RESEARCH ARTICLE OPEN ACCESS

Hydrological Information System using Archydro Data Model

Mr. Pritam R. Patil [1], Dr.S.B.Thorat [2], Dr.S.R.Pande [3]
Research Scholars [1]
Dept of Electronics and Computer Science Rashtrasant Tukadoji Maharaj Nagpur University Nagpur
Director [2]
SSBES, Institute of Technology & Management,VIP Road, Nanded
Head [3]
Dept. of Computer Science, Shri Shivaji Science College,Congress Nagar, Nagpur
Maharashtra – India

ABSTRACT

This paper addresses a computer system capable of integrating, storing, analyzing, and displaying geographic information. Currently, the Geographic Information System is not only limited to cartography but also related to various data management such as natural resource management, environmental impact assessment, and etc. The Internet system allows more geographic information sharing as many users can access at the same time. The Internet GIS system including Management Information is a research and application area that utilizes the Internet systems to facilitate the access, processing, and dissemination of geographic or non-geographic information.

***Keywords* :-** Web-GIS; Geographic Information System; Decision Support System;

I. INTRODUCTION

The study area is Marathawada region selected, the Hydrologic Information System can be developed using the selected data model Arc hydro. The ArcGIS Hydro data model Arc Hydro is a geospatial and temporal data model for surface water resources that operates within ArcGIS and supports hydrologic simulation models. Arc Hydro defines a set of water resources feature classes (classes with Point, multipoint, polyline, polygon, annotation or network features) in ArcGIS (such as watersheds, monitoring points) and the relations between these classes and stores them in a geodatabase. A geodatabase is a special form of a relational database that stores geospatial coordinate data of a GIS layer in one field in a relational data table. The complete model consists of five categories to divide water resources elements: network, drainage, channel, hydrography and time series.

This model is used for this research because it can automatically transfer a geodatabase into a Hydrologic Information System and therefore has great potential to be used for water resources studies. The model uses an ArcGIS geometric network to trace the flow of water through a stream network and can relate drainage, stream confluences, water discharge and monitoring points required in this research using ArcGIS relationship classes.

II. HYDROLOGICAL INFORMATION SYSTEM

The occurrence of water shows great variability in space and time and requires that adequate measurement networks are established to define spatial variability and that they are maintained over a sufficient period of time to define temporal variability of a water variable. Management of water services for domestic, industrial, agricultural and power generation - and protection from the vagaries of floods and droughts, requires information on storages and fluxes of water.

A Hydrological Information System (HIS) consists of the physical infrastructure, software and human resources to collect, process, store and disseminate data on hydro meteorological, hydrological, geo-hydrological and related variables. The physical infrastructure includes the data observation networks, laboratories for analysis of samples, communication systems, and data storage and processing centers. The human resources are the trained staff who observe, key-in, process, disseminate the data and maintain the equipment computers, etc.

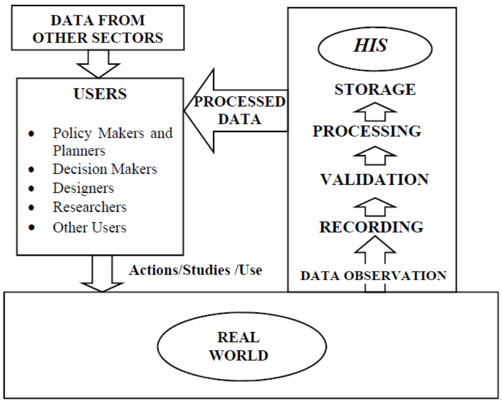

Fig. 1 Schematic diagram of a hydrological information system.

The activities under HIS can be broadly classified in the following categories:

- Assessing the needs of users
- Establishment of an observational network.
- Management of historical data.
- Data collection and transfer.
- Data processing analysis and reporting
- Data Exchange and reporting
- Data storage and dissemination

III. ARC HYDRO FRAMEWORK

The Arc Hydro framework provides a simple, compact data structure for storing the most important geospatial data describing a water resources system. This framework can support basic water resources studies and models, and can serve as a point of departure for the more extensive data models, that include time series and other Arc Hydro components. The framework contains information organized in several levels, as mentioned below:

A. ***Geodatabase:*** If a personal geodatabase is being used, this is a Microsoft Access .mdb file, or if an enterprise database like Oracle or SQL Server™ is being used, this is a relational database file on a server.

