Gezielte MET-Information für Air Traffic Management in Österreich und im Rahmen von SESAR

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MET Entwicklung & Innovation

Fortbildungstag 2016 der Österreichischen Gesellschaft für Meteorologie (ÖGM) und der Sektion München der Deutschen Meteorologischen Gesellschaft (DMG)
Hall, 25. Nov. 2016

SAFETY IS IN THE AIR

MET-Informationen für ATM

- Grundlagen der Flugsicherung
  - Aufgaben
  - Lufträume
- MET-Informationen
  - Tower Control (TWR)
  - Area Control Center (ACC)
  - Approach Control (APP)
  - Flow Management (FMP)
- SESAR
  - Programm
  - 4DWeatherCube – MET-GATE

Air Navigation Service Provision (ANSP) prinzipielle Leitlinien

Excellence bedeutet:
die wichtigsten Kunden- und Stakeholderanforderungen (Safety, Punctuality, Sustainability, Efficiency) im optimalen Gleichgewicht zu erfüllen.

Weather impact on Air Traffic Management

- Weather especially Wind, Thunderstorms and Low Visibility have big impact on airport capacity

- Weather cannot be changed but accurate forecasts help to be prepared and to minimize weather impact

- Weather impact in numbers:
  - Vienna International airport:

Delays LOWW ARR 2015			
	minutes	min/flight	percentage
Weather	101 894	0,40	80%
Total	127 341	0,50	

  - Winter 2015/16 weather delays mainly due to low visibility (almost no snow at Vienna airport)

Air Navigation Service Provision (ANSP)

- Air Traffic Services (ATS)
  - TWR – Tower Control
  - APP – Approach Control - Anflugkontrollstelle
  - ACC – Area Control Center - Bezirkskontrollstelle
  - AIM – Aeronautical Information Management - Luftfahrtinformationsdienst
  - FIC – Flight Information Center - Fluginformationszentrale
  - SAR – Search and Rescue – Such- und Rettungsdienst

- Aeronautical MET Service Provider – Flugwetterdienste

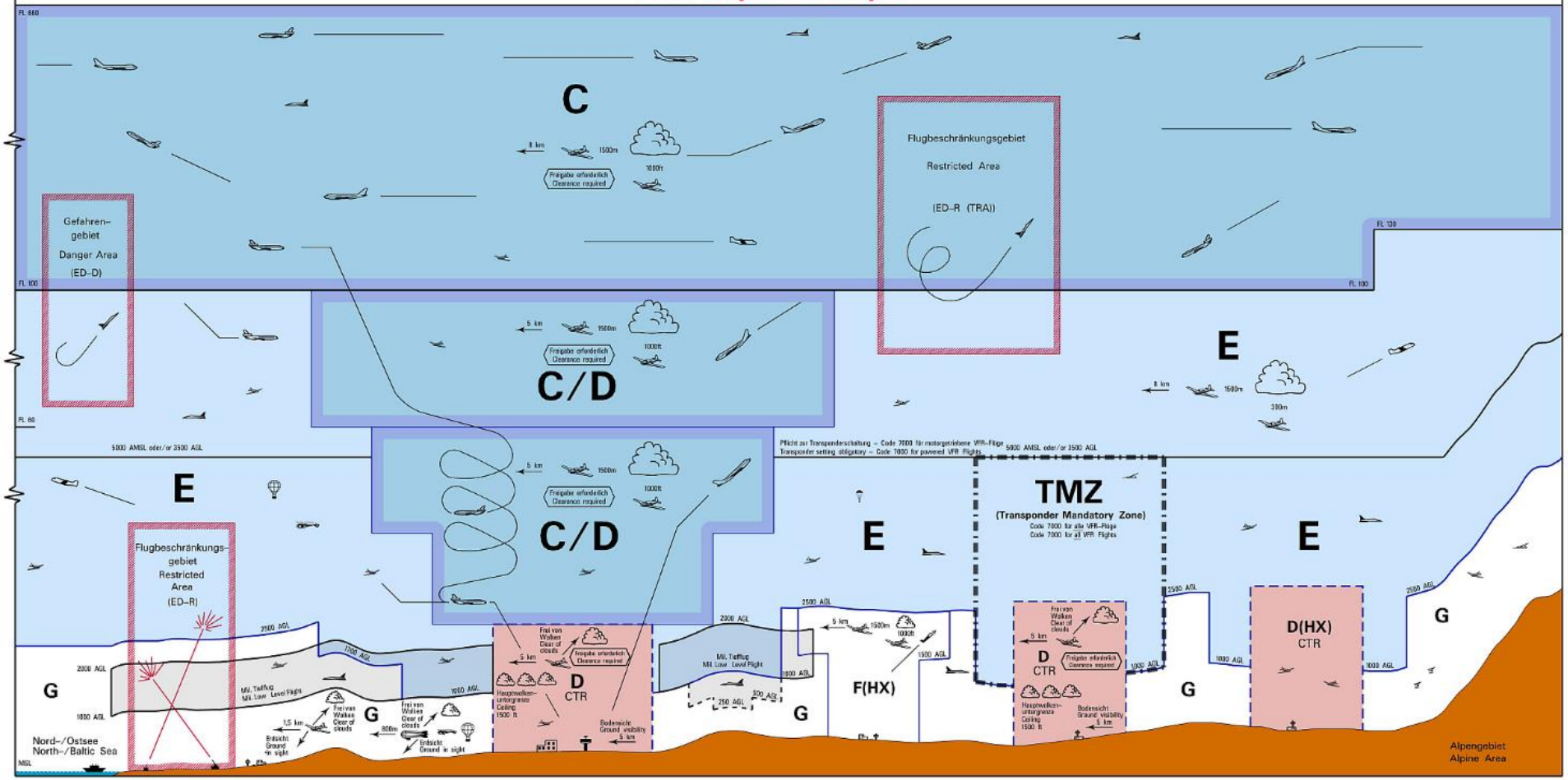
DFS Deutsche Flugsicherung

Luftraumstruktur/Sichtflugregeln in der Bundesrepublik Deutschland

Airspace Structure/Visual Flight Rules in the Federal Republic of Germany

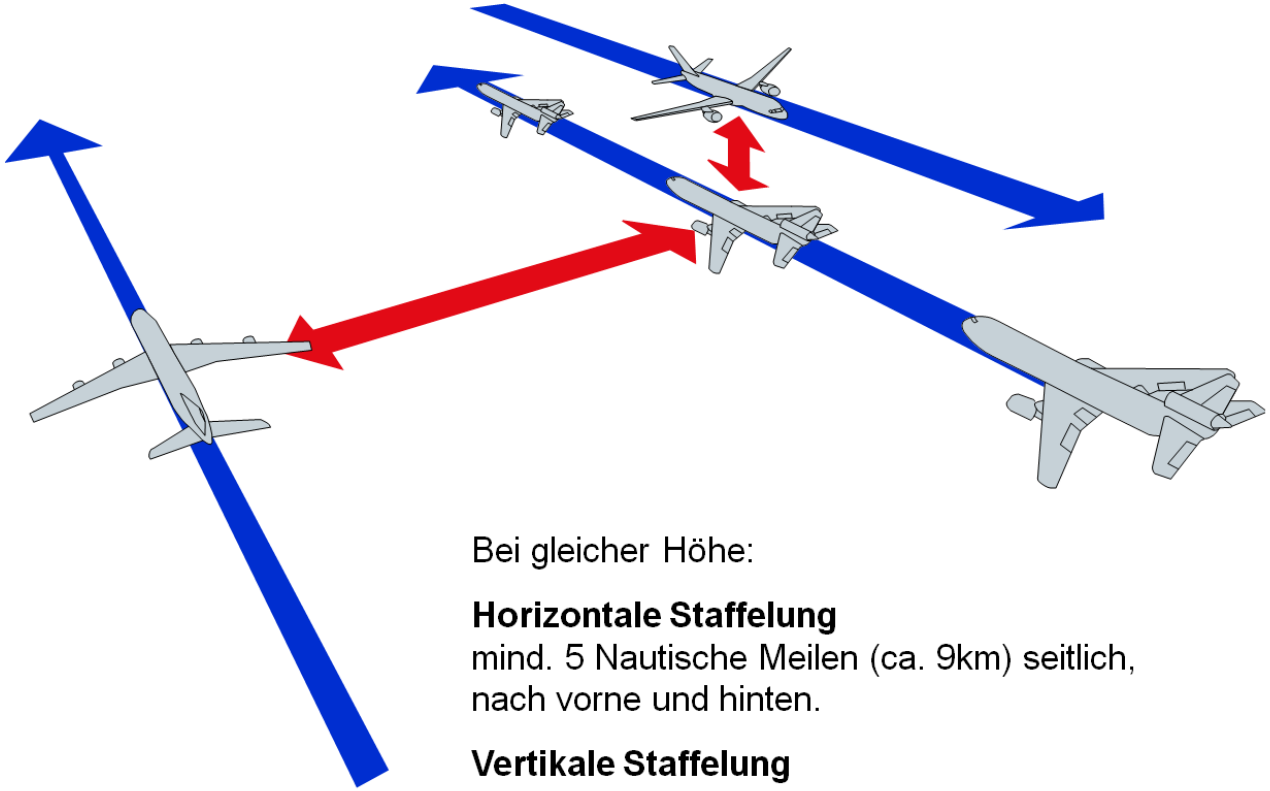
Fallbeispiel/Example

Schematische Darstellung
Schematical Figure



Details sind in den Luftfahrthandbüchern (AIP) publiziert

Staffelung (En-Route)



