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Liege Airport

RUNWAY PERFORMANCE REPORT 2022

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EXECUTIVE SUMMARY

This report gives an overview of Air Traffic Management (ATM) Performance at Liege Airport (International Civil Aviation Organization (ICAO) code: EBLG). ATM Performance is driven by four Key Performance Areas (KPAs): safety, capacity, environment and cost-efficiency. This report covers the first three of these four KPA's to provide skeyes' stakeholders and anyone of interest with the traffic figures for 2022 and further relevant data on the performance of the operations at Liege Airport.

Traffic

The aviation sector is recovering and throughout Europe, levels of 2019 are close to being reached. In contrast to many commercial services airports, however, Liege Airport was never affected by the dip in traffic during the COVID-19 crisis. In fact, quite the contrary is true: Due to its important role as one of Europe's major cargo hubs, Liege Airport witnessed a lot of growth and peaked in the number of movements during the COVID-19 crisis – handling pharmaceuticals products, medical equipment, as well as the increased demand of express parcel deliveries & e-commerce during the time. In 2022, the number of movements decreased and rather resembled pre-COVID-19 levels again. With 40,992 movements in 2022, Liege Airport is at -6% of the traffic in 2019 and -16% of 2021. This drop mainly stems from traffic flying according to instrument flight rules (IFR), which decreased by -20% from 43,611 movements in 2021 to 34,980 movements in 2022. Besides the reduced demand in medical supplies, the major contributing reasons to this decrease are the overall geopolitical instability due to the Russian invasion of Ukraine, restrictions from China's zero-Covid strategy, and FedEx moving its base out of Liege in March. Nonetheless, Liege Airport keeps a major role in the needs of the European cargo market (cargo as defined in the EUROCONTROL's Market Segment Rules, not taking into account cargo moved in the hull of passenger aircraft). In contrast to the decreasing number of IFR flights, traffic flying with visual flight rules (VFR) increased by 13% from 5,303 movements in 2021 to 6,012 movements in 2022. Furthermore, the airport itself reported that there are more and more passengers flying from and to Liege.

The traffic patterns throughout the day and over the week are analysed in this report, too. Similar patterns can be observed throughout the years: The cargo traffic leaves clear peaks from Tuesday to Friday with the arrival rush-hour at midnight and the departure wave at 04:00 in the morning.

As in the previous years, the most used runways are 22R and 04L. Due to the proximity of the parallel runways at Liege, the runway are oftentimes grouped in the analysis (22R & 22L as Runway 22; 04R & 04L as Runway 04). The share of usage of Runway 04 was 30% in 2022, which is comparable to the previous year. Monthly variations of runway usage are also provided and reveal a strong correlation with wind patterns (e.g. highest usage of Runway 04 with 64% in August due to north-easterly winds – least usage of Runway 04 in February with 1% due to strong south-westerly winds).

Safety

Safety is an important pillar in air traffic control. As such, safety occurrences and missed approaches are followed up by skeyes' safety unit who analyses the situations, trends and when relevant investigates.

The number of missed approaches, a procedure used when the approach cannot be continued for a safe landing, and particularly their cause, can indicate which measures are to be taken to improve the safety of air navigation service provision. In 2022, 58 missed approaches were logged, which is a decrease of 18% compared to 2021 (though traffic decreased by 16%). The rate of missed approaches per 1,000 arrivals decreased slightly by 2%. Unstable approaches and weather conditions were the most common reasons for a missed approach in 2022. skeyes promotes the increased use of PBN (Performance Based Navigation) procedures. Such an approach greatly improves predictability, and therefore, situational awareness can be enhanced. Currently the PBN transition at Liege Airport is pending on the approval of the Belgian Civil Aviation Authority (BCAA).

For safety occurrences, the report shows the events on runways and taxiways. Runway incursions increased from eight incursions in 2021 to eleven in 2022. Two of the runway incursions in 2022 had an ATM contribution: One of these was classified as a significant incident (severity C), the other had no immediate safety effect (severity E). Besides the runway incursions, there were also two runway events, eight taxiway/apron events, and five taxiway

incursions. All together, these 26 safety occurrences are less than in the previous year (30 in 2021). Other noteworthy items from the safety occurrences were a belly landing, a decrease in laser beam interference and less call sign confusions.

Capacity and Punctuality

Capacity and delay go hand in hand when it comes to runway performance. As in previous years, the declared capacity is based on the airport lay-out and the traffic statistics in Liege Airport, providing the number of movements that can be handled within one hour of time. As such, it can be used for scheduling purposes. The declared capacity of Liege Airport (34 movements/hour for Runway 22; 35 movements/hour for Runway 04) is based on a theoretical throughput capacity, which uses certain assumptions in its calculation. For a more complete view, this report also shows the effectively used capacity per runway configuration, i.e. how many movements took place per hour throughout the year. In 2022, Liege Airport exceeded the declared capacity only on one day (on the 16th of April), by six movements on Runway 04. This exceeding hour was composed to 97% of traffic flying according to visual flight rules (VFR). For VRF traffic, the separation rules are not applicable, which explains why the capacity could be exceeded.

Punctuality is affected by delay. An according performance indicator for runway operations at Liege Airport is thus the arrival delay, which is defined as the average Air Traffic Flow Management (ATFM) delay in minutes per flight, attributable to Liege tower under the control of skeyes. In 2022, the amount of arrival delay caused by Liege tower was 1,076 minutes (-19% compared to 2021). All this delay was due to weather, resulting in a delay of 0.06 minutes per arrival. No delay was due to causes attributed to the Air Navigation Service Provider (ANSP).

Aside from arrival delay, flights flying to and from Liege Airport can have delay that is caused by ATFM regulations in other sectors of their route. Even if this en-route delay is neither a runway nor an airport performance indicator, information on the punctuality of arrivals and departures is also provided. In 2022, 16,573 flights arriving at Liege Airport were delayed with a total of 19,905 minutes of ATFM delay. Of this delay, 10% (2,007 minutes) is attributable to skeyes while 90% was caused by ATFM measures placed by other ANSPs. Of all departures from Liege, 16,584 flights were delayed resulting in a total of 35,339 minutes of delay. Thereof, 3% (1,017 minutes) of is attributable to skeyes while 97% is attributable to other ANSPs. Translated to delay per flight, this is 1.67 minutes for flights from/to Liege. Reasons for the delay were mainly impacted traffic by Air Traffic Control (ATC) disruptions due to lack of capacity and staffing, weather related reasons, as well as special events such as the implementation of 4-flight in France.

Environment

To avoid noise around the airport and to optimize the amount of fuel needed for landings, skeyes encourages Continuous Descent Operations (CDO), also called green landings. The percentage of arrivals performing a ‘CDO Fuel’ (i.e. flying a CDO from FL100 to 3000 feet) decreased from 57% in 2021 to 50% in 2022. The percentage of arrivals performing a ‘CDO Noise’ (i.e. flying a CDO from FL60 to 3000 feet) decreased from 68% in 2021 to 60% in 2022. CDO statistics are inherently variable, because they are influenced by a multitude of external factors, such as the pilots’ CDO flying experience and experience with the airport, ATC experience, aircraft type and equipment, traffic flows, etc. Nonetheless, skeyes is continuously trying to increase the number of CDOs flown, by promoting the use of PBN procedures. Currently the PBN transition at Liege Airport is pending on BCAA approval.

This report also shows the yearly and monthly wind patterns at Liege Airport, as they are strongly linked to the choice of runway. Runway 22 is preferred over Runway 04 in terms of limited noise above the city of Liege. Although winds are predominantly coming from the South-West at the airport, 2022 and 2021 also observed several (strong) winds from blowing from the North-East. This largely explains the higher usage of Runway 04 in the last two years than in the years before.


LIEGE AIRPORT

SYNOPSIS

Ce rapport donne un récapitulatif des performances de la gestion du trafic aérien (Air Traffic Management (ATM) Performance) à Liege Airport (code de l'Organisation de l'Aviation Civile Internationale (OACI) : EBLG). Les performances ATM reposent sur quatre domaines de performance clés (KPA, Key Performance Areas) : la sécurité, la capacité, l'environnement et l'efficacité économique. Ce rapport couvre les trois premiers de ces quatre KPA afin de fournir aux stakeholders de skeyes et à toute personne intéressée les chiffres du trafic pour 2022 et d'autres données pertinentes sur la performance des opérations à Liege Airport.

Trafic

Le secteur de l'aviation se redresse et dans toute l'Europe, les niveaux de 2019 sont proches d'être atteints. Contrairement à de nombreux aéroports de services commerciaux, Liege Airport n'a cependant jamais été affecté par la baisse du trafic pendant la crise du COVID-19. En fait, c'est plutôt l'inverse qui est vrai : en raison de son rôle important en tant que l'un des principaux hubs de fret en Europe, l'aéroport de Liege a connu une forte croissance et a atteint un sommet en nombre de mouvements pendant la crise du COVID-19 - acheminement de produits pharmaceutiques, de matériel médical, ainsi que la demande accrue de livraisons de colis express et de commerce électronique au cours de la période. En 2022, le nombre de mouvements a diminué et ressemble à nouveau aux niveaux d'avant la COVID-19. Avec 40.992 mouvements en 2022, Liege Airport se situe à -6% du trafic de 2019 et à -16% de celui de 2021. Cette baisse du trafic provient principalement du trafic IFR (IFR, *Instrument Flight Rules*, règles de vol aux instruments), qui a diminué de 20%, passant de 43.611 mouvements en 2021 à 34.980 mouvements en 2022. Outre la baisse de la demande de fournitures médicales, les principales raisons de cette baisse sont l'instabilité géopolitique générale due à l'invasion russe de l'Ukraine, les restrictions liées à la stratégie 'zéro Covid' de la Chine et le déménagement de la base de FedEx de Liege en mars sont des raisons qui ont contribué à cette baisse. Néanmoins, Liege Airport continue à jouer un rôle majeur dans les besoins du marché européen du fret (le fret tel que défini dans les *Market Segment Rules* d'Eurocontrol, ne prenant pas en compte le fret transporté dans le fuselage des avions de passagers). Le trafic des vols à vue (VFR, *Visual Flight Rules*), au contraire, a augmenté de 13%, passant de 5.303 mouvements en 2021 à 6.012 mouvements en 2022. De plus, l'aéroport lui-même signale qu'il y a de plus en plus de passagers prennent l'avion au départ et à destination de Liege.

Les schémas de trafic du jour et de la semaine sont également analysés dans ce rapport. Des schémas similaires peuvent être observés tout au long des années : le trafic de fret connaît des pics importants du mardi au vendredi, avec l'heure d'affluence des arrivées à minuit et la vague des départs à 4h00 du matin.

Comme les années précédentes, les pistes les plus utilisées sont la 22R et la 04L. En raison de la proximité des pistes parallèles à Liege, les pistes sont souvent regroupées dans l'analyse (22R & 22L comme étant la piste 22 ; 04R & 04L comme étant la piste 04). La part d'utilisation de la piste 04 était de 30% en 2022, ce qui est comparable à l'année précédente. Les variations mensuelles de l'utilisation des pistes sont fournies et révèlent une forte corrélation avec les régimes de vent (par exemple, l'utilisation la plus élevée de la piste 04 avec 64% en août en raison de vents du nord-est - l'utilisation la plus faible de la piste 04 en février avec 1% en raison de forts vents du sud-ouest).

Sécurité

La sécurité est un pilier important du contrôle aérien. C'est pourquoi les événements de sécurité et les approches interrompues font l'objet d'un suivi par la *Safety Unit* de skeyes, qui analyse les situations, les tendances et, le cas échéant, mène des enquêtes.

Le nombre d'approches interrompues, une procédure utilisée lorsque l'approche ne peut être poursuivie pour effectuer un atterrissage en toute sécurité, et en particulier leur cause, peuvent indiquer les mesures à prendre pour améliorer la sécurité de la fourniture des services de navigation aérienne. En 2022, 58 approches interrompues ont été enregistrées, ce qui représente une baisse de 18% par rapport à 2021. Le taux d'approches interrompues pour 1.000 arrivées a légèrement diminué de 2%. Les approches instables et les conditions météorologiques ont été les raisons les plus fréquentes d'une approche interrompue en 2022. skeyes encourage l'utilisation accrue des procédures PBN (*Performance Based Navigation*). Ce type d'approche améliore grandement la prévisibilité, ce qui permet d'améliorer la conscience situationnelle. Actuellement, la transition PBN à Liege Airport est en attente de l'approbation de la DGTA.

En ce qui concerne les événements liés à la sécurité, le rapport indique les événements survenus sur les pistes et les voies de circulation. Les incursions de piste sont passées de 8 en 2021 à 11 en 2022. Deux des incursions de piste survenues en 2022 avaient une implication de la gestion du trafic aérien (ATM, *Air Traffic Management*) : l'une d'entre elles a été classée comme un incident significatif (de classe C), l'autre n'a pas eu d'effet immédiat sur la

sécurité (de classe E). Outre les incursions de piste, il y a également eu deux événements sur piste, huit événements sur voie de circulation/aire de trafic et cinq incursions sur voie de circulation. Au total, ces 26 événements de sécurité sont inférieurs à ceux de l'année précédente (30 en 2021). Parmi les autres éléments notables des événements liés à la sécurité, il y a eu un atterrissage sur le ventre, moins d'interférences dues à des faisceaux laser et moins de confusions de *call sign* (indicatif d'appel).

Capacité et ponctualité

Capacité et retard vont de pair lorsqu'il s'agit de la performance des pistes. Comme les années précédentes, la capacité déclarée est basée sur la configuration de l'aéroport et les statistiques de trafic à Liege Airport, fournissant le nombre de mouvements qui peuvent être traités en une heure de temps. En tant que telle, elle peut être utilisée à des fins de planification. La capacité déclarée (34 mouvements/heure pour la piste 22, 35 mouvements/heure pour la piste 04) est basée sur un débit théorique, dont le calcul repose sur certaines hypothèses. Par conséquent, ce rapport montre également la capacité effectivement utilisée par configuration de piste. En 2022, Liege Airport n'a dépassé la capacité déclarée qu'un seul jour, à savoir le 16 avril, avec six mouvements sur la piste 04. Cette heure de dépassement était composée à 97% de trafic VFR, pour lequel les règles de séparation ne sont pas d'application, ce qui explique que la capacité ait pu être dépassée.

La ponctualité est affectée par les retards. Un indicateur de performance pour les opérations de piste à Liege Airport est donc le retard à l'arrivée, qui est défini comme le retard ATFM (*Air Traffic Flow Management*) moyen en minutes par vol, imputable à la tour de Liege sous le contrôle de skeyes. En 2022, le retard à l'arrivée causé par la tour de Liege était de 1.076 minutes (-19% par rapport à 2021). Tous ces retards étaient dus aux conditions météorologiques, avec pour résultat un retard de 0,06 minute par arrivée. Aucun retard n'était dû à des causes imputables à l'*Air Navigation Service Provider* (ANSP).

Outre le retard à l'arrivée, les vols à destination et en provenance de Liege Airport peuvent subir des retards dus aux régulations ATFM dans d'autres secteurs de leur route. Même si ce retard en route n'est ni un indicateur de piste ni un indicateur de performance aéroportuaire, les informations sur la ponctualité des arrivées et des départs sont également fournies dans ce rapport. EN 2022, 16.573 vols à destination de Liege Airport ont subi des retard totalisant 19.905 minutes de retard ATFM. De ce retard, 10% (soit 2.007 minutes) est attribuable à skeyes, alors que 90% a été causé par des mesures ATFM placées par d'autres ANSPs. Concernant les départs de Liege, 16.584 vols ont subi du retard résultant en un total de 35.339 minutes de retard. De ce retard, 3% (1.017 minutes) est dû à skeyes, alors que 97% est attribuable à d'autres ANSPs. Traduit en retard par vol, cela revient à 1,67 minutes /vol pour les vols vers et en provenance de Liege Airport. Les raisons pour le retard sont majoritairement dues à des manques de capacité et personnel dans les ANSPs, la météo, ainsi que des événements exceptionnels comme l'implémentation du système 4-Flight en France.

Environnement

Pour éviter le bruit autour de l'aéroport et optimiser la quantité de carburant nécessaire aux atterrissages, skeyes encourage les opérations de descente continue (CDO, *Continuous Descent Operations*), également appelées atterrissages verts. Le pourcentage d'arrivées effectuant une *CDO Fuel* (c'est-à-dire effectuant une CDO du FL100 à 3000 pieds) a diminué, passant de 57% en 2021 à 50% en 2022. Le pourcentage d'arrivées effectuant une *CDO Noise* (c'est-à-dire une CDO du FL60 à 3000 pieds) a diminué, passant de 68% en 2021 à 60% en 2022. Les statistiques CDO sont intrinsèquement variables, car elles sont influencées par une multitude de facteurs externes, tels que l'expérience de vols CDO des pilotes et leur expérience de l'aéroport, l'expérience ATC, le type et l'équipement de l'aéronef, les flux de trafic, etc. Néanmoins, skeyes s'efforce continuellement d'augmenter le nombre de CDO effectuées, en promouvant l'utilisation de procédures PBN (*Performance Based Navigation*). Actuellement, la transition PBN à Liege Airport est en attente de l'approbation de la DGTA.

Ce rapport montre également les régimes de vent annuels et mensuels à Liege Airport, car ils sont fortement liés au choix de la piste. La piste 22 est préférée à la piste 04 en termes de limitation du bruit au-dessus de la ville de Liege. Bien que les vents dominants soient du sud-ouest à l'aéroport, on a également observé en 2022 et 2021 plusieurs vents (forts) soufflant du nord-est. Cela explique en grande partie l'utilisation plus importante de la piste 04L/R au cours des deux dernières années par rapport aux années précédentes.

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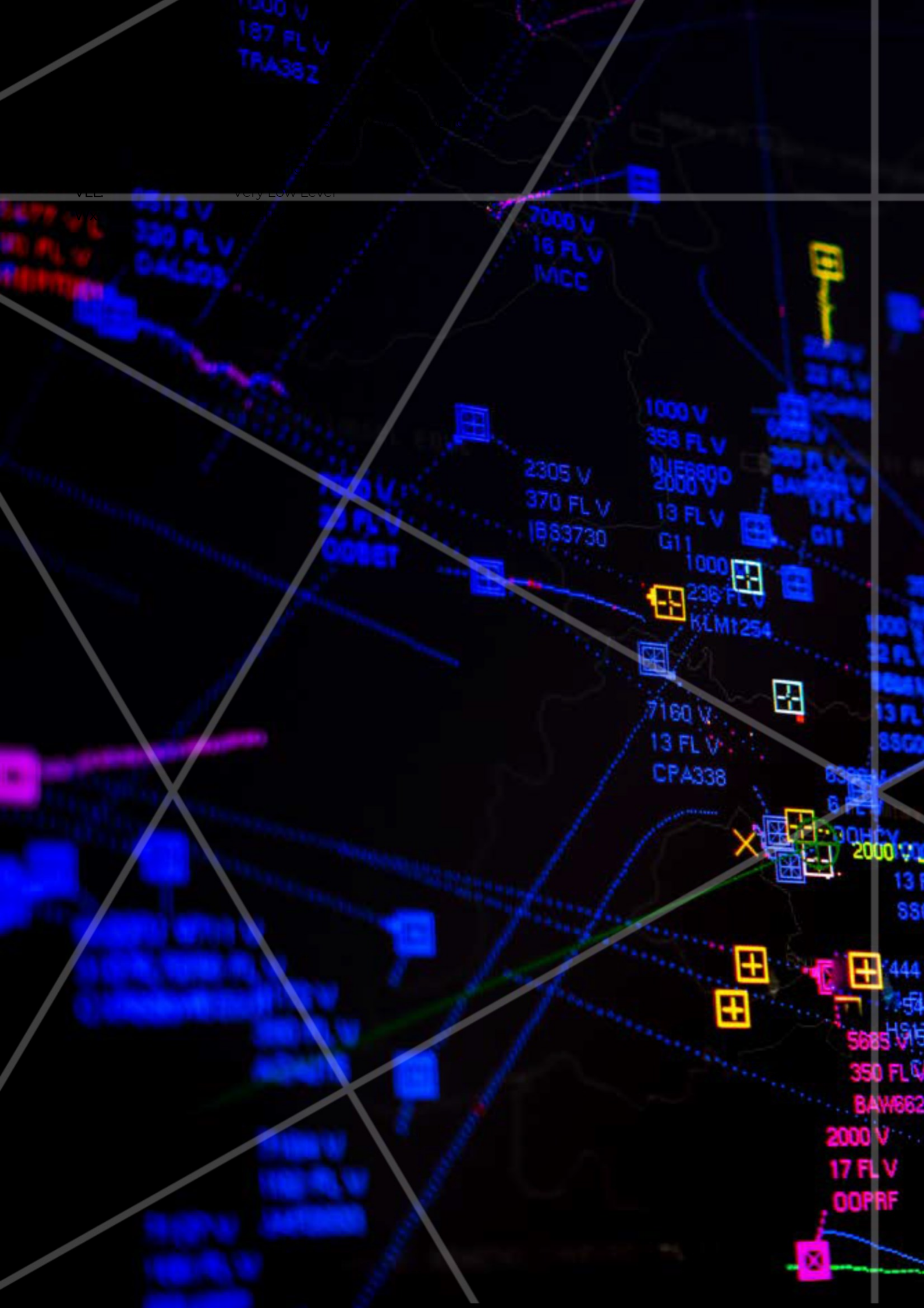
GLOSSARY

AAE:	Aerodrome Elevation
AAE:	above aerodrome elevation
ACFT:	Aircraft
AIP:	Aeronautical Information Publication
AMC:	Acceptable Means of Compliance
AMS:	Airport Movement System
ANSP:	Air Navigation Service Provider
A-SMGCS:	Advanced-Surface Movement Guidance and Control System
ATC:	Air Traffic Control
ATCO:	Air Traffic Control Officer
ATFM:	Air Traffic Flow Management
ATM:	Air Traffic Management
BCAA:	Belgian Civil Aviation Authority
CCO:	Continuous Climb Operations
CDO:	Continuous Descent Operations
CEM:	Collaborative Environmental Management
COVID-19:	Coronavirus Disease 2019
CRSTMP:	C-Capacity, R-Routeing, S-Staffing, T-Equipment, M-Airspace Management, P-Special Event
CTOT:	Calculated Take-off Time
CTR:	Control Zone
DSA:	Drone Service Application
EASA:	European Union Aviation Safety Agency
EBAW:	Antwerp International Airport ICAO Code
EBBR:	Brussels Airport ICAO Code
EBCI:	Brussels South Charleroi ICAO Code
EBKT:	Kortrijk-Wevelgem International Airport ICAO Code
EBLG:	Liege Airport ICAO Code
EBOS:	Ostend–Bruges International Airport ICAO Code
ETOT:	Estimated Take-off Time
EU:	European Union
ICAO:	International Civil Aviation Organization
IFR:	Instrument Flight Rules
ILS:	Instrument Landing Systems
KPA:	Key Performance Area
LRST:	Local Runway Safety Team
NM:	Network Manager
PBN:	Performance Based Navigation
PRU:	Performance Review Unit, EUROCONTROL
RAT:	Risk Analysis Tool
RMZ:	Radio Mandatory Zone
ROTA:	Runway Occupancy Time of Arrivals
RP3:	Reference Period 3
Runway 04:	Runway 04L & Runway 04R
Runway 22:	Runway 22L & Runway 22R
RWY:	Runway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1.Traffic

In this chapter, the traffic at Liege Airport is presented, as recorded by the Airport Movement System (AMS) developed by skeyes. The AMS is an in-house developed tower air traffic control (ATC) system and records the movements at an aerodrome and within its Control Zone (CTR). The movements are defined as an aircraft either crossing the CTR, landing or taking off at the aerodrome.

