TEMA

TRUSTED
EXTREMELY PRECISE
MAPPING AND PREDICTION
FOR EMERGENCY
MANAGEMENT

TEMA training Handbook

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Introduction

The TEMA platform is an advanced system designed to manage natural disasters, with a specific focus on fires and floods. Written for control room personnel, this manual was created to provide a comprehensive and detailed guide to using the TEMA system, explaining all of its features and modes of operation.

This document includes detailed technical descriptions of Smartdesk, with human-understandable explanation of TEMA features as the detection of people and vehicles, the segmentation of fires, smoke, and flooding, and many other advanced tools. It also covers scenario-based training for fires and floods, with specific tasks for each type of emergency.

Our aim is to present the TEMA system, its objectives, and its main features in a clear and concise manner, and to guide the reader through the more technical sections of the document. The manual is structured to ensure a gradual understanding and efficient use of the TEMA system in emergency management.

The manual is intended for professionals working in disaster control and management who require a structured and detailed guide for using TEMA. This document, together with specific training sessions, is an essential resource for ensuring efficient and coordinated operations in emergency situations.

1. TEMA technology descriptions

1.1. Smartdesk (SV-tech-07)

Use cases

RAS/KAHY wildfire and BRK/D.MALIAN flood use case scenarios.

Brief description

The Smartdesk is a mission management application that is installed on a computer in the control room. This software can be installed on most modern Windows computers.

What does the end user see?

The basic components of the Smartdesk application are maps, current weather, map measuring tools, map annotations. In addition to those basic tools, the Smartdesk visualises other data sources and technologies in the TEMA project. That information is visualised precisely on the map. For example, the map shows fires or floods, where photos were taken, drones are flying and their planned route, risk zones, and more.

Where does the end user see it?

The Smartdesk application is where most of the TEMA technologies are visualized

Image and description

The large table-size touchscreen PC with the Smartdesk application running.



Image and description

The Smartdesk application running on a laptop.



1.2. Human-comprehensible presentation of concept-based explanations (TFA-tech-02)

Use cases

RAS/KAHY wildfire and BRK/D.MALIAN flood use case scenarios.

Brief description

TFA-tech-02 provides human-comprehensible concept-based explanations for the object detection of vehicles and persons, and the segmentation of fire and flood, implemented by TFA-tech-05 and TFA-tech-06.

What does the end user see?

Concept-based explanations are primarily intended for technical partners for debugging and improving their models through understanding *why* a given prediction was made. Though the end user can also access those explanations if needed.

The end user sees a heatmap highlighting input regions most decisive for the prediction, together with the prediction result itself (i.e., the bounding box of the detected object, or the segmentation mask of fire or flood) overlaid on the input image on the left side of the explanation.

Further, the most important concepts responsible for this result and their corresponding conditional heatmaps are retrieved in the middle part of the explanation. Concepts are features (shapes or colors) that contribute the most to the prediction. Those concepts are illustrated via reference images extracted from training data.

Finally, the right side of the explanation depicts the same results (i.e., the prediction and heatmaps) for a "prototype", which is another input image extracted from the training data that most resembles the current prediction.

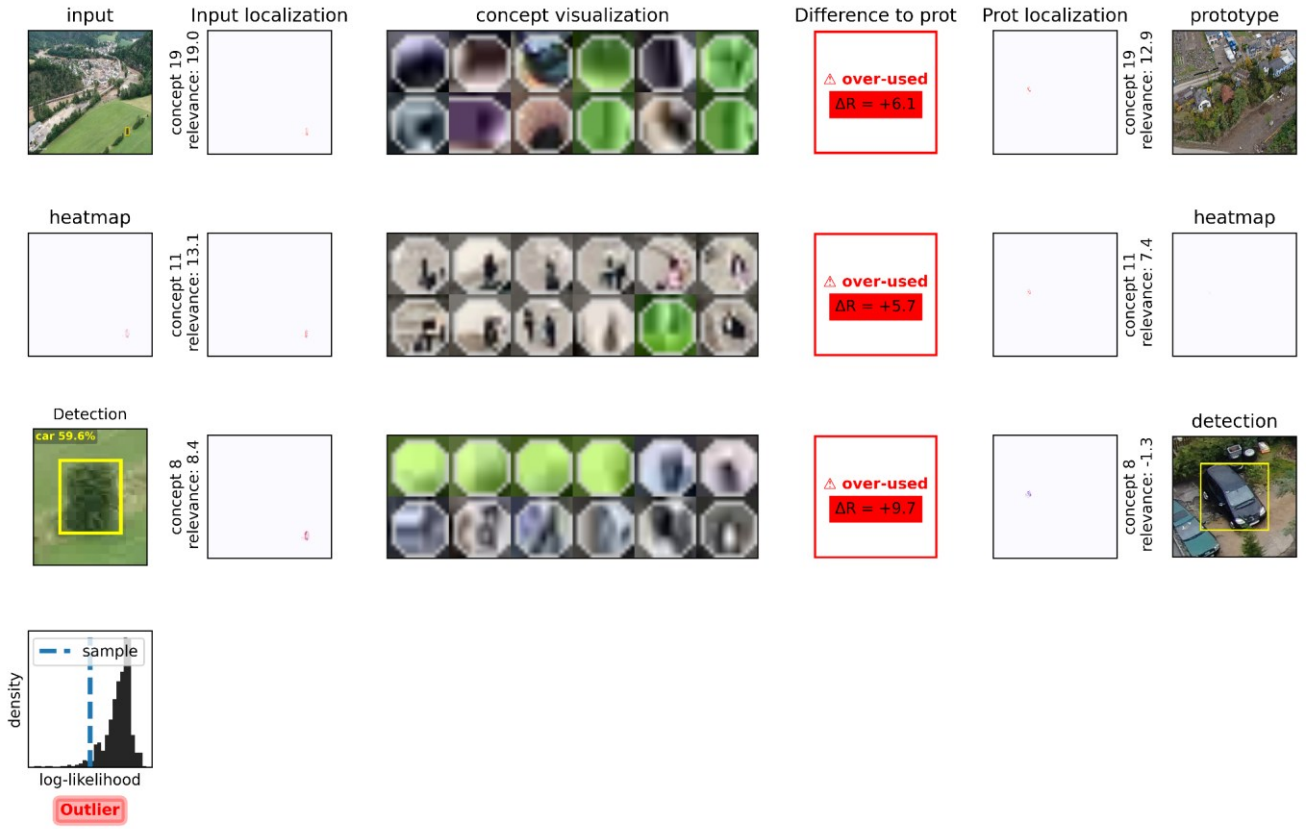
Most importantly, the "difference to prototype" column (which contains concept-based relevance score differences between the current input and the prototype, displayed inside green or red squares) enables one to inspect whether the current prediction is likely to be an "ordinary" one (in case the concept usage is similar between the current input and the prototype), or whether it is likely an "outlier" (in case the concept usage differs a lot).

Where does the end user see it?

Explanations are displayed on the SmartDesk provided by KAMK, and can be retrieved on-demand next to the prediction results of TFA-tech-05 and TFA-tech-06. Explanations are available via a clickable [Info] button that appears on the bottom toolbar when drone images are viewed.



Explanation for a vehicle detection result. The top-left corner of the explanation displays the object detection result as a yellow bounding box overlaid with the input image (here a red ambulance is detected in the input image). Below that, a heatmap highlights the most influential regions of the input image that contributed to this prediction. The three rows in the middle of the explanation ("concept visualization") depict the top three concepts responsible for that decision (each concept being illustrated via reference images that best represent each concept), alongside concept-conditional heatmaps. The first two concepts (concept 5 and 20) represent "red vehicle parts", and the third concept (concept 28) represents a "white vehicle part" most likely standing for the emergency vehicle lighting. (By default, concepts are numbered according to their channel number inside a convolutional layer of the prediction model). All three concepts are used in a "similar" fashion to the nearest prototypical prediction, which is depicted on the right side of the explanation. Hence the current prediction is labeled as an "ordinary" prediction (this label can be found at the bottom-left of the explanation).



Explanation for another vehicle detection result. Here again the top-left corner displays the object detection result as a yellow bounding box overlaid with the input image. Here a tree was mistakenly detected by the model as being a car. The nearest prototype on the right side of the explanation represents a prediction of a black car. We can see that “green concepts” (concept 19 and concept 8) representing vegetation, as well as the concept of “person” (concept 11) are “over-used” by the model for the current prediction w.r.t. the prototypical prediction, hence the current prediction was labeled as an “outlier”, indicating that this prediction might be unreliable.

1.3. Person/vehicle detection (TFA-tech-05)

Use cases

RAS/KAHY wildfire use case scenarios.

Brief description

In flood scenarios, TFA-tech-05 analyses drone images to automatically identify and highlight individuals and vehicles, enabling rapid localization of those in need and more efficient rescue operations.

What does the end user see?

The end user sees a clear pin overlaid on a 2D situational awareness map that marks the exact location of the detected person or vehicle in the flood area. Optionally, by clicking on this pin, a pop-up window opens that displays the corresponding drone image with the detected person or vehicle clearly highlighted within a bounding box, ensuring precise identification.

Where does the end user see it?

The pins of detected persons and vehicles overlaid on the 2D situational awareness map, and the optional pop-up window are displayed on the SmartDesk provided by KAMK.

Image and description



Detected persons (red) and vehicles (green) overlaid on the raw image captured by drone, displayed on the optional pop-up window. The colour of the bounding boxes highlighting the detected persons and vehicles can be adjusted (on request) according to the end-user's preferences.

1.4. Fire/smoke/flood/background segmentation (TFA-tech-06)

Use cases

RAS/KAHY wildfire use case scenarios. BRK/D.MALIAN flood use case scenarios.

Brief description

TFA-tech-06 processes (in real time) images captured by drones to quickly identify and highlight critical areas in emergency situations.

- For wildfires, TFA-tech-06 combines both RGB and InfraRed (IR) images and automatically spots image regions with fire and smoke. This information is then overlaid on a 2D or 3D situational awareness map using Information Fusion Technology, helping policy makers and first responders to quickly pinpoint dangerous zones and plan effective responses.
- In flood scenarios, TFA-tech-06 clearly separates floodwater from the rest of the scene. The processed data is overlaid on a 2D or 3D situational awareness map using Information Fusion Technology, providing a comprehensive view of the affected areas. This helps emergency teams assess the extent of flooding, plan evacuations, and direct rescue efforts efficiently.

What does the end user see?

The end user sees a layer of information overlaid on a 2D or 3D situational awareness map. This layer combines information from the processed drone images, processed satellite imagery, social media analysis and simulation results providing a comprehensive view of the affected areas and dangerous zones. This integrated data layer precisely maps the event's exact location and spatiotemporal extent on the 2D/3D situational awareness map.
Optionally, selecting a specific location on the map opens a pop-up window that displays the drone-captured image of the event (fire/flood) with the segmentation results clearly overlaid, providing a detailed view of the affected area on this specific location.

Where does the end user see it?

The layer of information overlaid on the 2D situational awareness map, and the optional pop-up window are displayed on the SmartDesk provided by KAMK.
The layer of information overlaid on the 3D situational awareness map is displayed on the Augmented Reality (AR) Headset provided by ND.

Image and description



Fire and smoke region segmentation overlaid on the raw image captured by drone, displayed on the optional pop-up window. The regions of the image depicting fire and smoke are clearly separated from the rest of the scene. The colour and opacity of the segmentation masks can be adjusted (on request) according to the end-user's preferences.

Image and description



Flood region segmentation overlaid on the raw image captured by drone, displayed on the optional pop-up window. The regions of the image depicting flood are clearly separated from the rest of the scene. The colour and opacity of the segmentation masks can be adjusted (on request) according to the end-user's preferences.

1.5. Person re-identification (TFA-tech-07)

Use cases

RAS/KAHY wildfire use case scenarios. BRK/D.MALIAN flood use case scenarios.

Brief description

TFA-tech-07 analyses in real time the images acquired by the drone to store the characteristics of a person detection on the image and give it a unique ID, in case the same person is detected in another image it can be re-identified.

What does the end user see?

The end user would see a unique ID to each detected person per image, representing that person.

Where does the end user see it?

The end user sees it associated with the detected persons overlaid on the SmartDesk provided by KAMK.

1.6. Flood processor (TFA-tech-08)

Use cases

BRK/D.MALIAN flood use case scenarios.

Brief description

Conventional satellite-based emergency mapping methods, as deployed for example by the Copernicus Emergency Management Service (CEMS), can be slow and labour-intensive. Recent advances in deep learning and the availability of new large-scale remote sensing datasets have opened new possibilities for automated image analysis. In TEMA we have developed novel deep learning methods to automatically analyse Sentinel-1 (radar) and Sentinel-2 (multi-spectral) satellite images and to extract binary water masks at 10 meters pixel-spacing. Time-series analysis is used to further derive secondary products about permanent water bodies and flood duration. The methods are implemented into a modular processing chain for surface water monitoring that enables automatic satellite data search, pre-processing, analysis, and dissemination over predefined areas of interest.

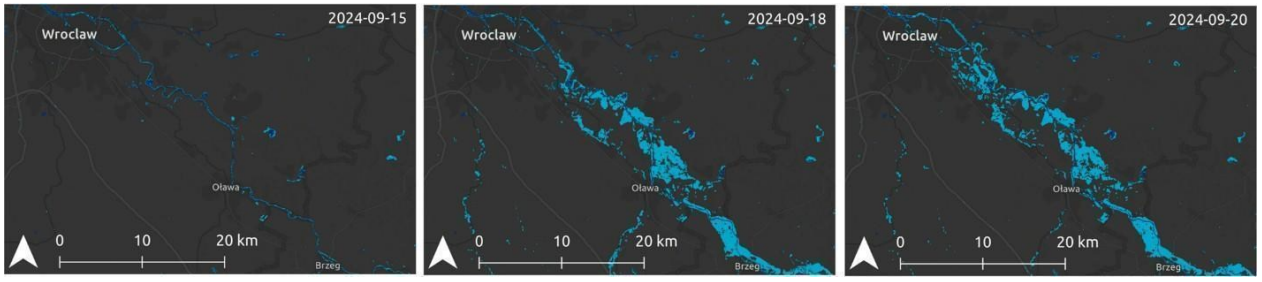
What does the end user see?

Water extent at 10 meters pixel spacing for large-scale situational awareness about potential hazard zones (flooded areas). Spatio-temporal evolution of flooded areas with a temporal resolution of 1 to 3 days (depending on satellite orbit and location of the area of interest).

Where does the end user see it?

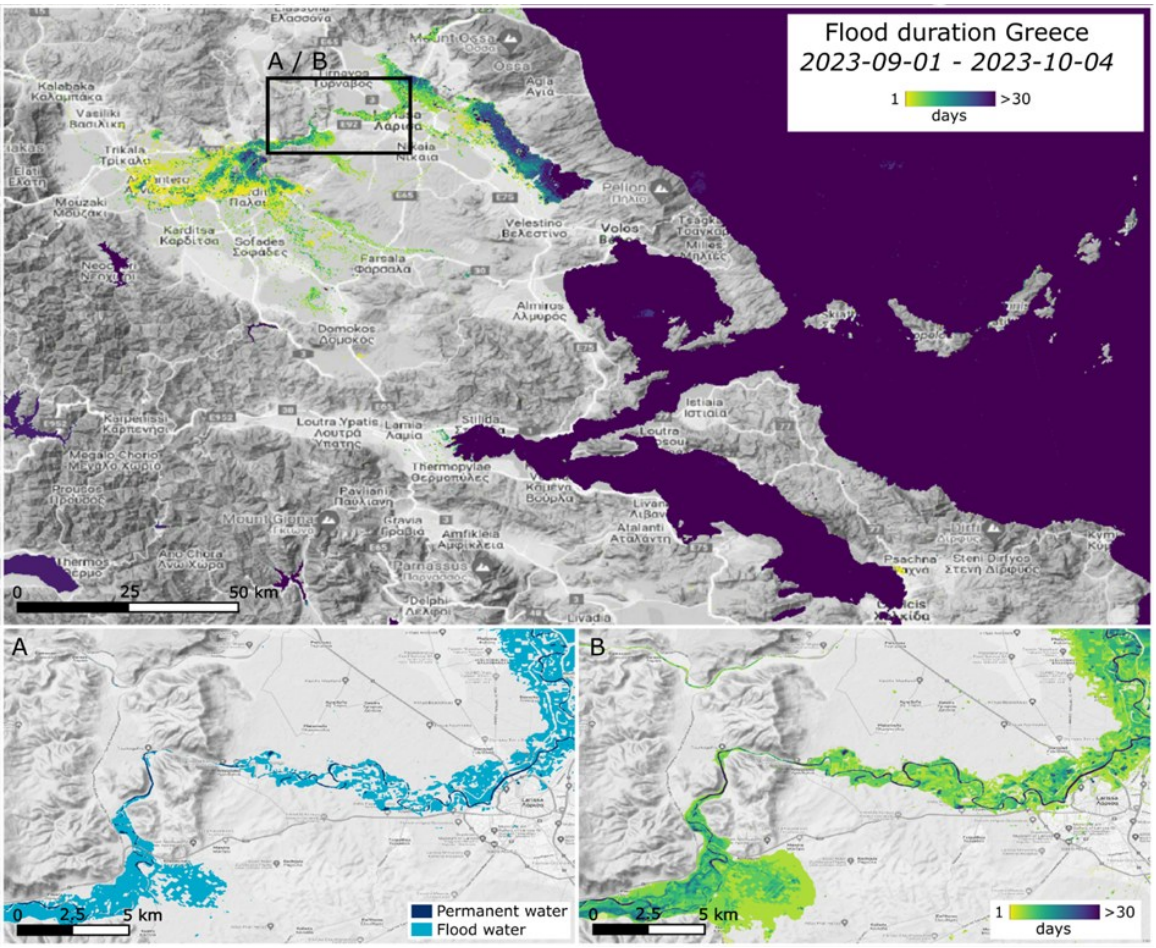
Information Fusion, Smart Desk, Digital Twin

Image and description



The flood situation over Wrozlaw, Poland between 2024-09-15 and 2024-09-20. Flood extent (light blue) and permanent water bodies (dark blue) were extracted from Sentinel-1 (radar) and Sentinel-2 (multi-spectral) satellite images by DLR's automated flood processing chain.

Image and description



Results from satellite-based flood monitoring over Greece with examples showing inundated areas on 2023-09-09 (A) and flood duration from 2023-09-01 until 2023-10-04 (B) around the city of Larissa.

1.7. Burn area processor (TFA-tech-09)

Use cases

RAS/KAHY wildfire use case scenarios

Brief description

Conventional satellite-based burnt area mapping methods, as deployed for example by the Copernicus European Forest Fire Information System (EFFIS), can be slow and labour-intensive. Deep learning methods in combination with rule-based expert knowledge allow for the derivation of accurate, automated burnt perimeters in near-real time. In TEMA we have further developed deep learning methods to automatically analyse satellite images from multiple sensors to extract burnt area masks with a spatial resolution of 250/300m and a temporal resolution of 4x / day, as well as up to 10 meters spatial resolution, available every 5 days. The methods are implemented into a modular processing chain for burnt area monitoring that enables automatic satellite data search, pre-processing, analysis, and dissemination over continental-scaled areas of interest.

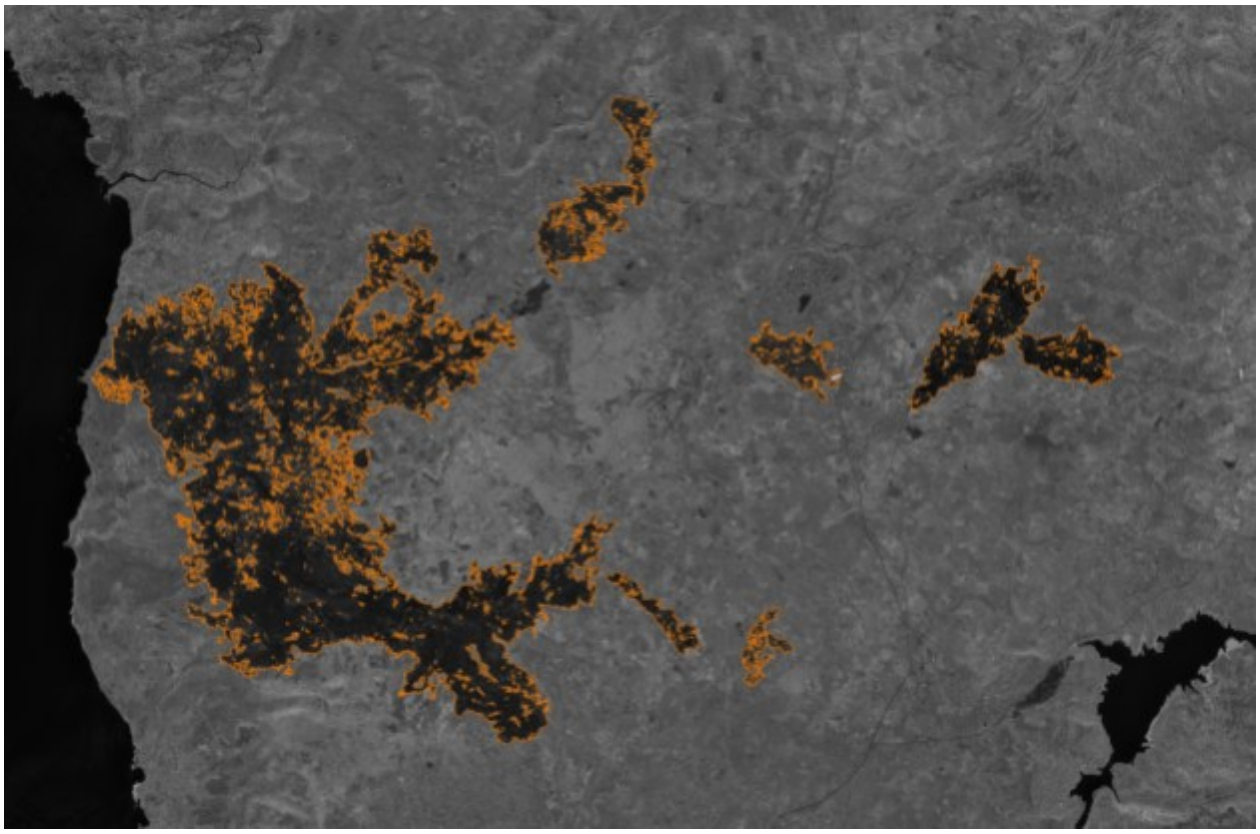
What does the end user see?

Burnt areas based on satellite imagery of the sensors Sentinel-3 OLCI, Aqua/Terra MODIS, Sentinel-2 MSI.

Where does the end user see it?