Bei gleicher Höhe:

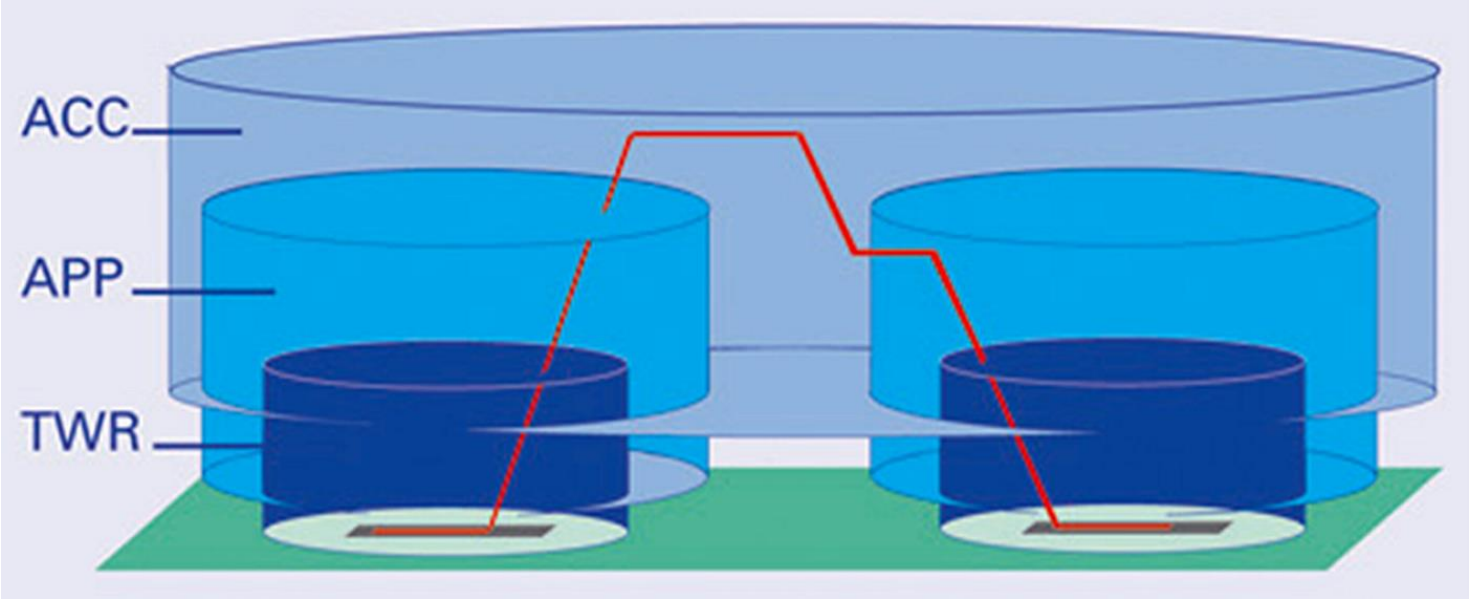
Horizontale Staffelung
mind. 5 Nautische Meilen (ca. 9km) seitlich, nach vorne und hinten.

Vertikale Staffelung
mind. 1.000 Fuß (300m)

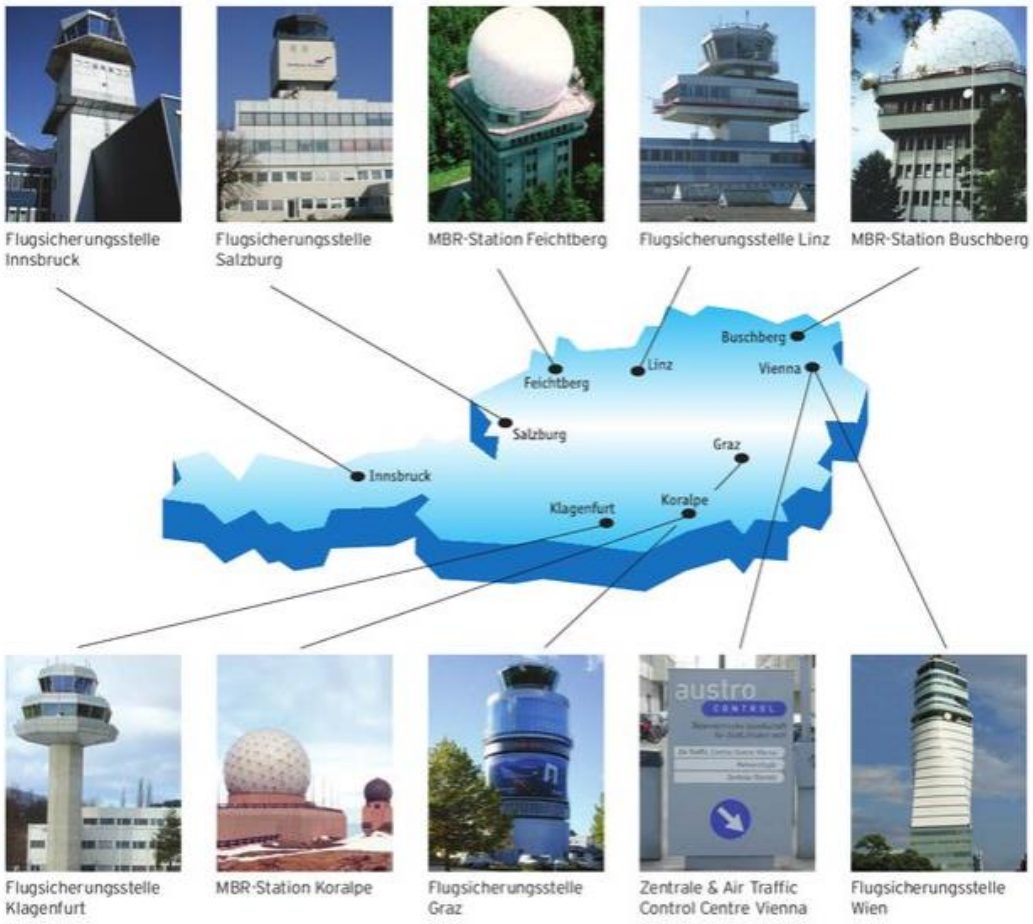
Excellence bedeutet:
die wichtigsten Kunden- und Stakeholderanforderungen (Safety, Punctuality, Sustainability, Efficiency) im optimalen Gleichgewicht zu erfüllen.

http://www.skybrary.aero/index.php/Reduced_Vertical_Separation_Minima_(RVSM)

Phasen eines Fluges



Standorte in Österreich



Tower Control (TWR) → Departure Management

Exakte Planung der Abläufe vom Block Off bis zum Take Off sichert ein sicheres, effizientes, pünktliches und nachhaltiges ATM-System

→ Airport Collaborative Decision Making (A-CDM)

Erforderliche MET-Informationen

- Wind 10m / 1000ft (wenn relevant)
- Niederschlag (flüssig, fest, gefrierend)
- Sicht (RVR) / tiefe Wolken
- T/Td Boden
- Vereisungswarnungen für TMA
- Pistenzustand