The figures presented throughout the report consider a movement as a take-off or landing of all traffic (flights under Visual Flight Rules (VFR) and Instrumental Flight Rules (IFR), helicopters and airplanes, commercial, military or general aviation). As this report considers runway performance, movements such as crossings of CTRs are not considered. As per BCAA's (Belgian Civil Aviation Authority) aerodrome movement definition:

- *one take-off* = *one movement (one departure)*
- *one landing* = *one movement (one arrival)*
- *one touch-and-go* = *two movements (one arrival and one departure)*

Traffic Overview

The number of aircraft movements at Liege Airport for the last four years is as follows:

- 2019: 43,451 (36,370 IFR; 7,081 VFR);
- 2020: 42,911 (37,791 IFR; 5,120 VFR);
- 2021: 48,914 (43,611 IFR; 5,303 VFR)
- 2022: 40,992 (34,980 IFR; 6,012 VFR);

In 2022, the total number movements was thus at a level of -16% of 2021 and at -6% of the pre-COVID-19 year 2019.

From Figure 1.1, which provides further information on the historical numbers of IFR and VFR flights, it can be seen that the large drop of traffic in 2022 is mainly due to the low number in IFR movements this year: There were 34,980 IFR movements in 2022, which is lower than in the last four years and 20% less than in 2021 (-8,631 movements).

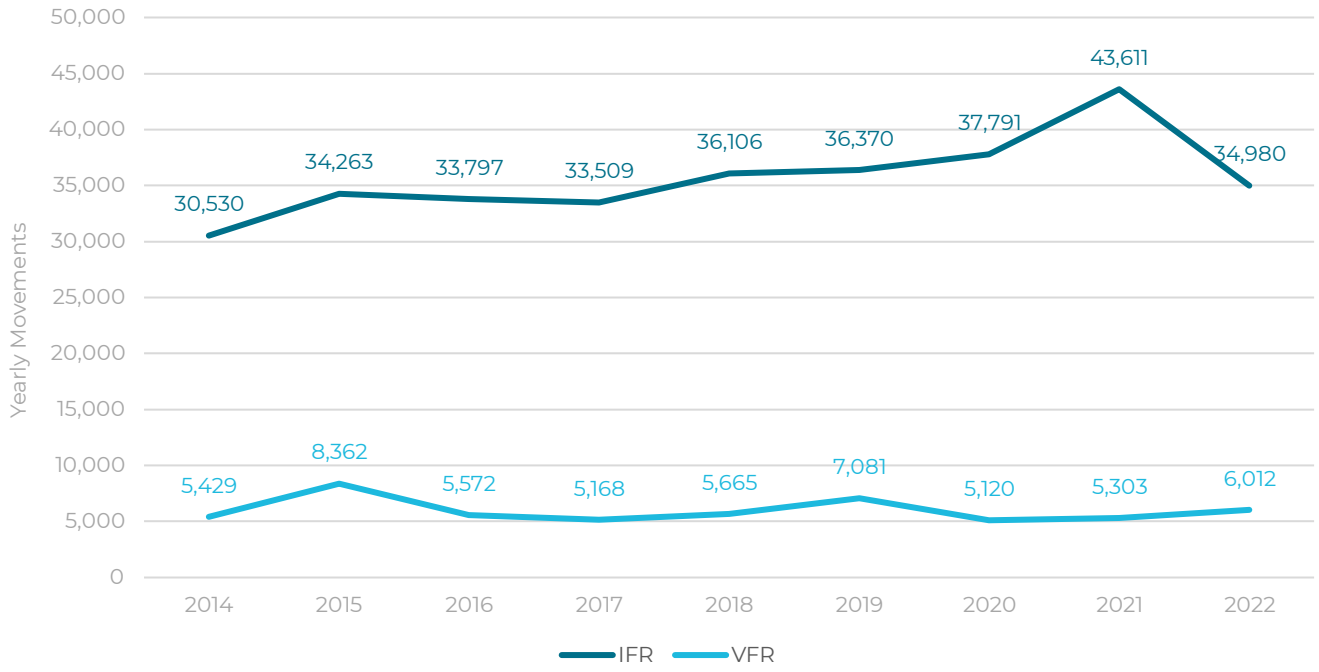


Figure 1.1: Historical traffic overview for IFR and VFR movements

During the years impacted by the COVID-19 pandemic (i.e. in 2020 and 2021) Liege witnessed a lot of growth (in IFR flights) due to its important role as one of Europe's major cargo hubs, handling pharmaceuticals products and medical equipment as well as the increased demand of express parcel deliveries & e-commerce during the time. The reasons why the growth of IFR movements discontinued in 2022 are multi-facetted. The following causes were identified to be major contributors to this negative development:

- FedEx, which used to be Liege's major air delivery service client, moved its operations in Liege partially to Paris Charles de Gaulle as of 28/03/2022.
- The Russian invasion of Ukraine on 24/02/2022 caused major changes in air traffic flows and led to an overall increase of geopolitical instability. As a consequence of the multitude of airspace restrictions and Western sanctions, AirBridgeCargo (ABC) activities had to stop operating in Liege. Also many other flights going to the Eastern hemisphere suffered from having to take longer routes to avoid Russian airspace. Increased fuel prices, less economical demand due to the geopolitical situation, and high inflation rates weakened cargo business operations worldwide.
- The zero-Covid strategy in China, which lasted until 07/12/2022, heavily impacted passenger and cargo operations as well. Due to restrictions imposed by the authorities in multiple major manufacturing hubs (e.g. Shenzhen, Dongguan, Changchun, Shanghai), supply chains were disrupted and less operations performed.

Potential future developments and growth of cargo activity is given by new bonds with MSC (Mediterranean Shipping Company) Air Cargo, which uses Liege Airport as its European hub since the inaugural flight on 03/12/2022.

Additionally, Air China started a new agreement on cargo and ramp handling with Worldwide Flight Services (WFS) in Liege.

In contrast to the drop of IFR traffic, VFR traffic is on the rise again at Liege Airport (+13% compared to 2021) though not yet fully reaching pre-COVID-19 levels (-15% compared to 2019). In 2022, VFR movements made up 15% of the traffic handled in Liege.

A monthly overview of the development of movements in 2022 is provided in Table 1.1 and Figure 1.2 (next page). It becomes evident that the previously mentioned events, especially the move of FedEx out of Liege towards the end of March and the Russian Invasion in Ukraine towards the end of February (with consequent sanctions in March), have had their impact: From January to March, the monthly comparison of 2022 to 2021 still yields an increase of movements ranging from +13% to +21% - but the rest of the months have a negative balance compared to the previous year (all at least 14% less than in 2019). The biggest decrease was observed in December 2022 (-33% of 2019). The number of VFR movements have ranged from -14% (in June) to +56% (in July). A lot of variations in VFR traffic can usually be explained by weather conditions as a sunny sky and good weather conditions promote the number of VFR flights.

Additionally, it is noteworthy that Liege Airport is now handling more passengers than before according to the annual report of the airport[1].

Table 1.1: Monthly movements per year at Liege Airport

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
IFR	**2019**	2,973	2,758	3,087	2,916	3,119	2,929	3,160	2,947	3,038	3,298	3,110	3,035	**36,370**
	2020	2,967	2,796	3,057	2,469	3,126	2,978	3,202	3,283	3,282	3,574	3,446	3,611	**37,791**
	2021	2,965	3,181	3,603	3,476	3,729	3,802	3,712	3,788	3,988	3,948	3,650	3,769	**43,611**
	2022	3,533	3,502	3,888	2,569	2,749	2,786	2,934	2,841	2,746	2,502	2,492	2,438	**34,980**
	2022 *vs* 2019	+19%	+27%	+26%	-12%	-12%	-5%	-7%	-4%	-10%	-24%	-20%	-20%	**-4%**
	2022 *vs* 2021	+19%	+10%	+8%	-26%	-26%	-27%	-21%	-25%	-31%	-37%	-32%	-35%	**-20%**
VFR	**2019**	362	633	625	725	714	740	575	579	908	470	388	362	**7,081**
	2020	320	399	248	106	243	629	803	728	676	446	298	224	**5,120**
	2021	223	383	526	486	505	513	396	567	585	515	358	246	**5,303**
	2022	333	536	772	482	630	442	619	532	564	552	313	237	**6,012**
	2022 *vs* 2019	-8%	-15%	+24%	-34%	-12%	-40%	+8%	-8%	-38%	+17%	-19%	-35%	**-15%**
	2022 *vs* 2021	+49%	+40%	+47%	-1%	+25%	-14%	+56%	-6%	-4%	+7%	-13%	-4%	**+13%**
Total	**2019**	3,335	3,391	3,712	3,641	3,833	3,669	3,735	3,526	3,946	3,768	3,498	3,397	**43,451**
	2020	3,287	3,195	3,305	2,575	3,369	3,607	4,005	4,011	3,958	4,020	3,744	3,835	**42,911**
	2021	3,188	3,564	4,129	3,962	4,234	4,315	4,108	4,355	4,573	4,463	4,008	4,015	**48,914**
	2022	3,866	4,038	4,660	3,051	3,379	3,228	3,553	3,373	3,310	3,054	2,805	2,675	**40,992**
	2022 *vs* 2019	+16%	+19%	+26%	-16%	-12%	-12%	-5%	-4%	-16%	-19%	-20%	-21%	**-6%**
	2022 *vs* 2021	+21%	+13%	+13%	-23%	-20%	-25%	-14%	-23%	-28%	-32%	-30%	-33%	**-16%**

[1] https://www.liegeairport.com/corporate/fr/ (URL retrieved on 27/02/2023)

Figure 1.3 provides more detail on the traffic with a calendar view containing the daily number of movements at Liege Airport. The days have to be read from top to bottom first and then from the left to the right. On the 9th of November 2022, there was a national strike in Belgium resulting in the day with the lowest number of movements (16). The lighter shades after March signify again that there was less traffic after this month. Additionally, some patterns per weekday can be observed – for example that Tuesday to Friday is generally busier than the other days.

Since Liege Airport is busiest at night, further light is shed upon the number of movements per hour of the night in Figure 1.4. Due to the loss of nightly cargo traffic, the usual peaks at midnight and 04:00 in the morning are lower than in previous years. The following sections further discusses the daily patterns of traffic at Liege Airport.

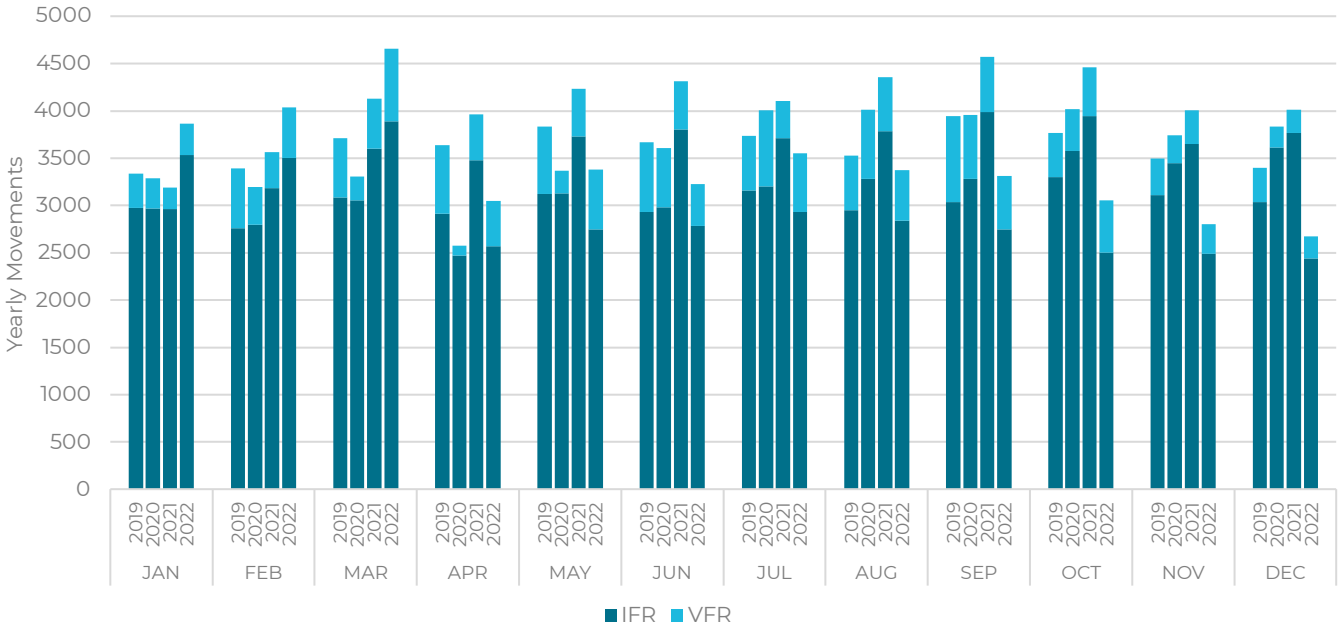


Figure 1.2: Total monthly movements per year

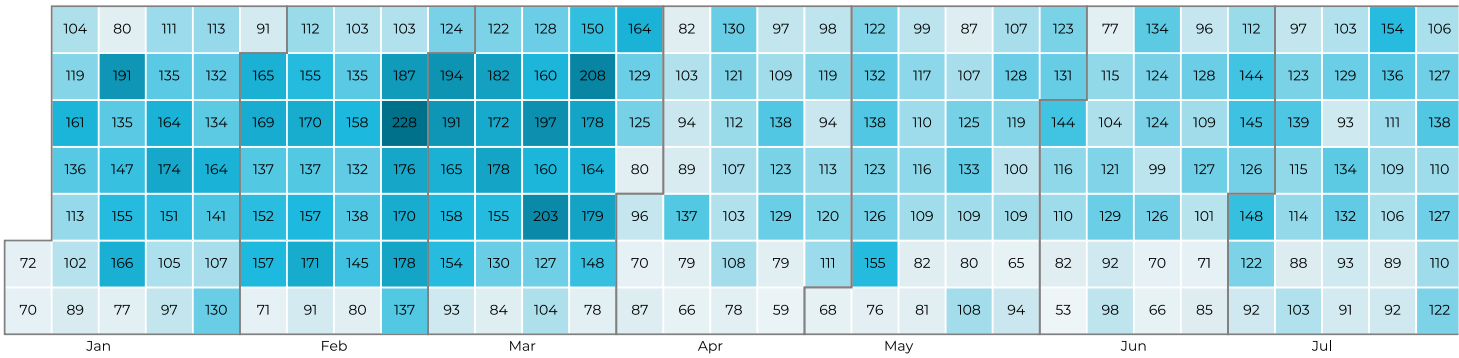
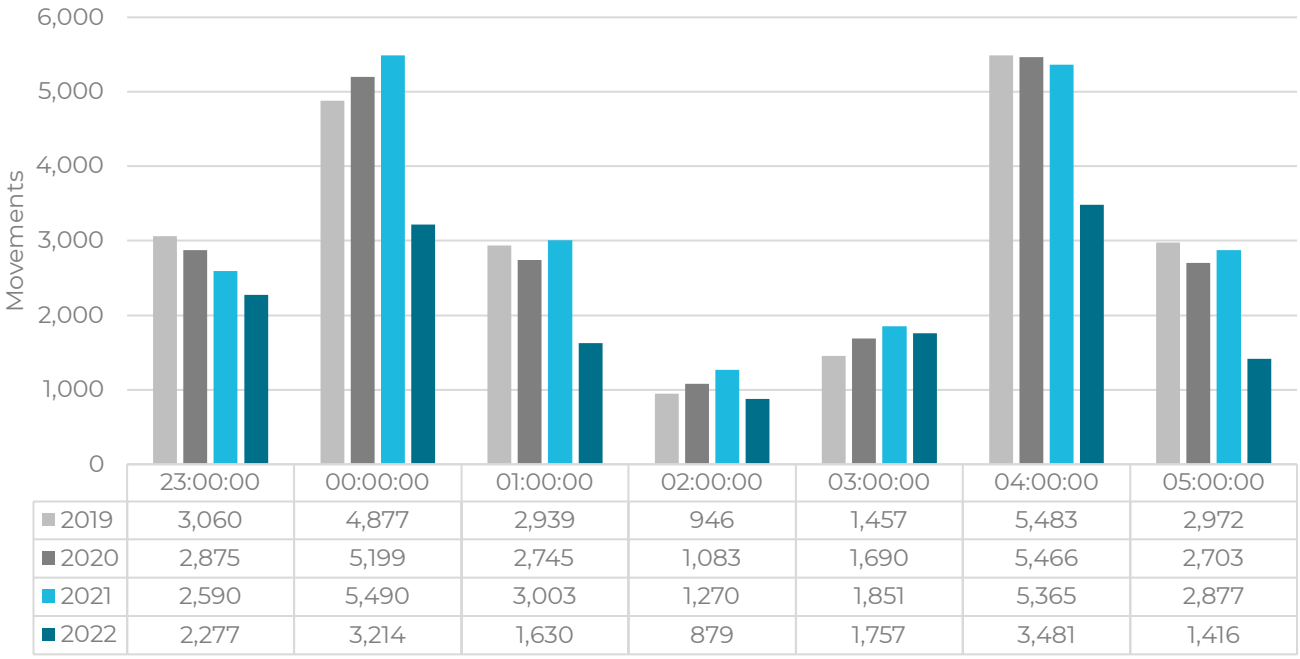
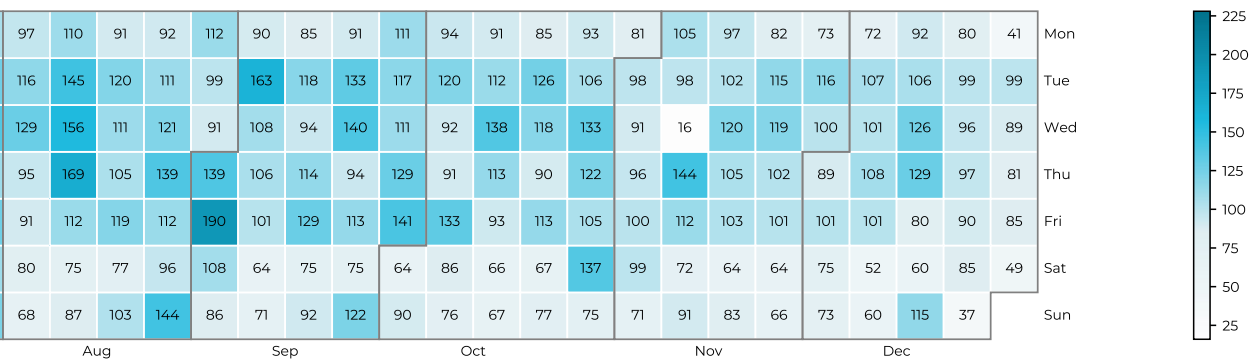


Figure 1.3: Calendar view of movements per day in 2022



	23:00:00	00:00:00	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00
2019	3,060	4,877	2,939	946	1,457	5,483	2,972
2020	2,875	5,199	2,745	1,083	1,690	5,466	2,703
2021	2,590	5,490	3,003	1,270	1,851	5,365	2,877
2022	2,277	3,214	1,630	879	1,757	3,481	1,416

Figure 1.4: Night movements at Liege Airport per hour and year



Traffic Patterns

Figure 1.5 shows the average hourly movements of IFR and VFR traffic throughout the hours of the day (in local time) in 2022.

For VFR traffic, the movement pattern is similar to the previous years; Most traffic occurs during the day with a small morning bump at 08:00 and a wide spread distribution until the evening. In the evening hours from 18:00 to 24:00 some slight differences throughout the years can be observed – the trend seems to make more use of late evening hours, which were freed up by the reduction in IFR traffic. A lot of touch-and-goes can be observed during the night hours (possibly of training flights), which result in the higher number of VFR movements.

The IFR traffic distribution, on the other hand, shows two pronounced peaks, representing the wave of cargo flight arrivals at midnight and second rush hour at 04:00 in the morning when those flights departure from Liege. Although these peaks are still present, it is noticeable that the number of movements of these peaks are much lower than in the years before: For example, in 2019, the yearly average of movements from 04:00 to 05:00 was 15, whereas it was only 9.5 in 2022. The main reason for this drop is the earlier mentioned restrictions and negative developments on cargo activity. For example, before the move of FedEx on 28/03/2022, Liege handled a daily average of 11.0 FedEx flight movements– after their relocation, this number reduced to 6.6 movements/day (in this analysis, FedEx flight movements describe all flights with a callsign starting with FDX – for an analysis, which also includes the subcontractors of FedEx, see the "Cargo" section of this chapter).

