GIS Applications In Flood Forecasting Using HEC-RAS

Prepared by
Abdullah Abbas

Instructor
Dr. Baqer Al-Ramadan

OUTLINES

- Introduction
- Flooding: Cause And Effect
- Meaning And functions
- Methodology
- Case Study (1) In Greece.
- Case Study (2) In Zaremrood River, Iran.
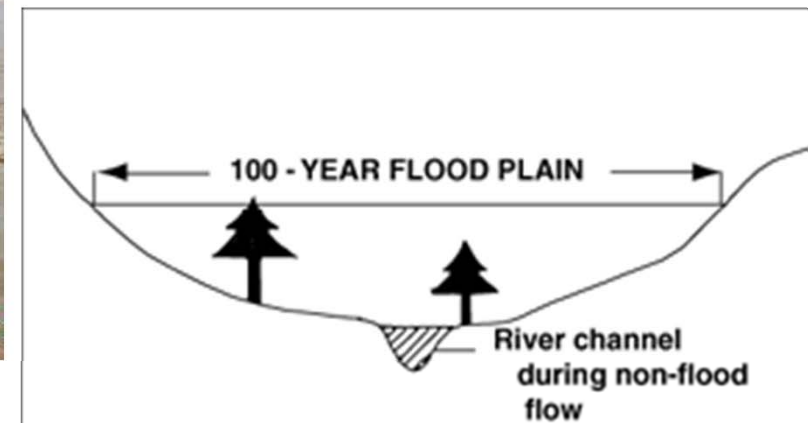- Results And Discussion.
- Conclusion & Recommendations

Introduction

What Is The Problem?

- Flood hazards.

Example Floodplain

100 - YEAR FLOOD PLAIN

River channel
during non-flood
flow

FLOOD PLAINS NORMALLY ARE DRY

Flooding: Cause And Effect

Why?

- To limit losses from water in its destructive capacity-flooding such as :

  - *Population*

  - *Homes*

  - *Infrastructure*

- **Managing and evaluating all river , rainfall, and Runoff. .**
- **Predicting of flood hazards**
- **Using a new technology**
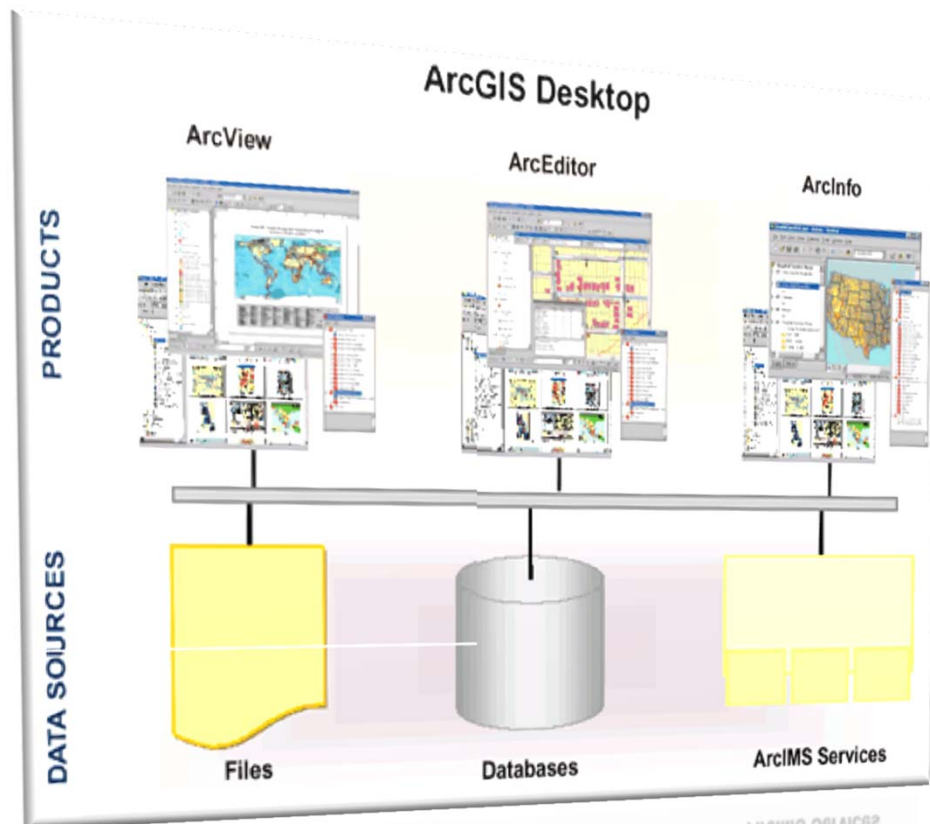
  - GIS (ArcGIS).

  - HEC-RAS.

