METEOROLOGY PANEL

ICAO MID Workshop on enhancing MET capabilities
(15 December 2025, ICAO MID Regional Office)

Agenda Item 1: Global and Regional Developments in MET (New products and services)

Evolution of Meteorological Service to support international air navigation

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Air Navigation Bureau, ICAO

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ICAO and Meteorological Service

What is ICAO?

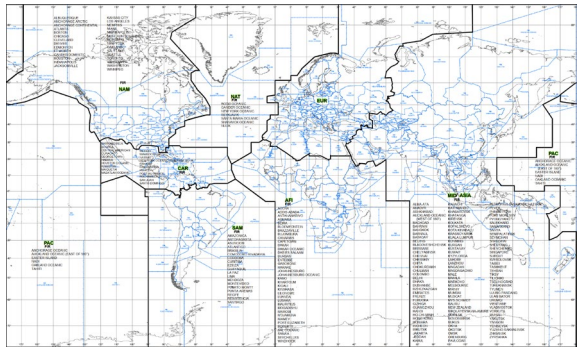
The Convention on International Civil Aviation (Chicago Convention, 7 Dec 1944)

- To develop international civil aviation in a safe and orderly manner and establish international air transport on the basis of equality and operated soundly and economically.
- Originally signed by 56 States >> As of today, 193 States has joined.
- ICAO cerebrated 80-year anniversary of the Convention last year.

Establishment of International Civil Aviation Organization (ICAO)

- Established as United Nation's specialized agency (1947)
- Headquarter: Montreal, Canada
- 7 Regional Offices / 1 Regional sub-office

EUR/NAT Region - Paris	NACC Region - Mexico City
MID Region - Cairo	SAM Region - Lima
WACAF Region - Dakar	APAC Region - Bangkok
AFI Region - Nairobi	APAC Regional sub-office - Beijing



ICAO SARPs for Meteorological Service

The Beginning of aeronautical meteorological service

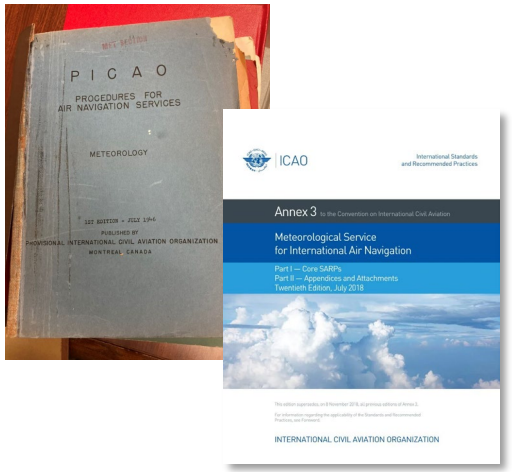
- 1944 – Exchange of the Chicago Convention
- 1947 – Establishment of ICAO Council, Special Session for Meteorology
- 1948 – Council adopted the first Annex 3 to the Convention

Title of the Annex 3 was "*Standards and Recommended Practices — Meteorological Codes*"

Annex 3 to the Convention on International Civil Aviation

"Meteorological Service for International Air Navigation"

2.1.1 The objective of meteorological service for international air navigation shall be to contribute towards the safety, regularity and efficiency of international air navigation.



- Defines ICAO SARPs (Standards and Recommended Practices) for meteorological services to support international air navigation
- Contracting States are encouraged to use the same provisions in domestic regulations

ICAO SARPs for Meteorological Service

Aeronautical meteorological service in current ICAO Annex 3 (until Amendment 80)

- "Product-centric" services designed to support specific phases of aircraft operations
- Provision of services are based on message dissemination through fixed communications (ATFN, AMHS).

Information for air space
- Low-level Area Forecast
- SIGMET, AIRMET
- Special Air Reports

Information provided by designated Centres
- WAFS SIGWX forecast, upper temp/wind data
- Volcanic Ash Advisory (VAA)
- Tropical Cyclone Advisory (TCA)
- Space Weather Advisory (SWXA)

