



# FloodHub; An Integrated Near-Real-Time Flood Monitoring System in support of decision making



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BEYOND Center of Earth Observation Research & Satellite Remote Sensing

**Project:** SMURBS



*Annual Meeting:* 3-4 December 2020

# 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>)

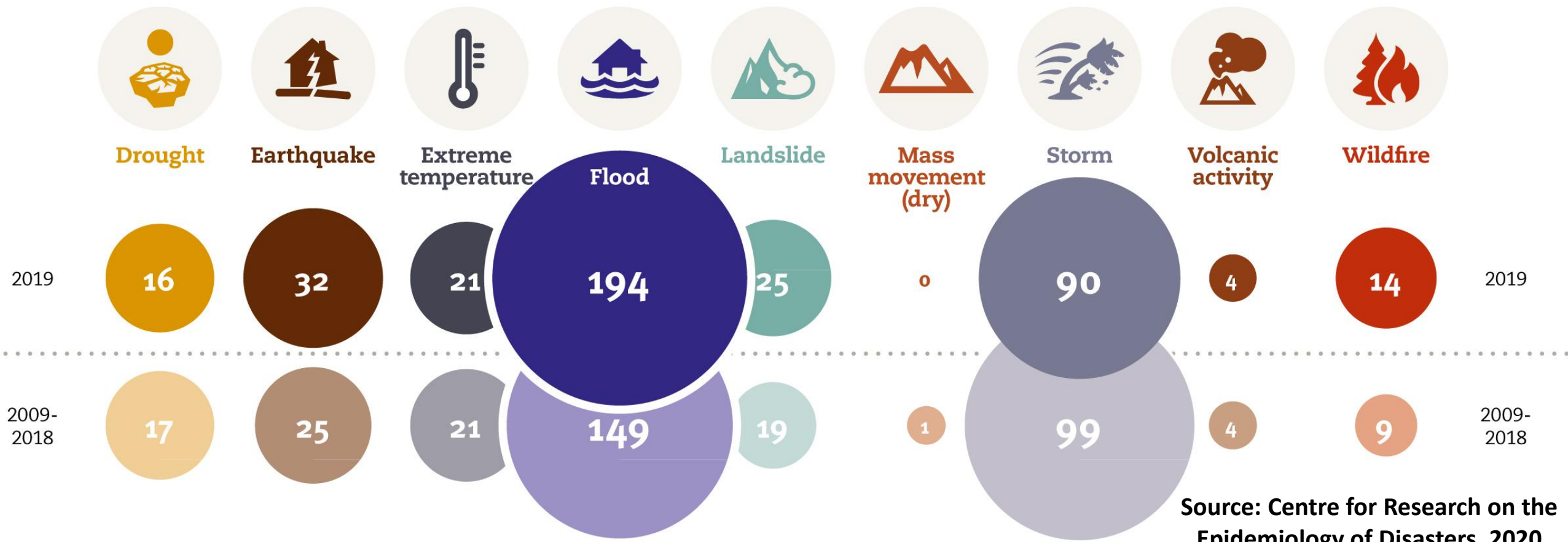


# Floods: the deadliest type of disaster, 43.5% of deaths in 2019 (CRED 2020)

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



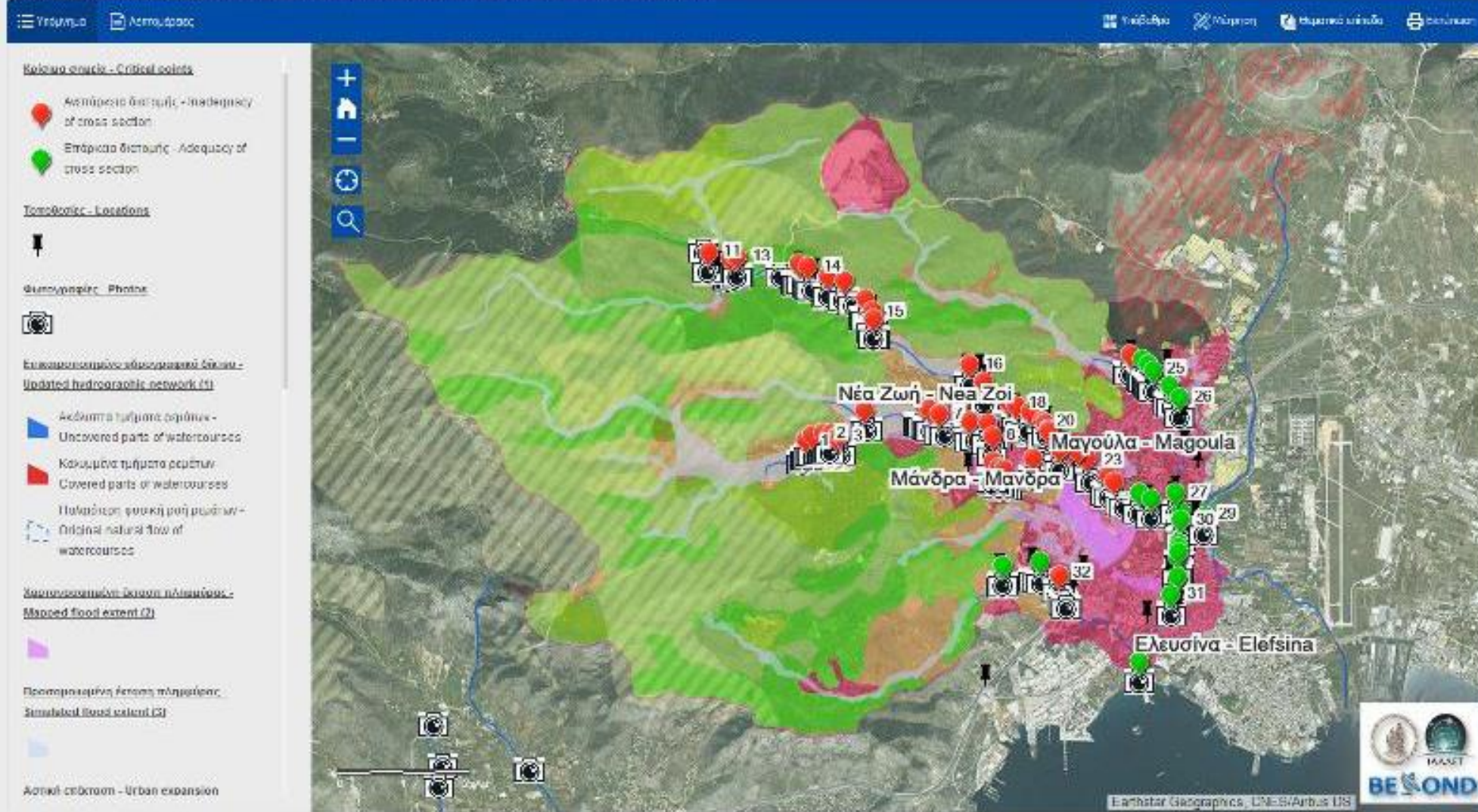


# Mandra flood 2017 (24 fatalities): Setup of an integrated web GIS platform



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

Ποιός Οδηγός και τις Παραπομπές 1,2,3,4 & 5 Δλ. Απομνημόνια: For the instructions and the References 1,2,3,4 & 5 see Details