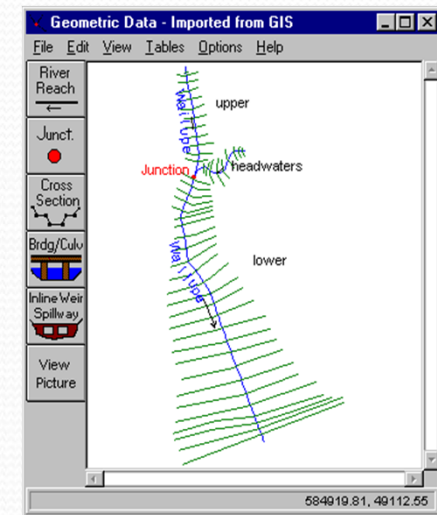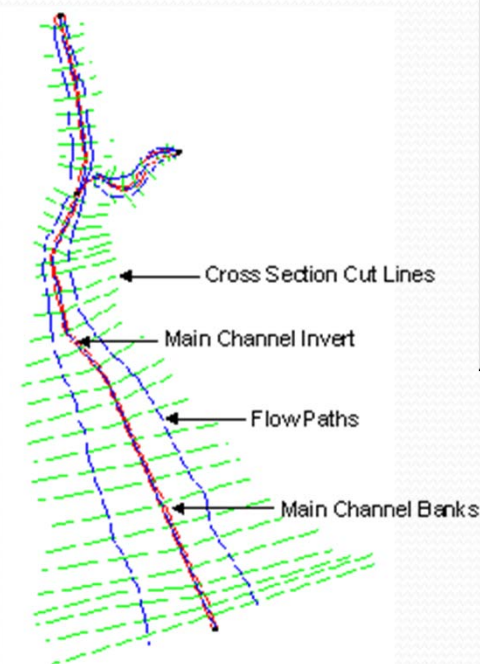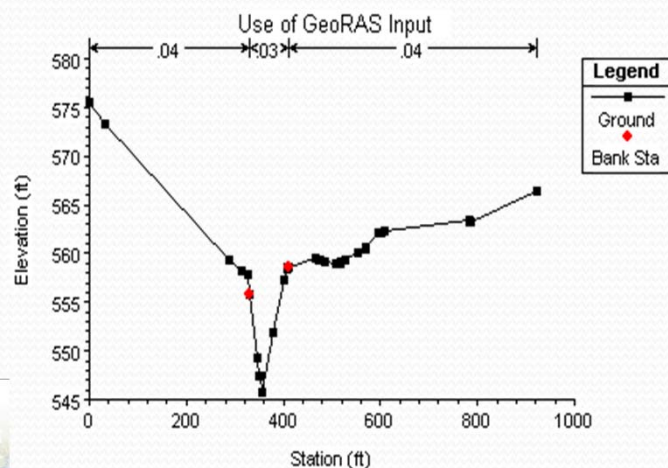**How ?**

Meanings And Functions

- **ArcGIS:** **G**eographic Information System, SW&HW

  - *Visualizing, managing,*
    - *editing, querying*
    - *Creating mapping*
    - *And analyzing*
  geographic data.

Meanings And Functions

- **HEC-RAS: developed by the** Hydrologic Engineering Center (HEC) for River Analysis System (RAS).

  - *hydraulic analysis program*

  - *analysis stream channel*
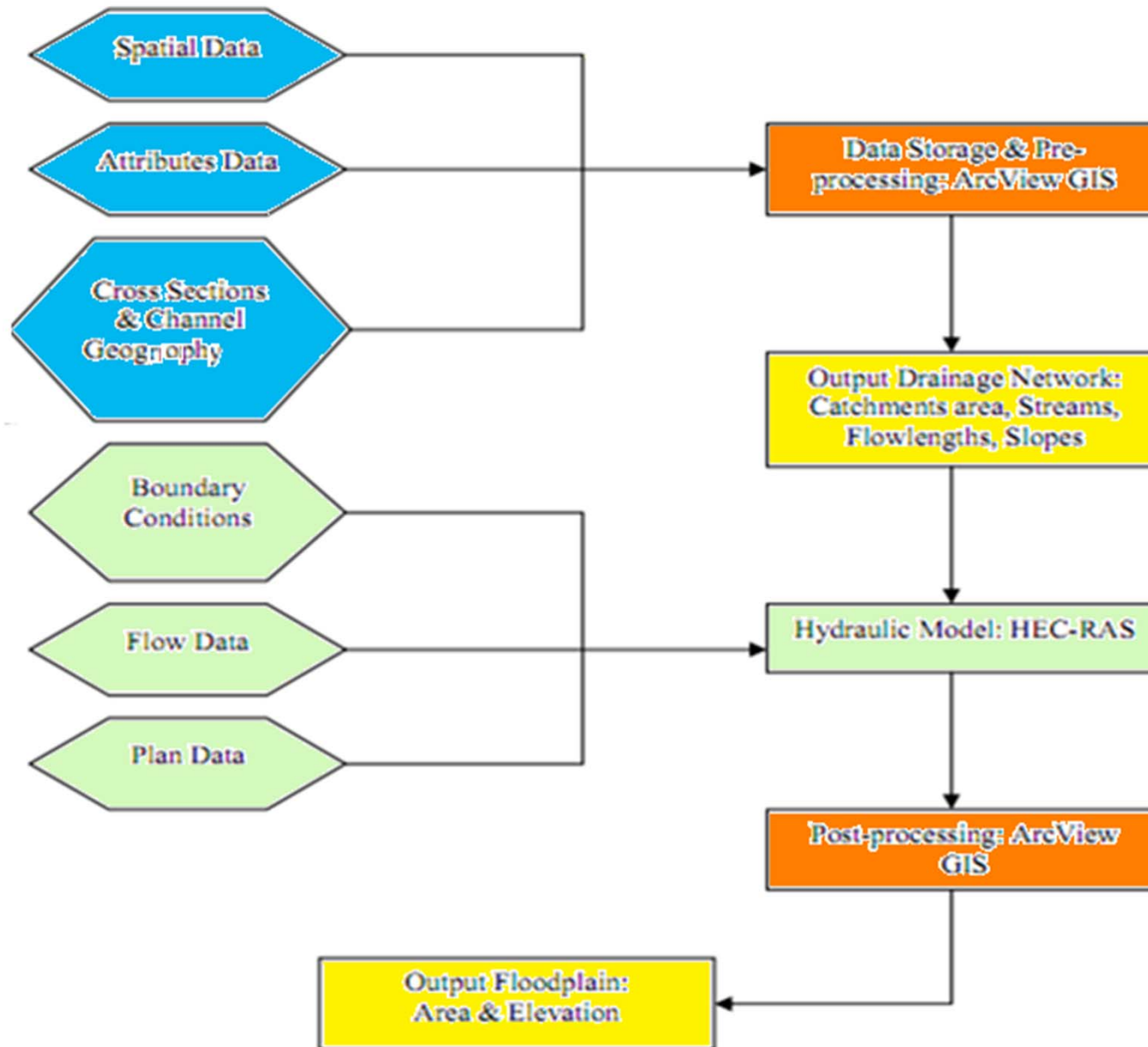
  - *Determination floodplain*

