

Contrasting Temperature Conditions at the Poles of Jupiter and Saturn

#507.01

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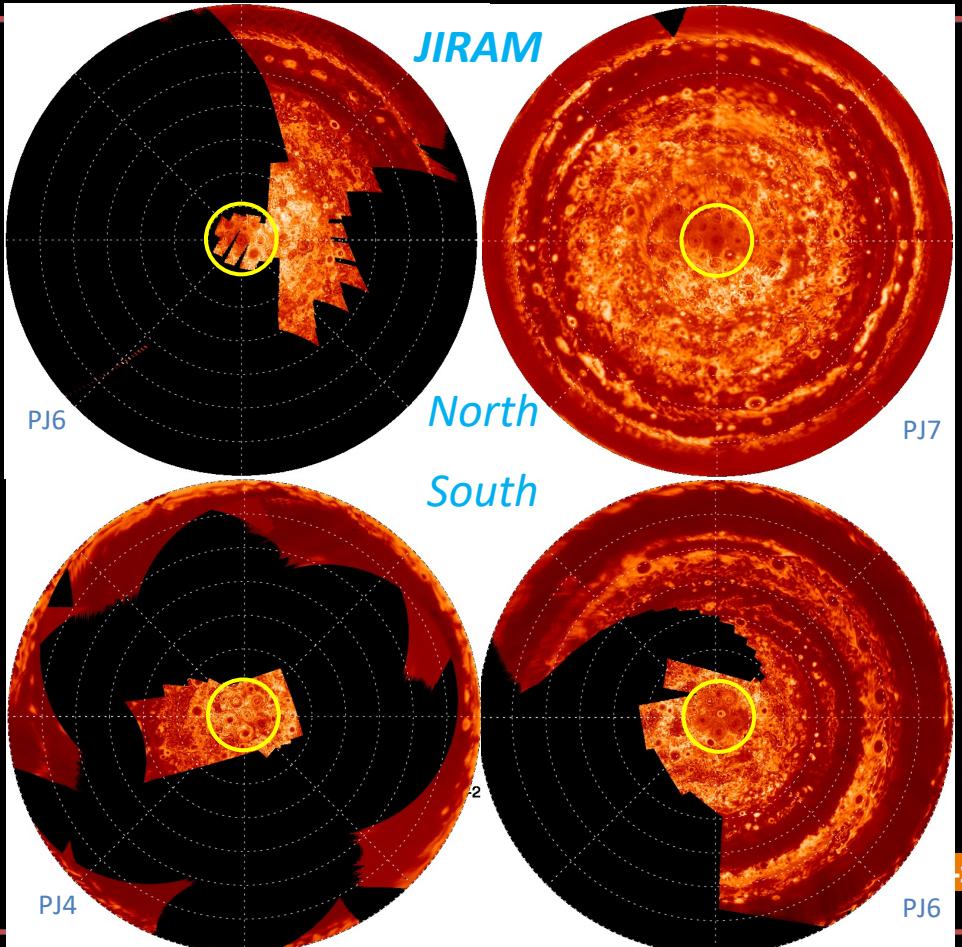
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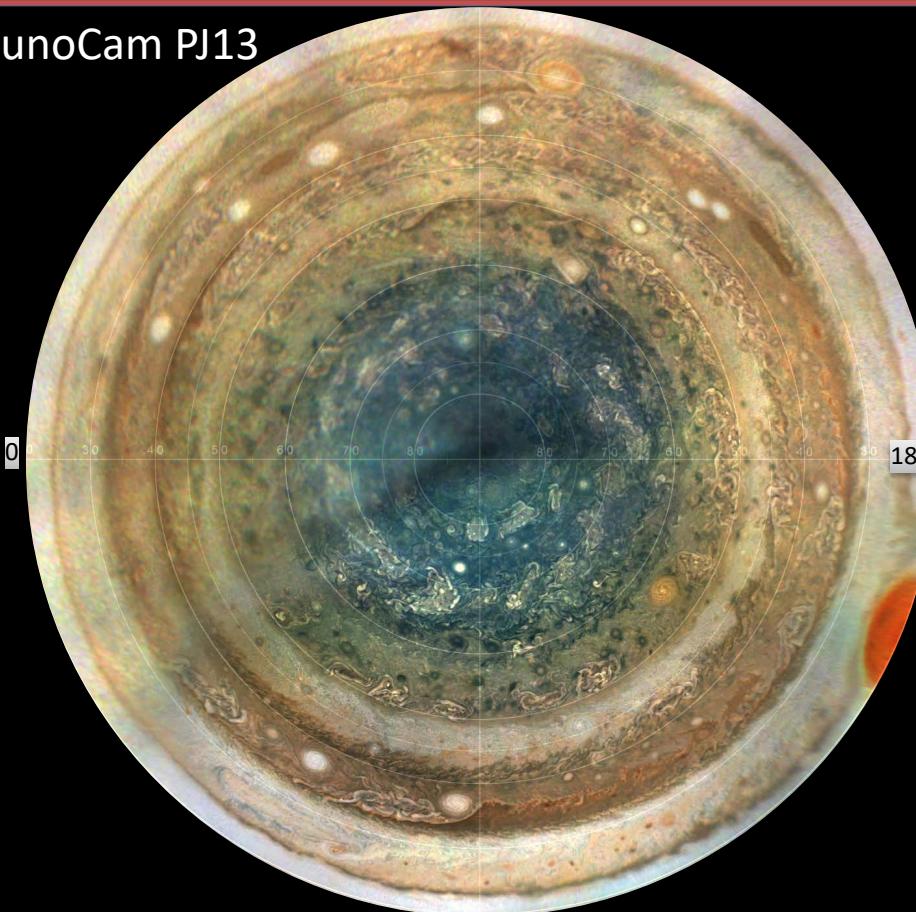
Motivation: Determine Jupiter's Polar Temperatures

- Contrast with **Saturn's seasonal poles**.
- Simultaneity with Juno UV-to-microwave.
 - **Spatial, temporal, spectral** context for Juno.
 - JIRAM 5- μ m coverage limitations.
- **May 2018: VLT** 4-nights; 5-20 μ m imaging coinciding with PJ13 (May 24th).
 - Polar atmosphere from \sim 2 bar to \sim 10 mbar.

