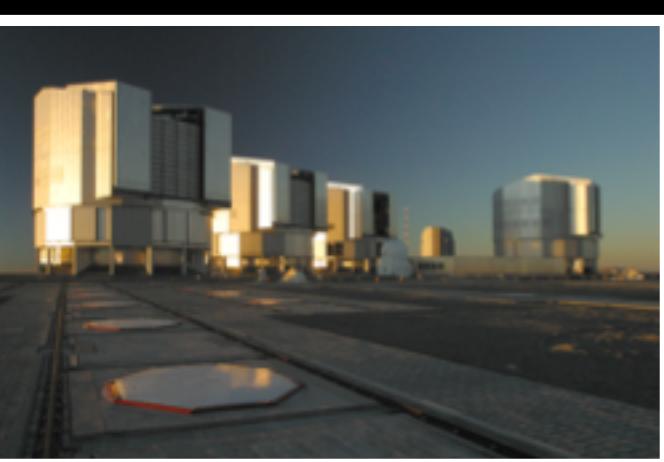


Mid-Infrared Support for Juno's Perijoves 2016-2018



@LeighFletcher, P.T. Donnelly,
A. Antunano, H. Melin, G.S.
Orton, J.A. Sinclair, M. Roman,
J. Blake, T.K. Greathouse



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Motivation: Temperatures during Juno Epoch

- **Mid-IR Sounding:**

- Temperature & windshear 1-700 mbar
- Aerosol Opacity
- Composition: volatiles (NH_3), disequilibrium (PH_3 , para- H_2), photochemical (CxHy).
- “Boundary conditions” for MWR/UVS.
- Comparisons for JunoCam/JIRAM

- **Rewind 3 years:**

- Juno workshop in 2015 (DPS National Harbor)
- Mid-IR 5-25 μm M, N and Q-bands
- VLT/VISIR; Subaru/COMICS; IRTF/TEXES

<http://bit.ly/1QzYlov>

White Paper: Juno and ESO

Joint Exploration of Jupiter by Juno and ESO (2016-2018)

A White Paper Submitted to the ESO Director of Science

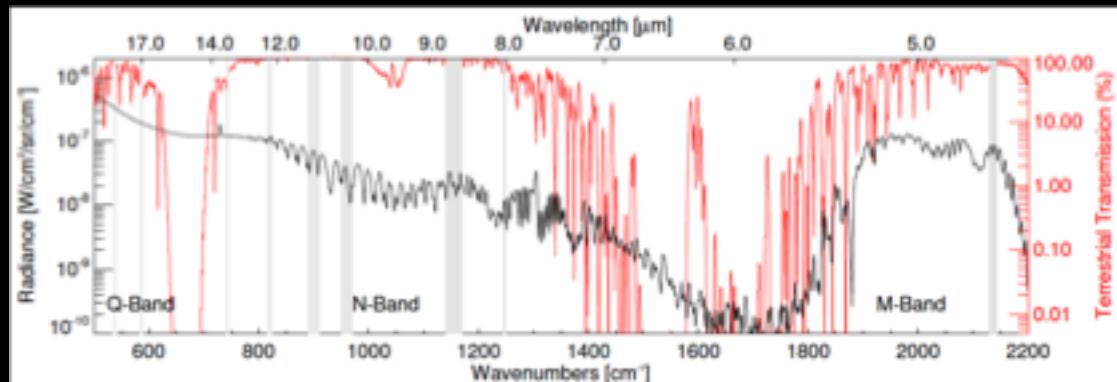
L.N. Fletcher¹, G.S. Orton², A. Adriani³, G. Bjoraker⁴, S. Casewell⁵, S. Cowley⁶, I. de Pater⁶, T. Encrernaz⁷, D. Grassi³, S. Guerlet⁸, B. Hesman⁴, R. Hueso⁹, P. Irwin¹, M. Janssen¹, S. Perez-Hoyos⁹, K. Retherford¹⁰, A. Sanchez-Lavega⁹, A. Simon⁴, J. Sinclair², T. Stallard⁵, N. Teanby¹¹, O. Witasse¹²



