

Jupiter in 2023/24, Report no.3, Appendix 2: Zonal wind profiles

Grischa Hahn (JUPOS team) has now produced zonal wind profiles (ZWPs) from four of the image pairs taken ~10 hours apart from Eric Sussenbach and Chris Go. These were on 2023 Nov.26 & 27, & Dec.10, and 2024 Jan.10. Sussenbach's images are shown in [Figure A1](#). The ZWPs are in [Figure A2](#), including the average of them (large orange points).

Hahn notes that an image timing error of 1 minute would change the wind speeds by 19 m/s. Therefore, he calibrated the four ZWPs by adjusting the baseline of each one to give the best fit to a ZWP that he had obtained from 2012 Hubble data.

The resulting profiles are of very good quality, generally agreeing well with each other, and with previous spacecraft data [[Ref.3 in main report](#)], but there are interesting differences. They confirm the unusual jet speeds that were reported in the main report. Some interesting speeds are as follows (in m/s relative to System 3).

NTBn jet: This has an unusually rapid retrograde speed, with a peak of -32 to -46 m/s in the four profiles, and -34 m/s in the average. The previous spacecraft average is -26.8 m/s, in which the fastest measurements were -32 m/s (Voyager in 1979) and -35.6 m/s (New Horizons in 2007) – both made when the NTB was faint prior to a NTBs jet outbreak, as it is now. This suggests that in this condition, the NTBn jet accelerates (westward), as well as the NTBs jet (eastward).

NTBs jet: The peak speed is +144 to +151 m/s in the four profiles, and +147 (± 7) m/s in the average, agreeing with our value from spot tracking. We still expect a NTBs jet outbreak in 2024 or 2025.

NEBs jet: The measurements are very scattered, consistent with the complex variability of features at present, but no sector is consistently faster than 110 m/s.

Equatorial Current: Here too the measurements are very scattered, but exceptionally slow in all sectors (down to ≤ 64 m/s), and down to ~55 m/s in two sectors. This is consistent with our preliminary measurements, and also with more precise JUPOS analysis, which has now been done by Gianluigi Adamoli (including the same spots that were done earlier). The chart of his results is in [Figure A3](#). Most tracks were only 4-8 days long, but well-defined, so typical uncertainties are $\sim \pm 3$ m/s. The average speed of six spots from -0.3 to +1.1°N, omitting outliers, is $u = +62.4 (\pm 2.1)$ m/s [DL1 = +91.2 (± 4.4) deg/30d]. The even slower outliers at ~50 m/s are, however, definite tracks.

SEBn jet: The peak jet speed is +137 to +144 m/s in the four profiles, agreeing with the faster range that we measured earlier.

SEB: ZWPs often show an inflexion on the cyclonic gradient across the SEB, and this is particularly marked in the three ZWPs from images that included the GRS (Nov.27, Dec.10, Jan.10). All three show a distinct retrograding peak at 13-14°S ('graphic), and thus an anticyclonic lane at ~14°S. Presumably this relates to the special conditions just p. and/or f. the GRS. The ZWP from Nov.26, far from the GRS, shows only a modest shoulder at 11-12°S.

SEBs jet: Only the ZWP from Nov.26, far from the GRS, shows rapid retrograding speed, -60.5 m/s (DL2 = +124 deg/30d), which matches the maximum speeds of the rings and waves that we tracked on the SEBs edge. The other ZWPs, flanking the GRS, show lesser retrograding speeds as might be expected.

STBn jet: This jet is known to be double and variable, with two sub-peaks at ~26.5°S and 29°S. The northern sub-peak is always present all around the planet, while the southern (29°S) sub-peak is mainly present alongside STB structured sectors, such as the STB segments A and G. Hahn's new ZWPs confirm this pattern. The Nov.26 ZWP, which does not cover a structured sector, shows only the northern sub-peak, at +33 m/s. The other three ZWPs all include part or all of STB segment A, and show both sub-peaks; the southern one ranges from +35 to +44 m/s.

STBs jet: This retrograde jet is also commonly faster alongside STB structured sectors. In Hahn's ZWPs, it is particularly fast in the Dec.10 one (-35 m/s, 32°S; DL2 = +76 deg/30d); this covers STB segment A.

