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Observation and Modelling of Continental Diurnal Cycles in West Africa

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West Africa is a major continental region in the Tropics where the diurnal cycle of processes is large. Important couplings between processes actually take place at this timescale. Therefore a proper modelling of these diurnal cycles still appears as an important step to improve simulations of the monsoon system as well as a very challenging one.

AMMA campaign provided a rich set of measurements to address this issue. The focus of this study is on processes occurring in the atmospheric low levels and their diurnal couplings. Quantitative diagnostics of the diurnal cycles based on analyses of observations are presented. They are complemented by coupled land-surface atmospheric modelling.

First, an analysis of radiosoundings is carried out to document and characterise the climatology of the different diurnal cycles along a meridional transect. The study concentrates on the two intensive observing periods with three-hour interval radiosoundings, made prior and after the onset. The nocturnal and daytime convective boundary layers are studied via diagnostics of boundary-layer heights and mean properties like wind, humidity, potential temperature. The results show and quantify contrasted diurnal cycles along the meridional transect and also as the season changes. It also reveals surprisingly well-mixed nocturnal boundary layers at Agadez and Niamey prior to the monsoon onset. These results highlight the different diurnal cycle regimes encountered over West Africa under dry, moist and wet conditions.

Then, an adequate modelling framework to relate this climatology to processes is presented. The atmospheric model Meso-NH is used with the interactive surface model ISBA and larger scale advection obtained from the ECMWF IFS. It enables us to study the representation of the diurnal cycles in a simple one dimensional framework. Moreover it allows investigating the role of diurnal cycles of surface fluxes, advective, convective and radiative processes in the building of the observed diurnal structure. Based on an analysis of diurnal composites, the simulated water and energy budgets will be discussed.

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