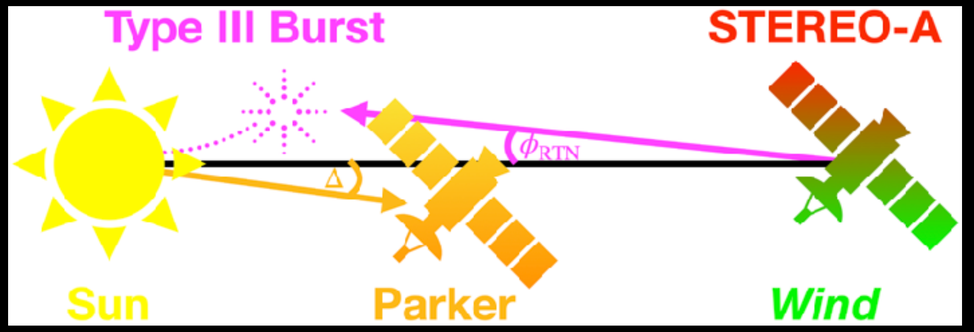
Radial Variations in Solar Type III Radio Bursts



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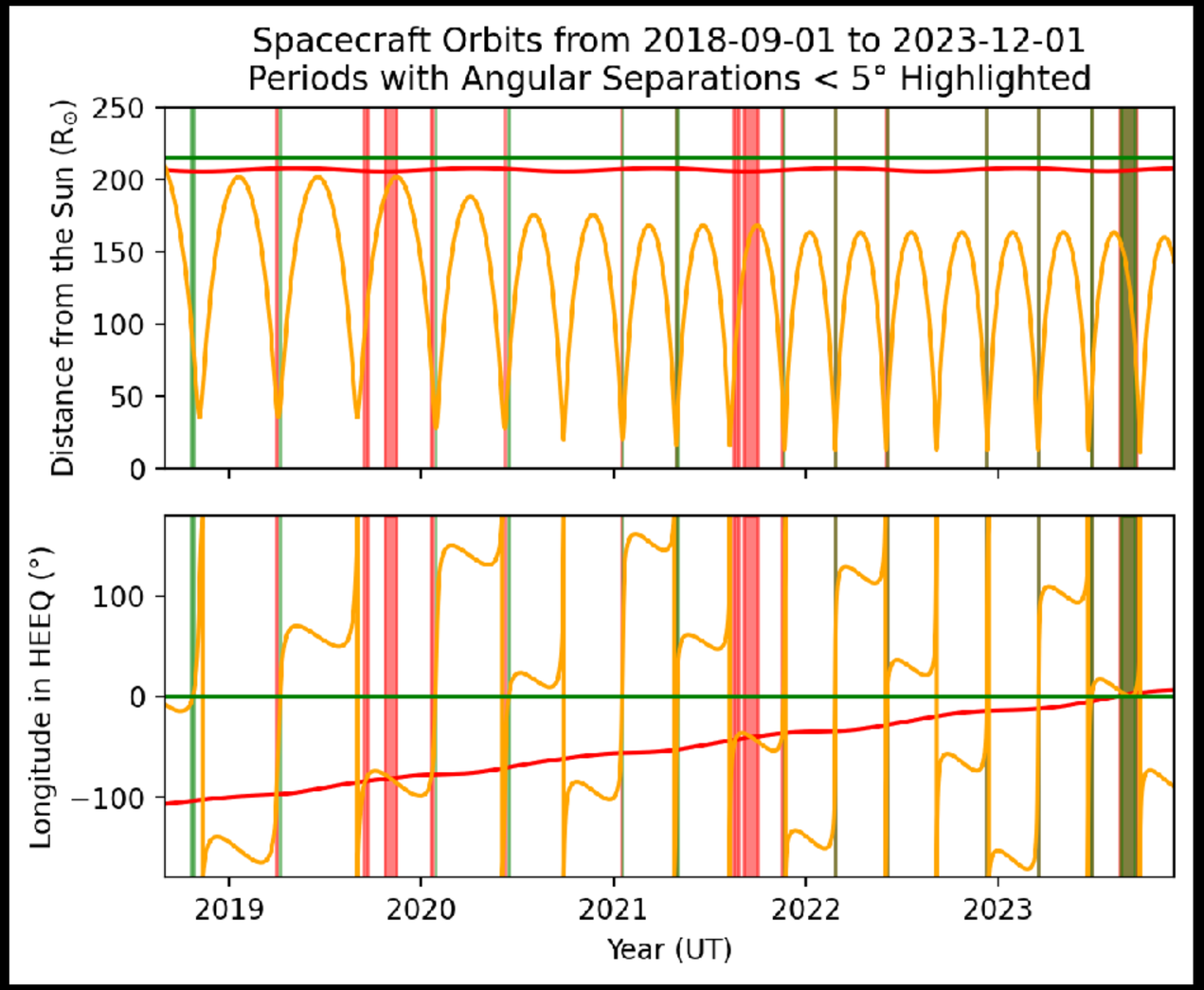
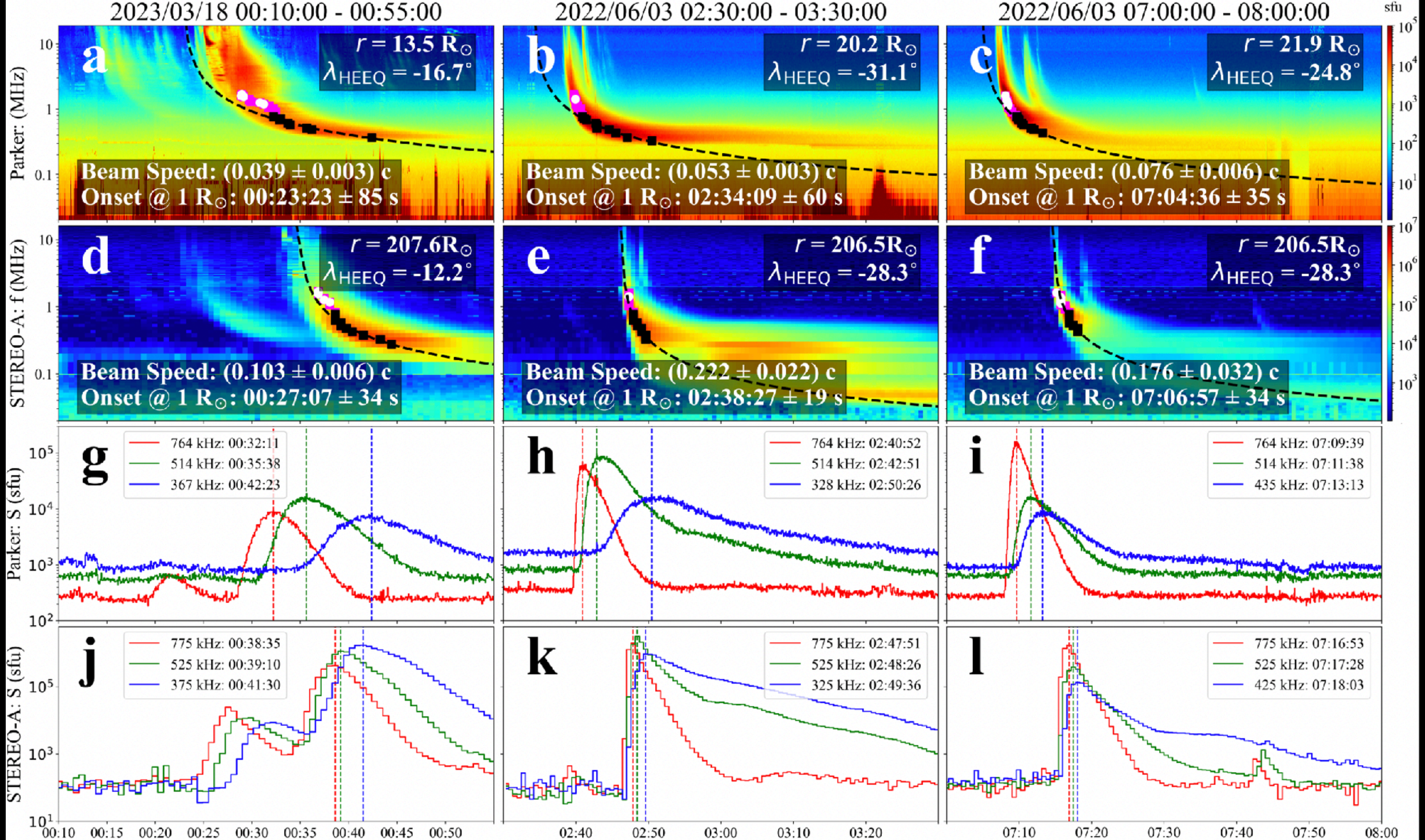
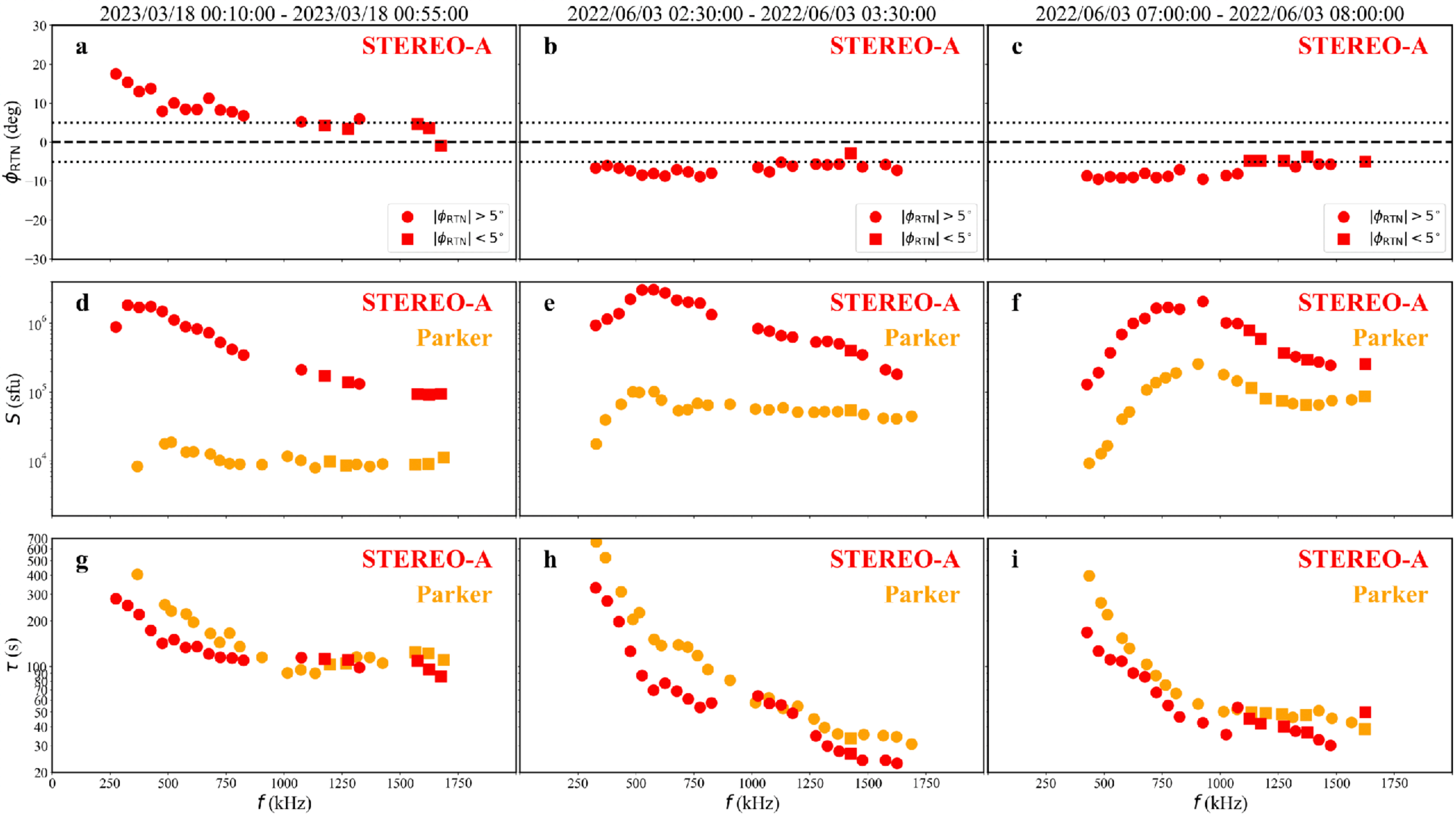
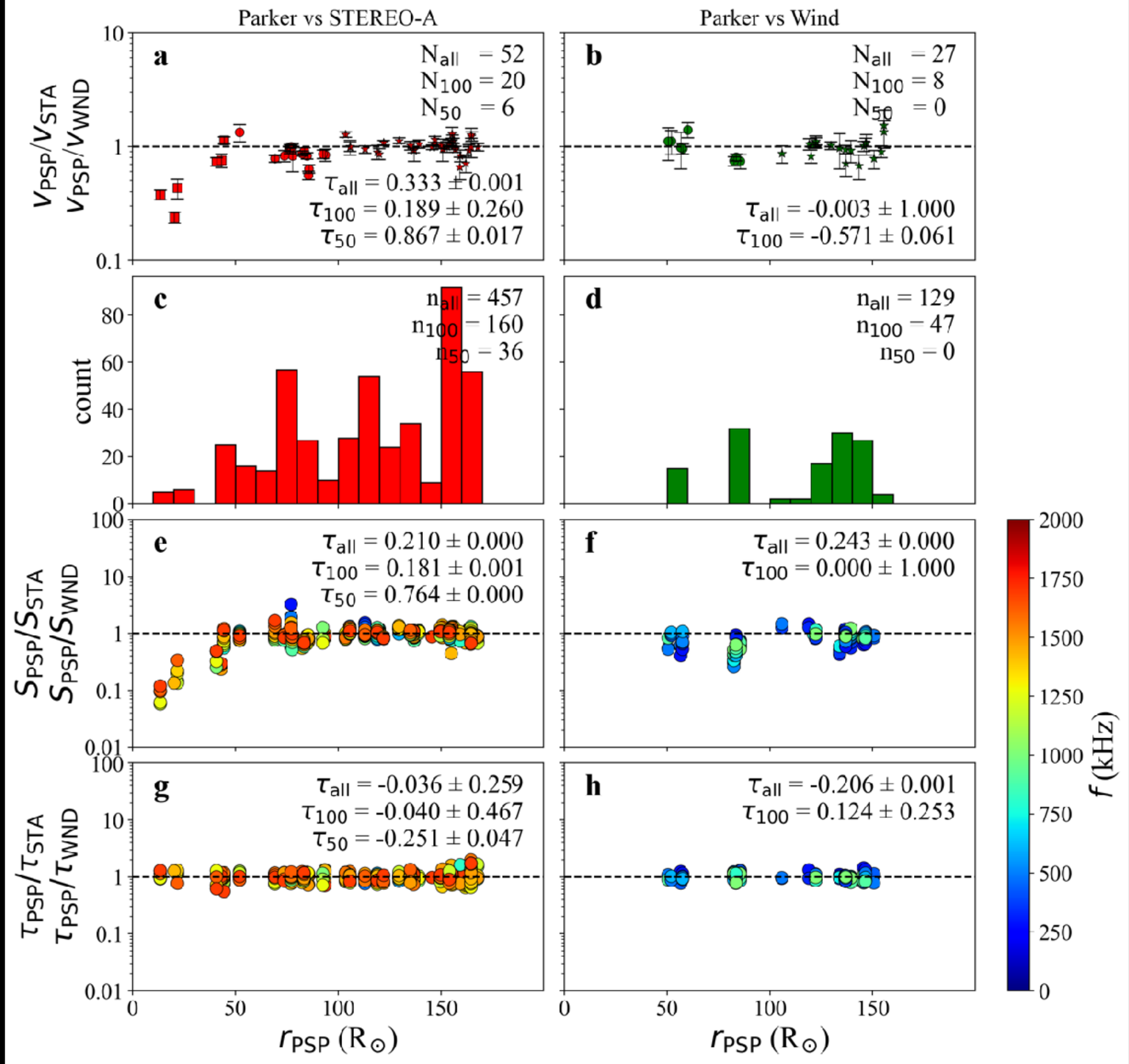


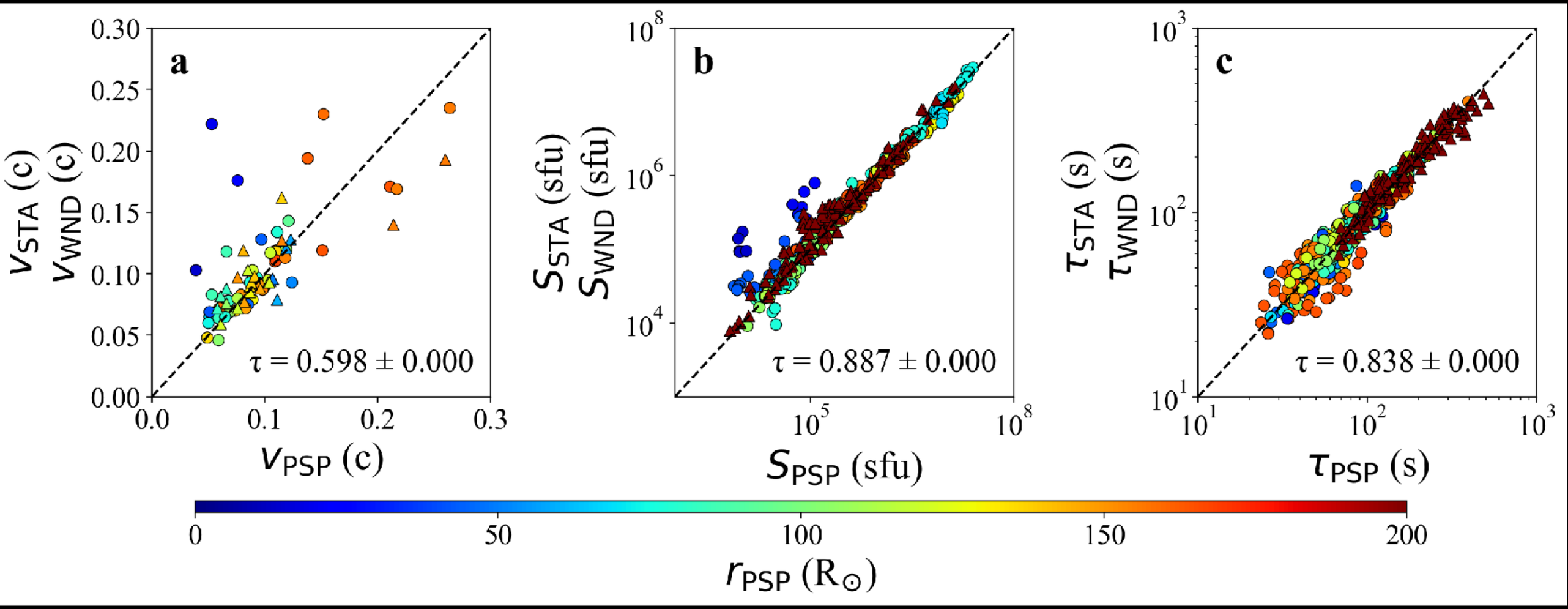
Table 1. Intervals of Radial Alignment for Parker Solar Probe with STEREO-A and *Wind* (Separation Angle < 5°)

Spacecraft	Start Time (UT)	End Time (UT)	ΔR_{max} ($R_\odot$)	# of bursts
Wind	2018-10-21 12:14	2018-10-26 07:27	136.5	0
STEREO-A	2019-04-01 09:42	2019-04-02 05:11	166.6	0
Wind	2019-04-07 13:30	2019-04-08 08:26	174.4	0
