# International AI Standards for Disaster Risk Management

Elena Xoplaki, CMCC Foundation
Euro-Mediterranean Center on Climate Change

# Activities thus far:

COMPONENTS OF AI PIPELINE

GUESS THE FEATURE

MODEL TRAINING

OPERATIONAL DEPLOYMENT

Next step: addressing challenges with standards

# COMPONENTS OF AN AI PIPELINE

## *Some challenges*

- It is important to understand each step and to put them in the correct sequence.
- Since each problem statement (and dataset) can have different requirements, additional (sub)steps can emerge.

(*adapted from* Vincenzi et al., 2024)

| Use case | Data preparation | AI modeling |
|---|---|---|
| What is the problem?<br>Why is AI needed?<br>What are benefits & risks? | Collecting data<br>Cleaning and labeling data | Dataset: Training data<br>Model design |

### 6.4 AI-system life cycle

An AI system life cycle encompasses the comprehensive series of stages involved in the creation, deployment, and maintenance of an AI-based system. This life cycle helps in structuring the development process to ensure effective, reliable, and ethical AI-based solutions. The life cycle typically includes several phases, each critical to the success of the AI-based system.

ETSI TR 104 119 V1.1.1 (2025-09)

**Best practices:**
Researchers and developers of artificial intelligence systems intended to be used for natural disaster management should carefully define the AI task and check the availability and quality of data that is planned to be used. Additionally, a vast amount of literature on different types of AI developments exists, and comparing similar studies can be helpful to obtain further knowledge. Finally, multi-effects of natural disasters should not be neglected but kept in mind.

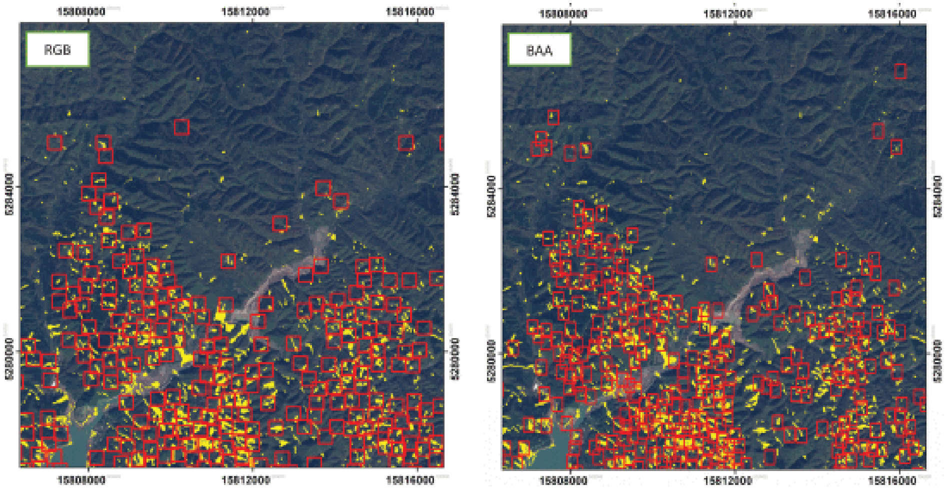
WG-Modeling Technical Report

# GUESS THE FEATURE

## *Some challenges*

- Units and unit systems impact interoperability. Data preparation is an important step in any AI pipeline.
- Subjectivity ("cultural bias") impacts the identification and labelling of features.

Landslide detection (Nava et al., 2021)




*"Data preparation is a fundamental process (...) examples include (...) units of the data (e.g., Km, m, mm) or the unit system (e.g., Imperial vs Metric)."*

WG-Modeling Technical Report

**Best practices:**

- Attempt to minimize the subjectivity in the class label definitions, by including a diverse group of experts that help reduce cultural biases.
- Provide different examples for the annotation task, given the annotators might have a different background of culture, social context, etc.
- Critically analyse assumptions on annotations. For instance, labelled data might not always be applicable as ground-truth as the meaning of class labels might change in the future.
- Decide the level of expertise required and accordingly, consider the background of annotators suitable for the task; consider test annotation exercises.

WG-Data Technical Report

# MODEL TRAINING

## *Some challenges*

- The problem statement should guide the selection of an appropriate model architecture and training method.
- Model evaluation should be task specific and include performance metrics, benchmarks, and human discrimination.

