



What is the ICAO Meteorological Information Exchange Model (IWXXM)?

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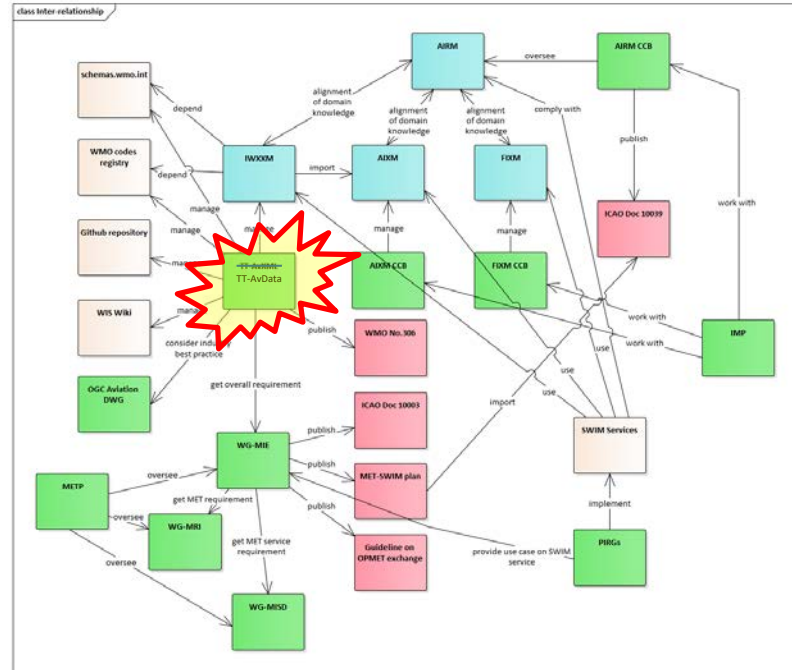
IWXXM in short



- A data format for reporting aviation weather information in machine readable XML/GML form
- Currently covers 7 TAC products including:
METAR/SPECI, TAF, AIRMET, SIGMET, Tropical Cyclone Advisory, Volcanic Ash Advisory, Space Weather Advisory
- Original TAC contents are enriched in their IWXXM counterparts with metadata (e.g. projection) and extension
- XML Schema and Schematron enforces report integrity and reporting requirements in ICAO Annex 3



Who makes IWXXM?



- Institution
- Exchange Model
- Documentation
- Web resources



WMO Approval Process

- **WMO Governance** – IWXXM is defined in WMO-No.306 Manual on Codes Volume I.3: Representations derived from data models.
- **Fast Track Amendment Procedure** – Used for amendments that have minor financial or operational implications (e.g. a minor version or patch release). Usually takes six months from the completion of the draft amendment to implementation of the decision.
- **In Session / between Technical Commission Sessions Amendment Procedure** – Used for amendments that have a noticeable financial or operational implications (e.g. a major version release). Usually takes eight months or more to complete.



Resources on Internet

- Wikipedia (<https://en.wikipedia.org/wiki/IWXXM>) – as landing page
- WMO
 - No.306 Vol. I.3 (https://library.wmo.int/index.php?lvl=notice_display&id=19508)
 - No.386 (https://library.wmo.int/index.php?lvl=notice_display&id=10728)
 - Schema repository (<https://schemas.wmo.int/>) and WMO Codes Registry (<https://codes.wmo.int>)
 - Q&A for implementors of IWXXM: <https://groups.google.com/a/wmo.int/forum/#!/forum/cbs-tt-avxml>
 - GitHub repositories (for development only)
 - IWXXM - <https://github.com/wmo-im/iwxxm>
 - IWXXM UML Model - <https://github.com/wmo-im/iwxxm-modelling>
 - TAC-to-IWXXM translation examples - <https://github.com/wmo-im/iwxxm-translation>
- ICAO
 - Doc No.10003 (<https://store.icao.int/en/manual-on-the-icao-meteorological-information-exchange-model-doc-10003>)



Hidden Secrets in the Version Number

MAJOR.MINOR.PATCH (X.Y.Z)

- **A MAJOR (X.y.z) version** introduces major conceptual changes. Forward data mapping is not guaranteed
- **A MINOR (x.Y.x) version** introduces new model elements and capabilities. Forward data mapping is guaranteed
- **A PATCH (x.y.Z) version** is limited to bug fixing. Forward and backward data mapping is guaranteed

