Jupiter's Zonal Winds from OPAL and DST

Perianne Johnson, Raul Morales-Juberias, Amy Simon & JIVE team

JIVE in NM Technical Review

26 June 2017

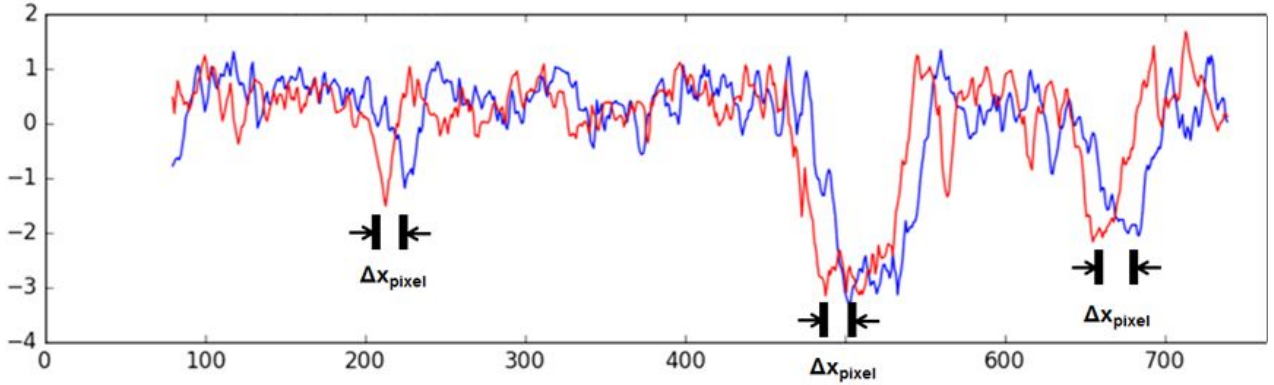
Introduction

- Motivation:
  - To identify and understand temporal and spatial variability in Jovian wind speeds
  - To have up-to-date image correlation wind profiles to compare with JIVE profiles
- Technique:
  - One-dimensional image correlation
  - Extracts zonal motion only
- Observations:
  - HST images of two consecutive rotations
  - Jan 19 2015, Feb 9 2016, (Dec 11 2016*)
  - Multiple wavelengths

*2016 b taken as part of Wide Field Coverage for Juno program (GO-14661)

Methodology

1. Use two images of same 30°-wide region that are separated by ~10 hours
2. Correlate brightness signal at each latitude and convert to velocity
3. Longitudinally shift region of interest and repeat process



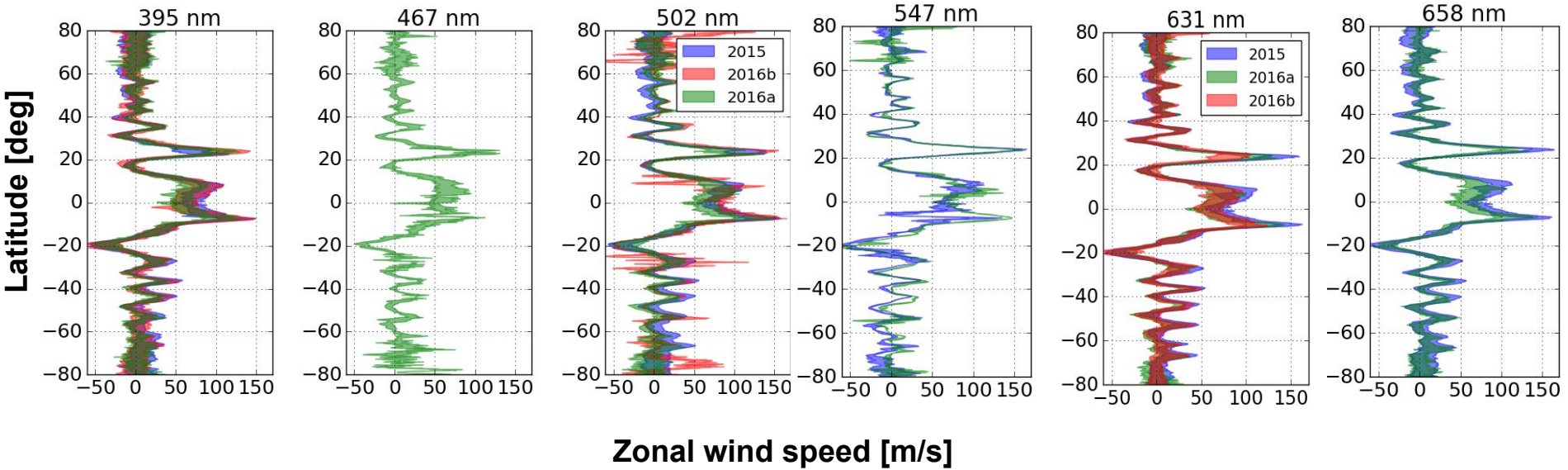
Methodology

- Filtering with Savitsky-Golay filter
- Removal of outliers + averaging each filter

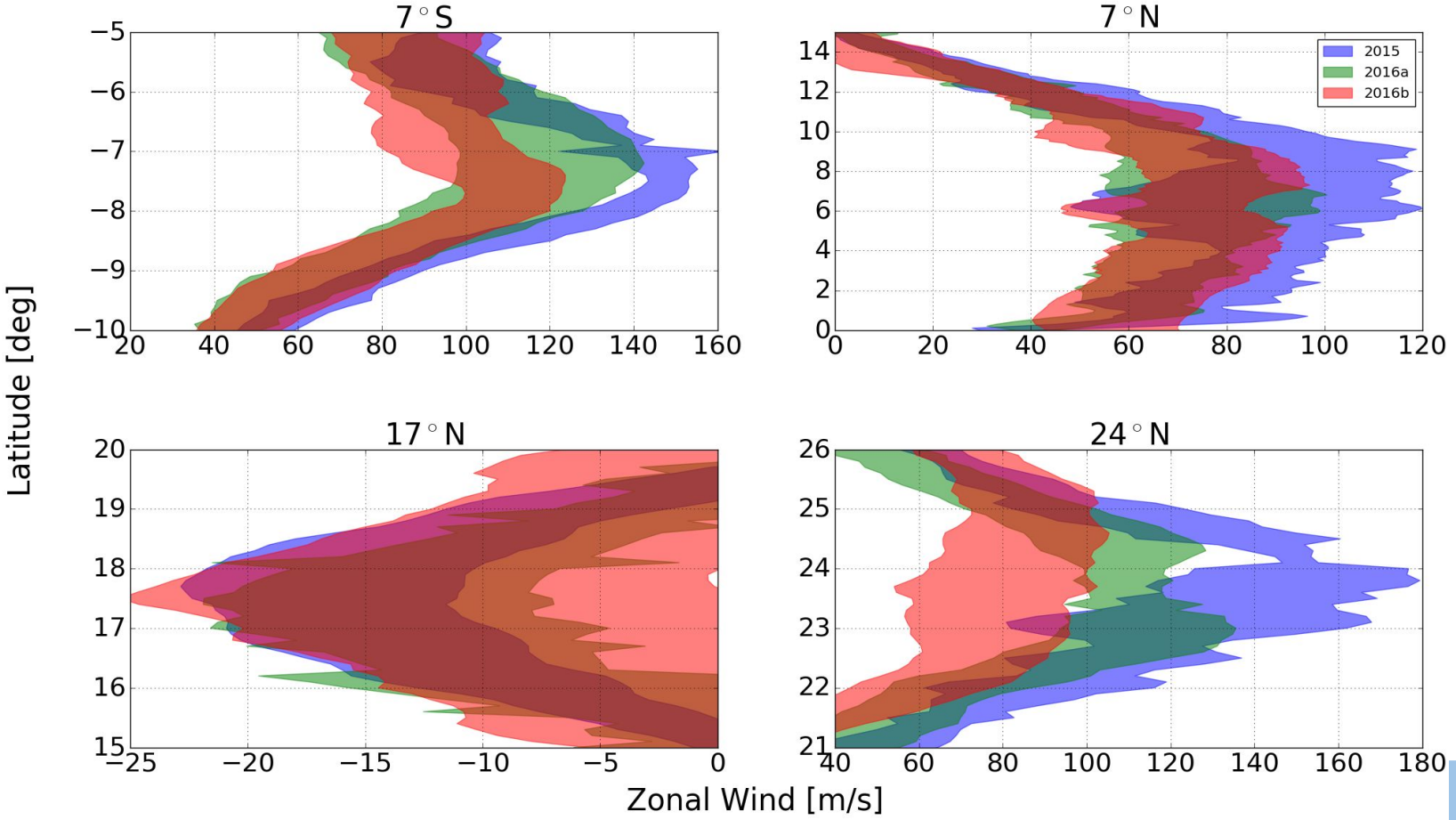
Date	Filters Included (nm)	Filters Excluded (nm)
Jan 19 2015	395, 502, 547, 631, 658	275, 343, 889
Feb 9/10 2016	395, 467, 502, 547, 631, 658	275, 343, 889
Dec 11 2016	395, 502, 631	225, 275, 343, 727, 750, 889

