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Temperature trends in Cairo towards 2090 for human health

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Cities face significant impacts from climate change now and in the future (Hallegatte, 2009). These impacts have potentially serious consequences for human health, lively-hoods, and assets, especially for the urban poor informal settlements. Climate change (IPCC, 2013) impacts range from an increase in extreme weather events like extrem temperatures or flooding and effects public health (Matzakaris, 2001). Cities generate their own local climate, and are generally warmer than their surroundings, which is the so called 'Urban heat island effect'. Worldwide urban population will grow from ∼3.33 billion today to ∼6.4 billion in 2050 (United Nations, 2013a).
In 2014, 35 914 thousand people live in urban areas of Egypt and the population will grow towards 2050 up to 68 864 thousands (World bank,2013a). Due to this increasing population density, urban climate and climate change is becoming the dominant environment for most of humanity, and cities will play a positive role in both climate change adaptation and UHI-mitigation strategies. Building resilience and adapting to climate change is increasingly a very high priority for cities. Besides mitigation, on which efforts have largely focused in the past, cities should play today a larger role in adaptation.
In this study, the first results of the ERA-net EU project LOCLIM3 (Local climate for 3 cities, Istanbul, Cairo and Nairobi) are presented. LOCLIM3 is a project to study on climate change adaptation in developing countries to prepare a practical guidance on how to responds to the challenges of climate change in their cities. Therefore an interdisciplinary team (urban and landscape planners, architects and meteorologists) research on climate change adaption as well as on Urban Heat Island (UHI) mitigation strategies regarding the building structure, material, and the potential change of the city structure. The results of the microclimate simulations with the micro climate mode (ENVI-met) for the urban area in the current situation and for the future will be discussed with stakeholders of each city.

This study provides the first climate evaluation for Cairo city of the high-resolution simulations from the MED-Cordex inititaive (www.medcordex.eu, Ruti et al., 2013; Herrmann et al., 2011). The high spatial resolution data of 12km with two different representative concentration pathway scenario (RCP4.5 and RCP8.5) were analysed. The data set of the limited-area atmosphere RCM (ALADIN-Climate, Radu et al., 2008; Colin et al., 2010; Herrmann et al., 2011) in its version 5 (Colin et al. (2010) is used in the framework of the regional CORDEX exercise (Mediterranean, Africa, North America areas). Analysis of Cairo city with the historical period of 1986-2005, and the time periods of 2041-2060 and 2071-2090 with RCP4.5 and RCP8.5 has been considered respectively.

Results indicate that a high resolution of 2.8km better reproduce the pattern of temperature for the city, which is helpful for urban planners and architects. The temperature data were analyzed for number of days greater/similar 35°C, number of days with a minimum temperature of greater/similar 20°C which is the definition of a tropical night and number of days with a minimum temperature less/similar 9°C. The mean maximum and minimum temperature gives also a good overview of the climate situation up to 2090, which is an important factor for mitigation and adaptation strategies in the field of urban- and landscape planning.

The yearly simulated 2m-temperature of mean minimum and mean maximum for both emission scenarios of RCP4.5 and RCP8.5 shows an increasing temperature trend from the historical period 1986-2005 to the future time slice of 2041 to 2090. The greatest deviation of the maximum temperature has been shown in July with an increasing trend from the historical run to the period 2071-2090 through a global warming of 1.9K (RCP4.5) and 3.5K for the RCP8.5 scenario. A much greater warming for Cairo city has been shown in the night temperatures. The minimum temperature represent a deviation from the reference period (1986-2005) up to 2090 of 4K during July to October with the RCP8.5 scenario and 2K with the RCP4.5 scenario. Tropical nights will increasing from May to October. Very similar results have been seen from number of days greater 35°C. The number of days with a temperature less or equal 9°C is increasing during the winter period from December to March with the tendency of much warmer days of the RCP8.5 scenario. Through the high spatial resolution of 2.8km for Cairo-city, the

climate of each month has been shown an increasing temperature for some districts of Cairo. This climate analysis will be used to simulate the microclimate for Cairo with ENVI-met to find adaptation strategies for the city up to 2090 and specially for human helath.