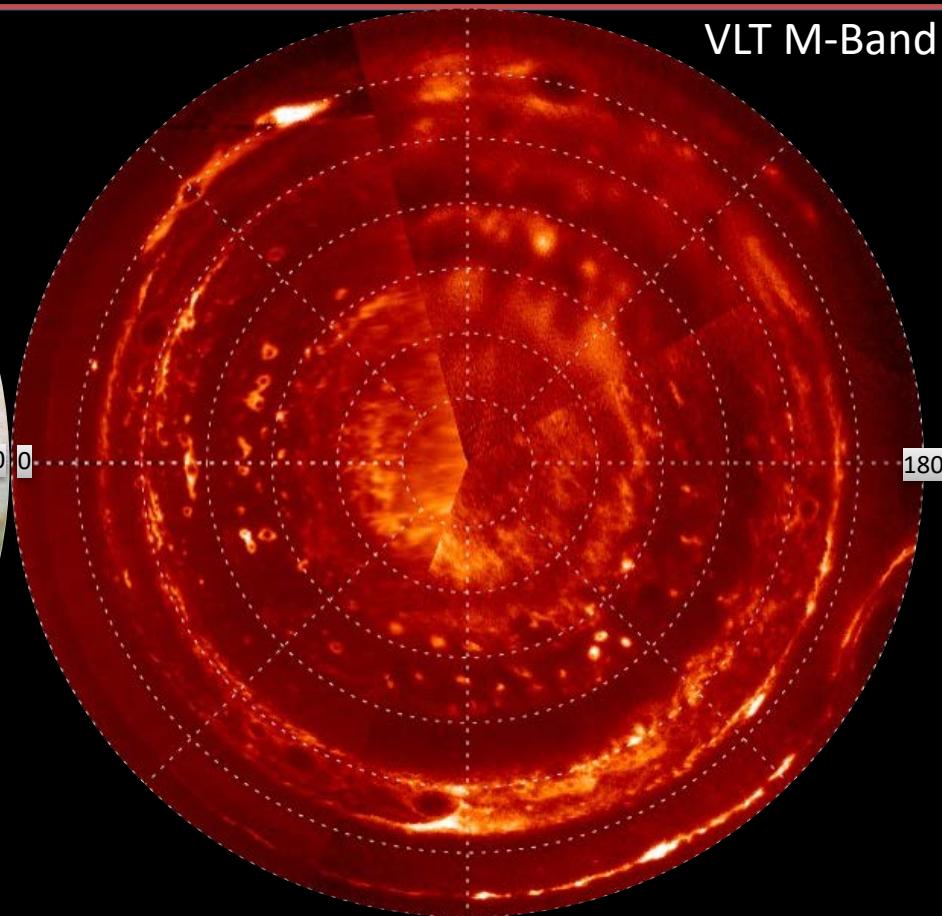


Deep Atmosphere at 5 μ m

JunoCam PJ13

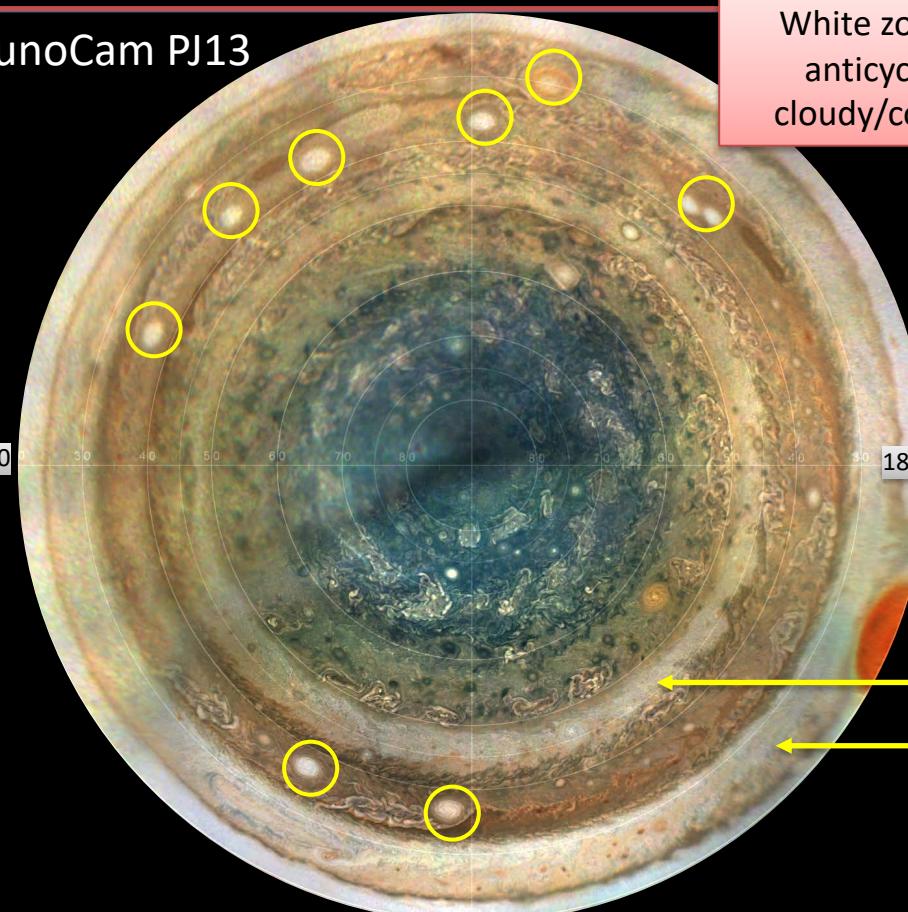


VLT M-Band



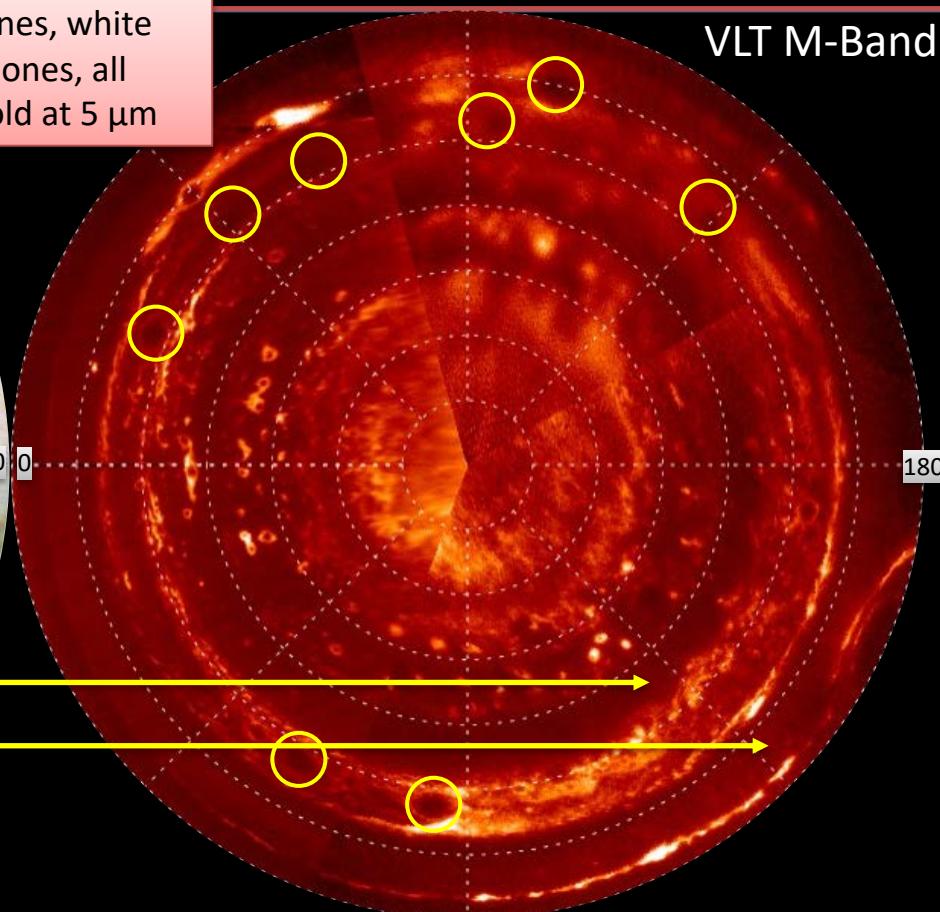
Deep Atmosphere at 5 μ m

JunoCam PJ13



White zones, white
anticyclones, all
cloudy/cold at 5 μ m

VLT M-Band

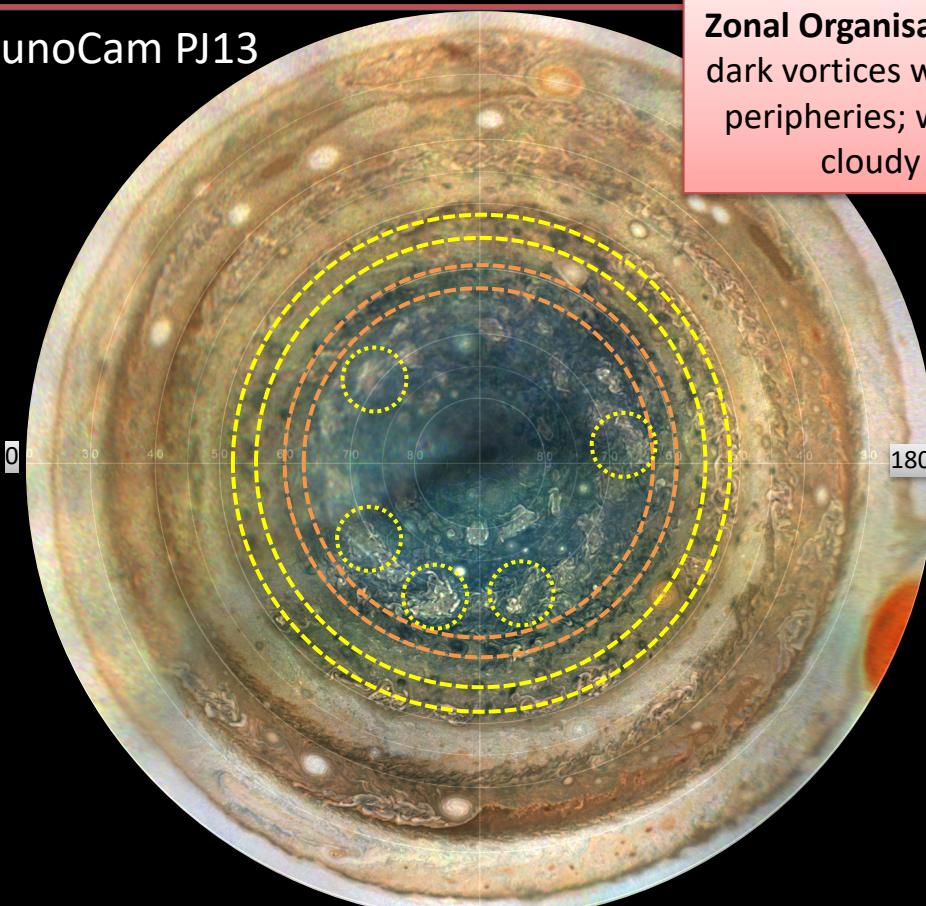


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@LeighFletcher, Poles of Jupiter, DPS #507.1

