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H203: Advancing Flood Characterization, Modeling, and Communication I Wednesday, 16 December 2020

FloodHub; An Integrated Near-Real-Time Flood Monitoring System in support of the decision makers based on Modeling, Multi-source EO and Crowdsourced data

Alexia Tsouni, Haris Kontoes, Themistocles Herekakis, Stavroula Sigourou, Theodora Perrou

National Observatory of Athens - BEYOND Center - FloodHUB

EuroGEO Disaster Resilience Action Group

BEYOND Centre of EO Research & Satellite Remote Sensing

http://beyond-eocenter.eu

FloodHUB

SMURBS ERA-PLANET

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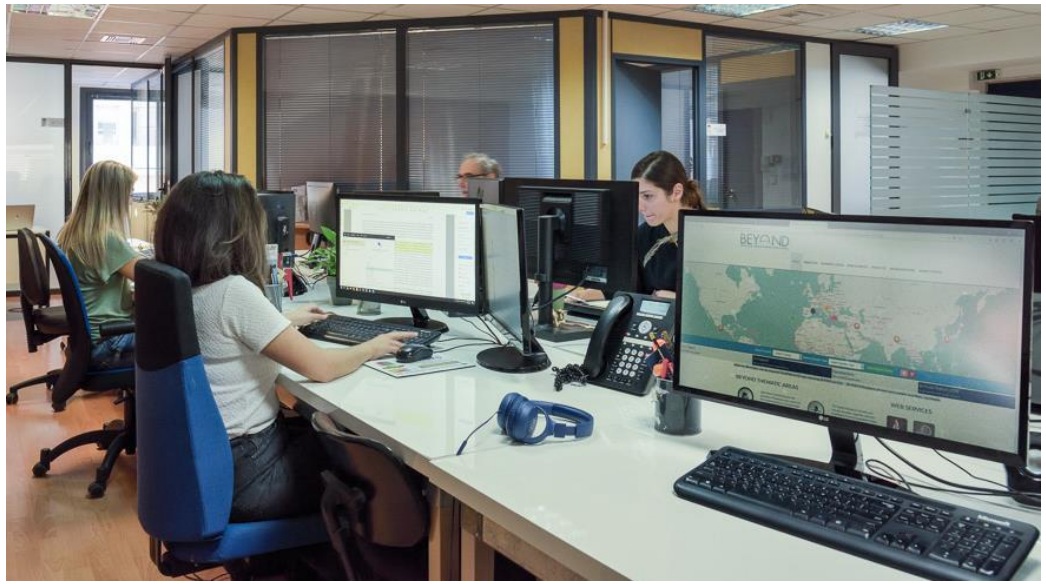
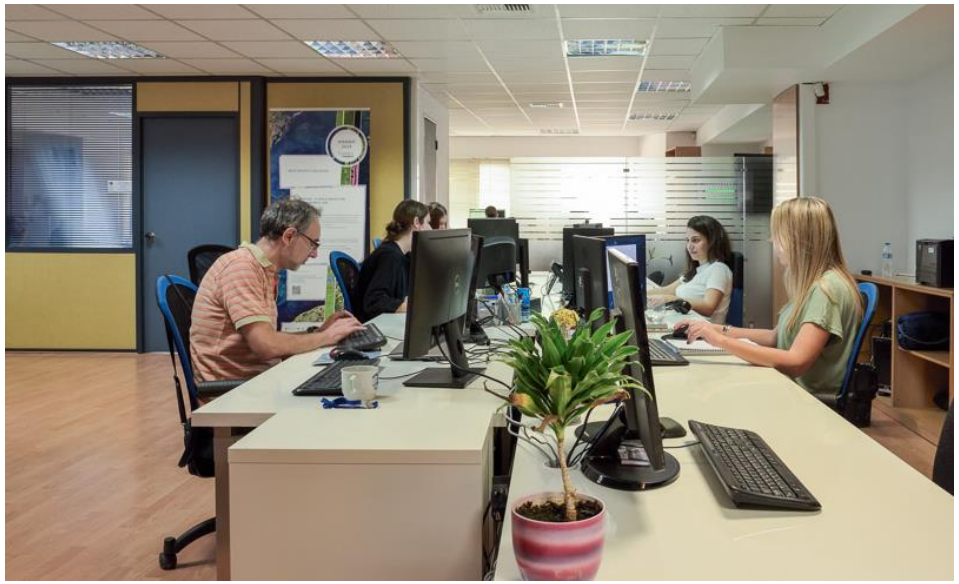
The BEYOND Center of EO Research & Satellite Remote Sensing





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The services of the BEYOND Center

BEYOND
Centre of EO Research & Satellite Remote Sensing

FloodHUB

24/7 Real-Time Forest Fire Monitoring service - Diachronic Burnt Scar Mapping (> 35 years)
- Fire Risk assessment (http://beyond-eocenter.eu/index.php/web-services/firehub)

Detection and diffusion of desert dust, dust, volcanic ash and toxic gases
(http://beyond-eocenter.eu/index.php/web-services/dusthub)

Early warning and monitoring of flood events - Diachronic Flood Extent Mapping
(http://beyond-eocenter.eu/index.php/web-services/floodhub)

Early warning and monitoring of geophysical disasters (earthquakes, landslides, volcanic eruptions)
- Ground Displacement Mapping (http://beyond-eocenter.eu/index.php/web-services/geohub)

Solar Atlas Service - Solar Energy Nowcasting Service - Short-term Forecasting System
(http://beyond-eocenter.eu/index.php/web-services/solarhub)

Data Extraction Application for Regional Climate
(http://beyond-eocenter.eu/index.php/web-services/climahub)

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The monitoring systems of the BEYOND Center

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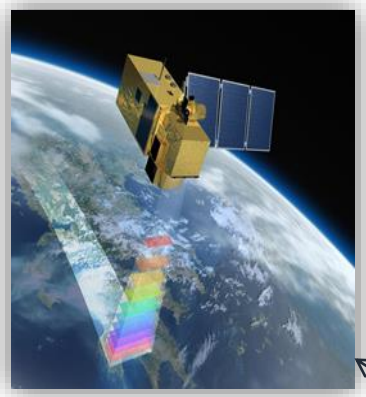
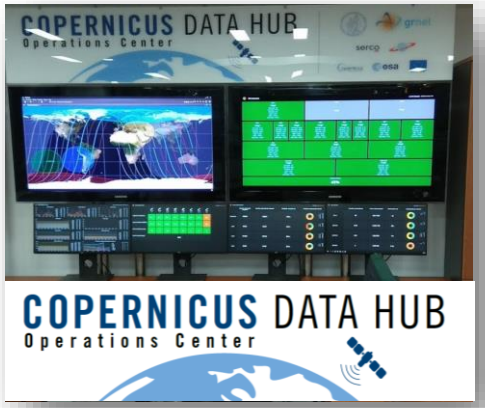
FloodHUB

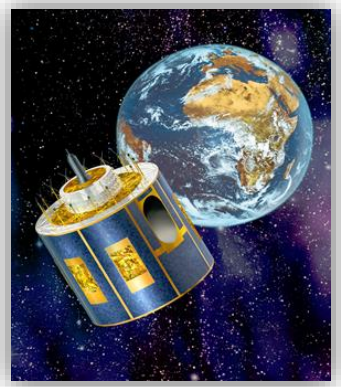


Satellites Polar Orbit

X-/L-band Station

Sentinel Mirror Site





Satellites Geostationary Orbit

MSG SEVIRI

HELLENIC MirrorSite

Ελληνικό Mirror Site (Copernicus satellite missions)
http://beyond-eocenter.eu/index.php/web-services/hellenic-mirror-site)

GreekHUB

Sentinels GreekHUB
(http://beyond-eocenter.eu/index.php/web-services/sentinels-greekhub)

Manned & Unmanned Aerial Vehicles

In-situ networks and crowdsourcing

in-situ

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Floods: the deadliest type of disaster
43.5% of deaths in 2019 (CRED 2020)

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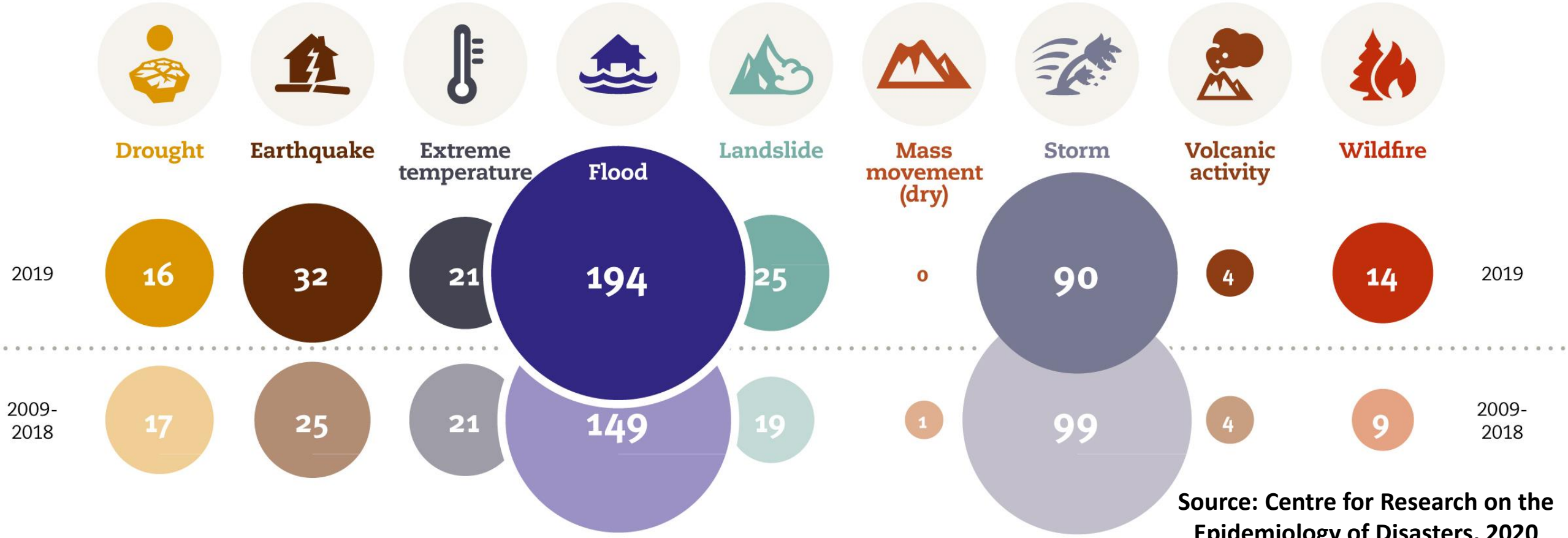
FloodHUB

Occurrence by disaster type: 2019 compared to 2009-2018 annual average

343
2009 to 2018

396
in 2019



Source: Centre for Research on the Epidemiology of Disasters, 2020

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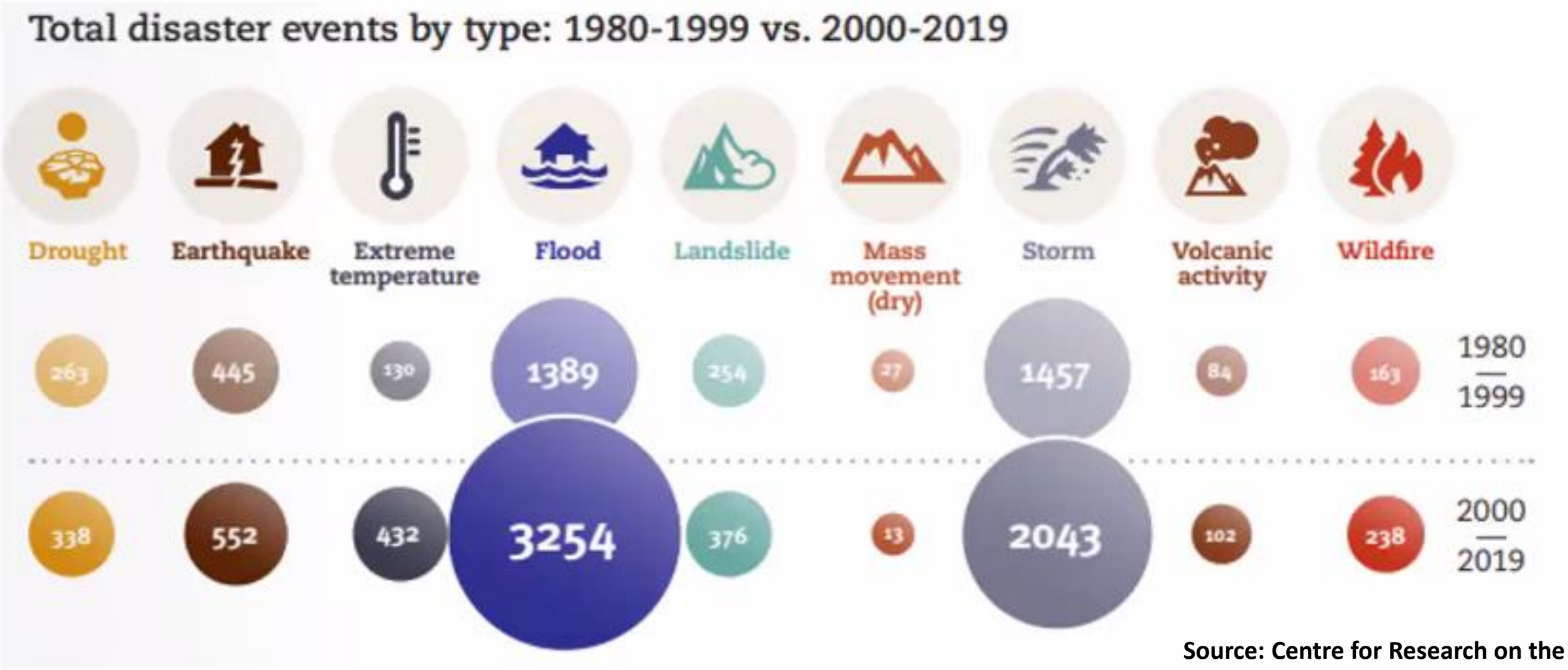

