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1) Background

CD13.57 contains information requests from LADACAN and responses from Wood concerning *inter alia* raw noise measurement data used by Bickerdike Allen.

CD8.49 contains the disclosed raw noise measurement data in the form of a number of spreadsheets, some containing over 100,000 entries.

CD13.57 includes LADACAN's request for Bickerdike Allen worksheets which filter and pre-process the raw data before it is used to calibrate the contour model.

The worksheets are the intellectual property of Bickerdike Allen and were not disclosed, so further detailed enquiries were made to establish the methodology.

Understanding precisely how Bickerdike Allen validated and pre-processed the data was necessary to identify the data sub-set used to derive the results in the ES.

LADACAN has combined the pre-processing information from 7 Jul 2022 in CD13.23, additional information from 8 Aug 2022 in CD13.57, and the new information from APP-W1.4 issued to us on 21 Sep 2022 which updated a response in CD31.57, to create a pre-processing methodology designed to match the specifications.

The LADACAN pre-processing methodology is intended to select the same subset of raw data as selected by Bickerdike Allen, perform the same de-duplication and data corrections where errors are identified and can be corrected, including the information in APP-W1.4 regarding the need to correct the aircraft type errors.

The LADACAN methodology has been validated by applying it to the disclosed raw data to filter it, select the validated sub-set and correct the designation errors (including the significant number of instances in 2018 when aircraft registrations did not tally with aircraft type, as indicated in APP-W1.4).

SEL averages were calculated for the individual fixed noise monitors NMT01-NMT03. To produce combined averages across the monitors, the method described by Bickerdike Allen on PDF p3 of CD13.16 and CD13.17 was used so that a comparison could be made with averages produced by BAP.

The SEL averages derived by the LADACAN methodology agree exactly with the most up-to-date 2018 averages quoted by Bickerdike Allen in report A11060-N67¹ in all but one instance, where the A321ceo arrival SEL average differs by a negligible 0.1dB.

The sample sizes and averages for 2019 agree with the Bickerdike Allen data in Table 1 of CD4.09 (PDF p4); the averages also agree with in Table 2 (PDF p5) and the sample sizes for Table 2 agree except in three cases where they differ by a negligible 2 samples out of multiple thousands.

The averages for 2018 agree with 2018 figures quoted by Bickerdike Allen in CD13.16 (PDF p3) once the later updates in A11060-N67 are taken into account.

Averages calculated using the LADACAN methodology agree with the clarification SEL averages listed by Wood in CD4.09 for 2015-2018 in the majority of cases: only five values out of 16 differ by just 0.1dB SEL (0.1%).

The validations confirm that the LADACAN methodology to isolate a valid subset of noise measurement data for further processing materially accords with that used by Bickerdike Allen, and that the combination-averaging methodology employed by Bickerdike Allen can be reproduced to give the same results.

¹ CD1.17 "Addendum_to_cd110_es_figures_and_appendices.pdf", Wood, Jul 2022

2) Raw data provided for each measurement

The screenshots below taken from the start of spreadsheet “NMT results - 2019 Q1.xlsx” from CD8.49 show the data items typically provided² for each raw noise measurement exported from the NTK system, which has correlated the timed noise data from the various monitors with radar and scheduling data about flights.

	Noise Events											
	NMT	NMT-ID	TLASmax	TTotal [s]	LASmax	SEL	Distance [m]	Altitude [ft]	ATA/ATD	A/D	Runway	Flight
6	NMT01	1	01/01/2019 02:45:45	19	68.1	78.7	300	1295	01/01/2019 02:47:00	Arrival	26	MVI 123
7	NMT02	2	01/01/2019 02:56:04	32	67.5	82	1041	3579	01/01/2019 02:54:00	Departure	26	SIG 266
8	NMT01	1	01/01/2019 04:15:10	43	77.3	87.7	304	1334	01/01/2019 04:16:00	Arrival	26	BCS 2218
9	NMT02	2	01/01/2019 05:35:15	32	70.7	83	1004	3384	01/01/2019 05:34:00	Departure	26	BCS 2130
10	NMT03	3	01/01/2019 06:03:41	17	73.2	84.2	1059	2487	01/01/2019 06:02:00	Departure	26	WUK 8122
11	NMT02	2	01/01/2019 06:03:41	24	74.3	84.2	705	2584	01/01/2019 06:02:00	Departure	26	WUK 8122

SID/STAR	Airline	Airline (Name)	From/To	Aircraft Type	Registration
AWY26	MVI	Metro Business Aviation	LLBG	GLEX	MANGO
OLY1B	SIG		EGCC	BE40	OKBII
AWY26	BCS	European Air Transport	EDDP	B752	GDHKN
MAT2Y	BCS	European Air Transport	EDDP	B752	GDHKN
MAT2Y	WUK		EYKA	A320	GWUKE
MAT2Y	WUK		EYKA	A320	GWUKE

