KPI

Annual Report 2021

ACDM GERMANY

/Flughafen München

DFS Deutsche Flugsicherung

Frankfurt Airport

BER FLUGHAFEN BERLIN BRANDENBURG

Düsseldorf Airport DUS

STUTTGART AIRPORT

Hamburg Airport

LEIPZIG·HALLE AIRPORT
MITTELDEUTSCHE AIRPORT HOLDING

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Content

1 Management Summary

Einleitung

Introduction

This report covers a set of general Key Performance Indicators (KPIs) that were deemed by the Editorial Board to be comparable among the A-CDM airports Munich, Frankfurt, Düsseldorf, Berlin, Stuttgart, and Hamburg.

The KPIs contained within this report serve to continuously monitor the A-CDM process and usually portray only individual parts of the overall process.

The KPIs allow a measurement of A-CDM effects and steering of the process. They are the basis for local reporting at the individual airports. The KPIs were defined using input from EUROCONTROL's A-CDM Implementation Manual, experiences of the local German Airport CDM airports, as well as local and future necessities.

The report is intended to provide a general overview of KPI trends at the A-CDM airports, as well as serve as basis for decisions regarding adjustments to or steering of the A-CDM process.

This report describes the experiences, measurements and results of the calendar year 2021. It utilises regular evaluations and measurements on a monthly basis, the conclusions that are drawn address points that were mutually agreed by *ACDM Germany* which are reflected in the KPI Concept.

This year's issue of the Report contains four new KPIs: TTOT Quality, SOBT Quality, TSAT Stability and CTOT Quality.

Summary of Results and Tendencies

During the second year of the Covid-19 pandemic, less stringent travel restrictions from the middle of the year onwards enabled traffic numbers to reach 60-70% of 2019 volumes. This recovery effect was also noticeable in a significantly lesser drop in traffic towards the winter season 2021/2022 than during pre-pandemic years.

Initial predictions of a slow traffic recovery led to an overall reduction in ANSP capacity. As the actual recovery during the summer months of 2021 progressed faster and more strongly than anticipated, this resulted in a larger share of flights being regulated. This trend will continue in the years 2022.

The pronounced demand peaks caused increased operational focus on the efficient use of available resources. This led to a more disciplined procedure adherence compared to the same months of the previous year. However, the similarly reduced capacities of airlines and airport partners also became visible during peak periods by causing disturbances in ground handling processes and short-term shifts in demand. This tendency will also continue well into 2022.

2 German Harmonisation Initiative A-CDM Germany

2.1 European A-CDM Concept

Airport Collaborative Decision Making (A-CDM) is the operational approach (idea/concept/process) to achieving an optimal turnaround process at airports. A-CDM covers the period from EOBT -3 h until take-off. It is a continuous process beginning with processing of the ATC flight plan, via landing of the inbound flight, the turnaround process on the ground, to departure.

By exchanging estimated landing and take-off times between the A-CDM airports and Network Management Operations Centre (NMOC), airports can be further integrated into the European ATM Network EATMN.

A-CDM improves operational collaboration between the partners:

- Airport Operator,
- Aircraft Operators,
- Handling Agencies,
- Ground Handling Agencies,
- Air Navigation Service Provider, and
- European Air Traffic Flow Management (NMOC).

A-CDM in Germany is based upon the European A-CDM spirit, the Community Specification of A-CDM, as well as recommendations by the German Harmonisation Initiative *A-CDM Germany*.

A-CDM aims to optimise utilisation of available capacity and operational resources at airports and within European airspace through high-quality target times and efficiency increases in the individual steps of the turnaround process.

2.2 German Harmonisation Initiative for A-CDM

European A-CDM fundamentally relies on Community Specification EN 303212. However, development of A-CDM in Germany has shown a need of harmonisation to a level of detail that is beyond the Specification's scope.
The A-CDM partners recognised this need and founded the German Harmonisation Initiative *A-CDM Germany*. Collaboration within the Initiative is determined by a Letter of Intent that was signed by all partners.

Partners within *A-CDM Germany* are currently:

- Deutsche Flugsicherung (DFS)
- Munich Airport (FMG)
- Frankfurt Airport (Fraport)
- Berlin Airport (FBB)
- Düsseldorf Airport (FDG)
- Stuttgart Airport (FSG)
- Hamburg Airport (FHG)
- Leipzig/Halle Airport (FLHG)

Leipzig/Halle Airport has commenced an Airport CDM project and is therefore already a member of *A-CDM Germany*, however implementation has not been completed yet. Therefore, Leipzig/Halle is not shown in the following chapters.

A-CDM Germany's goals are, among others:

- Exchange of information and best practices between the various A-CDM airports,

- Common understanding of A-CDM in Germany and common representation towards international partners (Eurocontrol, EU, ICAO, IATA)
- Harmonisation in the interest of partners and customers ("one face to the customer")
- Best Practices developed within *A-CDM Germany* can be provided to other European A-CDM projects and working groups to advance harmonisation.

Creation and coordination of harmonised procedures and documentations are achieved within *A-CDM Germany's* working groups and regular harmonisation meetings.

3 Purpose of the Report

This document shows A-CDM KPIs that are generally comparable across A-CDM airports in Germany. KPIs fit for inclusion in this report were selected by a working group with participation of all A-CDM airports as well as DFS. The group also defined required data to be gathered and calculation rules.

This report is not intended to replace local KPIs, nor does it pre-empt local KPI reporting routines. It is designed as a baseline to which local KPI concepts and reports can add additional indicators or even measure the same KPIs using different criteria.

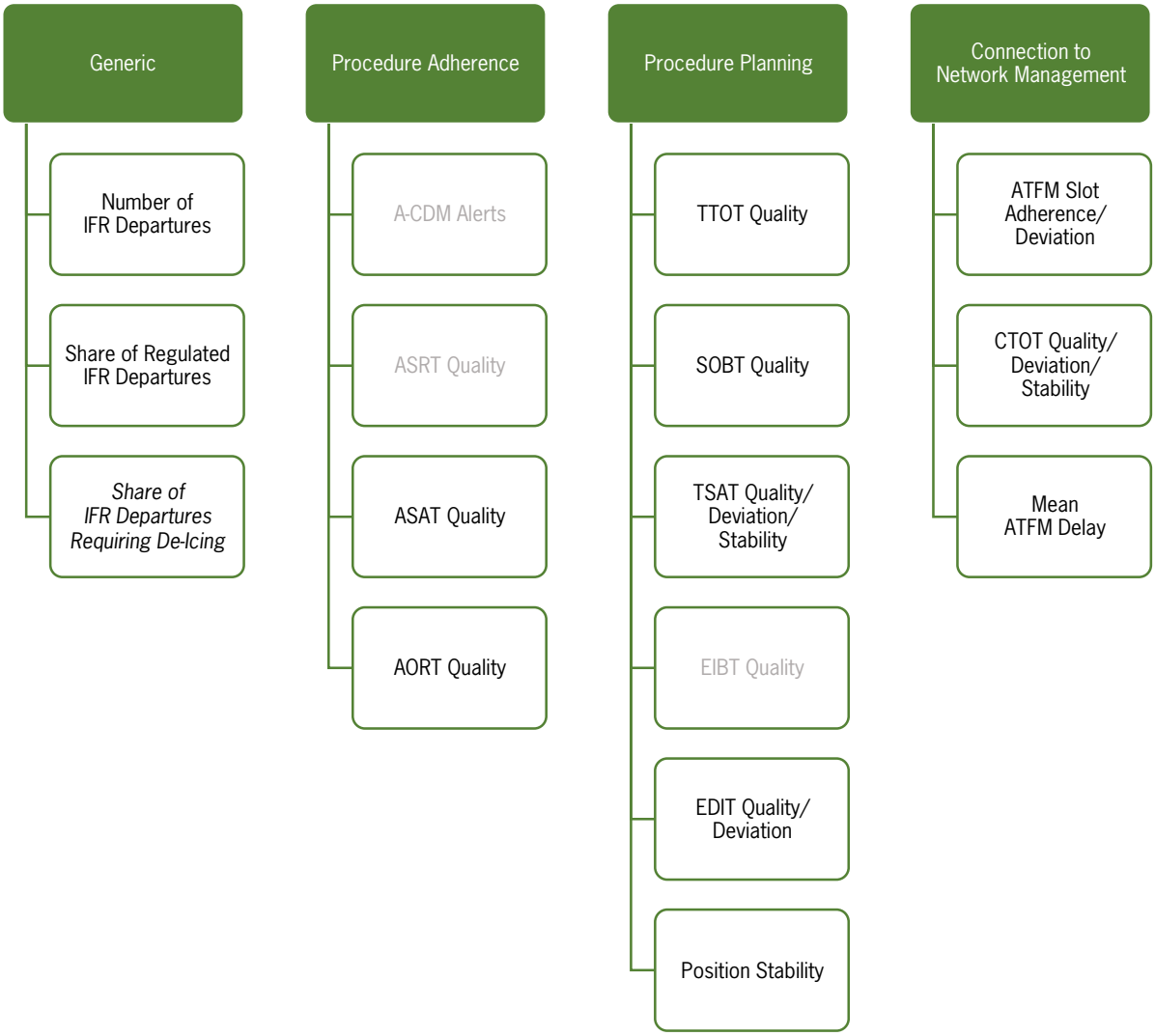
The common reporting that serves as basis for the KPIs contained within this report provide A-CDM airports with the opportunity of highlighting changes and developments, recognising potential for improvements, and developing harmonised A-CDM subprocesses.

Further details regarding the A-CDM process and its specifics at the individual airports are described within the local A-CDM procedure descriptions and publications.