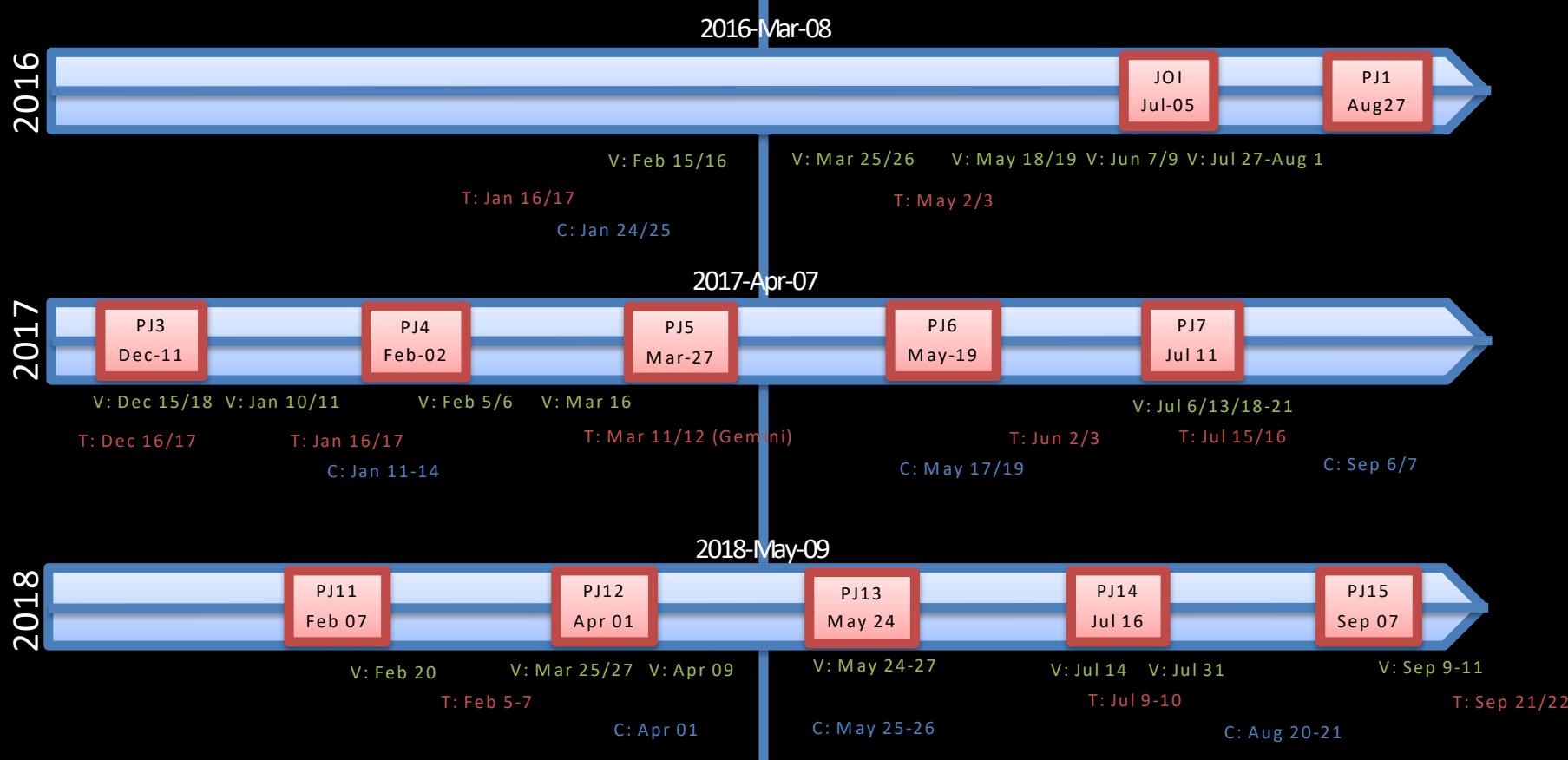
Spatial and temporal context



Complementary wavelengths

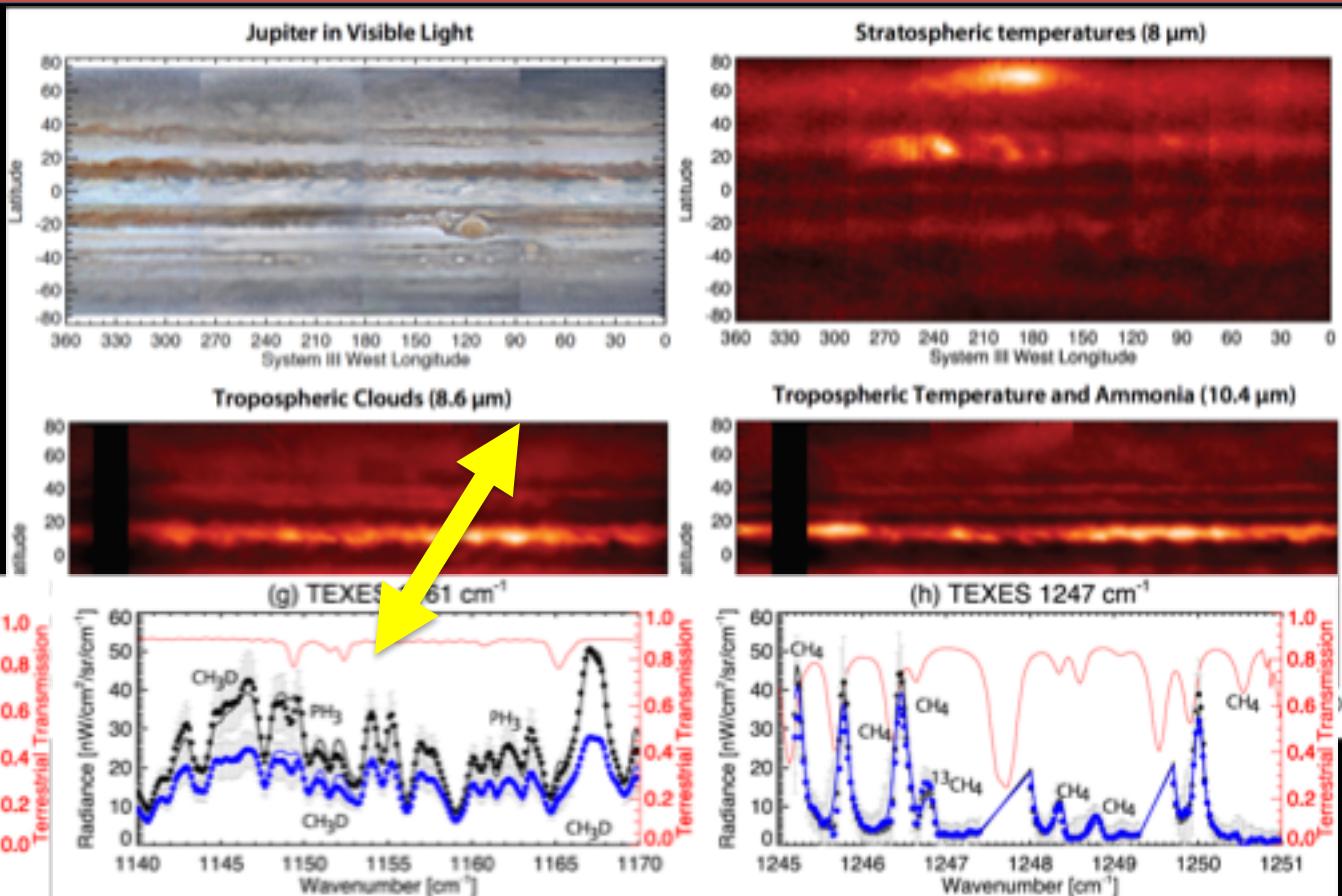


Mid-IR Data Availability



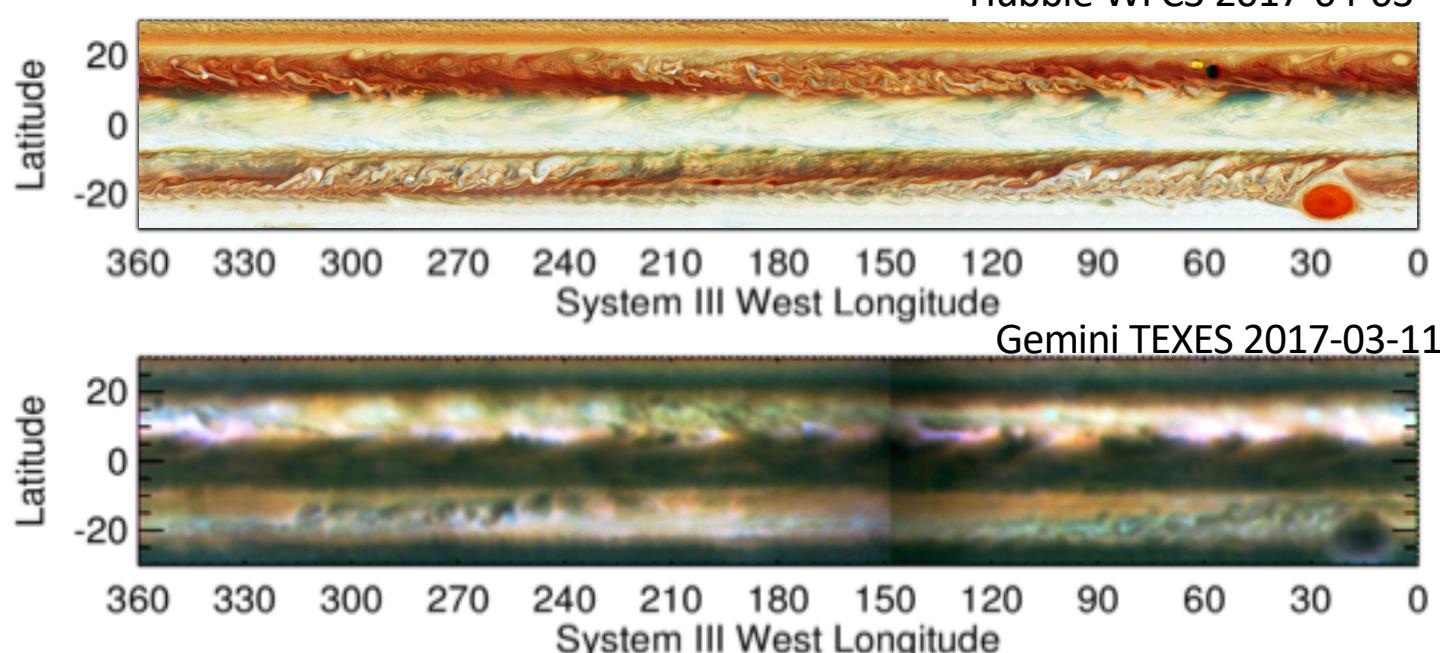
Results I: TEXES on the IRTF

- Global mapping from 3-m IRTF/TEXES in eight settings:
 - *Fletcher et al. (2016)*, *arXiv:1606.05498*
 - *Melin et al. (2018)*, *arXiv: 1801.00652*



