



HS4.4 - 'Operational forecasting and warning systems for natural hazards: challenges and innovations'  
Thursday 29 April 2021

## The innovation of the FloodHub system for a reliable flood early warning and crisis management

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National Observatory of Athens – IAASARS – BEYOND Center



<http://beyond-eocenter.eu>



# The BEYOND Center of EO Research & Satellite Remote Sensing



**BEYOND**  
Centre 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

**Early warning and monitoring of flood events - Diachronic Flood Extent Mapping**  
**(<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>)**

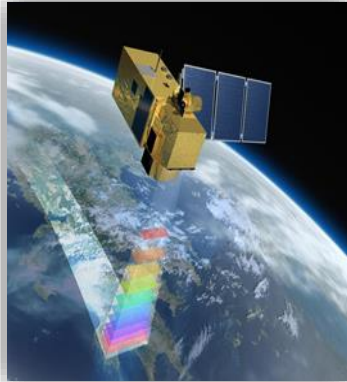
## ClimaHUB

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

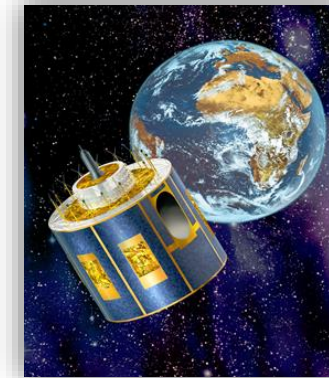
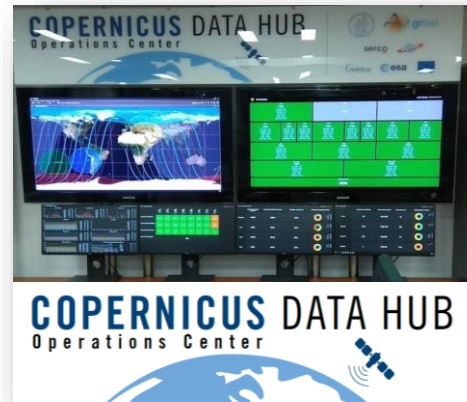
# The monitoring systems of the BEYOND Center



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



Satellites  
 Geostationary  
 Orbit  
 MSG SEVIRI



**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>)



Manned &  
 Unmanned  
 Aerial  
 Vehicles



In-situ networks and  
 crowdsourcing



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

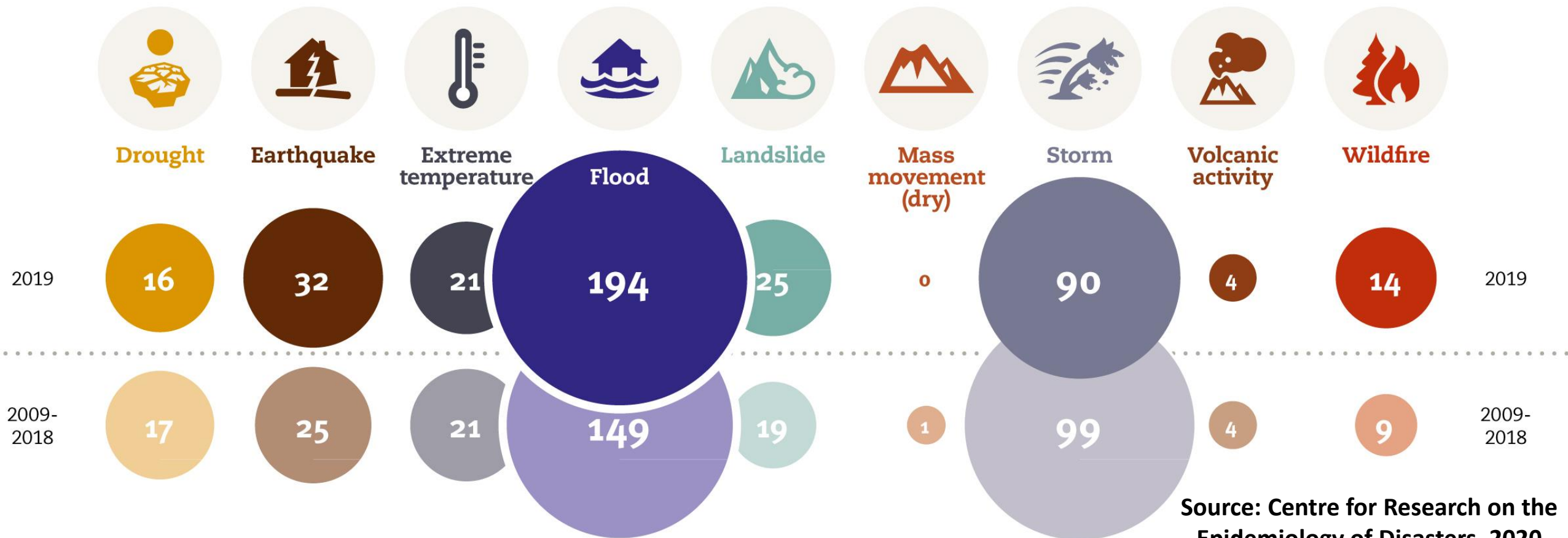
# Floods: the deadliest type of disaster

## 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



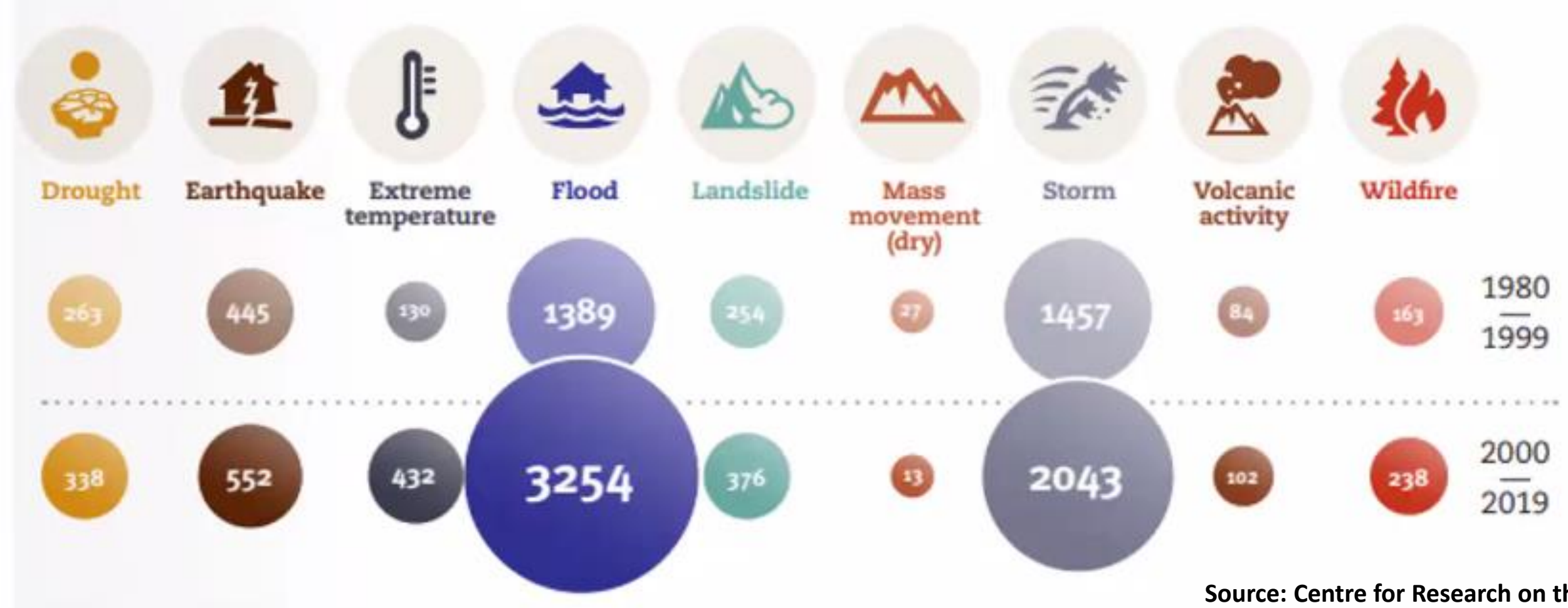
Source: Centre for Research on the Epidemiology of Disasters, 2020



# 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

Ποταμός και ηγ. Παράρτημα 1, 2, 3, 4 & 5 Δλ. Απορρόσησης - For the Instructions and the References 1, 2, 3, 4 & 5 see Details

