MMIA Data availability: Latitude Range vs Day of Year

The optical instruments on ASIM, the photometers and cameras of the MMIA instrument only observe during night time of the ISS orbit, with an added safety margin at twilight. The length of the night time period and the latitude range of ISS night varies with the beta angle of the ISS orbit. The beta angle is dependent of season (Day of Year) and the orientation of the ISS orbit. The ISS orbit is precessing very close to 6 times a full 360 degrees revolution in one year (with respect to the Sun).

Beta angle variation

The variation of the beta angle can be seen in Figure 1 and Figure 2, the values from mid 2020 and onwards are predictions.

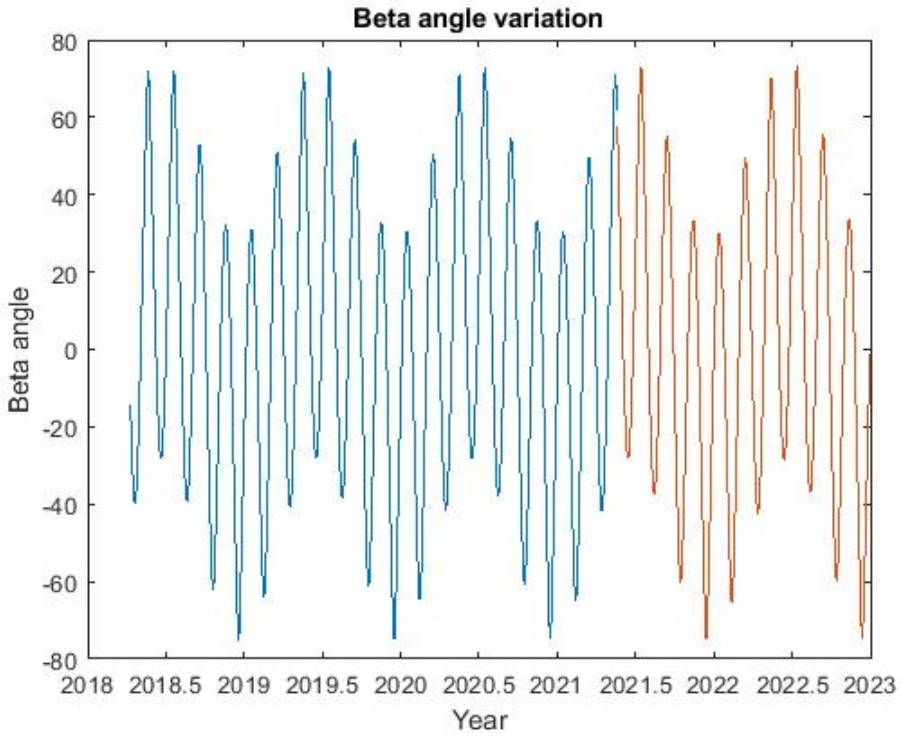

Figure 1: Beta angle (blue: actual, red: predicted). Fast variation is due to precession of ISS orbit, slow variation is seasonal.

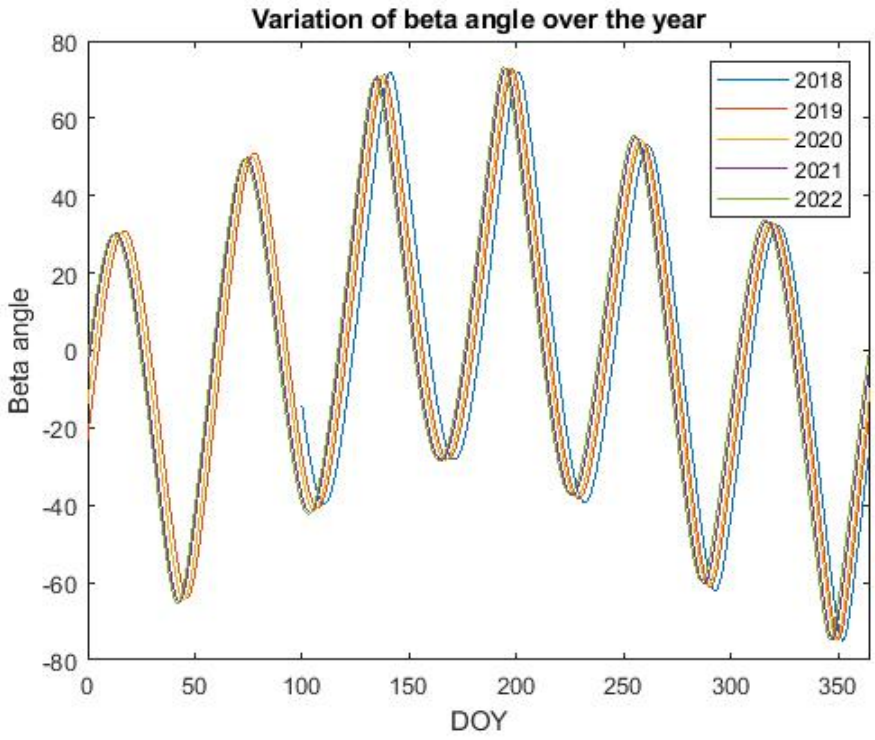

Figure 2: Beta angle vs DOY. Max beta angle is shifted back 2-3 days/year for actual beta angle. Predicted beta angle is shifted back 1-2 day/year.

