

# TERRA 4D

Crisis Management Platform

# Command and Control Centre Solution



## Real-time Monitoring

- Real-time visualization in geographical context
- Superior situational awareness
- Selective data distribution
- Workstation, mobile and web clients

## Processing & Automation

- Correlation of meta data
- Customizable, interactive workflow procedures (SOP)
- Automatic system responses
- Efficient incident resolution

## Analytics

- System overview dashboard
- Ad-hoc and frequent reporting
- Post situation analysis
- Forensic investigations
- Operator training

# Crisis Management Platform Architecture

- 3D GIS visualization of all integrated systems for intuitive and superior situational awareness
- User interface incorporating all aspects of flooding crisis: detection, monitoring, resolution (respond), recover
  
- Correlation of all subsystem data
- Automatic responses & rules engine
- Digital Twin based analytics and calculations
  
- Integration of all systems mentioned in the following slides
- Geo-referencing of all incoming information
- Bi-directional communication with systems and respond units



Command and  
Control Center

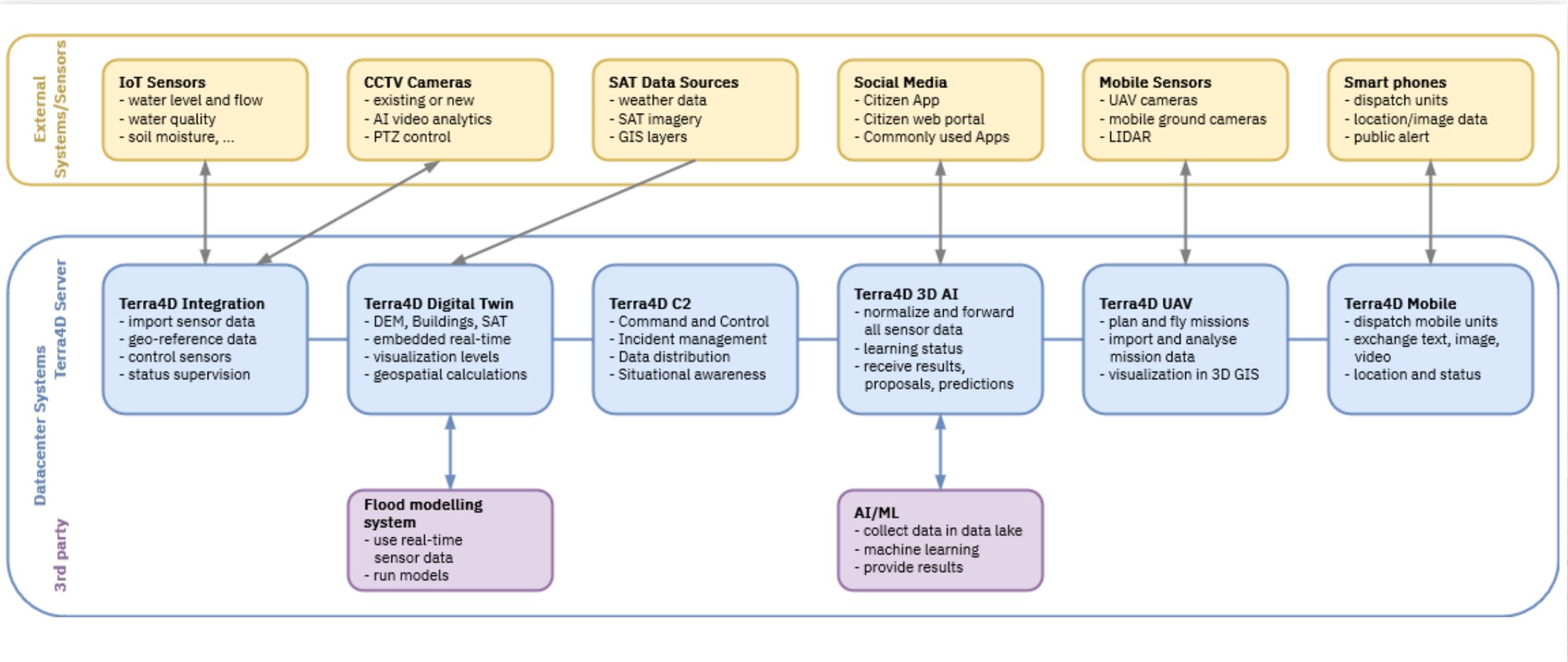


Integration  
Platform



Subsystems  
and Sensors

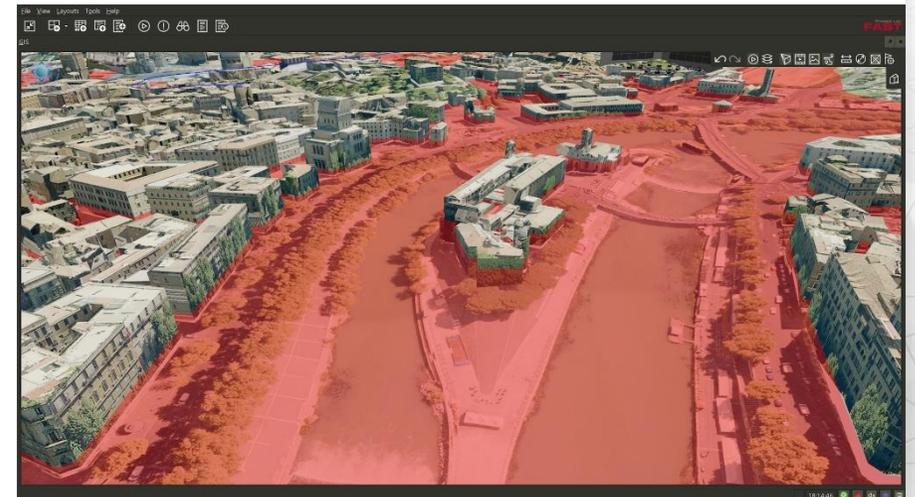
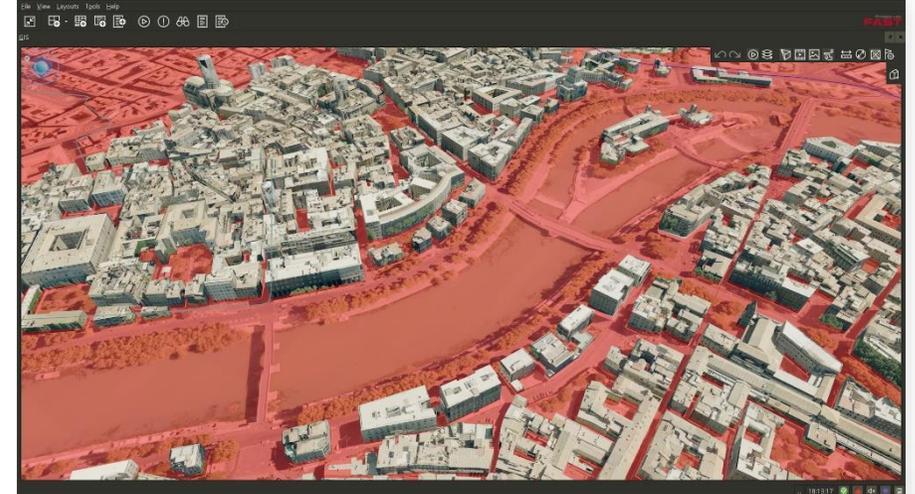
# Architecture Overview



