# DES HE STAND AI MET Applications

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### Abstract

This document presents a plan for collecting and analysis the standardisation needs of the KAIROS Solution 2 AI MET Applications. This document will cover a brief introduction of the technology and an overview of current industry standards relating to convective weather forecasts for aviation. The document will examine various aspects of the technology to be considered when determining the needs for standardisation. These characteristics include data quality, model development, performance metrics, interoperability to facilitate exchange of data with stakeholders, as well as well as security measures for ensuring the integrity of the data. Analysis of the standards needs for the KAIROS solutions will be performed in collaboration with national MET providers to ensure future compliance with authoritative agencies. This document will be updated regularly during the project execution.

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## Authoring & Approval

### Author(s) of the document

| Organisation name | Date |
|---|---|
| **APPLIED INNOVATIVE METHODS** | 12/08/2023 |
| **FINNISH METEOROLOGICAL INSTITUTE** | 01/09/2023 |

### Reviewed by

| Organisation name | Date |
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### Approved for submission to the SESAR 3 JU by[1]

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| CRIDA | 14/09/2023 |
| EUROCONTROL | 14/09/2023 |

[1] Representatives of all the beneficiaries involved in the project

| | |
|---|---|
| FMI | 14/09/2023 |
| IGA | 14/09/2023 |
| METEOMATICS | 14/09/2023 |
| METSAFE | 14/09/2023 |
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**Rejected by[2]**

| Organisation name | Date |
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| 00.02 | September 15th 2023 | | AI METHODS | Incorporate comments |
| | | | | |
| | | | | |

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[2] Representatives of the beneficiaries involved in the project

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# KAIROS

UNLOCKING THE POTENTIAL OF AI-BASED WEATHER FORECASTS FOR OPERATIONAL BENEFITS

# KAIROS

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# 1 Executive summary

This document is the standards deliverable for KAIROS Solution 2, AI MET Applications. This solution will extend the approach from KAIROS Solution 1 and use artificial intelligence to provide improved forecast capability for a variety of aviation hazards including turbulence, low visibility, high altitude ice crystals, $SO_2$ and dust. Forecast for these events will be provided in a variety of formats, i.e., TAF, in order to meet the needs of specific aviation stakeholders.

In this initial version of the standards deliverable, a plan of action is presented for the collection of the standardisation needs of the AI MET Applications technology. This plan will serve as a standards roadmap throughout the execution of the KAIROS project. This document will provide a brief overview of the proposed technology and the current industry standards relating to the creation of convective forecasts for aviation.

A comprehensive analysis will be performed to determine which existing standards can be applicable to the technology, which need to be amended, and suggest new standards that may need to be introduced.

The aim of this document is to perform a comprehensive analysis of the AI MET Applications technology and consider what characteristics must consider the need for standards. The document will examine aspects such as:

- Data quality

- Model development and validation

- Performance metrics

- Data interoperability/interface with end-users

- Security/Data integrity

The process of collecting the standardisation needs of the technology will be performed in collaboration the National Met providers, and other authoritative agencies to ensure a viable pathway for standardisation needed for technology transition.

Progress on the standard collection task will be presented in future versions of this document. The standards need for both KAIROS solutions will regularly be assessed during project meeting and technical assessments. The next version of this document is expected to be submitted in August 2024.

Comentado [JF1]: added i.e. TAF, to underline the need for Terminal area forecast data in this format for our tools

Comentado [JF2]: please check wording. reads strange. Could read "serves" or "will serve". Suggest to delete "be".

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# 2 Introduction

## 2.1 Purpose of the document

The purpose of this document is to identify standards that need to be considered for the implementation of an artificial intelligence-based weather prediction system for use by aviation. This document will take a comprehensive look at the standards needed to implement this technology into an operational setting. Intended readership of this document includes The European ATM Standards Coordination Group, and other aviation and weather stakeholders that may be interested in the technology and its implementation.

## 2.2 Background

The KAIROS project aims at transforming the way weather information is created and shared with aviation stakeholders. The project will leverage artificial intelligence technology to improve the quality of forecast. This technology will also help to automate the creation of forecasts and digitalize the dissemination of the information for end users. This document focuses on KAIROS Solution 2, AI MET Applications.