Disaster Resilience  
Action Group



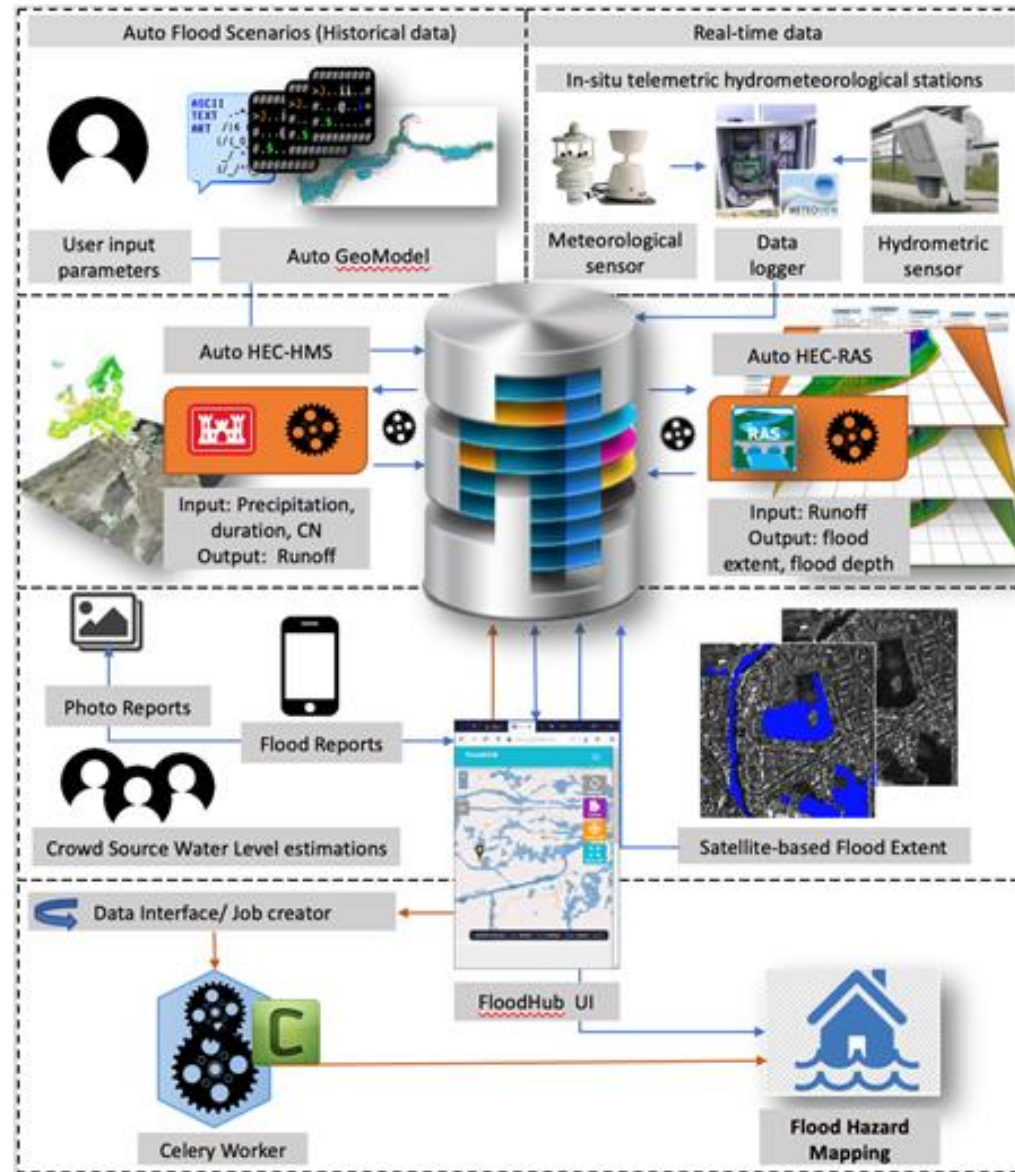
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# Mandra 2020: Architecture of the operational FloodHUB system

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).



The screenshot displays the METEVIEW2 web application. On the left, there is a sidebar with the METRICA logo and a menu. The main area shows a satellite map of Attica, Greece, with three yellow arrows pointing to the locations of the hydrometeorological stations. The stations are shown in three inset images: one on a road, one near a tunnel, and one in an urban area. The interface also includes a search bar, a menu, and a sidebar with the METRICA logo.

# FloodHub web platform of the 3 telemetric hydrometeorological stations

The screenshot shows the METEOVIEW2 web interface. On the left is a navigation sidebar with options like Home, Data, Notifications, Files, Users, and Settings. The main content area displays the station name 'Άγιος Αθανάσιος' and a 'SELECTION FILTERS FOR DATA VIEW' section. This section includes fields for 'Date Interval', 'Date From', 'Time from', 'Date To', and 'Time to'. Below these are buttons for various sensors: 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. At the bottom of the filters, there are 'View per:' buttons for Total, Minutes, Hour, Day, Week, Month, and Year, along with a 'Chart' button. A blue banner at the bottom of the screenshot contains text about the BEYOND Center of Excellence providing measurements for 10 parameters.

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

Search here...

MAIN NAVIGATION

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

Sign out in: 59:21 Refresh

METRICA Ltd.  
When it's a matter of trust.

Άγιος Αθανάσιος

Μάνδρα-Εκτροπή

Μάνδρα-Κόμβος

ΆΓΙΟΣ ΑΘΑΝΑΣΙΟΣ

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

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

Live Photos

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.



