



EXCELSIOR

ERATOSTHENES:
Excellence Research Centre for Earth Surveillance
& Space-Based Monitoring of the Environment



Earth Observation assimilation for real time flood monitoring and response

@excelsior2020eu



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BEYOND
Centre of EO Research & Satellite Remote Sensing



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 857510.



This project has received funding from the Government of the Republic of Cyprus through the Directorate General for the European Programmes, Coordination and Development.



CONSORTIUM

The BEYOND Center of EO Research & Satellite Remote Sensing



The services of the BEYOND Center

FireHUB

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>)

DustHUB

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

FloodHUB

Rapid Flood Mapping - Diachronic Flood Mapping - Flood monitoring and early warning
(<http://beyond-eocenter.eu/index.php/web-services/floodhub>)

GeoHUB

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

SolarHUB

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

ClimaHUB

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

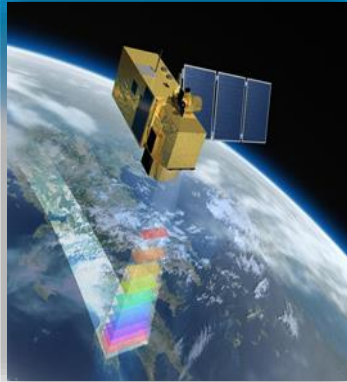
EYWA

Early Warning System for Mosquito Borne Diseases
(<http://beyond-eocenter.eu/index.php/web-services/eywa>)

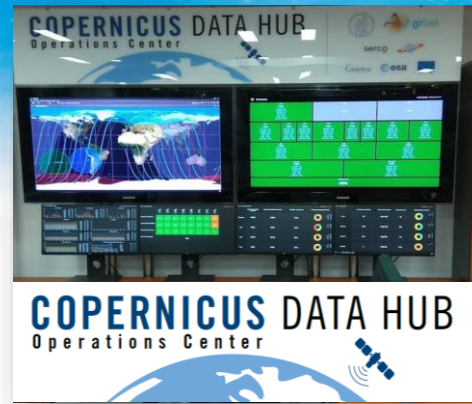
COVID - 19

Global spread monitoring of the COVID-19 pandemic
(<http://beyond-eocenter.eu/index.php/web-services/covid-19>)

The monitoring systems of the BEYOND Center



Satellites Polar Orbit
X-/L-band Station
Sentinel Mirror Site



Satellites
Geostationary
Orbit
MSG SEVIRI



Manned &
Unmanned
Aerial
Vehicles



In-situ networks and
crowdsourcing



Ελληνικό Mirror Site
(Copernicus satellite
missions)

<http://beyond-eocenter.eu/index.php/web-services/hellenic-mirror-site>)



Sentinels GreekHUB

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



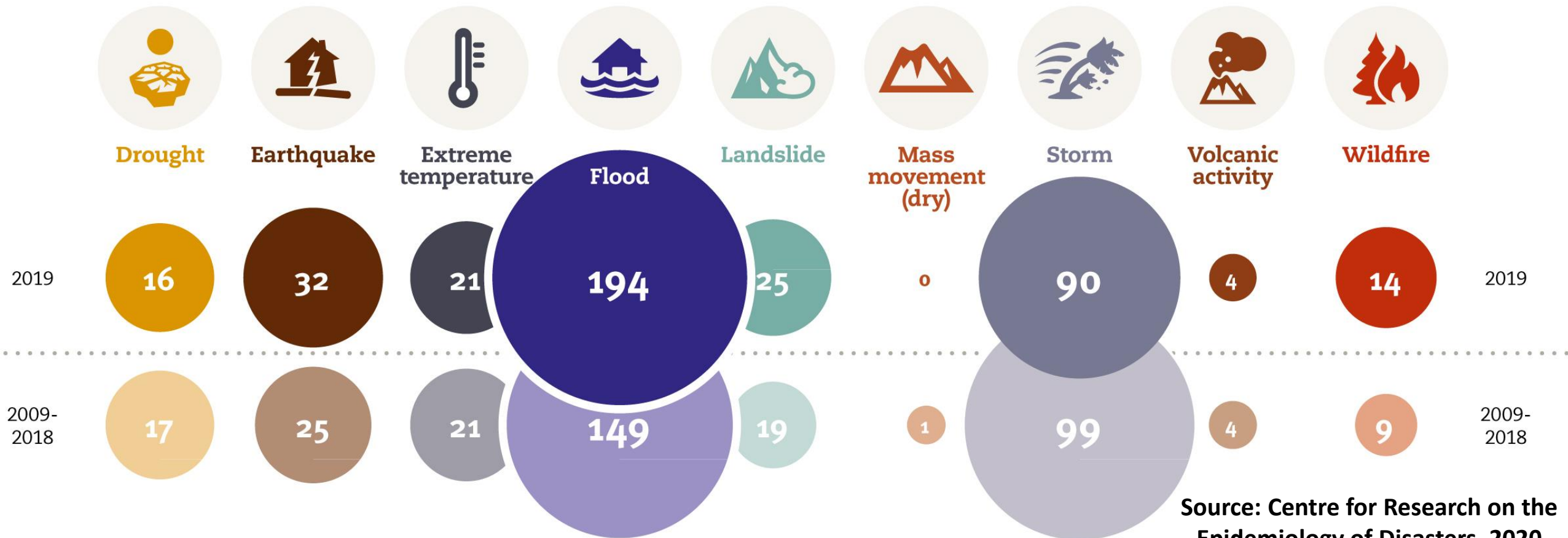
Διανέμει 55 TB/80K εικόνες δορυφόρων /Ημέρα
Λειτουργεί Αδιάλειπτα 24/7
Ταχύτητα Δικτύου GEANT 350-500 Mbps