SID/STAR: the local route flown by the flight

Airline and Airline (Name): the abbreviation and full name of the airline operating the flight

From/To: the International Civil Aviation Organisation code of the origin or destination airport

Aircraft type: make/type of aircraft (A=Airbus, B=Boeing, A20N=A320neo, A21N=A321neo)

Registration: the registration code unique to a particular aircraft (similar to a car registration)

Explanation of the headings used in the data columns

NMT: the name of a particular noise monitoring location

NMT-ID: the ID code of the particular noise monitor

TLAS_{max}: the time of the peak of the noise for a given flight

TTotal [s]: the duration in seconds of the SEL information

LASmax: peak dB(A) noise value of the flight at the NMT location

SEL: total sound energy of the flight at the NMT location

Distance [m]: spatial distance from the aircraft to the monitor

Altitude [ft]: the altitude of the aircraft at the peak noise value

ATA/ATD: airport time of the flight arrival or departure

A/D: indication of whether the flight is an Arrival or Departure

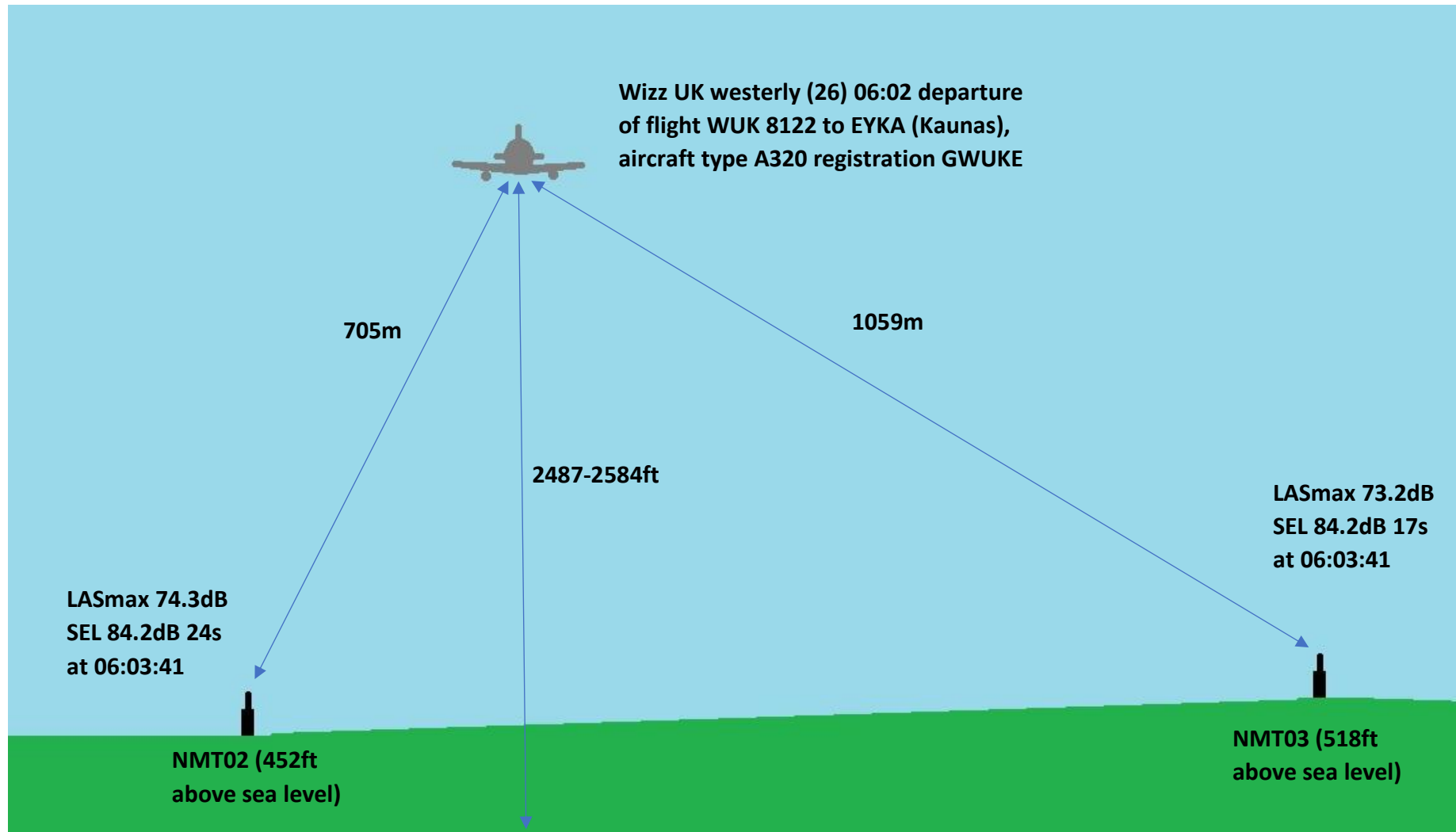
Runway: the runway operations direction (26: flights take-off and land towards the west, 08: towards the east)

