

宇宙惑星環境学

Space and Planetary Environment

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青木翔平 Aoki, Shohei
吉岡和夫 Yoshioka, Kazuo

放射輸送と大気の鉛直構造
大気化学とエアロゾル
大気流出と大気進化
大気力学
火星と金星の気候形成
巨大ガス惑星
太陽風と惑星プラズマ
太陽系探査

The score will be evaluated based on reports and attendance.

The theme for the paper will be given at the end of this course.

Dates of lectures:

10/9 10/16 10/23 10/30(Aoki)

11/6 11/13 11/20(Aoki)

12/4 12/11 12/18

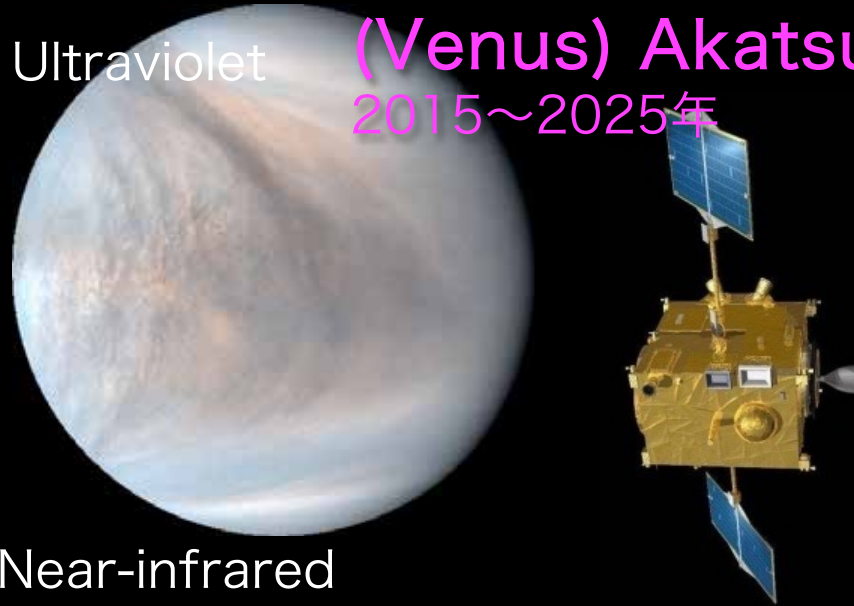
1/8 1/15 1/22(Yoshioka) 1/29

Lecture material by Imamura will be uploaded to UTOL.

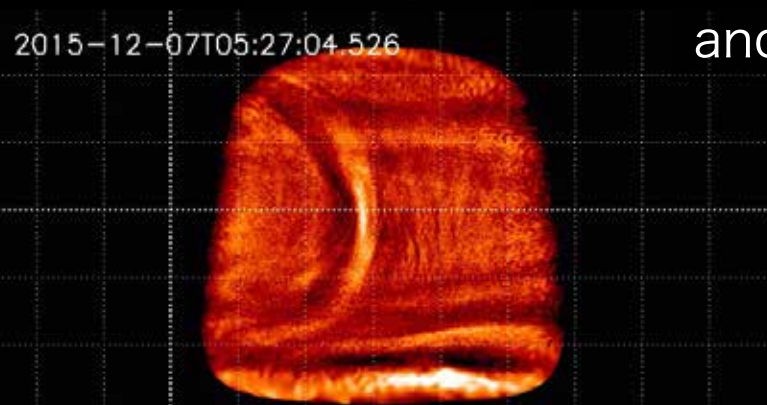
Ongoing planetary environment missions

Ultraviolet

(Venus) Akatsuki
2015~2025年



Near-infrared
(2.26 μm)