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

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

343
2009 to 2018

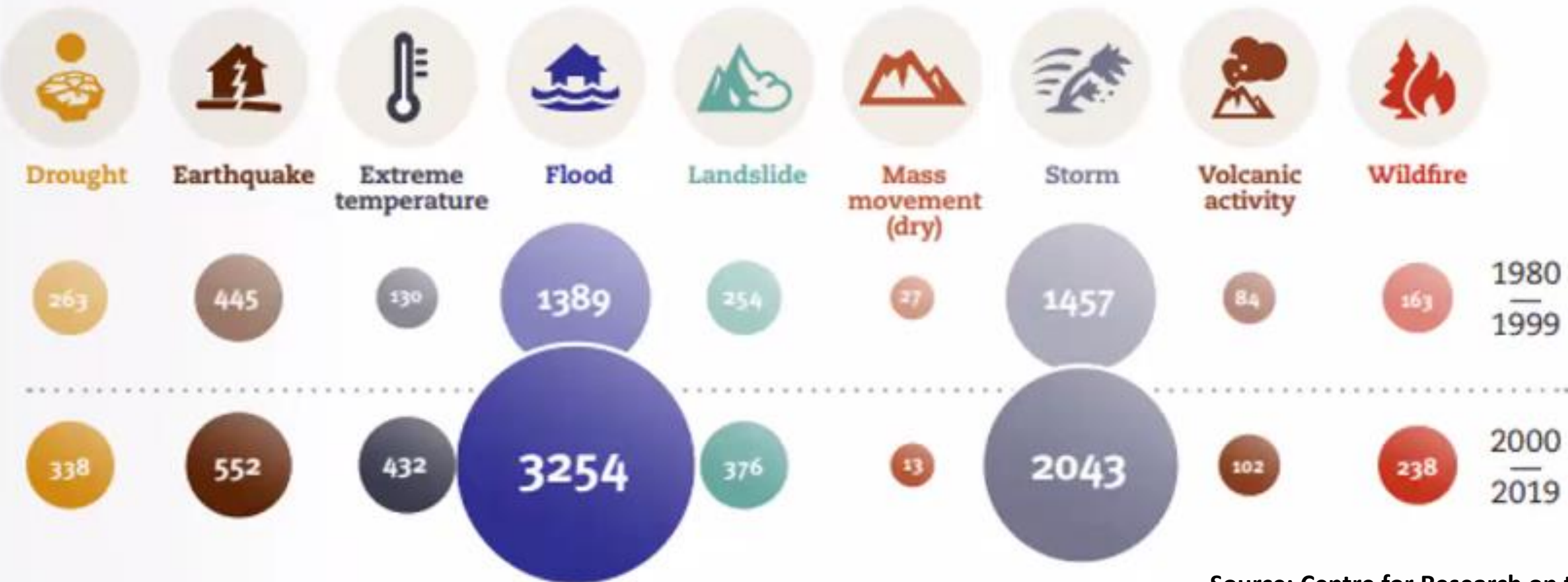
396
in 2019



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

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

Total disaster events by type: 1980-1999 vs. 2000-2019



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

Mandra flood 2017: Setup of an integrated web GIS platform



Analysis of the flood in west Attica on 15/11/2017

Ποιη Οδός και ηγ Παραπομπές: 1,2,3,4 & 5. Δλ. Απορρόσση: For the Instructions and the References: 1,2,3,4 & 5 see Details

Υπόψη
 Απορρόσση

 Ψηφιακό
 Μάσινση
 Ελαστικό επίπεδο
 Εξομάλισή

Κρίσιμα σημεία - Critical points

- Ανεπάρκεια διατομής - Inadequacy of cross section
- Επάρκεια διατομής - Adequacy of cross section

Τοποθεσίες - Locations

-

Φωτογραφίες - Photos

-

Ευκατασκευασμένο υδρολογικό δίκτυο - Modified hydrological network (1)

- Ακάλυπτα τμήματα ρευστών - Uncovered parts of watercourses
- Καλυμμένα τμήματα ρευστών - Covered parts of watercourses
- Πρωτόγενος φυσική ροή ρευστών - Original natural flow of watercourses

Χαρτογραφημένο έδαφος πλημμύρας - Mapped flood extent (2)

-

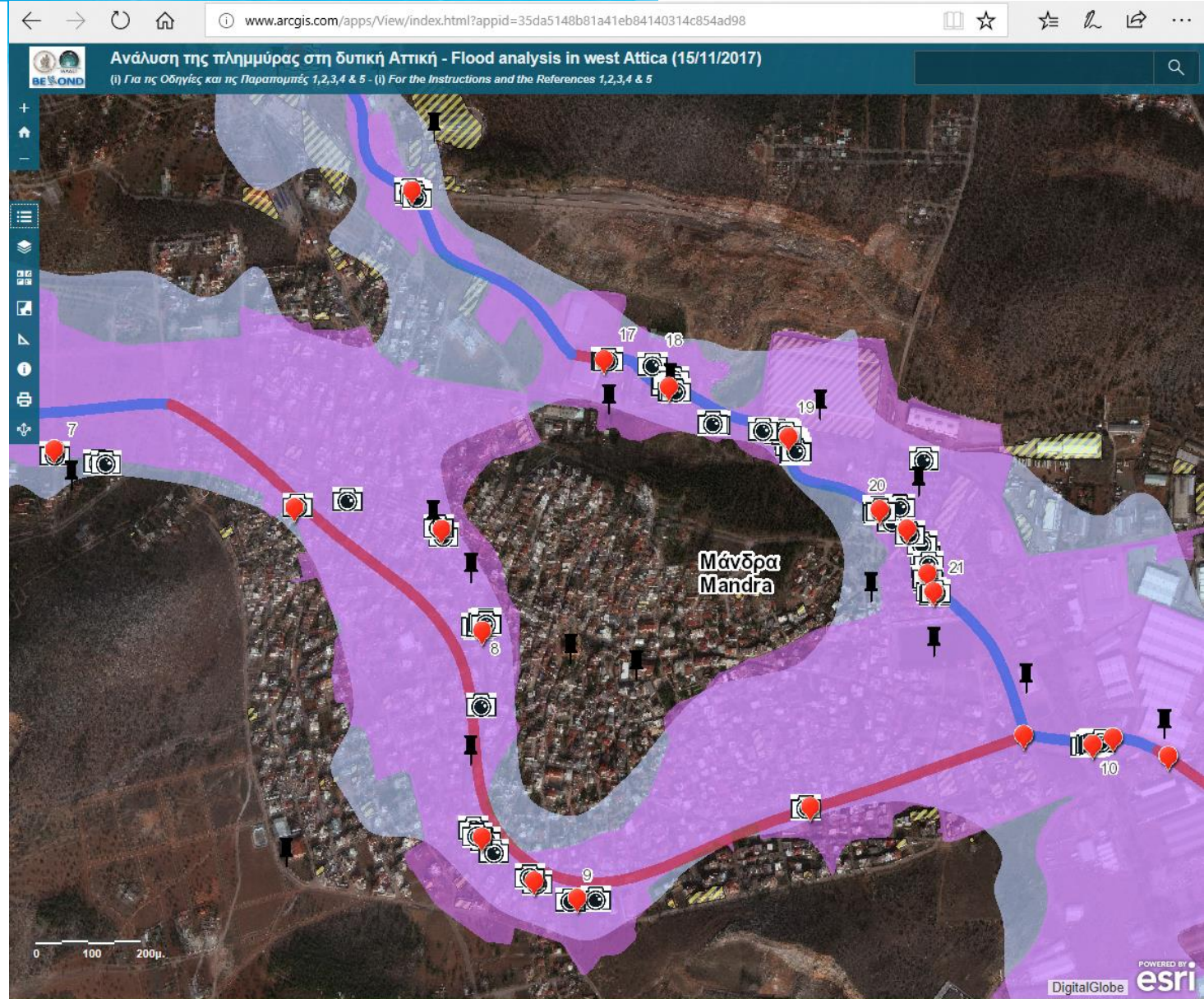
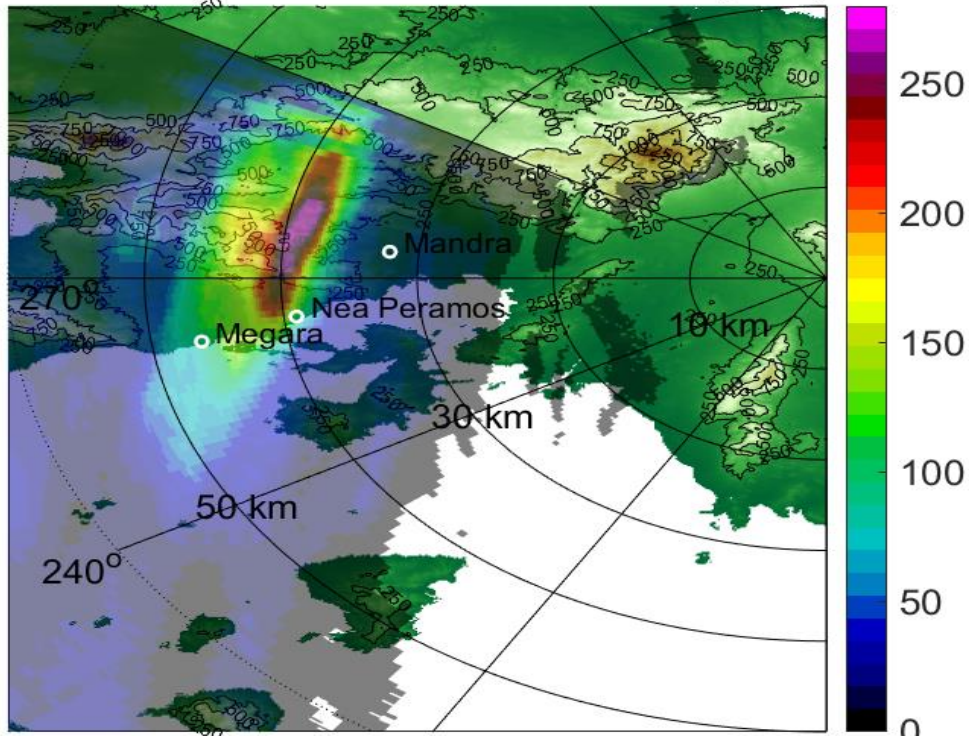
Προσπορευμένη έδαφος πλημμύρας - Simulated flood extent (3)