Results -- Extracted Profiles

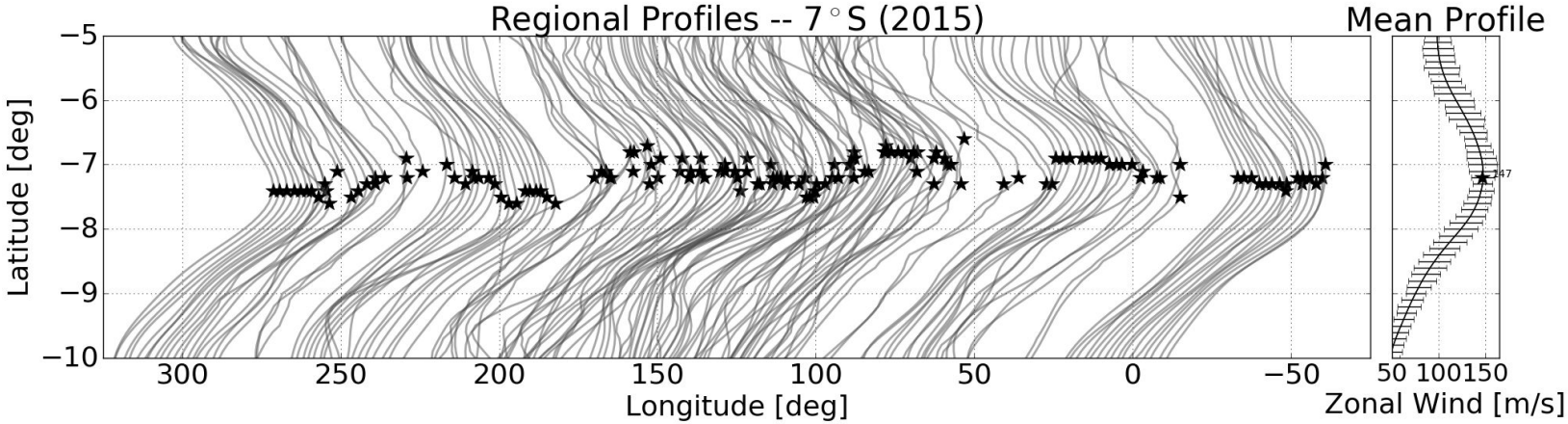
- 275 nm, 343 nm, and 889 nm were excluded due to poor contrast