Methodology

- **Study area.**

- **Datasets.**

- **Analysis.**
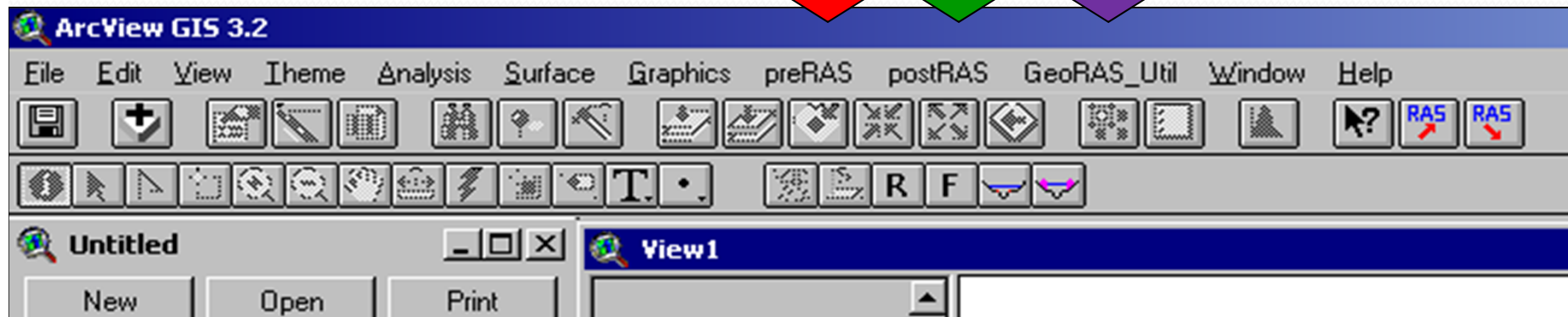
- **Hydraulic simulation.**