# FloodHub real-time crowdsourcing platform for staff and volunteers

The screenshot displays the FloodHub web application interface. At the top, there is a navigation bar with the 'BEYOND FloodHUB' logo and menu items: DASHBOARD, HOME, FLOODS, ABOUT, SETTINGS, LOGOUT, LOCK, and EN. Below the navigation bar, the interface is divided into several sections:

- Send Report:** A panel with buttons for GPS, Manual, Edit, Delete, Cancel, and Submit. Below these buttons are input fields for Depth (m) set to 0.6, and a table with fields for PUBID, OWNER (PORTALADMIN), and TIME (2020-10-05T12:25:30.292582).
- Select Scenario:** A panel with a summary 'Pnt: 5/5 | T = 100 | Dur. = 540 | CN = 2'. It includes dropdown menus for Repeat Period (100), Duration (h) (9), and CN Parameter (II (Med Cond)). There are 'Clear' and 'Display' buttons.
- Map:** A large map showing a flooded area with blue water. The map includes a yellow location pin, a zoom control panel (Refresh, Locate, Zoom Self, Zoom ADI), and various map navigation icons.



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# FloodHub integrated near-real-time flood monitoring system

The screenshot displays the FloodHub web application interface. At the top, a blue navigation bar contains the 'BEYOND FloodHUB' logo and menu items: DASHBOARD, HOME, FLOODS, ABOUT, SETTINGS, LOGOUT, LOCK, and EN. The main interface is divided into several sections:

- Send Report Panel:** Located on the left, it includes buttons for GPS, Manual, Edit, Delete, Cancel, and Submit. Below these are input fields for PUBID, OWNER, and TIME, and a Depth(m) input set to 0.
- Select Scenario Panel:** Below the report panel, it shows a 'Repeat Period' dropdown, a 'Duration (h)' dropdown, and a 'CN Parameter' dropdown set to 'II (Med Cond)'. There are 'Clear' and 'Display' buttons.
- Map:** The central part of the interface is a map showing a flood scenario in the Mandra region of Greece. A red line indicates the flood path through the area, with labels for 'Ελευσίνας - Θήβας' and 'Μάνδρα'. The map includes various geographical features like roads, rivers, and green spaces.
- Map Controls:** On the right side of the map, there are several control buttons: MED, Refresh, Locate, Zoom Self, and Zoom AOI.
- Footer:** At the bottom of the map area, there is a status bar with the text: 'position accuracy: - [m] altitude: - [m] heading: - [rad] speed: - [m/s]'.

POWERED BY BEYOND/NOA ABOUT US CONTACT

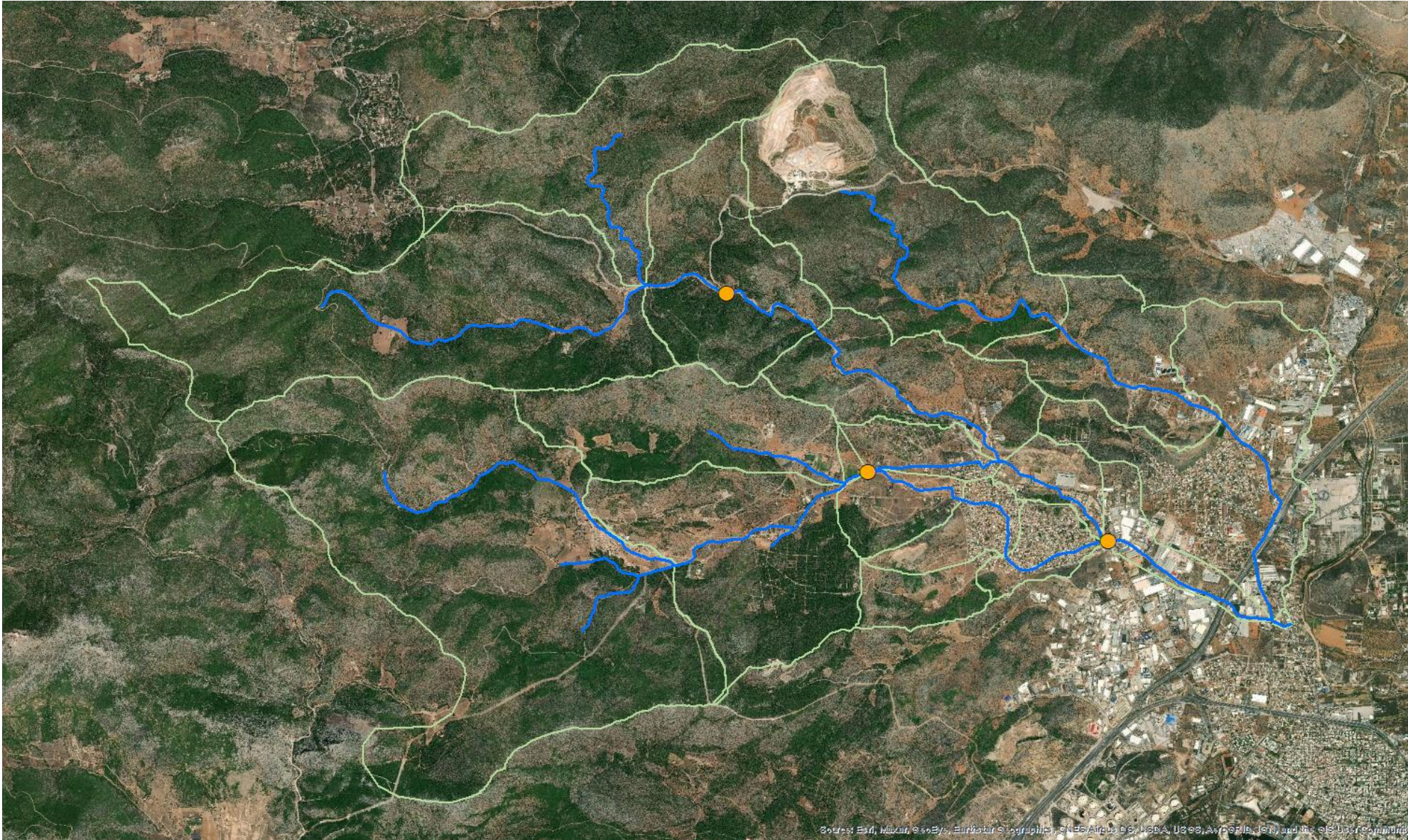
© 2020, FloodHUB - Crowd Source Platform developed by BEYOND Centre | NOA



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# FloodHub 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

