

Giant Planet Meteorology

ASTR691

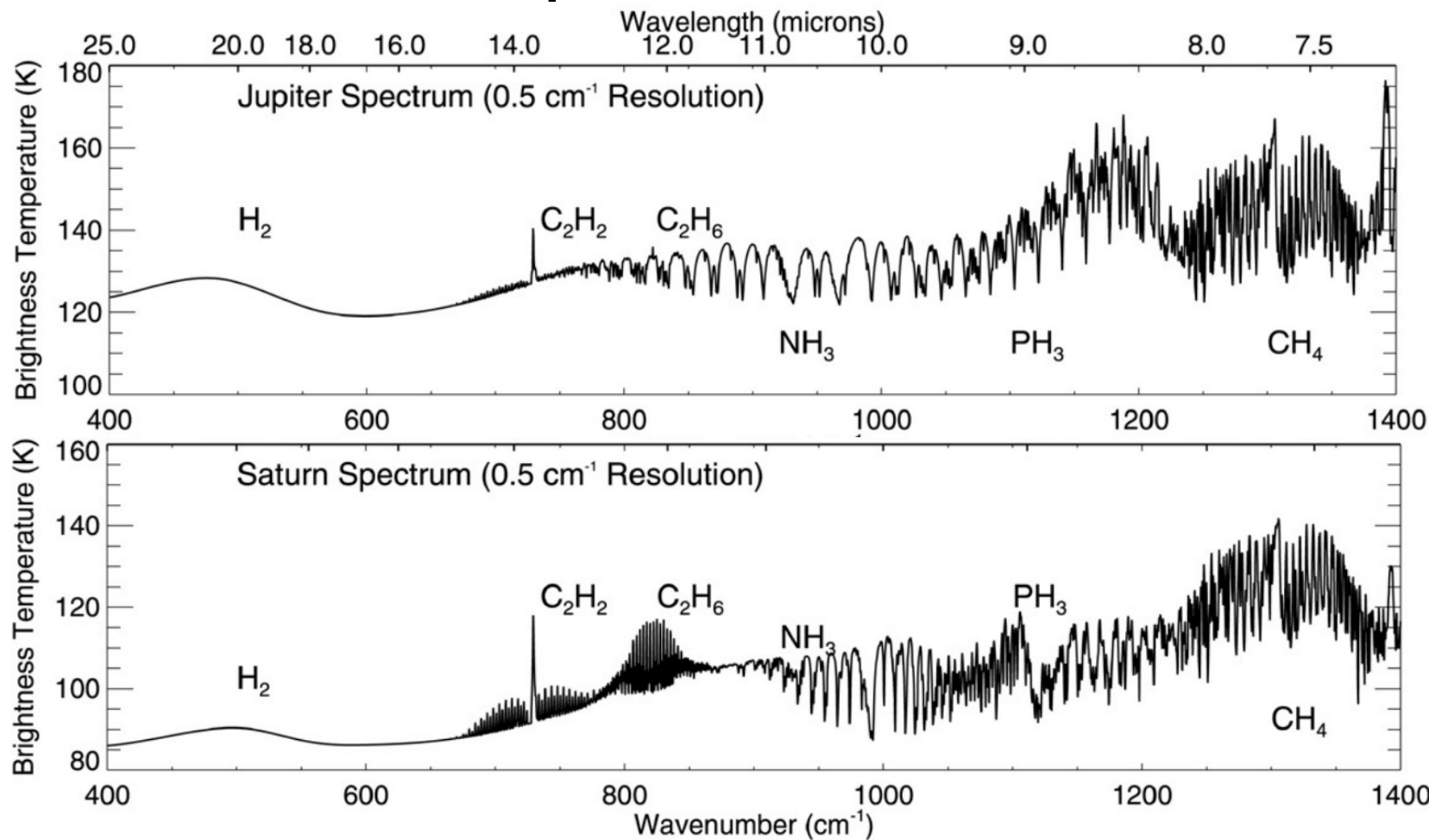
W15L1 - 2022/11/28

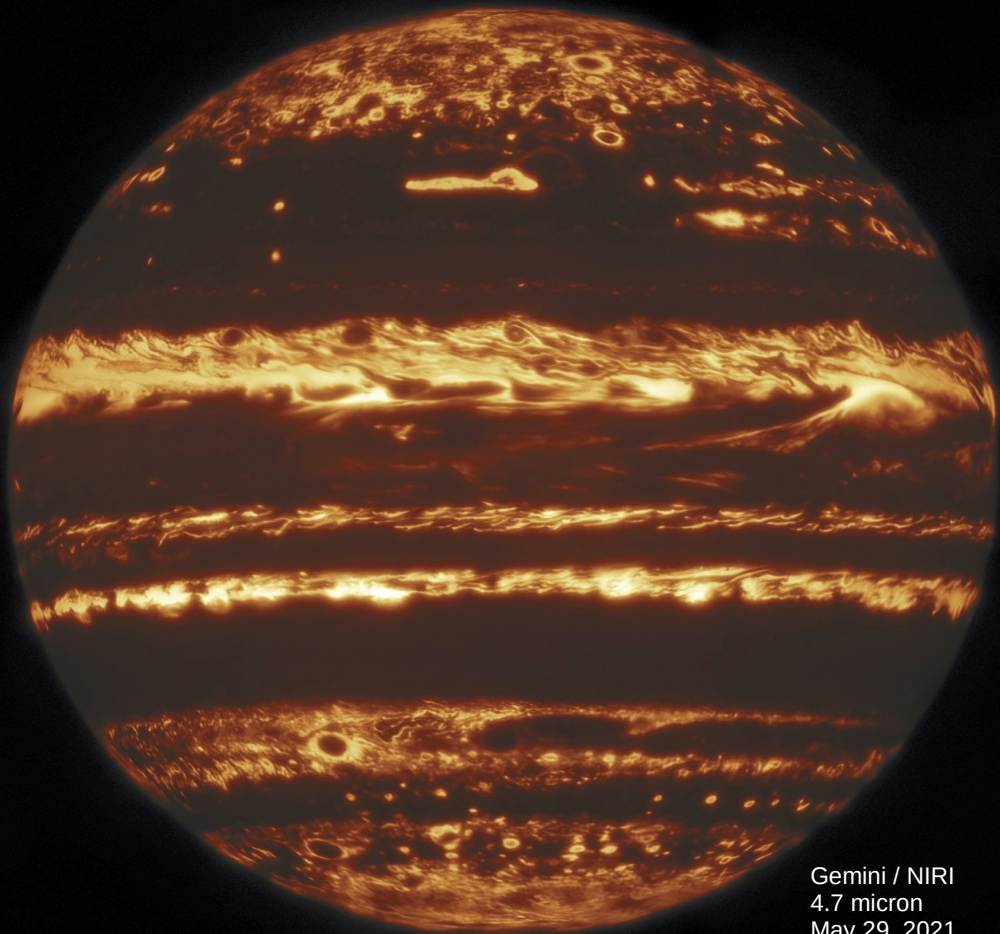
“Climate is what on average we expect, weather is what we actually get.” A.J. Herbertson, [1901](#).

