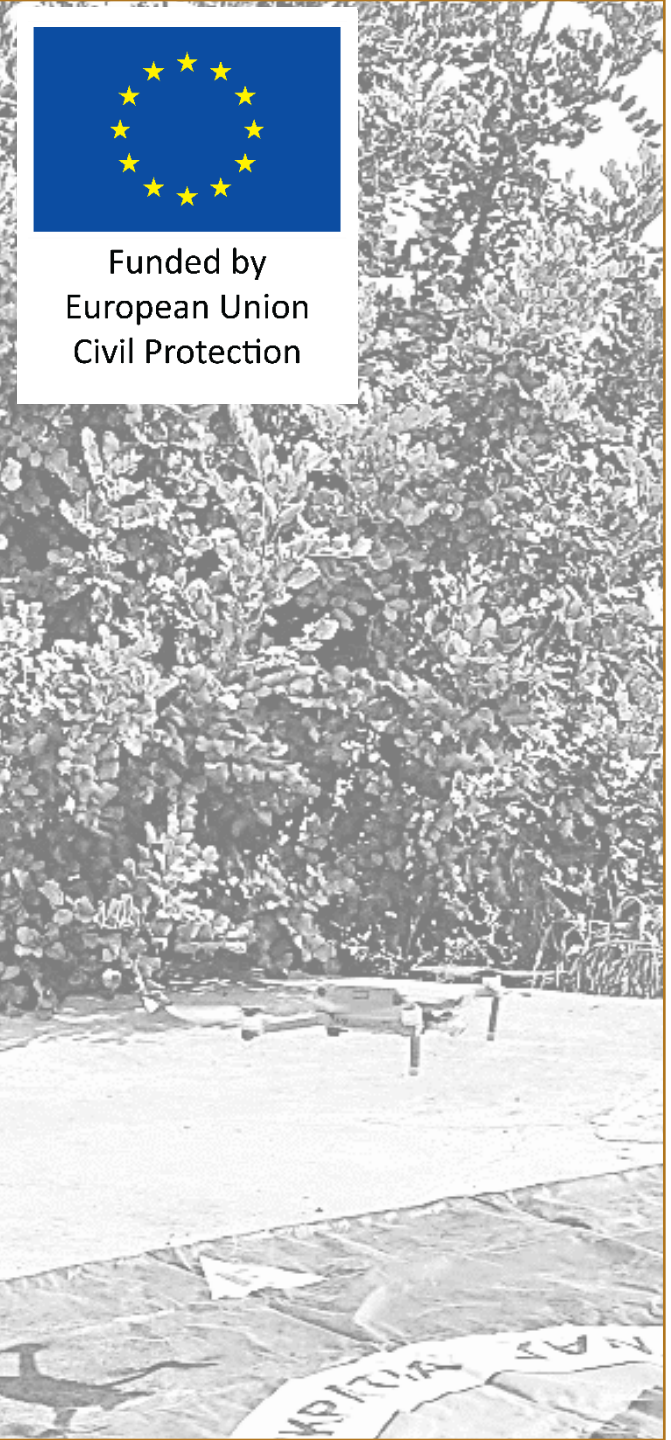

Funded by
European Union
Civil Protection

AI in Emergency Response

Panayiotis Kolios, PhD BEng AKC
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KIOS Research and Innovation Center of Excellence,
University of Cyprus
Web: www.kios.ucy.ac.cy/pkolios
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KIOS CoE, University of Cyprus

KIOS Technical Focus & Specialization

Intelligent monitoring, control, management and security of complex, large-scale, dynamical systems

Energy & Power Systems

Water Systems & Environmental Monitoring

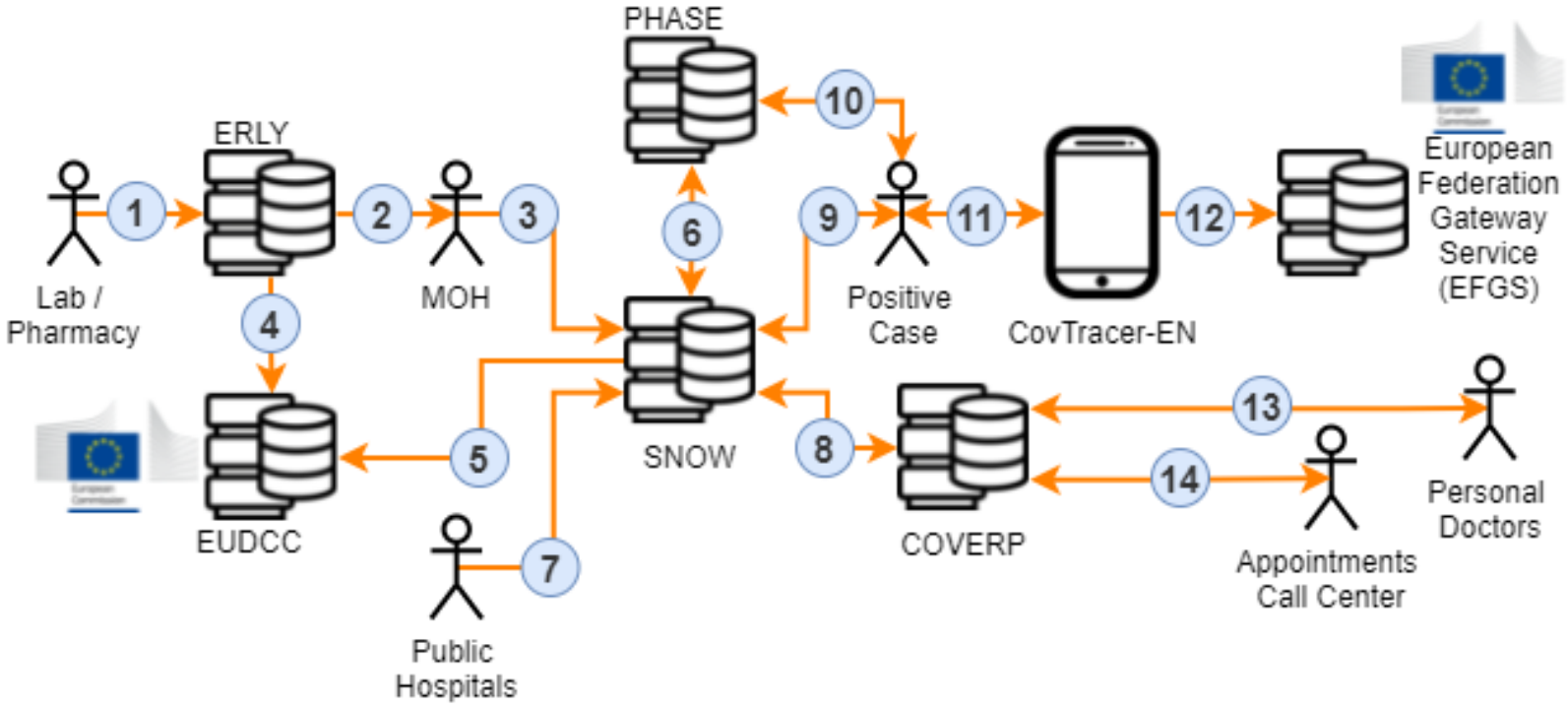
Intelligent Transportation Systems

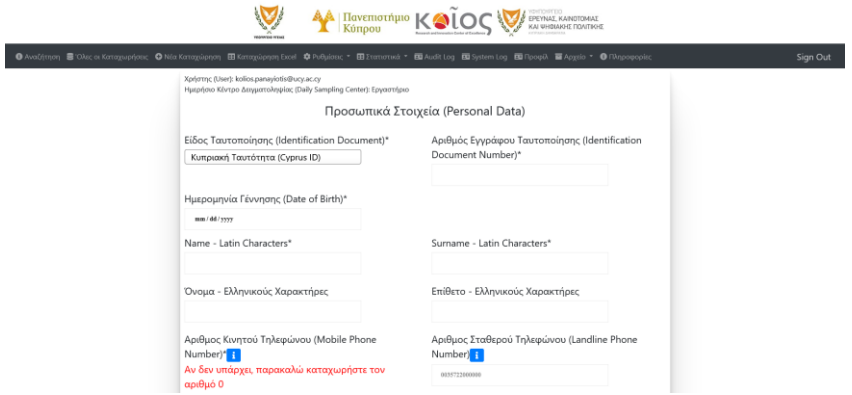
Healthcare Systems

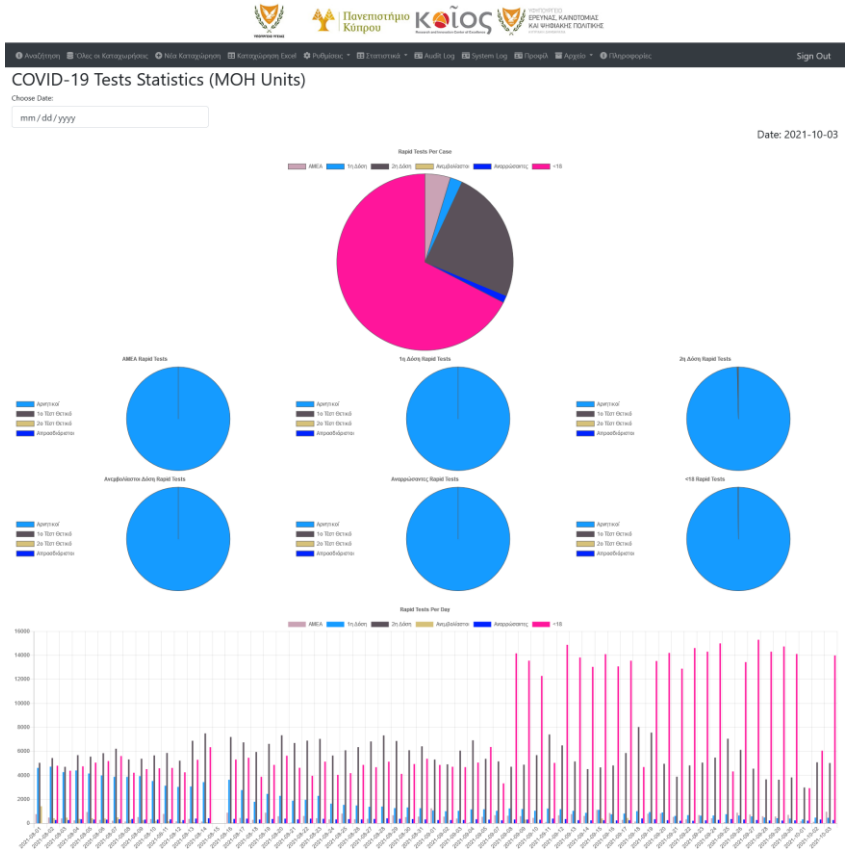
Telecommunication Networks & Cybersecurity

