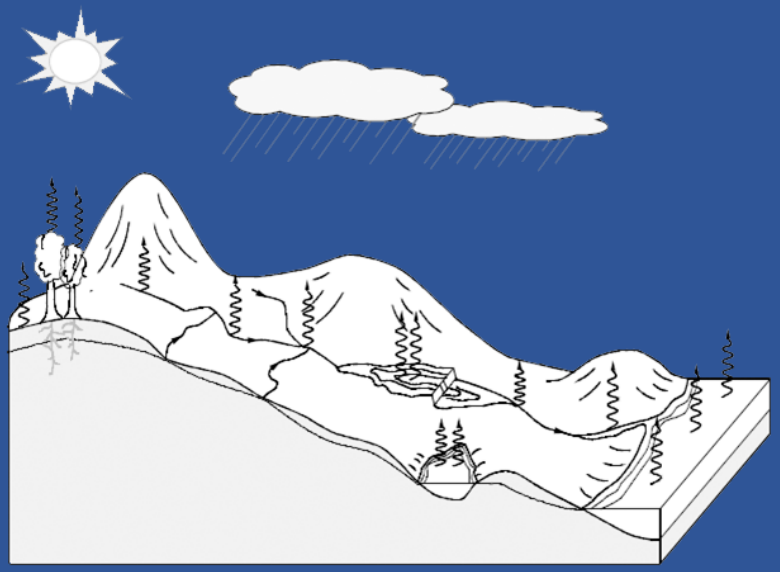
NATIONAL TECHNICAL UNIVERSITY OF ATHENS
SCHOOL OF CIVIL ENGINEERING
DEPARTMENT OF WATER RESOURCES AND ENVIRONMENT
LABORATORY OF HYDROLOGY AND WATER RESOURCES MANAGEMENT