Flight: The airline's schedule code for a particular flight

² As indicated in CD13.57, altitude data was not available in the information exported from the NTK system prior to 2017; also some spreadsheets have different column headings

3) Data in the context of flights and monitors

The diagram below (not to scale) serves to illustrate how the parameters of the noise measurement data relate to the aircraft and the monitoring locations NMT02 and NMT03 for Wizz UK flight WUK 8122 (westerly departure from runway 26) shown in rows 10 and 11 of the spreadsheet above, as an example.

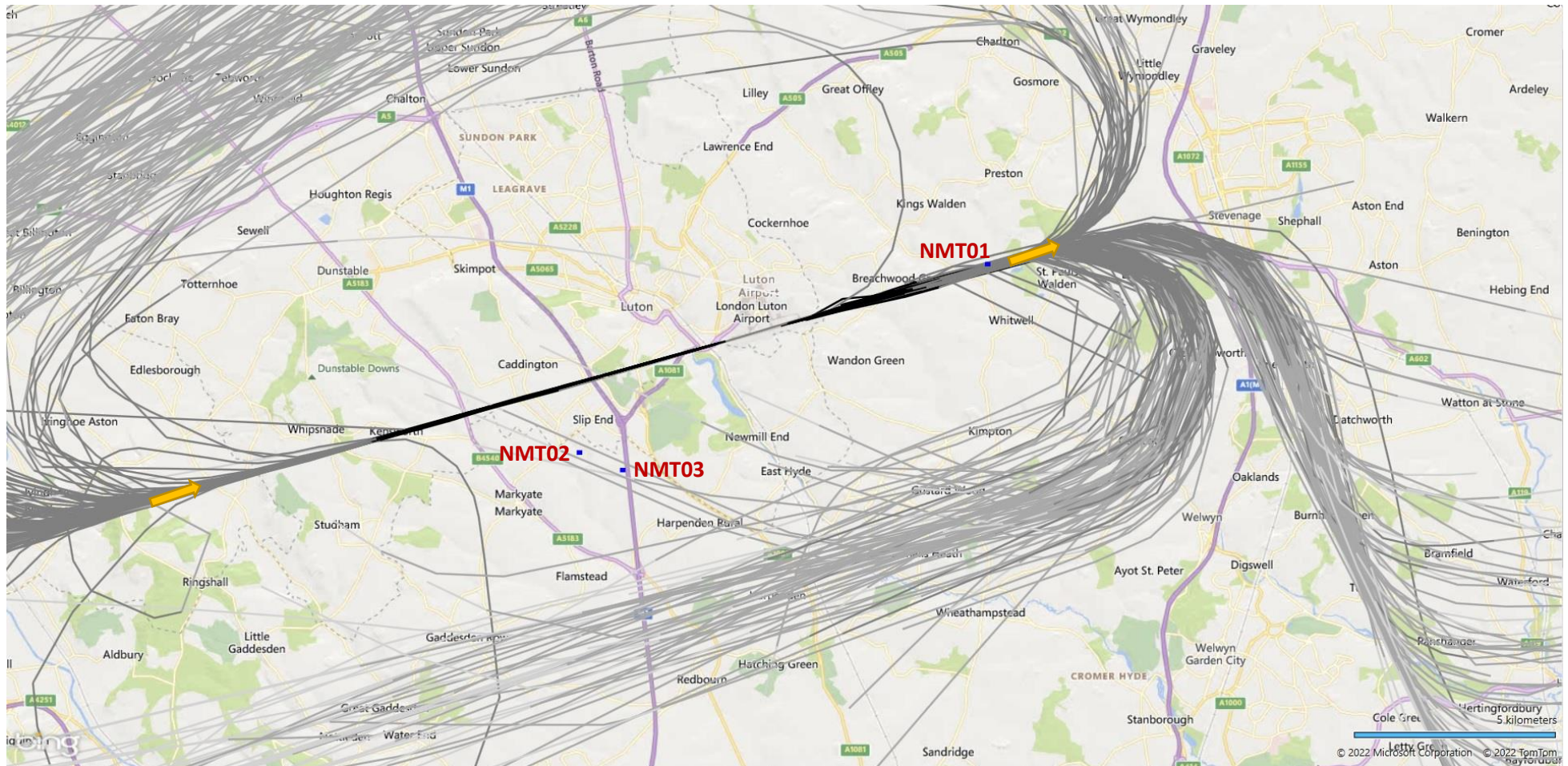


4) Flights and monitors in the context of the locality

4.1 Easterly operations – runway 08

Aircraft take off and land heading east. Arrivals are sequenced by air traffic control over an area to the north and west of the airport, turning and lining up for final approach over Whipsnade, Kensworth, Caddington and South Luton. Departures climb over Breachwood Green and St Paul's Walden, splitting according to route.

