Estimated cost of Belle II collaboration meetings and control room shifts

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Abstract

I present estimates of the cost of air fare and the quantity of CO_2 produced by air travel for Belle II General Meetings and Control Room shifts.

1 Introduction

I wanted to understand the costs and climate impact of Belle II-related travel.

2 Methodology

I extracted collaborator names, institutions, institutional location and other information from spreadsheets of Belle II collaborator and institutions obtained from B2MMS on 20 September 2019.

Attendance information for the 16^{th} to the 34^{th} B2GMs was obtained from html downloaded from the appropriate "Participant list" from indico.belle2.org or kds.kek.jp/indico.

Shifter information was obtained from html downloaded from the CR Captain and Navigator calendars at shift.belle2.org. I did not attempt to assess the costs and climate impact of BCG and detector expert shifters.

I obtained air fare information from kayak.com for travel between home institutions and Tokyo on 29 September 2019 for travel dates 10-26 October 2019 or on 13 Oct 2019 for travel dates 10-26 November 2019. I acknowledge that these fares may not be representative of costs for earlier or later B2GMs or shifts outside these time periods. These fares are used to estimate the air fare for the round-trip travel of B2GM attendees or CR shifters.

I used the ICAO Carbon Emission Calculator to obtain the estimated CO_2 in kg for round-trip air travel between home institutions and Tokyo in October 2019. The ICAO is the International Civil Aviation Organization of The United Nations. The

Calculator takes into account multi-leg travel between airports using known aircraft fuel consumption and passenger capacities.

I plotted and fitted the CO_2 emission and round-trip travel distance for non- and one-stop air travel from Belle II home institutions to Tokyo as shown in Figure 1. The fit assumes a linear dependence between round-trip air travel distance and CO_2 emission. I used these two parameterizations to estimate the CO_2 emission based on the travel distance from Belle II home institutions to Tokyo.

I assumed all collaborators from Japanese institutions would not use air transportation and assigned no CO_2 emission or air fare costs.

Some B2GM attendees do not appear in B2MMS. For some B2GM attendees, it was not possible to easily and unambiguously match their name to the name of a Belle II collaborator in B2MMS. Lack of an institution name or use of alternative spelling or naming in the B2GM participants complicates matching.