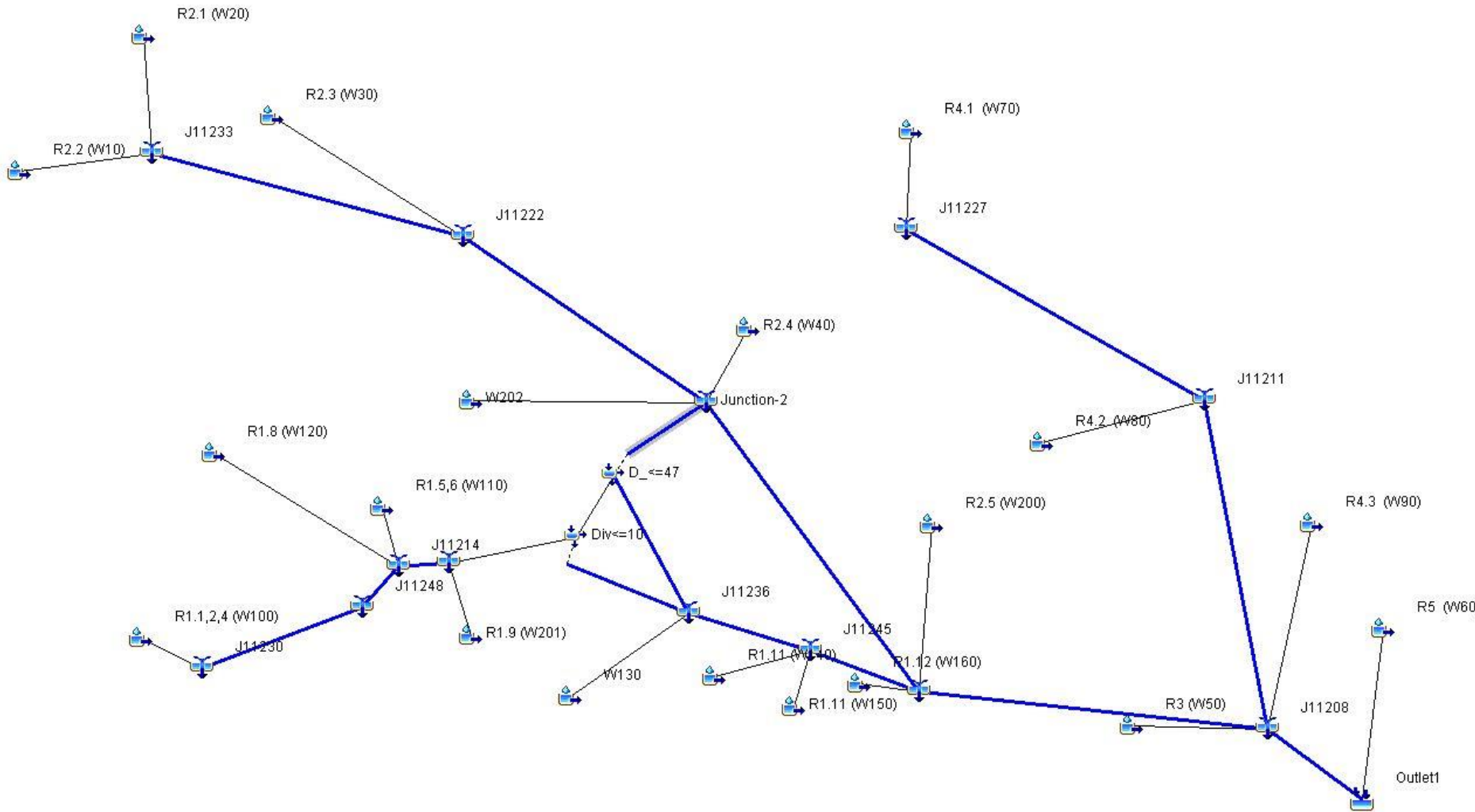
TIME OF  
CONCENTRATION  
Kirpich (SCS) method

