



Artificial Intelligence applied to disasters and crises management

Exploring the application of Large Language Models and other AI techniques to the European Crisis Management Laboratory analyses

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Abstract

The European Crisis Management Laboratory (ECML) does research and development in support of EU crisis preparedness and response policy. It fosters the use of science in situational awareness, adding value to the routine context analysis and operational activities of the EU's Emergency Response Coordination Centre (ERCC) and the EU's External Action Service (EEAS), and their information products. At the same time, the analyses of the ECML are meant to learn from real emergencies to enhance the EU's situational awareness capabilities by incorporating emerging dynamics and trends via anticipatory analyses.

The ECML performs scientific analyses of natural and man-made disasters, conflicts and complex crises at the global level via a daily monitoring by subject matter experts. The objective is to have salient situational awareness based on open sources and scientific models delivered timely and in the right format to operational analysts. Required reaction times can be minutes, when the impact assessment is performed via automatic systems like GDACS, the Global Disaster Alert and Coordination System, up to a few weeks for more in-depth analyses. The European Crisis Management Laboratory analyses are provided in the form of (web) systems and services, scientific reports and maps, publicly distributed or for the exclusive use of the European policy Directorates Generals and External Action Service, depending on their sensitivity.

The use of Large Language Models (LLM) represents an important opportunity for sense-making in a context of large amounts of open-source information and the time-constrained environment of crisis management. In this study, we examined the use of LLMs to enhance the efficiency and effectiveness of the open source-based scientific analyses performed by the ECML. Specific emphasis was put on Retrieval Augmented Generation (RAG) techniques to collect information from selected, corporate databases with trusted information, including some developed at the JRC. It provides analysts with texts drafted from a collection of selected, trusted sources of information that best fit the scope of the application. This report evaluates the merits of this approach, including the reliability of the AI-extracted information and the benefits for further training the AI engine.

Finally, the opportunities and limitations for rolling out such technology in operational environments are discussed.

1 Introduction

The ECML is active in different collaborations to support the following policies:

- Union Civil Protection Mechanism with DG ECHO (European Civil Protection and Humanitarian Aid Operations)
- Peace and Stability with EEAS/FPI (European External Action Service - Foreign Policy Instruments)
- European Health Union with DG HERA (Health Emergency Preparedness and Response)

All these collaborations involve the analysis of flows of information from different sources, that require the attention of the analyst to sift every day many news articles, web pages, or similar documents to find information about ongoing or imminent events that are relevant to ECML partners.

This study does not just illustrate the benefits of adopting Artificial Intelligence techniques to help analysts cope with this amount of information: it also illustrates how different approaches can be integrated in tools used daily and ease the adoption of AI by teams of users. The aim is in fact to speed up the collection of information, to increase the number of sources that can be explored and, in the end, to make the intelligence collection more effective.

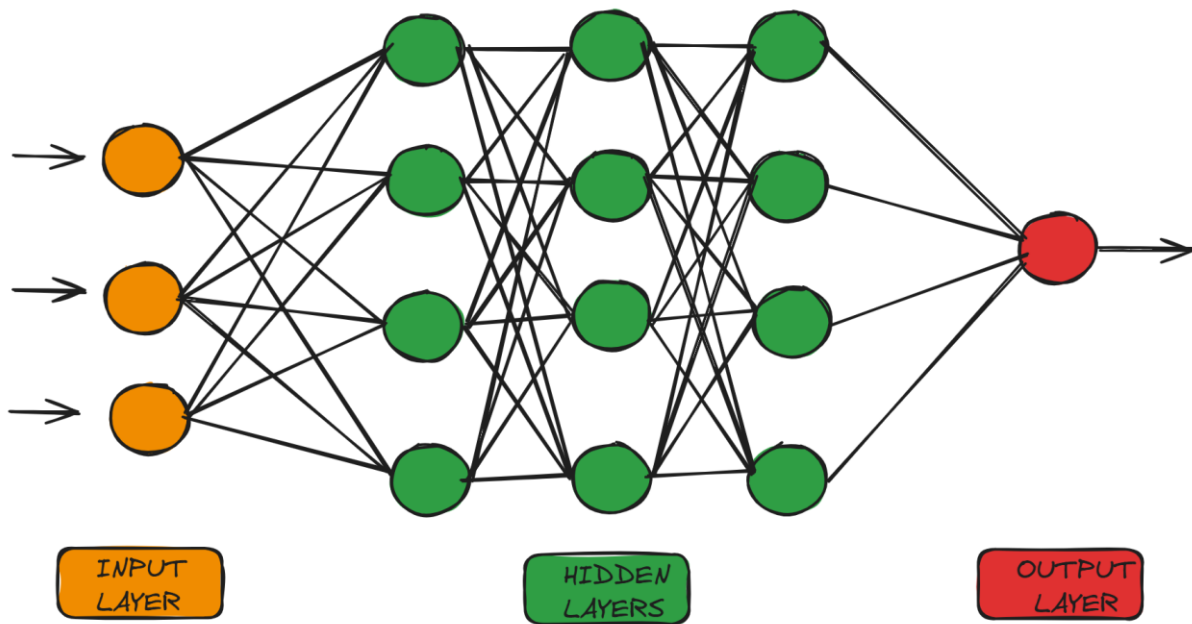
The document will therefore introduce the reader the technology and the techniques used to implement the use cases, that are described in detail in the next chapter. A mostly qualitative evaluation will then be reported before describing the possible evolution of the proposed implementations. The Conclusions chapter summarizes the findings.

1.1 Large Language Models: a category of Artificial intelligence techniques

Artificial Intelligence is a class of algorithms and processes aimed at replicating the way natural brains elaborate information. One of these behaviours is the basis for Machine Learning (ML). Usually, computers are programmed with static algorithms developed by programmers to solve specific problems. Contrarily, ML is a technique that uses generic software that can learn a task: the software offers many examples of input with the expected output, to create a statistical model able to produce the correct output for new input cases never experienced before. The set of original examples is called a training dataset.

One of this type of software are the Neural Networks. The experience of the training input is stored in the connection between nodes, in a way that resembles the neural connections of a brain.

Figure 1 A neural network



Language Models are an application of this technique using millions of nodes: they allow learning associations between patterns of text, either highly formalized, such as source code of programming languages, or more ambiguous, such as human languages, even when spoken freely or using jargon.

Large Language Models also include a quantity of knowledge by adding to their training sets carefully selected sources from the Internet. It can include also context specific texts like in the case of GitHub public projects to train models to support the programmers. Small Language Models are only trained to understand languages, usually only one with no translation capabilities and without additional information or knowledge: their training sets are not aimed at providing information that are not related to the basic understanding of a natural language, while LLMs are trained also to acquire knowledge by ingesting knowledge bases.

A Language Model is trained to create in output a text that is related to its input, based on the similarities with the associations found in the training dataset: the model recognizes patterns in the input and finds the most appropriate pattern for the output. The patterns are just the text structures, where the specific information can vary based on the context. The model recognizes the pattern in the input text, separates the context (the specific information) and applies the context to the most appropriate output pattern, making it specific to the input text. The simplest application is to determine the most appropriate next word to complete a sentence; but feeding it back to the model will require an additional word to complete the sequence. This process will complete the initial text with a new, generated text, that is limited only by the memory assigned to the model.¹

The input text is called *prompt*, and the output text *completion*.

For instance, a question is a prompt, and its answer is the completion. A truncated sentence can be a prompt and its remainder the completion. But there are cases that are more complex, like prompting with an algorithm to get the implementing source code as completion, or vice versa. A common use of this technology is the summarization of texts, where the prompt includes the original text and the request to summarize it, and the completion will be a summary of the given text.

A Language Model extracts patterns from its training set, including the memorization of specific information, such as the president of a country. Still, this knowledge includes only what was present in the training dataset.

¹ <https://medium.com/data-science-at-microsoft/how-large-language-models-work-91c362f5b78f>

Once the training is completed, a model has a limited capacity to increase its knowledge, and it can lead to hallucinations: the model will present an answer that is factually incorrect, but will be confident in doing so, sometimes even doubling down when you point out that what they're saying is wrong.

Retrieval-augmented generation (RAG) [...] when applied to LLMs, [...] can help to reduce the occurrence of hallucinations, as well as offer some other additional benefits (Barron, 2024). RAG is a natural language processing (NLP) technique that combines information retrieval and text generation to improve the quality and relevance of the generated text. In RAG, a retrieval model is used to extract relevant information from a large *corpus* of text or knowledge base, and this information is then incorporated into the text generation process to produce more accurate and contextually relevant outputs. This technique allows companies and institutions to ground the Language Model answers on their knowledge base, thus reducing the risk of hallucinations.

This report does not aim at providing an overview of the existing models and the related market offerings.

The JRC is actively researching LLM technologies, and one leading project is GPT@JRC². The GPT@JRC pilot project is an output of the GENESIS scientific project of JRC (Generative AI Scientific Research and Innovation Support). GPT@JRC has the objective to support applied research on the application of Generative AI technology in JRC and evaluate the risks and limitations of this technology.

GPT@JRC aims to provide JRC scientific and non-scientific staff the means to explore securely the application of Generative AI technology (in particular AI pre-trained Large Language Models) to their daily work. It is part of a JRC-wide study on the potential applications of this new technology within the European Commission.

GPT@JRC is also an enabler for JRC research “on AI” (Trustworthy AI portfolio) and “with AI” involving Large Language Models. This includes the evaluation and benchmarking of AI models, the study of their limitations and risks, performing research on Natural Language Processing and more broadly evaluating their potential application in other scientific domains.

GPT@JRC is hosted locally at the JRC datacentre. It supports both open and open-source AI models running locally at JRC, as well as commercial models running in the European Cloud under a Commission contract³.

1.2 Human interaction with AI

Users interact with AI daily without noticing it: several applications of AI technology in fact power applications of all kinds, including search engines and digital marketplaces. They learn from the users' activities to improve the users' experience by providing contents that are more and more closely related to the users' interests: when operating for one user, all information gathered about it are used to create a context with which the AI can create contents that fit best the user's habits.

When this happens just observing the user's activities without any closer interaction, this approach is called *autopilot*, since it operates on its own without any active contribution by the user, but for generic preferences. It can anyway bring to the user the results of its work in a *proactive* manner, like sending an email with shopping hints or news digests.

More sophisticated techniques like LLM, that allow an *interactive* use based on natural languages, offer a more advanced approach called *co-pilot*, when the user can converse with the AI and refine the content it creates. This dialogue, or chat, does not require a specific user interface, but can easily be integrated in other software, that users already know and are familiar with.

