Air traffic in Germany

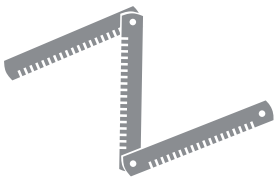
Mobility Report 2019

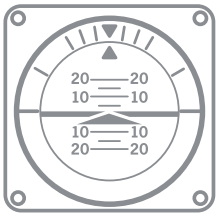
DFS Deutsche Flugsicherung

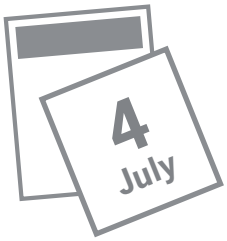
The year 2019

Air traffic in German airspace

Size of German airspace	IFR flights	IFR take-offs and landings	Peak day
390,000 square kilometres	3.334 million	2.295 million	11,012 IFR flights







Safety

Infringements of separation (en-route) Per 1 million flight hours (RAT ABC)

Benchmark	35

2018 22.55 2019 16.23

Infringements of separation (terminal) Also includes runway incursions per 100,000 aircraft movements (RAT ABC)

Benchmark	1.37

2018 0.72 2019 0.68

Punctuality

ATFM delay en-route
Delay per flight in minutes (ATC-related)

Benchmark	1.23

2018 1.23 2019 1.19

ATFM delay arrival
Delay per flight in minutes (ATC-related)

Benchmark	0.09

2018 0.015 2019 0.014

Environment

Horizontal flight efficiency
Deviation from the direct route

Benchmark	1.6%

2018 1.19%

2019 1.16%*

*ca. 3.8 km

2019 – Demand slackens off

Every year, the German air navigation service provider DFS and its 5,600 staff ensure that millions of passengers reach their destinations safely and efficiently. In 2019, the volume of traffic in German airspace declined for the first time after years of growth. In combination with numerous measures to improve punctuality, this development significantly reduced delays. The safety level in German airspace continues to be very high. The DFS Mobility Report for 2019 provides you with a source of detailed information about air transport. Here, you will also find the most important aviation trends in Europe and the world.

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2019 – From growth to decline

In 2019, Europe for the first time registered more than ten million flights in one year. Traffic volume declined towards the end of the year, however. In Germany, even fewer flights were counted overall than in the previous year.

At first glance, 2019 was a record year for air traffic in Europe. With a total of over ten million flights, the double-digit million mark was broken for the first time in the 28 EU Member States. In total, 1.2 percent more flights were recorded than in 2018. However, growth slowed considerably over the course of the year and volumes started to decline towards the end. In Germany, the trend was similar, but with an overall slight decline for the year.

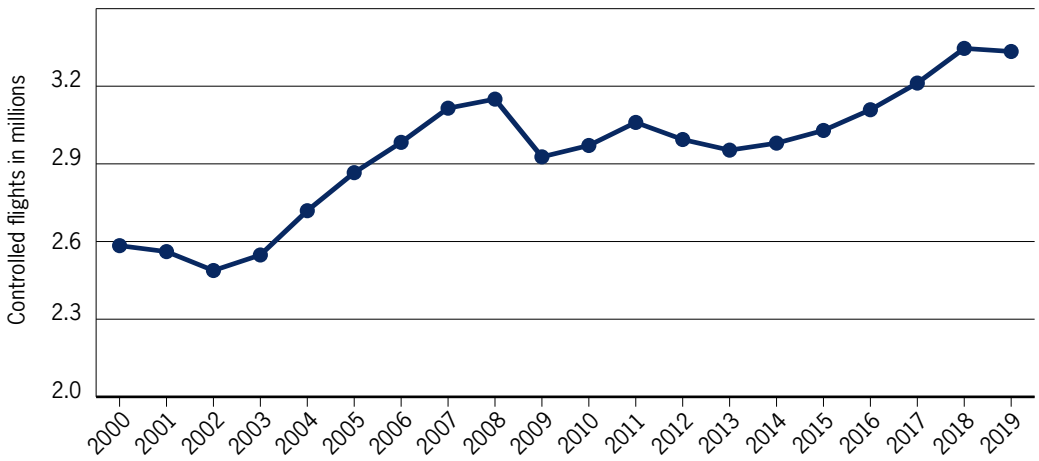
In German airspace, a total of 3.334 million flights under instrument flight rules (IFR) were recorded in 2019, 0.4 percent fewer than in the previous year. While the number of entries and exits stagnated, the number of overflights and domestic flights decreased. The breakdown between the segments remained virtually unchanged: At 38.7 percent, overflights still account for the largest portion of traffic volume. The share of entries and exits remained constant at 25.7 percent each, while the share of domestic flights remained at ten percent.

Air traffic has grown steadily in recent years. The forecasts for 2019 had also been positive. At the beginning of 2019, the significant growth in Europe initially continued, with monthly growth rates of up to 3.4 percent. Growth then slowed towards the middle of the year, with air traffic in Europe falling slightly in the fourth quarter, compared with the prior-year period. The reasons for this were the weakness of the global economy and the continuing negative news from the aviation industry.

The list of negative news included the bankruptcy of the Thomas Cook Group, which had an impact on Condor, the German charter airline. In addition, the Lufthansa Group began to

38.7
PERCENT
of all flights in German airspace are overflights. Their number declined.

Traffic numbers over the long term

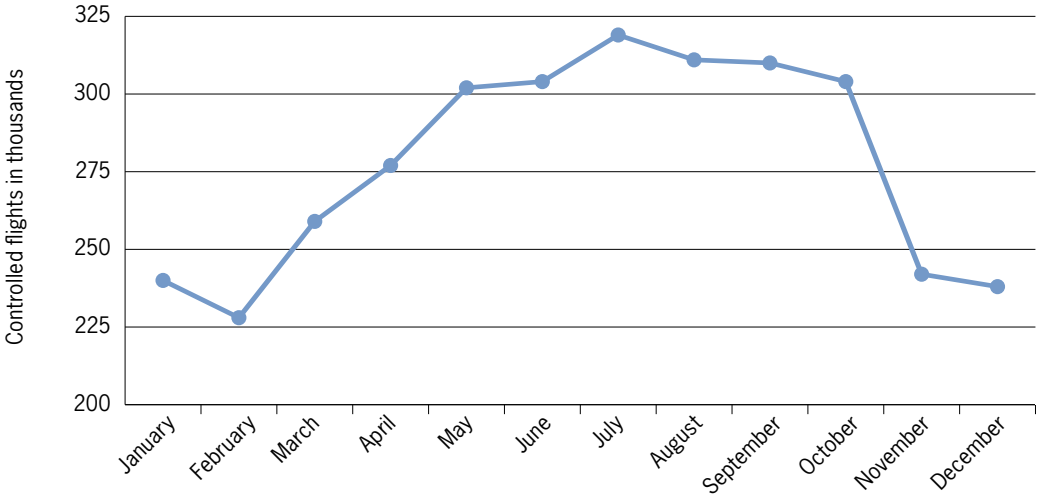


Source: DFS

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
2.584	2.561	2.488	2.548	2.719	2.866	2.983	3.115	3.150	2.927	2.971	3.060	2.994	2.953	2.980	3.029	3.109	3.212	3.346	3.334

In 2019, air traffic controllers handled 3,334,424 flights under instrument flight rules in German airspace, a decrease of 0.4 percent over the previous year. This is the first time since 2014 that traffic growth stagnated.

Traffic by month

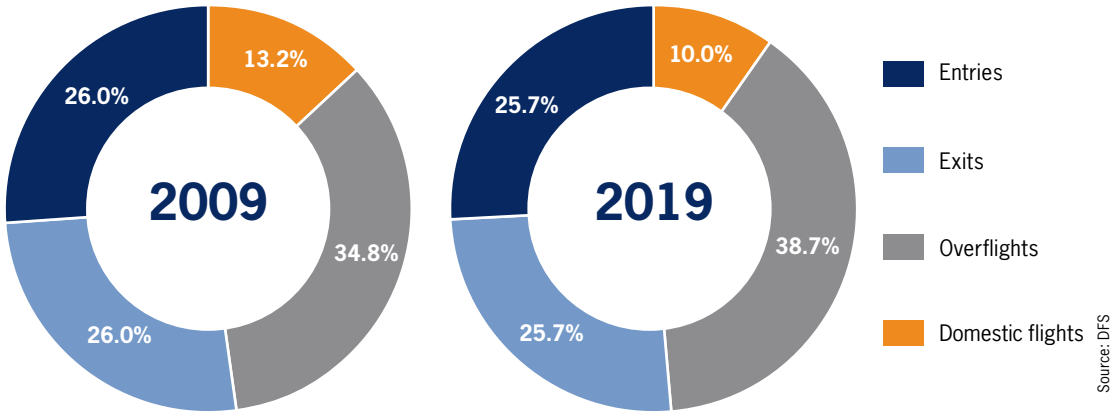


Source: DFS

Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
240,000	228,000	259,000	277,000	302,000	304,000	319,000	311,000	310,000	304,000	242,000	238,000

With 11,012 IFR flights, 4 July was the busiest day in 2019. July was also the busiest month of the year. A total of 319,000 controlled flights were recorded in July, about 8,000 more than in the second busiest month of August.

