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Aviation System Block Upgrades (ASBU) pertaining to Meteorological Information (AMET)

Second Meeting of the North American, Central American and Caribbean Working Group (NACC/WG) Aeronautical Meteorology (MET) Task Force (TF) (MET/TF/02)
Mexico City, 27 February to 1 March 2024

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Agenda

- Overview
- ASBU meteorological information
  - for 2013-2018 (Block 0)
  - for 2019-2024 (Block 1)
  - for 2025-2030 (Block 2)
  - for 2031-2036 (Block 3)
  - for 2037 and beyond (Block 4)
- Regional Air Navigation Plan

Basic Building Block (BBB) Framework of the Global Air Navigation Plan (GANP)

- Meteorological Information
- Aeronautical Information
- Search and Rescue
- Air Traffic Management
- Aerodrome Operations

ASBU Blocks and Timeframes

- An ASBU Block is a six years timeframe that defines a deadline for an element to be available for implementation.
- ASBU block timeframes:
  - Block 0 (B0): 2013 to 2018
  - Block 1 (B1): 2019 to 2024
  - Block 2 (B2): 2025 to 2030
  - Block 3 (B3): 2031 to 2036
  - Block 4 (B4): 2037 onward

ASBU Meteorological Information

- Meteorological information = AMET
  - *Note: In earlier editions of the GANP and ASBUs, the acronym AMET = Advanced meteorological information*
- The information in this presentation is based on the 6th Edition of the GANP, which was published in 2019
  - *Note: Due to unforeseen global events, the development and implementation of the some of the information in the 6th Edition of the GANP, especially in Block 1, have been or will be delayed*

AMET Elements for Block 0

- AMET-B0 details a sub-set of all available meteorological information used to support enhanced operational efficiency and safety
- Four elements:
  - AMET-B0/1 – Meteorological observations products
  - AMET-B0/2 – Meteorological forecast and warning products
  - AMET-B0/3 – Climatological and historical meteorological products
  - AMET-B0/4 – Dissemination of meteorological products
- Timeframe: 2013 to 2018

AMET-B0/1 – Meteorological observations products

- New Capabilities
  - Provision of observations of additional meteorological parameters/elements
  - More automated observations
  - Higher temporal and spatial resolution for lightning, radar and satellite information.

AMET-B0/1 – Meteorological observations products

- Products include:
  - Automatic Weather Observation System (AWOS) information (including real-time exchanged of wind and RVR data)
  - Local reports (MET REPORT/SPECIAL)
  - Aerodrome reports (METAR/SPECI)
  - Lightning Information
  - Ground-based weather radar information
  - Meteorological satellite imagery
  - Aircraft meteorological report (i.e. ADS-B, AIREP, etc.)
  - Vertical wind and temperature profiles
  - Volcano Observatory Notice for Aviation (VONA)
  - Wind shear alerts

AMET-B0/2 – Meteorological forecast and warning products

- New Capabilities:
  - Improved visualization of meteorological forecast products
  - Greater resolution (spatial and temporal) of gridded WAFS forecasts (e.g. wind, temperature, icing, turbulence, CB clouds)

AMET-B0/2 – Meteorological forecast and warning products

- Products include:
  - World Area Forecast System (WAFS) gridded products
  - Implementation of Significant Weather (SIGWX)
  - Aerodrome Forecast (TAF)
  - Trend Forecast (TREND)
  - Take-off Forecast
  - Tropical Cyclone Advisory (TCA)
  - Volcanic Ash Advisory (VAA)
  - SIGMET
  - AIRMET
  - Aerodrome Warning
  - Wind Shear Warning

AMET-B0/3 – Climatological and historical meteorological products

- No new capability
- Products include:
  - Aerodrome climatological tables
  - Aerodrome climatological summaries

AMET-B0/4 – Dissemination of meteorological products

- New capabilities:
  - Commencement of the exchange of meteorological information using the ICAO Meteorological Information Exchange Model (IWXXM), being the conversion of Traditional Alphanumeric Code (TAC), using an IWXXM schema, into XML
- Formats include:
  - TAC
  - Gridded
  - Graphical
  - BUFR
- Dissemination means include aeronautical fixed service (AFTN with increasing use of AMHS), and via secure internet services (i.e. WIFS/SADIS)

AMET Elements for Block 1

- AMET B1 details the meteorological information supporting automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support
- Four elements:
  - AMET-B1/1 – Meteorological observations information
  - AMET-B1/2 – Meteorological forecast and warning information
  - AMET-B1/3 – Climatological and historical meteorological information
  - AMET-B1/4 – Dissemination of meteorological information
- Timeframe: 2019 to 2024