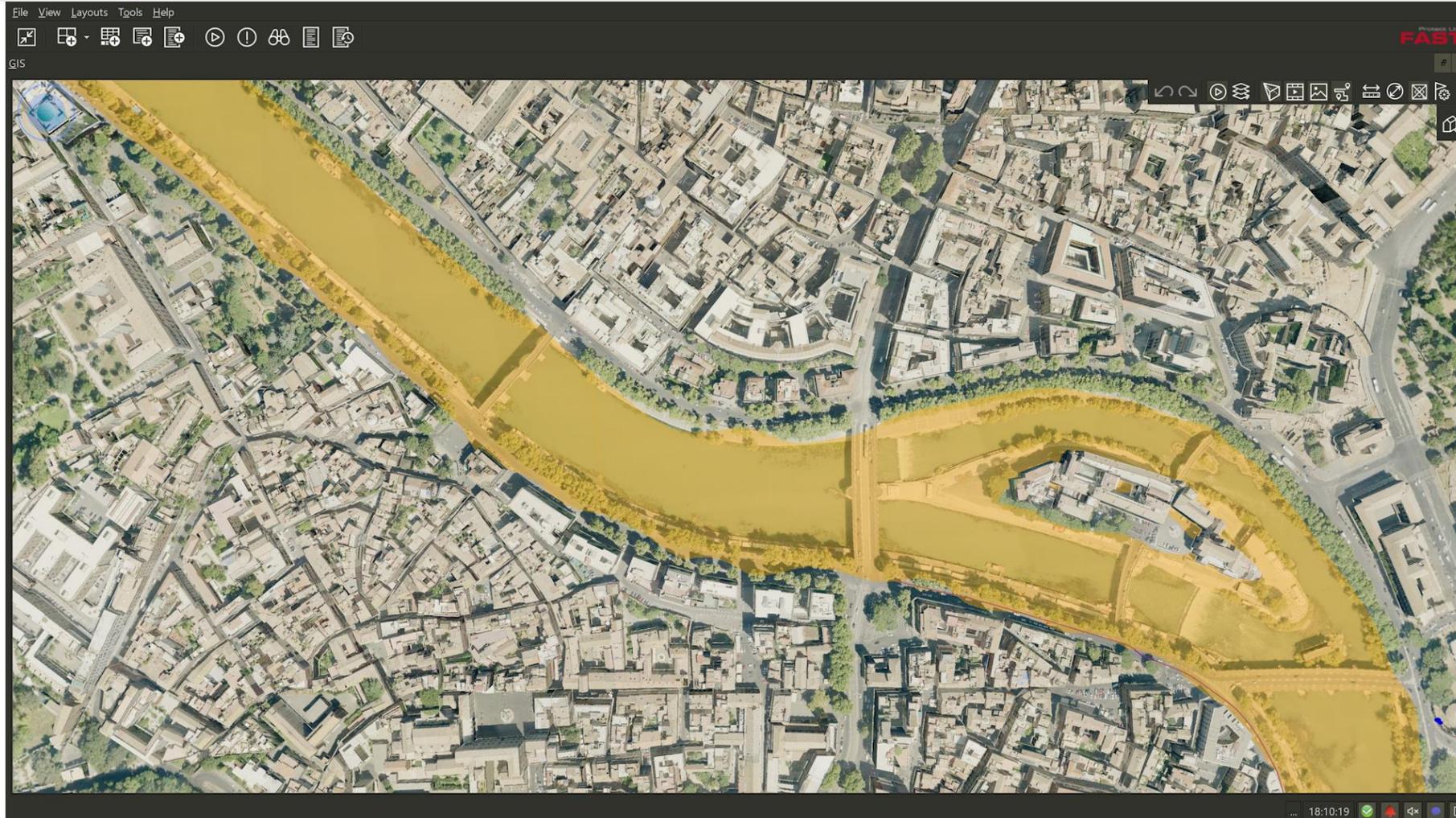
# Digital Twin

## DIGITAL TWIN

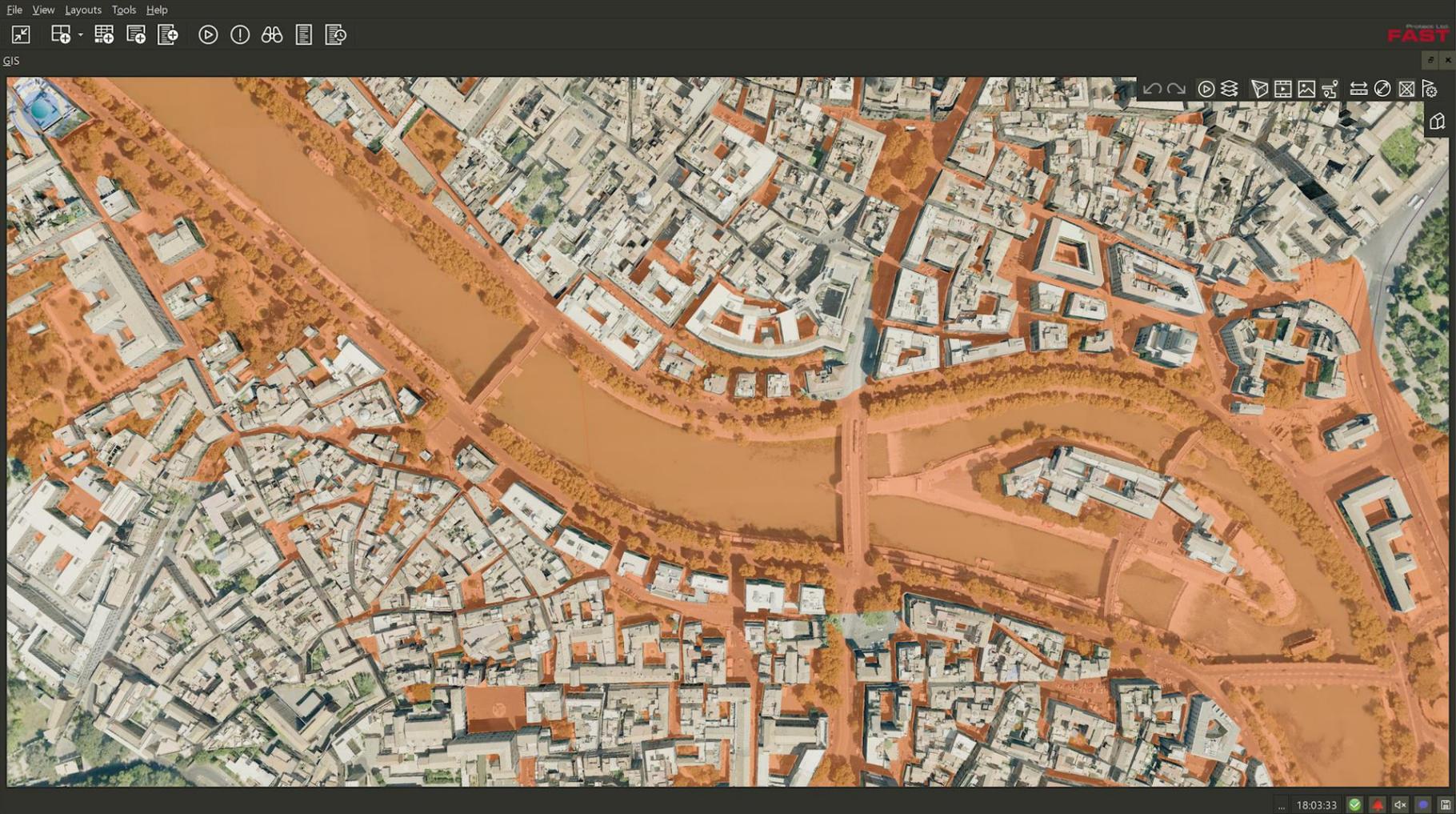
- 3D Geographical Information System including DEM (Digital Elevation Model) and 3D Buildings for complete cities and country
- Show water levels in different colours to represent severity
- Free navigation in 3D model to monitor hotspot areas
- Utilize 3D GIS technology to map flood-prone areas and understand the topography of the region
- See following 3 slides for different levels at river Tiber in Rome...



