Decision Support System Planning DSS (P)
for Integrated River Basin Planning & Management

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Roorkee

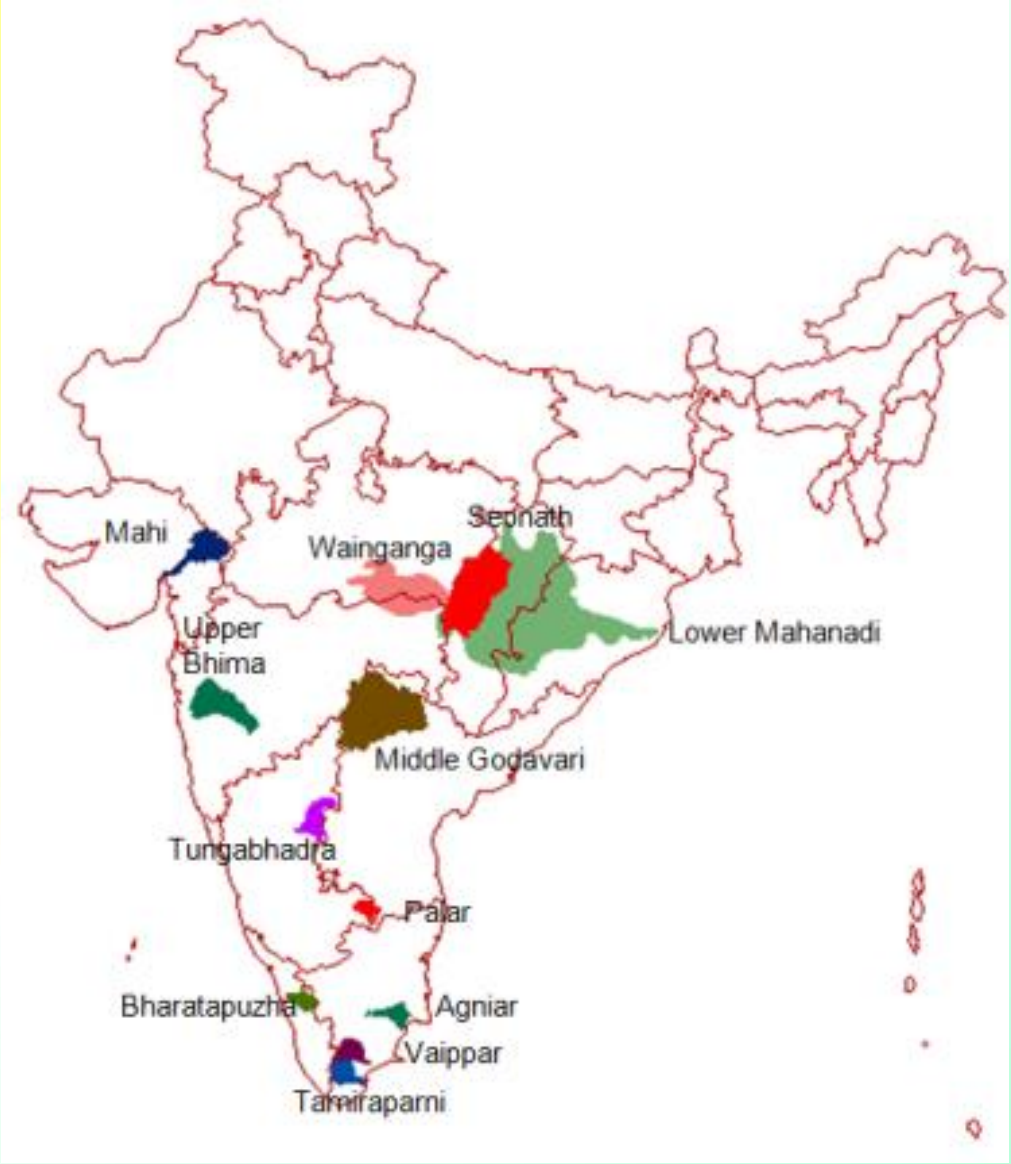
INDIA: HYDROLOGY PROJECT-II

Development of Decision Support System (Planning) [DSS(P)] for Integrated Water Resources Development & Management

National Institute of Hydrology
Roorkee, India

DHI Water Environment Health
Agern Alle 5, Denmark

Participating States



A Decision Support System

Decision

A reasoned choice among alternatives

Definition of a DSS

Computer based systems integrating tools and databases that assist a decision-maker in making informed decisions and analyze consequences.

Why a Decision Support System

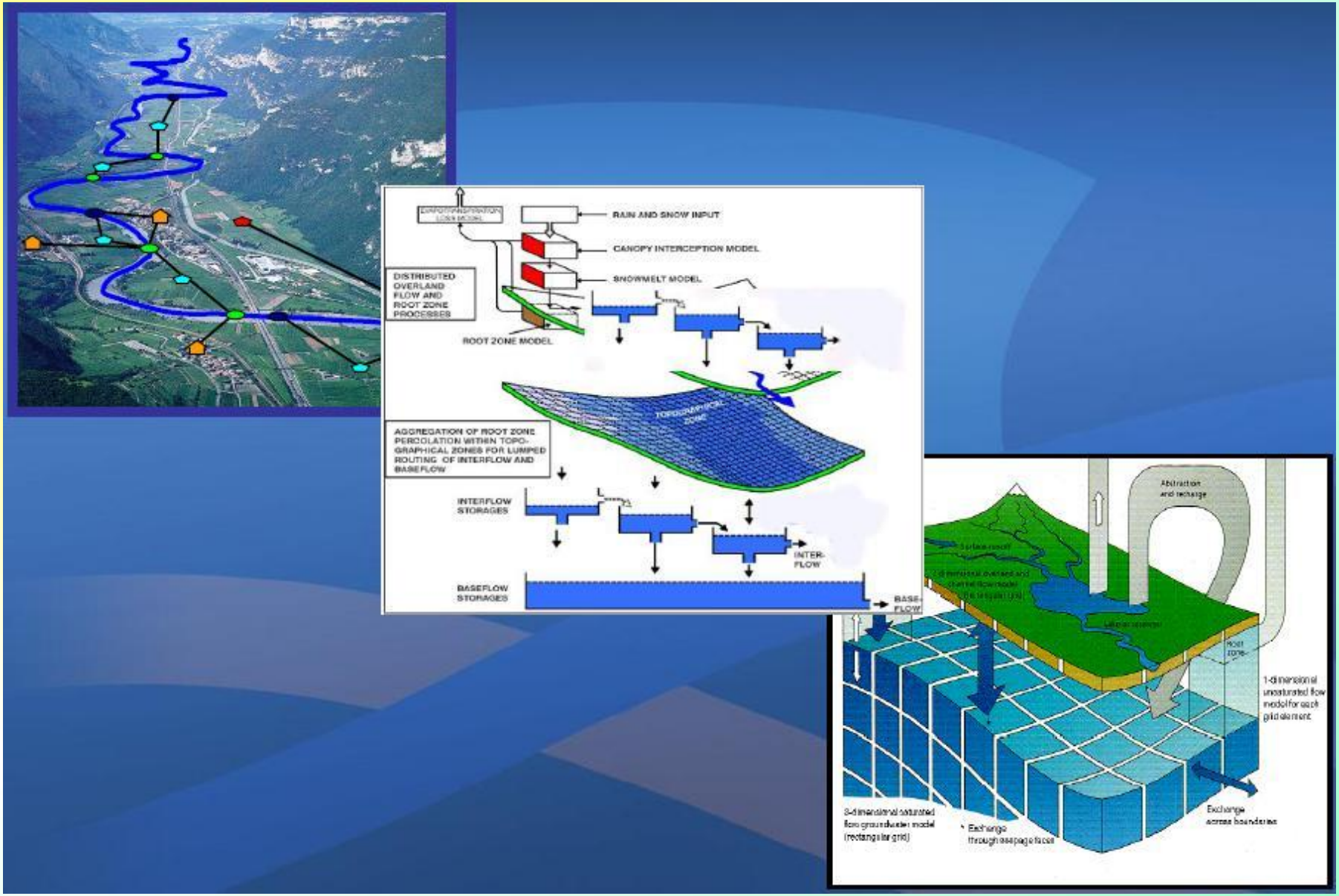
Misconception: A DSS takes decisions

- **Using a DSS, a project manager is able to make rational use of resources without an in-depth knowledge of modeling techniques**
- **Provides timely information**
- **Communicate result to a larger audience**
- **Open and unbiased working**
- **Scenario analysis**

Modeling Methodology under DSS (P)

- **A river basin is divided into a number of sub-basins based on the location of hydraulic structures and hydrological network**
- **A hydrological model (*NAM*) is calibrated for each sub-basin to estimate the hydrological components (evaporation, rainfall recharge, overland flow, interflow and base flow) ~ Soul**
- **An allocation model (*MIKE Basin*) in conjunction with hydrological inputs is used to allocate the available SW and GW ~ Heart**
- ***DSS* is used to analyze scenarios ~ Brain**

Hydrological Model under DSS (P)



NAM Model under DSS (P)

Objective

- NAM model provides a conceptual representation of land phase of hydrological cycle and simulates rainfall-runoff processes at the catchment scale.