Hydrological Simulation with HEC-HMS

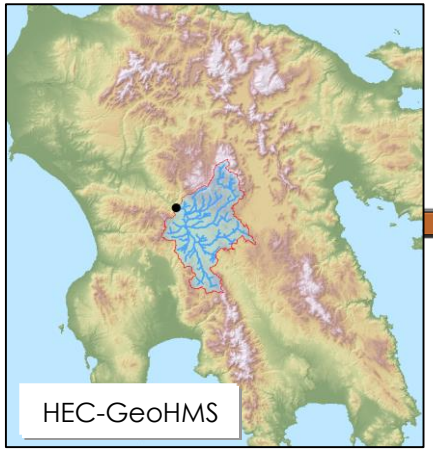


Evangelos Baltas, Professor NTUA

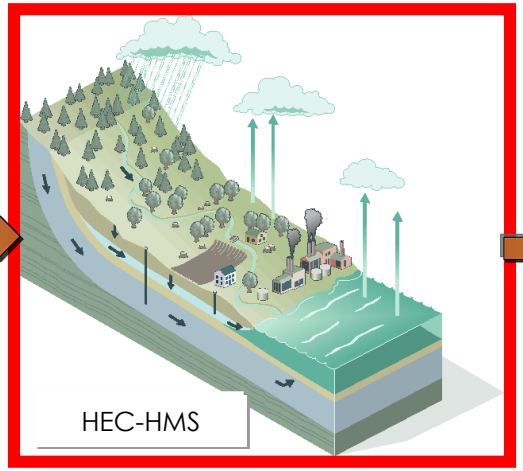
Apollon Bournas, PhD student

➢Complete Hydrological and Hydrodynamic analysis with HEC tools

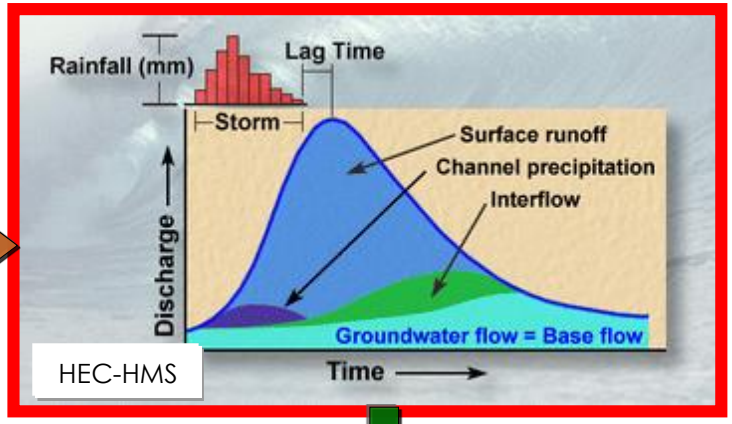
Basin Geomorphological Analysis



Hydrological Analysis



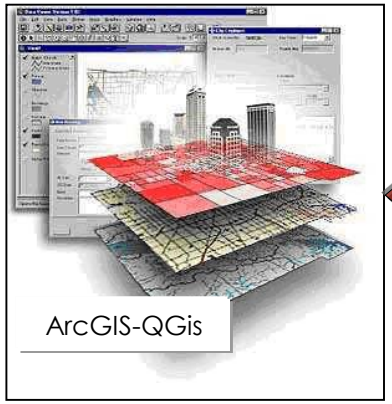
Rainfall – Runoff Analysis



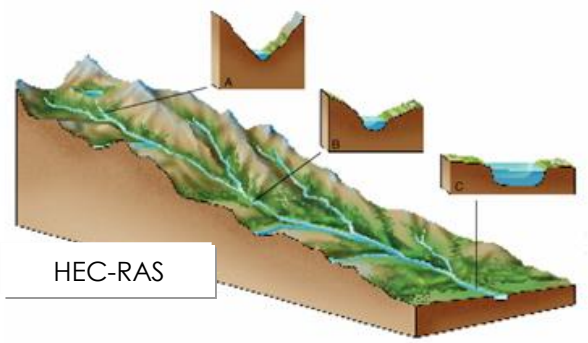
2D

1D

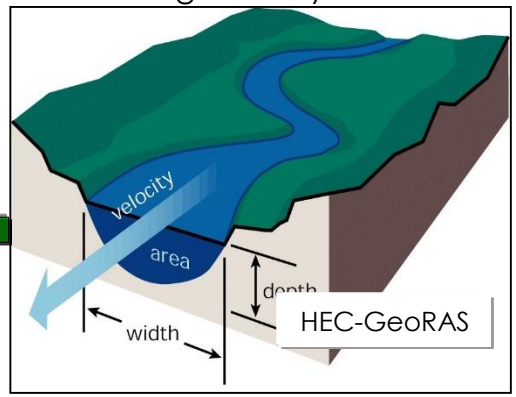
Flood Mapping



Hydrodynamic Simulations



Calculation of cross section geometry



The Software

Developed by the US Army Corps of Engineers (USACE)

