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Hydrology and Hydraulic Modeling for Flash Floods Risk Assessment and Mapping

A Methodology Proposal

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Flash Flood Assessment From Regional to Local Scale

- Hydraulic models are used to calculate on a local scale, all flood related parameters
- Flood Hazard and Disaster Risk may be “accurately” assessed-as possible
- **AIM** = Spot Problematic areas according to the hydraulic analysis performed

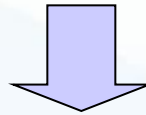


The procedure has been implemented in the area of Serres (Kentriki Makedonia)

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Methodological Framework for Flash Flood Hazard (FFH)

- Methodology for FFH is structured (among others) on basic principles of **hydrology** and **hydraulics**
- Standardized methodology for flood map production (step by step)
- Use of **Open Source Software**



- Geo-morphological and hydrological features of the river basin
- Calculation of hydrographs for different return periods
- Simulation of the river system-Detailed hydraulic analysis
- Estimation and Mapping of floodplain Inundation

Methodology Flowchart



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Hydrologic Analysis

- Hydrology analysis aims to determine the design hydrograph for different return periods
- **Hydrology Modeling System**
- Simulation of the precipitation-runoff processes of dendritic watershed systems.
- **Hydrographs** produced are used for studies of water availability, urban drainage, flow forecasting, future urbanization impact, reservoir spillway design, **flood damage reduction, floodplain regulation**, and systems operation.

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Our proposalHEC-HMS

- Designed by the Hydrologic Engineering Centre, U.S. Army Corps of Engineers
- HEC-HMS 3.5 for Windows, Solaris or Linux

Contains:

- Watershed Physical Description
 - Meteorology Description
 - Hydrologic Simulation
 - Parameter Estimation
 - Analyzing Simulations
 - GIS Connection
- Use depends on the available data in each case, **historical precipitation, time series** etc.
 - User can determine the mathematical model for analysis

Provide Design Hydrograph and Max Discharge Flow Needed

This software is free, widely used and scientifically accepted.

Large documentation on its use and technical background

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Data production for local scale implementation

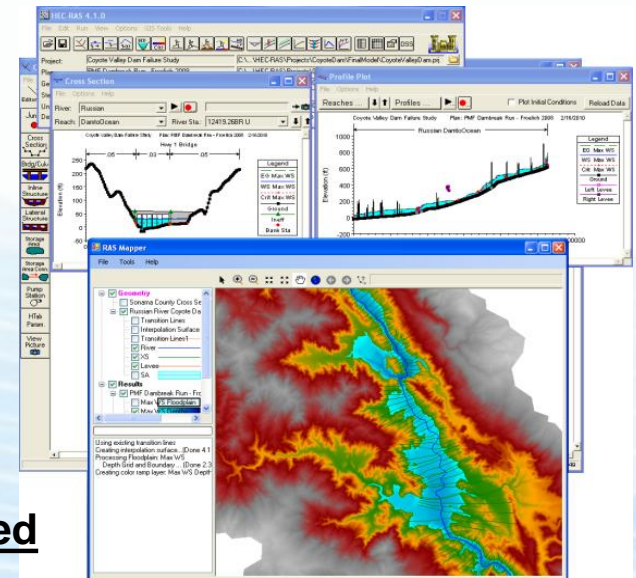
- **Max Discharge data:** Precipitation data, meteorological stations, past event data...but....not always available
- **DEM data:** **As accurate as possible ground geometry**
 1. Digitizing of available Maps of proper scale.....**1:500, 1:200**
 2. Satellite data-elevation data
 3. Surveying data in detail containing all structures in stream and surrounding area
- Land use & land cover data, city (urban) plans, places of interest, special structures
- Public network data (sewerage network and its discharge capability)
- Socio-economic data for the area of interest

Hydraulic Analysis....HEC-RAS

- The main objective of this methodological approach is the determination of the exact characteristics of a possible flood event for **different flood scenarios**.
- Assess the flooding parameters, with **HEC-RAS** software(River Analysis System, US Army Corps of Engineers - Hydrologic Engineering Center)
- **HEC-RAS** performs hydraulic calculations for a full network of natural and constructed channels

Capabilities of HEC-RAS:

- Hydraulic Analysis
- Data Storage and Management
- Graphics and Reporting
- RAS Mapper
- HEC-RAS 4.1 (among others...new Mapper and Sediment Transport Model)



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Implementation.....so far

Application steps:

1. Preparation, evaluation and synthesis of digital data
2. Field work
3. Hydrologic analysis through HEC-HMS
4. Hydraulic analysis through HEC-RAS
5. Flash Flood scenarios and Flood Risk maps

Digital Data produced:

- Contour lines and hydrographic network of 1:5.000 scale maps (HGMS-Hellenic Geographic Military Service),
- Corine Land Cover 2000 data updated by in situ research
- Precipitation data for a period of about 27years (HNMS Hellenic National Meteorological Service) -2 meteorological stations in the area.
- Surveying data of the stream bed and the surrounding area (stream geometry, cross sections, long sections-profile 1:200 scale)
- Street and city plan of 1:1000 scale maps.

