EUROCONTROL

SMART Wx Regulation Task Force

Work Package 1:

Collaborative best practices for handling of adverse weather at European Aerodromes

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1 Executive Summary

1.1 Aerodrome adverse weather remains the main reason for ATFM delay at European airports. While we cannot control the weather, the aviation community can improve the operational response to adverse weather effects on aerodrome capacity.

The SMART Wx TF, contributing to the Operational Excellence Programme and coordinated by the Airport Operations Team, addresses the collaborative best practices for handling of adverse weather at European Aerodromes. The Task Force composition reflects the contribution of wide plethora of operational stakeholders, such as:

- the Airspace Users of the low cost, scheduled airline carriers, and charter airlines;
- the Airport Operator companies and ACI-Europe;
- the ANSPs and FMPs, and
- the national MET Service providers.
- the SMART Wx TF is co-chaired by the A4E airlines association and the NM/Airports.

1.2 The SMART Wx TF identified fourteen recommendations grouped in the following areas:

- Development of tailored-made MET products and services, enabled by the quantum enhancement in MET technologies and user oriented MET innovation. Integration of MET advice in operations. Use of consistent interpretation of the MET forecast, explained in operational language and referencing specific operational threshold values (see chapter 5);
- Evolution of the FMPs' role towards closer working relationship with the airport stakeholders, in particular with the Airport Operations Centre (APOC); where APOC has not been established: with TWR ATC and the Airport/Aircraft Duty Manager (AODM);
- As detailed in chapter 6, the Network Manager has developed an arsenal of ATFM procedures to counter the effects of weather disruptions at aerodromes for the benefit of local stakeholders, the airspace users and the Network. The correct choice of appropriate ATFM procedure/regulation and its efficacy depends primarily upon two factors:
  - The FMP's awareness of the forecasted weather phenomenon and the extent of its effect on aerodrome capacity: estimated start time, duration, end time, severity and operational risk assessment.
  - Timely coordination and activation of the ATFM regulation with the NM Pre-Tact or NM Tactical teams.
- Integration of the Aerodrome element to the existing NM Cross-border procedure for en-route convective weather: include aerodrome weather phenomena; extend the procedure to year-round duration and enlarge the coordination to AODM and/or TWR ATC, as appropriate (see chapter 9);
- All operational stakeholders highlighted the importance of going into the weather event in a controlled manner, with a plan to manage effectively the situation, based on "Playbook" pre-agreed scenarios and 'what-if' assessment enabled by suitable software tools. The Task Force emphasises the benefit of establishing **local collaborative cell and common situational awareness** platform such as the Airport Operations Plan (see chapter 7).

- The importance of the Airspace Users' take on weather disruptions: delays, diversions and cancellations. The airlines operate several transport models and react differently to adverse weather. A scheduled commercial airline, or a national carrier operating "hub-spoke" network may have a different take on diversions and pre-tactical flight cancellations compared to a charter airline that is part of a tour operator.

  The report briefly summarises the implications of the Regulation EU261/2004 on airline business decisions and operational response.

- The importance of digitalisation of the airlines business: decision support tools for operational and business prioritisation and digital communication platforms for passengers (see chapter 8).

1.3 **The benefit** for the Aerodromes, ANSPs (including FMPs), the Airspace Users and the NM from implementing the SMART Wx Task Force recommendations, is increased predictability of operations, reduced cost at local and network level, while making full use of new customer-oriented MET products and digital decision support tools.

To drive real change in the collaborative management of ATFM regulations for adverse weather at aerodromes, the AOT and the NDOP/NDTECH are requested to endorse the recommendations, based on the collective operational wisdom of the SMART Wx TF.

1.4 Within the Airport Operations Team Work Plan and in the context of the Operational Excellence Programme, the SMART Wx Task Force has been working in close coordination with the operational stakeholders and experts involved in related Work-stream Topics such as those in the Work-stream 03, "Application of ATFCM", and in particular Topics on "Harmonisation of en-route/TMA weather management" (under ENR/TMA) and "Harmonisation of Airport weather management" (under APT/TWR).

1.5 In preparation for the next steps, the Airport Operations Team (AOT) representatives are invited to discuss the findings of the report internally within their respective organisations, involving the MET service providers in the dialogue. The recommendations in relation to local collaboration are intentionally left at the level of principle, because each aerodrome is different and a detailed procedure may be too prescriptive. If the airport stakeholders implement, tailored to their local circumstances, the recommendation#10 on establishing a local collaborative cell, this alone will be a significant step forward, because all best practices shared in the Task Force, are based on collaboration between the APOC/AODM, ATC TWR, FMP and home based carrier as a minimum.

In contrast, a concrete procedure has been proposed for the NM (see chapter 9), because the development relies upon the existing NM Cross-border procedure, in collaboration with the participating ANSPs, MET service providers and eventually APOC SUP/AODM and/or ATC TWRs. Further discussions on practical aspects of this procedure will take place within the corresponding Network CDM Working Arrangements, such as the Airport Operations Team (AOT) and ATFCM Operations and Development Sub-Group (ODSG).

2 Background

2.1 The chapter outlines the endorsement of the SMART Wx TF as part of the Operational Excellence Programme, the working arrangement with the Airport Operations Team, Objective & Scope and Task Force Membership.

2.1 The SMART Wx TF as part of the Operational Excellence Programme

2.2 The Smart Wx TF addresses the topic "Harmonised procedures for airports with similar operational environment" of the Work Stream 9 "Harmonised operational requirements supporting system connectivity, interoperability and implementation" of the Operational Excellence Programme.

2.3 The Operational Excellence Programme complements the development and implementation of the Airspace Re-configuration Programme. The Operational Excellence Programme aims at identifying and implementing best-in-class operational and technical evolutions to deliver harmonised common operational capabilities among all operational stakeholders.

2.4 The Network Directors of Operation (NDOP) and the Network Directors of Technology (NDTECH) manage the Operational Excellence Programme and report to the Network Management Board (NMB). The Joint NDOP/NDTECH Joint Prioritisation workshop in September 2020 included the topic addressed by the SMART Wx TF with high priority to be taken forward by the Airport Operations Team in the context of in the Operational Excellence Programme Management Plan, which was approved by the NMB at their meeting in November 2020.

2.5 A Champion operational stakeholder and Work stream Leader from NM lead the development of each topic in the Operational Excellence Programme.

The initial Champion organisation in the SMART Wx TF was the Industry Resilience Group until October 2020. This was taken over by A4E from October 2020 onwards and the A4E Champion is expected to be confirmed in the NDOP/NDTECH meetings in June 2021 following consultation between the NDOP and NDTECH chairs**. The Work Stream Leader from NM side is the NM/Airport unit.**

2.6 The Network Directors of Operation (NDOP) and Network Directors of Technology (NDTECH) appointed the Airport Operations Team (AOT) to execute the working arrangements with regard to the SMART Wx TF.

The working arrangements with the Airport Operations Team (AOT) include the approval of the Terms of Reference, ensure Task Force participation, review and endorse the deliverables before submission to the NDOP/NDTECH.

2.2 SMART Wx TF Objective, Scope and Work Packages

2.7 On **20 August 2020**, the Airport Operations Team (AOT) approved the establishment of the SMART Wx TF with the following Objectives and Work Packages:

Objective: The SMART Wx TF shall identify operational best practices that facilitate the handling of adverse weather in a collaborative manner whilst minimising the disruption to Airport and Network operations.

Scope: from D-15 to identify risks and trends in relation to the MET forecast; regarding operations: **Pre-tactical (D-6 to D-1), Tactical (D-0) to Post OPS D+7 time frame.**

WP1 Process/Procedure

- Identify Triggers, such as the forecast of various significant weather phenomena and corresponding Scenarios to cater for efficient handling of traffic with minimum loss of operational capacity.
- Identify the Actors involved in preserving airport capacity in adverse weather and describe the Necessary interactions during the pre-tactical and tactical phase of operations.

WP2 High level user requirements for Predictive & Modelling tool

- The decision maker(s) in the procedure need to be informed by suitable Predictive and Modelling tool. A risk-based approach using the likelihood of the forecasted event and possible operational impact will assess the risk of disruption and its scale and will support the decision on intervention.

2.8 This report covers the SMART Wx Task Force findings in Work Package 1 "Process/Procedure". **The Work Package 1 report on "Collaborative best practices for handling of adverse weather at European Aerodromes" has been endorsed by the Airport Operations Team on the 3 March 2021 in a dedicated working session**, in which each of the fourteen recommendations were explained, commented on and endorsed.

2.3 Task Force membership

2.9 The Task Force includes 25 members in senior operational and expert position:

- Airlines and Airline associations: A4E (co-chair), Vueling, IATA. Guest speakers from TUI, EasyJet and British Airways;
- ANSPs and FMPs: ANS Finland, DSNA (Reims FMP), ENAIRE and the DFS (Frankfurt TWR and APP);
- Airports and Airport associations: ACI-Europe, Amsterdam Schiphol, Stockholm Arlanda, Helsinki-Vantaa, Athens Venizelos, Zurich airport; Guest speaker from London Heathrow airport;
- MET service providers: MeteoSwiss (Switzerland MET Service Provider), UK MET Office, EUMETNET (MET Service Coordinator for the Cross-border procedure);
- Airport Slot coordinators: EUACA; and
- The NM: NM/Airports unit, Network Manager Operations Centre and NM Operational Analysis; Guest speaker: the Head of Network Operations Services (NOS) and the NM OPS Centre (NMOC).

3 Methodology

3.1 The WP1 report uses data and information drawn from:

- Discussions in plenary sessions based on sharing of best operational practices from key operational stakeholders: MET Service Providers, the Airport operators, ANSPs and FMP; the Airlines; and the NM Operations Centre (NMOC);
- Three Best Practices information-sharing sessions took place on 23 September 2020, 10 November 2020 and 16 December 2020. Dedicated web-based sharing platform was created on the OneSky Teams SMART Wx TF website;
- Analysis of specific cases of days with AD Wx disruptions, provided by the Central Office for Delay Analysis (CODA);
- Analysis of Strategic Regulatory, Operational Procedure and Technical documents, along with the findings of other Agency Task Forces on topics related to the Objective and Scope of the SMART Wx TF:
  - the Network Function Implementing Rule EU 2019/123, Ref [1];
  - the NM ATFCM Operations Manual edition 24.1 from 18 January 2021, Ref [2];
  - the Cross-border Procedure Operational Instruction from 2020, Ref [3];
  - the Arrival Planning Information (API) Implementation Guide edition 1.0 from 01 July 2020, Ref [4];
  - the Reports of the APOC/CONTINGENCY Task Force (from 2018), Ref [5];
  - the Report of the APOC-NMOC Task Force (from 2020), Ref [6]; and
  - the Reports of the NDOP Airport Integration Task Force (from 2018 and 2019), Ref [7];
  - European Commission "Study on the current level of protection of air passenger rights in the EU" from January 2020, Ref [8];
  - European Commission "Commission Staff Working Document: IMPACT ASSESSMENT Accompanying the document Proposal for a regulation of the European Parliament and of the Council amending Regulation (EC) No 261/2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delays of flights and Regulation (EC) No 2027/97 on air carrier liability in respect of the carriage of passengers and their baggage by air", Ref [9].

3.2 The analysis, recommendations and conclusions in this report reflect the consolidated opinion of the operational and expert *milieu*. The objective and impartial analysis aims to answer the question "what will work in operations and at what cost". The open and constructive debate in the sessions underpins the unbiased analysis and realistic conclusions of the report. Should a political alignment of some sort be deemed desirable, it will have to be performed at the level of the Airport Operations Team and the NDOP/NDTECH review.

4 Document structure

4.1 The report of the Work Package 1 of the SMART Wx TF addresses the topic of "Operational best practices on handling of adverse weather with minimum disruption to Airport and Network operations".

4.2 The main body of the document consists of concise description of the salient discussion points, analysis and recommendations on each sub-topic. Statistics and examples of local best practices are included in Appendixes for the readers that are interested in detailed argumentation.

4.3 Chapter 1 is the Executive summary that outlines the main findings of the Task Force.

4.4 Chapter 2 describes the *raison d'être* of the Task Force as part of the Operational Excellence Programme. It explains the working arrangement with the Airport Operations Team, the Task Force Objective & Scope and work packages; lists the participating organisations.

4.5 Chapter 3 gives a brief overview of the Task Force methods.

4.6 Chapter 4 is the current chapter.

4.7 Chapter 5 presents the opinion of the Task Force on the important role of MET Service Providers. The MET services need to evolve to respond to the specific operational requirements for the management of Weather phenomena at airports.

4.8 Chapter 6 discusses the role of the FMP in managing ATFM AD Wx Regulations and makes suggestions on improvements.

4.9 Chapter 7 addresses the local collaborative process and exchanges with the NMOC in the management of adverse weather conditions at aerodromes. It emphasises the benefit from Airport Operations Centre (APOC)/Ground Coordinator (GC) and Airport Operations Plan (AOP).

4.10 Chapter 8 informs on the Airspace users take on aerodrome weather disruptions that cause delays, diversions and flight cancellation. It features three types of airlines-commercial scheduled, low cost carriers and charter.

4.11 Chapter 9 provides an operational description of the "Integrated AS-AD Cross-border" Regulation procedure, which is the result of the integration of the existing Cross Border procedure with the findings of this report.

4.12 Chapters 10 and 11 list the Task Force Recommendations for each operational stakeholder group, along with conclusions and way forward for AOT and NDOP/NDTECH consideration.

5 The evolving role of MET Service providers

5.1 Historically the aviation weather forecast centred on the Airman, Aircraft operations and the Safety of the flight. The classical METAR and TAF legacy MET products belong to that era.

5.2 Previous disruptive weather events at airport locations acted as catalysts for developing new MET capabilities tailored to the specific requirements of airport operations, mainly centred on risk assessment of the weather disruption on airport operational capacity.

5.1 Integrating MET advice into operations. User oriented MET innovation.

5.3 **An operational response to weather starts from the MET forecast**. MET services demonstrate value, quality and efficiency and they contribute directly to enabling airport stakeholders take good decisions in operations. For this, the MET specialists demonstrate awareness and responsiveness to **specific operational threshold values for the various weather phenomena**. For example:

- Instead of general visibility forecast, focus on fog/low visibility at critical threshold values that trigger specific operational response, e.g. change from CAT I (RVR 550m, cloud ceiling>=60m) to CAT II (RVR 350m, cloud ceiling>= 30m);

- Another example: Appreciate the criticality of crosswind and tailwind component limitations to changes to runway configuration with different throughput. Airports with crossing runways deliver very different operational capacities depending on the runway configuration in use. For instance, Zurich airport operates six runway configurations (concepts). With concept "North" delivering the highest throughput:

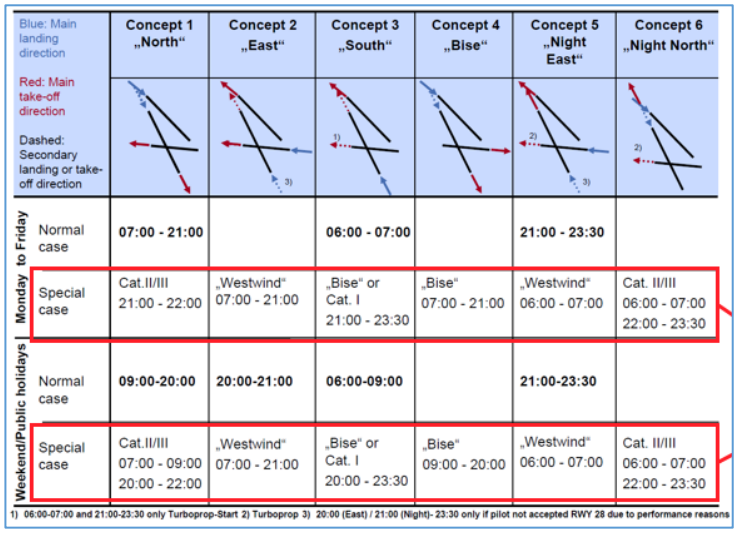

Figure 1: Zurich runway configurations ("bise" special case)
(Courtesy to Zurich Airport)

RWY 28 and RWY 16 for departure; RWY14 for arrival.
With Easterly wind, locally known as "bise", tailwind component for the main departure RWY28 in concept "North" **exceeds 5kts,** which requires the change to departure RWY10 with reduced throughput. The punctuality performance of the airport in the "bise" concept may drop down to 50%, while the performance target is set to 80%. The "bise" configuration calls for ATFCM regulations too.
Therefore for the operational stakeholders in Zurich it is important to anticipate the "bise" conditions and proactively prepare the coordinated response of Zurich airport and Skyguide (the ANSP), preferably involving SWISS too. The "O^2 briefing sheet" developed by Zurich airport (see chapter 5.4 "Examples of user-tailored MET products") uses the MET forecast to calculate and display critical threshold values for several weather

phenomena, such as the tailwind component for departure RWY28. The "O^2 briefing sheet" summary indicates if a change of runway configuration is expected or not.

