Monitoring real time the Arachthos River (Greece) using a Web GIS platform

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Floods

- Floods are one of the numerous extensive phenomena closely affiliated with the intense climate change-related natural disasters

- During the 20th century floods have led to the loss of more than 100,000 human lives while they have also affected over 1.4 billion people worldwide
- The degradation of the natural environment caused vulnerability towards floods for lots of areas of the planet

- Imperative for Local and Regional Authorities to develop and implement innovative risk management policies
- There is a great progress in disaster risk management policy:
  - more accurate forecasting
  - improved early warning systems
  - better evacuation procedures

Aims and Objectives

- The aim of the study is to present the early warning system of the broader area of Arachthos River, Greece which was an imperative after the floods that the gateway communities suffered during the winter of 2015.
- This effort is mainly based on the need for an integrated civil protection policy via the use of an operating system for monitoring and timely updating in a graphical environment, easily assessed by local authorities, citizens and multiple stakeholders
- Objectives:
  - Creation and operation of an electronic database, installation of special equipment & the design and development of a Geographical Information System for the wider area
  - Development of a risk assessment model as core of a Decision Support System in case of flood events
  - The System will support decisions in case of flood events via an application providing targeted information for the public and the relative authorities.

Study Area

- The study area includes **part of Arachthos River** as well as its broadest catchment area. With **110 km** length and **2,209 km²** catchment area, Arachthos River is the **largest river in Epirus** and the **8th largest nationally**.

- Upstream of the city of Arta, the Arachthos river meets in turn a **hydroelectric dam** "**Pournari I**", which is the **second largest dam in Greece** after the Mornos dam and a regulating dam (Pournari II), to control the outflows of Pournari I and irrigation of arable land. Following its path, Arachthos river crosses the plain of Arta with a length of about 28 km, from the city of Arta to the estuaries of Amvrakikos Gulf

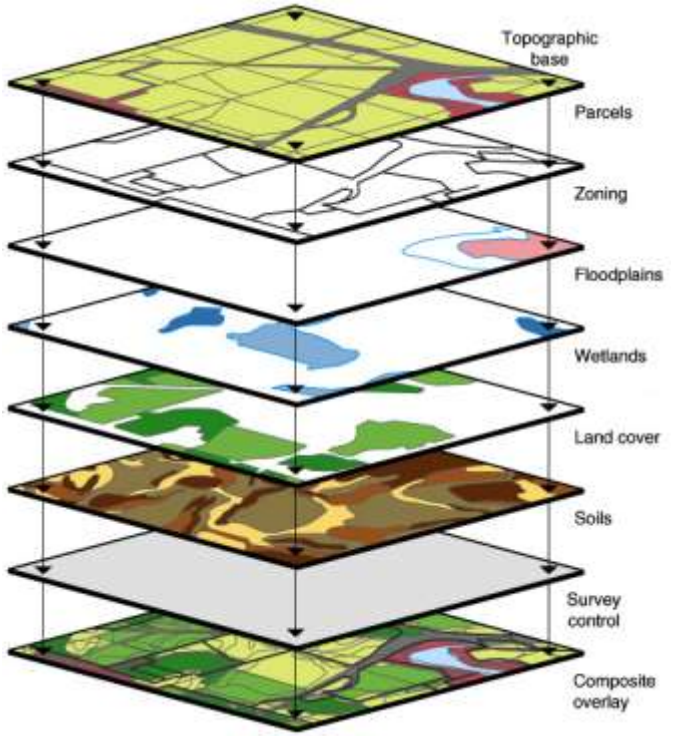
Broadest catchment area of Arachthos river

Arachthos river downstream of dam Pournari II

Web GIS

- Geographic Information Systems (GIS) already play an important role in flood risk assessment.
- They allow the direct exchange of spatial information through Web-GIS platforms that provide access to
  - various research communities, experts,
  - Professionals,
  - the general public.