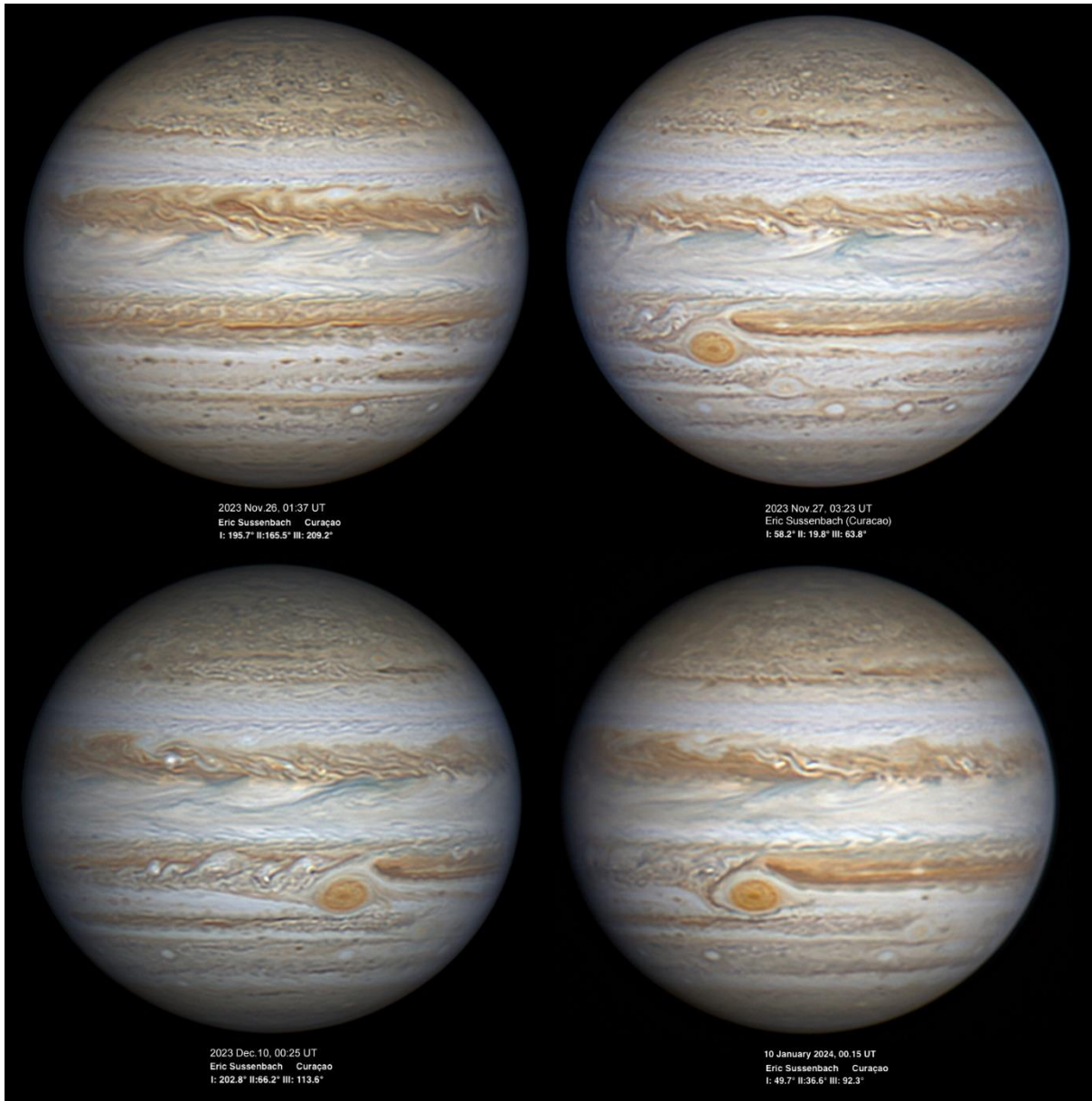


Figure A1.