- Convective weather/CB/ Thunderstorm at and in vicinity (10 km radius) of airports has increased in recent years due to climate change. Both-Southern (Athens) and Northern (Helsinki, Stockholm) European airports participating in the Task Force reported increase of both, frequency and intensity.

Figure 2: Lightning strike damages aircraft on parking stand
(Courtesy to AENA)

Thunderstorms at and in vicinity of an airport halt ground operations: due to the risk of lightning strike, aircraft refuelling, the use of GPU (Ground Power Unit) 400 Hz cable and of the Headset equipment by Ground handling, are prohibited. The French Ground Handling Manual advises all Ground handling staff to seek refuge in the service buildings for the duration of the thunderstorm at the airport. When ground services are put on hold, runway movements halt as well.

Accurate now-casting MET service (+30 min to +3 hours forecast) is particularly useful in Thunderstorms at the airport, because the dynamic prediction of the evolution of the thunderstorm allows for:

- ground operations prompt re-start in the recovery phase;
- flights in holding stacks to benefit from an estimation of the remaining holding time, based on which the aircrews decide to hold or divert;
- fine tuning of the applied ATFM Wx regulation to the predicted duration of the convective event, important for flights on long sectors held on the ground (see chapter 8.2).

Recommendation #1 MET forecasters' team embedded in OPS

The Task Force recommends that the MET forecasters' team be embedded into the operational airport and ATC units to promptly inform on threshold values for a variety of weather phenomena. The integration of MET advice could be conducted via teleconference, when the MET office is located remotely.
From ops perspective, very important elements of the MET forecast are the **start, duration, end time and severity of the Wx phenomenon,** because they directly relate to the parameters of the corresponding Wx AD ATFCM regulation -start, duration and arrival rate.
MET specialists to use plain language in text forecast.

5.2 Operationalised MET forecast. Consistency of MET advice. Common, harmonized and user oriented MET information.

5.2.1 Operationalisation of the MET forecast

5.4 Making the MET forecast "operational" consists of linking the characteristics of the forecasted weather phenomena to specific capacity reduction values. The benefits are two-fold:

- The forecasted event is linked with an estimation of operational capacity. Predicting weather is a scientific activity with its own language that operational staff may not be familiar with. By explaining the likely operational implications, ATC, aerodrome and airline staff grasp the essential take away - how the weather will impact their operational duties;

- By linking the Wx forecast to concrete capacity values, the interpretation of the Wx forecast remains consistent across all users and protected from subjective interpretation that may trigger different operational response from one person to another. For example when a CB activity is predicted and depending on the ATC SUP on duty, an ATFM regulation may be requested right away upon forecast receipt (more conservative approach), while other ATC SUP may await a confirmation of the forecasted CB occurring before requesting an ATFCM regulation.

5.5 An example of MET forecast operationalisation is the **LVP Matrix used for UK airports.** Operational actions are driven by a defined LVP Status: NATS and each Airport have pre-defined flow rates for each LVP status. ATFCM regulations are requested upon Medium to Medium High forecast probability of occurrence. Common and harmonized MET advice is the result of sharing of the **operationalised** weather forecast across all airport stakeholders, including NATS TWR and APP, the Airlines, the FMP and the Aerodromes concerned.

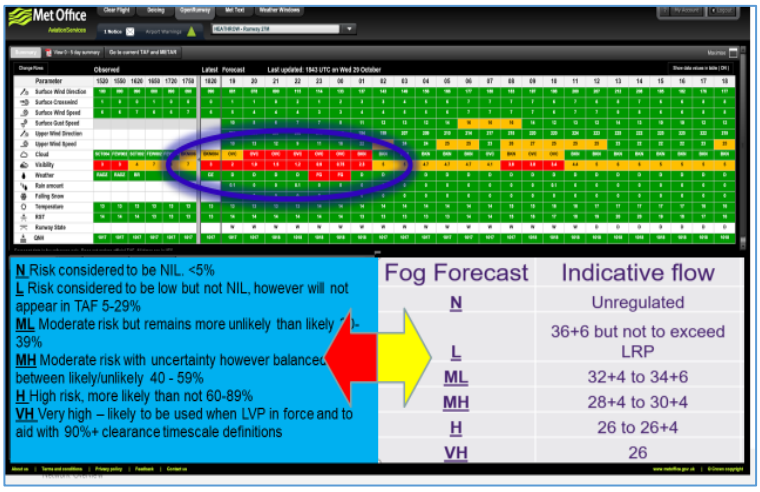

Figure 3: LVP Matrix with associated rate values

(Courtesy to the UK MET Office)

Recommendation # 2 Harmonised utilisation of risk thresholds for Wx AD ATFCM
Implementing a regulation depends on the forecasted risk of a specific Wx phenomenon, according to local instructions and procedures. It is recommended that ATFCM Wx AD regulations apply when defined risk threholds are reached. This leads to improved forecasting, along with predictable and objective decisions on implementing ATFCM regulations.

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5.2.2 Consistency of MET advice

5.7 Sharing of common situational awareness, in particular the weather forecast across all stakeholder groups is the pre-requisite for joint coordinated response to weather disruptions. Trust in the weather info, confidence in the accuracy, reliability and more importantly, consistency of weather advice are the necessary conditions for airport stakeholders to make consequential operational decisions such as reducing the number of flights.

The MET team based in the APOC/Airport and the MET team in the ACC both give MET advice on the same event. To provide a consistent MET product, it is important that both teams interpret the probabilistic forecast in the same way and use the same language for ops briefings. An example from the Task Force is the handling of the storm Ciara in February 2020 when special attention was given to the consistency of forecasting between the MET offices based in the Heathrow HOEC and in NATS Swanwick ACC. The operational staff from the airlines, HOEC and NATS were given a consistent interpretation of the storm; this built confidence in the forecast and supported a critical operational decision: reduction of 30% of flights.

Another recommendation came out of the Ciara storm experience - the importance of post-ops analysis to understand the effects of network-scale weather events over large area, especially on go-arounds and diversions.

5.3 Uncertainty of the Weather forecast. Risk Matrix

5.8 Accurate weather forecasting is essential for the readiness of the airports to deal with weather disruption. High reactionary delays occur when weather events happen unexpectedly at an airport, requiring last-minute change to the operational plan. **From operational perspective, early notification of developing weather phenomena with sufficient confidence in the forecast is essential.**

5.9 On the other hand, the operational stakeholders should understand the limitations of a weather forecast. It is a probabilistic estimation that contains a level of uncertainty that cannot be eliminated. Forecast probability varies for different phenomena, e.g. high winds and thunderstorms are easier to predict than fog (although for thunderstorms, the exact location and intensity estimation might be challenging).

5.10 **The question is "How to activate an operational plan based on a forecast that will always contain some degree of uncertainty". The answer lies in two aspects:**

Recommendation #3 Attention to the forecast uncertainty. Risk Matrix

- MET forecasters to draw attention to the uncertainties and possible effects (e.g. timing, intensity). This allows the operational user to ask questions to clear up uncertainties or to adjust their processes. For each weather phenomenon (e.g. snowfall) three scenarios should be estimated. These are: **best possible scenario, most probable and worst-case scenario.**
- The operational users to associate capacity decrease values to each one of the three scenarios (the best, the most probable and the worst).

- Secondly, define a Risk Matrix.

5.3.1 Risk Matrix

5.11 The terms “Risk” and “Uncertainty” are often used interchangeably, although they refer to different features of the weather forecast:

- “Uncertainty” refers to situations under which either the outcomes and/or their probabilities of occurrences are unknown to the decision-maker.
- “Risk” refers to decision-making situations in which the decision-maker knows all potential outcomes and their likelihood. **The Risk of Wx phenomenon associates the probability of occurrence to the expected operational impact**.

5.12 Weather terminology has a specific meaning, based on ICAO, but operational users may have a different understanding. The risk interpretation drives the behaviours desired, e.g. prompting a phone conference to enable more proactive planning. **Therefore, it is important to use consistent interpretation and terminology across all operational stakeholders.**

Example of Risk matrix

The Cross Border Forecast aims to highlight areas where there is a chance of convection. EUMETNET partners use a unified Risk Matrix to estimate the likelihood and the geographical extent of convection in these areas. The Risk Matrix shown distinguishes four grades of severity – marked by different colours - and three types of appearance of convection: isolated, clustered and widespread.

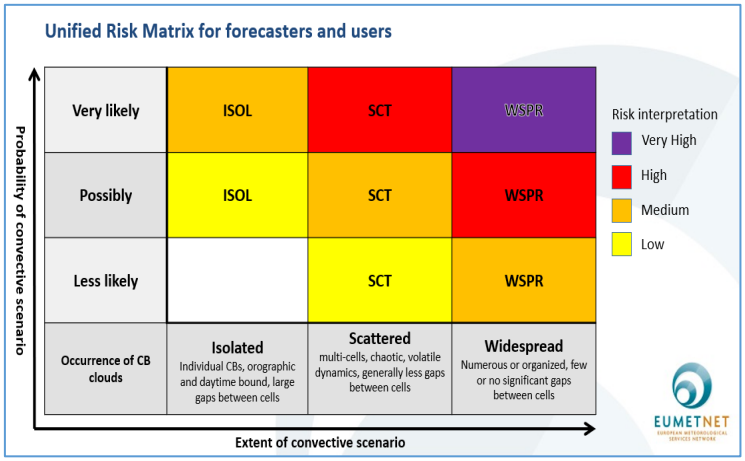


Figure 4: Risk Matrix Cross Border procedure

(Courtesy to the EUMETNET)

The Risk Matrix Y-axis shows the probability of the convective weather, the X-axis shows the spread/magnitude of the convection. The colour code represents the severity of the risk-from low (yellow) to high (violet).

5.4 Examples of user-tailored MET products

5.4.1 Winter Wx Briefing for UK Airports

5.13 Developed for use with charter airlines. Helps airlines manage customers' expectations e.g. an airline can proactively move coaches to alternate airports or time departures/arrivals.
Includes a Map of hotspots with text clarification and summary of weather situation for Saturday and Sunday.
The Winter Wx briefing is designed for individual airlines. For now there is no global warning system for airlines on deteriorating Wx at destination airports.

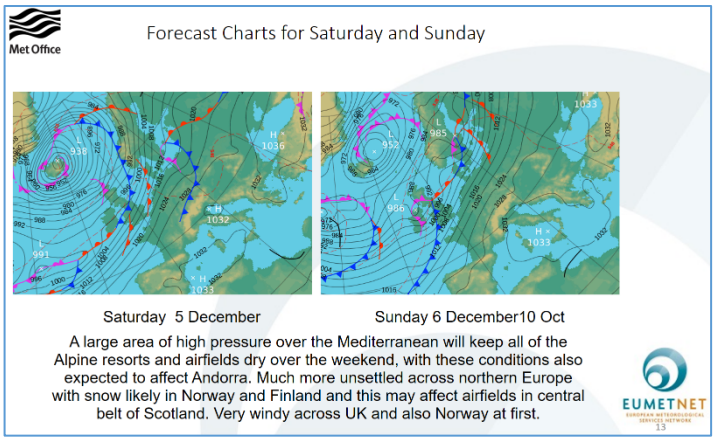


Figure 5: Winter Wx Briefing for UK Airports (Sat and Sun charts)
(Courtesy to the UK MET Office)

5.4.2 Zurich Airport and MeteoSwiss "O^2 briefing sheet"

5.14 Zurich airport and MeteoSwiss enhanced the TAF to the so-called "O2 briefing sheet" that represents a common MET situational awareness platform for Zurich airport and Skyguide. The HTML O^2 briefing sheet contains 24-hour predictions based on machine learning for the likelihood of the limiting "bise" runway concept, along with expected traffic demand per hour and forecasted MET conditions at the airport.

Weather Forecasting ZRH
O2 Briefing Sheet / Content

Format	HTML-Sheet
Distribution	0519 / 1119 / 1519 / 1819 / 2219 (automatic delivery)
Forecast Period	24 hours
Data Resolution	hourly resolution
Current Content	Meteogramm from MET Provider (Meteo Schweiz) + RWY Concept Forecast + DEP16 Prediction + Expected ARR and DEP according flight schedule

Figure 6: Content description of the O^2 briefing sheet
(Courtesy to MeteoSwiss and Zurich Airport)

6 Evolving the role of the Flow Management Position (FMP)

6.1 ATFCM Operations Manual v24.1 overview related to ATFCM Wx Aerodrome regulations/procedures

6.1 For the purpose of ATFCM, NMOC has traditionally interacted with the Flow Management Positions (FMPs). The *ATFCM Operations Manual [2]* is the reference document describing operational procedures between Network Manager Operations Centre (NMOC) ↔ FMPs. Only recently, the ATFCM Operations Manual extended to ATC/TWRs of A-CDM airports, for specific procedures, where ATC/TWR can directly contact NMOC, and vice versa, when coordination on individual flights is required.

As for Aerodromes – the FMP remains in charge of coordinating ATFM measures to protect the Airports in the FMP area of responsibility, when capacity-impacting events occur at airport locations, including adverse weather. The FMP is the main focal point for ATFM relevant information within the area of responsibility, including for the Airports under its jurisdiction. The FMP is also responsible for all ATFM measures. Airports can provide weather event information to the NMOC in the strategic, pre-tactical and tactical phases through the Airport Corner, but this aerodrome information does not initiate ATFM regulations. **The single channel for ATFCM AD regulations remains the FMP↔NMOC.**

6.2 Adverse weather at Aerodromes is a topic featured extensively in the ATFCM Operations Manual [2]. Chapter 6 "Procedures in unusual circumstances" discusses mostly weather phenomena affecting capacity at aerodromes: De-icing and Low Visibility Conditions.

- ATFCM Operations Manual Chapter 6.1.1 describes in detail the **"Departure/Slot Tolerance Window Extension procedure"** used to cope with De-icing and snow accumulations on the airport manoeuvring area.
- ATFCM Operations Manual Chapter 6.1.2 describes the procedure for ATFM regulation with Exceptional Conditions **"XCD Regulation"** to respond to Low Visibility when the LVPs limit the access of traffic to the airport: not all scheduled flights will comply with the RVR minima for CAT II, CAT III and PBN LPV/GLS approach procedures.
- Exceptional conditions "XCD" regulations may apply together with the **Delay Threshold Mechanism:** flights with a delay larger than the threshold (usually 3 hours) are suspended (receive a FLS) and those with a delay lower than the threshold receive a Slot Allocation Message (SAM).
- XCD regulation is also used in the event of non-availability (zero-rate regulation) of an aerodrome.

6.3 In severe cases of non-availability of the aerodrome (e.g. Heathrow's snowfall on 17-23 December 2010) where there is evidence that no improvement is expected in the next hours, an **EU restriction regulation** can be used. The application of EU restriction requires at least 2-hour lead-time to be effective and the publication of a NOTAM (see chapter 5.6.7 of the ATFCM Operations Manual).

6.4 In other cases where the weather phenomenon is of limited duration, an **Airport Cherry Pick regulation** (ATFCM Operations Manual chapter 5.6.3) may be more appropriate, instead of a blanket regulation to all traffic.

6.5 Another ATFCM Operations Manual chapter 5.5.8 **"Severe Weather Assessment procedure"** details the NM processes to identify, alert, communicate and monitor weather conditions likely to impact ATC and Aerodrome capacity and flight profiles. The procedure enables the pre-tactical sharing of NM expectations with the FMP in an endeavour to prompt a review of the potential impact and eventually trigger ATFCM AD regulation. The aim is to pro-actively protect ATC and aerodromes from excess workload and give time for the airspace users to explore operational options and optimise flight efficiency.

In Chapter 5.5.8, the ATFCM Operations Manual defines Severe Aerodrome Weather as following: *"Where a weather impact reduces capacity at an airport by 5% or more, when operating at 70% or more of its operating runway or ground capacity, whichever is the lesser, and may result in ground handling complexity, air holding of 20 minutes or more, or impact en-route complexity."*

The following aerodrome weather events are listed:

- Severe winter / summer storm.
- Convective activity: (CBs: isolated, widespread cells with or without lightning).
- Strong and/or gusting winds: >30kts or local RWY criteria.
- Visibility; Low Visibility Procedures (LVPs): (visibility<800m and RVR<550m) / cloud ceiling <60m.
- Severe precipitation (rain; freezing rain, snow & icing) on runway, or ground infrastructure.