Basic data requirements

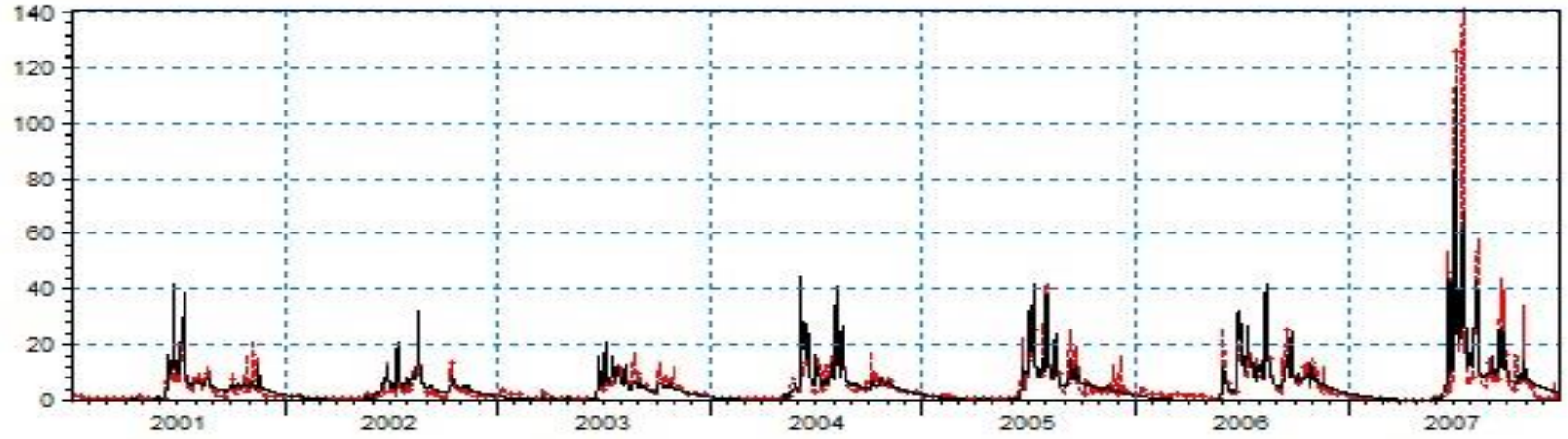
- Precipitation time series
- Temperature time series (for snow melt modeling)
- Evapo-transpiration time series
- Observed discharge time series

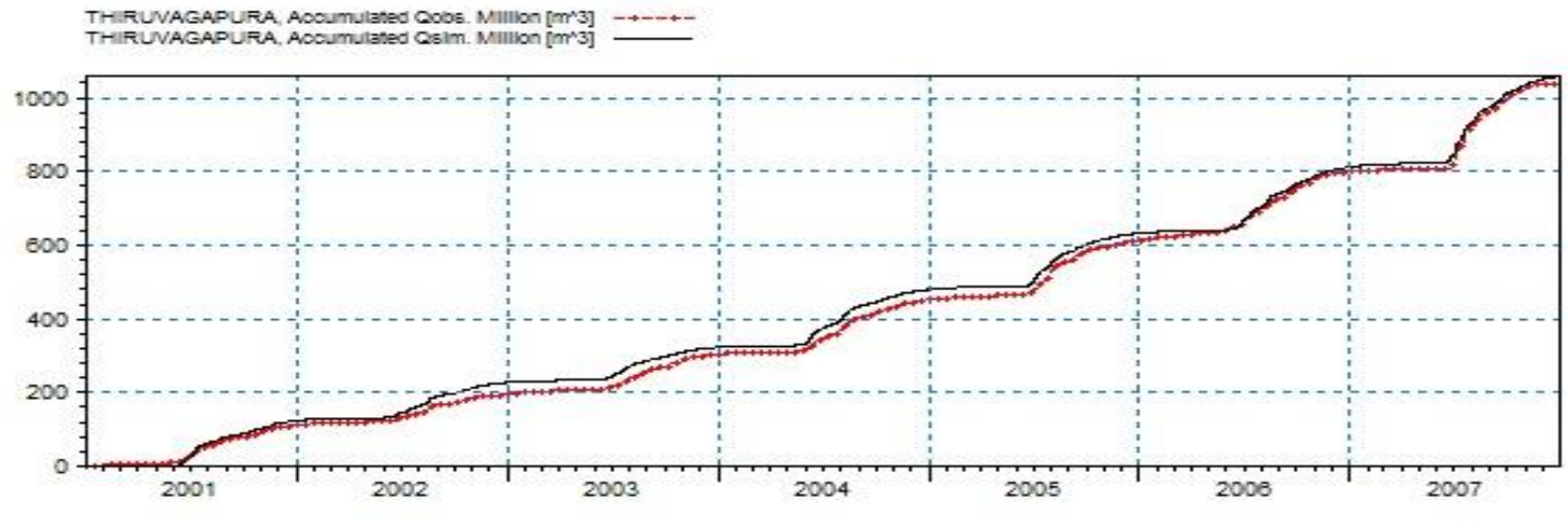
Basic model outputs

- Catchment runoff
- Subsurface contributions (base flow, interflow)
- Actual evapo-transpiration
- Groundwater recharge and levels
- Soil moisture storage content

NAM Results

Observed/Simulated Surface Water Flows





NAM Results

Tabular Presentation of Components of Hydrologic Cycle

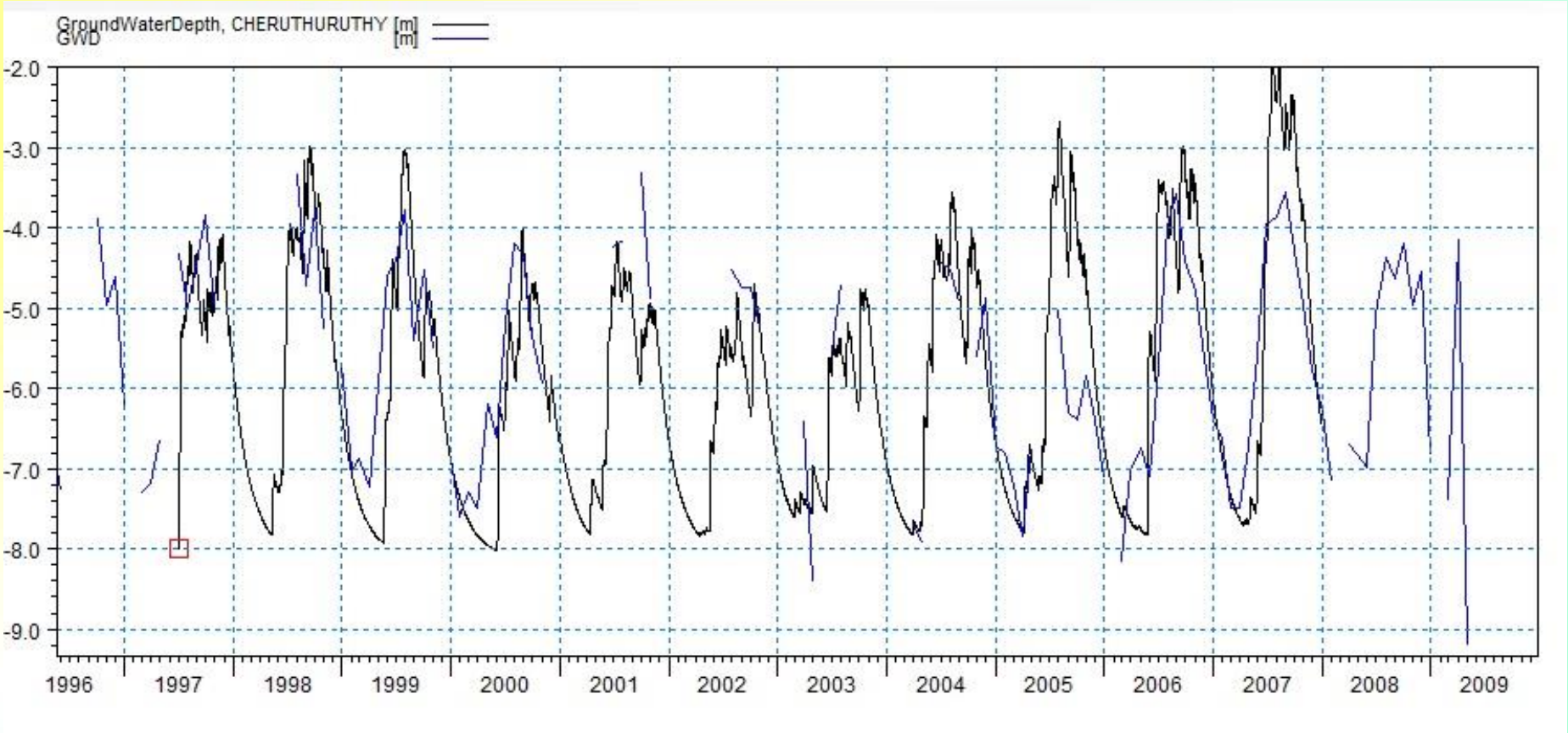
```
*************************************************************
*                                                           *
*     RAINFALL RUNOFF SIMULATION                            *
*     PARAMETER FILE    :        Thiruvegapura.rr11         *
*     SIMULATION DATE   : 15-AUG-2012  13:22:10             *
*                                                           *
*************************************************************


SIMULATED PERIOD : From: 2001/ 1/ 1  8:00   To: 2007/12/31  8:00

TIMESTEP   : 24.00 HOURS

(Accumulated values in mm)

Catchment: THIRUVAGAPURA, Area=   94.62 km2
```