STEREO-A	2019-09-14 01:02	2019-09-21 01:13	120.5	0
STEREO-A	2019-10-22 12:51	2019-11-14 14:49	18.9	0
STEREO-A	2020-01-19 17:20	2020-01-22 09:36	146.4	0
Wind	2020-01-28 04:58	2020-01-28 14:48	186.3	0
STEREO-A	2020-06-08 08:54	2020-06-08 19:14	178.0	0
Wind	2020-06-14 03:16	2020-06-16 14:14	155.8	0
STEREO-A	2021-01-14 07:27	2021-01-15 01:25	173.5	0
Wind	2021-01-16 21:43	2021-01-17 03:53	193.8	0
STEREO-A	2021-04-29 15:48	2021-04-29 19:48	191.2	0
Wind	2021-04-30 19:53	2021-05-01 05:07	191.6	0
STEREO-A	**2021-08-17 07:14**	**2021-08-26 07:46**	**138.0**	**2**
STEREO-A	**2021-09-05 11:21**	**2021-09-30 17:07**	**64.5**	**12**
STEREO-A	2021-11-15 04:32	2021-11-17 08:56	161.5	0
Wind	2021-11-19 13:35	2021-11-19 22:55	192.8	0
STEREO-A	2022-02-25 07:26	2022-02-25 10:26	194.2	0
Wind	2022-02-25 17:17	2022-02-25 20:05	201.7	0
STEREO-A	**2022-06-03 01:37**	**2022-06-03 08:41**	**186.8**	**2**
Wind	2022-06-04 04:52	2022-06-04 23:39	184.9	0
STEREO-A	2022-12-10 00:18	2022-12-10 08:08	186.6	0
Wind	2022-12-10 10:48	2022-12-10 16:18	197.4	0
STEREO-A	**2023-03-18 00:25**	**2023-03-18 03:20**	**194.2**	**1**
Wind	2023-03-18 04:01	2023-03-18 07:12	201.1	0
STEREO-A	**2023-06-25 15:31**	**2023-06-27 08:12**	**165.0**	**4**
Wind	**2023-06-26 07:21**	**2023-06-28 14:40**	**168.9**	**5**
STEREO-A	**2023-08-19 21:00**	**2023-09-20 20:13**	**138.4**	**31**
Wind	**2023-08-21 20:04**	**2023-09-18 19:18**	**135.3**	**22**