Source: Centre for Research on the Epidemiology of Disasters, 2020

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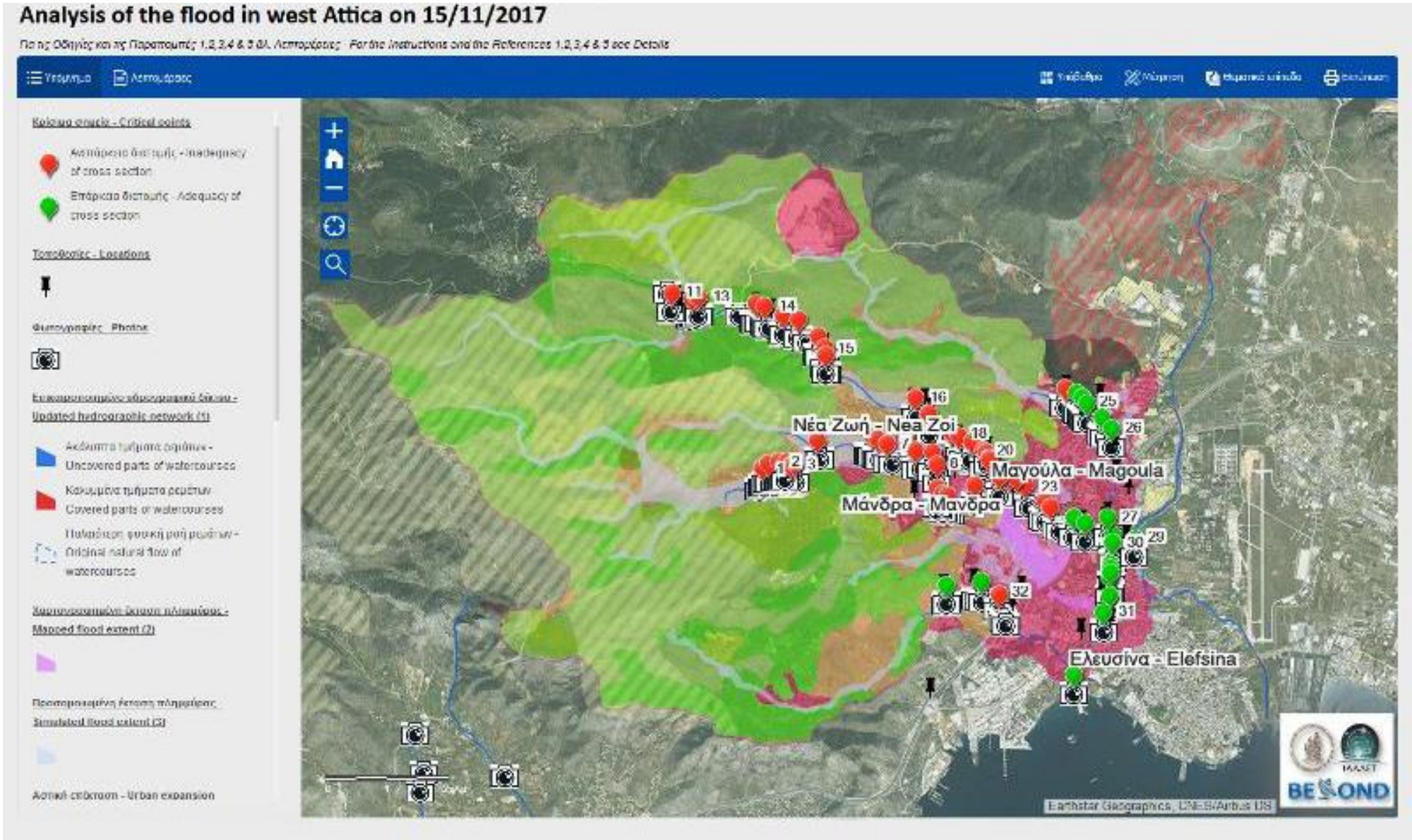
Mandra flood 2017: Setup of an integrated web GIS platform

EuroGEO

Disaster Resilience Action Group



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Mandra flood 2017: modelling (blue) vs EO mapping (pink)

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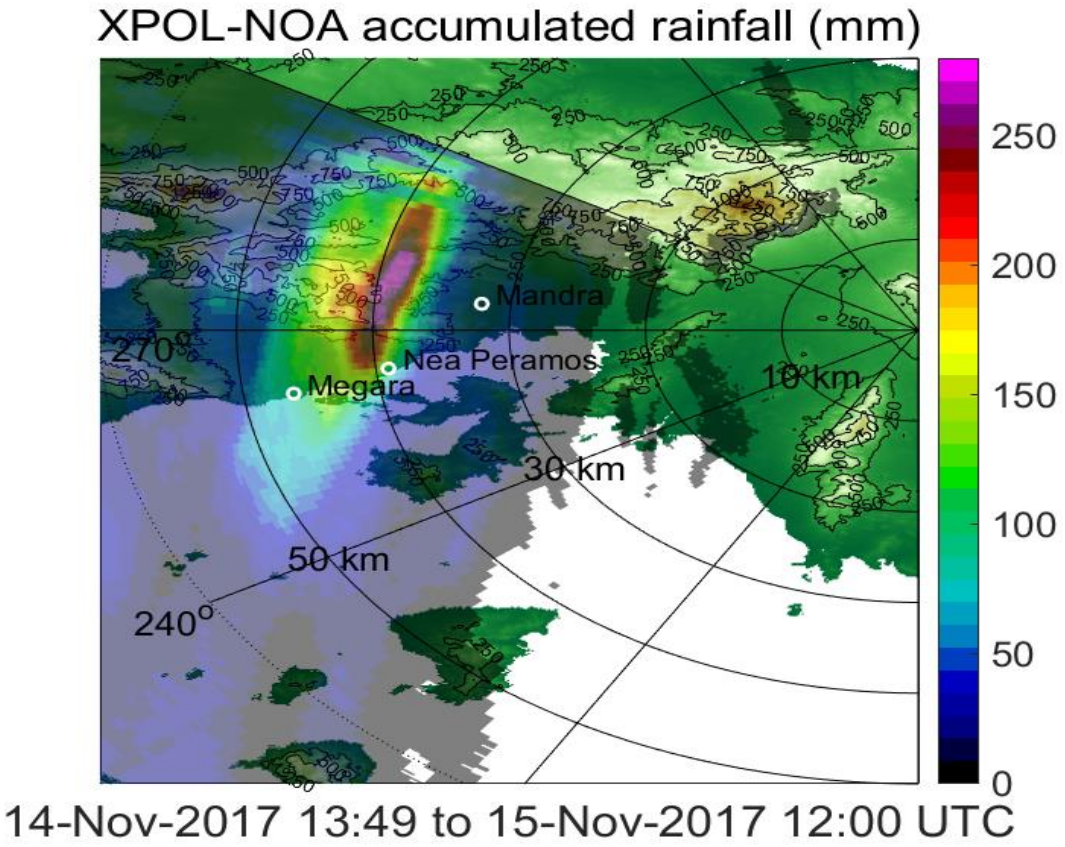
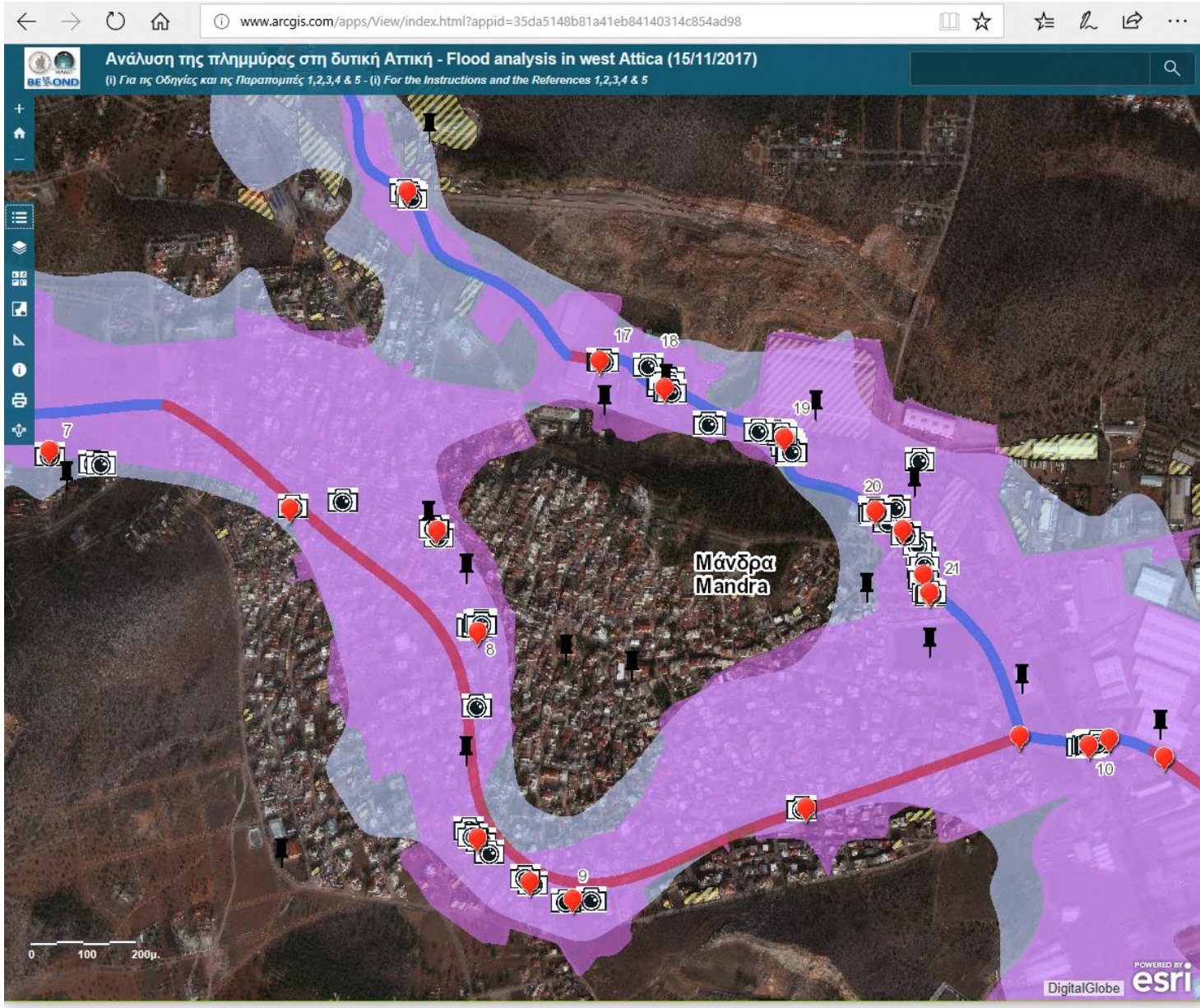
FloodHUB





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Disaster Resilience Action Group