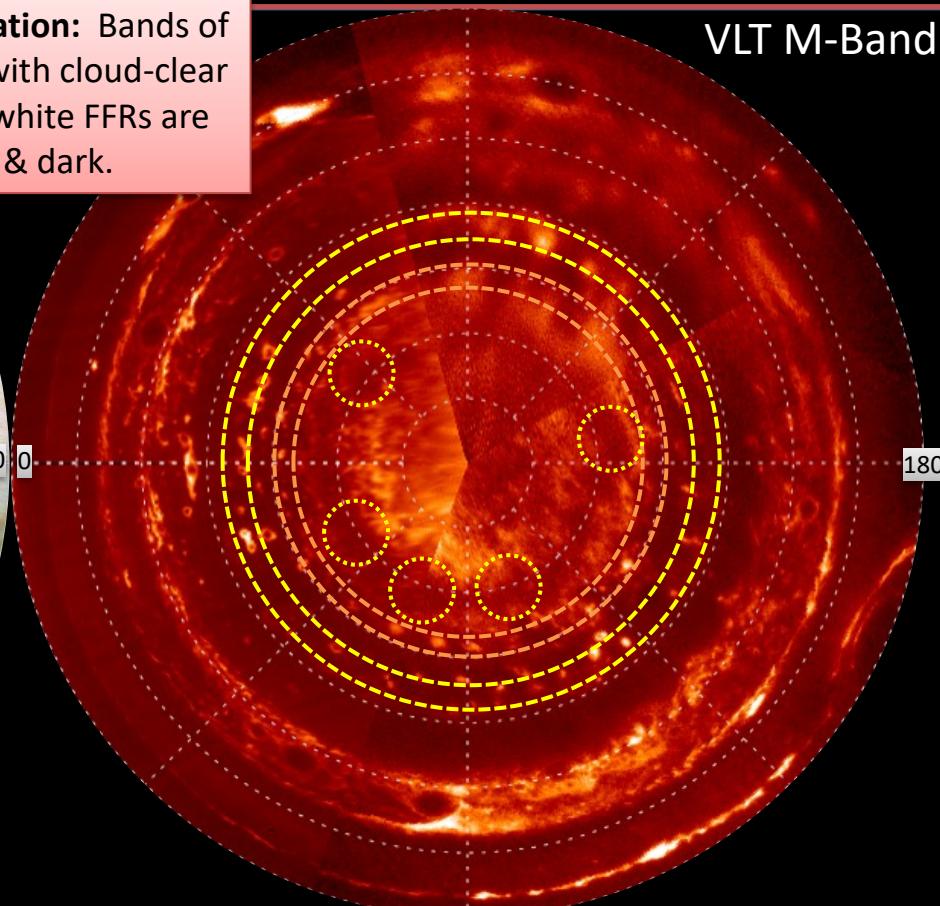
Deep Atmosphere at 5 μ m

JunoCam PJ13



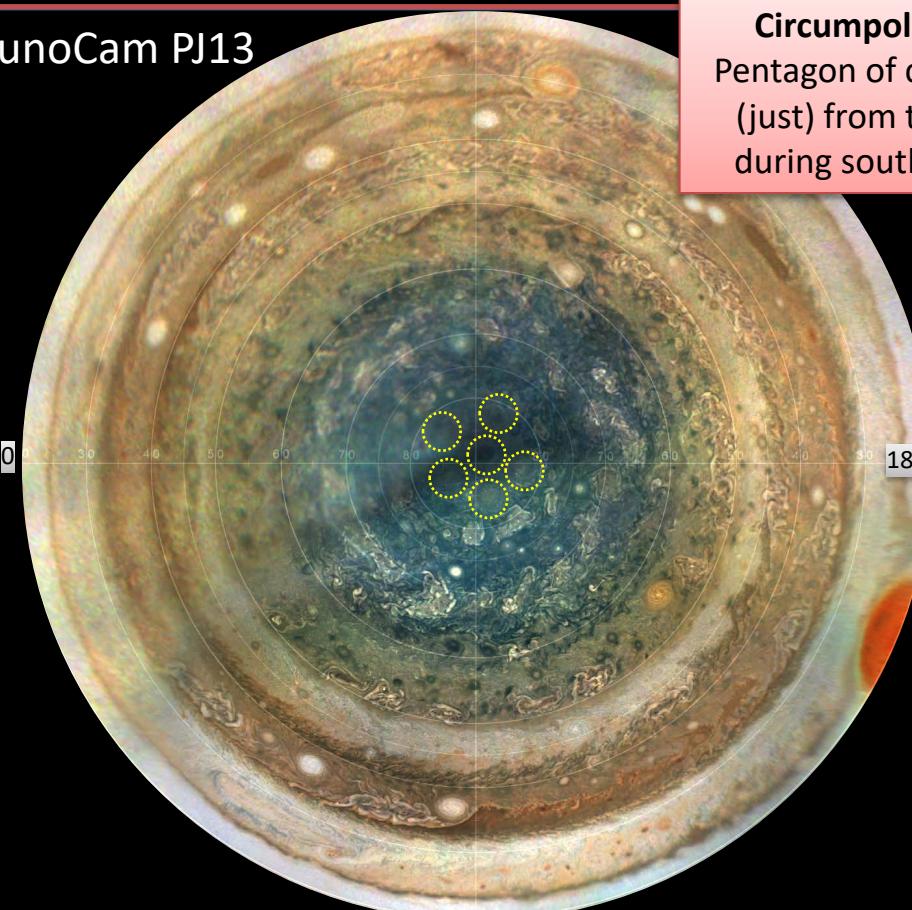
Zonal Organisation: Bands of dark vortices with cloud-clear peripheries; white FFRs are cloudy & dark.

VLT M-Band



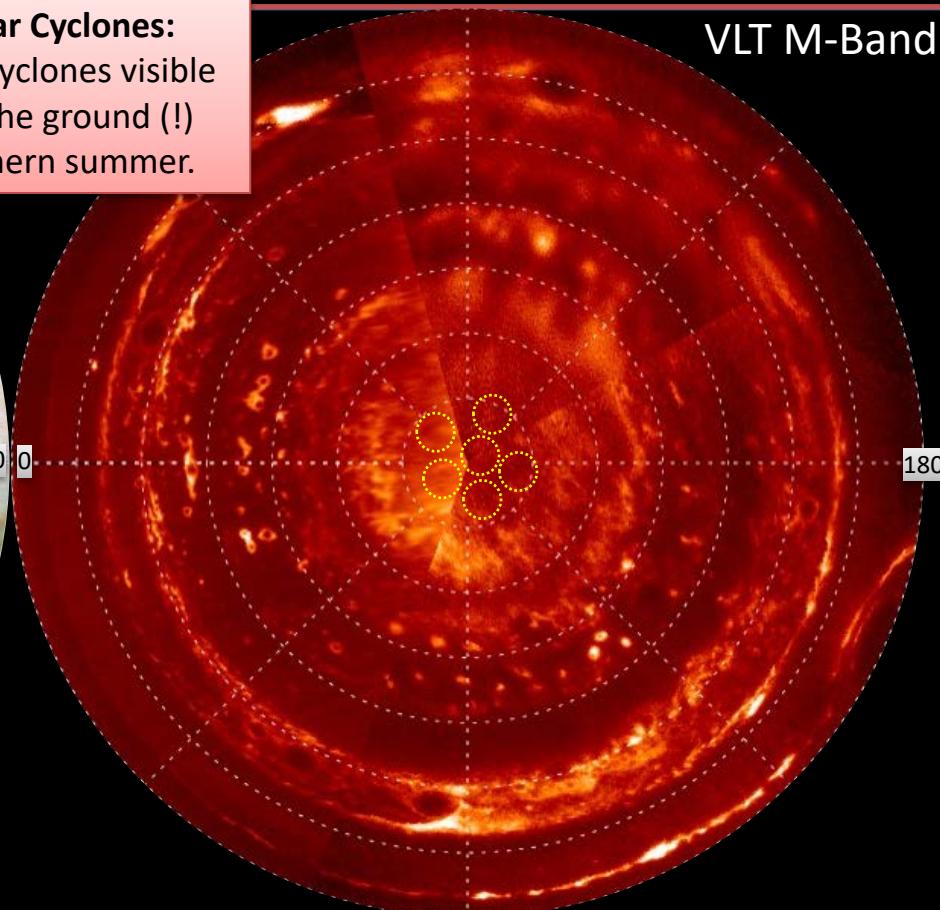
Deep Atmosphere at 5 μ m

JunoCam PJ13

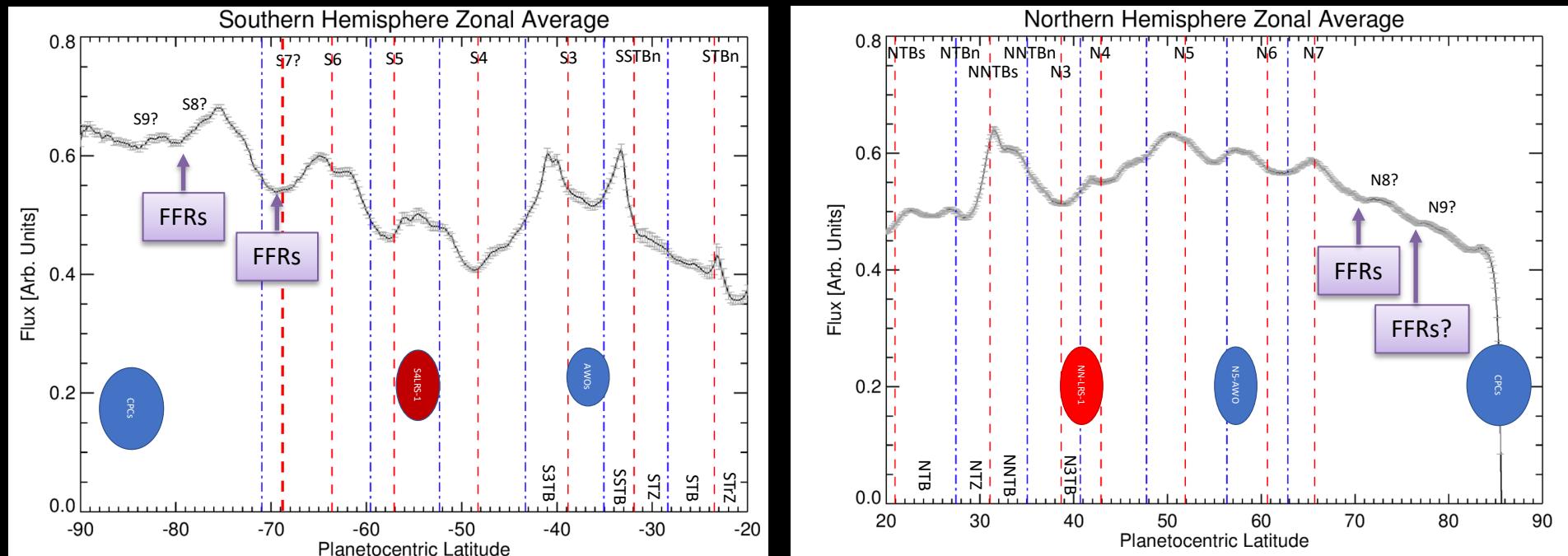


Circumpolar Cyclones:
Pentagon of cyclones visible
(just) from the ground (!)
during southern summer.