“Everybody talks about the weather but nobody seems to do anything about it.” C.D. Warner, [~1884](#)

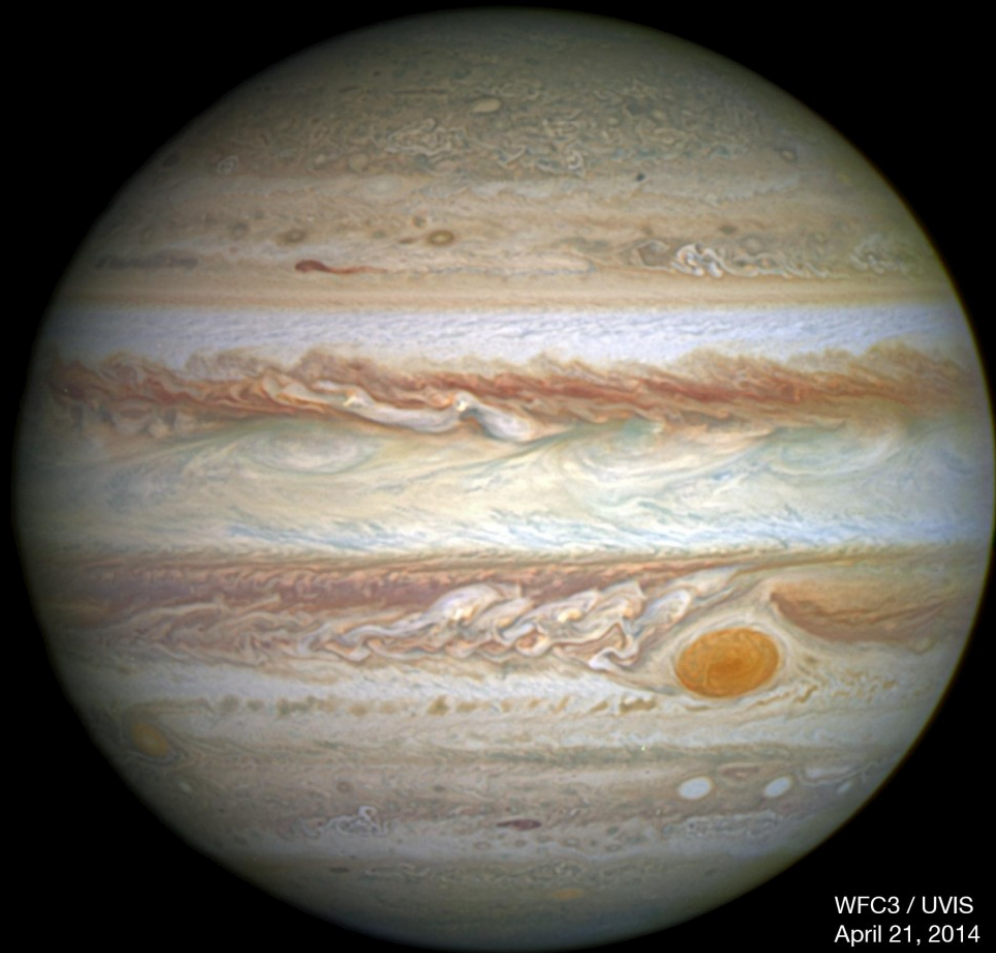
(both sometimes mistakenly attributed to Mark Twain)

Even 1D planetary spectra are complicated – but planets are 3D!





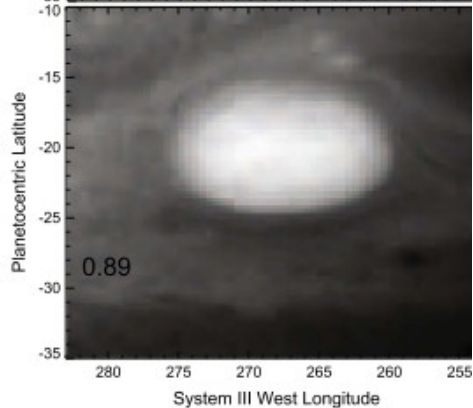
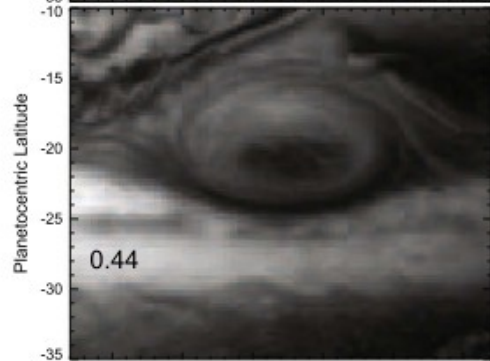
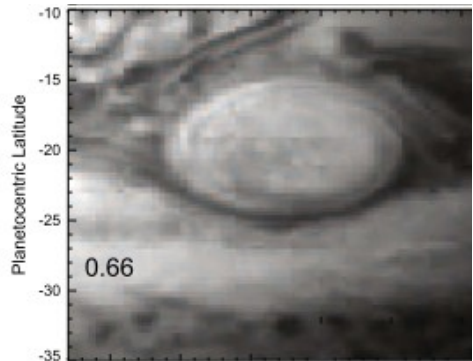
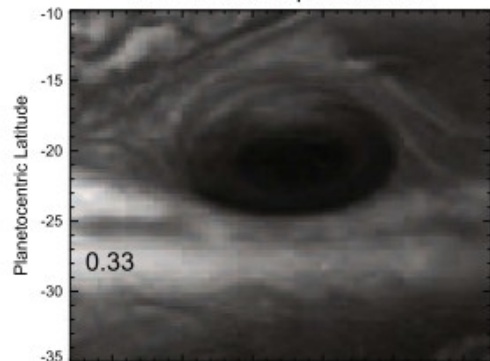
Gemini / NIRI
4.7 micron
May 29, 2021



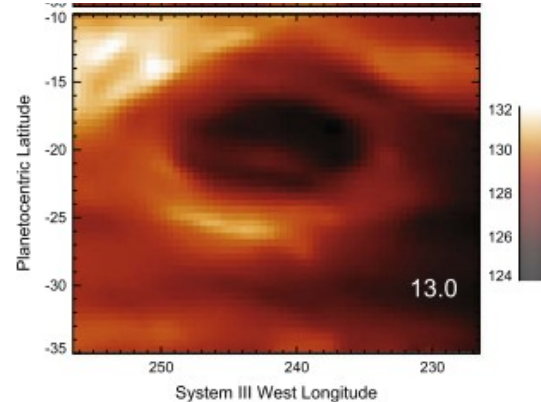
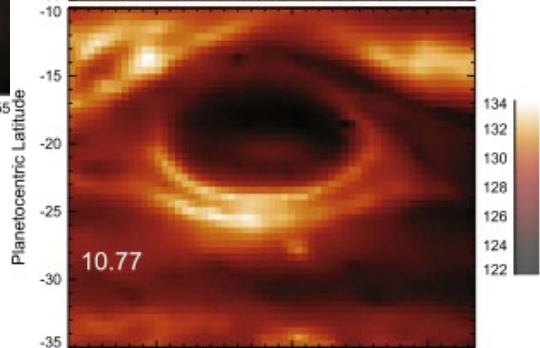
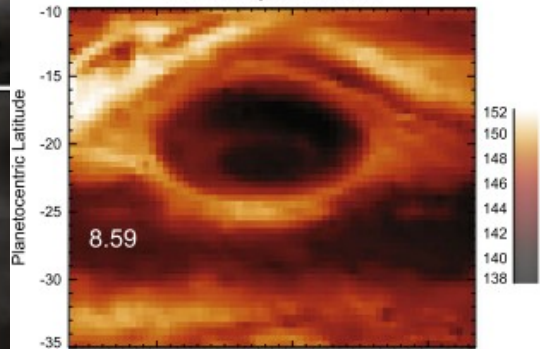
WFC3 / UVIS
April 21, 2014

Wong et al. (2020)