-

Αστική επέκταση - Urban expansion

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

XPOL-NOA accumulated rainfall (mm)

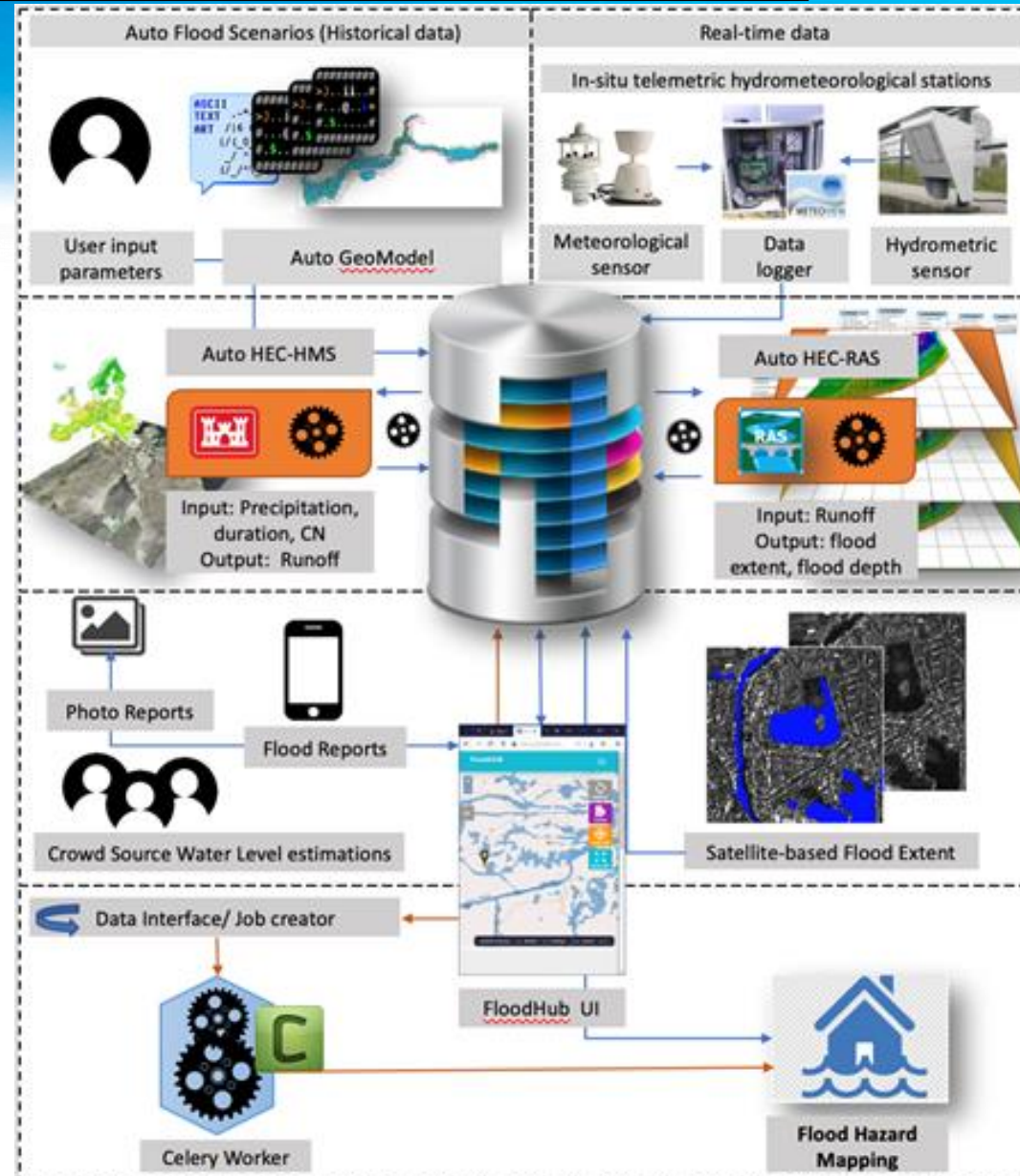


Disaster Resilience
Action Group

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).

