- Summary Report-2020 NTBs jet-stream Outbreak

2020 Aug 18 (CH4) I. Miyazaki

2020 Aug 18 I. Miyazaki

Shinji Mizumoto, ALPO-Japan





1. Three Plumes occurred - 1



NTB NEB

280°

2020/08/18 (CH4) I. Miyazaki 13:38.4 I. Miyazaki 14:52.5

2020/08/19 T. Ishibashi 11:04.0 +40° S. Ota 12:40.3

+20°

by Shinji Mizumoto

260°(L1)

1. Three Plumes occurred - 2

1) The phenomenon called "NTBs jet-stream Outbreak" has occurred every 5 years since 1970 (with a 17-year pause on the way), but this time it has occurred in 3 years and 10 months since Oct. 2016.

2) Three plumes occurred, the active area spread to all longitudes in late Sep., and the time of occurrence – weakening / disappearance are as follows.
Plume #1: 2020 Aug. 18 – Oct. 07-14
Plume #2: 2020 Sep. 01 – Sep. 25-28
Plume #3: 2020 Sep. 08 – Sep. 19-22



2. Four Elements of Outbreak Activities



OPAL 2016 Zonal Winds]



[NTBs jet-stream Outbreak - Animation (L1)] 2020 Aug. 18 - Oct. 16 Link: Ref. 11)

by Shinji Mizumoto



2) Forming dark spots (patches) on the f. side of plumes.

4) Interaction between NEBn and white clouds retrograding on NTrZs.

[HST: IR images - Animation (L1)] 2020 Sep. 20 Link: Ref. 15)



[HST: UV images - Animation (L1)] 2020 Sep. 20 Link: Ref. 16)



[Interaction between Outbreak (NTrZs white clouds) and NEBn - Animation (L2)] 2020 Sep. 08 - Nov. 07 Link: Ref. 17)



Points to note: NEBn disturbance state and WSZ (\blacktriangle) change.

- The NTrZs white clouds invaded NEBn, and NEBn became disturbed (probably related to NEB expanding).
- The invasion of the NTrZs white clouds into NEBn may be related to NEBZ barges (cyclonic vortices).
- WSZ: White Blue-gray, not bright by CH4 It seems that white clouds in the upper layer have been stripped off.
- > The other AWO, WSb, may have disappeared while remaining missing.



NTBs white clouds and NTrZs white clouds appear to be fluttering and stretched by steep wind velocity gradients.
 → Rift structure

4. Weakening / Disappearance of Plumes - 1



4. Weakening / Disappearance of Plumes - 2

[Plume #1 Disappearance process - Animation (L1)] 2020 Oct. 02-16 Link



Points to note: Brightness change of plume # 1

- When plume #1 (▲) reached the end of outbreak #2 (NTBs white clouds, plume #2 has disappeared at this time), plume #1 weakened (decreased brightness) and then disappeared (not detected by CH4). Plume #2 and #3 also disappeared through a similar process. Three elements other than plume also weakened to diffuse after the disappearance of plume.
- > NTrZs white clouds does not appear to be involved in plume weakening.

5. NTB Revival



2020 Aug 05-06 before NTBs outbreak

Points to note: Change in NTB concentration

• NTB revived as a result of outbreak activities.