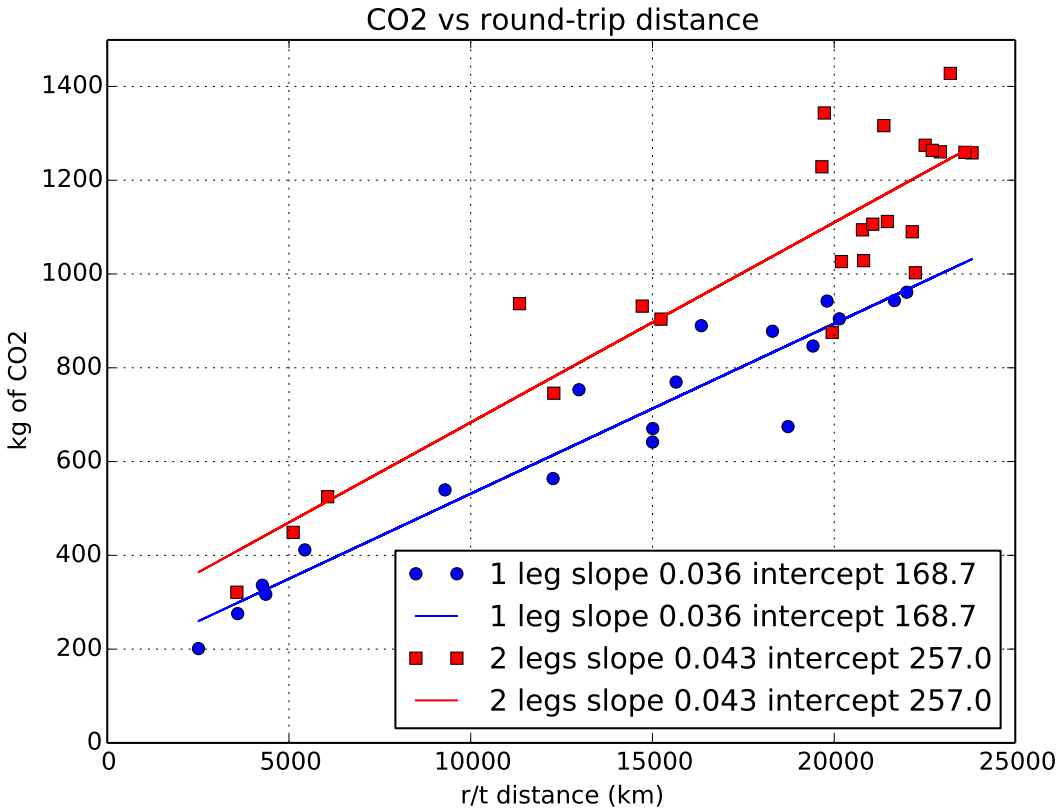

Figure 1: CO_2 in kg *vs.* air travel round-trip distance in km for single-leg (non-stop) and two-leg (one-stop) air travel from Belle II home institutions to Tokyo. The results of linear fits to the two groups are shown.

The statistics for B2GMs are shown in Table 2. In the table, the 'actual totals' are the sum for attendees that are not 'unknown' or 'bad'. The 'estimated totals' scale

the 'actual totals' by the ratio of the 'bad' to 'actual' shifters. The total participants, fares, CO_2 and round-trip distances for the B2GMs are shown in Figures 2, 3, 4 and 5, respectively.

The statistics for CR shifters are shown in Table 2. The totals for shifters, fares, CO_2 and distances are shown in Figures **??**, 7, 8 and 9, respectively. For shifters, the estimated minima assume that each participating shifter only makes one round-trip journey per shift period. The estimated maxima assumes that each participating shifter makes a round-trip journey for each set of non-temporally-contiguous shifts. For example, if Jane Boggs had shifts M-Th for weeks 2, 3 and 4 of the shift period, Jane would be assumed to make three round-trip journeys for the estimated maximum and a single round-trip journey for the estimated minimum.

Participants				Actual totals			Estimated totals			
att	japn	unk	bad	fares(USD)	CO2(kg)	r/t (km)	Fare(USD)	CO2(kg)	r/t (km)	Event
205	43	0	30	163656	112513	2272886	200851	138084	2789451	16th B2GM
181	42	0	28	135180	92396	1845707	169279	115703	2311290	17th B2GM
179	41	0	26	137982	94021	1898363	170014	115848	2339054	18th B2GM
228	49	0	27	183860	126616	2551332	216519	149107	3004530	19th B2GM
181	40	0	19	151449	102653	2061792	175035	118640	2382890	20th B2GM
202	49	0	21	167668	112013	2265797	194342	129833	2626265	21st B2GM
203	46	0	17	183136	120598	2449779	205374	135242	2747253	22nd B2GM
202	49	0	13	171334	115919	2326887	187244	126683	2542955	23rd B2GM
213	51	0	12	182663	128024	2595791	197276	138266	2803454	24th B2GM
219	51	0	12	187494	129222	2606687	201917	139163	2807202	25th B2GM
232	58	0	11	203172	137384	2762283	216883	146655	2948694	26th B2GM
239	61	0	4	204451	141509	2825701	209151	144762	2890659	27th B2GM
243	56	0	5	212197	146643	2915939	218027	150671	2996048	28th B2GM
254	43	0	2	248207	167866	3365543	250582	169472	3397749	29th B2GM
273	59	0	4	254996	175975	3536904	259853	179327	3604274	30th B2GM
247	65	0	1	216261	150633	3022017	217456	151465	3038713	31st B2GM
247	58	0	1	228323	155420	3128826	229537	156247	3145468	32nd B2GM
300	72	0	3	277281	191231	3865529	280978	193780	3917070	33rd B2GM
282	70	0	1	248209	175114	3479166	249385	175944	3495655	34th B2GM
282	64	4	3	252503	174645	3497188	256093	177128	3546911	35th B2GM

Table 1: B2GM statistics. att = Number of attendees, japn = Number of attendees from Japan, unk = could not associate institution with attendee, bad = attendee not in B2MMS. Latter case can arise if name of individual could not be unambiguously or easily matched to a B2MMS entry.