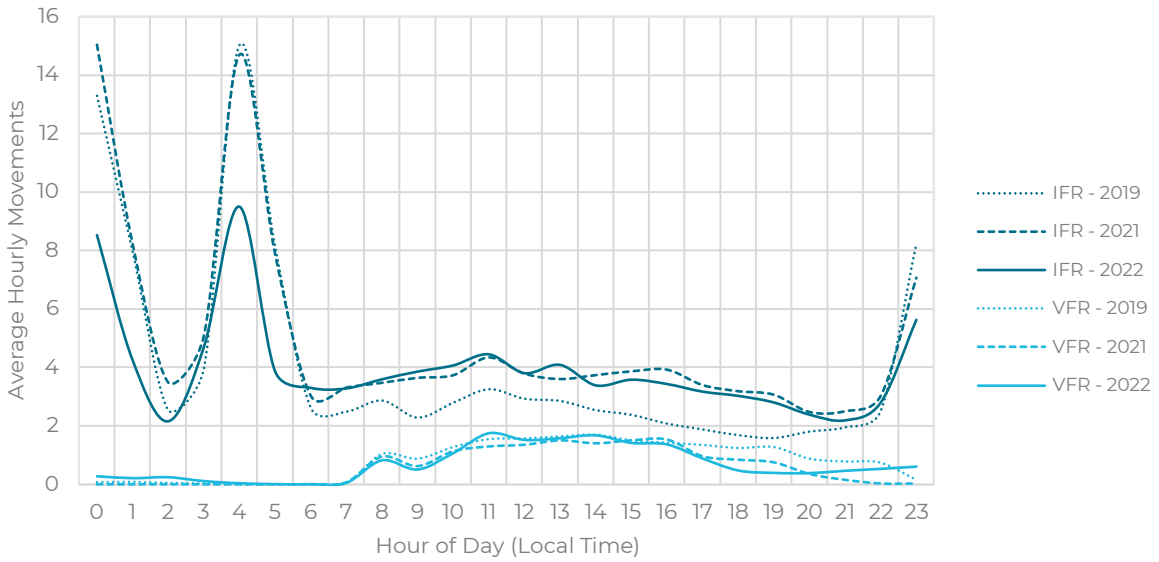


Figure 1.5: Yearly average of IFR and VFR movements per hour in the day for 2022 per flight rule (local time)

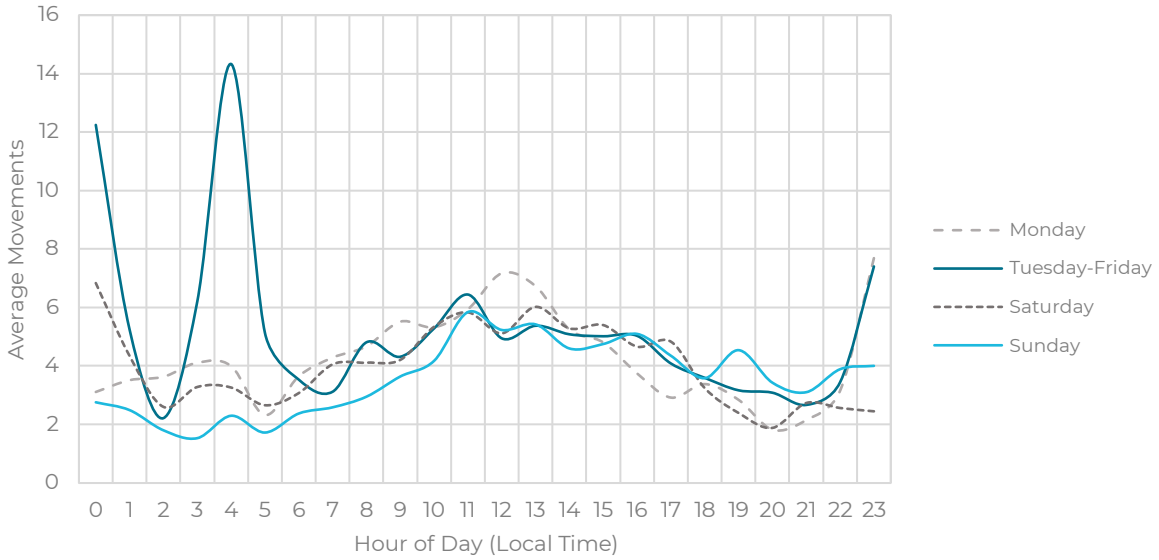


Figure 1.6: Yearly average of IFR and VFR movements per hour in the day per weekday for 2022 (local time)

The traffic pattern at Liege Airport can also be decomposed depending on the days of the week, as shown in Figure 1.6. From Tuesday to Friday, the traffic is similar and thus grouped together in the graph. During these days, cargo companies perform most of their operations, which leads to the two peaks of arrivals and departures, which have already been explained previously. On Saturdays, the midnight peak still appears, but very few departures happen. Sunday is usually the day with the least traffic. On Monday mornings, the aircraft that did not depart on Sunday take off continuously between 00:00 and 04:00. At around 23:00, traffic numbers then rise again to reach the arrival peaks of Tuesday nights.

Runway Use

There are two parallel runways at Liege Airport, 04L/22R and 04R/22L (see Figure 1.8 for the according ICAO chart). The use of runways depends on several factors like wind direction, airport layout, approach and departure routes, works on taxiways, visibility, etc.

Due to the proximity of the parallel runways at Liege, these are so-called "*dependent runways*", which means that operations on one runway affect the operations on the other. Regarding Liege Airport, only one runway at a time may be used: i.e. either 04L or 04R, but not both at the same time. For this reason, this chapter and also the capacity analysis in Chapter 3 oftentimes consider the following logical runway groups rather than the single runways:

- Runways 04L and 04R are summarised as Runway 04.
- Runways 22L and 22R are summarised as Runway 22.

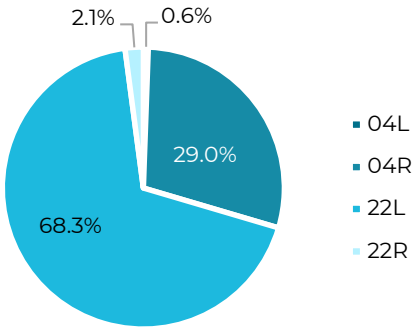


Figure 1.7: Share of runway use

Despite the common grouping of runways, the pie chart in Figure 1.7 also gives an overview of the share of usage of each single runway in 2022. Although Runways 04L/22R and 04R/22L are easily interchangeable, it shows that there is a clear preference at Liege Airport for Runway 04R/22L. The reason for this preference is that the runway for 04R/22L is longer, and furthermore, 04R/22L is equipped with the CAT III instrument landing systems (ILS).

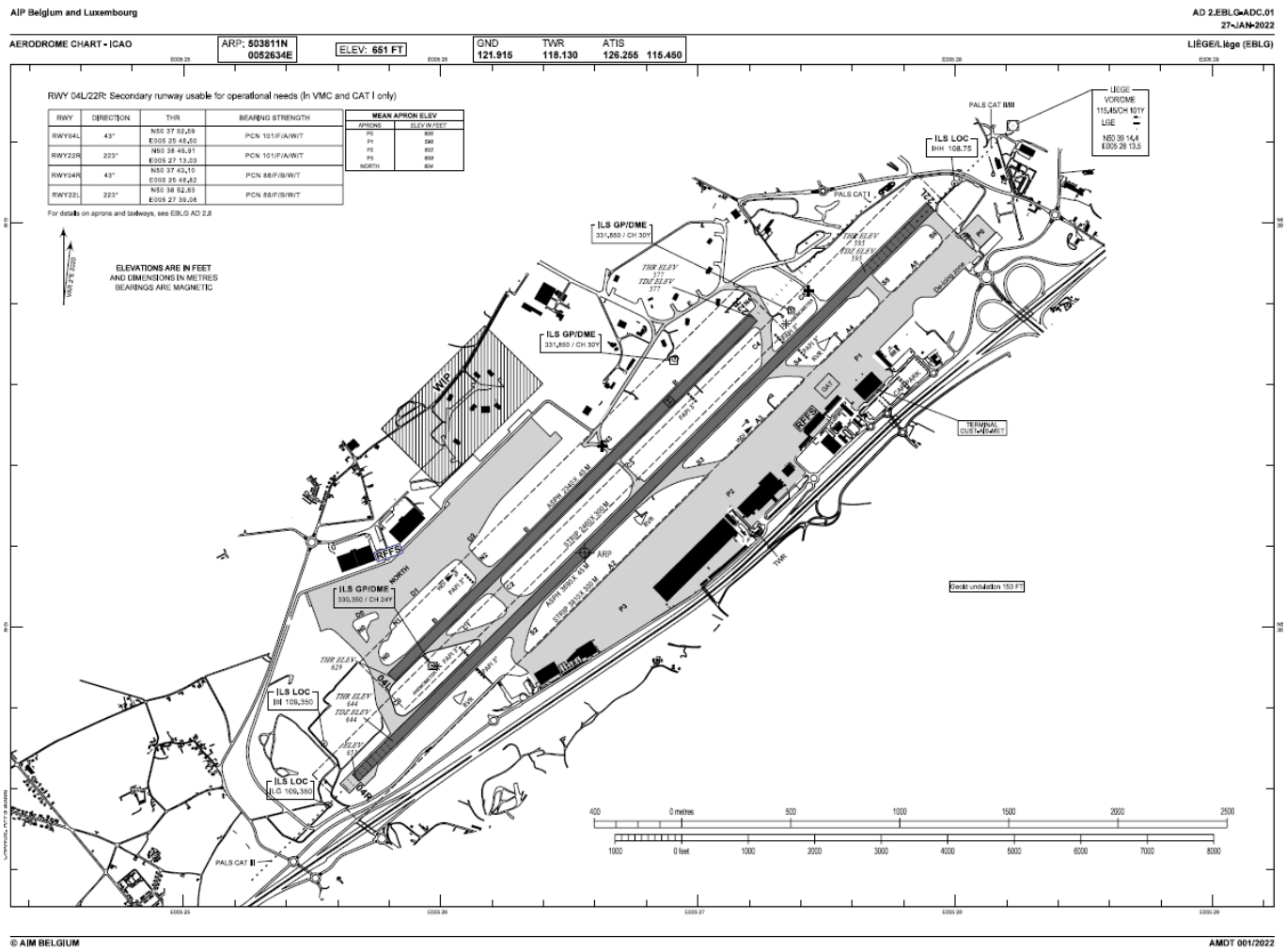


Figure 1.8: Aerodrome ground movement chart – ICAO

Figure 1.9 shows the ratio of use of Runway 04L to 04R as well as the ratio of use of Runway 22L to 22R.
In 2022, these shares remained rather similar to the previous year. Runway 04L/22R is usually only used when Runway 04R/22L is blocked; i.e. due to runway and taxiway works, maintenance of equipment, etc.

In Figure 1.10, one can see the evolution of total movements per year for the Runways 04L and 22R.

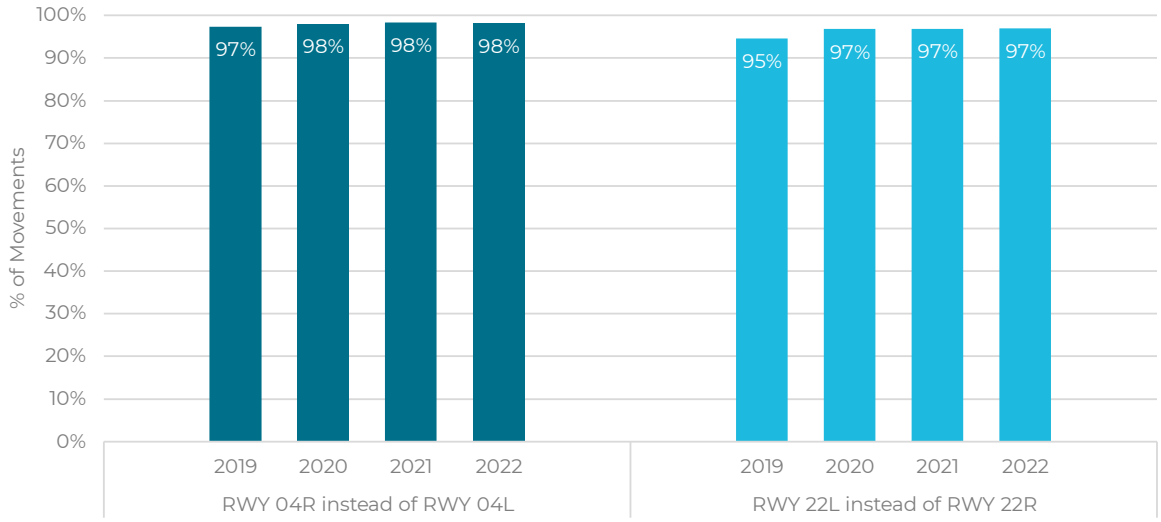


Figure 1.9: Share of runway use per year between runways 04L & 04R and 22L & 22R

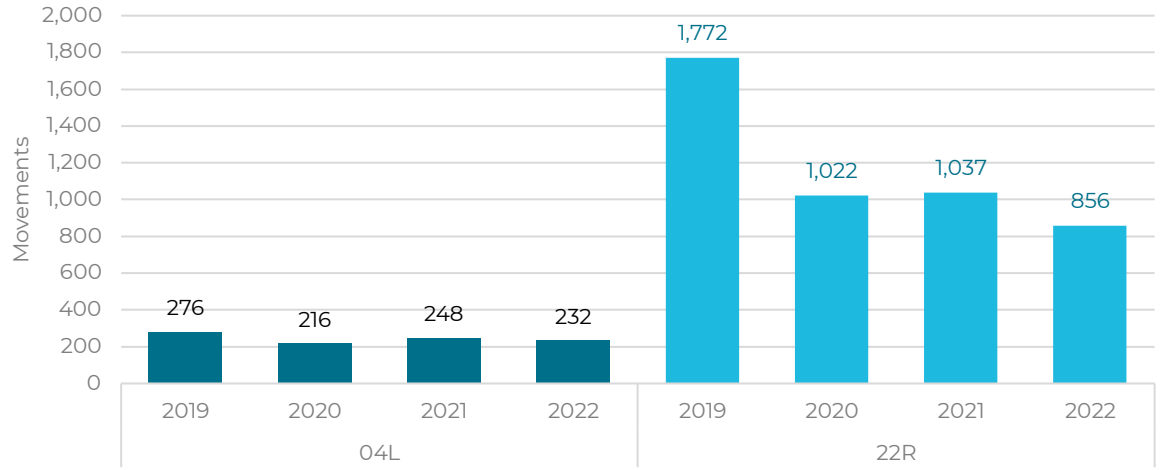


Figure 1.10: Number of movements per year on runways 04L and 22R

The share of usage of runway group 04 and runway group 22 can be seen in Figure 1.11. Clearly, the most used runway group was 22L/R, which registered about 70% of the movements in 2022 while runway group 04L/R only served 30% of the movements. The reason for the generally higher use of Runways 22L/R is the wind direction: At Liege Airport, winds are mainly observed from a South-Westerly direction and flights should depart and land with head wind for aeronautical reasons. The wind roses underneath the bar chart (see also Figure 4.5 in Chapter 4 for bigger graphs and further explanations on the wind roses) further demonstrate the influence of different wind patterns on the runways in use: In 2021 and 2022, for example, there were more winds blowing from the North-East than in the previous two years and accordingly, runway group 04 was also more often in use during these years (both around 30% whereas the usage was at approx. 25% in 2019 and 2020).

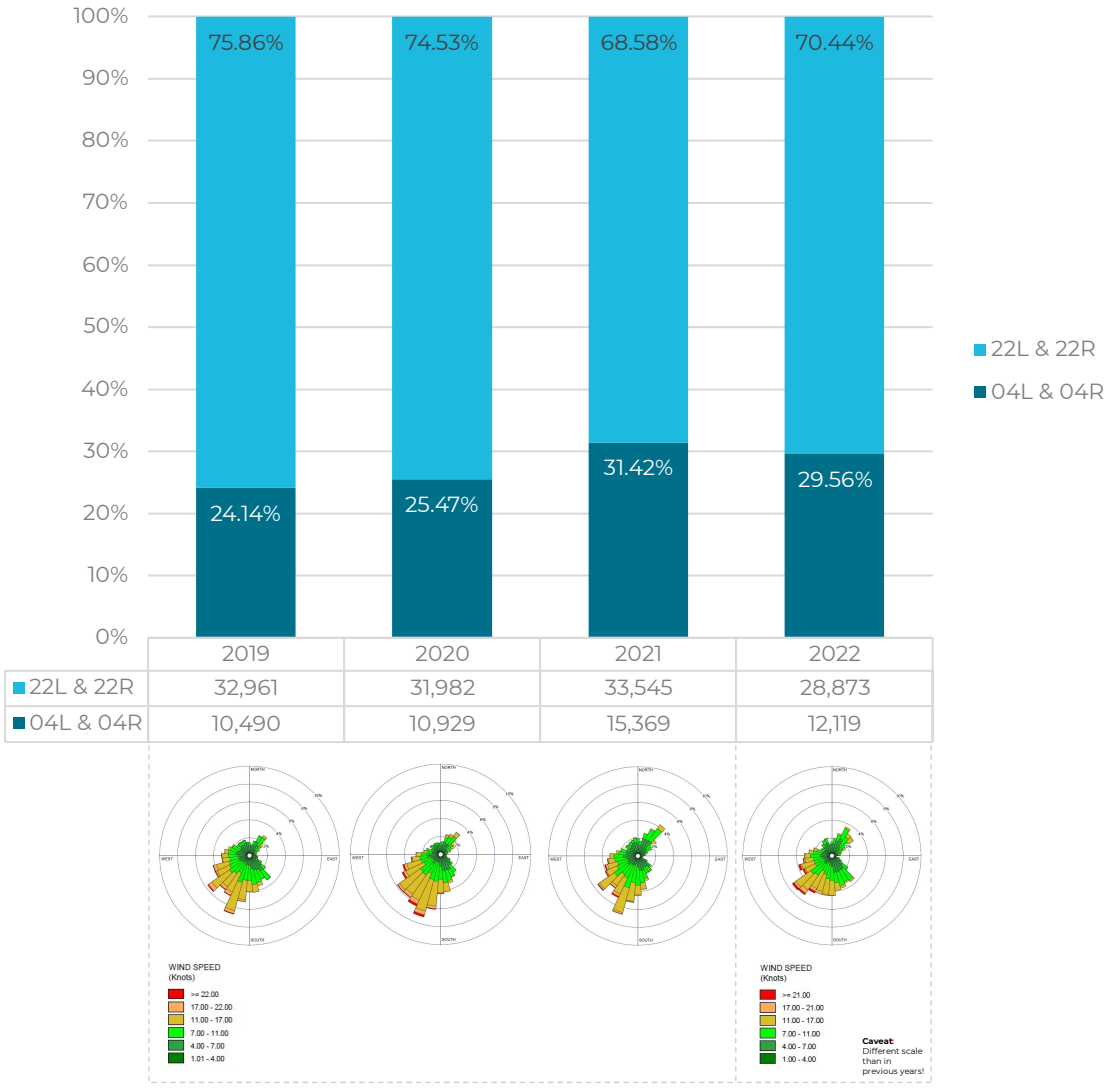


Figure 1.11: Runway use per year (22L & 22R and 04L & 04R combined)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IATA

Figure 1.12 depicts the information on runway usage as previously given for each year on a monthly basis. Again, a strong correlation of runway usage with wind can be observed. Particularly in April and August, the runways 04L and 04R were used more than 50%, with a maximum usage of 64.3% in August. The wind roses – which can also be seen in a bigger format in Figure 4.6, Chapter 4– reveal that in August, strong North-East winds prevailed, which explains this high usage of runways 04L and 04R. On the other extreme, February experienced many very strong winds (also above 21 knots) from the South-West, which is why the share of usage of runways 22L and 22R was at almost at 99% during this month.

The number of arrivals and departures per runway per month can be found in Table 1.2.

Figure 1.12: Runway use per month in 2022 (22L & 22R and 04L & 04R combined) and monthly wind roses

Table 1.2: Arrivals and Departures per Runway in 2022

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
Arrivals	**04L**	1	0	11	16	13	27	15	25	7	4	2	6	**127**
	04R	268	30	1,025	847	593	540	677	1,074	397	154	73	366	**6,044**
	22L	1,613	1,939	1,244	648	1,047	1,003	1,063	560	1,195	1,319	1,263	937	**13,831**
	22R	36	48	46	11	40	38	23	26	58	50	66	29	**471**
	Total	1,918	2,017	2,326	1,522	1,693	1,608	1,778	1,685	1,657	1,527	1,404	1,338	**20,473**
Departures	**04L**	0	0	10	15	8	25	9	19	5	7	2	5	**105**
	04R	182	27	915	856	571	553	656	1,052	428	145	77	381	**5,843**
	22L	1,737	1,951	1,364	645	1,080	1,014	1,084	593	1,189	1,331	1,268	930	**14,186**
	22R	29	43	45	13	27	28	26	24	31	44	54	21	**385**
	Total	1,948	2,021	2,334	1,529	1,686	1,620	1,775	1,688	1,653	1,527	1,401	1,337	**20,519**

Cargo

Liege Airport is Belgium's largest cargo hub and one of the major European players, which fully favours full freighters. Therefore, a closer look at cargo movements is taken based on the air traffic market segmentation rules from STATFOR/EUROCONTROL[2] and the flight plan information captured by skeyes' airport movement system. The EUROCONTROL's Market Segment Rules provides a definition for air traffic market segments based on lists of aircraft types, aircraft operators and the flight types filed on flight plans. For this study, cargo refers to "all-cargo" segment, not taking into account cargo moved in the hull of passenger aircraft.

Table 1.3: Cargo movements per year at Liege Airport

	IFR	other market segments	cargo	% cargo of all IFR
2019	36,370	7,338	29,032	**79.82%**
2020	37,791	5,953	31,838	**84.25%**
2021	43,611	9,437	34,174	**78.36%**
2022	34,980	10,451	24,529	**70.12%**

Figure 1.13 and Table 1.3 provide an overview of the yearly evolution of cargo traffic, other market segments (i.e. mainline, business aviation, low-cost scheduled, non-scheduled, regional, military, and other) and the share of cargo over all IFR traffic. The year of 2022 witnessed a significant drop in cargo figures.

Looking back, the year of 2020 was the year with the highest share of cargo at Liege Airport (84%): Due to the COVID-19 pandemic, there were many lockdowns and travel restrictions on the one hand, but also a high need for transportation of medical goods and other parcels on the other hand. Cargo traffic was higher than in 2019 and traffic of other market segments dropped to a minimum, which explains the peak in the share of cargo. Then, in 2021, the total number of cargo movements continued to rise (to the maximum of 34,174 movements), but traffic of other market segments also started to pick up again (likely also due to an increase in business aviation thanks to the opening of the business terminal that year), so that the share of cargo dropped to 78% although the total number of movements increased. In 2022, traffic of other market segments than cargo are still on the rise. Liege airport itself reported to have witnessed an increase in passengers of +18% and a total number of 166,898 passengers[3]. In terms of movements, the other market segments increased by +11%. Cargo movements, however, dropped (-28%) to a low of 24,529 movements, such that the share of cargo movements at Liege Airport in 2022 was only 70%.