Mandra 2020: Development of the operational FloodHUB system

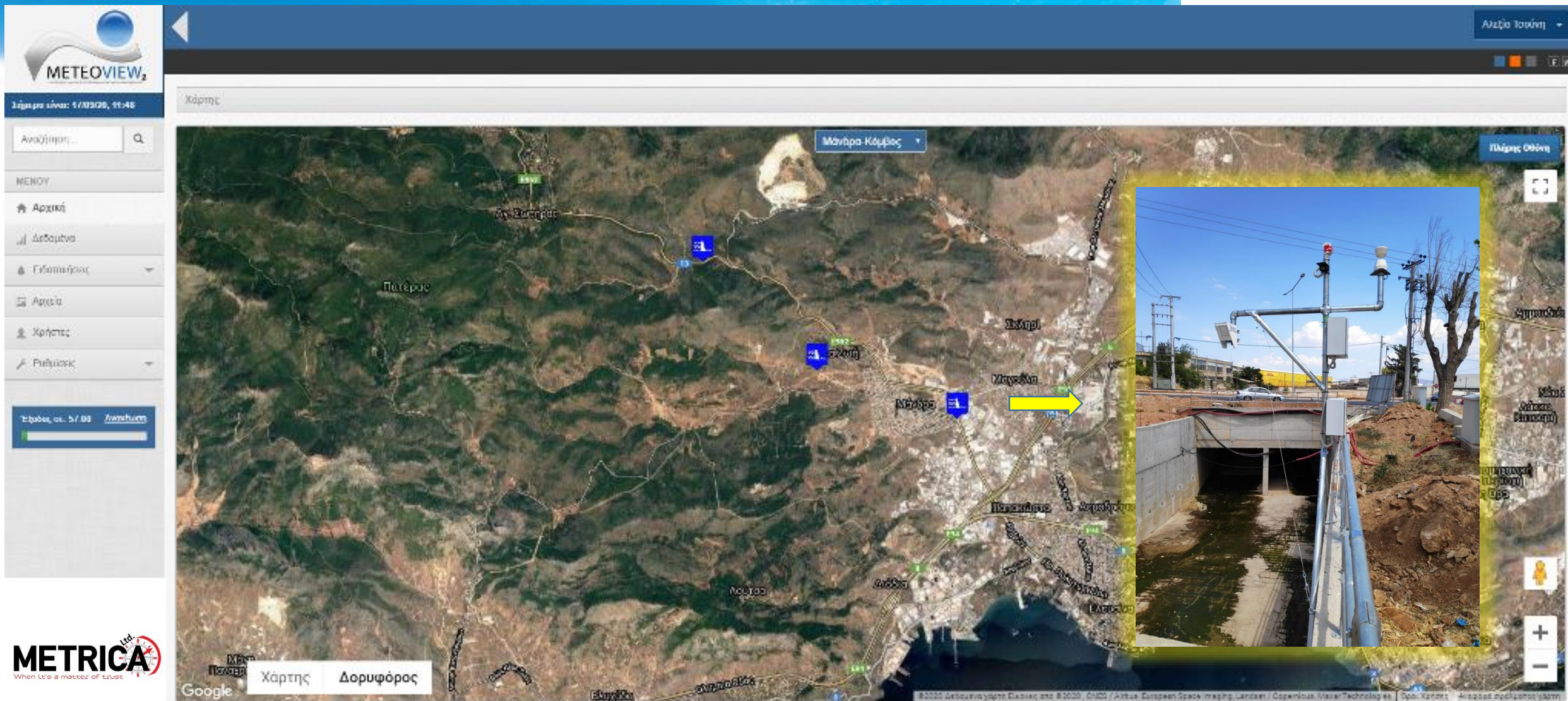
Procurement and installation of 3 telemetric hydrometeorological stations with co-funding by the Hellenic Petroleum S.A. and the SMURBS/ERA-PLANET project, in collaboration with the Attica Region



Upgrade in the framework of the CLIMPACT project



Web platform of the 3 telemetric hydrometeorological stations



The screenshot displays the METEVIEW web interface. On the left, there is a navigation menu with options like Αρχική, Δεδομένα, Γεωπαράμετροι, Αρχείο, Χρήστες, and Ρυθμίσεις. The main area shows a satellite map of a region with a yellow arrow pointing to a specific location. The map includes labels for various locations such as Μάνηρα, Κόμβος, Πυλέρου, and Μανηρά. An inset image on the right shows a hydrometeorological station with a weather vane and other sensors. The interface also features a search bar, a date and time display (Σήμερα είναι: 1/10/2020, 11:48), and a progress bar at the bottom left.

Web platform of the 3 telemetric hydrometeorological stations

ΜΕΤΕΟVIEW₂

Σήμερα είναι: 1/03/20, 11:48

Αναζήτηση

ΜΕΝΟΥ

- Αρχική
- Δεδομένα
- Γεωγραφικός
- Αρχείο
- Χρήστες
- Ρυθμίσεις

Έπιβατα: 0.5 / 08

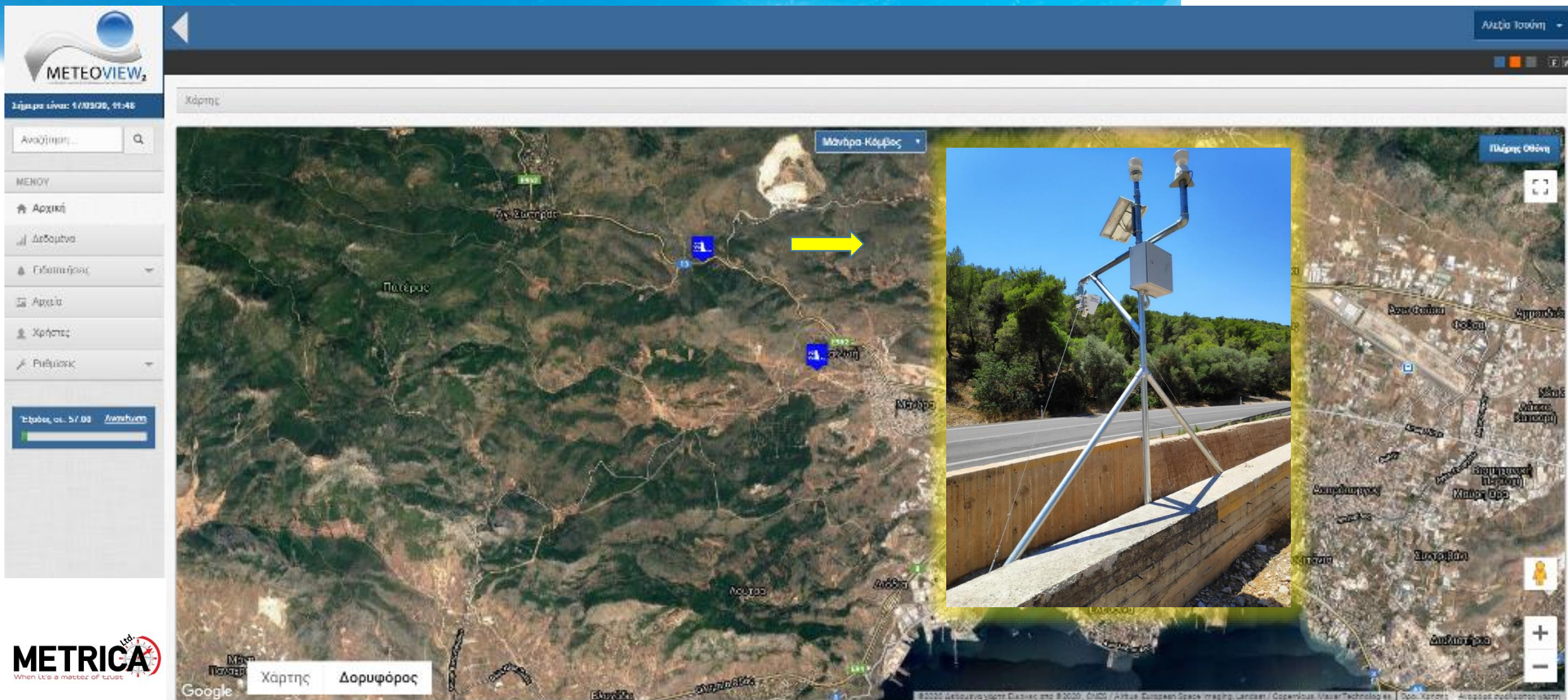
Χάρτης

Μάνηρα Κόμβος

Πλάγιος Οθόνη

Χάρτης Δορυφόρος

Web platform of the 3 telemetric hydrometeorological stations



The screenshot displays the METEVIEW web interface. On the left, there is a navigation menu with options like 'Αρχική', 'Δεδομένα', 'Γεωπαράμετροι', 'Αρχείο', 'Χρήστες', and 'Ρυθμίσεις'. The main area shows a satellite map of a mountainous region in Greece. A yellow arrow points to a specific location on the map, which is identified as 'Μάνηρα Κόμβος'. An inset image shows the physical telemetric station equipment, including a weather vane, a rain gauge, and a solar panel, mounted on a tripod structure. Another inset map shows a detailed view of the station's location within a village, with labels for 'Πλάγιος Οδός' and other local landmarks. The interface includes a search bar, a 'Μέτροι αέρα: 1/03/20, 11:48' display, and a 'Μέτροι αέρα: 5/ 00' progress indicator.