- Most used software for Hydrological Applications
- Free to download and use

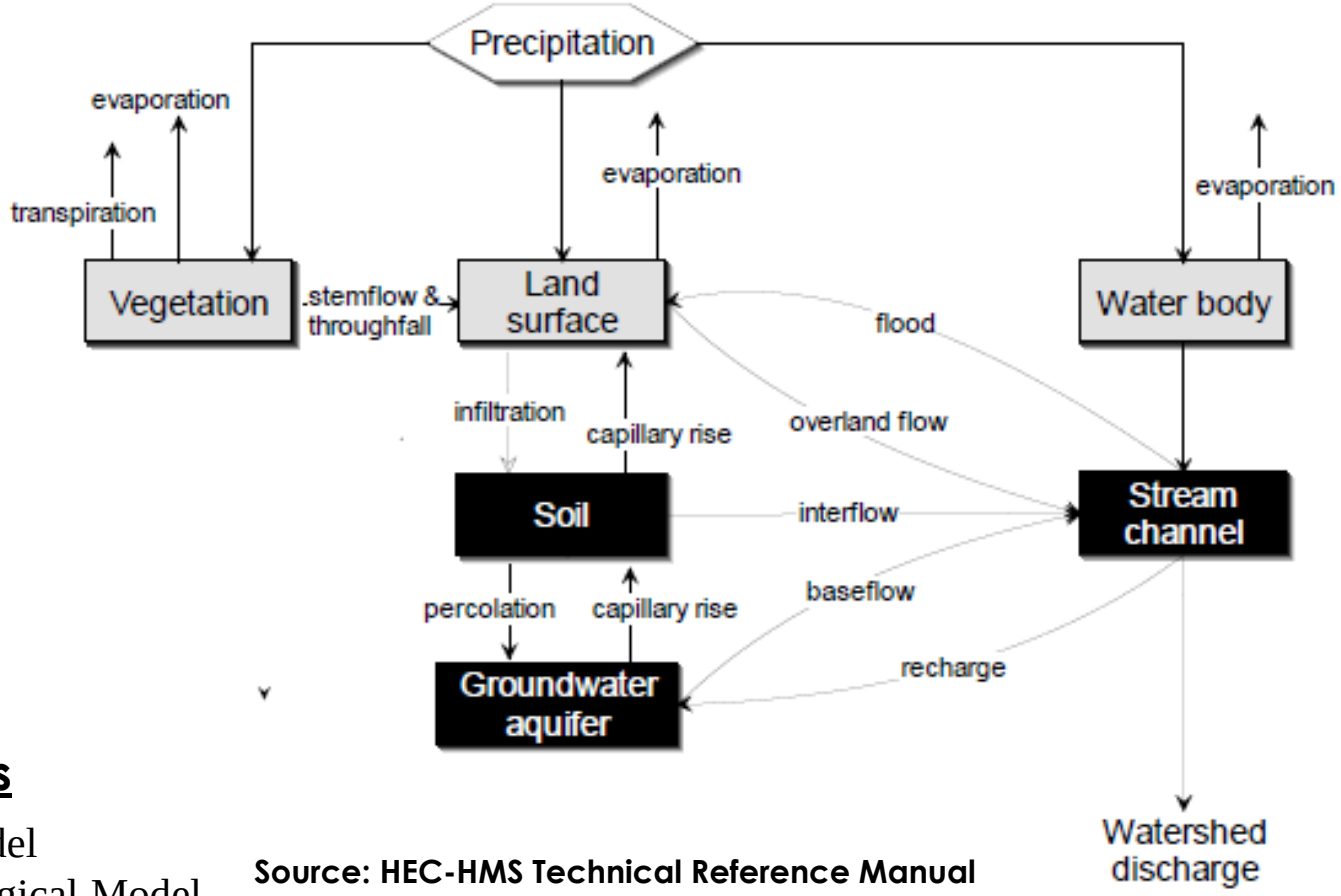
Developer Web-site
https://www.hec.usace.army.mil/software/hec-hms/

Downloads -> Current Version **HEC – HMS 4.10 (Includes GIS analysis)**

Documentation:
HEC-HMS User's Manual
HEC-HMS Quick Start Guide
HEC-HMS Applications Guide

Technical Reference
HEC-HMS Technical Reference Manual

Basic Rainfall – Runoff model



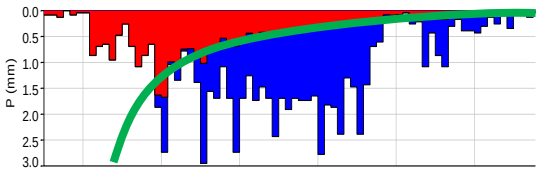
Source: HEC-HMS Technical Reference Manual

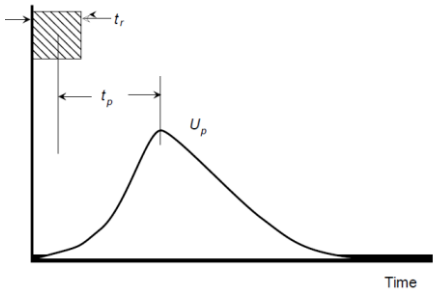
Submodels

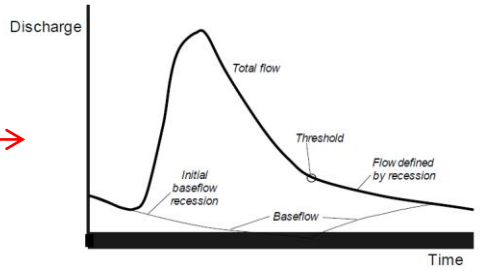
- Basin Model
- Meteorological Model
- Loss Method
- Transform Method
- Baseflow Method
- Routing Method

