METEOROLOGY PANEL

Meteorology in SWIM

ICAO Meteorology Panel (METP)

Presented by Karen Shorey

Introduction

- SWIM enables interoperability across the entire global air traffic management (ATM) system
- Meteorology in SWIM (MET-SWIM) applies the global SWIM framework to the aeronautical meteorological (MET) domain
- MET-SWIM is intended to replace the Aeronautical Fixed System (AFS), the legacy point-to-point message exchange system at some point

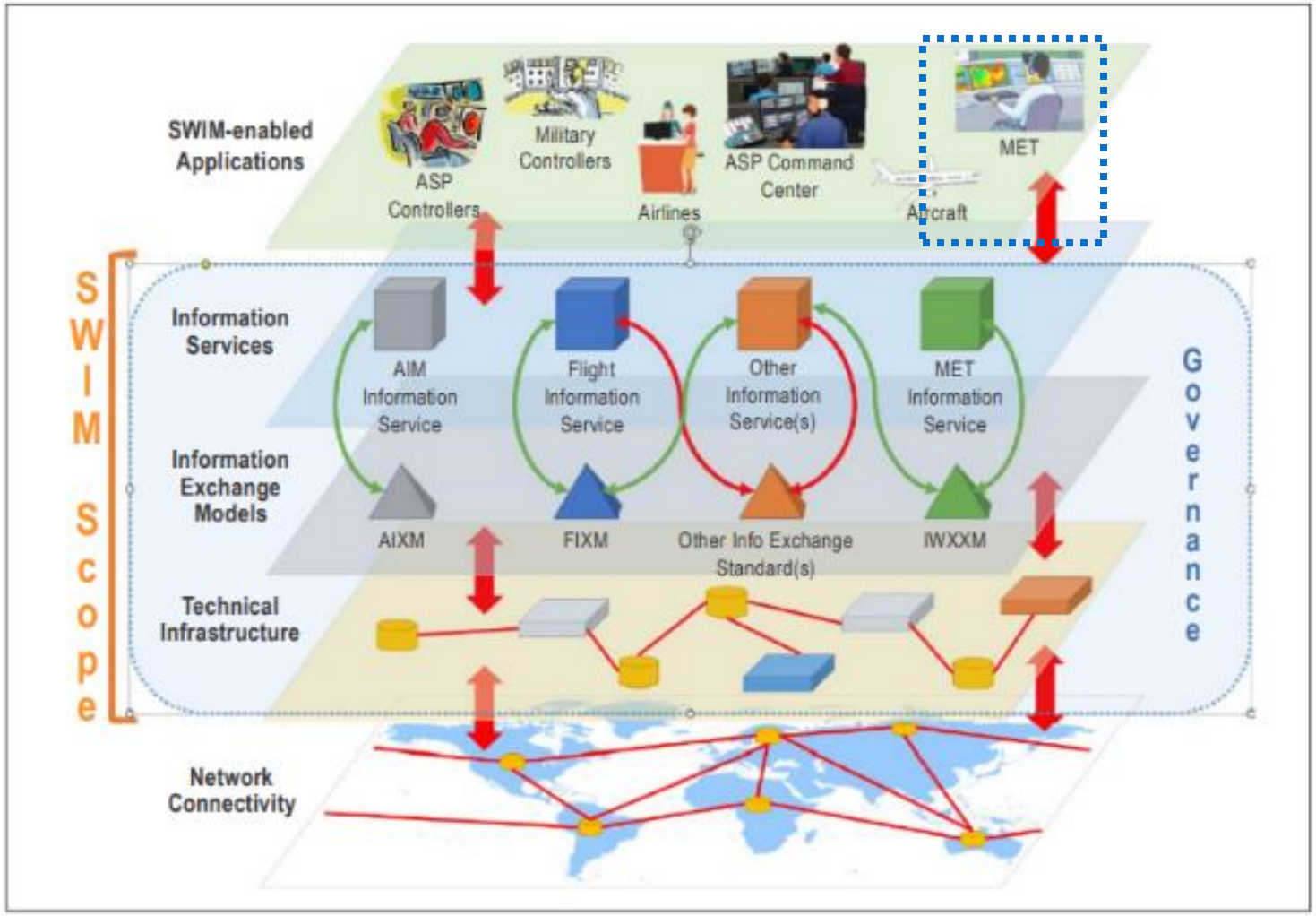


Figure 1-1 from ICAO Doc 10203, *Manual on SWIM Implementation*

Transition from products to information services

- Traditional MET products in teletype, traditional alphanumeric code (TAC) format no longer suffice for international air navigation
- MET information is now required to be provided and exchanged in ICAO Meteorological Information Exchange Model (IWXXM) format (aligned with flight and aeronautical information domains)