MMIA observations: Latitude Range

In Figure 3 the maximum and minimum latitudes for MMIA instruments are plotted for each day. Notice that there gaps in observation for periods when the ISS is not in eclipse (there are also gaps for various other reasons, such as ISS operations or maintaice.

In Figure 4 the same can be seen as a function of day of year, and Figure 5 is a close up of this during the northern Summer period, and Figure 6 for the southern Summer period. Notice that there are two periods of observation gaps in the northern Summer period and only one gap during the southern Summer period due to the orientation of the ISS orbit.

In Table 1 the periods with no MMIA observations are listed (only gaps due to beta angle) with predictions up to 2021.

In Table 2 daily latitude ranges for possible MMIA observations are listed from beginning of the ASIM mission with actual values up to 2020, DOY 212 and predictions up to 2022, DOY 120.

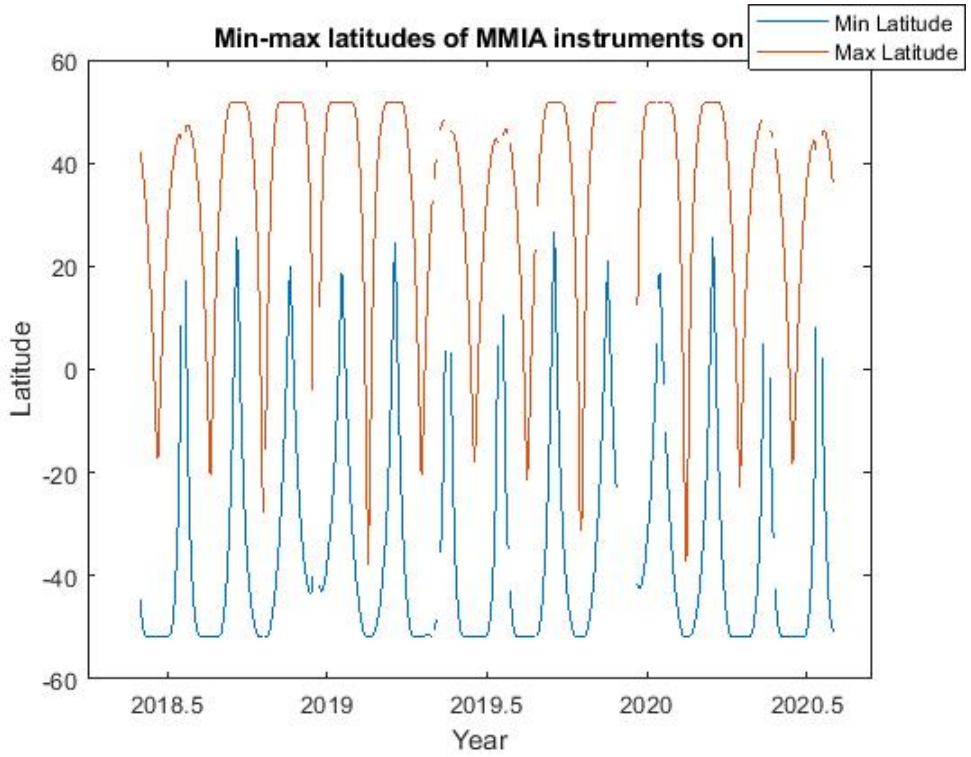

Figure 3: Daily maximum and minimum latitude of MMIA observation time

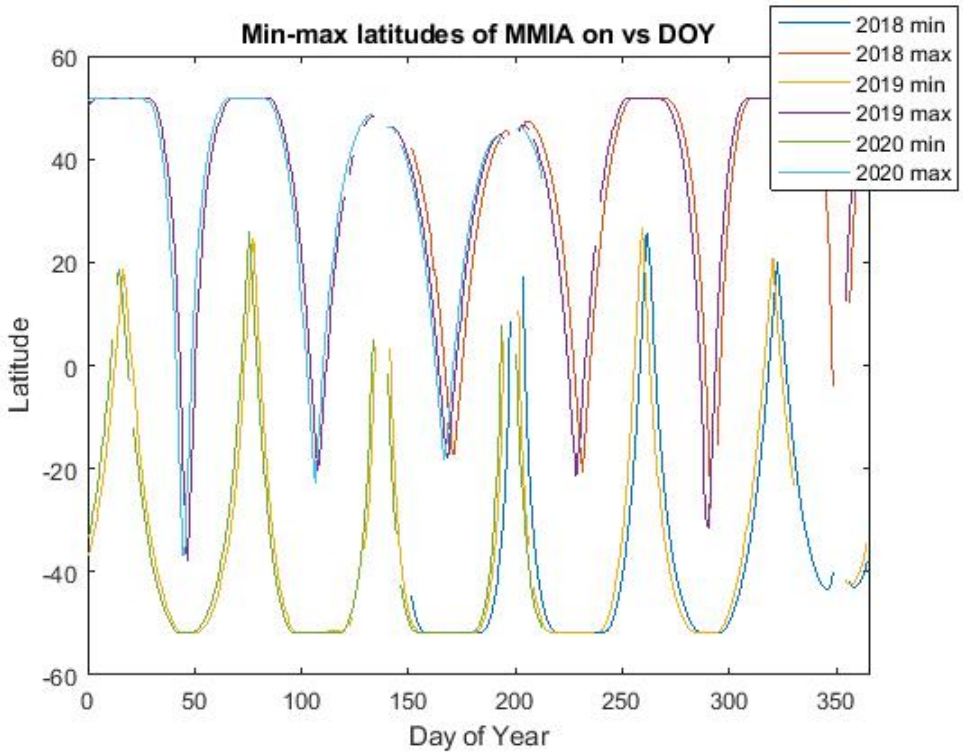

Figure 4: Daily maximum and minimum latitude of MMIA observation time vs DOY

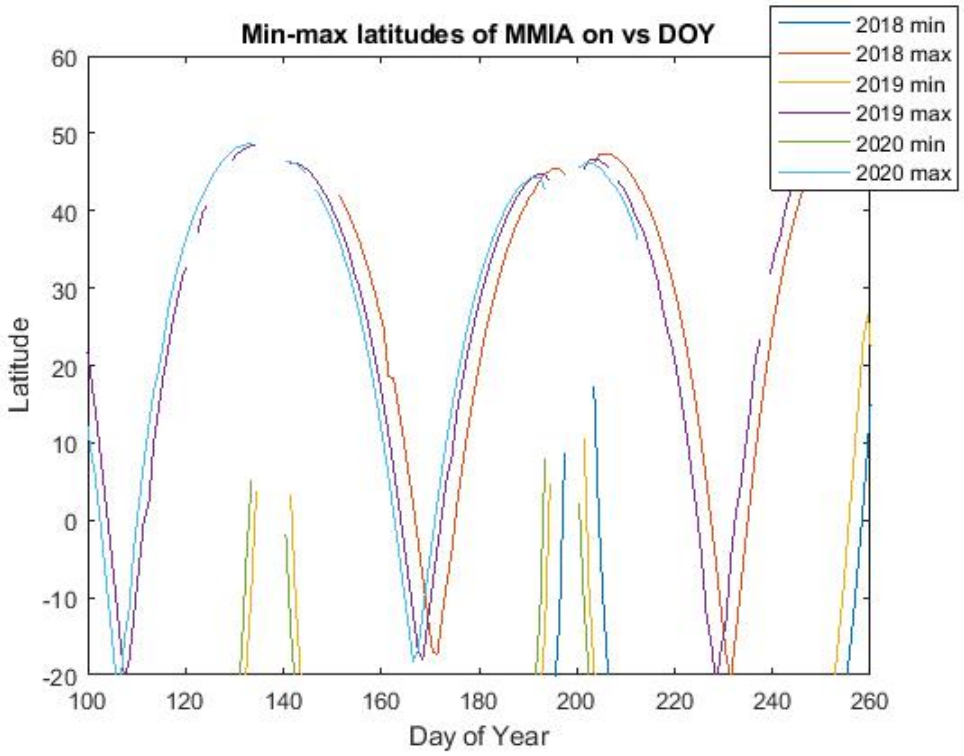

Figure 5: Daily maximum and minimum latitude of MMIA observation time during northern Summer

