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Noise Contours around Brussels Airport

for the year 2021

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for the year 2021

Report

Brussels Airport Company

Brussels National Airport 1C

1930 Zaventem, Belgium

To70 België B.V.

Haag 74

3930 Hamont-Achel, Belgium

tel. +32 470 11 79 28

Email: info@to70.be

By:

Kjeld Vinkx – Recognised expert for environment, noise and vibration

Benyamin De Leeuw

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1 Introduction

1.1 Background

The Government imposes an obligation on Brussels Airport Company to annually calculate noise contours in order to perform an assessment of the noise impact caused by departing and landing aircraft on the area surrounding the airport. For Brussels Airport, these calculations are imposed in the Environmental Legislation (VLAREM).

These noise contours are calculated according to a strictly-defined methodology (see §1.3) and reflect evolutions in the number of movements and fleet changes, as well as the actual use of runways and flight paths. Weather conditions and other events in the year affect this actual use.

To check their accuracy of the calculations, the noise contours are compared with the sound measurements at a number of locations around the airport.

Between 1996 and 2014, these contours were calculated by the Acoustics and Thermal Physics Laboratory of the Belgian university KU Leuven. This assignment was carried out by the WAVES research group of the Ghent University (UGent) between 2015 and 2020. From 2021, these calculations have been carried out by To70. The calculations are commissioned by the airport operator, Brussels Airport Company.

1.2 Disclaimer

This assignment is performed by recognised sound experts working at To70 with the explicit assignment to submit a report in compliance with the legal obligations imposed on Brussels Airport Company pertaining to the applicable legislation. The recognised sound experts at To70 are responsible for the conformity of this result, but are not responsible for the quality and comprehensiveness of the raw data provided to them.

This report contains no information, judgement or opinion about the applicable (environmental) legislation at federal or regional level, and is not suitable to be used for this purpose.

1.3 Compulsory calculations

In accordance with the VLAREM environmental legislation, the operator of an airport categorised as class 1[1] must have the following noise contours calculated annually:

- L_{den} noise contours of 55, 60, 65, 70 and 75 dB(A) to show noise impact over 24 hours, and to determine the number of people who are potentially seriously inconvenienced;
- L_{day} noise contours of 55, 60, 65, 70 and 75 dB(A) to show noise impact during the day from 07:00 to 19:00;
- $L_{evening}$ noise contours of 50, 55, 60, 65, 70 and 75 dB(A) to show noise impact during the evening from 19:00 to 23:00;
- L_{night} noise contours of 45, 50, 55, 60, 65 and 70 dB(A) to show noise impact at night from 23:00 to 07:00;

[1] Class 1 airports: airports that meet the definition of the Chicago Convention of 1944 on the establishing of the International Civil Aviation Organisation, and having a take-off and arrival runway of at least 800 metres;

The VLAREM environmental legislation stipulates that the noise contours are calculated using a calculation model that is compatible with the methodology, as stated in ECAC Doc. 29, 3rd edition (2005) or a later edition. On 7 December 2016, the 4th edition of ECAC Doc. 29 was adopted. The 4th edition is thus decisive for the method of calculation.

Supplementary to the VLAREM obligations, the environmental permit of Brussels Airport Company imposes extra noise contour calculations for:

- L_{den} and L_{night} noise contours, such as are required by the present VLAREM obligation;
- Frequency contours for 70 dB(A) and 60 dB(A). As in preceding years, Brussels Airport Company asked To70 to discuss the following frequency contours:
    - Frequency contours for 70 dB(A) during the daytime period (07:00 to 23:00) with frequencies 5x, 10x, 20x, 50x and 100x
    - Frequency contours for 70 dB(A) at night (07:00 to 23:00) with frequencies 1x, 5x, 10x, 20x and 50x
    - Frequency contours for 60 dB(A) during the daytime period (07:00 to 23:00) with frequencies 50x, 100x, 150x, and 200x
    - Frequency contours for 60 dB(A) at night (23:00 to 07:00) with frequencies 10x, 15x, 20x, and 30x

The number of people who are potentially seriously inconvenienced within the various L_{den} contour zones must be determined on the basis of the dose-response relationship laid down in VLAREM.

The noise zones must be shown on a 1/25 000 scale map.

1.4 History of noise contours

The annual calculation of noise contours started in 1996. Until VLAREM was amended to comply with the European guideline on environmental noise in 2005, the following division of the operational day was used (day: 06:00 – 23:00; night: 23:00 – 06:00). Since VLAREM was adjusted in accordance with the guideline, the official noise contour reports are calculated according to the breakdown of the day in the guideline (day: 07:00 – 19:00; evening: 19:00 – 23:00; night: 23:00 – 07:00).

Since 2011 the INM 7 model (sub-version INM 7.0b) has been used for the calculation of the noise contours. Model version 6.0c was used for the officially-reported noise contours every year from 2000 to 2010. Because the model used and the related aircraft database have an impact on the calculation of the noise contours, the noise contours for the year 2000 and from 2006 to 2010 were recalculated using version 7.0b[2]. In this way, it is possible to assess the evolution of the noise contours since 2000 without being influenced by the calculation model used.

[2] With regard to the frequency contours of 60 and 70 dB(A), only the year 2010 was calculated with version 7.0b of the INM calculation model.

From the beginning of 2021, the calculations are made with the Echo calculation model, developed by AerLabs B.V. With Echo, the calculations are performed according to the methodology stated in ECAC Doc. 29 4th edition. In addition to this, changes have been implemented with respect to previous annual calculations in the data used and the entry data in the calculations. These changes are explained in more detail in chapter 3. The impact of the new calculation method has been mapped by mapping the sound contours for 2021 according to the calculation method applied in 2020.

1.5 Noise calculation model: Echo

From this year, the calculation of the noise contours is performed with the Echo noise calculation model. Echo is configured according to the specifications of ECAC Doc. 29, 4th edition (2016). Echo has been verified on the basis of the verification framework of ECAC Doc. 29, 4th edition, Volume 3. Echo makes use of ANP database version 2.3.

This software meets the conditions stated in Vlarem: "The noise contours are calculated using a calculation model that is compatible with the methodology, as stated in ECAC Doc. 29, 3rd edition (2005) or a later edition." The software also meets the European directive for ambient noise 2002/49/EG.

1.6 Population data

The most recent population data available is used to determine the number of residents living inside the contour zones and the number of people who are potentially seriously inconvenienced. For the calculation of the exposure figures in this report use is made of the population data on 1 January 2022. By using the population data on 1 January 2022 instead of those on 1 January 2021, the analysis takes into account the general increase in the number of people living in the vicinity of the airport. In the reporting about 2020, the population data on 1 January 2020 were adopted. Thus the development in the number of people living within the contour areas and those who are potentially highly inconvenienced are the consequence of the developments in the population in a 2 year period.

In the past, the exposed population was determined on the basis of a homogeneous distribution of the number of residents over the surface area of the statistical sector. From 2017, the calculation method was refined, whereby the actual location of the address points were included. Based on the address files in the Brussels-Capital Region and Flanders, in combination with the population information per statistic sector, the number of persons is calculated for each address location. This is done by uniformly distributing the number of persons per statistic sector over the number of address locations. In Flanders, address locations on business estates were excluded, unless there are several address locations in a statistical sector on business estates.

1.7 Source data

For the calculation of the noise contours, and in order to be able to compare the results against those of the noise monitoring network, Brussels Airport Company has made source data available. A comprehensive summary of these source data carrying references to the corresponding files has been included in 0.

2 Definitions

2.1 Explanation of a few frequently-used terms

2.1.1 Noise contours

As a result of flight traffic, noise impact is either observed or calculated for every point around the airport. Due to a difference in distance from the noise source, these values may vary sharply from one point to another. Noise contours are isolines or lines of equal noise impact. These lines connect together points where equal noise impact is observed or calculated.

The noise contours with the highest values are those situated closer to the noise source. Farther away from the noise source, the value of the noise contours is lower.

2.1.2 Frequency contours

The acoustic impact of overflight by an aircraft can be characterised at every point around the airport by, for example, the maximum noise level observed during overflight. This maximum noise level can be determined, for example, as the maximum of the equivalent sound pressure levels over 1 second ($L_{Aeq,1s,max}$) during this overflight.

The number of times that the maximum sound pressure level exceeds a particular value can be calculated for the passage of all aircraft overflights during a year. The number of times on average that this value is exceeded each day is the excess frequency. Frequency contours connect locations where this number is equal.

2.1.3 Noise zones

A noise zone is the zone delimited by two successive noise contours. The noise zone 60-65 dB(A) is, for example, the zone delimited by the noise contours of 60 and 65 dB(A).

2.1.4 The A-weighted equivalent sound pressure level $L_{Aeq,T}$

The noise caused by overflying aircraft is not a constant noise, but has the characteristic of rising sharply to a maximum level and thereafter declining sharply again. Noise impact at a specific place resulting from fluctuating sounds over a period is represented by the A-weighted equivalent sound pressure level $L_{Aeq,T}$.

The A-weighted equivalent sound pressure level $L_{Aeq,T}$, over a period T, is the sound pressure level of the constant sound containing the same acoustic energy in that same period as the fluctuating sound. The unit for an A-weighted equivalent sound pressure level is the dB(A).

The designation A-weighted (index A) means that an A-filter is used to determine the sound pressure levels. This filter reflects the pitch sensitivity of the human ear. Sounds at frequencies to which the ear is sensitive are weighted more than sounds at frequencies to which our hearing is less sensitive. Internationally, A-weighting is accepted as the standard measurement for determining noise impact around airports. This A-weighting is also applied in the VLAREM legislation on airports.

Three types of $L_{Aeq,T}$ contours are calculated in this report, namely:

- L_{day}: the A-weighted equivalent sound pressure level for the daytime period, defined as the period between 07:00 and 19:00
- $L_{evening}$: the A-weighted equivalent sound pressure level for the evening period, defined as the period between 19:00 and 23:00
- L_{night}: the A-weighted equivalent sound pressure level for the night period, defined as the period between 23:00 and 07:00

2.1.5 L_{den}

The European directive on the control and assessment of environmental noise (transposed in VLAREM II), recommends using the L_{den} parameter to determine the exposure to noise over a longer period. The L_{den} (**L**evel **D**ay-**E**vening-**N**ight) is the A-weighted equivalent sound pressure level over 24 hours, with a (penalty) correction of 5 dB(A) applied for noise during the evening period (equivalent to an increase of the number of evening flights by a factor of 3.16), and 10 dB(A) during the night (equivalent to an increase of the number of night flights by a factor of 10). For the calculation of the L_{den} noise contours, the day is divided as per section 57 of VLAREM II, with the evening period from 19:00 to 23:00 and the night period from 23:00 to 07:00. L_{den} is the weighted energetic sum of these three periods with a weighting according to the number of hours for each period (12 hours for the day, 4 hours for the evening, and 8 hours for the night).

2.2 Link between annoyance and noise impact

An exposure relationship is imposed by VLAREM II to determine the number of people who are potentially seriously inconvenienced within the L_{den} noise contour of 55 dB(A). This equation shows the percentage of the population that is potentially seriously inconvenienced by the noise impact expressed in L_{den} (Figure).

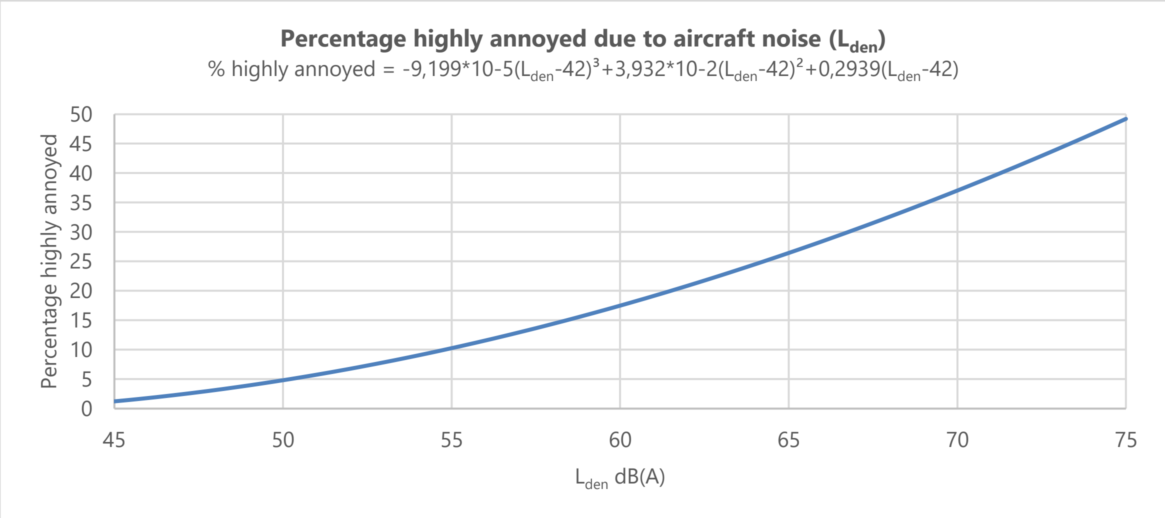

Figure 1: Percentage of people who are potentially seriously inconvenienced due to L_{den} for aircraft noise.

(Source: VLAREM – environmental legislation based on Miedema 2000)

The aforementioned equation was established from a synthesis/analysis of various noise annoyance studies at various European and American airports carried out by Miedema[3], and was adopted by the WG2 Dose/Effect of the European Commission[4]. Note that L_{den} only determines around 30% of the variation in reported severe inconvenience[5'6].

European environmental noise directive

In October 2018, a WHO report appeared in which new exposure-effect relationships were proposed. The target value for observed health effects was set at 45 dB L_{den} and 40 dB L_{night}[7]. In a recent expansion to the Environmental Noise Directive (EU-Directive 2002/49/EC)[8] exposure-effect relationships adapted by WHO were adopted in the EU. With a decision of the Government of Flanders dated 28/01/2022 this was transposed to the Flemish legislation with regard to the reporting in the framework of the European environmental noise directive. No changes were implemented to the provisions in Vlarem II Chapter 5.57 Airports. For this reporting, the same exposure-effect relationship for determining the number of potentially seriously inconvenienced applicable (Figure).

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[3] Miedema H.M.E., Oudshoorn C.G.M., Elements for a position paper on relationships between transportation noise and annoyance, TNO Report PG/VGZ/00.052, July 2000.

[4] European Commission, WG2 – Dose/Effect, Position paper on dose response relationships between transportation noise and annoyance, 20 February 2002

[5] van Kempen EEMM et al. Selection and evaluation of exposure-effect relationships for health impact assessment in the field of noise and health, RIVM Report No. 630400001/2.005. Bilthoven: RIVM; 2005.

[6] Kroesen M, Molin EJE, van Wee B. Testing a theory of aircraft noise annoyance: a structural equation analysis. J Acoust Soc Am 2008;123:4250–60.

[7] WHO Europe, Environmental Noise Guidelines for the European Region (2018), ISBN 978 92 890 5356 3http://www.euro.who.int/en/publications/abstracts/environmental-noise-guidelines-for-the-european-region-2018,

[8] COMMISSION DIRECTIVE (EU) 2020/367 of 4 March 2020 amending annex III to directive 2002/49/EG of the European Parliament and the Council concerning the method of determining the damaging effects of ambient noise.

3 Methodology

From the start of 2021, use has been made for the calculation of noise contours of the Echo calculation model, developed by AerLabs B.V. This model and the methodology used comply with the methodology prescribed in the VLAREM legislation (Chapter 5.57 Airports). 29, 4th edition (2016). Supplementary to this, several details have been implemented in the calculation method distinguishing these from previous year calculations. This chapter gives a description of the working method.

The procedure for calculating noise contours consists of three phases:

- Collection of information concerning the flight movements, the routes flown, aircraft characteristics and meteorological data.
- Performing the noise calculations with the Echo calculation model.
- Processing of the contours using a Geographic Information System (GIS).

3.1 Data input

The year calculations are based on the actual number of flights, divided into the number of flights during the day (07:00 - 19:00), evening (19:00 - 23:00) and night (23:00 - 07:00).

The following data is required to specify aircraft movements:

- Aircraft type
- Time
- Nature of the movement (departure/arrival)
- Destination or origin
- Landing/take-off runway used
- Flight path followed

The flight information is provided by Brussels Airport Company as an export of the flight movements from the central database (CDB). All the necessary information is stored in this database. The quality of the data is very good.

Each aircraft type is linked to an aircraft type for which the noise and performance data needed for noise calculations are included in the Aircraft Noise and Performance (ANP) database, see §3.2. In most cases, the aircraft type is present in the ANP database. For a small fraction of aircraft that cannot be directly linked, a suitable type is sought based on number of type of engines and starting weight.

Helicopters are not included specifically in the calculations, but they are added proportionally to the flight movement type (landing/take-off) and the time of day. In 2021, helicopter flights were responsible for about 1.9% of movements.

3.1.1 Radar data

Aircraft follow certain routes which are essentially determined by the runway used and the SID flown (Standard Instrument Departure) for take-offs, or by the runway used and the STAR ('Standard Arrival Route') for arrivals. The existing SIDs and STARs are shown in the AIP ('Aeronautical Information Publication'). This official documentation specifies the procedures to be followed for the flight movements at a specific airport.

These departure descriptions are not strict spatial stipulations, but are laid down as procedures. They must be performed when a manoeuvre is made when a certain height or geographical location is reached. Reaching this height and/or geographical location depends on the aircraft type, weight (and indirectly on the destination), as well as weather conditions. This may result in a very large geographical distribution of the actual flight paths for the same SID. This creates bundles of movements that use the same or similar SIDs.

In previous years, a statistical division of the routes actually flown was used in the noise calculations per bundle based on radar data and translated to representative flights paths with a distribution of the traffic over these paths. For frequently-used SIDS, the calculations are refined by a further subdivision based on aircraft type. The representation of the flight paths was thus a statistical approach to the actual flights paths.

The noise calculations is now based on the actual flight paths of the flights, by making direct use of radar data. This radar data gives the position of the aircraft every 4 seconds. Based on these data, the flight path can be accurately represented.

In the noise calculations, take-offs are modelled from the starting point on the runway. This start point is available for each flight based on information that is supplied by Brussels Airport Company. Approaches are modelled on the basis of the runway threshold, whereby a flight height is assumed of 50 foot above the runway threshold.

3.1.2 Meteorological data

For the calculation of the noise contours, the actual average meteorological conditions are used. These meteorological conditions are available for each thirty minutes via Brussels Airport Company. The wind direction, wind speed and temperatures are linked to the individual flight movements. The headwind is calculated for each individual flight movement and for the runway used. In this way, an annual averaged meteorological condition, which is weighted for the number of flights under each meteorological condition, is obtained.

The wind speed is provided in accordance with the calculation method and converted to knots (kn). The meteorological parameters for 2021 are:

- Average headwind (annual average across all runways, take-off and landing): 6.7kn.
- Average temperature: 10.5°C.
- Average humidity: 79%.
- Average air pressure: 1016.29 mBar.

3.1.3 Take-off profile

The weight of the aircraft at departure influences the take-off profile. Given that this actual weight is not available in the CDB, a method proposed by ECAC Doc. 29 is used to take into account this effect ('stage length'). The Aircraft Noise and Performance (ANP) database gives an assumed take-off weight per stage length. It is assumed that the greater the distance from Brussels Airport to the destination, the more this aircraft will operate at its maximum take-off weight. This is justified, among other things, by the fact that the kerosene constitutes an important part of the total weight of an aircraft. This complies with the methodology of the preceding annual reports.

The coordinates of all airports can be found on the website 'http://openflights.org/data.html'. This list is used to calculate the distance to Brussels Airport from any airport.

The profiles for take-offs are modelled according to the Noise Abatement Departure Procedure (NADP) 1, with acceleration at a height of 3000 foot. This corresponds with the stipulated take-off procedure on Brussels Airport. In previous years, a "standard" take-off profile was calculated in INM, which corresponds with the NADP 2.

3.1.4 Approach profiles

Flights approaching Brussels Airport descend in practice from a great height in a continuous descent to the runway or fly before the final approach for a while at a fixed height. Until this year, one standard approach profile for approaching traffic was used in the noise calculations. In order to take the impact on noise of different ways of approach into account, three approach profiles have been made available this year for approaching traffic for use in the calculations.

- An approach profile with a continuous descent.
- An approach profile with a horizontal segment at c. 560 metres above the airport. This corresponds with an approach altitude of 2,000 foot above sea-level.
- An approach profile with a horizontal segment at c. 870 metres above the airport. This corresponds with an approach altitude of 3,000 foot above sea-level.

The allocations of the most appropriate approach profile for a flight is based on the radar data. Based on this, 37.5% of the approaching traffic is linked to a continuous descent, 40.4% to a descent with a horizontal segment at 2,000 foot and 22.1% to a descent with a horizontal segment at 2,000 foot.

3.2 Aircraft source data

Alongside the relevant data about aircraft movements, runway use and flight paths, the calculation of the noise impact also demands appropriate noise and performance data for the aircraft concerned. The source of the information is the international Aircraft Noise and Performance (ANP) databased, approved by the ECAC.

The ANP database gives noise and performance data of aircraft. The data in the database cover most larger, modern aircraft models and variants. Aircraft models and variants that are not included in the ANP database must be represented by substitutes (often designated as 'proxy' aircraft): aircraft with comparable noise and performance characteristics that are included in the ANP database, whereby a correction is applied based on the difference in noise impact based on noise certification data.

For the year calculation, use is made of ANP version 2.3 (October 2020).

For the year calculation, all registered passages are linked to a 'proxy' based on the 'ANP Aircraft Substitution Tables' for heavy aircraft.[9] The link is made based on aircraft type and engine type. A number of aircraft types cannot be linked on the basis of the substitution list. For those types, the allocation of the proxy aircraft is done based on the number and type of engines and start weight.

With regard to the proxy aircraft, a correction factor is applied in the noise calculations for the difference in noise impact between the actual aircraft type and the proxy aircraft. This correction is made on the basis of noise certification data. For most movements (98.1%), Brussels Airport Company has the noise certification data of the aircraft concerned. For the movements for which this is not the case, the correction is based on the correction in the ANP substitution list. That correction is each time based on the most noisy model variant of the aircraft concerned.

3.3 Match between measurements (NMS) and calculations (INM)

Echo enables calculations at specific locations around the airport. To check the assumptions concerning the input data and the accuracy of Echo, the calculated noise impact is compared with sound measurements taken at 31 locations.

The comparison with measurements provides a validation of the calculations. Both the noise calculations as well as the noise measurements imply limitations and uncertainties. The noise calculations do not, for example, take the actual height at which an aircraft flies overhead into account (this is determined by the assigned standard departure and approach profiles, not by the actual radar data). The measuring stations are unmanned because they are monitored continuously throughout the year. Local deviations caused by local noise events or background noise, for example, may affect the measured levels. Although these are removed as far as possible from the measurements (for example, through an automatic link between noise events and aircraft, based on the radar data), such contributions to the measured levels cannot be completely excluded.

Reliability of the calculation method can, however, be achieved when there is sufficient matching between the annual averages of the measured noise events and the annual average forecast based on the average day, across a sufficient number of measuring stations.

3.4 Technical data

The calculations are performed with Echo within a grid of 70 x 70 kilometres around the airport, with a mesh size of the grid of 250 metres. The altitude of the airport reference measuring point in relation to sea level is 175 ft.

[9] The ANP substitution list is drawn up for ANP version 2.2. In ANP version 2.3, the noise and performance data has been added for several new aircraft types. These types were added to the substitution list by To70.

3.5 Changes in the calculation method in respect to previous years

The calculation of the noise contours is updated in a number of components compared to previous years. The most important changes are:

- The calculation model is changed. In previous years, the noise calculations were performed with INM 7 (sub-version INM 7.0b). The calculations are now performed with the Echo calculation model. With Echo, the calculations are performed according to the methodology stated in ECAC Doc. 29 4th edition. The most important chance in this is in the correction of standard noise data to a specific atmospheric absorption. Doc. 29 suggest two methods for determining the atmospheric absorption. The first is the use of the method traditional used, dating from 1975, which is also applied in INM.[10] Doc. 29 advises the use of a more recent method from 2013.[11] The recommendation in Doc. 29 has been followed.
- For the source data (sound and performance data) of aircraft, use is made of the data in the international Aircraft Noise and Performance (ANP) database (version 2.3, October 2020), see §3.2. In the previous calculations, use was made of the data available in INM 7 (sub-version INM 7.0b). Compared to the data in INM, this concerns the following differences:
  - The noise levels for approaches by the aircraft types A300, A310, A319, A320, A321, A330 and A340 are, with regard to the values in INM, corrected in the latest ANP database;
  - The data of the following aircraft types are added: 7478, 7773ER, 7878R, CNA525C, CNA560E, CNA560U, CNA560XL, CNA680, EMB170, EMB175, EMB190, EMB195, A350-941, ATR72, 7378MAX.
- With regard to the proxy aircraft, a correction factor has been applied in the noise calculation for the difference in noise impact between the actual aircraft type and the proxy aircraft (see §3.2). This correction was not applied in previous years.
- Every flight is modelled based on the actual flight path. In previous years, use was made of representative flight paths with a distribution of the traffic over these paths, see §3.1.1. For take-offs, account has been taken in the modelling with the start point on the runway, which is registered per flight.
- The profiles for take-offs are modelled according to the Noise Abatement Departure Procedure 1, with acceleration at an altitude of 3,000 foot. This corresponds with the stipulated take-off procedure on Brussels Airport. In previous years, calculations were made with a "standard" take-off profile in INM version 7.0b, which corresponds with the Noise Abatement Departure Procedure 2.
- In order to take into account the impact of the various ways of approach (continuous descent versus a segment at a fixed height), a distinction is made for approaching traffic between a continuous descent, a descent with a horizontal segment at c. 560 metres above the airport and a descent with a horizontal segment at c. 870 metres above the airport.

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[10] Society of Automotive Engineers, Standard values of atmospheric absorption as a fuction of temperature and humidty, SAEARP-866A, 1975.

[11] Society of Automotive Engineers, Application of pure-tone atmospheric absorption losses to one-third octave-band levels, SAE-ARP-5534, 2013.

The impact of the new calculation method has been mapped by mapping the sound contours for 2021 according to the calculation method applied in 2020. 0 gives the impact of the change in calculation method on the location of the noise contours and on the surface and the number of inhabitants within the noise contours.

4 Results

4.1 Background information about interpreting the results

4.1.1 Number of flight movements

One of the most important factors for the annual noise contours around an airport is the number of movements which occurred during the past year. Following the decline of the number of movements between 2011 and 2013, there was an increase of 6.9% in 2014 and a further increase of 3.4% in 2015. In 2016 the number of aircraft movements fell to 223.688 (-6.5%). This is largely a result of a temporary closure following the attacks on the airport on 22 March 2016. In 2017, the number of movements increased by 6.3% to 237.888. In 2018, the number of movements increased by 1.0% to 235.459. In 2019 there was once again a slight decline of 0.4% and the total number of movements was 234.460. In 2020, the picture was entirely defined by the impact of the global pandemic and the consequences for international travel. The number of flight movements fell by 59.1% to 95.811. In 2021,118,733 aircraft movements were performed, which is an increase of 23.9% compared to 2020, but, due to the continuing consequences of the pandemic, the total is considerable lower than in the years up to 2020.

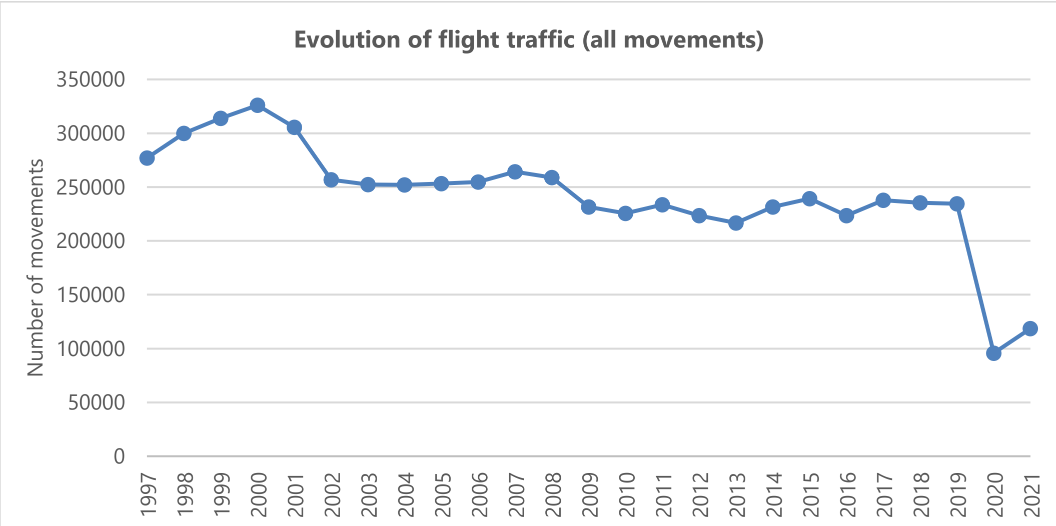


Figure 2: Evolution of flight traffic (all movements) at Brussels Airport.

The number of night-time movements (23:00-06:00) rose by 19.2 % from 11,131 in 2020 to 13,273 in 2021, illustrated in Figure 3. Of these, 4,870 were take-offs. This includes helicopter movements and flight movements exempt from slot coordination, such as government and military flights.

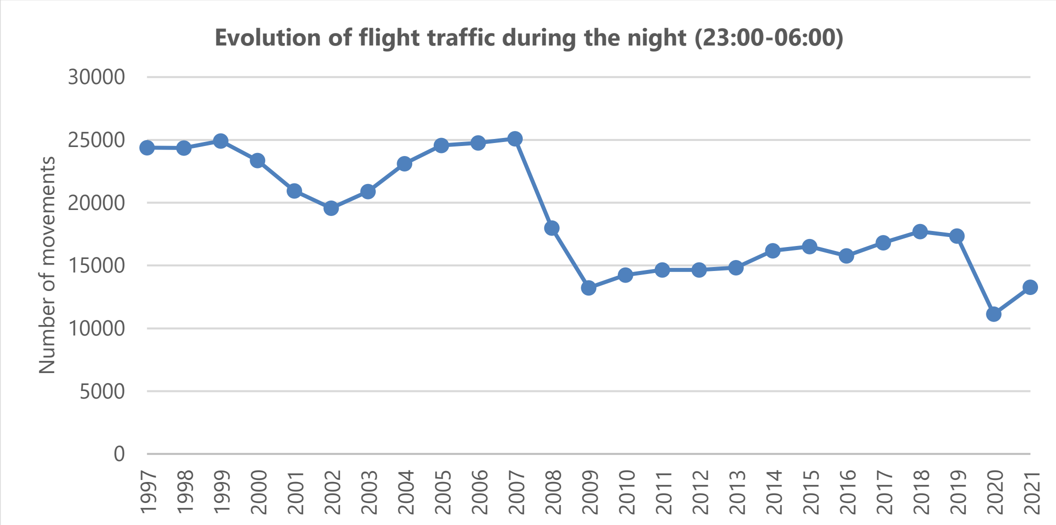


Figure 3: Evolution of flight traffic during the night (23:00-06:00) at Brussels Airport.

In 2021, the number of assigned night slots[12] for aircraft movements remained at 13,325 (10,970 in 2020), including 4,709 for departures (4,480 in 2020), within the limitations imposed on the slot coordinator of Brussels Airport, who since 2009 has been authorised to distribute a maximum of 16,000 night slots, of which a maximum of 5,000 may be allocated to departures (MD 21/01/2009, official amendment to the environmental permit).

The number of movements during the operational day period (06:00 to 23:00) rose by 24.5% from 84,680 in 2020 to 105,460 in 2021.

The number of movements in 2021, the data for 2020 and the trend are shown in
Table 1. The numbers for the night period are further broken down into operational night (23:00 - 06:00) and the morning period (06:00 - 07:00).

Table 1: Number of movements (incl. helicopter movements) in 2021 and the change in comparison to 2020 (VLAREM division of the day).

	2020			2021			Relative change versus 2020		
period	landings	departures	total	landings	departures	total	landings	departures	total
day (07:00 - 19:00)	30,160	32,041	62,201	37,805	39,194	76,999	+25.3%	+22.3%	+23.8%
evening (19:00 - 23:00)	9,861	8,932	18,793	11,623	11,425	23,048	+17.9%	+27.9%	+22.6%
night (23:00 - 07:00)	7,891	6,926	14,817	9,926	8,760	18,686	+25.8%	+26.5%	+26.1%
00:00 - 24:00	47,912	47,899	95,811	59,354	59,379	118,733	+23.9%	+24.0%	+23.9%
06:00 - 23:00	41,413	43,267	84,680	50,951	54,509	105,460	+23.0%	+26.0%	+24.5%
23:00 - 06:00	6,499	4,632	11,131	8,403	4,870	13,273	+29.3%	+5.1%	+19.2%
06:00 - 07:00	1,392	2,294	3,686	1,523	3,890	5,413	+9.4%	+69.6%	+46.9%

[12] night slot: permission given by the coordinator of the Brussels National Airport, pursuant to Regulation (EEC) No. 95/93 of the Council of 18 January 1993 concerning common rules for the allocation of slots at community airports, to use the entire infrastructure required for the exploitation of an air service at the Brussels National Airport on a specified date and at a specified landing and take-off time during the night, as assigned by the coordinator.

The general increase of 23.9% in the number of movements on an annual basis between 2021 and 2020 is evenly distributed throughout the day (+23.8%), evening (+22.6%) and night (+26.1%). The greatest rise is in the number of departures between 06:00 and 07:00 (+69.6%).

4.1.2 Other important evolutions

In addition to the number of flight movements, there are a number of other parameters that also determine the size and the position of the noise contours, such as the runway and the route used, flight procedures and the deployed fleet. The most important changes are summarised below.

