



CO₂ emissions from private flights to the World Economic Forum



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1 Introduction

The annual meeting of the World Economic Forum (WEF) in Davos brings together ‘leaders from government, business, and civil society to address the state of the world and discuss priorities for the year ahead’ (World Economic Forum, 2022b). In 2023, the number of participants is expected to exceed 2,500 (World Economic Forum, 2022a), many of whom will charter private flights to get to the venue.

Private flights have significantly higher emissions per passenger than any other standard mode of transport. According to Transport and Environment, private jets are 5 to 14 times more polluting per passenger than commercial flights, and 50 times more polluting than trains (Transport & Environment, 2021). Some private jets emit two tonnes of CO₂ per hour (Transport & Environment, 2021), while the carbon footprint of inhabitants of the EU-27 was equal to 6.8 tonnes of per person in 2019 (Eurostat, 2022).

This report analyses private flights associated with the WEF 2022, which was held from 22 May, 2022 until 26 May, 2022. It estimates the number of flights, their fuel use and CO₂ emissions during the event.

1.1 Methodology

The basis of the analysis is data on flights to and from airports in the vicinity of Davos. The data have been provided by Cirium¹. The airports are mentioned in Table 1.

Table 1 - All airports in the vicinity of Davos that are known to be used during the WEF

Airport	ICAO	Country
Zurich Airport	LSZH	Switzerland
Geneva Airport	LSGG	Switzerland
Altenrhein Airport	LSZR	Switzerland
Dübendorf Airbase	LSMD	Switzerland
Samedan Airport	LSZS	Switzerland
Friedrichshafen Airport	EDNY	Germany
EuroAirport Swiss	LFSB	France

While the quality of the data is generally good, and all or most private flights are tracked if the aircraft transponder is activated, these data do not show for which purpose a certain flight has been executed. For example, a private flight to Geneva could be used to visit a company in Geneva, go skiing in the Swiss Alps or visit the WEF. In order to estimate the number of flights for the WEF, we have therefore compared the flights in the WEF weeks with the flights in the weeks before and after. The peak during the WEF week was attributed to the WEF. Moreover, we crosschecked flight data in the preceding year to establish that there was no peak in the same period due to other reasons.

We calculated the CO₂ emissions of all flights in the WEF week using the Eurocontrol Small Emitters Tool (latest version at the time of writing, 2021) (Eurocontrol, 2021). In the annex, two tables are included which show the aircraft types that have been taken into account together with how many flights they made in 2022 and 2021.

¹ www.cirium.com/



We assumed that the share of CO₂ emissions and share of flights attributable to the WEF would equal the flights and CO₂ emissions during the timeframe of the WEF minus the flights when there is no WEF. We then calculated the CO₂ emissions for all private jet flights for each timeframe using formulas (Eurocontrol, 2021) that can calculate the CO₂ emissions for every relevant type of aircraft. Finally, we compared the CO₂ emissions to the number of vehicles that would emit the same emissions between a frequently used city-pair for private flights during the WEF.

