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SPATIAL OBJECT APPROACH FOR WATERSHED MODELING AND ITS APPLICATION IN THE YASU RIVER BASIN

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The results of application of a recently developed Spatial Object Watershed Model (SOWM) are presented. A version of this model called SOWM-YRB was developed and applied in the Yasu River basin. The model considers physical processes at grid level including interception, evaporation, transpiration and runoff. Net moisture balance at each grid is integrated spatially using Digital Elevation Model (DEM). The routing mechanism in the model effectively captures the effect topography, geology and surface condition allowing more realistic representation of catchment response to distributed inputs and parameters enabling investigation of effects of artificial and natural controls on water and pollutant flows.

The main idea of SOWM is to make a three dimensional water circulation model of a catchment by linking together vertical and horizontal processes controlling water flow. Different processes such as interception, evaporation, infiltration and routing are considered as objects which model water movement at different levels and send the output to one another. SOWM provides a framework where these models can be linked together to simulate water and pollutant movement in the basin. The contribution of each process in total simulation can be evaluated, different models for same process can be compared and various assumptions controlling the processes modeled can be clarified. The advantage of including artificial control in the watershed model is a distinguishing factor in this model.

The evapotranspiration component of this model is based on ISBA land surface scheme which define the vertical water balance including interception, evaporation from ground and transpiration. As far as we know this is the first time this scheme has been incorporated into a distributed hydrological model allowing the assumptions of runoff generation to be checked. The limitations of runoff generation mechanism in this scheme are highlighted and modifications necessary to describe storm runoff are implemented. The Green and Ampt infiltration model is coupled to the scheme as a criterion for on set of runoff generation to improve simulation of storm runoff.

This study provides a rare example of application of a fully distributed physically based hydrological model to investigate a water management problem using modern data products such as remotely sensed land use and digital elevation model (DEM). Little is still known among hydrologist about the value of such products for hydrological studies and water resources management in general. The successful simulation of the flood events in the study basin has highlighted the predictive ability of the model and emphasizes the value of remotely sensed data products in watershed management. The results also show a high potential of this model for studying effects of land use changes on flood runoff. The model has helped to identify the important processes determining flood runoff formation in the study basin and to clarify various assumptions in modeling this process.