Period	Q-obs	Q-sim	%diff	Rainfall	PotEvap	ActEvap	CapFlux	Recharge	Pumping	Irrig.	OF	IF	BF
2001/ 1/ 1 - 2002/ 1/ 1	1174.6	1307.8	-11.3	2375.3	1466.6	783.1	0.0	1006.0	107.9	0.0	385.2	140.4	782.2
2002/ 1/ 1 - 2003/ 1/ 1	878.1	1094.7	-24.7	2006.4	1591.5	850.1	0.0	830.0	107.9	0.0	220.9	123.8	750.1
2003/ 1/ 1 - 2004/ 1/ 1	1170.6	1010.8	13.6	2031.1	1540.4	932.6	0.0	798.3	107.9	0.0	196.1	111.6	703.0
2004/ 1/ 1 - 2005/ 1/ 1	1547.9	1656.3	-7.0	2550.6	1490.0	744.5	0.0	1164.7	107.9	0.0	506.6	129.9	1019.8
2005/ 1/ 1 - 2006/ 1/ 1	1707.1	1618.5	5.2	2586.3	1519.7	854.5	0.0	1009.7	108.2	0.0	574.1	130.6	913.8
2006/ 1/ 1 - 2007/ 1/ 1	1981.8	1897.3	4.3	2824.5	1514.9	775.2	0.0	1274.3	107.9	0.0	638.0	140.2	1119.1
2007/ 1/ 1 - 2007/12/31	2521.6	2612.9	-3.6	3485.7	1509.5	764.4	0.0	1436.7	107.5	0.0	1141.1	147.8	1323.9
2001/ 1/ 1 - 2007/12/31	10981.7	11198.3	-2.0	17859.8	10632.6	5704.5	0.0	7519.7	755.0	0.0	3662.0	924.4	6611.9

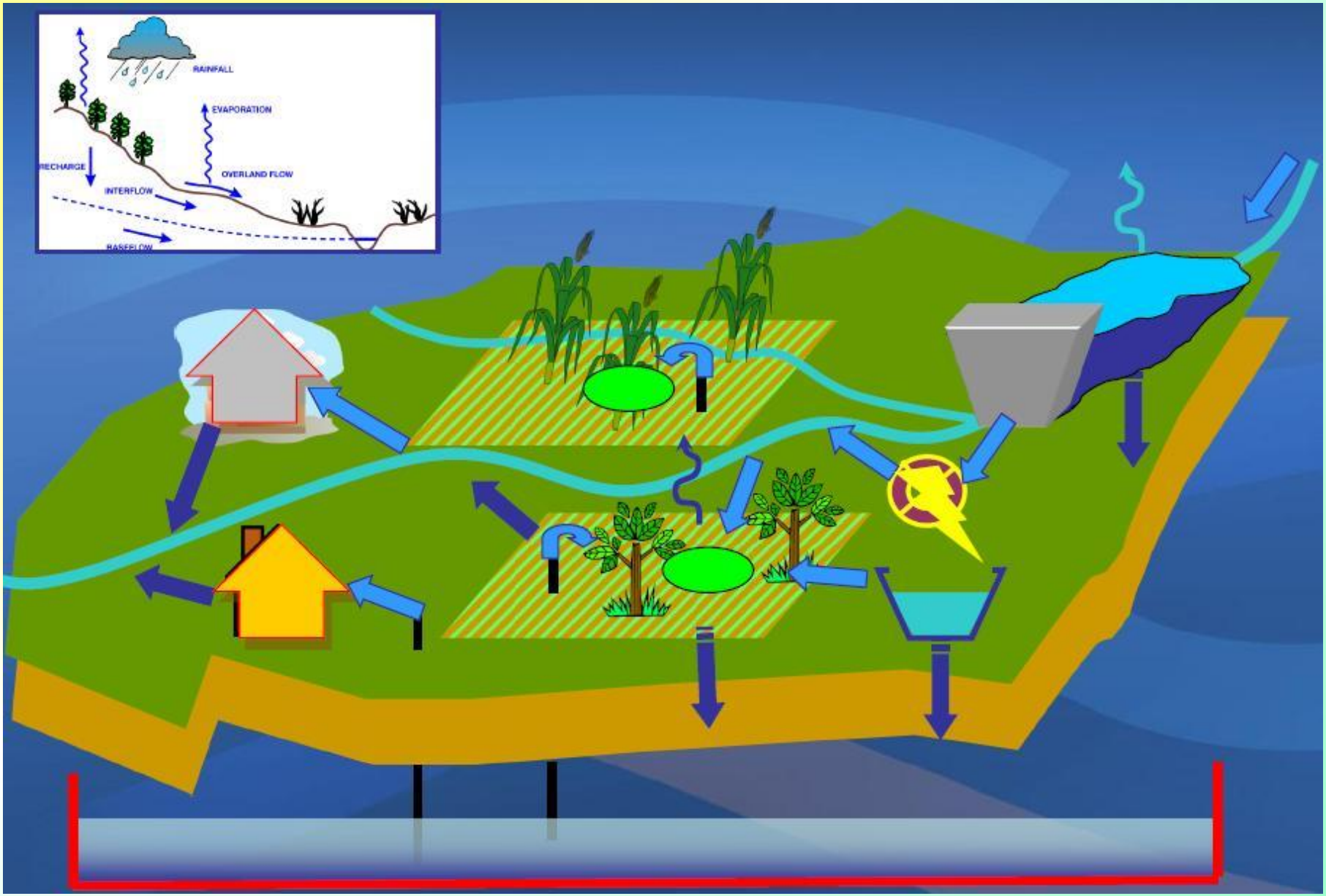
```
Coefficient of determination: R2 =  0.745
```