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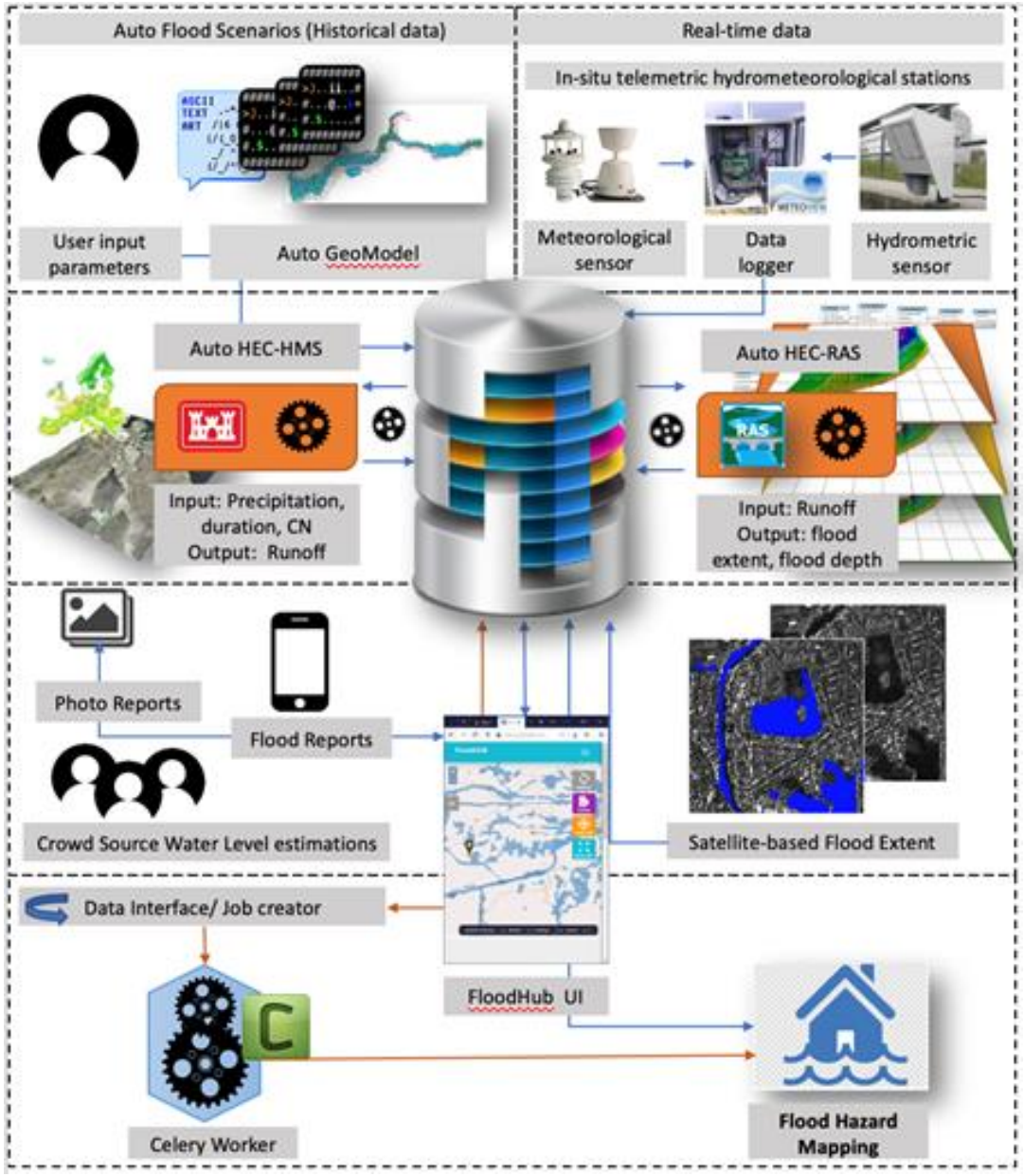
Mandra 2020: Architecture of the FloodHUB system

An integrated near-real-time flood monitoring system:

- based on modeling, multi-source EO and crowdsourced data
- with a fully scalable and transferable modular architecture
- delivering a reliable operational awareness picture of the crisis every 5-15 minutes to all the relevant authorities



Near-real-time ingestion and assimilation of:

- hydrometeorological parameters measured at 3 in-situ telemetric stations (installed at 3 critical locations)
- satellite data (e.g. from high resolution Sentinels collected from the Hellenic Mirror Site)
- crowdsourced data (collected via the dedicated crowdsourcing platform).

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Mandra 2020: Development of the operational FloodHUB system

HELLENIC PETROLEUM

Procurement and installation of 3 telemetric hydrometeorological stations with co-funding by the Hellenic Petroleum S.A. and the SMURBS/ERA-PLANET project, in collaboration with the Attica Region

SMURBS ERA-PLANET

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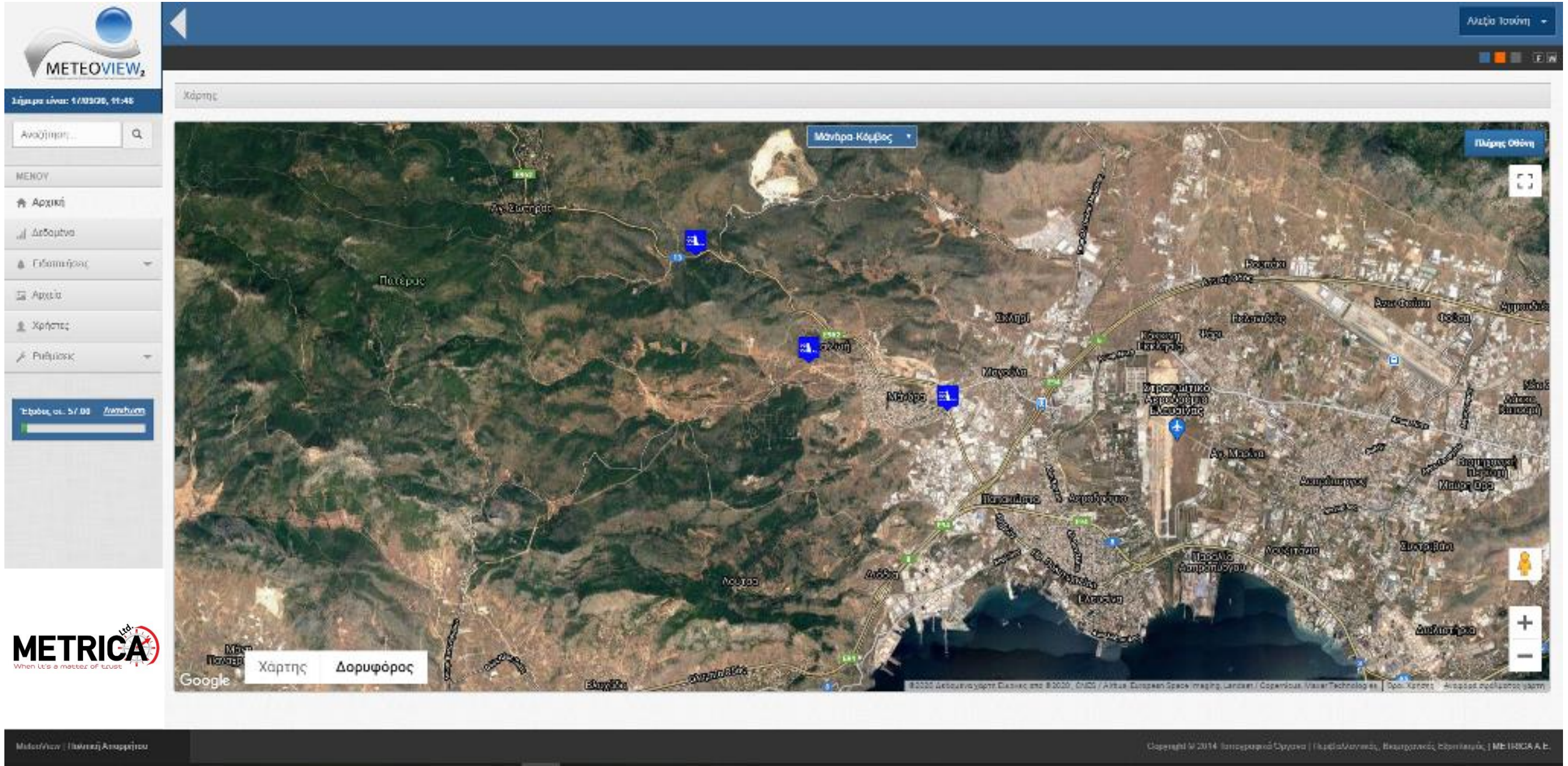
Web platform of the 3 telemetric hydrometeorological stations



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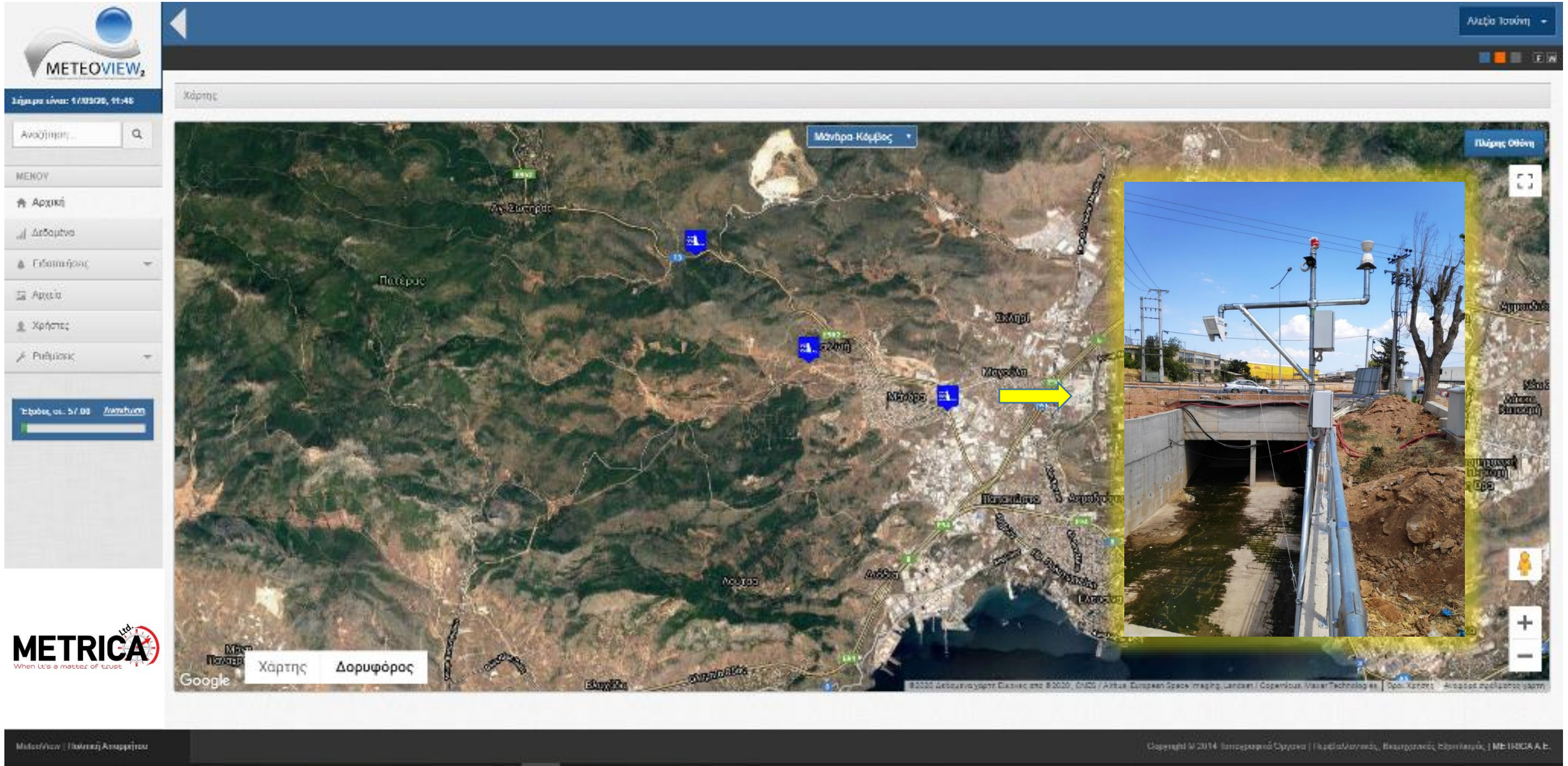

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Web platform of the 3 telemetric hydrometeorological stations

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Web platform of the 3 telemetric hydrometeorological stations