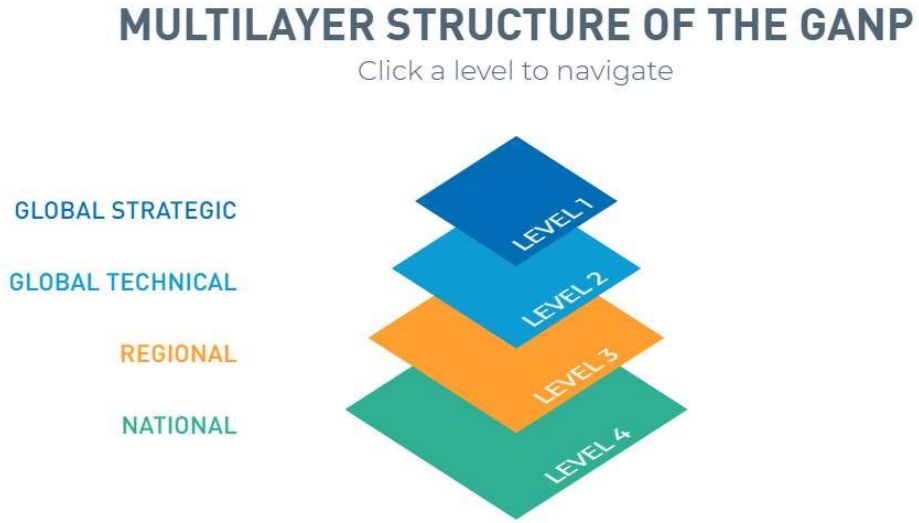
Information at aerodrome
- METAR/SPECI, Local reports
- TAF, TREND
- Aerodrome warnings
- Windshear warnings/alert

Aeronautical MET in GANP/ASBUs

ICAO Global Air Navigation Plan (GANP, Doc 9750)

- The GANP is an important planning tool for setting global priorities to drive the evolution of the global air navigation system
- Ensure that the vision of an integrated, harmonized, globally interoperable and seamless system becomes a reality.
- Multi-layer structure of air navigation plans, from global (GANP), regional (RANP) to national (NANP) levels.

URL: https://www4.icao.int/ganpportal/



Aeronautical MET in GANP/ASBUs

ASBU (Aviation Systems Block Upgrades)

- The ASBU framework is a part of Global Technical Level of the GANP, describing the evolutionary steps of the developments of concept of operations in different areas of air navigation systems.
- ASBU Threads – identified areas that consist of future air navigation systems described in GANP.
- ASBU Blocks – 6-yearly timelines for the evolution of air navigation systems. starting with Block 0 in 2013.
- ASBU Modules – A group of ASBU elements to be available for implementation within the defined deadline in the ASBU Block.
  - ASBU elements – Specific operational Improvements translated from the concept of operations in ASBU Threads..
  - ASBU enablers- Components (e.g., technology, training and regulatory provisions as well as the stakeholders) required for the implementation of ASBU elements.

Aeronautical MET in GANP/ASBUs

ASBU AMET Modules

AMET Block 0 (- 2013): Global, regional and local meteorological information to support flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning.

AMET Block 1 (-2019): Meteorological information supporting automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support.

AMET Block 2 (-2025): Integrated meteorological information in support of enhanced operational ground and air decision-making processes, particularly in the planning phase and near-term.

AMET Block 3 (-2031): Integrated meteorological information in support of enhanced operational ground and air decision-making processes, for all flight phases and corresponding air traffic management operations.

AMET Block 4 (-2037): 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.

Aeronautical MET in GANP/ASBUs

Migration into "information-based" (Amendment 81 and beyond)

- "MET" is a key-enabler for future air navigation systems. ICAO GANP/ASBUs envisages future integration of MET data into ATM decision-making system.

AMET Block 0:
Global, regional and local meteorological information to support flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning.

AMET Block 1:
Meteorological information supporting automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support.

...

AMET Block 4:
Integrated meteorological information supporting both air and ground decision making for all phases of flight and ATM operation, especially for implementing immediate weather mitigation strategies.

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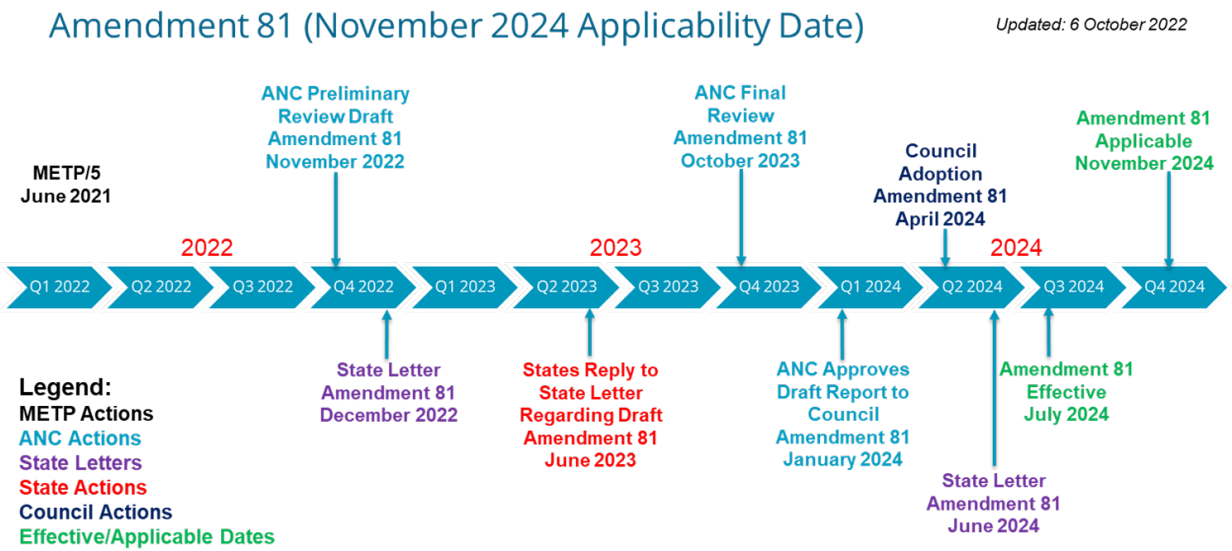
Development of ICAO Standards for aeronautical meteorology