Sources: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





# FloodHub 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

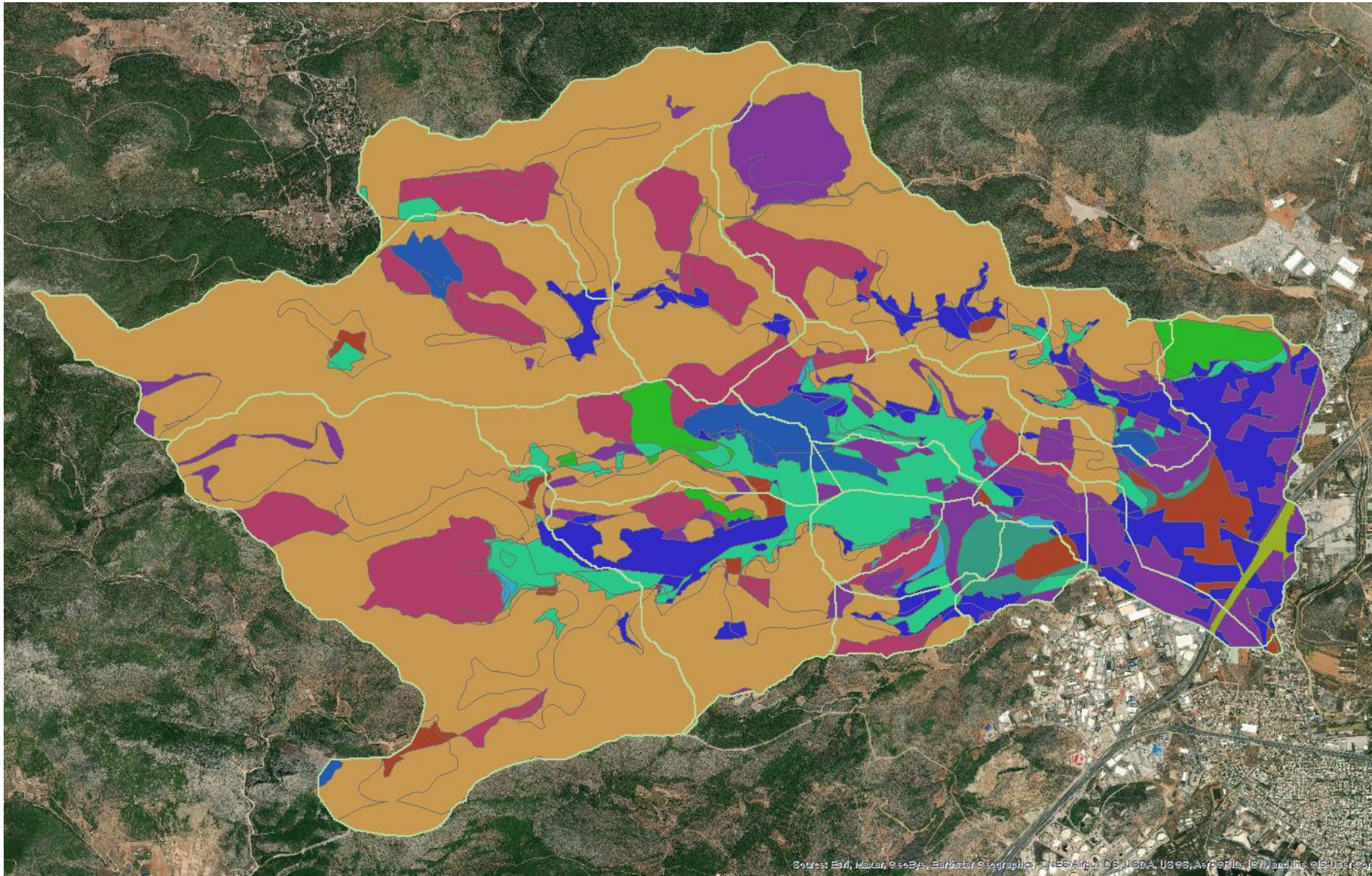
**Run:** all scenarios

**Output:** flow hydrographs





# FloodHub 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





# FloodHub hydrologic & hydraulic simulation

Antecedent Soil Moisture Conditions	T = 50 years	T = 100 years	T = 200 years	T = 500 years	T = 1000 years
<b>CN I Dry conditions</b>	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
<b>CN II Average conditions</b>	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
<b>CN III Wet conditions</b>	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 5m spatial resolution provided by the National Cadastre and Mapping Agency SA of Greece

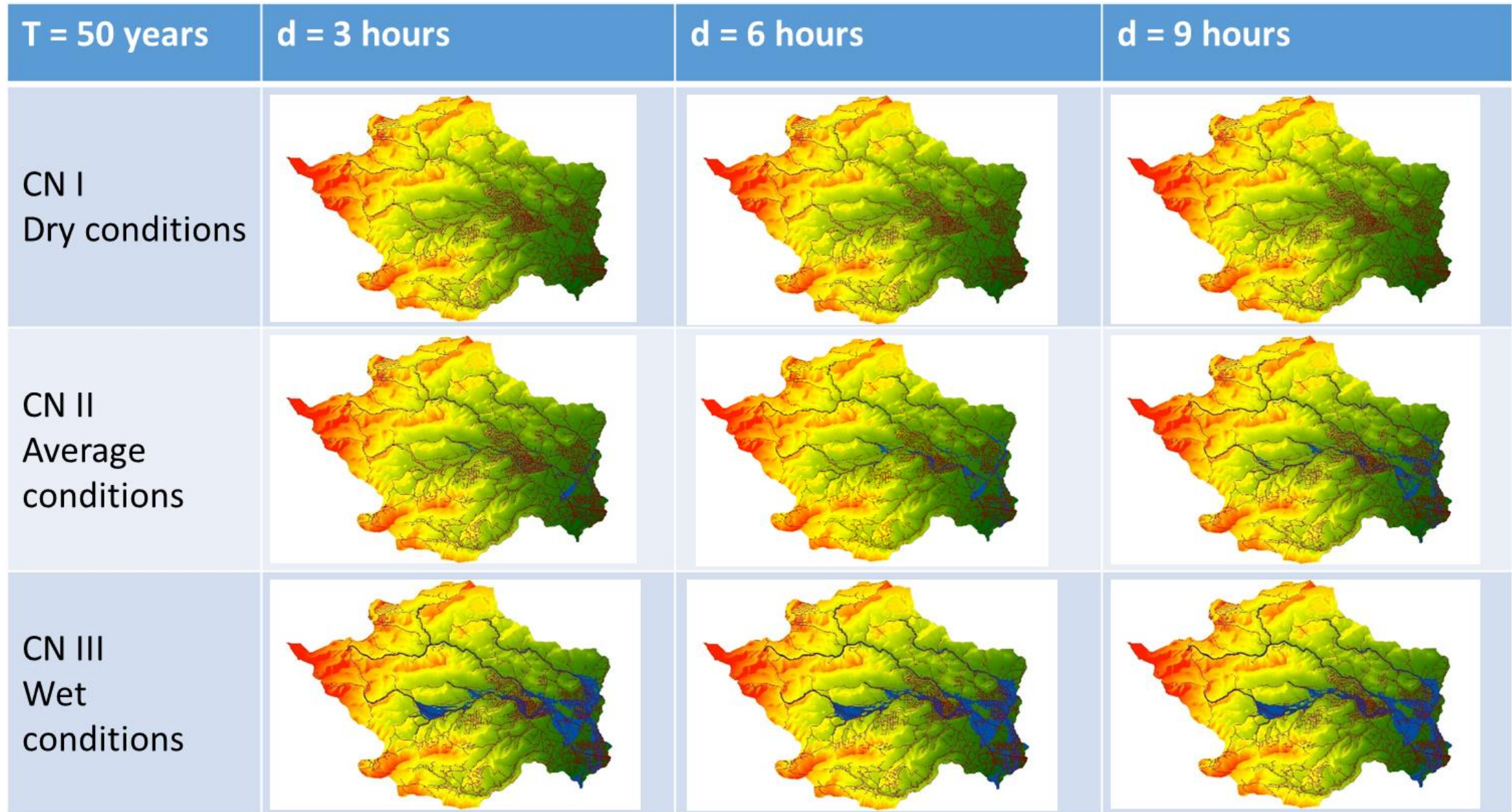
**Run:** All scenarios at 10m spatial resolution (2D mesh)

