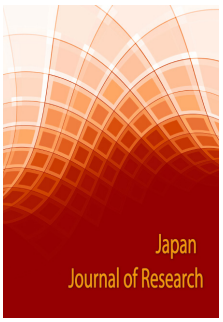
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Opinion Article



CovId-19, The Sun And Moon

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Introduction

CovId-19 seams completely unrelated to the Sun and Moon. Search result with AI mode for "CovId-19, the Sun and Moon" is as following:

Scientific evidence indicates that the sun (solar UV radiation) can inactivate the SARS-CoV-2 virus on surfaces and in the air, but the moon has no direct effect on COVID-19 transmission or severity.

The Sun's Influence

- **Virus Inactivation:** Solar ultraviolet (UV) radiation, particularly UV-B and UV-A, can rapidly inactivate the SARS-CoV-2 virus in aerosols and on surfaces. In strong summer sunlight, 90% of virus particles can be inactivated in a matter of minutes under optimal conditions.
- **Seasonality:** The higher intensity of solar UV radiation in summer and near the equator contributes to the seasonality of respiratory viruses, including the observed lower incidence and mortality rates of COVID-19 in those conditions.
- **Vitamin D Production:** Exposure to UV-B radiation from the sun leads to the production of vitamin D in the body, which plays a role in immune system function. Some observational studies suggest an inverse correlation between vitamin D levels and COVID-19 severity, though direct causal evidence is still debated and requires further research.
- **Limitations:** The sun's effect is limited in indoor settings, where most transmission occurs, as glass windows block most UV-B rays. Therefore, public health measures like social distancing and mask-wearing remain crucial regardless of weather conditions.

The Moon's Influence

- **No Direct Link to Disease:** There is no scientific evidence to suggest that the moon's phases or any other lunar effects have a direct impact on the transmission, incidence, or severity of COVID-19 in humans.
- **Secondary Effect Observation:** One study suggested that the global COVID-19 lockdowns in April-May 2020 may have had a minuscule, indirect effect on the moon's surface temperature. Researchers proposed that a temporary drop in human activity and associated air pollution resulted in less terrestrial (heat) radiation being emitted from Earth and reaching the moon's surface at night, causing a slight cooling effect. However, this finding has been disputed by other researchers who suggest the observed temperature dips were part of natural cyclical fluctuations and not a direct consequence of human activity during the pandemic.
- **Astrology vs. Science:** Any claims linking the moon's phases to the pandemic's origin or spread are considered astrological speculation, not scientific fact.

Search result with AI mode for "is covid-19 activity related to the sun and moon" is as following:

In scientific and medical consensus, there is no direct relationship between the sun and moon's gravitational pull or cycles and COVID-19 activity. Viral transmission is governed by epidemiological factors, while celestial bodies impact the Earth through mechanisms like radiation, which is an area of ongoing scientific inquiry related to viral behavior.

Connection to the sun

Sunlight can affect the COVID-19 virus, but its connection to solar cycles is not fully established.

- **UV radiation:** The sun's ultraviolet (UV) radiation, particularly UVC light, can inactivate viruses, including SARS-CoV-2. However, the amount of UVC that reaches the Earth's surface from the sun is negligible, so this effect is mostly confined to surfaces or to specialized

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artificial disinfection systems.

- **Seasonality:** Seasonal patterns for respiratory viruses are influenced by environmental factors such as temperature, humidity, and the amount of sunlight. In temperate climates, COVID-19 and other respiratory viruses often show higher activity during the colder, drier winter months. This is primarily due to a combination of factors:
- **Human behavior:** People spend more time indoors, leading to increased close contact and transmission.
- **Virus stability:** Cooler temperatures and lower humidity can help some viruses survive longer in the air and on surfaces.
- **Immune system:** Immune system function may also show seasonal variations.
- **Vitamin D:** Exposure to sunlight helps the human body produce vitamin D, which is important for immune function. Some studies have explored a link between vitamin D levels and COVID-19 outcomes, though more research is needed.

Solar cycles and cosmic rays: Some hypotheses have been proposed linking the sun's 11-year solar cycles and corresponding changes in cosmic radiation to viral mutations or outbreaks of pandemics. However, a 2022 study concluded that the emergence of COVID-19 could not be explained solely by the cosmic ray flux associated with solar minima.

The moon has no direct link

The moon has no known direct, biological effect on COVID-19 activity or other human viruses.

- **No epidemiological link:** No credible scientific research has found a causal relationship between the moon's phases, gravitational pull, or other factors and the transmission or severity of COVID-19. Claims about "blood moons" are rooted in superstition, not science.
- **Indirect effects on Earth's atmosphere:** The moon's gravitational pull affects Earth's tides and other natural phenomena, but these have no known biological or epidemiological impact on viruses.

In a rare and unusual observation during the early COVID-19 lockdowns, a reduction in human activity led to a measurable—but extremely minor—drop in the moon's nighttime surface temperature. This was a consequence of the lockdown's effect on Earth, not the moon's effect on the pandemic.

Summary of evidence

In short, the sun is relevant to COVID-19 activity through its effect on weather, vitamin D levels, and the virus's environmental stability, factors that contribute to the pandemic's seasonality. However, speculation about deeper cosmic or solar-cycle-driven links is unsupported by definitive evidence. The moon has no scientifically established relationship with COVID-19 activity, and claims to the contrary are unfounded.

The search result showed that the sun is relevant to covid-19 in certain way but “deeper cosmic or solar-cycle-driven links is unsupported by definitive evidence”. The moon is not relevant to covid-19.

If look at the CovId-19 cases number charts from https://www.worldometers.info/coronavirus, time-related properties can be seen as shown in Figure 1.

To analyze those time-related properties, Fourier transform can be used to perform a spectrum analysis.

Spectrum analysis

Data for spectrum analysis is from https://www.worldometers.info/coronavirus. For world wide spectrum analysis, data of “Last updated: March 07, 2023, 00:04 GMT” used with a date range from January 23, 2020 to March 05, 2023, 1137 days totally. January 22, 2020, 00:00 GMT used as time zero, assume all data time is 00:00 GMT. According Nyquist–Shannon sampling theorem, the minimun period should be 2 days, the

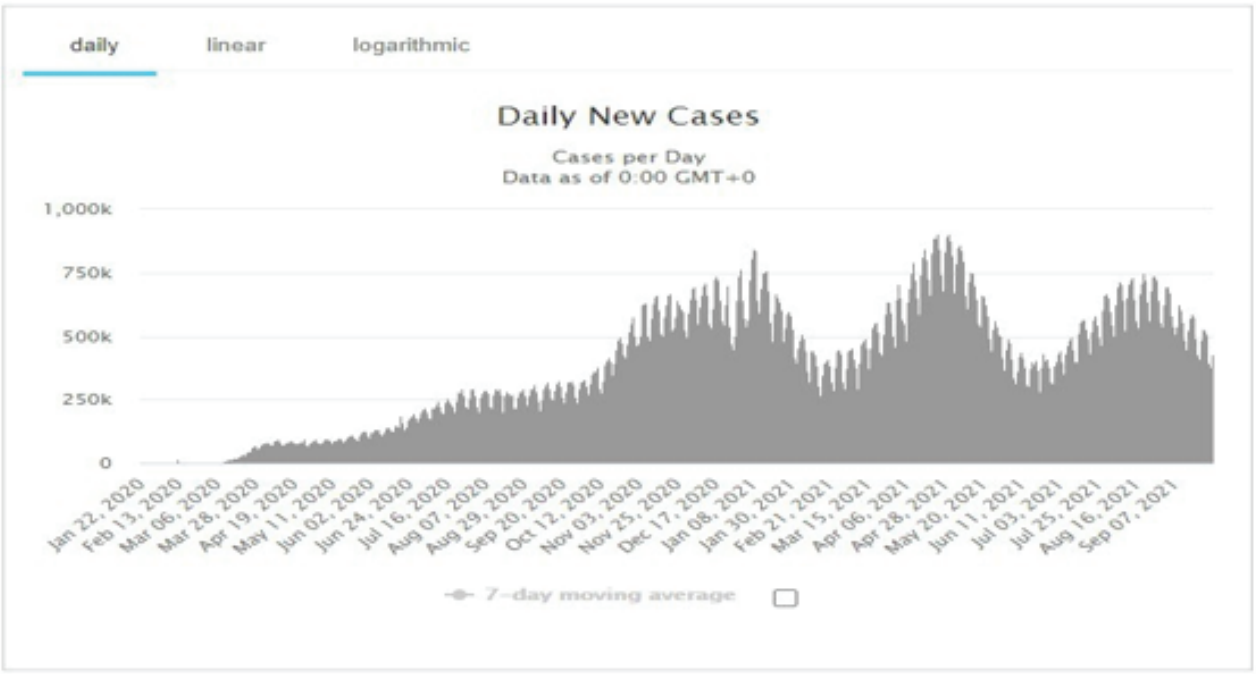


Figure 1. *CovId-19 Daily Cases*

maximum period should be 1137/2 = 568. Spectrum analysis period range is 2 days to 40days with a step of 0.1 day to cover one year, one month etc. to find possible any special period exist. The result is shown in Figure 2.

There are two 7day and 3.5day period peaks found. Almost all of the 227 countries and regions analyzed shown this property(see Figure 4 - 9). The 7day period could be interpreted as a result of human activities – weekly working style, and 3.5day period is just a 2nd harmonic. But this is a similar property as Figure 22 from [1] for earthquake research. See Figure 3.