Traditional approach	Future approach
Static, text-based products (e.g., METAR and TAF)	Dynamic, machine-readable data (e.g., IWXXM format)
Limited integration with automated systems	Seamless integration with ATM and airline systems, decision-aids

- Information services are automated, tailored to user needs and decision-making timeframes

Requirements for MET-SWIM

ICAO GANP - AMET Modules – AMET Bx/4 - Dissemination

AMET B0/4: Dissemination of Meteorological Products
Commencement of IWXXM, being the conversion of TAC using an IWXXM schema into XML/GML.

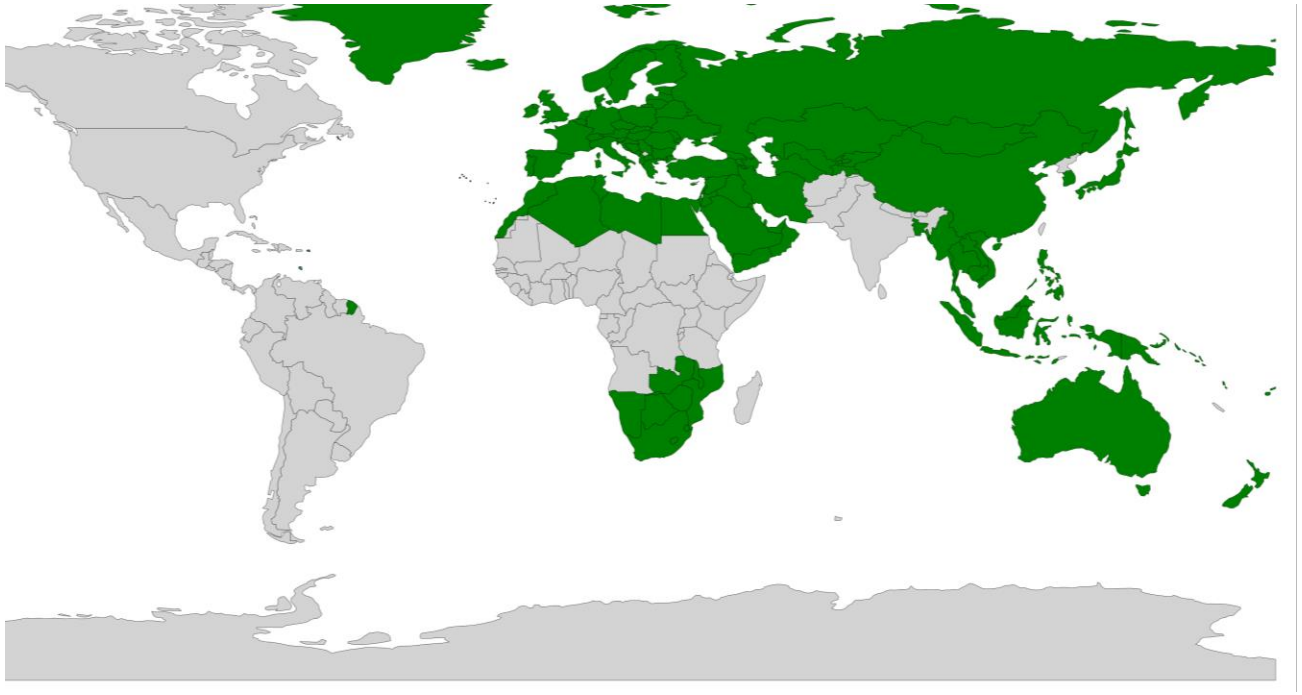
AMET B1/4: Dissemination of Meteorological Information
IWXXM form starts to replace TAC products. Human-readable products start to be derived from the IWXXM information (rather than the other way around). The introduction of web services allows for progressive replacement of fixed line dissemination systems.