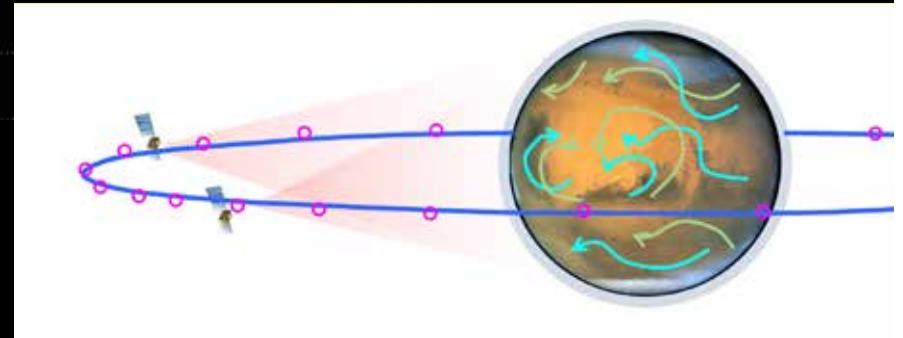


Mid-infrared
(10 μm)

(Mars) MMX
2026年~

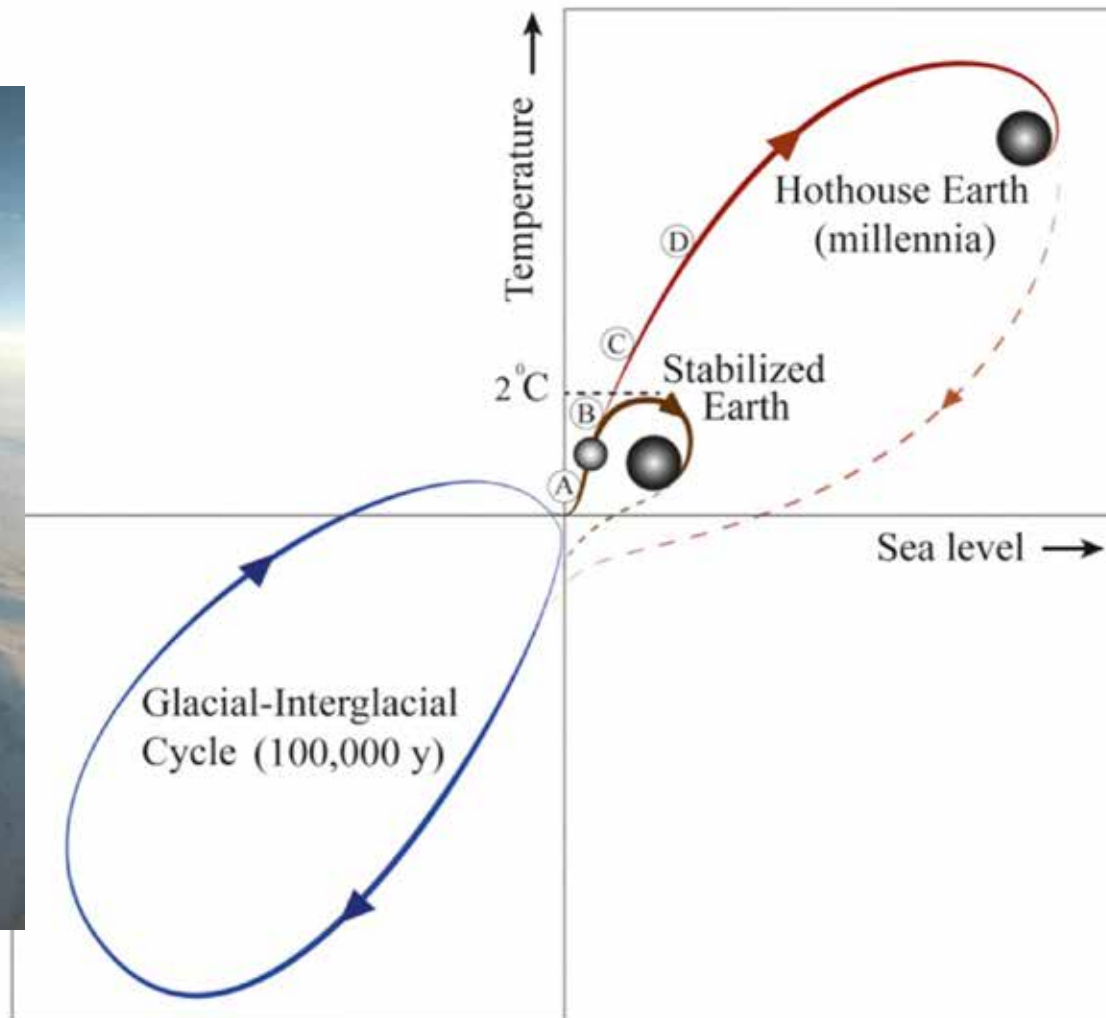


High-resolution mapping of
atmospheric composition
and dynamics



Why do we study planetary environments?

