AOGS 2006

Analysis of the Effect on Hydrologic Cycle in Urban Watershed by the Leakage of Tap Water Using Distributed Hydrologic Model

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In this paper, the authors analyzed the effect on hydrologic cycle in urban watershed by the leakage of tap water using distributed hydrologic model. In urban area, the hydrologic cycle is affected by the artificial water cycle including water supply and sewage networks. The leakage amount from tap water supply pipe systems infiltrates and increase groundwater level. Also, it flows into combined sewage networks and decrease the efficiency of sewage treatment plant. The distributed hydrologic model, WEP (Water and Energy transfer Processes model) is applied to urban watershed, Cheonggye-cheon stream in Seoul Metropolis in Korea. The Cheonggye-cheon watershed's area is 50.96km^2 and it is located in the downtown of Seoul City. The population of this area is over 1.4 million and the area is highly urbanized (76% of area is developed into residential and commercial regions). So, the hydrologic cycle was severely distorted by the impervious surface, subway lines, artificial water supply and sewage networks. For the analysis, the watershed was divided into grids of 50m size (179x199) and divided again into seventeen sub-watersheds. The land use, soil types and underground aquifer depth are collected and parameters for WEP were selected and calibrated with the observed stream flow. The effect of leakage from tap water supply pipes was simulated. The annual water balance for 2004 of two cases (Case I: with leakage and Case II: without leakage) were compared. According to the results, the leakage amount, 464mm - 12% of tap water supply, increase soil moisture, groundwater level, interflow and baseflow. The interflow of the Case I (309mm) is almost 12 times larger than the Case II. The baseflow of the Case I (211mm) is about 3 times larger than the Case II. From the simulation results, the amount of contribution from the leakage of tap water to the stream flow was analyzed. And in the case of the Cheonggye-cheon watershed, the amount of leakage from tap water is bigger than the infiltration amount from rainfall. And it is the major source of groundwater level lift and the unexpected inflow to the sewage treatment plant.