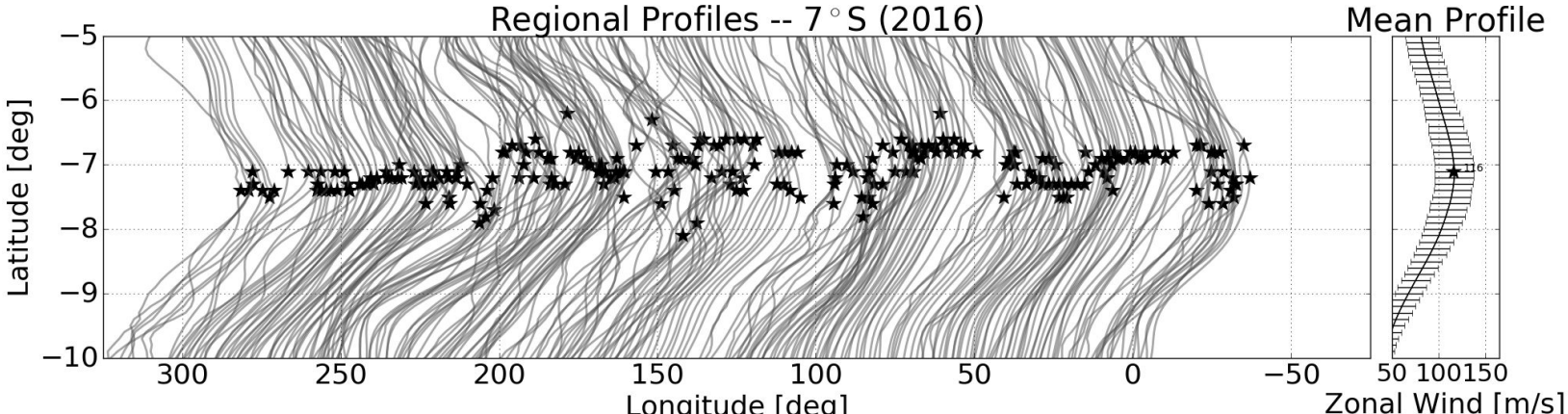


Results -- Temporal



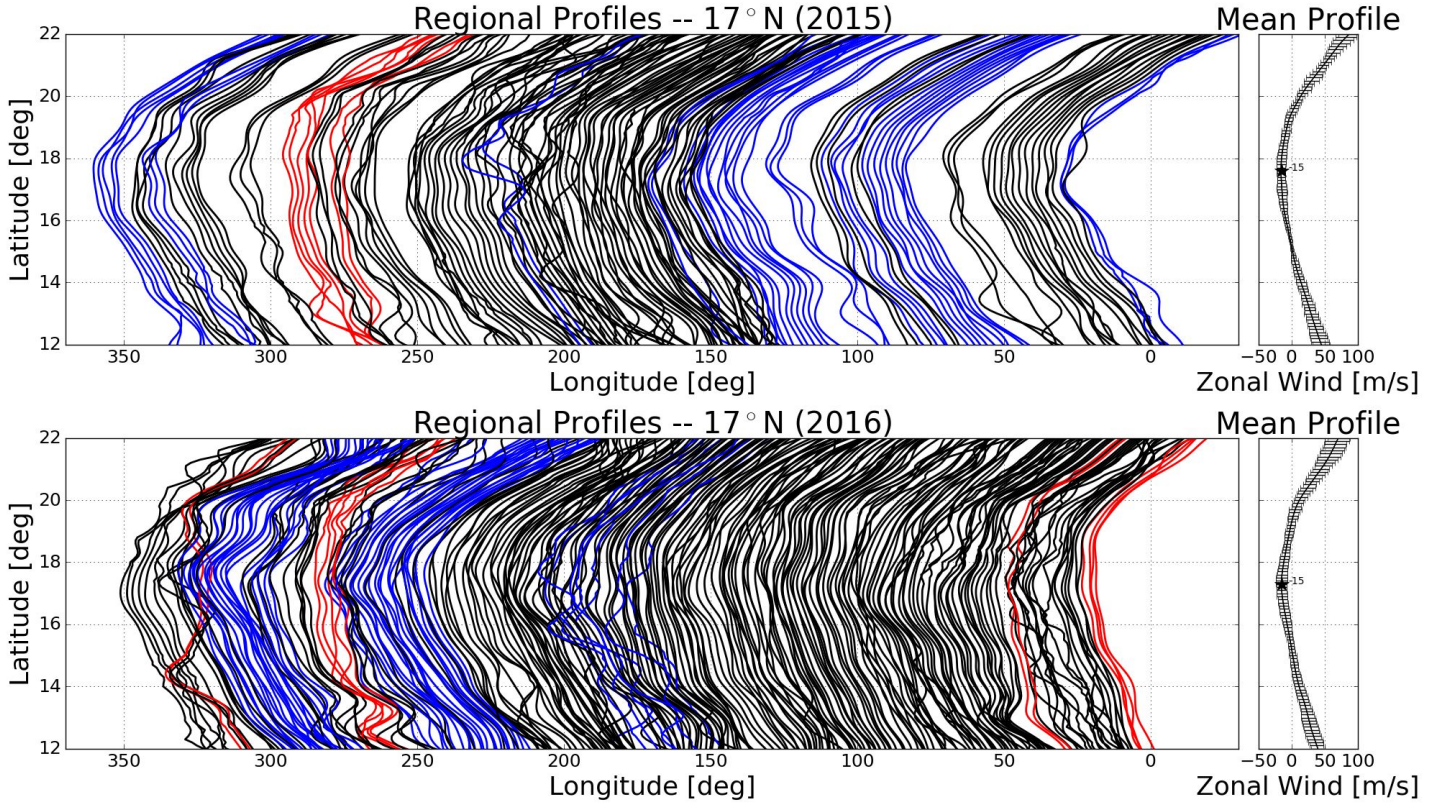
Results -- Spatial @ 7S (Chevrons)





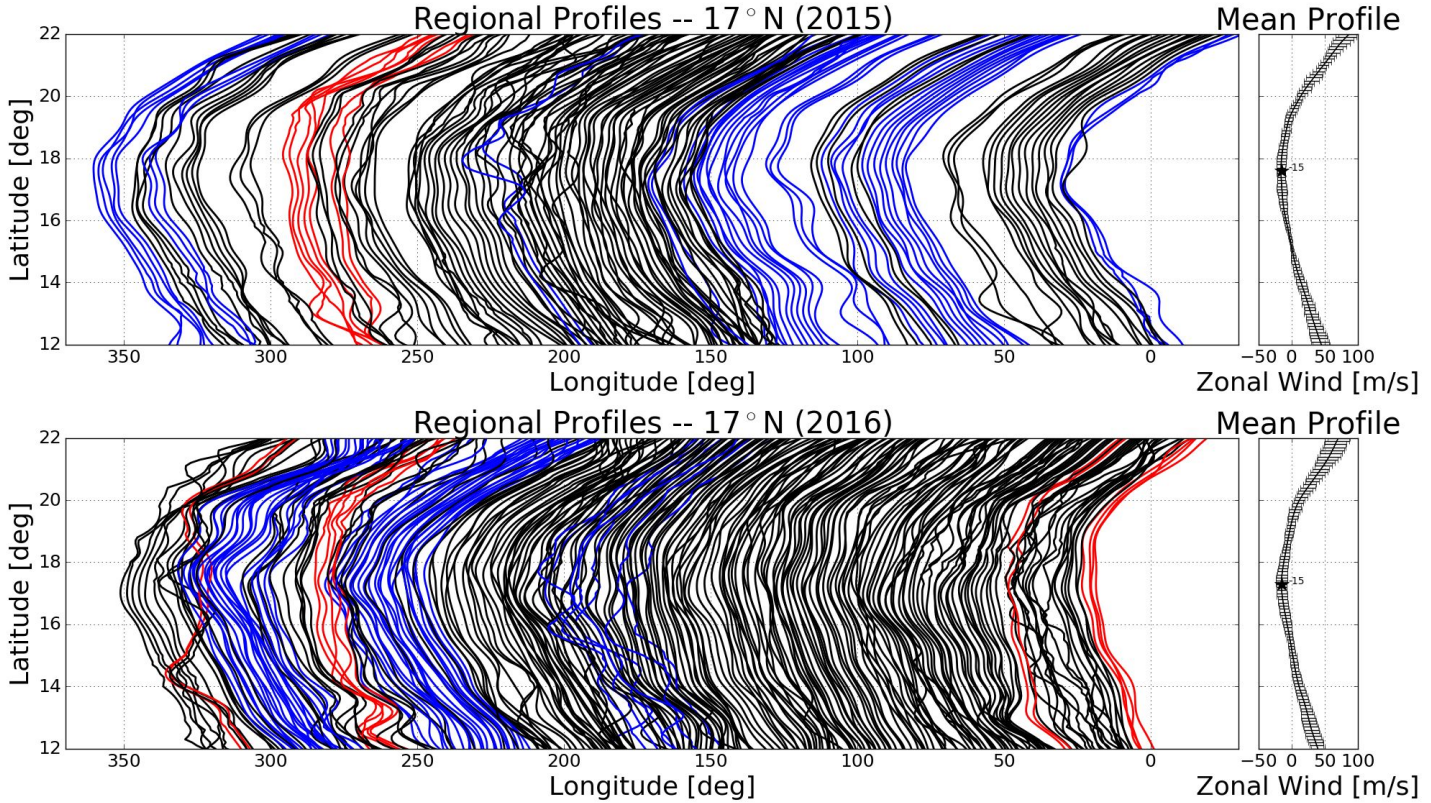
Results -- Spatial @ 17N

- Red = slower than avg by 1σ (6-7 ms^{-1})
- Blue = faster than avg by 1σ (6-7 ms^{-1})