Fixed noise monitor NMT01 monitors runway 08 departures; runway 08 arrivals do not have a fixed noise monitor. NMT02/NMT03 provide little information.

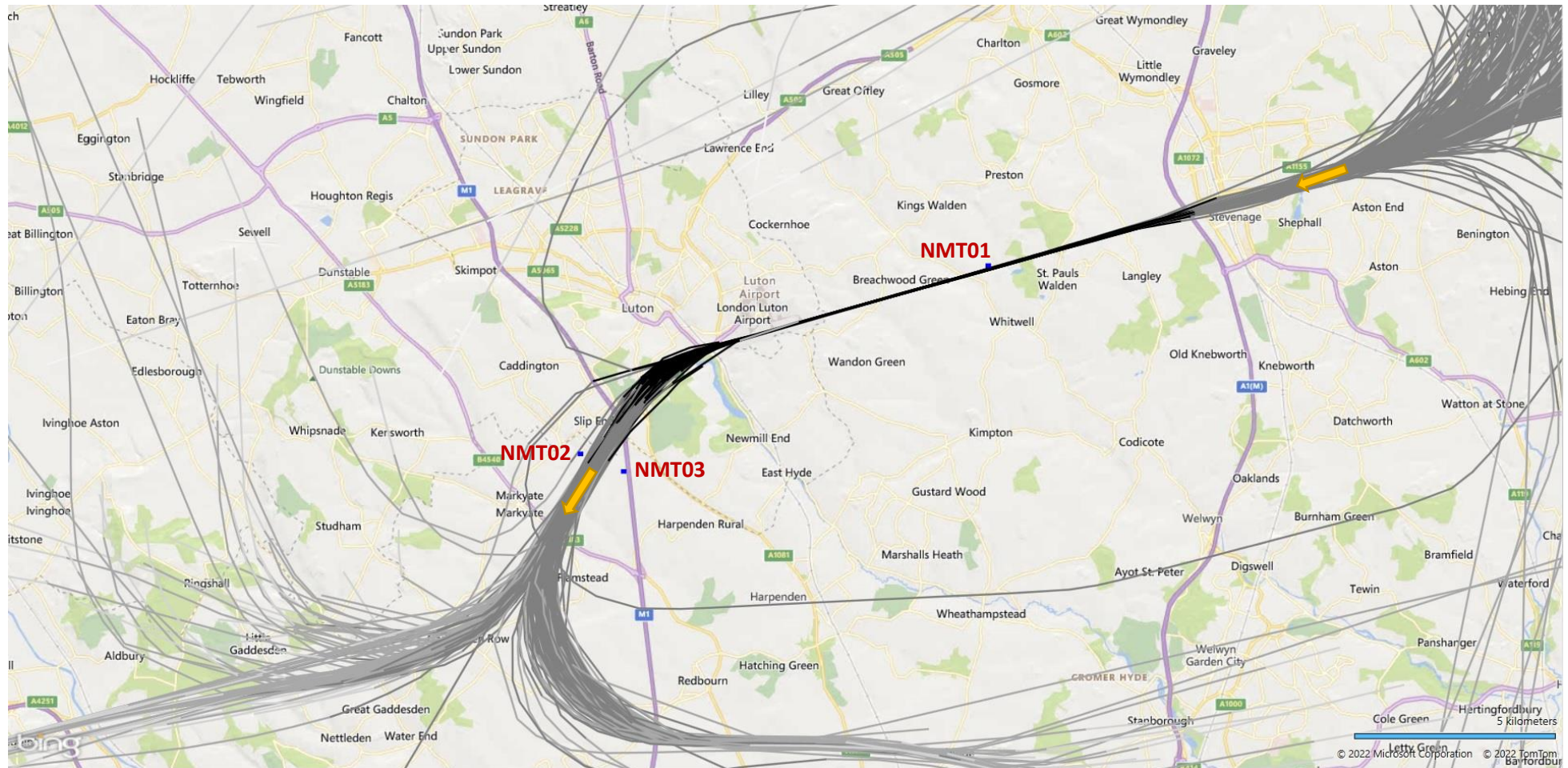


(Flight track data for 20 September 2019, obtained under licence from FlightRadar24; map information copyright © Microsoft 2022 and © TomTom 2022)

4.2 Westerly operations – runway 26

Aircraft take off and land heading west. Arrivals are sequenced by air traffic control over an area to the north and east of the airport, turning and lining up for final approach over Stevenage, St Paul's Walden and Breachwood Green. Departures climb over South Luton, Slip End, pass between Markyate and Flamstead and then split according to route.

