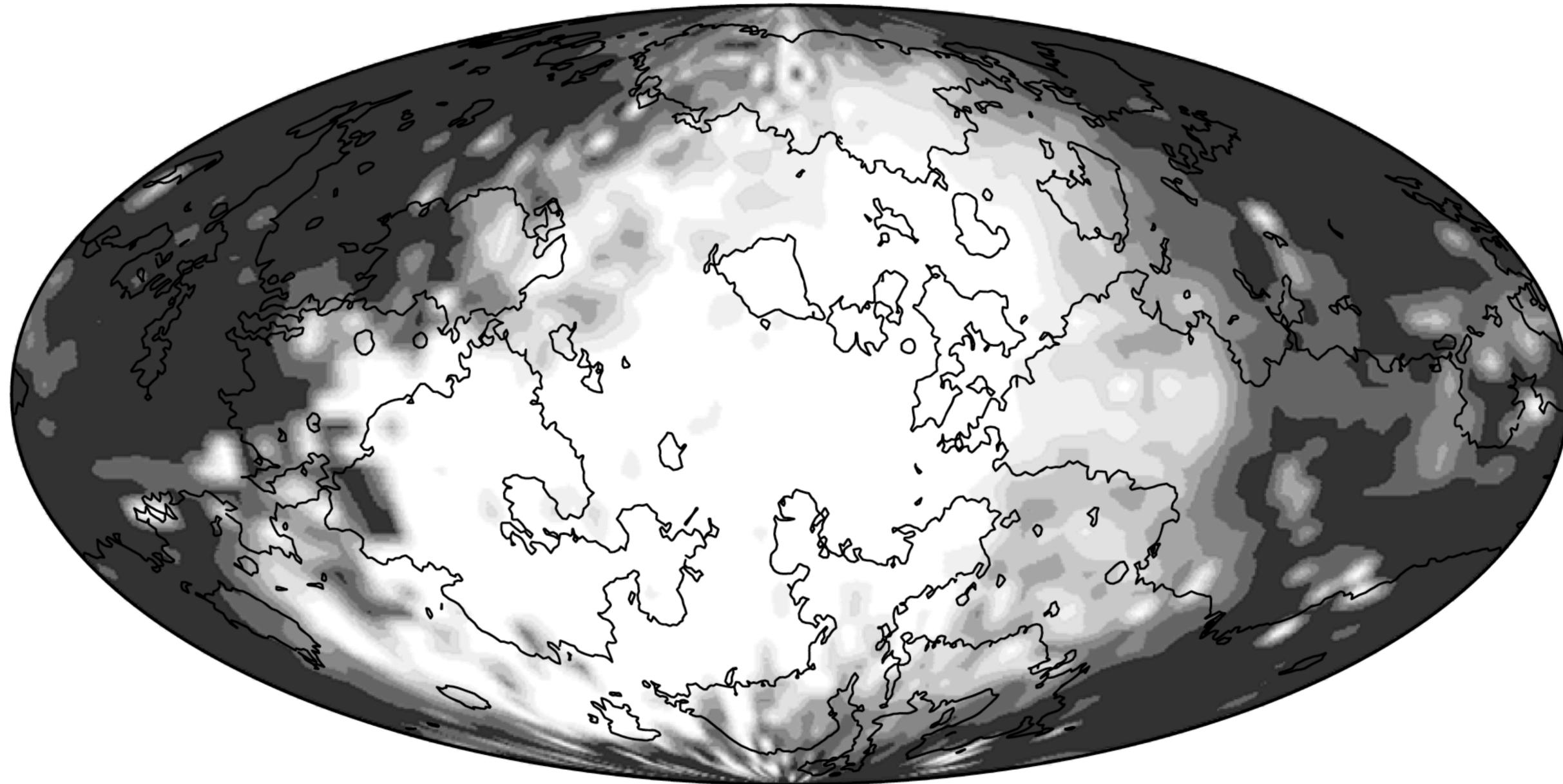
2.9 Ga



0.715 Ga



Ancient Venus: a habitable world?