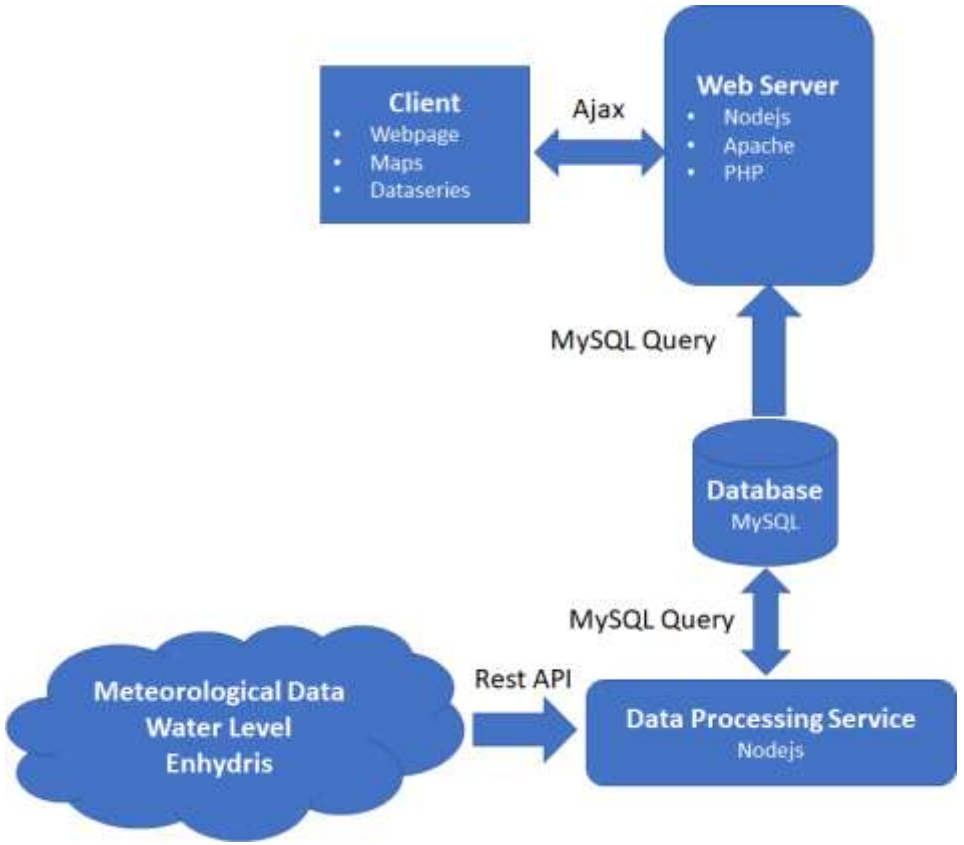
Geographical Information Systems



Architecture of the Web GIS

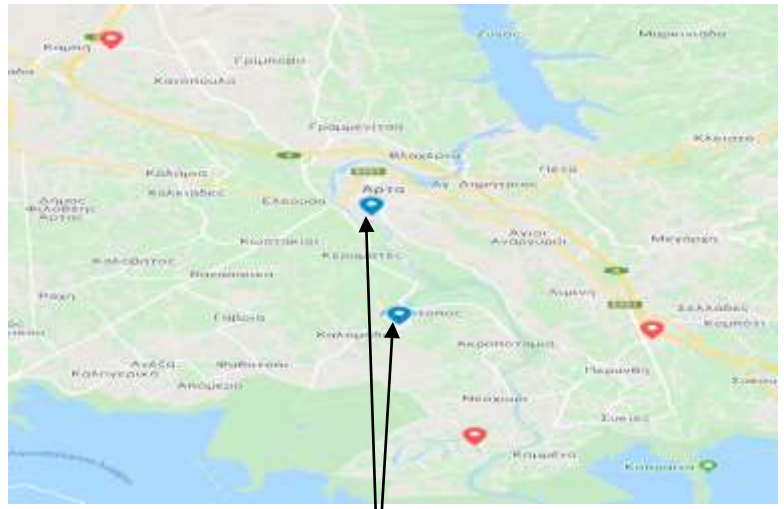
- The Web-GIS architecture of the system consists of:
  - Client: e.g. Chrome-Firefox internet browser.
  - Web - Server: which undertakes all the communication with the client and the database but also the implementation of the flood risk assessment methodology.
  - The database: where all our data are stored e.g. Meteorological data.
  - Data from external sources: e.g. data from in addition to installed meteorological stations such as the Openmeteo network.