Fleet changes during the day and in the evening (07:00 and 23:00).

The evolution of the most frequently used aircraft types during the day (07:00 - 23:00) is available in Figure 4 for heavy aircraft (take-off weight from136 tonnes, 'heavies') and in Figure 5 for lighter aircraft (a take-off weight up to136 tonnes). Shown are the aircraft types in 2020 and 2021 that on average have flown 1x per day.

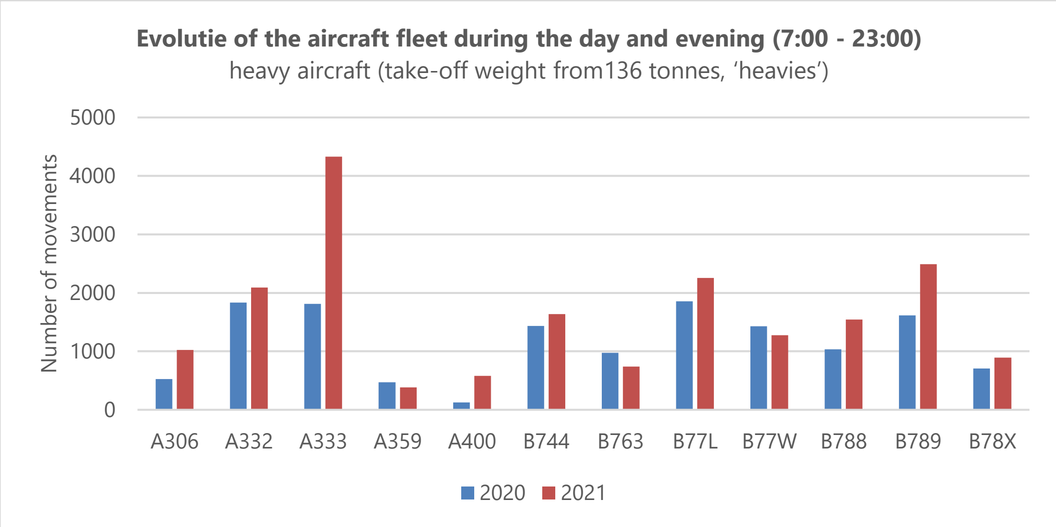


Figure 4: Evolution of the number of aircraft movements with heavy aircraft between 07:00 and 23:00.

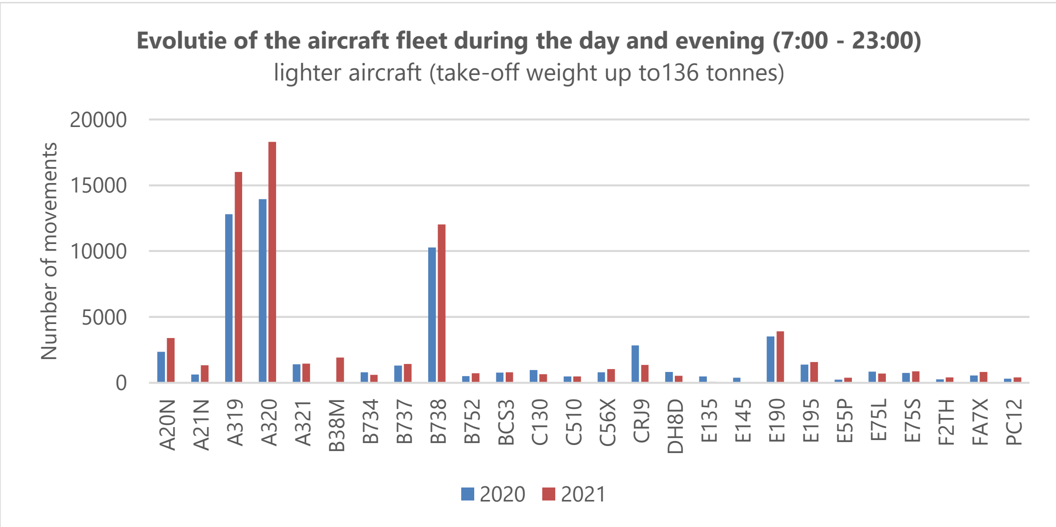


Figure 5: Evolution of the number of aircraft movements with lighter aircraft between 07:00 and 23:00.

The changes in the traffic picture is larger than in other years as a consequence of the worldwide pandemic. In general, the most-used aircraft remain the A309, the A320 and the B738 (together responsible for 46.3% of all movements in 2021 between 07:00 and 23:00). The number of movements with these aircraft has increased by 25.1%, which is in line with the increase in the total number of movements. The most prevalent heavy aircraft is the A333, for which the number of movements, percentage wise, has increased most in 2021: +139%. A drop in the number of movements with heavy aircraft is visible for the A359, the B763 and the B77W.

Fleet changes in the night period (from 23:00 to 07:00)

The evolution of the most frequently used aircraft types during the night is set out in Figure 6 for arrivals and in Figure 7 for departures. Shown are the aircraft types in 2020 and 2021 that on average flew a minimum of 1 flight per week.

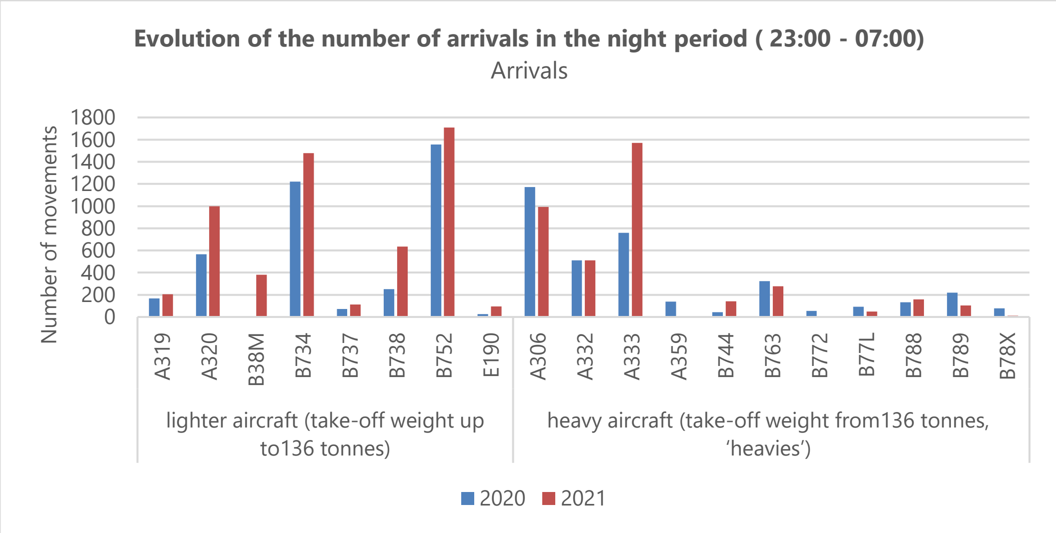


Figure 6: Evolution of the number of arrivals in the night period (from 23:00 to 07:00).

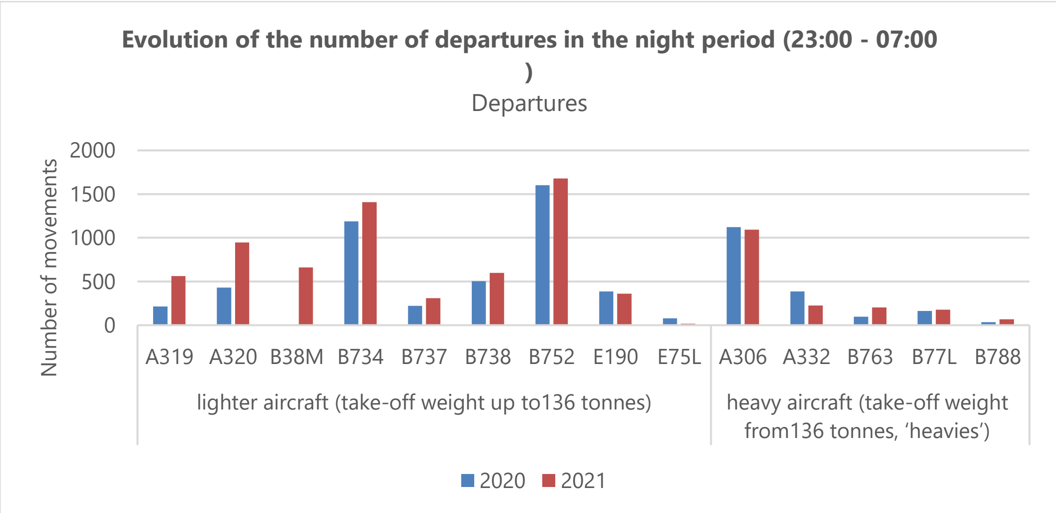


Figure 7: Evolution of the number of departures in the period between 23:00 and 07:00.

The most commonly used aircraft in the night is the B752 (18.1% of all movements in 2021), followed by the B734 (15.4%), and the A306 (11.1%). The number of arrivals with heavy aircraft in the night increased by 7.7% compared to 2020. This is mainly due to the increase in the number of arrivals with the A333. The number of take-offs in the night with heavy aircraft rose by 1.7% compared to 2020. The number of movements in the night with lighter aircraft increased with 43.1% (arrivals) and 38.6% (departures). This mainly concerns the A319, the A320, the B738 and the B38M.

Runway and route usage

Preferential runway usage

The preferential runway usage, published in the AIP (Skeyes), shows which runway should preferably be used, depending on the time that the movement occurs, and in some cases on the destination and the maximum take-off weight of the aircraft. This scheme did not change during the year 2021 (see Table 2).

If the preferential runway configuration cannot be used (for example due to meteorological conditions or maintenance on one of the runways), Skeyes will then choose the most suitable alternative configuration, taking account of factors including the weather conditions, runway equipment and traffic demand. In this respect, conditions are tied to the preferential runway usage arrangements, including wind limits expressed as the maximum crosswind and maximum tailwind at which each runway can be used. If these limits are exceeded, air traffic control must switch to an alternative configuration. Under preferential runway usage conditions, the maximum tailwind is 7 kt and the maximum crosswind is 20 kt. In the event of alternative runway usage, the maximum speeds are also 20 kt for crosswind but only 3 kt for tailwind.

Table 2: Preferential runway usage since 19/09/2013 (local time) (source: AIP)

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">Day</th><th>Night</th></tr>
<tr><th>06:00 to 15:59</th><th>16:00 to 22:59</th><th>23:00 to 05:59</th></tr>
<tr><td rowspan="2">Mon, 06:00 – Tues 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R/19(1)</td></tr>
<tr><td>Landing</td><td colspan="2">25L/25R</td><td>25R/25L(2)</td></tr>
<tr><td rowspan="2">Tues, 06:00 – Wedn 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R/19(1)</td></tr>
<tr><td>Landing</td><td colspan="2">25L/25R</td><td>25R/25L(2)</td></tr>
<tr><td rowspan="2">Wed, 06:00 – Thurs 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R/19(1)</td></tr>
<tr><td>Landing</td><td colspan="2">25L/25R</td><td>25R/25L(2)</td></tr>
<tr><td rowspan="2">Thurs, 06:00 – Fri 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R/19(1)</td></tr>
<tr><td>Landing</td><td colspan="2">25L/25R</td><td>25R/25L(2)</td></tr>
<tr><td rowspan="2">Fri, 06:00 – Sat 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R(3)</td></tr>
<tr><td>Landing</td><td colspan="2">25L/25R</td><td>25R</td></tr>
<tr><td rowspan="2">Sat, 06:00 – Sun 05:59</td><td>Departure</td><td>25R</td><td>25R/19(1)</td><td>25L(4)</td></tr>
<tr><td>Landing</td><td>25L/25R</td><td>25R/25L(2)</td><td>25L</td></tr>
<tr><td rowspan="2">Sun, 06:00 – Mon 05:59</td><td>Departure</td><td>25R/19(1)</td><td>25R</td><td>19(4)</td></tr>
<tr><td>Landing</td><td>25R/25L(2)</td><td>25L/25R</td><td>19</td></tr>
</table>

(1) Runway 25R for traffic via ELSIK, NIK, HELEN, DENUT, KOK and CIV / Runway 19 for traffic via LNO, SPI, SOPOK, PITES and ROUSY (aircraft with MTOW between 80 and 200 tonnes can use runway 25R or 19, aircraft with MTOW > 200 tonnes must use runway 25R, regardless of their destination).
(2) Runway 25L only if air traffic control considers this necessary.
(3) Between 01:00 and 06:00, no slots may be allocated for departures.
(4) Between 00:00 and 06:00, no slots may be allocated for departures.

Increased use of the runways, with exception of runway 19

Compared to 2020, use of the runways has increased, with exception of the use of runway 19. This is shown in Figure 8 for the period during the day and in the evening (from 07:00 to 23:00) and in Figure 9 for the night period (from 23:00 to 07:00). A complete account of the runway use is given in appendix A.1.

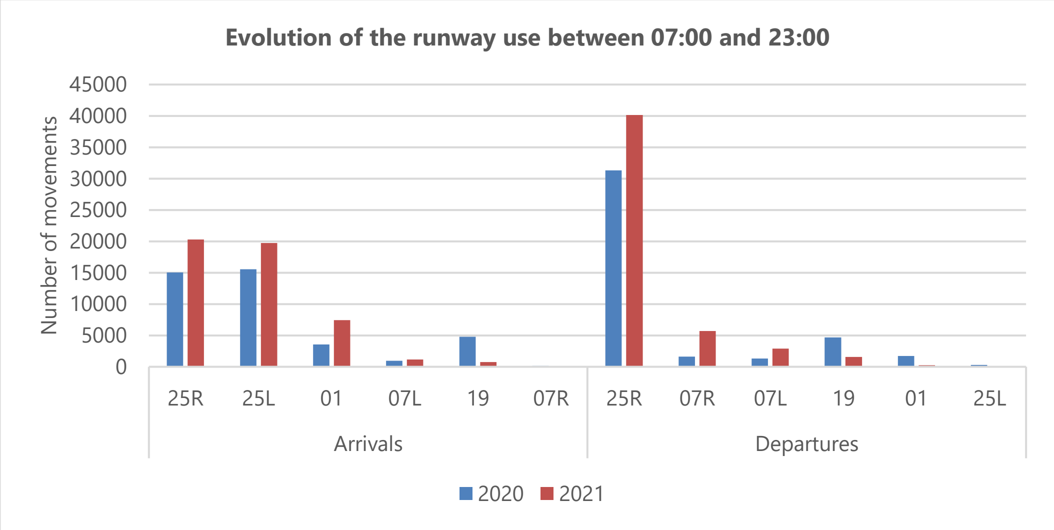


Figure 8: Evolution of the runway use between 07:00 and 23:00.

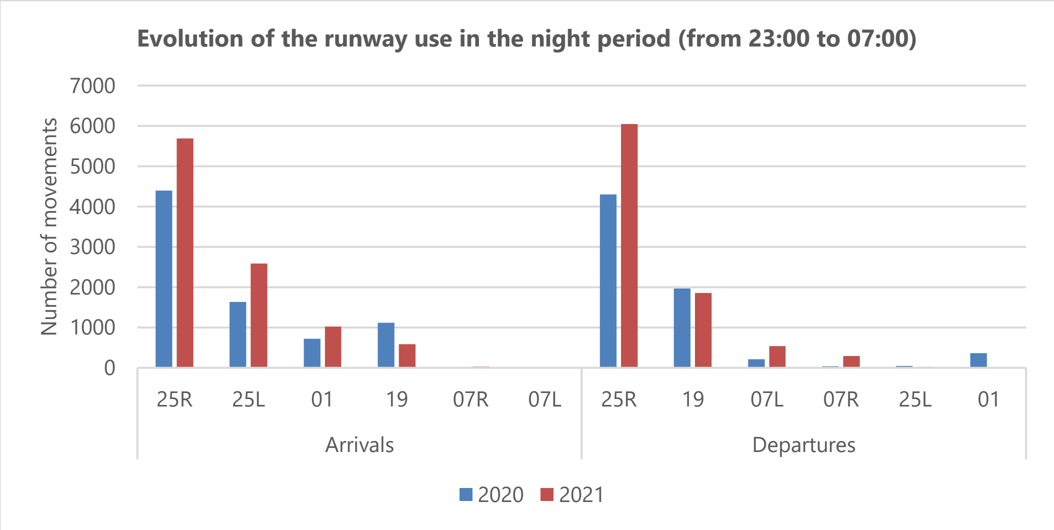


Figure 9: Evolution of the runway use in the night period (from 23:00 to 07:00).

Runway 25R is, as a consequence of the preferential runway usage and the prevalent wind conditions, the most used runway direction for departures in the night. Runways 25R and 25L are used approximately as much for landings during the day and in the evening. The rise in the use of the various runways is the direct consequence of the rise in the number of aircraft movements in 2021. The decrease in the use of runway 19 is the consequence of the relatively high use of runway 19 in 2020 because runway 25R-07L was out of use at the time for thorough renovation works,

4.2 Comparison of measurements and calculations

Echo enables a number of acoustic parameters to be calculated at a specified location around the airport The extent to which the calculated values correspond to the values registered and processed by the measuring system can be evaluated by performing these calculations at the Noise Monitoring System (NMS) measuring station locations. Different data sources are used in the NMS system and are correlated with each other: noise measurements, CDB, radar tracks and weather. Measurements and calculations are compared for the parameters $L_{Aeq,24h}$, L_{night} and L_{den}.

The calculated values are compared with the values of the correlated measured events. Only the acoustic parameters of an event are recorded by the monitoring network. To select the events by aircraft, an automatic link is made in the NMS to the flight and radar data; these are the so-called correlated events.

The system of correlation is imperfect and it is possible for events to be incorrectly attributed to overflying traffic and vice versa. To minimise the contribution of such incorrect classifications, a trigger level is set with a minimum duration time: an event is expected only when the trigger level of 10 s is exceeded. The event ends when the trigger level is not achieved during 5 s. The trigger levels are set for each measuring station and depend on the local noise in the area. These trigger levels were evaluated in the beginning of 2015 and adjusted for several measuring stations. At that time, the maximum duration of an event was increased from 75 s (for 2014) to 125 s. As in previous years, this criterion was retained for 2021. In events of even longer duration, the chance of this being caused by an airplane is quite small. Note that beyond the conditions relating to the event duration and trigger level, a correlation with a registered aircraft movement is also necessary based on its radar track results.

In the table below, a comparison is made between the values simulated with Echo at the different measuring station locations and the values measured/calculated on the basis of the correlated events for the chosen parameters. Aside from data from the measuring stations of Brussels Airport Company, results from the Environment, Nature and Energy Department (LNE) measuring stations (with codes NMT 40-2 and higher) are also recorded. The measurement data from these measuring stations are input and linked to flight data in the NMS of the airport.

For measuring stations of the BIM in the Brussels-Capital Region, the above-mentioned procedure is not possible because the measurement data is not supplied to BAC (until 2009, the measurement data from the BIM for two measuring stations - Haren and Evere - had in fact been made available to BAC). An overview of the locations of all measuring stations can be found in 0.

The measuring stations NMT01-2, NMT03-3, NMT15-3 and NMT23-1 are situated on the airport site and/or in the immediate vicinity of the runway system and the airport facilities. The flight-correlated noise events comprise contributions from ground noise as well as overflights. The link to specific flight movements is not always equally reliable for these measuring stations. For these reasons, the measured values at these measuring stations are less relevant for assessing noise emission from overflying aircraft, and while they are reported, they are not considered in the assessment of the accuracy of the simulations.

The fraction of time that the measuring system is active (so-called 'uptime') was in 2021 very high for all measuring stations. The minimal uptime was 97.35% and the average uptime was 99.11%. For the comparison of the measurements with the calculations (for a whole year), a correction is made per measuring stations for the uptime fraction. It is also assumed that during the periods lacking measurements, there was the same proportion of exposure to aircraft noise as during the periods in which the measuring station was active. The correction is, as a consequence of the high uptime, virtually negligible.

The comparison between calculations and measurements based on the $L_{Aeq,24h}$ shows that the discrepancy between the calculated values and the measured values across all measuring stations, except NMT09-2 (Perk), NMT21-1 (Strombeek-Bever), NMT45-1 (Meise) and NMT48-3 (Bertem), is smaller than 2 dB(A) (after also excluding the measuring points NMT01-2, NMT03-3, NMT15-3 and NMT23-1 as mentioned in the previous paragraph]. Measuring stations Perk and Bertem have few overflights and have a relatively low registered sound pressure level (resp. 41.0 and 25.5 dB(A) $L_{Aeq,24h}$). The registered sound pressure level is also relatively low (39.8 dB(A) $L_{Aeq,24h}$) for the measuring station Meise. The resulting margin for error is large and that is reflected in the comparison between the measurements and the calculations. At 11 measuring stations, the deviation is limited to up to 0.5 dB(A). At 18 measuring stations, the measurements are higher than the calculations, at 9 measuring stations the measurements are lower than the calculations (in each case with the abovementioned exclusions). The global discrepancy between simulations and measurements is 0.8 dB(A) ("root-mean-square error" or RMSE), when Perk, Meise and Bertem (and also NMT01-2, NMT03-3, NMT15-3 and NMT23-1) are excluded from this evaluation.

Globally, similar limited deviations between measurements and simulations are obtained for L_{night} (1.3 dB (A) RMSE, excluding measuring points NMT01-2, NMT03-3, NMT15-3, NMT23-1, Perk, Meise and Bertem). At 8 measuring stations, the differences are smaller than 0.5 dB(A).

For the noise indicator L_{den} the RMSE is 1.0 dB(A) (excluding NMT01-2, NMT03-3, NMT15-3, NMT23-1, Perk, Meise and Bertem). At most of the other measuring stations, the deviations were within 2 dB(A). Seven measuring stations had a deviation of maximum 0.5 dB(A). At 17 measuring stations the calculations result in an underestimation of the measured levels, at 10 measuring stations they lead to an overestimation (excluding NMT01-2, NMT03-3, NMT15-3, and NMT23-1).

Table 3: Match between calculations and measurements for noise indicator $L_{Aeq,24h}$ (in dB(A)). The grey rows in the table indicate comparisons between measurements and calculations which are difficult to perform (see text).

Code location	Location name	measures 2021 (dBA)	calculations 2021 Echo (dBA)	difference (dBA)
NMT01-2	STEENOKKERZEEL	56.8	61.7	-4.9
NMT02-2	KORTENBERG	63.2	63.1	0.1
NMT03-3	HUMELGEM-Airside	59.0	59.9	-0.9
NMT04-1	NOSSEGEM	60.5	60.1	0.4
NMT06-1	EVERE	48.1	47.3	0.7
NMT07-2	STERREBEEK	47.3	46.0	1.2
NMT08-1	KAMPENHOUT	54.3	54.5	-0.1
NMT09-2	PERK	41.0	45.8	-4.8
NMT10-3	NEDER-OVER-HEEMBEEK	52.6	51.1	1.5
NMT11-2	SINT-PIETERS-WOLUWE	50.7	50.3	0.3
NMT12-1	DUISBURG	43.5	43.0	0.5
NMT13-2	GRIMBERGEN	43.3	43.6	-0.3
NMT14-1	WEMMEL	45.5	44.6	0.9
NMT15-3	ZAVENTEM	44.0	50.4	-6.4
NMT16-2	VELTEM	53.2	53.6	-0.5
NMT19-4	VILVOORDE	49.9	49.6	0.3
NMT20-3	MACHELEN	49.8	51.4	-1.6
NMT21-1	STROMBEEK-BEVER	50.0	47.9	2.1
NMT23-1	STEENOKKERZEEL	64.6	66.3	-1.7
NMT24-1	KRAAINEM	51.3	51.1	0.2
NMT26-2	BRUSSEL	46.2	45.0	1.2
NMT40-2*	KONINGSLO	50.6	49.7	1.0
NMT41-1*	GRIMBERGEN	45.5	45.3	0.2
NMT42-2*	DIEGEM	61.4	59.5	1.9
NMT43-2*	ERPS-KWERPS	52.4	54.2	-1.9
NMT44-2*	TERVUREN	43.6	43.5	0.1
NMT45-1*	MEISE	39.8	42.4	-2.6
NMT46-2*	WEZEMBEEK-OPPEM	53.0	52.7	0.3
NMT47-3*	WEZEMBEEK-OPPEM	47.9	46.8	1.1
NMT48-3*	BERTEM	25.5	31.7	-6.3
NMT70-1*	ROTSELAAR	46.4	47.5	-1.1

* noise data Department of the Environment, off-line correlated by the NMS

Table 4: Match between calculations and measurements for noise indicator L_{night} (in dB(A)). The grey rows in the table indicate comparisons between measurements and calculations which are difficult to perform (see text).

Code location	Location name	measures 2021 (dBA)	calculations 2021 Echo (dBA)	difference (dBA)
NMT01-2	STEENOKKERZEEL	54.4	61.0	-6.6
NMT02-2	KORTENBERG	59.6	59.7	-0.1
NMT03-3	HUMELGEM-Airside	54.7	53.8	0.9
NMT04-1	NOSSEGEM	59.2	58.1	1.1
NMT06-1	EVERE	42.3	41.4	1.0
NMT07-2	STERREBEEK	50.1	47.8	2.3
NMT08-1	KAMPENHOUT	53.1	53.4	-0.3
NMT09-2	PERK	40.3	43.8	-3.4
NMT10-3	NEDER-OVER-HEEMBEEK	49.6	47.6	2.0
NMT11-2	SINT-PIETERS-WOLUWE	47.0	46.7	0.4
NMT12-1	DUISBURG	42.7	41.1	1.6
NMT13-2	GRIMBERGEN	36.4	38.8	-2.4
NMT14-1	WEMMEL	41.0	41.0	0.0
NMT15-3	ZAVENTEM	46.7	50.3	-3.6
NMT16-2	VELTEM	49.9	50.4	-0.4
NMT19-4	VILVOORDE	47.1	46.5	0.6
NMT20-3	MACHELEN	47.0	48.3	-1.3
NMT21-1	STROMBEEK-BEVER	47.4	44.7	2.7
NMT23-1	STEENOKKERZEEL	63.5	65.2	-1.6
NMT24-1	KRAAINEM	47.1	47.3	-0.2
NMT26-2	BRUSSEL	41.4	41.4	0.0
NMT40-2*	KONINGSLO	47.8	46.2	1.5
NMT41-1*	GRIMBERGEN	42.6	41.9	0.7
NMT42-2*	DIEGEM	57.4	54.7	2.7
NMT43-2*	ERPS-KWERPS	47.6	50.4	-2.8
NMT44-2*	TERVUREN	45.6	43.5	2.1
NMT45-1*	MEISE	33.7	38.8	-5.0
NMT46-2*	WEZEMBEEK-OPPEM	49.3	49.2	0.1
NMT47-3*	WEZEMBEEK-OPPEM	50.4	48.0	2.4
NMT48-3*	BERTEM	17.9	28.2	-10.3
NMT70-1*	ROTSELAAR	42.8	44.0	-1.3

* noise data Department of the Environment, off-line correlated by the NMS

Table 5: Match between calculations and measurements for noise indicator L_{den} (in dB(A)). The grey rows in the table indicate comparisons between measurements and calculations which are difficult to perform (see text).

Code location	Location name	measures 2021 (dBA)	calculations 2021 Echo (dBA)	difference (dBA)
NMT01-2	STEENOKKERZEEL	61.8	67.6	-5.8
NMT02-2	KORTENBERG	67.4	67.5	0.0
NMT03-3	HUMELGEM-Airside	62.9	63.1	-0.2
NMT04-1	NOSSEGEM	66.0	65.3	0.8
NMT06-1	EVERE	51.6	50.8	0.8
NMT07-2	STERREBEEK	55.7	53.6	2.1
NMT08-1	KAMPENHOUT	59.9	60.2	-0.3
NMT09-2	PERK	46.7	50.9	-4.2
NMT10-3	NEDER-OVER-HEEMBEEK	57.3	55.5	1.8
NMT11-2	SINT-PIETERS-WOLUWE	55.0	54.6	0.3
NMT12-1	DUISBURG	49.3	48.2	1.1
NMT13-2	GRIMBERGEN	47.0	47.7	-0.7
NMT14-1	WEMMEL	49.4	48.9	0.5
NMT15-3	ZAVENTEM	52.3	56.7	-4.4
NMT16-2	VELTEM	57.6	58.1	-0.5
NMT19-4	VILVOORDE	54.7	54.2	0.5
NMT20-3	MACHELEN	54.6	56.1	-1.5
NMT21-1	STROMBEEK-BEVER	54.8	52.4	2.4
NMT23-1	STEENOKKERZEEL	70.3	72.0	-1.7
NMT24-1	KRAAINEM	55.3	55.3	0.0
NMT26-2	BRUSSEL	50.2	49.4	0.7
NMT40-2*	KONINGSLO	55.4	54.1	1.3
NMT41-1*	GRIMBERGEN	50.3	49.8	0.5
NMT42-2*	DIEGEM	65.6	63.4	2.2
NMT43-2*	ERPS-KWERPS	56.1	58.4	-2.4
NMT44-2*	TERVUREN	51.3	49.9	1.5
NMT45-1*	MEISE	43.2	46.7	-3.5
NMT46-2*	WEZEMBEEK-OPPEM	57.2	57.1	0.2
NMT47-3*	WEZEMBEEK-OPPEM	56.0	54.0	2.0
NMT48-3*	BERTEM	28.2	36.0	-7.9
NMT70-1*	ROTSELAAR	50.7	51.8	-1.1

* noise data Department of the Environment, off-line correlated by the NMS

4.3 Noise contours

The results of the noise contour calculations for the parameters described above (L_{day}, $L_{evening}$, L_{night}, L_{den}, freq.70 and freq.60) are presented in this section.

The surface area and the number of residents is calculated for each noise contour. On the basis of the L_{den} contours, the number of potentially seriously inconvenienced persons is calculated according to the method described in paragraph 2.2. More information is available in the appendices: per municipality in appendix C, the evolution of the contours over multiple years in appendix E. Appendix D is the map appendix.

4.3.1 L_{day} contours

The L_{day} contours represent the A-weighted equivalent sound pressure level for the period 07:00 to 19:00 and are reported from 55 dB(A) to 75 dB(A) in steps of 5 dB(A). The evolution of the contours for 2020 and 2021 is shown in Figure 10.

The evaluation period for the L_{day} contours falls entirely within the operational daytime period (06:00 to 23:00) as specified at Brussels Airport. This means that the 'Departure 25R – Landing 25L/25R' runway usage is to be preferred at all times, except at the weekend on Saturdays after 16:00 and on Sundays before 16:00, when departures are to be distributed over 25R and 19. When this preferential runway usage cannot be applied due to weather conditions (often with an easterly wind), then the combination of departures from 07R/07L and landings on 01 or 07L/07R is generally applied.

There are a number of relevant findings. In the first place, there was a strong reduction in the number of landings during the day (+25.3%) as well as the number of departures (+22.3%). There are evolutions, too, in the runway usage, which relate to specific events in 2020 (i.e. the activities on runway 25R/07L and the "Single Runway Use" during the first lockdown). For arrivals on runway 01, a relative increase is visible (to 15.6% in 2021, compared to 8.3% in 2020) largely through a change in weather conditions (wind more frequently from north/north easterly direction) which, in combination with the general increase in the number of landings during the day, the number of landings on that runway has risen from 2,513 to 5,882. The use of runway 19, on the other hand, has dropped sharply from 3,940 landings in 2020 to 615 landings in 2021. The share of the use of runways 25L and 25R for landings was, in 2021, slightly higher than 2020: respectively 40.3% (in 2020: 38.4%) and 39.8% (in 2020: 37.1%. In combination with the increase in the total number of landings, this results in an increase of respectively 3,667 and 3,843 movements.

For the use of the runways for departures, there is largely an increase in the use of runway 01 (more use in 2020 due to Single Runway Use) and 19 (more use in 2020 due to work taking place on runway 25R/07L) and an increase in the use of runway 07R. The relative number of departures from runway 07R has increased during the day from 4,0% in 2020 to 12.0% in 2021, which means that the use of the runway has increased from 1,290 departures in 2020 to 4,719 departures in 2021. The relative number of departures from runway 01 has decreased from 4.0% in 2020 to 0.6% in 2021, which means that the number of departures has decreased from 1,270 to 248. For runway 19, the relative number of departures has decreased from 12.5% in 2020 to 3.3% in 2021, which corresponds with a decrease from 4,000 departures in 2020 to 1,282 departures in 2021. Runway 25R is, just as in 2020, by far the most used runway for departures. The share increased in 2021 from 75.5% to 78.3%. In combination with the increase in the total number of departures, there were 6,496 more departures from runway 25R in 2021 than in 2020.

In 2021, more heavy aircraft departed during the day (increase of 36.1%) and arrived (increase of 44.7%). The increase of the number of lighter aircraft is, with in total 20.5%, somewhat smaller.

To the west of Brussels Airport, the 55 dB contour is larger as a result of an increase in the number of departures from runway 25R and changes in the fleet. The increase in noise is larger than 1 dB. The lobe of the bed to the right is slightly smaller than in 2020 due to a change in the calculation method (updating source data, which has an effect specifically for the composition of the traffic on the flight routes concerned). The 60 dB and the 65 dB contours are both smaller than in 2020. The calculated reduction in noise impact in this area is not so much the consequence of a development in traffic, but rather of the change in the calculation method (see paragraph 3.5 and 0). In practice the noise impact in that area will increase as a consequence of the number of the aircraft movements and the changes in the fleet.

From the review of the results it is clear that, with the new calculation method, clear differences have arisen compared to the earlier calculation method, which cloud the evolution. The new calculation method, however, does adhere to the prescribed calculation method and the data used are more representative to reflect reality.

To the east of Brussels Airport, the L_{day} noise impact has increased compared to 2020. The noise impact in this area is largely caused by landings on runway 25L and 25R. The number of landings has increased on both runways compared to 2020. There is also an increase in the calculated noise impact due to changes in the calculation method (updating of the source data, in particular the correction for the sound levels of landings by Airbus aircraft).