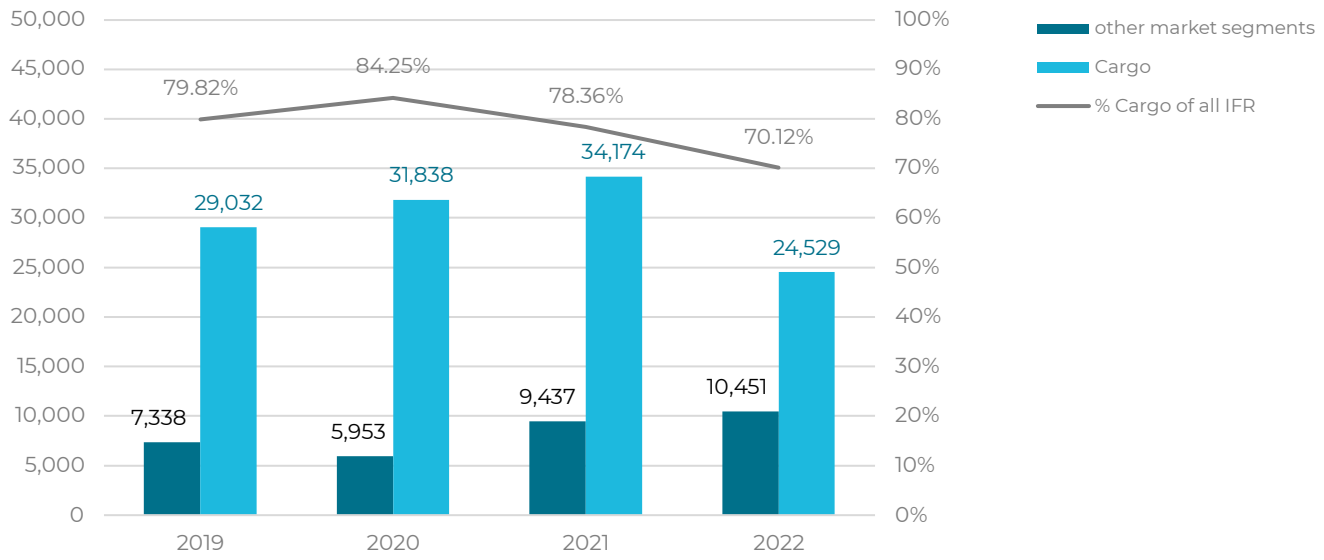
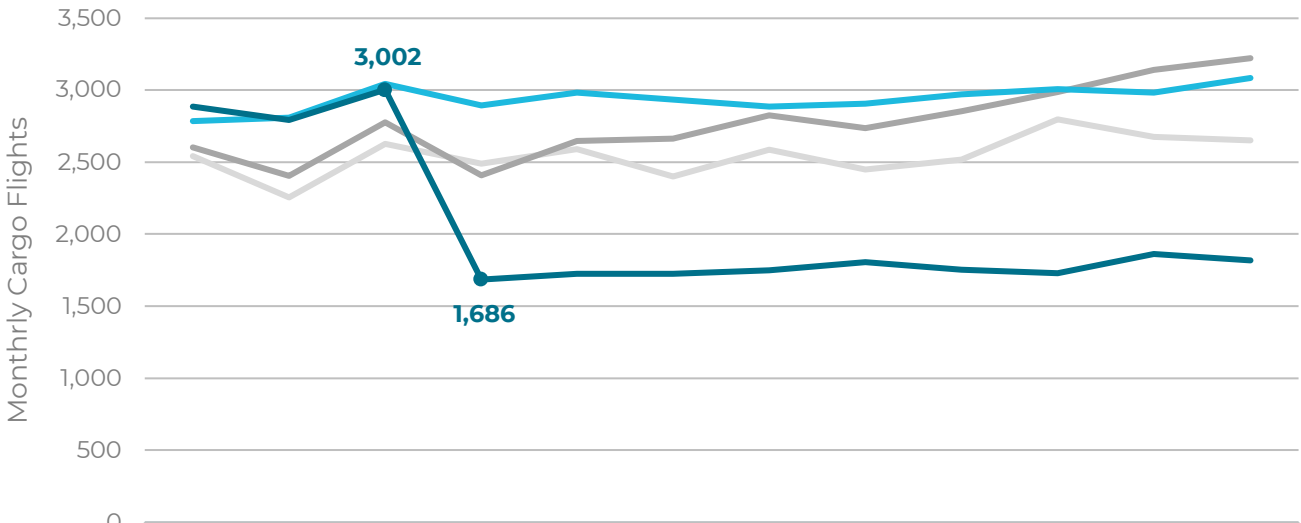


Figure 1.13: Yearly number of cargo movements and other segmentations at Liege Airport

[2] https://www.eurocontrol.int/publication/market-segment-rules (URL retrieved on 17/02/2023)

[3] https://www.liegeairport.com/corporate/fr/ (URL retrieved on 27/02/2023)

Figure 1.14 provides a more in-depth view on the evolution of the cargo figures per month per year. Very noticeable is that the beginning of the year 2022 started off as well as in 2021 with high traffic figures in January, February, and March. In April 2022, however, there were 1,316 cargo movements less than in the previous month (-44%) and the monthly movements of the rest of the year stayed around at this reduced level. As previously mentioned, Liege's main delivery service client FedEx partially moved its operations from Liege to Paris Charles de Gaulle as of 28/03/2022. Additionally, the Russian invasion of Ukraine on 24/02/2022 caused major changes in air traffic flows due to sanctions and led to an overall increased geopolitical instability, which further contributed to a decrease in cargo traffic.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	2,541	2,254	2,627	2,489	2,588	2,400	2,585	2,448	2,516	2,796	2,676	2,649
2020	2,601	2,404	2,775	2,406	2,648	2,662	2,823	2,735	2,852	2,988	3,141	3,222
2021	2,783	2,807	3,043	2,895	2,983	2,935	2,884	2,905	2,970	3,007	2,983	3,082
2022	2,884	2,793	3,002	1,686	1,723	1,725	1,749	1,804	1,751	1,730	1,863	1,819

Figure 1.14: Monthly number of cargo movements at Liege Airport per year

To obtain an estimate on how much of the drop in Figure 1.14 is accountable to the move of FedEx and how much can be explained by the geopolitical situation or other factors, Figure 1.15 shows the number of movements per month for FedEx and its subcontractors vs any other cargo flight. As subcontractors, we identified any flight with callsign letters TAY (ASL Airlines) or SWN (West Air Sweden) because these are known to operate for FedEx. It cannot be excluded that there are further subcontractors, which are not captured in this analysis and it is also unknown which share of the performed flights by ASL Airlines and West Air Sweden were actually executed for FedEx operations. In March, FedEx and its subcontractors together accounted for 58% of cargo movements, but in April this share reduced to 40%. There was a significant drop of 1,064 movements/month for FedEx and its subcontractors (-61%) and a smaller, but also noticeable drop for the other cargo movements (-245 movements/month, -19%). The fact that other cargo movements also dropped from March to April and then remained at a rather reduced level for the rest of the year reflects that it has been a difficult year for cargo operations in general.

For further information on the changes of clientele, details on the difference of movements per client by callsign are given in Figure 1.16.

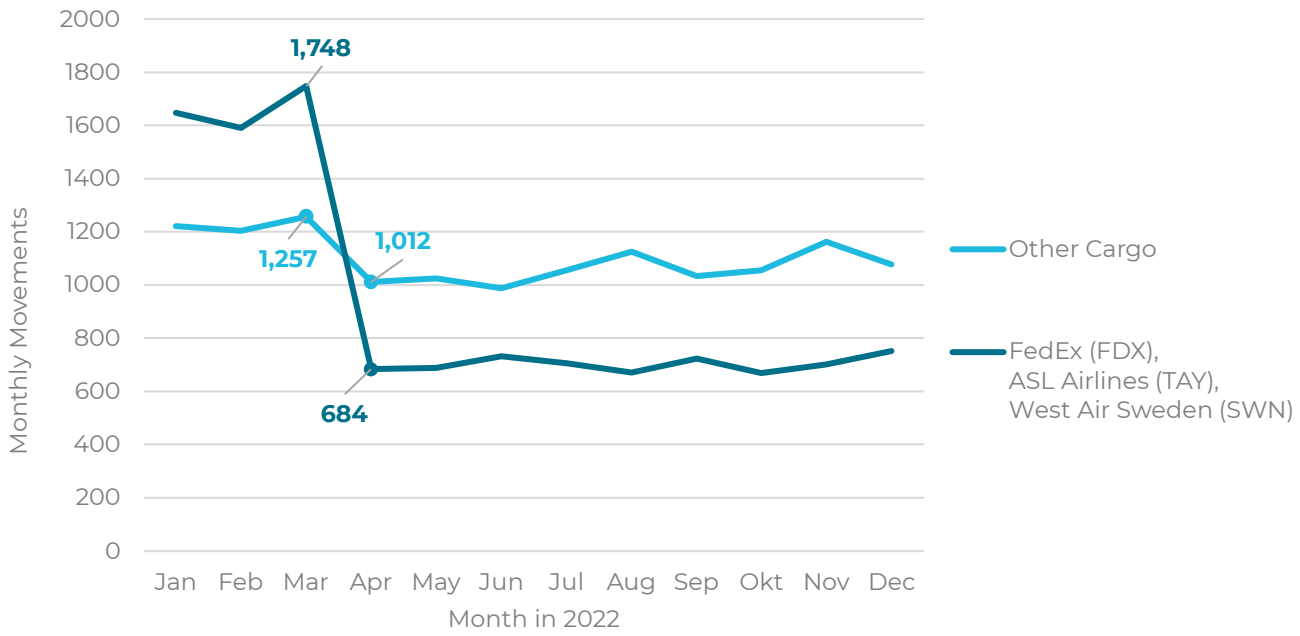


Figure 1.15: Monthly cargo movements of FedEx and its subcontractors vs any other cargo flight

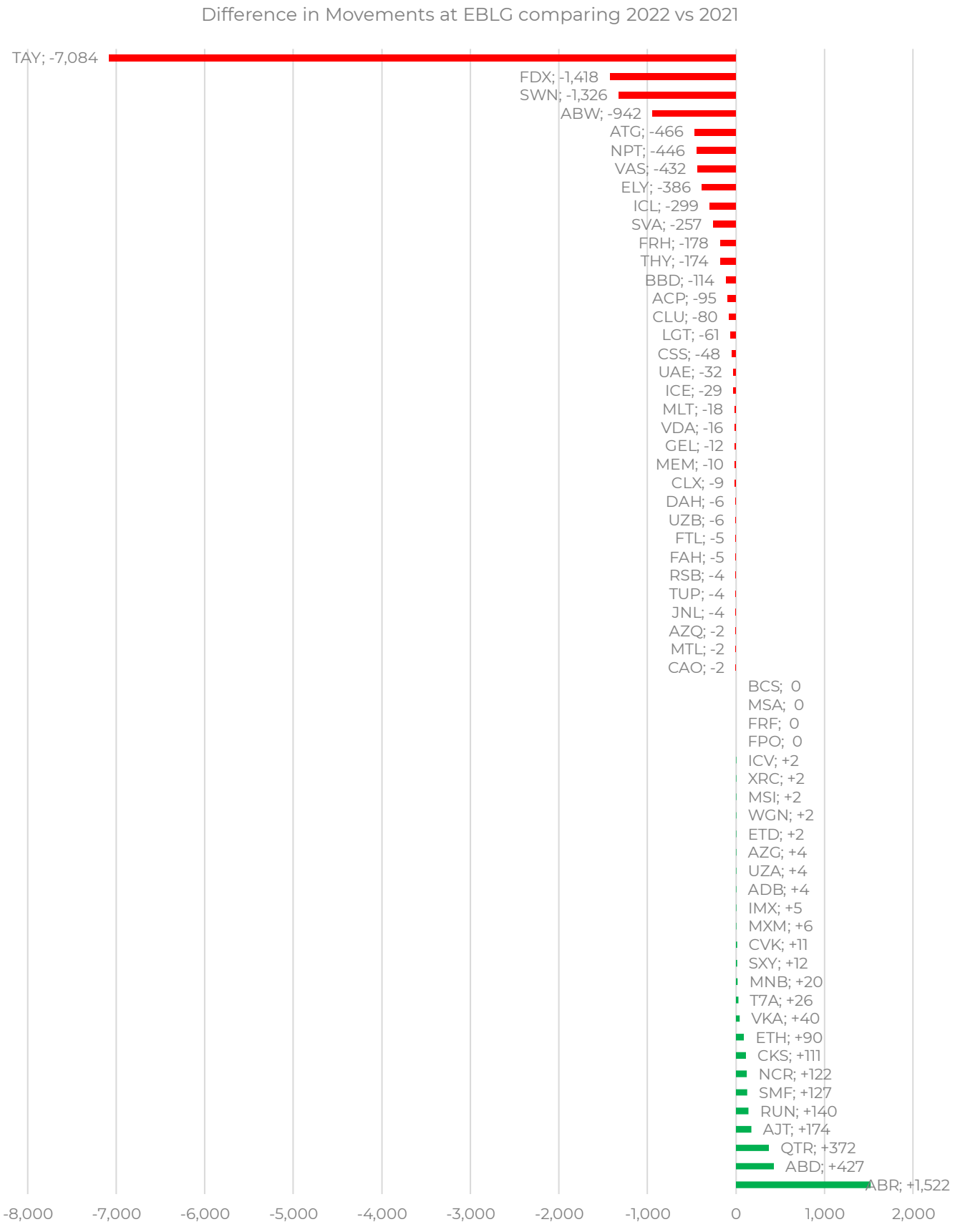


Figure 1.16: Differences in Yearly Movements per Cargo Airline (3 Letter Code of Callsign) comparing 2022 to 2021

Drone Activities

The challenges and opportunities associated with the expected widespread growth of unmanned aerial vehicles will be one of the factors driving the future of Air Navigation Service Providers (ANSP). Early 2020, the company skeydrone was created as subsidiary of skeyes. skeydrone envisages to play a central role in the implementation of U-space, a set of specific services and procedures designed to ensure safe and efficient access to airspace for a large number of drones, in Belgium. skeydrone offers a wide variety of services that enable safe and efficient drone operations in all types of airspace. Those services are provided to authorities – such as managers of Unmanned Aircraft System (UAS) geographical zones – and operators of critical infrastructure – such as ports, nuclear plants, prisons and industrial complexes. It provides soft- and hardware based solutions that allow to manage safety & security related risks associated with drone flights in and around their areas of responsibility. skeydrone also supports drone operators – both large and small enterprises, as well as government agencies – in order to offer solutions that allow to plan and execute flights in the safest and most efficient manners[4].

The UAS geographical zones, also called "GeoZones" are only accessible to drones complying with technical and operational criteria, as well as restrictions with regard to the use of these drones. Therefore, to facilitate planning, coordination and information flow between drone operators and Air Traffic Control, skeydrone has implemented a web application: the Drone Service Application (DSA). The two main objectives of DSA is to simplify the planning process for drone operators, and to visualize the planned drone operations for skeyes, which is the GeoZone manager for controlled airspace above and around the airports of Antwerp, Brussels, Charleroi, Kortrijk, Liege and Ostend[5,6]. This source is used to show the drone activity in the following figures of this section.

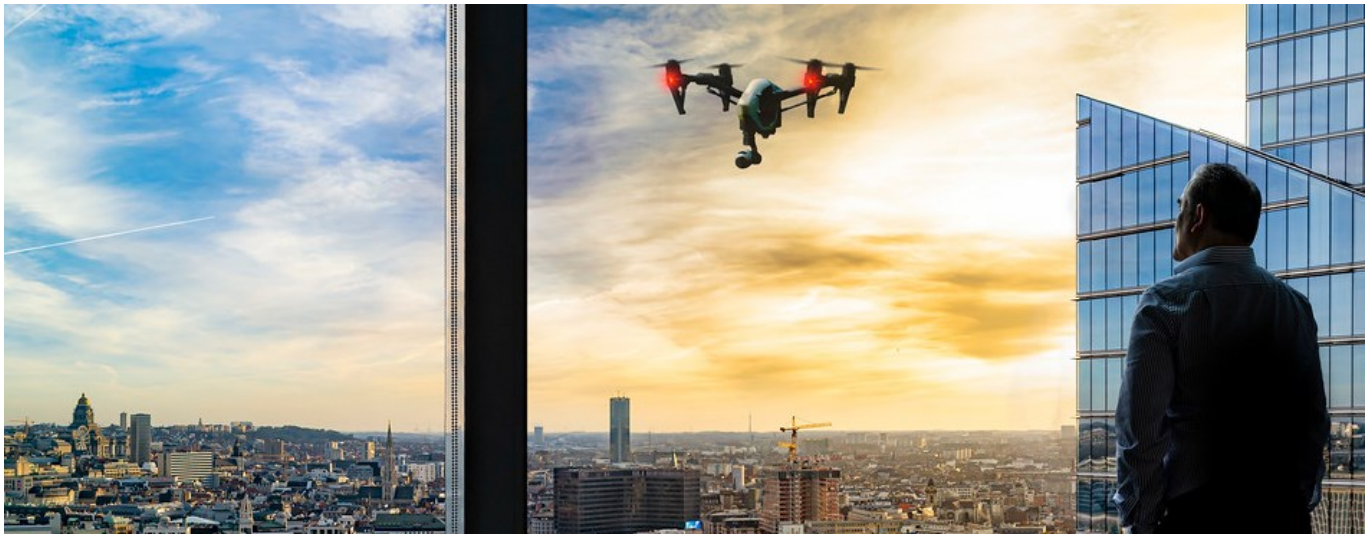
Figure 1.17 displays the number of drone activities, which were authorized in the DSA, and the level of risk involved in the operations per airport. These categories are defined by the risk the drone activity forms for manned aviation in very low level (VLL) zones. For all airports where a control zone exists, these are defined as:

- high risk: runway and surroundings
- moderate risk: departure/approach track, visual circuits and rest of the control zone above 400 ft above aerodrome elevation (AAE), excluding the high risk zone
- low risk: on the edge of the control zone below 400 ft AAE, outside the moderate and high risk zone

For Kortrijk-Wevelgem, where there is a Radio Mandatory Zone (RMZ), the categories are defined as:

- high/moderate risk: runway, departure/approach track, visual circuits from ground to the top of the RMZ
- low risk: the entire RMZ outside the high/moderate risk zone, but where drone operation cannot be higher than 400ft above ground level

Figure 1.19 shows the distribution of activities at EBLG over the year.



[4] Skeydrone, "Enabling safe drone operations", 2022. https://skeydrone.aero/ (URL retrieved on 21/04/2022)

[5] UAS geographical zone statuses can be seen at https://map.droneguide.be (URL retrieved on 21/04/2022)

[6] skeyes, "skeyes drone service application, https://www.skeyes.be/en/services/drone-home-page/you-and-your-drone/drone-service-application/ (URL retrieved on 21/04/2022)

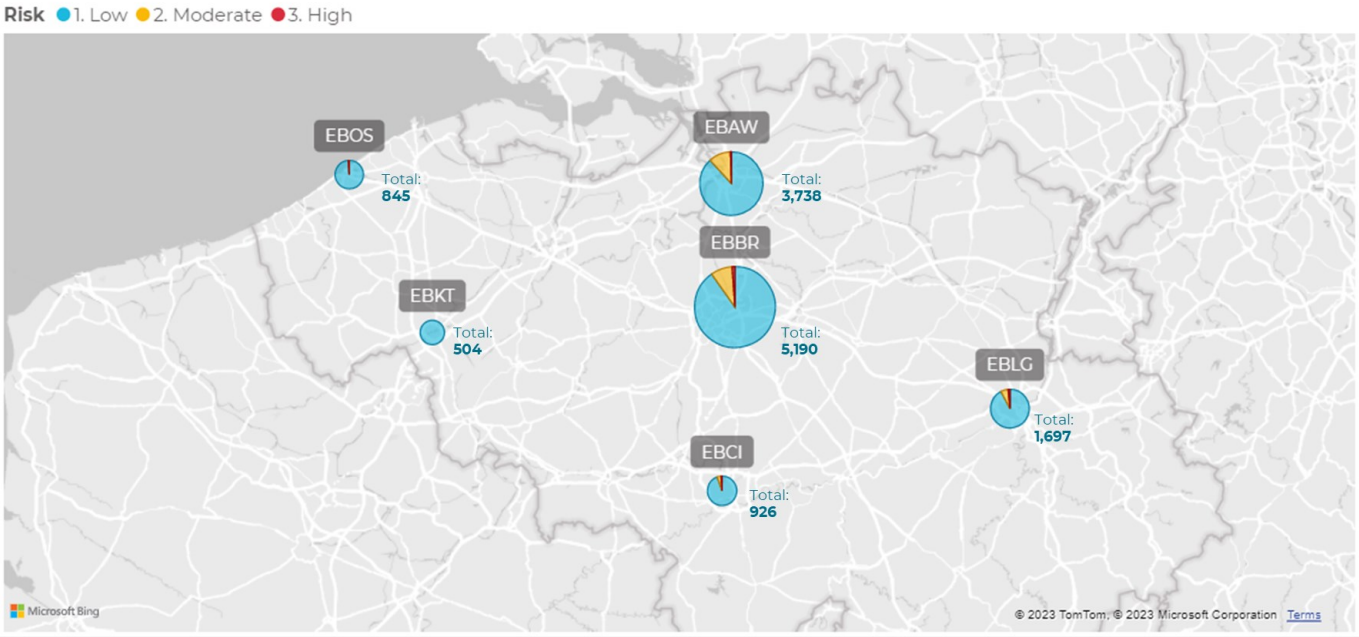


Figure 1.17: Authorized Drone Activities in 2022 at the Airports where skeyes provides Air Traffic Services

As per European Union Aviation Safety Agency (EASA) definition[7], activities can furthermore be categorized into a different risk classification scheme that considers the complexity of the operation. The following three classes exist:

- OPEN: Presents low risk to third parties. An authorisation from the Civil Aviation Authority (CAA) is not required.
- SPECIFIC: More complex operations or aspects of the operation fall outside the boundaries of the Open Category. Authorisation is required from the CAA.
- FORMER CLASS 1: Very complex operations, presenting an equivalent risk to that of manned aviation.

Table 1.4 provides an overview of the complexity of operations at Liege Airport and the other five airports, where skeyes provides services. An overall growth of activities can be observed (+5%) and particularly so in Liege (EBLG, +99%). The decrease in Antwerp (EBAW) can be explained by the fact that this airport was closed due to works on the runway for approximately one month during which drones were probably still flying but did not have to request an authorization of the operation. The drop of -42% in Ostend (EBOS) is largely due to the end of S MSC A operations over there. Kortrijk-Wevelgem (EBKT) shows a decrease of -17%.More operations, however, were authorized in the zones of Brussels (EBBR, +15%) and Charleroi (EBCI, +27%).

Table 1.4: Authorized drone activities per EASA risk category in 2022

	2022				2021	2022 vs 2021
	OPEN	SPECIFIC	FORMER CLASS 1[8]	Total	Total	
EBBR	3,481	1,709		**5,190**	**4,530**	+15%
EBCI	581	345		**926**	**731**	+27%
EBLG	1,161	536		**1,697**	**852**	+99%
EBOS	652	182	11	**845**	**1,451**	-42%
EBAW	2,557	1,181		**3,738**	**4,157**	-10%
EBKT	333	163	8	**504**	**610**	-17%
Total	8,765	4,116	19	**12,900**	**12,331**	+5%

[7] EASA, "Drones - regulatory framework background". https://www.easa.europa.eu/domains/civil-drones/drones-regulatory-framework-background (URL retrieved on 21/04/2022)

[8] Since 31/12/2020, the EU Drone Regulation has been in force in Belgium and old licenses for FORMER CLASS 1 operations expired a year after, i.e. at the end of 2021. Thus, no operations in the FORMER CLASS 1 category should have taken place in 2022 – yet some records can be found in the logs of the DSA. For further information, contact skeydrone..