6.6 As described in the previous paragraphs 6.2 through 6.5, the Network Manager has developed an arsenal of ATFCM procedures to counter Weather disruptions at aerodromes. The correct choice of appropriate ATFCM procedure/regulation and its efficacy depends primarily upon two factors:

- **The FMP's awareness of the forecasted weather phenomenon and the extent of its effect on aerodrome capacity-estimated start time, duration, severity and operational risk assessment (see chapter 5.3 and 5.2 of this report on the role of the MET forecaster);**
- **Timely coordination and activation of the ATFCM regulation with the NM Pre-Tact or NM Tactical teams.**

6.2 Suggested areas of improvement to the role of the FMP

6.7 As discussed in paragraph 6.6, there are two factors to ensure the correct and timely application of tailored ATFCM measures for managing adverse weather phenomena at aerodromes.

6.8 Therefore, from Airport and Network perspective it is of paramount importance that the FMP be:

Recommendation #4 FMP's Awareness of Airport Wx Risk and planned OPS response to Wx
▪ Fully aware of what is happening at the airport by following the evolution of the Aerodrome MET forecast from D-2 leading to the day of operations; (and other events affecting airport infrastructure and ground services, as appropriate). **In addition to the standard METAR and TAF it is recommended that the FMP receive the local Airport MET service detailed forecast (if produced/available).**
▪ The D-2 horizon aligns with the start of the preparation of the ATFCM Daily Plan (ADP). The ADP is a proposed set of tactical ATFCM measures prepared pre-tactically and

agreed between all partners concerned to optimise the European Network. It covers a 24-hour period (the day prior to the day of operation) for each day.

Normally the ADP starts as a draft on D-2 and it is finalised and promulgated on D-1 by means of the ATFCM Notification Message (ANM) and the Initial Network Plan (INP). The ADP forms the basis for the Initial Network Plan (INP) published on the NOP at D-1 to inform all network partners, in particular the airspace users on planned ATFCM regulations, Airport status, RAD status, and significant en-route and AD Wx phenomena. The Airspace users consult the INP to adjust their operations.

- Starting at D-2, when the weather forecast identifies a risk of adverse conditions, the FMP coordinates with **the local ATC TWR and the Airport/Aircraft Duty Manager or the APOC SUP** (where APOC is established) about the operational impact of the Wx forecast on the airport operations. This includes the apron capacity that may become the bottleneck, depending on the weather phenomena, such as thunderstorm at or in vicinity of the airport, snowfall, or freezing rain.
- After assessment of the forecasted Wx impact on the airport operations, the FMP coordinates with the NM Pre-tactical and Tactical Teams the most appropriate regulation measure for the affected airport(s) in their area of responsibility.

6.9 The "wish list" in the previous recommendation #4 about the FMP's Awareness and Operational Risk Assessment of the aerodrome weather, encounters a variety of impediments; these impediments are coupled with remedies, listed in Recommendation #5 below. **The intention is to preserve the existing working arrangement between the NMOC and the FMP that works well, and to reinforce the FMP ↔ local ATC TWR and Airport (Aircraft) Duty Manager/APOC SUP connection.**

Recommendation #5: Convergence of FMPs to Airport operat-ions/-ors

- Physical distance: The FMPs unit is part of the ACC centres located hundreds of kilometres away from the Airports. The FMPs have no direct visibility on the Airport operations and Wx conditions. FMPs rely on indirect information from TAF/METAR and ATC TWRs.
  - ❖ Remedy: Familiarisation visits to the airport (s) as part of the FMP training and renewal of licence rating. Knowledge of airport layout, hotspots and most frequent Wx phenomena.
- FMPs background: Normally en-route controllers become FMPs without (recent) experience as TWR controllers. Unless dedicated "Airport operations" module is provided as part of the ATFCM training syllabus, the FMPs may have no appreciation of the complex eco-system that airports are. Unlike en-route, airport operations are mostly driven by the services of the Airport Operator and the Ground Handling companies.
  - ❖ Remedy: Develop "Airport module" in the FMP Training syllabus. Focus on the role of Airports as nodes of the Network. In addition, elaborate on the responsibilities of every Airport Service. Invite FMPs and ATC TWR to local daily Airport videoconferences convened by the Airport/Aircraft Duty Manager/APOC SUP.
- Need for dedicated connection and coordination procedure with the Airport (Aircraft)

Duty Manager at non-APOC airports, in addition to the existing FMP-TWR contact. FMPs may rely on the ATC TWR for supply of timely and quality information about the effects of Wx phenomena on airport operations, including ground services, e.g. de-icing, snow clearing, fuelling and push-back operations.

Unless the ATC TWR is part of collaborative working arrangement with the Airport stakeholder (e.g. APOC), normally ATC TWR has direct contact only with the Ramp Agent, responsible for push-back and marshalling. Therefore, the situational awareness of the ATC TWR may not be sufficient to inform the FMP on the operational risk and the planned Airport response to adverse weather.

The Airport/Aircraft Operations Duty Manager or the APOC SUP (if APOC established) are responsible for assessment of the operational risk and decisions about the Airport Operator's response to adverse weather.

❖ **Remedy: establish APOC, or other local collaborative cell where the FMP is part of the working arrangement that deals with adverse Wx at the aerodrome. Hold daily videoconferences between TWR units and FMP representative including a meteorologist, who first presents the Wx forecast for the aerodrome(s) concerned after which FMP, TWR SUP and Aircraft Duty Manager/APOC SUP can discuss measures based on the same elaborate MET report and the experience of the local operational officers.**

Early briefing can focus on day of operations, an afternoon briefing on the following day (s). See the next chapter 7 of the report "Airport stakeholders' local collaboration cell."

6.10 The ideas on the FMP's convergence to Airport operations, expressed in Recommendation #5 have been evoked in previous AOT and NDOP Task Forces with European coverage:

- the NDOP Airport Integration TF [7] (in 2018-2019) on "Concepts for full Airport Integration. Changes to ATFCM: Roles and Responsibilities";
- the AOT "APOC-NMOC" TF [6] (in 2019-2020) on procedures for interaction between local APOCs and the NMOC;
- the AOT APOC/CONTINGENCY TF [5] (in 2017-2018) that worked on the AOP-NOP data set; and on APOC-NMOC procedures for Airport Emergencies.

7 Airport stakeholders' local collaboration cell

7.1 All participating Airports, ANSPs/FMPs and Airspace users described local procedures with varying degree of collaboration and joint decision-making.

7.2 The analysis highlights the commonalities across the presented best practices for management of adverse weather at aerodromes. The details of each best practice are available in the descriptions in the Appendix "B" (London Heathrow), "C" (Amsterdam Schiphol) and "D" (Stockholm Arlanda).

7.3 To keep abreast with the latest airport collaborative developments, the following chapter 7.1 takes APOC as default arrangement. Commentary is made when a distinction to non-APOC airports applies.

7.1 Airport Operations Centre (APOC). Technical enablers: Airport Operations Plan (AOP) and Demand-Capacity Balancing (DCB) tool

7.4 The chapter assumes the reader's background knowledge of concepts like APOC, AOP and DCB. Suggested reading on the subject: Airport Network Integration-Concept for establishment of an Airport Operations Plan" [8], "Concepts for full Airport Integration. Changes to ATFCM: Roles and Responsibilities" [7]; Arrival Planning Information (API) Implementation Guide edition 1.0 from 01 July 2020, [4];

The next paragraph gives an APOC definition together with two pictograms, as a short refresher on the topic.

An **Airport Operations Centre (APOC)** is one form of a ground coordination (GC) arrangement at an airport, whereby operational stakeholders (actors) collaborate for the effective/efficient implementation of an agreed operational plan, in a structured manner with agreed processes, either through physical or virtual interaction

The **Ground Coordinator (GC)** is a local coordination arrangement at an airport that can be established with or without an APOC, and ensures that consolidated information is shared between local stakeholders and with the NMOC.

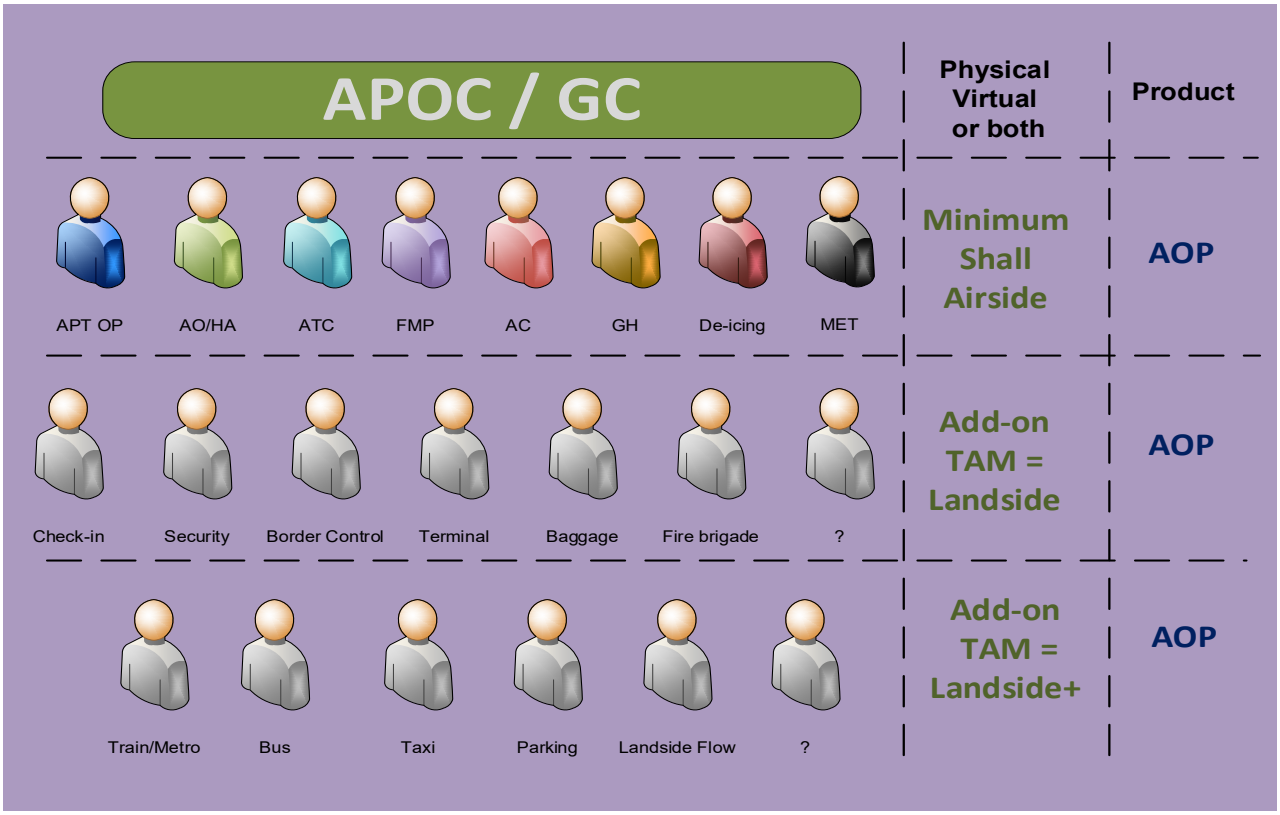


Figure 7: APOC/GC set-up overview (Source: NDOP APTI TF "Airport Network Integration: APOC and AOP")

The pictogram below outlines the relationship between APOC, AOP, DCB, and NOP.
It is the FMP-APOC relationship identified as generally missing today.

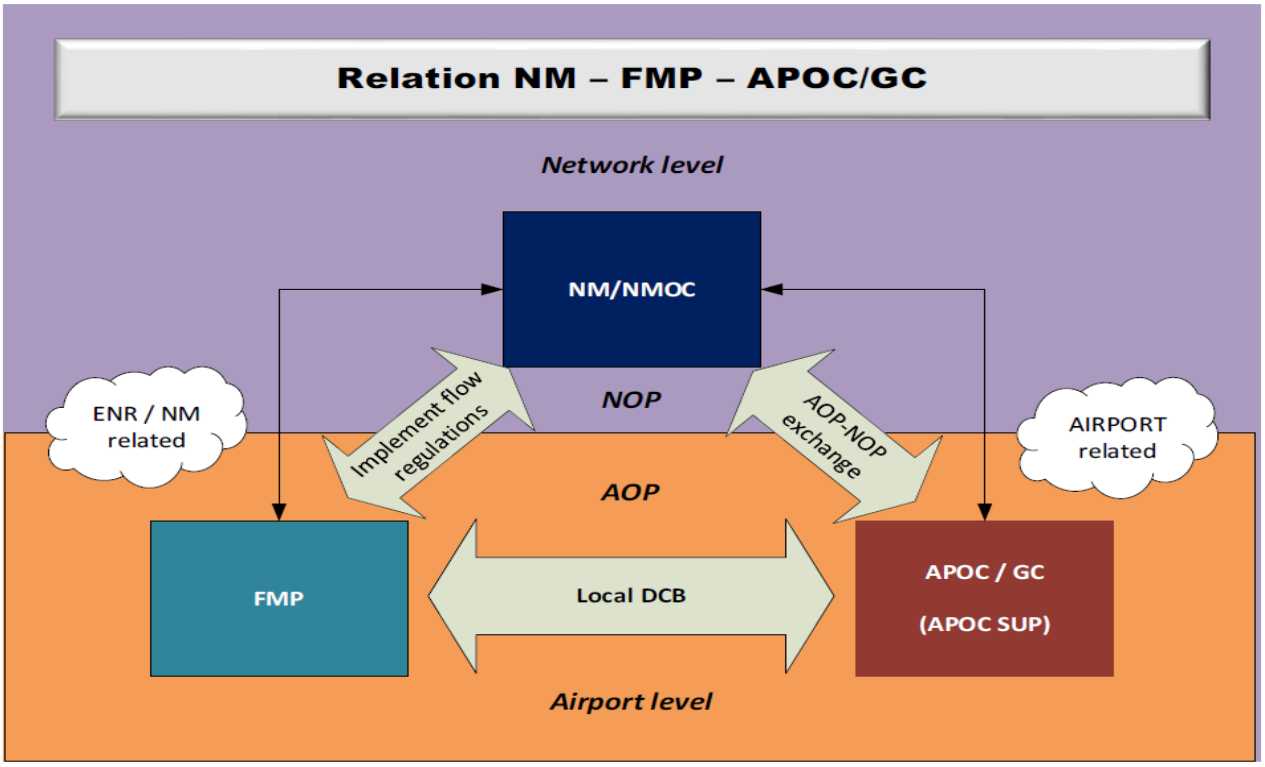


Figure 8: Relation NM-FMP-APOC/GC (Source: NDOP APTI TF "Airport Network Integration: APOC and AOP")

7.5 Common situational awareness is important in the pre-tactical and tactical phase for all airport stakeholders. A DCB tool and AOP together enable common situational awareness.

A DCB tool receives, as one of many inputs, an operationalised weather scenario, through a dedicated MET interface. A separate DCB tool component predicts the corresponding operational capacity values, taking into account trajectory adjustment for in-bound and out-bound traffic affected by weather, along with constraints on aerodrome infrastructure and services, caused by the phenomena. The constraints on infrastructure and service are based on historical experience with similar weather events. Artificial Intelligence may be used to identify patterns and similarities with previous occurrences.

As an output, the DCB tool implemented by Heathrow for instance, calculates the **predicted** in-block times for arrivals and off-block times for departures (PIBT and POBT). The DCB tool can calculate as well different 'what-if' scenarios based on reduction of demand if flights are cancelled, and/or for different arrival rates. The predicted in-block and off-block times feed directly into the AOP and are displayed next to the scheduled in-block and off-block times for each flight, for all airport services to see the deviation to the scheduled times for each flight. The AOP displays other details for the flight as well: IATA/ICAO call sign, aircraft type, stand and status. The AOP also shows high level KPIs, e.g. current global On-Time Performance (OTP), percentage of early arrivals, percentage of flights with arrival delay < 15 min, Punctuality indicators such as start-up and TSAT delay.

