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Impacts of urbanization and climate on groundwater in a growing Africa city: the case of Ouagadougou (Burkina Faso)

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African cities are presently facing the combined impacts of growing urbanization and climate change. In several instances; providing safe drinking water for all is still a challenge, especially for cities located on basement aquifers, were groundwater is scarce.
Here we assess the effects of climate change and land use change on groundwater amount and quality in the main city of Ouagadougou (Burkina Faso) taking advantage of the CIEH borehole, where a mostly continuous record lasts since 1978. This record spans most of the Great African Drought (1970-1990) and recovery from the Drought since the 2000s. A piezometric network of 14 wells and boreholes was setup around the CIEH borehole and monitored during the 2013-2014 hydrologic year. The piezometric network spans an old settlement, the Ouagadougou University, a vegetable gardening area and a natural forested area. Water balance estimates are provided by a 1D box model. The study area, although it lies partly on an old settlement in Ouagadougou and on the University area, presents a rather uniform runoff coefficient of 22% and ET amounting to 80-90 % of rainfall, which usually characterizes natural areas. It is suspected that the almost absence of asphalted surfaces, the presence of trees and flow of rainwater from roofs toward bare soils or sumps could be responsible of this budget. However, the two wells located in the forested Bangr Weogo recreational area are characterized by almost no runoff and a nearly 100 % ET. While drinking water can be pumped in several places in the city of Ouagadougou, chemical major analyses show that two mechanisms impact groundwater quality during the rainy season: (i) rise of the water table at pit latrine level, mainly in old settlements, and entrainment of harmful substances from soil to the aquifer in gardening area near some artisan activities.
The CIEH borehole is not fully representative of its neighboring area since (i) it lies in a piezometric low, (ii) it presents the smallest annual amplitude of the whole network. Modeling the 1978-2013 record at this borehole requires a nearly 10 % increase of recharge since 1990-1991, a period corresponding to partial and temporary recovery of rainfall after the Drought. Its water level lies nearly at the 1978 level; however, without the parameter change in 1991, it would lies 3 m below this level. Further extensive characterizations of hydrological properties near the CIEH borehole are suggested to allow further interpretations of its unique record.