ISOBAR 1st Workshop

Requirements for Integration of Weather info in ATFCM Processes

Marta Sánchez – CRIDA
Senior ATM R&D Engineer and ISOBAR Project Coordinator
Welcome!
Motivation

Artificial Intelligence Solutions to Meteo-Based DCB Imbalances for Network Operations Planning

- Weather info
- Weather products
- Air traffic flow and capacity management

Learning from historical data and operational feedback
Opening Remarks

Guest Speaker: **Manfred Mohr**
Assistant Director SESAR

Manfred started his airline career as technician and engineer at Lufthansa in Hamburg. He performed as chief instructor for A340 and A330 Engine Information Systems, later becoming Deputy in Administration of the Airbus Fleet Chief pilot, responsible for 1500 Pilots. He was full responsible in managing the A380 operation of Lufthansa.

In April 2009 he started working with SESAR JU as Airspace User representative for Lufthansa Group (LH, Swiss, Austrian, Brussel Airlines and Lufthansa Cargo).

Since 2014 he is working for IATA in BRU and MAD as Assistant Director for SESAR, EUROCAE TAC Member and UAS Expert in Europe in the Safety and Flight Operation Department.
Overview of ISOBAR

Development of **five main AI components** to support the DCB supply chain in the management of non-nominal and critical situations:

- *Convective weather cells*;
- *at pre-tactical and tactical levels* (-24h up to execution, with a focus on later tactical phase).

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**Diagram:**

- **Initial demand**
  - Probabilistic weather forecast
  - Declared capacity

- **Data Integration**

- **ISOBAR CORE**
  - Convective Cells and Storm prediction
  - Demand and Capacity Characterisation
  - Mitigation Strategy Prescription

- **ATFCM effectiveness**

- **Post-analysis**
  - Ops Feedback
  - Actual Demand

- **DCB**

- **Tactical ATFCM Operations**
  - ATC Ops
Research Questions

RESEARCH QUESTIONS

• Q1: HOW CONVECTIVE WEATHER INFO AND DEMAND-CAPACITY IMBALANCES CAN BE DYNAMICALLY USED BY ATFM OPERATORS?

• Q2: HOW TO INTEGRATE THE WEATHER UNCERTAINTY ON THE DCB PROCESS IN LINE WITH OPERATIONAL TIMEFRAMES?

How the project addresses it

• Transformation of weather forecasts data into convective cells information adapted to ATM spatial and temporal dimensions.

• Enhanced ATFCM operational procedures integrating predictive models and mitigation prescription into the collaborative decision-making.

• Use of pre-defined scenarios for mitigation measures and impact pre-assessment.
ISOBAR Consortium
Non-profit Spanish Reference Center of R&D in ATM established by ENAIRE, INECO, and UPM

**Activities**

- Focus on systematic monitoring of Key Performances such as Safety, Capacity and Efficiency and ATM data management and exploitation;
- Development of R&D solutions providing quantifiable performance benefits;
- Validation of new concepts and systems.

**In ISOBAR**

- Network ATFCM and local FMP enhanced processes;
- Performance framework and solution evaluation;
- ATM & Meteo data extraction, transforming and loading.
UC3M’s mission is to contribute to the improvement of society through teaching of the highest quality and cutting-edge research in line with stringent international guidelines. The University aspires to excellence in all its activities, with the aim of becoming one of the top universities in Europe.

In ISOBAR

✓ Meteo Engine (Neural Networks based storm predictor);
✓ Hotspot Detection (Neural Network based);
✓ Communication and Dissemination
Cranfield University is an exclusively postgraduate public university based in the UK, specialising in technology and management.

**MISSION**

Unlocking the potential of people and organisations by partnering with business and governments to deliver transformational research, postgraduate education and professional development.

**Activities**

- Over half of all aerospace engineering master's students in the UK study at Cranfield;
- Providing academic expertise supported by unique industrial-scale experimental facilities, including operating our own Cranfield Airport and aircraft for teaching and research;
- Professional development programmes for senior leaders in partnership with our clients.

**In ISOBAR**

- DCB hotspot mitigation;
- Performance framework definition;
- Simulation and solution evaluation
The French Civil Aviation University, a leading aeronautics and aviation university, based in Toulouse.