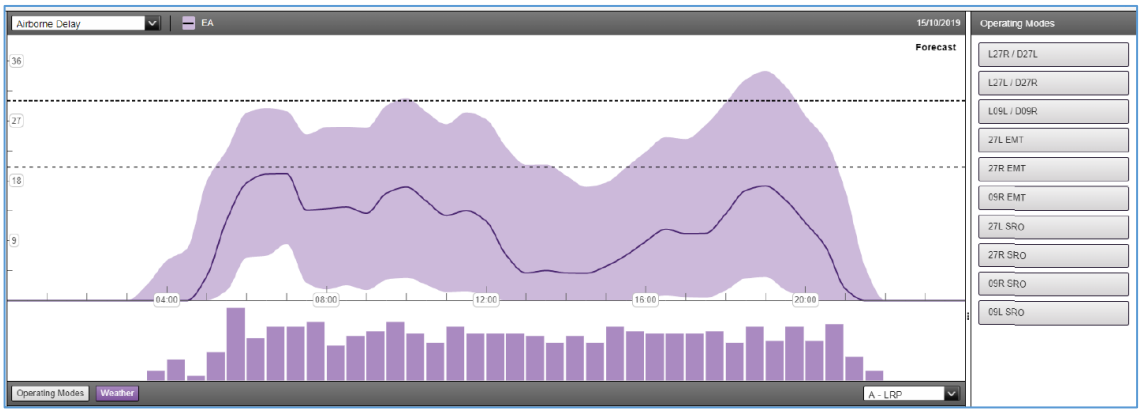


Figure 9: Heathrow DCB tool, Demand-Capacity Balancer page

Each operational stakeholder uses the AOP and the KPIs displayed on the AOP as a common reference to decide how to best respond and react based on their internal business processes.

7.2 Common features across Airport Collaborative Best practices for Management of adverse weather conditions

7.2.1 Established Local Collaborative Cell

7.6 **All best practices presented at the Task Force unanimously emphasised the benefits of local collaborative cell that enables optimal decision-making in adverse weather events.**

Interestingly, the creation of the **Heathrow APOC** originates from a severe weather event - heavy snowfall during Christmas holidays in 2010 (17-23 December). Following the severe disruption, the Winter Resilience Inquiry was launched, chaired by one of the non-executive BAA directors, transport specialist Professor David Begg. The Begg's report (named after the leader at the helm of the inquiry) strongly recommended the creation of local collaborative cell to manage disruptive weather, the **Heathrow Operational Efficiency Cell** (HOEC). The HOEC working arrangements and in particular the Heathrow DCB tool and AOP, along with the AOP-NOP connectivity aligned and used the SESAR developments in the Operational Focus Area "Airport Operations Management".

The Amsterdam Schiphol Collaborative Decision Making cell (CDM) has existed for the last 20 years and exemplifies the typical Dutch spirit of cooperation. Due to the country's history, along with its peculiar geographical location, (1/3 of the country territory is below sea level), the individual survival depended on the collective effort, including massive construction projects to conquer land from the water-building dykes, fortresses and embankments. The "Polder model" in economics for finding consensus, originates from the "Dutch Pragmatic Pluriformity".

The Stockholm APOC that is quite young (since 2018) applied the SESAR APOC and AOP concepts developed in the Operational Focus Area "Airport Operations Management" and further operationalised in the NDOP Airport Integration Task Force. The account on how the new collaborative processes improved winter operations, compared to the old Snow Plan, was impressive.

7.7 While Stockholm and Heathrow rely on the Airport Operations Plan (AOP) as sharing platform for all airport stakeholders, Amsterdam Schiphol uses human-to-human coordination. Four "CDM Capacity briefings" take place daily at 03.30, 09.15 (face-to-face meeting), 14.00 and 20.30 LT.

Across the three best practices the **minimum participation includes** the Airport/Aircraft Operations Duty Manager (chairing the meeting), the MET Office, the ANSP (TWR and APP), or ANSP liaison officer, home based carrier (OCC department), other airlines and Ground handling.

The daily collaborative cell meetings are named differently: "CDM Capacity Briefing" in Amsterdam, "APOC conference" in Heathrow and "Tactical Traffic Forum" in Stockholm Arlanda. The outcome of these daily collaborative conferences is the "Schiphol RWY Capacity Forecast", "Heathrow Service Plan" and the "Arlanda Snow Plan".

7.8 At Heathrow, the DCB tool estimates feed directly into the AOP to publish a plan for all; Stockholm also uses the AOP for updating the Snow Plan after each Tactical Traffic Forum; the "Schiphol RWY Capacity Forecast" is manually updated 4 times a day and distributed to all participants of the "CDM Capacity briefing".

- The operational areas discussed in the local collaborative cell daily conferences cover: **The Heathrow Service Plan, Schiphol RWY Capacity forecast , Stockholm Snow Plan** that are different names for a rolling Airport Operations Plan;

Recommendation #6: Proposed standard topics for the daily Airport collaborative conferences

- The Airport Operations Plan for D-2, refined at D-1, using input from a DCB tool, or expert judgement if a DCB tool is not available.
- Comparison of forecast demand vs. scheduled demand;
- Early identification of likely flow constraints for arrivals & departures;
- Commentary on likely impact of weather & operational restrictions;
- WIP;
- Airspace/ATC;
- Airline Requests.

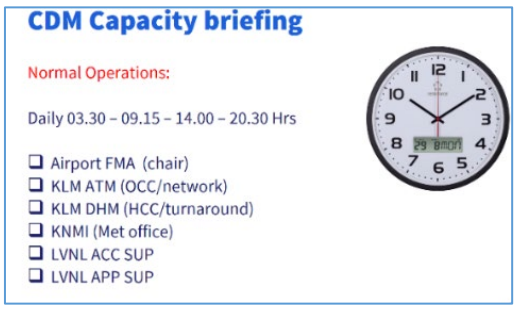


Fig 10 Participants in the AMS CDM Capacity Briefing

7.9 The detailed descriptions of the three collaborative arrangements at Heathrow, Schiphol and Stockholm Arlanda, are included in appendices "B" (Heathrow), "C" (Amsterdam) and "D" (Stockholm Arlanda).

7.2.2 Early start of weather trend monitoring

7.10 In all best practices, **the MET team is embedded** in the collaborative cell team, which facilitates communication, understanding of operational issues and timely provision of required MET products.

Recommendation #7 Monitor and do regular risks assessment starting at D-3

The best practices reported weather trend monitoring as early as D-15. Trend monitoring follows the evolution of the big-picture weather genesis that may give rise to specific phenomena with impact on aerodrome operations.

The risk of adverse weather that may affect the airport is reported to the operational stakeholders at D-3 at the collaborative cell conferences. As discussed in chapter 5.2.2 "Consistency of MET advice" MET specialists from the airport and ACC centre align their respective forecasts. **The Goal:** early tracking and preparation for weather conditions that might (severely) affect airport capacity.

7.2.3 Pre-agreed adverse weather capacity reduction scenarios (playbook)

7.11 All best practices reported the availability of a **set of pre-agreed weather reduction scenarios (playbook)**, developed for each type of weather phenomena at different level of severity. Amsterdam Schiphol has been using the "Adverse Conditions Manual" for more than 20 years. It contains runway configurations linked to capacity values for the most prevalent adverse weather phenomena-High winds and Heavy rain. Standard scenarios are also developed for Lightning strike (with audio and visual warning system), Low visibility and Snow operations.

Stockholm Arlanda works with a common Seasonal Snow Plan agreed with the APOC, LFV (the Swedish ANSP) and SWEDAVIA (Airport Operator) and home based carrier Scandinavian Airlines (Scandinavian airlines have temporarily discontinued the participation in the Tactical Traffic Forum due to the COVID situation. It will be reinstated as soon as practicable). Common capacity reduction table for snowfall is agreed between the aforementioned airport stakeholders.

Joint table to calculate the rate

Number are not updated

RWY	Cap	B/A 1x M-G 2x P-M	Snow 60min x1, 45min x2, 30min x3	Apron 1 x per apron	Gate 1 x per terminal	De-ice 1 x per handler	TWY 1 x per closure	Tech 1 x per system	Total
26/19R	61	-5 -10	-10 -15 -20	-6	-6	-6	-6	-6	
26/01L	50	-5 -10	-8 -12 -16	-5	-5	-5	-5	-5	
01L/08	68	-5 -10	-11 -17 -22	-7	-7	-7	-7	-7	
19R/08	72	-5 -10	-12 -18 -24	-7	-7	-7	-7	-7	
Single-RWY	40	-5 -10	-7 -11 -15	-4	-4	-4	-4	-4	
01L/01R 19R/19L	84	-5 -10	-14 -21 -28	-8	-8	-8	-8	-8	

Figure 11: Stockholm Arlanda rate calculation table

London Heathrow also confirmed working with pre-agreed capacity reduction scenarios for weather events that are pre-programmed in the DCB tool. The DCB algorithm continuously updates the predictions of in-block and off-block times of each flight, based on the selected MET scenario. The pre-programmed scenario is fine-tuned with specific parameters of the predicted weather event.

7.2.3.1 Time line for Operating pre-agreed capacity reduction scenarios for adverse Wx:

- D-15: the process starts 15 days ahead of the event by identifying risks and trends for the forecast, does not look into details, but on the big picture. May involve decisions such as additional staff from the airport operator in case of winter weather;
- D-5 to D-2: the forecast is detailed;
- D-2 to D-0: perform risk assessment, the start and duration are clearer, the forecast has higher granularity, certainty increases;

Recommendation #8: D-1 selection of capacity reduction scenario from pre-agreed playbook

At D-1 the precise capacity reduction scenario linked to the Wx event is selected and promulgated in the Airport Operational Plan (Schiphol RWY Capacity forecast, Heathrow Service Plan, Stockholm Snow Plan). The main outputs are: predicted arrival rate, predicted departure rate, taking into account arrival and departure traffic peaks. Incorporates flow rates/monitoring values for ATFCM regulations, displays likely departure delay.

The activation of the corresponding ATFCM AD Wx regulation with NM, to be done on the day of operations with sufficient lead-time, agreed between the airport stakeholders, in particular by the FMP responsible for ATFCM in the area of responsibility.

- At this point, **the FMP** has a good idea of the reduction of arrival rate to be requested with NM. The D-1 initial selection of agreed capacity scenario aligns with the D-1 preparations of the NM ATFCM Daily Plan (ADP), allowing the participating FMP to be well informed on the operational airport plan and capacity reduction agreed with the airport collaborative cell. For some Wx event with higher uncertainty of prediction, e.g. fog, the exact start and arrival rate reduction may be known only at D-0.
- In the morning at D-1 the main part of **the DCB discussion** takes place, including the home-based carrier. The capacity reduction scenario for the weather event is confirmed. Airport stakeholders refer to the agreed activated scenario in the AOP to decide on how to best respond and react using their internal business processes.

Recommendation #9: Now-casting and prompt change of scenario if needed, based on the evolution of the Wx phenomenon

D-0: Now-casting (+30 min to +3 hours). If a change of scenario is needed based on the now-casting - do it early. For example, KLM takes 2 hours to adapt to a new scenario and gates at AMS are saturated very quickly. At Schiphol for instance, it typically takes more than 2 hours before any change in scenario has real effect. Clear trigger points for changing of scenarios are necessary. The FMP to be kept in the loop if the change of scenario requires an update of the activated ATFCM AD Wx regulation (e.g. arrival rate, duration, end time).

- D+1 to D+5: post-event review, sharing of post-ops performance statistics, lessons learnt data base update.

7.3 Pre-tactical flight cancellation procedures-Sector briefing (Schiphol) and Capacity Constraints Intervention Policy (Heathrow)

7.12 The Heathrow and Schiphol best practices use pre-tactical flight cancellation on the day leading to the day of operations. Pre-tactical flight cancellations are used when significant weather events are forecasted which prevents the execution of a full schedule for the day. The “Demand versus Capacity” protocol (DvC) is activated at Heathrow to cope with weather disturbances with duration of 24 hours. For severe Wx events extending over several days (e.g. storm Ciara in 2020) with a significant impact longer than 24 hours, or any event or loss of asset seriously affecting processing capacity, a more restrictive procedure is used - the Heathrow ATM Demand and Capacity Balancing procedure (HADACAB).

There are two conditions for the application of pre-tactical flight cancellation practices:

- They are only used at airports that operate a schedule with no "fire breaks" to recover from delays throughout the day, with "blanket" pattern traffic demand. Heathrow and Schiphol are known to operate close to their capacity limits all day, every day: Heathrow with global capacity of 88 mvnts/hour on only two parallel runways and Schiphol with 110 mvnts/hour global capacity with six runways that cannot be operated at the same time (wind direction) and are subject to serious environmental restrictions. Strict night curfews apply to both airports.

  Amsterdam handles a traffic pattern with seven daily peaks of the home based carrier KLM. Recovery from delays especially in the first rotation is close to impossible. Heathrow operates a "blanket "traffic demand. This is why pre-tactical flight cancellations on the D-1 are required from the Airspace users, when capacity reduction reaches critical thresholds:

  - For Schiphol: any event that reduces total capacity (in- + outbound) by 50% or more for a period of 4 consecutive operating hours or more;
  - For Heathrow: any forecasted weather event that reduces the arrival flow rate below 36/60, Night Jet Movements (night curfew infringement) of 10+ movements, High or Medium High risk of fog, or snow.
- The Sector briefing procedure used at Schiphol and the Demand versus Capacity protocol may not be applicable to airports where there is no local collaborative cell (APOC) working arrangement, because the pre-tactical cancellations require a strong working relationship not only with the participating airlines, but also with other local collaborative cell stakeholders.

Therefore, for airports with traffic pattern showing gaps between arrival and departure peaks that allow for delay recovery, and for airports without APOC, it is recommended to implement collaborative local cell first and optimise the schedule and operational efficiency, before consideration of pre-tactical flight cancellation procedures.

Analysis of balancing between arrival and departure flows at aerodromes with arrival and departure peaks, using Helsinki as case study, is available in Appendix I.

7.3.1 Motivating the Airlines to participate: a combination of enforcement and incentive

7.13 The Heathrow Demand vs Capacity (DvC) is used only when necessary, on average 4-5 times per year, because it is realised that the procedure requires intense re-scheduling for the airspace users. The HADACAB[1] (escalated capacity reduction procedure) is used on average twice per year. The DvC[2] at Heathrow involves all airlines with five rotations/day or more. It is realised that long haul flights with less than five daily rotations will have a difficulty to re-book passengers. All airlines are treated equally by fairly spreading the burden of cancelling flights pre-tactically across more than 20 airlines operating from the airport.

[1] Heathrow ATM Demand and Capacity Balancing procedure
[2] Demand versus Capacity Protocol

7.3.1.1 Incentives and requirements for the airlines to participate:

- Airlines are aware that without DvC, the cancellations will occur anyway on the day of operation with worse effect on their schedule, because the opportunity to properly re-book and re-plan operations may not be present then;
- DvC requires pre-tact cancellations on the day leading to the day of operations at 11AM LT at the latest; thus giving enough time to airlines to re-book passengers on a later flight or with another airline within the same group. In addition, cancelling on D-1 improves passengers' experience, compared to a situation with passengers showing up in the terminal and being told that their flight has been cancelled. Passengers' experience is an important performance indicator for airlines and is one of the criteria against which airlines are ranked.
- The airlines community trusts the Heathrow DvC process that only the strict minimum of cancellations are requested; over the years, based on the implementation of the DCB tool and enhanced MET products and also lessons learned from previous DvC occurrences, unnecessary cancellations have been eliminated;
- Flights to cancel are determined freely by the airline, respecting a percentage requirement. The Aircraft Operations Duty Manager (leading the HOEC DvC conferences) announces only the requested cancellation percentage and the airlines decide on the specific candidate flight(s) according to their business model and operational needs.
- The MET forecast feeds into the DCB tool that produces as output the range of possible delays for a given airline. **The airspace users respond better to operational indicators like delay, than to a purely MET forecast.** The Heathrow DCB tool is a very helpful aid to prepare delay estimations of the MET event for the DvC/HADACAB coordination conferences with the airlines. Post-analysis of the benefit from applying a pre-tactical cancellation is an integral part of the procedure in order to build confidence in the process and for continuous improvement.

- **EU 261 protection:** the UK CAA backs-up the DvC procedure by publishing the list of pre-tactically cancelled flights on their website, thus giving protection against any compensation claims related to the cancellation; the pre-tactical cancellation list is communicated by midnight of the previous day and requires a NOTAM publication announcing the activation of the DvC protocol.
- **EU Reg 793/2004 (updated EU 95/93 Slot regulation) Alleviation.** The DvC agreement with the UK ACL (UK airport slot coordinator) is that the pre-tactically cancelled flights will not be counted towards the 20% quota of the 20/80 rule. On D+1 ACL will review the event to analyse each pre-tactically cancelled flight for alleviation from the 80/20 "use it or lose it" requirement, justified by any of the following reasons in Article 10(4) of the Slot regulation, which includes inter alia:
    - Closure of an airport or airspace;

  - Serious disturbance of operations at the airports concerned, including other Community airports related to routes which have been affected by such disturbance;
  - Interruption of air services due to action intended to affect these services, which makes it practically and/or technically impossible for the air carrier to carry out operations as planned.