METRICA Ltd
When it's a matter of trust

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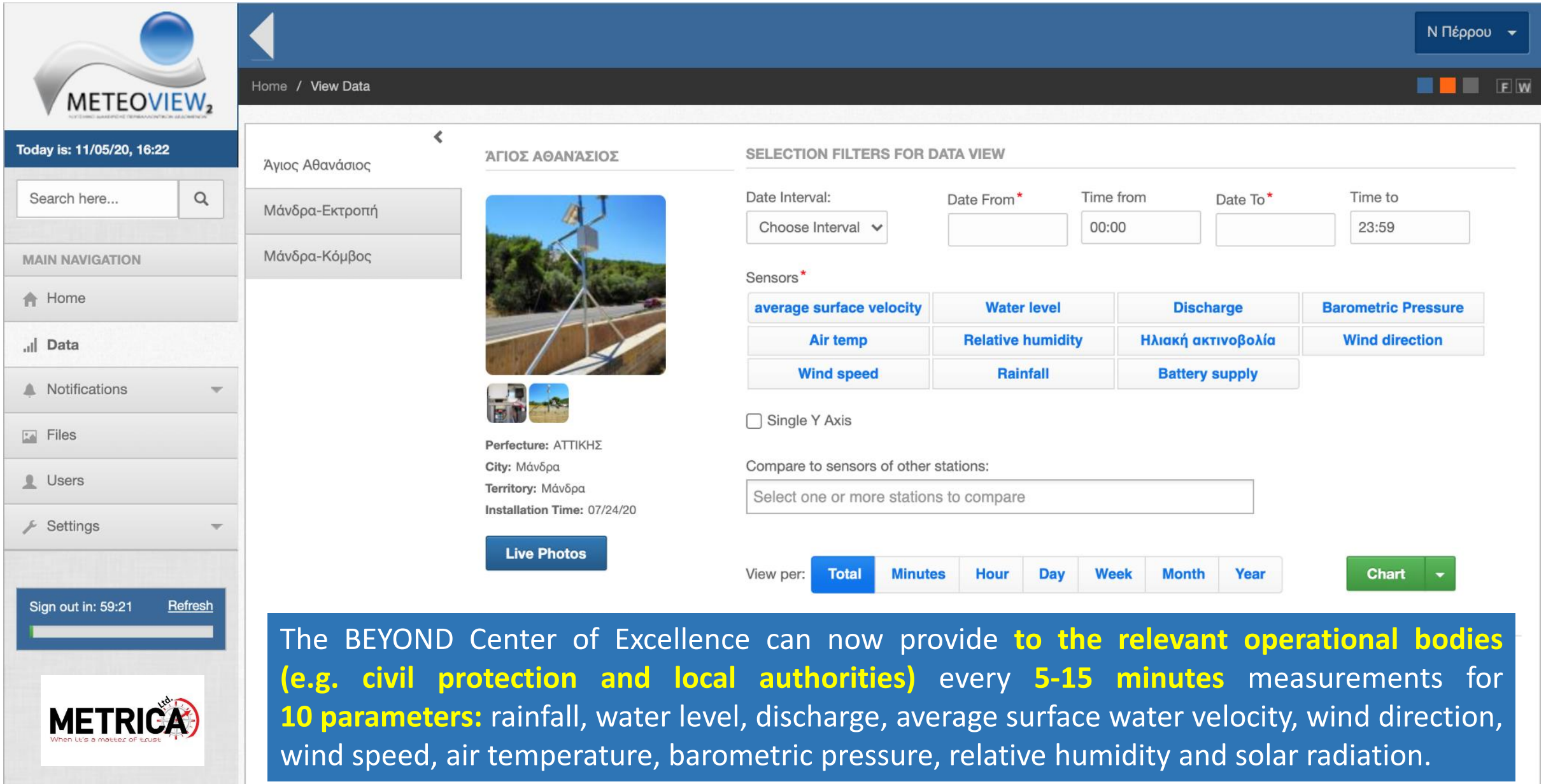
Web platform of the 3 telemetric hydrometeorological stations

BEYOND Centre of EO Research & Satellite Remote Sensing

FloodHUB



The BEYOND Center of Excellence can now provide **to the relevant operational bodies (e.g. civil protection and local authorities)** every **5-15 minutes** measurements for **10 parameters:** rainfall, water level, discharge, average surface water velocity, wind direction, wind speed, air temperature, barometric pressure, relative humidity and solar radiation.

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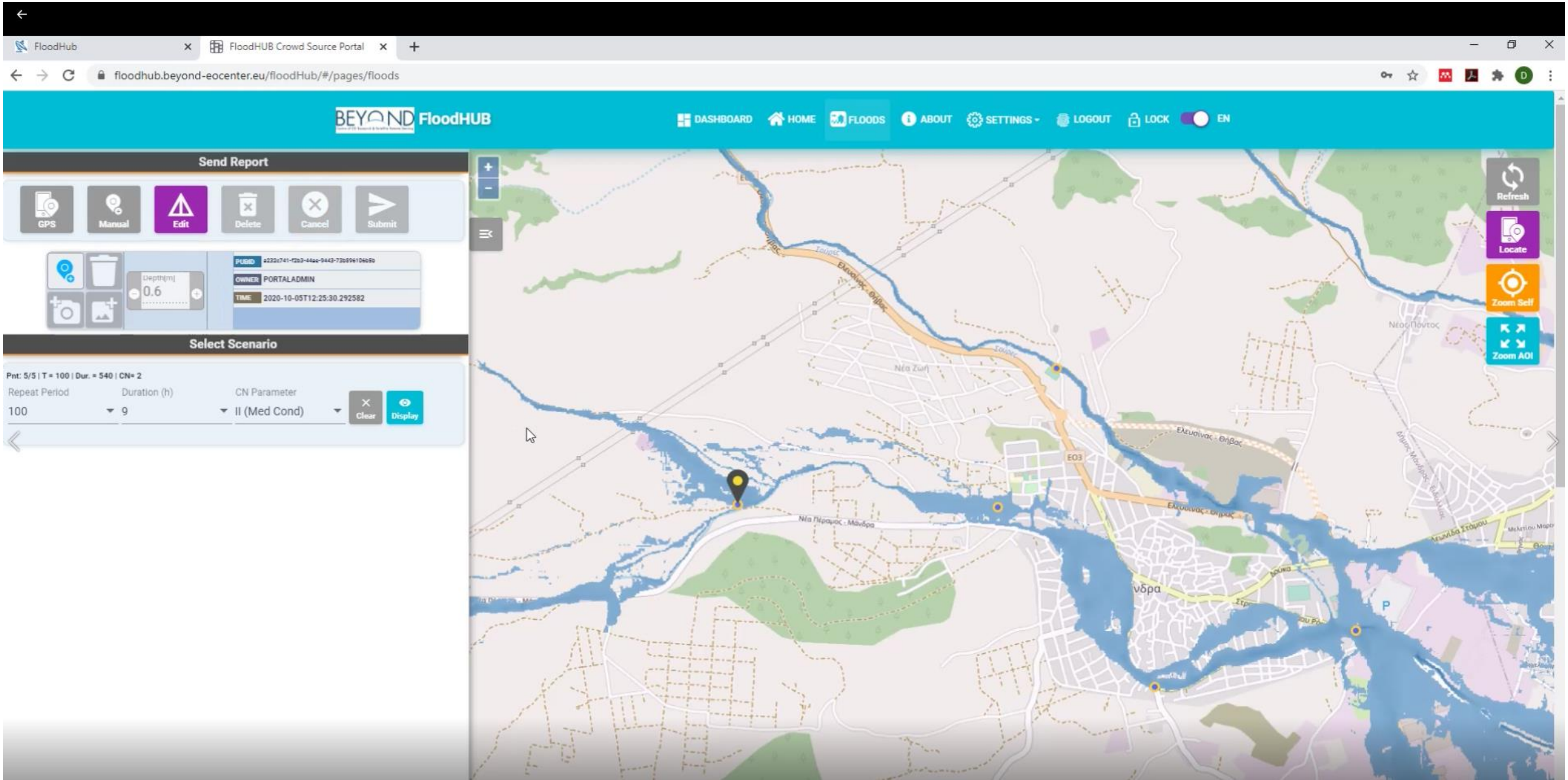
Real-time crowdsourcing platform for staff and volunteers



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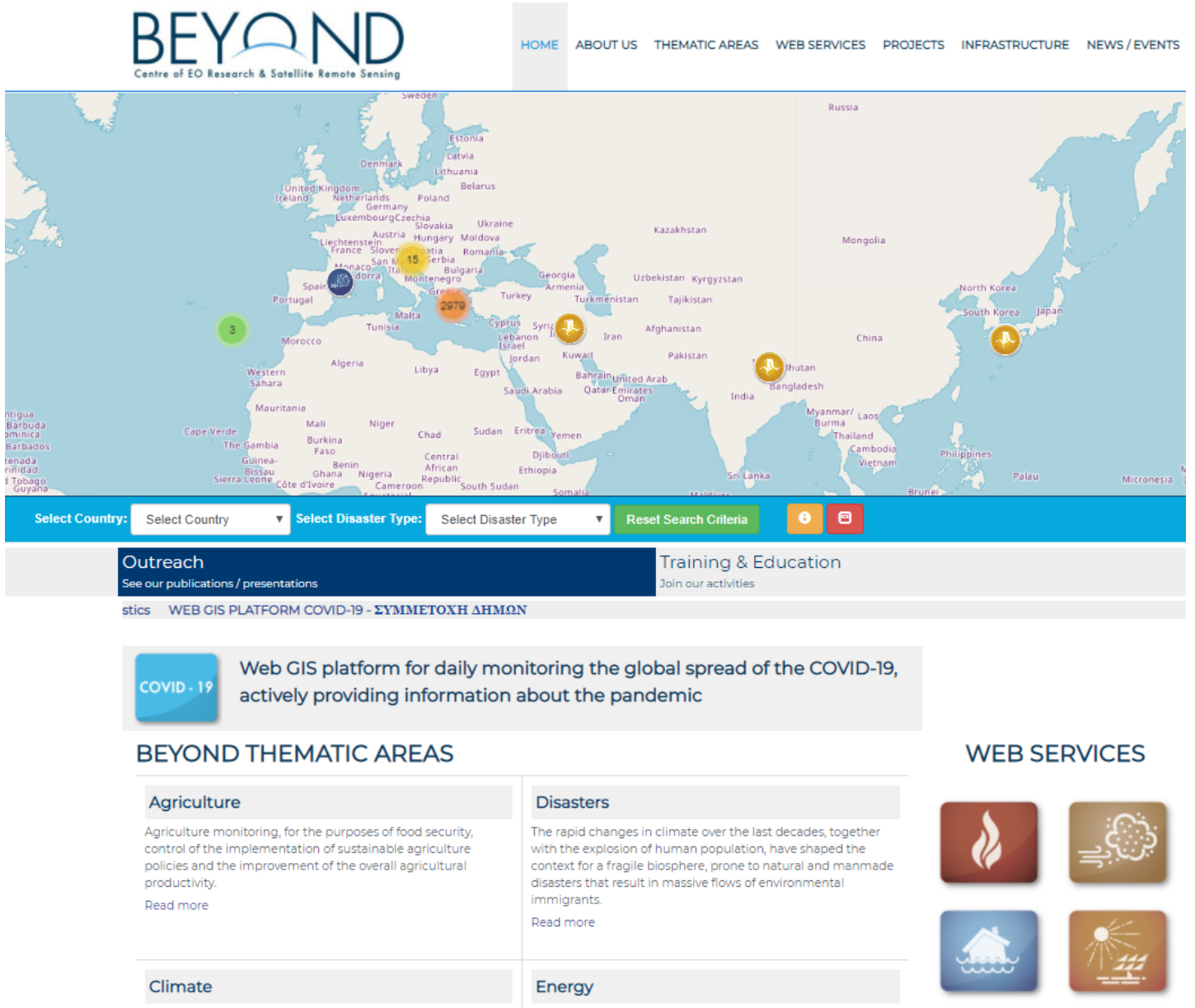
Integrated near-real-time flood monitoring system



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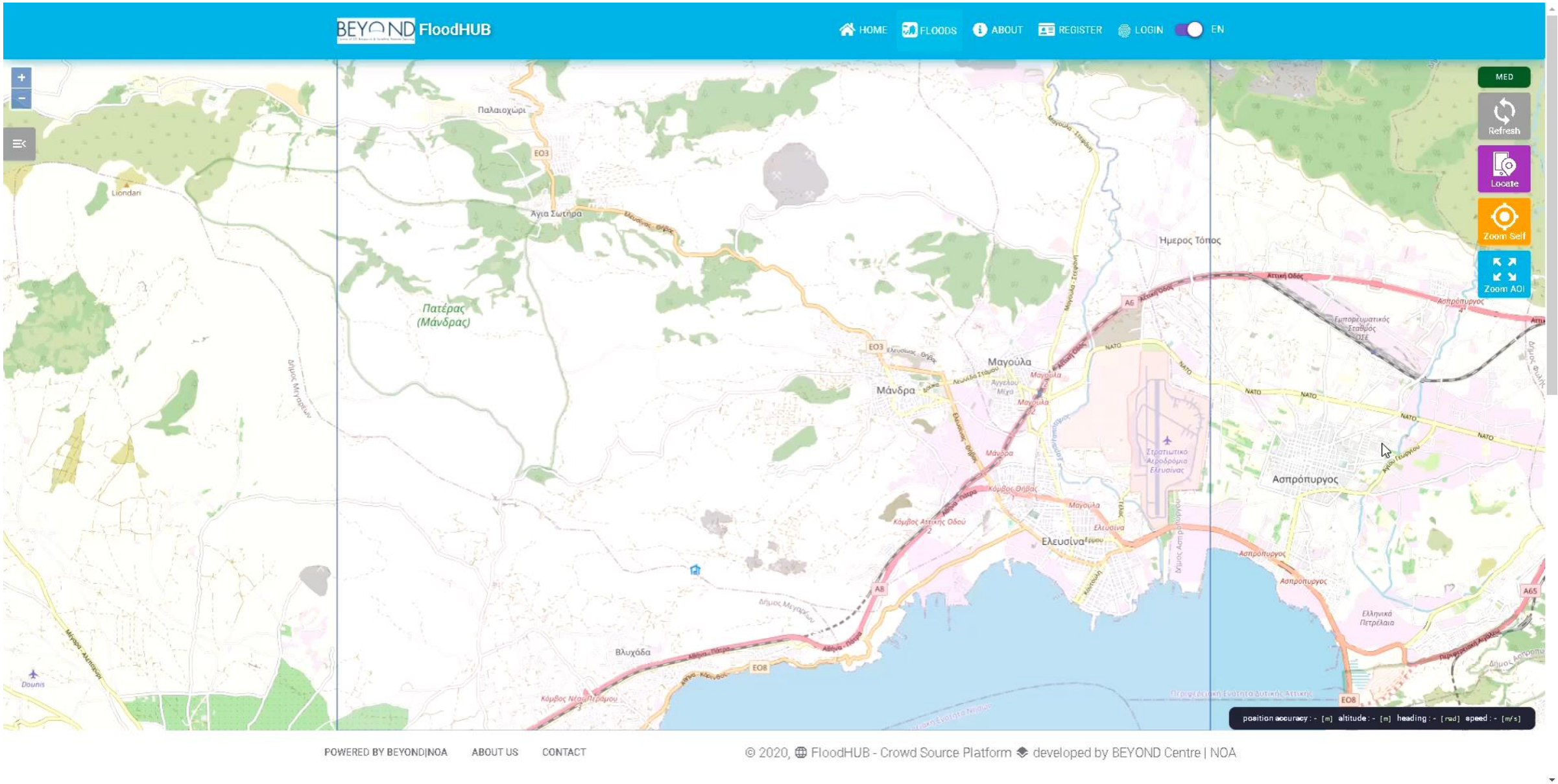