This should not just be a coincidence. The two 7day and 3.5day period peaks in reference[1] are result of tide effect caused by the Sun and Moon, and imply that there is a possibility of that covid-19 is relevant to the Sun and moon. This could be figured out by analyzing the phase shift property. If the 7day

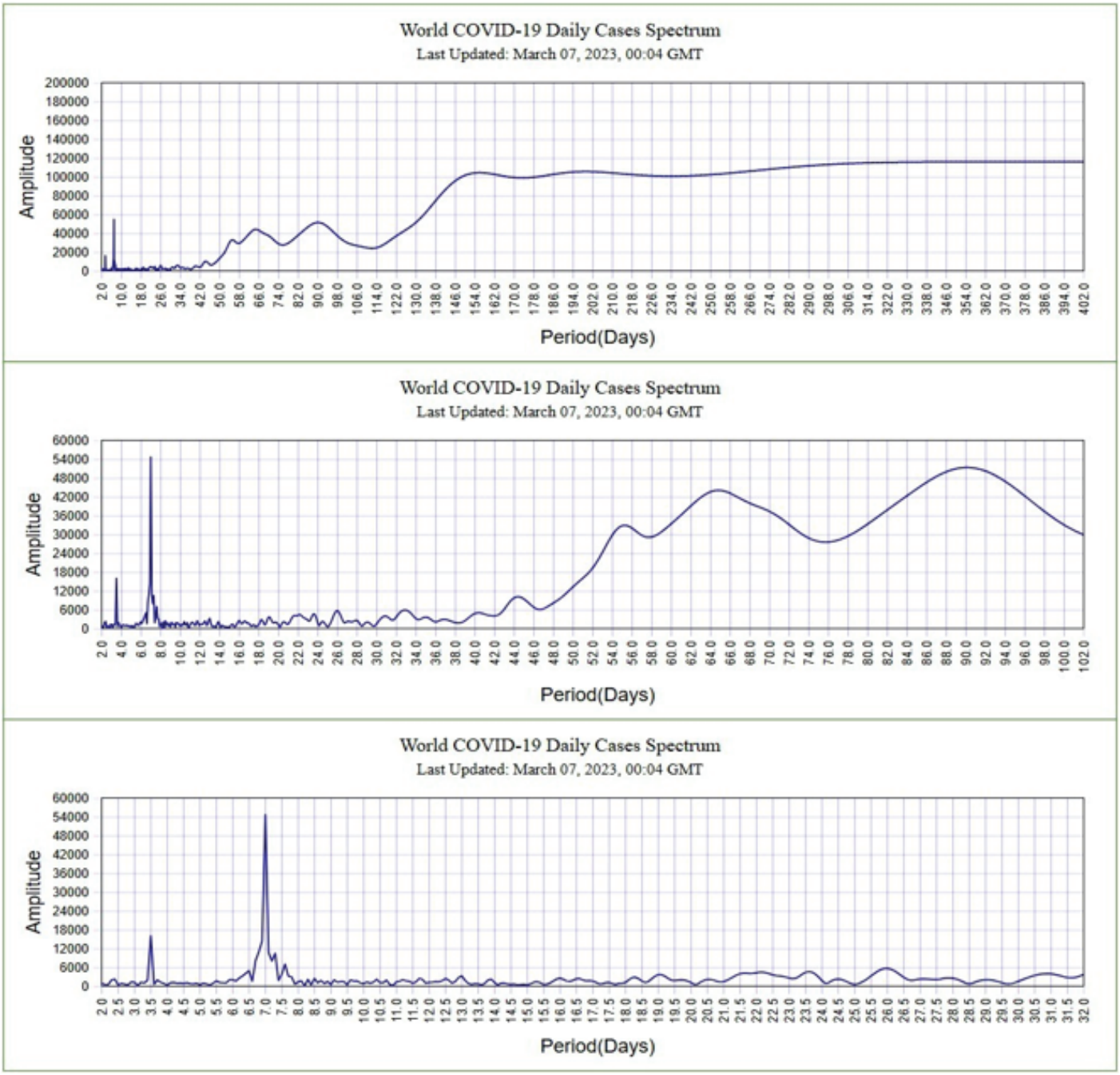


Figure 2. *World covid-19 daily cases spectrum*

period is relevant to weekly working style, it should be time zone related that the 7day period should show a property of moving westward. If is relevant to tide, the 7day period should show a property of moving both eastward and westward for the Sun and Moon are moving in opposite direction from the earth point of view.

The moving direction could be checked by the phase shift, and will be moving from leading phase shift (with a bigger phase shift) to lagging phase shift(with a smaller phase shift). The all phase shift are shown in Table 1 and Table 2.