- To provide ab initio and further training for the professionals, executives, and main players of civil aviation in Europe and worldwide.
- To cover a broad range of innovations in the air transport system, from fundamental research to the design and deployment of new services in the operational environment.

**Activities**

**Research teams:**
- OPTIM: Optimisation and Machine learning;
- TELECOM: Advanced telecommunication and networks for ATS;
- Interactive Informatics: Critical systems engineering and Man-Systems interfaces;
- DEVI: Data, Economics, and Visualisation.

- AI for DCB hotspot mitigation:
  - In particular, development of meta-heuristic and Reinforcement Learning algorithms for large scale trajectory planning. *(with Cranfield University)*
EUROCONTROL is an intergovernmental organisation with 41 member states, HQ in Belgium

EUROCONTROL provides civil-military expertise across the full spectrum of air traffic management to support European aviation. Expertise deployed in a number key roles: Network Manager, Maastricht Upper Airspace Control Centre, Central Route Charge Office, major player in SESAR Joint Undertaking.

In ISOBAR

- Development of an AI model for an automated resolution support tool
- Enrich R-NEST, PLANTA and INNOVE validation platform with advanced capabilities
- Enrich the NM Performance Dashboard prototype
- Improve Weather Operations for the Network Manager Function
DSNA (Direction des Services de la Navigation Aérienne) is the national air navigation services provider of France. DSNA is entrusted with the provision of air traffic services, associated communication, navigation and surveillance services and aeronautical information services in all airspace under French responsibility and at designated airports.

Activities
- ATC and ATM services in one of the 5 major ACCs of Europe.
- SESAR 1 development phase and active contributor to SESAR2020 wave 1.
- Deployment of many PCP and non-PCP SESAR solutions.

In ISOBAR
- Definition of the enhanced ATFCM concept;
- Identification of demand capacity imbalances;
- ISOBAR B2B Services and Tools Integration;
- Evaluation of ATFCM measures effectiveness.
AEMET, Spanish Meteorological Service

AEMET is responsible for providing weather forecast, warnings of hazardous weather and represents Spain in WMO, EUMETSAT and ECMWF.

Activities

- AEMET's main task is to develop, implement and provide meteorological services falling within the competences of the State, as well as to give support to other public and private activities.
- AEMET provides meteorological support ENAIRE, the Spanish air navigation manager.

Provision of convection forecasts from gamma-SREPS, a high resolution ensemble prediction system over the Spanish area.
French national weather service

Providing **weather forecasts** and assistance to civil security, **air navigation**, and military forces.

**Activities**

- Development of state-of-the-art numerical weather prediction models;
- Development of innovative products using ensemble prediction systems;
- Promoting a wider use of ensemble prediction systems;

**In ISOBAR**

*Providing high-resolution convection forecasts with a focus on the use of ensemble prediction systems.*
Sopra Steria Aeroline Business Unit offers its expertise to world aerospace corporations and ATM major stakeholders through long-term partnerships.

**Activities**

- Software engineering on ATM/ATFCM and airport systems, from concept to deployment, e.g.: 4-FLIGHT, SYSAT, French new ATC systems for En-Route & Approach and Flight and Flow Management Systems for EUROCONTROL;
- Innovative Approaches (co-design, Agile, UX, digilabs) and Techniques, e.g.: machine learning, mobility, internet of things, big data, cloud
- Interoperability solution (SVS) and cybersecurity expertise

**In ISOBAR**

- AI modelling to predict airlines behaviour;
- Prototyping of evaluation tool of the concept.
Global Total Lightning Observation Network Owner and Operator. United States.

**MISSION**

To provide real time, historical total lightning data and derived products

**Activities**

- Products and services oriented to aviation solutions: safety, sustainability and scalability.
- Continuous R&D effort. MIT collaboration.
- Committed with start-of-the-art technologies: AI, new vis tools...

*Providing real-time / historical data over the ISOBAR geobox and introducing nowcasting techniques.*
Swiss International Air Lines – the National Airline of Switzerland
Part of the Lufthansa Group

- **Mission/Vision of the research activities:**
  Active participation in internal and European (SESAR VLDs and ER4) projects to enhance the current ATM situation, shape the future ATM with airspace users inputs, needs and visions.