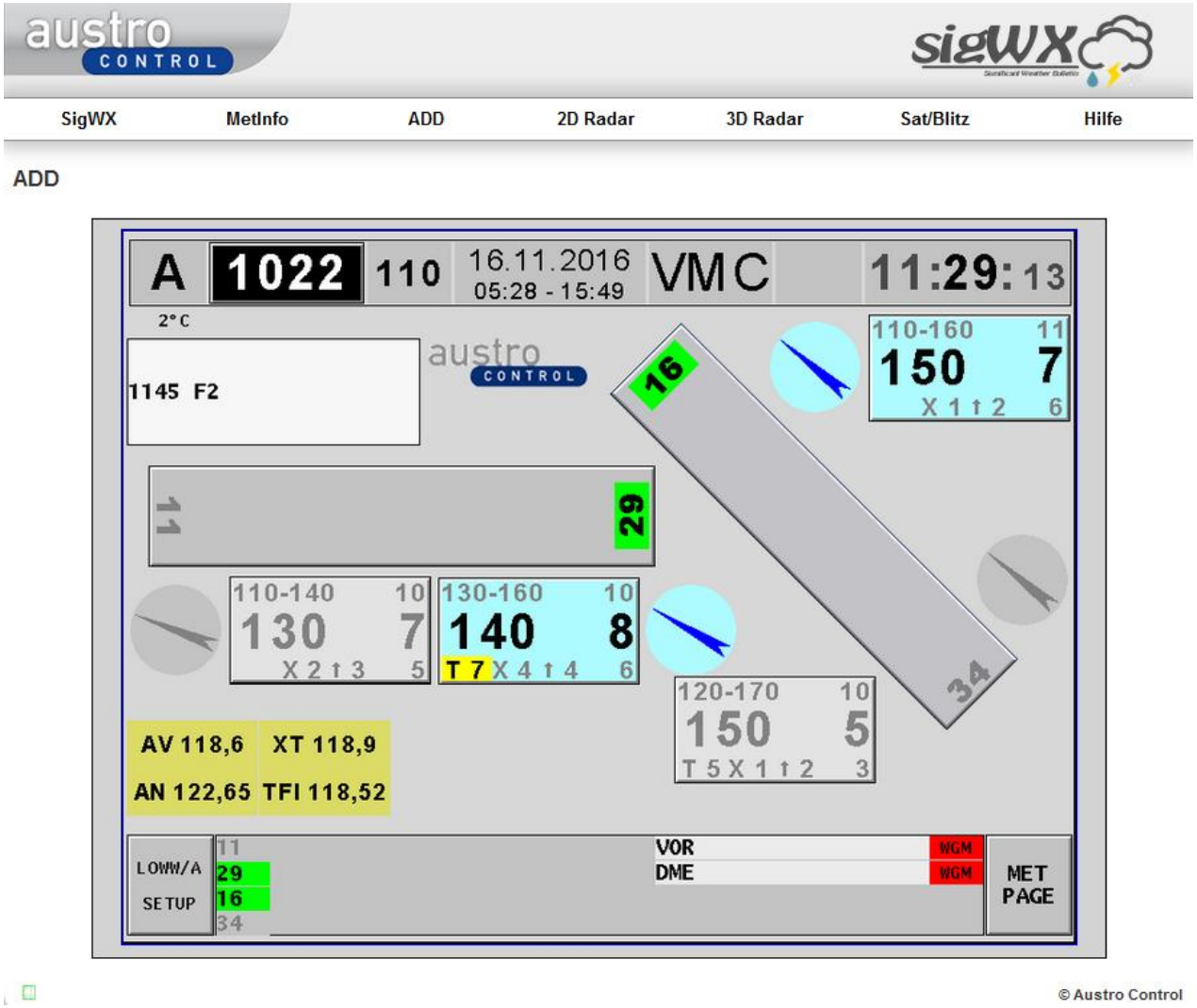
→ Auftriebsberechnungen, Enteisung, Auswahl der Start-Piste, Zeitberechnungen vom BlockOff bis zum TakeOff, Planung des Starts, …

→ MET Report / CDM-Systeme

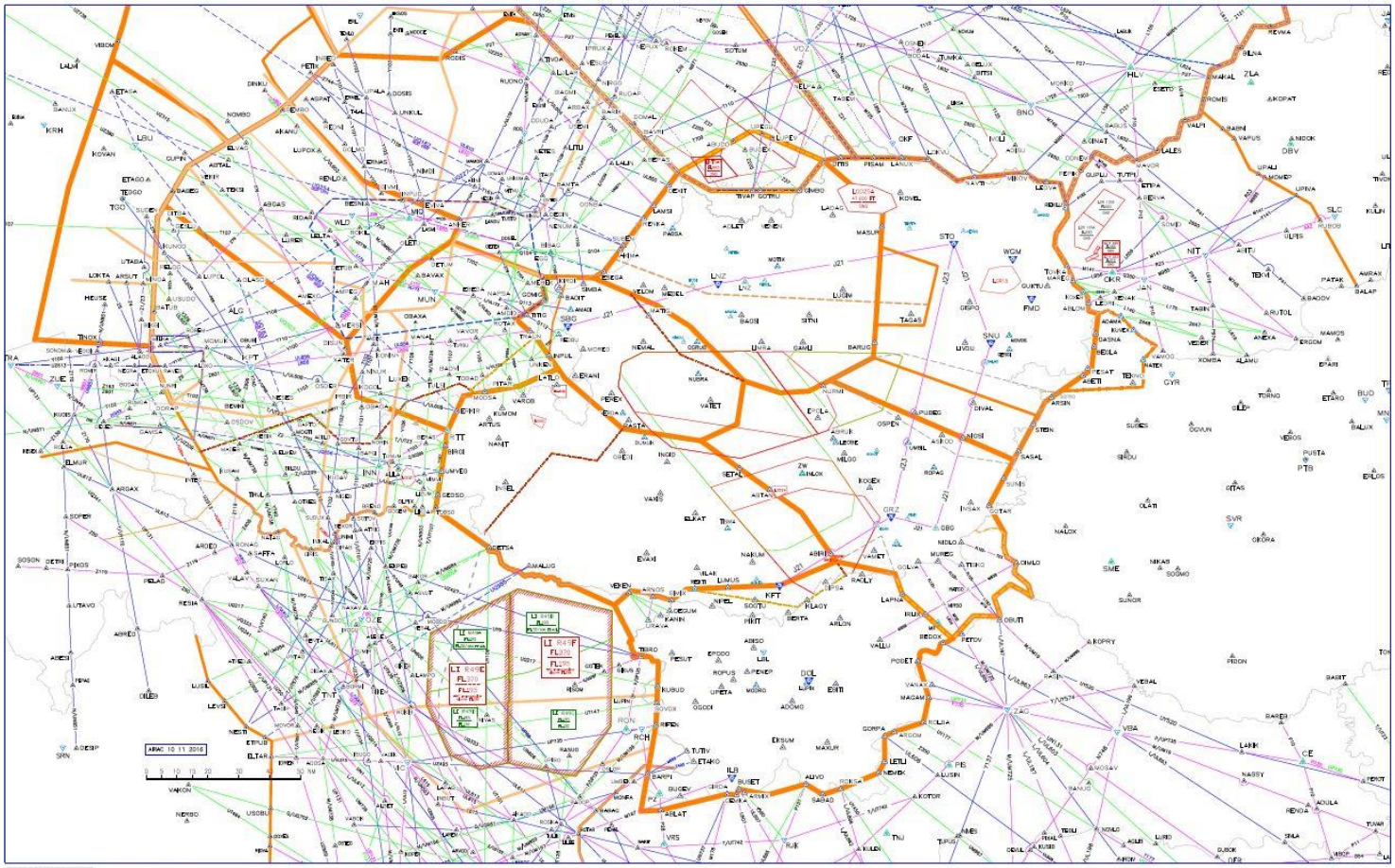
http://sigwx.austrocontrol.at

http://flughafenwetter.austrocontrol.at/loww

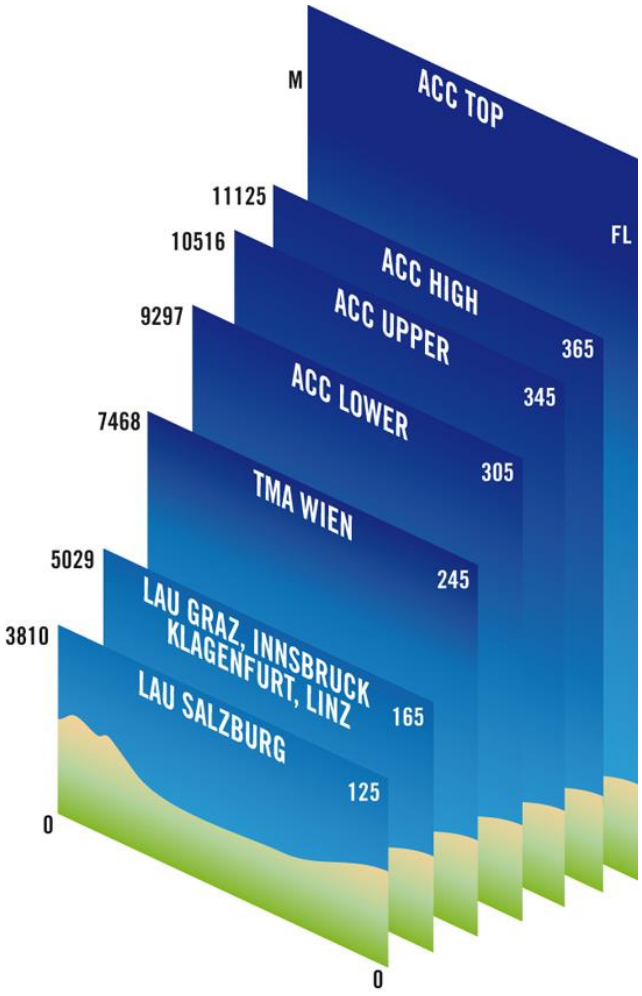
Aerodrome Data Display



Area Control Center (ACC)
horizontale Sektorisierung



Area Control Center (ACC)
vertikale Sektorisierung



Area Control Center (ACC)
MET-Informationen

„klassische“ ICAO Annex 3 - Produkte

- World Area Forecast System (WAFS) – offizielle Information
  - Wind / T – Charts (Flight Levels)

