

# 2023-24 / Mid-NEB Plume & NTrZ ADSs



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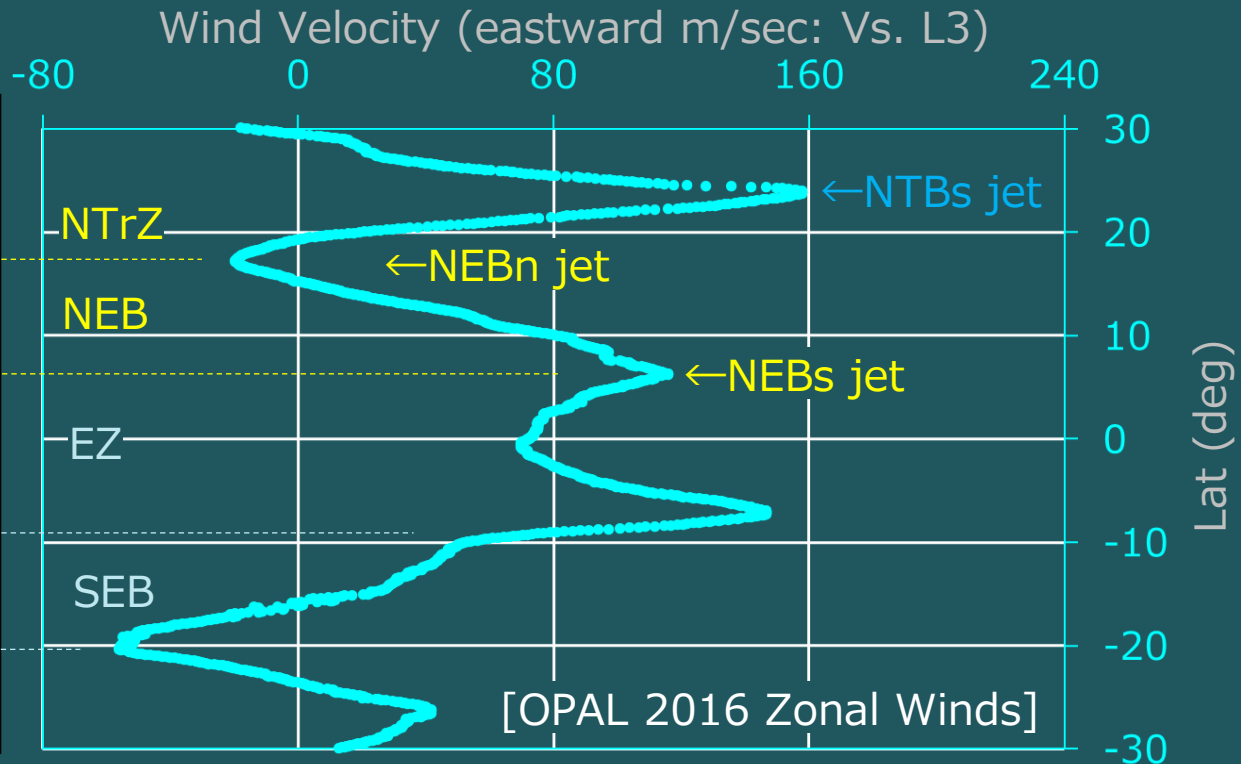
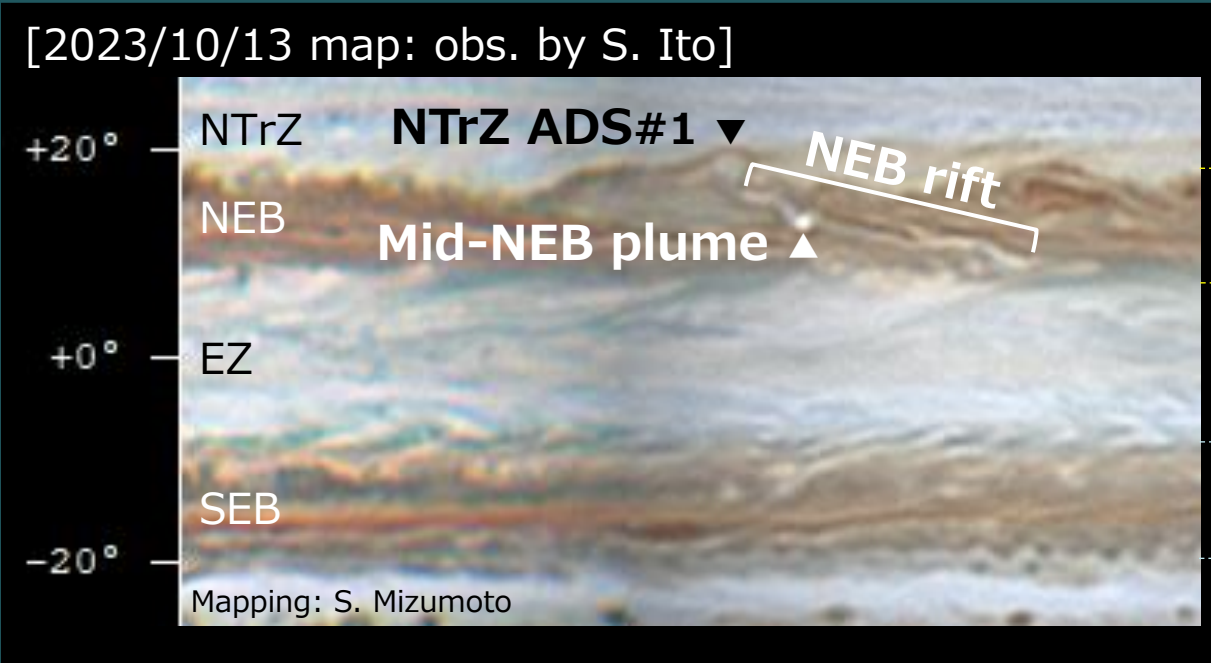
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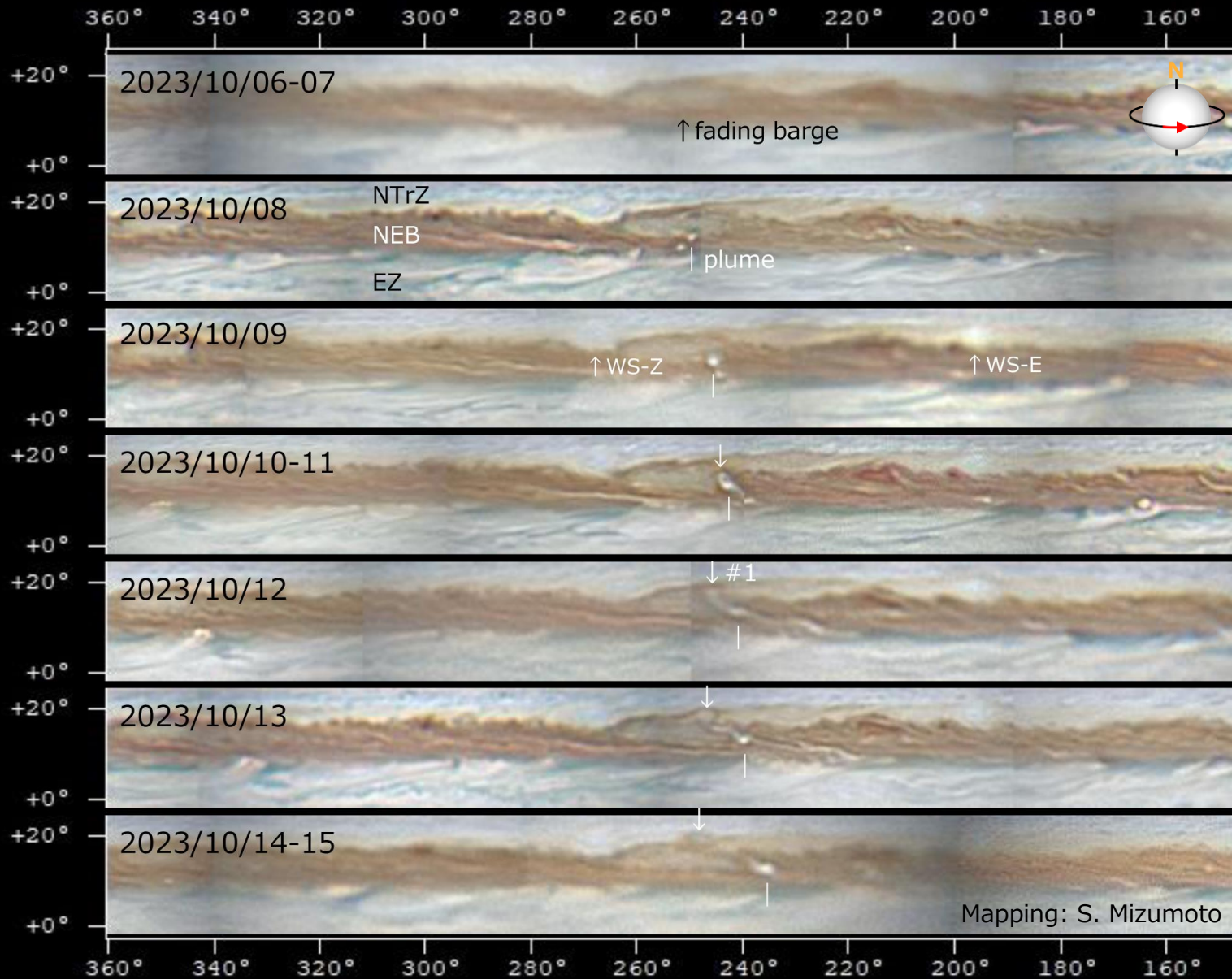
- Final slide: ADS#5 / Maps Animation