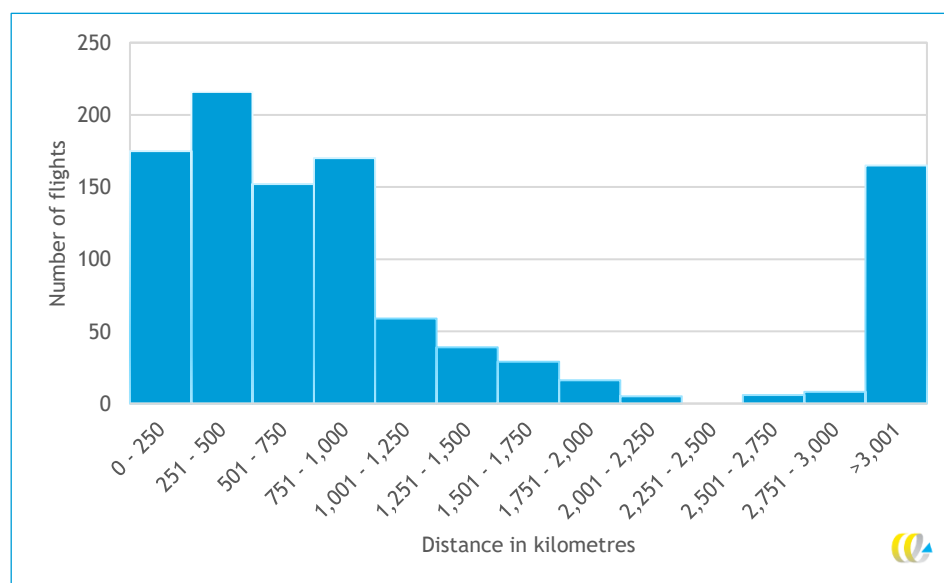
2 Results

In 2022, WEF took place from 22 May, 2022 to 26 May, 2022. During that week (21 May-27 May, 2022), 1,040 private flights arrived at or departed from the selected airports. In the weeks before and after this period, on average 540 flights arrived at or departed from the same airports. Therefore, we attribute 500 flights to the WEF, which is 48% of all private flights during this week.

We also checked the same weeks in 2021, when there was no WEF, and did not find an increase in flights in this week.

The average distance flown in the WEF week (1,650 km) was much higher than during other weeks (870 km). Especially flights over 3,000 km were more frequent in the WEF week, as shown in Figure 1.

Figure 1 - Distance distribution of all flights during the week around the WEF 2022 (21-27 May, 2022)



The emissions of flights to and from the selected airports in the WEF week of 2022 amounted to 9.7 kilotonnes CO₂. 35,000 average cars driving from Paris to Davos (around 750 kilometres), and back would emit approximately the same amount of CO₂.² Since the average emissions during the other weeks amounted to 2.3 kilotonnes, 7.4 kilotonnes CO₂ can be attributed to private flights to the WEF.

² Calculated according to: www.opendata.cbs.nl/statline/#/CBS/nl/dataset/



3 Detailed results

3.1 Number of flights and CO₂ emissions

In Table 2, the number of flights has been calculated for days during the WEF in 2022 (marked in red), as well as for days that are surrounding the WEF.

Table 2 - Private flights during and around the WEF 2022

Date	Flights
14-5-2022	54
15-5-2022	60
16-5-2022	78
17-5-2022	58
18-5-2022	92
19-5-2022	75
20-5-2022	69
21-5-2022	96
22-5-2022	174
23-5-2022	145
24-5-2022	135
25-5-2022	225
26-5-2022	194
27-5-2022	71
28-5-2022	52
29-5-2022	91
30-5-2022	108
31-5-2022	95
1-6-2022	96
2-6-2022	94
3-6-2022	94
4-6-2022	39
5-6-2022	45
Sum	2,240

Table 2 shows a clear peak during the WEF 2022. Just before and just after the WEF, a ‘transition period’ can be distinguished, in which the number of flights is approximately between the high WEF numbers and the lower regular numbers.

Table 3 shows the number of flights, average distances and CO₂ emissions on a weekly basis for 2022.



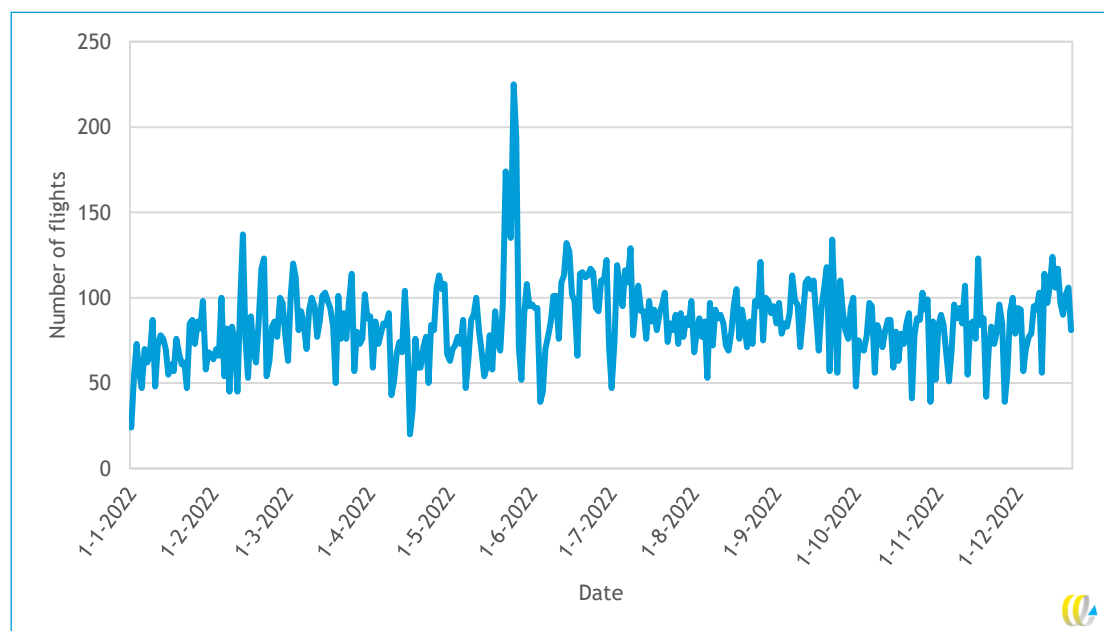
Table 3 - Sum of flights, average distance and total CO₂ emissions during and around the weeks of WEF 2022