4 Results

In order to achieve the local operational and network benefits associated with A-CDM, the quality of target times and process adherence are essential. For this reason, commonly available indicators from the following categories were selected:

- Generic Traffic Numbers
- Procedure Adherence of A-CDM Partners
- Procedure Planning
- Connection to Network Management



The KPIs coloured in light grey are not yet part of this report as the necessary historic data is not yet available at all German A-CDM airports. As soon as this changes, they will be included in a subsequent Annual KPI Report.

As of reporting year 2021, adjusted time slot tolerances were used. The end marker of the slot tolerance was extended by 59 seconds, so KPIs now match operational procedures.

Example: TSAT 10:00. Start-Up Approval may be issued between 09:55:00 and 10:05:59 (previously: 10:05:00).

4.1 Generic

4.1.1 Number of IFR Departures

Description
Number of IFR departures within the calendar year as well as the previous calendar year and 2019 reference values

Goal
Show the amount and trend of traffic

Charts

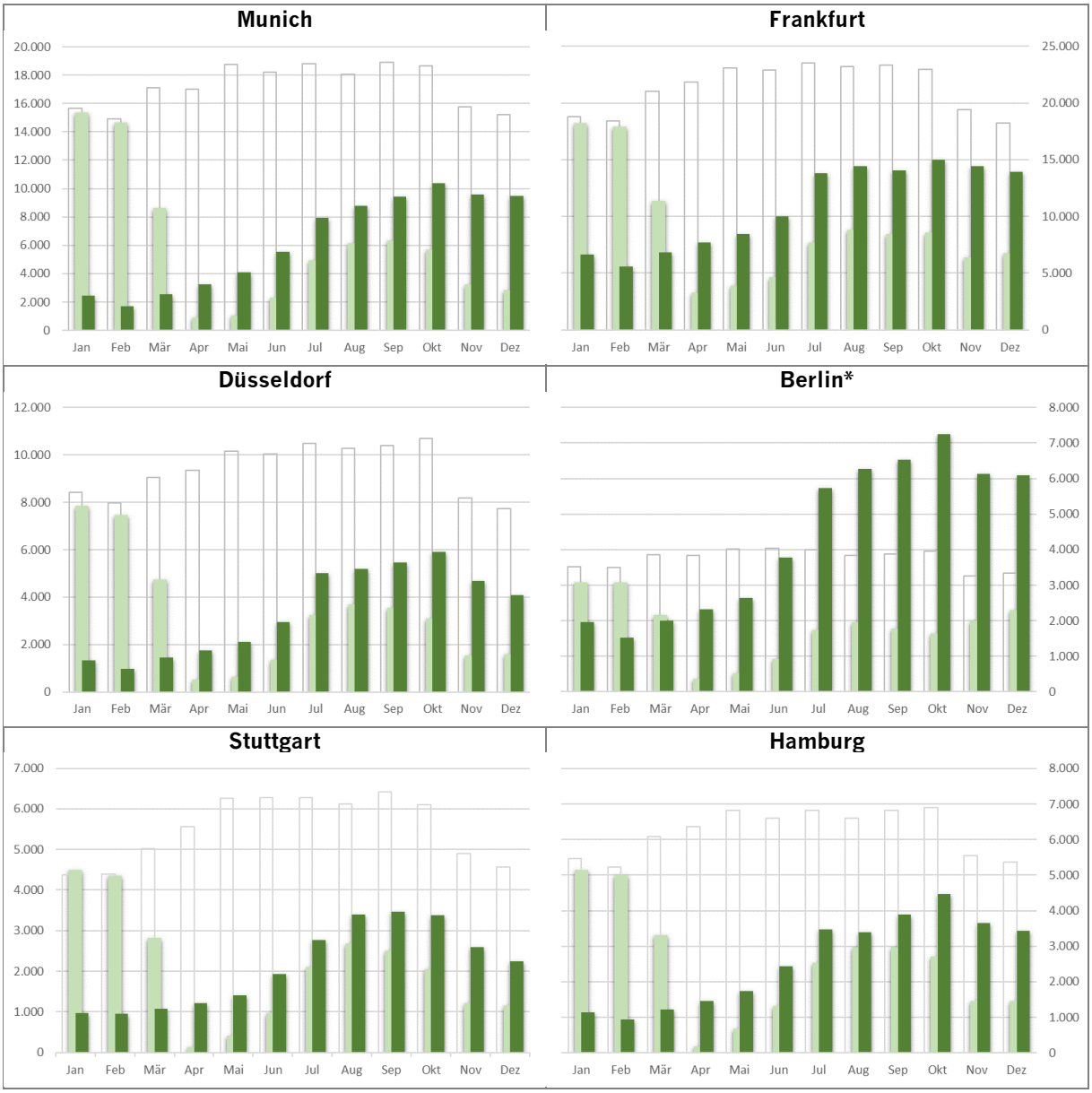


Fig. 1: Number of IFR departures 2021 (dark green), 2020 (light green) and 2019 (white)

** Berlin values up to and including October 2020 only refer to Berlin-Schönefeld, later to Berlin Brandenburg International.*

Conclusion

The global Covid-19 pandemic arrived in Europe in March 2020. Starting then, the resulting travel restrictions and economic uncertainty led to drastically lower traffic numbers. After Covid restrictions and travel limitations in the destination countries were eased, a significant increase in traffic levels was seen beginning in June 2021, mainly due to holiday travellers. Nevertheless, traffic numbers remained well below 2019's level.

The six German A-CDM airports' share of total IFR departures in the year 2020 was 66,2% and thereby returned roughly to its pre-pandemic level.

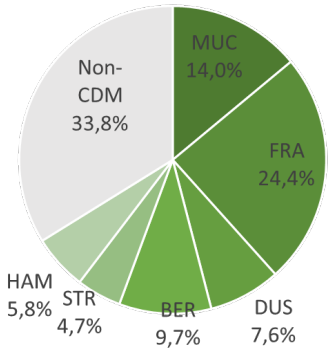


Fig. 2: Share of total departures originating from A-CDM airports in Germany 2021

4.1.2 Share of Regulated IFR Departures

Description
Share of IFR departures with ATFM slot (CTOT), in %

Goal
Illustrate the monthly share of IFR departures that were subject to an air traffic flow measure by NMOC.

Charts

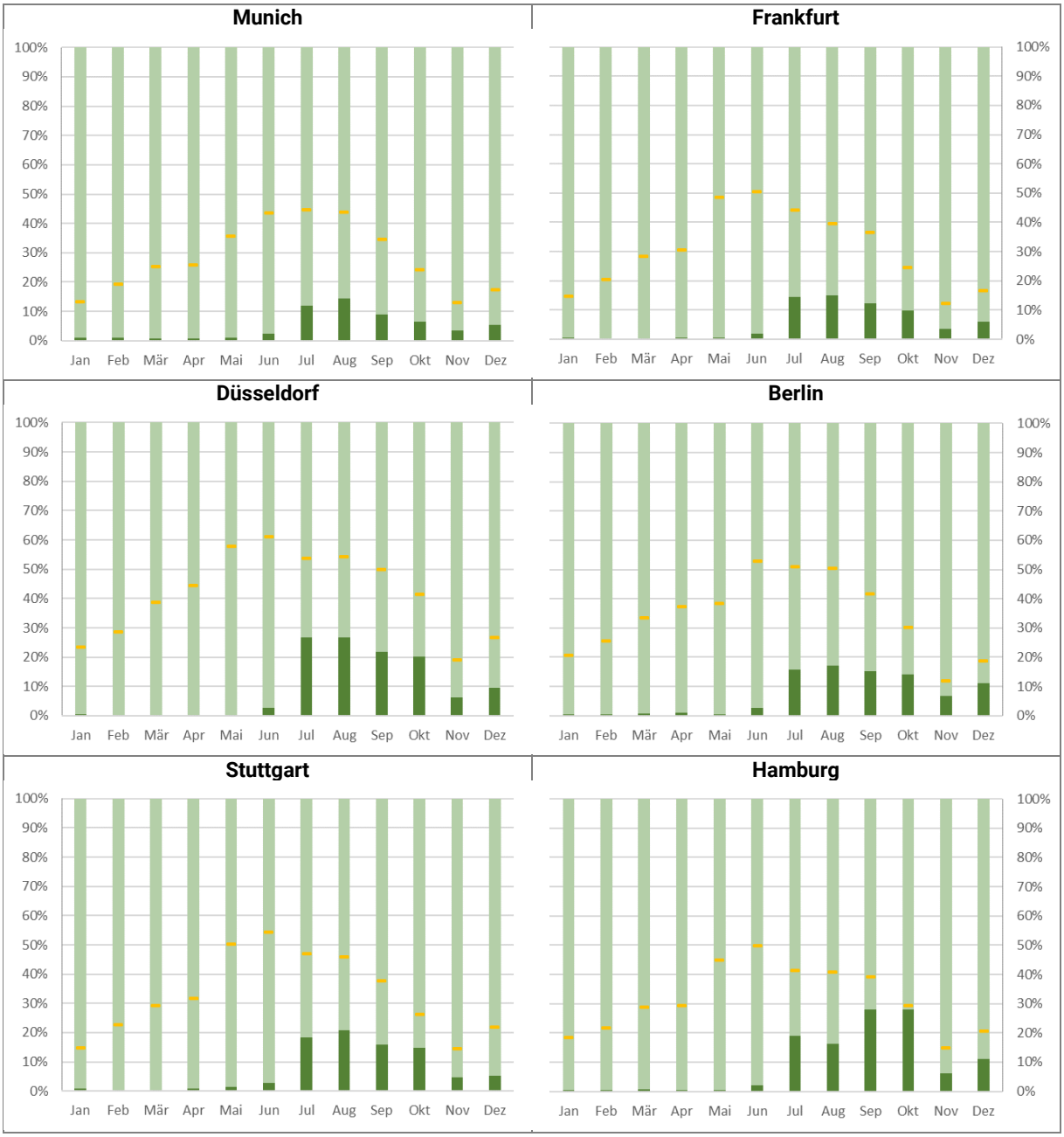


Fig. 3: Share of unregulated (light green) and regulated (dark green) IFR departures 2021, and 2019 share (yellow)

Conclusion

The strong drop in air traffic that began in March 2020 due to the Covid-19 pandemic made ATFM regulations almost unnecessary. Accordingly, initial predictions of a slow recovery led to an overall reduction in ANSP capacity, but as they actual recovery which began in mid-2021 happened earlier and more rapidly, this resulted in a bigger share of flights being regulated.