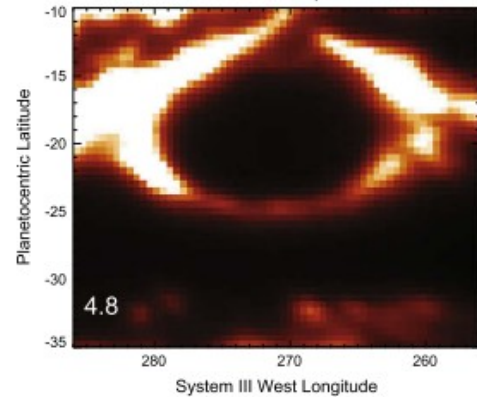
Hubble/ACS April 24 2006



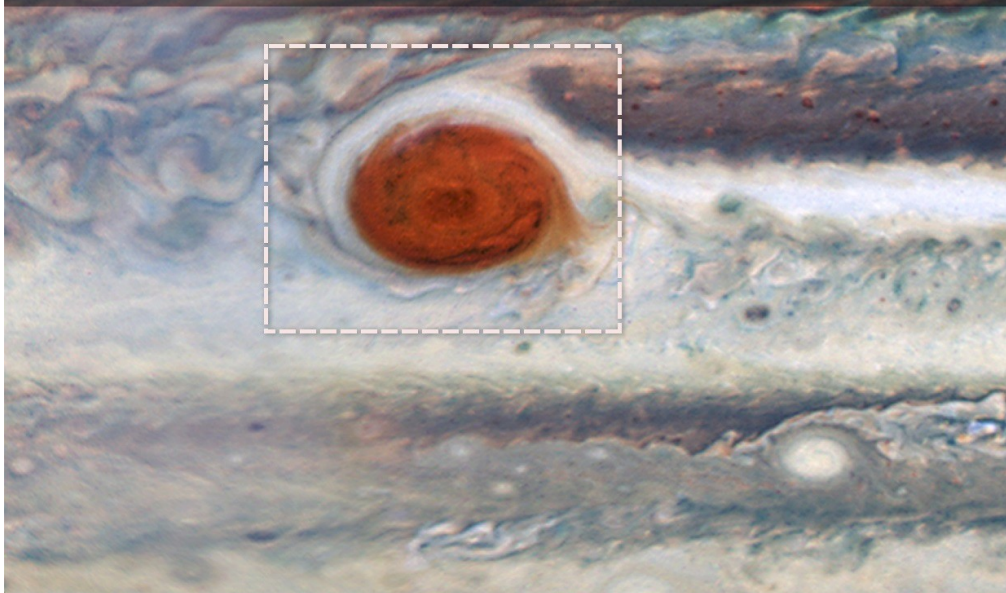
VISIR April 9 2006



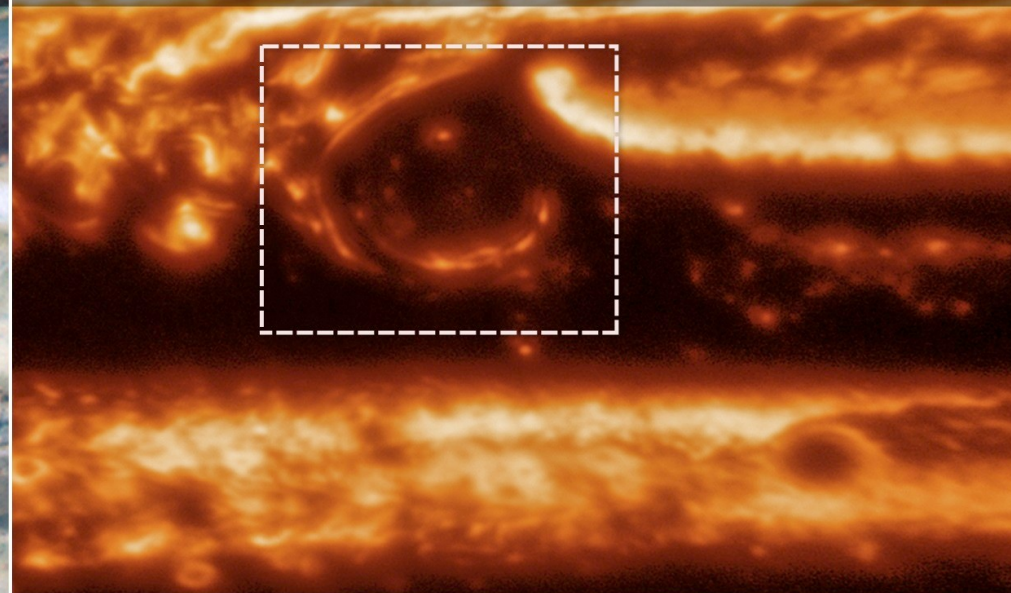
IRTF/NSFCAM2 April 25 2006



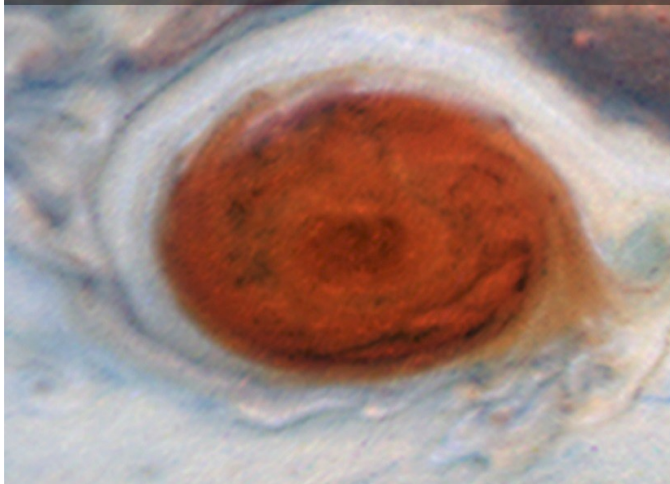
HST/UVIS RGB color enhanced | Apr 1, 2018



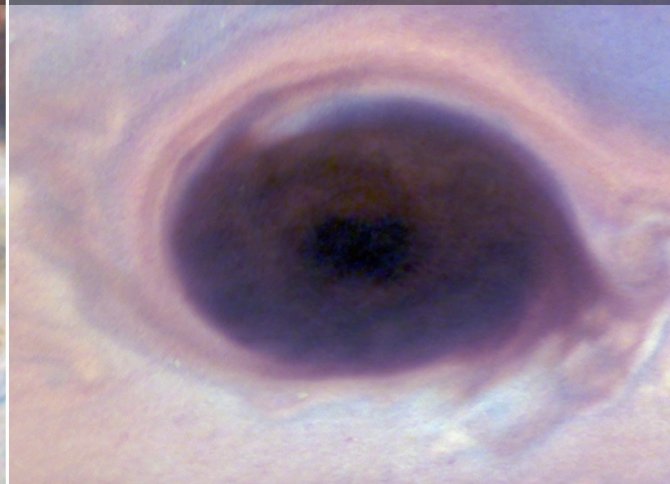
Gemini/NIRI 4.7 μm thermal infrared emission



