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Evaluation of satellite LandSAF and SRB products, ECMWF ISF and AMMA re-analysis surface incoming radiation with AMMA flux station data: Role of clouds and aerosols

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Surface heating resulting from incoming short-wave and long-wave radiation is central to land-atmosphere interactions in the West African monsoon systems. Most studies so far rely on models or on satellite data to provide estimates of radiation fluxes. Whether or not these estimations are accurate across the meridional transect is not known, because of the scarcity of observations in West-Africa. The first results from the ARM mobile facility in Niamey (Niger) or from the BSRN data from Tamanrasset (Algeria) and Illorin (Nigeria) suggest that there may be serious biases due to aerosols. Both models and satellite estimates however currently try to address these issues.

In this study, we provide a comprehensive evaluation of surface incoming short-wave and long-wave radiation from the LandSAF, the ECMWF IFS and the ECMWF AMMA-reanalysis over a latitudinal transect spanning 17°N (Bamba, Mali) to 9°N (Benin), for years 2005-2008. Collocated sun-photometers (AERONET) are used to diagnose the aerosol loadings.

At seasonal time-scale, satellite products tend to perform better than models for the incoming SW radiation, whereas models perform better for incoming LW. The accuracy of both estimates is often less at shorter time scales (e.g. diurnal cycle). The largest biases occur in the pre-monsoon period, which is marked by high aerosol loadings, within a relatively hot and moist atmosphere. In comparison to aerosols, clouds tend to be less of a problem, although they are underestimated in models. Compensations frequently occur between biases in the short-wave and long-wave domains. Aerosols and clouds radiative forcing across the West African meridional gradient will be discussed in view of these results.