MET ALOFT INFORMATION FOR ATM

1. INTRODUCTION

1.1 The main purpose of this document is to provide guidance for the standardization and harmonization of meteorological information related to all aspect of airspace management. This so-called 'MET aloft information' describes the current or future state of the atmosphere representative for the airspace concerned.

1.2 MET aloft information is provided in addition to the global aeronautical meteorological en-route forecasts in digital form as provided by the World Area Forecast System (WAFS) based on local agreement (Ref. Annex 3 - Meteorological Service for International Air Navigation, Part I, Chapter 3, paragraphs 3.1).

1. BACKGROUND

1.1 Where both airspace and aerodromes are reaching their capacity limits, it becomes more and more important for ATS-units to anticipate as precise and early as possible for the position of each individual aircraft in the airspace which it is responsible for.

1.2 A good knowledge on the expected positions of aircraft at every given time is an important consideration for accepting traffic in its airspace and for the aerodromes under its responsibility. These expected positions and the associated uncertainties translate in a predicted load of the airspace and aerodromes. These predictions need to be balanced with the available capacity of the concerned airspace and aerodromes.

1.3 This demand and capacity balancing of aerodromes and airspace heavily depends on information of the winds, aloft for the concerned airspace and on the ground. When this information is provided, the actual runway configuration, approaches and sector loads can be established with a high level of certainty with respect to the execution phase of the considered flights. As such, MET aloft information in addition to other services that describe aerodrome weather (including winds) are crucial for determining sector and aerodrome acceptance rates.

1.4 MET aloft data have been used already by ATS-units for a long time as an input for Flight and Data Processing (FDP) systems. The information used primarily consists of wind and incidentally temperature data. With the introduction of new operating concepts, associated procedures and supporting systems, the rudimentary information used today by some stakeholders concerned will no longer be sufficient to meet the requirements for predictable demand and capacity balancing processes. Some examples of emerging concepts and MET aloft information considerations:

- Improved (4D) trajectory management in general will lead to a better management of flights in the airspace concerned and consequently to higher airspace capacity. Forecasted winds aloft in combination with forecasted upper-air temperature and density can improve the 4D trajectory prediction;
- Continuous Descent and Climb Operations (CDO) require detailed MET aloft information from top of descend to the threshold v.v.;
- Modern queue management techniques, such as time based spacing and point merge sequencing require detailed MET aloft information for the TMA;
- Wind Shear warnings.[1]

[1] Wind Shear warnings are not addressed in this document, see the appropriate guidance material on Wind Shear.

3 GENERIC REQUIREMENTS

3.1 Due to the broad scope of MET aloft information to support local implementations of emerging ATM concepts and related systems, it is evident that no single set of detailed MET aloft information requirements can be established. Detailed MET aloft information requirements will vary between use cases and required tools. Hence it is therefore considered to identify only a generic set of MET aloft information requirements.

3.2 The following generic requirements could be identified:

- **Consistency** between all the MET information provided for the whole area of responsibility/interest including MET aloft information;
- **Update frequency** in function of the foreseen use and the covered area (update frequency higher for TMA use and lower for en-route use);
- **Resolution** (horizontal, vertical & time resolution) of the information in function of the foreseen use and covered area (resolution higher for TMA use and lower for en-route use);
- **Forecast range/validity period** of the information in function of the foreseen use (shorter range/validity period for operations and longer range/validity period for planning purposes);
- **Data types** to be made available as a minimum: wind & temperature;
- **Exchange** of information by means of standardised format to enable interoperability;
- **Latency** of data dissemination as limited as possible, in function of but not exceeding the update frequency.

3.3 More detailed and potentially additional requirements have to be agreed between the ATS unit, other ATM stakeholders and the MET Service provider concerned.

3.4 **Appendix 1** provides two examples of functional and non-functional requirements for MET aloft information service implementations. Example 1 is a basic service primarily focused on runway selection and TMA operations. The second example, example 2, is a more detailed service in support of sector demand capacity balancing and FDP.

3.5 Some current (foreseen) practices with respect to MET aloft information are provided in Attachment A.

Appendix 1 to this document

Examples of functional and non-functional requirements for MET aloft information services

Example 1; a basic service primarily focused on runway selection and TMA operations (not CDO).