Information Fusion, Smart Desk, Digital Twin

Image and description



The image shows the derived perimeter for the Montiferri wildfire in Sardinia, August 2021. The NIR band of the Sentinel-2 (10m) image used for the derivation is shown as a background.

Image and description



The image shows the derived perimeter for the wildfire in the Kuhmo region / Finland, in May 2024. The RGB bands of the Sentinel-2 image (10m) used for the derivation are shown as a background.

1.8. Privacy preservation during visual analysis (TFA-tech-10)

Use cases

RAS/KAHY wildfire use case scenarios. BRK/D.MALIAN flood use case scenarios.
Data processing after each trial in order to determine and address private data sharing issues.

Brief description

The privacy preservation tool receives video frame inputs and person/car detections (from TFA-tech-05) and outputs new video frames where the detected person faces, and car plates have been processed in order to render them no longer re-identifiable.

What does the end user see?

The user sees processed video frames where facial recognition and car plate reading is no longer possible.

Where does the end user see it?

This technology cannot be seen by the end user during trials or in Smartdesk, as it is merely used as post-processing.

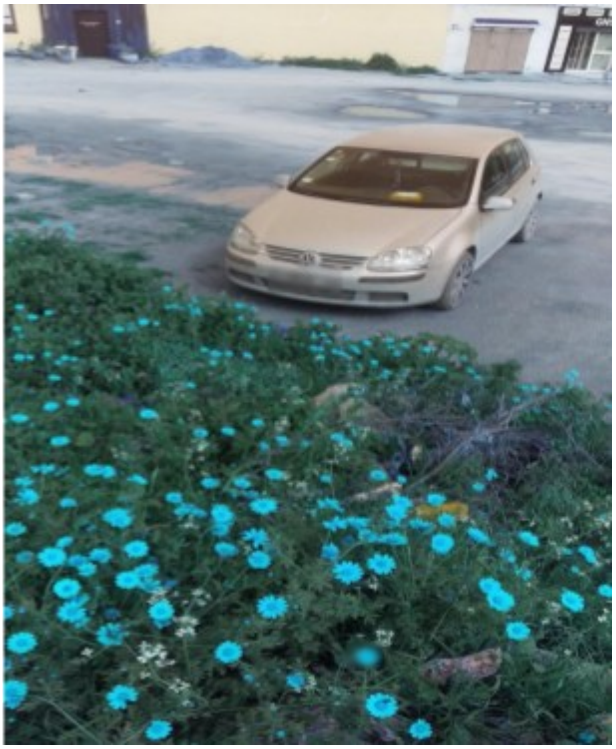
Image and description



Outputs of the technology. Processed video frames where faces are no longer recognizable.

Image and description





Processed video frames where car plates are no longer readable.

1.9. Geo-social media analysis (TFA-tech-11)

Use cases

RAS wildfire use case scenario. BRK/D.MALIAN flood use case scenarios.

Brief description

TFA-11 analyses social media content to highlight affected areas and provide crowd-sourced, in-situ information in real time. It processes posts from multiple social media platforms (X, Bluesky, TikTok, Telegram, Mastodon, etc.), extracts location and identifies thematic clusters, emotions (fear, anger, joy, sadness) and activity hot spots. These results are then overlaid on a 2D situational awareness map to support timely decision-making for emergency response teams and policy makers.

For all use cases, TFA-11 uses advanced natural language processing and geospatial analysis. It clusters posts into topics based on their text contents (topic modelling) and identifies the underlying emotions. Furthermore, it outlines those that are disaster related and uses the extracted information to specify disaster-related social media content hotspots, depicted as hexagons. The technologies used are capable of handling multiple languages simultaneously (English, German, Italian, Greek) and thus work for all use cases of TEMA.

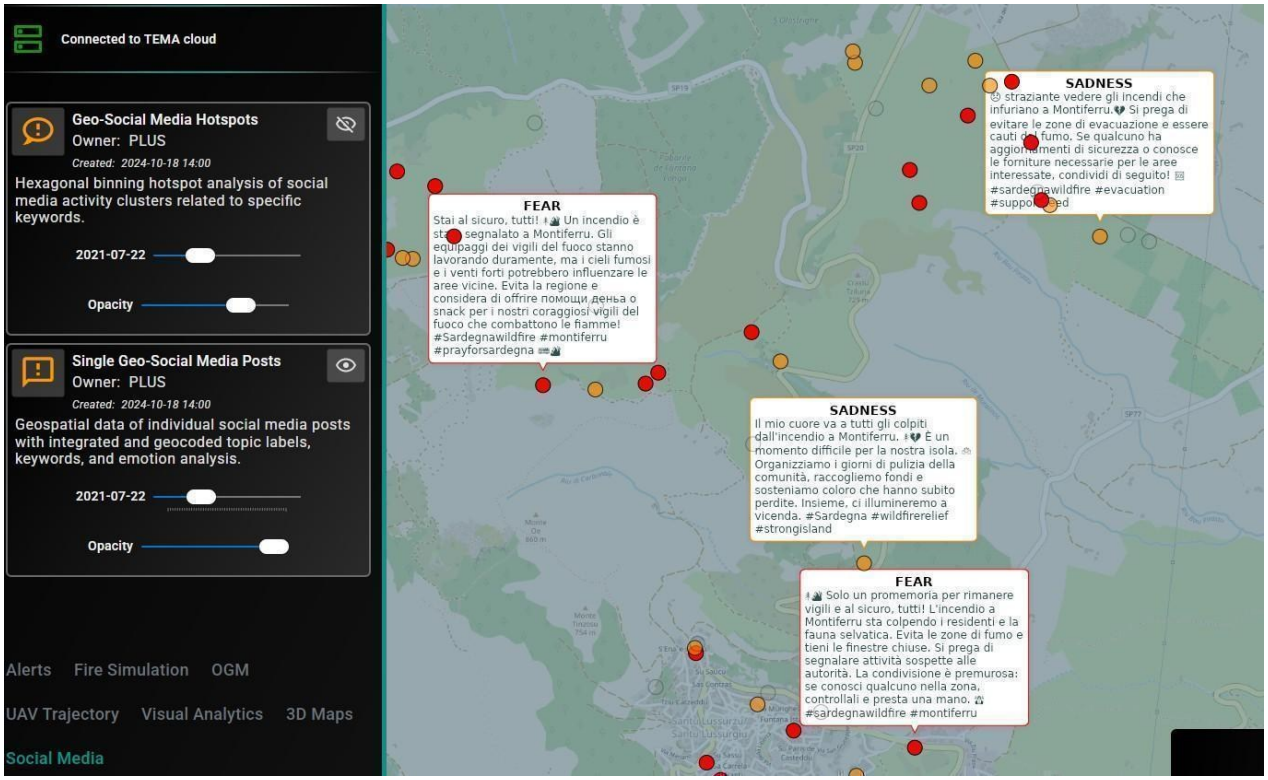
What does the end user see?

The end user sees individual posts as points on a 2D situational awareness map. The posts are coloured by their underlying emotion. Additionally, he/she sees hexagonal grid cells that cover the areas within the AOI, which are coloured based on the number of disaster-related tweets occurred within that cell. E.g. Darker cells indicate higher disaster-related tweet activity.

Where does the end user see it?

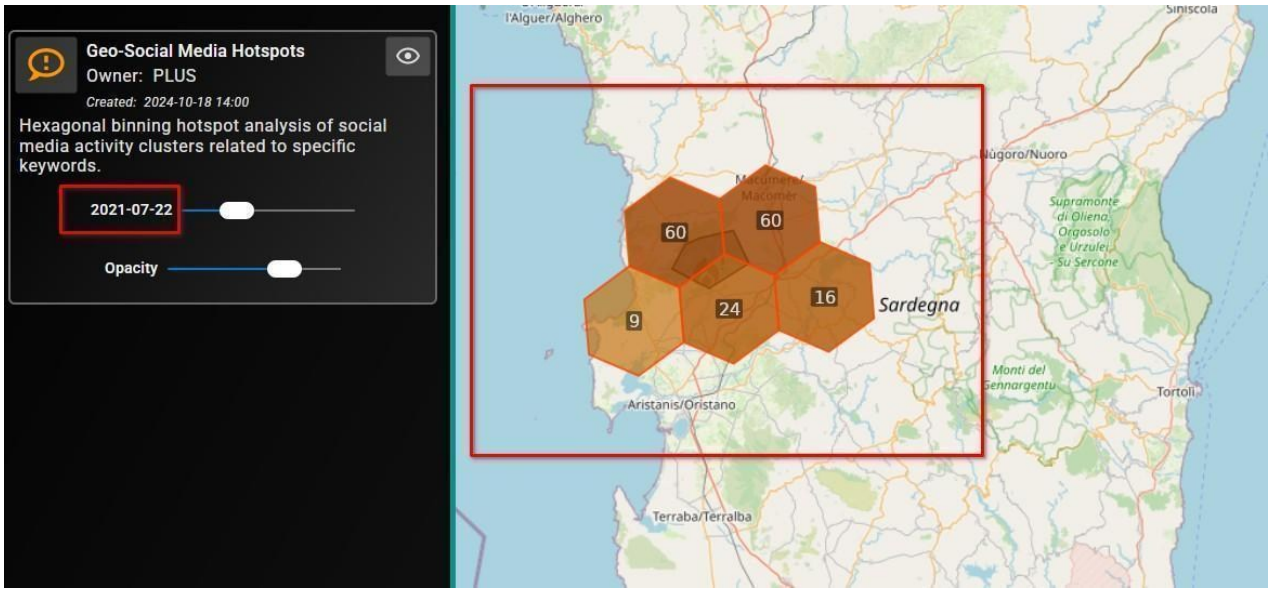
The information layer overlaid on the 2D situational awareness map, and the optional pop-up window are both displayed on the SmartDesk provided by KAMK.

Image and description



Individual social media posts, coloured by their sentiment (red=fear, orange=sadness, grey=joy) on the 2D situational awareness map. Using the date slider, the user can decide until which date the social media data should be displayed.

Image and description



Social media hotspot grids coloured based on the number of disaster-related posts occurred on the particular day selected using the slider. This number is indicated as an absolute integer in the corresponding hexagons as well.

1.10. Wildfire analyst – forest fire simulation (PDM-tech-01)

Use cases

RAS/KAHY wildfire use case scenarios.

Brief description

Wildfire Analyst® (WFA) is a software tool designed to assist fire managers, firefighters, and other stakeholders in making informed decisions regarding wildfire management and response. WFA FireSim module provides real-time analysis of wildfire behaviour and simulates the spread of wildfires in seconds to support real time decision making.

What does the end user see?

FireSim provides outputs within the considered simulation perimeter. This simulation perimeter is defined by isochrones that represent the number of hours of the simulation. Hence, the respective outputs are calculated from the location(s) of the ignition point(s) until reaching the maximum of the simulation hours that were defined.

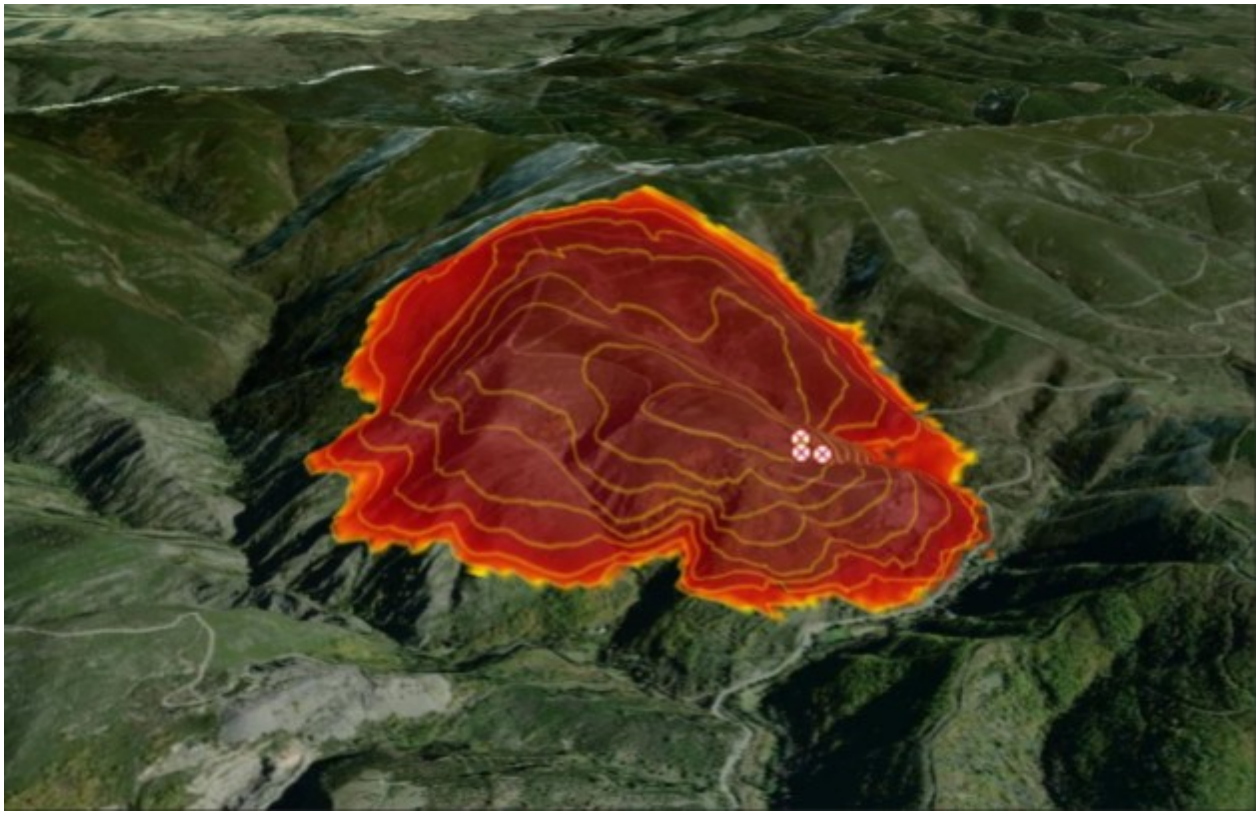
The fire behaviour outputs FireSim can provide are shown in the table below:

Fire behaviour layer	Short description
Arrival Time Vector (h)	Hourly fire perimeters
Rate of Spread (m/min)	Speed of the fire for each cell of the simulation
Flame length (m)	Expected height of the flames
Fireline Intensity (kW/m)	Expected intensity of the flames
Firepath	Main paths taken by the fire in the simulation. It shows the fire cells that are estimated to be most active in the fire (minor, secondary, main)

Where does the end user see it?

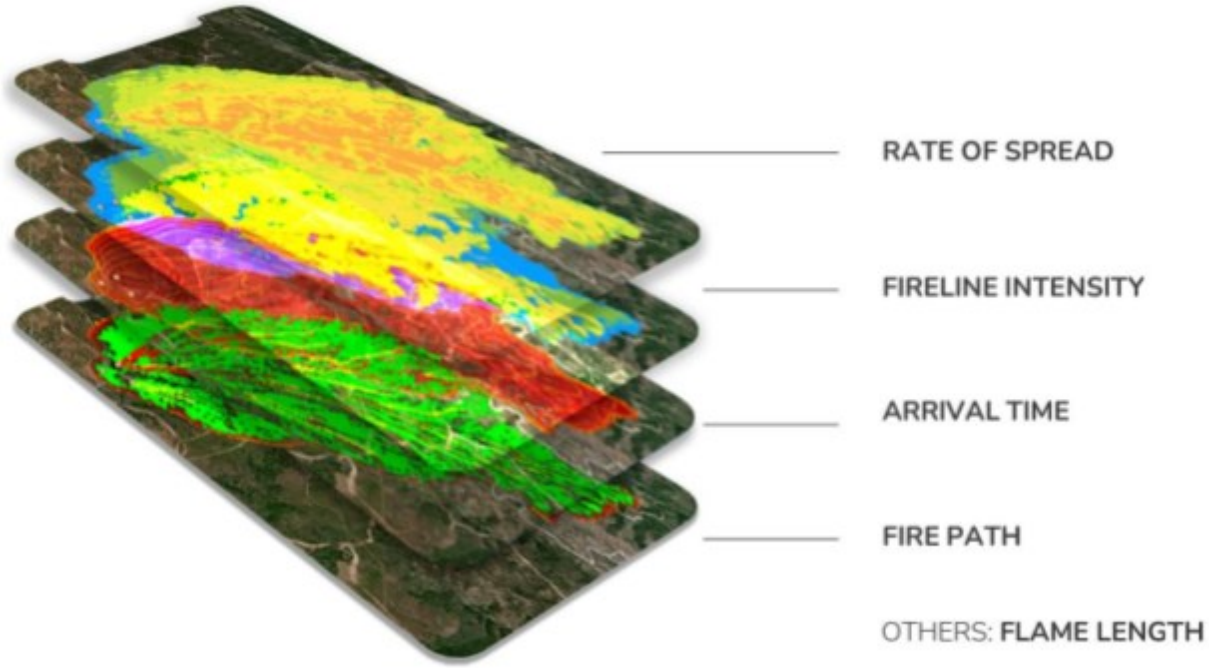
Smart Desk, Digital Twin.

Image and description



Arrival time output for an 8-hour simulation.

Image and description



Different fire behaviour outputs showing the values per pixel of the different fire variables calculated in the current simulation. A legend is generated on-the-fly for Smart Desk visualization.

1.11. Flood simulation – 3Di Water Management (PDM-tech-02)

Use cases

BRK- flood scenario and D.MALIAN flash flood scenario.

Brief description

3Di Water Management is a simulation software, which can be used in water management studies and during floods. It allows the user to simulate real-world scenarios and adjust them. The 3Di simulation software calculates in which direction water flows, how much water flows in these directions and where floods will be at a certain moment in time. It is designed for emergency response teams to gain a mutual understanding of a flood event and gives the option to try out measures in scenarios to prevent and mitigate the impact of a flood. 3Di Water Management can simulate rainfall events, riverine floods, coastal floods, dike breaches or a combination of these events.

What does the end user see?

3Di Water Management produces maps of areas of interest with information of the predicted event. For example, per timestep of the simulation, a water depth map can be generated to highlight locations which are prone to flooding, where water will accumulate or gather. Over time, it becomes visible how a flood propagates over an area and gives information about maximum water depths that occur at specific locations. This information allows emergency response teams to make informed decisions whether an area is still accessible or safe to enter.
Beside maps where water depths or water levels per time step are generated, 3Di Water Management can produce information of flow velocities at critical locations, such as bridges, dams, or highways. It can predict the arrival time of water at a certain point, so that the end-user knows when and if a location will be flooded.

Where does the end user see it?

The end-user will see these maps in the SmartDesk as 2D-maps.
The end-user will see these maps as well in a Digital Twin environment on the SmartDesk as a 3D-map, where water levels are matched and visualized in a 3D-model environment.
These 3Di Water Management results from the 3D-model are visualized as well in the XR-headsets, which will be used for training purposes of fire fighters or emergency response teams.

Image and description

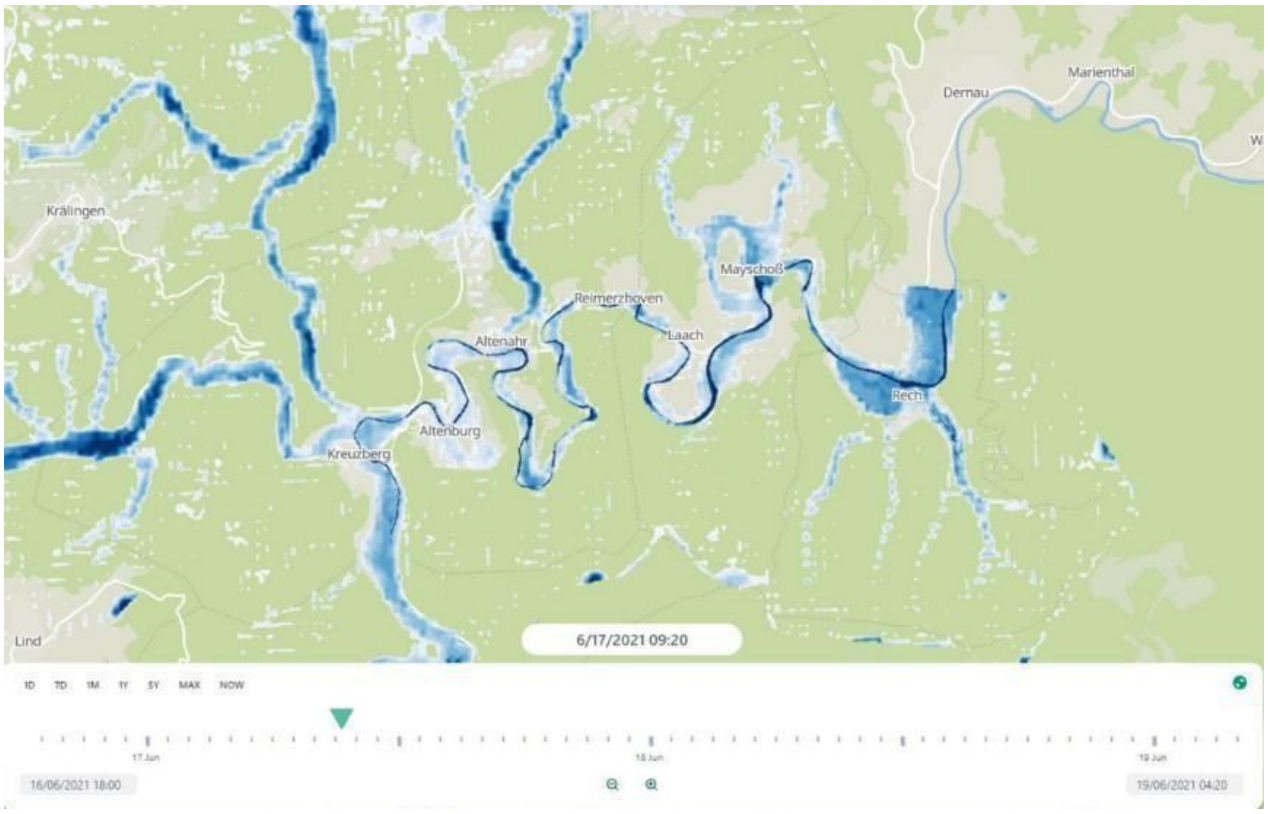


Image and description



1.12. Information fusion (PDM-tech-05)

Use cases

RAS/KAHY wildfire use case scenarios.
BRK- flood scenario and D. MALIAN flash flood scenarios.

