**King Fahd University of Petroleum & Minerals**
**City & Regional Planning Department**
**Introduction to Geographic Information Systems**
**Term Paper Presentation**

# GIS Applications in Water Resources Engineering

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# Outline

- ➤ Introduction
- ➤ Objectives
- ➤ Literature Review
- ➤ GIS for Surface Water Hydrology
- ➤ GIS for Groundwater Hydrology
- ➤ GIS for Water Quality
- ➤ Conclusion

# Introduction

❖ GISs are strongly impacting the fields of water resources engineering.

❖ GIS is now accepted as a useful tool for assembling water resources information.

❖ Processing and modeling of data can be done using GIS.

❖ The GIS software packages used most widely throughout the world are the Arc hydro, Arc Info and ArcView systems developed by ESRI in Redlands, California.

# Introduction

❖There are many applications of GIS in a river basin, such as:

✓ Defining the watershed and its hydrologic and hydraulic characteristics

✓ Interpolating groundwater contaminate concentration

✓ Finding the coincidence of factors

✓ Monitoring the occurrence and intensities of thunderstorm

# Objectives

*The main objective of this paper is:*

- *To give more explanation of GIS concepts in water resources engineering planning and design.*

- *To know how GIS can provide hydrologists with more hydrologic information.*

- *To make a general overview how it has been used to support water resources development.*

## Literature Review

➡️ *An application of hydrological response units (HRUs) in Germany-Brol catchment (by Albert, 1997).*

➡️ *Development of unit hydrograph that helps scientists to determine internal distribution flow through watershed (by Davie Maidment, 1993).*

➡️ *A hydrological model that uses detailed basin characteristics to predict hydrological processes (by Smedt, Yongbo, and Gebremeskel, 2000).*

# GIS for Surface Water Hydrology

*Surface water hydrologic data:*

❖*Terrain*

- Digital elevation models
- Slop and aspect
- Watersheds and sub-catchments
- Drainage network

❖*Soil*

- Permeability
- Layer depth
- Soil textural
- Soil water content

# GIS for Surface Water Hydrology

*Surface water hydrologic data:*

❖ ***Precipitation & climate***

- Rain-gauge data

- Gauge locations & context

- Statistics(e.g., *intensity, duration*)

- Temperature

- Evaporation & transpiration

❖ ***Streamflow records***

- Storm runoff events

- Statistics(e.g., *frequency, peak value*)

# GIS for Surface Water Hydrology

→ *Floodplain Management*

✓ Applications of GIS for determination of management information.

✓ GIS has become central to the conduct of such modeling that required for supporting flood management strategies.