- Drift Rate (DL3) :  $\pm$  deg/d,  $\pm$  deg/30d  
 + : longitude increase  
 - : longitude decrease
- Plume: White cloud eruption phenomenon.
- Rift/Rift Activity: Ruptures created by white clouds being stretched east-west and north-

south by wind velocity gradients in the relevant latitude region, and such activity.

- (NTrZ) ADS: Anticyclonic Dark Spot
- NEB Expansion/NEB Revival/NEB Outbreak: In the past, they occurred at 3-5 year intervals.

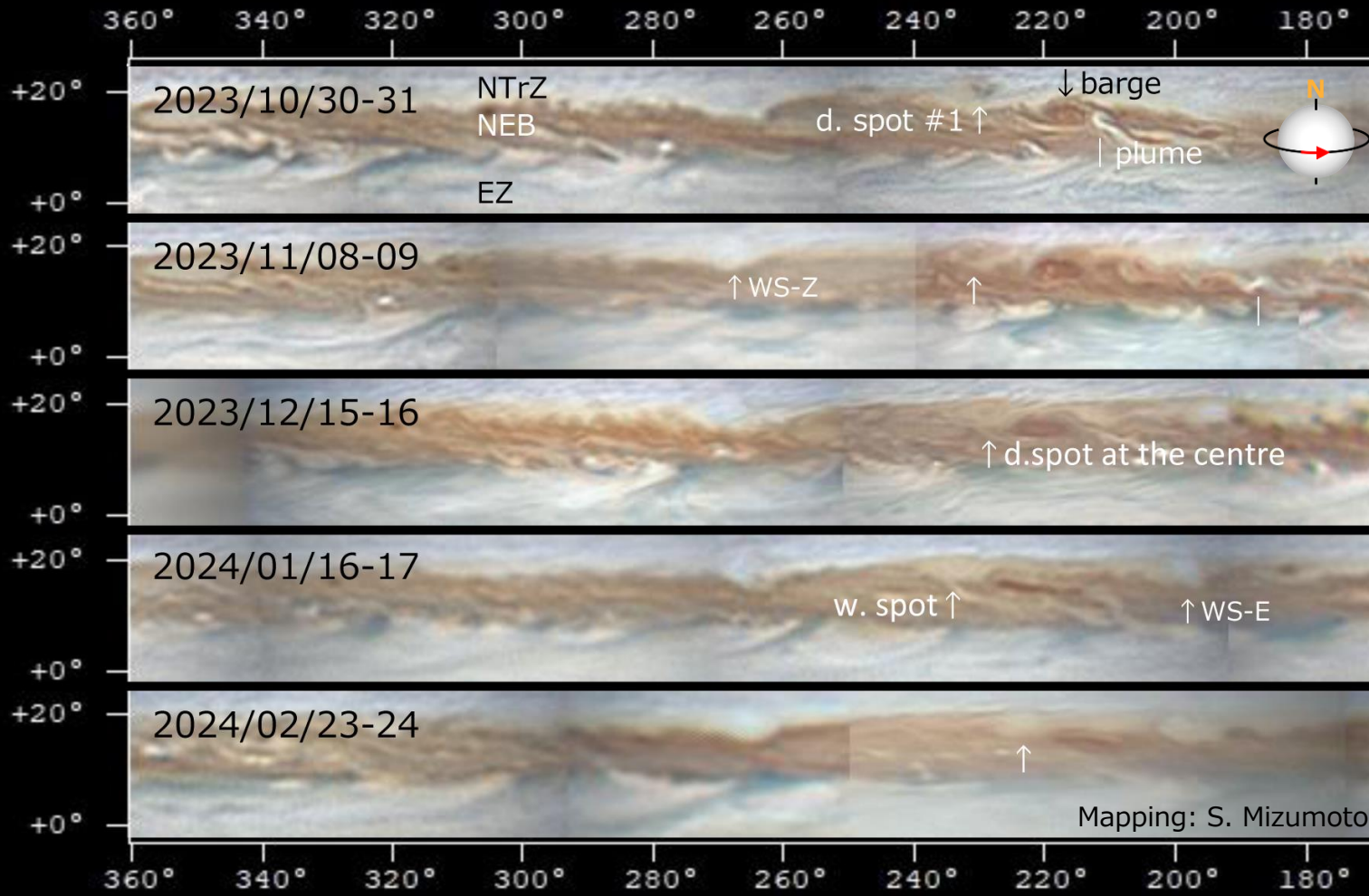


## <Plume Eruption>

- October 8, 2023: Mid-NEB plume erupted on p-side of WS-Z (obs. by I. Miyazaki).  
L3=250 deg, L2=219 deg
- The plume was a progressive and intermittent eruption of white clouds, which persisted for 180 days until the end of the apparition.  
DL3=-1.62 deg/day

## <ADS#1 Formation>

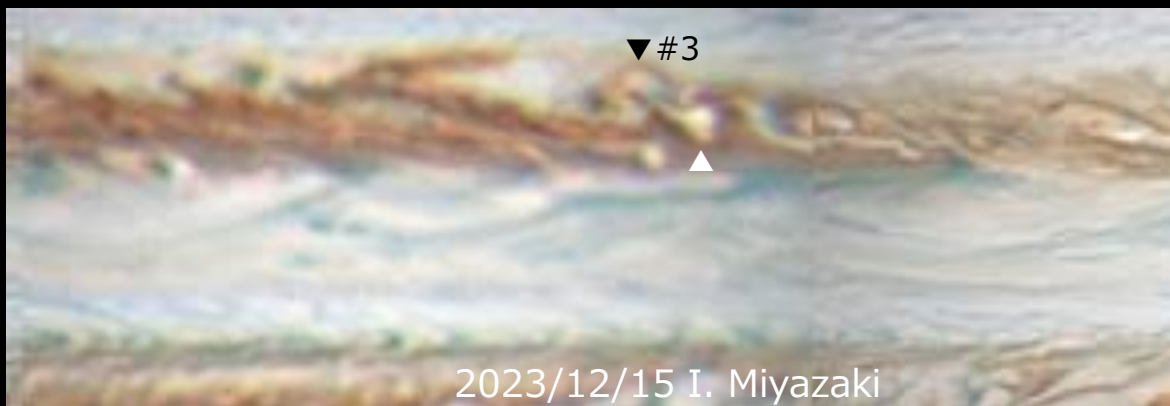
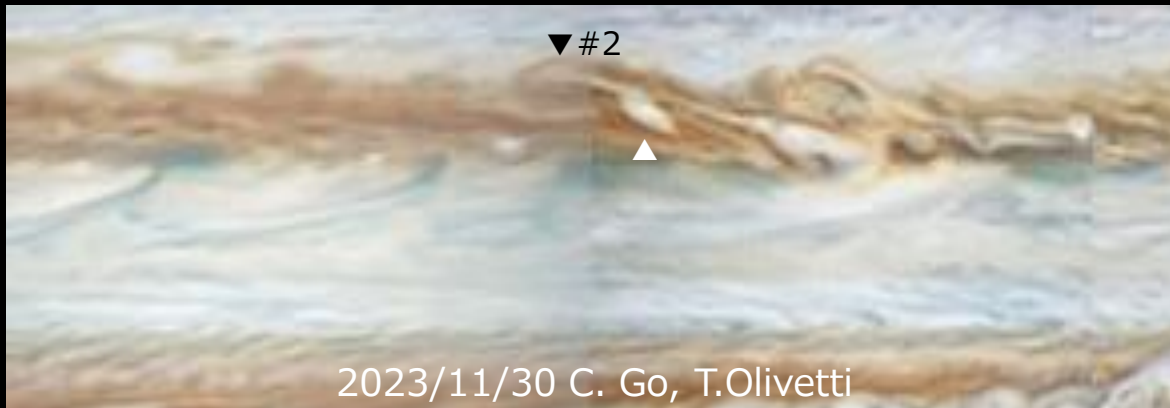
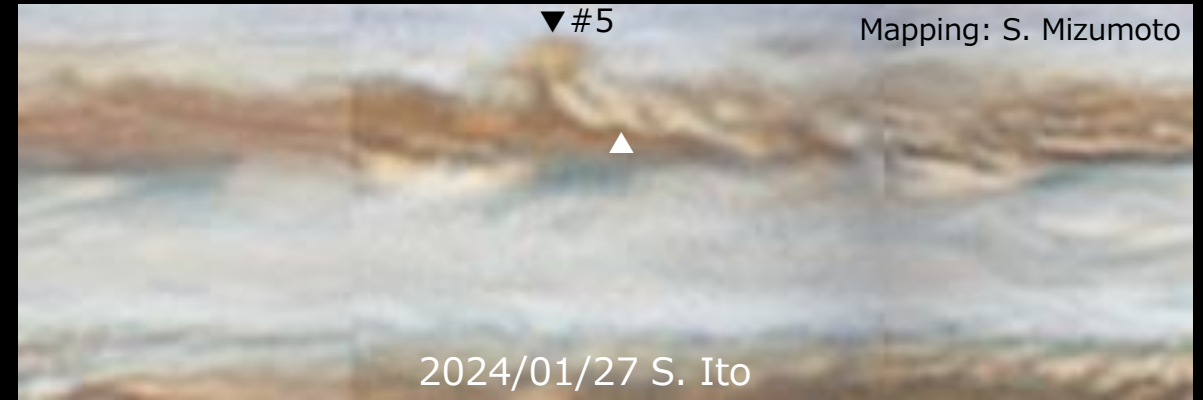
- October 12, 2023: White clouds supplied by the plume reached the NTrZ through rift activity, forming the ring-shaped NTrZ ADS#1 (obs. by K. Suzuki, F. Reali).  
L3=246 deg, L2=214 deg



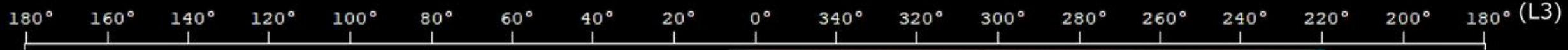
- Late October 2023: ADS#1 weakened.
- Early November 2023: The ADS became surrounded by a white cloud, fed by the plume.
- Late January 2024: The dark spot gradually faded and had disappeared, apparently changing to only white spot.
- Similar phenomena were also observed with ADS#3.