ICAO SARPs for Meteorological Service

Annex 3 amendment process

- Proposed amendment is subject to the official reviewing process
  - Preliminary review (PR) by the Air Navigation Commission (ANC)
  - Consultation with Contracting States and International Organizations
  - Final review (FR) by the Air Navigation Commission (ANC)
  - Approval by Council
- After Council's approval
  - Publication
  - Effective
  - Applicable (November AIRAC)



Example of amendment process

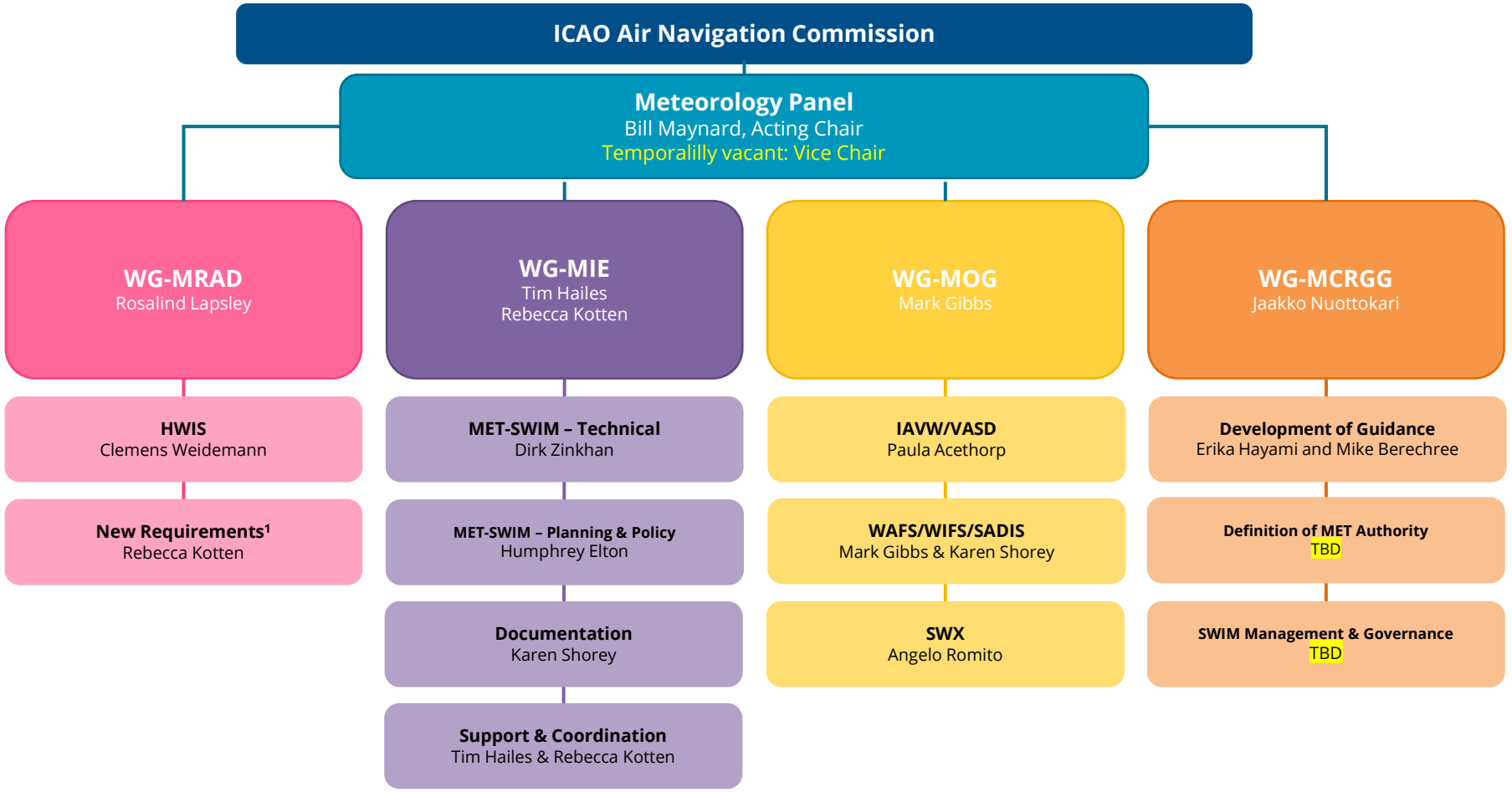
ICAO Meteorology Panel (METP)

