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Principal components of local climate and their implications for climate change adaptation: Case study from the Savannah of Nigeria

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Although synoptic-scale forcing has some influence on local climate, a degree of local forcing which varies by region and season exerts strong influence on local climate. The influence of this local forcing is even critical in the West African Savannah where the climate is controlled by meso-scale convective systems which depend on local geographic factors including topography and land-cover to propagate. These systems create a degree of eco-climatic complexes which often vary by season and across space and control the local climate. Many impact applications including climate change adaptation and ecosystems management are very sensitive to these complexes and their associated fine scale climate variations that are often coarsely parameterized climate models. This study demonstrates how a degree of local forcing creates patterns of eco-climatic complexes that control the local climate in the wooded savannah of Nigeria. Data on some geographic factors of local climate including elevation, slope, aspect, rainfall, temperature, vegetation, population density and soil potential for agriculture were generated and integrated within a geographic information system (GIS). Output from the GIS was subjected to principal component analysis. The result was profiled for associations between climate and these factors and to also determine the controlling factors of the local climate under present and future climate scenarios. Data on present pattern of settlement, land-use, and drainage was also integrated and analyzed in relation to the resulting eco-climatic complexes. Although present climate trend shows little warming for temperature and no clear trend for rainfall, future climate scenario suggests a significant decline in rainfall (about 4mm/month/decade), the collapse of the bi-modal rainfall pattern and a rise (0.02oc per /month/decade) in mean monthly maximum temperature. The results also suggest a local climate system driven by the coupling between terrain, rainfall and temperature in all seasons. Under the present climate, this climate-orographic relation creates eco-climatic complex which predominates from the southeast to northwest corridor in all seasons except the monsoon season of June-July-August (JJA) when it spatially reverses to the southeast to northeast corridor. Although this pattern is projected to continue under future climate scenario, its spatial influence is projected to diminish around the northwest and the system is projected to weaken with rainfall becoming less significant in JJA. The pattern of rural settlements and agrarian land-use strongly suggests settlement clusters and rural livelihood systems that are dependent on climate-positives from the propagation of this eco-climatic complex. The long-term climate-positives produced in the southeast to northwest corridor also serve as the ecological-nerve of Ogun and Oshun watersheds that support human activities in the western part of Nigeria.