1.3 The research topic

This report aims to describe the various experimental applications of AI in the European Crisis Management Laboratory (Lab) to support scientific and/or operational analysis of crises and disasters. This study is anyway

² <https://gpt.jrc.ec.europa.eu/about>

³ <https://gpt.jrc.ec.europa.eu/info>

open to a wider scope and audience, considered that information monitoring and summarization are relevant activities at all levels of crisis management, regional, national and international.

The challenges of information management in situational awareness have changed in the last few decades. In the past the main problem was retrieving reliable information regarding a crisis situation, now analysts are challenged by too much information (De Groeve, 2020), and best practices are not sufficient to cope with it (Knowledge management practices in disaster management: Systematic review, 2020). Analysts must sift through it, to identify what is relevant and which questions still need to be addressed. In this report we specifically look at approaches to help analysts handle the flow of information with proactive and interactive approaches, relying on information already available in JRC and the Commission large databases.

The study was conducted with in-house scientific analysts. While their tasks are not identical to operational analysts in Commission crisis rooms, they are sufficiently similar to test various approaches. The study was conducted in a period of 18 months, from January 2023 to July 2024. In this period, the following use cases were considered:

- monitoring open-source information from selected, trusted sources,
- drafting a daily bulletin on ongoing or upcoming disasters, which are published as “ECHO Daily Flash” in the Emergency Response Coordination Centre (ERCC) portal,
- enriching the rapid impact assessments pages of the GDACS (Global Disaster Alert and Coordination System) portal, specifically about tropical cyclones and volcanic hazards.
- data mining and categorization of information for the analyses of ongoing conflicts globally in support of the External Action Service, that includes validated open-source information as well.

The report describes the AI methodology implemented, including the technical details, the use cases experimented with, and the results. In that section the advantages and limitations of these approaches and future outlooks will also be described.

1.4 The research context

The JRC implemented and maintains several information systems aggregating and producing information. The study aims at leveraging this huge amount of data through the adoption of AI techniques. The prototypes described are also an in-house JRC development effort.

1.4.1 Data sources

In the experimentation the following sites were involved either directly or indirectly:

- GSS, Global Situation System, a still unreleased project of an aggregator of information coming from authoritative sources, such as GDACS, ERCC Portal, or similar. It pushes the new information into the AI based analysis process. It is still in development, and for internal use only.
- GDACS⁴, Global Disaster Alert and Coordination System, a collector of natural events that assesses their humanitarian impact. It is open to public use. Its information is collected through GSS and accessed directly.
- ERCC Portal⁵, the official website of ERCC, Emergency Response and Coordination Centre, publishes daily information on ongoing situation that are humanitarily relevant and is partially open to public use. It is directly involved in the experimentation and is also one of GSS sources.
- ⁶EIOS, Epidemic Intelligence from Open Sources system – based on an initiative of the World Health Organization (WHO) and funded by DG HERA – is used by a wide number of public health institutions and network globally, including the ECDC, the Global Health Security Initiative, and several EU member states. It supports intelligence gathering (i.e. triage of information, early identification and verification

⁴ <https://gdacs.org/>

⁵ <https://erccportal.jrc.ec.europa.eu/>

⁶ <https://portal.who.int/eios/>

of signals, data analytics) from selected publicly available sources in multiple languages, including media as well as official bulletins from national and local authorities, covering all hazards and according to a one health approach. The information is harvested and enriched with automatic categorization based on potential threats and other topics of interest for crisis management, as well as with additional metadata such as mentioned locations and entities. Eventually, the system makes customisable flows of information available for monitoring and analysis through a portal (Spagnolo, 2020) and related web APIs. The latter are used to feed the daily analysis of news. The system is open to registered users only.

- EMM⁷, European Media Monitor, uses text mining and analysis tools to extract information from online data, including traditional or social media, or from other large publicly available document sets. It is open to public use. EIOS relies on its technology to fetch the information from the Internet and get automatic classification and other extracted metadata. Since 2006, EMM data is also displayed in GDACS to provide additional timely information in the aftermath of a disaster.

1.4.2 Software development

To speed up the development and reach quickly the prototypal stage, the supporting software leveraged the Azure PaaS (Platform as a Service).

To feed the knowledge base a set of Azure Functions (2023) was developed, activated by different means:

- The GSS system notifies new events (classified as red and orange, or reevaluated as such) pushing them on a queue, that an Azure function monitors: as soon as a new event is notified, the function receives it and processes the related URL
- Every time EEAS releases a set of URLs of interest (Daily Headlines), it is sent to an email distribution list. A MS Teams channel email address is also in the distribution list. A Power App monitors the channel and posts any new message to an Azure Function processing http calls. If the message contains a set of Daily Headlines, each URL is extracted and processed
- Every 5 minutes a time activated Azure function poll the EIOS system for new articles, that it processes starting from the original content
- Every morning, about an hour before analysts start their activities, a set of time activated Azure function starts to collect and digest useful information. One of these collects the analysis performed in the previous 24 hours and send them to the analysts through dedicated MS Teams channels
- Another http-oriented Azure function is used to receive images and perform the related processing

Azure functions proved to be a good solution, because:

- They require to program just the business logic without worrying about the infrastructure to run the code
- They are billed for the execution time only, making it one of the most cost-effective solutions
- They can be in many different languages, thus helping to leverage the legacy solutions already in use

To allow the users interacting with the AI, an MS Teams bot (2024) was developed.

An MS Teams bot can interact with the users through a chat. To do so it must be registered in the Teams system and given an URL to which the messages will be sent together with the references to answer them.

To perform as the bot backend, a web application was used instead of Azure functions, but still deployed in Azure to ease MS Teams reaching it. While it is possible to use Azure functions for this task, they are slow in startup and the resulting interaction is not user-friendly.

The data categorization use case, being it a part of the ERCC Portal, was developed as a .Net library.

⁷ <https://emm.newsbrief.eu/>

Soon the Azure based software will be revamped using Semantic Kernels (2024). Published in 2024, this technology simplifies the integration of AI models. Additionally, it allows more sophisticated RAG techniques that include plug-ins, a way to allow the models integrate external resources of heterogeneous nature in the RAG processes.

For this reason, the source code is presently not distributed as open-source.

2 Methodology for the use cases

This study used an OpenAI⁸ implementation of a Large Language Model (LLM) called Generative Pre-trained Transformers (GPT). GPT is a program able to write like humans. The GPT models for this research are hosted in Microsoft Azure cloud (Azure). The research uses the summarisation and semantic search capabilities of the LLM to extract and categorise information from the selected sources (news providers, webpages, images), as indicated by the team of analysts. The choice was out of availability only: the service was the easiest to access for the researcher, still providing all the required functionality.

The LLM used is Microsoft Azure hosted GPT-3.5-turbo model. This model is versatile and fast enough without requiring GPT-4, which was still in the tuning phase when the experimentation started. GPT-3.5 was used to summarise and extract text from a large quantity of information. When required, the model translated the content into English. GPT-4 has been used in a second time for one use case only.

The JRC, with the project GPT@JRC, provides models from OpenAI and other providers. There are limitations, though, that were not compatible with the research, at least when it started. For instance, to provide the analysts with additional information, the model was fed with data sources to perform a Retrieval Augmented Generation (RAG). This functionality was not provided by the GPT@JRC project until recently; therefore, GPT@JRC was not involved in the experimentation.

The knowledge base for the LLM used in the study is provided by in-house systems. The data is extracted by the European Media Monitor (EMM) engine (2023) for the scraping activity from a list of sources (e.g. news articles, web pages) that are collected and filtered by the Epidemiological Intelligence from Open Source (EIOS) system (EIO). Images collected by the analysts are also processed. The LLM extracts the most relevant information from the sources and stores the results in a new data source that is used later for context and background. This means that the knowledge base will bootstrap itself: in time, the analyst will benefit of information previously stored to understand better the situation in the involved countries.

The retrieval model helps to identify and save relevant information from a vast amount of data, which is then used as a knowledge base for generating coherent and informative text. This approach can be particularly useful in tasks such as question answering, summarisation, and content generation, where the inclusion of relevant external knowledge can significantly enhance the quality and depth of the generated text.

Presently, the indexing process is based on Lucene⁹. All information stored by the analysis process is scanned using AI to extract metadata, including places, people, and organisations. The Lucene indexing engine allows fast and effective retrieval of information related to a prompt, and the AI can use the extracted information to generate an answer grounded on this self-augmenting knowledge base.

During the study the Microsoft platform evolved, refining the Application Programming Interface (API)¹⁰ offered by Open AI and Azure. The AI Microsoft products used are still in preview, and none

⁸ <https://openai.com/>

⁹ <https://lucene.apache.org/>

¹⁰ **API** is a set of rules, protocols, and tools that allows different software applications to communicate and interact with each other. In web development, for example, APIs are commonly used to enable communication between a web application and a server, allowing the application to retrieve or send data.

have reached the production stage regarding reliability, repetitiveness, and completeness. This made the research more difficult. The tools and software had to be adjusted several times.

The main processing elaborated in these experimentations are:

- **Text processing** (summary, categorisation, and classification), Figure 2: news articles and other text retrieved from the selected web pages are processed to create a brief to enable the analyst to assess at first glance if the information deserves attention. The results are received in Microsoft Teams. At second stage the analyst can also make prompts to the AI via the Microsoft Teams chatbots.
- **Data classification** (information extraction and formalization), Figure 10: when creating new content, the AI is used to extract a set of metadata to enrich the related database entry and ease the retrieval activities at a second time. Metadata are related to the Loss Data in terms of affected people and infrastructures and can be numbers, such as the quantity of affected people, or labels, such as *riot* or *famine*.
- **Image processing** (summary, categorization, and classification), Figure 12: text extraction and analysis of the text contained in images in different languages and alphabets. Summary of text from a huge catalogue of maps/images to provide the background and contents of the images provided.

The AI algorithms were refined several times following the feedback of the beta testers, i.e., the ECML analysts. The close interaction with them was extremely important for assessing how the technologies can support their daily work and potentially the work of operational crisis management analysts in EU institutions or Member State institutions. Since it is an experimental study, additional features were added to the prototype, to enrich the user experience and allow the user to perceive the potentiality of new tools integrated with their work environment, e.g. fast access to other JRC systems (see 2.2.4).