Date from	Date until	Sum flights	Average distance (km)	Total CO ₂ emissions (kilotonne)
7-5-2022	13-5-2022	537	875	2.3
14-5-2022	20-5-2022	486	993	2.4
21-5-2022	27-5-2022	1,040	1,646	9.7
28-5-2022	3-6-2022	630	824	2.6
4-6-2022	10-6-2022	519	780	2.0

Table 3 shows a substantial peak in business flights during the WEF 2022 (marked in red), both the number of flights, and the average distance of the flights are twice as high as in other weeks. Therefore the total CO₂ emissions are approximately four times higher than usual.

Figure 2 shows all business and private flights to airports mentioned in the methodology for 2022.

Figure 2 - Business/private flights to/from airports around Davos in 2022



3.2 Flight distances

The peak during the WEF is clearly visible when the flights per day are shown in a line graph. You can see multiple peaks at the end of May 2022 surpassing 200 and almost hitting 250 flights a day, which are in line with when the WEF was hosted in 2022. In the remainder of the year, the number of daily flights is between 50 and 100 flights per day most of the time and rarely exceeds 100 flights a day.

We have already noticed that during the WEF, the average distance is higher than during the surrounding weeks. For 2022, until 21 December, the average distance per flight is 897 km. This is almost half the average during the WEF, which was 1,646. Figure 3 shows the distribution of distances of all the flights in 2022 until 21 December.



Figure 4 shows the distribution of distances of all the flights during the week of the WEF 2022. Figure 4 shows for each distance category how many flights have been executed and what percentage of total that is for 2022 until 21 December. Figure 5 shows the absolute and percentual number of flights for each distance category for the timeframe of WEF 2022.