    Berechnung / Adaptierung der Überflugzeiten (über Waypoints, Navigationspunkten, …)
  - Significant Weather Charts

    Bereiche wo Abweichungen von der im Flugplan geplanten Route zu erwarten sind
- SIGMET-Warnungen http://sigwx.austrocontrol.at

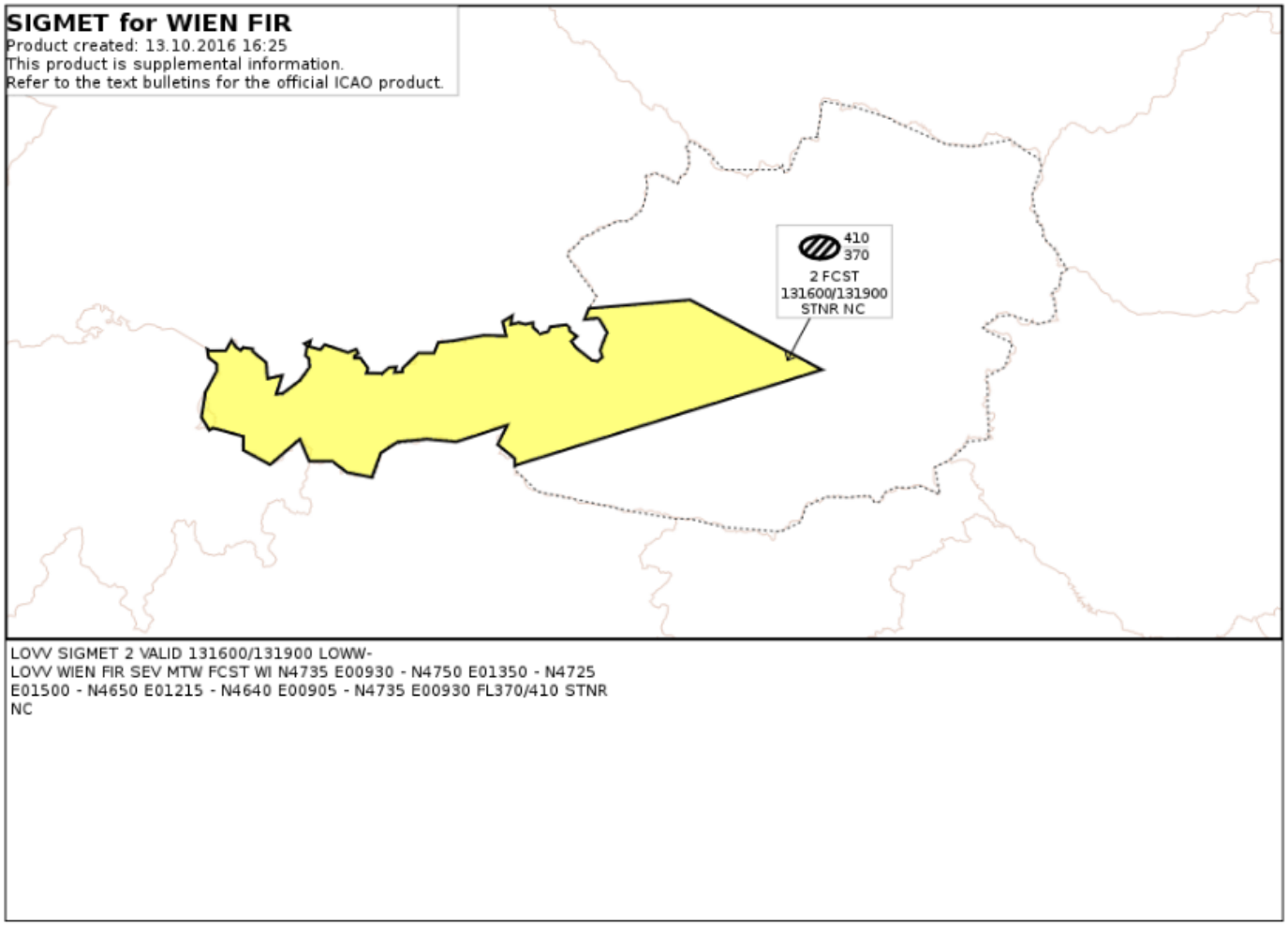
SIGMET Beispiel

```
WSOS31 LOWW 291515
LOVV SIGMET 1 VALID 291515/291700 LOWW-
LOVV WIEN FIR SQL TSGR OBS AT 1515Z WI N4815 E01300 - N4815 E01415 -
N4745 E01415 - N4745 E01300 - N4815 E01300 TOP FL400 INTSF
FCST AT 1700Z WI N4815 E01500 - N4815 E01615 - N4745 E01615 - N4745
E01500 - N4815 E01500=
```

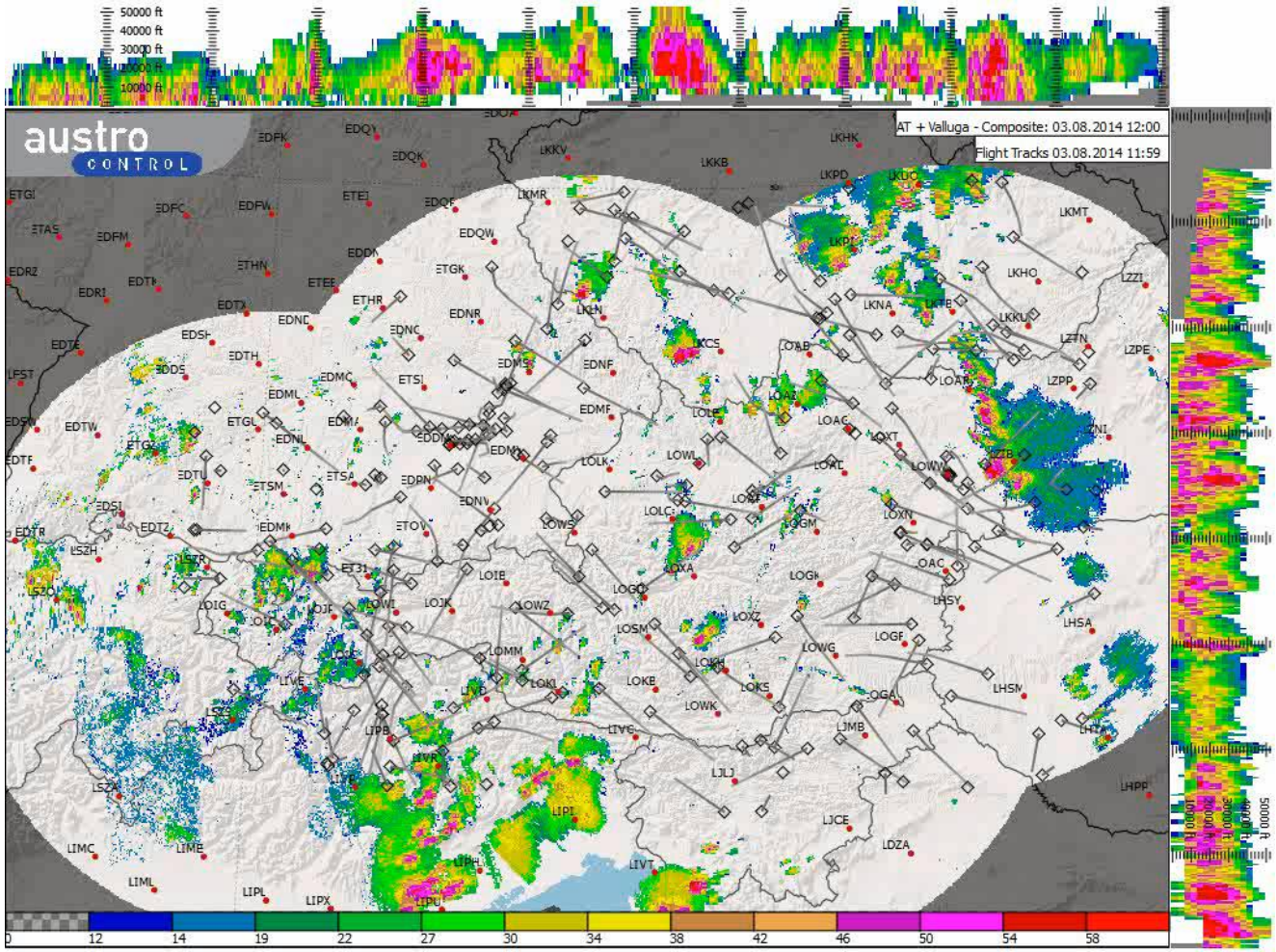
Erklärung

linienförmig angeordnete Gewitterzellen mit Hagel wurden um 1515 Uhr utc beobachtet und werden weiterhin vorhergesagt, ***Ort****: innerhalb eines Vielecks, bestehend aus den Punkten 48°15´N / 13°00´E – 48°15´N / 14°15´E – 47°45´N / 14°15´E – 47°45´N / 13°00´E,* ***Höhe****: Tops der CB bis FL400,* ***Verlagerung****: weggelassen, weil Ort zum Ende des Gültigkeitszeitraumes angeführt,* ***Entwicklung****: intensivierend,* ***Ort zum Ende des Gültigkeitszeitraumes****: innerhalb eines Vielecks, bestehend aus den Punkten 48°15´N / 15°00´E – 48°15´N / 16°15´E – 47°45´N / 16°15´E – 47°45´N / 15°00´E*