AMET-B1/1 – Meteorological observations information

- New capabilities:
  - Commencement of change from product-centric to data-centric information
  - Commencement of space weather ~~and sulphur dioxide (SO2)~~ services
  - Enhanced hazardous weather services
  - Introduction of new and enhanced space-based observations
  - Introduction of new observational information from both un-manned and manned aircraft (i.e. observations from lidar)

Note: Sulphur dioxide was deferred until further notice due to a lack of scientific and health-based requirements criteria for observations and forecasts

AMET-B1/1 – Meteorological observations information

- The following SWIM-compliant observational parameters and phenomena will begin to be made available to users and will include:
  - Wind speed and direction (aerodrome) including gusts
  - Wind speed and direction from departure to Top of Climb (TOC) and then Top of Descent (TOD) to landing
  - Wind speed and direction en-route
  - Air temperature and dew point temperature (aerodrome)
  - Air temperature and dew point temperature (or equivalent, i.e. humidity) from departure to TOC and then TOD to landing (including the following derived outputs: freezing level, lower tropospheric temperature inversions)
  - Air temperature and dew point temperature (or equivalent) en-route
  - Pressure (aerodrome) (i.e. QNH/QFE)
  - Visibility (aerodrome) (horizontal, slant, vertical), runway visual range (RVR)
  - Cloud type (of operational significance)
  - Cloud coverage, bases, tops and layers

AMET-B1/1 – Meteorological observations information

- (Continued) The following SWIM-compliant observational parameters and phenomena will begin to be made available to users and will include:
  - Cloud coverage, bases, tops and layers
  - Thunderstorms, Lightning, Convection (TCU & CB)
  - Precipitation (i.e. drizzle, rain, freezing rain, snow, hail)
  - Weather (i.e. dust storm, sand storm, funnel cloud, squall, smoke, haze, mist, fog)
  - Icing, including airframe and engine
  - Liquid water content, iced water content
  - Turbulence, mountain waves, wind shear
  - Fronts
  - Radioactive clouds, toxic chemicals
  - Tropical cyclones
  - Volcanic ash
  - Aerodrome surface (runway) temperature, state
  - Sea temperature, state and wave height (seaports)
  - Space weather events
  - Tsunami, flood

AMET-B1/1 – Meteorological observations information

- Characteristics of the meteorological information include:
  - Time (i.e. observation time)
  - Units of measurement
  - Resolution (spatial)
  - Geo Location (2D/3D/4D context, point, line or polyhedron)
  - Movement
  - Severity, accumulation, intensity range (Max. – Min.)
  - Variations
  - Data sample period
  - Auto or human (observed, measured or calculated)
  - Amendment / correction
  - Operational status
  - Source
  - Thresholds
  - Format (TAC, gridded, graphical, IWXXM)
  - Data quality flag
  - Runway identification or location identifier / effects/impact on aviation systems (i.e. communications, navigation & surveillance systems)
  - Radiation (exposure)

AMET-B1/2 – Meteorological forecast and warning information

- Products include:
  - World Area Forecast System (WAFS) gridded products
  - Implementation of Significant Weather (SIGWX)
  - Aerodrome Forecast (TAF)
  - Trend Forecast (TREND)
  - Take-off Forecast
  - Tropical Cyclone Advisory (TCA)
  - Volcanic Ash Advisory (VAA)
  - SIGMET information
  - AIRMET information
  - Aerodrome Warning
  - Wind Shear Warning

AMET-B1/2 – Meteorological forecast and warning information

- New capabilities:
  - Commencement of change from product-centric to data-centric information.
  - Commencement of space weather ~~and sulphur dioxide (SO2)~~ services.
  - Enhanced hazardous weather services.
  - First steps in the provision of probabilistic information derived from ensemble prediction systems.