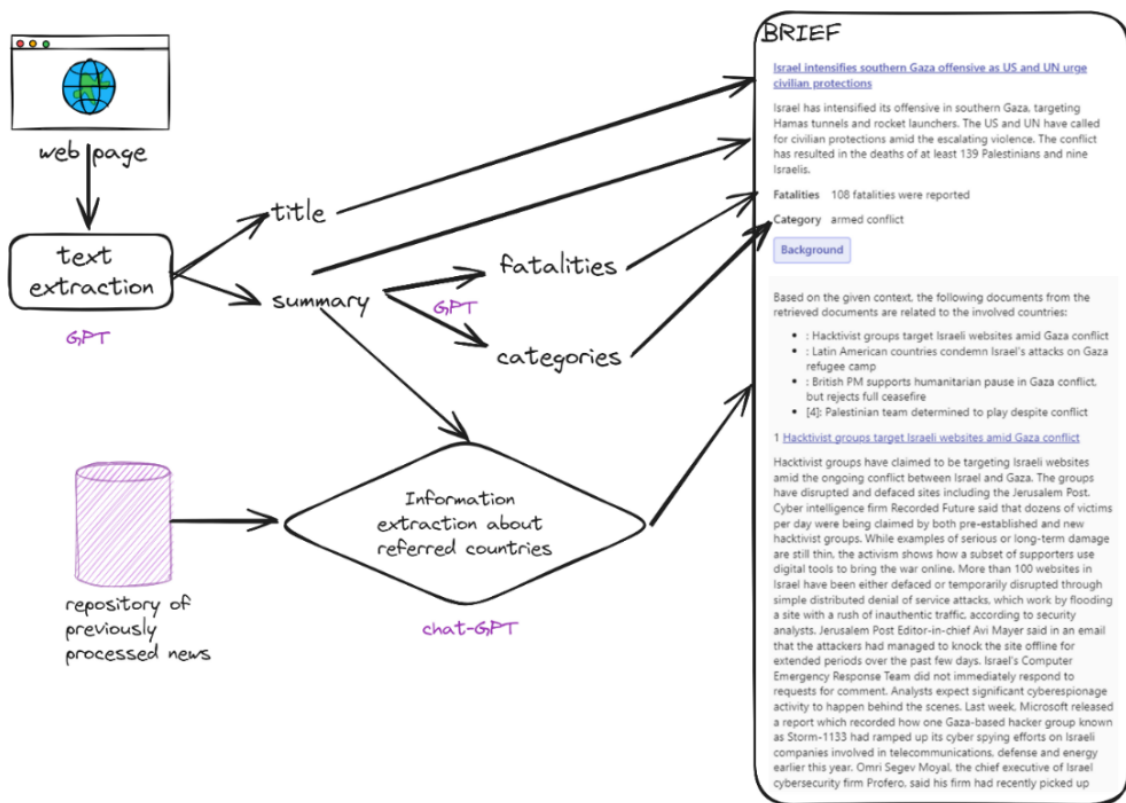
2.1 Text processing

Text processing using AI refers to the use of artificial intelligence techniques and algorithms to analyse, interpret, and extract meaning from textual data. The analysis is not limited to the sentence structure and organisation, i.e. the syntax, but also looks at how the words combine in different contexts to provide different meanings, i.e. the semantics.

This type of application of LLM can include tasks such as natural language processing (NLP), sentiment analysis, language translation, text summarisation, and information extraction. AI-based text processing systems can understand and process human language in a way that simulates human understanding, enabling them to perform complex tasks such as answering questions, generating human-like responses, and extracting relevant information from large volumes of text. These capabilities have numerous practical applications, including customer service chatbots, language translation services, content analysis, and information retrieval, among others.

The tools for the text processing (Figure 2) support the analyst giving in a very short time an exhaustive summary of the news (extracting it from a huge number of sources) and/or providing an answer to specific prompts (questions) inserted by the analyst in the chat box of Microsoft Teams. Therefore, instead of writing all content from scratch, the analyst can exploit a draft generated by the AI, which can be validated, refused, edited, or used as-is, depending on the quality of the preliminary result. This information is then stored, indexed, classified, and categorised.

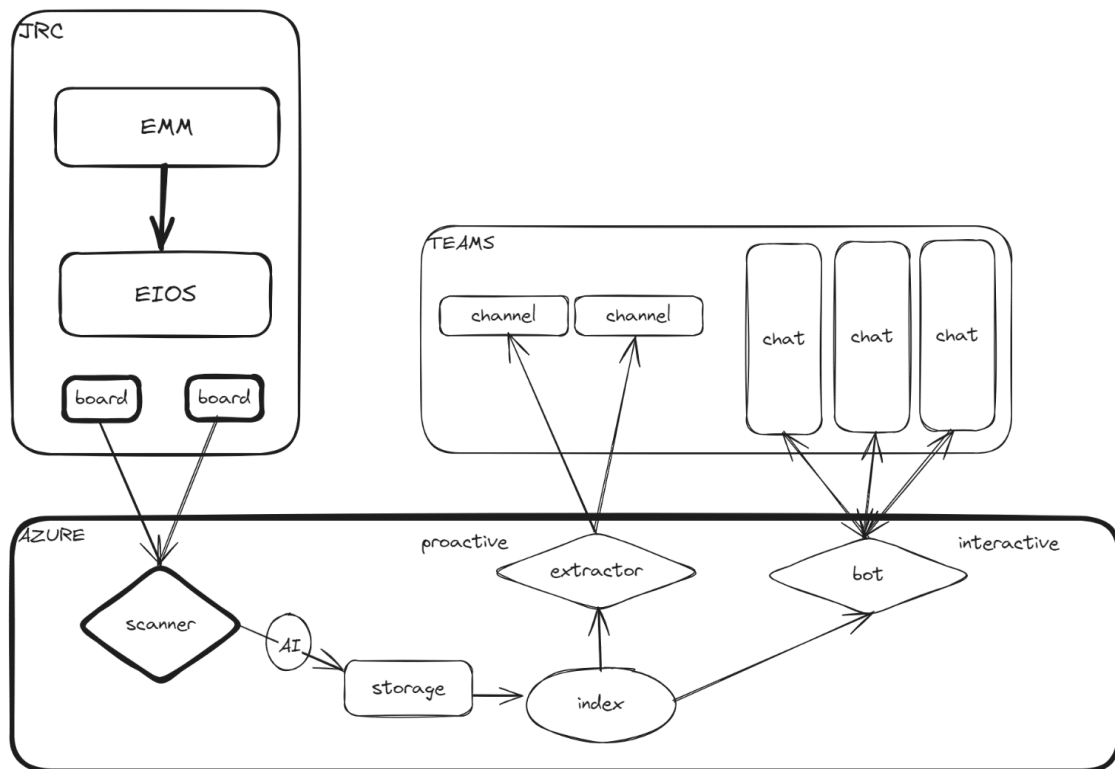
Figure 2 Text processing diagram.



The Open-source information is selected by the analysts through the EIOS boards as a result of the EMM scraping activity (Figure 3). The research is also aimed at assessing the quality of the RAG: this task is performed using LLM to extract relevant information from a dataset, i.e. the information stored in the database will be used to generate an additional text to provide more context to the main content. Since the dataset and the processed information are stored together, the system bootstraps itself, increasing its knowledge base whenever new information is ingested. Refer to section 3.1 for the evaluation provided by the users.

The generated database can be exploited in two separate ways: proactively and interactively (Figure 3). These processes are performed and communicated with the analysts through the Microsoft Teams cloud-based tool. This application was selected as it was already used by the analysts for in their daily activities.

Figure 3 Proactive and Interactive information extraction diagram.



2.2 Text processing use-cases

The process and tools described in the previous paragraph are applied to provide data and information for the following:

- Compilation of the DG-ECHO flash daily¹¹ prepared by the ECML team, validated by the ERCC and then published on the ERCC portal. This task requires that every morning the team of analysts fetches information from a set of reliable web sources combined with the results of web searching to find information about the ongoing events worth to be reported. Official sources are combined with press agencies to complement the information. The proactive procedures that collect in advance news, translate them when needed and summarize them free the operators from the tedious activity of collecting information and provide them a summary of the news, that can be used straightforward or not, depending by the analysts' judgement.
- Mapping activities about conflicts, migration dynamics, natural or man-made disasters. To complete the maps with facts and figures, the analysts must seek this information in a variety of sources. Having them already collected in one single place allows a much faster production.
- Some activities related to GDACS rapid impact estimations of relevant event from natural hazards. It can happen that press reports facts or figures before they are officially published by authorities. This valuable information can be provided promptly thanks to the scheduled collection of information from the web.

Regarding the ECHO Daily Flashes and the mapping activities, the ECML analysts (i.e. the beta tester analysts of this AI application) can interact with MS Teams to query the system through prompts based on the information needed for the analytical product at hand. They also receive the selected

¹¹ <https://erccportal.jrc.ec.europa.eu/ECHO-Products/Echo-Flash#/echo-flash-items/latest?ds=true>

information automatically (proactive tool) to support their daily information analysis: periodically, the results of an automatic analysis of newly available information is sent to the users through a MS Teams channel.

Based on the AI application, the ERCC portal is also being enriched with a new, additional functionality e.g. the progressive population of a newly established database of human loss data. This last application will be described in the dedicated paragraph on data categorisation.

Regarding GDACS, open AI is currently being experimentally applied to extract relevant information related to volcanic activities and tropical cyclone events. Specifically, for tropical cyclones, the AI application is used for obtaining preliminary information from standard broadcast bulletins from the Joint Typhoon Warning Center (JTWC)¹². The extraction process involves creating structured data from an unstructured JTWC bulletin text file. The structured data is identified by locating and analysing limited key information in unstructured text. The extracted data is used in the internal procedure as input data necessary for the system to announce the presence of a low-pressure circulation system, whose genesis can reach the identification and processing of a potential tropical cyclone event. For volcanoes, the procedure analyses a collection of news extracted by a specific EIOS board, filtering by the name of the volcano to be analysed. From the information identified by this analysis, for each volcano included in the news extraction, a structured data reporting several selected information for each eruption, including the number of displaced and evacuated people, the number of fatalities, if the eruption caused a lahar, etc.

The resulting data structure is used in the internal procedure to create an overview of volcanoes' activities and to obtain the information necessary to create an automatic level of potential impact of this volcanic activity.

The aim of this study is not to prove that some activities can be performed automatically by this new technology: this is its starting point. The study is the feasibility of introducing these techniques in existing processes to improve them in a safe and reliable manner. Not only the AI should reduce the workload, improve the efficiency and help to provide the same results in less time; it should also offer new features to improve the sense making from a large amount of information from different sources.

Instead of figures, this experiment relies on the user experience to prove the expected results.

2.2.1 News providers

The system benefits from the integration with other systems (Figure 3):

- The EMM service fetches the resources from the web and extracts the text from a large number of sources;
- The flow of articles is then categorised further by EIOS that allows creating feeds based on the sources' collections called *boards*: each user can create their own selection of sources and use boards to have dedicated feeds. Specific boards have been configured according to the fields of interests of the analysts' teams. each team will receive on a MS Teams channel only news from the sources selected on their boards.

¹² <https://www.metoc.navy.mil/jtwc/jtwc.html>

The results of the summarisations of articles are stored together, though, not separated by board, to allow the analysts to access all of them when interacting with the datasets and benefit from all the information collected.