Fixed noise monitor NMT01 monitors runway 26 arrivals; runway 26 departures typically pass between noise monitors NMT02 and NMT03.

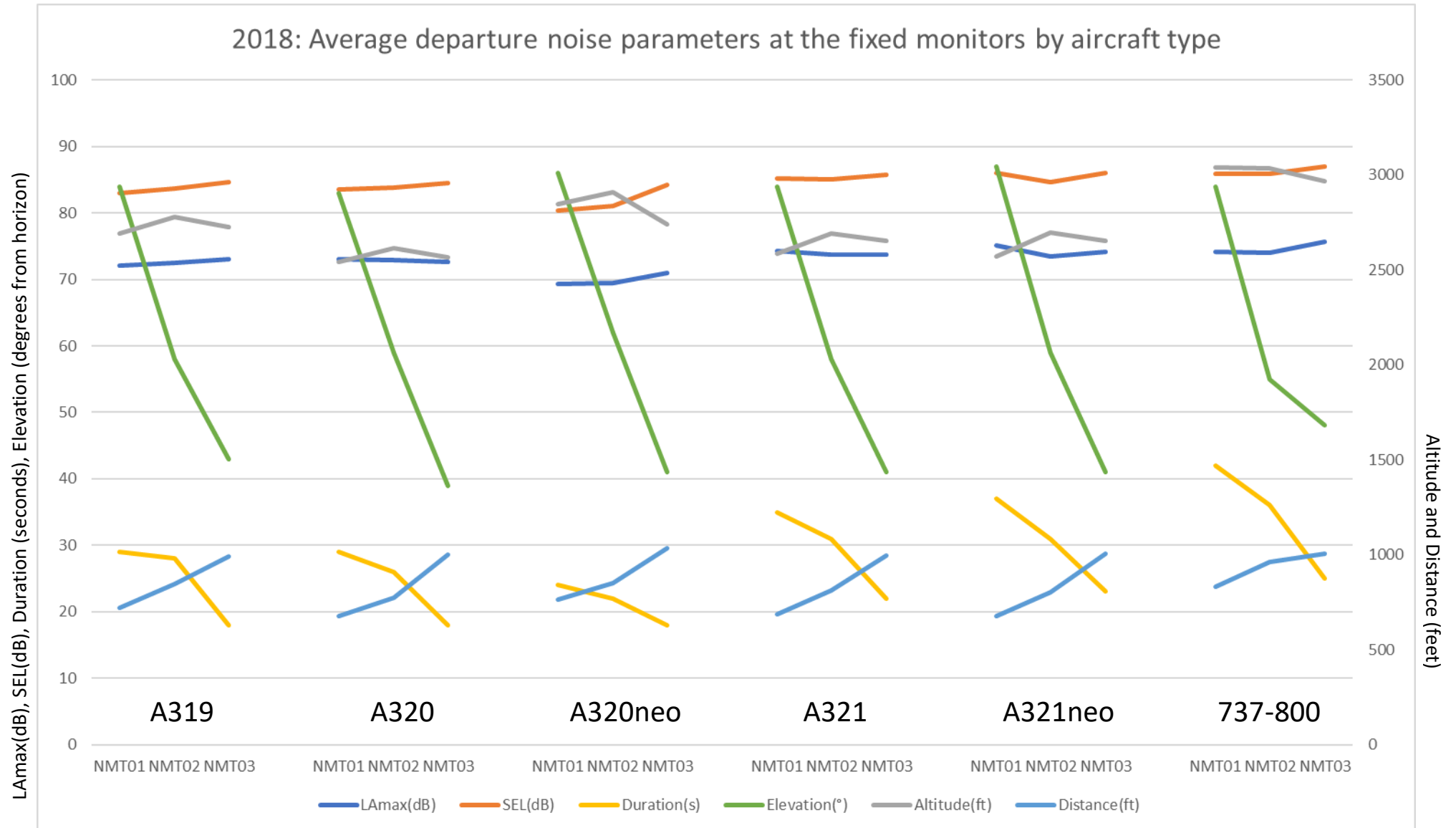


(Flight track data for 2 September 2019, obtained under licence from FlightRadar24; map information copyright © Microsoft 2022 and © TomTom 2022)