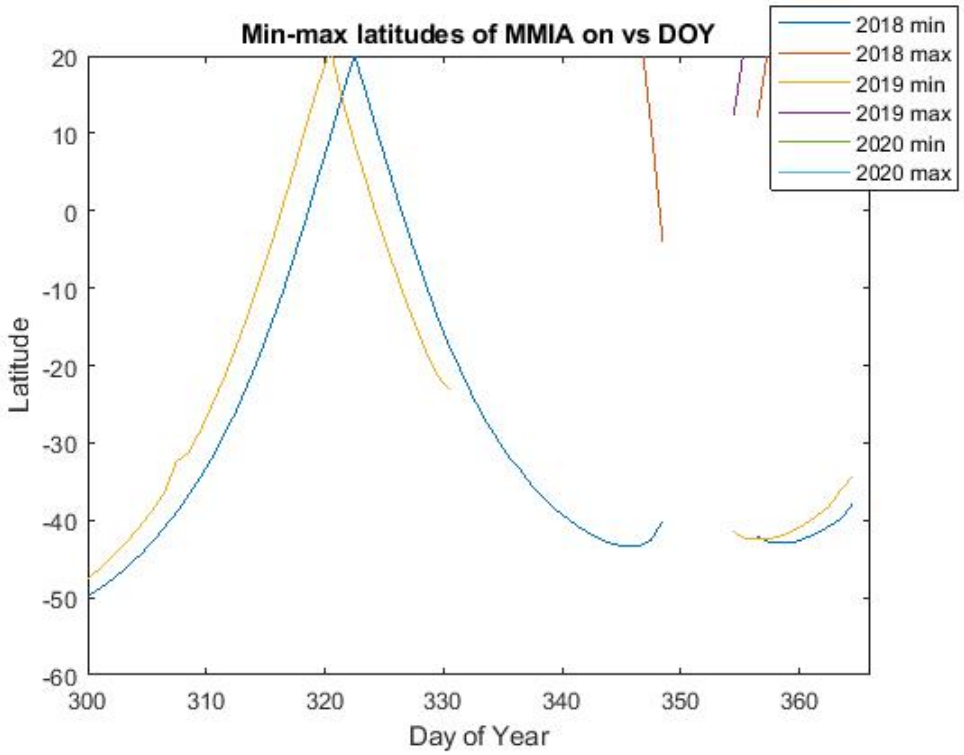

Figure 6: Daily maximum and minimum latitude of MMIA observation time during southern Summer

	Gap 1	Gap 2	Gap 3
2018		199 – 203	350 – 356
2019	136 – 141	196 – 201	349 – 354
2020	135 – 140	195 – 200	347 – 353
2021	134 – 137	193 – 198	345 – 355
2022	133 - 136	192 - 197	344 - 350

Table 1: DOY gaps in MMIA observation due to high beta angle. Numbers in red are predictions.

Table 2: Daily latitude range for possible MMIA observations. The values from 2020, DOY 213 and onwards are predicted values. '–' means no MMIA observations are available.

DOY	2018	2019	2020	2021	2022
1	–	-37 – 50	-33 – 52	-29 – 52	-27 – 52
2	–	-35 – 51	-31 – 52	-27 – 52	-25 – 52
3	–	-33 – 51	-28 – 52	-24 – 52	-22 – 52
4	–	-32 – 52	-27 – 52	-21 – 52	-18 – 52
5	–	-30 – 52	-24 – 52	-18 – 52	-14 – 52
6	–	-26 – 52	-21 – 52	–	-10 – 52
7	–	-24 – 52	-16 – 52	-9 – 52	-6 – 52
8	–	-21 – 52	-14 – 52	-6 – 52	-2 – 52
9	–	-18 – 52	-9 – 52	-1 – 52	2 – 52
10	–	-14 – 52	-6 – 52	3 – 52	7 – 52
11	–	-10 – 52	0 – 52	8 – 52	13 – 52
12	–	-6 – 52	5 – 52	13 – 52	16 – 52
13	–	-1 – 52	–	18 – 52	15 – 52
14	–	3 – 52	16 – 52	17 – 52	12 – 52
15	–	9 – 52	19 – 52	12 – 52	7 – 52
16	–	13 – 52	17 – 52	7 – 52	2 – 52
17	–	19 – 52	12 – 52	2 – 52	-3 – 52
18	–	16 – 52	7 – 52	-3 – 52	-7 – 52
19	–	11 – 52	2 – 52	-8 – 52	-12 – 52
20	–	6 – 52	-3 – 52	-12 – 52	-16 – 52
21	–	1 – 52	–	-16 – 52	-20 – 52
22	–	-2 – 52	-12 – 52	-20 – 52	-23 – 52
23	–	-7 – 52	-16 – 52	-24 – 52	-26 – 52
24	–	-13 – 52	-19 – 52	-27 – 52	-29 – 52
25	–	-17 – 52	-23 – 52	-30 – 52	-32 – 52
26	–	-21 – 52	-26 – 52	-32 – 52	-34 – 51
27	–	-24 – 52	-29 – 52	-35 – 51	-37 – 51
28	–	-28 – 52	-32 – 51	-37 – 51	-39 – 50
29	–	-30 – 52	-34 – 51	-39 – 50	-40 – 49
30	–	-33 – 52	-37 – 51	-41 – 49	-42 – 47
31	–	-36 – 51	-39 – 50	-42 – 47	-44 – 45