Web platform of the 3 telemetric hydrometeorological stations

The screenshot displays the METEVIEW2 web interface. On the left is a navigation sidebar with options like Home, Data, Notifications, Files, Users, and Settings. The main content area shows the station 'Αγιος Αθανάσιος' with a photo of the station equipment and details: 'Perfecture: ΑΤΤΙΚΗΣ', 'City: Μάνδρα', 'Territory: Μάνδρα', and 'Installation Time: 07/24/20'. A 'Live Photos' button is also present. To the right, the 'SELECTION FILTERS FOR DATA VIEW' section includes fields for 'Date Interval', 'Date From', 'Time from', 'Date To', and 'Time to'. Below this is a grid of sensor selection buttons: 'average surface velocity', 'Water level', 'Discharge', 'Barometric Pressure', 'Air temp', 'Relative humidity', 'Ηλιακή ακτινοβολία', 'Wind direction', 'Wind speed', 'Rainfall', and 'Battery supply'. There is also a 'Single Y Axis' checkbox and a 'Compare to sensors of other stations' dropdown menu. At the bottom, a 'View per:' section offers time intervals: 'Total', 'Minutes', 'Hour', 'Day', 'Week', 'Month', and 'Year', along with a 'Chart' button.

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.

Real-time crowdsourcing platform for staff and volunteers

Send Report

GPS Manual Edit Delete Cancel Submit

Depth[m] 0.6

PURID: 4232c741-72b3-44aa-9443-72b69e10668a

OWNER: PORTALADMIN

TIME: 2020-10-05T12:25:30.292582

Select Scenario

Pnt: 5/5 | T = 100 | Dur. = 540 | CN= 2

Repeat Period: 100

Duration (h): 9

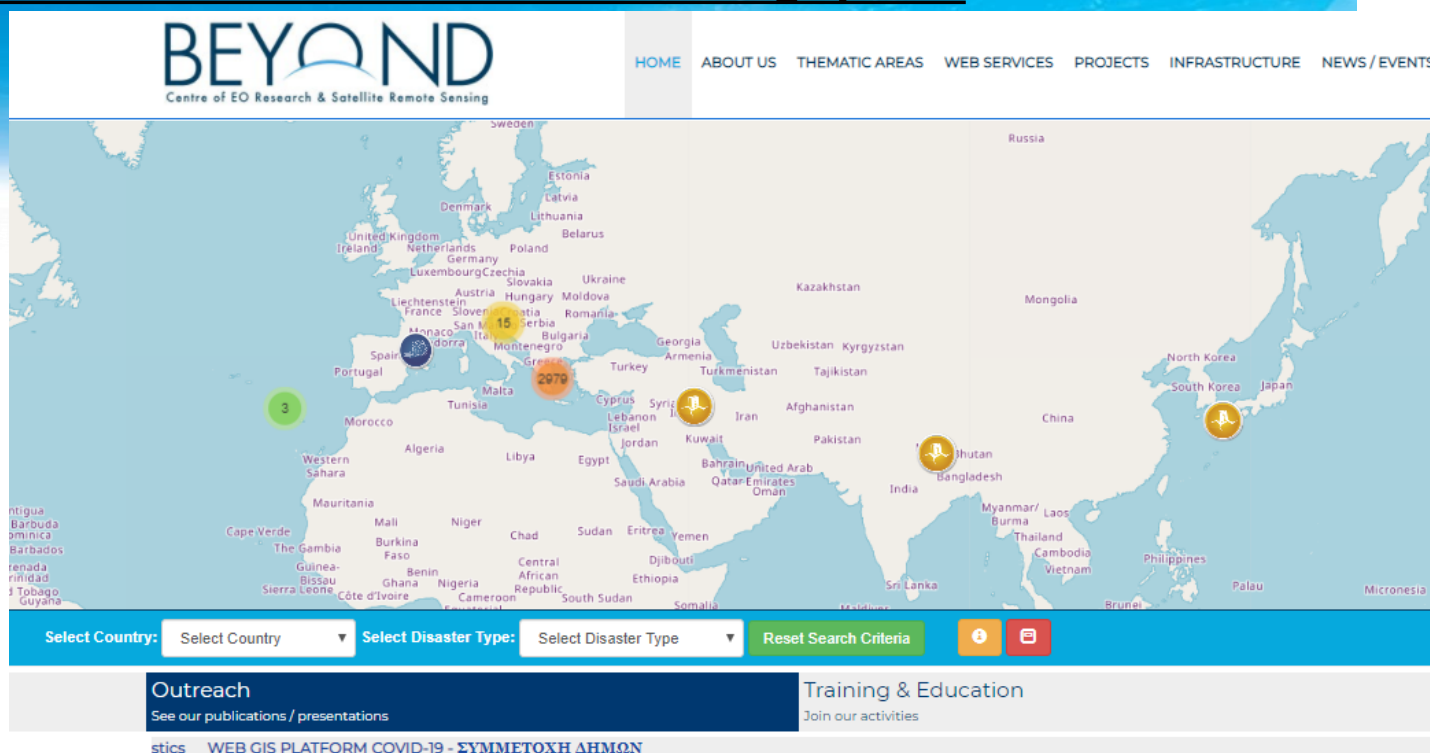
CN Parameter: II (Med Cond)

Clear Display

DASHBOARD HOME FLOODS ABOUT SETTINGS LOGOUT LOCK EN

Refresh Locate Zoom Self Zoom AOI

Integrated near-real-time flood monitoring system



The screenshot shows the BEYOND website interface. At the top, there is a navigation menu with links: HOME, ABOUT US, THEMATIC AREAS, WEB SERVICES, PROJECTS, INFRASTRUCTURE, and NEWS / EVENTS. Below the menu is a world map with several circular markers indicating disaster locations. A search bar at the bottom of the map area contains the following elements: "Select Country:" followed by a dropdown menu, "Select Disaster Type:" followed by another dropdown menu, and a "Reset Search Criteria" button. Below the search bar, there are two main sections: "Outreach" with the text "See our publications / presentations" and "Training & Education" with the text "Join our activities". At the bottom of the page, there is a link to "stics" and a reference to "WEB GIS PLATFORM COVID-19 - ΣΥΜΜΕΤΟΧΗ ΔΗΜΩΝ".

COVID - 19

Web GIS platform for daily monitoring the global spread of the COVID-19, actively providing information about the pandemic

BEYOND THEMATIC AREAS

Agriculture

Agriculture monitoring, for the purposes of food security, control of the implementation of sustainable agriculture policies and the improvement of the overall agricultural productivity.

[Read more](#)

Climate

Disasters

The rapid changes in climate over the last decades, together with the explosion of human population, have shaped the context for a fragile biosphere, prone to natural and manmade disasters that result in massive flows of environmental immigrants.