Figure 1.18 provides a detailed view of the activities around EBLG in 2022, displaying the centroid coordinates of all UAS airspace reservations. It can be seen that a lot of operations agglomerate alongside the river.

Figure 1.19 gives a view on the daily number of operations throughout the year of 2022. The missions of these activities are oftentimes related to photo- and videography, but also serve security reasons (e.g. crowd or road traffic management), scientific research, mapping purposes, or maintenance and inspection missions (e.g. of power lines, solar panels, wind turbines, air quality), etc. On the peak day of authorized operations in Liege, which was the 2nd of December, 22 of the 28 operations intended to take pictures of the works on the tram in Liege. The second peak, on the 22nd of August, included lots of photography missions for Liege's communities alongside some photogrammetry and mapping activities.

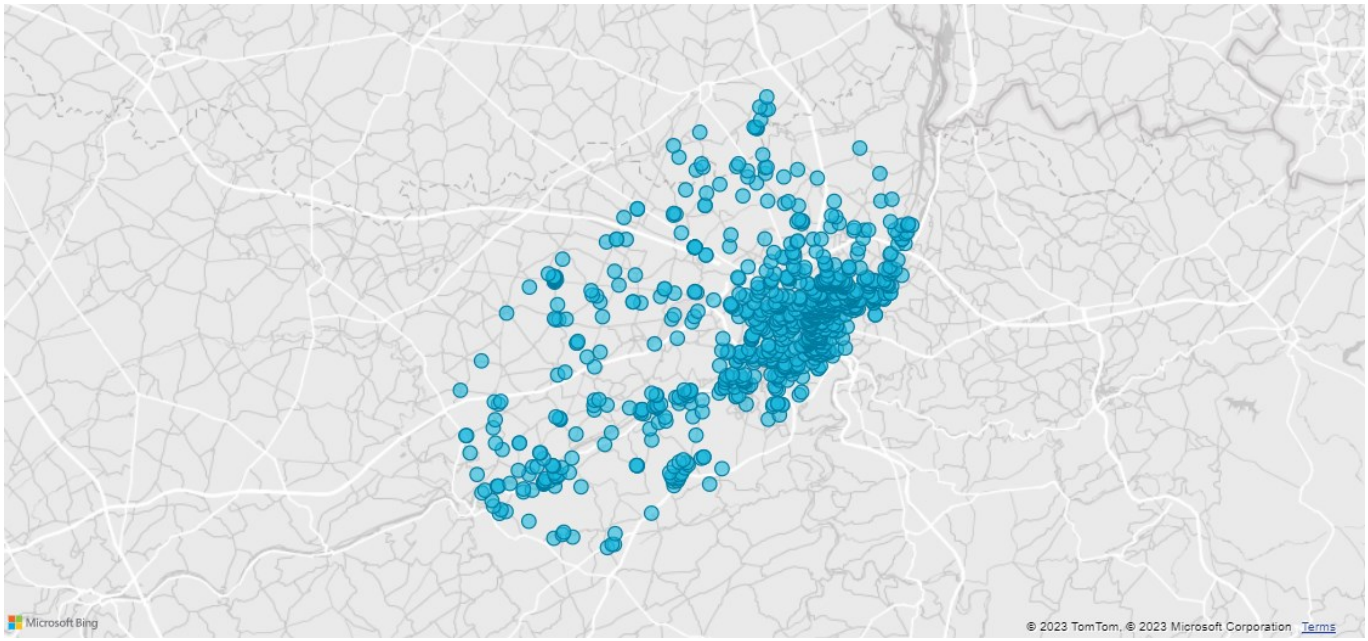


Figure 1.18: Coordinates of centroids of authorized airspace polygons of drone activities near Liege Airport in 2022

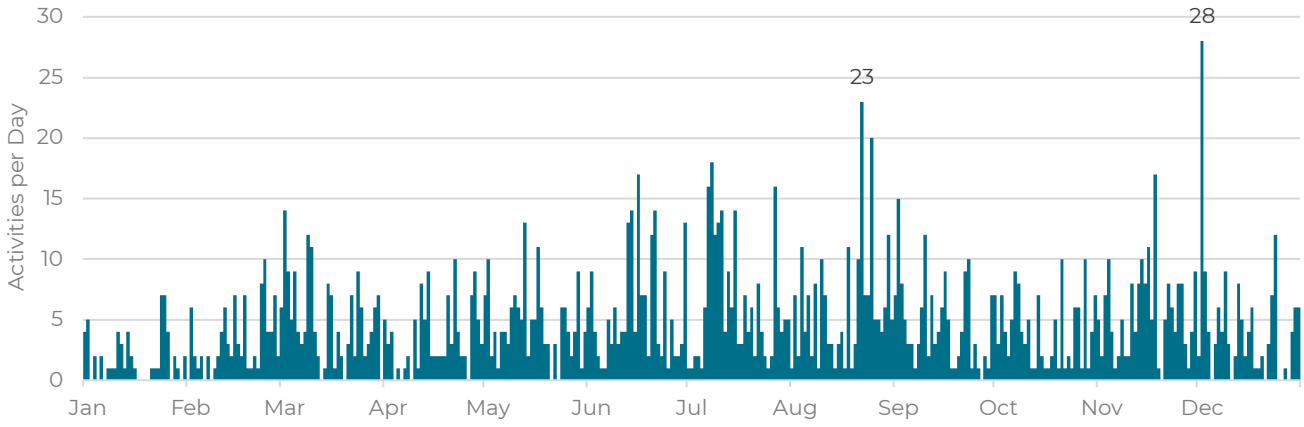


Figure 1.19: Authorized drone activities near Liege Airport throughout the year 2022


skyguide

2.Safety

This chapter is divided into four topics: missed approaches, runway incursions, other noteworthy incidents and improvements and recommendations.

The missed approaches covered in the following chapter are based on internal logging. As such the quality and accuracy of the available information is commensurate with the level of reporting. These logs of missed approaches are not considered as safety occurrences. They are an operational solution allowing to maintain safety margins when the approach cannot be continued for a safe landing. At the same time, particularly during peak hours at busy airports, they also increase the traffic complexity and the residual safety risk. It could be argued that missed approaches are a hybrid leading indicator, and that by analysing the reasons leading to this type of procedure, it can be examined whether there are any systemic deficiencies in a technical equipment, in a procedure or in manner in which Air Traffic Control Officers (ATCOs) and/or pilots apply these procedures.

The runway incursions are a lagging runway safety indicator. The runway incursions and other noteworthy incidents are safety occurrences. These are subject to a risk classification using the Risk Analysis Tool (RAT) methodology to assess the contribution that skeyes had in the chain of events (in accordance with EU Regulation 376/2014 and EU Regulation 2019/317). This chapter indicates the severity classification that was derived from the calculated RAT risk for the safety occurrences. The following definitions apply for the severity classification (in accordance with EASA AMC).

Table 2.1: Severity classification

Severity Classification	Description
A – Serious incident	An incident involving circumstances indicating that an accident nearly occurred.
B – Major incident	An incident associated with the operation of an aircraft, in which the safety of the aircraft may have been compromised, having led to a near collision between aircraft, with ground or obstacles (i.e. safety margins were not respected; in this case, not as a result of an air traffic control (ATC) instruction).
C – Significant incident	An incident involving circumstances indicating that an accident, or a serious or major incident could have occurred if the risk had not been managed within the safety margins, or if another aircraft had been in the vicinity.
D – Not determined	Insufficient information was available to determine the severity, or inconclusive or conflicting evidence precluded such determination (RAT RF < 70 %).
E – No safety effect	An incident which has no safety effect.
N – No ATM ground contribution	No system, procedure or person involved in the provision of ATC services initiated or contributed to the incident.

Missed Approaches

Missed approaches are performed according to published procedures, under the instructions of the air traffic controller, or they are initiated by the pilot when the approach cannot be continued for a safe landing. Besides the discomfort for passengers and crew, missed approaches increase the air traffic management complexity. The number of missed approaches and particularly their cause can therefore indicate, which measures are to be taken to improve the safety of air navigation service provision. All missed approaches are recorded by cause of event, and the internal reporting is done by the ATCOs. The missed approaches are monitored on a weekly basis. This report gives a yearly overview and a comparison over four years for each runway at Liege Airport (runways 04L, 04R, 22L, 22R).

Overview

In 2022, there were 58 missed approaches. Figure 2.1 shows the number of missed approaches per cause. Unstable approaches were the main reason of missed approaches in 2022 at Liege Airport, accounting for a share of 38%. Oftentimes, unstable approaches occur due to tailwind at higher altitudes or when the aircraft takes a very direct route and is therefore unable to reduce its speed/altitude sufficiently. The second most reason for missed approaches in 2022 is thunderstorm/windshear. Sometimes, it also occurs that a missed approach is done deliberately, e.g. for training flights (one occurrence) or for technical flights (one occurrence in the “other” category).

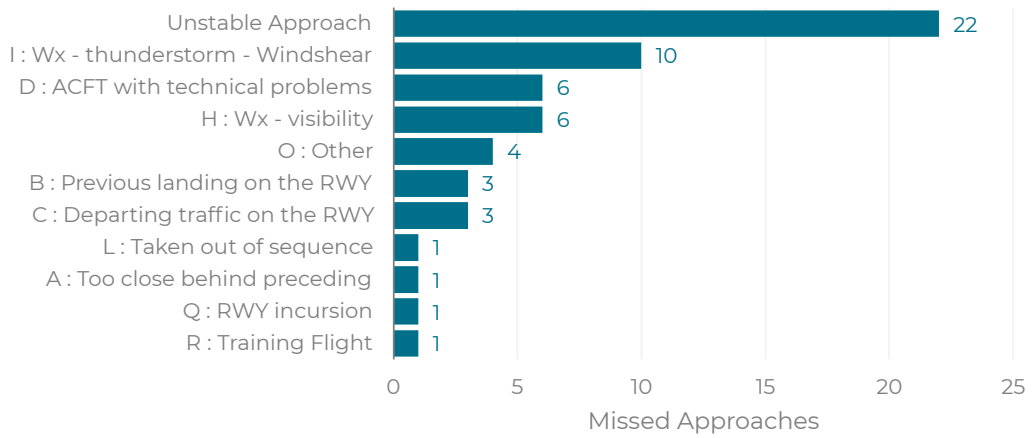


Figure 2.1: Causes of missed approaches in 2022

In Figure 2.2, the yearly number of missed approaches is compared over the period from 2019 until 2022, together with the development of number of arrivals as a reference. The number of arrivals is provided by the AMS under the BCAA's (Belgian Civil Aviation Authority) aerodrome movement definition.

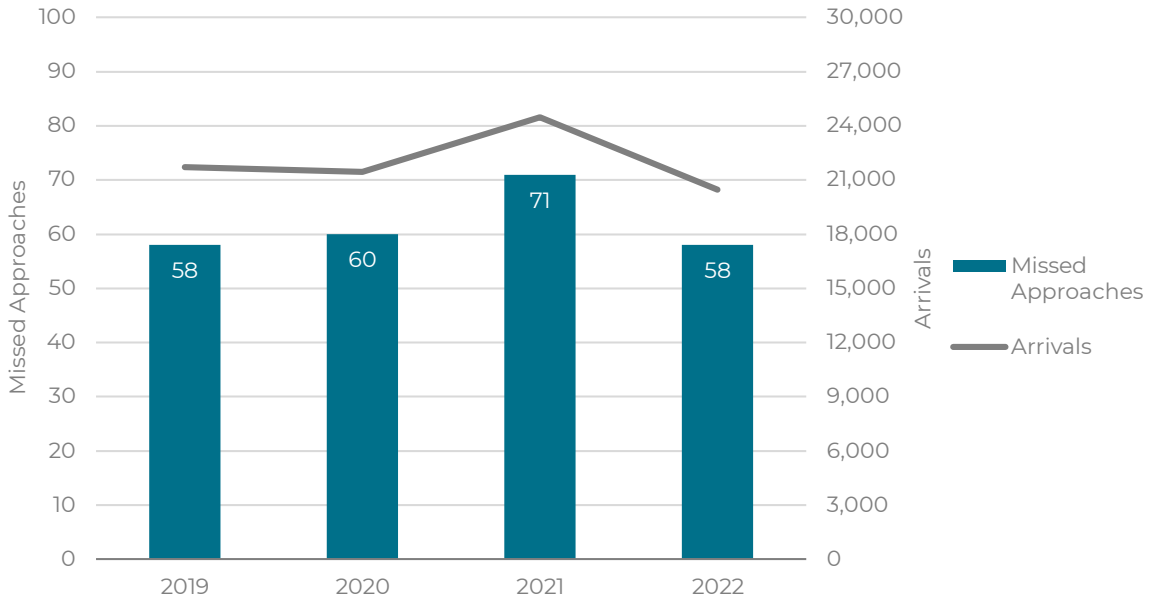


Figure 2.2: Missed approaches and number of arrivals per year

Figure 2.3 further provides the number of missed approaches per runway per year and Figure 2.4 sets this into perspective with the traffic by looking at the yearly rate of missed approaches per 1,000 arrivals. The overall rate remained rather stable over the years, ranging from 2.7 to 2.9 missed approaches for 1,000 arrivals.

Note that Runway 04L and 22R are oftentimes not in use, so that the rates include less data points, which are too few for a statistically reasonable calculation of the rates. In 2022, no missed approaches were recorded on these runways.

Comparing the figures for runways 04R and 22L in 2022 with the previous year, the rate of missed approaches dropped from 4.0 to 2.2 for Runway 04R and rose from 2.5 to 3.3 for Runway 22L. Such differences in the rate can partially be explained through weather conditions. For example, thunderstorms and windshear caused only one missed approach in 2022 on 04R, but seven in the previous year, whereas on Runway 22L the trend was the other way around with nine missed approaches in 2022 and only two in 2021 due to thunderstorms.

Further details can be found from Table 2.2, which shows the top five causes of missed approaches in 2022 per runway and also the number of missed approaches with these reasons in the previous three years, 2019 until 2021, as well as the percentage of the total missed approaches attributable to these causes.

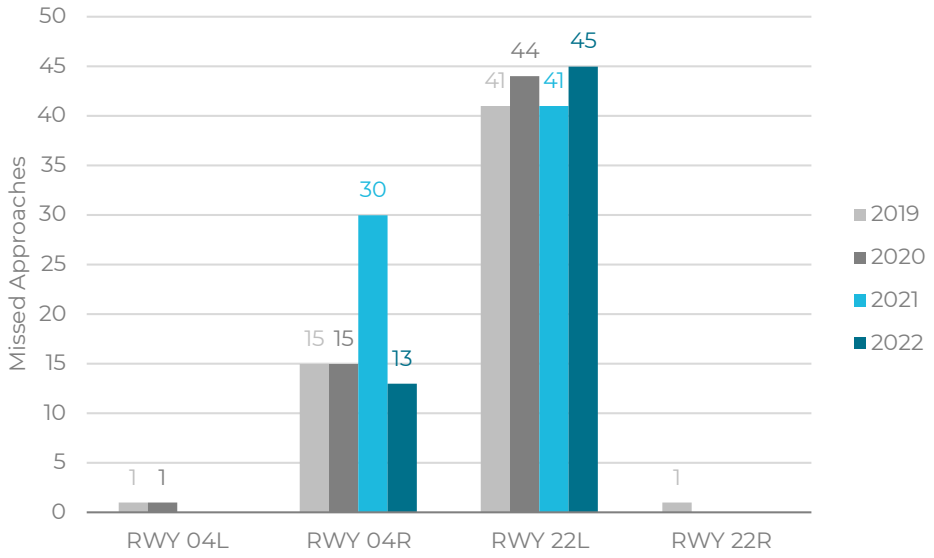


Figure 2.3: Missed approaches per runway per year

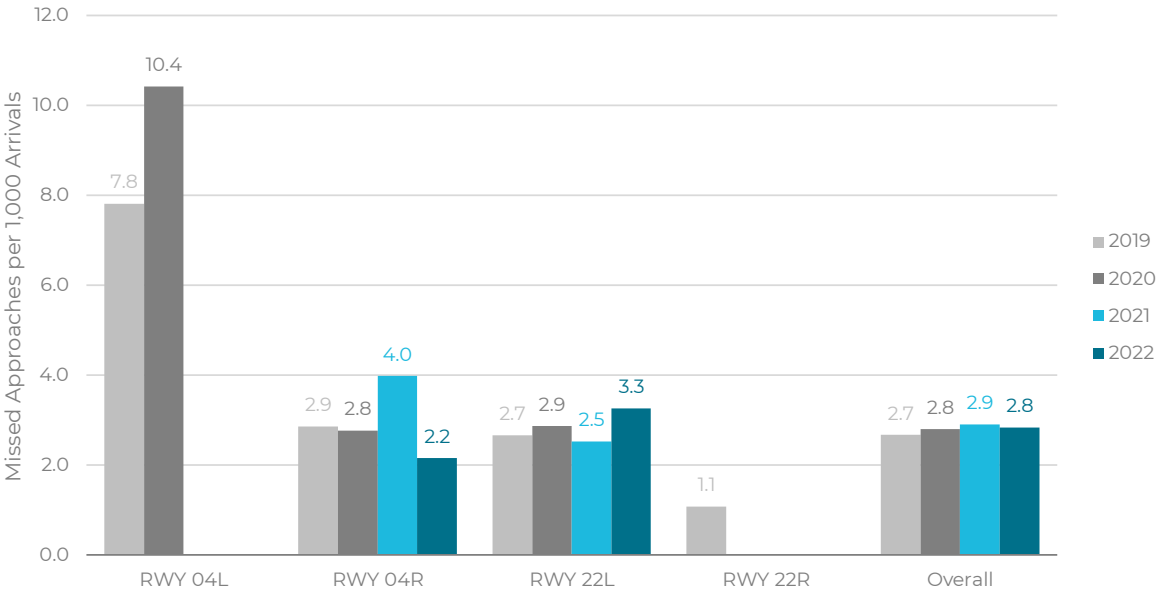


Figure 2.4: Rates of missed approaches per runway per year

Table 2.2: Top five causes in 2022: Occurrence of missed approaches per runway, per year

Top 5 causes in 2022 for **RWY 04R**	2019	2020	2021	2022
Total Missed Approaches	15	15	30	13
Unstable Approach	10	5	9	5
H : Wx - visibility	1	1	3	2
D : ACFT with technical problems	1	4	2	2
O : Other			3	1
I : Wx - thunderstorm - Windshear	1	4	7	1
Share of the above causes	87%	93%	80%	85%

Top 5 causes in 2022 for **RWY 22L**	2019	2020	2021	2022
Total Missed Approaches	41	44	41	45
Unstable Approach	25	16	24	17
I : Wx - thunderstorm - Windshear	3	10	2	9
D : ACFT with technical problems	2	6	2	4
H : Wx - visibility	2		1	4
O : Other		2	2	3
Share of the above causes	78%	77%	76%	82%

Top 5 causes in 2022 for **RWY 04L**	2019	2020	2021	2022
Total Missed Approaches	1	1	0	0
I : Wx - thunderstorm - Windshear	1			
Unstable Approach		1		
Share of the above causes	100%	100%		

Top 5 causes in 2022 for **RWY 22R**	2019	2020	2021	2022
Total Missed Approaches	1	0	0	0
P : FOD on the RWY	1			
Share of the above causes	100%			

Runway Incursions

According to ICAO[9], a runway incursion is defined as "any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft". According to the Acceptable Means of Compliance (AMC)[10], an incorrect presence is hereby defined as the unsafe, unauthorised or undesirable presence or movement of an aircraft, vehicle, or pedestrian – irrespective of the main contributor (e.g. ATC, pilot, driver, technical system).

A monthly overview of the runway incursions in 2022 can be seen in Figure 2.5. The graph shows an increase in incursions towards the end of the year, reaching a maximum of three incursions in December. A total of eleven runway incursions happened in 2022 – only two of them with air traffic management (ATM) contribution. The colours of the bar chart indicate the severity as defined in Table 2.1

The runway incursion in March included a cargo aircraft, which was taxiing to take-off on Runway 22L via taxiway S6 without a clearance. The air traffic controller missed an incorrect read-back from the pilot, but the incursion was classified to not have any safety effect (severity E).

The runway incursion in October, was classified as significant (severity C): A vehicle of the airport was instructed to maintain its position at holding point S4. At this time, the low visibility procedure was installed and the stop bar was lit. Nonetheless, the vehicle crossed the stop bar without an ATC clearance. A landing aircraft was not informed and there was no go-around issued, because the vehicle still came to a stop well clear off the runway.

Of the other nine runway incursions without ATM contribution, one was a take-off without the required clearance (in June), three times it was an aircraft entering the runway without clearance (twice in July, once in September, and once in November), and the remaining four incursions involved aircraft that stopped at the holding point but a part of them was already beyond the holding point.