4.1.3 Share of IFR Departures Requiring De-Icing

Description
Share of IFR departures that required aircraft de-icing, in %

Goal
This KPI serves only as context information for other KPIs, e.g. TSAT Quality.

Charts

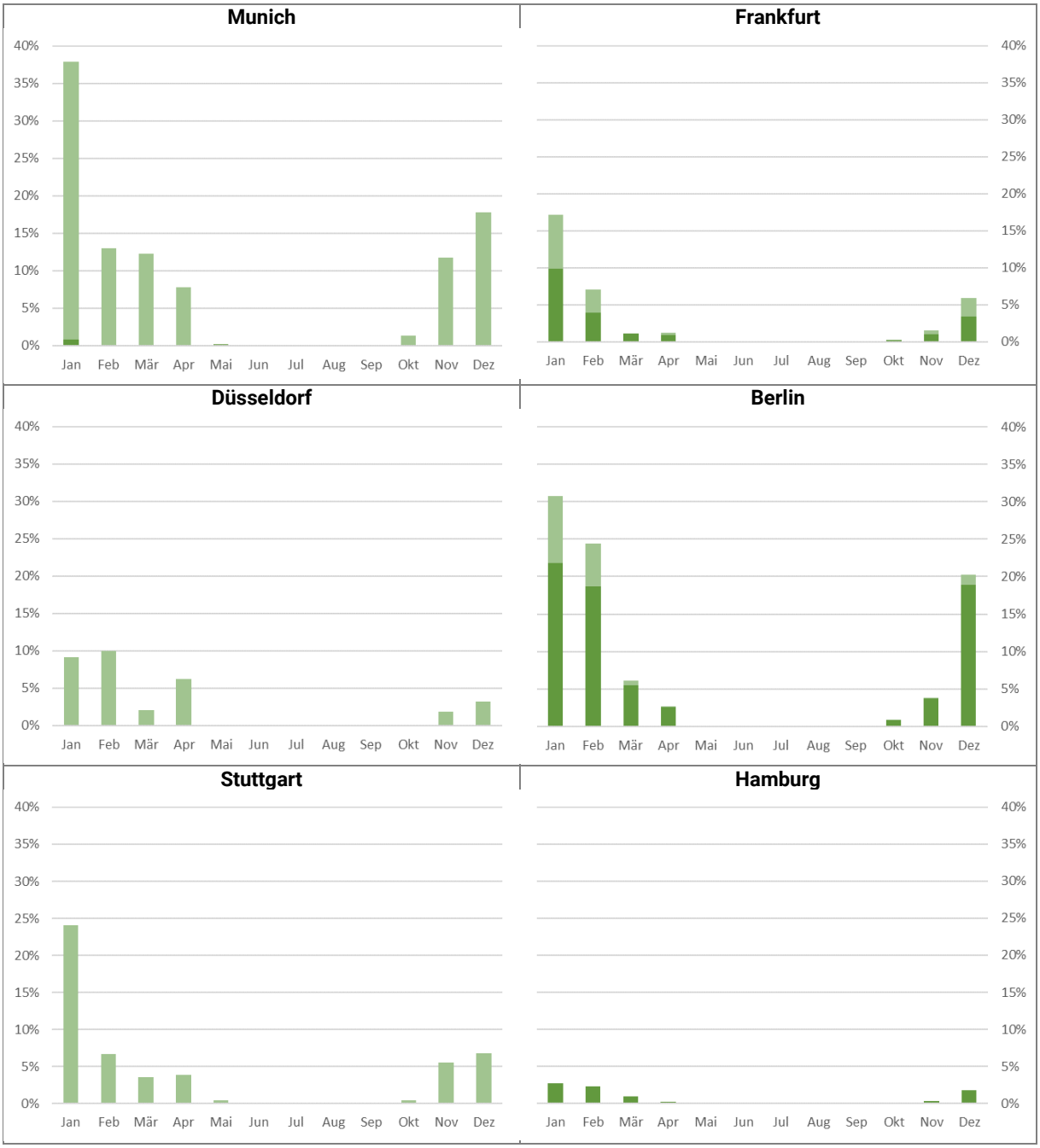


Fig. 4: Share of IFR departures 2021 requiring aircraft de-icing on stand (dark green) and remotely (light green)

Most airports only do remote de-icing, i.e. on designated de-icing areas. In this case, de-icing takes place after TSAT.
In the case of on-stand de-icing the flights are de-iced on their parking stands, i.e. after TOBT but before TSAT. Planned de-icing begin and duration are included in the TSAT calculation.

4.2 Procedure Adherence

4.2.1 ASAT Quality

Description
Share of IFR departures that received start-up approval (ASAT) within TSAT ± 5 min via radio, in %

Goal
Measure procedure adherence of Air Traffic Control (Tower)

Charts

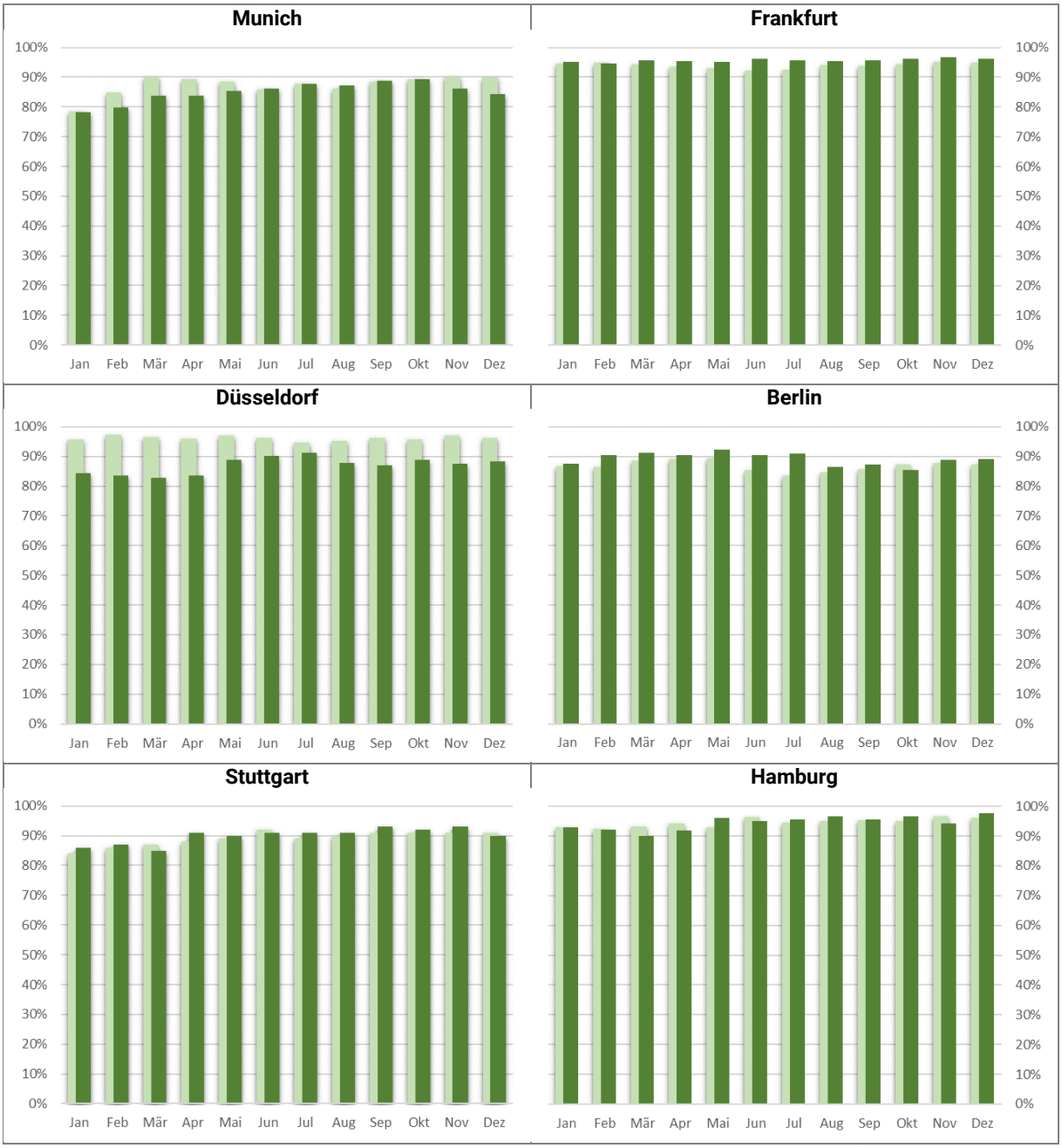


Fig. 5: Share of IFR departures that received start-up approval within TSAT ± 5 min via radio in 2021 (dark green) and 2019 (light green)

Conclusion
Most airports show an increasing ASAT quality along with rising traffic volume. During periods of peak demand, stronger focus was given to efficient use of available resources which led to stronger procedure adherence.