Emergency Management Response

COVID19 Decision-support





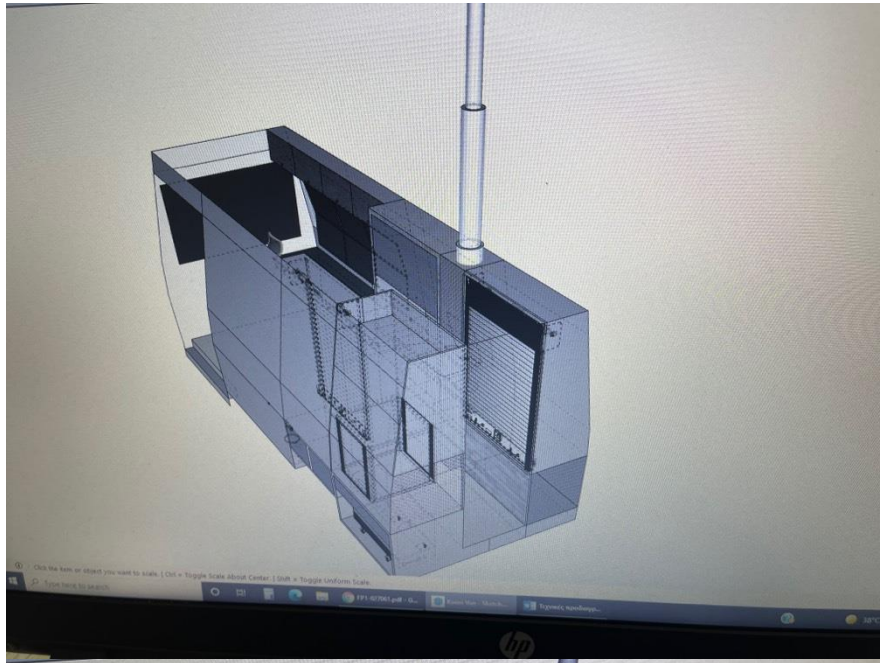


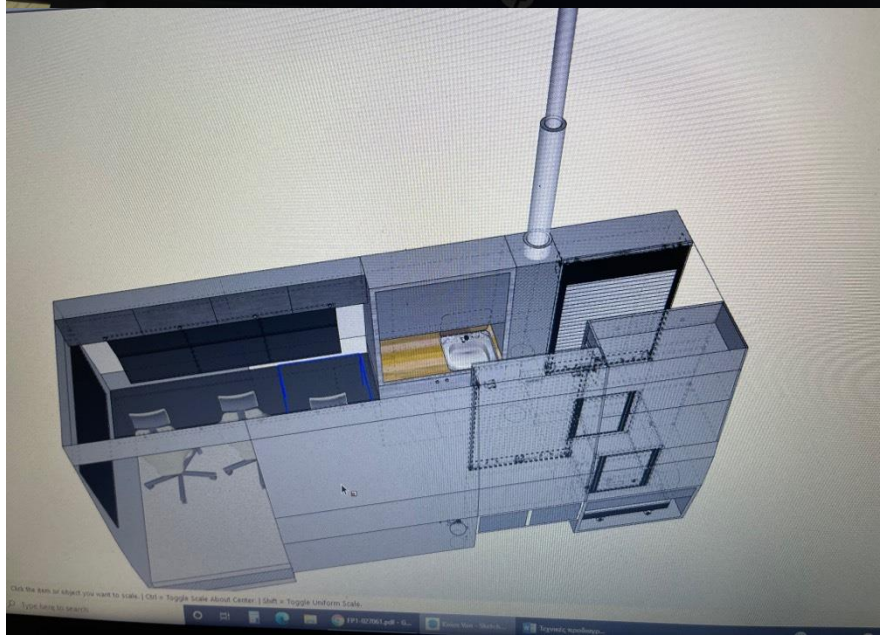
- > € 2,000,000.00 EU R&D funding (**DG ECHO** PREDICATE, SWIFTERS, LEAPFROG, AIDERS, ARTION projects, **DG HOME** CERETAB, **H2020** PathoCERT, CARAMEL, SESAME, **RIF** Ronda, MARISENSE)
- Industry R&D funding from national first responders (**Cyprus Police, Ministry of Defence**) and critical infrastructure operators (**EAC**)
- UCPM trainings including the **Exchange of Experts** and the **AMC**
- PreSeed funding by **Cyprus Seeds** and **Research & Innovation Foundation**

Facility

- Drones
  - 3 DJI M300, 4 DJI M100, 2 DJI M210 platforms
  - 12 DJI Mavic units
  - Fixed-wing Parrot and DeltaQuad
- Camera payloads
  - HD, thermal, multispectral cameras
  - Lidar sensors
  - Spectroscopy sensors
- Power
  - One 1045Wh Power station
  - Multiple drone batteries
- Computing
  - 2 Ruggedized laptops, 1 ruggedized tablet
  - 2 GPU laptops
  - 12 Nvidia Jetson Nano
  - 2 Samsung Tablets, 12 smartphones
  - HPC cluster