2023/03/18 00:10:00 - 00:55:00
2022/06/03 02:30:00 - 03:30:00
2022/06/03 07:00:00 - 08:00:00
sfu
Parker: (MHz)
STEREO-A: f (MHz)
Parker: S (sfu)
STEREO-A: S (sfu)
a
r = 13.5 R⊙
λHEEQ = -16.7°
Beam Speed: (0.039 ± 0.003) c
Onset @ 1 R⊙: 00:23:23 ± 85 s
b
r = 20.2 R⊙
λHEEQ = -31.1°
Beam Speed: (0.053 ± 0.003) c
Onset @ 1 R⊙: 02:34:09 ± 60 s
c
r = 21.9 R⊙
λHEEQ = -24.8°
Beam Speed: (0.076 ± 0.006) c
Onset @ 1 R⊙: 07:04:36 ± 35 s
d
r = 207.6R⊙
λHEEQ = -12.2°
Beam Speed: (0.103 ± 0.006) c
Onset @ 1 R⊙: 00:27:07 ± 34 s
e
r = 206.5R⊙
λHEEQ = -28.3°
Beam Speed: (0.222 ± 0.022) c
Onset @ 1 R⊙: 02:38:27 ± 19 s
f
r = 206.5R⊙
λHEEQ = -28.3°
Beam Speed: (0.176 ± 0.032) c
Onset @ 1 R⊙: 07:06:57 ± 34 s