AMET B2/4: Dissemination of Information Services in SWIM
Implementation of a data-centric MET information into a SWIM environment. User-defined products derived from meteorological information in IWXXM. Wider use of secure web services and decommissioning of fixed line and satellite dissemination systems. Commencement of the use of business-to-business services, allowing integration of MET information into ATM systems. Increased use of air-to-air datalink for transmission of upper air meteorological observation in near real-time.

AMET B3/4: Dissemination of Information Services in SWIM
Continued implementation of a data-centric meteorological information service into SWIM. Enhancement of IWXXM with further schemas and formats for meteorological information exchange. User-defined products automatically derived from meteorological information IWXXM form. Extensive use of secure web services, in particular business-to-business services that allows full integration of meteorological information.

IWXXM exchange

- IWXXM became a Standard format for the exchange of MET information in November 2020 with Amendment 79 to ICAO Annex 3, Meteorological Service for International Air Navigation
- As of June 2026, global availability of IWXXM is lacking; there remains a limited volume of IWXXM being exchanged globally over the Aeronautical Fixed System (AFS)
- IWXXM should be exchanged over the Aeronautical Message Handling System (AMHS)
- Data should be produced using 2025-2 Schemas https://schemas.wmo.int/iwxxm/2025-2/



Guidance material

- Reference documents are provided on the ICAO Public METP page: https://www.icao.int/airnavigation/aeronautical-meteorological-service/documents
- Current documentation related to IWXXM and SWIM include:

IWXXM Guidelines, Version 5

Provides guidance on implementing IWXXM format **over the AFS**

Guidelines for MET-SWIM Implementation

Provides practical, operational guidance to stakeholders on how to implement MET services in SWIM

MET-SWIM Roadmap, Version 3

Defines global, phased pathway for transitioning MET information from message-based to service-based exchange

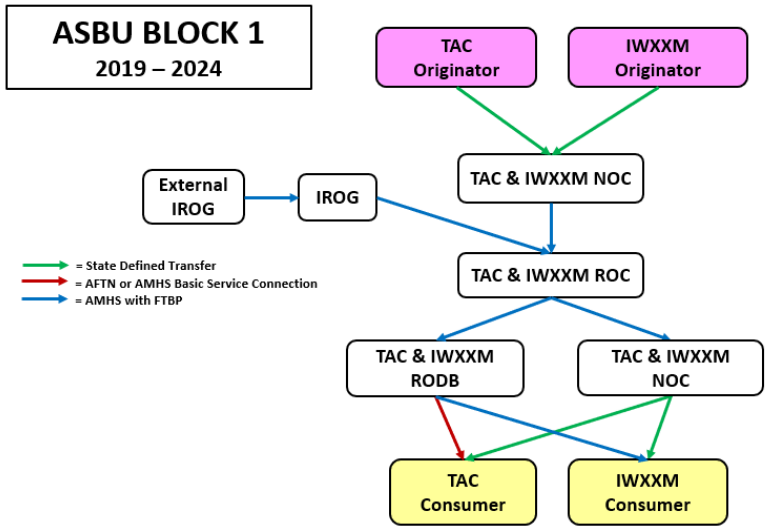
Requirements for MET-SWIM

- Amendment 81 to ICAO Annex 3, *Meteorological Service for International Air Navigation*, included the following provision (ref. para. 2.2.10):