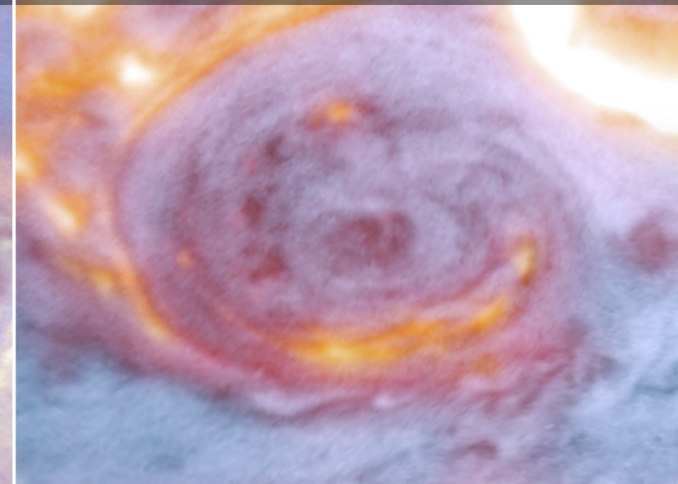
HST/UVIS RGB



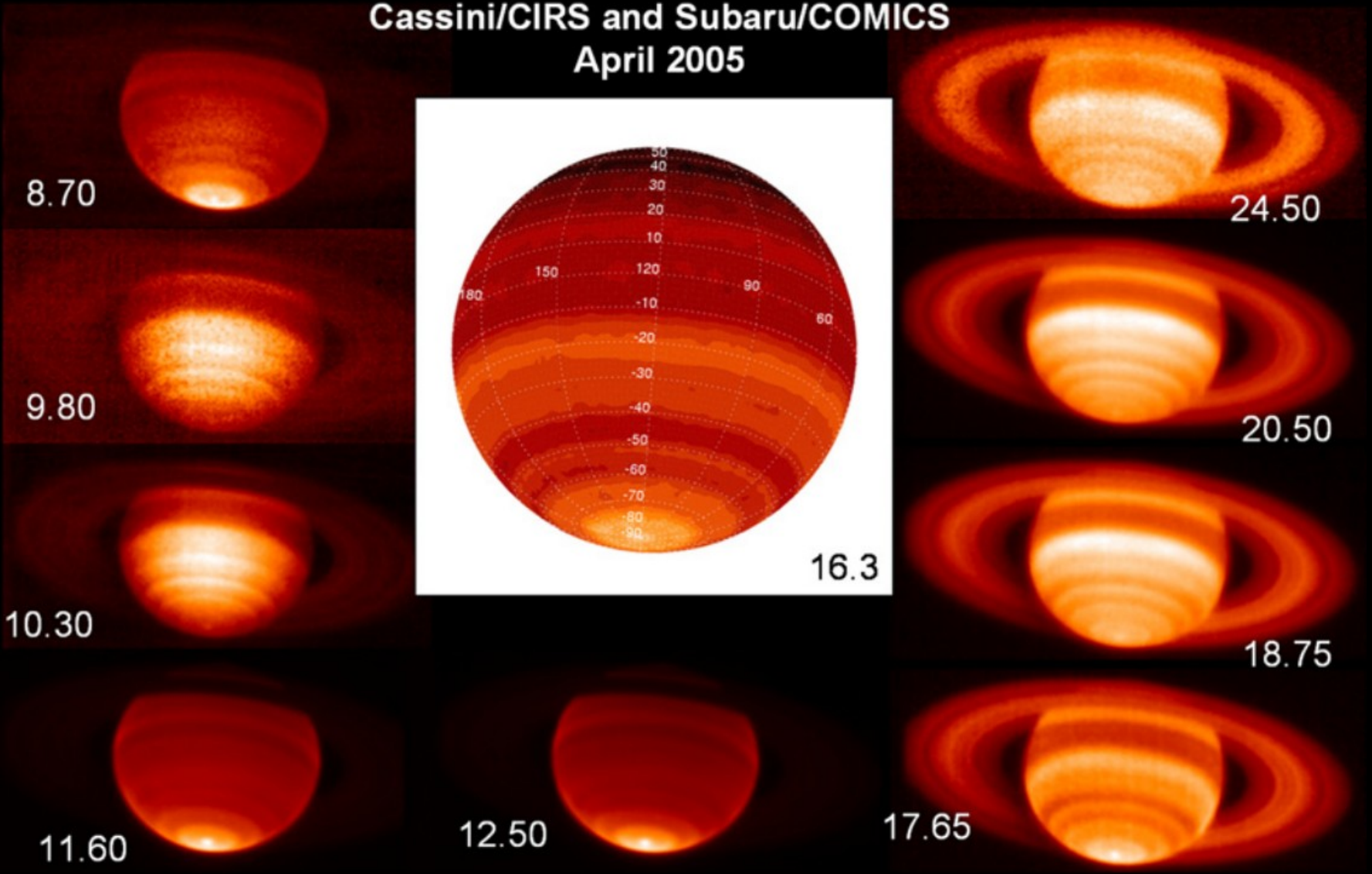
HST/UVIS ultraviolet color

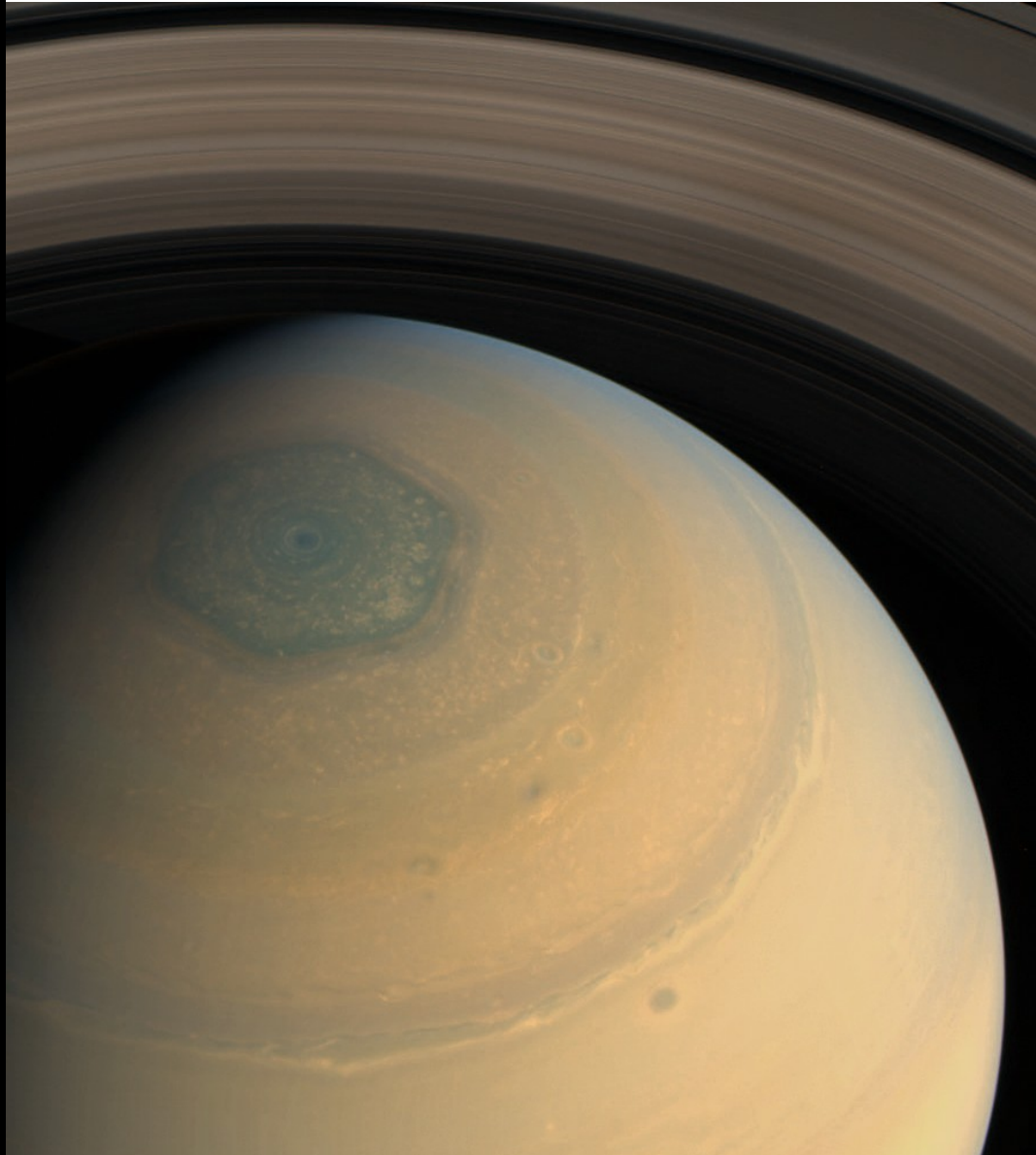
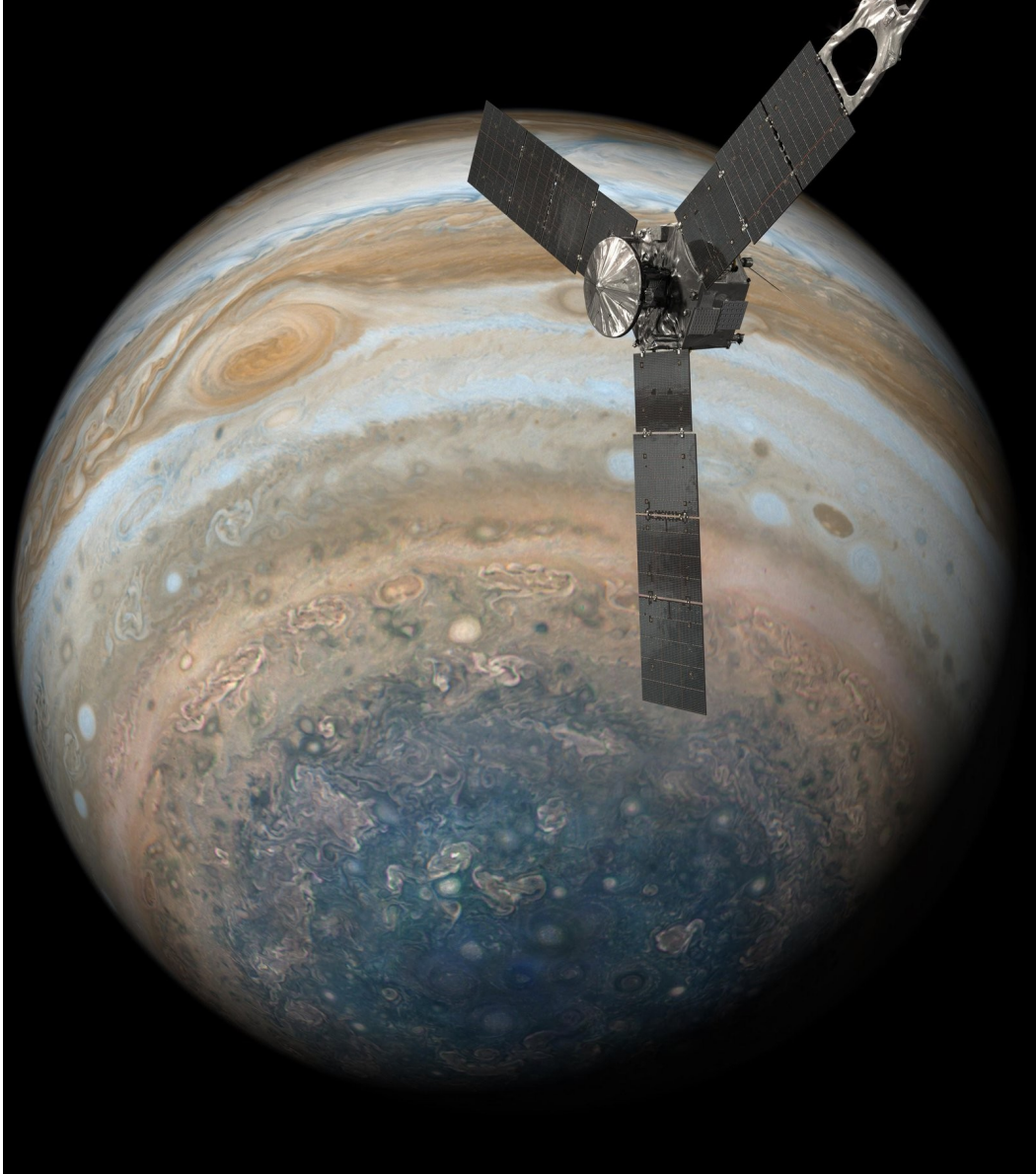