- An AIP publication requiring airlines to comply with capacity reduction procedures DvC and HADACAB;
- The DvC and HADACAB compliance requirement makes part of the Conditions of Use agreement signed between the Heathrow airport and operating airlines in regards to access to airport services and infrastructure;
- The wash-up after the event includes monitoring of airline compliance; all participants in the DvC procedure (HOEC, UK CAA, ACL, participating airlines) attend quarterly steering group meetings where a review of the procedure results and improvement areas are addressed;

The full description with timeline of the different steps is provided in Appendix B and Appendix E.

7.14 For complete appreciation of the topic on pre-tactical cancellations, it is recommended to read the chapter 8 on Airlines' take on flight cancellations, diversion and delays.

7.4 Suggested areas for improvement

Recommendation #10 High level features of the Local Collaborative Cell

- Establish local collaborative cell-(APOC or GC) depending on the size and needs of the airport;
- Implement Airport Operations Plan (AOP) as common information sharing platform and the Demand-Capacity Balancing (DCB) tool as main decision-making support tool (assesses the predicted effect of each constraint and allows for 'what-if scenarios');
- The establishment of APOC and AOP is formalised by a Memorandum of Cooperation (MoC) between the stakeholders' organisations involved. To pursue an effective management of MET events, the APOC MoC could include explicit requirement for collaborative MET planning processes, involving the MET Service Provider, the Airport Operator, the Local ATC Unit and Ground Handling as a minimum.
- Use pre-agreed capacity reduction scenarios, coordinated with all airport stakeholders;
- If pre-tactical flight cancellations are used at airports that operate a schedule with no "fire breaks" to recover from delays throughout the day; and if strong collaborative practices have been established between the airport stakeholders (Heathrow and Schiphol are known to operate close to their capacity limits all day, every day and are the only two aerodromes that reported using pre-tactical flight cancellations); additional steps are recommended to support the participating airlines:

- Regulation (EC) 261/2004 protection for the participating airlines, involvement of the NSA (HADACAB[3] and DvC[4]). Uniformity across Europe;
- EU Regulation 793/2004 slot alleviation (HADACAB and DvC).

8 Airspace users' take on Wx disruptions-delays, diversions and cancellations. Decision support tools for operational and business prioritisation

8.1 Airlines operate different transport models and react differently to weather disruption. A scheduled commercial airline, or a national carrier operating "hub-spoke" network may have a different take on diversions and pre-tactical flight cancellations compared to a charter airline that is part of a tour operator managing hotels and coaches linked to the flight.

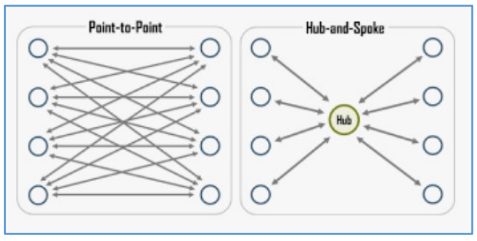
8.1 Short overview of "hub-spoke" transport model comparison to "point-to-point" model

8.1.1 Hub-spoke transportation model (national carriers, commercial scheduled airline)

8.2 The "**hub-spoke" transport model** organises routes as a series of "spokes" that connect destination points to a central "hub". The hub-spoke transportation model has benefits and disadvantages; it is the preferred model by national carriers and big commercial airlines, while the low-cost airlines go for the "point-to-point" model.

On the **benefits side**, the hub-and-spoke model, as compared to the "point-to-point" model, requires fewer routes. For example, in a network with n=12 destinations, the hub-spoke system requires only 11 routes (num $_{routes}$ =n-1) to connect all destinations. A classical point-to-point system would require 66 routes (num $_{routes}$ = n (n-1)/2). However, with the "hub-spoke" model, the distance travelled per route is greater than with a point-to-point system. For the same number of aircraft, having fewer routes to fly means each route can be flown more frequently and with higher load factor because the demand for passengers can come from more than one location.

Complicated operations, such as baggage sorting, are carried out at the hub rather than at every spoke node and this enables savings from logistics. As a result, the spokes are simpler to operate and so new routes can be created easily.



From the passenger perspective: airlines operating hub-spoke model tend to wait for late connecting passengers via the hub for the last flights of the day or for destinations only served once a day.

On the **drawbacks side:** as the model is centralised, any disturbance to the hub (single point of failure) sends shock waves throughout the whole hub- spoke network. Delays at the hub due to bad weather result in delays throughout the network. Day-to-day operations may be relatively inflexible

[3] Heathrow ATM Demand and Capacity Balancing procedure
[4] Demand versus Capacity protocol

and will not allow occasional periods of high demand between two spokes, because this will require more capacity at the hub. As a result, route scheduling is complicated for the Airline OCC, because scarce resources must be used carefully to avoid overloading the hub. Careful traffic analysis and precise timing are required to keep the hub operating efficiently.

8.1.2 Point-to-point transportation model (low cost carriers)

8.3 The point-to-point model is used widely by LCC such as Ryanair, EasyJet and Wizzair. Each flight is sold independently and there is no concept of "connecting flights", therefore baggage must be collected and re-checked even to transfer between flights booked with the same airline. It also means that LCC airlines do not wait for transfer passengers even if the same carrier operates the consecutive flights. This is driven by the fact that every point-to point flight is treated independently and due to the Air Passenger Rights compensation cost increase. The average EU 261/2004 cost per passenger affected by disruption has increased from €89 in 2011 to €138 in 2018, driven by increasing passenger claims and airline compliance. In combination with falling airline yields, this means that in 2018 the average EU 261/2004 cost for every passenger affected by disruption was 90% of the yield that each passenger affected by disruption generated. The consideration given to the reduction of airlines yields holds even stronger for the COVID and post-COVID recovery period. For the LCC airlines, the EU 261/2004 cost has risen to 6% share of overall expenses in the pre-COVID period.

Another disadvantage is that the frequency of trips may be reduced because the number of origin–destination pairs is much larger compared to the same number of destinations served by a hub-spoke airline.

On the benefits side: with no need to satisfy connections for passengers, and not being dependent on a hub airport, the point-to-point network is more resilient to delays.

8.1.3 Charter airlines as a part of a Tour Operator Group

8.4 Charter airlines operate a specific business model because the flight is linked to supplementary services of the tour operator such as coach service and hotel accommodation. Charter airlines operate a model that is sensitive to any disturbance to their original plan and they tend to start planning and prepare coordinated scenarios within the tour operator group, including with partner airlines, well in advance. The charter airline FOO (Flight Operations Officer or Flight Dispatch) may hold talks with individual destination airports and ANSPs in order to fine-tune the airline operational plan in a way that provides stability on the day of operations.

8.2 Long sector flights caught in Wx ATFCM AD regulations at the destination airport.

8.5 One particular issue that affects all types of airlines, arises when a long sector flight (Estimated En-route Time EET>4 hour) is held at the departure airport due to ATFCM regulations applied for convective weather at the destination airport. The convective storm may well be over at the time the flight (after 4 hours) arrives at the airport. It is deemed unnecessary by the airspace users that the long sector flight should be held on the ground due to convective weather ATFCM AD regulation at the destination airport 4 hours flying time away. From airspace user perspective, the operator of a long sector flight could rather wish to take-off and take the risk to divert in case the convective weather is not yet cleared at destination, than wait on the ground at departure aerodrome. The risk

of diversion at destination incurs lesser damage than the disruption to the airline schedule and Flight crew Duty Period limits. This is true especially when the AD ATFCM Wx regulation catches a long sector flight in the first rotation, because all subsequent flights planned with the same airframe will be delayed, most probably infringing a night curfew in last rotation, along with Flight crew Duty Period limits.

Recommendation #11: NM to Analyse and potentially Optimise AD Wx ATFCM measures applied due to convective Wx at destination airport affecting flights with EET>4 hours

NMOC to investigate optimised ATFCM measures for flights with EET>4 hours affected by convective Wx AD ATFCM regulations at the destination airport.

8.2.1 FMP Finland new ATFM procedure addressing long intra-European flights

8.6 Related to the operational situation, described above, **FMP Finland has developed a new ATFM procedure.** It addresses the long intra-European flights that are regulated and held at the outer stations due to forecasted weather phenomena at Helsinki-Vantaa aerodrome with probability of 40% to 60%.

Statistics from 2015 to 2018 related to the correlation between forecasted CBs at the airport and the applied ATFM AD Wx regulations, show that up to 40% of the time the ATFM AD Wx regulations were unnecessary, because the convective activity did not materialise.

Helsinki has established itself as a gateway to the Far East and the unnecessary ATFM Wx delays needlessly impeded the flights that bring in connecting passengers from across Europe to the long haul Far East sectors. The business impact on Finnair caused by these “false alarm” ATFM Wx regulations has been significant. This is why as from 2018 the Finnish MET Institute has refined its definition of convective Wx forecast by including direct sighting of CBs above the airport, and thunderstorm observed in visual line of sight.

The FMP has also changed their practices, compared to the old working method when an ATFM Wx regulation would be requested right away upon forecasted weather phenomena in the TMA. In the new procedure, the FMP monitors the flight activation list. The FMP implements an ATFM regulation with the NMOC and notifies the APOC when the ATC activated flights exceed 80%, and not later than one hour before the planned start of the ATFM regulation. The result is that the ATFM regulations are requested with short anticipation (1 hour prior start time), which means that the long intra-European flights are not caught in the regulation and penalised by delays. In this case, the ATFM delay is absorbed by the short haul flights. If the regulation is cancelled, or the monitoring value increases, the short haul flights are integrated promptly in the arrival traffic demand.

ADVANTAGES & DISADVANTAGES	
OLD PROCEDURE	NEW PROCEDURE
▪ Regulation published well in advance ▪ Relatively high activation threshold -> different practises depending on subjective interpretation of CB forecast.	▪ Regulation published fairly late (latest 1h prior start time); ▪ Long flights more or less never regulated; ▪ Decision threshold for reduced capacity is lower;

▪ Same long intra-European flights (Spain, Italy…) always delayed, even if the regulation would be later cancelled.	▪ Short haul flights more severely delayed than before (if regulation activated); ▪ Less unnecessary regulations.

8.3 Weather delays and the Regulation (EC) 261/2004 compensation

8.7 Most of the text in this sub-chapter is a direct quote from the EC "Study on the current level of protection of air passenger rights in the EU" from January 2020 [8] and the EC "Commission Staff Working Document IMPACT ASSESSMENT, Accompanying the document Proposal for a regulation of the European Parliament and of the Council amending Regulation (EC) No 261/2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delays of flights and Regulation (EC) No 2027/97 on air carrier liability in respect of the carriage of passengers and their baggage by air" from 13 March 2013 [9].

8.3.1 Certain costs of the obligations imposed by the Regulation (EC) 261/2004 constitute strong disincentives for compliance

8.8 In the framework of the "Impact Assessment" from 13 March 2013 and the EC Study from January 2020, the public and targeted consultations with consumer and passenger representatives, Airlines and their Associations, Travel Agent and Tour Operator Associations and National Enforcement Bodies (NEB) have shown that:

Airlines are not able to bear or to price in costs and risks (of assistance/care and compensation) in certain situations:

8.3.1.1 In extraordinary events of long duration, which are beyond the airlines' control, the obligations are potentially of an unlimited duration

8.9 The 2010 volcanic ash crisis provides a good example of a situation where third-party decision-making had a direct impact on air carrier operations and their resulting liability exposure under the Regulation. On 14 April 2010, seismic activity at Eyjafjallajökull, Iceland, culminated in an eruption, which generated large plumes of silica-based material, being potentially dangerous to aircraft operations. As a result, European airspace was closed for a week. Whilst the events were classified as 'extraordinary circumstances' (and therefore air carriers were not liable for compensation), air carriers were still liable for care and assistance costs, as confirmed in the CJEU[5] case of "McDonagh v Ryanair". Given the widespread travel disruption, the costs of such care and assistance were considerable: Ryanair and easyJet estimated their total exposure under the Regulation as a result of the eruption and associated airspace closure stood at £29 Million and €23.7 Million respectively. The Commission Staff Working Document (Impact Assessment [9]) accompanying the Commission's 2013 proposal for revisions to the Regulation noted that:

"[i]f the Regulation had been fully complied with during the crisis, it would have increased airlines' combined costs by an estimated €960 million (which is roughly 1.5 times the expenses for care and assistance in a "regular" year, and this within a period of less than a week)."

[5] CJEU-Court of Justice of the European Union. Decisions of the CJEU become integral part of the EU Regulation addressed by the CJEU decision.

8.3.1.2 In certain small-scale operations (with small aircraft on short distances), the costs of the Regulation (EC) 261/2004 increase disproportionately to the air fare;

8.10 When the Regulation was introduced in 2004 and entered in force on the 17 February 2005, the specific impact that its provisions could have on small regional operations was not taken into account. However, as shown in annex 9 (p.100) of the EC Impact Assessment, the incremental cost of the obligations of the Regulation appears to be heaviest for the **regional carriers**. There are clear indications in the data analysed that the absolute and relative cost of the obligations under Regulation (EC) 261/2004 increases the smaller the scale of the operations.

- Data analysis and stakeholder contacts point towards a higher cancellation rate that increases mainly accommodation costs and financial compensation and which is due to numerous underlying reasons, for example the use of smaller aircraft which are more vulnerable to adverse weather, the high frequency of take-offs and landings which makes small regional aircraft more vulnerable to technical defaults or the fact that regional carriers typically have small aircraft fleets and therefore less replacement options than bigger carriers;

- The issues highlighted above are exacerbated in the case of regional carriers providing feeder connections to network hubs. A small delay on the flight operated by the regional carrier may result in a missed connection that generates the maximum compensation liability (i.e. €600). This liability sits with the regional carrier and is not commensurate to the revenue it is allocated as part of the connecting itinerary or indeed the overall scale of its operations. **Regional carriers state that the impact of this is such that it threatens their viability and risks reducing the connectivity that they offer to more remote regions.**

The higher (EC) 261/2004 costs for regional airlines translate into higher prices, which can be significant enough to discourage passengers from travelling by air to make that journey or from travelling at all. **This may have a negative impact on regional accessibility as the regional carriers often serve islands or other remote areas, which are very dependent upon air transport.**

8.3.1.3 Certain aspects of the financial compensation (which comes on top of care and assistance) have a strong disincentivizing effect

8.11 Resistance from air carriers against financial compensation has increased since the “Sturgeon v Condor” judgement in the Court of Justice of the European Union (CJEU) in 2009 (Joined Cases C-581/10 and C-629/10), **which extended compensation payments from cancellations to long delays** (delay compensations were not required in the original version of the Regulation). And the “Wallentin-Hermann v Alitalia” (CJEU case C-549/07 from 22 Dec 2008) judgement, **which extended** compensation to many cases where the flight disruption is not due to an airline's commercial decision (e.g. technical defaults). For instance a damage to the aircraft due to bird strike is treated as an “exceptional circumstance”, but damage to the aircraft due to strike by a ground handling equipment (e.g. staircase or ground handling vehicle) is not treated as an “exceptional circumstance”.

8.3.1.4 Airlines are liable for care and compensation where disruptions are due to third parties, but the latter do not get economic incentives to take measures to reduce the frequency and/or the severity of such disruptions.

8.12 The application of Regulation (EC) 261/2004 has shown lack of transparency with regard to the **liability of the different actors in the ATM industry chain**. The party responsible for flight disruptions is not always clearly identified and the cost of passenger rights is mostly borne by the air carriers, with limited possibilities of recourse against a possible responsible third party. Article 13 of the Regulation does not preclude air carriers from claiming costs from third parties where they are responsible for the disruption. However, in itself, it does not provide any such right and to date airlines state they have not been able to claim successfully against third parties. The main third parties, who could be responsible for disruption, are principally airports, air navigation service providers (ANSPs) and Ground Handlers. But in practice it is very difficult to claim against these bodies in view of legal obstacles in contracts or national law (e.g. airport conditions of use generally only allow claims in very exceptional cases which are difficult to prove; airports and ANSPs are usually government bodies and may have State immunity from claims; ground handlers are protected by the IATA Standard Ground Handling Agreement, which means that in most circumstances airlines cannot claim costs from them).