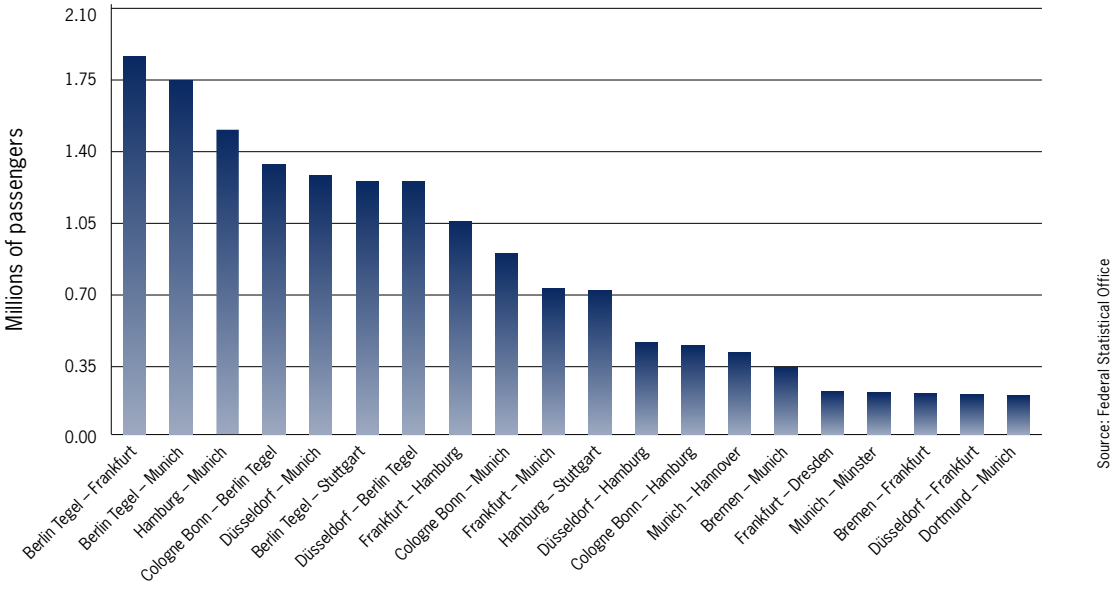
Traffic segments



Source: DFS

The proportion of overflights in German airspace has increased significantly within ten years. Conversely, the proportion of domestic flights has declined.

Main domestic connections



Source: Federal Statistical Office

According to the German Federal Statistical Office, 23.2 million passengers travelled to domestic destinations in 2019. Berlin – Frankfurt, Berlin – Munich and Hamburg – Munich were the most popular city pairs. This chart is based on the last known destination of the passengers – feeder flights to a hub airport were therefore not taken into account.

More than 11 THOUSAND
flights were counted in German airspace on 4 July 2019.

cancel and shift routes operated by Eurowings, Austrian Airlines continued to withdraw to Vienna and strikes by the flight attendants' union Ufo affected many flights. The worldwide flight ban on the Boeing model 737MAX also had a considerable impact. The overall situation was compounded by the insolvencies of numerous airlines, including Germania, BMI Regional, Small Planet and Primera Air.

As pointed out above, traffic growth in Germany reflected the European trend. There was strong growth in the first half of the year, but this weakened and then collapsed towards the end of the year. In addition to the weaker development of the global economy, route cancellations and bankruptcies, there is another reason for this: In April 2019, a Europe-wide initiative was launched under the leadership of Eurocontrol in order to decongest the airspaces that had been particularly heavily burdened by the traffic growth of recent years. Under this initiative, some flights were transferred from upper to lower airspace and some were moved laterally. They were then controlled by other, less congested control centres in order to improve punctuality. This initiative had a particularly strong impact on traffic volumes in the busy German airspace.

The monthly distribution of flights remained constant, with more than 300,000 flights controlled in six months. As in previous years, July was again the strongest month with almost 319,000 flights. The day with the highest traffic volume was also in this month. On 4 July 2019, DFS counted more than 11,000 flights on one day for the second time in its history.

There was no uniform trend at the 16 designated German international airports controlled by DFS. Overall, the number of take-offs and landings stagnated at 2.3 million IFR flights, with both moderate growth at some airports and heavy losses at others. Düsseldorf (+3.3 percent) and Stuttgart (+3.5 percent) recorded significant increases, mainly due to the route expansion by Eurowings. The situation in Berlin was particularly interesting: Tegel recorded an increase of 3.4 percent, while Schönefeld Airport recorded double-digit losses (-10.6 percent). The reason for this was that Easyjet withdrew capacity from Schönefeld and transferred it to its base in Tegel. There were also heavy losses at Erfurt (-14.5 percent) and Saarbrücken (-12.4 percent) airports. This was mainly due to the insolvencies of the airlines Germania and BMI Regional.

Germany's regional airports recorded a 3.1 percent drop in traffic in 2019. The main reason for this was the trend of many low-cost airlines to withdraw from small airports and fly to large ones instead. The biggest losers were Niederrhein (-22.3 percent), Hahn (-16.8 percent) and Rostock-Laage (-12.3 percent). The main reason for the decline at Hahn and Niederrhein airports was probably Ryanair's relocation of routes. At Niederrhein and Rostock airports, the insolvencies of Germania and other airlines had an impact. Contrary to the trend, the largest regional airport Dortmund (+7.8 percent) and the fourth largest regional airport Memmingen (+9.4 percent) continued to grow. Both gained from the relocation of routes by low-cost airlines. Another winner was Heringsdorf with a plus of eleven percent. This airport benefited strongly from new holiday flights by Eurowings on weekdays.

IFR take-offs and landings at Germany's international airports

	2015	2016	2017	2018	2019	Change in %
Berlin Schönefeld	74,355	94,886	99,870	100,778	90,124	–10.6
Berlin Tegel	183,696	184,974	173,045	186,535	192,958	3.4
Berlin in total	*258,051*	*279,860*	*272,915*	*287,313*	*283,082*	–1.5
Bremen	34,211	32,861	30,246	31,198	29,984	–3.9
Dresden	22,823	22,727	21,450	22,233	20,707	–6.9
Düsseldorf	209,361	216,875	220,904	218,204	225,440	3.3
Erfurt Weimar	4,869	4,907	5,455	5,502	4,704	–14.5
Frankfurt	468,027	462,742	475,365	511,844	513,722	0.4
Hamburg	149,937	151,785	153,931	148,853	149,239	0.3
Hannover	62,320	61,797	62,401	65,928	64,781	–1.7
Cologne Bonn	127,356	135,391	139,760	142,870	142,117	–0.5
Leipzig Halle	62,417	61,488	65,963	74,736	75,432	0.9
Munich	377,082	391,521	401,728	410,242	414,068	0.9
Münster Osnabrück	17,611	16,808	18,223	19,359	18,939	–2.2
Nürnberg	48,665	49,495	53,074	54,149	49,417	–8.7
Saarbrücken	9,945	9,285	8,787	9,119	7,988	–12.4
Stuttgart	118,931	118,918	117,939	128,194	132,669	3.5
Total	**1,971,606**	**2,016,460**	**2,048,141**	**2,129,744**	**2,132,289**	**0.1**

IFR take-offs and landings at Germany's regional airports

	2015	2016	2017	2018	2019	Change in %
Augsburg	6,732	6,516	7,049	6,920	7,402	7.0
Braunschweig	11,727	10,471	9,784	9,747	9,198	–5.6
Dortmund	20,114	19,262	20,220	22,523	24,270	7.8
Friedrichshafen	12,393	10,109	9,919	10,237	10,795	5.5
Hahn	20,957	20,634	20,662	19,459	16,196	–16.8
Heringsdorf	984	982	838	892	990	11.0
Hof Plauen	1,515	1,313	1,488	1,435	1,506	4.9
Ingolstadt Manching	6,601	5,529	5,669	5,482	5,074	7.4
Karlsruhe Baden-Baden	13,930	12,707	13,016	12,383	12,469	0.7
Kassel Calden	3,788	3,792	4,342	4,674	4,839	3.5
Lahr	1,461	1,493	1,543	1,504	1,581	5.1
Lübeck Blankensee	4,310	2,284	1,922	2,742	2,859	4.3
Magdeburg Cochstedt*	1,246	518	5	1	3	200.0
Mannheim	6,309	6,591	6,460	6,767	6,648	–1.8
Memmingen	11,298	10,541	11,681	13,802	15,103	9.4
Mönchengladbach	5,726	5,072	6,025	6,594	6,479	–1.7
Niederrhein	13,187	12,714	13,066	11,995	9,315	–22.3
Paderborn Lippstadt	13,048	12,666	12,805	14,114	13,295	–5.8
Rostock Laage	8,449	6,866	7,880	9,795	8,587	–12.3
Schwerin Parchim	1,768	1,320	1,056	527	24	–95.4
Westerland Sylt	5,553	5,359	5,717	6,088	5,925	–2.7
Total	**171,096**	**156,739**	**161,147**	**167,681**	**162,558**	**–3.1**

At the international airports, the number of take-offs and landings was only slightly above the previous year's level. In 2019, the increase was only 0.1 percent. At the regional airports, traffic volumes actually fell by 3.1 percent. This table is based on all take-offs and landings under instrument flight rules (IFR). Domestic flights count as two aircraft movements – one take-off and one landing.

* Flight operations at Magdeburg Cochstedt Airport were discontinued in September 2016.

The old and the new

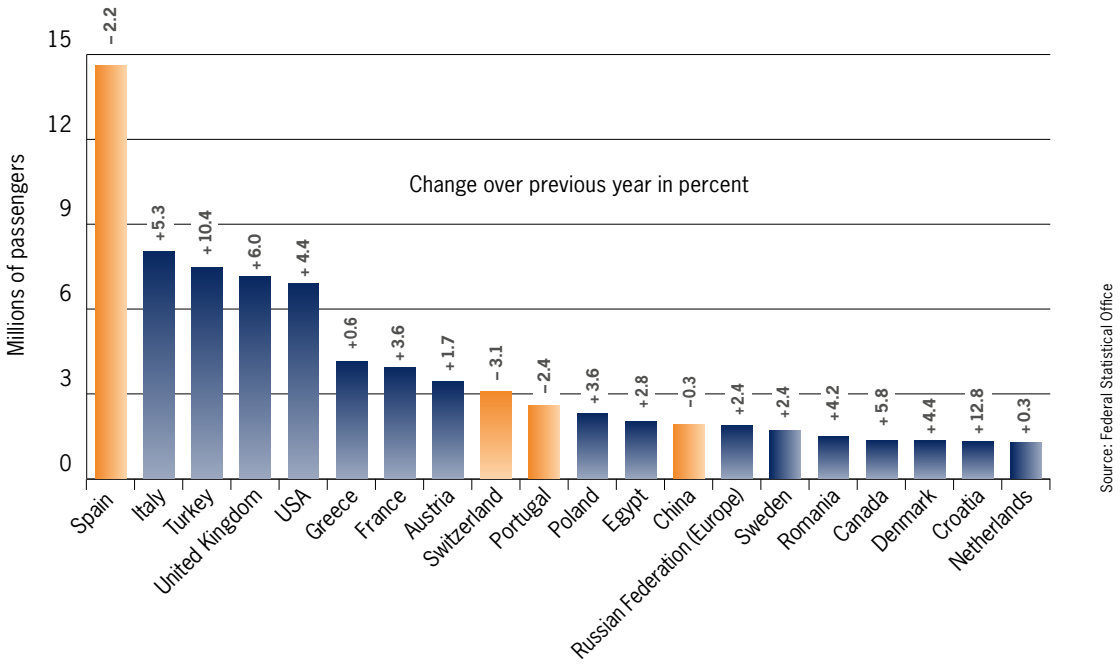
Spain and Italy were the most popular destinations for Germans again in 2019. Turkey continued to make up past declines – and Croatia was the growth winner of the year.