HST+Gemini 631nm + 4.7 μm

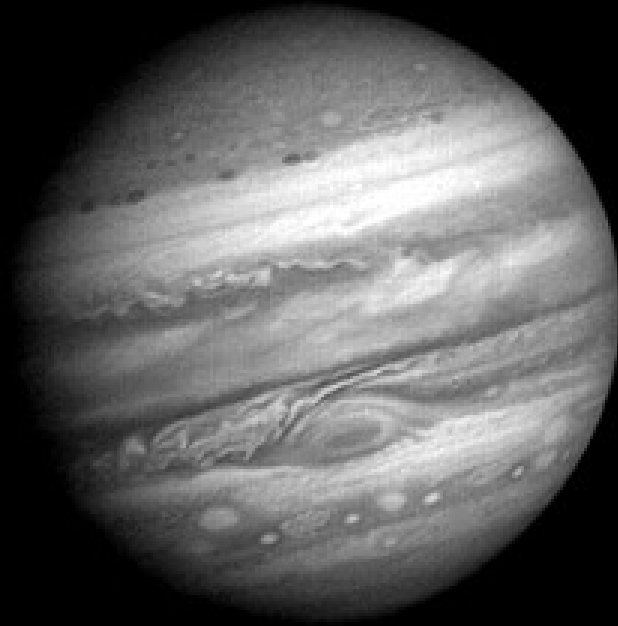


Cassini/CIRS and Subaru/COMICS
April 2005



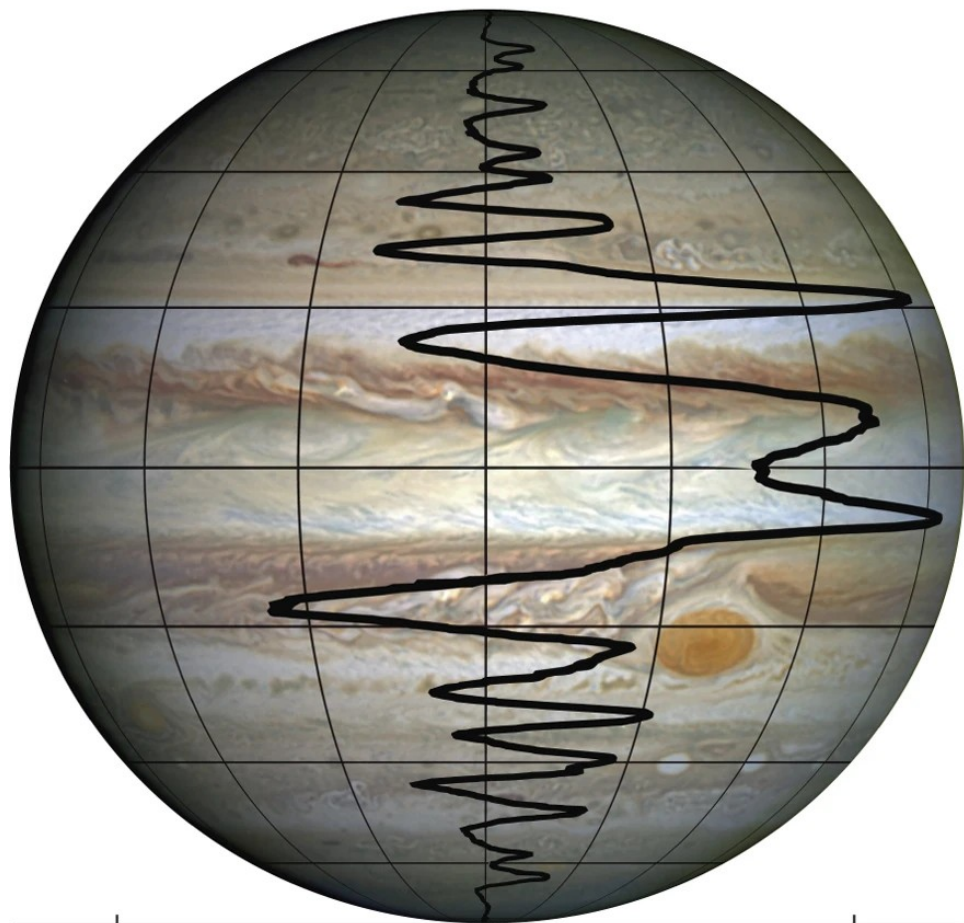


From Voyager 1's
approach to Jupiter



a

Full wind



-100

0

100

Zonal wind (m s⁻¹)**b**

60

40

20

0

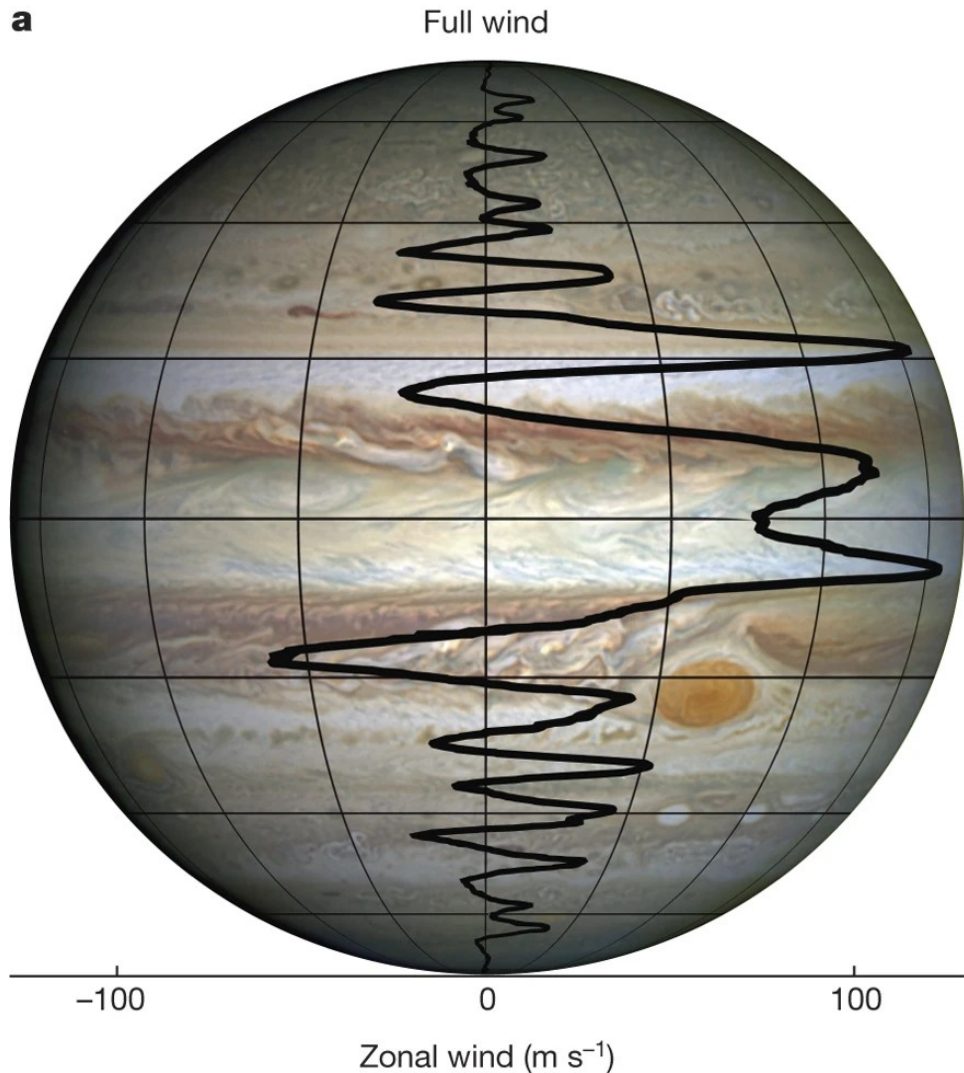