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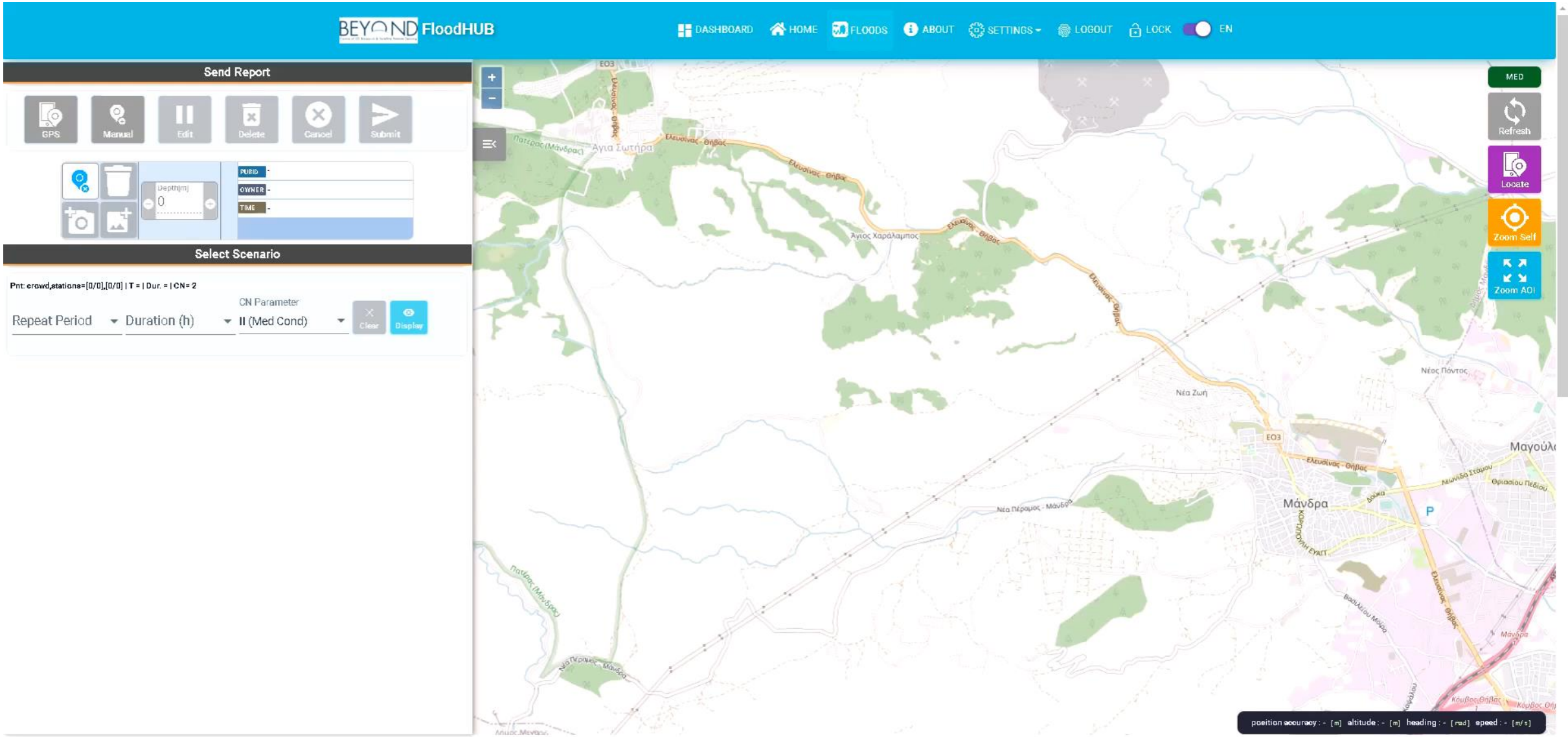
Integrated near-real-time flood monitoring system

BEYOND Centre of EO Research & Satellite Remote Sensing
FloodHUB



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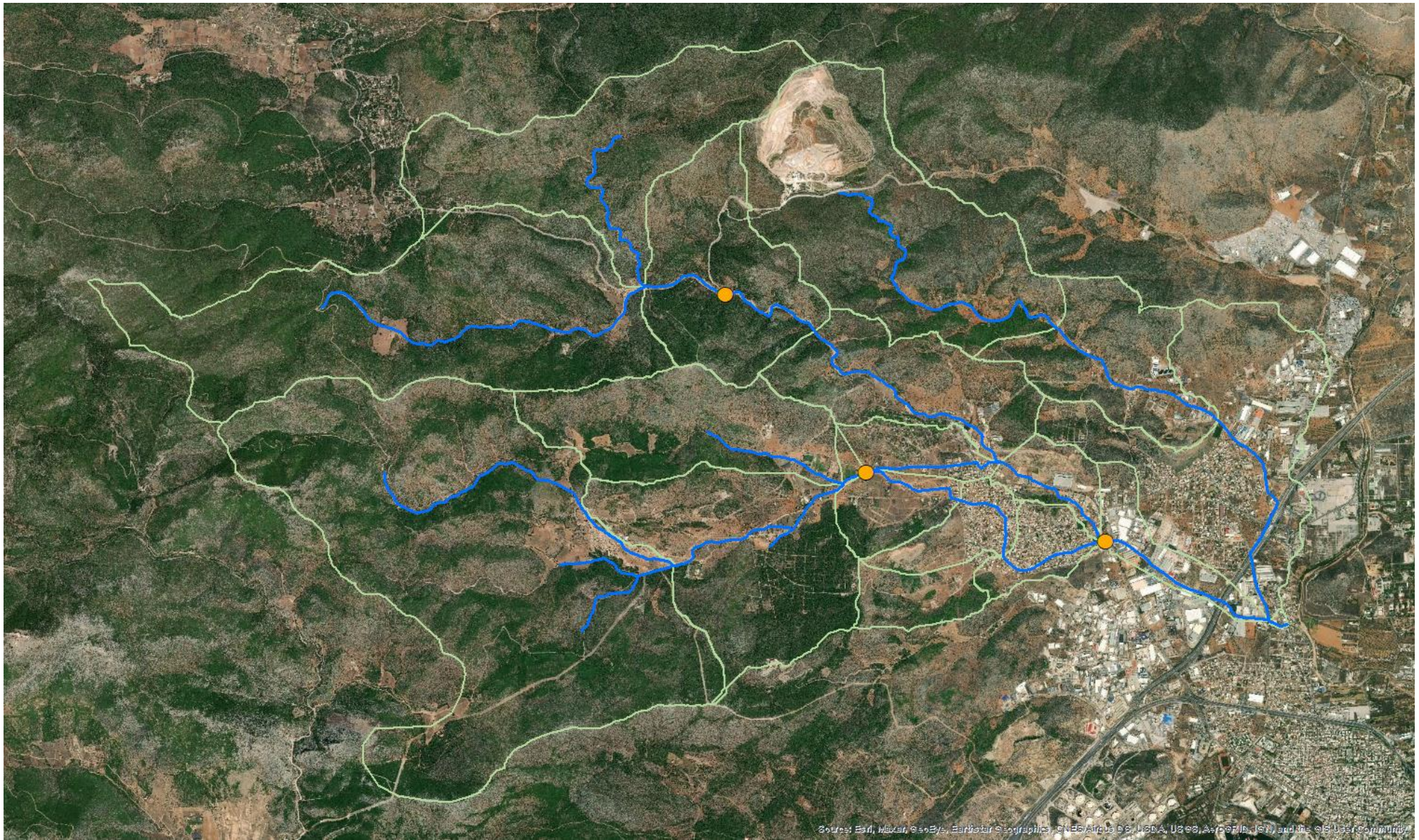
Hydrologic & hydraulic simulation



RIVER BASIN
57 km^2

SUBBASINS
19

RAINFALL IDF CURVE
Koutsoyiannis & Baloutsos, 2000

$$i(d,T) = 40.6\,(T^{0.185} - 0.45)/(d + 0.189)^{0.796}$$

DISTRIBUTION
Worst profile method

TIME OF CONCENTRATION
Kirpich (SCS) method

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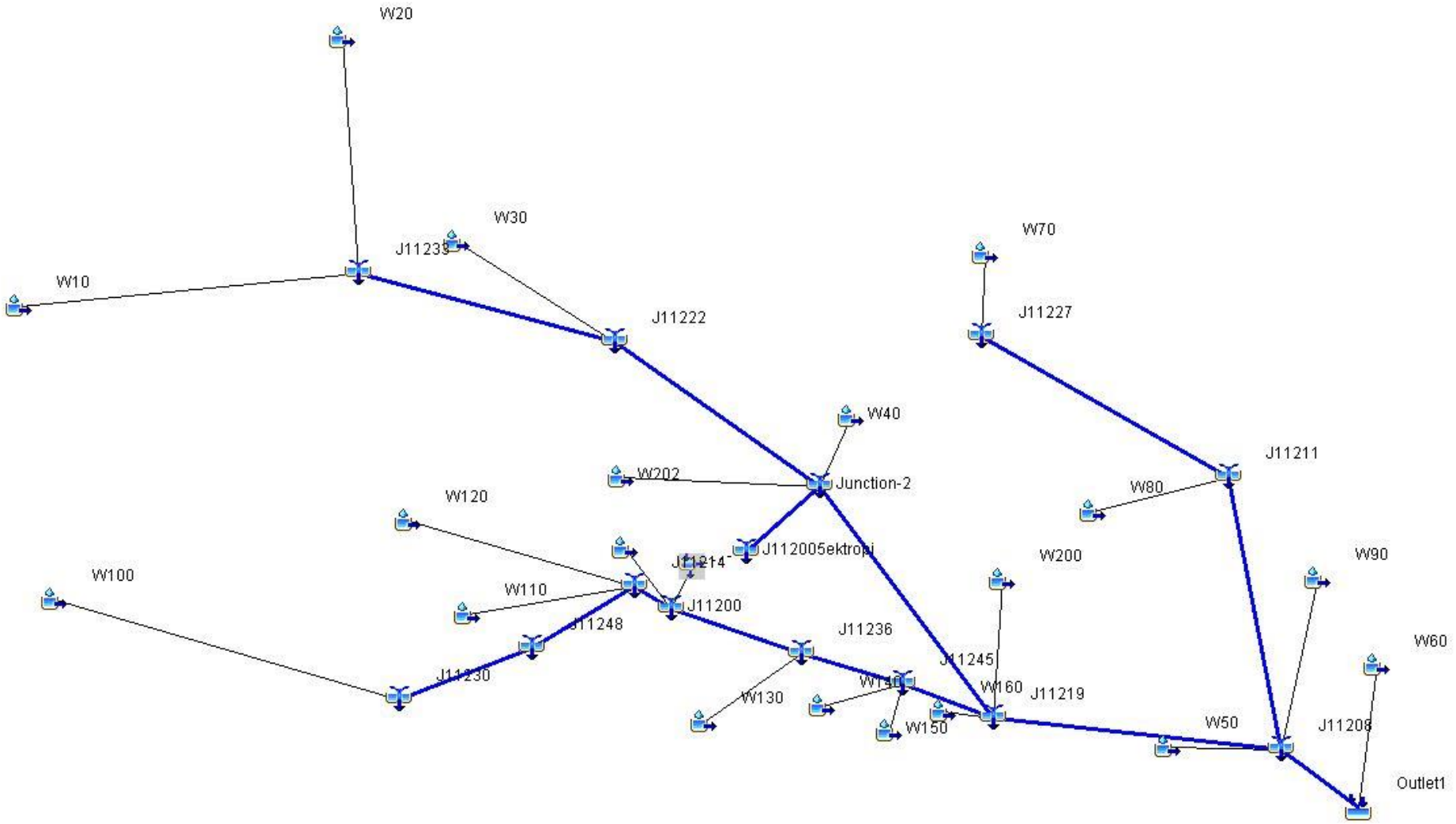
Hydrologic & hydraulic simulation



HYDROLOGIC MODELING:
HEC-HMS
(free & open access)

Input: rainfall data through HEC-DSS for various combinations of return periods T (years) and rainfall duration d (hours)