Meteorology Panel (METP)

- One of ANC Panels discussing further development of aeronautical meteorological services, addressing specific global issues and enhancement of global standards
- Non-governmental expert group, consisting of 31 Member experts designated from 26 States / 7 International Organizations, plus 2 observers.
- Key Areas of Work
  - Extended use of IWXXM and SWIM-enabled meteorological service development
  - Further developments of:
    - World Area Forecast system (WAFS)
    - Space weather information service
    - International Airways Volcano Watch (IAVW)
  - Development of future aeronautical meteorological information services:
    - Aerodrome Observation/Forecast Information Services
    - Hazardous Weather Information Service (HWIS)
  - Guidance on cost recovery framework and governance

ICAO Meteorology Panel (METP)

Current METP Working Group Structure



https://www.icao.int/airnavigation/metp/pages/default.aspx

METP activities

- METP Membership (as of December 2025)

STATE/ORGANIZATION	MEMBER	STATE/ORGANIZATION	MEMBER
ARGENTINA	Claudia Ribero	NIGERIA (Observer)	Douglas Chibuzo Egere
AUSTRALIA	Tim Hailes	REPUBLIC OF KOREA	Seung-Ju Lee
BAHRAIN	Dheya Ali Al-Alawi	RUSSIAN FEDERATION	Yuliya Naryshkina
BRAZIL	Vicente Batista Rangel	Romania (Observer)	Silviu Gogu
CANADA	Bill Maynard	SAUDI ARABIA	Waleed Alsulaim
CHILE	Rodrigo Fajardo	SINGAPORE	Wee Kiong Cheong
CHINA	Zhongfeng Zhang	SOUTH AFRICA	Albert Moloto
CÔTE D'IVOIRE	Babakar Sy Diop	SWITZERLAND (Observer)	Marcel Haefliger
CUBA	Iván González Valdés	UNITED ARAB EMIRATES	Al Raeesi, Omar Mohamed Meer
FINLAND	Jaakko Nuottokari	UNITED KINGDOM	James Shapland
FRANCE	Pierre Tabary	UNITED STATES	Rebecca Kotten
GERMANY	Klaus Sturm	ASECNA	Nuria Mikue Asumu Mbese Esono
INDIA	Gajendra Kumar	EUROCONTROL	Rosalind Lapsley
ITALY	Angelo Romito	IATA	Jiska Manicus
JAPAN	Michiko Ikeda	ICCAIA	TBC
KENYA	Winstone N. Gicheru	IFALPA	Hendrik Wille
MEXICO	Joaquin Rodriguez Hernandez	IFATCA	Eric Avila
NEW ZEALAND	Paula Acethorp	WMO	Stephanie Wigniolle

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Amendment 82 – Milestone amendment for evolution

Annex 3 amendment 82

June 2021	Fifth meeting of ICAO METP (METP/5)	Comprehensive draft amendment proposals formulated. IP1: Restructured Annex 3 and a new PANS-MET IP2: Further development of Space Weather Information Service IP3: Extended use of the IWXXM IP4: Further development of International Airways Volcano Watch (IAVW) IP5: Further development of World Area Forecast System (WAFS) IP6: Clarified definition of meteorological authority
November 2022	ANC Preliminary Review (221st Session)	
Jan – July 2023	State/IO consultation process	
November 2023	ANC Final Review (224th Session) *Deferred	Further review was requested. Consequently, the applicability date was postponed from Nov 2024 until Nov 2025.
23 June 2024	ANC Final Review (cont'd, 226th Session)	
2 April 2025	Council Adoption (234th Session)	Annex 3 Amendment 82 and a new PANS-MET (Doc 10157) were approved
27 Nov 2025	Applicability Date	AMD82 / PANS-MET (1st Edition) became applicable ((25 November 2026 for QVA recommendation for all VAACs