For the tenth year in a row, the number of people travelling abroad increased. In comparison to 2009, it doubled. In 2019, more than 105 million passengers started their journey abroad at a German airport.

Spain remains the most popular destination for Germans. Spain remains the most popular destination for Germans. Nearly one in six international flights headed to Spain, and almost 15 million people travelled to the Spanish mainland, the Balearic Islands or the Canary Islands in 2019 – although this is a decline of 2.2 percent compared with the previous year. Italy came in second with more than eight million travellers and an increase of 5.3 percent. Turkey advanced to third place with around 7.5 million travellers and an increase of over 10 percent. This means that the country on the Bosporus surpassed the record number of passengers seen in 2015. At that time, 7.2 million passengers travelled to Turkey, before traffic fell sharply as a result of terrorist attacks and domestic political disputes.

The number of air passengers heading to the United Kingdom (+6 percent, 4th place) and the United States (+4.4 percent, 5th place) also increased significantly. The big winner of the year, however, was Croatia with a plus of almost

Top 20 destinations



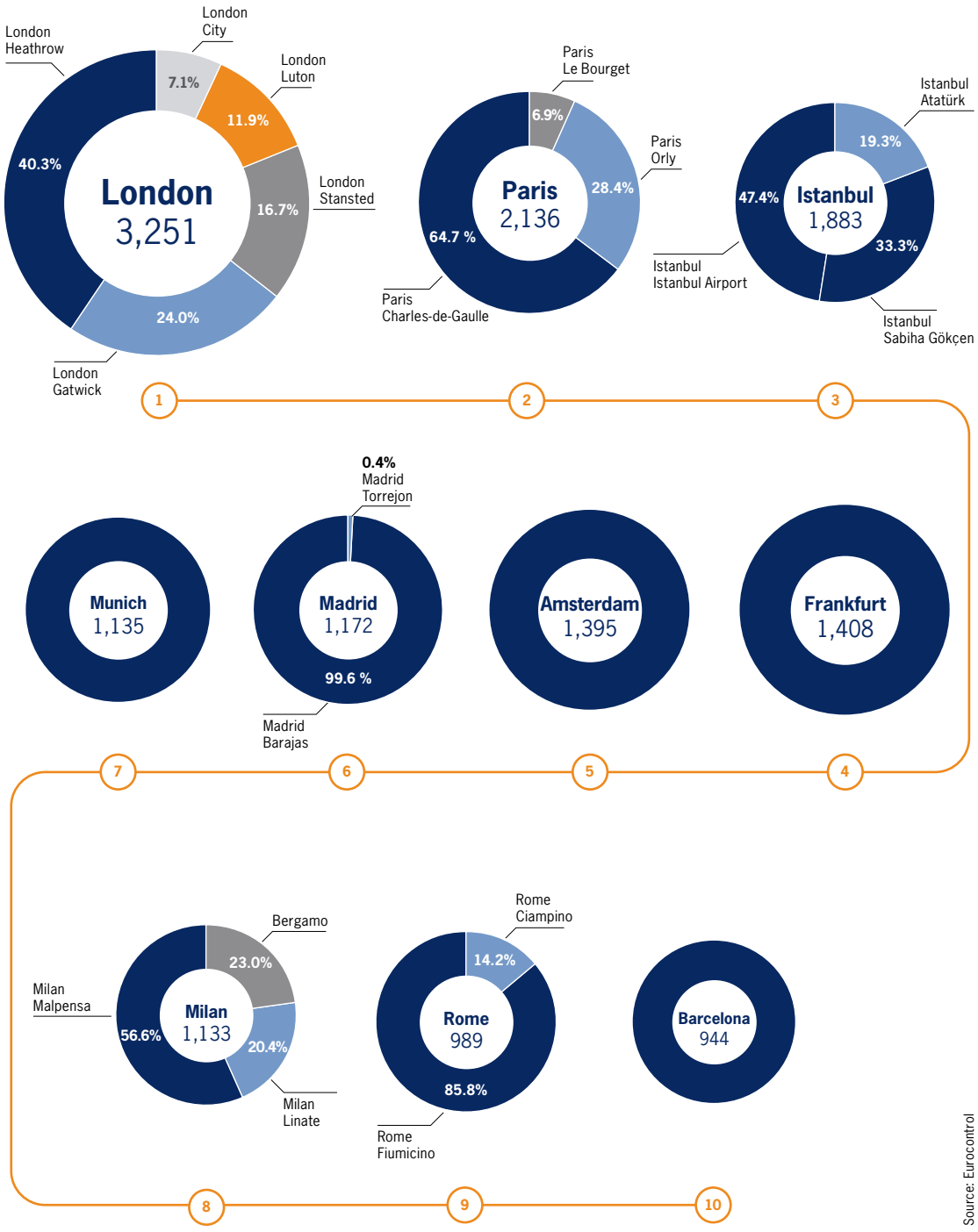
The number of passengers travelling abroad continued to rise in 2019. A total of over 105 million passengers from Germany took off for foreign destinations. Above all, the destinations Turkey and Croatia recorded significant growth.

7.5
MILLION
people travelled to Turkey in 2019 – more than in the record year 2015.

13 percent. Around 1.3 million people travelled to this holiday destination on the Adriatic Sea from German airports in 2019. The change in general travel flows is also reflected in the volume of traffic in EU countries. According to Eurocontrol, traffic growth was above average in many States in Eastern Europe. This is particularly true for North Macedonia (+15.5 percent), Ukraine (+11.8 percent) and Bosnia-Herzegovina (+11.2 percent). Traffic growth in Croatia amounted to 10.4 percent.

European metropolitan airports

Average number of departures per day



With more than 1,400 take-offs and landings daily, Frankfurt is the largest airport in Europe, followed by Amsterdam and Paris Charles-de-Gaulle airports. London remains Europe's airport metropolis, however. More than 3,200 flights took off and landed at Heathrow, Gatwick, Stansted, Luton and City airports every day on average over the year. These figures only consider flights under instrument flight rules. The statistics include airports located up to 50 kilometres from the city centre with at least one aircraft movement per day.

Billions of people in the sky above us

The passenger growth seen in recent years continued at a slightly slower pace in 2019. Despite stagnating flight numbers, new records were set for passenger numbers. The load factor of the aircraft was also higher than ever.

The number of air travellers has continued to rise. According to the International Air Transport Association (IATA), good 4.5 billion passengers were in flight worldwide in 2019 – more than ever before (2018: 4.3 billion). The number of passenger-kilometres – i.e. the distance travelled multiplied by the number of passengers – also increased by 4.2 percent on average worldwide. This means that growth, which was still 6.5 percent in the previous year, slowed down noticeably.

German airports also recorded more passengers than ever. Around 250 million passengers took off and landed in Germany in 2019. This is 1.5 percent more than in the previous year although the number of controlled flights in German airspace declined slightly compared with the previous year. According to the German Federal Statistical Office, the number of departing passengers thus rose for the tenth year in succession.

While international passengers increased, the number of domestic passengers fell to 23.1 million - 1.8 percent less than in 2018. The main domestic flight connections continued to be Berlin - Frankfurt, Berlin - Munich and Hamburg - Munich. Each of these connections had more than 1.5 million passengers in 2019. The last known destinations of the passengers were taken into account and domestic feeder flights within Germany for journeys whose actual destination is abroad were not considered.

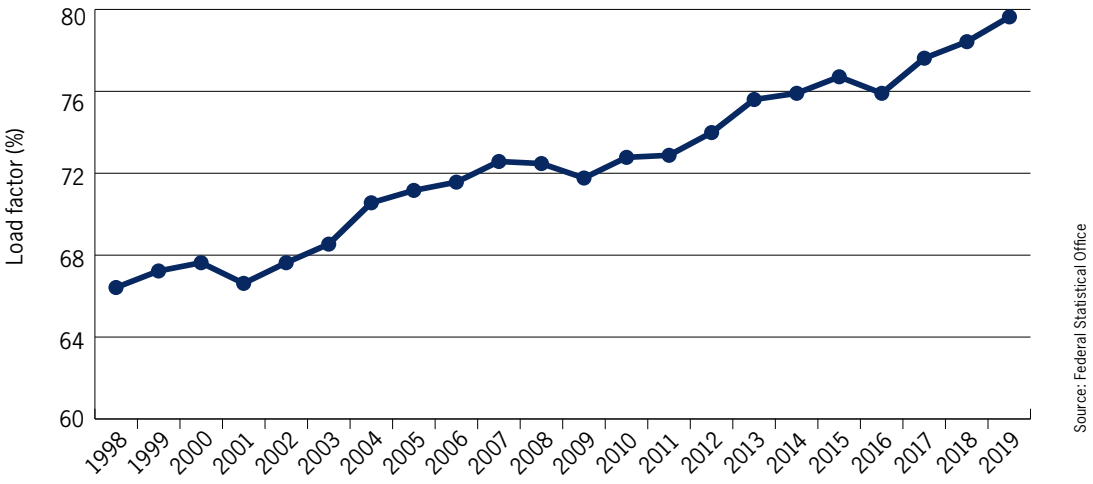
The difficult economic situation of many airlines led to a new record in seat occupancy. According to the German Federal Statistical Office, the occupancy of aircraft taking off and landing in Germany rose to 79.6 percent. At 80.8 percent, the load factor for international destinations was significantly higher than for domestic flights (68.8 percent). Most seats were occupied on flights to the Spanish island of Fuerteventura (92.5 percent), the Egyptian seaside resort of Hurghada (91.8 percent), Las Palmas on Gran Canaria and Kyiv Zhuliany in Ukraine (91.7 percent each).

The busiest airport in Europe remains Frankfurt Airport. On average, there were about 1,400 take-offs and landings per day. However,

Almost 80 PERCENT
of aircraft seats were occupied – a new record.

