

Supplemental Material

Supplementary Captions

Table S1. COVID-19 movement control order measures (Bernama, 2020a; Bernama 2020b; Md Shah *et al.*, 2020; Prime Minister's Office, 2020a; Prime Minister's Office, 2020b)

Table S2. Average concentration, variations before and during MCOs and relative change (%) of: PM_{2.5}, CO, NO₂, and SO₂ for sub-urban stations.

Table S3. Average concentration, variations before and during MCOs and relative change (%) of: PM_{2.5}, CO, NO₂, and SO₂ for urban stations.

Table S4. Average concentration, variations before and during MCOs and relative change (%) of PM_{2.5}, CO, NO₂, and SO₂ for Industrial stations.

Table S5. Average concentration, variations before and during MCOs and relative change (%) of: PM_{2.5}, CO, NO₂, and SO₂ for rural stations.

Table S1. COVID-19 movement control order measures (Bernama, 2020a; Bernama 2020b; Md Shah *et al.*, 2020; Prime Minister’s Office, 2020a; Prime Minister’s Office, 2020b)

Date	Measures	Location
January 25, 2020	First case of COVID-19 reported in Malaysia	Johor
March 18 – March 31, 2020	<p>Movement Control Order Phase 1</p> <ul style="list-style-type: none"> • All mass gathering is prohibited • All business services and educational institution were closed except for essential ones (e.g., water, electricity, energy, telecommunications, postal, transportation, banking, health, pharmacy, airport, safety, defense, cleaning, retail, and food supply) • All citizens have been prohibited from leaving the country • Foreigners/ visitors restricted from entering the country 	Entire country
March 27 – April, 14 2020	<p>Enhanced Movement Control Order (EMCO)</p> <ul style="list-style-type: none"> • All residents and people who were in the areas are not allowed to leave and no one can enter during the EMCO period. • All business activities had been ordered to close. • Roadblocks have been set-up and all entrance and exit points to the area had also been closed. • Drones were deployed to monitor the movement of the residents in the area. 	Simpang Renggam, Johor
	<p>Enhanced Movement Control Order (EMCO)</p> <ul style="list-style-type: none"> • All residents and people who were in the areas are not allowed to leave and no one can enter during the EMCO period. • All business activities had been ordered to close except for shops selling essential items in the buildings • All entrance and exit points to the area had also been closed 	Selangor Mansion and Malayan Mansion buildings
March 30- April 13, 2020	<p>Enhanced Movement Control Order (EMCO)</p> <ul style="list-style-type: none"> • All residents and people who were in the areas are not allowed to leave and no one can enter during the EMCO period. • All business activities had been ordered to close • Roadblocks have been set-up and all entrance and exit points to the area had also been closed 	Sungai Lui, Hulu Langat Selangor
April 1 – April 14, 2020	<p>Movement Control Order Phase 2</p> <ul style="list-style-type: none"> • Movements were restricted to a 10 kilometre radius from homes only to purchase or deliver food, daily necessities, and medicine. • Businesses premises selling essential items including supermarkets and petrol stations are to operate from 8 am to 8 pm only. 	Entire Country

April 14 – April 28, 2020	Enhanced Movement Control Order (EMCO) <ul style="list-style-type: none"> • All residents and people who were in the areas are not allowed to leave and no one can enter during the EMCO period. • All business activities had been ordered to close. • All entrance and exit points to the area had also been closed. 	Jalan Masjid India, Kuala Lumpur
April 15 – April 28, 2020	Movement Control Order Phase 3 <ul style="list-style-type: none"> • School and universities had been told to implement online learning. • Ministry of International Trade and Industry (MITI) has listed down several sectors that were allowed to operate with restricted conditions. • All citizen was required to stay at home but were still allowed to go out and get essential supplies 	Entire Country
April 29 – May 3, 2020	Movement Control order Phase 4 <ul style="list-style-type: none"> • Movements were still restricted to a 10-kilometre radius from homes only to purchase or deliver food, daily necessities, and medicine. • Students stranded at the university were allowed to go home with proper guidelines (stage by stage and only using buses that is provided by the university management 	Entire Country
May 4, 2020 – 9 June 2020	Conditional Movement Control Order (CMCO) starts <ul style="list-style-type: none"> • Movements were restricted by state borders • Interstate movement for stranded person were allowed on 7 May until 10 May only. 	Entire Country

Table S2. Average concentration, variations before and during MCOs and relative change (%) of: PM_{2.5}, CO, NO₂, and SO₂ for sub-urban stations.