* See <https://github.com/wmo-im/iwxxm/wiki/Common-approaches-across-exchange-models> for details



New versioning scheme

- Previously, all packages will have the same version number as IWXXM no matter they have changed or not:
 - IWXXM 1.1: METAR/SPECI 1.1, TAF 1.1, SIGMET 1.1
 - IWXXM 2.1: METAR/SPECI 2.1, TAF 2.1, SIGMET 2.1, AIRMET 2.1, TCA 2.1, VAA 2.1
 - IWXXM 3.0: METAR/SPECI 3.0, TAF 3.0, SIGMET 3.0, AIRMET 3.0, TCA 3.0, VAA 3.0, SWA 3.0
- In the upcoming version to become operational by Nov 2021, a new versioning scheme will be adopted
- Versioning of individual package in the new versioning scheme will be separated from IWXXM and version number of individual package will be advance only if it has changed



IWXXM Versions

IWXXM Version	METAR/SPECI	TAF	SIGMET	AIRMET	TCA	VAA	SWA	WAFS SIGWX F/C	Requirements
1.1.0	1.1.0	1.1.0	1.1.0	N/A	N/A	N/A	N/A	N/A	Am76
2.1.0	2.1.0	2.1.0	2.1.0	2.1.0	2.1.0	2.1.0	N/A	N/A	Am77
3.0.0	3.0.0	3.0.0	3.0.0	3.0.0	3.0.0	3.0.0	3.0.0	N/A	Am78
2021-2RC1	3.1.0RC1	3.0.1RC1	3.0.0 (Note 1)	3.1.0RC1	3.1.0RC1	3.1.0RC1	3.0.1RC1	1.0.0RC1	Am79 + Am80

Note 1: TT-AvData opted in a meeting to validate IWXXM changes that the proposed implementation in accordance to Amendment 79 to Annex 3 was not mature enough for publication.



IWXXM 2021-2RC1

- Incorporates*:
 - Changes to existing requirements and new requirements in Amendments 79 and 80 (e.g. Introduction of WAFS Significant Weather Forecast)
 - Bug fixes and enhancements
- Published in May 2021 for public consultation up to 14 Jun 2021
- It will then be refined and submitted for WMO's approval process
- If everything goes smoothly, IWXXM 2021-2 should become operational by Nov 2021

* See <https://github.com/wmo-im/iwxxm/wiki/Development-Roadmap> for details



Can we prepare reports compliant to latest ICAO Annex 3 in previous IWXXM version(s)?

- Yes and no
- **Yes:** In a patch (e.g. from TAF 3.0.0 to TAF 3.0.1), only non-structural changes will be involved so the instances based on TAF 3.0.0 and TAF 3.0.1 schemas will be exactly the same.
- **No:** For all other changes resulting in a change of major and/or minor version number(s)
- Therefore sometimes it is sufficient to only mention the major and minor numbers of a version, like TAF 3.0



Validation

- Validation is the process of checking a document written in XML to confirm that it is both well-formed and also valid in that it follows a defined structure.
- ICAO considered it important and has asked producers to validate the IWXXM reports prepared before dissemination.
- Validation comes in two parts:
 - Validation against a schema, like taf.xsd
 - Validation against the schematron rules, iwxxm.sch



Schema Vs Schematron



Check against document blueprint (schema)




Check with a script (schematron)



metar-A3-1.xml [C:\Users\blchoy\Downloads\metar-A3-1.xml] - <oXygen/> XML Developer

File Edit Find Project Options Tools Document Window Help

XPath 2.0 ▾ • Execute XPath on 'Current File' 

Project

- sample.xpr
 - sample.xpr
 - css
 - debugger
 - epub
 - fo
 - import
 - json
 - jsp
 - nvd
 - relaxng
 - schematron
 - svg

The Master Files support is disabled [Read more](#)

Outline

Element name filter

- iwxxm:METAR "uuid.510df5de-fe" (1)
- !- the same as observationTime
- iwxxm:issueTime (1)
- !- The aerodrome at which this
- iwxxm:aerodrome (1)
- !- time at which the METAR ph
- iwxxm:observationTime (1)
- iwxxm:observation (1)