The Architecture of the Web-GIS



Hardware Installations

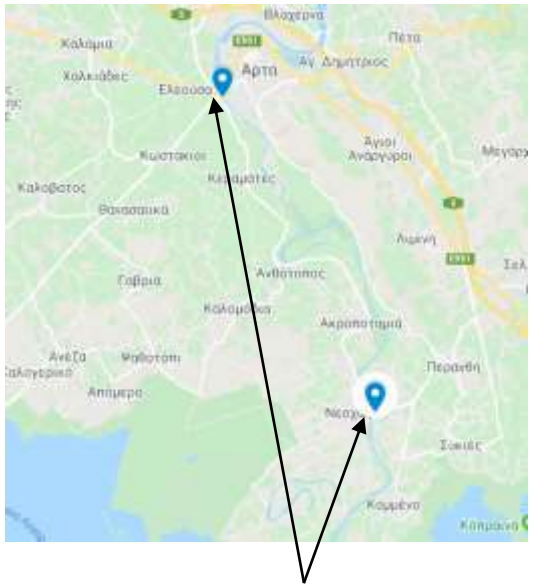
- Meteorological Stations
  - Two meteorological stations (Davis Vantage Pro 2) were installed in vital locations.
  - The meteorological stations upload their data every ten minutes to our database.
  - The data that they send are the following:
    - rainfall,
    - pressure,
    - wind direction,
    - wind speed and
    - Temperature.



Davis Vantage Pro 2

Hardware Installations

- Water Level Stations
  - Two water level sensors (SYMMETRON's Stylitis 20) were installed in the area of interest.
  - The sensors use a battery for power supply and send the data via General Packet Radio Service (GPRS).
  - The Stylitis sensor sends the water level of the river and the remaining voltage of the battery data every 30 minutes as text file.