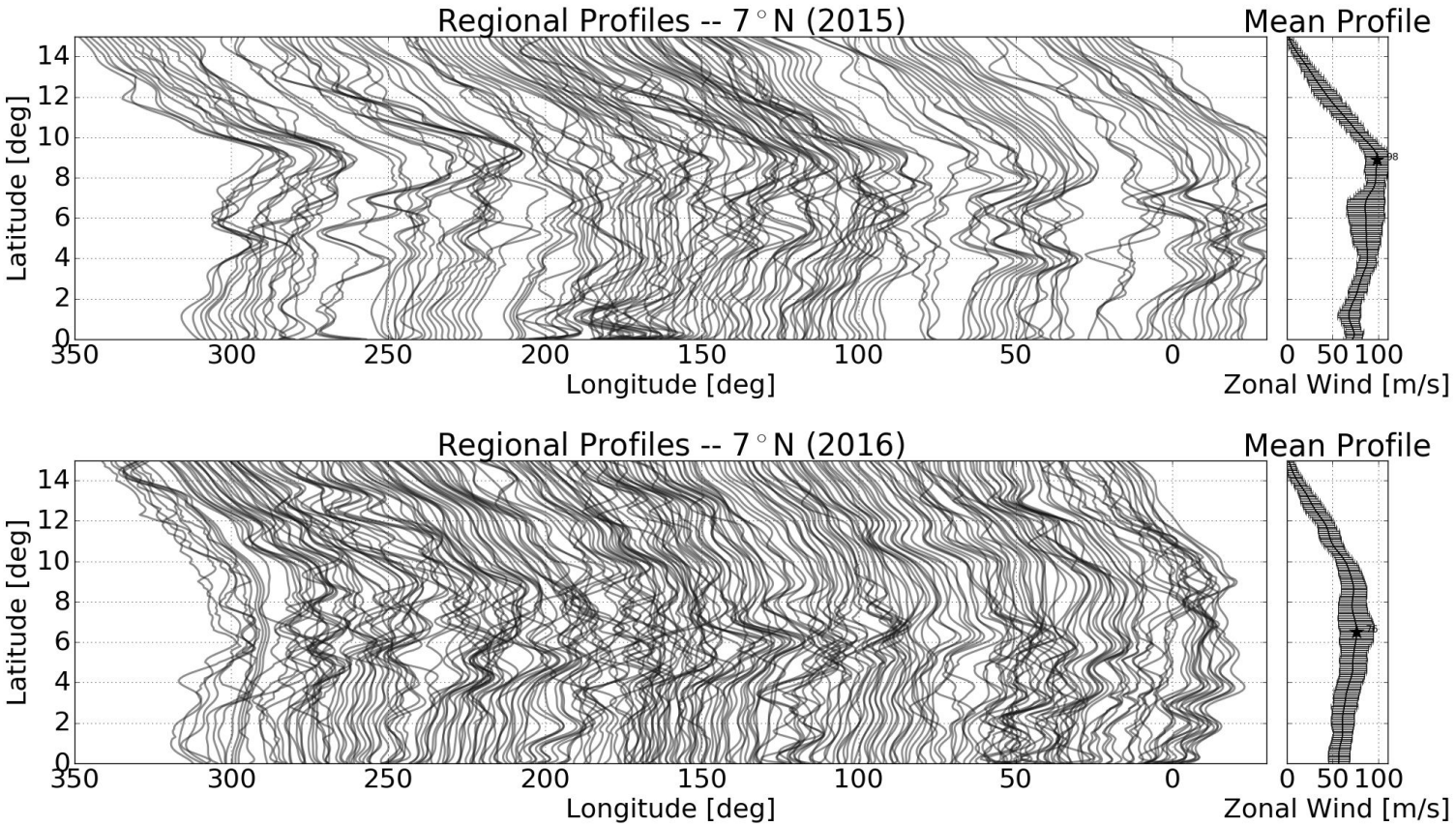


Results -- Spatial @ 17N

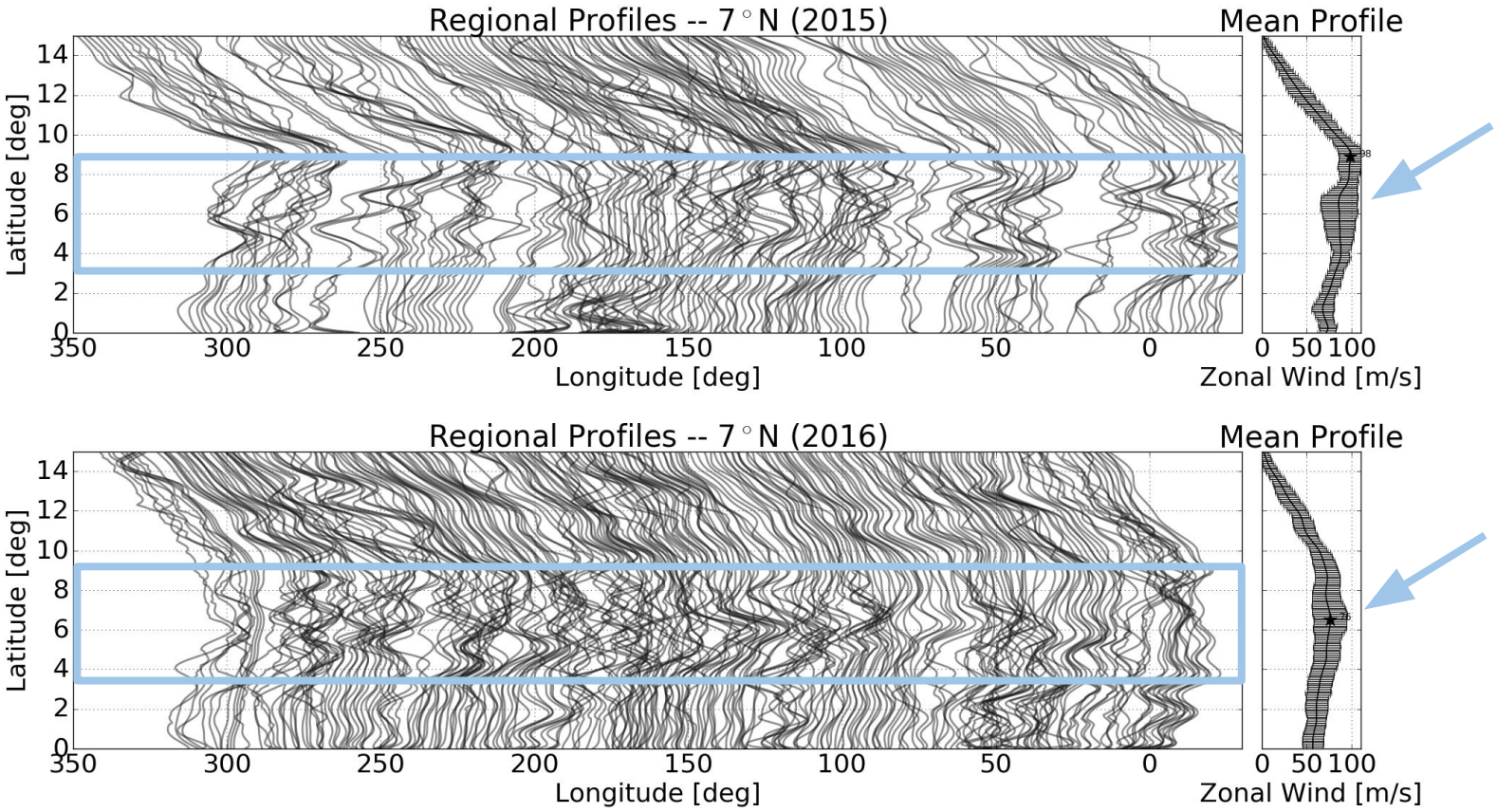
- Red = slower than avg by 1σ (6-7 ms^{-1})
- Blue = faster than avg by 1σ (6-7 ms^{-1})