Figure 3 - Distance distribution of all flights in 2022 until 21 December

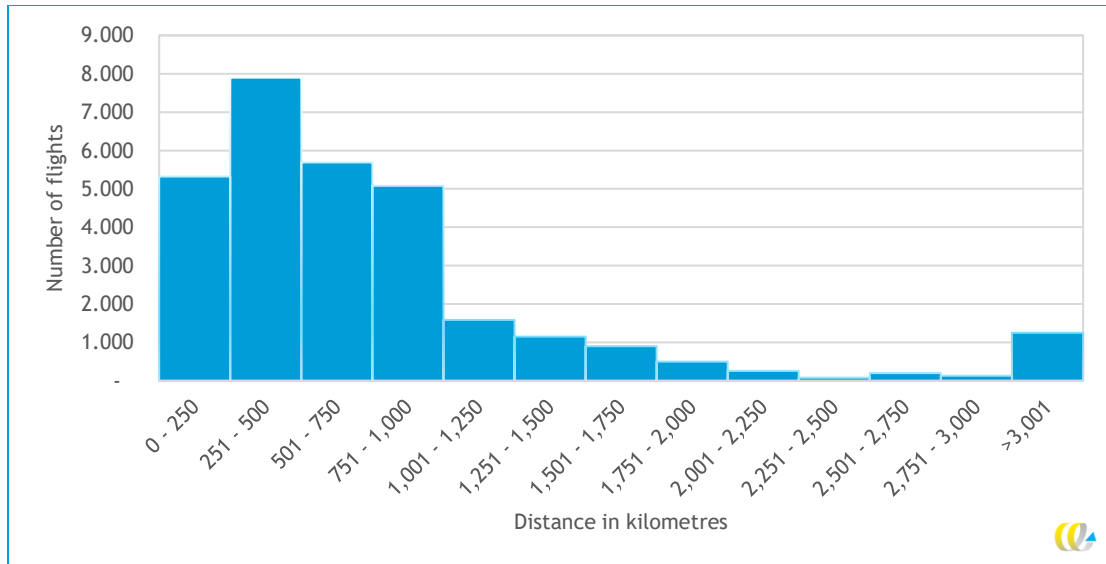


Figure 4 - Distance distribution of all flights during WEF 2022 (21-27 May 2022)

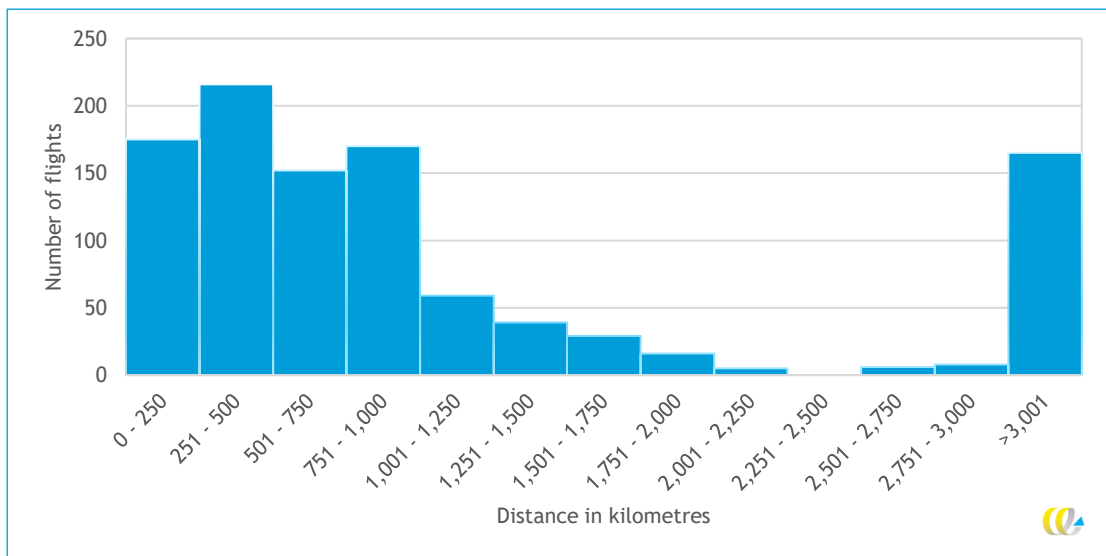


Table 4 - Sum and percentage of total of each distance category for 2022 until 21 December

Distance	Sum	Percentage
0-250	5,322	18%
251-500	7,898	26%
501-750	5,691	19%
751-1,000	5,079	17%
1,001-1,250	1,586	5%
1,251-1,500	1,146	4%
1,501-1,750	901	3%
1,751-2,000	502	2%
2,001-2,250	255	1%
2,251-2,500	81	0%
2,501-2,750	203	1%
2,751-3,000	135	0%
> 3,001	1,246	4%
Sum	30,045	100%

Table 5 - Sum and percentage of total of each distance category for the timeframe during and just around WEF 2022 (21 - 27 May 2022)

Distance	Sum	Percentage
0-250	175	17%
251-500	216	21%
501-750	152	15%
751-1,000	170	16%
1,001-1,250	59	6%
1,251-1,500	39	4%
1,501-1,750	29	3%
1,751-2,000	16	2%
2,001-2,250	5	0%
2,251-2,500	0	0%
2,501-2,750	6	1%
2,751-3,000	8	1%
> 3,001	165	16%
Sum	1,040	100%

The pattern of distance distribution is similar for the year. The only large difference is that during the WEF 2022, the percentage of flights > 3,001 becomes a lot higher (16% compared to 4%). Because the WEF is considered as an event of international importance, many attendees travel long distances. Compared to the weeks before and after the WEF, the percentage of flights between 0 and 250 kilometres is around 17-18%.