- **Results.**

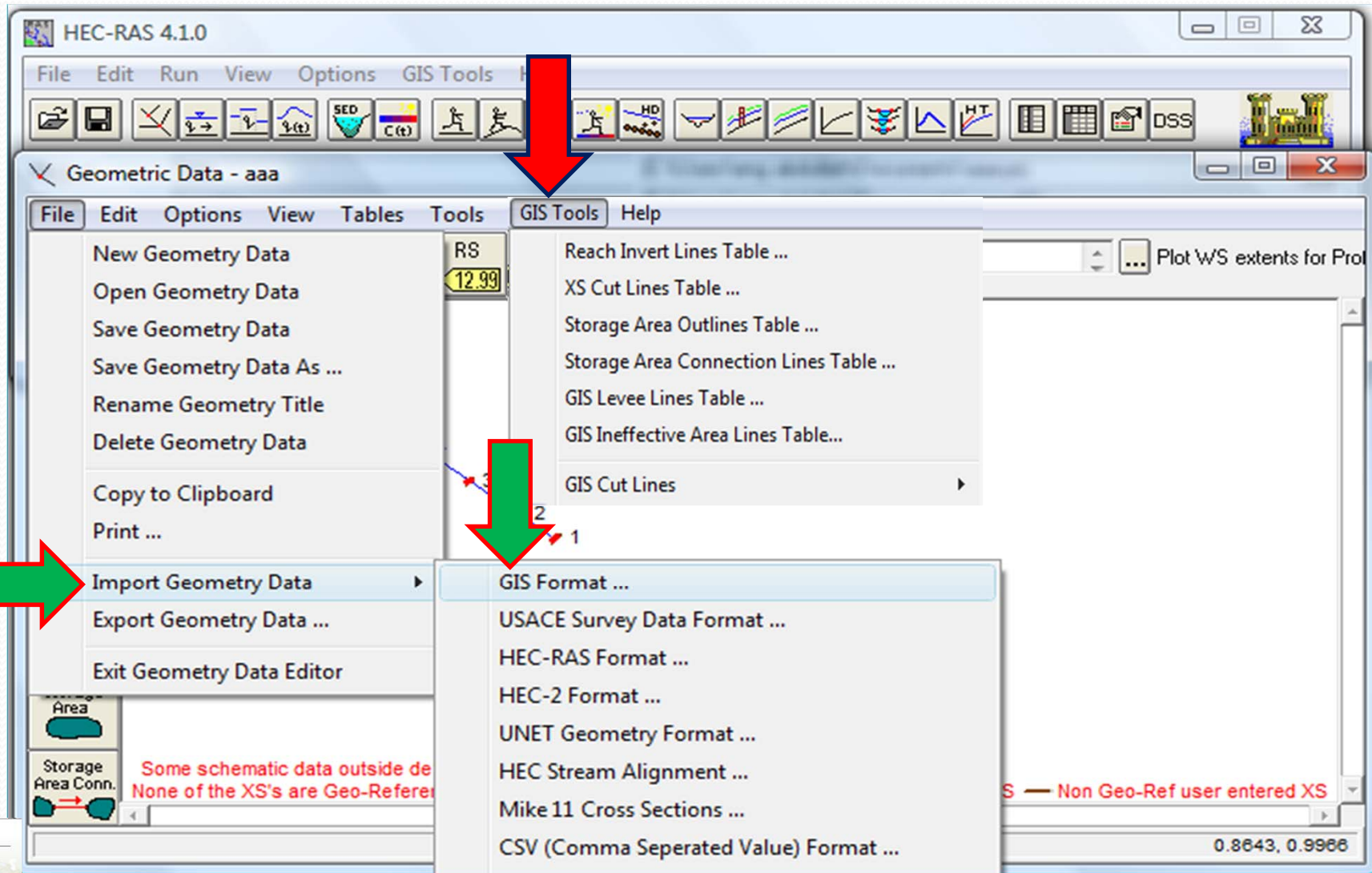# Procedure Of Applications (ArcView & HEC-RAS)

Summary For Analysis

- Interface between ArcView and HEC-RAS

- What does it do?
  - PreRAS Menu - prepares Geometry Data necessary for HEC-RAS modeling
  - GeoRAS_Util Menu – creates a table of Manning's n value from land use shapefile
  - PostRAS Menu – reads RAS import file, creates Velocity and Depth TINs
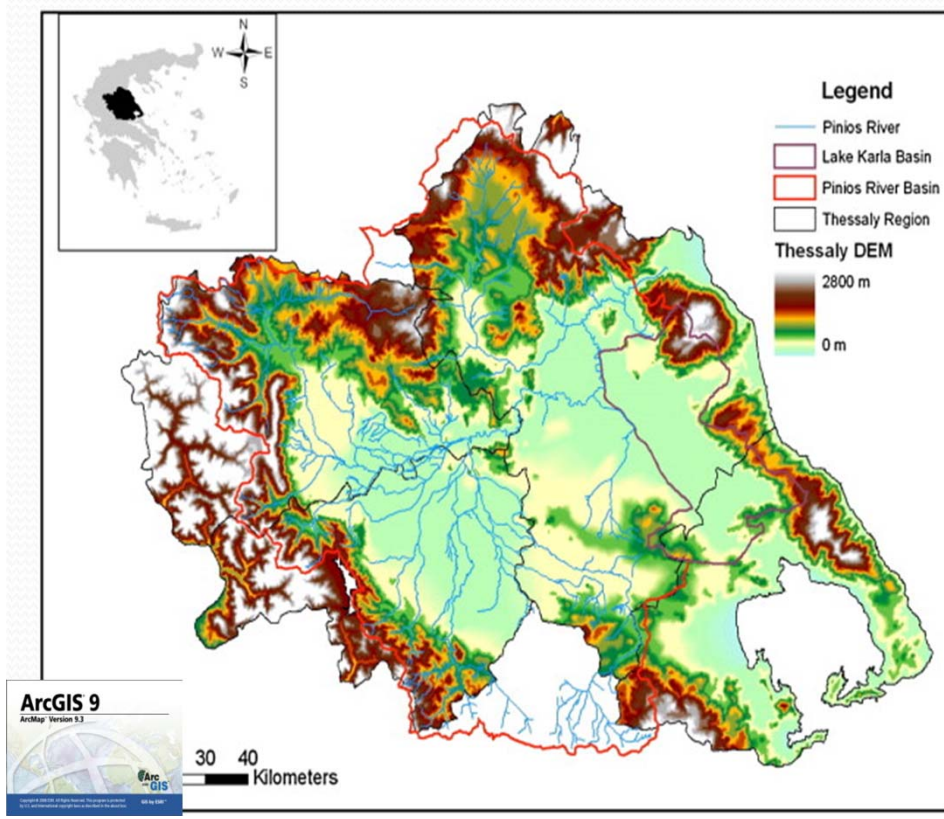
Summary For Analysis

Case Studies

GIS-Based Floodplain Mapping In Thessaly plain, Pineios river Greece – Case Study (1)

Flood Forecasting In Zaremrood River, Iran – Case Study (2).