- January 22, 2024: ADS#5 was formed (obs. by A. Wesley).  
L3=70 deg, L2=11 deg
- Initially, it showed a rapid change in latitude, reaching nearly +20 degrees, but about one month after its formation, it settled at around +18 to +19 degrees (See slide 12).
- Among the five ADSs formed, it was the largest and its existence was confirmed over a period of 82 days until the end of the apparition.



- The progressing plume intermittently erupted.
- White clouds supplied by the plume formed the ADS five times due to rift activity.
- All five ADSs were formed from the same plume.



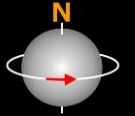
Credit: NASA / JPL / SwRI / MSSS / Gerald Eichstädt / John Rogers / Shinji Mizumoto

ADS: Anticyclonic Dark Spot

PJ55: 2023/10/15

▲ Mid-NEB Plume

▼ #1



NTrZ  
NEB

PJ56: 2023/11/22

▼ #1

▲ Mid-NEB Plume

ADS-2 (#2)

WS-B

WS-Z

ADS (#1)

WS-E

PJ57: 2023/12/30

PJ58: 2024/02/03

WS-B

ADS-5 (#5)

WS-Z

ADS-1 (#1)

WS-E

ADS-2 (#2)

WS-C

WS-B

Faded  
barge

ADS-5 (#5)