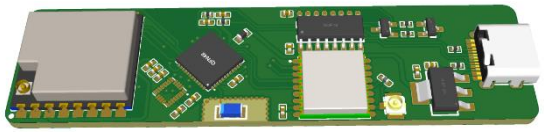
Mobile C3



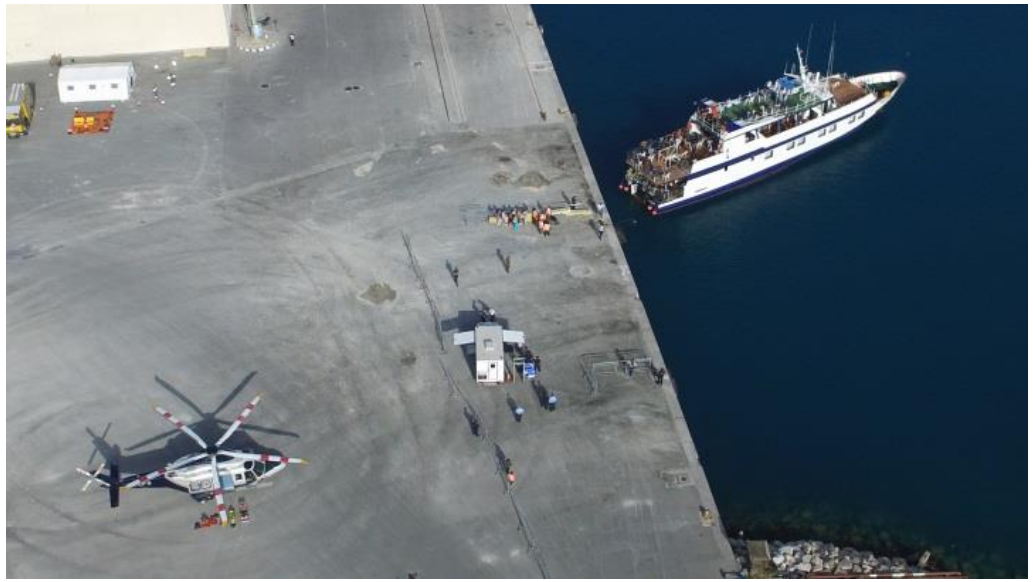


Computing Servers

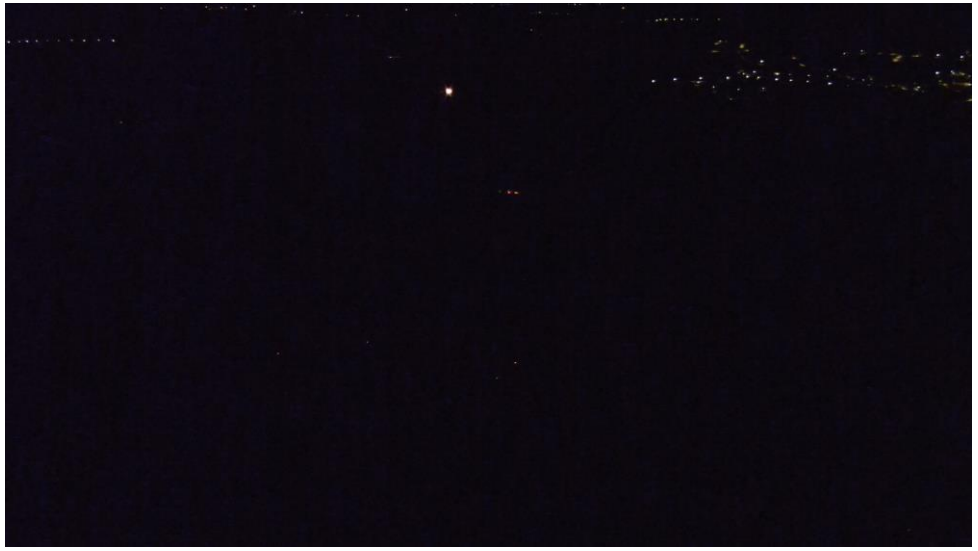
PCBs



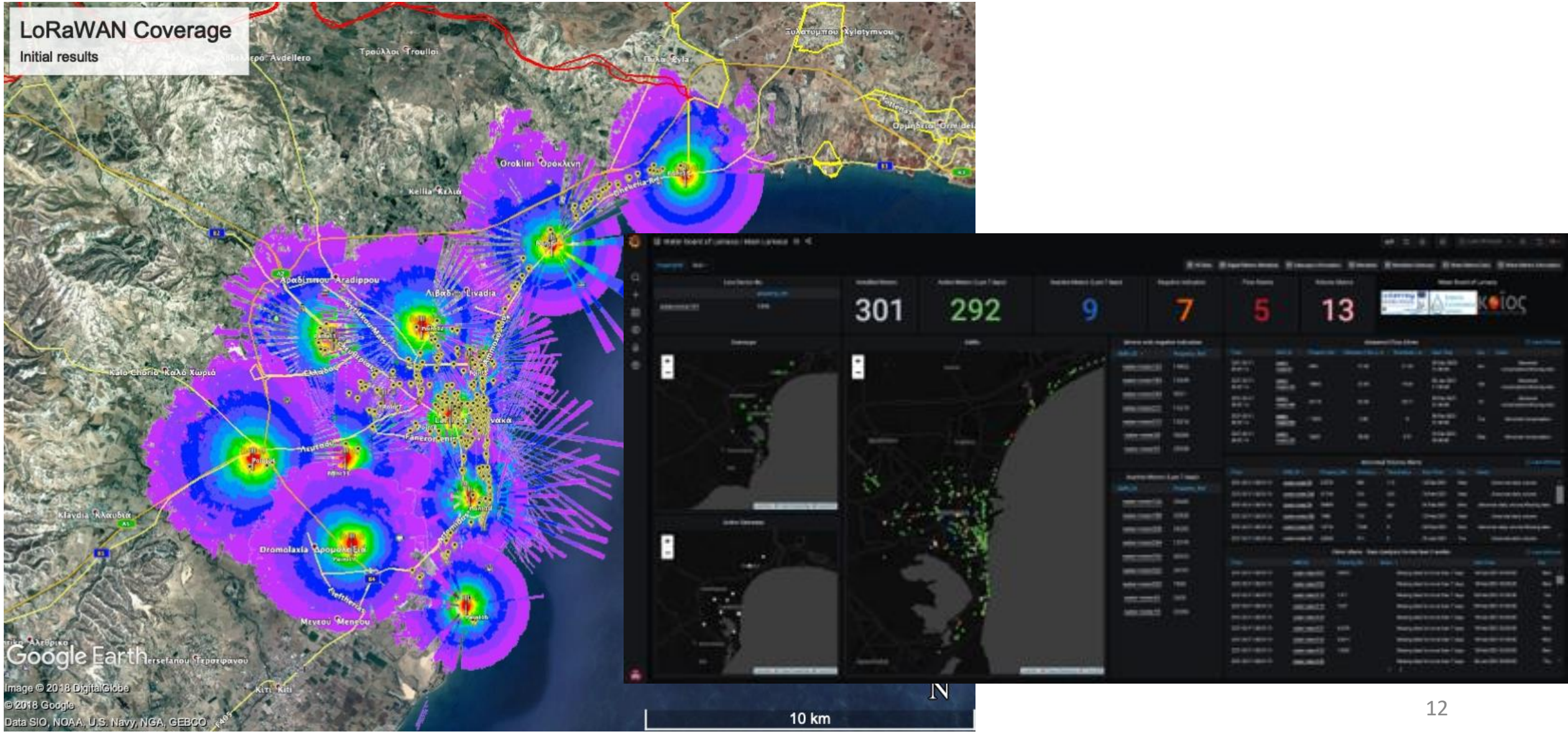
Exercises and Trainings



Field Deployments



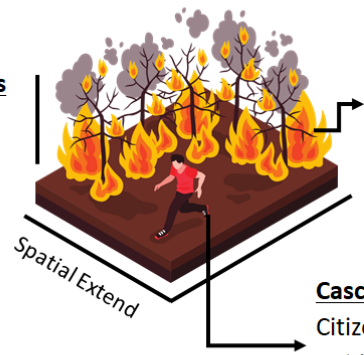
LoRa Sensor Network & Data



AI for Emergency Response

FIRES

Situational Awareness
Flame height
Fire Temperature
Spread rate

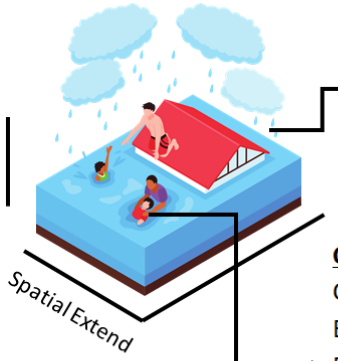


Modelling
Weather
Vegetation type
Modeling of Spread

Cascading Effects
Citizens
Buidlings
Road accessibility

FLOODS

Situational Awareness
Water height
Water speed
Real time flood discharge

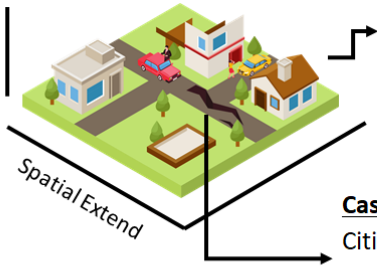


Modelling
Weather forecast
Rainfall

Cascading Effects
Citizens
Buidlings
Road accessibility
Industrial/Sensitive area
Topographic drainage basin
Hydrographic network

EARTHQUAKES

Situational Awareness
Structural assessment of buildings
Find survivors

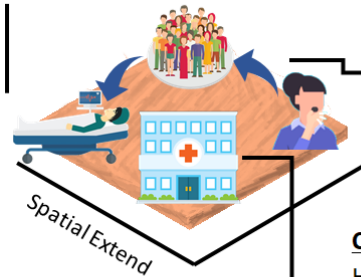


Modelling
Weather forecast
Estimated population density

Cascading Effects
Citizens
Buidlings
Road accessibility

PANDEMICS

Situational Awareness
People Count
Proximity Alert
Mask Detection



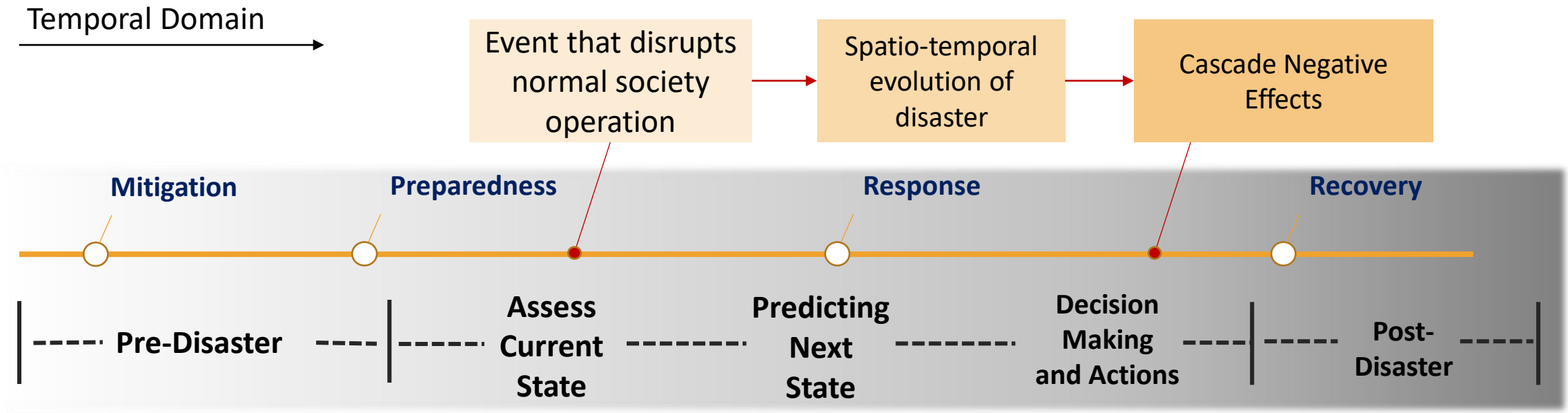
Modelling
Sickness Trend
Infection Rate

Cascading Effects
Hospital Capacity
Shortage of medicine
Lockdowns

What can AI/ML do?

- What kind of help can AI/ML provide in the Disaster Management cycle?
  - Systems that forecast events in order to take actions before a disaster
  - Decision-support systems
  - Decision-making systems
  - AI-powered automated robotic devices