Legend
- Pinios River
- Lake Karla Basin
- Pinios River Basin
- Thessaly Region

Thessaly DEM
- 2800 m
- 0 m

ArcGIS 9
ArcMap Version 9.3

30 40
Kilometers
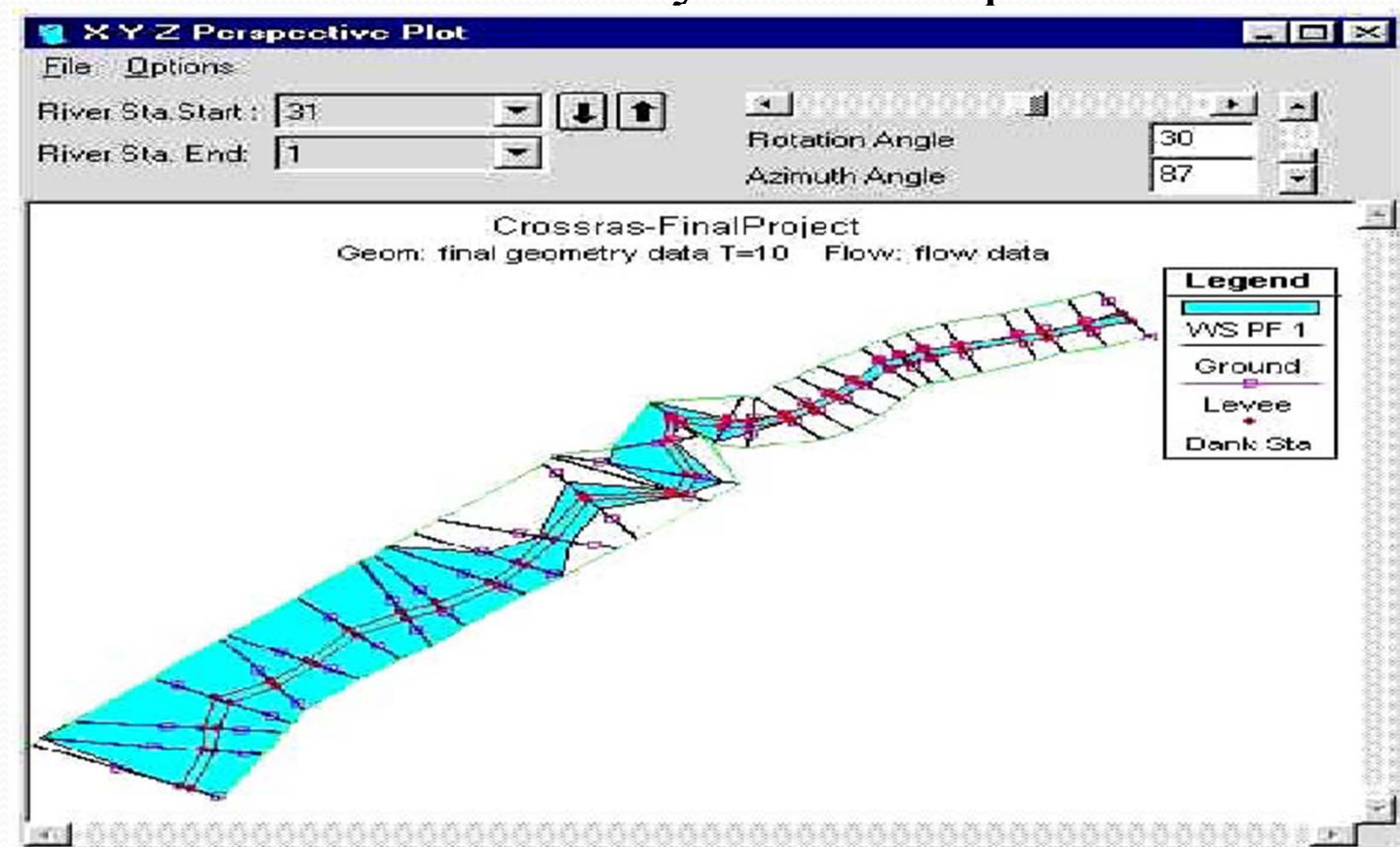
Results And Discussion
Datasets

- **Generation of HEC-RAS input file using ArcView pre-processor ,** The length of river is ~6.5 Km, width ~500m**.**