Participants				Est. minimum totals			Est. maximum totals			
att	japn	unk	bad	fares(USD)	CO2(kg)	r/t (km)	Fare(USD)	CO2(kg)	r/t (km)	Event
59	22	0	0	46115	31862	629322	126772	88019	1719704	2019c BCG
55	7	0	0	54082	37137	721596	117673	79641	1549829	2019c CR captain
55	7	0	0	54082	37137	721596	117673	79641	1549829	2019c navigator
19	0	0	0	25968	17752	366310	62853	41827	867943	2020a CR captain
19	1	0	0	24389	16216	341444	61461	39152	830944	2020a CR navigator

Table 2: Shifts statistics. att = Number of shifters, japn = Number of shifters from Japan, unk = could not associate institution with shifter, bad = shifter with unknown institution. Latter cases can arise if individual is not in B2MMS or name of individual could not be unambiguously or easily matched to a B2MMS entry.

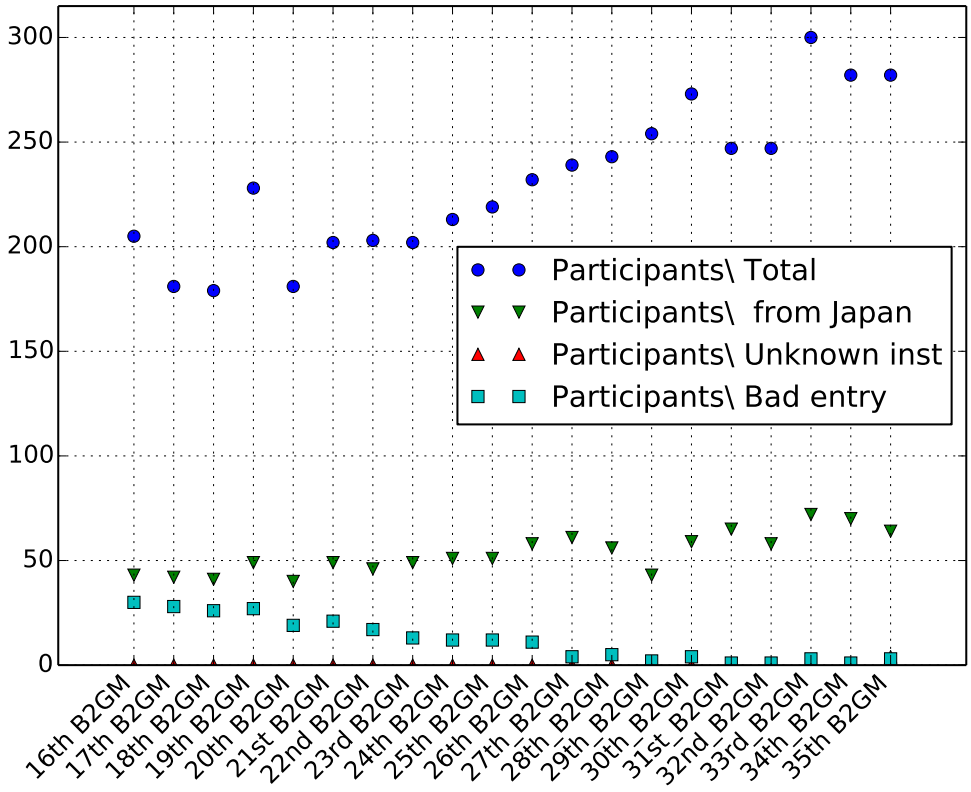

Figure 2: Participants in B2GMs.