B. ***Feature data set*****:** This is a folder that stores feature classes within the geodatabase. The feature data set has a defined map projection, coordinate system, and spatial extent.

C. ***Geometric network*****:** This is where information that topologically connects hydro edges and hydro junctions is stored.

D. ***Feature class*****:** This is where information on individual geographic featun's is ston'd, such as watershed or stream segment information.

E. ***Relationship*****:** This is where features from one class are related to those in another. In this case, each watershed, water body, and monitoring point is located to a hydro junction on the network.

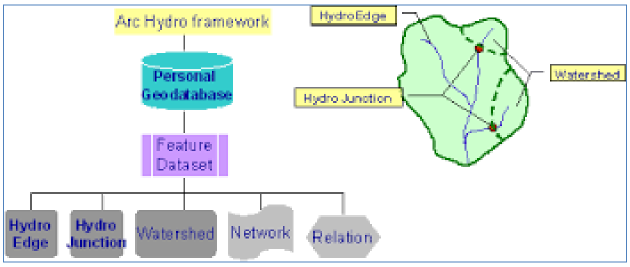

Fig. 2 Analysis diagram for the Arc Hydro framework

Since Hydro junctions are topologically linked to Hydro Edges in the hydro network, the combination of this network and the other relationships shown in the analysis diagram means that the classes in the Arc Hydro framework are connected into an integrated data structure. This supports tracing water movement from one feature to another through the landscape. The creation of an integrated database, instead of a collection of data layers, is a key accomplishment of the Arc Hydro design in ArcGIS, providing a stronger foundation for building water resources applications in GIS than has previously existed.

In ArcCatalog, you create a new, empty geodatabase containing a feature data set called Arc Hydro, copy your data layers into it, then use ArcCatalog's geometric network wizard to build a hydro network. You need to do this in Arclnfo since geometric networks cannot be built using Arc View. Then, you add the standard Arc Hydro attributes to the data using the Schema Creation Wizard in ArcCatalog, and fill in the values of these attributes using the Arc Hydro tools.

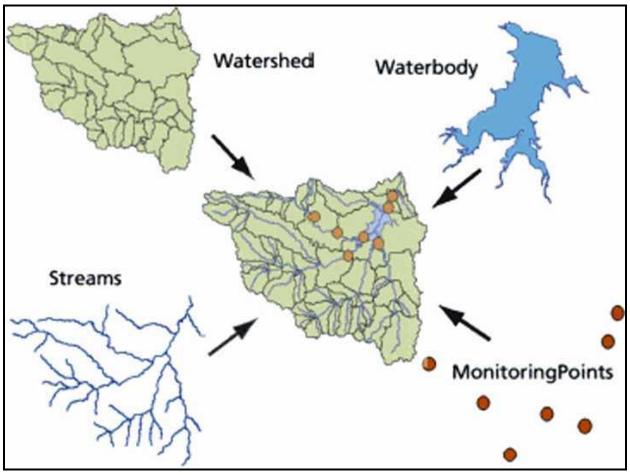

Fig. 3 The Arc Hydro framework

IV. RESEARCH OBJECTIVE

The main objective of this study is to develop and evaluate a Marathwada Hydrologic Information System that visualizes spatially water Resource making use of hydrologic parameter extraction and as a support tool for water Position monitoring.

To reach the main objective of the study, the following research questions need to be answered:

- What thematic layers, hydrologic parameters and water Level variables are required to determine spatial water Position of a basin?
- Which methods exist to automatically extract the thematic layers and parameters from raster elevation data and can these methods be incorporated in a HIS?

V. CONCEPTUAL MODEL

A Marathwada Hydrologic Information System is a Geographic Information System capable of hydrologic analysis & this research consists of three Features:

- The development of a MHIS for a selected study area as Marathawada region, which cover eight districts.
- Visualization of Godavari basin layer covered by Marathwada Region.
- Precipitation (Rain Fall), Evapotraspiration & water yield Position of selective rivers in Marathwada Region.