Brief description

Information Fusion is a core service that continuously consolidates all situational data into a single operational view. It ingests drone-borne segmentation masks, satellite detections, social media, and physics-based forecasts (outcomes of the predictive models, e.g., FireSim and 3D hydrodynamics), reconciles their spatial resolutions, and updates the underlying occupancy-grid model in real time. Every incoming notification is processed the moment it arrives. Probabilistic filtering assigns an explicit confidence value to each grid cell, so active fire fronts, flood extents, and tracked objects appear with clear, colour-coded probabilities. The resulting layers (Maps4Fire, Maps4Flood, Maps4Objects) are streamed directly to the TEMA dashboard to show near real-time the current status of the monitored natural disaster.

What does the end user see?

- Maps4Fire / Maps4Flood (Natural Disaster layers)
    - The natural disaster surface is rendered in grayscale:
        - Very light grey → high probability of fire or inundation in that cell.
        - Dark grey → low probability (little or no evidence of hazard).
        - As fresh drone, satellite, or forecast data arrive, the greyscale intensities adjust automatically, letting you spot the event's growth or recession at a glance.
        - A scale bar in the legend converts grey tone to probability (0 – 1) for quick interpretation.

- Maps4Objects (object-tracking layer)
    - Each detected object appears as a small marker labelled with its class and confidence:
        - Person (0) e.g., Person (0.82)
        - Vehicle (1) e.g., Vehicle (0.75)
        - The numeric score (0–1) indicates the current likelihood of the detection being correct, and it is updated every time new UAV imagery or social-media evidence is fused.

Where does the end user see it?

The end-user will see these maps in the SmartDesk as 2D maps.

Image and description

The image below illustrates the Maps4Fire probability map for the Montiferru (RAS) fire scenario. The semi-transparent grey polygon outlines the Alert's ROI, and within it, each grid cell is rendered in grayscale, very light tones for high fire probability (active flames), medium greys for moderate risk, and dark greys for low or no fire likelihood (burnt area). This layer updates automatically with new UAV, satellite, and geo-social media analysis (Hotspot), and the predictive models' inputs, providing an at-a-glance view of the fire's most intense areas.



Image and description

The image below shows the Maps4Objects; the yellow dots represent individual detections, either a person (class 0) or a vehicle (class 1) (you can know the class of the tracked object by pointing at it). The Maps4Objects shows in near real-time the detected and tracked objects.



1.13. Decision support for remote sensing (PDM-tech-06)

Use cases

BRK flood use case scenario. D.Malian flood use case scenario. KAHY wildfire use case scenario.

Brief description

The decision support tool automatically processes and fuses web data (e.g. public alerts, sensor observations, weather forecasts), identifies areas of interest (i.e. the warning area) and intersects them with relevant satellite image acquisitions. This approach improves the end user's situational awareness by automatically generating decision proposals.

What does the end user see?

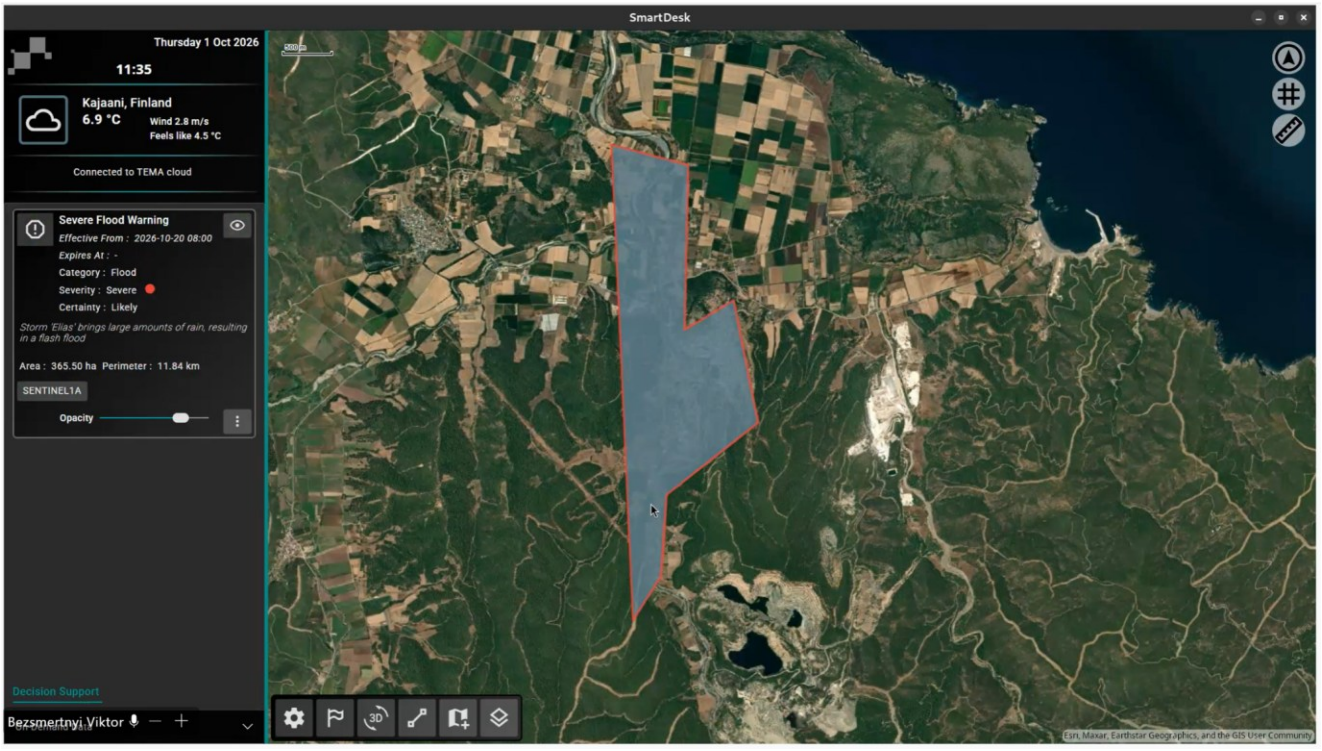
Decision proposals include the warning area on the map and a description. In addition, the user can see planned and acquired satellite data acquisitions. This is useful for users that work in satellite-based emergency mapping. They get aware of when which type of satellite data gets available for the generation of crisis maps, satellite-based flood extent and burnt areas. The user is supported by transparency on the underlying data sources, the expected (and actual) time of satellite data acquisition, attributes of relevance and overlap of satellites for events.

Where does the end user see it?

Smart Desk under the tab “Decision Support” as well as E-Mail report containing information on incidents, related warnings & satellite acquisitions.

Image and description

Geospatial display of the warning area in the SmartDesk on the map and additional information on the warning and alerting agency and available satellites on the left-hand side. The warning area is surrounded by color depending on the severity.



Once the user selects a satellite the respective satellite acquisition segment is shown as an overlay in the map. Acquired satellite data is marked by a green border while planned acquisitions appear with a blue border. Information on the overlap/coverage of the warning area and the timing can be displayed by

selecting a satellite segment in the map.

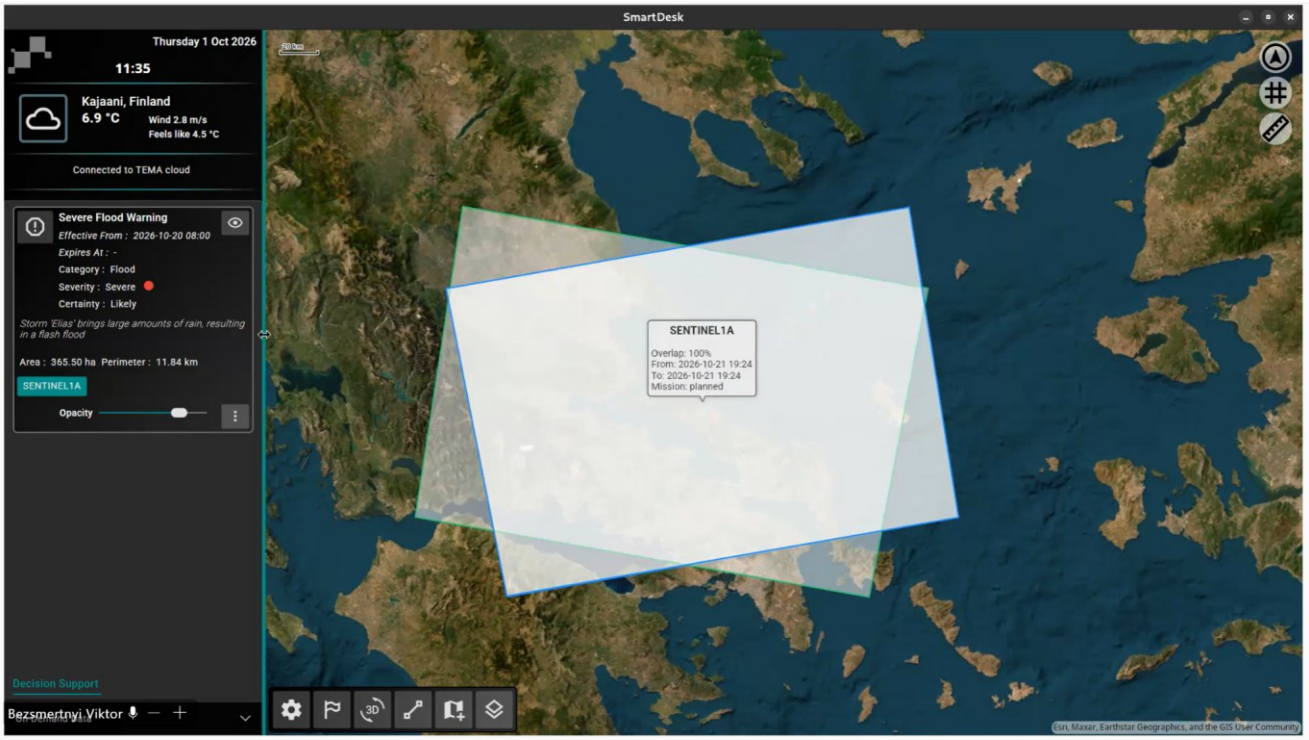


Image and description

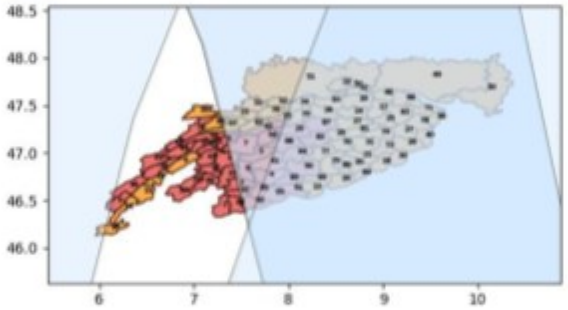
E-Mail report containing for each reported incident information on related warnings and planned/acquired overlapping satellite overpasses.

#3 Meteorology: Incident **from 2024-10-01 09:00 to 2024-10-02 09:00.**

95 warning(s) with highest severity: Severe from MeteoAlarm, DWD. The max. certainty is **Likely**

4 overlapping satellite segments found with a maximum overlap of 80%

- **Planned: 4**
- **Acquired: 0**



Satellite Segments overlapping incident

Satellite	Priority	Overlap	Mission Status	Start at
Sentinel-1A	1	80	planned	2024-10-01T17:12:00
Sentinel-1A	1	80	planned	2024-10-01T17:12:00
Sentinel-2B	2	61	planned	2024-10-02T10:17:42
Sentinel-1A	1	0	planned	2024-10-03T05:44:24

1.14. Drone-based image and data acquisition (SV-tech-01)

Use cases

RAS/KAHY wildfire use case scenarios.
BRK- flood scenario and D. MALIAN flash flood scenario

Brief description

Drone-based Image and Data Acquisition (SV-tech-01) is an edge-layer technology that captures high-resolution imagery (visual and thermal) with essential metadata and multi-sensor data directly from unmanned aerial vehicles (UAVs). Operating on both the drones and a dedicated base station, it creates a seamless front-end for the TEMA platform. During emergency-response and natural-disaster management, such as wildfires or floods, SV-tech-01 enables rapid aerial reconnaissance, streaming real-time data to first responders. These live, high-definition feeds are important to assess damage, locate survivors, and track critical assets and vehicles with precision.

What does the end user see?

Image stream

Where does the end user see it?

1. On the base station (e.g. laptop) on which the SV-tech-01 is deployed to receive the transmitted data e.g., stream of images
2. On the drone remote controller (RC)

Image and description

The image below presents an RGB aerial frame captured by a drone-mounted visual camera. It is enriched with comprehensive geospatial metadata, precise GPS coordinates, camera pose, viewing azimuth and pitch, flight altitude, and more, so the scene can be accurately georeferenced and seamlessly integrated into downstream mapping and analytics workflows.



Image and description

The image below illustrates a drone-captured thermal (IR) scene. It comes enriched with geospatial metadata, GPS coordinates, camera orientation, viewing angle, altitude, and other key EXIF tags, ensuring the frame can be precisely georeferenced and aligned with mapping and analytics workflows.



1.15. 3D computer vision – Photogrammetry (SV-tech-03)

Use cases

RAS/KAHY wildfire use case scenarios.
BRK/D.MALIAN flood use case scenarios.

Brief description

SV-tech-03 utilizes photogrammetry to process drone-captured images, creating high-resolution 3D models and 2D orthophotos that accurately represent the current state of an area affected by a disaster. These outputs provide detailed spatial information for emergency planning and response. The 3D models are available as interactive visualizations, while the 2D orthophotos support detailed analysis and presentation, integrating with other TEMA technologies for comprehensive situational awareness.

What does the end user see?

The end user sees a high-resolution 3D model of the disaster area, navigable in real time, alongside a 2D orthophoto providing a top-down view of the terrain. The 3D model highlights key features such as damaged infrastructure, fire perimeters, or flood extent, while the orthophoto offers precise measurements of affected areas. Both outputs are overlaid with annotations (e.g., risk zones, detected objects) from other TEMA technologies (e.g., TFA-tech-05, TFA-tech-06).

Where does the end user see it?

In the Smartdesk and the XR Viewer.

1.16. XR interactive visualization (SV-tech-06)

Use cases

RAS/KAHY wildfire use case scenarios.
BRK/D.MALIAN flood use case scenarios.

Brief description

SV-tech-06 integrates 3D models from SV-tech-03 with additional 2D and 3D data (e.g., segmentation results, simulation outputs) into an interactive XR (Extended Reality) viewer. This enables immersive exploration through a VR headset, allowing users to navigate disaster areas, analyse spatial relationships, and interact with real-time data in a fully immersive environment. The system supports intuitive controls for zooming, rotating, and annotating, enhancing decision-making for first responders and policymakers.

What does the end user see?

The end user sees an immersive 3D real-time view of the disaster area through a VR headset, combining the 3D model from SV-tech-03 with dynamic data layers (e.g., fire spread from PDM-tech-01, flood extent from PDM-tech-02). The visualization includes interactive elements such as clickable pins for detected objects (e.g., persons, vehicles from TFA-tech-05) and colour-coded risk zones. Users can toggle data layers, measure distances, and view pop-up details (e.g., water depth, flame intensity) in the immersive environment.

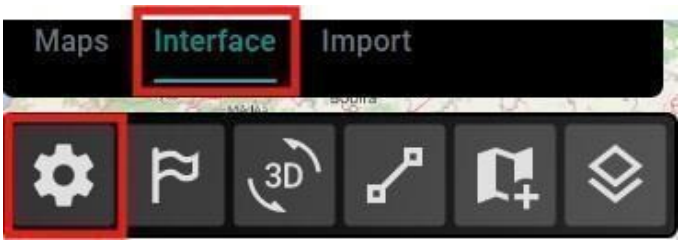
2. Smartdesk learning manual

2.1. Introduction

Settings

F11 - toggle full screen mode. On some laptops, [fn] button + F11 button.

Users can change the user interface scaling/ interface size to be more visible on smaller or bigger monitor. To change the size of the interface, navigate to the [Settings] and choose [Interface]. The scale factor setting is used to increase or decrease the size of menus and text in the whole app.



Saving and annotating images

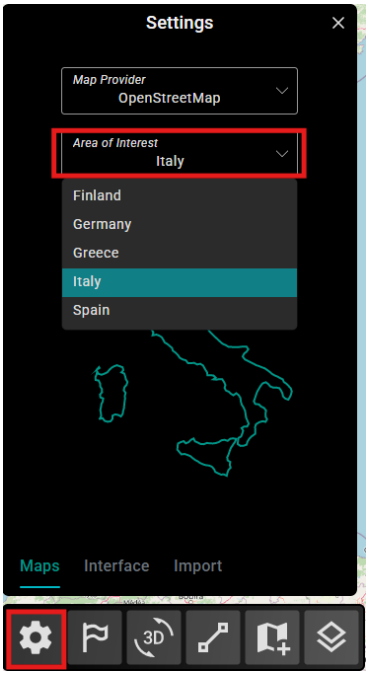
Users can annotate images from the map, drone or video recordings.
Images from map - By right-clicking on the map, select [snapshot].
Images from drones – double-click on any drone image.
Videos – Open a video, pause it and click the camera icon.
The user can crop, draw, add text, blur, add shapes and crop. Images can be copied to the clipboard or saved to the PC. Exported images will have a watermark TEMA logo.



To save the image, click on the three-dot menu (hamburger menu) and select [Save] or click ‘Ctrl+S’. Users can also right-click and select [Save].

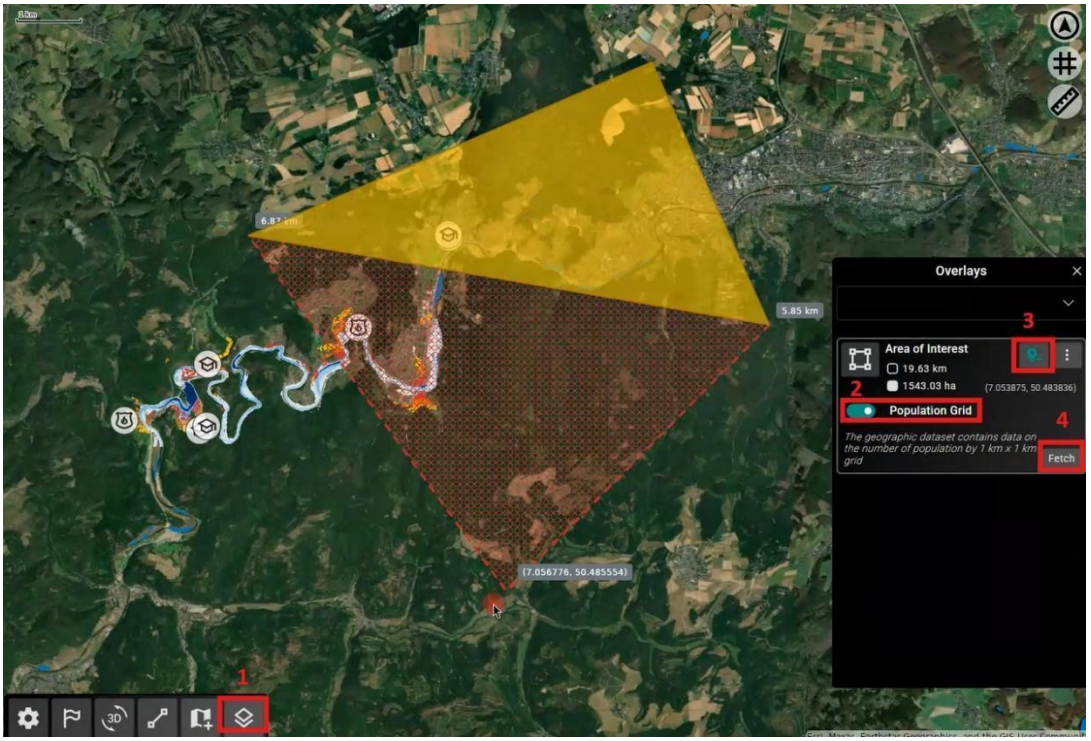
Map types and country selection

Different map types are provided, and more can be added on request. Maps are selected from [Settings] icon. The map and data are focused on the specific country that is selected.

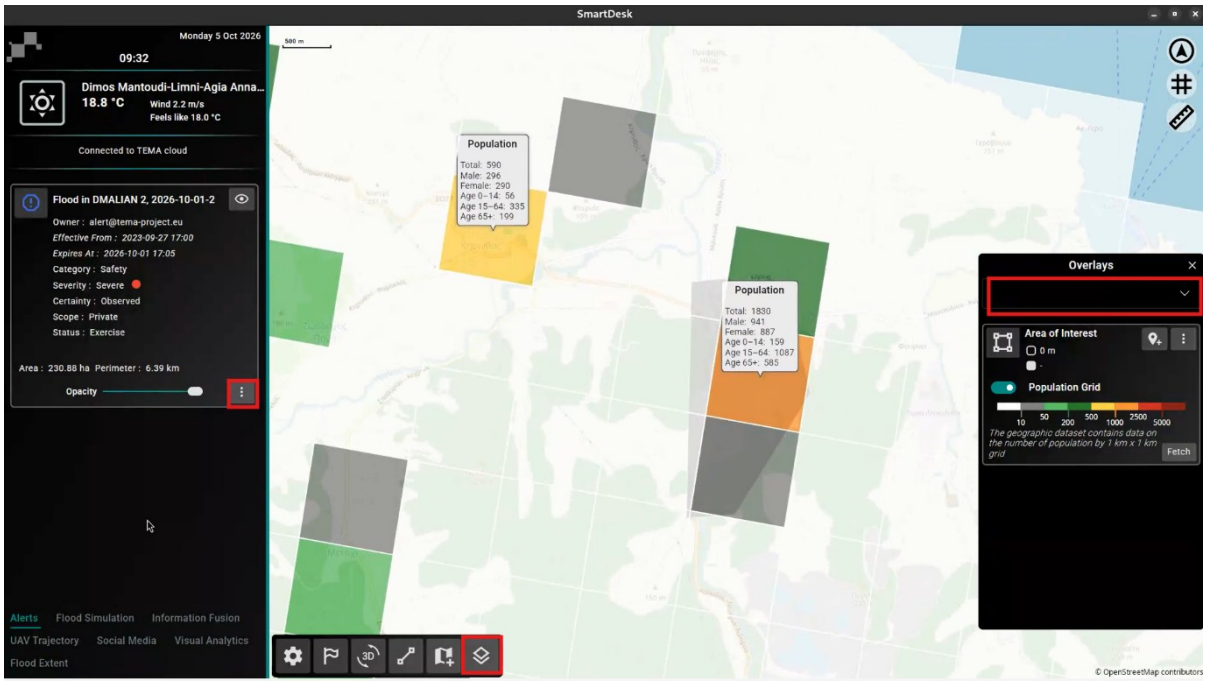


Map overlays

There are specific map layers relevant to each pilot. For example, population grid data at the 1km scale. The data is sourced for example from Eurostat or statistics Finland. These overlays are accessed through the [Overlays button] on the bottom menu bar. The user can then enable and disable different information layers.



Users can also share map overlays between SmartDesk: select the dropdown button at the top of the overlay menu that is on the right side and fill the information. The mission ID is found from the three-dot menu on the left side info card.