Stations	Region	PM _{2.5} (µg m ⁻³)			CO (ppm)			NO ₂ (ppm)			SO ₂ (ppm)		
		Before MCO	MCOs	%	Before MCO	MCOs	%	Before MCO	MCOs	%	Before MCO	MCOs	%
Kangar	N	12.96	10.5	-18.94 ⁺	0.4707	0.4360	-7.36 ⁺	0.0027	0.0015	-44.65 ⁺	0.0005	0.0008	56.64 ⁺
Langkawi	N	12.97	9.81	-24.34 ⁺	0.4319	0.2759	-36.13 ⁺	0.0042	0.0019	-55.38 ⁺	0.0008	0.0011	30.09 ⁺
Alor Setar	N	20.16	11.3	-43.93 ⁺	0.5128	0.4962	-3.23	0.0049	0.0032	-35.43 ⁺	0.0007	0.0005	-24.26 ⁺
Sg Petani	N	19.01	11.84	-37.71 ⁺	0.4425	0.3270	-26.10 ⁺	0.0072	0.0044	-38.94 ⁺	0.0007	0.0007	10.56 ⁺
Seberang Perai	N	21.24	12.37	-41.76 ⁺	0.7077	0.5120	-27.66 ⁺	0.0072	0.0046	-36.72 ⁺	0.0007	0.0007	0.33
Balik Pulau	N	19.45	13.88	-28.65 ⁺	0.5633	0.4263	-24.33 ⁺	0.0039	0.0027	-30.25 ⁺	0.0006	0.0008	29.64
Taiping	N	25.25	11.75	-53.47 ⁺	0.2407	0.1997	-17.04	0.0087	0.0041	-52.38 ⁺	0.0011	0.0010	-2.66
Pegoh Ipoh	N	18.87	15.09	-20.03 ⁺	0.4181	0.3335	-20.24 ⁺	0.0067	0.0037	-44.04 ⁺	0.0003	0.0008	172.48 ⁺
Tg Malim	N	9.52	7.36	-22.73 ⁺	0.5198	0.4303	-17.22 ⁺	0.0055	0.0026	-53.43 ⁺	0.0005	0.0007	39.61
Batu Muda KL	C	21.47	17.81	-17.02	1.1525	0.8349	-27.55 ⁺	0.0161	0.0053	-67.16 ⁺	0.0007	0.0005	-33.67 ⁺
Putrajaya	C	21.96	16.23	-26.12 ⁺	0.7058	0.4818	-31.74 ⁺	0.0077	0.0037	-52.36 ⁺	0.0011	0.0011	-0.61
Petaling Jaya	C	25.49	16.45	-35.47 ⁺	1.2540	0.5839	-53.43 ⁺	0.0258	0.0082	-68.26 ⁺	0.0009	0.0007	-23.80 ⁺
Klang	C	25.57	22.17	-13.28	0.9501	0.6162	-35.14 ⁺	0.0183	0.0087	-52.60 ⁺	0.0010	0.0009	-10.42
Banting	C	20.47	15.49	-24.34 ⁺	0.7939	0.5151	-35.12 ⁺	0.0101	0.0058	-42.52 ⁺	0.0014	0.0012	-15.29 ⁺
Nilai	S	23.53	15.78	-32.93 ⁺	0.5377	0.3942	-26.68 ⁺	0.0133	0.0067	-49.44 ⁺	0.0011	0.0009	-20.62 ⁺
Port Dickson	S	16.56	12.36	-25.37 ⁺	0.5878	0.5170	-12.05 ⁺	0.0073	0.0039	-46.90 ⁺	0.0022	0.0011	-51.83 ⁺
Bukit Rambai	S	15.8	12.39	-21.56 ⁺	0.5253	0.4301	-18.12 ⁺	0.0061	0.0036	-41.76 ⁺	0.0012	0.0013	9.64
Segamat	S	14.47	15.84	9.46	0.5606	0.5231	-6.69	0.0030	0.0029	-4.04 ⁺	0.0011	0.0013	18.63
Batu Pahat	S	12.87	10.13	-21.31 ⁺	0.6688	0.5025	-24.87	0.0051	0.0028	-45.43 ⁺	0.0019	0.0019	3.50
KotaTinggi	S	8.08	7.2	-10.90 ⁺	0.3905	0.4596	17.69	0.0017	0.0018	6.87 ⁺	0.0008	0.0010	38.36
Tangkak	S	14.81	11.3	-23.70 ⁺	0.7606	0.5423	-28.71 ⁺	0.0055	0.0027	-51.58 ⁺	0.0009	0.0009	0.17
Temerloh	E	14.61	12.38	-15.23 ⁺	0.4509	0.3741	-17.02 ⁺	0.0042	0.0020	-51.62 ⁺	0.0009	0.0006	-33.46 ⁺
Jerantut	E	15.52	10.25	-33.94 ⁺	0.3113	0.3585	15.17 ⁺	0.0026	0.0014	-47.56 ⁺	0.0007	0.0005	-34.03 ⁺
Indera Mahkota	E	9.25	8.35	-9.68 ⁺	0.3745	0.3810	1.72 ⁺	0.0046	0.0019	-58.09 ⁺	0.0012	0.0007	-39.57
Besut	E	12.84	11.83	-7.89	0.6305	0.4821	-23.53 ⁺	0.0018	0.0014	-23.30	0.0010	0.0007	-26.42 ⁺
Tanah Merah	E	22.82	18.74	-17.87 ⁺	0.6739	0.5478	-18.72	0.0052	0.0029	-44.85 ⁺	0.0010	0.0008	-22.04 ⁺
Kota Bharu	E	14.84	15.2	2.4	0.4208	0.4001	-4.91	0.0032	0.0023	-28.04 ⁺	0.0012	0.0008	-29.27 ⁺
Tawau	Sb	7.06	6.76	-4.23	0.5314	0.5864	10.34 ⁺	0.0042	0.0027	-36.46 ⁺	0.0005	0.0004	-15.49 ⁺