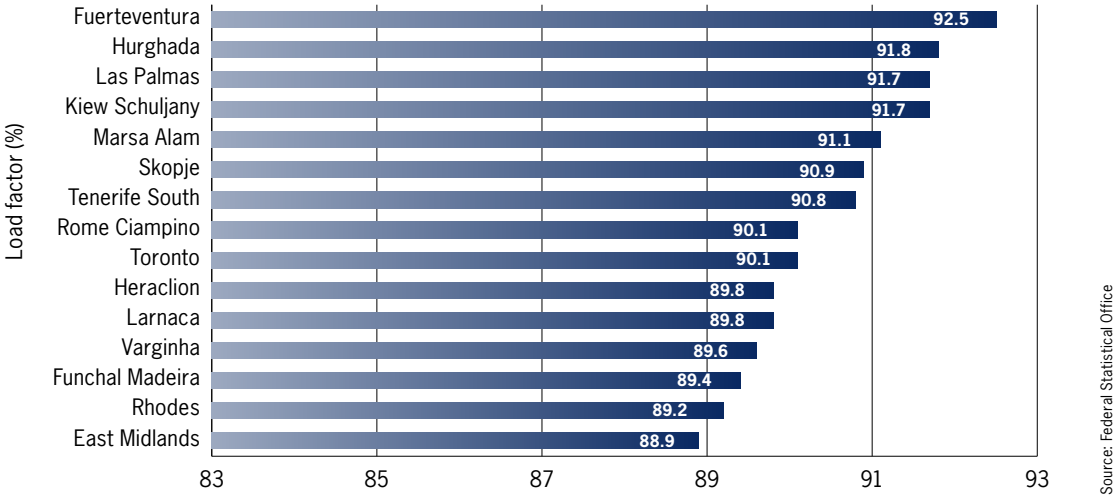
there are several European cities with more than one airport near the city. Most air traffic takes place in the Greater London area. At the five airports around the capital of the United Kingdom, around 3,250 aircraft took off and landed every day. There were fewer movements in the metropolis of Paris and its three airports, with around 2,140 take-offs and landings. The three airports in Istanbul, which together had good 1,880 movements a day, came in third.

Load factor



The extent to which seats are filled on the aircraft departing from and arriving at German airports has continued to increase. In 2019, just under 80 percent of all seats were occupied. This figure applies to the total number of flights. At 70.6 percent, domestic flights had a significantly lower load factor.

Destinations with the best load factor



In the ranking of destinations with the highest load factor, Fuerteventura superseded Hurghada at the top position. Overall, the load factor for 2019 increased significantly. The load factor for international flights was 80.5 percent. These figures reflect flight destinations with over 1,000 flights per year.

Worst year for air cargo since the financial crisis

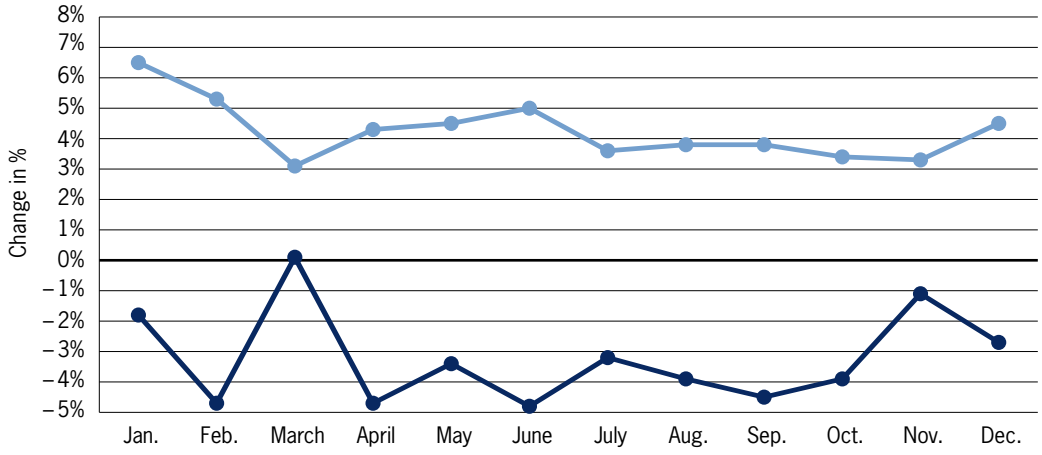
Worldwide air cargo declined. Weak economic activity and trade disputes resulted in declining volumes. The only winner was Africa.

3.3
PERCENT:
the decline in freight tonne-kilometres in 2019

Weak economic growth, which had already been seen in 2018, continued in 2019. Above all, the trade tensions triggered by resurgent protectionism and their effects on exports and industrial production slowed the global economy considerably. As a result, the volume of cargo transported worldwide fell for the first time since 2012: In 2019, according to IATA, it was 3.3 percent below the previous year's figure. This made it the worst year for air cargo since the global financial crisis, which began in 2008.

Cargo volumes fell most sharply in the Asia-Pacific region.Cargo volumes fell most sharply in the Asia-Pacific region. The trade dispute between China and the United States and the poor economic situation led to a 5.7 percent decline. In North America, the third-largest air cargo market, growth shrank by 1.5 percent. In Europe, cargo volumes fell by 1.8 percent. The only exception was Africa: Strong capacity increases and investments from Asia led to a plus of 7.4 percent. According to the German Federal Statistical Office, 4.9 million tonnes of cargo and mail were handled at airports in Germany. This was 3.3 percent less than in the previous year.

Freight and passenger traffic



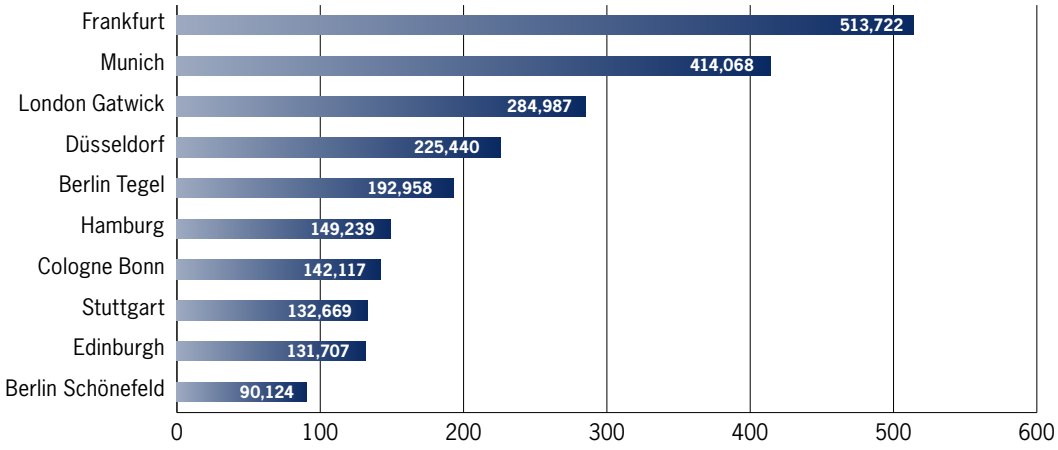
Source: IATA

Change in %	Passenger kilometres	Freight tonne kilometres
Africa	4.9	7.4
Asia Pacific	4.8	–5.7
Europe	4.2	–1.8
Latin America	4.2	–0.4
Middle East	2.4	–4.8
North America	4.1	–1.5
Total	**4.2**	**–3.3**

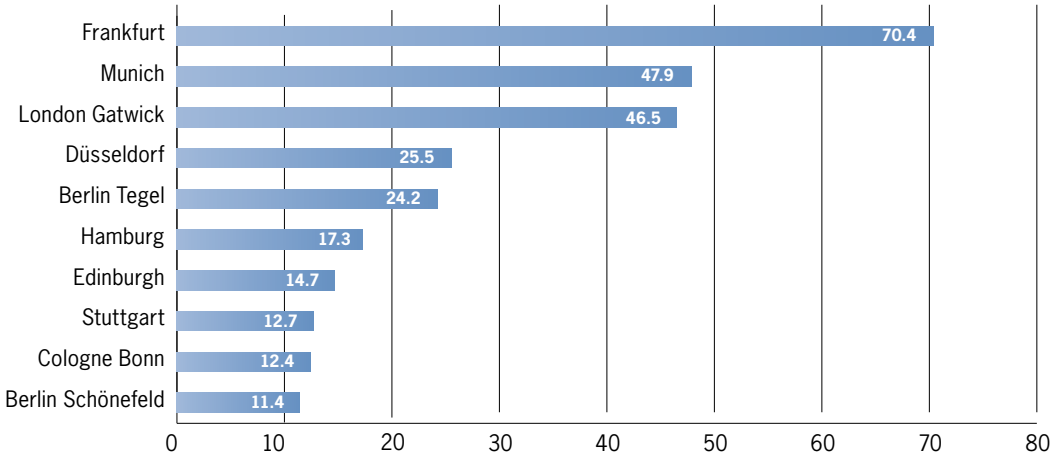
Global economic weakness was clearly reflected in the development of air cargo. The number of freight tonne-kilometres in 2019 decreased by 3.3 percent over the prior year. An increase of 4.2 percent was recorded in passenger-kilometres. However, the growth in passenger traffic has slowed considerably.