8.13 Appendix "F" of this report contains a case study of the rotations for an aircraft that was subject to ATFCM weather delay of only 34 minutes on first rotation. By the end of the day, the primary weather delay snowballed over the four remaining rotations of that day and amounted to total of a 400 minutes of delay and a risk of infringement of the night curfew at destination for the last rotation. The NM/Central Office for delay analysis (CODA) performed the case study, using the MIRROR tool.

8.14 Translated in numbers, for instance the compensation that an airline has to pay for a delayed B737-800 aircraft flight with 189 seats in a one-class layout will be 250 EUR compensation * 189 PAX = 47,250 EUR (42,525 EUR @ 90% claim rate); with care and assistance compensation: 400 EUR compensation * 189 PAX = 75,600 EUR (68,040 EUR @ 90% claim rate).

8.3.1.5 EU-based airlines operating from EU airports are in disadvantage to non-EU airlines based at non-EU airports that are not subject to Regulation (EC) 261/2004

8.15 Annex 6 (p.76) of the "Impact Assessment" shows that EU air carriers competing with non-EU airlines (not subject to EU 261) on routes from third countries to the EU, the EU-based carriers suffer cost disadvantage, versus these non-EU airlines. This could constitute an additional disincentive to comply for the directly concerned airlines.

As shown above, all these elements imply that, in current circumstances, airlines cannot recover or insure in an appropriate manner certain costs induced by the (EC) 261/2004 Regulation. This acts as a strong disincentive for compliance.

8.3.2 Current status of the proposed amendment of the Regulation (EC) 261/2004

8.16 In March 2013, the Commission proposed a revision of Regulation 261/2004, but the proposal has been on hold since November 2015. The reason for the blockage is the on-going dispute between UK and Spain over the Gibraltar airport that is built in the Isthmus strip (no-man's land between the Spanish and British part). Spain has requested the EU to exclude Gibraltar airport from European

Aviation Law. The EU has not yet taken a stance on this request and due to this pending decision, the revision of the (EC) 261/2004 is also on hold, although the ground work is done and the four policy scenarios are described and evaluated in the Impact Assessment [8].

On 19 October 2020, the European Commission published its Work Programme for 2021. In the annexes accompanying the work programme, the Commission lists the Air Passenger Rights Regulation as priority proposal.

8.3.3 Reactionary delays and Airline schedule robustness

8.17 Most inclement weather conditions are considered extraordinary circumstances under EU261/2004 which exempts airlines from paying additional financial compensations to passengers in case of long delays (whilst keeping the duty of care). However, the EU261/2004 exemption relates only to flights directly affected by bad weather, it does not cover the consequent reactionary delays, neither later flights by the same aircraft, nor later flights linked by connecting passengers or crew. EU261/2004 costs caused by reactionary delays have a significant financial impact on airlines. Therefore, airlines have to focus on schedule robustness: a trade-off between: a schedule that is attractive to passengers and makes good use of scarce resources (aircraft, staff etc.); and a schedule that is capable of absorbing typical delays.

Resilience to reactionary delay can be achieved by buffers in scheduled block-time, buffers in scheduled ground time, schedule fire-breaks, spare aircraft and crew, (pre-)tactical flight cancellations, etc. EUROCONTROL has developed schedule quality indicators to assist airlines to improve schedule robustness.

8.3.4 How the ATM stakeholders can better support the Airspace Users to mitigate the effects of Regulation (EC) 261/2004

Recommendation # 12: Focus on delay-free execution of the First Rotation Hours

The correct execution of the First Rotation ensures the stability of the rest of the schedule of the day. The earlier in the day an aircraft is impacted by a (Wx) ATFCM regulation, ATC or Ground Handling delay, the more likely the generation of reactionary delay on the next rotations. The reverse is also true: the last flight of the day with an ATFM delay typically does not generate reactionary delay.

Special attention and effort by all operational stakeholders should be dedicated to the delay-free execution of the First Rotation Hours. The operational stakeholders addressed in this recommendation include as a minimum: the Airport Operator, Airport ATC, Ground Handling and the NMOC.

8.4 Diversions

8.4.1 Specific aspect of Charter airlines operations

8.18 As discussed in chapter 8.1.3 the charter airlines are a specific airline group because the flight is linked to supplementary services of the tour operator such as a coach service and hotel

accommodation. Charter airlines operating model is sensitive to any disturbance to the original plan and the FOO (Flight Dispatch) starts planning and preparing coordinated scenarios within the tour operator group, including other partner airlines, well in advance. The Tour Operators, of which the charter airline is a part, service locations that are seasonal and not mainstream - Greek islands in summer, ski destinations (e.g. Innsbruck) in winter. If a flight has to divert, or cancel, there are no readily available means to mitigate the disruption along the business chain. The diverted passengers will have to be fed, transported by a third party company and accommodated in hotels during high season other than at the original destination, which is not a given. The passengers that were left in the original location will have to be offered an overstay night which clashes with the hotel occupancy schedule (and of course incur additional costs for the tour operator).

Therefore, charter airlines are reluctant to apply pre-tactical flight cancellations due to weather, or other reason.

Recommendation #13 Centralised repository/web service for airport weather forecast with European coverage

From an airline point of view, diversions are highly undesirable events, which calls for an accurate and centralised MET forecast well in advance of operations, ideally at D-2.

Another recommendation is that there should be a common MET portal for Airport Weather in Europe that the airlines could consult as a one-stop shop, rather than collecting information from individual European MET providers in a piece meal manner.

8.4.2 The importance of Playbook scenarios and decision support tools to effectively manage disruptive weather situations

8.19 All airlines in the Task Force emphasised the importance of going into the weather event in a controlled manner, with a plan to manage effectively the situation, based on playbook scenarios and 'what-if' assessment enabled by a suitable software tools.

8.20 British Airways stated their positive experience with the DvC protocol procedure in Heathrow, putting the emphasis on several aspects like the fairness and equitability of the procedure, the operational impact scenarios from the DCB tool, along with the accuracy and operationalised forecast provided by the UK MET Office. From BA perspective, the oversight and protection from the UK CAA and support from the ACL are important elements of the DvC working arrangement.

8.21 With regards to collaboration with the ANSP, BA informed of the "Plan 39" NATS initiative for mass diversion situations:

- An agreement with a number of airfields across the UK providing additional landing slot capacity;
- ATC does not need to contact every airfield separately but can immediately send 39 aircraft to 39 different stands at airports around the UK;
- Extend to Plan 78 in 2021.

8.22 easyJet informed the Task Force on the internal Disruption Planning meeting triggered by forecast of adverse weather, which brings together the relevant departments to formulate a pre-tactical plan and communicate to customers with as much a notice as possible. As discussed in chapter 8.3.1 and Recommendation #13 many different sources of MET forecast are being used, instead of one MET forecast repository. These different sources include: the Weather Outlooks from NATS up to a month ahead of time; Aviation 3-day forecast from the UK MET Office including risk presentation; Daily Impacts Hazard Forecast on D-0 ; De-icing Forecast for handling agents to minimize first wave de-icing delays; Network weather and aviation hazards report about airspace and en-route risks, US NOAA forecasts to track tropical storms and hurricanes.

8.23 Operational considerations pertaining to three main phases - “Aircraft not departed”, “En-route” and “Grounded due to Weather”- are grouped in **Playbooks** that are used to describe the steps to ensure that every aspect is considered for each disruption event.

- Playbooks are developed for specific weather situations or for specific destinations with peculiar conditions (e.g. Funchal FNC/LPMA: one of most challenging approaches in the world, peculiar topography - high grounds to the north of the RWY, strong and rapidly changing winds-difficult to forecast (FNC is an island), no precision approach, which requires high minima and manual landing, limited diversion options, requires crew experience);
- Defines triggers and objectives;
- Considerations for different situations, including (list not exhaustive):
  - Flight crew Duty Period;
  - Available fuel;
  - Sector length;
  - Severity of the weather event-limit values, or well beyond operating limits; trend;
  - Transport/accommodation at diversion airport;
  - How to get the aircraft back quickly from the diversion airport.

8.24 With many operational and business factors to consider, the Flight Cancellation process uses tools integrated in the easyJet Operations Control System (TOPS):

- The **Flight Prioritisation Tool** estimates the cost of disruption against the revenue potential of a specific flight;
  - Supports the assessment of the impact of different recovery scenarios and choosing accordingly;
  - Identifies the candidate flights in a mass-cancellation event (e.g. DvC protocol).

- The **Flight Tracker App** is used for communication with customers:
  - Live updates of the flight status including expected delay and explanation of the delay reason;
  - Allows the passenger to self-manage re-booking, refund and hotel accommodation options

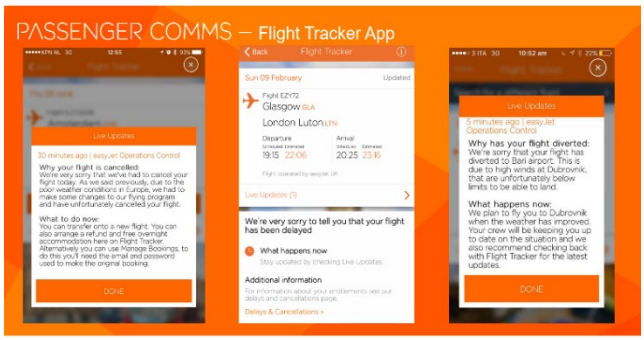


Figure 12: easyJet Flight Tracker App

9 Proposed SMART Wx AD Regulation procedure

9.1 Climate change in the last decade has exacerbated the typical weather phenomena, which are experienced at aerodrome locations. As a result, there is more variability in the weather. The figures 13 and 14 below show the share of aerodrome delay in the network and the high impact of AFTCM Weather delays on main hub airports of the European ATM network.

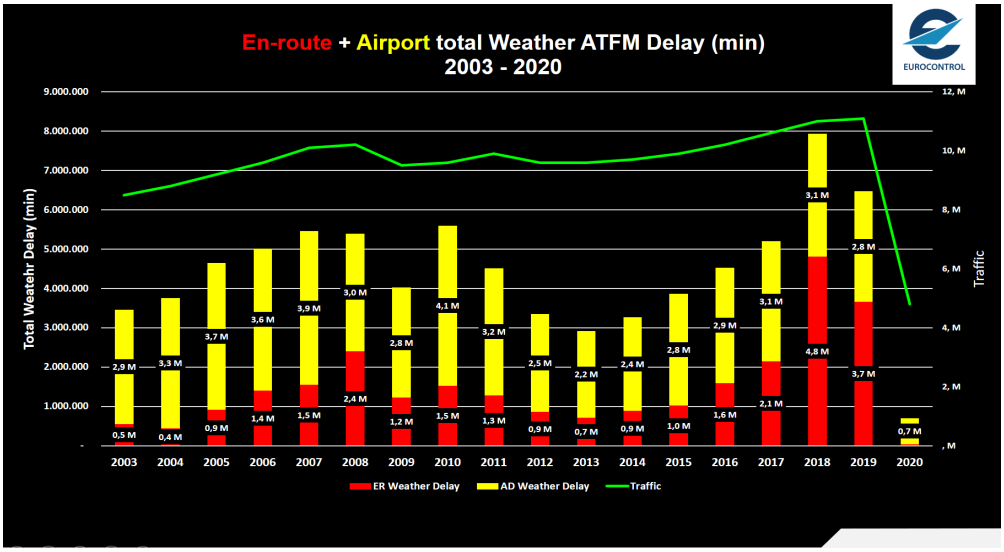


Figure 13: Aerodrome vs En-route ATFM delay shares 2003-2020

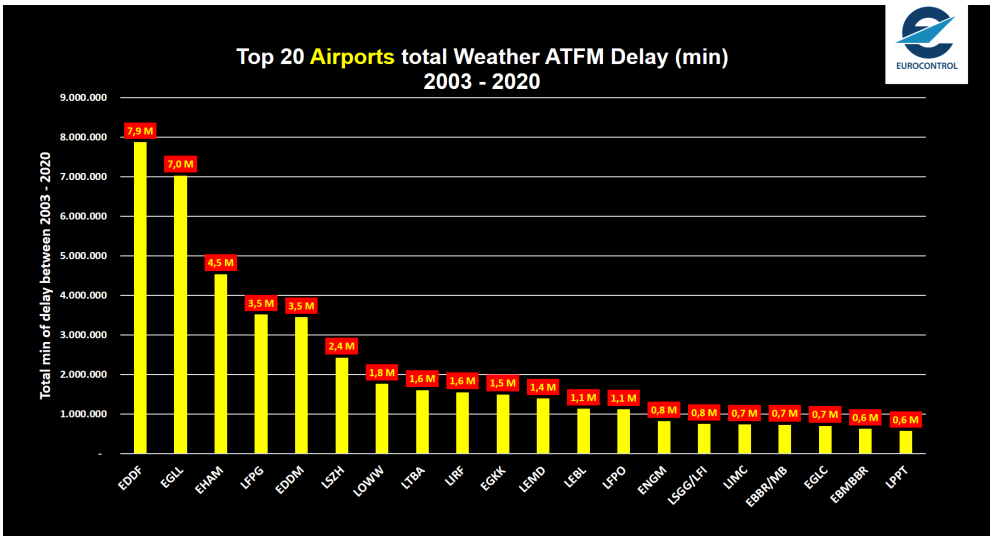


Figure 14: ATFM AD top 20 locations 2003-2020

Full set of statistics on Aerodrome ATFCM delay due to weather is available in Appendix "G".

9.1 Integration with the Cross-border Procedure

Chapter 9 represents the culmination of the report, because it suggests a concrete operational SMART Wx AD procedure. The process described in chapter 9.2 hereafter shall be considered in conjunction with chapter 5 "The evolving role of the MET Service provider", chapter 6 "Evolving the role of the FMP" and chapter 7 "Airport Stakeholder's local collaboration cell", **especially sub-chapter 7.2.3.1** "(local collaborative cell) Time line for Operating pre-agreed capacity reduction scenarios for adverse Wx".

9.1.1 The Cross-border Procedure

9.2 Following the recommendations of the 2018 Weather Forum, the Cross-border procedure is established to consolidate Weather forecast for convective weather (1 April-30 September) for the en-route. The objective of the Cross-border procedure is to improve collaborative planning of ATFCM measures, dissemination of information; reduce the number of Wx ATFCM regulations and improve the stability of aerodrome and network operations.

In 2020 thirteen MET offices and eight ANSPs participated: AEMET (Spain), ARSO (Slovenia), AustroControl, Croatia Control (CCL), DWD (Germany) , Italian Air Force, KNMI (Netherlands), Met Office UK, Meteo France, Meteo Swiss, OMSZ (Hungary), SHMU (Slovakia), skeyes (Belgium). More information on the Cross-border procedure is included in Appendix "H".

Recommendation #14: Extension of the current "Cross-border procedure to Aerodromes

The SMART WX Task Force recommends the integration of the Cross-border procedure for en-route with the recommendations and findings of this report. In concrete terms it is suggested that:

- The scope of the Cross-border procedure extends to cover Aerodrome MET forecast, provided by the participating MET service providers;
- The scope of the Cross-border procedure extends to cover other weather phenomena at aerodrome locations, in addition to the currently assessed convective weather. The weather events extension includes: snowstorm, freezing precipitation, high winds and fog;
- The scope of the Cross-border procedure extends to cover both, winter and summer seasons.