- **Consistency**; the information provided shall be consistent with all the issued products for the area of concern, the aerodrome and TMA (TAF, TREND, SIGMET, AIRMET, Aerodrome Warnings including Windshear);
- **Update frequency**; the information provided shall be updated every 60 minutes;
- **Resolution**; the information provided shall 1)be representative for the Aerodrome Reference Point (single point grid) and 2)comprises the height levels 1000ft, 2000ft, 3000ft and flight level 50;
- **Forecast range/validity period;** the information provided shall have a validity period of 180 minutes in 30 minutes time steps;
- **Data types;** the information provided shall comprise of wind direction, wind speed and temperature for the prescribed levels;
- **Exchange;** the information provided shall be exchanged by means of an agreed format between the ATS-unit and MET service provider concerned. When the information will be shared with other stakeholders, the information shall be formatted in XML/GML and structured in accordance with WXXM;
- **Latency;** the information provided shall be received and integrated by the ATS-unit concerned within 5 minutes after the issuance of the information by the MET service provider.

Example 2; a service in support of sector demand capacity balancing and FDP.

- **Consistency**; the information provided shall be consistent with the different sectors and with all the issued products for the area of concern;
- **Update frequency**; the information provided shall be updated every 3 hours;
- **Resolution**; the information provided shall 1)be representative for a grid with resolution 0.25ºx 0.25º and 2)comprises the ICAO WAFS height levels (Annex 3 refers);
- **Forecast range/validity period;** the information provided shall have a validity period of 24 hours in 1 hour time steps;
- **Data types;** the information provided shall comprise of wind direction, wind speed, temperature and air density for the prescribed levels;
- **Exchange;** the information provided shall be exchanged by means of an agreed format between the ATS-unit and MET service provider concerned. When the information will be shared with other stakeholders, the information shall be formatted in AML/GML or GRIB and structured in accordance with WXXM;
- **Latency;** the information provided shall be received and integrated by the ATS-unit concerned within 30 minutes after the issuance of the information by the MET service provider.

Attachment A to this document

Existing and foreseen practices for MET aloft information exchange

Germany

The Deutsche FlügSicherung (DFS) receives Winds Aloft data from the Deutsche Wetterdienst (DWD) twice a day and with a 3 hour forecast period based on midnight or midday. This means two sets of eight 3 hr GRIB1 files are received per day. For each forecast point in the 28km grid the following data is received:

- QNH - mean sea level reduced air pressure hPa
- Temperature at each flight level - ˚C
- Wind Direction – degrees from true North
- Wind Speed – kts

The following flight levels are required by the DFS – FL20, FL50, FL100, FL200, FL250, FL300, FL350, FL400, FL450, FL500, FL550, FL600, FL650.

The area required by the DFS is the whole of Germany as filled by a rectangular shape (See Figure 1). The shape is specified by the reference point of the top left hand corner.

The complete grid range is defined by 56.000N 04.000E --- 56.000N 17.750E
46.000N 04.000E --- 46.000N 17.750E

The grid size is 0.25 degrees in both directions implying a distance between two points within consecutive grid blocks of 28km. The scan mode is West to East then North to South.

Separate GRIB1 files are used to convey QNH, Wind Vector and temperature for each flight level.

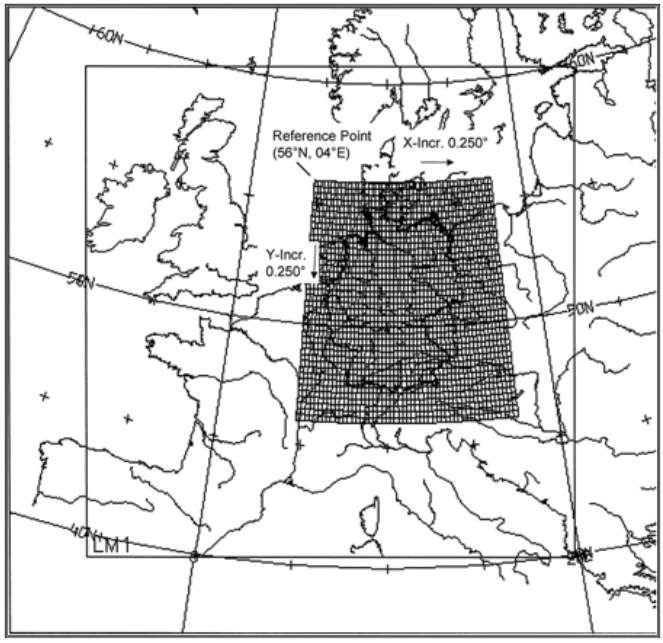

Figure 1 DWD Supplied WA Area

France

The DSNA receives from Météo France 2 sets of Winds aloft data in text format with different QoS: one for covering the French territory and one for covering the Paris TMA.