Υποψηφία
   
 Απορρόσησης

Υποψηφία
   
 Απορρόσησης
   
 Επεξεργασία
   
 Εξομάλυνση

#### Κρίσιμα σημεία - Critical points

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




#### Τοποθεσίες - Locations



Φωτογραφία - Photos

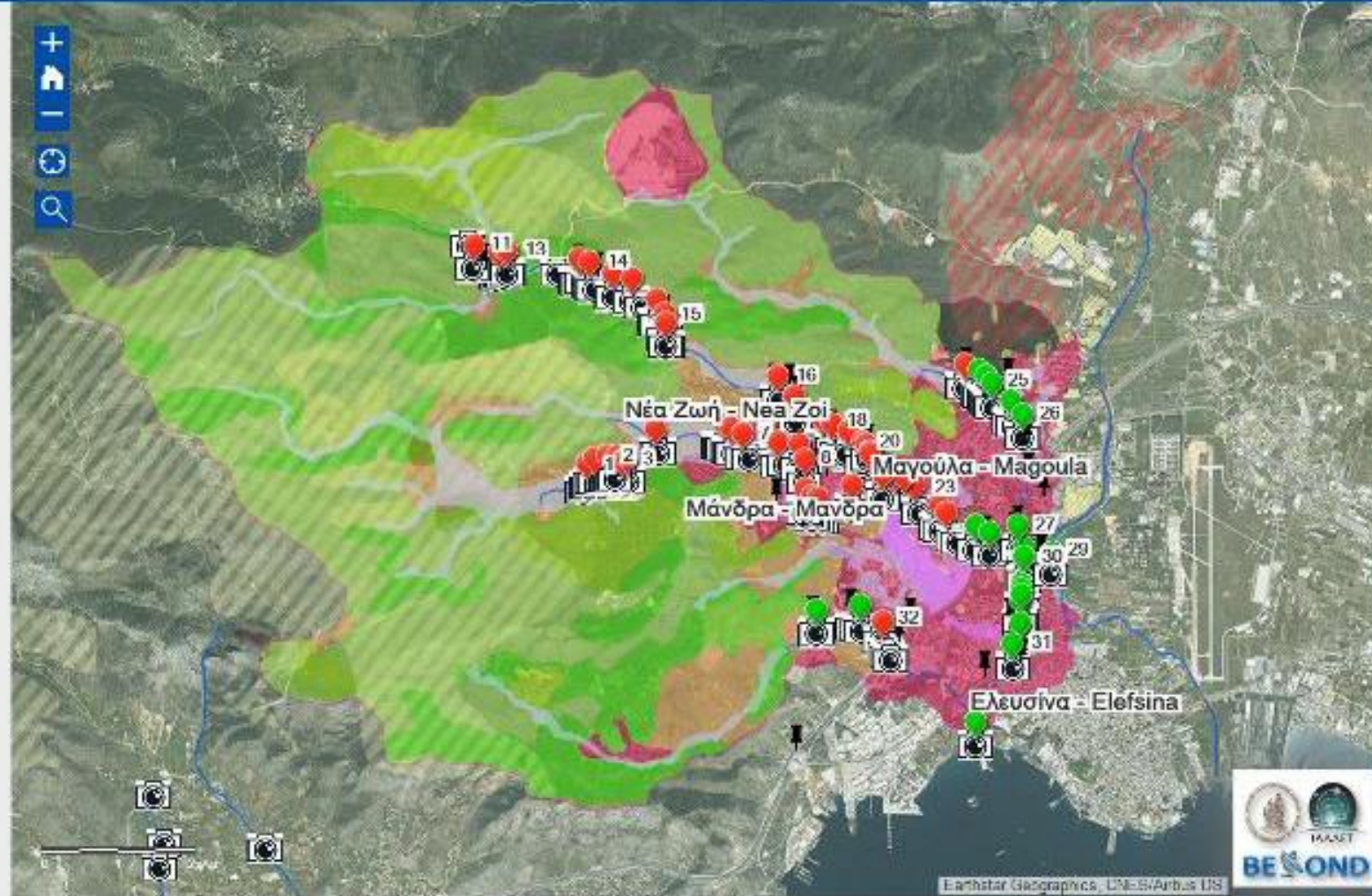


#### Ευρωπαϊκό δίκτυο υδρολογικών δικτύων - Updated hydrographic network (1)

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

#### Χαρτογραφημένο έδαφος πλημμύρας - Mapped flood extent (2)

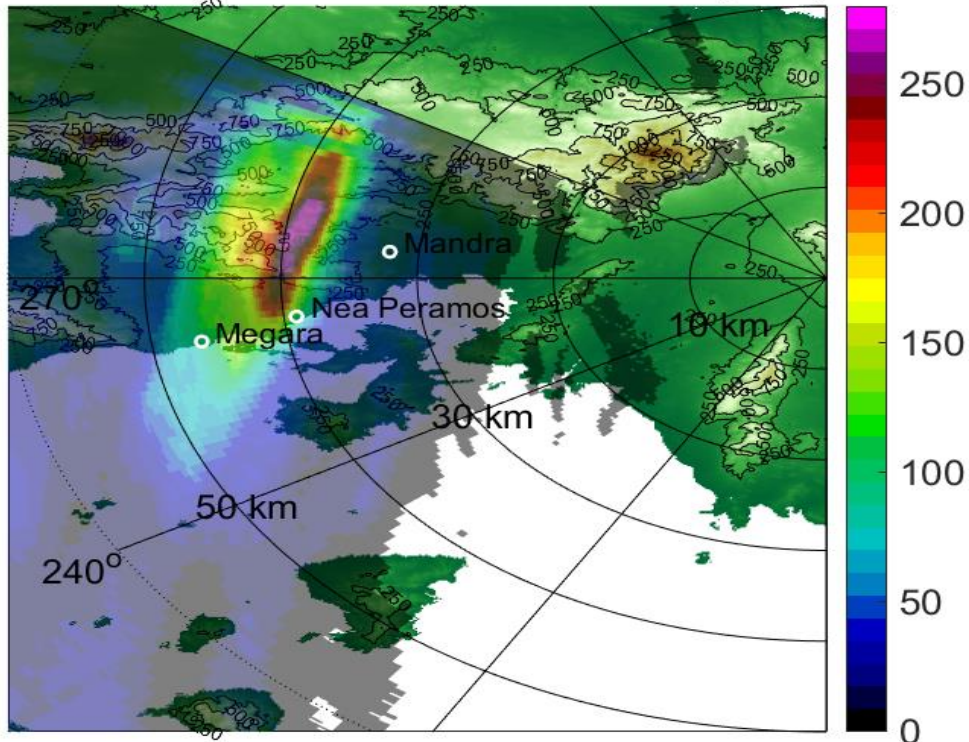
- 
 Πρωτογενής έκταση πλημμύρας - Simulated flood extent (3)
- 
 Αστική επέκταση - Urban expansion





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

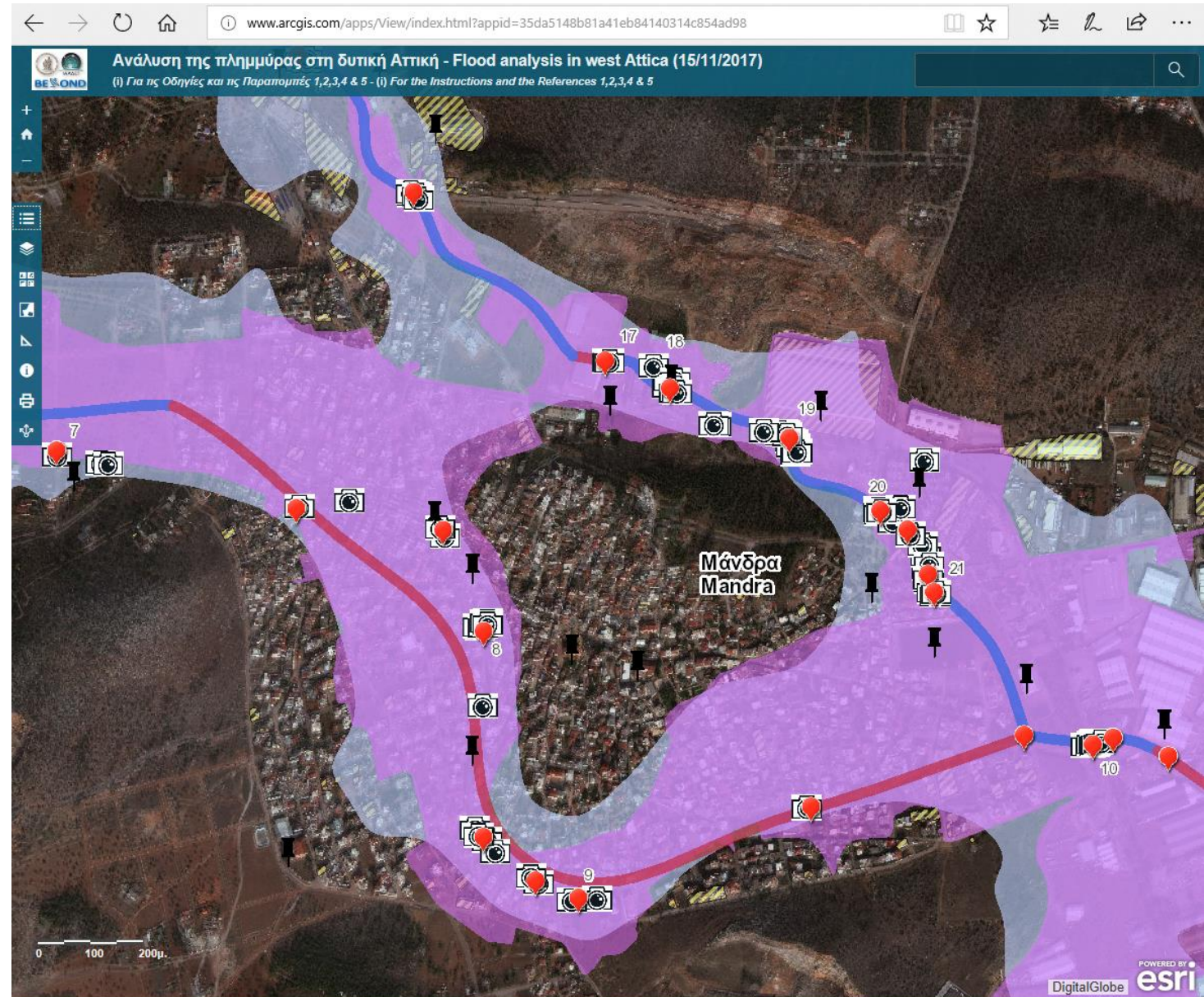
XPOL-NOA accumulated rainfall (mm)



