This study investigates the atmospheric water cycle of the West Africa Monsoon using elaborate products from the AMMA program. Land surface model simulations from ALMIP-1, forced with satellite precipitation and radiation products, allow for a comprehensive description of the surface water budget. NWP models and GPS total column water vapor observations allow completing the atmospheric component with moisture flux divergence (MFD) derived as a budget residual. NWP models provide their own complete description of the water cycle. Three NWP model reanalyses are examined over the period 2002-2007: ERA-Interim, NCEP/NCAR reanalysis 1 and NCEP/DOE reanalysis 2. Significant limitations due to deficiencies in model physics and inconsistencies introduced by the assimilation process are revealed compared to the hybrid water budget dataset. They are: an underestimation of precipitation in the Sahel, along with a surprisingly too strong evapotranspiration in the same region indicating poor coupling between these two parameters in the models. Large discrepancies in MFD are also observed between the analyzed and forecast estimates and with the hybrid MFD. A major problem is identified in the representation of the shallow meridional circulation. Comparison with operational NWP models from ECMWF, NCEP and Meteo-France lead to similar conclusions.

These results stress the importance of the heat low dynamics and of its links with convection in the Sahel. Furthermore, they provide new diagnostics which can be used to evaluate and improve the representation of the water cycle over West Africa in large-scale weather and climate models.