[Read more](#)

Energy

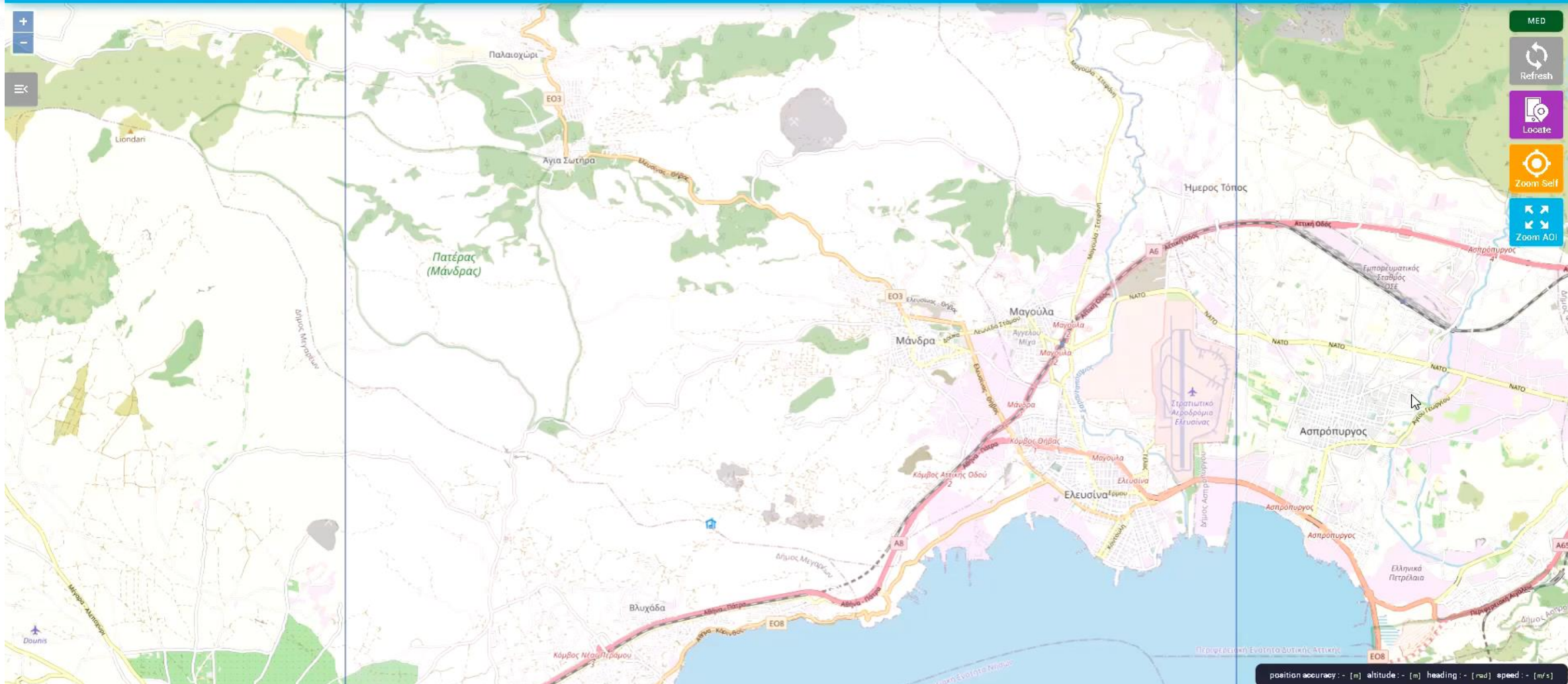
WEB SERVICES



Integrated near-real-time flood monitoring system

BEYOND FloodHUB

HOME FLOODS ABOUT REGISTER LOGIN EN



Integrated near-real-time flood monitoring system

BEYOND FloodHUB

DASHBOARD HOME FLOODS ABOUT SETTINGS LOGOUT LOCK EN

Send Report



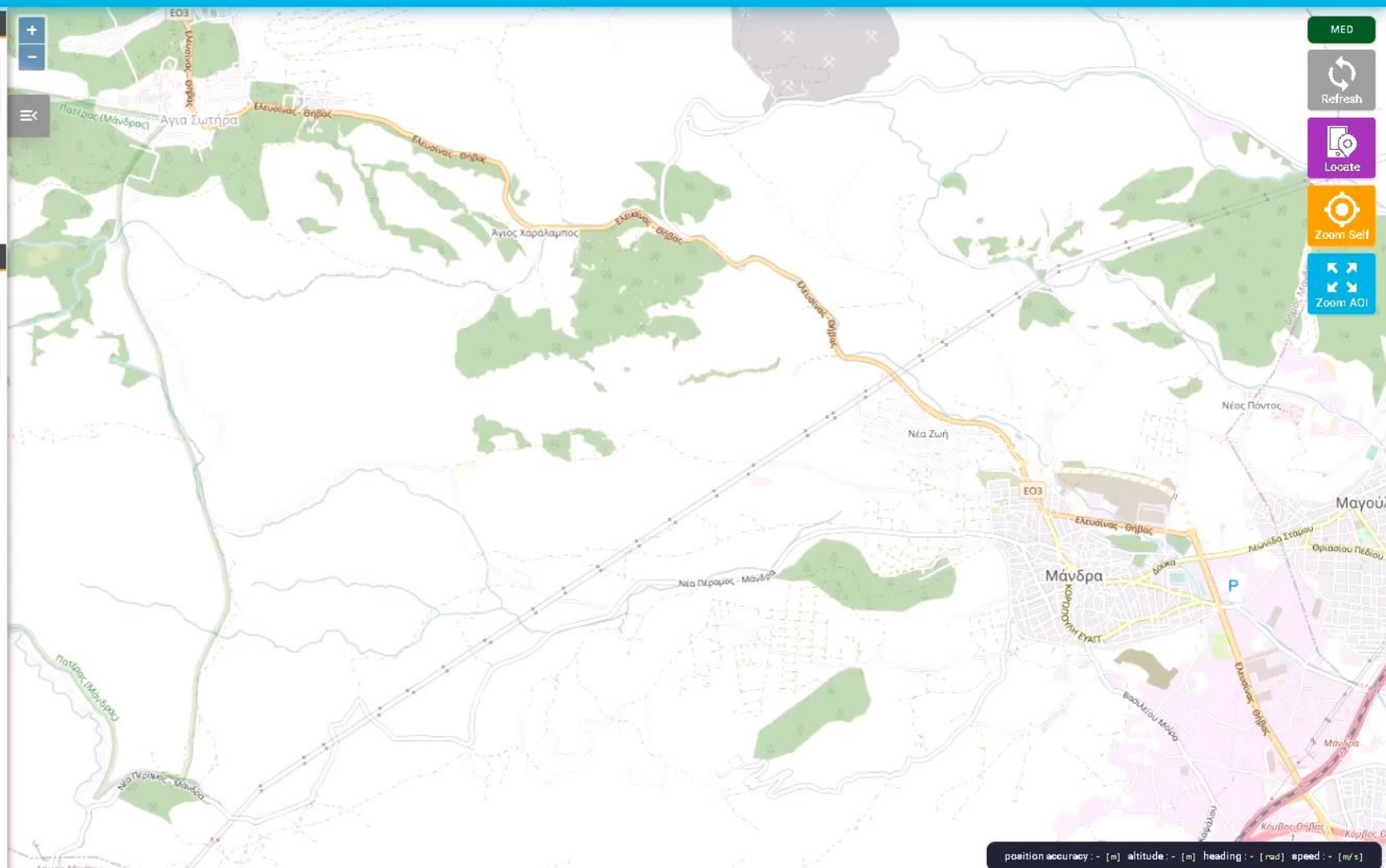
Depth [m]