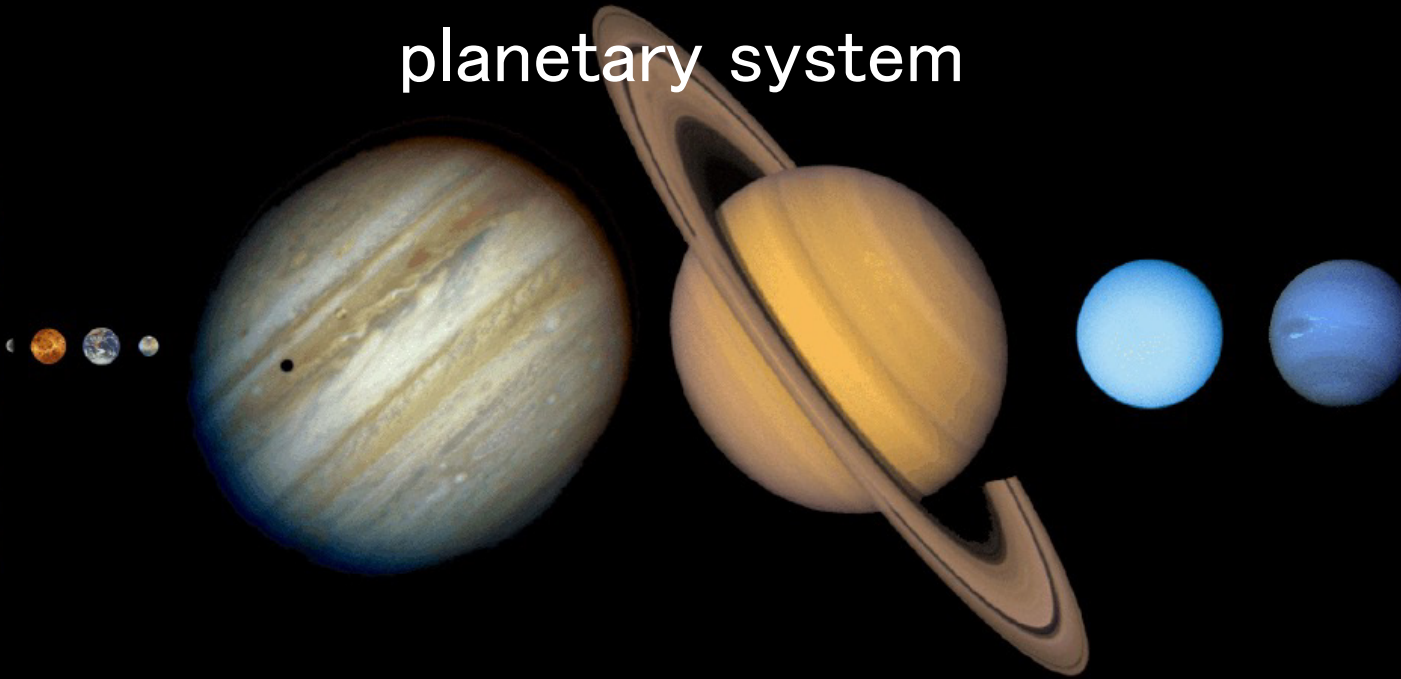
Possible future pathways of the climate against the background of the glacial–interglacial cycles