NAM Results

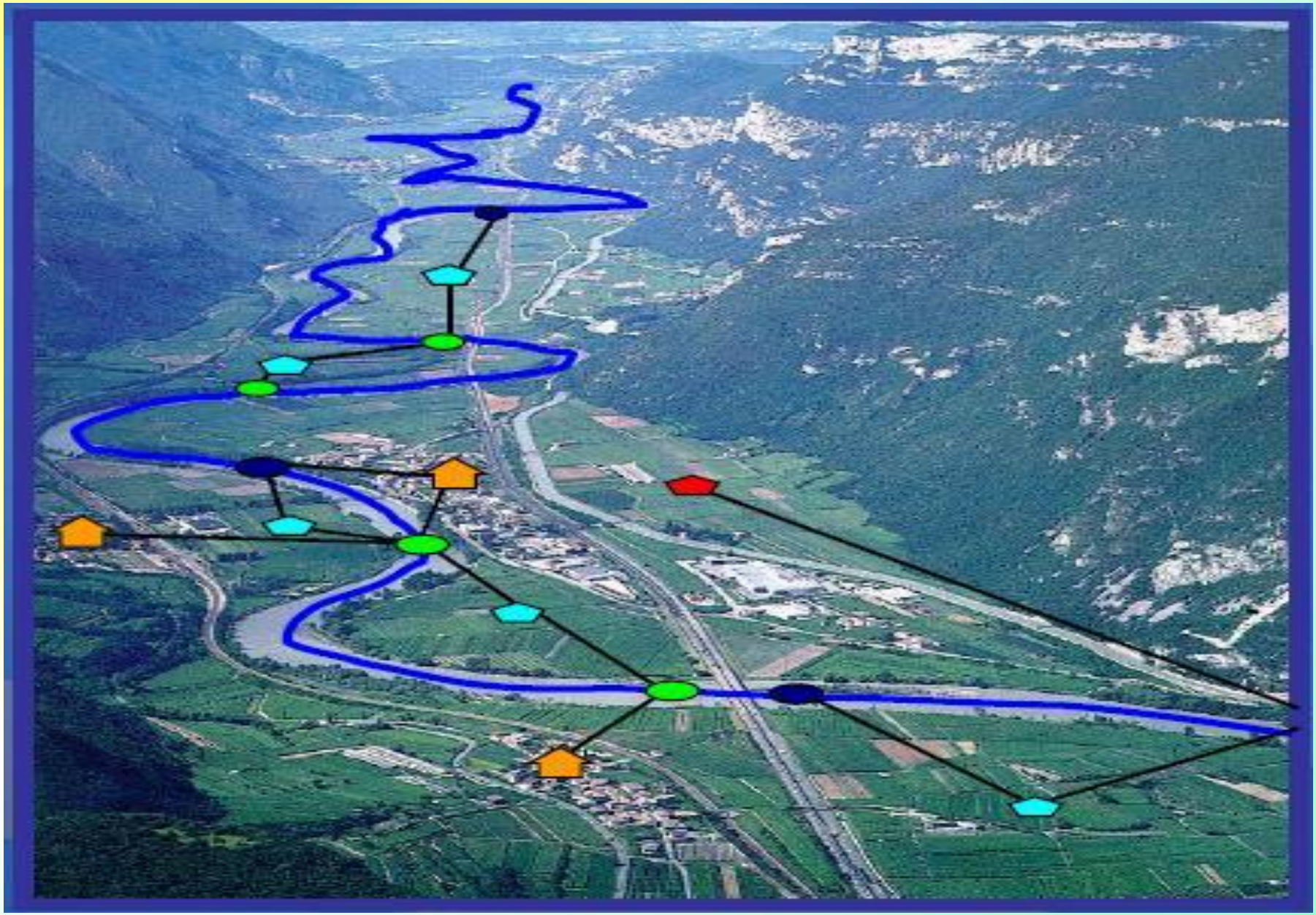
Observed/Simulated Groundwater Levels



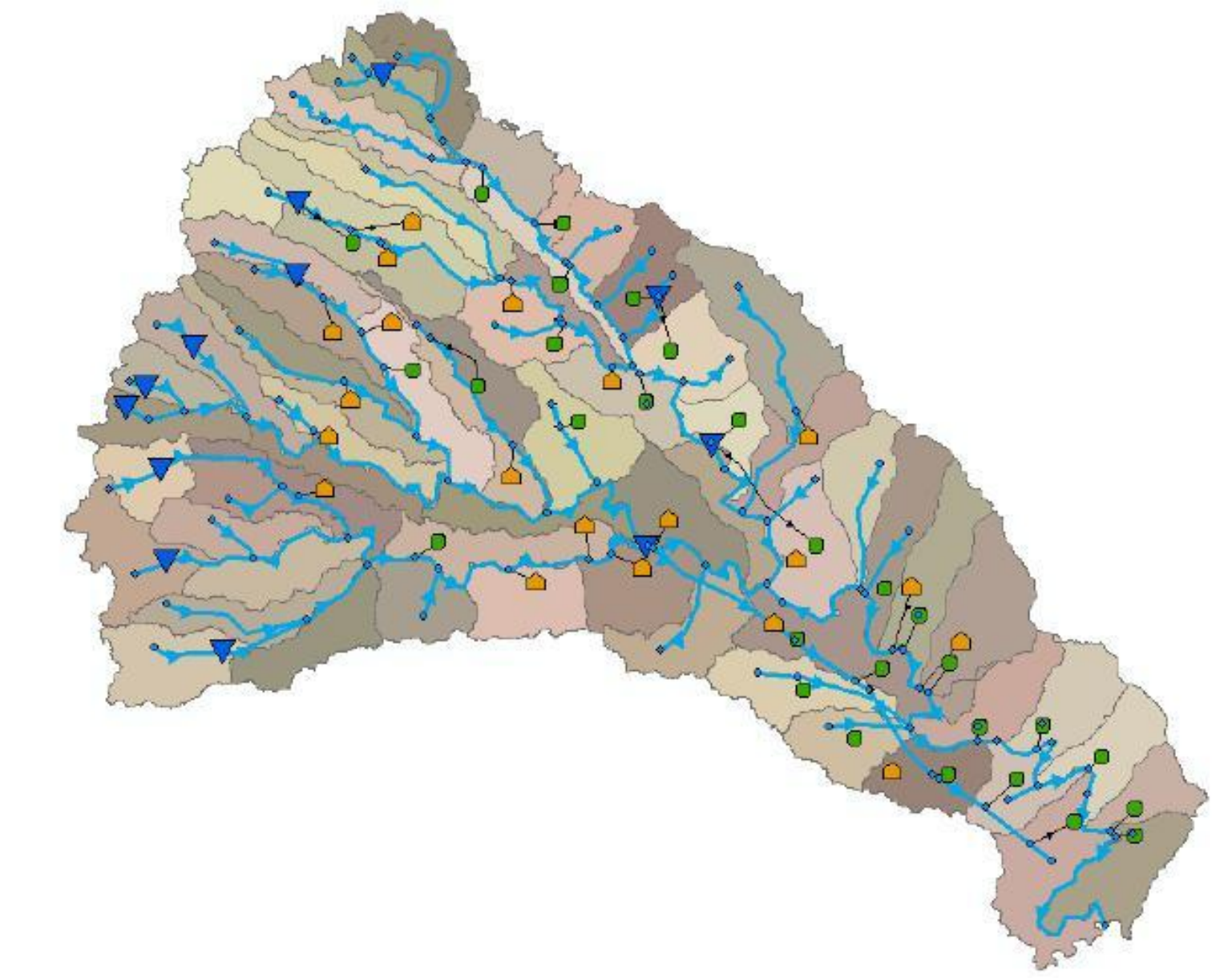
River Basin Model Concept



River Basin Schematization



Sample Basin Schematization in a Model

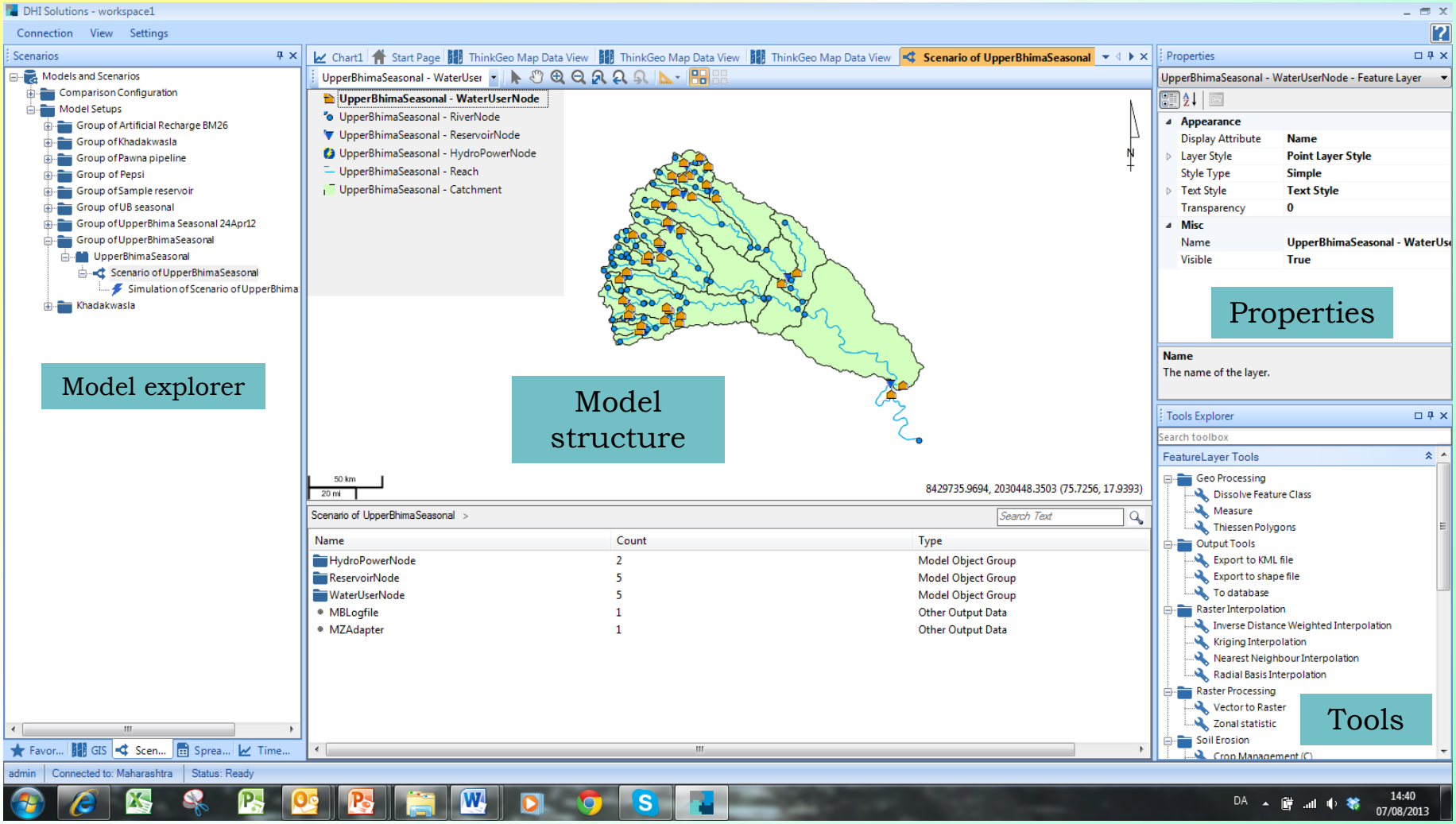


DSS (P) Main Functionalities

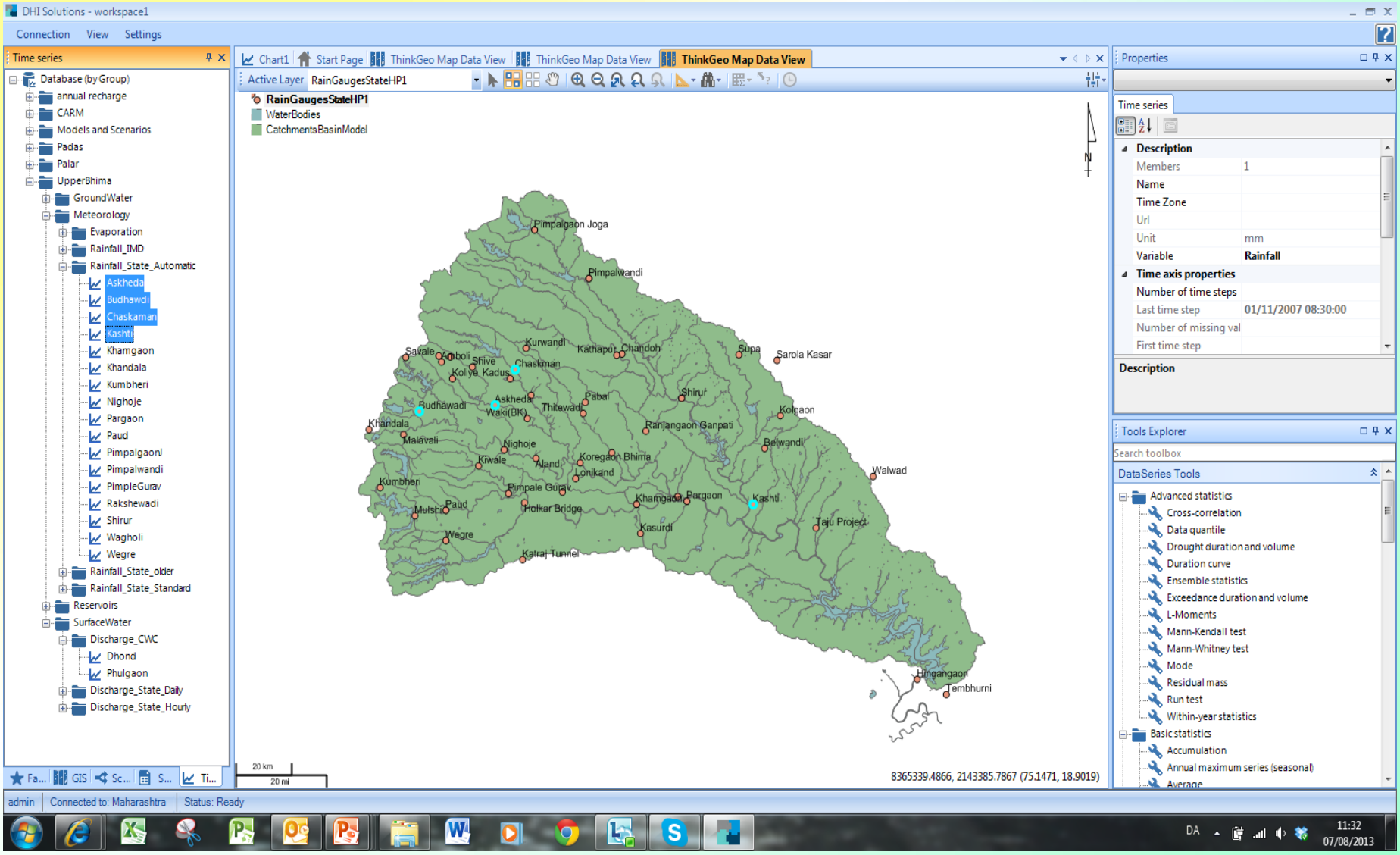
- Process and analyse GIS and time series information