WS-Z

WS-1

WS-E

PJ59: 2024/03/07

PJ60: 2024/04/09

▼ ADS#5

▼ ADS#6

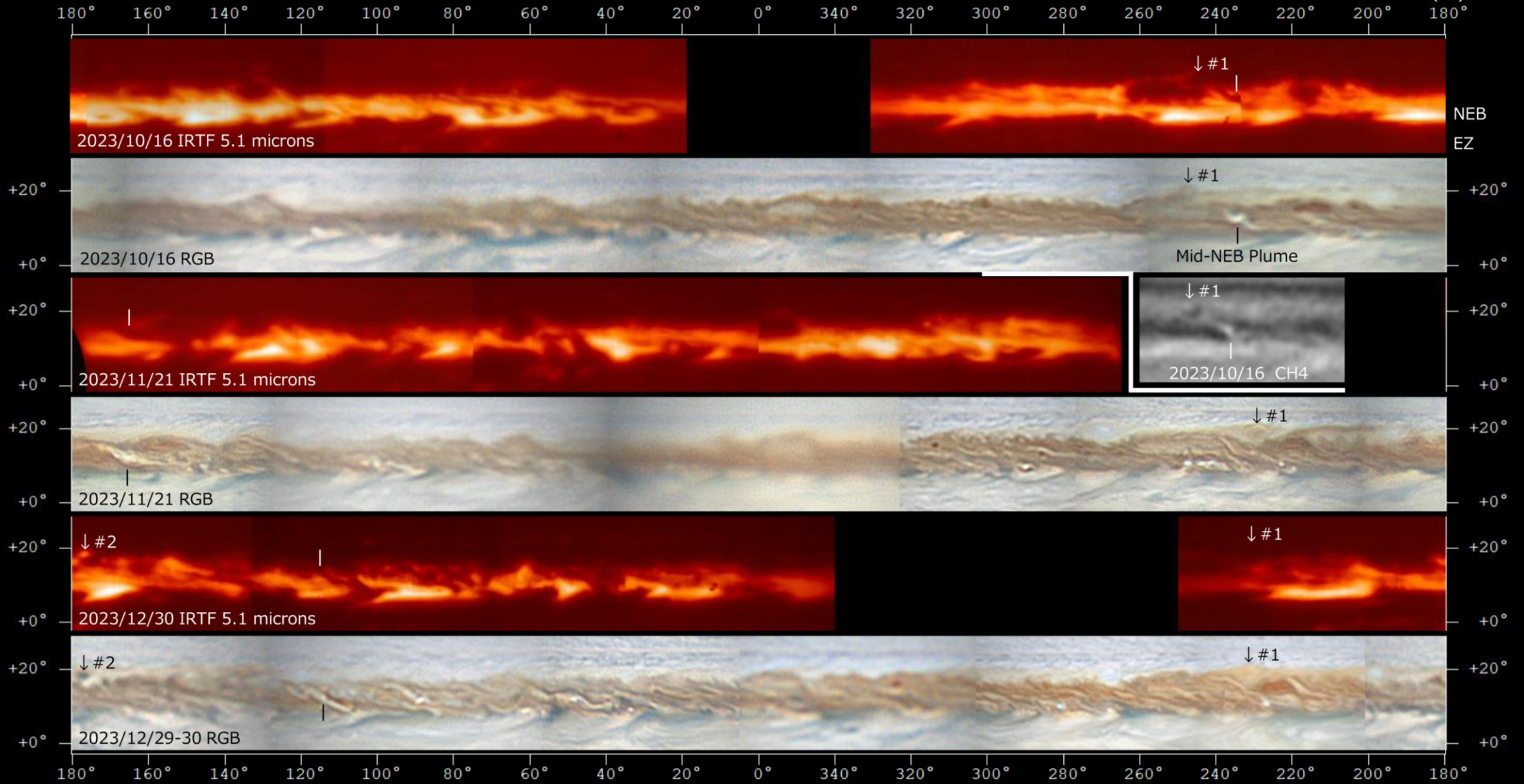
▼ WS-Z



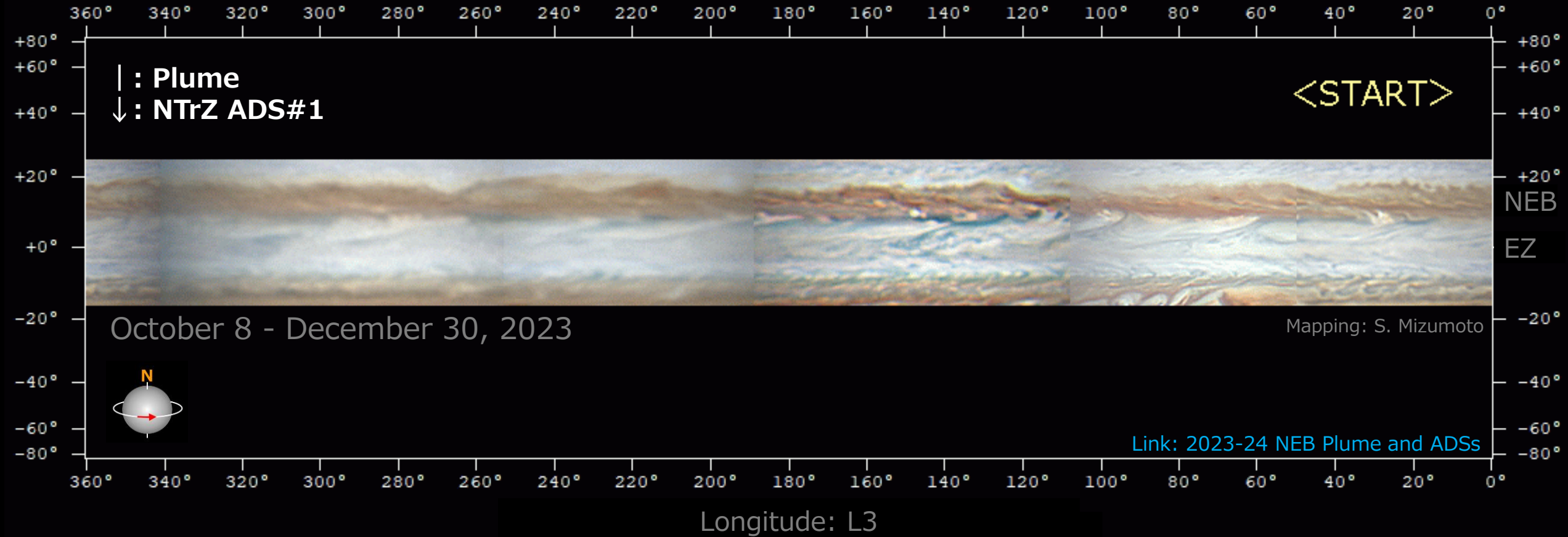