14-Nov-2017 13:49 to 15-Nov-2017 12:00 UTC

EuroGEO

Disaster Resilience  
Action Group

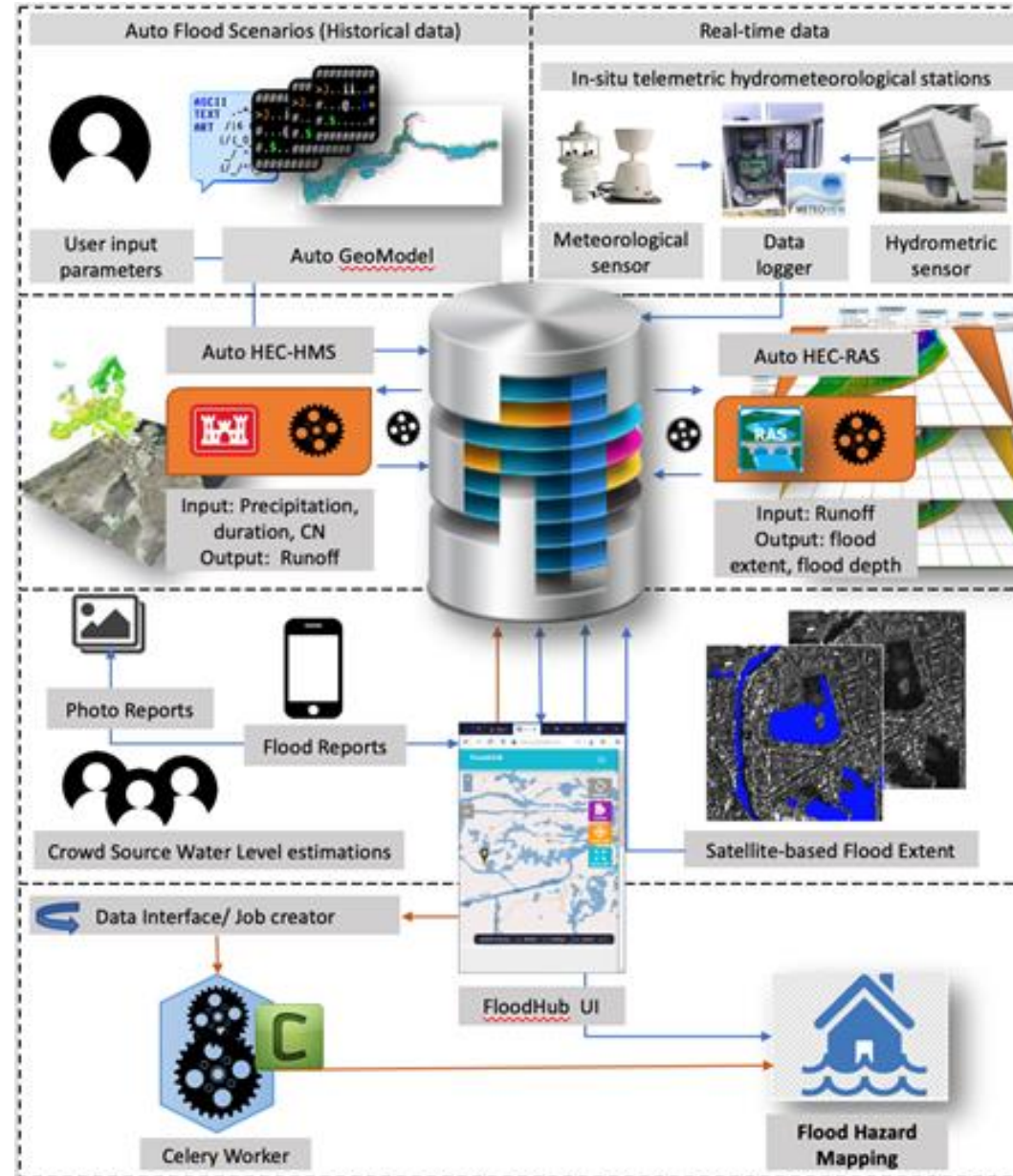




# Mandra 2020: Architecture of the FloodHUB system

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





# Web platform of the 3 telemetric hydrometeorological stations

**METEOVIEW<sub>2</sub>**

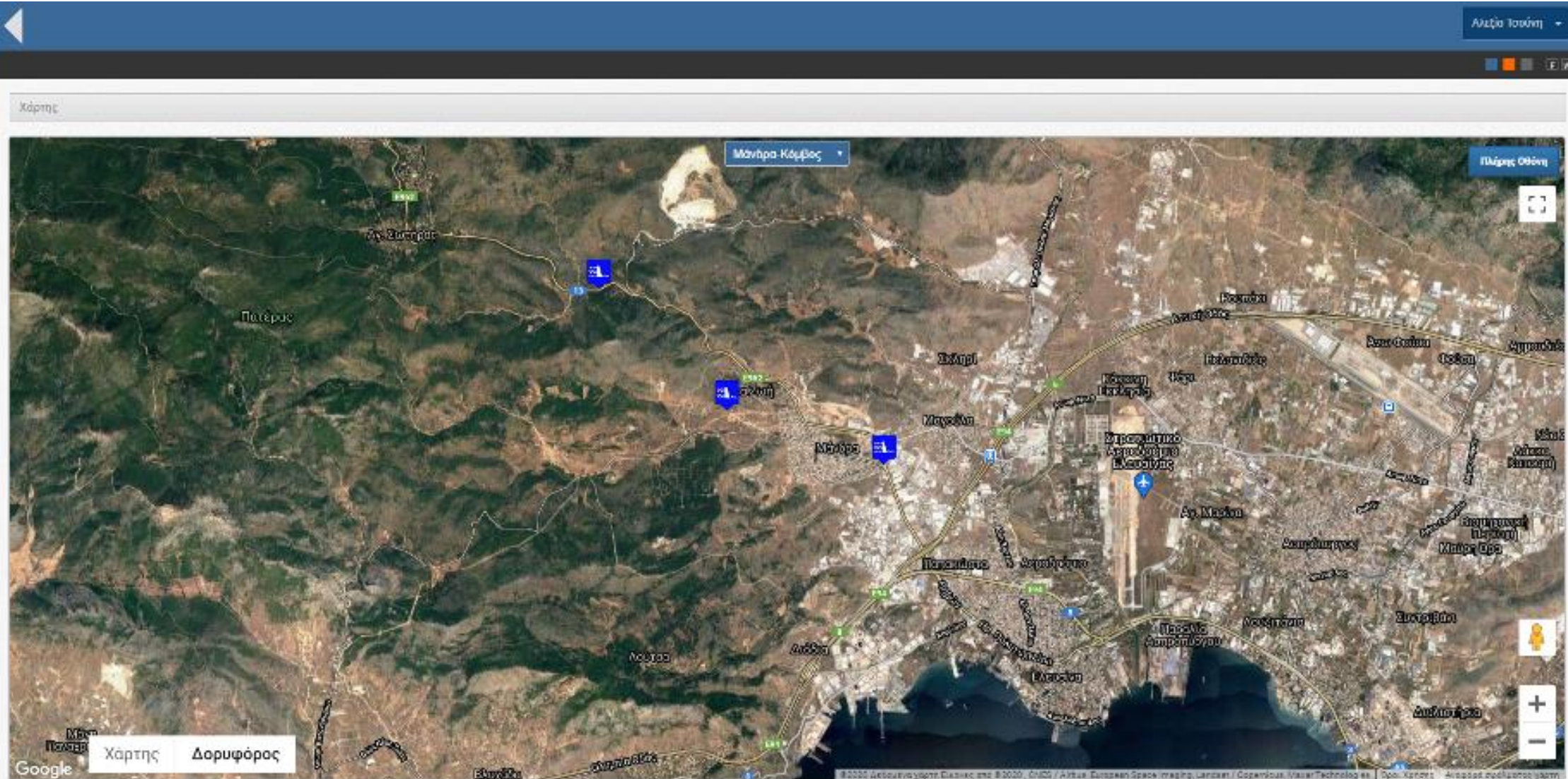
Σήμερα είναι: 1/03/20, 11:45

Αναζήτηση...

MENΟΥ

- Αρχική
- Δεδομένα
- Εξοπλισμός
- Αρχείο
- Χρήστες
- Ρυθμίσεις

Έργο: 01. 5/ 00 [Ανέχεται](#)





# Web platform of the 3 telemetric hydrometeorological stations

The screenshot displays the METEOVIEW2 web interface. On the left, there is a sidebar with a search bar, a menu, and a progress bar. The main area shows a satellite map of a coastal region with various labels in Greek. A yellow arrow points to a specific location on the map. An inset image on the right shows a telemetric station structure. The interface includes a top navigation bar with a back arrow and a language selector. The bottom of the map area shows Google Maps controls and a copyright notice.



