SEP Events from STEREO A (Dec. 2006 - Sept. 2017) and B (Dec. 2006 - Sept. 2014) (Updated on 11/3/2017)

The list is compiled by Dr. Lan Jian (lan.jian@nasa.gov) using the criterion that the flux of 13-100 MeV protons from HET measurements > 10 pfu (1 pfu = 1 p $cm^{-2}sr^{-1}s^{-1}$), to mimic the list of Solar Proton Events provided by NOAA Space Weather Prediction Center using the GOES spacecraft data (http://www.swpc.noaa.gov/ftpdir/indices/SPE.txt). Checking with the data is highly recommended because there are data gaps sometimes.

Hourly data from Hight Energy Telescope (von Rosenvinge et al., Space Sci. Rev., 2008) are used. The events in 2006 are in the solar wind, outside the Earth's bow shock. There are no events reaching the criterion in 2007-2010 at either STEREO spacecraft.

There is a list of >25 MeV proton events and relevant solar events in a separate study by Richardson et al. (Solar Phys. 2014).

# of STA	Start Time				End Time				Maximum Flux (pfu)	Fluence ($cm^{-2}sr^{-1}$)	Comments
	Year	Month	Day	Hour	Year	Month	Day	Hour			
1	2006	12	6	20.5	2006	12	11	22.5	1031.77	83391997	CME and flare
2	2006	12	13	3.5	2006	12	14	17.5	449.22	21894825	CME and flare
3	2011	3	9	8.5	2011	3	9	16.5	26.88	676257	gradual rise, CME and flare
4	2011	3	21	3.5	2011	3	22	21.5	685.06	25013660	CME
5	2011	6	4	16.5	2011	6	7	23.5	2021.23	103897555	CME and flare
6	2011	11	4	0.5	2011	11	5	0.5	124.00	4049773	flare and CME
7	2012	1	24	8.5	2012	1	26	20.5	27.86	4183357	CME
8	2012	1	28	5.5	2012	1	31	11.5	1311.82	23479615	the 2nd rise is based on 1/24/2012 flux, no clear source
9	2012	3	9	23.5	2012	3	12	22.5	15.92	3465837	gradual rise, fast CMEs on 3/7 and 3/8
10	2012	3	21	9.5	2012	3	21	20.5	37.48	920542	3/21 7:25 CME, no good flare
11	2012	3	24	1.5	2012	3	24	11.5	69.65	995532	3/24 00:10 CME, no good flare

12	2012	5	27	12.5	2012	5	28	7.5	546.73	8425291	5/26 20:57 CME, no good flare
13	2012	7	23	4.5	2012	7	27	19.5	27002.30	443080467	7/23 2:36 CME
14	2012	9	20	20.5	2012	9	22	16.5	175.77	10051864	9/19 12:25 CME
15	2012	9	27	13.5	2012	9	29	11.5	154.23	7638152	9/27 9:55 CME
16	2012	11	8	12.5	2012	11	9	5.5	19.36	841853	11/8 10:55 CME
17	2013	3	5	4.5	2013	3	7	17.5	1151.18	51289550	3/5 03:25 CME
18	2013	8	20	6.5	2013	8	22	12.5	260.53	21631482	8/19 23:24 CME
19	2013	10	5	14.5	2013	10	6	1.5	21.18	720568	CME and flare?
20	2013	10	11	8.5	2013	10	12	4.5	152.47	4274389	CME and flare
21	2013	11	2	5.5	2013	11	3	7.5	56.64	2612211	CME and flare
22	2013	11	4	13.5	2013	11	6	1.5	98.69	4677715	2nd and gradual rise in a SEP event, CME, no flare at the right time
23	2013	11	7	11.5	2013	11	8	5.5	47.71	1925607	CME, no flare at the right time
24	2013	12	26	10.5	2013	12	27	9.5	28.10	1632087	CME, no M or X class flare detected by GOES
25	2014	1	9	3.5	2014	1	10	2.5	24.71	1576536	SEP onset on 1/6, gradual increase, CME, no M or X class flare detected by GOES
26	2014	2	25	2.5	2014	2	26	9.5	108.28	5745902	weaker SEP events ahead, CME, X4.9 flare detected by GOES
27	2014	3	12	16.5	2014	3	12	20.5	24.01	283356	CME, M2.5 flare detected by GOES at N14W70
28	2014	8	28	20.5	2014	8	29	0.5	23.47	289856	no STA images, STB observed halo CME on 8/28 when A & B were only 30^{o} apart in longitude
29	2014	9	2	7.5	2014	9	4	15.5	579.95	7634659	no STA images, STB observed a halo CME on 9/1 when A & B were only 30^{o} apart in longitude