Represents the airspace users view and needs, as well as bring operational expertise about flights rerouting and priority of flights during disrupted situations.
## Agenda

<table>
<thead>
<tr>
<th>TIME</th>
<th>CONTENT</th>
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<tr>
<td>10:00 - 10:30</td>
<td><strong>Introduction</strong>&lt;br&gt;- Welcome and Opening Remarks;&lt;br&gt;- Overview of ISOBAR, consortium and research questions;&lt;br&gt;- Workshop Objectives.</td>
<td><strong>Opening Remarks</strong> by Manfred Mohr&lt;br&gt; - Assistant Director SESAR at IATA&lt;br&gt; Marta Sánchez (CRIDA) - ISOBAR Project Coordinator&lt;br&gt; ISOBAR Partners</td>
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<td>10:30 - 12:00</td>
<td><strong>Operational Scenario and Use Cases</strong>&lt;br&gt;- High-resolution numerical weather products in support of convective storm prediction.&lt;br&gt;- Link with Cross-Border weather operations tasks and EUMETNET.&lt;br&gt;- <strong>Use Cases</strong>: mitigation of demand-capacity imbalance due to weather/convective event forecast. A storm story:&lt;br&gt; 1. French flow management;&lt;br&gt; 2. Cross-border NetSpot identification;&lt;br&gt; 3. Evolution into Spanish airspace.</td>
<td>** Florenci Rey (EarthNetworks)** - Director of Business Development Europe&lt;br&gt; <strong>Christopher Peregrine (EUROCONTROL)</strong> - NM Head of Operations Analysis Services&lt;br&gt; 1. Thierry Durigneux (DSNA) - FMP Manager&lt;br&gt; 2. Stephane Pierre (EUROCONTROL) - Airflow Manager&lt;br&gt; 3. Francisco Tortosa (ENAIRE) - ATC Specialist at Flow Control Division / Andre Rungger (SWISS) - Flight Dispatcher</td>
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### Lunch Break
Agenda

14:00 - 14:30
Gaming Introduction
- Objectives, methodology and tools;
- Sample Use Case: detailed workflow & ISOBAR prototype service target functionalities.

Danlin Zheng (CRIDA) - ATM Researcher and Validation Engineer

14:30 - 16:00
Gaming and Brainstorming
- Target snapshot (5 min);
- Parallel discussion groups - requirements for ISOBAR prototype service (10 min);
- Groups' outcomes in plenary session and refinement of requirements (15 min).

Moderators:
Yan Xu (Cranfield University) - Lecturer in ATM/CNS
Javier García-Heras (UC3M) - Principal Researcher
Eva Puntero (CRIDA) - Senior ATM Researcher

16:00 - 16:30
Wrap Up
- Takeaways;
- Short survey;
Next steps: stay tuned to ISOBAR

Marta Sánchez (CRIDA) - ISOBAR Project Coordinator

ALL ATTENDEES
Thank you very much for your attention!

This project has received funding from the SESAR Joint Undertaking under the European Union’s Horizon 2020 research and innovation programme under grant agreement No 891965.
Florenci Rey (Earth Networks)  
- Director of Business Development Europe

1st ISOBAR Workshop
October 1st, 2020
What are the ISOBAR goals?

MAIN OBJECTIVE
To convert the outputs of high-resolution numerical weather products to convective information able to feed storm prediction in the spatial and temporal granularities required at local and regional levels of ATFCM, avoiding the existing excessive atomization and serving a wide range of geospatial regions and timescales at the same time.

GOALS
• Provision of a MET ENGINE (ME) focused on storm-cell activity on the selected geobox/sectors. ME will use state-of-the-art numerical weather modelling capabilities enhanced with AI and nowcasting / real-time data available tools at tactical and pre-tactical timeframes.
• Proposal of an useful, standard visual interface for final users
• Provide easy and useful access to ME outcomes
• Proposal of a ready-to-use, paneuropean tool designed by and for ATM personnel
What’s in the **ISOBAR MET ENGINE**?

- **A.** Post-processing of High-Resolution NWP Products
- **B.** Processing of Convective Indicators and storm data (lightning)
- **C.** Storm Predictive Model: PROBABILISTIC TOOL
Why ISOBAR’s approach is new?

THE MET ENGINGE CONCEPT IS BASED ON

- HIGH RESOLUTION NWP MODELS
  - Greater precision
  - Dense granularity
  - Different timescales available: Strategic and Tactical
  - Use of Historical NWP Libraries

- ENHANCED NWP OUTPUT
  - Combining Storm Real Time Data and NWP outputs
  - Use of precise and common Convective Indicators
Why ISOBAR’s approach is new?