Results -- Spatial @ 7N (5µm Hot spots)

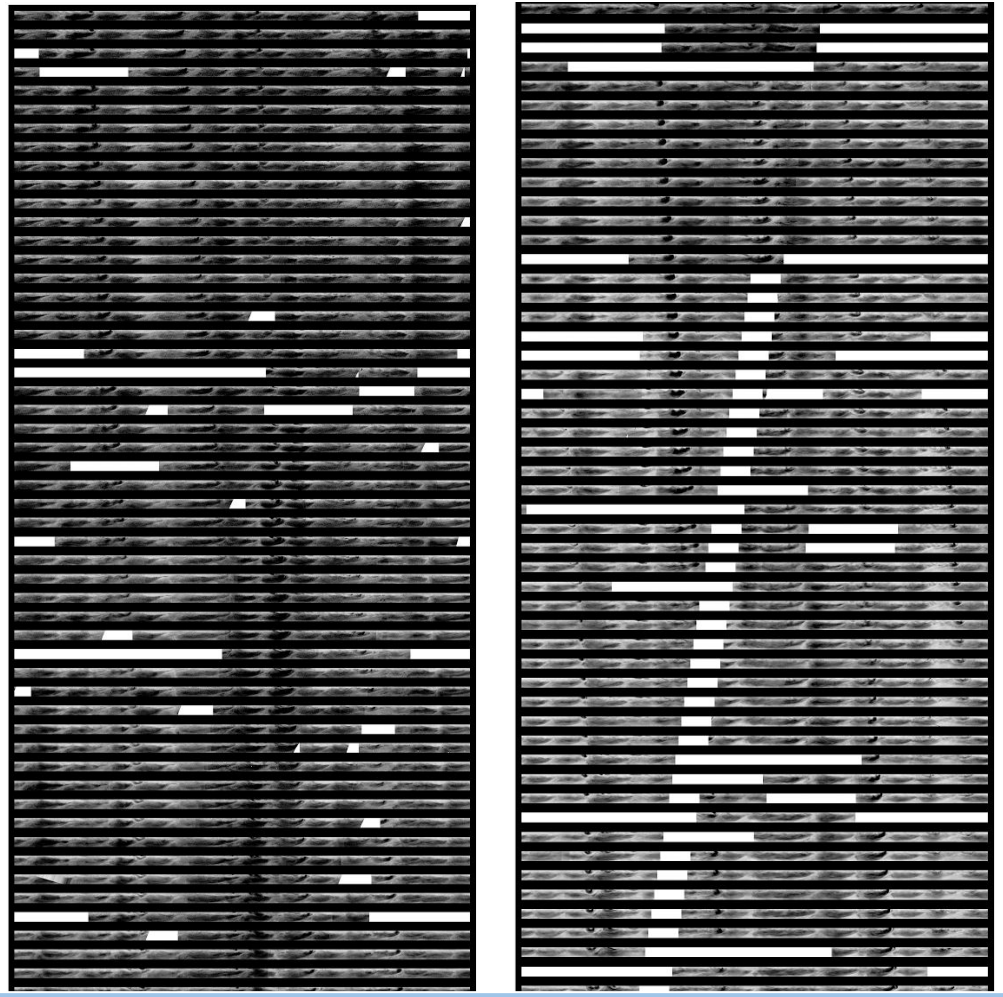


Results -- Spatial @ 7N (5µm Hot spots)



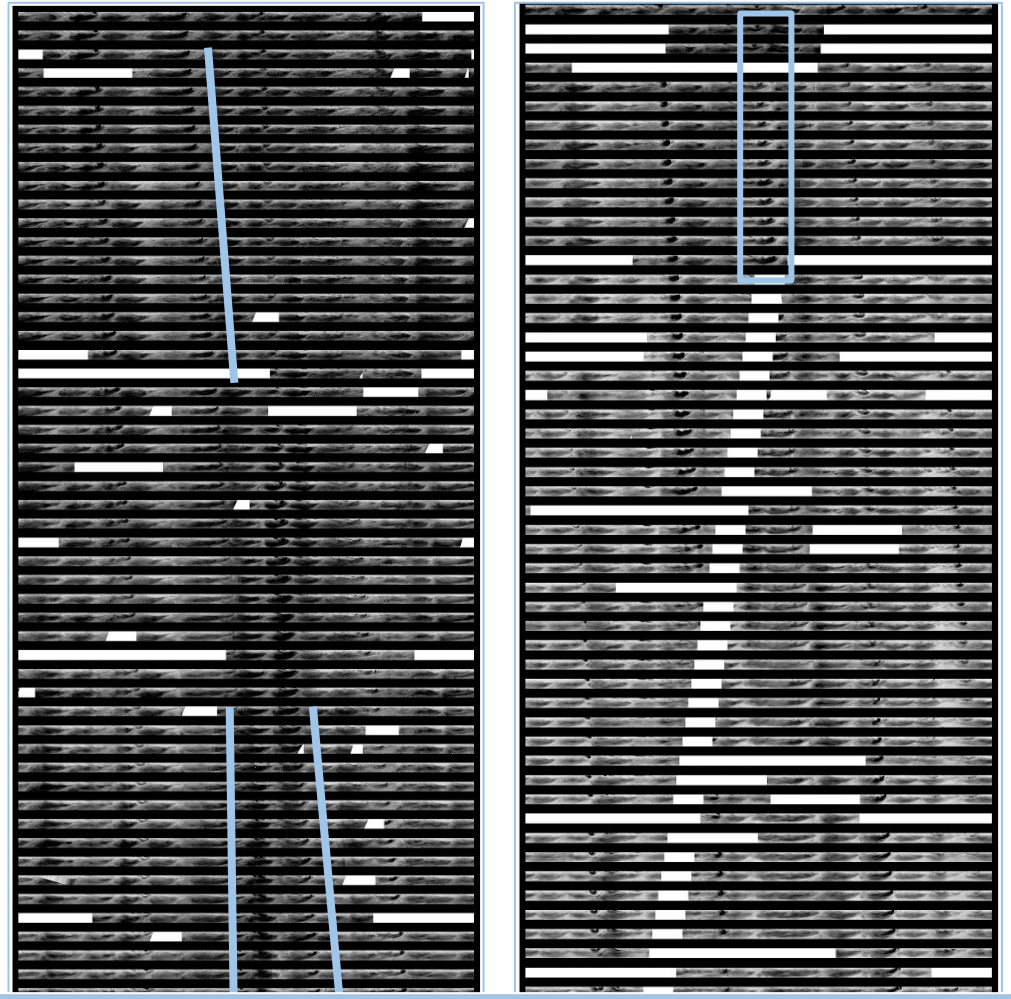
Results -- Hot Spots

- OPAL data uncertainties
  - Significant spatial variation
- Voyager 1 flyby (right)
  - Shifted to 103 m/s reference frame
  - See individual spot/plume motions