> 2.2.10 **Recommendation.**— *Contracting States should ensure that the meteorological information supplied to the users listed in 2.1.2 is provided through information services.*
>
> *Note 1.— In the context of system-wide information management (SWIM), the notion of information service addresses machine-to-machine interaction in a service-oriented architecture.*
>
> *Note 2.— Procedures on information services are contained in the* Procedures for Air Navigation Services – Information Management *(PANS-IM, Doc 10199).*
>
> *Note 3.— Guidance material on information services can be found in the* Manual on System-wide Information Management Implementation *(Doc 10203).*

- As a result, the ICAO METP is developing subsequent Standards and Recommended Practices (SARPs) to enable information services for the provision of MET information

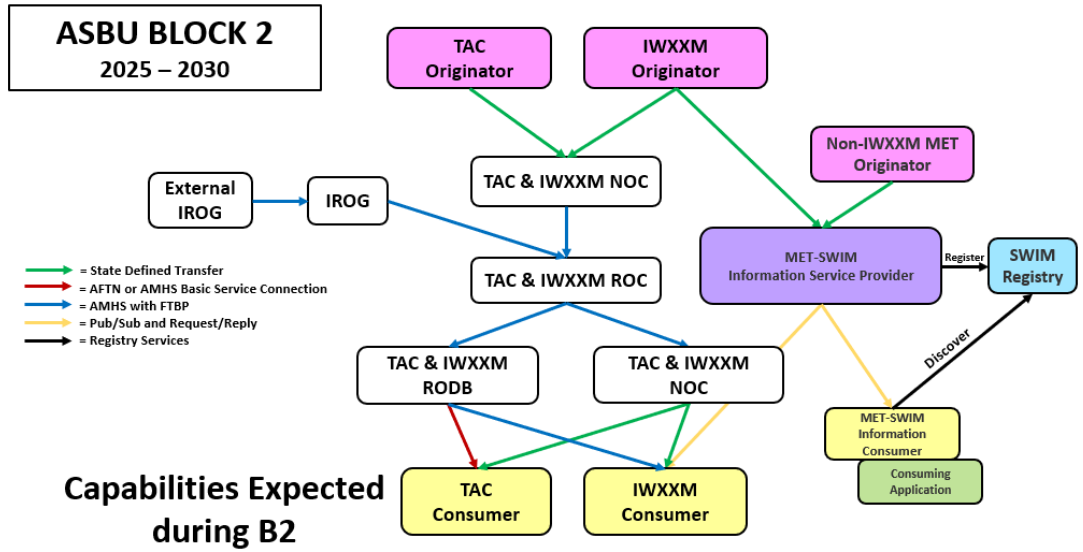
Current and future MET-SWIM services



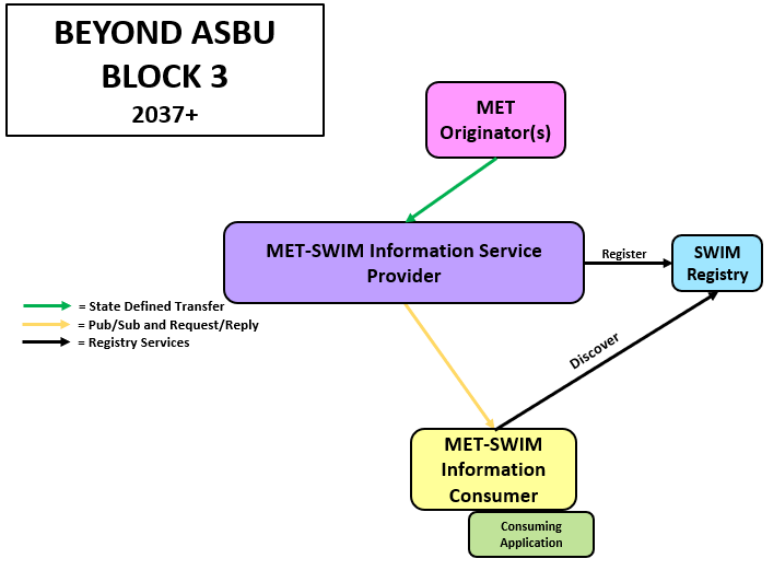
The Past

The provision of aeronautical meteorological information via SWIM-enabled information services will be one of the most significant developments in aviation in the last 30 years