DOY	2018	2019	2020	2021	2022
32	–	-38 – 51	-41 – 49	-44 – 45	-45 – 43
33	–	-40 – 50	-43 – 47	-45 – 43	-46 – 40
34	–	-41 – 48	-44 – 45	-46 – 39	-47 – 36
35	–	-43 – 47	-46 – 42	-48 – 36	-48 – 32
36	–	-44 – 44	-47 – 39	-49 – 31	-49 – 26
37	–	-46 – 41	-48 – 35	-49 – 25	-50 – 19
38	–	-47 – 38	-49 – 31	-50 – 18	-51 – 10
39	–	-48 – 34	-50 – 24	-51 – 10	-51 – -1
40	–	-49 – 29	-51 – 18	-52 – -1	-52 – -14
41	–	-50 – 23	-51 – 10	-52 – -13	-52 – -28
42	–	-51 – 16	-52 – -1	-52 – -26	-52 – -35
43	–	-52 – 7	-52 – -12	-52 – -38	-52 – -34
44	–	-52 – -2	-52 – -26	-52 – -37	-52 – -29
45	–	-52 – -19	-52 – -37	-52 – -25	-52 – -17
46	–	-52 – -27	-52 – -36	-52 – -12	-52 – -5
47	–	-52 – -38	-52 – -23	-52 – -5	-52 – 5
48	–	-52 – -32	-52 – -16	-52 – 9	-51 – 14
49	–	-52 – -19	-52 – -1	-51 – 16	-51 – 22
50	–	-52 – -12	-52 – 9	-51 – 23	-51 – 27
51	–	-52 – 3	-52 – 16	-51 – 28	-50 – 31
52	–	-52 – 11	-51 – 23	-50 – 31	-49 – 35
53	–	-52 – 16	-51 – 28	-49 – 36	-48 – 38
54	–	-51 – 23	-50 – 32	-48 – 39	-47 – 42
55	–	-51 – 29	-49 – 36	-47 – 42	-47 – 44
56	–	-50 – 33	-48 – 39	-46 – 44	-45 – 46
57	–	-49 – 37	-48 – 42	-45 – 46	-44 – 47
58	–	-49 – 40	-46 – 44	-44 – 47	-42 – 48
59	–	-48 – 42	-45 – 46	-42 – 49	-40 – 50
60	–	-47 – 44	-44 – 47	-40 – 50	-38 – 50
61	–	-45 – 46	-42 – 49	-38 – 51	-36 – 51
62	–	-44 – 47	-40 – 49	-36 – 51	-34 – 51
63	–	-41 – 48	-37 – 50	-33 – 52	-31 – 52
64	–	-39 – 49	-36 – 51	-30 – 52	-28 – 52
65	–	-37 – 51	-34 – 51	-27 – 52	-24 – 52
66	–	-36 – 51	-30 – 52	-23 – 52	-20 – 52
67	–	-33 – 52	-27 – 52	-19 – 52	-15 – 52
68	–	-30 – 52	-23 – 52	-14 – 52	-9 – 52
69	–	-27 – 52	-19 – 52	-9 – 52	-3 – 52
70	–	-22 – 52	-14 – 52	-1 – 52	3 – 52
71	–	-18 – 52	-9 – 52	4 – 52	11 – 52
72	–	-13 – 52	-3 – 52	11 – 52	17 – 52
73	–	-7 – 52	4 – 52	19 – 52	21 – 52