SCS-CN (Curve Number) method for extracting the excess from the gross rainfall, and the unit hydrograph, for propagating the surface runoff to the basin outlet

Run: all scenarios

Output: flow hydrographs

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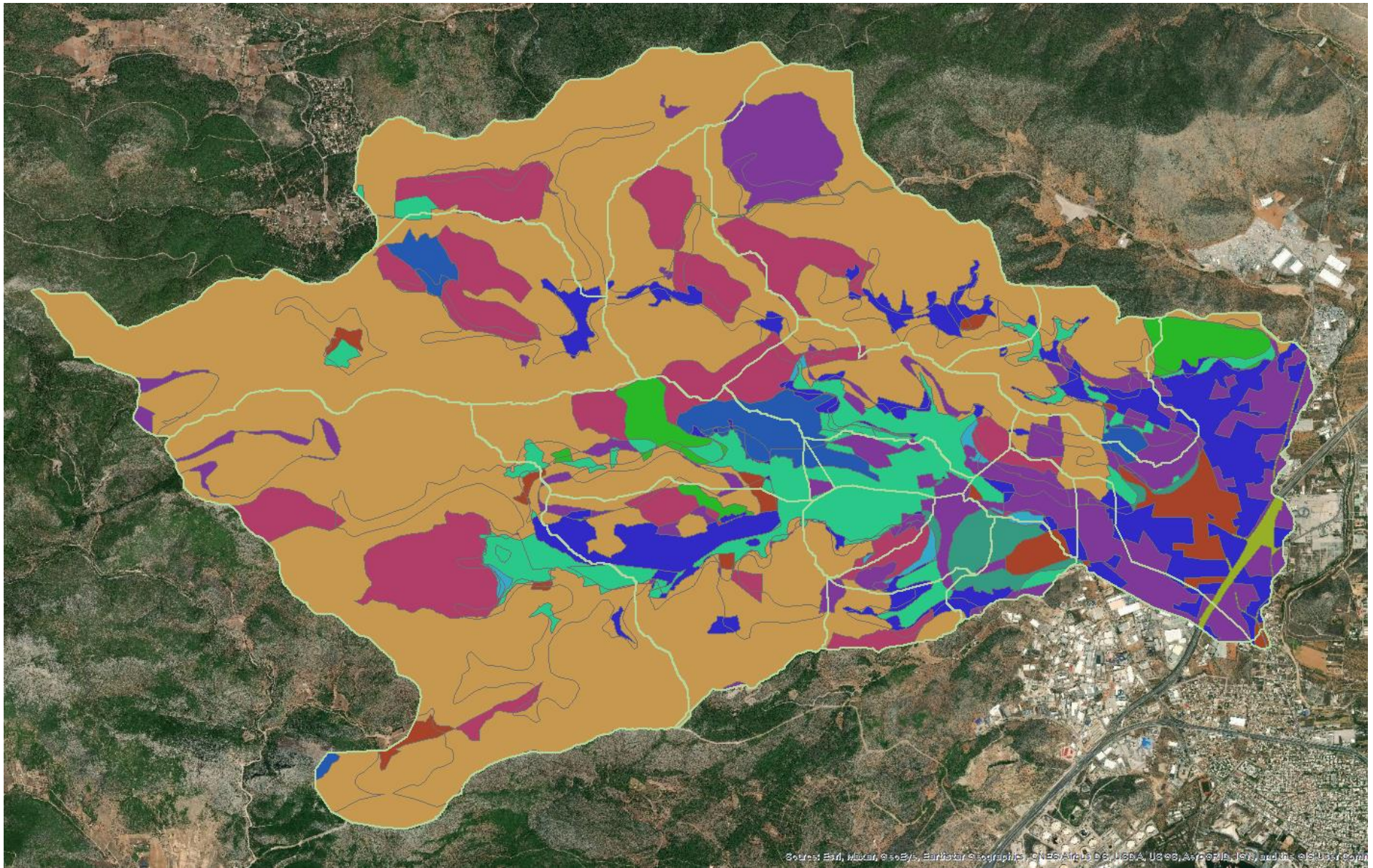
Hydrologic & hydraulic simulation



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Hydrologic & hydraulic simulation

Antecedent Soil Moisture Conditions	T = 50 years	T = 100 years	T = 200 years	T = 500 years	T = 1000 years
CN I Dry conditions	T50 CNI D3	T100 CNI D3	T200 CNI D3	T500 CNI D3	T1000 CNI D3
	T50 CNI D6	T100 CNI D6	T200 CNI D6	T500 CNI D6	T1000 CNI D6
	T50 CNI D9	T100 CNI D9	T200 CNI D9	T500 CNI D9	T1000 CNI D9
CN II Average conditions	T50 CNII D3	T100 CNII D3	T200 CNII D3	T500 CNII D3	T1000 CNII D3
	T50 CNII D6	T100 CNII D6	T200 CNII D6	T500 CNII D6	T1000 CNII D6
	T50 CNII D9	T100 CNII D9	T200 CNII D9	T500 CNII D9	T1000 CNII D9
CN III Wet conditions	T50 CNIII D3	T100 CNIII D3	T200 CNIII D3	T500 CNIII D3	T1000 CNIII D3
	T50 CNIII D6	T100 CNIII D6	T200 CNIII D6	T500 CNIII D6	T1000 CNIII D6
	T50 CNIII D9	T100 CNIII D9	T200 CNIII D9	T500 CNIII D9	T1000 CNIII D9

HYDRAULIC MODELING:
HEC-RAS
(free & open access)

Input:
* flow hydrographs for each stream of the hydrographic network
* banks and road network through breaklines
* DEM at 5m spatial resolution provided by the National Cadastre and Mapping Agency SA of Greece

Run: All scenarios at 10m spatial resolution (2D mesh)

Output: flood extent

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Flood mapping results
T = 50 years

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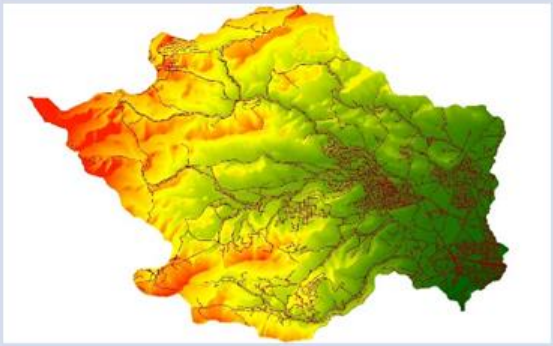
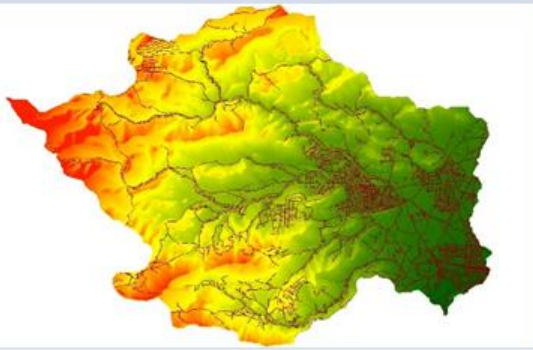
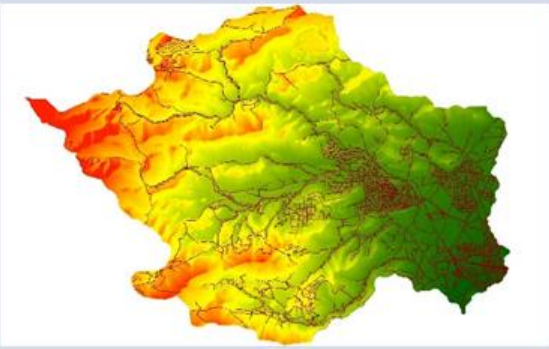
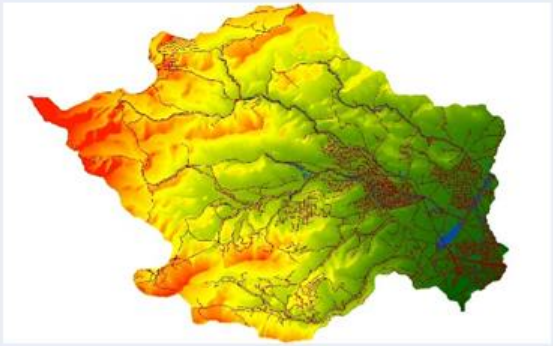
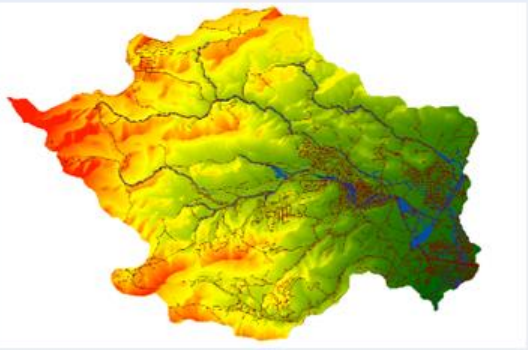
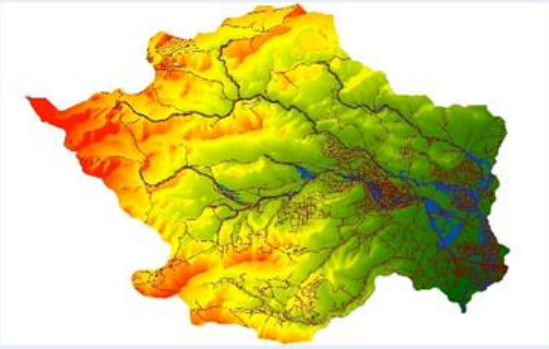
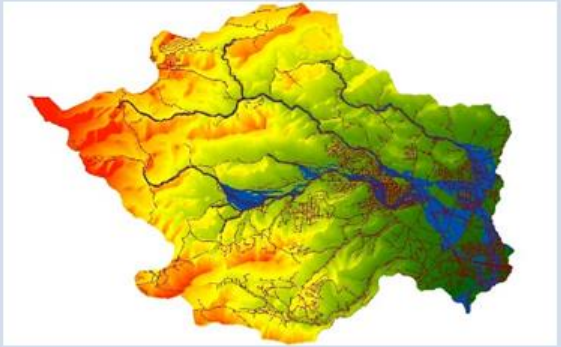
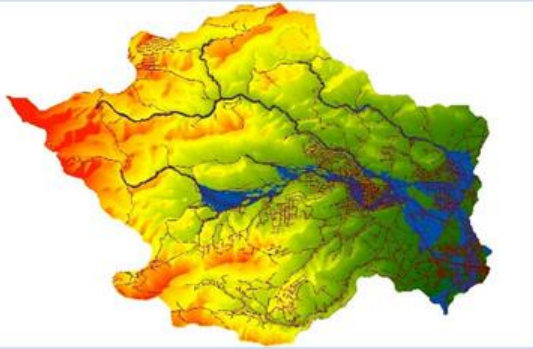
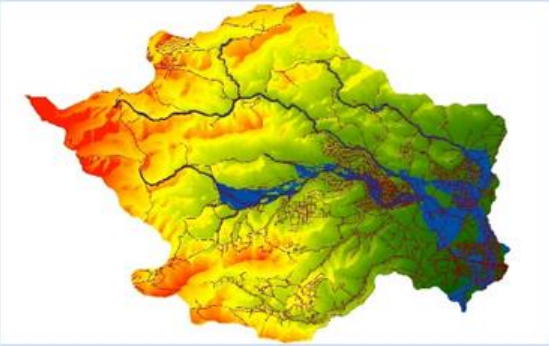
T = 50 years	d = 3 hours	d = 6 hours	d = 9 hours
CN I Dry conditions			
CN II Average conditions			
CN III Wet conditions			