Düsseldorf Airport shows a continuously lower ASAT quality during 2021 than during 2019. The local A-CDM team has implemented measures to strengthen procedure adherence which should have a positive effect on ASAT quality in 2022.

4.2.2 AORT Quality

Description
Share of IFR departures that asked for their off-block clearance (AORT) within the window of ASAT + 5 min (start-up via radio) or TSAT ± 5 min (start-up via datalink), in %

Goal
Measure procedure adherence of the Flight Crew

Charts

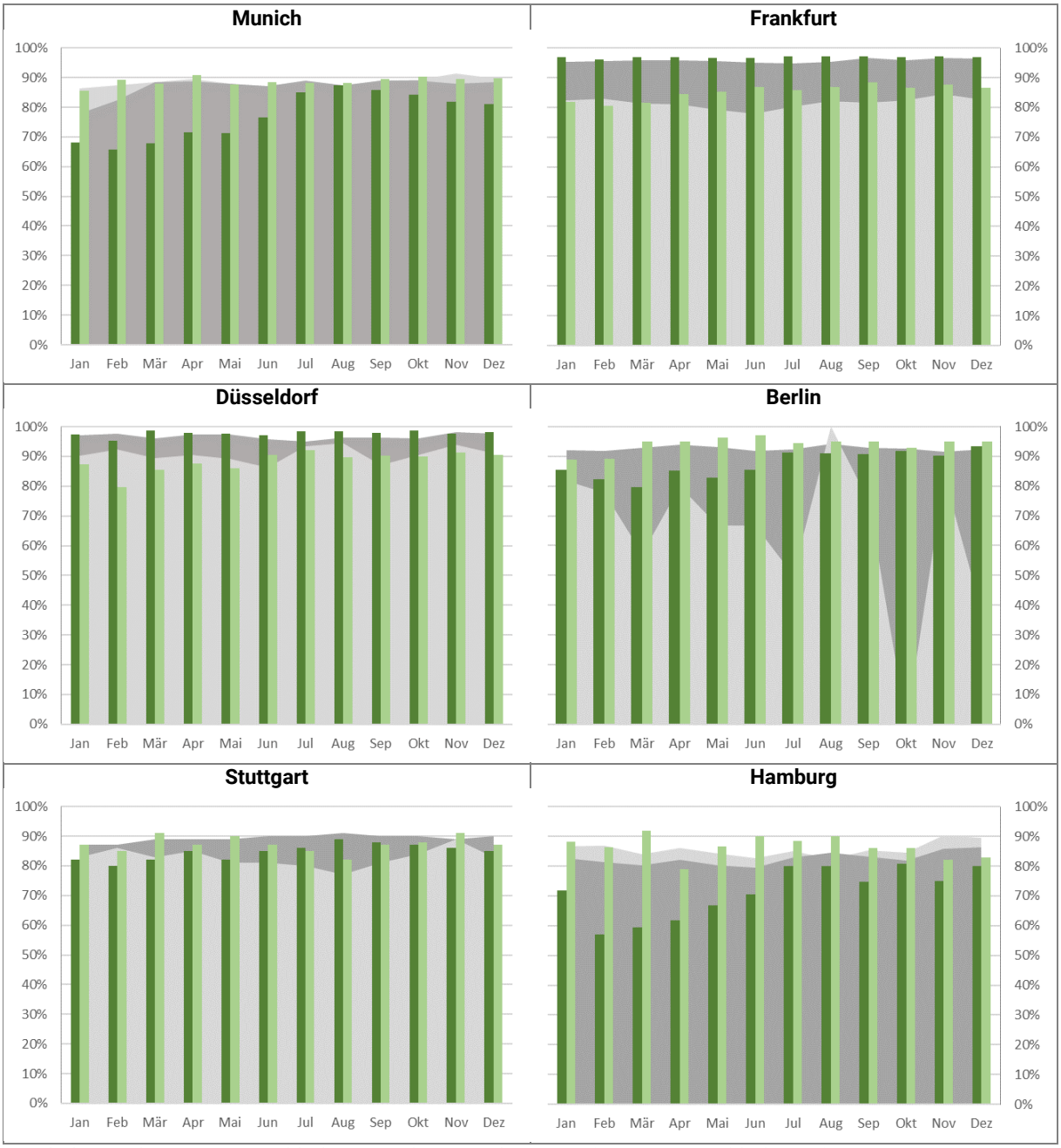


Fig. 6: Share of IFR departures 2019 with conformant AORT (green) compared to 2018 (grey), radio in darker shade, datalink in lighter shade

Conclusion

AORT quality is shown only for flights' final off-block requests that resulted in off-block clearance. Denied off-block requests, for instance after exceeding ASAT time tolerance, are not considered.

Last year's trend of a lower than usual procedure adherence continues into the first half of 2021. With rising traffic numbers from mid-2021, procedure adherence generally improves.

4.3 Procedure Planning

4.3.1 TTOT Quality

Description
Progression of the difference between current E/TOBT + current EXOT to ATOT (in minutes), in 5-minute intervals from 120 minutes prior ATOT.

Goal
Determination of TTOT prediction quality as reported to the Network Manager for unregulated flights.

Charts

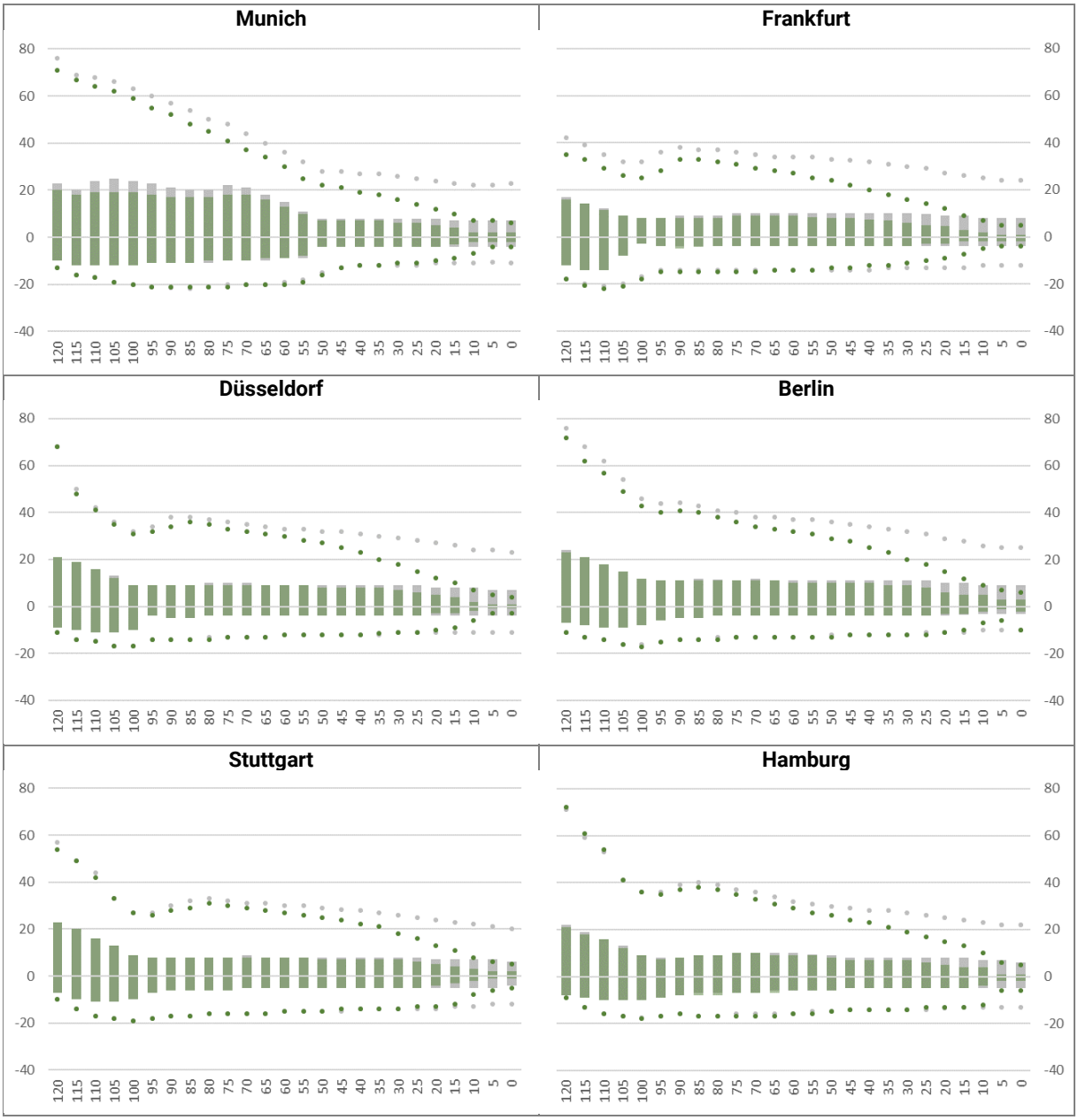


Fig. 1: Median (columns) and 90th percentile (dots) differences between E/TTOT and ATOT in minutes with a given lead time in minutes prior ATOT, split by flights with E/TTOT < ATOT (positive Y values) and E/TTOT > ATOT (negative Y values). ETOT in grey, TTOT in green.

Conclusion

Generally, every flight has a predicted take-off time based upon the ATC FPL's EOBT (ETOT). A-CDM airports additionally provide a prediction based upon the locally updated TOBT and the current departure capacity (TTOT). Both values are available to the Network Manager.

The above charts show that predictions based on local A-CDM data have a lower deviation from actual take-off times than those based on ATC FPLs only. From 90 to 50 minutes before departure, this improved quality is most pronounced because both TOBT and TSAT process are factored in at this stage.