THE MET ENGINGE CONCEPT IS BASED ON

• AI LEARNING ALGORITHM
  • State-of-the-art AI techniques
  • Final product: PROBABILISTIC STORM PREDICTION TOOL
The MET ENGINE concept
1st ISOBAR Workshop

Thank you very much for your attention!

This project has received funding from the SESAR Joint Undertaking under the European Union’s Horizon 2020 research and innovation programme under grant agreement No 891965.
Together we are stronger

Christopher Peregrine
Head of Operations Analysis Service
UNTIL NOW

2015
Weather Resilience Forum

2018
Weather Forum

2018
Weather Workshop

Apr – Sep 2019
Cross-Border Weather Procedure

Jun – Sep 2020
Cross-Border Weather Procedure

Aug - Sep 2018
Cross-Border Weather Trial

Weather Forum – 1st October 2020
ISOBAR 1st Workshop – 1st October 2020

**BENEFITS**

- Raised situational awareness
- Earlier decision making
- RAD relaxations
- Increasing stability
- Better planned re-routings
- Staff planning
**TIMELINE**

### D-1
- 9:00 Weather Forecast
- 09:00 – 11:00 Building Plan
- Coordinating
- 11:30-12:30 Conferencing (if required 10-15min; aiming for 11:30)
- 16:00 – 17:00 Publishing the Plan

### D-0
- 07:00 Update of D-1 Forecast
- 12:00 Update of 07:00 Forecast
- Focused Conferencing (if required)

*All times UTC*
The main focus of CB/TS activity today will be across Spain and SW France. Here, clusters of CBs are expected to form with tops up to FL400. This area of activity will move very slowly E/NE into S & W France. There is also a risk of isolated individual CBs over the Alps, with tops up to FL340.
MATRIX EVOLUTION

Unified Risk Matrix for forecasters and users

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<th>H</th>
<th>VH</th>
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<td>N</td>
<td>L</td>
<td>L</td>
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</table>

- Isolated: Individual CBs, orographic and daytime bound
- Occasional: Multi-cells, dynamic or pulsating
- Frequent: Widespread, often dynamically triggered, >=75% of area
- Organized: Cold front, SQL, MCS

Risk interpretation:
- Very High
- High
- Medium
- Low

2019 ———— 2020
THE FUTURE
(IS HERE)

- AO involvement
- Simplified Matrix
- Focus on Tactical - Nowcasting
- Focused collaboration (use of technology)
- Met Forecaster in the Ops Room
- Forecast vs Capacity Reduction
- Widening the Geographical Scope
- Year-round Airport involvement (SMART WX TF)
ISOBAR – 1st Workshop

French Flow Management Use Case

Thierry Durigneux - FMP Manager Reims

Virtual event - 1st October 2020
Purpose

The aim of this document is to describe an operational scenario that will serve as a basis to identify and to develop the future operating methods and processes in ISOBAR.

It describes a convective weather situation and how the “Local FMP & Network” team could better manage weather situations: avoid the cascading effects across the network, and together look for a “global optimum” gain.

The following use case focuses on how we could better use the network according to expected weather situations. The chosen date to illustrate it, is the 26th of July 2019.
Summary

- The **NM CBT scope** as a basic to start with.
- Local contribution to Network into a **continuous process**, we are pushing for.
- **Weather Scenarios & Playbook** concepts.
- Our proposal: use case as a first « **Weather scenario** » and first **Playbook** measure.
- Graphical illustration mixing actual weather (26\textsuperscript{th} of July 2019) and flights paths of the proposed use case.
Use case presented in the NM CBT scope

Participants 2020
- Austrocontrol
- CrisControl
- DFS
- DSNA
- ENAIRE
- MUAC
- NATS
- Skyguide

Meteorological service coordination led by EUMETNET.

When?
- D-1 at 9h Utc
- D : 2 updates at 7h and 12h Utc

4 production slots
- 9-12 h Utc
- 12-15 h Utc
- 15-18 h Utc
- 18-21 h Utc
Process: weather data to contribute to a continuous operational flow management

NM CBT D-1 weather forecast

NM Analysis

Collaborative conference

Playbook approval

Initial Network Plan

09 10 11 12 13 14 15 16 17 ...

