Modernising Aviation Observations and Forecasts

Overview of the Aerodrome Meteorological Observational and Forecast Information Systems (AMOIS and AMFIS)

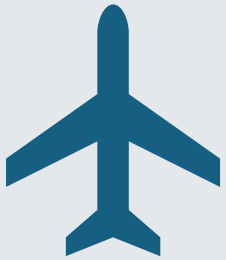
On behalf of the ICAO METP WG-MRAD

Why a new concept?

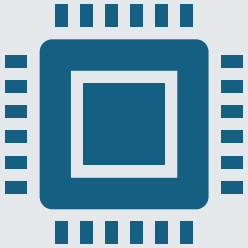
Why a new concept?



Needs of aviators and aviation stakeholders have evolved immensely over the decades that legacy products have been used



ICAO Global Air Navigation Plan (GANP) includes evolving state of global air navigation datasets into Information Services via SWIM

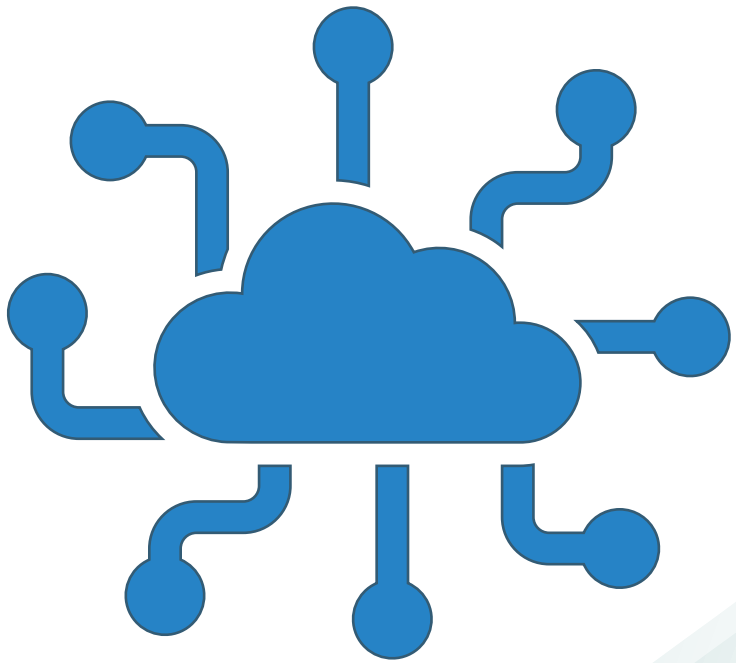


Information Services will allow for more fluid integration of pertinent data into increasingly modern operational technology

Information Services and Weather Datasets

End users and MET Service Providers have modernized significantly, and deserve equally sophisticated, robust information service to support their changing needs. They need:

- Higher frequency, higher precision data
- End user customisation abilities
- Inclusion of additional observation and forecast parameters in streamlined format
- Easy integration into evolving digital systems



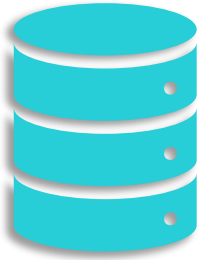
Facilitate operational decision making with high value, high glance data



More effective and efficient decision making

Only looking at what you need to see

Decision makers spend less time parsing for critical information



More information available for end users which allows for tailored threshold-based risk management practices

Custom display highlighting data critical to end user

Allows user to create workflows that more quickly identify safety concerns

Taking observations from here…

```
EHAM 091855Z 25015KT 220V280 9999 FEW026 15/08 Q1014 NOSIG=
EHAM 091925Z 24014KT 9999 FEW022 15/09 Q1014 TEMPO 6000 TSRA SCT028CB=
EHAM 091955Z 25013KT 210V270 9999 -SHRA FEW019 FEW028CB 15/10 Q1014
     TEMPO 27020G32KT 6000 TSRA=
```