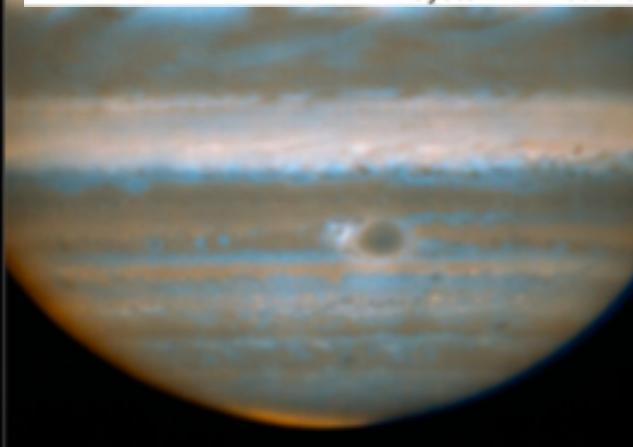
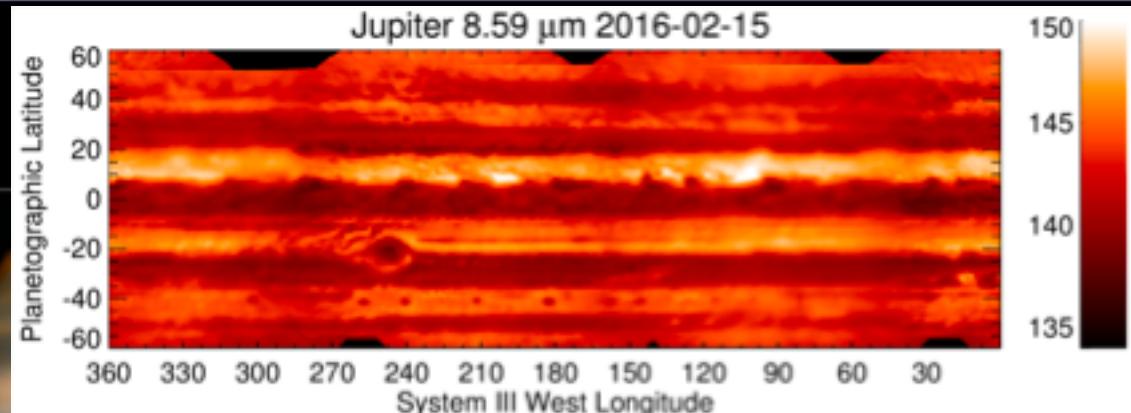
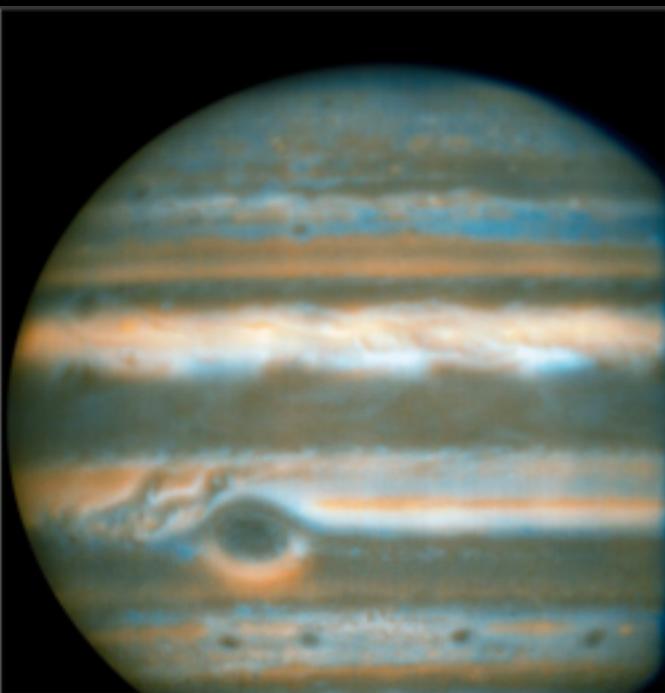
Results II: TEXES Moves to Gemini