Credit: Gordon Björaker (NASA/GSFC) / Shinji Mizumoto (ALPO-J)

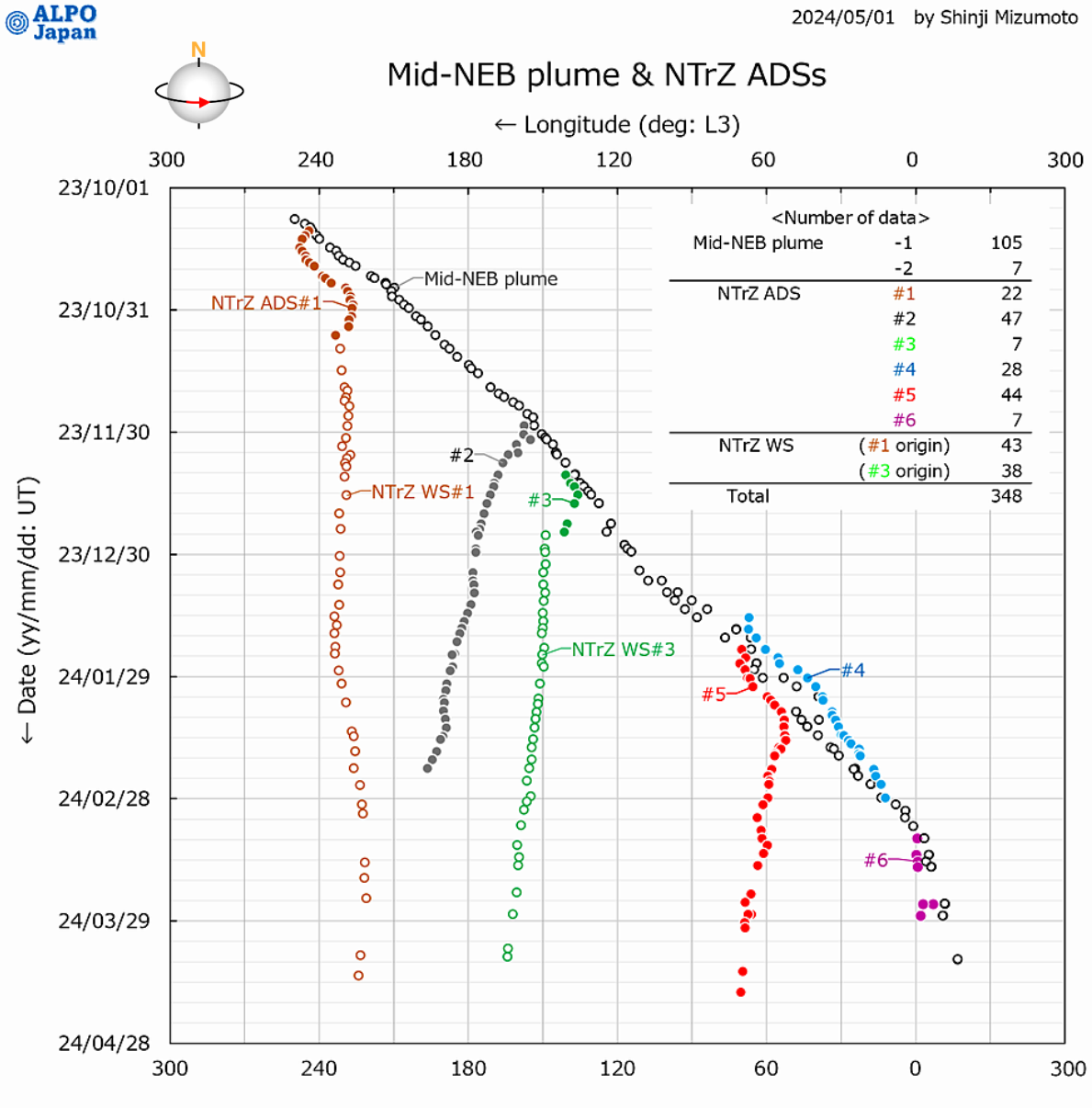
IRTF: Infrared Telescope Facility (L3)