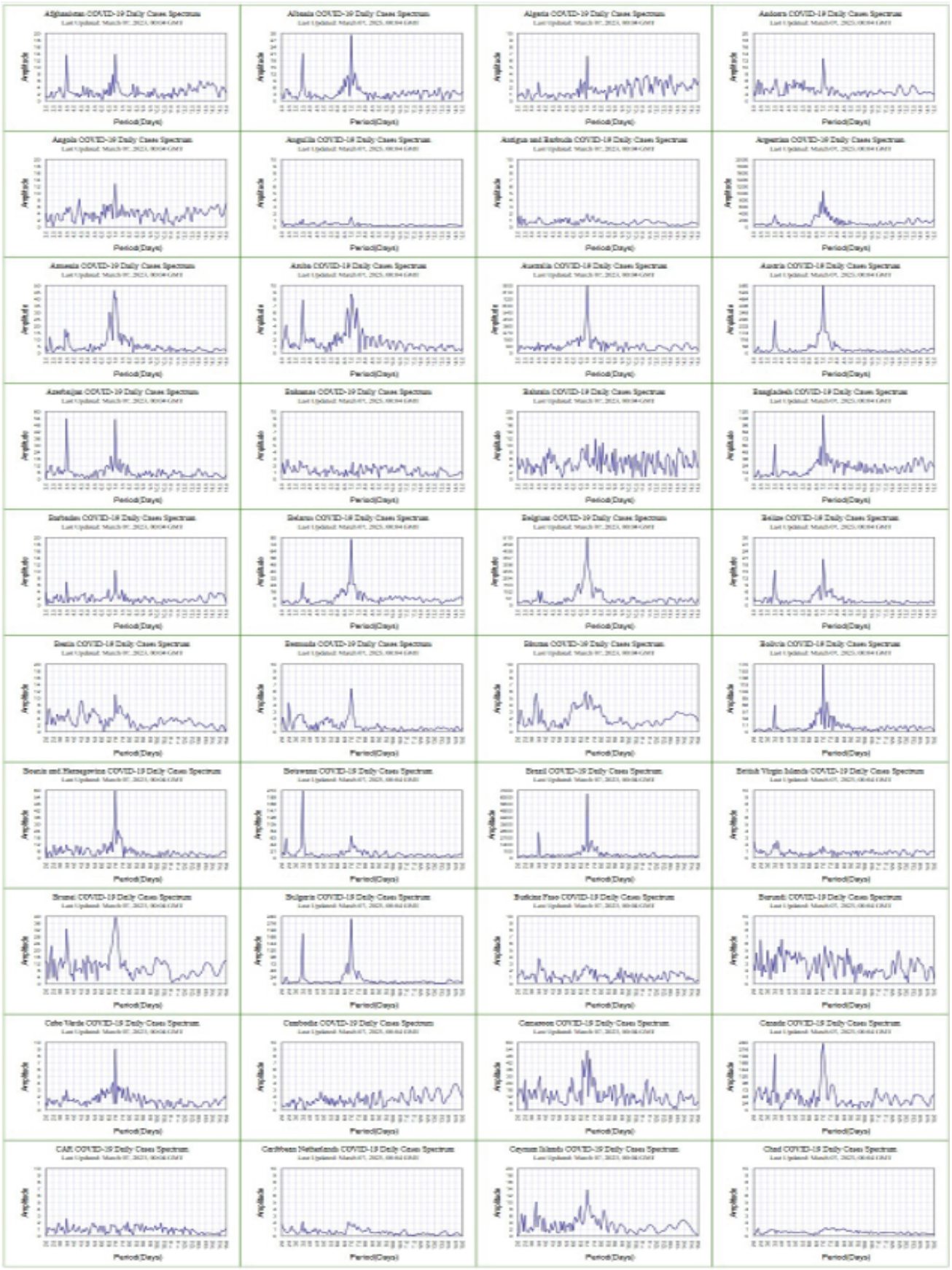


Figure 4. *Countries and Regions Spectrum - 1*

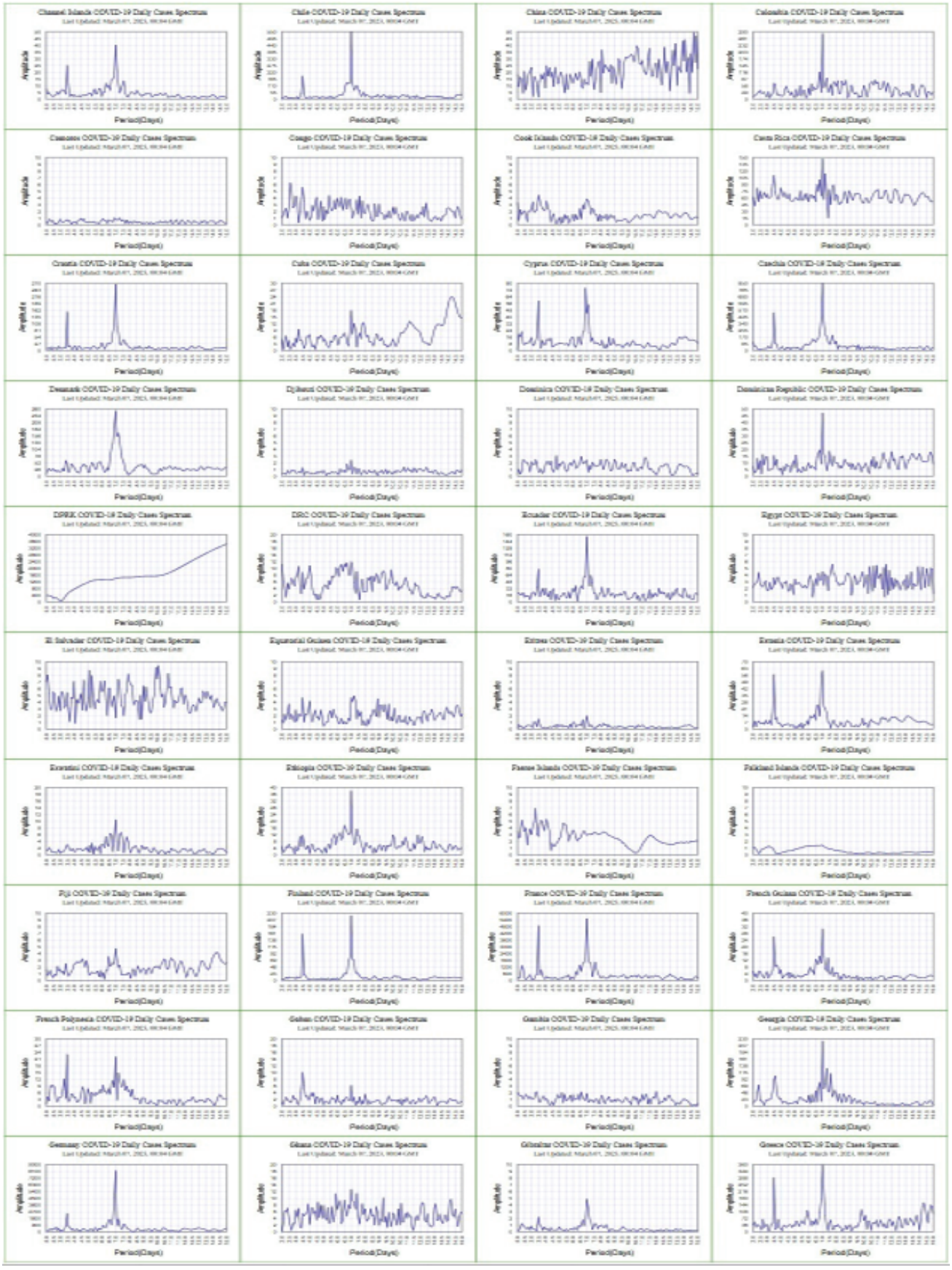


Figure 5. *Countries and Regions Spectrum - 2*

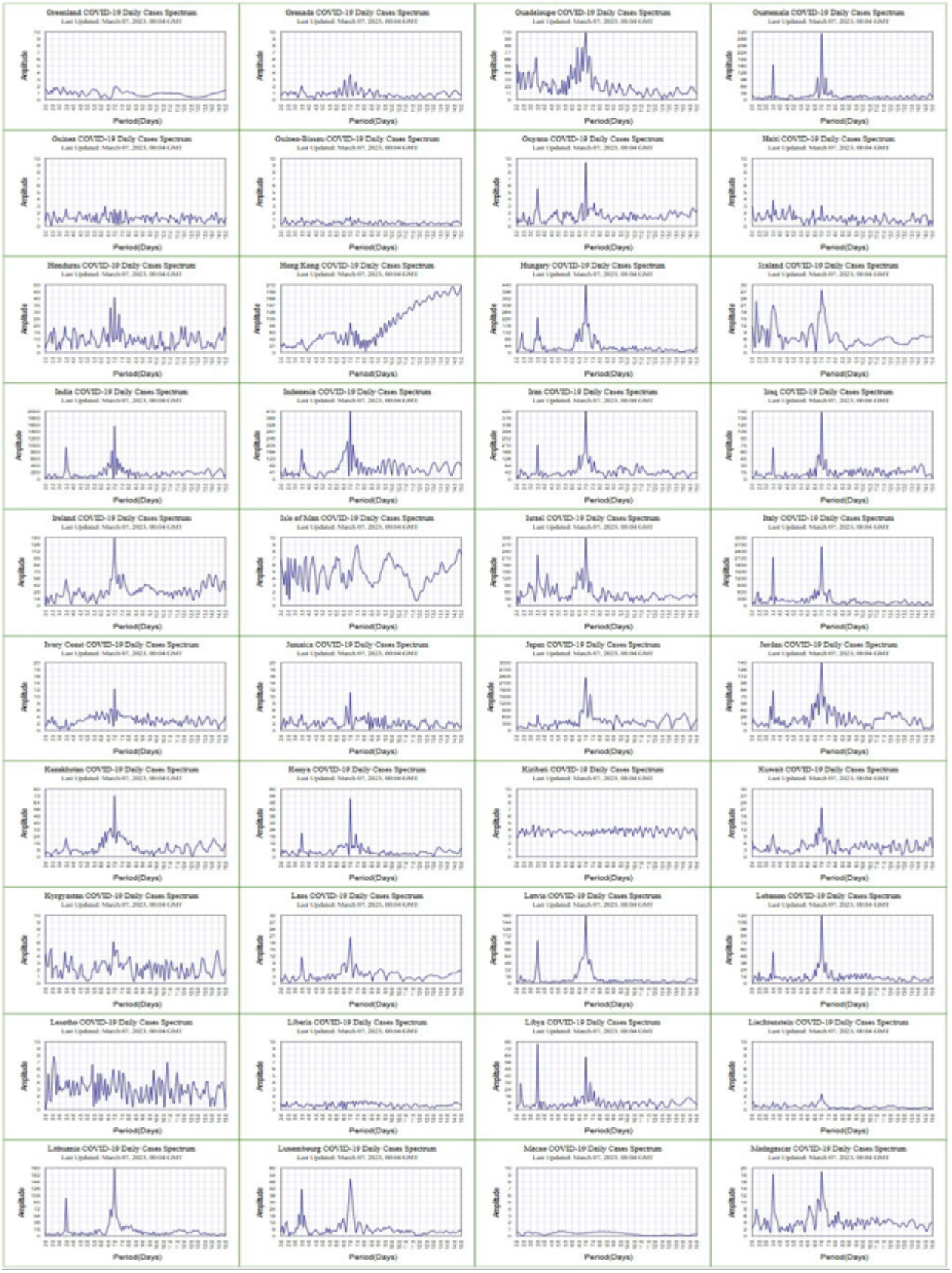


Figure 6. *Countries and Regions Spectrum - 3*

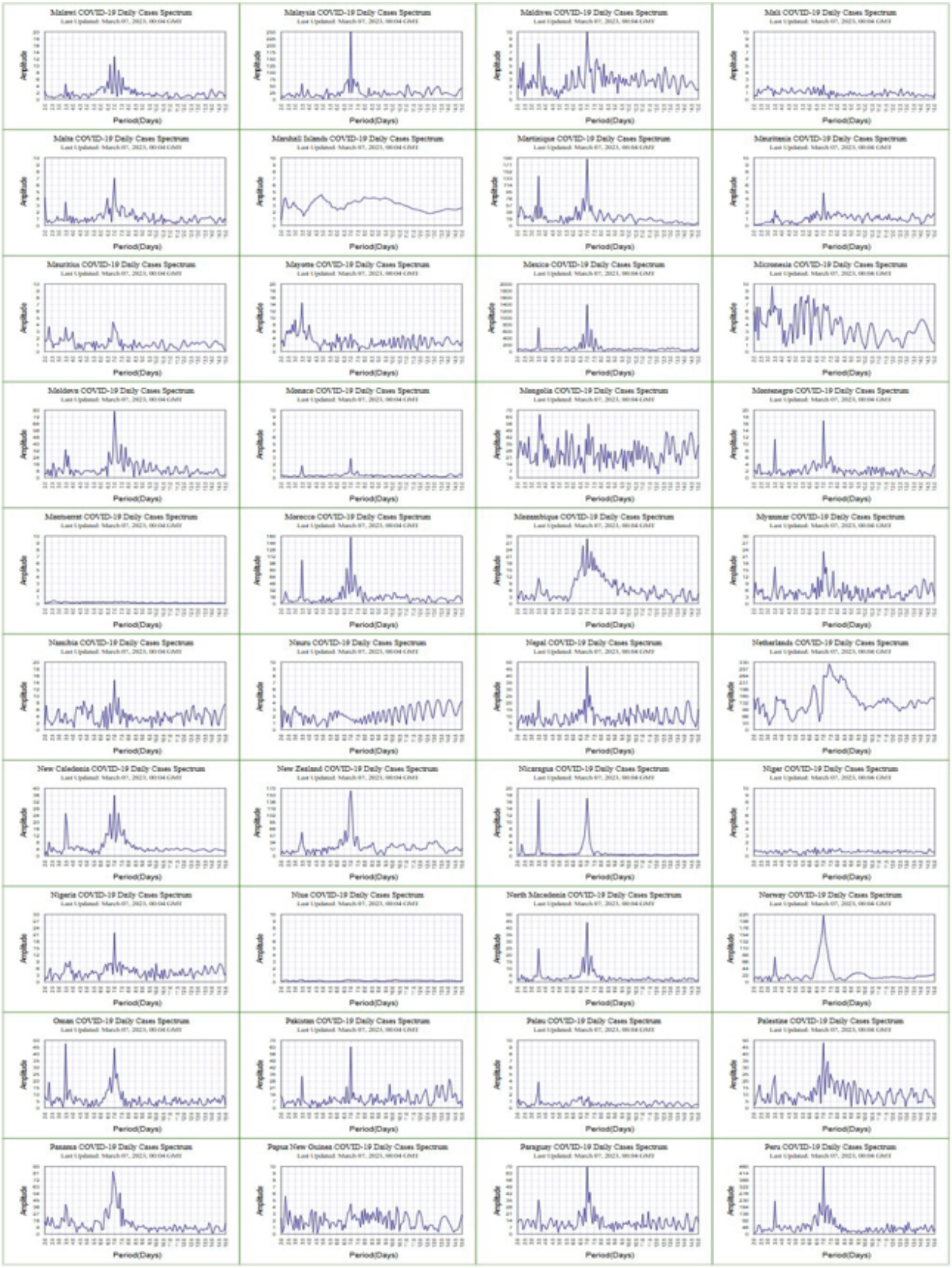


Figure 7. *Countries and Regions Spectrum - 4*

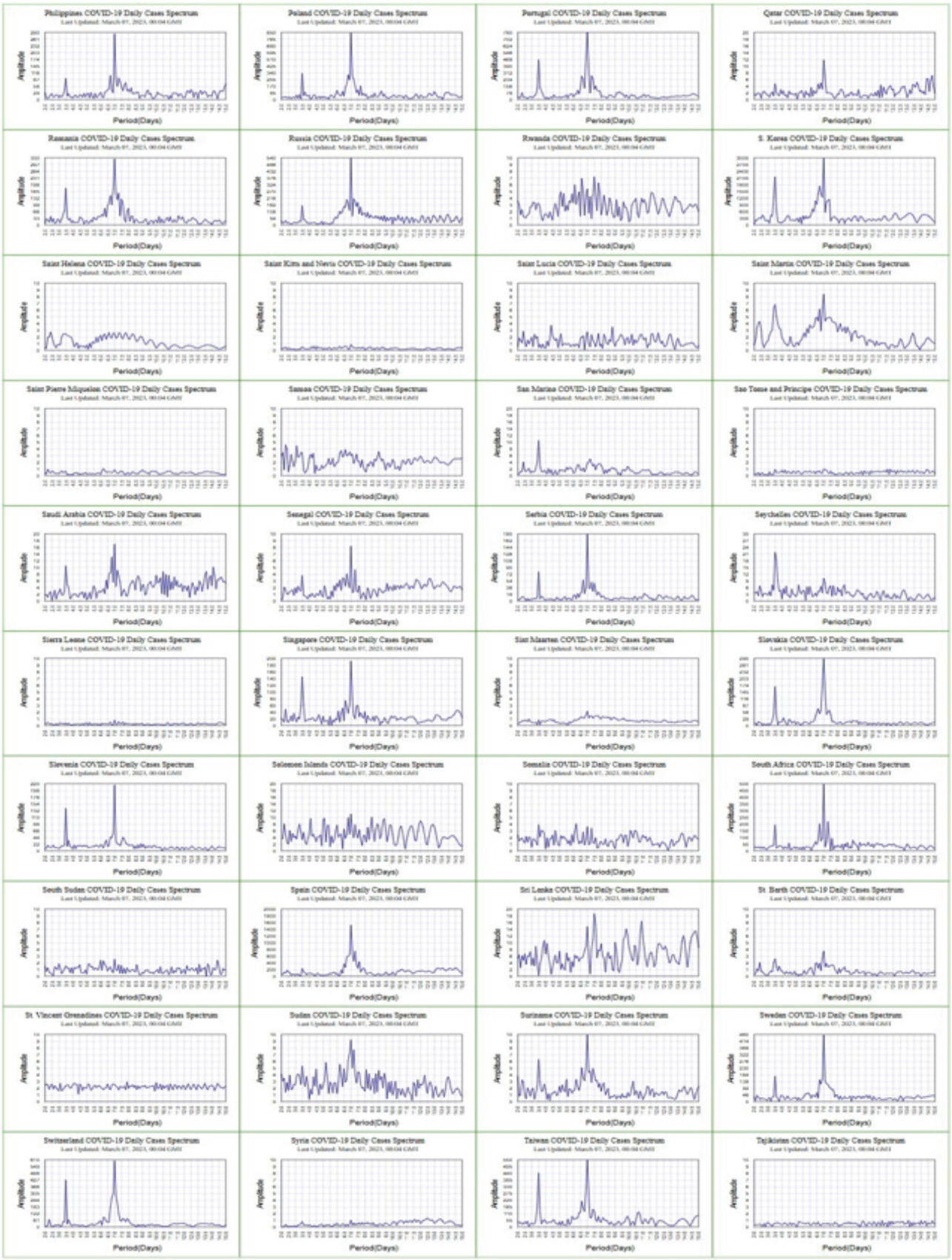


Figure 8. *Countries and Regions Spectrum - 5*

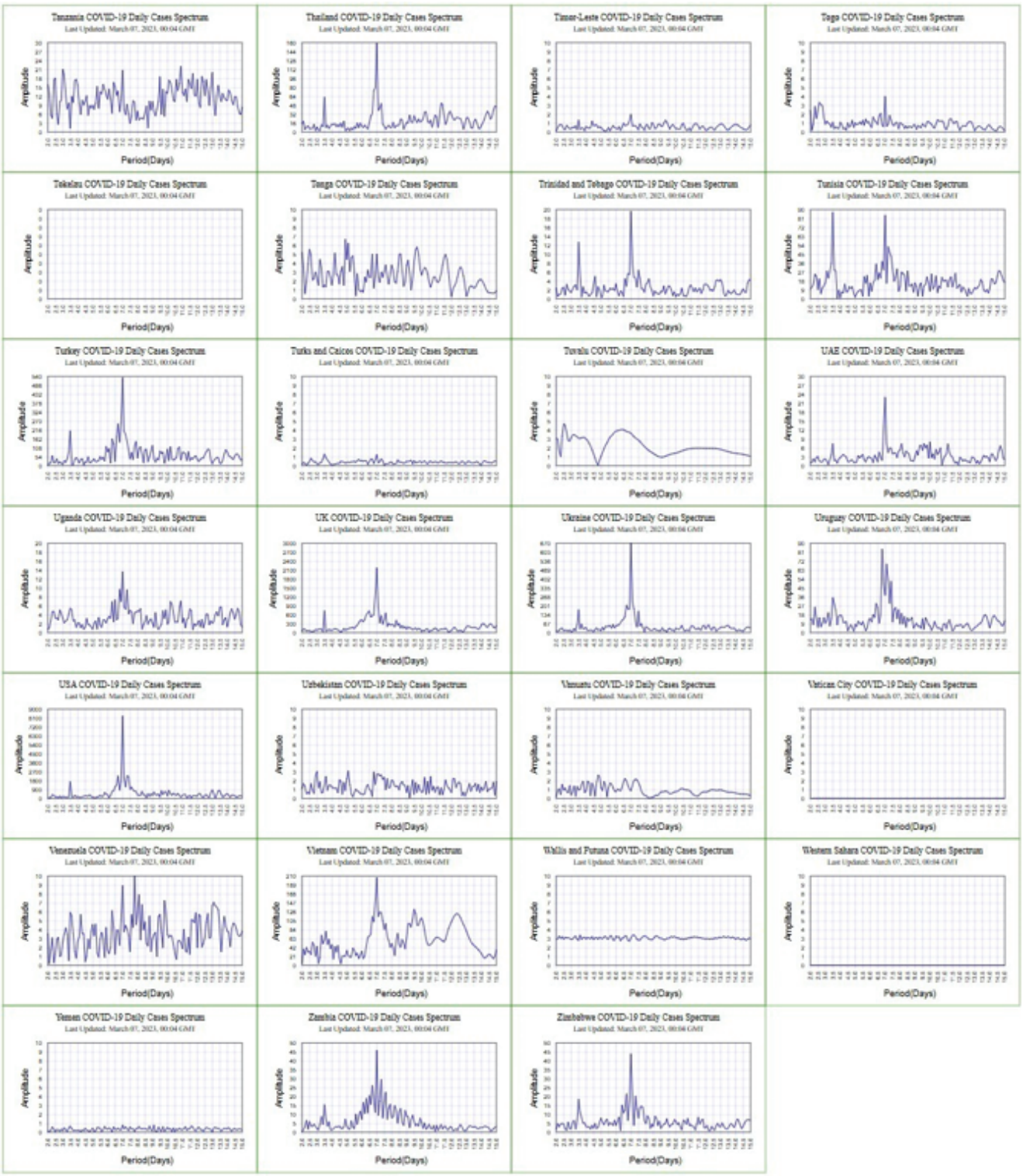


Figure 9. *Countries and Regions Spectrum - 6*

Table 1. *Countries and Regions Spectrum Phase Shift - 1*

Index	Country / Region	Total cases	7day Phase		3.5day Phase	
			Degree	Days	Degree	Days
1	Afghanistan	209406	-28.70	-0.56	108.86	1.06
2	Albania	334427	58.26	1.13	-44.59	-0.43
3	Algeria	271477	33.76	0.66	-117.83	-1.15
4	Andorra	47875	9.84	0.19	159.76	1.55
5	Angola	105277	21.14	0.41	-133.57	-1.30
6	Anguilla	3904	-61.15	-1.19	-160.22	-1.56
7	Antigua and Barbuda	9106	37.55	0.73	66.13	0.64
8	Argentina	10044125	23.16	0.45	-130.21	-1.27
9	Armenia	446819	79.79	1.55	26.61	0.26
10	Aruba	44044	73.82	1.44	-142.49	-1.39
11	Australia	11385534	52.54	1.02	-78.36	-0.76
12	Austria	5940935	47.17	0.92	-15.21	-0.15
13	Azerbaijan	828730	73.62	1.43	-15.65	-0.15
14	Bahamas	37491	38.42	0.75	-134.86	-1.31
15	Bahrain	709230	-39.86	-0.78	73.46	0.71
16	Bangladesh	2037829	-23.51	-0.46	153.48	1.49
17	Barbados	106645	17.77	0.35	-79.33	-0.77
18	Belarus	994037	109.20	2.12	34.03	0.33
19	Belgium	4727795	91.12	1.77	97.13	0.94
20	Belize	70757	-20.15	-0.39	173.53	1.69
21	Benin	27990	-11.32	-0.22	-76.35	-0.74