SIGMET Beispiel grafische Darstellung



Beispiel - Gewitter



Area Control Center (ACC)
MET-Informationen

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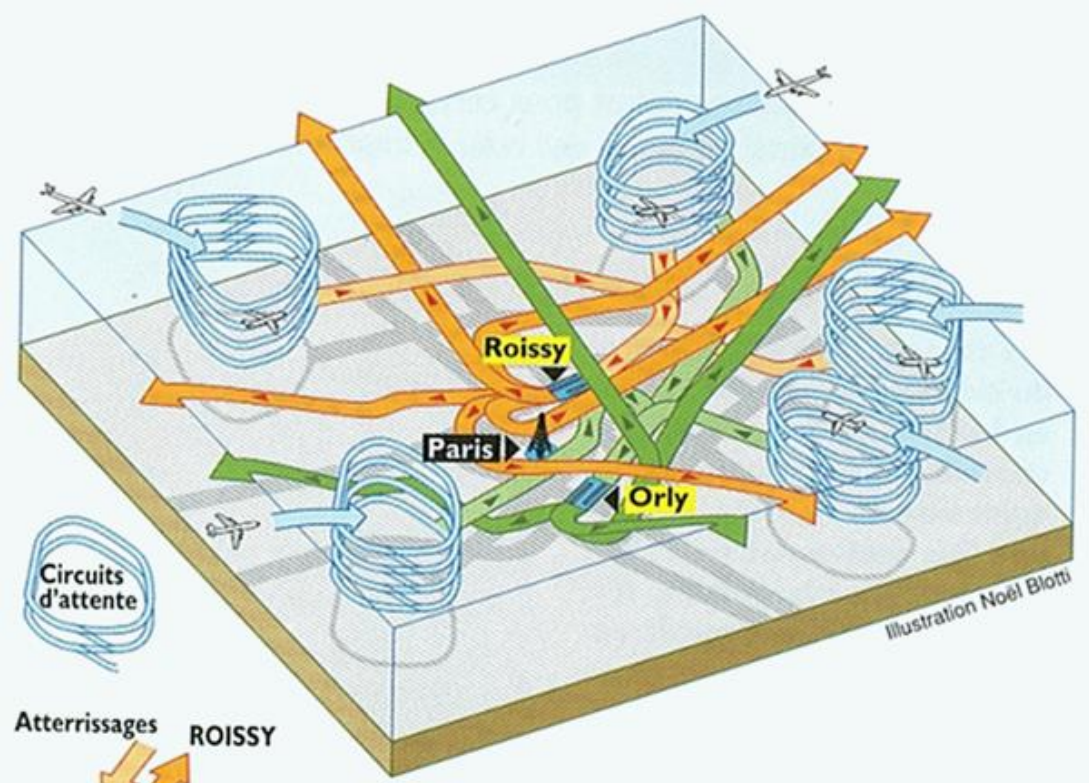
    Bereiche wo Abweichungen von der im Flugplan geplanten Route zu erwarten sind
- SIGMET-Warnungen http://sigwx.austrocontrol.at

Sektorenvorhersage

- Signifikante Wetterphänomene (Gewitter, Turbulenz, Vereisung)
  → sigwx-Bulletin http://sigwx.austrocontrol.at

Approach Control (APP) - Anflugkontrolle



Auszüge aus dem österreichischen Luftfahrthandbuch (AIP)

Innsbruck

- *Standard Arrival Chart - Instrument - ICAO*
- *Instrument Approach Chart - ICAO (RNAV (RNP) RWY 26)*

Wien-Schwechat

- *Standard Arrival Chart - Instrument – ICAO*
- *RNAV Arrival Chart - Transition to final APCH RWY 29*
- *RNAV Arrival Chart - Transition to final APCH RWY 34*
- *RNAV Arrival Chart - Noise Abatement Transition to final APCH RWY 29*

Approach Control (APP) – Anflugkontrolle
MET-Informationen

- „klassische“ ICAO Annex 3 – Produkte
  - SIGMET / GAMET / LL-SWC
  - METAR / MET Report
  - TAF / Trend

- Approach-Prognose
  - sigWX Bulletin → http://sigwx.austrocontrol.at
  - Exkurs LVP (Low Visibility Procedures)

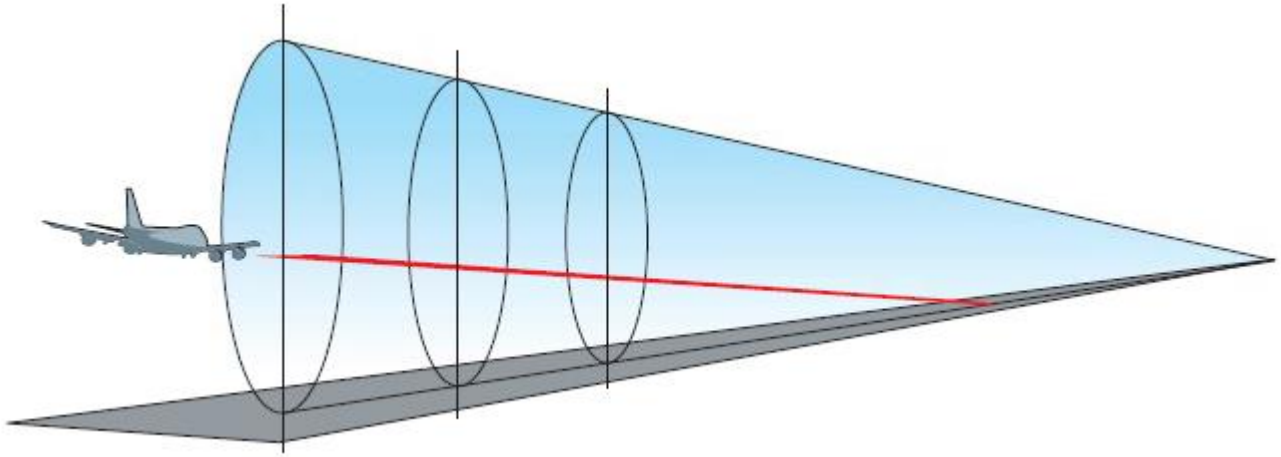
Weather impact on Air Traffic Management
Low Visibility Procedures

- What are **L**ow **V**isibility **P**rocedures

LVP state	RVR	Ceiling	Separation	Capacity
normal			2.5NM	>40
LVP	< 600m or	BKN < 200ft	4NM	25
LVP CATIII	< 350m		6NM	18

- LVP seen from the cockpit:
  https://www.youtube.com/watch?v=mSNE3SmYA-8

InstrumentenLandeSystem (ILS)



Category of Operation	Decision Height (DH) (2)	RVR	Visibility not less than
CAT I	not lower than 60 m (200 ft)	not less than 550 m	800m
CAT II	lower than 60 m (200 ft), but not lower than 30 m (100 ft)	not less than 350 m (1)	
CAT IIIA	lower than 30 m (100 ft) or no DH	not less than 200 m	
CAT IIIB	lower than 15 m (50 ft) or no DH	less than 200 m but not less than 50 m	
CAT IIIC	no DH	no RVR limitation	