The AI MET Applications technology will train ML algorithms to predict several types of weather phenomena impacting aviation including turbulence, low visibility, high altitude ice crystals, $SO_2$, and dust. Algorithms will be trained with historical forecast and diverse types of weather observation data, including satellite observations, weather reports, and sensor data from aircraft and ground weather stations. Like solution 1, solution 2 will also ingest live weather data in an online learning architecture for continuous improvement of its weather forecasts.

It is anticipated that the AI MET Applications technology will touch on standards from several industries. From the perspective of weather and aviation, existing standards from the WMO and ICAO will be studied. The project will also investigate current standards dealing with AI as well as technical standards regarding the digital exchange of data. A literature review of the existing standards that can apply to the AI MET Applications technology is underway, findings regarding these standards will be added to this document in the next submission.

## 2.3 Structure of the document

The aim of this document is to provide a comprehensive view of the standards that must be considered to implement the AI MET Applications solution. This document will be organized into four sections.

Section 1 of the document is the Executive Summary, this section will provide a general overview of the document, highlighting the major advancements regarding the identification of standards needs since the previous submission.

Section 2 of the document will provide the introduction and background of the technology and current industry standards. A brief overview of the AI MET Applications technology is provided as well as the

current industry standards that are applicable. Section 2 will also contain a glossary of terms and list of acronyms utilized throughout the document.

Section 3 will provide the technical details the document. The section will first identify the several characteristics of the technology in which standardisation will need to be considered. Next, for each identified characteristic it will be determined which existing standards from those provide in Section 2, can meet the need and which may need to be amended. This section will also provide insights on any new standards that are needed to implement the technology. Any supporting technical details of the technology that are needed in considering the standards need will also be provided in this section.

Lastly, Section 4 of the document will provide a list of related documents referenced within the document.

## 2.4 Glossary of terms

| Term | Definition | Source of the definition |
|---|---|---|
| *AIR-REPORT* | *A report from an aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting.* | *ICAO Annex* |
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**Table 1: Glossary of terms**

## 2.5 List of acronyms

*To be completed.*

| Acronym | Definition |
|---|---|
| AI | Artificial Intelligence |
| ATM | Air Traffic Management |
| FTI&U | Fast Track Innovation and Uptake |
| ICAO | International Civil Aviation Organization |

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| | |
|---|---|
| ML | Machine Learning |
| SPR-INTEROP/OSED | Safety Performance Requirement and Interoperability Requirements/Operational Service Environment Description |
| REG | Regulatory deliverable |
| SESAR 3 JU | SESAR 3 Joint Undertaking |
| TS/IRS | Technical Specification/Interface Requirement Specification |
| WMO | World Meteorological Organization |

**Table 2: List of acronyms**

# 3 Standardisation needs capture

KAIROS Solution 2: AI MET Applications will create AI-based forecast for multiple aviation weather hazards. AI MET Application will use artificial intelligence to improve the forecast of turbulence, low visibility, high altitude ice crystals, $SO_2$ , and dust. The technology will develop forecast at various spatial and temporal resolutions and formats to meet the needs of multiple aviation end users.

When analysing the standardisation needs of the technology, it is important to consider how aviation forecast are created today. Aviation weather forecasts are created manually by meteorologist. Meteorologists apply their knowledge to interpret data from numerical weather prediction products. Based on their knowledge and experience, meteorologist will create forecast and weather advisories for phenomena impacting aviation. The proposed technology aims to help meteorologist and decision makers by automatically interpreting the numerical weather prediction data to create a prediction for a variety of weather phenomena.

 For standardisation purposes several aspects of the technology will be explored:

1. **Data quality**

The AI MET Applications technology relies on existing forecast data and observation data. This data is used as input data for training and evaluating the AI models. Standards mut be utilized to ensure the quality and source of the data and well as the quality of the output data. This aspect can benefit from existing standards relating to the forecast and observations that can be used for aviation. Current standards may need to be amended if new sources of data are introduced.

2. **Model development and validation**

Artificial intelligence is a novel technology that is finding its way into many industries. Standards needs relating to the creation and validation of the ML models must be examined. The aim of these standards would be to help provide transparency and explainability of the models.

3. **Performance metrics**

The use of performance metrics standards will be needed to show the benefits provided by the AI technology. These standards will help quantify the accuracy of the forecasts. This area of standardisation will pull from existing weather standards.