The DFS Group and the largest airports where it operates

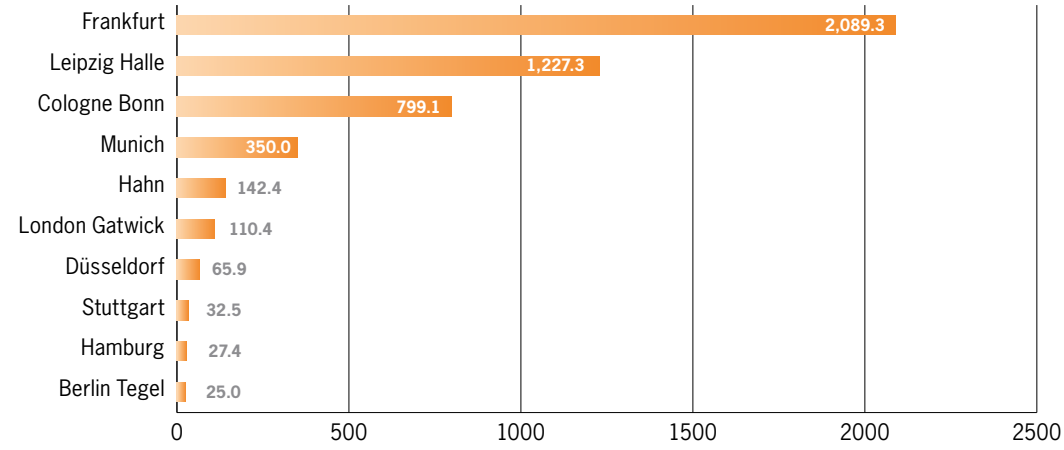
Top 10 for number of flights (IFR arrivals and departures)



Top 10 for number of passengers (millions)

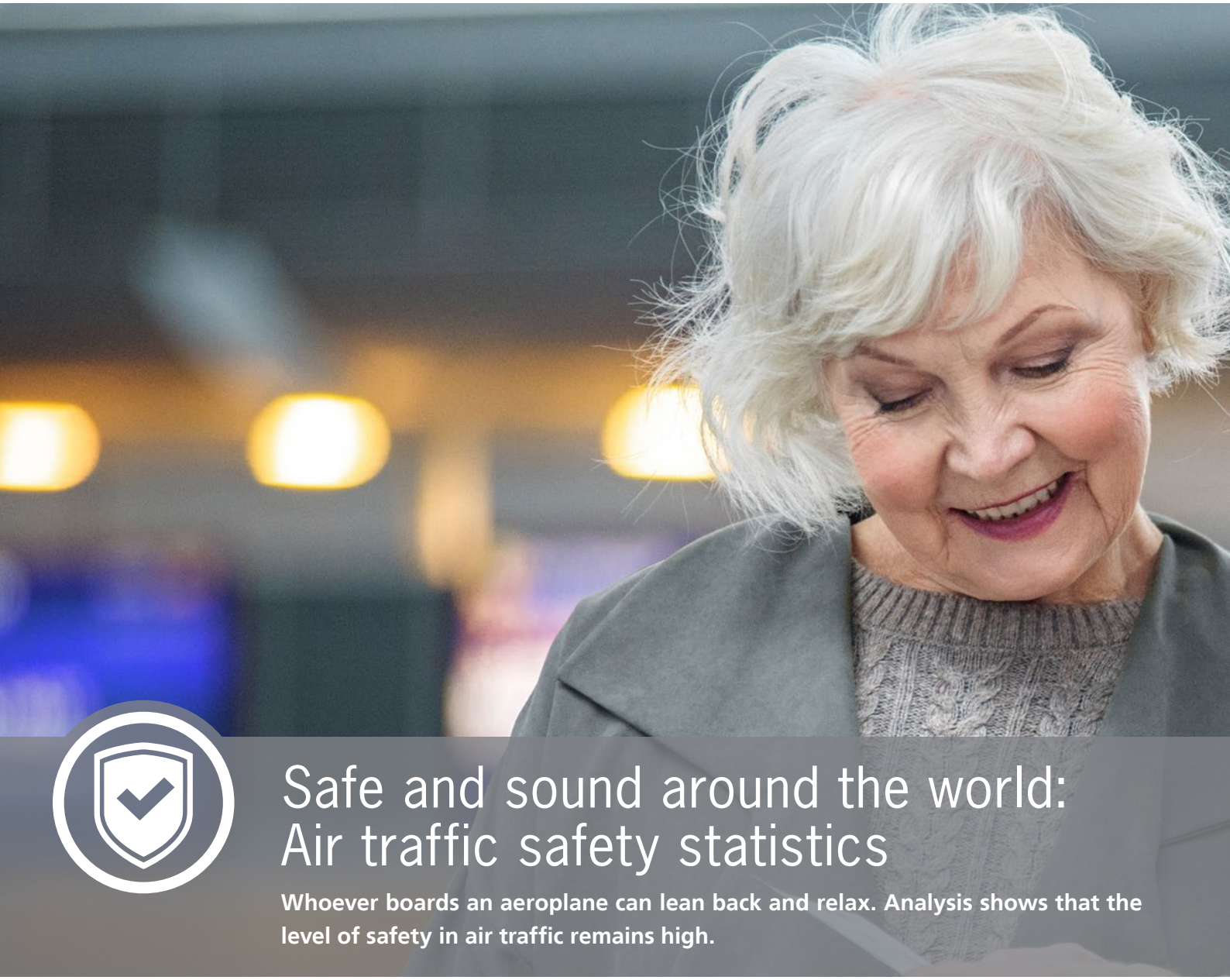


Top 10 for freight volume (thousands of tonnes)



Source: DFS, Federal Statistical Office

The DFS Group controls more than two million take-offs and landings, brings more than 280 million passengers and around five million tonnes of freight safely to their destinations. Together with its German and UK subsidiaries, DFS performed strongly in 2019 at a total of 25 German airports as well as at London Gatwick and Edinburgh.



Safe and sound around the world: Air traffic safety statistics

Whoever boards an aeroplane can lean back and relax. Analysis shows that the level of safety in air traffic remains high.

Despite the worldwide increase in traffic volume – in 2019 around 4.5 billion passengers were carried worldwide – flying remains an especially safe way of travelling. This is shown by the current figures of the International Civil Aviation Organisation (ICAO). According to these figures, a total of 247 people were killed in 2019 in accidents involving commercial aircraft, about half as many as in the previous year. These statistics are based on all commercial flights with a take-off weight of more than 5.7 tonnes. The majority of the victims were in the crash of a Boeing 737 MAX in Ethiopia in March 2019. Due to a similar incident in October of the previous year, this aircraft type has since been taken out of service worldwide.

Although aircraft accidents with high casualty figures receive a lot of media attention, the actual risk to the individual passenger is extremely low. This is also shown by a comparison with other means of transport. According to the German Federal Statistical Office, in 2019 around 3,000 people were killed in road traffic in Germany alone – twelve times as many as in global air traffic.

According to IATA, there were 0.91 accidents per million flights by jet and turboprop aircraft worldwide. An accident is considered to have occurred if the aircraft has been damaged to such an extent that repair is no longer worthwhile. This is considerably better than the average figure for the past five years, which was 1.58 accidents per million flights. Statistically speaking, a single passenger would have to make almost 1.1 million flights to be affected by an aircraft accident. At the same time, incidents involving jet aircraft, which account for the majority of commercial air transport, occur even significantly less frequently than those involving turboprop aircraft.

However, the probability of being involved in such an accident varies from region to region in the world. In a long-term comparison, the risk of a serious aircraft accident is highest in Africa.

4.5
BILLION
passengers reached their destinations safely in 2019.

Busy but orderly: Safety in German airspace

Despite high traffic density, the safety level in German airspace remains high. This is due not only to air traffic control, but also to the airlines and airports.

153

INFRINGEMENTS OF SEPARATION

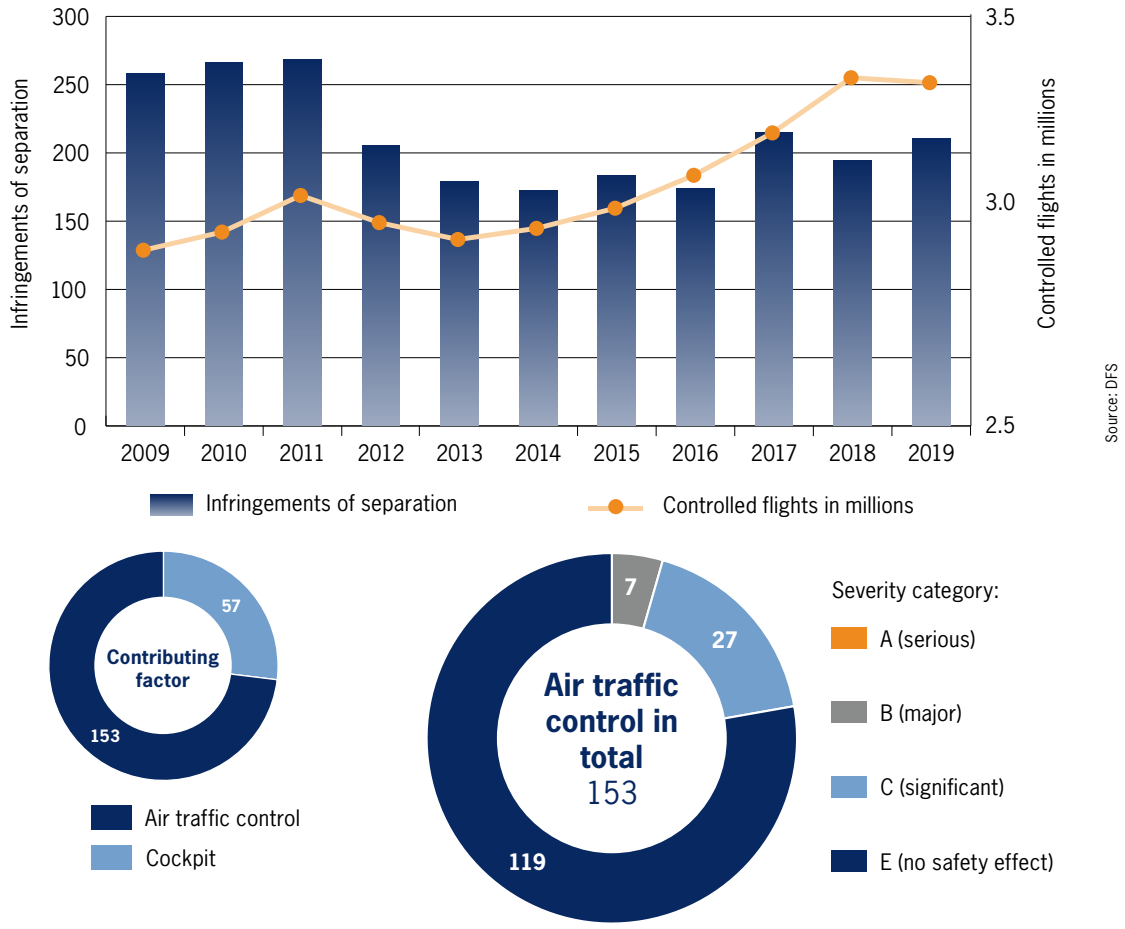
with DFS involvement were registered in German airspace in 2019.

DFS has one special core task to perform to guarantee the safety of air traffic. It ensures that aircraft on the ground and in the air are always a sufficient distance apart. Due to the high speeds that are reached in flight, these distances are deliberately large: In the air, the vertical distance is at least 1,000 feet (300 m) and the horizontal distance is three to eight nautical miles (5.6 to 14.8 km). Despite the high traffic density – every third flight in Europe passes through German airspace – and the great complexity, flying in Germany remains safe.