DOY	2018	2019	2020	2021	2022
74	–	2 – 52	11 – 52	26 – 52	17 – 52
75	–	6 – 52	19 – 52	20 – 52	13 – 52
76	–	14 – 52	26 – 52	13 – 52	6 – 52
77	–	21 – 52	20 – 52	7 – 52	-1 – 52
78	–	25 – 52	12 – 52	1 – 52	-8 – 52
79	–	17 – 52	5 – 52	-9 – 52	-15 – 52
80	–	10 – 52	-2 – 52	-15 – 52	-21 – 52
81	–	2 – 52	-9 – 52	-21 – 52	-25 – 52
82	–	-5 – 52	-15 – 52	-25 – 52	-30 – 52
83	–	-12 – 52	-21 – 52	-30 – 52	-33 – 51
84	–	-18 – 52	-24 – 52	-33 – 51	-37 – 50
85	–	-23 – 52	-30 – 51	-37 – 50	-40 – 49
86	–	-28 – 52	-34 – 51	-40 – 49	-42 – 48
87	–	-32 – 51	-37 – 50	-42 – 48	-44 – 47
88	–	-36 – 51	-40 – 49	-44 – 47	-46 – 45
89	–	-39 – 50	-43 – 48	-46 – 45	-48 – 43
90	–	-42 – 49	-45 – 47	-48 – 43	-49 – 41
91	–	-44 – 47	-47 – 45	-49 – 41	-50 – 39
92	–	-46 – 46	-48 – 43	-50 – 39	-51 – 36
93	–	-48 – 44	-50 – 41	-51 – 36	-52 – 33
94	–	-48 – 42	-50 – 38	-52 – 33	-52 – 29
95	–	-50 – 39	-51 – 36	-52 – 30	-52 – 26
96	–	-51 – 37	-52 – 33	-52 – 26	-52 – 21
97	–	-51 – 34	-52 – 29	-52 – 21	-52 – 17
98	–	-52 – 31	-52 – 25	-52 – 17	-52 – 11
99	–	-52 – 28	-52 – 21	-52 – 12	-52 – 6
100	–	-52 – 24	-52 – 15	-52 – 6	-52 – -1
101	–	-52 – 19	-52 – 10	-52 – 0	-52 – -8
102	–	-52 – 15	-52 – 6	-52 – -6	-52 – -16
103	–	-52 – 9	-52 – 0	-52 – -12	-52 – -19
104	–	-52 – 4	-52 – -6	-52 – -18	-52 – -19
105	–	-52 – -2	-52 – -12	-52 – -22	-52 – -18
106	–	-52 – -8	-52 – -19	-52 – -16	-52 – -12
107	–	-52 – -15	-52 – -23	-52 – -10	-52 – -5
108	–	-52 – -20	-52 – -15	-52 – -3	-52 – 1
109	–	-52 – -18	-52 – -11	-52 – 2	-52 – 6
110	–	-52 – -12	-52 – -3	-52 – 8	-52 – 11
111	–	-52 – -6	-52 – 2	-52 – 12	-52 – 16
112	–	-52 – 0	-52 – 8	-52 – 17	-52 – 20
113	–	-52 – 2	-52 – 12	-52 – 21	-52 – 24
114	–	-52 – 10	-52 – 17	-52 – 24	-52 – 27
115	–	-52 – 14	-52 – 19	-52 – 28	-52 – 30

DOY	2018	2019	2020	2021	2022
116	–	-52 – 19	-52 – 23	-52 – 30	-52 – 33
117	–	-52 – 22	-52 – 27	-52 – 33	-51 – 35
118	–	-52 – 26	-52 – 30	-51 – 35	-51 – 37
119	–	-52 – 29	-52 – 33	-51 – 37	-50 – 39
120	–	-52 – 32	-51 – 35	-50 – 39	-49 – 41
121	–	-52 – 33	-51 – 37	-49 – 41	-48 – 42
122	–	-41 – 35	-50 – 39	-48 – 42	-46 – 43
123	–	-50 – 37	-49 – 41	-46 – 43	-44 – 44
124	–	-49 – 40	-48 – 42	-44 – 45	-42 – 45
125	–	-49 – 41	-46 – 43	-41 – 46	-39 – 46
126	–	–	-44 – 44	-39 – 46	-35 – 47
127	–	-44 – 44	-42 – 45	-35 – 47	-31 – 48
128	–	–	-38 – 46	-30 – 48	-25 – 48
129	–	–	-35 – 47	-24 – 48	-18 – 49
130	–	-35 – 46	-30 – 48	-18 – 49	-9 – 49
131	–	-31 – 47	-24 – 48	-8 – 49	2 – 49
132	-2 – 45	-27 – 48	-17 – 48	4 – 49	15 – 49
133	–	-18 – 48	-4 – 49	10 – 48	–
134	–	-9 – 48	5 – 49	–	–
135	–	4 – 48	–	–	–
136	–	–	–	–	–
137	–	–	–	–	13 – 46
138	–	–	–	14 – 46	-2 – 46
139	–	–	–	-2 – 46	-13 – 46
140	–	–	–	-14 – 46	-22 – 46
141	–	–	-2 – 46	-22 – 46	-28 – 46
142	–	3 – 46	-14 – 46	-29 – 46	-33 – 45
143	–	-10 – 46	-23 – 46	-34 – 45	-38 – 44
144	–	-20 – 46	-29 – 46	-38 – 44	-42 – 43
145	–	-27 – 46	-33 – 45	-42 – 43	-45 – 42
146	–	-33 – 45	–	-45 – 42	-47 – 41
147	–	-38 – 44	-42 – 43	-47 – 41	-49 – 39
148	–	-41 – 43	-45 – 42	-49 – 39	-50 – 38
149	–	-44 – 42	-47 – 41	-50 – 38	-51 – 36
150	–	-47 – 41	-49 – 39	-51 – 36	-51 – 34
151	–	-48 – 40	-50 – 38	-51 – 34	-52 – 32
152	-45 – 42	-50 – 38	-51 – 36	-52 – 32	-52 – 30
153	-47 – 41	-51 – 36	-51 – 34	-52 – 30	-52 – 27
154	-49 – 39	-51 – 35	-52 – 32	-52 – 27	-52 – 24
155	-50 – 38	-52 – 32	-52 – 29	-52 – 24	-52 – 21
156	-51 – 36	-52 – 30	-52 – 27	-52 – 21	-52 – 18
157	-51 – 34	-52 – 28	-52 – 24	-52 – 18	-52 – 14