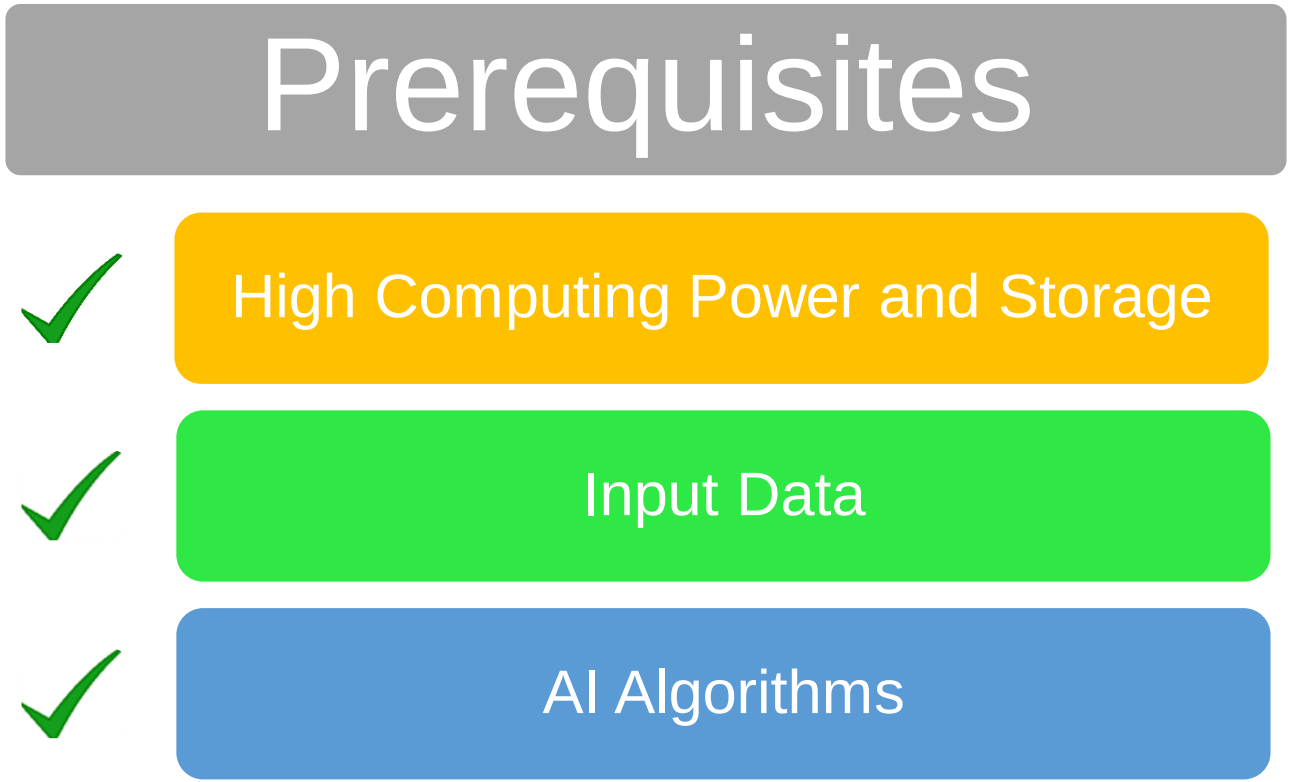
Stages of Disaster



Emergency Management Activities

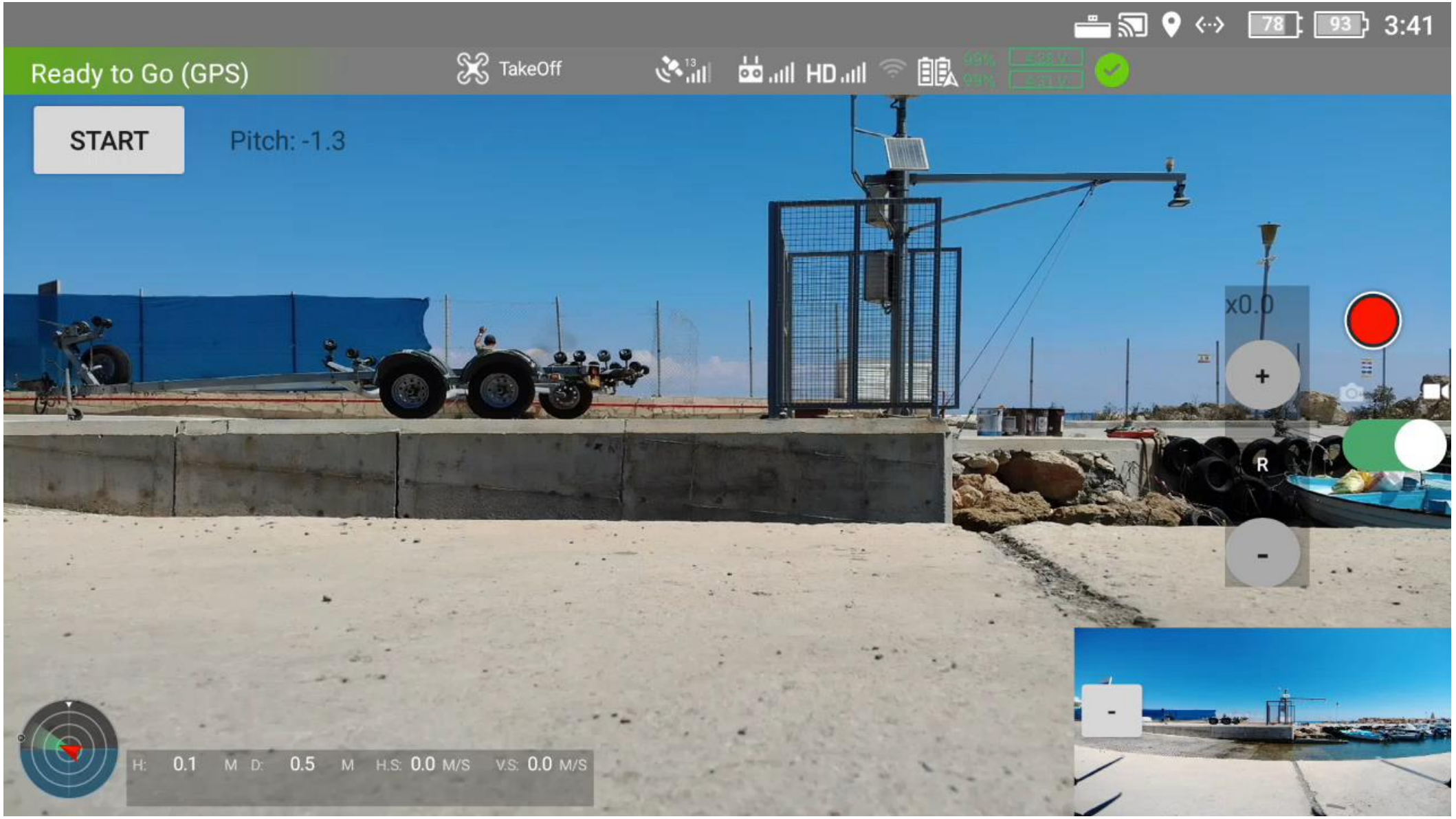
- Forecasting and Prediction
- Early Warning & Vulnerability Assessment
- Image Disaster Recognition
- UAV-based monitoring
- Recognizing People
- Planning for Cascading Effects
- Predictive Modelling
- Search and Rescue
- Route Finding
- Mapping & Damage Assessment
- Recovery & Strategy Assessment