protoplanetary disk

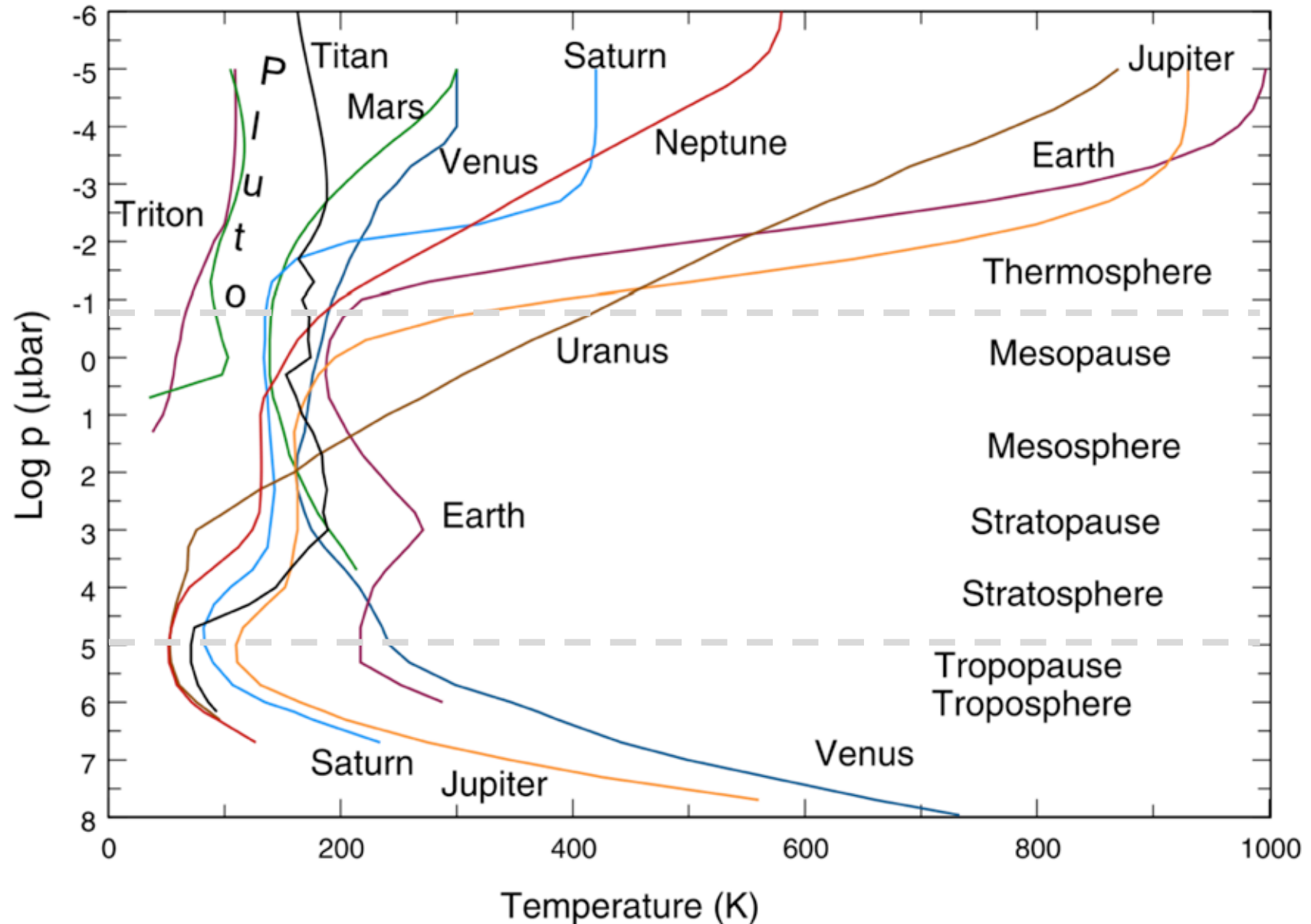


planetary system