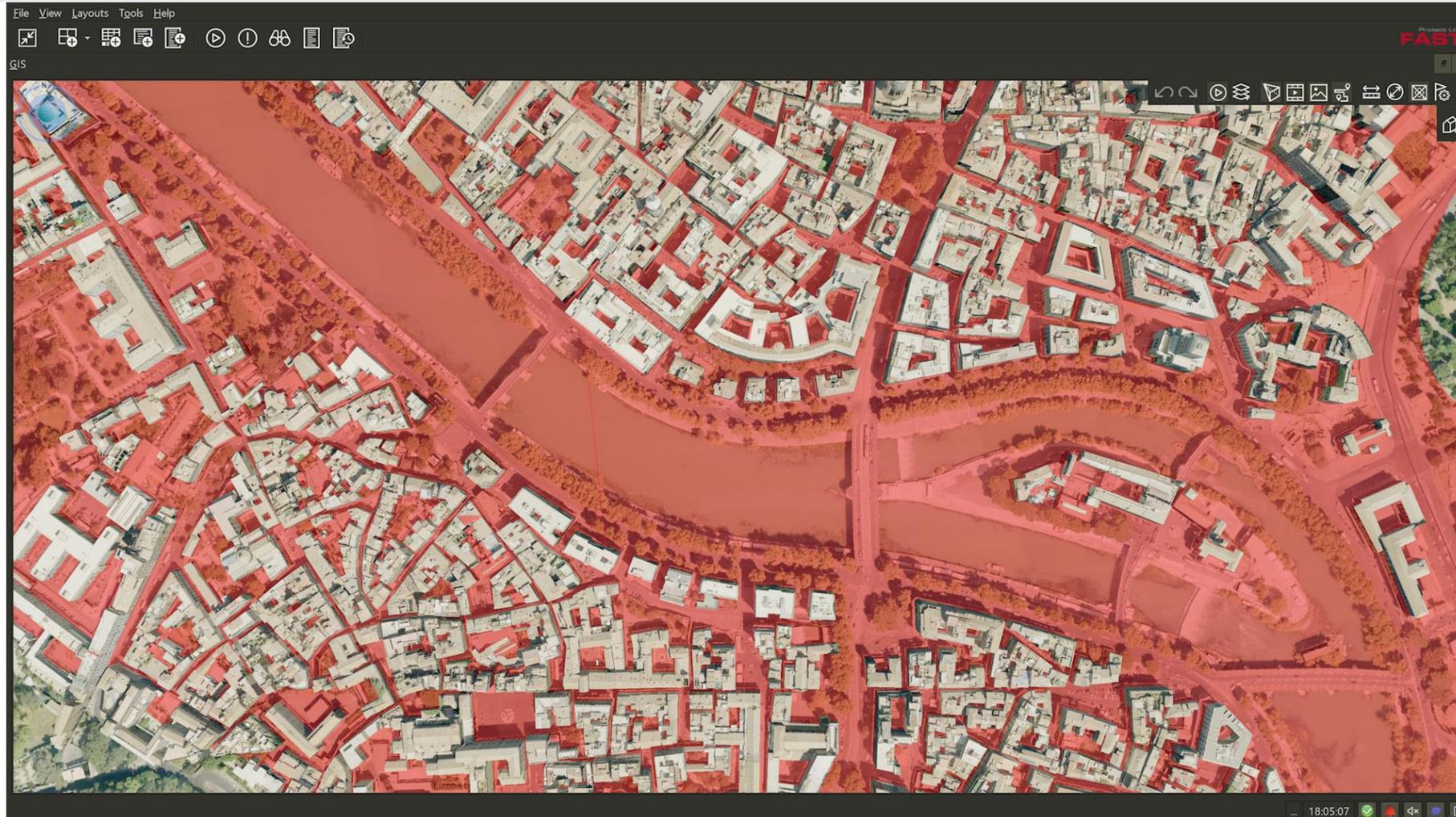
# Digital Twin – Water level upper limit



# Digital Twin – Water level start flooding



# Digital Twin – Water level critical



# Weather Monitoring Systems

- Connect to weather monitoring systems across the city
- Present real-time data in crisis management center
- Share real-time data with simulation tools
- Rainfall Gauges: Measure precipitation levels to anticipate potential flooding events
- Weather Stations: Monitor atmospheric conditions, including temperature, humidity, and wind speed, to predict storm patterns