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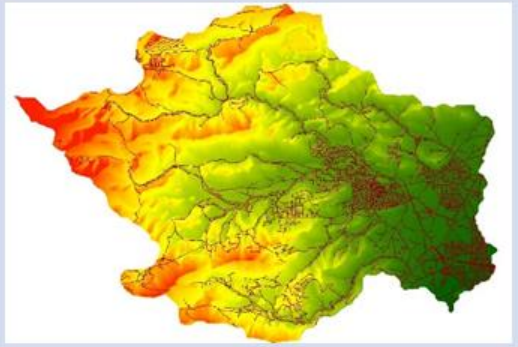
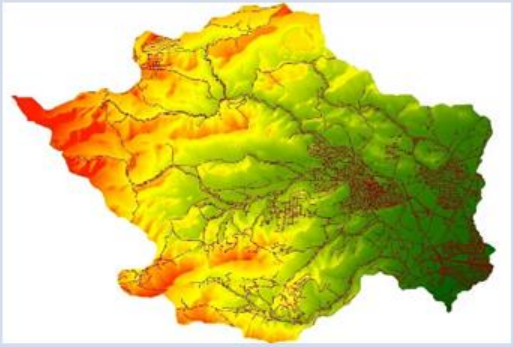
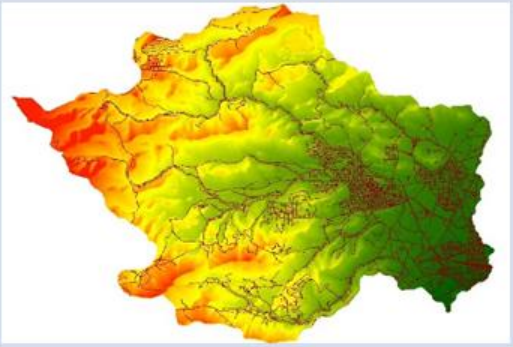
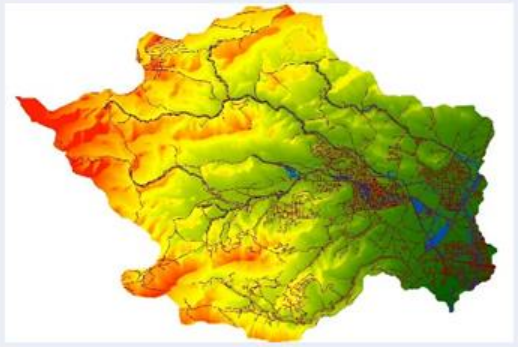
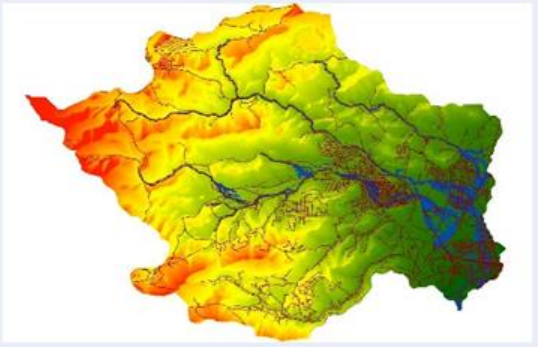
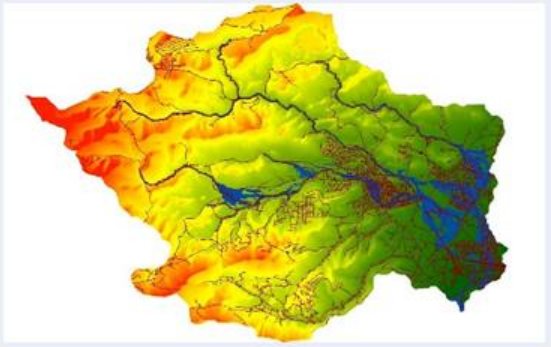
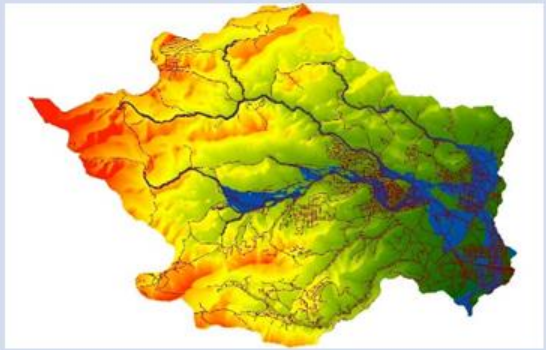
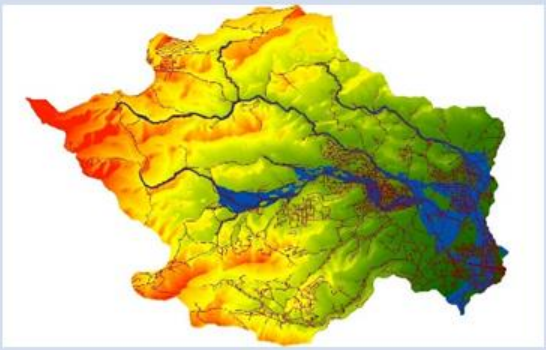
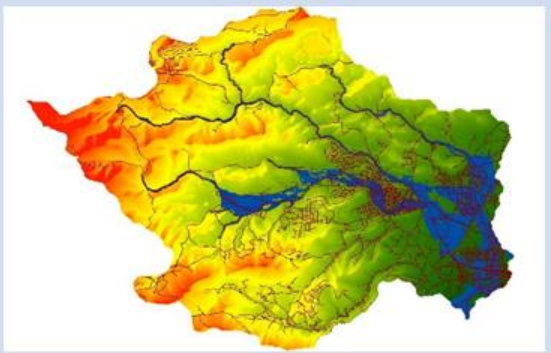
Flood mapping results
T = 100 years

T = 100 years	d = 3 hours	d = 6 hours	d = 9 hours
CN I Dry conditions			
CN II Average conditions			
CN III Wet conditions			

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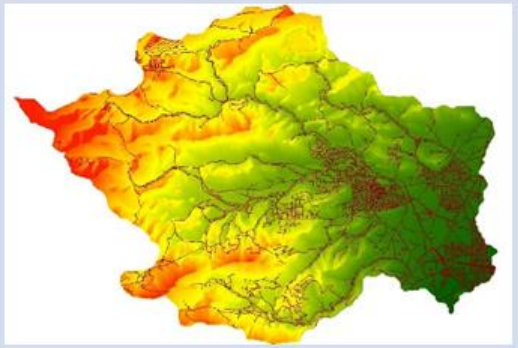
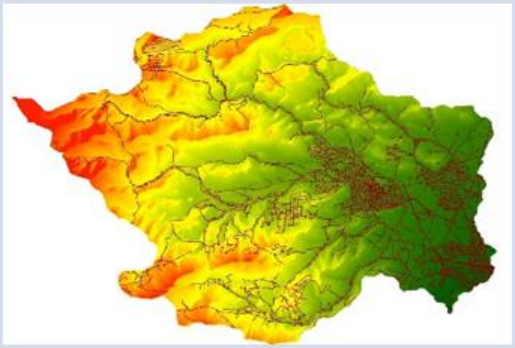
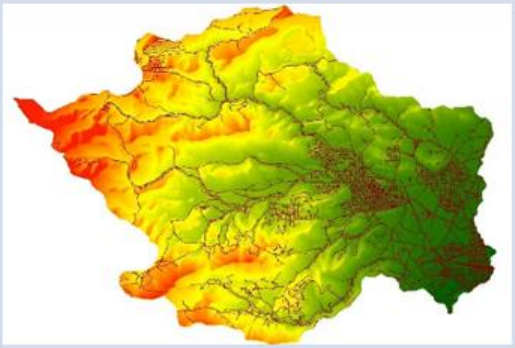
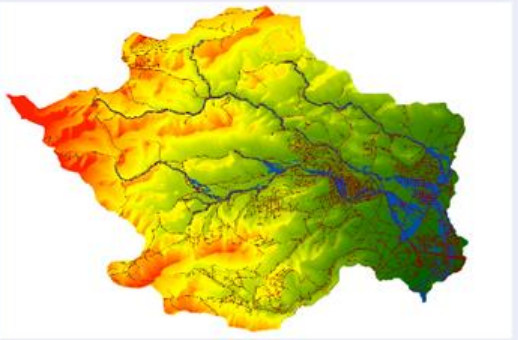
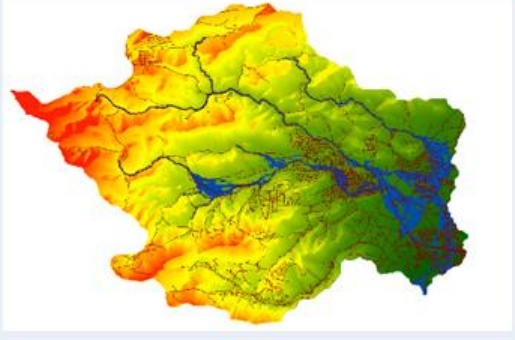
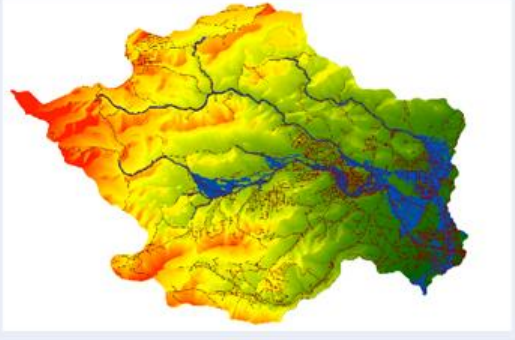
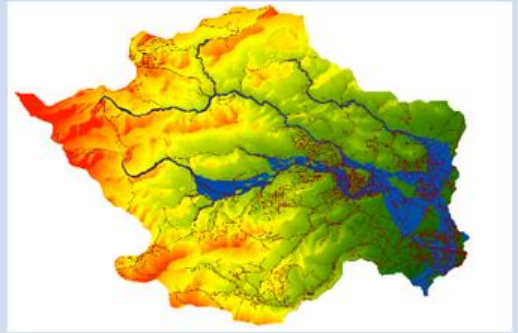
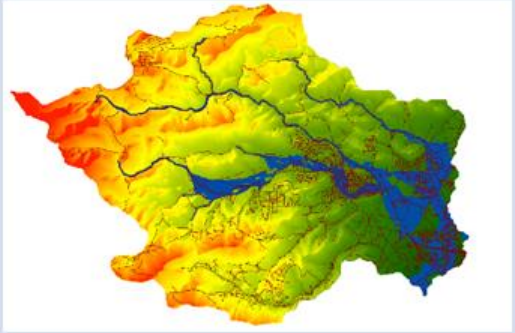
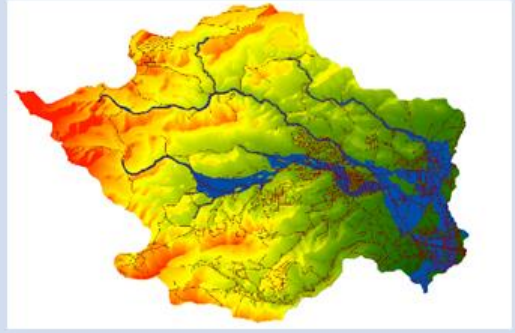
Flood mapping results
T = 200 years

T = 200 years	d = 3 hours	d = 6 hours	d = 9 hours
CN I Dry conditions			
CN II Average conditions			
CN III Wet conditions			

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Flood mapping results
T = 500 years

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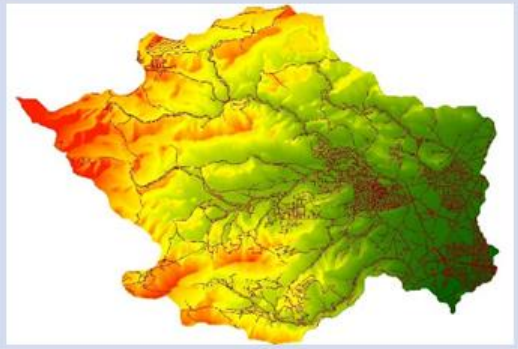
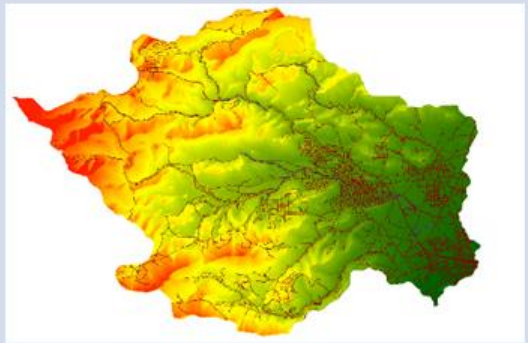
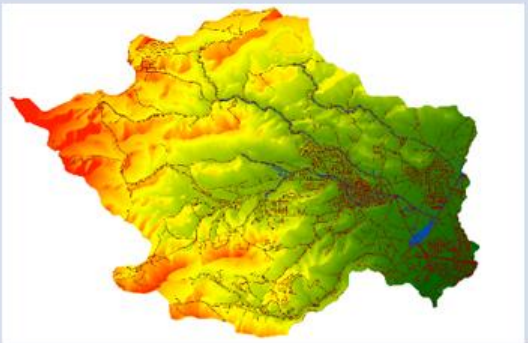
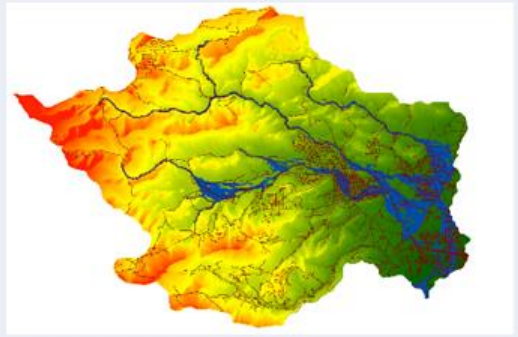
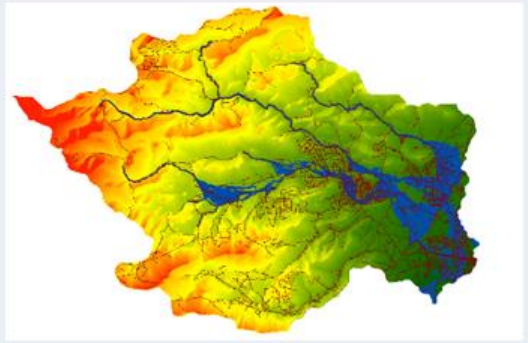
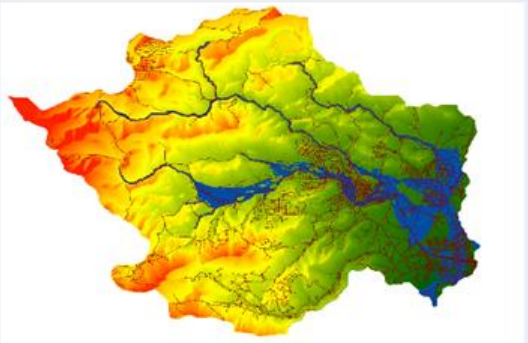
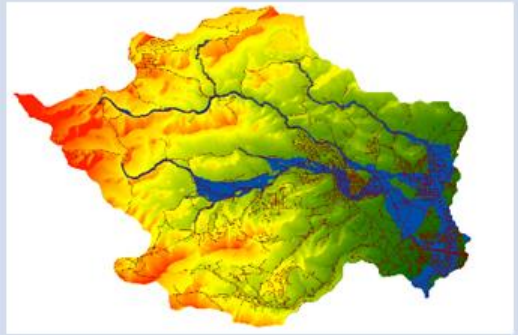
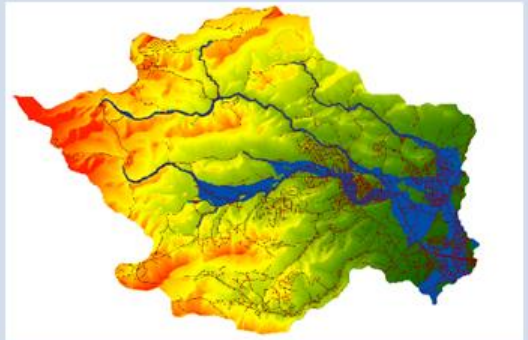
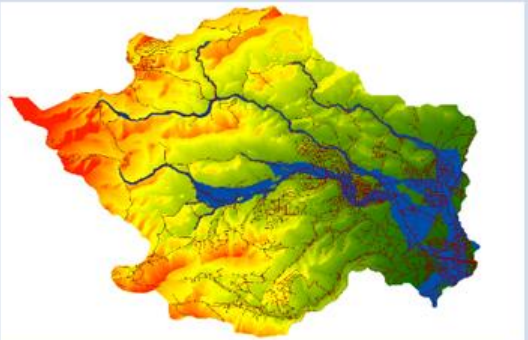
T = 500 years	d = 3 hours	d = 6 hours	d = 9 hours
CN I Dry conditions			
CN II Average conditions			
CN III Wet conditions			