DOY	2018	2019	2020	2021	2022
158	-52 – 32	-52 – 25	-52 – 21	-52 – 14	-52 – 10
159	-52 – 30	-52 – 22	-52 – 17	-52 – 10	-52 – 6
160	-52 – 27	-52 – 19	-52 – 14	-52 – 6	-52 – 1
161	-52 – 25	-52 – 15	-52 – 10	-52 – 1	-52 – -3
162	-52 – 19	-52 – 11	-52 – 6	-52 – -3	-52 – -9
163	-52 – 18	-52 – 7	-52 – 1	-52 – -9	-52 – -14
164	-52 – 15	-52 – 3	-52 – -3	-52 – -14	-52 – -17
165	-52 – 11	-52 – -2	-52 – -8	-52 – -17	-52 – -16
166	-52 – 6	-52 – -7	-52 – -13	-52 – -16	-52 – -14
167	-52 – 2	-52 – -12	-52 – -18	-52 – -13	-52 – -8
168	-52 – -3	-52 – -17	-52 – -17	-52 – -8	-52 – -3
169	-52 – -7	-52 – -18	-52 – -12	-52 – -3	-52 – 2
170	-52 – -12	-52 – -13	-52 – -7	-52 – 2	-52 – 6
171	-52 – -17	-52 – -8	-52 – -2	-52 – 6	-52 – 10
172	-52 – -17	-52 – -4	-52 – 2	-52 – 11	-52 – 14
173	-52 – -12	-52 – 1	-52 – 7	-52 – 14	-52 – 18
174	-52 – -8	-52 – 6	-52 – 11	-52 – 18	-52 – 21
175	-52 – -4	-52 – 8	-52 – 15	-52 – 21	-52 – 24
176	-52 – 2	-52 – 14	-52 – 18	-52 – 24	-52 – 27
177	-52 – 7	-52 – 18	-52 – 22	-52 – 27	-52 – 29
178	-52 – 11	-52 – 21	-52 – 24	-52 – 30	-52 – 32
179	-52 – 15	-52 – 24	-52 – 27	-52 – 32	-51 – 34
180	-52 – 18	-52 – 27	-52 – 30	-51 – 34	-51 – 36
181	-52 – 22	-52 – 29	-52 – 32	-51 – 36	-50 – 37
182	-52 – 25	-52 – 32	-51 – 34	-50 – 37	-49 – 39
183	-52 – 27	-52 – 34	-51 – 36	-49 – 39	-47 – 40
184	-52 – 30	-51 – 36	-50 – 37	-47 – 40	-45 – 41
185	-52 – 32	-50 – 37	-49 – 39	-45 – 41	-43 – 42
186	-51 – 34	-49 – 39	-47 – 40	-43 – 42	-39 – 43
187	-51 – 36	-47 – 40	-45 – 41	-39 – 43	-34 – 44
188	-50 – 38	-45 – 41	-42 – 42	-34 – 44	-29 – 44
189	-49 – 39	-43 – 42	-39 – 43	-29 – 44	-21 – 44
190	-47 – 41	-39 – 43	-34 – 44	-21 – 44	-10 – 44
191	-45 – 42	-35 – 44	-26 – 44	-10 – 44	6 – 43
192	-42 – 43	-30 – 45	-21 – 44	6 – 43	–
193	-38 – 44	-23 – 45	-12 – 44	–	–
194	-34 – 45	-14 – 45	8 – 43	–	–
195	-29 – 45	5 – 44	–	–	–
196	-22 – 45	–	–	–	–
197	-12 – 45	–	–	–	–
198	9 – 45	–	–	–	6 – 45
199	–	–	–	4 – 46	-8 – 46

