Geophysical Research Abstracts
Vol. 18, EGU2016-183, 2016
EGU General Assembly 2016

Impacts of land use and land cover change on water resources and water scarcity in the 20th century: a multi-model multi-forcing analysis

Ted Veldkamp (1), Yoshihide Wada (2,3,4), Philip Ward (1), and Jeroen Aerts (1)

(1) Institute for Environmental Studies, VU Amsterdam, Amsterdam, Netherlands (ted.veldkamp@vu.nl), (2) Center for Climate Systems Research, Columbia University, New York, USA, (3) NASA Goddard Institute for Space Studies, New York, USA, (4) Department of Physical Geography, Utrecht University, Utrecht, Netherlands

Socioeconomic developments increasingly put pressure on our global fresh water resources. Over the past century, increasing extents of land were converted into (irrigated) agricultural production areas whilst dams and reservoirs were built to get grip on the timing and availability of fresh water resources. Often targeted to be of use at local, regional, or national levels, such human interventions affect, however, terrestrial water fluxes on larger scales. Although many of these interventions have been studied intensively at global and regional scales, the impact of land use and land cover change has often been omitted, and an assessment on how land conversions impact water resources availability and water scarcity conditions was not executed before, despite its importance in the development of sound integrated river basin water management plans.

To address this issue, we evaluate in this contribution how land use and land cover change impact water resources and water scarcity conditions in the 20th century, using a multi-model multi-forcing framework. A novelty of this research is that the impact models applied in this study use the dynamic HYDE 3.1 – MIRCA dataset to cover the historical (1971-2010) changes in land use and land cover. Preliminary results show that more than 60% of the global population, predominantly living in downstream areas, is adversely affected by the impacts of land use and land cover change on water resources and water scarcity conditions. Whilst incoming discharge generally (in 97% of the global land area) tends to decrease due to upstream land conversions, we found at the same time increases in local runoff levels for a significant share (27%) of the global land area. Which effect eventually dominates and whether it causes water scarcity conditions is determined by the dependency of a region to water resources originating in upstream areas, and by the increasing rates with which the (locally generated) stream flow is used to fulfil (non-)agricultural water demands.

In this study, we used 15 model-combination (five impact-models and three meteorological forcing datasets) to estimate the impacts of land use and land cover change on water resources and water scarcity conditions. To clarify the patterns in water scarcity and water resources conditions, we assessed the impacts of land use and land cover change on the underlying hydrological parameters: local runoff, incoming discharge from upstream areas, and (potential) evapotranspiration. Finally, we evaluated the consistency of our results by the number of model-combinations that support the ensemble-mean signal.