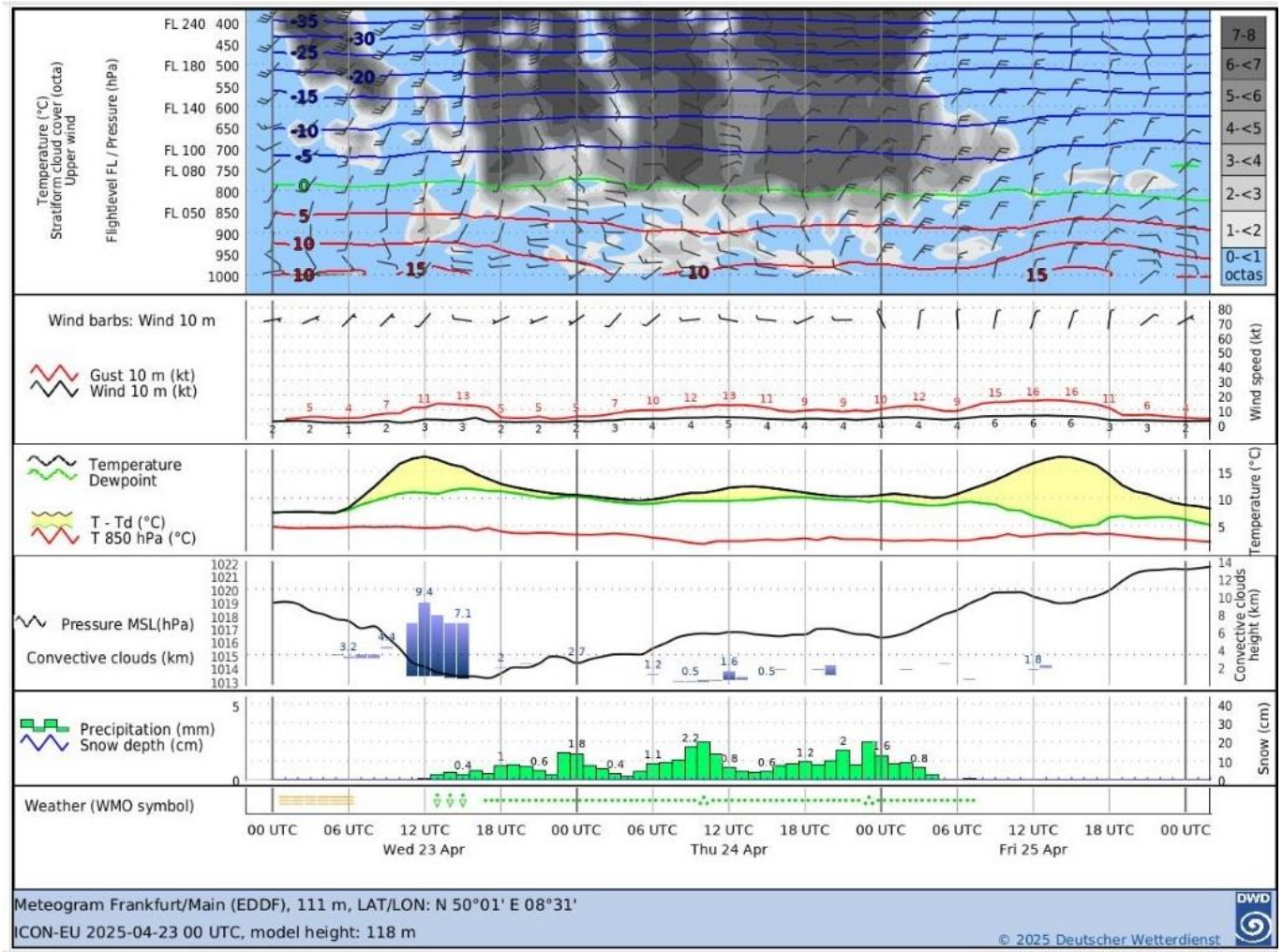
… to here

OBS Location	OBS Parameter	1855Z	1900Z	1905Z	1910Z	1915Z	1920Z	1925Z	1930Z	1935Z	1940Z	1945Z	1950Z	1955Z	2000Z	2005Z	2010Z
RWY18R TDZ	Wind direction (true)	250	240	250	260	250	260	240	260	250	240	220	230	250	260	270	260
	Wind speed (KT)	15	13	15	14	12	14	14	14	15	14	16	14	13	14	15	18
	Wind gusts (KT)	18	20	22	21	18	20	20	22	24	23	24	20	18	19	22	**27**
	Wind direction variation	220…280	220…300	210…270	240…300	230…300	240…290	220…270	250…300	220…280	210…280	190…250	200…260	210…270	230…300	250…320	240…300
RWY36L TDZ	Wind direction (true)	260	250	250	270	260	270	250	250	260	250	230	220	240	230	300	310
	Wind speed (KT)	14	15	15	16	14	13	12	13	14	15	16	15	15	16	17	20
	Wind gusts (KT)	17	18	20	19	21	20	22	19	23	22	25	21	20	20	**25**	**30**
	Wind direction variation	220…270	220…320	220…270	240…300	230…300	250…290	230…290	250…300	250…320	230…310	190…250	210…260	190…250	180…250	190…330	200…340
EHAM	Prevailing visibility	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	8000	7000	6000
RWY18R TDZ	Visibility (m)	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	8000	7000	6000
RWY36L TDZ	Visibility (m)	9999	9999	9999	9999	9999	9999	9999	9999	9999	9000	8000	7000	6000	6000	5000	4000
RWY18R TDZ	Present weather	-	-	-	-	-	-	-	-	-	-	-SHRA	-SHRA	-SHRA	-SHRA	SHRA	**TSRA**
RWY36L TDZ	Present weather	-	-	-	-	-	-	-	-	-	-SHRA	-SHRA	SHRA	SHRA	SHRA	SHRA	**TSRA**
RWY18R TDZ	Cloud amount (layer 1)	FEW	FEW	FEW	FEW	SCT	SCT	FEW	FEW	FEW	SCT	FEW	FEW	FEW	SCT	SCT	SCT
RWY18R TDZ	Cloud base (layer 1, FT)	2300	2300	2300	2300	2400	2500	2200	2300	2200	2100	1900	1900	1900	1800	1700	1800
RWY36L TDZ	Cloud amount (layer 1)	FEW	NSC	FEW	FEW	SCT	SCT	SCT	FEW	SCT	SCT	SCT	SCT	SCT	SCT	BKN	BKN
RWY36L TDZ	Cloud base (layer 1, FT)	2200	-	2300	2200	2200	2200	2100	2200	2200	2100	2000	2000	2000	1900	1800	1800
EHAM	CB amount	-	-	-	-	-	-	-	-	-	-	FEW	FEW	FEW	SCT	SCT	SCT
EHAM	CB base (FT)	-	-	-	-	-	-	-	-	-	-	2800	2800	2800	2800	2700	2800
EHAM	Air temperature (C)	15,4	15,4	15,3	15,3	15,2	15,1	15,1	15,1	14,9	14,8	14,7	14,6	14,6	14,5	14,4	14,2
EHAM	Dew Point	8,4	8,4	8,5	8,5	8,6	8,7	8,7	8,8	8,9	9,1	9,1	9,4	9,7	10,5	11,5	11,6
EHAM	QNH	1014,8	1014,8	1014,7	1014,7	1014,7	1014,7	1014,6	1014,4	1014,6	1014,3	1014,2	1014,1	1014,0	1013,7	1013,3	1013,2

Taking forecasts

from here…

```
EHAM 090441Z 0906/1012 27008KT 9999 FEW018
    BECMG 0907/0910 25018KT TEMPO 0910/1012 6000 SHRA SCT022CB PROB30
       TEMPO 0914/0917 25020G30KT 4000 TSRA
    BECMG 0920/0923 21008KT
    BECMG 1007/1010 25016KT=
```



… to here

The Concept

Information Services – AMOIS and AMFIS

The Intention

Provide users high-resolution, machine-readable datasets

Allow MET service providers the option to include new MET parameters

To ensure that aviation stakeholders have access to all available MET data

Allow users more control over how they interact with MET data

Create a flexible and adaptable service that fits the needs of users today and in the future

AMOIS

Aerodrome Meteorological Observational Information Service

An information service aiming to provide aviation weather observation datasets, prioritizing:



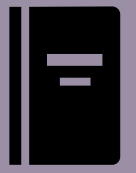
Feed of aerodrome observational information from all available sensors*



New optional elements, as determined by local need or agreement



Greater temporal and spatial resolution



Maintaining as a minimum, all elements currently available through legacy observation reports