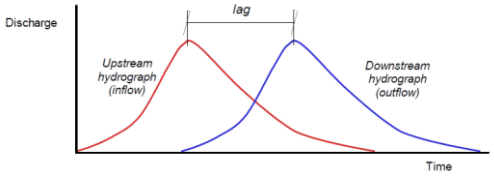
Hydrological Submodels

Hydrologic Element	Calculation Type	Method
Subbasin	Canopy	Dynamic Simple (also gridded)
	Surface	Simple (also gridded)
	Loss Rate	Deficit and constant (also gridded) Exponential Green and Ampt (also gridded) Initial and constant SCS curve number (also gridded) Smith Parlange Soil moisture accounting (also gridded)
	Transform	Clark unit hydrograph Kinematic wave ModClark SCS unit hydrograph Snyder unit hydrograph User-specified s-graph User-specified unit hydrograph
	Baseflow	Bounded recession Constant monthly Linear reservoir Nonlinear Boussinesq Recession
Reach	Routing	Kinematic wave Lag Lag and K Modified Puls Muskingum Muskingum-Cunge Normal Depth Straddle stagger
	Gain/Loss	Constant Percolation







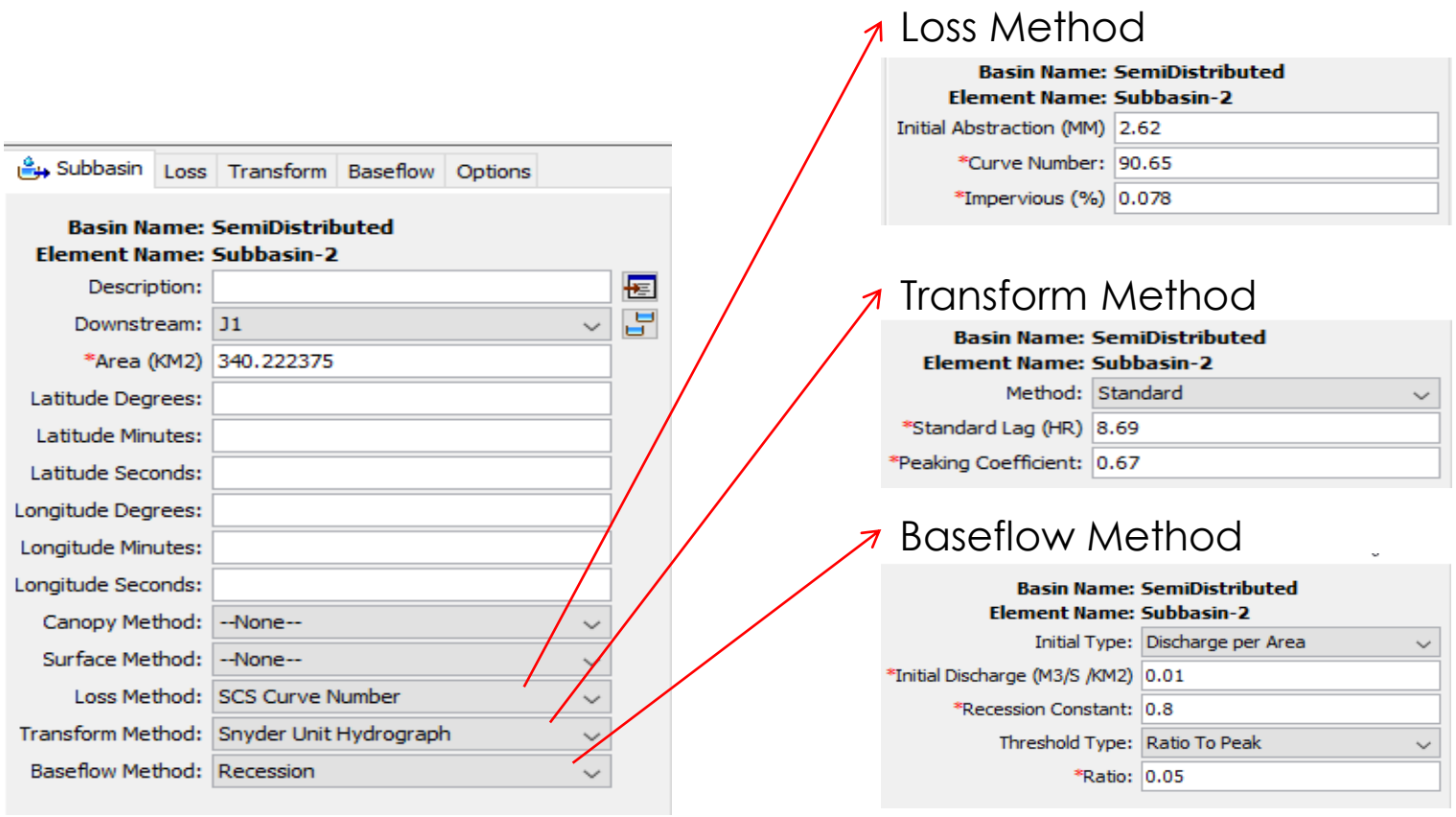


Sournce: HEC-HMS Technical Reference Manual

Data Input

What parameter should I enter at each selection? -> **HEC-HMS User's Manual.**

What is the nature or how can I calculate the parameter that I am supposed to enter. What is the equation used to solve the problem? **HEC-HMS Technical Reference Manual**



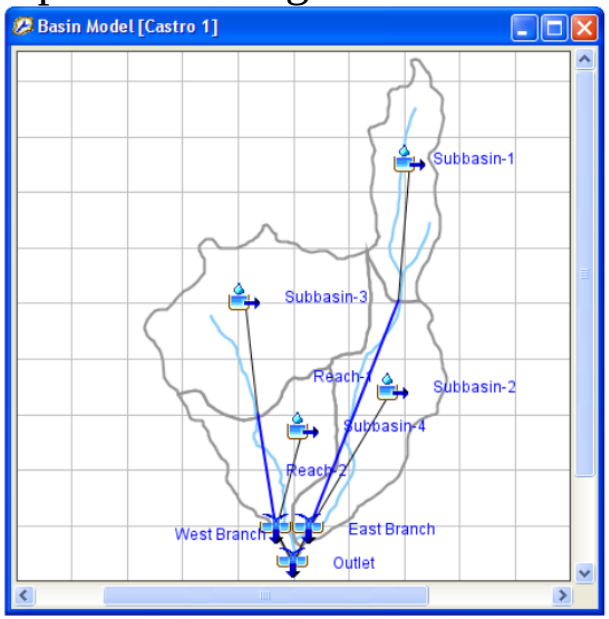
Watershed Physical Description

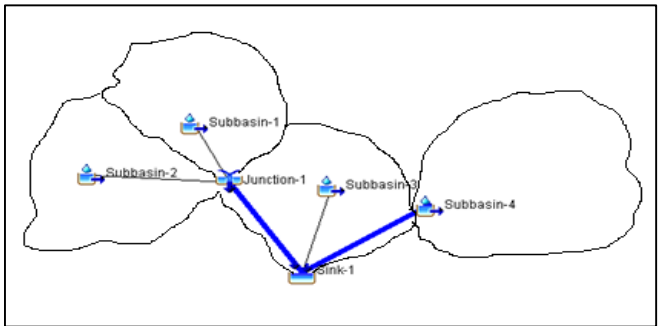
Hydrological Elements

Hydrological Elements are the basic building blocks of a basin model. An element represents a physical process such as a watershed catchment, stream reach, or confluence. Each element represents part of the total response of the watershed to atmospheric forcing.

