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Simulation of the response of non-point source pollution to the changing environment in a basin scale

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The purpose of this work is to reveal the variations of non-point source pollution (NPSP) in a basin scale under changes of land use/cover and rainfall. Based on GIS technique and Hydrological Simulation Program-Fortran [U+FF08] HSPF [U+FF09] model, and taking the Dongjiang basin in South China as a study case, the annual variation and spatial distribution of NPSP in the study basin were analyzed. The loads of three typical non-point source pollutants, BOD, Total Nitrogen (TN) and Total Phosphorus (TP), were calculated. Four land-use scenarios were simulated by the logistic regression of Cellular Automata (CA) model. Responses of the runoff, sediment and NPSP loads to the 4 land-use scenarios were predicted with HSPF model. The relationship between rainfall, runoff and pollution load was fitted by the Generalized Additive Models for Location, Scale, and Shape (GAMLSS). Key conclusions are as follows.

(1) The loads of the three pollutants were high in flood season and low in dry season in accordance with the intensity of rainfall. The annual distribution had a hill-being shape that low loads were on both sides and high in the middle with peak happening in July. The spatial distributions of sediments, BOD and TP, in loads per unit area, were consistent with the spatial distribution patterns of precipitation. TN, however, distributed in a different pattern.

(2) Among different land uses, urban area had the highest loss of sediments, followed by the bare ground, farmland, orchard, woodland, grassland and water area. While the biggest output per unit area of BOD was urban land, followed by bare land and waters. The most serious loss per unit area of TN was urban land, followed by grassland and arable land.

(3) Dramatic change of natural land to urban land-use would greatly increase surface runoff, causing much higher loads of sediments, BOD and TP in the basin. However, TN loads would reduce in wet years and increase in dry years because the biological metabolism for TN is much quicker in humid environment. Rainfall had significant effect on the non-point source pollution load.