- Publish selected information (general, drought, flood..)
- Model applications for long-term/short-term planning

Scenarios | Time Series | GIS | Indicators | Dashboard (web publishing) | Scripting | Meta data | Work spaces | Spread-sheets

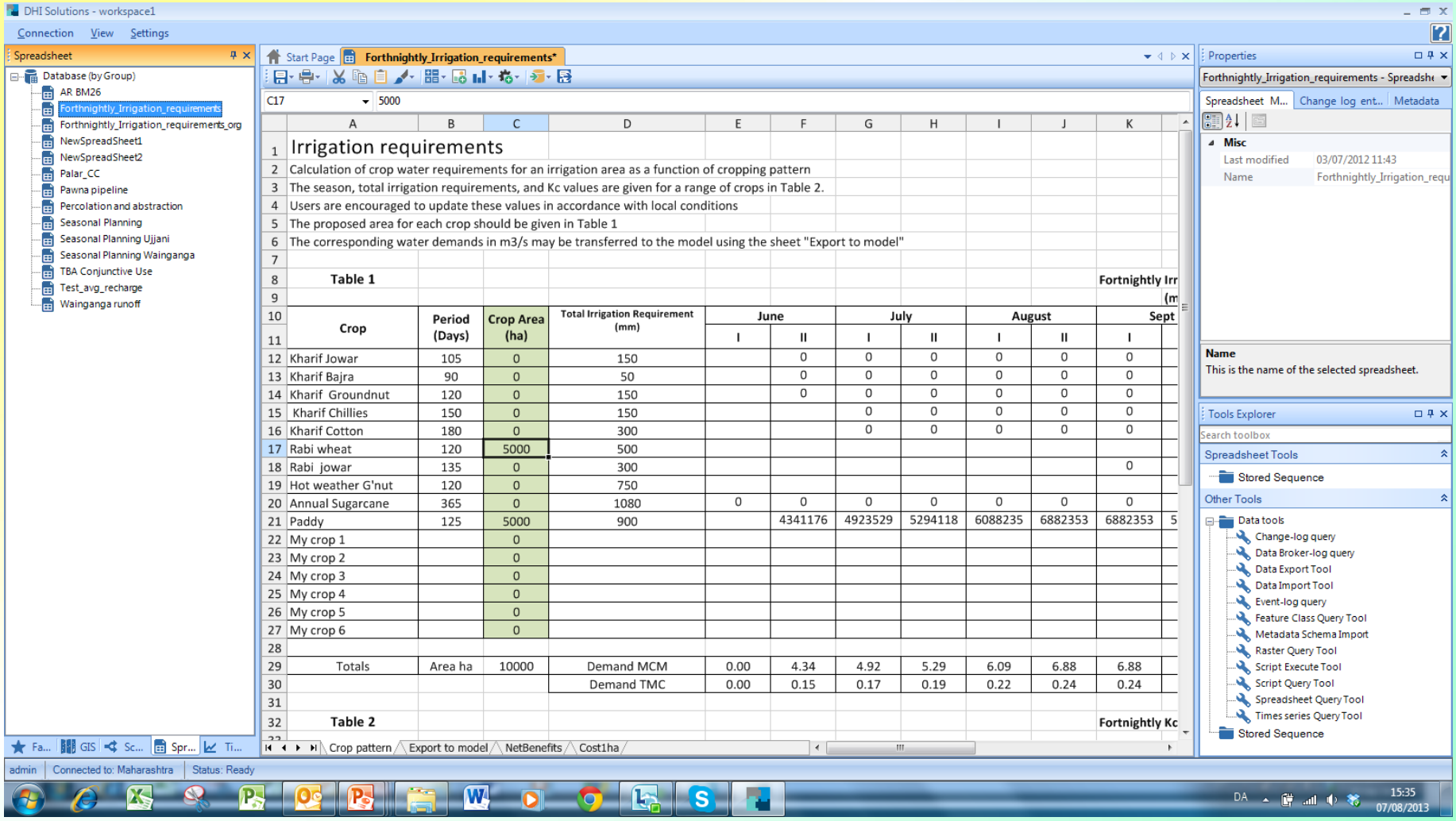
DSS (P) – Generation & Comparison of Scenarios



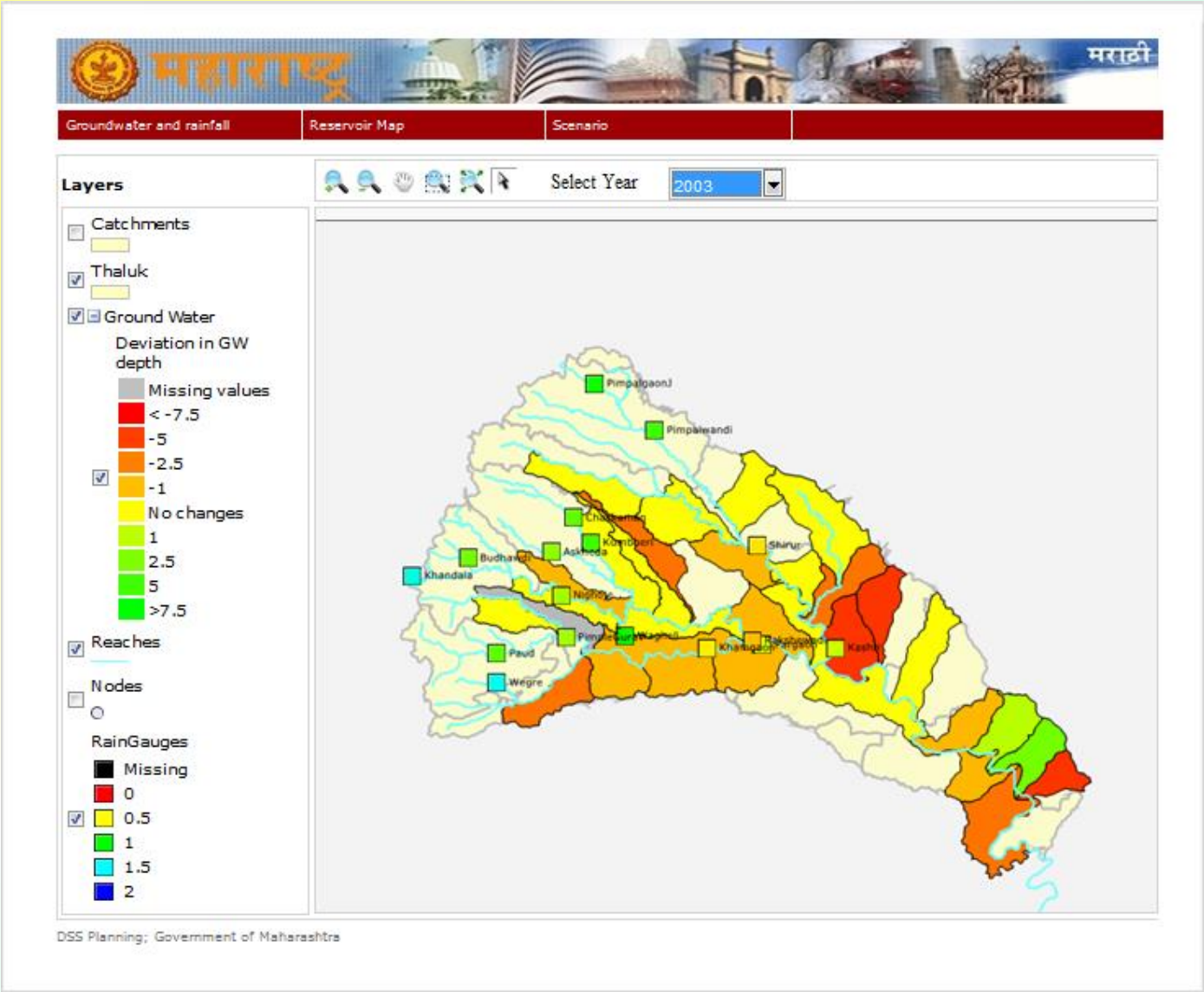
DSS (P) - Association between GIS & Time Series