Hubble WFC3 2017-04-03



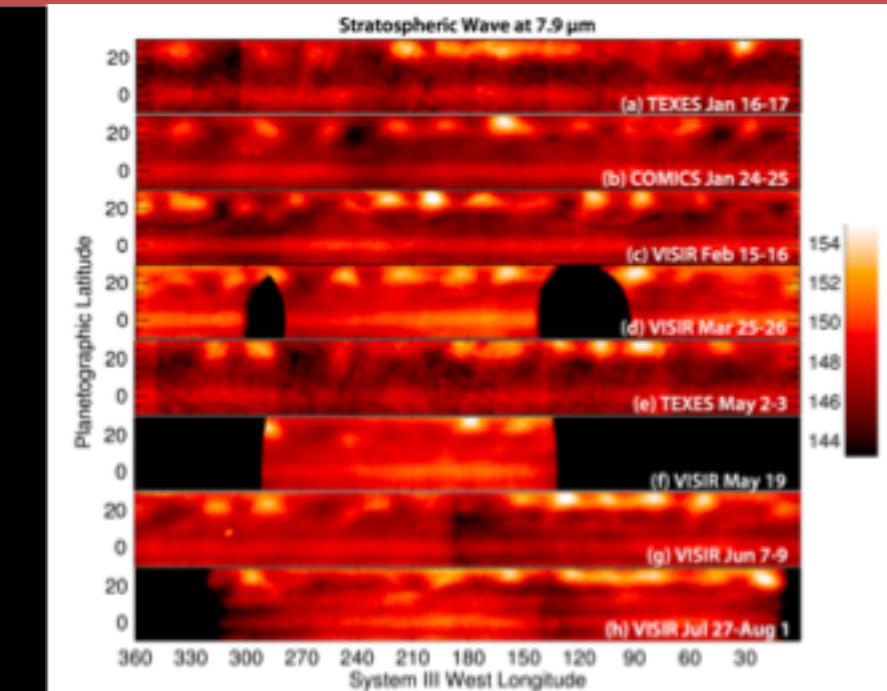
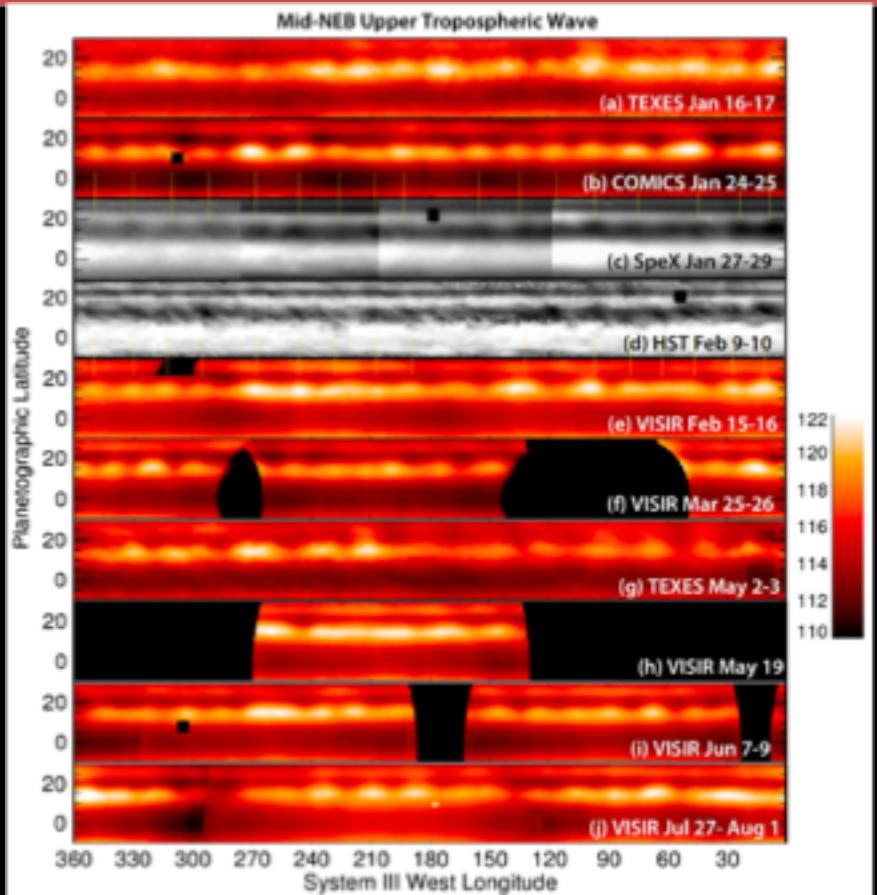
- Moved TEXES from IRTF to Gemini in 2017.
- Between PJ4 and PJ5.
- Highest-resolution thermal maps ever obtained from Earth, paper in prep.

Results III: VISIR Record



- 7-20 μm filtered imaging close to each PJ 2016-18.
- Thesis work: P.T. Donnelly
- Visitor mode in May 2018 (PJ13).
 - Polar Maps in multiple wavelengths – see talk 507.1 (Friday)