To the south of Brussels Airport, the landing contour grew due to more than a doubling in the number of arrivals on runway 01 (from 2,513 to 5,882). With the strong drop in the number of take-offs from runway 19, the contour closer to the airport is less wide than in 2020.

To the north of Brussels Airport, the greatest change is visible. The number of departures on runway 01 dropped sharply (from 1,270 to 248) and the landings on runway 19 dropped sharply as well (from 3,940 to 615). The noise impact has thus decreased by more than 5dB. This is mainly an effect of the renovation of runway 25R in 2020.

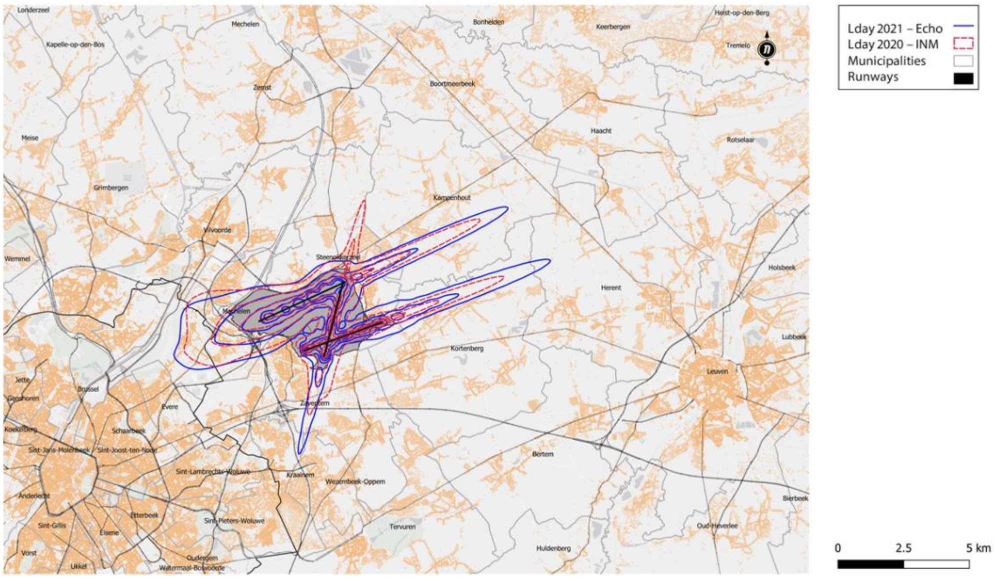


Figure 10: L_{day} noise contours around Brussels Airport in 2020 (dotted red) and 2021 (solid blue).

The total surface area within the L_{day} contour of 55 dB(A) rose in 2021 by 19% compared to 2020 (from 2,547 to 3,024 ha). The number of residents inside the L_{den} contour of the 55 dB(A) noise contour rose by 16% (from 18,507 to 21,401). The number of residents within the contour increased by 931 (+4.5%) due to developments in the resident numbers.

4.3.2 $L_{evening}$ contours

The $L_{evening}$ contours represent the A-weighted equivalent sound pressure level for the period 19:00 to 23:00 and are reported from 50 dB(A) to 75 dB(A) in steps of 5 dB(A). The evolution of the contours for 2020 and 2021 is shown in Figure 11. Due to a lower level being reported in comparison with L_{day}, there is a visually magnifying effect. By correcting 5 dB(A), the 50 dB(A) contour becomes as important for the calculation of L_{den} as the 55 dB(A) L_{day} contour. The evaluation period for the $L_{evening}$ contours falls entirely within the operational daytime period (06:00 to 23:00), as specified at Brussels Airport.

There are a number of relevant findings, which are similar to those of the day period. In the first place, there was a slight increase in the number of landings during the evening (+17.9%) and in the number of departures (+27.9%). There are also evolutions in the runway usage, connected to the specific events in 2020 (i.e. the activities on runway 25R/07L and the "Single Runway Use" during the first lockdown). For arrivals, there is a relative increase in the use of runway 01 (to 13.4% in 2021 compared to 10.5% in 2020), which, in combination with the general increase in the number of landings during the evening, leads to landings on that runway increasing from 1,032 to 1,554. The increase in the evening is thus smaller than the increase during the day. The use of runway 19 has, just as during the day, decreased strongly, from 866 landings in 2020 to 118 landings in 2021. The share of the use of runway 25R for landings was higher in 2021 than in 2020: 45.2% in 2021, compared to 38.9% in 2020. In combination with the increase in the total number of landings, this resulted in an increase of 1,416 landings on runway 25R. The share of the use of runway 25L for landings was lower in 2021 than in 2020 (38.6% compared to 40.0%), but in absolute terms, this is an increase of 540 landings.

In the evening period, in common with the period during the day, there is a strong decrease in the use of runways 01 and 19 for departures. The relative number of departures from runway 07R has increased in the evening from 3.7% in 2020 to 8.7% in 2021, which means the use of the runway has increased from 332 departures in 2020 to 992 departures in 2021. The relative number of departures from runway 01 has decreased from 5.0% in 2020 to 0.1% in 2021, which means the number of departures has decreased from 449 to 13. For runway 19, the relative number of departures has decreased from 7.8% in 2020 to 2.6% in 2021, which corresponds with a decrease from 697 departures in 2020 to 299 departures in 2021. Runway 25R is, just as in 2020, by far the most used runway for departures. The share increased in 2021 from 80.0% to 82.9%. In combination with the increase in the total number of departures, there were 2,331 more departures in 2021 from runway 25R than in 2020.

To the north west of Brussels Airport (turn to the right from runway 25R), the 50 and 55 dB contours are smaller. The increase in the number of departures from runway 25R leads in principle to an increase in the noise impact, but through changes in the fleet for traffic on the underlying routes, the noise impact decreases. The decrease is the consequence of the decrease in the number of departures with a B744 (and heavy and relatively noisy aircraft) in the evening on the underlying routes: from 223 in 2020 to 132 in 2021. The decrease is more than 2 dB. To the south west of Brussels Airport (turn to the left from runway 25R), the 50dB contour is larger due to the increase in the number of departures from runway 25R on the routes in the direction of the south west and south east. The increase in noise is larger than 1 dB. The 60 dB contour is smaller than in 2020. The calculated reduction in noise impact in this area is not so much the consequence of a the reduction of the number of departures by a B744 but rather of the change in the calculation method (see paragraph 3.5 and 0).

To the east of Brussels Airport, the $L_{evening}$ noise impact has increased by 1 to 2 dB compared to 2020. The noise impact in this area is largely caused by landings on runway 25L and 25R. The number of landings has increased on both runways compared to 2020. There is also a calculated increase due to changes in the calculation method (updating of the source data, in particular the correction for the sound increase of landings by Airbus aircraft).

To the south of Brussels Airport, the landing contour grew due to the increase in the number of arrivals on runway 01 (from 1.032 to 1.554). With the strong drop in the number of take-offs from runway 19, the contour closer to the airport is less wide than in 2020. This also corresponds with the development of the noise impact for the day period.

In common with the L_{day} noise impact, the greatest change for the $L_{evening}$ is visible to the north of Brussels Airport. The number of departures on runway 01 dropped sharply (from 449 to13) while the landings on runway 19 dropped sharply as well (from 866 to 118). The noise impact has thus decreased by more than 5dB.

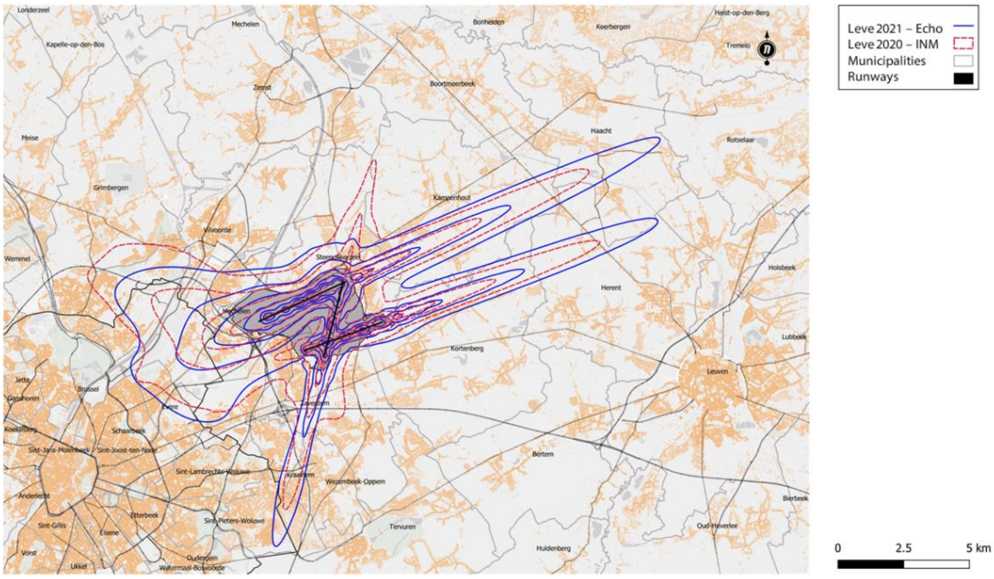


Figure 11:$L_{evening}$ noise contours around Brussels Airport for 2020 (dotted red) and 2021 (solid blue).

The total surface area inside the $L_{evening}$ contour of 50 dB(A) in 2021 is 7% larger than in 2020 (from 7,252 ha to 7,757 ha). The number of residents inside the $L_{evening}$ contour of 50 dB(A) increased by 1% (from 76,262 to 76,812). The relative increase in population is smaller than the increase in surface area, considering the shrinkage of the $L_{evening}$ contour is partly in the more densely-populated zones compared to areas where the surface has increased. The number of residents within the contour increased by 2,867 (+3.5%) due to developments in the resident numbers. Without this increase in population numbers, the number of residents within the 50 dB(A) $L_{evening}$ contour has decreased.

4.3.3 L_{night} contours

The L_{night} contours represent the A-weighted equivalent sound pressure level for the period 23:00 to 07:00 and are reported from 45 dB(A) to 70 dB(A) in steps of 5 dB(A). The evolution of the contours from 2020 to 2021 is shown in

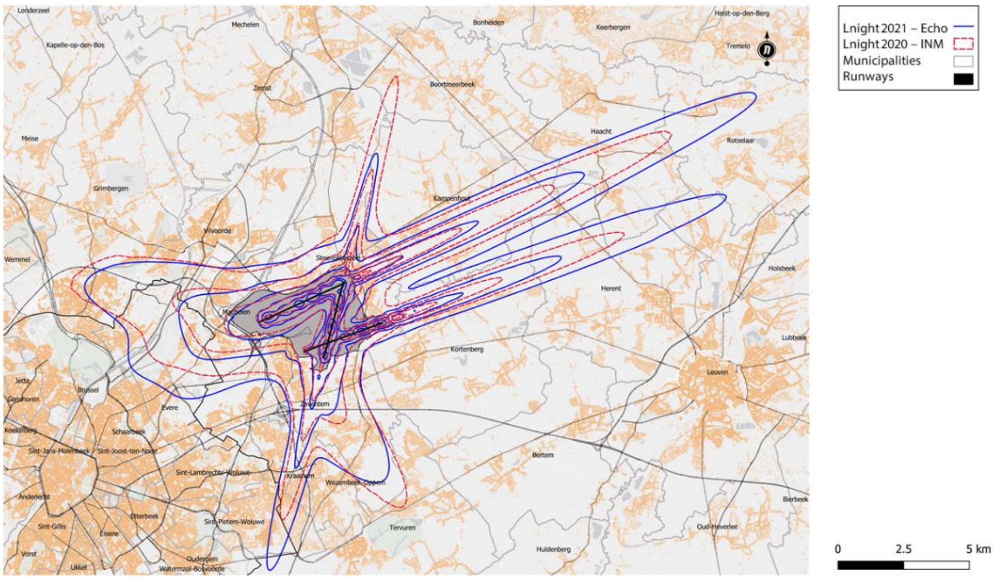


Figure 12. Due to an additional contour being reported, a magnifying effect between the day and the evening is created. The 45 dB(A) L_{night} contour is larger than the 55 dB(A) contour for daytime and is now, due to the correction of 10 dB(A) for the calculation of L_{den}, just as significant as the L_{day} contour of 55 dB(A) and the $L_{evening}$ contour of 50 dB(A).

The evaluation period for the L_{night} contours does not coincide with the operational night period (23:00 to 06:00) and also consists of the flights during the operational daytime period between 06:00 and 07:00. The noise contours are a combination of the runway and route usage during the operational night and during the operational day.

There are a number of relevant findings for the night, which are similar to those of the day. Both the number of landings and the number of departures in the night have increase by c. 26%. In line with the developments in the use of the runways during the day and in the evening, it can also be seen that the number of arrivals on runways 01, 25L and 25R has increased. In particular, the number of landings on runway 25L has increased in the night, from 1,633 in 2020 to 2,586 in 2021 (+58.4%), largely due to the resumption of passenger traffic. The number of landings on runway 19 during the night, in line with those during the day and evening, has increased compared to 2020.

In the night period, in common with the period during the day and the evening, there is a strong decrease in the use of runways 01 and 19 for departures. The relative number of departures from runway 07R has increased in the night from 3.0% in 2020 to 6.2% in 2021, which means the use of the runway has increased from 39 departures in 2020 to 294 departures in 2021. The relative number of departures from runway 01 has decreased from 5.2% in 2020 to 0.1% in 2021, which means the number of departures has decreased from 363 to 8. For runway 19, the relative number of departures has decreased from 28.4% in 2020 to 21.1% in 2021, which corresponds with a decrease from 1,968 departures in 2020 to 1,852 departures in 2021. Runway 25R was, just as in 2020, by far the most used runway for departures in the night. The share increased in 2021 from 62.0% to 69.0%. In combination with the increase in the total number of departures, there were 1,749 more departures in 2021 from runway 25R than in 2020.

The development in the noise impact for the night period is similar to the development in the noise impact for the evening period, whereby the increase and decrease of the noise impact occur at the same locations. The development is explained further later.

To the north west of Brussels Airport, the 45 and 50 dB contours are smaller. The increase in the number of departures from runway 25R leads to an increase in the noise impact, but through changes in the fleet for traffic on the underlying routes, the noise impact decreases. The decrease is the consequence of the decrease in the number of departures with a A306 (from 390 in 2020 to 247 in 2021) and A332 (from 79 in 2021 to 23 in 2021), both heavy and relatively noisy aircraft. The decrease is around 1 dB. To the south west of Brussels Airport, the 45 dB contour and the 50dB contour are larger due to the increase in the number of departures from runway 25R, mainly between 06:00 and 07:00 (from 1,422 to 3,182 movements), on the routes in the direction of the south west and south east. The increase in noise is 1 to 3 dB.

Also in the night period, the calculated noise impact to the east of Brussels Airport is higher than in 2020. In the extension of runway 25L, the noise impact is around 3dB higher as a consequence of the increase in the number of the landings (+58.4%) and the changes in the calculation method. In the extension of runway 25R, the noise impact increase to around 2 dB through the increase in the number of landings (+20.4%) and the changes in the calculation method.

To the south of Brussels Airport, the landing contour grew due to the increase in the number of arrivals on runway 01 (from 720 to 1.024). Through a (limited) decrease in the number of take-offs from runway 19 in combination with changes in the fleet on the underlying routes, the noise impact from starting traffic is lower in 2021 than in 2020.

In common with the L_{day} and $L_{evening}$ noise impact, the greatest change for the L_{night}noise impact is visible to the north of Brussels Airport. The number of departures in the night from runway 01 dropped considerably (from 363 in 2020 to 8 in 2021), and also the number of landings on runway 19 decreased strongly (from 1,120 in 2021 to 583 in 2020). The noise impact has decreased by more than 4 to 5 dB because of this.

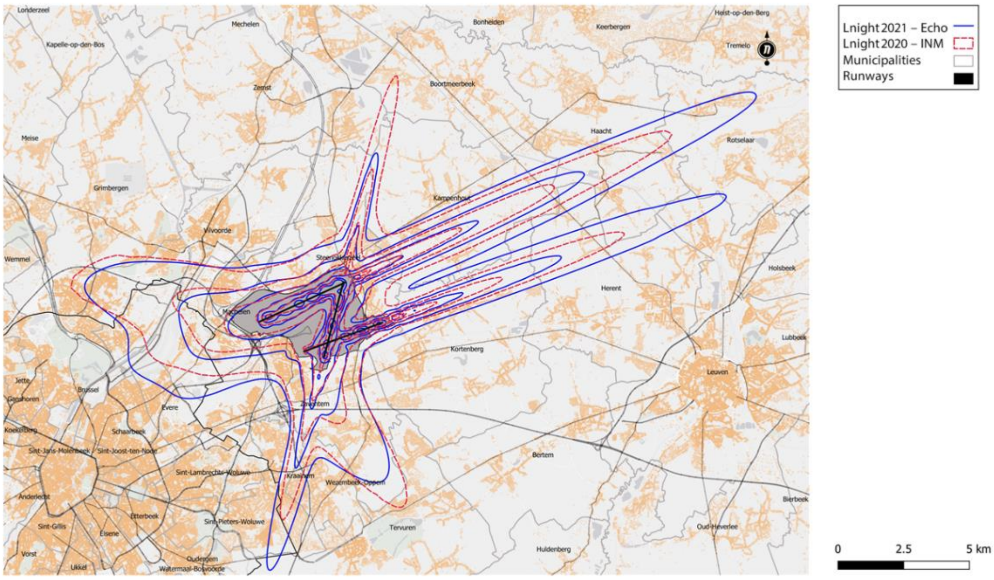


Figure 12: L_{night} noise contours around Brussels Airport in 2020 (dotted red) and 2021 (solid blue).

The total surface area within the L_{night} contour of 45 dB(A) in 2021 is 25% larger than in 2020 (from 8,691 ha to 10,870 ha). The number of residents within the L_{night} contour of 45 dB(A) increased by 29% (from 81,566 to 104,908). The number of residents within the contour increased by 3,403 (+3.4%) due to developments in the population numbers.

4.3.4 L_{den} contours

The L_{den} unit is a combination of L_{day}, $L_{evening}$ and L_{night}. The evening flight movements are penalised with 5 dB(A) and the night flight movements with 10 dB(A). In

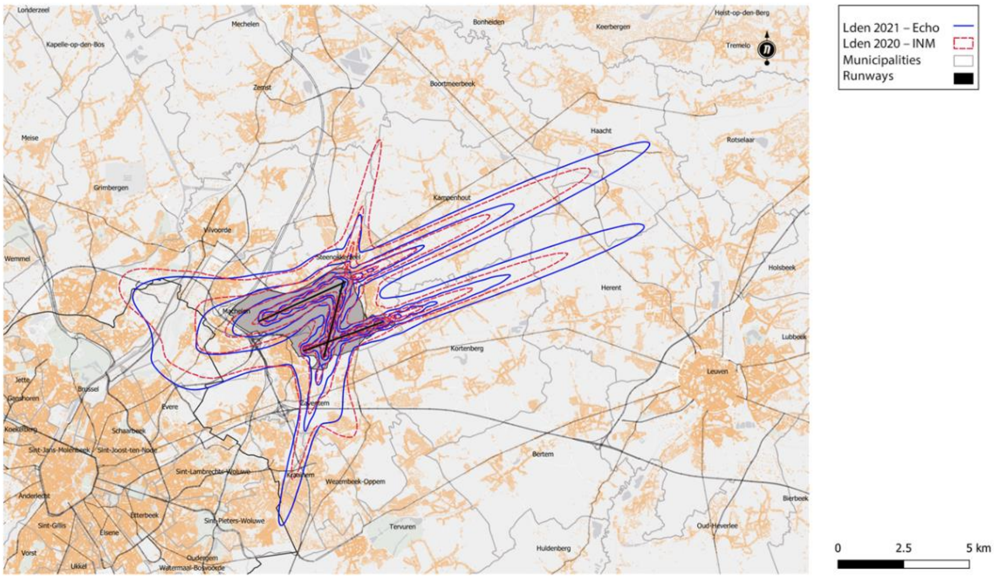


Figure 13a you can see the evolution of the L_{den} contours for 2020 and 2021. The L_{den} contours are reported from 55 dB(A) to 75 dB(A) in steps of 5 dB(A).

The changed form is a weighted combination of all effects which are outlined in detail in the discussion of L_{day}, $L_{evening}$ and L_{night} contours. The findings for the different periods to the west of the airport are confirmed. The shrinkage of the lobe to the north west as a consequence of the changes in the fleet on the underlying routes of departures from runway 25R is decisive for the L_{den} contour. All other changes are the same for the day, evening and night, which is reflected in the L_{den} contour.

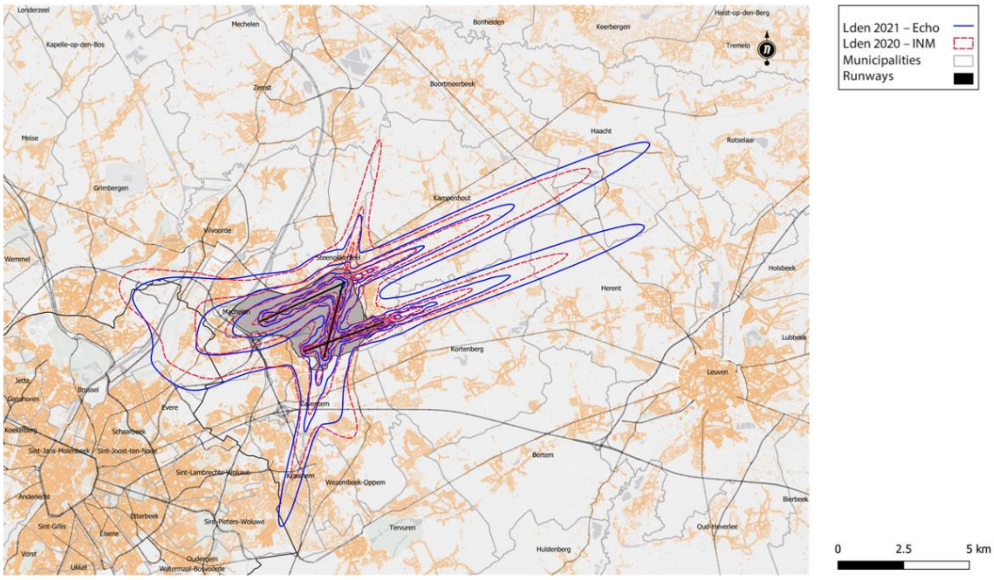


Figure 13a: L_{den} noise contours around Brussels Airport in 2020 (dotted red) and 2021 (solid blue).

The total surface area inside the L_{den} noise contour of 55 dB(A) increased in 2020 by 17% compared with 2020 (from 5,549 ha to 6,520 ha). The number of residents within the L_{den} contour of 55 dB(A) increased by

12% (from 45,508 to 51,119). The number of residents within the contour increased by 1,804 (+3.7%) due to developments in the resident numbers.

For comparison, Figure 13b shows the L_{den} contours for 2021 against the contours for 2019. The L_{den} contours for 2021 are in general (considerably) smaller than the L_{den} contours calculated for 2019 due to a lower number of flights for 2021 (118,733) than for 2019 (234,460). Only to the east of Brussels Airport is the contour for runway 25R larger than for 2019 due to the correction of the noise levels for landings by Airbus aircraft.

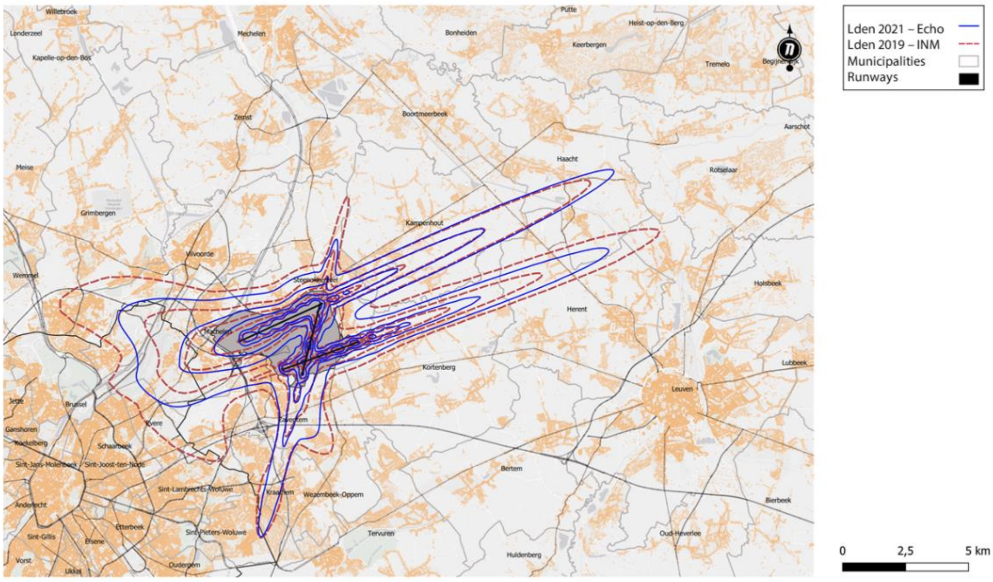


Figure 14b: L_{den} noise contours around Brussels Airport in 2019 (dotted red) and 2021 (solid blue).

4.3.5 Freq.70,day contours (day 07:00 - 23:00)

The Freq.70,day contours are calculated for an evaluation period consisting of both the L_{day} and $L_{evening}$ evaluation periods. The evolution of the Freq.70,day contours reflects the general decrease in traffic, changes in the runway usage and the changes in the fleet (see Figure 15). The figure indicates the contours where on average a noise level of 70 dB(A) occurs 5x, 10x, 20x, 50x and 100x per day during the day period (07:00 to 23:00).

In common with the development of the L_{day} and $L_{evening}$ noise impact, the contours for departures from runway 25R in the north-westerly direction have shrunk. Contours for departures from runway 25R in the south-easterly direction have also shrunk. In addition to the changes in the fleet, this is also the consequence of changes in the calculation method: through modelling of the departments according to the Noise Abatement Departure Procedure (NADP) 1, the noise level directly under the flight path is lower than with a NADP 2 procedure (see also 0). This means that a noise level of 70 dB is reached less frequently on locations.

To the east of Brussels Airport, the effect of the increase in the number of landings on runway 25L and 25R is clearly visible, which results in the contours being larger. The consequence of the increase in the number of landings is amplified by the relatively stronger increase in the number of landings with large aircraft.

The changes in the frequency contours to the south and to the north of Brussels Airport compared to the contours in 2020 is similar to the changes in the L_{day} and $L_{evening}$ as a consequence of the change in runway usage: larger landings contours to the south of the airport due to a strong increase in the number of arrivals on runway 01, shrinkage of the contours around the underlying flight paths for departures from runway 19 and shrinkage of the contours to the north of the airport (as a consequence of a decrease in the number of landings on runway 19). For the landings on runway 19, the contours were completely eliminated, given that in 2021 there were, on average, fewer than 5 events per day during 07:00 and 23:00.

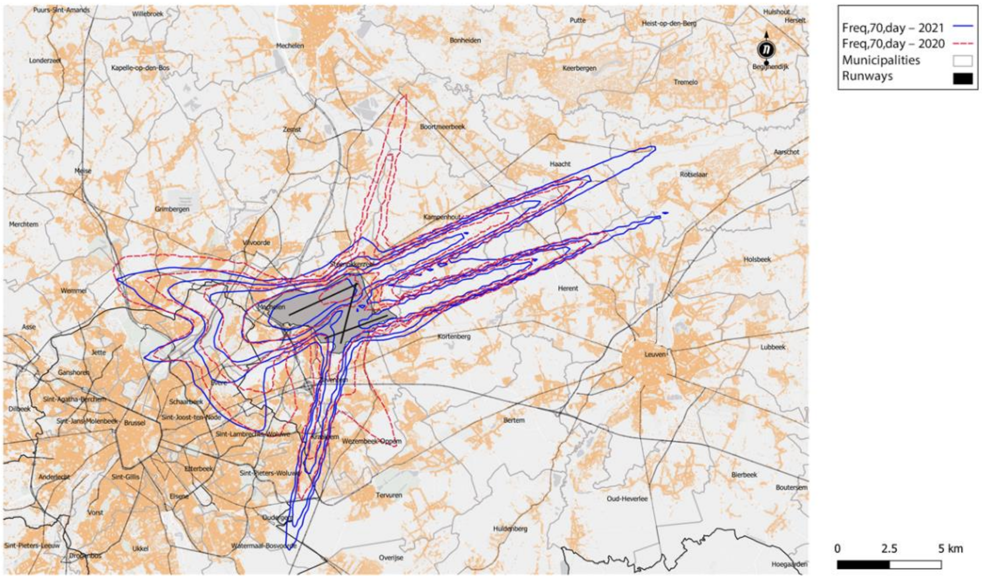


Figure 15: Freq.70,day contours around Brussels Airport in 2020 (dotted red) and 2021 (solid blue).

The total surface area inside the contour of '5x above 70 dB(A)' decreased in 2021 by 9% compared with 2020 (from 11,036 ha to 9,998). The number of residents inside the Freq.70,day contour of 5 events decreased by 5% (from 159,753 to 151,451).

4.3.6 Freq.70,night contours (night 23:00-07:00)

The Freq.70,night contours are calculated for the same evaluation period as the L_{night}. The evolution of the Freq.70,night contours reflects the general increase in traffic and the changes in the runway usage and the changes in the fleet that were discussed for L_{night}. The figure indicates the contours where on average a noise level of 70 dB(A) occurs 1x, 5x, 10x and 20x per day during the night period (23:00 to 07:00). At no location is a noise level of 70 dB(A) reached more than 50x during the night period.

In common with the development of the L_{night} noise impact, the contours for departures from runway 25R in the north-westerly direction have shrunk. The L_{night} noise impact for the other take-off directions from runway 25R has increased, but the frequency contours have not, or only to a limited degree. In addition to the effect of changes in the fleet, this is also the consequence of changes in the calculation method: through modelling of the departures according to the Noise Abatement Departure Procedure (NADP) 1, the noise level under the flight path is lower than with a NADP 2 procedure. This means that a noise level of 70 dB is reached less frequently on locations.

The frequency contours to the east of Brussels Airport are larger than in 2020 as a result of the increase in the number of landing (25L: +58.4% and runway 25R: +29.4%) and the changes in the calculation method.

To the south of Brussels Airport, the landing contour grew due to the increase in the number of arrivals on runway 01 (from 720 to 1.024). Through a (limited) decrease in the number of take-offs from runway 19 in combination with changes in the fleet on the underlying routes, the noise impact from traffic taking-off is lower in 2021 than in 2020. For the landings on runway 25L, the higher contours were completely eliminated, given the average of less than 10 events per night between 23:00 and 07:00 in 2021.

To the north of Brussels Airport only the contour for one event above the 70 dB(A) is visible, because on average there were way fewer than 5 movements between 23:00 and 07:00. With the drop in the number of arrivals on runway 19, the contour is furthermore smaller than in 2020.

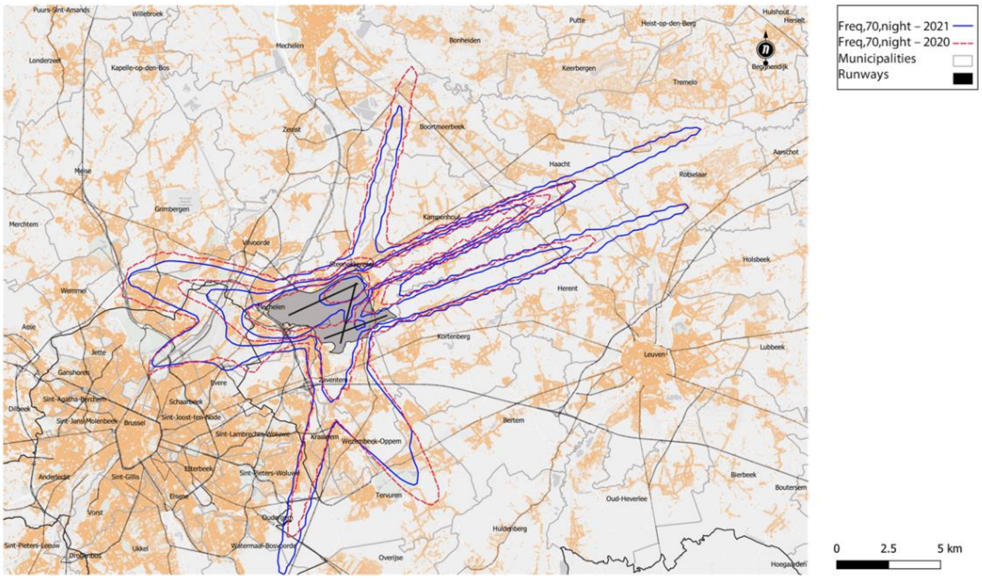


Figure 16: Freq.70,night contours around Brussels Airport in 2020 (dotted red) and 2021 (solid blue).

The total surface area within the 1x above the 70 dB(A) contour during the night increased in 2021 by 1% compared to 2020 (from 10,976 ha to 11,087 ha). The number of residents within this contour has, however, dropped by 5% (from 114,295 to 108,852). That the number of residents within the contour has decreased while the surface area has increased is because the shrinkage of the contour lies in more densely populated areas.

4.3.7 Freq.60,day contours (day 07:00-23:00)

The Freq.60,day contours are calculated for an evaluation period consisting of both the L_{day} and $L_{evening}$ evaluation periods. The evolution of the Freq.60,day contours reflects the general increase in traffic and the changes in the runway usage and the fleet changes that have already been discussed. The figure indicates the contours where on average a noise level of 60 dB(A) occurs 50x, 100x and 150x per day during the day period (07:00 to 23:00). At no location is a noise level of 60 dB(A) reached more than 200x during the day period.