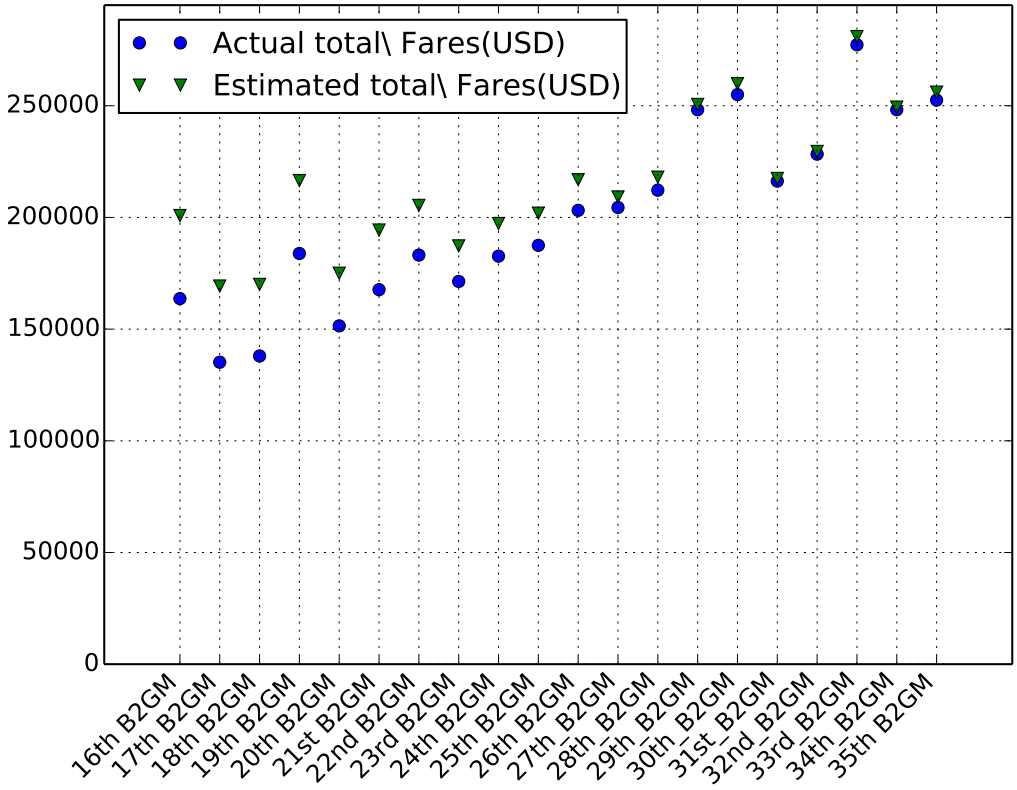

Figure 3: Actual and estimated total airfare in USD for B2GMs. See text for details.

