

# AGU FALL MEETING

Online Everywhere | 1-17 December 2020

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

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National Observatory of Athens - BEYOND Center - FloodHUB

**EuroGEO**  
Disaster Resilience  
Action Group



**BEYOND**  
Centre of EO Research & Satellite Remote Sensing

<http://beyond-eocenter.eu>

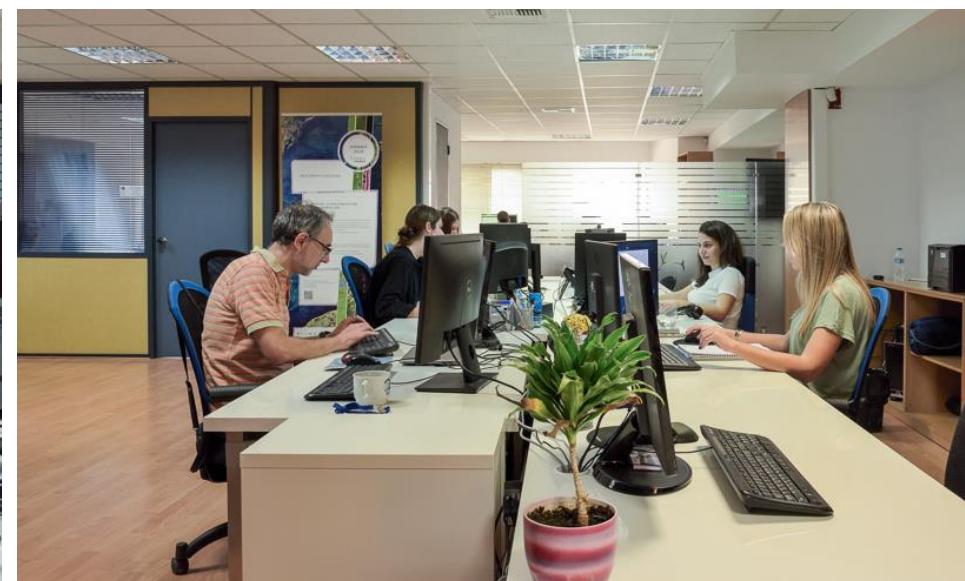


**SMURBS**  
ERA-PLANET

# 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>)

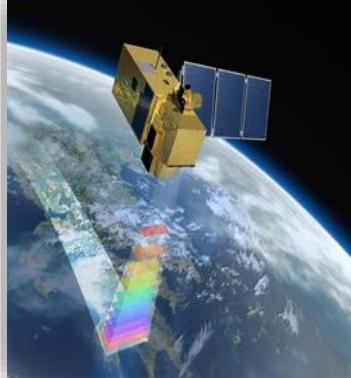
SolarHUB

**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



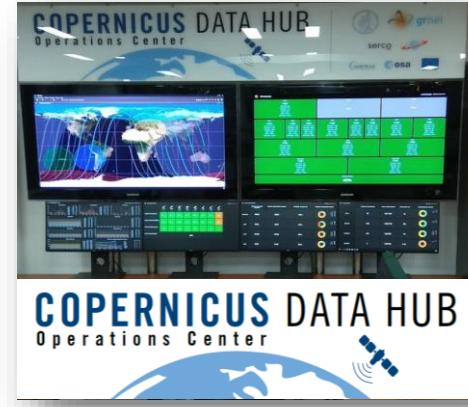
Satellites Polar Orbit  
X-/L-band Station  
Sentinel Mirror Site



Manned &  
Unmanned  
Aerial  
Vehicles



In-situ networks and  
crowdsourcing



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>



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

# Floods: the deadliest type of disaster

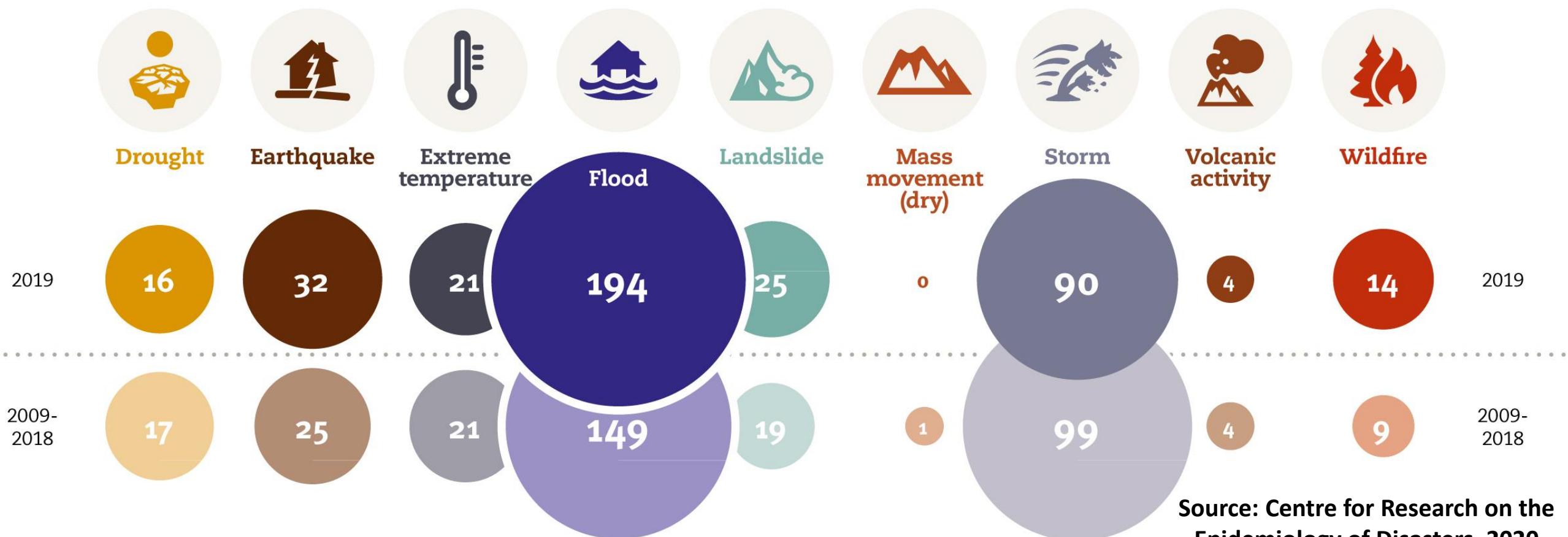
## 43.5% of deaths in 2019 (CRED 2020)



