Enhancement of a Physically Based Hydrological Cycle Model

SHER.

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Abstract

There are many hydrological models developed and applied in the variety of the study. Those models can be categorized by several facets. Those are, for example, dimension of the area, time scale (long term or short term), variables that the model outputs (river flow, river stage, groundwater height, etc.) and structures (dams, intakes, pump stations, sewer pipes, etc.) that are implemented within the model. Since the computer power which a common hydrologist can use had been drastically enhanced, more complicated models that include many functions inside are becoming applicable to the problems that are used to be studied by relatively simple models. SHER (Similar Hydrologic Element Response) model was originally developed by Prof. Herath and Prof. Musiake and was applied for urban hydrological cycle analysis which computes water flows on the surface and in the underground. The influences of urbanization, that may be caused by water resource development, increase of impervious area and decrease of paddy fields, on the hydrological cycle was focused in this model. However, in recent years, this model was used in the variety of the study; flood forecasting, low flow analysis and etc. It might be because that the SHER model took into account the difference of the hydrological characteristics between recharging area and discharging area. The recharging area could be described that the area where groundwater table would not reach to ground surface and it has only a small chance that the subsurface layer becomes saturated. The discharging area could be described as the area where the subsurface layer tends to be saturated when relatively large rainfall event happens. When the watershed models were set up, those areas have to be defined by the modelers and if their definitions represent the actual phenomena in the watershed perfectly the SHER model outputs agreed with the observation very precisely.

This paper presents the enhancements made on the SHER model. In the revised model, intakes from the rivers are implemented and water distributions are also implemented. Water from the intakes is distributed to the paddy fields or some other type of areas. Dams are also implemented in the model. The outlet from the dams is controlled in accordance with the regulations that define the outlet as a function of dam inflow, reservoir water level, river flow rate at the specific station and the day of the year. Inundation is also computed in the model by adopting the so-called pond model. Surface excess water is stored in the hypothetical pond on the surface. Flows between hypothetical ponds are computed by the weir formulas or orifice formulas.

It was found that the revised SHER model is applicable for many studies such as flood forecasting where the dams took a significant role during the floods and draughts. Moreover, it is applicable for inundation forecasting systems.

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