# Web platform of the 3 telemetric hydrometeorological stations

**METEOVIEW<sub>2</sub>**

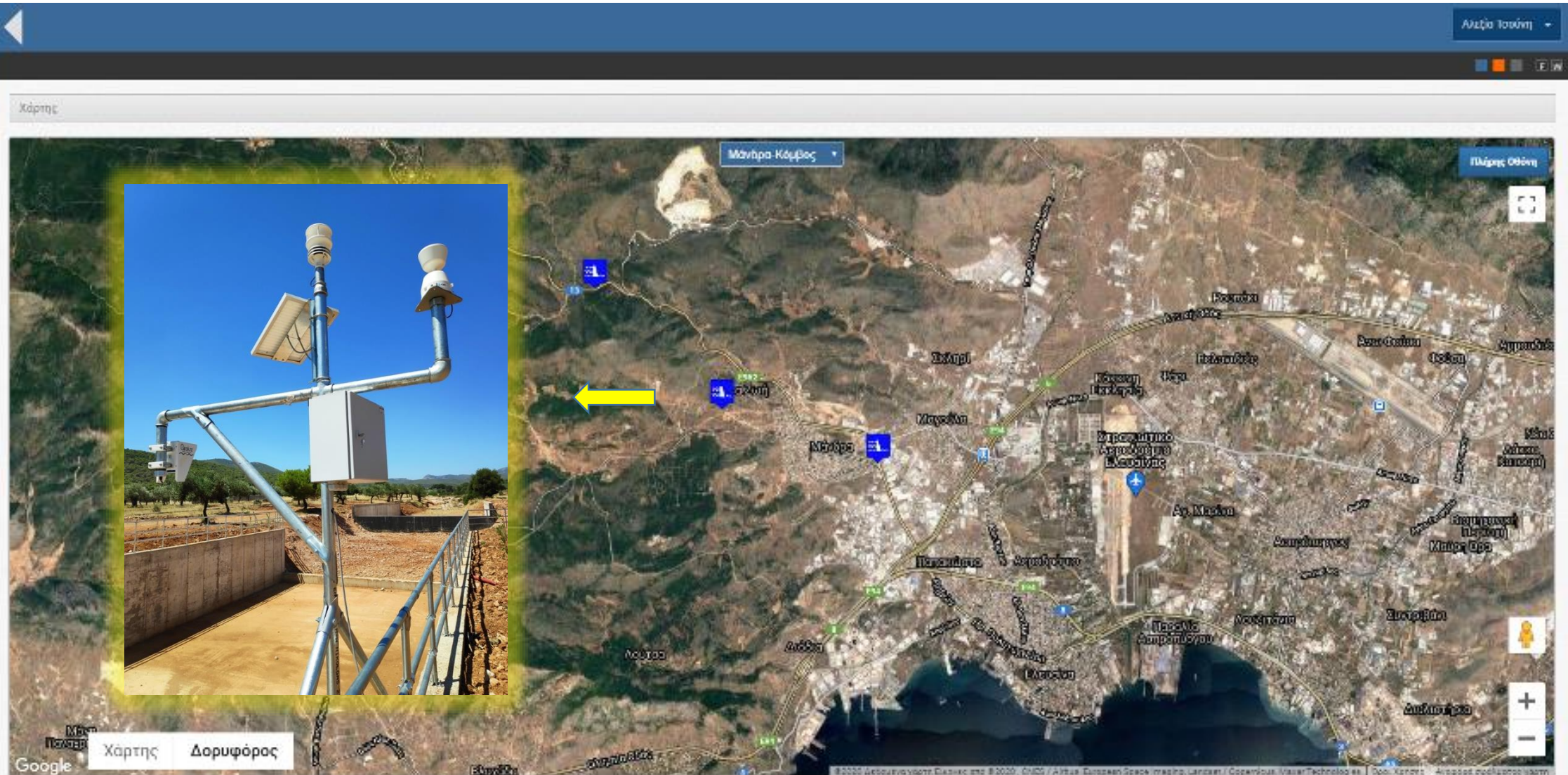
Σήμερα είναι: 1/03/2020, 11:48

Αναζήτηση...

MENΟΥ


- Αρχική
- Δεδομένα
- Εξοπλισμός
- Αρχείο
- Χρήστες
- Ρυθμίσεις

Έκδοση: 0.1.5 / 0.0





# Web platform of the 3 telemetric hydrometeorological stations



METEOVIEW

Σήμερα είναι: 1/03/20, 11:48


ΜΕΝΟΥ


- Αρχική
- Δεδομένα
- Εξοπλισμός
- Αρχείο
- Χρήστες
- Ρυθμίσεις


Έκδοση: 0.1.5 / 0.0

←
Αλλαγή Τύπου

Χάρτης









# Web platform of the 3 telemetric hydrometeorological stations



Today is: 11/05/20, 16:22

MAIN NAVIGATION

- Home
- Data
- Notifications
- Files
- Users
- Settings

Sign out in: 59:21 [Refresh](#)

Home / View Data

Ν Πέρρου

Άγιος Αθανάσιος

Μάνδρα-Εκτροπή

Μάνδρα-Κόμβος

Perfecture: ΑΤΤΙΚΗΣ  
City: Μάνδρα  
Territory: Μάνδρα  
Installation Time: 07/24/20

Live Photos

### SELECTION FILTERS FOR DATA VIEW

Date Interval: Choose Interval ▼

Date From\*:

Time from: 00:00

Date To\*:

Time to: 23:59

Sensors\*

average surface velocity	Water level	Discharge	Barometric Pressure
Air temp	Relative humidity	Ηλιακή ακτινοβολία	Wind direction
Wind speed	Rainfall	Battery supply	

☐ Single Y Axis

Compare to sensors of other stations:

Select one or more stations to compare

View per: Total Minutes Hour Day Week Month Year

Chart ▼

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



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The screenshot displays the FloodHUB Crowd Source Portal interface. The top navigation bar includes links for DASHBOARD, HOME, FLOODS, ABOUT, SETTINGS, LOGOUT, LOCK, and a language toggle set to EN. On the left, there are two main panels: 'Send Report' and 'Select Scenario'. The 'Send Report' panel contains buttons for GPS, Manual, Edit, Delete, Cancel, and Submit, along with a depth input field set to 0.6 and a table showing report details. The 'Select Scenario' panel includes parameters for Pnt, T, Dur, and CN, with a 'Display' button. The main area is a map showing a river network with flood simulation overlays in blue and orange. A yellow location pin is placed on the map. On the right side of the map, there are controls for Refresh, Locate, Zoom Self, and Zoom AOI.



# Integrated near-real-time flood monitoring system



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[WEB SERVICES](#)
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[INFRASTRUCTURE](#)
[NEWS / EVENTS](#)




Select Country:  Select Disaster Type:  [Reset Search Criteria](#)

**Outreach**  
 See our publications / presentations

**Training & Education**  
 Join our activities

[Statistics](#)
[WEB GIS PLATFORM COVID-19 - ΣΥΜΜΕΤΟΧΗ ΔΗΜΩΝ](#)