Sandakan	Sb	11	9.09	-17.31 ⁺	0.6142	0.5039	-17.96	0.0035	0.0016	-53.85 ⁺	0.0007	0.0008	16.04 ⁺
Kota Kinabalu	Sb	11.76	9.35	-20.51	0.5122	0.5564	8.64 ⁺	0.0031	0.0012	-62.21 ⁺	0.0016	0.0007	-52.73 ⁺
Labuan	L	12.08	13.59	12.47	0.9920	0.6185	-37.65 ⁺	0.0022	0.0014	-35.78 ⁺	0.0008	0.0011	24.28 ⁺
Miri	Sr	15.26	13.37	-12.43	0.5398	0.5366	-0.59	0.0040	0.0019	-51.22 ⁺	0.0005	0.0005	1.00
Bintulu	Sr	13.48	12.56	-6.8	0.4515	0.4457	-1.29	0.0042	0.0030	-29.41 ⁺	0.0005	0.0003	-44.25
Sibu	Sr	10.42	8.86	-14.98 ⁺	0.2704	0.2435	-9.96	0.0041	0.0021	-49.35 ⁺	0.0008	0.0009	17.34 ⁺

⁺ indicate average concentration before MCO vs average concentration during MCOs significant at $p < 0.05$; NA: not available.