The changes in the frequency contours for 60 dB reflects to the west of Brussels Airport the increase in the number of departures from runway 25R and to the east of the airport the increase in the number of arrivals on runway 25L and on runway 25R. To the south and to the north of the airport, there are no contours of 50x or higher, since in 2021 there were on average fewer than 50 events per day between 07:00 and 23:00.

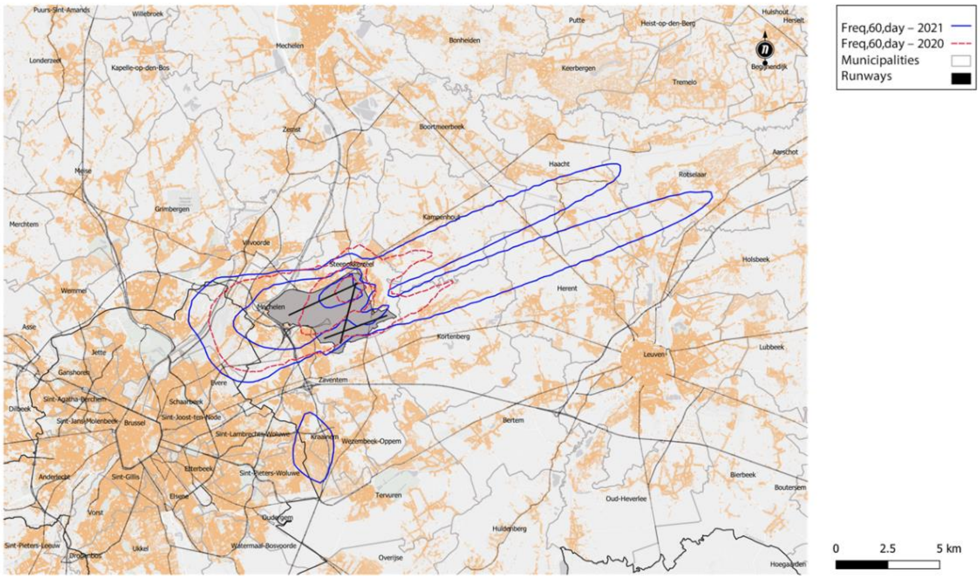


Figure 17: Freq.60,day contours around Brussels Airport in 2020 (dotted red) and 2021 (solid blue).

The total surface area within the Freq.60,day-contour of 50x above 60 dB(A) rose very sharply in 2021 by 134% compared with 2020 (from 3,824ha to 8.959 ha.). The number of residents within the Freq.60,day contour of 50x above the 60 dB(A) also rose sharply by 111% (from 36,790 to 77,644).

4.3.8 Freq.60,night contours (night 23:00-07:00)

The Freq.60,night contours are calculated for the same evaluation period as the L_{night}. The evolution of the Freq.60,night contours reflects the general increase in traffic, changes in the runway usage and the changes in the fleet. The figure indicates the contours where on average a noise level of 60 dB(A) occurs 10x, 15x and 20x per day during the night period (23:00 to 07:00). At no location is a noise level of 60 dB(A) reached more than 30x during the night period.

In line with the changes in the frequency contours for 60 dB for the day period, the frequency contours for the night reflects to the west of Brussels Airport the increase in the number of departures from runway

25R and to the east of the airport the increase in the number of arrivals on runway 25L and on runway 25R. To the south and to the north of the airport (with the exception of a small region to the east of the Brussels Capital Region where various routes cross each other), there are no contours of 10x or higher, since in 2021 there were on average fewer than 10 events per day between 23:00 and 07:00.

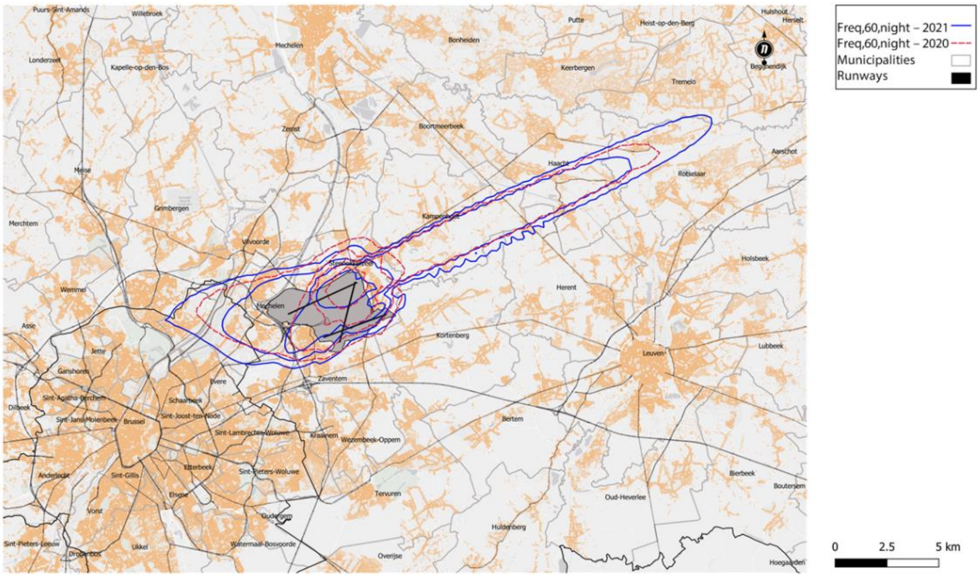


Figure 18:Freq.60,night contours around Brussels Airport for 2020 (dotted red) and 2021 (solid blue).

The total surface area within the Freq.60,night contour with 10x above 60 dB(A) rose in 2021 by 29% compared with 2020 (from 5,827 ha to 7,491 ha). The number of residents inside the Freq.60,night contour of 10x above 60 dB(A) increased by 44% (from 45,803 to 66,026).

4.4 Potentially seriously inconvenienced

The number of people who are potentially seriously inconvenienced is determined on the basis of the calculated L_{den} and the exposure-effect relationship for serious inconvenience, as stipulated in VLAREM II (see paragraph 2.2). The number of people who are potentially seriously inconvenienced is also reported per municipality. This report uses the most recent population numbers (1 January 2022).

Table 6 shows the results for the number of potentially seriously inconvenienced persons. The results are also shown graphically in Figure 19.

The total number of potentially highly inconvenienced persons in 2021 within the contour of 55 dB(A) is 7.715, an increase of 14.2% in comparison to 2020 a decrease of 46% compared to 2019. The results are based on a new calculation method for the exposure, the same method for allocation of the population (based on address points) and the evolution in the population density. The number of potentially seriously inconvenienced within the contour of 55 dB(A) increased by 271 (+3.6%) due to developments in the population numbers.

Compared to 2019, many municipalities, as in 2020, fall outside the L_{den} 55 dB contour, in particular: Grimbergen, Leuven and Sint-Lambrechts-Woluwe. In most other municipalities the number of potentially highly inconvenienced increased compared to 2020: Brussels (+100), Evere (+100). Haacht (+72), Herent (+85), Kampenhout (+152), Kortenberg (+200), Kraainem (+233), Machelen (+48) and Wezembeek-Oppen (+191). Only in Haacht and in Kampenhout are the numbers higher than in 2019, mainly due to the new calculation method (the correction for the noise levels of landings by Airbus aircraft). In the other municipalities, the number of potentially highly inconvenienced people decreased compared to 2020: Steenokkerzeel (-90), Vilvoorde (-133), Zaventem (-97) and Zemst (-2).

The most exposed municipalities in absolute numbers are Machelen, Steenokkerzeel, Zaventem and Brussels, in total 6,176 potentially seriously inconvenienced or 80.0% of the total number.

Table 6: Evolution of the number of people who are potentially seriously inconvenienced inside the L_{den} 55 dB(A) noise contour.

year	2000	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
calc. model	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	INM 7.0b	Echo
Method	opp	opp	opp	opp	opp	opp	opp	opp	opp	opp	opp	opp	adres	adres	adres	adres	adres
Info population	1jan'00	1jan'03	1jan'06	1jan'07	1jan'07	1jan'08	1jan'08	1jan'10	1jan'10	1jan'10	1jan'11	1jan'11	1jan'16	1jan'17	1jan'19	1jan'20	1jan'22
Bruxelles	2,441	1,254	1,691	1,447	1,131	1,115	1,061	1,080	928	1,780	1,739	1,789	1,803	1,889	1,898	959	1,151
Evere	3,648	2,987	3,566	3,325	2,903	2,738	2,599	2,306	1,142	2,975	1,443	1,850	1,505	1,875	1,754	0	100
Grimbergen	3,111	479	1,305	638	202	132	193	120	0	175	428	517	449	440	485	0	0
Haacht	96	103	119	58	36	31	37	37	24	50	115	70	78	66	51	2	74
Herent	186	88	140	162	119	115	123	134	107	152	111	161	133	136	136	3	88
Huldenberg	112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kampenhout	529	747	727	582	453	483	461	399	430	469	648	566	457	563	439	329	481
Kortenberg	664	548	621	604	512	526	497	422	603	443	366	438	431	521	495	101	301
Kraainem	1,453	934	1,373	1,277	673	669	667	500	589	111	368	379	388	524	393	22	256
Leuven	70		9	22	2	1	3	5	0	11	0	0	13	18	22	0	0
Machelen	3,433	2,411	2,724	2,635	2,439	2,392	2,470	2,573	2,278	2,505	2,598	2,649	3,015	2,995	3,032	2,194	2,242
Meise	506	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Overijse	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rotselaar	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schaarbeek	2,026	995	1,937	1,440	603	1,153	1,652	1,703	76	1,647	354	956	6	165	0	0	0
Woluwe-St-Lambert	1,515	382	1,218	994	489	290	196	150	0	0	0	1	142	44	241	0	0
Wolume-St-Pierre	642	411	798	607	396	477	270	82	390	0	79	102	90	338	85	0	7
Steenokkerzeel	1,769	1,530	1,584	1,471	1,327	1,351	1,360	1,409	1,455	1,439	1,675	1,525	1,506	1,595	1,545	1,388	1,298
Tervuren	1,550	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vilvoorde	2,622	1,158	1,483	1,177	894	812	868	851	302	1,012	1,120	1,136	1,146	1,103	1,129	139	7
Wemmel	142	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wezembeek-O.	1,818	739	878	670	359	425	408	399	457	172	282	252	268	360	250	35	226
Zaventem	5,478	3,490	3,558	3,628	2,411	2,152	2,544	2,716	2,618	1,884	2,638	1,835	2,144	2,315	2,464	1,582	1,485
Zemst	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Total	**33,889**	**18,257**	**23,732**	**20,737**	**14,950**	**14,861**	**15,409**	**14,886**	**11,399**	**14,825**	**13,965**	**14,226**	**13,575**	**14,948**	**14,420**	**6,756**	**7,715**

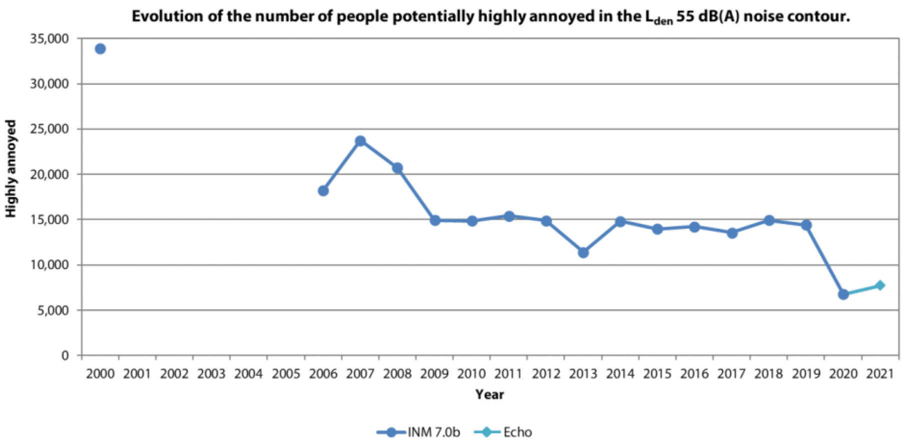


Figure 19: Evolution of the number of people who are potentially seriously inconvenienced inside the L_{den} 55 dB(A) noise contour.

Appendix A. Runway usage

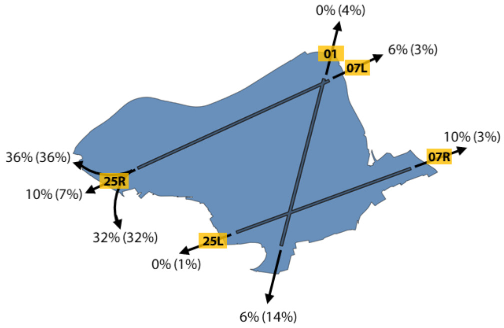
This appendix gives a complete description of the runway usage. The number of departures and arrivals are given for each runway, both absolute or percentage-wise, for 2021 and place against those for 2020, for:

- The total
- The day period, from 07:00 to 19:00
- The evening period, from 19:00 to 23:00
- The night period, from 23:00 to 07:00

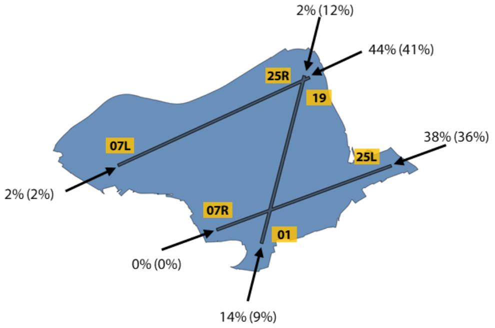
The figures give the share of departures and arrivals for each runway, with runway usage in 2020 between brackets. The tables also give the absolute number of movements.

Total runway usage: all flights day, evening and night.

Departures



Arrivals

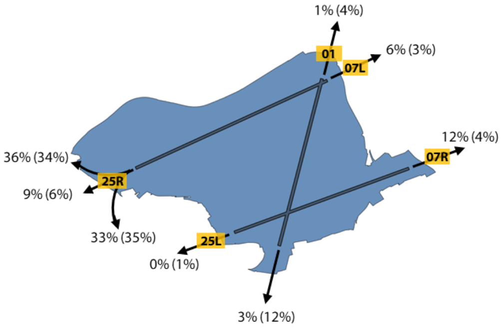


All flights (day, evening en night) Departures				
	Number		Percentage	
Runway	2020	2021	2020	2021
01	2,082	269	4.3%	0.5%
07L	1,502	3,444	3.1%	5.8%
07R	1,661	6,005	3.5%	10.1%
19	6,665	3,433	13.9%	5.8%
25L	367	30	0.8%	0.1%
25R	35,623	46,198	74.4%	77.8%

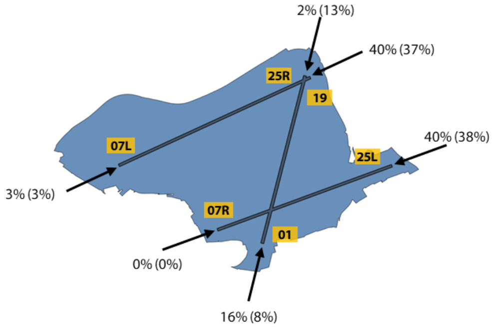
All flights (day, evening en night) Arrivals				
	Number		Percentage	
Runway	2020	2021	2020	2021
01	4,265	8,460	8.9%	14.3%
07L	993	1,187	2.1%	2.0%
07R	135	88	0.3%	0.1%
19	5,926	1,316	12.4%	2.2%
25L	17,162	22,322	35.8%	37.6%
25R	19,430	25,981	40.6%	43.8%

Runway usage for the day period, from 07:00 to 19:00

Departures



Arrivals

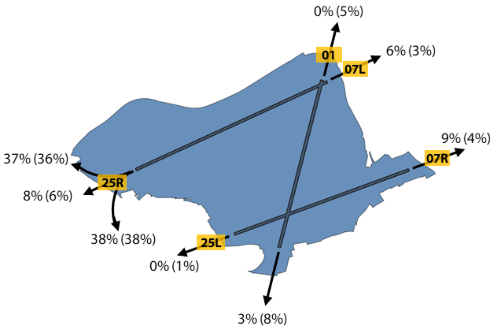


Flights day Departures				
	Number		Percentage	
Runway	2020	2021	2020	2021
01	1,270	248	4.0%	0.6%
07L	1,051	2,256	3.3%	5.8%
07R	1,290	4,719	4.0%	12.0%
19	4,000	1,282	12.5%	3.3%
25L	246	9	0.8%	0.0%
25R	24,185	30,680	75.5%	78.3%

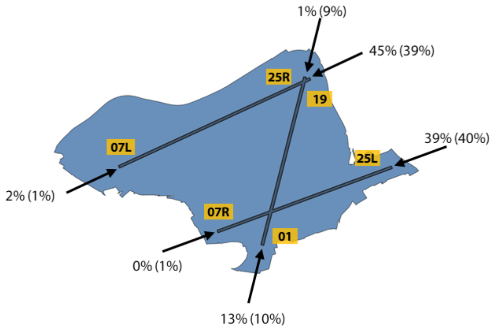
Flights day Arrivals				
	Number		Percentage	
Runway	2020	2021	2020	2021
01	2,513	5,882	8.3%	15.6%
07L	862	988	2.9%	2.6%
07R	66	31	0.2%	0.1%
19	3,940	615	13.1%	1.6%
25L	11,584	15,251	38.4%	40.3%
25R	11,195	15,038	37.1%	39.8%

Runway usage for the evening period, from 19:00 to 23:00

Departures



Arrivals

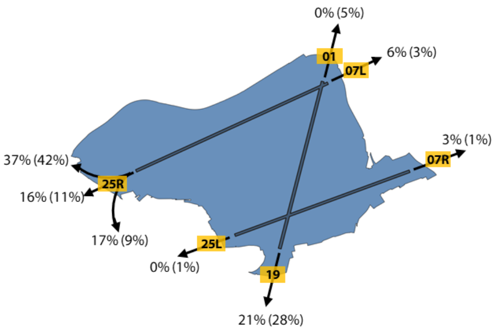


Flights evening Departures				
	Number		Percentage	
Runway	2020	2021	2020	2021
01	449	13	5.0%	0.1%
07L	240	647	2.7%	5.7%
07R	332	992	3.7%	8.7%
19	697	299	7.8%	2.6%
25L	72	1	0.8%	0.0%
25R	7,142	9,473	80.0%	82.9%

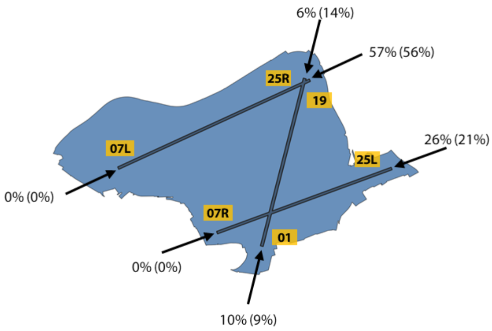
Flights evening Arrivals				
	Number		Percentage	
Runway	2020	2021	2020	2021
01	1,032	1,554	10.5%	13.4%
07L	116	186	1.2%	1.6%
07R	65	27	0.7%	0.2%
19	866	118	8.8%	1.0%
25L	3,945	4,485	40.0%	38.6%
25R	3,837	5,253	38.9%	45.2%

Runway usage for the night period from 23:00 to 07:00

Departures



Arrivals



Flights night Departures				
	Number		Percentage	
Runway	2020	2021	2020	2021
01	363	8	5.2%	0.1%
07L	211	541	3.0%	6.2%
07R	39	294	0.6%	3.4%
19	1,968	1,852	28.4%	21.1%
25L	49	20	0.7%	0.2%
25R	4,296	6,045	62.0%	69.0%

Flights night Arrivals				
	Number		Percentage	
Runway	2020	2021	2020	2021
01	720	1,024	9.1%	10.3%
07L	15	13	0.2%	0.1%
07R	4	30	0.1%	0.3%
19	1,120	583	14.2%	5.9%
25L	1,633	2,586	20.7%	26.1%
25R	4,398	5,690	55.7%	57.3%

Appendix B. Location of the measuring stations

This appendix gives the locations of the measuring station.

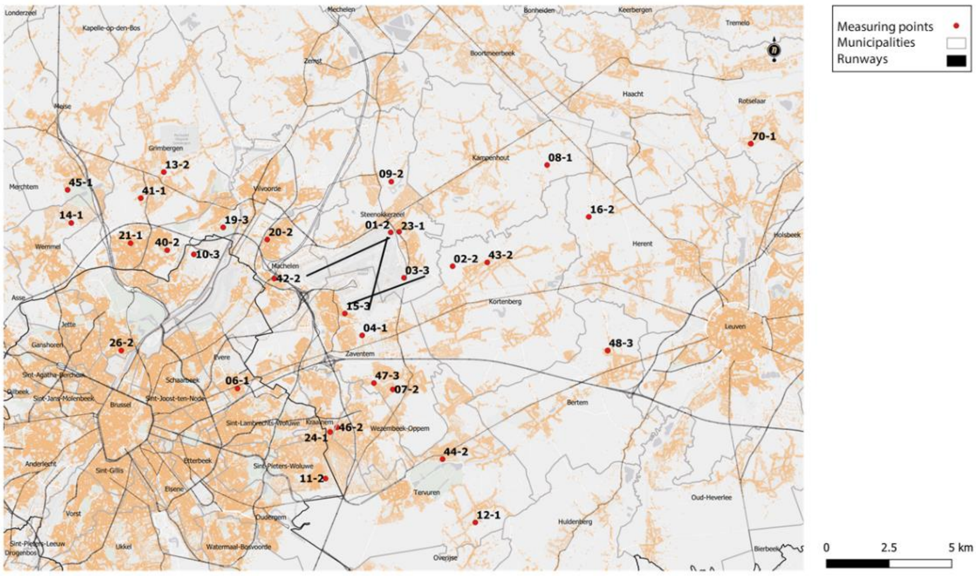


Figure 19: Location of the measuring stations

Table 7: Overview of the measuring stations

Code location	Location name
NMT01-2	STEENOKKERZEEL
NMT02-2	KORTENBERG
NMT03-3	HUMELGEM-Airside
NMT04-1	NOSSEGEM
NMT06-1	EVERE
NMT07-2	STERREBEEK
NMT08-1	KAMPENHOUT
NMT09-2	PERK
NMT10-3	NEDER-OVER-HEEMBEEK
NMT11-2	SINT-PIETERS-WOLUWE
NMT12-1	DUISBURG
NMT13-2	GRIMBERGEN
NMT14-1	WEMMEL
NMT15-3	ZAVENTEM
NMT16-2	VELTEM

Code location	Location name
NMT19-3/4	VILVOORDE
NMT20-2/3+	MACHELEN
NMT21-1	STROMBEEK-BEVER
NMT23-1	STEENOKKERZEEL
NMT24-1	KRAAINEM
NMT26-2	BRUSSEL
NMT40-2*	KONINGSLO
NMT41-1*	GRIMBERGEN
NMT42-2*	DIEGEM
NMT43-2*	ERPS-KWERPS
NMT44-2*	TERVUREN
NMT45-1*	MEISE
NMT46-2*	WEZEMBEEK-OPPEM
NMT47-3*	ZAVENTEM
NMT48-3*	BERTEM
NMT70-1*	ROTSELAAR

* noise data Department of the Environment, off-line correlated by the NMS

Appendix C. Results of contour calculations – 2021

This appendix gives the number of residents per contour zone and per municipality.

Number of residents per contour zone and per municipality

Table 8: Number of residents per L_{day} contour zone and municipality – 2021.

Number of residents	L_{day} - contourzone dB(A) (day 07:00-19:00)					
Municipality	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
Brussel	5,588	-	-	-	-	5,588
Kampenhout	629	152	-	-	-	781
Kortenberg	994	19	-	-	-	1,013
Kraainem	38	-	-	-	-	38
Machelen	5,125	2,985	22	-	-	8,132
Steenokkerzeel	2,933	514	23	0	0	3,471
Wezembeek-Oppem	8	-	-	-	-	8
Zaventem	2,371	0	0	-	-	2,371
Total	**17,686**	**3,670**	**45**	**0**	**0**	**21,401**

Table 9: Number of residents per $L_{evening}$ contour zone and municipality – 2021.

Number of residents	$L_{evening}$ - contourzone dB(A) (evening 19:00-23:00)						
Municipality	**50-55**	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
Brussel	5,411	5,432	-	-	-	-	10,843
Evere	16,120	-	-	-	-	-	16,120
Haacht	947	-	-	-	-	-	947
Herent	856	-	-	-	-	-	856
Kampenhout	2,682	654	155	-	-	-	3,491
Kortenberg	2,219	523	9	-	-	-	2,751
Kraainem	3,560	-	-	-	-	-	3,560
Machelen	6,435	4,788	2,976	9	-	-	14,209
Schaarbeek	10	-	-	-	-	-	10
Sint-Pieters-Woluwe	1,567	-	-	-	-	-	1,567
Steenokkerzeel	5,255	2,604	537	27	0	0	8,422
Vilvoorde	1,972	-	-	-	-	-	1,972
Wezembeek-Oppem	2,388	-	-	-	-	-	2,388
Zaventem	7,394	2,281	0	0	-	-	9,675
Total	**56,816**	**16,282**	**3,677**	**37**	**0**	**0**	**76,812**

Table 10: Number of residents per L_{night} contour zone and municipality – 2021.

Number of residents	L_{night} - contourzone dB(A) (night 23:00-07:00)						
Municipality	**45-50**	**50-55**	**55-60**	**60-65**	**65-70**	**>70**	**Total**
Brussel	11,154	3,967	-	-	-	-	15,121
Evere	6,243	-	-	-	-	-	6,243
Grimbergen	958	-	-	-	-	-	958
Haacht	2,588	11	-	-	-	-	2,599
Herent	1,310	21	-	-	-	-	1,331
Kampenhout	3,575	1,513	349	101	-	-	5,538
Kortenberg	2,212	900	25	-	-	-	3,136
Kraainem	3,894	109	-	-	-	-	4,004
Leuven	411	-	-	-	-	-	411
Machelen	6,037	8,191	513	7	-	-	14,748
Rotselaar	2,002	-	-	-	-	-	2,002
Sint-Pieters-Woluwe	2,870	-	-	-	-	-	2,870
Steenokkerzeel	4,669	3,857	566	305	0	0	9,396
Vilvoorde	8,652	-	-	-	-	-	8,652
Wezembeek-Oppem	3,895	101	-	-	-	-	3,996
Zaventem	17,480	6,395	26	0	-	-	23,901
Total	**77,952**	**25,065**	**1,479**	**412**	**0**	**0**	**104,908**

Table 11: Number of residents per L_{den} contour zone and municipality – 2021.

Number of residents	L_{den} - contourzone dB(A) (d. 07h-19h, ev. 19h-23h, n. 23h-07h)					
Municipality	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
Brussel	7,082	635	-	-	-	7,717
Evere	933	-	-	-	-	933
Haacht	671	-	-	-	-	671
Herent	746	-	-	-	-	746
Kampenhout	2,260	643	162	-	-	3,065
Kortenberg	1,795	302	-	-	-	2,097
Kraainem	2,216	-	-	-	-	2,216
Machelen	7,193	5,482	309	-	-	12,985
Sint-Pieters-Woluwe	64	-	-	-	-	64
Steenokkerzeel	5,905	1,574	458	30	0	7,967
Vilvoorde	53	-	-	-	-	53
Wezembeek-Oppem	1,851	-	-	-	-	1,851
Zaventem	9,463	1,290	1	0	-	10,754
Total	**40,232**	**9,926**	**931**	**30**	**0**	**51,119**

Table 12: Number of residents per Freq.70,day contour zone and municipality – 2021.

Number of residents	Freq.70,day - contourzone (day 07:00-23:00)					
municipality	**5-10**	**10-20**	**20-50**	**50-100**	**>100**	**Total**
Brussel	3,649	2,287	5,921	392	-	12,250
Evere	31,260	11,580	-	-	-	42,841
Grimbergen	8,961	-	-	-	-	8,961
Haacht	1,088	289	2	-	-	1,379
Herent	173	141	540	21	-	874
Kampenhout	1,546	770	1,410	444	-	4,170
Kortenberg	1,325	1,111	1,208	859	-	4,504
Kraainem	1,036	2,123	1,668	-	-	4,827
Leuven	161	-	-	-	-	161
Machelen	1,945	1,933	3,683	5,291	323	13,175
Rotselaar	364	-	-	-	-	364
Schaarbeek	7,549	-	-	-	-	7,549
Sint-Lambrechts-Woluwe	12,933	-	-	-	-	12,933
Sint-Pieters-Woluwe	2,526	3,200	50	-	-	5,777
Steenokkerzeel	2,106	2,678	3,187	1,239	2	9,212
Vilvoorde	7,823	1,336	26	-	-	9,185
Wezembeek-Oppem	917	1,713	1,042	-	-	3,672
Zaventem	4,688	1,591	2,140	1,200	0	9,619
Total	**90,051**	**30,752**	**20,878**	**9,447**	**325**	**151,451**

Table 13: Number of residents per Freq.70,night contour zone and municipality – 2021.

Number of residents	Freq.70,night - contourzone (night 23:00-07:00)				
municipality	**1-5**	**5-10**	**10-20**	**>20**	**Total**
Boortmeerbeek	745	-	-	-	745
Brussel	6,542	159	5,059	-	11,760
Evere	3,796	-	-	-	3,796
Grimbergen	5,737	-	-	-	5,737
Haacht	1,284	2	183	-	1,469
Herent	396	-	556	-	952
Kampenhout	1,555	1,575	784	-	3,914
Kortenberg	1,477	-	1,704	-	3,181
Kraainem	4,982	-	-	-	4,982
Leuven	318	-	-	-	318
Machelen	4,870	4,970	3,461	-	13,300
Rotselaar	1,673	-	-	-	1,673
Schaarbeek	752	-	-	-	752
Sint-Pieters-Woluwe	6,017	-	-	-	6,017
Steenokkerzeel	5,405	2,195	1,773	0	9,373
Tervuren	2,744	-	-	-	2,744
Vilvoorde	8,744	-	33	-	8,778
Wezembeek-Oppem	5,447	-	-	-	5,447
Zaventem	17,695	1,445	4,674	-	23,815
Zemst	100	-	-	-	100
Total	**80,278**	**10,346**	**18,228**	**0**	**108,852**

Table 14: Number of residents per Freq.60,day contour zone and municipality – 2021.

Number of residents	Freq.60,day - contourzone (day 07:00-23:00)				
municipality	**50-100**	**100-150**	**150-200**	**>200**	**Total**
Brussel	8,448	1,606	-	-	10,054
Evere	4,802	-	-	-	4,802
Haacht	2,304	-	-	-	2,304
Herent	1,338	-	-	-	1,338
Kampenhout	4,365	-	-	-	4,365
Kortenberg	3,858	-	-	-	3,858
Kraainem	6,644	-	-	-	6,644
Leuven	1,135	-	-	-	1,135
Machelen	6,795	7,887	-	-	14,682
Rotselaar	1,888	-	-	-	1,888
Sint-Pieters-Woluwe	5,358	-	-	-	5,358
Steenokkerzeel	5,361	2,622	0	-	7,983
Vilvoorde	112	-	-	-	112
Wezembeek-Oppem	3,948	-	-	-	3,948
Zaventem	4,788	4,385	-	-	9,173
Total	**61,144**	**16,500**	**0**	**-**	**77,644**

Table 15: Number of residents per Freq.60,night contour zone and municipality – 2021.

Number of residents	Freq.60,night - contourzone (night 23:00-07:00)				
municipality	**10-15**	**15-20**	**20-30**	**>30**	**Total**
Brussel	12,377	4,846	-	-	17,223
Haacht	1,142	2,028	-	-	3,170
Herent	387	99	-	-	485
Kampenhout	1,768	4,339	-	-	6,107
Kortenberg	30	12	-	-	42
Machelen	3,904	11,074	5	-	14,983
Rotselaar	3,227	2	-	-	3,229
Steenokkerzeel	1,186	2,355	4,388	740	8,669
Tremelo	53	-	-	-	53
Vilvoorde	110	-	-	-	110
Zaventem	2,705	3,246	6,004	-	11,955
Total	**26,888**	**28,000**	**10,397**	**740**	**66,026**

C.2 Number of persons who are potentially highly inconvenienced per contour zone and per municipality.

Table 16: Number of residents potentially highly inconvenienced contour zone and municipality – 2021.