The proactive approach (autopilot) provides the analyst with automatically generated content. Therefore, all the news collected during the previous 24 hours are sent every morning via Teams, grouped by source. For each item, the AI provides a maximum of five hundred words summary and a twenty words title. This allows the analysts to assess the relevance of the information and decide to include the information in the new contents they are producing and, if needed, to refer to the original content or adopt the automatically generated texts. The title includes a link to the original content (Figure 2Figure 2 and Figure 4Figure 4). The same process can be applied to several types of link collections, like RSS feeds or mailing lists.

2.2.2 Daily Headlines

A specific use case for this application is the one related to the Daily Headlines received by the ECML from the European External Action Service. Every day, the European External Action Service (EEAS) distributes the headlines mail bulletin, a collection of relevant information collected by its analysts browsing the Internet: all linked web pages are analysed, and the results sent through the same channel to the ECML team of analysts dedicated to the conflict, crisis and security monitoring. Before this, the headlines were received through email. Each analyst had to click on the link to fetch the content, maybe translate it, and read through it to assess the relevance. This process is now less time consuming. On top of this, the archived emails were not easy to search through and contained just a title of the information and the link, that could easily obsolete over time. Now, the analysis results stay and are used for RAG.

For the EEAS Daily Headlines, the following information is extracted and categorized with the indicated keywords:

Fields

- Headline date
- Headline title
- Region
- Country
- Location(s)
- News classification:
 - Armed conflict (keywords: clashes, battles, shelling, airstrikes, drone strikes, missile strikes)
 - Violence against civilians/human rights violations (keywords: killing, shooting, abduction, robbery, forced displacement, dispossession)
 - Riots/ Protests (protests, riots, protesters, demonstrators, demonstrations)
 - Political and strategic developments (deployment, meeting, ceasefire, announcement, diplomacy, agreement, peace deal, elections, summit, briefing)

- Topic (e.g. migration, ethnic and/or religious tensions, elections, ongoing conflict, proxy war, economic crisis, climate change...)
- Summary/context
- Information source
- Link
- Fatalities


2.2.3 Microsoft Teams for interactive uses

The proactive tool delivers content by sending messages to specific channels. This is achieved through a webhook, a web access point that accepts only messages correctly formatted and based on a restricted set of formats, simple text, for instance.

A well-established and proper format is Adaptive Cards¹³, which allows the data to be laid out and formatted in a specific way and is well supported by different software, including MS Teams, MS Outlook, and all browsers.

¹³ Adaptive cards are a type of user interface component that can be used in various applications and platforms to present content in a customizable and interactive format, which is both constant and coherent with the look and feel of the hosting application. Adaptive cards can contain text, images, buttons, input fields, and other interactive elements, and can be used for a wide range of purposes such as displaying information, collecting user input, and facilitating interactions with other services or applications. See adaptivecards.io

Figure 4 Examples of proactive exchange of summarization of contents

 Daily-Extract 04/12 06:45

ANSA

[Conference of Services for Construction of Rotella Bridge to be Held on December 18th](#)
Created 03/12 16:05

On December 18th, the conference of services for the construction of the Rotella Bridge will be held. The bridge will connect the municipalities of Fermo and Porto San Giorgio, in the Marche region of Italy. The project has been in the works for over 20 years and is expected to improve transportation and accessibility in the area. The conference will address environmental and technical issues related to the construction of the bridge.

Fatalities 0

Category political and strategic developments

[Three family members of Eiffel Tower attacker arrested in Paris](#)
Created 03/12 16:05

French police have arrested three family members of the man who killed a police officer at the Eiffel Tower last week. The attacker, identified as 34-year-old French national Cedric G., was shot dead by police after he stabbed a police officer in the neck. The three family members were arrested on suspicion of providing support to the attacker. The investigation is ongoing.

Fatalities 1

Category violence against civilians/human rights violations

[Rocket from Lebanon injures Israeli soldiers in Upper Galilee](#)
Created 03/12 15:05

MS Teams allows programming bots to support the analysts. A bot is mainly a web-based service that MS Teams can call and that provides the message the analyst exchanged with the bot in a chat. The bot will reply through the chat itself the results of the task requested by the analyst and can perform any action and access any information both inside and outside the MS Teams environment.

The process of collecting information from the web and analysing it can be started interactively by the analyst, by pasting a link into the chat.

All the collected information is available to the AI through an indexing service, and the analysts can interact with the AI, asking questions that will be answered based on the information available in the database. As an extension, the analysts can access a set of additional databases in the same way. The analysts can select the database to query just by prefixing the prompt with the name assigned to the database (or part of it: news or “n” are equivalent if the initial cannot refer ambiguously to more than one database). The analyst can also set a default database to be used for all prompts without a prefix. The system will answer by providing a short summary of all the retrieved information, with citations to allow the analyst to refer each document (Figure 5 **Error! Reference source not found.**).

At the moment, available data sources are:

- **The Global Situation System (GSS)**¹⁴: relevant events inserted into the GSS database, such as red or orange alerts from GDACS¹⁵

¹⁴ The Global Situation System (GSS) is a single-point-of entry for the analysis of past and ongoing disasters and crises through an integrated visualization environment of multiple Early Warning Systems (EWS). The platform, requested by DG ECHO to the ECML, has been

- **News:** articles provided by the Epidemic Intelligence from Open Sources (EIOS)¹⁶ dedicated dashboards and scraped by Europe Media Monitor (EMM)
- Volcano Observatory Notice for Aviation (VONA)¹⁷

Figure 5 Example of AI based database interrogation or RAG, December, 19th 2023.

is Reykjanes posing a danger?

 EcmlSmartAssistant 16:38

Yes, there are concerns about volcanic instability in the Reykjanes Peninsula [1][2][3][14]. The Icelandic Met Office has warned that large amounts of magma are spreading underground and could surface in the southwestern town of Grindavik [1]. Thousands of tremors have been recorded around the nearby Fagradalsfjall volcano in recent weeks, and seismic activity has raised alarms that they could be a precursor to an eruption [1][2][3]. The increased seismic activity has led to the evacuation of the small fishing town of Grindavik [3][14]. The western part of Grindavik has sunk by more than a meter since last Friday, and continues to do so at a rate of about 4cm a day [14]. If there is an eruption, there could be significant damage to local infrastructure and a release of toxic fumes [14].

Bibliography

[1 Iceland declares state of emergency as volcanic eruption fears rise](#)

Iceland has declared a state of emergency after a series of earthquakes raised fears of a volcanic eruption. Authorities have ordered thousands living in the southwestern town of Grindavík to evacuate as a precaution. The Icelandic Met Office (IMO) says it is concerned large amounts of magma, molten rock, is spreading

designed by the ECML analysts and developers and is in prototype stage at the time of writing, therefore available only to selected services of the European Commission.

¹⁵ Global Disaster Alert and Coordination System, www.gdacs.org

¹⁶ <https://www.who.int/initiatives/eios>

¹⁷ Volcanic observatories provide information on the change of volcanic activity to the Volcanic Ash Advisory Centers (VAAC) following an international Volcanic Observatory Notice for Aviation (VONA) format, as specified by the International Civil Aviation Organization (ICAO).


Figure 6 Actual information published as Daily Flash

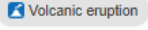
EUROPE | 19 December 2023 | Published

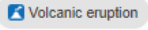
Iceland - Volcanic eruption


(IMO, Iceland Civil Protection, media)

- On 18 December at 22:17 UTC, a 4 km long volcanic fissure started erupting lava. The fissure is located in correspondence of the dyke intrusion that formed in November almost 3 km from Grindavík Town (Reykjanes Peninsula, south-western Iceland).
- The rate of lava flow during the first two hours of the eruption was approximately hundreds of cubic metres per second, with the largest lava fountains on the northern end of the fissures. In recent hours, lava is spreading laterally from either side of the newly opened fissures.
- Following the seismic swarm due to the dyke intrusion recorded in November, about 4,000 people were earlier evacuated from Grindavík and the nearby Blue Lagoon.
- National authorities have raised the Civil Protection Service Level to Emergency. The Civil Defense Coordination Center has been activated.

 EUCPM Activation

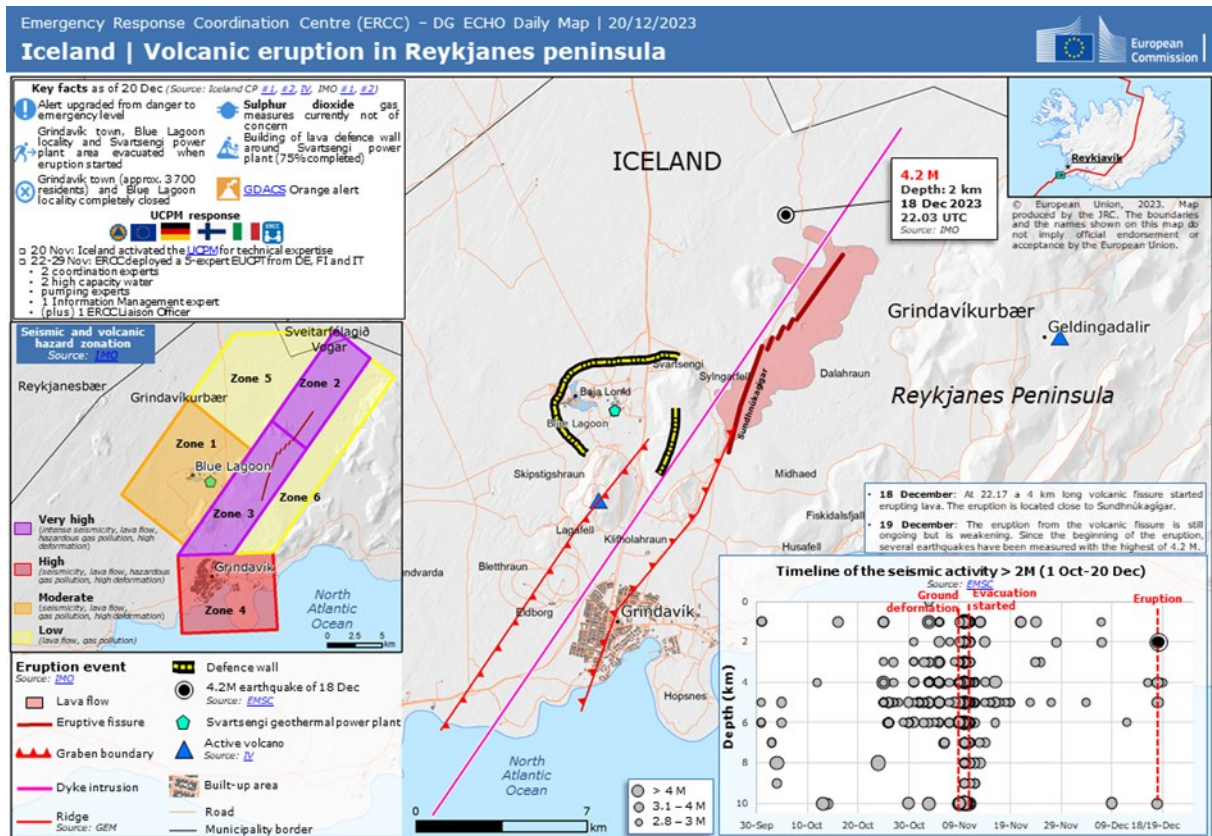
Main Event Type 

Event Types 

Countries 

The information gathered by the AI are used to enrich the initial information published by the national authorities. The automatic translation allows processing more information, selecting relevant news from their summary. This is more important, when information comes more promptly from media than from institutional sources.