AMET-B1/2 – Meteorological forecast and warning information

- The following SWIM-compliant forecast parameters and phenomena will begin to be made available to users and will include:
  - Wind speed and direction (aerodrome) including gusts and operationally significant wind shifts
  - Air temperature and dew point temperature (aerodrome)
  - Upper level:
    - Wind (speed and direction), including departure to Top of Climb (TOC) and then Top of Descent (TOD) to landing
    - Air temperature and dew point temperature or equivalent (i.e. humidity), including height of freezing level and lower tropospheric temperature inversions
  - Flight level and temperature of tropopause
  - Geopotential altitude for flight levels
  - Pressure (aerodrome) (i.e. QNH, QFE)
  - Visibility (aerodrome), runway visual range (RVR)
  - Cloud type (of operational significance)
  - Cloud coverage, bases, tops and layers
  - Thunderstorms, lightning, convection (TCU & CB)

AMET-B1/2 – Meteorological forecast and warning information

- (Continued) The following SWIM-compliant forecast parameters and phenomena will begin to be made available to users and will include:
  - Precipitation (i.e. drizzle, rain, freezing rain, snow, hail)
  - Weather (i.e. dust storm, sand storm, funnel cloud, squall, smoke, haze, mist, fog)
  - Icing (airframe and engine)
  - Liquid water content, iced water content
  - Turbulence, mountain waves, wind shear
  - Fronts
  - Radioactive clouds, toxic chemicals
  - Tropical cyclones
  - Volcanic ash
  - ~~Sulphur dioxide (SO2) and other hazardous gases~~
  - Aerodrome surface (runway) temperature, state
  - Sea temperature, state and wave height (seaports)
  - Space weather events
  - Tsunami, flood

AMET-B1/2 – Meteorological forecast and warning information

- Characteristics of the meteorological information include:
  - Precipitation Time (i.e. issue time, validity, commencement/cessation, lead time)
  - Units of measurement
  - Resolution (temporal & spatial)
  - Geo Location (2D/3D/4D context, point, line or polyhedron)
  - Movement
  - Severity, accumulation, intensity range (Max. – Min.)
  - Variations
  - Probability of occurrence
  - Confidence / uncertainty of forecast
  - Reliability
  - Data sample period
  - Auto
  - Change indicator / period
  - Amendment / correction
  - Operational Status Source
  - Thresholds
  - Format (TAC, gridded, graphical, IWXXM)
  - Data quality flag
  - Runway identification or location identifier
  - Effects / impact on aviation systems (i.e. communications, navigation & surveillance systems)
  - Radiation (exposure)

AMET-B1/3 – Climatological and historical meteorological information

- New capabilities:
  - Enhanced climatological data
- The following climatology parameters and phenomena will begin to be made available to users and will include:
  - En-route winds
  - Airport parameters (i.e. air and surface temperature, wind, precipitation, etc.)
- Characteristics of the climatological information will include:
  - Averages (daily/monthly/yearly) over 10, 20, 30, 50 years
  - Extremes over 1, 5, 10, 20, 30 years, since start of measurement

AMET-B1/4 – Dissemination of meteorological information

- New capabilities:
  - ~~Meteorological information in IWXXM form starts to replace TAC products~~. Human-readable products will start to be derived from the IWXXM information (rather than the other way around). The introduction of web services allows for progressive replacement of fixed line dissemination systems.
- Formats include:
  - Tailored products (human-readable)
  - Impact-translated products
  - Gridded
  - Graphical (*Note: PNG and BUFR to be phased out in Block 2*)
  - IWXXM
  - TAC - ~~being phased out~~ (*Note: TAC not likely to be phased out until 2030 timeframe*)
- Dissemination means includes aeronautical fixed service (AFTN with increasing use of AMHS), and via secure internet services (i.e. WIFS/SADIS)

AMET Elements for Block 2

- AMET-B2 details integrated meteorological information in support of enhanced operational ground and air decision-making processes, particularly in the planning phase and near-term
- Four elements:
  - AMET-B2/1 – Meteorological observations information
  - AMET-B2/2 – Meteorological forecast and warning information
  - AMET-B2/3 – Climatological and historical meteorological information
  - AMET-B2/4 – Meteorological information service in SWIM
- Timeframe: 2025 to 2030

AMET-B2/1 – Meteorological observations information

- New capabilities:
  - Further development of space weather observation services
  - Further development of observation services for terminal areas
  - Implementation of information services to support a data-centric environment
  - Higher spatial and temporal resolution of meteorological observations
  - Automated observations which will support user-defined services using meteorological information in IWXXM form

AMET-B2/1 – Meteorological observations information

- This element builds on the meteorological information services defined in AMET-B1
- Full MET-ATM integration will ensure that meteorological information is included in the logic of a decision process and the impact of the meteorological conditions on the operations are automatically derived, understood and taken into account
- Increased situational awareness to support tactical in-flight avoidance of hazardous meteorological conditions
- It is assumed that aircraft will be equipped for meteorological information display capabilities, such as EFBs. Taking advantage of enhanced aircraft connectivity to maximise observation functionality of aircraft

