Geophysical Research Abstracts
Vol. 15, EGU2013-10965, 2013
EGU General Assembly 2013

Impacts of climate change on river discharge and hydropower generation for the Alpine region

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The aim of this work is to investigate the impacts of climate change on the runoff characteristics of rivers in the greater Alpine region (with focus on Austria) and the related changes in power generation from run-of-river plants up to 2050. Four representative regional climate model simulations from the ENSEMBLES project have been selected in order to cover the bandwidth of possible climate changes from hot and dry over moderate to humid and warm. All simulations are based on the SRES greenhouse gas emission scenario pathway A1B. The respective simulated daily temperature and precipitation time series (horizontal resolution of 25 km) were error-corrected using meteorological observations (E-OBS v4). These data is used as input for a parsimonious lumped-parameter rainfall-runoff model at a monthly time step. Observed river discharge data from relevant rivers within the Alpine region were used to calibrate and validate the model for each catchment individually. This approach allows to estimate the effect of climate change on future river discharges (without taking into account potential changes in land use). Changes in river runoff for the periods 2011-2030 and 2031-2050 compared to 1961-1990 were computed for the individual catchments and the different scenarios. These data were used to compute changes in power generation of nearby run-of-river plants taking discharge capacities of the hydro plants into account. Depending on the climate scenario and the catchment or country analyzed, the changes in runoff and power production are quite different, indicating the uncertainty in the climate data and related runoff predictions. However, the changes are not very significant and are in the order of a few percent of increase or decrease. The most significant changes are observed in the south (Northern Italy and Southern France). Estimated seasonal changes in runoff to months of higher electricity demand (winter months) might have positive impacts for the electricity industry.