Annex 3 AMD82 major changes

Restructured Annex 3 and introduction of a new PANS*-MET – A New Structure

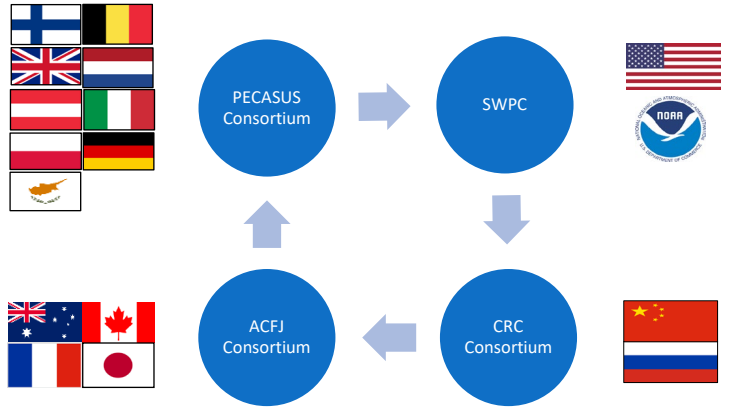
- Principles of restructuring of the Annex 3 and development of a new PANS-MET
  - Contain higher level of requirements in the Annex and technical specifications in the PANS
  - Relocate descriptive provisions and technical specifications in Annex 3 Appendices and Attachments to the new PANS
- PANS-MET, as a means of compliance document;
  - Enables the transition of MET service from “product centric” to “information centric” under SWIM
  - Improve responsiveness to States’ national regulations for evolving technical requirements by PANS
- Benefit from this restructuring;
  - The new PANS-MET will provide solely technical specifications to ensure compliance with higher-level requirements in Annex 3, assisting States in optimizing their implementation plan.
  - The adjustment of national regulations could be resolved more easily at lower level, compared to current “all-in-one” Annex 3.

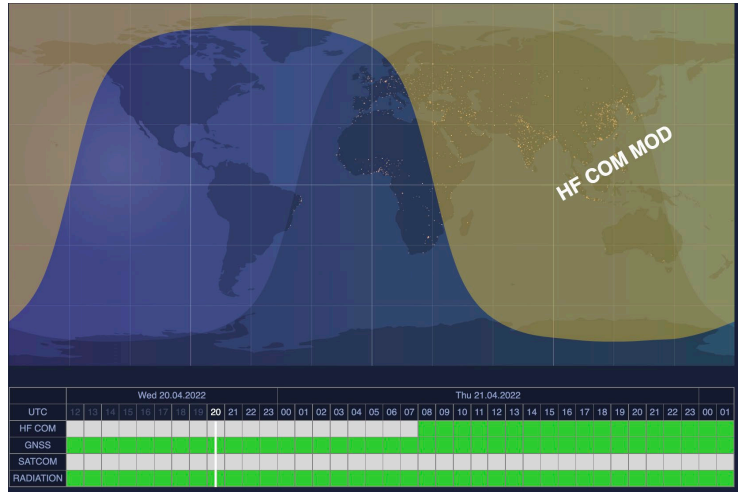
**PANS: Procedures for Air Navigation Services*

Annex 3 AMD82 major changes

Space Weather Information Services

- Included to Annex 3 since the 78th amendment (Nov 2018)
- Designated SWXCs provides globally-coordinated service
  - 4 global SWXCs (ACFJ, PECASUS, US and CRC)
  - 1 Regional SWXC (SANSA)
- Operational services started in November 2019
- Targeted aviation impact by space weather phenomena (e.g. Solar radiation storms, Solar flares, Geomagnetic storms and Ionospheric disturbances)
  - HF Communications (HF COM)
  - GNSS-based navigation and surveillance (GNSS)
  - Radiation impacts on avionics and human health (RAD)
- Details are described in ICAO Manual on Space Weather Information in Support of International Air Navigation (Doc 10100)





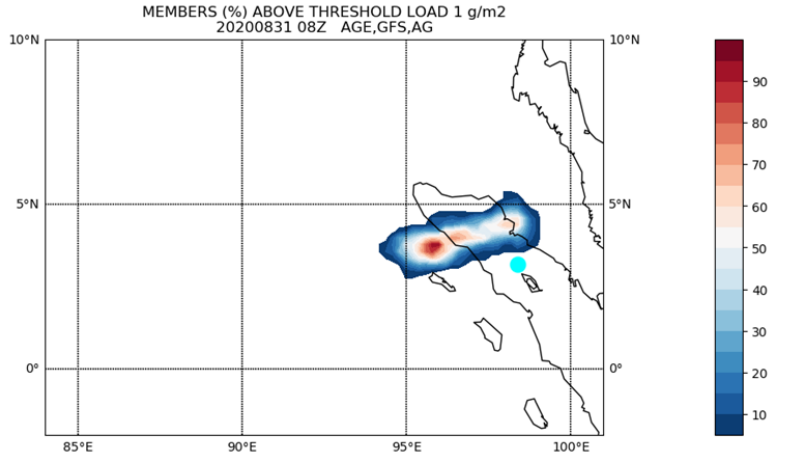
Annex 3 AMD82 major changes

Quantitative Volcanic Ash concentration information (QVA)