Number of potentially highly annoyed	L_{den} - contourzone in dB(A) (d. 07h-19h, av. 19h-23h, n. 23h-07h)					
Municipality	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
Brussel	1,033	118	-	-	-	1,151
Evere	100	-	-	-	-	100
Haacht	74	-	-	-	-	74
Herent	88	-	-	-	-	88
Kampenhout	300	132	48	-	-	481
Kortenberg	241	60	-	-	-	301
Kraainem	256	-	-	-	-	256
Machelen	983	1,171	88	-	-	2,242
Sint-Pieters-Woluwe	7	-	-	-	-	7
Steenokkerzeel	821	319	147	12	0	1,298
Vilvoorde	7	-	-	-	-	7
Wezembeek-Oppem	226	-	-	-	-	226
Zaventem	1,239	246	0	0	-	1,485
Total	**5,374**	**2,046**	**283**	**12**	**0**	**7,715**

Appendix D. Noise contour maps: evolution for 2020-2021

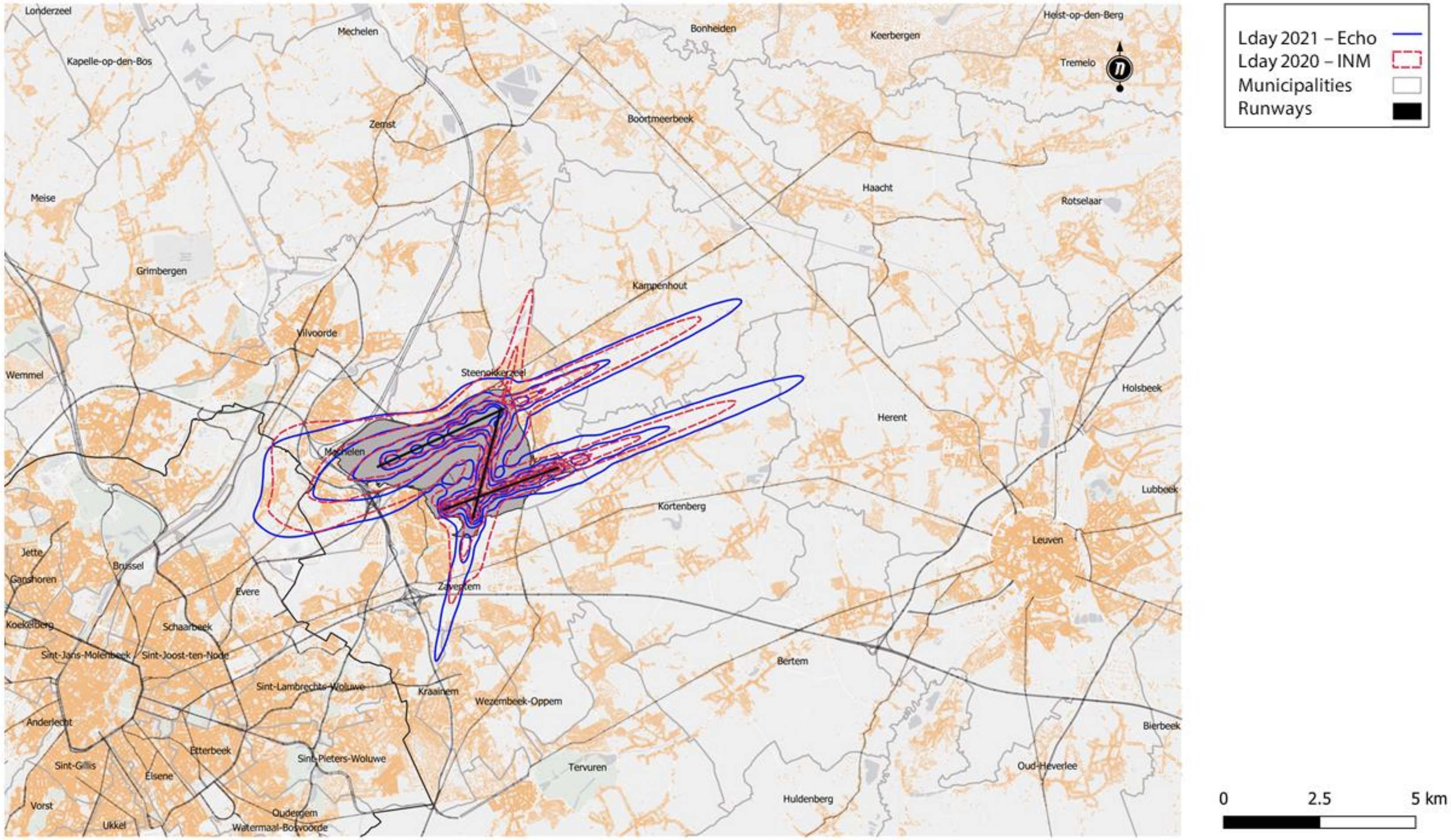
In this appendix the noise maps are available in A4 format.

- L_{day} noise contours for 2020 and 2021, background population map – 2021
- $L_{evening}$ noise contours for 2020 and 2021, background population map – 2021
- L_{night} noise contours for 2020 and 2021, background population map – 2021
- L_{den} noise contours for 2020 and 2021, background population map – 2021
- Freq.70,day noise contours for 2020 and 2021, background population map – 2021
- Freq.70,night noise contours for 2020 and 2021, background population map – 2021
- Freq.60,day noise contours for 2020 and 2021, background population map – 2021
- Freq.60,night noise contours for 2020 and 2021, background population map – 2021

- L_{day} noise contours for 2020 and 2021, background NGI topographical map
- $L_{evening}$ noise contours for 2020 and 2021, background NGI topographical map
- L_{night} noise contours for 2020 and 2021, background NGI topographical map
- L_{den} noise contours for 2020 and 2021, background NGI topographical map
- Freq.70,day noise contours for 2020 and 2021, background NGI topographical map
- Freq.70,night noise contours for 2020 and 2021, background NGI topographical map
- Freq.60,day noise contours for 2020 and 2021, background NGI topographical map
- Freq.60,night noise contours for 2020 and 2021, background NGI topographical map

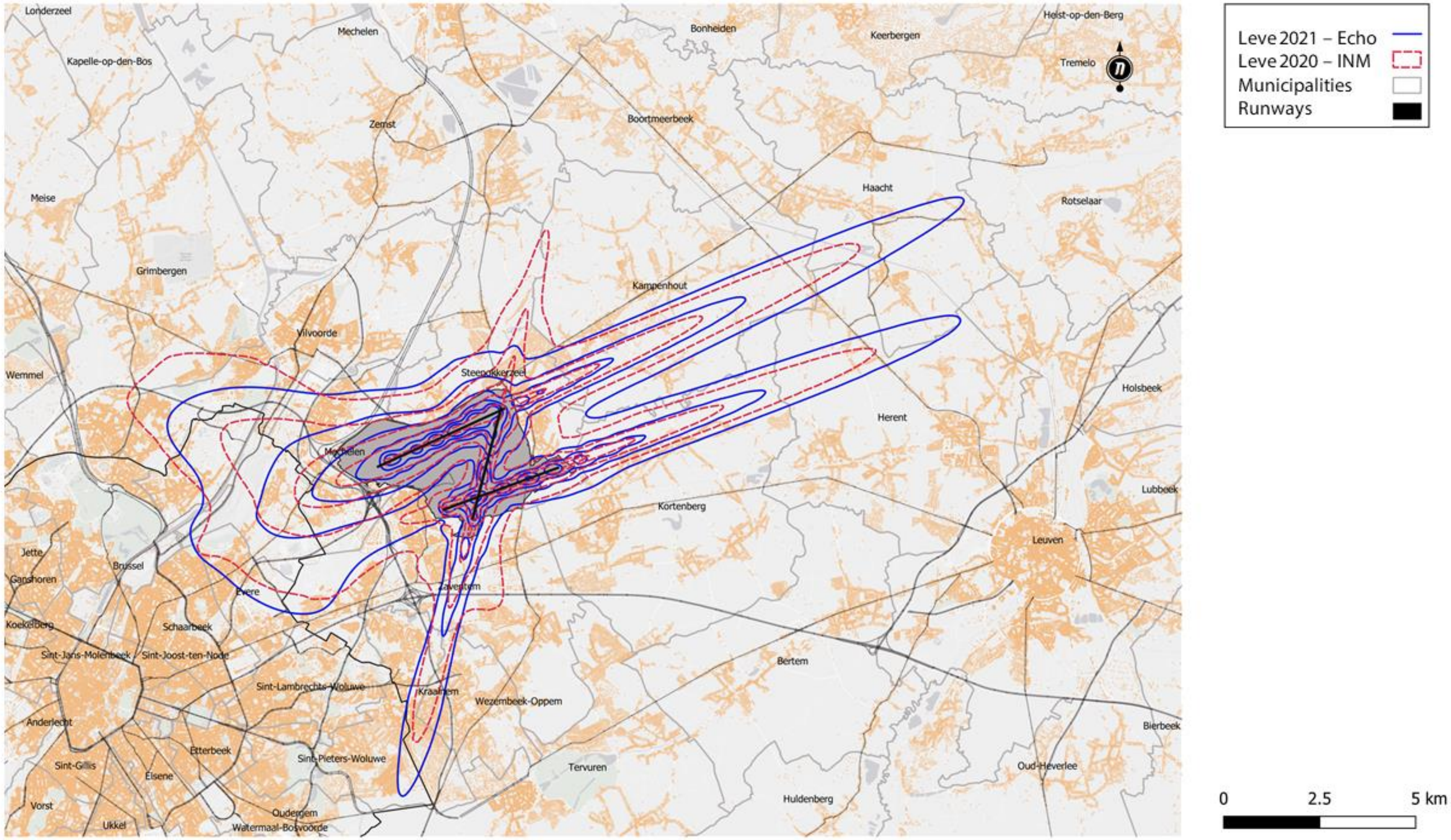
Evolution of L_{day} (07:00 to 19:00) noise contours - background population map 2021

The contours are shown here for 2020 and 2021 where, between 07:00 and 19:00, the noise impact by air traffic is, on average, 55, 60, 65, 70 and 75 dB(a). The values are ascending inwards: the outermost contour corresponds with 55 dB(A), etc.



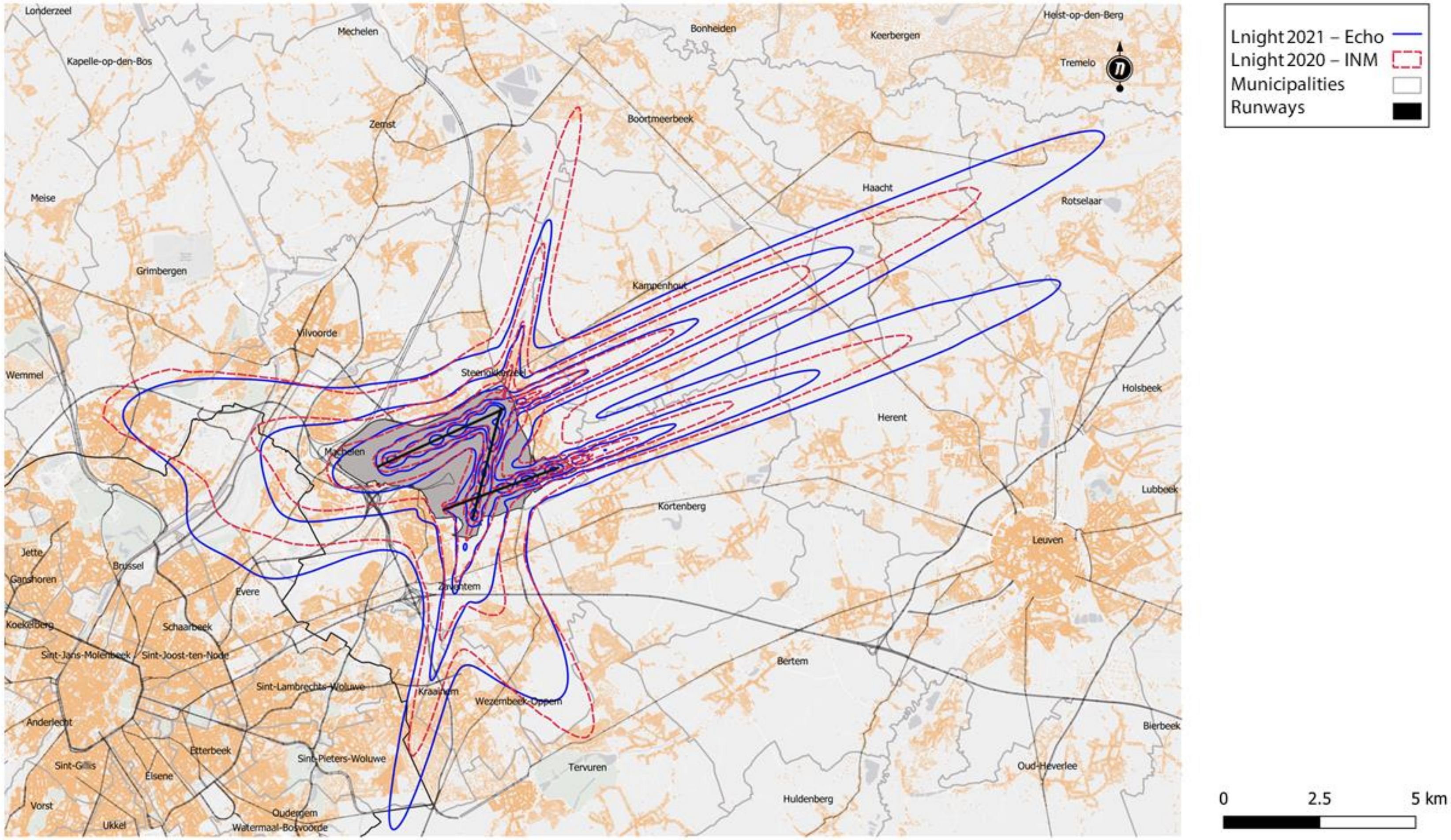
Evolution of $L_{evening}$ (19:00 to 23:00) noise contours - background population map 2021

The contours are shown here for 2020 and 2021 where, between 19:00 and 23:00, the noise impact by air traffic is, on average, 50, 55, 60, 65, 70 and 75 dB(a). The values are ascending inwards: the outermost contour corresponds with 50 dB(A), etc.



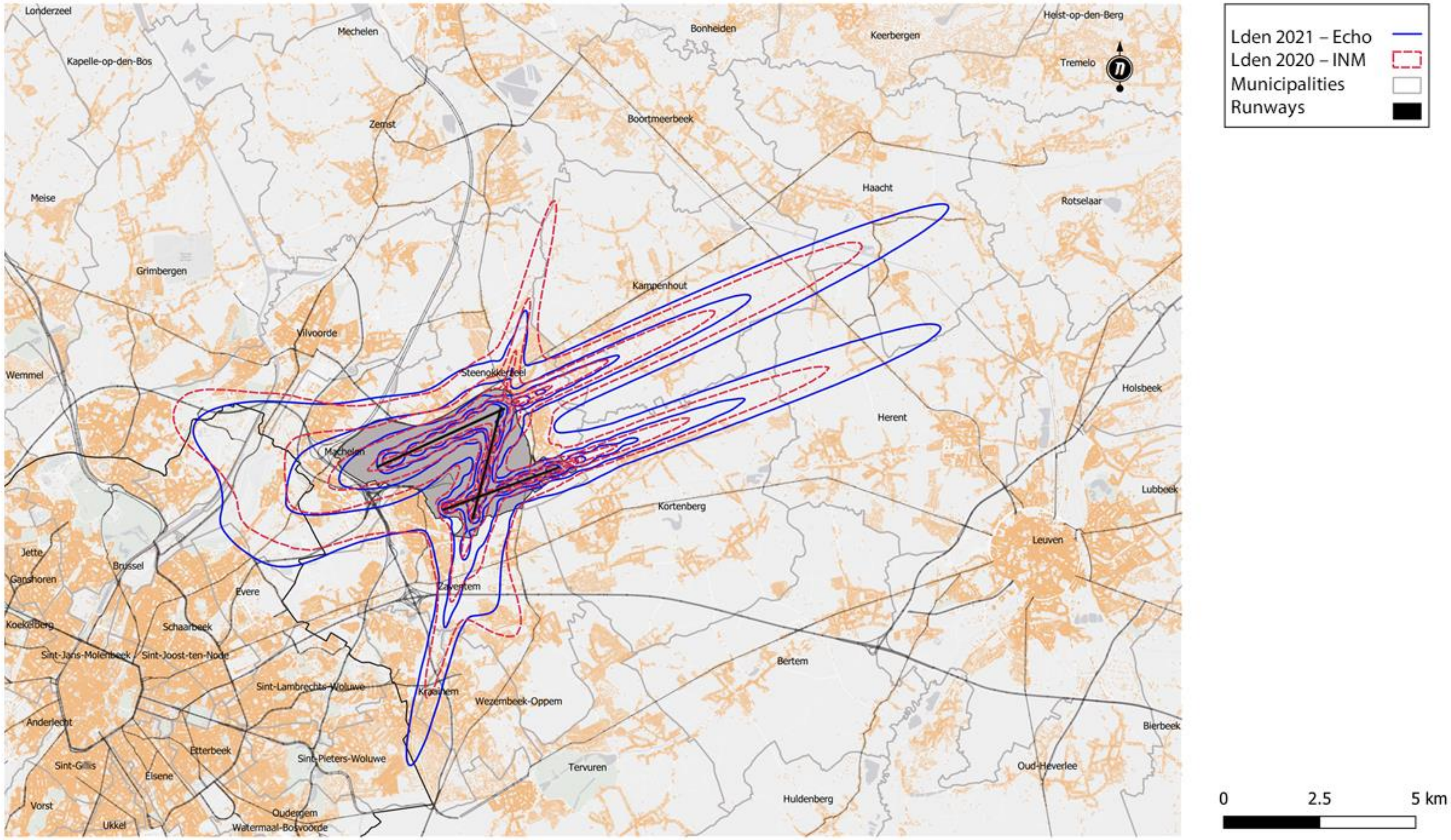
Evolution of L night (23:00 to 07:00) noise contours - background population map 2021

The contours are shown here for 2020 and 2021 where, between 23:00 and 07:00, the noise impact by air traffic is, on average, 45, 50, 55, 60, 65 and 70 dB(a). The values are ascending inwards: the outermost contour corresponds with 45 dB(A), etc.



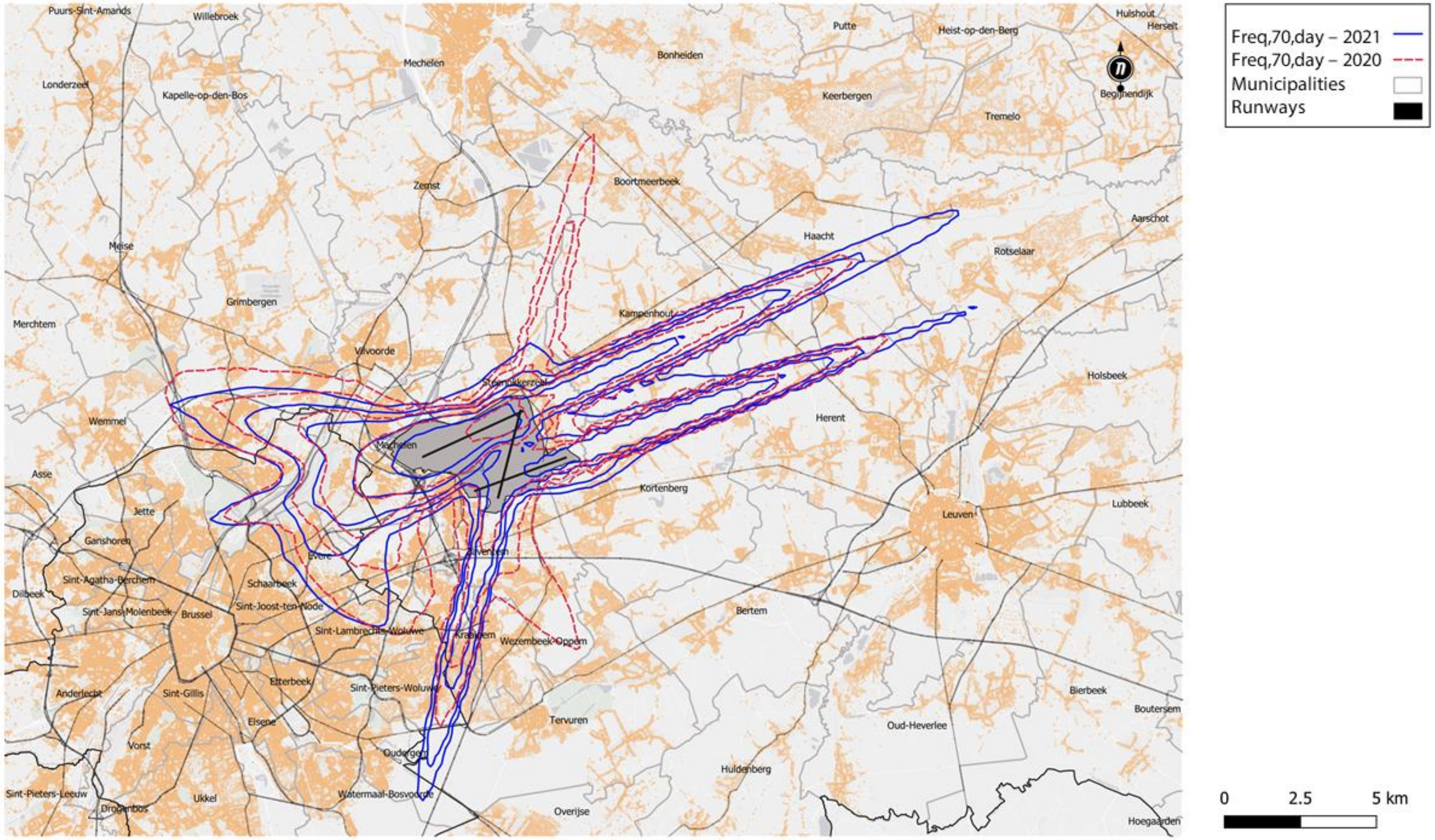
Evolution of L_{den} noise contours - background population map 2021

The contours are shown here for 2020 and 2021 where the noise impact by air traffic is, on average, 55, 60, 65, 70 and 75 dB(a). The values are ascending inwards: the outermost contour corresponds with 55 dB(A), etc.



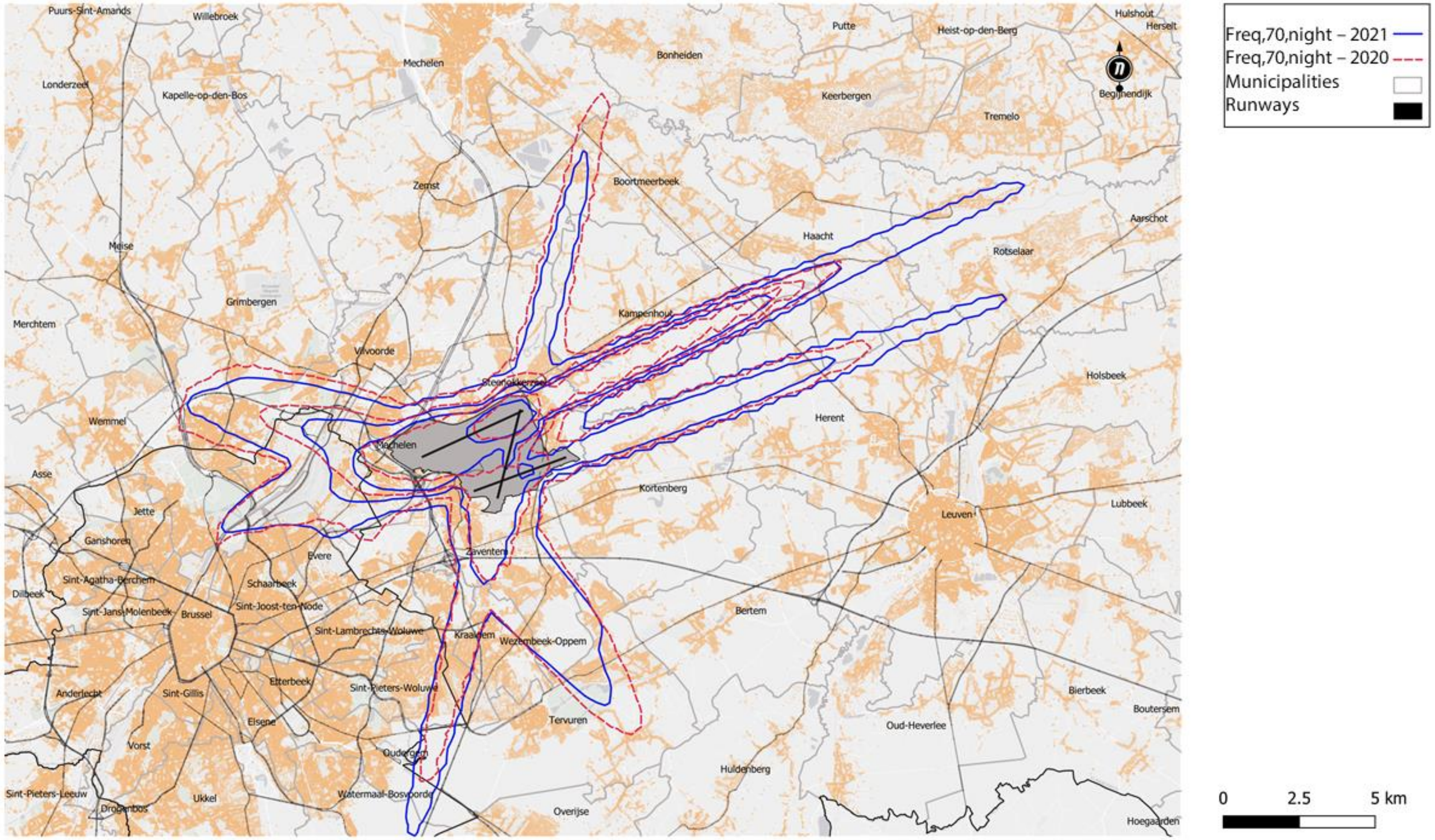
Evolution of Freq.70,day - background population map 2021

The contours are shown here for 2020 and 2021 where on average a noise level of 70 dB or higher is observed 5x, 10x, 20x, 50x and 100x per day during an aircraft passage between 07:00 and 23:00, The values are ascending inwards: the outermost contour corresponds with of 5x per day, etc.



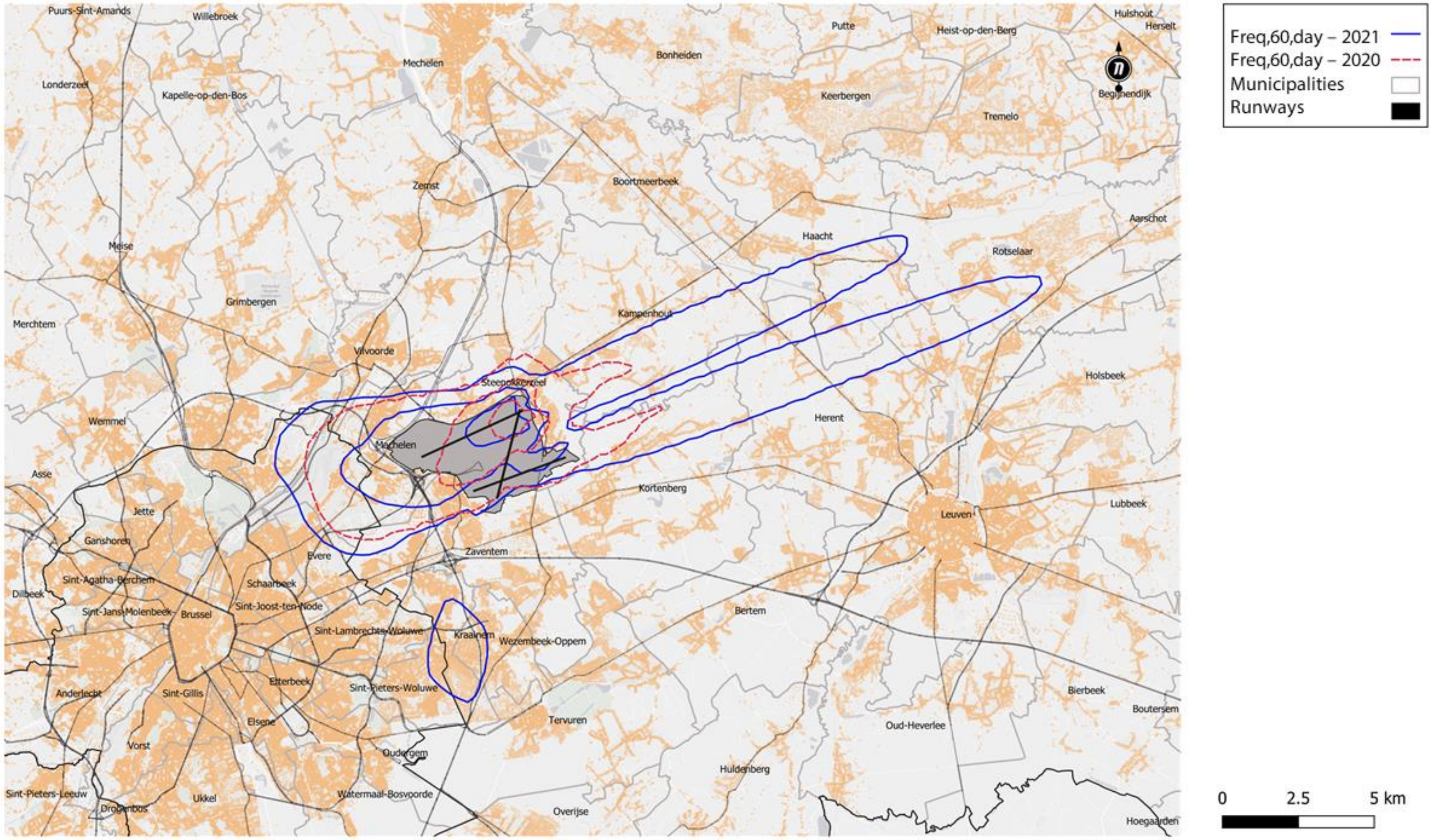
Evolution of Freq.70, night - background population map 2021

The contours are shown here for 2020 and 2021 where on average a noise level of 70 dB or higher is observed 1x, 5x, 10x, 20x and 50x per day during an aircraft passage between 23:00 and 07:00, The values are ascending inwards: the outermost contour corresponds with 1x per day, etc.



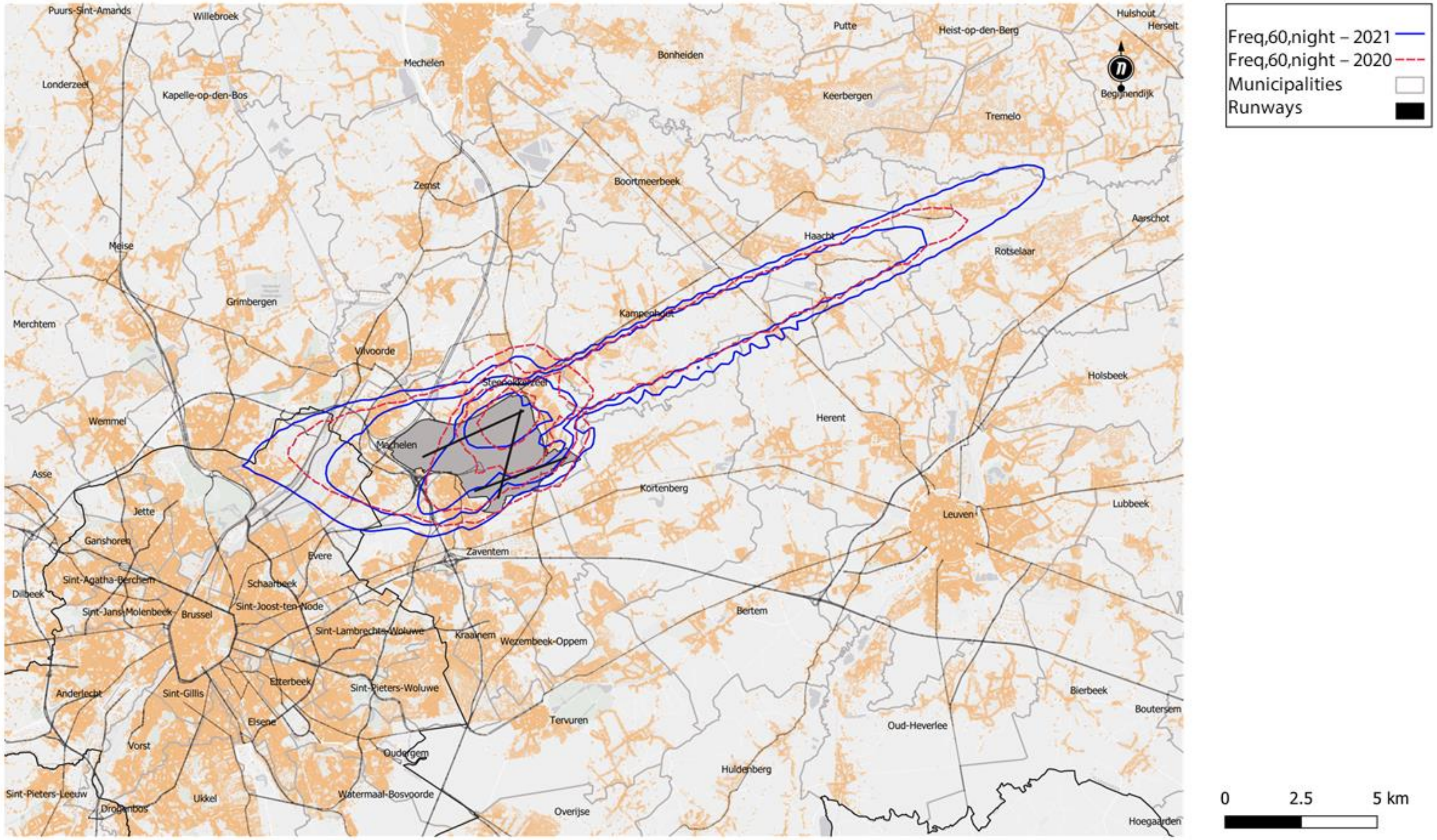
Evolution of Freq.60,day - background population map 2021

The contours are shown here for 2020 and 2021 where on average a noise level of 60 dB or higher is observed 50x, 100x, 150x and 200x per day during an aircraft passage between 07:00 and 23:00, The values are ascending inwards: the outermost contour corresponds with of 50x per day, etc.