0

PUBID
OWNER
TIME

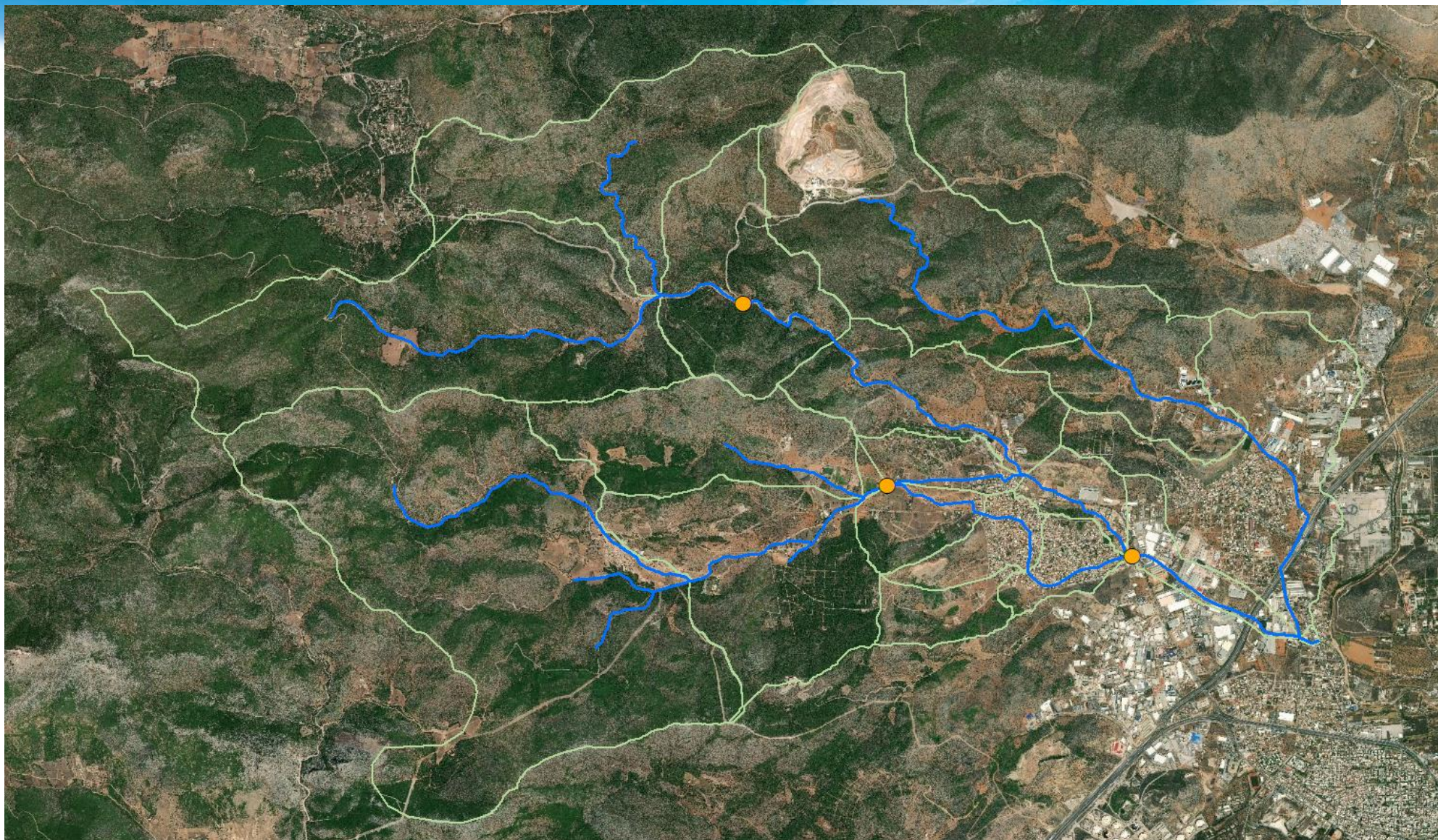
Select Scenario

Pnt: crowd_stations=[0/0],[0/0] | T = | Dur. = | CN = 2

Repeat Period Duration (h) CN Parameter II (Med Cond) Clear Display



Hydrologic & hydraulic simulation



RIVER BASIN
57 km²

SUBBASINS
19

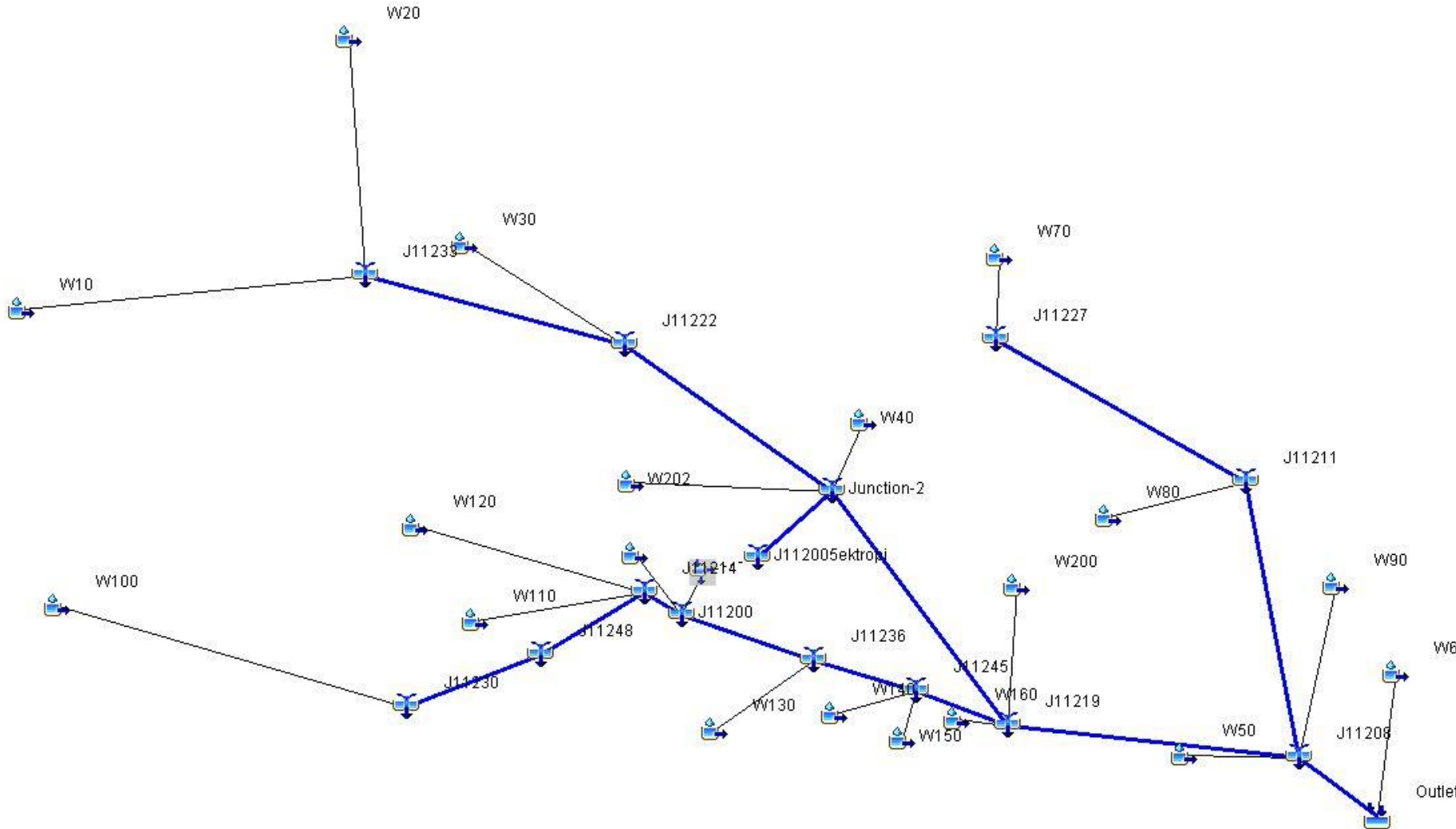
RAINFALL IDF CURVE
Koutsoyiannis &
Baloutsos, 2000