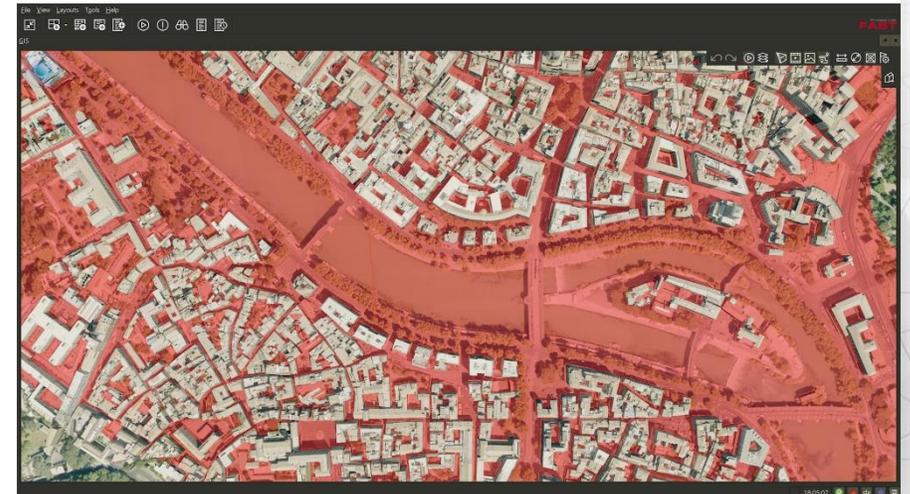
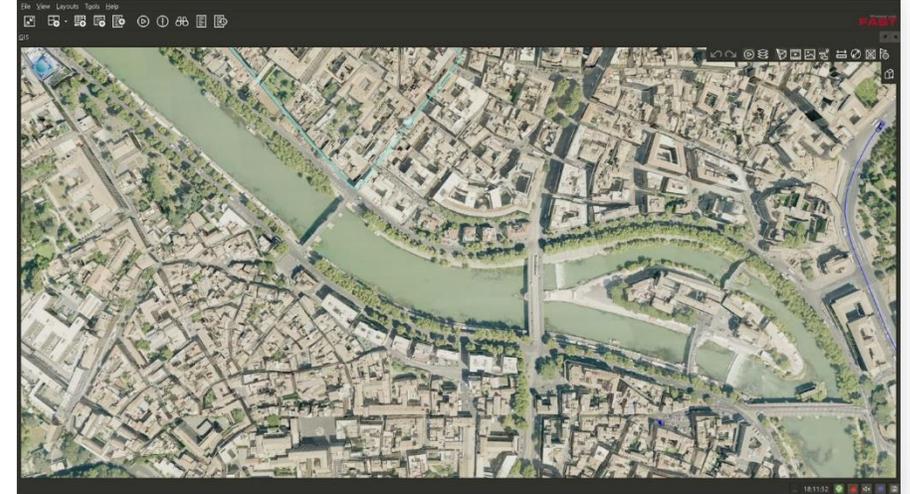


# LIDAR - Flood Plain Mapping

- LIDAR: Provides high-resolution topographical data for accurate flood modelling (post-event data capturing via UAV missions, e.g. for construction areas)
- GIS: Utilize Digital Twin technology to interpolate and map flood-prone areas by understanding the topography of the region

