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Correlation between hydraulic and spatially distributed topographic index modeling for flood risk mapping based on areal imagery and remote sensing data

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INTRODUCTION & AIM

Flood risk mapping is a key instrument for integrated flood risk management. The scope of this study was to create a methodology to assist in **identifying flooding risk hotspots** and **potential flood prone areas**, providing thus a quick, yet reliable method for identifying areas of high flooding risk. This project aimed to produce flood hazard maps that integrate flood inundation areas and flood extent in the area of interest. Hydraulic Analysis (HEC-RAS) and GIS-based methods were the main components in analyzing flood hazards.

The **Topographic Wetness Index** (TWI), was also introduced as an index to characterize the wetness or soil moisture conditions related to a particular landscape based on topography/elevation.

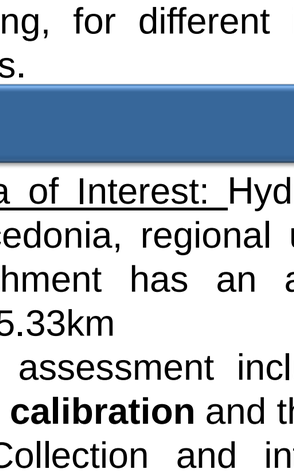
The interpretation of TWI and hydrological analysis correlation into flood risk potential offered a group of flood risk maps with distinct categorization and classification of risk areas (low to high), providing different flood zoning, for different inundation areas according to different discharge flows.

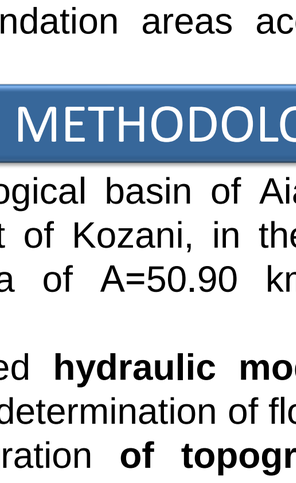
METHODOLOGY

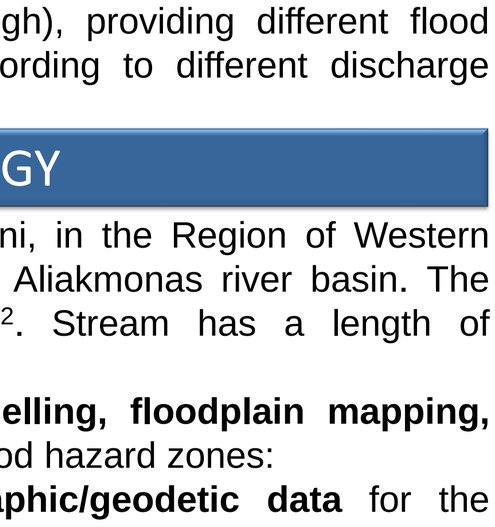
Area of Interest: Hydrological basin of Aiani, in the Region of Western Macedonia, regional unit of Kozani, in the Aliakmonas river basin. The catchment has an area of A=50.90 km^2. Stream has a length of L=15.33km

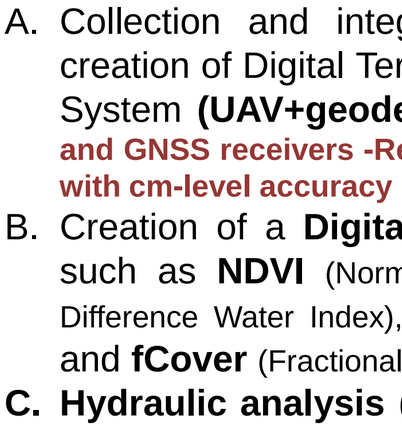
The assessment included **hydraulic modelling, floodplain mapping, TWI calibration** and the determination of flood hazard zones:

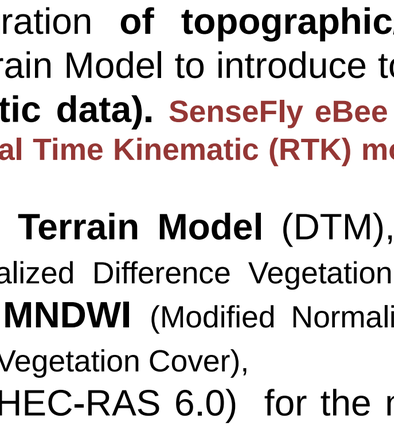
A. Collection and integration **of topographic/geodetic data** for the creation of Digital Terrain Model to introduce to Geographic Information System **(UAV+geodetic data).** **SenseFly eBee Plus UAV (high resolution), and GNSS receivers -Real Time Kinematic (RTK) mode for real-time positioning with cm-level accuracy**
B. Creation of a **Digital Terrain Model** (DTM), remote sensing indices such as **NDVI** (Normalized Difference Vegetation Index), **NDWI** (Normalized Difference Water Index), **MNDWI** (Modified Normalized Difference Water Index), and **fCover** (Fractional Vegetation Cover),
C. Hydraulic analysis (HEC-RAS 6.0) for the main stream line in study area. The analysis was executed for **Qmax** of 50y and 100y return period respectively for the same hydrological basin.
D. Topographic Wetness Index-TWI calculation and calibration with the results of HEC-RAS.
E. Large- scale application and evaluation
F. Flood Risk Maps development