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

**343**  
2009 to 2018

**396**  
in 2019

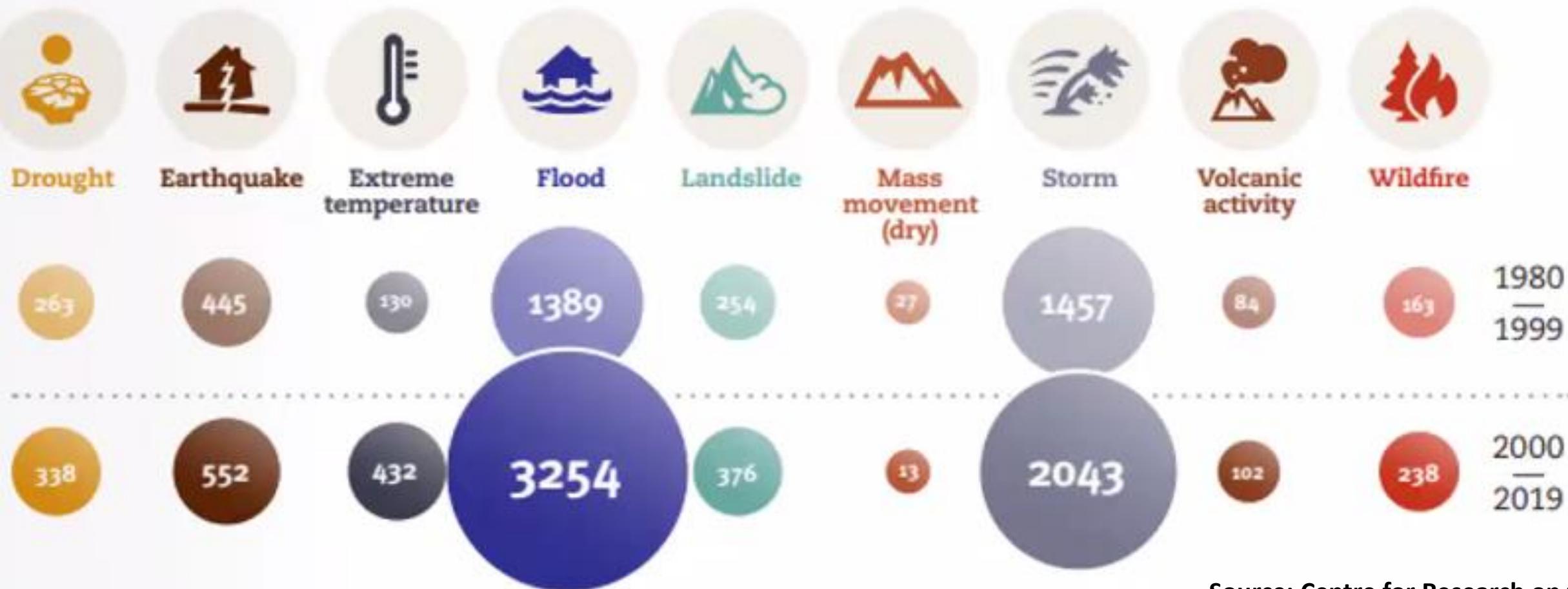


# Floods: the deadliest type of disaster

## 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

Πατησί Οδηγός και της Παραπομπής 1,2,3,4 & 5 στην Αστροφύση - Φορτίο Instructions and the References 1,2,3,4 & 5 see Details

Υπόθεση | Αντικαθίστανται

Kritikoi enitiki - Critical points

- Αναπόρειο διατάξις - inadequacy of cross section
- Επαρκεία διατάξις - Adequacy of cross section

Tomofóniko - Locations

Φωτογραφίες - Photos

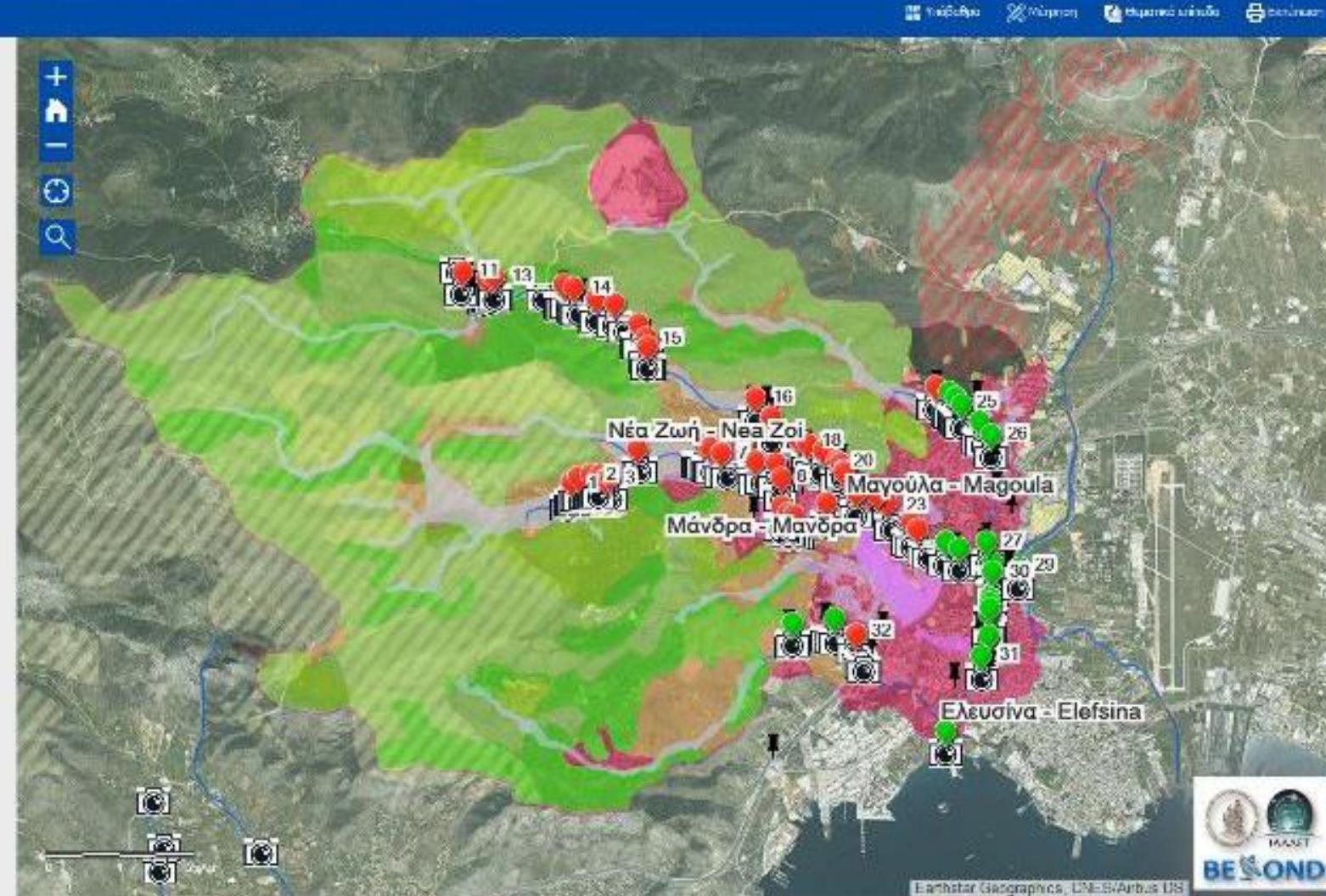
Επαναπανεμένο αλυδονοματικό δίκτυο - Updated hydrographic network (H)

- Ακαύματα τημένο ποτάμια - Uncovered parts of watercourses
- Κάλυψη τημένο ποτάμια - Covered parts of watercourses
- Ηλεκτρικό φυσική ροή ποταμών - Original natural flow of watercourses

Χρησιμοποιημένη έκταση πλημμύρας - Flooded area extent (F)

Προσπορειακή έκταση πλημμύρας - Simulated flood extent (S)