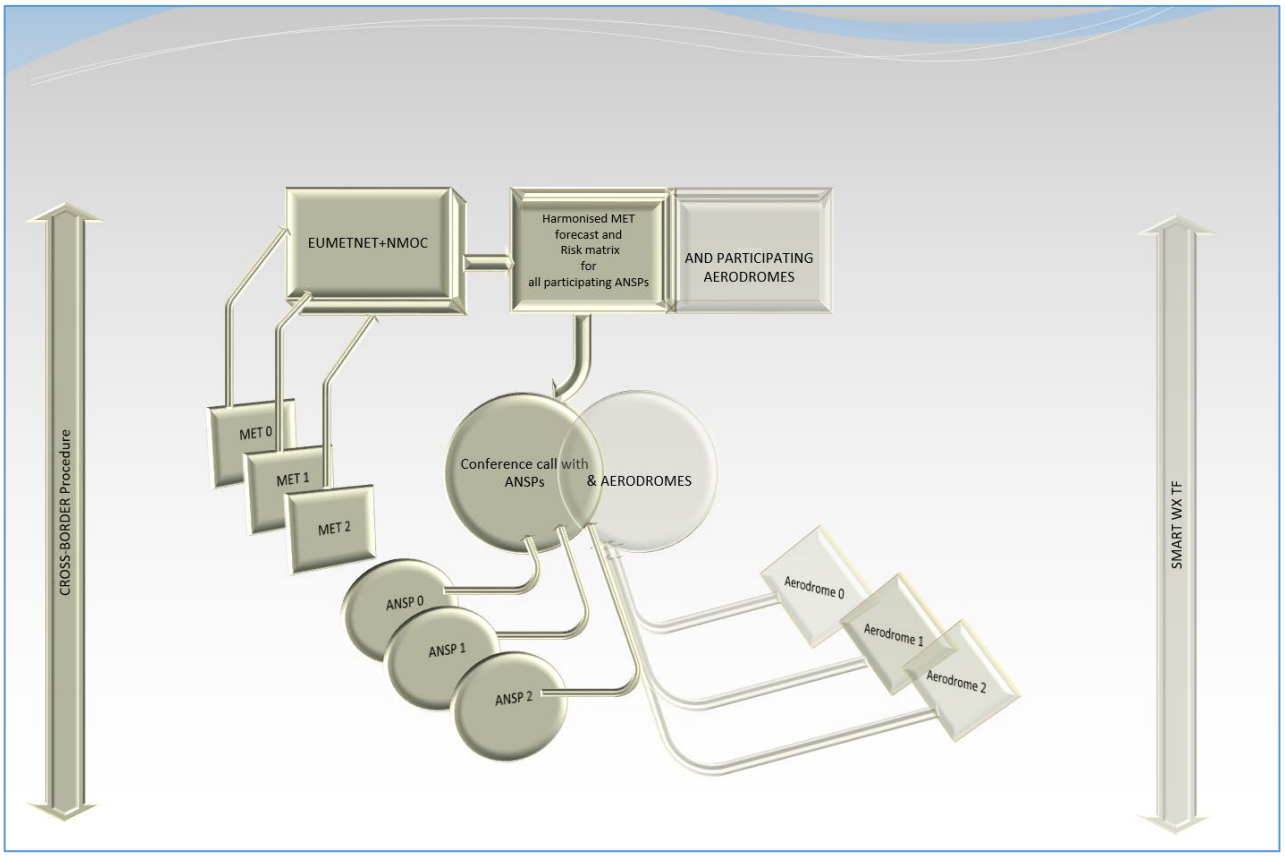


Figure 15: Integrating Aerodromes to the Cross-border procedure

9.2 Integrated "AS(Airspace)-AD(Aerodrome) Cross-border" Procedure description

9.2.1 Participants

The ANSPs participating to the current Cross-border procedure process: NATS, DSNA, MUAC, Austrocontrol, ENAIRE, Skyguide, CroControl and DFS.

In addition, to involve the APOCs (where established), or Aerodrome/Aircraft Operations Duty Managers of the main aerodromes for which the respective ANSP provides ATFCM services: EGLL, EGKK, LOWW, LEMD, LEBL, LEPA, LSZH, EDDF and EDDM (list not exhaustive).

The official meteorological service providers of each of the ANSPs involved will be providing the forecasts under the coordination of EUMETNET.

The geographical coverage of the procedure is the states covered by the participating ANSPs and Aerodromes.

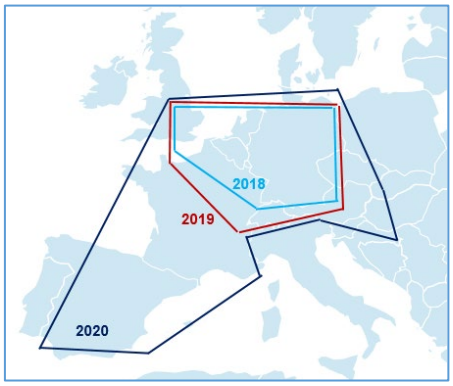


Figure 16: Geographical coverage ASAD

9.2.2 Duration

The procedure will take place between 1 January and 31 December.

9.2.3 Weather Forecast

The MET providers of each participating ANSP and Aerodrome produce all weather forecasts used in this procedure. The Weather forecasts are coordinated, collated and published by EUMETNET.

The forecasts shall be sent by EUMETNET to participating NMOC, ANSPs, and Aerodromes to provided email addresses at the given times.

- A pre-tactical weather forecast shall be produced at 0900 D-1 valid for the next day.
- A tactical forecast shall be produced twice per day. It will be available at 0700 and 1200 D-0. Each forecast will be an update of the previous forecast (i.e. 0700 forecast is an update of the D-1 forecast etc).
- The weather forecasts will depict the expected weather phenomena for various periods during the day e.g. 09-12, 12-15, 15-18, 18-21UTC.
  ***Note**: The 2nd tactical forecast will not include the 09-12 situation).*
- The forecast will be presented as a summary page depicting the time segments relevant to the forecast validity.
- The weather forecast will depict a colour coded convection risk corresponding to the given risk matrix;
- If the weather forecast depicts red or purple polygons indicating a high or very high risk of any of the weather phenomena, in any of the time periods provided, there will be a teleconference called by NM. However, if the weather phenomena is limited to one or several aerodromes in the same state, the Airport Function will liaise with the local APOC/AODM and use their discretion before escalating according to pre-defined criteria to NM/DOM in case the Network is likely to be impacted. In case of lower than normal traffic levels (such as during Covid-19 pandemic), NM OMs will use their discretion in calling conferences based on forecast information, expected traffic and staffing levels.

  To further support airports integrate as a component part of the network, the Airport Function has been re-enforced to provide support services through the NMOC for all airports. An airport Strategic Analysis service will be deployed to identify expected airport network issues and prepare solutions from 6 weeks before operation through to D-2. This service will ensure that the NMOC, the Airport Function and airports are ready to implement or adjust pre-agreed solutions on the day of operations. On the day of operations the Airport Function will liaise between NMOC and APOC and/or the local airport community, to check if the AOP can still be maintained, what issues may arise and if/what changes can be expected (e.g. diversions, change of runway configuration/capacities etc.).

  The position shall monitor any other airport for which an ATFM regulation is active or planned to mitigate delay or optimise slot list.

9.2.4 AS-AD Cross-border Procedure Timeline

D-1

0900: The lead forecast organisation representing EUMETNET will send a forecast for the next day to all participating organisations in pdf format and it will comprise either the simple forecast or the full forecast as outlined in 9.2.3.
This is the latest time that the forecast shall be sent, it is probable that it will be done even earlier.

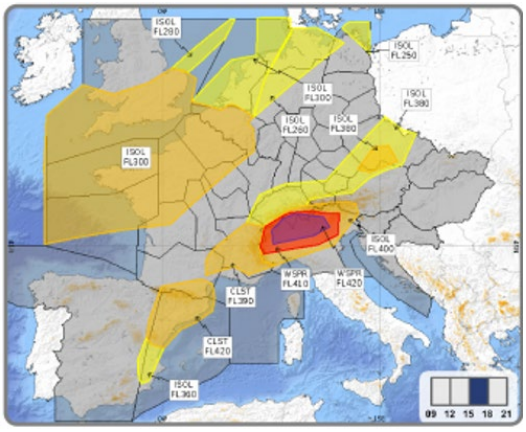


Figure 17: Wx Risk colour coding

Between 0900-1100:
NM staff will assess the forecast and based on the agreed triggers will decide whether to call a conference or not.
Agreed triggers:
If there are **no red or purple polygons indicating high or very high-risk areas** within the procedure area a short summary forecast will be received from the lead MET organisation, and **no conference** will be called.

If there are **red or purple polygons indicating high or very high-risk areas** within the procedure area, a detailed summary forecast will be received from the lead MET organisation and a **teleconference should normally be called.**
The NM Deputy Operations Manager (DOM) and the NM Airport Function Officer (AFO) will consult with NM Operations Manager (OM) in calling conferences based on forecast information, expected traffic and staffing levels. The judgement should take into consideration the very low traffic levels and COVID-19 crisis effect on the Network.
If the forecast shows **red or purple polygons indicating high or very high-risk areas** but **no conference** is called, pre-tact should call the directly affected ANSPs and coordinate the expected weather situation with them.
Any relevant information should be published in the Initial Network Plan (INP).

1100:
If the above triggers are **NOT** met, NM Deputy Operations Manager (NM DOM) (if not available NM Airport Function Officer) will email participants and the lead met provider to inform that a conference will **NOT** take place.

If the above triggers are met, NM DOM (if not available NM AFO) will email participants and the lead MET provider with confirmation of a teleconference and the appropriate telephone numbers to call.
This email shall state the required ANSPs and Airports that should attend based on the forecast, attendance by the other ANSPs and Airports is optional. They may wish to attend to maintain situational awareness.

A distribution list of all the required emails has been stored on both the NM OM (Operations Manager) and NM DOM (Deputy Operations Manager) computers as AS-AD Cross Border Weather Coordination.

An email should only be sent once in receipt of the **D-1 forecast at or around 0900.**

1130-1230 (as close to 1130 as possible): Brief teleconference of 10-15 minutes run by NM DOM. Representatives from:

- NM Airport Function Office (NM AFO);
- Pre-tact and AOLO;
- Each participating ANSP and Airport;
- The lead MET provider.

1600: A summary of any teleconference will be prepared by pre-tact staff and published on the NM Initial network plan (INP) along with the summary page of the D-1 forecast.
If no teleconference was held, only the summary page of the D-1 forecast will be published.

D-0
0700: A tactical forecast updating the D-1 forecast shall be provided to all participants by the lead forecast organisation representing EUMETNET via email.
This forecast shall cover the tactical day 09-12, 12-15, 15-18, 18-21 UTC.

1200: A further forecast shall be provided updating the 0700 forecast covering the period 12-15, 15-18, 18-21 UTC.
Note: *It is not necessary to send an email to participants following receipt of the tactical forecasts*.

NM DOM (if not available NM AFO) shall use:

- The forecast update,
- INP,
- AOLO feedback,
- Current and expected network situation.

To decide which ANSPs should participate in collaborative coordination.
Note: *This is a judgement call and as such, it is difficult to give exact criteria in making the decision.*

Calls can be made at different times based on the situation but an assessment by NM operational staff shall be made at least at 0700 and 1200 UTC, after the forecast is received.
In certain circumstances it may be appropriate to invite particular aircraft operators to such coordination.
The calls should be made in conjunction with the emailed forecast, which provides an easy to understand visualisation of relevant information.
If the weather situation justifies i.e. widespread adverse weather activity throughout the procedure area, a full tactical teleconference should be called to reduce coordination workload.

9.2.4.1 Teleconference content

The D-1 conference shall be audio, or a TEAMS conference. This is in order to keep it simple and reduce workload as much as possible.

For the D-1 conference the lead MET provider shall give a short (no more than 5 minutes) interpretation of the forecast and answer any questions.

On D-1 and D-0 each participant shall give an expected (best guess) impact assessment of identified weather including:

- Which sectors may be affected - directly and indirectly;
- Which Airport services and facilities may be affected - directly and indirectly; Terminal, parking stands, Ground Handling, De-icing, Taxiing, RWY snow clearing.
- When measures MAY be applied;
- Estimated capacity reductions if known;
- Possible areas of capacity for re-routing;
- Possible mitigation scenario for the Airport operation; duration of the mitigation scenario;
- Impact on staffing situation-both AD and AS locations;
- Impact of military activity;
- Identify re-routing opportunities/scenarios;
- Impact on other initiatives/procedures.

D-1 information shall be prepared by pre-tact staff and published in the Initial Network Plan (INP). Relevant tactical information shall be published on the NOP portal headline news.

9.2.4.2 Information in the Initial Network Plan (INP)

It is expected that the summary page of the weather forecast shall be uploaded to the INP every day regardless of whether a teleconference has taken place.

A short summary of any D-1 conference shall be provided including agreed RAD relaxations with the relevant image and timings.

9.2.4.3 Review

Feedback on any issue raised with this procedure should be given to the operations analysis (OPA) team and the NM Airport Function. It is recognised that the procedure may need to be amended during its validity; therefore regular reviews will be held throughout the procedure period. A full review meeting shall be held in October and appropriate reporting will follow.

10 Summary of recommendations

Rec' number	Recommendation title	Recommendation description	Stakeholders involved
1	MET forecasters' team embedded in OPS	The Task Force recommends that the MET forecasters' team be embedded into the operational airport and ATC units to promptly inform on threshold values for a variety of weather phenomena. The integration of MET advice could be conducted via teleconference, when the MET office is located remotely. From ops perspective, very important elements of the MET forecast are the **start, duration, end time and severity of the Wx phenomenon,** because they directly relate to the parameters of the corresponding Wx AD ATFCM regulation -start, duration and arrival rate. MET specialists to use plain language in text forecast.	MET Service Provider
2	Harmonised utilisation of risk thresholds for Wx AD ATFCM	Implementing a regulation depends on the forecasted risk of a specific Wx phenomenon, according to local instructions and procedures. It is recommended that ATFCM Wx AD regulations apply when defined risk thresholds are reached. This leads to improved forecasting, along with predictable and objective decisions on implementing ATFCM regulations.	MET Service Provider, ANSP/FMP
3	Attention to the forecast uncertainty. Risk Matrix	▪ MET forecasters to draw attention to the uncertainties and possible effects (e.g. timing, intensity). This allows the operational user to ask questions to clear up uncertainties or to adjust their processes. For each weather phenomenon (e.g. snowfall) three scenarios should be estimated. These are: **best possible scenario, most probable and worst-case scenario.** ▪ The operational users to associate capacity decrease values to each one of the three scenarios (the best, the most probable and the worst). ▪ Secondly, define a Risk Matrix.	MET Service Provider, ANSP/FMP, APOC/AODM, Ground Handling
4	FMP's Awareness of Airport Wx Risk and planned OPS response to Wx	FMP to be: ▪ Fully aware of what is happening at the airport by following the evolution of the Aerodrome MET forecast from D-2 leading to the day of operations; (and other events affecting airport infrastructure and ground	FMP, local ATC TWR, APOC/AODM

Rec' number	Recommendation title	Recommendation description	Stakeholders involved
		services, as appropriate). **In addition to the standard METAR and TAF it is recommended that the FMP receive the local Airport MET service detailed forecast (if produced/available).** ▪ The D-2 horizon aligns with the start of the preparation of the ATFCM Daily Plan (ADP). The ADP is a proposed set of tactical ATFCM measures prepared pre-tactically and agreed between all partners concerned to optimise the European Network. It covers a 24-hour period (the day prior to the day of operation) for each day. Normally the ADP starts as a draft on D-2 and it is finalised and promulgated on D-1 by means of the ATFCM Notification Message (ANM) and the Initial Network Plan (INP). The ADP forms the basis for the Initial Network Plan (INP) published on the NOP at D-1 to inform all network partners, in particular the airspace users on planned ATFCM regulations, Airport status, RAD status, and significant en-route and AD Wx phenomena. The Airspace users consult the INP to adjust their operations. ▪ Starting at D-2, when the weather forecast identifies a risk of adverse conditions, the FMP coordinates with **the local ATC TWR and the Airport/Aircraft Duty Manager or the APOC SUP** (where APOC is established) about the operational impact of the Wx forecast on the airport operations. This includes the apron capacity that may become the bottleneck, depending on the weather phenomena, such as thunderstorm at or in vicinity of the airport, snowfall, or freezing rain. ▪ After assessment of the forecasted Wx impact on the airport operations, the FMP coordinates with the NM Pre-tactical and Tactical Teams the most appropriate regulation measure for the affected airport(s) in their area of responsibility.	
5	Convergence of FMPs to Airport operat-ions/-ors	▪ Physical distance: The FMPs unit is part of the ACC centres located hundreds of kilometres away from the Airports. The FMPs have no direct visibility on the Airport operations and Wx conditions. FMPs rely on indirect information from TAF/METAR and ATC TWRs. ❖ Remedy: Familiarisation visits to the airport (s) as part of the FMP training and renewal of licence rating. Knowledge of airport layout, hotspots and most frequent Wx phenomena.	FMP, local ATC TWR, APOC/AODM,