Hydrologic Elements

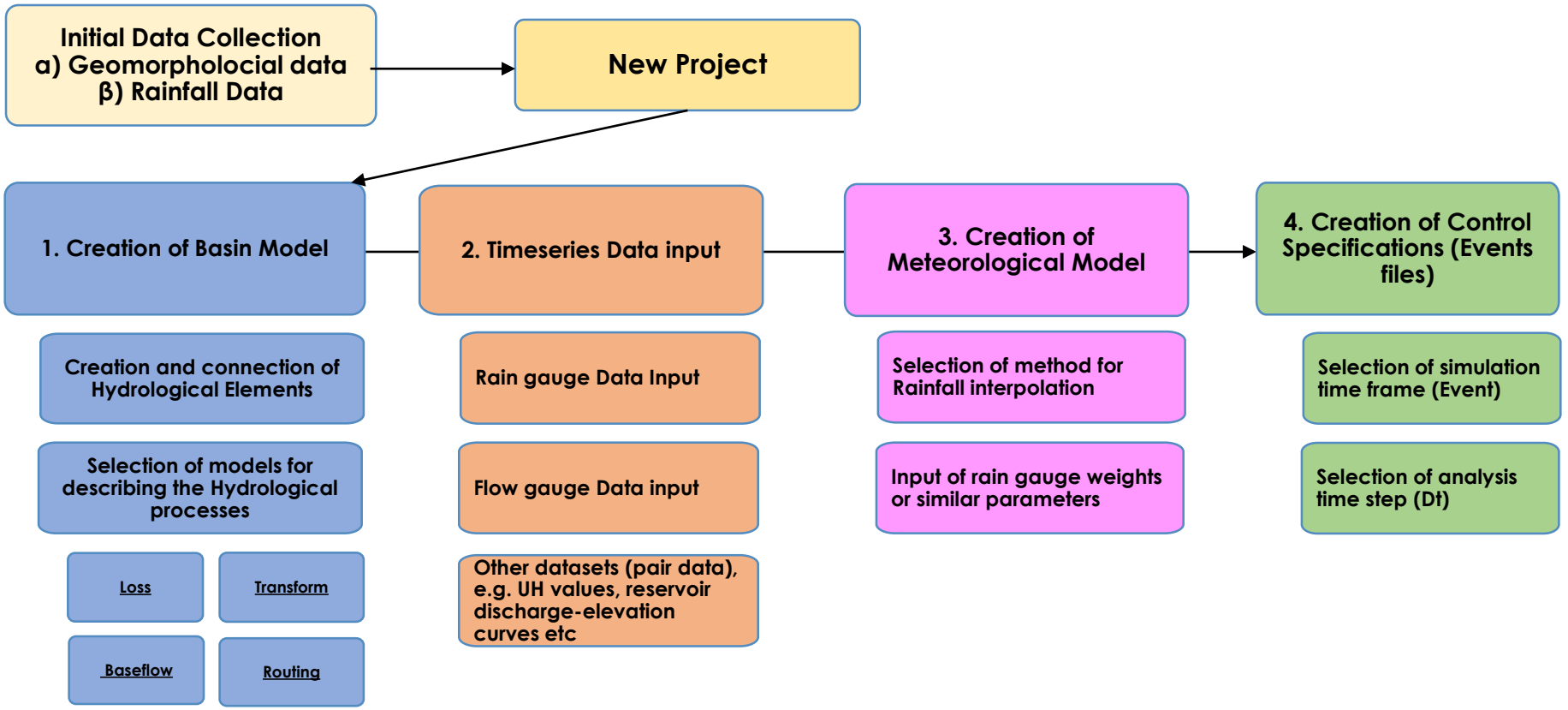
- Subbasin
- Reach
- Junction
- Sink
- Source
- Reservoir
- Diversion

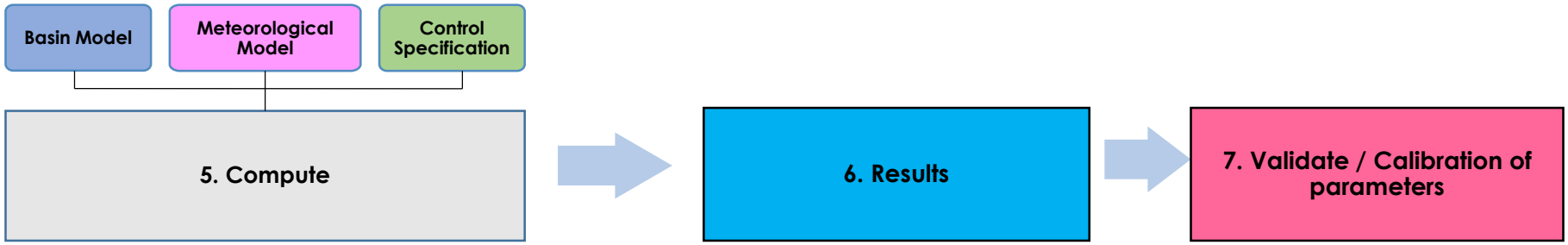




For each element, a set of essential parameters need to be determined, based on the sub model selection used and the nature of the Hydrological Element.