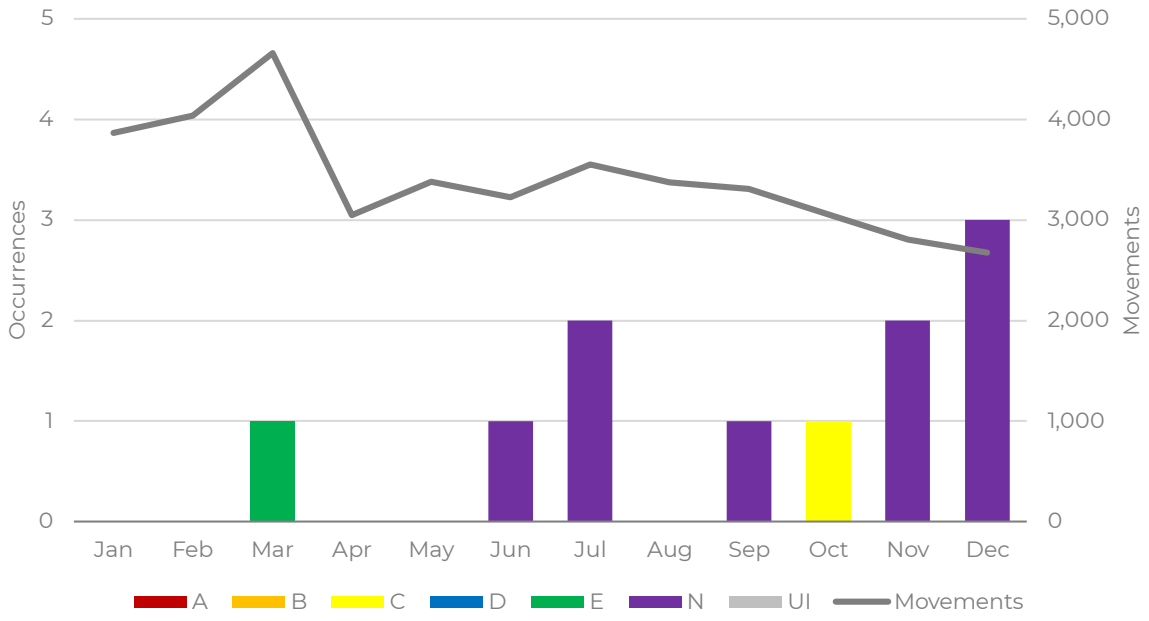


Figure 2.5: Runway incursions in 2022 per month, per category

[9] ICAO Doc 4444 – PANS–ATM

[10] AMC 3 of EU Reg 2019/317

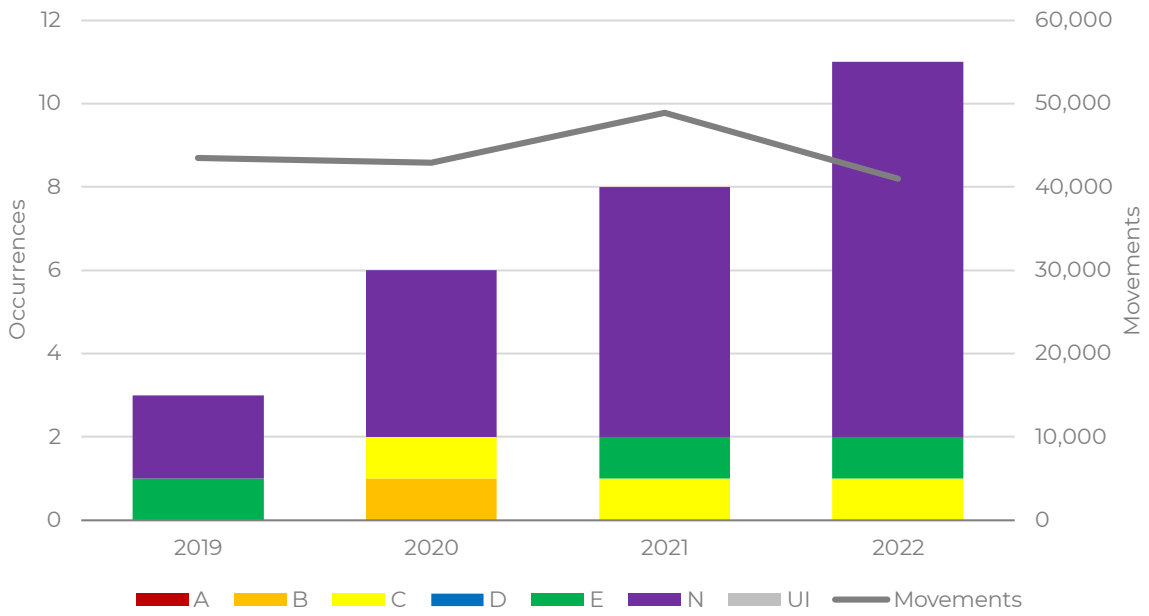


Figure 2.6: Runway incursions 2019-2022, per year, per category

Figure 2.6 gives a yearly overview of the runway incursions from 2019 until 2022. An increase is seen over the years, from three in 2019, to six in 2020, eight in 2021, and eleven in 2022. A better way of comparing these figures, though, is the rate of runway incursions. Figure 2.7 shows the rate per 100,000 movements for Liege Airport for the period from 2019 until 2022. Whereas the rate of incursions without ATM contribution increased, the rate of runway incursions with ATM contribution in 2022 is actually comparable to the previous two years. The A-SMGCS (Advanced-Surface Movement Guidance and Control System), partially came into operation on March 16th 2021 and is now fully operational since February 2022. This system continues to increase the controllers' situational awareness regarding every target on the movement surface and thus might generate a better detection of runway incursions, explaining the increase on runway incursion reports with no ATM contribution in 2022.

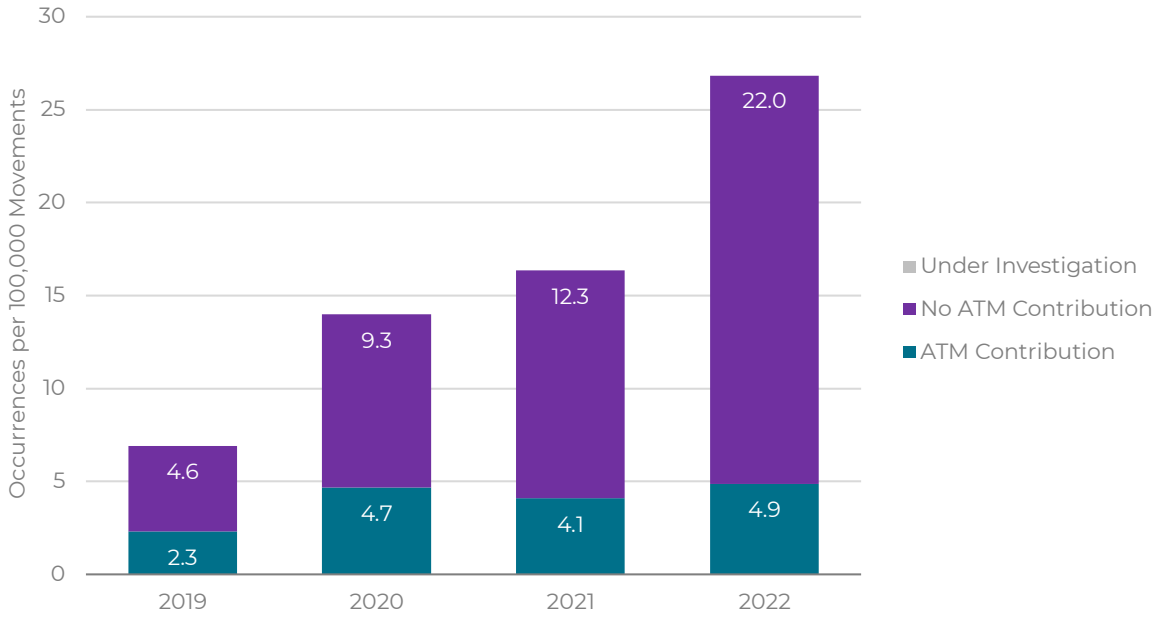


Figure 2.7: Rates of runway incursions per 100,000 movements, per year

Other Noteworthy Incidents

An decrease in **runway events** was observed: Whereas five runway events were recorded in 2021, only two occurred in 2022 – one on the 3rd of January 2022 (without ATM contribution) and the other on 23rd of December 2022 (still under investigation).

The number of **taxiway incursions** also decreased: From twelve in 2021 to five in 2022. One of them, a taxiway incursion on the 15th of September 2022, had ATM ground contribution with ascribed severity classification E (i.e. no safety impact). An aircraft was instructed to push facing N0 because N1 behind the stand of the aircraft was closed. The readback of the pilot mentioned N1 instead of N0, but the mistake was missed by the ATCO. Therefore, the aircraft taxied via N1, where it got stuck until the inspection and marshaller successfully guided it through the obstacles of the lighting.

There were eight **taxiway/apron events** recorded in 2022, which is slightly more than in the previous year (five in 2021). However, none of them were with ATM ground contribution.

Figure 2.8 provides an overview over the previously mentioned incidents over the past four years.

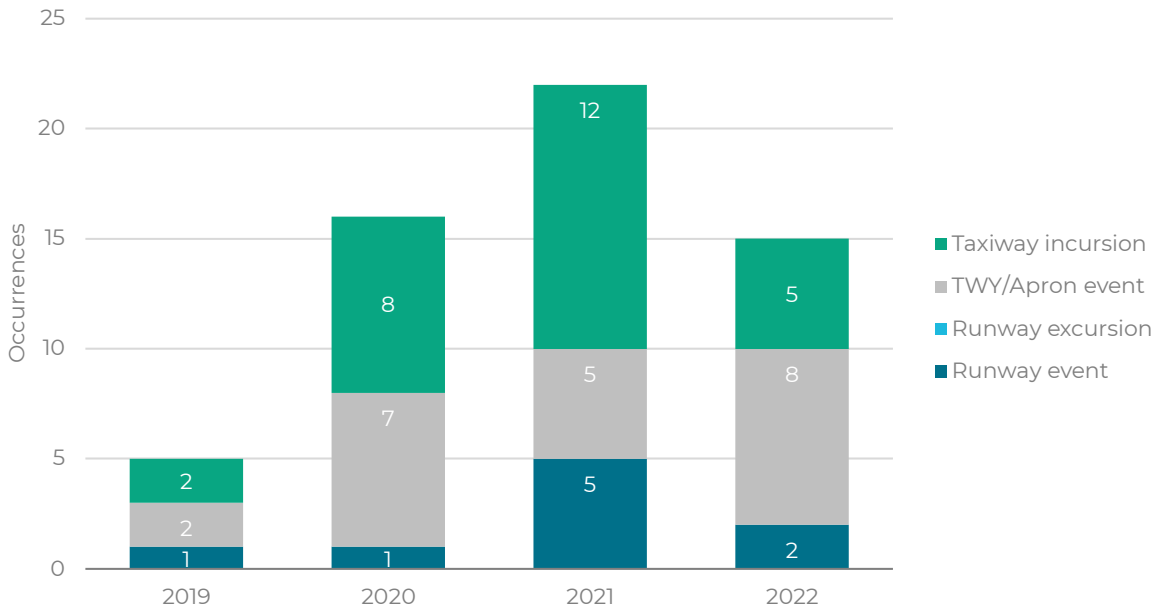


Figure 2.8: Runway and taxiway incursions and events over the past four years

Furthermore, there were less laser beam interference (12 in 2022, 14 in 2021) and less call sign confusions (16 in 2022, 24 in 2021) reported.

As seen in Figure 2.9, the rate of Wildlife reports per 100,000 movements slightly increased 70.7 in 2022. In absolute numbers, there were 29 reports related to wildlife in 2022 and 2020, 28 in 2021, and 15 in 2019.

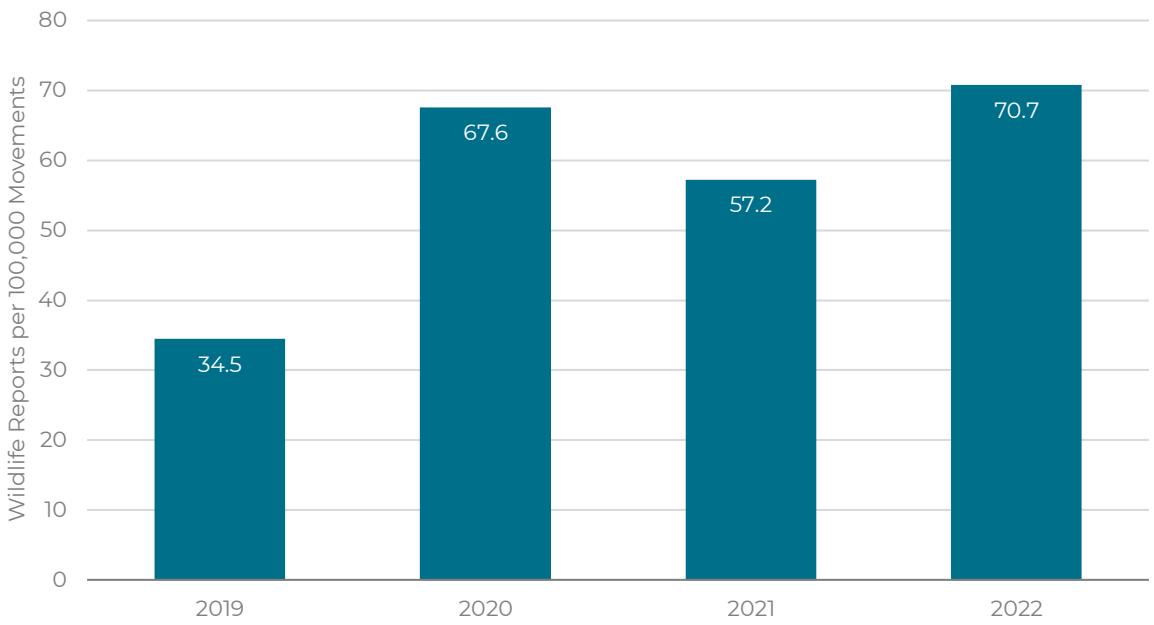


Figure 2.9 : Rate of wildlife reports at Liege Airport

Last, but not least, there was one accident in 2022, which was a belly landing on Runway 04R on the 15th of June 2022. No harm was done to the pilot and the instructor of the training flight, but the runway had to be closed to deal with a small fuel leak of the aircraft and to prevent any follow-up accidents. The airport, however, remained open.

Improvements And Recommendations

skeyes has established a Local Runway Safety Team (LRST) together with the stakeholders at Liege Airport. All apron events, taxiway incursions, runway incursions, and more if deemed useful, are discussed in the LRST to present the view of each stakeholder. As such, each stakeholder can focus more easily on possible actions to be taken on their side. This also means that all incidents mentioned in the previous sections, were presented in these LRST meetings.

Furthermore, the A-SMGCS (Advanced-Surface Movement Guidance and Control System), which was implemented by skeyes and Liege Airport and partially came into operation on March 16th 2021, is now fully operational since February 2022. This system continues to increase the controllers' situational awareness regarding every target on the movement surface and thus helps to limit the number of runway incursions with ATM contribution.

The upgrade of the ILS on Runway 04R from CAT I to CAT III back in 2017 has already shown clear benefits by reducing the rate of missed approaches on that runway: While there were eleven missed approaches due to low visibility in 2017, there have only been twelve from 2018 to 2022 altogether. There is an ongoing project to analyse possible ILS improvements for Liege Airport for 2024.

skeyes promotes the increased use of PBN (Performance Based Navigation) procedures. Such approach procedures fit in the on-going transition towards a PBN Environment (EU regulation), and greatly improve predictability, therefore, situational awareness can be improved. Currently the PBN transition at Liege Airport is pending on BCAA approval.


CTC 687

3. Capacity & Punctuality

This chapter addresses the airport capacity and punctuality.

In the first section, the declared capacities for different runway configurations are given along with a view on the effective utilisation of this capacity.

In the second section, the punctuality at Liege Airport is studied. The arrival delay, delay due to regulations placed by Liege Airport on the arrivals, is analysed and the delay from the airport's point of view is given, i.e. the impact on traffic to or from Liege Airport caused by regulations not only at Liege Airport, but also in the Belgian en-route airspace and by other Air Navigation Service Providers (ANSPs).

Airport Capacity

The capacity of an aerodrome, i.e. how many operations can be handled in a certain amount of time, is influenced by several factors including the airport layout, the fleet mix of the arriving and departing traffic, ATC procedures, weather conditions and technological aids.

For optimal conditions, a theoretical measure of the capacity is calculated per runway configuration of the airport: This Theoretical Capacity Throughput, which determines the average number of movements (arrivals and/or departures) that can be performed on the runway system within one hour, is calculated considering certain assumptions of optimal conditions.

Assumptions:

- There is a continuous supply of arrivals and/or departures.
- Simultaneous Runway Occupancy (SRO) is prohibited (air traffic control rule).
- The Safe Wake Vortex Separation distance between two flights has to respected at all times (air traffic control rule).
- The fleet mix (i.e. types of aircraft and weight categories) is well represented by the fleet mix of the reference period for the calculations.
- Approach and departure procedures do not change.
- Conditions of flying and service provision are optimal (weather, staffing, etc.).

For the calculation of the Theoretical Capacity Throughput, on top of the above mentioned assumptions, the following parameters have been considered:

- The fleet mix of the busiest month in 2018 is taken as reference.
- A nominal radar separation of 3NM.
- A loss factor of 15% is considered for inter arrival times, which accounts for the fact that controllers rather want to err on the right side when separating aircraft.
- The average Runway Occupancy Time for Arrivals (ROTA) is based on a study from EUROCONTROL (in 2014) for aircraft landing at Liege airport.
- The average approach speed is 136 knots (based on measurements).
- The average headwind differs per runway and is subtracted from the average approach speed.
- The inter-departure-time is a function of the between take-off-clearance delivery and the aircraft reaching a given altitude.
- Runways 22L and 22R, and 04L and 04R can only be operated as a single runway due to its proximity and are therefore sometimes referred to as Runway 22 and Runway 04, respectively.

The Declared Capacity is set as 90% of the Theoretical Capacity Throughput for each runway system. Here, it is noteworthy that the declared capacity only represents the capacity of IFR flights, because safe Wake Vortex Separation Distances between two flights have been assumed during the calculation. Therefore, it is also referred to as “Declared IFR Capacity”. Table 3.1 displays this declared capacity per runway configuration at Liege Airport. Note that this is still a theoretical calculation and currently not used for schedule coordination purposes.

Table 3.1: Declared IFR capacity

Runway Configuration	Runways		Declared Capacity (movements/hour)		
	DEP	ARR	Only Departures	Only Arrivals	Mixed Fleet
22 -22	22L,22R	22L,22R	28	28	**34**
04 -04	04L,04R	04L,04R	28	28	**35**

Besides the calculated theoretically possible capacity, the **Effectively Used Capacity** is an important performance indicator for the airport and for the air navigation service provider handling the arrivals and departures. Figure 3.1 shows the distribution of hourly movements per runway configuration for rolling hours with a step of one minute during the times the runway configuration was at least one hour in use in 2022. For this plot, helicopter movements are not considered, but both VFR and IFR flights[11]. The declared capacity is indicated as a horizontal line. The peak of the distribution shows the most likely number of movements you will have during the next hour when picking a random minute of the year during which the runway configuration is in use and will stay in use for this next hour.

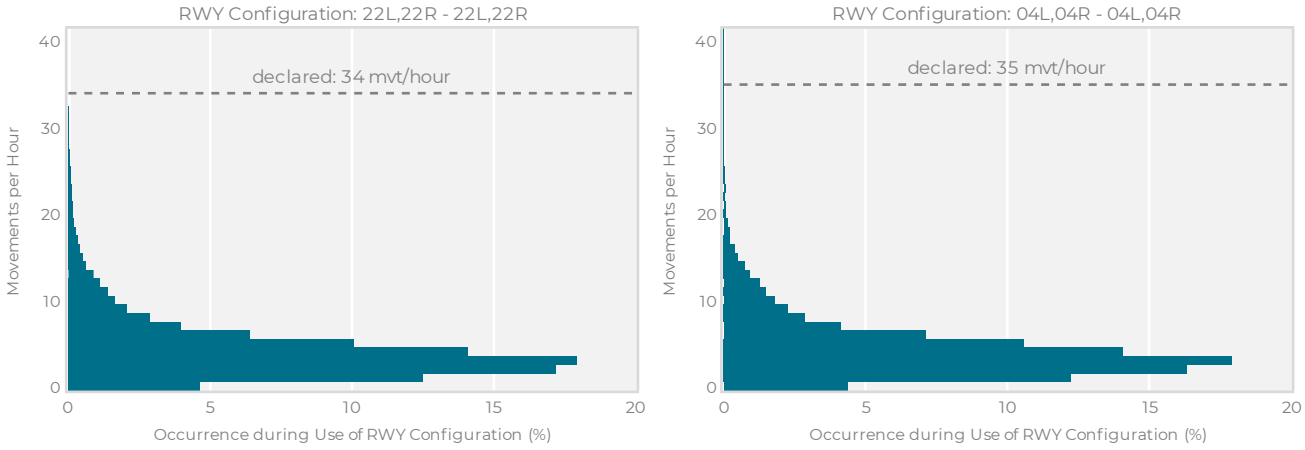


Figure 3.1: Effectively used capacity in 2022

Each day of the year where capacity has been exceed in at least once, is listed in Table 3.2. This table also shows the extreme values (minimum/maximum) of interest considering all exceeding rolling hours of this day and configuration. In 2022, the declared capacity has never been exceeded for runway configuration 22 - 22. For runway configuration 04 -04, it was only exceeded on April 16th 2022. The hour, during which the declared capacity has been exceeded was composed of a very high share of VFR movements (97%), for which the IFR separation rules do not apply, such that a higher throughput could be reached.

Table 3.2: Days with hours exceeding the capacity at EBLG in 2022 per runway configuration

Runway Configuration	Date (local time)	Extra Movements maximum number (*)	VFR Share minimum hourly percentage (*)	Departures Share minimum hourly percentage (*)	Departures Share maximum hourly percentage (*)
22 -22	/	/	/	/	/
04 -04	16/04/2022	6	97.2%	48.6%	52.8%

(*) of all exceeding hours of the day

To summarize, the Theoretical Throughput Capacity per runway configuration is the theoretical number of operations that an aerodrome can handle within an hour under optimal conditions. In practice, such optimal conditions cannot be reached. The declared capacity is thus set at 90% of the optimum. As a performance indicator, we regard the effectively used capacity, i.e. how many operations have actually been performed within each hour of the year and check if the declared capacity has ever been exceeded.

[11] Only showing IFR flights would give a distorted view on the number of hourly movements – especially for airports with high VFR shares. For interpretation, however, it is to be considered that the declared capacity is only declared for IFR movements.

Punctuality

Punctuality can be seen as a service quality indicator from a passenger perspective. This section observes one of the factors that influences the punctuality: ATFM (air traffic flow management) delay. ATFM delay is defined as the time difference between estimated take-off time (ETOT) and calculated take-off time (CTOT) of the NM (Network Manager, EUROCONTROL) and is due to ATFM measures that are classified according to the respective causes listed below:

- A – Accident;
- C – ATC Capacity;
- D – De-icing;
- E – Equipment (non-ATC);
- G – Aerodrome Capacity;
- I – Industrial Action (ATC);
- M – Airspace Management;
- N – Industrial Action (non-ATC) ;
- O – Other;
- P – Special Event;
- R – ATC Routeing;
- S – ATC Staffing;
- T – Equipment (ATC);
- V – Environmental Issues;
- W – Weather;
- NA – Not Specified.

According to the FABEC Performance Plan the causes with ANSP contribution are (in the order as listed in the Performance Plan):

- C – ATC Capacity;
- R – ATC Routeing;
- S – ATC Staffing;
- T – Equipment (ATC);
- M – Airspace Management;
- P – Special Event.

Hence, in the remainder of the report all causes with ANSP contribution are referred to as “CRSTMP” while “Other Categories” aggregates all categories but CRSTMP and W (weather). The discussion in this section starts with the performance indicator: arrival delay. Arrival delay is the delay of a flight due to a regulation placed by the airport of arrival. In a second part, the impact of ATFM measures from an airport’s point of view is given, showing the ATFM delay on arrivals to and departures from Liege Airport.