Improved take-off predictions allow a more accurate traffic prognosis for the purpose of Air Traffic Flow Management and a more efficient use of airspace capacity.

4.3.2 SOBT Quality

Description
Monthly share of flights whose first EOBT provided in an ATC flight plan is equal to the SOBT agreed with the Airport Coordinator, in %

Goal
Difference between seasonal planning vs. first planning on the day of operations

Charts

Fig. 2: Monthly share of IFR departures 2021 where first EOBT = SOBT

Conclusion
A high SOBT quality shows reliability of the strategic planning processes (seasonal planning) compared to the actual flight intention as expressed by the ATC flight plan. Significant differences between flight planning and slot coordination are being monitored and investigated by the German Airport Coordinator's Slot Performance Monitoring.

4.3.3 TSAT Quality, Deviation and Stability

TSAT Quality

Description
Monthly share of last TSATs that were equal to TOBT, in %

Goal
Operational adherence to planning on the day of operations.

Charts

Fig. 3: Share of regulated and unregulated IFR departures 2020 (green) and 2019 (grey) where last TSAT = TOBT. Non-regulated flights in darker shade, regulated lighter.

TSAT Deviation

Description
Monthly mean deviation of TOBT and last TSAT, in minutes

Goal
Show mean deviation of planning on day of operations versus actual operations

Charts

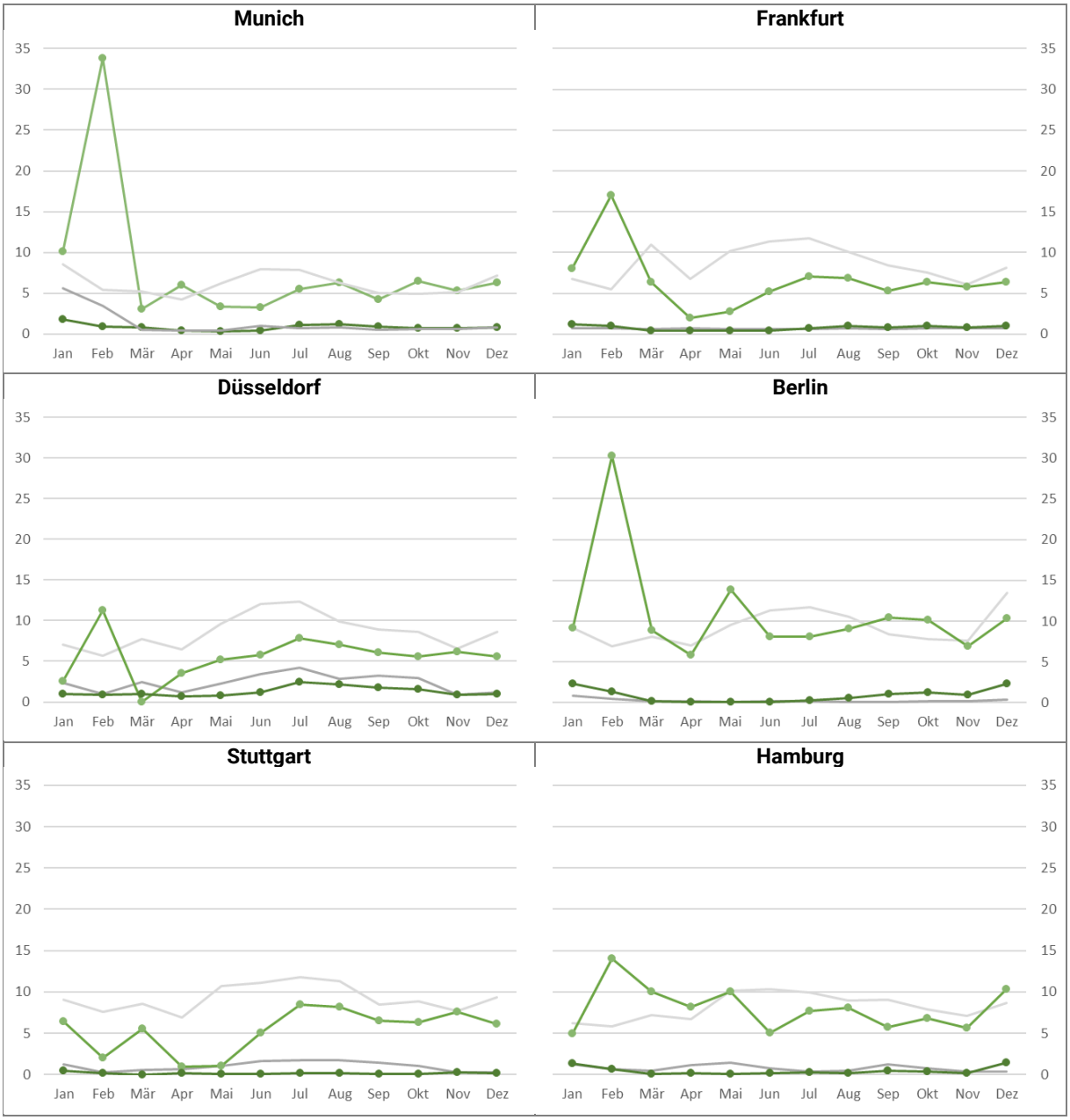


Fig. 4: Mean deviation of last TSAT and TOBT in minutes for 2021 (green) and 2019 (grey). Non-regulated flights in darker shade, regulated lighter.

TSAT Stability

Description
Number of TSAT changes from first publication (TOBT – 40 min) for non-regulated and regulated flights

Goal
Measuring TSAT stability

Charts

Fig. 5: Mean number of TSAT changes per regulated (light green) and non-regulated (dark green) flight and month without first TSAT, including deletions

Conclusion
For unregulated flights, a low TSAT quality shows that local capacity constraints have caused delays. For regulated flights, TSAT generally follows CTOT and therefore correlates more with ATFM delay.

TSAT quality is better at all airports compared to 2019 due to lower traffic demand. Munich shows some additional TSAT delays from July to September 2021 due to local capacity reductions caused by runway resurfacing work.

4.3.4 EDIT Quality and Deviation

EDIT Quality

Description
Monthly share of IFR departures with on-stand de-icing or remote de-icing whose EDIT was within ADIT ±3 min, in %

Goal
Verify the reliability of estimated de-icing duration as input parameter for A-CDM

Charts

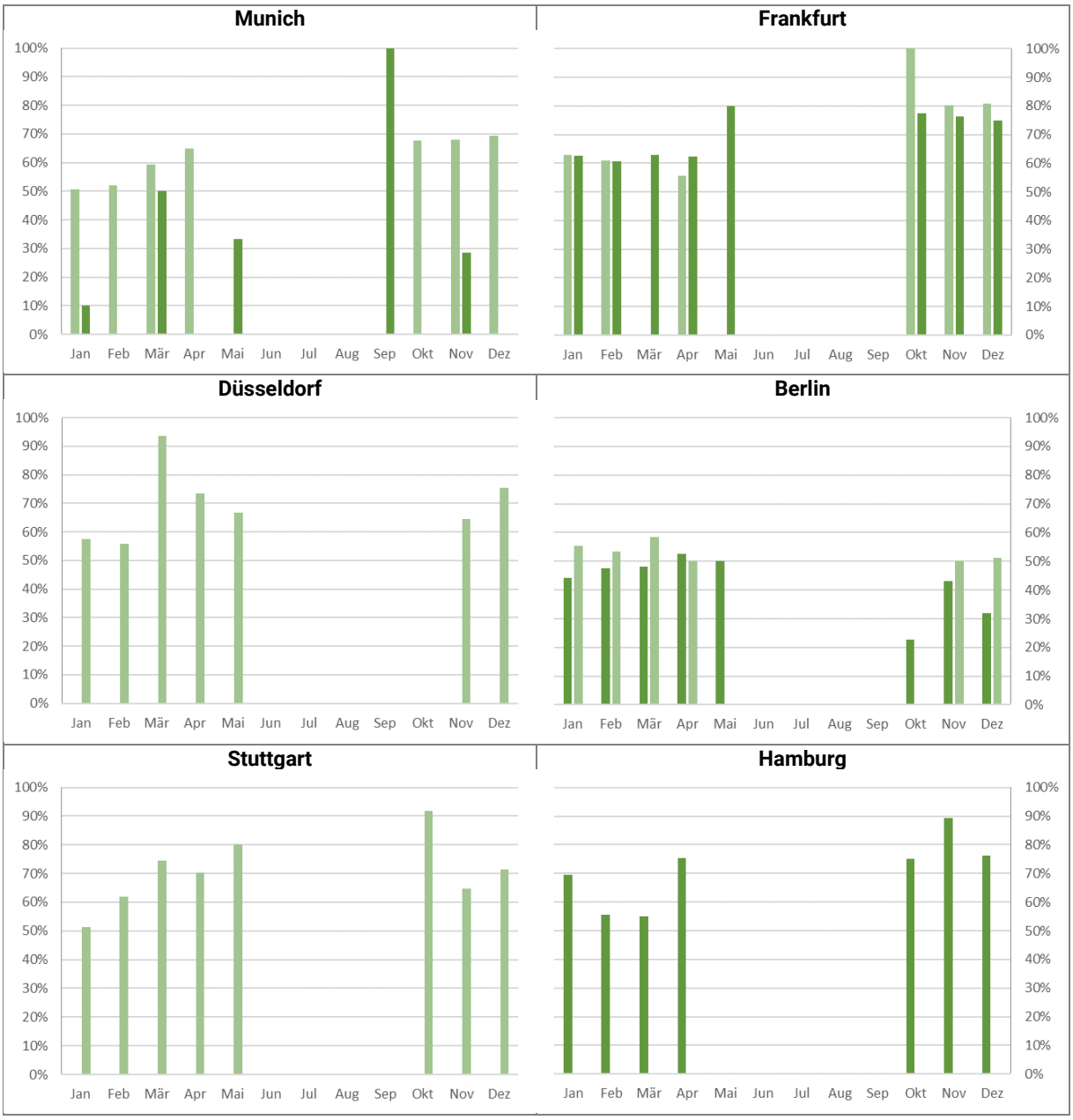


Fig. 6: Percentage of flights with remote (light green) and on-stand de-icing (dark green) where EDIT = ADIT±3 min