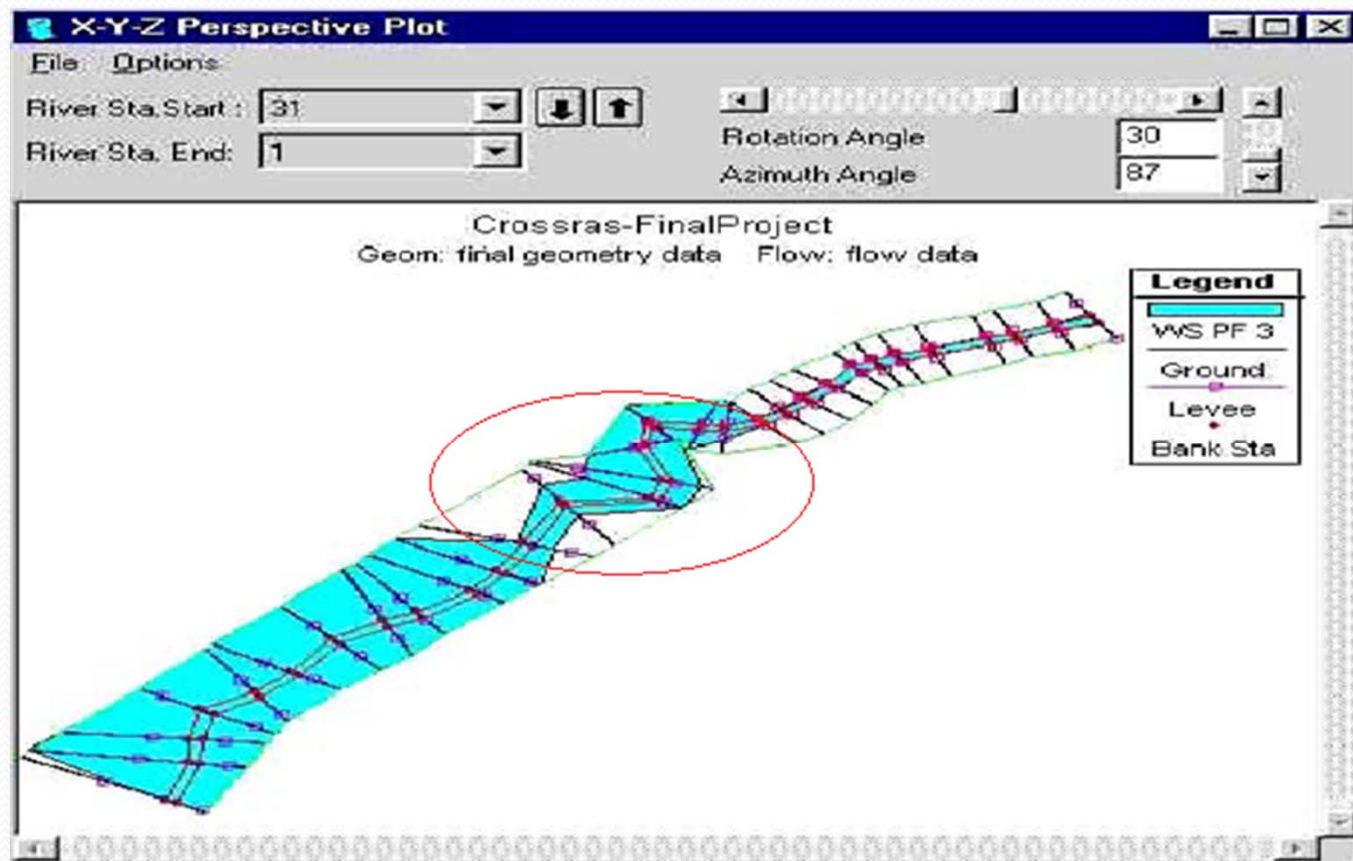# **Hydraulic Simulation Using HEC-RAS**

- Water surface extents for the 10 - year return period.

Hydraulic Simulation Using HEC-RAS

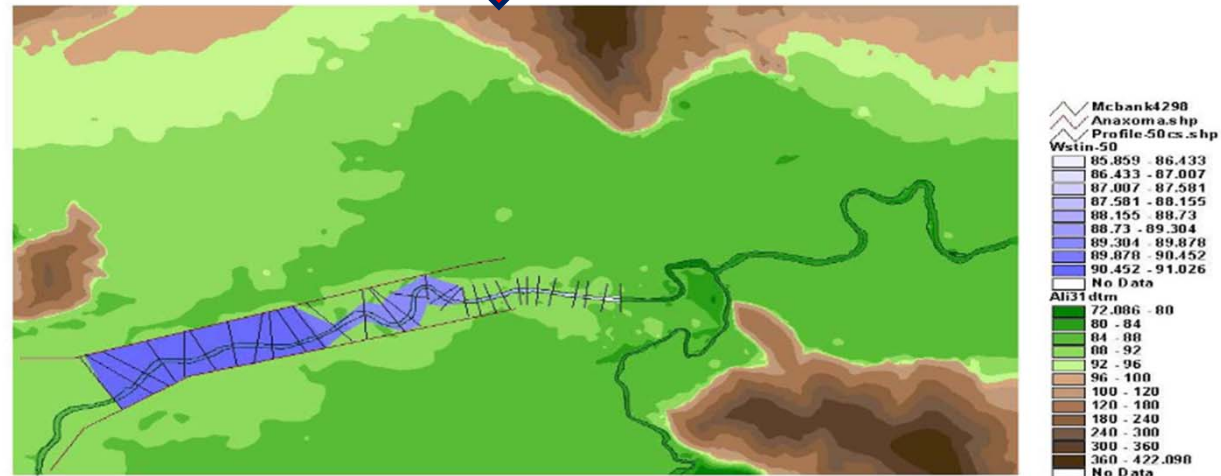- Water surface extents for the 50- year return period.