DSS (P) – Use of Spreadsheets

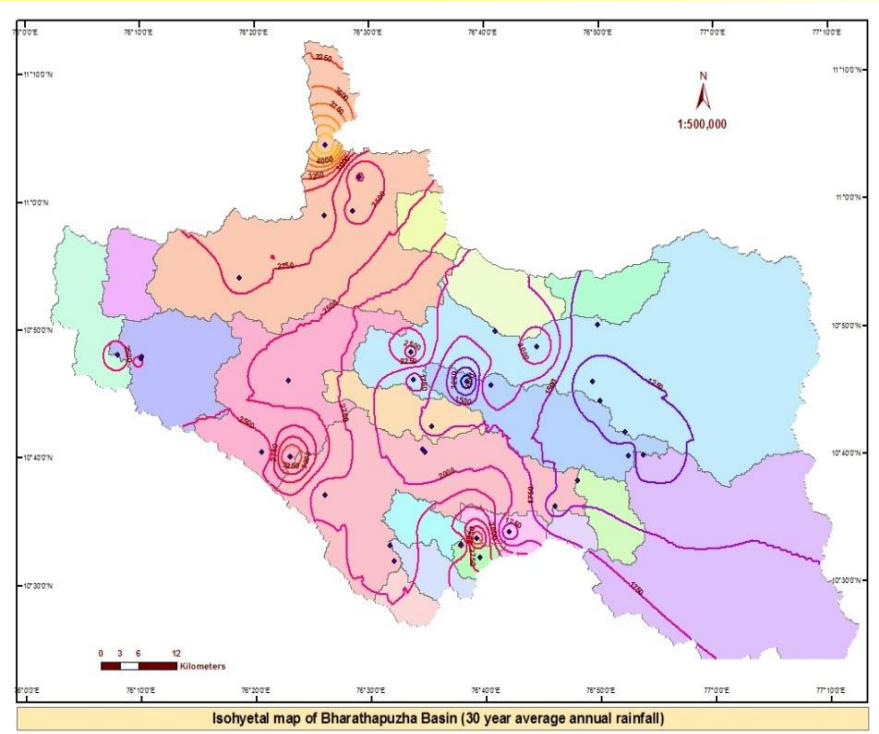


DSS (P) – Publishing information on web



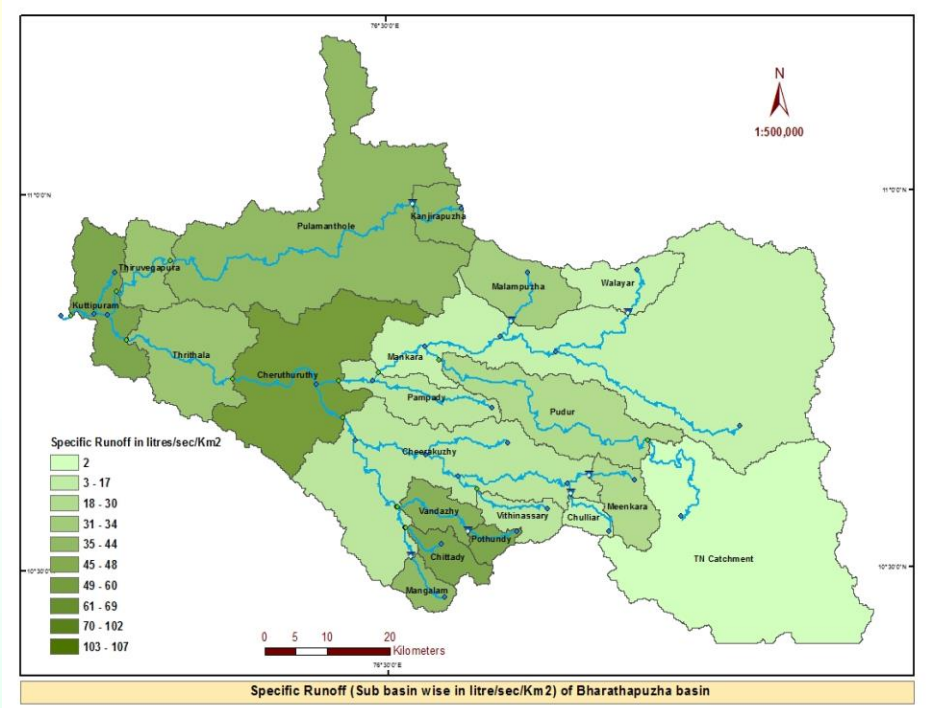
DSS (P) – Brief Description of Some Applications

Water Availability in the Basin



Isohyetal map of Bharathapuzha Basin (30 year average annual rainfall)

Rain fall distribution



Specific Runoff (Sub basin wise in litre/sec/Km2) of Bharathapuzha basin

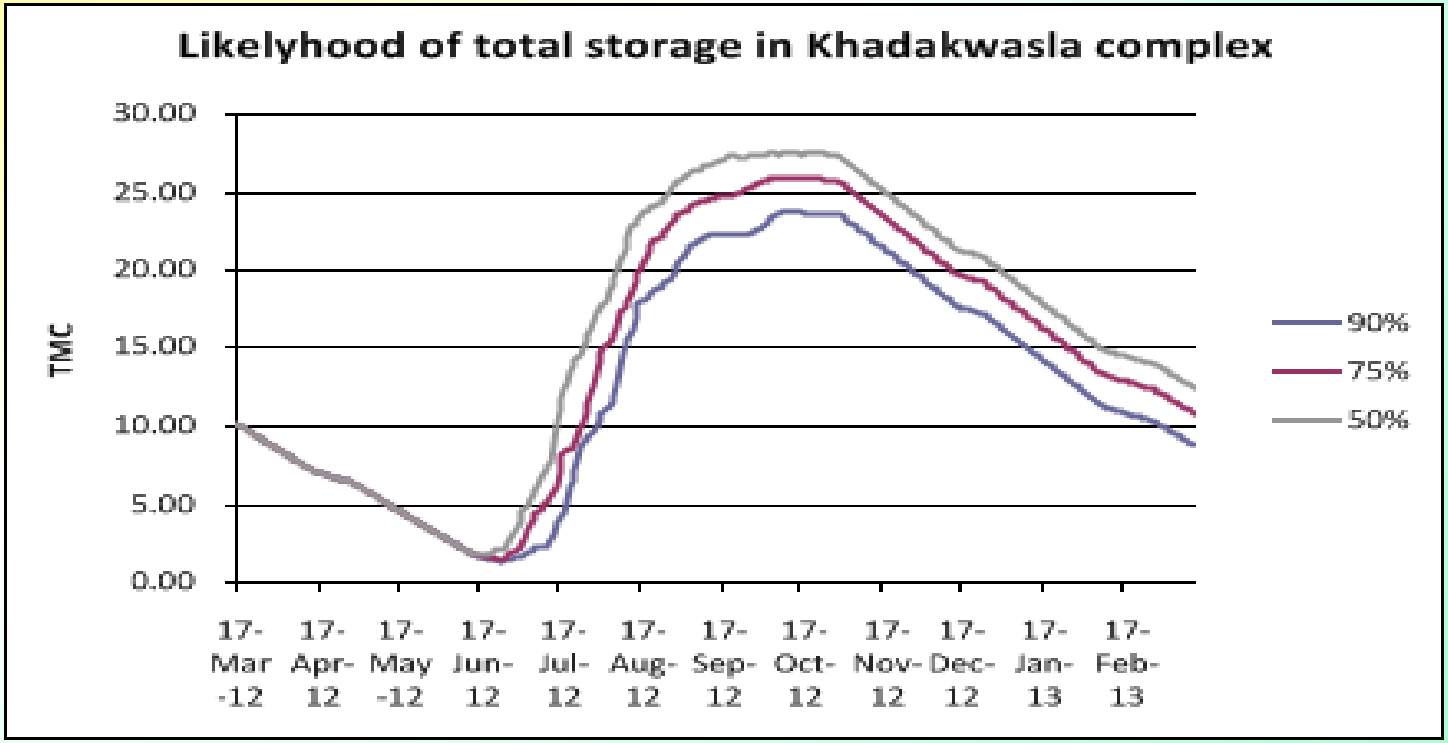
Specific runoff in the basin

DSS (P) – Brief Description of Some Applications

Seasonal Planning of Reservoirs

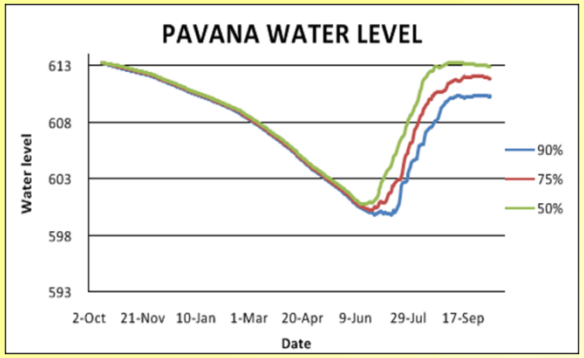
For given scenarios of planned water allocation:

