PAMEXEA

Patterns and mechanisms of climate extremes in East Africa

DURATION
01/10/2013 – 31/12/2017

BUDGET
997.513 €

PROJECT DESCRIPTION

Context

Catastrophic droughts afflicting the Horn of Africa region in recent years highlight the heavy impact of a variable climate on vulnerable populations and socio-economic systems in (semi-)arid East Africa; and the enormous challenge to develop a sustainable agricultural economy in a future of climate change, growing demographic pressure and naturally scarce water resources. Severe, recurrent drought is the principal weather-related hazard, and the quality of long-term weather predictions is a major bottleneck hampering drought mitigation and adaptation. Most worrying is the uncertain impact of 21st-century climate change on regional freshwater resources, due to incomplete understanding of the effects of a warming atmosphere on the regional hydroclimate. Current IPCC prognoses for East Africa, based on global climate model (GCM) simulations, have insufficient spatial downscaling to guide the water-resource planning which developing economies need to prepare for the future.

General objectives and underlying research questions

Applying ‘the past is the key to the (present and) future’ approach, PAMEXEA aims to improve understanding of these East African climate trends and extremes as basis for appropriate water-resource management. Specifically, we aim to find out how processes of natural climate variability at seasonal, inter-annual and decadal time scales will interact with anthropogenic climate forcing to create future trends in rainfall and drought. The results of this project will contribute to improved long-term rainfall prognoses for East Africa at the sub-regional scale, and improve the capability of climate models to predict the future occurrence of extreme drought.

Methodology and nature of its inter-disciplinarity

PAMEXEA consists of four inter-connected work packages. First, next-generation climate models now being developed must be tested against long time series of past climate trends and weather extremes that adequately represent their frequency (recurrence interval) and intensity. In East Africa only a handful of such datasets currently exist, hampering analysis of spatial patterns. In WP1 we apply geological, geochemical and biological methods of lake-based palaeohydrological reconstruction to the sediment records from three Kenyan lakes to optimize documentation of past climate variability during the last 2000 years. In WP2 we integrate these new records with a quality-screened compilation of all existing climate-proxy data from East Africa, to produce a spatially-resolved history of East African climate change. Our effort differs from previous such paleodata syntheses in two aspects. First, we integrate all palaeohydrological time series, also those which are fragmentary or have low time resolution, as long as these ‘time windows’ on past climate events at particular locations are reliably dated. Second, since all continuous climate-proxy datasets available for East Africa involve moisture-balance indicators extracted from lake sediments, we use (inverse) hydrological modelling of selected datasets to assess the relationship between reconstructed moisture-balance variation and the timing and amplitude of the rainfall variability causing this variation. Since this exercise translates the proxy data into real time series of past rainfall, the results will allow a direct comparison of climate-model simulations with documented African climate history. Still, improvements in the prediction of weather extremes and long-term climate change clearly depend on the availability of climate models which capture the principal large-scale climate-dynamical processes, the principal mechanisms of tropical climate forcing at short and medium time scales, and all region-specific feedbacks and land-ocean-atmosphere interactions. In WP3 we test the hindcasting performance of existing climate models, i.e. their ability to replicate the temporal and spatial patterns of past climate variability reconstructed in WP2 as a guide to their relative ability to simulate future climate trends under prescribed combinations of natural and anthropogenic climate forcing. These results will serve as reference framework for the development of regional climate models.

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Potential impact of the research on science, society and/or on decision-making

Our effort is framed in the IGBP ‘Africa-2k’ working-group contribution to produce syntheses of climate-proxy data for each of the world’s continents, to support the development of improved climate-model simulations informing future IPCC assessments. Our ultimate goal is to contribute to better forecasting of seasonal and longer-term climate variability as urgently required for mitigation, and management of extreme weather in East Africa. As regards direct policy guidance on climate extremes and water-resource availability, the challenge is to make projections sufficiently robust to allow delineating specific areas in East Africa where policies should promote either the cultivation of drought-tolerant varieties of food crops, livestock ownership by subsistence farmers, or pure and mobile livestock herding; and for each of these economic activities develop measures to prevent soil loss and land degradation. WP4 focuses on communicating to local governments, dryland communities and other stakeholders which improvements in climate forecasting have been made and what its future prospects are, but also the reality of its limitations.

Finished research products

Workshops, datasets, publications, reports with policy guidelines.

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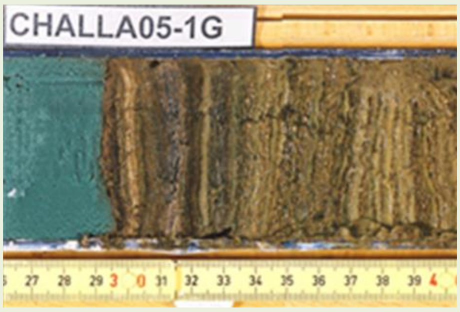
LINKS

http://www.ugent.be/we/biology/en/research/limnology/currentresearch.htm

http://www.itc.nl/projects/Bas/Bas.aspx?Id=1757



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