Table 6 - Ultra-short haul flights within the timeframe of the WEF 2022 split out per 50 km and country pairs

0-50 km	Flights (0-50 km)	51-100 km	Flights (51-100 km)	101-150 km	Flights (101-150 km)	151-200 km	Flights (151-200 km)	201-250 km	Flights (201-250 km)
Switzerland-Switzerland	2	Switzerland-Switzerland	22	Switzerland-Germany	10	Germany-Germany	2	Italy-Switzerland	22
Germany-Switzerland	1	Germany-Switzerland	13	Germany-Switzerland	8	Switzerland-Germany	4	Switzerland - Switzerland	19
		Switzerland-France	12	France-Switzerland	1	Switzerland-Switzerland	3	Switzerland -Italy	18
		France-Switzerland	11	Italy-Switzerland	1	Germany-Switzerland	3	Switzerland -Germany	6
		Switzerland-Germany	6	France-Germany	1			Germany-Switzerland	3
				Switzerland-Switzerland	1			Switzerland -Austria	1
				Switzerland-Austria	1			Italy-Germany	1
				Germany-Germany	1			Germany-Italy	1
								Germany-Germany	1
Sum	3	Sum	64	Sum	24	Sum	12	Sum	72

Table 6 shows that among the ultra-short haul flights, most flights are between 201-250 km and between 51-100 km. Not all airport pairs include Switzerland, because two airports that are used to attend the WEF in Davos are located just across the border of Switzerland (Germany and France). It is interesting to see that a substantial amount of the ultra-short haul flights consist of national Swiss flights. These ultra-short haul flights, especially the large group of flights between 51-100 km, could have been substituted by car or train without a big loss of time occurring (however, the data do not show whether the flights had passengers on board or were repositioning flights). In Annex A, a table is included that shows for each country pair how many flights have been executed between 21 and 27 May 2022, the week of the WEF 2022. In Annex A, tables and figures for 2021 have also been included. A possible comparison between 2021 and 2022 should take into account that 2021 is a COVID-19 year, which make these two years difficult and questionable to compare.

4 Literature

Eurocontrol, 2021. Small emitters tool (SET) - 2021

Eurostat, 2022. *Greenhouse gas emission statistics - carbon footprints*, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Greenhouse_gas_emission_statistics_-_carbon_footprints#:~:text=The%20total%20carbon%20footprint%20of,2%20per%20person%20in%202019.&text=In%202019%2C%20EU%2D27%20emitted,by%20importing%20goods%20and%20services.

Transport & Environment, 2021. *Private jets: can the super-rich supercharge zero-emission aviation?*



World Economic Forum, 2022a. *Annual Meeting Davos 2023*, <https://www.weforum.org/agenda/2022/11/annual-meeting-davos-2023/>.

World Economic Forum, 2022b. *World Economic Forum Annual Meeting “Cooperation in a Fragmented World” 16-20 January 2023*, <https://www.weforum.org/events/world-economic-forum-annual-meeting-2023>.

A Annex

Table 7 - All country pairs private jets flew on during the week around the WEF 2022

Country Pair	Sum
Austria-Switzerland	14
Belgium-Germany	2
Belgium-Switzerland	3
Brazil-Germany	1
Bulgaria-Switzerland	1
Canada-Germany	1
Canada-Switzerland	2
Cape Verde-Switzerland	1
Cayman Islands-Switzerland	1
Croatia-Germany	1
Croatia-Switzerland	3
Czech Republic-Switzerland	5
Denmark-Germany	2
Denmark-Switzerland	5
Egypt-Switzerland	1
Estonia-Switzerland	2
Finland-Switzerland	2
France-Germany	5
France-Switzerland	79
Georgia-Switzerland	1
Germany-Angola	1
Germany-Belgium	3
Germany-Canada	1
Germany-Denmark	1
Germany-France	5
Germany-Germany	23
Germany-Greece	1
Germany-Ireland	2
Germany-Italy	5
Germany-Netherlands	1
Germany-Poland	1
Germany-Slovenia	1
Germany-Spain and Canary Islands	3
Germany-Switzerland	59
Germany-Turkey	1
Germany-United Kingdom	4
Germany-United States	7
Ghana-Switzerland	1
Greece-Germany	1
Greece-Switzerland	5