-20

-40

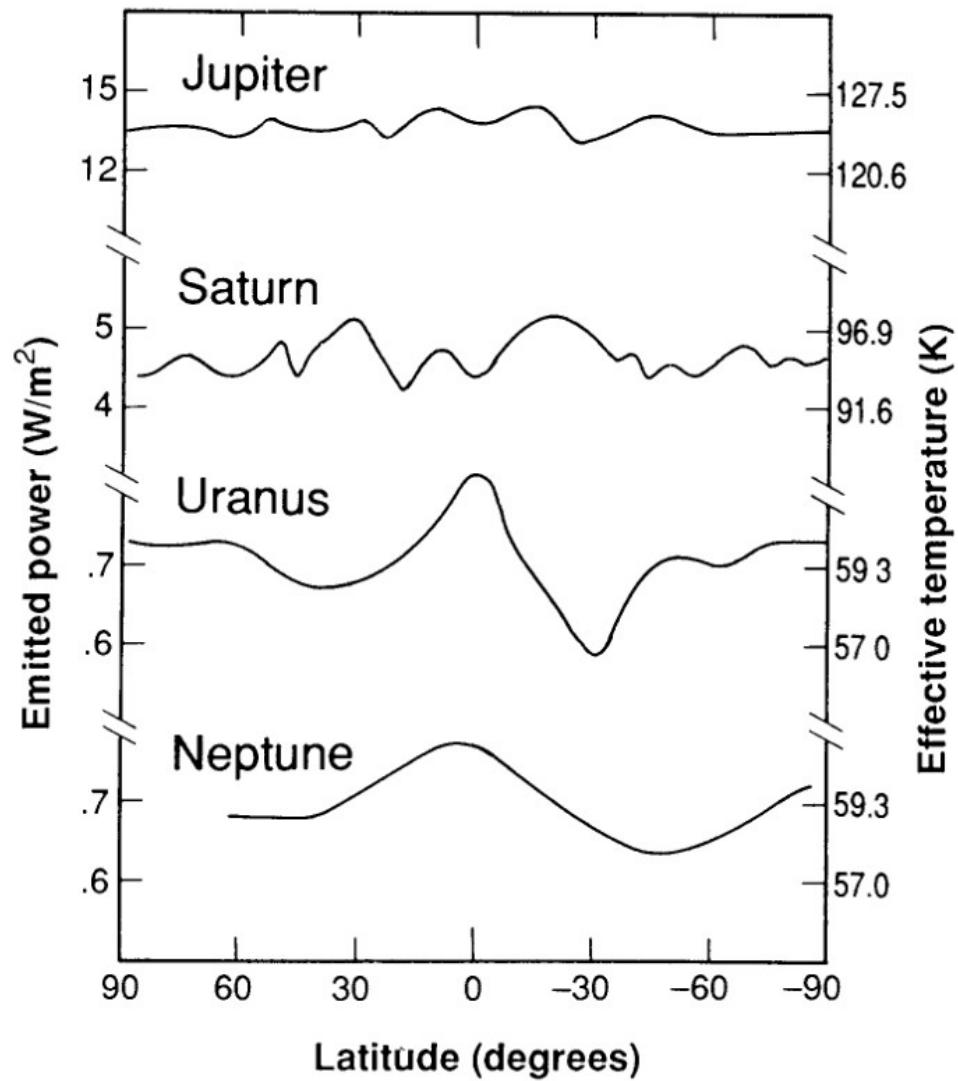
-60

Latitude (°)

Kaspi+2018



Kaspi+2018



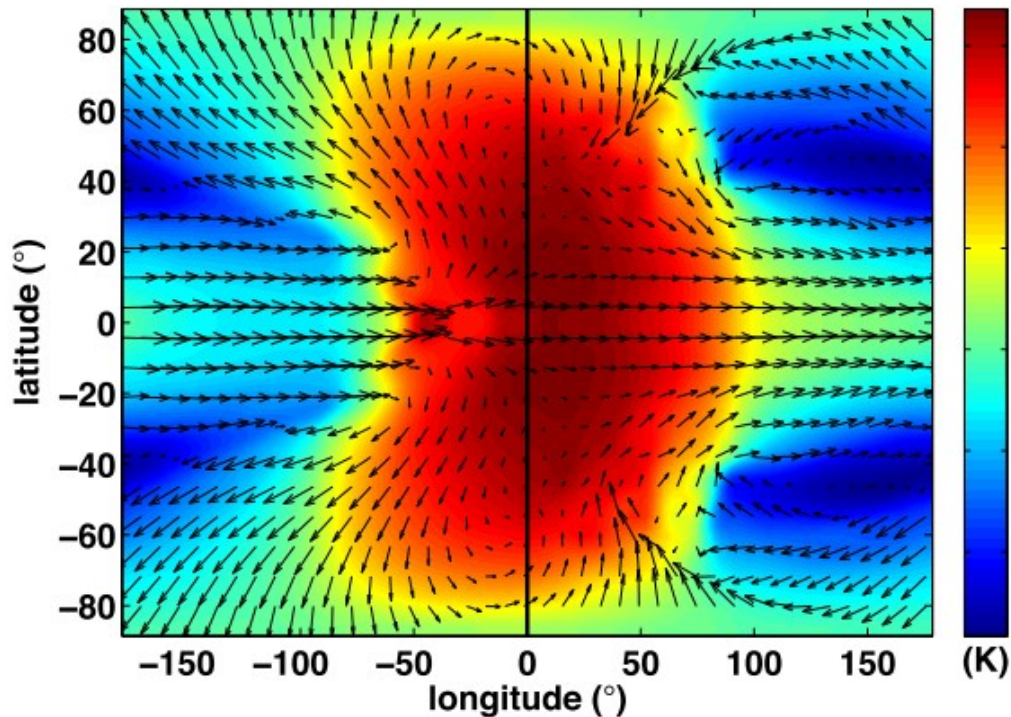
Ingersoll 1990

We can also simulated these processes in
exoplanet atmospheres:

WASP-43b: R_{Jup} , $2 M_{\text{Jup}}$, ~ 1400 K.