Employing AI in Emergency Response



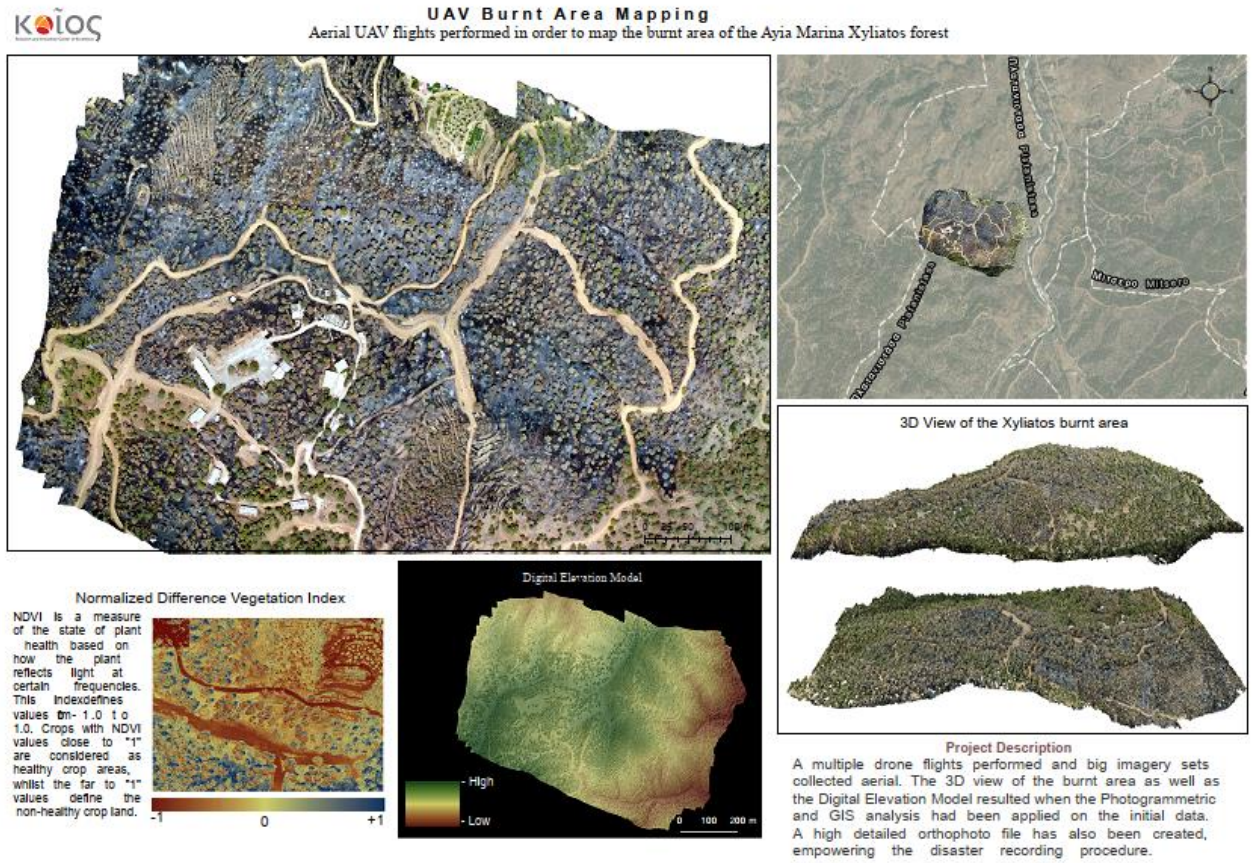
What we do

Detection and tracking

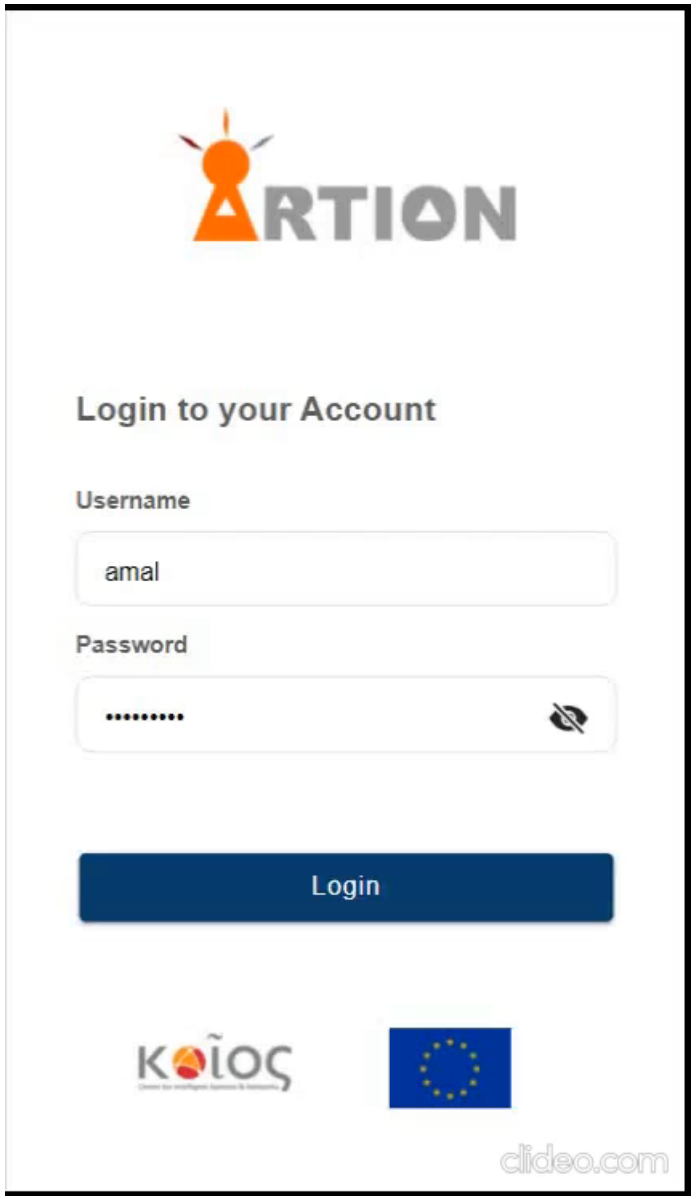


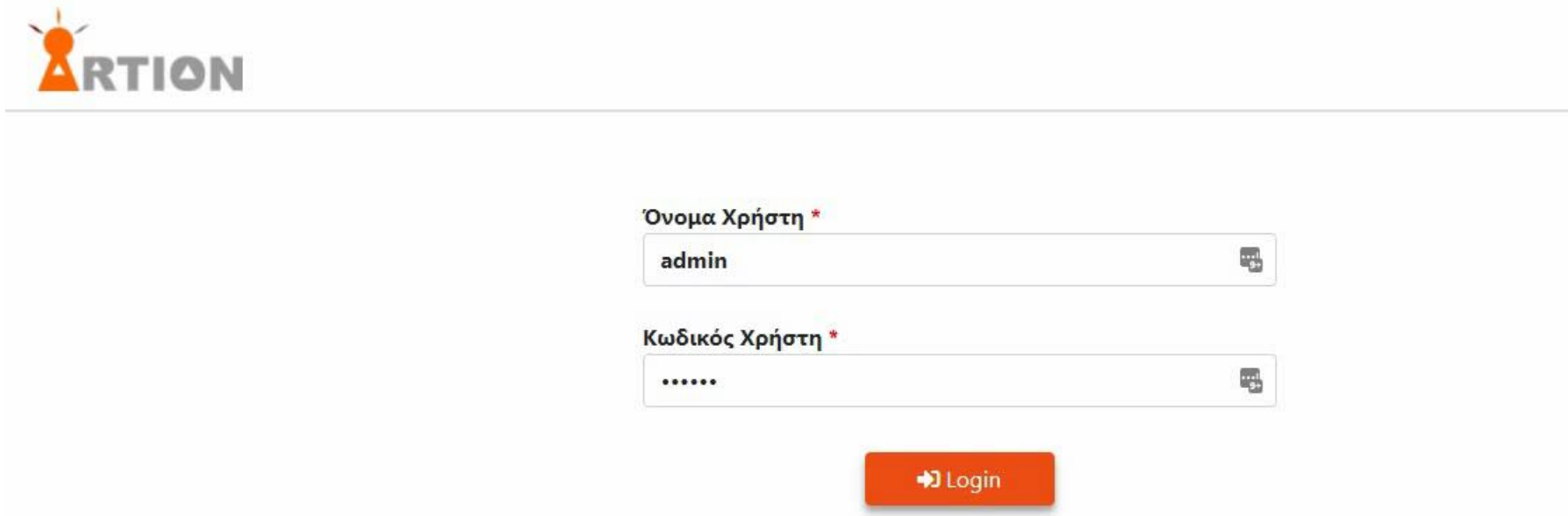
Integrated hardware and software intelligent systems

Damage assessment and severity (Xyliatou)



Web and Mobile apps

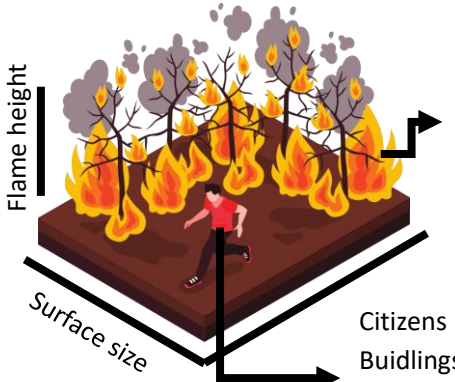




Integrated hardware and software data fusion

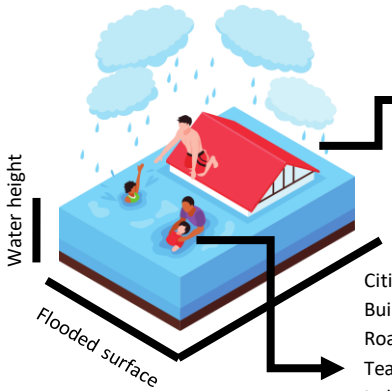
AIDERS

Needs



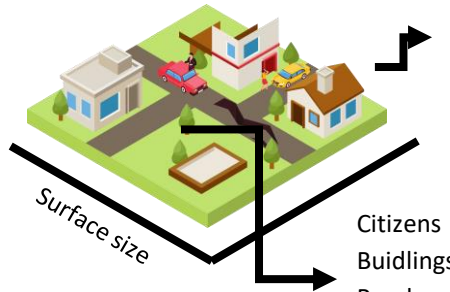
Weather
Fire Temperature
Spread rate
Vegetation type

Citizens
Buidlings
Road accessibility
Teams and means



Weather forecast
Rainfall
Water speed
Real time flood discharge

Citizens
Buidlings
Road accessibility
Teams and means
Industrial/Sensitive area
Topographic drainage basin
Hydrographic network



Weather forecast
Estimated population density
Structural assessment

Citizens
Buidlings
Road accessibility
Teams and means

Sensors

Camera
Conventional RGB Images

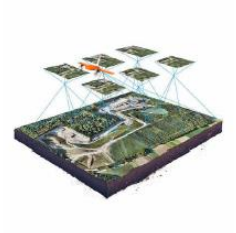
Thermal
Relative Temperature Data

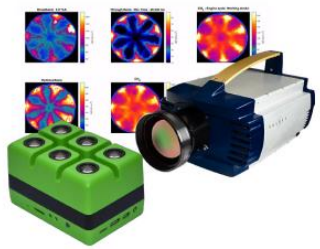
Multispectral
Broad Spectral Data (between 3-5 bands)

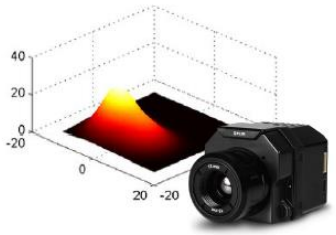
RadioMetric
Thermal and Radiometric data