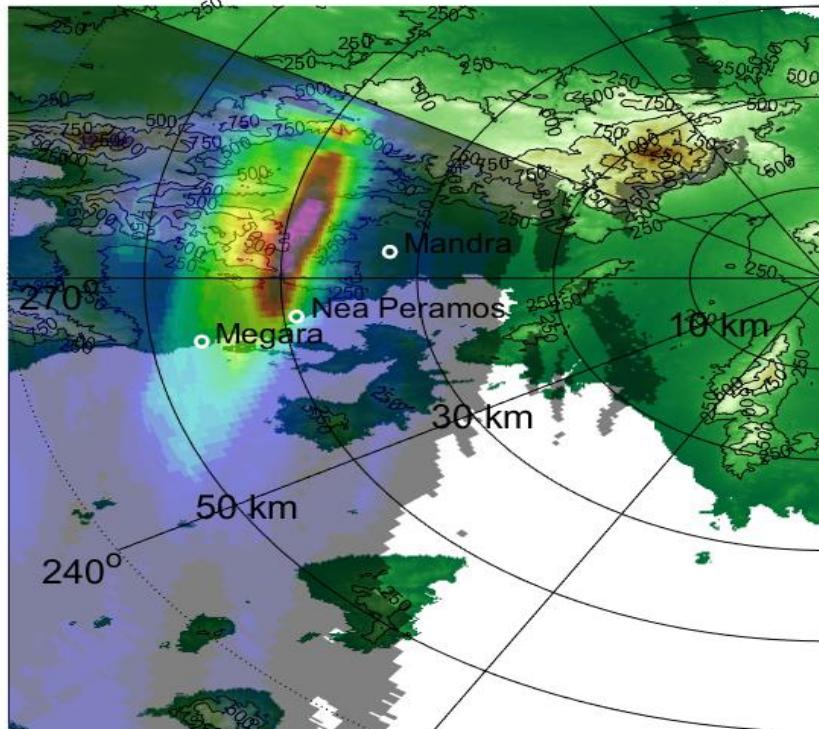
Αστική επέκταση - Urban expansion



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



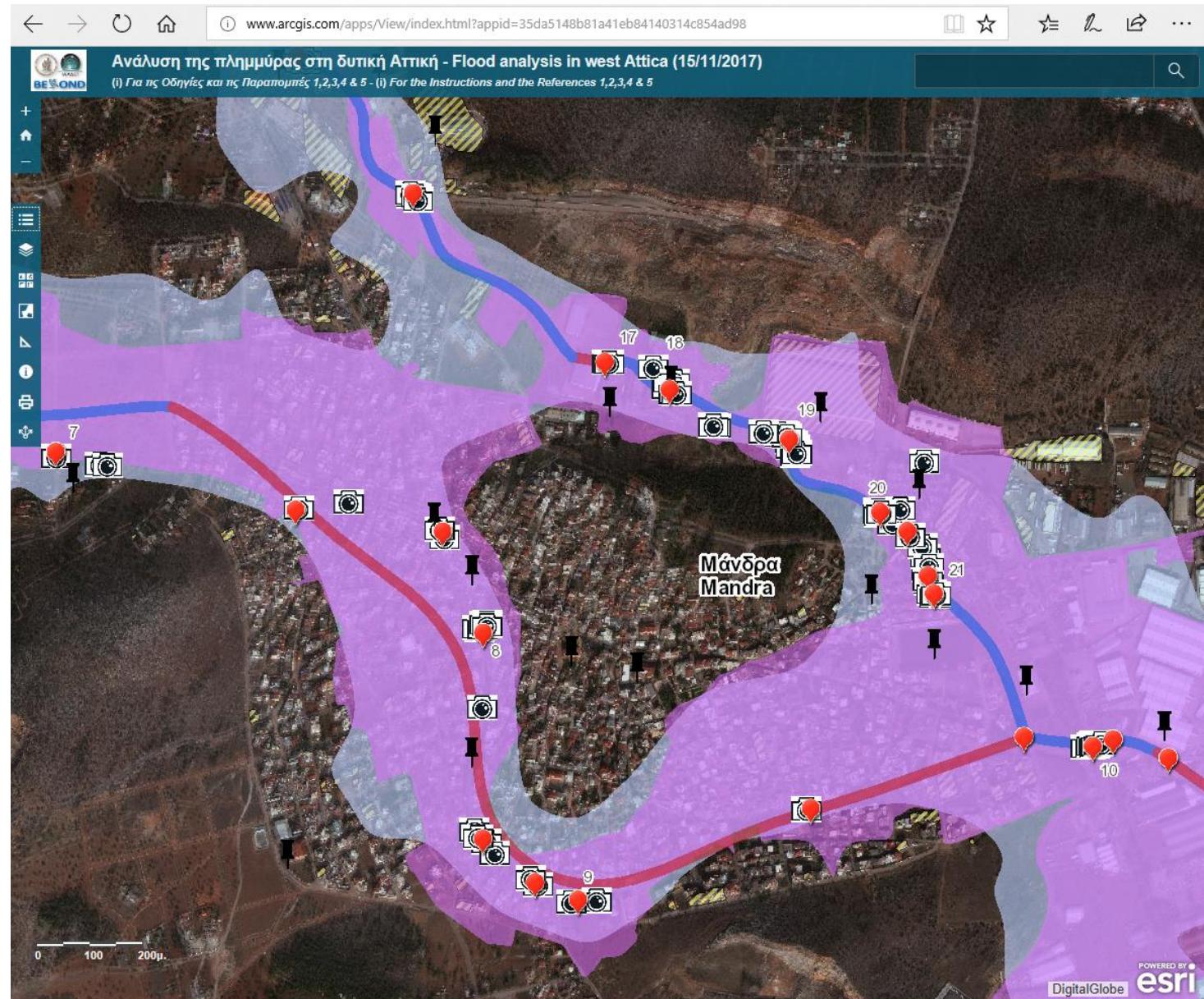
XPOL-NOA accumulated rainfall (mm)



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

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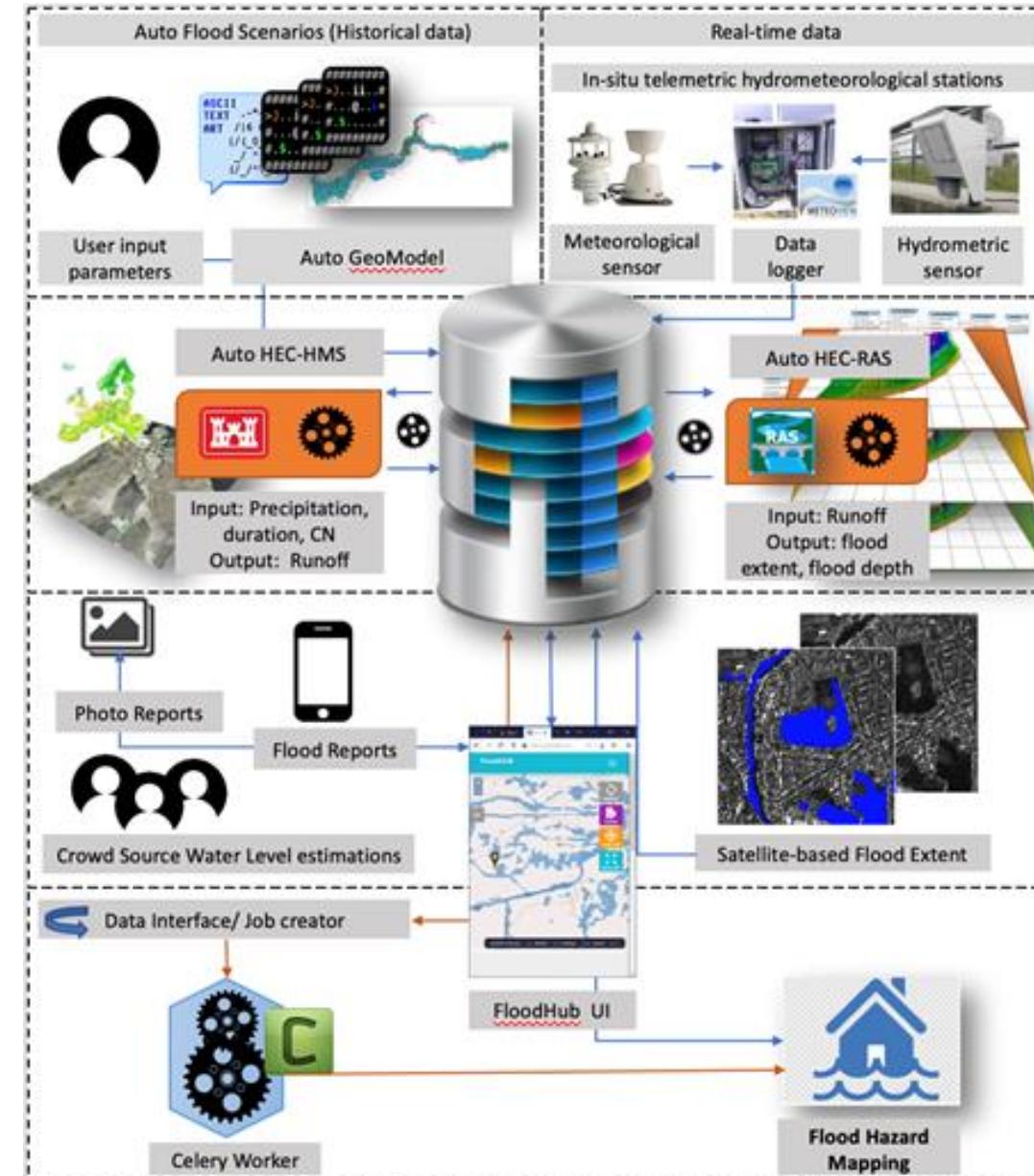


# Mandra 2020: Architecture of the FloodHUB system



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).

# 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**



# Web platform of the 3 telemetric hydrometeorological stations



The figure shows a screenshot of the METEOVIEW software interface. The main window displays a satellite map of a coastal region in Greece, specifically around the town of Neos Marmaras. The map includes labels for 'Mavriko-Kouros', 'Agios Spyridon', 'Neos Marmaras', 'Agios Nikolaos', and 'Poteras'. A yellow arrow points from the map to a photograph of a weather station mounted on a pole next to a concrete underpass. The software interface includes a sidebar with navigation options like 'Αναζήτηση...', 'ΜΕΝΟΥ', 'Αρχική', 'Δεδομένα', 'Ειδοποίηση', 'Άρθρο', 'Χρήστος', and 'Ρεύματα'. The bottom of the screen features a toolbar with icons for 'Χάρτης' (Map), 'Δορυφόρος' (Satellite), 'Google', and other tools. The right side of the interface shows a detailed view of the weather station equipment.