* Human made observations may also be included in AMOIS

AMFIS

Aerodrome Meteorological Forecast Information Service

A new information service, providing aviation weather forecast data at (and in proximity of) an aerodrome, prioritizing:

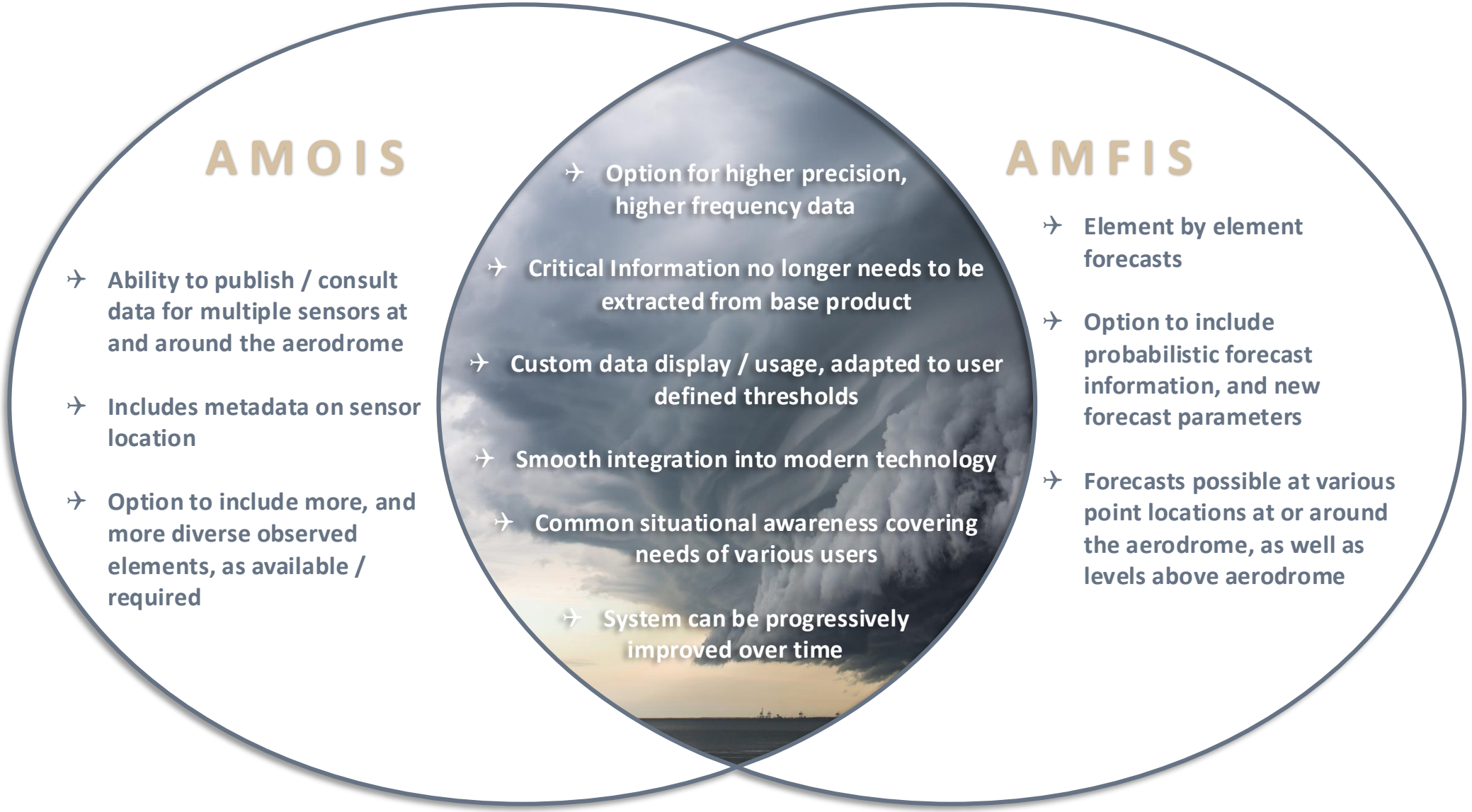
Higher resolution datasets

Maintains, as a minimum, all elements contained in TAF and landing/trend forecasts as currently specified in Annex 3 and PANS-MET

New optional elements determined by local need and agreement, possibility of:

- ✈ greater variety of forecast parameters
- ✈ forecast information around and above aerodrome
- ✈ probabilistic forecast information

Improvements from legacy systems



Key Principles

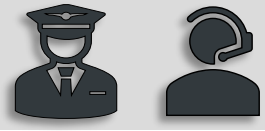
Data generation and uses

How it works - Data to End User

Legacy TAC data creation

```
EHAM 091925Z 24014KT 9999 FEW022 15/09 Q1014 TEMPO 6000 TSRA S
EHAM 091955Z 25013KT 210V270 9999 -SHRA FEW019 FEW028CB 15/10
     TEMPO 27020G32KT 6000 TSRA=
```

End user interpretation



AMOIS & AMFIS IWXXM data creation

```
.opengis.net/gml/3.2" xmlns:aixm=
t/iwxxm/3.0.0/iwxxm.xsd http://dd
sueTime>
TimeInstant gml:id="uuid.87916c77
gml:timePosition>2026-04-29T16:36
:TimeInstant>
ssueTime>
rodrome>
:AirportHeliport gml:id="uuid.8df
aixm:timeSlice>
   <aixm:AirportHeliportTimeSlice
      <gml:validTime/>
      <aixm:interpretation>SNAPS
      <aixm:locationIndicatorICA
      <aixm:ARP>
         <aixm:ElevatedPoint gm
            <gml:pos>51.446388
         </aixm:ElevatedPoint>
      </aixm:ARP>
   </aixm:AirportHeliportTimeSlic
```