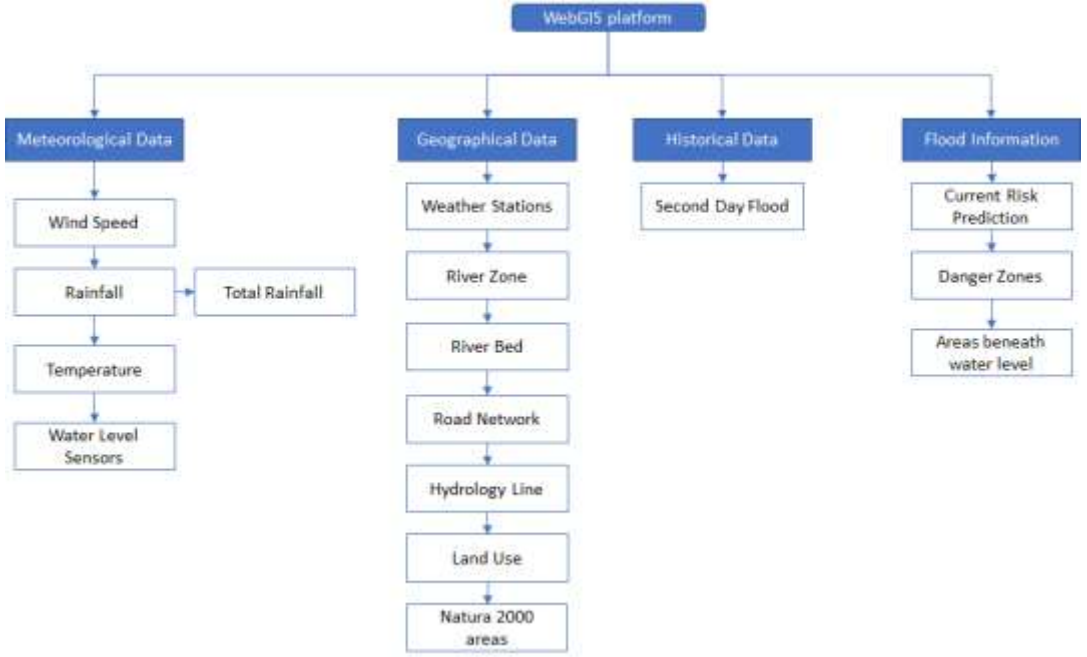
SYMMETRON's Stylitis 20

Technologies: Front End Client

- The front-end of the system is a modern Web-based GIS application that gathers and visualize useful information from:
  - satellite datasets,
  - national datasets provided by the local authorities,
  - as well as measurements from meteorological stations and water level sensors.
- The front End component consists of 3 parts:
  - The first part is the web page development and its design.
  - The second part is the visualization of geographical data with the use of the Google Maps, on a responsive map.
  - The third part of the client is the representation of the data retrieved from the meteorological station and the water level sensors.

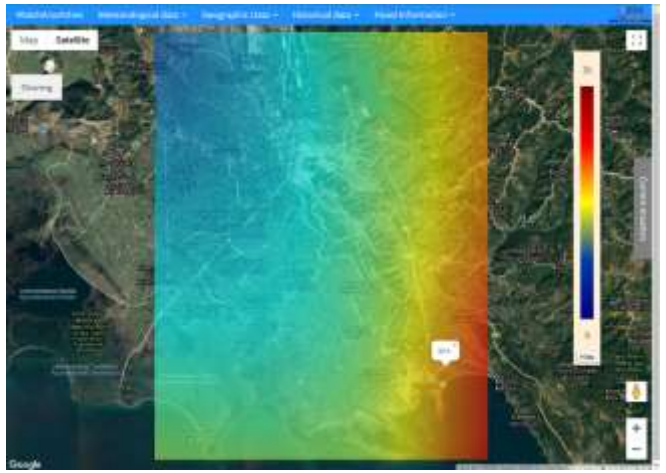
Front End - Web Page

- The web page of the system can display various data which can be categorized in the following categories:
  - Meteorological Data: This menu hosts the data that are received from the Meteorological stations and water level sensors.
  - Geographical Data: This menu hosts different data layers that have been obtained from various sources. In case of emergency, local authorities can use that crucial information.
  - Historical Data: This menu displays the layer of previous floods.
  - Flood Information: This menu displays the data for the flood risk.



Front End Map

- The system uses the Google Maps API. The Google Maps API provides a set of tools to visualize data, and especially geographical data, on the embedded map.
- GIS data can be separated into two categories, raster and vector data.
  - The raster divides the spatial area into grids of the same size with each being assigned a specific value, representing different geo-referenced data.
  - The vector data use points, lines and polygons to represent different spatial data.