# Web platform of the 3 telemetric hydrometeorological stations



The figure displays a screenshot of the METEOVIEW 2 software interface. On the left, there is a vertical sidebar with various menu items such as Αναζήτηση, ΜΕΝΟΥ, Αρχική, Δεδομένα, Ειδοποίηση, Αρχεία, Χρήστες, Ρυθμισκή, and Επόμενη σελίδα. The main area has a title bar with 'METEOVIEW 2' and a search bar. Below the title bar, it says 'Χάρτης' and shows a timestamp 'Στιγμιότυπο: 1/03/2020, 11:48'. A large blue arrow points to the right, indicating the direction of the map view.

The central part of the screen shows a photograph of a weather station mounted on a metal pole. The station includes a solar panel, a wind sensor, and a rain gauge. Below the photograph, there is a small logo for 'METRICA' and the text 'Κάρτης Δορυφόρας'.

To the right of the photograph is a satellite map of the Mani Peninsula in Greece. The map shows the coastline, roads, and various locations labeled in Greek. A yellow arrow points from the photograph towards the map, indicating the location of the weather station. The map also features a legend at the top right and zoom controls at the bottom right.

# Web platform of the 3 telemetric hydrometeorological stations



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

Χάρτης

Αναζήτηση...  🔍

MENOU

Αρχική

Δεδομένα

Εικόνες

Άρθρα

Χρήστες

Ρεπορτάκια

Έπιπλα, σε... 57/99 [View more](#)

Χάρτης Δορυφόρος

Επίπλα Δεδομένα Ελλήνων στο 2020, CHM / Airbus European Space Imaging, Landset / Cogentous Visual Technologies | Φρεγάκη | Απορροή πουλιών για την

**METRICA**  
When it's a matter of trust

Χάρτης Δορυφόρος

Google

Copyright © 2014 Ιανουαριανό Πρόγραμμα | Ημερολόγιο, Βιβλιοθήκη, Βιβλιοθήκη, Βιβλιοθήκη | METEOROLOGICAL

# Web platform of the 3 telemetric hydrometeorological stations



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

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

Search here...

**MAIN NAVIGATION**

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

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

**METRICA** When it's a matter of trust

**ΆΓΙΟΣ ΑΘΑΝΑΣΙΟΣ**

**SELECTION FILTERS FOR DATA VIEW**

Date Interval: Choose Interval  Date From\*  Time from  Date To\*  Time to

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:

View per: **Total** Minutes Hour Day Week Month Year

**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.

# Real-time crowdsourcing platform for staff and volunteers



The screenshot displays the BEYOND FloodHUB Crowd Source Portal interface. At the top, there's a navigation bar with links for DASHBOARD, HOME, FLOODS, ABOUT, SETTINGS, LOGOUT, and a language switch (EN). On the left, a sidebar titled "Send Report" includes buttons for GPS, Manual, Edit, Delete, Cancel, and Submit. It also shows a preview of a report with fields for PUBID, OWNER, and TIME. Below this is a "Select Scenario" section with dropdowns for Pnt, T, Duration, and CN Parameter, along with Clear and Display buttons. The main area is a map of a coastal region with several flood inundation maps overlaid. A legend on the right identifies these maps: Refresh (grey), Locate (purple), Zoom Self (orange), and Zoom AOI (blue). The map shows various locations like Neo Filastoc, Nika Zografou, and Elliniko, with rivers like the Souda and Koukouli. A yellow location marker is placed on the map.

# Integrated near-real-time flood monitoring system



## BEYOND THEMATIC AREAS

### Agriculture

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

[Read more](#)

### 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](#)

### Climate

### Energy

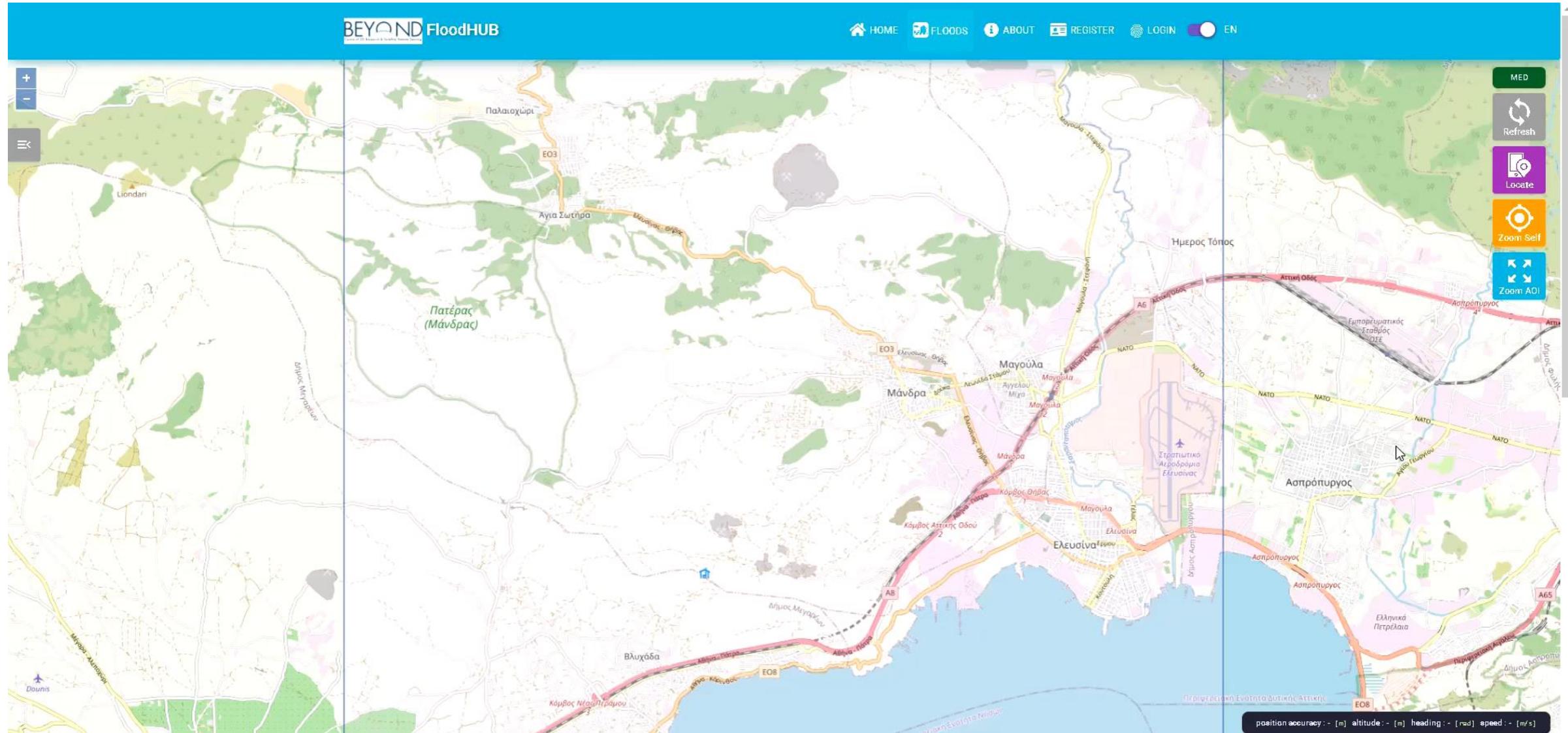
## WEB SERVICES



# Integrated near-real-time flood monitoring system



BEYOND  
Centre of EO Research & Satellite Remote Sensing



# **Integrated near-real-time flood monitoring system**



The screenshot displays the BEYOND FloodHUB application interface. At the top, a blue header bar contains the logo 'BEYOND FloodHUB' and navigation links: DASHBOARD, HOME, FLOODS, ABOUT, SETTINGS, LOGOUT, LOCK, and EN. On the far right, there is a green button labeled 'MED' and several grey action buttons for Refresh, Locate, Zoom Self, and Zoom AOI.