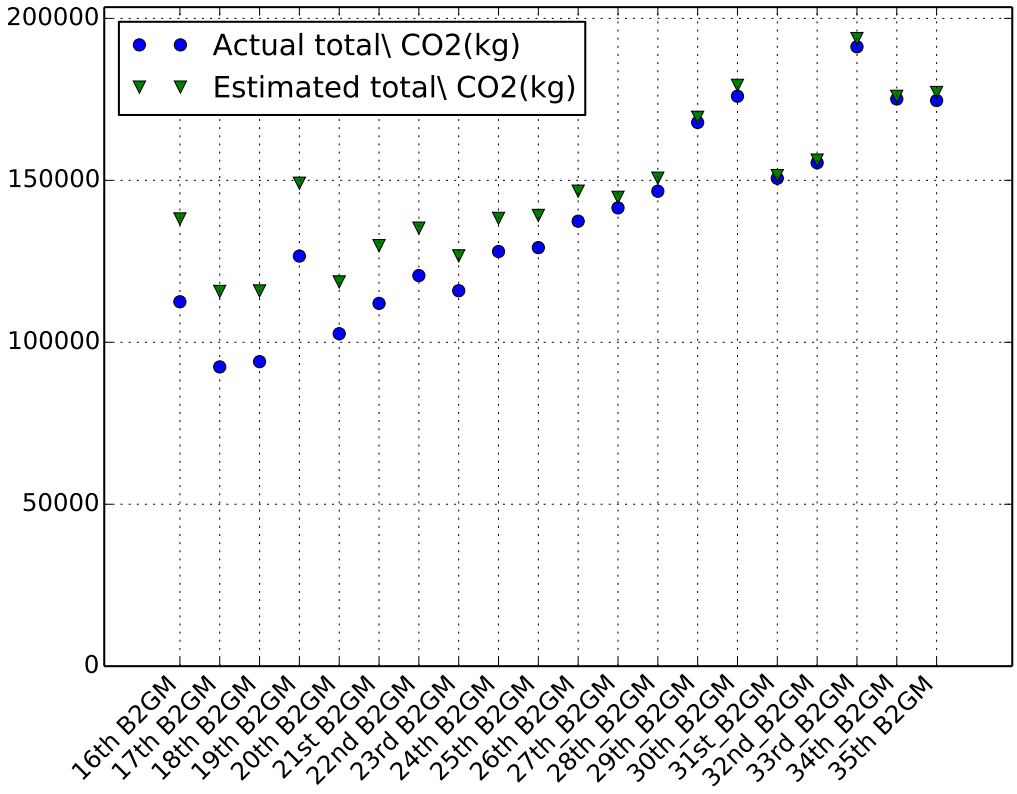

Figure 4: Actual and estimated total CO_2 in kg for B2GMs. See text for details.