VLT M-Band



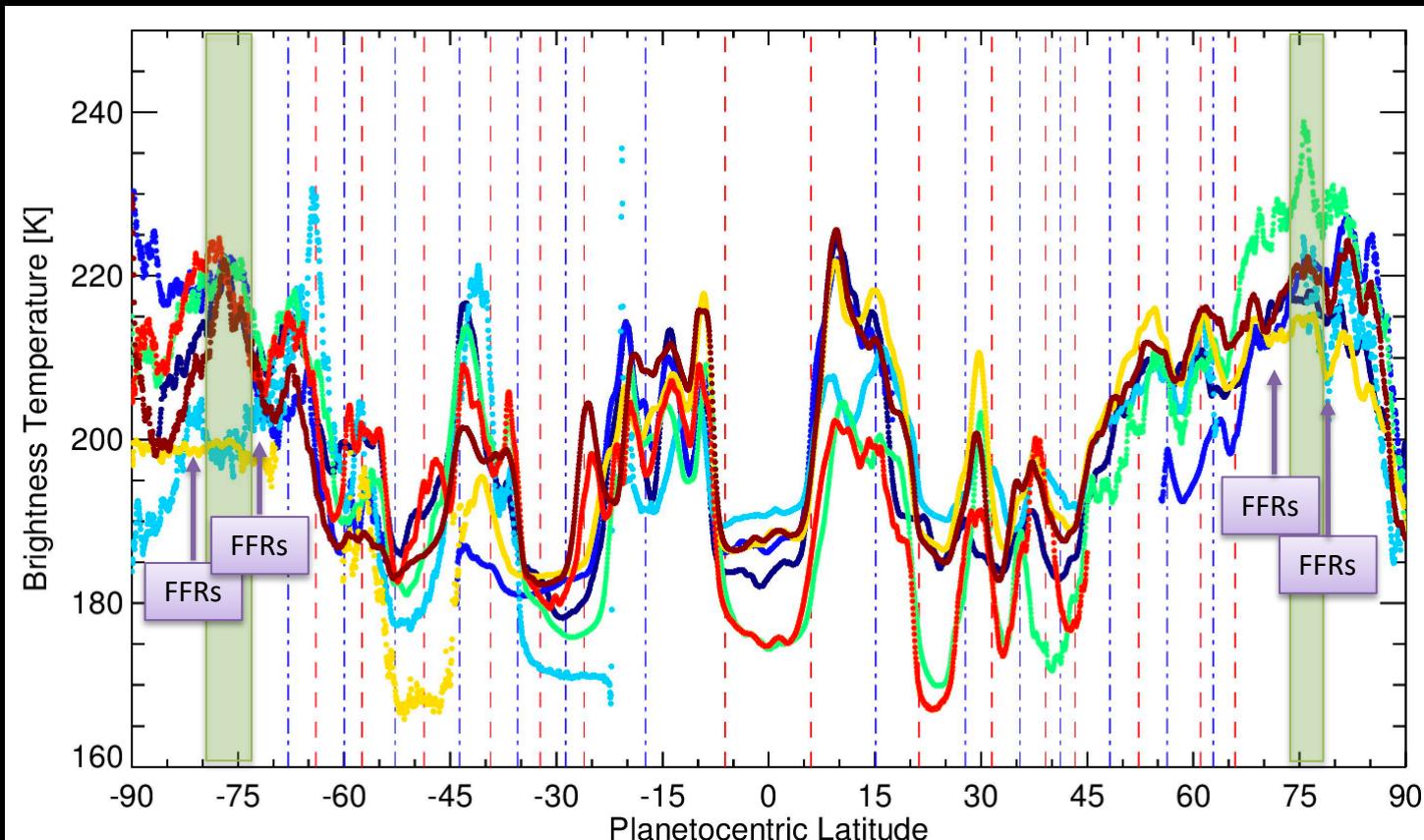
Zonal Organisation Persists to High Latitudes



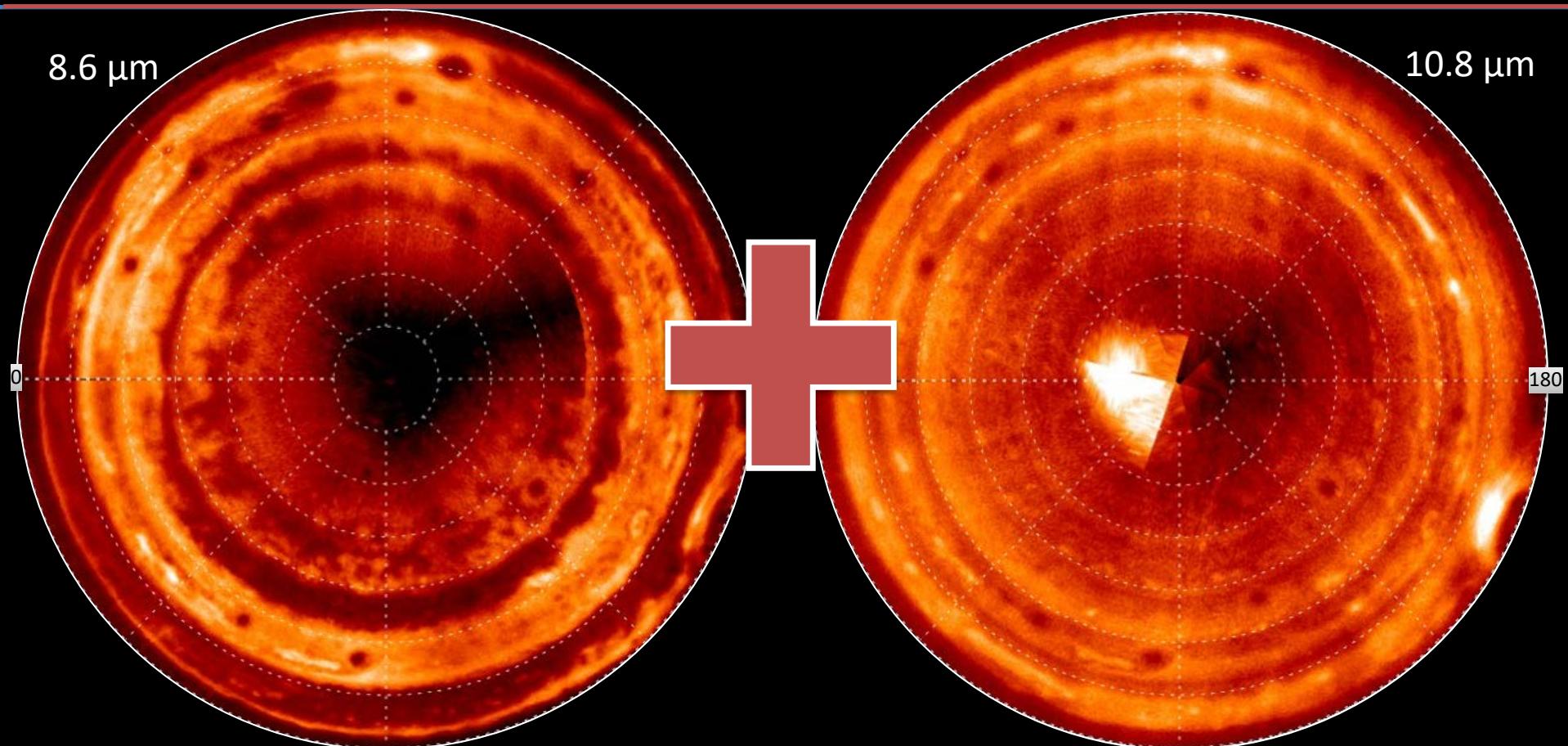
- Cyclonic FFRs appear like sprawling cloudy (dark) disturbances within 5- μ m bright bands.
- Belts have prograde jets (red) on equatorward side; retrograde jet (blue) on poleward side