The main content area features a map of a coastal region with various geographical features like rivers, roads, and buildings. Overlaid on the map are several green shaded areas representing flood zones or inundation models. A legend in the bottom right corner indicates that these green areas represent water levels between 0m and 2m. The map also includes labels for locations such as Πατέρας (Μάνδρα), Άγιος Χωρόλαμπος, Νέα Ζυγή, Μάνδρα, Μαγούλα, and Καύκες Θερβάντης.

To the left of the map, a sidebar titled 'Send Report' contains buttons for GPS, Manual, Edit, Delete, Cancel, and Submit. Below these are icons for location, depth (0m), and camera. A form section includes fields for PUBID, OWNER, and TIME, with a depth input set to 0m. Further down, a 'Select Scenario' section allows users to choose a repeat period and duration (h), currently set to 'II (Med Cond)'. A 'CN Parameter' dropdown is also present. At the bottom of the sidebar, a message box shows 'Pnt: crowd,stations=[0/0],[0/0] | T = | Dur. = | CN = 2'.

# Hydrologic & hydraulic simulation



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

# SUBBASINS

## 19

# RAINFALL IDF CURVE

## Koutsoyiannis & Baloutsos, 2000

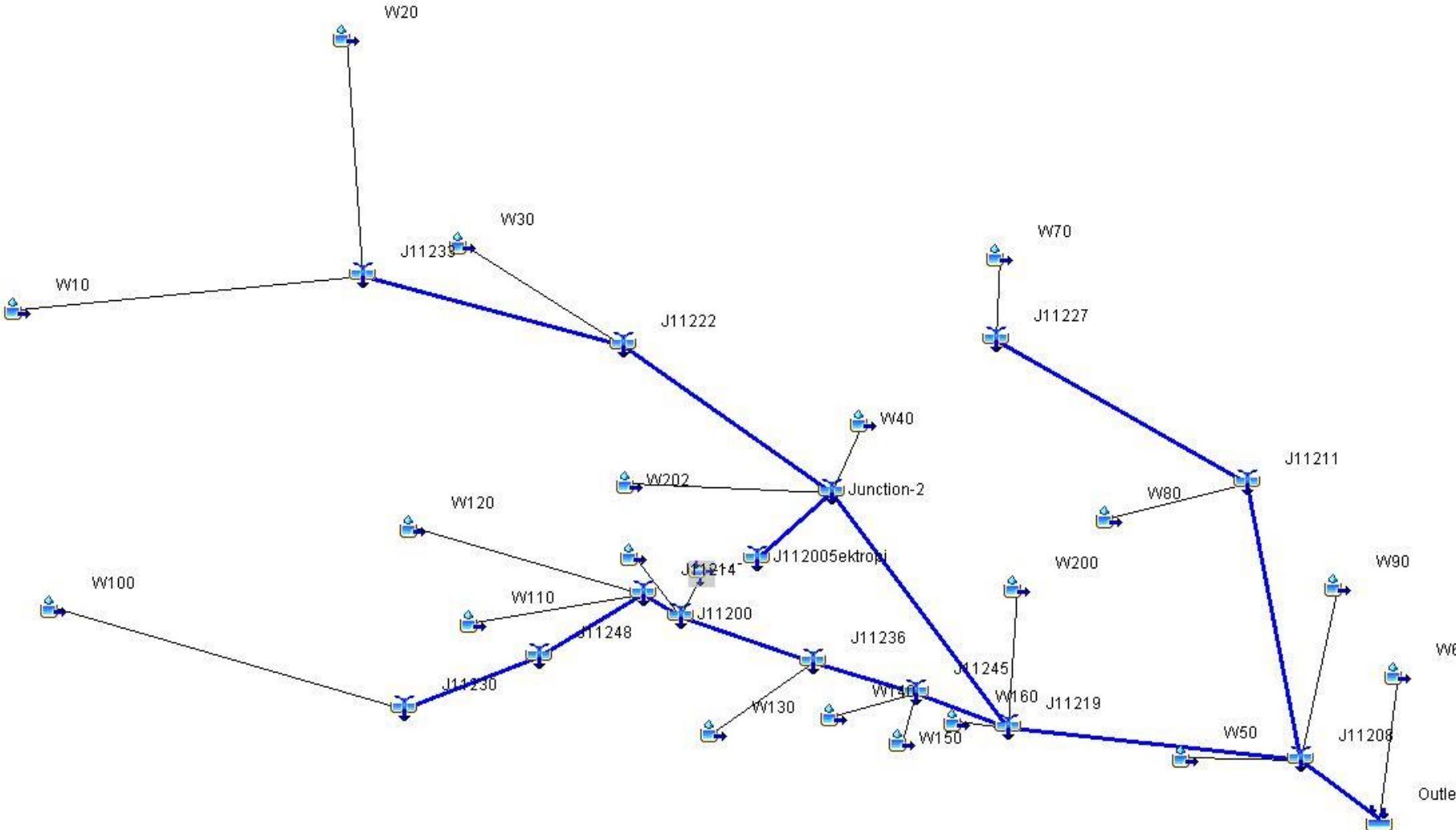
$$i(d,T) = 40.6 (T^{0.185} - 0.45) / (d + 0.189)^{0.796}$$

## DISTRIBUTION

### Worst profile method

# TIME OF CONCENTRATION Kirpich (SCS) method

# Hydrologic & hydraulic simulation



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

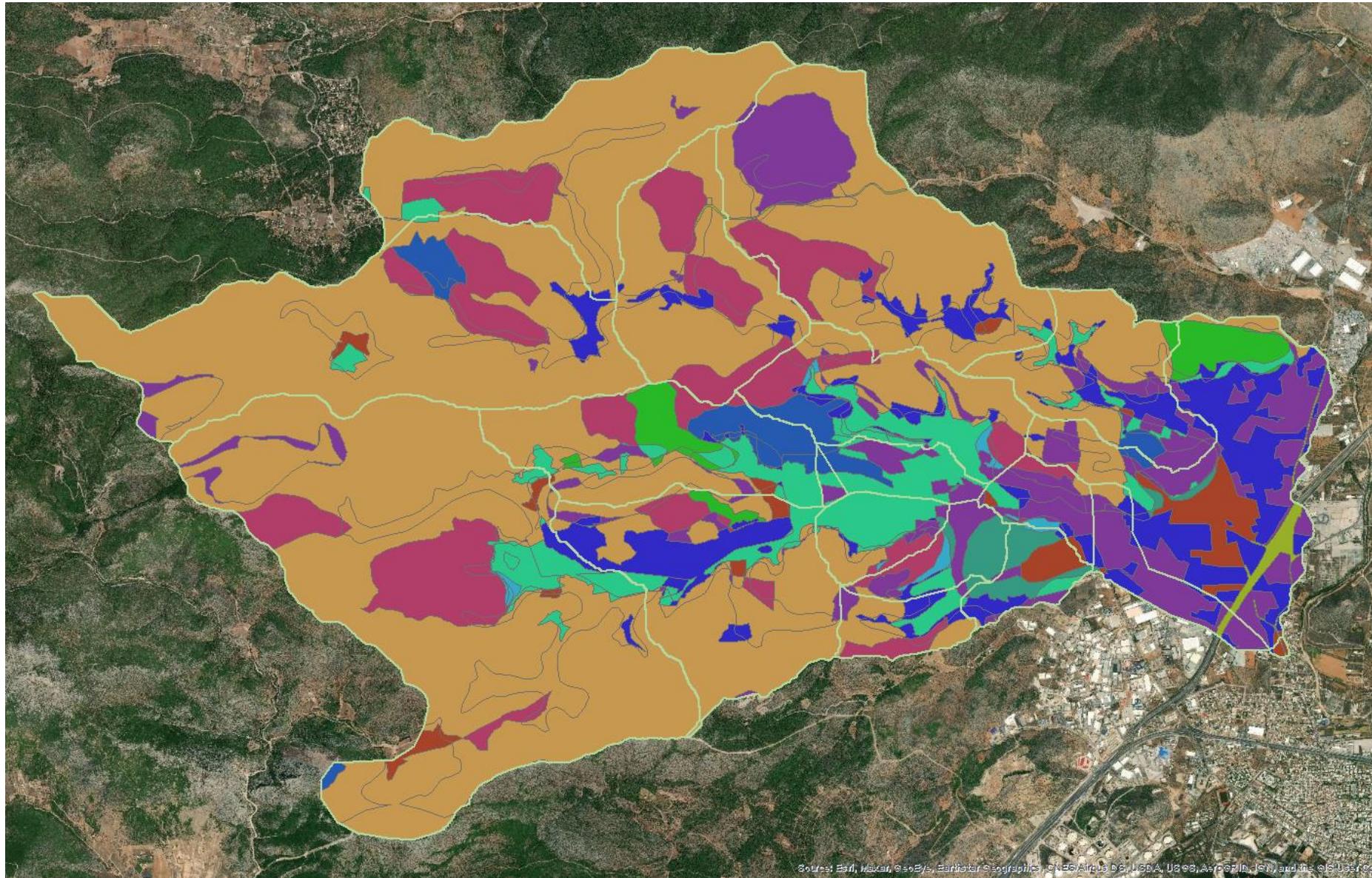
**Input:** rainfall data through HEC-DSS for various combinations of return periods T (years) and rainfall duration d (hours)