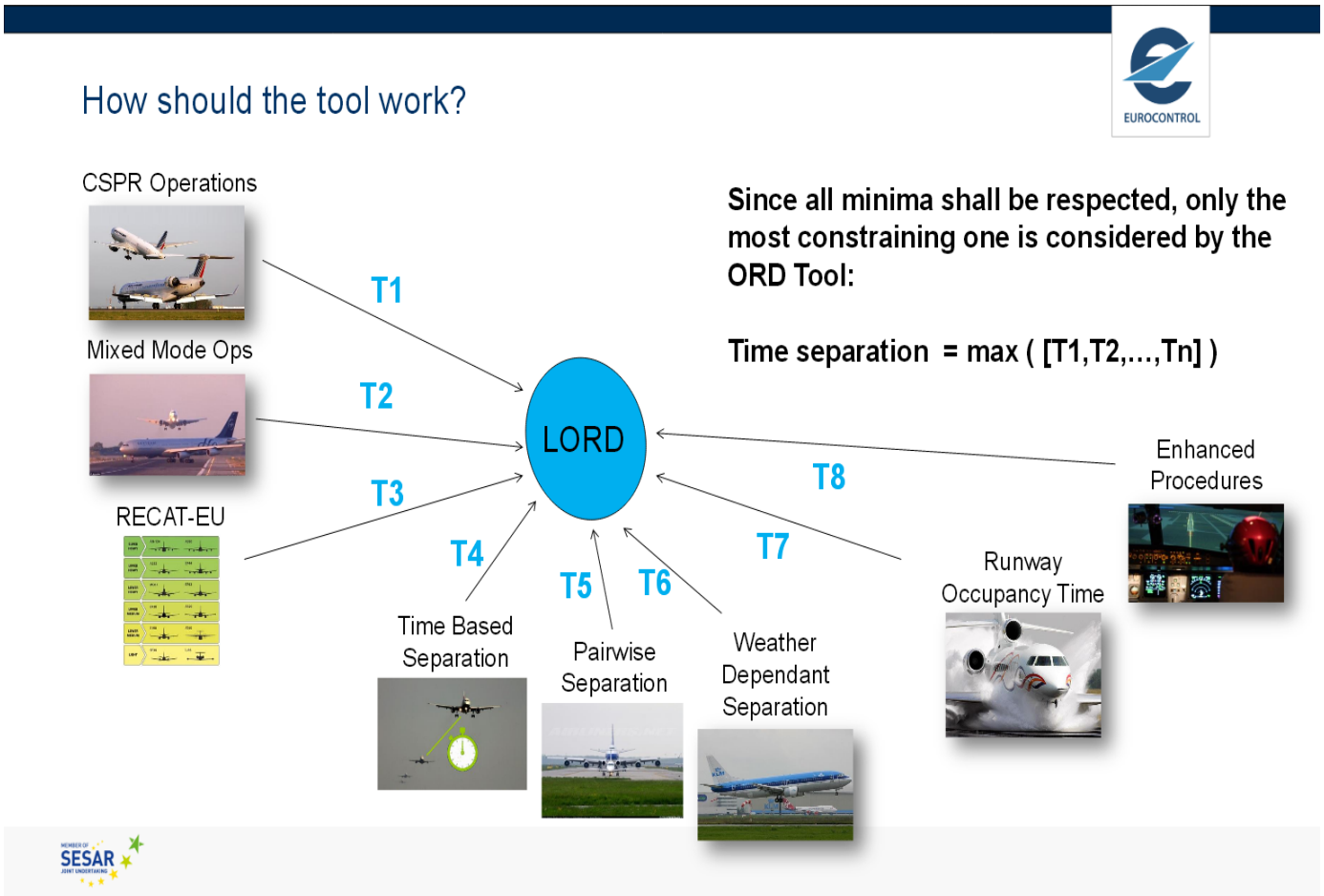
Approach Control (APP) – Anflugkontrolle
MET-Informationen

- „klassische“ ICAO Annex 3 – Produkte
  - SIGMET / GAMET / LL-SWC
  - METAR / MET Report
  - TAF / Trend / Klartextwarnungen

- Approach-Prognose
  - sigWX Bulletin http://sigwx.austrocontrol.at
  - LVP (Low Visibility Procedures)

- Zusatzinformationen
  - Wind-Profile (Wind-Profiler / SODAR)
  - Mode-S Profile
  - Wake Vortex Surveillance Tool
  - Final Approach Manager

Leading Optimised Runway Delivery (LORD)



→ zusätzliche MET-Informationen notwendig

Weitere Beispiele für MET-Informationen

- DWD: Gemeinsames Schichtbriefing
- Meteo France: CDM@CDG
- KNMI: Schiphol Probability Forecast

Saturday 15 January 03 UTC till Sunday 16 January 06 UTC

utc:	03	04	05	06	07	08	09	12	15	18	21	24	03	06
Visibility < 5 km and/or ceiling < 1000 ft (%)	60	70	80	90	90	80	40	20	5	5	5	10	30	50
RVR < 1500 m and/or ceiling < 300 ft (%)	30	40	50	50	50	40	10	5	0	0	0	0	0	10
RVR < 550 m and/or ceiling < 200 ft (%)	15	20	25	30	30	20	5	0	0	0	0	0	0	0
RVR < 350 m (%)	5	10	15	20	20	10	0	0	0	0	0	0	0	0
Wind direction (deg)	160	160	160	160	160	160	160	170	180	190	230	240	240	240
Wind speed (kt)	5	4	5	5	5	6	7	9	9	9	10	12	12	13
Gusts (kt)											15	17	18	19
Standard deviation wind direction (deg)	30	30	30	30	30	25	25	20	20	20	20	15	15	15
Standard deviation wind speed (kt)	2	2	2	2	2	2	2	2	2	2	2	3	3	3
Temperature (°C)	1	0	-1	-1	-1	-1	0	2	5			5	4	4
Dewpoint (°C)	1	0	-1	-1	-1	-1	0	0					2	2
Snow (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Moderate or heavy snow (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freezing rain (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Remarks	Short term	Long term
Visibility and ceiling		
Wind		
Temperature/dewpoint		
Precipitation		

Last update: short term 00.10 utc, long term 22.50 utc

Table 8. Revised format of Probability Forecast Schiphol (SKV).

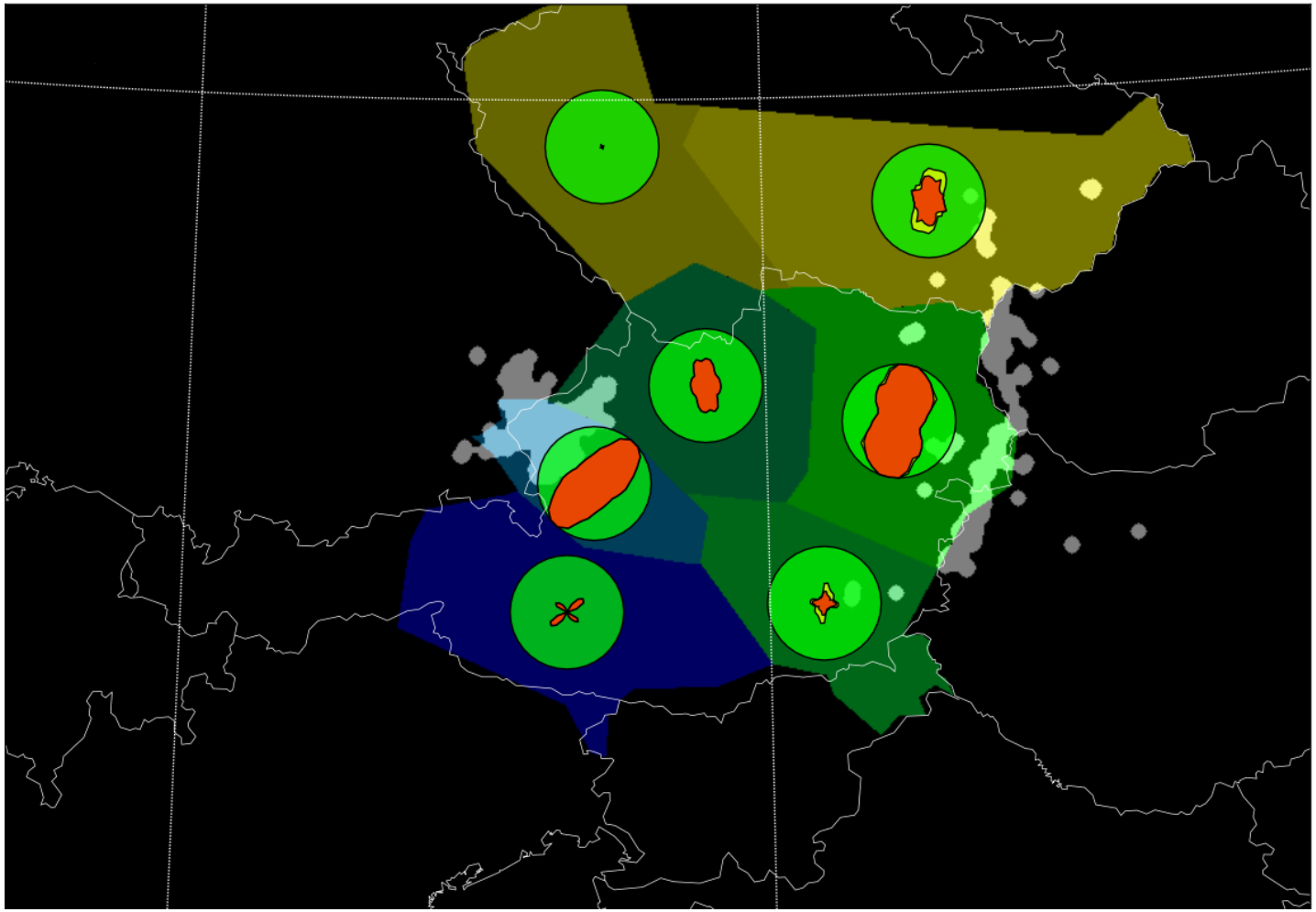
Air Traffic Flow and Capacity Management (ATFCM)