1) French territory service:
   - Update 2 times per day
   - Flight levels: 180, 240, 300, 340 & 390
   - Horizontal resolution: 8 selected grid points based on a 0.5°x0.5° grid
   - Temporal resolution: forecast T+12
   - Weather phenomena: wind direction & wind speed

2) Paris TMA service:
   - Update every hour
   - Flight levels: 3000 ft, 5000ft, 10000ft
   - Horizontal resolution: 50NM around Paris – Charles De Gaulle on a 0.1°x0.1° grid
   - Temporal resolution: forecast T+3, +6, +9, +12, +15, +18 and +21
   - Weather phenomena: wind direction & wind speed
   - Impact-related information : thresholds for wind speed and corresponding colour-codes

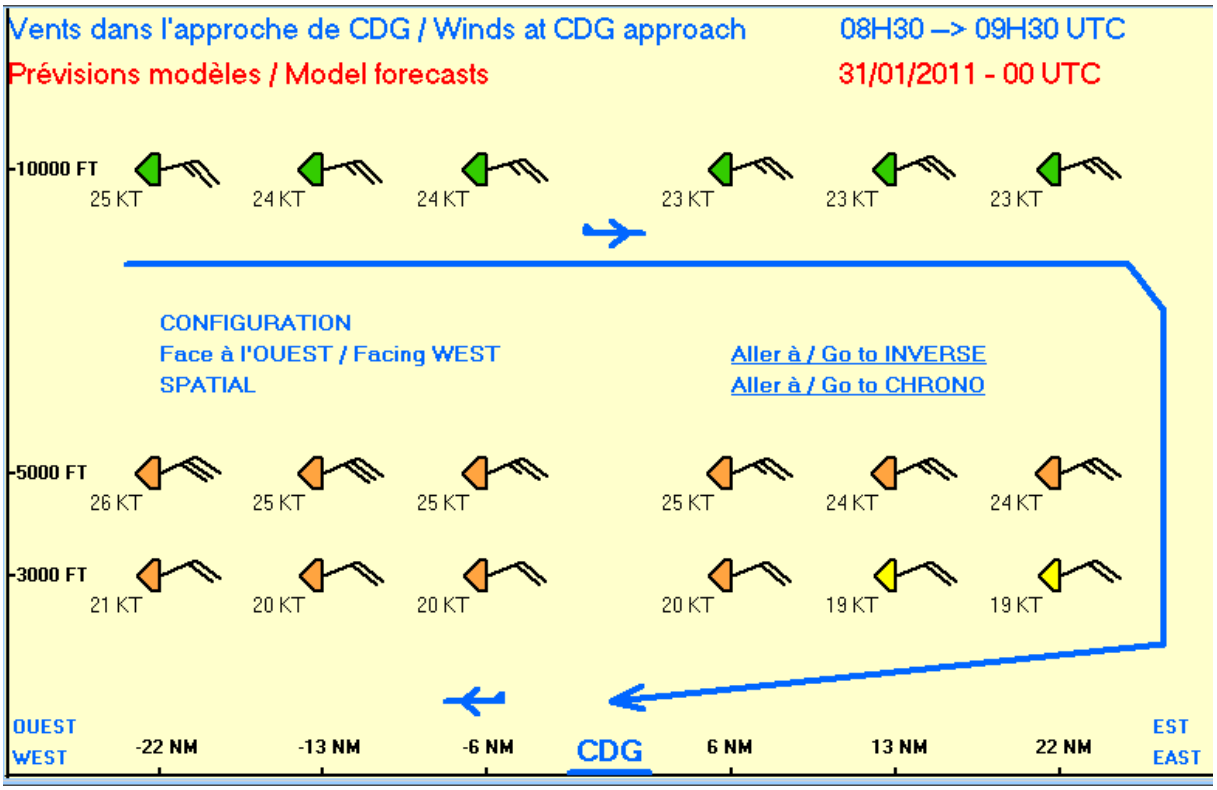

Figure 2 Example of Météo France Supplied WA Information to CDG

EU Functional Airspace Block Europe Central (FABEC) area – (planned MET Aloft service)
The different METSPs in the FABEC area are cooperating to provide the FABEC ATSPs one set of Met aloft data, based on the identified requirements. The first step will be a single set of data supporting the "basic" service. Discussions are ongoing to improve this data set by providing a higher horizontal, vertical and time resolution in support of TMA operations.