**Output:** flood extent



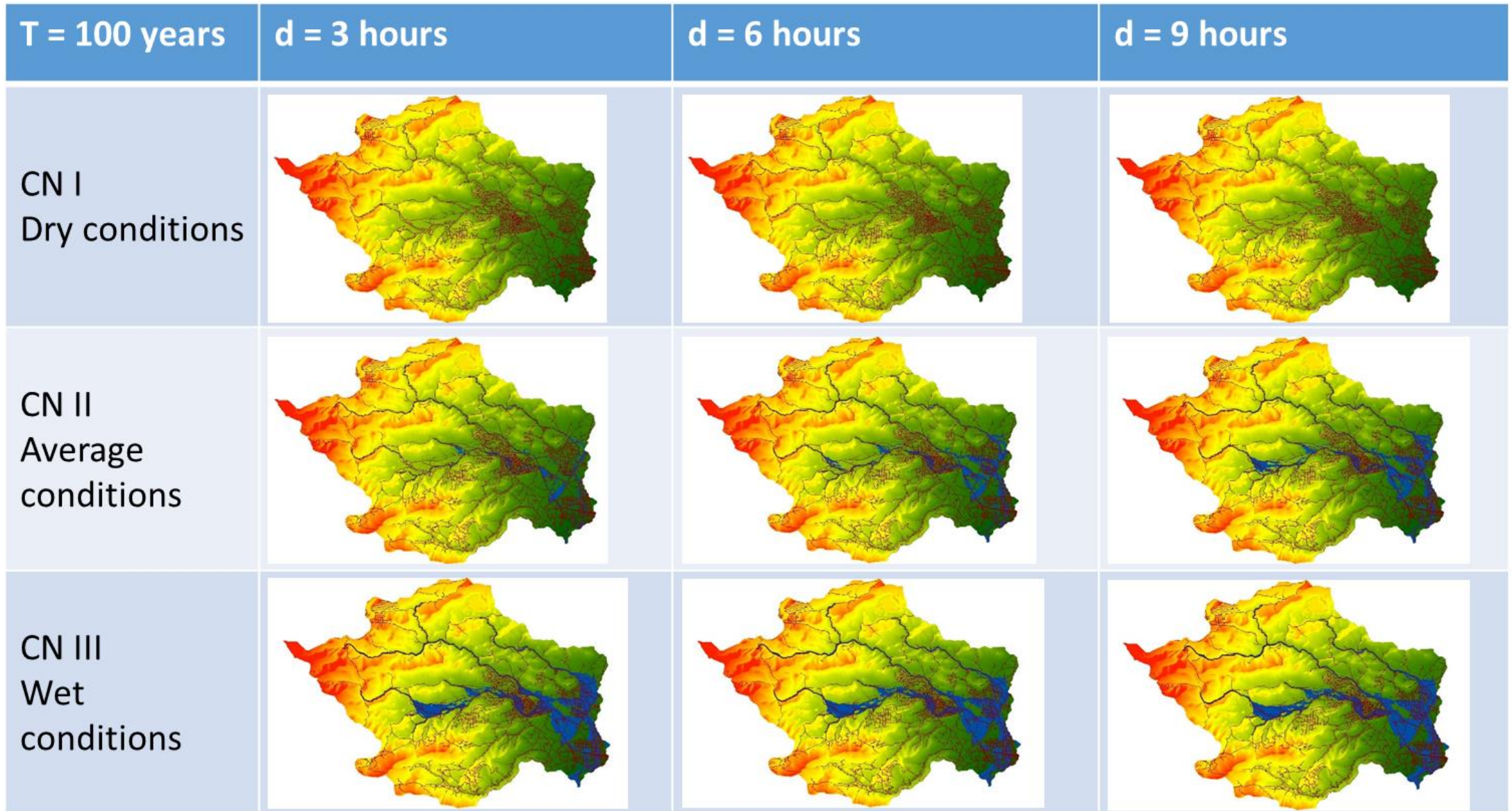
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# Flood mapping results for T = 50 years