D-1 PreTactical

Local inputs

Playbook proposal

Local Analysis

NM CBT D-1 weather forecast

NM CBT D0 weather forecast update
9-12, 12-15, 15-18, 18-22

NM CBT D0 weather forecast update
12-15, 15-18, 18-22

Adjusted Playbook approval

Updated Local inputs
- Estimated Impact
- Scenarios (playbook) proposals

NM CBT D0 update
9-12, 12-15, 15-18, 18-22

NM CBT D0 weather forecast update
12-15, 15-18, 18-22

Continuous playbook process proposed by Reims for next steps

Weather scenarios proposed by Reims in the NM CBT initiative Summer 20

NM CBT weather informations

Network: NMOC

Local FMP
Weather scenarios? Towards a Playbook of ATFCM solutions

- **Weather Scenarios**, a network driven opportunity looking for an overall global gain:
  - To build them: identify flights having an acceptable network rerouting option (compared to others who have none or very penalising ones) - to look for avoiding difficult and chaotic situation and network dominos effects.
  - **Weather Playbook** (to develop): a set of measures agreed between partners local FMP, Network and AOs.

- Use case proposed: first weather scenario, first playbook measure.

Our weather scenario proposal was agreed in principle in the NM Cross Border scope: NMOC, ANSPs, AOs

**First step**: start the continuous process by D-1

- If D-1 high convective activity during peak hours on key blocks or very high convective forecasted in a sensitive area
- Ask for reroutings weather scenarios to deconflict high potential of chaotic situation (locally + domino effects)

Anytime, the Network has the final decision
26th of July 2019
Weather situation expected at D-1
Available capacity

**NB**: in 2019, the NM CBT trial was only covering Reims airspace area of responsibility. That’s why the above coloured presented map is not one of the CBT. It is the Météo France one **used operationally**, and to illustrate the situation at national scale.
What might have been Network opportunities to mitigate the weather impacts?

**To avoid severe expected weather convection**, use network opportunities to move flows from west to east to better manage collectively traffic flows.
26th of July 2019
What might have been candidates for a D-1 weather scenario?

Look for possible candidates
EDDL-LEPA
Düsseldorf > Palma

List a set candidates

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Identify clearly onloaded areas

Eurocontrol CHMI data

Eurocontrol Nest data
Proposed use case

2 Flows to build weather scenarios:
- **Southbound flow**: EH.., EB.., ELLX, EDDK, EDDL > LEPA, LEIB, LEMH, LEBL, LEGE
- **Northbound flow**: LEPA, LEIB, LEMH, LEBL, LEGE > EH.., EB.., ELLX, EDDK, EDDL

**Use case**:
- Called « French flip flop »
- Not only French but also Crossborder ANSPs: MUAC at the north, Barcelona and Palma in the south

**Process to use** (as described in the timeline above):
- First step: based on the D-1 described process
- Further steps D0

If at D-1, is expected:
- very high convection
- Or high convection in key areas

Then Depending on weather situations push traffic demand to the east or west option with « weather scenarios »
Actual weather and flights paths use case proposal
ISOBAR – 1st Workshop

Cross-Border at NM Use Case

Stephane PIERRE (EUROCONTROL)
Airflow Manager

Virtual event - 1st October 2020
The aim of this operational scenario is to describe an operational context that will serve as a basis to identify and to develop the future operating methods and process in ISOBAR.

It aims at describing a convective weather situation and the cascading effects across the network.

The current scenario is based on a convective day, the 27th of August 2019.
Scenario Description

Weather forecast for the 27\textsuperscript{th} of August as published on the 26\textsuperscript{th}
Scenario Summary

On the pre-tactical day, The weather forecast indicates convective activity over

• the Balearics
• Barcelona
• Barcelona airspace
• expanding over the French Pyrenees.