Country Pair	Sum
Hungary-Switzerland	4
India-Switzerland	1
Ireland-Switzerland	6
Israel-Germany	1
Israel-Switzerland	1
Italy-Germany	4
Italy-Switzerland	53
Kuwait-Switzerland	1
Luxembourg-Switzerland	1
North Macedonia-Switzerland	1
Malta-Switzerland	1
Montenegro-Switzerland	1
Morocco-Switzerland	1
Namibia-Switzerland	1
Netherlands-Switzerland	8
Nigeria-Switzerland	3
Poland-Germany	2
Poland-Switzerland	6
Portugal-Switzerland	4
Republic of Serbia-Switzerland	3
Romania-Switzerland	2
Rwanda-Switzerland	1
Saudi Arabia-Germany	1
Saudi Arabia-Switzerland	1
Singapore-Germany	1
Slovakia-Switzerland	2
Slovenia-Germany	1
Slovenia-Switzerland	1
Spain and Canary Islands-Germany	2
Spain and Canary Islands-Switzerland	18
Sweden-Switzerland	2
Switzerland-Antigua and Barbuda	1
Switzerland-Austria	12
Switzerland-Azerbaijan	1
Switzerland-Belgium	7
Switzerland-Bosnia and Herzegovina	1
Switzerland-Brazil	1
Switzerland-Bulgaria	2
Switzerland-Canada	2
Switzerland-Cayman Islands	1
Switzerland-Croatia	2
Switzerland-Cyprus	1
Switzerland-Czech Republic	7
Switzerland-Denmark	7
Switzerland-Egypt	1
Switzerland-Equatorial Guinea	1
Switzerland-Estonia	2
Switzerland-Finland	1
Switzerland-France	80
Switzerland-Georgia	2



Country Pair	Sum
Switzerland-Germany	62
Switzerland-Greece	8
Switzerland-Hungary	4
Switzerland-Iceland	1
Switzerland-India	2
Switzerland-Indonesia	1
Switzerland-Iraq	1
Switzerland-Ireland	7
Switzerland-Israel	3
Switzerland-Italy	54
Switzerland-Kuwait	1
Switzerland-North Macedonia	2
Switzerland-Malaysia	1
Switzerland-Malta	1
Switzerland-Montenegro	1
Switzerland-Morocco	1
Switzerland-Netherlands	5
Switzerland-Norway	4
Switzerland-Oman	1
Switzerland-Poland	9
Switzerland-Portugal	12
Switzerland-Qatar	1
Switzerland-South Korea	1
Switzerland-Serbia	3
Switzerland-Romania	2
Switzerland-Saudi Arabia	1
Switzerland-Senegal	1
Switzerland-Slovakia	1
Switzerland-Slovenia	1
Switzerland-South Africa	1
Switzerland-Spain and Canary Islands	31
Switzerland-Sweden	6
Switzerland-Switzerland	49
Switzerland-Turkey	4
Switzerland-United Arab Emirates	7
Switzerland-United Kingdom	49
Switzerland-United States	43
Thailand-Switzerland	1
The Democratic Republic of The Congo-Switzerland	1
Turkey-Germany	2
Turkey-Switzerland	5
United Arab Emirates-Germany	1
United Arab Emirates-Switzerland	8
United Kingdom-Germany	7
United Kingdom-Switzerland	48
United States-Germany	7
United States-Switzerland	51
United States-United States	1
Uzbekistan-Switzerland	1



Figure 5 - Business/private flights to/from airports around Davos in 2021 without a WEF