Zonal Organisation Persists over Time

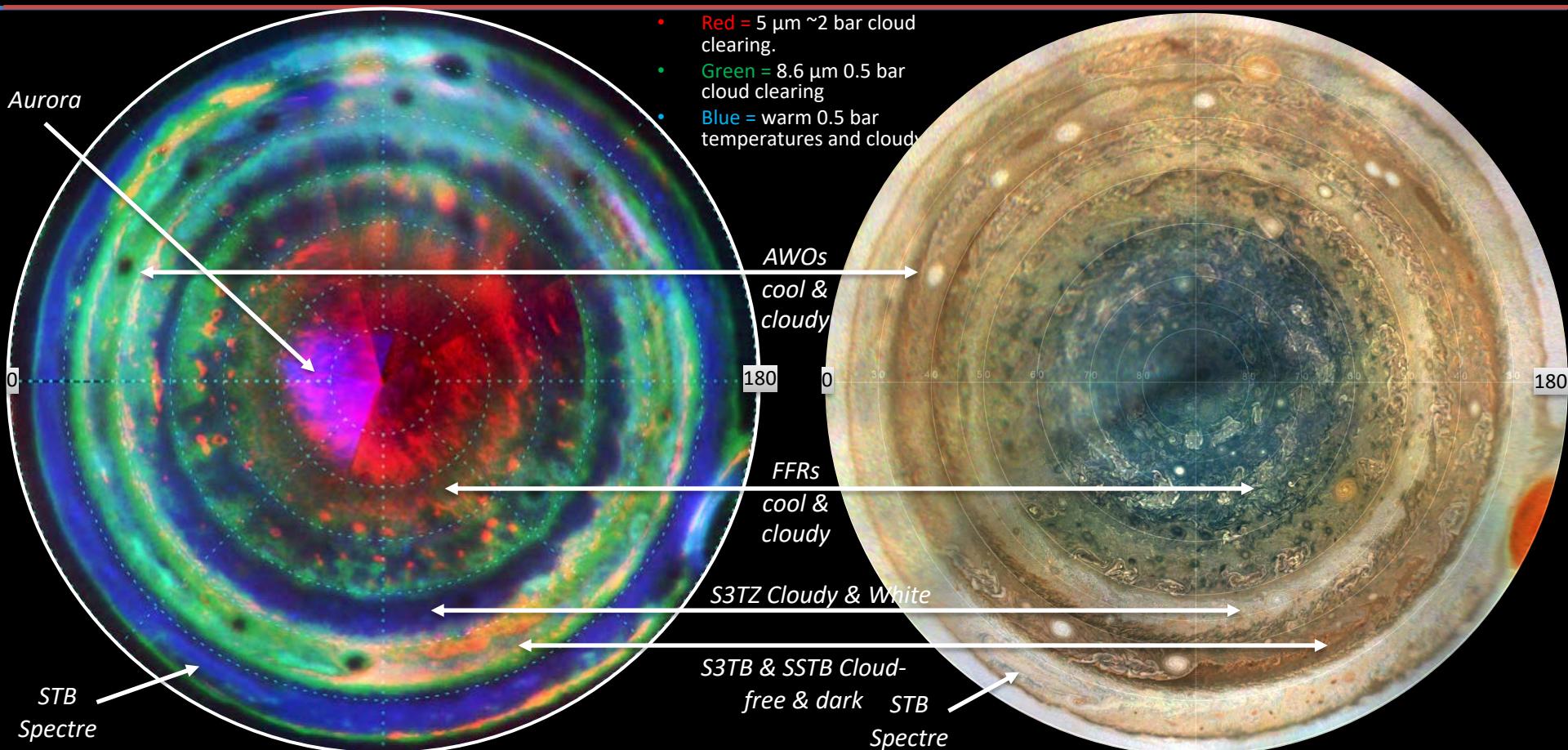
- Juno/JIRAM PJ3-9 time series at 5 μm .
- Dark belts of cyclonic FFRs either side of bright bands 73-77S and 74-78N
 - Weak zonal motions from Cassini.
 - Barrado-Izagirre et al. (2008) suggested oscillating winds poleward of $\pm 70^\circ$
- Reasonably consistent over ~ 1 year.



Tropospheric Clouds/Temperatures at 500 mbar

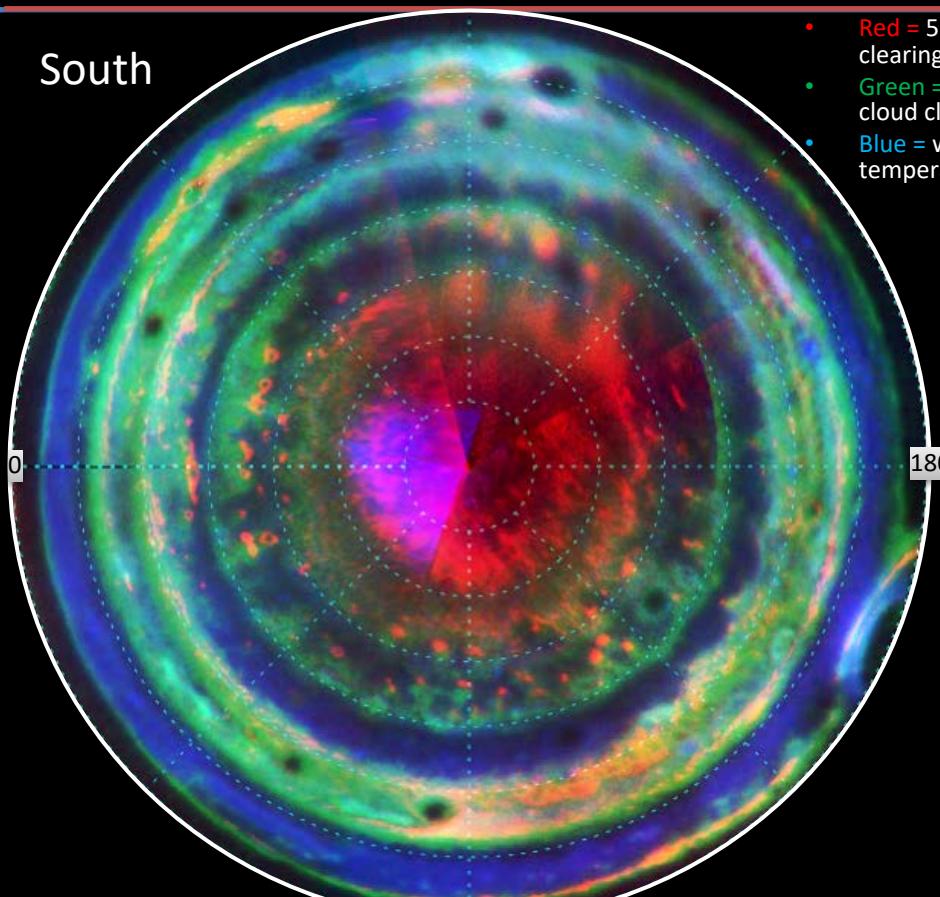


Tropospheric Clouds/Temperatures at 500 mbar



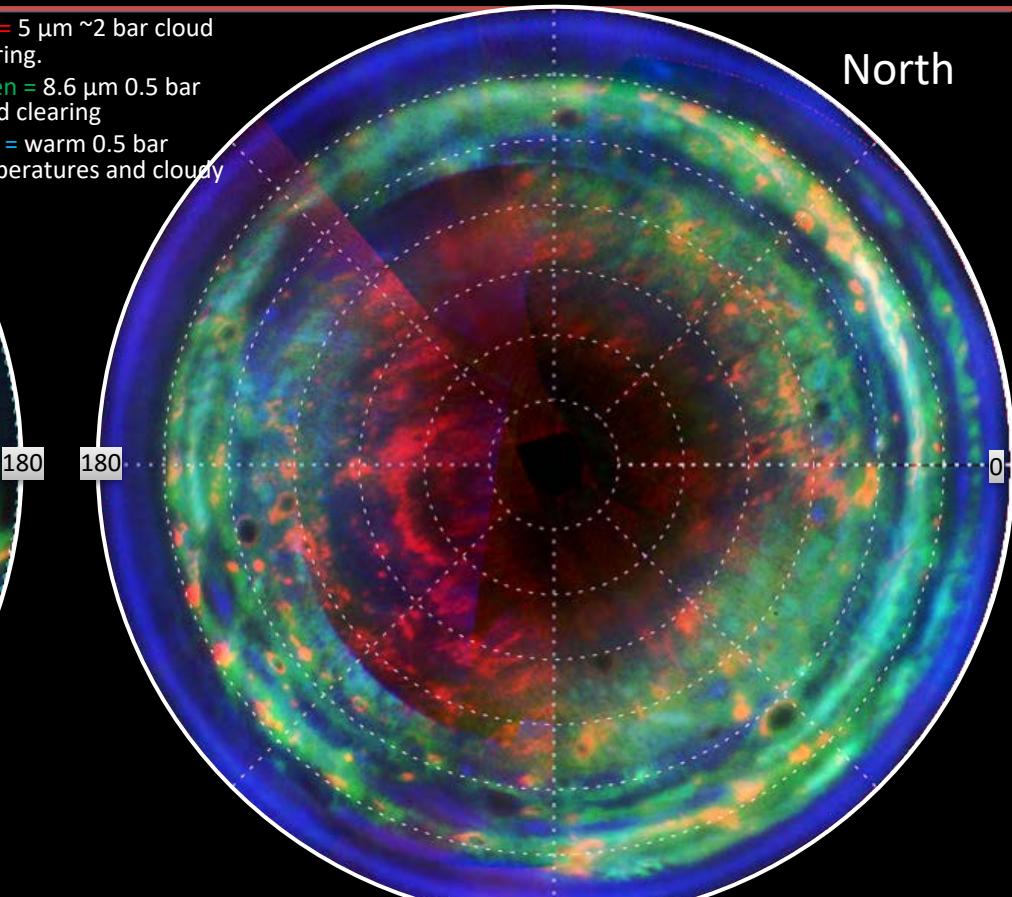
Tropospheric Clouds/Temperatures at 500 mbar