DFS makes sure that the specified minimum distances are strictly adhered to. Any deviation is registered as an infringement of separation and is thoroughly investigated. DFS Safety Management analyses and evaluates the incident – and assigns it to one of four categories according to its severity. They act as a type of early warning system for DFS. Potential risks become visible by thoroughly investigating the individual deviations. This enables DFS to take countermeasures before any negative impact on air safety is felt.

Since 2015, DFS has used a new method to evaluate infringements of separation. It is called the risk analysis tool (RAT) and was developed to be used uniformly across Europe. This tool was

Infringements of separation



An infringement of separation occurs when the distance between two aircraft is less than prescribed. In 2019, 210 infringements of separation were documented in German airspace – DFS was involved in 153 of these. According to the preliminary figures (as of 31 March), the majority of these were not safety-related.

introduced to harmonise safety classifications so that the safety levels of countries across Europe could be more accurately compared with each other. The RAT system differentiates between the categories: serious, major, significant and no safety effect.

In 2019, 210 infringements of separation were recorded in German airspace for 3.3 million aircraft movements, slightly more than in the previous year (2018: 195). DFS was a contributing factor in 153 of these (2018: 152). However, only a small percentage of these had an appreciable effect on safety. Of the 153 cases, 119 were not safety-related at all. Twenty-seven cases were classified as “significant” and seven as “major”. As in the previous year, not a single incident was classified in the highest severity category “serious”.

Busy but orderly: Safety on the ground

2 out of 3 RUNWAY INCURSIONS involved the cockpit crew.

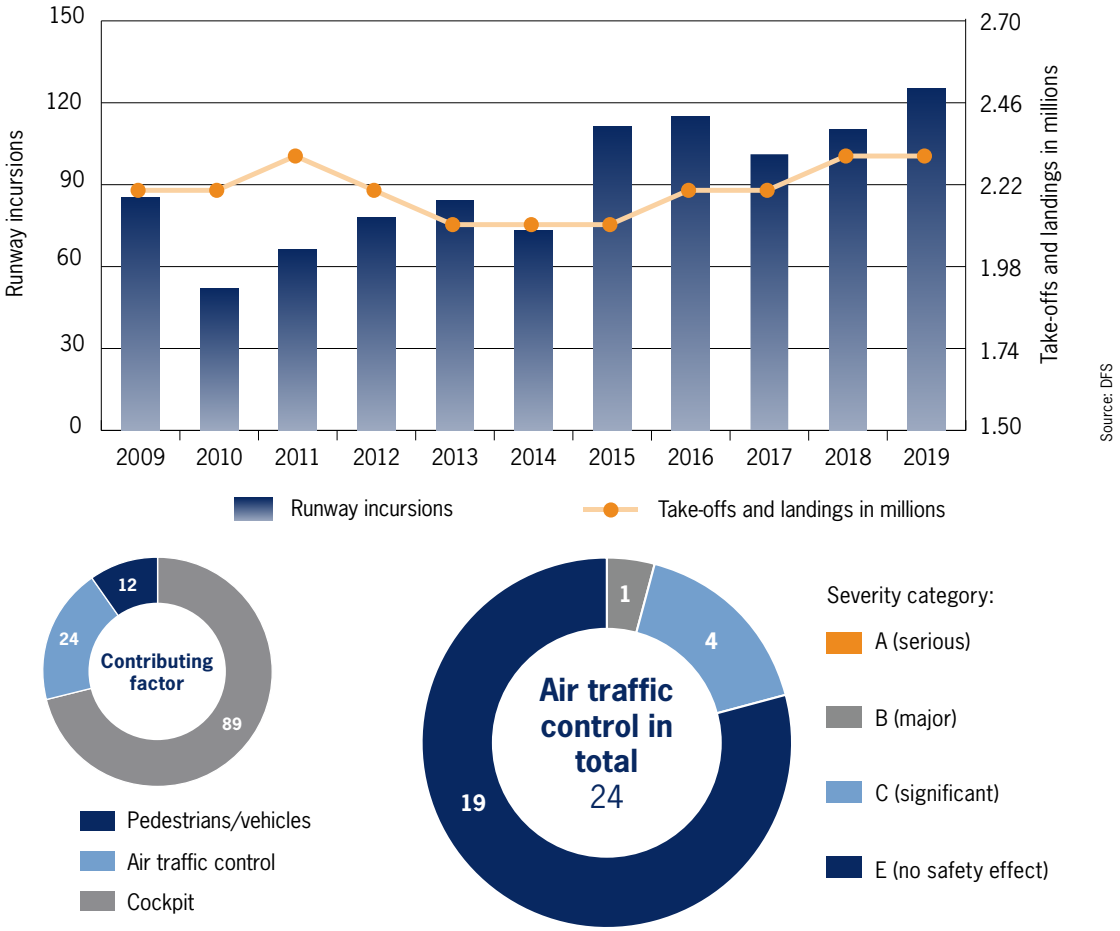
DFS not only ensures safety in the skies above Germany. At the 16 designated international airports in Germany, DFS air traffic controllers also monitor all aircraft under their control while taxiing, taking off and landing.

Whether in the air or on the ground, aircraft must always have sufficient distance from each other. For this purpose, tower controllers monitor compliance with minimum distances that apply on the ground. Similar to infringements of separation in the air, they make sure these distances are maintained at all times. Whenever an aircraft takes off or lands, a protected area is activated in which no other aircraft, vehicle or person is allowed to enter. If this does happen, this is called a runway incursion.

Runway incursions are recorded and investigated by DFS in the same way as

infringements of separation, regardless of the actual risk of danger. The new RAT system is also used for this purpose across Europe. In 2019, 125 runway incursions were recorded out of more than two million take-offs and landings at Germany's designated international airports (2018: 110). In 89 cases, the cockpit crew contributed to the incursion, while a further 12 cases were attributable to pedestrians or vehicles. In only 24 cases was air traffic control the contributing factor, 19 of which were not safety-related. Four cases were classified as "significant" and one as "major". As in previous years, not a single case fell into the highest category, "serious".

Runway incursions



On the ground, too, minimum distances need to be maintained: In the protected area of a surface designated for the take-off and landing of aircraft, the presence of other aircraft, vehicles or people is not allowed. If it does happen, this is called a runway incursion. Every runway incursion is recorded and analysed.

According to preliminary figures (as of 31 March), of the 125 runway incursions that occurred at German airports in 2019 only 24 involved DFS. The evaluation using the Risk Analysis Tool shows that none of them was classified in the highest severity category.

Unknown flying objects

Drones are small, fast and agile. With them, anyone can make their dream of flying come true. In the vicinity of airports, however, they pose an immediate threat to aviation.

The number of drones in Germany is increasing, their estimated number is more than one million. They could become indispensable aids for rescue services or inspections conducted from the air, for example flying along pipelines or high-voltage power lines. However, there are still significantly more private than commercial users. And with the rise in the number of private drone pilots, the risk increases that they – unconsciously or in individual cases even intentionally – will interfere with civil air traffic with their unmanned flying objects.

If a pilot feels threatened by a drone or if tower controllers detect a drone in the danger zone, this is referred to as interference. There were 125 reported incidents caused by drones in 2019, which means that the number has almost doubled compared with 2016. Frankfurt, Germany's largest airport, also had the most incidents at 28. Five incidents were reported each at Berlin's city-centre Tegel Airport and at Munich Airport. The annual overview shows that the months with the most aircraft movements are also the months with the most drone incidents.

There are already tools available for hobby pilots to help prevent such conflicts. These include the free DFS drone app. It informs hobby pilots where they can fly their drones and provides information about the applicable

rules and regulations for the use of drones in Germany. The app alerts pilots of small drones and toy drones to potential dangers and supports professional pilots with chart information. The app is free of charge and available for Android and Apple devices.

In order to integrate unmanned aircraft safely into airspace, DFS and Deutsche Telekom founded the joint venture Droniq. Droniq provides a technical platform to track drones, enabling drone flights beyond the visual line of sight of the pilot. This is done by means of the mobile communications network and a transponder that is attached to the drone. It transmits position information to a traffic management system, which processes the data and displays it together with the position data of manned aviation. In this way, a complete air situation display is created.

DFS also offers drone pilots a comprehensive range of information on its website, which has been compiled by DFS and the Federal Ministry of Transport and Digital Infrastructure.