30	2014	9	25	19.5	2014	9	26	9.5	255.22	4290746	no STA images, STB COR2 observed a halo CME at 21 UT on 9/24 at 21UT. Because there are large data gaps at STA, the fluence may be incorrect.
31	2014	10	15	6.5	2014	10	16	21.5	176.26	3342622	solar observation is too short to tell
32	2014	12	13	19.5	2014	12	17	21.5	2037.31	51565621	flare from short EUVI movie, ICME on 12/16 with speed of about 600 km/s
33	2015	3	6	19.5	2015	3	6	23.5	56.15	786543	solar observation is too short to tell
34	2017	7	23	10.5	2017	7	25	0.5	988.68	47761109	CME and 2 B-class flares on 7/23
35	2017	7	25	4.5	2017	7	25	9.5	18.06	301259	the same event with the previous one, separated by a dip in intensity profile
36	2017	9	13	8.5	2017	9	16	2.5	57.36	6073828	CME and flares
37	2017	9	18	11.5	2017	9	19	8.5	257.78	5040994	CME

# of STB	Start Time				End Time				Maximum Flux (pfu)	Fluence ($cm^{-2}sr^{-1}$)	Comments
	Year	Month	Day	Hour	Year	Month	Day	Hour			
1	2006	12	6	19.5	2006	12	12	0.5	1142.04	39073	CME and flare
2	2006	12	13	3.5	2006	12	14	18.5	413.87	51967	the 2 are 1 event, flare and CME
3	2006	12	15	4.5	2006	12	15	8.5	16.08	38294	
4	2011	3	8	1.5	2011	3	8	9.5	39.12	909795	the 2 are 1 event, flare and CME
5	2011	3	8	14.5	2011	3	8	17.5	14.40	181029	
6	2011	9	22	12.5	2011	9	26	3.5	1191.64	106348294	flare and CME
7	2011	10	4	19.5	2011	10	5	1.5	12.10	290412	10/4 11:25 and 12:10 CME
8	2012	1	23	9.5	2012	1	25	6.5	47.02	4352497	1/23 two fast CMEs

9	2012	3	4	20.5	2012	3	5	21.5	74.18	2784298	CME
10	2012	3	6	2.5	2012	3	6	8.5	12.41	295315	it is the declining stage of the revious event
11	2012	3	7	2.5	2012	3	10	20.5	1584.10	76224430	3/7 00:15 CME
12	2012	3	27	5.5	2012	3	29	4.5	43.68	3803015	gradual, CME and flare
13	2012	7	12	21.5	2012	7	13	0.5	11.59	159477	7/12 7:46 C3.1 S21E06, 15:37 X1.4 S13W03, CME
14	2012	7	25	2.5	2012	7	25	4.5	17.13	163708	7/23 2:25 halo CME,
15	2012	7	25	15.5	2012	7	28	1.5	25.06	3761808	it is the 2nd jump of the previous after a dip of flux, no good flare
16	2012	8	31	21.5	2012	9	3	7.5	546.41	44217386	8/31 19:25 CME
17	2012	9	22	23.5	2012	9	23	10.5	23.86	763412	CME
18	2012	9	28	5.5	2012	9	28	7.5	11.62	118808	CME
19	2013	3	6	5.5	2013	3	7	14.5	30.47	2776362	3/5 3:45 NE halo CME
20	2013	4	11	8.5	2013	4	12	18.5	180.50	8075118	4/11 7:10 CME
21	2013	5	13	18.5	2013	5	15	8.5	301.16	11616014	there is a second increase, CMEs
22	2013	6	21	6.5	2013	6	22	2.5	25.96	1415836	CME
23	2013	8	21	3.5	2013	8	22	13.5	22.01	2242099	CME
24	2013	10	11	13.5	2013	10	12	6.5	15.51	37452	CME and flare
25	2013	10	25	14.5	2013	10	26	7.5	31.90	38233	CME and flare
26	2013	11	7	13.5	2013	11	8	21.5	547.98	61693	a second sharp rise after a gradual SEP event started on 11/2, CME, no flare at the right time
27	2013	12	26	10.5	2013	12	27	1.5	26.93	46662	CME, no M or X class flare detected by GOES

28	2014	2	25	2.5	2014	2	28	3.5	214.94	37144	two weaker SEPs ahead, CME, X4.9 flare detected by GOES
29	2014	4	2	16.5	2014	4	3	7.5	104.50	38777	13:54 CME on 4/2 seen by STA COR2 when A & B were 42^{o} apart in longitude
30	2014	9	1	12.5	2014	9	4	21.5	2299.93	52242	no STA images, STB observed a halo CME on 9/1 when A & B were only 30^{o} apart in longitude
31	2014	9	25	4.5	2014	9	27	14.5	238.91	36559	no STA images, STB COR2 observed a halo CME at 21 UT on 9/24 at 21UT; data became unavailable after the event

Records:

1. 3/12/2004, add the SEP events in January 2011 - September 2013

2. 5/1/2014, remove the SEP events from LET observed by both STEREO A and B in 2007-2010, add the SEP events from HET in Dec 2006 - Dec 2010 and Oct 2013 - Mar 2014 using consistent criterion, add leading notes

3. 2/11/2015, add the SEP events during Apr 2014 - Jan 2015 for STA, Apr - Sept 2014 for STB

4. 6/9/2015, change the comments for 9/25/2014 event, and add some notes at the top

5. 11/8/2016, add the SEP events during Jan 2015 - Oct 2016 for STA

6. 7/15/2017, update the list to Dec 2016 for STA

7. 11/3/2017, update the list to Sept 2017 for STA