Figure 7 The Daily Map describing the volcanic event in Iceland.



2.2.4 Additional features

The co-piloting experience is complemented by additional features that allow interaction with other JRC systems and fetching useful information, e.g. lists of recent events from GDACS or the INFORM¹⁸ profile of a country.

Starting the sentence for the Bot with **gdacs**, the analyst requests that the AI parse the following question to translate it to a query of the GDACS database. The resulting list of events is then sent back to the analyst, and each item is linked to the page of the event described.

¹⁸ <https://drmkc.jrc.ec.europa.eu/inform-index>

Figure 8 GDACS database queried through the bot.

gdacs tell me about the fires in guatemala in 2024

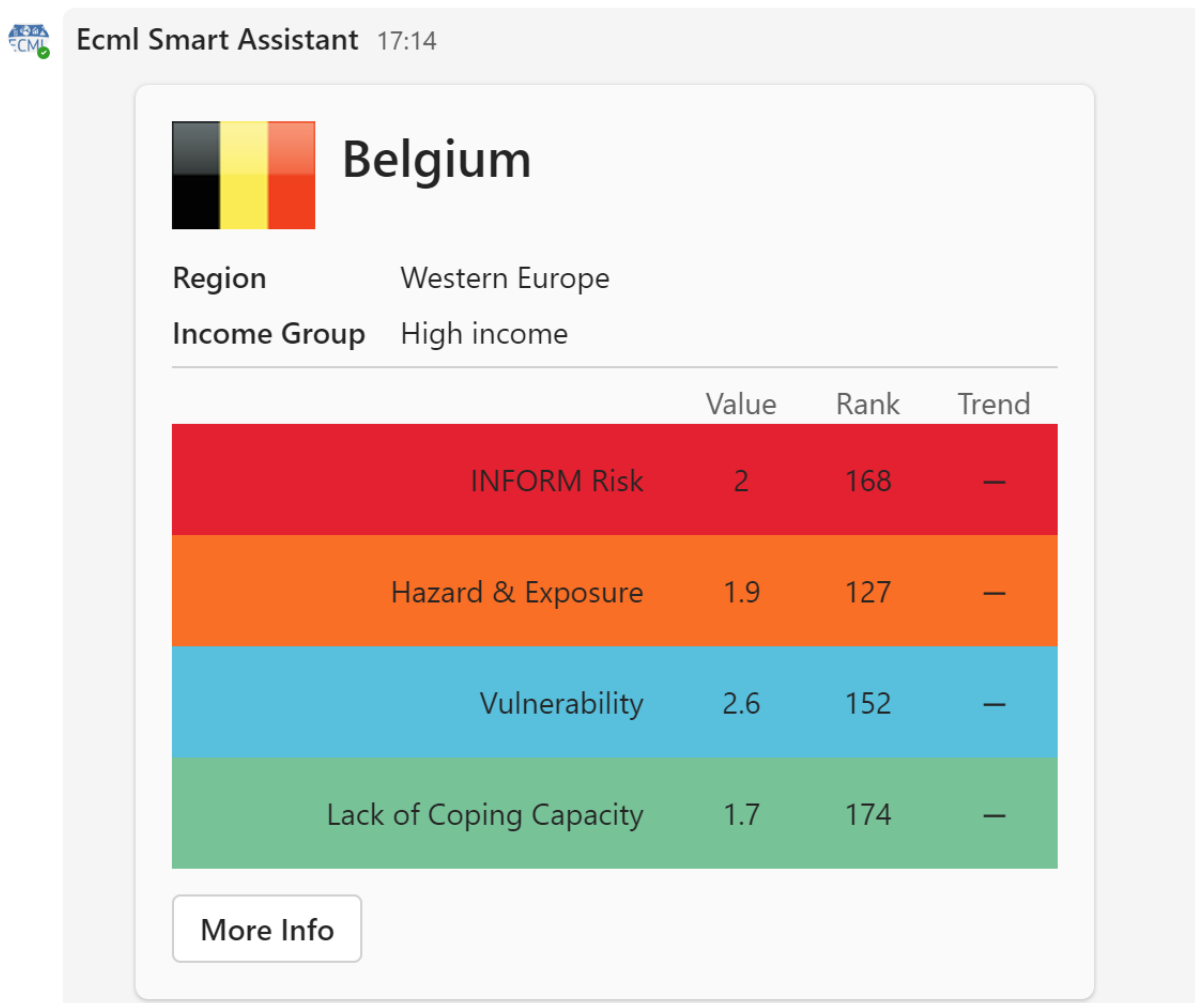
2 minutes ago

	Forest Fire (1431 ha) in Guatemala 15 May 2024
	Forest Fire (6141 ha) in Guatemala 12 May 2024
	Forest Fire (1136 ha) in Guatemala 23 May 2024
	Forest Fire (2041 ha) in Guatemala 16 Apr 2024
	Forest Fire (2807 ha) in Guatemala 20 Apr 2024
	Forest Fire (2095 ha) in Guatemala 16 Apr 2024
	Forest Fire (2130 ha) in Guatemala 22 Apr 2024
	Forest Fire (1540 ha) in Guatemala 20 Apr 2024

Starting the sentence with **profile** will request the Bot to treat the following text as the name of a country, but an ISO-3 code is also recognized; therefore, **profile Italia** and **profile ITA** are equivalent. Capital letters can be used but are not necessary.

Figure 9 The risk profile of Belgium published by INFORM.

profile belgium



2.2.5 Data categorisation and classification

Language models proved to be able to analyse the texts and extract information into a structured data format. This capability, extremely useful in many contexts, including the disaster risk management one where the speed of data processing is utmost important under emergency circumstances, aims at creating intelligence from a variety of heterogeneous sources of information, both structured and unstructured.

Every day, the ECHO Daily Flash¹⁹ are published on the ERCC Portal. The ECHO Daily Flash provides a snapshot of unfolding disasters and main humanitarian crises, in Europe and the rest of the world. The product consists of short summaries of the main events of the past few days, presented in short bullet points, in neutral, simple language, sticking to facts.

¹⁹ <https://erccportal.irc.ec.europa.eu/ECHO-Products/Echo-Flash#/echo-flash-items/latest?ds=true>

The ECHO Daily Flash is compiled by the ECML analysts, validated by the ERCC and finally published on the ERCC portal to provide the European Union Civil Protection Mechanism with continuously updated situational awareness about significant events occurring globally.

Starting from September 2023, when drafting the ECHO Daily Flash single items, the ECML team adds a set of metadata related to the impact:

Title: title must start with the main countries, followed by the main hazard types, if very important, the main affected location is mentioned, but impact and loss data are excluded;

EventTypeCode: is the code (e.g. AS for Assault, or EQ for Earthquake) of the main Hazard Type;

EventCodes: lists the codes of the other Hazard types (do not include EventTypeCode of the main Hazard Type);

MainCountryIso3Code: is the Iso3 Code of the main country if any;

CountriesIso3: are the Iso3 of the other countries (do not include MainCountryIso3Code);

AffectedAreas: lists the affected areas

LossData: is an array of the loss data and this is their structure

Value: is the quantity,

Indicator: is the type of loss, such as Affected, Fatalities, or Destroyed Buildings,

AffectedArea: is the affected location where the loss occurred

This information can be automatically extracted from the text into a structured data format, which the system can easily handle and compile as draft metadata for the ECHO Daily Flash item. The analyst then can rapidly validate the captured metadata. This approach offers several advantages:

- Reducing the human activity regarding tedious tasks (only validation, rather than compilation);
- Minimising errors;
- Faster production of the ECHO Daily Flash items.

The model used for this process is GPT4 32K which allows the processing of a huge amount of text. The instance is deployed in the JRC environment known as GPT@JRC, and it is the first use of it in this experimentation, because no RAG feature was needed.

The process follows these steps (Figure 10):

1. The analysts create the ECHO Daily Flash Draft in the ERCC Portal filling in the form with the description of the event in English.
2. The Portal prepares a prompt with general instructions for extracting data from the text provided at step 1.
3. The Portal sends the prompt to GPT@JRC API (using LLM Gpt432K)
4. GPT@JRC returns the extracted data in a JSON format to the Portal
5. The analysts validate the generated data and store it in the repository.

Figure 10 ERCC Portal co-pilot process.