Date	UT	Observer	Channel	Longitude	Sy.	Latitude
2023 Oct 07	05:58.7	E.Sussenbach	Colour	341°... 50°	3	-16°...+25°
2023 Oct 06	00:56.5	A.Frantzis	Colour	50°...108°	3	-16°...+25°
2023 Oct 07	18:46.6	I.Miyazaki	Colour	108°...189°	3	-16°...+25°
2023 Oct 06	15:20.5	S.Ito	Colour	189°...253°	3	-16°...+25°
2023 Oct 06	16:54.6	O.Inoue	Colour	253°...341°	3	-16°...+25°

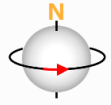


2024/05/01 by Shinji Mizumoto

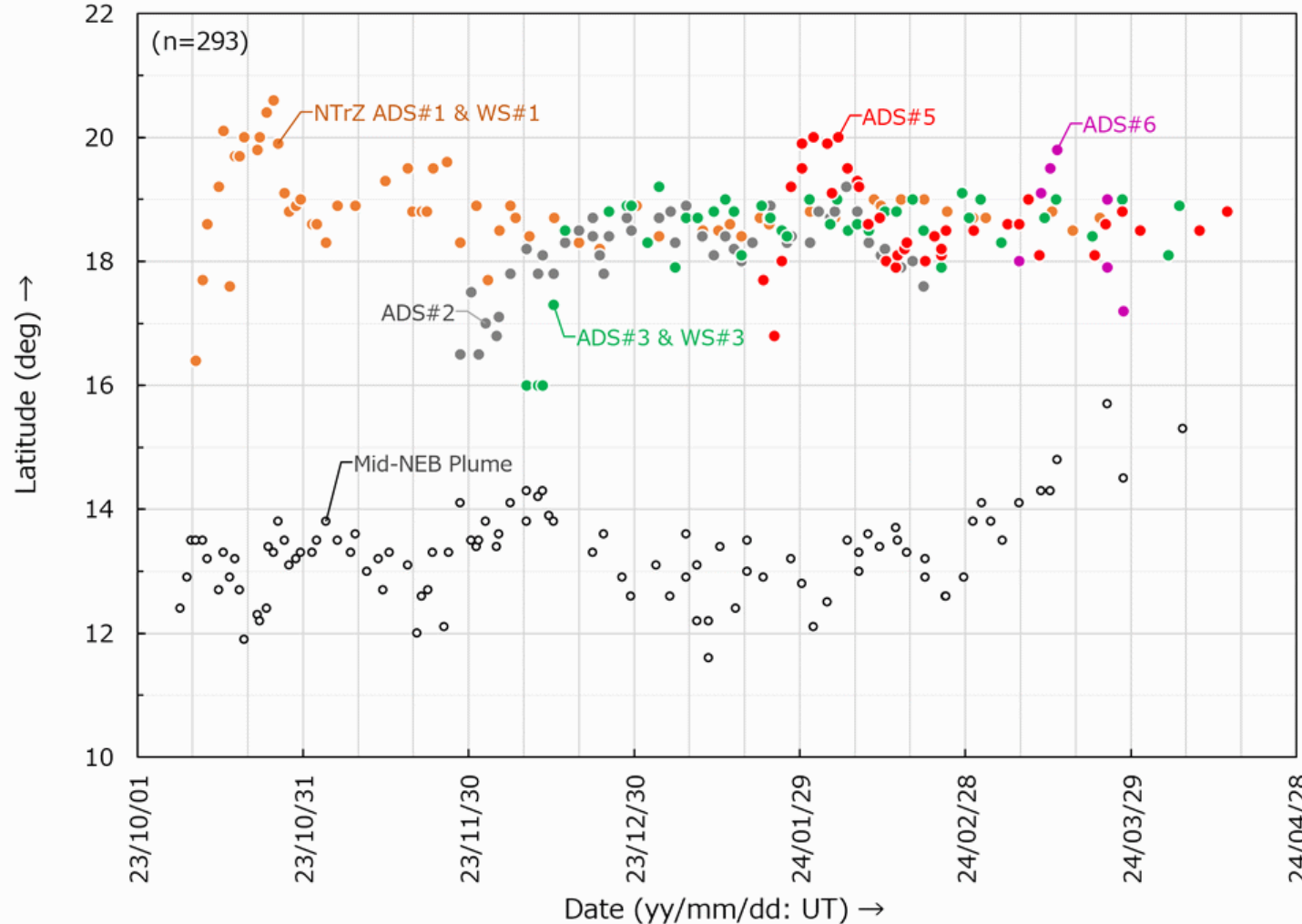


Mid-NEB plume & NTrZ ADSs/WSs Drift Rate (DL3)				
Object		Period (yy/mm/dd: UT)	DL3 (deg/d)	DL3 (ded/30d)
Mid-NEB plume		23/10/08 - 24/02/27	- 1.62	- 48.6
		24/02/29 - 24/04/07	- 0.62	- 18.6
NTrZ ADS	#1	23/10/11 - 23/10/24	- 0.80	- 24.0
		23/10/25 - 23/11/06	+0.22	+6.6
	#2	23/11/28 - 24/02/20	+0.41	+12.3
	#3	23/12/10 - 23/12/15	- 1.02	- 30.6
		23/12/17 - 23/12/24	+0.57	+17.1
	#5	24/01/22 - 24/02/06	- 1.11	- 33.3
		24/02/08 - 24/04/15	+0.28	+8.4
	#6	24/03/06 - 24/03/27	- 0.22	- 6.6
	#4	24/01/14 - 24/01/31	- 1.73	- 51.9
		24/02/02 - 24/02/27	- 1.13	- 33.9
NTrZ WS	#1	23/11/09 - 24/04/11	- 0.05	- 1.5
	#3	23/12/25 - 24/04/06	+0.16	+4.8

- NTrZ white spots may be derived from NTrZ ADSs.
- Early March 2024: Plume decelerated.
- #4 was not an ADS and was not thought to have a direct relationship with plume-rift activity.

