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Sensitivity of the southern West African mean atmospheric state to variations in low-level cloud cover as simulated by ICON

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This contribution presents first results of numerical sensitivity experiments that are carried out in the framework of the project DACCIWA (Dynamics-Aerosol-Chemistry-Cloud Interactions in West Africa). DACCIWA aims to investigate the impact of the drastic increase in anthropogenic emissions in West Africa on the local weather and climate, for example through cloud-aerosol interactions or impacts on radiation and stability. DACCIWA organised a major international field campaign in West Africa in June-July 2016 and involves a wide range of modelling activities.

Several studies have shown – and first results of the DACCIWA campaign confirm – that extensive ultra-low stratus clouds form in the southern parts of West Africa (8°W–8°E, 5–10°N) at night in connection with strong nocturnal low-level jets. The clouds persist long after sunrise and have therefore a substantial impact on the surface radiation budget and consequently on the diurnal evolution of the daytime, convectively mixed boundary layer. The objective of this study is to investigate the sensitivity of the West African monsoon system and its diurnal cycle to the radiative effects of these low clouds.

The study is based on a series of daily 5-day sensitivity simulations using ICON, the operational numerical weather prediction model of the German Weather Service during the months July – September 2006. In these simulations, low clouds are made transparent, by artificially lowering the optical thickness information passed on to the model's radiation scheme.

Results reveal a noticeable influence of the low-level cloud cover on the atmospheric mean state of our region of interest and beyond. Also the diurnal development of the convective boundary layer is influenced by the cloud modification. In the transparent-cloud experiments, the cloud deck tends to break up later in the day and is shifted to a higher altitude, thereby causing a short-lived intensification around 11 LT. The average rainfall patterns are modified as well, though no conclusion on the long-term impact on rainfall can be made due to the forced initial conditions in the presented experiment. In the future, the impact on the development of the West African monsoon system will be assessed.