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The Satellite Based Hydrological Model (SHM): Routing Scheme and its Evaluation

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The collection of spatially extensive data by using the traditional methods of data acquisition is a challenging task for a large territory like India. To overcome such problems, the Satellite based Hydrological Model (SHM), a large scale conceptual hydrological model for the Indian Territory, is being developed under the PRACRITI-2 program of the Space Applications Centre (SAC), Ahmedabad. The model aims at preparing sustainable water management scenarios using remote sensing data from Indian satellites to handle the fresh water crisis in India. There are five modules namely, Surface Water (SW), Forest (F), Snow (S), Groundwater (GW) and Routing (ROU) in the SHM. The SW, F and S modules convert rainfall into surface runoff and generate input (infiltration and percolation) for the GW module, and GW generates baseflow using that input. In this study, a cell-to-cell routing (ROU) module has been developed for SHM. It is based on the principle of Time Variant Spatially Distributed Direct Hydrograph (SDDH) to route the generated runoff and baseflow generated by various modules upto the outlet. The entire India is divided into 5km x 5km grid cells and properties at the center of the cell are assumed to represent the property of the cell. In the routing scheme, for each cell a single downstream cell is defined in the direction of steepest descent, to create the flow network. These grid cells are classified into overland cells and channel cells based on the threshold value taken into consideration. The overland flow travel time of each overland cell is estimated by combining a steady state kinematic wave approximation with Manning's equation and the channel flow travel time of each channel cell is estimated using Manning's equation and the steady state continuity equation. The travel time for each cell is computed by dividing the travel distance through that cell with cell velocity. The cumulative travel time from each grid cell to the watershed outlet is the sum of travel times of cells along the flow path. The time lag function has been added with cumulative travel time to get the arrival time at outlet of flow from each cell. Thereafter, the calibration and the validation of the SHM have been carried out. The results show that the routing module implemented here performs well and complements the other modules of SHM