Arrival ATFM delay

As of January 1st 2015, skeyes is subject to an annual target with regard to ATFM arrival delay. ATFM arrival delay is the delay of a flight due to a regulation from an airport. The target is defined as the average arrival delay per IFR flight, as defined in the FABEC Performance Plan, §3.1. (C). (ii), which is in accordance with the European Performance Regulation (EU) no 317/2019, Annex 1 , section 1, §3.1(b).

Targets are set on a national level and on an airport level, where the national target is the aggregation of the airport targets. For reference period 2, 2016-2019, the national target was 0.10 minutes/flight, and only Brussels airport and Liege Airport were considered as contributing airport. The target for Liege Airport on CRSTMP arrival delay was 0.06 minutes/flight. For reference period 3 (RP3), 2020-2024, only Brussels Airport is considered as contributing airport. Initially the national target was planned to be 1.82 minutes/flight for all causes and 0.17 minutes/flight for CRSTMP causes (9.34% of target delay for all causes). However, due to the unexpected impact of COVID-19 on the air traffic, the European Commission requested a revision of Union-wide performance targets for RP3. The current proposal

only includes arrival delay targets for Belgium as of 2022 (1.08 minutes/flight all causes and 0.12 minutes per flight, 11.11%, for CRSTMP causes; and only contributing airport remains Brussels Airport).

For this performance indicator, a comparison is made over the last four years. Table 3.3 gives the amount of arrival delay of Liège tower and the total number of arrivals per year. Note that in this section, the number of arrivals and the arrival delay for each flight are calculated by NM and have been provided by the Performance Review Unit (PRU / EUROCONTROL)[12]. In 2022, a total of 1,076 minutes of arrival delay at Liege tower were registered. Like in the two previous years, the only reason for arrival delay was weather.

Translated into the key performance indicator delay per arrival, this results in a total arrival delay of 0.06 minutes per arrival in 2022. As the only reason was weather, the CRSTMP (reasons with ANSP contribution) arrival delay was zero minutes per arrival. This can be also be seen in Figure 3.2, which shows the arrival delay rates for the past four years. It shall be recalled that for 2020, 2021, and 2022, there were no arrival delay target set for Liege Airport.

Table 3.3: Arrival delay Liege Airport per year and cause

		Minutes of ATFM Arrival Delay				# Arrivals
		CRSTMP	Weather	Other categories	**Total**	
Arrivals	**2019**	439	1,117	0	**1,556**	17,444
	2020	0	2,658	0	**2,658**	18,343
	2021	0	1,325	0	**1,325**	20,971
	2022	0	1,076	0	**1,076**	16,573

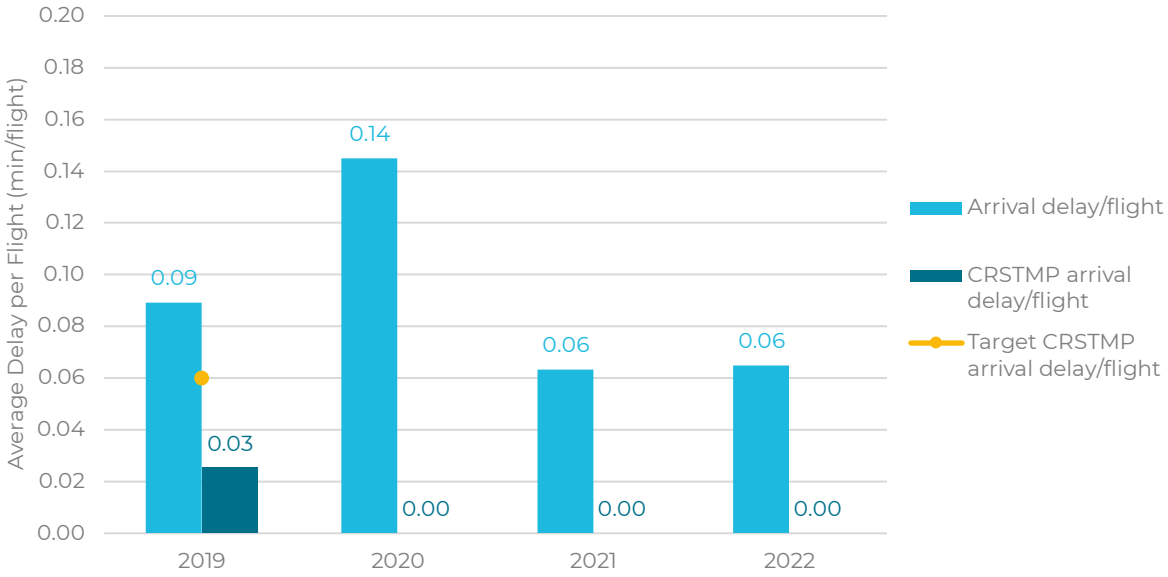


Figure 3.2: Arrival delay KPI at Liege Airport for 2019-2022 per year

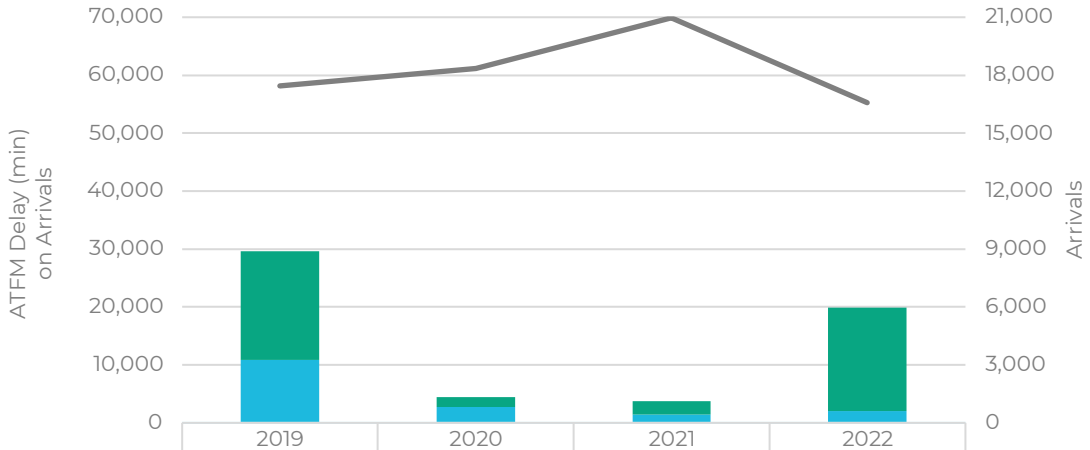
[12] Hence the difference with figures in Chapter 1, where movements are counted using the AMS and the BCAA criteria. NM only accounts for flights with a registered flight plan.

All ATFM impact on traffic at Liege Airport

Besides being delayed by Liege tower, flights to or from Liege Airport can also be delayed by ATFM measures in any ATC sector along their flight route; i.e. en-route or at the other departure or arrival airport. Regulations can be put in place at all ATC sectors of the flight plan: en-route sectors, departing airport and destination airport. The impact of all of these regulations give the total ATFM delay of traffic at Liege Airport.

In 2022, the delay figures were significantly higher than in 2020 and 2021, yet lower than in 2019. The low numbers in the previous two years can be explained by the large traffic decrease worldwide caused by the COVID-19 pandemic. The air traffic network had many bottlenecks, which were not suited for the traffic volumes of the previous years and, therefore, causing much delay. With the removal of these bottlenecks due to the low traffic, local factors, such as weather at the airport, became the most dominant factors in terms of delay. Hence, the very low amount of delay perceived in 2020 and 2021. In 2022, traffic largely recovered and is almost back at pre-COVID-19 levels (e.g. European traffic is at 83% according to EUROCONTROL[13]), which partially explains the rising number of ATFM delay. Additionally, a lot of strikes all over Europe occurred due to pay disputes of airport personnel and the lack of workforce after down-staffing during the COVID -19 pandemic. It is to be pointed out that in contrast to 2019, only a small share of ATFM delay was caused by skeyes.

Figure 3.3 and Figure 3.4 provide a view on the delay on departing and arriving traffic from/to Liege Airport over the last four years. The respective figures are also given in Table 3.4.



	2019	2020	2021	2022
Other ANSP	18,776	1,719	2,326	17,898
skeyes	10,881	2,730	1,379	2,007
IFR arrivals (with flight plan)	17,444	18,343	20,971	16,573

Figure 3.3: ATFM delay of arriving flights and number of IFR arrivals per year and attributable origin

In 2022, 16,573 flights arriving at Liege Airport were delayed with a total of 19,905 minutes of ATFM delay. 10% (2,007 minutes) of this delay is attributable to skeyes while 90% (17,898 minutes) is attributable to ATFM measures placed by other ANSPs.

[13] https://www.eurocontrol.int/publication/eurocontrol-analysis-paper-2022-year-european-aviation-bounced-back (URL retrieved on 27/02/2023)

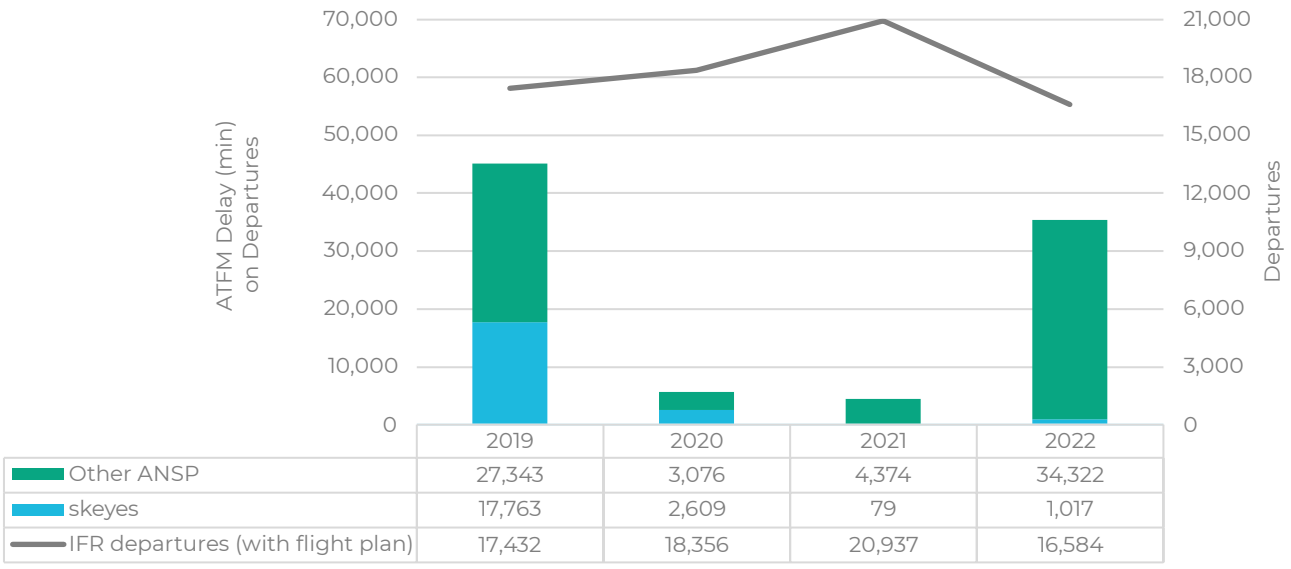


Figure 3.4: ATFM delay of departing flights and number of IFR departures per year and attributable origin

16,584 departing flights from Liege Airport were delayed resulting in a total of 35,339 minutes of delay. Thereof, 3% (1,017 minutes) of is attributable to skeyes while 97% (34,322 minutes) is attributable to other ANSPs.

Table 3.4: ATFM delay per year of arriving flights attributable to skeyes and other ANSPs

		Minutes of ATFM Delay			% of Delay attributable to skeyes	IFR movements (with flight plan)
		Other ANSP	skeyes	Total		
Arrivals	**2019**	18,776	10,881	29,657	36.7%	17,444
	2020	1,719	2,730	4,449	61.4%	18,343
	2021	2,326	1,379	3,705	37.2%	20,971
	2022	17,898	2,007	19,905	10.1%	16,573
	2022 *vs* 2019	-5%	-82%	-33%		
	2022 *vs* 2021	+669%	+46%	+437%		
Departures	**2019**	27,343	17,763	45,106	39.4%	17,432
	2020	3,076	2,609	5,685	45.9%	18,356
	2021	4,374	79	4,453	1.8%	20,937
	2022	34,322	1,017	35,339	2.9%	16,584
	2022 *vs* 2019	+26%	-94%	-22%		
	2022 *vs* 2021	+685%	+1187%	+694%		

The impact of all these regulations give the total ATFM delay of traffic at Liege Airport. Traffic was mainly impacted by ATC disruptions due to lack of capacity and staffing as well as weather related reasons. Another event that impacted the punctuality in Liege Airport was the implementation of 4-flight in France. Regulations were put in place (particularly in France and Germany) to protect that airspace and also the neighbouring from an overload.

To give a view on the severity of the impact, the delayed flights can be categorised based on the length of their delay. The following four categories have been established:

- Between one and 15 minutes
- Between 15 and 30 minutes
- Between 30 and 60 minutes
- More than 60 minutes.

It is clear that for both arriving traffic (Figure 3.5) and departing traffic (Figure 3.6), a similar distribution is seen:

More than half of delayed flights going to Liege Airport had a delay that did not exceed 15 minutes (55%). For 81%, the delay was below 30 minutes and only 4% of flights going to Liege Airport were delayed by more than 60 minutes.

Similarly, more than half of delayed flights departing from Liege Airport had a delay that did not exceed 15 minutes (57%). For 85%, the delay was below 30 minutes and only 2% of flights departing from Liege Airport were delayed by more than 60 minutes.

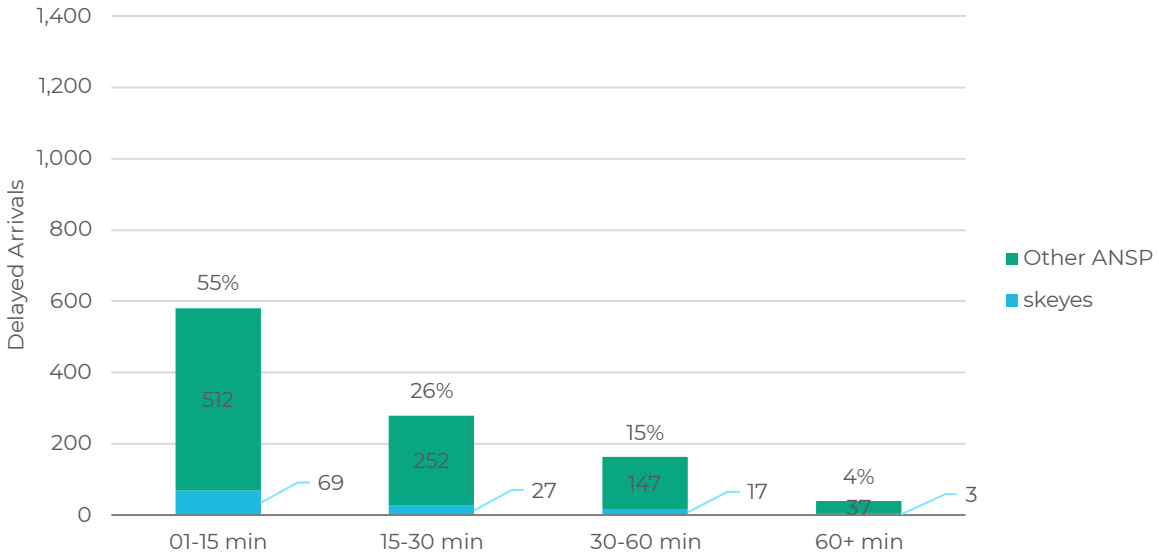


Figure 3.5: Delayed arriving flights in 2022 per attributable origin

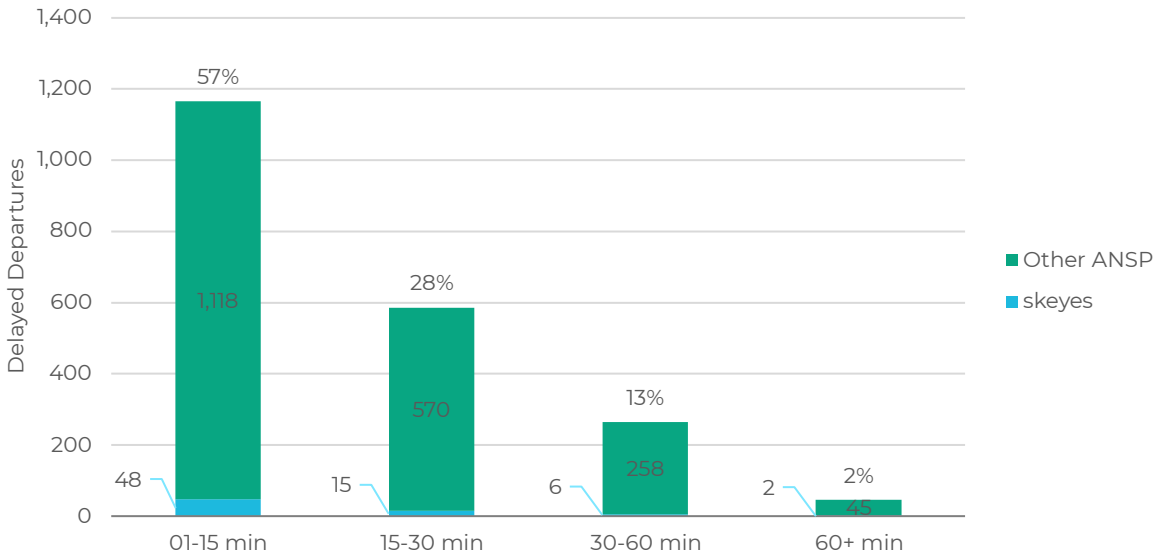


Figure 3.6: Delayed departing flights in 2022 per attributable origin

4. Environment

The first part of this chapter is dedicated to Continuous Descent Operations (CDO), also called green approaches. The objective of CDOs is to reduce aircraft noise, fuel burn and emissions by means of a continuous descent, to fly the approach glide path at an appropriate altitude for the distance to touchdown. skeyes put in place indicators to monitor the use of CDOs, in collaboration with the other members of FABEC.

The second part focuses on of predominant winds at Liege Airport, as wind is a leading factor in the choice of runway use, which in turn has an influence on the noise above the city of Liege. Runways 22L and 22R are preferred over runways 04L and 04R in this context. Furthermore, there are ongoing processes that aim to ensure a continuous dialogue with all the stakeholders and communities for more and more clarity in the runway configuration choice and other incentives, like environmental fees, to reduce the noise pollution.

Continuous Descent Operations

A Continuous Descent Operation (CDO) is an aircraft operating technique, in which an arriving aircraft descends from an optimal position with minimum thrust and avoids level flight to the extent permitted by the safe operation of the aircraft and the compliance with published procedures and ATC instructions. By doing so, the aircraft will use less fuel and produce less noise. Based on the recommendations made by EUROCONTROL, two CDO performance indicators were developed in 2016:

- CDO Fuel: binary indicator (yes/no) indicating if a CDO was flown from flight level 100 to 3,000ft;
- CDO Noise: binary indicator (yes/no) indicating if a CDO was flown from flight level 60 to 3,000ft.

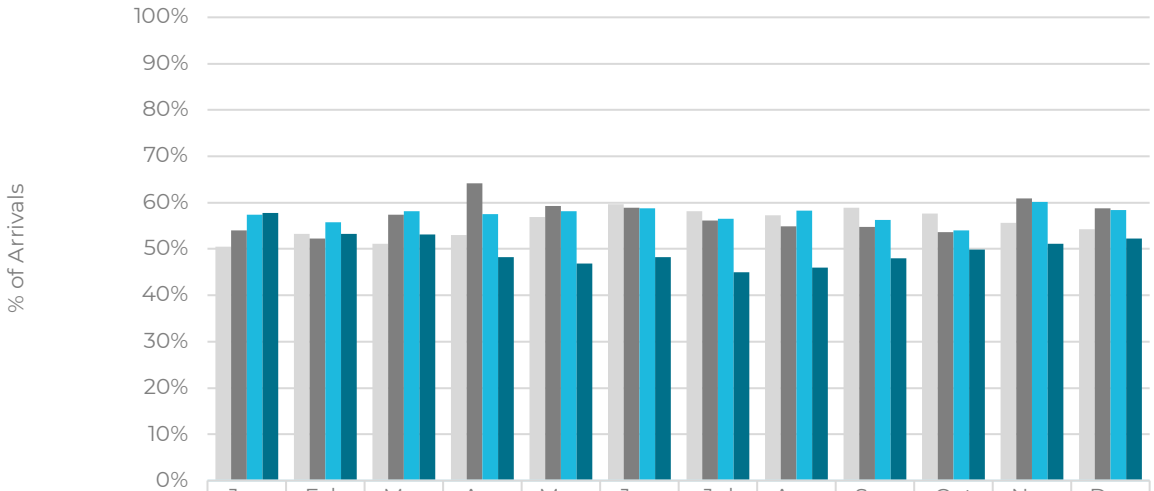
A descent is considered as a CDO if no level off lasting more than 30 seconds is detected. A level off is considered as a segment during which the aircraft has a rate of descend of less than 300 feet/minute.

Figure 4.1 and Figure 4.2 show – in percentage of arriving flights - the monthly evolution of CDO fuel and noise occurrences, respectively, at Liege Airport. Flights such as touch-and-go's and helicopters are not taken into account. Note that this counting of arrivals differs from the BCAA movements definition used in the previous chapters. As such, differences to the number of arrivals presented in Chapter 1 are to be observed.

It can be seen that, compared to 2021 and oftentimes also the previous years, the percentage of CDO fuel was lower in 2022 (except for January). Also the CDO noise operations decreased in all months compared to 2021.

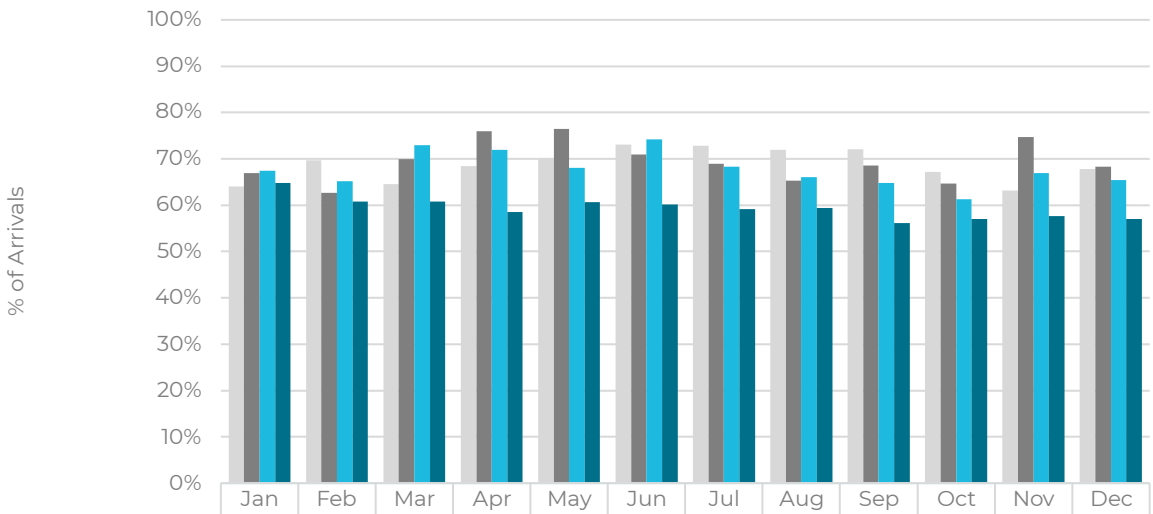
For CDO fuel, the largest decrease compared to the previous year was in June; from 59% in 2021 to 48% in 2022.