22	Bermuda	18814	-4.43	-0.09	100.52	0.98
23	Bhutan	62620	13.74	0.27	-8.17	-0.08
24	Bolivia	1193908	74.49	1.45	-36.71	-0.36
25	Bosnia and Herzegovina	401636	22.69	0.44	-150.02	-1.46
26	Botswana	329727	-21.99	-0.43	131.47	1.28
27	Brazil	37076053	39.58	0.77	-88.90	-0.86
28	British Virgin Islands	7305	9.44	0.18	166.63	1.62
29	Brunei	278698	-47.46	-0.92	-94.48	-0.92
30	Bulgaria	1297062	-8.64	-0.17	-156.01	-1.52
31	Burkina Faso	22056	-48.37	-0.94	-90.80	-0.88
32	Burundi	53631	-39.26	-0.76	146.91	1.43
33	Cabo Verde	63244	52.39	1.02	-35.82	-0.35
34	Cambodia	138719	87.55	1.70	109.29	1.06
35	Cameroon	124392	27.43	0.53	81.43	0.79
36	Canada	4591149	23.43	0.46	126.26	1.23
37	CAR	15368	-7.91	-0.15	-151.64	-1.47
38	Caribbean Netherlands	11676	-23.19	-0.45	-157.88	-1.53
39	Cayman Islands	31472	29.07	0.57	98.17	0.95
40	Chad	7678	-123.21	-2.40	-176.46	-1.72
41	Channel Islands	101382	-20.77	-0.40	-174.09	-1.69
42	Chile	5182360	116.37	2.26	80.09	0.78
43	China	503302	79.19	1.54	-12.90	-0.13
44	Colombia	6360089	87.42	1.70	18.25	0.18
45	Comoros	9001	26.78	0.52	-124.86	-1.21
46	Congo	25375	9.01	0.18	167.96	1.63
47	Cook Islands	7030	5.21	0.10	-144.14	-1.40
48	Costa Rica	1204164	29.90	0.58	-103.88	-1.01
49	Croatia	1269326	63.28	1.23	-18.39	-0.18
50	Cuba	1112631	168.04	3.27	-44.34	-0.43
51	Cyprus	650685	88.70	1.72	-146.86	-1.43
52	Czechia	4614143	47.92	0.93	-42.59	-0.41
53	Denmark	3175554	14.79	0.29	-135.43	-1.32
54	Djibouti	15690	-21.01	-0.41	150.41	1.46
55	Dominica	15760	-6.19	-0.12	-60.90	-0.59
56	Dominican Republic	660705	100.83	1.96	27.94	0.27
57	DPRK	4772813	-124.38	-2.42	117.62	1.14