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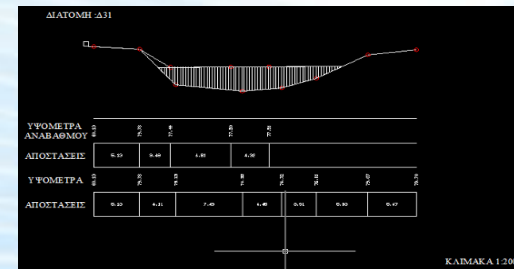
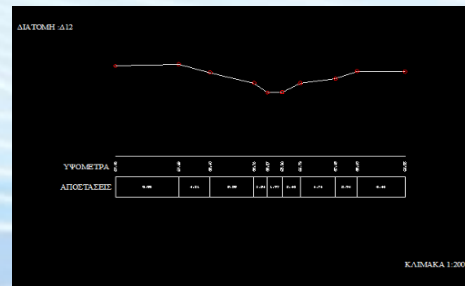
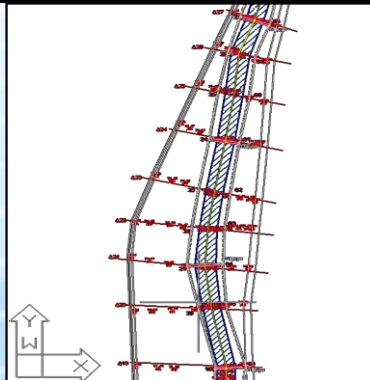
Data on Local Scale for Input Geometry in HEC-RAS



City map
digitizing

Cross
sections

Surveying
Data



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Implementation.....so far

Hydrologic Analysis led to the **basin discharge computation** (flow and sediment).

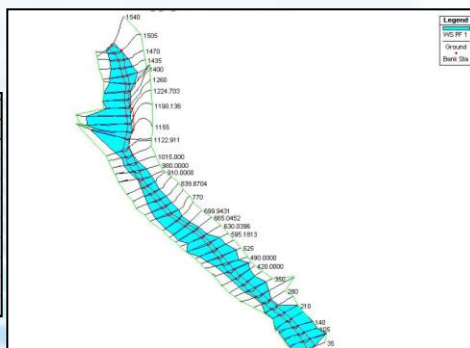
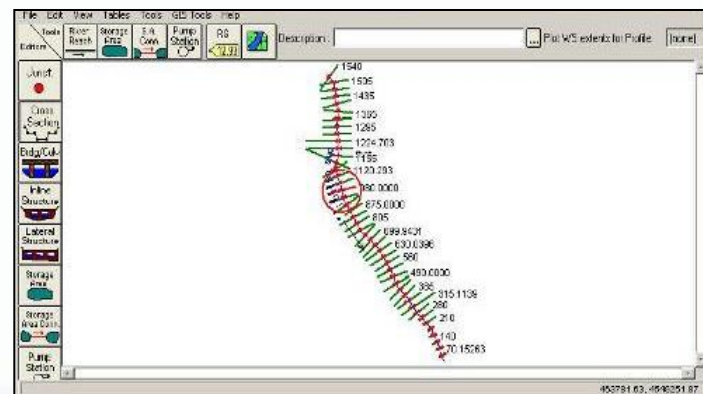
	10y	50y	100y
Flow Discharge (m³/s)	64.50	117.46	240.85
Sediment Discharge(m³/s)	14.15	25.77	52.84

Hydraulic Analysis in HEC-RAS used the **flow and sediment discharge**

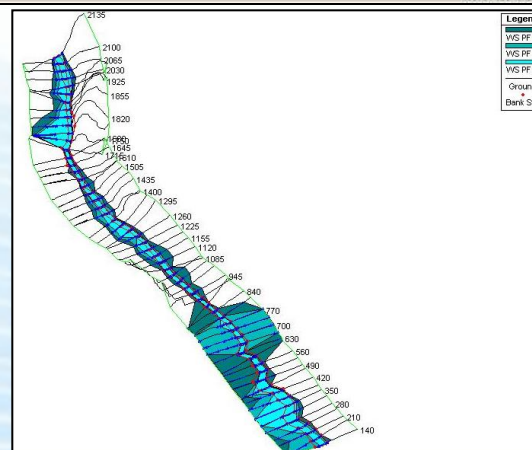
Results

Reach	River Sta	Profile	Q Total (m ³ /s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m ²)
1	18	PF 1	330.00	142.24	145.08		145.60	0.001906	3.18	103.76
1	17	PF 1	330.00	141.62	144.26	144.26	145.47	0.005135	4.88	67.62
1	16	PF 1	330.00	141.00	143.61	143.61	144.83	0.005194	4.88	67.60
1	15	PF 1	330.00	140.10	143.25	143.25	144.57	0.005031	5.10	64.65
1	14	PF 1	330.00	138.22	141.91		142.69	0.002448	3.91	84.44
1	13	PF 1	330.00	137.54	142.05		142.54	0.001239	3.10	106.52
1	12	PF 1	330.00	136.92	140.82	140.82	142.29	0.005031	5.38	61.39
1	11	PF 1	330.00	136.58	140.30	140.30	141.75	0.005049	5.33	61.88
1	10	PF 1	330.00	136.36	140.12		141.14	0.003284	4.47	73.86

Geometry input



“3-D” flood model



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Flood Risk Mapping....so far

10 (a), 50(b) and 100(c) year return flood period



a



b



c

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Thank you!

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