Results IV: NEB Variability and Thermal Waves

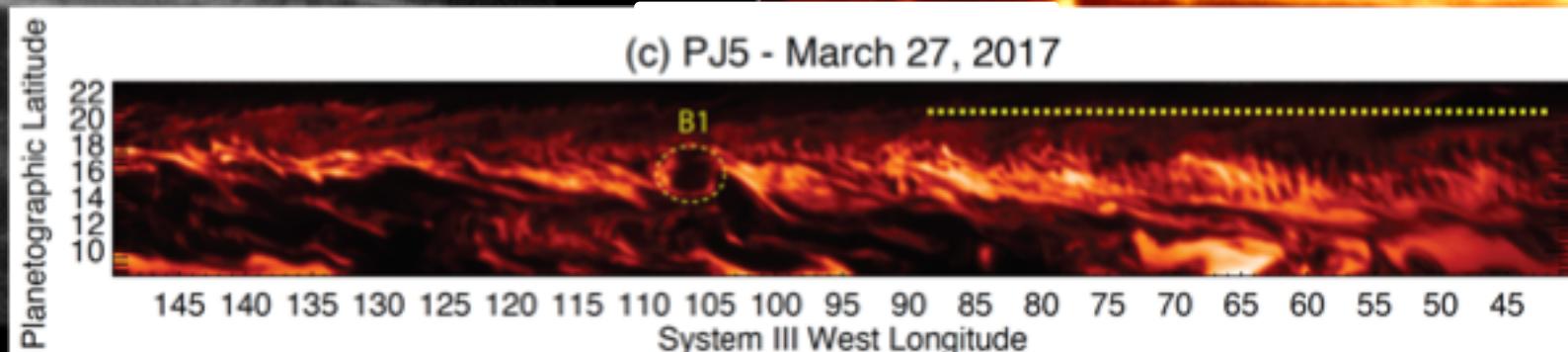


- NEB Expansion Cycle (3-5yr)
- Spawned tropospheric NEB thermal wave.
- Possibly related stratospheric NTBs wave.
- Fletcher et al. 2017, (arXiv:1708.05179)

Results V: Mesoscale Waves (VLT, HST, Juno)

VLT/VISIR M-Band Burst
2017-01-11T08:30 (82W) North

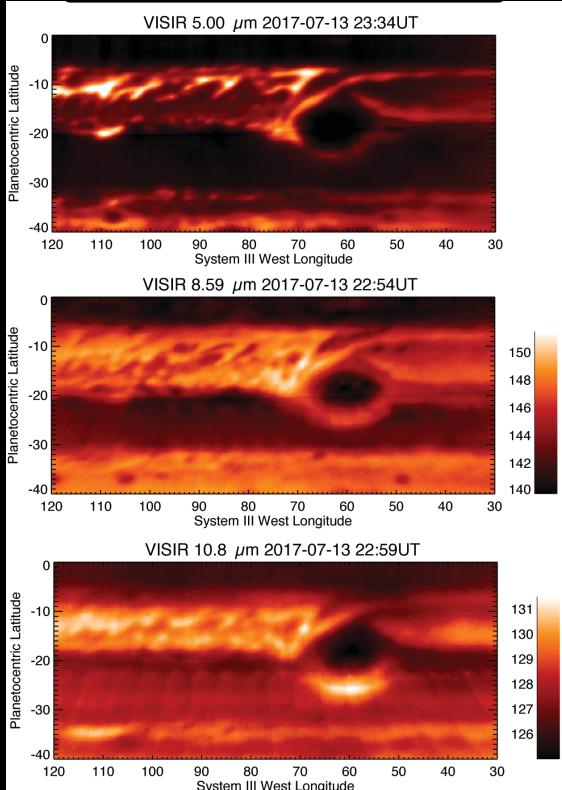
- Fletcher et al. 2018 (arXiv: 1807.10484)
- Simon et al. 2018 (arXiv: 1807.10692)
- Adriani et al. 2018