g
764 kHz: 00:32:11
514 kHz: 00:35:38
367 kHz: 00:42:23
h
764 kHz: 02:40:52
514 kHz: 02:42:51
328 kHz: 02:50:26
i
764 kHz: 07:09:39
514 kHz: 07:11:38
435 kHz: 07:13:13
j
775 kHz: 00:38:35
525 kHz: 00:39:10
375 kHz: 00:41:30
k
775 kHz: 02:47:51
525 kHz: 02:48:26
325 kHz: 02:49:36
l
775 kHz: 07:16:53
525 kHz: 07:17:28
425 kHz: 07:18:03
00:10 00:15 00:20 00:25 00:30 00:35 00:40 00:45 00:50
02:40 02:50 03:00 03:10 03:20
07:10 07:20 07:30 07:40 07:50 08:00


2023/03/18 00:10:00 - 2023/03/18 00:55:00
2022/06/03 02:30:00 - 2022/06/03 03:30:00
2022/06/03 07:00:00 - 2022/06/03 08:00:00
a
b
c
STEREO-A
ϕ_{RTN} (deg)
$|\phi_{RTN}| > 5°$
$|\phi_{RTN}| < 5°$
d
e
f
Parker
S (sfu)
g
h
i
τ (s)
f (kHz)


Parker vs STEREO-A
Parker vs Wind
a
N_{all} = 52
N_{100} = 20
N_{50} = 6
τ_{all} = 0.333 ± 0.001
τ_{100} = 0.189 ± 0.260
τ_{50} = 0.867 ± 0.017
b
N_{all} = 27
N_{100} = 8
N_{50} = 0
τ_{all} = -0.003 ± 1.000
τ_{100} = -0.571 ± 0.061
v_{PSP}/v_{STA}
v_{PSP}/v_{WND}
c
n_{all} = 457
n_{100} = 160
n_{50} = 36
d
n_{all} = 129
n_{100} = 47
n_{50} = 0
count
e
τ_{all} = 0.210 ± 0.000
τ_{100} = 0.181 ± 0.001
τ_{50} = 0.764 ± 0.000
f
τ_{all} = 0.243 ± 0.000
τ_{100} = 0.000 ± 1.000
S_{PSP}/S_{STA}
S_{PSP}/S_{WND}
g
τ_{all} = -0.036 ± 0.259
τ_{100} = -0.040 ± 0.467
τ_{50} = -0.251 ± 0.047
h
τ_{all} = -0.206 ± 0.001
τ_{100} = 0.124 ± 0.253
τ_{PSP}/τ_{STA}
τ_{PSP}/τ_{WND}
r_{PSP} ($R_\odot$)
r_{PSP} ($R_\odot$)
f (kHz)


a
b
c
v_{STA} (c)
v_{WND} (c)
v_{PSP} (c)
$\tau = 0.598 \pm 0.000$
S_{STA} (sfu)
S_{WND} (sfu)
S_{PSP} (sfu)
$\tau = 0.887 \pm 0.000$
τ_{STA} (s)
τ_{WND} (s)
τ_{PSP} (s)
$\tau = 0.838 \pm 0.000$
r_{PSP} ($R_\odot$)

Conclusion

- Demonstrated a consistent pattern in the properties of solar Type III radio bursts as observed from varying solar distances.
- Identified no significant radial variations in electron beam speeds, radio fluxes, or exponential decay times for events above 50 solar radii.
- Near the Sun (below 50 solar radii), observed a decrease in beam speeds and radio fluxes, suggesting potential effects of radio beaming or changes in radio source sizes.