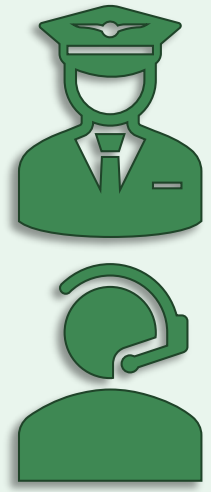
Data ingestion into digital systems



Visualisation



End user interpretation

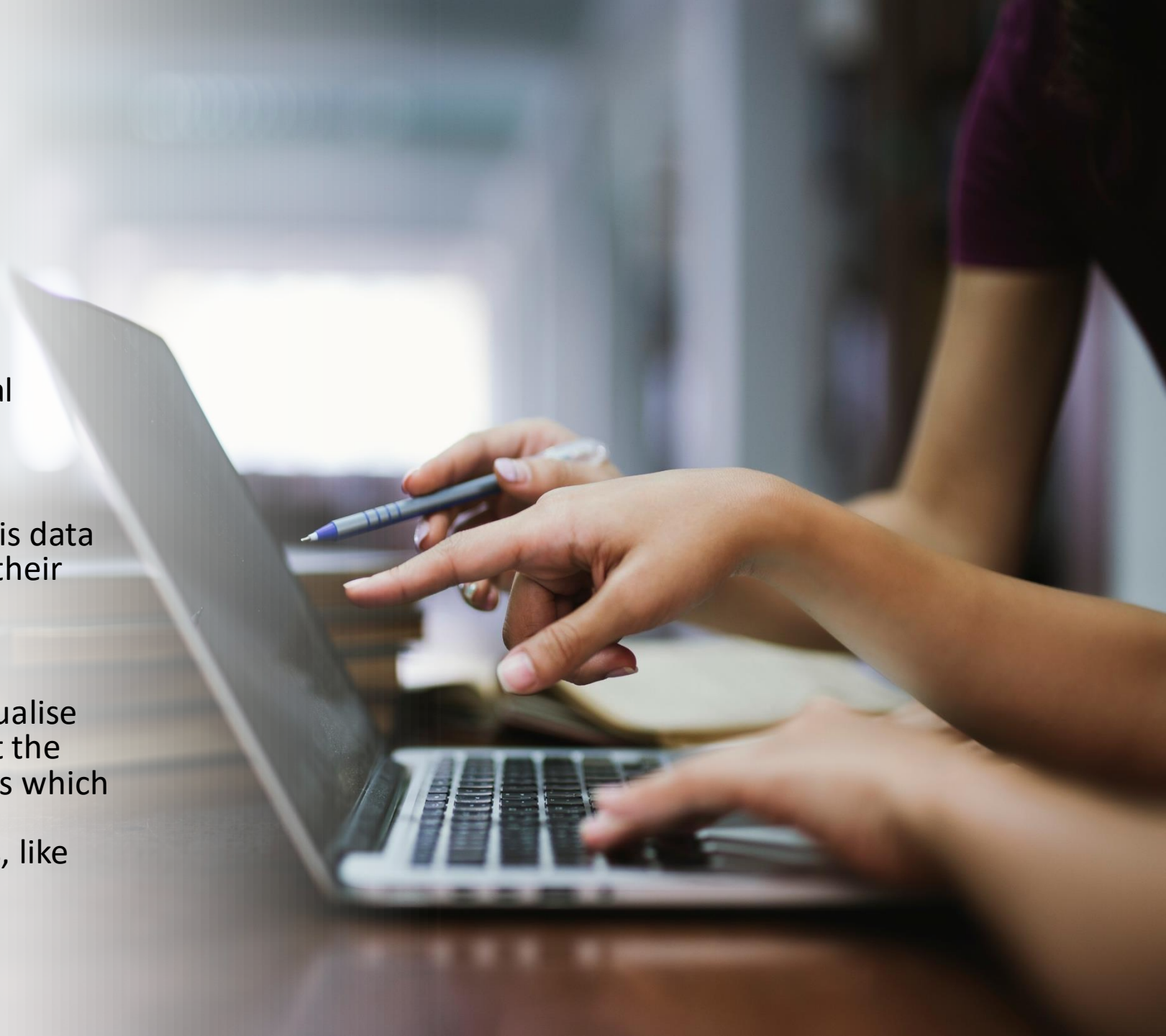


MET Data
vs
Use of MET Data

AMOIS and AMFIS will provide digital datasets in modern IWXXM format

Users can decide how to visualise this data within their operations, bespoke to their needs

Users may equally choose not to visualise MET data directly, but rather consult the solutions from decision support tools which process the MET data (potentially in combination with non-MET datasets, like FIXM and AIXM)



MET data visualisation

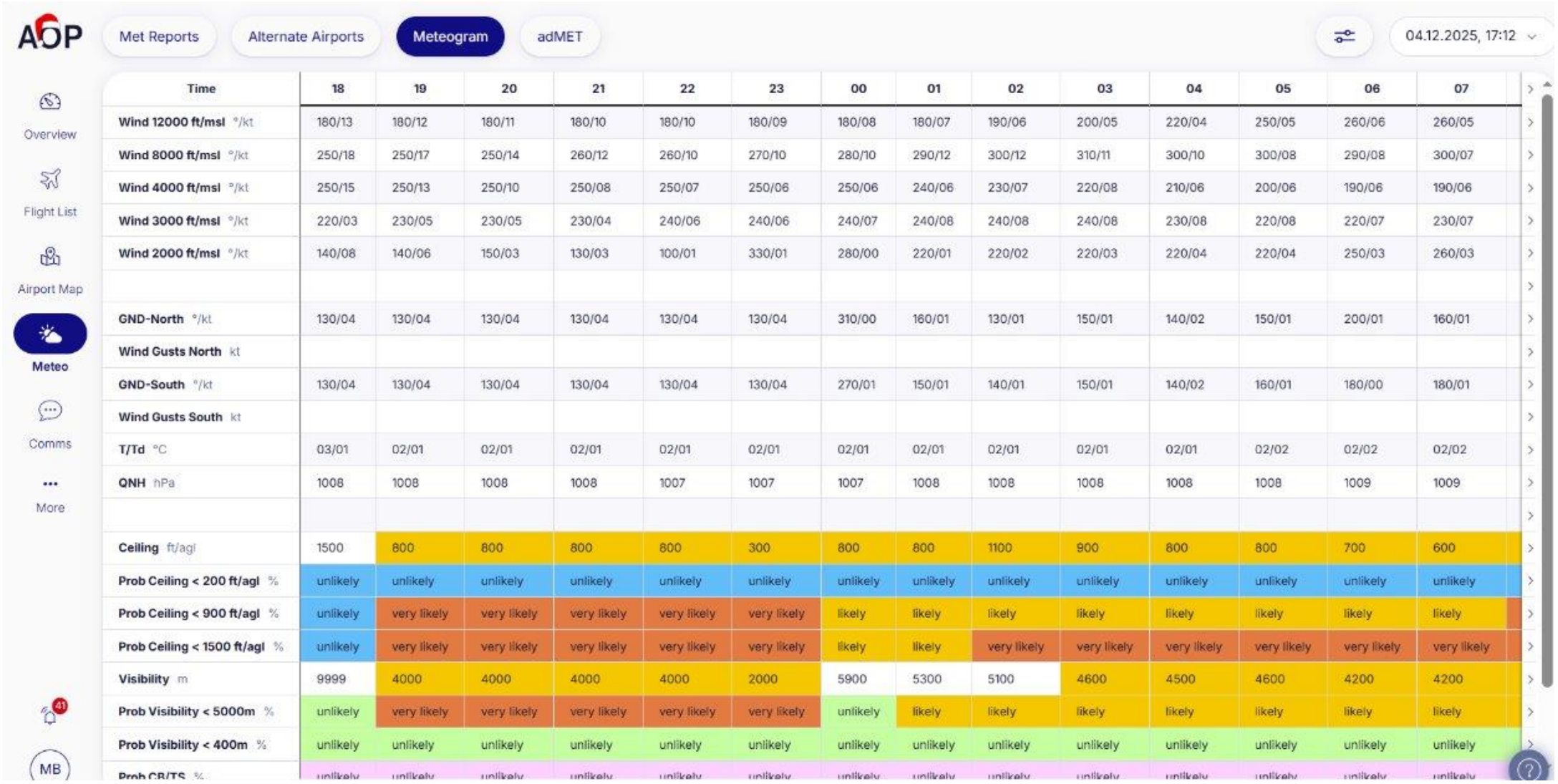
Real examples of MET data visualisations, and concepts of future products