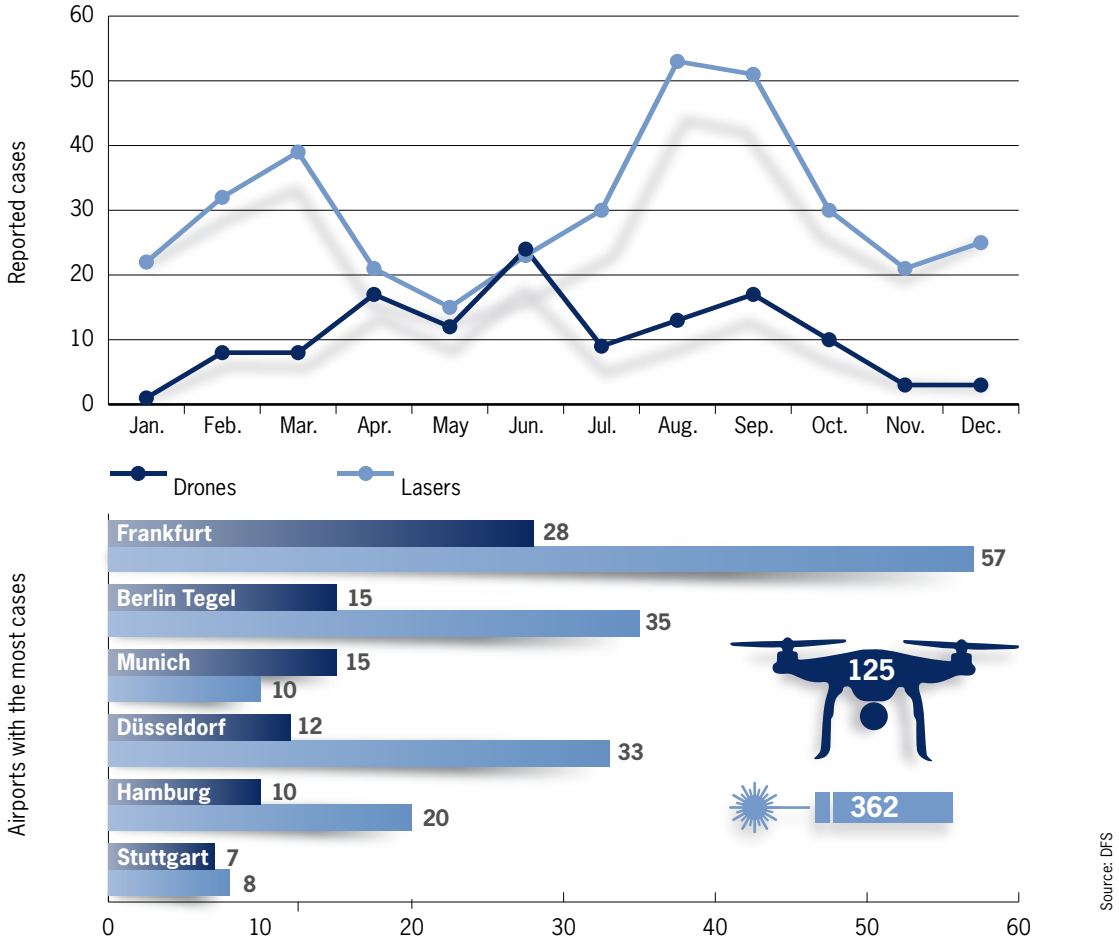
www.safe-droneflight.de

362

CASES OF LASER GLARE

were reported to DFS controllers in 2019. This is three times the number of incidents caused by drones.

Disruptions caused by drones and laser glare



The intensified public relations work pays off: The number of disruptions caused by drones in air traffic decreased in 2019. DFS recorded 125 cases – a fifth less than in the previous year. During the same period, pilots reported 362 cases of laser glare to towers and control centres, most of them in the vicinity of an airport. Every case of interference, whether caused by a drone or by laser glare, is reported to the police.

A fight for seconds: Delays in air traffic

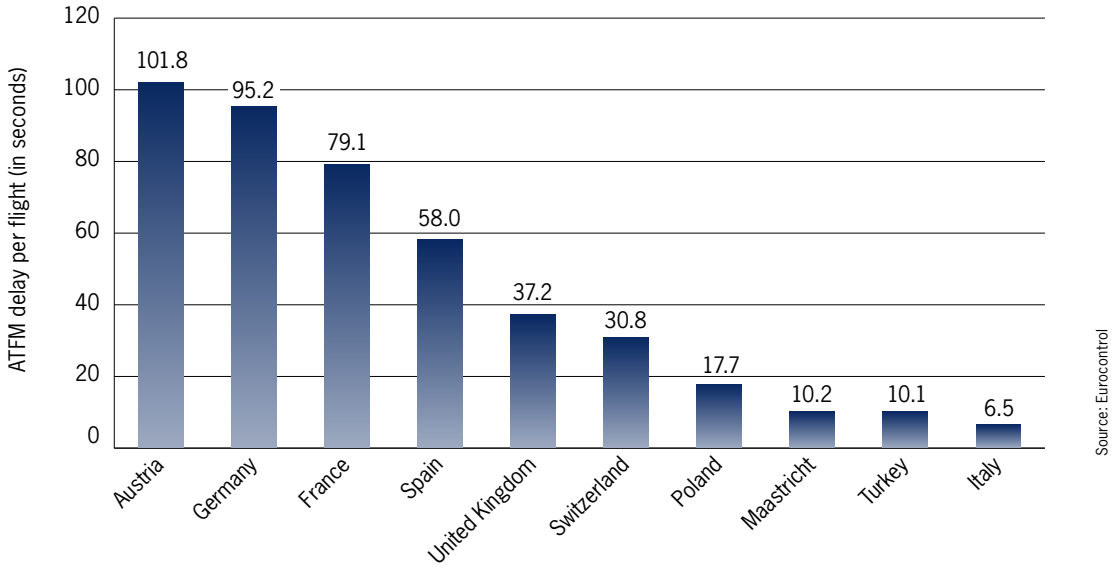
Delays in air traffic have decreased significantly. This is due to a host of measures that airlines, airport operators and air navigation service providers have taken together – including across borders.

Airlines, airport operators and air navigation service providers in Europe achieved a turnaround in 2019. Compared with the previous year, when the strong growth in traffic led to bottlenecks both in the air and on the ground, flying has become much more punctual again. In 2019, every aircraft had an average delay of 13.1 minutes at departure, one and a half minutes less than in the previous year. At landing, the delay was reduced to an average of 12.2 minutes. This was achieved despite the fact that traffic figures in Europe continued to rise and the traffic volume in Germany was only slightly below that of the record year 2018.

This is due to numerous measures that airlines, airports and air navigation service providers have jointly implemented – from the provision of reserve aircraft and crews to the expansion of areas for security checks, to extra shifts for air traffic controllers and a more even distribution of traffic. In a joint initiative, Europe's air navigation service providers, under the leadership of Eurocontrol, have moved traffic from particularly congested sectors to less frequented ones, i.e. they shifted individual flights from upper to lower airspace or diverted them horizontally – thus ensuring greater punctuality.

In air traffic, there can be many different causes of delays, which can disrupt the closely timed processes between airlines, airports and air traffic control. Technical defects, delays in handling or adverse weather conditions are just a few examples. Nevertheless, compared with other means of transport, aircraft are surprisingly punctual. In 2019, only every fifth aircraft in Europe arrived at its destination more than 15 minutes late. More than half of all aircraft reached their destination on time or even early.

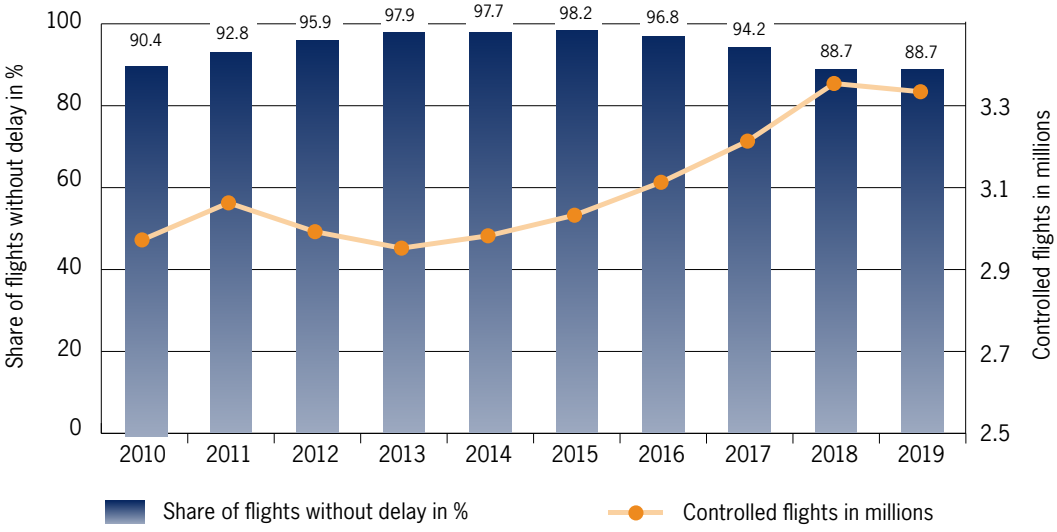
Punctuality in comparison



Source: Eurocontrol

The average delay time caused by air traffic flow management (ATFM) measures was approximately 95 seconds per flight in German airspace. Only about 71 seconds of the delay in 2019 were caused by air traffic control. The figure shows the punctuality in Europe's ten countries and control centres with the highest traffic volumes.

Traffic and punctuality



Source: DFS

With a stagnating traffic volume, the proportion of flights in German airspace without delays also remained the same. In 2019, 11.3 percent of flights were affected by air traffic flow management measures, due to bad weather, capacity bottlenecks or a high traffic volume, for example.

44

PERCENT

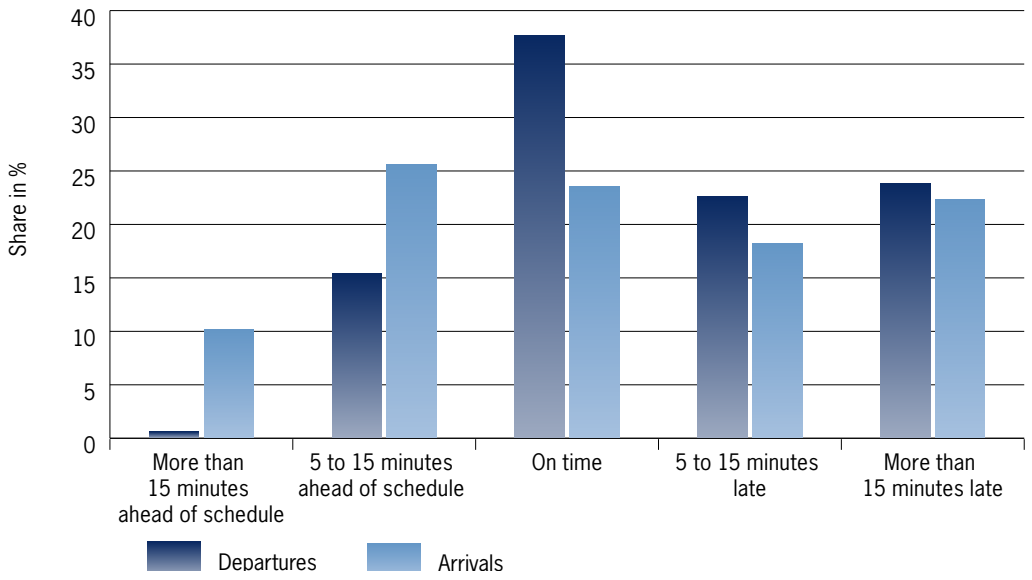
of all delays in Europe are caused by airlines.

The main reason for departure delays are the airlines – they account for around 44 percent of all delays in European air traffic. This is the result of the analyses presented by Eurocontrol's Central Office for Delay Analysis (CODA) every month. The analyses are based on reports from pilots, who assign each delay to one or more causes. Europe's air navigation service providers were responsible for about 21 percent of all delays, closely followed by airports with about 17 percent. In total, primary delays accounted for 7.4 minutes per flight. Delay experts distinguish these from reactionary, or knock-on, delays, which were 5.7 minutes per flight.