Show / hide information

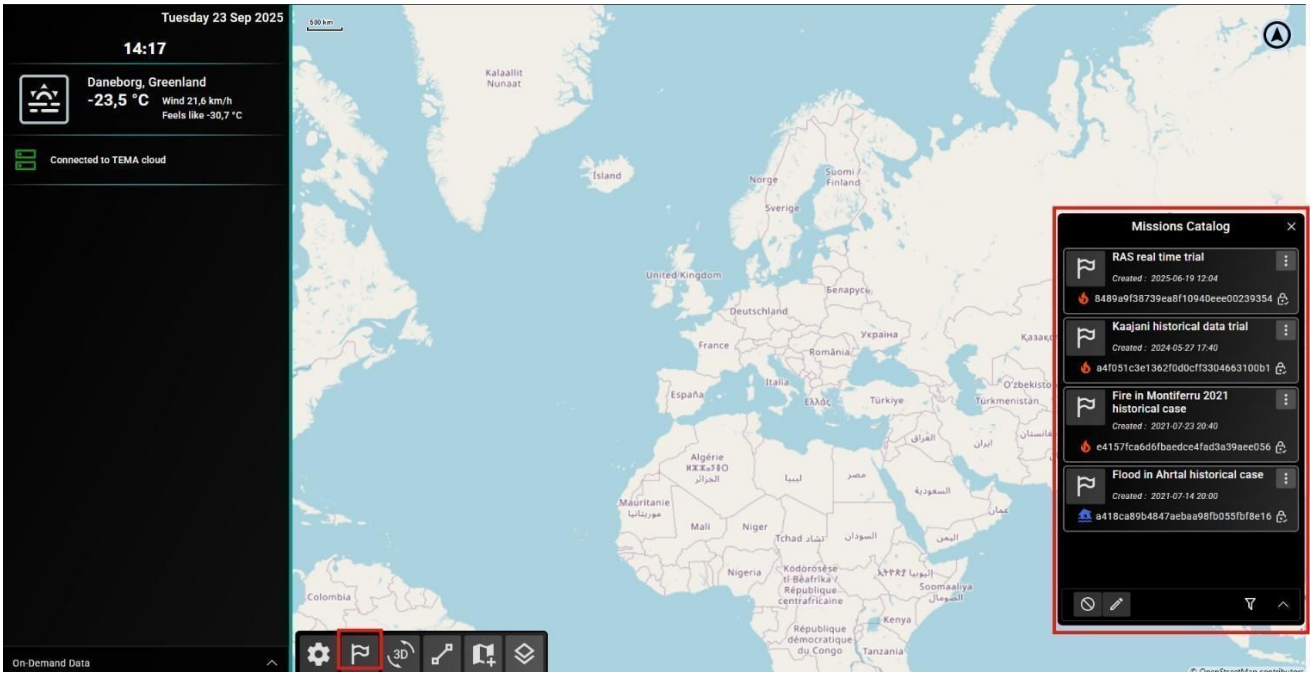
By default, information related to an incident is hidden. When an information tab is opened on the lef side, each data sample has a show / hide button, represented by an ‘’eye’ icon. By clicking the ‘’eye’’ icon, the information is shown.



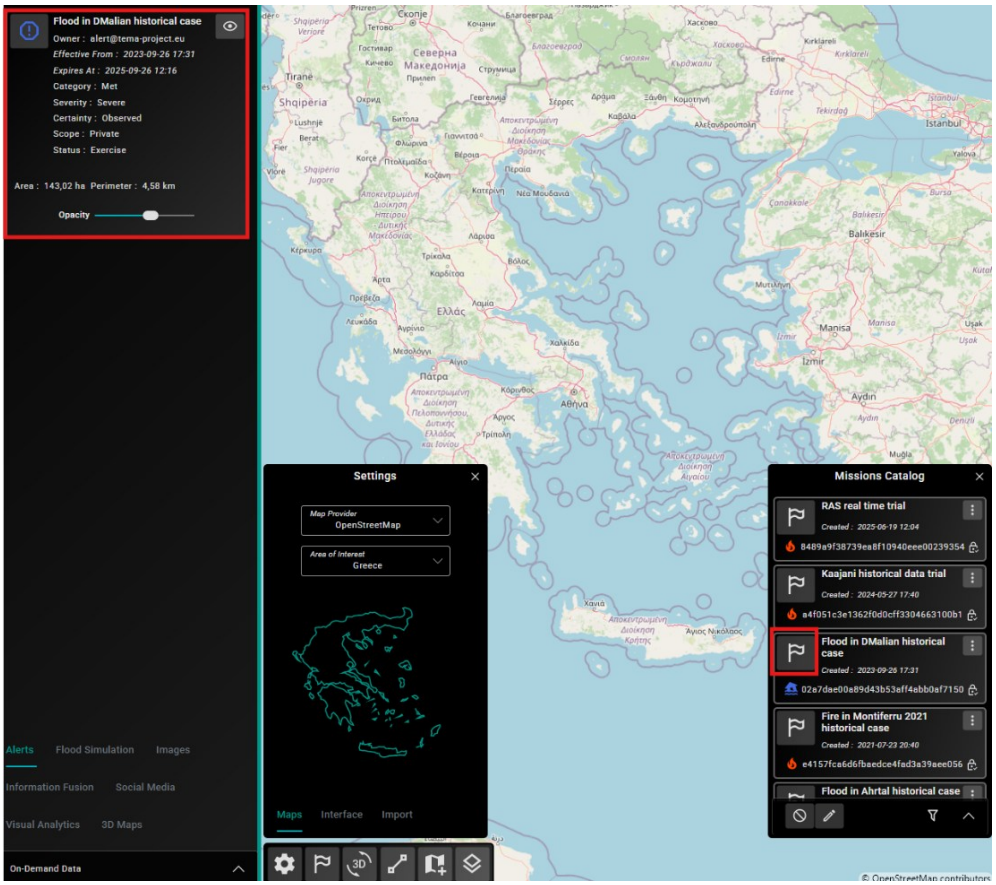
Missions Catalogue

Shows a list of missions chronologically. The sandbox version includes two missions, a flood example, and a fire example.

The [missions catalogue] is accessed by clicking the [flag icon]. To show data specific to an incident, click on the flag next to the incident information.

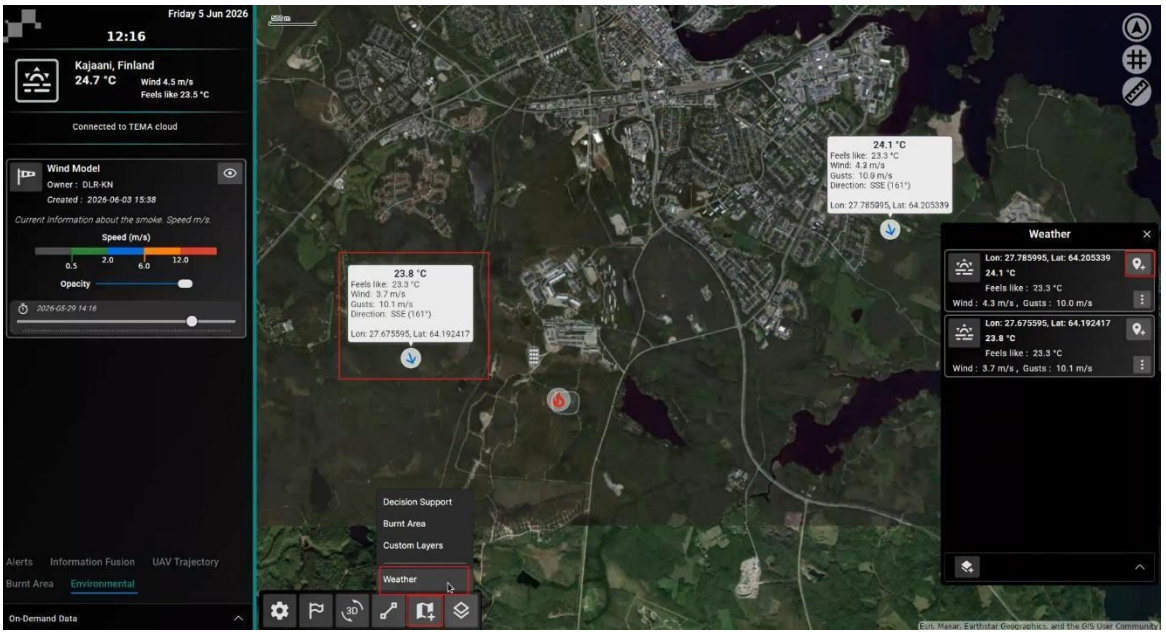


When an incident is chosen. The Smartdesk starts loading the relevant data. A new [component card] appears on the left side of the dashboard. The [component card] shows information relevant to the alert.

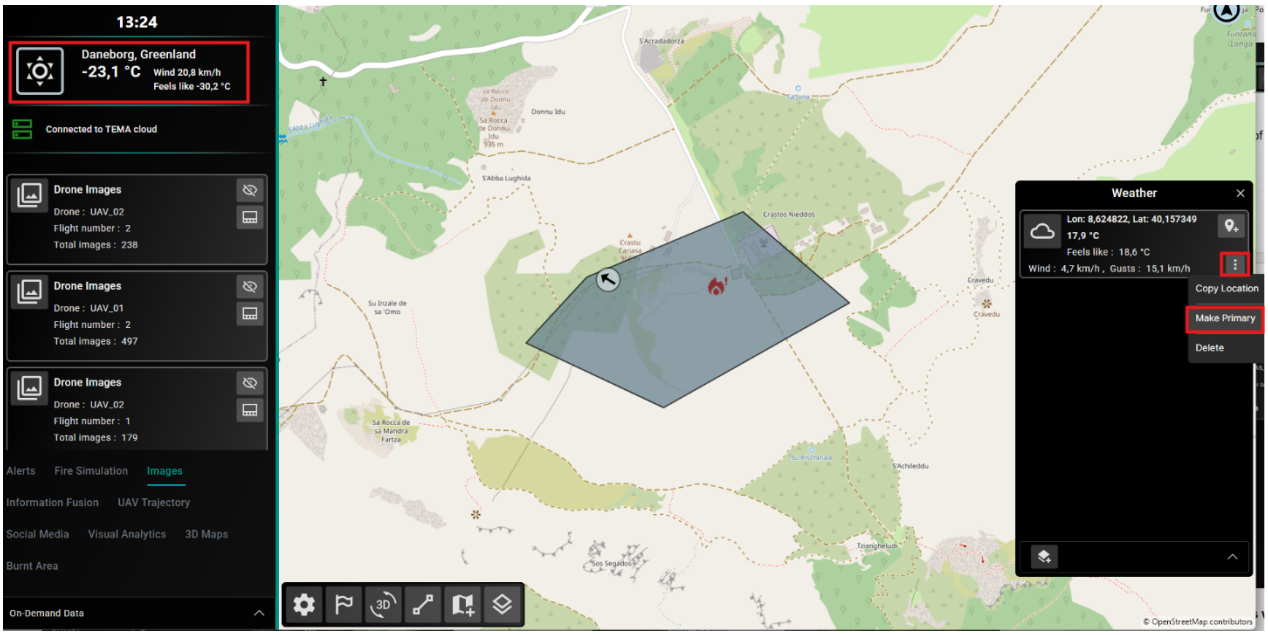


2.2. Weather

Weather in the top left info card can be changed, and additional info points for weather can be added to anywhere on the map. Select the [map icon] on the bottom and navigate to [Weather]. Clicking the [Point of interest] button and then clicking on the map will add a new weather info point.



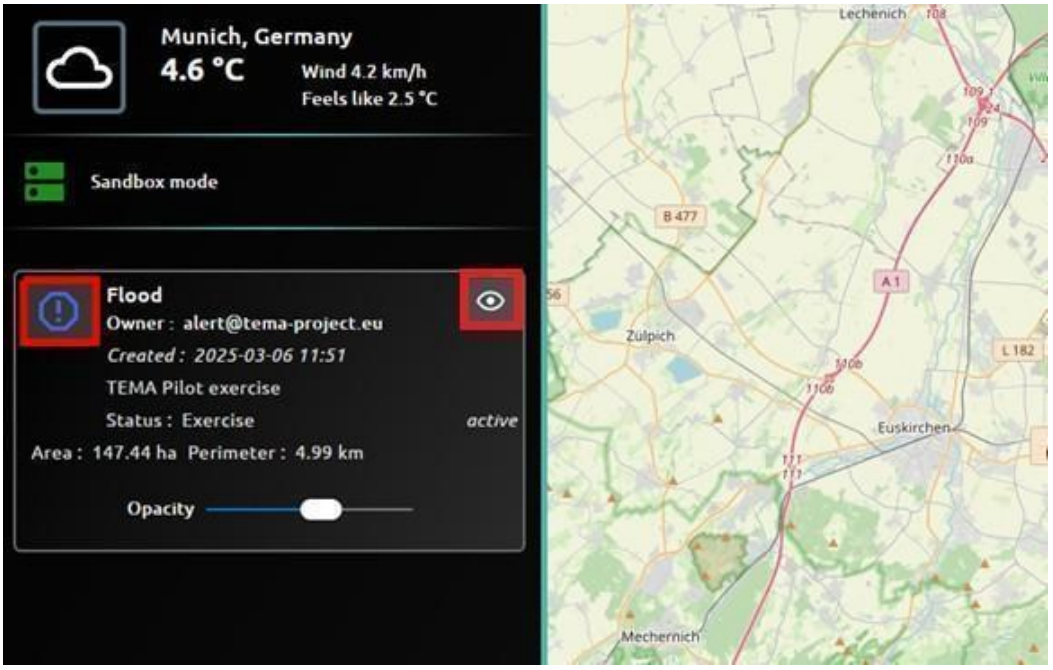
To change the weather shown on the main dashboard on the left side, click on the [Three-dot menu] and select [Make primary].



2.3. Starting the mission management process

Click on the [emergency notification] icon to start managing an incident. The Smartdesk then navigates to the area of interest and shows the risk area.

By clicking the [eye] icon, the estimated incident area is shown or hidden.

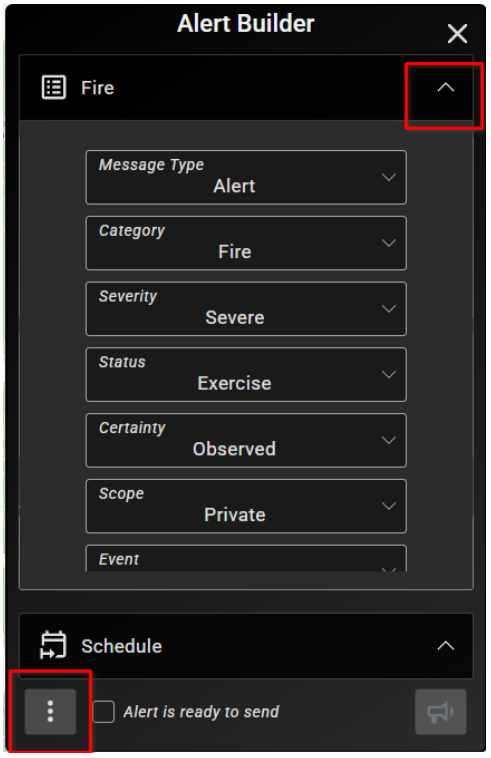


Alert builder

With the alert builder tool, the operator can build new missions. The first step is to go into the [Missions catalogue] and add a new alert:

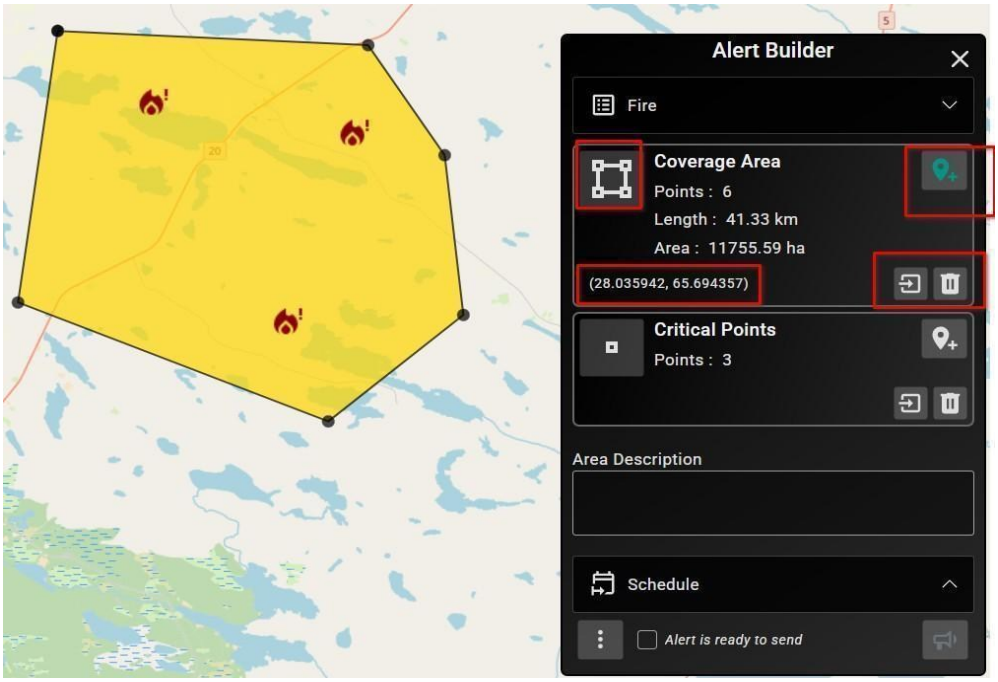


Clicking the [Pen icon] opens a new window, called ‘’Alert Builder’’. Here the operator can define the properties of the event or import previously configured properties from templates.



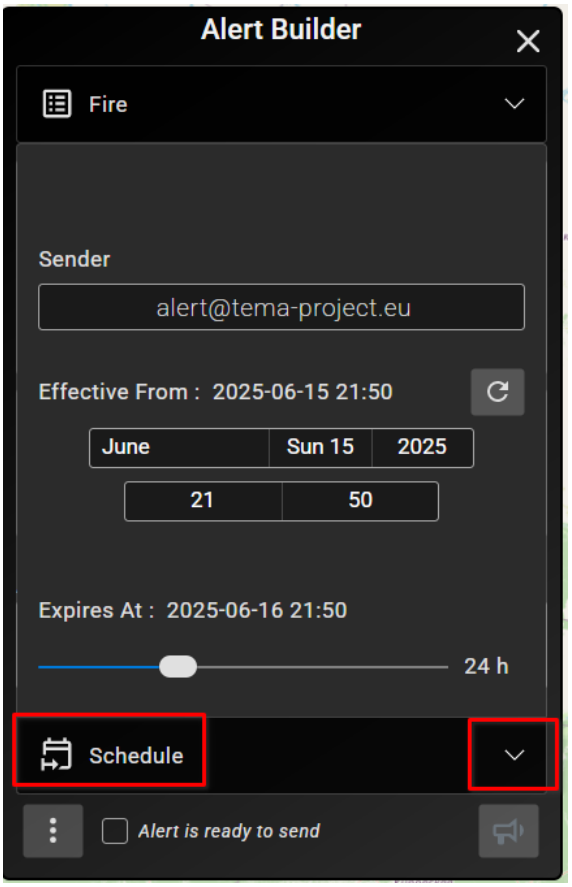
Once the information is filled in, the operator selects the relevant area, or relevant points from the map. It is also possible to import this information in the GeoJSON file format. Additional polygons can then be also added to mark the area.

Users can also define own base for drone trajectories with the ‘UAV route planner’s feature. The feature can be chosen from the bottom left three-dot menu.

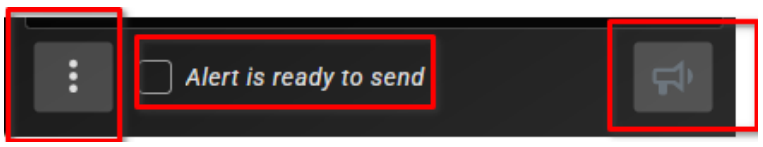


The final section is the schedule. Here the operator can define the time range of the event. There are two possible cases:

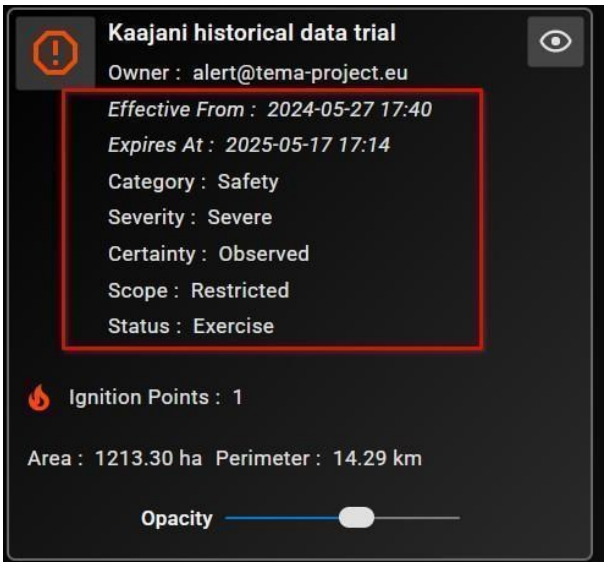
1. Effective From (“effective”) is in the **past** (historical case), other properties of the alert: “sent” => “effective”
   “expires” => current time + duration
2. Effective From is in the **future**
   “sent” => “current time”
   “expires” => “effective” + duration



The last step is confirmation and sending or exporting the current template for future purposes.