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



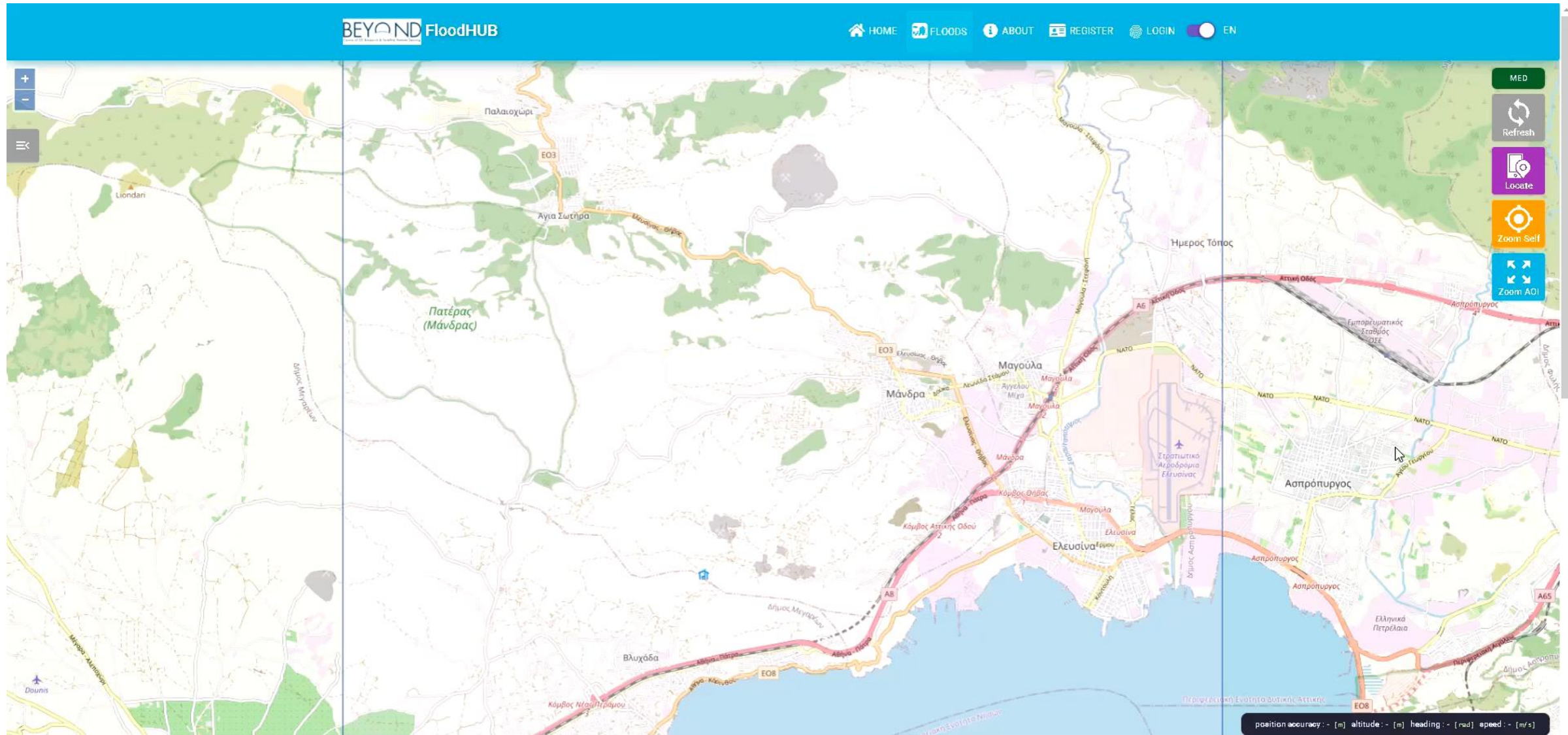


# Integrated near-real-time flood monitoring system



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FloodHUB

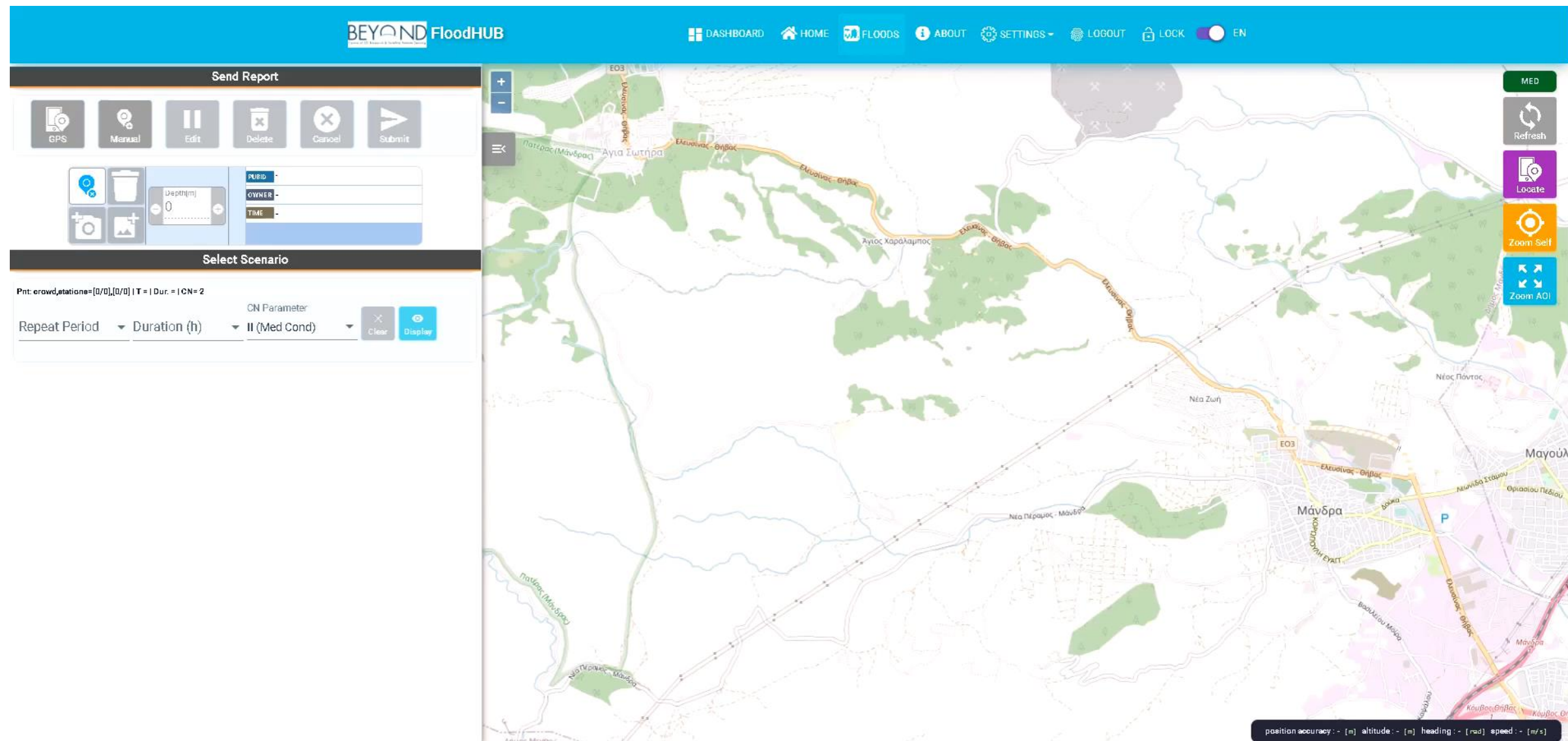




# Integrated near-real-time flood monitoring system

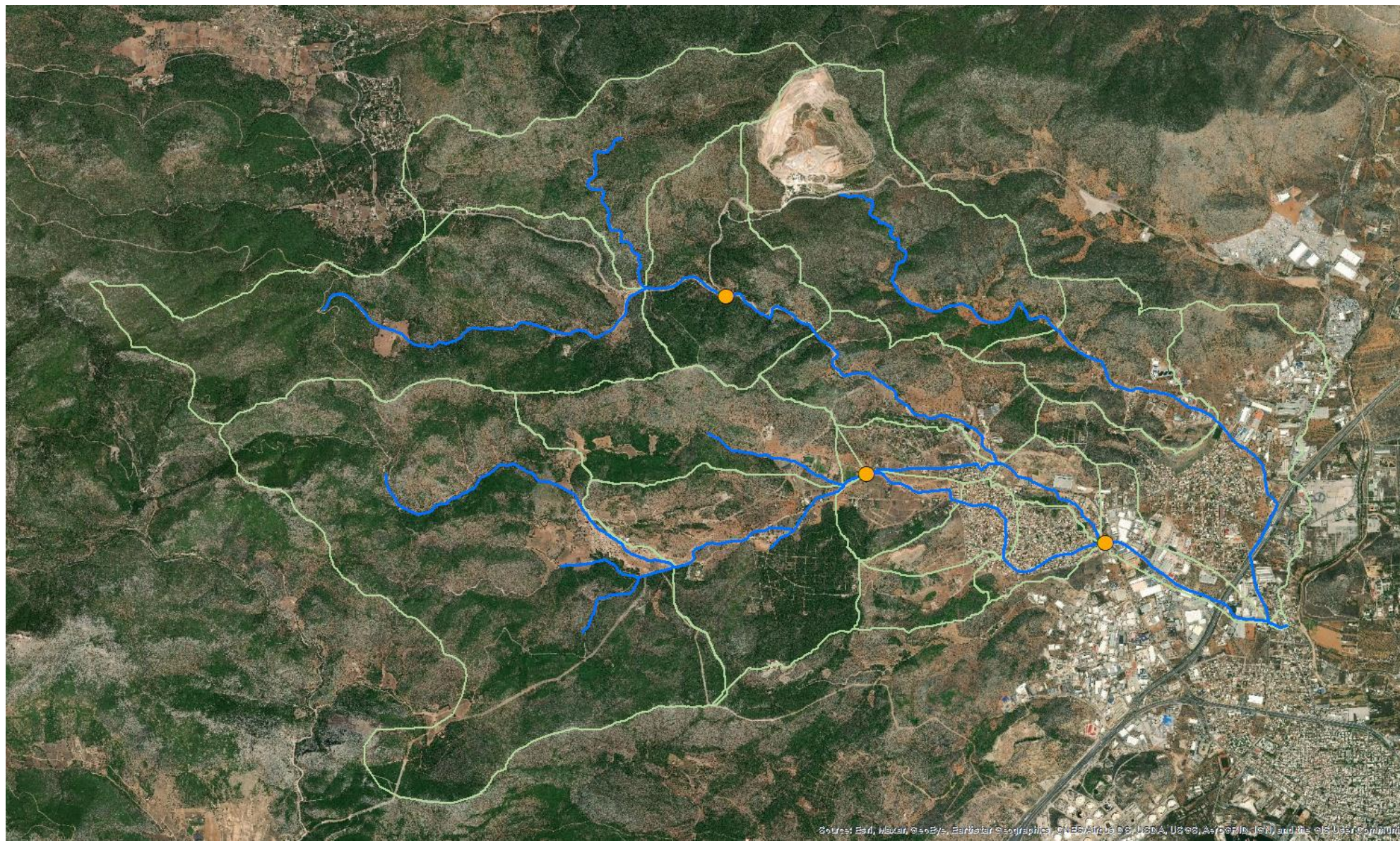


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# Hydrologic & hydraulic simulation



RIVER BASIN  
57 km<sup>2</sup>

SUBBASINS  
19

RAINFALL IDF CURVE  
Koutsoyiannis &  
Baloutsos, 2000

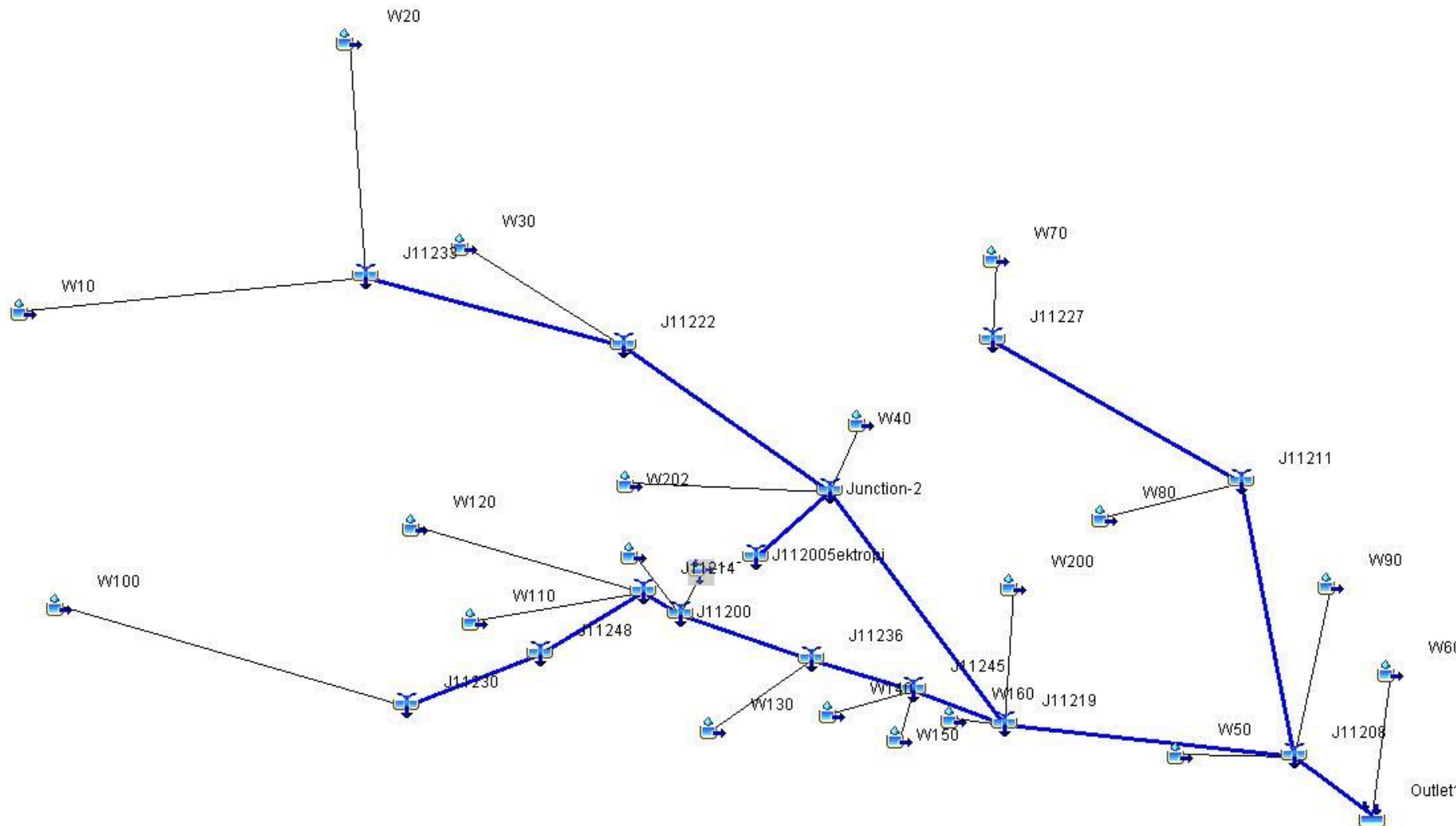
$$i(d,T) = 40.6 (T^{0.185} - 0.45) / (d + 0.189)^{0.796}$$

