Climate change over southern Africa

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Over the southern part of Africa, strong climatological gradients exists, ranging from the humid tropical climate in the Congo region to the drylands in the western part of South Africa, e.g. the Namib desert. Changes in the climatological gradient will alter the hydrological cycle over southern Africa, and thus may have significant consequences in the affected regions. Projected future changes are investigated using the recent version of the coupled atmosphere/ocean general circulation model of the Max Planck Institute for Meteorology. The model comprises the atmospheric component ECHAM5, the ocean component MPI-OM and the OASIS coupler. For the 4th assessment report of the Intergovernmental Panel on Climate Change (IPCC), an ensemble of climate simulations was conducted for the period of 1860-2100. The coupled model was run without flux correction at T63 (about 1.9° or 200 km grid size) horizontal resolution and 31 vertical levels in the atmosphere, and about 1.5° horizontal resolution and 40 vertical layers in the ocean. For the past climate (1860-2000), observed concentrations of CO_2, Methane, N_2O, CFCs, Ozone (tropospheric and stratospheric), and sulphate aerosols (direct and first indirect effect) were prescribed. For the future climate (2001-2100) these concentrations were prescribed according to three different IPCC scenarios (B1, A1B, B2).

In our study over South Africa we focus on a control period representing current climate from 1961-1990, and on a future period representing a possible climate in the end of the 21st century from 2071-2100. Special attention is paid to changes of the hydrological cycle over large hydrological regimes. Thus, we are focusing on some major river systems in the southern African region located from north to south: Congo river, Zambezi river and Orange river (see Fig. 1). In addition, past changes in the region were analysed by considering observations, re-analysis data and downscaled re-analysis data using the regional climate model REMO.

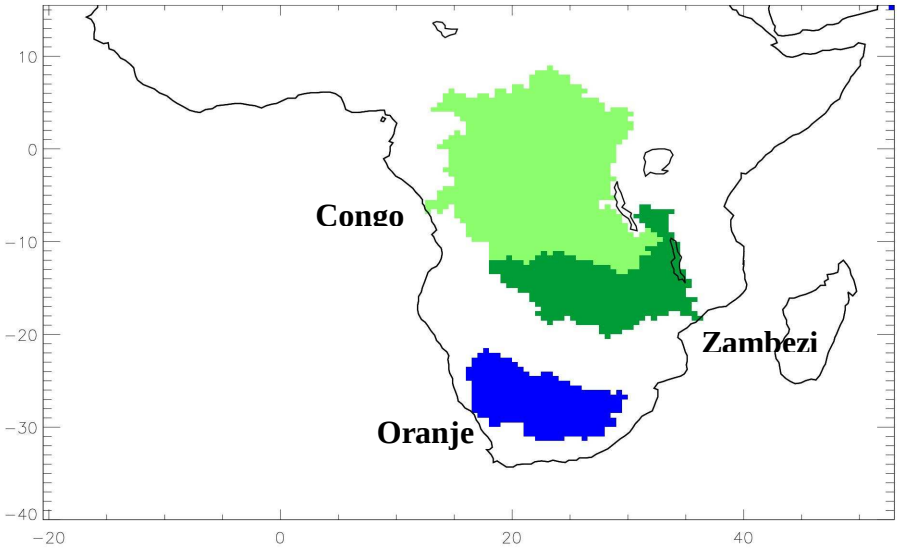

Fig. 1. Catchments of Congo, Zambezi and Orange river at 0.5 degree resolution

The results from the ECHAM5/MPI-OM IPCC simulations show a projected gradient in the climate change signal in the hydrological cycle over southern Africa for all three scenarios (see Fig. 2). A severe future drying is projected for the Oranje catchment (about -20% for precipitation, -50% for runoff), a moderate drying for the Zambezi catchment (about -7% for Precipitation, -15% for Runoff), and an enhancement of the hydrological cycle is projected for the Congo catchment (about +10% for precipitation, evaporation and runoff for A1B and A2, about + 6% for B1). The drying in the southern parts leads to less evaporation and intensifies the warming of the area.