The following sections presents the operational scenarios sequence.
Scenario Description

Time line

D-1 PreTactical

09 10 11 12 13 14 15 16 17

Initial Network Plan

Playbook approval

Collaborative conference

NM Analysis

weather forecast

D0 Tactical

07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22

weather forecast update
12-15, 15-18, 18-22

weather forecast update
9-12, 12-15, 15-18, 18-22
Scenario Description

Weather forecast for the 27\textsuperscript{th} of August as published on the 26\textsuperscript{th}
## General Outlook

### High Pressure system
Over most of continental Europe

### Low pressure system
West of Ireland, convective troughs over W-UK and N-Spain.

CBs developing across the eastern part of the Alps, central Europe, E-Germany and also E-Spain (Barcelona and the Balearics)

## SEVERE WX ALERTS.

### ENROUTE

**CONVECTION**

**OCNL CB act top FL 380-400**

**LECP / LECB / LECM**

**ISOL CB act top FL 350-380**

EDWW / EDUU / LKAA / LHCC / LDZO / EGTT

LOVV

### AIRPORT

**EGLL 02-08 HZ**

**EDDM 03-06 BCFG**

**EDDS 02-07 BCFG**

**EDDT 11-18 G30KT TSRA CB**

**LSGG 18-24 TSRA CB**

**LSZH 04-07 800m FG**

**LOWW 06-16 TSRA CB**

**LFPG/PO 15-21 TCU**

**LEBL 07-17 CB**

**LEPA 07-16 G35KT TSRA CB**

**LPPR 00-08 500m FG**
Scenario Description

PRE-TACTICAL D-1

Situation at D-1 – 09:00 UTC:

NM and ANSP/FMP receive the weather/convective events forecast generated by the ISOBAR Meteo engine.
Isobar like translation of weather situation
What is a gate, how does it work?

- A gate is a vertical surface, defined by 2 geographical points and a range of level.
- The role of a gate is to capture specific flows for counts, plotting or regulation purposes.
- It allows to visualize the flows for a given time period.
- Highlights overloaded sectors along the flows.
- Suggests opportunities for rerouting.
Scenario Description

The ISOBAR AI engine determines:

• the induced capacity reduction
• The resulting DCB impact
Scenario Description

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Scenario Description
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Forecast at D-1 – 09:30 UTC:

NM starts the analysis of the weather forecast and predicted convective events. The resulting capacity reduction is forecasted to start at D0-0830 UTC:

Situation as forecasted at D0 0830

NM to build the network gates according to the shape of the affected area

• In black, directly affected area

• In green, wider area with opportunity for Re-routing

• In blue, Net spot to determine all the actors involved, including those likely to contribute to delay mitigation
Scenario Description

At D-1 – 10:00 UTC:

• NMOC sends a Netspot proposal to the concerned actors to support a collaborative process (teleconference).

LECM FMP
LEBL FMP
LEPA FMP
LECS FMP
LFBB FMP
LFMM FMP
Scenario Description

At D-1 – 11:00 UTC:

The teleconference shall allow the concerned actors (i.e. NM and Local FMPs, and most affected AOs) to exchange information and to discuss the characteristics of the netSpot list of actors, delineation, start time, end time, severity, etc...).

A playbook will be built containing possible mitigation measures:

- Flows to be re-routed
- Flows to be regulated
Scenario Description

Partners to identify alternative routes to build the playbook

Weather affected area
Gates to capture affected flights
Gates to highlight opportunities
Netspot zone
Scenario Description

Which sector may be affected
Estimated capacity reduction
Impact on staffing situation
Impact on military activity
When measures may be applied
Possible areas of capacity for rerouting
Identify re-routing opportunity/scenarios (scenario playbook)

Playbook scenario will be mainly based on:
Block regulations with rate (to be determined/ regarding weather conditions and staffing situation)
Rerouting of specific flows to avoid congested sectors
Regulation of specific flows.
**D-1 – 13:00 UTC:**

The agreed playbook scenario(ii) will be published on the NOP, stating:

- The probability
- The measures planned
- The decision time for application of the measures
**Scenario Description**

**D-1 – 16:00 UTC:**

Measures already applied in pre-tactical will be published in the INP.
TACTICAL D0

On the Tactical D0, NM reassess the situation and adjust the Network Plan.

At D0 – 07:00 UTC:

A tactical forecast updating the D-1 forecast is provided.

- If there is a significant evolution, NM can call a teleconference to review the course of action.
- If in line with the D-1 forecast, pre-agreed measures will be coordinated with the concerned FMPs, adjusted as necessary before implementation.
- Continuous monitoring of the situation and necessary adjustments will be carried on along the day.
Scenario Description

Post operation.

Post ops is an important component of the process to feed and improve:

• data sets
• the metrics
• the procedures
• Confidence of the partners
• Cost/benefit analysis of the measures.
• Enrich the playbook.