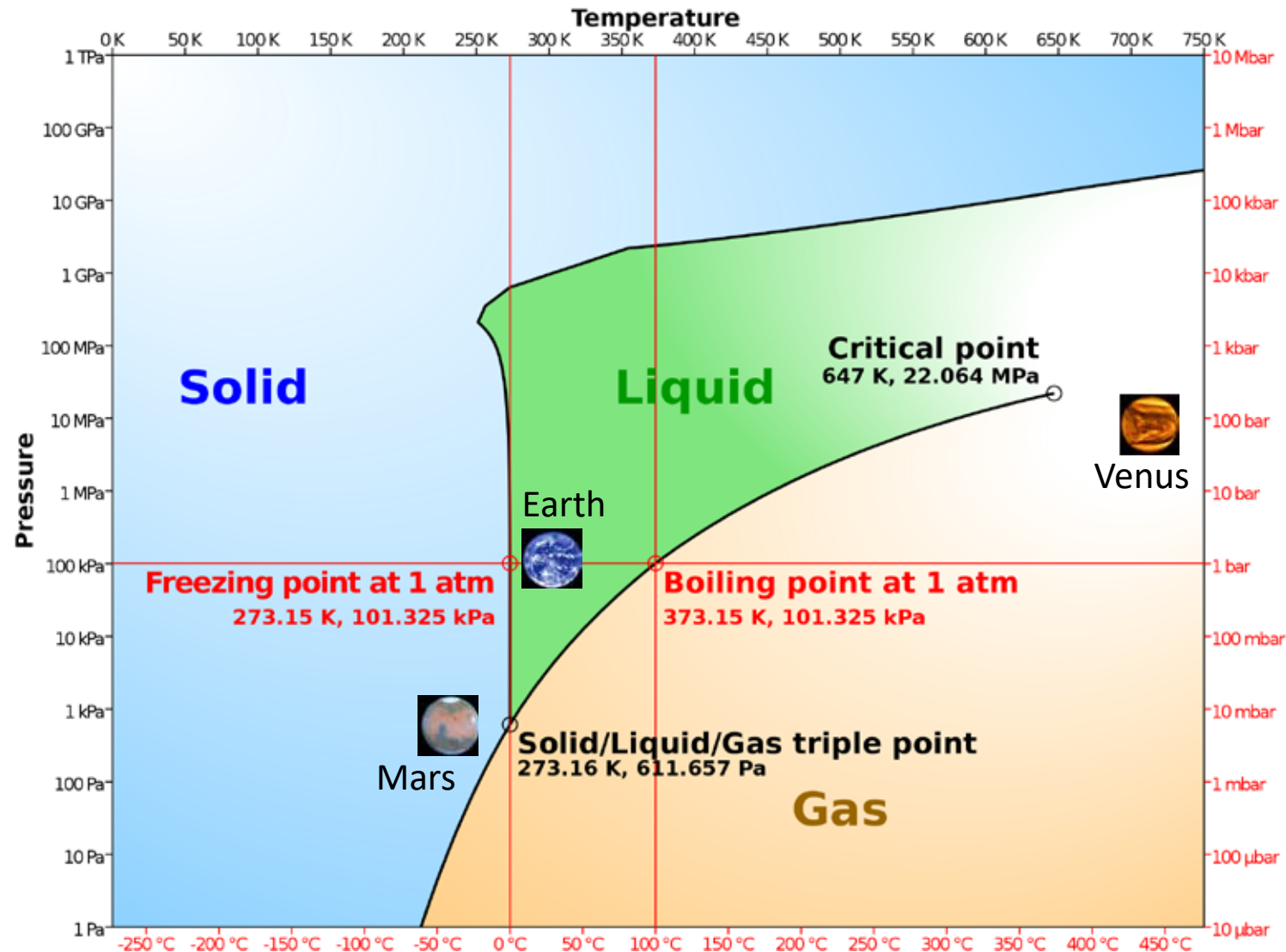
Vertical temperature profiles of planetary atmospheres

(Mueller-Wodarg et al.)