South



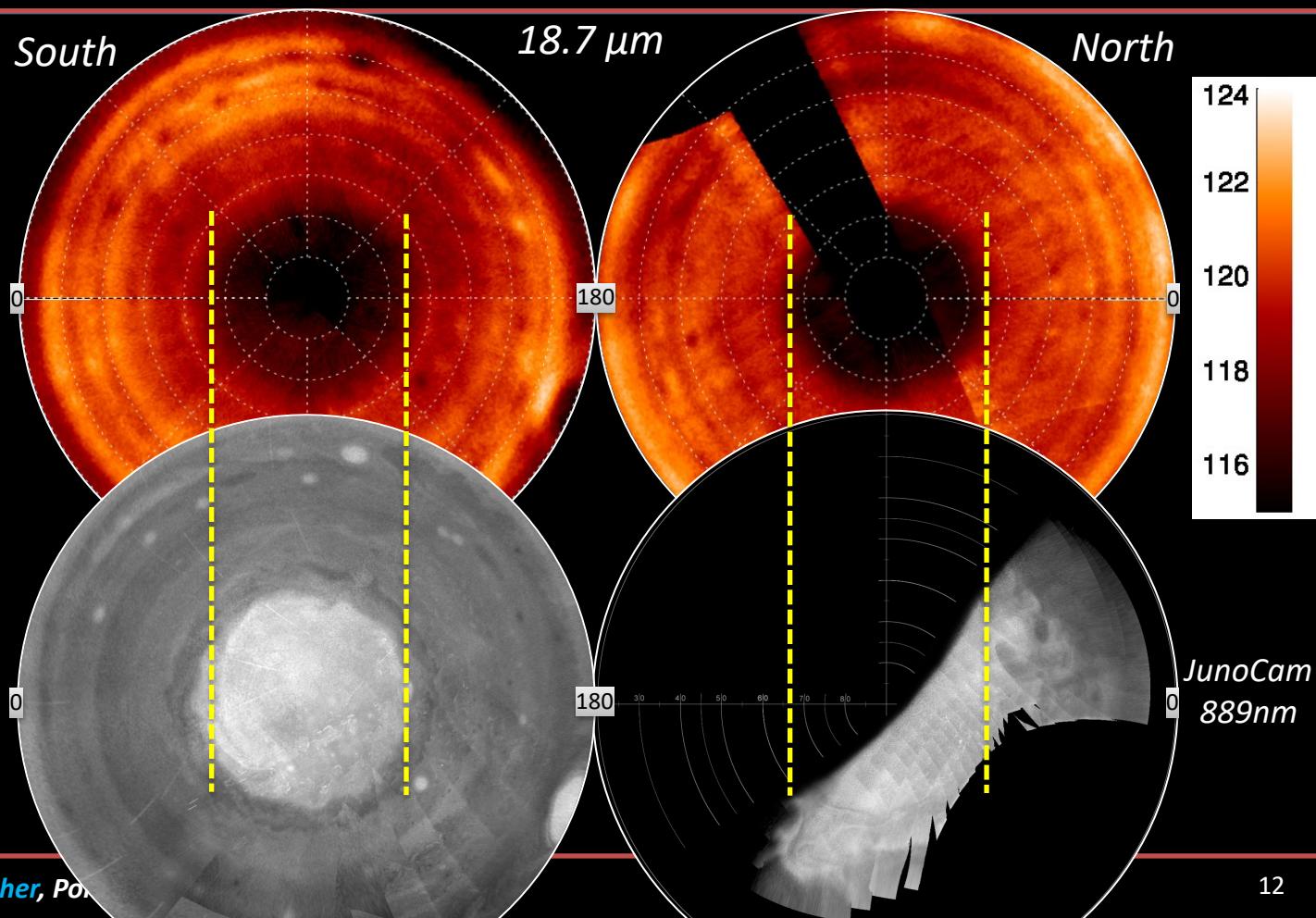
- Red = $5 \mu\text{m}$ ~2 bar cloud clearing.
- Green = $8.6 \mu\text{m}$ 0.5 bar cloud clearing
- Blue = warm 0.5 bar temperatures and cloudy

North



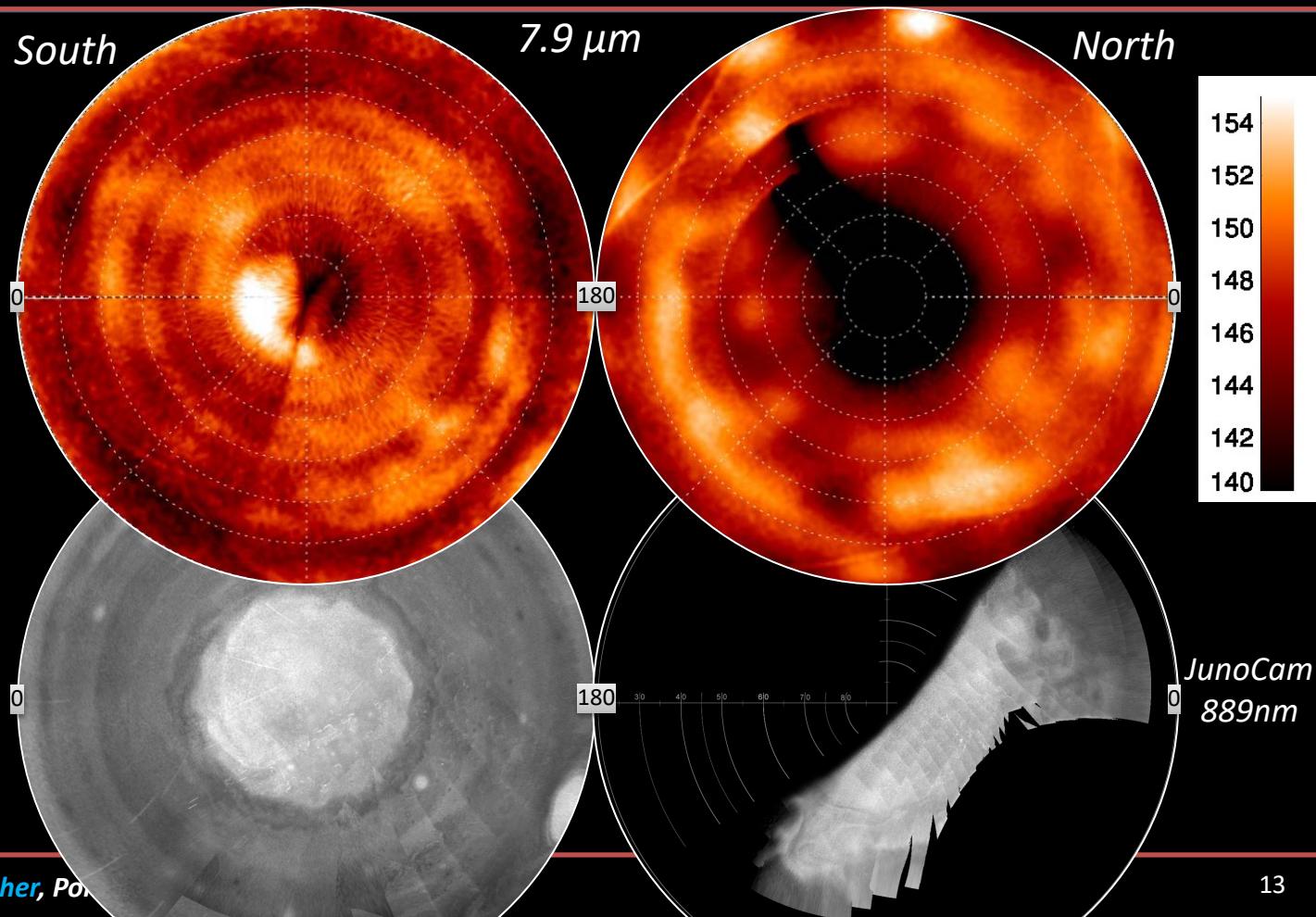
Tropopause Temperatures – Cold Polar Vortices

- Cold anticyclones reach high; cyclones not evident.
- Distinct cold polar vortices poleward of N⁷TBs (65.9N) and S⁶TBn (64.0S).
 - $du/dz > 0 \rightarrow$ strengthen prograde flow with height.
- Northern vortex distinct but no correlation with JunoCam CH4-band images.
 - Radiative cooling, constrained by eastward jet.
 - Denser NPH than shown by JunoCam?