Accumulated Rainfall displayed as a Raster

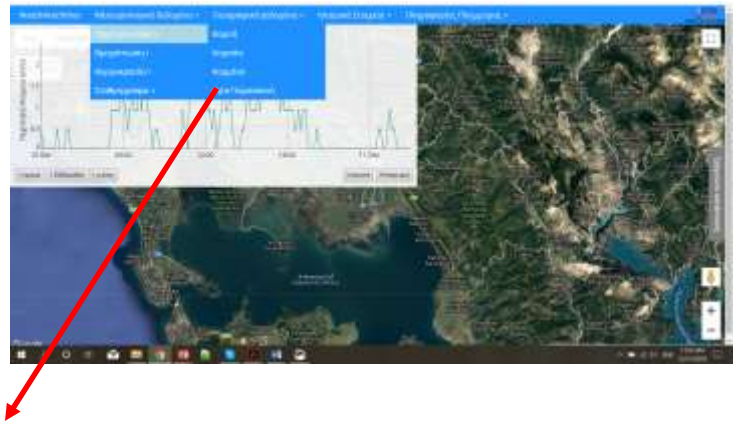
Various Vector Data

Front End - Data Series

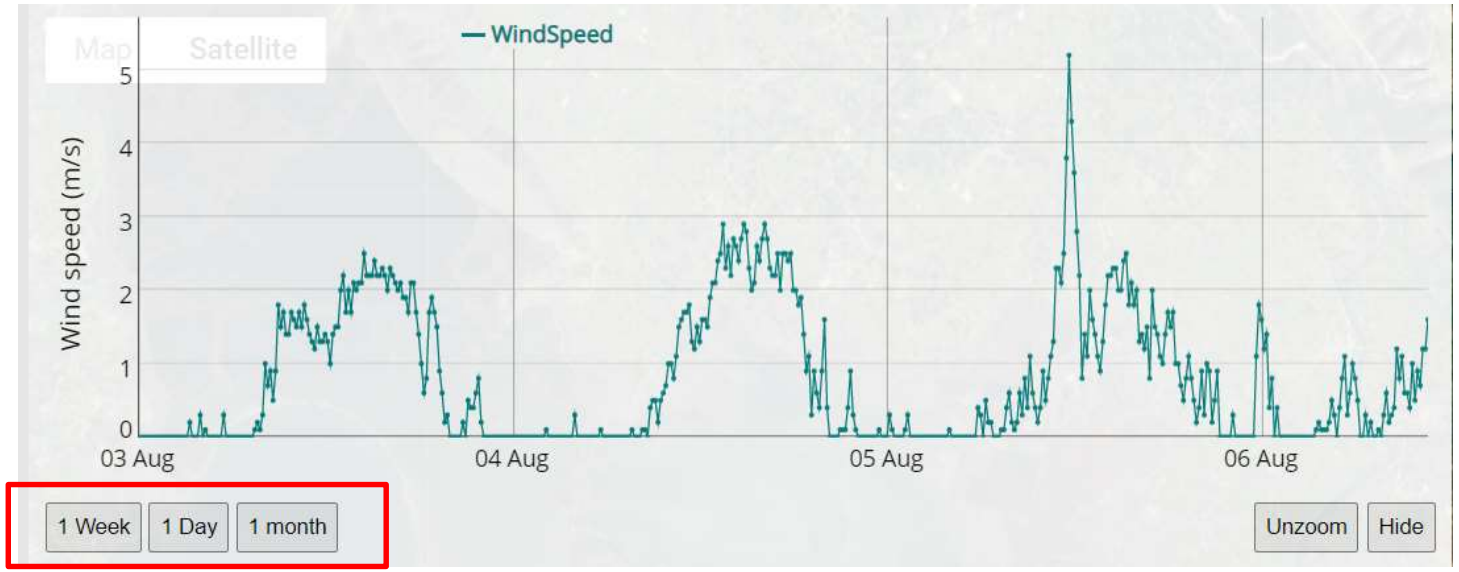
- Data from the five meteorological stations and the two water level sensors are stored in the database of the WebGIS.
- Each meteorological station provides data for rainfall, wind speed, wind direction and barometric pressure in two ways:
  - Using graph plots,
  - Using a panel that display the latest records of rainfall and the water level.

Front End - Data Series

- Wind Speed



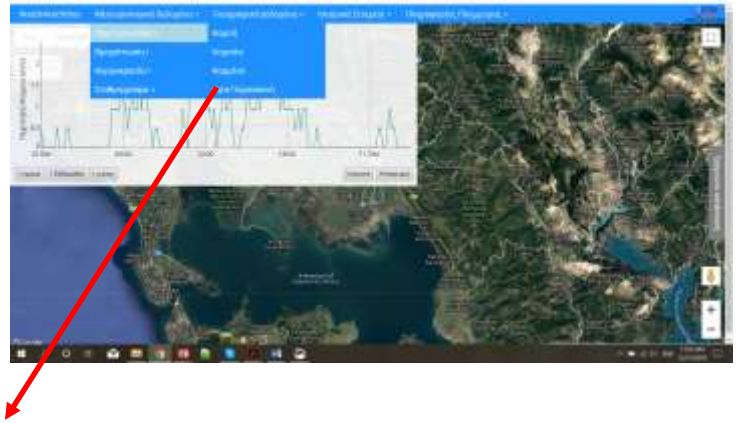
- Wind Speed measured in m/sec:
  - Data series displayed using 15min intervals.
  - The user can select a time frame of day/week/month.