**Best practices:**
The evaluation of AI systems is application specific or task oriented and includes human discrimination, problem benchmarks, and peer confrontation. There is a wide range of metrics and methods reported in the literature such as confusion matrices, ROC curves, MSE, MAE, inlier ratio, Pearson Correlation Coefficient, PSNR, SSIM, and IoU. Additional quality aspects such as robustness, reliability, and explainability should be considered when assessing an AI system for deployment, in particular, for high-risk scenarios. Additionally, poor performance and vulnerabilities such as data poisoning should be considered when evaluating the reliability of a machine learning model. It is also a good practice to involve domain experts such as meteorologists, emergency responders, and other relevant stakeholders in the testing and evaluation of natural disaster management models to ensure they align with the needs of those who will be using the models in real-world situations and provide valuable insights that can inform response and recovery efforts. This can help to ensure that the models are accurate, reliable, and useful in real-world applications.

WG-Modeling Technical Report

**Comment**

https://doi.org/10.1038/s41561-025-01639-x

### Explainability can foster trust in artificial intelligence in geoscience

Jesper Sören Dramsch, Monique M. Kuglitsch, Miguel-Ángel Fernández-Torres, Andrea Toreti, Rustem Arif Albayrak, Lorenzo Nava, Saman Ghaffarian, Ximeng Cheng, Jackie Ma, Wojciech Samek, Rudy Venguswamy, Anirudh Koul, Raghavan Muthuregunathan & Arthur Hrast Essenfelder



Uptake of explainable artificial intelligence (XAI) methods in geoscience is currently limited. We argue that such methods that reveal the decision processes of AI models can foster trust in their results and facilitate the broader adoption of AI.

determine the importance of climatic variables such as precipitation for meteorological drought prediction[14]. In the latter example, the results aligned with physical model interpretations, emphasizing the need to include specific climatic variables as predictors in the model. Figure 1 demonstrates the possible benefits of XAI across different dimensions, using natural hazards as an example domain.

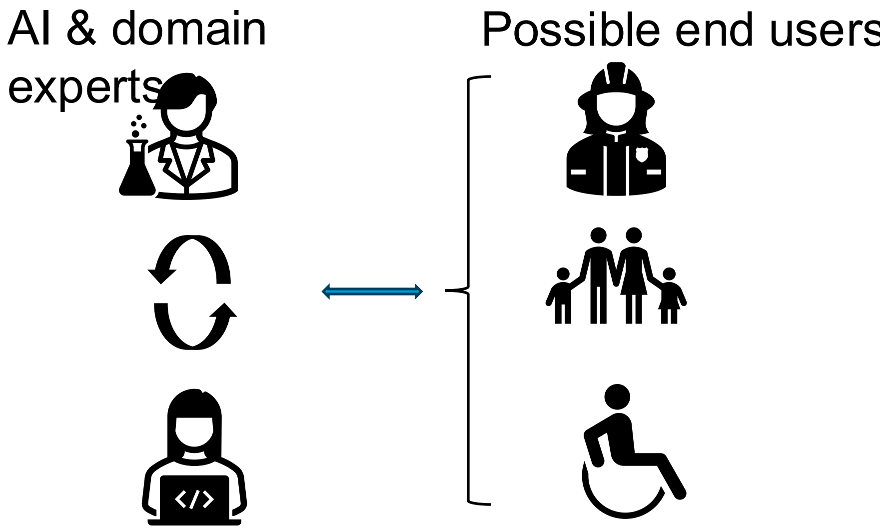
**Uptake of XAI in geoscience**

Given these benefits, we were curious to see how the geoscience community is applying XAI. To acquire an overview, we extracted

# OPERATIONAL DEPLOYMENT

## *Some challenges*

- Trust in AI-based systems depends on many factors; these can include the “stakes,” the performance, and the interpretability.
- To ensure that an AI-based systems meets end-user needs, diverse and interdisciplinary teams are encouraged.




**Best practice(s):** For those using AI in communication systems for NDM, it is also suggested to: **Cultivate diverse, interdisciplinary and local teams.** AI-based algorithms are often developed by geoscience or ML experts in an academic setting, where development is not always tied to the inclusion of end user needs. Also, data scientists and machine learning practitioners may not have the necessary background or expertise to fully evaluate potential risks, while DRR practitioners are not necessarily experts on AI / ML.