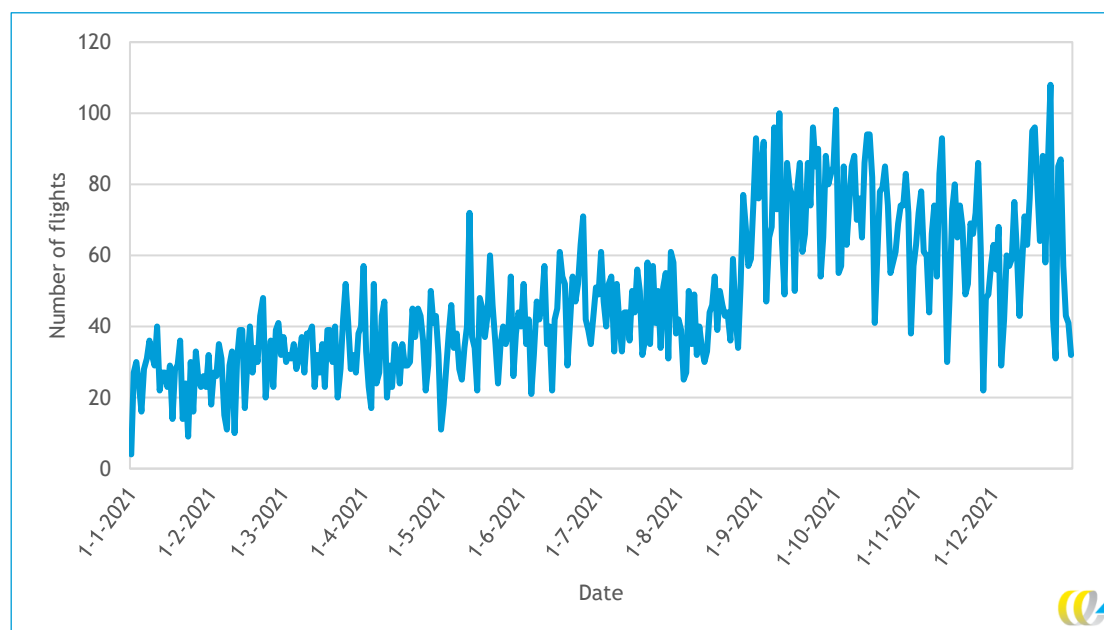


Table 8 - Sum of flights, average distance and total CO₂ emissions for the same weeks as we analysed for 2022 (as there was no WEF in 2021)

Date from	Date until	Sum flights	Average distance (km)	Total CO ₂ emissions (kilotonne)
7-5-2021	13-5-2021	274	1,039	1.4
14-5-2021	20-5-2021	289	807	1.2
21-5-2021	27-5-2021	253	777	0.9
28-5-2021	3-6-2021	289	892	1.3
4-6-2021	10-6-2021	287	779	1.0

Table 9 - Private flights for the same days in 2021 as were analysed in 2022 (as there was no WEF in 2021)

Date	Flights
14-5-2021	34
15-5-2021	22
16-5-2021	48
17-5-2021	45
18-5-2021	37
19-5-2021	43
20-5-2021	60
21-5-2021	46
22-5-2021	35
23-5-2021	24
24-5-2021	35
25-5-2021	40
26-5-2021	35
27-5-2021	38



Date	Flights
28-5-2021	54
29-5-2021	26
30-5-2021	38
31-5-2021	44
1-6-2021	40
2-6-2021	52
3-6-2021	35
4-6-2021	42
5-6-2021	21
Sum	894

Table 10 - Number of aircraft per aircraft type that flew to/from the included airports mentioned in Table 1
in 2022 (Source: Cirium data)