5) Noise monitoring data averages for main aircraft types

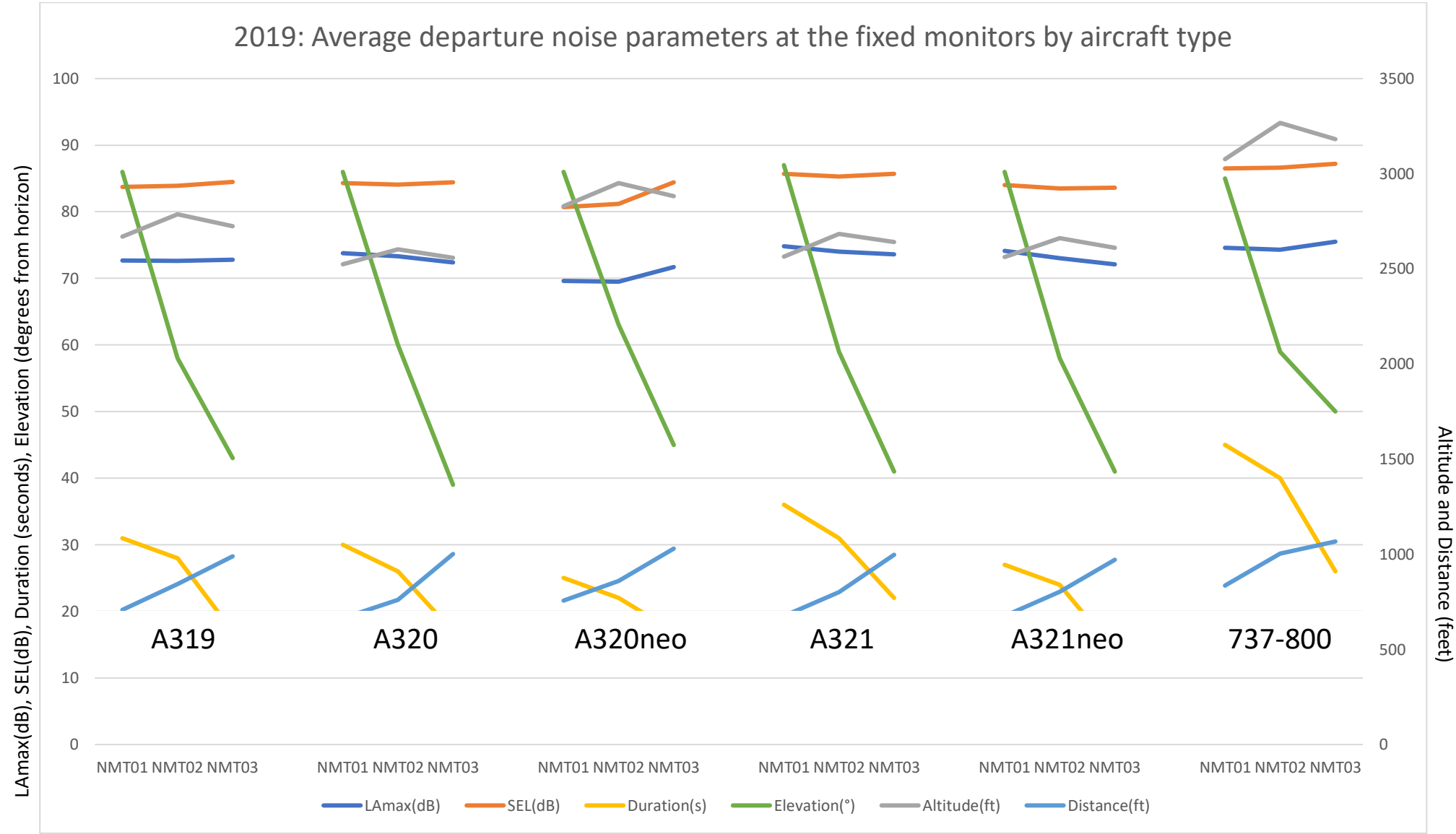
5.1 Chart of 2018 averages

(Derived using "NMT01 (2018).xlsx", "NMT02 (2018).xlsx" and "NMT03 (2018).xlsx" from CD8.49)



5.1 Chart of 2019 averages

(Derived using “NMT results - 2019 Q1.xlsx”, “NMT results - 2019 Q1.xlsx”, “BAP Noise results - 2019 Q3.xlsx” and “Noise Events - 2019 Q4.xlsx” from CD8.49)