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <!--
3   An example of a METAR.  Original METAR from ICAO Annex 3 Example A3-1:
4
5   METAR YUDO 221630Z 24004MPS 0600 R12/1000U DZ FG SCT010 OVC020 17/16 Q1010
6   BECMG TL1700 0800 FG BECMG AT1800 9999 NSW
7 -->
8 <iwxxm:METAR xmlns:iwxxm="http://icao.int/iwxxm/3.0" xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gml="http://www.opengis.net/gml/3.2">
9
10  <!-- the same as observationTime except for corrections -->
11  <iwxxm:issueTime>
12    <gml:TimeInstant gml:id="uuid.e5460ae4-98a4-48fa-bbfc-21799896f1f2">
13      <gml:timePosition>2012-08-22T16:30:00Z</gml:timePosition>
14    </gml:TimeInstant>
15  </iwxxm:issueTime>
16
17  <!-- The aerodrome at which this observation took place -->
18  <iwxxm:aerodrome>
19    <aixm:AirportHeliport gml:id="uuid.143d63d9-15f5-442e-9bdc-1f3db93fb699">
20      <aixm:timeSlice>
21        <aixm:AirportHeliportTimeSlice gml:id="uuid.75c3340c-3679-4e31-8a6c-efdabe375d49">
22          <gml:validTime/>
23          <aixm:interpretation>SNAPSHOT</aixm:interpretation>
24          <aixm:designator>YUDO</aixm:designator>
25          <aixm:name>DONLON/ INTERNATIONAL</aixm:name>
26          <aixm:locationIndicatorICAO>YUDO</aixm:locationIndicatorICAO>
```

Attributes

Attribute	Value
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Attributes Model

Transformation ...

Type filter text

Associ... Scenario

Tr.. Enti.. <> E..

Validation successful

C:\Users\blchoy\Downloads\metar-A3-1.xml U+003C 2 : 1 26 new mes...



Collectives and aggregation

- An IWXXM report is required to be put into a collective before disseminating via AMHS.
- Some IWXXM report types (METAR and TAF) may require aggregation, in the same way as their TAC counterparts, before being put into a collective



Extension

- To facilitate consistency in how additional content appears in the IWXXM XML documents, the IWXXM schemas have elements named "extension" in many complex type definitions.
- States can define their own XML types that support their additions to the Annex 3 products' technical specifications. Their unique types can then appear within the extension element(s) of the corresponding IWXXM XML documents.
- Because the <any> type has the attribute "processContents" set to "strict", this requires that a schema file (XSD) must exist and be found by the XML processor. The processor then uses this schema file to validate the content inside the <extension> element.



Example: METAR COLOUR STATE INFORMATION

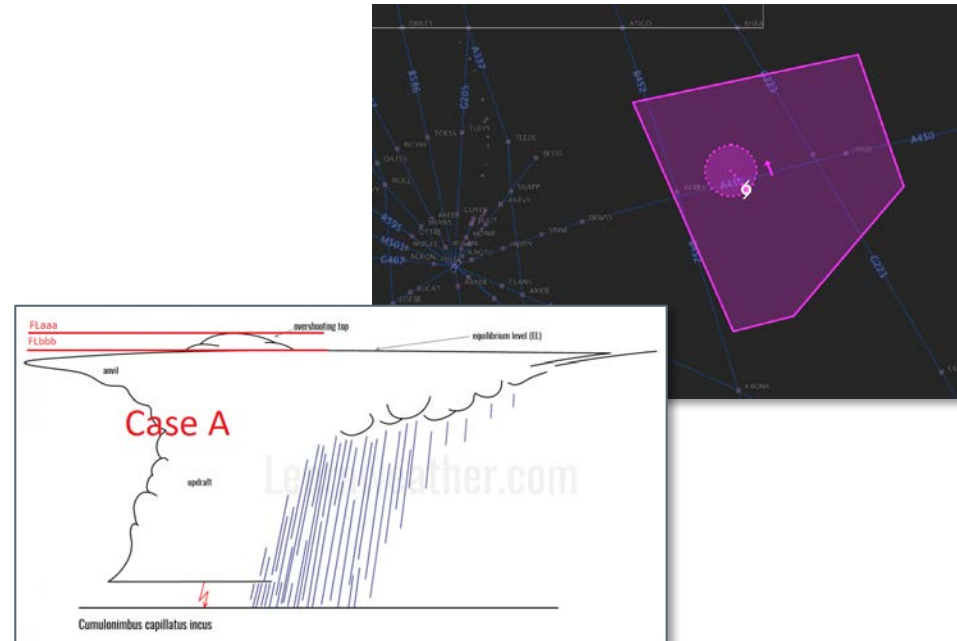
METAR EGUB 120850Z 18024G36KT 9999 BKN017 OVC045 16/13 Q1008 **WHT** TEMPO 6000 -RA SCT012 **GRN**=