6. Rotation Period / Wind Velocity of Outbreak - 1

[2020 NTBs jet-stream Outbreak - Rotation Period / Wind Velocity] Link: Ref.19) by Kuniaki Horikawa										
Object	Rotation Period	Drift (L1/day)	n	Limiting Date (2020 mm/dd)	Limiting Longitude (L1)	Latitude (deg)	Wind Velocity (m/s)			
Plumes (mean)	9h47m18.3s ± 8.7s	-4.777 ± 0.219	3			$+23.2 \pm 0.1$	$+159.9 \pm 2.8$			
Plume #1	9h47m10.5s ± 1.7s	-4.971 ± 0.042	87	08/18 - 10/12	7.4 – 99.9	$+23.2 \pm 0.4$	$+162.5 \pm 0.6$			
Plume #2	9h47m16.6s ± 4.0s	-4.820 ± 0.099	27	09/01 - 09/25	132.2 – 14.2	$+23.3 \pm 0.5$	$+160.4 \pm 1.3$			
Plume #3	9h47m27.7s ± 5.5s	-4.540 ± 0.137	15	09/08 - 09/20	36.6 - 345.3	$+23.1 \pm 0.3$	$+156.9 \pm 1.8$			
Dark spot (mean)	9h49m58.5s ± 19.7s	-0.782 ± 0.490	12			$+24.0 \pm 0.3$	+106.6 ± 6.2			
Dark spot #1-1	9h49m43.8s ± 4.7s	-1.147 ± 0.115	46	08/20 - 09/24	1.8 - 320.8	$+24.2 \pm 0.4$	$+111.2 \pm 1.5$			
Dark spot #1-2	9h49m47.4s ± 16.1s	-1.056 ± 0.399	13	08/25 - 08/31	343.6 - 335.3	$+23.8 \pm 0.7$	$+110.3 \pm 5.2$			
Dark spot #1-3	9h49m56.8s ± 6.5s	-0.825 ± 0.160	17	08/29 - 09/16	331.4 - 315.9	$+23.7 \pm 0.5$	$+107.4 \pm 2.1$			
Dark spot #1-4	9h50m24.9s ± 7.6s	-0.126 ± 0.189	20	09/03 - 09/25	305.1 - 296.4	$+24.0 \pm 0.6$	$+ 98.0 \pm 2.5$			
Dark spot #1-5	9h50m10.7s ± 6.3s	-0.479 ± 0.157	15	09/07 - 09/21	288.7 – 279.5	$+23.8 \pm 0.6$	$+102.8 \pm 2.1$			
Dark spot #1-6	9h50m33.2s ± 10.8s	0.080 ± 0.268	12	09/08 - 09/19	271.4 - 276.5	$+23.6 \pm 0.3$	$+ 95.6 \pm 3.5$			
Dark spot #1-7	9h49m58.2s ± 6.3s	-0.788 ± 0.156	10	09/11 - 09/25	265.6 – 252.9	$+23.8 \pm 0.8$	$+106.8 \pm 2.0$			
Dark spot #2-1	9h49m47.5s ± 7.3s	-1.054 ± 0.181	31	09/04 - 10/04	124.3 - 88.0	$+24.1 \pm 0.7$	$+110.1 \pm 2.4$			
Dark spot #2-2	9h49m55.9s ± 3.6s	-0.846 ± 0.090	22	09/11 - 10/04	95.3 - 73.7	$+24.1 \pm 0.7$	$+107.3 \pm 1.2$			
Dark spot #2-3	9h50m12.1s ± 12.4s	-0.443 ± 0.307	11	09/15 - 09/29	79.3 – 70.5	$+23.8 \pm 0.4$	$+102.3 \pm 4.0$			
Dark spot #3-1	9h49m19.3s ± 5.4s	-1.756 ± 0.134	12	09/13 - 09/27	25.6 – 2.8	$+24.7 \pm 0.6$	$+118.6 \pm 1.7$			
Dark spot #3-2	9h49m51.9s ± 9.9s	-0.944 ± 0.245	7	09/15 - 09/20	13.9 - 8.8	$+23.9 \pm 0.5$	$+108.7 \pm 3.2$			

6. Rotation Period / Wind Velocity of Outbreak - 2



15

6. Rotation Period / Wind Velocity of Outbreak - 3

[2020 NTBs jet-stream Outbreak - Latitude / Wind Velocity]



Summary of outbreak rotation period / wind velocity.

- They are typical values for NTBs jet-stream outbreaks.
- Rotation period of dark spots: The dark spots that occur earlier in each outbreak tend to have a faster rotation period.
 Multiple mergers of dark spots were observed.
- The rotation period of plume #1 was slowdown after it became weak. Link: Plume-Latitude

7. Summary / Acknowledgments

[2020 NTBs jet-stream Outbreak – Summary]

4 elements of activities	Occurrence / Development	Weakening / Disappearance	Latitude	Rotation Period	Wind Velocity	Notices
1) Plumes	3 plumes occurred. #1: 2020 Aug. 18 #2: 2020 Sep. 01 #3: 2020 Sep. 08	When plume reached the end of the outbreak on the p. side, plume weakened / disappeared. #1: 2020 Oct. 07-14 #2: 2020 Sep. 25-28 #3: 2020 Sep. 19-22	+23.2* (deg)	9h47m18.3s*	+159.9* (m/sec)	 Bright with CH4 / UV images. → Extrusive phenomenon rising high above the main cloud deck. Prograde on L1 at high speed. → NTBs jet-stream Not clear if they were anticyclonic vortices.
2) Dark spots	Forming on the f. side of plume.	Weakened with the disappearance of plumes.	+24.0*	9h49m58.5s*	+106.6*	Anticyclonic vorticesColor: Bluish gray
3) NTBs white clouds	Flowed out from plume.	Weakened with the disappearance of plumes.	+25.5			 Related to the weakening / disappearance of plumes.
4) NTrZs white clouds	Flowed out from plume.	Weakened with the disappearance of plumes.	+20.8			 Violent interaction with NEBn during expanding. → NEBn was disturbed and WSZ (AWO) was temporarily unknown.

 \cdot The outbreak activity area spread to all longitudes in late Sep..

• Due to the activities 1)-4) above, the faint NTB was revived.

* by Kuniaki Horikawa

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Thank you for listening.

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