# GIS for Surface Water Hydrology

❖ *GIS for surface water hydrology modeling*

➢ *The basic processes of hydrologic model include:*

- *Precipitation.*

- *Abstractions and infiltration losses, soil moisture accounting.*

- *Overland flow generation and routing.*
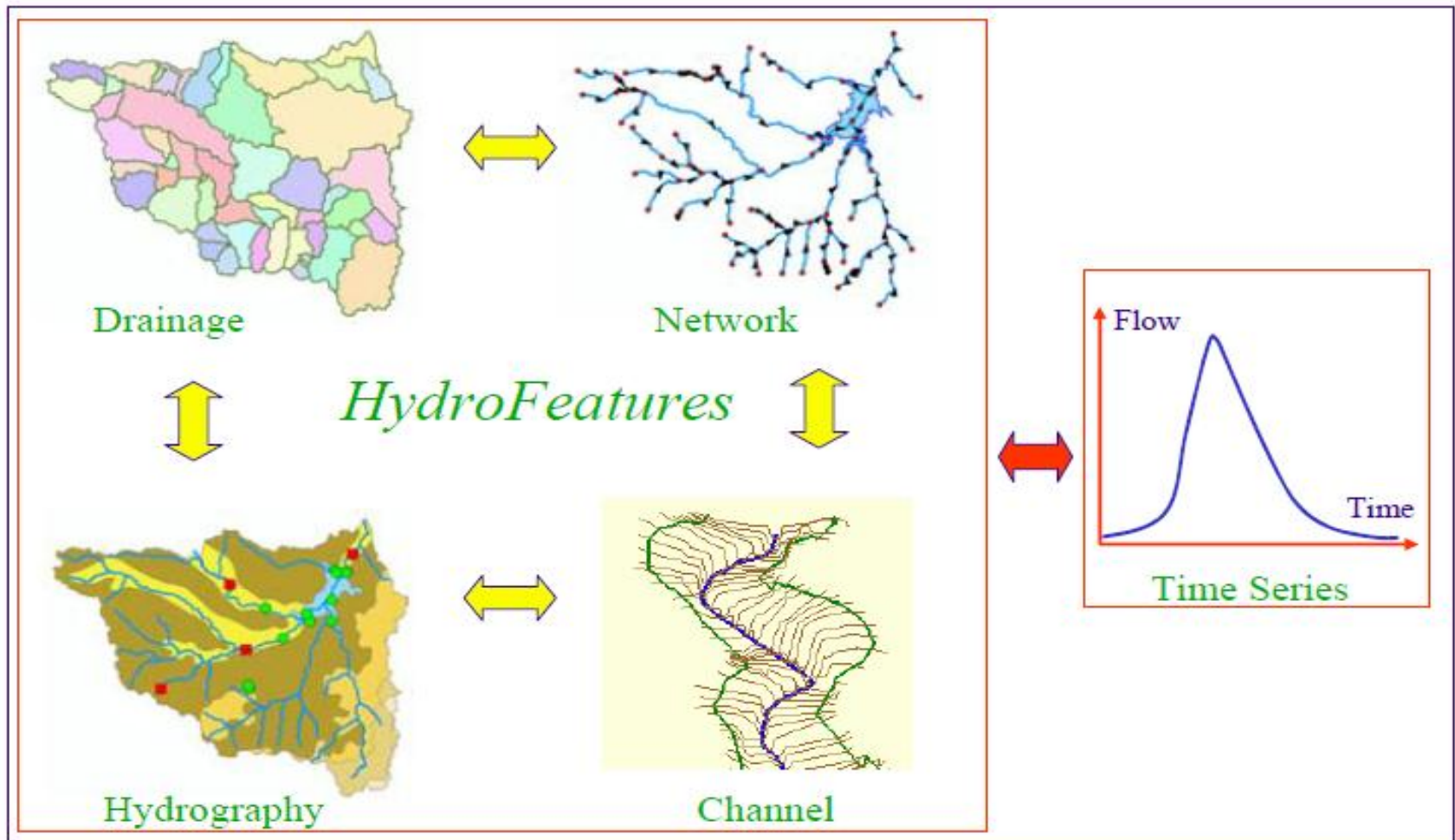
- *Stream channel routing hydraulics.*

# GIS for Surface Water Hydrology

▶ *Arc Hydro data model and tools:*

➢ Arch hydro is a data structure that supports hydrologic simulation models.

➢ Arc hydro data model provides a template for the creation of a wide variety of hydrologic and water resources.
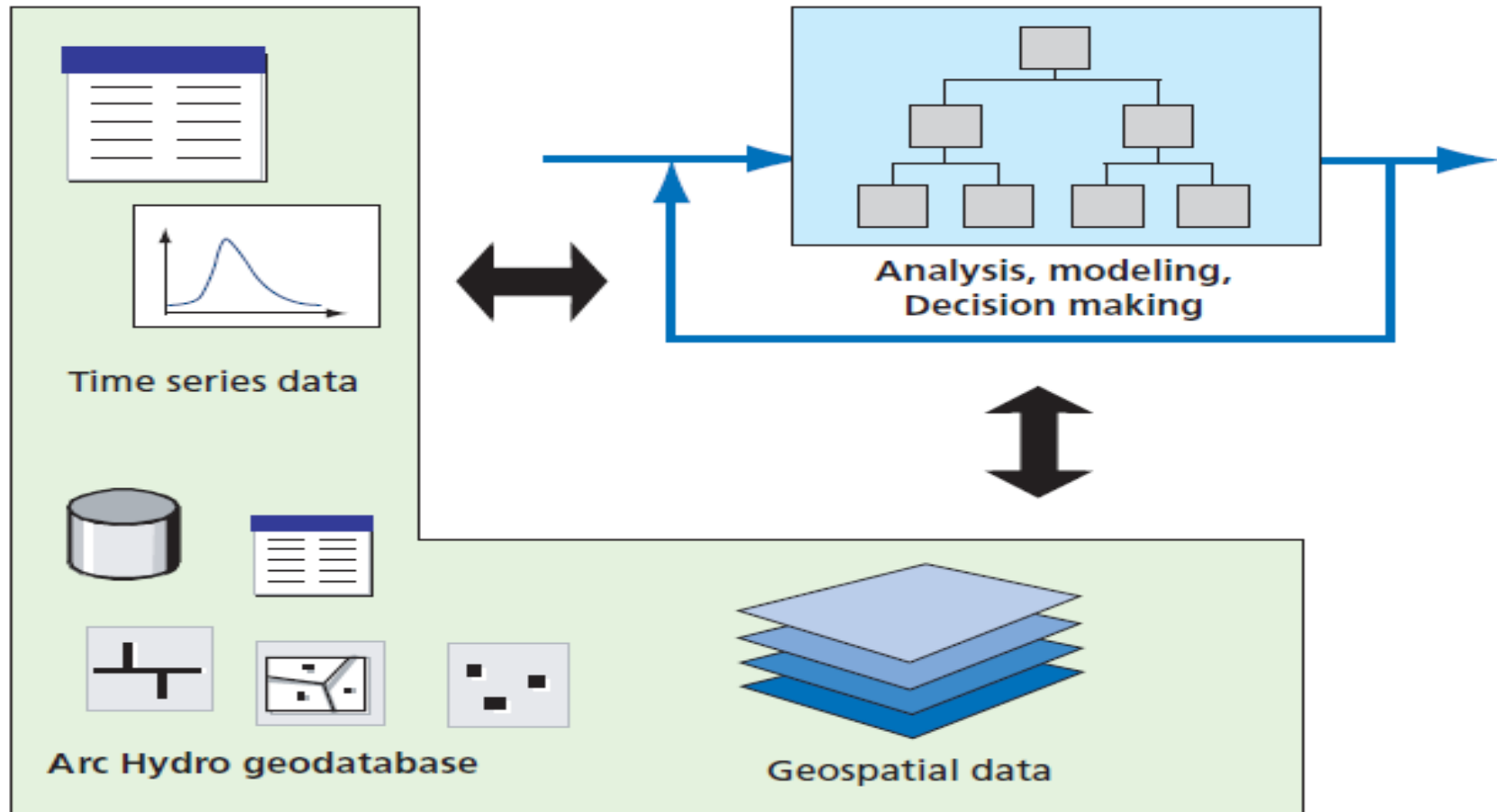
# GIS for Surface Water Hydrology