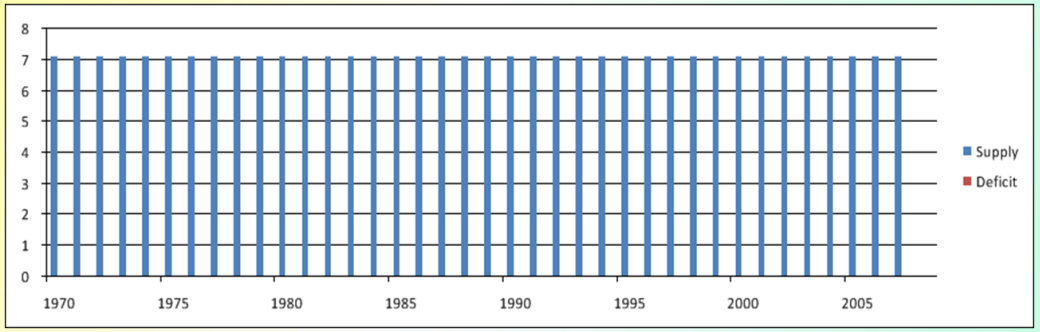
- **What is the risk of reaching critically low levels in coming dry season?**
- **What is the likelihood of filling the reservoir in the coming wet season?**



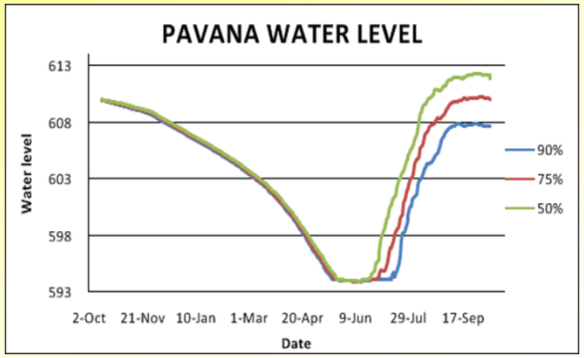
DSS (P) – Applications

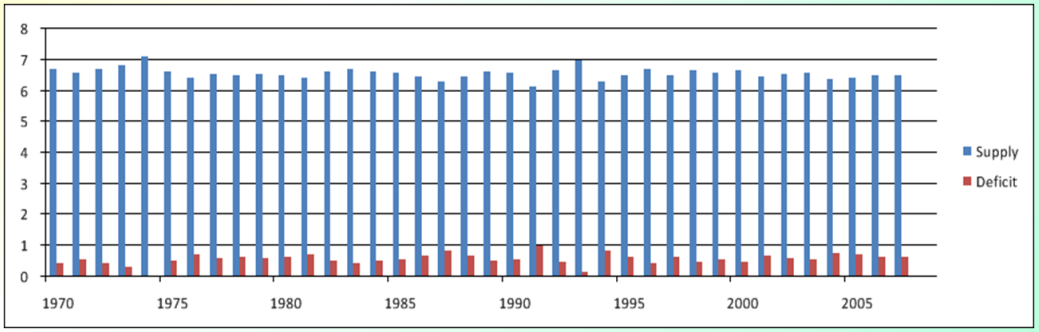
Pavana Seasonal Planning



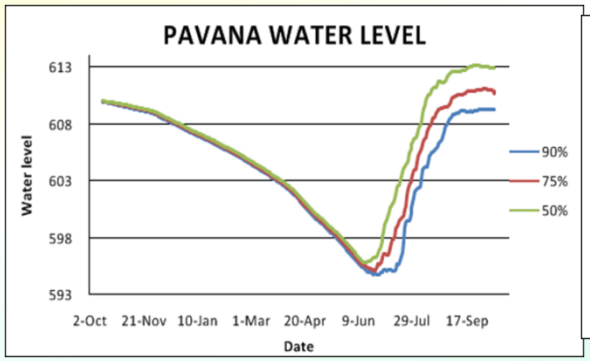


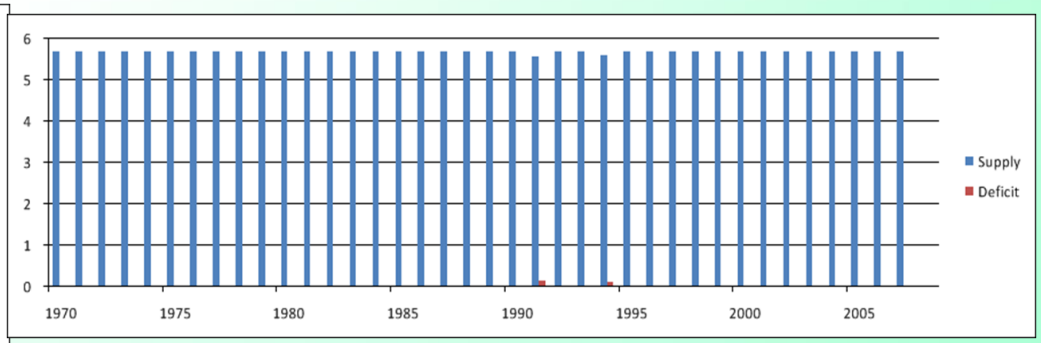
Initial Level FRL





Initial Level Reduced





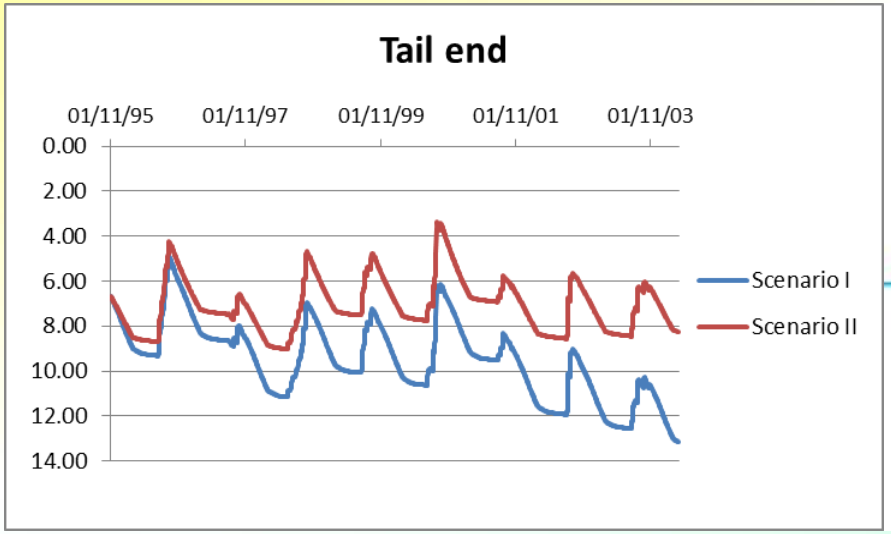
Reduced Demands

DSS (P) – Brief Description of Some Applications

Conjunctive Use of SW & GW

Combined use of SW & GW in Sri Ram Sagar Project

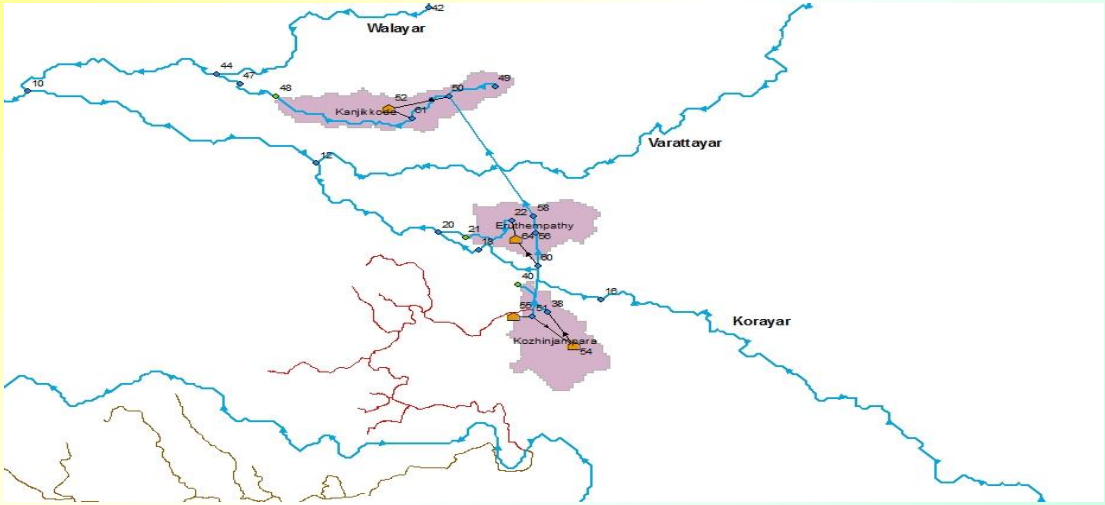
- ✓ **Scenario I: no restriction on SW use**
- ✓ **Scenario II: limited SW abstraction by head and middle section users permitted**

