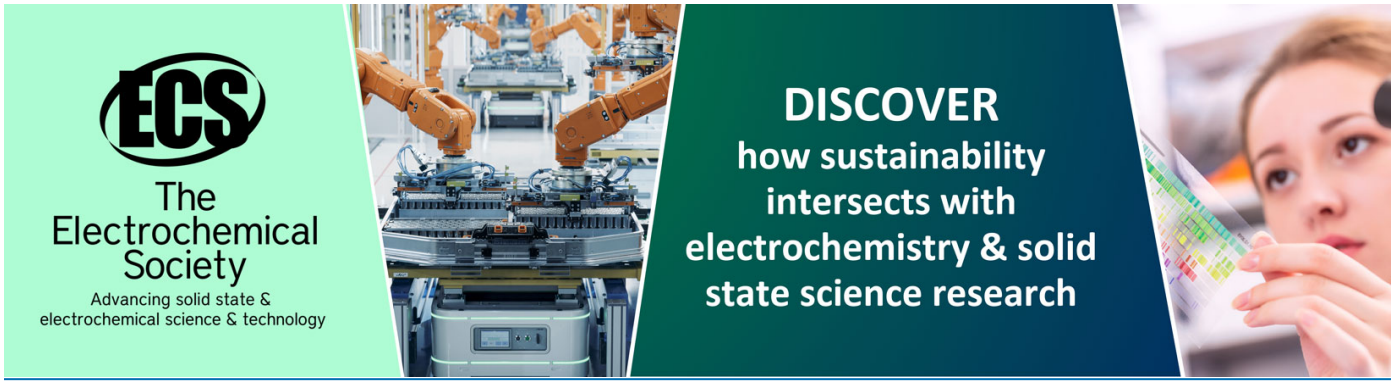
Climate change in the Sahel: Connecting past and future



P34.10

Climate change in the Sahel: connecting past and future

Alessandra Giannini
Columbia University, International Research Institute for Climate and Society, Palisades, NY, USA

The semi-arid Sahel, the southern margin of the Sahara desert spanning the African continent from the Atlantic Ocean to the Red Sea, has long been the focus of attention of research related to drought, desertification and climate change. As drought persisted in the 1970's and 1980's, scientists hypothesized a causal relation between the change in land use/land cover and the shift to a drier climate. More recent climate modeling studies tell a different story - that the shift to persistent drought was the consequence of a reorganization of the climate system global in scale that manifested itself in the warming of the tropical oceans surrounding Africa, especially the equatorial Indian Ocean. However, the association between warming oceans and continental drying does not aid in the interpretation of current change, or of projections of future change. In recent years, the rains have partially recovered in the Sahel, and vegetation cover possibly even more than can be explained by rain alone, despite the continued warming of the tropical oceans. Future projections are utterly uncertain, with some models predicting a significant increase in rainfall, others a decrease, yet others no significant change. Paradoxically, this uncertainty in projections may be related to the land surface. If we assume the dominant role of the oceans in driving Sahelian climate, a hypothesis warranted by recent modeling studies, can we explain the uncertainty in projections by differences in the balance between the influence of remote oceanic forcing and that of local land interaction, as the land responds to the additional radiative forcing from anthropogenic emissions? In this study I exploit the the multi-model archive made available by the World Climate Research Programme's 3rd phase of the Climate Model Intercomparison Project (WCRP/CMIP3) in preparation for the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4). By relating precipitation change to the local change in terms in the net surface energy budget, most notably evaporation and net surface radiation, I describe land-atmosphere feedbacks that are indicative of the relative dominance of local or remote atmospheric conditions. In models where the remote oceans dominate, warming of the oceans inevitably leads to drying of the Sahel. In models where the local land surface dominates, increased net surface radiation and evaporation drive a strengthened monsoon, and a wetter Sahel. These preliminary results point to the need for monitoring and diagnosing the net surface energy balance, as the direct radiative effect of anthropogenic emissions emerges from the background noise of year-to-year variability, in order to resolve the uncertainty in projections of climate change in the Sahel.

