Geophysical Research Abstracts
Vol. 17, EGU2015-9852, 2015
EGU General Assembly 2015

Key aspects in representing the impact of irrigation on hydrology and climate

Philipp de Vrese and Stefan Hagemann
Max Planck Institute for Meteorology, Land in the earth system, Hamburg, Germany (philipp.de-vrese@mpimet.mpg.de)

The hydrological cycle is a key component in the climate system and its alteration presents a critical anthropogenic influence on climate change. The amount of solar radiation absorbed by water vapor within the atmosphere makes it the most important greenhouse gas. Furthermore strong positive climate feedbacks are presumed in connection with atmospheric water vapor; increasing temperatures could increase the global water vapor concentration by increasing the water vapor pressure at saturation. This in turn increases the amount of absorbed solar radiation and thus temperatures. It is often assumed that on the global scale the atmospheric input of water vapor attributed to irrigation is negligible in comparison to the naturally occurring water vapor. On the regional scale however many studies showed that irrigation has a strong impact on climate which will very likely increase in the future due to increasing demands and changing climate conditions. Furthermore it is plausible that the estimated impact of irrigation is not only depending on the scope (regional vs. global) but also on the design of a given study. Thus the key concern of this study was not only to estimate the impact of irrigation on a global scale, but rather to evaluate the importance of the way irrigation is represented in a model. On one hand, the effect of the representation of different irrigation characteristics was investigated e.g. the extent to which irrigation was applied to the vegetated/ non-vegetated part of a grid box. On the other hand it was investigated, whether the scheme used to couple the two model components plays an important role for the impact of irrigation on climate.

For the investigation, several 20-year-AMIP-type experiments were conducted using the Max Planck Institute for Meteorology's earth system model, i.e. the general circulation ECHAM6 coupled to a version of the land-surface model JSBACH, which had been modified to represent irrigated areas. It was found that irrigation potentially has a strong impact on the simulated climate not only in the regions featuring large irrigated areas such as India but also globally. Thereby the magnitude of the impact is strongly depending on the way irrigation is represented. Especially the difference between different coupling schemes, i.e. parameter aggregation or different versions of flux aggregation, had a substantial impact on the way irrigation affects global climate. Thereby the choice of the coupling scheme made the difference between the effects of irrigation being mostly regionally confined or significant on the supraregional scale. Also the impact due to specific irrigation characteristics is significant on the global scale.