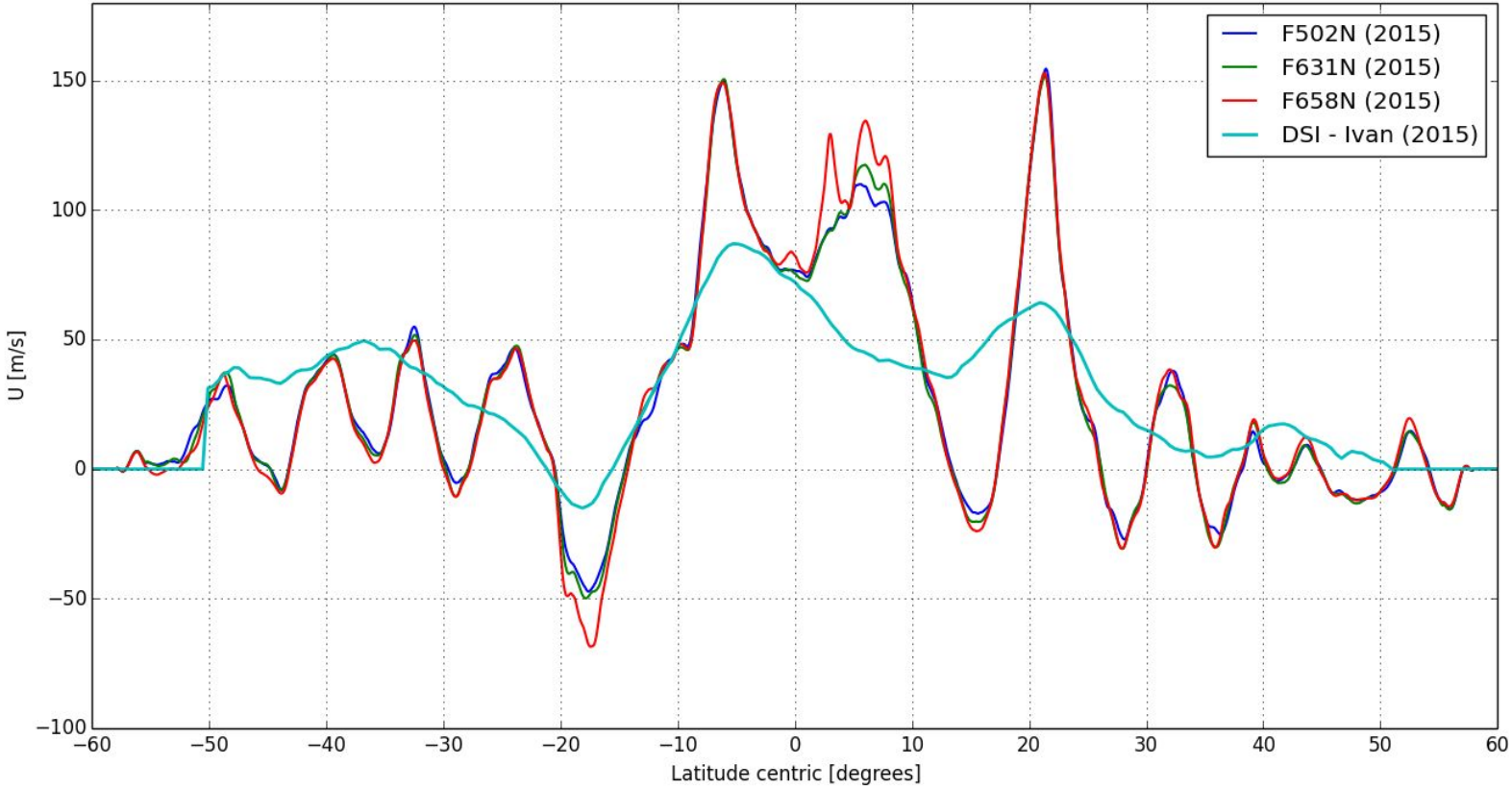


Results -- Hot Spots

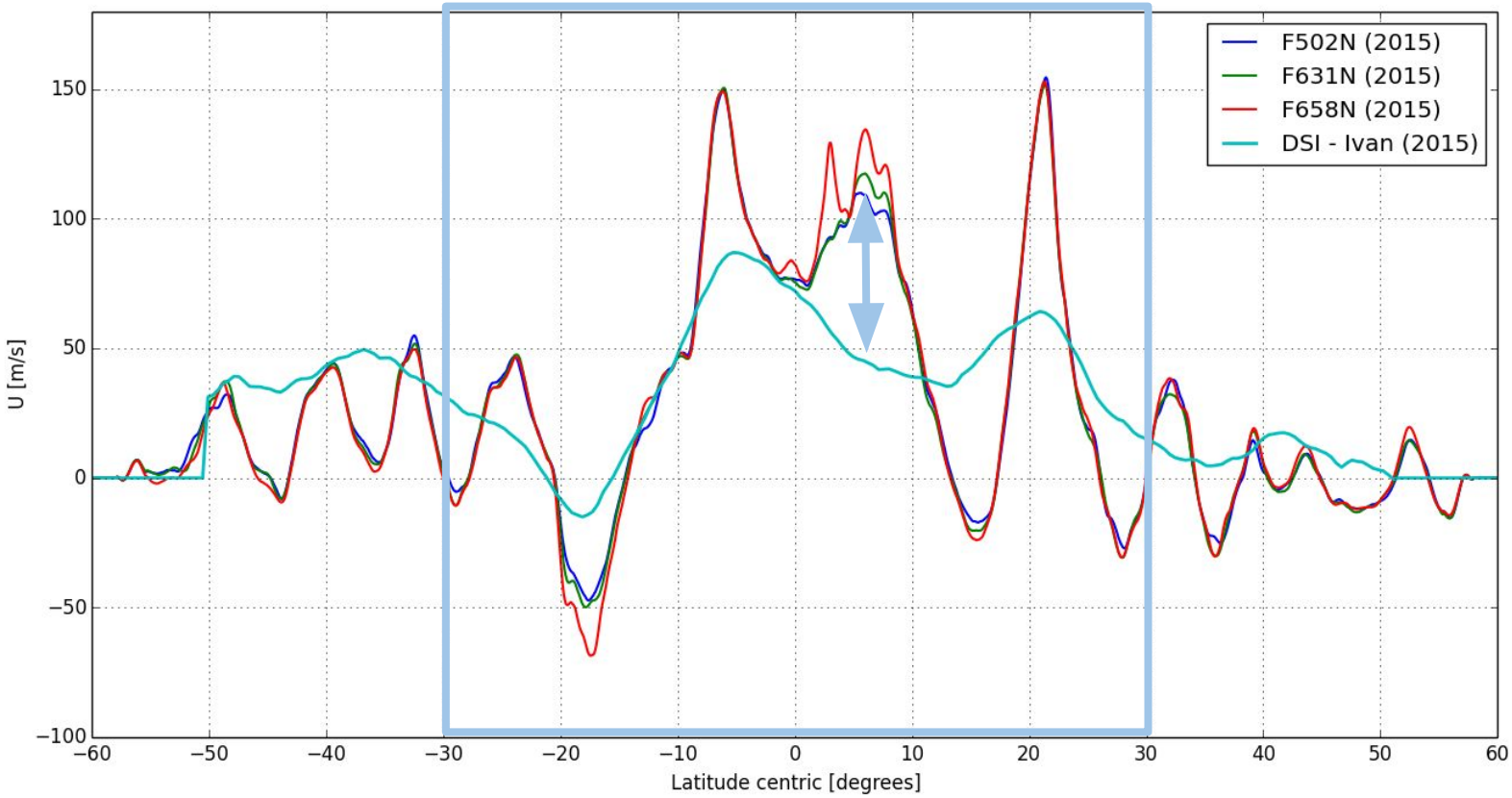
- OPAL data uncertainties
  - Significant spatial variation
- Voyager 1 flyby (right)
  - Shifted to 103 m/s reference frame
  - See individual spot/plume motions