- 9 Volcanic Ash Advisory Centres (VAACs) provides:
  - 24/7 monitoring/forecasting of volcanic ash extension in the atmosphere
  - Issuance of Volcanic Ash Advisories (VAAs)
  - In coordination with State Volcano Observatories (SVOs)
- Strong user requirements for further development
  - Timely detections of eruptions/ash clouds
  - 4D characteristics (x, y, z, t) of VA clouds
  - Amount of ash in cloud (quantitative) / Uncertainty information
- QVA initial operational capability is expected to start in Nov 2025
  - The 82nd Amendment to ICAO Annex 3
- Further challenges
  - Further needs for more in-situ observations of ash amounts
  - Reduce uncertainties and variance of forecast results

Proposed Concentration Thresholds for Ash

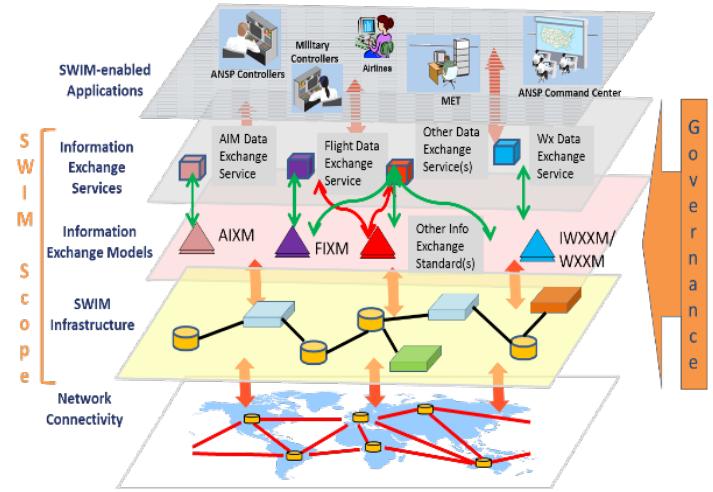
Threshold	Ash Concentration range (mg / m3)
Very Low	< 0.2
Low	0.2-2.0
Medium	2.0-5.0
High	5.0-10.0
Very High	> 10.0



Annex 3 AMD82 major changes

Digitalization of Meteorological information

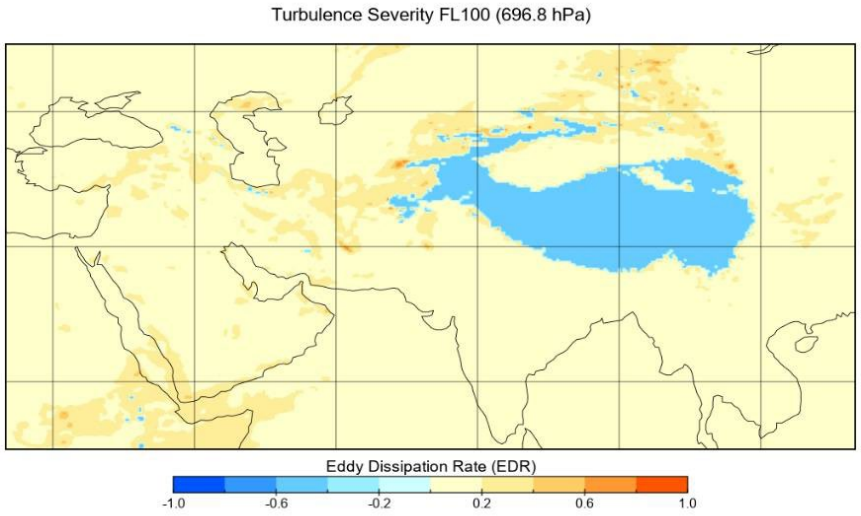
- IWXXM implementation has been promoted
  - Standard Practice implemented in November 2020
  - Regional Workshops/Webinars has been conducted
- SWIM-enabled information services are expected to be implemented more widely
  - MET service provision transition from “Product-Centric” services to SWIM-enabled information services will occur
- MET information services via SWIM will:
  - Remove of limitations from legacy TAC (High-Fidelity information)
  - Allow further MET information exchange in IWXXM form
  - Enable integrated use in decision-making systems / fit-for-purpose visualization on end-user systems
- The 81st amendment to ICAO Annex 3 (November 2024) recommends implementation of SWIM-enabled information services for the supply of MET information.