EDIT Deviation

Description
Monthly mean deviation of ADIT and EDIT for IFR departures with on-stand de-icing or remote de-icing in minutes per de-iced flight and airport, in minutes

Goal
Verify the accuracy of estimated de-icing duration as input parameter for A-CDM

Charts

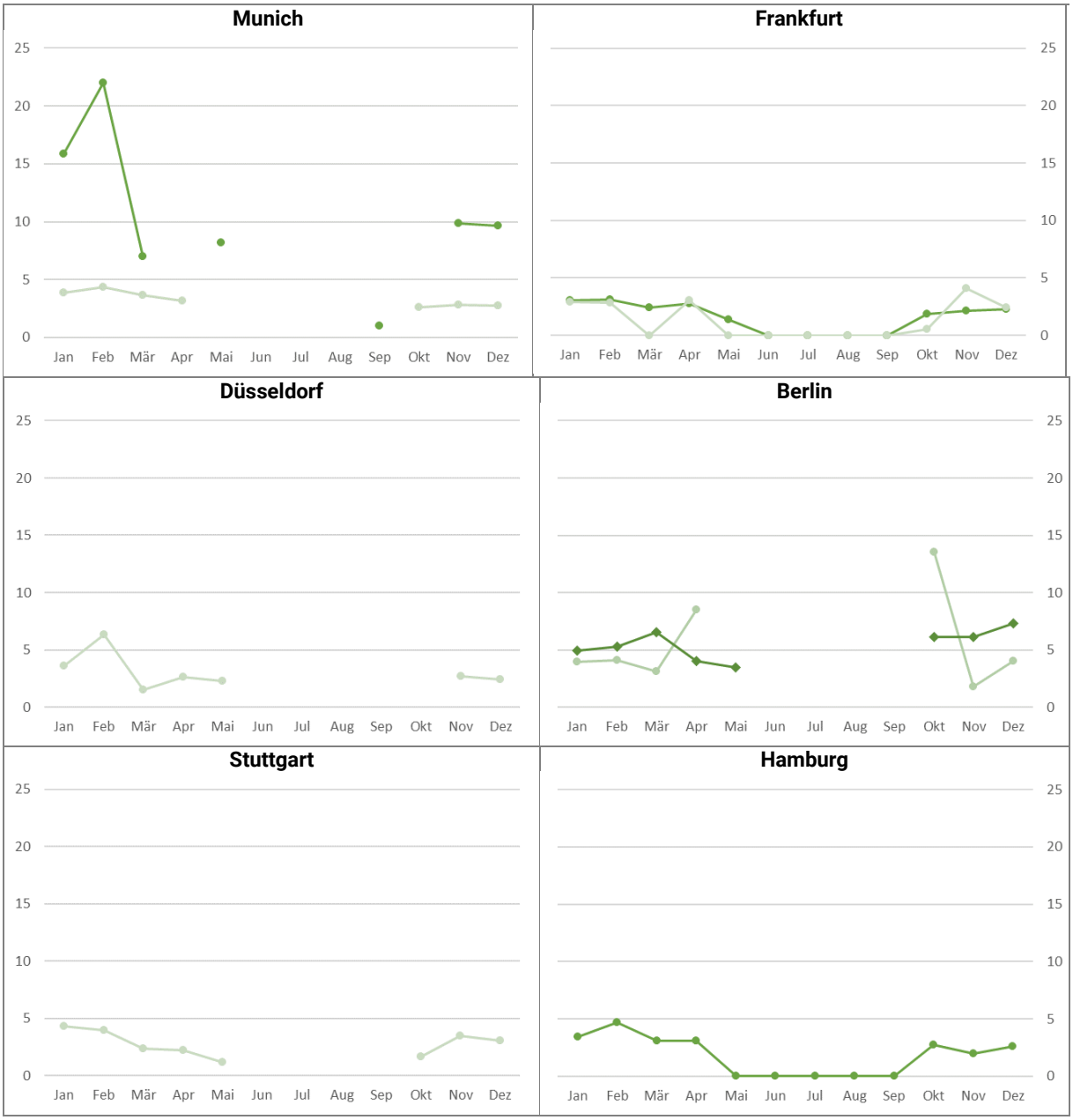


Fig. 7: Mean deviation in minutes of EDIT and ADIT for on-stand (dark green) and remote de-icing (light green)

Conclusion
EDIT quality for remote de-icing is generally higher as the process itself is less prone to disturbances and, therefore, easier to plan. On-stand de-icing performance depends on the location of the parking stand and activities on neighbouring areas which makes accurate EDIT predictions more difficult.

4.3.5 Position Stability

Description
Share of IFR arrivals for whom no position change had to be effected from ALDT-10 min until AIBT, in %

Goal
Determine the number of short-term position changes at the airport in relation to ELDT and ALDT. Indicates the reliability of positioning information for process planning.

Charts

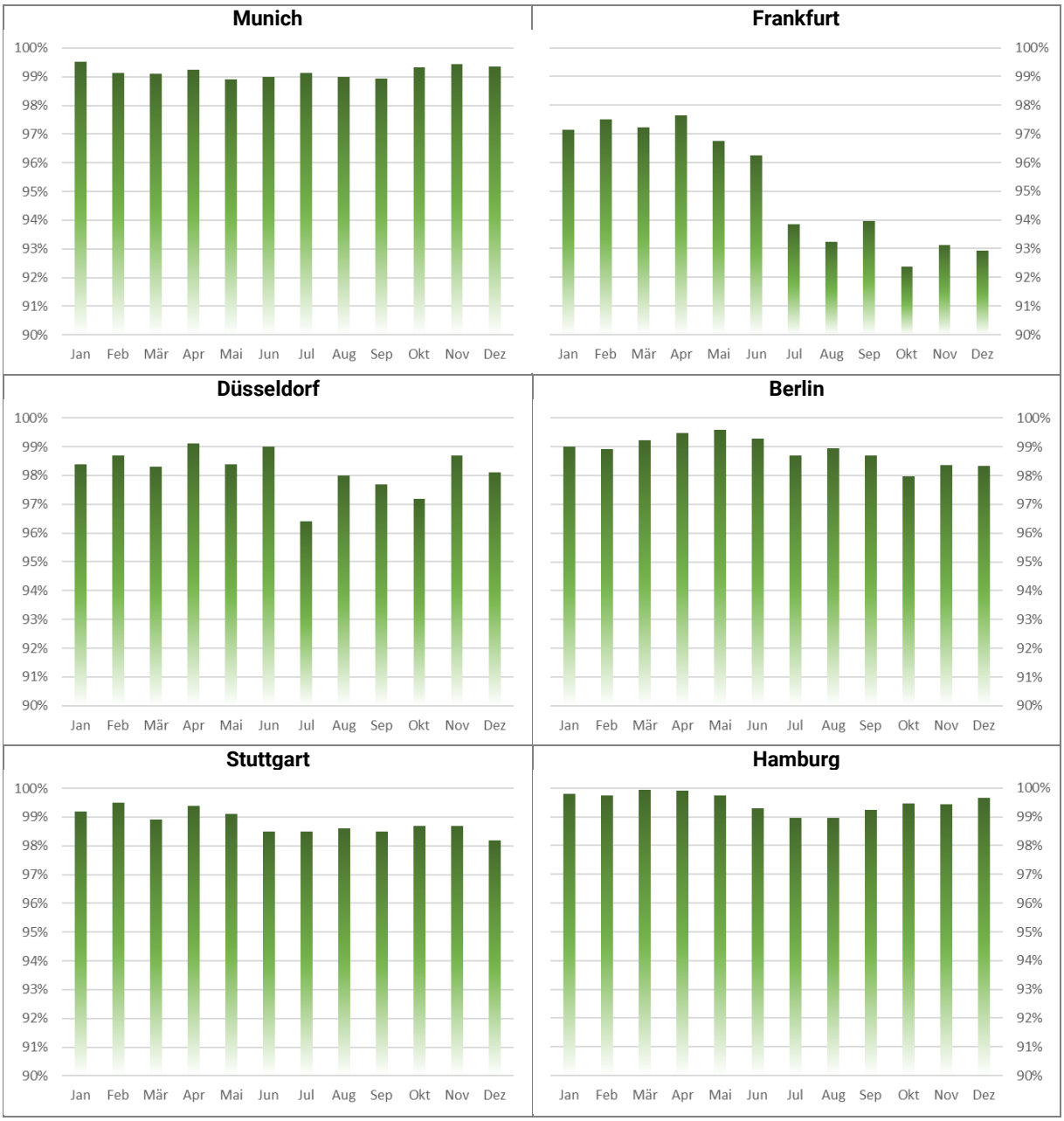


Fig. 8: Share of flights where no short-term position change was necessary

Conclusion
At Frankfurt Airport, increasing demand during peak times from mid-2021 onwards shows resource shortage in the number of parking stands. The same is visible, however less clearly, at other airports with the exception of from Munich where 27 additional parking stands were made available in 2021.