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)

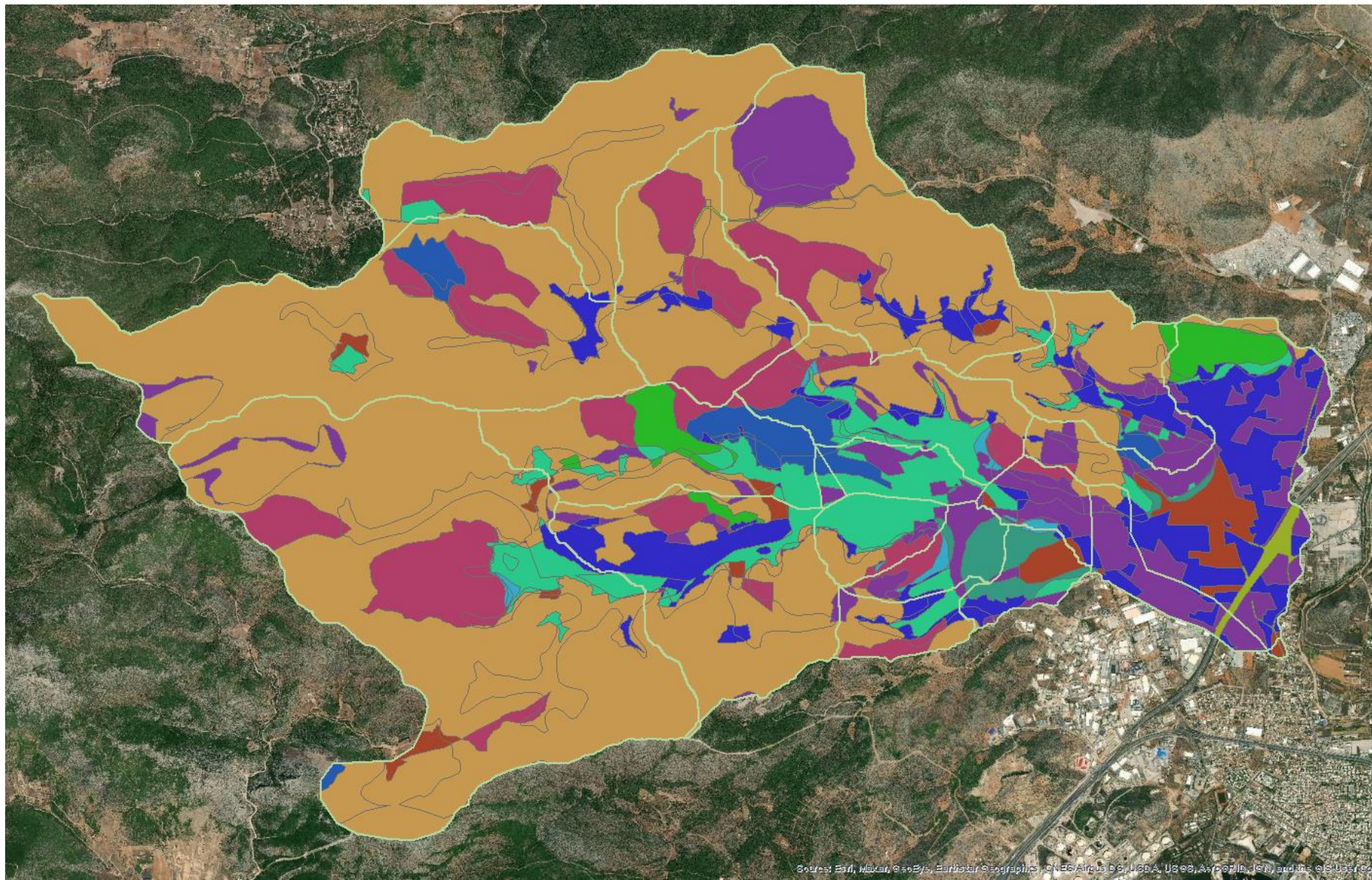
SCS-CN (Curve Number)  
method for extracting the  
excess from the gross rainfall,  
and the unit hydrograph, for  
propagating the surface  
runoff to the basin outlet

**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)

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

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

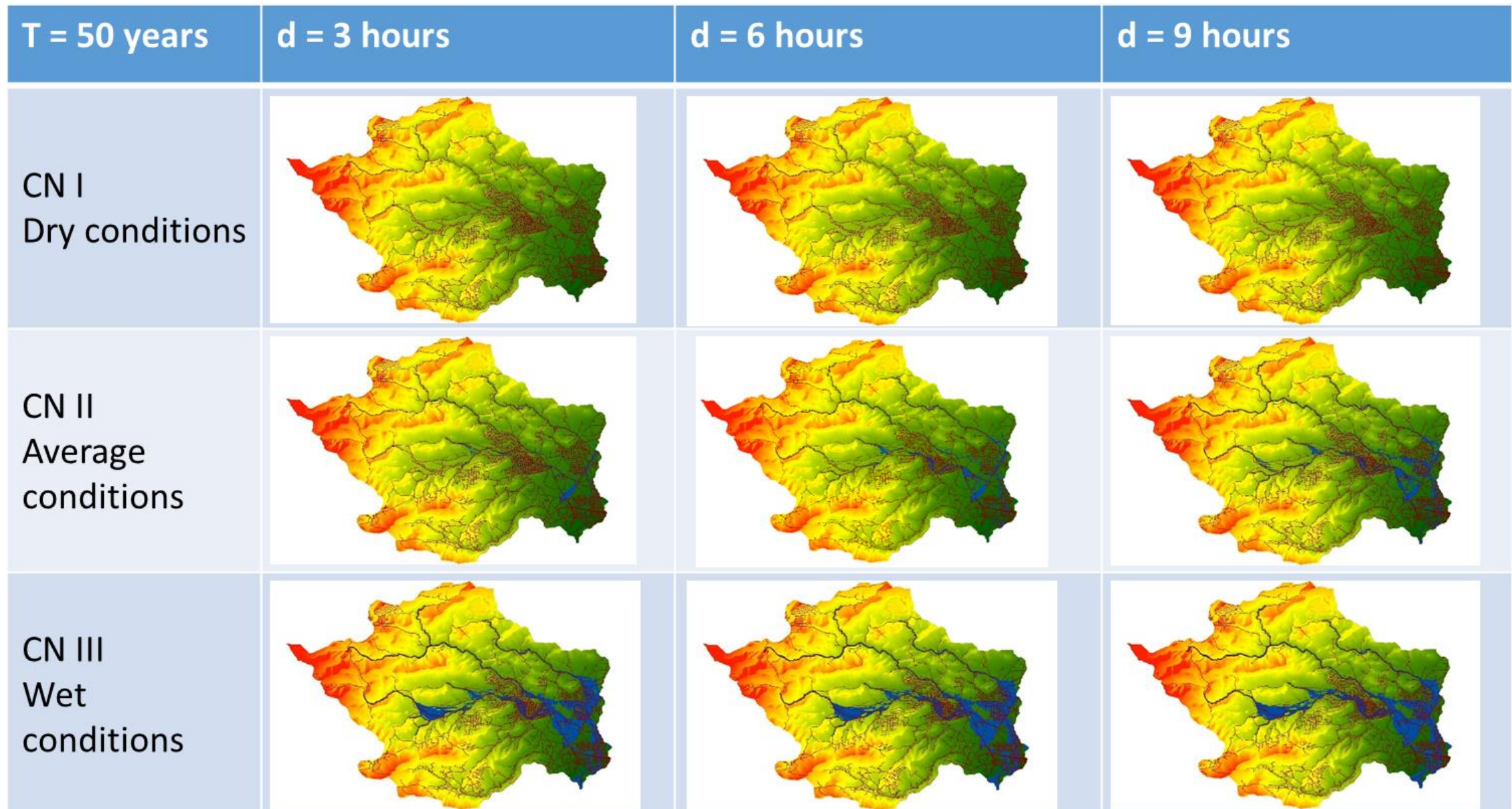
Run: All scenarios at 10m spatial resolution (2D mesh)