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(b) Eruption of large igneous provinces

Venus-like exoplanets

WILL ENABLE AN **ENSEMBLE-
APPROACH** TO UNDERSTANDING
THE **LOSS OF HABITABILITY**



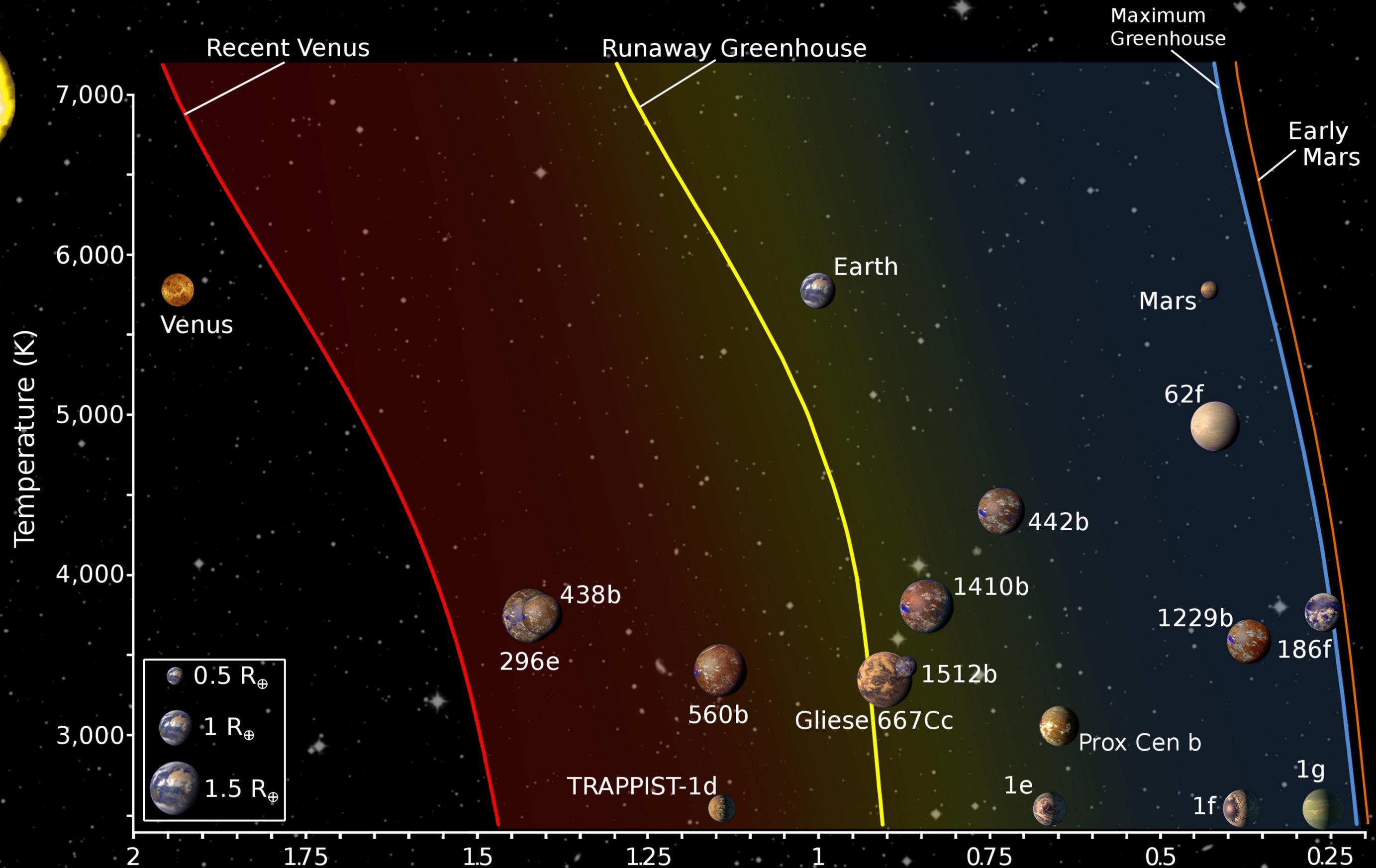
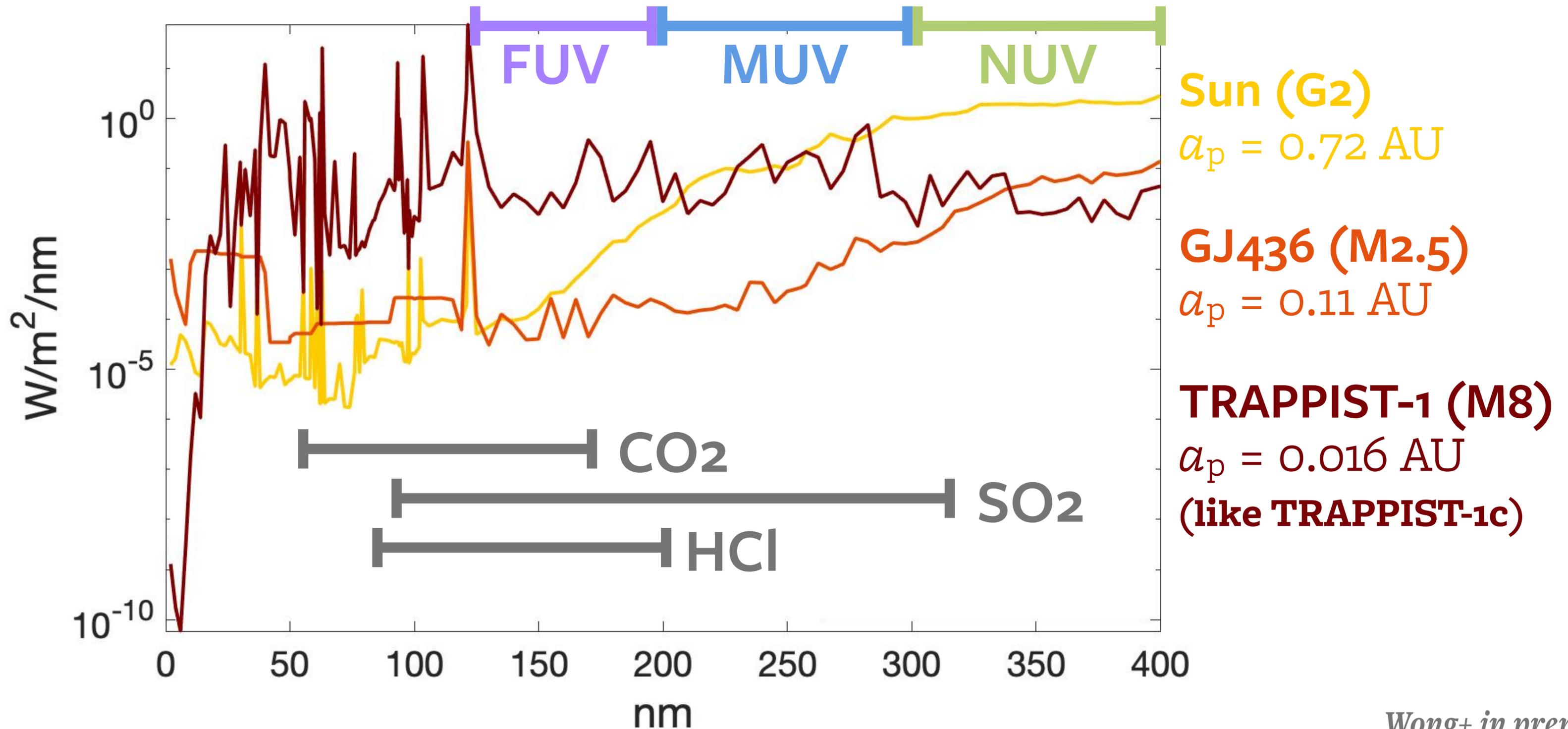
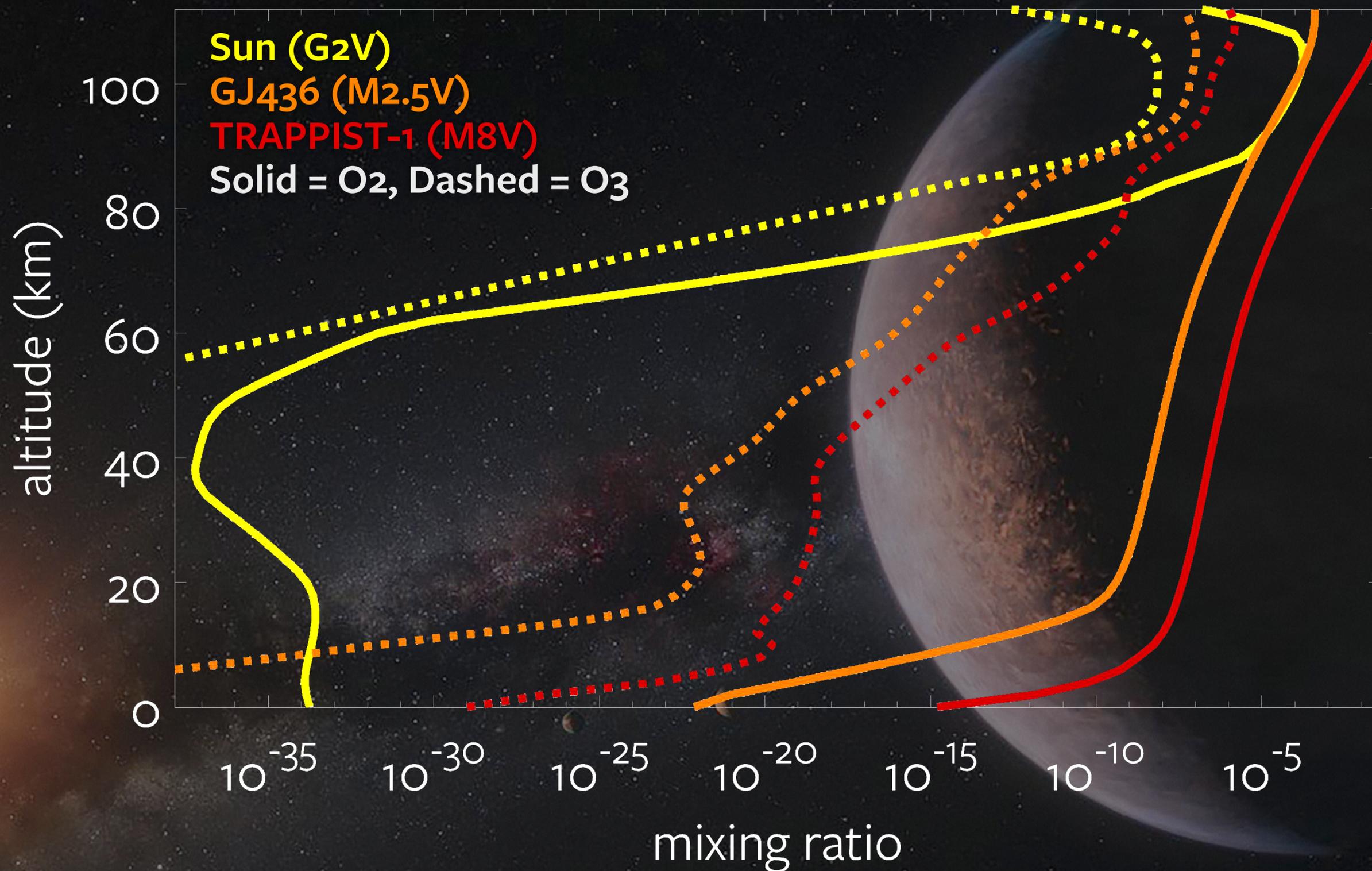