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Flood mapping results
T = 1000 years

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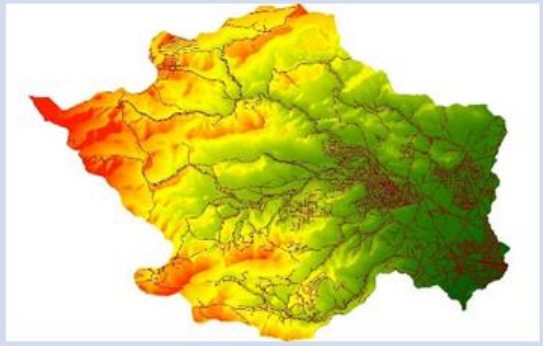
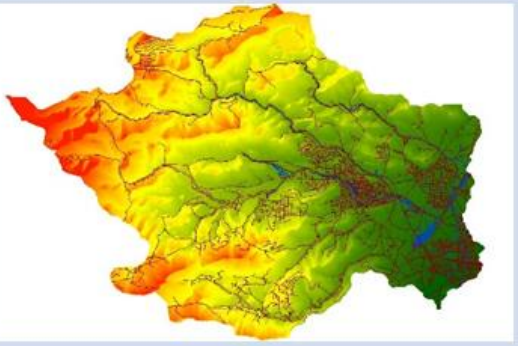
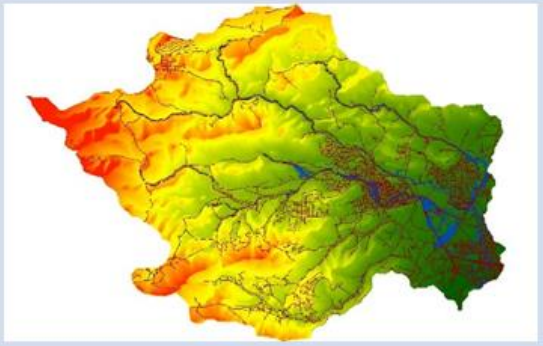
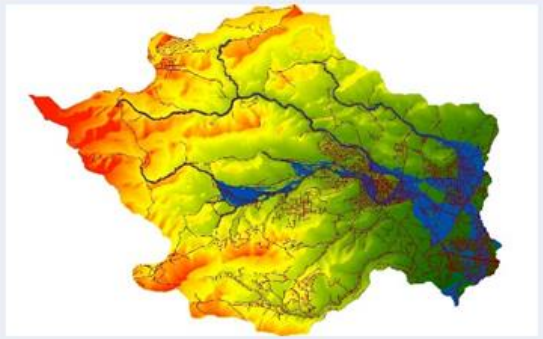
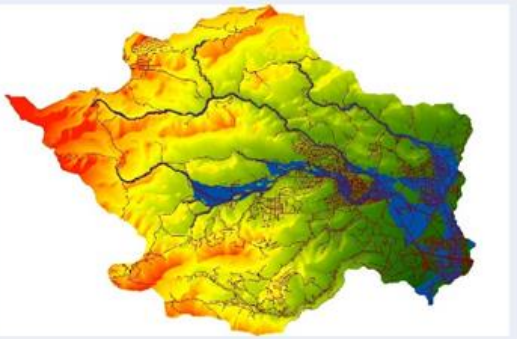
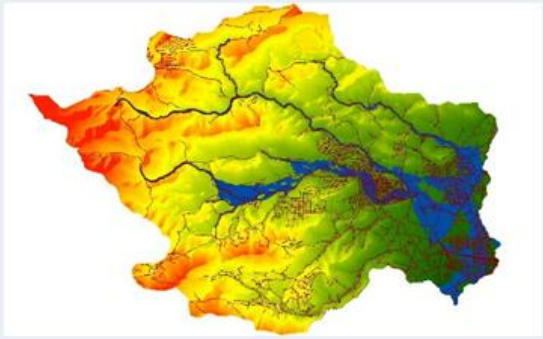
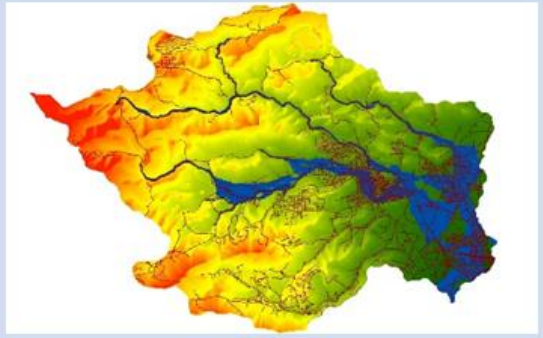
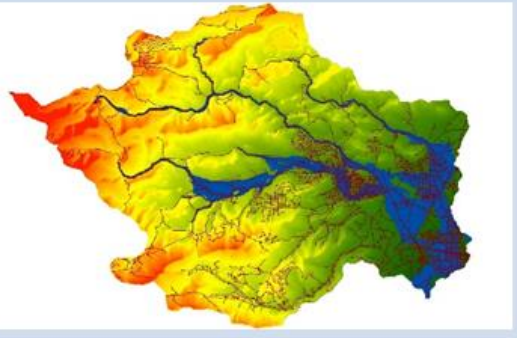
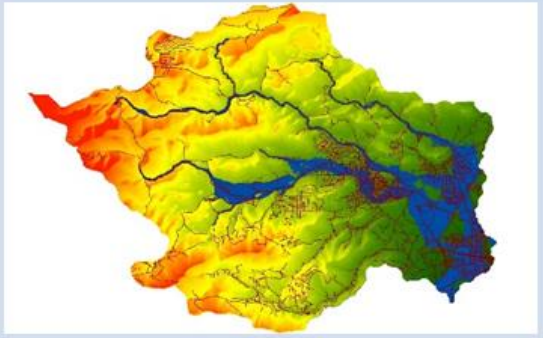
T = 1000 years	d = 3 hours	d = 6 hours	d = 9 hours
CN I Dry conditions			
CN II Average conditions			
CN III Wet conditions			

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Mandra flood 2017: modelling (blue) vs EO mapping (pink)

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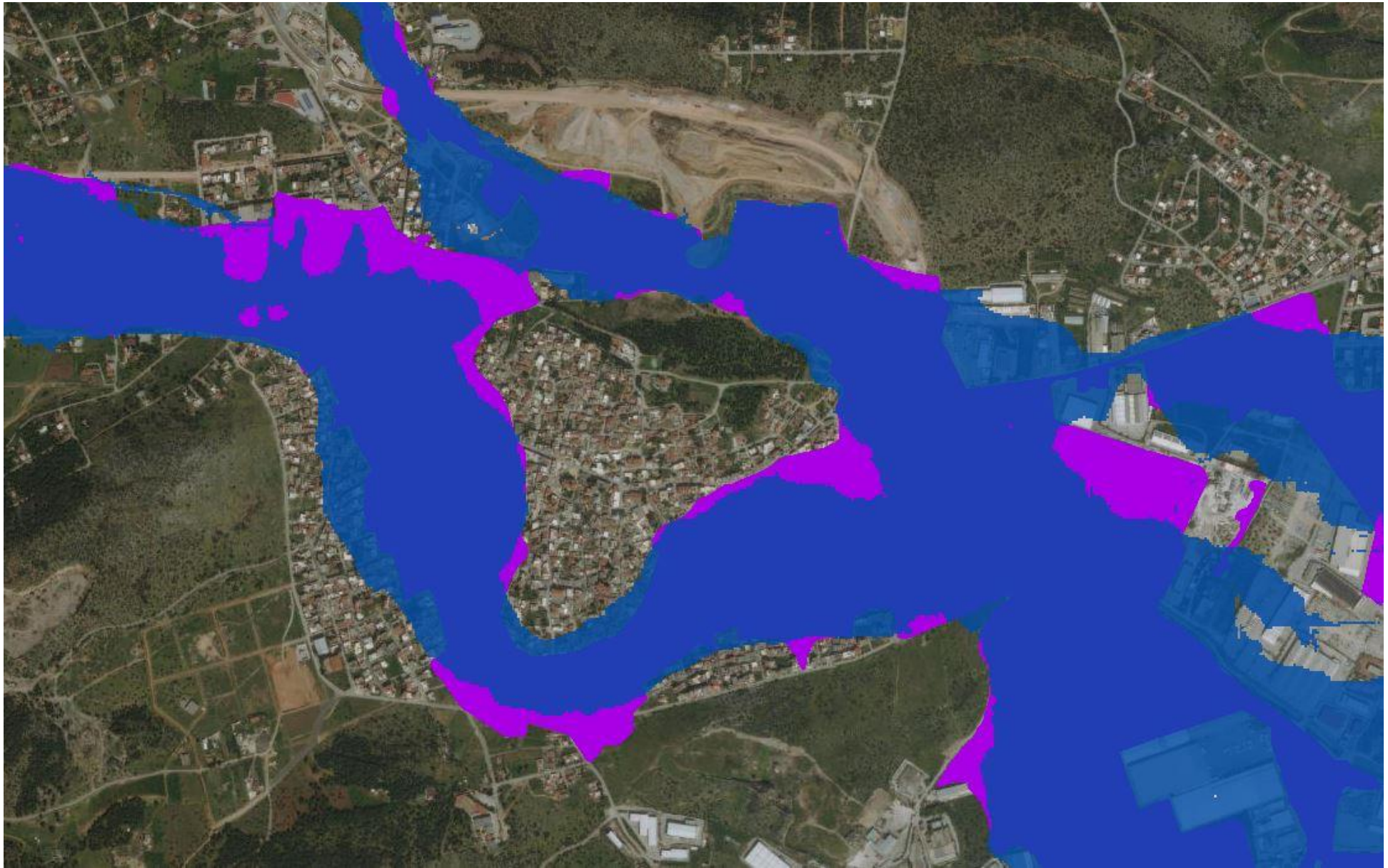
Blue: Simulation of flood scenario T1000 CNIII d6



Pink: VHR satellite-based mapping (Meteoview)

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FloodHUB system in support of the decision makers

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FloodHUB

In line with the requirements for the implementation of the:

- ✓ **EU Floods Directive 2007/60/EC "on the assessment and management of flood risks"**
- ✓ **Sendai Framework for Disaster Risk Reduction**
- ✓ **UN SDGs:**

- ✓ **GEO's Societal Benefit Areas:**
  - Disaster Resilience
  - Sustainable Urban Development
  - Water Resources Management
  - Public Health Surveillance
  - Food Security and Sustainable Agriculture
  - Infrastructure and Transportation Management

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Stakeholders' trainings in the operational FloodHUB system

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Stakeholders' trainings in the operational FloodHUB system

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Thank you for your attention!

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