Hydrological Analysis Steps with HEC-HMS

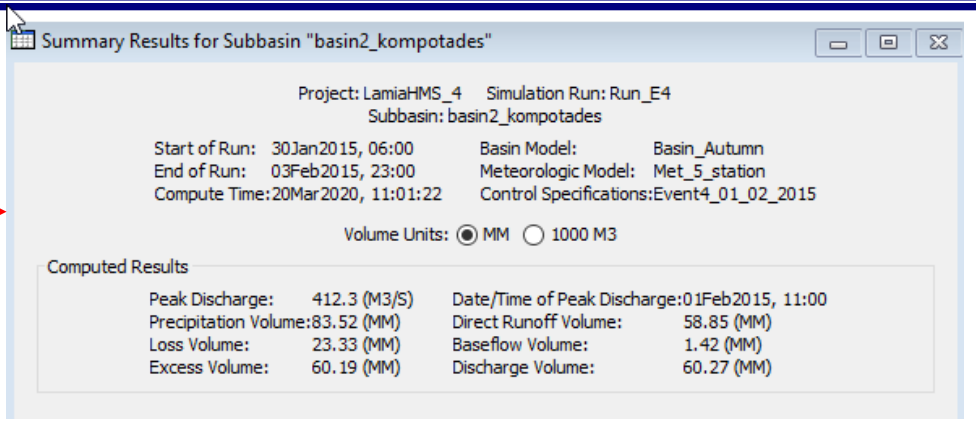


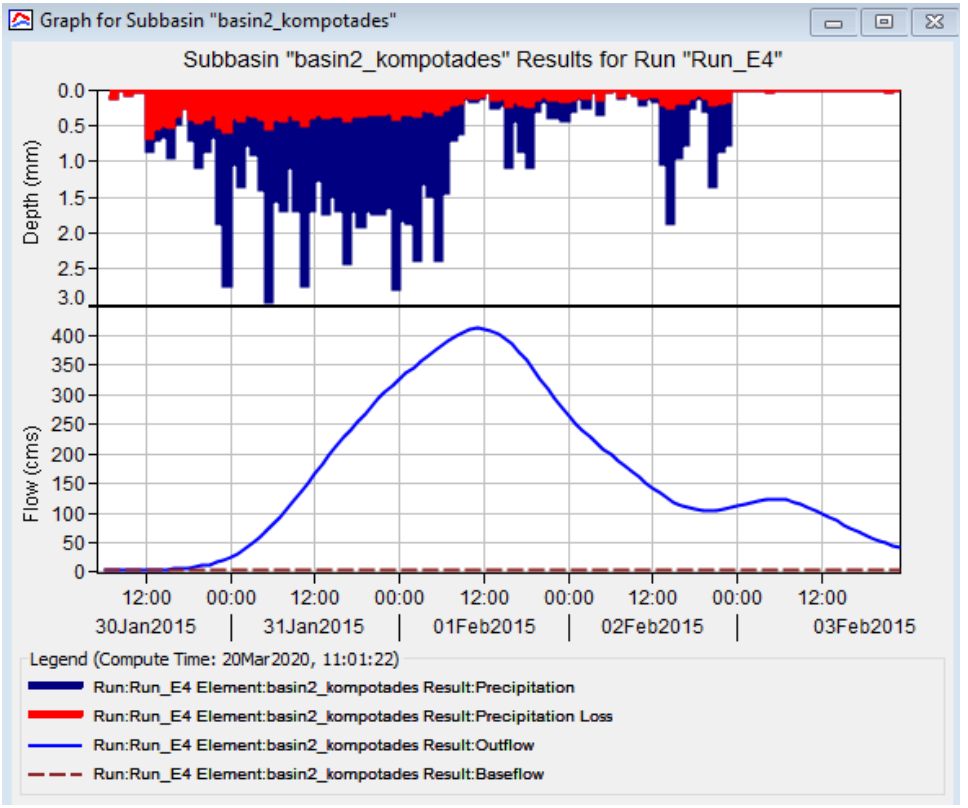


Hydrological Analysis Results

Summary Results

- **Summary Table**
- **Graph**





Main Outputs:

- Peak Discharge
- Precipitation Volume
- Loss Volume
- Excess Volume
- Time to Peak
- Direct Runoff Volume
- Baseflow Volume
- Discharge Volume

! Careful of units displayed

$mm*A(km^2) = 10^3\ m^3$