Time Frame

Front End - Data Series

- Rainfall



- Rainfall measured in mm:
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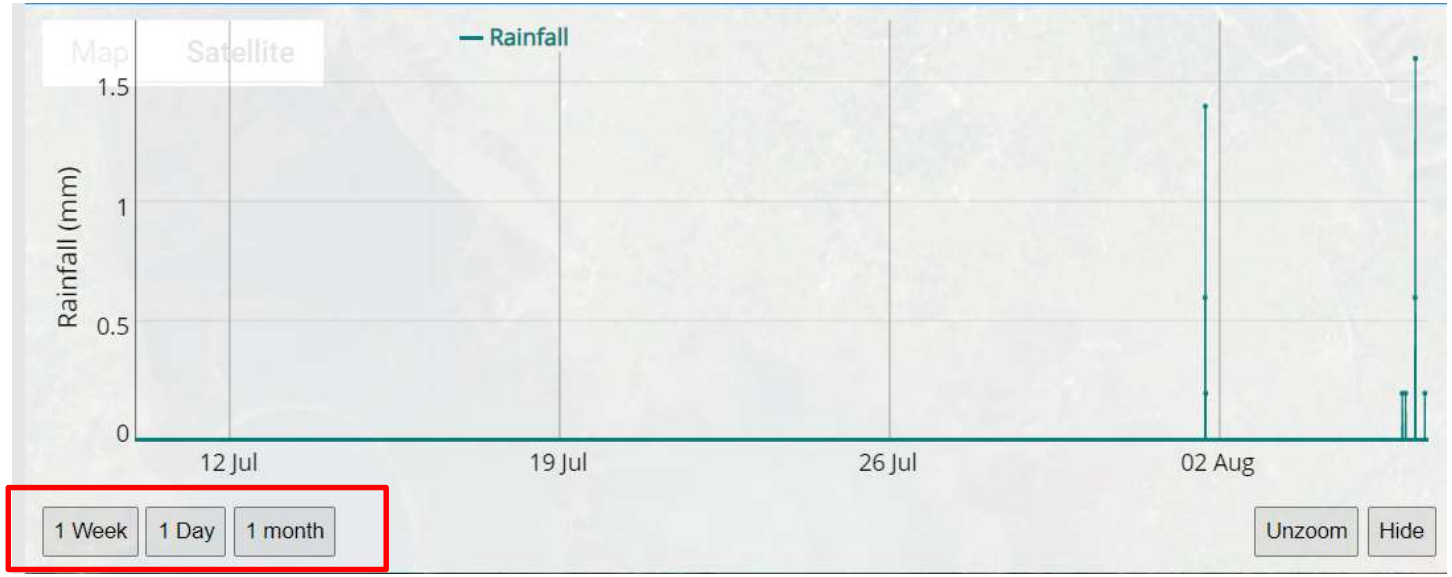
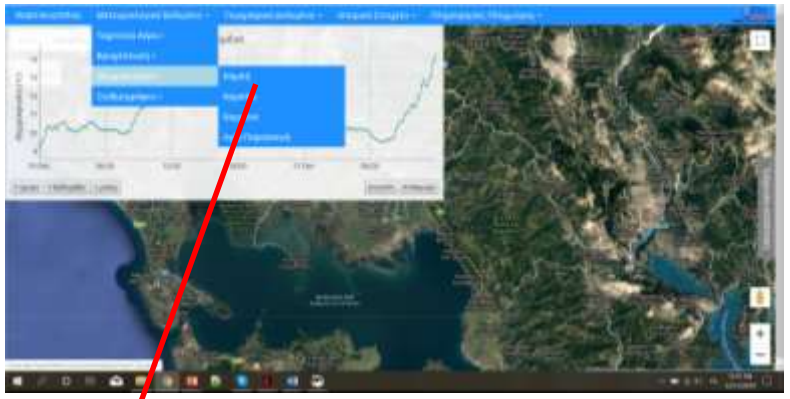