4.4 Network Management

4.4.1 ATFM Slot Adherence and Deviation

ATFM Slot Adherence

Description
Share of flights adhering or not adhering to Slot Tolerance Window prescribed by NM, in %

Goal
Measure procedure adherence of regulated flights. Nominally, ATOT should be within the Slot Tolerance Window (STW, usually CTOT -5/+10 min but may be extended in special conditions). Adjustment of the CTOT to the local TTOT within the A-CDM process improves ATFM slot adherence, pre-departure sequence and procedure adherence.
"Early" flights have an ATOT before STW begin, "late" flights have their ATOT after STW end.

Charts

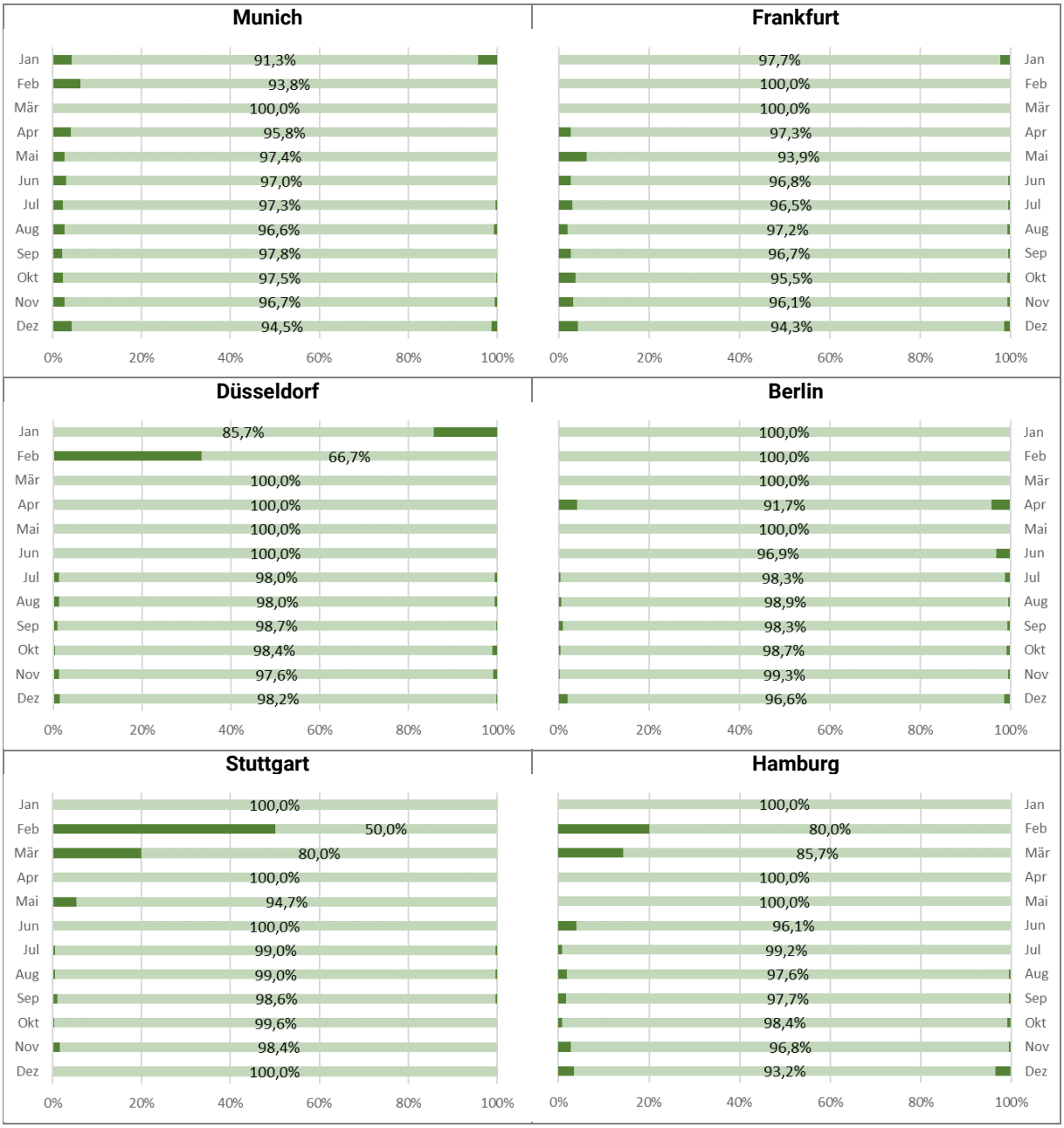


Fig. 9: Share of flights with ATOT before (dark green left), within (light green) and after (dark green right) STW

ATFM Slot Deviation

Description
Mean Deviation from the STW prescribed by NM, in minutes

Goal
Measure the level of slot deviations for regulated flights. This measurement counts only flights whose ATOT was outside of the Slot Tolerance Window and measures the time in minutes between ATOT and the nearest STW limit. “Early” flights have an ATOT before STW begin, “late” flights have their ATOT after STW end.

Charts

Fig. 10: Mean deviation in minutes of ATOT and STW for early (light green) and late (dark green) departures

Conclusion

Values for the months of January until May are not indicative due to the extremely low number of regulated flights.

As soon as the number of regulated flights increases from June, flights that depart outside of the Slot Tolerance Window frequently appear to be departing too early rather than too late. One explanation could be that the taxi times of some flights are estimated too high. At Munich Airport, this is exacerbated by flight sequencing that aims to have flights arrive at the runway at the beginning of the Slot Tolerance Window (CTOT-5 min). If taxi times tend to be shorter than planned, these flights would very likely arrive at the runway too early. The other airports sequence flights according to CTOT which allows for a 5-minute tolerance to compensate for taxi time variability.

4.4.2 CTOT Quality, Deviation and Stability

CTOT Quality

Description
Monthly percentage of IFR departures with CTOT = TTOT+≤5 min/+≤15 min/+>15 min at First CTOT, First TSAT Issue and AOBT

Goal
Measure suitability of network CTOT to the local A-CDM process over the progress of a turnaround

Charts

Fig. 11: Share of regulated IFR departures 2021 per month where CTOT is a maximum of 5 (dark green), 15 (green) or more than 15 minutes (light green) later than TTOT. First CTOT left, First TSAT Issue centre, AOBT right.

CTOT Deviation

Description
Mean monthly deviation CTOT-TTOT at First CTOT, First TSAT Issue and AOBT, in minutes

Goal
Measure suitability of network CTOT to the local A-CDM process over the progress of a turnaround

Charts

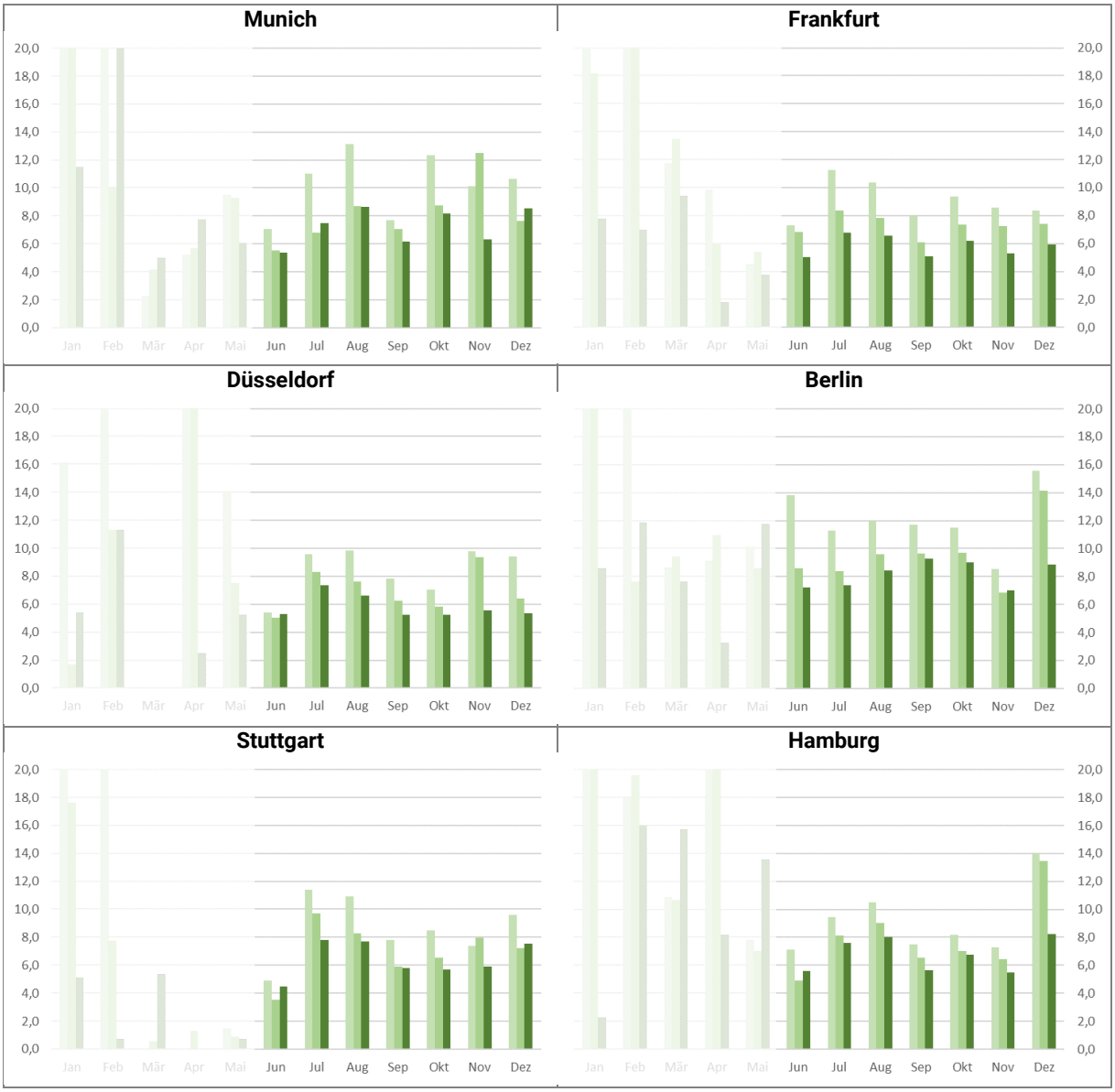


Fig. 12: Mean deviation CTOT-TTOT of regulated IFR departures 2021 at First CTOT (light green), First TSAT Issue (green) and AOBT (dark green)

* Due to the very low number of regulated flights from January to and including May 2021 these values are not indicative and were therefore disregarded. The y-scale was adapted to fit the representative months.