Export Of HEC-RAS Results

Water surface
elevations for
the 10- year
return period.

Water surface
elevations for
the 50- year
return period.
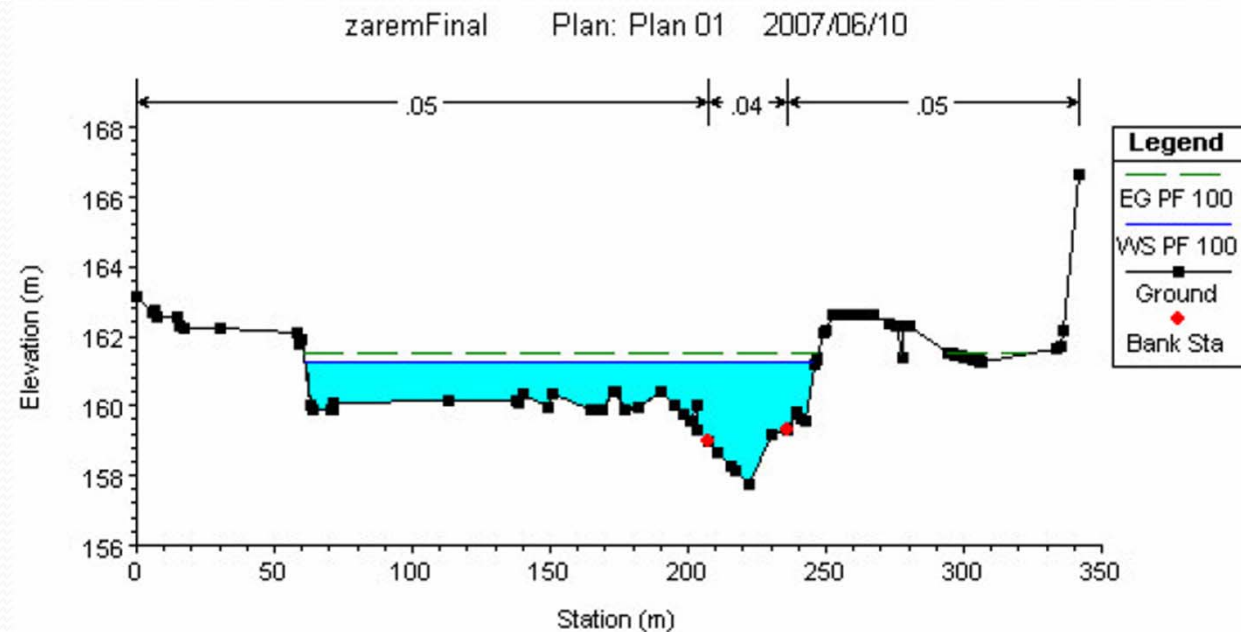
Cross section plots of 2 years flood level, using HEC-RAS Model

Cross section plots of 100 years flood level, using HEC-RAS Model

The Final Result

- 100-year water surface profile of Zaremrood River as a result of HEC-RAS simulation.

Conclusion

Using GIS with HEC-RAS in flood forecasting is the best way for evaluation:

➢ Rapid preparation of geometry data (point and click), via import/export files.

➢ Floodplain maps can be made faster

➢ Floodplain maps can include several flow scenarios.

➢ Makes data into visual event – easier for your brain to process!

Recommendations

- Establish local flood forecasting centers.