For CDO noise, the largest decrease compared to the previous year was in June; from 74% in 2021 to 60% in 2022.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CDO Fuel 2019	51%	53%	51%	53%	57%	60%	58%	57%	59%	58%	56%	54%
CDO Fuel 2020	54%	52%	57%	64%	59%	59%	56%	55%	55%	54%	61%	59%
CDO Fuel 2021	57%	56%	58%	57%	58%	59%	57%	58%	56%	54%	60%	58%
CDO Fuel 2022	58%	53%	53%	48%	47%	48%	45%	46%	48%	50%	51%	52%

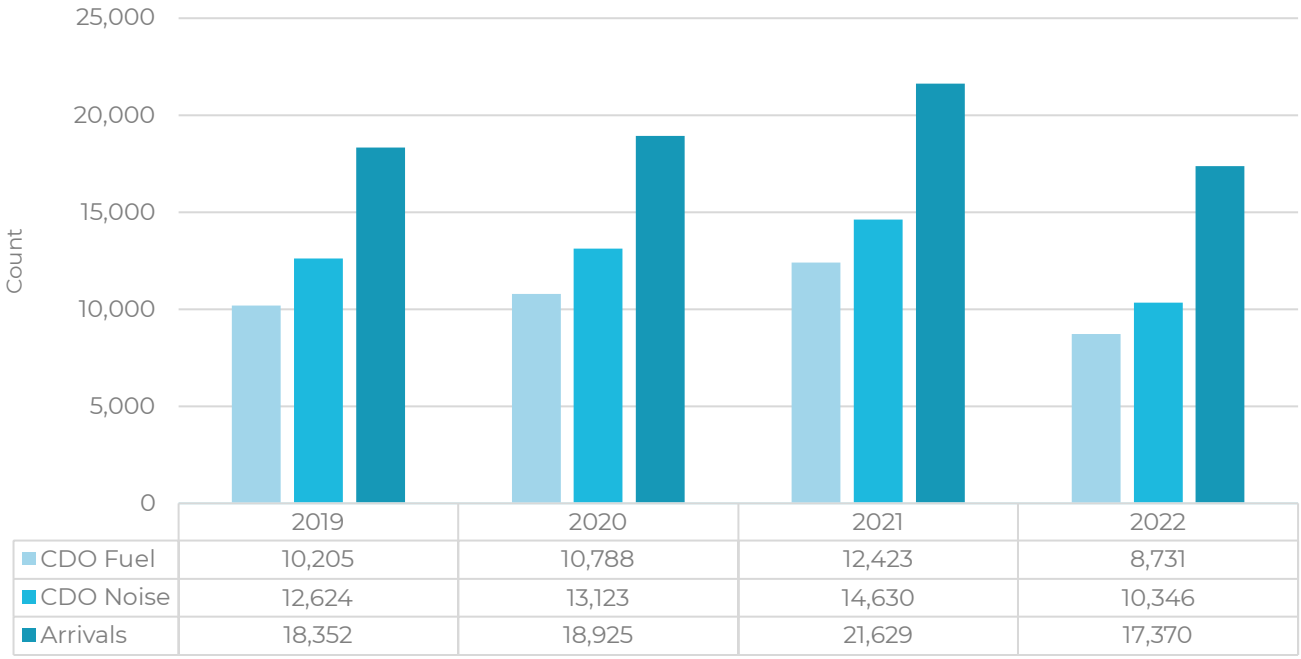
Figure 4.1: CDO Fuel flown per year as percentage of arrivals



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CDO Noise 2019	64%	70%	65%	68%	70%	73%	73%	72%	72%	67%	63%	68%
CDO Noise 2020	67%	63%	70%	76%	77%	71%	69%	65%	69%	65%	75%	68%
CDO Noise 2021	67%	65%	73%	72%	68%	74%	68%	66%	65%	61%	67%	65%
CDO Noise 2022	65%	61%	61%	59%	61%	60%	59%	59%	56%	57%	58%	57%

Figure 4.2: Noise flown per year as percentage of arrivals

The yearly number of CDO fuel and noise flown decreased both in absolute numbers as well as in the percentage of arrivals per runway. This is shown in Figure 4.3 and Figure 4.4 respectively. In the latter, runways 04L & 04R, as well as runways 22L & 22R have been combined. It is to be mentioned that with the reduced cargo movements (see Chapter 1, Section "Cargo"), more traffic occurred during the day instead of the night in Liege (46% of the movements happened during the night in 2021, but only 36% in 2022), and during the day there is more interference with other airports, which makes it more difficult to perform a CDO. Therefore, the relative increase in traffic during the day can (partially) explain the reduced number of CDOs.



	2019	2020	2021	2022
CDO Fuel	10,205	10,788	12,423	8,731
CDO Noise	12,624	13,123	14,630	10,346
Arrivals	18,352	18,925	21,629	17,370

Figure 4.3: Total number of CDO Fuel and CDO Noise flown per year

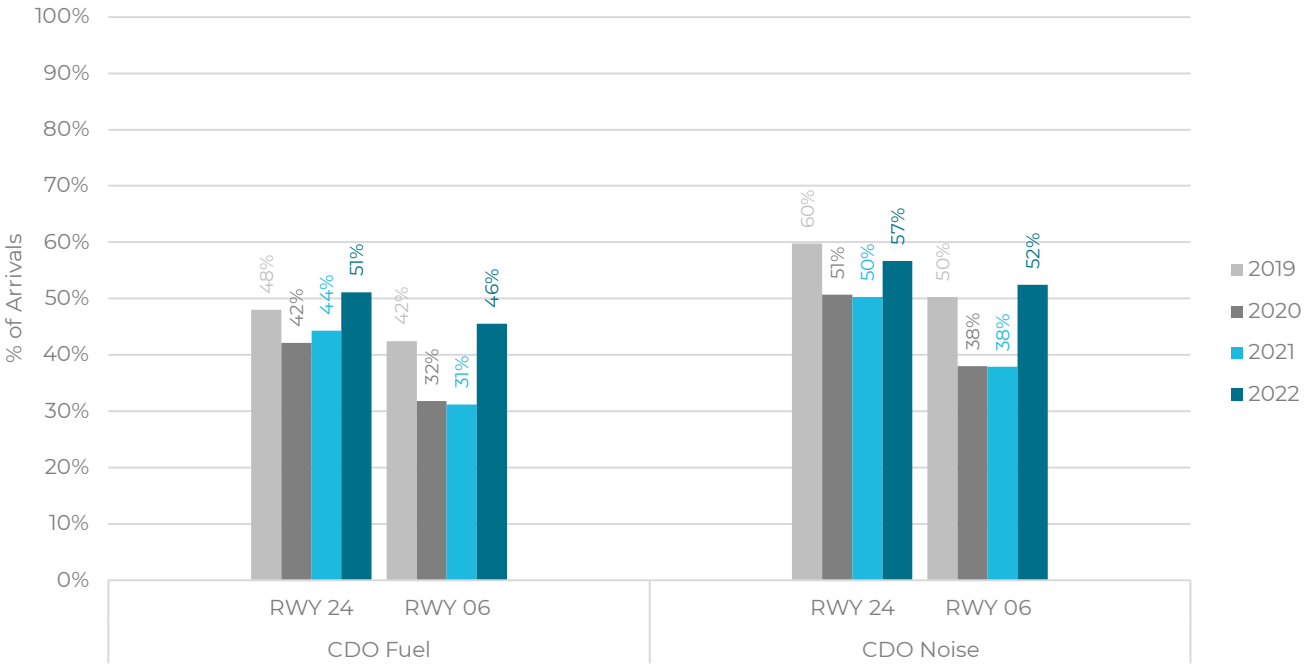


Figure 4.4: CDO Fuel and CDO Noise flown per runway per year as percentage of arrivals

Differences for runways and throughout the years can be observed. CDO statistics are inherently variable, because they are influenced by a multitude of external factors, such as:

- Pilots' CDO flying experience
- Pilots' experience with specific airport
- ATC experience
- Runway usage (equipment)
- Aircraft type/equipment
- Military airspace open/closed
- Traffic flows
- Impact of other traffic streams on arriving traffic, often linked to time of the day.

As a result, it is difficult to pinpoint one specific reason for an increase or decrease from one year to the next.

Improvement Measures and Activities

To promote and facilitate the number of CDOs flown to Liege Airport, different measures are investigated or have already been implemented:

- Assisting the aircraft operators in improving their flight efficiency in general, and CDO in particular, is an integral part of skeyes' Environmental Action Plan (set up in 2021);
- skeyes continues to be one of the core partners of the 'Collaborative Environmental Management' (CEM) platform at Liege Airport, launched in September 2020. The objective is to increase cooperation with airlines and the airport in undertaking joint initiatives that further reduce the environmental impact of airport operations. Stakeholders in the discussions are Liege Airport, skeyes, SOWAER, and the main airlines operating at Liege Airport;
- skeyes promotes the increased use of PBN (Performance Based Navigation) procedures, also during the CEM platform. Such approach procedures fit in the on-going transition towards a PBN Environment (EU regulation), and greatly improve predictability for the flight crews such that CDO performance can be improved. Currently the PBN transition at Liege Airport is pending on BCAA approval.
- skeyes monitors and adapts, where feasible, operations to enhance flight efficiency. E.g., during COVID travel restrictions, some constraints were relaxed due to the reduction of traffic in the Belgian airspace, and both air traffic controllers and pilots were encouraged to pro-actively facilitate and fly CDO/CCO (continuous descent operations/continuous climb operations), as well as more direct routings;
- skeyes is in contact with airlines presenting CDO statistics and communicating the phraseology;
- skeyes is increasing awareness amongst ATCOs through courses, and by informing them of the current statistics and performance;
- As a member of FABEC, skeyes actively participated to the 2nd workshop on Vertical Flight Efficiency in December 2021. During this workshop, numerous ongoing initiatives and best practices to improve – amongst others – CDO performance were exchanged between airlines, air navigation service providers, military authorities, etc.
- Liege Airport is one of the first Belgian airports, which has the necessary aviation fuel installations and accordingly trained fuelling staff to receive, store and distribute sustainable aviation fuel (SAF).

Wind Patterns

One of the main factors for the choice of the runway, is wind. At Liege Airport, the wind typically blows in a the north-easterly or south-westerly direction, with predominant winds from the South-West. This can also be seen in the wind roses in Figure 4.5. The wind roses show the average wind strength in knots (colour coded) and direction the wind is blowing from as the angle of the petal. This way the wind of the years 2019 to 2022 is summarized.

By comparing the wind patterns for the different years, it can be observed that there have been some strong winds (above 17 knots) from the South-West in 2022 and 2020. In 2021, exceptionally many winds of less than 11 knots blew from the North-East, but also in 2022 this pattern can be observed stronger than in 2020 or 2019. Additionally, there have been more winds on the North-West / South-East axis, which results in more cross winds for the aircraft arriving and landing in Liege.

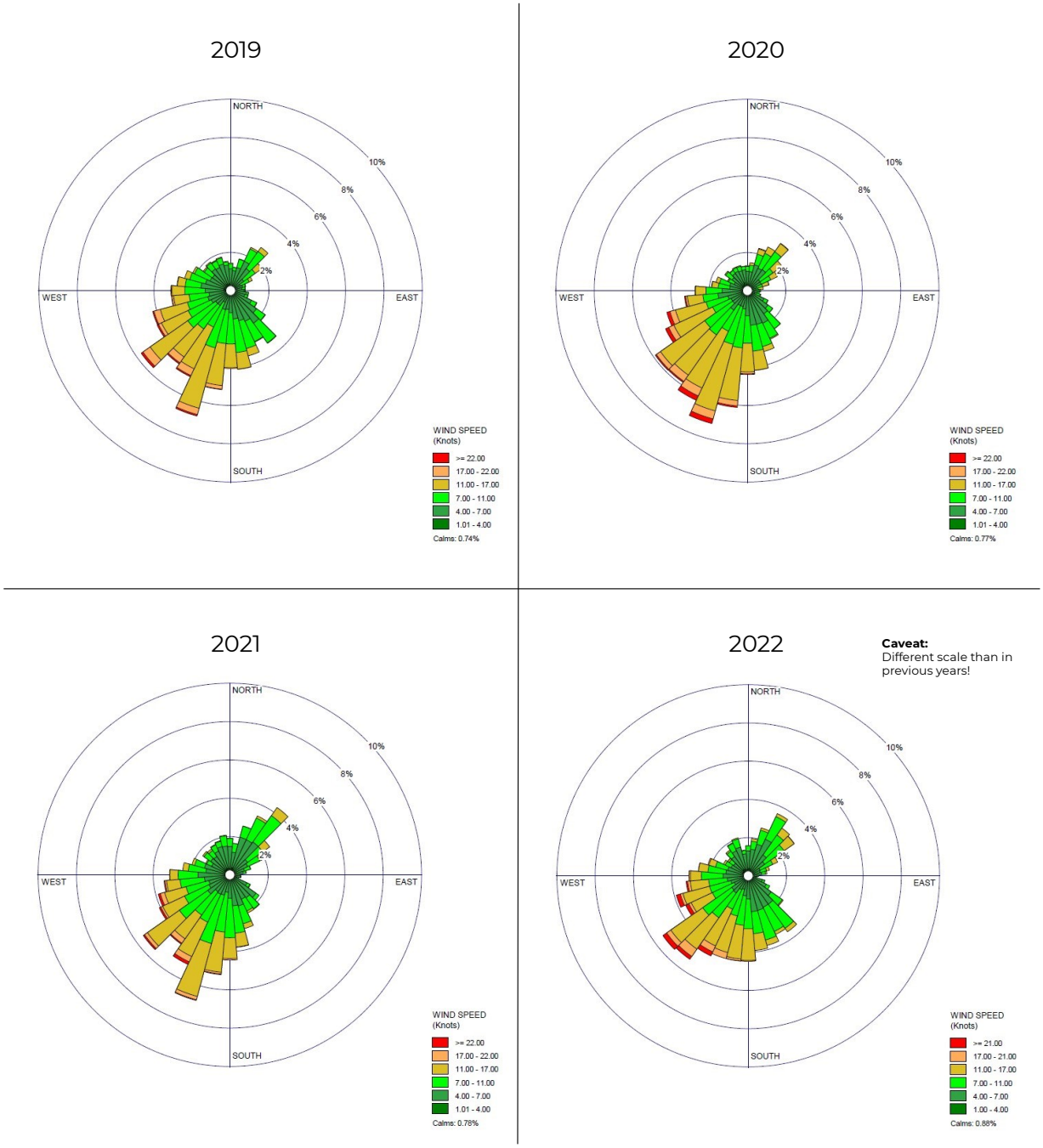


Figure 4.5: Wind roses at Liege Airport 2019-2022

A monthly view on winds in 2022 is given in Figure 4.6. In January, February, November, and December, there were a lot of stronger winds from the South-West or South. In March, some winds from the South-East led to cross winds, and a lot wind also blew from the North-East. August was another month with winds mainly coming from the North-East, which explains the higher runway usage of 04L & 04R during this month (see Chapter 1 – Runway Use). In general, runway usage heavily correlates with wind patterns since the aeronautics of the aircraft favour head wind for take-off and landings, such that the air speed is increased.

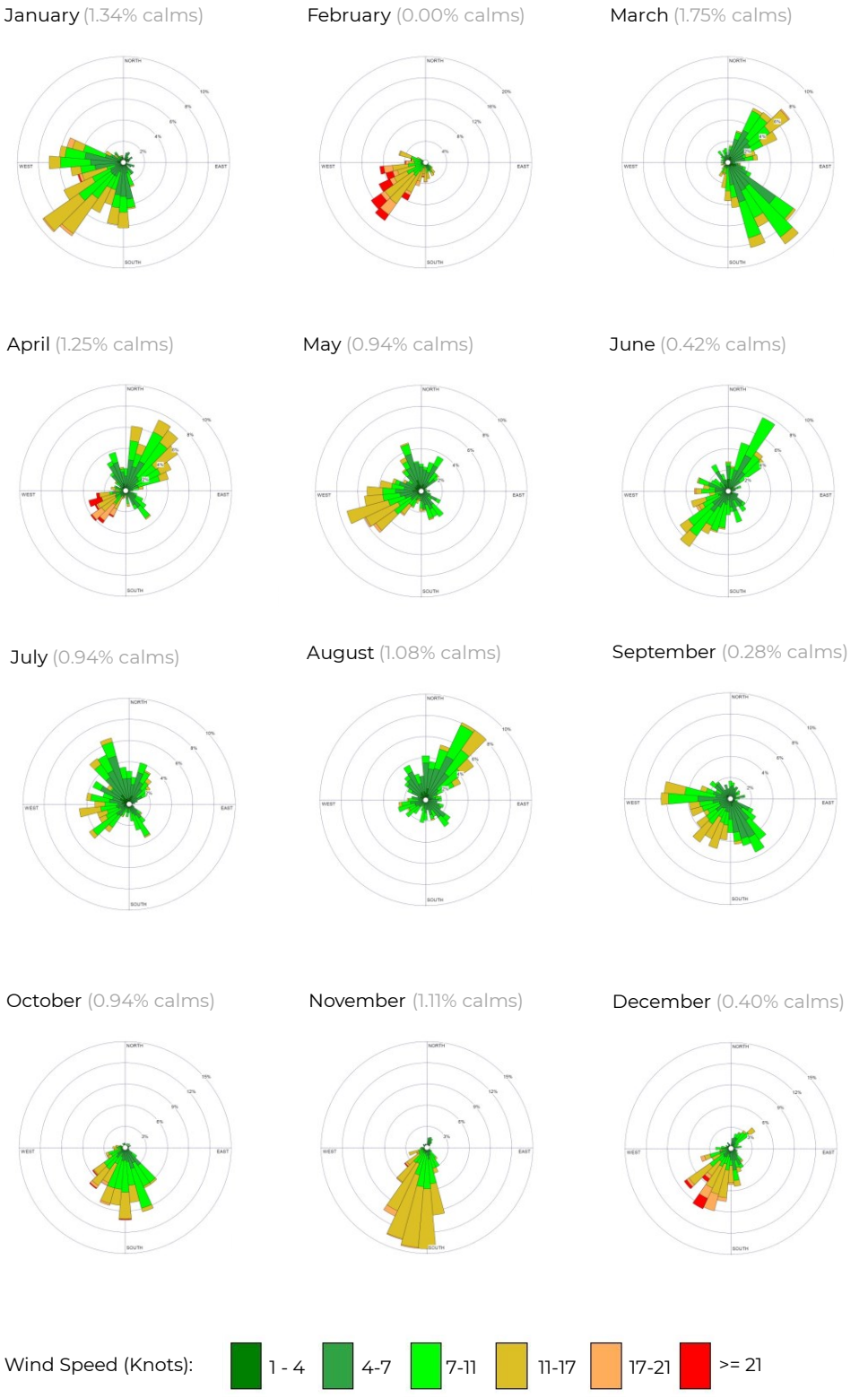


Figure 4.6: Wind roses at Liege Airport per month of 2022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ANNEX

ANNEX: Fact Sheet 2022

Traffic

Yearly evolution

- Despite the increase in VFR (+13%), the drop in IFR movements (-20%) led to an overall decrease of -16%.

Movements	2019	2020	2021	2022	2022 vs 2021	2022 vs 2019
Total	43,451	42,911	48,914	40,992	-16%	-6%
IFR	36,370	37,791	43,611	34,980	-20%	-4%
VFR	7,081	5,120	5,303	6,012	+13%	-15%

Quarterly comparison

- Q1 shows an increase in traffic compared to pre-COVID-19 years (+20% to 2019). The rest of the year reflects a decrease in traffic due to the move of FedEx (28/03/2022) and other factors like the geopolitical instability and sanctions due to the Russian invasion of Ukraine (24/02/2022).

Movements	2019	2020	2021	2022	2022 vs 2021	2022 vs 2019
Q1	10,438	9,787	10,881	12,564	+15%	+20%
Q2	11,143	9,551	12,511	9,658	-23%	-13%
Q3	11,207	11,974	13,036	10,236	-21%	-9%
Q4	10,663	11,599	12,486	8,534	-32%	-20%

Safety

Missed Approaches

- 58 missed approaches in 2022 (-18% vs 2019)
- TOP 3 causes in 2022:
  1. Unstable approach (22)
  2. I : Wx - thunderstorm - Windshear (10)
  3. D : ACFT with technical problems (6)

Safety Occurrences

- 11 runway incursions, 2 with ATM contribution
- 15 other occurrences of runway safety events – less than in the previous year (22 in 2021)
- less laser beams and less call sign confusions than in the previous year

Capacity & Punctuality

Capacity

Runway Configuration	Declared IFR Capacity	Maximum Movements/Hour in 2022
22 - 22	34 movements/hour	32 movements/hour
04 - 04	35 movements/hour	41 movements/hour

Capacity exceeded on 1 days for 04-04 only due to majority VFR traffic. IFR capacity was never exceeded.

Punctuality:

Arrival delay:

- ✈ Arrival Delay: 0.06 min/flight
- ✈ CRSTMP delay: 0 min/flight

ATFM impact:

- ✈ Departures 7,208 minutes ATFM delay, 13% (947 min) due to skeyes' regulations)
- ✈ Arrivals: 5,164 minutes ATFM delay, 7% (381 min) due to skeyes' regulations)

Environment

CDO

- 22L&R → Percentage of arrivals with CDO decreased from 2021 to 2022:
  CDO fuel from 59% to 51%, CDO noise from 68% to 60%
- 04L&R → Percentage of arrivals with CDO decreased from 2021 to 2022:
  CDO fuel from 55% to 48%, CDO noise from 67% to 58%

Wind Patterns

- Wind from the South-West was less stronger than last year. Nonetheless, a lot of wind also blew from the North-East (similar to last year, but a lot more than in 2019 and 2020).

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