Geophysical Research Abstracts
Vol. 14, EGU2012-10340, 2012
EGU General Assembly 2012

Future changes in the African monsoon through a pool of CMIP5 models

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Based on the approach of Fontaine et al. (2011) we study the accuracy of the African Monsoon (AM) simulations and expected future changes. We used 8 available CMIP5/AR5 AOGCMs from 8 different climate centres and the RCP4.5 emission scenario. Data are analysed with a multi-model approach and the "one model one vote" concept. The results refer to the 'present' period (1960-1999) and to a 'future horizon' (2031-2070), and are discussed in terms of monsoon dynamics and climate change.
CMIP5 AOGCMs produces a warmer world in the future, especially over land (and more strongly over the Saharan desert, the southern Europe, the middle East and the Mediterranean Sea). The sea-band thermal grandient is enhanced and create therefore the basic energy conditions for a reinforced monsoon in the future. The future changes show an inverse tendency regarding the rainfall amounts with less (more) rainfall expected over the western (central-eastern) Sahel. The surplus are associated with a more intense monsoon circulation, an increasing of the mean moisture flux convergence over the continental Sahel favoured by the greater surface warming over the continent. The deficits are chiefly linked to subsidence anomalies in mid-troposphere preventing deep moist convection and precipitation due to modifications in the zonal circulation.
An African Rainfall Pattern Index (ARPI), based on the standardized rainfall differences between these regions is defined for capturing the rainfall contrast over years 1900 to 2100. It has been compared to the thermal evolution on both the present and future periods. This allowed us to document the effect of the global warming on Sahelian rainfall patterns by extracting low-frequency signals (20-year-cut-off) and applying a singular spectrum analysis (SSA) to investigate better long-term evolution: the results show that the temperature signal shares more than a half of the ARPI variance indicating that the rainfall tendancy could be produced by the global warming. The contrasted rainfall pattern change at Sahelian latitudes is therefore expected to occur more frequently in the future. These results are according to Fontaine et al. (2011) who shown through 12 CMIP3 models an increasing (decreasing) of rainfall amounts above the central part (western part) of the Sahel in a future period.