Index	Country / Region	Total cases	7day Phase		3.5day Phase	
			Degree	Days	Degree	Days
58	DRC	95749	-2.34	-0.05	159.16	1.55
59	Ecuador	1057121	67.41	1.31	-53.10	-0.52
60	Egypt	515698	89.74	1.74	-167.16	-1.63
61	El Salvador	201785	79.71	1.55	120.71	1.17
62	Equatorial Guinea	17229	64.42	1.25	-168.00	-1.63
63	Eritrea	10189	6.99	0.14	-153.35	-1.49
64	Estonia	615119	12.81	0.25	-72.35	-0.70
65	Eswatini	74267	21.29	0.41	-118.00	-1.15
66	Ethiopia	500060	52.96	1.03	-72.17	-0.70
67	Faeroe Islands	34658	-140.19	-2.73	-39.40	-0.38
68	Falkland Islands	1930	30.34	0.59	56.30	0.55
69	Fiji	68897	43.65	0.85	117.08	1.14
70	Finland	1462976	-30.08	-0.58	173.85	1.69
71	France	39639112	41.92	0.82	-49.66	-0.48
72	French Guiana	98041	19.23	0.37	147.55	1.43
73	French Polynesia	77957	-16.31	-0.32	166.20	1.62
74	Gabon	48981	17.80	0.35	169.56	1.65
75	Gambia	12586	-36.59	-0.71	-49.73	-0.48
76	Georgia	1825598	49.71	0.97	-46.14	-0.45
77	Germany	38210850	13.45	0.26	-158.88	-1.54
78	Ghana	171209	-119.59	-2.33	6.14	0.06
79	Gibraltar	20433	33.17	0.65	125.85	1.22
80	Greece	5871458	12.49	0.24	-110.73	-1.08
81	Greenland	11971	-3.50	-0.07	-144.00	-1.40
82	Grenada	19680	33.04	0.64	-98.60	-0.96
83	Guadeloupe	201852	5.21	0.10	99.69	0.97
84	Guatemala	1237564	49.46	0.96	-68.01	-0.66
85	Guinea	38267	49.85	0.97	98.99	0.96
86	Guinea-Bissau	8960	40.33	0.78	-131.41	-1.28
87	Guyana	73075	68.34	1.33	-22.95	-0.22
88	Haiti	34202	-76.83	-1.49	162.01	1.58
89	Honduras	472219	58.79	1.14	88.38	0.86
90	Hong Kong	2883700	101.23	1.97	37.15	0.36
91	Hungary	2195926	-7.33	-0.14	121.46	1.18
92	Iceland	209093	-31.05	-0.60	127.69	1.24
93	India	44688101	74.12	1.44	-19.80	-0.19
94	Indonesia	6737303	57.78	1.12	-43.54	-0.42
95	Iran	7570743	-24.29	-0.47	143.38	1.39
96	Iraq	2465545	2.43	0.05	179.93	1.75
97	Ireland	1703850	38.74	0.75	-168.41	-1.64
98	Isle of Man	38008	-42.55	-0.83	17.60	0.17
99	Israel	4801511	-48.61	-0.95	150.04	1.46
100	Italy	25603510	47.91	0.93	-52.67	-0.51
101	Ivory Coast	88240	77.00	1.50	20.92	0.20
102	Jamaica	154196	-172.75	-3.36	161.39	1.57
103	Japan	33264491	87.27	1.70	-0.20	0.00
104	Jordan	1746997	-48.41	-0.94	131.70	1.28
105	Kazakhstan	1408124	117.92	2.29	81.71	0.79
106	Kenya	342919	64.90	1.26	-55.56	-0.54
107	Kiribati	5013	-54.86	-1.07	-92.65	-0.90
108	Kuwait	663456	7.72	0.15	-176.85	-1.72
109	Kyrgyzstan	206673	68.66	1.33	-23.76	-0.23
110	Laos	218020	50.03	0.97	-52.48	-0.51
111	Latvia	976162	50.81	0.99	-46.51	-0.45
112	Lebanon	1232517	55.42	1.08	-22.75	-0.22
113	Lesotho	34790	105.64	2.05	-170.80	-1.66
114	Liberia	8090	-57.62	-1.12	-166.85	-1.62

Table 2. *Countries and Regions Spectrum Phase Shift - 2*

Index	Country / Region	Total cases	7day Phase		3.5day Phase	
			Degree	Days	Degree	Days
115	Libya	507187	-49.08	-0.95	120.58	1.17
116	Liechtenstein	21426	67.45	1.31	-42.23	-0.41
117	Lithuania	1306368	57.47	1.12	-38.59	-0.38
118	Luxembourg	297757	-2.07	-0.04	150.37	1.46
119	Macao	3514	39.20	0.76	44.26	0.43
120	Madagascar	67889	162.45	3.16	-30.71	-0.30
121	Malawi	88702	57.43	1.12	-83.45	-0.81
122	Malaysia	5043978	72.31	1.41	-47.73	-0.46
123	Maldives	185732	-81.65	-1.59	141.73	1.38
124	Mali	33053	37.64	0.73	-8.66	-0.08
125	Malta	117477	37.68	0.73	-66.10	-0.64
126	Marshall Islands	15618	-59.95	-1.17	-104.26	-1.01
127	Martinique	229807	-40.01	-0.78	-84.99	-0.83
128	Mauritania	63668	41.74	0.81	-81.37	-0.79
129	Mauritius	41752	99.39	1.93	168.99	1.64
130	Mayotte	42004	-31.71	-0.62	-171.31	-1.67
131	Mexico	7470653	102.34	1.99	35.81	0.35
132	Micronesia	23948	28.53	0.55	175.71	1.71
133	Moldova	607450	31.28	0.61	-79.96	-0.78
134	Monaco	16115	16.87	0.33	-108.20	-1.05
135	Mongolia	1007897	45.83	0.89	18.72	0.18
136	Montenegro	288630	31.62	0.61	-61.22	-0.60
137	Montserrat	1403	38.11	0.74	-28.80	-0.28
138	Morocco	1272490	59.31	1.15	-46.58	-0.45
139	Mozambique	233098	52.44	1.02	-80.83	-0.79
140	Myanmar	633947	22.38	0.44	-91.18	-0.89
141	Namibia	171156	149.34	2.90	-119.02	-1.16
142	Nauru	5247	132.81	2.58	148.32	1.44
143	Nepal	1001149	8.77	0.17	-157.34	-1.53
144	Netherlands	8598182	33.09	0.64	-171.15	-1.66
145	New Caledonia	79881	-38.44	-0.75	-130.05	-1.26
146	New Zealand	2228291	19.58	0.38	-82.75	-0.80
147	Nicaragua	18491	-50.87	-0.99	-102.68	-1.00
148	Niger	9931	9.29	0.18	1.00	0.01
149	Nigeria	266598	42.05	0.82	-69.66	-0.68
150	Niue	791	-25.60	-0.50	-79.85	-0.78
151	North Macedonia	346852	42.14	0.82	-63.43	-0.62
152	Norway	1479259	7.11	0.14	-144.57	-1.41
153	Oman	399449	-90.40	-1.76	74.35	0.72
154	Pakistan	1577214	114.09	2.22	76.40	0.74
155	Palau	5989	38.10	0.74	-149.79	-1.46
156	Palestine	621008	-35.97	-0.70	132.26	1.29
157	Panama	1031273	32.11	0.62	-88.10	-0.86
158	Papua New Guinea	46809	-37.25	-0.72	117.79	1.15
159	Paraguay	808401	48.10	0.94	-157.95	-1.54
160	Peru	4486832	70.44	1.37	-18.96	-0.18
161	Philippines	4077109	152.99	2.97	134.47	1.31
162	Poland	6432765	66.59	1.29	-19.98	-0.19
163	Portugal	5568084	-2.25	-0.04	-153.30	-1.49
164	Qatar	494737	-31.92	-0.62	136.77	1.33
165	Romania	3346046	29.28	0.57	-86.07	-0.84
166	Russia	22353291	130.33	2.53	59.19	0.58
167	Rwanda	133180	30.85	0.60	-83.95	-0.82
168	S. Korea	30569215	42.95	0.84	-22.33	-0.22
169	Saint Helena	2166	94.33	1.83	-167.35	-1.63
170	Saint Kitts and Nevis	6597	53.10	1.03	-33.32	-0.32
171	Saint Lucia	30004	71.77	1.40	128.30	1.25
172	Saint Martin	12257	40.95	0.80	105.55	1.03
173	Saint Pierre Miquelon	3452	-8.83	-0.17	-163.91	-1.59
174	Samoa	16607	-7.70	-0.15	-90.93	-0.88
175	San Marino	23583	-84.66	-1.65	-178.95	-1.74
176	Sao Tome and Principe	6281	37.63	0.73	-119.61	-1.16
177	Saudi Arabia	829882	-11.44	-0.22	-175.81	-1.71
178	Senegal	88921	111.30	2.16	45.19	0.44
179	Serbia	2497248	11.35	0.22	-117.23	-1.14
180	Seychelles	50665	-6.26	-0.12	146.24	1.42
181	Sierra Leone	7760	97.84	1.90	28.97	0.28
182	Singapore	2230570	19.17	0.37	-81.03	-0.79
183	Sint Maarten	11020	-2.57	-0.05	-134.85	-1.31
184	Slovakia	1863419	60.67	1.18	-28.97	-0.28
185	Slovenia	1329966	38.93	0.76	-52.84	-0.51
186	Solomon Islands	24575	-76.08	-1.48	172.09	1.67
187	Somalia	27324	-92.59	-1.80	71.19	0.69
188	South Africa	4065857	74.36	1.45	-3.72	-0.04
189	South Sudan	18368	-27.98	-0.54	150.34	1.46
190	Spain	13770429	33.41	0.65	153.22	1.49
191	Sri Lanka	672034	-0.04	0.00	121.61	1.18
192	St. Barth	5439	37.62	0.73	104.53	1.02
193	St. Vincent Grenadines	9589	91.58	1.78	-170.39	-1.66
194	Sudan	63809	-14.27	-0.28	-129.80	-1.26
195	Suriname	82467	12.48	0.24	-65.83	-0.64
196	Sweden	2698535	17.87	0.35	-108.19	-1.05
197	Switzerland	4391007	27.95	0.54	-70.58	-0.69
198	Syria	57467	-19.55	-0.38	159.56	1.55
199	Taiwan	10112117	45.90	0.89	-28.27	-0.27
200	Tajikistan	17786	-71.18	-1.38	-80.42	-0.78
201	Tanzania	42846	-8.96	-0.17	128.58	1.25
202	Thailand	4728182	114.74	2.23	69.19	0.67
203	Timor-Leste	23418	95.83	1.86	21.87	0.21
204	Togo	39394	64.14	1.25	-47.30	-0.46
205	Tokelau	5	0.00	0.00	0.00	0.00
206	Tonga	16807	42.23	0.82	154.59	1.50
207	Trinidad and Tobago	189296	49.84	0.97	-74.92	-0.73
208	Tunisia	1150962	61.02	1.19	-43.33	-0.42
209	Turkey	17042722	7.33	0.14	-116.93	-1.14
210	Turks and Caicos	6551	56.34	1.10	0.88	0.01
211	Tuvalu	2805	-21.33	-0.41	92.21	0.90
212	UAE	1052664	76.62	1.49	-51.71	-0.50
213	Uganda	170504	115.35	2.24	46.52	0.45
214	UK	24370154	15.49	0.30	-96.10	-0.93
215	Ukraine	5389439	78.60	1.53	-62.82	-0.61
216	Uruguay	1034303	24.89	0.48	174.84	1.70
217	USA	105398674	59.06	1.15	-107.79	-1.05
218	Uzbekistan	251071	109.96	2.14	100.81	0.98
219	Vanuatu	12014	117.26	2.28	56.62	0.55
220	Vatican City	29	-31.15	-0.61	148.75	1.45
221	Venezuela	552125	119.04	2.31	-39.72	-0.39
222	Vietnam	11526966	51.46	1.00	-70.40	-0.68
223	Wallis and Futuna	3427	95.77	1.86	-150.30	-1.46
224	Western Sahara	10	-163.41	-3.18	28.74	0.28
225	Yemen	11945	-10.22	-0.20	153.25	1.49
226	Zambia	343135	50.46	0.98	-64.64	-0.63
227	Zimbabwe	264127	7.82	0.15	-132.36	-1.29

Literature Review

A blank world map from https://simplemaps.com/ is used to check the 7day period moving direction, just by put the phase shift into the map, the phase shift are converted to -3.5day – 3.5day. See Figure 10.