CTOT Stability

Description
Number of CTOT updates per IFR departure with CTOT

Goal
Measure CTOT stability

Charts

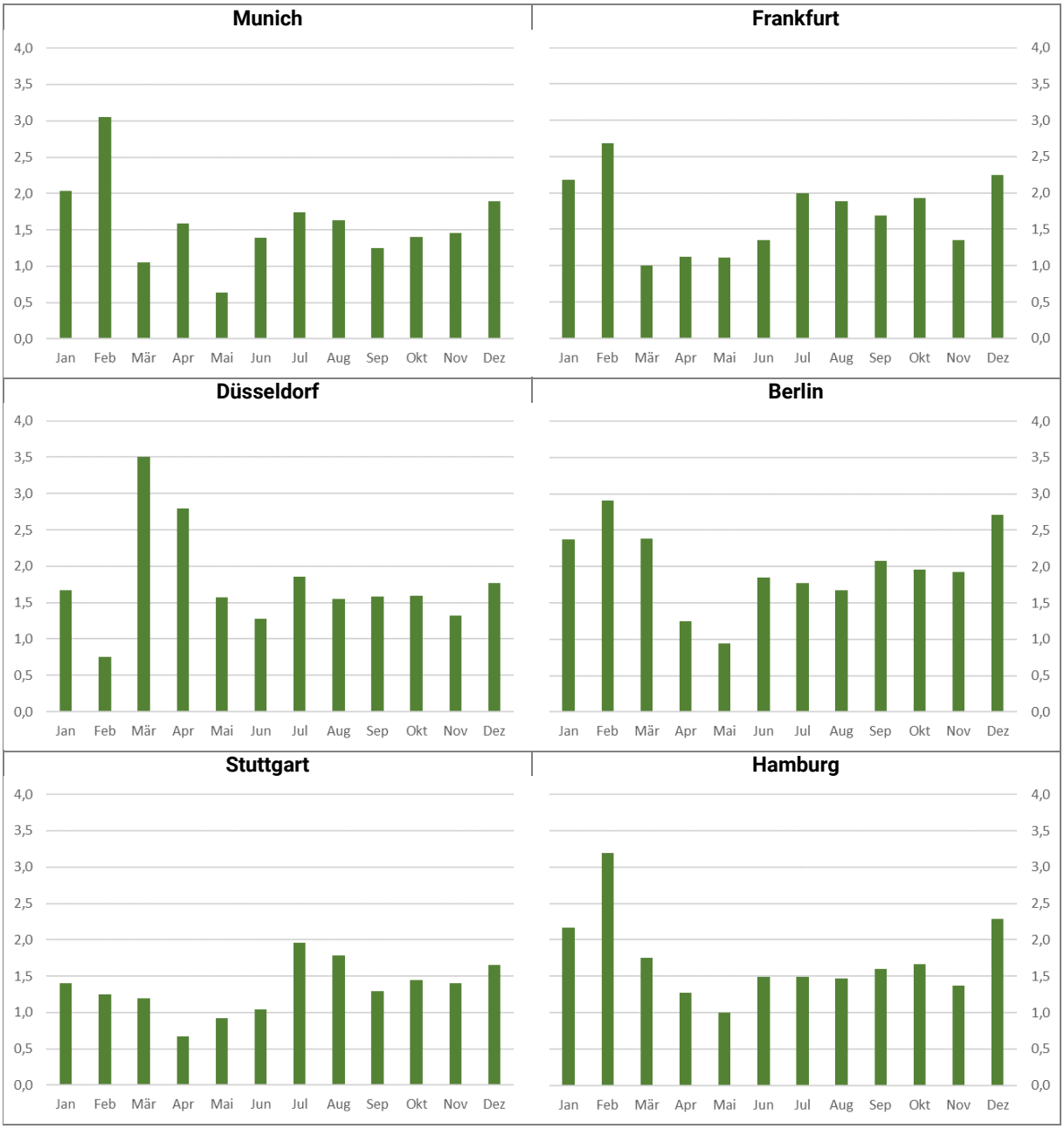


Fig. 13: Mean number of CTOT updates (without first CTOT) per flight and month

Conclusion

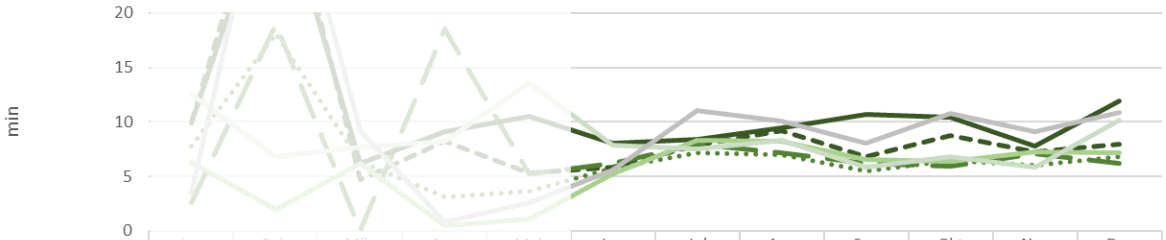
The indicators CTOT Quality and Deviation show how well the network CTOTs fit to the earliest locally possible take-off times. It can be seen that over the course of the A-CDM process, the assigned CTOTs fit increasingly well to the local times. The first issued CTOTs usually translate into higher delay than later updates as the Network Manager's optimisation algorithm constantly attempts to find earlier CTOTs that fit better to the TOBT-based departure time. Early TOBT updates therefore raise the likelihood of lower ATFM delays.

4.4.3 Average ATFM Delay

Description
Average ATFM delay per regulated departure, in minutes

Goal
Measure the average ATFM delay for regulated departures

Chart



	Jan	Feb	Mär	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
MUC	10,0	35,7	4,7	8,3	5,3	5,8	7,9	9,2	6,8	8,7	7,2	7,9
FRA	7,8	18,1	6,4	3,1	3,6	5,7	7,1	6,9	5,5	6,4	6,0	6,8
DUS	2,6	19,0	0,0	18,5	5,3	6,2	7,9	7,1	6,2	5,9	7,0	6,2
SXF/BER	9,9	32,7	6,2	9,1	10,5	8,0	8,4	9,4	10,7	10,5	7,8	12,0
STR	6,3	2,0	6,2	0,5	1,1	5,2	8,3	8,2	6,5	6,4	7,2	7,2
HAM	12,5	6,8	7,7	8,2	13,6	7,8	7,5	8,3	5,8	6,8	5,8	10,2
Non-CDM	3,5	37,6	9,2	0,8	2,6	5,5	11,0	10,0	8,1	10,8	9,1	10,9

Fig. 14: Average ATFM delay per airport in minutes

Conclusion
Due to the low number of regulated flights, delay values for the months January to and including May 2021 are not indicative and were therefore disregarded.
Beginning in mid-2021 most German Airport-CDM airports show a lower ATFM delay than non-CDM airports.

5 Outlook

The expected strong rise in traffic demand and increasingly visible resource shortages during traffic peaks towards the end of 2021 make it likely that problems in procedure adherence as well as overall capacity limitations both in the Network and locally at airports will intensify. To maintain plannability and stability of operational processes and use limited resources as effectively and efficiently as possible, a high TOBT quality will be essential.

With this in mind, the Editorial Board is planning to extend the Annual KPI Report with the TOBT-related indicators Timeliness and Foresight. Timeliness looks at how long before the current TOBT a TOBT update is effected. Foresight analyses by how much TOBT entry time and TOBT value differ.

List of Abbreviations

	DESCRIPTION
ADIT	Actual De-Icing Time
AORT	Actual Off-Block Request Time
ASAT	Actual Start-Up Approval Time
ASRT	Actual Start-Up Request Time
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATOT	Actual Take-Off Time
CTOT	Calculated Take-Off Time
DCL	Datalink Clearance
EDIT	Estimated De-Icing Time
FPL	ATC Flight Plan
IFR	Instrument Flight Rules
NM	Network Manager
NMOC	Network Manager Operations Centre
SOBT	Scheduled Off-Block Time
STW	Slot Tolerance Window
TOBT	Target Off-Block Time
TSAT	Target Start-Up Approval Time

List of Sources

KAPITEL	KPI	QUELLE
4.1.1	Number of IFR Departures	NM ATFCM Monthly Summary per Airport
	Share A-CDM	DFS
4.1.2	Share of Regulated IFR Departures	NM ATFCM Monthly Summary per Airport
4.1.3	Share of IFR Departures Requiring De-Icing	Airports
4.2.1	ASAT Quality	Airports
4.2.2	AORT Quality	Airports
4.3.1	TTOT Quality	DFS
4.3.2	SOBT Quality	DFS
4.3.3	TSAT Quality, Deviation and Stability	DFS
4.3.4	EDIT Quality and Deviation	Airports
4.3.5	Position Stability	Airports
4.4.1	ATFM Slot Adherence and Deviation	NM ATFCM Monthly Slot Adherence
4.4.2	CTOT Quality, Deviation and Stability	DFS
4.4.3	Mean ATFM Delay	NM ATFCM Monthly Summary per Airport