The Present



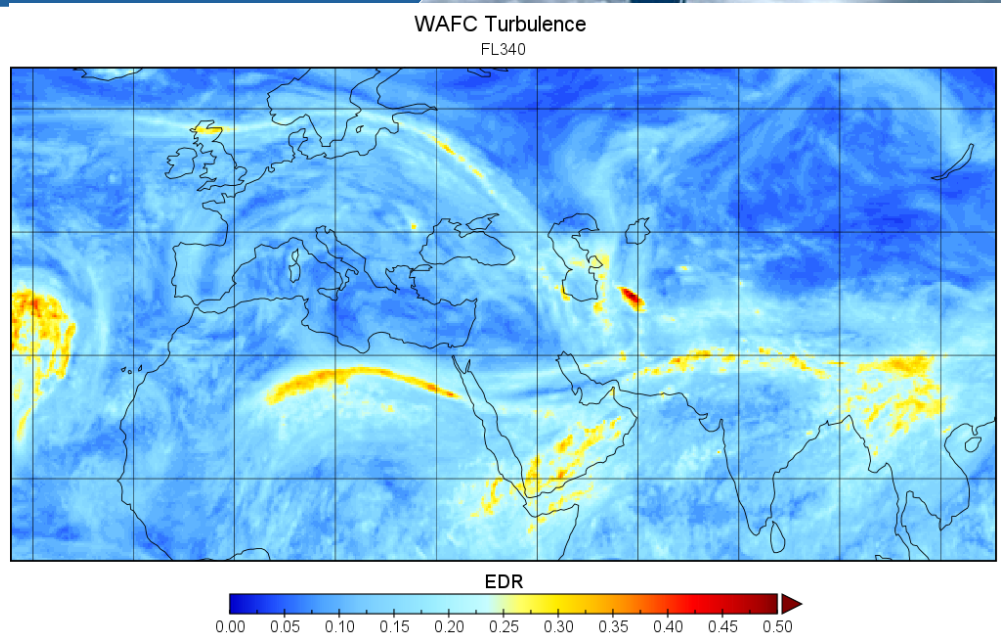
Capabilities Expected during B2

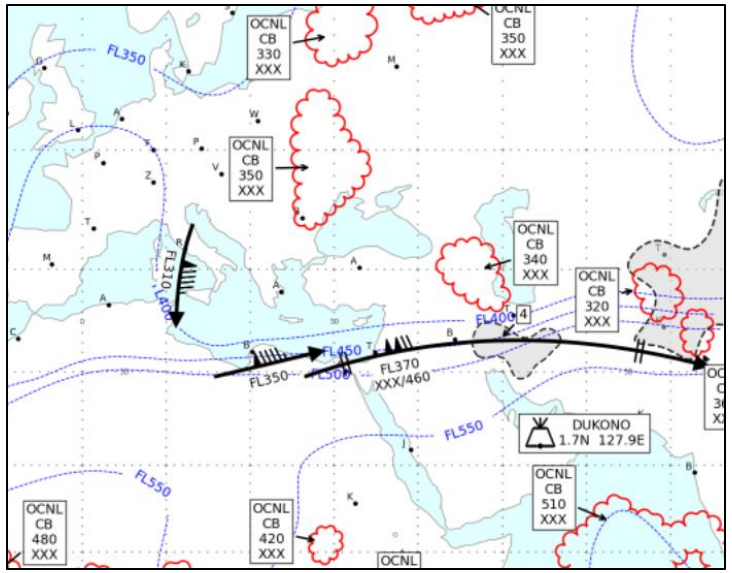


The Future

Current MET-SWIM services

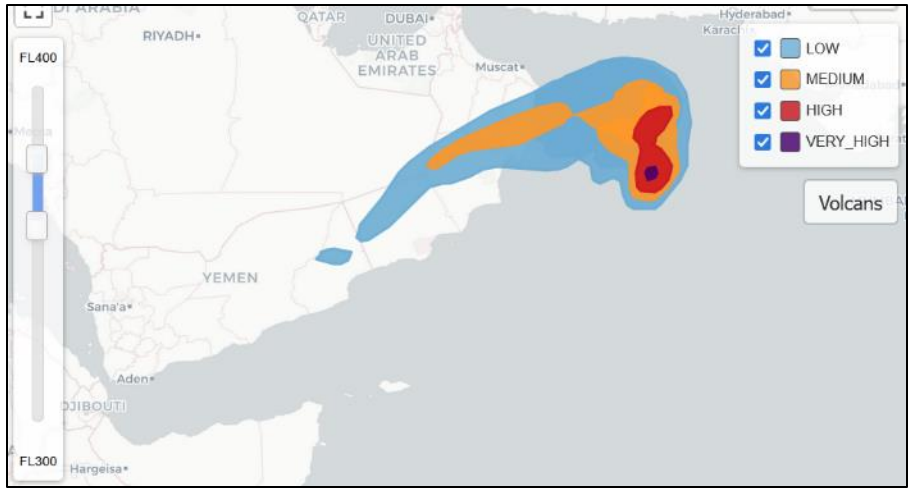
- WAFS
- Secure Aviation Data Information Service (SADIS) and WAFS Internet File Service (WIFS) Application Program Interfaces (APIs)
  - SADIS API, provided by World Area Forecast Centre (WAFC) London, and WIFS API, provided by WAFC Washington, became operational in 2025
  - Both systems are SWIM compliant and based on the Open Geospatial Consortium (OGC) Environmental Data Retrieval (EDR) API framework
  - SADIS API and WIFS API provide access to upgraded WAFS gridded data sets, global METARs, TAFs, SIGMETs and other advisories, and multi-timestep WAFS SIGWX forecasts
  - These systems supply data to National Met Services, ANSP's, Flight planning companies, Airlines, and other aviation specific software suppliers across the globe