It can be seen from Figure 10 that the 7day period move in both direction – eastward and westward, and follow certain rules. In west coast of both north and south America and west area of Africa, the moving direction mainly towards east. Libya, Chad, CAR,and DRC in Africa form a trough-like area which the 7day period move to this area both from east and west.

The states in USA have a better geographical distribution, and there are more detailed case number reported for each state, further analysis is done based on USA reported case number. For USA spectrum analysis, data of "Last Updated: March 09, 2023, 03:05 GMT " used. January 22, 2020, 00:00 GMT used as time zero, amuse all data time is 00:00 GMT. The USA spectrum is shown in Figure 11.

Spectrum for all states are shown in Figure 12 – 14. The phase shift is shown in Table 3.

It is the same as in world analysis, 7day period is still moving both east-ward and west-ward. Arizona, North Dakota, Oklahoma, North Carolina and South Carolina are with a bigger phase shift leading, and show a peak-like property. Wyoming and Minnesota are with a bigger phase shift lagging, and show a trough-like property. This should mean something instead of data processing error base on their geographical distribution, might need to do further analyzing. Wisconsin, Illinois, Indiana and Kentucky formed a peak-like area, and 7day period is moving away from this area to both east and west. Minnesota, South Dakota, Nebraska, Iowa, Kansas and Missouri formed a trough-like area, 7day period is moving to this area both from east and west..