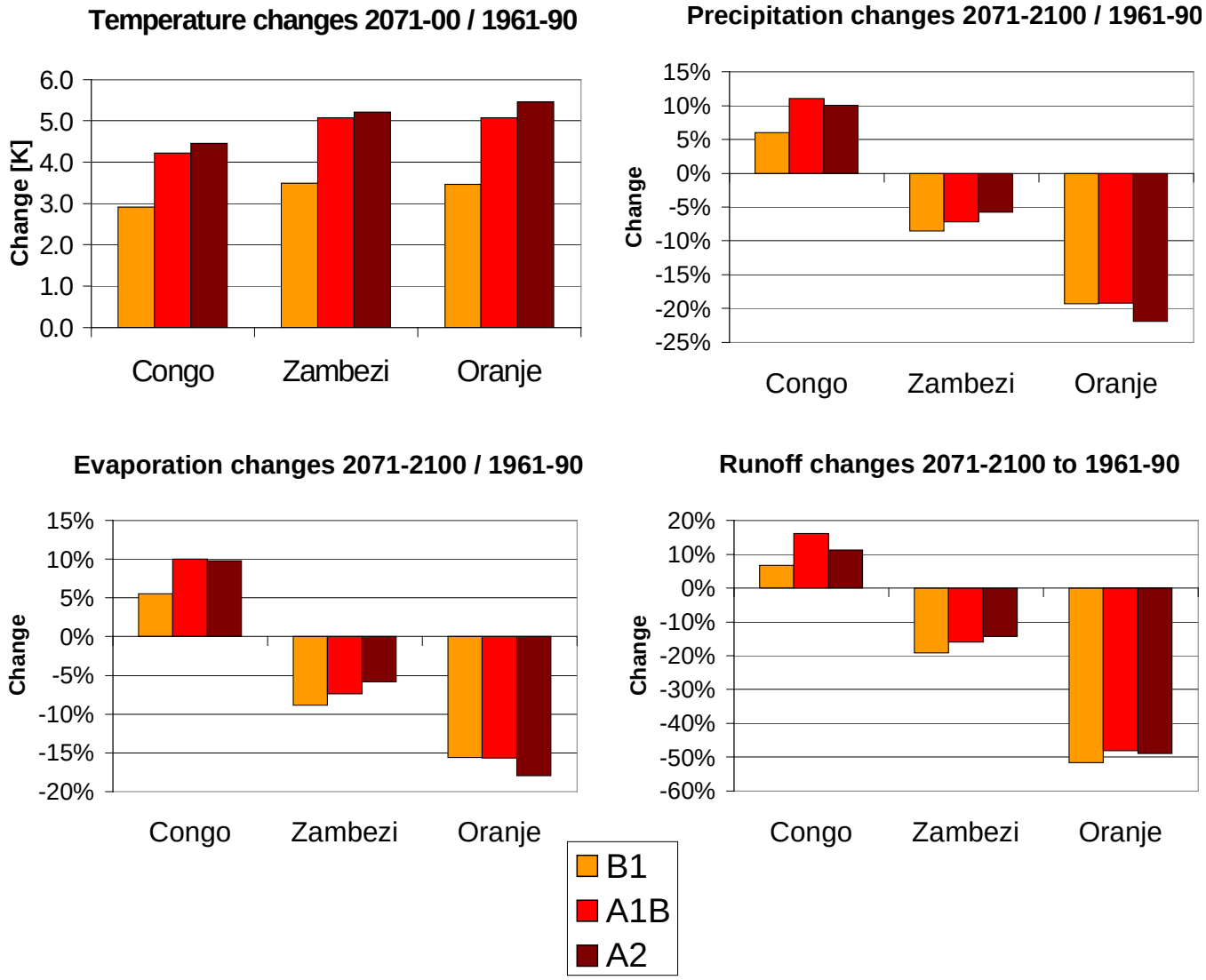

Fig.2. Projected changes (2071-2100 compared to 1961-1990) in the hydrological cycle over the Congo, Zambezi and Oranje river catchments.