- Providing early warning by forecasting magnitude.
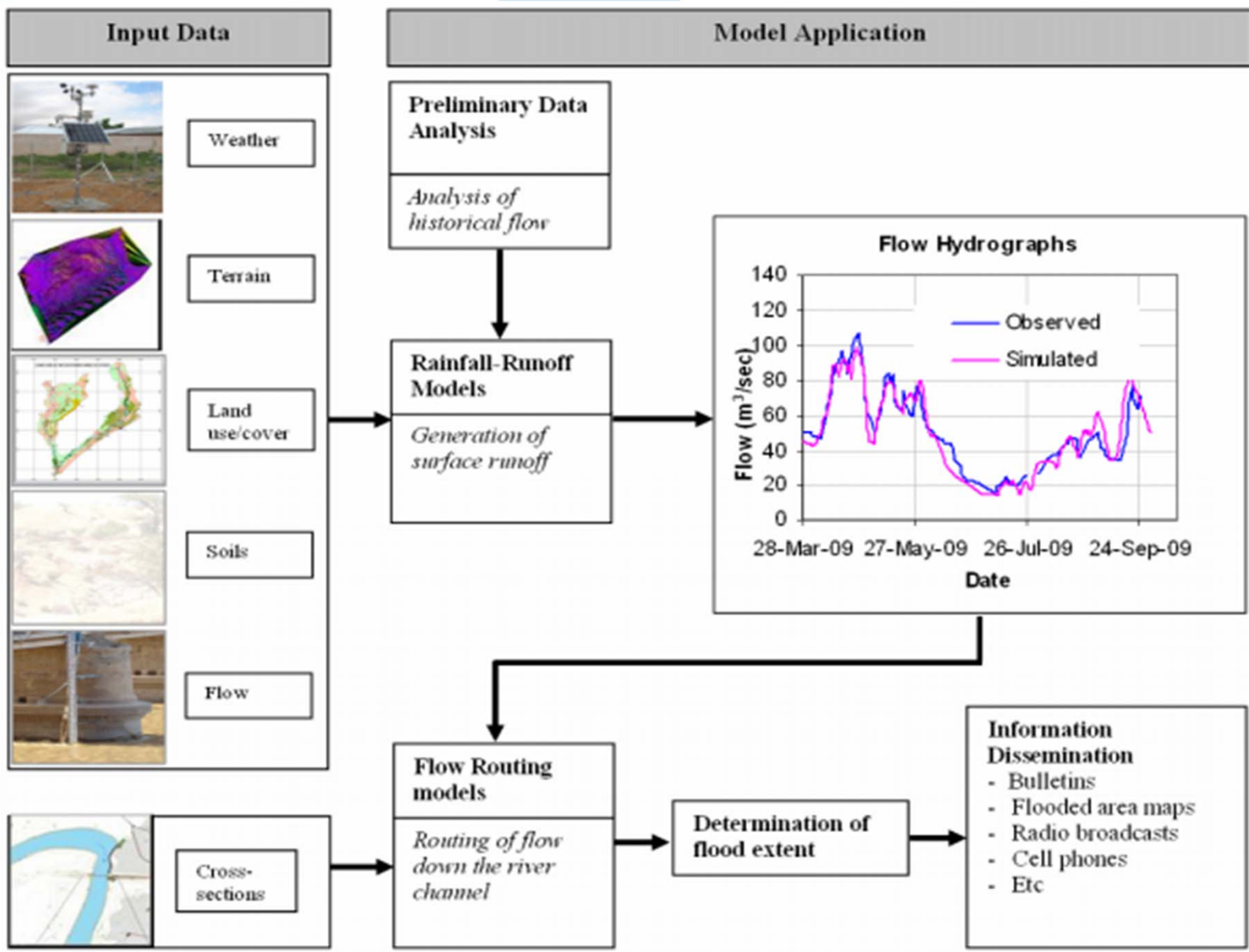
- Improve communication between the National Weather Service and emergency management personnel identifying where flooding is occurring.

- Establish The Flood Forecasting System.

The Flood Forecasting System

References

- Yang J, Townsend RD, Daneshfar B (2006). Applying the HEC-RAS model and GIS techniques in river network floodplain delineation. Canadian. *J. Civil. Eng. 33(1): 19-28.*

- ESRI inc., (1998). AVRas- the HEC-RAS interface ArcView extension. *Suer's manual*

- Griva A., (2000). Geographical mapping in the Thessaly plain. *National Technical University of Athens.* Maidment D.R.,(1993). Handbook of hydrology. *Mc Graw- Hill Inc,USA.*

- Shaw E.M.,(1994). Hydrology in practise. *Chapman & Hall, London.*

- Tate E.C.,(1999). Floodplain mapping using HEC-RAS and ArcView GIS. *University of Texas at Austin, Austin.*

- Tchoukanski J., (1997). Profile extractor. *User's manual (http:www.esri.com).*

- USACE-HEC, (1999). Hydraulic Engineering Center's River Analysis System (HEC-RAS). *User's manual.*

- Hardmeyer K, Spencer BA (2007). Using risk-based analysis and geographic information systems to assess flooding problems in an urban watershed in Rhode Island. *J. Environ. Manage. 39(4): 563- 574.*

- Hausmann P, Weber M (1988). Possible contributions of hydro informatics to risk analysis in insurance, In: Proc. *2nd International Conference on Hydro informatics, Zurich, Switzerland, 9–13 September, Balkema, Rotterdam.*

- Hydrologic Engineering Center, 2005. HEC-RAS river analysis system. Hydraulic Reference *Manual ver. 3.1.3 U.S. Army Corps of Engineering., 262pp.*

- Machado M, Ahmad S (2006). Flood hazard assessment of Atrato River in Colombia. *J. Water Resour. Manage. 21(3): 591-609.*

- Noman NS, Nelson EJ, Zundel AK (2003). Improved process for floodplain delineation from digital terrain models. *J. Water Resour 129: 427-436.*

Thank You