WG-Comms Technical Report


nature COMMUNICATIONS

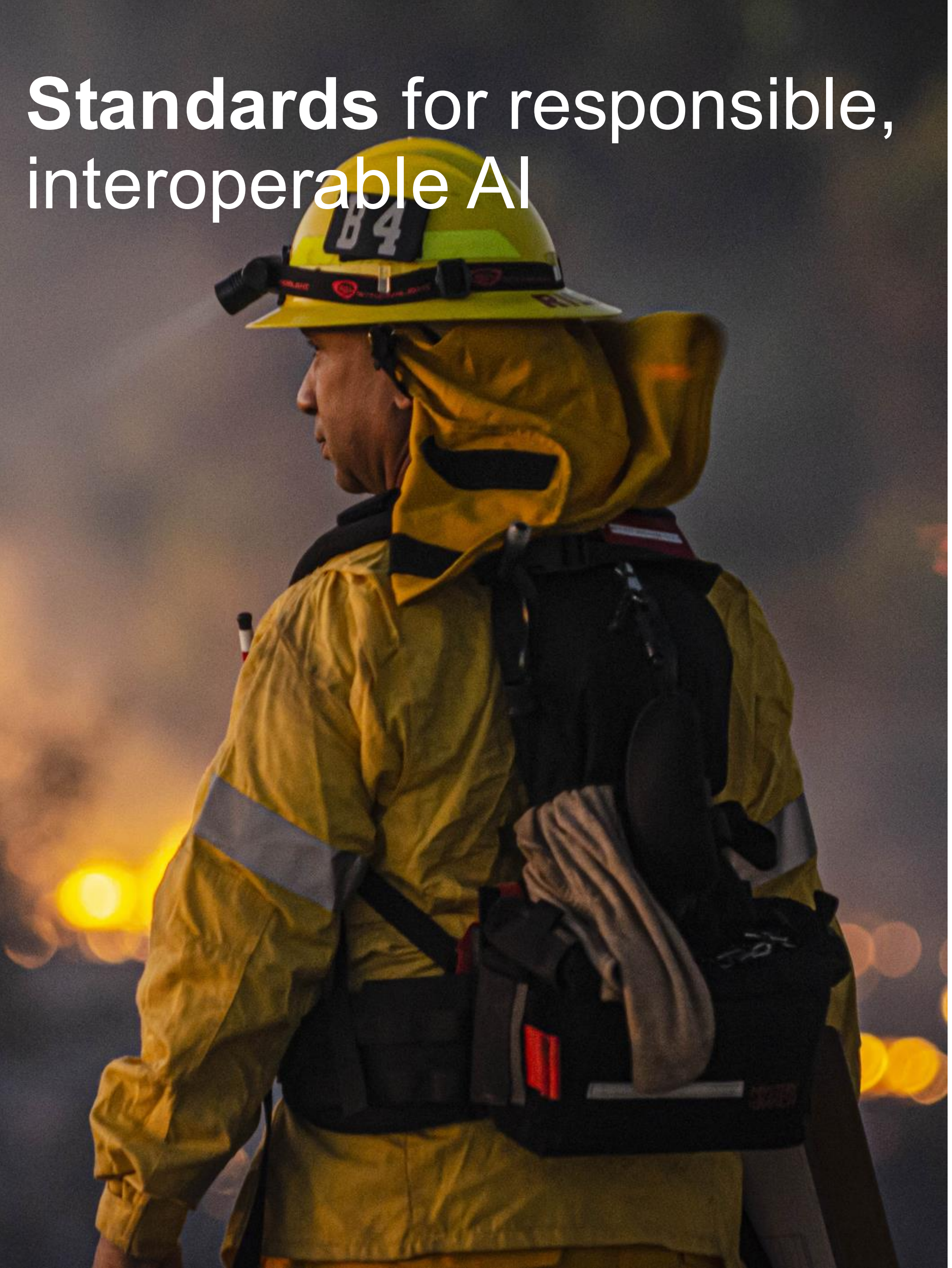
COMMENT

https://doi.org/10.1038/s41467-022-29285-6 OPEN

Facilitating adoption of AI in natural disaster management through collaboration

Monique M. Kuglitsch[1], Ivanka Pelivan[1], Serena Ceola[2], Mythili Menon[3] & Elena Xoplaki[4]

# **Standards** for responsible, interoperable AI



**nature**

Explore content ⌄ About the journal ⌄ Publish with us ⌄ Subscribe

nature > comment > article

COMMENT | 01 October 2024

## AI to the rescue: how to enhance disaster early warnings with tech tools

**Artificial intelligence can help to reduce the impacts of natural hazards, but robust international standards are needed to ensure best practice.**

*"AI tools created in the absence of international standards could have a variety of problems, including (…) not being compatible or interoperable with each other. Because disasters can move across borders, this is a lost opportunity for continuous early-warning coverage."*

# From regional to international scale

Funded by the European Union

ARTEMis
AleRT and impact-forecast standards for Emergency Management

MedEWSa

**Assess**: In-depth, pan-European assessment of the existing landscape in emergency management

Assessing existing systems, collaboration capabilities, compliance with standards, interoperability isses.