4. **Data interoperability/interface with end-users**

This aspect of the technology will deal with the format of data and how it is disseminated to the various end users. This aspect of the technology will adhere to current standards relating to data formats and sharing.

5. **Security/Data integrity**

This aspect of the technology will address security concerns for ensuring the integrity of the data and algorithms.

The five areas mentioned above will be used to help provide an initial comprehensive view of the standards needs for the AI MET Applications solution. Additional areas may be added to the list as needed during the execution of the project.

## 3.1  Need for new or amended standard(s)

The five technology aspects mentioned in the previous section will help identify the various needs for standards of the AI MET Applications solution. For each aspect, the existing standards will be identified, as well as suggestion for amendments and new standards. Regarding the changing of standards, it will be preferred to address the technology with existing standards as modifications to MET/ICAO standards can take multiple years.

### Data quality

**Applicable Existing Standards:**

TBD

**Suggested Amendments:**

TBD

**Existing Gaps:**

TBD

### Model development and validation

**Applicable existing Standards:**

TBD

**Suggested Amendments:**

TBD

**Existing Gaps:**

TBD

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## Performance metrics

**Applicable existing Standards:**

TBD

**Suggested Amendments:**

TBD

**Existing Gaps:**

TBD

## Data interoperability/interface with end-users

**Applicable existing Standards:**

TBD

**Suggested Amendments:**

TBD

**Existing Gaps:**

TBD

## Security/Data integrity

**Applicable existing Standards:**

TBD

**Suggested Amendments:**

TBD

**Existing Gaps:**

TBD

## 3.2 Objectives to be achieved

KAIROS Solution 2, AI MET Applications aims leverage artificial intelligence, and the developments under KAIROS Solution 1, to create forecasts for various aviation weather hazards. The technology will provide a improve weather predictions at various temporal and spatial resolutions to meet the specific need of aviation end users. The technology will also be able to have a live feed of forecast and observation data to create forecast, validate predictions and regularly update the algorithm. The technology must also provide the forecast in the adequate format and make it widely accessible to stakeholders.

**Comentado [JF3]:** This yellow text is a "place holder"(c&p) from the SOI1 document !?. It shall refer to SOL2 etc..

## 3.3 Expected benefits

Expected benefits from the technology are timely, precise, and digital weather forecasts. This improved weather information will allow aviation stakeholders such as ANSPs, airports and aircraft operator take better informed operation decisions.

**Comentado [JF4]:** Same comment as above .

## 3.4 Identification of amended or new standard(s)

Identification of current standards is still ongoing.

## 3.5 Technical development support

Technical activities will be performed within the KAIROS project will help support the identification of standards. Technical deliverables such as the VALP, VALR, and the TS/IR will cover aspects relating to the model development and validation, the identification performance metrics, as well as provide technical specification regarding the execution of the models, data formats of the outputs, and the design of architectures used for disseminating the forecasts with end users.

# 4 References

## 4.1 Applicable documents

SESAR solution pack

[1] …

Standard development office standard(s)

[2] See appendix A

ICAO documents

[3] ICAO Annex 3 Meteorological Service for International Air Navigation

Other documents

[4] 101114701 - KAIROS Grant Agreement, 26/05/2023

[5] SESAR 3 execution framework

## 4.2 Reference documents

TBD

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## Appendix A    Standard material development

This will be completed in future version of the document.

*For SESAR solutions under demonstration (i.e. either at TRL7 for FT&IU projects or at TRL8 for DSD projects), please provide a high-level summary of the draft standard material (TRL7) or the final standard material (TRL8).*

## Appendix B    Initiated change request to A - RDP

| # | Proposing organisation | RDP v15 line | Title | Type of change | Details of proposed change | | | | | | | | Rationale | EASCG decision |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Domain | Reference / Title | Organisation | Target date | WG / Committee | Status | SDM references | Comments | | |
| | *Select* | *Provide the line number* | *Provide the title as currently listed in the RDP* | *Select* | *Domain* | *Reference / Title* | *Organisation* | *Target date* | *WG / Committee* | *Status* | *SDM references* | *Comments* | *Please provide a rationale for the proposed change* | *Will be filled in during the discussion* |

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