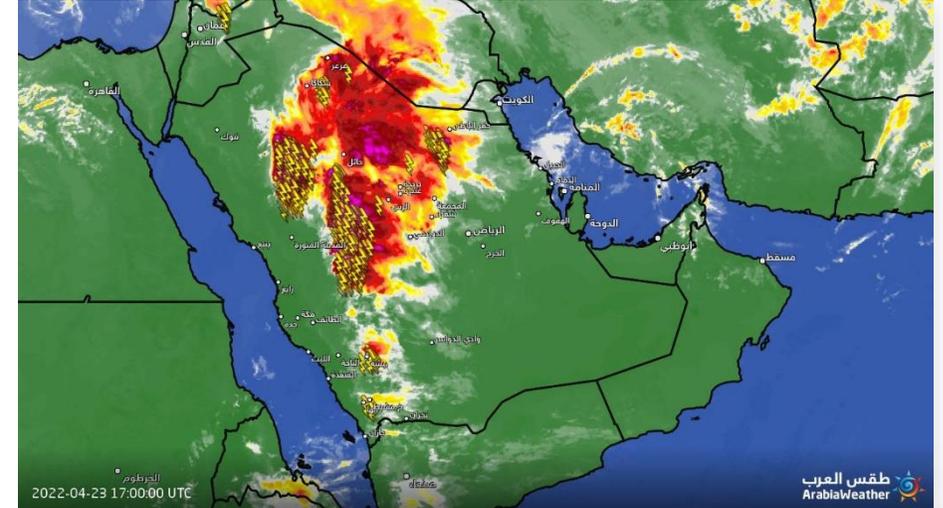


Legend ■ Flooded ■ Non-flooded ■ Persistent water



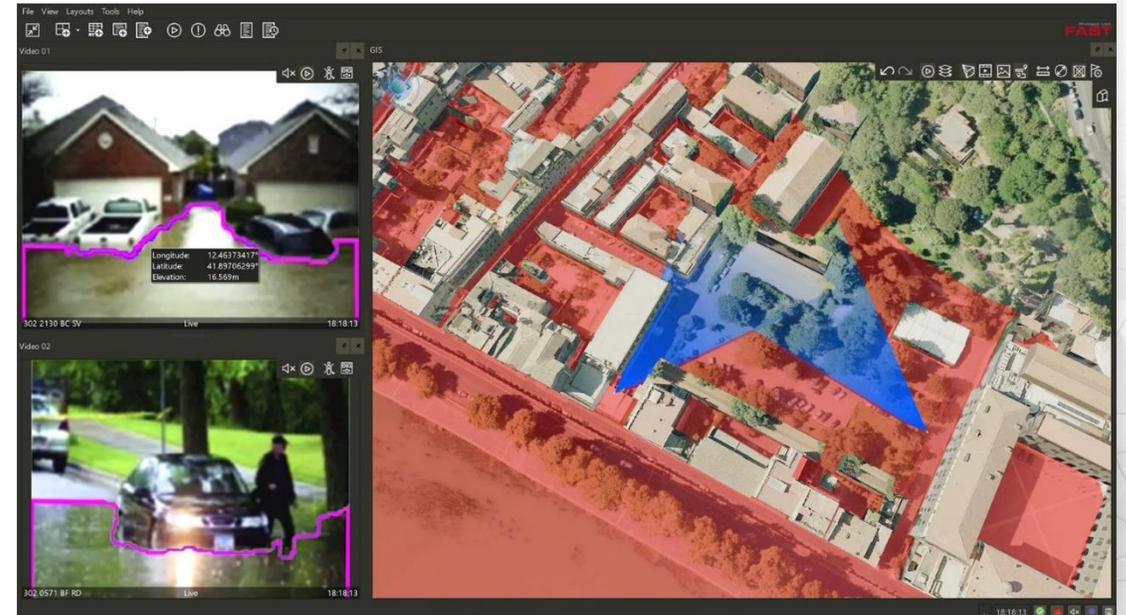
# Remote Sensing

- Satellite Imagery and AI/ML: Use satellite data to monitor large-scale weather patterns, identify potential flood areas, and assess the extent of flooding
- UAV: Plan and coordinate drone missions for conducting aerial surveys to capture real-time images and videos of flood-affected areas for rapid assessment
- Show results of drone missions directly on the map and interpolate it into wider areas



# Sensor Networks

- CCTV: Use AI/ML enabled VCA tools to detect and monitor water floodings on streets, places, in pipes and canals
- Water Quality Sensors: Monitor changes in water quality during flooding events
- Soil Moisture Sensors: Measure soil saturation levels to assess the ground's capacity to absorb water
- Use AI/ML to learn from all these data over time to enhance precision of decisions



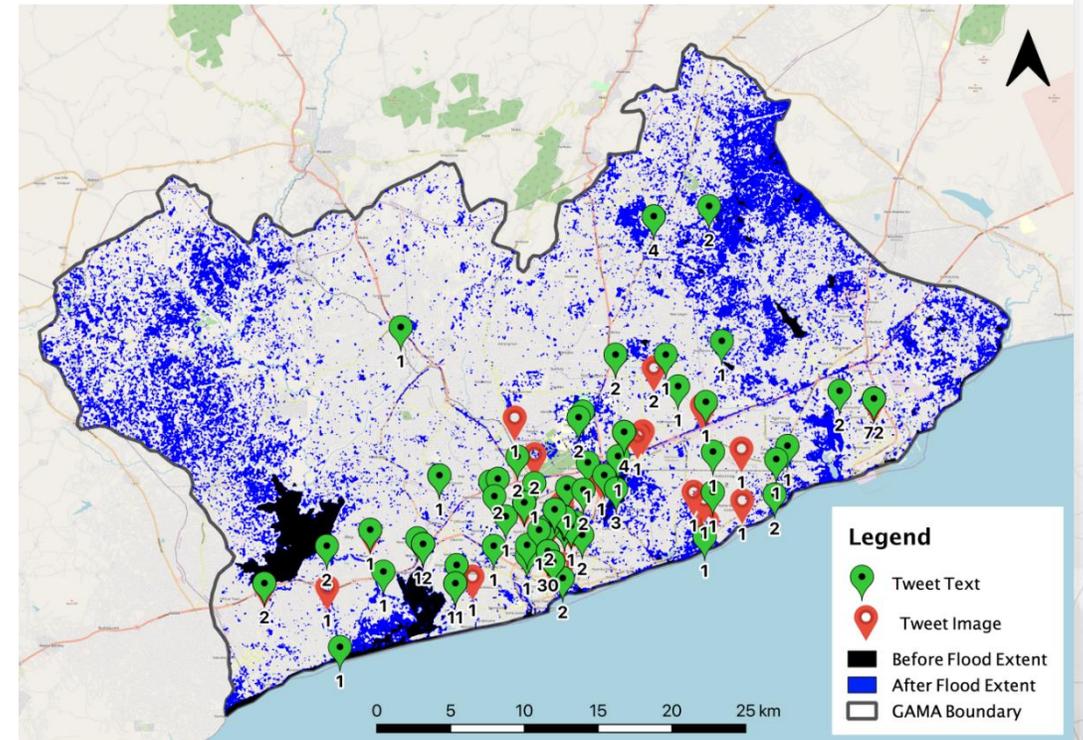
# Video Analytics with Digital Twin Interpolation

- Use geo-referenced video to get 3D coordinate of every video pixel in CCTV camera running video analytics
- Interpolation of flooding level into wider areas utilizing the Digital Twin, DEM and 3D Building layers
- Very cost efficient: use existing CCTV cameras with server based Video Analytics, interpolate from few sensors into wider areas