- Für den geplanten und operativ dann auch anfallenden Verkehr müssen in den einzelnen Flugsicherungseinheiten (TWR, APP, ACC) aber auch auf den Flughäfen die notwendigen Kapazitäten zur Verfügung stehen.
- Auf FIR-Ebene stimmen Flow Manager (FMP) und Supervisoren die Verkehrsinformationen mit der aktuellsten Wettervorhersage ab, wenn notwendig kann der verantwortliche Supervisor dann Maßnahmen zur Kapazitätsregulierung setzen:
  - Level-Capping
  - Re-Routing
  - Regulierungen

→ Eurocontrol Network Manager (NMOC)

- Einfluss auf ATFCM aus einem numerischen Vorhersagemodell abgeleitet → Network Weather Resilience Tool

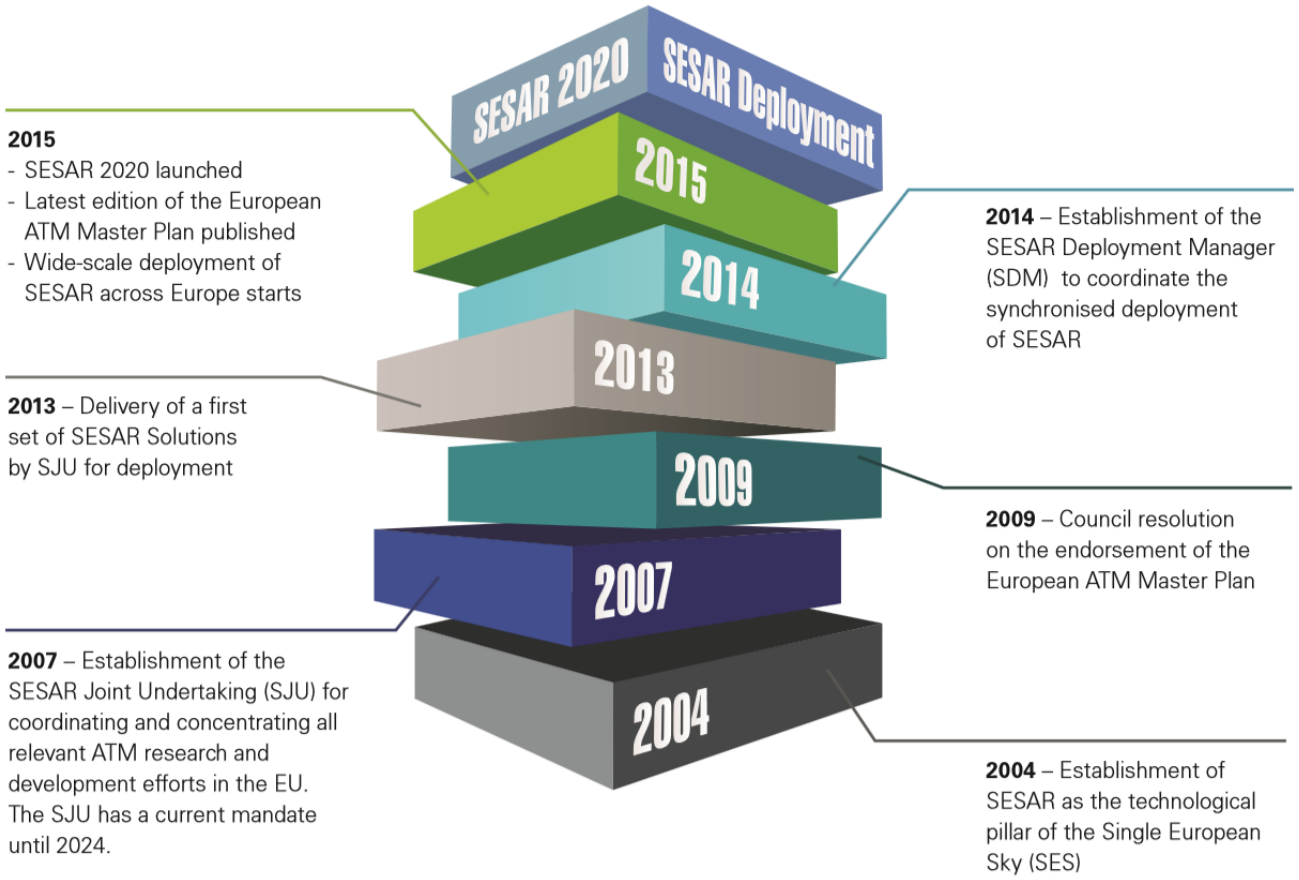
Alternative Informationen



DELIVERING BENEFITS TO EUROPE AND ITS CITIZENS

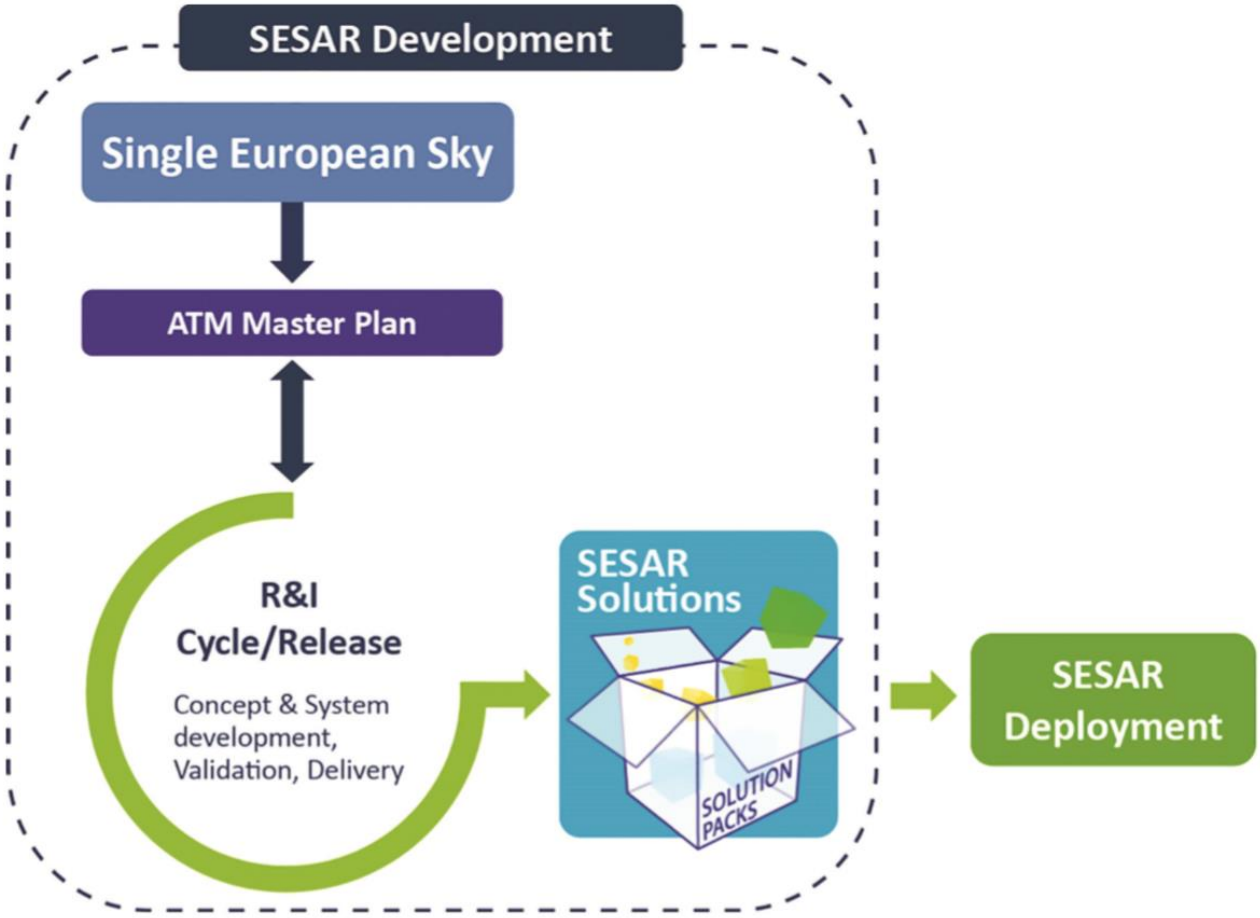
SESAr building blocks

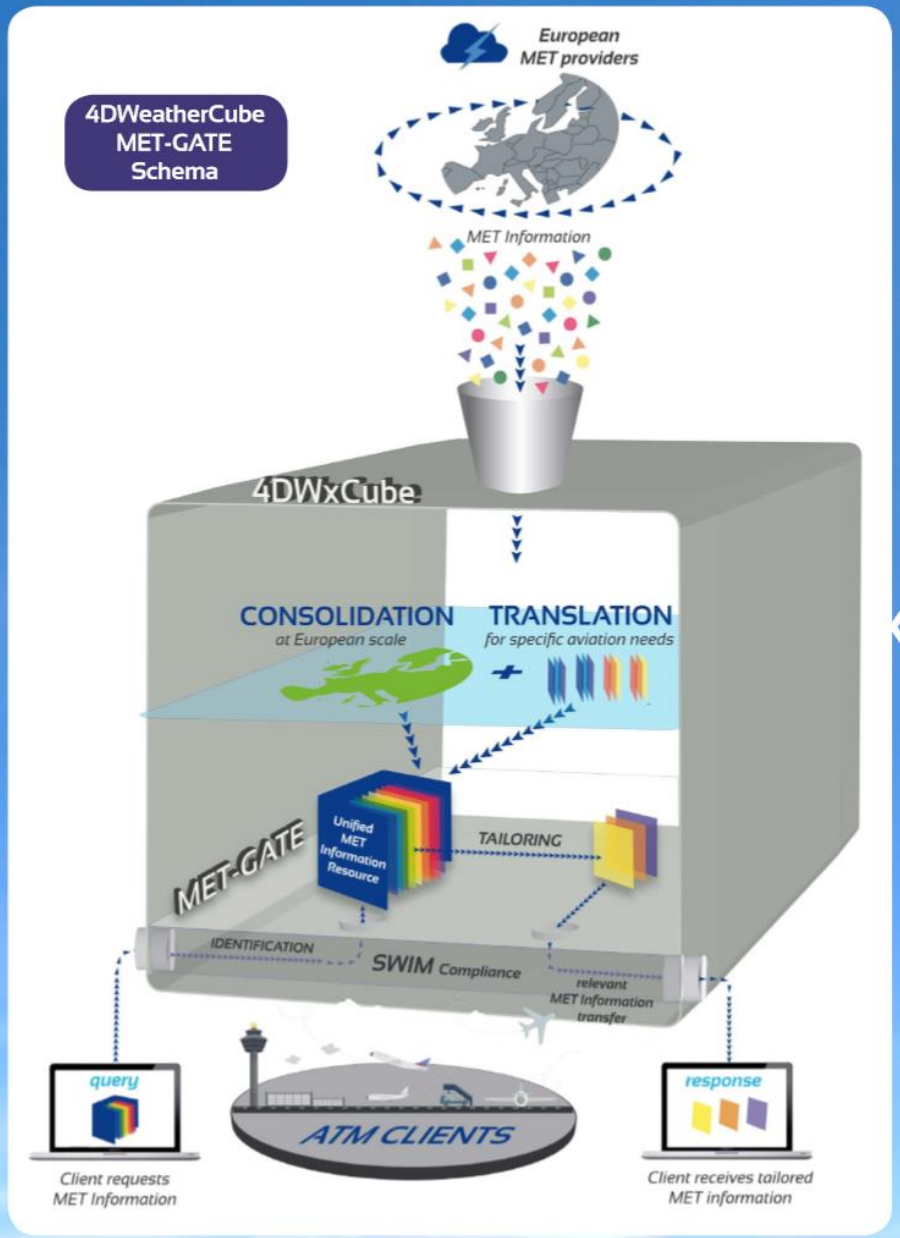
Figure 1: SESAR building blocks



SESAR Lifecycle

Figure 2: SESAR lifecycle





4DWeatherCube MET-GATE

MET Information Services
Generation, ATM Tailoring and Exchange

Innovative meteorological services will participate in improving in the management of European Air Traffic. As part of the Single European Sky ATM Research (SESAR WP11.2) Programme. National MET services, members of EIG EUMETNET, are bringing together their expertise to develop a new generation of meteorological observing and forecasting systems for aviation. The 4DWeatherCube MET-GATE system which generates and transfers ATM tailored MET information is the technical response to SESAR MET challenges.

4DWeatherCube MET-GATE Partners

EUMETNET · METEO FRANCE · DWD · Met Office · THALES

In the SWIM Information Services category, the Best-in-Class award 2015 went to the 4D WeatherCube MET-GATE which was submitted by EUMETNET.
See more at: http://www.sesarju.eu/newsroom/all-news/sesar-swim-master-class-2015-winners-announced

4DWeatherCube
MET-GATE

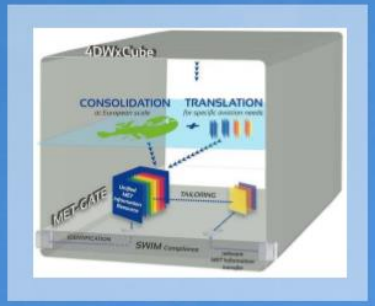
What is the 4DWxCube and its outline?

The 4DWxCube is the technical response to the MET challenges in SESAR. It's a virtual repository of shared consistent aeronautical meteorological information, produced by multiple MET Service Providers and made available to ATM stakeholders via its SWIM compliant MET-GATE.

The 4DWxCube is a system of systems made of:

> Functional blocks performing MET "Consolidation & Translation"

> The MET-GATE system



What does "Translation & Consolidation"mean?

The MET-GATE accesses information from "Consolidation & Translation" MET-ATM Information Functional Blocks. Functions of "Consolidation & Translation" ensure that MET information provided to the ATM stakeholders is :

> Reliable
- Coming from authorised providers (NMSs)