Aircraft type	ICAO Code	Sum
Cessna-Citation Excel / XLS (C56X)	C56X	3,176
Embraer-Phenom 300 (E55P)	E55P	2,937
Pilatus PC-12 (PC12)	PC12	2,428
Bombardier-Challenger 600/601/604/605/650 (CL60)	CL60	2,401
Cessna-Citation Latitude (C68A)	C68A	1,660
Cessna-Citation CJ2 (C25A)	C25A	1,429
Bombardier-Global Express/6000/6500 (GLEX)	GLEX	1,382
Bombardier-Challenger 350 (CL35)	CL35	1,322
Cessna-Citation Mustang (C510)	C510	1,307
Dassault-Falcon 2000 (F2TH)	F2TH	1,123
Pilatus PC-24 (PC24)	PC24	933
Cessna-Citation Sovereign (C680)	C680	813
Embraer-Phenom 100 (E50P)	E50P	783
Dassault-Falcon 7X (FA7X)	FA7X	721
Cessna-Citation CJ3 (C25B)	C25B	666
Cessna-Citation CJ1 / CitationJet / 525 (C525)	C525	658
Embraer-Legacy 600 / 650 (E35L)	E35L	612
Hawker-Premier 1 / Hawker 200 (PRM1)	PRM1	573
Gulfstream-GV/500/550 (GLF5)	GLF5	483
Gulfstream-G600/650 (GLF6)	GLF6	380
Cirrus-SF-50 Vision (SF50)	SF50	357
PIPER PA-46-500TP Malibu Meridian (P46T)	P46T	356
King Air 200 (BE20)	BE20	333
Dassault-Falcon 900 (F900)	F900	319
Cessna-Citation CJ4 (C25C)	C25C	305
Bombardier-Challenger 300 (CL30)	CL30	269
Eclipse-Eclipse 500 (EA50)	EA50	261
Embraer-Legacy 450 / Praetor 500 (E545)	E545	247
Dassault-Falcon 8X (FA8X)	FA8X	245
Bombardier-Challenger 800/850 (CRJ2)	CRJ2	221
Bombardier-Global 7000 / 7500 (GL7T)	GL7T	217
Bombardier-Global 5000 / 5500 (GL5T)	GL5T	205



Aircraft type	ICAO Code	Sum
Hawker Beechjet 400/400A /Nextant (BE40)	BE40	196
Gulfstream G300/350/400/450 (GLF4)	GLF4	190
Socata-TBM-900 (TBM9, only TBM in in SET)	TBM9	178
HondaJet (HDJT)	HDJT	176
Hawker-Hawker 700/750/800/850/900 (H25B)	H25B	174
King Air 350 (B350)	B350	163
Piaggio-P-180 Avanti (P180)	P180	161
Gulfstream-G280 (G280)	G280	140
Piper-Malibu Meridian (PA46)	PA46	140
Embraer-Legacy 500 / Praetor 600 (E550)	E550	126
Cessna 208 Caravan (C208)	C208	117
King Air 90 (BE9L)	BE9L	98
Socata-TBM-850 (TBM8, only TBM in in SET)	TBM8	93
Learjet 45 (LJ45)	LJ45	88
Learjet 60 (LJ60)	LJ60	78
Cessna-560 Encore / 5 / Ultra (C560)	C560	71
Learjet 75 (LJ75)	LJ75	61
Gulfstream-G200 / Galaxy (GALX)	GALX	60
Airbus A319 (A319)	A319	59
Learjet 35/36 (LJ35)	LJ35	59
Learjet 31 (LJ31)	LJ31	55
Cessna-Citation 3 / 6 / 7 (C650)	C650	46
Embraer-ERJ-190 / Lineage 1000 (E190)	E190	43
Cessna-Citation X / 10 (C750)	C750	40
Cessna-Citation 1SP (C501)	C501	39
Dassault-Falcon 50 (FA50)	FA50	39
Boeing 737-700 (B737)	B737	38
Socata-TBM-700 (TBM7, only TBM in in SET)	TBM7	38
Piper-Cheyenne 2 (PAY2)	PAY2	37
Learjet 40 (LJ40)	LJ40	29
Dassault-Falcon 20 /200 (FA20)	FA20	23
Gulfstream-G100 / Astra (ASTR)	ASTR	22
Hawker-4000 / Horizon (HA4T)	HA4T	21
King Air 300 (BE30)	BE30	20
Boeing 737-800 (B738)	B738	18
Cessna-Conquest 1 (C425)	C425	15
Gulfstream-G150 (G150)	G150	13
Cessna-Citation II / 2 / S2 (C550)	C550	12
Airbus A320 (A320)	A320	9
QUEST-Kodiak (KODI)	KODI	9
Learjet 55 (LJ55)	LJ55	7
Airbus A318 (A318)	A318	6
Cessna-Citation / 1 (C500)	C500	3
Airbus A330-200 (A332)	A332	2
Cheyenne Piper 400	PAY4	1
Dassault-Falcon 10 / 100 (FA10)	FA10	0