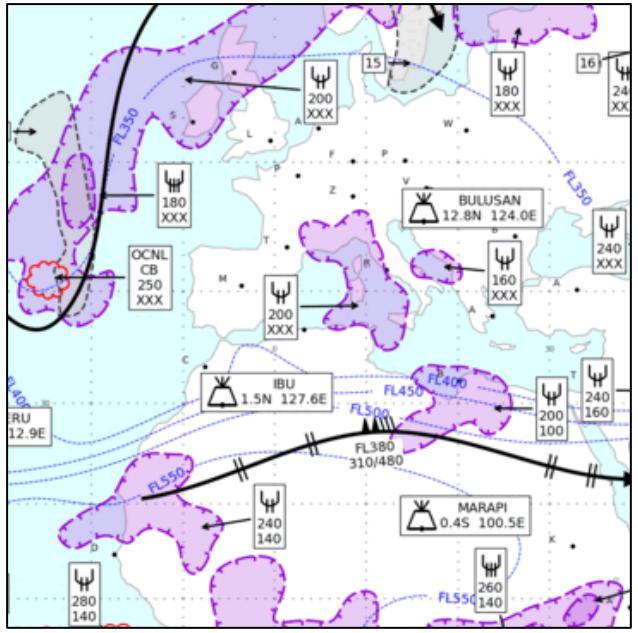


Annex 3 AMD82 major changes

Further development of WAFS

- Upgrades to WAFS forecasts to better serve GANP
- WAFCs to issue upper air gridded information with increased spatial and temporal resolution for extended forecast periods (up to 36 hours).
- Also, it is proposed to start the issuance of SIGWX forecast in IWXXM form (SIGWX objects).



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Annex 3 AMD82 major changes

Clarified definition of meteorological authority

Meteorological authority *is responsible for:*

- High-level internal coordination with the civil aviation authority
- International coordination with meteorological authorities of other States

Meteorological service provider *is responsible for:*

- Dealing with day-to-day, operational issues in relation to the service provision
- Operational coordination within a State with users

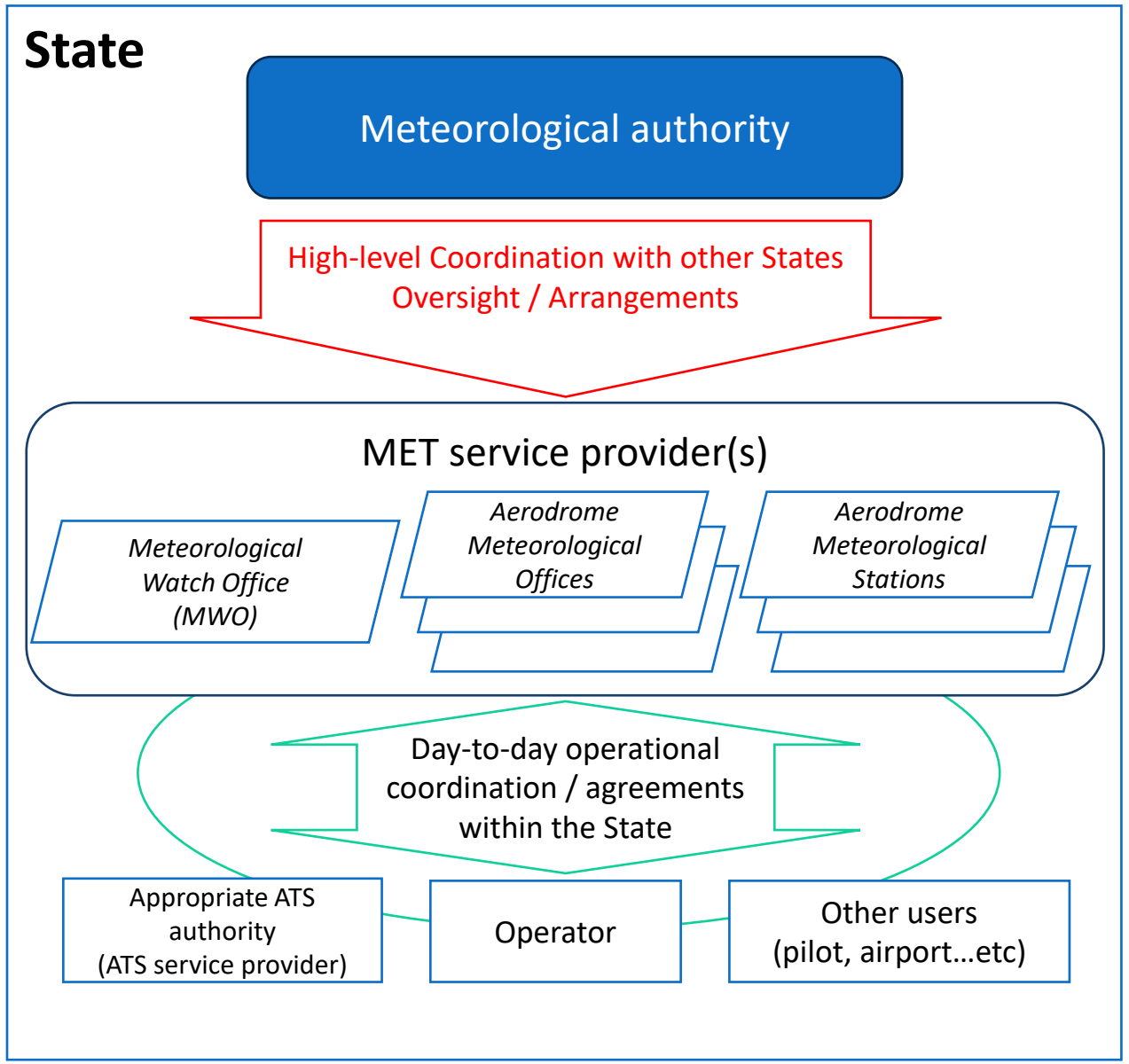
- Since 1990's, increasing trend for States to delegate the MET service provision to an entity (public or private), distinct from the one responsibility for regulation and oversight.
  - ICAO USOAP has identified in many States the lack of sufficient separation of regulatory/oversight function and the service provision.
- MET Divisional Meeting (July 2014) requested ICAO to modify Annex 3 to provide further clarifications concerning the role of meteorological authority
- Functional separation between "authority" and "service provider"