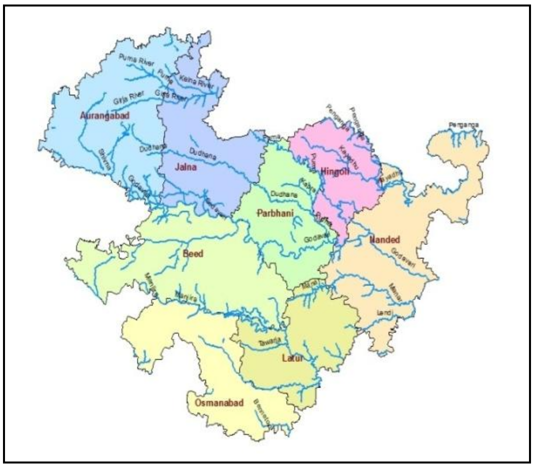

Fig. 4 River Network of Marathwada Region

TABLE I

ATTRIBUTE TABLE OF ABOVE SPATIAL MAPS

Sr. No.	**River Name**	**Length (km.)**
1	Penganga	162.92
2	Godavari	116.64
3	Manar	109.37
4	Lendi	67.72
5	Siddha	34.53
6	Kahala N	34.2
7	Kahala R	33.35
8	Asna N	25.06
9	Kayadhu	24.82
10	Parvati	21.43
11	Mandhlaa	18.69
12	Tiru	16.57
13	Manjra	16.39
14	Gundarguni	15.07
15	Sudda Vagu	6.7
16	Aran	0.92
17	Pus	0.81
	Total	**705.19**

VI. WEBGIS PLATFORM

The ICT approach and the WebGIS platform represent the added value of the project. The use of algorithmic geospatial analysis within the common GIS software, needs a certain know-how ranging from the characteristics of different data formats to the concept of reference systems, but the overall system is high-performance.

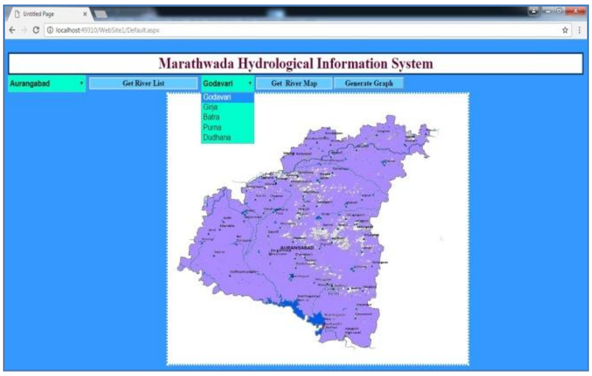

Fig.5 Marathwada Hydrologic information systems of Aurangabad Region

VII. PRECIPITATION AND EVAPOTRANSPIRATION

The input of water to Earth's surface as precipitation, and the output of water from the surface as evapotranspiration. Precipitation is any form of solid or liquid water that falls from the atmosphere to the earth's surface. Rain, drizzle, hail and snow are examples of precipitation. In India, rain is the most common form of precipitation. With the main types of precipitation identified, the methods of measuring them are described and the potential errors identified. Experiments could be done with containers of different height or diameter to check the volume of water caught after a rainstorm.

Differences in the rates of evaporation in winter (low energy but high wind speeds) and summer (high energy and low wind speeds) can be illustrated by noting how long it takes to dry an impervious surface such as a road or pavement. If a surface is dry, the amount of evaporation is likely to be small, however sunny and windy the weather is. Hence we have to distinguish between the atmospheric conditions favouring evaporation, which we all the potential rate, and the actual rate of evaporation, which is determined by atmospheric conditions and the state of the ground. Actual evaporation or evapotranspiration, if the effects of transpiration through the plant leaves are also included, can be much less. In an extreme case, potential evapotranspiration in a desert is very high but actual evapotranspiration may be almost zero. Unfortunately it is difficult to measure. Methods of measuring evapotranspiration are described, together with a variety of estimation methods.

For those with access to the Internet there are a number of sources of precipitation data. The National Climate Data Center, amongst others, provides both long-term averages and actual monthly totals for some other parts of the world.

VIII. TYPES OF PRECIPITATION

- Rain is the most frequent form of precipitation on a global scale.
- Rain consists of innumerable drops of water with diameters up to about 6 mm.
- Rainfall from layer clouds tends to be less intense and with smaller drops than rain from convectional clouds associated with unstable air.
- Larger drops have greater kinetic energy and so have a greater impact on soil. They may cause erosion of the soil surface if the rain is sustained for any length of time.