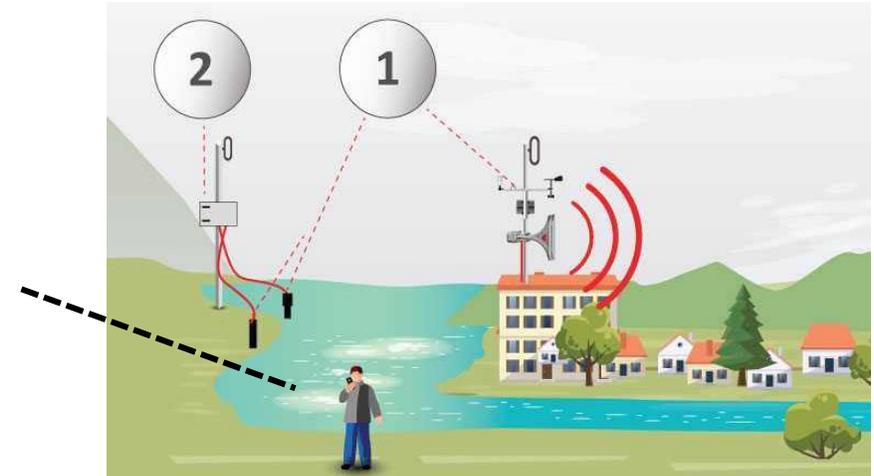
# Data Analytics and Machine Learning

- Predictive Analytics: Use historical data and machine learning algorithms to predict potential flood events
- Data Fusion: Integrate data from multiple sources to enhance the accuracy of flood predictions
- Social Media: Integration with Social Media Platforms to gain early warnings of floods in the city where no other systems and sensors are in place



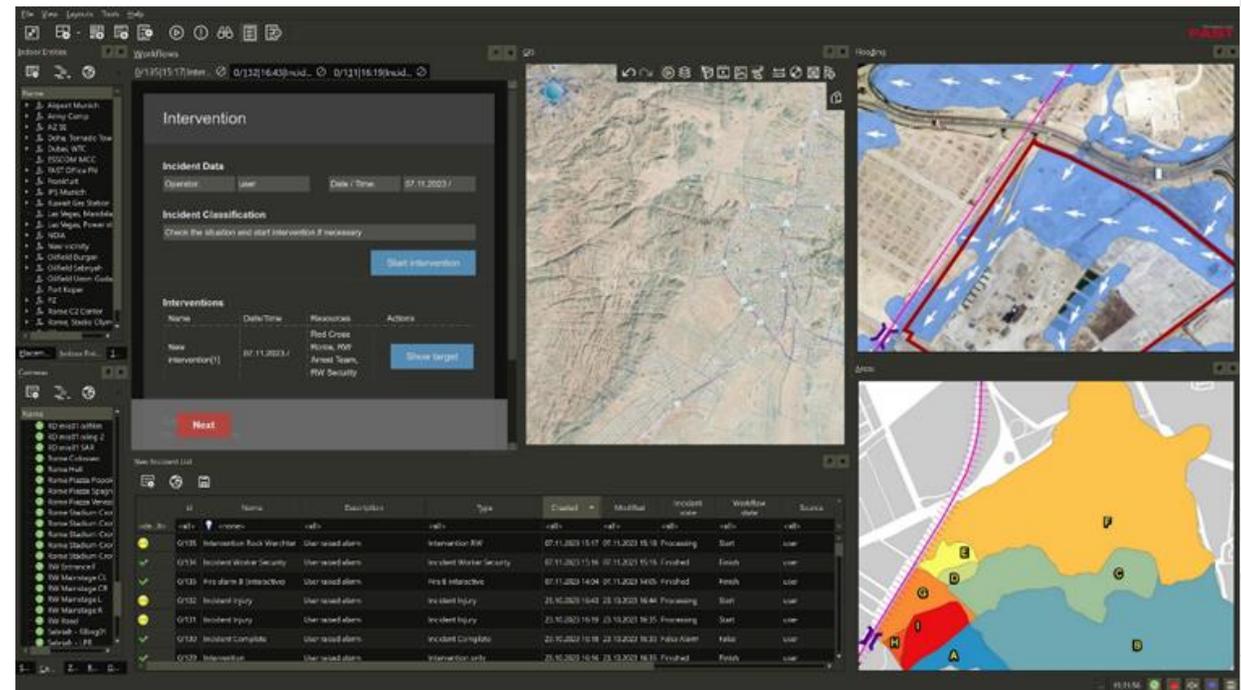
# Communication Systems

- Early Warning Systems: Implement automated systems to send alerts to residents and authorities based on predictive models
- Public Alert Systems: Utilize and manage various communication channels (SMS, sirens, mobile apps) to alert the public about potential flood events



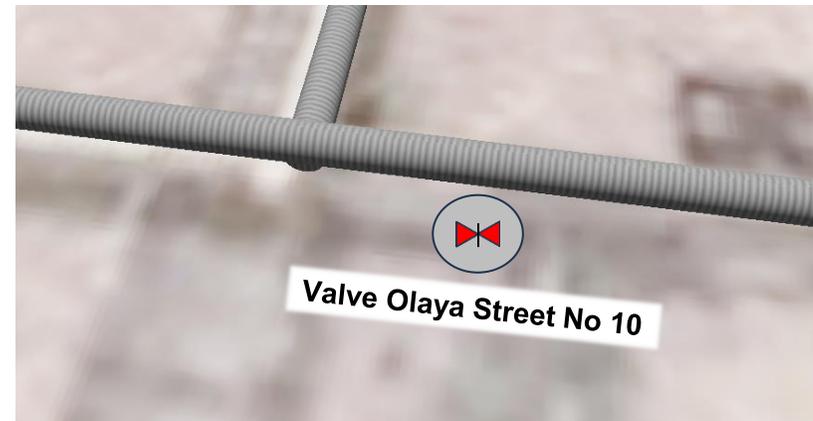
# Hydrological Modelling System

- Computer Models: Use hydrological models to simulate and predict the behaviour of drainage systems and canals under different weather conditions
- Real-Time Data Integration: Integrate real-time sensor data into these models for more accurate predictions