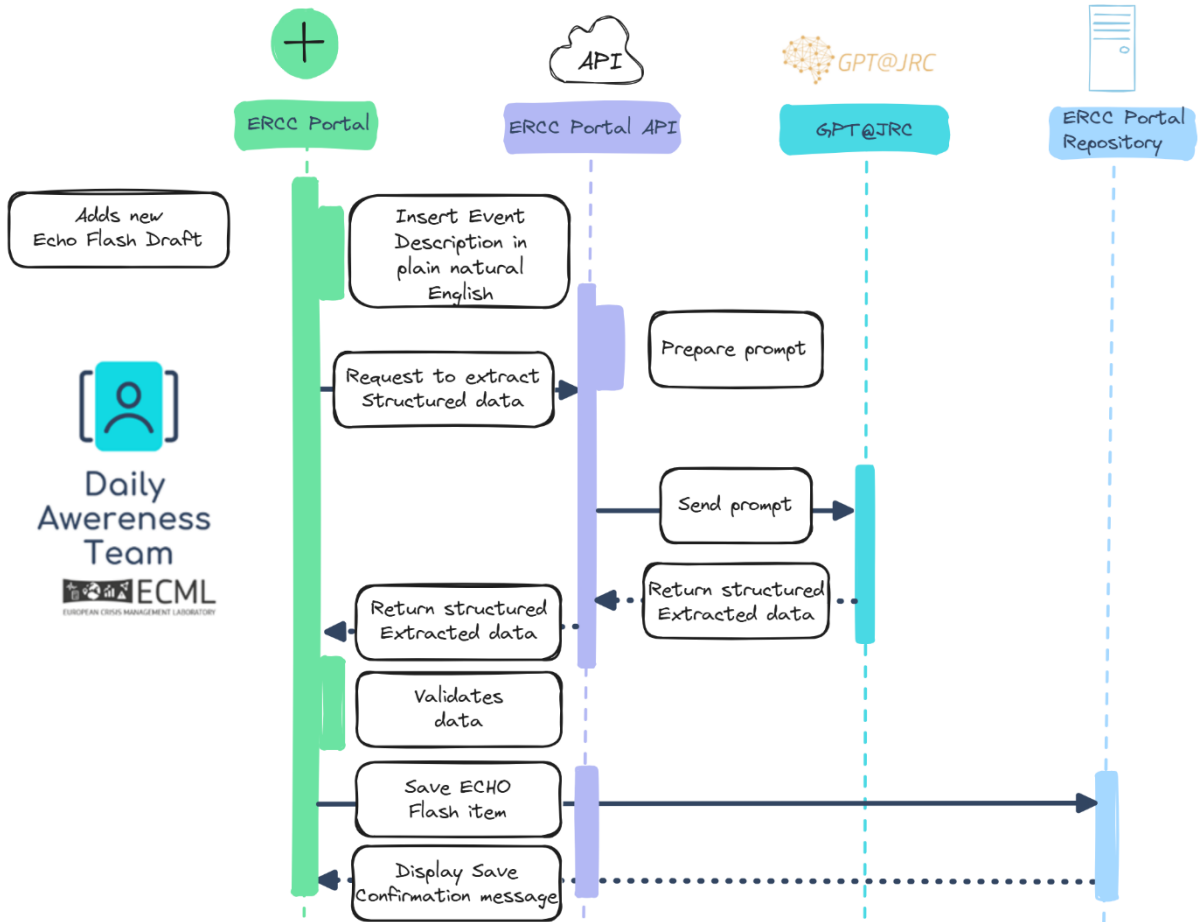
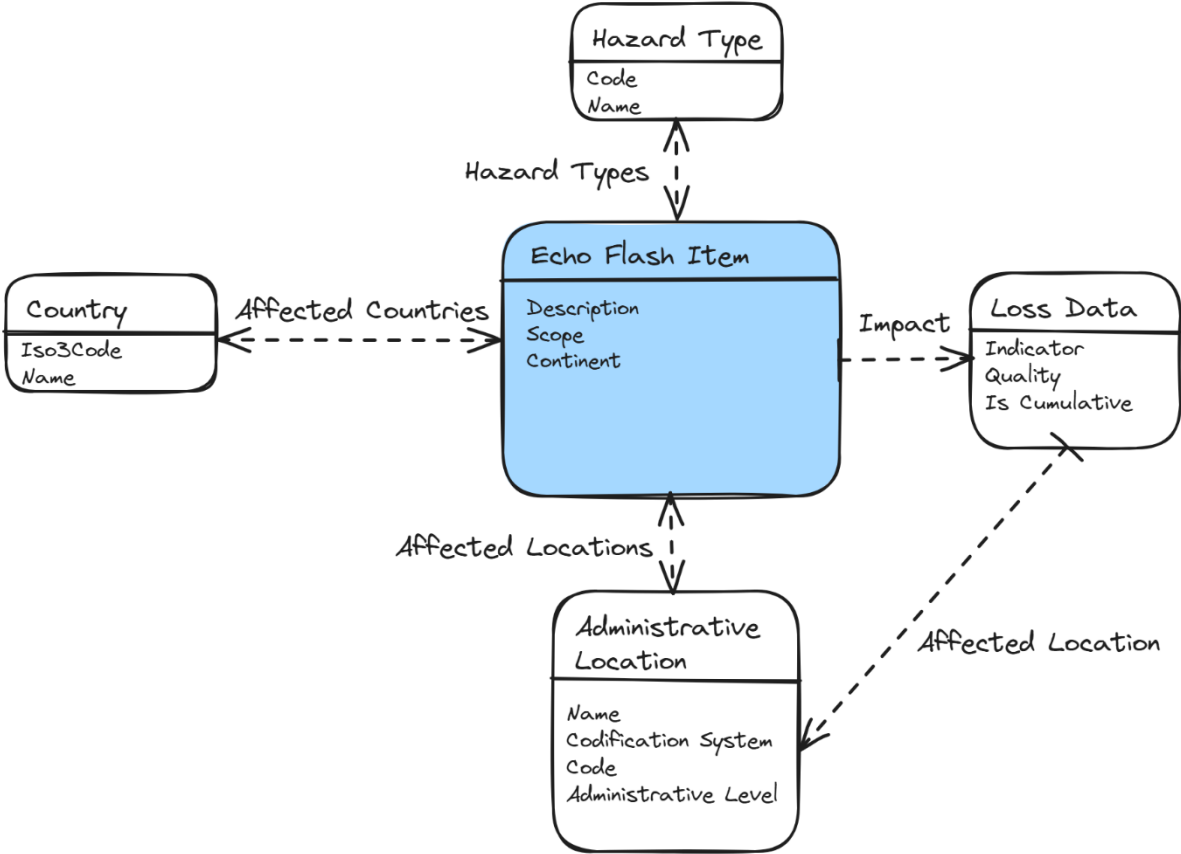


Figure 11 Figure 11 below shows an example of the fields used for data extraction, categorisation and classification starting from an ECHO Daily Flash.

Figure 11 An example of field used for the DG-ECHO Daily Flash categorization and classification.



Affected areas and Loss data Extraction from Legacy ERCC Portal repository

The daily work of automatic flash generation started on August 30, 2023. Until October 30th, 2024 a total of 913 Echo Flash Items has been generated, with a total of 3834 records of affected areas and 3098 records of loss data. All these data have been manually validated by the users. The validated data constitute the validation and training datasets to attempt the extraction of data (loss data and affected areas) from the legacy database.

Evaluation Metrics

		Real	
		Positive	Negative
Model	Positive	<i>tp</i>	<i>fp</i>
	Negative	<i>fn</i>	<i>tn</i>

According to the schema, the metrics used to evaluate the accuracy of the results are²⁰:

²⁰[Understanding Precision, Recall, F1-score, and Support in Machine Learning Evaluation | by Nirajan Acharya | Medium](#)

- **Precision**, to measure the proportion of confirmed positive predictions among all positive predictions made by the model, confirmed or not.
- **Recall**, to measure the proportion of confirmed positive predictions among all actual positive instances in the dataset, detected or not. It is complementary to precision.
- **F1-score** is the harmonic mean of precision and recall: it combines the two values to provide a single metric, balancing the trade-off between the two.

In formulas:

- Precision is $\frac{tp}{tp+fp}$, where tp is true positives and fp false positives in the model test.
- Recall is $\frac{tp}{tp+fn}$, where tp is true positives and fn false negatives in the data set.
- F1-score is $2 \cdot \frac{precision \cdot recall}{precision+recall} = \frac{2 \cdot tp}{2 \cdot tp+fp+fn}$.

Results

For the validation dataset, 1068 Echo Flash Items were selected, including 1361 Loss Data records and 2150 Affected Areas.

The automatic extraction procedure obtained:

	True Positives	False Positives	False Negatives
Loss Data	1599	0	312
Affected Areas	1695	552	1448

Here are a couple of concrete examples with the validation data and those obtained with the extraction:

Article Body

“Since December 2023, the activity of Lewotobi Laki-laki volcano located in the southeastern part of the island of Flores (eastern Indonesia), is increasing. On 1 January 2024, a huge eruption was observed, and the ash cloud reached up to 1,500 m above the crater and moved from southwest to west.

According to the National Agency for Disaster Countermeasure (BNPB), more than 1,500 people have been evacuated in East Flores Regency from the Boru Village (1,185 residents) and Konga Village (328 residents). In addition, a total of seven villages in two Districts of East Flores Regency have been affected by the eruption.

Local authorities are setting up refugee tents, and providing masks and blankets for the affected community. Moreover, they are on the field for monitoring, and cleaning the roads from the spread of volcanic ash using water tanker.

The status level of the volcano has raised at 3 (Alert) meaning that activities within a 3 km radius of the eruption center are prohibited.”

Validation Dataset

Affected Locations

Boru, Village

East Flores, Regency

Flores, Island

Konga, Village

Loss data

East Flores: Displaced, 1500

Result dataset

Affected Locations

East Flores, Regency

Boru, Village

Konga, Village

Loss Data

East Flores: Displaced, 1500

Article Body

“Several wildfires continue to burn across central and southern Chile, since 26 January, causing population evacuation and damage.

As of 31 January, according to the National System for Disaster Prevention, Mitigation and Attention (SENAPRED) there are currently four active wildfires in Navidad, San Pedro, Sao Paolo and Puerto Montt Municipalities and a red alert has been issued. The most widespread is the Puerto Montt (Llanquihue Province in Los Lagos Region) with a total burnt area of 677 ha.

According to the same source and to media, 74 people have been evacuated from 19 homes, a school is used as shelter in Puerto Montt and three people have been injured due to wildfire-related incident.

Over the next 24 hours, according to the JRC Global Wildfire Information System (GWIS), the fire danger forecast is from high to extreme over central Chile, including the already affected regions.”

Validation Dataset

Affected Locations

Navidad, Municipality

Puerto Montt, Municipality

San Pedro, Municipality

Sao Paolo, Municipality

Loss Data

Puerto Montt: Displaced, 74

Puerto Montt: Injured, 3

Result Dataset

Affected Locations

- Navidad, Municipality
- San Pedro, Municipality
- Sao Paolo, Municipality
- Puerto Montt, Municipality

Loss Data

- Puerto Montt: Displaced, 74
- No reference location: Injured, 3

Procedure improvements

Since the beginning, several techniques have been experimented to improve the results.

The use of libraries for Natural Language Processing, Tokenization and Named Entity Recognition, such as Nexus, Humanize, Standord NLP, was initially experimented, also by virtue of their lower resource consumption compared to Large Language Models. The results were however poor, especially with a high rate of false positives due to hallucination.

After a refinement of the engineering of the prompts, function calling was adopted, because it allows keeping the results (intended as the structure of the data model returned and the data types) as intermediate results for further analysis.

A new technique, recently made available in Azure OpenAI, allows to fine tune the LLM (gpt-4o)²¹ and it is under evaluation.

It is also planned to evaluate some classification models with Machine Learning .Net²².

A validation procedure for affected areas has also been implemented, on the basis that echo flash items in the legacy repository are associated with countries. Geolocation services are then called to verify the existence of an administrative location in the referred country.

Refer to the Results section for the evaluation.

2.3 Image processing

Image processing using AI involves techniques to analyse, interpret, and manipulate digital images. This can include tasks such as object recognition, image classification, image segmentation, and image enhancement. AI-based image processing systems can understand the content of images, identify objects and patterns within them, and make decisions based on the visual information they contain. These capabilities have numerous practical applications, including facial recognition systems, medical image analysis, autonomous vehicles, and quality control in manufacturing, among others.