**Advance & Integrate**: Advance existing procedures and tools and enable cross-border knowledge transfer towards integration

- Methods to deploy links between authorities
- Enabling cross—border and cross- sectoral collaborations
- Advancing EO capabilities & meterological inputs
- Pathway to integrated EMS

**Harmonize**: Common technical standards, homogeneous methodologies and protocols

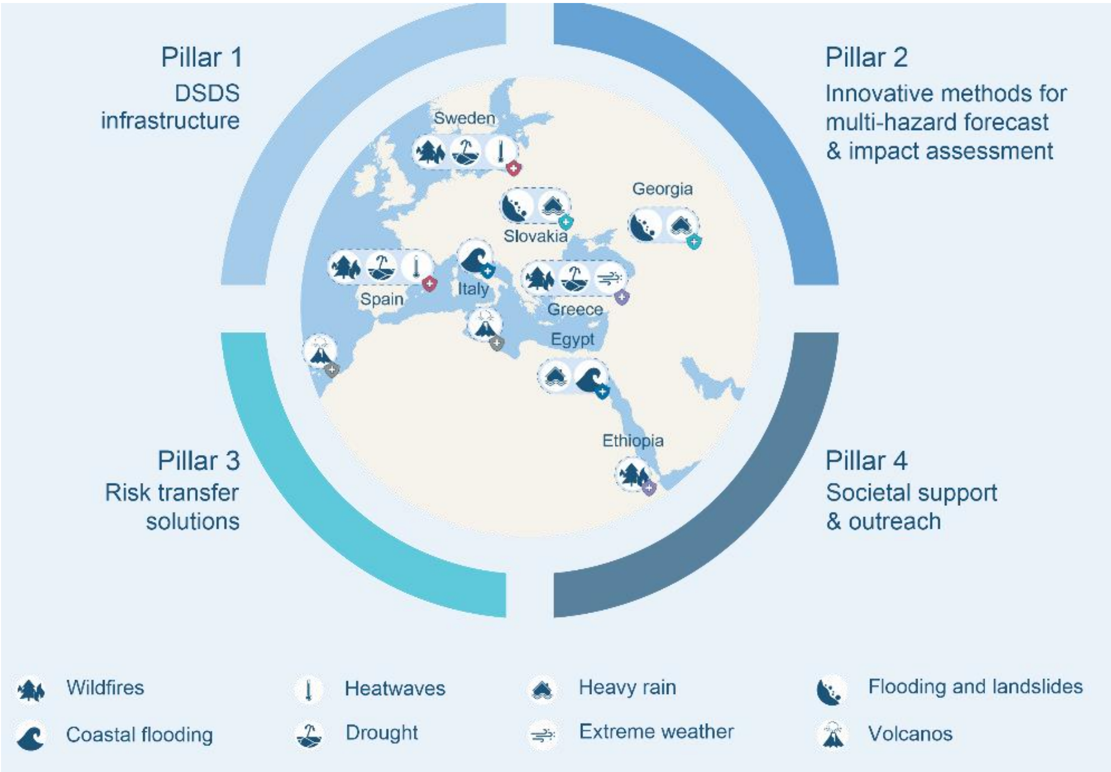
- Common technical standards
- Harmonized procedures and protocols for alert and impact forecasting

**Optimise collaborative risk assessments**: AI-fueled early identification & visualization of risks

- Advanced real-time risk prediction
- Risk and vulnerability analyses and visualisation

**Awareness and Capacity building**: Identify knowledge gaps, train and inform

**Validate**: Thorough cross-border and cross-sectoral validations and impact assessments in multiple hazards



ITUPublications International Telecommunication Union Standardization Sector

ITU-T Focus Group Technical Report

(11/2023)

Focus Group on Artificial Intelligence for Natural Disaster Management

**Innovative approaches to natural disaster management: Leveraging AI for data-related processes**

ITUPublications International Telecommunication Union Standardization Sector

ITU-T Focus Group Technical Report

(03/2024)

Focus Group on Artificial Intelligence for Natural Disaster Management

**FG-AI4NDM WG-Modeling**

**Technical Report on Transformative AI Models for Natural Disaster Management**

ITUPublications International Telecommunication Union Standardization Sector

ITU-T Focus Group Deliverable

(02/2023)

Focus Group on Artificial Intelligence for Natural Disaster Management

(FG-AI4NDM)

**FG-AI4NDM-COM**

**AI for communications: Towards natural disaster management**

ITUPublications International Telecommunication Union Standardization Sector

ITU-T Focus Group Report

(12/2022)

ITU/WMO/UNEP Focus Group on Artificial Intelligence for Natural Disaster Management

(FG-AI4NDM)

**FG-AI4NDM Roadmap**

**Standardization Roadmap on Natural Disaster Management: Trends and Gaps in Standardization**

ITUPublications International Telecommunication Union Standardization Sector

ITU-T Focus Group Deliverable

(10/2022)

Focus Group on Artificial Intelligence for Natural Disaster Management

(FG-AI4NDM)

**FG-AI4NDM WS-GLOS**

**Glossary – Artificial Intelligence for Natural Disaster Management**

# Access our documents and get involved!