Chun-Wei Huang et al., Hydrol Current Res 2012, 3:4
http://dx.doi.org/10.4172/2157-7587.S1.004

OMICS Group Conferences
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International Conference on
Hydrology & Ground Water Expo

September 10-12, 2012 Hilton San Antonio Airport, USA

Assessing the ecosystem services of water resources and runoff regulation in the upstream of highly urbanized area - A case study in Wutu watershed, Taiwan

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Ecosystem services are the benefits provided by ecosystems, including provisioning, regulating, supporting and cultural services. Due to increasing human activities, ecosystems have been rapidly degraded and the sharply collapse of ecosystem functions has become a serious issue. The degradation of runoff regulation function is one of the major ecosystem function losses. The hydrological components, such as soil moisture and surface runoff are very sensitive to the change of land use. Urbanization is one of the major anthropogenic impacts resulting in decline of regulating functions of watershed. An appropriate land use planning, especially in the upstream of highly urbanized area is essential to maintain the function of ecosystem services of the entire watershed. This study focuses on assessing the impact of urbanization on the ecosystem services of water resources and runoff regulation in the Wutu watershed. The study cases were simulated by spatial allocation model and distributed hydrological model. Different levels of urbanization scenarios were generated using the Conversion of Land Use and its Effects model (CLUE-s). In CLUE-s model, the logistic regression is used to empirically quantify the relations between land use and its driving factors for combining with dynamic modeling of competition between land use types. After acquiring the land use patterns, the Distributed Hydrology-Soil Vegetation Model (DHSVM) is applied to simulate the impact of urbanization on hydrological components (soil moisture and groundwater level). In order to obtain reliable and accurate simulation results, a novel heuristic algorithm, dynamically dimensioned search (DDS) is applied for the calibration of the DHSVM. DDS algorithm has the ability to find the global optimal solution robustly. The results showed that intensive urbanization leads not only to the loss of soil moisture but also to the increase of surface runoff. The results provide useful information on how urbanization would affect hydrological components for future land use planning.

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