The water cycle over West Africa is poorly understood and numerical models perform inconsistently in this region. A fundamental weakness of models in West Africa is their representation of the rain-bringing organized cumulonimbus systems, which bring approximately 80% of the Sahel’s precipitation. As part of the African Monsoon Multidisciplinary Analysis (AMMA), investigation of the lifecycle of these convective systems is being conducted, including the coupling with the land surface through initiation of storms over areas of increased soil moisture. A case study observed during the AMMA field program on 31st July 2006 suggests that gravity waves from a parent mesoscale convective system interacted with a boundary layer anomaly due to soil moisture, to generate a major new storm over Mali. This case study has been reproduced in a nested Limited Area Model (LAM) version of the UK Met Office Unified Model. These simulations, along with aircraft and satellite observations are used to study the initiation of this storm, to assess the significance of the gravity waves and soil moisture anomalies, and to evaluate the representation of these processes in different model configurations. This improves our understanding of the dynamics of such storms as well as highlighting problematic aspects of the West African water cycle in the numerical model.