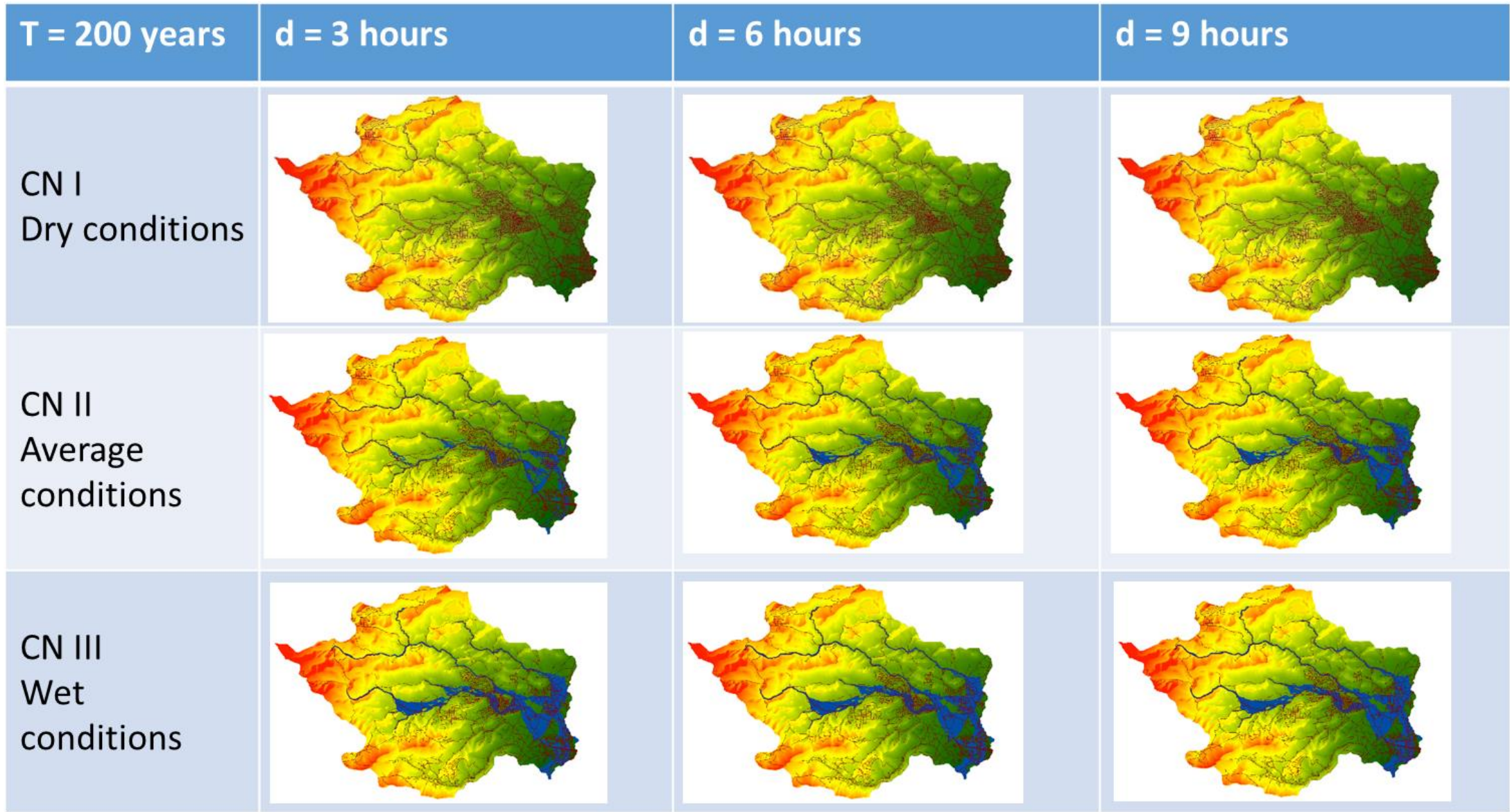




# Flood mapping results for T = 100 years

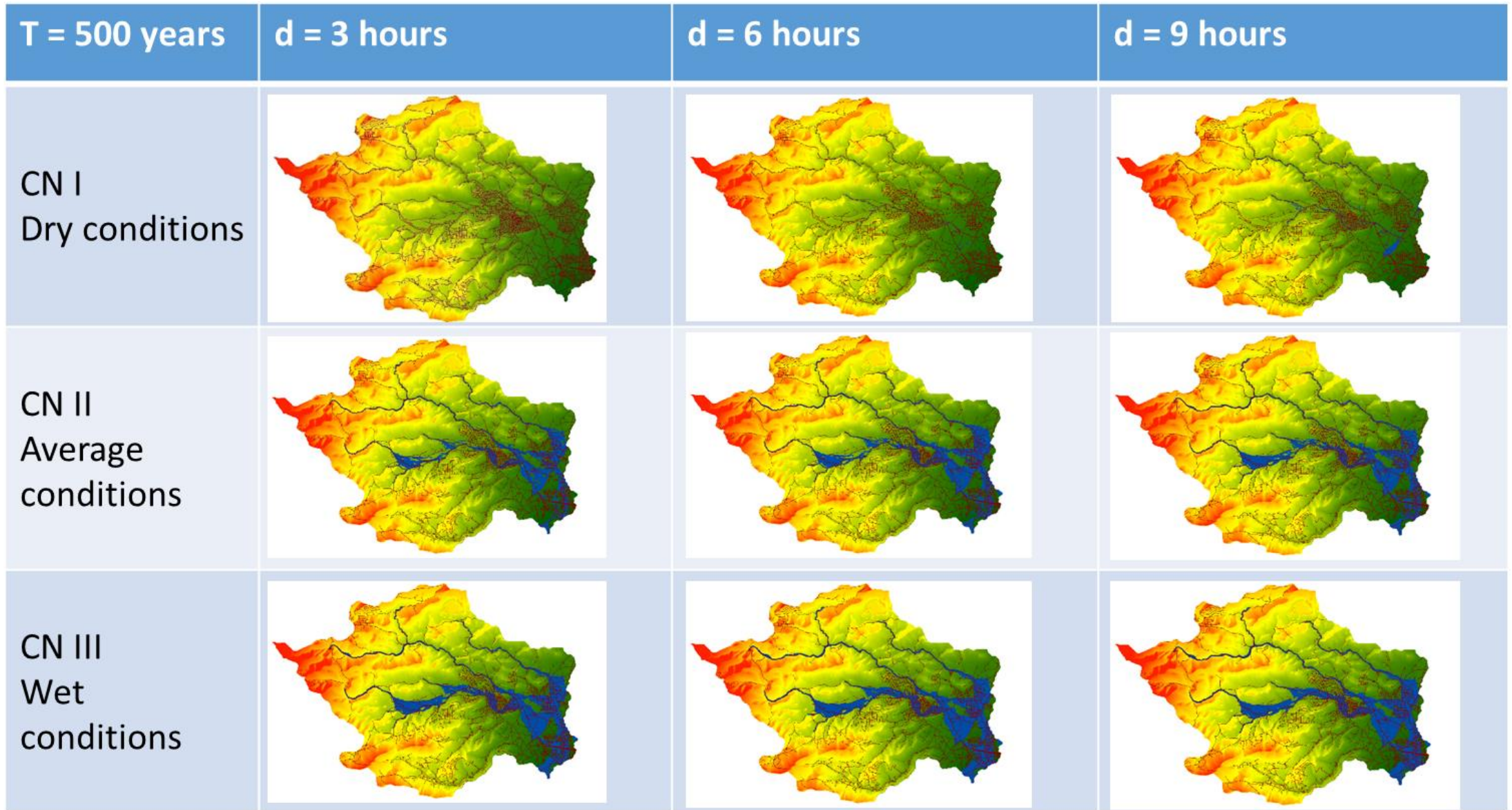


# Flood mapping results for T = 200 years

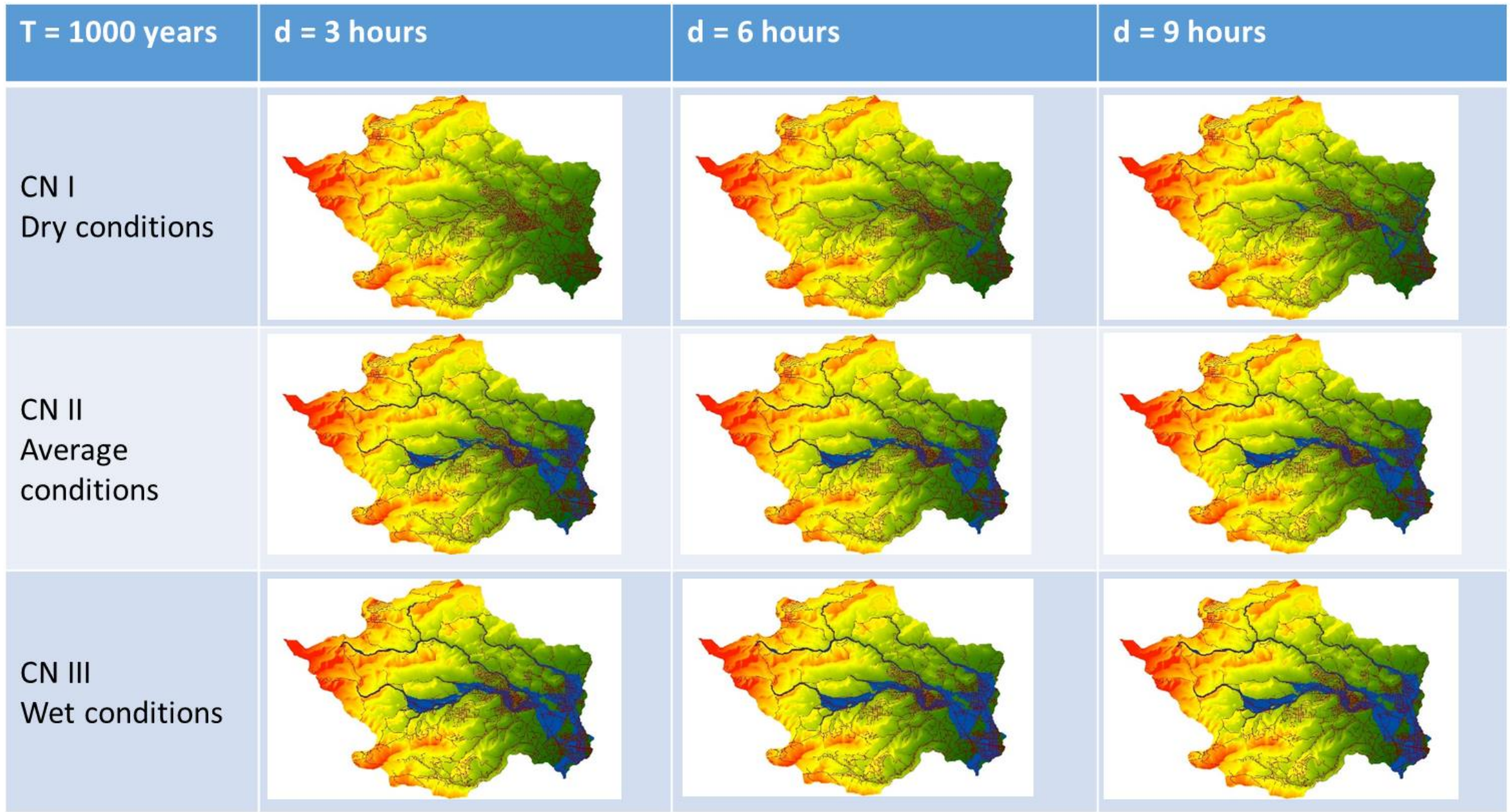




# Flood mapping results for T = 500 years



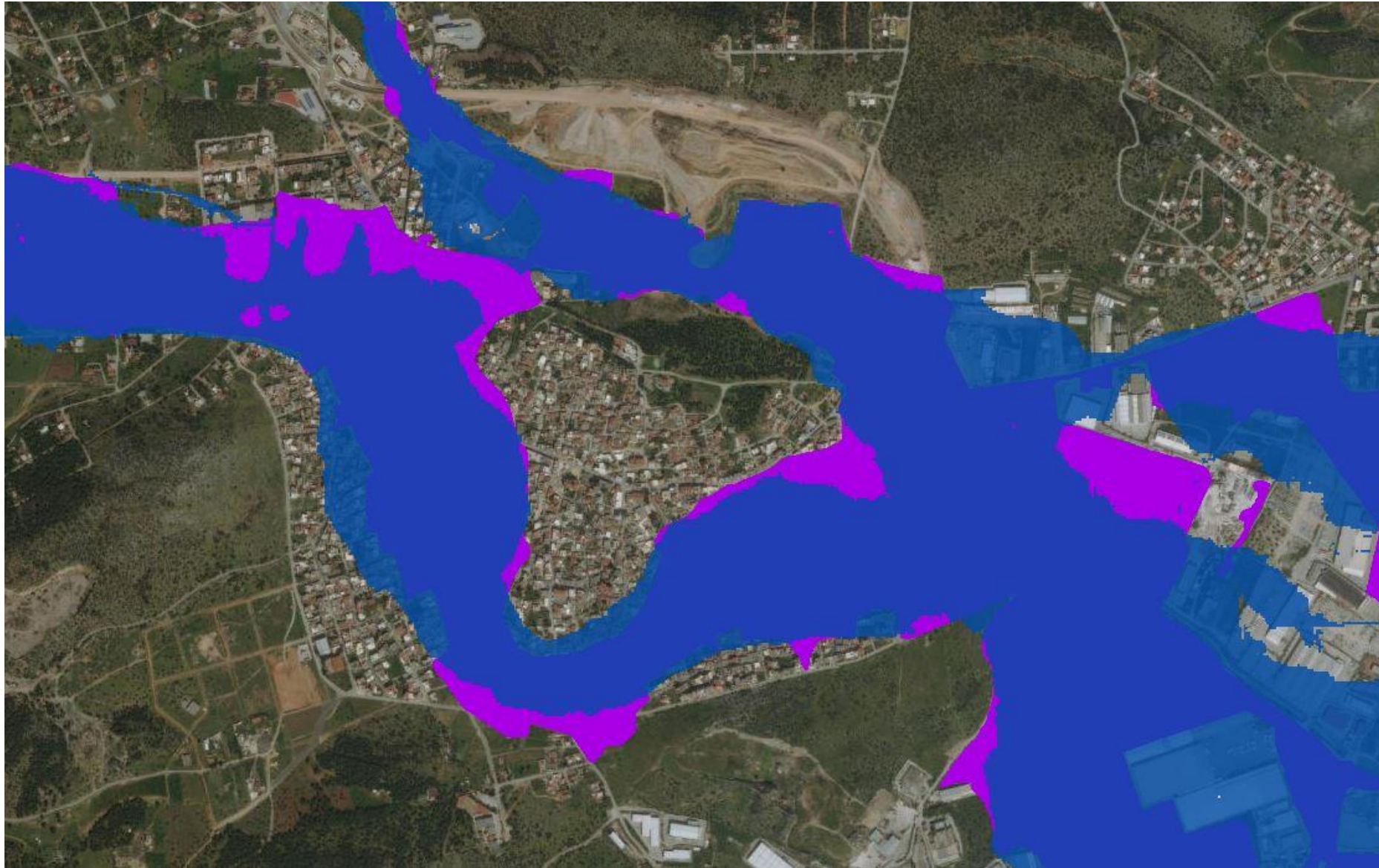
# Flood mapping results for T = 1000 years





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

**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

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' engagement in the operational FloodHUB system



Our platform processes the in-situ measurements and the information provided by trained pioneers and volunteers.



Lefteris Kosmopoulos  
Deputy Regional Governor of West Attica



Indeed, you do have an excellent scientific team, with dedication and expertise, which contributes to our safety.



Christos E. Stathis  
Mayor of Mandra - I·dyllia - Erithres - Oinoi



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# Media interest in the operational FloodHUB system



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# The BEYOND Center of EO Research & Satellite Remote Sensing



Thank you for your attention!

<http://beyond-eocenter.eu>

[alexitsouni@noa.gr](mailto:alexitsouni@noa.gr)



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