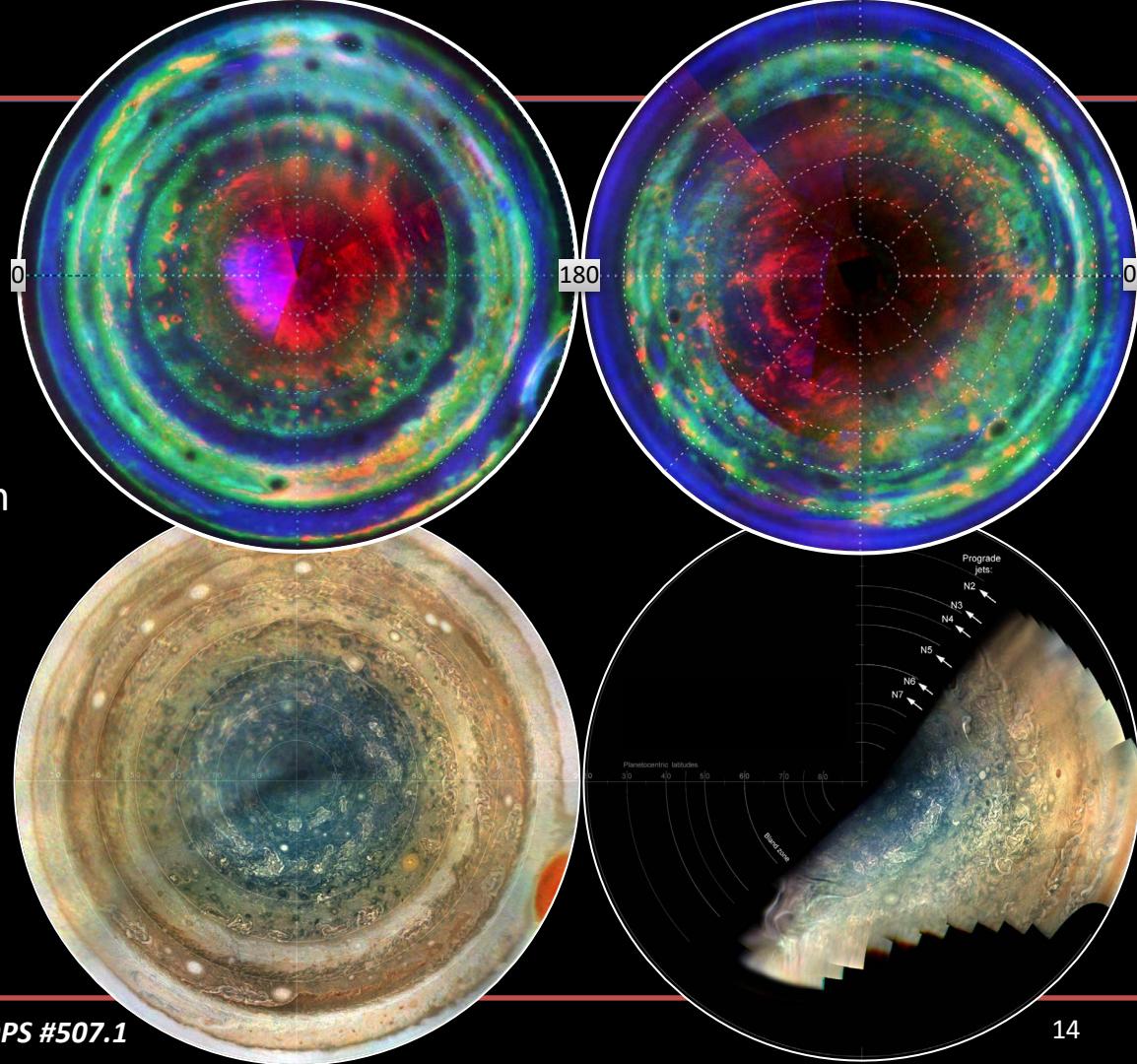
Stratospheric Temperatures

- Benefit from **absence of northern auroral emission**:
 - “Switched off” since Jan’17
- Cold cap persists to ~20 mbar; consistent with radiative cooling.
- But **no close association** with 890-nm aerosols.
- Intense **wave activity** in the north, more zonal organization in the south.



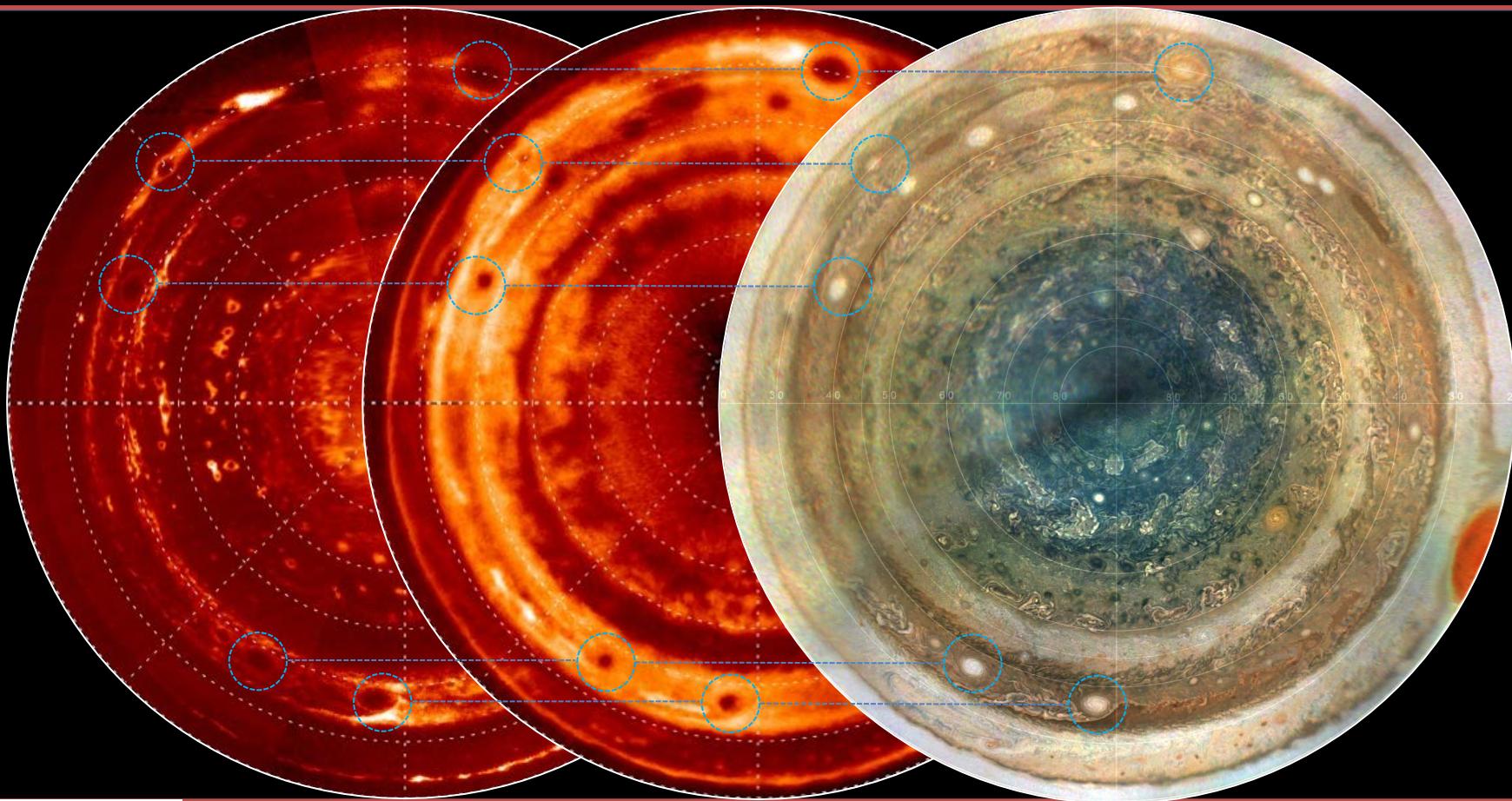
Conclusions

- **Zonal organization** of 5- μm emission (cyclonic FFRs, small vortices) visible to high latitudes.
- **Polar cyclones** visible (just) from Earth.
- Aerosol coverage and T vary considerably with height (5, 8.6, 10.7, 18.6 μm).
- Radiatively-cooled **polar vortices** from 20-500 mbar poleward of 64-67° jets (positive windshear), disconnected from aerosol distribution (?).
 - Opposite of Saturn's seasonally-warmed warm polar vortices (negative windshear).
- **Questions:**
 - *Does MWR see the same high-latitude banding?*
 - *Spectral differences between FFRs, cyclones, and brighter bands?*