```
<iwxxm:observation>
...
<iwxxm:extension>
  <ukmoav:UKAerodromeColourState>
    <ukmoav:UKColourState xlink:href="http://reference.metoffice.gov.uk/aviation/UKAerodromeColourStates/WHT"/>
  </ukmoav:UKAerodromeColourState>
</iwxxm:extension>
...
</iwxxm:observation>
...
<iwxxm:trendForecast>
...
<iwxxm:extension>
  <ukmoav:UKAerodromeColourStateTrend>
    <ukmoav:UKColourState xlink:href="http://reference.metoffice.gov.uk/aviation/UKAerodromeColourStates/GRN"/>
  </unmoav:UKAerodromeColourStateTrend>
</iwxxm:extension>
...
</iwxxm:trendForecast>
```



Links with AIXM

- Aeronautical Information Exchange Model (AIXM) enables the provision of aeronautical information in digital format
- IWXXM imports AIXM for:
 - identifying
 - ATM units
 - FIR/UIR/CTA
 - Aerodromes
 - Runways
 - defining the geospatial coverage of weather features (e.g. a thunderstorm)





Geo-referencing

- IWXXM mandates the use of 2.5D (a short form for geospatial references making use of a two dimensional CRS with coordinate tuples and separate definition of elevation) for geospatial representation
- In alignment with AIXM which streamlines computation involving geospatial objects of weather and aeronautical features

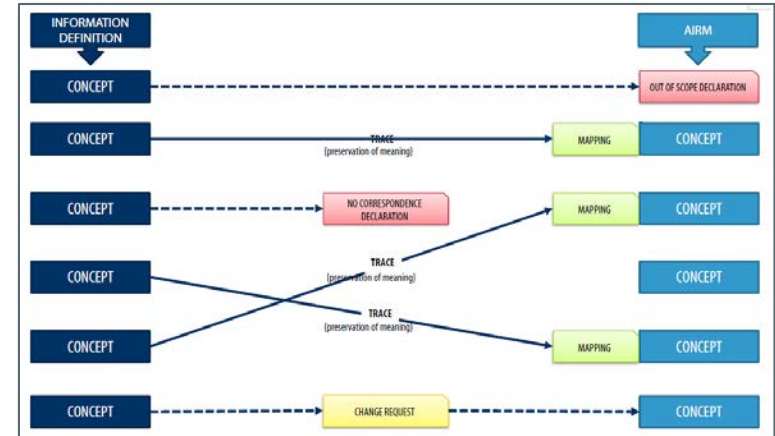


Original image from https://ext.eurocontrol.int/aixm_confluence/display/AIX/Latvia



Links with AIRM

- The ATM Information Reference Model (AIRM) is the ATM system-wide reference vocabulary for defining ATM information
- To achieve semantic interoperability, Features in XMs are mapped to concepts in AIRM
- Users should note that the current semantic mappings from IWXXM to AIRM was based on version 1.1 which has been deprecated. Efforts are being made to refresh the mappings to IWXXM 3





Limitations of IWXXM induced by TAC Counterparts

- TAC has a number of constraints which are natural consequence of its compactness. This makes the representation of certain cases difficult, if not impossible.
- Examples include:
 - Maximum and minimum temperature forecasts in TAF
 - Dissipation of tropical cyclone within the forecast period in a Tropical Cyclone Advisory
 - Including of more than 4 RVR reports in METAR
- It was considered a better approach to allow greater range of information to be provided with IWXXM, and relax unnecessary constraints on the number of report to be included for an elements. These suggestions will be brought up for ICAO's consideration



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and Caribbean
(NACC) Office
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(SAM) Office
Lima

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Headquarters
Montréal

Western and
Central African
(WACAF) Office
Dakar

European and
North Atlantic
(EUR/NAT) Office
Paris

Middle East
(MID) Office
Cairo

Eastern and
Southern African
(ESAF) Office
Nairobi

Asia and Pacific
(APAC) Sub-office
Beijing

Asia and Pacific
(APAC) Office
Bangkok



THANK YOU