Geophysical Research Abstracts
Vol. 21, EGU2019-17049, 2019
EGU General Assembly 2019

The impact of climate change on the water quality in the KwaZulu-Natal province of South Africa

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South Africa is facing population and climate-related challenges such as pressure on arable land, provision of clean and safe drinking water, and water-borne health problems. The devastating drought during 2014-2018 further amplified those problems and put additional pressure on already stressed water resources in the uMngeni River basin in the KwaZulu-Natal province. Even today, additional water is being transferred from the neighbouring basins to satisfy the needs of the rapidly increasing urban population. Understanding the impact of changing climate can lead to an increase in the region's resilience by providing direction for adaptation strategies. The uMngeni River basin supports two large urban centres, subsistence and intensive commercial agriculture, forestry, and dairy farming. Apart from the limited amount of water available in the catchment itself to support these activities, the usability of its waters is threatened by decreasing water quality, in particular nutrient enrichment and eutrophication due to the farming, old infrastructure, and improper solid waste management. A set of scientific tools (e.g. http://hypeweb.smhi.se/) helps the decision makers to understand how the water availability and nutrient loads might change in the future and to plan appropriate adaptation strategies. We present here climate impact indicators (CIIs) produced from the outputs of the HYPE model (Lindström et al., 2010) that quantify the changes in the simulated discharge and nutrients in the greater uMngeni River area projected due to climate change. We used climate data from 18 Global Climate Models (GCM's) developed at various institutions with different initial conditions (https://climate.copernicus.eu/) and emission scenarios (RCP4.5 and RCP8.5) to force the HYPE model. From these 18 GCM's, the six that adequately described the current local climate in the study area were used to quantify the CIIs. The period 2011-2100, broken into three 30-year segments was used to evaluate the impacts in the near future, mid-century, and far future as compared to the current period (1971-2000). Four out of the six models predicted deterioration in water quality, which might amplify the eutrophication problem. Eutrophication would impact human health, increase treatment costs, algal blooms; and possibly reduce agricultural land productivity. The change in total nitrogen concentrations was projected between -5 and 20% across all future periods but the percentage changes for phosphorus were generally higher than for nitrogen. The total phosphorus concentration is projected to change by -2 to 35%. The models also predicted a decrease in the water discharge of up to 40%, which would reduce drinking water availability and increase infrastructural costs. The decision makers need to identify the spatial patterns in order to implement mitigative measures like improvement of land management to reduce fertiliser demand, undertake solid waste management but also invest in water efficient technologies e.g., drip irrigation.

Lindström G. et al. (2010). Development and test of the HYPE (Hydrological Predictions for the Environment) model – A water quality model for different spatial scales. Hydrology Research 41.3-4:295-319.