Winds Aloft (WA) data sheet

	WA Météo France	WA DWD	WA ECMWF
NWP Model	ARPÉGE	COSMO-EU	ECMWF
Modell Runs	Every 6h (T=00/06/12/18 UTC)		Every 12h (T=00/12 UTC)
Forecast time	T+36h		T+48h – T+240
Time steps	3h		12h
Horizontal data coverage	Rectangular grid: 12°W – 18°E / 58°30' N – 36°30'N		
Horizontal resolution	0, 25° x 0, 25°~28x28km		
Vertical resolution Flight Level data will be on corresponding pressure levels	ICAO WAFS Levels 050(850hPa)/100(700hPa)/140(600hPa)/180(500hPa)/240(400hPa)/ 270(350hPa)/300(300hPa)/320(275hPa)/340(250hPa)/360(225hPa)/ 390(200hPa)/410(175hPa)§/450(150hPa)/530(100hPa) §AMDT76		
Grid Data Data format: GRIB2	U & V wind components (m/s) Air temperature (Kelvin) Air density (kg/m³) QNH (Pascal) – level independent		

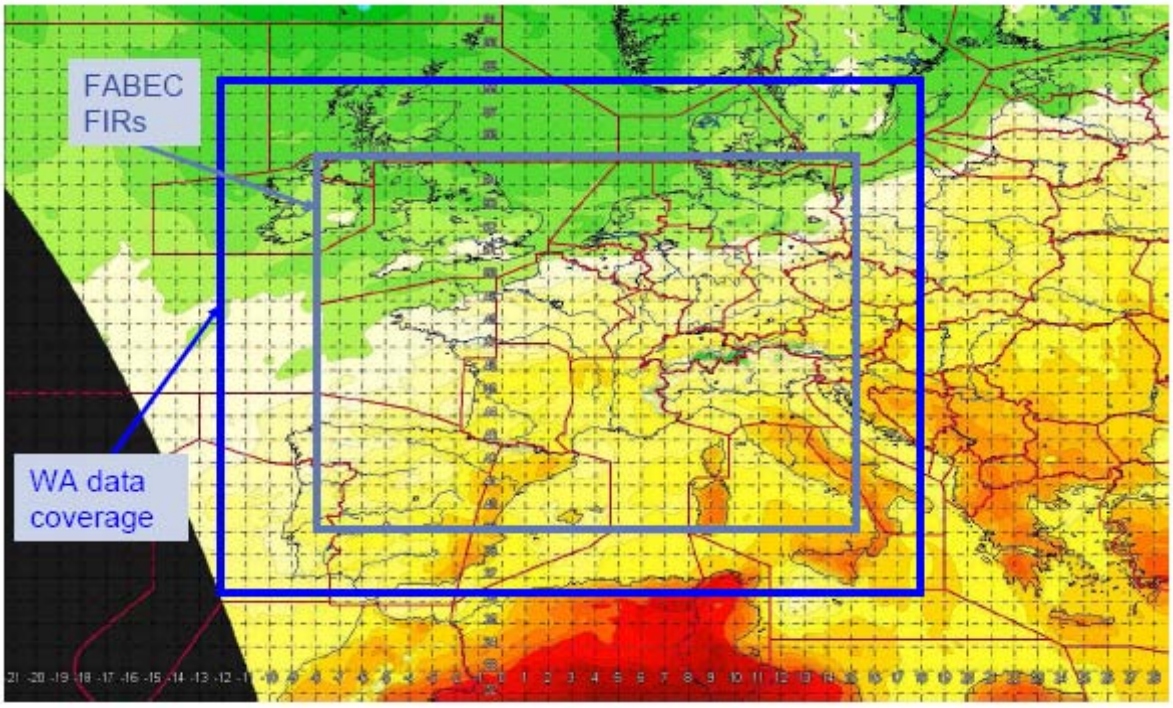

Figure 3 Overview of planned MET Aloft service for FABEC

Detailed identified requirements for the FABEC area

Basic Service	Enhanced Service
• Update rate of 6 hours • Forecast period up to T+36 hours in forecast steps of 3 hours • Area of interest = Area of Control + configurable buffer (250NM) • Horizontal grid resolution of 0.25° x 0.25° • Vertical resolution: ICAO WAFS levels • Data types to be made available: o wind (speed in m/s and direction in °true) o temperature (in Kelvin) o density (in kg/m³) o QNH (level independent; in Pascal) *note: identified units cater for later conversions to kt, km/h, °magnetic, °Celsius & hPa* • Data exchange formats to be used are GRIB and XML • 1 consistent data set for whole area of interest	• Update rate of 1 hour • Forecast period up to T+6 hours in forecast steps of 30 minutes • Area of interest = configurable buffer (250NM) around airport or point of interest • Horizontal grid resolution of 0.025° x 0.025° • Vertical resolution: steps of 5FL up to FL100; steps of 10FL up to FL530 • Data types to be made available: o wind (speed in m/s and direction in °true) o temperature (in Kelvin) o density (in kg/m³) o QNH (level independent; in Pascal) *note: identified units cater for later conversions to kt, km/h, °magnetic, °Celsius & hPa* • Data exchange formats to be used are GRIB and XML