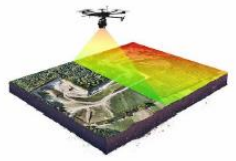
Lidar
Elevation and structural data

CBRNE
Multi-Gas detection data



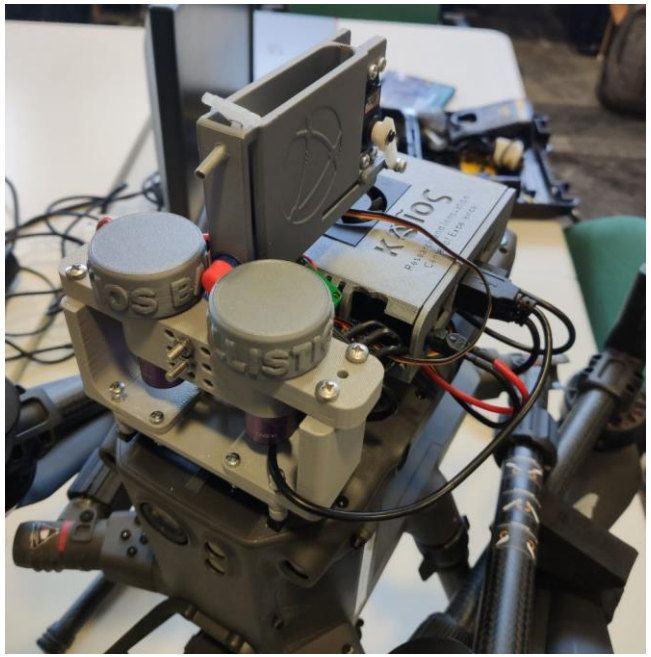


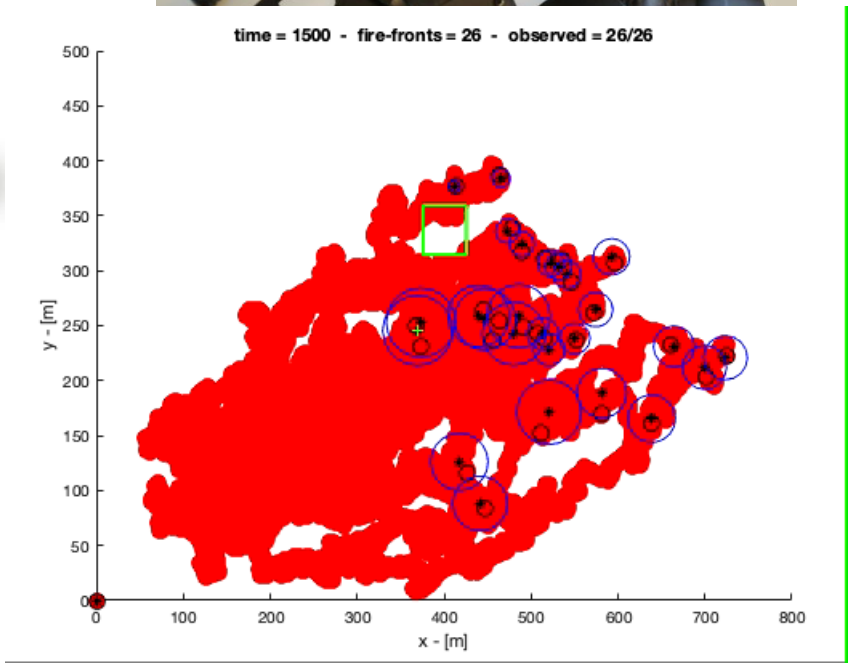




Fire analysis

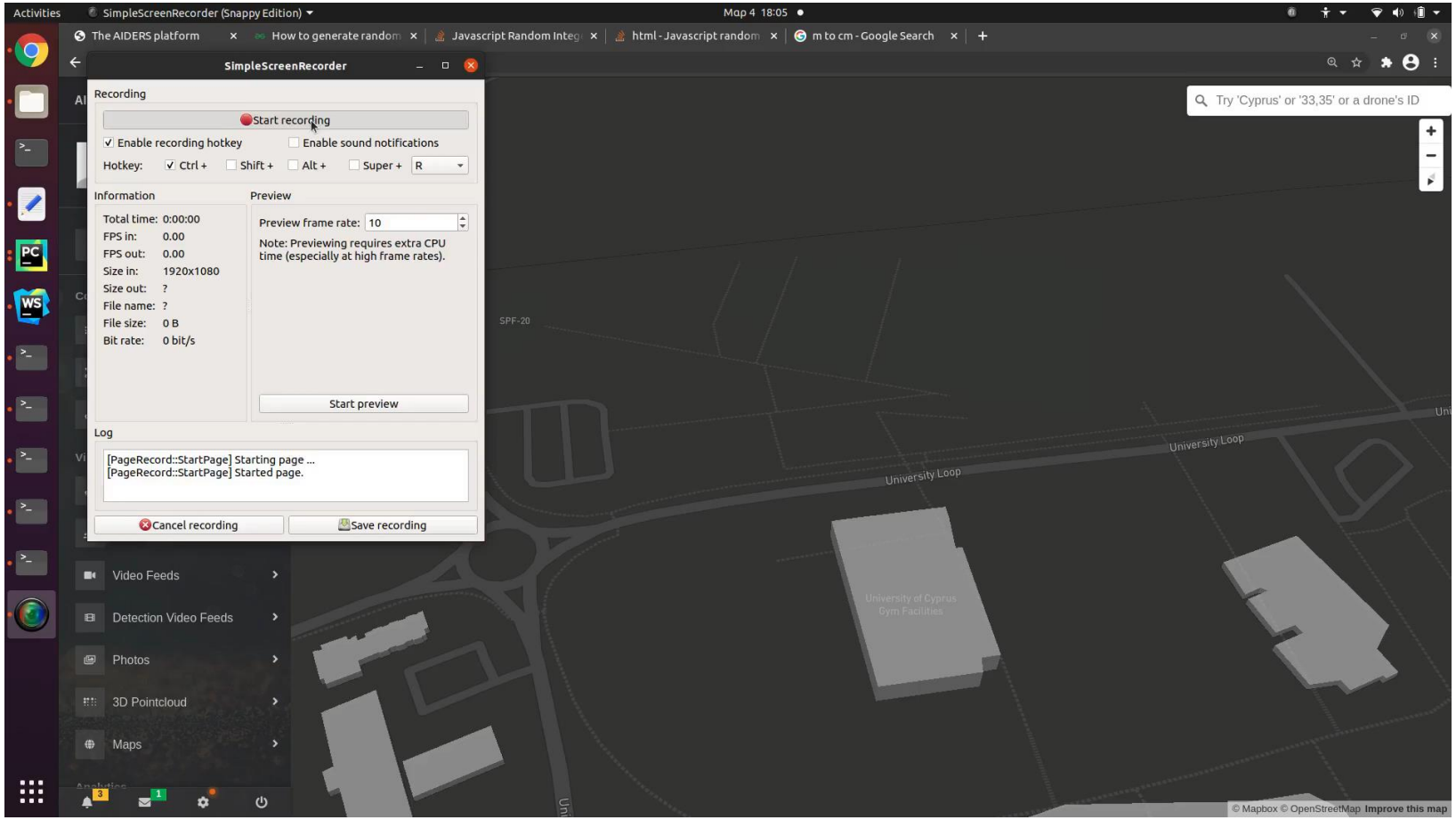
- Need information in all phases:
  - Prevention / Preparedness
  - Response
  - Recovery
- Data needed include:
  - Weather, tolopogy, fuel conditions, fire behavior