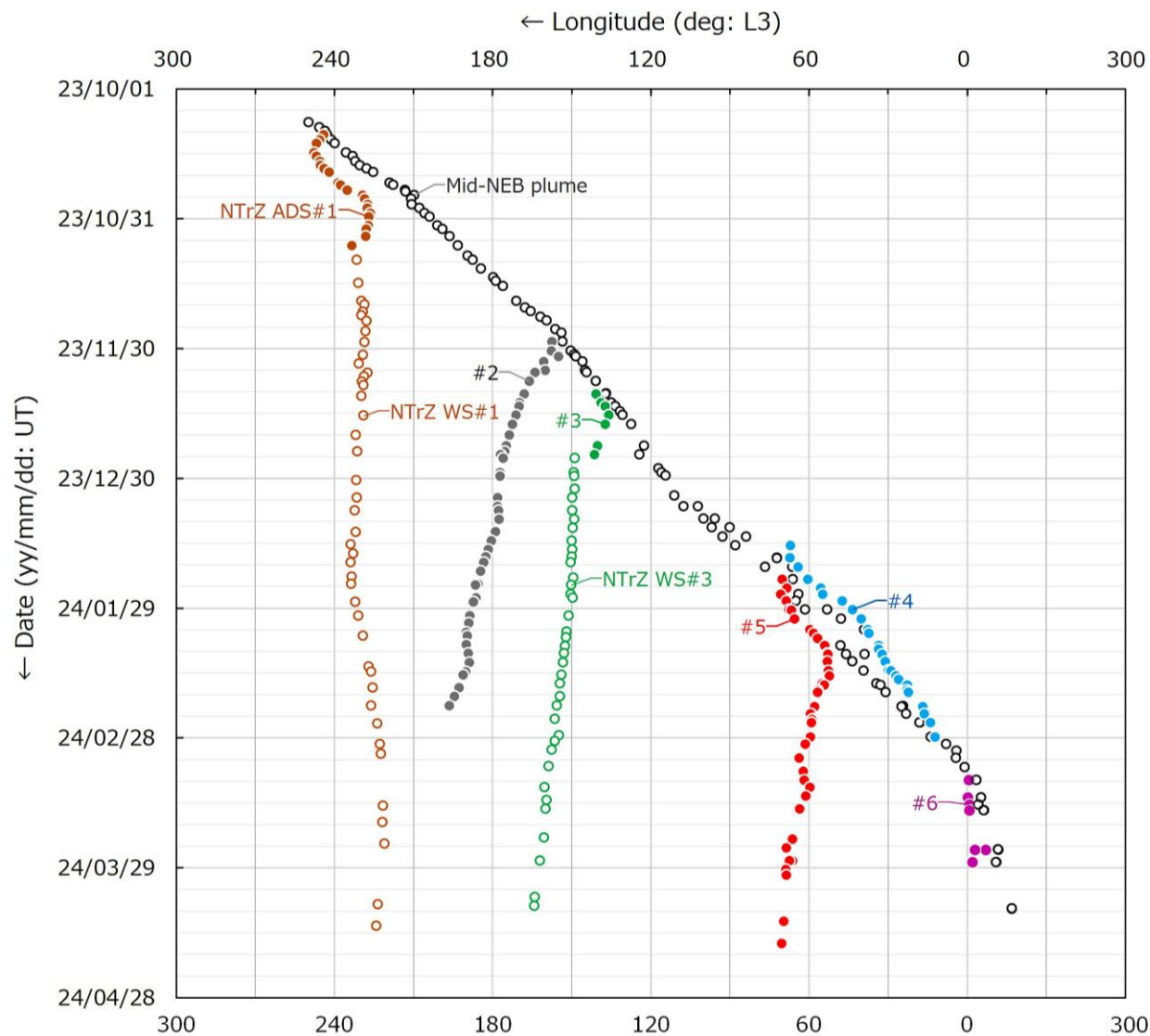


## 2023-24 Mid-NEB Plume & NTrZ ADSs Latitude

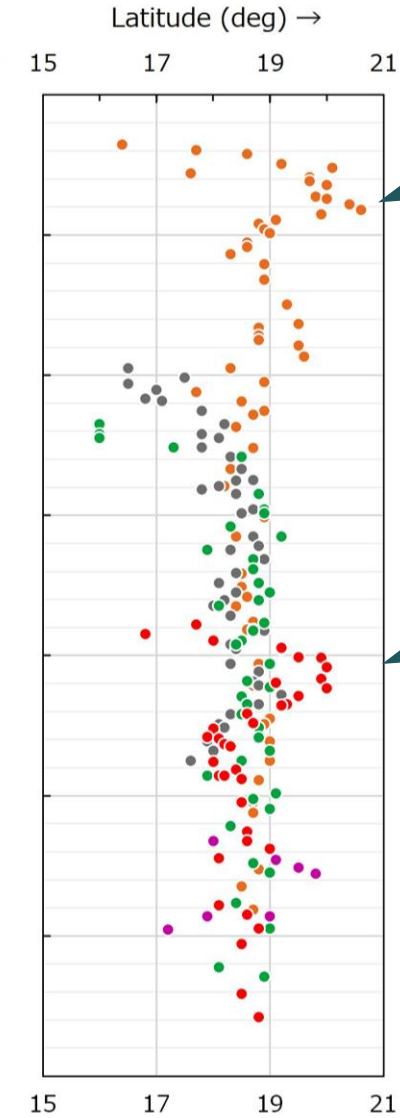


- The plume has been shifted north since the end of February 2024.
- ADS#1, ADS#5, (ADS#6):
  - Initially showed rapid changes in latitude, reaching up to nearly +20 degrees.
  - About one month after their formation, they settled at latitudes of +18 to +19 degrees.
- ADS#2, ADS#3:
  - Similar trend were observed, but they were minor.
- The above latitude changes are consistent with the longitude changes (drift chart).