Disaster risk management involves the use and production of maps to provide a spatial presentation of geolocated information. Every day, the ECML analysts examine several maps to extract information. Often the language of the maps analysed is not English. Also, the output of the analysis process, in addition to written

²¹ [Customize a model with Azure OpenAI Service - Azure OpenAI | Microsoft Learn](#)

²² [ML.NET | Machine learning made for .NET](#)

reports, contains new maps, realized by the ECML analysts themselves and published either on the [Science for Peace portal](https://science4peace.jrc.ec.europa.eu/)²³ (for conflict and migration) or on the [DG-ECHO portal](https://ercportal.jrc.ec.europa.eu/ECHO-Products/Maps#/maps/latest)²⁴ for natural and/or man-made disasters.

To assist the ECML analysts with these activities, an image processing utility is provided to:

- (a) Extract information in English from images.
- (b) Describe the content of the image from the extracted text.
- (c) Prepare the set of metadata to associate with a published map.

The process in Figure 12 presents the steps of image processing. It is based on different AI techniques. Some are consolidated and production level services, and others are based on LLM.

Azure AI Vision is a unified service that offers computer vision capabilities. It can

- analyse images
- read text
- detect faces

It includes prebuilt image tagging, text extraction with optical character recognition (OCR), and responsible facial recognition. It is used to analyse the image to recognize its content, e.g. *map of a country*, and to collect all texts present in the image.

Azure AI Translator can translate text instantly or in batches across more than one hundred languages. It supports a wide range of use cases, such as translation for call centres, multilingual conversational agents, or in-app communication. It is used to ensure that the text will be in English.

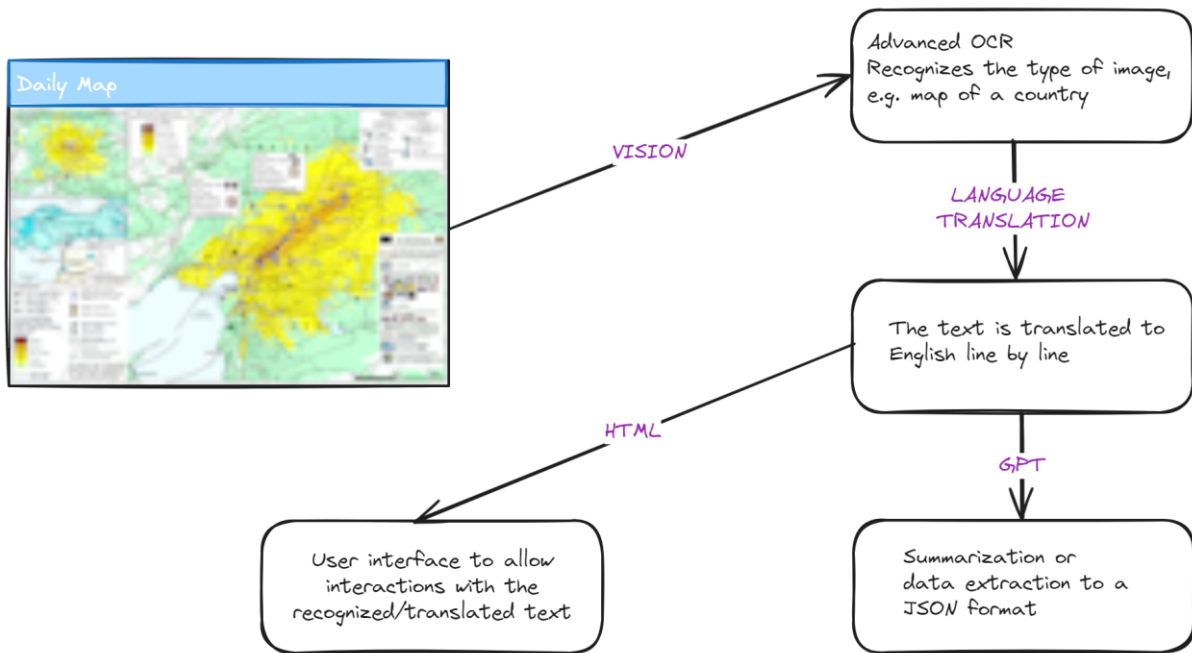
Texts that were identified in the image are then combined into one, each text being a line of it, and the result is passed to GPT-3.5 turbo.

The prompt is the same one used in Figure 10 ERCC Portal co-pilot process. and aims to extracting locations and human loss data in a structured format.

²³ <https://science4peace.jrc.ec.europa.eu/>

²⁴ <https://ercportal.jrc.ec.europa.eu/ECHO-Products/Maps#/maps/latest>

Figure 12 Image processing.



The resulting information is returned to the analyst through the MS Teams chat. The data is formatted using an Adaptive Card, which includes a link to a web visualization of the image.

The original image is shown to the analyst. Hovering the mouse over a text will display its translation (the text is displayed even if it is already in English). Clicking with the mouse on a text will copy its English translation into the analyst’s clipboard, allowing pasting it into another document. The link can be shared with other analysts.

Figure 13 Extraction of translated text.

Russian_peacekeeping_2021_24.png

Unfortunately, the text you provided does not contain enough information to accurately describe a map of a country. It appears to be a report on the situation in a specific area related to a peacekeeping operation. Can you provide more context or information?

Обстановка в районе проведения миротворческой операции
 Situation in the area of the peacekeeping operation
 ию на 27 января 2021 г.)

26.01.2021 г.		Всего с 14.11.2020 г. (чел.)
чел.	автобусы	
192	4	51 408

УСЛОВНЫЕ ОБОЗНАЧЕНИЯ

- ▲ - наблюдательный пост
- ☒ - медицинский отряд
- зона ответственности российского миротворческого контингента

© Ministry of Defence of the Russian Federation

Image processing use-cases

This process can support the ECML analysts in extracting the information included in maps or figures in different languages. Furthermore, this tool could support the building of a map catalogue with all the relevant maps made during the past 10 years for conflict, migration, and natural and/or man-made disasters. This catalogue would include the maps classified by country/theme and other relevant fields. A description of the content of the maps will also be provided.

The stakeholders could browse the map inventory using selected fields.

This process is not restricted to maps: the Vision service is able to determine the type of image (e.g. map of a country) and this is passed as context to help the LLM to elaborate better the text. Maps are an optimal context, since the language is formal and in all samples are present common structures to present information: a specific Machine Learning would provide more accurate results. GPT4V, the model version able to handle images (the V suffix is in fact a reference to vision), will also be tested in the same context to evaluate its performance.

This use case is an example of information that are published digitally; but remain analogical in some way. The AI offers the tools to create utilities and applications that no longer require the human intervention along the process to convert the data and are reliable.

3 Results

Automated processing can be applied to a larger quantity of data than human analysts can cope with. Well-known sources of information, selected as credible and reliable over the years by the ECML analysts based on their expertise, are scanned daily, searching for relevant information. However, this might not be exhaustive, as new sources of information are becoming available almost every day, plus those from local stakeholders might not be always rapidly identified and exploited. Using AI minimises the risk of missing important information but also sifts away what is not relevant. The analysts benefit from this approach for several reasons:

- More sources can be scanned in the same (or less) amount of time. Before this approach was developed, the analysts scanned around six sources every day; they were selected in EIOS to create a board, but rapidly around other twelve were added. This means that the automated process analyses every day **more than three times** the sources previously selected.
- Only contents classified by the system as relevant are presented, requiring less effort to validate them. The analysts are now required to read the summaries conveniently found all in the same place, instead of following a link to be found in a home page, with possible delays due to network issues, in case translate the content, automatically or manually, before even starting to read the content. **The time** needed to assess the content from the summary **is minutes less** than the overhead needed to find and consume the contents.
- The system can draft content for the analysts, requiring less time to produce new and derived contents. If very relevant, the analyst can always refer to the original content through the provided link and perform personally the extraction of the text. Otherwise, **the summary** is already sufficient, and it **can be used immediately**: copied in a report, forwarded to colleagues, or turned into other types of content present in MS Teams, such as an action or a task.
- **Large legacy datasets**, such as GDACS or the ERCC portal in the case of ECML, can be seamlessly included in the knowledge basis, increasing the information available. This allows the analysts to access them in the same context and **automatically integrating them in the text generation** performed interactively.

3.1 Analysts' feedback

The overall experience of the ECML analysts, i.e., the beta testers of these experimental AI applications in the specific domains of disaster and conflicts monitoring, is positive, but the prototypes present limitations.

The integrated translation features are extremely valuable since they speed up the processing of the information, which is also summarised. The time required to assess the interest in the information is strongly reduced. The integration with MS Teams is also a positive factor, since it reduces the effort of switching contexts during the content creation and interaction with the colleagues.

Technologically speaking, the implementation helps integrate with other tools, such as the ERCC Portal, in which the ECML already introduced the automatic data extraction functionalities, in the context of these experimental applications of AI to its analytical activities.

Several analysts have found the GPT@JRC tool more useful than the ECML bot. This is mainly due to the size of the dataset behind it. Limiting the model of the dataset to the RAG, implies that the

completeness of the information depends on the dataset. The prototype can interface with several small databases; but the access to large datasets, e.g. EMM, would significantly improve the quality of the result. This development is presently under study. Of course, it would become a matter of trade-off between the size of the datasets to be used and the reliability/credibility of the sources included in the AI process.

The possibility to increase the scope of the information scanned daily was much appreciated by the analysts. It already allows a better understanding of the impact of the events, thanks to the additional information extracted from the media. However, many analysts would benefit from a more detailed preselection of the news in order to avoid being overwhelmed by excessive information. The self-augmenting datasets can be very useful for periodic reporting activities, such as those requested by EEAS. Nonetheless, direct access to the dataset with a simple query interface is mandatory to prove its usefulness for the analysts.

3.2 Data categorisation and classification

The results are very satisfactory for loss data, less so for affected areas. The current work is focusing mainly on the reduction of false positives.

After a manual check it was noted that often the users did not insert all locations users when saving the flash items, even when actually cited in the text; therefore, a review of the validation dataset is also underway.

Initial results	Precision	Recall	F1-Score
Affected Area	0.68	0.48	0.56
Loss Data	1.00	0.81	0.89

After refinements	Precision	Recall	F1-Score
Affected Area	0.75	0.54	0.63
Loss Data	1.00	0.84	0.91

The refinements ongoing on the process and the training datasets promise to improve even more the results, possibly reaching 100% of precision on affected area as well.