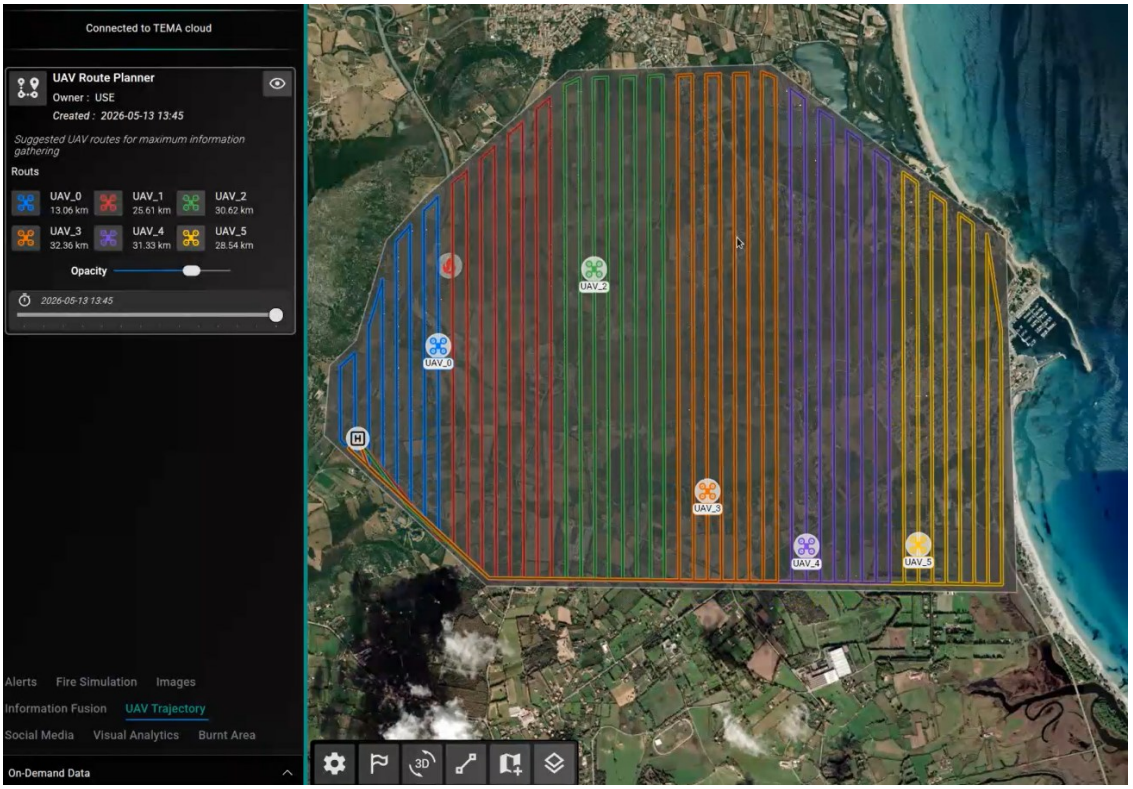
The alert component card shows the event properties:



2.4. Drones and drone data

To see drone information choose [UAV trajectory] from the bottom left tab. The info cards on the left show all planned drone routes and the planned fly distance. Map types can be changed to show for example satellite images, topographic maps, or street maps. User can go through trajectories to received during the mission to see the full timeline of data.

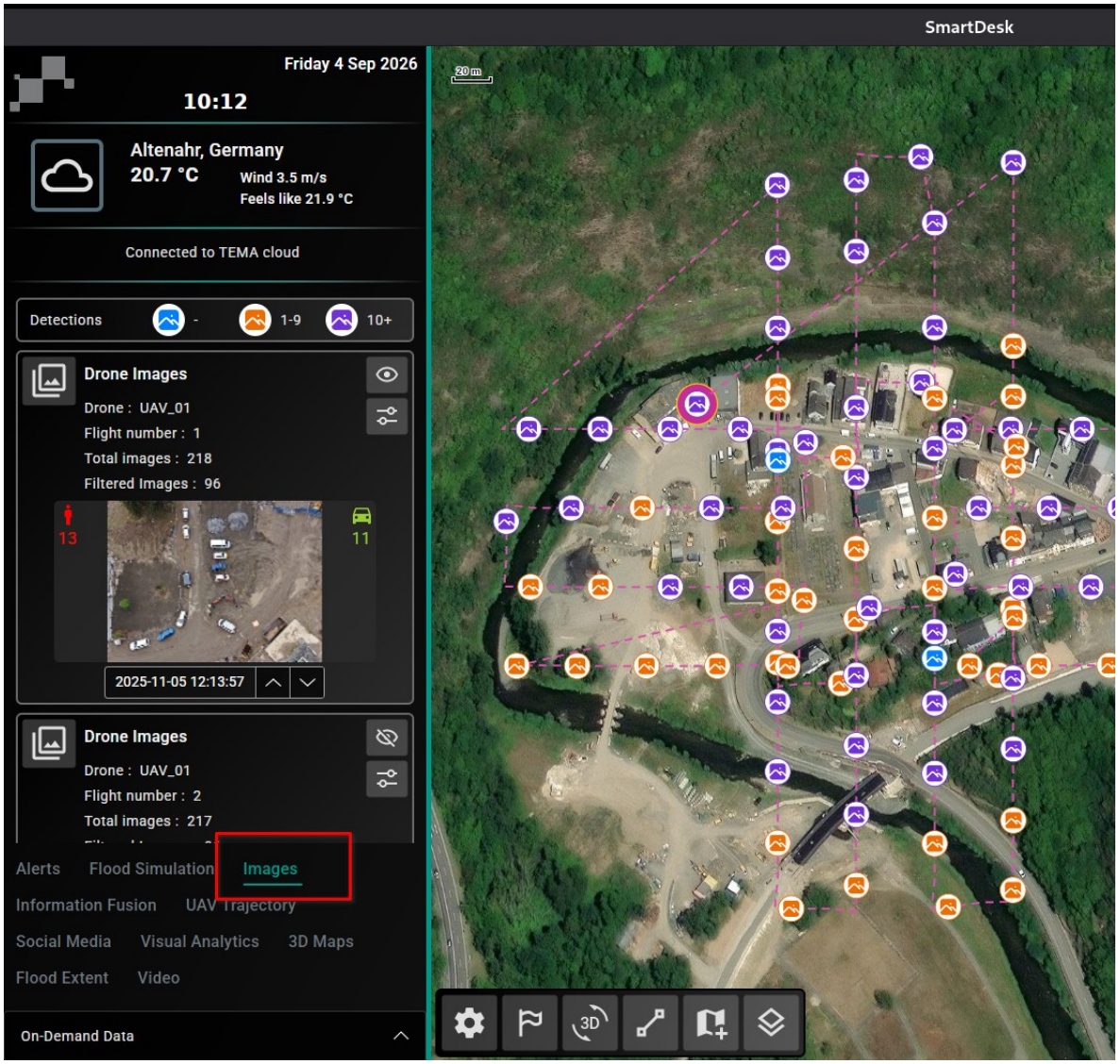
The trajectories are automatically computed based on the defined disaster area. The limitation of what area the drone can cover is dependent on the type of drone used. This range of a drone is typically between 2 and 10km² per single battery charge. If new information is received on the disaster area, the drone trajectory can be automatically adjusted.



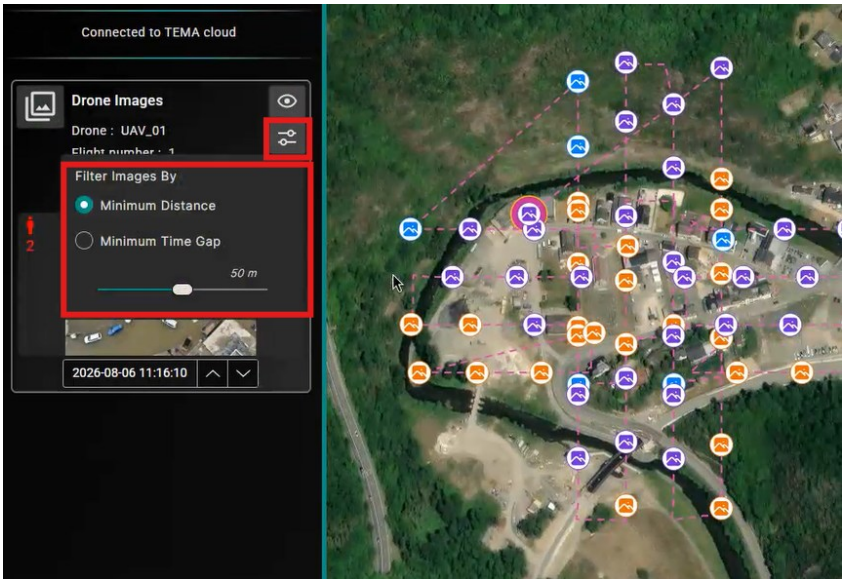
Images from drones

Images from drones can be opened by clicking on the image tab in the bottom left panel. Pictures are uploaded from the drone.

Each drone flight will be shown separately in its own card on the left side. The screenshot below shows only one flight that collected 218 images. Images show time when they were added to the Smartdesk. When moving between images, the map also shows which image is shown.

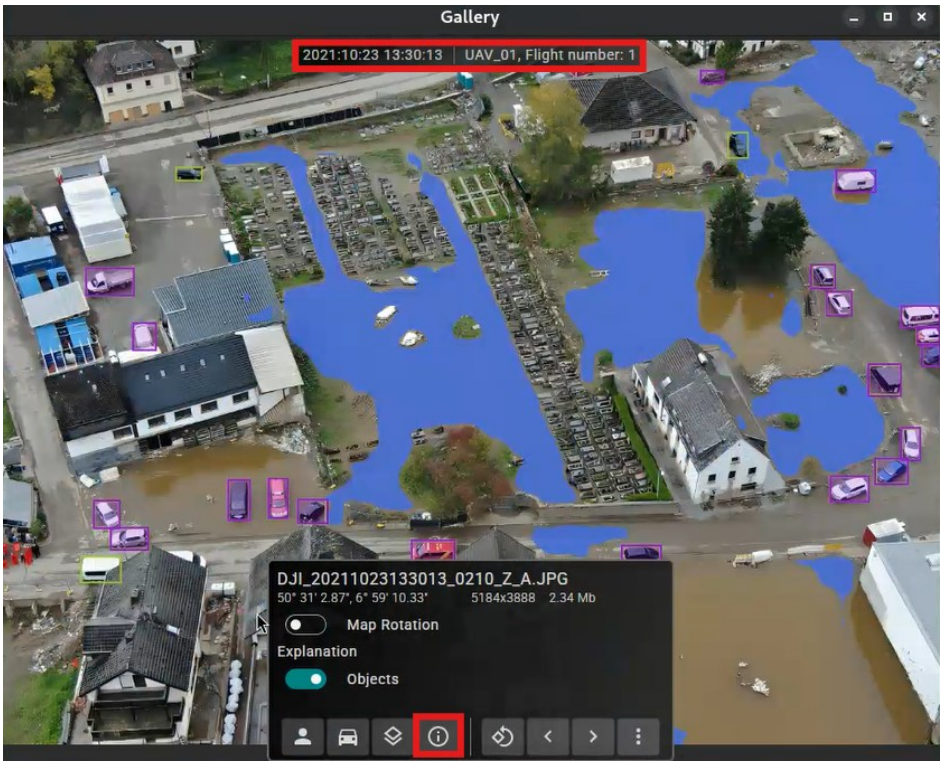


This function allows the filtering of images. Images can be filtered between distance of the drone flown, or time between each photo taken.

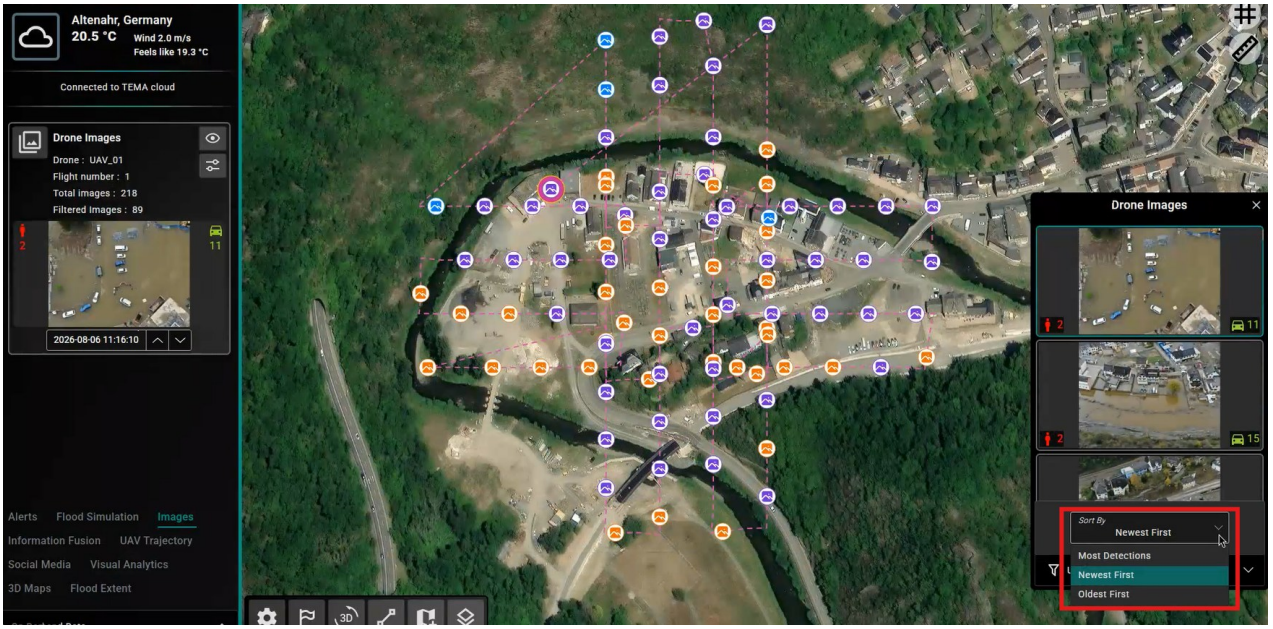


Double-clicking on any image or image icon on the map opens the image viewer. The image viewer opens in a separate window and can be moved to a separate monitor. It is possible to highlight persons, cars, fire or water, explainable AI that have been detected.

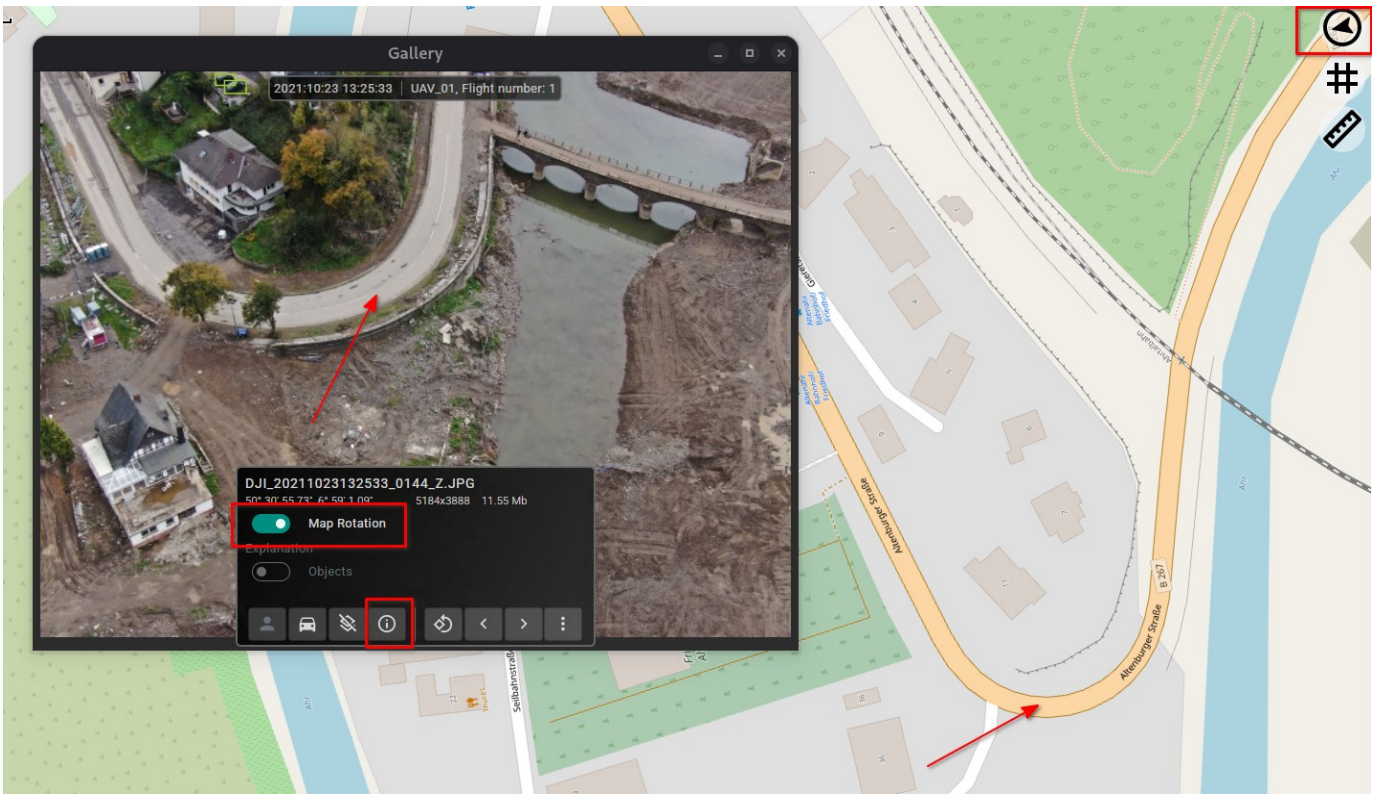
Each image shows at the top when the photo was taken, and which drone and flight took the photo. Additional information about the photo, such as the exact location can be found from the info button.



By tapping and holding, or clicking and holding on the image, the image gallery opens. Images can be sorted by number of detection or by when they were added to the Smartdesk.



With the image viewer open, selecting images will rotate the map to show from which angle the image was taken. The map direction can be rest to north by clicking the [compass icon] in the top right corner.



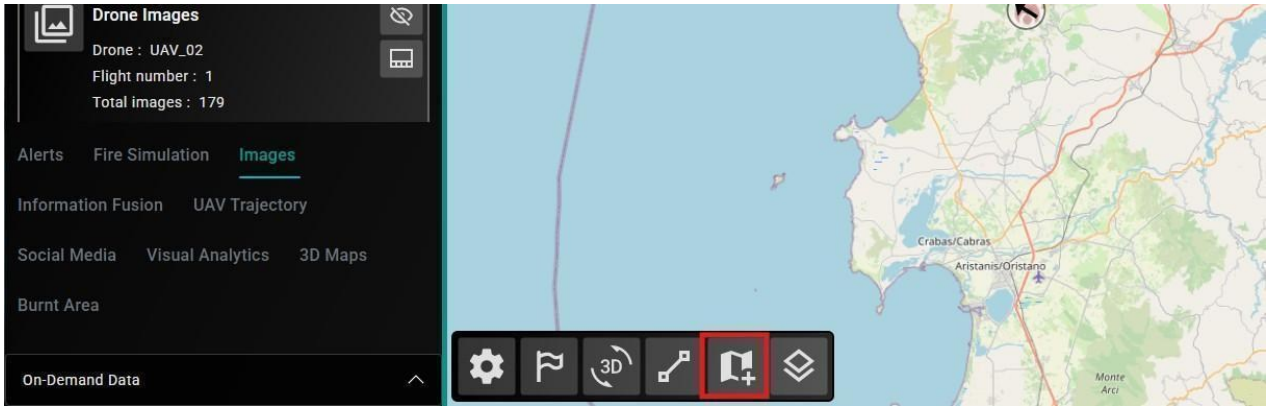
Vehicle detection explanation

Explanation for a vehicle detection result. The left side of the explanation displays the object detection result as a yellow bounding box overlaid with the input image (here a white van is detected).
To access the feature, open the ‘Images’ tab and select an image. If the feature is available, the toggle button will be clickable. Enable [Objects] to enable explanations, and then click on the purple boxes that appear.

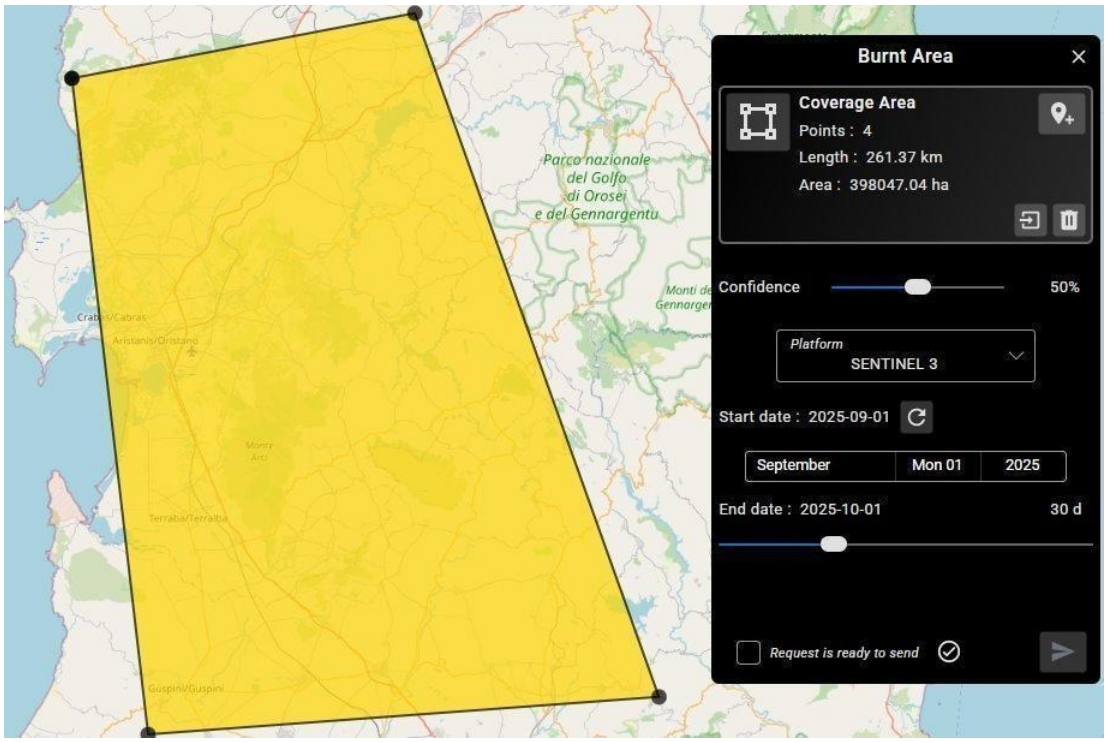


Burnt area detection

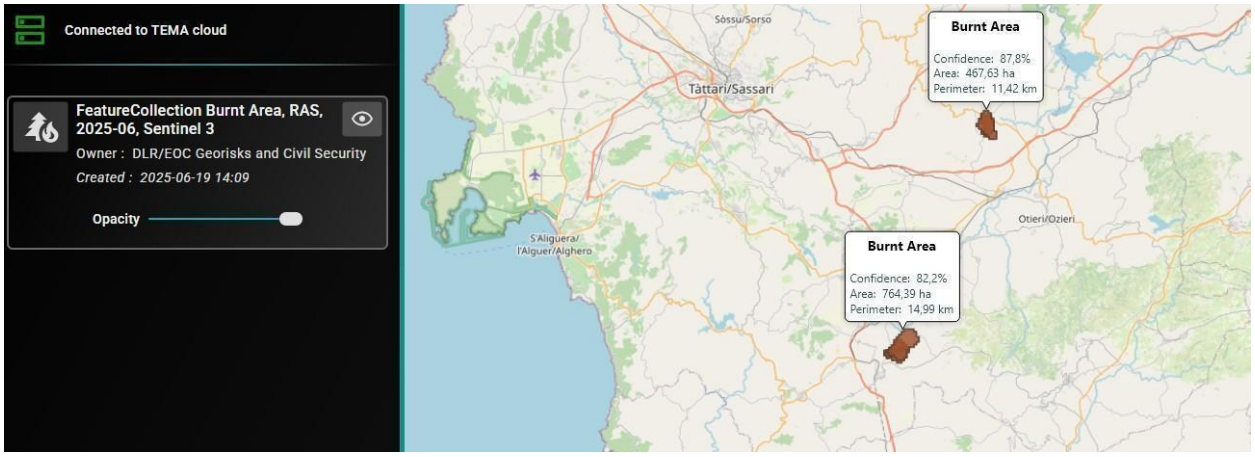
The burnt area detection tool displays areas on the map that have burnt within a specific time window. The control panel for burnt areas is accessed by selecting the [Map] icon, and then [Burnt area] from the popup.