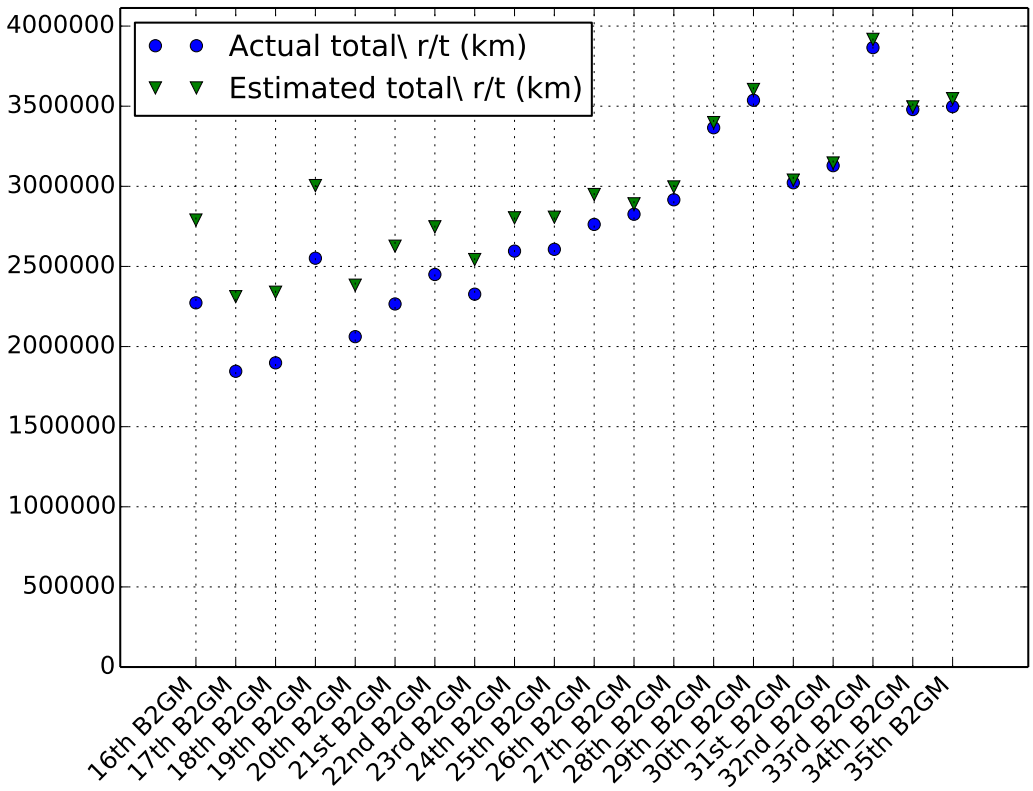

Figure 5: Actual and estimated total round-trip air travel distance for B2GMs. See text for details.

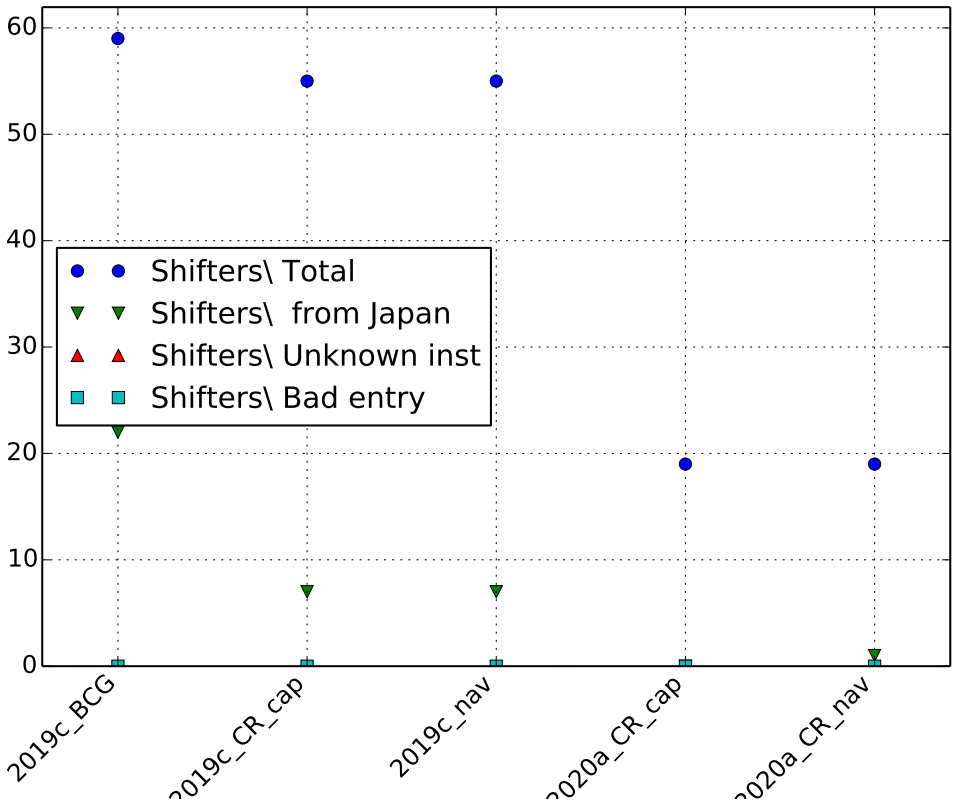

Figure 6: Actual and estimate total shifters for CR shifts. See text for details.