Table S3. Average concentration, variations before and during MCOs and relative change (%) of: PM_{2.5}, CO, NO₂, and SO₂ for urban stations.

Stations	Region	PM _{2.5} (µg m ⁻³)			CO (ppm)			NO ₂ (ppm)			SO ₂ (ppm)		
		Before MCO	MCOs	%	Before MCO	MCOs	%	Before MCO	MCOs	%	Before MCO	MCOs	%
Seberang Jaya	N	23.94	14.24	-40.51 ⁺	0.8144	0.5786	-28.95 ⁺	0.0131	0.0070	-46.46 ⁺	0.0011	0.0009	-13.63 ⁺
Minden	N	21.48	11.51	-46.43 ⁺	0.6121	0.4764	-22.17 ⁺	0.0085	0.0043	-49.79 ⁺	0.0010	0.0009	-4.24
TasekIpoh	N	19.73	14.24	-27.83 ⁺	0.6512	0.4859	-25.37 ⁺	0.0090	0.0035	-60.62 ⁺	0.0009	0.0008	-2.99
Cheras	C	21.35	14.5	-32.06 ⁺	0.8069	0.5606	-30.53 ⁺	0.0148	0.0051	-65.56 ⁺	0.0004	0.0006	38.49 ⁺
Shah Alam	C	19.77	16.12	-18.45 ⁺	0.8392	0.6217	-25.92	0.0130	0.0065	-49.52 ⁺	0.0012	0.0010	-13.12
Seremban	S	13.96	11.61	-16.82 ⁺	0.6157	0.4864	-20.99 ⁺	0.0068	0.0027	-61.10 ⁺	0.0008	0.0010	25.19
Bandaraya Melaka	S	14.25	12.58	-11.74 ⁺	0.5487	0.5167	-5.83	0.0058	0.0033	-43.19 ⁺	0.0008	0.0009	10.09
Larkin	S	14.3	13.4	-6.34	0.4559	0.3134	-31.25 ⁺	0.0083	0.0041	-50.92 ⁺	0.0018	0.0019	8.45 ⁺
Pasir Gudang	S	10.6	10.76	1.5	0.5050	0.4718	-6.56 ⁺	0.0047	0.0046	-1.66 ⁺	0.0010	0.0011	13.22
Kuala Terengganu	E	15.7	14.92	-4.93	0.5581	0.4595	-17.66	0.0040	0.0022	-43.63 ⁺	0.0012	0.0009	-22.43 ⁺
Kuching	Sr	9.13	8.43	-7.6	0.5564	0.5946	+6.86	0.0039	0.0024	-39.71 ⁺	0.0002	0.0003	+61.15

⁺ indicate average concentration before MCO vs average concentration during MCOs significant at $p < 0.05$; NA: not available.

Table S4. Average concentration, variations before and during MCOs and relative change (%) of: PM_{2.5}, CO, NO₂, and SO₂ for industrial stations.

Stations	Region	PM _{2.5} (µg m ⁻³)			CO (ppm)			NO ₂ (ppm)			SO ₂ (ppm)		
		Before MCO	MCOs	%	Before MCO	MCOs	%	Before MCO	MCOs	%	Before MCO	MCOs	%
Kulim	N	20.18	11.21	-44.46 ⁺	NA	NA	NA	0.0084	0.0047	-44.33 ⁺	0.0010	0.0011	10.23
Pengerang	S	8.44	10.4	23.1800	NA	NA	NA	0.0027	0.0029	6.28	0.0013	0.0015	19.91 ⁺
Balok Baru	E	12.05	9.15	-24.07 ⁺	NA	NA	NA	0.0058	0.0028	-51.85 ⁺	0.0019	0.0006	-65.97
Kemaman	E	16.47	11.27	-31.54 ⁺	NA	NA	NA	0.0023	0.0018	-19.02 ⁺	0.0007	0.0008	21.64
Paka	E	10.4	7.83	-24.72 ⁺	NA	NA	NA	0.0014	0.0009	34.61	0.0007	0.0007	-2.92 ⁺
Kimanis	Sb	10.45	10.65	1.9900	NA	NA	NA	0.0020	0.0011	-46.38 ⁺	0.0008	0.0007	-5.24 ⁺
Samalaju	Sr	10.84	9.81	-9.5200	NA	NA	NA	0.0019	0.0016	-13.90	0.0010	0.0005	48.18

⁺ indicate average concentration before MCO vs average concentration during MCOs significant at $p < 0.05$; NA: not available.