Zonal wind profile
 Longitudinal Drifts Jupiter 2023-2024
 Sussenbach versus Go (10h); ZWP by G. Hahn

- 2023-11-26-gray.ddf (dD = +20,000 m/s for B = 0°)
- 2023-11-27_gray_opt.ddf (dD = +5,000 m/s for B = 0°)
- 2024-01-10-Sussenbach_Go-gray.ddf (dD = -2,000 m/s for B = 0°)
- 2023-12-10-Sussenbach_Go-gray.ddf (dD = +5,000 m/s for B = 0°)
- Average

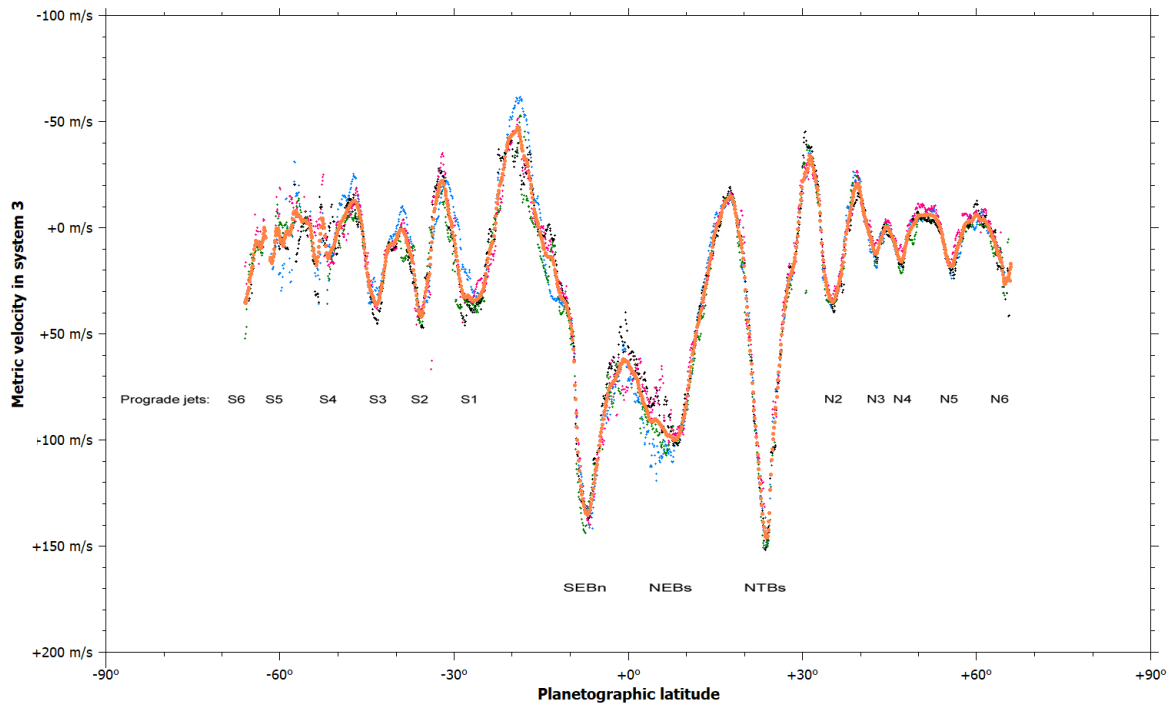


Figure A2.

Zonal drift profile for equatorial grey spots
 2023, (JUPOS analysis by G. Adamoli)

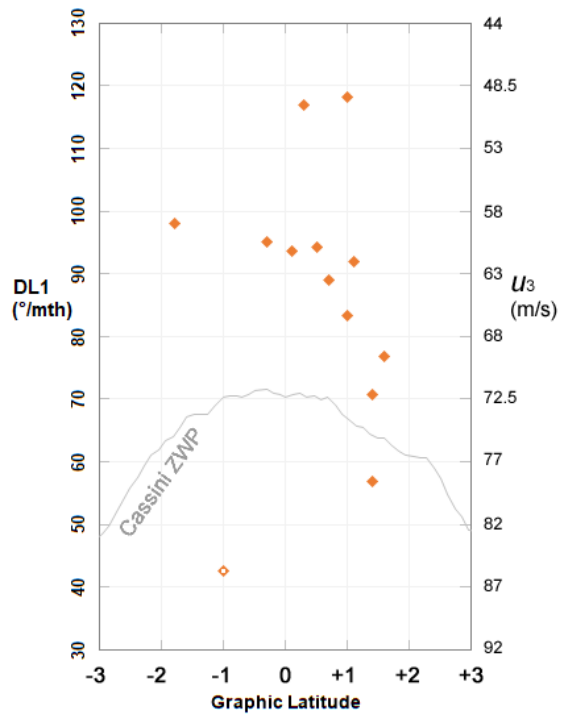


Figure A3.