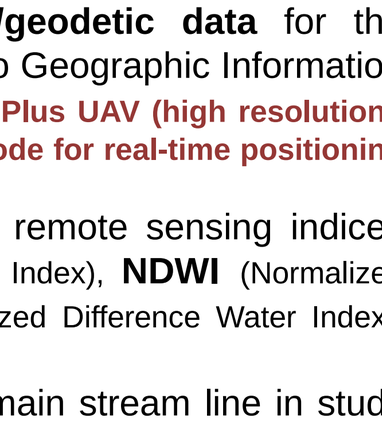






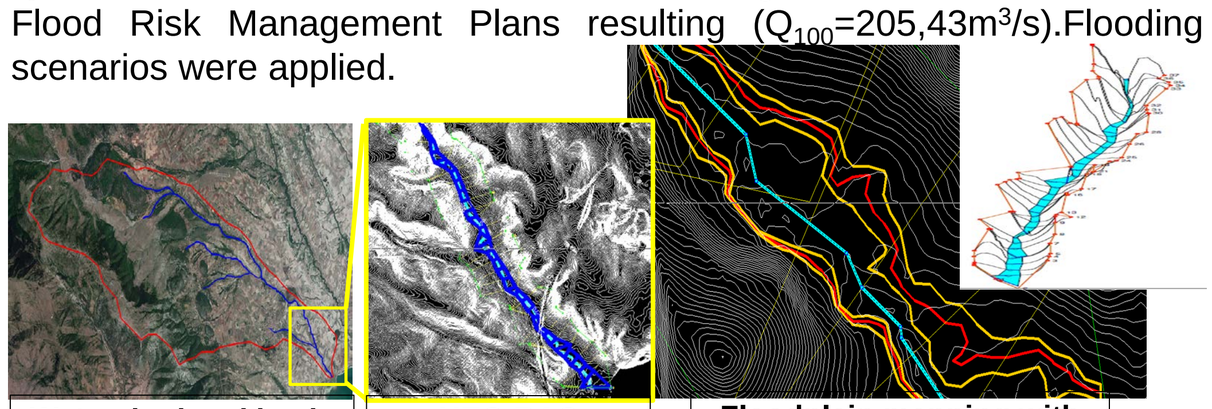






RESULTS & DISCUSSION

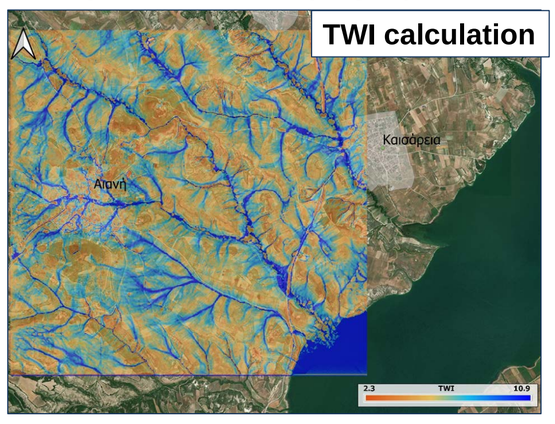
Qmax was calculated in HEC=RAS 6.0 using the rainfall curves of the Flood Risk Management Plans resulting (Q_{100}=205,43m^3/s).Flooding scenarios were applied.

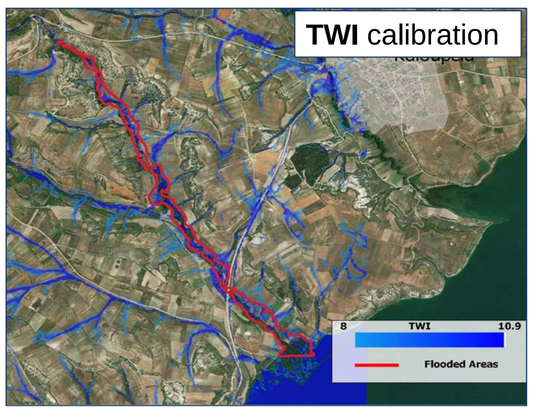


Watershed and basic hydrographic network | **HEC-RAS modelling** | **Floodplain mapping with contour use method**

The topographic indexes' results were then calibrated, based on the hydraulic analysis outputs, in terms of: i) **thresholding** and **ii) adjusting the acceptable value range** based on the calculated inundation profiles for various return periods.

The correlation was conducted between analytical hydraulic modeling and spatial distribution modeling to determine areas at flooding risk primarily based on topographic characteristics.





- **TWI<4** =>drier or less wet areas=> **Low Flood Risk.**
- **4<TWI<8** => moderate wetness conditions. **Medium Flood Risk**
- **TWI>8 =>**water-saturated areas => **Higher Flood Risk**
- Blue shaded area show increased susceptibility to accumulation of runoff and subsequent flooding

CONCLUSIONS

TWI was determined as an **alternative to the traditional approach** of delineating flood-prone areas.

It provides a more **cost-efficient approach** to flood determination than conventional hydrodynamic models.

This method identified flood-prone areas and may be used as a process for **estimating risk hotspots of high flooding susceptibility** and pinpoint zones of high exposure to flooding risk.

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