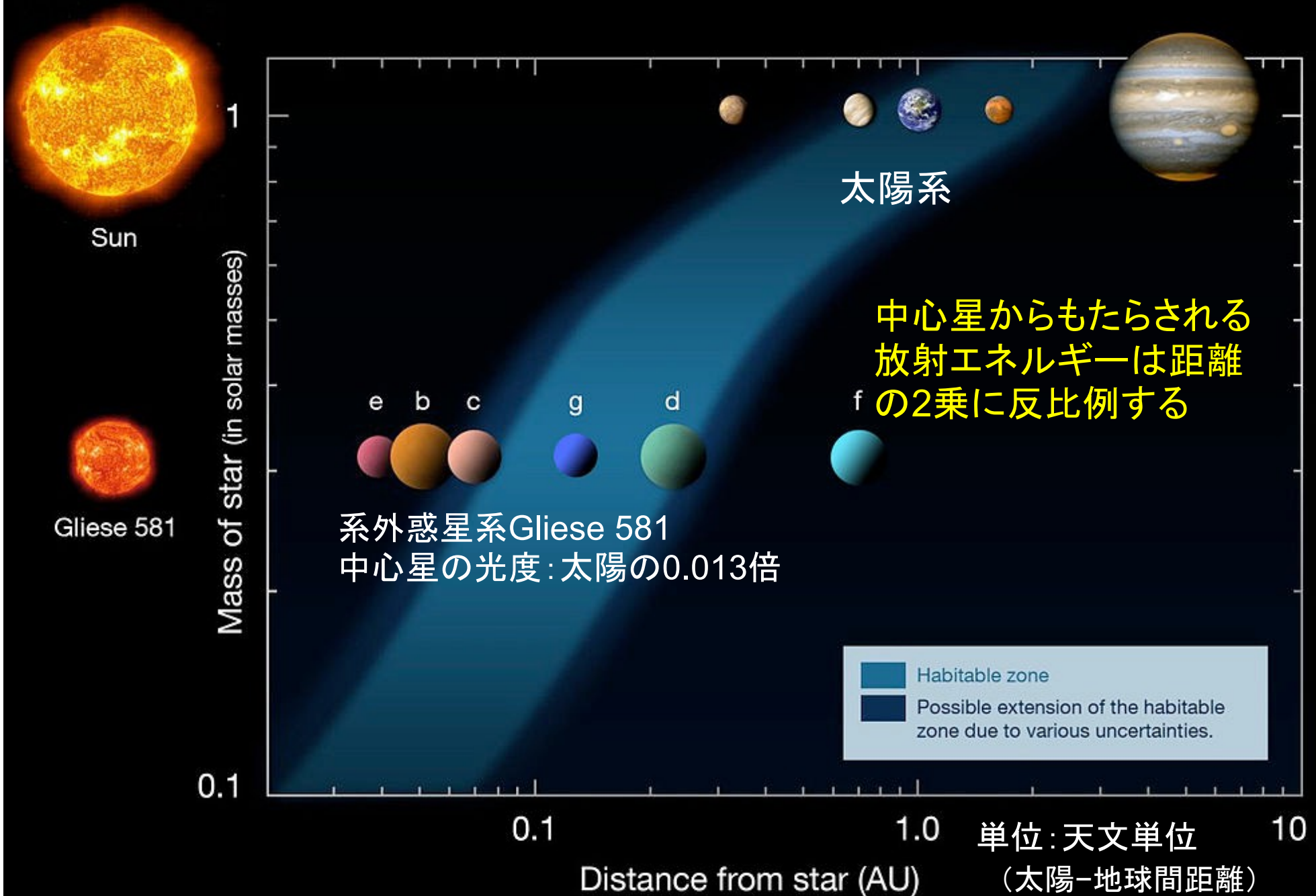


Phase change diagram for water

From Wikipedia



Habitable zone (液体の水の存在領域)



Inner edge of habitable zone

- Water loss limit
Escape of water/hydrogen to space
- Runaway greenhouse limit
Complete evaporation of ocean

→ How/when did **Venus** lose water and get the thick CO₂ atmosphere ?

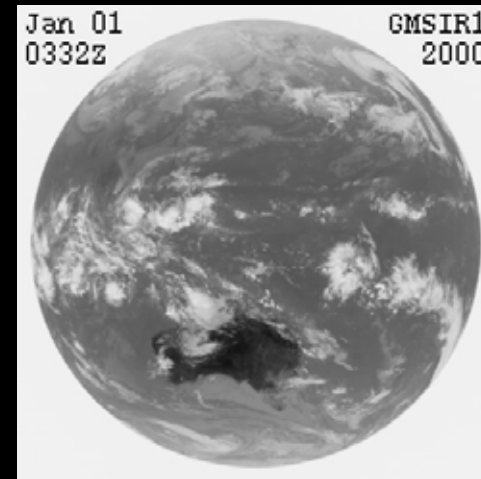
Outer edge of habitable zone

- Greenhouse effect by CO₂ and other gases
 - Enhancement of cloud albedo in cold, massive atmospheres
- How/when did **Mars** lose thick atmosphere and freeze ?