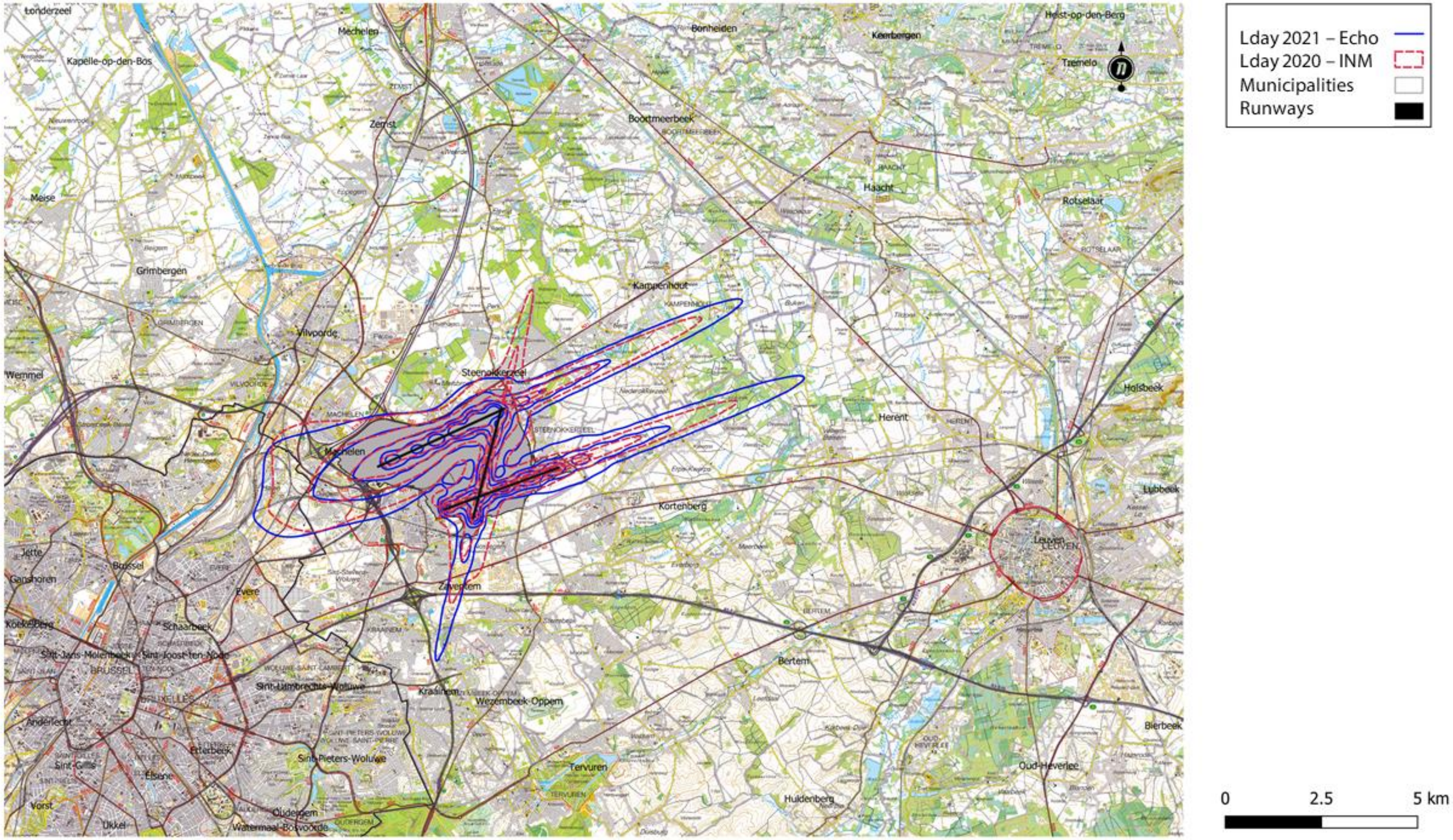
Evolution of Freq.60, night - background population map 2021

The contours are shown here for 2020 and 2021 where on average a noise level of 60 dB or higher is observed 10x, 15x, 20x and 30x per day during an aircraft passage between 23:00 and 07:00, The values are ascending inwards: the outermost contour corresponds with of 10x per day, etc.



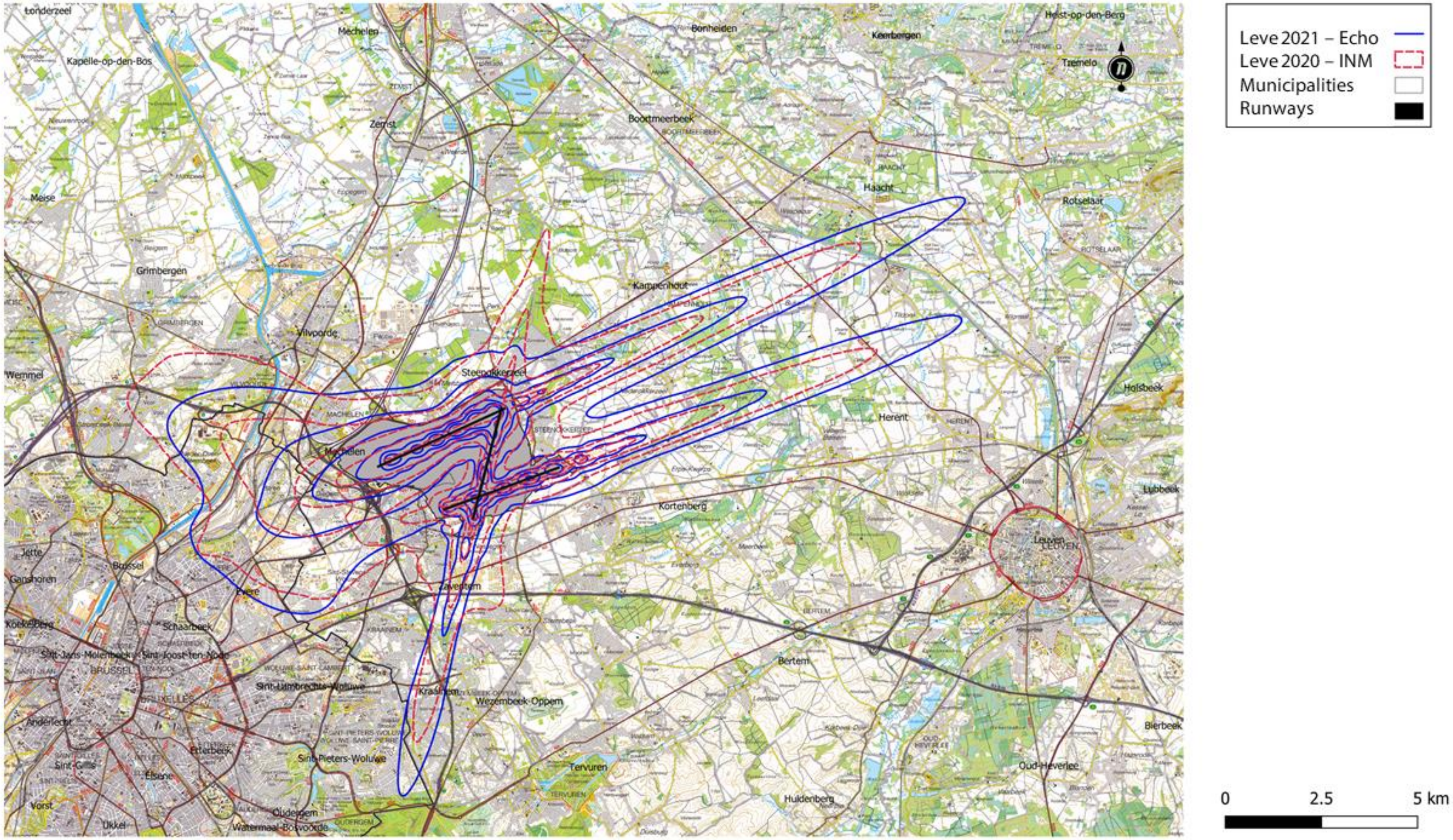
Evolution of L_{day} (07:00 to 19:00) noise contours - background NGI topographical 2021

The contours are shown here for 2020 and 2021 where, between 07:00 and 19:00, the noise impact by air traffic is, on average, 55, 60, 65, 70 and 75 dB(a). The values are ascending inwards: the outermost contour corresponds with 55 dB(A), etc.



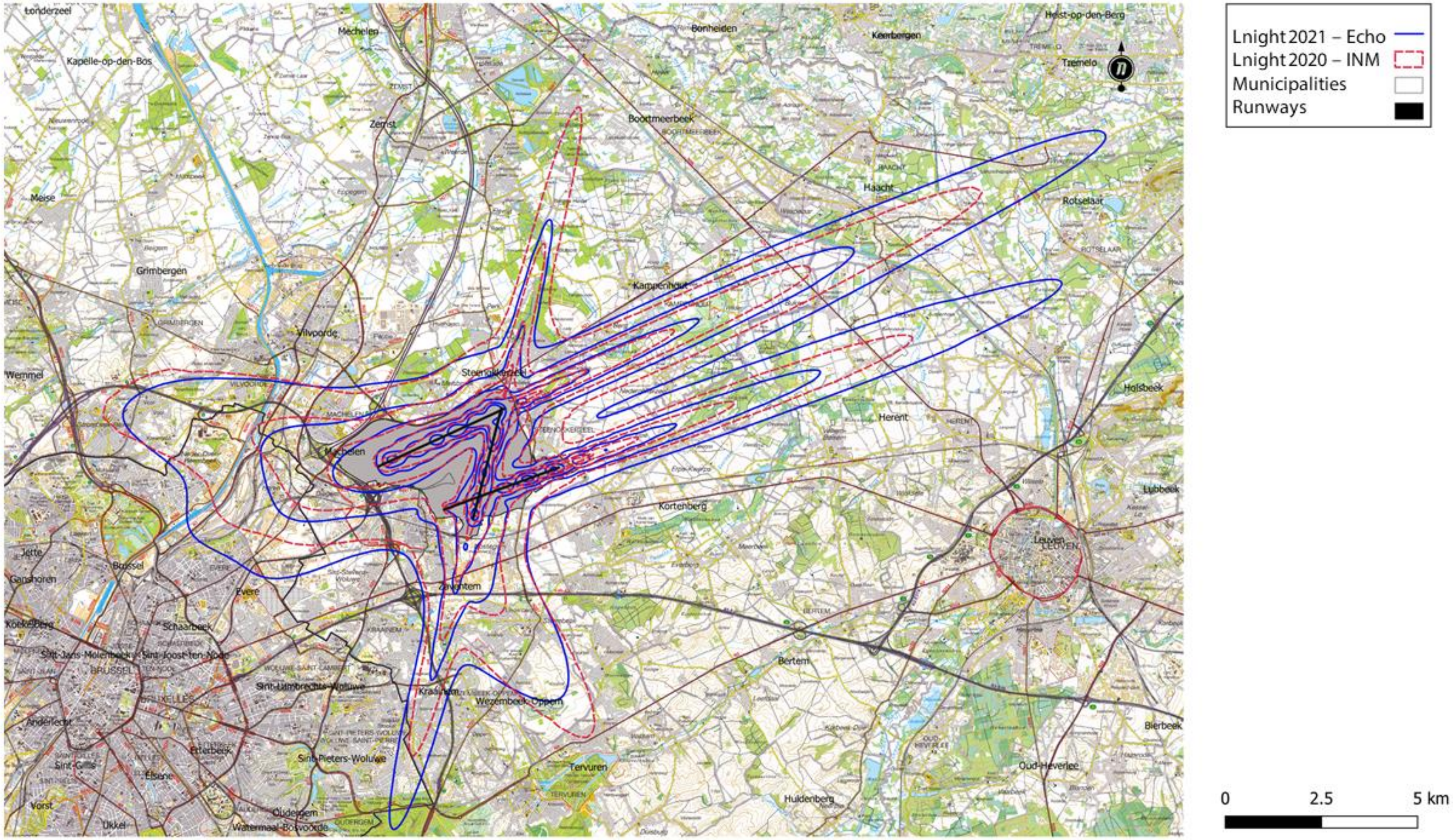
Evolution of $L_{evening}$ (19:00 to 23:00) noise contours - background NGI topographical 2021

The contours are shown here for 2020 and 2021 where, between 19:00 and 23:00, the noise impact by air traffic is, on average, 50, 55, 60, 65, 70 and 75 dB(a). The values are ascending inwards: the outermost contour corresponds with 50 dB(A), etc.



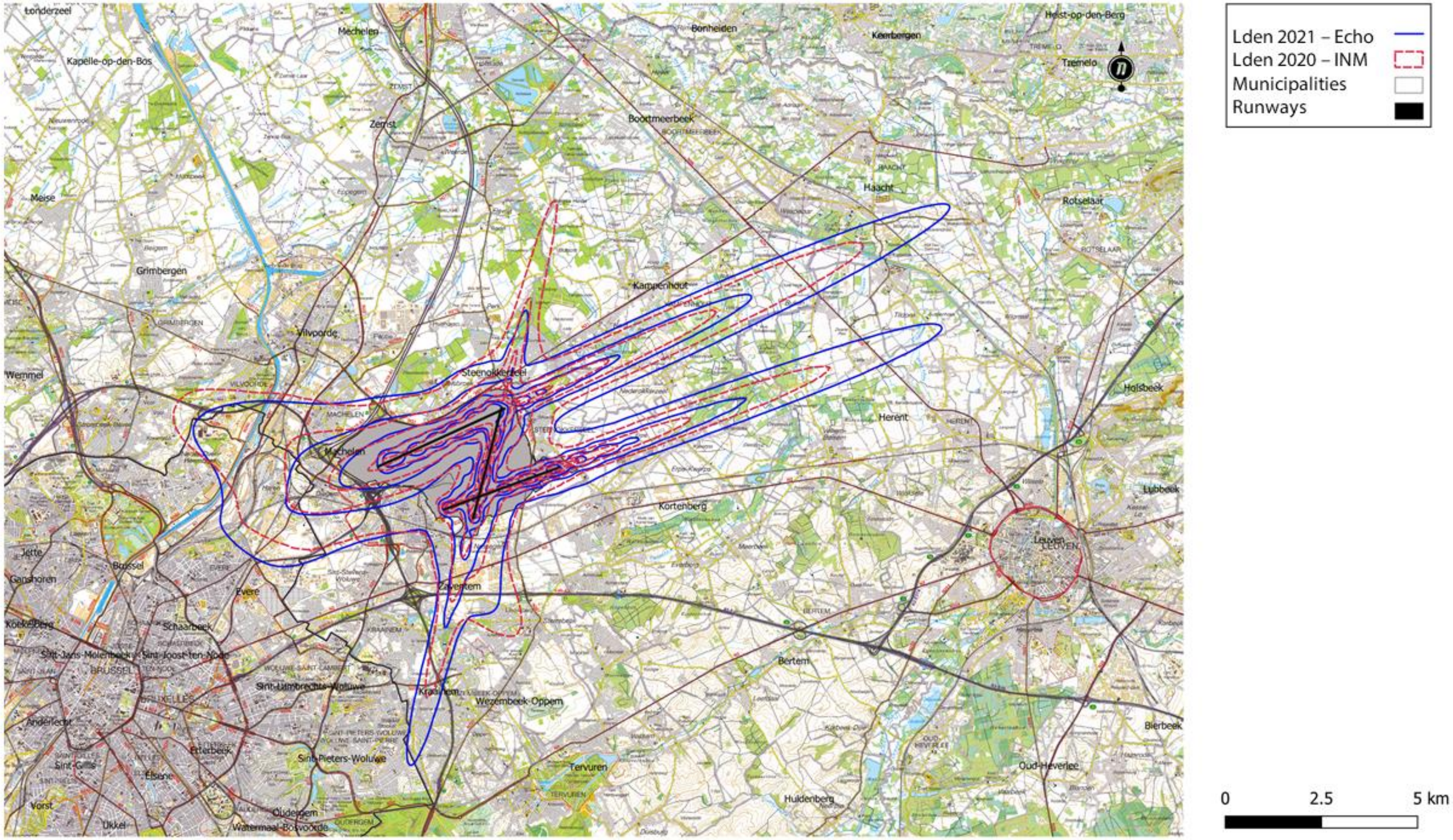
Evolution of L night (23:00 to 07:00) noise contours - background NGI topographical 2021

The contours are shown here for 2020 and 2021 where, between 23:00 and 07:00, the noise impact by air traffic is, on average, 45, 50, 55, 60, 65 and 70 dB(a). The values are ascending inwards: the outermost contour corresponds with 45 dB(A), etc.



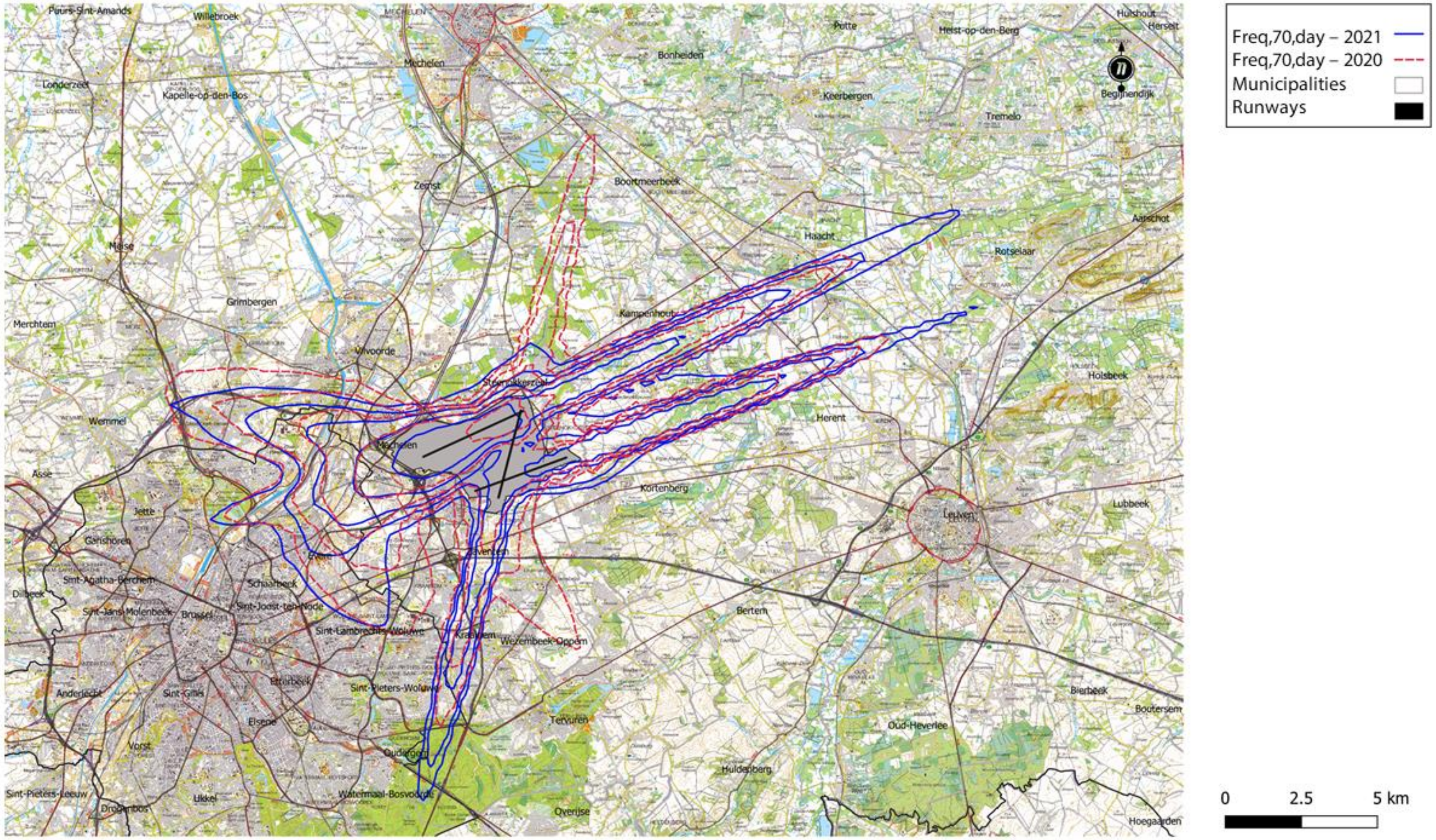
Evolution of L_{den} noise contours - background NGI topographical 2021

The contours are shown here for 2020 and 2021 where the noise impact by air traffic is, on average, 55, 60, 65, 70 and 75 dB(a). The values are ascending inwards: the outermost contour corresponds with 55 dB(A), etc.



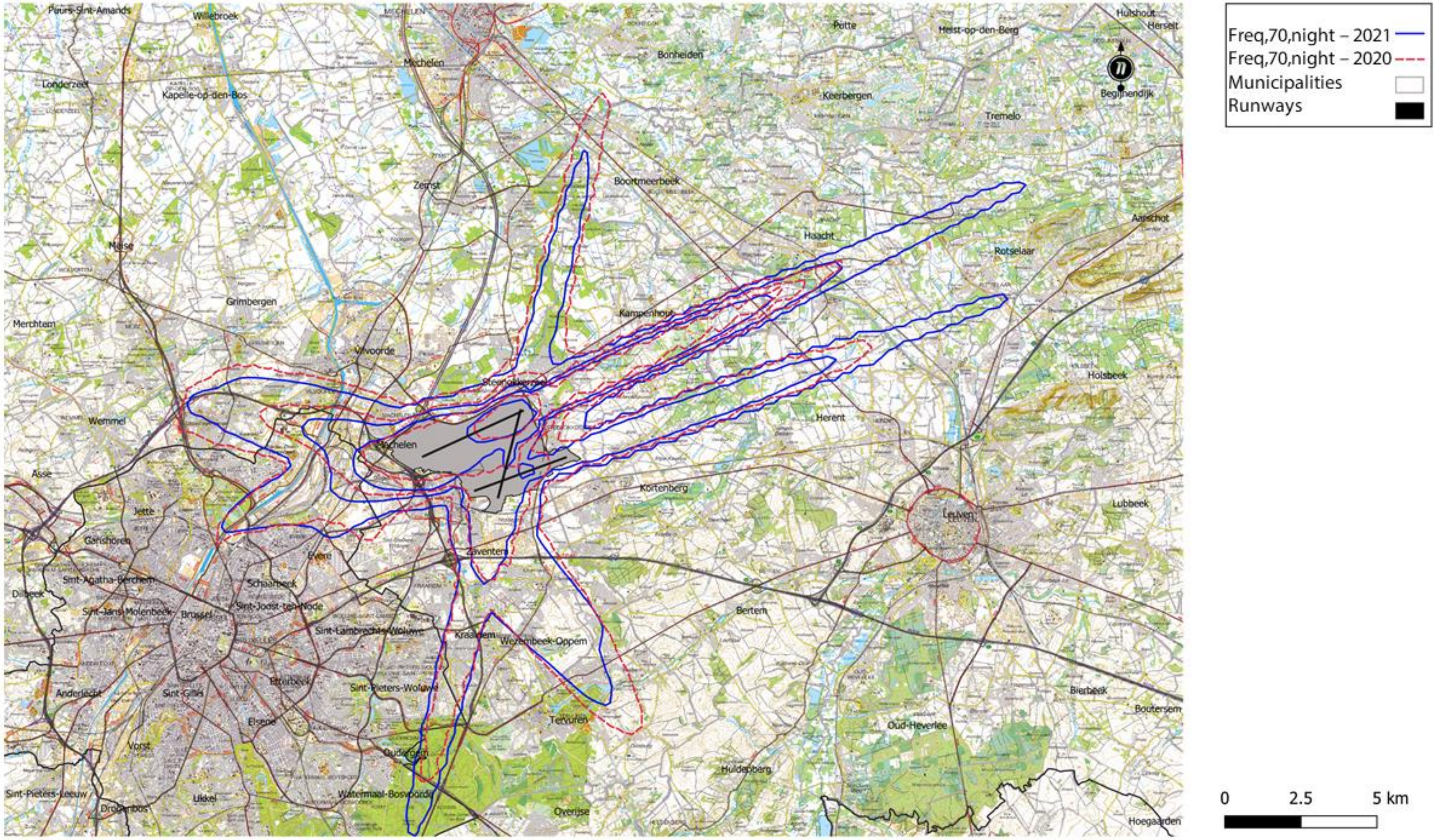
Evolution of Freq.70,day - background NGI topographical 2021

The contours are shown here for 2020 and 2021 where on average a noise level of 70 dB or higher is observed 5x, 10x, 20x, 50x and 100x per day during an aircraft passage between 07:00 and 23:00, The values are ascending inwards: the outermost contour corresponds with of 5x per day, etc.



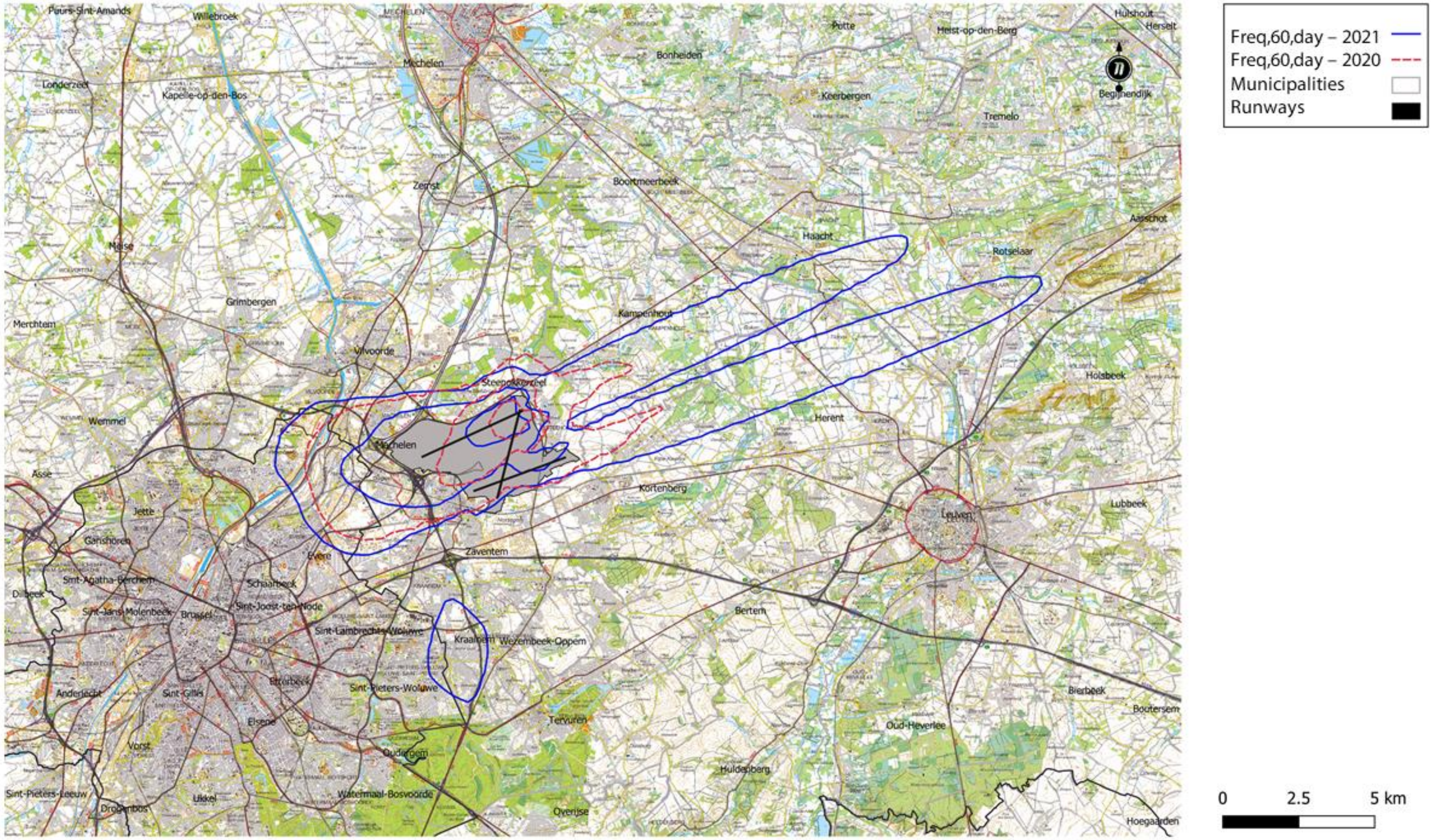
Evolution of Freq.70, night - background NGI topographical 2021

The contours are shown here for 2020 and 2021 where on average a noise level of 70 dB or higher is observed 1x, 5x, 10x, 20x and 50x per day during an aircraft passage between 23:00 and 07:00, The values are ascending inwards: the outermost contour corresponds with of 1x per day, etc.



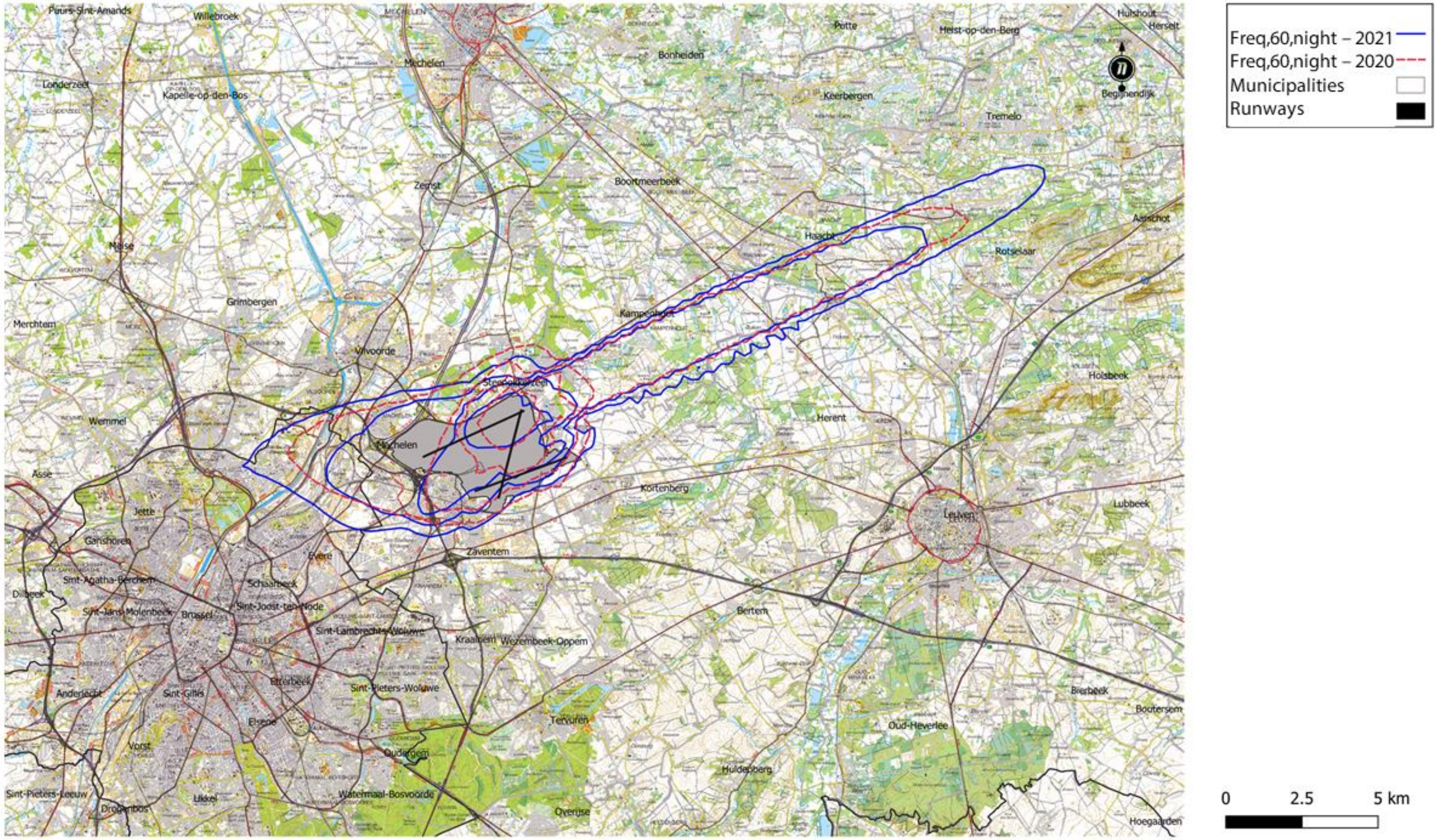
Evolution of Freq.60,day - background NGI topographical 2021

The contours are shown here for 2020 and 2021 where on average a noise level of 60 dB or higher is observed 50x, 100x, 150x and 200x per day during an aircraft passage between 07:00 and 23:00, The values are ascending inwards: the outermost contour corresponds with of 50x per day, etc.



Evolution of Freq.60, night - background NGI topographical 2021

The contours are shown here for 2020 and 2021 where on average a noise level of 60 dB or higher is observed 10x, 15x, 20x and 30x per day during an aircraft passage between 23:00 and 07:00, The values are ascending inwards: the outermost contour corresponds with of 10x per day, etc.



Appendix E. Evolution of the surface area and the number of residents

E.1 Evolution of the surface area per contour zone: L_{day}, $L_{evening}$, L_{night}, Freq.70,day, Freq.70,night, Freq.60,day and Freq.60,night.

Table 17: Evolution of the surface area inside the L_{day} contours (2000, 2006-2021).