Potential MET data visualisations

TIME (UTC)	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Wind DIR	160	150	140	130	120	120	110	060	010	360	010	010	010	020	030	040	040	050	130	200	210	230	230	240	230	240	240	230	230	240	240	230	230	220
Wind SPEED(kt)	5	7	7	7	8	7	5	4	7	12	13	13	14	15	13	9	7	4	1	5	5	7	8	10	12	13	15	14	13	13	14	13	13	12
Wind GUSTS(kt)	10	14	14	14	14	14	12	12	16	19	21	19	19	19	17	14	12	8	8	12	14	14	16	16	17	19	21	19	19	19	19	17	17	16
RWY04																																		
CrossWind(kt)	4	6	7	7	8	7	5	1	3	7	6	6	7	5	2	0	0	1	1	2	1	1	2	4	2	5	6	3	3	5	5	3	3	0
TailWind(kt)	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	7	8	9	12	12	14	14	13	12	13	13	13	12
500ft TailWind(kt)	3	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	12	10	15	20	14	13	13	13	14	9	7	7	7	6	4
1000ft TailWind(kt)	3	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	12	15	20	19	17	17	17	17	14	13	11	7	7	6	4
RWY22																																		
CrossWind(kt)	4	6	7	7	8	7	5	1	3	7	6	6	7	5	2	0	0	1	1	2	1	1	2	4	2	5	6	3	3	5	5	3	3	0
TailWind(kt)	0	0	0	0	1	1	2	4	6	9	11	11	12	14	13	9	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500ft TailWind(kt)	0	0	0	0	0	1	0	8	10	16	16	16	18	22	25	14	14	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000ft TailWind(kt)	0	0	0	0	0	1	4	7	15	16	24	22	29	29	30	21	15	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RWY15																																		
CrossWind(kt)	1	1	0	2	3	3	3	4	5	7	9	9	10	12	12	9	7	4	0	4	5	7	8	10	12	13	15	14	13	13	14	13	13	12
TailWind(kt)	0	0	0	0	0	0	0	0	5	10	9	9	10	8	5	2	2	0	0	0	0	0	0	1	0	1	2	0	0	1	1	0	0	0
500ft TailWind(kt)	0	0	0	0	0	0	0	0	6	16	16	16	14	17	10	0	0	0	0	0	0	0	0	2	4	4	4	2	1	4	4	4	6	2
1000ft TailWind(kt)	0	0	0	0	0	0	0	0	4	16	14	17	17	17	7	0	0	0	0	0	0	0	2	6	6	6	6	2	4	7	4	4	6	2
RWY33																																		
CrossWind(kt)	1	1	0	2	3	3	3	4	5	7	9	9	10	12	12	9	7	4	0	4	5	7	8	10	12	13	15	14	13	13	14	13	13	12
TailWind(kt)	5	7	7	7	7	6	4	0	0	0	0	0	0	0	0	0	0	0	1	3	2	0	1	0	1	0	0	1	1	0	0	1	1	3
500ft TailWind(kt)	4	10	10	10	5	5	0	3	0	0	0	0	0	0	0	2	2	1	10	12	4	1	1	0	0	0	0	0	0	0	0	0	0	0
1000ft TailWind(kt)	4	5	10	10	5	5	2	4	0	0	0	0	0	0	0	7	9	14	13	12	1	1	0	0	0	0	0	0	0	0	0	0	0	0