  - large volume of data that need to be processed both different phases

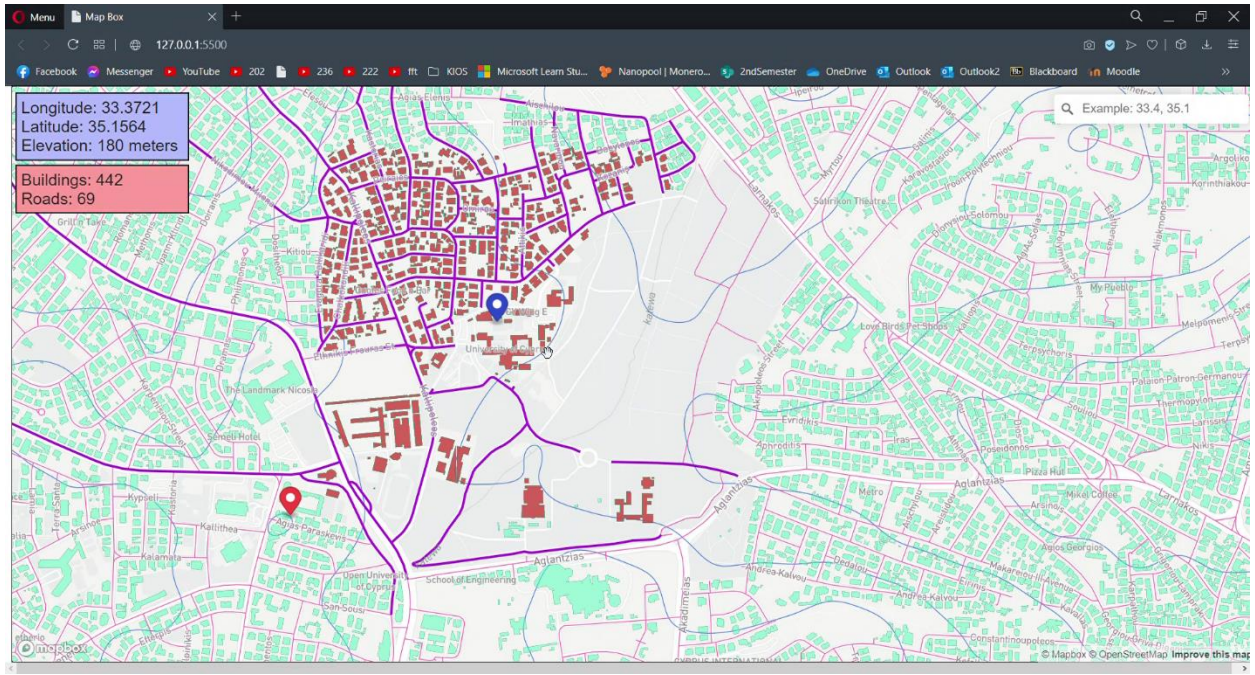
Multispectral overlay

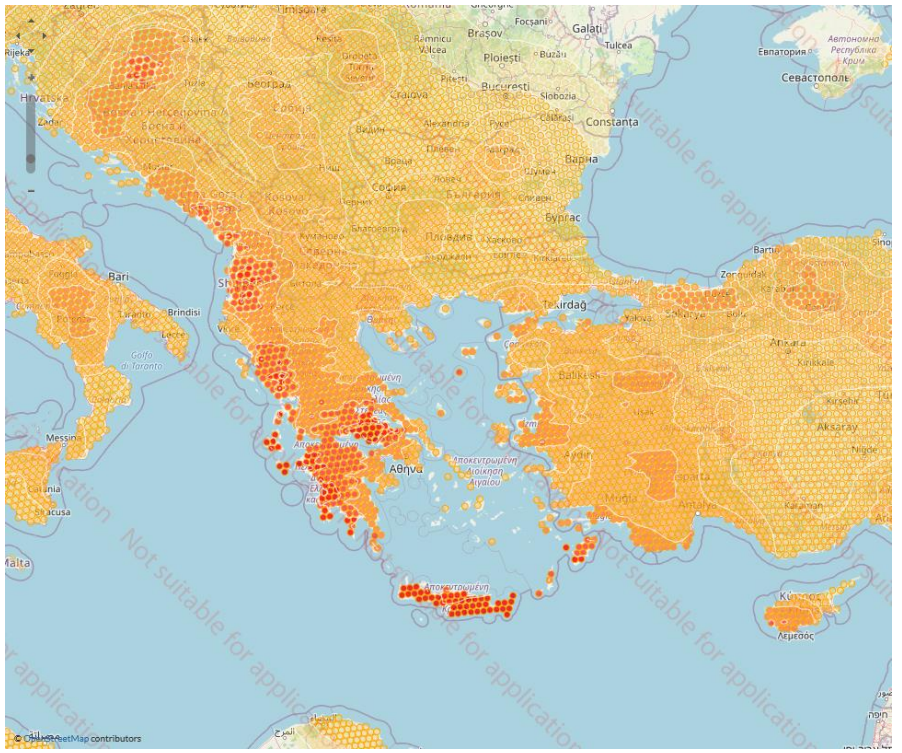


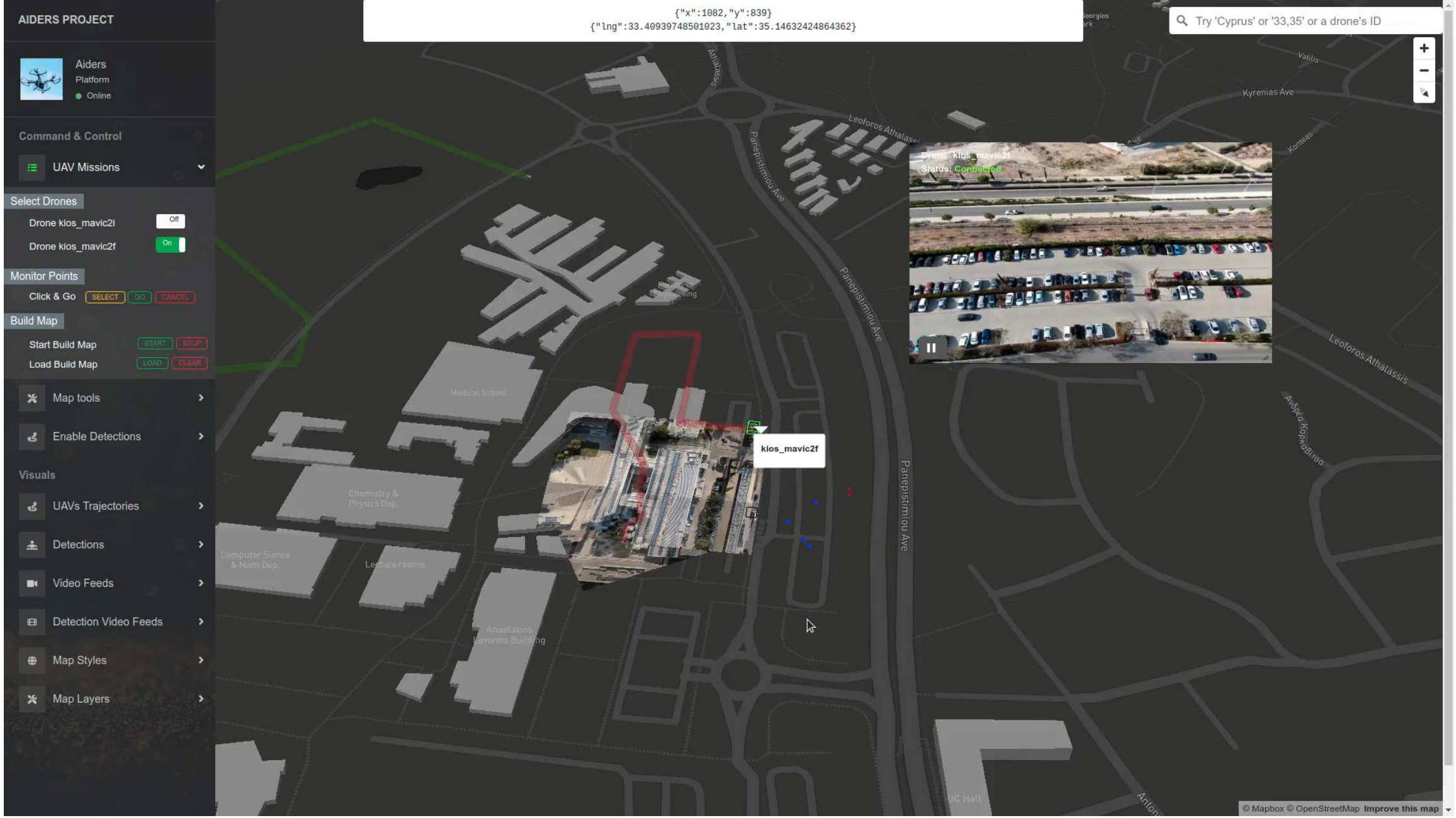

Dasaki Achnas Test Mission

Earthquake assessment

- Hazard and risk assessment
  - Using OpenQuake, etc
- Data needed include:
  - Soil type, Building quality, distance from fault, number of floors, population density, distance from public open area






AIDERS PROJECT
Aiders
Platform
Online
Command & Control
UAV Missions
Select Drones
Drone kios_mavic2i
Off
Drone kios_mavic2f
On
Monitor Points
Click & Go
SELECT
GO
CANCEL
Build Map
Start Build Map
START
STOP
Load Build Map
LOAD
CLEAR
Map tools
Enable Detections
Visuals
UAVs Trajectories
Detections
Video Feeds
Detection Video Feeds
Map Styles
Map Layers
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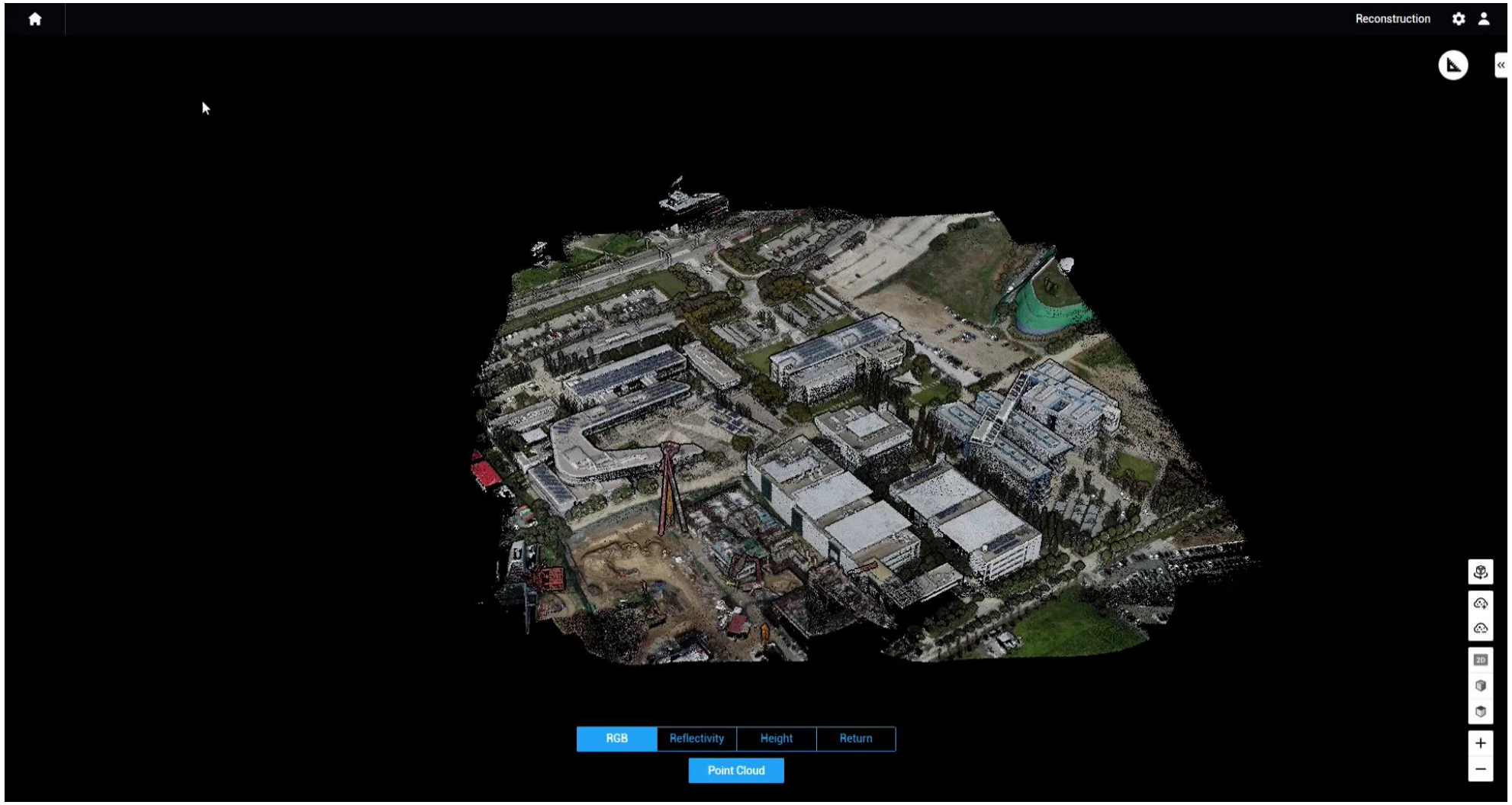
{"lng":33.40939748501023,"lat":35.14632424864362}
Try 'Cyprus' or '33,35' or a drone's ID
Drone: kios_mavic2f
Status: Connected
kios_mavic2f
Leoforos Athalassis
Panepistimiou Ave
Kyrenias Ave
Medical School
Chemistry & Physics Dep.
Computer Sience & Math Dep.
Lecture rooms
Anastasios Leventis Building
UC Hall
© Mapbox © OpenStreetMap Improve this map