- With managed uncertainty of MET forecast
- The one with highest performance scores

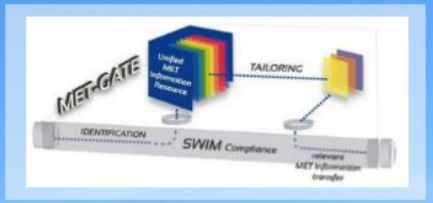
> Based on latest science

> Common, harmonised, consistent & seamless

> Translated for specific aviation needs

What is the MET-GATE?

The MET-GATE is the one stop shop for MET information.
It accesses consolidated and translated MET information, performs the relevant data collection, selects and provides fit-for-purpose MET information for ATM stakeholders through MET-ATM SWIM services.



What are the 4 facets of the MET-GATE ?

> Ensuring consistency among Europe by guaranteeing the same view sharing of the observed and forecasted MET situation

> Ensuring the SWIM compliance in term of SWIM data model AIRM, SWIM service model ISRM, SWIM technical infrastructure

> A unique access portal which guarantees the reliability of MET information supply and a high level of performance crucial for ATM Services

> Providing Smart Functionalities such as:
- Build a collection of MET information according to a time-related criterion, a geographical criterion (cross section, vertical profile, 4D trajectory) and/or a list of physical parameters (wind direction, temperature...)
- Extract a contour from gridded data (isoline)
- Provide alarm when a parameter exceeds a threshold
- Convert data format

What are the MET-ATM SWIM services defined so far?

> Aeronautical MET messages : METAR, TAF and SIGMET

> Nowcast and forecast of MET Hazards such as convection, CAT, icing or winter conditions

> Wind observation and forecast

> Advanced airport MET observation and forecast

> Precipitation and lightning information

MET-ATM SWIM services are defined according to a virtuous circle between the MET and ATM communities.

What are the objectives of the MET-GATE prototype ?

> Verify the technical feasibility of the system

> Participate to validation and demonstration exercises (e.g SESAR TOPLINK demonstration project)
- The MET-GATE prototype can be slightly adapted to each validation exercise
- Some functions can be built «to measure» to fulfil exercice requirements
- During the exercise period, the MET-GATE prototype will most likely be running on a Météo-France server and will be fed by MET information coming from numerous National MET Services (NMSs')
- For local validation exercises, the MET-GATE prototype could be installed on a local platform
- ATM clients can receive the required MET information by requesting MET-GATE prototype services

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MET-GATE FAQ: http://publicwiki.meteo.fr/confluence/x/E4Br

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