IX. EVAPOTRANSPIRATION

- Evaporation is the process of converting liquid water to a vapour state.
- Transpiration is the process of water loss through plant leaves and adds to the overall transfer of water from the ground to the atmosphere.
- Potential evapotranspiration is a climatically defined concept which indicates how much evapotranspiration would take place if the ground surface was continuously moist.
- For evapotranspiration to take place, we need an energy supply, usually heat from the sun, air movement to remove the evaporated moisture, and a humidity gradient so that the air above the surface is not saturated.
- Actual evapotranspiration depends not only on atmospheric factors but on the amount of moisture and the nature of the vegetation at the surface. A barren and totally dry ground surface, as in some deserts, will generate no actual evapotranspiration, though its potential rate would be high.

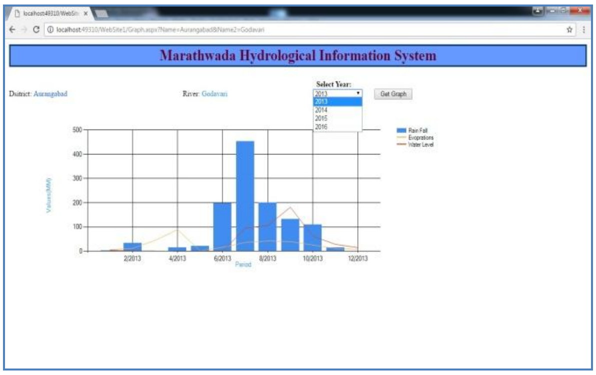

Fig. 6 Rainfall, Evaporation & Water Level interpretation of Godavari River

X. CONCLUSION

The development of a Marathwada Geospatial Web Portal is proposed as the best solution to Hydrological Information and Data Management. The Web Portal built around a hydrological data model synthesizes data from diverse sources describing the water resource, provides visualization tools and link to externally modeled results. This Geospatial Web Portal would provide a strong platform for the planning, execution and monitoring of status of water resources.

The purpose of this work is to furnish software tools that can be used as a decision support system in water resource management policies at the basin level, with particular attention given to the creation of a database of uniform data that can be easily updated and to the development of mathematical models that are easy to use, both as regards the interpretation of output data and the choosing of water management hypotheses.

The ICT approach and the WebGIS platform represent the added value of the project. The use of algorithmic geospatial analysis within the common GIS software, needs a certain know-how ranging from the characteristics of different data formats to the concept of reference systems, but the overall system is high-performance.

REFERENCES

[1] Arc Hydro: GIS for Water Resources by David Maidment(ESRI Press)

[2] ArcHydroToolsOverview:http://downloads.esri.com/blogs/hydro/ah2/arc_hydro_tools_2_0_overview.pdf

[3] ArcHydroTools:http://ftp.swfwmd.state.fl.us/pub/GWIS/ArcHydroTools_v2.0/Doc/Arc_Hydro_GP_Tools_2.0_Tutorial.pdf

[4] Comprehensive Terrain Preprocessing Using Arc Hydro Tools: http://www.hydrosys.net

[5] M.B.AbbottandA.W.Minns(1998),“Computational hydraulics”(2ndEd.)AshgatePress,Aldershot, 557p.

[6] https://www.tutorialspoint.com/asp.net/asp.net_tutorial.pdf

[7] J.G.Arnold R.Srinivasan, R.S.Muttiah, J.R.Williams 1998.Large area hydrologic modeling and assessment- Part 1:

[8] Model development. Journal of the American Water Resources Association 34(1),73-89.

[9] V.T. Chow,D.R. Maidment,L.W.Mays (1988). Applied Hydrology. McGraw-Hill, New Delhi4. J.A.York

[10] J.A.Cunge(1969). On the subject of a flood propagation method (Muskingum Method).Journal of Hydraulics Research 7(2), 205-230.

[11] W.G.Gray, ,A.Leijnse, R.L.Kollar. C.A. Blain (1993), “Mathematical tools for changing spatial scales in the analysis of physical system.” CRC Press, Boca Raton, FL,232p.

[12] D.R. Maidment(2002) Arc Hydro: GIS for Water Resources, ESRI Press, Redlands, Calif 203 pp.[7]. Mehdi Mashud Khan, Angela Kneece, IshwariSivagnanam, Jared John Shoultz(2009). http://www.esri.com/news/arcuser/0507/dhec.html (accessed January 17, 2013)