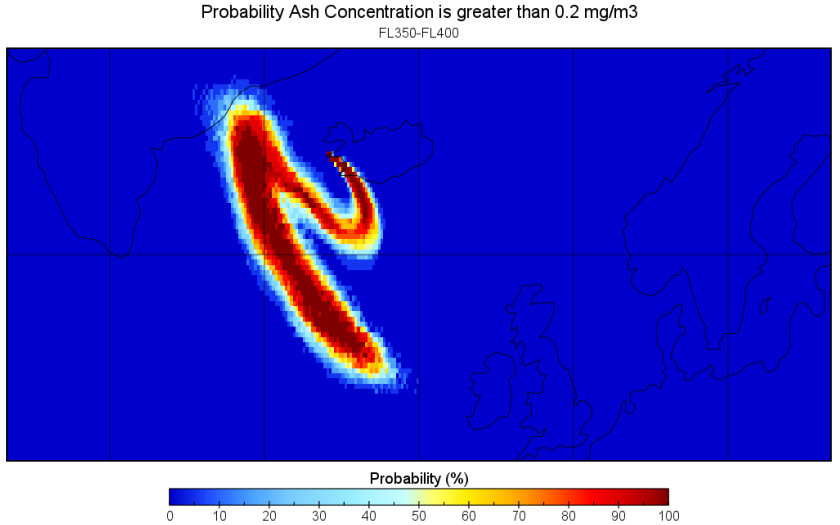


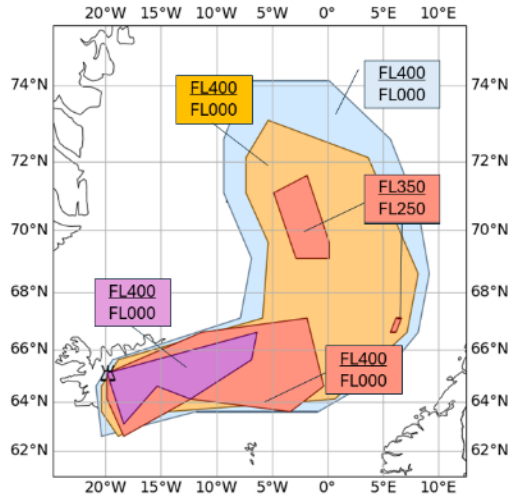


Current MET-SWIM services

- Quantitative Volcanic Ash (QVA)
- Introduced to ICAO Annex 3 with Amendment 82
  - VAAC London and VAAC Toulouse QVA API's became operational on 27 November 2025. The other 7 VAACs will follow in late 2026.
  - Provides deterministic and probabilistic gridded ash concentration forecasts as well as QVA ash polygons
  - All VAACs agreed to use the OGC-EDR API framework
  - These systems are starting to supply data to National Met Services, ANSP's, Flight planning companies, Airlines, and other aviation specific software suppliers across the globe







Future MET-SWIM services

- **Aerodrome Meteorological Observation Information Service (AMOIS)** and **Aerodrome Meteorological Forecast Information Service (AMFIS)** are planned to be the future aerodrome observations and forecasts, with significantly increased temporal resolution (e.g., data on 1-minute intervals) and optional parameters
- New IWXXM schema will be developed for AMOIS and AMFIS
- The aerodrome observation and forecast information is intended to only be available via SWIM information services (e.g., not for distribution over the AFS)
- METP is aiming for November 2030 applicability of these services as Recommended Practices in Annex 3

Future MET-SWIM services

- **Hazardous Weather Information Service (HWIS)** is planned to be the future en-route warning information service, to complement SIGMETs
- The METP timeline for HWIS is not yet determined, but likely November 2033

- **Space Weather Information Service (SWX)** is planned to exchange space weather information (e.g., the Space Weather Advisory (SWXA) via SWIM services (likely Advanced Message Queuing Protocol (AMQP)) by November 2030

Stakeholder impacts

- Benefits of MET-SWIM across the entire aviation system:
  - ATC → Real-time updates and better rerouting
  - Pilots → Real-time hazard awareness in cockpit systems
  - Dispatchers → More accurate flight planning
  - Airlines → Proactive operations management
  - ANSPs → Automated data for ATM systems
  - Aerodrome ops → Better planning for aerodrome conditions

Stakeholder impacts

- Challenges of implementing MET-SWIM services:
  - Much larger data volumes for users to manage
    - Systems must be adapted to handle influx of data
    - Users should only select data they need (ex: not download global data)
  - “No country left behind”
    - Difficult to strike a balance between innovation and realistic expectations for global standardization
    - Not every State has the same capabilities
    - ICAO Regions move at different paces
  - Visualization of MET data
    - Should visualization of MET data be standardized in the future, when data is no longer in TAC format?
  - Investment requirements
    - Sustainability of legacy systems (end of lifecycle) and persistent use of legacy products
    - Costs associated with implementing new systems

Key takeaways

- ICAO has endorsed the transition to data-centric MET services
- Transition from legacy METAR, TAF, SIGMETs, etc. to digital, automated information services
- WAFS, QVA, AMOIS, AMFIS, and HWIS define the next generation of aviation weather data
- Final requirements and timelines being actively developed by the ICAO METP
- Stakeholders should:
  - Stay informed of progress on implementation plans
  - Participate in national, regional, and global planning efforts
  - Collaborate with system developers to ensure SWIM and IWXXM readiness
  - Educate and prepare to understand and adopt future MET information services

METEOROLOGY PANEL

Thank you!