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

DISTRIBUTION
Worst profile method

TIME OF
CONCENTRATION
Kirpich (SCS) method

Hydrologic & hydraulic simulation



HYDROLOGIC MODELING:

HEC-HMS

(free & open access)

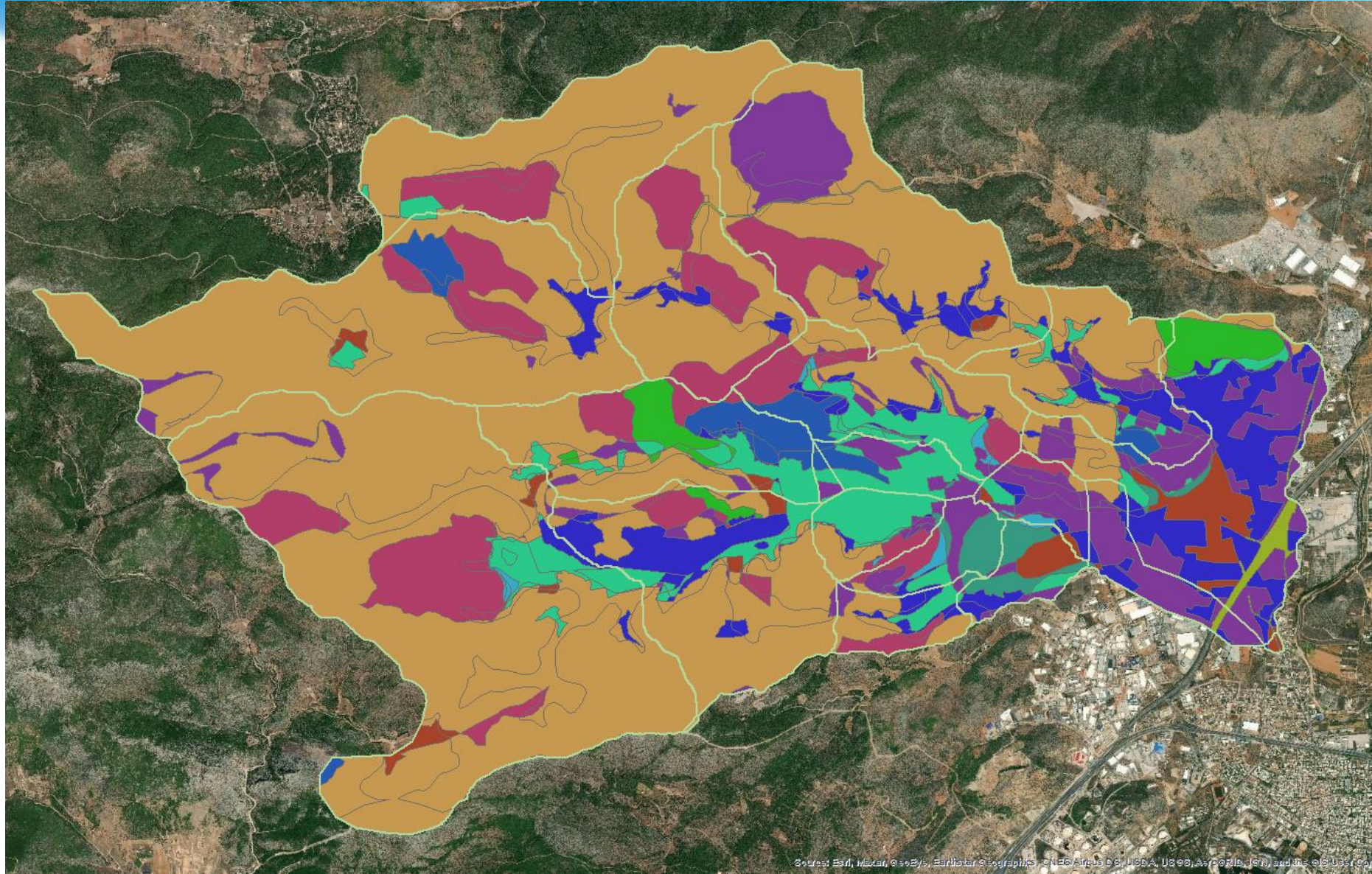
Input: rainfall data through HEC-DSS for various combinations of return periods T (years) and rainfall duration d (hours)

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

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)

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Run: all scenarios

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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 CN I D3	T100 CN I D3	T200 CN I D3	T500 CN I D3	T1000 CN I D3
	T50 CN I D6	T100 CN I D6	T200 CN I D6	T500 CN I D6	T1000 CN I D6
	T50 CN I D9	T100 CN I D9	T200 CN I D9	T500 CN I D9	T1000 CN I D9
CN II Average conditions	T50 CN II D3	T100 CN II D3	T200 CN II D3	T500 CN II D3	T1000 CN II D3
	T50 CN II D6	T100 CN II D6	T200 CN II D6	T500 CN II D6	T1000 CN II D6
	T50 CN II D9	T100 CN II D9	T200 CN II D9	T500 CN II D9	T1000 CN II D9
CN III Wet conditions	T50 CN III D3	T100 CN III D3	T200 CN III D3	T500 CN III D3	T1000 CN III D3
	T50 CN III D6	T100 CN III D6	T200 CN III D6	T500 CN III D6	T1000 CN III D6
	T50 CN III D9	T100 CN III D9	T200 CN III D9	T500 CN III D9	T1000 CN III 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 2m 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

Flood mapping results T = 50 years

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

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			

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			

Flood mapping results T = 500 years

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

Flood mapping results T = 1000 years

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

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



Blue:

Simulation
of flood
scenario
T1000
CNIII
d6

Pink:

VHR
satellite-
based
mapping
(Meteoview)

FloodHUB system in support of the decision makers

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

Stakeholders' trainings in the operational FloodHUB system



The BEYOND Center of EO Research & Satellite Remote Sensing



Thank you for your attention!

Acknowledgements

Call: **H2020-WIDESPREAD-2018-01**
Topic: **WIDESPREAD-01-2018-2019 Teaming Phase 2**
Project full title: **ERATOSTHENES: Excellence Research Centre for Earth Surveillance and Space-Based Monitoring of the Environment**
Project acronym: **EXCELSIOR**



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CONSORTIUM



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