Time Frame

Front End - Data Series

- Temperature



- Rainfall measured in mm:
  - Data series displayed using 15min intervals.
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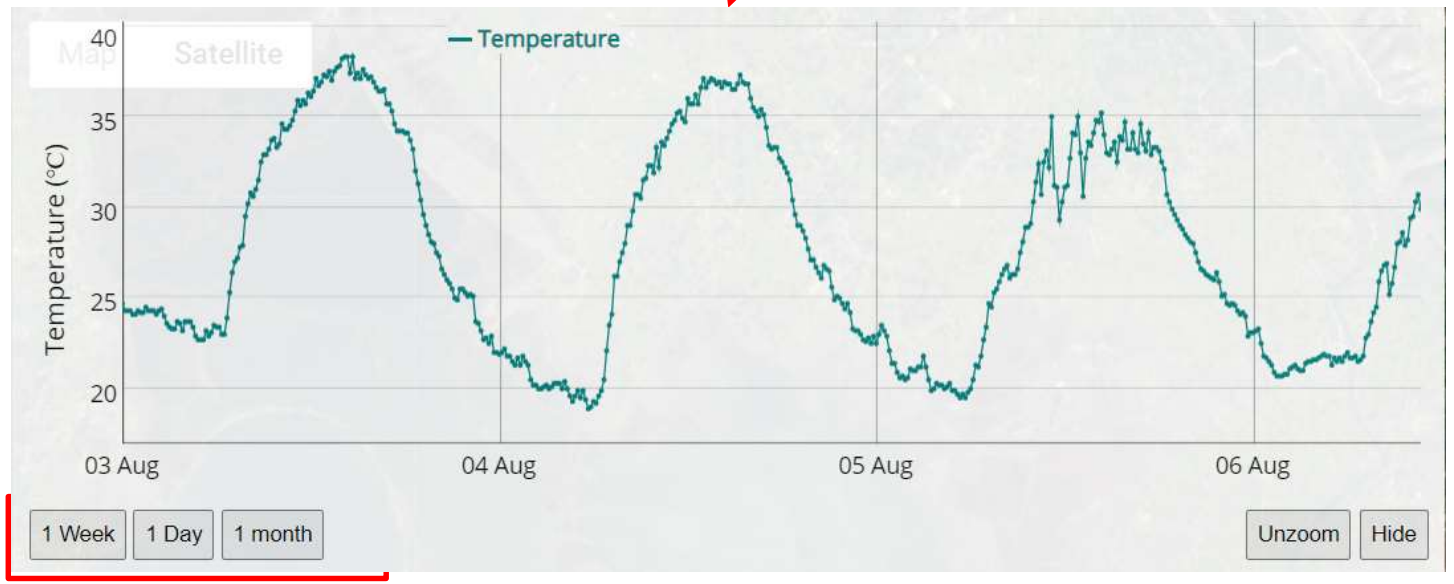
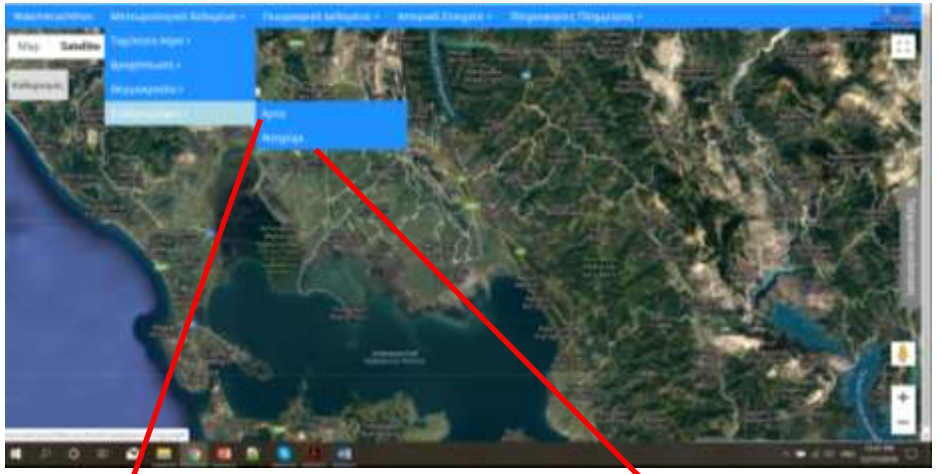