Output: flood extent



# Flood mapping results

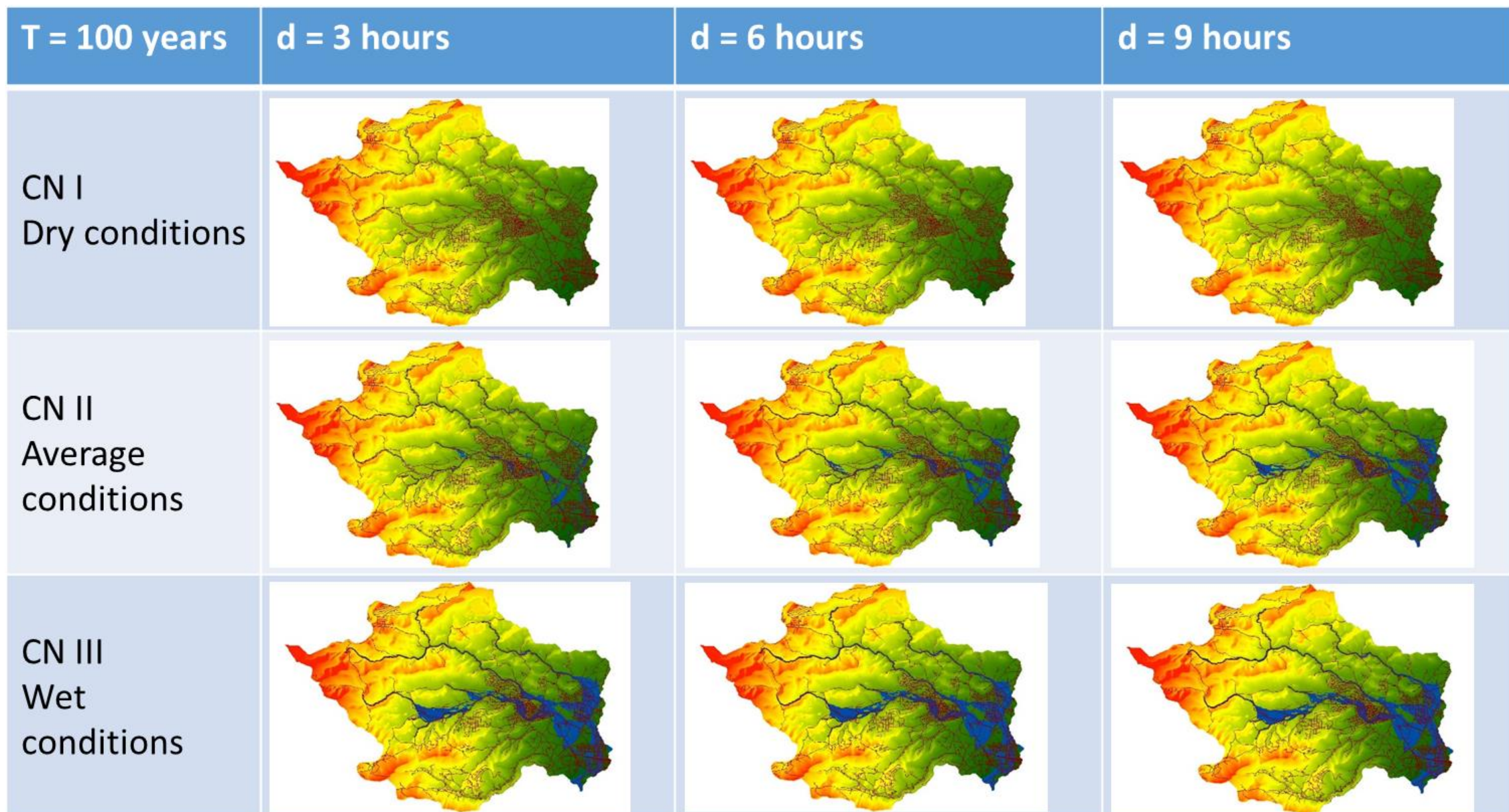
## T = 50 years





# Flood mapping results

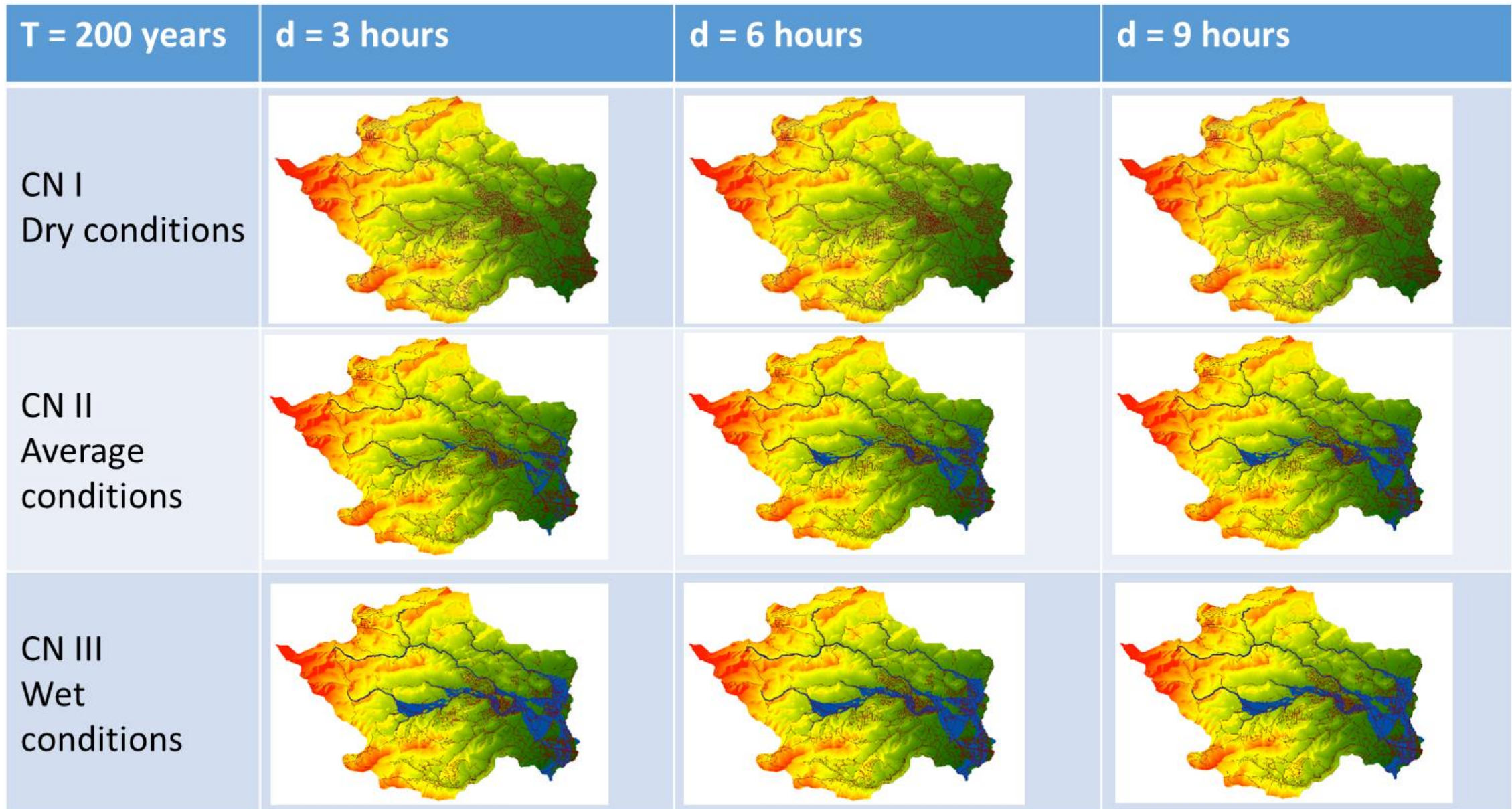
## T = 100 years





# Flood mapping results

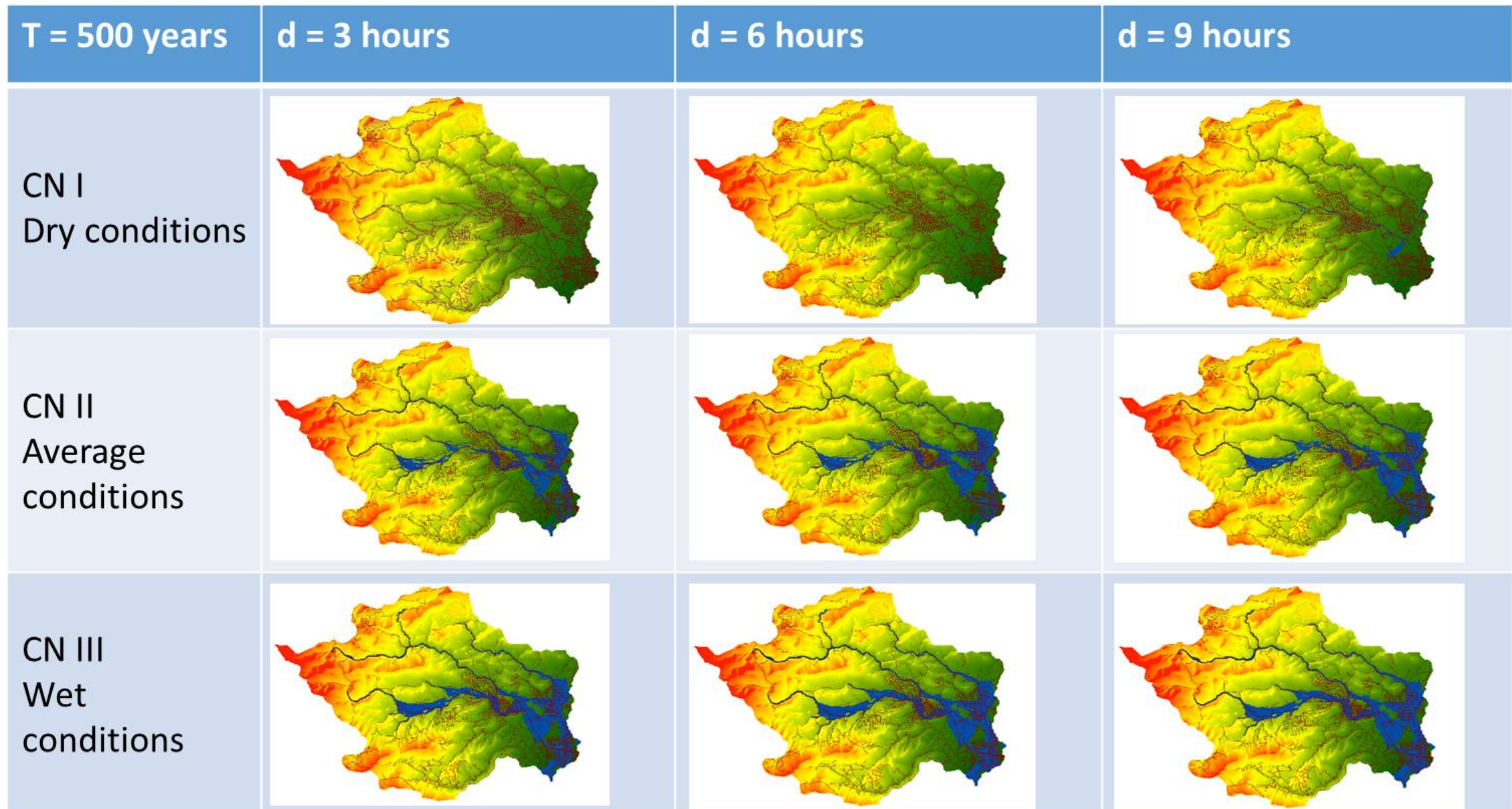
## T = 200 years





# Flood mapping results

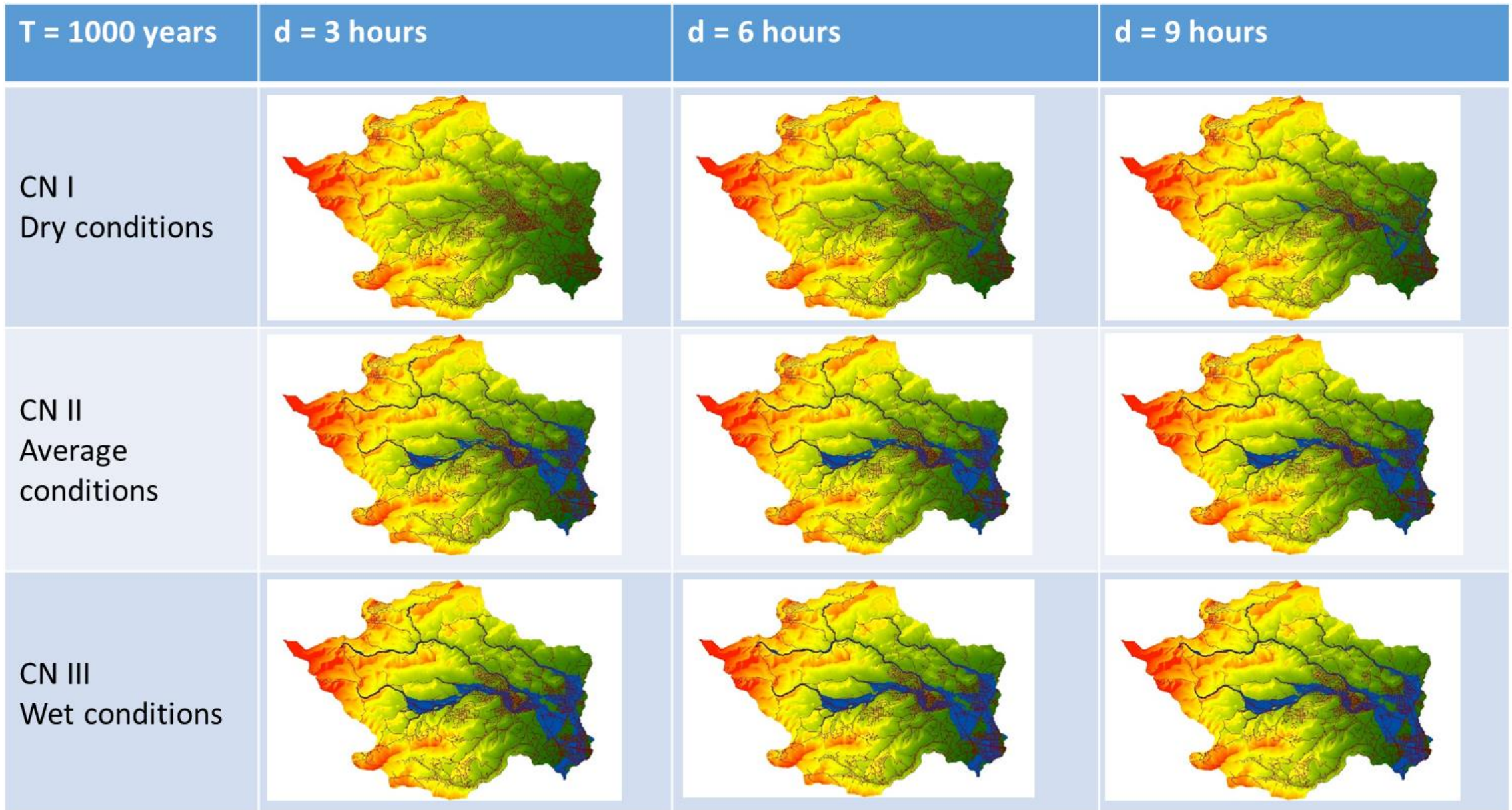
