Title: Aerosol and land use change feedbacks on Southern Africa Regional climate.

Key-words: Aerosols, southern Africa, land-use change, RegCM3.

Team: Emissions, deposits and impacts.

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Abstract: Southern Africa is experiencing large-scale social and economic changes that are affecting the regional environment. Significant impacts have been caused by population growth, population migration, industrial development, water shortages, and agriculture. Increasing demands for domestic food sources and exports in southern Africa are leading to a growing demand for agricultural land as well as an intensification of industrialization.

This intensification induces significant changes in regional land use, and affect the regional atmosphere: Due to a strong and persistent circulation pattern over the southern half of the continent, airborne emissions are transported hundreds of kilometers from one part of the region to another. The emissions circulated within this semi-closed “gyre” come from the burning of fossil fuels and industrial activities (e.g the Valll triangle), biomass burning in wildfires and domestic fires, and natural processes in terrestrial and aquatic ecosystems. The gyre persists, on average, about two-thirds of the year. This natural atmospheric pattern traps and accumulates trace gases and airborne particles (aerosols) for up to two weeks. This pattern, tends to form under and maintain predominately cloud-free conditions, which results in active photochemical transformations of the gases and aerosols by the increased sunlight.

Together with land use change, the particle burden perturbs the surface/atmosphere radiative balance, as well cloud properties, with ensuing regional climatic impacts. Over Southern Africa, these regional impacts come in addition to the climatic effects of global change and ENSO variability. The quantitative characterization of these anthropogenic regional factors and their relative climatic impact is still uncertain. In this domain, the improvement and the use of integrative climate modeling tools is a necessity for environmental management and climate change mitigation (IPCC 2001, 2007).

A regional climate / aerosol model (RegCM) will be used to characterize past and present land use and aerosol climate forcing. Simulations will be carried out for the period of 1996-2006, during which a number of field experiments were carried out in the region (SAFARI 2000, AMMA, SACCLAP, IDAF, EUCARII). Results from these experiments as well as from the AERONET (local/regional network of sun photometers), from MODIS and from CALIPSO/CALIOP Lidar will be used to validate the model. Emission and land use change scenarios will then be used to simulate the aerosol forcing on the regional climate for the coming century (2030-2100).