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High resolution (4Km) simulation of the African Monsoon over the Sahara for today and the Mid-Holocene

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The West African Monsoon (WAM) is investigated with the Weather Research Forecast (WRF) atmospheric model. It is known that GCMs that operate at coarse horizontal resolutions with convective parameterizations do not simulate the correct diurnal cycle of precipitation, and fail to capture some aspects of the monsoon, especially during the mid-Holocene. The goal of our study is to try to improve the diurnal cycle of precipitation, and see how convective and cloud characteristics affect the monsoon and its response to forcing changes. For this we choose a number of parameterization options of convection, boundary layer, and microphysics. We perform our runs at both "high" (convective-permitting, 4km) resolution as well as coarser (20 and 60 Km) resolutions.

It is shown that the high-res simulations accurately capture the late afternoon and night-time peak of precipitation that we see in observations, while the parameterized-convection simulations simulate convection too early in the day as found in previous studies. Cloud optical properties in the high-res simulations are sensitive to microphysical scheme. The high-res simulations are further used to study a number of topics related to the WAM like, a) the mid-level (700hPa) northerly return flow and its effect on the progression of the rain band, b) the relationship of mid level clouds extending north of the WAM with the monsoonal circulation.

The simulations are also used to investigate whether improving the diurnal cycle of precipitation, and the cloud optical properties, are enough to change the sensitivity of monsoonal precipitation over the Sahara to increased summertime insolation conditions characterising the Mid-Holocene period.