• In that respect we need to determine and format those elements beforehand to facilitate the automation of data collection and analysis.
ISOBAR – 1\textsuperscript{st} Workshop

\textit{Spanish Flow Management Use Case}

Francisco Tortosa (ENAIRE) – ATC Specialist at Flow Control Division

Andre Rungger (SWISS) – Flight Dispatcher

Virtual event - 1\textsuperscript{st} October 2020
Some weather figures

- **Weather** conditions account for roughly one third of ATM delays.

- Among the diverse weather causes, **convective weather** is a leading one, accounting for almost half of weather-related delays in summer.

- 10% of the weather delay in 2018 concentrated in only the top ten days.

How convective weather situations are managed at local FMP and network levels makes the difference in terms of:

- Avoiding cascading effects across the network
- Achieving global optimum gain: more efficiency in mitigation measures
A storm story…

**D-1 Monday 26th of August 2019**

- Spanish FMP at Barcelona ACC is analysing the situation for the next day, the day of operation: **D0 Tuesday 27th of August 2019**.

The process is defined by:

- Weather and ATM input information
- Timings for analysis and coordination with **NM, adjacent airspaces & AUs**
- Data exchanged between stakeholders for coordination

- **Decision times**
- **D-1 13:00**  
  - Publication in NOP

- **Results**: imbalance solution implemented
Weather forecast input from ECMWF
European Centre for Medium-Range Weather Forecasts

Forecast from August 26th 12:00 (August 27th 00:00 – 12:00)

Forecast from August 26th 12:00 (August 27th 12:00 – 24:00)

When?
- D-1 at 00h and 12h UTC
- D-0 at 00h and 12h UTC

Hourly forecasts for D0 presented according to EUMETNET risk matrix colour codes
Weather data input in continuous operational flow management

Timeline consistent with concepts “weather scenario” and “playbook”
Weather scenarios – agreement with stakeholder Playbook -> towards a Playbook of ATFCM solutions

Weather scenario and associated playbook proposal by FMP and agreed with:
NMOC, other FMPs/ANSPs, AUs

AUs Planning Principles
Flight Planning is:

**4DTBO**: Trajectory Based Operation including:
- RAD, PTR’s & LOAs

**WX**: only upper winds H+6,+12,+24 and +36

**Shorthaul (H-12)**, flights up to 6 hrs
- completely automated
- cheapest route is selected

**Longhaul (H-8)** reviewed by dispatcher:
- WX hazards are monitored!
- Pre-flight impact analysis and In-flight for potential inflight reroutings
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Current problem with turbulence data: Too little shared

Current limitation: Too often the case with aircraft flying through turbulence

- All 3 aircraft will hit the same turbulence because the data is too often not shared by ATC, nor between airlines or different solution providers
- All available data needs to be shared to mitigate turbulence encounters globally

The main reason, the information are available, but reactive, too late! Creating additional cost and delay! Lack of predictability, leading to a conservative flight planning, additional fuel, we are not able to fly optimized descent, cruising and speed!
Weather Monitoring

TURBULENCE
EDR-based forecasts

ICING
Airfoil-specific forecast

THUNDERSTORMS
Global view of convection

ISOBAR 1st Workshop – 1st October 2020
27th August 2019, 0400UTC

Input from Barcelona FMP and Fran.

What might have been network opportunities to mitigate the weather impacts?
27th August 2019, 1200UTC
27th August 2019 – Report LECB

- 19 Weather regulations
- Rate 0 at different time periods in LEIB, LEPA, LEAL, LERS
- 8 traffic diverted
- Affected sectors in LECB, regulated with reduced capacity:
  - LVU, LVL, BAS, LVS, CCC, GO1, GO2, GO3, DDI, P2R
Reroutings potential solutions for en-route affected flights
Improvements expected

- Increased **accuracy**
- Presentation of weather forecast in a visual format adapted to ATM needs -> easier to check forecasts reliability, link with implemented measures (actual occurrences and solutions)
- So it is possible to react earlier and perform early publication of potential mitigation measures –> increased **predictability**.
- Web based “nowcasting”, especially for D-0 and postops analysis
  - Analyse traffic + weather data
- Some RAD relaxation for affected flows.
- Increased meteorological phenomena (Haze prediction – canaries)
- Aerodrome specific data: LVP prediction, potential access route, probable configurations (if predictable).