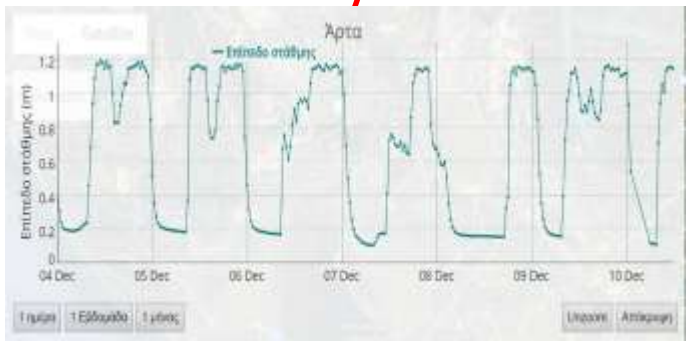
Time Frame

Front End - Data Series

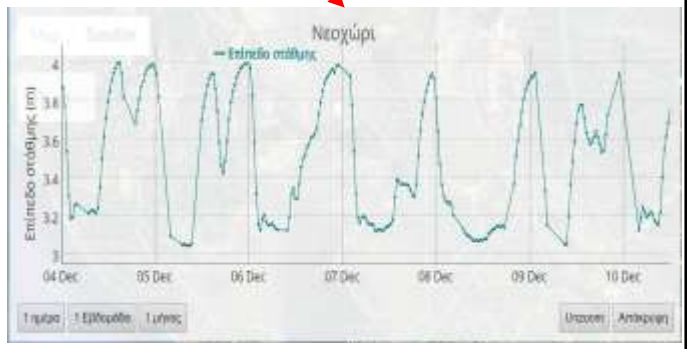
❑ Water Level

- The measurements are sent every 15min.
- The data are represented as a time series.





Water Level Sensor #1



Water Level Sensor #2

Back End- Data Series

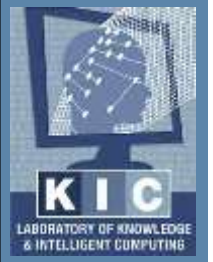
- The data acquired are produced from the
  - The water level sensors and
  - The meteorological stations.
- Moreover, the rainfall data from the meteorological stations are summarized with the interval of one day, three days, five days and tens days and then stored in a different format.
- The services that are used to display the data are created with the NodeJS Javascript framework.

Back End- Database

- The system uses MySQL relationship database to store the data.
- MySQL is free and open-source software that is used by many database-driven web applications.
- The data are separated into two types, data from the stations or sensors and data from static files such as KML.
- The web server handles the communication between the client and the database by providing SQL queries to the database.

Conclusions

- The system presented is a web GIS platform for monitoring the river flood of the riversides of Arachthos.
- The architecture and the technologies that were used to develop the platform were described.
- The integrated information system of flood monitoring provides information to every interested party and is expected to encourage local authorities to monitor the river and its condition, improving the efficiency and promptness in flood crisis management for the area of Arachthos Basin.



Thank you!

Any Questions

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