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Impacts of Sub-Basin Development on the Nile Hydrology, Using GIS Modeling

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In
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STATEMENT

This thesis is submitted to Ain Shams University for the degree of Master of Science in Civil Engineering.

This work is conducted in collaboration with the departments of Ain Shams University, Faculty of Engineering and Planning Sector, Ministry of Irrigation and Water Resources, as part of PhD research to quantify the impact of land use change on the Nile climatology.

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No part of this thesis has been submitted for a degree or qualification at any other University or Institution.

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ABSTRACT

Many development projects involving Nile waters are currently underway or being studied. These projects will lead to changes in land-use patterns, and affect water distribution and availability. It is important to assess the effects of a) these projects, and b) evolving water resource management and policies, on regional hydrological processes. This research seeks to establish a basis for evaluation of such impacts within the Nile River sub-basin, using the RegCM3 Regional Climate Model to simulate interactions between the land surface and climatic processes. The research, presents the analysis of the climate effects of land use change for Baro-Akobo sub-basins based on two relatively long (25years) regional model (RegCM3) simulations. Two different vegetation cover datasets are employed, one representing the current land use and the other representing the potential vegetation cover without human intervention. The possible effects and feedbacks induced by anthropogenic land use change on the climate of Baro-Akobo are analyzed based on the differences in various simulated climatic variables between the two simulations. The result for ECHAM A1B scenario is estimated as following; 1)The annual precipitation will increase by 15%; 2)The average Temperature change for the dry months is vary from 1.9C0 to 4.0C0 however the change during wet months is vary from the 1.0C0 to 2.0C0; 3) The daily evapo-transpiration rates showed a small change (+2% to +5%) during the dry months although the increase in the evaporation rate is reach 13 % during the wet months; 4) The overall annual change in flow is small (+3.0%). However, the seasonality of flow increased. In average, early flood season flows in JJAs increase by (+11%), while dry season and late flood season flows decrease by (-6%). The result for the Land use change scenario by replacing the wetland and swamps located at the Baro-Akobo-Sobat basin with irrigated croplands lead to the following:- 1)The change in precipitation between the current land use conditions and the proposed scenario is estimated as (~+0.5%). 2)The temperature will increase during the dry months by (~+0.4 to ~2.5) while the temperature will decrees during the wet season by around (~-0.5 to -2.0); 2)Decrease in the evapo-transpiration rate by (-8.7) during the wet months and increase in the daily evapo-transpiration rates during the dry months by (+ 1.9); 3)The change in the annul flow is estimate as (+6%).

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ABBREVIATIONS

AGCMs	Atmospheric Global Circulation Models
AOGCM	Atmosphere Ocean General Circulation Models
AVHRR	Advanced Very High Resolution Radiometer
AVHRR	Advanced Very High Resolution Radiometer
BATS	Biosphere-Atmosphere Transfer Scheme
BATS	Biosphere-Atmosphere Transfer Scheme
CAR CCM3	National Center for Atmospheric Research Community Climate Model
CCM3	The NCAR Community Climate Model
CPTEC-INPE AGCM	The Center for Weather Forecasts and Climate Studies (CPTEC) of the National Institute for Space Research (INPE)
CRU	Climate Research Unit
CRU	Climate Research Unit, United Kingdom
CTL	Control run
DJF	December-February
DRA	Dry
ECHAM	European Community-Hamburg
ENSO	El Nino/Southern Oscillation
ET	Evapo-transpiration
GAO	Global Atmosphere Ocean
GCMs	Global Climate Models
GIS	Geographical Information System
GL	Generalized Linear
GLCC	Global Land Cover Characterization
GLCC	Global Land Cover Characterization
GPCP	Global Precipitation Climatology Project
HAD	High Aswan Dam
hPa	Unit of measurement of pressure (height in Pascal)
ICTP	International Center for Theoretical Physics
ICTP	Abdus Salam International Center for Theoretical Physics
IPCC	Intergovernmental Panel on Climate Change
IPCC TAR	IPCC - Third assessment Report
IRB	Ipswich River Basin
ITCZ	Inter-Tropical Convergence Zone
JJA	June- July- August