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

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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 )

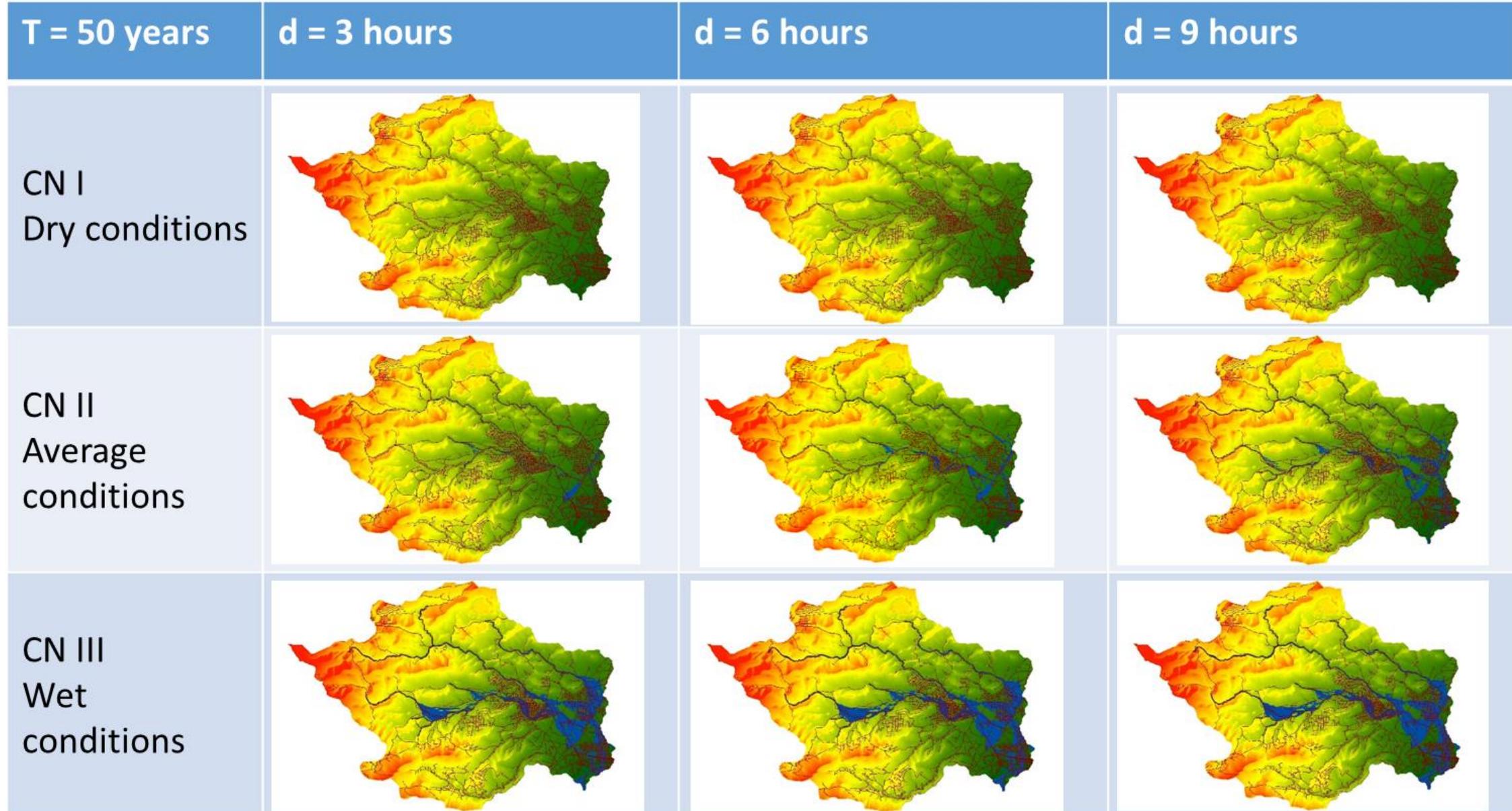
**Input:**

- \* 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)