### Mid-NEB plume & NTrZ ADSs

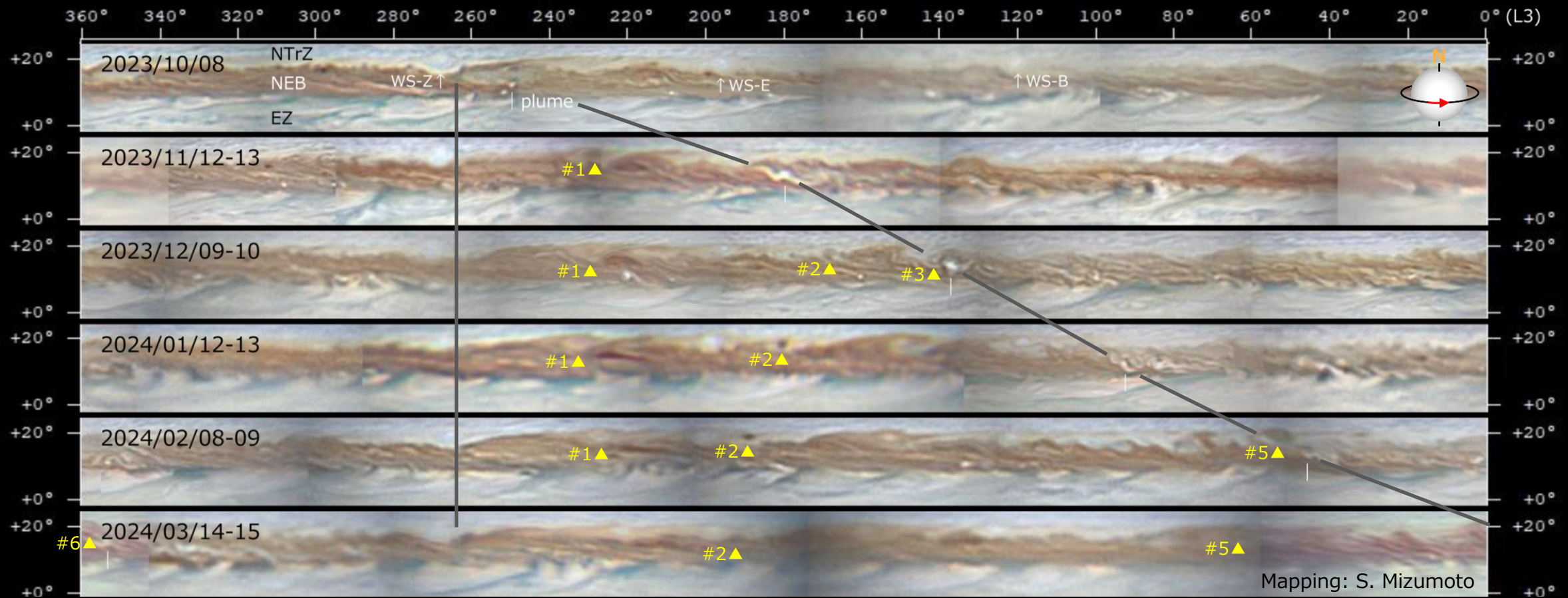


### ADSs Latitude



#1: Initially showed rapid changes in latitude

#5: Initially showed rapid changes in latitude



- Increased activity in the NEBn-NTrZ on the following side of the plume was observed after its passage, as indicated by pronounced unevenness along the northern edge of the NEB.
- As the NEB's northern edge extended northward and thickened, it also expanded longitudinally, contributing to the overall NEB expansion.

Object	Period (yy/mm/dd: UT)		Duration (days)	DL3 (deg/d)	Lat. (deg)	Notes/Special instructions		
Mid-NEB plume	23/10/08	24/02/27	142	- 1.62	+13.1	Increased NEBn-NTrZ activity on the f-side of the plume after the passage of the plume, as suggested by the intense unevenness of the northern edge of the NEB. As the NEB's northern edge extended northward and became denser, it also expanded in the longitudinal direction, causing the NEB expansion.		
	24/02/29	24/04/07	38	- 0.62	+14.4	Shifted north → Deceleration		
NTrZ ADS	#1	23/10/11	23/10/24	13	- 0.80	+16.4	←10/11	White clouds supplied by the plume reached the NTrZ through rift activity, forming the ring-shaped NTrZ ADSs.  ADS#1 and ADS#5 initially showed rapid changes in latitude, reaching up to nearly +20 degrees. About one month after their formation, they settled at latitudes of +18 to +19 degrees.
		23/10/25	23/11/06	12	+0.22	+18.9	Deceleration → Changed to WS	
	#3	23/11/28	24/02/20	84	+0.41	+18.2		
		23/12/10	23/12/15	5	- 1.02	+16.0	←12/10	
	#5	23/12/17	23/12/24	7	+0.57	+18.5	Deceleration → Changed to WS	
		24/01/22	24/02/06	15	- 1.11	+16.8	←01/24	
	#6	24/02/08	24/04/15	67	+0.28	+18.4	Deceleration	
		24/03/06	24/03/27	21	- 0.22	+18.6		
#4	24/01/14	24/01/31	17	- 1.65	---	#4 was not ADS, appears to be unrelated to plume/rift activity.		
	24/02/02	24/02/27	25	- 1.13				
NTrZ WS	#1	23/11/09	24/04/11	154	- 0.05	+18.7	NTrZ ADS#1 origin	
	#3	23/12/25	24/04/06	103	+0.16	+18.7	NTrZ ADS#3 origin	

- **Mid-NEB plume eruption**
  - The Mid-NEB plume erupted on October 8, 2023.
  - The plume was a progressive and intermittent eruption of white clouds.
  - White clouds emerging from the plume were stretched in east-west and north-south directions by wind velocity gradients, forming a rift.
  - This phenomenon continued for nearly six months until the end of the apparition.
- **NTrZ ADSs formation**
  - Rift activities led to the transport of white clouds into the NTrZ, where they formed five ring-shaped ADSs.
  - ADS#1 and ADS#5 initially exhibited rapid shifts in latitude, reaching up to nearly +20 degrees before stabilizing at latitudes between +18 and +19 degrees one month after formation.
  - ADS#1 and ADS#3 eventually transformed into white spots.
- **NEB expansion event**
  - Following the plume's passage, the region between the NEB and NTrZ became notably active and unstable.
  - The northern edge of the NEB extended and thickened northward.
  - As the plume progressed, the expansion of the NEB extended in the direction of decreasing longitude.



### Acknowledgements

- I would like to express my gratitude to all the observers who provided their valuable observation data.
- I would like to express my gratitude to Gordon Bijöraker (NASA/GSFC) for providing the IRTF 5.1 microns images.
- A special thanks to John H. Rogers (BAA Jupiter Section) for his invaluable input into the preparation of this report.

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1. [Yuichi Iga \(2001\), Formation of NEB Rift in 2000-2001, ALPO-Japan](#)
2. [Yuichi Iga \(2002\), The Activity of NEB in 2001-2002, ALPO-Japan](#)
3. [Kuniaki Horikawa, Chronicle of the Planet Jupiter since 2000, OAA Jupiter-Saturn Section](#)
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8. [Shinji Mizumoto \(2024\), 2023-24 NEB Plume and ADSs L3 maps, ALPO-Japan](#)

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