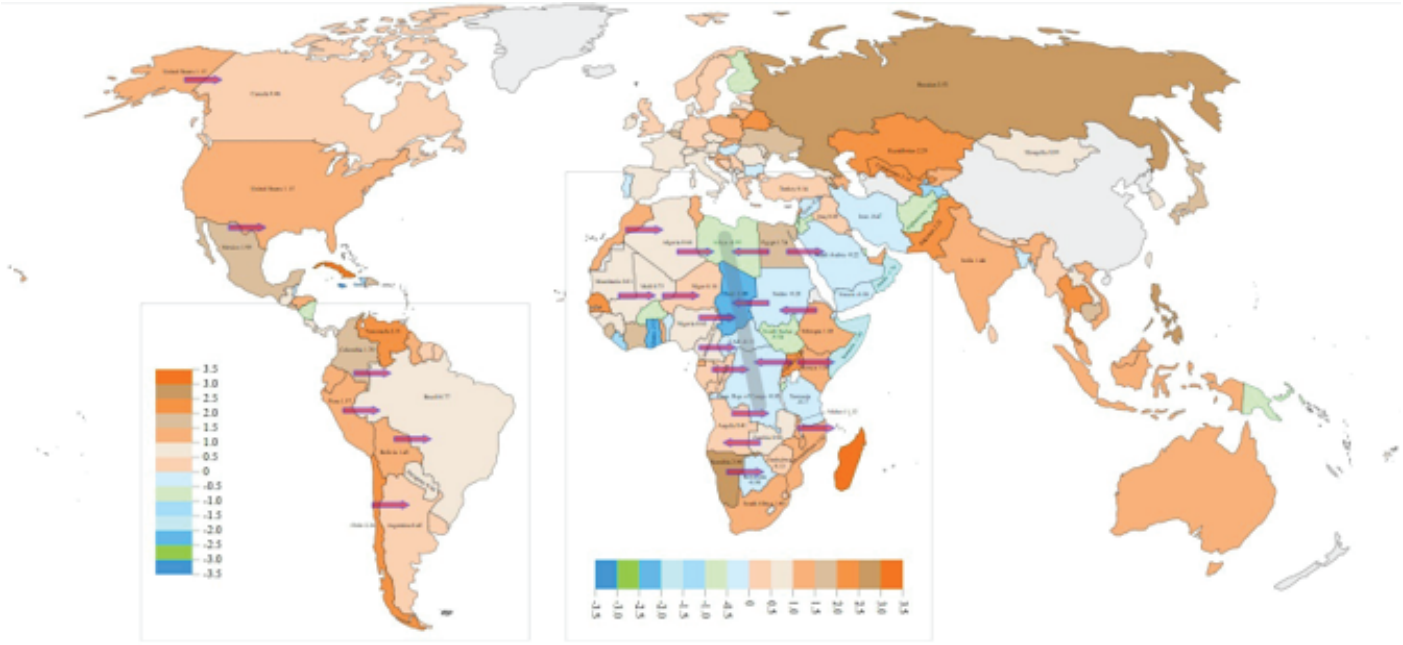


Figure 10. *7day period moving direction*

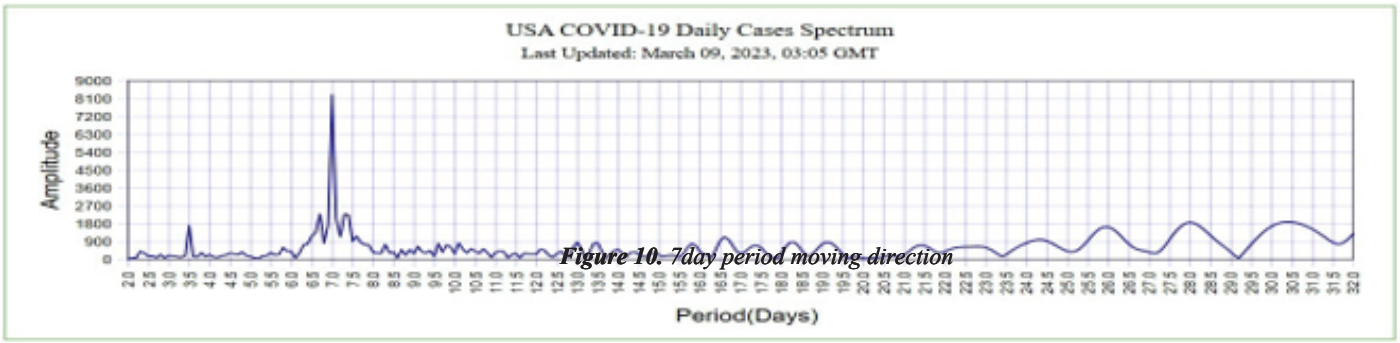


Figure 10. *7day period moving direction*

Figure 11. *USA Spectrum*

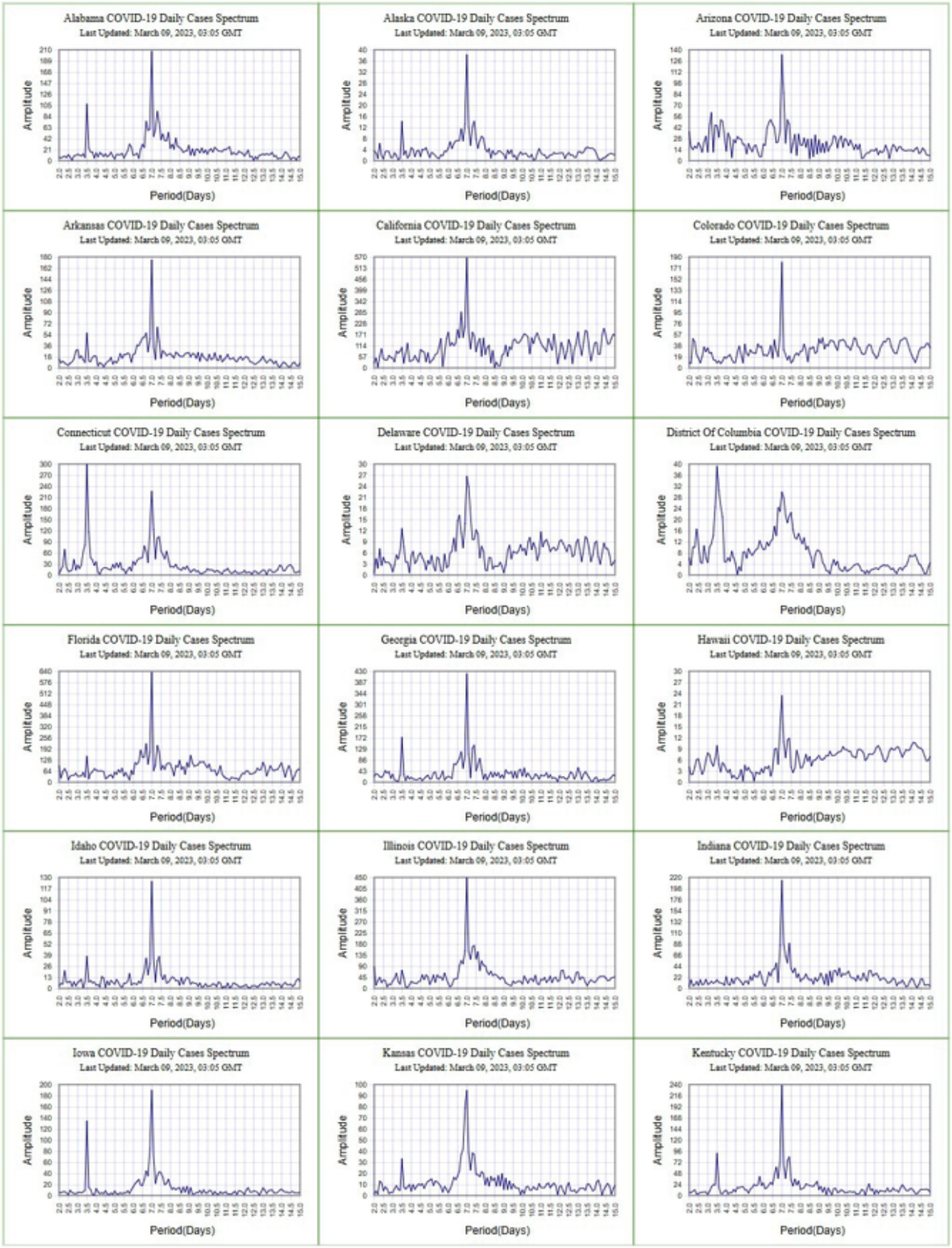


Figure 12. *USA_Spectrum_Charts1*

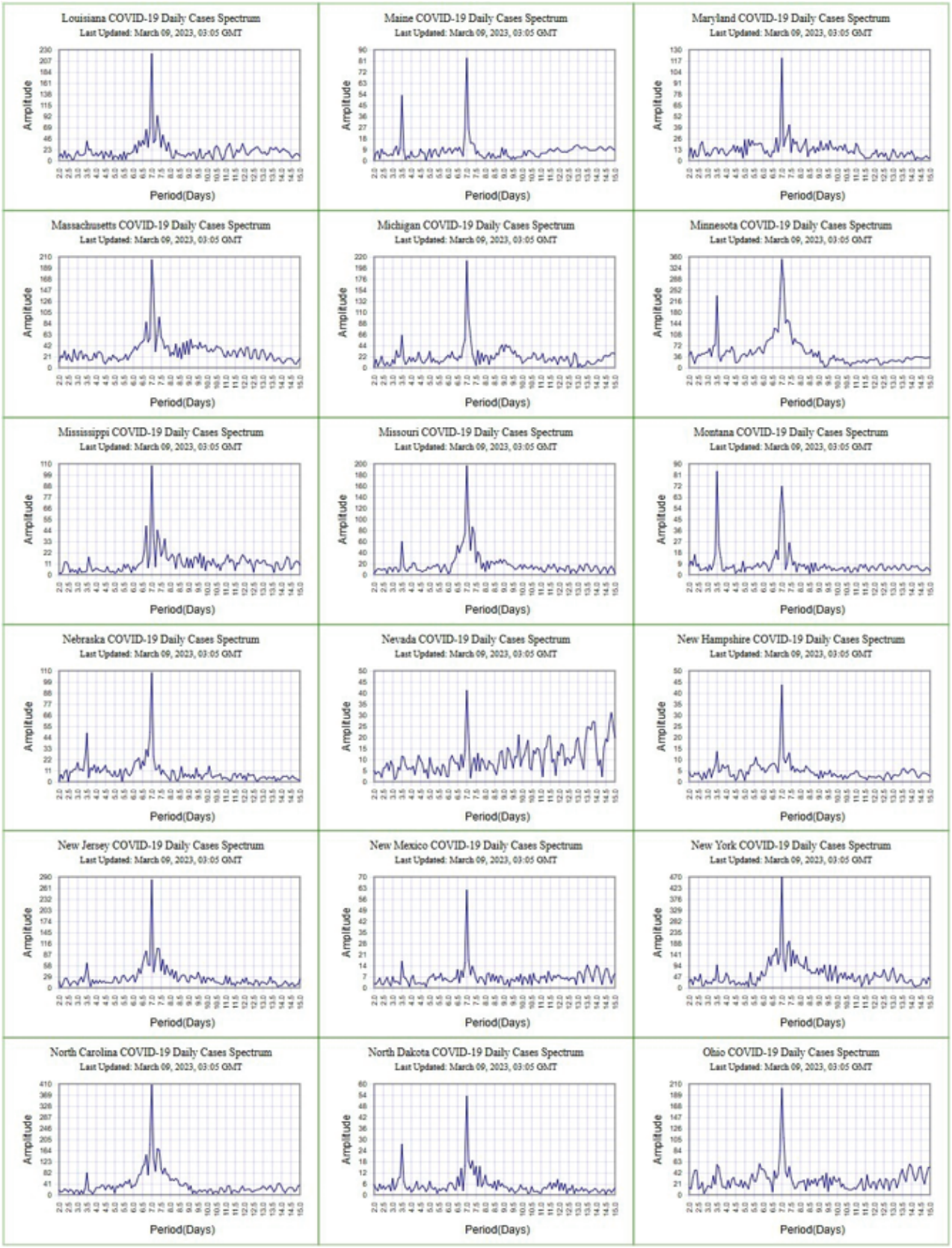


Figure 13. USA_Spectrum_Charts2

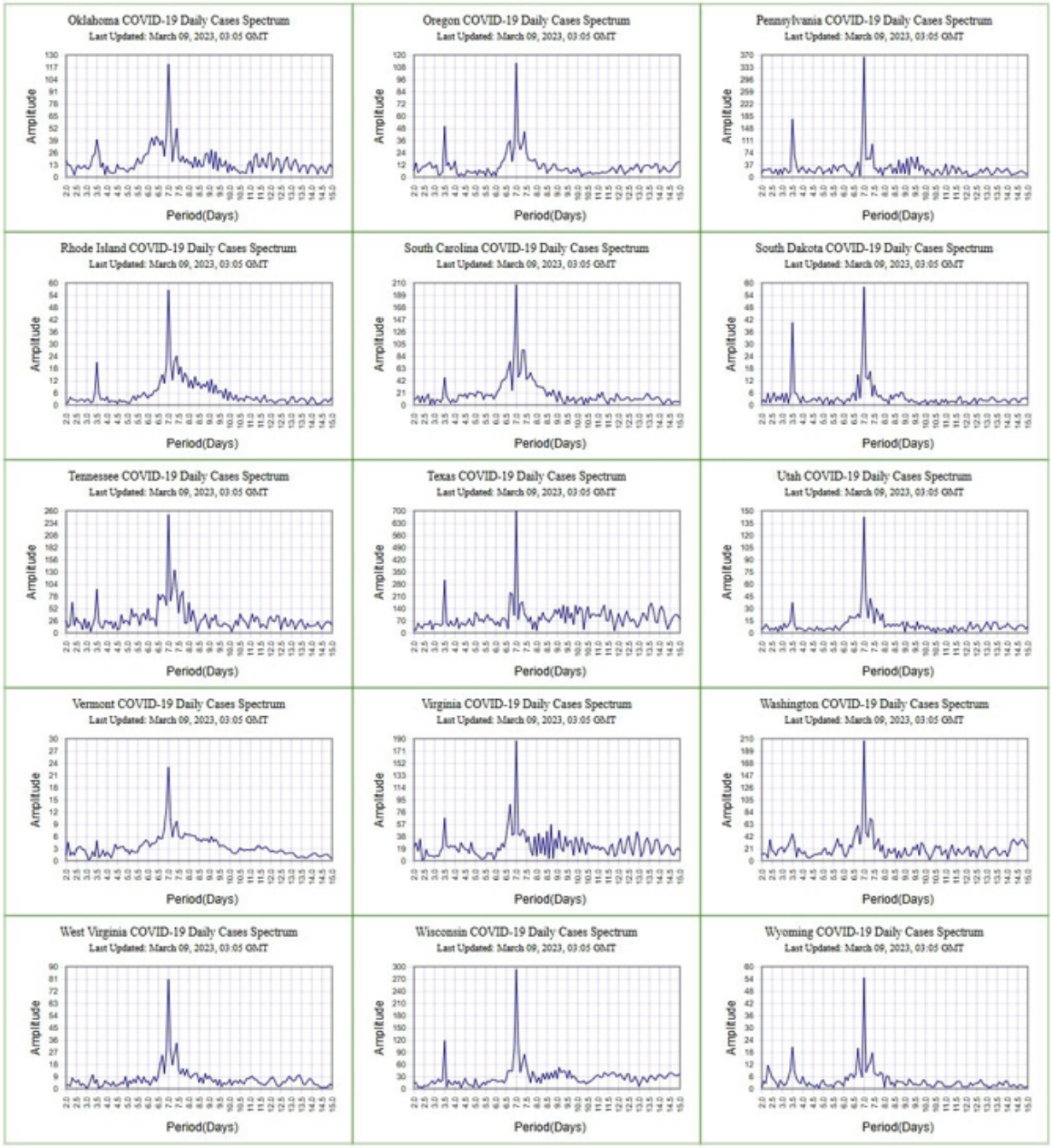


Figure 14. USA_Spectrum_Charts3

Table 3. USA_Spectrum_Phase

Index	State	Total cases	7day Phase		3.5day Phase		Index	State	Total cases	7day Phase		3.5day Phase	
			Degree	Days	Degree	Days				Degree	Days	Degree	Days
1	Alabama	1644533	38.82	0.75	-66.72	-0.65	27	Montana	329386	47.64	0.93	-156.32	-1.52
2	Alaska	294347	69.14	1.34	-16.59	-0.16	28	Nebraska	565924	22.50	0.44	-106.11	-1.03
3	Arizona	2407765	119.57	2.32	-90.93	-0.88	29	Nevada	890122	76.47	1.49	-127.15	-1.24
4	Arkansas	1006622	49.19	0.96	-72.05	-0.70	30	New Hampshire	376862	87.47	1.70	5.07	0.05
5	California	12094613	80.86	1.57	-142.48	-1.39	31	New Jersey	3048211	71.12	1.38	-49.74	-0.48
6	Colorado	1764400	63.74	1.24	-125.96	-1.22	32	New Mexico	670688	58.56	1.14	117.17	1.14
7	Connecticut	976494	-43.15	-0.84	168.64	1.64	33	New York	6963892	80.46	1.56	147.02	1.43
8	Delaware	330793	109.78	2.13	96.10	0.93	34	North Carolina	3472644	130.61	2.54	73.76	0.72
9	District Of Columbia	177215	-24.34	-0.47	173.15	1.68	35	North Dakota	286247	52.54	1.02	-65.97	-0.64
10	Florida	7516906	70.87	1.38	-63.07	-0.61	36	Ohio	3392320	50.61	0.98	-43.95	-0.43
11	Georgia	3061485	52.67	1.02	-72.72	-0.71	37	Oklahoma	1284450	118.43	2.30	45.22	0.44
12	Hawaii	380608	128.49	2.50	87.62	0.85	38	Oregon	963565	61.05	1.19	-65.53	-0.64
13	Idaho	521120	12.30	0.24	-122.64	-1.19	39	Pennsylvania	3520813	70.22	1.37	-64.67	-0.63
14	Illinois	4050952	66.56	1.29	-111.73	-1.09	40	Rhode Island	436193	52.13	1.01	-43.22	-0.42
15	Indiana	2051104	71.93	1.40	-30.16	-0.29	41	South Carolina	1836568	135.52	2.64	49.35	0.48
16	Iowa	1050812	25.04	0.49	-80.80	-0.79	42	South Dakota	278489	21.15	0.41	1.14	0.01
17	Kansas	937870	2.21	0.04	-149.79	-1.46	43	Tennessee	2496032	71.58	1.39	-54.85	-0.53
18	Kentucky	1717956	99.34	1.93	40.55	0.39	44	Texas	8426699	19.55	0.38	-121.25	-1.18
19	Louisiana	1573810	29.43	0.57	-90.35	-0.88	45	Utah	1088853	67.19	1.31	-22.24	-0.22
20	Maine	318130	34.56	0.67	-82.48	-0.80	46	Vermont	151477	39.79	0.77	-61.12	-0.59
21	Maryland	1364866	92.10	1.79	-72.69	-0.71	47	Virginia	2287447	78.85	1.53	-53.04	-0.52
22	Massachusetts	2220962	48.28	0.94	122.95	1.20	48	Washington	1915286	92.36	1.80	19.81	0.19
23	Michigan	3064125	38.32	0.75	-116.80	-1.14	49	West Virginia	643270	82.70	1.61	-33.60	-0.33
24	Minnesota	1775264	-15.35	-0.30	-142.87	-1.39	50	Wisconsin	2005874	52.46	1.02	-74.11	-0.72
25	Mississippi	990756	52.45	1.02	151.70	1.47	51	Wyoming	183385	-8.59	-0.17	145.30	1.41
26	Missouri	1752734	10.41	0.20	-150.62	-1.46							

To continue analyze 7day period, put the phase shift into a USA map as shown in Figure 15.