## T = 500 years





# Flood mapping results

## T = 1000 years

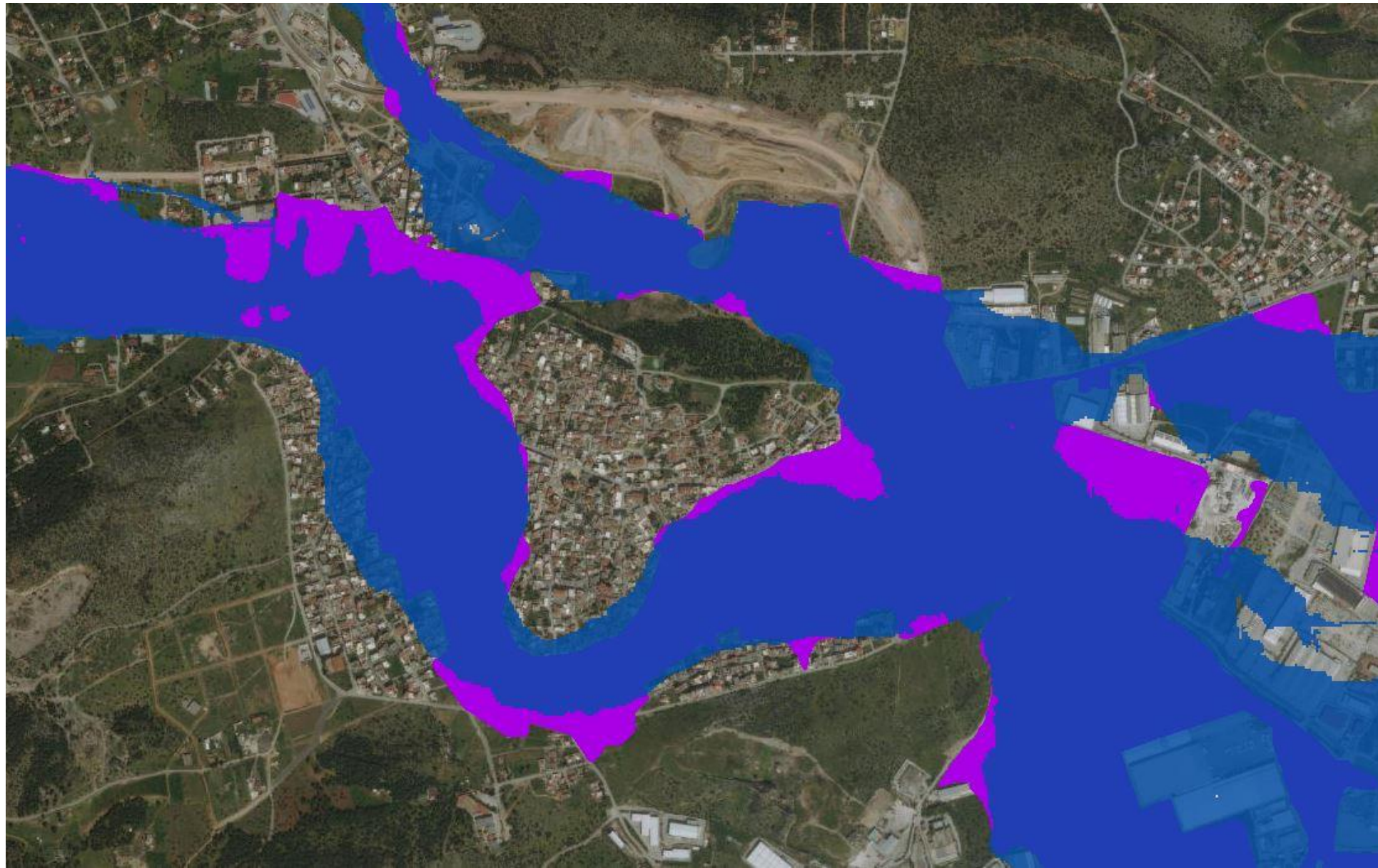




# Mandra flood 2017: modelling (blue) vs EO mapping (pink)

**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





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**Thank you for your attention!**

**Contact me: [alexiatsoni@noa.gr](mailto:alexiatsoni@noa.gr)**