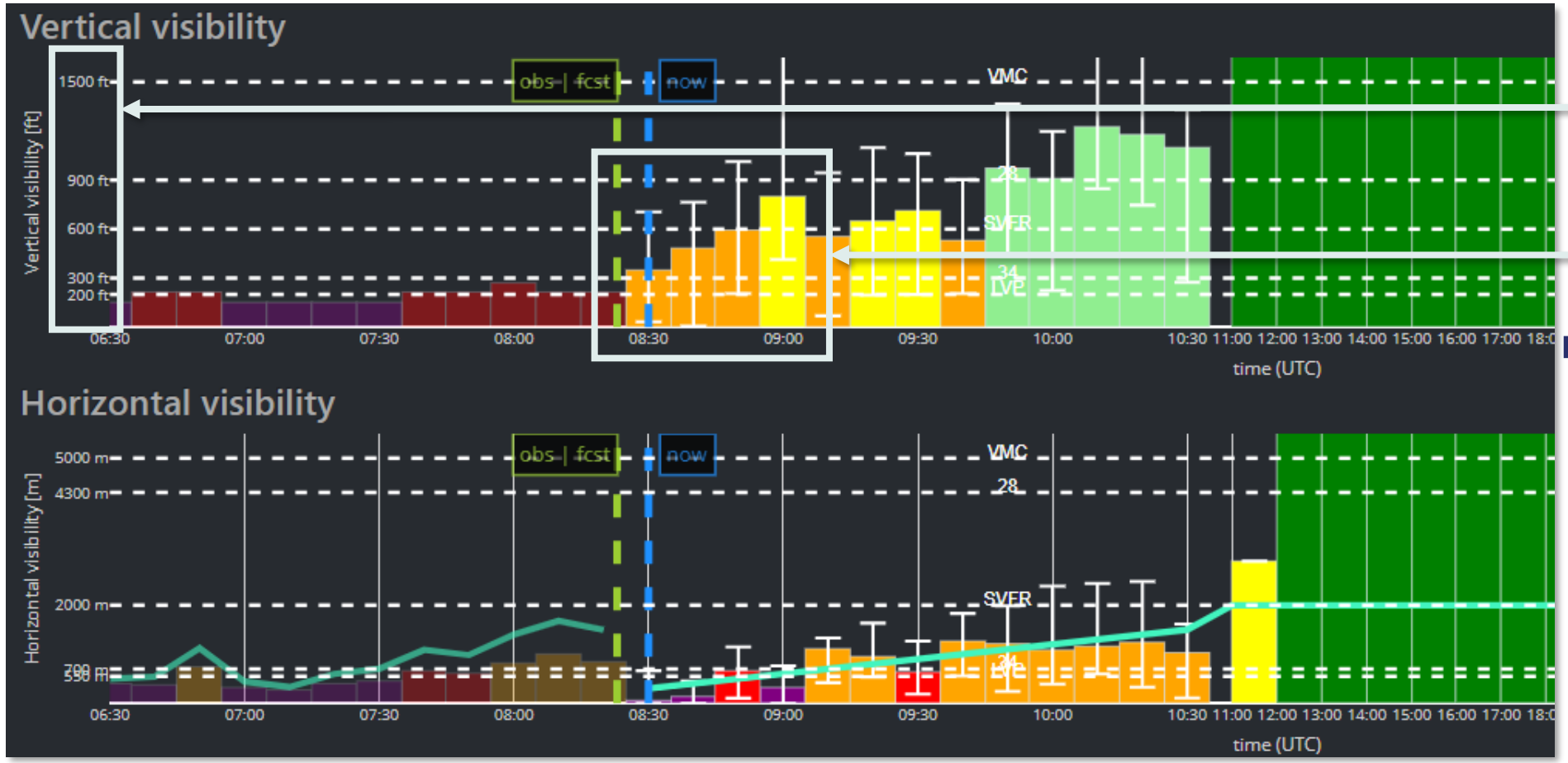
TIME (UTC)	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Temperature	19	20	19	18	17	16	15	15	13	12	11	11	12	12	12	13	13	13	13	13	13	13	12	12	13	14	16	17	17	18	18	19	19	18
Dew point	6	6	7	7	7	7	9	10	9	10	9	10	11	11	11	12	12	12	12	13	13	12	12	11	11	11	12	12	11	10	10	9	8	8
Snow (cm/h)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rain (mm/h)	0	0	0	0	0	0	0	0.1	0.9	1.1	0.7	2.7	4.0	4.9	6.4	1.8	0.3	0	0	0.1	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0
Visibility/Weather																	-DZ	-DZ	-DZ	-DZ	-DZ	-DZ	BR	BR											
TEMPO VIS/WX								-SHRA	-SHRA	-SHRA	SHRA	SHRA	SHRA	TSRA	TSRA	TSRA							-SHRA	-SHRA											
Cloud ceiling																																		
TEMPO Ceiling																																		
LVP-prob (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	20	20	30	30	20	10	0	0	0	0	0	0	0	0	0	0	0
CB-prob (%)	0	0	0	0	0	0	0	10	10	30	40	50	60	60	60	50	40	20	10	10	10	10	20	20	10	0	0	0	0	0	0	0	0	0
CB cloud base (ft)								5500	5500	5500	6000	6000	5500	5000	5000	5000	4500	4000	4000	3500	3000	3000	3000	3500	3500									
TS (probability %)	0	0	0	0	0	0	0	0	0	10	10	20	30	40	30	30	20	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inversion at low levels																																		

Potential MET data visualisations



Time	18	19	20	21	22	23	00	01	02	03	04	05	06	07
Wind 12000 ft/msl °/kt	180/13	180/12	180/11	180/10	180/10	180/09	180/08	180/07	190/06	200/05	220/04	250/05	260/06	260/05
Wind 8000 ft/msl °/kt	250/18	250/17	250/14	260/12	260/10	270/10	280/10	290/12	300/12	310/11	300/10	300/08	290/08	300/07
Wind 4000 ft/msl °/kt	250/15	250/13	250/10	250/08	250/07	250/06	250/06	240/06	230/07	220/08	210/06	200/06	190/06	190/06
Wind 3000 ft/msl °/kt	220/03	230/05	230/05	230/04	240/06	240/06	240/07	240/08	240/08	240/08	230/08	220/08	220/07	230/07
Wind 2000 ft/msl °/kt	140/08	140/06	150/03	130/03	100/01	330/01	280/00	220/01	220/02	220/03	220/04	220/04	250/03	260/03
GND-North °/kt	130/04	130/04	130/04	130/04	130/04	130/04	310/00	160/01	130/01	150/01	140/02	150/01	200/01	160/01
Wind Gusts North kt														
GND-South °/kt	130/04	130/04	130/04	130/04	130/04	130/04	270/01	150/01	140/01	150/01	140/02	160/01	180/00	180/01
Wind Gusts South kt														
T/Td °C	03/01	02/01	02/01	02/01	02/01	02/01	02/01	02/01	02/01	02/01	02/01	02/02	02/02	02/02
QNH hPa	1008	1008	1008	1008	1007	1007	1007	1008	1008	1008	1008	1008	1009	1009
Ceiling ft/agl	1500	800	800	800	800	300	800	800	1100	900	800	800	700	600
Prob Ceiling < 200 ft/agl %	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Prob Ceiling < 900 ft/agl %	unlikely	very likely	very likely	very likely	very likely	very likely	likely	likely	likely	likely	likely	likely	likely	likely
Prob Ceiling < 1500 ft/agl %	unlikely	very likely	very likely	very likely	very likely	very likely	likely	likely	very likely	very likely	very likely	very likely	very likely	very likely
Visibility m	9999	4000	4000	4000	4000	2000	5900	5300	5100	4600	4500	4600	4200	4200
Prob Visibility < 5000m %	unlikely	very likely	very likely	very likely	very likely	very likely	unlikely	likely	likely	likely	likely	likely	likely	likely
Prob Visibility < 400m %	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely
Prob CB/TS %	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely	unlikely

