Geophysical Research Abstracts, Vol. 8, 04355, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04355
© European Geosciences Union 2006

# Synoptic-Scale Density-Current Like Flows related to Evaporational Cooling over the Sahara

**P. Knippertz** (1), A. H. Fink (2)

(1) Institute of Atmospheric Physics, Johannes Gutenberg-University of Mainz, Germany, (2) Institute of Geophysics and Meteorology, University of Cologne, Germany
(knippertz@uni-mainz.de / Phone: +49-6131-3926756)

The Saharan planetary boundary layer (SPBL) is characterized by relatively warm temperatures and very low relative humidity. Even during the cool season, differences between the dry- and the wet-bulb temperatures (wet-bulb depression) of more than 15K at the surface and around 10K at 800 hPa are not unusual. Thus, the SPBL possesses a large potential for low-level evaporational cooling, when upper-level precipitation systems penetrate into the Sahara from the mid-latitudes. Rough estimates show that only a little more than 8 mm of evaporating rain is sufficient to cool a layer of 200 hPa by 10K. The resulting cold pool will spread out toward and under the surrounding warmer air in the form of a density current. The spreading will end when the Coriolis force has turned the velocity vector of the density current to the right (in the Northern Hemisphere) to restore geostrophic balance. The external Rossby radius of deformation gives an estimate of the equilibrium distance. At the low latitudes of the Sahara it is about 400-500 km for the assumed cold pool, which shows the synoptic-scale nature of such a density current. In the present paper a prominent dust storm over the Sahara that occurred in March 2004 is investigated in order to demonstrate the proposed mechanism with observational data. The analysis is based on synoptic and upper-air station reports and ECMWF data. Inversion of potential vorticity under the assumption of the Charney nonlinear balance is used to estimate the magnitude of the unbalanced part of the mass field over the Sahara. The analysis suggests that the spreading of the cold and dusty air related to the original density current is supported by additional unbalanced processes: divergent outflow from an extreme precipitation region to the northeast of the cold pool and inertial instability in the entrance region of a nearby subtropical jet streak. Down-slope acceleration of the cold pool by the orog-

raphy, suppression of low-level warming through the radiative effects of the dust and cold advection by the balanced component of the flow have most likely contributed to the generation of the observed large-scale temperature anomaly of up to 18K over the Central Sahara.