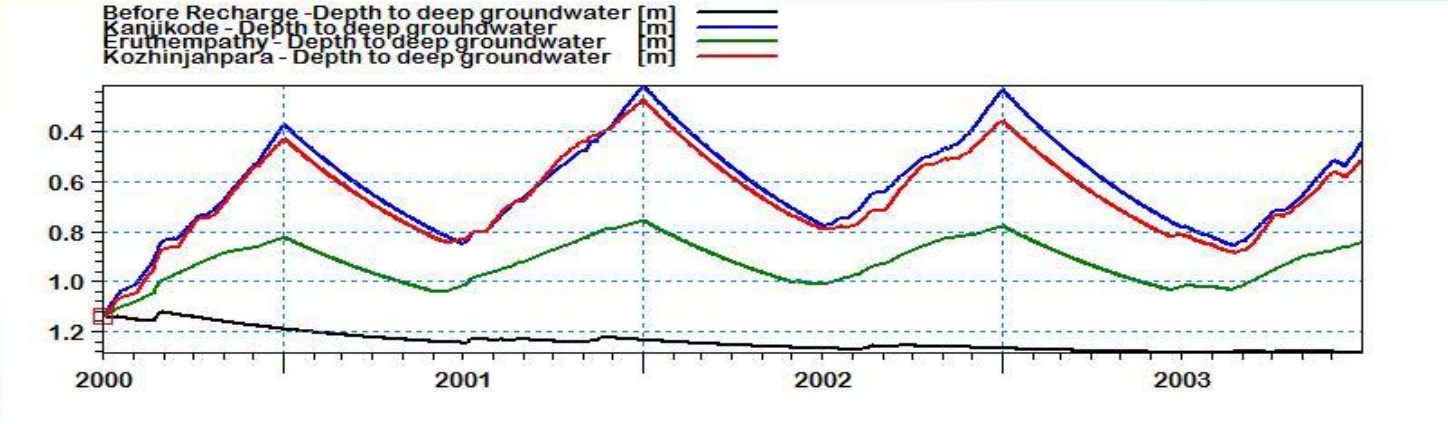


DSS (P) – Brief Description of Some Applications

Inter Sub-basin Transfer

To study viability of inter sub-basin water transfer during monsoon to rain shadow regions to augment ground resource.

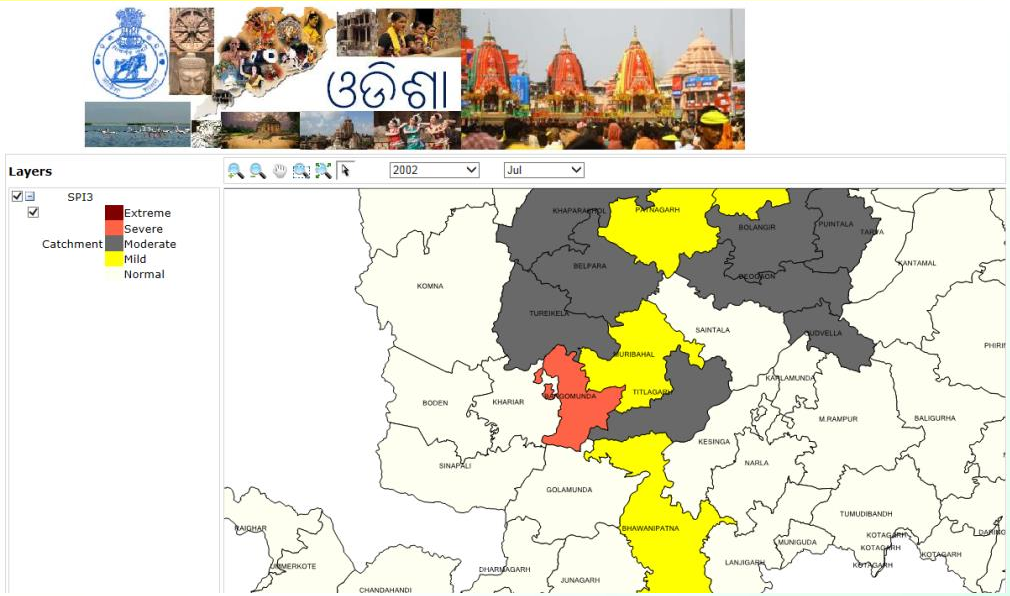


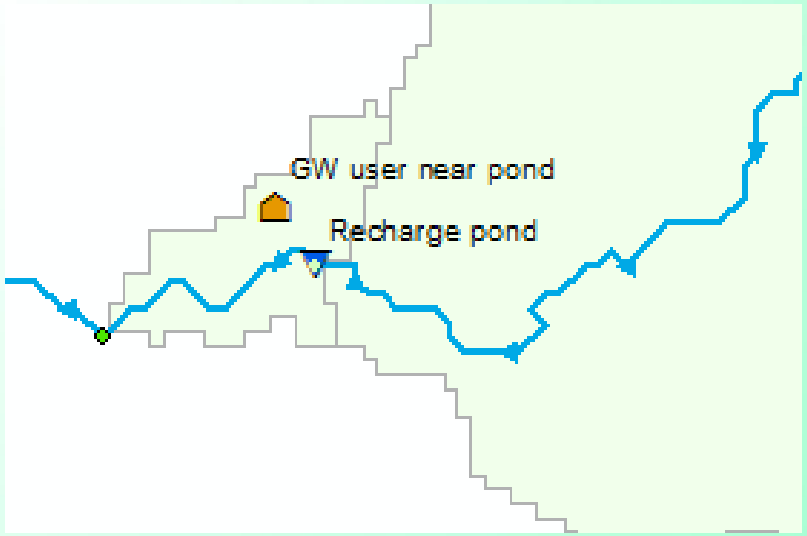


DSS (P) – Brief Description of Some Applications

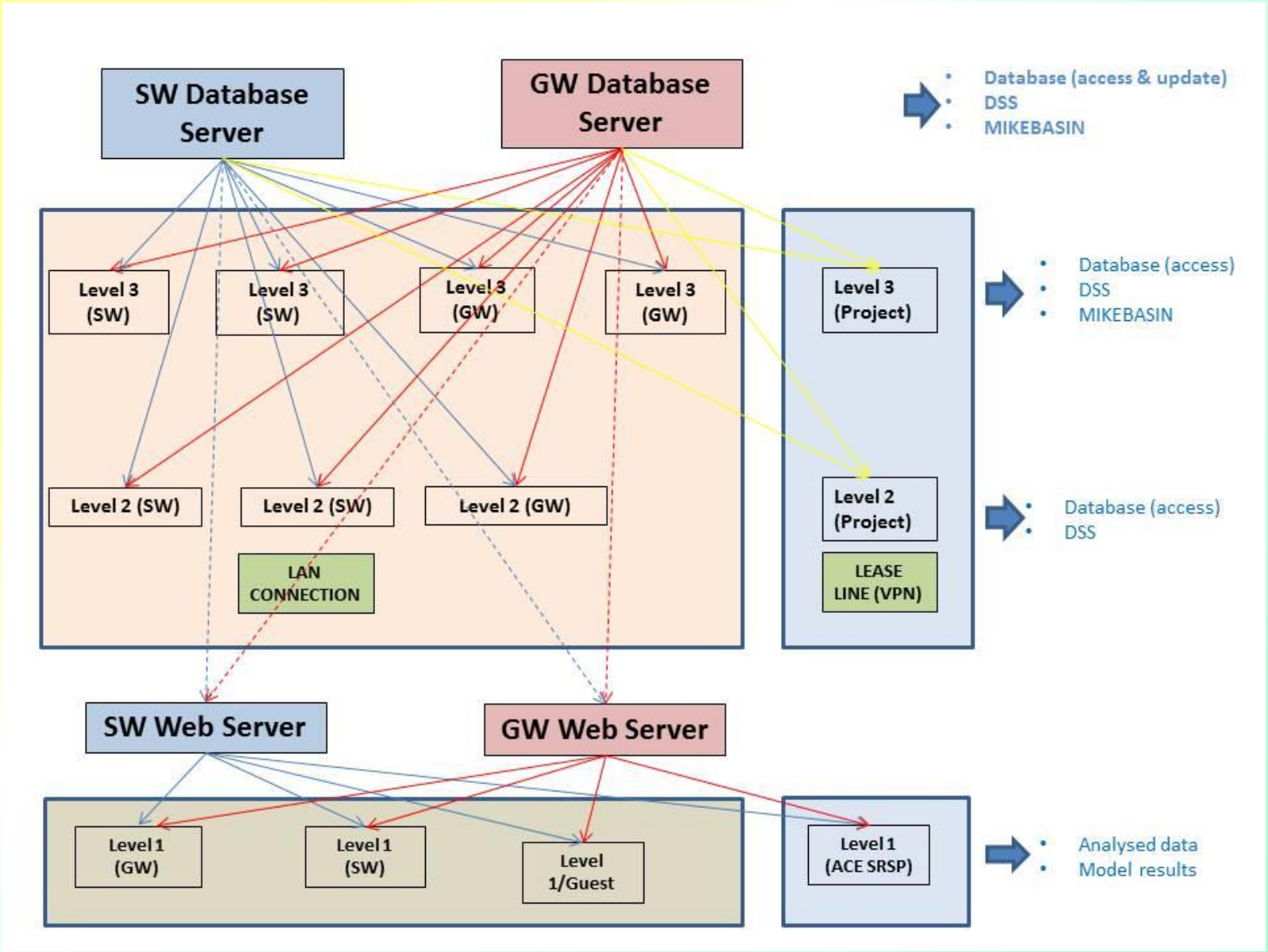
Drought management

- **Drought Indicators**
- **Assessing the impact of check dams and artificial recharge measures**





State SW-GW Installations in Servers



THANKS