Area (ha)	L_{day} contour zone in dB(A) (day 07.00-19.00)					
year	55-60	60-65	65-70	70-75	>75	Total
2000*	5,919	2,113	827	383	242	**9,485**
2001						
2002						
2003						
2004						
2005						
2006*	3,787	1,379	545	213	150	**6,073**
2007*	3,978	1,431	575	227	153	**6,364**
2008*	4,072	1,492	596	232	161	**6,553**
2009*	3,461	1,300	523	206	133	**5,622**
2010*	3,334	1,261	514	196	126	**5,431**
2011*	3,330	1,241	509	199	127	**5,406**
2012*	2,978	1,121	466	189	117	**4,871**
2013*	2,779	1,106	455	176	121	**4,637**
2014*	2,924	1,120	474	187	116	**4,821**
2015*	3,143	1,180	489	230	93	**5,135**
2016*	2,886	1,087	545	123	82	**4,723**
2017*	2,990	1,109	471	216	90	**4,876**
2018*	3,037	1,150	486	227	87	**4,987**
2019*	2,963	1,105	554	138	91	**4,851**
2020*	1,521	602	247	176	0	**2,547**
2021*	1,636	677	287	116	83	**2,799**
2021**	1,936	649	258	115	65	**3,024**

* Calculated with l'INM version 7.0b, ** Calculated with Echo

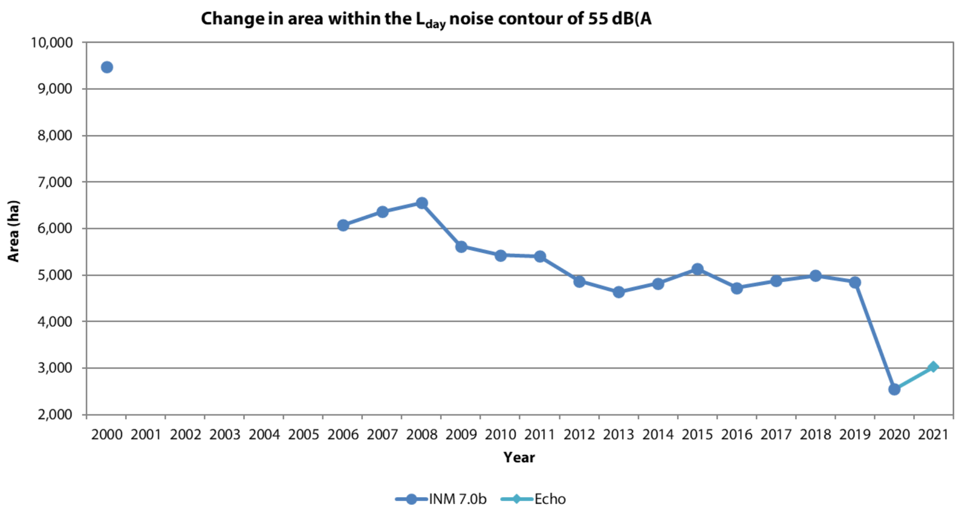


Figure 20: Evolution of the surface area inside the L_{day} contours (2000, 2006-2021).

Table 18: Evolution of the surface area inside the $L_{evening}$ contours (2000, 2006-2021)

Area (ha)	$L_{evening}$ contour zone in dB(A) (evening 19.00-23.00)						
year	50-55	55-60	60-65	65-70	70-75	>75	Total
2000*	11,266	5,265	1,889	741	346	216	**19,723**
2001							
2002							
2003							
2004							
2005							
2006*	8,483	3,000	1,106	449	178	113	**13,329**
2007*	9,106	3,369	1,223	506	200	124	**14,528**
2008*	10,052	3,730	1,354	548	218	135	**16,037**
2009*	8,313	3,126	1,146	463	178	109	**13,336**
2010*	7,821	3,073	1,124	452	171	106	**12,747**
2011*	7,711	3,004	1,106	446	175	105	**12,547**
2012*	7,608	2,881	1,046	427	171	103	**12,237**
2013*	6,998	2,668	994	401	161	104	**11,222**
2014*	7,421	3,087	1,106	445	175	50	**12,283**
2015*	8,244	3,051	1,108	450	205	89	**13,147**
2016*	8,402	3,188	1,137	536	135	91	**13,488**
2017*	8,556	3,172	1,108	457	205	92	**13,590**
2018*	9,134	3,445	1,207	489	225	99	**14,599**
2019*	8,836	3,283	1,138	542	142	97	**14,038**
2020*	4,440	1,751	621	441	0	0	**7,252**
2021*	3,922	1,517	619	263	103	75	**6,499**
2021**	5,117	1,637	632	213	91	67	**7,757**

* Calculated with l'INM version 7.0b, ** Calculated with Echo

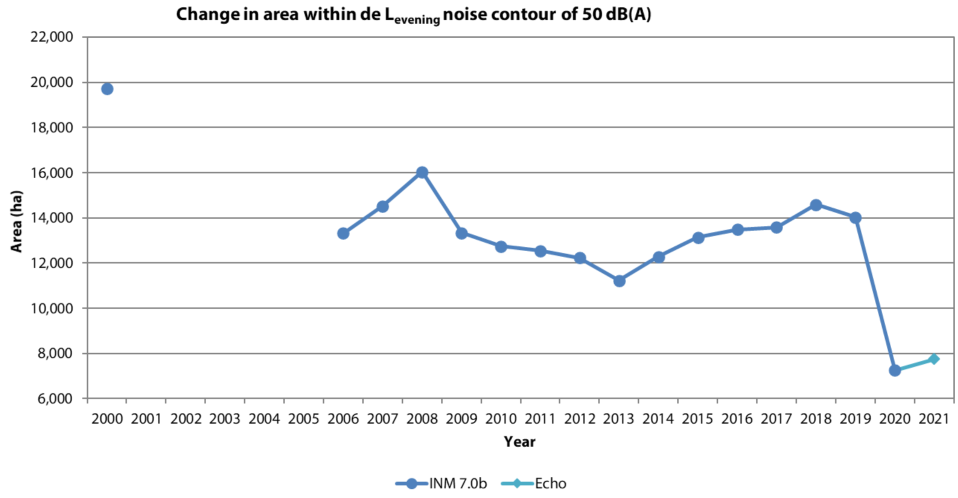


Figure 21: Evolution of the surface area inside the $L_{evening}$ contours (2000, 2006-2021).

Table 19: Evolution of the surface area inside the L_{night} contours (2000, 2006-2021)

Area (ha)	L_{night} contour zone in dB(A) (night 23.00-07.00)						
year	45-50	50-55	55-60	60-65	65-70	>70	Total
2000*	13,927	6,145	2,366	1,090	492	290	**24,310**
2001							
2002							
2003							
2004							
2005							
2006*	10,135	3,571	1,450	554	211	153	**16,075**
2007*	10,872	3,936	1,597	625	236	165	**17,430**
2008*	9,375	3,232	1,260	495	189	123	**14,673**
2009*	7,638	2,613	1,014	397	155	96	**11,913**
2010*	7,562	2,633	999	390	154	96	**11,835**
2011*	8,184	2,803	1,066	413	164	106	**12,736**
2012*	8,525	2,827	1,074	419	168	105	**13,118**
2013*	7,817	2,857	1,525	172	130	0	**12,501**
2014*	7,800	2,921	1,120	448	179	115	**12,583**
2015*	8,451	3,019	1,172	460	194	117	**13,413**
2016*	7,969	2,930	1,111	441	188	109	**12,748**
2017*	7,995	2,929	1,112	427	186	104	**12,754**
2018*	8,495	3,084	1,148	442	178	128	**13,476**
2019*	8,172	3,016	1,124	437	190	105	**13,044**
2020*	5,418	2,016	756	308	193	0	**8,691**
2021*	4,912	1,901	789	306	135	94	**8,137**
2021**	7,129	2,428	840	282	123	68	**10,870**

* Calculated with l'INM version 7.0b, ** Calculated with Echo

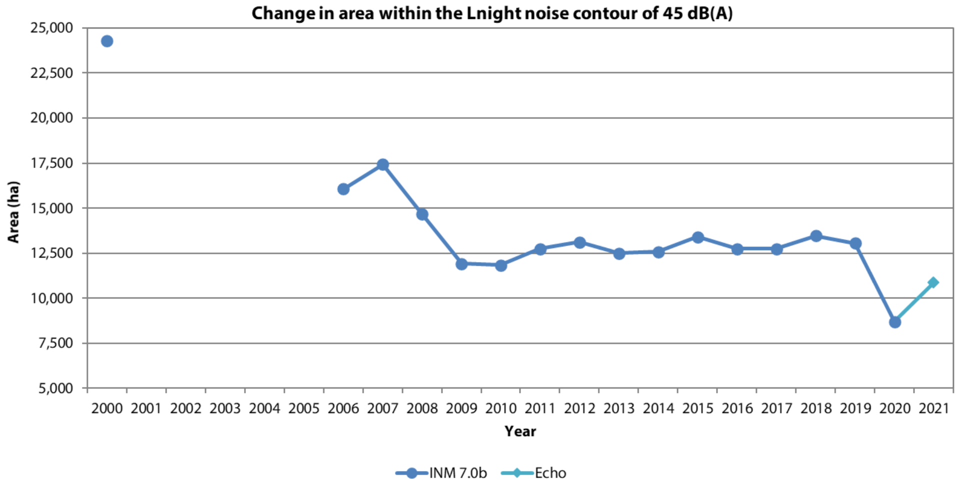


Figure 22: Evolution of the surface area inside the L_{night} contours (2000, 2006-2021)

Table 20: Evolution of the surface area inside the L_{den} contours (2000, 2006-2021)

Area (ha)	L_{den} contour zone in dB(A) (d. 07-19, ev. 19-23, n. 23-07)					
year	55-60	60-65	65-70	70-75	>75	Total
2000*	10,664	4,063	1,626	745	497	**17,594**
2001						
2002						
2003						
2004						
2005						
2006*	6,963	2,448	957	373	251	**10,992**
2007*	7,632	2,640	1,036	416	271	**11,996**
2008*	7,118	2,483	953	379	246	**11,178**
2009*	5,771	2,077	797	316	203	**9,163**
2010*	5,576	2,052	782	308	199	**8,917**
2011*	5,767	2,076	800	316	208	**9,167**
2012*	5,623	1,998	771	308	205	**8,905**
2013*	5,152	1,981	767	299	216	**8,415**
2014*	5,429	2,066	800	325	136	**8,756**
2015*	5,695	2,159	825	332	224	**9,236**
2016*	5,554	2,085	797	326	213	**8,974**
2017*	5,579	2,088	795	325	213	**9,000**
2018*	5,957	2,186	832	336	228	**9,540**
2019*	5,646	2,115	802	331	220	**9,115**
2020*	3,445	1,270	494	208	133	**5,549**
2021*	3,220	1,256	527	209	156	**5,368**
2021**	4,290	1,378	543	176	132	**6,520**

* Calculated with l'INM version 7.0b, ** Calculated with Echo

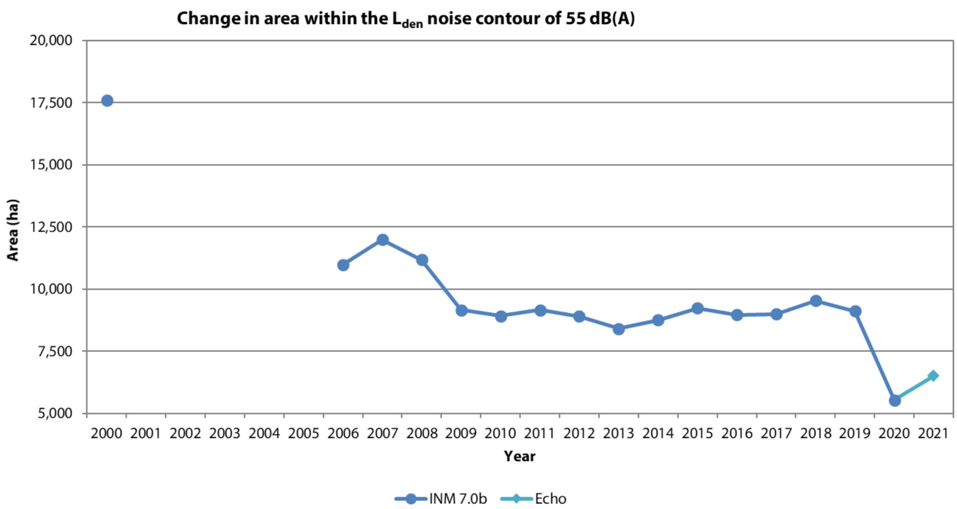


Figure 23: Evolution of the surface area inside the L_{den} contours (2000, 2006-2021)

Table 21: Evolution of the surface area inside the Freq.70,day contours (2006-2021)

Area (ha)	Freq.70,day contour zone (day 07.00-23.00)					
Year	5-10	10-20	20-50	50-100	>100	Total
2006						
2007						
2008						
2009						
2010*	5,171	3,164	4,119	2,097	1,877	**16,428**
2011*	4,933	2,989	4,216	1,934	1,854	**15,926**
2012*	5,155	3,662	3,797	1,578	1,684	**15,877**
2013*	4,660	3,915	3,154	1,879	1,503	**15,557**
2014*	4,809	3,745	3,465	1,631	1,722	**15,372**
2015*	6,650	4,431	3,442	1,903	1,887	**18,314**
2016*	3,331	3,407	3,372	1,715	1,666	**13,491**
2017*	3,556	3,415	3,375	1,625	1,750	**13,722**
2018*	3,851	3,553	3,286	1,811	1,773	**14,276**
2019*	3,489	3,432	3,249	1,607	1,844	**13,621**
2020*	4,334	2,988	2,600	958	156	**11,036**
2021**	3,408	2,402	2,386	1,333	469	**9,998**

* Calculated with l'INM version 7.0b, ** Calculated with Echo

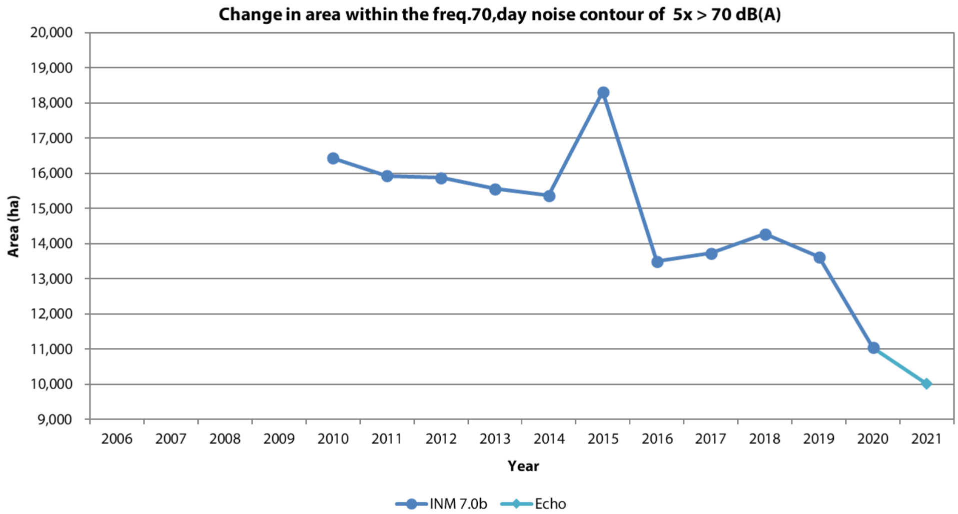


Figure 24: Evolution of the surface area inside the Freq.70,day contours (2006-2021).

Table 22: Evolution of the surface area inside the Freq.70,night contours (2006-2021).

Year	1-5	5-10	10-20	20-50	>50	Total
2006						
2007						
2008						
2009						
2010*	9,535	2,679	1,948	748	0	**14,910**
2011*	9,557	2,662	2,095	801	0	**15,115**
2012*	9,226	2,846	2,005	861	0	**14,938**
2013*	9,083	2,821	2,223	723	0	**14,944**
2014*	8,169	2,586	2,030	1,001	27	**13,813**
2015*	7,949	2,928	1,876	1,133	0	**13,885**
2016*	8,104	2,439	2,149	998	0	**13,690**
2017*	7,813	2,512	2,142	959	0	**13,427**
2018*	8,207	2,508	2,362	957	0	**14,034**
2019*	7,834	2,345	2,299	1,012	0	**13,489**
2020*	7,397	1,990	1,385	204	0	**10,976**
2021**	6,797	2,475	1,627	188	0	**11,087**

* Calculated with l'INM version 7.0b, ** Calculated with Echo

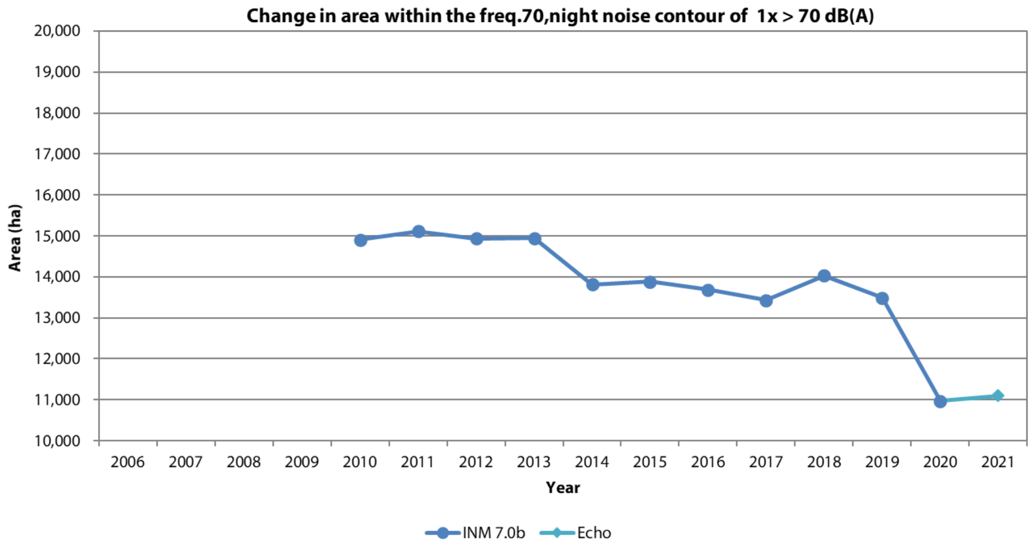


Figure 25: Evolution of the surface area inside the Freq.70,night contours (2006-2021).

Table 23: Evolution of the surface area within the Freq. 60,day contours (2006-2021)

Area (ha)	Freq.60,day contour zone (day 07.00-23.00)				
Year	50-100	100-150	150-200	>200	Total
2006					
2007					
2008					
2009					
2010*	9,288	3,313	1,681	2,409	**16,692**
2011*	9,112	3,405	1,476	2,579	**16,572**
2012*	9,007	2,691	1,754	1,885	**15,337**
2013*	8,005	1,958	2,053	972	**13,632**
2014*	9,329	2,112	1,865	2,050	**15,357**
2015*	9,211	3,511	1,633	1,848	**16,203**
2016*	9,256	2,670	1,918	1,916	**15,760**
2017*	8,315	3,795	1,795	2,223	**16,129**
2018*	9,359	3,235	1,876	2,159	**16,629**
2019*	8,816	3,495	1,916	2,239	**16,467**
2020*	3,072	635	117	0	**3,824**
2021**	7,255	1,514	190	0	**8,959**

* Calculated with l'INM version 7.0b, ** Calculated with Echo

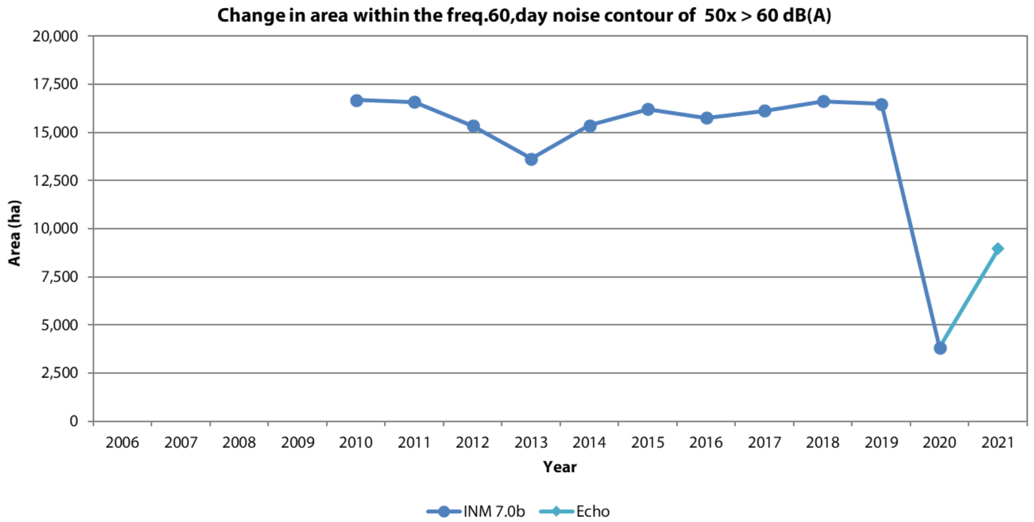


Figure 26: Evolution of the surface area within the Freq. 60,day contours (2006-2021)

Table 24: Evolution of the surface area inside the Freq.60,night contours (2006-2021).

Area (ha)	Freq.60,night contour zone in dB(A)				
Year	10-15	15-20	20-30	>30	Total
2006					
2007					
2008					
2009					
2010*	5,577	1,797	1,930	725	**10,030**
2011*	6,436	1,972	1,930	905	**11,242**
2012*	7,522	1,778	1,932	1,004	**12,236**
2013*	5,083	2,367	1,888	1,031	**10,369**
2014*	4,807	2,542	1,845	1,670	**10,864**
2015*	5,819	1,786	3,064	1,295	**11,964**
2016*	5,142	3,635	2,053	1,222	**12,052**
2017*	5,612	3,310	2,349	1,183	**12,454**
2018*	5,580	3,434	2,746	1,301	**13,061**
2019*	5,802	3,774	2,480	1,296	**13,352**
2020*	4,111	882	567	267	**5,827**
2021**	2,845	3,459	869	318	**7,491**

* Calculated with l'INM version 7.0b, ** Calculated with Echo

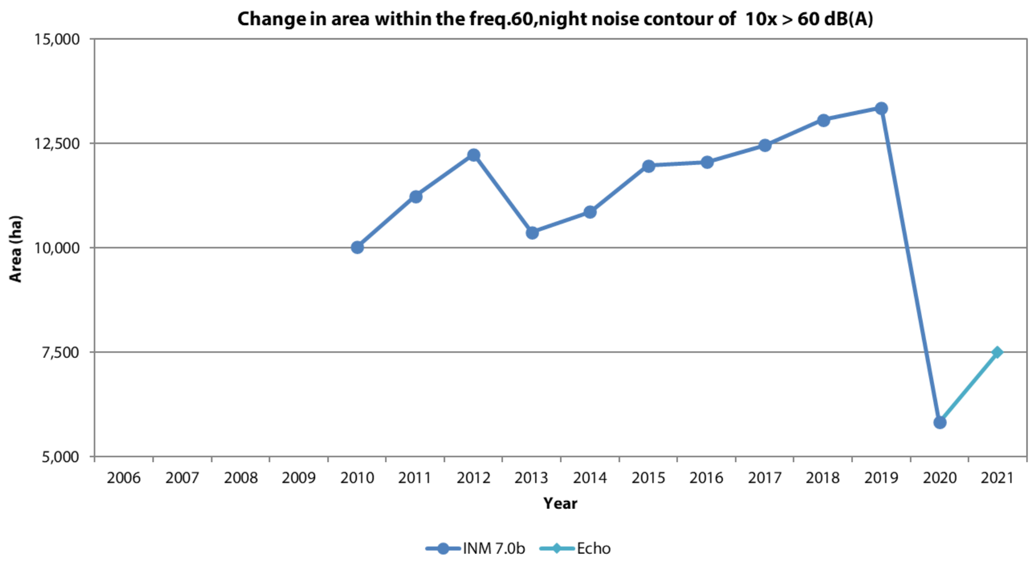


Figure 27: Evolution of the surface area inside the Freq.60,night contours (2006-2021).

Evolution of the number of residents per contour zone: L_{day}, $L_{evening}$, L_{night}, Freq.70,day, Freq.70,night, Freq.60,day and Freq.60,night.

Table 25: Evolution of the number of residents inside the L_{day} contours (2000, 2006-2021).

number of residents		L_{day} contour zone in dB(A) (day 07.00-19.00)					
year	Population data	55-60	60-65	65-70	70-75	>75	Total
2000*	01jan00	106,519	13,715	5,660	1,134	20	**127,048**
2001							
2002							
2003							
2004							
2005							
2006*	01jan03	39,478	9,241	2,714	74	3	**51,511**
2007*	01jan06	47,260	9,966	3,168	102	3	**60,499**
2008*	01jan07	44,013	10,239	3,217	101	4	**57,575**
2009*	01jan07	32,144	8,724	2,815	58	3	**43,745**
2010*	01jan08	30,673	8,216	2,393	35	7	**41,323**
2011*	01jan08	28,828	8,486	2,460	46	7	**39,828**
2012*	01jan10	23,963	8,277	2,110	22	2	**34,375**
2013*	01jan10	22,737	7,482	1,318	7	2	**31,546**
2014*	01jan11	22,998	8,649	2,249	22	2	**33,920**
2015*	01jan11	23,662	8,945	2,350	99	0	**35,056**
2016*	01jan11	20,554	8,380	2,094	28	0	**31,057**
2017[1]*	01jan16	21,950	9,003	3,108	0	0	**34,062**
2018[1]*	01jan17	23,289	8,993	2,798	3	0	**35,083**
2019[1]*	01jan19	21,875	9,342	3,270	3	0	**34,489**
2020[1]*	01jan20	14,195	4,191	122	0	0	**18,507**
2021[1]*	01jan22	15,137	4,888	407	0	0	**20,432**
2021[1]**	01jan22	17,686	3,670	45	0	0	**21,401**

[1] evaluation of adresses

* Calculated with l'INM version 7.0b, ** Calculated with Echo

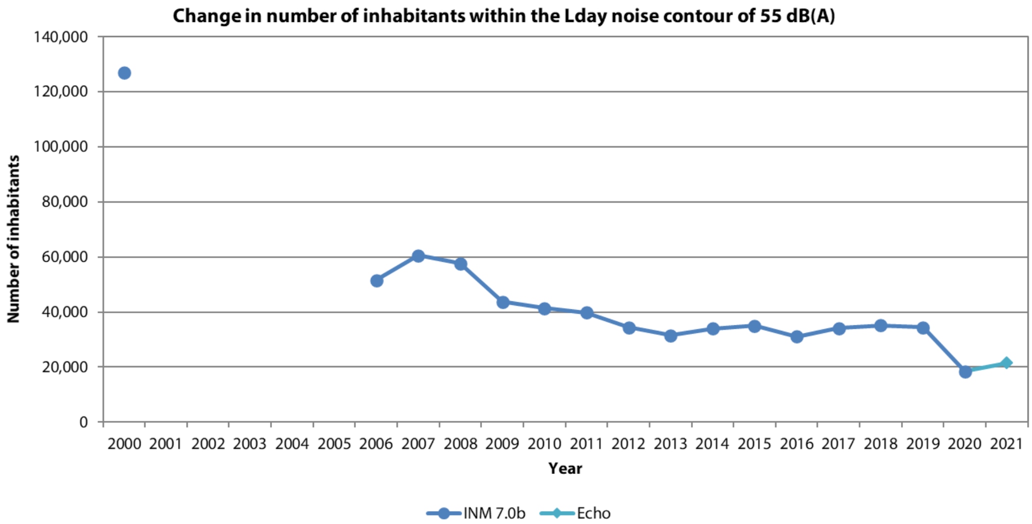


Figure 28: Evolution of the number of residents inside the L_{day} contours (2000, 2006-2021).

Table 26: Evolution of the number of residents inside the $L_{evening}$ contours (2000, 2006-2021).

number of residents		$L_{evening}$ contour zone in dB(A) (evening 19.00-23.00)						
year	Population data	50-55	55-60	60-65	65-70	70-75	>75	Total
2000*	01jan00	209,265	86,637	13,246	4,990	602	9	**314,750**
2001								
2002								
2003								
2004								
2005								
2006*	01jan03	185,699	24,488	7,138	2,030	28	3	**219,386**
2007*	01jan06	214,616	35,445	8,217	2,583	38	2	**260,901**
2008*	01jan07	249,024	43,589	9,514	2,969	52	3	**305,152**
2009*	01jan07	198,351	29,774	7,448	2,186	32	2	**237,793**
2010*	01jan08	198,934	37,729	7,127	2,057	25	5	**245,878**
2011*	01jan08	198,540	41,951	7,110	2,077	32	5	**249,716**
2012*	01jan10	213,799	46,427	7,309	2,072	27	1	**269,635**
2013*	01jan10	148,866	25,888	6,432	1,054	7	1	**182,247**
2014*	01jan11	187,698	23,913	9,632	2,052	29	0	**223,324**
2015*	01jan11	168,549	22,593	8,790	2,424	88	0	**202,444**
2016*	01jan11	204,319	29,643	9,140	2,796	52	0	**245,949**
2017[1]*	01jan16	206,220	26,880	9,055	3,173	5	0	**245,334**
2018[1]*	01jan17	226,101	34,113	10,033	3,538	57	0	**273,841**
2019[1]*	01jan19	213,243	28,965	9,814	3,531	5	0	**255,558**
2020[1]*	01jan20	54,642	16,266	5,093	261	0	0	**76,262**
2021*	01jan22	51,036	13,952	4,771	445	0	0	**70,204**
2021**	01jan22	56,816	16,283	3,676	37	0	0	**76,812**

[1] evaluation of adresses

* Calculated with l'INM version 7.0b, ** Calculated with Echo

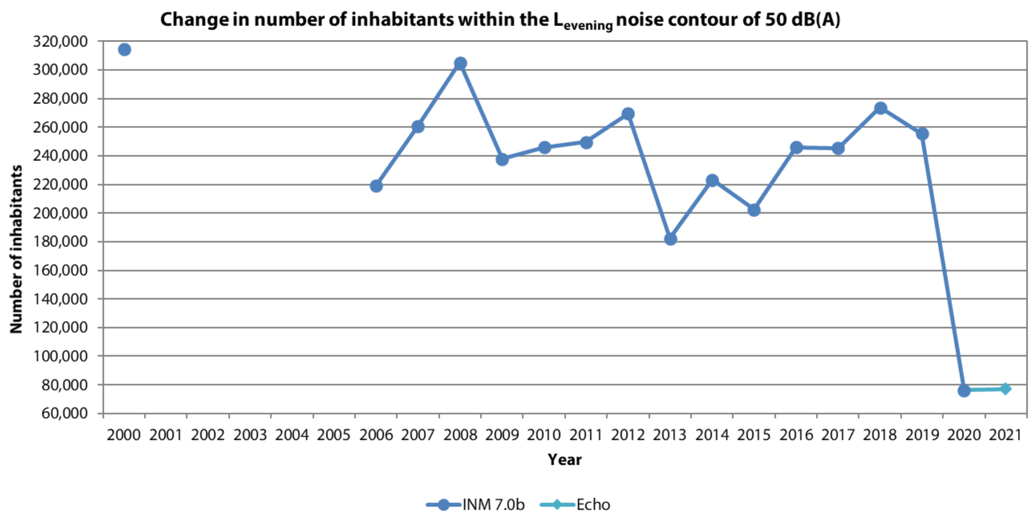


Figure 29: Evolution of the number of residents inside the $L_{evening}$ contours (2000, 2006-2021).

Table 27: Evolution of the number of residents inside the L_{night} contours (2000, 2006-2021).

number of residents		contourzone L_{night} en dB(A) (night 23:00-07:00)						
year	Population data	45-50	50-55	55-60	60-65	65-70	>70	Total
2000*	01jan00	139,440	57,165	18,384	8,394	1,325	72	**224,779**
2001								
2002								
2003								
2004								
2005								
2006*	01jan03	167,033	28,985	8,836	1,167	174	8	**206,202**
2007*	01jan06	199,302	32,473	11,607	2,185	181	26	**245,772**
2008*	01jan07	151,736	26,450	7,985	1,017	133	3	**187,323**
2009*	01jan07	122,871	19,528	6,303	622	92	2	**149,418**
2010*	01jan08	129,820	19,986	6,077	571	89	5	**156,548**
2011*	01jan08	129,969	22,490	6,414	622	94	5	**159,594**
2012*	01jan10	124,012	24,015	6,963	585	78	2	**155,655**
2013*	01jan10	91,140	28,407	7,152	51	3	0	**126,754**
2014*	01jan11	163,270	24,221	7,889	869	110	3	**196,362**
2015*	01jan11	125,407	26,956	8,239	762	159	2	**161,524**
2016*	01jan11	128,939	23,476	7,954	715	131	0	**161,216**
2017[1]*	01jan16	106,964	27,127	7,484	469	66	0	**142,110**
2018[1]*	01jan17	122,588	29,355	7,601	501	64	0	**160,109**
2019[1]*	01jan19	127,079	27,978	8,065	529	66	0	**163,718**
2020[1]*	01jan20	60,530	18,372	2,217	390	57	0	**81,566**
2021*	01jan22	53,615	16,777	3,905	333	68	0	**74,698**
2021**	01jan22	77,128	25,889	1,479	412	0	0	**104,908**

[1] evaluat [1] evaluation of adresses

* Calcul: * Calculated with l'INM version 7.0b, ** Calculated with Echo

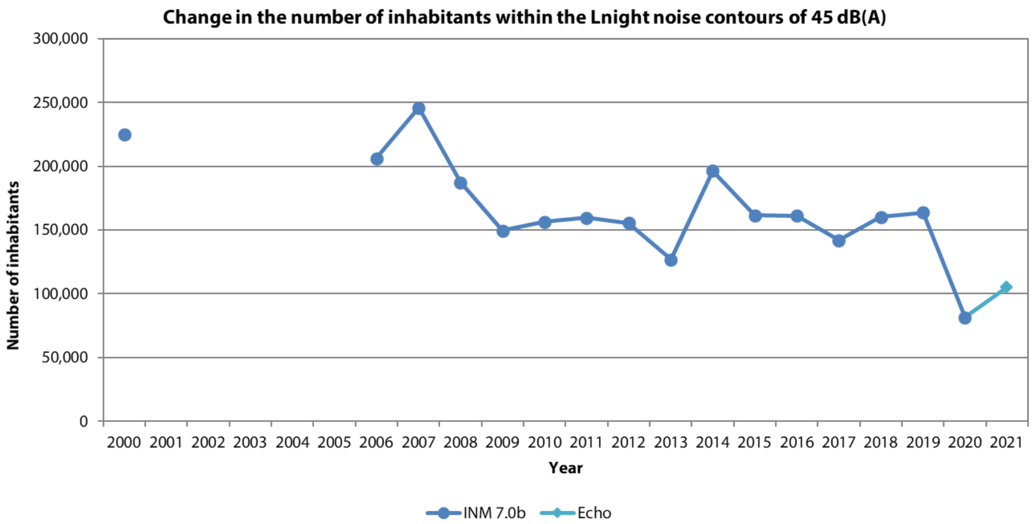


Figure 30: Evolution of the number of residents inside the L_{night} contours (2000, 2006-2021).