Table S5. Average concentration, variations before and during MCOs and relative change (%) of: PM_{2.5}, CO, NO₂, and SO₂ for rural stations.

Stations	Region	PM _{2.5} (µg m ⁻³)			CO (ppm)			NO ₂ (ppm)			SO ₂ (ppm)		
		Before MCO	MCOs	%	Before MCO	MCOs	%	Before MCO	MCOs	%	Before MCO	MCOs	%
Seri Manjung	N	18.35	14.16	-22.85 ⁺	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kuala Selangor	C	15.54	14.27	-8.16 ⁺	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alor Gajah	S	11.52	10.71	-6.99	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kluang	S	9.22	8.03	-12.81	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rompin	E	9.12	12.1	32.74	NA	NA	NA	NA	NA	NA	NA	NA	NA
Limbang	Sr	8.6	7.16	-16.69 ⁺	NA	NA	NA	NA	NA	NA	NA	NA	NA
Miri	Sr	12.53	9.76	-22.14 ⁺	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mukah	Sr	6.78	6.42	-5.34	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kapit	Sr	6.38	6.34	-0.54	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sarikei	Sr	8.3	5.82	-29.91 ⁺	NA	NA	NA	NA	NA	NA	NA	NA	NA
Seri Aman	Sr	7.32	6.56	-10.39	NA	NA	NA	NA	NA	NA	NA	NA	NA
Samarahan	Sr	6.43	6.91	7.4	NA	NA	NA	NA	NA	NA	NA	NA	NA

⁺ indicate average concentration before MCO vs average concentration during MCOs significant at $p < 0.05$; NA: not available.

Figure Captions

Fig. S1. Temporal variations of meteorological parameters during study periods.

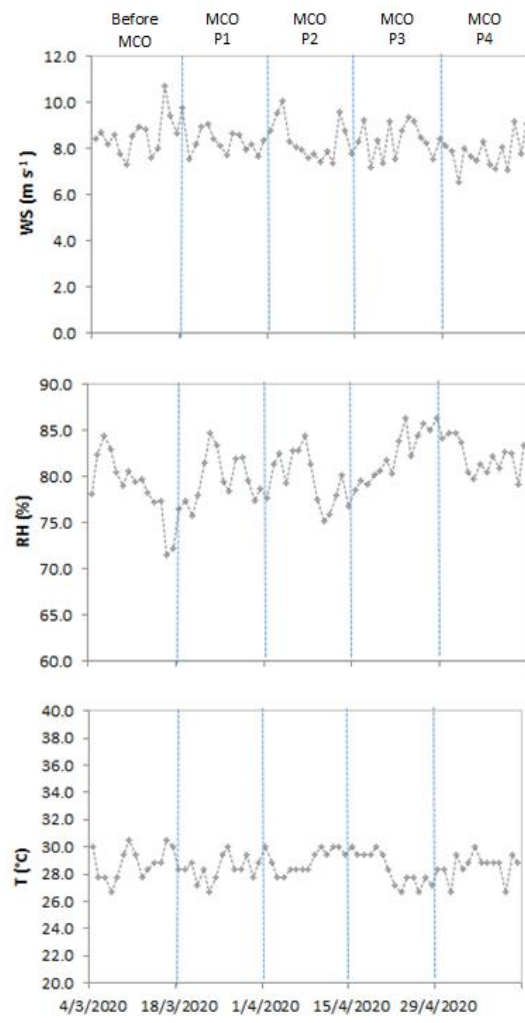


Fig. S1.