Potential MET data visualisations



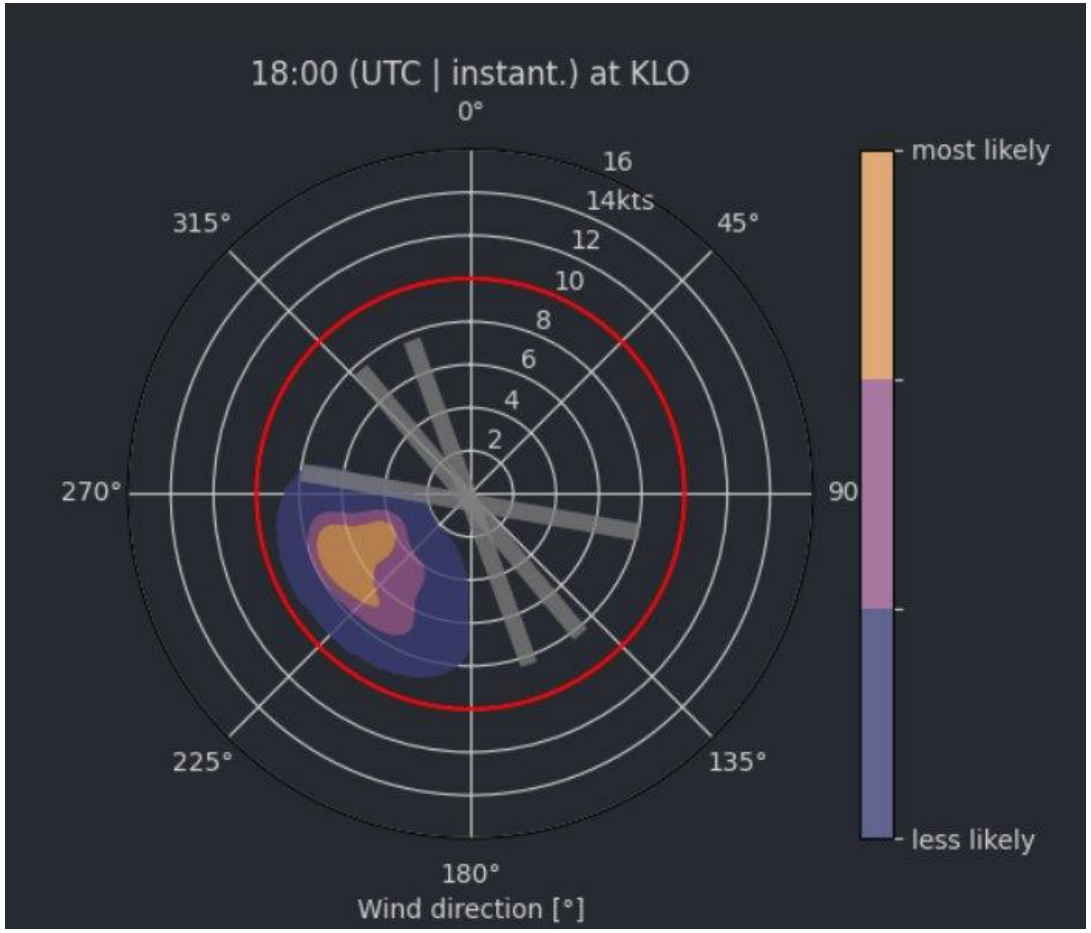
Vertical visibility procedure thresholds

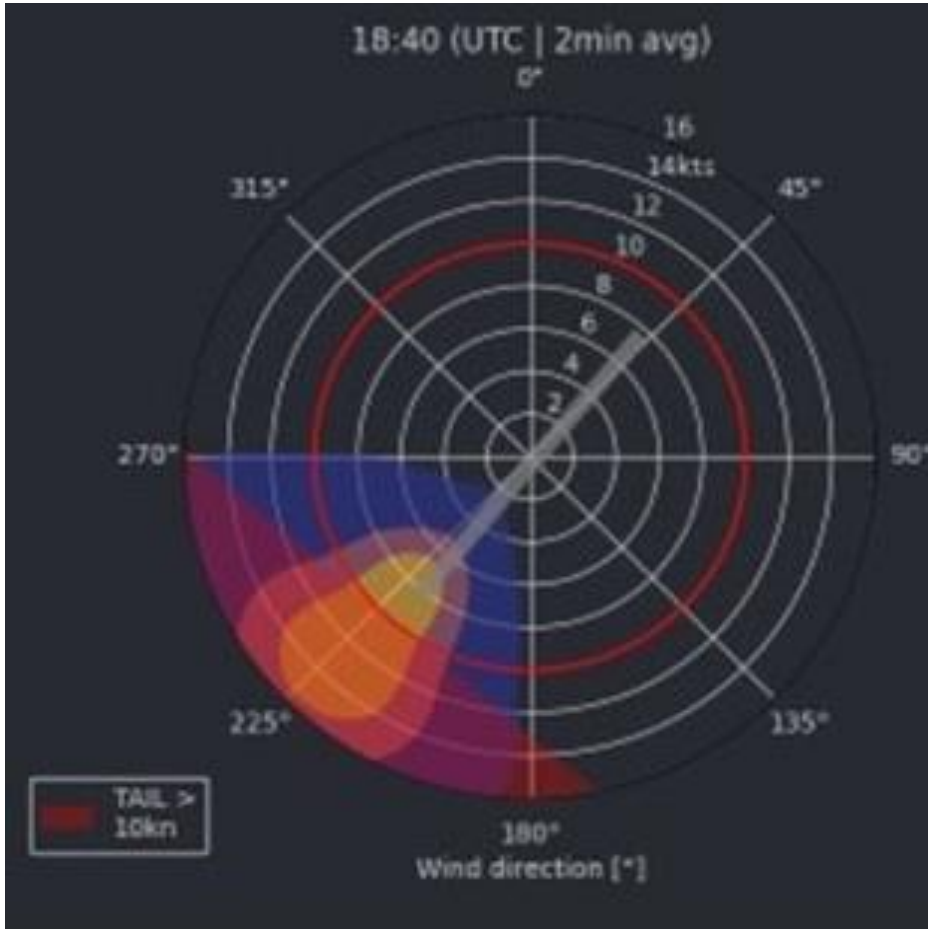
Visibility predictions + uncertainty bars