DOY	2018	2019	2020	2021	2022
200	–	–	–	-9 – 46	-18 – 46
201	–	–	2 – 46	-18 – 46	-25 – 46
202	–	10 – 45	-11 – 46	-25 – 46	-30 – 46
203	–	-9 – 47	-20 – 46	-30 – 46	-35 – 45
204	17 – 46	-19 – 47	-25 – 46	-35 – 45	-39 – 44
205	0 – 47	-26 – 46	-31 – 46	-39 – 44	-43 – 44
206	-12 – 47	-32 – 46	-36 – 45	-43 – 43	-45 – 43
207	-21 – 47	-35 – 46	-39 – 44	-45 – 43	-47 – 42
208	-28 – 47	–	-44 – 43	-47 – 41	-49 – 40
209	-33 – 47	-43 – 44	-46 – 43	-49 – 40	-50 – 39
210	-37 – 46	-45 – 43	-48 – 41	-50 – 38	-51 – 37
211	-41 – 45	-46 – 42	-49 – 40	-51 – 37	-51 – 35
212	-43 – 44	-48 – 40	-50 – 38	-51 – 35	-52 – 33
213	-45 – 43	-50 – 39	-51 – 36	-52 – 33	-52 – 31
214	-47 – 42	-51 – 37	-51 – 35	-52 – 31	-52 – 28
215	-49 – 41	-51 – 35	-52 – 33	-52 – 28	-52 – 26
216	-50 – 39	-52 – 33	-52 – 30	-52 – 25	-52 – 22
217	-51 – 37	-52 – 31	-52 – 28	-52 – 22	-52 – 19
218	-51 – 35	-52 – 28	-52 – 25	-52 – 19	-52 – 15
219	-52 – 33	-52 – 25	-52 – 22	-52 – 15	-52 – 11
220	-52 – 31	-52 – 22	-52 – 18	-52 – 11	-52 – 6
221	-52 – 28	-52 – 19	-52 – 14	-52 – 6	-52 – 2
222	-52 – 25	-52 – 15	-52 – 10	-52 – 1	-52 – -3
223	-52 – 22	-52 – 11	-52 – 5	-52 – -4	-52 – -10
224	-52 – 18	-52 – 6	-52 – 0	-52 – -11	-52 – -14
225	-52 – 14	-52 – 1	-52 – -6	-52 – -15	-52 – -16
226	-52 – 10	-52 – -5	-52 – -11	-52 – -18	-52 – -12
227	-52 – 5	-52 – -12	-52 – -17	-52 – -15	-52 – -9
228	-52 – 0	-52 – -16	-52 – -21	-52 – -11	-52 – -3
229	-52 – -6	-52 – -16	-52 – -16	-52 – -5	-52 – 2
230	-52 – -12	-52 – -16	-52 – -12	-52 – 1	-52 – 8
231	-52 – -17	-52 – -13	-52 – -7	-52 – 7	-52 – 13
232	-52 – -21	-52 – -5	-52 – 1	-52 – 12	-52 – 18
233	-52 – -15	-52 – 1	-52 – 7	-52 – 17	-52 – 22
234	-52 – -9	-52 – 4	-52 – 12	-52 – 21	-52 – 26
235	-52 – -3	-52 – 10	-52 – 17	-52 – 25	-52 – 29
236	-52 – 3	-52 – 15	-52 – 21	-52 – 29	-52 – 32
237	-52 – 9	-52 – 21	-52 – 25	-52 – 32	-51 – 35
238	-52 – 14	-52 – 23	-52 – 29	-51 – 35	-51 – 38
239	-52 – 19	–	-52 – 32	-51 – 37	-50 – 40
240	-52 – 23	-52 – 32	-51 – 35	-50 – 40	-49 – 42
241	-52 – 27	-51 – 35	-51 – 38	-49 – 42	-47 – 44

DOY	2018	2019	2020	2021	2022
242	-52 – 30	-51 – 36	-50 – 40	-47 – 44	-45 – 46
243	-52 – 33	-50 – 40	-49 – 42	-46 – 46	-43 – 47
244	-51 – 36	-49 – 42	-47 – 44	-43 – 47	-41 – 49
245	-50 – 39	-47 – 44	-45 – 46	-41 – 48	-38 – 50
246	-49 – 41	-46 – 46	-43 – 47	-38 – 50	-34 – 51
247	-48 – 43	-44 – 47	-41 – 48	-34 – 50	-30 – 51
248	-46 – 45	-40 – 48	-38 – 50	-31 – 51	-25 – 52
249	-45 – 47	-38 – 50	-34 – 51	-26 – 52	-20 – 52
250	-42 – 48	-35 – 51	-31 – 51	-21 – 52	-13 – 52
251	-39 – 49	-31 – 51	-26 – 52	-14 – 52	-6 – 52
252	-37 – 50	-26 – 52	-21 – 52	-7 – 52	3 – 52
253	-33 – 51	-21 – 52	-14 – 52	1 – 52	13 – 52
254	-29 – 52	-15 – 52	-8 – 52	10 – 52	22 – 52
255	-24 – 52	-9 – 52	0 – 52	20 – 52	24 – 52
256	-19 – 52	-1 – 52	8 – 52	24 – 52	24 – 52
257	-13 – 52	7 – 52	16 – 52	24 – 52	23 – 52
258	-6 – 52	15 – 52	25 – 52	22 – 52	15 – 52
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