5.3 Numerical values of 2018 averages

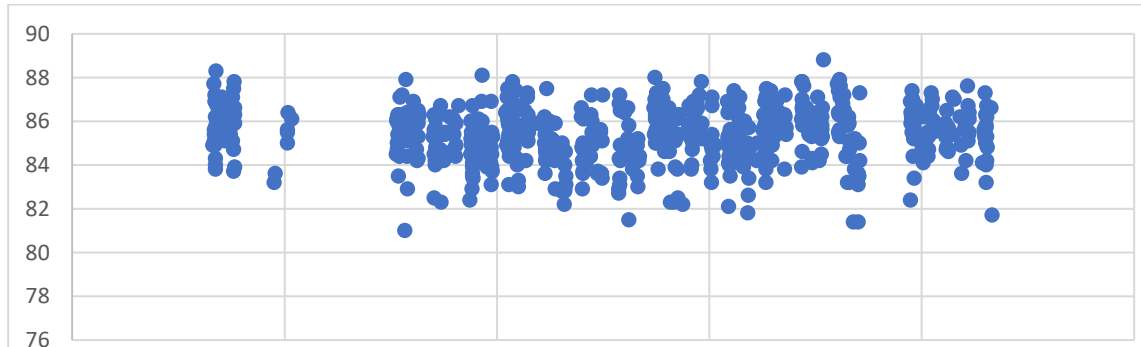
Aircraft	RwyAD	Monitor	LMax(dB)	SEL(dB)	Altitude(ft)	Duration(s)	Distance(ft)	Elevation(°)	BAP Ave*
A319	08D	NMT01	72.1	83	2690	29	722	84	83.6
A319	26D	NMT02	72.5	83.7	2777	28	844	58	
A319	26D	NMT03	73	84.6	2725	18	993	43	
A320	08D	NMT01	73.1	83.6	2544	29	678	83	83.9
A320	26D	NMT02	72.9	83.8	2613	26	773	59	
A320	26D	NMT03	72.7	84.5	2566	18	999	39	
A20N	08D	NMT01	69.3	80.4	2846	24	762	86	81.5
A20N	26D	NMT02	69.5	81.1	2909	22	853	62	
A20N	26D	NMT03	71	84.2	2741	18	1034	41	
A321	08D	NMT01	74.3	85.2	2584	35	687	84	85.3
A321	26D	NMT02	73.8	85.1	2691	31	811	58	
A321	26D	NMT03	73.8	85.8	2652	22	995	41	
A21N	08D	NMT01	75.1	86	2570	37	675	87	85.7
A21N	26D	NMT02	73.4	84.7	2697	31	804	59	
A21N	26D	NMT03	74.1	86.1	2653	23	1004	41	
B738	08D	NMT01	74.2	85.9	3038	42	829	84	86.2
B738	26D	NMT02	74	85.9	3036	36	963	55	
B738	26D	NMT03	75.7	87	2968	25	1003	48	
A319	26A	NMT01	74.9	84.7	1308	30	301	80	84.7
A320	26A	NMT01	74.4	84.4	1308	30	301	80	84.4
A20N	26A	NMT01	73.2	83.6	1318	30	298	83	83.6
A321	26A	NMT01	74.4	84.3	1293	30	299	78	84.3
A21N	26A	NMT01	74.5	84.3	1291	30	288	84	84.3
B738	26A	NMT01	75.9	85.7	1304	33	300	80	85.7

