Geophysical Research Abstracts
Vol. 17, EGU2015-4522, 2015
EGU General Assembly 2015

Forest-Savanna Transitions in West-Africa: The climatic imprint of bimodal distributions in vegetation cover

Stefan Dekker (1), Zun Yin (2), Mara Baudena (1), Bart van den Hurk (3), and Henk Dijkstra (2)

(1) Utrecht University, Environmental Sciences, Copernicus Institute of Sustainable Development, Utrecht, Netherlands (s.c.dekker@uu.nl), (2) Utrecht University, Institute for Marine and Atmospheric Research, (3) Royal Netherlands Meteorological Institute de Bilt

Positive land-climate feedbacks can suddenly shift the vegetation state. Observed bimodal distributions of woody cover in West Africa provide evidence that alternative ecosystem states may exist under the same precipitation regimes. Understanding the explicit climate conditions where the woody cover bimodality can exist is important to predict crucial transitions of ecosystems due to climate change. This also helps in understanding the complexity of land-climate interactions.
In this study, we show that bimodality can also be observed in mean annual shortwave radiation and above ground biomass. Through conditional histogram analysis, we find that the bimodality of woody cover in West-Africa can only exist under low mean annual shortwave radiation and low above ground biomass.
From our analysis we find that the mean annual precipitation is not a sufficient predictor of a potential land cover change. Indicators of climate seasonality are strongly related to the observed land cover type. However, these indicators can only demonstrate the potential occurrence of bimodality but cannot exclude the probability of bimodal vegetation distributions.
Regions with high potential of land cover transitions are displayed. The result suggests for instance that the tropical forest in the Congo basin, may be unstable and shows the possibility to significantly decrease. An increase in the area covered by savanna and grass is possible, which coincides with an observed re-greening of the Sahara
These findings derived from observations only, are compared with three different Dynamic Global Vegetation Models (JSBACH, LPJ-GUESSSPITFIRE and aDGVM) describing the forest, savanna, and grassland transitions. Through these comparisons we improve the understanding of the bistable behavior of savanna systems due to two main mechanisms, 1) water limitation to tree growth, and tree-grass competition for water, 2) a grass-fire feedback, which maintains both forest and savanna occurrences in mesic areas.