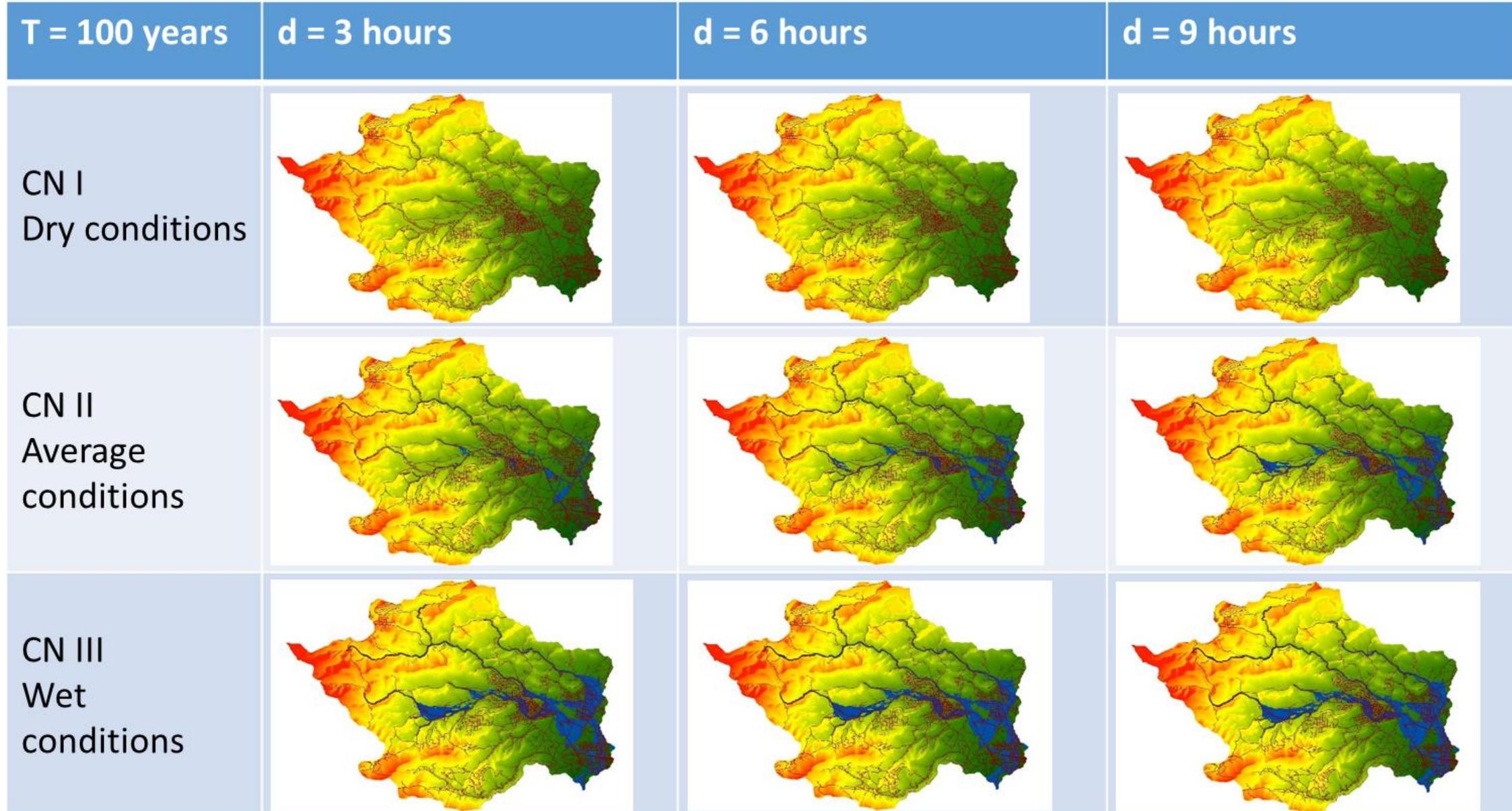
**Output:** flood extent

## Flood mapping results $T = 50$ years

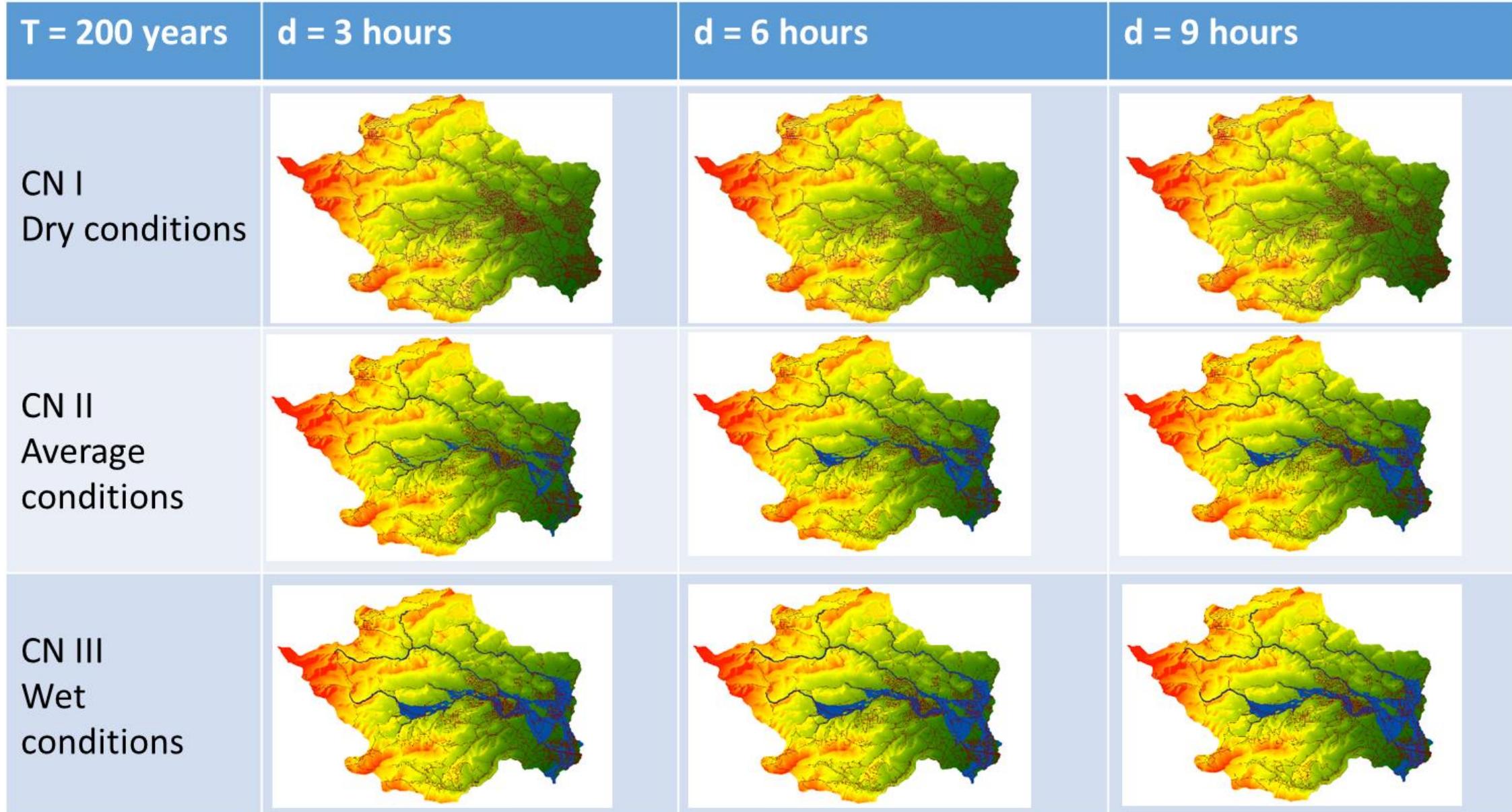


# Flood mapping results

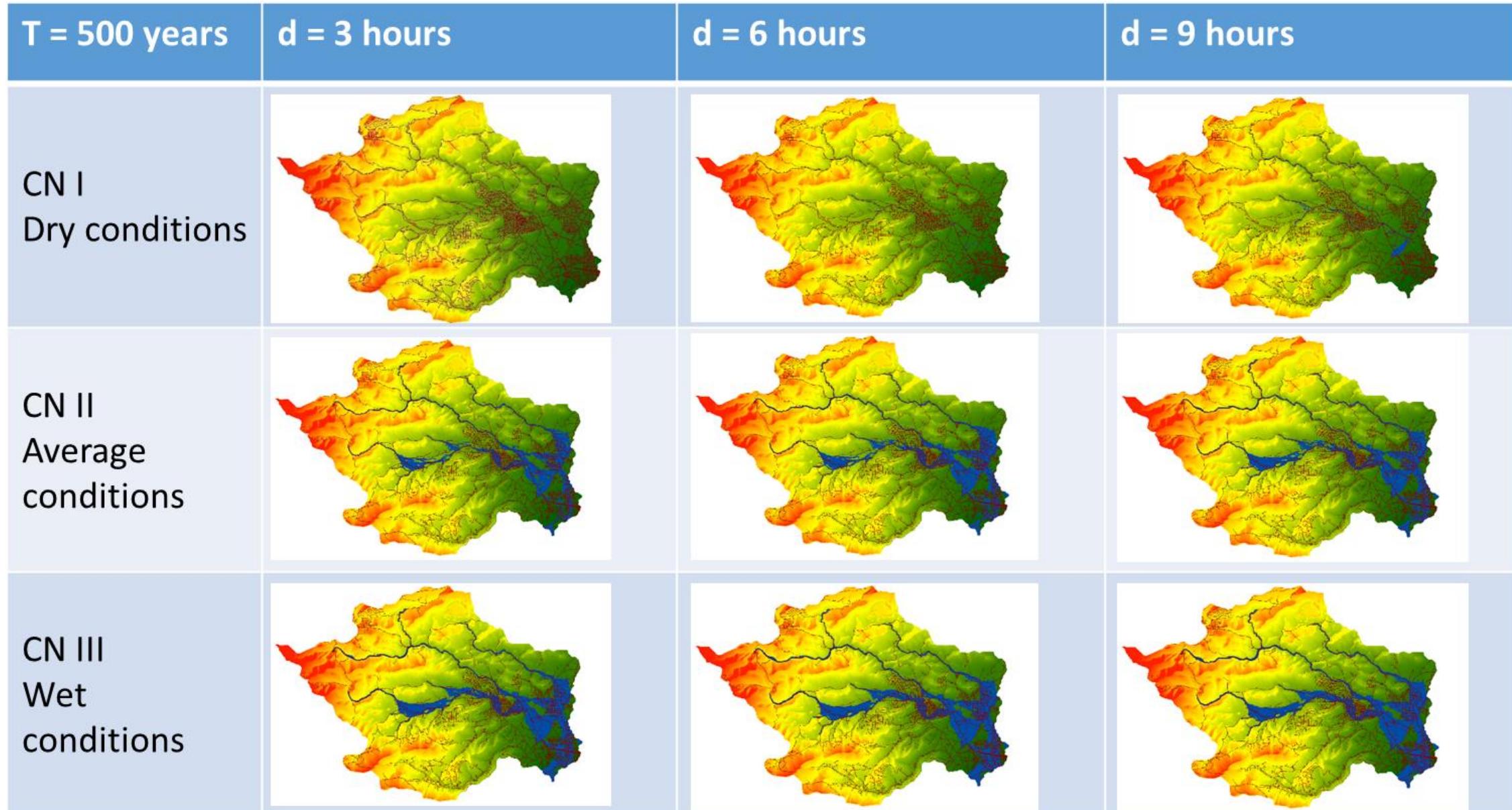
## T = 100 years



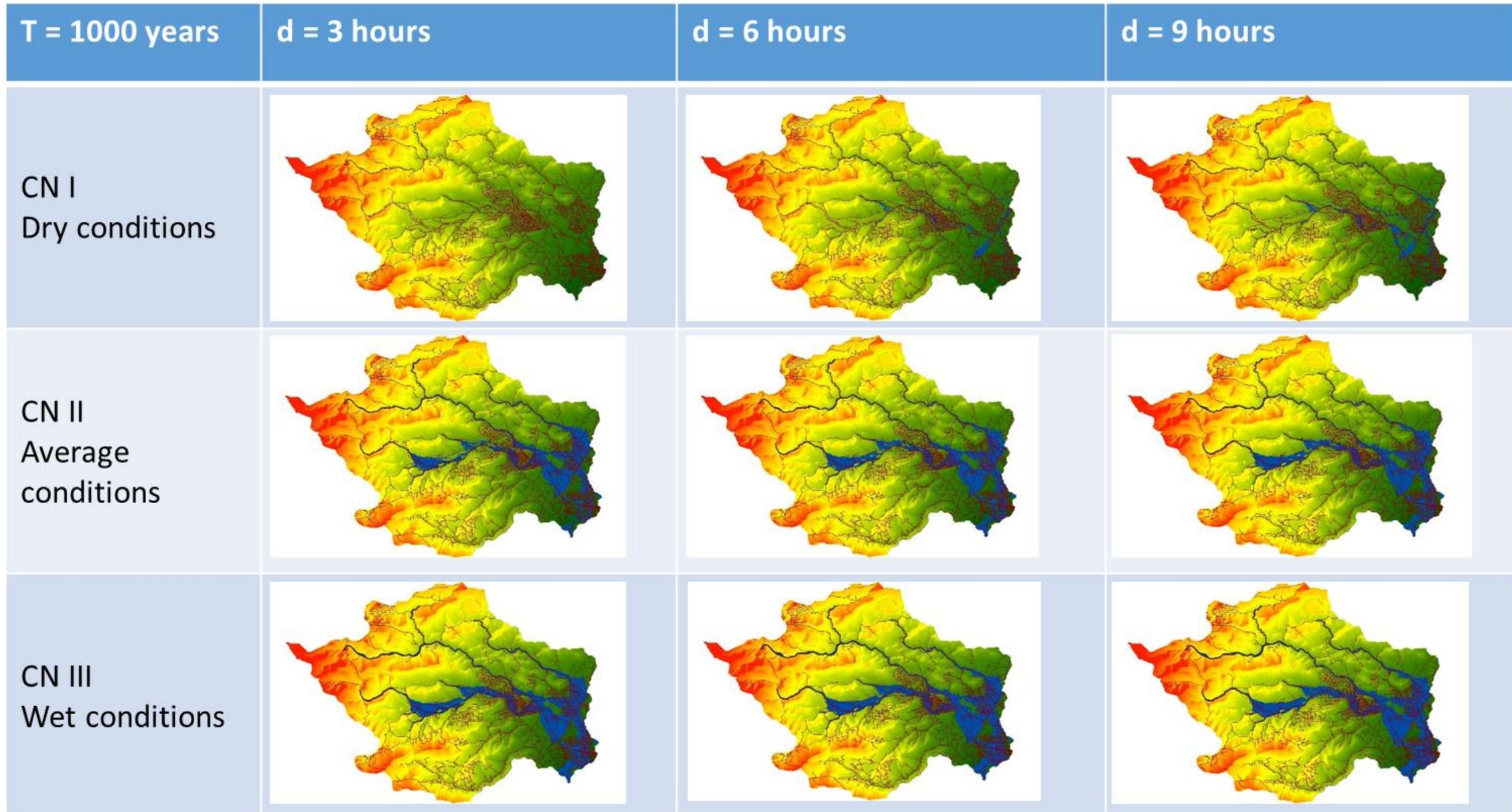
## Flood mapping results $T = 200$ years



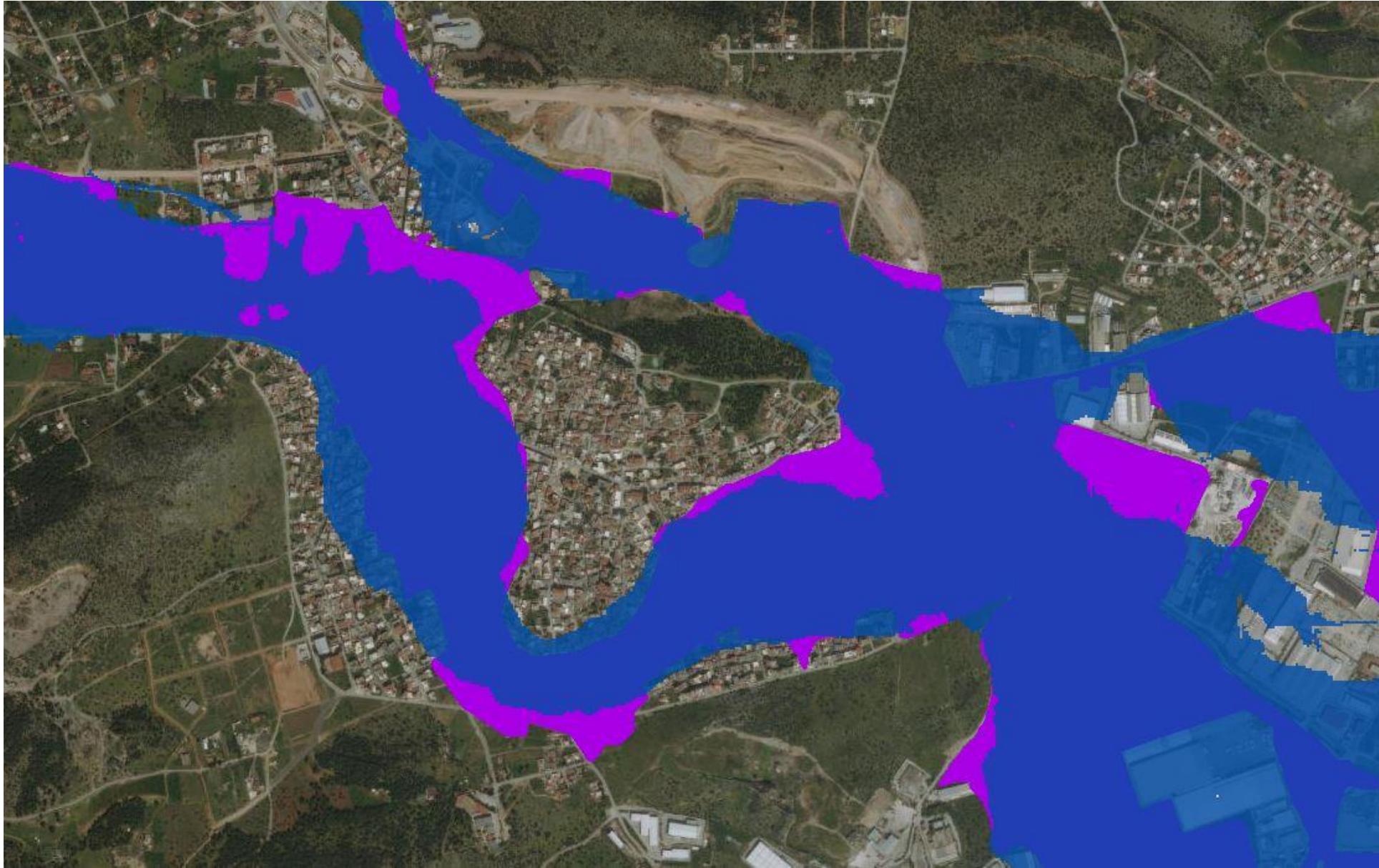
## Flood mapping results $T = 500$ years



## Flood mapping results $T = 1000$ years



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



# 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



# Stakeholders' trainings in the operational FloodHUB system



# The BEYOND Center of EO Research & Satellite Remote Sensing



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Thank you for your attention!

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