The user defines the specific area of interest, chooses the satellite and sets the date range.

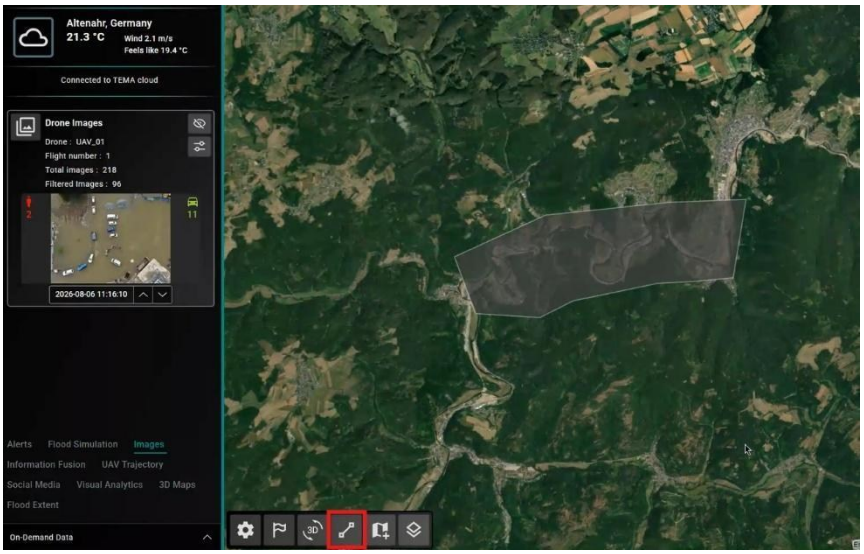


The outputs are shown on the left-hand side. Using the [Eye] icon they are overlayed on the map. Clicking on any of the marked areas shows additional information specific to that burnt area.

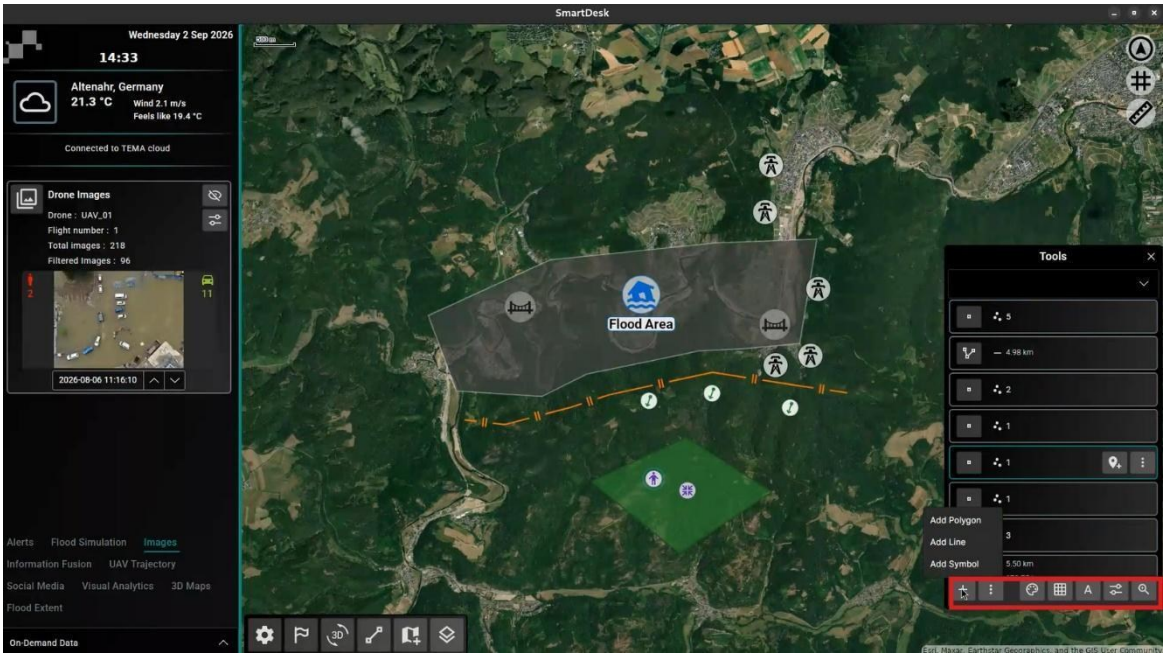

Connected to TEMA cloud
FeatureCollection Burnt Area, RAS, 2025-06, Sentinel 3
Owner : DLR/EOC Georisks and Civil Security
Created : 2025-06-19 14:09
Opacity
Sòssu/Sorso
Tàttari/Sassari
Burnt Area
Confidence: 87,8%
Area: 467,63 ha
Perimeter: 11,42 km
Otieri/Ozieri
S'Alguera/
l'Alguer/Alghero
Burnt Area
Confidence: 82,2%
Area: 764,39 ha
Perimeter: 14,99 km

Map tools

Users can prepare tactical maps by adding symbols, text and lines on the map. The map tools are accessed via the bottom menu bar, by selecting the map tool icon.

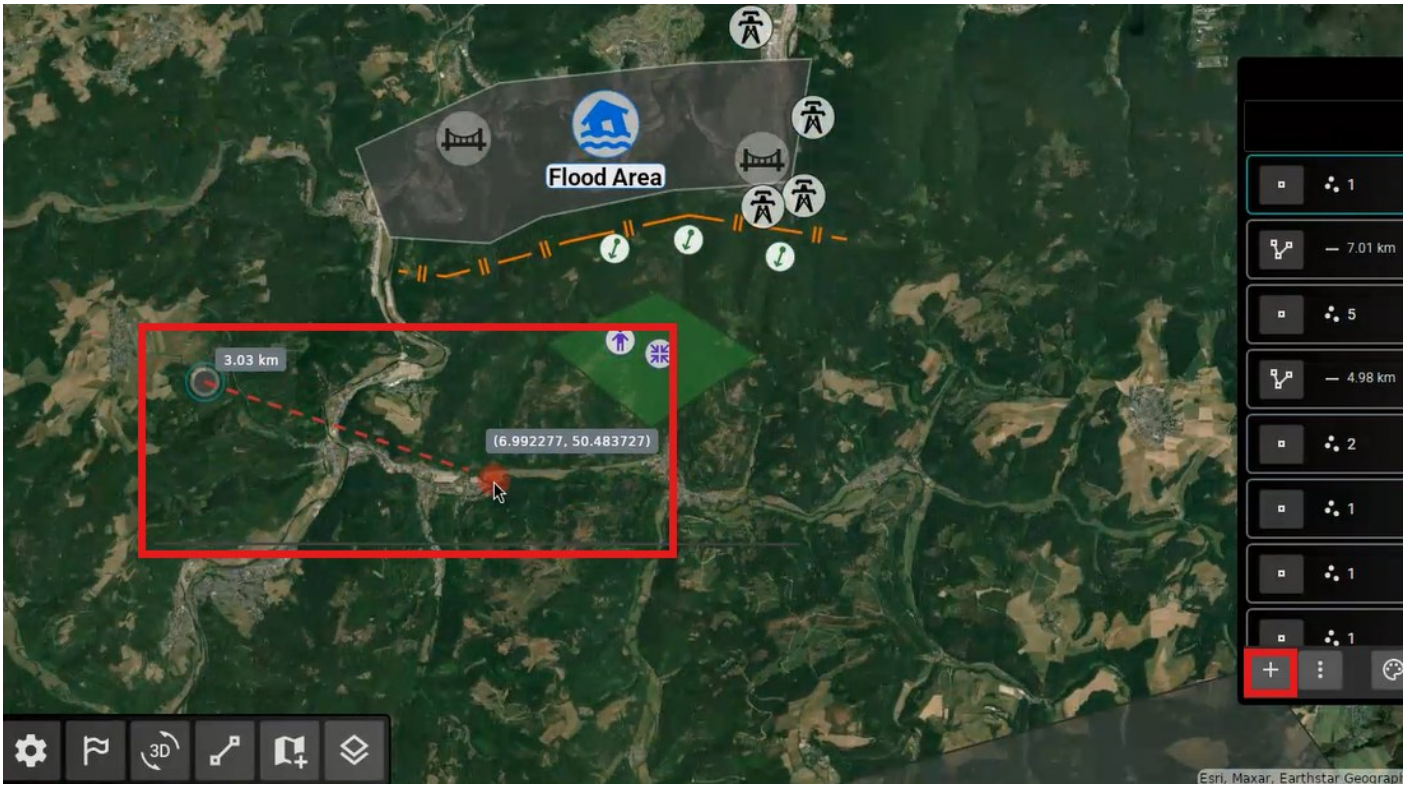


After clicking, a new menu appears on the right side. From there, lines, polygons, symbols can be added as well as text, and their color can be changed.



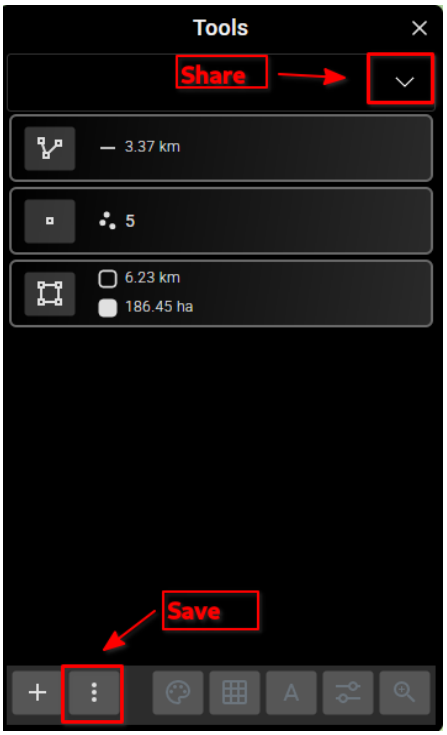
To measure a surface area, the user clicks the measurement icon in the top right corner. The mouse is then in surface measure mode. Clicking and dragging on the map will then measure.

Measurements can be made by placing lines or polygons. Place the starting point hold the mouse to mark the starting and end points. The distance and surface area are shown in the right side menu.

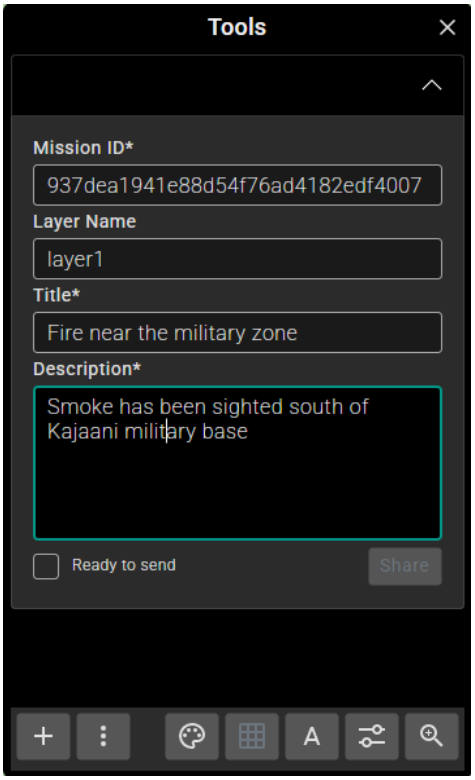


Creating and sharing custom maps

User can create and share annotated maps that include polygons, lines, symbols and text. After completing the annotations, press the [expander] button (arrow) in the tools tab.

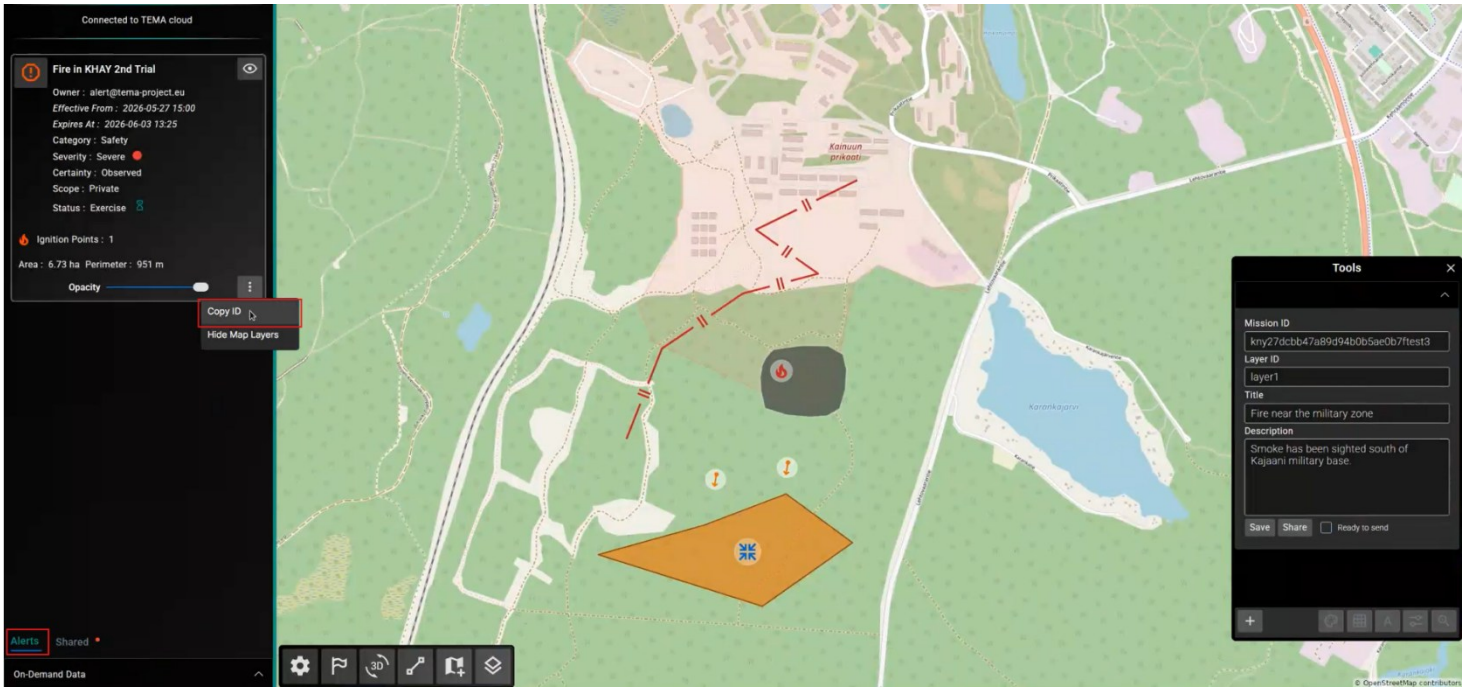


A new menu will open where users need to fill relevant information. Everything must be filled, apart from ‘layer name’.

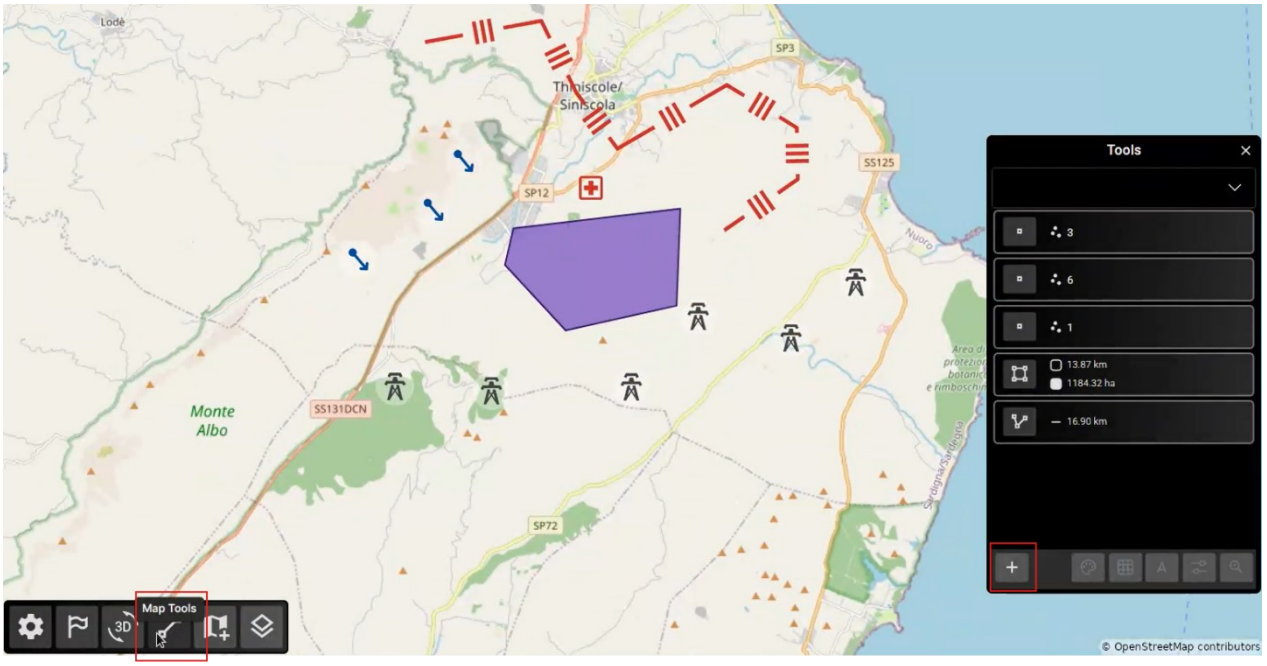


The ‘Mission ID’ can be found from the [Alerts] tab, and then from the specific mission. Select ‘Copy ID’ and paste it into ‘Mission ID’. The title and description can be written as needed. When everything is ready, check the ‘ready to send’ box and click [Share].

The updated image will be shared to all active Smartdesk applications and shown in the bottom left as [Shared]. The same map can be updated and send out to all users, so long as the ‘layer ID’ name is not changed. The user can toggle through all map versions using the timeline on the left-side tab.



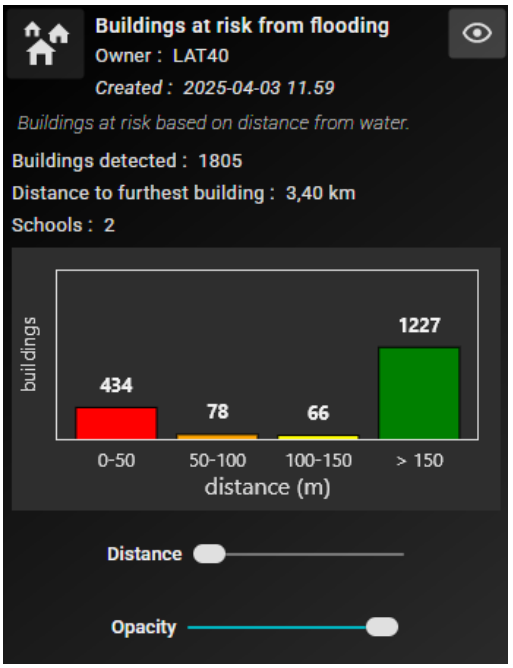
Users can use update map tools to annotate freely on the map by for example adding custom lines, symbols and measurements.



2.5. Geovisual Analytics

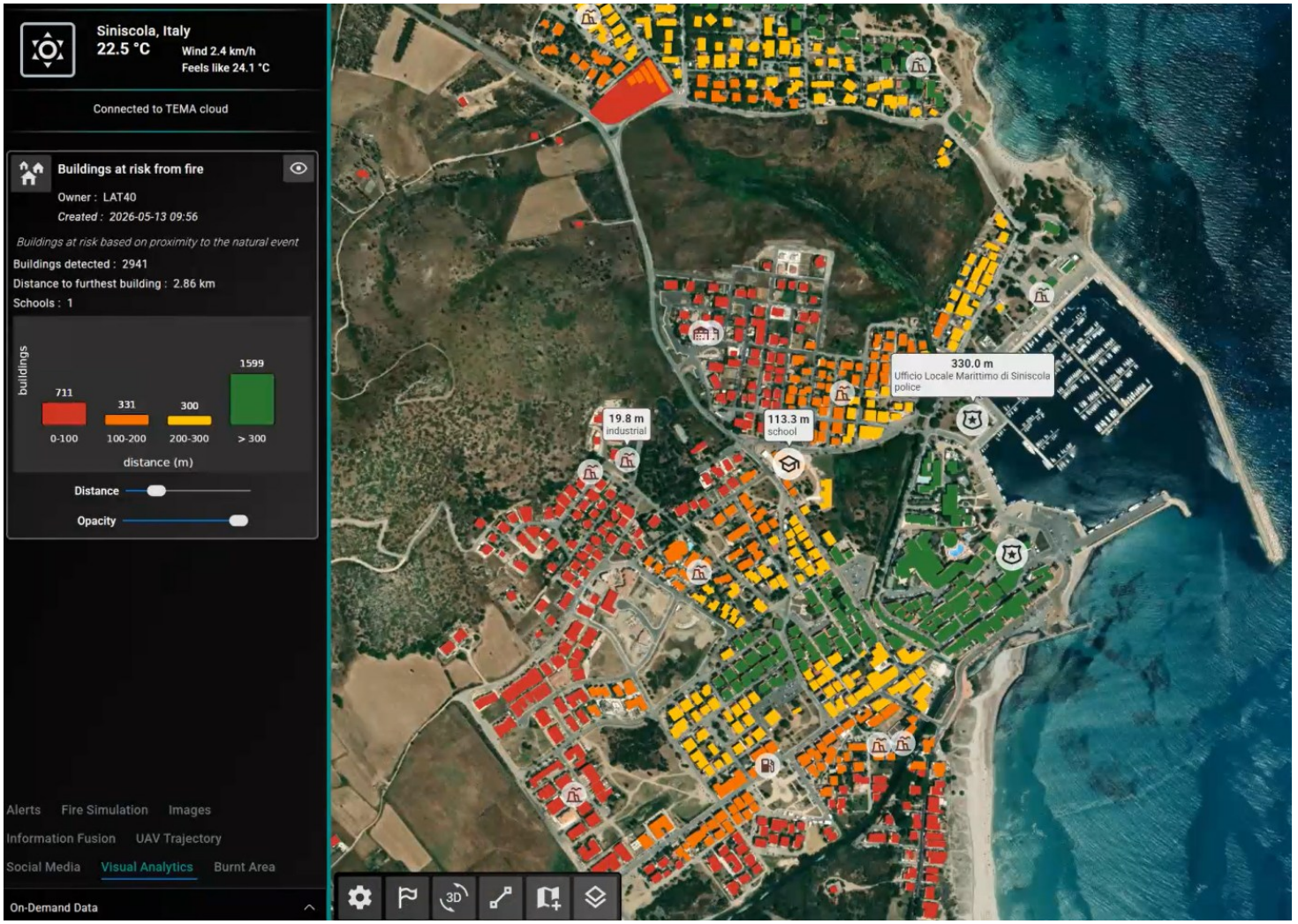
The Geovisual analytics tool shows the end user the distance from fire and distance from flood. The tool shows the total number of buildings in the disaster area and the distance to the furthest building within the area.