Image Credit: Chester Harman
Planets: PHL at UPR Arcibo, NASA/IPL

Different UV spectral slopes



Abiotic O₂ & O₃ profiles



Life on Venus? Astronomers See a Signal in Its Clouds

The detection of a gas in the planet's atmosphere could turn scientists' gaze to a planet long overlooked in the search for extraterrestrial life.

| SCIENCE |

Possible sign of life on Venus stirs up heated debate

"Something weird is happening" in the clouds of the planet next door—but some experts are raising doubts about the quality of the data.

8 MINUTE READ

BY NADIA DRAKE

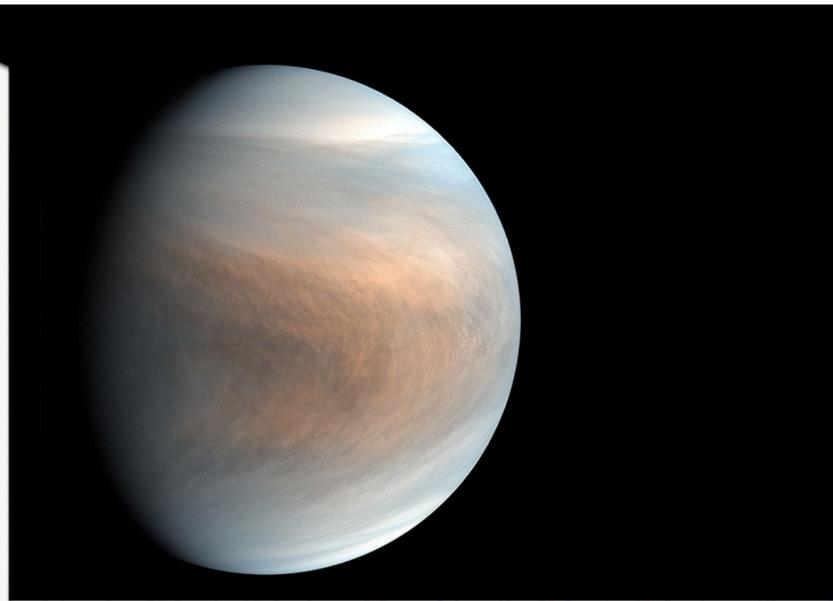


SCIENCE

Something Weird Is Happening on Venus

The discovery of a strange gas in its atmosphere puts the planet "into the realm of a perhaps inhabited world," a researcher says.

MARINA KOREN SEPTEMBER 14, 2020



MORE STORIES

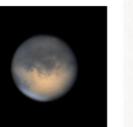
Venus, the Best and Brightest

ANDREA WULF



The Most Overhyped Planet in the Galaxy

MARINA KOREN



A Solar System of Fire and Ice

MARINA KOREN



PAPER IN THREE SENTENCES

- + PH₃ was detected in Venus's atmosphere.
- + Conventional chemistry cannot explain its existence.
- + Perhaps it is a sign of life!

Greaves+ 2020ab, Bains+ 2020

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FOLLOW-UP QUESTIONS

- + PH₃ or SO₂? Where in the atm? Was there a signal at all?
- + Do we know the venusian environment well enough?
- + Can life meet the challenges of the venusian environment? Why would it make PH₃?

Villaneuva+ 2020, Encrenaz+ 2020, Trompet+ 2020, Truong & Lunine 2020, Lincowski+ 2021

DISCUSSION

WHAT **COMMUNITY-DRIVEN PROTOCOLS**
SHOULD WE DEVELOP TO HANDLE THE
GROUNDBREAKING DISCOVERIES OF
BIOSIGNATURES ON EXTRASOLAR WORLDS?

Image: Dana Berry/Skyworks Digital/CfA

Venus-like exoplanets

WILL SHED LIGHT ON PLANETARY
EVOLUTION AND HABITABILITY AND
HOW COMMON WE ARE

Venus

IS A PROVING GROUND FOR
TECHNIQUES THAT WILL HELP US
DETERMINE THE ABOVE

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