5.4 Numerical values of 2019 averages

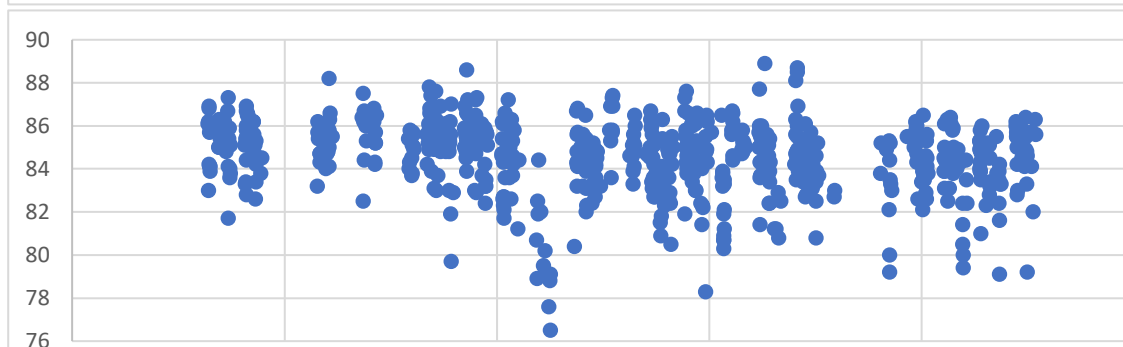
Aircraft	RwyAD	Monitor	LAmaz(dB)	SEL(dB)	Altitude(ft)	Duration(s)	Distance(ft)	Elevation(°)	BAP Ave*
A319	08D	NMT01	72.7	83.7	2669	31	708	86	84.0
A319	26D	NMT02	72.6	83.9	2787	28	843	58	
A319	26D	NMT03	72.8	84.5	2724	17	989	43	
A320	08D	NMT01	73.8	84.3	2524	30	664	86	84.3
A320	26D	NMT02	73.3	84.1	2602	26	760	60	
A320	26D	NMT03	72.4	84.4	2557	17	1001	39	
A20N	08D	NMT01	69.6	80.7	2830	25	756	86	81.8
A20N	26D	NMT02	69.5	81.2	2950	22	860	63	
A20N	26D	NMT03	71.7	84.4	2882	17	1029	45	
A321	08D	NMT01	74.8	85.7	2565	36	675	87	85.6
A321	26D	NMT02	74	85.3	2684	31	800	59	
A321	26D	NMT03	73.6	85.7	2641	22	997	41	
A21N	08D	NMT01	74.1	84	2563	27	676	86	83.8
A21N	26D	NMT02	73	83.5	2662	24	802	58	
A21N	26D	NMT03	72.1	83.6	2610	14	970	41	
B738	08D	NMT01	74.6	86.5	3077	45	835	85	86.7
B738	26D	NMT02	74.3	86.6	3267	40	1004	59	
B738	26D	NMT03	75.5	87.2	3182	26	1067	50	
A319	26A	NMT01	75.2	85.1	1306	31	293	84	85.1
A320	26A	NMT01	74.8	84.8	1308	31	294	84	84.8
A20N	26A	NMT01	73.6	84.1	1316	30	294	85	84.1
A321	26A	NMT01	74.7	84.6	1290	30	288	84	84.6
A21N	26A	NMT01	74.9	84.8	1321	30	296	85	84.8
B738	26A	NMT01	76.2	86.0	1309	34	294	84	86.0

6) A320ceo departure noise values at NMT02 before, during and after South Luton noise monitoring Dec 2014-Jan 2015

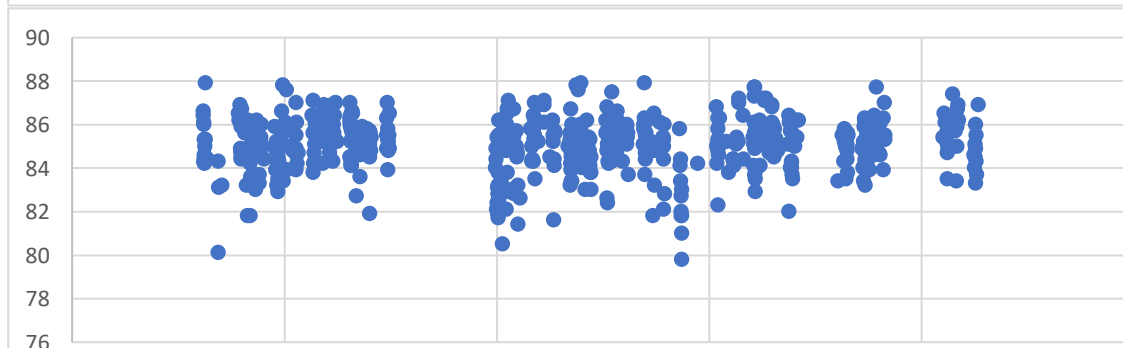
SEL values of individual validated A320 noise measurements at NMT02 for runway 26 departures during consecutive 3-week periods scatter-plotted against time (CD8.49 "Airbus A320ceo NMT Data 2014-2017.xlsx").



Vertical axis: SEL dB(A) for each validated noise measurement
Horizontal axis: time of event over period 30 Nov-22 Dec 2014
(Periods of time with no values correspond to easterly flights)
Average of SEL values during this 3-week period: **85.4db(A)**



Vertical axis: SEL dB(A) for each validated noise measurement
Horizontal axis: time of event over period 23 Dec 2014-14 Jan 2015
(Periods of time with no values correspond to easterly flights)
Average of SEL values during this 3-week period: **84.5db(A)**



Vertical axis: SEL dB(A) for each validated noise measurement
Horizontal axis: time of event over period 15 Jan-6 Feb 2015
(Periods of time with no values correspond to easterly flights)
Average of SEL values during this 3-week period: **85.1db(A)**

7) A320ceo long-term departure SEL yearly averages at NMT01 and NMT02 by airline, 2014-2019

Yearly averages of A320ceo departure SEL values from NMT01 (easterly) and NMT02 (westerly) plotted separately for easyJet and Wizz, with % of overall samples.