Using the [Distance] slider, the user can classify buildings into four categories, which is based on the distance from the fire or flood. The image example below shows that within 50m from the fire or flood, there are 434 buildings, 78 buildings are between 50m-100m from the incident, 66 buildings are 100m-150m from the incident, and 1227 buildings are at least 150m from the incident.



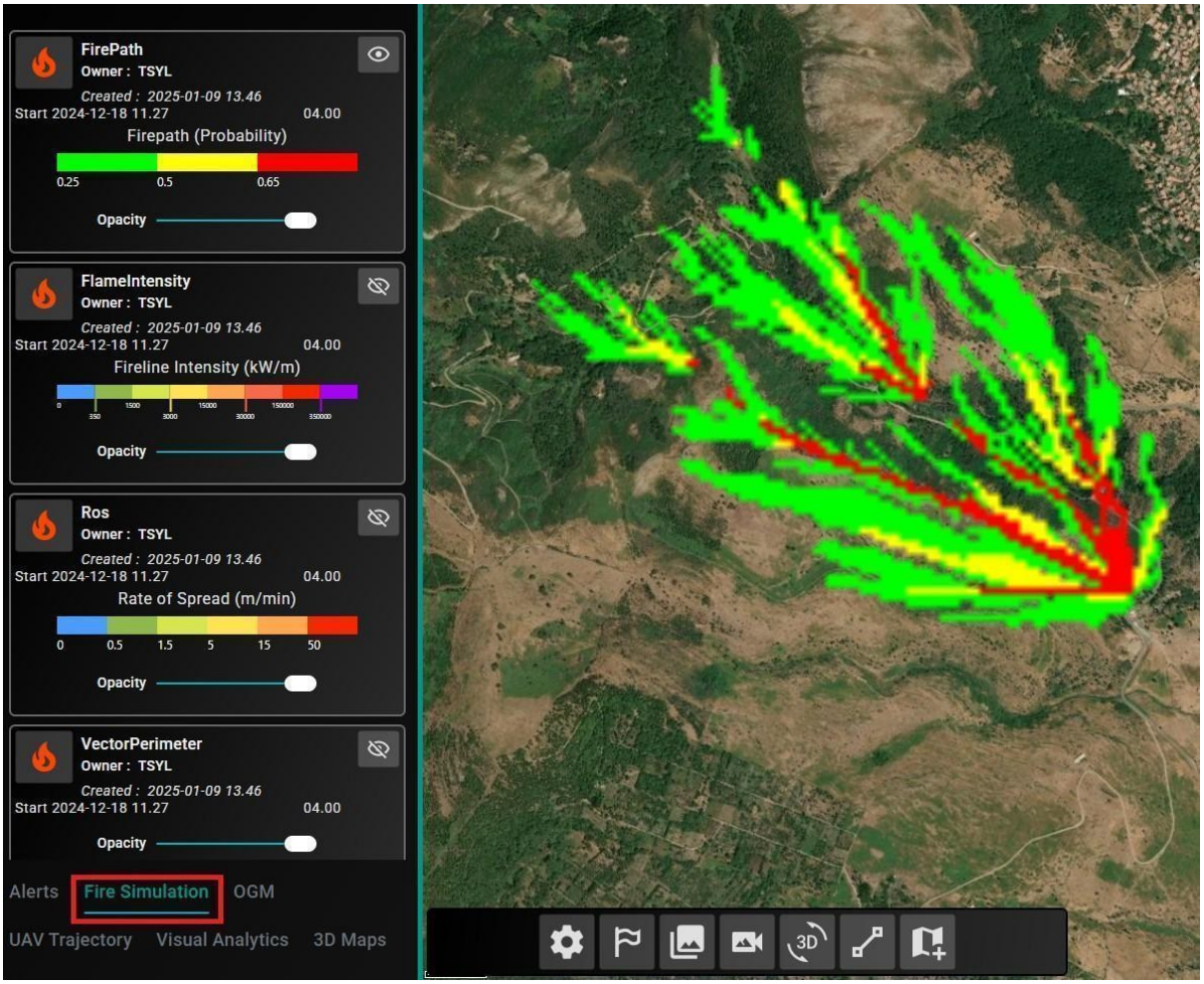
Buildings of special interest will be shown as well. The map shows primary and secondary types of buildings. Primaries are always visible: schools, fire stations, police stations and hospitals. When zooming, the secondary becomes visible: warehouses, industry buildings, petrol stations. Building types shown can be changed on request.

Using probability calculations, the TEMA system calculates which areas have a high probability of floods. By enabling [OGM] (Occupancy Grid Map), the map overlay shows the high flood/fire probability areas. Same as in the chart above, the colors on the map indicate the buildings' distance from the disaster area.



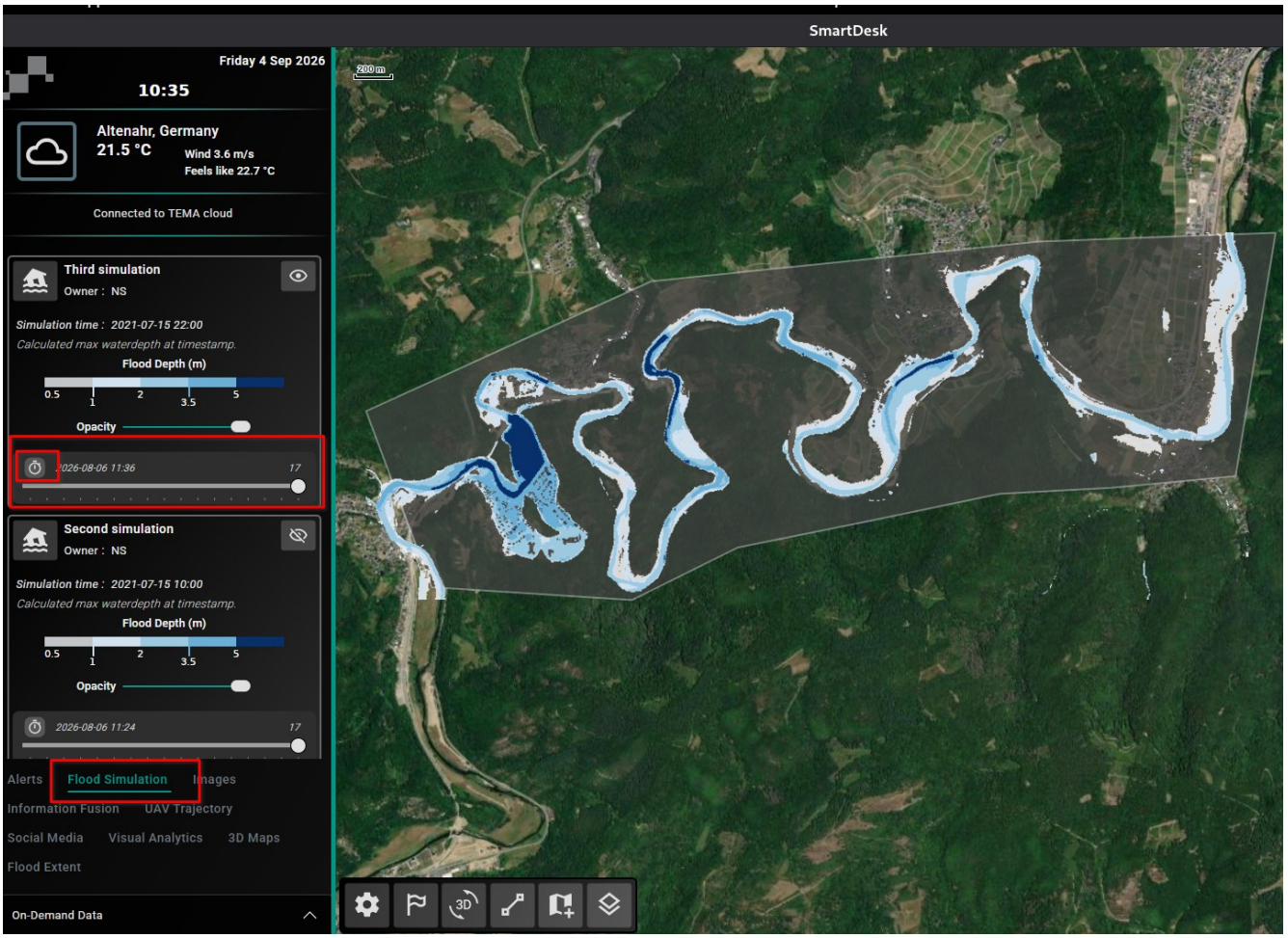
2.6. Fire Simulation

FireSim module provides real-time analysis of wildfire behavior and simulates the spread of wildfires in seconds to support real time decision making. The module shows the fire path, flame intensity, rate of spread, hourly fire perimeters (vector perimeter) and expected height of the flames.
The FireSim is accessed through the [Fire Simulation] tab. This is only available by selecting the fire mission first.



2.7. Flood simulation

Flood simulation data can be accessed through the bottom left tab [Flood simulation]. When clicked, available prediction of water levels is listed in the [component card]. Each simulation has a timeline showing estimated water depth over time.
The flood simulation is overlayed on top of the map.

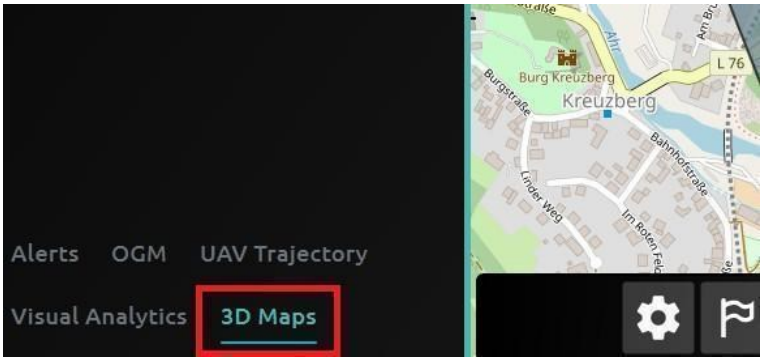


2.8. 3D maps

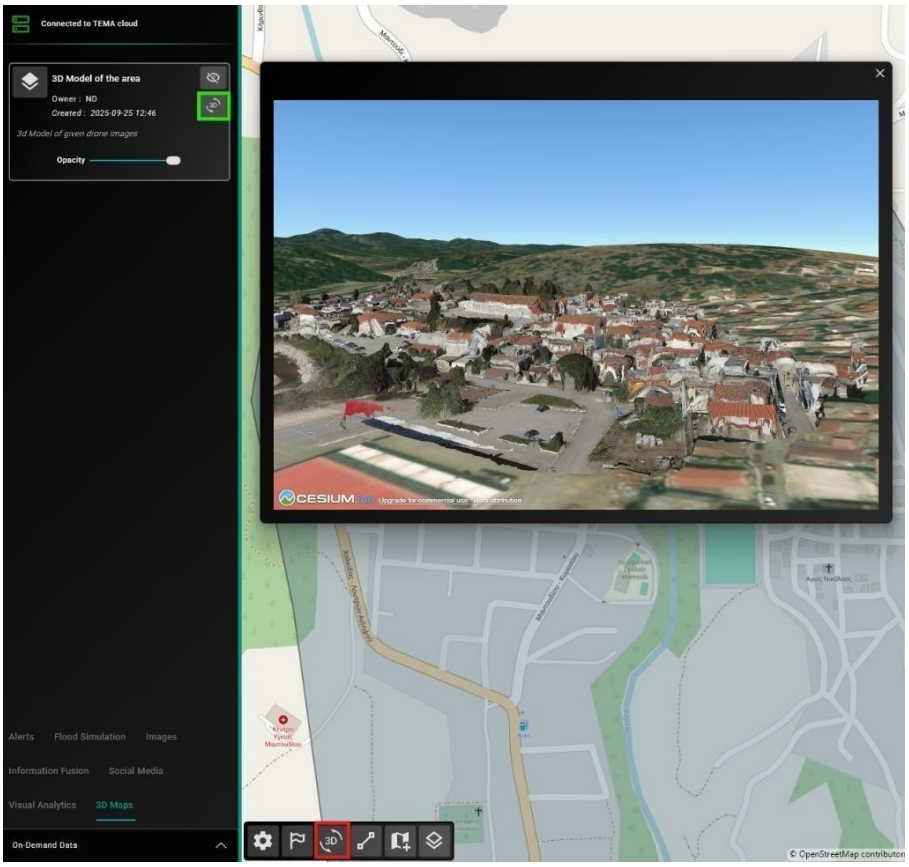
The Smartdesk visualizes 3D models of the disaster area. The user interacts with the 3D space.
Open the 3D viewer from the bottom panel. The window that shows planet Earth can be resized by dragging the bottom-right edge of the window.



Available 3D models of the disaster site can be found from the ‘’3D maps’’ tab.

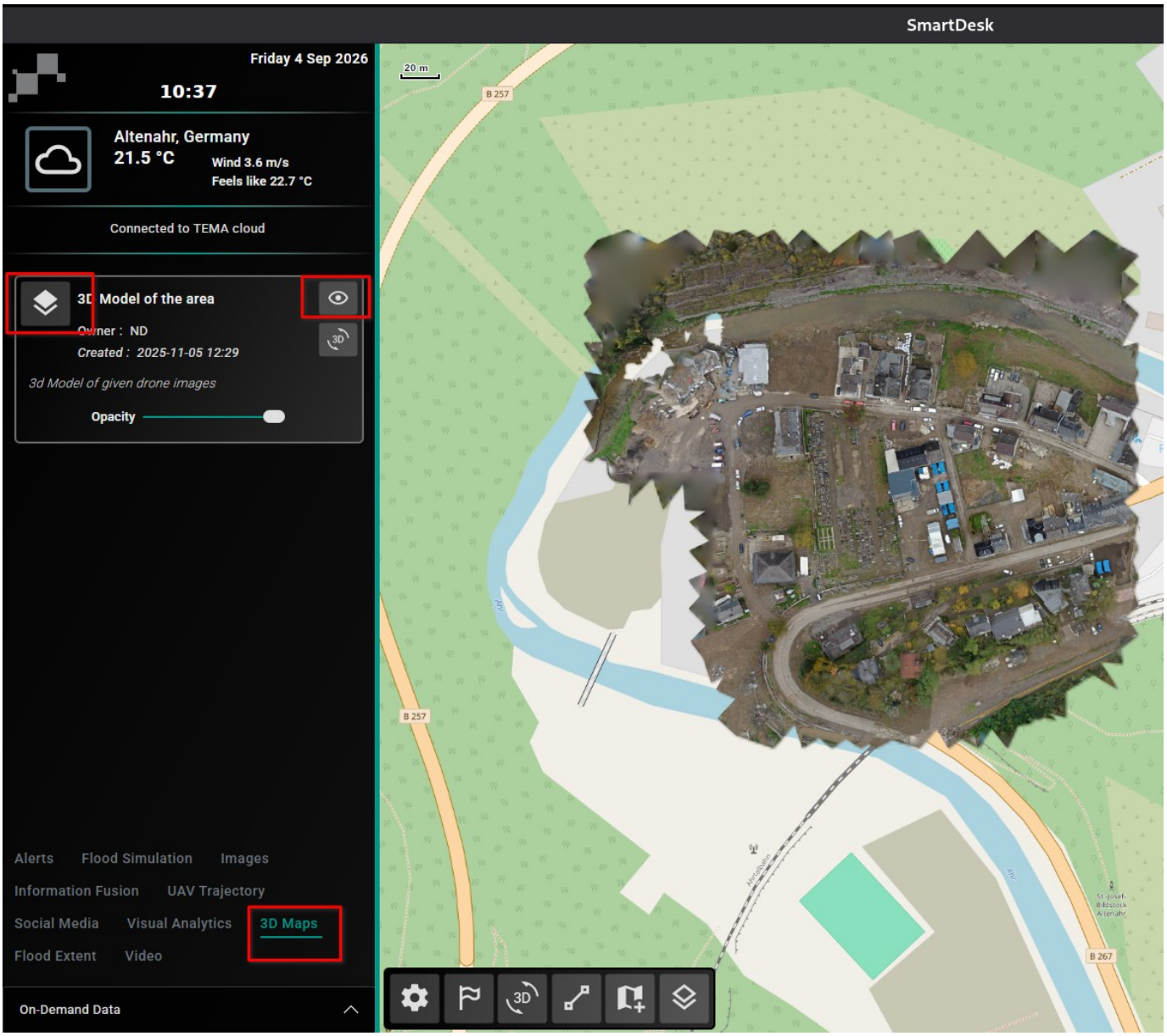


Finally, click the ‘’3D’’ button (green) to open the 3D viewer. By pressing the button the view is focused on the 3D model.
Note: The 3D viewer needs a moment to load. After the first step, wait that the 3D model of Earth appears. In case that nothing happens, restart the mission from the [flag button], and repeat the process.



Ortho mosaic

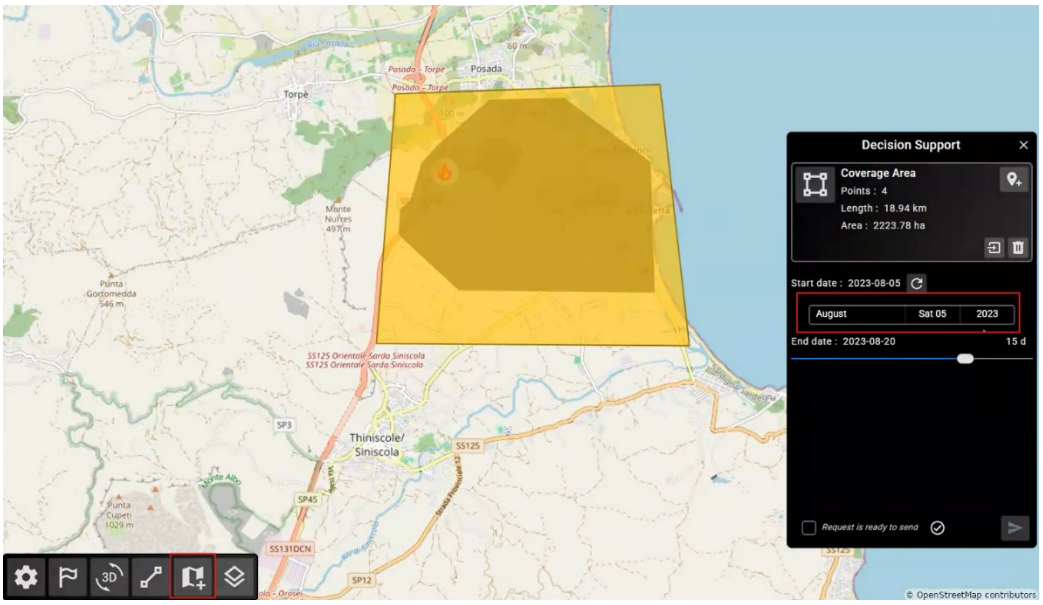
Ortho mosaics are 2D maps created from drone images. To see Ortho mosaic, select the [eye icon] from the component card to overlay the new images on top of the map.



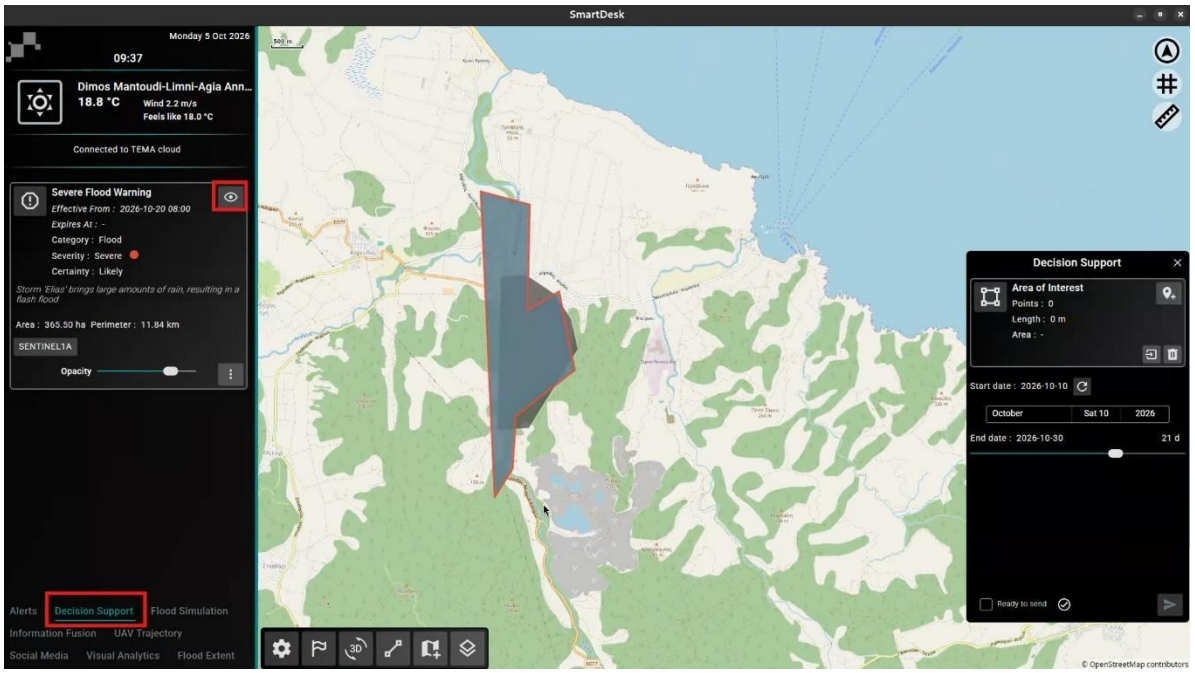
2.9. Decision support

The decision support service provides users with information on warnings, with relevant advice, and satellite images.

