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A REVIEW ON MODELS FOR THE ASSESSMENT OF SURFACE WATER HYDROLOGY

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Abstract –Water is an important natural source for the suitability of humans as well as other creatures on the earth.it plays a vital role in shaping of human existence on the earth and ecosystem. Due to drastic increase in the population, developmental activates, industrial and agricultural activities, water has been a key resource which has to be maintained and regulated in an optimum way. There are various models that are intended for the study of water and its flow as well as its extent. In this study a review of SWAT (Soil and water assessment tool) model with comparison of two other model have been executed to identify the accuracy and extent of usage. With respect to the SWAT model, other 2 models are compared to have ideology of the models. This study indicates the usability and extent of applications that can be adopted using the models.

Keywords - SWAT Model, MIKE-SHE, TOPMODEL

I. Introduction

Water is the prime need for the survival of the humans and other creatures on the earth. About 97.5% of the earth water is salty and just 2.5% of the water is freshwater however more than 2/3 of fresh water is been locked in the polar ice caps and glaciers, this means only 0.5% of water exists in our lakes, rivers and groundwater for agricultural, industrial and domestic use. With such a small amount of freshwater pollution is one of the foremost worry. According world health organization only 0.007% of the world's entire water supply is safe for the drinking and this miniature scale quantity of water must be shared with the 7 billion people on the planet. About 1.2 billion people live in a water famine places which includes India as one of the primary water crises places in the world. Surface water is a source of water which is effortlessly available for every needs such as Drinking, Agriculture etc. In the other side the global warming which is being inclined by the human activities has become most important concern all over the world and has a substantial impact on worldwide mean temperature, sea level and extreme rainfall (Chen et al. 2014).The world is perceiving amplified incidence of floods and droughts (Ahmed et al. 2013). A review of models such as SWAT (Soil and water assessment tool, MIKE-SHE (Mike system hydrologique Europeen),TOP MODEL (Topography-based Model) has been carried out based on the literature review and understanding in this study to analysis the model capacities.

II. Methodology

A. SWAT (soil and water assessment tool)

SWAT (Soil water assessment tool) has been chosen for the hydrological modeling with reference to various literatures which intended that SWAT is most proper for this study. SWAT is an semi-distributed hydrological model developed by "USDA Agricultural Research Service and Texas University" which provides its services in assess the effects of climate change, contamination transport, land managing, sediment loading in an watershed or basin (Arnold et al. 1998).Usually SWAT runs by opting a single watershed, and the dividing it into numerous sub-basins. These sub-basins are then fragmented into several unique land use, soil and slope combinations which is known as Hydrological Response unit (HRUs). There are several models which can be accommodated for this specific study. SWAT is the most commonly used hydrological model due to its user-friendly interface and well documented (Gassman et al., 2007). Fig 2.1 shows the extent of SWAT usage compared to the other models.

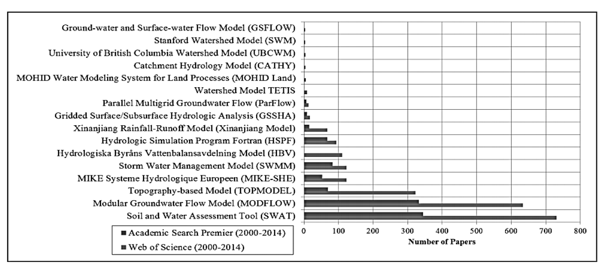

Fig 2.1: Watershed Models Listed by Number of Papers Available in Journal Paper Databases (Source: Wible, 2014)

The hydrologic cycle as simulated by SWAT is oriented on the water balance equation

$$S_{wt} = S_{wo} + \sum_{i-1}^{t} \left(R_{day} - Q_{surf} - E_a - W_{seep} - Q_{gw}\right)$$

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"Where Sw_t is the final soil water content (mm),

S_{wo} is the initial soil water content on day (mm),

t is the time (days),

R_{day} is the amount of precipitation on day (mm),

Q_{surf} is the amount of surface runoff on day (mm),

E_a is the amount of evapotranspiration on day (mm),

W_{seep} is the amount of water entering vadose zone from the soil profile on day (mm),

Q_{gw} is the amount of return flow on day (mm)".

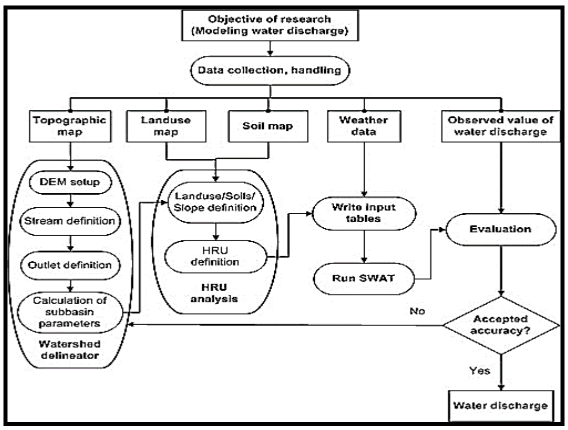

Fig 2.2: Flowchart of the methodology for SWAT (source:L oi,2012)

Fig 2.2 shows the workflow system of SWAT model setup and execution. SWAT requires spatially distributed data such as DEM (Digital elevation model), LULC map, Soil data and weather data such as precipitation and temperature for its setup and execution. Further the Discharge data is required for the calibration and validation of the model.

The methodology implementation can be stated into four parts:

- Gathering of data and Handling
- Execution of the hydrological model
- Model Calibration and Validation
- Analysis of SWAT Results

B. MIKE-SHE (Mike system hydrologique Europeen)

MIKE SHE is an integrated hydrological modelling system for setting up and simulating surface water flow and groundwater flow. MIKE SHE can simulate the entire land segment of the hydrologic cycle and regulate components to be used independently and customized to local needs. MIKE SHE emerged from Système Hydrologique Européen (SHE) as developed and extensively applied since 1977 onwards by a consortium of three European organizations: the Institute of Hydrology (the United Kingdom), SOGREAH (France) and DHI (Denmark). Since then, DHI has continuously invested resources into research and development of MIKE SHE. MIKE SHE can be used for the analysis, planning and management of a wide range of water resources and environmental problems related to surface water and groundwater, especially surface-water impact from groundwater withdrawal, conjunctive use of groundwater and surface water, wetland management and restoration, river basin management and planning, impact studies for changes in land use and climate.

C. TOP MODEL (Topography-based Model)

TOPMODEL is a rainfall-runoff model (Beven and Kirkby, 1979) that takes advantage of topographic data (specific catchment area and wetness index) related to runoff generation, although Beven et al. (1995) prefer to consider TOPMODEL as not a hydrological modeling tie together, but rather a set of conceptual implements that can be used to replicate the hydrological behaviour (in particular the dynamics of surface or subsurface contributing areas) of catchments Rainfall-Runoff process in a distributed or semi-distributed way. The National Weather Service River Forecast System (NWSRFS) is a different such model that is further conceptual in nature connecting to the secretarial for water storage in a number of conceptual stores representing the hydrologic position of components of the watershed apprehensive in rainfall-runoff processes.

III. Conclusion

Based on the literature review and understandings it can be concluded that SWAT model is model is most vital to use as the SWAT model is highly documented and easy to understand.it cannot be stated that other 2 models are difficult. The adoption or setting up models depends upon the study area, data availability and understanding of the models. From the fig 2.1 we can project that SWAT model has been adopted more than compared to the other models.

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