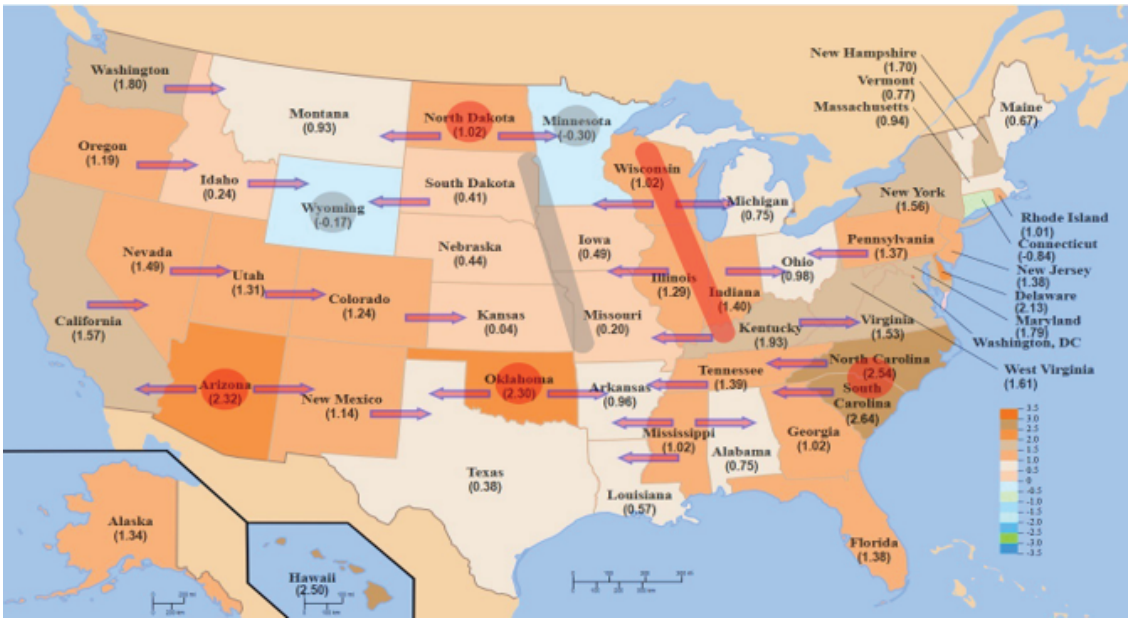


Figure 15. *USA 7day period moving direction*

It is the same as in world analysis, 7day period is still moving both east-ward and west-ward. Arizona, North Dakota, Oklahoma, North Carolina and South Carolina are with a bigger phase shift leading, and show a peak-like property. Wyoming and Minnesota are with a bigger phase shift lagging, and show a trough-like property. This should mean something instead of data processing error base on their geographical distribution, might need to do further analyzing. Wisconsin, Illinois, Indiana and Kentucky formed a peak-like area, and 7day period is moving away from this area to both east and west. Minnesota, South Dakota, Nebraska, Iowa, Kansas and Missouri formed a trough-like area, 7day period is moving to this area both from east and west.

3.5day period property analysis

USA 3.5day period spectrum and phase data is used to analyze 3.5day period property.\

At first, put the spectrum charts based on the state geographical location, certain property shows up. See Figure 16.

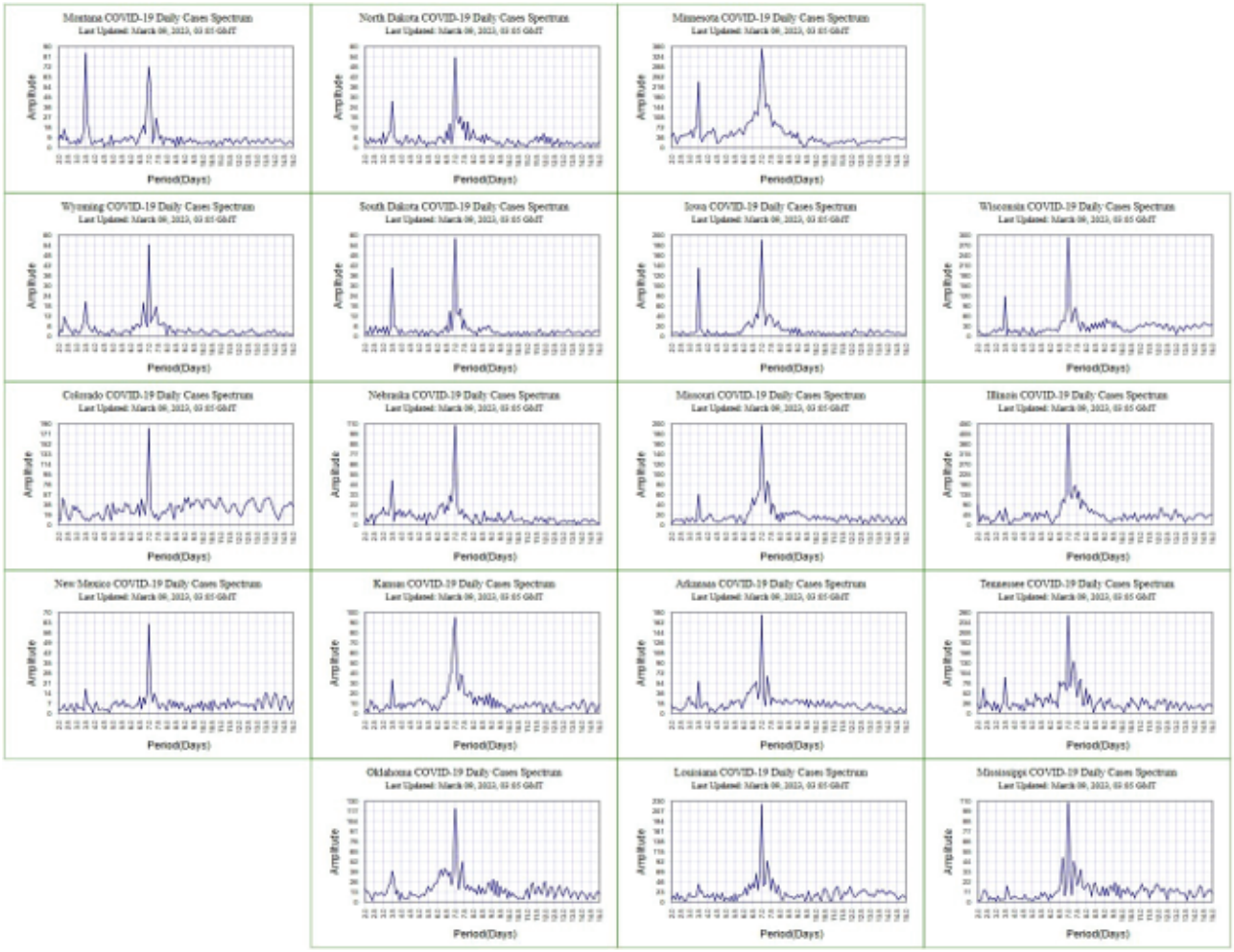


Figure 16. *Spectrum charts lined up with their geographical location*

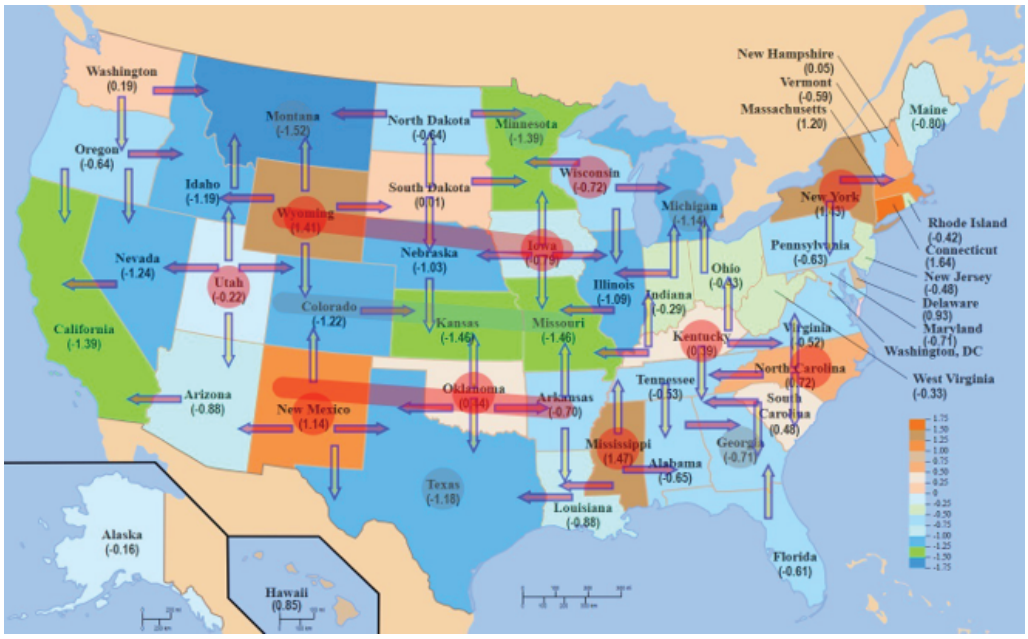


Figure 17. *3.5day period moving direction*

It can be seen that 3.5day period seams changing vertically. put the phase information into a map to check further. See Figure 17.

It can be seen from Figure 17 that there seams no clear pattern for horizontal moving, and certain pattern shown up for vertical moving. Wyoming, South Dakota and Iowa formed a peak-like area,

3.5day period is moving both northward and southward. Colorado, Kansas and Missouri formed a trough-like area, 3.5day period is moving into this are from both north and south. New Mexico, Oklahoma and Arkansas formed another peak-like area.

Conclusion

The above analysis confirmed that 7day period followed the property of tide caused by the Sun and moon. For 3.5day period showed a latitude related property, this could be seasonal effect – the Sun nearer and farther. So that CovId-19 case numbers should be related the Sun and Moon mathematically.

References

1. Sheng Zhao Earthquake, Volcano and Earth Rotation Harmonics Open Journal of Earthquake Research Vol.12 No.3, August 20232