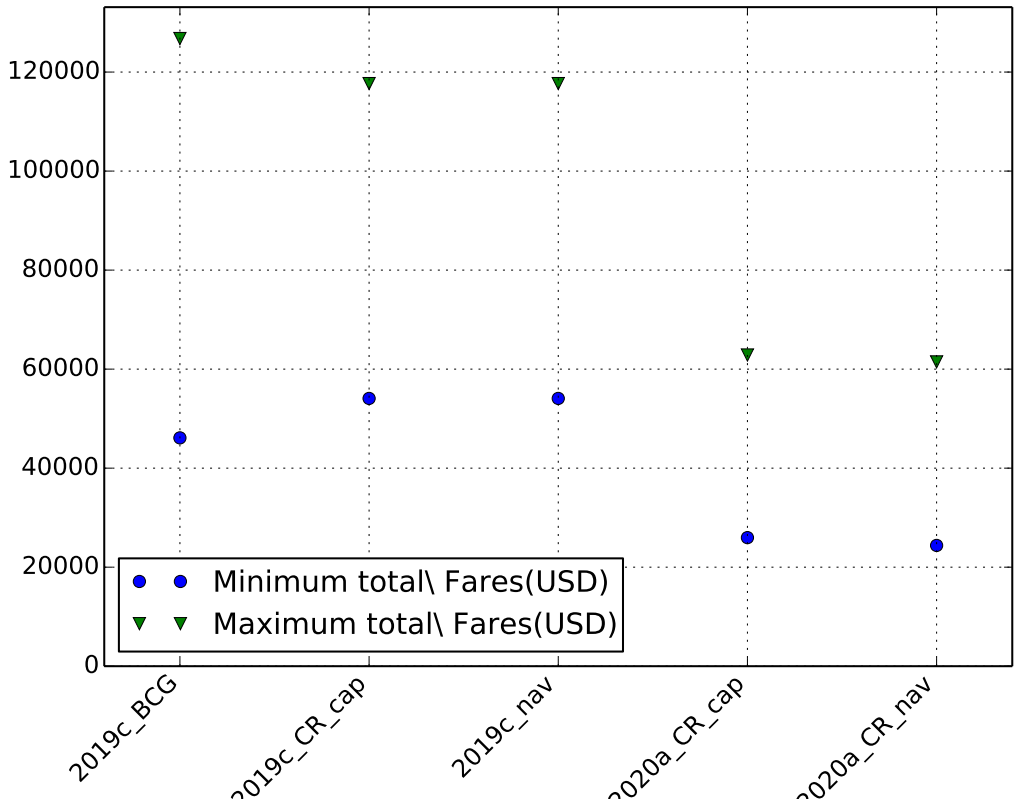

Figure 7: Actual and estimated total airfare in USD for B2GMs. See text for details.