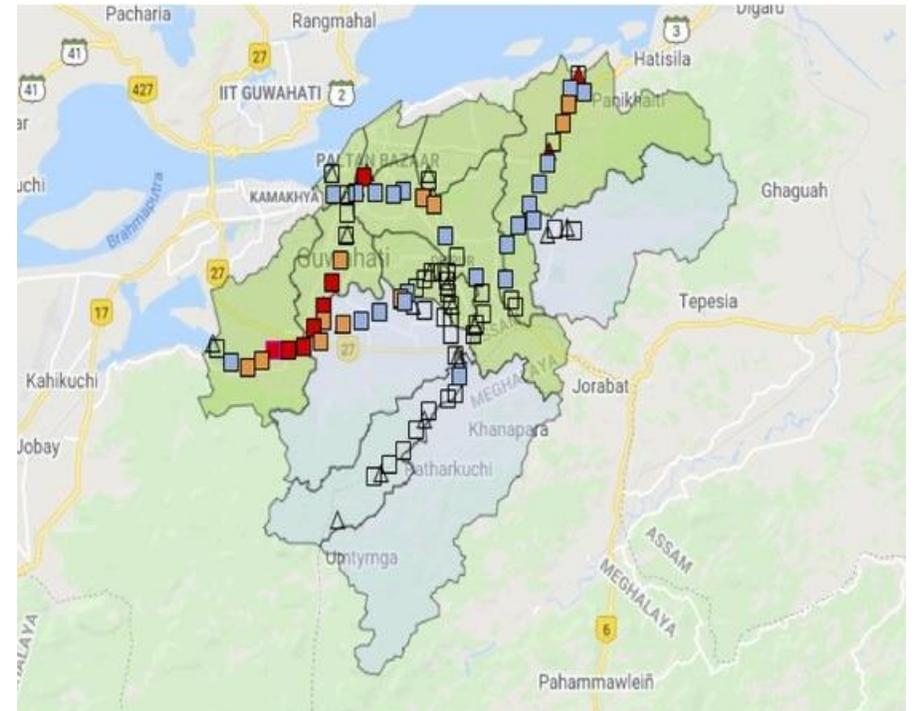
# Smart Infrastructure

- Smart Flood Barriers and Gates: Deploy barriers that can be automatically activated to prevent water ingress
- Smart Pump Systems: Use automated pump systems to manage water levels in drainage systems



# Emergency Response Systems

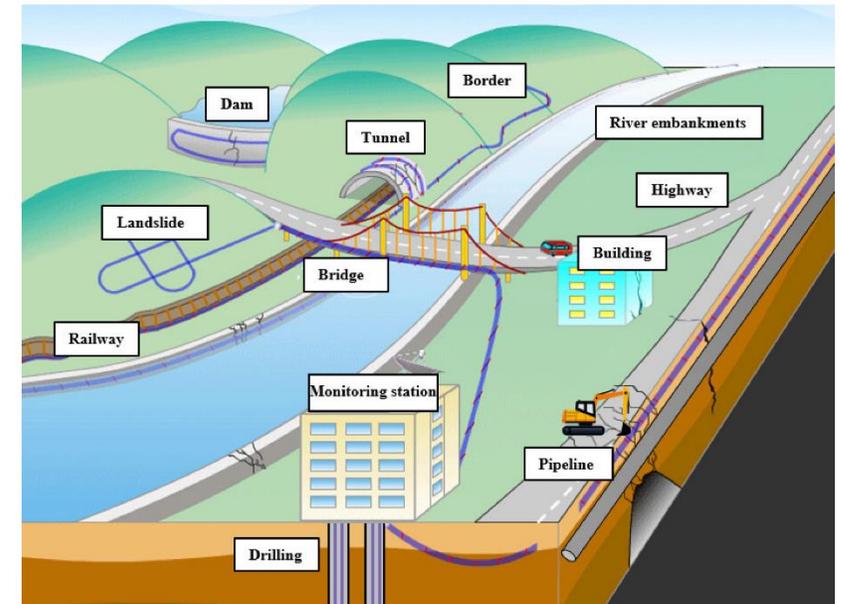
- Command and Control Centres: Coordinating emergency responses based on real-time data, e.g. via TETRA, DMR, 4G/5G smart devices incl. T4D Tracker and Dispatcher App
- Evacuation Planning: Use modelling and simulation tools to plan and optimize evacuation routes and shelters
- Traffic Management: Use real-time data and simulation tools to control traffic in affected areas



# Distributed Optical Fibre Sensing (DOFS)

DOFS is a technology that uses changes in the speed of light in a fibre optic cable to capture information about the cable's surroundings.

- High resolution: DOFS can detect changes in water levels with a resolution of a few centimetres for more accurate forecasting
- Long range: DOFS sensors can be deployed over long distances, enabling the monitoring of large areas.
- Durability: DOFS sensors are very durable and can be used for many years.



# Water Pipe Gauges

- Water Level Sensors: Measure water levels in pipes and canals to provide early warnings of rising water levels
- Flow Sensors: Monitor the rate of water flow to predict the volume of water moving through water bodies



# Thank you!



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