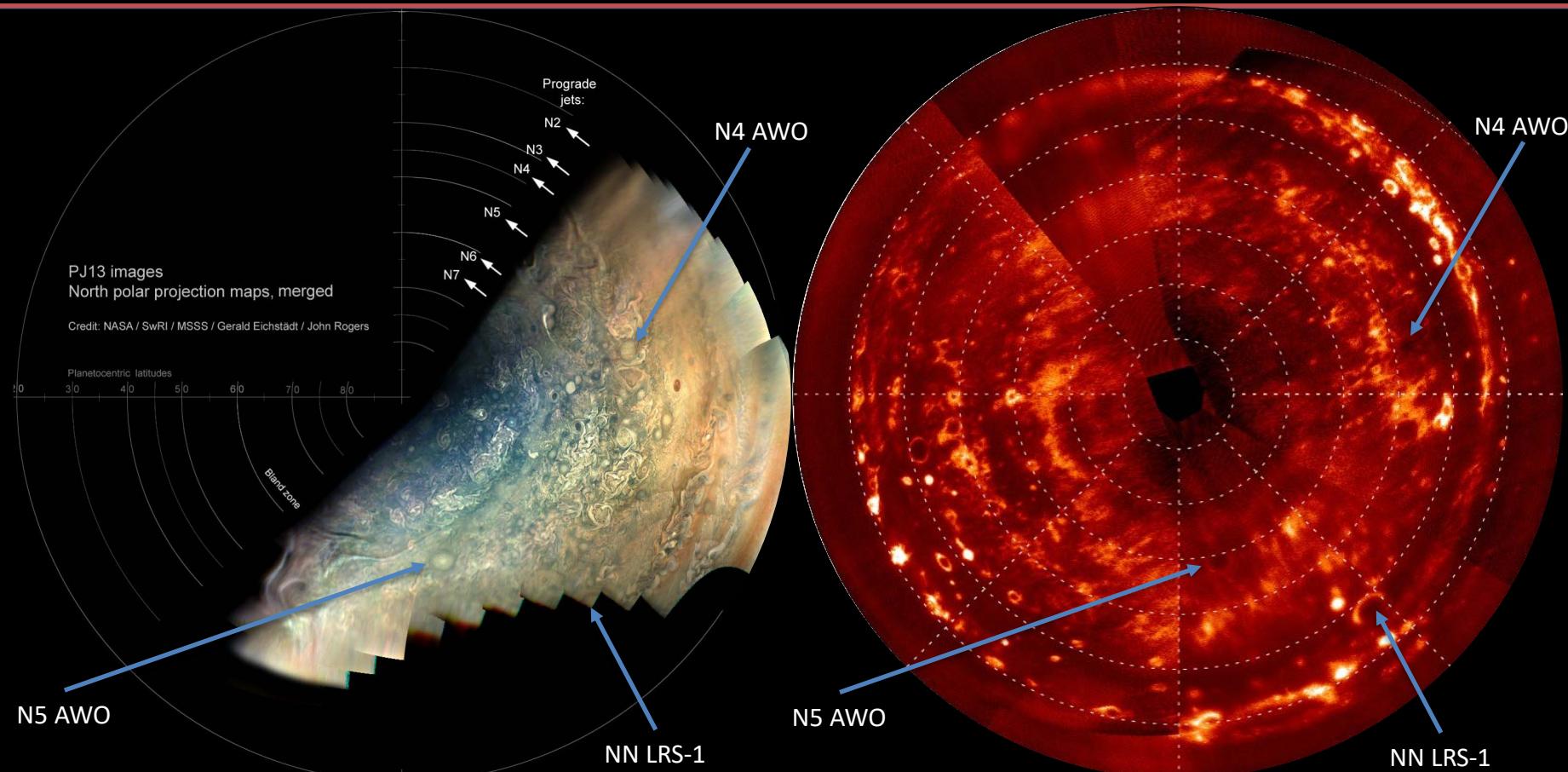


Backup Material

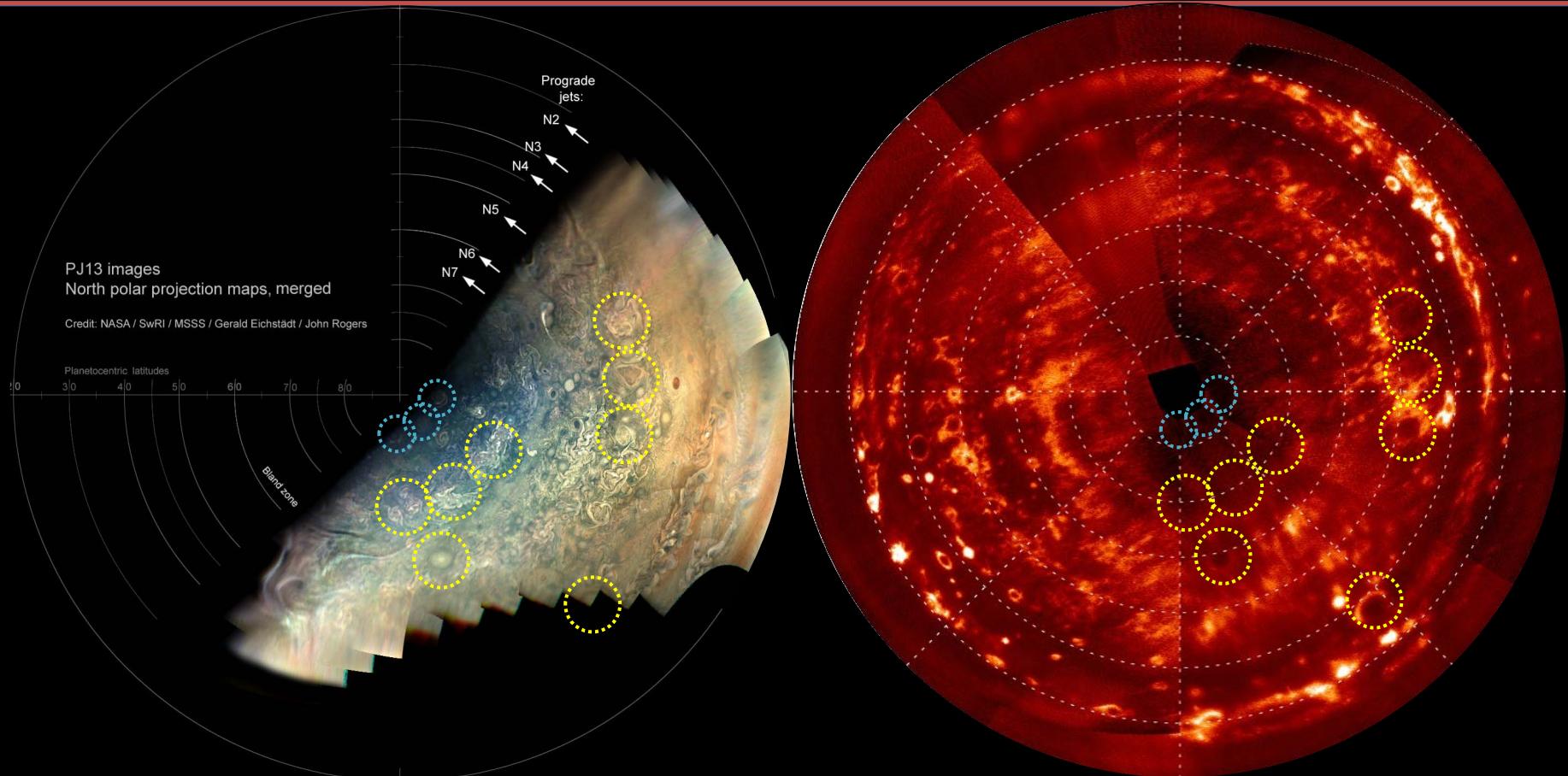
Vortex Size Changes with Height



North Pole at 5 μ m



North Pole at 5 μ m



Barrado-Izagirre: HST and Cassini

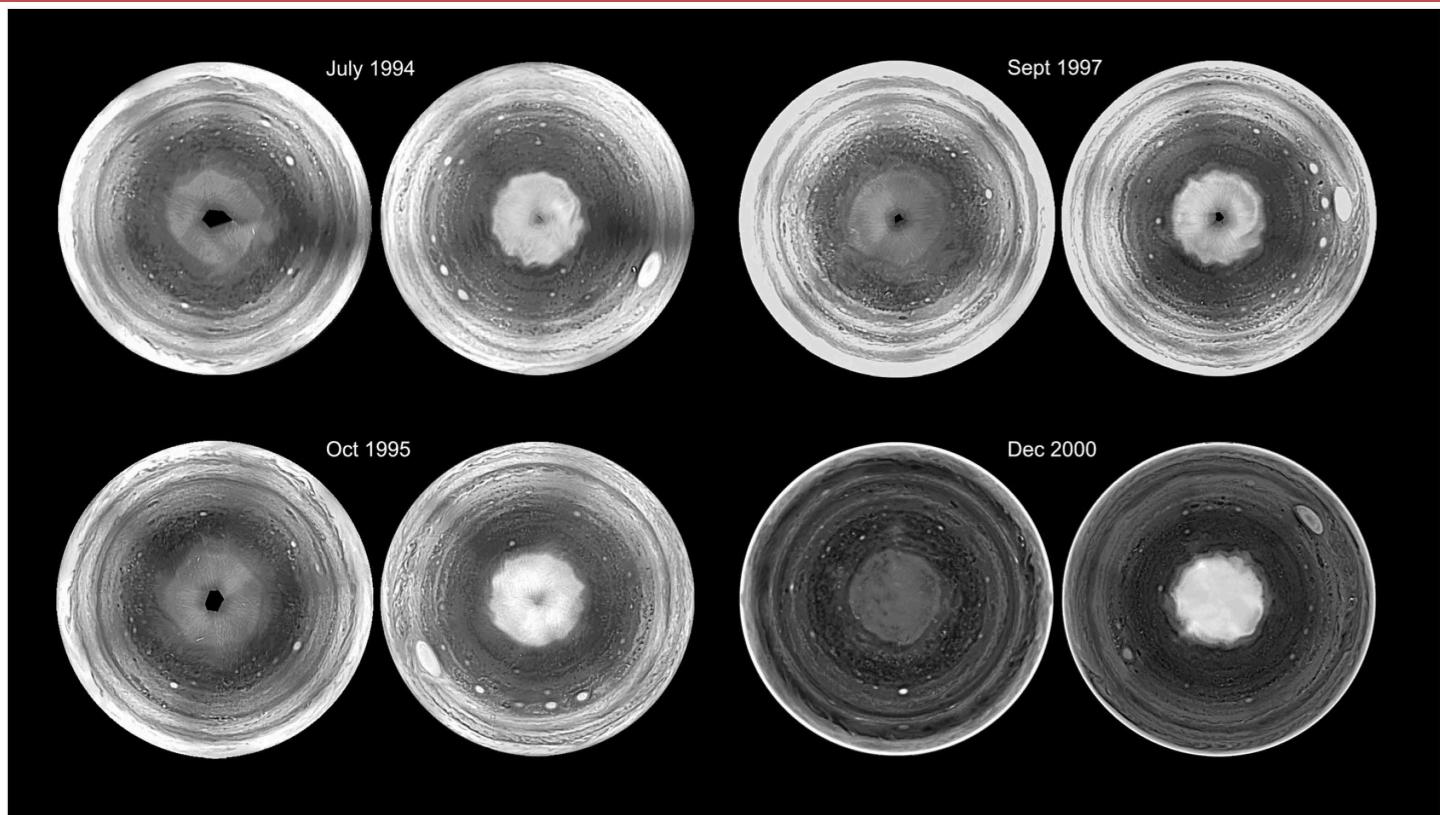


Fig. 6. Polar projections from 0° to 90° over the 1994–2000 periods. HST images through 1994 to 1997 and Cassini images in 2000 were used to study the characteristics of the polar hazes. For each year north polar projections are on the left and south polar projections are on the right. Cassini images were photometrically corrected using the CISSCAL software and a Lambert scattering correction.