Geophysical Research Abstracts
Vol. 16, EGU2014-1126, 2014
EGU General Assembly 2014

Response of the Indian summer monsoon to future greenhouse gas emission pathways to the year 2300 simulated by the MPI-ESM

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In this study the potential future changes in different aspects of the Indian summer monsoon (ISM) associated with the RCP-scenarios are assessed. Different kinds of mechanisms leading to these changes will be addressed, with some of them working locally and some of them remotely. The study is based on several sets of ensemble simulations with the newly developed MPI-ESM. In one set of simulations (1850-2005), emissions and concentrations, respectively, of the well-mixed greenhouse gases and the sulphate aerosol load have been prescribed according to observations, in three other sets of simulations (2006-2100), the aforementioned anthropogenic forcing agents have been prescribed according to the RCP2.6-, RCP4.5- and RCP8.5-scenario, respectively. For each of these scenarios, one simulation has been extended over the period 2101-2300, in accordance with the CMIP5-protocol.

The three kinds of scenario simulations are characterized by marked changes in different aspects of the ISM, such as an intensification of the summer monsoon precipitation despite a weakening of the large-scale monsoon circulation. The magnitude of these changes varies with the strength of the underlying scenario, with the strongest (weakest) scenario showing the largest (smallest) changes, respectively. As for the simulations extending to 2300, the RCP8.5-scenario shows a further amplification of the projected changes in the ISM after 2100, finally reaching a state, where the monsoon flow is broken down during June, shortening the monsoon season by about one month. Despite the absence of the characteristic monsoon flow, the rainfall in the Indian region is also increased during June. Considering the simulated changes for the shortened monsoon season and for June separately, allows for a detailed analysis of the different mechanisms leading to the projected increase in the monsoon rainfall on one hand and the reduction of the large-scale monsoon flow on the other.