# GIS for Surface Water Hydrology



A hydrologic information system connects time series and geospatial data with hydrologic analysis and modeling.

# GIS for Groundwater Hydrology

✓ GIS has found extensive applications for groundwater assessment.

✓ Principle types of data are commonly required.

✓ Some data and information such as geologic and hydro-geologic maps are difficult to obtain and require years to develop.

✓ GIS can help with modeling process to provide database and supporting systematic model parameter assignment.

# GIS for Water Quality

➢ Water quality is one of the most important subjects in water resources.

➢ GIS performs a central role of efforts to monitor water quality changes within a body, and modeling water quality of aquatic systems.

# Conclusion

❖ GISs and simulation models have contributed to the identification and evaluation of potential solutions to water problems during the past decade.

❖ GIS has influenced the development and implementation of hydrologic models at several different levels.

❖ GISs have provided tools to compute average values more efficiently and to include at least some level of spatial effects by watersheds into sub-watersheds.

❖ There are many advantages for using GIS in water resources, such as the ability of modeling systems for rivers, channels, and coastal waters.

Land Use

Roads

Streams

Elevation
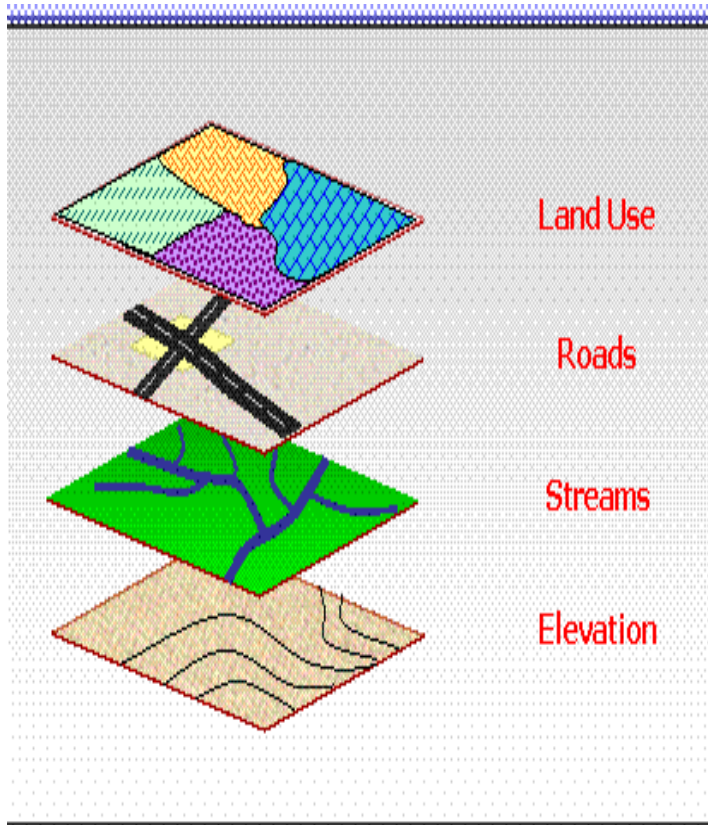
*Water* is fundamental to human life and the functioning of the natural environment

*Q & A*
*Thanks for your listening*