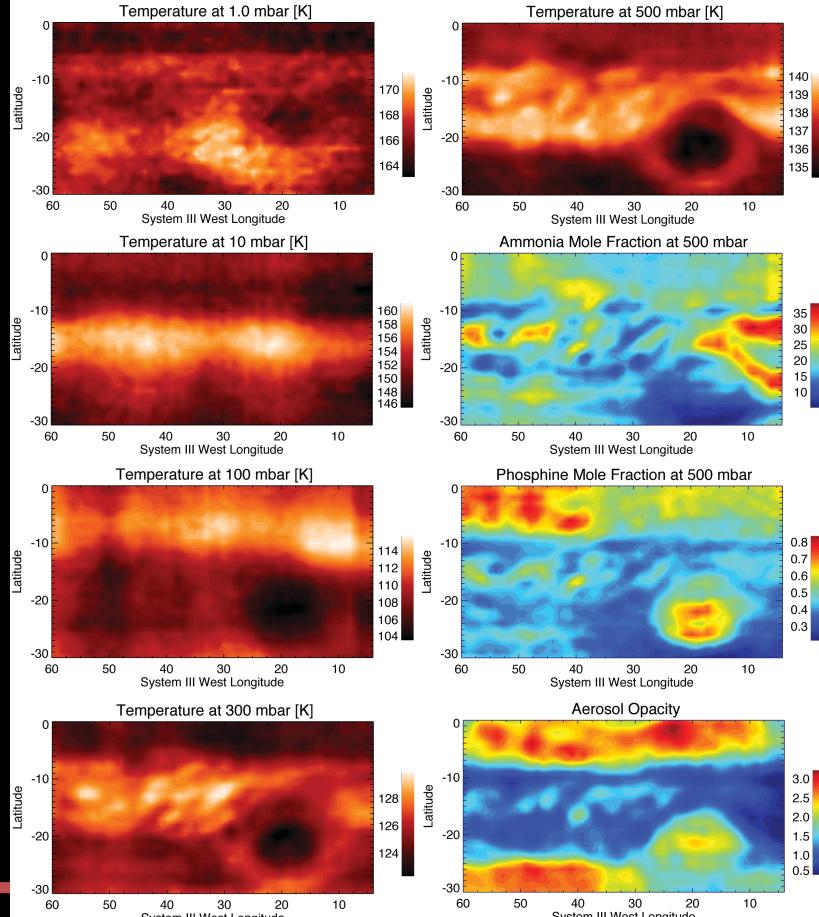
Result VI: Great Red Spot

Gemini/TEXES – Mar 11th

VLT/VISIR – July 13th 2017



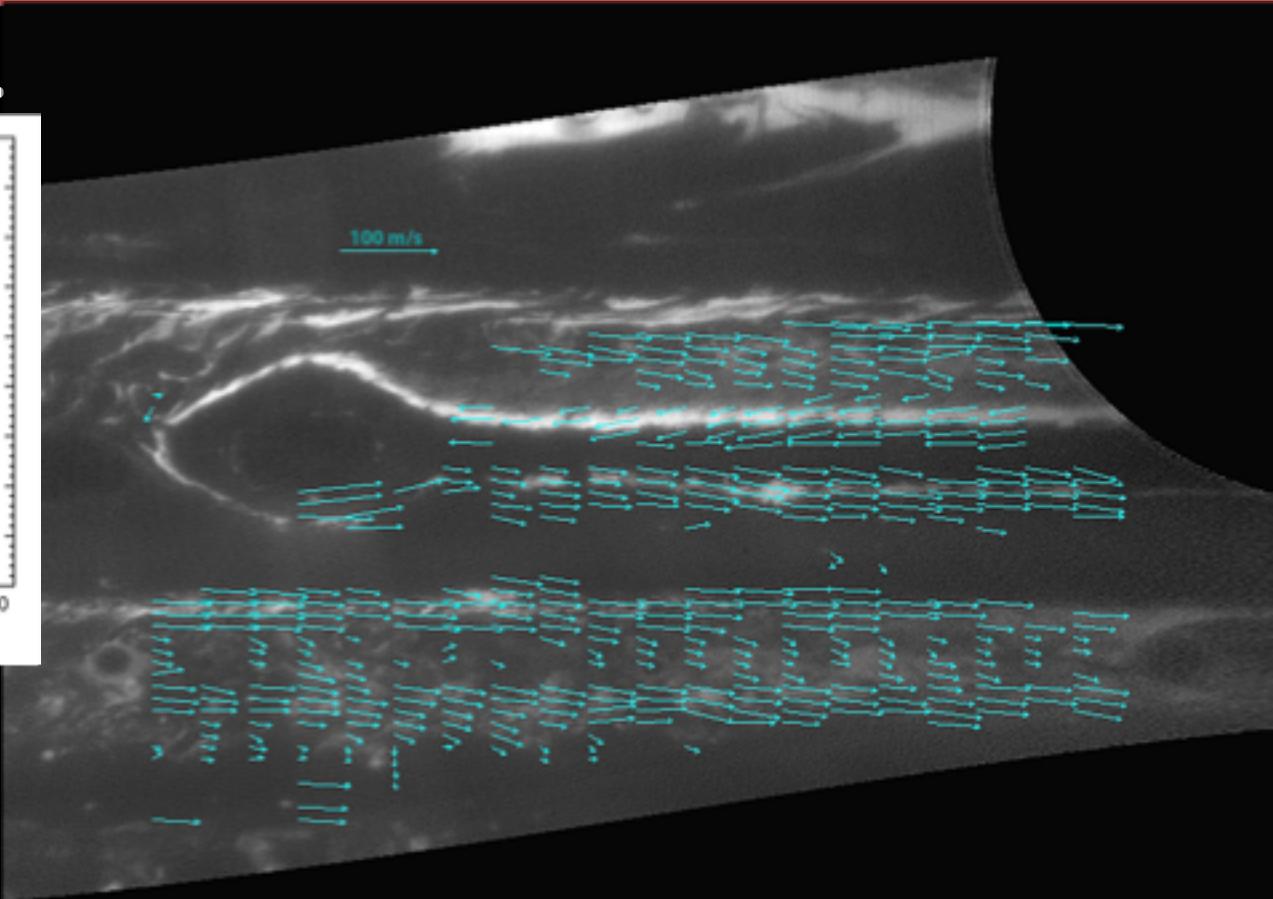
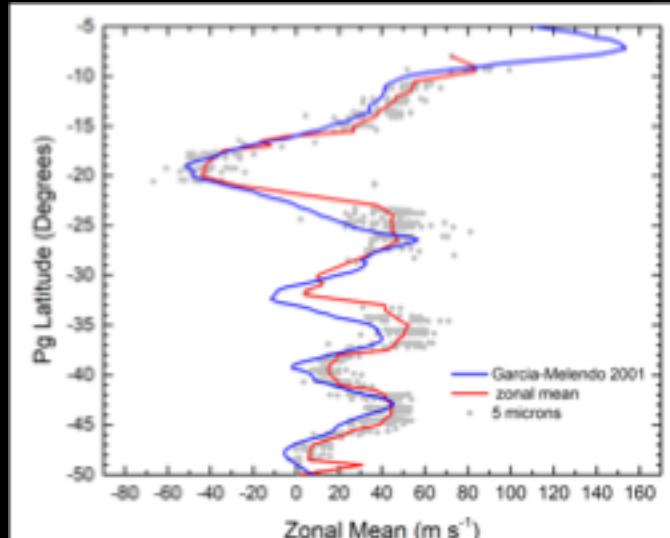
- Measurements of temperature and composition near to PJ7 (GRS flyover).