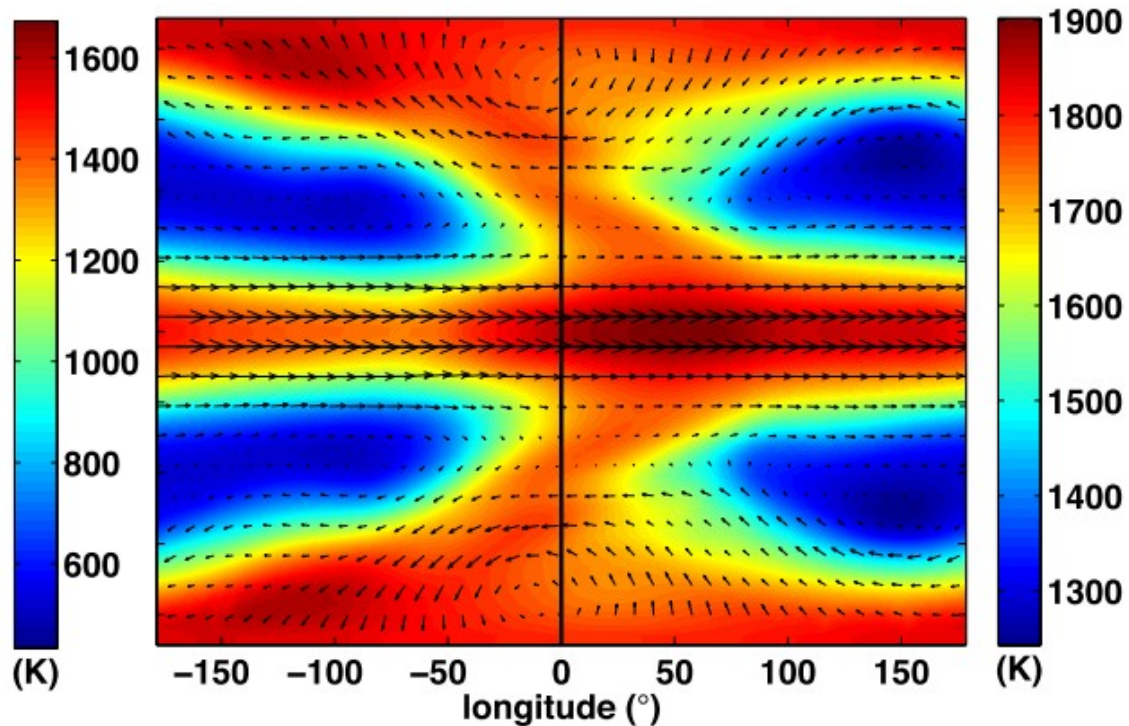
Temperature at P=0.01 bar

5× solar, C32, 10.63 mbar



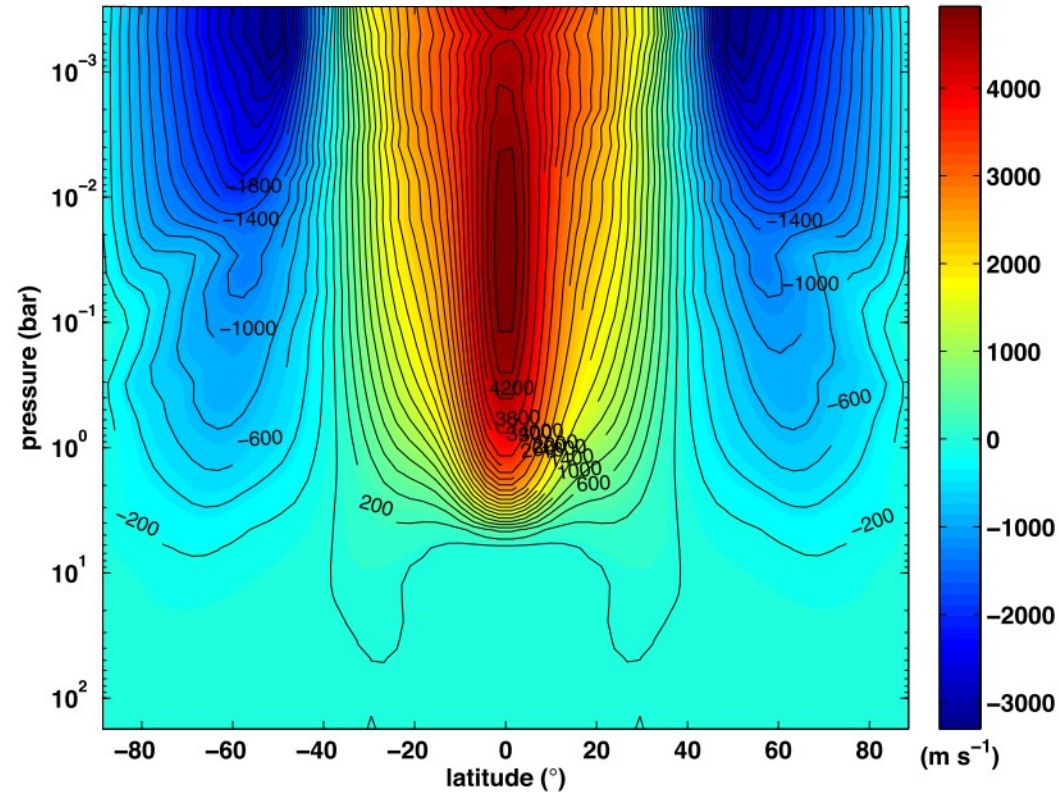
Temperature at P=1.2 bar

5× solar, C32, 1.18 bar



WASP-43b: R_{Jup} , $2 M_{\text{Jup}}$, ~ 1400 K.

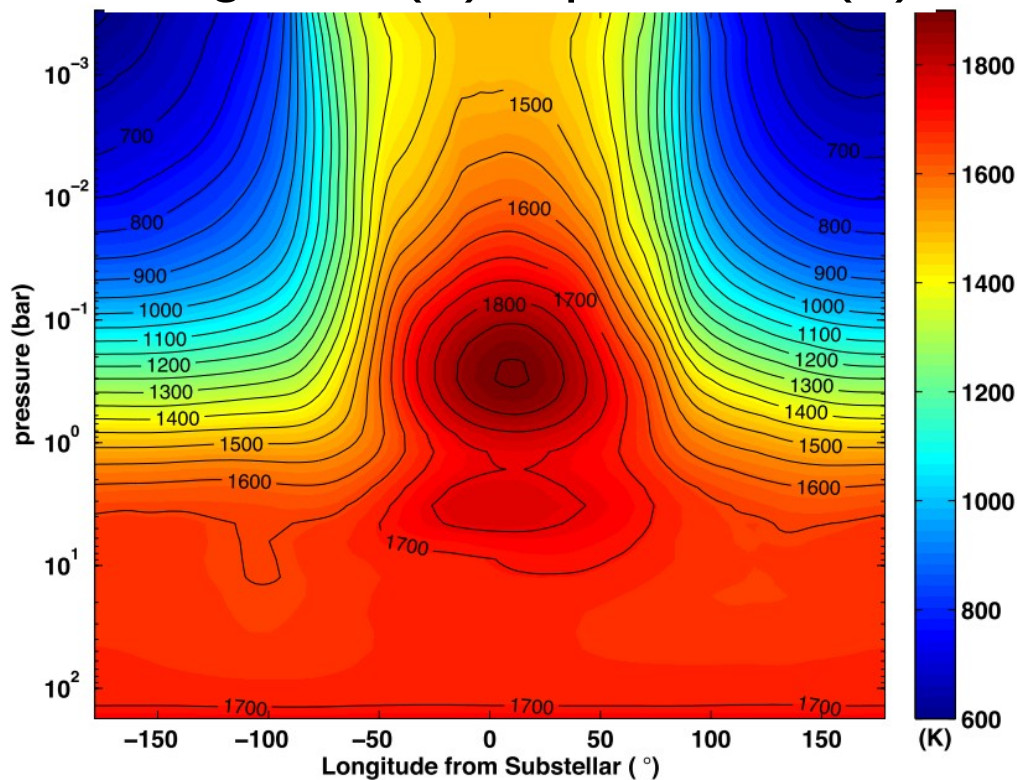
Wind Speed vs.
latitude (X) & pressure (Y)