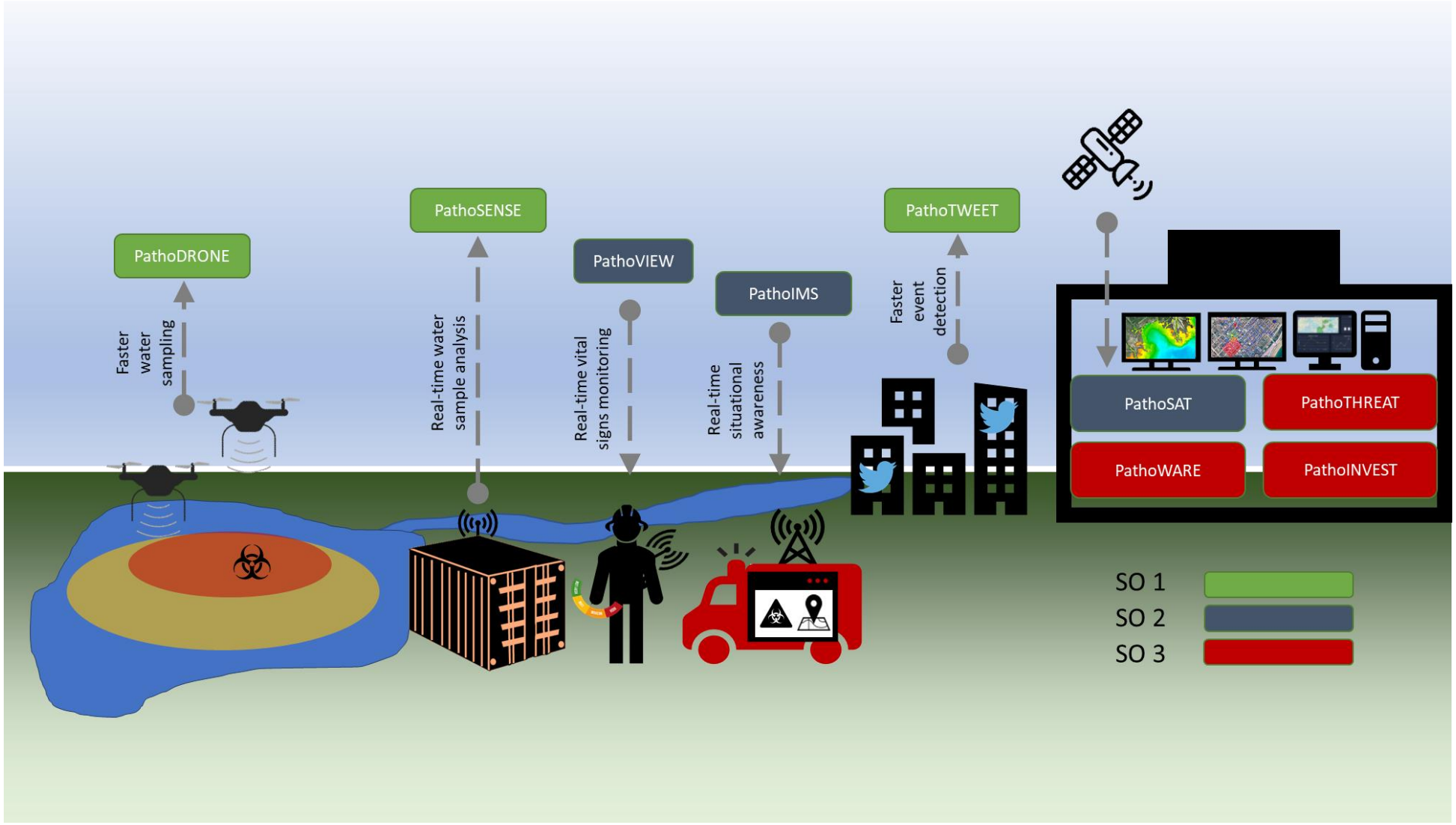
3D reconstruction



Water contamination Case Study

Technology layout

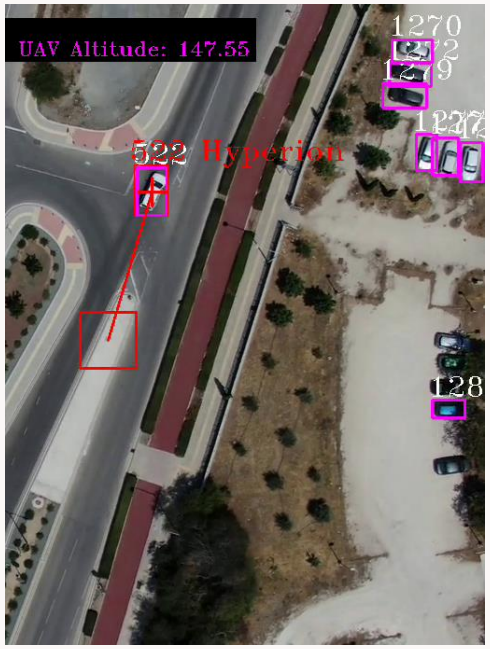
PathoCERT



Water contamination Case Study

Technology layout

Emergency Response Technologies



Autonomous Systems

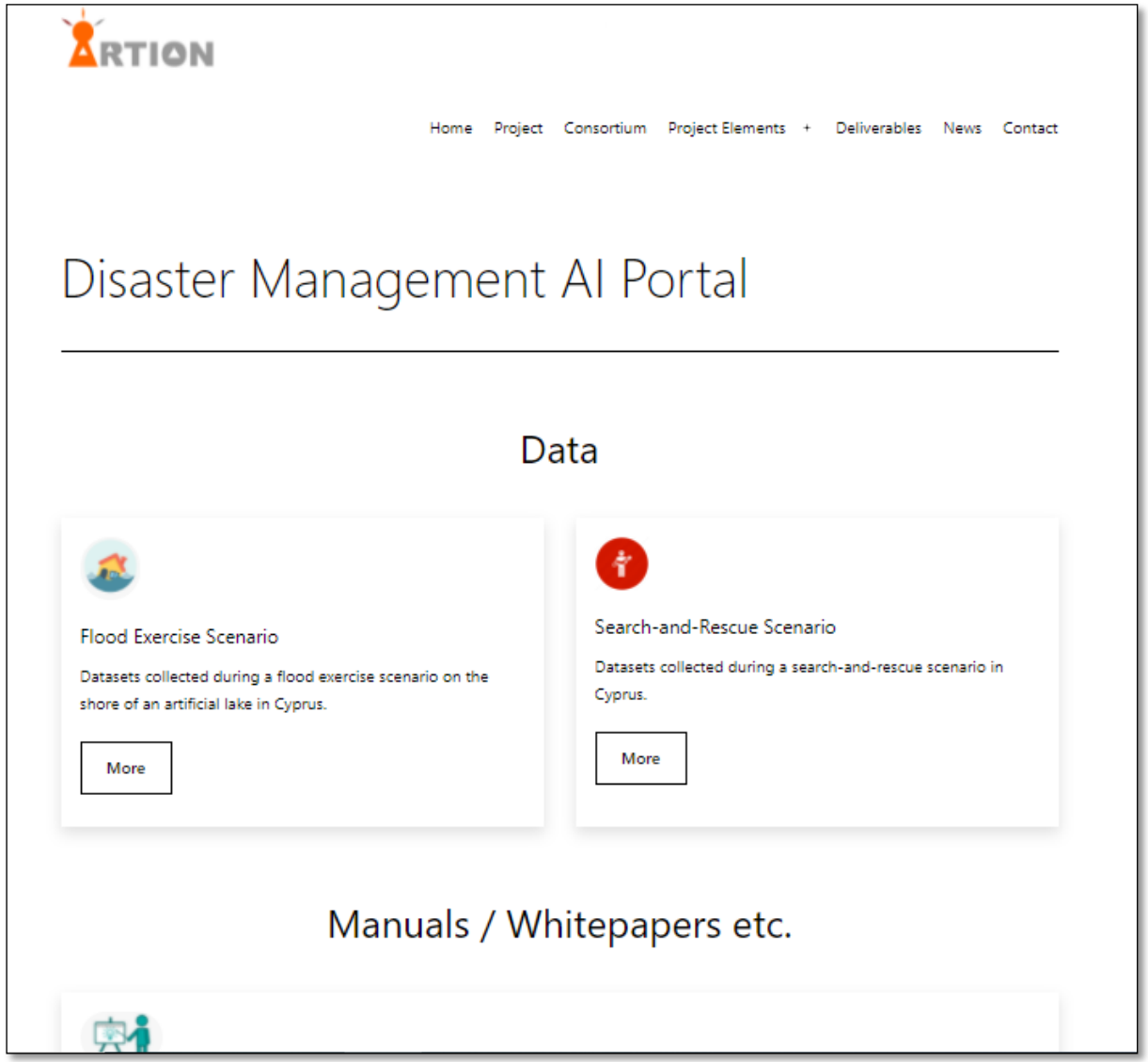
Embedded Hardware

UCPM Trainings

Field Exercises

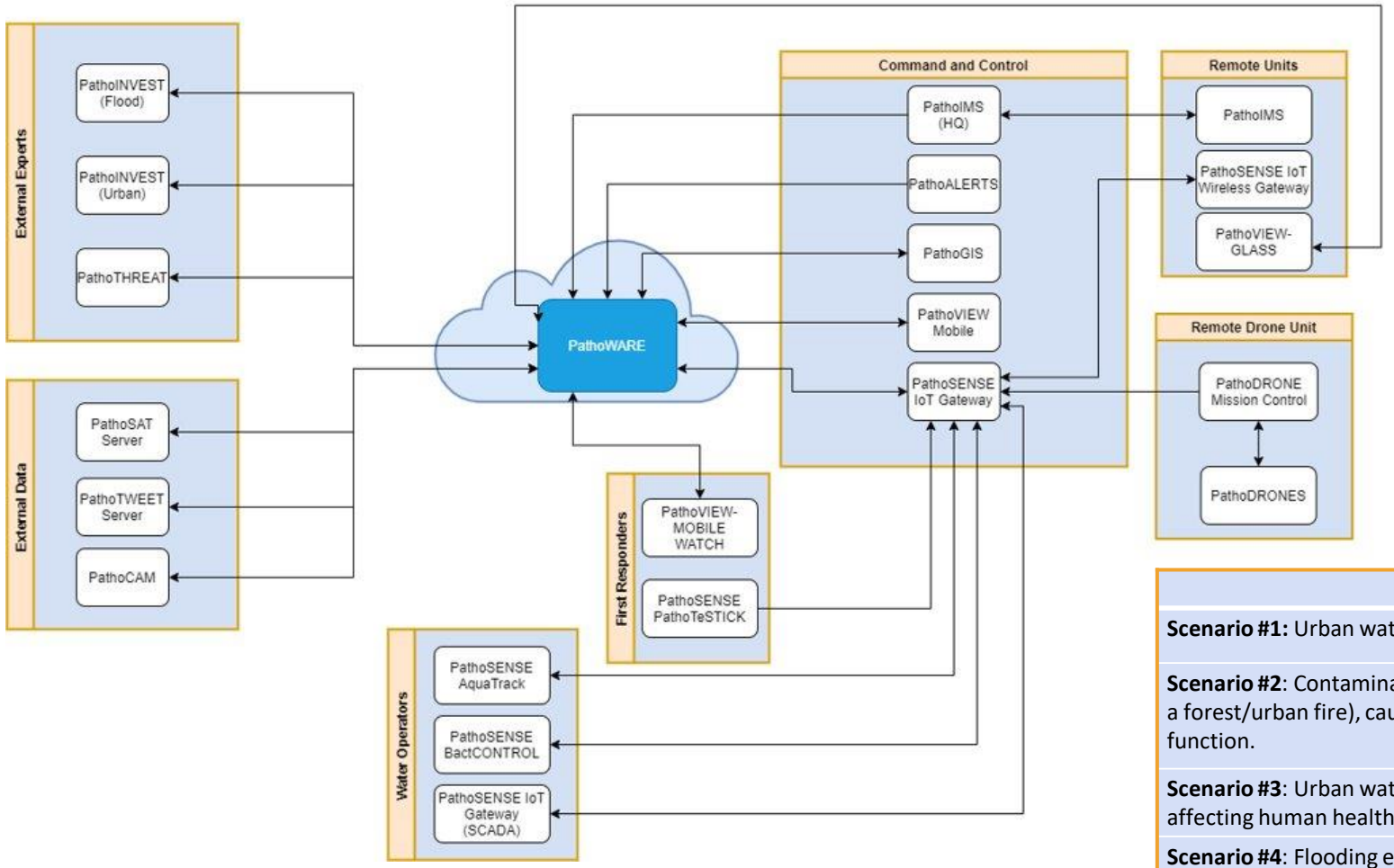
Disaster Management AI Portal

- Available at: https://www2.kios.ucy.ac.cy/ARTION/
- Datasets, algorithms, manuals, etc.
- New material will be regularly posted



ARTION

H2020 PathoCERT



Field exercises
Scenario #1: Urban water contamination after an earthquake due to wastewater infiltration
Scenario #2: Contaminated water sources due to a natural/accidental event (rainfall after a forest/urban fire), causing problems at infrastructures, e.g., the water treatment plant unable to function.
Scenario #3: Urban water contamination of unknown source (including terrorist attack), possibly affecting human health.
Scenario #4: Flooding event, which is mixed with waste products, affecting a certain area that needs to be evacuated.
Scenario #5: Search and rescue mission within in a lake/sea/river with possibly contaminated water.