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@LeighFletcher, Juno Workshop at DPS, October 2018

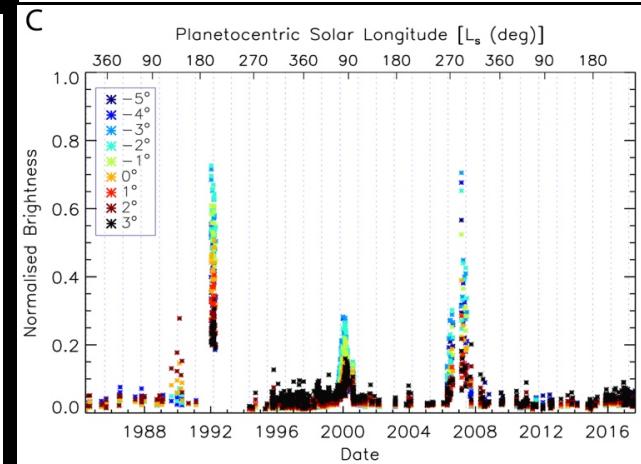
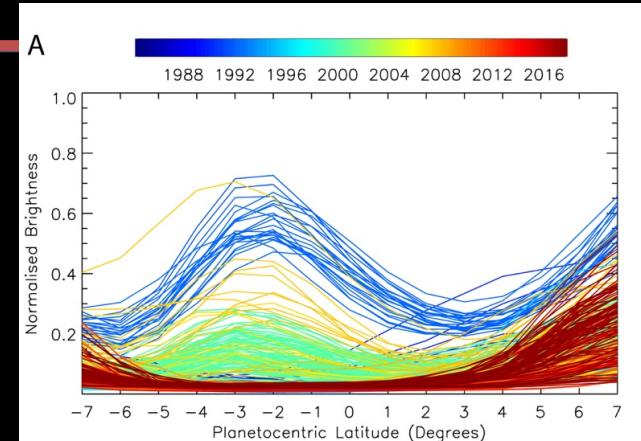
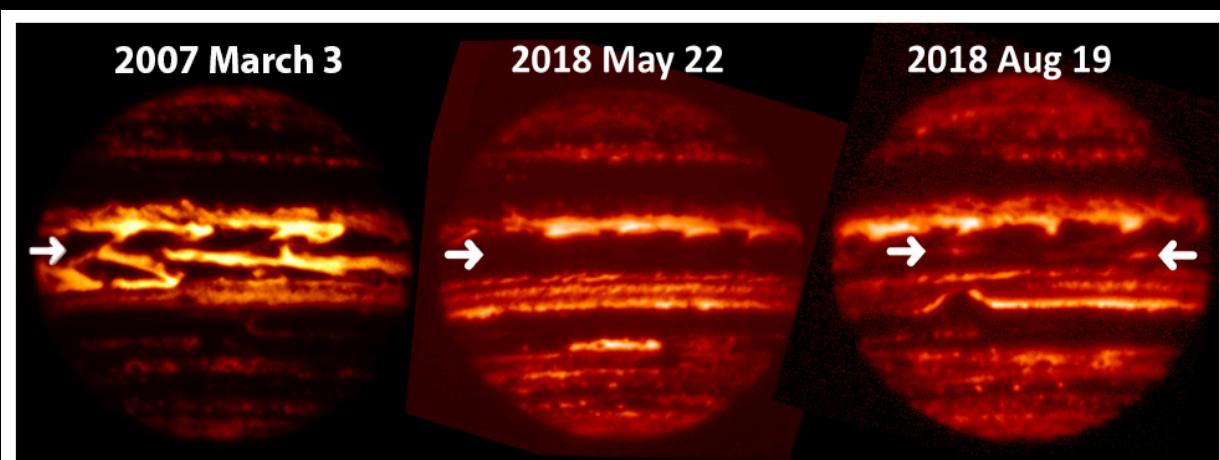
Result VI: Great Red Spot



Credit: Arrate Antunano

Results VII: Equatorial Disturbance

- Long-term tracking of Jupiter 5- μ m banded structure over 3 jovian years from IRTF/VLT.
- Discovery of **equatorial disturbance** events (5 since 1970); predict new one for 2019 (Antunano et al., in press, DOI: 10.1029/2018GL080382, talk 500.1 on Friday).
- Proposals submitted to track outburst.



Perspectives

- Plenty of thermal-IR data 2016-18 to constrain temperatures associated with phenomena Juno observes:
 - *Please contact us!*
- **Future Plans:**
 - Opposition 2019-Jun-10
 - VISIR off telescope for 2019 apparition ☽
 - COMICS always challenging to get time; proposals submitted for PJ19,20,21.
 - TEXES proposals submitted for PJ18 (Feb) and PJ19 (April).
- **This Meeting:**
 - Fletcher et al. (Friday, #507.1)
 - Antunano et al. (Friday, #500.1)
 - De Pater et al. (Friday, #503.02)
 - Ge et al. (Thursday, #402.01)