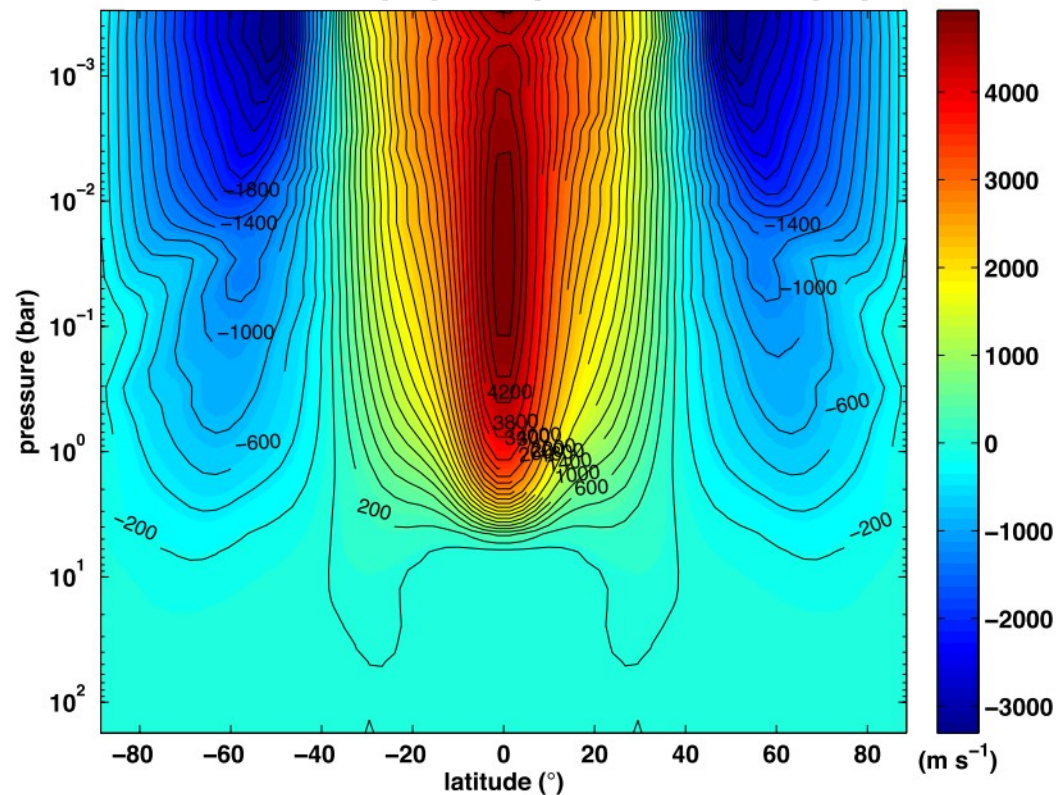
Kataria+2014

WASP-43b: R_{Jup} , $2 M_{\text{Jup}}$, ~ 1400 K.

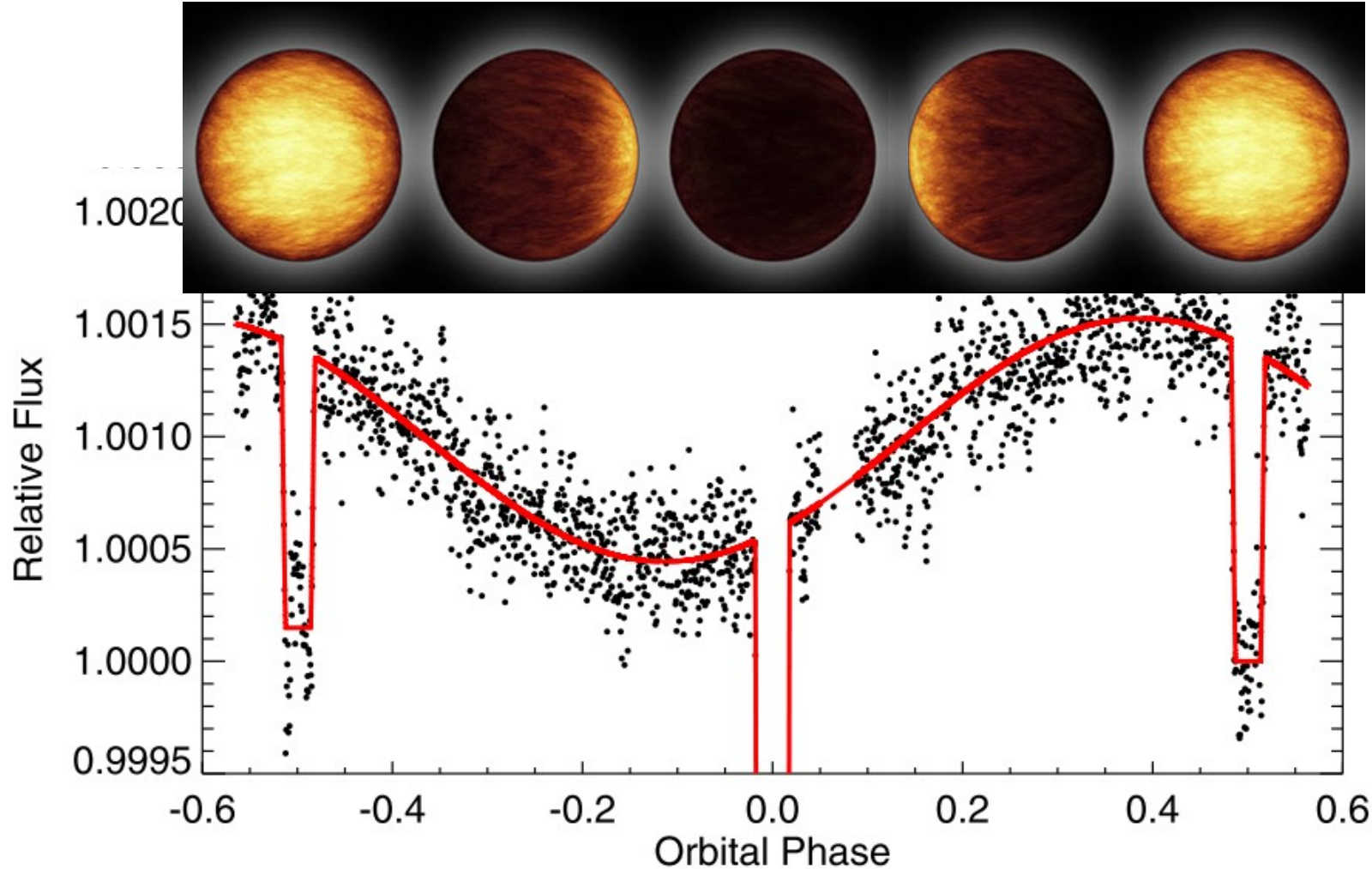
Temperature vs.
longitude (X) & pressure (Y)



Wind Speed vs.
latitude (X) & pressure (Y)



We can observe these effects via exoplanet “phase curves”:



Zellem+2014