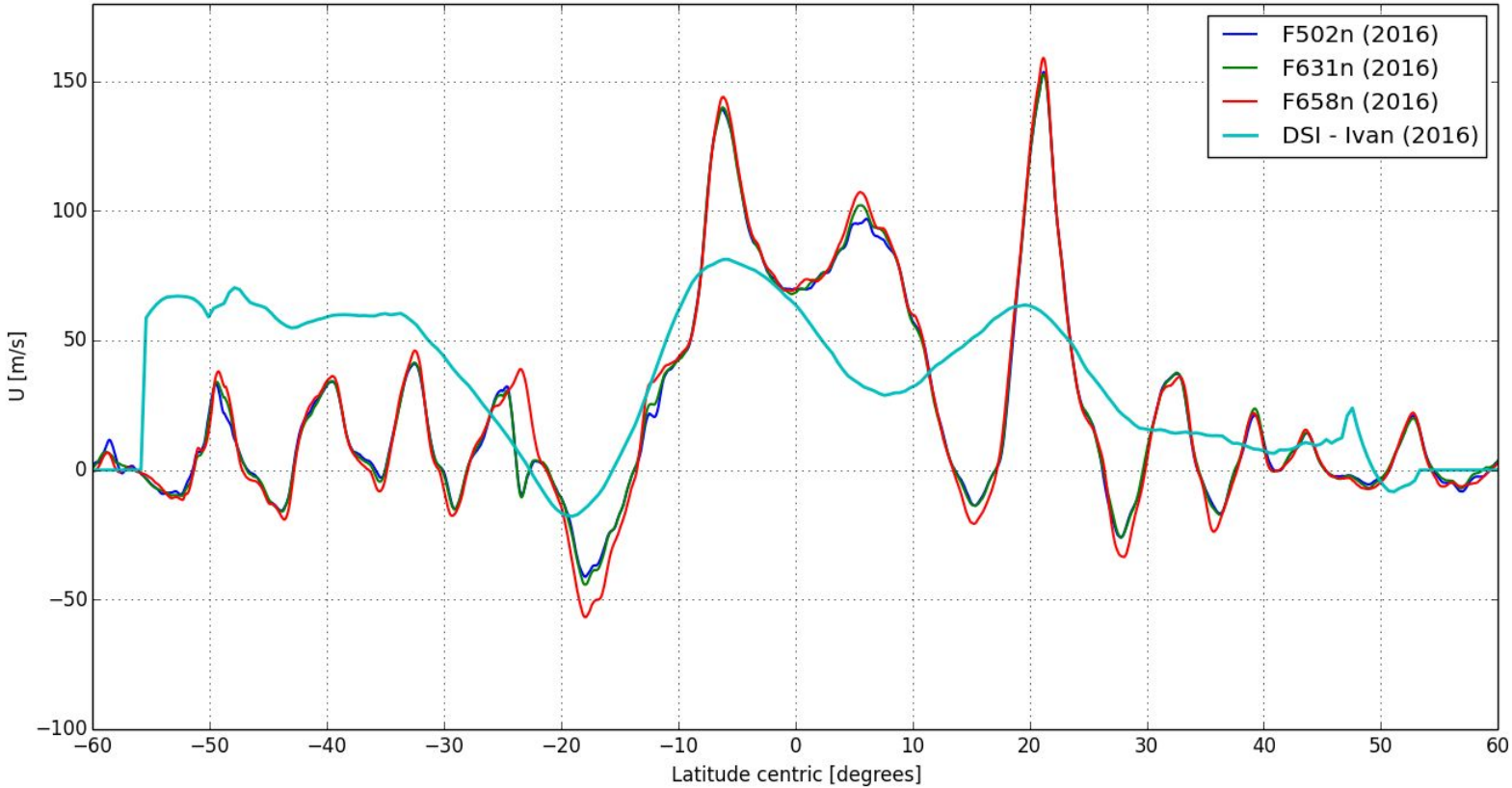
Comparison -- OPAL vs DSI (2015)