3.3 Criticalities

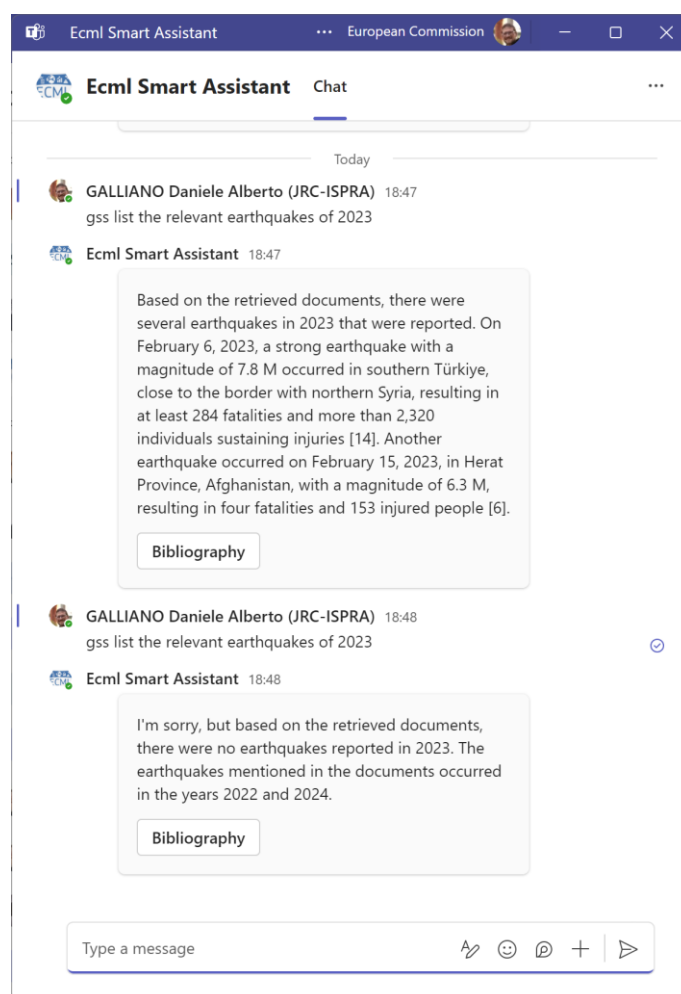
The technology is quite new, and it is evolving very fast. Simultaneously, implementations also evolve and can be influenced by these fast changes. The research encountered frequent updates which were not backward compatible and/or showed disrupting bugs. This required several code rewritings. So far neither OpenAI nor Microsoft planned a production level version of the software, that implements and makes available the models: it is always presented as a preview. This means

that implementing operational procedures now, using this technology implies accepting the risk of disruptions of service. In early 2024 a new technology called Semantic Kernel was released by Microsoft: it allows an effortless integration of the AI services with traditional software and cope automatically with the interaction with models. This abstraction upgrades seamlessly the connections with the AI services and eases the software production process. The Semantic Kernels allows as well as more sophisticated techniques to allow the models accessing external datasets and information, including plug-ins, and will be used for the next version of the software used in the ECML.

The quality of the text generated by the model is so high that it is quite convincing even when based on a wrong understanding of the text, which can derive from a wrong choice of the parameters used to configure the algorithm or, more simply, by the lack of a real understanding of the facts, that allows the model to make statements that are not correct. This represents a threat that points towards the need for always foreseeing a subject matter expert (human) validation of the AI extracted information. Analysts should never grow used to the high quality of the texts produced and blindly trust the statements from the AI.

Another limitation encountered in this study is that the nature of the models is such that their behaviour is not repeatable, while this is a fundamental aspect of the software development: a software must repeat the same output given the same input, to have a predictable behaviour and allow its verification.

Figure 14 Example of not reproducible output.



On the other hand, a complete proof reading of every text provided by the AI would invalidate the effort. An approach could be having an alternative AI process run in parallel and results being rated according to the level of convergence. It is also possible to instruct another process to fact-check the first one. The analyst would then be aware of the reliability of the text production. In the case of automatic procedures, the productions with a very low rate should require validation from a analyst. In the meantime, analysts should be trained to estimate the quality of AI productions.

Addressing these potential disadvantages requires careful consideration of the ethical, social, and technical implications of using AI in disaster management, as well as ongoing efforts to ensure transparency, accountability, and human oversight in deploying AI systems during critical situations.

If open-source information is handled, the cloud is an optimal solution in terms of reliability and ease of configuration; but for Sensitive Not Classified contents (SNC) an on-premises set-up such as GPT@JRC should be used. The results achieved by this research can easily be ported to this environment, rapidly reaching the same level of service previously available only through the cloud environment. Therefore, a transition to the use of GPT@JRC is being assessed as a potential next step of this research. New technologies such as MS Semantic Kernel allow to integrate seamlessly different instances of models, even provided by different platforms; therefore, the same interface can be given to the user, while *under the hood* the most appropriate model instance is chosen depending on the nature of the information to be handled.

4 Future outlooks

The rapid development of AI technology offers new tools and approaches every day, which should be exploited to support disaster risk management activities.

The sense making capabilities of these tools are enhanced continuously and are now able to include better extraction of information from other media than just texts, including images, video, or audio streams.

As productivity tools are moving towards including co-piloting features, it is recommended to prepare content creation systems to offer as much as possible standard programming interfaces for integration. This new approach, based on smart agents, connects to other systems to assist analysts in their daily activities. Basic tasks like text composition can be easily delegated to the AI; the analysts will be more appropriately committed to extract the sense from the amount of information processed by the AI. This implies that in case that the AI fails and generates false statements, the analysts will have the chance to edit them out: the users are promoted from editors to chief-editors.

The capabilities of AI to evaluate the quality of its own production must be exploited to ensure the quality of the generated contents. During this experimentation, several times the generated contents were easily detectable as not valid: a complimentary process should be applied to detect invalid generated contents. Keep in mind that static controls cannot be adopted, since the output of the models are often not repeatable in nature.

Using the models with data that are more specific to the requested tasks already showed improvements in the results. Developing models trained with specific data would provide even better results (Tuazon, et al., 2024).

Semantic indexing of the information used in RAG also improves the output of the models. Embeddings are anyway an indexing technique that is more advanced than those used in this research.²⁵

Nowadays, AI platforms give analysts the possibility to use various models with a similar programming interface. Comparing the results obtained from these different models not only holds scientific value, but also proves beneficial for automatically assessing the quality of the content created or obtaining more reliable outcomes through a majority report approach. GPT@JRC has an ongoing activity to evaluate commercial and open solutions and a joint study could improve the quality of the present implementation.

The advantages in having on-premise or even better, internally developed solutions are:

- Prompter implementation of a solution that is better aimed at the users' specific needs compared to a generalistic tool
- Better control of the software needed to make the AI tools available to the users: even if models are used as a black box, the exchange of information with the users must be controlled to avoid information disclosure or tampering

²⁵ Embeddings are the way LLMs capture semantic meaning. They are numeric representations of non-numeric data that an LLM can use to determine relationships between concepts. Embeddings can be used to help an AI model understand the meaning of inputs so that it can perform comparisons and transformations, such as summarizing text or creating images from text descriptions. ([How Embeddings Extend Your AI Model's Reach - .NET | Microsoft Learn](#))

- More means to exploit legacy solutions and private datasets
- More freedom in adopting the models and AI tools best fitting the needs: the JRC is already using other Machine Learning technologies to approach disaster management projects or to enhance existing ones.

With this approach it is also easier to enhance the transparency of the AI solutions.

5 Conclusions

In this study we demonstrated the usefulness of AI in the context of crisis management, by placing it in an environment that is not operational although very close to.

[In the four use cases, AI solutions reduce the effort of tasks both by reducing significantly the time needed to perform the same activities and allowing to increase the amount of information that can be analysed. Additionally, integrating the AI in a primary work tool such as MS Teams virtually eliminates the need to switch contexts, a time consuming and user labouring activity.

Taking on board new technologies can sometimes be challenging. Offering them through the integration with the normal work environment and specifically through the tool adopted throughout the whole Commission for collaboration and communication, MS Teams, is a winning strategy, because it reduces the learning curve and allows a smooth transition. It also benefits from the accessibility and ease of use of MS Teams without requiring the development of a new analyst interface.

Additional measures can be implemented to improve the prototypes presented, in order to reach a level suitable for production. This includes implementing automatic quality control to prevent the dissemination of incomplete or erroneous information to the analysts.

This approach also represents a valuable opportunity to implement the extraction of knowledge from historical archives of data and analytical products, which otherwise would probably never be done. This would allow (i) the identification of trends not necessarily already detected in past events and (ii) the compilation of the most needed databases about human losses and, in general, the impact of past disasters.

This study demonstrates the potential of AI in crisis management, providing a foundation for further exploration and application beyond the initial use cases. Rather than serving as a definitive or exhaustive assessment, this work highlights opportunities for expanding AI's role in enhancing operational efficiency and information processing across diverse scenarios.

Information sources

The boards defined in EIOS and used to collect information as described in 2.2 are described below.

Board profiled to follow news relevant for Conflict monitoring at global level

Included categories:

- Attack on HCW
- Bioterrorism
- Conflict
- Cyber Attack
- Forced displacement
- Forced return migration
- Genocide
- Political Unrest
- Social cohesion
- Terrorist Attack
- Water Conflict

Sources:

- AP
- afp-fr
- africaintelligence
- al-Arabiya
- alarabiya-en
- ansa
- barrons
- bbc
- crisisgroup
- criticalthreats
- iwpr
- kyvindependent
- reliefWeb
- reuters
- rferl
- unhcr-org
- unocha
- usnews

Time period: **(Import Date) Last 48 Hours**

Board profiled to generate contents for the ERCC Daily Flashes.

Included categories:

- Drought
- Earthquakes
- Floods
- Heatwave
- Hurricanes

- Landslides
- Natural Disasters
- Tornado
- Cyclonic storm
- Tsunami
- Typhoons
- Volcanic eruption
- Wildfires

Sources:

- AP
- GDACS
- aljazeera-en
- allafrika
- ansa
- bbc
- catnat
- euronews-en
- floodlist.com
- gardaworld
- paho-html
- reliefWeb
- reuters
- unocha
- xinhuanet_en

Time period: **(Import Date) Last 24 Hours**

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List of abbreviations and definitions

AI	Artificial Intelligence
API	Application Programming Interface (API)
DG	Directorate General
DG-ECHO	European Civil Protection and Humanitarian Aid Operations
DL	Deep Learning
EC	European Commission
ECML	European Crisis Management Laboratory
EEAS	European External Action Service
EIOS	Epidemiological Intelligence from Open Source
EMM	European Media Monitoring
ERCC	Emergency Response Coordination Centre
EU	European Union
GDACS	Global Disaster Alert and Coordination System
GIS	Geographic Information System
GPT	Generative Pre-trained Transformers
JRC	Joint Research Centre
LLM	Large Language Model
MediSys	Medical Information System
ML	Machine Learning
MLM	Machine Learning Model
NLP	Natural Language Processing
RAG	Retrieval Augmented Generation
SNC	Sensitive Not Classified
UN	United Nations

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