+30h

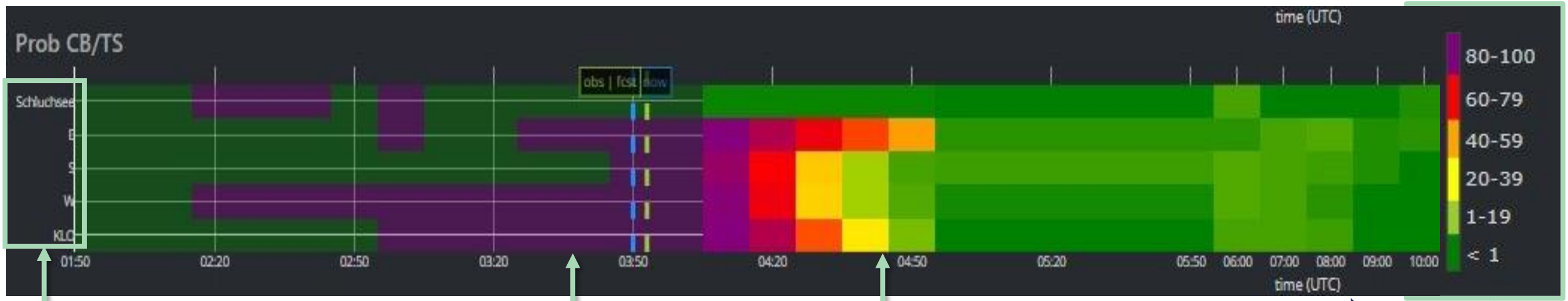
Possible conclusion:
From now on LVP can probably end, most certainly in 30min

Potential MET data visualisations





Potential MET data visualisations



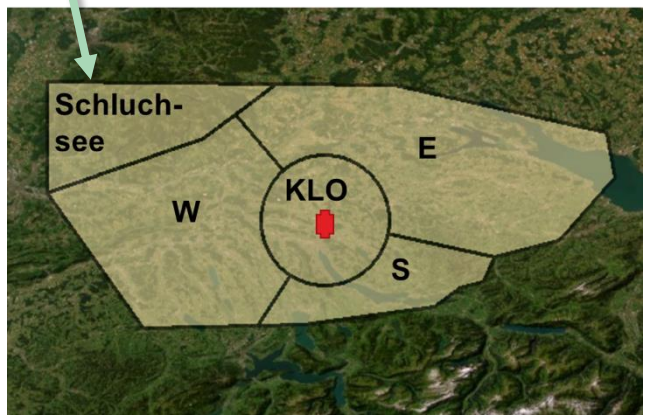
Sectors

Observed LTG (Prob = 0 or 1)

Forecast thunderstorm probability per sector

+30h

Thunderstorm probability



Possible conclusion:
Region Schluchsee available for holding until region “W“ can be used for approach (20-30min)

From concept to operations

Implementation considerations

Prerequisites to implementation



SWIM INFRASTRUCTURE



DIGITAL DATA SETS (IWXXM)



DIGITAL DATA VIEWERS (MODERN TECHNOLOGY, SOFTWARE / APPS)

Dependency on technology and IWXXM

AMOIS / AMFIS Implementation depends on

1. Modern technology
2. Connection to SWIM
3. Users with infrastructure capable of displaying / ingesting IWXXM datasets
4. MET providers with capability to produce high frequency, high-quality IWXXM datasets
5. Cyber security implications



Skills, Tasks and Roles - how will it be different?

- Human contributions to aviation weather data will evolve
  - AMOIS and AMFIS designed to include many automatically generated parameters, with the ability for human intervention and value adding (observer and meteorologist alike)
- The same IWXXM datasets can be shared amongst ANSPs / MET Service providers, and key users / stakeholders, giving common and comprehensive situational awareness
- AMOIS and AMFIS will have the option of providing more diverse aviation weather parameters datasets, at higher precision
- SWIM Information Services ensure data interoperable with digital systems, enabling vast customisation options

Communicating the concept

Information regarding AMOIS and AMFIS will be updated on the ICAO Public website for AMOIS / AMFIS.

For more information about where this fits in the global picture, please refer to

ICAO GANP Portal - ASBU Blocks

Guidelines for MET-SWIM Implementation

Work in Progress

- New AMOIS/AMFIS IWXXM schema
- Development of SARPs to include in Annex 3 and PANS MET
- Identifying consequential amendments
- AMOIS / AMFIS FAQs
- Guidance on AMOIS / AMFIS Implementation

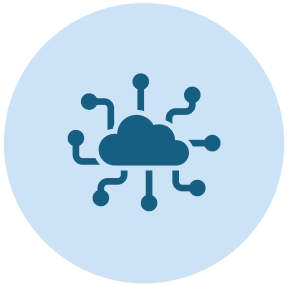
Key Takeaways



AMOIS and AMFIS a new strategy of providing aviation observations and forecasts



AMOIS and AMFIS datasets can be used to create weather visualisations specific to user needs or feed decision support tools



New digital datasets will be able to integrate into modern technology and tools



Stakeholders and users should stay informed through ICAO communications and the PIRGs for more information regarding AMOIS and AMFIS development

Further questions

More details can be found at:
https://www.icao.int/airnavigation/aeronautical-meteorological-service/EAeM

For questions, please reach out to amet@icao.int