Clouds and atmospheric circulation



Venus



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Earth

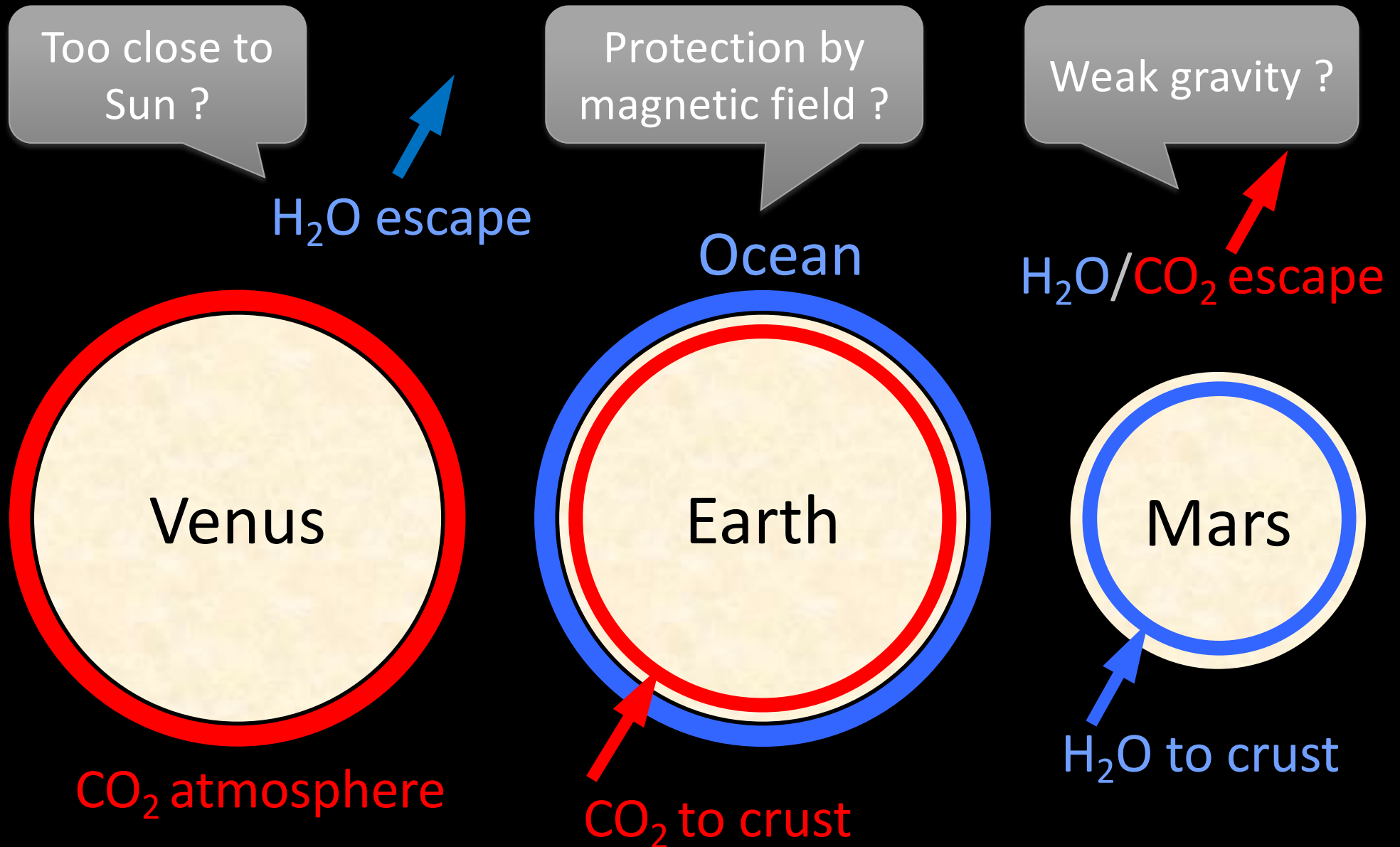


Mars

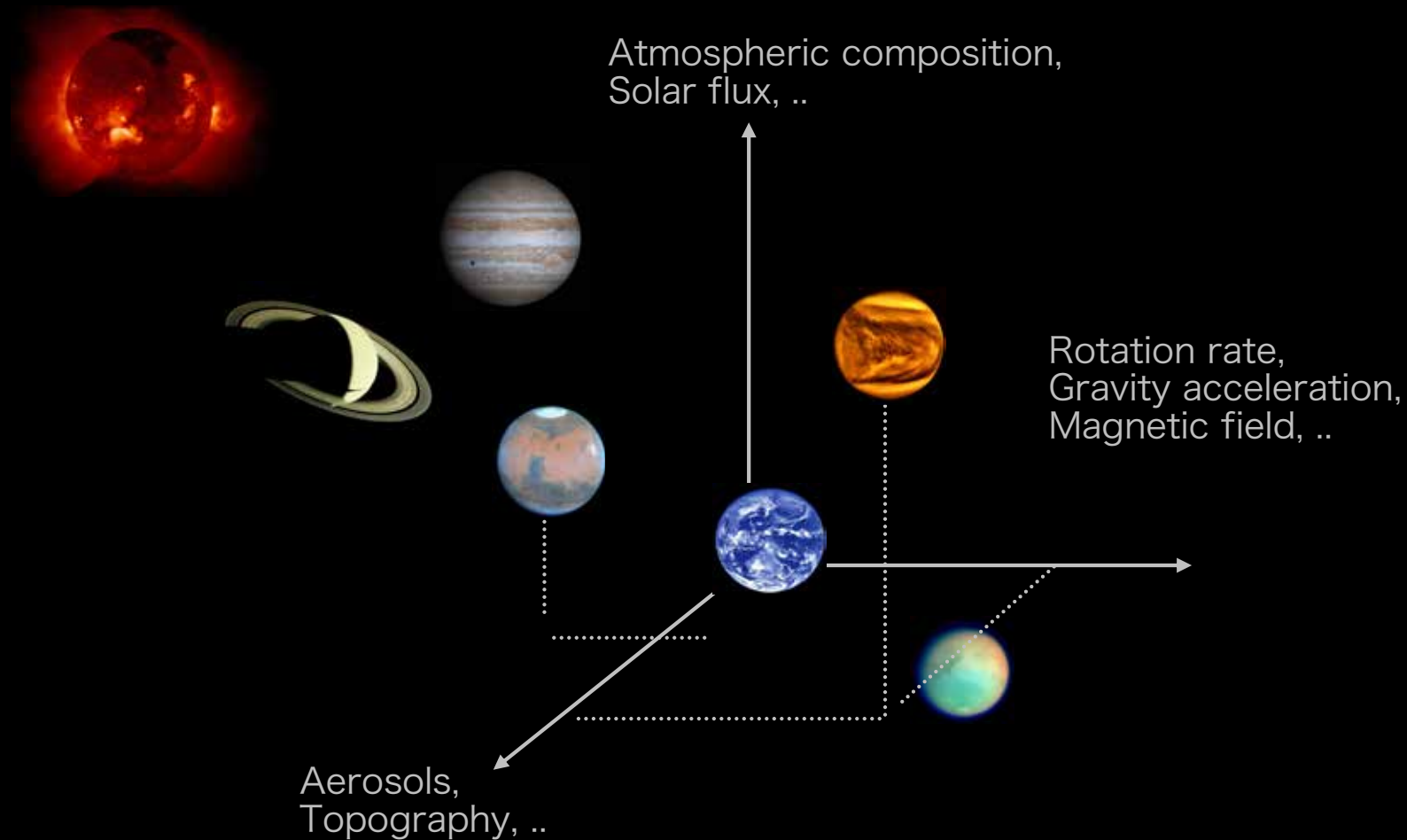


Jupiter

Possible scenarios of planets' evolution



Understanding the diversity in a multi-dimensional parameter space



Questions

- How does the climate system work and evolve with time?
- How are the compositions and structures of planetary atmospheres controlled?
- How does a star-planet system evolve with time?