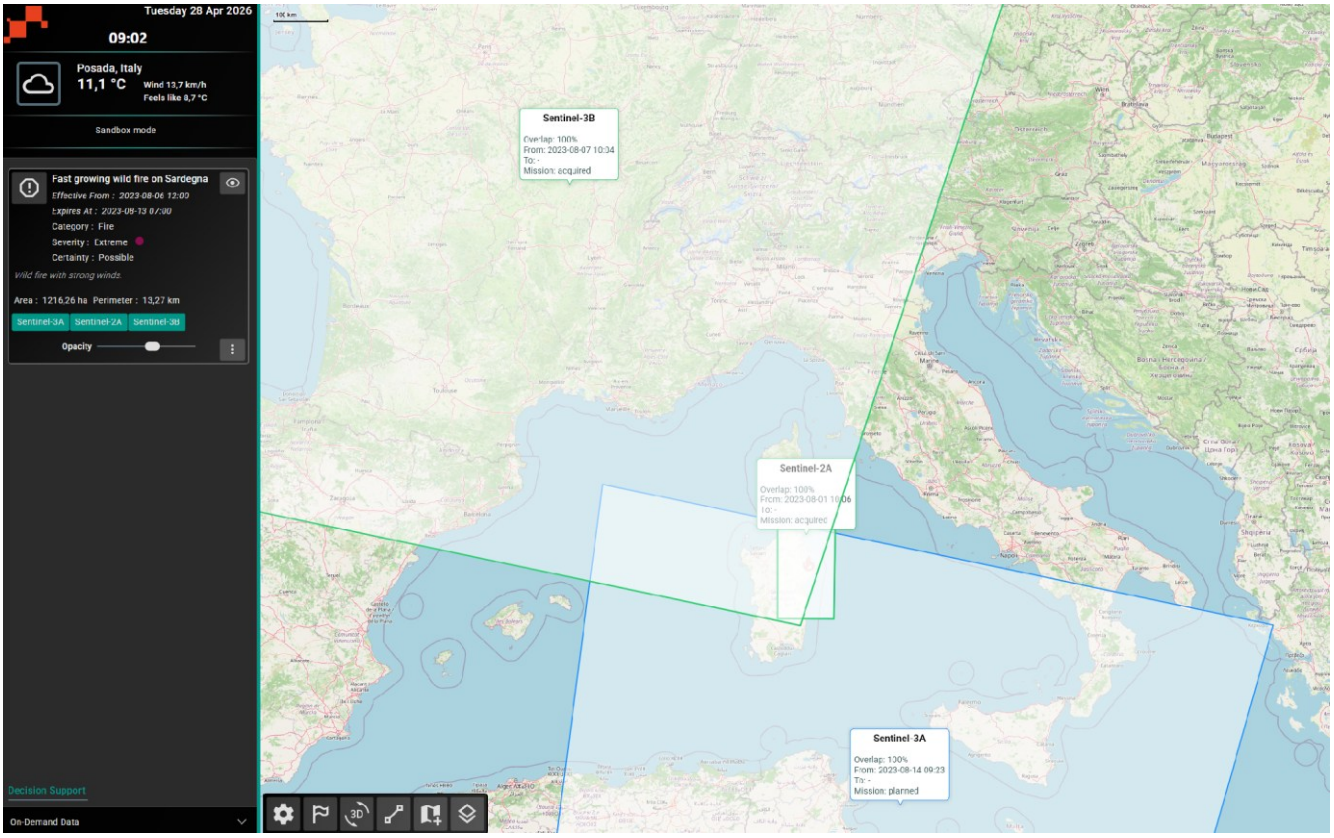
For training session, select fire area on the map. To get information on a specific area, click [add map icon] on the bottom of the window, press the [decision support], and select points on the map to mark your area of interest. The date can be unchanged. Once an area is selected, check the [Request is ready to send] and click on the [send] button.



Clicking the [eye] icon will mark the relevant region in grey colour.

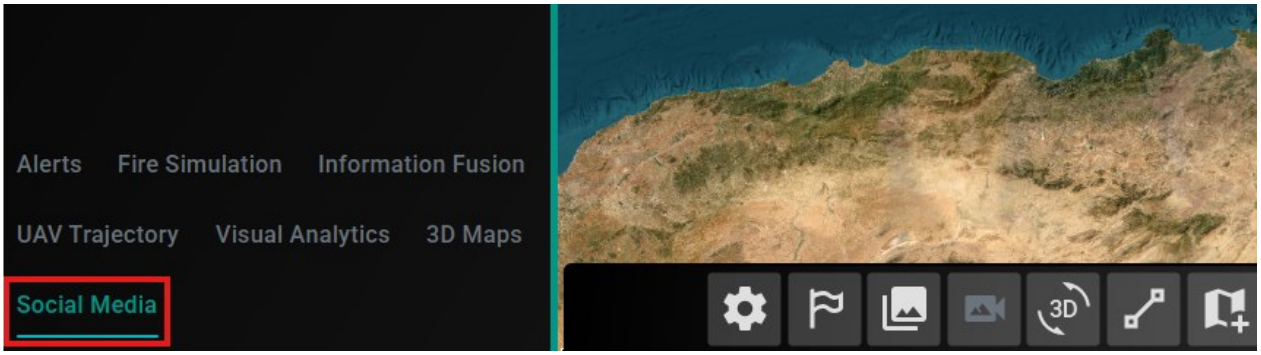


The user can click on the [Satellite] (e.g. Sentinel) button to see satellite overpass, and if the mission has been planned or acquired. Clicking on the area will provide more information.

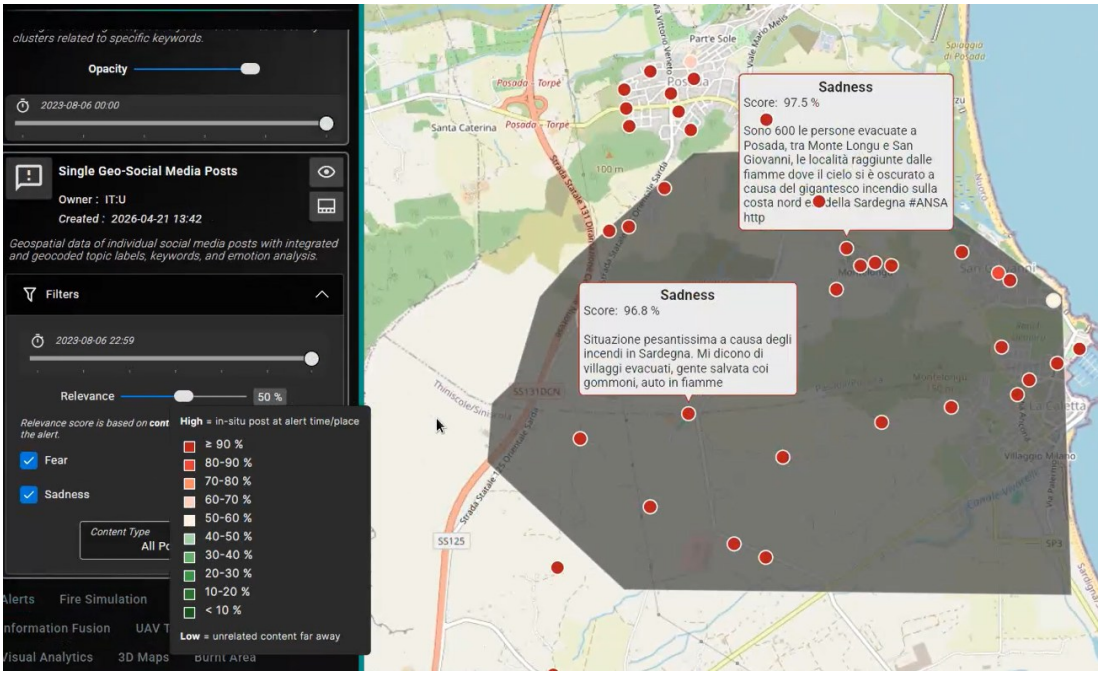


2.10. Geosocial-media analysis

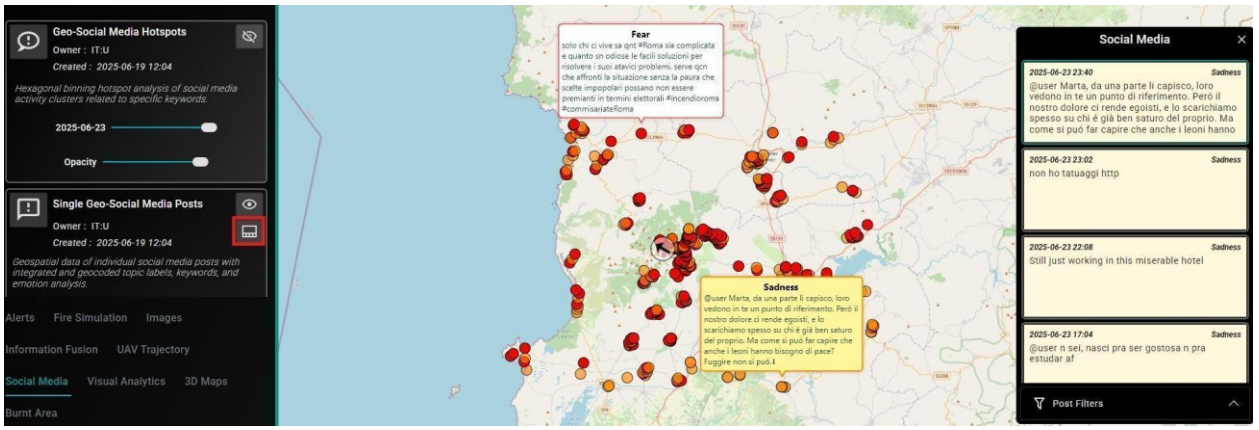
The social media analysis provides an overview of relevant posts made in the disaster area. To view social media posts, select the [Social Media] tab from the bottom left menu.



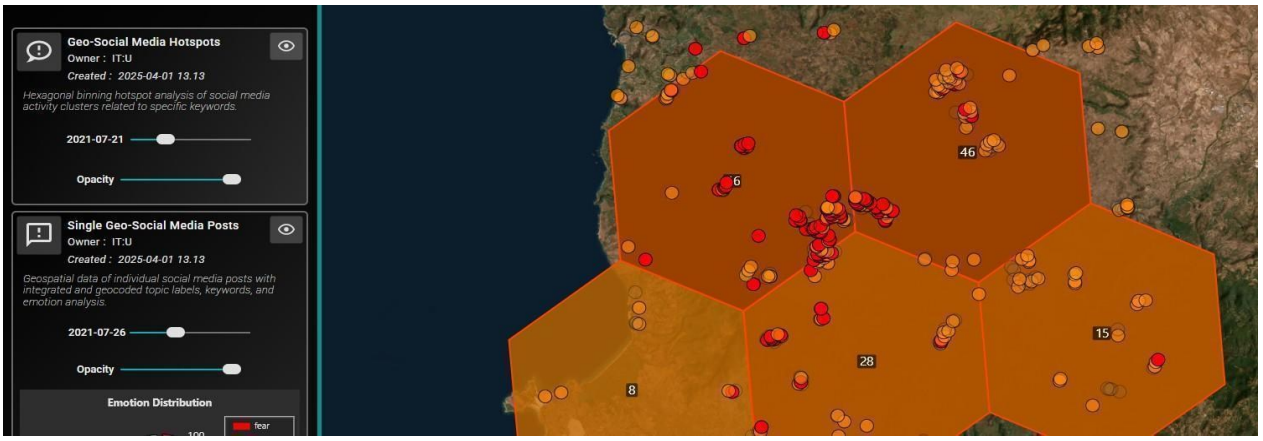
The user can filter posts based on the identified sentiment in the post.



By selecting the [Feed] button from the left-hand info card, the social media feed opens. The posts are presented in a separate feed on the right-hand side. Selecting a post will open a yellow text box on the map, showing where it was sent from.



The user can use the first slider to see what was posted each day. And the approximate area where the post comes from. The individual dots can be clicked to see the post texts, and the colours represent the



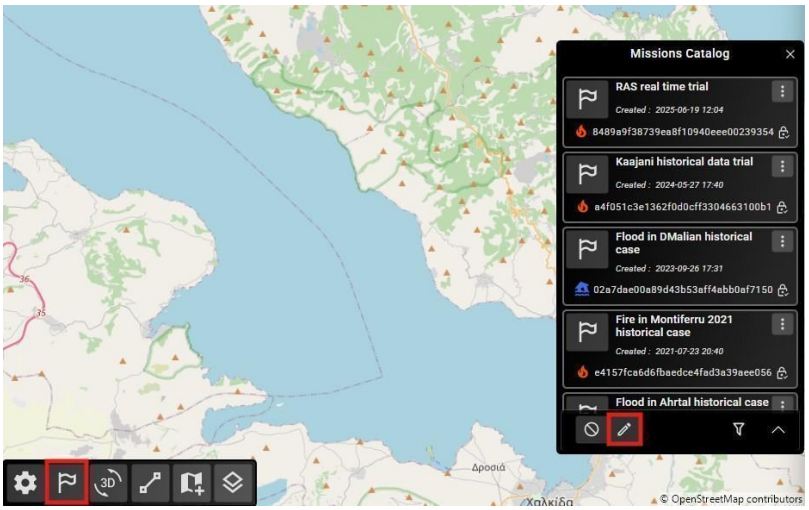
emotions within the post. Red – fear, orange – sadness, yellow – anger, and grey – joy.

Smartdesk displays the output of the TFA-tech-12: Sentiment analysis for short texts, which automatically generates textual descriptions of images, helping users better understand visual content shared during emergency events.



2.11. How to start own mission

To create your own missions, navigate to the [flag icon] and open the missions catalogue. Select the pen icon.

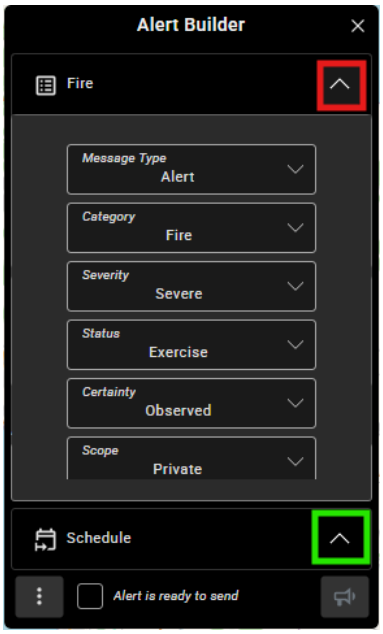


A new window will open that has two sub-menus in it. The top menu is used to define mission facts, and the bottom menu is used to set the incident date. In the middle of the menu, the user define the mission area, and points of interest (at the moment, only ignition points are implemented properly).

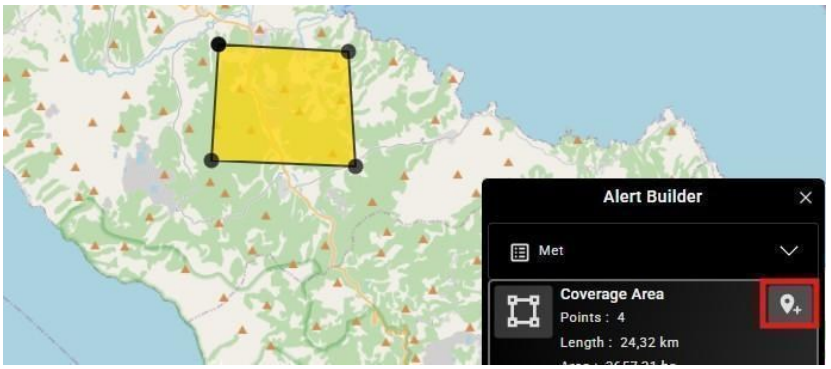
Mission facts: Click on the red arrow to define the mission. For floods, the following are needed:

Category – Met

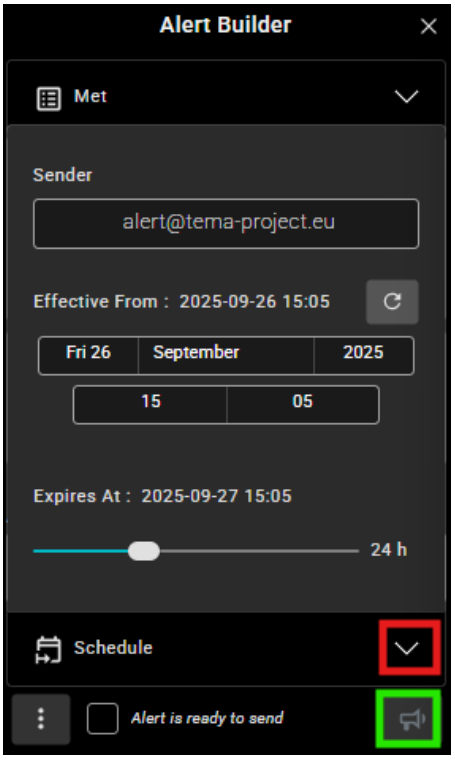
Event – Flood (scroll down in the menu)



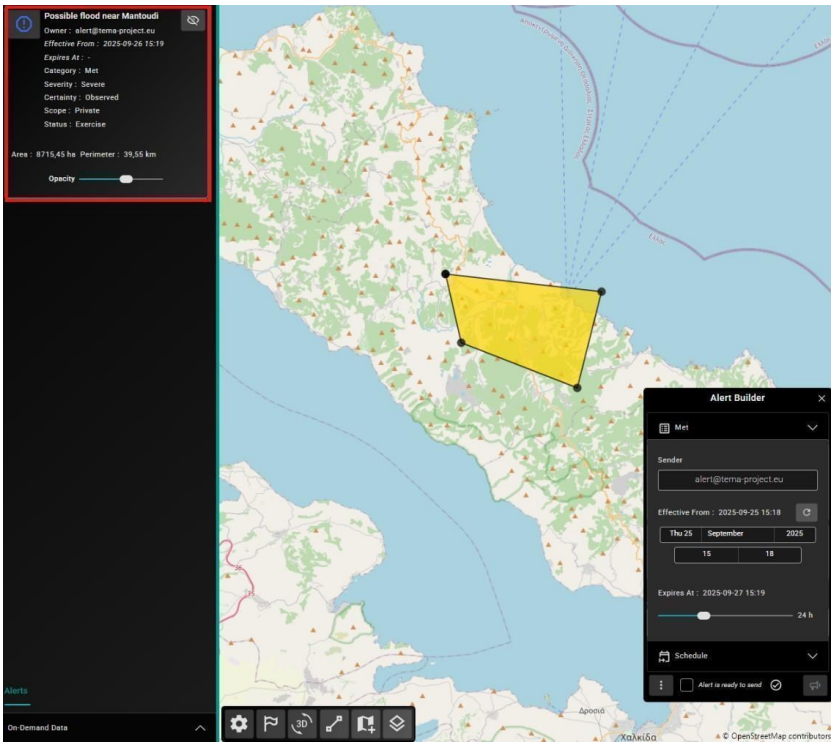
In the main menu, using the red-marked button, the incident area can be marked.



In the bottom menu, the date range of the incident can be defined. Once ready, select the checkbox [Alert is ready to send] and press the megaphone button (green).



The new mission will appear on the right-hand side.



Successfully created missions will be also visible on other SmartDesk as alerts.

3. Training tasks

Flood training tasks

1. Adjust your scaling preferences.
    a. Change map type to OpenStreetMap.
2. Change map view to pilot country.
3. Change the primary weather shown in the top left corner.
4. Navigate to the ‘Missions catalogue’ and start the flood mission.
5. Decision support
    a. Request decision support for the relevant area (mark area around the mission AOI, set date from 10.10.2026 and set the end date to 30.10.2026)
    b. Open [Decision support] to see the result.
6. Select [Map tools].
    a. Create a tactical map by drawing and by placing symbols (units, safe areas, evacuation sites, potential flood risk zones, parking areas, infrastructure…)
    b. Add descriptions to symbols.
    c. Save map to PC.
    d. Designate access route with blue color and mark where units should be deployed in yellow.
7. Add 2 weather info points near the incident.
8. Open drone view of the flood.
9. Drone images functionality:
    a. Change the map view to show a satellite map instead. (World Imagery)
    b. Filter images by distance or time
    c. Review images. Zoom in to find the civilians. Have any people or cars been identified in the disaster area?
    d. Rotate the image. Select [Three dots menu], click ‘copy location’, and paste the coordinates into a word document. Create a cropped snapshot of selected objects in the image.
10. Open the topographic map.
    a. Mark a risk perimeter.
    b. Share the area location to other operatives. (Paste to word pad for testing)
11. Open the visual analytics tab and enable the view.
    a. Set distance to 50m per risk zone.
    b. Check the number of buildings at risk.
    c. Right click on the map and take a screenshot, annotate and save it.
12. Open the flood simulation tool and review the flood data.
13. Check the ‘Social Media’ tab to see what citizens have posted online.
14. Open the 3D viewer.
    a. Review the area.
    b. Check the same map in 2D using an orthomosaic view.
15. Users can also define their own missions. See the final section of the learning manual (in sandbox mode mark some area of interest and define alert parameters without sending).

Fire training tasks

1. Adjust your scaling preferences.
    a. Change map type to OpenStreetMap
2. Navigate to the ‘Missions catalogue’ and select the relevant mission.
3. Open the [Map overlays] and check the population statistics around the incident area.
4. Add local weather to the main info card, and 3 weather info points around the ignition point.
5. Select [Map tools].
    a. Create a tactical map by drawing and by placing symbols (units, defense zones, water source, safe areas, evacuation sites, potential fire risk zones, parking area, infrastructure)
    b. Add descriptions to symbols.
    c. Save map to PC.
6. Take a screenshot and save it the PC. Add the screenshot to a word document.
7. Open drone view of the area.
8. Drone functionality:
    a. Change the map view to show satellite map instead. (World Imagery)
    b. Review images. Are there any people or vehicles in the risk area?
    c. Rotate the image. Select [Three dots menu], click ‘copy location’, and paste the coordinated into a word document.
9. Open the topographic map.
    a. Measure the distance from the ignition point to a nearby house.
    b. Measure surface area around the ignition point.
    c. Share the area location to other operatives. (Paste to word document for testing)
10. Open the visual analytics tab and enable the view.
    a. Set distance to 50m per risk zone.
    b. Open OGM (Occupancy Grid Map). High risk ignition zones are marked purple.
11. Open the FireSim tool and review hourly fire perimeter.
12. Check the ‘Social media’ tab to see what citizens have posted.
    a. Enable the hotspots and individual posts from the left tabs [Eye icon].
13. Open the 3D viewer.
    a. Review the types of roads and types of vegetation near roads.
14. Decision support
    a. Request decision support for the incident area.
15. Users can also define their own missions. See the final section of the learning manual.