Geophysical Research Abstracts
Vol. 15, EGU2013-236, 2013
EGU General Assembly 2013

Quantifying the impact of land use change on hydrological responses in the Upper Ganga Basin, India

Georgia-Marina Tsarouchi (1), Ana Mijic (1), Simon Moulds (1), Ila Chawla (2), Pradeep Mujumdar (2), and Wouter Buytaert (1)

(1) Department of Civil and Environmental Engineering, Imperial College London, United Kingdom (g.tsarouchi11@imperial.ac.uk), (2) Department of Civil Engineering Indian Institute of Science Bangalore, India

Quantifying how changes in land use affect the hydrological response at the river basin scale is a challenge in hydrological science and especially in the tropics where many regions are considered data sparse. Earlier work by the authors developed and used high-resolution, reconstructed land cover maps for northern India, based on satellite imagery and historic land-use maps for the years 1984, 1998 and 2010.

Large-scale land use changes and their effects on landscape patterns can impact water supply in a watershed by altering hydrological processes such as evaporation, infiltration, surface runoff, groundwater discharge and stream flow. Three land use scenarios were tested to explore the sensitivity of the catchment's response to land use changes: (a) historic land use of 1984 with integrated evolution to 2010; (b) land use of 2010 remaining stable; and (c) hypothetical future projection of land use for 2030. The future scenario was produced with Markov chain analysis and generation of transition probability matrices, indicating transition potentials from one land use class to another. The study used socio-economic (population density), geographic (distances to roads and rivers, and location of protected areas) and biophysical drivers (suitability of soil for agricultural production, slope, aspect, and elevation).

The distributed version of the land surface model JULES was integrated at a resolution of 0.01º for the years 1984 to 2030. Based on a sensitivity analysis, the most sensitive parameters were identified. Then, the model was calibrated against measured daily stream flow data. The impact of land use changes was investigated by calculating annual variations in hydrological components, differences in annual stream flow and surface runoff during the simulation period. The land use changes correspond to significant differences on the long-term hydrologic fluxes for each scenario. Once analysed from a future water resources perspective, the results will be beneficial in constructing decision support tools for regional land-use planning and management.