AMET-B2/2 – Meteorological forecast and warning information

- New capabilities:
  - Further development of space weather services
  - Further development of forecast and warning services for terminal areas
  - Phenomena-based meteorological information is no longer constrained by Flight Information Regions (FIRs)
  - Implementation of a data-centric information set
  - Higher spatial and temporal resolution of meteorological forecasts and warnings
  - Automated forecast and warning services derived from meteorological information in IWXXM form
  - Further development of probabilistic information derived from ensemble prediction systems and how this type of information can be presented or integrated into user's decision processes
  - Next generation volcanic ash cloud forecasts to be fully implemented. It will allow decision makers to use both deterministic and probabilistic forecasts for contamination levels, taking into account their risk management practices and the quantitative exposures allowed by the engine manufacturers

AMET-B2/3 – Climatological and historical meteorological information

- New capabilities:
  - Climatological data (including satellite-based and in-situ climatological data, and a combination of the two) available for more locations and more frequently updated.
- Climatological information services will support the design and planning of infrastructure, flight routes and airspace management.

AMET-B2/4 – Meteorological information in SWIM

- New capabilities:
  - Implementation of data-centric meteorological information services, integrated into the System Wide Information Management (SWIM) environment
  - User-defined services derived from meteorological information in IWXXM form
  - Wider use of secure web services and message brokers as part of the transition from fixed line dissemination systems
  - Commencement of the use of business-to-business services that allows integration of meteorological information into ATM systems
- SWIM-compliant meteorological information to be more readily exchanged with the aircraft to improve operational awareness and decision making using air/ground data connectivity and aircraft on-board systems.

AMET Elements for Block 3

- AMET-B3 details the integrated meteorological information in support of enhanced operational ground and air decision-making processes, for all flight phases and corresponding ATM operations
- Four elements:
  - AMET-B3/1 – Meteorological observations information
  - AMET-B3/2 – Meteorological forecast and warning information
  - AMET-B3/3 – Climatological and historical meteorological information
  - AMET-B3/4 – Meteorological information service in SWIM
- Timeframe: 2031 to 2036

AMET-B3/1 – Meteorological observations information

- New capabilities:
  - Further development of space weather observation services
  - Further development of observation services for terminal areas
  - Higher spatial and temporal resolution of meteorological observations
  - Observations to support tactical routing decisions under environmental considerations i.e. contrail or noise avoidance, if required.
- Full MET-ATM integration will ensure that high resolution meteorological observation information is included in the logic of a decision process and the impact of the meteorological conditions on the operations are automatically derived, understood and taken into account.
- Increased situational awareness to support tactical in-flight avoidance of hazardous meteorological conditions.

AMET-B3/2 – Meteorological forecast and warning information

- New capabilities:
  - Further development of space weather information service
  - Further development of forecast and warning services for terminal areas
  - Higher spatial and temporal resolution of forecasts and warnings
  - Further development towards a fully integrated forecast service fit for the purpose of all flight phases and ATC operations, in support of gate-to-gate seamless operations.
- Greater use of forecast information from ensemble prediction systems (multiple scenarios) will enable ATM stakeholders to consider multiple air traffic scenarios from ATM systems, flight management systems and airport management systems, and to derive uncertainty information on air traffic situation

AMET-B3/3 – Climatological and historical meteorological information

- New capabilities:
  - Climatological data information available for more locations and more frequently updated
- Climatological information services will support the design and planning of infrastructure, flight routes and airspace management.

AMET-B3/4 – Meteorological information in SWIM

- New capabilities:
  - Implementation of data-centric meteorological information services, integrated into the SWIM environment.
  - Enhancement of IWXXM with further schemas and formats for meteorological information exchange
  - User-defined products automatically derived from meteorological information in IWXXM form
  - Extensive use of secure web services, in particular business-to-business services that allows full integration of meteorological information
  - Commencement of the use of business-to-business services that allows integration of meteorological information into ATM systems
- Meteorological information to be more readily exchanged with the aircraft to improve operational awareness and decision making using air/ground data connectivity and aircraft on-board systems.

ASBU Elements for Block 4

- AMET-B4 is expected to detail the integrated meteorological information supporting both air and ground decision making for all phases of flight and ATM operations, especially for implementing immediate weather mitigation strategies
- Details are being developed at ICAO

Regional Air Navigation Plan (ANP)

- Volume III contains the status of States' implementation of the ASBUs
  - See Table PMP III-6 *Deployment planning: selected ASBU Elements / Operational Improvements for the CAR/SAM Region* in the CAR/SAM ANP Volume III, November 2023