Geophysical Research Abstracts
Vol. 20, EGU2018-14364, 2018
EGU General Assembly 2018

Can vegetation feedback mitigate climate extremes under future climate change for Africa?

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Future changes in climate extremes are of major concern for terrestrial ecosystems, human livelihood and socio-economics. It has been suggested that climatic extreme events, such as droughts or heatwaves under future climate change would increase globally, with regional hotspots spanning from low-latitude semi-arid regions to high-latitude tundra. In the future, driven by biotic and abiotic factors, it is believed that vegetated land surface would change further, introducing additional uncertainty when assessing changes in climate extremes. High resolution Regional Earth System Models (RESMs) are capable to provide useful information for regional climate change studies, with unique added value compared to coarser scale global Earth System Models (ESMs). However, the absence of vegetation dynamics in many previous climate studies limits the potential to assess extreme events and their impacts. Here we used a regional Earth system model, RCA-GUESS, that incorporates dynamic vegetation to assess future changes in climate extremes for Africa. By comparing the simulations with and without vegetation dynamics and feedback, we are able to isolate the impact of vegetation on climate extremes. We found that the current semi-arid regions of Africa such as the Sahel, Eastern Africa, and Southern Africa would experience dramatic changes in terms of shrub encroachment and woody thickening. Further more, such changes are found to impose significant impacts on local to regional climate extreme events. This study suggests that vegetation feedback in some cases can mitigate climate extremes, depending on the characteristics of vegetated land cover, vegetation response to stress, and its interaction with surrounding environmental changes. We therefore emphasize the necessity of considering vegetation dynamics for assessing changes in climate extremes for Africa, a region where climate change and climate services are closely related to vulnerabilities of local ecosystems and human society.

Keywords: Climate extremes, vegetation feedback, RCA-GUESS