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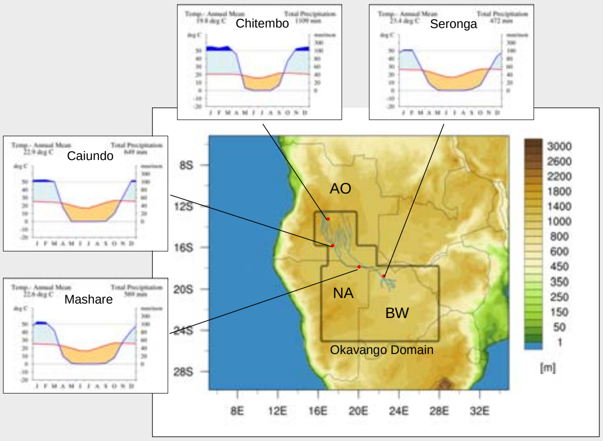
Moisture Transport and Water Budget

in the Okavango Basin

Introduction

The Okavango River originates in the rainy Bié Plateau in Angola (AO), touches the northwestern part of Namibia (NA) with its savanna woodlands and terminates in the world's largest inland delta situated in the Kalahari Desert in Botswana (BW). Especially in the delta region, the river is the major water source for people settling in the area, but it also provides the unique fauna and flora with water. Therefore, possible changes in the moisture transport and the water budget in the Okavango Basin caused by a changing climate would affect also the biodiversity and the lives of the people living in that region.

Climate Conditions

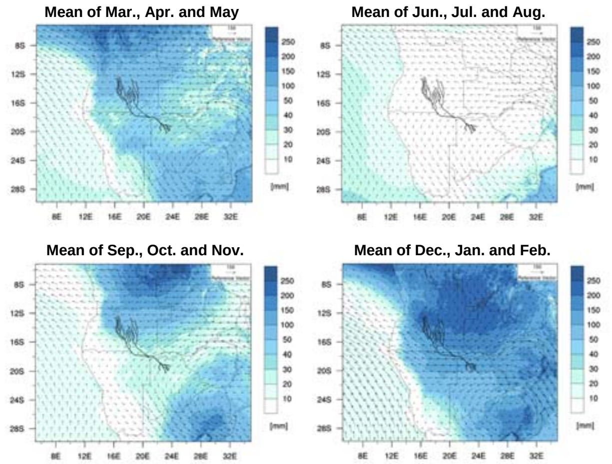


Four different core-sites (Chitembo, Caiundo, Mashare and Seronga) were selected to characterize the various climate conditions along the Okavango River. The climate diagrams (Walther and Lieth, 1967) were calculated for the period 1976-2005 using data from the Climatic Research Unit (CRU) (Mitchell and Jones, 2005).

Method

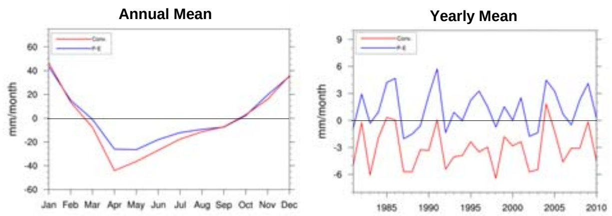
A high-resolution hindcast simulation with the regional climate model REMO (Jacob and Podzun, 1997; Jacob, 2001) forced with ERA-INERIM reanalysis data (Dee et al., 2011) for the period 1981-2010 was created. This hindcast simulation has been conducted with a high spatial (25x25 km) and temporal resolution and provides more detailed climatological information for the Okavango region compared to the application of general circulation models (GCMs) (e.g. Haensler et al., 2011). From this simulation, the vertically integrated moisture transport into the region of interest (calculated from specific humidity, the meridonal and zonal wind components, air pressure on model levels) and water budget (calculated as the difference between precipitation and evaporation) were derived.

Precipitation and Moisture Transport



Mean seasonal precipitation (shaded, mm/month) and mean vertically integrated moisture transport (arrows, kg/ms) calculated from model data for the period 1981-2010.

Water Budget and Moisture Convergence



Monthly mean and yearly mean moisture budget in the Okavango Basin (framed domain, see map) derived from model data for the period 1981-2010: Convergence of vertically integrated water vapour flux (Conv., red) and the difference of precipitation minus evaporation (P-E, blue).

Summary

The climate of the Okavango Basin is characterized by changing environmental conditions along the river and by relatively high temperatures leading to more rapid evaporation fluxes. The precipitation shows a pronounced annual cycle in all core-sites with rainfall in the south-hemispheric summer season (wet period) and almost no rainfall in the south-hemispheric winter season (dry period). Accordingly, in the wet period the moisture transport is enhanced originating from south-east to east in the northern part and from east-north-east to east in the southern part of the basin. In the dry period the moisture transport is rather weak originating mainly from east to north-east. As a result of the seasonal current and precipitation pattern, the Okavango Basin is a moisture sink (positive moisture convergence) from October to March and a moisture source (negative moisture convergence) from April to September. On the interannual time scale the vapour flux convergence and the difference between the precipitation and evaporation show roughly a five-year-cycle caused by large-scale circulation and SST-anomalies. The next steps will be to analyse the processes controlling the moisture transport and the water budget in the Okavango Basin and to analyse the impact of climate change on the Okavango water budget under different climate scenarios using a multi-model ensemble.

References

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