  (in line with safety management principles, as stipulated in Annex 19 - *Safety Management,* the *Safety Oversight Manual* (Doc 9734, para 3.3.4.1 and 3.3.4.2), and the *Manual on Aeronautical Meteorological Practice* (Doc 8896, para 1.1.5).

Respective roles of MET authority/service provider(s)

- Restructured Annex 3/new PANS-MET will clearly define
  a) meteorological authority's role as being responsible for:
     - regulatory/oversight functions
     - arrangements for the provision of meteorological services
     - high-level coordination with stakeholders and meteorological authorities in other States.
  b) meteorological service provider(s) designated by the meteorological authority as being responsible for:
     - the provision of services
     - day-to-day operational coordination with users.

- Meteorological watch office (MWO), aerodrome meteorological offices and aerodrome meteorological stations are operated by meteorological service provider(s) after having been designated by the meteorological authority of the State.



Summary, Challenges and Opportunities

Summary, challenges and opportunities

- Consistent implementation of enhanced meteorological information services is a key enabler for the successful evolution of air navigation system (GANP/ASBUs, AMET Thread) .
- Requirements for aeronautical meteorological services are defined in ICAO Annex 3. A new PANS-MET is expected to be introduced in Nov 2025.
- Meteorology Panel (METP) develops future ICAO SARPs for enhanced meteorological services to support GANP, in close coordination with WMO.

Summary, challenges and opportunities

- Transition to digitalized and quantitative MET information service is a fundamental shift. SWIM-enabled information services using IWXXM data format should not mean just a “change of delivery means, and will leads to the “information-centric” service.
- Key to success is to facilitate States’ implementation through:
  - State level: coordination between civil aviation authority (CAA) and meteorological authority (MA), and/or further beyond (NMHS, users, industry).
  - Regional level: regional/sub-regional coordination will be helpful for smoother implementation of new services.
- Further Implementation support can be provided – ask ICAO EUR/NAT Office (through the State’s established channel (via CAA or MA).

Useful links

- ICAO GANP Portal: https://www4.icao.int/ganpportal/
- ICAO e-library: https://elibrary.icao.int/home;seoMode=true
  - Annex 3: https://elibrary.icao.int/product/264207
  - World Civil Aviation Report Vol.6 – 2023 Edition: https://elibrary.icao.int/product/443879
- ICAO TV: https://www.icao.tv/
  - Air Navigation World 2023 – Shaping Skies of Tomorrow
    - Harmonized & quantitative meteorological information services https://www.icao.tv/air-navigation-world/season:1/videos/anw2023-harmonized-quantitative-meteorological-information-services
    - Delivery, use and integration of future meteorological information https://www.icao.tv/air-navigation-world/season:1/videos/anw2023-delivery-use-and-integration-of-future-meteorological-information

Thank you

Any questions?