Rec' number	Recommendation title	Recommendation description	Stakeholders involved
		▪ FMPs background: Normally en-route controllers become FMPs without (recent) experience as TWR controllers. Unless dedicated "Airport operations" module is provided as part of the ATFCM training syllabus, the FMPs may have no appreciation of the complex eco-system that airports are. Unlike en-route, airport operations are mostly driven by the services of the Airport Operator and the Ground Handling companies. ❖ Remedy: Develop "Airport module" in the FMP Training syllabus. Focus on the role of Airports as nodes of the Network. In addition, elaborate on the responsibilities of every Airport Service. Invite FMPs and ATC TWR to local daily Airport videoconferences convened by the Airport/Aircraft Duty Manager/APOC SUP. ▪ Need for dedicated connection and coordination procedure with the Airport (Aircraft) Duty Manager at non-APOC airports, in addition to the existing FMP-TWR contact. FMPs may rely on the ATC TWR for supply of timely and quality information about the effects of Wx phenomena on airport operations, including ground services, e.g. de-icing, snow clearing, fuelling and push-back operations. Unless the ATC TWR is part of collaborative working arrangement with the Airport stakeholder (e.g. APOC), normally ATC TWR has direct contact only with the Ramp Agent, responsible for push-back and marshalling. Therefore, the situational awareness of the ATC TWR may not be sufficient to inform the FMP on the operational risk and the planned Airport response to adverse weather. **The Airport/Aircraft Operations Duty Manager or the APOC SUP (if APOC established)** are responsible for assessment of the operational risk and decisions about the Airport Operator's response to adverse weather. ❖ **Remedy: establish APOC, or other local collaborative cell where the FMP is part of the working arrangement that deals with adverse Wx at the aerodrome. Hold daily videoconferences between TWR units and FMP representative including a meteorologist, who first presents the Wx forecast for the aerodrome(s) concerned after which FMP, TWR SUP and Aircraft Duty Manager/APOC SUP can**	

Rec' number	Recommendation title	Recommendation description	Stakeholders involved
		discuss measures based on the same elaborate MET report and the experience of the local operational officers. **Early briefing can focus on day of operations, an afternoon briefing on the following day (s). See the next chapter 7 of the report "Airport stakeholders' local collaboration cell."**	
6	Proposed standard topics for the daily Airport collaborative conferences	▪ The Airport Operations Plan for D-2, refined at D-1, using input from a DCB tool, or expert judgement if a DCB tool is not available. ▪ Comparison of forecast demand vs. scheduled demand; ▪ Early identification of likely flow constraints for arrivals & departures; ▪ Commentary on likely impact of weather & operational restrictions; ▪ WIP; ▪ Airspace/ATC; ▪ Airline Requests.	APOC/AODM, ATC TWR and APP, FMP if required, home-based carrier, local MET Office
7	Monitor and do regular risks assessment starting at D-3	The best practices reported weather trend monitoring as early as D-15. Trend monitoring follows the evolution of the big-picture weather genesis that may give rise to specific phenomena with impact on aerodrome operations. **The risk of adverse weather that may affect the airport is reported to the operational stakeholders at D-3 at the collaborative cell conferences**. As discussed in chapter 5.2.2 "Consistency of MET advice" MET specialists from the airport and ACC centre align their respective forecasts. **The Goal:** early tracking and preparation for weather conditions that might (severely) affect airport capacity.	MET Office at aerodrome location, in coordination with the MET Office at the ACC Centre
8	D-1 selection of capacity reduction scenario from pre-agreed playbook	At D-1 the precise capacity reduction scenario linked to the Wx event to be selected and promulgated in the **Airport Operational Plan (Schiphol RWY Capacity forecast, Heathrow Service Plan, Stockholm Snow Plan).** The main outputs are: predicted arrival rate, predicted departure rate, taking into account arrival and departure traffic peaks. Incorporates flow rates/monitoring values for ATFCM regulations, displays likely departure delay;	APOC/AODM, ATC TWR and APP, home-based carrier

Rec' number	Recommendation title	Recommendation description	Stakeholders involved
		The activation of the corresponding ATFCM AD Wx regulation with NM, to be done on the day of operations with sufficient lead-time, agreed between the airport stakeholders, in particular by the FMP responsible for ATFCM in the area of responsibility.	
9	Now-casting and prompt change of scenario if needed, based on the evolution of the Wx phenomenon	D-0: Now-casting (+30 min to +3 hours). If a change of scenario is needed based on the now-casting - do it early. For example, KLM takes 2 hours to adapt to a new scenario and gates at AMS get saturated very quickly. At Schiphol for instance, it typically takes more than 2 hours before any change in scenario has real effect. Clear trigger points for changing of scenarios are a must. The FMP to be kept in the loop if the change of scenario requires an update of the activated ATFCM AD Wx regulation (e.g. arrival rate, duration, end time).	MET Office at aerodrome location, APOC/AODM, ATC TWR and APP, home-based carrier
10	High level features of the Local Collaborative Cell	▪ Establish local collaborative cell-(APOC or GC) depending on the size and needs of the airport; ▪ Implement Airport Operations Plan (AOP) as common information sharing platform and the Demand-Capacity Balancing (DCB) tool as main decision-making support tool (assesses the predicted effect of each constraint and allows for 'what-if scenarios'); ▪ The establishment of APOC and AOP is formalised by a Memorandum of Cooperation (MoC) between the stakeholders' organisations involved. To pursue an effective management of MET events, the APOC MoC could include explicit requirement for collaborative MET planning processes, involving the Airport Operator, the Local ATC Unit and Ground Handling as a minimum. ▪ Use pre-agreed capacity reduction scenarios, coordinated with all airport stakeholders; ▪ If pre-tactical flight cancellations are used at airports that operate a schedule with no "fire breaks" to recover from delays throughout the day; and if strong collaborative practices have been established between the airport stakeholders (Heathrow and Schiphol are known to operate close to their capacity limits all day, every day and are the only two aerodromes that reported using pre-tactical flight cancellations); additional steps are recommended to support the participating airlines:	APOC/AODM, ATC TWR and APP, FMP if required, home-based carrier, local MET Office, Ground Handling

Rec' number	Recommendation title	Recommendation description	Stakeholders involved
		○ Regulation (EC) 261/2004 protection for the participating airlines, involvement of the NSA (HADACAB[6] and DvC[7]). Uniformity across Europe; ○ EU Regulation 793/2004 slot alleviation (HADACAB and DvC).	
11	NM to Analyse and potentially Optimise AD Wx ATFCM measures applied due to convective Wx at destination airport affecting flights with EET>4 hours	NMOC to investigate optimised ATFCM measures for flights with EET>4 hours affected by convective Wx AD ATFCM regulations at the destination airport.	NMOC in collaboration with Airspace Users
12	12: Focus on delay-free execution of the First Rotation Hours	The correct execution of the First Rotation ensures the stability of the rest of the schedule of the day. The earlier in the day an aircraft is impacted by a (Wx) ATFCM regulation, ATC or Ground Handling delay, the more likely the generation of reactionary delay on the next rotations. The reverse is also true: the last flight of the day with an ATFM delay typically does not generate reactionary delay. **Special attention and effort by all operational stakeholders should be dedicated to the delay-free execution of the First Rotation Hours. The operational stakeholders addressed in this recommendation include as a minimum: the Airport Operator, Airport ATC, Ground Handling and the NMOC.**	Airport Operator, Airport ATC, Ground Handling and the NMOC, Airspace Users
13	Centralised repository/web service for airport	From an airline point of view, diversions are highly undesirable events, which calls for an accurate and centralised MET forecast well in advance of operations, ideally at D-2.	MET Service Providers, NM

[6] Heathrow ATM Demand and Capacity Balancing procedure
[7] Demand versus Capacity protocol

Rec' number	Recommendation title	Recommendation description	Stakeholders involved
	weather forecast with European coverage	It is desirable to establish a common MET portal for Airport Weather in Europe that the airlines could consult as a one-stop shop, rather than collecting information from individual European MET providers in a piece meal manner.	
14	Extension of the current "Cross-border procedure to Aerodromes	The SMART WX Task Force recommends the integration of the Cross-border procedure for en-route with the recommendations and findings of this report. In concrete terms it is suggested that: ▪ The scope of the Cross-border procedure extends to cover Aerodrome MET forecast, provided by the participating MET service providers; ▪ The scope of the Cross-border procedure extends to cover other weather phenomena at aerodrome locations, in addition to the currently assessed convective weather. The weather events extension includes: snowstorm, freezing precipitation, high winds and fog; The scope of the Cross-border procedure extends to cover both, winter and summer seasons.	MET Offices at aerodrome and ACC locations, APOC/AODM, ATC TWR, FMP, EUMETNET, NMOC

11 Conclusions and Proposed way forward

11.1 To drive real change in the collaborative management of ATFM regulations for adverse weather at aerodromes, the AOT and the NDOP/NDTECH are requested to endorse the recommendations, based on the collective operational wisdom of the SMART Wx TF.

11.2 Within the Airport Operations Team Work Plan and in the context of the Operational Excellence Programme, the SMART Wx Task Force has been working in close coordination with the operational stakeholders and experts involved in related Work-stream Topics such as those in the Work-stream 03, “Application of ATFCM”, and in particular Topics on “Harmonisation of en-route/TMA weather management” (under ENR/TMA) and “Harmonisation of Airport weather management” (under APT/TWR).

11.3 In preparation for the second step, the NDOP and AOT representatives are invited to discuss the findings of the report internally within their respective organisations, involving the MET service providers in the dialogue. The recommendations in relation to local collaboration are intentionally left at a principle level, because each aerodrome is different and a detailed procedure may be too prescriptive. If the airport stakeholders implement, tailored to their local circumstances, the recommendation#10 on establishing of a local collaborative cell, this alone will be a significant step forward, because all best practices shared in the Task Force, attested of robust collaboration between the APOC/AODM, ATC TWR, FMP and home based carrier as a minimum.

Establishing common Situational Awareness, enabled by an Airport Operations Plan (AOP) and what-if capability, provided by a Demand Capacity Balancing (DCB) tool, has been identified as the second most important recommendation.

11.4 In contrast, a detailed procedure has been proposed for the NM (see chapter 9), because the development relies upon the existing NM Cross-border procedure, in collaboration with the participating ANSPs, MET service providers and eventually APOC SUP/AODM and ATC TWRs. Further discussions on practical aspects of this procedure will take place within the corresponding Network CDM Working Arrangements, such as the Airport Operations Team (AOT) and ATFCM Operations and Development Sub-Group (ODSG).

Appendix

A. Definitions

Air Traffic Flow and Capacity Management (ATFCM). ATFM extended to include the optimisation of traffic patterns and capacity management. Through managing the balance of capacity and demand the aim of ATFCM is to enable flight punctuality and efficiency, according to the available resources with the emphasis on optimising the network capacity through the collaborative decision making process.

ATFCM Daily Plan (ADP). The set of tactical air traffic flow management measures prepared during the Pre-Tactical phase.

ATFCM Slot Allocation Exemption. The exemption of a flight from air traffic flow management slot allocation.

ATFCM Measures. Actions taken to accomplish air traffic flow and capacity management.

Aircraft Operator. A person, organisation or enterprise engaged in, or offering to engage in, an aircraft operation.

Capacity [for ATFCM purposes]. The operationally acceptable volume of air traffic.

Collaborative Decision Making (CDM). Process which allows decisions about events to be taken by those best positioned to make them on the basis of most comprehensive, up-to-date and accurate information. This in turn will enable decisions about a particular flight to be made according to the latest information available at the time, thereby enabling the flight to be dynamically optimised to reflect near or real-time events.

Critical Event. An unusual situation or crisis involving a major loss of EATMN capacity, or a major imbalance between EATMN capacity and demand, or a major failure in the information flow in one or several parts of EATMN.

Flow Management Position (FMP). The FMP's role is, in partnership with the NM, to act in such a manner so as to provide the most effective ATFCM service to ATC and AOs.
An FMP is responsible for ensuring the local promulgation, by the appropriate means (national NOTAM, AIP, ATM operational instruction, etc.) of procedures which affect ATC Units or operators within the FMP's area. FMPs shall monitor the effectiveness of such procedures.
Whatever the organisation, the ANSP responsible for the FMP(s) within a State is responsible for establishing local procedures, ensuring the NM is in possession of all relevant data during each ATFCM phase and for checking the accuracy of that data.
Each FMP area of responsibility is normally limited to the area for which the parent ACC is responsible including the area(s) of responsibility of associated Air Traffic Services (ATS) units as defined in the NM Agreement. However, depending on the internal organisation within a State, some

FMPs may cover the area of responsibility of several ACCs, either for all ATFCM phases or only for part of them."

Network Manager (NM). Function provided by the EUROCONTROL Network Manager Directorate (NMD) as described in the NM Implementing Rule of the European Commission.

Overload. An occurrence when an air traffic controller reports that he/she has had to handle more traffic than they consider it was safe to do so.

Post Operations. An ATFCM phase that takes place after the day of operation for analysis of planning procedures and coordination, the results of which are fed back into the planning process for further consideration.

Pre-Tactical. An ATFCM phase which takes place during six days prior to the day of operation and consists of planning and coordination activities.

Rate. A value, required as input to slot allocation.

Rerouteing [for ATFCM purposes]. An ATFCM measure which requires an aircraft operator to file an alternate route/flight level in order to resolve ATC capacity problems and minimise delays.

Route Availability Document (RAD). A sole source planning document that combines AIP route flow restrictions with ATFCM routeing requirements designed to make the most effective use of ATC capacity.

Slot [for ATFCM purposes]. CTOT issued by the NM.

Slot Adherence. Compliance with a CTOT by the aircraft operator and ATC, taking into account the slot tolerance.

Slot Allocation. An ATFCM measure implemented by means of a departure slot in order to balance traffic demand against available ATC capacity.

Slot Tolerance. A window of time around a CTOT available to ATC for which the aircraft must not depart outside.

Strategic. An ATFCM phase which takes place seven days or more prior to the day of operation and includes research, planning and coordination activities.

Suspension [for ATFCM purposes]. An ATFCM measure resulting in the suspension of a flight.

Tactical. An ATFCM phase, which takes place on the day of operation.

B. London Heathrow AOP and the DCB tool; “Capacity Constraints interventions- Demand versus Capacity (DvC) protocol and HADACAB”

See also DvC description in Appendix E.

Appendix B: Heathrow presentation to SMART Wx TF December 2020 on DvC and HADACAB

C. Amsterdam Schiphol “Collaborative Decision Making (CDM)” and “Sector Briefing” procedures

Appendix C: Amsterdam Schiphol presentation to SMART Wx TF December 2020 on CDM, Sector briefing and Adverse Wx Playbooks

D. Stockholm Arlanda “Snow Plan”

Appendix D: Winter Coordination at Stockholm Arlanda

E. Demand versus Capacity (DvC) protocol description

Appendix E: Industry Common DvC Protocol (draft)

F. Reactionary delay build up-MIRROR Case study

Appendix F: Case study on propagation of Weather delay across flight rotations

G. Statistics on ATFCM AD Wx delay

Appendix G: Statistics on ATFM Wx AD delays

H. Cross-border procedure overview

Appendix H: Cross-border procedure – overview

I. Balancing of arrival and departure flows at aerodromes with pronounced arrival and departure peaks. Helsinki case study

Appendix I: Helsinki case study on Balancing of arrival and departure flows at aerodromes with pronounced arrival and departure traffic peaks

References

[1] Network Function Implementing Rule EU 2019/123;

[2] NM ATFCM Operations Manual edition 24.1 from 18 January 2021;

[3] Cross-border Procedure Operational Instruction from 2020;

[4] Arrival Planning Information (API) Implementation Guide edition 1.0 from 01 July 2020;

[5] Report of the APOC/CONTINGENCY Task Force (from 2018);

[6] Report of the APOC-NMOC Task Force (from 2020);

[7] Reports of the NDOP Airport Integration Task Force (from 2018 and 2019);

[8] European Commission "Study on the current level of protection of air passenger rights in the EU" from January 2020, Ref [8];

[9] European Commission "Commission Staff Working Document: IMPACT ASSESSMENT Accompanying the document Proposal for a regulation of the European Parliament and of the Council amending Regulation (EC) No 261/2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delays of flights and Regulation (EC) No 2027/97 on air carrier liability in respect of the carriage of passengers and their baggage by air" from 13/03/2013, Ref [9].

Abbreviations

Term	Definition
APOC	Airport Operations Centre
AOP	Airport Operations Plan
ADP	ATFCM Daily Plan
AOLO	Aircraft Operator Liaison Officer
FOO	Flight Operations Officer (Flight Dispatch)
HADACAB	Heathrow ATM Demand and Capacity Balancing procedure
INP	Initial Network Plan
MET	Meteorology or Meteorological
NM DOM	Network Manager Deputy Operations Manager
NM OM	Network Manager Operations Manager
NM AFO	Network Manager Airport Function Officer/Office
SNOC	Senior Network Operations Coordinator
WIP	Works In Progress
Wx	Weather

Table 1 - Abbreviations table

EUROCONTROL

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