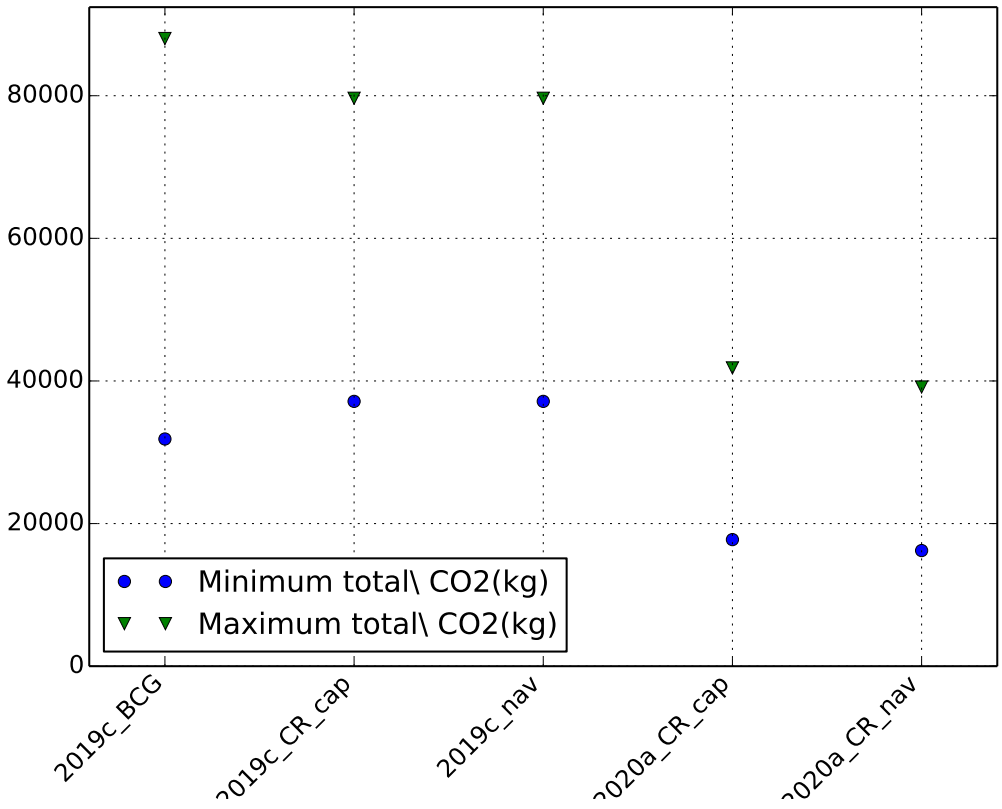

Figure 8: Actual and estimated total CO_2 in kg for B2GMs. See text for details.

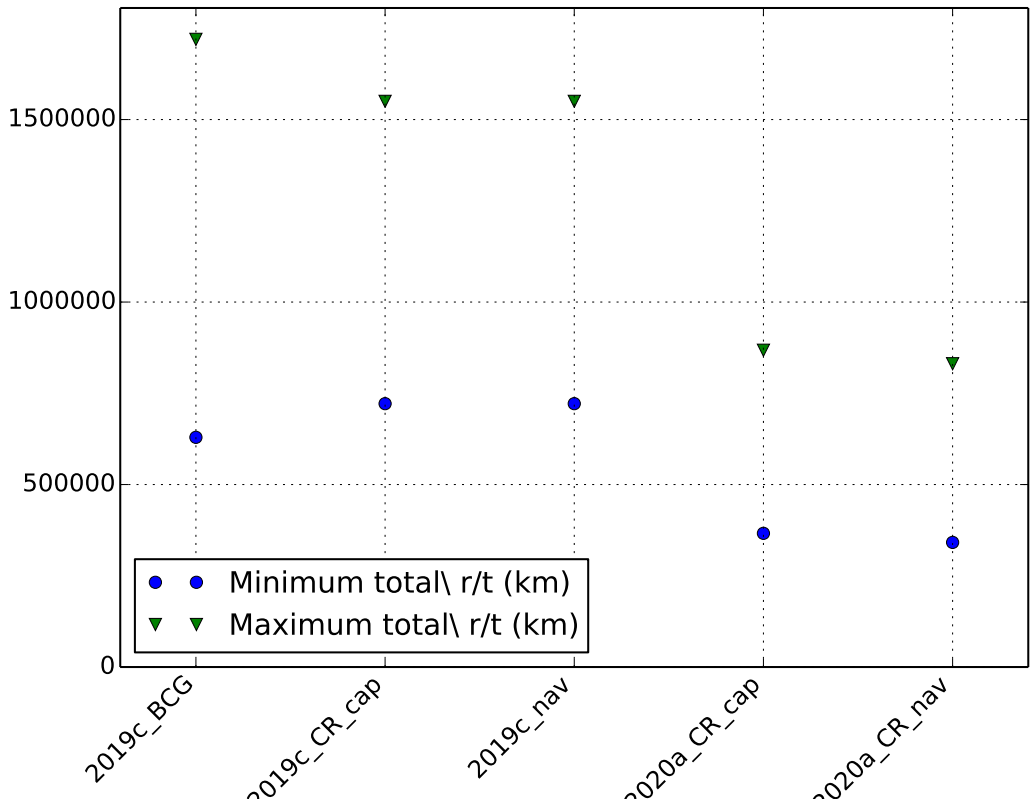

Figure 9: Actual and estimated total round-trip air travel distance for B2GMs. See text for details.