The water cycle of West Africa is investigated with the help of a new hybrid water budget dataset developed in the framework of AMMA. Surface water and energy fluxes are estimated from an ensemble of land surface model simulations forced with precipitation and radiation from satellite products. Precipitable water tendencies are estimated from NWP model analyses and vertically integrated atmospheric moisture flux convergence is estimated as a residual. This approach provides an advanced, comprehensive water and energy budget at the surface. West Africa is shown to be alternatively a net source and sink region of atmospheric moisture, depending on the season. Several limiting and controlling factors of the regional water cycle are highlighted, suggesting strong sensitivity to atmospheric dynamics and surface radiation. The relationship between evapotranspiration and precipitation is shown to be very different between the Sahel and the regions more to the south. Strong correlations are found between precipitation and moisture flux convergence from daily to interannual time scales. Water budgets computed from NWP model reanalyses reveal significant limitations due to deficiencies in model physics and inconsistencies introduced by the assimilation process. The results are compared to past studies which were clearly lacking consensus. A major source of uncertainty in previous water budgets is shown to reside in the evapotranspiration term, either computed directly or as a residual. This work provides 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.