Punctuality improved at almost all European airports in 2019. The 16 international German airports were able to improve their punctuality by an average of 3.1 minutes per departure. Above all, Cologne Bonn, Leipzig and Münster improved significantly. Delay due to security measures plays a particularly important role at those airports where the proportion of flights to the United States or other intercontinental destinations is particularly high. Airports that mainly serve traffic within the European continent have an advantage here.

The proportion of flights within Germany affected by air traffic flow management measures remained the same as in the previous year. Only 11.3 percent of flights in German airspace were affected by capacity bottlenecks.

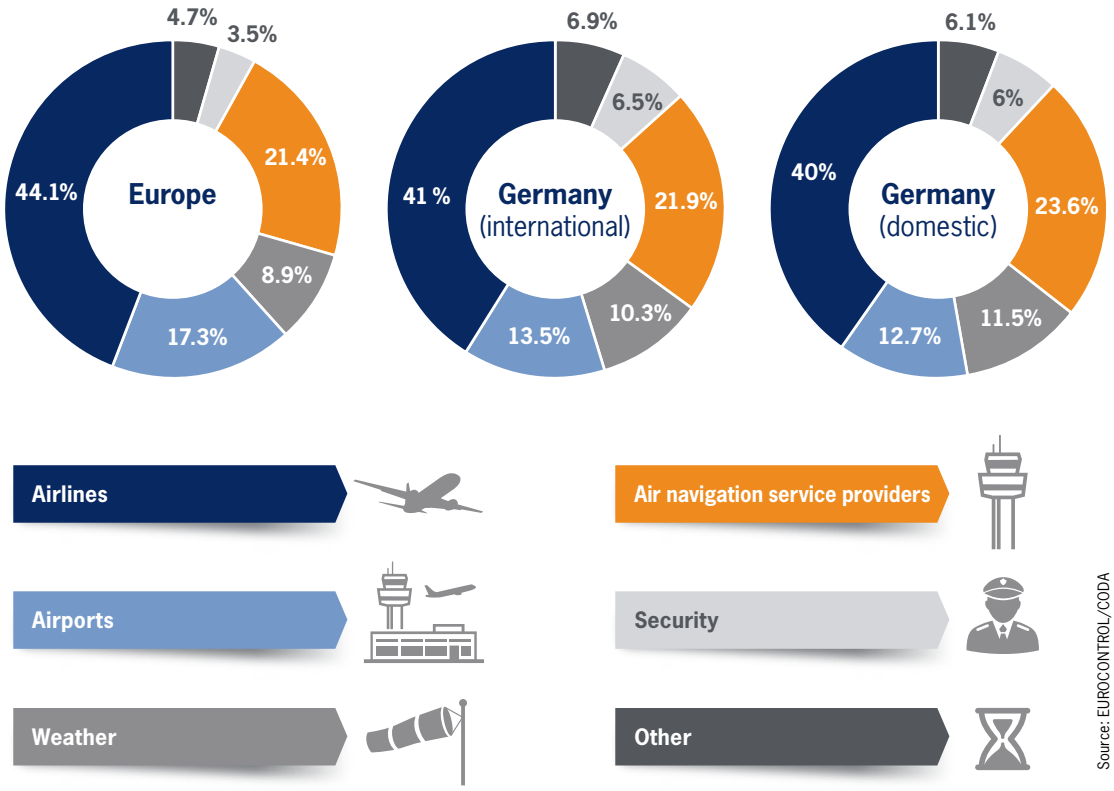
Traffic and punctuality



Source: EUROCONTROL/CODA

Delays in air traffic decreased in 2019. Half of all flights were on time. Three out of ten aircraft reached their destination more than 5 minutes early. On the other hand, every second aircraft took off more than 15 minutes late, due to ground handling delays or bad weather, for example.

Causes of delays – departures



Source: EUROCONTROL/CODA

Paris Charles-de-Gaulle	
Airlines	62%
Airports	12.2%
Weather	2.5%
Air navigation service providers	13.8%
Security	8.2%
Other	1.4%

Madrid Barajas	
Airlines	49.3%
Airports	22.9%
Weather	4.7%
Air navigation service providers	16.3%
Security	3.9%
Other	2.9%

London Heathrow	
Airlines	67.2%
Airports	18.7%
Weather	4.6%
Air navigation service providers	5.6%
Security	3%
Other	0.9%

Amsterdam	
Airlines	42.8%
Airports	33.9%
Weather	3.3%
Air navigation service providers	15.7%
Security	1.6%
Other	2.7%

Frankfurt	
Airlines	38.8%
Airports	21.2%
Weather	6.4%
Air navigation service providers	15.5%
Security	9.5%
Other	8.5%

Munich	
Airlines	49%
Airports	8.8%
Weather	12.1%
Air navigation service providers	15.1%
Security	8.9%
Other	6.1%

Saving fuel, reducing noise: Air traffic and environmental protection

Ideal flight routes save fuel, cause less harm to the environment and reduce noise for local residents. However, in an airspace as busy as Germany's, it is not always an easy task to find the optimum compromise.

DFS air traffic controllers guide aircraft to their destinations safely and punctually. They select the most direct route feasible to be as environmentally friendly as possible. This is a challenge in the busy German airspace. With more than 3.3 million aircraft movements per year and up to 11,000 flights per day, it is simply impossible for every flight to reach its destination without deviating slightly from the shortest route. In addition, environmentally friendly routes are not automatically low-noise routes. Especially in the vicinity of an airport, it is often necessary to deviate from the shortest route in order to protect residents from aircraft noise as much as possible.

It is the task of DFS to always find the optimum compromise – i.e. safe routes which can handle the required traffic volume and which are both environmentally friendly and low in noise. Evaluations show that DFS comes very close to this optimum. The average route flown by aircraft in German airspace in 2019 was just 1.16 percent longer than the most direct route. This corresponds to a deviation of only 3.8 kilometres per flight. In comparison, Frankfurt Airport's western runway is four kilometres long.

A further environmental protection measure is vertically optimised approach profiles. In a joint effort with European partners and airlines, more than 30 arrival procedures have been improved at the airports of Basel, Berlin Tegel, Frankfurt, Geneva, Munich, Stuttgart, Strasbourg, Vienna and Zurich. This means that the descent profiles have been designed for each aircraft type, allowing these aircraft to approach the airport with the lowest possible engine setting. In addition, the continuous descent operations (CDO) approach procedure introduced at all major airports has reduced noise levels. In contrast to conventional approach procedures,

which contain phases in which the aircraft levels off, an aircraft using CDO glides at the same rate of descent until it lands. This lowers the noise level and saves fuel. Continuous descent can only be used if specific conditions are met, however. The traffic volume has to be low, for instance.

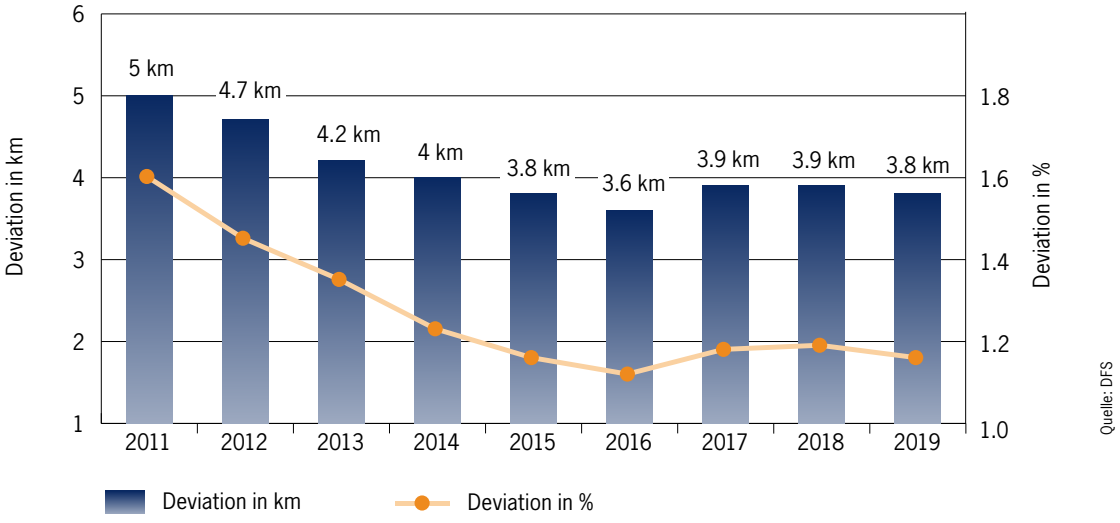
Another measure to protect the environment is the use of the Arrival Manager. This system improves approach separation: As early as 350 nautical miles before the destination airport, the speed of the aircraft is adjusted to match the required approach sequence. As a result, aircraft no longer have to fly detours to achieve the separation necessary for the approach. Depending on the airport, this can save up to one minute. The new procedure not only reduces fuel consumption, it also helps to keep the number of people affected by noise under an approach route to a minimum.

DFS also pays attention to noise reduction when planning flight procedures. It is currently working on the introduction of performance-based navigation (PBN) at all 16 international airports. Conventional navigation methods have so far been based on the use of terrestrial radio beacons, some of which have to be flown over directly, which leads to restrictions in flight procedure planning. Area navigation procedures, on the other hand, use GPS signals and, as a part of PBN, allow greater freedom in the design of flight paths. They can be designed more individually, which not only offers shorter routes, but also boosts airspace capacity and reduces noise.

DFS also supports the climate protection portal of the German Aviation Association (BDL), in which DFS is represented with various projects. This portal also explains the programme of the UN aviation organisation ICAO known as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). Its aim is to achieve carbon-neutral growth in air traffic. Emissions are to be offset by financing climate protection projects. More than 70 countries, including Germany, have committed themselves to participating in CORSIA.

3.8
KILOMETRES
is the average deviation from the direct route per flight.

En-route flight efficiency



In order to minimise the impact on the environment and to get passengers to their destination as quickly as possible, air traffic controllers guide the aircraft as directly as possible to their destination. In 2019, the allocated flight routes deviated by 3.8 kilometres from the shortest connection – with an average route length of 331 kilometres, this corresponds to a deviation of less than 1.2 percent.

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