Table 28: Evolution of the number of residents inside the L_{den} contours (2000, 2006-2021).

Aantal inwoners		L_{den} - contourzone in dB(A) (d. 07h-19h, av. 19h-23h, n. 23h-07h)					
Jaar	**Bevolkingsgegevens**	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Totaal**
2000*	01jan00	166,767	36,797	14,091	3,952	264	**221,871**
2001							
2002							
2003							
2004							
2005							
2006*	01jan03	107,514	18,697	5,365	560	63	**132,198**
2007*	01jan06	147,349	19,498	6,565	946	82	**174,442**
2008*	01jan07	125,927	19,319	5,938	717	24	**151,925**
2009*	01jan07	87,766	15,105	4,921	404	9	**108,205**
2010*	01jan08	87,083	15,619	4,506	337	11	**107,556**
2011*	01jan08	90,988	15,941	4,664	362	13	**111,969**
2012*	01jan10	86,519	16,220	4,617	319	6	**107,680**
2013*	01jan10	56,516	16,517	3,994	197	5	**77,229**
2014*	01jan10	84,747	16,525	5,076	368	9	**106,725**
2015*	01jan11	72,628	17,721	5,244	428	55	**96,075**
2016*	01jan11	77,229	16,694	5,284	450	23	**99,680**
2017[1]*	01jan16	70,139	17,645	5,264	257	0	**93,305**
2018[1]*	01jan17	77,812	19,476	5,413	413	0	**103,114**
2019[1]*	01jan19	72,561	19,231	5,448	383	0	**97,624**
2020[1]*	01jan20	34,236	9,801	1,361	110	0	**45,508**
2021**	01jan22	40,787	9,371	931	30	0	**51,119**

[1] evaluatie volgens adrespunt

* Berekend met INM 7.0b, ** Berekend met Echo

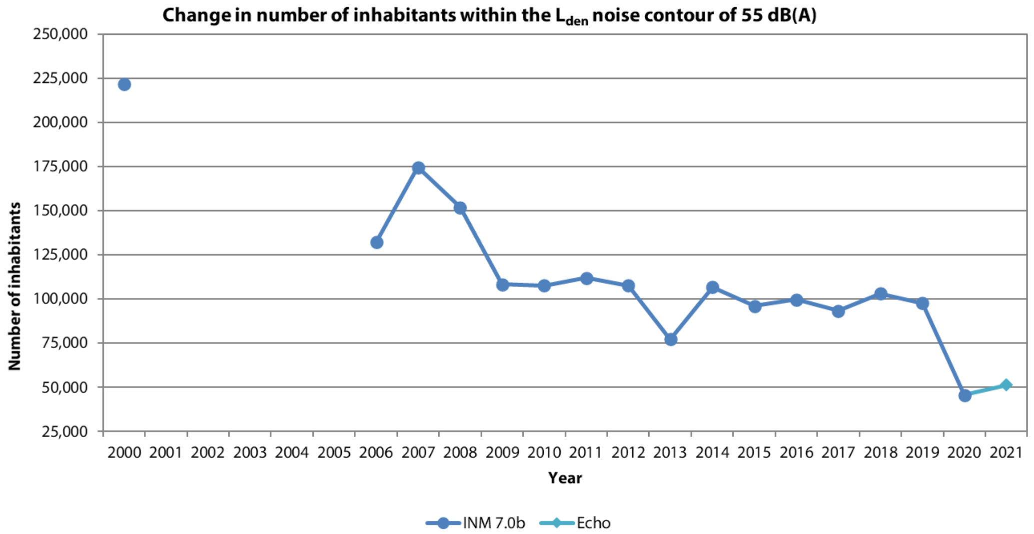


Figure 31: Evolution of the number of residents inside the L_{den} contours (2000, 2006-2021).

Table 29: Evolution of the number of residents inside the Freq.70,day contours (2006-2021).

Number of inhabitants		Freq.70,day contour zone (day 07.00-23.00)					
Year	Population data	5-10	10-20	20-50	50-100	>100	Total
2006							
2007							
2008							
2009							
2010*	01jan08	133,468	77,606	82,703	15,348	9,874	**318,999**
2011*	01jan08	133,014	80,395	78,893	11,783	10,018	**314,103**
2012*	01jan10	128,971	95,435	58,279	10,112	9,339	**302,136**
2013*	01jan10	94,888	84,745	33,045	14,225	6,554	**239,376**
2014*	01jan11	226,319	139,618	47,774	10,655	10,379	**434,746**
2015*	01jan11	163,105	104,564	43,843	11,547	11,204	**334,264**
2016*	01jan11	95,084	86,813	40,288	10,509	10,541	**243,235**
2017[1]*	01jan16	111,019	92,035	40,125	10,365	12,694	**266,238**
2018[1]*	01jan17	122,115	94,126	42,456	22,569	1,024	**282,289**
2019[1]*	01jan19	108,714	110,676	42,207	21,742	1,088	**284,427**
2020[1]*	01jan20	102,799	31,056	17,647	8,250	0	**159,753**
2021**	01jan22	90,050	30,752	20,878	9,446	325	**151,451**

[1] evaluation of adresses

* Calculated with l'INM version 7.0b, ** Calculated with Echo

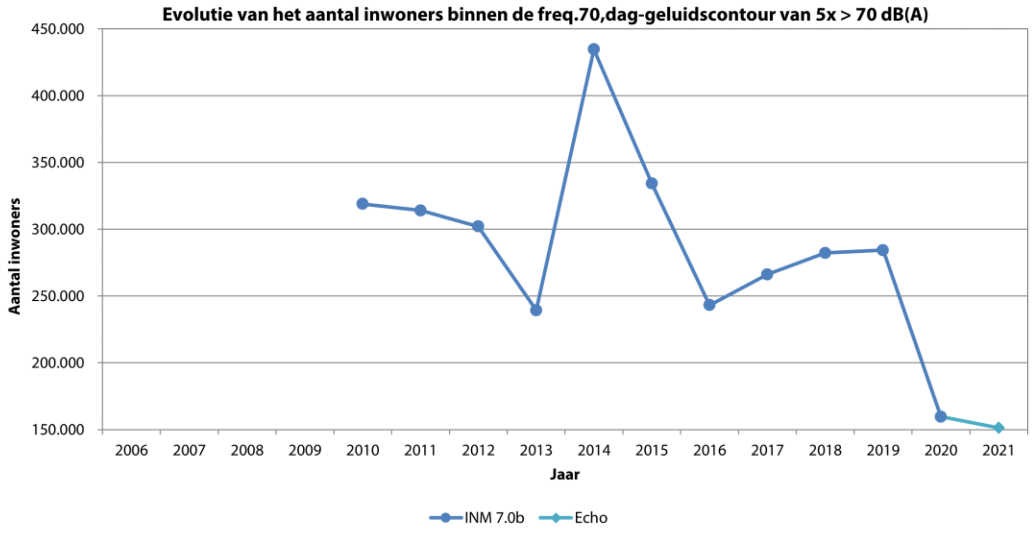


Figure 32: Evolution of the number of residents inside the Freq.70,day contours (2006-2021).

Table 30: Evolution of the number of residents inside the Freq.70,night contours (2006-2021).

Aantal inwoners		Freq.70,night contour zone (night 23.00-07.00)					
Year	Population data	1-5	5-10	10-20	20-50	>50	Total
2006							
2007							
2008							
2009							
2010*	01jan08	239,529	23,583	12,968	2,597	0	**278,677**
2011*	01jan08	232,090	22,587	13,071	3,261	0	**271,010**
2012*	01jan10	195,400	21,774	12,858	4,078	0	**234,110**
2013*	01jan10	158,701	22,985	15,876	1,774	0	**199,913**
2014*	01jan11	240,106	19,794	13,018	6,333	0	**279,251**
2015*	01jan11	167,925	22,934	13,681	6,400	0	**210,939**
2016*	01jan11	183,776	18,616	14,079	6,151	0	**222,622**
2017[1]*	01jan16	155,257	19,411	14,408	5,854	0	**194,930**
2018[1]*	01jan17	172,835	21,478	14,948	6,020	0	**215,281**
2019[1]*	01jan19	184,024	20,072	15,028	6,574	0	**225,698**
2020[1]*	01jan20	89,653	17,902	6,243	496	0	**114,295**
2021[1]**	01jan22	80,278	18,228	10,346	0	0	**108,852**

[1] evaluation of adresses

* Calculated with l'INM version 7.0b, ** Calculated with Echo

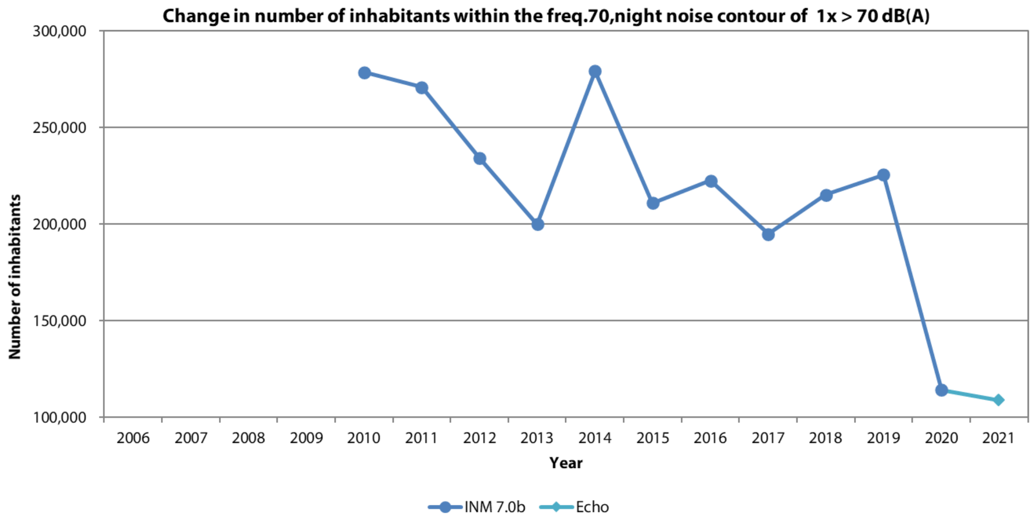


Figure 33: Evolution of the number of residents inside the Freq.70,night contours (2006-2021).

Table 31: Evolution of the number of residents inside the Freq.60,day contours (2006-2021).

Number of inhabitants		Freq.60,day contour zone (day 07.00-23.00)				
Year	Population data	50-100	100-150	150-200	>200	Total
2006						
2007						
2008						
2009						
2010*	01jan08	154,110	49,587	14,723	15,834	**234,253**
2011*	01jan08	152,727	50,646	8,604	18,816	**230,793**
2012*	01jan10	158,634	35,632	10,547	15,498	**220,312**
2013*	01jan10	123,956	12,877	18,257	3,603	**174,921**
2014*	01jan11	273,603	22,036	10,282	17,121	**323,042**
2015*	01jan11	191,263	23,810	12,105	16,596	**243,774**
2016*	01jan11	179,841	31,127	10,476	17,495	**238,939**
2017[1]*	01jan16	174,069	62,701	9,661	22,736	**269,167**
2018[1]*	01jan17	221,416	18,985	11,353	21,484	**273,238**
2019[1]*	01jan19	200,841	55,497	10,932	23,645	**290,915**
2020[1]*	01jan20	32,599	4,191	0	0	**36,790**
2021[1]**	01jan22	61,144	16,500	0	0	**77,644**

[1] evaluation of adresses

* Calculated with l'INM version 7.0b, ** Calculated with Echo

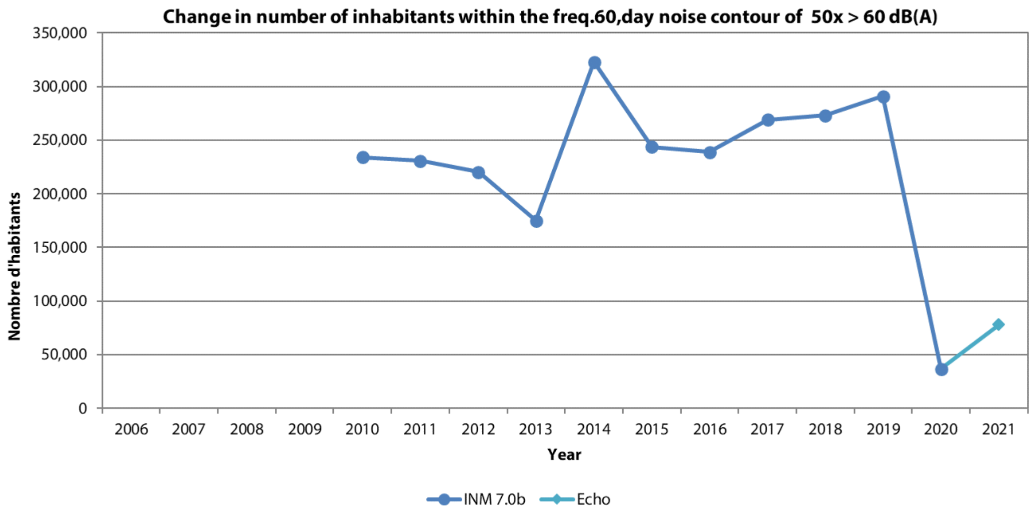


Figure 34: Evolution of the number of residents inside the Freq.60,day contours (2006-2021).

Table 32: Evolution of the number of residents inside the Freq.60,night contours (2006-2021).

Number of inhabitants		Freq.60,night contour zone in dB(A)				
Year	Population data	10-15	15-20	20-30	>30	Total
2006						
2007						
2008						
2009						
2010*	01jan08	62,090	9,411	21,231	3,262	**95,994**
2011*	01jan08	65,246	9,522	20,695	5,450	**100,913**
2012*	01jan10	80,911	8,723	20,642	7,009	**117,284**
2013*	01jan10	52,151	14,679	20,269	6,340	**93,438**
2014*	01jan11	79,725	27,741	18,637	12,317	**138,420**
2015*	01jan11	84,429	12,453	24,502	10,351	**131,736**
2016*	01jan11	81,235	20,356	21,869	8,779	**132,238**
2017[1]*	01jan16	93,532	15,687	23,488	9,538	**142,245**
2018[1]*	01jan17	98,609	16,849	24,728	10,016	**150,202**
2019[1]*	01jan19	110,835	17,770	24,096	10,817	**163,518**
2020[1]*	01jan20	30,334	10,565	4,365	539	**45,803**
2021[1]**	01jan22	26,888	28,001	10,397	740	**66,026**

[1] evaluation of adresses

* Calculated with l'INM version 7.0b, ** Calculated with Echo

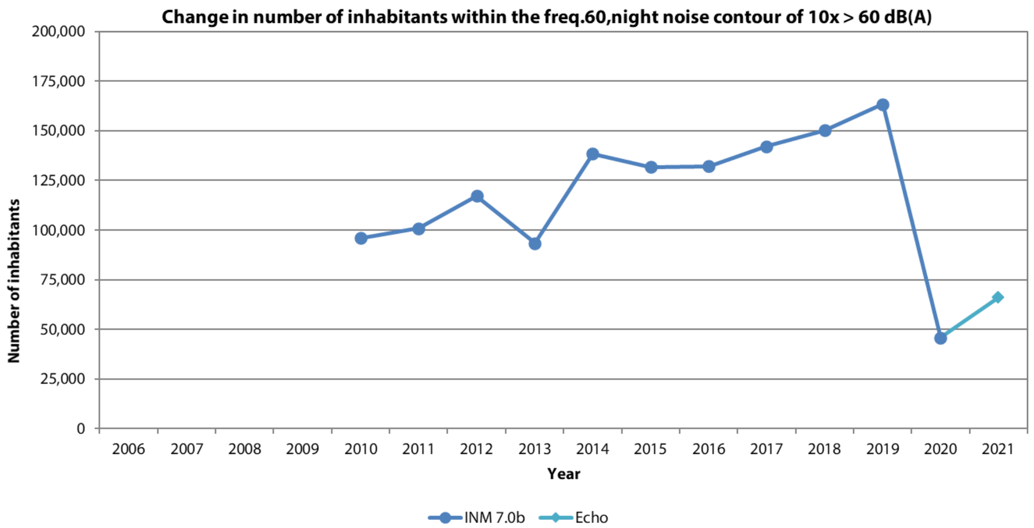


Figure 35: Evolution of the number of residents inside the Freq.60,night contours (2006-2021).

Appendix F. Impact of change of calculation method on noise calculations 2021

This appendix gives the impact of the change of the calculation method (see paragraph 3.5) on the location of the noise contours and on the surface and number of residents within the noise contours. The impact is determined by determining the results for 2021 on the basis of both the old and the new calculation method. The surface area and the number of residents within the noise contours are also shown for 2020, determined on the basis of the old calculation method. The contours reflect the total effect of the changes. For the most significant changes, the effect of the change concerned is indicated.

Impact per change

The able below gives the effect on the calculated noise impact for the most significant changes in the calculation method.

Table 33: Description of the impact per change in the calculation method of the contours.

Change	Impact on the noise levels
Changes calculation model: INM → Echo	The most significant change as a consequence of applying Doc. 29 calculation method, is the advice for the use of a more recent method to determine atmospheric absorption. This leads to a rise in the noise levels. The impact close to the airport is small, farther away the differences can be 1 to 2 dB.
Updating source data	The correction of the noise levels for approaches by Airbus aircraft lead to higher noise levels for approaches. The noise impact for Brussels Airport thus increases to the order of 1 dB (larger contours). The addition of data of a number of aircraft has a marginal effect.
Correction factor compared to the proxy aircraft type	The application of the factor 'corrects' for the differences in noise levels of the proxy aircraft type in the calculation and the actual aircraft type. The application of the correction factor leads to around 1 dB lower noise level for departures and 0.5 dB for arrivals and thus to smaller contours.
Modelling based on actual flight paths	A calculation based on the actual flight paths is locally more accurate and can have an effect on the location of the contours. The impact overall is, however, marginal.
Modelling departures based on NADP1 procedure	In line with the prescribed departure procedure at Brussels Airport, departures are modelled based on the NADP 1 instead of the NADP2 procedure. The calculated noise levels for take-offs are thus 1 to 3 dB lower in the area under the flight path at c. 5 to 10 km measured from the beginning of the runway and around 1 dB higher in the area to the side of the flight path.
Distinction in approach profiles	By taking account of the 'level flying' (whereby a section of the approach is flown at a fixed altitude) in the modelling, the calculated noise levels for approaches is somewhat higher. The impact is only visible at a greater distance (10+ km) before the runway.

Impact op L_{day} (07:00 to 19:00) noise contours

The effect of the change in the calculation method on the 55, 60, 65, 70 and 75 dB(A) L_{day} contours for 2021 is shown. The values are ascending inwards: the outermost contour corresponds with 55 dB(A), etc.

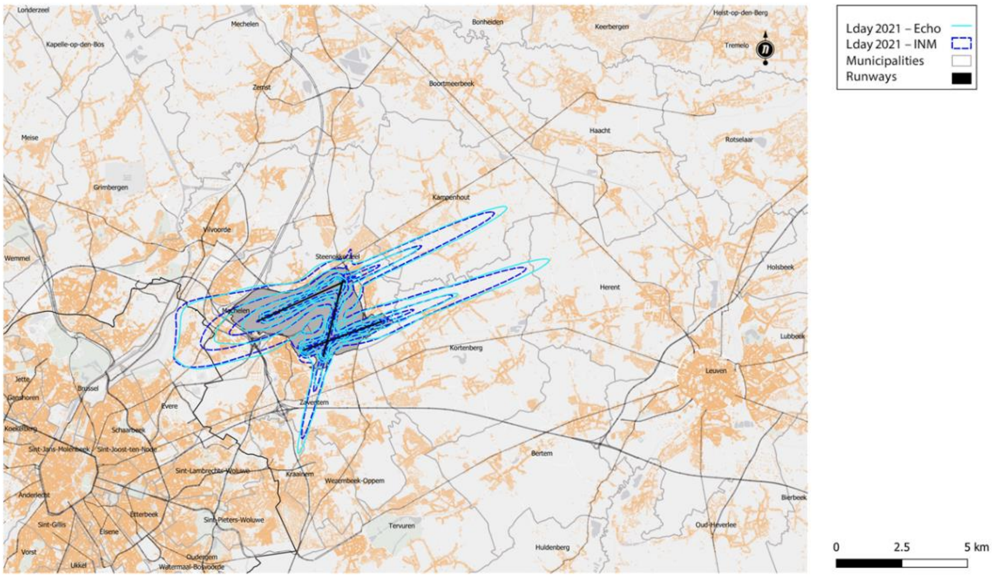


Table 34: Evolution of the surface area inside the L_{day} contours (2000, 2006-2021).

Surface (ha)		L_{day} - contour zone in dB(A) (day 07:00-19:00)					
Year	Calculation model	55-60	60-65	65-70	70-75	>75	Total
2020	INM 7.0b	1,521	602	247	176	0	**2,547**
2021	INM 7.0b	1,636	677	287	116	83	**2,799**
2021	Echo	1,936	649	258	115	65	**3,024**

Table 35: Evolution of the number of residents inside the L_{day} contours (2000, 2006-2021).

Number of inhabitants			L_{day} - contour zone in dB(A) (day 07:00-19:00)					
Year	Population data	Calculation model	55-60	60-65	65-70	70-75	>75	Total
2020	01jan20	INM 7.0b	14,195	4,191	122	0	0	**18,507**
2021	01jan22	INM 7.0b	15,137	4,888	407			**20,432**
2021	01jan22	Echo	17,686	3,670	45	0	0	**21,401**

Impact on $L_{evening}$ (19:00 to 23:00) noise contours

The effect of the change in the calculation method on the 50, 55, 60, 65, 70 and 75 dB(A) $L_{evening}$ contours for 2021 is shown. The values are ascending inwards: the outermost contour corresponds with 50 dB(A), etc. In this figure, it is striking that in particular to the west of the airport, the contour for departing traffic from runway 25R is smaller in a north-easterly direction but has a larger lobe around the take-off routes with a turn to the left in south-easterly direction. This is connected with the specific composition of the traffic on the routes concerned and the difference in the way in which this traffic (the B744 aircraft) in the previous and the new calculations are presented.

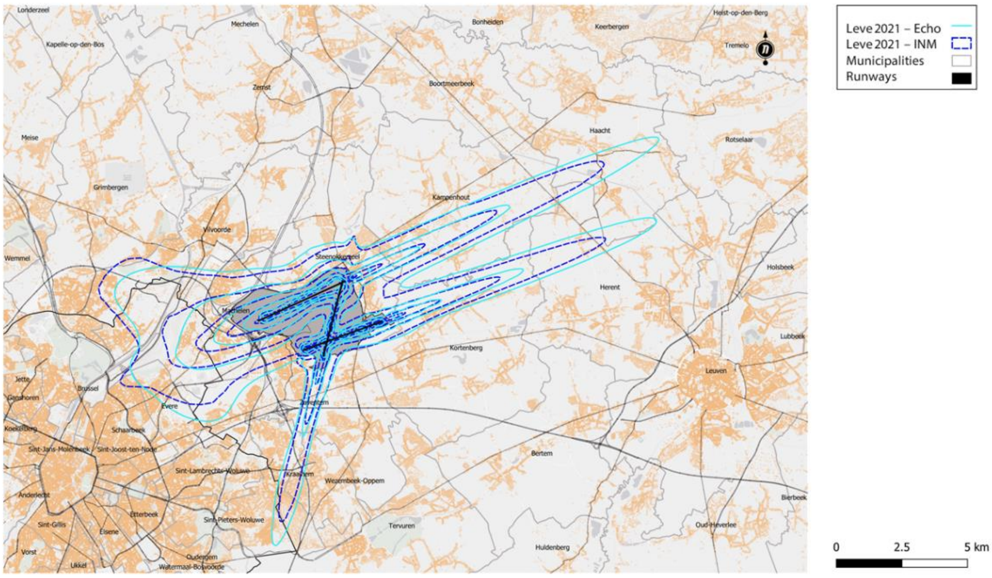


Table 36: Evolution of the surface area inside the $L_{evening}$ contours (2000, 2006-2021).

Surface (ha)		$L_{evening}$ - contour zone in dB(A) (evening 19:00-23:00)						
Year	**Calculation model**	**50-55**	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
2020	INM 7.0b	4,440	1,751	621	441	0	0	**7,252**
2021	INM 7.0b	3,922	1,517	619	263	103	75	**6,499**
2021	Echo	5,117	1,637	632	213	91	67	**7,757**

Table 37: Evolution of the number of residents inside the $L_{evening}$ contours (2000, 2006-2021).

Number of inhabitants			$L_{evening}$ - contour zone in dB(A) (evening 19:00-23:00)						
Year	**Population data**	**Calculation model**	**50-55**	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
2020	01jan20	INM 7.0b	54,642	16,266	5,093	261	0	0	**76,262**
2021	01jan22	INM 7.0b	51,036	13,952	4,771	445	0	0	**70,204**
2021	01jan22	Echo	56,816	16,283	3,676	37	0	0	**76,812**

Impact on L_{night} (23:00 to 7:00) noise contours

The effect of the change of the calculation method on the 45, 50, 55, 60, 65 and 70 dB(A) L_{night} contours for 2021. The values are ascending inwards: the outermost contour corresponds with 45 dB(A), etc.

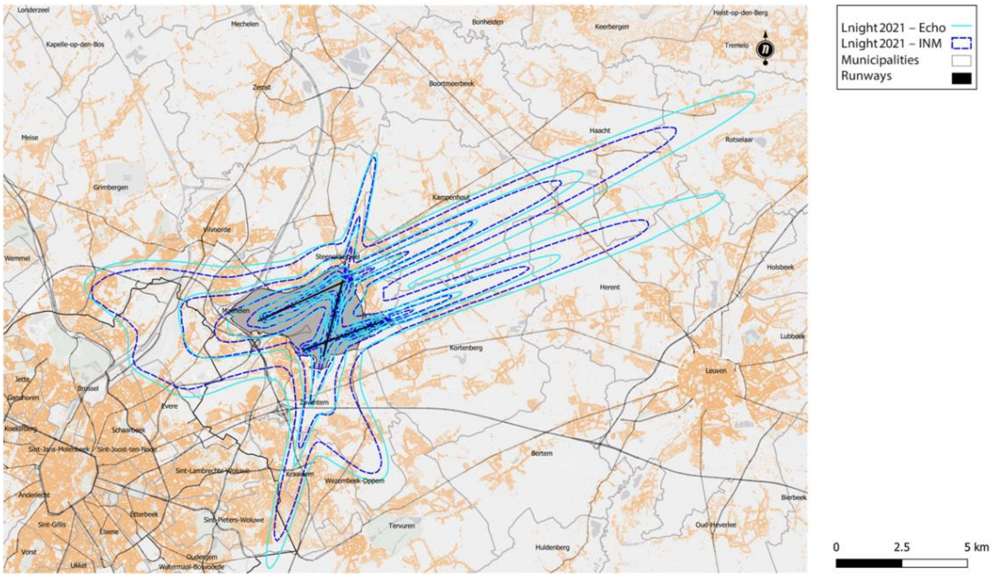


Table 38: Evolution of the surface area inside the L_{night} contours (2000, 2006-2021).

Surface (ha)		L_{night} - contour zone in dB(A) (night 23:00-07:00)						
Year	**Calculation model**	**45-50**	**50-55**	**55-60**	**60-65**	**65-70**	**>70**	**Total**
2020	INM 7.0b	5,418	2,016	756	308	193	0	**8,691**
2021	INM 7.0b	4,912	1,901	789	306	135	94	**8,137**
2021	Echo	7,129	2,428	840	282	123	68	**10,870**

Table 39: Evolution of the number of residents inside the L_{night} contours (2000, 2006-2021).

Number of inhabitants			L_{night} - contour zone in dB(A) (night 23:00-07:00)						
Year	**Population data**	**Calculation model**	**45-50**	**50-55**	**55-60**	**60-65**	**65-70**	**>70**	**Total**
2020	01jan20	INM 7.0b	60,530	18,372	2,217	390	57	0	**81,566**
2021	01jan22	INM 7.0b	53,615	16,777	3,905	333	68	0	**74,698**
2021	01jan22	Echo	77,128	25,889	1,479	412	0	0	**104,908**

Impact on L_{den} noise contours

The effect of the change in the calculation method on the 55, 60, 65, 70 and 75 dB(A) L_{den} contours for 2021 is shown. The values are ascending inwards: the outermost contour corresponds with 55 dB(A), etc.

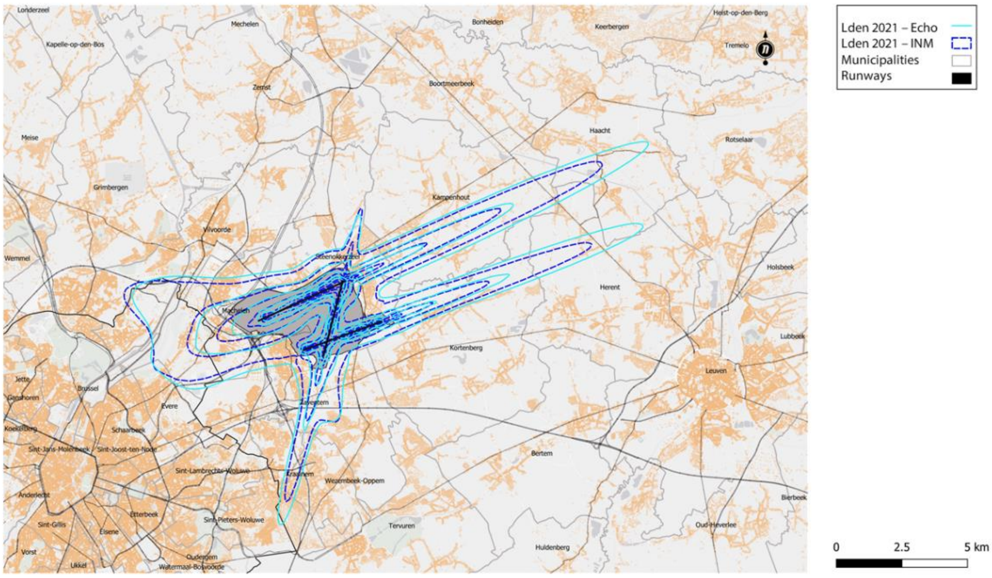


Table 40: Evolution of the surface area inside the L_{den} contours (2000, 2006-2021).

Surface (ha)		L_{den} - contour zone in dB(A) (d. 07h-19h, ev. 19h-23h, n. 23h-07h)					
Year	Calculation model	55-60	60-65	65-70	70-75	>75	Total
2020	INM 7.0b	3,445	1,270	494	208	133	**5,549**
2021	INM 7.0b	3,220	1,256	527	209	156	**5,368**
2021	Echo	4,290	1,378	543	176	132	**6,520**

Table 41: Evolution of the number of residents inside the L_{den} contours (2000, 2006-2021).

Number of inhabitants			L_{den} - contour zone in dB(A) (d. 07h-19h, ev. 19h-23h, n. 23h-07h)					
Year	Population data	Calculation model	55-60	60-65	65-70	70-75	>75	Total
2020	01jan20	INM 7.0b	34,236	9,801	1,361	110	0	**45,508**
2021	01jan22	INM 7.0b	28,951	9,912	2,321	117	0	**41,301**
2021	01jan22	Echo	40,787	9,371	931	30	0	**51,119**

Appendix G. Documentation of delivered files

Radar data for the year 2021 (source: BAC-TANOS)

2021-JAN-APR_flights.xlsx	12/01/2022	5,891 KB
2021-JAN-APR_ops.csv	12/01/2022	276,739 KB
2021-MAY-AUG_flights.xlsx	12/01/2022	12,089 KB
2021-MAY-AUG_ops.csv	12/01/2022	508,180 KB
2021-SEP-OCT_flights.xlsx	12/01/2022	7,526 KB
2021-SEPT-OCT_ops.csv	12/01/2022	318,002 KB
2021-NOV-DEC_flights.xlsx	12/01/2022	6,881 KB
2021-NOV-DEC_ops.csv	12/01/2022	285,156 KB

Flight data for the year 2021 (source: BAC-CDB)

cdb_2021_01_12.txt	12/01/2022	32,630 KB

Data entry point per flight for 2021 (source Skeyes)

EBBR_2021_DEP.xlsx	07/02/2022	8,368 KB

Weather data for the year 2021 (source: BAC-TANOS)

2021_meteo.xls	12/01/2022	3,296 KB

Noise events for the year 2021 (source: BAC-TANOS / dOMG)

2021-01_04_events TANOS.xlsx	24/01/2022	63,231 KB
2021-01_06_events TANOS_VO.xlsx	20/01/2022	21,508 KB
2021-05_08_events TANOS.xlsx	19/01/2022	102,446 KB
2021-06_12_events OMGEVING.xlsx	20/01/2022	44,774 KB
2021-09_12_events TANOS.xlsx	20/01/2022	92,897 KB

hour reports noise measuring network for the year 2021 (BAC-TANOS / dOMG)

status_OMGEVING_2021_all.xls	20/01/2022	3,907 KB
uur-rapporten_2021-0107 TANOS.xlsx	19/01/2022	23,795 KB
uur-rapporten_2021-0812 TANOS.xlsx	19/01/2022	16,975 KB

Address files Flanders and Brussels

Centraal Referentieadressenbestand (CRAB)	01/01/2022	Government of Flanders
OSLO business estates	10/02/2022	Government of Flanders
UrBis-Adm	01/01/2022	CIBG