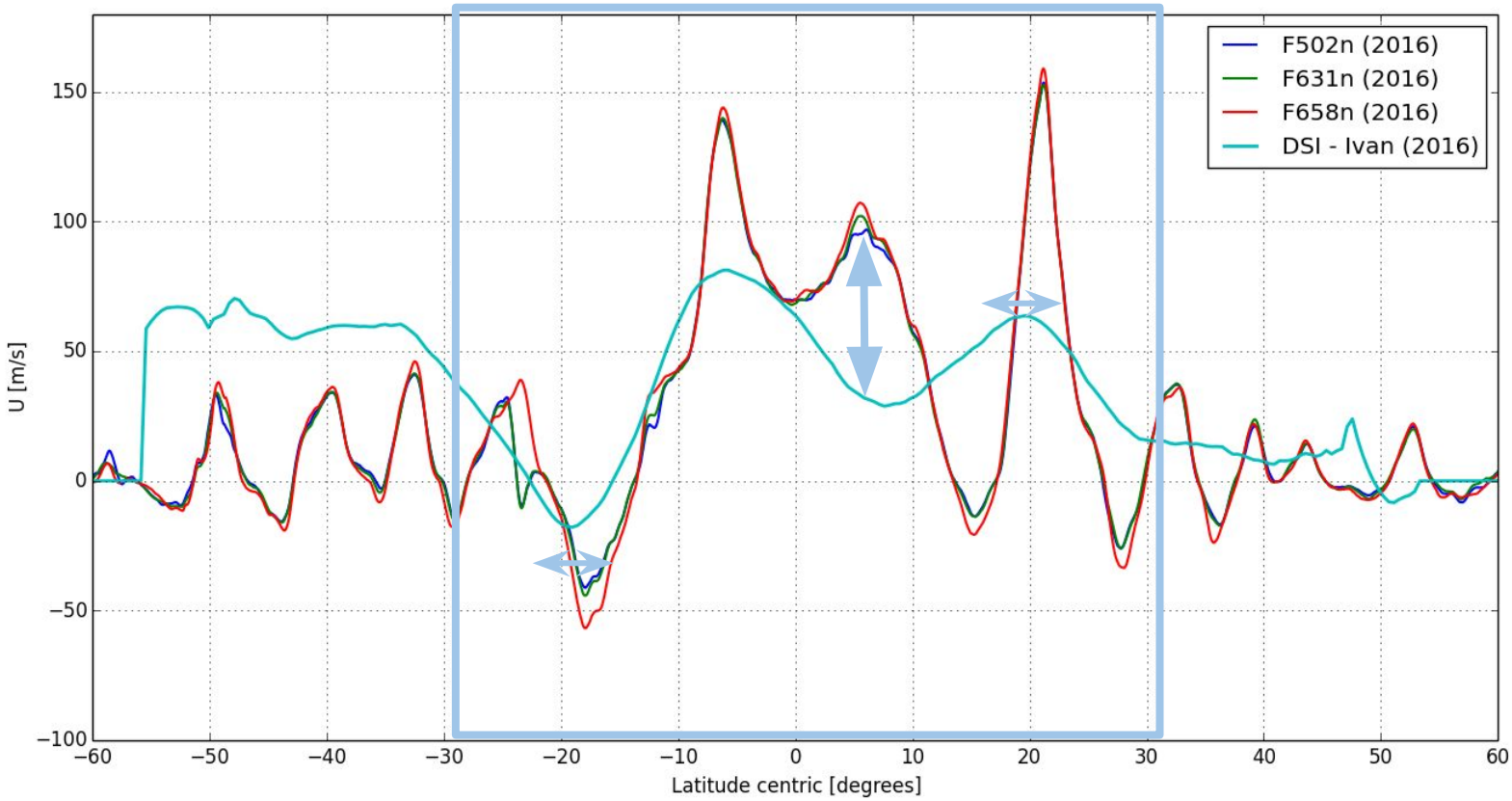
Comparison -- OPAL vs DSI (2015)



Comparison -- OPAL vs DSI (2016)



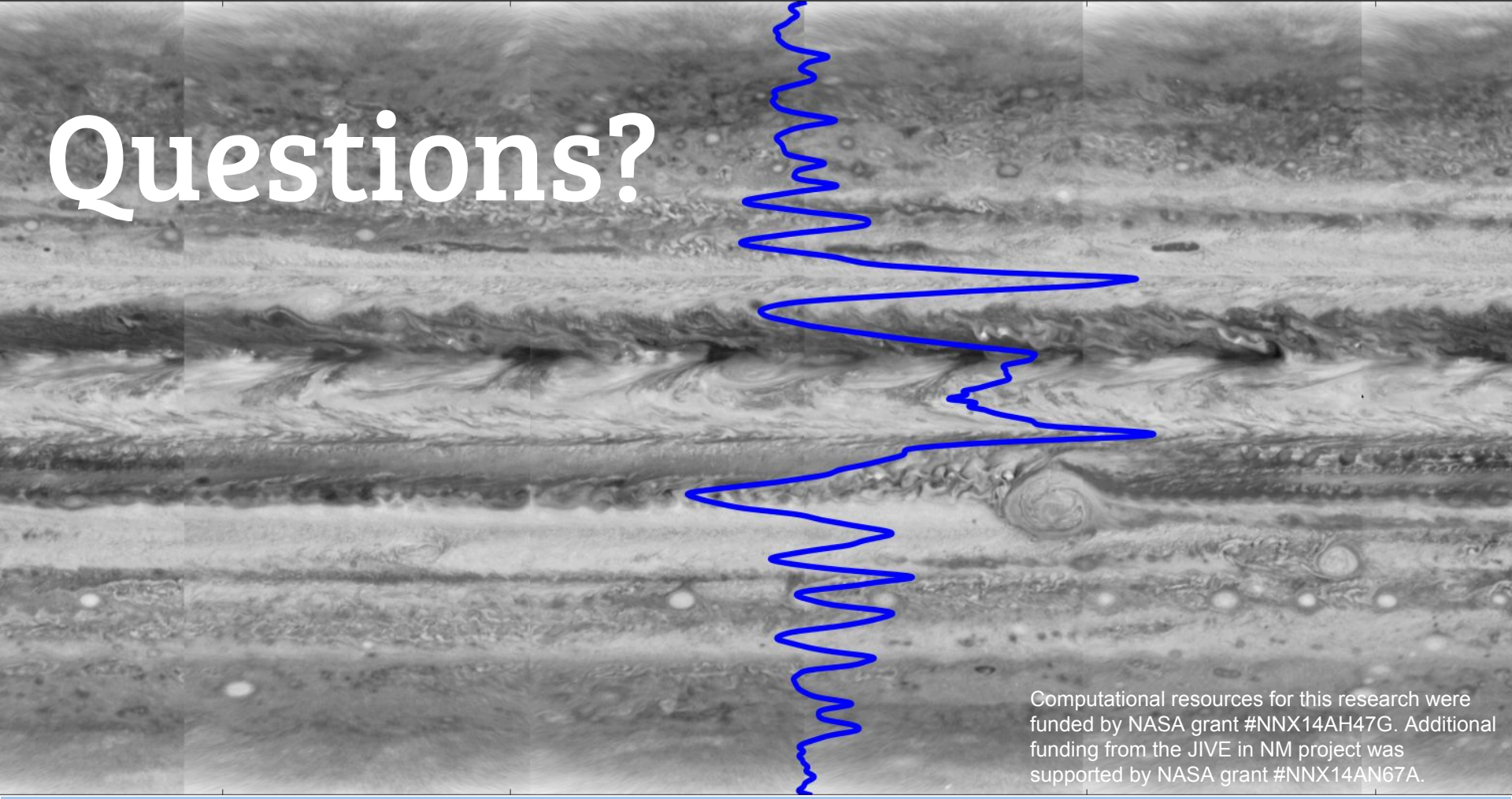
Comparison -- OPAL vs DST (2016)



Future Work and Conclusions

- Temporal Variations:
  - 24°N jet continues to vary
  - Relationship to convection -- modeling opportunity
- Spatial Variations:
  - 7°S: opportunity to analyze chevron's motion
  - 17°N: possible dichotomy in winds -- modeling opportunity
  - 7°N: wind speed is highly complicated
- Future Prospects:
  - Upcoming OPAL data sets -- February and April 2017
  - Doppler Spectral Imaging (JIVE/JOVIAL projects)

Questions?



Computational resources for this research were funded by NASA grant #NNX14AH47G. Additional funding from the JIVE in NM project was supported by NASA grant #NNX14AN67A.